Maine Integrated Freight Strategy

Final Report

prepared for

Maine Department of Transportation

prepared by

Cambridge Systematics, Inc.

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final report

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date

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Maine Integrated Freight Strategy Compliance with Fixing America's Surface Transportation (FAST) Act

Fast Act Requirement	Freight Plan Reference(s)
Plan Contents – A State Freight Plan Shall Include, at a Minimum:	
Identification of significant statewide freight trends, needs, and issues.	Section 4.1 – Freight System Trends Section 4.2 – Freight System Challenges
Description of freight policies, strategies, and performance measures that will guide freight-related transportation investment decisions.	Section 5 – Solutions and Recommendations Section 3.7.2 – Truck Travel Time Reliability
Critical multimodal rural freight facilities and rural and urban freight corridors.	Section 3.1-3.6 – System Inventory Appendix C – Critical Urban and Critical Rural Freight Corridors
Link to national multimodal freight policy and highway freight program goals.	Section 1.2 – Plan Goals
Description of how innovative technologies and operational strategies (including ITS) that improve the safety and efficiency of freight movements were considered.	Section 4.3.1 – Federal Funding (ITS and Commercial Vehicle Enforcement Programs) Section 5.1.1 – Infrastructure/Operational Recommendations (Highway)
Description of improvements to reduce roadway deterioration by heavy vehicles (including mining, agricultural, energy cargo or equipment, and timber vehicles).	Section 3.1 – Highway System Inventory Section 5 – Solutions and Recommendations
Inventory of facilities with freight mobility issues and a description of the strategies the State is employing to address the freight mobility issues.	Section 3.7 – Network Usage and Performance
Description of significant congestion or delay caused by freight movements and any mitigation strategies.	Section 3.7 – Network Usage and Performance Section 5 – Solutions and Recommendations
Freight investment plan that includes a list of priority projects and describes investment and matching funds.	Appendix D – Freight Investment Plan
Consultation with the State freight advisory committee.	Recommendation in Section 5.2 – Policy Strategies

Executive Summary

Maine's freight assets are the backbone of the State's economic vitality, enabling the movement of millions of tons of freight every year. In 2015, nearly 97 million tons of goods worth $96 billion traveled on Maine's roads, over its railroad tracks, through its ports and airports, or in its pipelines. The freight system delivers raw materials from fields, forests, and quarries to manufacturers, and finished products to warehouses and store shelves in order to serve Maine's businesses and residents. Maine has an opportunity to leverage its network of highways, rail, ports, pipelines and airports to meet the demands of an increasingly competitive global marketplace.

The movement of goods is a major contributor to the Maine economy. The State's freight transportation system is an important component of business retention and attraction. The State has been and continues to be focused on aggressively marketing its ports and its transportation infrastructure in general to businesses and potential trade partners within the U.S. and overseas.

Maine's freight infrastructure faces continually changing demands due to changing statewide, national and global freight trends and developments, including:

- Population growth stagnation, where significant population growth in the State's southern urban areas has been offset by decreases in the State's more northern and western rural areas;
- Long-term employment shift from goods-dependent industries to service industries in the State, driven in part by ongoing decline in manufacturing employment due to the high pace of technological innovation and automation in the manufacturing sector;
- Containerized trade through the Port of Portland, driven by Maine's Eimskip container service between Portland and Europe, has increased dramatically in recent years, and provided the opportunities for growth and expansion of international and domestic trade for Maine;
- Industry shifts in the energy and forest products sectors, and the impacts to the types and volumes of commodities being shipped in Maine and on many of the supporting freight and logistics operations in the State;
- Adoption of new technologies such as autonomous and connected trucks; and
- Increasing demand for same-day and next day deliveries.

This Maine Integrated Freight Strategy update will help businesses, policy-makers, taxpayers, and users of the transportation system gain a better understanding of the freight transportation issues facing the State. The Maine Integrated Freight Strategy was developed in compliance with Fixing America's Surface Transportation Act (FAST Act) requirements for state freight plans to ensure the State has access to Federal funding opportunities and competitive grant opportunities. The Integrated Freight Strategy's compliance with the FAST Act is summarized in the matrix in the previous page, listing the FAST requirements and where they are referenced in this freight plan.

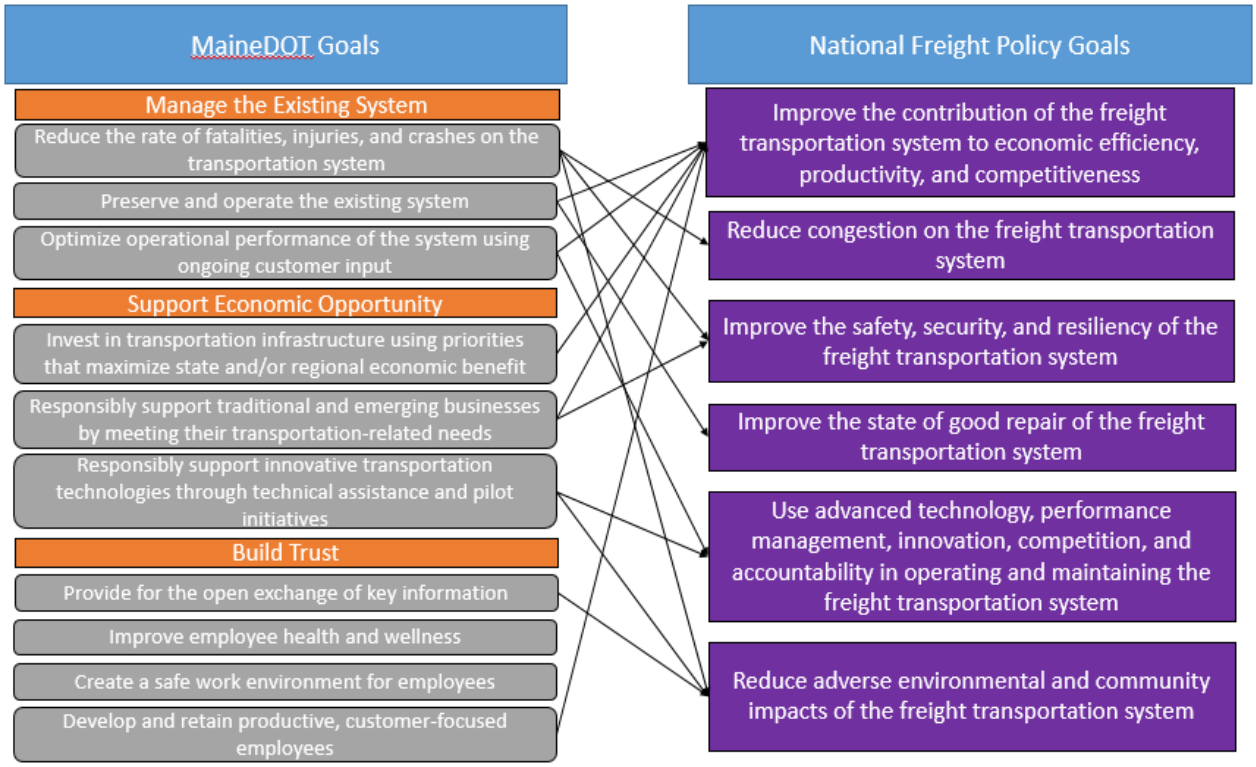
Plan Goals

MaineDOT has identified three overarching goals as part of the *Strategic Plan 2016 Update*.[1]

1. Manage the Existing System
2. Support Economic Opportunity
3. Build Trust

These goals and its objectives reflect national multimodal and highway freight program goals as shown in Figure ES.1 below.

Figure ES.1 MaineDOT and National Freight Policy Goals

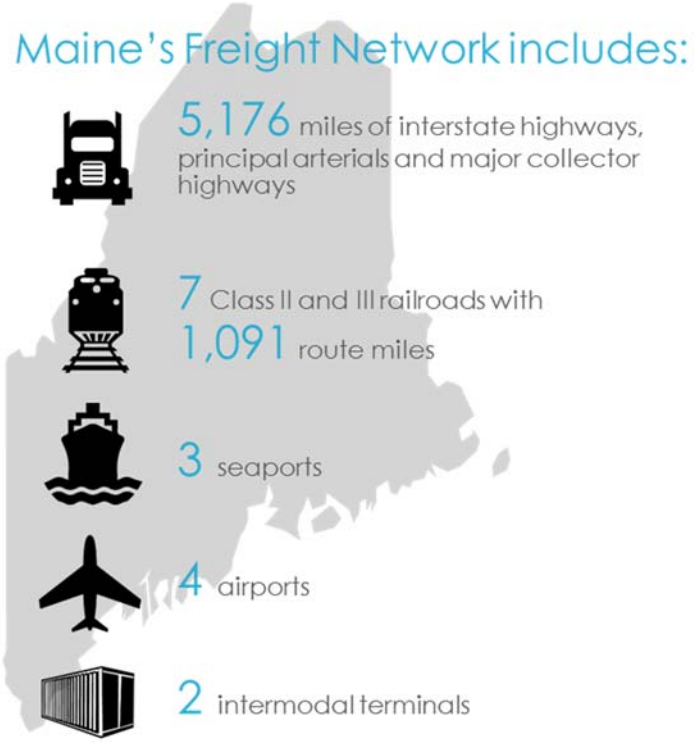


Source: https://www.fhwa.dot.gov/fastact/factsheets/nhfpfs.cfm.

Maine Freight System

The freight system in Maine is an essential resource for the State's key industries and serves as a strategic gateway to the Northeast U.S., Canada, and global markets. The Maine freight network is a multifaceted and multimodal system that consists of airports, international border crossings, seaports, intermodal facilities, a rail network, distribution centers, and most importantly, an extensive highway network:

[1] http://www.maine.gov/mdot/publications/docs/plansreports/StrategicPlan2016Update.pdf.



- **Highway:** The overwhelming majority of people and goods in Maine are moved over the State's 23,513 miles of public roads. Trucking is still the dominant mode for freight shipments, accounting for 86 percent of all freight tonnage moved to, from, within, and through the State.

- **Rail:** Maine's network of railroads connects the State to the North American and Canadian rail systems and plays a particularly important role in shipping for the forest products industry. Rail service is particularly cost effective when moving high-volume, low-value commodities over long distances.

- **Maritime:** Maine's long Atlantic coastline is vital to many industries, and the State's ports serve as hubs for maritime goods movement and connections between modes. Maine has multiple cargo ports, including Portland, Searsport, Eastport, and several other cruise ports and private terminals on the coast and major rivers.

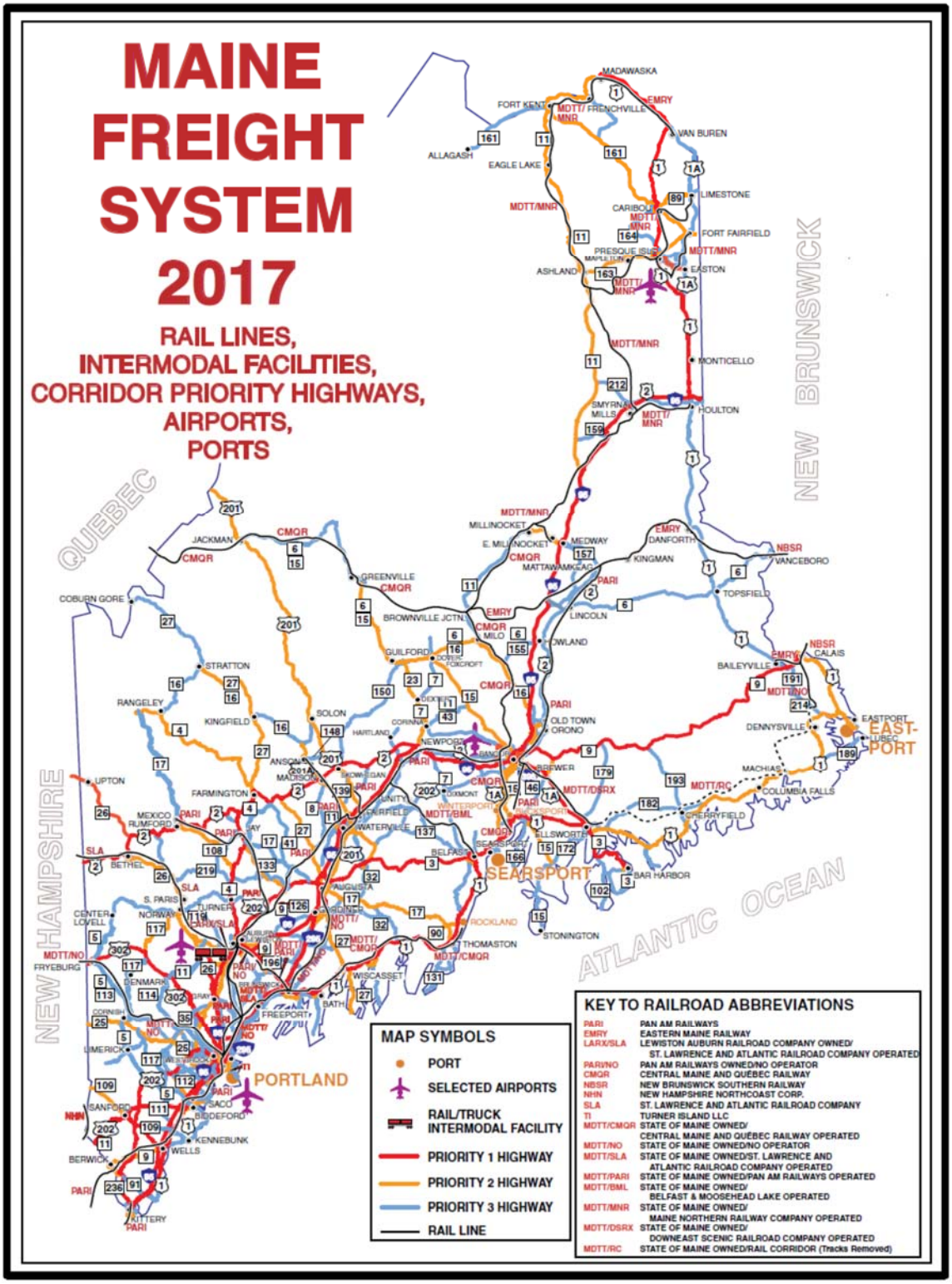
- **Air:** Airports are particularly important for the transportation of low-weight, high-value commodities such as semiconductors and for shipping perishable commodities like seafood. These commodities are important components of the Maine economy that rely on air cargo service for shipping to inland and overseas destinations.

- **Pipelines:** Pipelines transport petroleum products and natural gas to the State, or in some cases through the State to inland destinations. They provide the safest means of importing refined fuel to power Maine's motorized economy, importing natural gas from the Canadian Maritimes to provide a clean fuel and power source, and transporting crude oil imported by ships to serve oil refineries in Canada.

Along with the two active intermodal connectors, the International Marine Terminal in Portland and Pan Am Railways intermodal terminal in Waterville, and two other currently inactive intermodal terminals in Auburn and Presque Isle, these different modes combine to form a system that provides capacity, flexibility, and reliability to shippers and receivers in the State. Figure ES.2 provides a snapshot of the freight facilities in Maine in 2017.

The Maine transportation system will require substantial investment to maintain existing infrastructure and fund additional capacity. In turn, transportation investments will foster continued growth among the State's economy by improving industry competitiveness and productivity, creating jobs, and reducing economic losses due to travel time delays and excess fuel consumption. It is important to recognize the link between the efficiency of the statewide freight transportation system and the continued economic competitiveness of the State.

Figure ES.2 Maine's Freight System

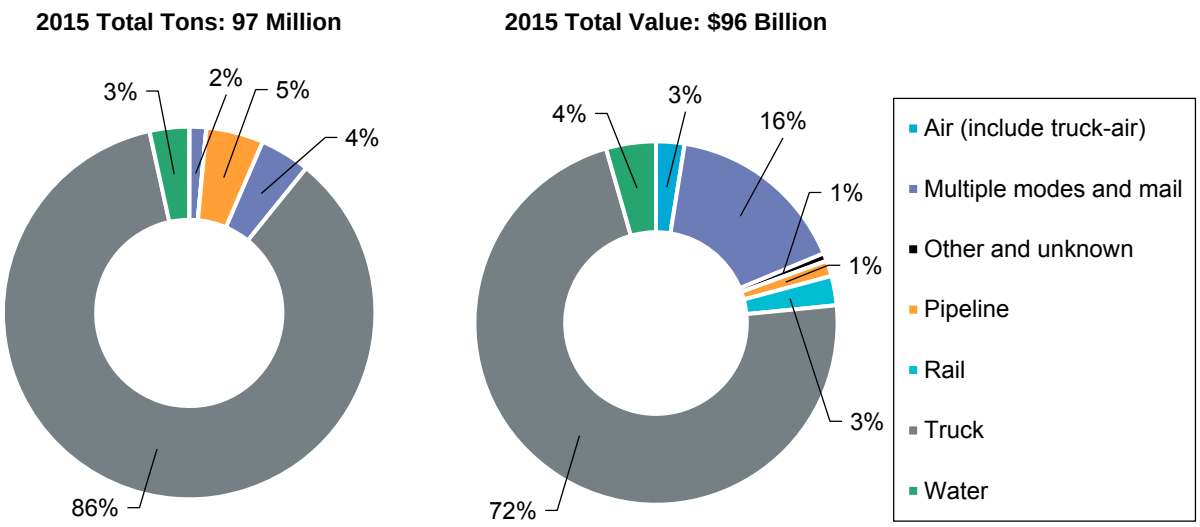


Source: MaineDOT.

Freight Activity and Demand

In 2015, about 97 million tons of freight valued at $96 billion moved over Maine's transportation system. As in most states, trucks are the dominant mode of freight transportation in Maine, with about 86 percent of total freight tonnage and 72 percent of freight value moving by truck in 2015; this heavy reliance on trucks has important implications for the State's infrastructure and the ability to sustain growth. After truck, Figure ES.3 shows that the next-highest modal categories by weight are pipeline (5 percent), rail (4 percent), water (3 percent), and multiple modes, including mail (2 percent). The modal split by freight value is somewhat different, though truck is still the dominant mode; multiple modes and air (all of which include truck freight) tend to carry lower-weight, higher-value commodities, while pipeline and rail tend to carry higher-weight, lower-value commodities.

Figure ES.3 Mode Split by Weight and Value in Maine
2015



Source: Federal Highway Administration (FHWA) Freight Analysis Framework Version 4.3; Consultant analysis.

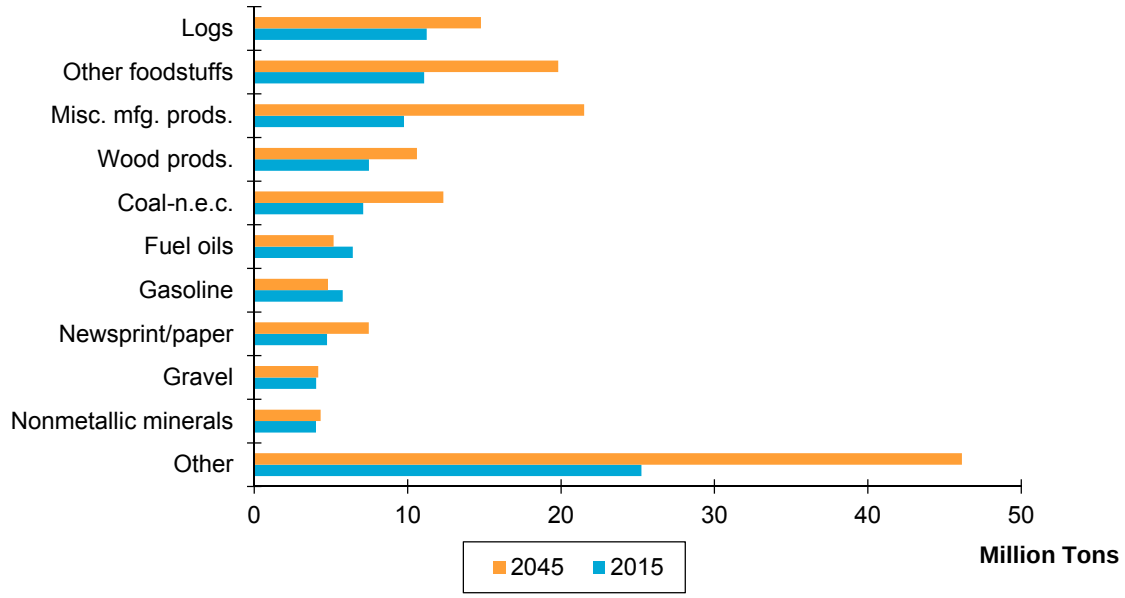
By weight in 2015, the top commodity in Maine was logs, accounting for 12 percent of the total weight of all goods moved in State. The other top five commodities include other foodstuffs, miscellaneous manufacturing products, wood products, and coal not elsewhere classified (coal – n.e.c.)[2]. The top five commodities account for 48 percent of the total weight of goods moved to, from, and within Maine in 2015. Figure ES.4 shows, the top ten commodities moved in Maine by weight for 2015 and their projected growth by 2045. **In 2045, all the top commodities moved by weight are projected to be the same as the 2015 top commodities.**

By value in 2015, the top commodity moved was mixed freight, followed by transport equipment, machinery, motorized vehicles, and coal – n.e.c. These five commodity types accounted for $37 billion or 43 percent of the total value moved. **The top commodities by value are projected to change through 2045.** Transport equipment will dominate, accounting for approximately 26 percent of the total value of goods moved,

[2] Coal-n.e.c. refers to coal and petroleum products not elsewhere classified, including natural gas.

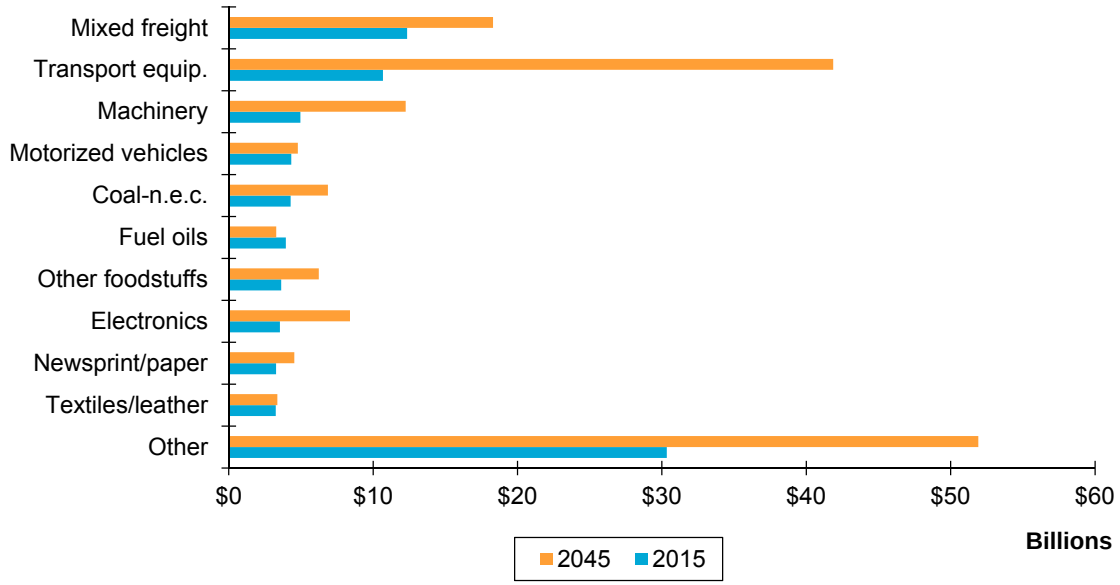
followed by mixed freight, machinery, electronics, and coal – n.e.c. The top five products combined will account for more than 54 percent or approximately $88 billion of the total value of all goods moved in the State. Figure ES.5 shows the top ten commodities moved by value in 2015 and their projected growth by 2045.

Figure ES.4 Maine Top Commodities
By Weight 2015 and 2045



Source: FHWA Freight Analysis Framework Version 4.3; Consultant analysis.

Figure ES.5 Maine Top Commodities
By Value 2015 and 2045



Source: FHWA Freight Analysis Framework Version 4.3; Consultant analysis.

Key Trends

Port Development. As a result of improved port infrastructure at the International Marine Terminal, the Port of Portland is poised to benefit from a growing container operation with Eimskip, Inc. that will improve economic development and bring more jobs to Maine. The Port already has benefited from a freight rail connection to Pan Am Railways and a private sector partner in Americold who will construct a cold storage warehouse facility on Maine Port Authority property within the Port to store refrigerated goods, including fish products to support the Maine trade economy. These improvements provide opportunities for growth and expansion of international and domestic trade for Maine, such as increased maritime and rail transloading and additional exports of forest products by rail.

Changes in the National Energy Sector. The domestic availability of shale oil and gas has changed the types and volumes of petroleum products and natural gas in Maine. More natural gas has resulted in more shipments of compressed natural gas and continued storage of liquid natural gas for peak energy needs. Pipeline reversals and low crude oil prices have resulted in fewer crude by rail movements and reduced crude oil pipeline shipments to Montreal. The Maine energy-transportation infrastructure has capacity to handle this changing market and will benefit from the trend toward cleaner burning fuels.

Shifts in the Forest Products Industry. As more Maine pulp and paper companies merge or close operations, there is an impact on many of the supporting freight and logistics operations in the State. In addition to the economic impact, goods and services associated with manufacturing wood products also have been impacted. This may provide opportunities to redevelop these facilities for other industries that may require access to lumber and wood products or other raw materials. In addition, remaining companies may benefit from working together and with the public sector to achieve transportation efficiencies in the movement of raw materials for manufacturing and of finished products to market.

Autonomous Vehicles (AV). Technology innovations have the potential to optimize and improve the transportation network. These innovations include the freight portion of the broader trends in autonomous and connected vehicles. Researchers have predicted that when the majority of the fleet is both connected and automated, there will be significant decreases in crashes, resulting in significant increases in safety and reliability. It also will lead to significant decreases in congestion (i.e., incidents, work zones, weather, and special events), which accounts for about 50 percent of total congestion.

E-Commerce. On-line retailers like Amazon have driven a major increase in package delivery directly to homes. Similarly, grocery delivery services have been developed in recent years, providing additional demands on the freight system to deliver to a geographically dispersed clientele. As same-day and next-day delivery has become the norm for e-commerce transactions, retailers have begun to reposition regional distribution centers and smaller distribution centers closer to urban areas – the centers of demand. Delivery on such a short timeframe is expensive, though it has become necessary, as customers have come to expect this level of service.

Motor Carrier Industry. The trucking industry will see further consolidation and restructuring even after the economic deregulation of the motor carrier industry in the 1980s. Small, independent trucking companies (approximately 80 percent of motor carrier firms own 5 to 10 trucks) will continue to exist; however, they will contract to large carriers or subscribe to dispatching or load matching services to ensure that capital is utilized effectively. Structural shifts in the economy that generate more high-value, lower-weight, time-sensitive goods should mean that the overall demand for trucking will be high. Driver shortages will continue

to be a recurring issue given the unregulated economic entry and boom-and-bust nature of the industry. New regulations including electronic logging devices (ELD) may impact truck parking and delivery patterns.

Shipping Industry. Ships continue to grow in size as shipping lines reduce the unit cost of moving containers and other commodities. The Panama Canal expansion, which was completed in 2016, doubled its capacity and allows for even larger ships to pass through. The eastern Maine coast has natural water depths that can accommodate these larger ships and Eastport in Maine has the capacity to serve the larger ships, however, the impacts to Maine will not be as significant as other ports in the Southeastern part of the nation.

Freight System Challenges

Increasing Reliance on Trucks. In Maine, 86 percent of total freight shipment tonnage is moved by truck. This modal dominance impacts the State and its residents through increased costs for highway construction and maintenance; higher costs to transport some goods; reduced market opportunities for Maine-based companies; and increased use of fossil fuels and resultant air quality issues. Some public officials and the general public have urged that more heavy freight be handled by the more efficient rail and water transportation modes, when these modes are reliable and make economic sense for shippers.[3] This is a challenge because trucking dominates freight haulage in the northeast U.S. region, and Maine's robust highway capacity and lack of any serious congestion allows trucking to overcome the natural price advantage of rail by providing a higher level of service that is both cost competitive and predictable.

Rail Investments and Needs. The State's rail system is in critical need for investment and support for modal diversion. Lack of investment in the rail system degrades Maine's business climate and results in increased truck traffic, pavement consumption, and stress on Maine's highway system as shippers opt for truck service over rail. The primary customer base for the railroad network in the State is directly related to the forest products and pulp and paper industries. This dominance and lack of other traffic has had a negative impact on business conditions for the railroads as these industries' markets and materials sourcing have undergone significant changes, especially during the most recent national economic downturn. In Maine the reduced level of rail freight traffic has resulted in lower levels of investment in the rail network, leading to decreased levels of service and reliability. Concurrently there is a groundswell of public interest to make better use of the railroad network. The State has worked with several of the private rail operators with public-private partnership projects using Federal and State funding to help address deferred maintenance within the rail system to improve transit times and reliability. Several significant projects are currently under construction. The State will continue to work with its rail operators to improve the infrastructure and work with the private operators on improving rail operations.

Specific rail infrastructure and operational needs identified in the 2014 Maine State Rail Plan are as follows:

- Some rail customers report that multicarrier routing in and out of Maine negatively impacts costs and transit time, resulting in diversion of traffic to motor carriers.
- Significant segments of the rail lines in Maine are not able to handle the emerging interline standard rail car of 286,000 lbs.

[3] 2014 Maine State Rail Plan.

- The two rail routes that are double-stack capable do not directly link Maine to the continental U.S. rail system, but rather connect to Canadian provinces.

- Although compliant with established Federal Railroad Administration (FRA) track classifications, many segments of the railroad network have old, outdated rail and ties, and bridges and other structures that are in need of investment to bring the rail lines to a state of good repair (SOGR). This would enable improved transit time and a normalized, more cost-effective maintenance program. Many parts of the network suffer from deferred maintenance practices that result from lack of resources.

Trade Imbalance. Maine exports more than it imports to its trading partners. As a result, Maine-based carriers have a difficult time obtaining Maine-bound shipments for their return trips, resulting in many "deadhead" miles being traveled on Maine's transportation network, increasing transportation costs for shippers, carriers, and consumers, and reducing overall efficiency. Coordination between shippers and carriers and advances in technology, however, may provide new tools for use by Maine businesses in managing their transportation and distribution functions while making these functions more efficient.

Searsport Dredging Needs. The channel for Searsport has not been dredged since the 1960s. It now has several shallow spots at 32 feet depth and a tight turning radius. Some larger vessels that call the port can only arrive at high tide, and tidal arrivals and departures create delays. A maintenance dredging project to restore the depth to 35 feet is in the permitting stage with a plan of completion by 2019 or early 2020. An improvement dredge project deepening the channel to 40 feet is also being planned by the State to be completed as a separate project following the completion of the maintenance dredge. Discharging the dredge spoils is a major challenge, especially for deepening the channel. Upland disposal sites significantly increase the cost of dredging projects while cheaper ocean disposal (such as pock marks (craters) in Penobscot Bay) face opposition from fishermen and environmental groups in the area. However, the State is committed to growth at Searsport and will continue to move the dredge projects forward.

Border Crossing Delays. Canada is a valuable trade partner for Maine. Maine imports a significantly higher volume of freight from Canada (9.4 million tons in 2015) than it exports to Canada (3.3 million tons in 2015). Customs and border crossing delays have been cited by stakeholders as having a major impact on their ability to efficiently export goods to Canada. One source of these delays is staffing issues, particularly for rail border crossings; trains are sometimes required to wait at the border while staff are diverted from nearby highway crossings. Additionally, the amount of paperwork, the tariffs and fees required by customs can contribute to shipment delays and higher transportation costs.

Solutions and Recommendations

The Maine transportation system will require substantial investment to maintain existing infrastructure and fund additional capacity. In turn, transportation investments will foster continued growth among the State's economy by improving industry competitiveness and productivity, creating jobs, and reducing economic losses due to travel time delays and excess fuel consumption. It is important to recognizing the link between the efficiency of the statewide freight transportation system and the continued economic competitiveness of the State.

Improve Road Conditions and Protect Highway Investments

Even though the State's economy has experienced a long-term trend of declining employment in freight-intensive industries, truck volumes continue to grow throughout Maine. Since trucks continue to be the dominant freight mode for the foreseeable future, efforts should be made to reduce congestion along key freight corridors, improve travel time reliability, and improve roadway conditions. The highway infrastructure and operational recommendations include:

- **Identify quick fix projects.** MaineDOT should continue to work with the private sector to identify small, easily implementable projects that can be accomplished quickly and with little funding.
- **Develop a robust Innovative Technology Deployment (ITD) program (formerly CVISN).** Progress has been made with current efforts, including the implementation of a new oversize/overweight permitting and routing system that will be linked with other ITD programs.
- **Maintain a state of good repair on major truck routes.** Trucks place a greater amount of stress on roadways than passenger vehicles resulting in damage to pavements, sidewalks, and gutters. Thus, it is important to preserve the physical condition of major freight routes.
- **Reduce congestion and improve travel time reliability on major truck routes.** Maine's interstate highway system is the core of the State's freight system as it transports the highest share of total tonnage. Overall, it provides for a high level of service. Therefore, efforts to reduce truck congestion and improve travel time reliability should be concentrated on non-Interstate truck routes that provide access to major freight assets.
- **Conduct a statewide truck parking study.** MaineDOT should prepare for the Federal mandate for Electronic Logging Devices (ELD) to maintain records of duty status (RODS) by conducting a study of truck parking needs throughout the State. The study should assess the challenges to providing safe truck parking facilities, determine how much capacity is needed, determine where capacity is needed, and assess how all these factors may change over the long range.

Expand Rail Service to Shippers, Improve Rail Security and Promote Rail as a Viable Transportation Mode for More Maine-Based Shippers

The lack of adequate and consistent rail service in the State is a major factor in the low rail mode share. Furthermore, the lack of rail service hurts Maine's business climate and results in increased truck traffic and stress on Maine's highway system as shippers opt for truck service over rail. The State should build on the work of the 2014 Maine State Rail Plan to expand freight rail market opportunities.

- Continue a strategy for investment in railroad infrastructure to improve the rail network to a state of good repair (SOGR) to enable rail to be a viable and sustainable transportation mode for more Maine-based shippers/consignees.
- Continue coordination with the railroads to accommodate heavier rail cars (286,000 pound) and double-stack clearances in corridors as may be appropriate to market conditions.
- Continue and expand programs to improve, separate, and consolidate highway-rail grade crossings.

- Direct state investments in rail infrastructure toward intermodal hubs such as the intermodal facilities at Auburn, Mack Point at the Port of Searsport, Estes Head terminal at the Port of Eastport, the Presque Isle Commerce Center, the Auburn area distribution center, and the Port of Portland.

- Continue cooperative efforts with railroads, shippers, and regional planning agencies to identify underused rail served facilities and sites that may be developed to grow rail market opportunities.

Support and Expand Port Cargo Facilities and Respond to New Market Opportunities

Maine's deep-water natural ports can be used economically and competitively to serve the growing demand for container facilities on the U.S. East Coast. Since the Panama Canal expansion increasingly larger ships are calling on East Coast ports such as Savannah and Charleston. Furthermore, rail intermodal traffic continues to be a growing market for freight rail operators as coal volumes continue to decline. These trends represent an opportunity for Maine. Following are the recommendations that should be considered to support and expand the State's port cargo facilities and to capitalize on new market opportunities:

- Continue to invest in maintenance and upgrades of Maine's ports.

- Continue to grow containerized cargo in Portland to capitalize on latest investments at the International Marine Terminal (IMT).

- Continue to program incremental capital improvements to the ports to enhance intermodal connections.

- Expand rail and port users at the IMT in Portland.

- Continue to promote and prioritize U.S. Army Corps of Engineers maintenance dredging and channel improvement projects in Searsport.

- Explore and develop the potential for a freight rail role in new energy markets, including biofuels, wind power and propane, and other emerging technologies.

Policy Strategies

Short Term

- Activate and engage a State Freight Advisory Committee (FAC). The FAC should include members of the public and private sector (including representation from key state freight industries, carriers, shippers and receivers).

- Market State maritime and rail assets to North Atlantic and Maine companies competing in those markets to assist those companies but also to improve the economics and use of those assets.

- Work with decision makers to think beyond Maine borders in regards to transportation and work with partners both regionally and internationally to improve the freight system.

- Work closely with the trucking and shipping community to address the deadhead miles issue where appropriate and effective efforts can be realized.

- Work closely with the private railroad operators and Federal agencies to improve railroad safety and security. It is recommended that these and other stakeholders be engaged formally through the FAC.
- Assess opportunities to allow limited access for higher weight Canadian trucks to travel short distances inside the State border.
- In conjunction with private sector and other local stakeholders, develop policies to increase and improve intermodal freight transportation. Specifically, MaineDOT should work to improve intermodal access to its deep-water ports.
- Work with the Administration and Legislature to establish predictable, reliable funding sources to address the need for ongoing program and project operating costs and future acquisitions of railroad rights-or-way and other facilities.
- Explore innovative funding sources, including public-private partnerships, multistate initiatives, and tax increment financing. Continue partnerships for Environmental Protection Agency (EPA) funded opportunities to acquire low emission diesel locomotives and APUs and similar environmental enhancement programs.[4]
- Continue Industrial Rail Access Program (IRAP) and Freight Rail Investment Program (FRIP) programs to encourage public private partnerships for investment in rail facilities.
- Encourage multicarrier projects that enhance intercarrier moves – to improve rail services, reduce transit time, and increase rail system reliability.
- Establish interagency coordination with state economic development and planning agencies to provide for a unified, statewide approach to goods movement planning and analysis.
- Collaborate with the Maine Port Authority to identify and evaluate potential state investments in multimodal freight projects related to enhancing connectivity between ports and rail services.
- Preserve rail corridors for current and/or future transportation needs. State acquisition of a rail corridor is justified when state ownership is the most efficient and cost-effective means of preserving the rail corridor.

Long Term

Develop a Freight Performance Measures Program. While the development and application of freight performance measures was emphasized in MAP-21 and in Federal Highway Administration's (FHWA) guidance on state freight plans and freight advisory committees, the FAST Act mandated that states report the Freight Reliability performance measure as part of their statewide freight plans (see Section 3.7.2). In addition, the FAST Act mandated that states set performance targets within one year of the establishment of national performance measures.

[4] Auxiliary Power Units that are used to maintain heat and power in railroad locomotives to prevent freezing and restarting problems. The U.S. EPA has provided grants to railroads to reduce fuel consumption and pollution.

Modernize State Transportation Investment Programs. The 2014 Integrated Freight Strategy recommended that state programs such as IRAP and SHIP be modernized in order to reflect the current funding realities. This is still a relevant recommendation, especially considering that the FAST Act has made available competitive grants for freight-specific projects through the INFRA program. Quantifying the link between freight transportation investments and economic benefits helps to articulate a stronger argument for approving one project over another across all levels of planning – Federal, state, and local. In addition, it facilitates cost-sharing discussions between public and private partners.

Identify Opportunities for Innovative Public-Private Partnerships. MaineDOT already has completed several successful public-private partnerships and should continue to identify and pursue opportunities where these partnerships may be appropriate. Innovative public-private partnerships are those that forgo direct contributions of cash by the private sector in favor of other assets.

Continue to Support Investments in Cross-Border Initiatives. MaineDOT should continue to focus on improving relationships with neighboring Canadian provinces and making improvements to Maine's border crossings. Border crossings act as bottlenecks in that they impact the free flow of freight across Maine and the rest of the U.S. MaineDOT should engage and partner with the U.S. Customs and Border Protection to make both physical and administrative investments (such as more staff) to reduce delay at border crossings.

Continue Outreach with the Private Sector Freight Community. As mentioned in the short-term strategies, MaineDOT could reactivate its State Freight Advisory Committee (FAC) as an avenue for dialogue between the State and Maine's freight transportation community. Through the FAC, MaineDOT could engage more private-sector stakeholders in the statewide transportation planning and programming process; and provide a forum for public agencies, industry groups, and local business chambers to coordinate and integrate freight movements. As part of its outreach, MaineDOT should continue to work to market the State's freight transportation assets and how the private sector can use these assets to expand their businesses within the region, nationally and internationally.

Prepare for the Next Generation of Truck Technology. Due to the pressures of thin profit margins, a nationwide shortage of drivers, and customers that want shorter and more reliable delivery timeframes, the motor carrier industry will be among the earliest adopters of autonomous and connected vehicle technology. MaineDOT should begin to prepare for a future with connected and autonomous trucks. This could involve conducting a planning-level study using models to predict the impacts of connected and autonomous on the safety and efficiency of Maine's highways. It also could involve conducting a pilot study where the real-world impacts are observed and measured.

1.0 Introduction

This section provides an introduction to the Maine Integrated Freight Strategy, explains the goals of this Plan and how they relate to the National Multimodal and Highway Freight Network Goals, and describes the organization of the remainder of the document.

1.1 Why Develop an Integrated Freight Strategy?

Maine's freight system plays a critical role on a daily basis for every resident and business. In 2015, nearly 97 million tons of goods worth $96 billion traveled on Maine's roads, over its railroad tracks, through its ports and airports, or in its pipelines. Delivering raw materials from field, forest, or quarry to manufacturer, and finished products to warehouses and store shelves (and sometimes back) in order to serve Maine's businesses and residents.

The State's freight infrastructure faces continually changing demands due to statewide, national and global changing freight trends and developments, including:

- Population growth stagnation, where significant population growth in the State's southern urban areas has been offset by decreases in the State's more northern and western rural areas;
- Long-term employment shift from goods-dependent industries to service industries in the State, driven in part by ongoing decline in manufacturing employment due to the high pace of technological innovation and automation in the manufacturing sector;
- Containerized trade through the Port of Portland, driven by Maine's Eimskip container service between Portland and Europe, has increased dramatically in recent years, and provided the opportunities for growth and expansion of international and domestic trade for Maine;
- Industry shifts in the energy and forest products sectors, and the impacts to the types and volumes of commodities being shipped in Maine and on many of the supporting freight and logistics operations in the State;
- Adoption of new technologies such as autonomous and connected trucks; and
- Increasing demand for same-day and next day deliveries.

As Maine adapts to these changing conditions in an environment where needs outstrip resources, how does MaineDOT identify and prioritize projects in order to "manage the transportation system to the greatest benefit of Maine's citizens and MaineDOT's customers?"[5] The answer is planning. MaineDOT has a long history of planning for freight activity in the State, starting with an Integrated Freight Plan in 1998, to more recent Maine Freight Strategy plans in 2011 and 2014. These documents, and this Integrated Freight Strategy, gather information on existing and future freight assets, issues and needs, and trends at the local, national, and global level, allowing MaineDOT to shape statewide freight policy and investment activities to respond to public- and private-sector freight needs.

[5] MaineDOT. Strategic Plan 2016 Update.

Further, this Integrated Freight Strategy fulfills Federal freight planning requirements found in the Fixing America's Surface Transportation (FAST) Act, passed in December 2015, allowing Maine to access Federal freight funds.

The Fixing America's Surface Transportation Act (FAST Act) of 2015 is a five year, $305 billion transportation bill providing funding for the nation's transportation planning and infrastructure investments. The FAST Act includes several provisions specifically geared to improving the performance of the national freight network and supporting investment in freight-related surface transportation projects. At the national level, this includes the development of a National Multimodal Freight Policy, National Freight Strategic Plan, and designation of a National Multimodal Freight Network. On the funding side, it also includes $6.3 billion in formula funding for freight projects on the National Highway Freight Network (NHFN) and a $4.5 billion discretionary, freight-focused grant program for states, metropolitan planning organizations (MPO), local governments, and other entities.

The Maine Integrated Freight Strategy was developed in compliance with FAST Act requirements for state freight plans to ensure the State has access to Federal funding opportunities and competitive grant opportunities. A table summarizing this plan's compliance with the FAST Act requirements is included as cover page for this Plan.

1.2 Plan Goals

MaineDOT has identified three overarching goals and a number of objectives as part of the *Strategic Plan 2016 Update*.[6] These goals and objectives are:

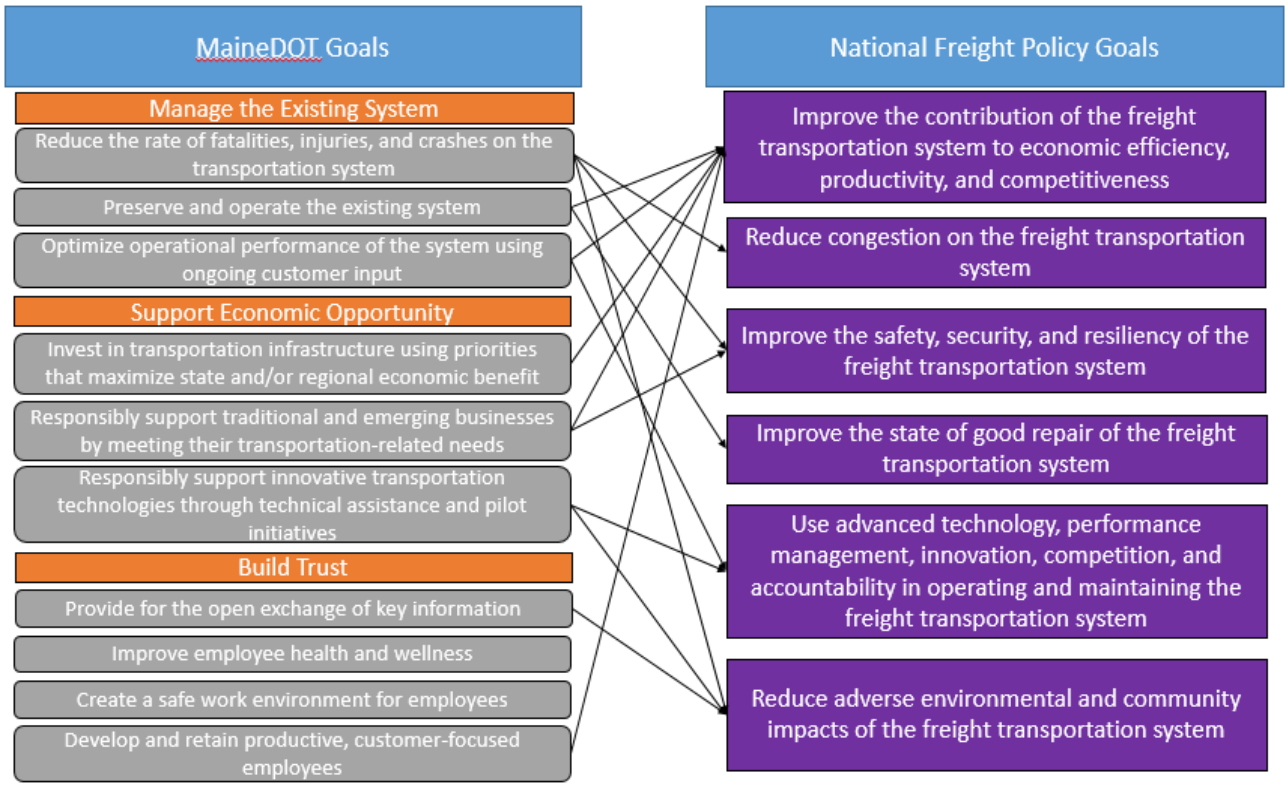
- **Manage the Existing System:** Effectively manage Maine's existing transportation system for safety and effectiveness within reliable funding levels.
  - Reduce the rate of fatalities, injuries, and crashes on the transportation system.
  - Preserve and operate the existing system.
  - Optimize operational performance of the system using ongoing customer input.
- **Support Economic Opportunity:** Wisely invest available resources to support economic opportunity for the department's customers.
  - Invest in transportation infrastructure using priorities that maximize state and/or regional economic benefit.
  - Responsibly support traditional and emerging businesses by meeting their transportation-related needs.
  - Responsibly support innovative transportation technologies through technical assistance and pilot initiatives.

[6] http://www.maine.gov/mdot/publications/docs/plansreports/StrategicPlan2016Update.pdf.

- **Build Trust:** Demonstrate the department's core values of integrity, competence, and service, both individually and organizationally.
  - Provide for the open exchange of key information.
  - Improve employee health and wellness.
  - Create a safe work environment for employees.
  - Develop and retain productive, customer-focused employees.

These broader transportation system goals are directly applicable to Maine's multimodal freight system. For example, reducing the rate of crashes, injuries, and fatalities will improve highway performance for all users, including trucks. Adding a freight lens, reducing the rate of *truck-involved* crashes, injuries, and fatalities will directly enhance freight mobility, improve the safety of the freight system, and reduce the adverse impacts of freight movement on communities. These goals and objectives reflect national multimodal and highway freight program goals as shown in Figure 1.1 below.

Figure 1.1 MaineDOT and National Freight Policy Goals



Source: https://www.fhwa.dot.gov/fastact/factsheets/nhfpfs.cfm.

1.3 Report Organization

The remainder of this report is divided into four main sections:

- **Section 2** provides an overview of Maine's demographic and economic trends – key drivers of freight activity – and summarizes freight activity in the State using freight flows developed from Federal Highway Administration (FHWA) data;
- **Section 3** inventories Maine's freight assets across all modes (highway, rail, maritime, air, and pipeline), identifies key freight corridors and clusters of freight-generating industries in the State, examines highway usage and performance, and analyzes truck-involved crash safety data;
- **Section 4** identifies trends at the global, national, and state level that will likely impact future freight flows in Maine, discusses issues and challenges facing Maine's freight network, and explores existing and potential sources to fund projects and policies; and
- **Section 5** discusses recommendations for projects, operational changes, and policy strategies to address Maine's freight system issues and challenges identified in Section 4.

This report also contains four appendices:

- **Appendix A – Commodity Flow Analysis:** Detailed information and methodology used to develop the freight activity data in Section 3;
- **Appendix B – Commodity Flow Study of Hazardous Materials:** Identifies transportation routes and annual transportation volumes by mode for various chemicals of HazMat commodity flows referencing the Maine Commodity Flow Study of Hazardous Materials completed in 2015 for the Maine Emergency Management Agency (MEMA);
- **Appendix C – Critical Urban and Critical Rural Freight Corridors:** These roadways are additional miles to be designated by MaineDOT to the National Highway Freight Network (NHFN) discussed in Section 3, and are eligible for National Highway Freight Program (NHFP) funds; and
- **Appendix D – Freight Investment Plan:** A detailed list of freight priority projects to be funded with National Highway Freight Program (NHFP) formula money, including investment and matching funds.

2.0 Maine's Economy and Freight Demand

Freight movement underpins and enables economic activity. The structure of local, regional and national economies are constantly changing and are highly sensitive to population growth, trade patterns, new technologies, and political forces and hence it is important to anticipate these changes for planning purposes. This section accomplishes two things. First, it provides a brief overview of Maine's population and industry trends – two factors that drive the demand and production of freight. Second, it highlights freight flows to, from, within, and through Maine using data from FHWA's Freight Analysis Framework Version 4.3. Further details about the methodology for processing and disaggregating the FAF 4.3 data are presented in Appendix A.

2.1 Population and Employment

One of the largest drivers of freight demand is population. Residents desire goods and services (increasingly being ordered over the Internet) and provide a workforce for Maine's companies. Maine's total population has been nearly unchanged over the last decade and stood at roughly 1.33 million residents in 2016.[7] However, between 2010 and 2016, population has grown in the southern portion of the State (Greater Portland and York County) and around Bangor, while population in more rural northern and western towns and counties continues to decline.[8] This matches trends in many parts of the U.S. where people, especially younger generations, are increasingly settling in more urbanized areas.

Employment in the State also has recovered to prerecession levels and averaged about 600,000 employees in 2016.[9] However, certain industries use and rely on freight transportation more than others. Sectors such as manufacturing, construction, natural resources, and mining rely on the transportation system and logistics services to receive raw supplies and manufactured goods and to send their finished/refined products to market. Certain service sectors that are not production oriented, such as retail and wholesale trade or transportation and warehousing, also are highly dependent on the movement of physical goods. By contrast, other service-providing industries such as education, health care, hospitality, and professional services use the freight transportation system less intensively for shipment of materials, office products, and other goods that support their operations.

