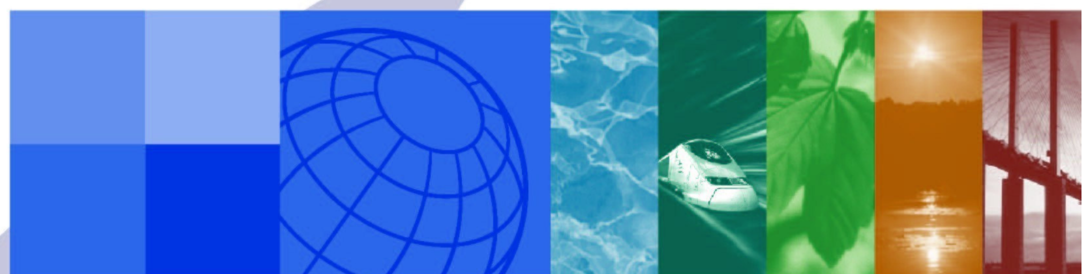
CPIP Consortium

Port of New York & New Jersey
Comprehensive Port Improvement Plan



Volume 1: The Plan

September 2005

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Contents

Volume 1: The Plan

Executive Summary

ES 1.1 *Introduction*

The Port of New York and New Jersey (the Port) plays a vital role in the economy of the New York/New Jersey metropolitan area. It is the largest container center on the East Coast and home to the largest auto and refined petroleum ports in the United States. The Port is unique in that it is a bi-state port that also supports one of the largest consumer demand regions in the world. As the demand for goods in the New York/New Jersey region has grown, the Port has developed in response, but until now without unified planning.

In 1999, the US Army Corps of Engineers (USACE) completed the Harbor Navigation Study (HNS) and Environmental Impact Statement (EIS), which evaluated navigation improvements to federal channels in the Port. This study recommended deepening channels to four general destinations within the Port to accommodate container ships with 50-foot draft. The HNS noted that the deeper channels would allow the volume of cargo presently handled by the Port to enter safely on fully loaded vessels, but also disclosed that existing Port infrastructure could not fully accommodate projected future cargo volumes in the coming decades.

In January 2000, port project sponsors, regulatory agencies, resource agencies and regional stakeholders executed a Memorandum of Understanding (MOU) for a Comprehensive Port Improvement Plan (CPIP). This MOU set forth a cooperative approach to develop a regionally supportable, unified plan (CPIP Plan) that would identify the improvements necessary to accommodate projected cargo volumes and respond to the need for an economically viable and environmentally sustainable Port. The CPIP Plan was initiated to address future cargo demand and port and transportation network capacity from the perspective of the Port as a whole, while also identifying port and associated transportation improvement options for each of the Port's individual facilities. The CPIP planning horizon extends from 2000 to the year 2060 - the year for which the USACE had previously forecasted cargo demand in its consideration of navigation improvements. The preparation of the CPIP Plan was directed and funded by the CPIP Consortium, comprising the Port Authority of New York & New Jersey, Empire State Development Corporation (ESDC), New Jersey Department of Transportation/Office of Maritime Resources (NJDOT/OMR) and New York City Economic Development Corporation (NYCEDC).

At the inception of the MOU it was considered that the CPIP Plan would have the potential to identify the need for several major federal, state, or local actions (e.g., actions to permit fill for expansion of port facilities, modification and/or expansion of existing transportation networks, channel improvements, and habitat enhancement and/or restoration projects, and wetland mitigation banks). Accordingly, in conjunction with the development of a CPIP Plan, the MOU foresaw the preparation of a CPIP Environmental Impact Statement (CPIP-EIS). The preparation of the CPIP-EIS was under the direction of the federal Co-Lead Agencies, comprising the US Environmental Protection Agency (USEPA), USACE and Federal Highway Administration (FHWA). ESDC, NJDOT/OMR and the New York City Office of the Deputy Mayor for Economic Development and Rebuilding were identified as the state and local Co-Lead Agencies, respectively. However, in August 2005 given the results of the CPIP Plan analyses, the federal Co-Lead agencies concluded that the preparation of a CPIP-EIS was not appropriate at the present time. Further information on this decision can be found in the separate "CPIP Environmental Assessment", which is a separate document completed by others.

The CPIP Plan's forecasts of future cargo volumes and assessments of port facility and transportation network capacity indicate that the overall capacity in the Port is sufficient for several decades, such that implementation of significant port improvements is not required in the near-term, beyond those port and transportation projects that are currently programmed and committed. In addition, the acreage of wetland and waterfront fill needed to create new land to accommodate forecasted cargo volumes was found to be substantially less than was assumed at the outset of CPIP.

ES 1.2 The Study Process for the CPIP Plan

The study was divided into four components:

- Forecasting cargo demand;
- Examining the capacity of existing port, highway and rail infrastructure;
- Developing terminal and landside transportation improvement options to cater for any shortfall in capacity;
- Evaluating alternatives and reporting.

A program of public involvement activities has been incorporated in the study method. A Stakeholder committee was formed, outreach meetings held, newsletters and data sheets issued and a project website maintained. All interim technical memoranda have been published on the website; www.cpiponline.org.

ES 1.3 *Forecast Demand*

The basic steps in arriving at the forecast of cargo demand for the Port were:

(i) Forecast the overall US trade;
(ii) Forecast the share of that trade that will be handled by the Port assuming the Port and all competing ports have the same relative accessibility for the shipping fleet as at present;
(iii) Adjust the share to account for changes in Port accessibility and other factors relative to competing ports;
(iv) Assign the proportion of total Port throughput to be handled by the baseline cargo terminals.

The modeling enabled the importance of dredged channel depth on demand to be investigated. Four cases were examined in which the Port's channels were deepened to either 45' or 50' with competitor's channels remaining at their existing depths or being deepened to match the Port's deepening program. Although more cargo demand could be expected if the Port of New York and New Jersey was the only port to deepen its channels, a more realistic situation was for the Port's competitors to also deepen. The cargo demand in the table below corresponds to the case adopted for the rest of the study, i.e. Port's channels being deepened to 50' and assumes channels at competing ports are dredged to the same depth.

Cargo Type	2060 Forecast Demand	Units
Containers	11,300,000	TEU
Automobiles	1,100,000	units
General Cargo	2,530,000	tons
Dry Bulk Cargo	6,170,000	tons
Liquid Bulk Cargo	5,090,000	tons

Table ES 1 2060 cargo demand

ES 1.4 *Forecast Vessel Fleet*

Demand at a port is dependent on its ability to accept the size of ships in the markets served by the Port. In the process of defining the demand for cargo at the Port it was therefore necessary to consider the vessel fleet that would wish to call at the Port between the years 2000 and 2060. The results of this analysis were also used to determine future berth lengths, berth dredged pocket sizes, and navigability in the berthing channels.

This study looked at:

- Container ships;
- Car carriers;
- General cargo ships;
- Dry bulk carriers;
- Tankers.

In contrast to other vessels using the baseline facilities in the Port the size of container ships has been steadily increasing over the years, and the increase shows little sign of stopping. Taken in combination with the importance of the container trade to the Port this trend has led to the need to pay particular attention in the study to the future size of container ships.

Car carriers, unlike containerships, are not forecast to increase significantly in size beyond the typical maximum size of 6,000 passenger car units (pcu) currently in operation, although their call frequency and batch volume will vary to accommodate seasonal fluctuations and underlying growth in demand.

The size of the general cargo vessel fleet is gradually declining and being replaced by handy-sized bulk-carriers and semi-containerships. There are relatively few new general cargo ships on order today and the current world fleet looks old. The reason for this decline is more or less explained by the containerization of most cargo, or the switch to using semi-bulk techniques by smaller bulk carriers. The current average size of general cargo ships and their replacements of around 21,000 DWT (15,000 GT) is likely to continue.

The majority of bulk carriers calling at the Port are of 'Handysize' and 'Handymax' dimensions (20-35,000 DWT and 35-50,000 DWT respectively), the typical workhorses of the dry bulk trades. Panamax bulk carriers (typically 60-80,000 DWT) that are involved in the high volume bulk trades such as coal and grain are not prevalent at the Port. It is not the trend for handy-size bulk carriers, such as those that typically call at the Port, to increase in size, but rather that growth in demand will be accommodated by increases in frequency of calls.

ES 1.5 Terminal Capacity

There are over 500 docks, wharves and piers in the Port and on Long Island, and a filtering exercise was undertaken to develop and agree a list of baseline terminals. The seventeen terminals on the baseline list handled 99% of the all import/export reported by the PANYNJ and US Customs in 1999. Capacity improvements at some terminals were ongoing during the study period and those improvements were included in baseline infrastructure for the terminals, for example, berth strengthening and deepening at Port Elizabeth.

Six steps in the cargo handling process at each terminal were investigated to arrive at a terminal's capacity:

Step 1: Vessel accommodation at the berth;
Step 2: Vessel loading/unloading;
Step 3: Cargo handling between vessel and yard;
Step 4: Yard storage;
Step 5: Cargo handling between yard and gate;
Step 6: Passage through the gate.

The limiting capacity for any given terminal was taken to be the least of the capacities of each of the individual steps in the operation.

Cargo type	Units	Actual throughput 2001	Existing capacity 2005	Forecast demand 2060
Containers	TEU	3,300,000	8,600,000	11,300,000
Automobiles	units	603,000	930,000	1,100,000
General Cargo	tons	850,000	3,680,000	2,530,000
Dry Bulk	tons	2,240,000	4,860,000	6,170,000
Liquid Bulk	tons	2,340,000	5,700,000	5,090,000

Table ES 2 Port capacity

The terminal capacity assessment indicated that by the time the current improvement projects are complete the existing container facilities at the port should be able to handle 8.6 million TEU/year without major capital investment and expansion. The capacity falls short of the 2060 demand forecast and additional improvements to increase capacity for containers, dry bulks and automobiles will be needed in the future.

ES 1.6 Facilities to Meet Demand

The capacity analysis demonstrated there would be shortfalls for some cargo types before the end of the study period and likely increases in land productivity were investigated to improve capacities. In the case of containers these improvements included, for example; the phasing in of high density grounded stacking systems.

The land required in 2060 for each type of cargo was calculated using the forecast demand and the estimated land productivity. The results are shown in Table ES 3.

Considering existing port facilities at Port Newark, Port Elizabeth, Port Jersey, Bayonne Peninsula, Howland Hook, North Brooklyn and South Brooklyn, 2,780 acres are available for cargo handling activities. This acreage is sufficient for the terminal land requirement of 2,138 acres plus an additional area of 632 acres for road and rail access, warehousing and off-terminal support.

It was concluded that the available land in the Port is sufficient, at the estimated productivities, to meet the forecast demand without the need for major aquatic or wetland fill projects.

Cargo type	**Land productivity (/acre/year)**	**Forecast demand**	**Land requirement (acres)**
Containers	5000 lifts	6,647,000* lifts	1,329
Automobiles	1,900 units	1,100,000 units	579
General Cargo	20,100 tons	2,530,000 tons	126
Dry Bulk	71,500 tons	6,170,000 tons	86
Liquid Bulk	285,000 tons	5,090,000 tons	18
		TOTAL	**2,138**

Table ES 3 2060 Land requirements

* Corresponds to 11.3 million TEU

ES 1.7 Cargo Terminal Improvements

Although enough land is available in the Port, currently it is not optimally arranged to serve the future demands for different types of cargo. A land allocation exercise was completed to distribute land areas to different cargo types based on a wide range of considerations:

- Forecast demand and future capacity by cargo type;
- Land area and waterfront availability;
- Shipping and inland transportation access;
- Existing infrastructure and superstructure;
- Cargo handling and storage;
- Land ownership and tenant lease holding;
- Capital and operating costs;
- Natural environment;
- Community and stakeholder interests;
- Commercial and political aspirations.

From this assessment, over thirty Options for cargo terminals were derived. The cargo terminal Options were assembled into Scenarios which were designed such that the demand for all cargo types would be met or exceeded by the Scenario arrangement. Scenario development was informed by the output from numerous recent port planning studies.

ES 1.8 *Mode Shares*

Today cargo leaves the Port by three modes; truck, rail or barge. In the case of containers, about 85% leave by truck, about 14% by train and the remainder by barge. For containers in particular there is an aspiration to increase the mode share carried by rail. The PIDN hopes to achieve a 23% mode share to rail by 2010 and 33% by 2020.

A strategy for encouraging mode shift to rail, based on revenue support to the railroads, was developed. There are societal benefits of mode shift from truck to rail and those benefits could be offset against the cost of providing revenue support to railroads delivering containers inside their accepted traditional market boundary, i.e. closer than 400 miles from the port. Such a scheme is successfully operated in the UK.

Five case studies were presented that looked at the inland delivery of containers in Europe. It is concluded that waterborne freight can be effective in winning market share over relatively short distances where large traffic concentrations are available, e.g. barge transport along the Rhine. Rail services can also be viable over very short distances provided there is a competitive environment with service support.

ES 1.9 *Highway Improvements*

The impact of Port trucks on the regional highway network, the highway corridors defined in the CPIP study and the local Port terminal connector roads which link the port terminals to the corridors was investigated. Port trucks have been defined in this study as the initial, or primary, movement of goods between Port terminals and their origin/destination.

The network is severely congested today. During the morning and evening rush hours much of the highway system serving the region and the Port operates at or above its capacity.

A traffic demand model was used to ascertain traffic on the highways. There are a number of models available in the region although none were ideally suited for this bi-state study. The NJDOT Truck Model, a regional and strategic model, with a coarse network requiring off-model analysis to consider movements close to the port terminals, was found to be the most suitable. The NJTPA and NYMTC models were used, along with local traffic counts, to provide peak-period figures.

Two series of analyses were completed; a base case in which it was assumed that all future cargo demand was handled at the existing Port terminals and a second series in which terminal development followed the pattern defined in the land allocation Scenarios described earlier.

Regionally, the analysis indicated that port-related truck trips represent significantly less than one percent of total trips on the regional network. The percentage is expected to increase marginally from 0.05% in 2000 to about 0.09% by 2060.

Analysis at a corridor level enabled routes important for goods movement to and from the Port to be identified. For the baseline case and the Scenario analyses even the most important routes, the I-95, I-78 and the Inner Port corridor were shown to accommodate low percentages of Port related traffic, ranging from about 1.6% on the I-78 corridor to about 9.5% on the Inner Port corridor, which include the Port area connector roads.

As expected, Port related trucks form the greatest percentage of total traffic on the connector roads adjacent to the terminals. For example, in 2060 port trucks on Doremus Avenue are expected to range between 58% and 63% of total traffic depending on scenario.

Highway improvements will be required across the highway network to reduce the delays and traffic congestion over the study period. Most of these improvements will be in response to growth in general background traffic and to growth related to other development initiatives unrelated to the Port (e.g. Peninsula Project at Bayonne). In CPIP, thresholds were set to identify traffic conditions resulting from Port growth and CPIP terminal scenarios. CPIP highway improvement recommendations were developed in those cases where these thresholds were met or exceeded.

In order to be considered as Port-related, an improvement had to be on a segment of roadway on which at least ten percent of the traffic was Port-related. Improvements were then considered on those roadways for which:

- There was an increase in traffic volume in the roadway segment of at least 5% over baseline growth values; or

- There was an increase in the volume to capacity (V/C) ratio in the roadway segment of at least 2% over baseline growth values.

Roadway segment improvements for 2020 were assumed to be necessary if a roadway peak hour V/C for a Scenario was 'near capacity' (0.86) or greater and for 2060 if V/C for a Scenario was 'at capacity' (0.96) or greater. Improvements comprised provision of additional lanes which can reasonably be accommodated without major disruption of adjacent facilities.

Signalized intersection improvements were triggered by the same criteria for V/C. Improvements comprised either adjustment of signal operation or provision of additional turn lanes by local widening that can reasonably be accommodated without major disruption of adjacent facilities.

Improvements range from relatively minor changes to lane configurations to widening projects that may encroach on Port area private property but without major disruption to adjacent facilities.

A summary of highway improvements is given in Table ES 4 below.

Project Type	Description	Number of Projects[1]		Total Estimated Costs	
		2020	2060	2020	2060
Intersection Signalization Improvements	Installing signals at unsignalized intersections. Upgrading existing traffic signals to accommodate widening/additional lanes. Implementing timing changes or new controllers at existing signalized intersections.	22	6	$6,600,000	$1,800,000
Intersection Approach Roadway Widening	Widening intersection approach/departure roadways for additional turn or thru lanes.	6	4	$7,200,000	$4,800,000
Roadway Widening	Constructing additional travel lanes on mainline roadway segments.	14	4	$54,874,800	$15,120,000
Interchange Ramp Modifications	Modifying or constructing new ramps at existing grade–separated interchanges.	3	1	$3,340,000	$1,050,000
Grade-Separated Structure Widening	Bridge widening to provide additional travel lanes for roadway segments on structure.	3	0	$3,024,000	$0

Table ES 4 Highway improvement summary

Costs at 2003 constant US dollars

[1] Some locations have more than one type of project

ES 1.10 Rail Improvements

There is an extensive network of rail lines, yards and terminals around the Port. The rail freight infrastructure is divided by the Hudson River, and services on the West-of-Hudson infrastructure have traditionally been superior to those on the east. Overall the freight system is constrained by; clearance and weight restrictions, conflicts with passenger services and capacity pinch-points. CSX Transportation and Norfolk Southern Railway are the main railroads serving the port.

Rail infrastructure serving the port was split into five components; on dock terminals, railroad yards, railroads terminals, the Conrail shared assets system and the wider railroad network.

There is an ongoing program of on dock rail terminal development in the port. ExpressRail is being expanded and new terminals are being built to serve the Port Newark Container Terminal and Howland Hook. Additions to these terminals and the provision of terminals at Port Jersey and South Brooklyn will cater for container demand through the study period.

Railroad terminals are commercial rail terminals for the origination, receipt and modal transfer of rail traffic. They may encompass any or all of the traffics handled by the on dock terminals and in some cases traffic may be drayed by truck from maritime terminals to an appropriate railroad owned terminal for its onward journey by rail.

Railroad yards are principally operational facilities for the building and breaking down of trains and traffic blocks, and the interchange of individual freight cars and blocks between trains. At some yards interchange will be taking place between the trains of different railroads. Generally railroads take an evolutionary approach to the way they use their yards and terminals. If yards become constrained the railroads will move to building trains closer to on-dock terminals. Railroad yard capacity is unlikely to be a problem during the study period.

The capacity of freight rail corridors and segments was ascertained in a spreadsheet based model. As with the terminal capacity and highway work a baseline analysis was completed along with analyses of the terminal development scenarios and two rail mode shares.

The results of the analysis indicated that improvements to the network would be required as listed on Tables ES 5 and ES 6.

Location	Description
CP Croxton, National Docks Secondary	2nd track, to CP Nave, required 2015/2020
PN – Rahway, Chemical Coast	Additional track on this segment, required 2020/2030
Newark – Aldene, Lehigh Line	Third track on this segment, required 2030/2040
Rahway – CP PD, Chemical Coast	Third track on this segment, required 2040

Table ES 5 Rail improvements - shared assets

Location	Description
Allentown – Montreal, Canadian Pacific	a) Second track between CP648 and Hallstead, PA; required 2030 b) Second track between Taylor Yard, Pa and CP 650, required 2050
. River Line, CSX	a) Second track between Kingston NY (milepost 90.5) and CP118; required 2005 b) Second track between CP24 and CP87, required 2005/2015
Pennsylvania Route, Norfolk Southern	a) Second track between CP Blandon and CP Laurel, required 2005. Work already planned, and therefore not costed. b) Third track between Rockville and CP Cannon, required by 2020 c) Third track between CP Cannon and CP Gray, required 2040. Difficult terrain.
Selkirk – Boston, CSX	a) Second track between CP123 and CP109, required 2020/2030 b) Second track between CP SM and State Line Tunnel, required 2020/2040 c) Second track between CP92 and CP64, required 2020/2040

Table ES 6 Rail improvements wider network

ES 1.11 Cost Estimate, Financial Analysis, Economic Analysis and Risk

Preliminary cost estimates for the terminal, rail and highway improvements were completed based on mid 2003 rates. In addition, a financial analysis of port terminal Options was prepared to arrive at the NPV of the investment based on a real discount rate of 7%. The cost estimate and breakeven price per TEU for container terminal Options is summarized in the table below:

Rank	Option		Additional capacity (000 TEU)	Improvement cost $m	Breakeven price per TEU $
1	**C12**	Port Elizabeth	672	12	139
2	**C13**	Port Elizabeth	912	33	143
3	**C3**	Port Elizabeth	1,777	133	146
4	**C4**	Port Elizabeth	1,209	94	148
5	**C2**	Port Newark South	1,025	97	151
6	**C9**	Bayonne Peninsula	1,275	215	156
7	**C1**	Port Newark South	345	24	157
8	**C8**	Bayonne Peninsula	850	179	162
9	**C11**	Howland Hook	282	55	168
10	**C6**	Port Jersey	765	187	168
11	**C7**	Port Jersey	965	217	174
12	**C14**	South Brooklyn	2,210	890	187
13	**C10**	Howland Hook	843	282	191
14	**C5**	Port Jersey	200	74	213

Table ES 7 Summary of container terminal option costs

On a breakeven price basis, the top ranked container terminal Options are in Port Elizabeth. These Options do not expand the terminal areas and the new infrastructure provides for new and deepened berths. An expanded terminal at Howland Hook and an unexpanded terminal at Port Jersey with an additional berth fare badly in the ranking. However, based on a Port terminal charge of approximately $200 the analysis shows most projects would operate within the parameters of existing port charges.

Improvements to the local highway connectors around the port terminals are estimated to cost in the order of $98m at mid 2003 prices. Most of the signalization work and intersection approach lane additions/widening will be needed in the next fifteen to twenty years. The variation in estimated highway improvement cost across the cargo terminal Scenarios is just over 4%.

The four rail infrastructure capacity improvements on the Conrail Shared Assets area cost in the order of $400m and those on the wider system $1,200m at mid 2003 prices.

The economic impact of container and automobile terminal development was assessed based on economic coefficients developed by the New York Shipping Association for the 26-county Port Region. The coefficients are functions of throughput and it follows that those projects offering the greatest additional capacity will have the greatest benefit. For example, the best performing container terminal projects are those at South Brooklyn and Port Elizabeth which offer more than 1 million TEU of incremental capacity.

A risk assessment for the plan was completed and the headline risks are summarized in the table below:

Risk	Mitigation
Forecast demand too low or too high	Review at regular intervals and update when assumptions change, i.e. when the Panama Canal is widened.
Bayonne Bridge air draft restriction	Monitor plans for raising bridge and future ship design parameters.
Failure to obtain necessary approvals	Manage permitting process
Land allocated for other uses	Keep plan under review
Highways reach capacity and limit the movement of port goods by truck.	Monitor capacity and provide capacity enhancements or mode alternatives
Railroads concentrate on alternative business opportunities or fail to offer services to increase mode share	Review rail demand and provide policy and support to drive innovation
CPIP planning ignored	Convene body with port-wide oversight

Table ES 8 Summarized risk table

ES 1.12 Environment

The main environmental issues that were expected when the study commenced were in connection with the anticipated need for substantial areas of waterfront fill which had been identified in previous studies. As this need for fill was shown to be superseded by recent advances in cargo handling efficiencies at container terminals, the expected environmental issues did not emerge.

There are areas of wetland impacted by the development of some of the terminal options. The largest area is at Port Elizabeth where a container terminal expands onto the Allied Signals property. Twenty seven acres of wetland are destroyed which have been compensated for on a 3 to 1 basis in the financial analysis.

Other environmental issues were considered in the development of terminal options including light, noise, dust and odors, air quality and public waterfront access.

Some cargo entering the Port will be destined for warehousing in the Port region. Investigations were undertaken to define the future requirements for warehouse space and to demonstrate that the warehousing related to ocean borne cargo did not require the use of wetlands. There are many sites in New Jersey adjacent to the Port and the I-95 corridor that have been designated as freight opportunity sites. The additional land required for warehousing amounts to about 300 acres by 2060 and the land available in the freight opportunities site database is over 4,000 acres. The work demonstrated that warehousing related to ocean borne cargo did not require the use of wetlands.

"Green" port initiatives involve environmentally sound actions that comply with, or exceed, existing regulatory requirements. The following opportunities have been assessed.

- Fill avoidance and minimization;
- Ecosystem restoration;
- Dredging avoidance and minimization;
- Brownfields;
- Community/tenant relations and environmental stewardship;
- Waterfront access;
- Air quality and emissions reduction;
- Green buildings;
- Alternative construction materials and recycling;
- Stormwater discharges;
- Oil spills;
- Ship and port-generated solid waste;
- Beneficial landscaping;
- Threatened and endangered species.

For additional information on environmental considerations associated with CPIP, please consult the "Comprehensive Port Improvement Plan Environmental Assessment" a separate document completed by others.

ES 1.13 *Linkages to Policy and Plans*

There are a number of plans and initiatives in the Port region that have an impact on the CPIP Plan, including the Cross Harbor Freight Movement Study, Portway, the NYMTC Regional Freight Plan and the Port Inland Distribution Network.

The Cross Harbor Freight Movement Study examines ways of improving the movement of goods throughout northern New Jersey and southern New York. The study investigated four alternatives; a no action alternative, a traffic systems management alternative, an expanded float operation and freight tunnels. The DEIS identifies the New Jersey alignment as the preferred alternative. The development of a new container terminal in South Brooklyn is not a precondition for the development of the rail tunnel. However, a new container terminal will need good intermodal rail access to the West of Hudson to be competitive. A cross harbor tunnel would provide this.

Portway Phase 1 has provided a series of port linked projects to improve intermodal and roadway connections, relieve congestion, meet future travel demands and promote economic development in the area around the approaches to Port Elizabeth and Port Newark. The Portway Extensions Concept Development study followed on from Phase 1 and considered:

- System and operational improvements, e.g. off-peak freight operations;
- Non-roadway infrastructure, e.g. elimination of height and weight restrictions;
- Selected roadway; enhancements, e.g. truck priority and truck only facilities.