Maine has continued a long-term employment trend away from freight-intensive, goods-dependent industries and toward service industries that do not generate as much freight activity. Figure 2.1 shows historical trends of employment by sector in Maine over the last decade (2006 to 2016). Goods-dependent industries accounted for about 36 percent of all employment in the State in 2016. These industries generally saw declines in employment from 2006 to 2016, while service industries with less intensive freight transportation needs had growth in employment.

Note that employment is driven by a combination of demand for different goods and services, competition inside and outside the State, and the level of automation or technological efficiency in each sector; an industry undergoing technological change may have declining employment but growing output. As a result,

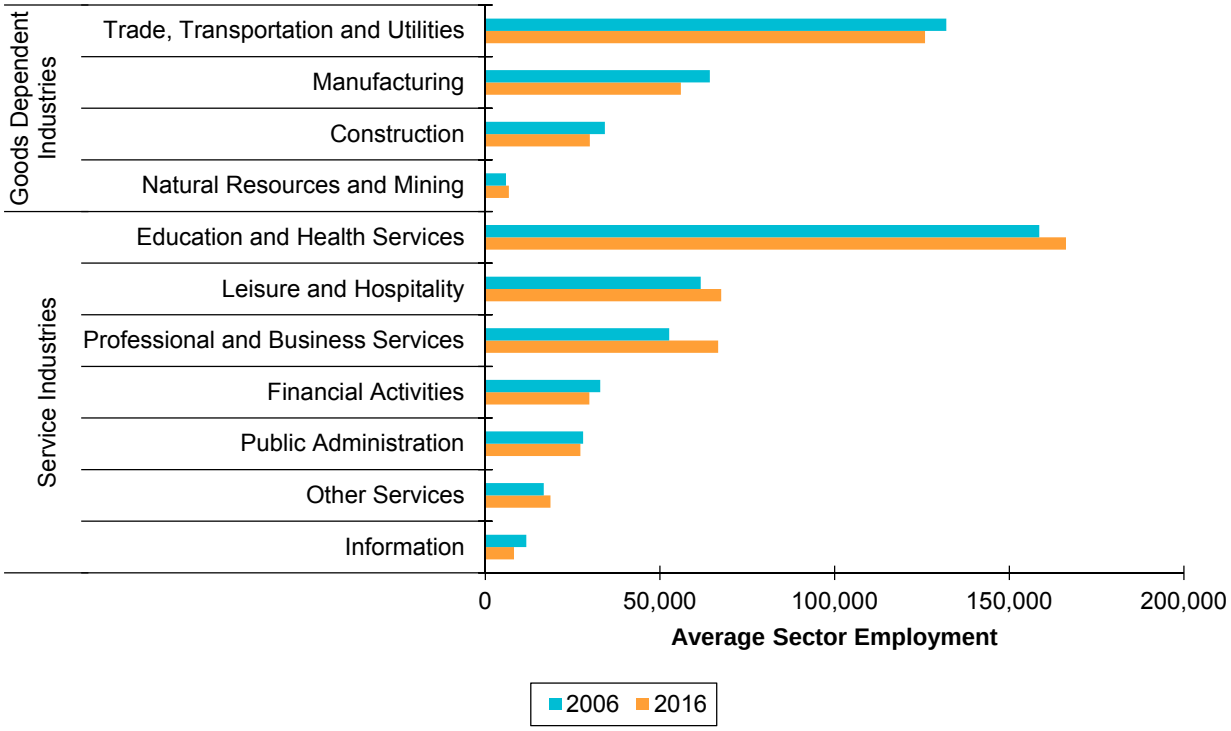
[7] U.S. Census Bureau Population Estimates.

[8] Portland Press Herald, http://www.pressherald.com/2017/05/26/interactive-population-change-maine-towns-2010-2016/.

[9] Maine Department of Labor, Center for Workforce Research and Information, Quarterly Census of Employment and Wages.

employment does not necessarily reflect the composition of freight activity in the State, discussed in the next section.

Figure 2.1 Maine Employment by Sector
2006 and 2016



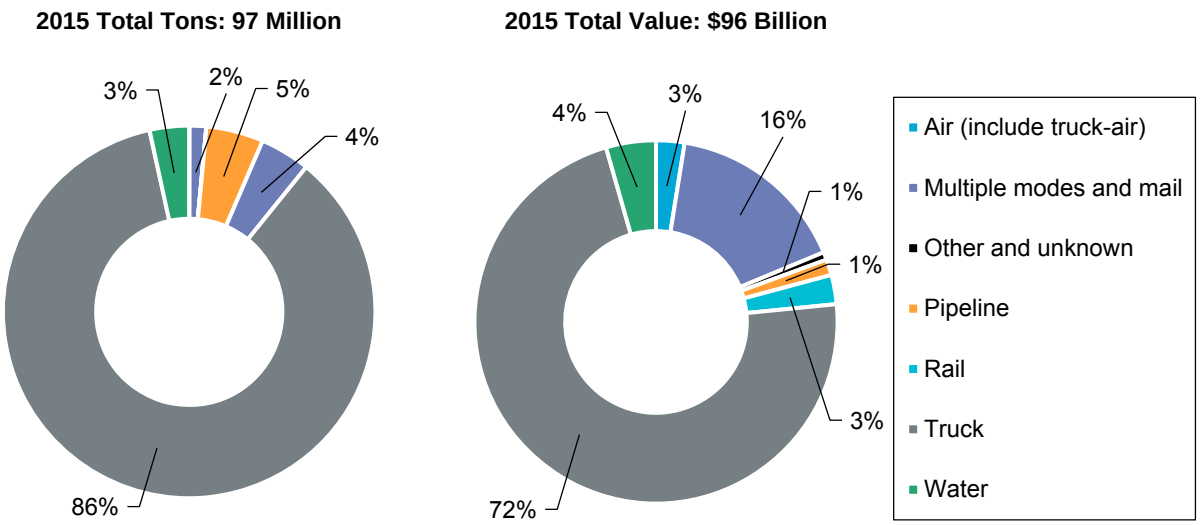
Source: Maine Department of Labor, Center for Workforce Research and Information, Quarterly Census of Employment and Wages; Consultant analysis.

2.2 Freight Activity and Demand

Statewide commodity flows provide an overall picture of the freight moving into, out of, within, and through the State of Maine. FHWA's Freight Analysis Framework Version 4.3 data was disaggregated to obtain county-level flows for 2015 by mode, direction, commodity type, origin, and destination. Appendix A details the methodology used for the disaggregation process.

In 2015, about 97 million tons of freight valued at $96 billion moved over Maine's transportation system. As in most states, trucks are the dominant mode of freight transportation in Maine, with about 86 percent of total freight tonnage and 72 percent of freight value moving by truck in 2015; this heavy reliance on trucks has important implications for the State's infrastructure and the ability to sustain growth. After truck, Figure 2.2 shows that the next-highest modal categories by weight are pipeline (5 percent), rail (4 percent), water (3 percent), and multiple modes, including mail (2 percent). The modal split by freight *value* is somewhat different, though truck is still the dominant mode; multiple modes, mail, and air (all of which include truck freight) tend to carry lower-weight, higher-value commodities, while pipeline and rail tend to carry higher-weight, lower-value commodities.

Figure 2.2 Mode Split by Weight and Value in Maine
2015



Source: FHWA Freight Analysis Framework Version 4.3; Consultant analysis.

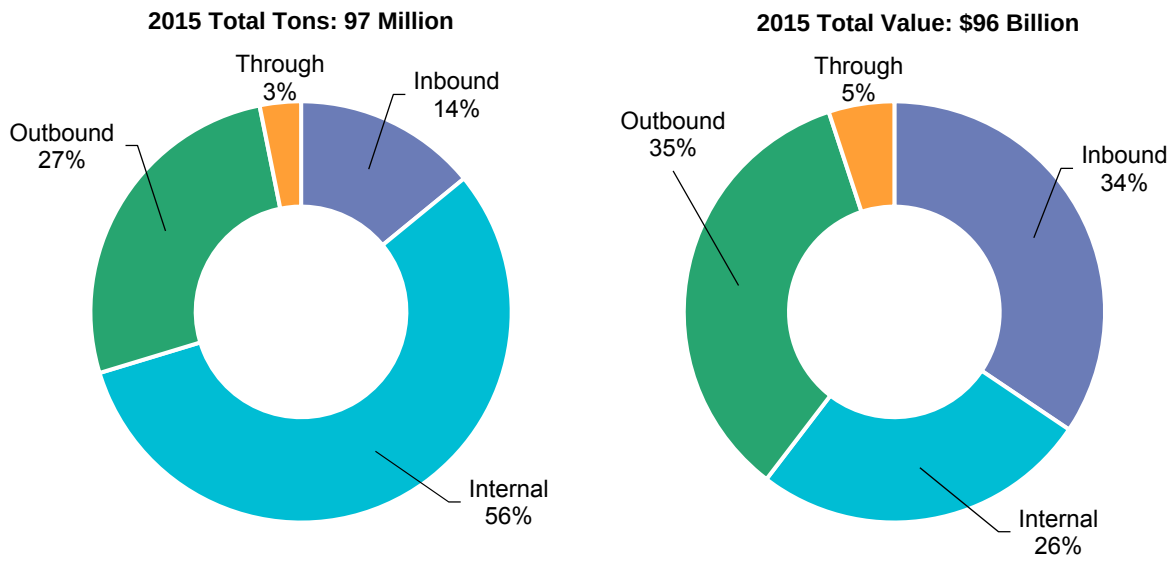
Freight flows in the State of Maine are assigned to one of four directions based on their domestic origin and destination:[10]

- **Inbound:** Freight moving from outside Maine to a destination inside the State.
- **Outbound:** Freight originating in Maine and moving to a destination outside the State.
- **Internal:** Freight moving between two locations within the State.
- **Through:** Domestic freight passing through Maine but with both an origin and a destination in other U.S. states. It should be noted that through freight only includes truck flows.

Figure 2.3 shows that Maine has a mix of inbound, outbound, and internal freight, with a very small share of freight passing through Maine as a result of its location in the north-eastern corner of the country. Internal flows account for just over half of Maine's freight tonnage, but only one quarter of freight value. Maine has a much larger share of outbound freight tonnage (27 percent) than inbound tonnage (14 percent); this imbalance can make it difficult for outbound trucks to obtain Maine-bound shipments for their return trips, resulting in "deadhead" miles that drive up the cost of outbound shipping.

[10] Note that international flows are categorized by their domestic entry or exit points. For example, a freight flow from New Hampshire to Maine would be an inbound flow; likewise, a flow from New Hampshire to Canada with a border crossing in Maine would also be an inbound flow, based on the exit point in Maine. Additionally, a flow from Maine to Canada would be an internal flow since its origin and exit points are both in Maine.

Figure 2.3 Direction of Flows by Weight and Value in Maine
2015

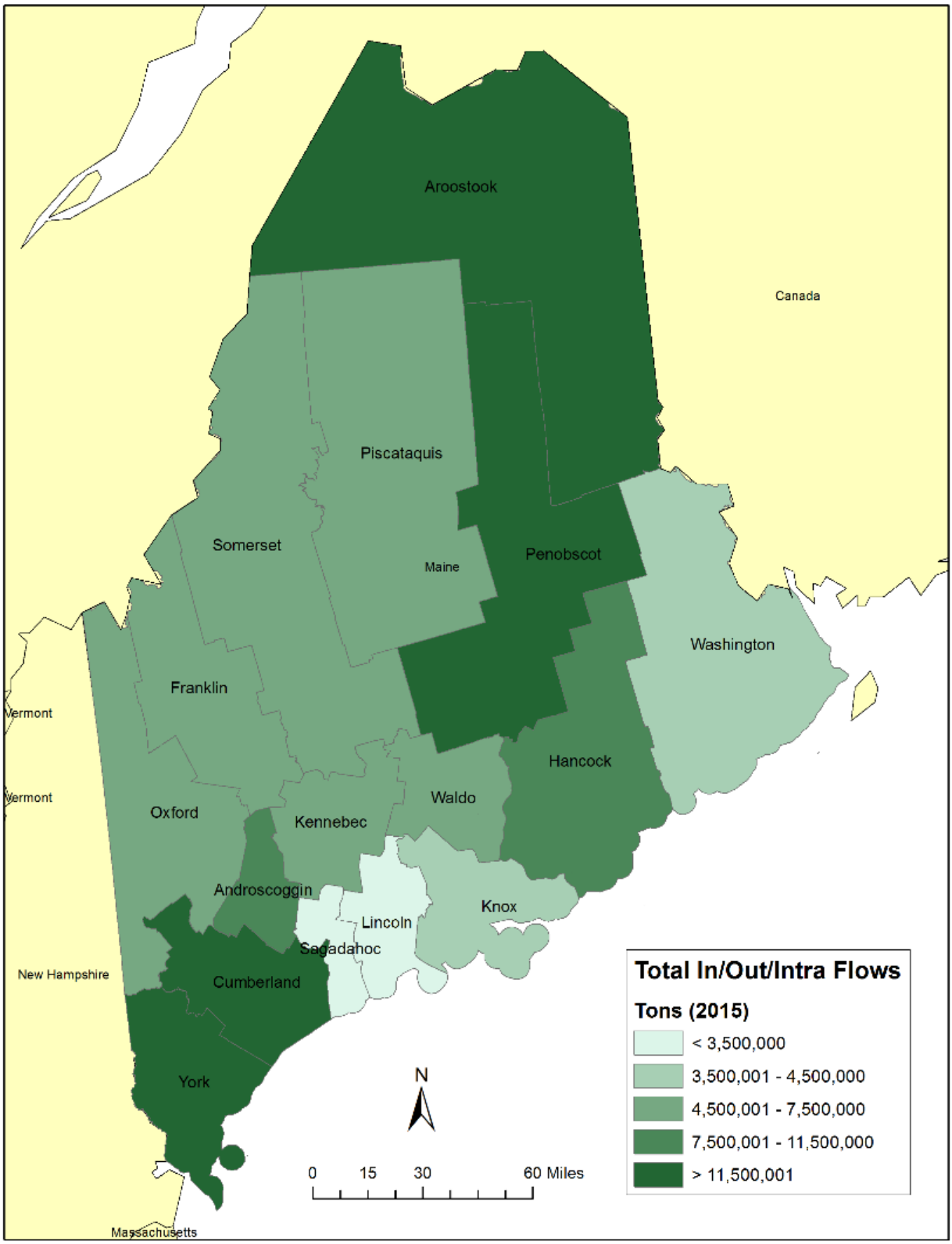


Source: FHWA Freight Analysis Framework Version 4.3; Consultant analysis.

The top commodity moved by weight in 2015 was logs (12 percent of total tonnage), followed closely by other prepared foodstuffs, fats and oils, and miscellaneous manufactured products. The next top products were largely heavy bulk commodities, including: wood products; other coal and petroleum products not elsewhere classified (including gaseous hydrocarbons such as liquefied natural gas, liquefied propane, liquefied butane, petroleum coke, petroleum asphalt, among others); fuel oils (including diesel, bunker c, and biodiesel); gasoline, aviation turbine fuel and ethanol; and, pulp, newsprint, paper and paperboard. These commodities combine to make up two-thirds of all freight tonnage (about 64 million tons) and highlight the importance of the forest product industry in the State. Mixed freight (consumer products) and transportation equipment made up 27 percent of freight value moved in 2015, with remaining freight value spread over other high-value commodity types (e.g., machinery and motorized vehicles).

At the county level, Aroostook and Cumberland have the highest volume of freight activity in the state, followed by Penobscot and York. These top counties are all adjacent to the important I-95 freight corridor. Aroostook County in northern Maine is the top county by weight, with about 21 percent of the State's freight tonnage moving in the county. This reflects the county's important role in the State's forest product industry and its border crossings which enable U.S.-Canadian trade. Cumberland, a coastal county containing the Portland metropolitan area, is the top county by value moved (about 15 percent of the State total), and recently has had significant economic growth around food products.

Figure 2.4 Freight Weight by County for Inbound/Outbound/Intra Flows *2015*



Source: FHWA Freight Analysis Framework Version 4.3; Consultant analysis.

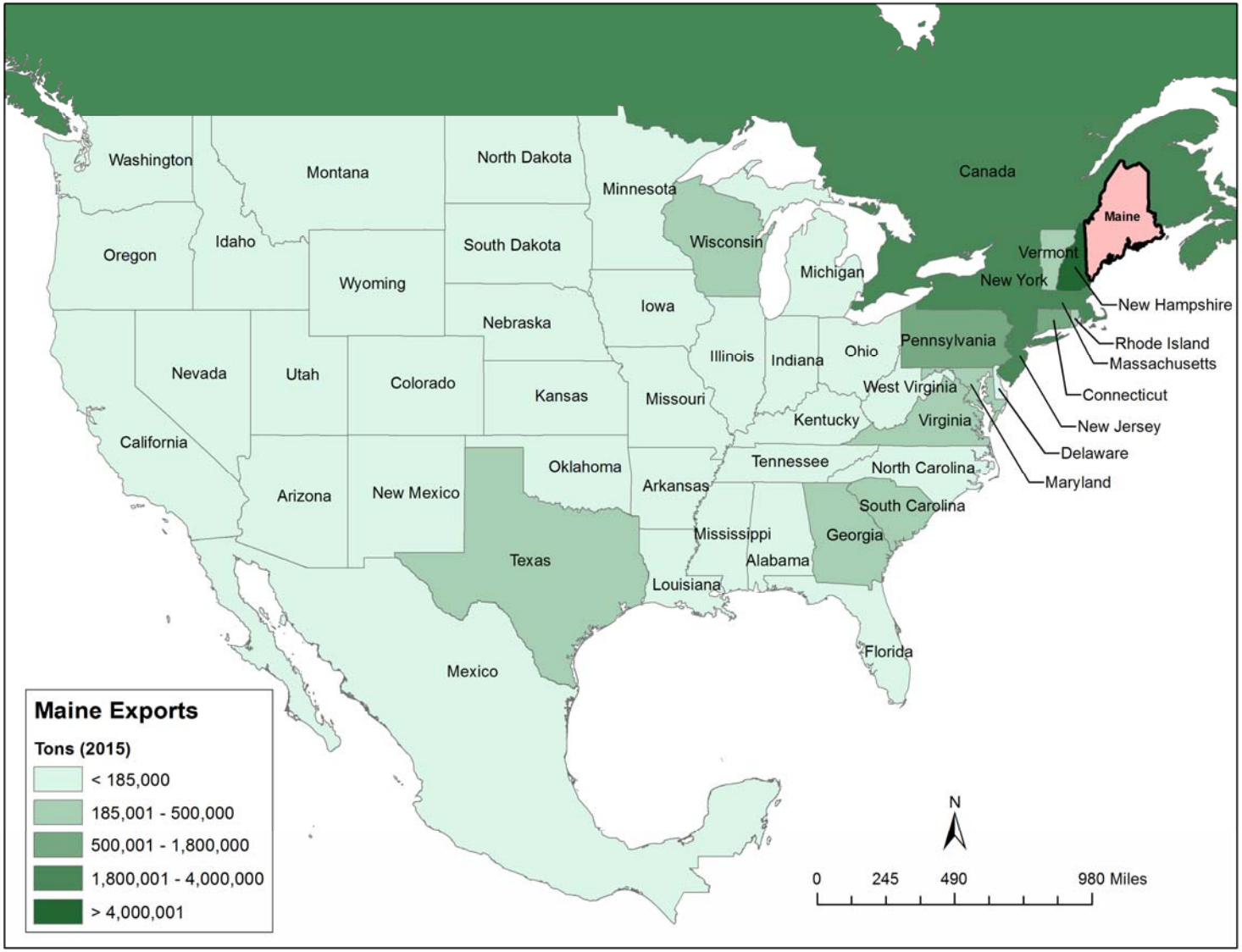
Maine's primary domestic trade partnerships are all in the Northeast region. New Hampshire alone accounted for 33 percent of Maine's outbound freight tonnage (11 percent by value) and 26 percent of Maine's inbound freight tonnage (7 percent by value) in 2015. Maine's next-biggest trading partners are Massachusetts (about 15 percent of all inbound and outbound trade by weight and value) and New York (about 10 percent). Altogether, the Northeastern states (New Hampshire, Vermont, Massachusetts, New York, Connecticut, Rhode Island, Pennsylvania, and New Jersey) account for 82 percent of Maine's inbound and outbound freight by weight and roughly 60 percent by value.

The large majority of freight crossing Maine's borders (81 percent by weight in 2015) is domestic trade with other U.S. states; however, international trade also is a vital component of freight movement in Maine. In 2015 the State's foreign imports and exports totaled about 15 million tons and $22 billion of freight. Predictably, Canada is by far Maine's most important international trading partner, accounting for 84 percent of Maine's international freight trade by weight (13 million tons) and 80 percent by value ($17 billion). This is greater than Maine's trade with any single U.S. state, but it also is highly imbalanced; Maine imports roughly three times the weight and value that it exports internationally.

Figure 2.5 and Figure 2.6 map Maine's imports and exports domestic and North American trading partners in 2015.

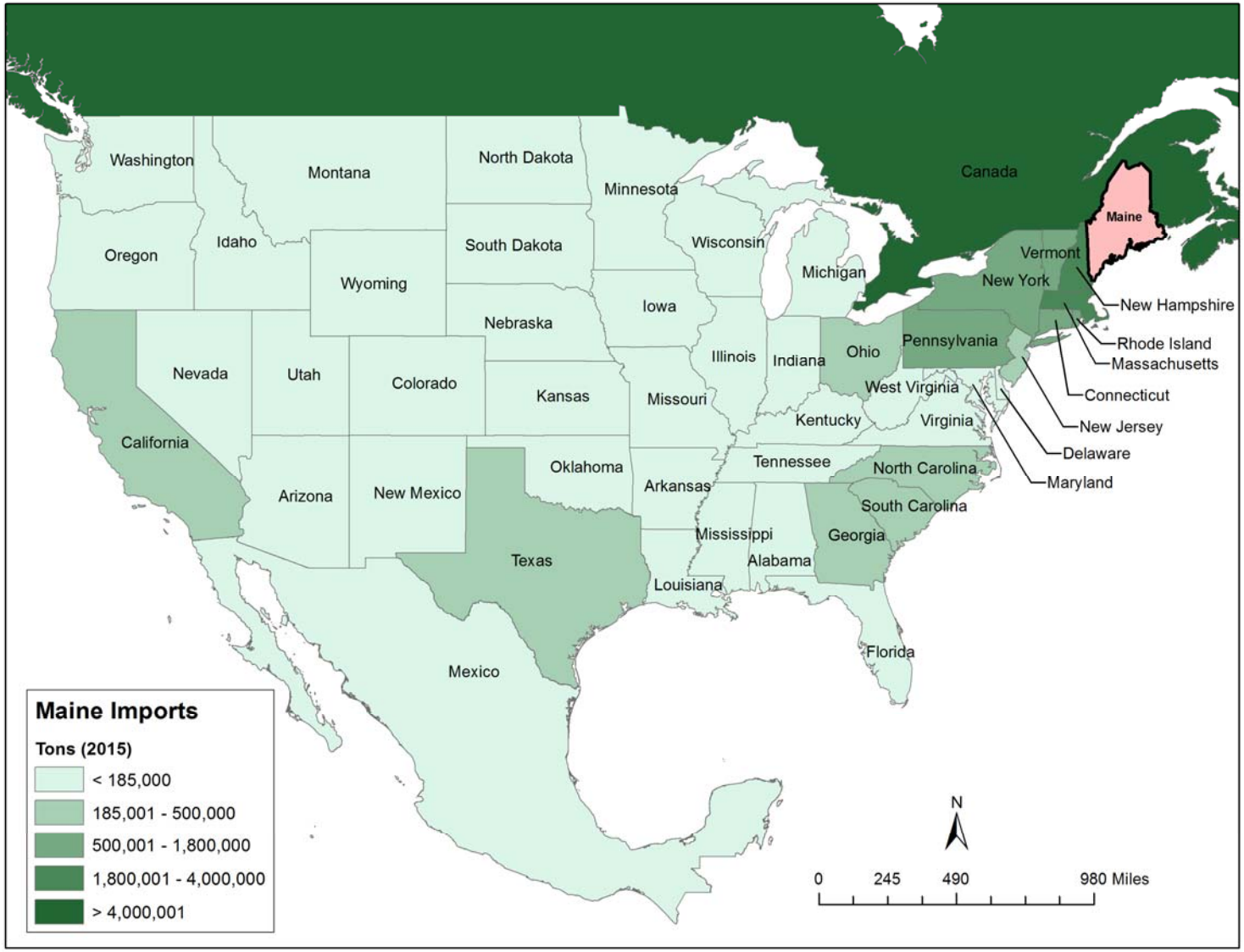
Figure 2.5 Maine's Outbound/Export Trading Partners

2015



Source: FHWA Freight Analysis Framework Version 4.3; Consultant analysis.

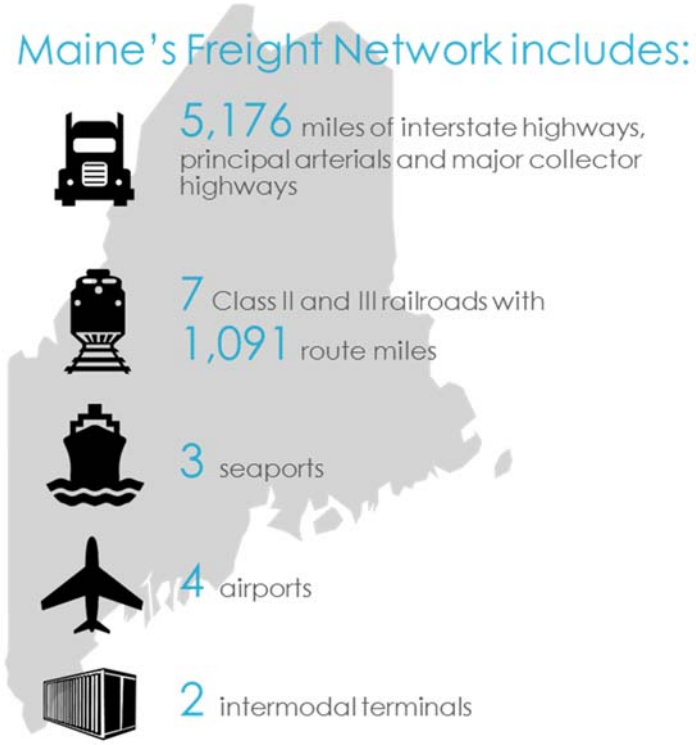
Figure 2.6 Maine's Inbound/Import Trading Partners
2015



Source: FHWA Freight Analysis Framework Version 4.3; Consultant analysis.

3.0 System Inventory, Network Usage, and Performance

The freight system in Maine is an essential resource for the State's key industries and serves as a strategic gateway to the Northeast U.S., Canada, and global markets. The Maine freight network is a multifaceted and multimodal system that consists of airports, international border crossings, seaports, intermodal facilities, a rail network, distribution centers, and most importantly, an extensive highway network:



- **Highway:** The overwhelming majority of people and goods in Maine are moved over the State's 23,513 miles of public roads. Trucking is still the dominant mode for freight shipments, accounting for 86 percent of all freight tonnage moved to, from, within, and through the State. Other modes of transporting freight in and through Maine complement the highway network, meeting the needs of specific industries and providing alternatives for shippers and receivers.

- **Rail:** Maine's network of railroads connects the State to the North American and Canadian rail systems and plays a particularly important role in shipping for the forest products industry. Rail service is an underutilized but important component of the transportation network in Maine and is particularly cost effective when moving high-volume, low-value commodities over long distances.

- **Maritime:** Maine's long Atlantic coastline is vital to many industries, and the State's ports serve as hubs for maritime goods movement and connections between modes. Maine has three major cargo ports – Portland, Searsport, and Eastport – and several other cruise ports and private terminals on the coast and major rivers.

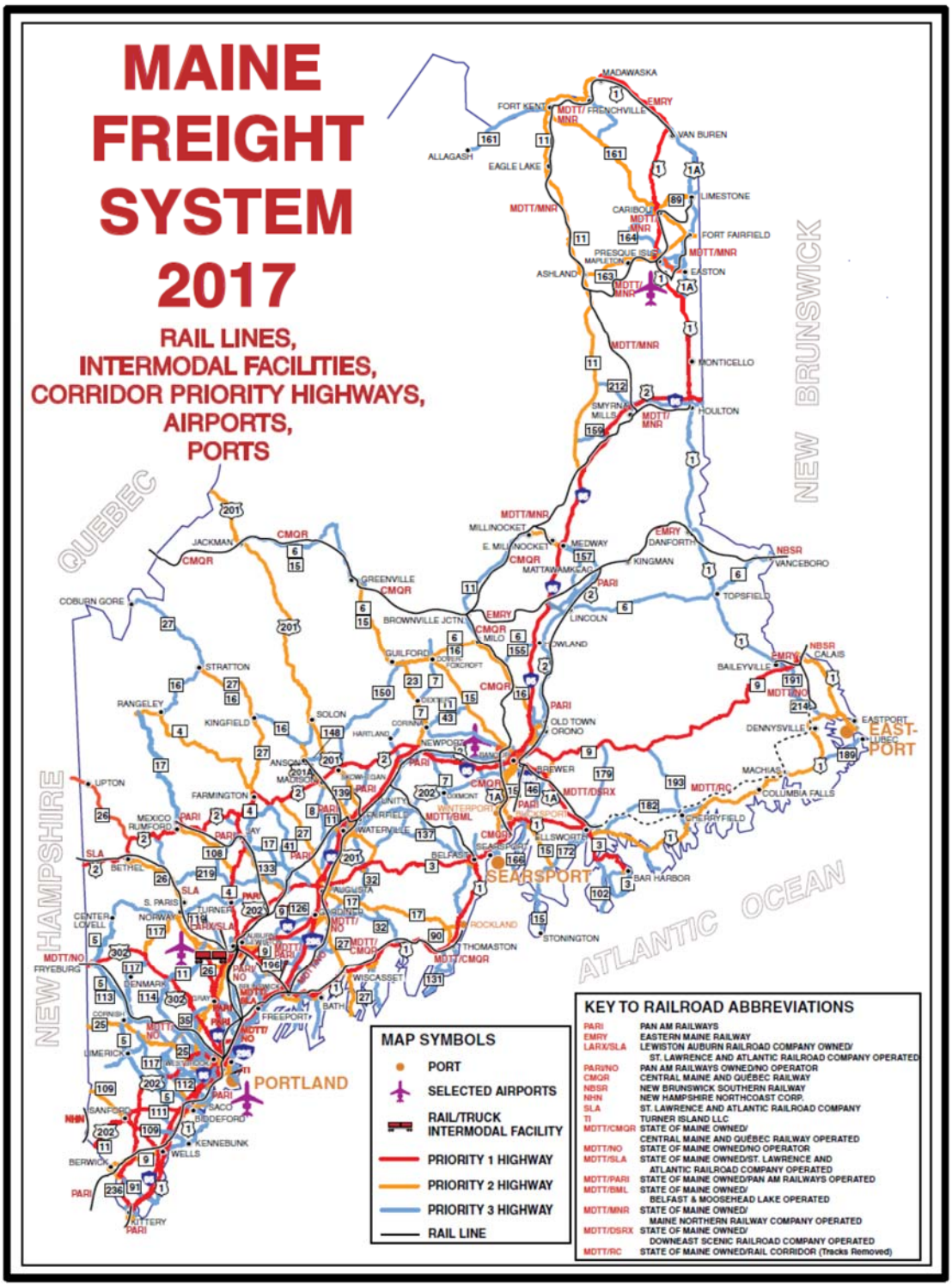
- **Air:** Airports are particularly important for the transportation of low-weight, high-value commodities such as semiconductors and for shipping perishable commodities like seafood. These commodities are important components of the Maine economy that rely on air cargo service for shipping to inland and overseas destinations.

- **Pipelines:** Pipelines transport petroleum products and natural gas to the State, or in some cases through the State to inland destinations. They provide the safest means of importing refined fuel to power Maine's motorized economy, importing natural gas from the Canadian Maritimes to provide a clean fuel and power source, and transporting crude oil imported by ships to serve oil refineries in Canada.

Along with the two active intermodal connectors, the International Marine Terminal in Portland and Pan Am Railways intermodal terminal in Waterville, and two other currently inactive intermodal terminals in Auburn

and Presque Isle, these different modes combine to form a system that provides capacity, flexibility, and reliability to shippers and receivers in the State. Figure 3.1 provides a snapshot of the freight facilities in Maine in 2017.

Figure 3.1 Maine's Freight System



Source: MaineDOT.

While Maine's existing transportation system accommodates current demand reasonably well, strategic investment in maintaining and expanding infrastructure has the potential to stimulate the State's economy by making it easier and cheaper to ship goods into and out of the State. The rest of this section provides more details on the specific elements that comprise Maine's multimodal freight system.

3.1 Highway

Highway transport is the primary mode of goods movement in Maine. By far, it accounts for the largest share of overall tonnage by mode representing nearly 86 percent of total inbound, outbound, internal, and through flows for all modes combined in the State. Even goods with a primary mode of transport other than highway – rail, air, ship, or pipeline – typical rely on trucks for at least the first or last miles of travel.

There are approximately 23,265 miles of roadway in the State of Maine. MaineDOT uses a five-level classification system to describe and prioritize responsibility for these roadways. Priority 1 includes all Interstates and key principal arterials, including the Maine Turnpike – the tolled portion of I-95 from Kittery to Augusta – which accounts for 249 miles and 9.2 percent of all VMT.[11] Priority 2 accounts for non-Interstate high-value arterials, such as U.S. 201. Table 3.1 presents definitions and total mileage for each priority level, and Figure 3.2 shows the State's highway system by classification.

Table 3.1 MaineDOT Roadway Classification and Miles Served

Priority	Definition	Miles	Percent of Miles Covered	Percent of Traffic Covered
Priority 1 Roads	The Maine Turnpike, the interstate system, and key principal arterials like Route 1 in Aroostook County, the Airline (Route 9), Route 2 west of Newport, and Route 302.	1,625	7%	42%
Priority 2 Roads	Non-Interstate, high-value arterials (including all National Highway System (NHS) highways that are not Priority 1).	1,348	6%	18%
Priority 3 Roads	Remaining arterials and most significant major collector highways.	2,203	9%	16%
Priority 4 Roads	Remainder of the major collector highways, often also part of Maine's unique State Aid system, in which road responsibilities are shared between the State and municipalities.	3,740	9%	12%
Priority 6 Roads	Local roads and streets, the year-round responsibility of municipalities.	14,349	62%	13%

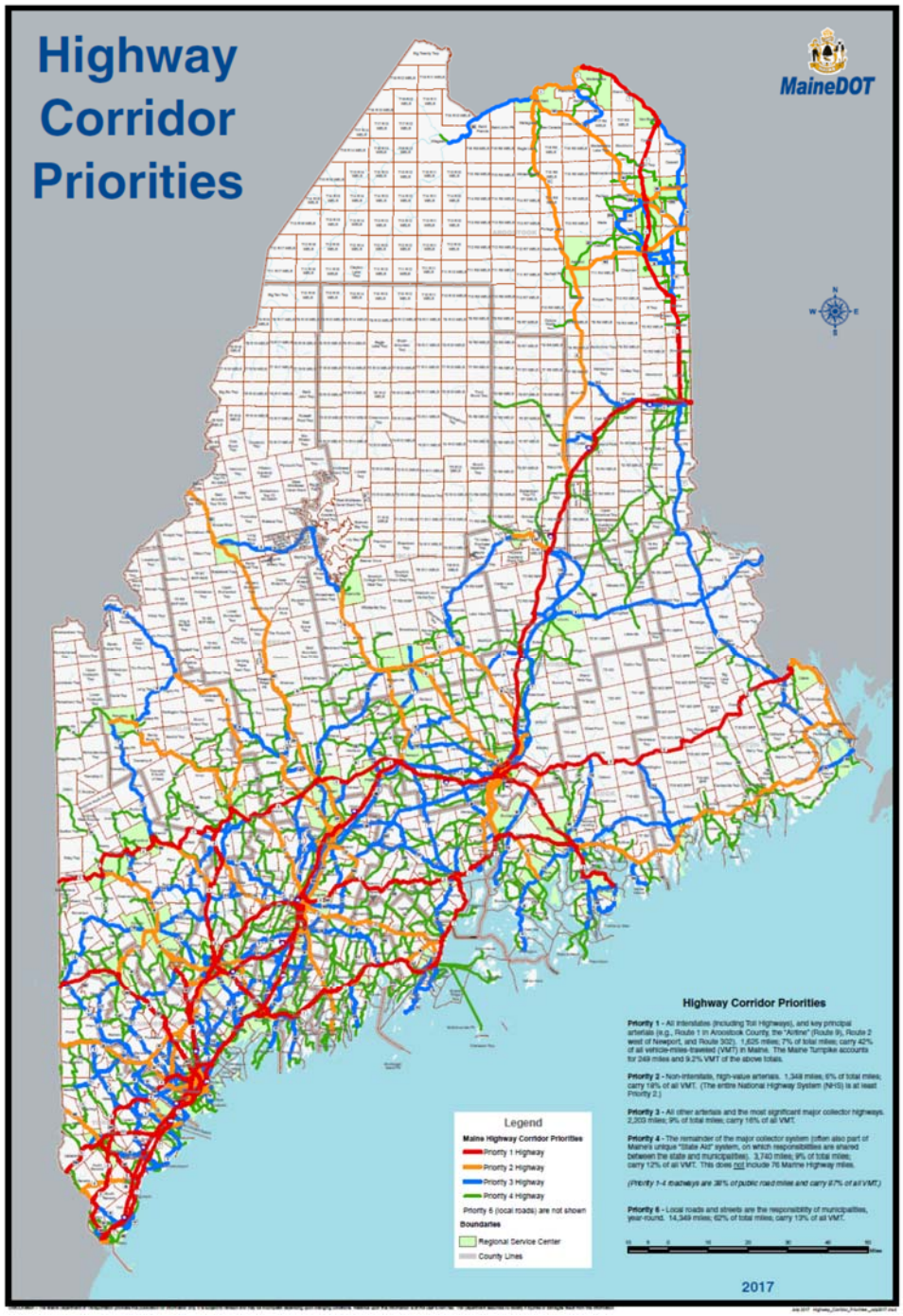
Source: MaineDOT.

As previously noted, most freight in Maine is transported via truck, making the Interstate system vital to the State's economy and prosperity. In 2012, the truck weight limit on Maine's Interstate highways (most notably I-95) was raised from 80,000 pounds (the national standard) to 100,000 pounds to account for the unique challenges associated with Maine's forest industry, such as loading logging trucks in remote locations. While this change in weight limits permitted additional freight trucking use, it also created additional wear on

[11] http://maine.gov/mdot/publications/docs/guides/SPEAK_MaineDOT_web.pdf.

Maine's most important roadway system. In response to this concern, MaineDOT developed an Interstate Operating Plan in 2016 to manage and maintain the State's Interstate highways and further study the effects of the increased weight limit.[12]

Figure 3.2 Map of Maine's Classification and Mileage



Source: MaineDOT.

[12] MaineDOT Roads Report, 2016.

3.1.1 National Highway Freight Network

The MaineDOT classification system highlights some of the most important highways in the State. As mentioned above, the U.S. Department of Transportation's Federal Highway Administration also has identified a set of highways that are important for freight movement in its National Highway Freight Network (NHFN), which is one component of the National Multimodal Freight Network. The NHFN was established as part of the FAST Act with the purpose of strategically directing Federal resources and policies toward improved performance of highway portions of the U.S. freight transportation system. The NHFN consists of four subsystems of roadways:

4. **Primary Highway Freight System (PHFS) –** A network of highways identified as the most critical highway portions of the U.S. freight system according to national data.

5. **Other Non-PHFS Interstate Highways –** These are the remainder of the Interstate highway system not included in the PHFS.

6. **Critical Rural Freight Corridors (CRFC) –** These are roadways not in an urbanized area, which provide access to the PHFS and the interstate highway system with other important freight or public transportation facilities. A provision in the FAST Act calls for each state to establish its own CRFC (limited to 150 miles of highway or 20 percent of the PHFS mileage in the State) for inclusion in the NHFN. These routes in Maine are identified in Appendix C.

7. **Critical Urban Freight Corridors (CUFC) –** These are roadways in urbanized areas, which provide access to the PHFS and the interstate highway system with other important freight or public transportation facilities. A provision in the FAST Act calls for each state to establish its own CUFC (limited to 75 miles of highway or 10 percent of the PHFS mileage in the State) for inclusion in the NHFN. These routes in Maine are identified in Appendix C.

Figure 3.3 illustrates Maine's two PHFS Routes – I-95 and U.S. 201. I-95 is Maine's primary Interstate highway (303 miles), and it carries the largest volume of freight in the State. U.S. 201 from I-95 to the Canadian border (103 miles) also is identified as a critical highway for freight in the national network.

Many other highways play an important role in the State's freight network. Maine contains several Interstate spurs connected to I-95, the longest of which, I-295, provides an alternative route between Portland and Augusta. The State also has a number of important U.S. highways routes, including U.S. 1, U.S. 2, and U.S. 201, as well as an extensive State highway system, including key routes such as ME 4 and ME 9.

Figure 3.3 Maine's Portion of the National Highway Freight Network

Source: U.S. DOT, Federal Highway Administration, https://ops.fhwa.dot.gov/freight/infrastructure/ismt/state_maps/states/maine.htm.

3.1.2 Freight Intermodal Connectors

Intermodal connectors are short roadway segments that connect different modes, typically the highway system to a terminal, port, airport, or other non-highway facility. These connectors help facilitate the transfer of goods by multiple modes and provide alternatives for shippers and receivers. Maine has a number of intermodal connectors serving airports, truck/rail terminals, truck/pipeline terminals, and ports.

Some connectors are designated by the FHWA as National Highway System (NHS) Intermodal Connectors based on freight volume thresholds. According to the FHWA and MaineDOT, there are eight freight-related facilities with intermodal connectors in Maine, four of which have connectors that also are included in the Primary Highway Freight System, National Highway Freight Network, and National Multimodal Freight Network.[13] These facilities and connectors are summarized in Table 3.2. All but two of the facilities are located in Portland, which is the most important intermodal hub in the State. The Auburn Intermodal Truck/Rail Transfer Facility provides rail-to-rail and rail-to-truck accessibility and is the only inland port of entry in the State, offering on-site U.S. Customs and Border Protection. Portland International Jetport is the largest freight airport in the State.

As with highways designated by FHWA, this is not an exhaustive list of important intermodal facilities and connectors. Movement of freight in Maine also depends on many other nodes with intermodal connectors such as Mack Point at the Port of Searsport, Estes Head at the Port of Eastport, the Loring Commerce Center, and the Auburn Wal-Mart distribution center.

Table 3.2 FHWA Freight-Related Intermodal Connectors in Maine

Facility	Type	Facility ID	Number of Freight Connectors	Total Connector Length	NHS Intermodal Connector(s)	PHFS Intermodal Connector(s)
Auburn Intermodal Truck/Rail Transfer Facility	Truck/Rail Facility	ME10R	1	2.2	✓	
Bangor International Airport	Airport	ME8A	2	4	✓	
Merrill Marine Terminal (Port)	Port Terminal	ME4P	2	2.4	✓	✓
Merrill Marine Terminal (Rail)	Truck/Rail Facility	ME11R	2	0	✓	
Pan Am Intermodal Terminal	Truck/Rail Facility	*Added by MaineDOT	1	N/A	N/A	N/A
Portland Freight Terminal District	Truck/Rail Facility	ME1R	1	2.1	✓	✓
Portland International Marine Terminal	Port Terminal	ME12P	1	1	✓	✓
Portland Jetport	Airport	ME2A	3	4.51	✓	✓

Source: FHWA NHS Intermodal Connector: Tables https://www.fhwa.dot.gov/planning/national_highway_system/intermodal_connectors/maine.cfm, FHWA National Highway Freight Network: Tables https://ops.fhwa.dot.gov/freight/infrastructure/ismt/state_maps/states/maine.htm, and MaineDOT.

[13] This excludes transit stations, ferry terminals, and intercity bus terminals, which serve passengers rather than freight.

3.2 Rail

Freight rail has been an important component of Maine's freight network for over 150 years. Unlike the Interstate highway system, which only connects Maine south to the northeast and Atlantic U.S. states and east to New Brunswick, Maine's rail lines were designed in part to link the State north and west to Montreal and the Great Lakes.[14] While trucks are now the dominant mode of freight shipping in the State, railroads still provide significant freight capacity for domestic and international trade and provide alternatives for shippers. Freight rail is a cost-effective option for moving high-volume, low-value commodities, so rail continues to play a particularly important role for Maine's forest products industry. In 2015, an estimated 66,100 carloads of rail freight originated or terminated in Maine, and approximately 42 percent of the carloads originating in Maine carried pulp, paper, lumber, and wood products.[15]

North America is home to seven Class I railroads (all privately owned) that account for about 80 percent of all national rail traffic and more than 90 percent of all freight railroad revenue, but these seven Class I railroads do not operate in parts of New England, including Maine, Vermont, or New Hampshire. As such, the Class II and Class III regional and short-line railroads in Maine are crucial for connecting to the Class I railroads and moving goods within the State. Rail operators do not necessarily own their tracks, and it is common for states to purchase lines that the private sector has abandoned over time and lease them to private operators. The State of Maine owns portions of six active railroads, four of which carry freight; as of 2013, the State owned the Aroostook Lines operated by Maine Northern Railway (229.2 miles), the Rockland Branch now operated by Central Maine & Quebec (57.3 miles). Additionally, smaller portions of track operated by the Saint Lawrence and Atlantic Railroad (24.27 miles) and the Pan Am Railway (9.6 miles) are owned by the State but do not currently have active freight traffic. In addition to these active railroads, the State of Maine also owns several inactive lines that could be made serviceable but not carrying any freight; as of 2013, the State owned 33.6 miles of inactive track from Brunswick to Augusta, 29.5 miles from Belfast to Burnham .and 45.9 miles from Westbrook to Fryeburg.

The rail freight network depends not only on the railroads, but also on yards, terminals, and other facilities that allow for storage, repair, rail switching, interchange (moving rail cars between railroads), intermodal transfers (moving containers between rail and other modes), and transloading (transferring bulk commodities between rail and other modes). As of 2010, there were 17 general purpose freight rail yards in Maine with different rail operators: nine operated by Pan Am Railway, three by Central Maine and Quebec, three by Saint Lawrence and Atlantic, and two by Maine Northern Railway. The only active intermodal facility transferring containers between truck and rail was the Pan Am Intermodal Facility in Waterville owned by Pan Am Railways. This facility has two transfer tracks and currently is primarily used for intermodal service for Poland Springs Water. The intermodal ramp at the Portland IMT has also been used in the past years for truck to rail transfers. Two other facilities at Presque Isle and Auburn are capable of intermodal activity but have not operated recently. There are also several facilities in the State offering transloading of bulk materials (but not transfer of containers), including the Port of Auburn, Savage-Safe Handling in Auburn, GAC Chemical in Searsport, Truck/Rail Log/Chip Transfer along the CMQR and MNR, Turner's Island marine-rail terminal in South Portland, and the Rockland Cement Pier.

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[14] Maine Rail Plan, 2014.

[15] Association of American Railroads, Freight Railroads in Maine 2015, https://www.aar.org/Style%20Library/railroads_and_states/dist/data/pdf/Maine-2012.pdf.

portions of six active railroads, four of which carry freight; as of 2013, the State owned the Aroostook Lines operated by Maine Northern Railway (229.2 miles), the Rockland Branch now operated by Central Maine & Quebec (57.3 miles). Additionally, smaller portions of track operated by the Saint Lawrence and Atlantic Railroad (24.27 miles) and the Pan Am Railway (9.6 miles) are owned by the State but do not currently have active freight traffic. In addition to these active railroads, the State of Maine also owns several inactive lines that could be made serviceable but not carrying any freight; as of 2013, the State owned 33.6 miles of inactive track from Brunswick to Augusta, 29.5 miles from Belfast to Burnham .and 45.9 miles from Westbrook to Fryeburg.

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Table 3.3 describes Maine's rail operators with route mileage operated as of 2015 and Figure 3.4 shows the passenger and freight rail system in Maine.

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[16] Maine Rail Plan, 2014

[17] Portland Press Herald, http://www.pressherald.com/2015/09/02/rockland-brunswick-tourist-train-imperiled/

[18] Maine Rail Plan, 2014

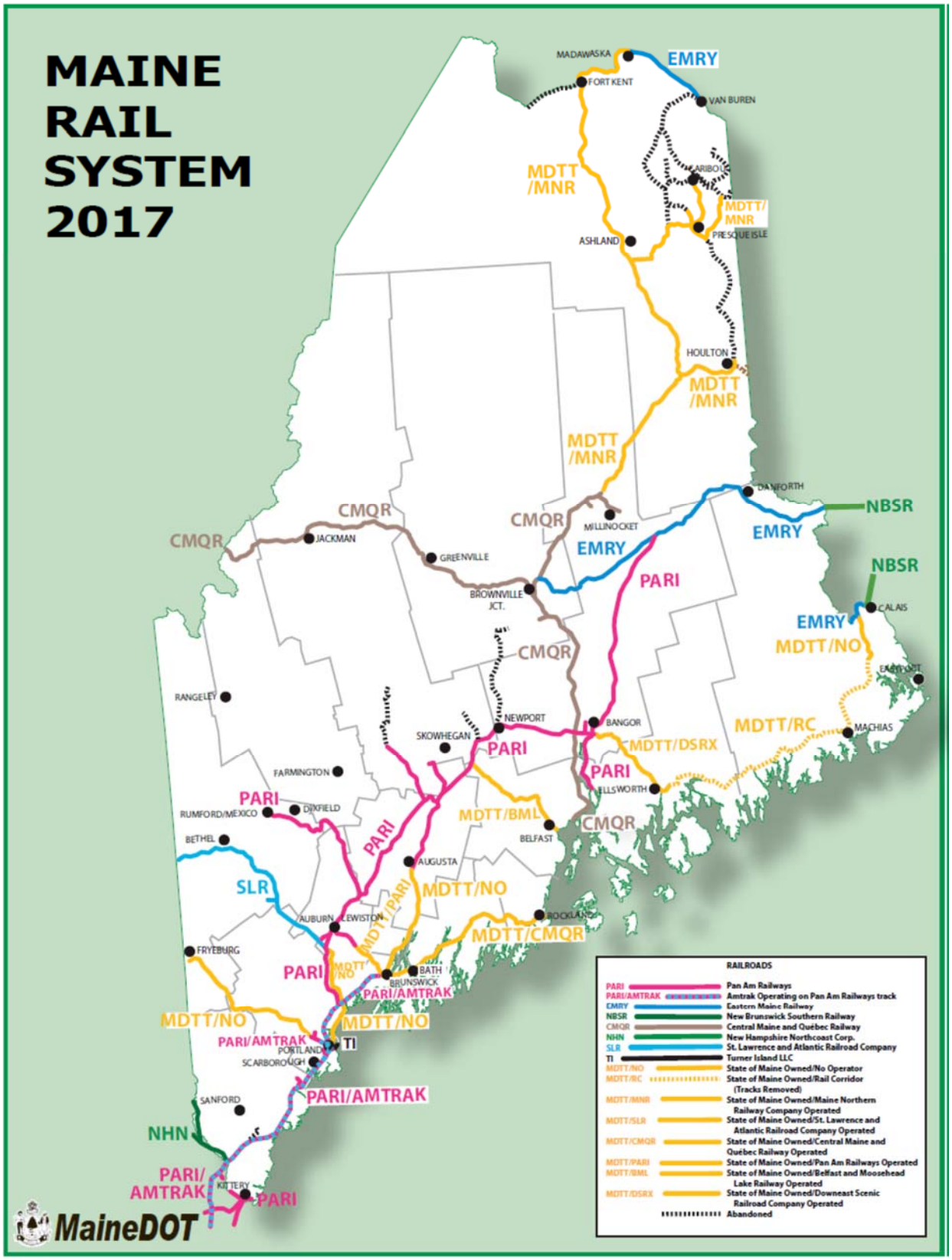
rail was the Pan Am Intermodal Facility in Waterville owned by Pan Am Railways. This facility has two transfer tracks and currently is primarily used for intermodal service for Poland Springs Water. The intermodal ramp at the Portland IMT has also been used in the past years for truck to rail transfers. Two other facilities at Presque Isle and Auburn are capable of intermodal activity but have not operated recently. There are also several facilities in the State offering transloading of bulk materials (but not transfer of containers), including the Port of Auburn, Savage-Safe Handling in Auburn, GAC Chemical in Searsport, Truck/Rail Log/Chip Transfer along the CMQR and MNR, Turner's Island marine-rail terminal in South Portland, and the Rockland Cement Pier.

Table 3.3 Rail Operators in Maine

Rail Operator	Mileage Operated in 2015
Class II	
Central Maine and Quebec Railway (CMQR): Connects to the Canada Pacific (CP); links northern Maine, Saint John, New Brunswick, and Montreal; and provides access to the port facilities of St. John in New Brunswick and Searsport, Maine. The rail's route from Searsport to Montreal can accommodate double-stack intermodal services, and has the capacity to carry 286K lb. rail cars.	295
Pan Am Railway (PARI): Formerly known as the "Guilford Rail System." Main line connects Mattawamkeag in Maine to Mechanicville in New York, via the lines of other New England-based rail lines. Maintains repair shops in Waterville, Maine.	372
Subtotal	*667*
Class III	
Maine Northern Railway (MNR): Operates on a portion of the former "Montreal, Maine, and Atlantic Railroad" (MMA) lines, which are now state-owned Aroostook Lines. Major freight commodities are forest products, including finished lumbers, wood products, wood chips, and paper. Uses a yard at Oakfield as its operational hub for the Aroostook lines.	233
Eastern Maine Railway (EMRY): Created as a holding company to own trackage in Maine. Operations provided by the New Brunswick Southern Railroad (NBSR).	105
Saint Lawrence and Atlantic Railroad (SLR): Headquartered in Auburn, Maine and Richmond, Quebec. Contiguous mainline track between Maine and Quebec. Serves warehouse distribution and intermodal transloading facilities in the Maine.	84
New Hampshire North Coast Railroad* (NHN): Very small portion in Maine, not serving any freight customers in the State.	0.3
Subtotal	*422.3*
Terminal and Switching	
Turner's Island, LLC (TI): Connects with Pan Am Railways in South Portland, Maine to provide shipping nationwide. Privately owned and operated. Open area with 14 acres for bulk storage, 9,000 sq. feet of dry warehouse space.	2
Total	**1,091.3**

Source: AAR Maine Freight Railroads Profile, 2015 https://www.aar.org/Style%20Library/railroads_and_states/dist/data/pdf/Maine-2012.pdf. *Maine Rail Plan 2014.

Figure 3.4 Maine's Rail System



Source: MaineDOT.

Maine's freight railroad network is adequate to meet current demands, but is clearly in need of improvement to successfully attract new levels of business, some needed improvements are being completed as part of a current TIGER project and a recently awarded FASTLANE project.[19] One important limitation on future growth of rail freight in the State and the entire New England region is restrictions on vertical clearance. Freight traveling through New England is impacted by low overpasses, tunnels, and electrical catenary wires, which in some instances prevent the railroads from providing full double-stack service. Two exceptions are the CMQR-EMRY and SLR lines, which have double-stack clearance between Maine and Canada. Another obstacle to growth is weight limits. According to Maine's 2014 Rail Plan, portions of the rail network (including bridges and other supporting infrastructure) are 50 to 100 years old and cannot support the emerging interline weight standard of 286,000 lbs. per rail car. The routes that have an approved capacity of 286,000 lbs. include EMRY and CMQR extending across the State from New Brunswick to Quebec, the CMQR route from Searsport to Millinocket and Pan Am Railways south of Bangor. With the recent award of a 2017 FASTLANE grant from the U.S. Department of Transportation (DOT), the Maine Northern Railway will be upgraded to meet 286,000-pound loadings by the end of 2019.

3.3 Maritime

Maine's marine freight network comprises more than its marine terminals and includes the ports, waterways, highways, rail network, as well as inland production, logistics, and distribution centers that support the maritime trade. There are currently three major seaports in Maine: Portland, Searsport, and Eastport (shown in Figure 3.5). The Port of Portland is operated by the Maine Port Authority (MPA), which is governed by a seven member Board of Directors led by a fulltime Executive Director. The MPA has offices in Augusta and Portland and maintains a close working relationship with MaineDOT, including shared staffing responsibilities in planning and finance. The ports of Searsport and Eastport work closely with the MPA especially in regard to infrastructure improvements.

The MPA has bonding authority and also works with MaineDOT to help finance large infrastructure projects for Maine ports. The MPA currently leases and operates the International Marine Terminal in the Port of Portland. The Port of Searsport is operated by Sprague Energy. The Port of Eastport operations are coordinated by a Port Director that reports to the local Eastport Port Authority. All of the ports work closely with the MPA and MaineDOT on planning, public financing and infrastructure improvements.

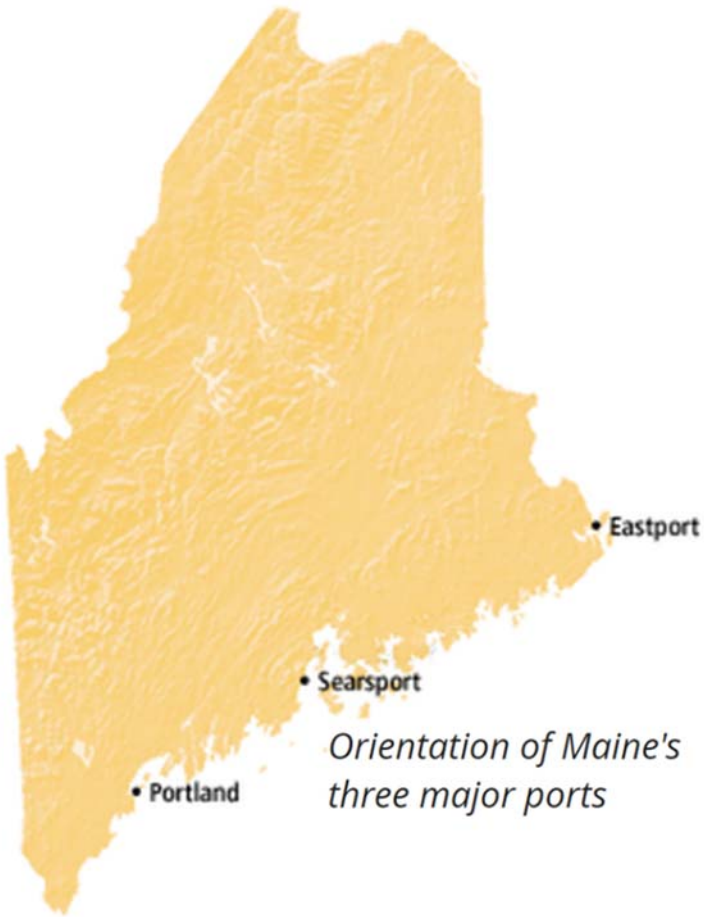
Maine has other smaller ports supporting the fishing industry, fuel distribution, state-operated ferry service to coastal island communities and tourism. There are two ports on the Penobscot River, Bucksport and Bangor, and a number of private terminals and other ports, such as Rockland and Bar Harbor, that could play a larger role in maritime freight in the future.[20,21] With the closure and dismantling of the Bucksport paper mill there maybe new opportunities for new port development and uses at Bucksport.

[19] Maine Rail Plan, 2014

[20] http://www.choosebangor.com/facts-figures/transportation.html

[21] http://www.cruisemaineusa.com/ports

Figure 3.5 Maine's Major Seaports



Source: Maine Port Authority.

Maine's largest cargo port is the Port of Portland, which at one time was the second largest oil-processing port on the East Coast and the largest tonnage seaport in New England. Since the late 1990s, Montreal refineries imported overseas oil, through the Port of Portland and Portland Pipeline, and used the Enbridge Pipeline between Montreal and southern Ontario to move product further west. However, recent changes in crude oil prices and the domestic availability of shale oil resulted in changes in the crude oil supply chain, reducing the importance of overseas-sourced oil. To reflect this, Enbridge received permission to reverse the flow of their Pipeline, sending shale oil from North Dakota and western Canada to refineries in Quebec.[22] This reduced reliance on the Portland Pipeline to feed the Montreal refineries, and subsequently reduced inbound oil shipments to the Port of Portland.

Despite this recent trend, the Port of Portland still supports nine marine terminals, seven of which include refined petroleum products. The International Marine Terminal (IMT) specializes in containerized freight and project cargo, and offers nearby connections to the highway system, the Portland International Jetport, and Pan Am Railways via a rail spur. Since 2013, the Icelandic shipping company Eimskip has used the IMT as a logistical hub for North America. Eimskip's container service from Portland to Europe has dramatically increased containerized shipping at the port, provided an anchor to port operations, and stimulated additional investment in the IMT. In recent years MaineDOT and the Maine Port Authority have purchased land to

[22] https://www.neb-one.gc.ca/pplctnflng/mjrpp/ln9brvrsl/index-eng.html.

expand the terminal, and in 2015 they completed a competitive bid process for privately financed construction of a cold storage facility at the terminal to support growth in throughput of refrigerated commodities and support the Maine food industry.[23] These investments reflect a public commitment to keep a portion of the Portland waterfront focused on industrial and maritime port uses. The rail spur connecting to Pan Am Railways has been used by Poland Springs for truck to rail transloading, and supports maritime to rail shipping and additional industries. Table 3.4 lists Portland's nine marine terminals currently in operation.

Table 3.4 Port of Portland Terminals

Terminal Name	Primary Cargo Services
Merrill	Bulk, break bulk, petroleum
Sprague Energy	Petroleum
Mobil	Petroleum
Global	Petroleum
Citgo/Turner's Island	Petroleum, bulk, break bulk
International Marine Terminal (IMT)	Containerized, project
Portland Pipeline Pier #1	Petroleum
Gulf Oil	Petroleum
Portland Pipe Line Pier #2	Petroleum

Source: Maine Port Authority.

As previously stated, Maine also has two other seaports that provide significant freight/cargo services for the region, both nationally and internationally.[24] The Port of Searsport includes dry and liquid cargo piers, storage areas, and an intermodal truck-to-rail facility with over 6,500 feet of on-site rail siding operated by the Central Maine and Quebec Railway connecting to Canadian Pacific, Canadian National, Pan Am, and New Brunswick & Maine Railways. The Port of Eastport has two terminals with three berths accommodating large ships (550 feet, 700 feet, and 900 feet), open storage, and warehousing.

[23] http://www.pressherald.com/2015/07/16/cold-storage-project-on-portland-waterfront-lures-industry-leaders/.

[24] Maine Port Authority, http://www.maineports.com/ports

Figure 3.6 Port of Portland IMT Operations

Source: Cambridge Systematics, Inc.

3.4 Air

Air has the least physical capacity of any freight mode in Maine, but it still plays a vital role in the State's freight network. Air is particularly competitive for shipping low-volume, low-weight, and high-value goods over long distances. Perishable food items, pharmaceuticals, and high-value manufactured goods like electronics or precision instruments are common commodities that require fast, reliable transport. In the Commodity Flow Survey in 2012, the Bureau of Transportation Statistics (BTS) reported that the average distance per air freight shipment was 1,120 miles – higher than all the other single-mode freight shipment categories.

There are four airports in Maine with freight activity identified by the Maine Port Authority, shown in Figure 3.7. The air freight companies that work within these airports include DHL, Federal Express (FedEx), United Parcel Service (UPS), Portland Air Freight, and Telford Group.[25]

[25] Maine Port Authority, http://www.maineports.com/air.

Figure 3.7 Maine's Freight Airports

Source: Maine Port Authority.

In 2016 Portland International Jetport handled roughly 90 percent of inbound and outbound air cargo tonnage (freight and mail) in the State, as shown in Table 3.5 and Table 3.6 below.[26] The Portland International Jetport connects to truck, rail, and ship options as part of the Portland area's multimodal transportation network. While it handles much less freight, Bangor International Airport can accommodate any size of freight aircraft and has freight loading/unloading equipment and warehousing.[27]

[26] Note that no data for Auburn-Lewiston Municipal Airport was reported for 2016, and very small freight movements at two other airports are omitted.

[27] Bangor International Airport, Cargo Information 2016, http://www.flybangor.com/cargo-info.

Table 3.5 Tons of Air Freight Originating in Maine
2016

Total Tons Originating in Maine		4,567.6
Airport of Origin	**Tonnage**	**Percent Compared to Maine Total**
Bangor International Airport	286.3	6.3%
Portland International Jetport	4,218.5	92.4%
Northern Maine Regional Airport	62.8	1.4%

Source: Bureau of Transportation Statistics, 2016 T-100 Air Cargo Market Data.

Table 3.6 Tons of Air Freight Terminating in Maine
2016

Total Tons Arriving in Maine		5,647.4
Destination Airport	**Tonnage**	**Percent Compared to Maine Total**
Bangor International Airport	332.1	5.9%
Portland International Jetport	4,976.2	88.1%
Northern Maine Regional Airport	338.8	6.0%

Source: Bureau of Transportation Statistics, 2016 T-100 Air Cargo Market Data.

3.5 Pipeline and Hazardous Material

Pipelines are used to transport petroleum products, natural gas, and other hazardous materials in Maine. Hazardous materials (HazMat) also are transported by ship or barge, rail, and truck. Air transport occurs routinely but only in limited quantities with strict packaging requirements and the shipping of many specific chemicals by air is forbidden due to inherent safety concerns. Hazardous materials for the purposes of this study are defined in two categories: 1) Petroleum Products; and 2) Extremely Hazardous Substances (EHS).

Maine imports crude oil and other refined petroleum products for fuel and heating purposes, and chemicals are widely used for manufacturing, refrigeration, water treatment and the production of pulp and paper products. Recent national trends in the domestic transportation of crude oil and natural gas have changed how petroleum products and chemicals are transported in Maine.

3.5.1 Pipelines

There are four companies that maintain three different types of pipelines used to transport refined petroleum products, crude oil, and natural gas in Maine. They include Buckeye Partners, the Portland Pipeline Company, Portland Natural Gas Transmission System, and Maritime and Northeast Pipeline System (see Figure 3.8).

Buckeye Partners

The Portland-Bangor Pipeline owned by Buckeye Partners (BPL) is used to transport refined petroleum products. Buckeye has 115 active terminals in the United States that provide bulk storage and throughput

services with respect to liquid petroleum products and renewable fuels, including ethanol, and have an aggregate storage capacity of over 55 million barrels. In Maine, BPL Transportation maintains a 124-mile pipeline that runs from Portland to Bangor, Maine. The Bangor terminal has approximately 140,000 barrels of storage capacity. In 2014, Irving entered a joint venture with Buckeye Partners to buy the South Portland terminal from ExxonMobil. The jointly owned Portland marine terminal has approximately 725,000 barrels of storage capacity.

Portland Pipeline Company

The Portland-Montreal Pipeline Company (PMPL) operates a crude oil pipeline from Portland to Montreal Canada. The company owns and operates a tanker unloading facility, two tank farms (South Portland, Maine and Montreal, Quebec), and a system of pump stations and crude oil pipelines that extend 236 miles from the State of Maine to Quebec. The pipelines deliver crude oil to customers in Montreal, Quebec. The tank farm in South Portland consists of 23 tanks with approximately 3.5 million barrels of storage capacity. Two pipelines (18 inch and 24 inch) and eight pump stations are operated out of the South Portland, Maine operations center, which moves the crude from the South Portland tank farm to Montreal. The crude oil volumes from Maine to Montreal in this pipeline have declined over the past five years due to the domestic availability of shale oil in the U.S. and due to pipeline reversals from other companies transporting crude oil to Montreal.

Portland Natural Gas Transmission System

Portland Natural Gas Transmission System (PNGTS) transports natural gas to New England from Canada. This pipeline system begins in northern New Hampshire and extends to the coast of Maine. The Portland Natural Gas Transmission System primarily provides natural gas to natural gas utilities, paper mills, and power plants in Maine, New Hampshire, Vermont, and Massachusetts.

PNGTS merges with the Maritimes and Northeast Pipeline system at Wells, Maine, where they form a joint 100 mile, 0.6 Bcf per day, natural gas pipeline that extends south through southern New Hampshire and terminates in northern Massachusetts.

Natural gas is typically transported by major interstate pipelines that run across the U.S. These steel pipelines are 20 to 42 inches in diameter and are buried underground along 100 foot rights-of-way. Compressor stations along the pipelines maintain the gas pressures, which can range from 200 to 1,500 pounds per square inch. The natural gas is then transported to distribution points where it passes through a gate station. Local distribution companies then lower the pressure, add an odorant that gives natural gas its distinct smell, and transport the gas through lower pressure and smaller two to eight inch mainlines to homes and business. Service lines branching off the distribution mainline bring the gas directly into homes or businesses.

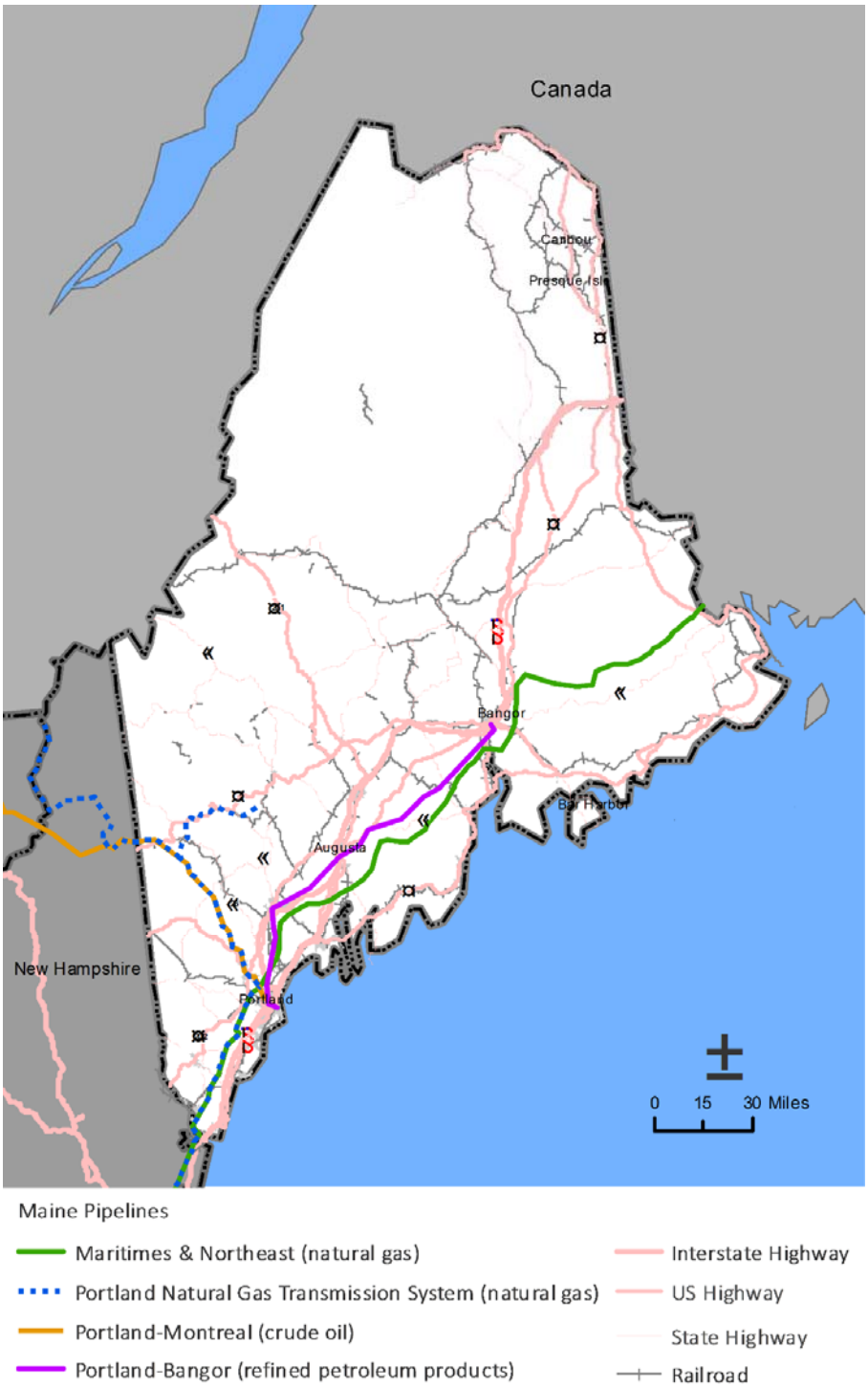
Maritimes and Northeast Pipeline System

Maritimes & Northeast Pipeline (M&NP) is a 1,101-kilometer mainline transmission pipeline built to transport natural gas from the Canadian Maritimes off the east coast of Nova Scotia south through Maine to other markets in northeastern United States. A joint venture of Enbridge Inc., Emera Inc. and ExxonMobil, M&NP is headquartered in Halifax, Nova Scotia and operates an additional business office in Waltham, Massachusetts.

The M&NP system consists of an underground mainline measuring between 24 and 30 inches in diameter extending from Goldboro, Nova Scotia through Nova Scotia and New Brunswick to the Canadian – U.S. border near Baileyville, Maine. The pipeline continues through Maine and New Hampshire into

Massachusetts where it connects with the existing North American pipeline grid at Dracut, Massachusetts. The pipeline also extends from Methuen, Massachusetts to Beverly, Massachusetts.

Figure 3.8 Maine Pipeline System



Sources: Cambridge Systematics Inc., Maritimes & Northeast, Portland Natural Gas Transmission System, Portland Pipeline Company and Buckeye Terminals Web Sites.

3.5.2 Petroleum Terminals

Marine petroleum terminals in the Port of Portland and Searsport receive ships and barges, and provide storage areas for gasoline, motor fuels, ethanol, kerosene, jet fuel, and other refined products. Additionally there are some small terminals that receive petroleum products by barge, examples are Bangor and Bucksport.

Portland Marine Terminals

There are nine marine terminals in Portland, eight of which handle petroleum products (see Table 3.4).

Inland motor fuel terminals are located primarily in Portland, Auburn, Waterville, and Searsport. Some are supported by pipeline, some also are served by rail, and all support truck loading operations. For example, the Portland-Montreal Pipeline Company operates 23 tanks with approximately 3.5 million barrels of storage capacity.

Searsport Marine Terminal

Searsport has a 1.6 million gallon active tank farm for storing liquid cargo, and two liquid cargo piers with a multipurpose hose platform serving both piers. Berth 1 measures 700 feet with a depth of 37 feet at mean low water (MLW). Berth 2 measures 500 feet with a depth of 25 feet at MLW. There are multiple truck and rail loading racks, a 90,000 square-foot warehouse, and 70 acres nearby for development.

Propane Terminals

Major propane terminals serving Maine are located in Portsmouth, New Hampshire, Biddeford, Auburn, and Portland, Maine. Smaller propane facilities are located throughout the State for year-round fuel supply and storage. According to officials at Pan Am Railroad, propane by rail has grown from one terminal in 2000 accepting 500 cars, to 10 terminals and 10,000 carloads.[28] In Portsmouth, New Hampshire, the Sea 3 Company stores up to 26,500,000 gallons. Propane is shipped to Maine by rail through Lac Mégantic, Quebec and also transported by rail from New Brunswick's St. John refinery. Rail propane movements have changed in Aroostook County, as the Caribou Dead River facility has moved to Presque Isle operating year round. Biddeford stores and distributes propane inbound 15 railcars per week, stored in 2.5 million-pound capacity tanks (30,000 gallons each). Propane is transported by truck to as far north as Augusta from Biddeford.[29]

[28] Atlantic Marine and Rail Newsletter, Chop Hardenbergh, Formal issue 17#05 1 June 2017.

[29] Maine Emergency Management Agency (MEMA).

Newington is the third terminal on the U.S. East Coast with liquefied petroleum gas (LPG) export capability alongside Marcus Hook, Pennsylvania, and Chesapeake, Virginia. LPG cargoes are regularly flowing across the Atlantic to Europe, the Mediterranean, and Africa.

3.5.3 Hazardous Materials (HazMat)

HazMat routes and volumes of selected fuels and Extremely Hazardous Substances (EHS) were identified as part of the Maine HazMat Study in 2015 and are summarized in this section. EHS included chemicals such as chlorine gas (for water treatment), anhydrous ammonia (for refrigeration) and others. Table 3.7 describes fuels, and other EHS hazardous materials transported in Maine. See Appendix B for additional details, including HazMat routes and volumes.

Table 3.7 Hazardous Material Volumes Transported by Mode in Maine
In Pounds

Hazardous Material	Truck (x1,000)	Rail (x1,000)	Ship (x1,000)	Pipeline (x1 million)
Selected Fuels				
Compressed Natural Gas (CNG)	170,553			
Crude Oil		988,934,000		19,016
Ethanol	687,653		858,039	
Methanol	12,419			
Other Hazardous Materials				
Extremely Hazardous Substances (EHS)	254,503	31,895		

Source: Maine Commodity Flow Study of Hazardous Materials, 2015.

3.6 Key Freight Corridors

Maine has multimodal freight transportation assets, including highways, rail lines, waterways, airports and pipelines, as well as interchange points between the modes, such as airport terminals, seaports, rail terminals, pipeline terminals, and warehouse/distribution centers. Identifying the most significant freight corridors that are responsible for carrying the majority of the freight moving in the State, allows MaineDOT to focus limited resources on the portion of the system that impacts the greatest number of users and the majority of the total freight volume being moved.

3.6.1 Key Highway Corridors

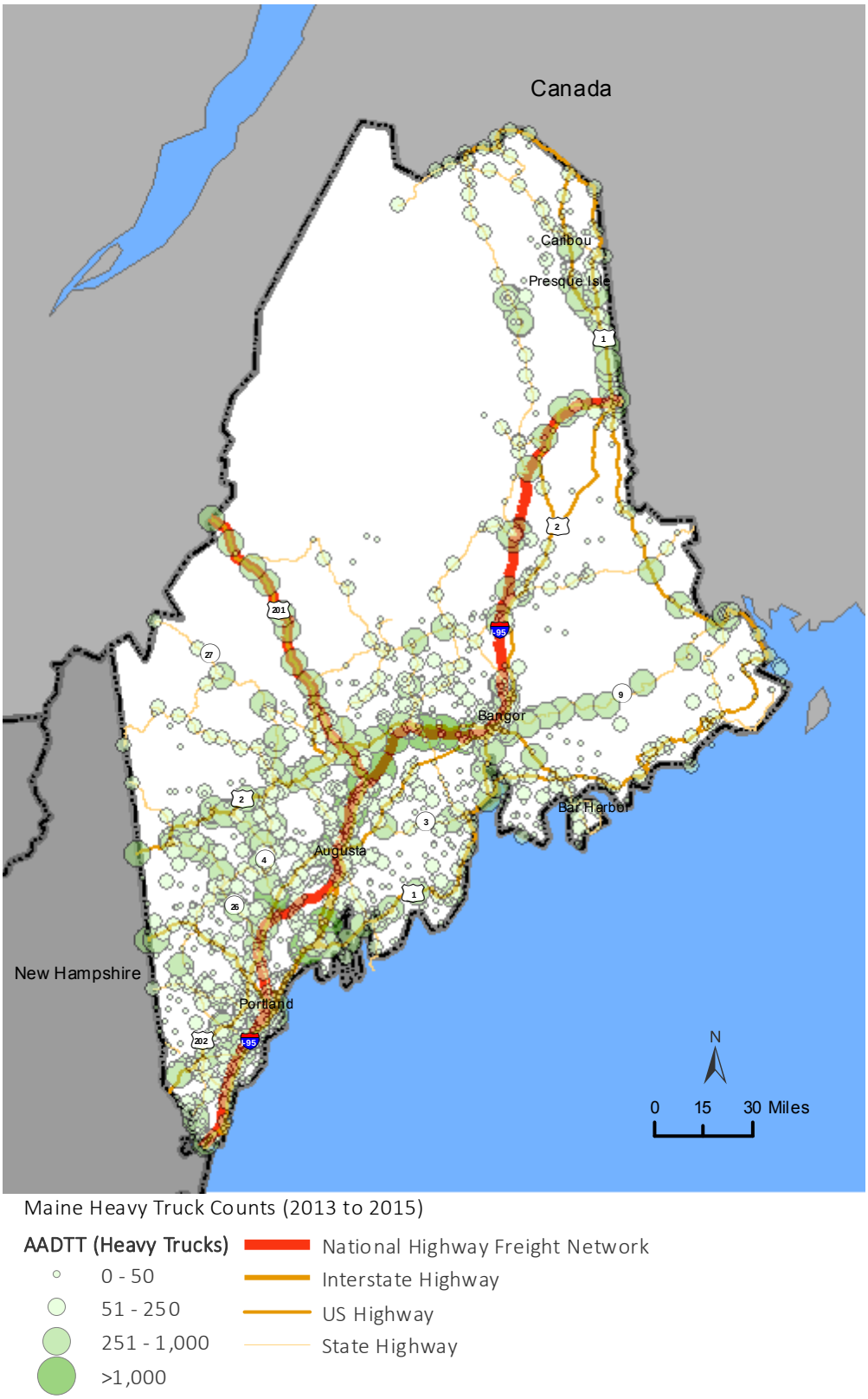
Truck count data is an important element in identifying significant freight corridors. MaineDOT collects a combination of short-term counts using road tube counters and long-term counts using permanent stations at many locations across the State. Trucks are counted by truck type classification.

Figure 3.9 shows average annual daily truck traffic (AADTT) estimates at different locations based on truck counts collected in 2013, 2014, and 2015. Larger circles represent a higher average volume of truck traffic moving past a particular point. This analysis indicates that much of the State's truck traffic is on a few key interstate and state highways. The highest truck counts are clustered around interstate highways I-95 and

I-295 from the New Hampshire border to Bangor; non-Interstate highways serving the same corridor (ME 4, U.S. 2, U.S. 202, ME 3, and U.S. 1) also have high truck traffic. Several additional non-Interstate highways experience high truck traffic as well. U.S. 2 and ME 9 form an east-west corridor from northern New Hampshire to the Canadian border (overlapping with I-95 between Palmyra and Bangor), and ME 26 connects this east-west corridor to I-95 north of Portland. U.S. 201, ME 27, and ME 4 carry significant truck traffic between I-95 and Canada (toward Quebec City and Montreal). The northernmost portion of U.S. 1 also connects I-95 to northern Maine and the northern border with Canada.

It is useful to compare the heaviest truck volume segments in the State to the National Highway Freight Network (NHFN) in order to gain a better understanding of the ability of the Federal network to serve state needs. By overlaying statewide truck counts with the NHFN (in red), the NHS, and portions of the State network, Figure 3.9 illustrates the gaps in the NHFN that are important to statewide truck movements. There are several alternate routes from the southern tip of Maine to Bangor that experience significant truck traffic but are not part of the NHFN, including U.S. 202, U.S. 1 along the coast from Brunswick to Bangor, ME 3 from Augusta to the coast near Searsport, I-295 connecting Portland and Augusta, and ME 4 and U.S. 2 from Lewiston to Bangor. The NHFN also does not include the east-west corridor formed by U.S. 2 and ME 9, ME 26 connecting I-95 to U.S. 2, ME 27 paralleling U.S. 201 north to Canada, or U.S. 1 providing access from I-95 to Presque Isle, Caribou, and the northern border with Canada.

Figure 3.9 Maine Truck Volumes Compared to the National Highway Freight Network



Source: Federal Highway Administration, Office of Freight Management and Operations; MaineDOT.

3.6.2 Key Rail Corridors

Rail, maritime, and air freight also play an important role in Maine's multimodal freight network. The 2014 Maine State Rail Plan identified two existing multimodal trade corridors and two emerging trade corridors in Maine:

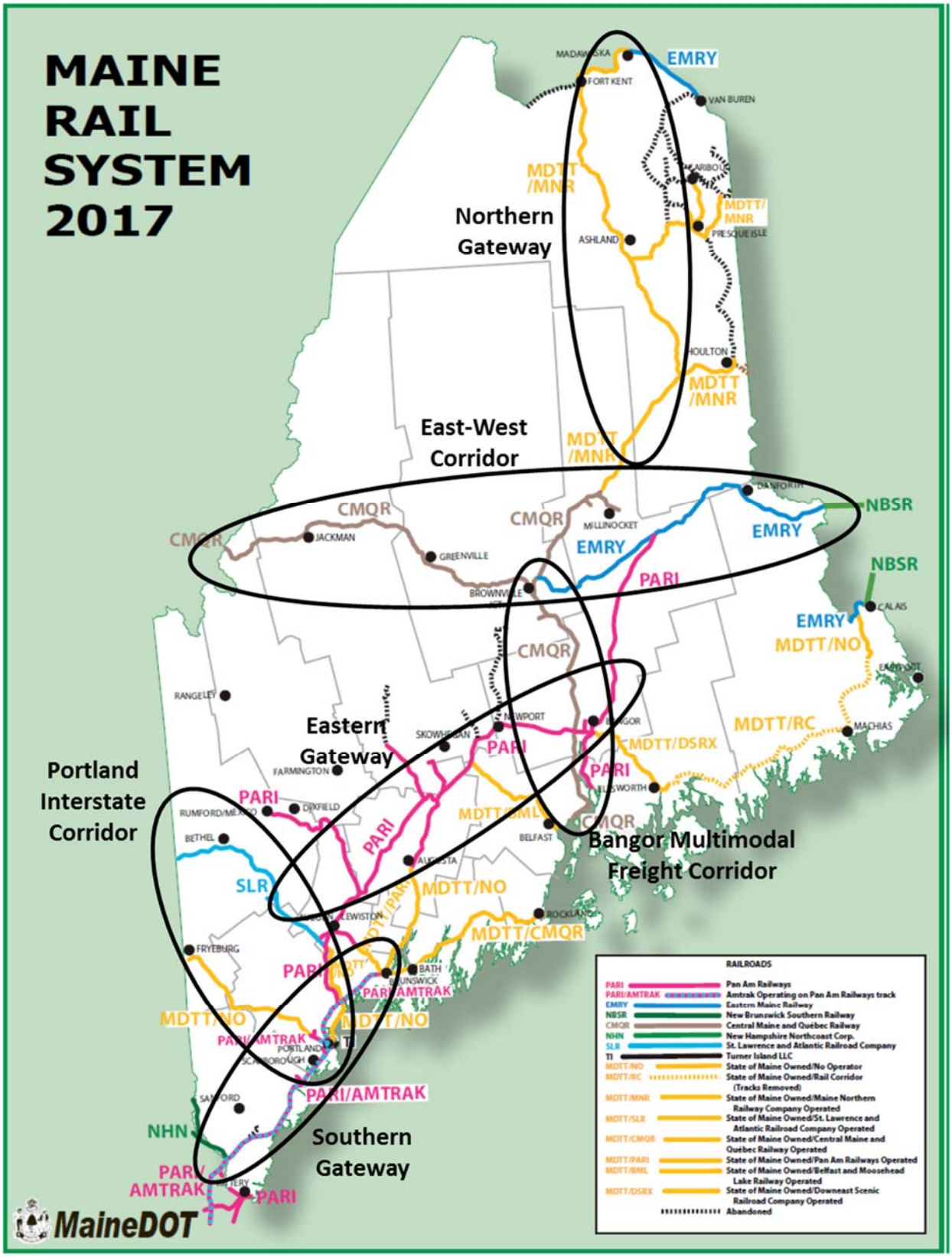
- The "Freight Triangle" connecting Portland, Brunswick and Lewiston-Auburn.
- The Searsport-Bangor Trade Corridor connecting the coastal port of Searsport to the inland port in Bangor.
- The Eastport Gateway Trade Corridor potentially connecting the Port of Eastport to the North American rail system (but currently lacking direct rail service).
- The Northern Gateway Trade Corridor serving northern Maine and the forest products industry (with 233 miles of former Montreal, Maine and Atlantic Railway rail lines now owned by MaineDOT).

Building on these existing and potential trade corridors as well as passenger rail needs, the Rail Plan further identifies six "Critical Rail Corridors" shown in Figure 3.10 (from south to north):

1. Southern Gateway
2. Portland Interstate Corridor
3. Eastern Gateway
4. Bangor Multimodal Freight Corridor
5. East-West Corridor
6. Northern Gateway Corridor

The southern Critical Rail Corridors largely parallel highway freight activity and offer intermodal connections between rail, highway, ports in Portland and Eastport, and airports in Portland, Auburn-Lewiston, and Bangor. The East-West Corridor is a rail corridor linking New Brunswick and Quebec (with the potential to connect Eastport to the rail network), and the Northern Gateway Corridor includes highways and rail lines linking northern Maine to Canadian and U.S. markets.

Figure 3.10 Critical Rail Corridors from 2014 Maine State Rail Plan



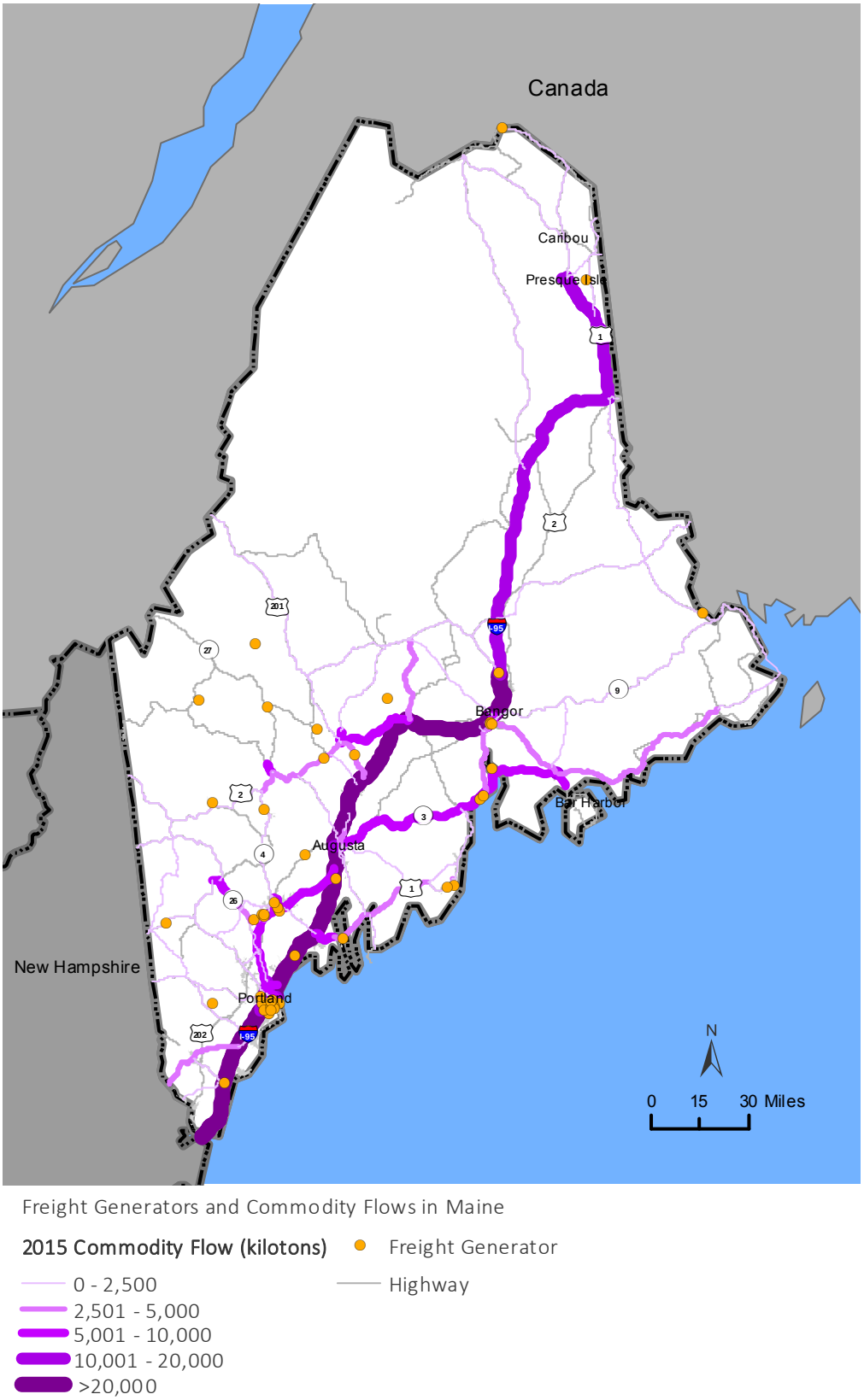
Source: MaineDOT; 2014 Maine State Rail Plan, Figure 6-2.

3.6.3 Freight Clusters

The locations of freight-intensive industries in the State point to areas of high truck traffic and freight activity. Figure 3.11 shows the locations of major freight-generating facilities in Maine, which represent a mix of agriculture, forestry, manufacturing, warehousing, and distribution. These freight generators are largely clustered in the metropolitan areas of Portland, Lewiston, Augusta, and Bangor, and they are mostly in the southern portion of the State with a denser network of transportation options. These facilities, which are mainly manufacturing/processing or distribution focused do not necessarily capture the freight needs in rural areas of northern and eastern Maine where much of the primary harvesting in the agricultural and forestry sectors occur.

Most of the identified freight generators are located on or have access to the I-95 corridor from the southern tip of Maine to Bangor. Figure 3.11 also shows an assignment of truck commodity flows in 2015 to the Maine highway network. This assignment shows that the I-95 corridor clearly carries the largest commodity flows, highlighting the importance of that corridor to the movement of goods in and through the State. There also were significant freight flows between I-95 and U.S. 2 north of Portland, along U.S. 2 between New Hampshire and Bangor, on the coast between Searsport (south of Bangor) and Eastport (the easternmost part of the State), and from Bangor to the northern part of the State. All of these commodity flows include through-shipments, which do not necessarily contribute economically to the State; however, the transportation network also supports valuable local economic activity for a variety of industries, including the freight generators shown in Figure 3.11.

Figure 3.11 Maine Commodity Flows and Freight Generators



Source: FHWA Freight Analysis Framework Version 4.3; MaineDOT; Consultant analysis.

3.7 Network Usage and Performance

In order to develop highway-based performance measures for motor carriers operating throughout Maine, this analysis primarily utilizes travel time data from the National Performance Management Research Data Set (NPMRDS). The NPMRDS is a Federal Highway Administration (FHWA) data set that contains travel times in five-minute increments for the roadways that comprise the National Highway System (NHS). Travel times in the NPMRDS are given for passenger vehicles, trucks, and for all vehicles combined. Though the NPMRDS aims to provide full coverage of the NHS, data is sometimes missing from various links and must be interpolated. Furthermore, the data set sometimes contains travel time data on limited portions of roadways that are not located on the NHS. In the analysis, the travel time data is analyzed in four distinct periods capturing an entire 24-hour period:

- AM peak – 6:00 – 10:00 a.m.
- Midday peak – 10:00 a.m. – 3:00 p.m.
- PM peak – 3:00 – 7:00 p.m.
- Off peak – 7:00 p.m. – 6:00 a.m.

3.7.1 Truck Congestion

Congestion faced by motor carriers is captured by examining average truck speeds relative to a reference speed. Average truck speeds are derived from travel time data contained in the NPMRDS. Using data from the January 2016 through December 2016 time period, the average truck speeds for NHS roadways in Maine were calculated. For Interstate highways, a reference speed of 55 mph was used as that value is representative of average, uncongested conditions on the State's Interstate highways when examining the data. For non-Interstate NHS roadways, a reference speed of 45 mph is utilized. Overall, the results suggest that the average truck speeds on interstate highways are usually above 55 mph during AM peak, Midday, PM peak, night time, and the weekend. Only short parts of the interstate highways close to Canadian border crossings and urban areas such as Portland, Augusta, and Bangor show low levels of congestion.

Figure 3.12 shows the average truck speeds for the AM peak period. The results suggest that during this time period, parts of the Interstate system close to Canadian border and major urban areas are among the region's poorest performing segments with average truck speeds that are less than 35 mph. While lower truck speeds observed in urban areas may be due to congestion, those observed near the Canadian border are more likely due to delays at border crossing stations. Overall, these segments constitute less than one percent of the total interstate mileage in the State as shown in Table 3.8. About 95 percent of the interstate segments have strong performance with average truck speeds more than 55 mph.

Performance during the Midday period, shown in Figure 3.13, is similar to that observed during the morning peak. The most severe congestion is limited to portions of Interstate system close to the border with Canada or within urban areas. These portions (shown in light red and dark red) constitute about one percent of the total interstate mileage in the State (see Table 3.8). A stretch of I-95 between Augusta and Portland shows slow average truck speed between 45 and 55 mph; this is likely a result of projects to reconfigure the Exit 80 interchange in Lewiston and to construct an open road tolling plaza in West Gardiner, both of which affected

traffic on the Interstate during 2016.[30] However, much of the Interstate system shows strong performance with about 92 percent having average truck speeds 55 mph or higher.

Performance during the PM peak period, shown in Figure 3.14, is similar to that observed during the morning peak. The most severe congestion is limited to portions of the Interstate system close to the border with Canada or within urban areas. These portions constitute about one percent of the total Interstate mileage in the State. A stretch of I-95 between Augusta and Portland shows slow average truck speed between 45 and 55 mph, likely due to the construction projects described above. However, most of the system (about 91 percent of the system by directional mile) shows strong performance with average truck speeds exceeding 55 mph.

Table 3.8 presents a summary of truck travel conditions by direction on Interstate highways as captured by average speeds. During the AM peak, nearly 95 percent of the State's Interstate highways by directional mile provides for average truck speeds that are at least 55 mph. There is a relatively small portion of the system by directional mile (about 0.3 percent) that suffers more severe congestion during the AM peak period. The results are similar for the PM peak period and Midday period.

Table 3.8 Average Truck Speeds on the Interstate System in Maine

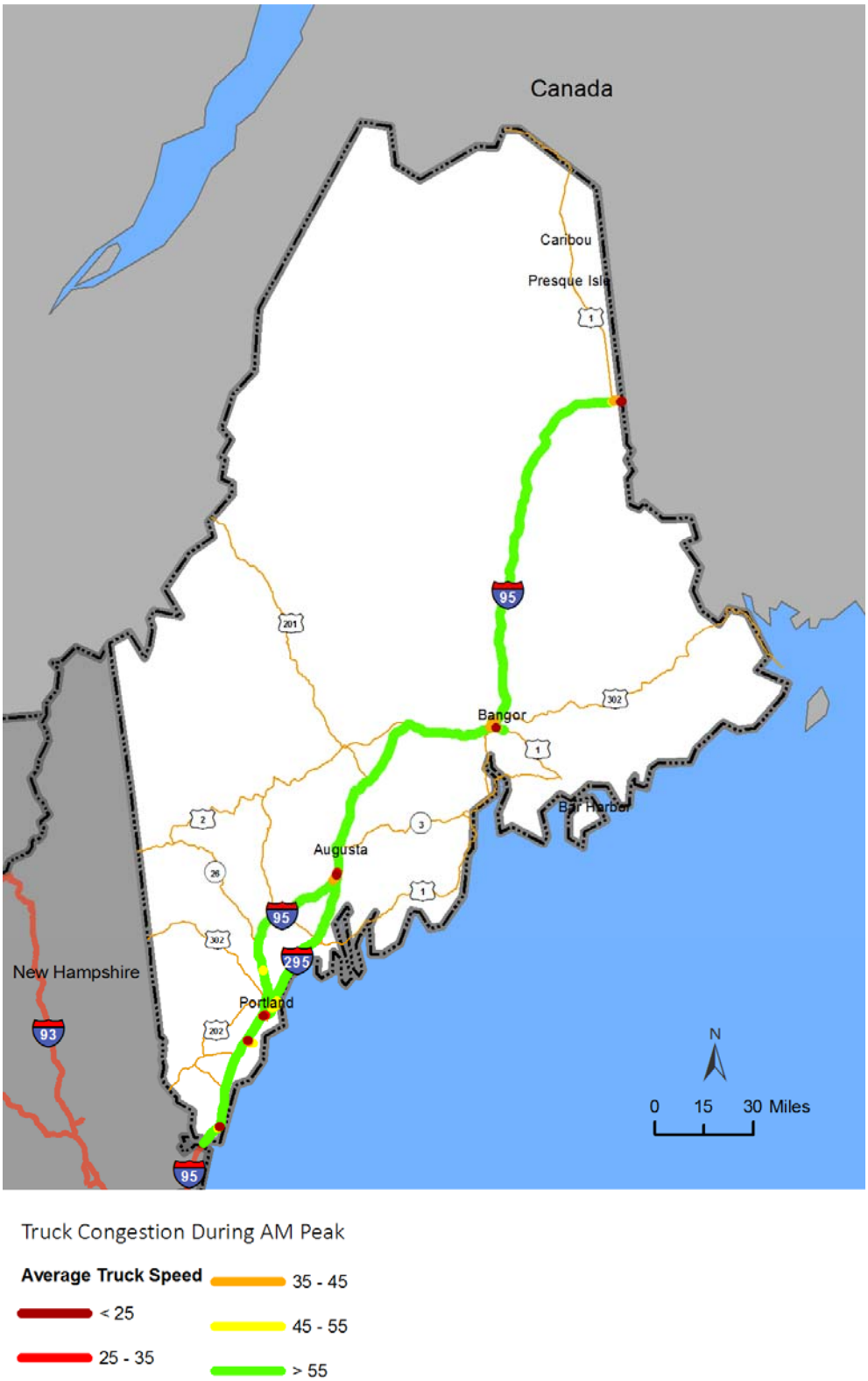
	AM Peak		Midday		PM Peak	
Avg. Truck Speed Percentage	Directional Miles	Percent of Total	Directional Miles	Percent of Total	Directional Miles	Percent of Total
<25	2.03	0.27%	2.03	0.27%	2.85	0.38%
25 – 35	2.60	0.35%	4.90	0.66%	4.77	0.64%
35 – 45	10.25	1.38%	9.59	1.30%	14.36	1.94%
45 – 55	23.63	3.19%	42.04	5.68%	43.36	5.86%
≥55	702.10	94.80%	682.04	92.09%	675.26	91.18%
Total	**740.60**	**100.00%**	**740.60**	**100.00%**	**740.60**	**100.00%**

Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

[30] Maine Turnpike Authority, http://www.maineturnpike.com/Projects-Planning/Construction-Projects/Lewiston-SPUI.aspx, http://www.maineturnpike.com/Projects-Planning/Construction-Projects/2015-11-West-Gardiner-ORT.aspx.