The Portway projects have helped alleviate congestion and will continue to assist in goods movement to and from the Port.

The purpose of the NYMTC Regional Freight Plan is to develop a roadmap for improving freight transportation in the NYMTC region. The freight plan presents multimodal capital projects, operational improvements, and policy changes.

The Regional Freight Plan's recommendations were formulated to meet the following objectives:

- Reduce future truck volumes on some roadways;
- Improve traffic operations on some roadways;
- Increase rail mode share in the region;
- Improve environmental quality;
- Create a more efficient and cost-effective freight delivery system.

Achieving the goals of the NYMTC Regional Freight Plan will improve the movement of goods to and from the Port. However, some of the actions will have greater impact than others; for example, improving the Eastern Corridor (I-278) will have more of an impact than works on the JFK Airport Corridor.

The Port Inland Distribution Network is a new system for distributing containers moving through the Port. PIDN's primary goals are to:

- Reduce inland distribution costs;
- Reduce truck trips (i.e. vehicle miles traveled -VMTs);
- Improve air quality;
- Increase throughput capacity;
- Increase market share.

The study examined the origin and destination of containers entering the United States through the Port and identified trade clusters where most of the containers go to or come from. Traditionally containers to these clusters were transported by truck and the study examined alternative modes. A series of barge and train services were proposed and a barge service to Albany from the Port is currently being supported. The PIDN proposals match strategies developed in this Plan to encourage mode shift to rail and barge.

ES 1.14 Realization of the Plan

ES 1.14.1 Port Development

At the start of the study there was an expectation that the plan would identify a single preferred Port improvement plan. However, the planning process indicated there was no need for major fill projects in the harbor and the cargo handling infrastructure could be provided within the existing Port acreage. Any number of combinations of terminal development options throughout the Port can be produced that will cater for the expected cargo demand.

Decisions relating to the scope and timing of individual container terminal expansion will be driven as much by market forces as by physical capacity and it is probable that container terminal expansion will be before all the existing surplus capacity is utilized.

The toolkit in Volume 2 presents port planning data and maps for terminal sites that can be used to guide Port-wide planning. The four planning scenarios act as an overall guide for planning and identify where development might take place.

ES 1.14.2 Port Funding

In the past port ownership and operations were dominated by the public sector. However, the significant changes in the shipping market during the 1990s have exerted enormous pressure on public ports to modernize or allow private participation with a view to improving efficiency and reducing costs.

The Port Authority is the landowner for most of the terminals in the Port with private companies acting as operators. For example, Port Newark Container Terminal is operated by P& O Ports North America. The Port Authority uses bond finance to invest in their leaseholds, where they pay for works "in the ground" such as for the strengthening of berths. Terminal operators pay for yard equipment.

Global Marine Terminal at Port Jersey is privately owned and the land for the proposed facility on the Bayonne Peninsula is owned by the City of Bayonne. These entities will arrange their own funding.

ES 1.14.3 *Highway Funding*

There are established mechanisms for publicly funding highway construction and improvements..

The total cost of the Port related highway improvements is relatively low for a multiyear investment program. The 63 multi-site projects only cost in the order of $98 million. However, it has to be accepted that transportation improvement funding is highly competitive and bona fide needs greatly exceed resources. To attract funding the projects must be supported by current regional planning efforts and to attract funding from federal sources the projects must appear in the Long Range Transportation Plans and Transportation Improvement Programs of the MPOs. The improvements suggested in the plan are consistent with the various regional planning efforts, such as, Portway and the NYMTC Freight Plan.

Some of the highway projects around the terminals at Port Elizabeth are within the Port boundary and would be funded by the Port Authority.

ES 1.14.4 *Rail Funding*

Public funding of rail infrastructure is complicated because most of the infrastructure is privately owned and that improvements are likely to be beyond the means of the railroads and regional MPOs and DOTs alone. Mode shift from truck to rail brings about societal benefits that enable public bodies to participate in the funding of rail improvements.

Rail improvements are likely to be financed from a mix of funding sources and delivered in public-private partnership arrangements. Early agreement of the strategic framework for project delivery is essential for success.

The first capacity improvements are required along the River Line.

ES 1.15 *Evaluation*

In order to evaluate the terminal Options and Scenarios the procedure used was to establish a set of evaluation criteria and illustrate the relative merits of Options and Scenarios on colored charts.

The evaluation criteria selected covered port planning, transport links, financial and economic analysis and qualitative environmental issues. Each evaluation criterion was assessed on the basis of being a best, indifferent or worst case in comparison to the other Options under consideration. For terminal Options the evaluation showed:

- The best overall rated Container terminals are C12 and C13 (Port Elizabeth), and the worst are C5 (Port Jersey) and C9 (Bayonne Peninsula);
- The best overall rated Auto terminals are A4 and A13 (Port Newark South) and the worst are A9 and A10 (Bayonne Peninsula);
- The best General Cargo terminal is G4 (Port Newark South);
- The marginally better bulk terminals are D1 and D2 (Port Newark North);
- Liquid terminals cannot be significantly differentiated.

The evaluation charts of individual options were combined to yield an evaluation for each land allocation scenario. Although the charts are not identical, they show no significant advantages between the different Scenarios.

ES 1.16 *The Brooklyn Waterfront Projects*

New York City Economic Development Corporation has created three projects as part of an economic development initiative for the Brooklyn waterfront. The three Brooklyn Waterfront Projects are:

- Development of a cruise terminal and maritime industrial zone at North Brooklyn
- Construction of a recycling plant at South Brooklyn
- Development of an auto/general cargo terminal at South Brooklyn

These projects were not included as part of the CPIP baseline, because they did not meet the criteria for inclusion in the baseline, i.e. they were not programmed for construction and not funded at the time of the CPIP baseline development. The projects were developed independently of the CPIP process and did not use the CPIP methodology. The impact of these projects on CPIP planning is presented in an

Addendum to the CPIP. The Brooklyn Waterfront Projects can be developed within the CPIP planning parameters.

ES 1.17 *Conclusions*

The conclusions given are for the present expectation of the situation in 2060.

Cargo terminal Options were devised and arranged into four Scenarios: Orange, Red, Yellow and Blue, that would cater for the whole demand without major expansion of the Port or major filling of wetlands. The analysis has also demonstrated that warehousing related to ocean borne cargo does not require the use of wetlands Consequently no preferred plan for achieving major infilling of wetlands was required.

In the absence of statutory authority for the Plan or a single governing Agency it is not possible to prescribe a pattern of phased development for the Plan. In any case, the evaluation of alternatives showed that no particular plan had an overall significant advantage.

The Plan provides a useful resource for both the private and public sector in the development of proposals and in the initial identification of the issues relating to proposals.

The highway analysis demonstrated that there is very little impact of Port-related trucks on the regional highway network. Also the impact of Port-related trucks on the highway corridors is small and for any given corridor, there is little difference between the baseline growth case and a variety of alternative Port development scenarios.

With few exceptions, there is only a minor difference in levels of congestion between Scenarios and between mode split options on the connector roadways. The Port Newark/Elizabeth terminal area is currently congested and future traffic is expected to continue to slow port operations. By 2020 congestion on most area roadways is expected to severely impact travel times. For the Port Jersey and Bayonne Terminal areas Port truck trips comprise only a small percentage of total vehicle traffic on these links. By 2020, however, highway improvements would be necessary for port traffic to adequately access these terminals. At Howland Hook Terminal area Port trucks comprise a relatively large percentage of the total traffic on the connector roadways studied, but they are expected to remain under capacity through 2060. If Red Hook Terminal area is operational, some improvements may be needed for Columbia Street for port trucks to be able to easily access the terminal in future years. In the South Brooklyn Terminal area, 39^{th} Street and 2^{nd} Avenue are expected to be below capacity, even out to 2060.

The improvements required to alleviate the congestion described above were relatively minor and comprised either adjustment of signal operation or provision of additional turn lanes by local widening which can reasonably be accommodated without major disruption of adjacent facilities.

The rail analysis showed that capacity improvements are needed as not all of the rail infrastructure in the region is used by freight railroads servicing the Port. For example many lines are for passenger only services.

The ExpressRail, Port Newark and Howland Hook container rail terminals are expected to be able to handle all of the future container volume to 2060 with minor improvements in some cases. A new rail terminal proposed for Port Jersey is restricted by the access arrangements. If they are resolved this terminal would handle all but the highest expected volumes. If a container terminal is developed at South Brooklyn, a new rail terminal is required, provided a Cross Harbor rail tunnel has been constructed.

The financial and economic analysis of container terminals at Port Elizabeth are favorable because they are not expanded in area and have the majority of infrastructure in place except for additional or deepened wharves. New auto terminals are likely to be highly uncompetitive. General cargo development at Port Newark South is the only viable option.

In economic terms in the Port region the additional port capacity required in 2060 would potentially generate 22,000 jobs associated with containers and 1,100 jobs associated with automobiles.

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1 Introduction

1.1 CPIP

This report presents the findings of the study for the Comprehensive Port Improvement Plan (CPIP) for the Port of New York and New Jersey (the Port). The report has been prepared in conjunction with the development of an environmental assessment by others, using findings in this report as a basis for the assessment.

This report is referred to as the CPIP and is in two volumes. This is Volume 1, The Plan, which describes the study process and gives the background and results of the studies. Volume 2, Toolkit, presents a planning toolkit that gives data for each Port site in a highly accessible format to aid development decisions for the cargo terminals, highway and rail facilities affected by port development.

Volume 1 has tables included in the text and Figures included in Appendix A. The volume is structured as follows.

An Executive Summary is given at the front.

Chapter 1 comprises this introduction.

Chapter 2 describes the CPIP study, the study team and the study process.

Chapter 3 gives the demand for cargo which defines the Port requirements and forms the basis of highway and rail analysis.

Chapter 4 gives details of the cargo vessel fleet of the future.

Chapter 5 defines the Port facilities upon which the plan is formulated and gives the capacity of the existing cargo terminals.

Chapter 6 defines the Port facilities needed in the planning period through 2060.

Chapter 7 describes the proposed cargo terminal improvements required to meet the future demand.

Chapter 8 looks at the existing modal split between highway, rail and barge and presents strategies for increasing the non-highway mode share.

Chapter 9 describes the highway network used by Port related traffic and the proposed highway improvements required for the growth in background highway traffic together with the growth in Port related trucks.

Chapter 10 describes the rail network used by Port related cargo and the proposed rail improvements required for the growth in background rail traffic together with the growth in Port related cargo.

Chapter 11 gives the results of cost estimates, financial analysis and economic impacts for a range of Port development proposals. Risk is also described.

Chapter 12 describes the environmental issues associated with the cargo terminal, highway and rail improvements and presents Green Port planning opportunities.

Chapter 13 describes the linkages between published Policies and Plans and the development proposals.

Chapter 14 discusses the realization of the Plan including funding of port, highway and rail projects .

Chapter 15 presents the evaluation of the port development proposals.

Chapter 16 gives the conclusions of the study.

2 The CPIP Study

2.1 Introduction

The Port of New York and New Jersey (the Port) serves one of the largest markets in the United States. Its primary market area includes more than 70 million people in 13-states, requiring goods and services to support their daily lives and businesses. In an increasingly global marketplace, a growing amount of the goods consumed in the New York/New Jersey region and in the surrounding market areas arrives from overseas locations via the Port. As the demand for goods in the region has grown, the Port has developed in response, but until now without unified or comprehensive planning guiding its development.

In 1999, the US Army Corps of Engineers (USACE) completed the Harbor Navigation Study (HNS) and Environmental Impact Statement (EIS), which evaluated navigation improvements to federal channels in the Port. This study recommended that channels be deepened to four general destinations within the Port to accommodate container ships with 50-foot draft at all tides. The HNS noted that the deeper channels would allow the volume of cargo presently handled by the Port to enter safely on fully loaded vessels, but also disclosed that existing Port infrastructure could not fully accommodate projected future cargo volumes in the coming decades.

In January 2000, port project sponsors, regulatory agencies, resource agencies and regional stakeholders executed a Memorandum of Understanding (MOU) for a Comprehensive Port Improvement Plan (CPIP). This MOU set forth a cooperative approach to develop a regionally supportable, unified plan (CPIP Plan) that would identify the improvements necessary to accommodate projected cargo volumes and respond to the need for an economically viable and environmentally sustainable Port. This approach was adopted to facilitate the development of a plan that could address future demand for both containerized and non-containerized cargo, and port and transportation network capacity from the perspective of the Port as a whole, while also identifying port and associated transportation improvement options for each of the Port's individual facilities. As a result, a series of future site-specific Port improvement options were developed as integral parts of larger, port-wide scenarios, each of which fulfilled the need to accommodate the Port's forecasted cargo demand. Transportation options for rail and road were then identified relative to each of the Port scenarios.

The CPIP planning horizon was established to extend from 2000 to the year 2060 - the year for which the USACE had previously forecasted cargo demand in its consideration of navigation improvements. The Port improvement options and scenarios illustrated in the following CPIP Plan and Toolkit reflect the situation of the Port in 2060. The preparation of the CPIP Plan was directed and funded by the CPIP Consortium, comprising the Port Authority of New York & New Jersey, Empire State Development Corporation (ESDC), New Jersey Department of Transportation/Office of Maritime Resources (NJDOT/OMR) and New York City Economic Development Corporation (NYCEDC).

Given the forecasted growth in cargo demand, a perceived need for associated and significant port infrastructure improvements and the geographic scope of the CPIP effort, it was considered at the inception of the MOU, that the CPIP would have the potential to identify the need for several major federal, state, or local actions (e.g., actions to permit fill for expansion of port facilities, modification and/or expansion of existing transportation networks, channel improvements, and habitat enhancement and/or restoration projects, and wetland mitigation banks). Thus, in conjunction with the development of a CPIP Plan, the MOU foresaw the need for preparation of a CPIP Environmental Impact Statement (CPIP-EIS).

The CPIP EIS was to serve as a planning tool in support of the CPIP Plan's development. Early environmental review and evaluation of port and associated transportation improvement options would serve to highlight potential adverse effects and identify opportunities for environmental enhancements, such that improvement options could be refined before they were finalized in the CPIP Plan. The CPIP EIS was to be prepared in compliance with the provisions of the National Environmental Policy Act of 1969, the implementing regulations and associated rules of the Council on Environmental Quality, and the implementing regulations of the signatory agencies.

The preparation of the CPIP-EIS was under the direction of the federal Co-Lead Agencies, comprising the US Environmental Protection Agency (USEPA), USACE and Federal Highway Administration (FHWA). ESDC, NJDOT/OMR and the New York City Office of the Deputy Mayor for Economic Development and Rebuilding were identified as the state and local Co-Lead Agencies, respectively. However, given the results of the CPIP Plan analyses summarized in the following pages, the federal Co-Lead agencies concluded that the preparation of a CPIP-EIS was not appropriate at the present time. Further information on this decision can be found in the separate "CPIP Environmental Assessment", which is a separate document completed by others.

The CPIP Plan's forecasts of future cargo volumes and the CPIP Plan's assessment of Port facility and transportation network capacity indicate, that the overall capacity in the Port, considering both containerized and non-containerized cargo, is sufficient for several decades. Thus, implementation of significant port improvements is not required in the near-term, beyond those port and transportation projects that are currently programmed and committed.

The CPIP Plan analyses also demonstrate that the acreage of wetland and waterfront fill needed to create new land to accommodate forecasted cargo volumes in the Port is substantially less than assumed at the outset of the CPIP project. This reassessment is largely due to international advances in cargo handling productivity at container terminals, which lead to a more efficient use of existing Port terminal land. Ongoing improvements in productivity coupled with the use of existing terminal land primarily for cargo handling operations will serve to supersede the need to create new land even as cargo demand continues to increase.

2.2 The Study Team

Sir William Halcrow and Partners Inc were appointed as the Prime Consultants (the Consultant) for the CPIP study in May 2001, bringing together a team of specialist sub-consultants including MDS Transmodal, Gannett Fleming, Duncan Maritime, Zetlin Strategic Communications, Hirani Engineering and Moffatt and Nichol Engineers.

2.3 *The Study Process*

2.3.1 *Technical Memoranda*

The progress of the study has been reported in technical memoranda as follows:

Task subject	Volume	Title of report
Task E – Market Demand and Port Capacity	1	Market Forecast and Outlook
	2	Capacity and Aggregate Capacity Needs at Port Facilities
	3	Current and Planned Capacity of Regional Transportation Network - Highways
	4	Current and Planned Capacity of Regional Transportation Network – Rail
Task F – Port Improvement Options	1	Cargo Terminal Options
	2	Highway Options
	3	Effects on Regional Transportation Network - Rail
Task G	-	Port Development Proposals
CPIP	1	The Plan
	2	Toolkit

At each stage, the results and findings of the task studies were presented to the CPIP Steering Committee and others for review and comment. Comments were considered and the necessary amendments were incorporated.

2.3.2 *Public Involvement*

A program of public involvement activities has been incorporated in the study method as described below.

(a) The Stakeholder Committee

In addition to wider processes, for example, direct solicitation of input through such means as inserts in newsletters or public meetings held at key milestones of the project, a Stakeholder Committee was formed to provide a forum for Stakeholders with direct and indirect interests in the Port of New York & New Jersey to debate and help shape the future of the Port. The Stakeholder Committee covers a cross-section of interests represented by elected officials, community boards, agencies, businesses, labor groups, advocacy groups and civic interests, and informed the study of public priorities and concerns as strategies were developed. Any interested organization and/or individual were welcome to sit on the Stakeholder Committee.

To organize the hundreds of stakeholders into an entity that would act as a forum for those with an interest in the Port of New York and New Jersey, the following format was adopted that allowed the Stakeholder Committee to be self-governing:

When a stakeholder joined the Stakeholder Committee, he or she self-selected into one of four Interest Groups (Environmental; Community/Government; Harbor/Trade/Labor/Business; Infrastructure/Security/Fiscal), based upon his or her primary interest. These four groups identified, debated and commented on issues arising within their group and discussed them with the other Interest Groups and the entire Stakeholder Committee. The Special Interest Groups were asked to meet as they felt necessary.

As part of the Stakeholder Committee, Sub-Committees comprised a cross-section of interests formed to discuss and examine alternatives related to Port terminals, facilities and access. Issues, options and drawbacks were analyzed with the hope of striking a balance between environmental, commercial, civic and goods movement concerns and to improve awareness among Stakeholders of the diverse nature of issues confronting the Port. These Sub-committees met during Stakeholder Committee meetings, but also separately as agreed upon by the sub-committee's membership.

The Stakeholder Committee had representatives on the Steering Committee, with each member representing one of the four Interest Groups. These representatives provided the Steering Committee with input representing a cross section of Stakeholder interests. Representatives also reported back to their Interest Group.

To support self-governance, the Stakeholder Committee elected a Stakeholder Council. The Council consisted of representatives from each of the four Interest Groups. Stakeholder Council members considered conclusions, concerns and contributions from the Stakeholder Committee and Special Interest Groups and provided input into the CPIP plan. The Council, in turn, was asked to keep the Stakeholder Committee interest groups updated on the project's progress, findings and key milestones reached. Stakeholder Committee representatives to the Steering Committee also sat on the Council.

(b) Newsletters and Fact Sheets

In addition to facilitating meetings, public information materials were developed as part of the outreach program to share information with stakeholders and keep stakeholders current on the progress of the study. Four Newsletters/Brochures, each at least four pages in length and containing photos, text and graphics were published at key milestones. The newsletters were designed to educate and set parameters for public discussion providing constituents with the information they needed to provide constructive input. When appropriate, inserts were included to further explain complicated concepts. Newsletters were posted on the CPIP web site and mailed directly to Registered Stakeholders. The published newsletters are:

- Spring 2002: CPIP Gets Under Way
- Spring 2003: Port Forecasts and Market Demands
- Summer 2004: Cargo Terminal Options Brochure
- Summer 2005: Comprehensive Port Improvement Plan Completed

Two fact sheets were also published, distributed and posted on the following subjects:

- The Highway Network
- The Rail Network

(c) Project Website

The CPIP web page served to raise the project's visibility and to provide an additional mechanism for public input. The web site provided e-mail access for constituents as a way to retrieve information and provide comments from the convenience of their home or office.

The site was arranged according to the following sections: Overview; What's New; Participants; Documents; Get Involved!; and Links.

Overview: Provided a general overview of the project including the reasons for the study's genesis and the Memorandum of Understanding signed by the CPIP Agencies**.**

What's New: Notified visitors of new publications available to the site, advertised future public involvement opportunities and any other new information pertaining to the project.

Participants: Provided an overview of the Stakeholder and Steering Committees' importance, role and structure, listed participants of the different Stakeholder Interest Groups and provided meeting summaries.

Documents: Presented for stakeholder review and information all publicly available newsletters, fact sheets and technical reports.

Get Involved!: This section encouraged website visitors as the study progressed to submit their views, comments and suggestions on the project. These were carefully collated and considered by the CPIP Agencies during the preparation of CPIP. Submissions were analyzed and periodically posted on the web page for public review and comment. The CPIP Discussion Room also provided Stakeholders the opportunity to share concerns and issues in specific discussions based on topic (i.e. Environmental, Labor, Community) in a real time forum with other registered Stakeholders.

Links: Companies and agencies associated with the CPIP Project were included in this section as points of further reference.

In 2002 the CPIP project website was modified to include web pages on the development of a CPIP Environmental Impact Statement (which was later cancelled and replaced with a CPIP Environmental Assessment). As a result, information about the preparation of the CPIP Plan and the CPIP EIS/EA were combined into one web location, which served to increase the visibility of and the linkages between both processes and to assist project Stakeholders in gathering knowledge and data relevant to their interest in the Port.

2.3.3 *Technical Program*

The first task was to establish the demand for cargo in order to provide a basis for the cargo terminal, highway and rail analysis.

The analysis then defined the current capacity of the Port, highway and rail facilities and looked at the future requirements to 2060. Several alternative cases for improvements to cargo terminal, rail and highway facilities were investigated, evaluated and compared with a baseline (no change) case. The relative importance of Port related truck traffic on the local and regional highway network was assessed. As part of these studies alternative cases for modal split of freight transport were also investigated together with possible strategies for achieving the desired shift from road to rail and barge.

Cost estimates for Port, highway and rail improvements were prepared in order to investigate the financial implications and economic impacts for a range of Port development proposals.

The environmental implications of the proposed development options were considered during the preparation of proposals and in particular, the potential impact on wetland areas was calculated. Green Port planning opportunities were considered and quantified for the options under consideration.

The linkages between published Policies and Plans and the development proposals were considered and discussed.

During the formulation of options for development, the evaluation of the proposals resulted in the identification of adjustments and improvements which were then incorporated before finalizing the CPIP.

3 Forecast Demand

3.1 *General*

This Chapter describes the methods, models and assumptions used in the CPIP study to generate the forecast of demand at the Port of New York and New Jersey (the Port) for cargo terminals, highways and rail facilities from the present day until 2060. Some aspects of the market and the main issues affecting the forecast are described and the resulting forecasts are presented.

The information presented here summarizes the CPIP demand forecast studies, which were carried out between 2001 and 2004 and were reported in previous CPIP Technical Memoranda[1,2]. The summaries given in this report give historical data for 1999 or earlier and forecast data is generally extracted in this report for the years 2020 and 2060. For further details and intermediate years if required readers should refer to the listed memoranda.

3.2 *Cargo Demand – US and the Port*

3.2.1 *Model Assumptions/Forecasting Methodology*

The basic steps in arriving at the forecast of cargo demand for the Port were:

- Forecast the overall US trade. This is done in international units of tonnes. (1 tonne = 0.9842065 long tons)

- For container trade convert tonnages to TEU using factors which vary according to overseas trade country. For vehicles convert tonnages to vehicle units using a factor established from actual trade in 1999.

- Forecast the share of that trade that will be handled by the Port assuming the Port and all competing ports have the same relative accessibility for the shipping fleet as at present.

- Adjust the share to account for changes in Port accessibility and other factors relative to competing ports.

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[1] CPIP, Task E Technical Memorandum, Volume 1: *Market Forecast and Outlook*, Draft #2, February 2003, Halcrow et al.
[2] CPIP, Technical Memorandum: *Assumptions for the Development of Market Forecasts*, Draft, December 2001, Halcrow et al.

• Assign the proportion of total Port throughput to be handled by the baseline cargo terminals.[3]

3.2.2 *Overall US Trade*

Forecasting of the overall US trade was carried out using the FORK program[4] which takes past data, by commodity and by country, and automatically seeks an explanation for historical changes in tonnage, with time, by examining:

(a) the changes in the countries' main economic indicators, and

(b) the trends for the particular country-country-commodity relationships.

Coefficients developed are then used to forecast trade volume on the basis of OECD[5] forecasts of those economic indicators. Important features of the model include:

(c) use of physical volume such as tonnage and TEU instead of the more conventional value measure,

(d) disaggregation of overall volume trends into components to reveal underlying trends, and

(e) use of forecast economic indicators such as GDP, Exchange Rate, and Consumer Price Index.

The data used for the forecasting of overall US trade were the 1990 and 1999 results in the Waterborne Databank[6], which provides maritime cargo flows by overseas country and port, US port, commodity and containerized percentage. The 1990 data gave the historical perspective whilst the 1999 data provided the base value for the forecast.

Annual trade growth rates were projected using FORK and US trade data from 1990 to 2000. The containerized cargo tonnages were then further refined using PIERS [7] data to determine inland origin/destination and TEU equivalents. Inland state

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[3] Baseline cargo terminals are the facilities forming part of the study scope see Chapter 5.
[4] FORK forecasting software, MDS Transmodal. Further detail of FORK is given in reference 2 above
[5] Organization for Economic Co-operation and Development
[6] USA Department of Transport, Maritime Administration (Office of Statistical and Economic Analysis)
[7] Port Import Export Reporting Service. PIERS data provides maritime flows in metric tonnes and TEUs by overseas country, US port and US state, from shippers' records.

distributions were calculated by direction (import or export), overseas country group and US port. These were then further modified by forecasts of state population distribution over the next 25 years. Given that state population distribution forecasts are not available beyond 2025, the 2025 distribution was assumed to hold until 2060.

3.2.3 *Port's Share of the US Market*

Forecasting of the Port's share of the US market relative to competing ports in the USA was based on:

- Growth within the area served by the Port
- Comparative shipping cost
- Comparative port costs
- Comparative inland distribution costs

Models were developed which derived market share using the total cost of transport between the foreign trade area and the inland US destination. The models were calibrated using PIERS data and then used to derive Port share in various transport scenarios, including transport cost variations and accessibility assumptions for the Port and other East Coast US ports.

Firstly a base case for market share was prepared on the assumption that access to the Port relative to its competitors on the East Coast USA was unchanged. This base case was then adjusted for containerized cargo by assuming improved access at the Port effected by channel deepening in line with ship size increases, with and without similar improvements at competing ports. The method for making adjustments used the import volumes and a cost driven model[8] that takes account of the containerized transport chain from overseas country to US State. The conversion from import volumes to total volume used the same relationship as found in actual current data.

The final forecast for the study was taken as the case where the Port is dredged to 50 feet and other ports are also dredged, and is given in Section 3.3. The steps leading to the final forecast are given in the following.

[8] See CPIP, Section E1.2.4 of Task E Technical Memorandum, Volume 1, Market Forecast and Outlook

3.2.4 *Total US Trade*

(a) All Commodities

The summary forecasts of US imports and exports together with historical data, by cargo type are given in Table 3.1[9] and in graph form in Figures 3.1 and 3.2.

Cargo Type ('000 tonnes)	1999 (Actual)	2020 (Forecasted)	2060 (Forecasted)
Imports			
Containers	77,763	165,833	338,375
Dry bulks	121,334	230,024	429,308
Crude oil	400,609	617,187	1,029,883
Other Liquid Bulks	122,094	216,579	399,127
Semi Bulks	42,248	77,737	155,445
Vehicles	4,569	5,331	8,209
General cargo	13,689	27,379	55,568
Total	**782,306**	**1,340,070**	**2,415,913**
Exports			
Containers	58,593	99,771	188,429
Dry bulks	193,460	272,964	495,329
Crude oil	5,284	4,969	7,436
Other Liquid Bulks	32,127	58,216	113,627
Semi Bulks	18,334	6,920	11,776
Vehicles	876	2,700	6,216
General cargo	35,560	59,040	104,000
Total	**344,234**	**504,579**	**926,813**
Total Import + Export	**1,126,540**	**1,844,650**	**3,342,726**

Table 3.1 US imports and exports, by cargo type 1999 to 2060 [10]

It is seen in Table 3.1 that US international trade is forecast to increase from 1.1 billion tonnes in 1999 to 1.8 billion tonnes by 2020, and to 3.3 billion tonnes by 2060.

Figure 3.1 illustrates the imbalance between imports and exports. Imports are 2.3 times exports in 1999 and this imbalance in trade grows such that imports are 2.7 times exports by 2015. However there is a slight improvement in the balance in later years such that imports are 2.6 times exports by 2060.

[9] Based on Fig E1-9 and E1-10 and Table E1-11 of CPIP, Task E Technical Memorandum, Volume 1, Market Forecast and Outlook

[10] Includes transit traffic.

Figure 3.2 shows that crude oil is the main cargo, accounting for over 40% of all imports throughout the forecast period and therefore dominating the overall import trend.

(b) Containers

Due to its importance within the Port, the summary forecasts for total US container trade expressed in loaded TEU are given in detail in Table 3.2 and Figure 3.3.

Imports	('000TEU)	% of Total
1999	9,714	62
2020	21,095	68
2040	32,153	69
2060	43,363	70
Exports	**('000TEU)**	
1999	5,923	38
2020	10,078	32
2040	14,473	31
2060	19,012	30
Total	**('000TEU)**	
1999	15,637	-
2020	31,173	-
2040	46,626	-
2060	62,375	-

Table 3.2 US container imports and exports, 1999 - 2060[11]

Total US loaded container trade doubles from 1999 to 2020, and doubles again by 2060. The growth in container imports drives the trend due to its predominance.

The main conclusions drawn from this analysis were that import containers account for 62% of the container trade in 1999, 68% in 2020, and 70% in 2060. This has an important influence on the total container throughput of the country because the imbalance between import and export containers has to be corrected by the additional export of empty containers.

In order to see:

- where the Port stands in the US ports market for import/export containers,

[11] Excluding import and export empties, domestic containers and military containers

- how much of the trade the Port captures, and
- how this is forecast to change by 2060,

The ports are listed in Table 3.3 along with the forecast loaded TEU for 1999 to 2060. The results are illustrated in Figure 3.4.

Port [12] **('000 TEU)**	**1999**	**2020**	**2060**	**Share of Total 1999**	**Share of Total 2060**
Los Angeles	5,112	11,074	22,535	32.7%	36.1%
PONYNJ[13]	1,937	3,614	7,195	12.4%	11.5%
Seattle	1,472	2,888	5,861	9.4%	9.4%
Charleston	1,171	2,114	4,078	7.4%	6.5%
Norfolk	938	1,682	3,275	6.0%	5.3%
Houston	924	1,855	3,649	5.9%	5.9%
Miami	853	1,847	3,773	5.5%	6.0%
Oakland	853	1,774	3,521	5.5%	5.6%
Savannah	703	1,276	2,485	4.5%	4.0%
New Orleans	520	958	1,887	3.3%	3.0%
Philadelphia	325	548	1,052	2.1%	1.7%
Baltimore	318	616	1,241	2.0%	2.0%
Portland	259	458	895	1.7%	1.4%
Jacksonville	149	295	597	1.0%	1.0%
Boston	104	174	330	0.7%	0.5%
Total	**15,637**	**31,173**	**62,375**		

Table 3.3 US container imports and exports by port [14]

[12] The word 'port' here is taken to mean the collection of ports in the local area indicated, for example, Los Angeles includes both the Port of Los Angeles and the Port of Long Beach.
[13] These volumes are for international containers only and do not include the 'other' containers described in Table 3.4.
[14] Based on: Table E1-15 of CPIP, Task E Technical Memorandum, Volume 1, Market Forecast and Outlook. (Container volumes exclude import and export empties, domestic and military)

The main conclusions drawn from the data in Table 3.3 were:

(i) There are no significant winners or losers of market share;

(ii) Los Angeles has the greatest market share by a substantial margin;

(iii) The market share of all other ports is either steady or decreases slightly;

(iv) The market share of the Port drops from 12.4% in 1999 to 11.5% in 2060.

The pattern of growth for the ports is illustrated in Figure 3.4 where the Port performance is shown alongside West Coast, East Coast and Gulf ports.

It should be noted that the scale of Figure 3.4a is larger than 3.4b and 3.4c because of the sheer size of the Los Angeles port throughput. The graphs in Figure 3.4 show that:

(v) Los Angeles continues to be the leading port area by a large margin throughout the study period

(vi) The Port of New York and New Jersey is the second most important port area overall and is the leading port on the East/Gulf Coast.

(vii) Growth of all port areas is steady during the period

3.2.5 *Port Share - Present Relative Accessibility*

In this Section, the share of US trade that goes through the Port is forecast on the assumption that dredging of all ports keeps up with increases in ship size, such that the accessibility of all ports relative to each other is the same as at present. Adjustment of the forecast for changes in relative accessibility is given in Section 3.2.6.

(a) All Commodities

The summary forecasts for the Port imports and exports expressed in tons for the years 1999, 2020 and 2060 are given in Table 3.4[15]. The data is illustrated in Figure 3.5 which shows the split between imports and exports over the study period and Figure

[15] Based on: Table E1-17 of CPIP, Task E Technical Memorandum, Volume 1, Market Forecast and Outlook.

3.6 which shows the relative importance of each cargo type and its share of the Port tonnage between 1999 and 2060.

Cargo Type	1999 (Actual) (million tonnes)	2020 (Forecasted) (million tonnes)	2060 (Forecasted) (million tonnes)
Other liquid bulk	24 (15.6%)	43 (15.6%)	79 (15.4%)
Containers	17 (12.5%)	34 (12.8%)	66 (12.5%)
Crude oil	14 (3.4%)	25 (4.0%)	47 (4.5%)
Dry bulk	5.4 (1.7%)	11 (2.2%)	21 (2.3%)
Semi bulk	1.7 (2.8%)	2.9 (3.4%)	5.5 (3.3%)
Vehicles	0.9 (16.5%)	1.1 (13.7%)	1.9 (13.2%)
General cargo	0.8 (1.6%)	1.5 (1.7%)	2.9 (1.8%)
Total of all cargos	**64**	**118**	**224**

Table 3.4 The Port's imports, exports and share (%) of US total at present relative accessibility.

The main conclusions drawn from Table 3.4 were:

(i) The Port handles relatively large shares of the country's international liquid bulk, container and vehicle markets.

(ii) Port trade is forecast to increase from 64 million tonnes in 1999 to 118 million tonnes in 2020 increasing then to 224 million tonnes in 2060.

(iii) 'Other liquid bulks' are the main cargo, accounting for more than 35% of the total Port tonnage throughout the study period. Containers account for more than 27% of the Port tonnage and crude oil accounts for more than 21%.

It is seen on Figure 3.8 that there is a dip in the volume of vehicles in the early years, and although the Port is seen to acquire an increasing volume of trade in later years it is seen from Table 3.4 that the Port's share of the US vehicle trade declines slightly over the forecast period. It should be noted that although the tonnage of vehicles appears modest, the land requirements for the Port are significant even for these low tonnages.

Figure 3.5 illustrates that the Port is predominately an import port in overall trade and also in the case of containers, i.e. the volume of container loaded imports exceeds that of container loaded exports. This has an important influence on the total container throughput of the Port because the imbalance between import and export containers has to be corrected by the additional export of empty containers to be filled overseas. This correction is made in Table 3.5.

The main conclusions drawn from Figure 3.6 were:

(iv) 'Other liquid bulks', will continue to be the dominant trade flow in the Port.

(v) Containers have a significant and rising share of the Port's trade.

(vi) Crude oil is a major component of the Port's trade.

(vii) The proportion of Port tonnage allocated to dry bulk, semi bulk, vehicles and general cargo, and the tonnages involved are relatively modest[16].

(b) Containers

In addition to the full international import and export containers that the Port handles, allowance has been made for 'other' containers (import and export empties, domestic containers and military containers) that are handled by the Port. The ratio of total containers to loaded imports for years beyond 1999 was based on the current 1999 figure of 2.19. The volumes for the years 1999 to 2060 are shown in Table 3.5.

('000 TEU)

Year	**1999 (Actual)**	**2020 (Forecasted)**	**2040 (Forecasted)**	**2060 (Forecasted)**
Imports	1,375	2,715	4,092	5,497
Exports	562	899	1,291	1,698
Other	1,078	2,340	3,591	4,860
Total	**3,015**	**5,954**	**8,974**	**12,055**

Source: MDS Transmodal Ltd

Table 3.5 The Port's container imports and exports[17] - present relative accessibility

[16] However, the land requirements of vehicles are significant, as described in Chapter 4.

The main points to be noted from Table 3.5 are the predominance of full imports over full exports and the significant amount of 'other' containers, largely a result of handling export empties to correct the imbalance in full containers. It should be noted that the volume shown here is before adjustment for future relative accessibility (see Section 3.2.6).

3.2.6 *Port Share- Future Accessibility*

Section 3.2.5 described the forecast share of cargo at the Port assuming that all ports had the same degree of relative accessibility in the future. The actual degree of accessibility is most critical for the container trade, where ship sizes are continuously increasing in draft beyond the capability of current channels to accept them fully laden. Table 3.6 gives a summary of the forecast for container volumes through the Port given different port deepening programs. The method of analysis that was used is described in Section 3.2.3.

(m TEU – all container trade)

Deepening Program	2020 (Forecasted)	2040 (Forecasted)	2060 (Forecasted)
Other ports remain as at present			
Case 1: 45' dredge at the Port	6.1	9.5	13.2
Case 2: 50' dredge at the Port	6.2	10.4	15.0
Other ports dredge			
Case 3: 45' dredge at the Port	3.6	3.7	3.4
Case 4: 50' dredge at the Port	5.6	8.5	11.3

Table 3.6 Container volumes through the Port by deepening program[18]

The most realistic future situation was assumed to be Case 4 in Table 3.6, i.e. other ports will dredge to keep up with increases in ship size and the Port will also do the same. The case of a 50' dredge at the Port was selected at the time the analysis was carried out on the basis that approval and funding to dredge to this depth was expected. Approval has now been obtained.

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[17] Based on: Table E1-19 of CPIP, Task E Technical Memorandum, Volume 1, Market Forecast and Outlook.

[18] Based on: Table E1-29 of CPIP, Task E Technical Memorandum, Volume 1, Market Forecast and Outlook.

3.3 *Final Forecast - Port Demand at Baseline Facilities*

3.3.1 *General*

This Section gives the final demand forecast for the baseline facilities defined in Section 5. The final demand figures given below are the figures upon which the cargo terminal land allocation, berth numbers, highway and rail congestion, and highway and rail improvements to 2060 were based.

Although the terminals identified as part of the CPIP project baseline handle nearly all of the containers and automobiles entering the Port, they handle a smaller proportion of general and bulk cargos. Based on 1999 data, the baseline terminals handled 30% of the overall general cargo, 29% of the dry bulk and just 6% of the liquid bulk.

Given the variety of factors which influence the mix of cargo types in the Port, including the complexity of the relationships driving the relative success or otherwise of the numerous small terminals throughout the Port, the diverse ownership of the terminal facilities, and the long planning period, it is difficult to predict future proportions of cargo types with any degree of certainty. Therefore, it has been assumed for the purposes of this study that the baseline proportions remain constant throughout the planning period.

3.3.2 *Containers*

The final forecast of container throughput for the Port is given in Table 3.7 and is illustrated on Figure 3.7. These volumes take account of loaded imports and exports, import and export empties, domestic and military containers and are for a channel deepening case which assumes the Port is dredged to 50' and other ports also dredge. As virtually all containers in the Port are handled at the baseline facilities there is no further adjustment needed.

2050	1999	2005	2010	2020	2030	2040	2050	2060
Demand (mTEU/Yr)	2.8	3.6	4.5	5.6	7.1	8.5	9.9	11.3

Table 3.7 Forecast container demand for the Port

3.3.3 *Vehicles*

The final forecast of vehicle demand for years beyond 1999 is given in Table 3.8 and is illustrated on Figure 3.8. The tonnages of vehicles were converted at the rate of approximately 0.59 units per tonne, based on the actual units per tonne experienced in 1999. As virtually all vehicles in the Port are handled at the baseline facilities there is no further adjustment needed.

	1999	2005	2010	2020	2030	2040	2050	2060
Forecast Demand (Units/Yr)	517,000	518,000	507,000	674,000	759,000	872,000	985,000	1,098,000

Table 3.8 Forecast vehicle demand for the Port

3.3.4 *General Cargo*

The final forecast of general cargo demand is given in Table 3.9 for the Port as a whole and for the baseline facilities, which were determined to be approximately 30% of the overall Port demand. The results are illustrated on Figure 3.9.

('000 tonne/year)	1999	2005	2010	2020	2030	2040	2050	2060
Forecast Total Demand	2,453	2,845	3,289	4,360	5,343	6,364	7,386	8,408
Forecast Baseline Facilities Only	738	855	989	1,311	1,606	1,913	2,221	2,528

Table 3.9 Forecast general cargo demand for the Port.

3.3.5 *Dry Bulk*

The final forecast of dry bulk cargo demand is given in Table 3.10 for the Port as a whole and for the baseline facilities, which were determined to be approximately 29% of the overall Port demand. The results are illustrated on Figure 3.10.

('000tonne/year)	1999	2005	2010	2020	2030	2040	2050	2060
Forecast Total Demand	5,398	6,768	8,065	10,771	13,423	16,096	18,772	21,448
Forecast - Baseline Facilities Only	1,553	1,947	2,320	3,098	3,861	4,630	5,400	6,170

Table 3.10 Forecast dry bulk demand for the Port

3.3.6 *Liquid Bulk*

The final forecast of liquid bulk cargo demand is given in Table 3.11 for the Port as a whole and for the baseline facilities, which were determined to be approximately 6% of the overall Port demand. The results are illustrated on Figure 3.11.

('000tonne/year)	1999	2005	2010	2020	2030	2040	2050	2060
Forecast Total	24,316	28,839	33,272	42,606	51,711	60,915	70,121	79,326
Forecast - Baseline Facilities Only	1,559	1,849	2,133	2,731	3,315	3,905	4,495	5,086

Table 3.11 Forecast liquid bulk demand for the Port

3.4 Harbor Navigation Study Forecast

3.4.1 General

The US Army Corps of Engineers (USACE) completed the Harbor Navigation Study (HNS) and EIS in 1999, which evaluated navigation improvements to federal channels in the Port. This study recommended that channels be deepened to four general destinations within the Port to accommodate larger container ships with 50-foot draft. A forecast of demand was carried out as part of the study.

3.4.2 The HNS Forecast

The HNS presented a projected container throughput for the Port of 19.1 million TEU in 2060 compared to an equivalent number of 11.3 million TEU in the CPIP forecast. However, the two forecasts are almost identical for import container volume in 2060. The HNS forecasts 5.57 million loaded import TEU for 2060 and the CPIP forecasts 5.50 million loaded import TEU. The difference in the total projected container throughput is associated with assumptions surrounding empty, military and domestic containers. The HNS also includes an aggressive forecast for export containers, in which US export volumes were expected to exceed import volumes after 2040. In terms of exports, the CPIP forecast took the view that the anticipated growth in US export earnings would be more focused on services and the sale of high value added goods rather than goods shipped by maritime containers. The US (and PONYNJ in particular) was expected to continue to ship a high proportion of empty containers to balance growing imports. In the CPIP forecast, import volumes continue to exceed export volumes throughout the study period.

The 2060 planning period used in CPIP was dictated by the analysis period in the HNS.

3.5 Recent Port Throughput

3.5.1 General

The HNS study was based upon trade data available for 1995 and the CPIP study on data for 1999. Since these dates, container traffic to the USA in general and through the Port in particular has grown at rates far in excess of the historical trend. The high growth rate seen in the Port today is a reflection of an upswing in US trade growth. Fluctuations in world trade are not unusual. For example, in the 1970's, the value of US imports grew by only 2.3% per annum in real terms while in the 1990's, growth was 9% per annum in real value, leading to a 6% per annum growth in containerized tonnages. Admittedly, had forecasts for either study been based on more recent data, it is likely that projections for import containers in 2060 would be marginally higher.

However, it is important to emphasis that newer projections would give only marginally higher forecasts. On a national level, it is not to be expected that the current historically high rates of growth, which are benefiting all US ports, can be maintained over the long term. Trade growth cannot be open-ended and will, logically, be moderated eventually by the physical volume of goods consumers are able to utilize. Also, much of the growth in container traffic over the last 5 years has been fueled by a massive increase in the US trade deficit. Over the 1990s, that trade deficit averaged 1.8% of total world trade. By 2004, the deficit had reached 5.7% in dollar terms (source OECD). Over the long run, these high trade deficits are not expected to be sustainable. This view on the trade deficit is also reflected in the HNS study's forecast, which expected the US to shift towards a trade surplus in the longer term, balancing the present deficit. That inevitably deflates container volumes which are import driven.

In terms of the Port in particular, much of the Port's recent growth has been based upon imports from the Far East, principally using the all water route via the Panama Canal and bypassing West Coast ports. Labor strife and congestion at West Coast ports have also influenced the recent growth in cargo at the Port. The all water route via Panama is not available to the largest ships being built now, which are expected to dominate world trade in the near future. The mean size of the largest 200 container ships trading in 2000 was 5000 TEU. By 2008, based on ships on order, the mean size of the largest 200 container ships trading will approach 8500 TEU, twice the capacity of 'Panamax' vessels. If the size constraints on the all water route via Panama were removed, the CPIP forecast for the Port would rise substantially. Currently however, there are no fixed and/or funded plans to widen the Panama Canal.

In addition, it should be noted that the CPIP forecast assumed that the US railroad industry would continue to be able to absorb trade growth via the West Coast at existing rates (as given in 1999/2000). However, handling trade growth volumes will involve investment levels which the railroads may or may not wish to address. A lack of investment in railroad infrastructure across the continent might also bring about higher forecast demand for the Port.

Although the possibility of railroad congestion across the US and its possible repercussions were known to the CPIP Agencies, the future of this private industry is outside the purview of the Port and port sponsors. Thus, any assumptions made about growth, investment, timelines or congestion severity would be highly speculative. For the purposes of the CPIP Study, it was agreed to consider the railroad business as a market driven industry, which would adjust accordingly to demand levels.

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4 Forecast Vessel Fleet

4.1 General

Demand at a port is dependent on its ability to accept the size of ships in the markets served by the Port. In the process of defining the demand for cargo at the Port it was therefore necessary to consider the vessel fleet that would wish to call at the Port between the years 2000 and 2060. This Section examines the pattern of ship arrivals at the Port in 2000 and provides the detailed vessel forecast for the future. The results of this analysis were also used to determine future berth lengths, berth dredged pocket sizes, and navigability in the berthing channels.

This study looked at:

- Container ships
- Car carriers
- General cargo ships
- Dry bulk carriers
- Tankers

In contrast to other vessels using the baseline facilities in the Port the draft of container ships has been steadily increasing over the years, and the increase shows little sign of stopping. Taken in combination with the importance of the container trade to the Port this trend has led to the need to pay particular attention in the study to the future size of container ships.

4.2 Methodology

Data for vessel arrivals at the Port in 2000 were obtained from Lloyds Marine Intelligence Unit. Forecasts were then made based on:

- trends in ship size over the previous period,
- known changes in ships under construction,
- influences on ship size dependent on the future market to be served.

4.3 *Container Ships*

4.3.1 *Current calling pattern*

The current calling pattern of container ships is given in Table 4.1.

TEU category	No of ships	Ship size	Average	Maximum
500-1,000	1	Gross tons	34,604	57,803
1,000-1,500	18	Dwt	39,639	67,680
1,500-2,000	96	LOA (ft)	752	968
2,000-2,500	476	TEU	3,012	4,600
2,500-3,000	587			
3,000-3,500	354			
3,500-4,000	173			
4,000-4,500	317			
4,500-5,000	68			
5,000+	0			
Total	**2,090**			

Table 4.1 Containership arrivals by TEU, 2000

Source: LMIU

The containership data shows that two-thirds of all containerships calling at the Port were vessels of 2,000-3,500 TEU and the largest containership recorded at the Port was 4,600 TEU. It has to be noted that the largest container ships in the current world fleet are unable to access the port fully laden.

4.3.2 *Vessel dimensions in the future*

(a) Method

The approach adopted towards forecasting the mix of container ships by capacity likely to visit the Port has been based upon the same model which forecasts trade volumes by port.

Firstly, an overall view was taken that the pace at which container ship size would grow would be based on the long run behavior of the container shipping market. For many years, operators chose to build precisely to parameters constrained by the Panama Canal (see Table 4.2) rather than risk building ships which lacked the trading flexibility to pass through it. In the last decade, however there has been a phase of 'catching up' by building larger ships in line with container trade growth. Over the longer period, the industry appears to have increased the individual capacity of its larger vessels at a rate of approximately 70% of that for overall trade, and that is the factor which has been used in this analysis. The more than quadrupling of underlying trade over the study period can therefore be expected to approximately triple the mean size of vessel trading.

Length overall	958 feet
Beam	106 feet
Draft	42 feet 8 inches

Table 4.2 Panama Canal ship size constraints

Secondly, for each of the individual eight trading areas (e.g. Far East, North Europe etc.), the individual mean ship size and distribution of ships around that mean was calculated for the whole US market. The mean was assumed to grow in line with the market and the distribution assumed to remain constant over time. Each trade route was then modeled as a series of market sectors by ship size band; different ships can access different ports (by draught limitations) and have different operating cost structures. It is thereby possible to estimate the optimum strategies which each trade and ship size band might adopt, always ensuring that the model is able to explain present behavior. By following this process, it is possible to not only estimate the volume of container traffic each port might attract, but also the size of ships likely to be utilized within an internally consistent model. The results are necessarily 'bunched' because it is assumed that for each line, fleet or ship size band, all the ships involved are of the same capacity.

(b) Impact of the 50ft channel

A 50ft channel will effectively allow unfettered access to the Port for all foreseeable container ships including those larger than Panamax[19].

The situation depicted in the trade and ship forecasts is that by 2020 about 22% of all ships calling in the Atlantic seaboard of the US will be of post-Panamax size. These post Panamax ships will be carrying about 40% of the total containerized trade along the coast.

Generally speaking, these ships will be deployed on most of the relevant trade routes whether the Port of New York and New Jersey can accept them or not. For example Halifax and Norfolk can accept these ships, and work already done for PIDN[20] shows that even within the Port's immediate hinterland there is already a considerable overlap between different port hinterlands. As a result, if the Port is not dredged to 50ft then fewer of the larger ships will serve the Port. It should be noted that some

[19] Panamax – The maximum size of Vessel that can pass through the Panama Canal, limited by beam and draft.
[20] Port Inland Distribution Network, Moffatt & Nichol, 2001

post Panamax ship designs may also have too high an air draught to pass beneath the Bayonne Bridge although it has been assumed that this will not be a limiting factor.

The projections assume that the Port terminal operators are responsive to changes in the competitiveness of the Port brought about by the degree of dredging. Thus, for example, if failure to dredge led to the Port having to concentrate on the smaller 'niche' end of the market, market rates for cargo handling would inevitably fall to match those of the smaller ports. Similarly, if the market became convinced that the Port will not dredge beyond 45ft, then operators may relocate elsewhere more quickly than suggested in Table 4.3. Note that dredging to a '50 foot' standard is assumed to take place between 2005 and 2010.