Figure 3.12 Average Truck Speeds on Interstate Highways in Maine

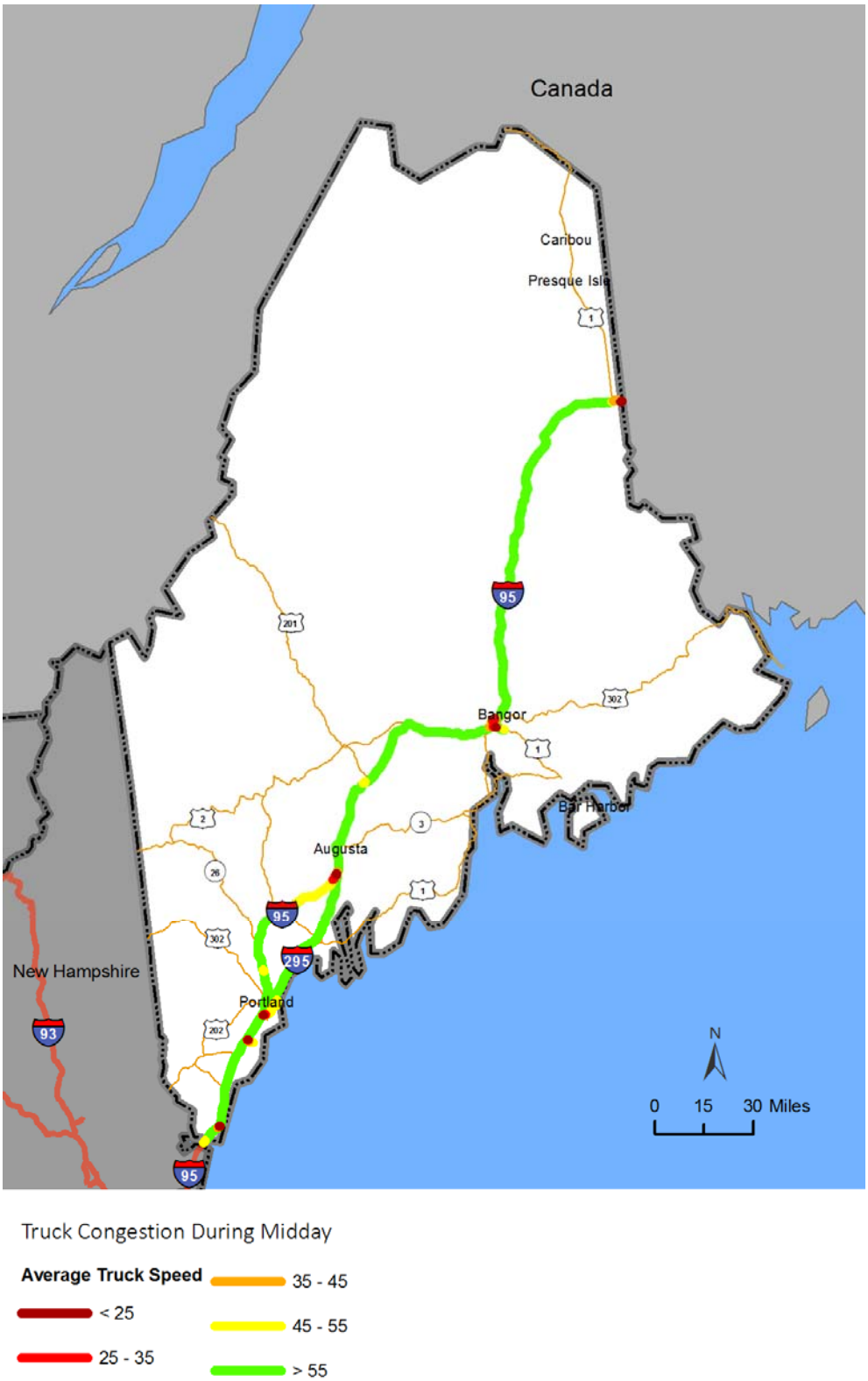
6:00 a.m. – 10:00 a.m. Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Figure 3.13 Average Truck Speeds on Interstate Highways in Maine

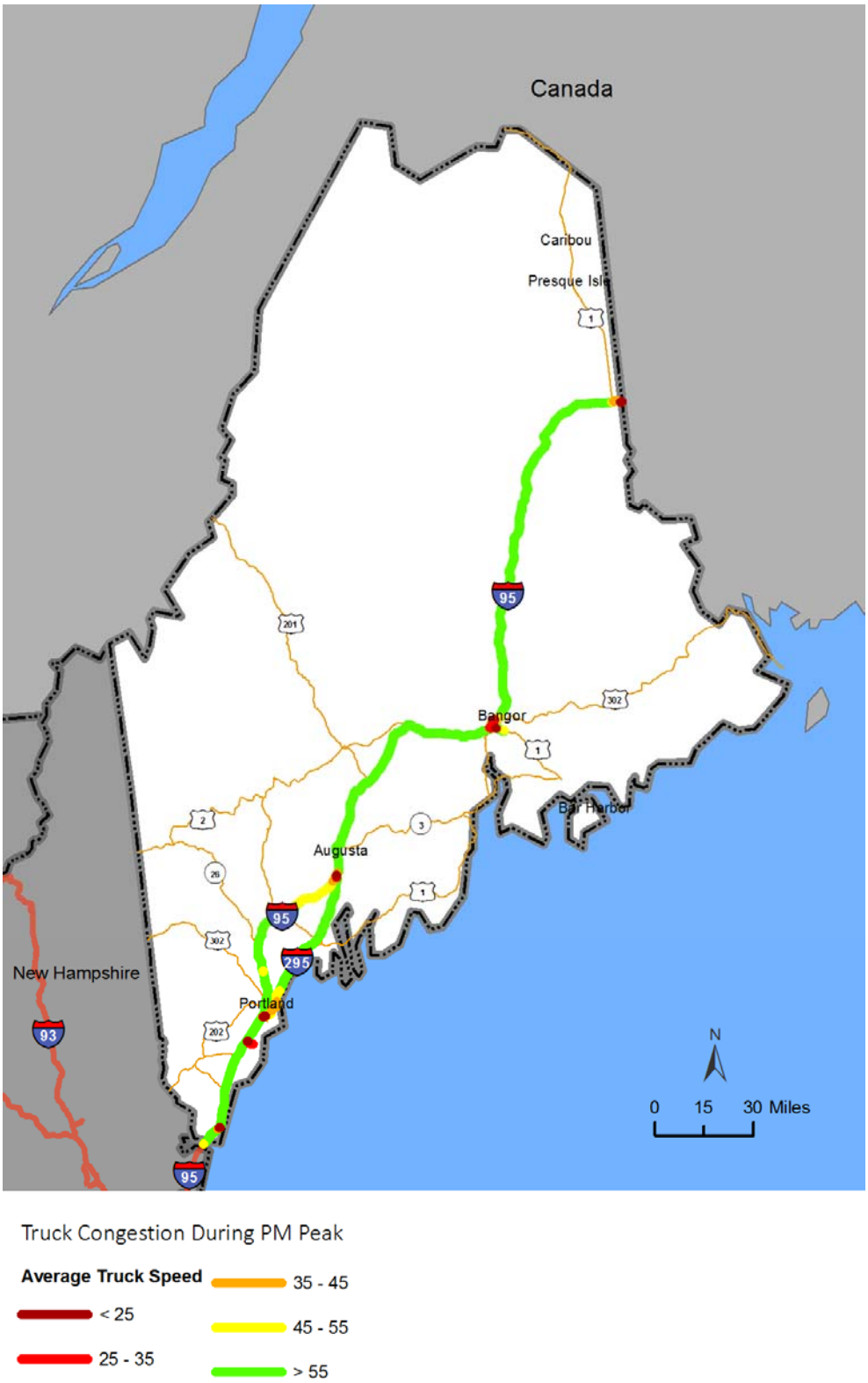
10:00 a.m. – 4:00 p.m. Midday Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Figure 3.14 Average Truck Speeds on Interstate Highways in Maine

4:00 p.m. – 8:00 p.m. Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Non-Interstate Highways Truck Congestion

Average truck speeds on non-Interstate highways are typically much lower than those observed on the Interstate system, due primarily to the fact that these are unlimited access roadways with many intersections. Also, the NPMRDS data do not filter out the delay that could result from intersection control devices such as stop signs and traffic signals. In addition, trucks may intentionally operate at lower speeds on non-Interstate highways because of safety concerns and lower speed limits.

Figure 3.15 shows the average truck speeds for the AM peak period on non-Interstate NHS highways. The results suggest that during this time period much of the non-Interstate NHS operates with average truck speeds that are less than 25 mph. These segments account for 33 percent of the total non-Interstate mileage by directional mile. Only about 7 percent of the non-Interstate system has average truck speeds that exceed 45 mph.

Performance during the Midday period is similar to that observed during the morning peak. The most severe congestion occurs within urban areas and highways that provide access to Canada, including U.S. 1 and U.S. 201. These portions constitute about 37 percent of the total non-Interstate NHS directional mileage. About 7 percent of the non-Interstate mileage has average truck speeds of 45 mph or more. Midday performance is shown in Figure 3.16.

Performance during the PM peak period is shown in Figure 3.17 and also is similar to that observed during the morning peak. The most severe congestion occurs in major urban areas and highways that cross the Canadian border. These portions constitute about 38 percent of the total non-Interstate NHS directional mileage in the State. On the other hand, only 8 percent of the non-Interstate NHS segments show strong performance with average truck speeds more than 45 mph. Performance on ME 9 generally exceeds other highways during this and other time periods. While ME 9 has nearly unlimited access like many other non-Interstate NHS highways, its location in a relatively flat and sparsely populated region limits interruptions to traffic flow and makes it an efficient route for trucks. Maine has applied for INFRA funding to extend ME 9 to connect to I-395 directly avoiding downtown Brewer where most of the congestion on ME 9 currently occurs.

Table 3.9 presents a summary of truck travel conditions by direction on non-Interstate NHS highways as captured by average speeds. During the AM peak, nearly 33 percent of the State's non-Interstate NHS highways by directional mile show poor performance with average truck speed less than 25 mph. There is a small portion of the system by directional mile (about 7 percent) that provides strong performance with average truck speed greater than 45 mph during the AM peak period. The results are generally similar for the PM peak period and Midday period.

Additional factors that could impact truck travel speeds and highway performance in Maine include weather and terrain. Disruptions due to weather in the winter months, tourism-related traffic in the peak summer months, as well as disruptions due to wildlife collisions especially in rural and forested areas throughout the State may impact overall truck speeds on these roads.

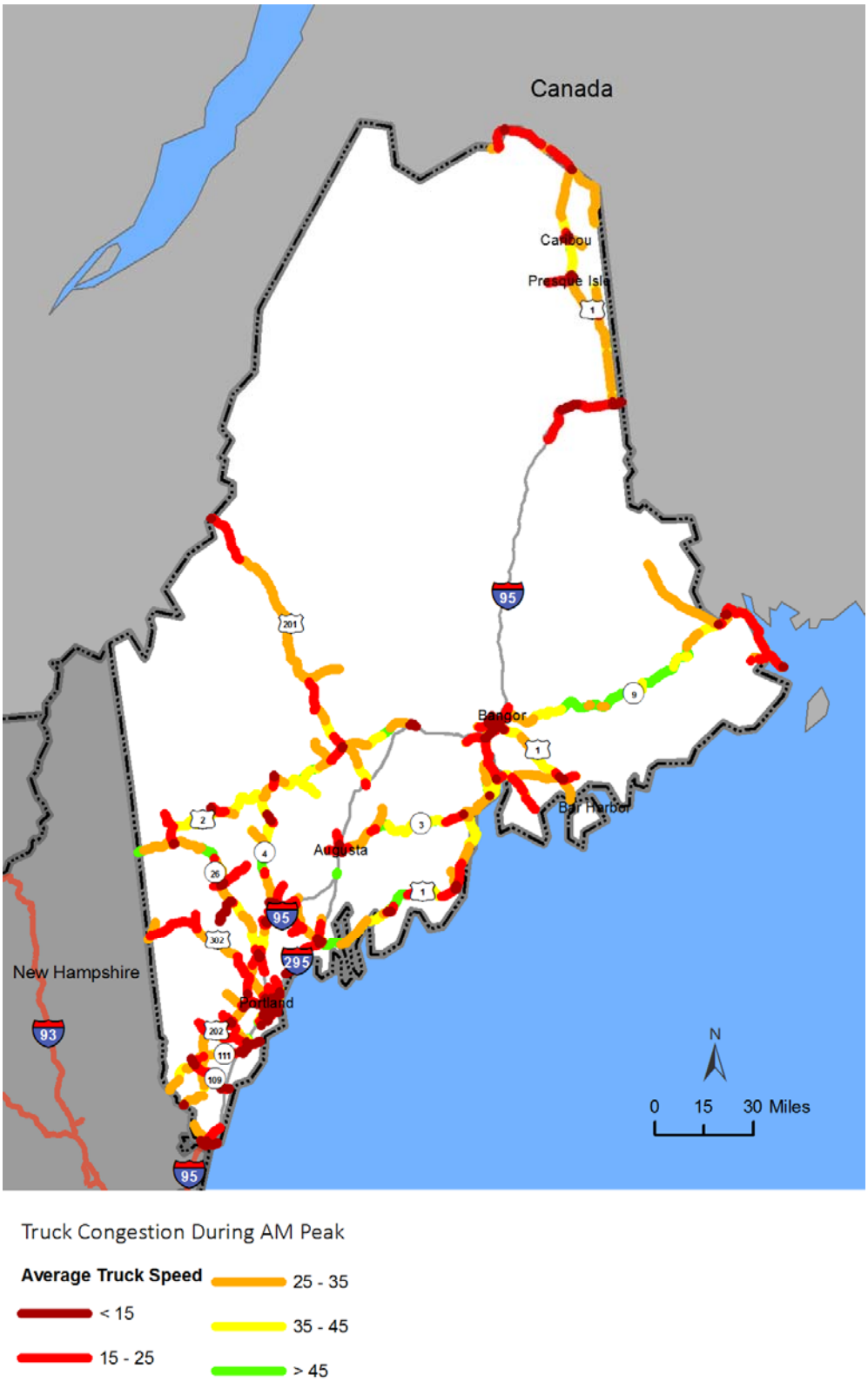
Table 3.9 Average Truck Speeds on the Non-Interstate Highways in Maine

Avg. Truck Speed Percentage	AM Peak		Midday		PM Peak	
	Directional Miles	Percent of Total	Directional Miles	Percent of Total	Directional Miles	Percent of Total
<15	230.84	7.67%	342.97	11.40%	371.26	12.34%
15 – 25	762.47	25.34%	783.55	26.04%	782.14	26.00%
25 – 35	1,082.89	35.99%	1,046.56	34.78%	912.86	30.34%
35 – 45	718.20	23.87%	623.27	20.72%	682.19	22.67%
≥45	214.35	7.12%	212.39	7.06%	260.29	8.65%
Total	**3,008.75**	**100.00%**	**3,008.75**	**100.00%**	**3,008.75**	**100.00%**

Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Figure 3.15 Average Truck Speeds on NHS Non-Interstate Highways in Maine

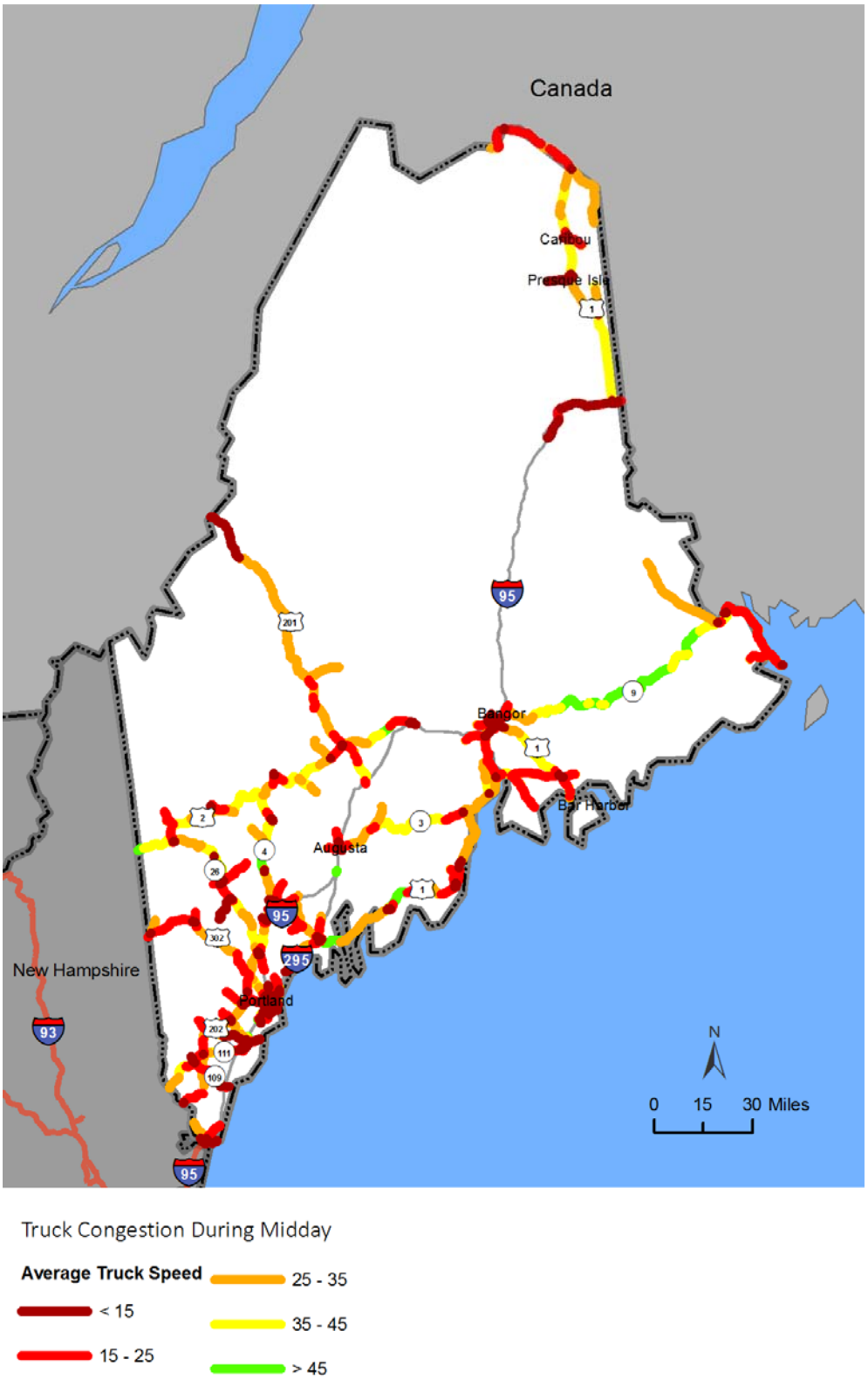
6:00 a.m. – 10:00 a.m. Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Figure 3.16 Average Truck Speeds on NHS Non-Interstate Highways in Maine

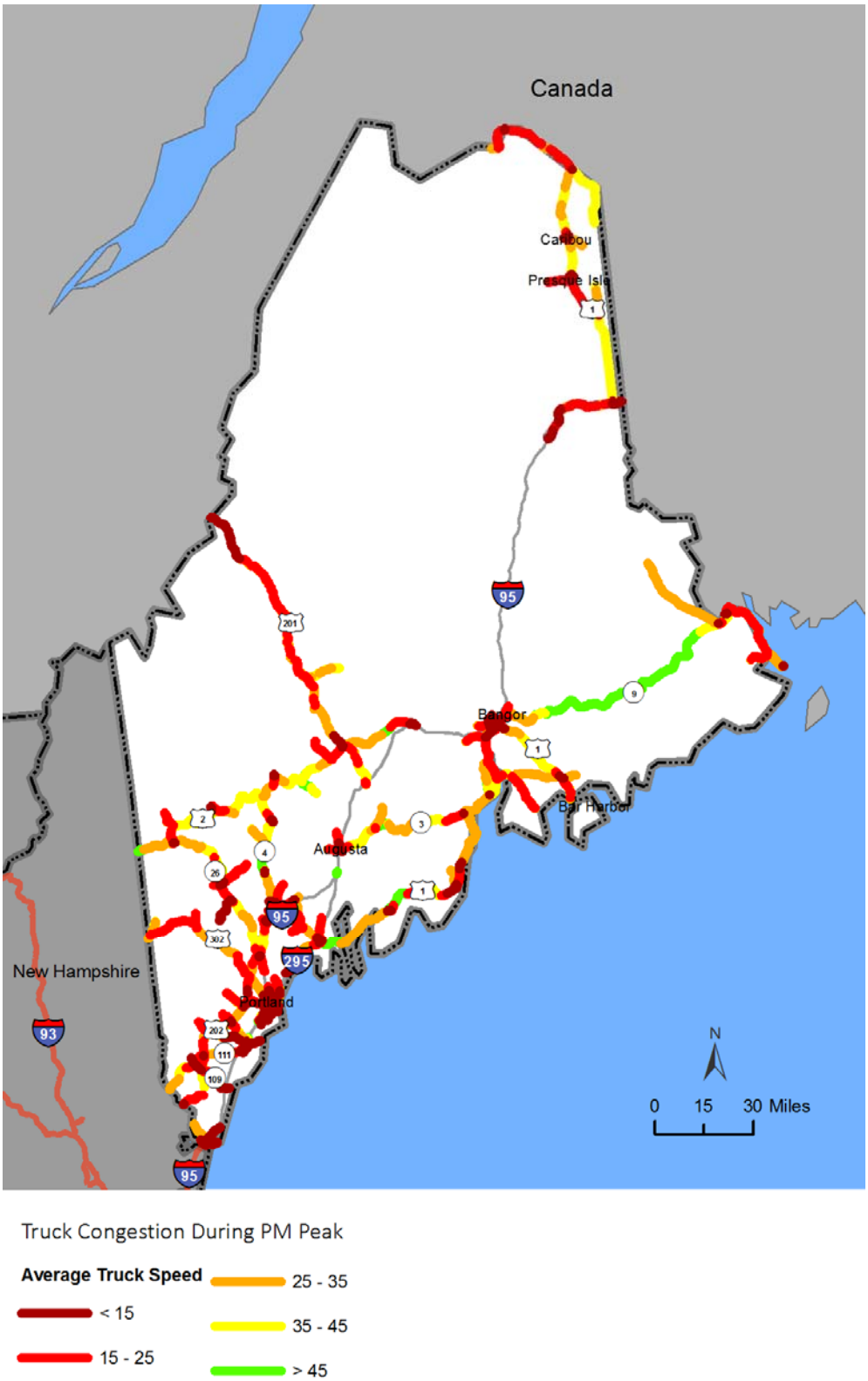
10:00 a.m. – 4:00 p.m. Midday Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Figure 3.17 Average Truck Speeds on NHS Non-Interstate Highways in Maine

4:00 p.m. – 8:00 p.m. Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

3.7.2 Truck Travel Time Reliability

Truck travel time reliability on the State's NHS routes is captured by calculating the Truck Travel Time Reliability (TTTR) index. In effect, the TTTR index gives an idea of how variable travel times are on the highway network. Highly variable, or inconsistent, truck travel times result in unreliable service over the highway network. Unreliability is a direct cost to motor carriers as they must hedge against unreliable travel times by budgeting additional time into their schedules. This translates into higher transportation costs that may be passed on to shippers. More importantly, wasted time reduces available hours of service for the truck drivers.

The TTTR index is the freight performance measure adopted by FHWA that must be reported for Interstate highways.[31] The TTTR index is calculated as the ratio of the 95th percentile travel time to the 50th percentile travel time: TTTR = 95th Percentile Truck Travel Time/50th Percentile Truck Travel Time. High TTTR values indicate unreliable truck travel times while low TTTR values indicate more reliable travel times. For example, a TTTR value equal to two indicates that truck travel times may be twice as long as average travel times for a given time period.

Like the average truck speeds, the TTTR measures are derived from the January 2016 through December 2016 travel time data contained in the NPMRDS. Overall, the results suggest that the majority of the Interstate system provides for very reliable truck travel times as indicated by low values of the TTTR index.

Figure 3.18 shows the TTTR index for the AM peak period, Figure 3.19 shows TTTR during the Midday period, and Figure 3.20 shows TTTR during the PM peak. Similar to average travel time, only small parts of the Interstate highway close to the Canadian border and major urban areas show poor travel time reliability. The share of Interstate system segments exhibiting poor reliability (depicted as light red and dark red segments in the accompanying figures) is relatively stable, comprising approximately two percent of the total Interstate directional mileage in the State. At all times, portions with poor truck travel time reliability are located close to major urban areas and Canadian border crossing. In addition, during the Midday Peak, Interstate 95 between Augusta and Lewiston does not perform as well as other portions of the Interstate system outside of urban areas, possibly caused by construction projects occurring during the data collection period.

Table 3.10 presents a summary of truck travel conditions by direction as captured by the truck travel time reliability index (TTTR). During the AM peak, just over 3 percent of the region's highway system by directional mile exhibits TTTR indexes that exceed 1.6. This indicates that truck travel times during the AM peak are overall very reliable. Reliability is slightly worse during the PM peak period. About 4.3 percent of the State's Interstate highway system by directional mile exhibits TTTR indexes that exceed 1.6. With regard to Midday period, the reliability conditions are still very good with just less than three percent of the State's highway system by directional mile shows TTTR indexes greater than 1.6.

[31] National Performance Management Measures: Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program, *Federal Register*, Vol. 82, No. 11, January 18, 2017, https://www.Federalregister.gov/documents/2017/01/18/2017-00681/national-performance-management-measures-assessing-performance-of-the-national-highway-system.

The Freight Reliability performance measure is a weighted average (by segment length) of the maximum TTTR indexes observed over the five time periods specified in the FHWA final rule on performance measures.[32] Its calculation is required for the Interstate system only and is computed as follows:

$$\frac{\sum_{i=1}^{T}(SL_i * \max TTTR_i)}{\sum_{i=1}^{T} SL_i}$$ [33]

Where:

- i = An Interstate system reporting segment;
- $\max TTTR_i$ = The maximum TTTR of the five time periods of Interstate system reporting segment "i";
- SL_i = Segment length of Interstate system reporting segment "i"; and
- T = A total number of Interstate system reporting segments.

For Maine, the Freight Reliability measure using 2016 data is equal to 1.33. This suggests that overall the State's Interstate highways provide for a high level of reliability for truck travel, with a minimal amount of variation across time and space.

Table 3.10 Average Truck Travel Time Reliability on the Interstate System in Maine

Truck Travel Time Reliability	AM Peak		Midday		PM Peak	
	Directional Miles	Percent of Total	Directional Miles	Percent of Total	Directional Miles	Percent of Total
1 – 1.3	673.74	90.97%	670.50	90.53%	650.34	87.81%
1.3 – 1.6	44.18	5.97%	48.50	6.55%	58.56	7.91%
1.6 – 2	9.85	1.33%	11.54	1.56%	14.08	1.90%
2 – 3	10.66	1.44%	7.89	1.07%	13.40	1.81%
>3	2.17	0.29%	2.17	0.29%	4.22	0.57%
Total	**740.60**	**100.00%**	**740.60**	**100.00%**	**740.60**	**100.00%**

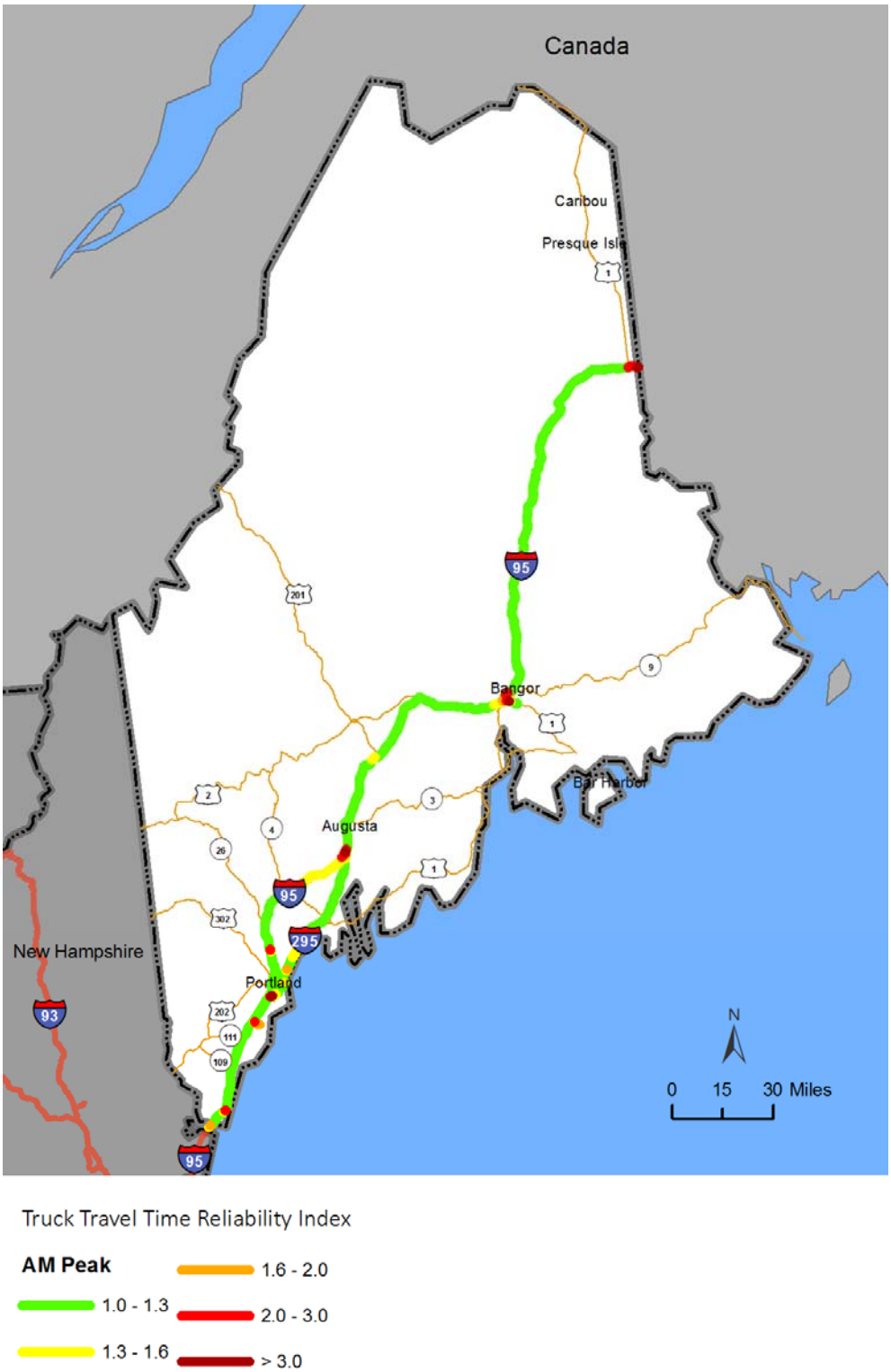
Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

[32] 1) AM Peak = 6 a.m. – 10 a.m. Monday – Friday; 2) Midday = 10 a.m. – 4 p.m. Monday – Friday; 3) PM Peak = 4 p.m. – 8 p.m. Monday – Friday; 4) Overnight = 8 p.m. – 6 a.m. Sunday – Saturday; and 5) Weekend = 6 a.m. – 8 p.m. Saturday – Sunday.

[33] National Performance Management Measures: Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program, *Federal Register*, Vol. 82, No. 11, January 18, 2017, https://www.Federalregister.gov/documents/2017/01/18/2017-00681/national-performance-management-measures-assessing-performance-of-the-national-highway-system.

Figure 3.18 Average Truck Travel Time Reliability Index on Interstate Highways in Maine

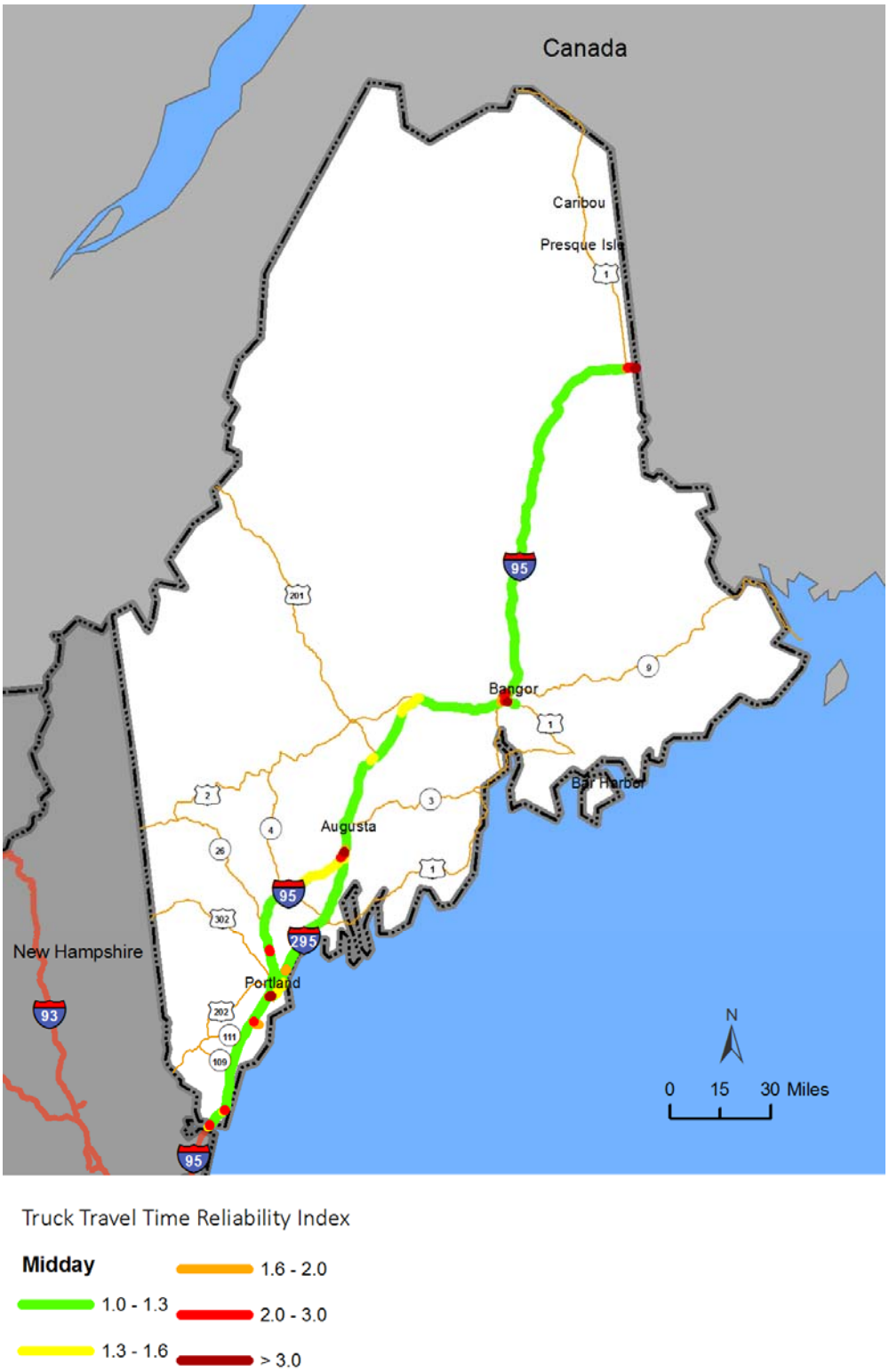
6:00 a.m. – 10:00 a.m. Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Figure 3.19 Average Truck Travel Time Reliability Index on Interstate Highways in Maine

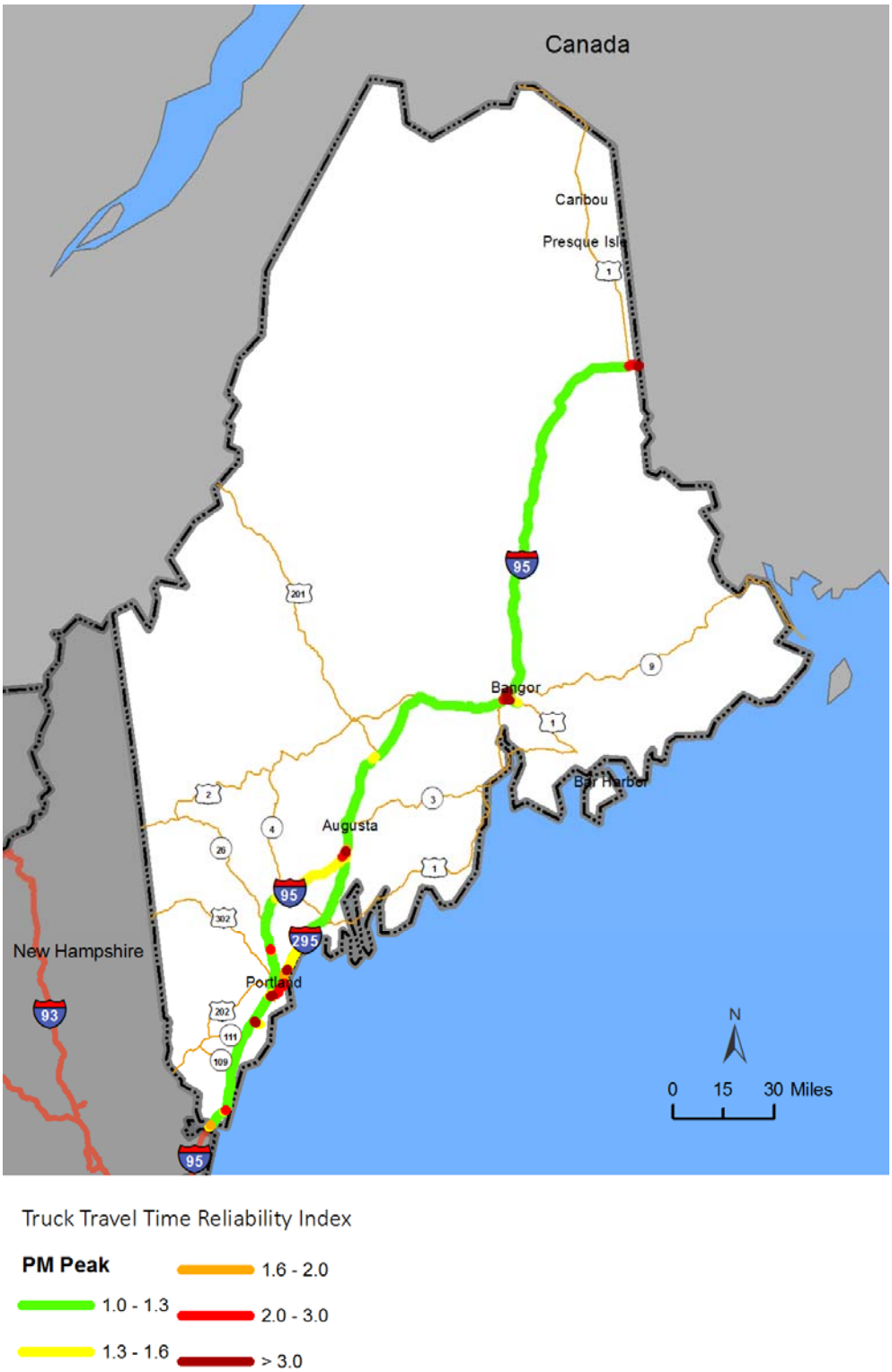
10:00 a.m. – 4:00 p.m. Midday Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Figure 3.20 Average Truck Travel Time Reliability Index on Interstate Highways in Maine

4:00 p.m. – 8:00 p.m. Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Non-Interstate Highways Truck Travel Time Reliability

Although not required under the FHWA performance measure, this NPMRDS data also can provide insight into reliability for some roads beyond the Interstate system. Figure 3.21 shows the travel time reliability for the AM peak period for non-Interstate roads with available data. The results suggest that during this time period much of the non-Interstate NHS highway system is challenged in its ability to provide for reliable truck travel. About 67 percent of non-Interstate NHS highways (by directional mile) exhibits TTTR indexes that exceed 1.6. However, as noted in the discussion of average truck speeds on non-Interstate NHS highways, performance is affected by intersecting roadways and driveways as these facilities are generally not limited access. Also, the NPMRDS data do not filter out control delay (e.g., delay due to stop signs and traffic signals) which contribute to increased travel times. In addition, trucks may intentionally operate at lower speeds on non-Interstate highways because of safety concerns and lower speed limits.

Reliability conditions during the Midday period are similar to that observed during the AM peak (see Figure 3.22). The poorest reliability is observed close to major urban areas and on highways that cross the Canadian border, including U.S. 1 and U.S. 201. About 72 percent of non-Interstate NHS roadways by directional mile have TTTR values that exceed 2. Just below 12 percent of the non-Interstate NHS roadways show strong reliability with TTTR indexes less than 1.6.

Travel time reliability during the PM peak period is similar to that observed during the AM peak (see Figure 3.23). The poorest reliability is observed close to major urban areas and on highways and the Canadian border. About 71 percent of non-Interstate NHS roadways have TTTR values that exceed 2. Just under 15 percent of the system provides for very good travel time reliability as indicated by TTTR values less than 1.6. Similar to the observations made regarding average truck speeds, performance on ME 9 as captured by truck travel time reliability generally exceeds other highways during this and other time periods, in part due to its rural location and design that includes uphill passing lanes and few intersections.

Table 3.11 presents a summary of truck travel time reliability conditions by directional mile on non-Interstate NHS highways. During the AM peak, nearly 67 percent of the State's non-Interstate NHS highways by directional mile show poor reliability conditions with TTTR indexes higher than 2. There is a small portion of the system by directional mile (about 14 percent) that provides good reliability with TTTR indexes less than 1.6 during the AM peak period, with generally similar results across the Midday and PM peak periods.

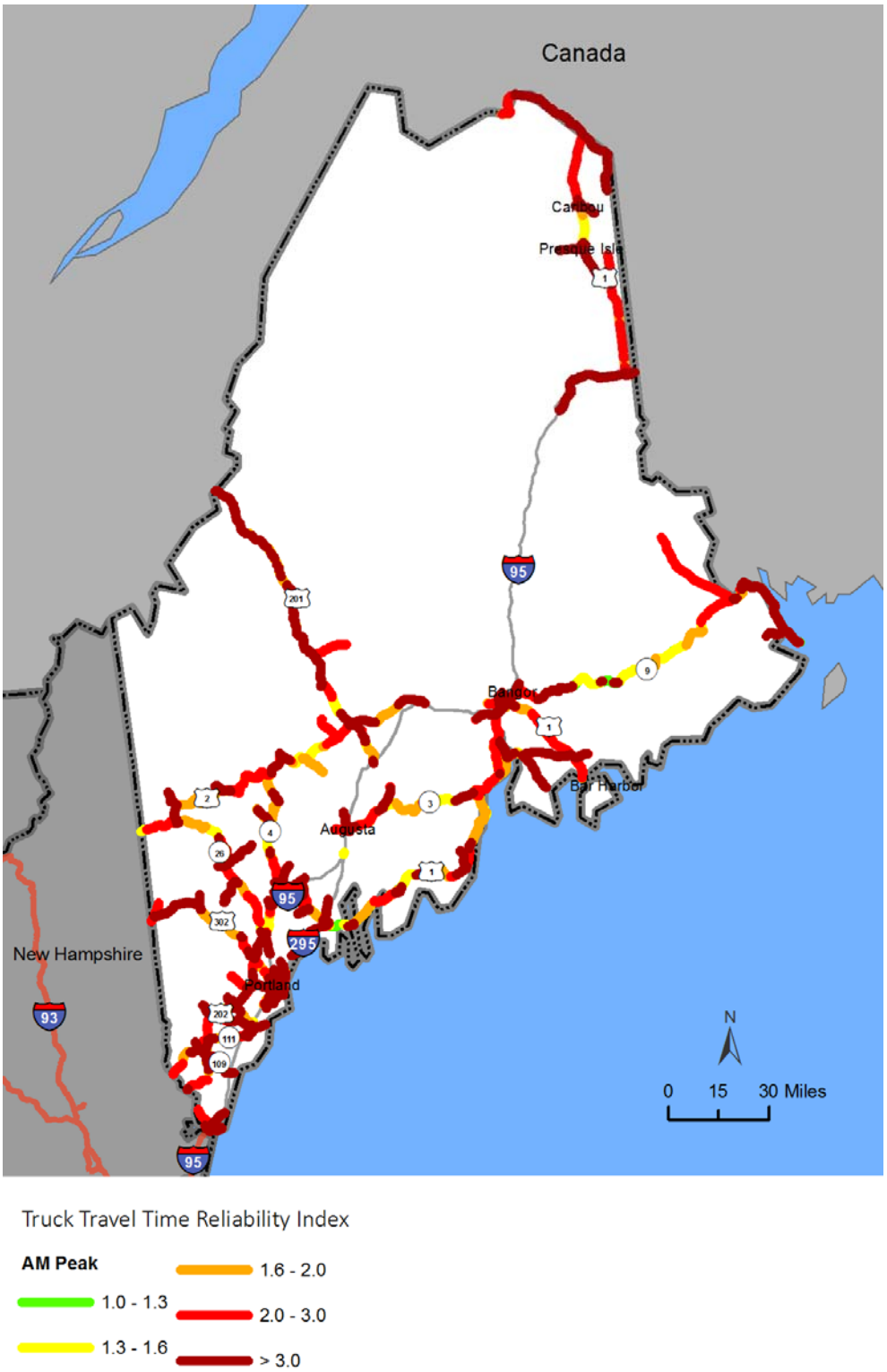
Table 3.11 Average Truck Travel Time Reliability on the NHS Non-Interstate Highways in Maine

Truck Travel Time Reliability	AM Peak		Midday		PM Peak	
	Directional Miles	Percent of Total	Directional Miles	Percent of Total	Directional Miles	Percent of Total
1 – 1.3	55.03	1.83%	58.71	1.95%	67.60	2.25%
1.3 – 1.6	354.79	11.79%	293.68	9.76%	377.26	12.54%
1.6 – 2	570.00	18.94%	483.89	16.08%	416.57	13.85%
2 – 3	1,146.67	38.11%	785.33	26.10%	722.38	24.01%
>3	882.25	29.32%	1,387.13	46.10%	1,424.94	47.36%
Total	**3,008.75**	**100.00%**	**3,008.75**	**100.00%**	**3,008.75**	**100.00%**

Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Figure 3.21 Average Truck Travel Time Reliability Index on NHS Non-Interstate Highways in Maine

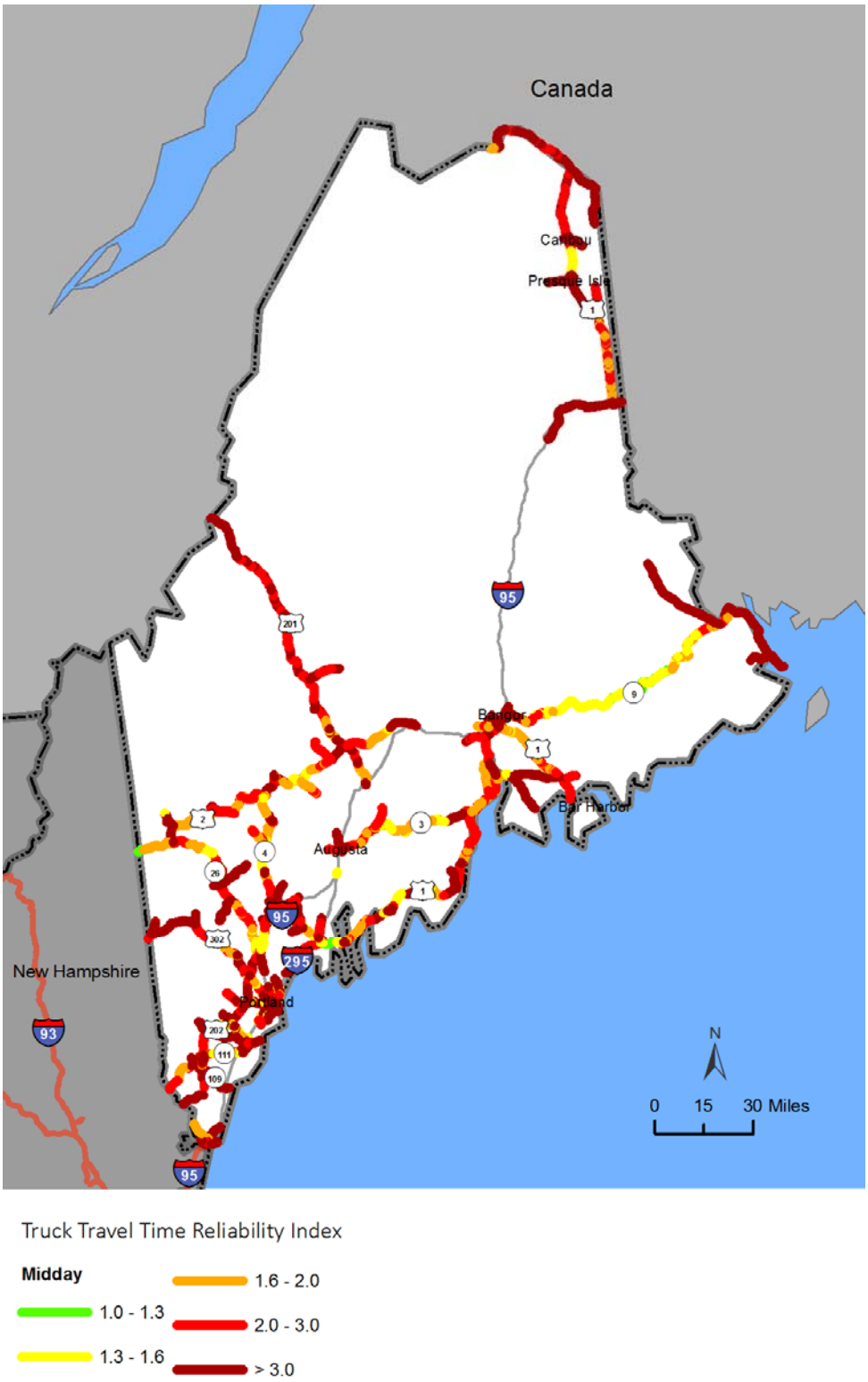
6:00 a.m. – 10:00 a.m. Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Figure 3.22 Average Truck Travel Time Reliability Index on NHS Non-Interstate Highways in Maine

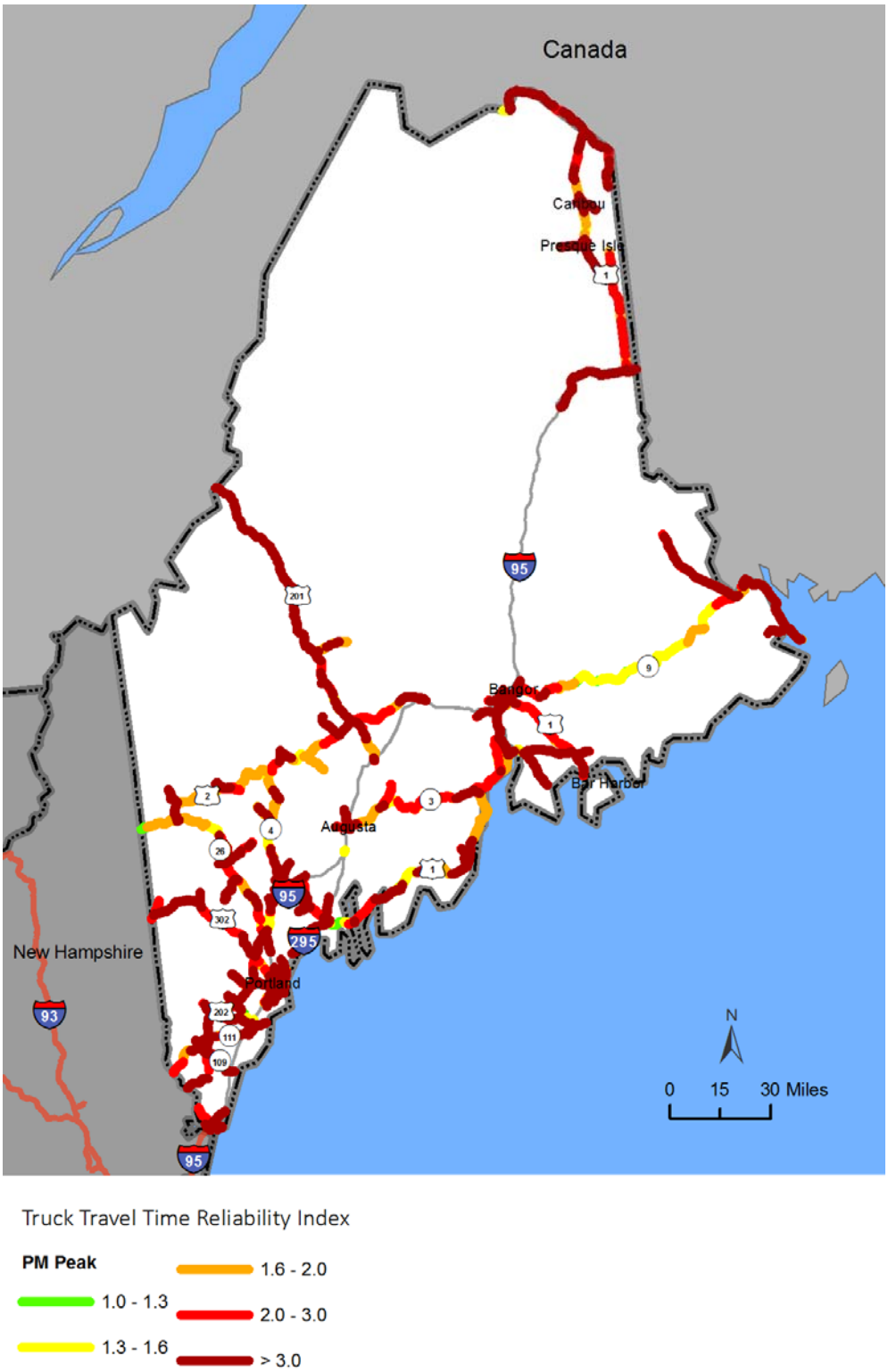
10:00 a.m. – 4:00 p.m. Midday Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

Figure 3.23 Average Truck Travel Time Reliability Index on NHS Non-Interstate Highways in Maine

4:00 p.m. – 8:00 p.m. Peak Period



Source: National Performance Management Data Set (NPMRDS); Consultant analysis.