(c) Forecast

The projected development of containership calls to the Port over the period 2000 – 2020 is set out in Table 4.3 and illustrated in Figure 4.1. The table forecasts that the proportion of the numbers of ships greater than 4000 TEU, i.e. those able to exploit the benefits of a dredging program, will grow from 16% at present to 62% in 2020 and 85% by 2060. For the Port this represents a significant and rapid change to much larger ships.

Ship Size	**2000**	**2020**		**2040**		**2060**	
'000 TEU		45'	50'	45'	50'	45'	50'
<2,000	558	60	60	35	35	43	43
2,000 – 3,999	1685	779	779	660	426	302	302
4,000 – 4,999	416	691	691	435	435	375	135
5,000 – 5,999	0	229	229	484	484	635	479
6,000 – 7,999	0	83	229	97	484	101	497
8,000 +	0	83	229	88	481	92	911
TOTAL	**2659**	**1,924**	**2,215**	**1,799**	**2,343**	**1,548**	**2,367**

Table 4.3 Container ships calling at the Port by dredging program, other ports deepened

The average and maximum size of container ships arriving at the Port are forecast to increase to 4,000 TEU and around 8,000 TEU respectively by 2020[21]. It is considered probable that container ships will reach 12,000 TEU capacity before 2060 as discussed in Task E Technical Memorandum[22]. However, there appears to be a consensus that

[21] CPIP Task E Technical Memorandum, Volume 1, Section E1.3.5.
[22] CPIP Task E Technical Memorandum, Volume 1, Section E1.3.3.8

although beam and length will increase to provide greater capacity, draft will not greatly exceed the current maximum of 47.5ft.

Based on the data given in Table 4.3 the average ship length for 2060 was estimated to be 1,028ft

It was forecast that the lengths of container ships in the future will be concentrated more at the longer end of the scale as shown in Figure 4.1 whereas at present there is a wider range of lengths in service. In 2060 the assumed dimensions for planning purposes was taken as the 12,000 TEU ship:

- Length 1214ft
- Beam 141ft plus
- Draft 47.5ft

For berth and channel depths the draft of 47.5ft of the current largest vessels as mentioned above is not expected to increase, and this was used for assessment from the present day to 2060. The only change with time would be the proportion of vessels having the 47.5ft design draft.

4.4 *Car Carriers*

4.4.1 *Current calling pattern*

The current calling pattern of car carriers at the Port is given in Table 4.4.

GT category	No of ships	Ship size	Average	Maximum
10-20,000	10	Gross tons	43,752	67,140
20-30,000	30	Dwt	16,370	38,300
30-40,000	89	LOA (ft)	613	790
40-45,000	109	Car capacity	3,726	5,553
45-50,000	110			
50-55,000	77			
55-65,000	54			
65,000+	2			
Total	**481**			

Table 4.4 Car carrier arrivals by size category, 2000

The car-carrying fleet appears to be consolidated around the largest vessels of this type operating in international trades. For these vessels, draft is not a limiting factor at the Port.

4.4.2 *Vessel dimensions in the future*

Car carriers, unlike containerships, are not forecast to increase significantly in size beyond the typical maximum size of 6,000 passenger car units (pcu) currently in operation, although their call frequency and batch volume will vary to accommodate seasonal fluctuations and underlying growth in demand[23].

The dimensions for a 6,000pcu vessel are:

- Length 656ft
- Beam 105ft
- Draft 33ft

4.5 General Cargo Ships

4.5.1 *Current calling pattern*

The size of the general cargo vessel fleet is gradually declining and being replaced by handy-sized bulk-carriers and semi-containerships[24]. There are relatively few new buildings on order today and the current world fleet looks old. The reason for this decline is more or less explained by the containerization of most cargo, or the switch to using semi-bulk techniques by smaller bulk carriers.

4.5.2 *Vessel dimensions now and in the future*

The current average size of general cargo ships and their replacements of around 21,000 DWT (15,000 GT) is likely to continue. The average size of general cargo ship was therefore taken to be:

- Length 550ft
- Beam 83ft
- Draft 35.5ft

The typical maximum general cargo ship currently calling at the port is about 27,000 DWT, and the ship dimensions are:

- Length 600ft
- Beam 88ft
- Draft 36ft

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[23] See CPIP Task E Technical Memorandum, Volume 1, Section E1.3.7.

[24] See CPIP Task E Technical Memorandum, Volume 1, Section E1.3.9.

There are some exceptionally large cargo ships calling at the port with sizes ranging up to 48,000 DWT. These ships have the dimensions:

- Length 722 ft
- Beam 106 ft
- Draft 43 ft

It was assumed that these larger ships would be accommodated on a few of the longer general cargo berths that occur in the Port, but subject to restricted draft of 36ft.

4.6 *Dry bulk carriers*

4.6.1 *Current calling pattern*

The current calling pattern of dry bulk carriers at the Port is given in Table 4.5.

GT category	No of ships	Ship size	Average	Maximum
0-10,000	5	Gross tons	20,716	43,806
10-15,000	65	Dwt	33,481	76,017
15-20,000	38	LOA (ft)	590	794
20-25,000	90			
25-30,000	34			
30-35,000	3			
35-40,000	11			
40-45,000	6			
Total	**252**			

Table 4.5 Bulk carrier arrivals by size category, 2000
Source:LMIU

The majority of bulk carriers calling at the Port are of 'Handysize' and 'Handymax' dimensions (20-35,000 DWT and 35-50,000 DWT respectively), the typical workhorses of the dry bulk trades. Panamax bulk carriers (typically 60-80,000 DWT) that are involved in the high volume bulk trades such as coal and grain are not prevalent at the Port.

4.6.2 *Vessel dimensions in the future*

It is not the trend for handy-size bulk carriers, such as those that typically call at the Port, to increase in size, but rather that growth in demand will be accommodated by increases in frequency of calls[25].

Dry bulk ships are therefore expected to be typically up to 36,000 DWT. The ship dimensions are:

- Length 617 ft
- Beam 92 ft
- Draft 36 ft

There are some larger dry bulk ships calling at the Port, ranging up to about 75,000 DWT with the following dimensions:

- Length 770 ft
- Beam 117 ft
- Draft 45 ft

However, it was assumed that these ships will call at specialized berths not in the designated study sites, or in some cases come part laden to straight runs of several berths, where their additional length can be accommodated.

[25] See CPIP Task E Technical Memorandum, Volume 1, Section E1.3.8.

4.7 *Liquid Bulk Tankers*

4.7.1 *Current calling pattern*

The current calling pattern of tankers at the Port is given in Table 4.6.

GT category	No of ships	Ship size	Average	Maximum
0-10,000	26	Gross tons	33,309	80,187
10-15,000	39	Dwt	57,470	154,970
15-20,000	95	LOA (ft)	672	899
20-25,000	186			
25-30,000	257			
30-40,000	162			
40-50,000	34			
50-60,000	183			
60-70,000	2			
70-80,000	32			
80,000+	1			
Total	**1,017**			

Table 4.6 Tanker arrivals by size category, 2000

Source: LMIU

Tankers calling at the Port were typically of 'Panamax' dimensions (42.6ft draft), while visits by 'Suezmax[26]' tankers (54.1ft draft) were relatively limited. Those that do call at the Port will either be operating part-laden to reduce draft, or are required to unload some of their cargo into smaller ships or barges in the approaches before proceeding to the oil terminal berths.

4.7.2 *Vessel dimensions in the future*

As in the case of dry bulk ships, the future typical size of tanker calling at the terminals is expected to be about 36,000 DWT with dimensions as given above for 36,000 DWT dry bulk ships.

Other liquid bulk ships up to 60,000 DWT currently call at the Port with the following dimensions:

- Length 710 ft
- Beam 120 ft
- Draft 43 ft

[26] Suezmax – The maximum size of Vessel that can pass through the Suex Canal, limited by beam and draft.

As liquid berths are few in number in the port layouts, and generally enclosed by other adjacent berths, it was considered prudent to allow some longer berths for these larger ships, although the capacity calculations and the dredged depth were based on the 36,000DWT vessels.

4.8 *Deepening of Navigation Channels to 50ft*

Deepening of channels to 50ft is mainly of relevance to container ships. The most likely situation is that, in the longer term, other US ports will be deepened based upon the same case as is being made for the Port, i.e. deepening will lead to a general reduction in transport cost per unit for maritime container cargo and will be in the wider public interest.

In part also because of the barrier that the Panama Canal represents to the larger container ships, which will entirely dominate future deep sea container transport, modeling indicates that even by deepening to 50ft the Port will still handle approximately 6% less containers than would be explained solely by the forecast changes in the differential growth of cargo between the Port's hinterlands and forelands. As compared with the proportion of US container traffic currently passing through the Port, there would be a fall in the proportion handled of import containers from approximately 14% to 12% of total US trade.

The conclusion is, therefore, that dredging the Port to a 50ft depth will not lead to a net increase in the proportion of US container traffic passing through the Port and can be regarded as a strategy designed to allow the Port to continue to serve its existing client base. Without such a deepening program, the Port could not maintain its position as a significant container port, and would lose market share. With that program, the 11.3m TEU p.a. forecast for 2060 under conditions of other ports deepening can be compared with the capacity of the Port's existing terminals of only 8.6m TEU. It therefore follows that the deepening to 50ft will constitute a necessary but not sufficient condition for the Port being able to continue to retain its current client base. Other measures will be required for the Port to maintain that level.

4.9 *Conclusions*

Based on the findings presented in this Chapter it is forecast that by 2060:

- Container ships will be concentrated at the larger end of the size scale whereas at present there is a wide range of sizes in service. Container ship draft is expected to reach a maximum of 47.5ft;

- Car carriers, general cargo ships and bulk ships are not expected to increase in size

A 50 foot deep channel will be required for container ships, but other vessels are largely catered for by the existing channel depths in the Port.

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5 Cargo Terminal Baseline Facilities and Existing Capacity

5.1 Baseline Analysis

5.1.1 Selection of Terminals to Include in Baseline

The Port of New York and New Jersey covers a large area and has over 500 terminals of various sizes serving national and international trade in a wide range of commodities. The CPIP study concentrated only on those facilities, other than bulk oil, that are primarily concerned with import/export cargoes. Other terminals in the Port primarily used for handling bulk oil, passengers, domestic goods and local fish catches, as well as dockyards, mooring facilities, unused facilities and terminals with no prospect of providing access for international vessels were excluded.

Using these criteria, baseline cargo terminals were defined by establishing a list of existing terminals and by using a process of elimination as described in the following.

(a) Determination of Existing Cargo Terminals

In order to develop a comprehensive port improvement plan, it is necessary to first establish the existing situation, specifically the number and location of cargo terminals and the volumes of different cargoes they currently handle, for the purposes of assessing the existing capacity of the Port and for identifying options for future improvements.

Three principal sources of information were researched to determine the existing situation:

- The US Army Corps of Engineers' database of piers, wharves and docks in the Port of New York & New Jersey, contained in their report "Port Series No 5 (Revised 1999)"

- The US Customs' and the Port Authority's published database of cargo volumes imported and exported through the Port in 1999, sorted by mode of appearance[27] and terminal.

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[27] Mode of appearance is a standard term used to describe the way cargo on board a ship arrives. e.g. in containers, as dry-bulk or liquid-bulk, on wheels (vehicles etc) or in boxes or bags or loose (general cargo).

- Visual observation.

(b) Review of USACE Database of Facilities

The USACE database lists 559 docks, wharves and piers in the Port of New York & New Jersey and in the ports on Long Island. In order to determine which of these 559 facilities should be included in the baseline, the database was first sorted into categories of principal use (e.g. containers, cars, general cargo, bulk cargo etc.) and then progressively filtered in 3 stages as follows:

- Filter for Relevance: The CPIP study is primarily concerned with the Port's ability to handle import/export cargoes, i.e. those arriving from and destined for foreign ports or countries, excluding bulk oil[28]. Thus, terminals primarily used for handling bulk oil, passengers, domestic goods and local fish catches, as well as dockyards, mooring facilities and currently unused facilities were filtered out. This process reduced the total from 559 facilities to 93 facilities.

- Filter for Depth and Location: The remaining facilities were then reviewed for suitability as an existing import/export terminal on the basis of location and depth. Any remaining facility with a reported approach channel and alongside depth of less than 15 ft below MLW was considered unlikely to be handling significant volumes of import/export cargo in deep-sea vessels and was therefore filtered out. Similarly any facility located upstream of bridges with an air-draft of less than 135 ft MHW or in narrow channels insufficient to allow turning or in areas that are patently environmentally sensitive, was also considered unlikely to be handling significant quantities of import/export cargo in deep-sea vessels and was therefore filtered out. This process reduced the remaining total from 95 facilities to 53 facilities.

- Filter for Consolidation: The USACE database separately identifies a number of docks, wharves and piers that are considered part of single terminals. The remaining facilities were therefore reviewed and consolidated such that multiple docks, wharves and piers within a single terminal counted as just one. This process reduced the remaining total from 53 to 32. It was also determined that 17 of these 32 terminals handled 99% of all import/export cargo reported by the PANYNJ and US Customs

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[28] Early discussions with the CPIP Steering Committee determined that while trade & vessel forecasts were to be considered in the study, privately owned crude oil and petrochemical terminals were not.

The above process is summarized in Table 5.1.

Dock/Wharf/Pier Type	Total	Filtered for Relevance	Filtered for Depth & Location	Filtered for Consolidation
Container Terminals	13	13	13	7
Automobile Terminals	8	8	7	4
General Cargo Terminals	15	15	15	8
Dry Bulk Terminals				
Aggregates	35	35	4	4
Cement	5	5	5	4
General	6	6	5	3
Scrap	11	11	4	2
Float Bridge Terminals	2	0	0	0
Liquid Bulk	135	0	0	0
Passenger Ferry	26	0	0	0
Cruise Ship	3	0	0	0
Tourist & Excursion	7	0	0	0
Domestic Waste	25	0	0	0
Fishery	10	0	0	0
Dockyards	1	0	0	0
Mooring	140	0	0	0
Unused	117	0	0	0
TOTAL	**559**	**93**	**53**	**32**

Table 5.1 Summary of USACE database review

5.1.2 *Baseline Cargo Terminal Improvements*

It is appropriate to include in the cargo terminal baseline, any improvements that are either currently in progress or substantially certain to proceed so that the Port capacity assessment takes them into account.

The improvements adopted for the baseline were those that:

- are included in the terminal owner/operator's current (2001) approved capital expenditure plan, **and**
- have the necessary permits and fund allocations to proceed, **and**
- are sufficiently well defined to enable the nature and scope to be identified and the impact assessed.

Following the application of these criteria, and discussions with the marine terminal operators and PANYNJ, the actual and planned improvements that should be included in the marine terminal baseline are listed in Table 5.2.

Terminal	Baseline Marine Terminals	Baseline Improvements	Planned Completion
Container Terminals	Port Newark (PNCT)	Berth deepening Additional cranes Pavement reconstruction Yard reconfiguration	2004 2004 2004 2004
	Port Newark (ASI)	None Known	
	Port Elizabeth (Maher)	Berth deepening Additional cranes Pavement reconstruction Yard reconfiguration Conversion to fully straddle carrier operation	2004 2004 2004 2004 2004
	Port Elizabeth (APMT)	Berth deepening Additional cranes Pavement Reconstruction Yard Reconfiguration	2004 2004 2004 2004
	Port Jersey (Global)	None Known	
	Port Ivory (Howland Hook)	Wharf extension Additional cranes	2004 2004
	N Brooklyn (Red Hook)	None Known	
Automobile Terminals	Port Newark (FAPS)	None Known	
	Port Newark (Toyota)	None known	
	Port Elizabeth (DAS)	None known	
	Port Jersey (NEAT/BMW)	None known	
General Cargo Terminals	Port Newark Public Berths	None known	
	North Brooklyn Marine Terminal	None known	
	South Brooklyn Marine Terminal	General Refurbishment	2004
	Port Ivory Howland Hook	None known	
Bulk Terminals	Port Newark Dry Bulk Berths	None known	
	Port Newark Liquid Bulk Berths	None known	

Table 5.2 Summary of baseline cargo terminals & improvements

5.1.3 *Conclusion on Baseline Cargo Terminals*

Following the review of the USACE and customs databases it was concluded that the baseline facilities for this study should be the 17 cargo terminals and their improvements shown in Table 5.2.

These baseline terminals and associated improvements were adopted as the baseline for the purposes of assessing the existing capacity of the Port and for identifying options for future improvements.

5.1.4 *Baseline for Existing Shipping Channels*

The shipping channels serving the terminals at the Port are continuously being improved. In order to assess the accessibility of the Port terminals and to establish the costs of any additional work required by development proposals, it was necessary to identify the baseline conditions for the channels. The channels within the Port are shown in Volume 2: Toolkit, Figure 2.5 and are currently undergoing a major deepening program. This harbor dredging program falls under the jurisdiction of and is being managed by the US Army Corps of Engineers. The status of the dredging program in 2003 was as shown in Table 5.3.

Project	Description	Status
A	Deepening of Kill van Kull & Newark Bay Channels from 40-ft to 45-ft MLLW.	Approved, commenced and partially complete.
B	Deepening of Arthur Kill & Howland Hook Channels from 35-ft to 41-ft/40-ft MLLW	Approved and due to commence in Summer 2002
C	Deepening of Port Jersey Channel from 35-ft/38-ft to 41-ft MLLW.	Approved and due to commence in Summer 2002
D	Deepening of Ambrose l, Bay Ridge, Port Jersey, Kill van Kull, Newark Bay, Howland Hook & Elizabeth Channels to 53-ft/50-ft MLLW	Approved and planned to commence in 2004 subject to final agreement.

Table 5.3 Status of harbor dredging program

It was concluded that the baseline for existing marine channels should include the current and imminent deepening projects identified as A to D in Table 5.3.

5.1.5 *Baseline Applicability*

The baseline terminals and dredging programs were defined in 2001 and adjustments to the scope of port improvement projects have occurred in the intervening years. However, it should be noted that many of the terminal improvements were planned for completion in 2004, and that the dredging projects are part of a multi-year program. Under these circumstances, the defined baseline continues to be appropriate for the study. Any adjustments to baseline projects can be considered to be within the umbrella of the overall planning options that cater for development through to 2060.

5.2 Assessed Capacity of Baseline Cargo Terminals

5.2.1 Capacity Assessment Method

(a) Introduction

The 'assessed' capacity of Port terminals is defined for this study as the capacity assuming present operating methods and productivities at fully utilized terminals. (The productivity levels for future capacity assessment are described in Section 6.4)

This Section describes the methods used to assess the capacity of the cargo terminals at the Port.

The input data definitions and values of parameters are given in Task E Technical Memorandum, Volume 2, Appendix E2-A and the capacity assessment spreadsheets are given in Appendix E2-B.

The formulae for each step of the cargo handling process are explained in general terms below. Input data was either obtained from the operators of the terminals, or where no value was provided, values were assumed based on the Consultant's experience of similar terminals.

Queuing theory was used for calculating the 'Berth Capacity' and 'Ship to Berth' steps, taking into account the number of berths, the average vessel waiting time expressed as a percentage of vessel service time, and the resulting berth occupancy.

(b) General Description

For each of the terminals the throughput capacity of each step in the cargo handling cycle from the berth to the gate was considered independently:

The limiting capacity for any given terminal was the least of the capacities of the above steps.

(c) Container Terminals

Throughput capacity estimates were calculated for the following container terminal facilities:

- Port Newark Container Terminal (P&O)
- Port Newark Container Terminal (ASI)
- Maher Container Terminal

- Maersk Container Terminal
- Howland Hook Container Terminal
- Global Container Terminal
- Red Hook Container Terminal

The terminal operations were reduced to six steps for each terminal, and for each step an estimate was prepared for container movements in terms of container lifts and TEU per annum. In addition, the container lifts and TEU per acre per annum were calculated for comparison between terminals.

The cargo handling process was split into the following steps and given the nomenclature shown:

Step 1: Vessel accommodation at the berth - *Berth Capacity*
Step 2: Vessel loading/unloading[29] - *Ship to Wharf*
Step 3: Cargo handling in the yard - *Wharf to Yard*
Step 4: Yard storage - *Yard Dwell*
Step 5: Cargo handling in the yard - *Yard to Truck*
Step 6: Passage through the gate - *Gatehouse Operation*

Step 1: Berth Capacity

Berth capacity is the throughput that can be produced over the existing wharf assuming that as many cranes as necessary are provided to match the ship arrivals. For the purposes of this step it is assumed that a sufficient amount of yard equipment is provided to meet the cycle time requirements of the wharf cranes and that the available depth alongside is sufficient to accommodate the adopted average containership. The main constraining factors in this process are the ship waiting time which has been limited to 10% of service time, and the existing wharf length. The calculation is shown below:

Lifts/Gross Acre/Year =

[29] Cargo handling in the yard, both between crane and yard (Step 3) and between yard and truck (Step 5) is carried out using the same type of equipment drawn from a common pool at each terminal

Days/year × Working hours/day × % Berth time working × Berth occupancy × Number of berths × Number of cranes/berth × Number of crane lifts/hour × % Crane availability ÷ Gross terminal area

Step 2: Ship to Wharf

Ship to Wharf is the capacity of the ship to wharf operation based on the actual available number of wharf cranes. The main constraining factors are the number of cranes and their rate of working. The calculation is shown below:

Lifts/Gross Acre/Year =

Days/year × Working hours/day × % Berth time working × Berth occupancy × Existing number of wharf cranes × Number of lifts/crane/hour × % Crane availability ÷ Gross terminal area

Step 3: Wharf to Yard

Wharf to Yard capacity is based on the number of lifts per year that could be typically achieved in the Wharf to Yard operation by straddle carriers or tractor/trailer units and top loaders, reach stackers or rubber-tired gantries. For the purposes of this study it was assumed that a sufficient number of tractor/trailer units is provided to meet the cycle time requirements of the other yard equipment. The percentage allocation of plant between Wharf to Yard and Yard to Gate operations was proportioned so as to balance the number of lifts land-side and ship-side. The main constraining factors are the number of machines and the work rate. The calculation is shown below:

Lifts/Gross Acre/Year =

Days/year × Working hours/day × Existing number of mobile equipment × Assumed availability of plant x Berth occupancy × Number of lifts/hour per machine × % Equipment assigned to wharf operations ÷ Gross terminal area ÷ Peaking factor

Step 4: Yard Dwell

Yard Dwell is the capacity of the yard based on its storage potential. The main constraining factors are the area of the yard, the stacking density and the dwell time. The calculation is shown below:

Lifts/Gross Acre/Year =

[Handling capacity/ year (imports) + Handling capacity/year (exports) + Handling capacity/year (reefers) + Handling capacity/year (empties)] ÷ Gross terminal area

Step 5: Yard to Gate

Yard to Gate capacity is based on the number of lifts per year that could be typically achieved by straddle carriers, top loaders, reach stackers or rubber-tired gantries in the yard to gate operation. ('Gate' in this context also means the truck and intermodal transfer operation remote from the gate). For the purposes of this study it is assumed that a sufficient number of bomb-carts and/or tractor-trailer units is provided to meet the cycle time requirements of the other yard equipment. The percentage allocation of plant between Wharf to Yard and Yard to Gate operations was proportioned so as to balance the number of lifts land-side and ship-side. The main constraining factors are the number of machines and the work rate. The calculation is shown below:

Lifts / Gross Acre / Year =

[Days/year × Working hours/day × Existing number of mobile equipment × Assumed availability of plant × Number of lifts/hour per machine] × % Mobile equipment assigned to landside operations × Gross terminal area ÷ Peaking factor

Step 6: Gatehouse Operation

Gatehouse Operation capacity is the capacity of the gatehouse complex where trucks enter and leave the terminal. The main constraining factors are the number of gates and the gate processing time. The calculation is shown below:

Lifts/Gross Acre/Year =

Days/year × Working hours/day × Number of existing gates x Number of lifts processed per hour per gate ÷ Gross terminal area

Values & Assumptions

Individual values used in the calculations are described in detail in Task E Technical Memorandum, Volume 2, Appendix E2-A.

(d) Automobile Terminals

Throughput estimates have been calculated for 4 automobile terminals:

- Port Newark (FAPS)
- Port Newark (Toyota)
- Port Elizabeth (DAS)
- Port Jersey (NEAT/BMW)

The automobile handling process was split into the following steps:

Step 1 Vessel accommodation at the berth - *Berth Capacity*
Step 2 First point of rest – *Temporary Storage Area Capacity*
Step 3 Main yard storage - *Storage Yard Capacity*

Step 1: Berth Capacity

Berth capacity is the throughput that can be achieved over the existing wharf assuming a typical unloading rate. The main constraining factors in this process are the ship waiting time which has been limited to 10% of service time, and the existing wharf length. The calculation is shown below:

Units per acre/year =

Days/year × Working hours/day × Number of units offloaded per hour × Berth time working × Number of berths × Berth occupancy ÷ Gross terminal area

Step 2: Temporary Storage Area Capacity

The temporary storage area is the 'First Point of Rest' (FPOR) where vehicles are placed immediately after discharge and/or inspected before being taken to the main storage area. The calculation was as follows:

Units per acre/year =

(Days/year × Working hours/day) ÷ Dwell time × Existing number of FPOR slots ÷ Area of FPOR

Step 3: Storage Yard Capacity

Storage yard capacity is the capacity of the yard based on the selected parking density, the available area of the yard and the dwell time. Historically, vehicle storage yards in

PONYNJ are unlike container storage yards in that they provide for not only transit storage for import/export vehicles, but also long term storage for domestically produced vehicles and regional vehicle distributors of all types. The Consultants have assumed that the entire area of the automobiles terminals can be made available for transit storage of import/export vehicles if necessary and the resulting capacity assessment is made on this basis. The calculation is as shown below:

Units per acre/year =

[(Gross terminal area × % Factor for buildings & other non-storage areas) − Area of FPOR] × Number of slots per acre × [(Days/year × Working hours/day) ÷ (Average dwell time × Working hours/day)] ÷ Gross terminal area excluding FPOR

(e) General Cargo Terminals

General cargo terminals handle a wide range of different commodities that have an equally wide range of time sensitivities and storage requirements. While it is quite possible to make a reasonable assessment of handling rates for different commodities, it is very difficult to assess the throughput capacity because this depends on the storage requirements and dwell time in the terminal, which may vary from cargo to cargo, market to market, season to season, consignee to consignee and so on.

For the purposes of throughput capacity, the Consultants have assumed that general cargo imports and exports are cleared through the yard and gate at the same rate as they are cleared through the ship and the berth. In other words, the capacity of the general cargo terminals has been based on the berth capacity alone.

The calculation for this is shown below:

Maximum throughput per annum =

Days/year × Working hours/day × Number of berths × Unloading rate x Number of gangs available per vessel × % Berth working time × Berth occupancy

(f) Bulk Cargo Terminals

The assessment of the throughput capacity of bulk cargo terminals reflects the same problems as the general cargo terminals.

Liquid bulks are typically imported in tanker-ships and stored in purpose built tanks as near the berth as possible, with connections between ship and shore by pipeline. The capacity of the tanks and the amount of storage area they occupy within the terminal will vary from product to product, depending on storage life, demand profile and the size and frequency of ship deliveries.

It is not possible to establish characteristic parameters to determine the storage requirements and dwell times of a wide range of commodities handled through a common user terminal because they are almost entirely dependent upon commercial consideration rather than upon physical infrastructure.

For the purposes of throughput capacity, therefore, the Consultants have assumed that bulk cargo imports and exports are cleared through the yard and gate at the same rate as they are cleared through the ship and the berth. The throughput capacity of the bulk terminals has been assessed on the basis of the berth capacity alone and on the premise that there is sufficient buffer storage, or temporary lay-down area, available at each of the baseline terminals in PONYNJ to service the berths and accommodate the overnight accumulation of bulk cargo.

The calculation for this is shown below:

Maximum throughput per annum =

Days/year × Working hours/day × Number of berths × Unloading rate x Number of gangs available per vessel × % Berth working time × Berth occupancy

5.2.2 *Container Terminals – General Operating Principles*

(a) Introduction

The general operating methods of the various container terminals in the Port are described in detail in Task E Technical Memorandum, Volume 2, Section E2.1.4. The following gives a summary of the main headings.

(b) Berth & Yard Operating Systems

The container terminal berth and yard operating systems in the Port generally fall into one of the categories below:

- Grounded + Top-Lift or Reach-Stacker
- Grounded + Straddle Carrier
- Grounded + Rubber Tired Gantry

- Wheeled or Chassis

(c) Landside Delivery & Receiving Systems

The landside delivery and receiving system is generally similar in principle for all container terminals operating a top-lift, straddle carrier or rubber tired gantry system and is as follows:

Landside Operations- Grounded Import Units: A truck arriving at the gate will seek out a serviceable chassis from the chassis storage area, enter the container exchange area, and be loaded. The truck will then proceed to the exit gate or the rail terminal. At the rail terminal, the container will be grounded to await the relevant train. The later loading to railcar will be carried out by reach stacker.

Landside Operations- Grounded Export Units: On arrival at the entry gate a transfer slot will be allocated, where the container will be transferred from the truck to a specific position within the terminal. On completion of unloading, the truck may drop the chassis in the chassis parking area and leave the terminal as a bobtail, or may pick another empty chassis from another shipping company's parking lot in order to collect an import container.

Landside Operations – Wheeled Import/Export Units: For container terminals operating a wheeled style system, the procedure is broadly similar to the above except that an export container is delivered to an assigned parking slot where the truck driver leaves it, on the road chassis, and departs the terminal as a bob-tail. An import container is already on a road chassis so the truck driver simply arrives as a bob-tail, hitches up and hauls it away.

(d) Yard Stacking Systems

Typical stack layouts and densities for the various styles of operating systems used at the container terminals in the Port are described and illustrated in Section E2.1.4.4 of Task E Technical Memorandum, Volume 2.

(e) Crane Rate of Working

The rate at which a crane can work is usually measured in lifts per hour. Current average crane working rates are typically around 20-22 lifts/hour for the older generation of Panamax cranes and 30-33 lifts/hour for the newer post-Panamax cranes. These values are subject to continual improvement.

(f) Labor Force & Working Hours

In principle, all container terminal operators are prepared to work ships and the yard 24 hours per day, 365 days each year. In reality, however, adverse weather conditions coupled with holidays and local working practices reduce the actual working time to a practical maximum of 20 hours per day, 360 days per year (with minor local variations)[30].

The landside receiving and delivering function of the terminals does not follow the same pattern and the normal hours (again with slight variances) are from 7 a.m. – 5 p.m., Monday thru Friday only, i.e. 10 hours per day, 5 days per week.

5.2.3 *Container Terminals - Particulars & Capacities*

(a) Introduction

Layout plans and summaries of the particulars and assessed capacity of each of the container terminals in the Port are given in Volume 2: Toolkit.

As noted in the Task E report, the assessed capacity should be based on the yard area or berth number as other elements such as equipment can readily be increased until they are not limiting.

[30] The labor force at each terminal is semi-permanent and working practice is such that the labor hired to load/discharge a vessel will stay with that vessel until all cargo operations are completed. Theoretically this can result in a continuous working period that may exceed 24 hours at a stretch, although with container vessels this is rare and the normal time to discharge averages around 12-14 hours.

(b) Maher

Item	Units	Value/Description
Terminal	-	Maher
Location		Port Elizabeth
Description		
Gross Area	Acres	475 (Based on post-redevelopment area)
Total Berth Length	Feet	8,900 (~9.2 berths at current ship size)
Method of Operation	-	Grounded + Straddle
Method of Stacking	-	In rows, maximum 3 high
Current Throughput (2001)	Lifts/Year	813,642
Current Productivity (2001)	Lifts/Acre/Yr	1,681 (Based on pre-redevelopment area of 484 acre)
Assessed Capacity		
Berth	Lifts/Year	3,187,000
Yard	Lifts/Year	2,217,000
Gates	Lifts/Year	2,137,000

Table 5.4 Maher container terminal (2001)

(c) Maersk Sealand (APMT)

Item	Units	Value/Description
Terminal	-	Maersk-Sealand
Location		Port Elizabeth
Description		
Gross Area	Acres	350 (Based on post-redevelopment)
Total Berth Length	Feet	6,000 (~5.9 berths at current ship size)
Method of Operation	-	Partly Grounded + RTG / Partly Wheeled + Chassis
Method of Stacking	-	Partly Block-stacked to 5 high / Partly Wheeled 1 high
Current Throughput (2001)	Lifts/Year	382,391
Current Productivity (2001)	Lifts/Acre/Yr	1,438 (Based on pre-redevelopment area)
Assessed Capacity		
Berth	Lifts/Year	2,476,000
Yard	Lifts/Year	1,183,000

Table 5.5 Maersk-Sealand container terminal

(d) PNCT

Item	Units	Value/Description
Terminal	-	PNCT
Location	-	Port Newark, Newark, NJ
Description		
Gross Area	Acres	156
Total Berth Length	Feet	4,800 (~4.9 berths at current ship size)
Method of Operation		Grounded + Straddle Carrier
Method of Stacking		In rows up to 2 high
Current Throughput (2001)	Lifts/Year	229,422
Current Productivity (2001)	Lifts/Acre/Yr	1,471
Assessed Capacity		
Berth	Lifts/Year	1,393,000
Yard	Lifts/Year	530,000

Table 5.6 Port Newark container terminal

(e) Howland Hook

Item	Units	Value/Description
Terminal	-	Howland Hook
Location		Port Ivory, Staten Island, NY
Description		
Gross Area	Acres	147
Total Berth Length	Feet	3,000 (~3 berths at current ship size)
Method of Operation		Grounded + Reach Stacker
Method of Stacking		Block Stack up to 3 High
Current Throughput (2001)	Lifts/Year	293,176
Current Productivity (2001)	Lifts/Acre/Yr	1,994
Assessed Capacity		
Berth	Lifts/Year	800,000
Yard	Lifts/Year	498,000

Table 5.7 Howland Hook container terminal

(f) Global

Item	Units	Value/Description
Terminal	-	Global
Location		Port Jersey, Bayonne, NJ
Description		
Gross Area	Acres	100
Total Berth Length	Feet	1,800 (~2 berths at current ship size)
Method of Operation	-	Grounded + RTG
Method of Stacking	-	Block stack up to 5 high
Current Throughput (2001)	Lifts/Year	175,620
Current Productivity (2001)	Lifts/Acre/Yr	1,756
Assessed Capacity		
Berth	Lifts/Year	383,000
Yard	Lifts/Year	758,900

Table 5.8 Global Marine container terminal

(g) Red Hook

Item	Units	Value/Description
Terminal	-	Red Hook
Location		North Brooklyn, Brooklyn, NY
Description		
Gross Area (Containers)	Acres	42
Total Berth Length	Feet	2,080 (~3 berths at current ship size)
Method of Operation	-	Grounded + Top-Lift
Method of Stacking	-	Block Stack up to 3 high
Current Throughput (2001)	Lifts/Year	40,563
Current Productivity (2001)	Lifts/Acre/Yr	507
Assessed Capacity		
Berth	Lifts/Year	536,000
Yard	Lifts/Year	128,000

Table 5.9 Red Hook container terminal

(h) ASI Barge Container Terminal

Item	Units	Value/Description
Terminal	-	ASI Barge Terminal
Location		Marsh Street, Port Newark, NJ
Description		
Gross Area	Acres	32
Total Berth Length	Feet	1,200 (~2 berths at current ship size)
Method of Operation	-	Grounded + Top-Lift
Method of Stacking	-	Block Stack up to 3 high
Current Throughput (2001)	Lifts/Year	10,669
Current Productivity (2001)	Lifts/Acre/Yr	333
Assessed Capacity		
Berth	Lifts/Year	171,000
Yard	Lifts/Year	101,000

Table 5.10 ASI barge container terminal

(i) Summary

For the purposes of planning future requirements, it is appropriate to assume that additional cranes and gates will be provided when required to meet demand and therefore to consider the capacity on berth numbers and yard area only. On this basis, the assessed capacity of the existing baseline container terminals is summarized in Table 5.11. The relationship of assessed capacity to demand is shown on Figure 3.7.

Terminal	Gross Area (Acres)	Number of Berths	Assessed Capacity		Limiting Factor
			(Lifts/Yr)	(Lifts/ Acre/Yr)	
Maher	475	9.2	2,217,000	4,667	Yard
Maersk	350	5.9	1,183,000	3,380	Yard
PNCT	156	4.9	530,000	3,397	Yard
Howland Hook	147	3.0	498,000	3,388	Yard
Global	100	2.0	383,000	3,830	Berth
Red Hook	42	3.0	128,000	3,048	Yard
ASI Port Newark	32	2.0	101,000	3,156	Yard
Total	1,302	30	5,040,000	3,871	
Current Actual (2001)	*1,265*	*30*	*1,945,483*	*1,538*	

Table 5.11 Assessed capacity of baseline container terminals

The assessed capacities of the container terminals, as noted above, are not the maxima that could potentially be achieved within the existing footprints, but rather the capacities that can actually be achieved using the present methods of operation. Through the introduction of further improvements in handling and stacking, the capacity of the existing container terminals in the Port will be significantly increased.

5.2.4 *Automobile Terminals – General Operating Principles*

(a) Introduction

The following sub-sections broadly describe the general operating methods of the various automobile terminals in the Port.

(b) Automobile Import/Export Handling System

(i) Shipside Operations- Import Units

Automobiles are driven from various positions within the ship to a first point of rest[31] in a specified area of the compound common to all imported vehicles, by ILA drivers from a stevedore company employed by the ship or its agents. Shipside operations can be carried out during any time of the day or night at the request of the vessel owners.

(ii) Landside Operations- Import Units

On completion of discharge, the automobiles are inspected by an independent surveyor. The vehicles are then transferred to another area of the compound by the terminal staff, where they are stored awaiting the instructions from the importer regarding any further work required to be carried out to the vehicles prior to collection. On completion of this work, the vehicle will be placed in a row awaiting collection for delivery to the consignee by road or by rail.

(iii) Landside Operations- Export Units

Export vehicles which are delivered by road truck will be unloaded by the truck driver into the designated area. The vehicle will then be driven either directly into the last point of rest[32] (which is usually the same area as the first point of rest) or, if this is occupied, via an interim storage area and then into the last point of rest.

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[31] First point of rest is, as the name suggests, the area in which import vehicles are landed and temporarily held for inspection by and handover to the terminal operator.

[32] Last point of rest is, as the name suggests, the area in which export vehicles are last temporarily held for inspection by and handover to the ship agents for loading.

Export vehicles that arrive at the terminal by railroad are driven off the rail-cars either directly into the last point of rest or via an interim storage area.

(iv) Shipside Operations- Export Units

Prior to the ship's arrival, the vehicles designated for that ship will be assembled by the terminal staff in the last point of rest close to and convenient to the berth(s) within the terminal. Automobiles are driven from the defined export lanes at this last point of rest in the terminal compound to the vessel by ILA drivers.

(v) Added Value Operations

The automobile terminals in the Port offer services that add value to the process of importing and exporting vehicles. These services include pre-delivery preparation, such as de-waxing or removal of protective film, cleaning, minor bodywork repairs (where damaged in transit), installation of moon-roofs and other optional equipment according to the consignee's requirements. This work is carried out in specially designed facilities located within the terminal area.

In addition, the terminals in the Port offer a vehicle storage service for both import vehicles and domestic vehicles.

(c) Parking Layouts

In the first (and last) point of rest, vehicles are usually parked very close together in the sequence in which they are off-loaded from (and loaded to) the ship. Little or no selectivity is required since they are generally driven away from the area in the same order that they arrived (first in, first out).

A variety of parking arrangements are used in the different automobile terminals. The arrangement adopted by any particular terminal is a function of the available space, the degree of selectivity required and the need to minimize the potential for damage. The Consultants have adopted a parking arrangement, known as "2-pack", which is designed to hold two vehicles in line and allows direct access to all cars without interim moves. This arrangement results in a parking density of 182 vehicles/acre.

(d) Labor Force & Working Hours

In principle, all automobile terminals can work ships for 24 hours per day, 365 days each year. In practice, however, not all terminals do so and the decision about whether or not to off-load import (or load export) vehicles at night rests with the importer, generally the vehicle manufacturer. Some importers consider the overtime costs to high and the risk working at night too great in terms of damage. Others are prepared to manage and accept the risk. In recognition of this situation, the Consultants have adopted an average berth working time that allows a limited amount of night working. As with container terminals, the deep-sea ILA labor force at each terminal is semi-permanent and working practice is such that the labor hired to load/discharge a vessel will stay with that vessel until the operation is completed. This rarely results in a continuous working period for the labor of more than a few hours.

The landside receiving and delivering function of the automobile terminals, including the pre-delivery preparation activities, tend to work 7 a.m. – 5 p.m., Monday thru Friday. Again, this is partly for reasons of cost and damage limitation, but also because of the custom and practice of road transporter contractors to work during the day only. The warehouse ILA labor force at each terminal is semi-permanent and employed by the terminal operator.

5.2.5 *Automobile Terminals – Particulars & Capacities*

(a) Introduction

Layout plans and summaries of the particulars and assessed capacity of each of the automobile terminals in the Port are given in Section E2.1.7 of Task E Technical Memorandum, Volume 2. The following summarizes the main points.

Item	**Units**	**Value/Description**
Terminal	-	NEAT
Location		Port Jersey, Bayonne, NJ
Description		
Gross Area	Acres	115
Effective Berths	Number	2 (1 of limited length - Shared with BMW)
Current Throughput (2001)	Vehicles/Year	88,530 (Including domestic vehicles)
Current Productivity (2001)	Vehicles/Acre/ Yr	769
Assessed Capacity		
Berth	Vehicles/Year	391,190 (Including BMW)
First Point of Rest	Vehicles/Year	447,672
Yard	Vehicles/Year	94,403

Table 5.12 NEAT automobile terminal

Item	Units	Value/Description
Terminal	-	BMW
Location		Port Jersey, Bayonne, NJ
Description		
Gross Area	Acres	20 (Including multi-level car park)
Effective Berths	Number	2 (1 of limited length - Shared with NEAT)
Current Throughput (2001)	Vehicles/Year	71,170
Current Productivity (2001)	Vehicles/Acre/ Yr	3,558
Assessed Capacity		
Berth	Vehicles/Year	Included in NEAT
First Point of Rest	Vehicles/Year	Included in NEAT
Yard	Vehicles/Year	162,621

Table 5.13 BMW automobile terminal

Item	Units	Value/Description
Terminal	-	FAPS
Location		Port Newark, Newark, NJ
Description		
Gross Area	Acres	175
Effective Berths	Number	3
Current Throughput (2001)	Vehicles/Year	205,800 (Including domestic cars)
Current Productivity (2001)	Vehicles/Acre/ Yr	1,176
Assessed Capacity		
Berth	Vehicles/Year	736,603
First Point of Rest	Vehicles/Year	447,672
Yard	Vehicles/Year	208,982

Table 5.14 FAPS automobile terminal

Item	Units	Value/Description
Terminal	-	DAS
Location		Port Elizabeth, Elizabeth, NJ
Description		
Gross Area	Acres	89
Effective Berths	Number	1
Current Throughput (2001)	Vehicles/Year	67,900 (Including domestic cars)
Current Productivity (2001)	Vehicles/Acre/ Yr	763
Assessed Capacity		
Berth	Vehicles/Year	108,202
First Point of Rest	Vehicles/Year	447,672
Yard	Vehicles/Year	398,885

Table 5.15 DAS automobile terminal

Item	Units	Value/Description
Terminal	-	Toyota
Location		Port Newark, Newark, NJ
Description		
Gross Area	Acres	90
Effective Berths	Number	2
Current Throughput (2001)	Vehicles/Year	170,000
Current Productivity (2001)	Vehicles/Acre/Yr	1,889
Assessed Capacity		
Berth	Vehicles/Year	391,190
First Point of Rest	Vehicles/Year	447,672
Yard	Vehicles/Year	359,082

Table 5.16 Toyota automobile terminal

(b) Summary

The limiting capacity for any given terminal is the least of the capacities of each of the individual steps in the operation. The assessed total capacity of the automobile terminals in the Port, based on the existing number of berths, first point of rest areas and area of yards is summarized in Table 5.17.

Terminal	Gross Area (Acres)	No. of Berths	Acres/ Berth	Assessed Capacity		Limiting Factor
				(Units/Yr)	(Units/Acre/Yr)	
FAPS	175	3	58.3	208,982	1,194	Yard
DAS	89	1	89.0	108,202	1,216	Berth
Toyota	90	2	45.0	359,082	3,990	Yard
NEAT	115	2	67.5	94,403	821	Yard
BMW	20	0	0	162,621	8,131	Yard
Total	**489**	**8**	**61.1**	**933,288**	**1,909**	
Current Actual (2001)[33]	*489*	*8*	*61.1*	*603,400*	*1,234*	

Table 5.17 Summary of assessed capacity of automobile terminals

This assessed capacity is based on the current pattern of dwell times which vary widely according to the popularity of particular models at any one time. The assessed capacity should therefore be treated with caution when using the results for the purposes of

[33] The total vehicle throughput in 2001 is based on PANYNJ data and excludes 7,400 vehicles reported as being handled at various terminals other than the 5 automobile terminals included in the baseline. There is, however, some uncertainty about whether the total includes or excludes domestic vehicles that are stored in the automobile terminals but are not imported or exported. There is also some uncertainty about the allocation of the reported total for Port Newark Public Berths, which serve both FAPS and Toyota, and the allocation of the reported total for Port Jersey, which serves both NEAT and BMW.

future automobile terminal land requirements. The relationship of assessed capacity to demand is shown on Figure 3.8.

5.2.6 *General Cargo Terminals*

(a) Introduction

Layout plans and detailed summaries of the particulars and assessed capacity of each of the baseline general cargo terminals are given in Section E2.1.8 of Task E Technical Memorandum, Volume 2.

Item	Units	Value/Description
Terminal	-	Port Newark Public Berths
Location		Port Newark, Newark, NJ
Description		
Gross Area	Acres	32
Total Berth Length	Feet	1,200 (~2 berths)
Current Throughput (2001)	Tons/Yr	42,633
Current Productivity	Tons/Acre/Yr	1,332
Assessed Capacity		
Limiting Capacity (Berth)	Tons/Yr	310,000

Table 5.18 Port Newark public berths (general cargo)

Item	Units	Value/Description
Terminal	-	Red Hook General Cargo Berths
Location		North Brooklyn, Brooklyn NY
Description		
Gross Area (General Cargo)	Acres	30 open + 8 covered
Total Berth Length	Feet	3,410 (~3 berths)
Current Throughput (2001)	Tons/Year	742,773
Current Productivity	Tons/Acre/Yr	19,547
Assessed Capacity		
Limiting Throughput (Berth)	Tons/Year	1,185,000

Table 5.19 Red Hook general cargo berths

Item	Units	Value/Description
Terminal	-	Howland Hook Fruit Terminal
Location		Port Ivory, Staten Island, NY
Description		
Gross Area (Covered)	Acres	2.75
Total Berth Length	Feet	3,000 shared with container ships (~4 berths, shared)
Current Throughput (2001)	Tons/Year	66,382
Current Productivity	Tons/Acre/Yr	24,139
Assessed Capacity		
Limiting Throughput (Berth)	Tons/Year	130,000

Table 5.20 Howland Hook fruit terminal

Item	Units	Value/Description
Terminal	-	South Brooklyn Marine Terminal
Location		South Brooklyn, Brooklyn NY
Description		
Gross Area	Acres	110
Total Berth Length	Feet	6,135 (~8 berths)
Current Throughput (2001)	Tons/Year	0
Current Productivity	Tons/Acre/Yr	0
Assessed Capacity		
Limiting Throughput (Berth)	Tons/Year	2,054,000

Table 5.21 South Brooklyn Marine Terminal

(b) Summary

The assessed total capacity of the baseline general cargo terminals in the Port is summarized in Table 5.22. The relationship of assessed capacity to demand is shown on Figure 3.9

Terminal	Area (Acres)	Actual Throughput (2001)		Assessed Capacity	
		Tons/Yr	Tons/Acre /Yr	Tons/Yr	Tons/Acre /Yr
Port Newark Public Berths	32	42,633	1.332	310,000	9,688
North Brooklyn Marine Terminal	38	742,773	19,546	1,185,000	31,184
Howland Hook Fruit Terminal	3	66,382	22,127	130,000	43,333
South Brooklyn Marine Terminal	110	0	0	2,054,000	18,672
Total	**183**	**851,788**	**11,668**	**3,679,000**	**20,100**

Table 5.22 Summary of assessed capacity of general cargo terminals

These capacities are based only on the number of berths and a generalized average handling rate for the commodities imported and exported. They do not take into account the storage area requirements and associated dwell times except to the extent that there is sufficient space available at each berth to load and unload trucks receiving and delivering the cargo from and to the terminal.

5.2.7 *Bulk Cargo Terminals*

(a) Introduction

Layout plans and summaries of the particulars and assessed capacity of the bulk cargo terminals in the baseline are given in Section E2.1.9 of Task E Technical Memorandum, Volume 2.

Item	Units	Value/Description
Terminal	-	Port Newark Dry Bulk Terminals
Location		Port Newark, Newark, NJ
Description		
Gross Area	Acres	68 Acres (Approximately)
Total Berth Length	Feet	4,200 (~ 6 berths)
Current Throughput (2001)	Tons/Year	2,239,878
Current Productivity (2001)	Tons/Acre/Yr	32,939
Assessed Capacity		
Assessed Total Throughput	Tons/Yr	4,857,750

Table 5.23 Port Newark dry bulk terminal

Item	Units	Value/Description
Terminal	-	Port Newark Liquid Bulk Terminals
Location		Port Newark, Newark, NJ
Description		
Gross Area	Acres	20 (Liquids stored in tanks)
Total Berth Length	Feet	2,800 (~ 4 berths)
Current Throughput (2001)	Tons/Year	2,341,600
Current Productivity (2001)	Tons/Acre/Yr	117,080
Assessed Capacity		
Assessed Total Throughput	Tons/Year	5,699,760

Table 5.24 Port Newark liquid bulk terminal

(b) Summary

The assessed total capacity of the bulk cargo terminals in the Port, in terms of throughput and productivity is summarized in Table 5.25. The relationship of assessed capacity to demand is shown on Figures 3.10 and 3.11.

Terminal	Area (Acres)	Actual Throughput (2001)		Assessed Capacity	
		Tons/Yr	Tons/Acre /Yr	Tons/Yr	Tons/Acre /Yr
Port Newark Dry Bulk Berths	68	2,239,878	32,939	4,857,750	71,438
Port Newark Liquid Bulk Berths	20	2,341,600	117,080	5,699,760	284,988
Total	**88**	**4,581,478**		**10,557,510**	

Table 5.25 Summary of assessed capacity of bulk cargo terminals

These capacities are based on the number of berths and a generalized average handling rate for the commodities imported and exported, and assumes that there is sufficient space available at each berth to load and unload trucks receiving and delivering the cargo from and to the terminal.

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6 Facilities Required to Meet Demand

6.1 Introduction

This Chapter describes the derivation of land area, approach channels, berthing channels berthing pockets, and berth length requirements to meet the forecast demand in 2060.

As the overall land requirements were seen as the most difficult aspect to satisfy, the initial planning was based on the land areas for each type of cargo. Then the berth length needed to serve these areas was calculated and some minor rearrangements implemented to ensure that sufficient berth space was available beside each land area in order to reach the full potential capacity of the land area.