3.8 Safety

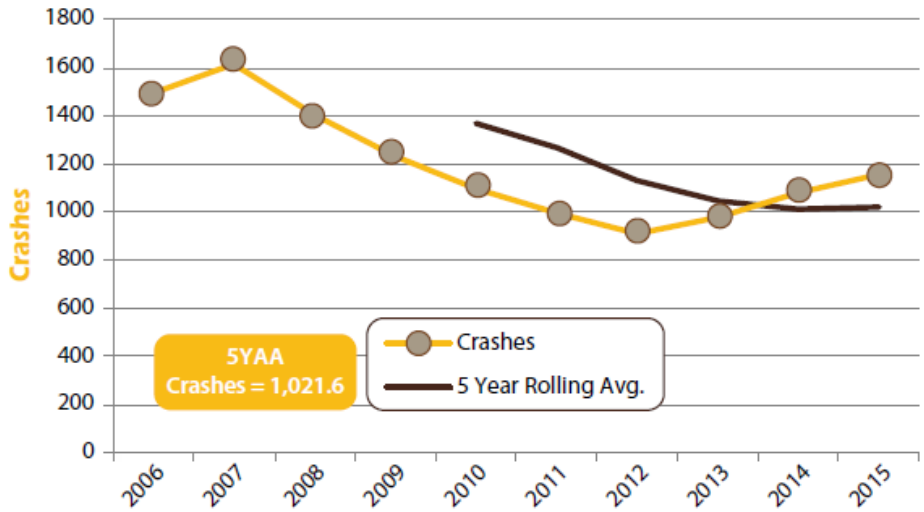
Reducing the rate of fatalities, injuries, and crashes on the transportation system in the first objective under the "Manage the Existing System" goal identified by MaineDOT. Reducing crashes involving trucks and freight trains improves network performance and reduces costs.

3.8.1 Highway Safety

Commercial vehicle safety is a key concern for freight movement. Crashes can injure both truck drivers and other road users. Crashes create delay, reducing reliability in a corridor and can potentially cause shipments to miss their delivery window, adding cost. Finally, goods in transit also can be damaged or destroyed, again creating additional cost, and often generating additional trips.

Figure 3.24 shows that annual commercial vehicle (and buses with 15+ person capacity) crashes resulting in an injury were nearly halved from 2007 to 2012. Crashes rose from 2012 to 2015, but still remain at a lower level than a decade ago. MaineDOT is collaborating with industry and safety groups to identify potential safety improvements, and the department already is investing in some measures to further reduce crashes such as centerline and shoulder rumble strips on key routes with runoff or lane crossing issues.

Figure 3.24 Maine Commercial Vehicle Crashes with Injury
2006-2015

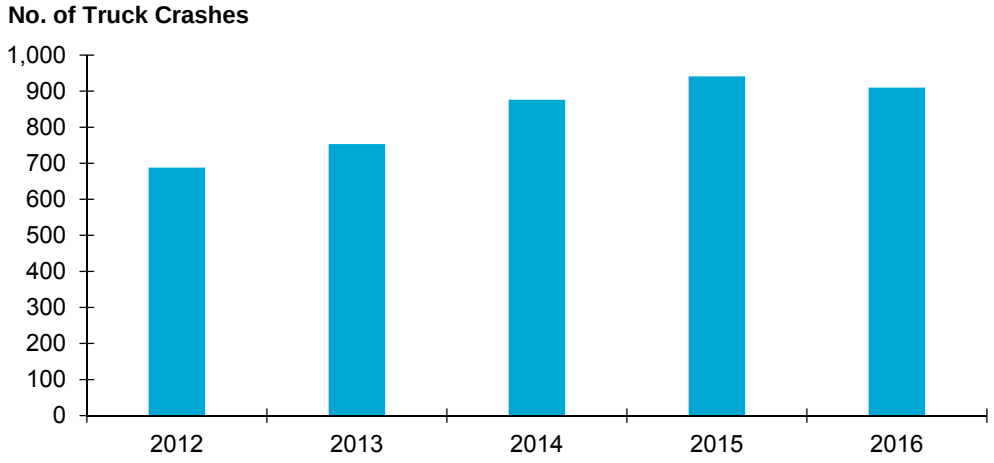


This category includes large trucks and buses with a seating capacity of 15 or more (including the driver) that result in an injury.

Source: Maine Highway Safety Facts 2016.

The remainder of the safety analysis focuses on the most recent five years of truck crashes. Over the 2012 through 2016 time period, 4,168 crashes involving commercial trucks (both single unit and trailers) occurred in the State. The total number of crashes increased each year from 2012 to 2015 and then decreased slightly in 2016 (see Figure 3.25).

Figure 3.25 Maine Truck Crashes by Year
2012-2016



Source: MaineDOT; Consultant Analysis.

As shown in Table 3.12, three counties accounted for nearly half of all truck crashes in the State over the five-year period, and seven counties accounted for 80 percent of all truck crashes. As expected, these counties all lie along Maine's most significant trucking corridors – the I-95 corridor from the southern tip of the State up to Bangor, U.S. 201 from I-95 toward Quebec City, and U.S. 1 from I-95 into northern Maine.

Table 3.12 Maine Truck Crashes by County
2012-2016

County	Number of Truck Crashes	Percent of Total
Cumberland	773	19%
York	688	17%
Androscoggin	522	13%
Kennebec	436	10%
Penobscot	424	10%
Somerset	298	7%
Aroostook	205	5%
Franklin	154	4%
Oxford	131	3%
Hancock	117	3%
Lincoln	95	2%
Washington	86	2%
Knox	75	2%
Waldo	70	2%
Sagadahoc	62	1%
Piscataquis	32	1%
Total	**4,168**	**100%**

Source: MaineDOT; Consultant analysis.

When truck crashes are divided by county population to produce a truck crash rate per 1,000 population (see Table 3.13), the ranking of counties is somewhat different; rural counties with smaller populations tend to have higher crash rates than larger counties. The two counties with the highest crash rates per 1,000 population, Somerset (5.8) and Franklin (5.1), are both located in the midwestern portion of the State in rural and forested areas away from population centers on the coast, but still containing important freight routes (parts of U.S. 2, U.S. 201, ME 4, and ME 27). Those two counties account for only 6 percent of the State's population, but 11 percent of crashes in the State.

As estimated by the Federal Motor Carrier Safety Administration (FMCSA), the average cost of providing emergency services for heavy and medium truck crashes is $191.[34,35] For truck crashes that result in fatalities, the cost estimate climbs to $1,378. For rural areas with high truck crash rates by population, these could represent significant public costs as there are fewer resources to provide emergency services. This is in addition to the delay costs to the communities due to truck crashes.

Table 3.13 Maine Truck Crash Rate by County
2012-2016

County	Population (1,000s)	Percent of Total Population	Truck Crashes per 1,000 Population
Somerset	52	4%	5.8
Franklin	30	2%	5.1
Androscoggin	107	8%	4.9
Kennebec	121	9%	3.6
York	200	15%	3.4
Aroostook	70	5%	2.9
Lincoln	34	3%	2.8
Penobscot	153	12%	2.8
Cumberland	286	22%	2.7
Washington	32	2%	2.7
Oxford	57	4%	2.3
Hancock	55	4%	2.1
Knox	40	3%	1.9
Piscataquis	17	1%	1.9
Waldo	39	3%	1.8
Sagadahoc	35	3%	1.8
Overall	**1,329**	**100%**	**3.1**

Source: MaineDOT; American Community Survey 2015; Consultant analysis.

[34] FMCSA. (2015). Unit Costs of Medium and Heavy Truck Crashes.

[35] Measured in 2015 dollars.

Table 3.14 shows crash by severity. Approximately 5 percent of crashes (214) were of the most severe injury outcomes – fatalities and incapacitating injuries. The large majority of truck-involved crashes (about 65 percent or 2,695 total crashes) resulted in no injuries.

Table 3.14 Maine Truck Crashes by Severity
2012-2016

Crash Severity	Number of Crashes	Percent of Total
Fatality	56	1%
Incapacitating Injury	158	4%
Evident Injury	428	10%
Possible Injury	831	20%
Property Damage Only and Unknown	2,695	65%
Total	**4,168**	**100%**

Source: MaineDOT; Consultant analysis.

Certain types of crashes often have more severe outcomes than others. In particular, crashes involving pedestrians or cyclists, or those occurring head-on or at an angle tend to result in more serious injuries. Table 3.15 presents a summary of truck crashes by type throughout the State. Head-on/sideswipe truck crashes comprised approximately 7 percent (291) of total crashes. Crashes involving pedestrians or cyclists comprised about 1 percent (37) of total crashes. A significant share of truck-involved crashes consisted of crash types that do not tend to result in serious injuries – going off the road, intersection movements, and rear ends/sideswipes.

Table 3.15 Maine Truck Crashes by Type
2012-2016

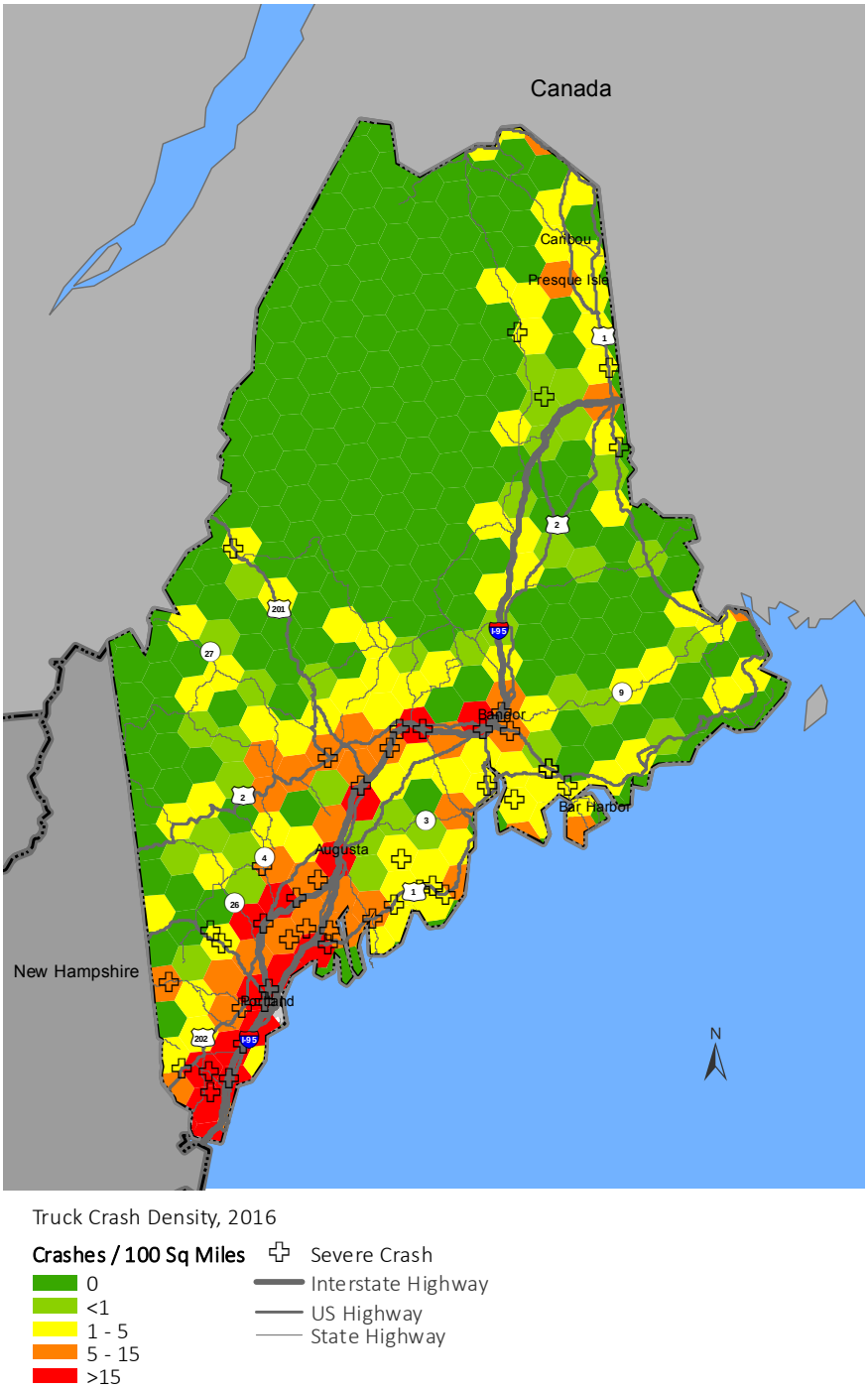
Crash Type	Number of Crashes	Percent of Total
Head-on/Sideswipe	291	7%
Pedestrians and Cyclists	37	1%
Train	5	0.1%
Rollover	87	2%
Went Off Road	717	17%
Intersection Movement	686	16%
Rear End/Sideswipe	1,802	43%
All Others	543	13%
Total	**4,168**	**100%**

Source: MaineDOT; Consultant analysis.

A heat map of truck crashes for the most recent year of available data, 2016, was developed by calculating the density of crashes per square mile (see Figure 3.26). As expected, the analysis indicates that crashes in 2016 were clustered around coastal metropolitan areas and along Maine's primary freight corridors: I-95 and alternative routes, the east-west corridor (especially U.S. 2 west of I-95), U.S. 201 and ME 27 connecting northwest to Canada, and U.S. 1 extending from I-95 to northern Maine. This clustering of truck crashes is likely due to greater truck activity at those locations relative to other areas of the State.

Figure 3.26 also displays the specific locations of severe truck crashes (resulting in either fatalities or incapacitating injuries) in 2016. Severe crashes generally follow a similar pattern to the heat map of all crashes, with most severe crashes distributed along major highway routes or in major metropolitan areas. One possible exception is U.S. 1 along the coast between Portland and Bangor, which appeared to have a disproportionate concentration of severe truck crashes in 2016.

Figure 3.26 Maine Truck Crash Heat Map
2016



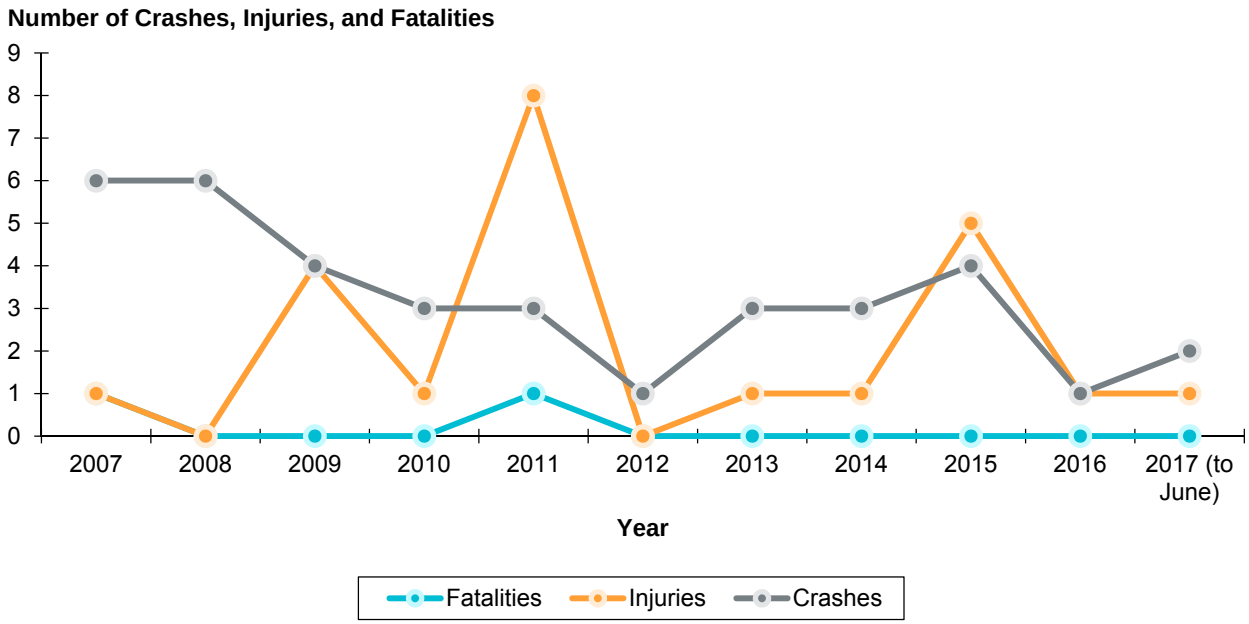
Source: MaineDOT; Consultant analysis.

3.8.2 Highway-Rail Crossing Safety

Rail crashes, especially those that occur at highway-rail crossings, are a special concern for freight movement. Crashes create delays on both the highway and rail networks and damage infrastructure and goods in transit, in addition to the potential for injury or loss of life.

Between 2007 and June 2017, there were 36 crashes at highway-rail crossings resulting in 23 injuries and 2 fatalities (shown in Figure 3.27). This represents 0.2 percent of crashes, 0.2 percent of injuries, and less than 0.1 percent of fatalities nationwide during this time. Of the fatalities, one occurred in 2007 in Oxford County, and one in 2011 in York County. Cumberland County had the most highway-rail crossing crashes over this period with eight, followed by seven in Aroostook County and six in York County.

Figure 3.27 Maine Highway-Rail Crossing Incidents, Injuries, and Fatalities *2007-2017*



Source: Federal Railroad Administration (FRA) GX Dash. On-line at: https://explore.dot.gov/t/FRA/views/HIghway-RailCrossingCollisions2007-2017/National?%3Aembed=y&%3AshowShareOptions=true&%3Adisplay_count=no&%3AshowVizHome=no.

4.0 Key Trends, Issues, and Challenges

The demand for and performance of Maine's freight transportation system is driven by a number of trends at the statewide, national, and global scale. Whether in terms of technology innovations in transportation (automated vehicles), socioeconomics (urbanization), new business and consumer practices (growing consumer demand for e-commerce), or global trade patterns (containerization and intermodal growth), these changes must be understood in order to better prepare Maine's freight system to serve the needs of its industry and residents. These trends, and the issues and challenges facing Maine's freight network are the topic of this section.

4.1 Freight System Trends

Maine's economy is underpinned by freight movement. Freight activity is growing in the State, and the structure of the economy – at the National, state, and Local levels – is changing, driven by demographic changes, emerging technologies, and changing trade patterns and political forces. This section describes trends that are most likely to shape freight demand in the State in the next several decades, starting with an overview of long-term statewide, national, and global trends across the transportation industry and concluding with an examination of those trends' impact on future activity and demand for freight movement in the State.

4.1.1 Trends and Implications of Growth

There are a number of global, national, and statewide trends that will continue to affect the performance and utilization of the Maine freight system. These trends include continued statewide modest decline in population and labor force, global shifts in manufacturing, the emergence of e-commerce fulfillment centers, and the advent of autonomous vehicles.

Maine-Specific Trends

Industry Analysis and Freight Demand Growth

Demand for freight transportation is driven in large part by the characteristics of the State's economy and therefore reflects the industries and businesses that make up its economy. These industries include:

- **Goods-Dependent industries**, or businesses that rely on the transportation system and logistics services to receive raw supplies and manufactured goods and to send their refined/finished product to market. This group includes industries such as natural resources and mining, retail and wholesale trade, construction, and transportation and warehousing.

- **Service industries** are not as dependent on freight movement, but do rely on shipments of materials, office products, or other small shipments of goods and supplies. This category includes industries such as government, education, health care, and other professional services. For these industries, freight can be thought of as a supply that facilitates business operations.

Sectors involved in making, moving, and selling goods (such as manufacturing and construction) have seen greater job losses while sectors with more intensive human capital requirements (such as professional and business services and healthcare/social assistance) have seen job increases. This highlights the much discussed skills gap: workers from production and retail jobs are being displaced while employers are

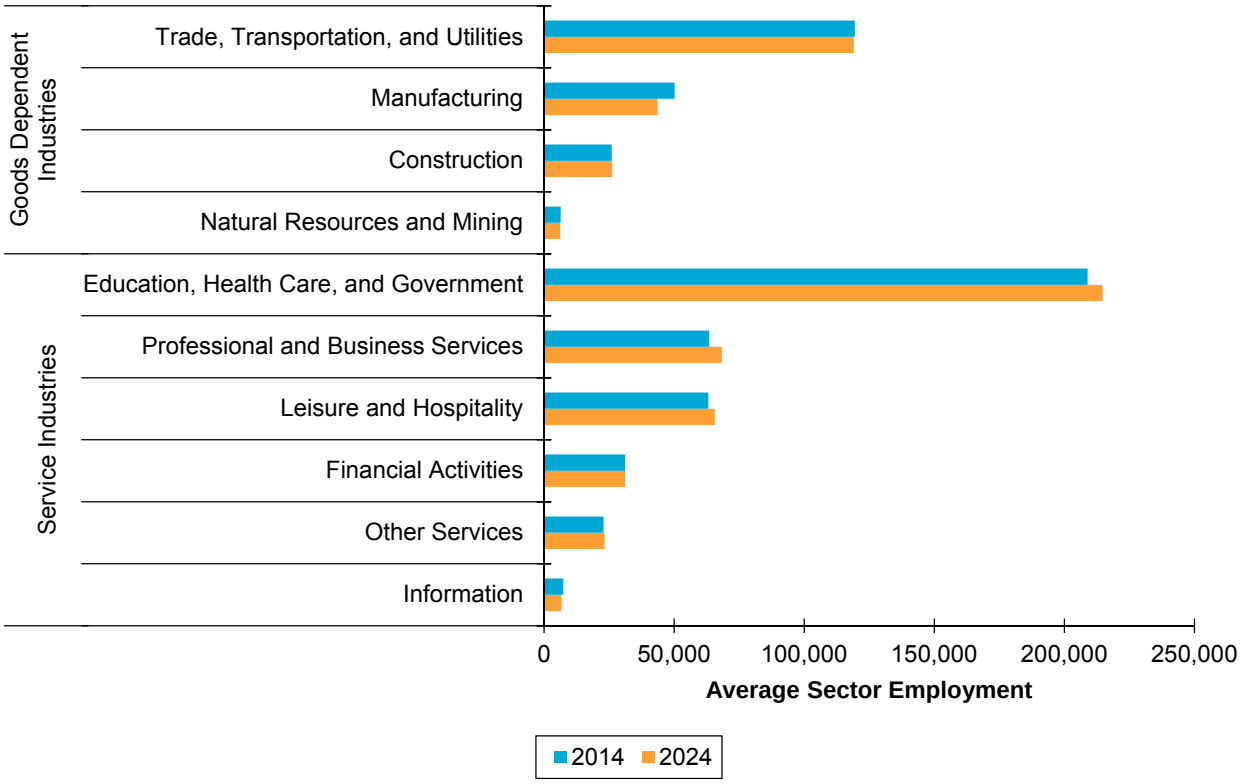
seeking workers with higher degrees of technical skills. Many of the jobs lost over the past five years required no postsecondary education, while most of the expected growth is among jobs that do require postsecondary education.

According to the *Maine Workforce Outlook: 2014 to 2024*, relatively low birth rates have made the median age in Maine higher than the U.S. as a whole. These low birth rates and the retirement of Baby Boomers are expected to cause a modest decline in state population and labor force between now and 2024. The aging of Maine's population is projected to drive a decline in education employment offset by an increase in health care employment.

As in many states, manufacturing is also projected to continue a long-term decline in employment. This is partly a result of the high pace of technological innovation and automation in the manufacturing sector. Technological advances continue to reduce the need for manual labor in many manufacturing processes while maintaining or increasing outputs; manufacturing continues to be an important contributor to the State's economy and depends on a reliable and efficient freight transportation network. This ongoing decline in manufacturing employment contributes to the long-term employment shift from goods-dependent industries to service industries in the State, and it is offset by projected growth in professional and business services and leisure and hospitality.

Overall, employment is projected to increase 1 percent from 2014 to 2024 (net of these sector-specific shifts). Figure 4.1 shows projected employment by sector in 2024 relative to 2014.

Figure 4.1 Maine Projected Changes in Employment by Sector
2014 and 2024



Source: Maine Workforce Outlook: 2014 to 2024; Consultant analysis.

Improved Port Operations

International and domestic trades have seen enormous growth in the use of standardized intermodal containers as a means of transporting products. Demand for containerized movement of cargo has exceeded the nation's freight transportation supply and stripped the network's capacity to provide adequate throughput, partly because the interdependencies inherent in today's networked freight transportation operations have stimulated greater demand for freight services as businesses have lowered their overall logistics costs and substituted cheap freight services to replace more expensive inventory holding options.

Maine has been working to position itself to benefit from that trend. Containerized trade through the Port of Portland, driven by Maine's Eimskip container service from Portland to Europe, has increased dramatically in recent years, jumping from 7,400 metric tons in 2011 to 105,523 metric tons in 2015. A 2016 FASTLANE grant was awarded for additional productivity and infrastructure improvements at the Port of Portland, enabling Maine companies to capitalize on the increased use of containers for international freight.[36]

Based on the Port Development Strategic Plan developed by the Maine Port Authority:

- Maine is well positioned to capture container cargo to Chicago, the Midwest and parts of Canada; there is a dearth of container handling facilities on the Northeastern coast of North America, particularly between Halifax and New York/New Jersey.
- Geographically, Maine ports are competitively positioned to handle cargo making landfall on the Eastern seaboard.
- Maine's inland transportation network serving major metro areas of the Mid West and Canada is a comparative advantage. It now allows Maine to reach destinations that were previously not economical with Eimskip's new rail connections in Portland.
- Maine's highways and rail networks are relatively less congested compared to those of other States on the East Coast. Cargo shipped through Maine is time competitive to Midwest destinations.
- Maine has deep-water natural ports that can be used economically and competitively – to serve the growing demand for facilities on the U.S. East coast.

As a result of improved port infrastructure at the International Marine Terminal, the Port of Portland is poised to benefit from a growing container operation with Eimskip, Inc. that will improve economic development and bring more jobs to Maine. The Port already has benefited from a freight rail connection to Pan Am Railways and a private sector partner in Americold who will construct a cold storage warehouse facility on Maine Port Authority property within the Port to store refrigerated goods, including fish products to support the Maine trade economy . These improvements provide opportunities for growth and expansion of international and domestic trade for Maine, such as increased maritime and rail transloading and additional exports of forest products by rail. MaineDOT and the Maine Port Authority are committed to keeping a portion of the Portland waterfront dedicated to industrial and port activities; however, continued growth depends on building the

[36] Fostering Advancements in Shipping and Transportation for the Long-Term Achievement of National Efficiencies (FASTLANE) Grants were part of the National Freight Highway Program funding strategy, discussed further in Section4.3. This Grant was replaced by the Infrastructure for Rebuilding America (INFRA) Grant in 2017.

customer base of the Port and successfully responding to local community concerns about Port operations and expansion.

Changes in the National Energy Sector

The domestic availability of shale oil and gas has changed the types and volumes of petroleum products and natural gas in Maine. More natural gas has resulted in more shipments of compressed natural gas and continued storage of liquid natural gas for peak energy needs. Pipeline reversals and low crude oil prices have resulted in fewer crude by rail movements and reduced crude oil pipeline shipments to Montreal. The Maine energy-transportation infrastructure has capacity to handle this changing market and will benefit from the trend toward cleaner burning fuels.

Shifts in the Forest Products Industry

As more Maine pulp and paper companies merge or close operations, there is an impact on many of the supporting freight and logistics operations in the State (see Figure 4.2 for the location of the forest product facilities in Maine). In addition to the economic impact, goods and services associated with manufacturing wood products also have been impacted. This may provide opportunities to redevelop these facilities for other industries that may require access to lumber and wood products or other raw materials. In addition, remaining companies may benefit from working together and with the public sector to achieve transportation efficiencies in the movement of raw materials for manufacturing and of finished products to market.

One example of public-private partnership is a new law that allows MaineDOT to allow overweight trucks on specified routes provided that the operation would be safe and that the applicant would pay at least 50 percent of the cost of required improvements or additional maintenance (based on an engineering analysis).[37] This change in law could reduce the cost of forest product shipments by not forcing forest products companies to break down or reduce the size of their loads for short hauls over public roads. . Another opportunity for partnership is standardization of bunk spacing on trucks for logs. Currently, there is some variation in the bunk spacing on log trucks allowed by the mills so shippers are required to reconfigure the bunks on their trucks between loads or mills. Standardizing bunk spacing could improve efficiency, though obtaining loads for return trips (backhauls) on trucks with log racks and other specialized configurations will continue to be a challenge.

MaineDOT is actively collaborating with forest products businesses and trade groups in the State to better understand and address the industry's transportation infrastructure and operational needs. The success of this collaboration depends on a level of trust and the willingness of the industry to share private data that could inform policy and investment priorities.

[37] Maine Revised Statutes, Title 29-A, Chapter 21, Subchapter 1, §2354-D. http://legislature.maine.gov/legis/statutes/29-A/title29-Asec2354-D.html

Figure 4.2 Wood Product Facilities in Maine

Source: MaineDOT.

National and Global Trends

The transportation industry faces numerous changes that have the potential to impact the movement of freight. These trends are happening at the national and international level, but will be felt in Maine as well:

Autonomous Vehicles (AV)

Technology innovations have the potential to optimize and improve the transportation network. These innovations include the freight portion of the broader trends in autonomous and connected vehicles. Researchers have predicted that when the majority of the fleet is both connected and automated, there will be significant decreases in crashes, resulting in significant increases in safety and reliability. It also will lead to significant decreases in nonrecurring congestion (i.e., incidents, work zones, weather, and special events), which accounts for about 50 percent of total congestion.[38] AVs have become a major focus in the technology and transportation industries, with well over 200 companies developing AVs or technology related to vehicle automation.[39] Forecasts vary for when these vehicles will first be available and how quickly adoption will take place. Whatever the timeline, it is clear that AVs will have a transformative impact on the transportation industry – including how freight is moved, the demand for goods and travel, and the land use and development patterns across the country. Commercial vehicles will likely be the earliest adopters of connected and automated vehicle technology given the intense pressures faced by the transportation industry. These include a shortage of commercial vehicle drivers that is likely to worsen over time, pressure from shippers to reduce costs and increase reliability, and increasing demand that is expected to continue well into the future as the tonnage of freight moved on the multimodal freight system steadily grows.

Drones and TNC

Alternate delivery systems such as unmanned aerial vehicles, or drones, and freight shuttles have the potential for overhauling “last mile” approaches, and pilot programs both in the U.S. and Europe are testing such deliveries. While the impacts of drones and regulations surrounding them still remain to be seen, it is worthwhile to keep track of how this could impact other freight industry modes. Another source of technology is the potential evolution of transportation network companies (TNC) to expand into freight delivery beyond some of the current last-mile systems such as meal delivery. A more expansive TNC approach could have implications for costs (and thus driver earnings and retention), congestion reduction, and modal shift.

E-Commerce

On-line retailers like Amazon have driven a major increase in package delivery directly to homes. Similarly, grocery delivery services have been developed in recent years, providing additional demands on the freight system to deliver to a geographically dispersed clientele. As same-day and next-day delivery has become the norm for e-commerce transactions, retailers have begun to reposition regional distribution centers and smaller distribution centers closer to urban areas – the centers of demand. Delivery on such a short timeframe is expensive, though it has become necessary, as customers have come to expect this level of service. Strategically placed fulfillment centers allow firms to deliver the level of shipping service that consumers demand while maintaining relatively affordable costs. The impact of the emergence of e-commerce and its supporting infrastructure on the Maine freight system is likely to be an increased importance on freight system reliability and more frequent truck trips in urban regions that utilize smaller vehicles and alternative delivery methods.

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[38] FHWA. Office of Operations. http://ops.fhwa.dot.gov/program_areas/reduce-non-cong.htm.

[39] https://www.wired.com/2017/05/mapped-top-263-companies-racing-toward-autonomous-cars/.

Motor Carrier Industry

Industry observers expect that the trucking industry will see further consolidation and restructuring even after the economic deregulation of the motor carrier industry in the 1980s. Small, independent trucking companies (approximately 80 percent of motor carrier firms own 5 to 10 trucks) will continue to exist; however, they will contract to large carriers or subscribe to dispatching or load matching services to ensure that capital is utilized effectively. Information-technology-intensive firms will generally prosper at the expense of less information-technology-intensive firms – a trend that will favor large firms. Structural shifts in the economy that generate more high-value, lower-weight, time-sensitive goods should mean that the overall demand for trucking will be high. Driver shortages will continue to be a recurring issue given the unregulated economic entry and boom-and-bust nature of the industry. Price competition with rail will squeeze some transcontinental truckload operations out of business, though the implementation and acceptance of AVs – which could reduce the need for additional drivers and reduce transit time for long trips – may impact this.

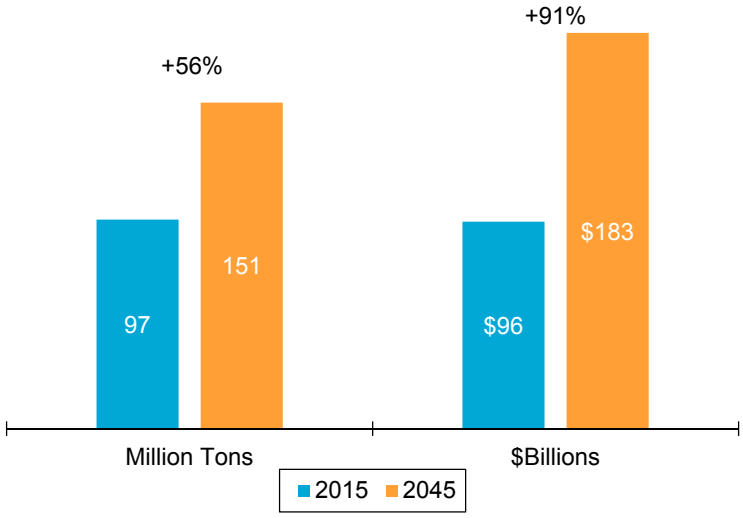
Shipping Industry

Ships continue to grow in size as shipping lines reduce the unit cost of moving containers and other commodities. The Panama Canal expansion, which was completed in 2016, doubled its capacity and allows for even larger ships to pass through. The eastern Maine coast has natural water depths that can accommodate these larger ships and Eastport in Maine has the capacity to serve the larger ships, however, the impacts to Maine will not be as significant as other ports in the Southeastern part of the nation. At some time in the future the Icelandic shipping company Eimskip, would like to use the new Northern Sea passage, which could allow for faster transshipments from Asia (China/Korea) to Portland, Maine via a route through the Arctic.

4.1.2 Future Activity and Demand

The FHWA Freight Analysis Framework (FAF) data used to summarize freight activity throughout the State in Section 2.2 also includes a forecast of commodity flows in 2045. This forecast highlights important trends that will shape the State's economy and transportation infrastructure needs over the next 30 years. As shown in Figure 4.3, overall freight flows on Maine's transportation network are expected to grow 56 percent by weight and 91 percent by value over the next three decades.

Figure 4.3 Maine Projected Increase in Total Freight Flows
2015 and 2045

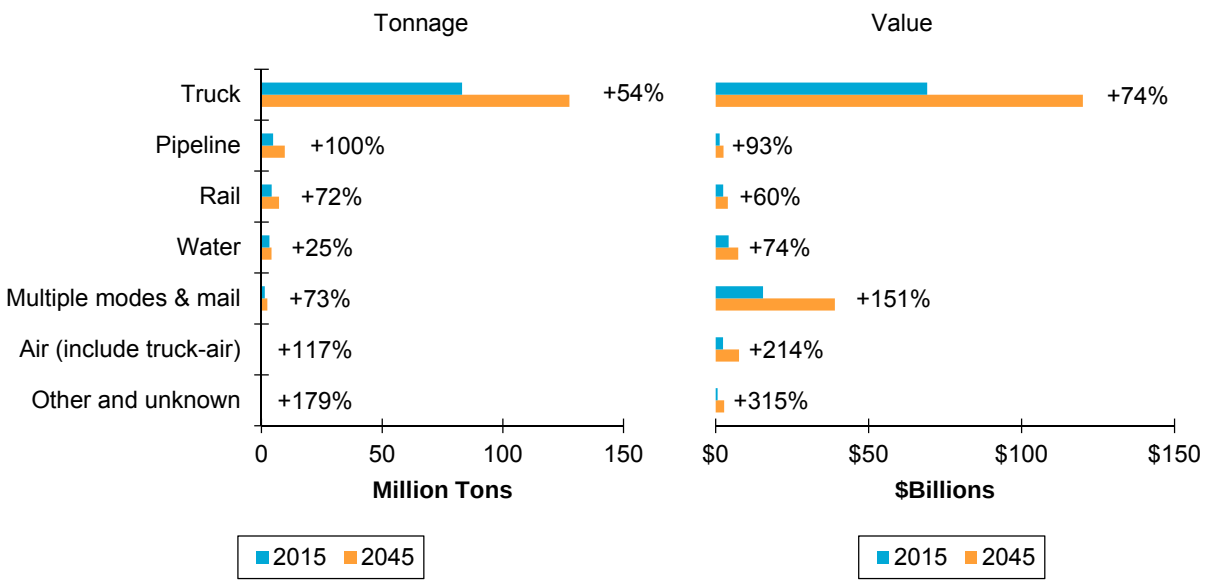


Source: FHWA Freight Analysis Framework Version 4.3; Consultant analysis.

Figure 4.4 shows the projected changes in freight flows by mode. All modes are projected to see substantial growth in freight activity. While pipeline, air, and multiple modes and mail are forecast to have the highest growth rates, overall mode shares are not expected to change significantly; trucks will continue to be the dominant mode of freight transport in the State.

Figure 4.4 Maine Projected Change in Freight Flows

By Mode 2015 and 2045

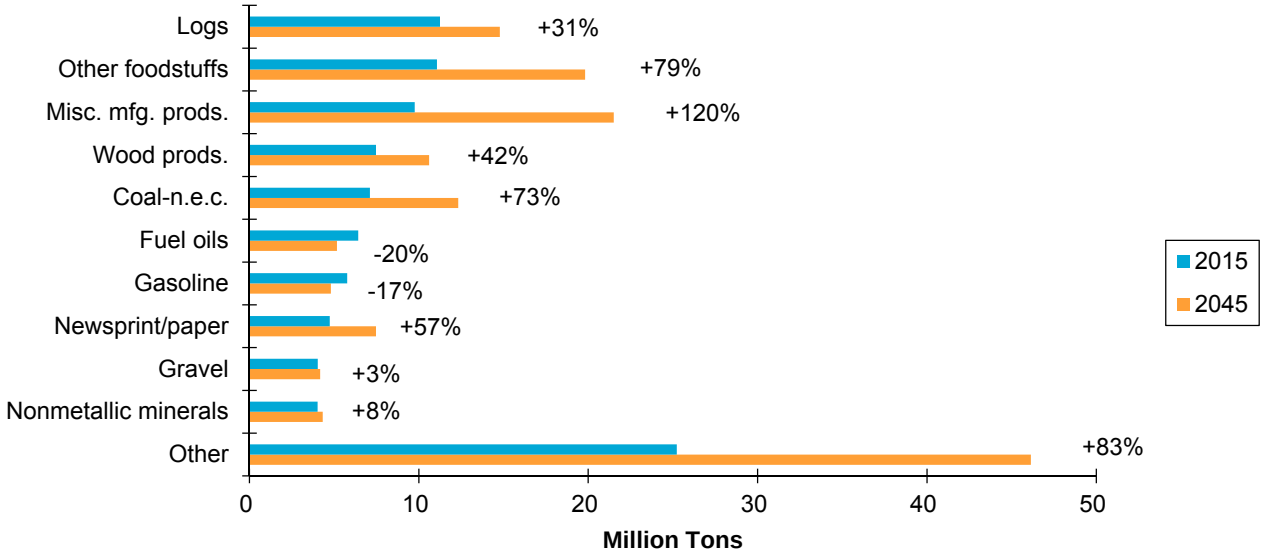


Source: FHWA Freight Analysis Framework Version 4.3; Consultant analysis.

The mix of commodities is expected to change somewhat over the same time period. Figure 4.5 shows that the top five commodities by tonnage are all projected to grow over the next three decades; however, other prepared foodstuffs, fats and oils; miscellaneous manufactured products; and other coal and petroleum products not elsewhere classified (including gaseous hydrocarbons such as liquefied natural gas, liquefied propane, liquefied butane, petroleum coke, petroleum asphalt, among others), are expected to grow much faster than logs and wood products. The newsprint/paper commodity category, is also forecasted to grow consistently with national trends, and includes pulp, paperboard, and paper products like toilet paper and paper towels in addition to paper for writing and printing. Of the top commodities by value (shown in Figure 4.6), transportation equipment, machinery, and electronics have the highest growth rates and are expected to more than double in freight value by 2045.

Figure 4.5 Maine Projected Change in Freight Tonnage

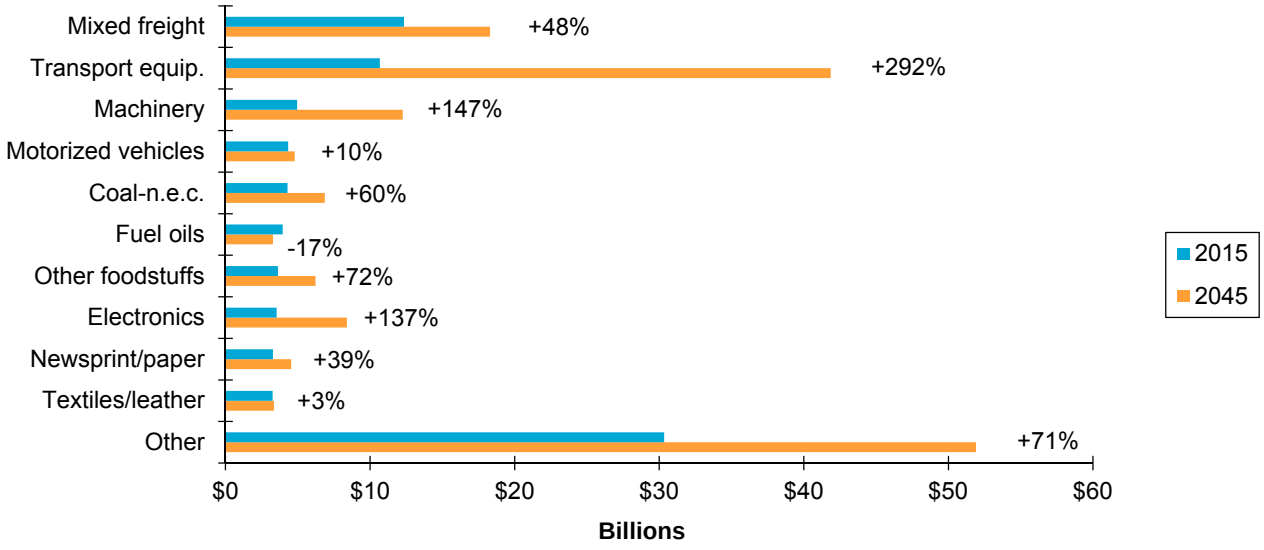
By Commodity 2015 and 2045



Source: FHWA Freight Analysis Framework Version 4.3; Consultant analysis.

Figure 4.6 Maine Projected Change in Freight Value

By Commodity 2015 and 2045



Source: FHWA Freight Analysis Framework Version 4.3; Consultant analysis.

4.2 Freight System Challenges

There are a number of factors that drive freight movement and will shape the changes in freight volumes over time, as described in the previous sections. Issues and needs of the freight system that are most critical for Maine's freight system users are described below.

4.2.1 Increasing Reliance on Trucks

In Maine, 86 percent of total freight shipment tonnage is truck based. This modal dominance impacts the State and its residents through increased costs for highway construction and maintenance; higher costs to transport some goods; reduced market opportunities for Maine-based companies; and increased use of fossil fuels and resultant air quality issues. Some public officials and the general public have urged that more heavy freight be handled by the more efficient rail and water transportation modes, when these modes are reliable and make economic sense for shippers.[40] This is a challenge because trucking dominates freight haulage in the northeast U.S. region, and Maine's robust highway capacity and lack of any serious congestion allows trucking to overcome the natural price advantage of rail by providing a higher level of service that is both cost competitive and predictable.

4.2.2 Rail System Investment and Modal Diversion Needs

The 2014 Maine Rail Plan identified a need for rail system investment and support for modal diversion as a critical need of the State's rail system. Lack of investment in the rail system degrades Maine's business climate and results in increased truck traffic, pavement consumption, and stress on Maine's highway system as shippers opt for truck service over rail. The primary customer base for the railroad network in the State is directly related to the forest products and pulp and paper industries. Paper-related commodities account for approximately 71 percent of terminating rail freight.[41] This dominance and the lack of other traffic has had a negative impact on business conditions for the railroads as these industries' markets and materials sourcing have undergone significant changes, especially during the most recent national economic downturn. In Maine the reduced level of rail freight traffic has resulted in lower levels of investment in the rail network, leading to decreased levels of service and reliability. Concurrently there is a groundswell of public interest to make better use of the railroad network.

MaineDOT believes in investing in transportation options that lower business shipping costs and must be business driven. Investment in railroad infrastructure improves efficiency and reliability. Most of this investment is typically financed by private railroad companies with revenue generated from freight operations. MaineDOT has been proactive in efforts to encourage the use of rail for goods movement through the IRAP and FRIP funding program for projects that help lower transportation costs to Maine business.[42] These programs have been effective in encouraging public-private partnerships that engage both shippers and the railroads in project planning, funding decisions, and cost sharing. It must be clearly recognized, however, that freight movement decisions are often far removed from Maine and are driven by cost, schedule and supply chain management principles and in reaction to market forces.

[40] 2014 Maine State Rail Plan.

[41] Ibid.

[42] IRAP is the Industrial Rail Access Program; FRIP is the Freight Rail Investment Program, both operated by MaineDOT with state funding, and require private party cost sharing of at least 50 percent of project cost.

Specific rail infrastructure and operational needs identified in the 2014 Maine State Rail Plan are as follows:

- Some rail customers report that multicarrier routing in and out of Maine negatively impacts costs and transit time, resulting in diversion of traffic to motor carriers.
- Significant segments of the rail lines in Maine are not able to handle the emerging interline standard rail car of 286,000 lbs.
- The two rail routes that are double-stack capable do not directly link Maine to the continental U.S. rail system, but rather connect to Canadian provinces.
- Although compliant with established Federal Railroad Administration (FRA) track classifications, many segments of the railroad network have old, outdated rail and ties, and bridges and other structures that are in need of investment to bring the rail lines to a state of good repair (SOGR) that would enable improved transit time and a normalized, more cost-effective maintenance program. Many parts of the network suffer from deferred maintenance practices that result from lack of resources.

4.2.3 Trade Imbalance

Maine exports more than it imports to its trading partners. As a result, Maine-based carriers have a difficult time obtaining Maine-bound shipments for their return trips, resulting in many “deadhead” miles being traveled on Maine’s transportation network, increasing transportation costs for shippers, carriers, and consumers, and reducing overall efficiency. However, coordination between shippers and carriers and advances in technology, may provide new tools for use by Maine businesses in managing their transportation and distribution functions while making these functions more efficient.

4.2.4 Searsport Channel Dredging Needs

The channel for Searsport has not been dredged since the 1960s. It now has several shallow spots at 32 feet depth and a tight turning radius. Some larger vessels that call the port can only arrive at high tide, and tidal arrivals and departures create delays. A maintenance dredging project to restore the depth to 35 feet is in the permitting stage with a plan of completion by 2019 or early 2020. An improvement dredge project deepening the channel to 40 feet is also being planned by the State to be completed as a separate project following the completion of the maintenance dredge. Discharging the dredge spoils is a major challenge, especially for deepening the channel. Upland disposal sites significantly increase the cost of dredging projects while cheaper ocean disposal (such as pock marks (craters) in Penobscot Bay) face opposition from fishermen and environmental groups in the area. However, the State is committed to growth at Searsport and will continue to move the dredge projects forward.

4.2.5 Border Crossing Delays

Canada is a very valuable trade partner for Maine. Maine imports a significantly higher volume of freight from Canada (9.4 million tons in 2015) than it exports to Canada (3.3 million tons in 2015). Customs and border crossing delays have been cited by stakeholders as having a major impact on their ability to efficiently export goods to Canada. One source of these delays is staffing issues, particularly for rail border crossings; trains are sometimes required to wait at the border while staff are diverted from nearby highway crossings. Additionally, the amount of paperwork and the tariffs and fees required by customs can contribute to shipment delays and higher transportation costs.

Freight movements into, out of, and through the State can be affected by the policies, procedures, and practices of other agencies and stakeholders, such as customs and law enforcement, shippers, or logistics providers, well outside the State. International and domestic freight shipments often involve more than one mode, travel through several jurisdictions in the region, and serve national and international markets. However, operations, management, and investment decisions affecting this system are often made at the State and local levels (for highways and intermodal connectors), at the facility level (for ports and airports), or at the national corridor level (for railroads).

4.2.6 Funding Needs

A shortfall of funding resources to make system improvements continues to be a challenge. MaineDOT already commits a large portion of its budget to the maintenance and preservation of the transportation system, including freight infrastructure projects. A continued effort to compete for Federal discretionary grants is warranted, and advances in public-private investments are needed to help bridge the funding gaps. Maine also has made major advances in public-private investments and should continue to do so to help bridge the funding gaps in the transportation improvements that are most needed. One example of a public-private partnership is a new law that allows MaineDOT to issue permits to overweight trucks on specified routes provided that the operation would be safe and that the applicant would pay at least 50 percent of the cost of required improvements or additional maintenance (based on an engineering analysis); this could potentially reduce shipping costs in certain industries like forest products while providing private funds for infrastructure maintenance and improvement.[43] A more detailed discussion of funding issues and opportunities will be discussed in the following section.

4.3 Freight System Funding

Obtaining dedicated funding for freight projects has long been an issue. The cost to upkeep and expand the freight system in Maine (and across the country) frequently outstrips available funds. However, the passage of the FAST Act provided a dedicated source of freight funding. Federal and state sources of money, and ongoing challenges, are discussed in this section.

4.3.1 Federal Funding

National Highway Freight Program Formula Funds

The primary source of funding for freight projects is the National Highway Freight Program (NHFP), established as part of the FAST ACT, which identified formula funds for investments on the National Highway Freight Network with up to 10 percent available for intermodal projects.[44] The Maine share of these freight program dollars is presented in Table 4.1. Maine's apportionment of the NHFP funds for the period spanning 2016 to 2020 is $29.4 million, or an average of about $5.8 million per year. Appendix D provides Maine's fiscally constrained Freight Investment Plan (FIP) that lists the priority projects where the National Highway Freight Program (NHFP) funds will be invested.

[43] Maine Revised Statutes, Title 29-A, Chapter 21, Subchapter 1, §2354-D. http://legislature.maine.gov/legis/statutes/29-A/title29-Asec2354-D.html.

[44] Federal Highway Administration, Freight-FAST-Act Factsheet, Retrieved June 2017 from https://cms.dot.gov/sites/dot.gov/files/docs/Freight-FAST-Act-Factsheet.docx.

Table 4.1 National Highway Freight Program Funding for Maine

Fiscal Year	Total NHFP Apportionment
2016	5,366,346
2017	5,133,026
2018	5,599,666
2019	6,299,623
2020	6,999,582
2016-2020 Total	**29,398,243**

Source: FHWA Estimated Highway Apportionments under the FAST Act, https://www.fhwa.dot.gov/fastact/funding.cfm.

INFRA/FASTLANE and TIGER Grants

In addition to apportioned funds, the FAST Act created a new $4.5 billion discretionary freight-focused grant program that allows states, MPOs, local governments, tribal governments, special-purpose districts and public authorities (including port authorities) and other parties to apply for funding to complete projects that improve safety and hold the greatest promise to eliminate freight bottlenecks and improve critical freight movements for a five-year period.[45] Formerly called Fostering Advancement in shipping and Transportation for the Long-Term Achievement of National Efficiencies (FASTLANE) grants, the freight grant program was recently revised and now is referred to as the Infrastructure for Rebuilding America (INFRA) grants. States can leverage their own dedicated transportation funding with these Federal sources, as well as with other local, regional, and private-sector funding.[46] In addition to INFRA, U.S. DOT's Transportation Investment Generating Economic Recovery (TIGER) program continues to fund competitive grants totaling $5.1 billion since 2009.[47]

Maine has pursued these Federal funds to great success in recent years:

- 2017 FASTLANE Grant worth $7.89 million to improve rail capacity on the Maine Northern Railway. This project will repair and upgrade 22 rail bridges to allow a 151-mile section of track to carry 286,000-pound rail cars.[48]

- 2016 FASTLANE Grant worth $7.7 million towards the Maine Intermodal Port Productivity Project at Portland's International Marine Terminal. This is part of a $15.4 million effort involving funds from the state and private sector to add rail capacity, improve gate operations, purchase a new crane, and move the current maintenance facilities to expand space at the pier.[49]

[45] Ibid.

[46] Federal Highway Administration, Surface Transportation Block Grant Program Fact Sheet. Retrieved July 2017 from https://www.fhwa.dot.gov/fastact/factsheets/stbgfs.pdf.

[47] https://www.transportation.gov/tiger/about.

[48] https://www.collins.senate.gov/newsroom/senator-collins-announces-789-million-grant-project-improve-rail-capacity-northeastern.

[49] http://www.equipmentworld.com/maine-dot-awarded-7-7-million-in-fastlane-grants-for-terminal/.

- 2015 TIGER Grant worth $20 million awarded to the Maine Regional Railways Project. Led by MaineDOT and backed by multiple private railways, this grant will go towards rehabilitating 384 miles of track. Rail lines and yards will be redesigned and improved to increase allowable speeds and allow for increased economic competitiveness.[50]

- 2014 TIGER Grant worth $25 million to help replace the Sarah Mildred Long Bridge, also known as SML or the "Long Bridge." This critical piece of infrastructure provides a highway and rail crossing over the Piscataqua River connecting the towns of Kittery, Maine and Portsmouth, New Hampshire. The SML Bridge and nearby I-95 Bridge are estimated to provide a combined $8.4 billion to Maine's economy each year, and they provide access for 62 percent of all trucks crossing Maine borders.[51] The proposed replacement will feature an integrated rail-highway deck for a lift span structure and a wider navigation opening. The lift span will allow taller ships to navigate the Piscataqua River and will lower for rail crossings; this innovative feature along with an increased deck elevation will reduce the number of bridge openings by 64 percent, reducing vehicular traffic and navigational delay costs. The bridge is scheduled to open in the fall of 2017.[52]

Other major freight projects for which MaineDOT is pursuing federal funding in 2018, include:

- 2018 TIGER Grant application for Penquis Region Rural Bridges Project worth $21,772,440 (50/50 Federal and State match) to replace three key highway bridges in rural Maine that require near term replacement. These are critical to supply chains for business in the region and Maine's forest economy in Piscataquis and Penobscot Counties.

- 2018 INFRA Grant application for I-395 / Rt. 9 Connector, worth $79,250,000 (INFRA request $33,825,000), to build a new 6.1 mile limited access connector from I-395 in Brewer, ME to Rt. 9 in Eddington, ME, on the NHS and CUFC/CRFC network.

Section 130 Highway/Rail Crossing Improvement Program

The FAST Act provides approximately $1.3 million annually for safety improvements at Maine's rail/highway crossings. Traditionally these funds have been used for improvements to signals and roadway surfaces. Eighty percent of the available annual Section 130 funding targets major rail crossing improvements using criteria developed by MaineDOT and local municipal officials. MaineDOT directs the remaining 20 percent of the annual funding on low-cost updates to warning systems in key highway corridors throughout the State.

MaineDOT is working to improve communication and coordination with the State's four railroads as it undertakes this program. Besides the normal signal and surface improvements traditionally associated with the program, MaineDOT will look to customize the program to provide flexible funding in areas such as crossbuck replacement, LED light replacement, and pavement markings that will provide enhanced safety benefits at a reasonable cost.

[50] U.S. DOT, TIGER 2015 Awards.

[51] Sarah Mildred Long Bridge Replacement Grant Application, 2014.

[52] Maine DOT Delivers. 2016 Year-End Report, 2017.

Intelligent Transportation Systems and Commercial Vehicle Enforcement

The FAST Act provides $60 million per year for an Advanced Transportation and Congestion Management Technologies Deployment Program. This competitive grant program will focus on the development of pilot projects and model deployment sites for the installation and operation of advanced transportation technology. This program could be used to fund projects such as real-time truck parking information systems or innovative truck enforcement technology that would benefit both freight mobility and help protect the State's infrastructure.

Another commercial vehicle enforcement program that Maine receives funding from is the Innovative Technology Deployment (ITD) Program, formerly known as the Commercial Vehicle Information Systems and Networks (CVISN) Program. ITD is a nationwide program managed by the Federal Motor Carrier Safety Administration (FMCSA) designed to improve commercial vehicle safety. It is an information sharing initiative involving a partnership of government agencies, motor carriers, and other stakeholders and third parties.

The Performance and Registration Information Systems Management (PRISM) is a related program that explores the potential benefits of using state commercial vehicle registration sanctions as an incentive to improve motor carrier safety. PRISM allows enforcement personnel to access Federal safety ratings information for all participating states. These programs seek to establish information systems architecture for commercial vehicle operations which will: streamline credentials administration; focus safety enforcement on high-risk carriers; reduce motor carrier congestion costs through automated commercial vehicle operations; and enhance intrastate and interstate information exchange.

Maine is actively involved in these programs and has utilized Federal funding to implement various required components, including:

- A state-specific data exchange system Commercial Vehicle Information Exchange Window (CVIEW) that facilitates exchange of inter and intrastate motor carrier and commercial vehicle information within the State and with national infrastructure;
- Automated application and processing of International Registration Plan (IRP) and International Fuel Tax Agreement (IFTA) credentials; and
- Installing transponder-based e-screening at the Kittery and York weigh stations to allow enforcement personnel to more efficiently select vehicles for weighings or safety inspections

In 2012, Maine was deemed Core ITD Compliant by the FMCSA and is actively involved in the program as an Expanded ITD participant. Current efforts include implementing a new oversize/overweight permitting and routing system that will be linked with other ITD programs to ensure that carriers applying for permits are operating legally and can be routed in the most efficient way possible.[53]

Other Federal Funding

Freight movements also can be enhanced by projects funded through other sources in the FAST Act, many of which are a continuation of MAP-21 programs. Projects that are not explicitly freight related could be considered for funding through these "general" highway programs. For example, safety improvements that

[53] March 2017 ITD Program Project Manager Conference Call.

benefit both trucks and passenger vehicles (such as a truck climbing lane) or projects that reduce heavy truck delay and thus limit idling and decrease greenhouse gas emissions could obtain funds from nonfreight sources, including: National Highway Performance Program (NHPP),[54] Congestion Mitigation and Air Quality (CMAQ) Program,[55] Highway Safety Improvement Program (HSIP),[56] and the Surface Transportation Program (STP) which has been modified to become the Surface Transportation Block Grant Program (STBGP).[57]

Finally, there are a number of potential funding sources for nonhighway freight projects that are administered by other Federal agencies, including:

- U.S. Army Corps of Engineers Harbor Maintenance Trust Fund;
- U.S. Federal Rail Administration Railroad Rehabilitation and Improvement Financing;
- U.S. Department of Housing and Urban Development Community Development Block Grants;
- U.S. Department of Commerce Economic Development Administration Grants;
- U.S. Environmental Protection Agency Brownfield Assessment Grants, Brownfield Revolving Loan Fund Grants, and Brownfield Cleanup Grants;
- U.S. Environmental Protection Agency Clean Diesel Program;
- U.S. Internal Revenue Service Qualified Railroad Track Maintenance Credit;
- U.S. Department of Agriculture Rural Development Community Facilities Grants and Direct and Guaranteed Loans;
- U.S. Maritime Administration Small Shipyard Grants;
- U.S. Fish and Wildlife Boating Infrastructure Grants; and
- U.S. Federal Aviation Administration Airport Improvement Program.

Maine has used many of these sources to help fund projects. For example, in 2017, MaineDOT planned work on 19 port and marine projects totaling $32.5 million. In addition to FASTLANE funding at Portland's

54 The FAST Act adds two permissible uses for NHPP funds beyond those specified in MAP-21 including the ability to pay subsidy and administrative costs for Transportation Infrastructure Finance and Innovation Act (TIFIA) projects and for improvements to bridges that are not on the National Highway System.

55 CMAQ funds can now be used to maintain air quality standards in an attainment area (not just for attainment of standards in the first place).

56 States do not have the ability to shift funds designated for infrastructure safety programs to behavioral/educational activities. This ensures that resources remain in construction-related programs. HSIP also designates several new safety improvements eligible for funding including vehicle-to-infrastructure communication, roadway improvements that provide separation between pedestrians and motor vehicles.

57 The FAST Act simplified the list of uses eligible for program funds and increases the way that STP funds can be used on local roads and rural minor collectors. STBGP receives the same percentage of formula funds that the STP program did under MAP-21.

IMT, planned maritime investments include $3 million for dredging a commercial shipping channel at the Port of Searsport and $3.8 million for Boating Infrastructure (BIG) from U.S. Department of Fish and Wildlife and Small Harbor Improvement Programs (SHIP). Maine also is eligible for Federal assistance for maritime investment as part of the "M-95" Marine Highway Corridor and has worked with the U.S. Maritime Administration to plan potential barge service from the Port of Portland to the Port of New York/New Jersey.[58]

Maine's airports received more than $26 million in FY 2016 in formula and discretionary funds through the Federal Aviation Administration (FAA) Airport Improvement Program (AIP). Northern Maine Regional Airport received the largest discretionary grant ($3.94 million) to rehabilitate a taxiway. In total, Maine's four freight airports received nearly $13 million in AIP funding for FY 2016. The majority of the work is directed towards projects that will improve air service for both passenger and freight operations; approximately $3.4 million will improve terminal buildings at Bangor International.[59] State and local matching funds provide additional money for these projects.

4.3.2 State Funding

In addition to Federal sources, Maine has a number of state funds that direct money towards freight-related projects.

Small Harbor Improvement Program (SHIP)

The goals of the SHIP program are to:

- Promote public access, economic development, and a commitment to preserving infrastructure along the coast.
- Help municipalities make improvements to public wharves, landings, and boat ramps.
- Protect a dwindling asset through a successful state/local partnership.
- Preserve natural resource-based industries.

In 1995 the MaineDOT received their first block of funding for the SHIP. Since 1995, several rounds of grants have dispersed millions of dollars to several coastal municipalities for various projects. Examples of successful initiatives under this program include a pier reconstruction, float installations, boat ramp rehabilitation, new hoist installation, and gangway replacement. In 2014, MaineDOT awarded more than $2.75 million to 19 projects, matched with another $1.5 million in local funds.

SHIP supports the approximately 18,000 licensed commercial fishermen and related industries along the Maine coast that increasingly rely on these public facilities for access to resources. Without this program, municipalities would likely forsake such important projects or be forced to carry out the project with only local resources. Subsequently, the program enjoys widespread support from coastal municipalities and statewide commercial fishing and marine interests.

[58] Maine Port Authority, http://www.maineports.com/new-england-marine-highway-project

[59] Federal Aviation Administration. FY 2016 AIP Summary (All Grants). https://www.faa.gov/airports/aip/grant_histories/#history Accessed September 13, 2017.

Industrial Rail Access Program (IRAP)

The Industrial Rail Access Program (IRAP) is MaineDOT program to encourage economic development and employment through the increased use of rail transportation. IRAP provides 50/50 matching funds to private businesses that are looking to upgrade sidings, switches and other rail infrastructure in order to provide new or more efficient connections between businesses and the general rail network. Increased funding will help protect the public interest in rail operations in the State and will assist with meeting the backlog of interest in IRAP projects. This will create new traffic and job opportunities, allow businesses to be more competitive, reduce greenhouse gases and maintain state-owned track and connections to national Class I carriers. MaineDOT programmed $1.25 million in funding for IRAP – applications were due in February 2017.[60] The 2017 to 2019 *Work Plan* includes $3.75 million in funding for IRAP over the three year span.

Critical Rail Corridors Program

MaineDOT also has adopted a corridor approach to transportation planning and defined the Critical Rail Corridors Program. The 2014 State Rail Plan served to identify six "Critical Rail Corridors" in the statewide freight rail system (shown in Figure 3.10). These corridors were identified based on current and projected demand for goods movement and personal mobility. This Critical Rail Corridors approach considers the transportation system as a whole, in which the whole is greater than the sum of its parts. Although this is a "rail" program, it is focused on the need to examine and consider all transportation assets within a corridor, not just railway assets. Proposed investments should enhance the capacity of the overall network, and in the case of goods movement, allow the market to operate on a level playing field for all modes.

Corridor programs and projects are evaluated using the following criteria:

- Safety
- Multimodal
- Economic Development
- Sustainability
- Public-Private Partnerships

The Critical Rail Corridors Program is modeled after the successful Industrial Rail Access Program (IRAP) and is intended to encourage public-private partnerships. The State's 2010 to 2011 Capital Work Plan originally anticipated $16 million in funding for this program. The funding request was reduced significantly, and a $2 million bond for this program (leveraging an additional $2 million in private funds) was approved in the fall of 2009. The most recent 2017 to 2019 Work Plan does not include any allocation of funds for this program.

Freight Rail Interchange Program (FRIP)

The FRIP program provides 50 percent matching funds on capital investment projects for improvements to railroad interchanges/junctions. The goal of such projects is to improve the flow of goods in and out of the State as well as between the rail providers. This program provided $1.8 million in state matching funds for

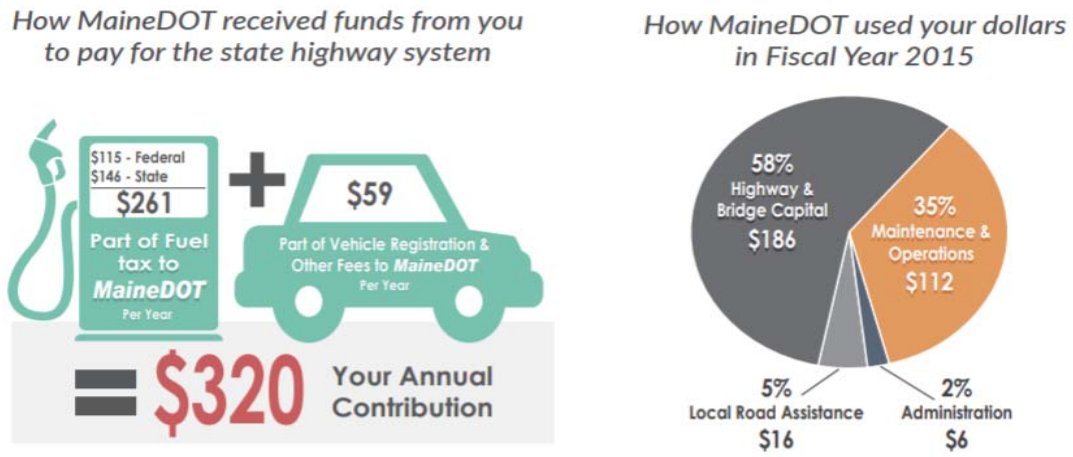
[60] http://maine.gov/mdot/ofbs/irap/.

the Danville Junction project, a safety and operations improvement project with the two operating railroads providing the balance of the funding. This railroad interchange of St. Lawrence and Atlantic Railroad and Pan Am Railways is located south of the Auburn intermodal facility in Danville, Maine. The project reduced freight transit time by as much as 36 hours, enhancing the capability of the railway network to meet customer requirements for more timely service.

General Funds and Bonds

Freight needs (especially highway related) can often be addressed through nonfreight spending. For example, road maintenance and repair that is paid for through general highway funds also has a positive impact on freight movement in the State. Funds used on maintenance and operations – including snow plowing – reduce delays and improve safety for all road users. Figure 4.7 provides an overview of money received through Maine's gasoline tax and how those funds were used in 2015.

Figure 4.7 Maine Fuel Tax – Funds and Spending



Source: MaineDOT Delivers. 2016 Year-End Report.

In addition, Maine voters passed Maine Question 6 in November 2016 which allowed Maine to $100 million in bonds, with $80 million targeted to highway and bridge construction and maintenance, and $20 million for facilities and equipment related to "ports, harbors, marine transportation, aviation, freight and passenger railroads, and bicycle and pedestrian trails that preserve public safety or otherwise have demonstrated high transportation economic value."[61] A similar bond, Maine Question 3, worth $105 million is on the ballot for November 7, 2017.[62]

A second bond issue, Maine Question 1, was approved in June 2017 and could impact freight movement in the State. The Technology Sectors Funds and Businesses Loans Bond Issue provides $50 million in bonds for infrastructure and equipment upgrades in targeted technology sectors with potential for growth and job creation. Freight-intensive industries, including composites and advanced materials, forest products and agriculture, and precision manufacturing are among the targeted technology sectors.[63]

[61] https://ballotpedia.org/Maine_Transportation_Bond,_Question_6_(2016).

[62] https://ballotpedia.org/Maine_Question_3,_Transportation_Bond_Issue_(2017).

[63] https://ballotpedia.org/Maine_Question_1,_Technology_Sectors_Funds_and_Bhttp://legislature.maine.gov/statutes/23/title23sec1612.htmlusiness_Loans_Bond_Issue_(June_2017).

5.0 Solutions and Recommendations

Some key conclusions can be drawn from the analyses performed as part of this Integrated Freight Strategy. Maine's highways are the backbone of its freight system as the majority of goods are moved within and throughout the State over the road. In particular, many of the State's freight-intensive industries are located near the I-95 corridor. However, the maritime and freight rail infrastructure represent underutilized assets that could work to Maine's competitive advantage.

Overall, Maine's highway freight system currently performs well and is projected to continue providing a high level of service to motor carriers in the future. However, there is room for critical improvement on some key corridors to improve and maintain a high level of service. The State's highway freight performance challenges are concentrated on I-95 in Maine's major cities, namely Portland and Bangor. Though unrelated to highway capacity or other operational/design features, highway performance at Maine's border crossings also suffers due to U.S. Customs and Border Patrol delays sometimes related to understaffing.

Though Maine's long-term employment trend has seen a shift away from freight-intensive, goods-dependent industries, freight activity on the Maine freight system is still predicted to increase. Certain industries (such as manufacturing, construction, natural resources, and mining) use and rely on freight transportation more than others. Also, though not production oriented, certain service sectors (such as retail and wholesale trade or transportation and warehousing), are still highly dependent on the movement of physical goods. Together, these findings indicate that existing challenges will only worsen over time if there is no intervention.

The Maine transportation system will require substantial investment to maintain existing infrastructure and fund additional capacity. In turn, transportation investments will foster continued growth among the State's economy by improving industry competitiveness and productivity, creating jobs, and reducing economic losses due to time delays and excess fuel consumption. It is important to recognizing the link between the efficiency of the statewide freight transportation system and the continued economic competitiveness of the State.

Based on these conclusions, the Integrated Freight Strategy suggests solutions and recommendations that could be implemented to improve Maine's freight system. Many of the solutions and recommendations identified in the 2014 Integrated Freight Strategy are still relevant, despite changes within and outside the State. Therefore, the Plan identifies those that are still pertinent from the 2014 Integrated Freight Strategy while proposing new solutions and recommendations based on the knowledge gained in the current Plan. The recommendations are grouped into two categories:

- **Infrastructure and Operational Improvements –** freight improvement projects that will expand or physically enhance the State's transportation infrastructure and operations.

- **Policy Strategies –** strategies that seek to optimize governmental regulations or incentives to better manage freight traffic on the existing transportation network.

Additionally, Appendix D provides a short-term fiscally constrained Freight Investment Plan (FIP) that lists the priority projects where the National Highway Freight Program (NHFP) funds will be invested. Eligible projects must contribute to the efficient movement of freight on the National Highway Freight Network (NHFN).

5.1 Infrastructure/Operational Recommendations

5.1.1 Highways

Improve Road Conditions and Protect Highway Investments

Even though the State's economy has experienced a long-term trend of declining employment in freight-intensive industries, truck volumes continue to grow throughout Maine. Since trucks continue to be the dominant freight mode for the foreseeable future, efforts should be made to reduce congestion along key freight corridors, improve travel time reliability, and improve roadway conditions. The recommendations from the 2014 Integrated Freight Strategy are still relevant.

- **Identify quick fix projects.** Maine DOT should continue to work with the private sector to identify small, easily implementable projects that can be accomplished quickly and with little funding.

- **Develop a robust Innovative Technology Deployment (ITD) program (formerly CVISN) for State Police Commercial Vehicle enforcement efforts.** Supporting targeted commercial vehicle enforcement through technology solutions remove unsafe/damaging trucks and carriers off the roads remains a priority. Progress has been made with current efforts, including the implementation of a new oversize/overweight permitting and routing system that will be linked with other ITD programs. This will ensure that carriers applying for permits are operating legally and can be routed in the most efficient way possible. These efforts should be continued as well as the enhancement of weigh stations and implementation of virtual weight stations in areas of need to focus enforcement efforts on noncompliant carriers. The State Truck Size and Weight Enforcement Plan[64] details the plan of operation for technology used for truck size and weight enforcement such as weigh-in-motion (WIM) scales, portable and fixed scales, and electronic screening technology.

In addition to those recommendations the 2017 Integrated Freight Strategy update also makes recommendations specific to major truck routes. Heavy trucks exert a high cost on roadways in the form of increased damage to pavements, sidewalks, and curbs and gutters. Unreliability on major truck routes is a direct cost to motor carriers in the form of additional time that must be factored into driver schedules in order to account for inconsistent travel times. This study identified a number of major truck routes based on daily truck volumes, including I-95, I-295, ME-4, U.S. 202, ME-3, and U.S. 1, among others. Based on these observations, the following recommendations are included:

- **Maintain a state of good repair on major truck routes.** Trucks place a greater amount of stress on roadways than passenger vehicles resulting in damage to pavements, sidewalks, and gutters. Thus, it is important to preserve the physical condition of major freight routes. Routes that carry significant truck volumes should be maintained at greater frequencies in order to account for this. Also, lower volume routes that are last-mile freight connectors to Maine's seaports, rail terminals, airports and intermodal terminals should be high-priority roadways for maintenance.

- **Reduce congestion and improve travel time reliability on major truck routes.** Maine's interstate highway system is the core of the State's freight system as it transports the highest share of total tonnage. Overall, it provides for a high level of service. Therefore, efforts to reduce truck congestion and improve travel time reliability should be concentrated on non-Interstate truck routes that provide

[64] 2018 Maine Truck Size and Weight Enforcement Plan

access to major freight assets such as the Ports of Searsport and Eastport, which do not have direct access to the interstate highway system.

- **Conduct a statewide truck parking study.** Beginning December 18, 2017, the Federal Motor Carrier Safety Administration mandated that much of the motor carrier industry begin using Electronic Logging Devices (ELD) to maintain records of duty status (RODS). An effect of this new mandate is that it will be more difficult for drivers to violate hours-of-service rules that require drivers to rest for a minimum amount of hours once they reach their maximum amount of on-duty hours. Currently, drivers manually maintain paper logs that may not accurately record their actual amount of driving or on-duty hours. Electronic logs will be more accurate and readily available to law enforcement officers. As a result, it is predicted that the need for adequate truck parking (both in terms of capacity and location) will increase as the industry complies with this new mandate. MaineDOT should prepare for this change by conducting a study of truck parking needs throughout the State. The study should assess the challenges to providing safe truck parking facilities, determine how much capacity is needed, determine where capacity is needed, and assess how all these factors may change over the long range.

5.1.2 Rail

Expand Rail Service to Shippers, Improve Rail Security and Promote Rail as a Viable Transportation Mode for More Maine-Based Shippers

The lack of adequate and consistent rail service in the State is a major factor in the low rail mode share. Furthermore, the lack of rail service hurts Maine's business climate and results in increased truck traffic and stress on Maine's highway system as shippers opt for truck service over rail.

The State should build on the work of the 2014 Maine State Rail Plan to expand freight rail market opportunities. The Maine State Rail Plan made a number of recommendations that are listed below. These include developing a strategies to encourage both public and private investment in the freight rail infrastructure (such as the Industrial Rail Access Program), upgrading rail lines to meet the 286,000-pound loading standard and raising vertical clearances to allow for double-stacked train operations. Securing funds to increase the weight capacity of Maine's rail corridors are a must if the State hopes to increase the modal share of freight traffic traveling by rail. The 2014 Maine State Rail Plan recommendations for freight rail are:

Infrastructure Recommendations

- Continue a strategy for investment in railroad infrastructure to improve the rail network to a state of good repair (SOGR) to enable rail to be a viable and sustainable transportation mode for more Maine-based shippers/consignees. The priority for public funds should be for state-owned infrastructure, and in private infrastructure that provides essential services within the targeted trade corridors within and to and from the State through public-private partnerships.

- Continue a strategy to encourage private-sector investment in railroad infrastructure to bring critical rail corridors to SOGR.

- Continue coordination with the railroads to accommodate heavier rail cars (286,000 pound) and double-stack clearances in corridors as may be appropriate to market conditions. This plan should address the timing and funding of improvement projects to provide for connections to southern New England and the continental United States.

- Continue and expand programs to improve, separate, and consolidate highway-rail grade crossings. Develop a strategy to close unnecessary, unsafe highway/railroad at-grade crossings. Make full use of the Federal "section 130" program.

- Direct state investments in rail infrastructure toward intermodal hubs such as the intermodal facilities at Auburn, Mack Point at the Port of Searsport, Estes Head terminal at the Port of Eastport, the Presque Isle Commerce Center, the Auburn area distribution center, and the Port of Portland. These transportation nodes have the potential to generate freight traffic into the freight rail system. These efforts also should be integrated with highway funding of NHS intermodal connectors.

Services and Operations Recommendations

- Develop and utilize state and Federal data resources to identify and evaluate rail market opportunities and to identify potential for modal diversion from highway to rail.

- Explore and develop potential freight rail role in new energy markets, including biofuels, wind power, domestic crude oil and propane, and other emerging technologies.

- Continue cooperative efforts with railroads, shippers, and regional planning agencies to identify underused rail served facilities and sites that may be developed to grow rail market opportunities.

- Explore appropriate role of the State in addressing rail car equipment needs of Maine shippers.

5.1.3 Ports

Support and Expand Port Cargo Facilities and Respond to New Market Opportunities

Maine's deep-water natural ports can be used economically and competitively to serve the growing demand for container facilities on the U.S. East Coast. Since the Panama Canal expansion increasingly larger ships are calling on East Coast ports such as Savannah and Charleston. Furthermore, rail intermodal traffic continues to be a growing market for freight rail operators as coal volumes continue to decline. These trends represent an opportunity for Maine. Following are the recommendations that should be considered to support and expand the State's port cargo facilities and to capitalize on new market opportunities:

- Continue to **invest in maintenance and upgrades** of Maine's ports.

- Continue to **grow containerized cargo in Portland** to capitalize on latest investments at the IMT and opportunities of a growing market in Portland and direct connection to Europe.

- Continue to program incremental **capital improvements to the ports to enhance intermodal connections**, such as rail to Portland and Searsport.

- **Expand rail and port users at the IMT** in Portland.

- Explore investing in a **rail transload facility in the Eastport area** should business opportunities justify constructing a facility.

- Continue to **improve U.S. 1 between the Port of Eastport and Calais border crossing** to ensure safety of travel between the two points.

- Continue to work with U.S. DOT and United States Maritime Administration (MARAD) to invest in **articulated tug-barges (ATB)** and the development of a marine highway connection between Portland and New York/New Jersey.

- Continue to promote and prioritize U.S. Army Corps of Engineers **maintenance dredging and channel improvement projects in Searsport.**

- Continue to invest in waterfront development projects through the **SHIP program.**

- Continue to **promote the handling of wind components** at Maine ports.

- **Improve U.S. 1 between Portland and Searsport in order to improve access between the Ports of Searsport and Eastport with Maine's largest city.** U.S. 1 is the most direct route between Portland and the Ports of Searsport and Eastport. Improving U.S. 1 for truck travel (e.g., adding raised medians, limiting the number of driveways, improved signal timing, etc.) would help to improve reliability and ease congestion.

- **Dredging Searsport to 40 feet.** There are strong concerns about the environmental impacts and the economic impacts to the fishing industry of dredging Searsport to 40 feet. Furthermore, the U.S. Army Corps of Engineers is reluctant to approve dredging to 40 feet without more shipping traffic. However, without a deeper channel shipping traffic will decline as the industry moves toward increasingly larger ships to take advantage of economies of scale.

- **Explore and develop the potential for a freight rail role in new energy markets, including biofuels, wind power and propane, and other emerging technologies.** With declining volumes of coal being shipped by rail, railroads have begun to explore new markets for their services. MaineDOT and the Maine Port Authority should work with the State's rail operators to determine which new markets may make sense to pursue. In recent years, the transport of domestic crude oil and propane by rail has grown due to energy exploration in the Bakken Shale Play in eastern Montana and western North Dakota. Other new market opportunities may exist that Maine and Maine's ports could take advantage of.

5.2 Policy Strategies

Policy strategies are divided into two types: short and long term. Short-term strategies address current or near-term needs. Short-term strategies are worthwhile to pursue in any environment, even as the State continues to change into the future. Like the infrastructure/operational recommendations, many of the strategies identified in the 2014 Integrated Freight Strategy are still relevant and are therefore included in the update. However, the current plan and the 2014 State Rail Plan also identified new strategies to supplement those that already are underway.

5.2.1 Short Term

- **Activate and engage a State Freight Advisory Committee (FAC).** The FAC should include members of the public and private sector (including representation from key state freight industries, carriers, shippers and receivers) and its role would be to advise on freight-related priorities, issues, projects, and funding needs; act as forum for discussion of transportation decisions affecting freight mobility;

communicate and coordinate regional priorities with other organizations; and, promote sharing of information between sectors.

- **Market State maritime and rail assets** to North Atlantic and Maine companies competing in those markets to assist those companies but also to improve the economics and use of those assets.

- Work with decision makers to **think beyond Maine borders** in regards to transportation and work with partners both regionally and internationally **to improve the freight system**.

- **Work closely with the trucking and shipping community to address the deadhead miles issue where appropriate and effective efforts can be realized.** It is recommended that this be accomplished through the FAC. Additionally, advances in technology may provide new tools for use by Maine businesses in managing their transportation and distribution functions while making these functions more efficient. Such advancements, including the use of the Internet to provide load matching services and identify backhauls, may provide Maine businesses the opportunity to improve their efficiency and lower their overall freight transportation costs.

- **Work closely with the private railroad operators and Federal agencies to improve railroad safety and security.** It is recommended that these and other stakeholders be engaged formally through the FAC.

- **Assess opportunities to allow limited access for higher weight Canadian trucks to travel short distances** (perhaps two to five miles) **inside the State border** to access Maine-based rail reload/ transload facilities. This could improve revenue opportunities for the railroads and make rail freight more competitive for Maine shippers.

- In conjunction with private sector and other local stakeholders, **develop policies to increase and improve intermodal freight transportation.** Specifically, MaineDOT should work to improve intermodal access to its deep-water ports.

- Work with the Administration and Legislature to **establish predictable, reliable funding sources** to address the need **for ongoing program and project operating costs and future acquisitions of railroad rights-or-way** and other facilities.

- Explore **innovative funding sources, including public-private partnerships, multistate initiatives, and tax increment financing.** Continue partnerships for Environmental Protection Agency (EPA) funded opportunities to acquire low emission diesel locomotives and APUs and similar environmental enhancement programs.[65]

- Continue **IRAP and FRIP programs** to encourage public private partnerships for investment in rail facilities.

- Encourage **multicarrier projects that enhance intercarrier moves –** to improve rail services, reduce transit time, and increase rail system reliability.

[65] Auxiliary Power Units that are used to maintain heat and power in railroad locomotives to prevent freezing and restarting problems. The U.S. EPA has provided grants to railroads to reduce fuel consumption and pollution.

- Establish **interagency coordination with state economic development and planning agencies** to provide for a unified, statewide approach to goods movement planning and analysis.
- **Collaborate with the Maine Port Authority** to identify and evaluate potential state investments in multimodal freight projects related to enhancing connectivity between ports and rail services.
- **Preserve rail corridors for current and/or future transportation needs.** State acquisition of a rail corridor is justified when state ownership is the most efficient and cost-effective means of preserving the rail corridor.

5.2.2 Long Term

Develop a Freight Performance Measures Program

State and Federal transportation agencies have long used asset and performance management techniques to assess, measure, and gauge infrastructural and operational capabilities of their systems. Each state tends to have individual interpretations as to how, if, and which performance measures should be incorporated into their planning and programming processes, but while approaches differ, agencies tend to measure the same basic physical and operational elements. In an effort to incorporate uniformity in these measures and emphasize a performance-based approach in applying the Federal Highway Program, the U.S. DOT, by way of MAP-21 and FAST Act legislation, has proposed several performance measures across key management areas, including safety, pavements, bridges, freight, emissions, performance, and congestion. This approach will incorporate performance management into Federal and state transportation programs, unify high-level national transportation goals, and link key measures to state and local funding opportunities.

While the development and application of freight performance measures was emphasized in MAP-21 and in FHWA's guidance on state freight plans and freight advisory committees, the FAST Act mandated that states report the Freight Reliability performance measure as part of their statewide freight plans (see Section 3.7.2). In addition, the FAST Act mandated that states set performance targets within one year of the establishment of national performance measures. Figure 5.1 shows the Federal guidance for the transportation performance management process. Just as the 2014 Integrated Freight Strategy recommended that the performance measures in the Strategic Plan (which already are aligned with national goals as seen in Table 5.1) be applied to the freight system, the update also recommends this strategy with the addition of the Federally mandated freight performance measure.

Figure 5.1 Federal Guidance for Transportation Performance Management

Source: FHWA Transportation Performance Management.

Table 5.1 Alignment of Maine's Freight Performance Measures with National Transportation Goals

National Goal Area	Maine Performance Measure in the Strategic Plan
Safety	Motor Carrier Safety Programs FMCSA (metrics).
	Implement Rail Safety Program (# incidents).
	Implement Port Safety Program (# incidents).
Infrastructure Condition	Integrate truck, port, and rail projects in capital work plan.
Congestion Reduction	Participate in National Truck Network.
System Reliability	Coordinate and certify freight size and weight numbers.
	Manage rail operating leases (# car loads).
Freight Movement and Economic Vitality	Integrate with National Data-FHWA planning (freight volumes).
	Develop new Freight PP Partnerships ($ value).
Environmental Sustainability	Comply with Federal and state environmental laws and regulations and Strategic Plans.
Reduced Project Delivery Delays	Coordinate with Multimodal Unit (project delivery goals).

Source: MaineDOT Office of Freight Transportation.

Modernize State Transportation Investment Programs

The 2014 Integrated Freight Strategy recommended that state programs such as IRAP and SHIP be modernized in order to reflect the current funding realities. It also determined that this could be accomplished through developing methodologies and tools to quantify the public benefits of rail projects and to answer key questions such as the following:

- What types of investments are appropriate and justifiable in the freight system?
- Where will the State realize the greatest public benefits from investments?
- How are public benefits quantifiable?

This is still a relevant recommendation, especially considering that the FAST Act has made available competitive grants for freight-specific projects through the INFRA program. Quantifying the link between freight transportation investments and economic benefits helps to articulate a stronger argument for approving one project over another across all levels of planning – Federal, state, and local. In addition, it facilitates cost-sharing discussions between public and private partners.

Identify Opportunities for Innovative Public-Private Partnerships

MaineDOT already has completed several successful public-private partnerships and should continue to identify and pursue opportunities where these partnerships may be appropriate. One example of public-private partnerships is a new law that allows MaineDOT to issue permits to overweight trucks on specified routes provided that the operation would be safe and that the applicant would pay at least 50 percent of the cost of required improvements or additional maintenance (based on an engineering analysis). This change in law could reduce the cost of forest product shipments by reducing permit fees.

Having private-sector funding is important in a competitive funding environment as potential projects that have nonpublic funding attached to them are normally looked upon more favorably than those that do not. Innovative public-private partnerships are those that forgo direct contributions of cash by the private sector in favor of other assets. Examples include lease-back arrangements, through which the private sector donates property to a state or local government and then leases it back for a given period of time (thereby providing a steady stream of income to the state/locality); or donation of air rights over completed freight facilities, which the state or local government can then turn into revenue by leasing to a third party. These innovative public-private partnerships can be a win-win for the public and private sectors, as they can effectively leverage public-sector investments while minimizing up-front capital expenditures by the private-sector freight community.

Given the State's desire to improve the quality and accessibility of rail service, public-private partnerships in this arena should be strongly pursued. Other states and municipalities have partnered with rail operators and real estate development companies to develop rail-anchored logistics developments, such as the Marion Industrial Center in Marion, Ohio. The Marion Industrial Center is anchored by a Union Pacific intermodal terminal with on-site trucking services and warehouses and distribution centers. Clustering these freight assets (and their associated activities) into a single location allows shippers to take advantage of multiple services simultaneously. The concentration of several potential customers in a single location lowers the cost of providing rail (and truck) service to that area, thereby making it more attractive to rail operators.

Continue to Support Investments in Cross-Border Initiatives

MaineDOT should continue to focus on improving relationships with neighboring Canadian provinces and making improvements to Maine's border crossings. Canada continues to be the State's top trading partner, accounting for 84 percent of Maine's international freight trade by weight (13 million tons) and 80 percent by value ($17 billion). Border crossings act as bottlenecks in that they impact the free flow of freight across Maine and the rest of the U.S. MaineDOT should engage and partner with the U.S. Customs and Border Protection to make both physical and administrative investments (such as more staff) to reduce delay at border crossings.

Continue Outreach and Maintain and Improve Relationships with Private-Sector Freight Community

As mentioned in the short-term strategies, MaineDOT could reactivate its State Freight Advisory Committee (FAC) as an avenue for dialogue between the State and Maine's freight transportation community. Through the FAC, MaineDOT could engage more private-sector stakeholders in the statewide transportation planning and programming process; and provide a forum for public agencies, industry groups, and local business chambers to coordinate and integrate freight movements. As part of its outreach, MaineDOT should continue to work to market the State's freight transportation assets and how the private sector can use these assets to expand their businesses throughout the region and internationally.

The performance-based planning and programming framework places emphasis on target-setting and reporting performance results to the public and key stakeholders. Regarding freight performance, the FAC is an important group to engage on the State's freight performance results and their implications for achieving MaineDOT's freight targets. Not only would their insights provide valuable information to MaineDOT staff for assessing how current projects under consideration may affect performance and contribute to achieving targets, using the FAC for this aspect of performance-based planning and programming would help to keep an important constituency engaged in the freight planning process.

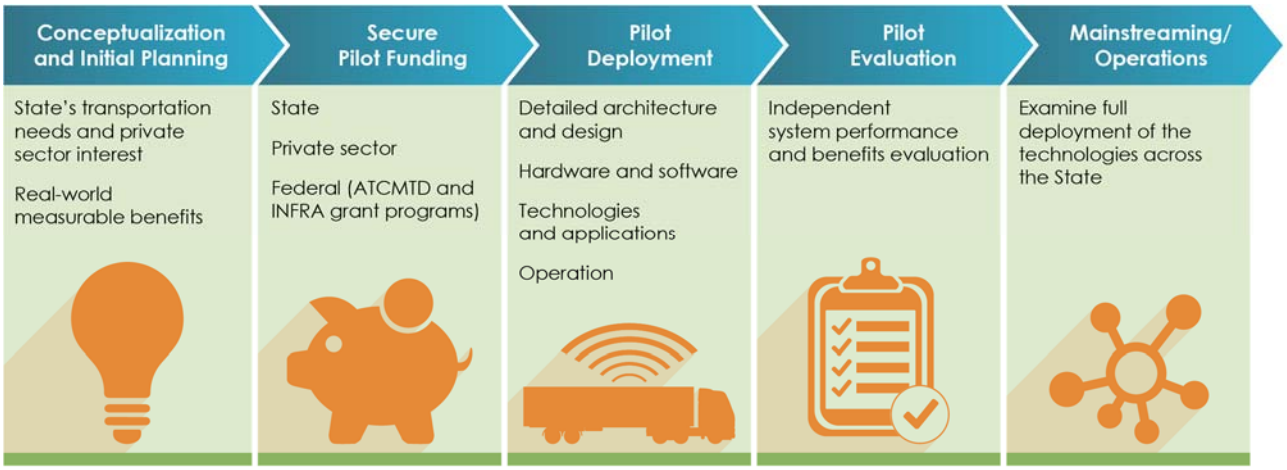
Prepare for the Next Generation of Truck Technology

Due to the pressures of thin profit margins, a nationwide shortage of drivers, and customers that want shorter and more reliable delivery timeframes, the motor carrier industry will be among the earliest adopters of autonomous and connected vehicle technology. In fact, a technique that has been used for years in the trucking industry, truck platooning, is expected to be the beneficiary of the first wave of this technology. Level 2 truck platooning is an extension of cooperative adaptive cruise control that uses automated lateral and longitudinal vehicle control, while maintaining a tight formation of vehicles with short following distances. A platoon is led by a manually driven truck and allows the drivers of the following truck(s) to disengage from the driving tasks and monitor the system performance. Truck platooning has a demonstrated potential for significant fuel saving benefits and associated reductions in emissions from the vehicles within the platoon. Additionally, truck platooning has the potential to ease congestion on highway corridors, since it does away with the "accordion" effect of having lines of vehicles speed and slow-down in unpredictable ways. Even a market penetration rate of around 10 percent for truck platooning can provide a noticeable increase in roadway throughputs and associated increased vehicle efficiencies.

MaineDOT should begin to prepare for a future with connected and autonomous trucks. This could involve conducting a planning-level study using models to predict the impacts of connected and autonomous on the safety and efficiency of Maine's highways. It also could involve conducting a pilot study where the real-world impacts are observed and measured. Conducting a pilot study would require MaineDOT and its partners to

develop a plan, secure pilot funding, deploy the technology on Maine's highways, and evaluate the results. Figure 5.2 outlines the general process for planning and implementing technology pilots. In either scenario, the State would benefit from studying this technology and its potential effects early so that Maine is prepared to meet its associated challenges and take advantage of opportunities.

Figure 5.2 Process for Planning and Implementing Technology Pilots



Appendix A. Commodity Flow Analysis

The future needs of Maine's freight system are substantially driven by what future freight demand might look like. This analysis presents existing and potential future demand for freight in the State for the plan year of 2045. It also provides insight into modal dependence, route choice, and equipment and service needs of the State's businesses.

A.1 Data and Methodology

The main data source used in the commodity flow analysis is the **Federal Highway Administration's (FHWA) Freight Analysis Framework (FAF) version 4.3.** The Freight Analysis Framework (FAF), produced through a partnership between Bureau of Transportation Statistics (BTS) and FHWA, integrates data from a variety of sources to create a comprehensive picture of freight movement among states and major metropolitan areas by all modes of transportation. Starting with data from the 2012 Commodity Flow Survey (CFS) and international trade data from the Census Bureau, FAF incorporates data from agriculture, extraction, utility, construction, service, and other sectors. FAF version 4 (FAF4) provides estimates for tonnage and value by regions (multicounty or state FAF zones) of origin and destination, a two-digit Standard Classification of Transported Goods (SCTG) commodity type, and mode. Data are available for the base year of 2012, and forecasts from 2015 through 2045 in five-year intervals. Freight Analysis Framework version 4.3 (FAF4.3) 2015 to 2045 data was disaggregated to obtain truck flows at the county level for the State of Maine.

A.1.1 Disaggregation of Truck FAF4 Database for Maine

This Appendix discusses the disaggregation process of the FHWA's Freight Analysis Framework version 4.3 (FAF4.3) database for use in Maine's Integrated Freight Strategy. As part of this effort, a tool was developed in MS Access, consistent with the format of the FAF4.3. FAF4.3 is an MS Access database that is available for download from the FHWA. While the FAF Study regions included in the FAF disaggregation database are unique to the Maine study, the disaggregation factors themselves can be applied to any set of FAF regions. The Maine FAF regions that were disaggregated include, FAF Zone 230 – Maine.

The FAF regional truck flows which are domestic, i.e., not imports and exports through a U.S. Port of Entry/Exit, are disaggregated to FIPS counties. Flows that are imports and exports through a water port are distributed to the water ports in that FAF region based on the share of the two-digit Standard Classification of Transported Goods (SCTG2) tons served by that port in the USACE's Navigational Data Center Waterborne Commerce database.[66] Flows that are imports or exports by truck at border crossings with Canada or Mexico are distributed to highway border crossings in that FAF region, with the same factor for each SCTG2 commodity, based on the reported trucks (for the FAF truck mode) at that border crossing as reported by BTS's Border Crossing/Entry data. For imports or exports through FAF regions that are not border crossings or water ports, the original FAF region as a Port of entry is retained.

The disaggregation database includes a table "FIPS and Ports/Borders to FAF4 Regions all" that is a cross walk of the FAF regions in which all FIPS counties, water ports and border crossings are located for the entire country. For the case of Maine, only the information germane to Maine is output from the tool. There

[66] Prior to 2014, only total tonnages for commodities were reported electronically by the USACE and only a single factor for all commodities was used for each port. Beginning with 2014, flows were reported by commodity by waterway, including ports, and those are now used to develop disaggregation factors.

are three water ports, the Port of Portland, Port of Searsport, and Port of Eastport, and 10 land border crossings, Jackman, Houlton, Vanceboro, Calais, Fort Kent, Madawaska, Fort Fairfield, Van Buren, Bridgewater, and Limestone. The factors for these ports and border crossings are utilized to disaggregate the imports and exports through them.

TransCAD Application

The process to apply disaggregation factors was originally developed for a CS project for the FAF version 2 (FAF2).[67] This process resulted in a disaggregated FAF database that was too large to fit within the 2 GB size limit in MS Access. The disaggregation factors to counties were based on the tons by two-digit SCTG that are produced in, or attracted to, a county. The disaggregation factors at ports were based on the tons that are imported, or exported, through those ports. The disaggregation factors for border crossing are based on the reported trucks or trains, as appropriate; trucks are used to disaggregate flows where the foreign mode is truck and trains are used to disaggregate flows where the foreign mode is rail. The water port and border flows are therefore based on actual reported flows. Only the county factors are based on tonnages that are computed from equations. However, most of the equations developed for FAF2 contain only one explanatory variable, or only one significant explanatory variable (e.g., the production of tons of SCTG 24 Rubber and Plastic was found to be a function of employment in NAICS 326 Plastics and Rubber Products Manufacturing). When the equation has only one variable, for example three-digit NAICS (NAICS3) employment, the share of tonnage in a county is essentially the share of that variable in the FAF region.

To support the 2011 FAF Geospatial project for FHWA, the disaggregation code was rewritten in TransCAD, which does not have the space limitations of MS Access. The output, to support the FAF Geospatial assignment to the FAF highway network, was converted from annual tons by all modes to daily trucks (see Table A.1 for the payload factors used).[68] To support other CS projects, the input data was developed for 2015, which is the provisional year of the FAF4.3. Those same disaggregation factors are applied to base and forecast flows; there are no national forecast of employment by industry, no forecasts of tons by commodity by water port, and no forecasts of trucks by border crossing.

To support the Maine Integrated Freight Strategy, this TransCAD code was rewritten to output not trucks, but tons by all modes. To maintain consistency with the region to region FAF4, the output from TransCAD was exported as a CSV file that could be imported into MS Access. Once in MS Access, the mode shares by Origin region, Destination region, and SCTG2 commodity was applied to all of the Origin county, Destination county, and SCTG2 commodity flows within that FAF region.

[67] Cambridge Systematics, "Development of a Computerized Method to Subdivide the FAF2 Regional Commodity OD Data to County Level OD Data" FHWA, January 2009.

[68] 295 equivalent average weekdays per year was the annual to daily conversion factor used, taken from the National Cooperative Freight Research Program (NCHRP) Report 8 "Freight-Demand Modeling to Support Public-Sector Decision-making" (2010).

Table A.1 Truck Payload Factors

Two-Digit SCTG Commodity	Tons per Truck	Two-Digit SCTG Commodity	Tons per Truck
01: Animals and Fish (live)	21.72	22: Fertilizers	23.79
02: Cereal Grains (including seed)	28.43	23: Other Chemical Products and Preparations, n.e.c.	20.05
03: Other Agricultural Products, except for Animal Feed	22.19	24: Plastics and Rubber	14.26
04: Animal Feed, Eggs, Honey, and Other Products of Animal Origin	22.92	25: Logs and Other Wood in the Rough	25.77
05: Meat, Fish, and Seafood, and Their Preparations	15.72	26: Wood Products	19.50
06: Milled Grain Products and Preparations, and Bakery Products	9.37	27: Pulp, Newsprint, Paper, and Paperboard	21.81
07: Other Prepared Foodstuffs, and Fats and Oils	17.81	28: Paper or Paperboard Articles	11.04
08: Alcoholic Beverages and Denatured Alcohol	18.69	29: Printed Products	10.26
09: Tobacco Products	11.29	30: Textiles, Leather, and Articles of Textiles or Leather	12.38
10: Monumental or Building Stone	26.69	31: Nonmetallic Mineral Products	31.39
11: Natural Sands	29.78	32: Base Metal in Primary or Semifinished Forms and in Finished Basic Shapes	15.10
12: Gravel and Crushed Stone	32.96	33: Articles of Base Metal	15.07
13: Other Nonmetallic Minerals, n.e.c.	31.56	34: Machinery	16.76
14: Metallic Ores and Concentrates	31.00	35: Electronic and Other Electrical Equipment and Components, and Office Equipment	13.14
15: Coal	34.95	36: Motorized and Other Vehicles (including parts)	17.43
16: Crude Petroleum	24.01	37: Transportation Equipment, n.e.c.	23.54
17: Gasoline and Aviation Turbine Fuel	21.11	38: Precision Instruments and Apparatus	9.49
18: Fuel Oils	27.88	39: Furniture, Mattresses and Mattress Supports, Lamps, Lighting Fittings, and Illuminated Signs	14.17
19: Other Coal and Petroleum Products, n.e.c.	20.01	40: Miscellaneous Manufactured Products	14.84
20: Basic Chemicals	21.79	41: Waste and Scrap	23.44
21: Pharmaceutical Products	14.41	43: Mixed Freight	26.53

Source: Cambridge Systematics program implementing the process described by FHWA in its FAF version 3 documentation "Network Assignment of Highway Truck Traffic in FAF3: Approach and Methodology" Oak Ridge National Laboratory, 2010.

Through Truck Flows

The disaggregation process only outputs the flows to, from, and within a study area such as Maine. The truck trips that pass through a study area, but have no cargo stops within the study area, cannot be determined from the FAF4.3 disaggregation matrix alone. The determination of through truck flows requires additional processing with the transportation network to which those trips would be assigned. Using terminology from CS' Travel Demand (model) Forecasting (TDF) Business Line, the FAF origin-destination (OD) Matrix was expanded (disaggregated) and in order to identify through trips (i.e., windowing) the network links on the Maine (study area) border were identified as a cordon line. The output from the windowing (subarea extraction) process is a CSV file that includes all through, to, and from trips that pass through the study area border/cordon line, and the through flows were extracted from this analysis to be incorporated with the disaggregation outputs. A database of to, from, within and through truck flows was created combining the results of the disaggregation and the windowing processes.

FAF4.3 Disaggregation within MS Access

While it was noted that the complete FAF disaggregation file could not fit within a single 2 GB MS Access database, the disaggregation factions, which apply to an origin or destination, can fit with a single access database. Those disaggregation factors for county-to-county domestic flows were computed separately using the following:

- 2012 County Business patterns data, where employment that was suppressed for a county and NAICS3 was estimated based on the firms identified in that county for that NAICS3 by employment range and the number of employees that is the mode point of that range. For example, if employment was suppressed for a NAICS3 in county z, but it was reported that there are 4 firms in the employment range of 1-4 employees, then it was estimated that there are 4 firms times 2.5 employees (the midpoint of that rage), or 10 employees in that NAICS3 in county z;
- 2010 county population from the U.S. Census;
- 2012 agricultural statistics for the counties; and
- 2012 coal consumption database in power plants by county.