6.2 Approach Channels

6.2.1 Container ships

A draft of 46ft for future container vessels was adopted in the Harbor Navigation Study[34]. Since then, the latest developments in ship construction indicate, as described in Section 4, that the estimated maximum future vessel draft for container ships likely to wish to call at the Port will in some cases be as much as 47.5ft.

The Harbor Navigation Study gives several reasons for taking a 50ft dredged depth corresponding to a container ship draft limit of 46ft, including part loading of vessels. Hence this CPIP study has adopted the 50ft maintained depth as adequate up to 2060 with the caution that this may in due course impose some restrictions on the largest fully loaded vessels if lines adopt them for trade with East Coast USA ports.

The required water depth for container ships was therefore taken as 50ft

Information on the air draft of future containerships is scarce. As stated in Task E[35], as ships get bigger the height restriction of Bayonne Bridge will become an increasing concern for container ship access along the Kill van Kull Channel to Port Newark North, Port Newark South, Port Elizabeth and Howland Hook. The development proposals in this study assume that any necessary raising of the bridge will be carried

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[34] USACE, Feasibility Report for New York and New Jersey Harbor Navigation Study, 1999, Vol II, Appendix E.
[35] CPIP Task E Technical Memorandum, Volume 2, Current Capacity and Aggregate Capacity, Section E.2.3.1.2.

out when required and consequently that there will be no airdraft restrictions for container ships wishing to transit the Kill van Kull.

6.2.2 *Auto Carriers*

The expected future draft of auto carrier ships is 33ft. Using the same 4ft clearance as in the Harbor Navigation study, the required water depth is 37ft in soft bottom channels.

Currently, auto carriers call at Port Newark North, Port Newark South, Port Elizabeth and Port Jersey only, and pass beneath the Bayonne Bridge to reach the Newark and Elizabeth sites without any airdraft difficulties.

Neither is water depth a concern for any of the channels at the designated study sites except Port Newark.

Auto carriers typically have a high-sided elevation that makes them vulnerable to being blown off-course by cross winds. Maneuvering in meandering and relatively narrow channels is therefore to be avoided if possible as is negotiating to the innermost berths of the other port sites.

6.2.3 *General Cargo Ships*

The expected future draft of general cargo ships is 36ft. Using the same 4ft clearance as given in the Harbor Navigation Study the required maintained water depth is 40ft.

Exceptionally large cargo ships of 43ft draft as described in Section 4 were assumed to be infrequent and part laden if visiting sites without adequate depth.

Air draft under the existing bridges on route to any of the study sites will not be a problem for general cargo ships.

6.2.4 *Dry and Liquid Bulk Ships*

The expected future draft of bulk cargo ships is 36ft. Using the same 4ft clearance as in the Harbor Navigation Study the required water depth is 40ft.

None of the dry- or liquid-bulk carriers currently calling at the Port, typically around 36,000 DWT, have air drafts that exceed the current limitations of bridge clearance. As the size of these vessels is not expected to increase they will be able to access all the terminals without difficulty.

6.3 Berthing Channels and Berth Pockets

6.3.1 General

Vessels intending to berth in the inner channels of the port require sufficient room for maneuvering between other moored vessels and for being stopped and pushed alongside the berth. They also require sufficient water depth alongside, at the berth pocket, to be afloat at all states of the tide. The ships also require turning space outside the inner channels to get the ship facing the right direction for departure. The adequacy of turning areas is beyond the scope of this study and is assumed to be covered by the external works in the approach channels

6.3.2 Berthing Channel Width

A suggested reasonable minimum channel width in the berthing area where the same type of ships are moored on both sides of the channel is 5 times the ship beam[36]. This gives the following required dimensions:

- Container berthing channel width, 5 x 141 ft = 705 ft.
- Auto berthing channel width, 5 x 105 ft = 525 ft.
- General cargo berthing channel width, 5 x 88 ft = 440 ft
- Dry bulk berthing channel width, 5 x 92 ft = 460 ft.
- Liquid bulk berthing channel widths, 5 x 120 ft = 600 ft.

It is recognized that the clearance required on each side of a passing ship at slow speed in a berthing channel could be less, but the above dimensions are considered the optimum for safe and efficient operation. Table 6.1 shows the suitability of channels for the five cargo types based on the dimensions given in Table 4.2.

[36] PIANC PTC II-30, Approach Channels A Guide for Design, June 1997, plus an allowance for moored ships and tug handling.

Channel Name	Sites Served	Most suitable for
Port Newark Channel	Port Newark N and Port Newark S (N side)	Auto, General Cargo, Dry & Liquid Bulk
Elizabeth Channel	Port Newark S (S side) and Port Elizabeth (N side)	Containers, Auto, General Cargo, Dry & Liquid Bulk
South Elizabeth Channel	Port Elizabeth (south)	All, only as a one-sided channel
Port Jersey Channel	Port Jersey and Bayonne Peninsula	Auto, General Cargo, Dry & Liquid Bulk
Pier 9A-9B Channel	North Brooklyn	All, only as a one-sided channel
Pier 8-9A Channel		All, only as a one-sided channel
Pier 7-8 Channel		All, only as a one-sided channel
Pier 6-7 Channel		All, only as a one-sided channel
Atlantic Basin Entrance		All, only as a one-sided channel
North Channel	South Brooklyn	All, only as a one-sided channel
South Channel		All, only as a one-sided channel

Table 6.1 Suitability of berthing channels

With reference to the Port Jersey Channel, it is seen from Table 6.1 that a double-sided access channel for large container ships of the future is not considered ideal. However, with care, and hence an increase in berthing maneuvering time, access is considered acceptable.

6.3.3 *Berth Depth, Length and Width*

At berth, ships should be provided with sufficient depth of water to cater for tide levels falling below normal levels. The berth depth should also allow for ships that nominally exceed the draft limits in the approach channel to take advantage of high tide when sailing to or from the berth. At berth they need an additional margin as the tide drops. These allowances are provided for in line with current practice in the Port where the berth pocket is the same depth as the channel. This gives an allowance of 2ft at the berth because a stationary ship does not need the 2ft sailing allowance required in the approaches.

The berth length needs to be longer than the maximum ship length to allow for maneuvering to the berth.

The berth lengths, depths and widths assumed in the analysis are given below:

- Container ship berth depth 50ft, berth length 1300ft, pocket width 180ft.
- Auto carriers berth depth 37ft, berth length 750ft, pocket width 150ft.
- General cargo ships berth depth 40ft, berth length 650ft pocket width 100ft.
- Dry bulk ship berth depth 40ft, berth length 700ft, pocket width 130ft.
- Liquid bulk ship berth depth 40ft, berth length 800 - 870ft, pocket width 130ft.

6.4 Land Area Requirements

6.4.1 General

This Section describes the derivation of land area requirements for the year 2060. The land area requirements for the port as a whole in 2060 were based on dividing the demand in 2060 by the assumed land productivity value (e.g. lifts/acre/year). This was done for each type of cargo. Land productivity values were based on the gross terminal area, i.e. the area of the terminal enclosed by its outer boundary including non-stacking areas such as the gate complex, administration areas, workshops, chassis parking, staff parking etc. For container terminals, the stacking area was assumed to be 70% of the gross terminal area, which percentage corresponds to the current average situation in the Port. It was assumed that future homeland security area requirements for cargo inspection, which at the time of the study had not been fully implemented, will be accommodated within the 30% allowance for non-stacking terminal area. The land area requirements were determined on the basis that sufficient berths and gates are provided and that no other limiting factors are present.

Some improvement in productivity between now and 2060 was taken into account. The general philosophy adopted was to base future productivity values on currently proven and widely used cargo handling technology taking into account the potential for improvements in productivity as discussed in Task E[37]:

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[37] CPIP Task E Technical Memorandum, Volume 2, Current Capacity and Aggregate Capacity, Section E2.1.10

(a) Container Yard Operations

Progressively phase out the few remaining wheeled chassis and top-lift/reach-stacker operations and complete phasing in the use of either rubber-tired or rail-mounted gantries or straddle carriers.

(b) Container Handling Systems

Progressively introduce semi- or fully-automated container handling equipment, using leading-edge information technology, computerized yard planning and satellite guided positioning.

(c) Container Terminal Gates

Progressively increase working hours of terminal gates and phase in electronic check-in systems, based on optical character recognition, smart cards and digital imaging technology.

(d) Highway Chassis Provision and Parking

In the short and medium term, establish more off-terminal chassis pools to free-up on-terminal land for operational use. In the longer term, phase out the current practice of carrier-owned chassis and transfer all chassis into the ownership of the truckers.

(e) Empty Container Storage

Acquire further off-terminal common-user empty container storage areas, promote increased use of PANYNJ's internet based empty container location system and provide incentives for carriers to back-load empties.

(f) Automobile Handling & Storage

Rationalize and consolidate fragmented automobile storage areas and encourage the relocation of pre-delivery preparation activities and long-term pre-distribution storage to off-terminal locations.

(g) Bulk & General Cargo Handling & Storage

Progressively introduce modern mobile off-loading cranes and cargo transfer equipment appropriate to the cargo and in line with increases in market demand.

6.4.2 *Land Productivity - Container Terminals*

This Section gives the derivation of the future land productivity value of 5,000 lifts per acre per year used in the analysis for land requirements up to 2060.

It was assumed that training, manning levels, work allocation, conditions of employment and management approach continue to improve to the extent that a more efficient working environment continues to develop over the nearly 60 year period covered by the study.

It was also assumed that the present trend towards denser stacking of containers in the yard using equipment capable of higher stacking will continue. In order to estimate the long-term future level of land productivity, the estimated near-future land productivity as assessed in Chapter 5 is examined in Table 6.2. For this table, it is assumed that there are sufficient berths available.

Terminal	Yard Operation	Near-Future Land Productivity [38] (Lifts/acre/yr)
Global, Port Jersey	Rubber Tired Gantry – 6 wide x 5 high stacking	7,600
Maher, Port Elizabeth	Straddle Carrier – 1 over 3 high stacking	4,700
PNCT, Port Newark	Straddle Carrier – 1 over 2 high stacking	3,400
Maersk (APM), Port Elizabeth	Part Chassis & Part Rubber Tired Gantry – 6 wide x 4 & 5 high stacking	3,400
Howland Hook, Staten Island	Top-Lift/Reach-Stacker – 3 wide x 3 high	3,400
ASI Marsh St, Port Newark	Top-Lift/Reach-Stacker – 2 & 3 wide x 3 high	3,200
ASI Red Hook, N Brooklyn	Top-Lift/Reach-Stacker – 2 wide x 3 high	3,000
Weighted average of land productivity for the whole Port		**3,871**

Table 6.2 Estimated near-future land productivity of Port container terminals

It is apparent from Table 6.2 that the use of rubber tired gantries (RTGs) yields the greatest yard productivity. The use of rail mounted gantries (RMGs), which are very similar, would offer an even higher productivity if adopted in the future. 1-over-3

[38] Near-future productivity is the estimated productivity when current improvements in terminal layout and equipment have been completed.

straddle carriers[39] provide a yard capacity that is approximately 60% of that provided by RTGs and RMGs. This is because RTGs and RMGs can stack boxes higher and more densely than straddle carriers[40]. The other methods of operation currently in use in the Port, namely 1-over-2 straddle carriers, top-lift, reach stackers and chassis operations all yield potential yard capacities of less than half that of RTGs. Reach stacker and chassis operations in the import-export stacks were assumed to be entirely phased out by 2060.

It was anticipated that terminal operators will progressively convert to the methods of operation that enable them to achieve higher productivity. For example if all existing container terminals in the Port were to convert to RTG operation, the average land productivity would rise from its estimated near-future level of 3,900 lifts/acre/year[41] to 7,600 lifts/acre/year, as shown in Table 6.2 for the case of Global terminal.

In practice, however, the preferred operating method of different terminals will vary depending on the markets they serve, their investment policies, labor agreements, the strategies of the operators and their requirements for equipment standardization and operational flexibility.

Presently, 4 of the 5 main container terminals are already either straddle carrier or RTG operations and Howland Hook, which is currently a top-lift/reach-stacker operation, is reported to be considering conversion to one or the other in the next few years.

On this basis, the long-term future land productivity of container terminal yards would lie somewhere between 7,600 lifts/acre/year, if all yards are RTG operations, and 3,400 lifts/acre/year, if all yards are straddle carrier operated. The weighted average of the main 5 terminals based on a mixed selection of assumed future methods of yard operation would be 5,440 lifts/acre/year, as indicated in Table 6.3. This still leaves considerable scope for higher productivity by adoption in later years of more RTGs, or RMGs.

[39] 1-over-3 straddle carrier can carry one box over a stack of three boxes.
[40] CPIP Task E Technical Memorandum, Volume 2, Current Capacity and Aggregate Capacity, Table E2-18.

[41] CPIP Task E Technical Memorandum, Volume 2, Current Capacity and Aggregate Capacity, Table E2-42

Terminal	Assumed Future Operation	Land Productivity (lifts/acre/yr)	Gross Area (acres)	Total Capacity (lifts/yr)
Maher	1-over-3 Straddle Carrier	4,700	475	2,232,500
Maersk (APM)	6 wide x 5 high RTG	7,600	350	2,660,000
PNCT	1-over-2 Straddle Carrier	3,400	156	530,000
Global	6 wide x 5 high RTG	7,600	100	760,000
Howland Hook	1-over-2 Straddle Carrier	3,400	147	499,800
		Total	**1,228**	**6,682,300**
Weighted Average = 6,682,300/ 1,228 = 5,440 lifts/acre/yr				

Table 6.3 Estimated container terminal long–term future land productivity

It should be noted that this level of land productivity assumes only 70% of the gross terminal is available for yard operations. It would not be unreasonable to expect, however, that as demand grows and pressure on land use builds, non-operational areas will be reduced. Also, the unit area capacity assumes continuation of the current levels of dwell time (import full 5 days, export full 7 days, refrigerated full 6 days, empty 25 days)[42]. Given the growing need to reduce inventories, the desired shift to rail transport, and with progressive improvements in communications and logistics, it is likely that these dwell times will be gradually reduced over time. Both these effects would increase land productivity.

It is sensible to provide a planning contingency against the uncertainties of the demand forecasts given in Chapter 3. The base case, which assumes both the Port and its East Coast competitor ports deepen to 50ft, was considered to be the most likely. It is nevertheless possible that other situations will materialize and result in a significantly greater demand through the Port.

Therefore, for planning purposes, a conservative long-term land productivity figure of 5,000 lifts/acre/year was adopted for container terminals in 2060.

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[42] CPIP Task E Technical Memorandum, Volume 2, Current Capacity and Aggregate Capacity, Appendix E2-B, Summary of Inputs to Container Terminal Capacity Assessments

6.4.3 *Land Productivity - Auto Terminals*

This Section gives the derivation of the future land productivity value of 1,900 units per acre per year used in the analysis.

The current productivities of the existing automobile terminals in the Port, were assessed as 1,909 units per acre per year as given in Table 5.17.

The large variation in the land productivities of the automobile terminals is a function of the widely ranging dwell times for different makes and models of vehicles, which range from an average of 5 days for BMWs to 45 days for the mix of vehicles handled by NEAT, with a current weighted average of 15 days[43]. There is no way of reliably forecasting the range and distribution of dwell times of different makes and models of vehicle into the future. It is expected that dwell times will tend to shorten in response to the need to reduce inventories, in which case the land productivity would tend to increase with time.

The other opportunities for improving the land productivity of automobile terminals through technology are limited because no cargo handling equipment is required, and the cars are simply transferred by being driven. It is possible to increase the density of parking in the storage yard, which would increase the land productivity, but this was considered an unlikely development because it reduces flexibility, involves double moves to select individual vehicles and increases the risk of damage.

It is also possible to increase the land productivity by building multi-story car parks, as currently employed at the BMW yard. This is an option, however, that is expensive and is likely to be limited to high value operations and specific market pressures.

As with container handling, it would be prudent to adopt a conservative land productivity value for automobile handling in order to provide a contingency against the inherent uncertainties of the total automobile demand forecast. It was therefore considered reasonable to adopt the current estimated average productivity of 1,900 units per acre per year for the purposes of estimating future land requirements for automobile handling.

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[43] CPIP Task E Technical Memorandum, Volume 2, Current Capacity and Aggregate Capacity, Appendix E2-B, Summary of Inputs to Container Terminal Capacity Assessments

6.4.4 *Land Productivity – General Cargo*

This Section gives the derivation of the future land productivity value of 20,100 tons per acre per year used in the analysis.

The current estimated land productivity for handling general cargo in the Port has been assessed, in Table 5.22, as 20,100 tons/acre/year. General cargo is, by definition, very variable in nature and includes project cargo, lumber, cocoa, bananas, palletized goods and the like. The total quantities of general cargo handled are also relatively modest (compared to containerized and bulk cargos) and are imported and exported in typically small shipments. General cargo terminals therefore tend to have simple, robust equipment that, with different slinging and hooking tools, can handle most of the commodities and types of packaging upon arrival. Until the volume of any particular commodity grows to the extent that investment in handling equipment specifically designed for that commodity is justified, the scope for improving handling rates is limited and the current and traditional methods of operation are likely to continue for the foreseeable future. As the productivity is based on a 5 day week and 8 hour day, there is a considerable contingency available to accommodate inherent uncertainties in the demand forecast.

It was therefore considered reasonable to adopt the estimated current land productivity of 20,100 tons/acre/year for the purposes of estimating future land requirements for general cargo handling.

6.4.5 *Land Productivity – Dry Bulk Cargo*

This Section gives the derivation of the future land productivity value of 71,500 tons per acre per year used in the analysis.

It has been estimated in Table 5.25, the land productivity for dry bulk cargo in the Port at the current time, could potentially be about 71,500 tons/acre/year if the facilities were fully utilized. This productivity could be significantly increased, should the need arise, by investing in large silos, and sophisticated unloaders and stacker-reclaimers. However, these investments are only justified where large volumes of specific commodities are involved, in which case dedicated terminals are usually developed such as Blue Circle Cement in the Kill Van Kull and NY Sand & Stone in Brooklyn Naval Yard. These large dedicated terminals are outside the scope of this study.

The baseline facilities of the Port handle a wide range of dry bulk cargos such as salt, granite blocks and scrap in quantities that do not warrant specialized equipment and therefore rely on simple, robust and multi-purpose cargo handling equipment in much the same way as the general cargo terminals. It was therefore considered reasonable to adopt the land productivity of 71,500 tons per acre per year for estimating future land requirements.

6.4.6 *Land Productivity – Liquid Bulk Cargo*

It has been estimated in Table 5.25, that the land productivity for liquid bulk cargo in the Port at the current time could potentially be 285,000 tons/acre/year. This productivity could be varied, in the future, by different storage tanks or dwell time for liquids in the tanks.

However there is no firm basis for assuming that significant changes will take place in the varied range of liquid cargoes handled. It was therefore considered reasonable to adopt the land productivity of 285,000 tons/acre/year for estimating future land requirements.

6.4.7 *Land Area Requirement for Terminals*

The future operational land area requirement was derived by dividing the forecast demand for each type of cargo by the land productivity for each type of cargo. The results of this calculation are shown in Table 6.4.

Cargo Type	**Land Productivity**	**Forecast Demand**	**Land Area Requirement** (acres)
Containers	5,000 lifts/acre/year	6,647,000[44]	1,329
Automobiles	1,900 units/acre/year	1,100,000	579
General Cargo	20,100 tons/acre/year	2,530,000	126
Dry Bulk Cargo	71,500 tons/acre/year	6,170,000	86
Liquid Bulk Cargo	285,000 tons/acre/year	5,090,000	18
		Total	**2,138**

Table 6.4 Land area requirements for different Cargo Types in 2060

[44] 11.3m TEU converted at 1.7 TEU per lift.

6.4.8 *Land Area Requirement for Terminal Warehousing*

This Section describes the need for warehousing on terminals or within the immediate Port area. For a review of warehousing requirements outside the Port refer to Section 12.3.

Operators of container terminals seldom request warehousing space on the terminal as it reduces the efficiency of their core business by taking up valuable waterfront land that could be used for increasing throughput. Occasionally an operator may wish to provide a container freight station capability if spare land is available and there is a business case for that activity. It is more likely that these services are provided more efficiently by an off-terminal freight station operation. The exception to the general rule is that some containers arrive in the Port with a payload that exceeds the legal onward transport limits. Warehousing is needed within the Port for lightening of these containers to the legal limit before they continue their journey on the public highways.

The demand for container load lightening warehouse space has been estimated in the Future Port Warehouse Requirements Study.[45] The report quotes a demand of 1 million square feet for heavy containers in 2020. Extending this forecast to 2060, using the ratio of 11.3 million TEU in 2060 and 5.6 million TEU in 2020 as derived in the CPIP forecast[46] gives a demand in 2060 of 2.02 million square feet, or 46.3 acres.

Although buildings are provided at auto terminals for preparation of vehicles, this activity does not require a large proportion of warehouse-sized buildings relative to the total terminal area occupied by auto parking.

Operations at general cargo terminals require a generous provision of warehousing space to protect break-bulk cargo from the weather prior to its onward transport. Space has been allowed within the general cargo terminal land allocation for sheds, so no further warehousing allowance is needed for this purpose.

Dry bulk terminals require storage space on the terminal which, if covered, usually needs to be custom built. Space has been allowed for storage in the land allocation for the terminal so no off terminal warehousing allowance is needed for this purpose.

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[45] Draft Report, Louis Berger & Associates in Association with DCG Corplan Consulting LLC.
[46] CPIP Task E Technical Memorandum, Volume 1, Market Forecast and Outlook, Table E1-29

Liquid bulk terminals do not require warehousing space as the product is stored in tanks before onward transport and the space for tanks has been included in the terminal land allocation.

Distribution warehousing was also studied in the Future Port Warehouse Requirements Study, which reports that '…the trend of new warehouse investments further removed from the port was a key finding…'. As stated, this distribution warehousing is typically outside the port boundary and hence no increase in Port warehousing for this purpose is expected.

Refrigerated storage does not need to be next to the waterfront. However, a substantial area of cold storage is currently available in the vicinity of the Port and a nominal allowance for continuing these activities has been made.

It is therefore concluded that an expansion of warehousing space in the Port is not required in preference to allocating space for waterfront dependent activities. In order to allow for cold stores and other potential warehouse needs a generous minimum allowance of 140 acres has been included.

6.4.9 Land Area Requirement for Road and Rail Facilities

The land estimated to be required for container handling intermodal terminals follows the current planning of the Port. The areas and published capacity of the terminals is given below:

- Port Elizabeth Express Rail Terminal 70 acres (1 million TEU/year)[47]
- Howland Hook Rail Terminal 40 acres (0.25 million TEU/year)[48]

It should be noted that Express Rail terminal was planned on the basis of using rubber tired gantries serving two tracks each and with varying amounts of stacking in the terminal. Productivity in terms of rail-bound TEU/acre/year of these terminals could be increased by using rail mounted gantry handling systems. The opportunity therefore exists for future release of rail terminal area for container stacking.

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[47] www.apmterminals.com
[48] https://mscs.marad.dot.gov

A temporary intermodal facility has been provided for PNCT across Corbin Street. In the near future this will be replaced by a permanent 4 track, 3000ft long loading facility.

In addition, a container handling intermodal terminal is proposed in this study to be located at Port Jersey to serve the terminals at Port Jersey and Bayonne Peninsula. The Consultant has estimated that this terminal should be 20 acres to handle 0.3 million TEU/year using the rail-mounted gantry crane method.

At South Brooklyn it is proposed to provide a 62 acre rail terminal for the case of a container terminal in that location.

In the case of auto terminals it is assumed that loading tracks will be provided on or near each terminal, except at Bayonne.

Allowances for roadways around the sites were based on a nominal estimate of the roadways required to get access between terminals and to connect between terminals and the surrounding road system. The total road and rail off-terminal, on-site areas provided are as shown in Table 6.5.

Site	Area (acres)
Port Newark North	45
Port Newark South	45
Port Elizabeth	200
Port Jersey	20
Bayonne Peninsula	-
Howland Hook	40
North Brooklyn	-
South Brooklyn[49]	-
Total	**350**

Table 6.5 Area required for road and rail facilities

Note: Maximum case given

[49] In the case of a container terminal at S Brooklyn, a rail terminal of 62 acres is required. It is not included in the table as it would replace some of the rail terminal space at other sites.

6.4.10 *Land Area Requirement for Amenities and Services*

Normally the provision of land required for port related amenities such as eating establishments, fuelling stops and miscellaneous service centers would be outside the port boundary. However, particularly in the case of Port Elizabeth/Newark, the port area is large and relatively isolated from facilities. A support area of approximately 140 acres has therefore been allowed for in the Port Elizabeth/Newark area.

6.4.11 *Total Land Area Requirements*

The total land area requirements are summarized in Table 6.6.

Area Required	**Acres**
Containers	1,330
Autos	580
General Cargo	130
Dry Bulk	90
Liquid Bulk	20
Total Required for Above Sections	**2,150**
Road and Rail[50]	350
Warehousing[48]	140
Support[48]	140
Total	**2,780**

Table 6.6 Total land area required in 2060

6.5 Berth Requirements

6.5.1 *General*

This Section describes the terminal demand and the berth productivity for use in the derivation of the number of berths required to meet terminal demand. The calculation of the number of berths for specific terminals is set out in Section 7.9. The basic principles of the calculation were the same as were used in Task E Technical Memorandum when establishing the near-future terminal capacities and the values of

[50] The road, warehousing and support areas allocated vary slightly around these values according to the space available in the particular arrangement

the parameters used were the same as in the Task E calculations except where noted below.

6.5.2 *Berth Capacity*

It should be noted that the land area allocation resulted in an overall capacity that exceeded the annual demand in 2060 by various amounts (see Table 7.3). In the berth calculations, nevertheless, the required annual berth capacity was taken as the figure needed to at least match the land capacity where possible.

Because berths were generally allocated in whole units of berth it is the case in some terminals that the theoretical berth capacity exceeds the land capacity. The terminal capacity, however, was still based on the land capacity because it was the limiting factor. For example if the calculations theoretically showed that 2.5 berths were required, then 3 were provided.

6.5.3 *Berth productivity - Container Berths*

The crane productivity for container cranes was increased from 25 lifts per hour (as used in near future capacity estimates) to a long term future rate of 35 and, exceptionally 40 lifts per hour, in recognition of ongoing technological advances in container crane design and the continuing adoption of the latest crane designs in the Port. Figures approaching these higher levels of productivity are already being achieved in some terminals worldwide and they are certain to be achieved in the Port by 2060 or perhaps much earlier.

6.5.4 *Berth productivity - Auto Berths*

The berth productivity for auto berths depends on the number of drivers employed in the unloading process and the ease with which the vehicles can maneuver in the ship internal layout and shore ramps. It was considered imprudent to assume that there would be significant technological advances in this process. A typical rate of 100 units per hour[51] as confirmed by operators was assumed in the analysis.

6.5.5 *Berth productivity - General Cargo Berths*

The berth productivity for general cargo berths is very sensitive to the type of cargo being handled. For example, bundled steel flats and bar will produce a higher productivity than bundled timber, in terms of tonnage, as the hooking and lifting times are similar. The range of products likely to be handled in 2060 cannot be

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[51] CPIP Task E Technical Memorandum, Volume 2, Current Capacity and Aggregate Capacity, Appendix E2-B, Auto Terminal Capacity

forecast with any certainty so an estimate had to be made. It was also considered unlikely that significant technological advances would be made in the future as these products have been handled in the same way for many years. For a mix of general cargo types the actual rate achievable was assumed to be 169 tons per berth per hour.

6.5.6 *Berth productivity - Dry Bulk Berths*

The productivity of dry bulk berths is governed by the rate of removal of material from the ship by grab or pneumatic conveyor and by the landside conveying equipment. Over a number of berths different systems will be used for different materials and the equipment will also be sized according to the scale of operation. Typical transfer rates per ship vary from about 400 tons per hour for pneumatic systems up to say 2,000 tons per hour for large grabs working on the largest ships. It was assumed reasonable to use an average rate of 10,000 tons per berth per day in 2060.

6.5.7 *Berth productivity - Liquid Bulk Berths*

The productivity of liquid berths is governed by the pumping rate for the particular liquid being transferred and there is also a wide variation in pumping rates dependent on the size and equipment of the vessel. The liquids that may be handled through the facilities in the future are also not known. It was assumed reasonable to use an average pumping rate of 4,000 tons per berth per hour in 2060.

6.5.8 *Berth length*

Historically, the length of an individual berth required to serve the shipping fleet has continuously increased. It was therefore necessary to consider what lengths the berths will be in 2060. A degree of complexity is also introduced depending on the number of berths on a straight run of wharf. If there are many berths, the length of wharf can be based on the average ship length, whereas if there are only two or three berths, the wharf length has to be based on the likelihood of two or three of the longest ships turning up at the same time. In the near future it is forecast that the container ships that call at the Port will be longer and of a more uniform length than at present. The berth length was therefore calculated on the basis of whole number multiples of berths required for the longest ships except in the case of four or more berths in a run of wharf, where the average was used.

A clearance was allowed between the ends of moored ships, the greatest clearance being allowed for liquid cargo due to the additional margin needed for the possible safety and pollution risks posed by flammable or hazardous materials.

In the berth calculations, the length of berth required for the longest ships (see Chapter 4) is based on the figures given in Table 6.7.

Cargo Type	Maximum Ship Length	Berth Length
Containers	1,214ft	1,300ft
Autos	656ft	750ft
General Cargo	600ft	650ft
Dry Bulk	617ft	700ft
Liquid Bulk	710ft	800 - 870ft

Table 6.7 Individual berth length for various cargo types

6.6 Requirements for Buildings

6.6.1 General

The following assumptions were used for assessing the building requirements for the terminals for the purpose of conceptual cost estimates.

Where a terminal already exists and the existing buildings are capable of being utilized no cost is added for expansion of administration, gate and inspection buildings unless the expansion is more than 20% of the existing area. Various light sheds and small buildings were not measured but were instead assumed to be included in contingency.

6.6.2 Administration

For container terminals the area of administration building, including customs and inspection was based on previous experience. The quantity required per additional 1,000 TEU was taken as 9 sq ft. For general cargo, auto and bulk terminals it was assumed that the administration would be housed within other terminal sheds.

6.6.3 Gate

Future container terminal gates are expected to be smaller than at present due to improved gate systems. The existing gate systems of Port Newark and Port Elizabeth container terminals are extensive and it is assumed they will cope with the additional traffic in the future. For Port Jersey and Bayonne Peninsula developments, pre-gates, gates and trouble-ticket offices were allowed at the rate of 1,000sq ft per berth for inbound and outbound canopies, and workshops for roadability[52] checks were allowed for at the rate of 5,000sq ft per berth. For calculation purposes this was approximated to a total gate requirement of 6,000 sq ft per 480,000 TEU.

6.6.4 *Workshop*

The additional area of workshop per TEU was allowed for at the rate of 0.03sq ft per TEU and for general cargo terminals at the rate of .004sq ft per ton. Other terminals have smaller demands for workshops and were not itemized.

6.6.5 *Container terminal sheds*

It was assumed that existing container terminals have no requirement for further stripping and stuffing on-terminal other than what already exists. On new sites 1.5% of the terminal area was assigned for warehouse facilities for load lightening of over weight containers on the basis of figures given in the 1999 Berger warehouse requirements study[53].

6.6.6 *Auto processing sheds*

The extent of processing on-site is variable and cannot be predicted for future terminals. The structures generally comprise light warehousing. It was assumed on the basis of observations of existing terminals that 2% of site area be set aside for processing. It was also assumed that the administration offices were incorporated in the same processing building.

6.6.7 *General cargo*

It was assumed that the existing sheds at North Brooklyn and South Brooklyn are adequate except in cases where the sheds are rebuilt due to poor condition or the supporting piers need to be demolished.

6.6.8 *Dry bulk*

As the future products are not known it was assumed that existing covered storage would be retained and that additional storage would be in the open for all terminals, to be on an equal basis.

6.6.9 *Liquid bulk*

It was assumed that the existing bulk liquid storage tank farms are at capacity. For future increases in throughput additional tanks will be required although the product

[52] Mechanical checks that the chassis is safe to be used on the road.
[53] LOUIS BERGER & ASSOCIATES INC, Future Port Warehouse Requirements Study, Draft Report, Nov 1999

and type of tanks or their size is unknown. Dwell time and associated seasonal peaks are the most significant factors in determining the storage required and this can vary from a few days for high value food and chemical products to months for fuel oils. In the latter case the terminal can become more alike to a strategic storage facility. For the purposes of this analysis an overall dwell time of 20 days was assumed.

A few large tanks of ordinary steel for fuel oil products are much cheaper than, for example, many small tanks made of stainless steel for storing the same volume of food products or chemicals. It was assumed that a mix of different sizes and types of tanks would be used.

6.6.10 Inspection facilities

The provision of inspection facilities, particularly in the current high security climate, is considered significant for container terminals where scanning, x-rays, and agricultural and foodstuffs products inspections and testing will be required. An allowance of .005sq ft per additional TEU was made.

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7 Cargo Terminal Improvements

7.1 General

This Chapter describes the methods and findings of the part of the study which looked at the reorganization or expansion of the cargo terminal facilities at the Port over the period to 2060. Although there is an almost unlimited number of possible options for improvement it was possible to devise the most likely options for the future terminals. Their combination into four likely Scenarios are presented and discussed.

7.2 Method

The specific requirements for the growth of the Port as a whole were determined as described in Chapter 6. The purpose of this part of the study was to investigate ways of meeting those requirements. From earlier studies it was anticipated that the requirements for land would dominate the future planning of the Port. Therefore the planning was predominately based on the land requirement aspects.

Firstly the availability of land at the identified sites was calculated from information provided to the Consultant. Then the attributes of those sites was examined and the best way of allocating land for the activities of the Port at the most suitable sites was determined. The allocation of land was carried out, in some cases, by changing the size of a terminal or by changing the nature of the activity carried out on the terminal. Each different terminal was designated as an Option and the combination of Options which met the overall cargo demand was termed a Scenario. Finally the terminal Options were provided with the required numbers of berths.

7.3 Sites

For ease of reference and evaluation the Port is divided geographically into the baseline sites identified in Chapter 5. Each site has various Options for terminal arrangements, which when taken together, make up the planning Scenarios The sites are:

- Port Newark North
- Port Newark South
- Port Elizabeth

- Port Jersey
- Bayonne Peninsula
- Howland Hook
- North Brooklyn
- South Brooklyn

These sites and their existing layouts are shown Volume 2: Toolkit, Figures 2.1, 3.1, 4.1, 5.1, 6.1, 7.1, 8.1 and 9.1.

7.4 Land Availability

The existing land area availability at each of the designated CPIP sites is summarized in Table 7.1.

Table 7.1 indicates that while there is almost enough operational area in the existing cargo handling terminals to meet the demand for operational area in 2060, there is also significant scope for further land to be made available for cargo handling by the following potential improvements:

- Reconfiguring the existing sites by relocating off-site those support activities that do not need to be located in close proximity to cargo handling operations.
- Incorporating into terminals the space presently occupied by the numerous access roads that intersect the sites.
- Acquiring suitable areas of land adjoining the boundaries of the existing sites.
- In-filling suitable adjacent waterfront areas where environmentally acceptable.

Site	Operational Area	Support Area	Potential Acquisition Area	Potential Fill Area	Total Area
EXISTING AREAS (Acres)					
Port Newark North	225	155	0	0	380
Port Newark South	340	240	0	0	580
Port Elizabeth	915	205	230	0	1,350
Port Jersey	246	0	0	20	266
Bayonne Peninsula	0	150	0	0	150
Howland Hook	147	0	118[54]	3	268
North Brooklyn	80	0	50[55]	0	130
South Brooklyn	80	0	112	130[56]	322
Total Available	**2,033**	**750**	**510**	**153**	**3,446**
FUTURE AREAS IN 2060 (Acres)					
Total Required	**2,150[57]**	**Allocation varies depending on Scenario**			**2,780**

Table 7.1 Summary of existing and future land areas

The Potential Fill Areas stated in Table 7.1 are offshore, where additional acreage is provided by filling/reclamation. These areas have been estimated by using the boundaries of existing and proposed terminal layouts. Some acreage may be on inland wetland, some on the littoral zone and some in deep water.

7.5 Site Attributes

The development of planning Scenarios takes into account the location and physical attributes of the designated sites as summarized in Task F[58]. The site attributes considered included:

- Current and future area
- Current ownership and use
- Current lease

[54] 85 acres of Port Ivory is included which has already been acquired but not developed.
[55] Piers 6,7,8 and 12
[56] Includes areas in South Brooklyn outside the Port Authority boundary
[57] See Table 6.6
[58] CPIP Task F Technical Memorandum, Volume 1, Cargo Terminal Options, Appendix C.

- Road, rail and seawards access
- Character of local community
- Natural environment
- Ground conditions
- Other general attributes

Previous studies into provision of terminals in the Port were reviewed[59] to glean any useful information on potential terminal locations and layouts, and the attributes of the various sites in the Port were assessed to judge their potential for handling the vessels and types and quantities of cargo.

7.6 *Options*

The Options for a particular site included different development proposals for the type of cargo to be handled and looked at development by:

- Change of use
- Expansion by acquisition
- Expansion by filling
- Improvement by rearrangement

The land that could be allocated to each cargo was calculated for each Option together with the associated berth space.

7.7 *Land Allocation and Scenarios*

A primary objective of the plan for the Port is that growth should be accommodated by the provision of sufficient land and berths for all the main cargo types. This requires the allocation of land and berths in an overall and integrated arrangement to meet the demand. The overall arrangements, termed Scenarios, were arranged such that the combined provision for different cargoes in the terminals forming each Scenario is consistent with the overall demand for each cargo.

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[59] See CPIP Task F Technical Memorandum, Volume 1, Cargo Terminal Options, Ch. 5.

7.7.1 *Development of Scenarios*

The assembly of different terminal Options into Scenarios takes account of a wide range of considerations, which are discussed below.

(a) *Forecast demand and future capacity by cargo type*. The Scenarios were assembled to ensure the areas of land allocated for handling each cargo are sufficient in total to meet the forecast demand to 2060. The development of land productivity values for planning is described in section 6.4 and how each Scenario handles demand is summarized in the Toolkit.

(b) *Land area and waterfront availability*. The area, shape and wharf length at a particular site influences the proposed usage of the site, and therefore the overall Scenario. For example, North Brooklyn is relatively small in plan area compared to Port Elizabeth, but has considerable wharf space - making it ideal for a General Cargo terminal. This removes the need for such terminals at other locations around the Port where larger terminal areas are more suited to container and other uses.

The Scenarios are assembled to minimize the requirement for fill, particularly in environmentally sensitive areas, as far as possible.

In addition, consideration is also given to ensure sufficient areas of land, in suitable locations, are allocated to support services for the cargo handling terminals (road and rail access corridors and common-user amenities and repair shops, shipping agency offices, etc.).

(c) *Shipping and inland transportation access*. The Scenarios are arranged where possible, to minimize or eliminate significant additional channel deepenings (in addition to those included in the Harbor Navigation Study) or the removal of existing airdraft restrictions. For example, the provision of container terminals seaward of the Bayonne Bridge at Bayonne and Port Jersey sites in some Scenarios is responsive to this consideration.

Consideration is also given to minimize scenarios requiring major additional road and rail infrastructure investment, particularly in already highly developed locations. For example, the Option to develop a container terminal at South Brooklyn, which would require considerable investment in new infrastructure, is included in only one Scenario.

(d) *Existing infrastructure & superstructure, land ownership and tenant lease holding.* Consideration of the above was given to minimize relocation of existing cargo handling operations; particularly those well established with long term leases or where land is in private ownership. For example, maintaining container terminals at Port Elizabeth and Port Jersey is responsive to this condition

(e) *Cargo handling and storage.* In addition to utilizing existing facilities, a desire to minimize the location of high volume cargo terminals in close proximity to residential, recreation, retail and amenity areas influenced Scenario arrangements. For example, auto storage at South Brooklyn or Bayonne is preferential to container or bulk handling operations at these locations.

(f) *Capital and operating costs.* The Scenarios were assembled to maintain and utilize the existing infrastructure as far as possible, thus reducing capital development costs. Operating costs were also considered when assembling Scenarios. For example, through the consolidation of auto terminal sites, offloading is centralized, and the sites offer more flexibility for sub dividing and leasing.

(g) *Natural environment.* Effects on the natural environment were minimized during arrangement of the Scenarios. This included maintaining the operation of existing terminals where viable and limiting any required dredging. For example, dredging of Port Newark Channel is not required in any Scenario, fill and wetland use has been minimized overall, and the existing nature reserve at Port Jersey is maintained in a number of the developed Scenarios.

(h) *Community and stakeholder interests.* The CPIP Stakeholder List of Priority Objectives was considered during the assembly of the Scenarios; some objectives are included in the above considerations. Others have been addressed within Options at particular sites - for example, options at Port Jersey include opportunities for waterfront public access.

(i) *Commercial and political aspirations.* During assembly of Scenarios, commercial aspirations were determined through discussion with terminal operators. For example, Maher's redevelopment plans were included within the baseline, and the shape of land reclamation at Howland Hook was guided by the terminal

operator's goals. Three of the Scenarios also meet the Federal "two users" requirement for the Port Jersey Channel, in connection with funding for the deepening program.

By combining the Options that evolved from the process described above, Scenarios were identified that met or exceeded the overall requirements for the Port in 2060 in terms of land area, berth provision and, as far as possible, site suitability.

The Scenarios were first presented in Task F[60] for comment and were subsequently adjusted and reported in Task G[61] in response to comments received from the CPIP Consortium and stakeholders.

Five Scenarios, Orange, Red, Green, Yellow and Blue were presented in Task F and are shown in Figures 7.1 to 7.5.

7.7.2 *Scenario Adjustment*

Following the Task G comment period, the Scenarios were adjusted as described in Table 7.2.

Four adjusted Scenarios, Orange, Red, Yellow and Blue have now been proposed as shown in Volume 2: Toolkit, Figures 12.1 to 12.4. The land allocation is summarized in Table 7.3 and the details are included in Volume 2: Toolkit, Chapter 12.

As noted in Table 7.2, one major adjustment included the deletion of the Green Scenario. In the process of assembling Scenarios the Consultant attempted to address all the ambitions of the interested parties planning to open new facilities. However, building too many terminals with capacity far in excess of demand can create a situation where one terminal may be unsuccessful in attracting sufficient business to remain viable. As an illustration of this consequence, the Green Scenario was developed and includes the conversion of the existing Port Newark Container Terminal into an auto terminal to balance the opening up of new container terminal capacity elsewhere in the Port. However, this Scenario did not stand out in the overall evaluation and, as it is generally undesirable to waste the existing investment that has taken place at Port Newark, it was agreed by the CPIP Agencies that the conversion of Port Newark Container Terminal to auto terminal use should not be considered further.

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[60] CPIP Task F Technical Memorandum, Volume 1, Cargo Terminal Options, Ch. 7.
[61] CPIP Task G Technical Memorandum, Port Development Proposals.

The conclusion to delete the Green Scenario was agreed by the CPIP Agencies, subject to incorporating some of the better aspects of Green Scenario into other Scenarios. These aspects are included in Table 7.2.

Task F Scenario	**Task G Adjustment**[62]
Green	Delete Green Scenario
Orange	O1 – Move Port Jersey rail terminal northward
	O2 – Reinstate Global Neat boundary
	O3 – Realign Howland Hook extension berth line
	O4 – Move berth in A1 into Port Newark Channel and move L1 berth east.
Red	R1 - Substitute C9 for C8 & A10 at Bayonne Peninsula
	R2 - Substitute A15 for A5 at Port Newark South
	R3 - Move Port Jersey rail terminal northward
	R4 – Move berth in A2 into Port Newark Channel and reduce berths in L2 from 3 to 2.
Yellow	Y1 – Exclude acquired land at Port Elizabeth
	Y2 - Substitute A12 for G3 and A11 at S Brooklyn
	Y3 - Move Port Jersey rail terminal northward
	Y4 – Preserve wetland at Port Jersey
	Y5 - Reinstate Global Neat boundary
	Y6 - Move berth in A1 into Port Newark Channel and move L1 berth east.
Blue	B1 - Move Port Jersey rail terminal northward
	B2 - Reinstate Global Neat boundary
	B3 – Substitute new Option L4 for L3
	B4 - Move berth in A1 into Port Newark Channel and move L1 berth east.

Table 7.2 Summary of adjustments to scenarios

[62] See Section 3.2 of CPIP Task G Technical Memorandum, Port Development Proposals for detailed reasoning for the adjustments.

		Container	Auto	General Cargo	Dry Bulk	Liquid Bulk
Area Required in 2060 (acres)		**1,329**	**579**	**126**	**86**	**18**
Area Allocated (acres)						
ORANGE	**Area**	1,574 (1,567)[1]	680	130	87	38
RED	**Area**	1,658 (1,597)[1]	580 (585)[1]	130	90	30
YELLOW	**Area**	1,433 (1,577)[1]	661 (600)[1]	130	87	38
BLUE	**Area**	1,513 (1,502)[1]	671 (665)[1]	130	87	38
Capacity Required in 2060		**11.3** (m TEU)	**1.10** (m units)	**2.53** (m tons)	**6.17** (m tons)	**5.09** (m tons)
Capacity Provided						
ORANGE	**Capacity**	13.4 (13.3)[1]	1.29	2.61	6.22	10.83
RED	**Capacity**	14.1 (13.6)[1]	1.10 (1.11)[1]	2.61	6.44	6.49 (8.55)
YELLOW	**Capacity**	12.2 (13.4)[1]	1.26 (1.14)[1]	2.61	6.22	10.83
BLUE	**Capacity**	12.9 (12.8)[1]	1.27 (1.26)1	2.61	6.22	6.93

Table 7.3 Summary of land allocation in scenarios

Note 1 : Value in Task F shown thus ( ).

7.8 Terminal Options in the Scenarios

7.8.1 General

The different Options making up a Scenario are as shown on Volume 2: Toolkit Figures 12.1 to 12.4.

The Options are numbered as follows:

- Container Terminal Options C1 to C14,
- Auto Terminal Options A1, A2, A4, A8, A9,A10 to A15,
- General Cargo Terminal Options G1 to G4,
- Dry Bulk Terminal Options D1, D2 and D4, and
- Liquid Bulk Terminal Options L1 to L4.

The individual Options are described in the following Sections.

7.8.2 *Port Newark North Options*

(a) General

In its existing configuration (see Toolkit Figure 2.1) this site contains several unconnected automobile terminals some of which are very small, one liquid bulk terminal and one dry bulk terminal. There are about a dozen covered stores, warehouses and other large buildings distributed around the site. Many minor roads and some rail tracks intersect the area. The existing land allocation is given in Toolkit Table 2.1.

All the Options for this site are set out on Toolkit Figures 2.3 and 2.4 and described below.

(b) Scenarios Orange, Yellow and Blue

These Scenarios have identical arrangements at Port Newark North. Most existing roads and rail tracks are removed, and a road corridor, rail corridor and terminal support industries zone are developed along the northern side of the site. The majority of covered storage sheds, warehouses and other large buildings are removed. The existing liquid bulk facilities are left substantially unchanged but the dry bulk cargo storage area is consolidated at the western end of the site. The auto terminals are consolidated into a large area that may be subdivided into leaseholdings as required.

(c) Scenario Red

Scenario Red at Port Newark North is generally similar to the above, but with adjustments to size and location of the areas allocated.

7.8.3 *Port Newark South Options*

(a) General

In its existing configuration (see Toolkit Figure 3.1) this site contains several unconnected automobile terminals, two liquid bulk terminals, a scrap storage area, a small container barge operation and the third largest container terminal in the Port. There are about a dozen covered stores, warehouses and other large buildings distributed around the site. Many minor roads and some rail tracks intersect the area. The existing land allocation is given in Toolkit Table 3.1.

All the Options for this site are set out on Toolkit Figures 3.3 to 3.6 and described below.

(b) Scenario Orange

Most existing roads and rail tracks are removed, and a centralized road access corridor and terminal support industries zone are developed. The existing small container terminal, covered storage sheds, warehouses, cool stores and other buildings are removed and the land progressively allocated a) to the existing container terminal for expansion and b) to consolidated auto terminal parking lots. The larger of the two existing liquid bulk terminals is left in place but the existing dry bulk terminals are converted to auto terminals.

(c) Scenario Red

Scenario Red at Port Newark South is similar to the Scenario Orange arrangement, but the liquid bulk terminal is converted to auto terminal use.

(d) Scenario Yellow

Scenario Yellow at Port Newark South is similar to the Scenario Orange arrangement but with a larger container terminal and a smaller auto terminal.

(e) Scenario Blue

Scenario Blue at Port Newark South is similar to Scenario Orange with the addition of general cargo on the northern and eastern berths and most of the central area converted to auto terminal use. Due to the high demand for berths, the liquid berths have been reduced in Port Newark South from the two provided in the Orange and Yellow Scenarios to one, which is sufficient to match the demand.

7.8.4 *Port Elizabeth Options*

(a) General

In its existing configuration (see Toolkit Figure 4.1) this site has recently been cleared of many minor roads and buildings to create the two largest container terminals in the Port. There are also two auto storage areas and some large warehouses including cold storage facilities. A major rail terminal is under construction at the center of the site. The existing land allocation is given in Toolkit Table 4.1.

All the Options for this site are set out on Toolkit Figures 4.3 and 4.4 and described below.

(b) Scenarios Orange and Red

Both existing container terminals are retained and extended by removing the existing auto terminal and warehouses. The land to the south west of the site, which is presently outside the port boundary, is designated for warehousing if it can be acquired and the three large existing cool stores are retained. Additional area at the south of the site near South Elizabeth Channel is acquired for container yard as it is near the waterfront.

(c) Scenarios Yellow and Blue

The existing arrangement of container terminals, with no additional land, is retained.

7.8.5 *Port Jersey Options*

(a) General

In its existing configuration (see Toolkit Figure 5.1) this site has the fifth largest container terminal in the Port and two auto storage areas, one area of which is divided into two compounds about a mile and a half from the berths. There are no large warehouses or other large buildings on the site although the surrounding area has these facilities. The port areas are relatively free of minor roads and buildings. The existing land allocation is given in Toolkit Table 5.1.

All the Options for this site are set out on Toolkit Figures 5.3 to 5.5 and described below.

(b) Scenario Orange

The existing container terminal is retained, the existing auto-terminals are removed and the areas thus freed-up are developed into a new container terminal and, in the area more remote from the berths, warehousing. A greater part of the waterfront is developed into berths and some filling is carried out at the waterfront and in the nature reserve area. An intermodal rail facility is developed along the northern edge of the peninsula to serve both container terminals.

(c) Scenario Red

Scenario Red at Port Jersey is generally similar to Scenario Orange except that the existing container terminal is expanded to occupy the entire peninsula as a single entity.

(d) Scenarios Yellow and Blue

Scenarios Yellow and Blue at Port Jersey are generally similar to the existing situation with the addition of an intermodal rail facility developed along the northern edge of Port Jersey to serve both the container and automobile terminals.

It should be noted that in the Blue Scenario there is only one container terminal planned at Port Jersey/Bayonne. The resulting situation of only one container terminal along the 50 foot channel would not meet the Federal "two users" requirement of the deepening program. This is an acknowledged flaw of this Scenario.

7.8.6 *Bayonne Peninsula Options*

(a) General

In its existing configuration (see Toolkit Figure 6.1) this site has no operational cargo terminals although it was previously the site of the Military Ocean Terminal. Some areas are currently temporarily leased for small scale activities and there is a Coast Guard base at the inner end of the channel. There are several warehouses and other large buildings distributed around the site together with the floor slabs of buildings that have already been demolished. A wharf that appears to be in good condition extends part way along the waterfront. Many minor private roads and some redundant rail tracks intersect the area but the whole area is closed to the public. The existing land allocation is given in Toolkit Table 6.1.