This data was used in the TransCAD program to estimate the domestic tonnage by SCTG2 commodity that originated in, or was destined to, each FIPS county. Those estimated county tonnages were extracted from TransCAD and imported into MS Access.

The border crossing factors for imports and exports were developed from the 2012 BTS Border Crossing/Entry database. The factors for water ports by SCTG2 was developed from the USACE's Waterborne Commerce database. Prior to 2014, the flows by commodity were only reported in pdf files. Beginning in 2014, flows by commodity were reported electronically by waterway. A crosswalk was developed between the Publication Commodity Codes as reported by USACE and the SCTG2 commodities as used in the FAF. This crosswalk and the waterway information was used to develop the tons by SCTG2 that were imported and exported through each port.[69]

[69] The disaggregation factors for the Port of New York have not yet been developed. Only the consolidated flows from the Port of New York and New Jersey were reported. It may yet be possible to report the tons imported and exported

The MS Access database disaggregation database includes a link to the "faf43_data" table in the official FAF 4.3 MS Access database. That "faf43_data" table includes the following fields:

- **Fr_orig:** The foreign origin, if any, for the record. The foreign zones are those specified in the FAF and consist of 8 international zones, two of which are the countries of Canada and Mexico.

- **Dms_orig:** The domestic origin for the record. The domestic zones are the 132 FAF4.3 regions covering the United States. The zones as defined by FAF4.3 are:

  - 79 metropolitan regions, which the U.S. Departments of Transportation (DOT) and Commerce (DOC) consider to be significant generators of national freight, where the metropolitan areas may include multiple states (for example, the New Jersey, New York and Connecticut portions of the New York City CSA are all separate FAF regions);

  - The balance of those 37 states which are outside of those metropolitan areas (the Rhode Island portion of the Boston CSA covers the entire state of Rhode Island and there is no balance of that state); and

  - 13 states without large metropolitan areas (the District of Columbia is a "state" portion of Washington D.C. metropolitan area).

- **Dms_dest:** The domestic destination for the record. The domestic zones are the same as described and defined under "Dms_orig" above.

- **Fr_dest:** The foreign destination, if any, for that record. The foreign zones are the same as those described above under "Fr_orig."

- **Sctg:** The commodity being reported in that record according the Standard Classification of Transported Goods (SCTG). This is reported at a two-digit level.

- **Dms_mode:** The mode used for domestic transportation according to the coding convention in FAF4.3. For these purposes only truck flows were disaggregated.

- **Trade_Type:** The type of movement of that record as: 1) Domestic only; 2) Import; or 3) Export. This information should be consistent with the foreign origins and destinations of that record.

- **TonsXX:** The flow in annual kilotons for that record in the year 20XX. These years include the surveyed flow in 2012, provisional flows for 2015, and forecast flows for 2020, 2025, 2030, 2035, 2040, and 2045.

- **ValueXX:** The value in annual millions of $2012 in the year 20XX. The same years as above for tons are included for value.

for some of the Ports that were previously reported in summary form and used in the TransCAD scripts (for example for each SCTG2, one new factor for the combination of Red Hook and Gowanus Creek; one new factor for the combination of Port Newark and Port Elizabeth; one factor for Howland Hook, etc.) These disaggregation factors would only be necessary to disaggregate import and exports by water through the NJ New York City (New Jersey Part) and NY New York (New York Part). This disaggregation is not needed for Maine, and those factors were not developed at this time.

The MS Access disaggregation database queries will:

- Create the crosswalk table for non-Maine zones;
- Extract and create tables of the Maine records from the FAF4.3. It is these tables that will be used by the disaggregation queries; and
- Create a table of disaggregated records for the study area.

If there are any border crossings or water ports within the study area, the flows are reported for those facilities. In Maine, there are three water ports and 10 border crossings. This will disaggregate all imports and exports by water for the water port and by truck for the land border crossings.

The format of the study area disaggregated table is as follows:

- **Fr_orig:** The foreign origin, if any, for the record. The foreign zones are those specified in the FAF and consist of eight international zones, two of which are the countries of Canada and Mexico.
- **Dms_orig:** The domestic origin for the record. These will be a county FIPS (YYXXX, where YY is the FIPS code for state and XXX is the FIPS code for a county in that state) within the study area; border crossings in the study area (1XXX); water ports in the study area (2XXX) and the original FAF region number outside of the study area.
- **Dms_dest:** The domestic destination for the record. The domestic zones are the same as described and defined under "Dms_orig" above.
- **Fr_dest:** The foreign destination, if any, for that record. The foreign zones are the same as those described above under "Fr_orig."
- **Sctg:** The commodity being reported in that record according the Standard Classification of Transported Goods (SCTG). This is reported at a two-digit level.
- **Dms_mode:** The mode used for domestic transportation according to the coding convention in FAF4.3.
- **Trade_Type:** The type of movement of that record as: 1) Domestic only; 2) Import; or 3) Export. This information should be consistent with the foreign origins and destinations of that record.
- **Tons15:** The flow in annual kilotons for that record in the year 2015.
- **Tons45:** The flow in annual kilotons for that record in the year 2045.
- **Value15:** The value in annual millions of $2,012 in the year 2015.
- **Value45:** The value in annual millions of $2,012 in the year 2045.

A.2 Statewide Freight Demand

In 2015, about 97 million tons of freight moved over Maine's transportation system, valued at $96 billion. By 2045, it is projected that Maine's transportation system will carry 151 million tons of freight annually, valued at $183 billion, an increase of 56 percent by tonnage and 91 percent by value.

A.2.1 Modal Split

Freight utilizes different modes of transportation. This section will analyze the existing and future trends of the statewide movement of freight via the roadways, railways, water, pipelines, and air.

Figure A.1 and A.2 display the current and future mode split of total freight tonnage and value. Trucks are the dominant mode of freight transportation throughout the State. About 86 percent of all freight tonnage and 72 percent of the total value was moved by truck in 2015. Trucks are expected to continue to move most of the State's tonnage and value over the next 30 years (84 percent of the 2045 total tonnage and 66 percent of the 2045 total freight value). Maine is dependent on trucks for movement of most of its freight, particularly those shipments that both originate and terminate within the region. Trucks normally provide the last link in the transportation chain, transporting all types of commodities from their intermediate destinations, such as seaports or rail terminals, to their final destinations.

After truck, pipeline and rail are the second and third most heavily used modes, respectively. Five percent of the freight tonnage was transported by pipeline in 2015, whereas four percent of the freight tonnage was transported by rail. Both shares are expected to increase slightly through 2045. When measured by cargo value, multiple modes and mail was the second most heavily used mode after truck with 16 percent of the value of shipments, and air and rail were mutually the third most heavily used modes with three percent of shipments each in 2015. Over the course of the next 30 years the share of multiple modes and mail of the total freight value is expected to increase to 21 percent.

Figure A.1 Maine Mode Share by Weight
2015 (left) and 2045 (right)

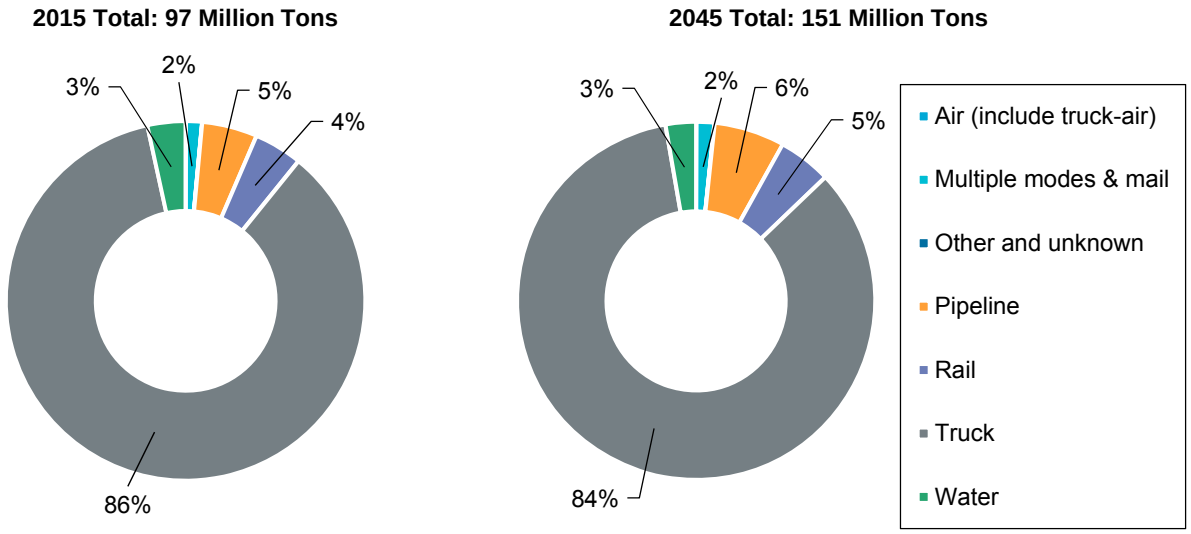
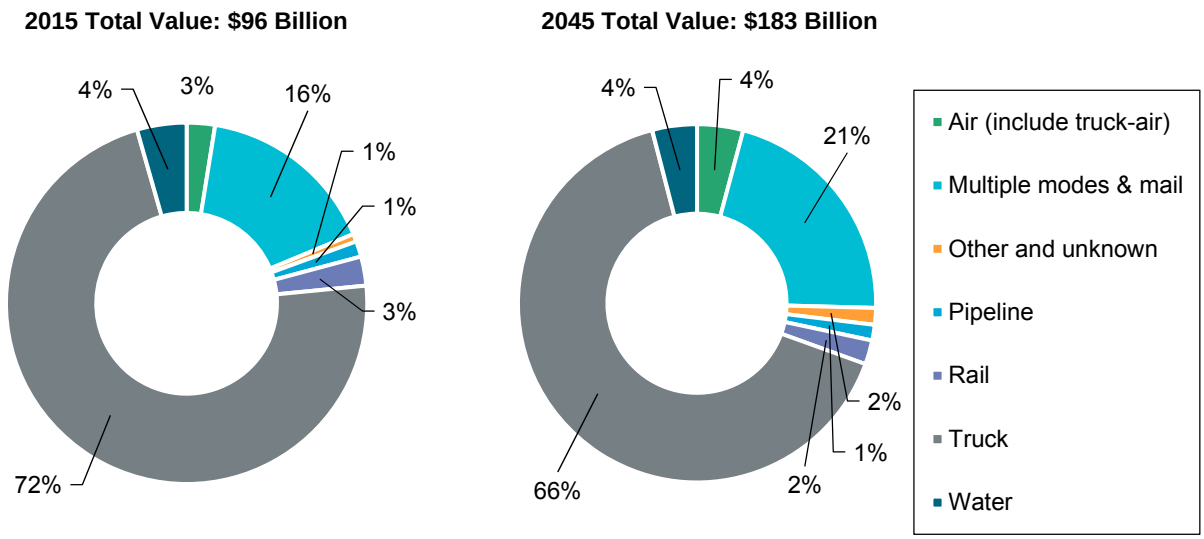


Figure A.2 Maine Mode Share by Value

2015 (left) and 2045 (right)



A.2.2 Directional analysis

Freight moves to, from, within, and through the State of Maine on a daily basis. Figure A.3 illustrates the current and future directional split of freight movements by weight. In 2015, intrastate shipments accounted for 56 percent of the 97 million tons moved, the largest percent of any direction. Outbound shipments accounted for the next highest direction at 27 percent, and inbound shipments accounting for 14 percent of the total tonnage moving in the State. The share of tonnage with through direction is very low. This is expected since Maine is located in the north-eastern corner of the country and therefore, it is either the first or last stop of the commercial trucks. Projected freight movements for 2045 remain mostly consistent with today's trends. By weight, the total tonnage of moved freight within the State is expected to drop to 51 percent. Outbound shipments share is projected to remain constant, with corresponding growth in inbound and through shipments.

When measured in value (as shown in Figure A.4), both outbound and inbound directions have mutually the highest total value of goods with 35 and 34 percent of the moved freight value, respectively. Intrastate accounts for 26 percent of shipments' value and through movements account for the remaining 5 percent. In 30 years, the current trend of directional split is expected to remain constant. Outbound movements are projected to slightly increase to 37 percent of the total moved freight value, inbound movements will follow with 35 percent, intrastate direction will decrease by 7 points to 19 percent, and through movements will increase to 9 percent of the total shipments' value.

Figure A.3 Maine Directional Split by Weight

2015 (left) and 2045 (right)

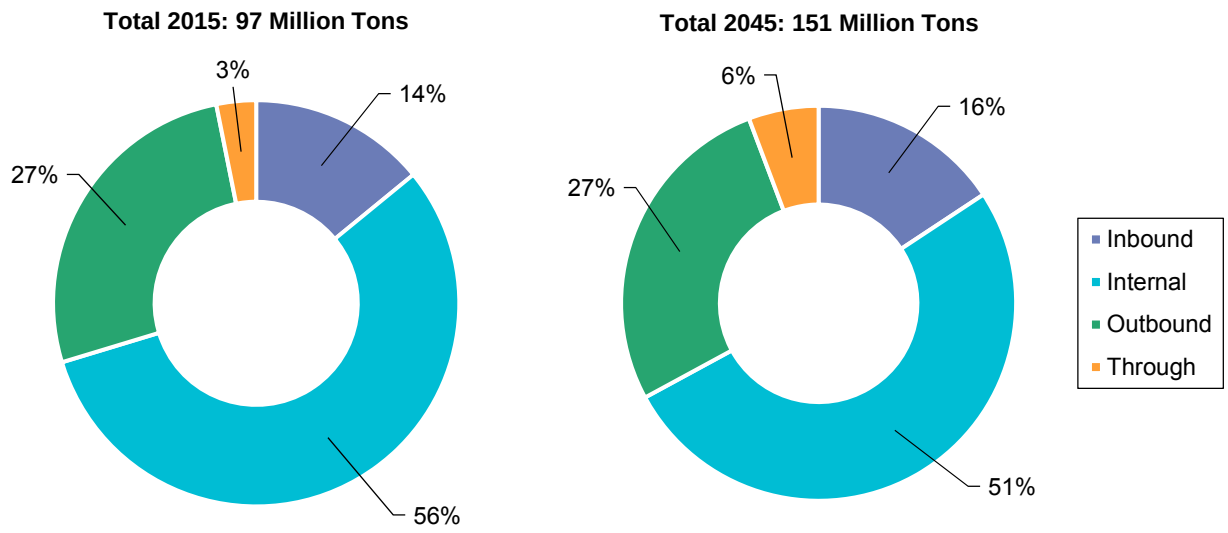
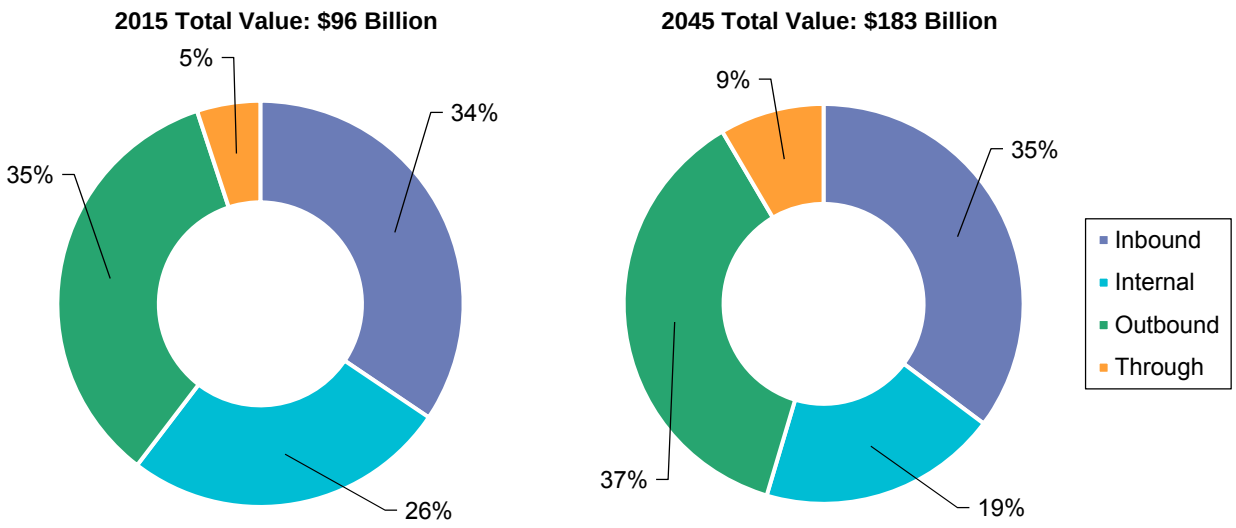


Figure A.4 Maine Directional Split by Value

2015 (left) and 2045 (right)

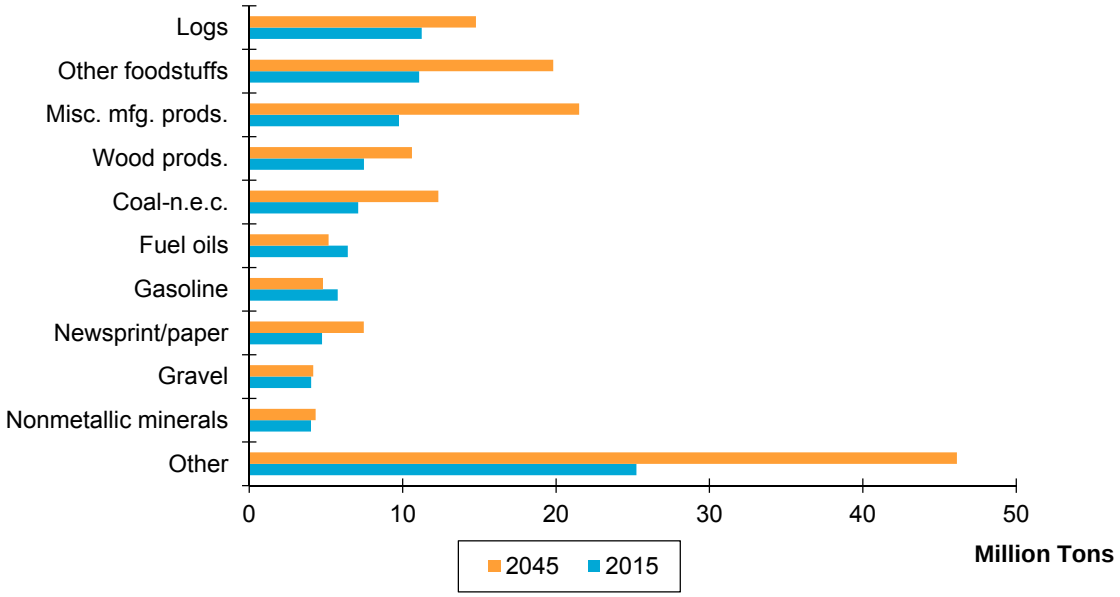


A.2.3 Top Commodities

By weight in 2015, the top commodity moved to, from, and within Maine was logs, accounting for 12 percent of the total weight of all goods. The other top five commodities include other foodstuffs, miscellaneous manufacturing products, wood products, and coal not elsewhere classified (coal – n.e.c.). The top five commodities account for 48 percent of the total weight of goods moved to, from, and within Maine in 2015.

Figure A.5 shows the top 10 commodities moved in Maine by weight for 2015 and their project growth by 2045. In 2045, all the top commodities moved by weight are projected to be the same as 2015 top commodities. All the current top five commodities are expected to increase in moved weight. In terms of ranking, miscellaneous manufacturing products will replace logs as the top commodity, other foodstuffs, logs, coal – n.e.c., and wood products will rank second to fifth by highest commodity weight.

Figure A.5 Maine Top Commodities
By Weight 2015 and 2045



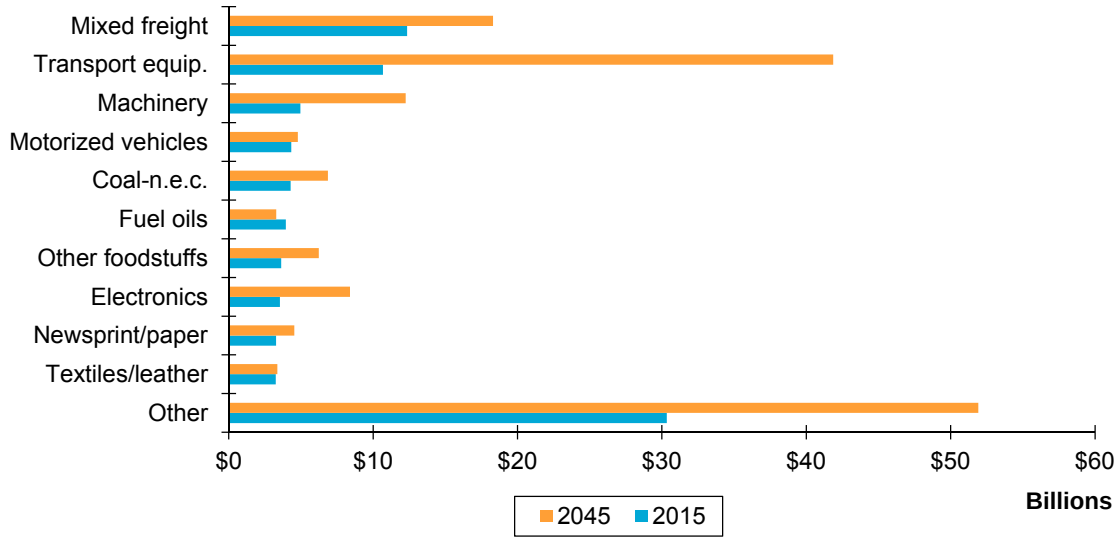
By value in 2015, the top commodity moved was mixed freight, followed by Transport equipment, machinery, motorized vehicles, and coal – n.e.c.[70] These five commodity types accounted for $37 billion or 43 percent of the total value moved.

The top commodities by value are projected to change through 2045. Transport equipment will dominate, accounting for approximately 26 percent of the total value of goods moved, followed by mixed freight, machinery, electronics, and coal – n.e.c.[71] The top five products combined will account for more than 54 percent or approximately $88 billion of the total value of all goods moved in the State. Figure A.6 shows the top 10 commodities moved by value in 2015 and their project growth by 2045.

[70] Coal-n.e.c. refers to coal and petroleum products not elsewhere classified, including natural gas.

[71] Ibid.

Figure A.6 Maine Top Commodities
By Value 2015 and 2045

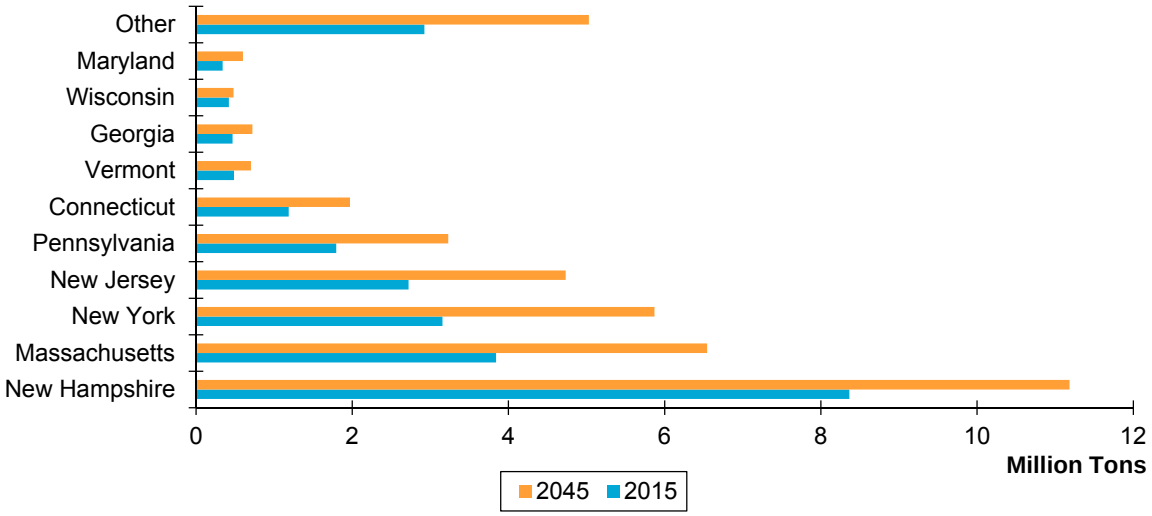


A.2.4 Domestic Trade Partners

Outbound Goods

Goods shipped from Maine travel to a wide range of U.S. destinations. By weight in 2015, Maine sent over 26 million tons of goods to destinations in the U.S. beyond the State. The top domestic destinations for freight were New Hampshire which accounted for 33 percent of the outbound tonnage, Massachusetts with approximately 15 percent, New York with approximately 12 percent, New Jersey with approximately 11 percent, and Pennsylvania receiving approximately 7 percent on Maine's outbound shipments by weight. All of the top destinations by weight in 2015 are in Northeastern United States. By 2045, the top five destinations are projected to remain constant. Figure A.7 shows the top domestic destinations for goods by weight in 2015 and 2045.

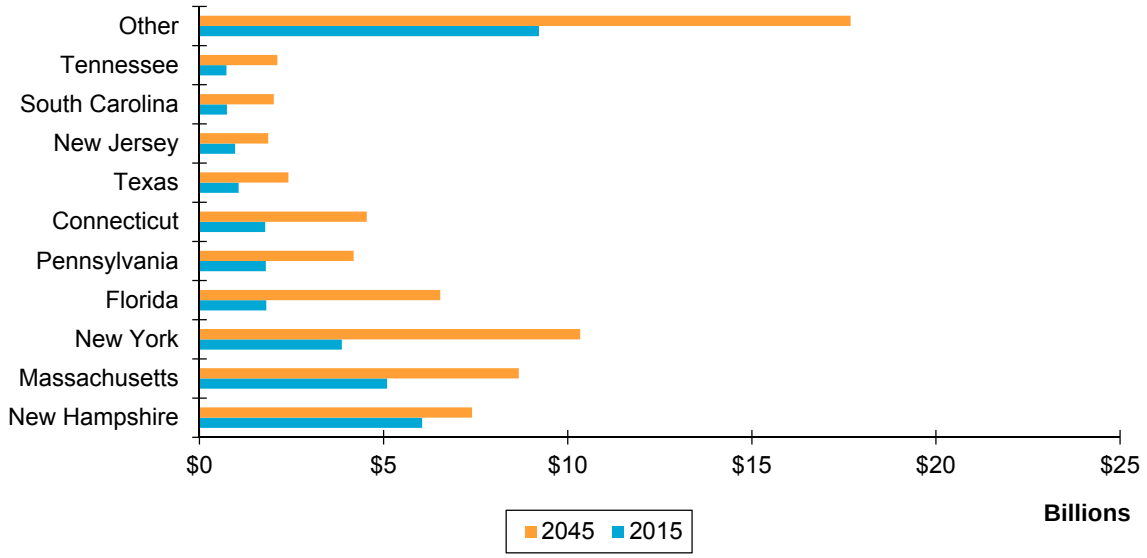
Figure A.7 Maine Top Domestic Destinations
By Weight 2015 and 2045



By value, the top 10 destinations in 2015 were dispersed more across the country than when measured by weight where the top destinations were mostly located in the Northeast. Maine's top five destinations by value shown in Figure A.8 accounted for $19 billion (56 percent) of the total outbound value in 2015. The top five destinations were New Hampshire (18 percent), Massachusetts (15 percent), New York (12 percent), Florida (5 percent), and Pennsylvania (5 percent).

By 2045, New York is expected to become the top destination by value, Massachusetts is projected to remain as the second top destination, New Hampshire and Florida will be third and fourth top destination for Maine, respectively, and Connecticut will be ranked fifth. These five destinations are projected to attract more than $37 billion or 55 percent of the total outbound value from Maine in 2045.

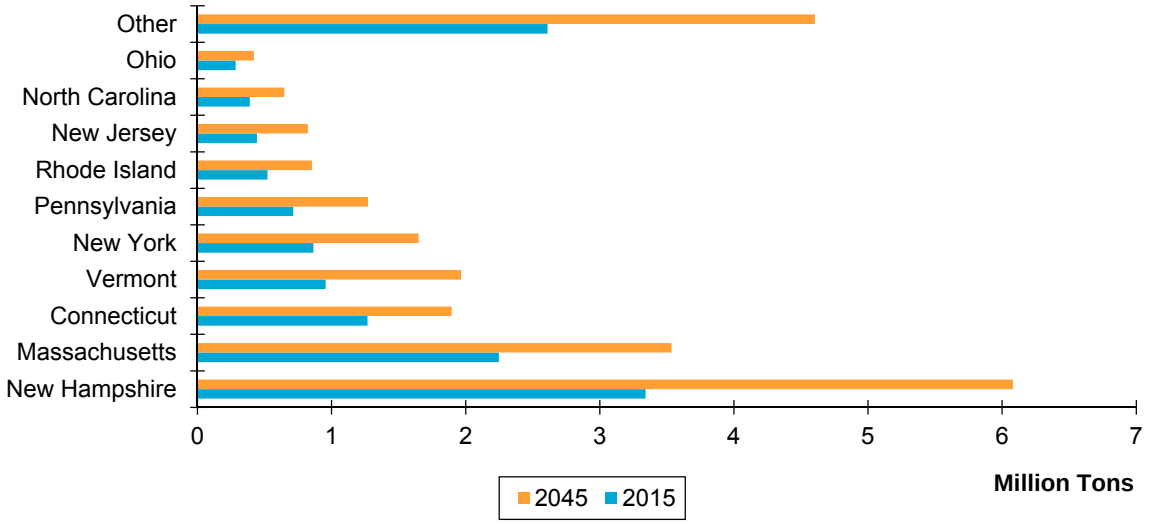
Figure A.8 Maine Top Domestic Destinations
By Value 2015 and 2045



Inbound Goods

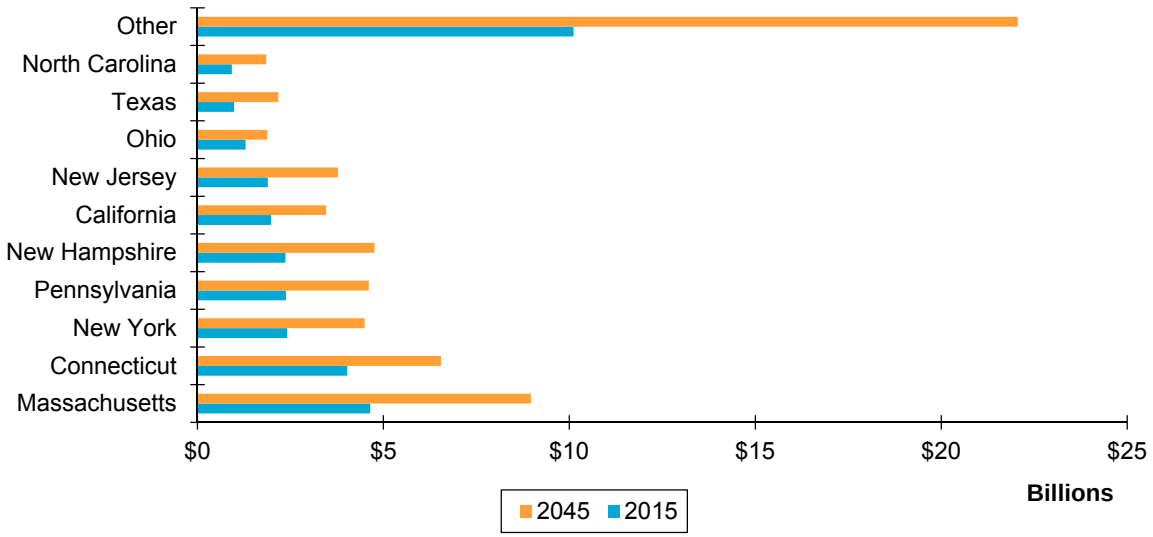
Maine receives goods from trading partners across the country. The top 10 origins shown in Figure A.9 accounted for 81 percent of the total inbound weight in 2015. Maine received the most goods by weight from New Hampshire, followed by Massachusetts, Connecticut, Vermont, and New York. These five origins accounted for 9 million (64 percent) of the total inbound tons to Maine. In 2045, the top five origins are projected to remain constant except for Vermont swapping places with Connecticut. The top five states are expected to account for 15 million tons and 64 percent of the inbound tons in 2045. Figure A.9 shows the top 10 domestic origins of goods by weight in 2015 and their 2045 projections.

Figure A.9 Maine Top Domestic Origin
By Weight 2015 and 2045



By value in 2015, the top domestic origin was Massachusetts, followed by Connecticut, New York, Pennsylvania, and New Hampshire. These five origins accounted for 48 percent ($16 billion) of the total value of goods shipped to Maine. The remaining top origins in 2015 are shown in Figure A.10. By 2045, all the 2015 top five origins are expected to be in 2045 top five with some shifting. Massachusetts will be at the top followed by Connecticut, New Hampshire, Pennsylvania, and New York. Together they are projected to generate 45 percent of the $64 billion inbound goods shipped to Maine. Figure A.10 shows the top domestic inbound trading partners for Maine and their 2045 projections.

Figure A.10 Maine Top Domestic Origins
By Value 2015 and 2045



A.2.5 International Trade Partners

In 2015, international trade accounted for approximately 15 million tons of the goods shipped to and from Maine worth over $22 billion. Seventy five percent of these foreign shipments were U.S. imports and the rest were U.S. exports. These international shipments include imports and exports through any U.S. ports. By 2045, foreign shipments in the State are projected to rise to 31 million tons of goods worth approximately $64 billion.

The international trading partners can be divided into eight regions:

- Canada
- Mexico
- Rest of Americas (South and Central America, including the Caribbean)
- Europe
- Africa
- Southwest and Central Asia
- Eastern Asia
- Southeast Asia and Oceania

Outbound Goods/Exports

For exports, the top three destinations in 2015 measured by weight were Canada, Eastern Asia, and Europe. These three destinations accounted for 97 percent of the 3.7 million tons of exported goods by weight in 2015. Regarding the value, Canada is on top of the list followed by Europe and Eastern Asia. Together they make 84 percent of the $6.2 billion exported by value. By 2045, total exports by weight are projected to increase to 8.5 million tons worth $20 billion, with the top three destinations remaining constant.

Foreign trade partners for Maine exports via any U.S. port in 2015 and 2045 are shown in Figures A.11 and A.12 for total weight and value respectively.

Figure A.11 Maine International Destinations
By Weight 2015 and 2045

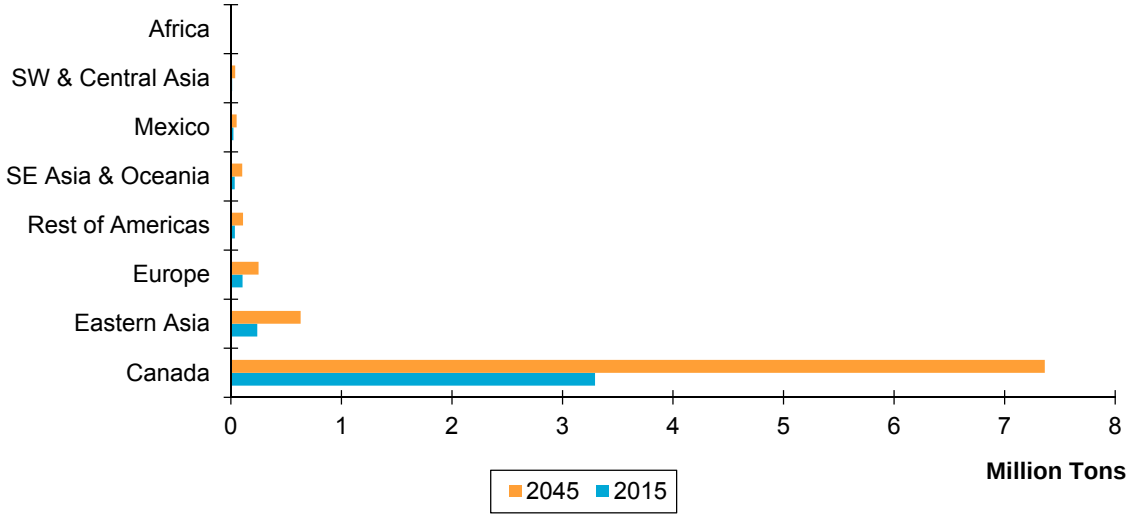
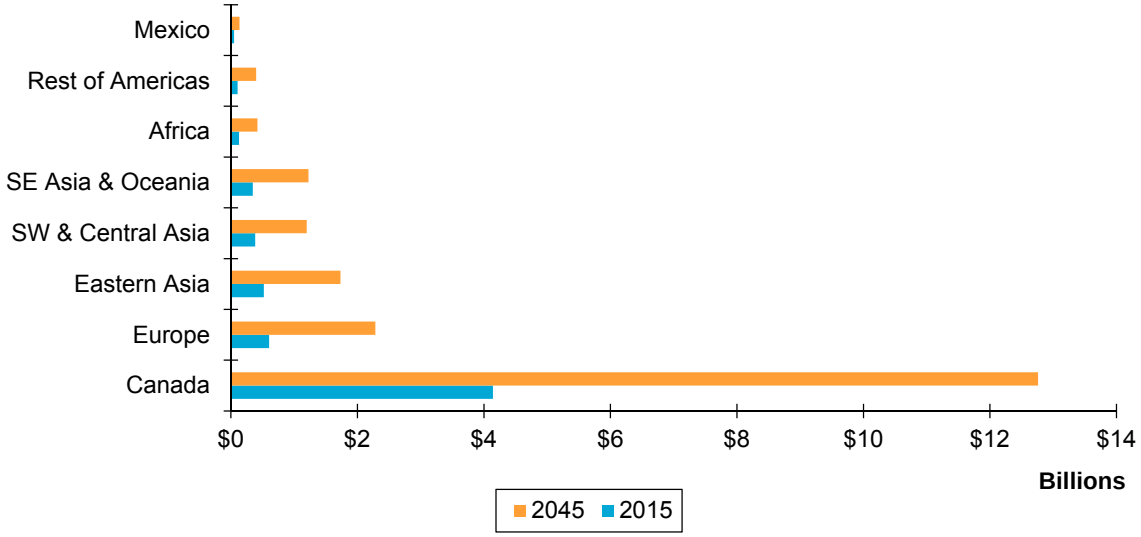


Figure A.12 Maine International Destinations
By Value 2015 and 2045



Inbound Goods/Imports

In 2015, Maine foreign imports totaled 11.4 million tons. The top international trading partners for these imports were Canada, rest of Americas, and Europe. By weight, Canada was the leading source for international goods in 2015. Combined with Mexico and Eastern Asia, these three foreign origins accounted for approximately 11.3 million or 99 percent of the imported tonnage. Total imported weight in 2045 is projected to grow to 22.3 million tons, with Canada accounting for 88 percent of the projected imported tons to become the largest import trading partner. Figure A.13 shows the import trading partners by weight in 2015 and 2045.

By value, imports totaled $15.3 billion in 2015. The top three imports trading partners by value were Canada, Europe, and Eastern Asia, together accounting for $14.8 billion or 97 percent of the imports. By

2045, the total value of Maine imports is projected to increase by over 186 percent to $44 billion. Canada, Europe, and Eastern Asia will remain the top three importers to Maine. The three origins will account for more than $42 billion or 97 percent of imports to Maine by value. Figure A.14 shows the import trading partners by value in 2015 and 2045.

Figure A.13 Maine International Origins

By Weight 2015 and 2045

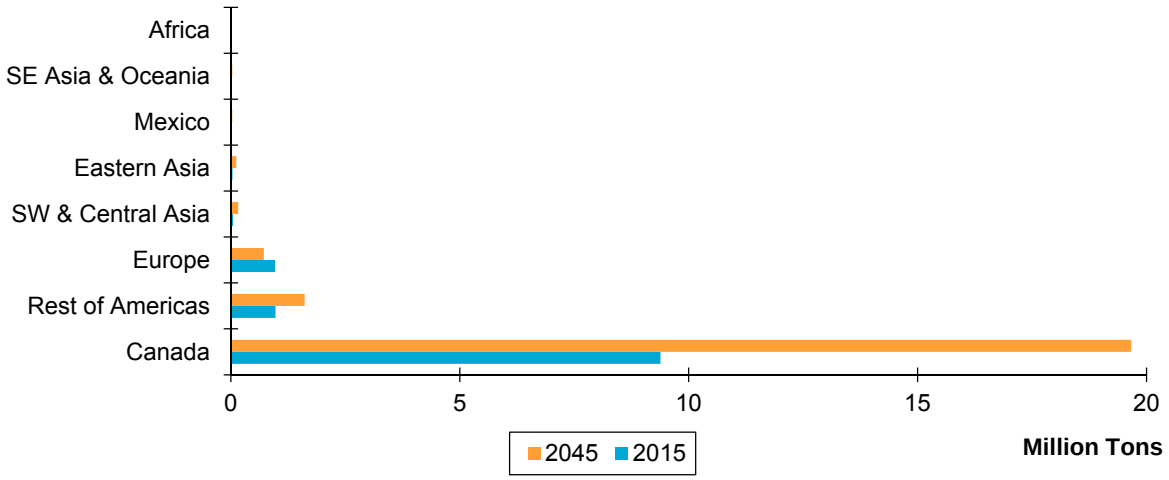
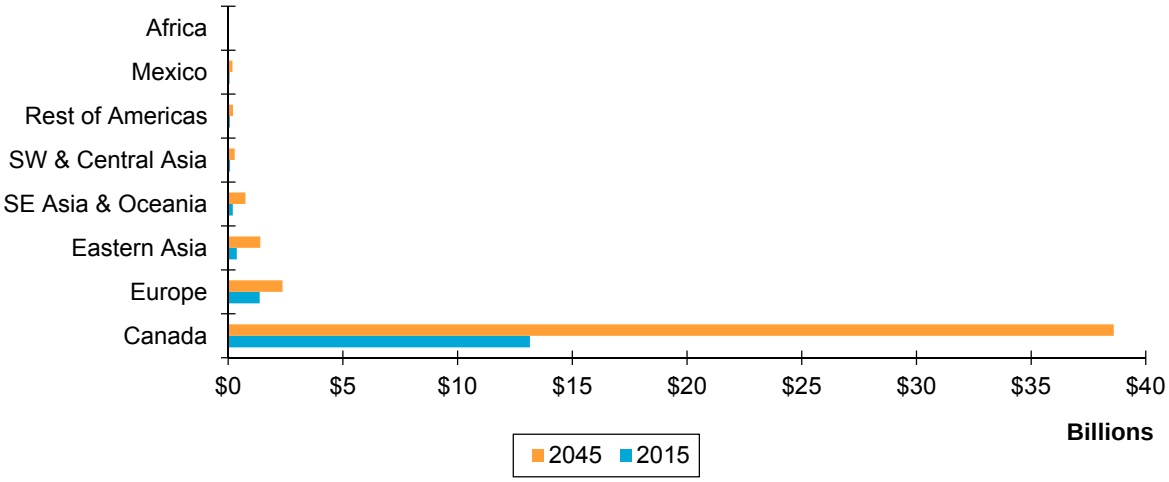


Figure A.14 Maine International Origins

By Value 2015 and 2045



A.2.6 County Level Trade

Aroostook County was the dominant goods-movement county in Maine in 2015. Aroostook County shipped 8.5 million tons and received 8.7 million tons of goods from other counties and states in addition to the 2.6 million tons of goods that moved within the County. This accounted for 21 percent of the 94 million tons shipped to, from, and within Maine in 2015. The remaining top counties for freight activity measured by weight were Cumberland, York, Penobscot, and Hancock. Altogether the freight tons generated by these five counties accounted for 54 percent of the cargo tons shipped to, from and within the State.

By 2045, Cumberland is projected to become the top county with freight activity in the State, projecting to generate 25 million (17 percent) of the tons shipped to, from, and within Maine. The top five counties with freight activity measured by weight (inbound, outbound and intracounty combined) are projected to be Cumberland, Aroostook, York, Penobscot, and Androscoggin, over the next 30 years. Among the top five, the largest percent growth by 2045 is projected for Cumberland County with 61 percent growth, followed by Androscoggin County with projections of 56 percent growth.

Figure A.15 shows the top 10 counties by weight in 2015 and 2045. These figures include shipments that moved in to, out of, and within each county. Figures A.16 and A.17 show the total tonnage of goods that moved within, to, or from each Maine County in 2015 and 2045 respectively.

Figure A.15 Top Maine Counties by Combined Inbound/Outbound/Intra Weight, *2015 and 2045*

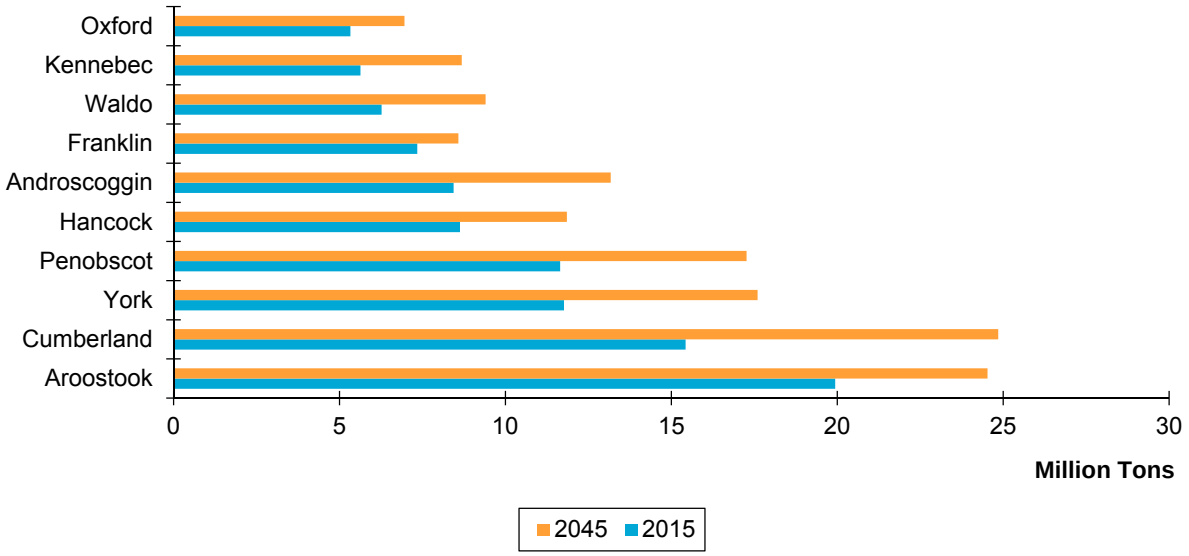


Figure A.16 Freight Weight by County for Inbound/Outbound/Intra Flows *2015*

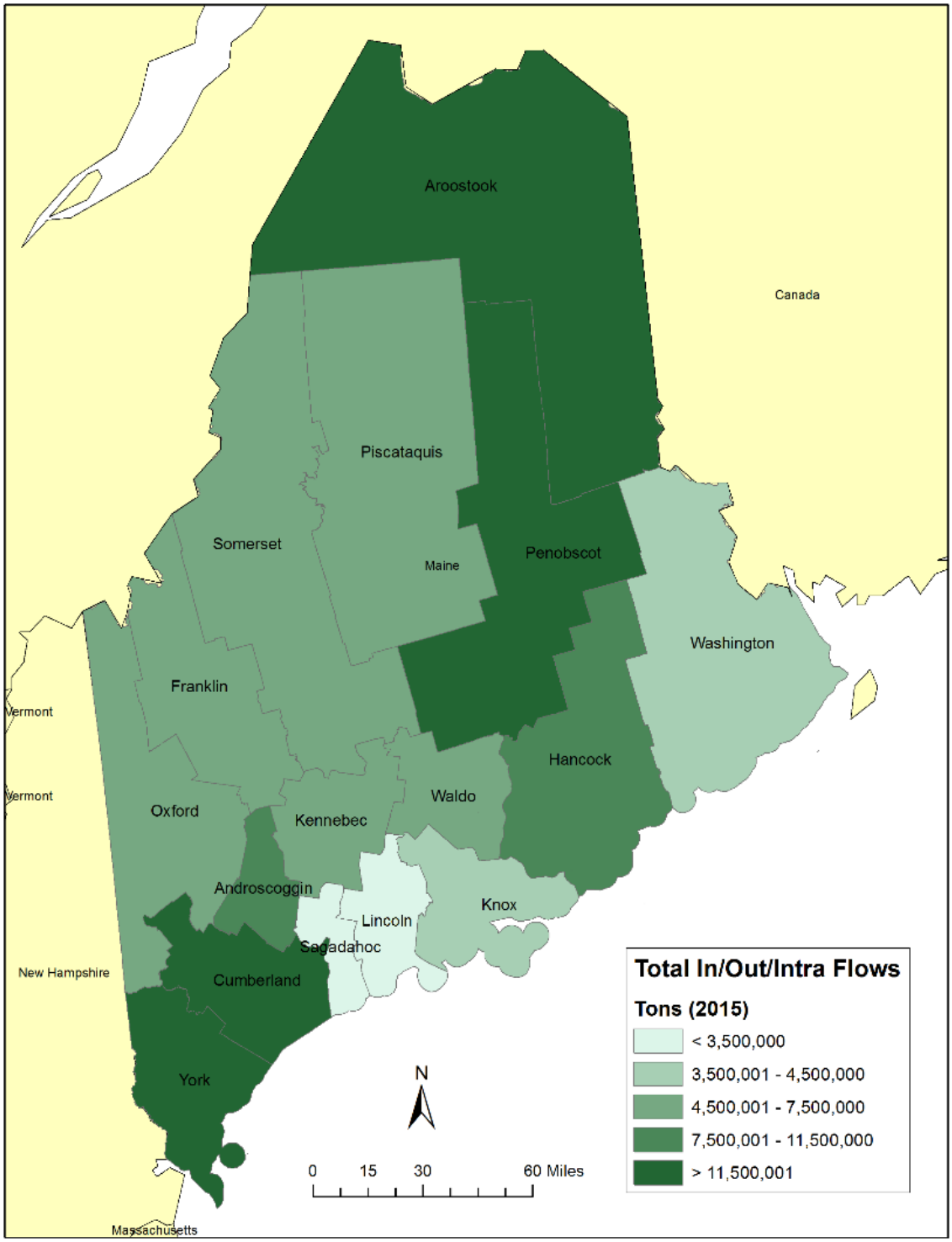
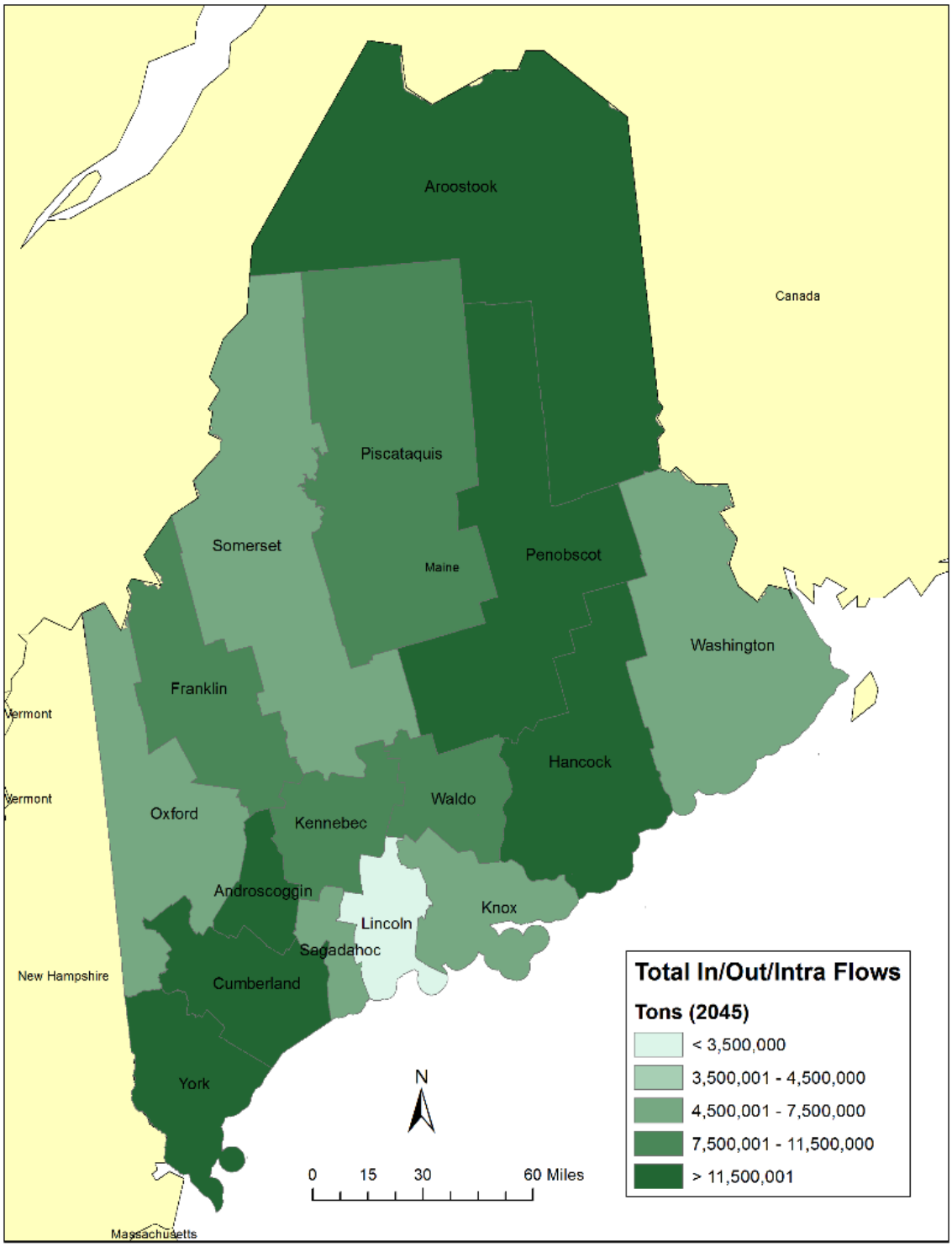


Figure A.17 Freight Weight by County for Inbound/Outbound/Intra Flows *2045*

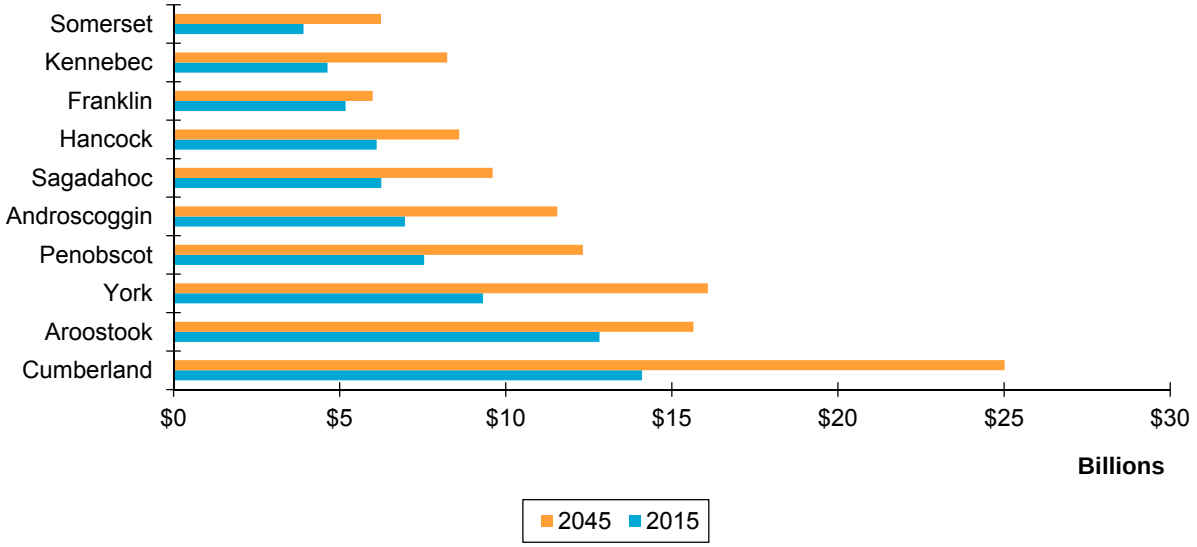


Cumberland County shipped the highest value of goods in 2015, accounting for 15 percent of the $91 billion in goods shipped to, from and within Maine in 2015. Outbound flows from Cumberland County totaled $4.9 billion, inbound flows $8.7 billion and intracounty shipments accounted for $0.4 billion. The remaining top five counties by freight value shipped and received in 2015 were Aroostook, York, Penobscot, and Androscoggin. Altogether the freight value generated by these four counties accounted for 55 percent of the cargo value shipped to, from, and within the State.

By 2045, Cumberland is expected to remain the leading county for freight value with 15 percent ($25 billion) total share of the projected $168 billion shipped to, from, and within the State. Cumberland County is projected to be followed by York, Aroostook, Penobscot, and Androscoggin in total freight value. By 2045, altogether these five counties are projected to generate $81 billion of freight moving to, from, and within the counties.

Figure A.18 shows the top 10 counties by value in 2015 and 2045 for total inbound, outbound, and intracounty movements.

Figure A.18 Top Maine Counties by Combined Inbound/Outbound/Intra Value *2015 and 2045*



Appendix B. Commodity Flow Study of Hazardous Materials

The Maine Emergency Management Agency (MEMA) completed a statewide Commodity Flow Study of Hazardous Materials in 2015. The study documented the transportation of 17 selected commodities classified as either Extremely Hazardous Substances (EHS) or Non-EHS commodities. Most of these commodities are either petroleum products such as crude oil and ethanol or chemicals used in the pulp and paper and other manufacturing industries. Since HazMat flows are a subset of Maine's overall freight transportation system, excerpts from this study are included in this appendix.

Documenting petroleum and HazMat flows can be challenging due to difficulties obtaining data and proprietary concerns about sharing data from different industries. Maine companies that store more than 10,000 pounds of hazardous materials are required to submit annual "Tier II" reports to MEMA. This is a national requirement for every state. In 2017, over 2,500 Maine facilities are expected to submit Hazardous Chemical Inventory Reports. Data from these reports were used in the Maine Commodity Flow Study of Hazardous Materials completed in 2015 to identify transportation routes and corresponding annual transportation volumes by mode for various chemicals.

B.1 Petroleum Transportation

There are multiple petroleum products transported to, from and within Maine for transportation and heating purposes. Maine imports all of its petroleum-based fuel and natural gas, as well as significant quantities of biofuels, such as ethanol.

The transportation modes and networks used to move fuel consists of the following:

- Pipelines for crude oil to Montreal, natural gas from Canada and refined petroleum products between Portland and Bangor;
- Railroads, including PanAm for natural gas liquids (NGL), including propane and butane, and selected amounts of crude oil;
- Trucks travel throughout the Maine highway system to transport refined fuels, propane, LNG and ethanol;
- Ships and barges transport crude oil, refined petroleum products, ethanol and other biofuels to the Ports of Portland and Searsport; and
- Truck tank trailer fleets and support services to enable the transport and local delivery of all fuels and natural gas in liquid form (LNG).

Selected petroleum products are described in this section, most of which are excerpted from the Maine Commodity Flow Study in 2015. They include the following:

- Compressed Natural Gas (CNG)
- Crude Oil

- Ethanol
- Methanol
- LNG and LPG

Compressed Natural Gas (CNG)

Due to the domestic availability of shale gas in the United States, Maine has seen a significant increase in the transportation of compressed natural gas (CNG) in recent years. CNG is delivered locally by tube trailers in Maine, and more delivery routes have been established since 2015. Major routes include the Maine Turnpike, U.S. 1, and ME 9. In 2014, annual volumes in Maine total 170,553,000 pounds transported by truck. For the year ending February 2015, the State imported 1,508 truckloads of CNG from Canada through Houlton, Maine, with a total of 303 million cubic feet of CNG imported through Houlton in 2014.[72] Figure B.1 depicts Maine CNG shipments in 2015.

Crude Oil

Crude oil has historically been transported through or around Maine to either Montreal by pipeline or to the New Brunswick Irving Refinery by rail. In 2013, the Portland Pipeline Company (PLC) transported 52,775,324 barrels of crude oil from tanker ships in South Portland to Montreal. However, crude volumes to Montreal have steadily dropped since the 2014 reversal of the Enbridge Pipeline. In 2016, 7,962,266 barrels were transported from South Portland to Montreal, a reduction of 85 percent. Crude by rail shipments have been shared by PanAm Railroad, in cooperation with New Brunswick and Maine Railways (NBM) by the newly formed Central Maine and Québec Railway Maine Central Railroad (PanAm) also in cooperation with NBM and by Maine Montreal and Atlantic (MMA) Railroad. Table B.1 displays these trends and Figure B.2 depicts crude oil transportation trends in 2015.

Table B.1 Maine Crude Oil Shipments
2013-2016 (In Barrels)

Pipeline or Railroad	2013	2014	2015	2016
Portland Pipeline (PLC)	52,775,324	32,609,995	22,154,429	7,962,266
Maine Central Railroad (MEC – PanAm) and New Brunswick and Maine Railways (NBM)	1,210,453	15,545		
Central Maine and Quebec (CMQ) and NBM		60		
Maine Montreal and Atlantic (MMA)	3,034,514			

Source: Maine Department of Environmental Protection.

Ethanol

Fuel blending regulations in the United States require significant volumes of ethanol to meet this requirement. Most of the ethanol is manufactured from corn oil in the Midwest and transported to east coast metropolitan areas and seaports by rail, where it is then moved by barge to New England and Maine. Some ethanol is transported to Maine by tanker truck, but most volumes are shipped by barge. Six ethanol

[72] U.S. Energy Information Administration.

facilities reported data in the Tier II inventory. All documented volumes of ethanol entering the State for delivery at these facilities is used for fuel blending with gasoline. Ethanol is stored in Searsport and in two facilities in South Portland. The facility in Searsport receives ethanol by tanker ship or barge, some of which is shipped by tank truck to Bangor. Two facilities in South Portland receive ethanol by barge and blend it with gasoline on site.

Barges offload only one-fifth of their load in Searsport, up to the capacity of shore-side tankage. There were at least 368 shipments of ethanol in Maine of any significant scale, eight by ship or barge, and 282 by truck. Trucks transported more than 15 million pounds of ethanol from Searsport to Bangor in at least 270 shipments. More than 660,000 pounds of ethanol was imported into Maine from Canada in 12 truck shipments through Jackman during the year ending February 2012. Figure B.3 displays ethanol shipments in Maine in 2015.

Liquid Natural Gas (LNG) and Liquefied Petroleum Gas (LPG)

Liquid natural gas is methane gas that has been cooled for storage purposes, then used later for heating. Once in place, LNG is reheated and placed into pipelines and transported as natural gas. LNG is not derived from methane but methane is the principal component of LNG. Natural gas contains the methane and trace amounts of other natural gas liquids, including propane and butane. It also is cooled for transportation purposes with approximately a 600 to 1 ratio, enabling LNG to be transported at a competitive cost. LNG is transported from Everett, Massachusetts throughout New England by truck, including Maine, and a total of 150,000 gals of LNG is stored in Lewiston. There were between three and four truck shipments per month from Everett, Massachusetts in 2015. The LNG is stored at Unitell, 95 River Road in Lewiston and the storage capacity is 605,000 lbs. Because of recent pipeline improvements in New England, LNG volumes by truck are expected to decrease since natural gas will be available by pipeline.[73]

Propane, also known as a Liquefied Petroleum Gas (LPG), is transported by rail and by truck to Maine, then widely distributed throughout the State by tanker truck. Propane terminals throughout the State provide an important fuel source for heating and cooking purposes. Other natural gas liquids such as butane also are transported to Maine in smaller quantities, primarily for fuel blending purposes during the winter months when motor fuels require higher octane levels.

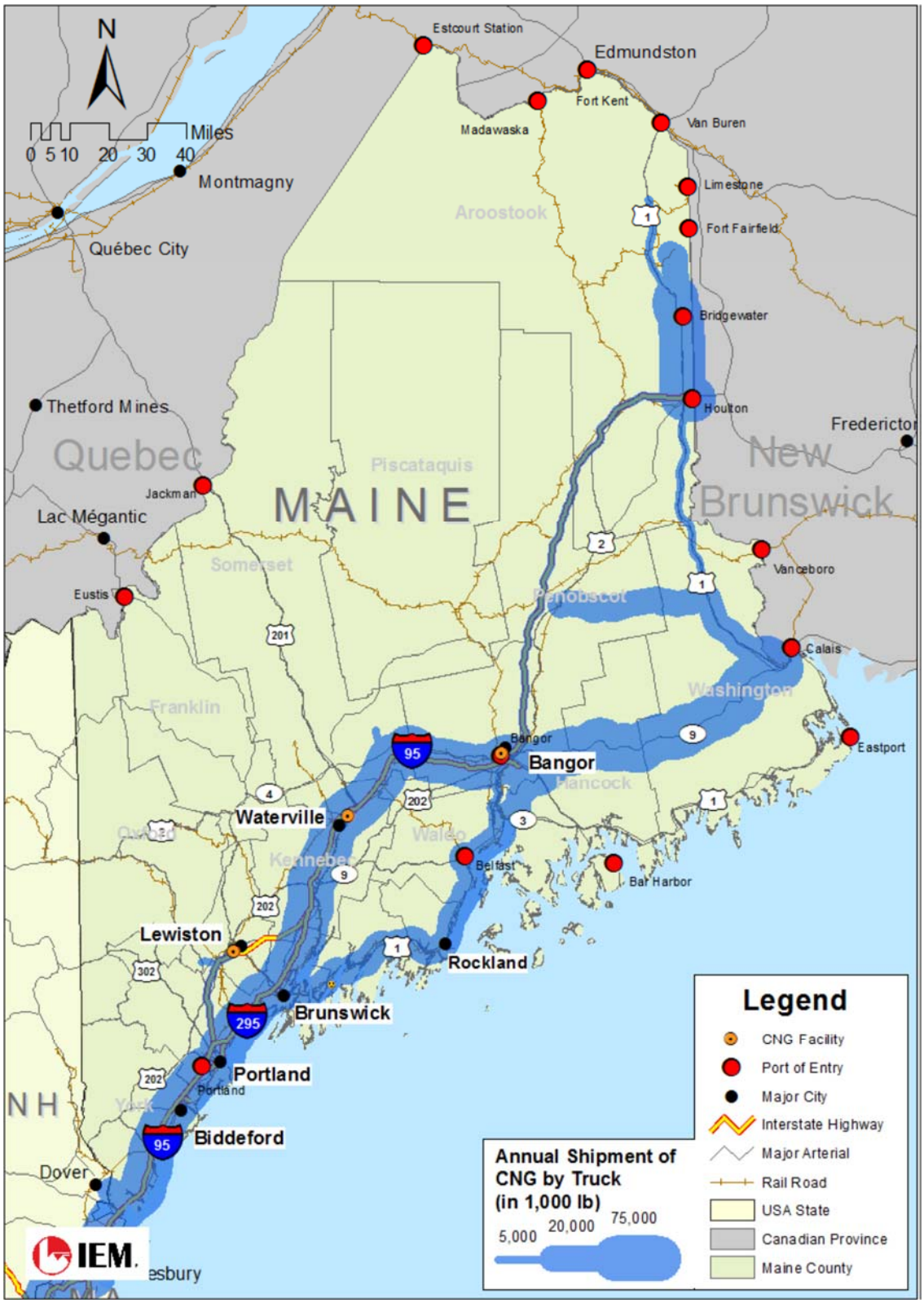
Figure B.4 depicts LNG truck shipments and propane rail shipments in Southern Maine and Figure B.5 depicts propane storage facilities.

Methanol

A total of 13 facilities stored methanol in Maine in 2014. Most facilities are either paper and fiber industries or propane dealers, though there are a few in other manufacturing industries. Methanol also is used as an anti-icing agent in propane tanks. Small amounts are added by propane distributors with each fill prior to and during the winter season to prevent icing of valve components. Half of the methanol is shipped by common carrier and the other half by tanker truck. There were close to 300 shipments per year of methanol in Maine in 2014. Almost 13 million pounds of methanol was imported into Maine from Canada in 274 truck shipments through Jackman and 30 shipments through Calais and Houlton. Figure B.6 depicts Maine's methanol shipments in 2015.

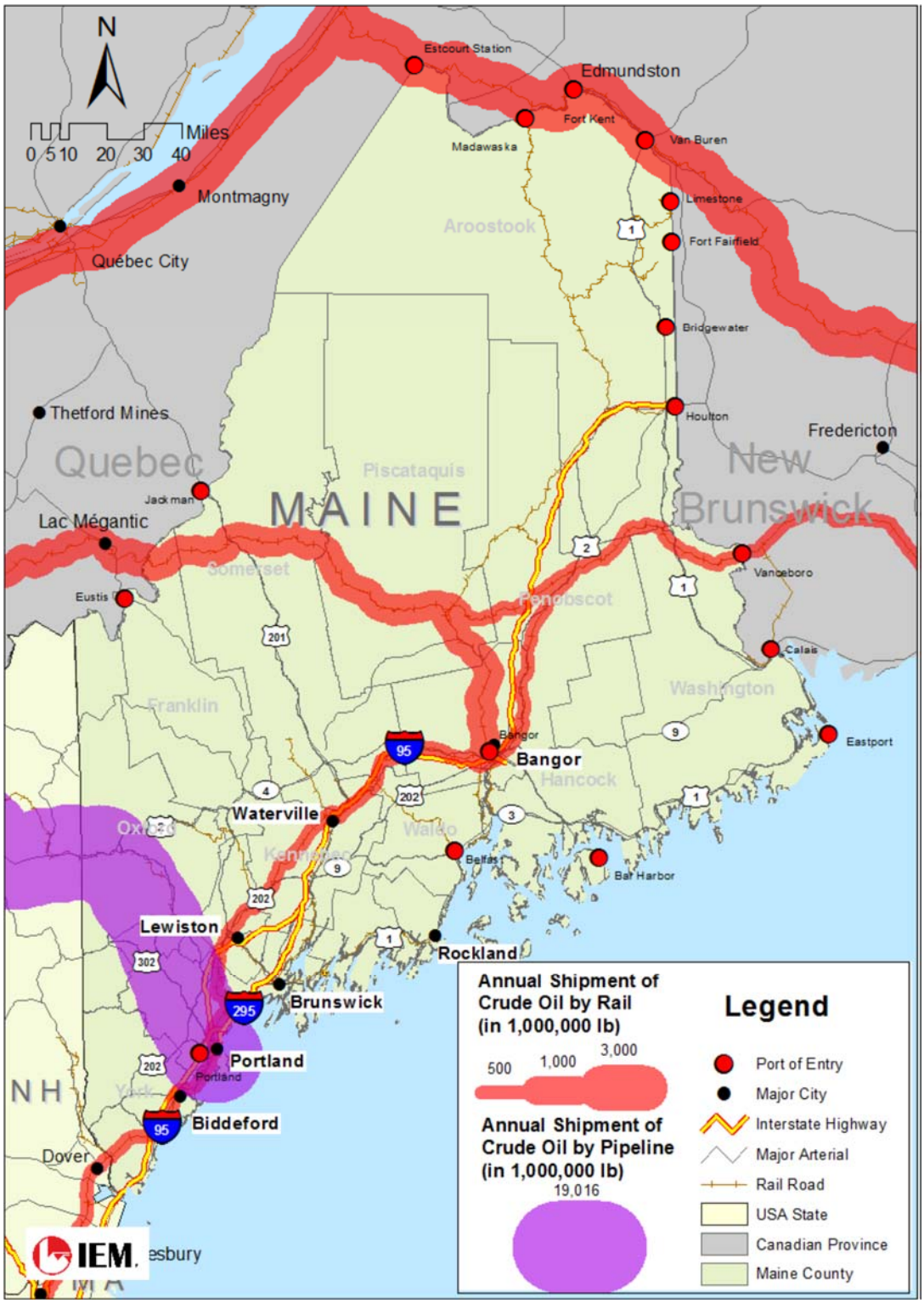
[73] Conversation with Engie, Inc. Officials, Everett, Massachusetts August 25, 2017.

Figure B.1 Maine Natural Gas (CNG) Shipments
2015



Source: Maine Commodity Flow Study of Hazardous Materials, 2015 (Maine Emergency Management Agency).

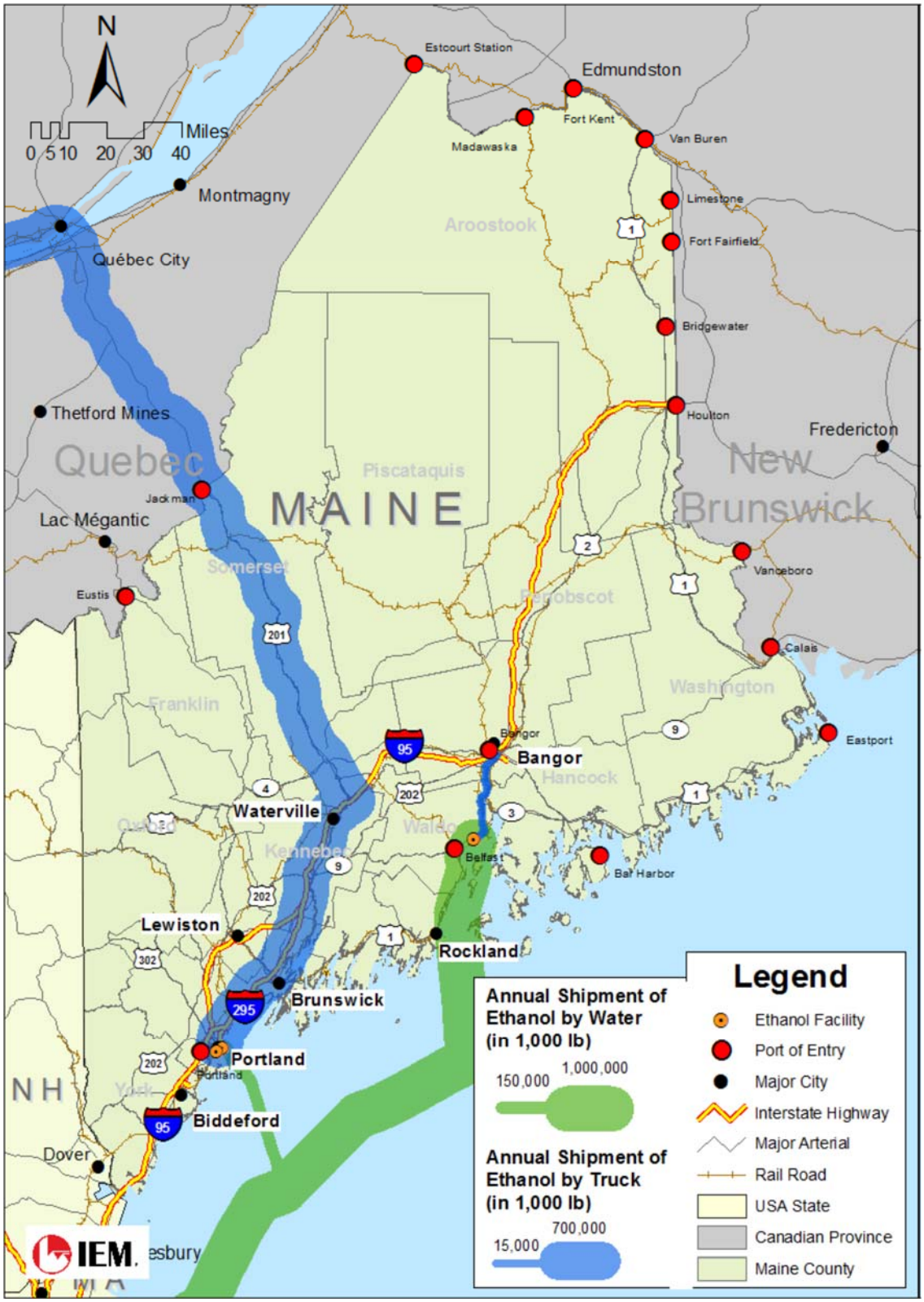
Figure B.2 Maine Crude Oil Shipments
2015



Source: Maine Commodity Flow Study of Hazardous Materials, 2015 (Maine Emergency Management Agency).

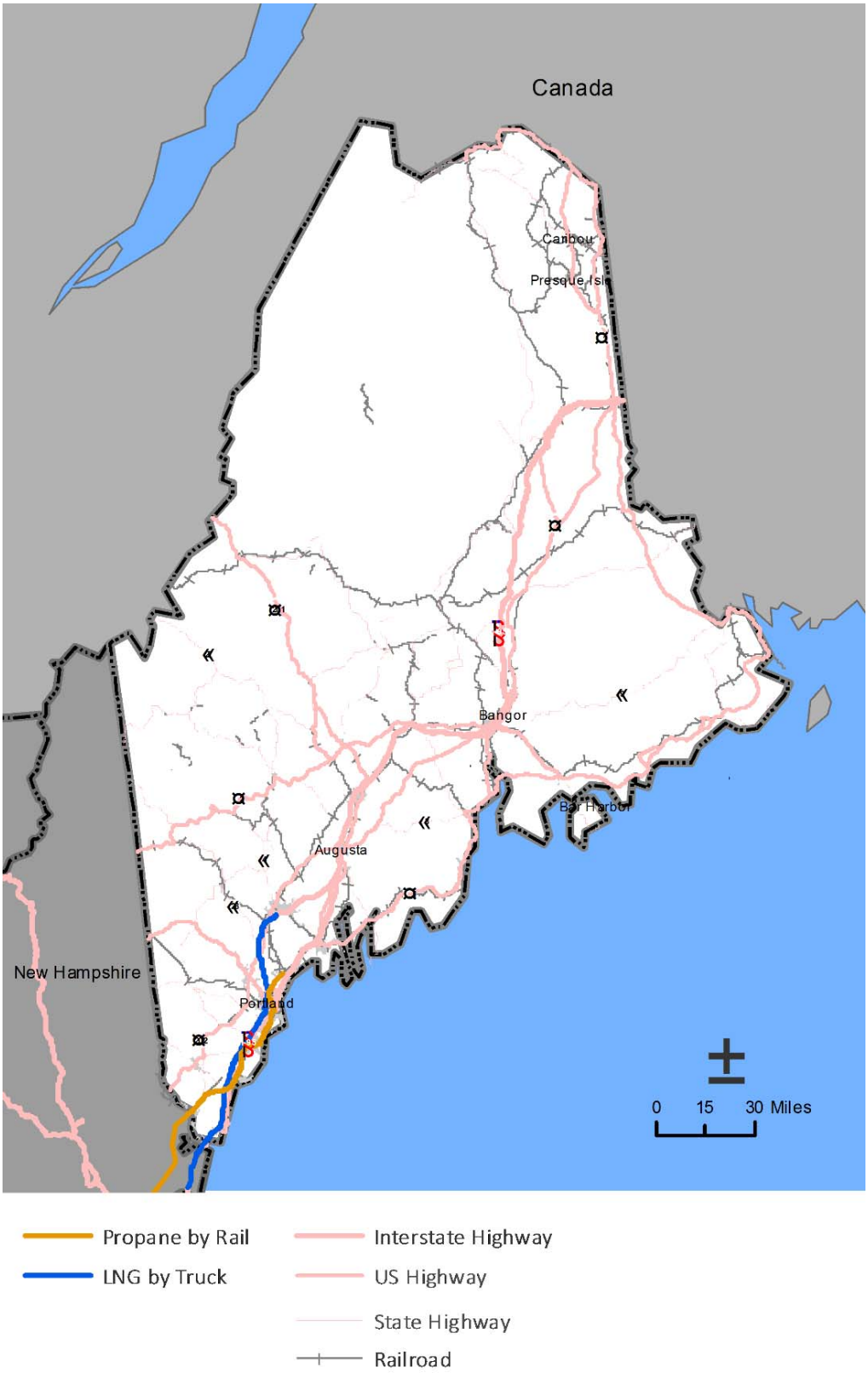
Note: The 2015 volumes depicted in Figure 2.10 reflect crude oil movements before the Enbridge Pipeline reversal in 2016.

Figure B.3 Maine Ethanol Shipments
2015



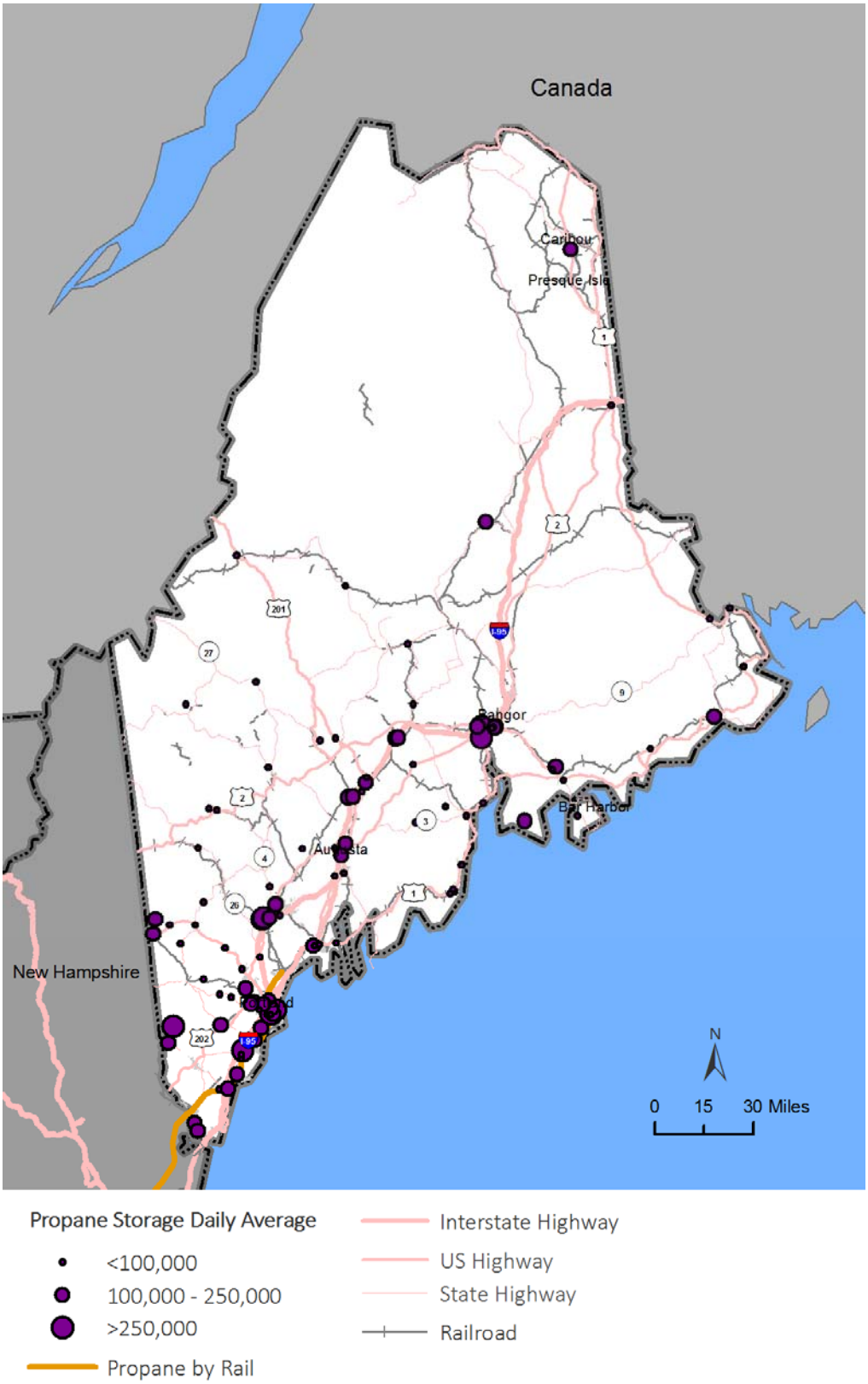
Source: Maine Commodity Flow Study of Hazardous Materials, 2015 (Maine Emergency Management Agency).

Figure B.4 Maine LNG and LPG Shipments



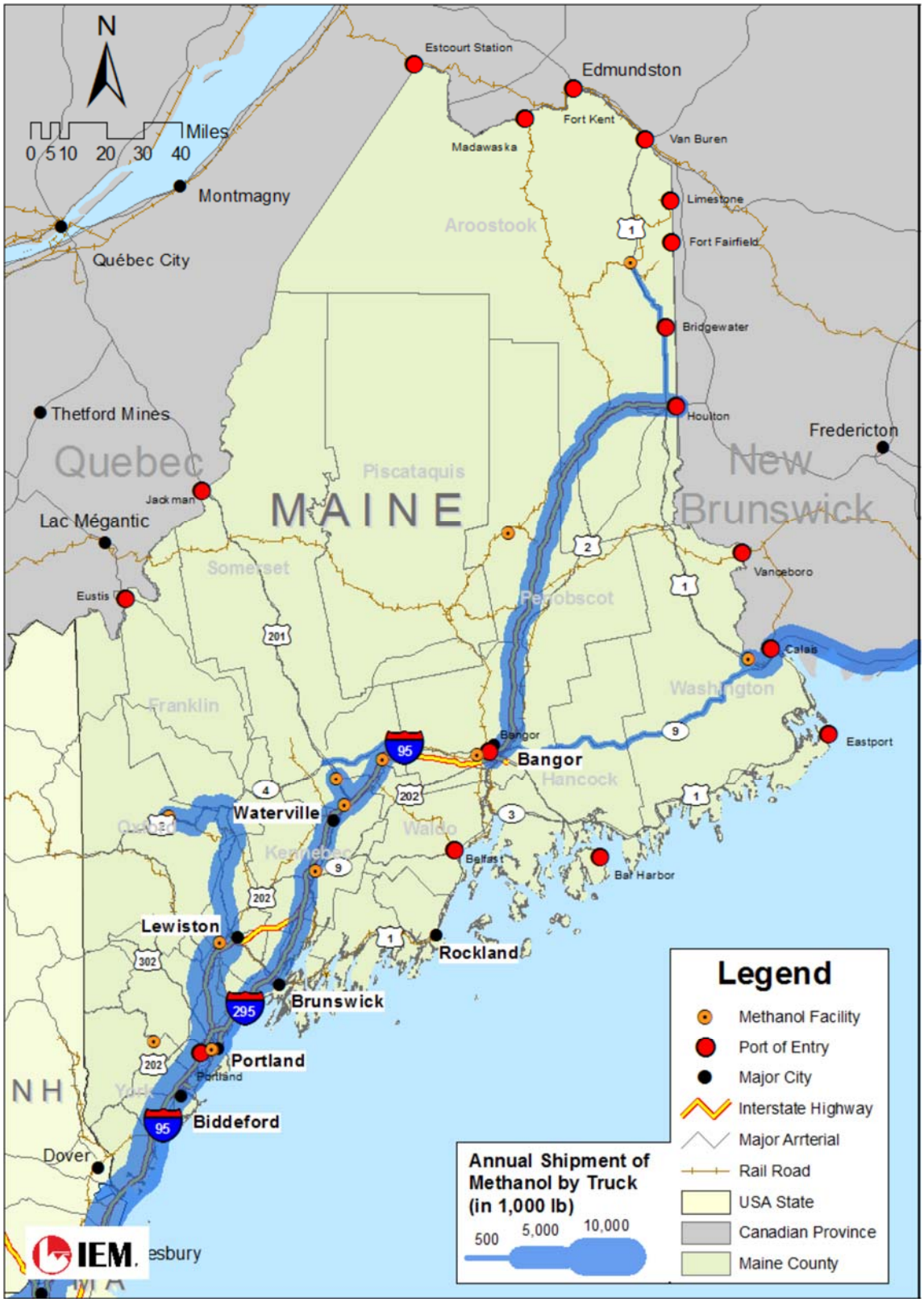
Source: Pan Am Railroad, MEMA, Consultant analysis.

Figure B.5 Maine Propane Storage Facilities



Source: MEMA Tier II Facilities Report, 2016, Consultant analysis.

Figure B.6 Maine Methanol Shipments
2015



Source: Maine Commodity Flow Study of Hazardous Materials, 2015 (Maine Emergency Management Agency).

Appendix C. Critical Urban and Critical Rural Freight Corridors

To qualify for Federal freight funding under the National Highway Freight Program (NHFP) as well as some Federal grant programs, freight projects must be located on, or improve, freight movement on the National Highway Freight Network (NHFN).

The NHFN is comprised of four component systems. The first two systems already have been designated by FHWA. The last two are identified by MaineDOT in consultation with regional and local planning partners. Together, the NHFN includes the following designations:

- **The Primary Highway Freight System (PHFS)** is a national network of highways identified by measurable national data as the most critical portions of the freight transportation system. In Maine, 416.32 miles of highway are identified in this category, including 406.1 miles of highway (I-95 and U.S. 201) and 10.21 miles of Intermodal Connectors.

- **Other Interstate highways not included on the Primary Highway Freight System.** This designation includes portions of Interstate highways not included on the PHFS. Three highways totaling 59.2 miles are, including in Maine: I-195 near Saco, I-295 in Portland, and I-395 near Bangor.

- **Critical Rural Freight Corridors (CRFC).** These are public roads not in urbanized areas that provide access to and connections from intermodal freight facilities on the PHFS and Interstate highways. Maine may designate up to 150.0 miles of rural corridors under this designation.

- **Critical Urban Freight Corridor (CUFC).** These are public roads in urbanized areas that provide access to and connections from intermodal freight facilities on the PHFS and Interstate highways. Maine may designate up to 75.0 miles of urban corridors under this designation.

A CRFC or CUFC must be certified by FHWA before NHFP funds may be authorized for a freight project. As a result, MaineDOT will continually evaluate and update corridor designations based on identified needs. This designation, and redesignation, process will take place on an ongoing basis in close coordination with stakeholders and FHWA.

Fast Act Requirements for Designating Critical Urban and Rural Freight Corridors

A CRFC must meet one or more of the following seven criteria:

A. Rural principal arterial roadway with a minimum of 25 percent of the annual average daily traffic of the road measured in passenger vehicle equivalent units from trucks.

B. Provides access to energy exploration, development, installation, or production areas.

C. Connects the PHFS or the Interstate System to facilities that handle more than: 50,000 20-foot equivalent units per year; or 500,000 tons per year of bulk commodities.

D. Provides access to a grain elevator, an agricultural facility, a mining facility, a forestry facility, or an intermodal facility.

E. Connect to an international port of entry.

F. Provides access to significant air, rail, water, or other freight facilities.

G. Is vital to improving the efficient movement of freight of importance to the economy of the State.

A CUFC must meet one or more of the following four criteria:

H. Connects an intermodal facility to the PHFS, the Interstate System, or an intermodal freight facility.

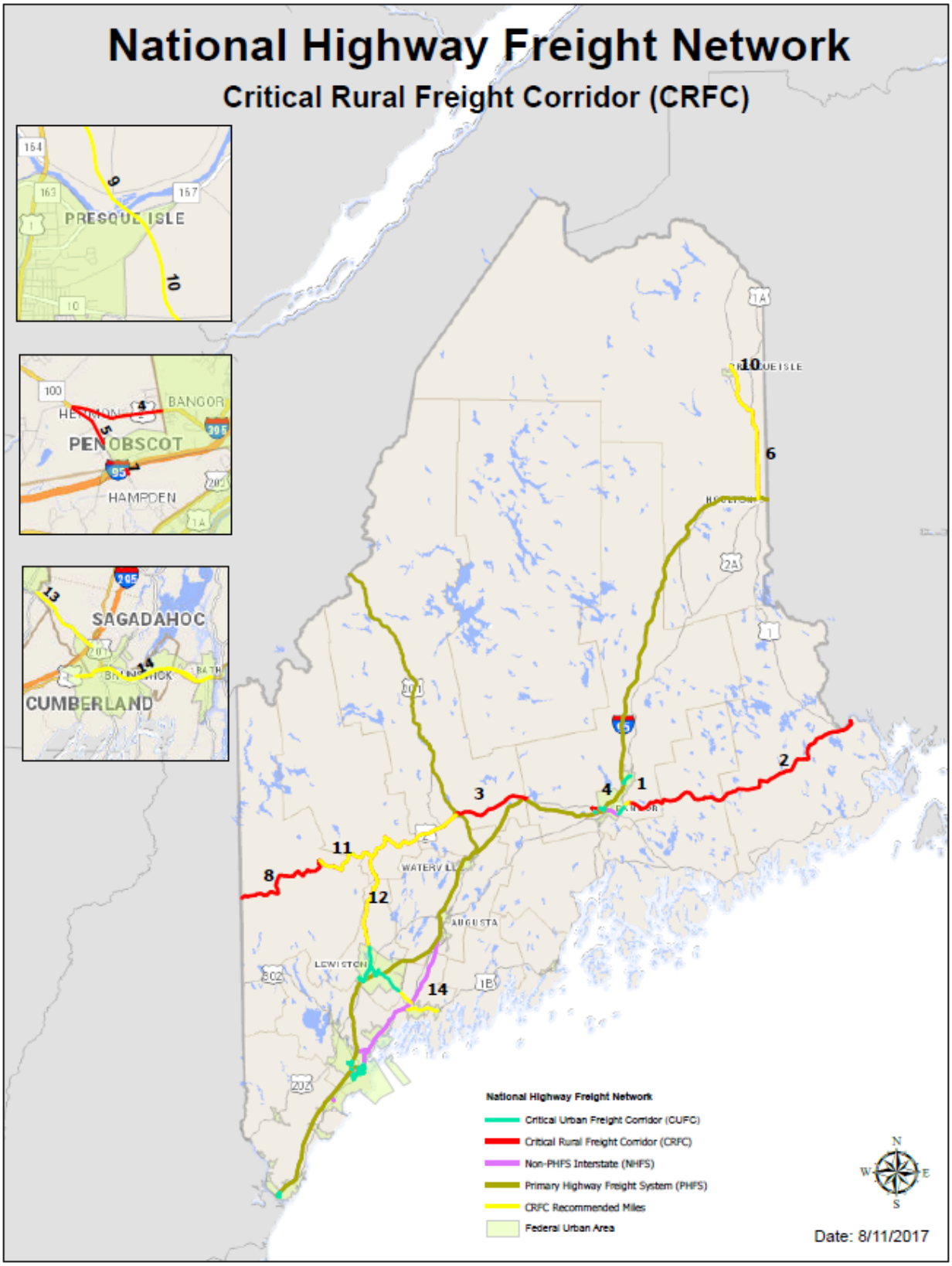
I. Located within a corridor of a route on the PHFS and provides an alternative highway option important to goods movement.

J. Serves a major freight generator, logistic center, or manufacturing and warehouse industrial land.

K. Is important to the movement of freight within the region, as determined by the MPO or the State.

Maine currently has designated 149.62 miles of CRFC and 72.64 miles of CUFC. These segments in addition to already designated NHFN are shown in Figure C.1 (CRFC in yellow and CUFC in teal) and Table C.1 on the following pages.

Figure C.1 Maine National Highway Freight Network



Source: MaineDOT.

Table C.1 Maine Critical Urban and Critical Rural Freight Corridors

Map ID	Route	Start Point	End Point	Miles	FAST Act Criteria ID[a]
Critical Urban Freight Corridors					
1	ME 103 (KACTS)	I-95 Exit 1 Dennett Road in Kittery	Shipyard Entrance	1.51	J
2	U.S. 1 Bypass (KACTS)	From New Hampshire Line (Sarah Mildred Long Bridge)	I-95 exit 2 via US1 Bypass and Traffic Circle	2.49	K
3	Scarborough Connector (PACTS)	U.S. 1	I-295 Exit 2	4.83	I
4	U.S. 1 (PACTS)	Scarborough Connector	I-295 Exit 4	3.80	I
5	Broadway/Casco Bay Bridge (PACTS)	PHFS ME 12 Commercial Street/Casco Bay Bridge	U.S. 1 near Cash Corner	4.84	K
6	Commercial/Franklin St. (PACTS)	PHFS ME 12P	I-295 Exit 7	3.53	H
7	Fore River Parkway (PACTS)	PHFS ME 2A/Congress St.	PHFS ME 4P/Fore River Parkway	1.81	H
8	Skyway Dr. (PACTS)	PHFS ME 2A near Jetport	I-95 Exit 46	0.41	K
9	Westbrook Arterial (PACTS)	I-95 Exit 47	25B/Main St.	3.03	K
10	Larrabee Road (PACTS)	Westbrook Arterial	I-95 Exit 49	1.15	K
11	ME 4 (ATRC)	Auburn/Turner Town Line	I-95 Exit 75	16.84	K
12	Kitty Hawk Avenue (ATRC)	Airport/Train Depot	I-95 Exit 75	2.54	J
13	Lincoln St. and Alfred Plourde Parkway (ATRC)	ME 4/Lincoln St. in Auburn	End of Alfred Plourde Parkway	6.06	K
14	Coldbrook Road (BACTS)	Urban Boundary near I-95 exit 180	Urban Boundary near RRX	0.86	K
15	U.S. 2 (BACTS)	Hermon/Bangor Town Line	I-95 Exit 182	1.62	K
16	Odlin Road (BACTS)	Hammond St.	I-395	0.94	K
17	Route 9 (BACTS)	End of I-395 on connector	Brewer/Eddington Town Line/Urban Boundary	2.96	K
18	U.S. 2A (BACTS)	I-95 Exit 193 on Stillwater Avenue	Main Street (Old Town)	3.43	K
19	ME 196 (ATRC)	I-95 Exit 80 Lewiston	Lisbon Urban Boundary	10.00	K
Total				**72.64**	

Map ID	Route	Start Point	End Point	Miles	FAST Act Criteria ID[a]
Critical Rural Freight Corridors					
1	ME 9	Brewer/Eddington Town Line	Route 9	2.48	A
6	U.S. 1	Houlton I-95 Exit 302	Presque Isle Urban Boundary	34.56	E
9	Presque Isle Bypass	Presque Isle Urban Boundary	End	2.42	G
10	Presque Isle Bypass	North end of Presque Isle Urban Boundary	End of PI Bypass	6.76	G
11	U.S. 2	Rumford Town Line	U.S. 201 in Skowhegan	57.28	A
12	ME 4	Turner/Auburn Town Line	Wilton Route 4/2 Intersection	30.66	A
13	ME 196	I-295 in Topsham	Lisbon Urban Boundary	5.25	G
14	U.S. 1	I-295 Exit 28	Washington St.	10.20	G
Total				**149.62**	

[a] For a guide to Fast Act Criteria ID, see: https://ops.fhwa.dot.gov/fastact/crfc/sec_1116_gdnce.pdf.

Appendix D. Freight Investment Plan

D.1 NHFP Freight Investment Plan

In addition to being located on, or improving movement on, the National Highway Freight Network, projects must be listed in a Freight Investment Plan (FIP) to qualify for Federal freight funding under the National Highway Freight Program (NHFP) as well as some Federal grant programs. Funding eligibility covers all planning, feasibility, preconstruction, mitigation, and construction activities for highway, bridge, and multimodal capacity, safety, and operational projects. Investments in technology, safety, operations, parking, security, and alternative fuels to improve system performance also are funded. Strategic planning, analysis, and data collections efforts also are funded through this program. Each fiscal year, up to 10 percent of NHFP funds may be used for intermodal or freight rail projects, including improvements located within private facilities.

The FIP must be fiscally constrained and document an investment approach for Federal funding, including sources of state matching funds. This appendix addresses these requirements and provides a framework for spending the approximately $29.4 million in Federal freight money expected through FY 2020 as shown in Table D.1.

Table D.1 Maine Freight Investment Plan

Project	Description	Project Cost	NHFP	Match	Source of Match
2018		**$10,811,500**	**$9,672,350**	**$1,139,150**	
Brunswick, I-295 On Ramp	Resurfacing – Beginning at Route 1 and extending westerly 0.89 of a mile (includes ramps for a total length of 1.89 miles).	$585,000	$526,500	$58,500	9095 State 57395000
Sherman-Medwy I-95 Southbound	Resurfacing – Beginning 1.89 miles north of Benedicta Twp. – Sherman town line and extending southerly 22.91 miles	$8,018,500	$7,176,150	$842,350	Advance Cons. For 315 Funds ($40,500); 9095 State 57395000 ($801,850)
Bangor – Alton I-95 Northbound	Resurfacing – Beginning 5.78 miles north of the Hampden town line and extending northerly 13.80 miles.	$2,208,000	$1,969,700	$238,300	Advance Cons. For 315 Funds ($15,000); 9095 State 57395000 ($223,300)
2019		**$10,047,000**	**$9,042,300**	**$1,004,700**	
Argyle – Howland I-95 Northbound	Resurfacing – Beginning at the Alton town line and extending north 15.16 miles to 1.54 miles northerly of the Howland town line.	$6,072,000	$5,464,800	$607,200	9095 State 57395000
Falmouth-Scarborough I-295 North & South	Resurfacing – Beginning at the Interstate 495 interchange and extending south 9.70 miles to the tollbooth and Interstate 295 northbound gaps.	$3,975,000	$3,577,500	$397,500	9095 State 57395000
2020		**$13,008,000**	**$10,705,584**	**$2,302,416**	
Medway-Herseytown I-95 Northbound	1 ¼" overlay - Medway-Herseytown I-95 Northbound Mile 241.47-254.17	$5,080,000	$4,180,840	$899,160	9095-State-2001001

Project	Description	Project Cost	NHFP	Match	Source of Match
Medway I-95 Southbound	Thin bond wearing surface - Medway town line to Forest Ave. Bridge I-95 Southbound Mile 63.25-112.8	$7,928,000	$6,524,744	$1,403,256	9095-State-2001001
2018-2020 Total		**$33,866,500**	**$29,420,234**	**$4,446,266**	

Source: MaineDOT.

D.2 INFRA/FASTLANE and TIGER Grants Awarded and Being Pursued

MaineDOT has pursued competitive Federal grant funds to great success in recent years:

- 2017 FASTLANE Grant worth $7.89 million to improve rail capacity on the Maine Northern Railway. This project will repair and upgrade 22 rail bridges to allow a 151-mile section of track to carry 286,000-pound rail cars.

- 2016 FASTLANE Grant worth $7.7 million towards the Maine Intermodal Port Productivity Project at Portland's International Marine Terminal. This is part of a $15.4 million effort involving funds from the state and private sector to add rail capacity, improve gate operations, purchase a new crane, and move the current maintenance facilities to expand space at the pier.

- 2015 TIGER Grant worth $20 million awarded to the Maine Regional Railways Project. Led by MaineDOT and backed by multiple private railways, this grant will go towards rehabilitating 384 miles of track. Rail lines and yards will be redesigned and improved to increase allowable speeds and allow for increased economic competitiveness.

- 2014 TIGER Grant worth $25 million to help replace the Sarah Mildred Long Bridge, also known as SML or the "Long Bridge." This critical piece of infrastructure provides a highway and rail crossing over the Piscataqua River connecting the towns of Kittery, Maine and Portsmouth, New Hampshire. The SML Bridge and nearby I-95 Bridge are estimated to provide a combined $8.4 billion to Maine's economy each year, and they provide access for 62 percent of all trucks crossing Maine borders. The proposed replacement will feature an integrated rail-highway deck for a lift span structure and a wider navigation opening. The lift span will allow taller ships to navigate the Piscataqua River and will lower for rail crossings; this innovative feature along with an increased deck elevation will reduce the number of bridge openings by 64 percent, reducing vehicular traffic and navigational delay costs. The bridge is scheduled to open in the fall of 2017.

Other major freight projects for which MaineDOT is pursuing federal funding in this year's competitive grant applications include:

- 2018 TIGER Grant application for Penquis Region Rural Bridges Project worth $21,772,440 (50/50 Federal and State match) to replace three key highway bridges in rural Maine that require near term replacement. These are critical to supply chains for business in the region and Maine's forest economy in Piscataquis and Penobscot Counties.

- 2018 INFRA Grant application for I-395 / Rt. 9 Connector, worth $79,250,000 (INFRA request $33,825,000), to build a new 6.1 mile limited access connector from I-395 in Brewer, ME to Rt. 9 in Eddington, ME, on the NHS and CUFC/CRFC network.