All the Options for this site are set out on Toolkit Figures 6.3 to 6.5 and described below.

(b) Scenarios Orange and Blue

The entire area designated for port use is cleared of unwanted buildings and other infrastructure and developed into an automobile terminal.

It should be noted that in the Blue Scenario there is only one container terminal planned at Port Jersey/Bayonne. The resulting situation of only one container terminal along the 50 foot channel would not meet the Federal "two users" requirement of the deepening program. This is an acknowledged flaw of this Scenario

(c) Scenario Yellow

In Scenario Yellow at Bayonne Peninsula the majority of the area designated for port use is cleared of existing buildings and developed into a container terminal. The balance of the available area, at the western end, is developed into an automobile terminal.

(d) Scenario Red

In Scenario Red at Bayonne Peninsula the entire area designated for port use is cleared of existing buildings and developed into a container terminal.

7.8.7 *Howland Hook Options*

(a) General

In its existing configuration (see Toolkit Figure 7.1) this site has the fourth largest container terminal in the Port with a small area set aside for the import of bananas. The site is mostly clear of buildings, road and rail although there is one large cargo shed and a small store for bananas. There is an area of potential expansion on the Port Ivory and proposed intermodal rail terminal sites, and additional land can possibly be created by filling the adjacent shallow margins of the channel out into the Arthur Kill. The existing land allocation is given in Toolkit Table 7.1.

All the Options for this site are set out on Toolkit Figure 7.3 and 7.4 and described below.

(b) Scenario Orange

A new container terminal is developed on the recently acquired parcels of land at Port Ivory, east of the existing terminal and intermodal rail facility. This Scenario will also require a limited amount of filling into the intertidal and submerged waterfront zone. Western Avenue is relocated and a parcel of land on its eastern side developed for warehousing.

(c) Scenarios Red, Yellow and Blue

In Scenarios Red Yellow and Blue at Howland Hook, the existing container terminal and intermodal railroad facility are retained and the parcel of land recently acquired to the east of Western Avenue is cleared and developed for warehousing.

7.8.8 *North Brooklyn Options*

(a) General

In its existing configuration (see Toolkit Figure 8.1) this site contains the smallest container terminal in the Port, and general cargo terminals. There are many warehouses and other large buildings distributed around the site particularly in the general cargo areas. The areas are free of minor roads and rail tracks. The existing land allocation is given in Toolkit Table 8.1.

All the Options for this site are set out on Toolkit Figures 8.3 and 8.4 and described below.

(b) Scenarios Orange and Red

The existing container operation is converted to general cargo handling operations. Piers 9 to 12 are progressively refurbished/rebuilt and redeveloped, and berth space only is provided at Pier 8. Piers 6 and 7 are not used.

(c) Scenario Yellow

Scenario Yellow at North Brooklyn is similar to Scenario Orange but the developed area is extended to include Piers 6 to 8 for general cargo.

(d) Scenario Blue

In Scenario Blue, North Brooklyn is released for other uses not related to this study.

7.8.9 *South Brooklyn Options*

(a) General

In its existing configuration (see Toolkit Figure 9.1) this site is partly derelict and mainly used for general auto storage and other uses not connected with the Port. There are four warehouses generally in poor repair and a small administration building. There is no public access within the boundary of the South Brooklyn Marine Terminal development area and disused rail sidings occupy a small part of that site. The waterfront to the south of the South Brooklyn Marine Terminal site comprises derelict piers, light industrial sheds and substantial warehousing buildings some of which are up to 8 stories high, and sidings for the 51st Street cross harbor float bridge. The existing land allocation is given in Toolkit Table 9.1.

All the Options for this site are set out on Toolkit Figure 9.3 to 9.6 and described below.

(b) Scenario Orange

Some reconfiguration of the berth arrangement is carried out along with refurbishment/rebuilding of piers. In the landside area, 30 of the 80 acres within the site are developed for general cargo handling and the remainder as an auto terminal.

(c) Scenario Red

Scenario Red at South Brooklyn is identical in layout to the Scenario Orange arrangement but in this case the auto terminal area is developed as a dry bulk terminal with an additional two berths.

(d) Scenario Yellow

In Scenario Yellow at South Brooklyn the entire 80 acres is developed into an auto terminal.

(e) Scenario Blue

The Consultant was requested to carry out the analysis of a large container terminal at South Brooklyn and to include in the proposal the plans for a public waterfront area at Sunset Park. In Scenario Blue a major development of two container terminals occupies the South Brooklyn Marine Terminal and extends to the south, adjacent to the Military Terminal. In addition a rail terminal is included, serving both container terminals.

7.9 Required Number of Berths

The berths required for each of the terminal Options are summarized in Table 7.3. As explained in Section 6.5.2 the berths generally provide a capacity that at least matches the capacity of the associated yard and, due to the fact that berths have generally to be provided in whole units, the berth capacity in some cases exceeds the yard capacity.

Terminal Option & Location		Number of berths		Terminal Option & Location		Number of berths
C1	Port Newark South	3		**A12**	S Brooklyn	2
C2	Port Newark South	3		**A13**	Port Newark South	2
C3	Port Elizabeth	5		**A14**	Port Newark South	2
C4	Port Elizabeth	5.2		**A15**	Port Newark South	3
C5	Port Jersey	2				
C6	Port Jersey	2		**G1**	N Brooklyn	10
C7	Port Jersey	3		**G2**	N Brooklyn	12
C8	Bayonne	2		**G3**	S Brooklyn	4
C9	Bayonne	2		**G4**	Port Newark South	12
C10	Howland Hook	3				
C11	Howland Hook	2		**D1**	Port Newark North	5
C12	Port Elizabeth	4		**D2**	Port Newark North	3
C13	Port Elizabeth	5		**D4**	S Brooklyn	3
C14	S Brooklyn	4				
				L1	Port Newark North	2 (870ft & 800ft)
A1	Port Newark North	2		**L2**	Port Newark North	2 (both 870ft)
A2	Port Newark North	3		**L3**	Port Newark South	2 (both 870ft)
A4	Port Newark South	3		**L4**	Port Newark South	1 (850ft)
A8	Port Jersey	2				
A9	Bayonne	2				
A10	Bayonne	1				
A11	S Brooklyn	1				

Table 7.4 Berths required for terminal options

Note 1: Instead of matching the berths to the yard capacity, it can be arranged that the berths just match the demand. This was done to alleviate the crowded berth layout in Options L2 and L4.

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8 Mode Shares and Mode Shift Strategies

8.1 *Introduction*

This Chapter describes the existing mode shares in the Port, possible mode shares in the future and strategies to encourage more cargo to leave the Port on non-highway modes.

Three mode share cases are described:

- Existing mode shares – the mode shares at the present time
- Enhanced mode shares – the future mode shares with incentives
- Potential enhanced mode share – the most optimistic future mode shares

Five case studies are also presented that demonstrate how barge, short haul rail and coastal shipping markets have developed in Europe.

8.2 *Mode Shares*

8.2.1 *Existing Port-Wide Mode Shares*

Table 8.1 shows the existing port-wide mode share for commodities leaving port terminals. These estimates are based on container terminal surveys, terminal operator and PANYNJ meetings, and a review of recent regional studies.

Commodity	Truck	Other Modes
Containers	85%	15%
Automobiles	90%	10%
General Cargo	95%	5%
Dry Bulks	95%	5%
Liquid Bulks	90%	10%

Table 8.1 Existing mode shares

The other modes in the table refer to rail and barge services. In February 2005 there were two barge services operating from the Port; the PIDN service to Albany and a service to Boston. They carry in total about 1%[63] of the containers entering and

[63] Minutes of meeting June 4, 2004 The Port Authority of NY & NJ

leaving the Port. For rail capacity analysis reported in later Sections the barge percentage has been ignored and other modes in the tables can be considered as the rail mode share.

8.2.2 *Future Port-Wide Mode Shares*

The PIDN is described in Chapter 13 and proposes various new services to increase the proportion of containers leaving the port by non-road modes. The PIDN aspiration is for 23% of containers to leave the Port by non-highway modes in 2010 and 33% by 2020[64].

PIDN addresses containers and for the purposes of this study the shares for the other commodities have been increased in the same proportion as that for containers. The enhanced and potential enhanced mode shares for all commodity types are summarized in Tables 8.2 and 8.3.

Commodity	Truck	Rail
Containers	77%	23%
Automobiles	84.5%	15.5%
General Cargo	92.3%	7.7%
Dry Bulks	92.3%	7.7%
Liquid Bulks	85%	15%

Table 8.2 Enhanced Mode Shares

Commodity	Truck	Rail
Containers	65%	35%
Automobiles	76.7%	23.3%
General Cargo	88.3%	11.7%
Dry Bulks	88.3%	11.7%
Liquid Bulks	76.7%	23.3%

Table 8.3 Potential Enhanced Mode Shares

8.2.3 *Mode Share by Terminal*

The percentages given in Tables 8.1 to 8.3 are port-wide mode shares. However, the rail mode share will vary across the numerous terminals depending on connectivity to

[64] Minutes of meeting June 4, 2004 The Port Authority of NY & NJ

landside infrastructure and the size and location of the terminal. This Section presents the method adopted to develop mode shares at the terminals around the port.

The method used to calculate rail share in any one terminal was to weight the terminal's rail share by the relative area of the terminal. This reflects the potential for greater rail economies of scale at terminals with the potential for greater rail volumes. As an example, ExpressRail already dominates the on-dock container rail terminals and its expansion will make it more cost-effective, with operational efficiency and with ample room to accommodate growth. It will therefore capture the highest rail share.

Different cargo types have been treated separately as they each use the space they have in different manners, but the general effect is that the largest terminals will attract a slightly higher proportion of the overall rail share in relation to their size, whereas the smallest will attract a slightly lower proportion. In a Scenario, therefore, individual terminal rail shares vary from the port wide average but the overall rail share remains at 23%.

Alternatively, the analysis could have been completed using the same mode share at each terminal. However, given the limitations and difficulties associated with predicting mode share, both methods are a reasonable way of comprehensively analyzing port related traffic. The analysis that follows is based on rail mode shares being weighted by the relative capacity of the terminal.

Weighting the rail mode share by terminal area in, for example, the Task F red scenario brings about rail shares as shown in Table 8.4. Although the port-wide share on rail is 23%, it can be seen the shares range from 31.3% at ExpressRail (Port Elizabeth) down to 9.3% at Howland Hook. The detailed rail shares by terminal for all scenarios are given in an earlier Technical Memorandum[65].

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[65] CPIP Task F Technical Memorandum, Volume 2, Highway Options, Appendix C

Terminal	Commodity	% by Truck	% by Rail
Newark	Containers	88.6	11.4
	Autos	93.1	6.9
	Dry Bulk Cargo	93.2	6.8
	Liquid Bulk Cargo	84.5	15.5
Elizabeth	Containers	68.7	31.3
Howland Hook	Containers	90.7	9.3
Port Jersey	Containers	88.6	11.4
South Brooklyn	General Cargo	66.6	33.4
	Dry Bulk Cargo	91.5	8.5

Table 8.4 Enhanced mode split for Red Scenario

8.2.4 *Application of Mode Shares in Analysis*

In each Scenario, the truck and rail mode shares for each terminal are the starting point for the analyses of highway and rail reported in Chapters 9 and 10. For example, in 2060 in the Red Scenario summarized in Table 8.4, the auto terminals at Port Newark will move 70,100 units out of the 1,020,000 units[66] capacity (i.e. 6.9%), by rail. Based on average auto train lengths and capacities, this volume can be converted into a number of trains per year on the rail network.

A similar approach was adopted for all commodity types and truck rail mode shares.

8.3 Mode Shift Strategies

8.3.1 *Introduction*

The existing port-wide rail mode share is about 15% and the two enhanced mode share cases represent an aspiration. Mechanisms have to be put in place to encourage the shift to rail and barge above the shares achieved today. This Section describes strategies to assist in achieving the mode shifts.

8.3.2 *Market Forecast*

A market demand forecast was undertaken in Task E[67]. The analysis was based upon forecasts of US trade by trading partner and US region, and the impact of trade growth on mean ship capacity and the consequent importance of depths available in different ports.

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[66] CPIP Task F Technical Memorandum, Volume 1, Terminal Options, Part 2, Appendix D
[67] CPIP Task E Technical Memorandum, Volume 1, Market Forecast and Outlook.

It was assumed in the forecast that the real transport cost of land bridge rail services would remain constant and that the railroads would expand the capacity of their infrastructure to deal with this growth.

Competition between modes was taken into account in order to establish the Port's inland transport competitiveness to each US State or group of counties.

The Task E analyses showed that, if containers were moved by the lowest cost mode to each inland market, 23% of containers would move by rail and 10% by barge, assuming in each case that such services were available. It was also assumed that the real cost of rail, road and barge services retained their present relationships. Today, about 15% of containers leave the Port by rail and only 1% by barge. Provided service levels are improved and infrastructure capacities are increased, the implication is that the present overall share of rail plus barge can be more than doubled without significant changes in the prices charged relative to road haulage.

8.3.3 Market Demand by State

The market demand in 2020 by State, developed in Task E, is given in Table 8.5. The table also includes forecast container volumes to each state by mode assuming the containers were transported there by the lowest cost mode. For example, all 114,000 TEU forecast to be imported into Illinois through the Port in 2020 would be transported there by rail.

In the case of New York, the modeling forecasted 38,000 TEU of imports would be transported by rail, 3,000 TEU by barge and the remaining 652,000 TEU by truck.

However, it will be noted that in order to achieve overall Port market shares for rail and barge of 23% and 10% respectively, relatively high market shares are required to those areas where rail and barge are potentially cost (if not service) competitive under present conditions. For example, in Connecticut and Massachusetts 80% of containers are assumed to be moved by barge.

Thousand TEU

State	Rail	Barge	Road	Total
AL	0			0
AR AZ CA CO				
CT*		136	34	170
DC			0	0
DE		7		7
FL GA				
IA	0			0
ID				
IL	114			114
IN	21			21
KS	0			0
KY	35			35
LA				
MA*		92	23	115
MD			141	141
ME	0	3	0	3
MI	60		5	65
MN	21			21
MO	3			3
MS MT				
NC	3		0	3
ND	1			1
NE	0			0
NH		5		5
NJ			694	694
NM				
NV				
NY	38	3	652	693
OH	183		2	185
OK OR				
PA	18		158	176
RI		10		10
SC	77			77
SD	0			0
TN	2			2
TX UT				
VA	0		4	4
VT	0		2	2
WA				
WI	18			18
WV	1		1	2
WY				
Total	**595**	**256**	**1,716**	**2,567**
Share	**23.2%**	**10.0%**	**66.8%**	**100.0%**

Table 8.5

State distribution of NY imports by mode, 2020, developed in Task E

*Assumes 80% by barge

8.3.4 *Barge Traffic*

This Section discusses the market for barge services from the Port.

Table 8.6 shows the barge share required, in the markets where barge is potentially competitive, to achieve an overall Port-wide barge mode share of 10%.

Market	**Estimated Import Volume (1000 TEU)**	**Barge Share (1000 TEU)**
Connecticut	170	136*
Delaware	7	7
Massachusetts	115	92*
New Hampshire	5	5
New York (Albany)	6	3
Rhode Island	10	10
Total	313	253

* Assumed barge share 80%
Excluding Maine
Based on 2020 imports

Table 8.6 Barge shares required to reach 10% overall share

Only the existing service with Massachusetts and the proposed service with Connecticut appear to have the potential to offer daily services. Experience from the extensive barge traffic that serves the Port of Rotterdam (which handled around 7m TEU in 2003 compared with 4m through PONYNJ) supports this conclusion. The great majority of Rotterdam barge traffic moves over distances in excess of 200 miles, to a handful of waterside cargo generators or, in the main, on high frequency large barges to major sources of cargo such as Duisburg in Germany. Barge traffic out of the Port of Rotterdam is discussed in further detail in Section 8.4.2.

Perhaps a more realistic vision of barge potential from the Port may simply be to establish regular daily departures for Massachusetts and Connecticut capturing around say 40% of the available market. The Massachusetts service would also serve New Hampshire, Rhode Island and Maine by onward road haulage. These services correspond to a mean barge load of 250 TEU based on a departure every weekday on each route. A 40% modal share to these two destinations is assumed to be a realistic maximum target in a market which can be reached overnight by truck. But containers carried by barge would generally be delivered on a 'next but one' day basis instead of next morning by road.

The very challenging assumptions above suggest that in 2020, only 4.5% (257,000 TEU) of containers to and from the Port would move by barge.

8.3.5 Rail Traffic

This Section discusses the potential rail market out of the Port.

(a) The Traditional Rail Market

The traditional rail market is about 400 miles from the port and is served by long trains up to 10,000 feet in length.

Projections for rail freight in Table 8.5 were based upon an 'all or nothing' allocation by mode for the major flows, assigning 100% of cargo over a given distance to rail based on least cost transport modeling. However, in practice, rail could not be expected to capture more than, say, 80% of a given geographical market.

Applying a market capture percentage of 80% to the forecast rail share to the individual states in Table 8.5, yields target rail markets as given in Table 8.7. For example, the modeling forecasts a rail import mode share in Illinois of 114,000 TEU which is equivalent to a target rail volume for imports and exports of 181,000 TEU (114,000 x 80% x 2 for balanced flows of imports and exports).

State	1000 TEU
Illinois	181
Indiana	34
Kentucky	55
Minnesota	34
Michigan	102
New York*	76
Ohio	296
Pennsylvania**	38
S. Carolina	124
Wisconsin	28
Other	16
Total	**984**

Table 8.7 Proposed target rail volumes to/from the Port

2020 before subsidized routes established

* Albany, Syracuse, Buffalo, Rochester **Pittsburgh

Table 8.7 also reflects the opportunity for rail operators to serve some less remote markets because they are en-route to their traditional markets and can therefore deal with 'part train' loads. These are to the upstate New York markets of Albany, Syracuse, Buffalo and Rochester and the Pennsylvania market of Pittsburgh. Adding these destinations would raise rail market share through the Port from a present level of around 15% to 17% in 2020 (984,000 TEU)).

(b) A Supported Local Rail Market

To increase the rail share above 17%, new markets will have to be identified. They will be closer to the Port than the traditional rail markets which have tended to be over 400 miles distant and served by long trains.

The cost model indicates that the breakeven distance between road and rail is at around 228 miles, assuming trains carry a payload of 300 containers each. Because of the need for rail to offer savings to compensate for the lower frequency offered, rail is unlikely to be competitive for distances less than 300 miles. Rail services to locations closer than 300 miles will therefore need continuing financial support.

The two possible major new markets for rail are in Pennsylvania and Maryland, where the forecast predicts import volumes transported by road of 158,000 TEU and 141,100 TEU respectively. The volumes available from Delaware would offer inadequate mass to justify rail services but there may also be an opportunity to win rail traffic in the Massachusetts and the Northern New England market over and above that captured by barge.

Given the short length of haul involved to central Pennsylvania and Maryland (150 miles), rail could only compete for a proportion of the available business, whatever the rail tariff, because road can offer same day deliveries within a trucker's road haul. It was assumed that 50% of the Pennsylvania and Maryland market would be prepared to accept next day deliveries (by rail) assuming a discount is available.

On the basis of a 50% share for rail, assuming at least daily/overnight services, services to central Pennsylvania and Maryland could raise rail volumes by a further 298,000 TEU to reach 1,282,000 TEU by 2020. Rail traffic to Massachusetts would add a further 53,000 TEU, making 351,000 additional TEU by rail altogether.

8.3.6 *Summary of Target Rail Mode Share*

The target rail mode share for the Port is made up of two components; the traditional rail volume and a local rail volume. The target mode shares are summarized in Table 8.8.

The target rail share is 23%. It would be most difficult to achieve a higher share because the great majority of containers received through the Port will be delivered by to receivers within a 100 mile radius which is too short a distance for rail services.

Description	1000 TEU
Traditional rail	870
Local rail	
Up State New York	38
W Pennsylvania	76
Central Pennsylvania & Maryland	298
Massachusetts	53
Rail	**1,335 (23%)**
Road	**4,088 (77%)**
Total	**5,680 (100%)**

Table 8.8 Target Port rail share, 2020

8.3.7 *Financial Support for Rail Transport*

Short haul rail service out of the Port will require ongoing financial support.

This Section considers the relative costs of transporting a container 150 miles by both rail and road and presents the ongoing support required to offer a rail customer a 10% discount below the road cost. The discount is intended to compensate for the lack of convenience of receiving a next day delivery by rail rather than a same day delivery by road. The relative costs for the 150 mile delivery are:

Road Haulage	$260
Rail Haulage	$368
Discounted price for 10% saving on road cost	$234
Support required per container transported by rail	$134

There will be local drayage of around 20 miles at the inland rail terminal, so the net saving in truck miles for a 150 mile delivery by train is about 130 miles. The support therefore costs about $1 per mile and the societal benefit cost of the transfer from road to rail has to be greater than this to justify the support payment. This is examined in the following Section.

8.3.8 *Societal Benefits*

The societal benefits of transferring freight from trucks to rail were investigated in the Cross Harbor Freight Movement studies.[68] [69]

The Cross Harbor Study considered a range of benefits that that project might confer. It estimated (page 5-1) that a rail tunnel, excluding an expanded Brooklyn Port, would reduce truck vehicle miles traveled (VMT) by 44 million per year. The consultants for that study used the Surface Transportation Efficiency Analysis Model, developed by the Federal Highway Administration, to value these benefits. The model calculates different levels of benefit for different road classifications. Assuming the same mix of road classifications as for the Cross Harbor Study, a value per mile of over $1.50 is arrived at. A benefit of $67.95m dollars per annum was estimated to correspond with those 44m truck miles saved, which gives a highway user benefit of $1.54 per mile.

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[68] Cross Harbor Freight Movement Major Investment Study, PIN X500.19 for New York City Economic Development Corporation May 2000.

[69] Cross Harbor Freight Movement Major Investment Study DEIS April 2004.

The Cross Harbor Study analysis also considered the benefits to rail users of an improved level of service at a lower tariff then competing road haulage. However, in this Port case, as the tariff would be set at the point where users were indifferent between road and rail, to induce a 50% level of rail patronage, that benefit could not be included in the overall benefit calculation.

The Cross Harbor Draft Environmental Impact Statement arrived at 'User and Societal' capitalized benefits of $69.8m for the 'Single Tunnel – New Jersey' Option[70], which corresponded to a regional reduction of approximately 40 million VMT per year[71]. On that basis, user and societal benefits would be $1.75 per vehicle mile.

These societal benefits are greater than the support payments required to sustain a rail service to a market 150 miles away from the Port and therefore appear to justify the support.

8.3.9 *Support for UK Intermodal Container Movements*

The Government agency responsible for railways in the United Kingdom, the Strategic Rail Authority, supports the movement of intermodal containers by providing grants for each container moved, with an aim of securing growth in this sector. The approach is based on societal benefits and is similar to that used in the Cross Harbor Studies. While any comparisons between different countries is likely to introduce complex issues of value judgment, it is worth noting that in the UK, this very recent (2003) exercise has established net societal benefits of transfer from road to rail which are at least as high, and generally higher, than assumed in the New York/New Jersey region.

On this basis, there would appear to be a sound case for providing financial support for each container moved by rail over a distance of around 150 miles to reflect the societal costs which road haulage to and from the Port generally imposes.

8.3.10 *Method of Making Financial Transfers*

Having accepted there is benefit in supporting the transfer of containers from truck to rail, it is important to consider how financial transfers might be made to reflect the lower costs imposed by rail. One way is to introduce a revenue support mechanism.

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[70] Page 20-4, Table 20-1, user and societal benefits for United States summed.

[71] Page 8-53, 2025 figures at 2002 dollars.

The UK Company Neutral Revenue Support System[72] is designed to pay any railroad delivering a service from a given origin (e.g. the port) to a destination (e.g. an inland terminal) at an agreed support tariff. For example, the payment for the 125 mile haul from Southampton to Birmingham is currently around $110 per container moved, paid after proof of carriage. This system is managed by posting a national support tariff, region to region, for which operators are eligible once their services are registered with the Strategic Rail Authority.

If this approach was to be transferred to the Port environment, a schedule of financial support levels would be published to different rail terminals, rising (as environmental benefits rise) and then falling as distance from the Port increases and the need for assistance falls, payable on proof of container carriage by rail. Support levels might be approximately $150 at 150 miles falling to zero at 250 miles, to provide adequate incentive to switch to rail.

However, it is worth noting that a $65 per unit Port Assessment charge is also influential in the competitiveness of the Port in that for destinations beyond 260 miles (roughly the break even distance for rail), that charge is not made. It might be possible to adjust the Port Assessment charge in such a way that it was levied on the basis of the mode used.

8.4 Case Studies

8.4.1 *Introduction*

Five case studies from Europe (see Figure 6.1) that demonstrate that short haul container traffics can be attracted to non-road modes, given appropriate geographical, market and fiscal conditions are described below.

The five cases studies presented cover:

- Barge services from Rotterdam
- Intermodal rail services on mainland Europe
- Coastal container shipping from North Sea ports

[72] http://www.railfreightonline.co.uk/

- Coastal container shipping in the British Isles

- Intermodal rail services within Great Britain

In reviewing the case studies, it is important to reflect on the cost of competing road haulage. In the UK, container road hauliers will generally charge a fixed rate of around $150 plus $1.75 per mile of road haulage. Thus, for example, if no backload is available, a delivery 150 miles from the port will be charged around $675.

On mainland Europe, lower fuel taxes will reduce incremental costs per mile to around $1.50 per mile, so the same delivery would cost $600. US and European mainland haulage costs appear to be similar.

8.4.2 *Case Study One: Barge Services from Rotterdam*

Table 8.9 gives the share that both barge and rail have of the Rotterdam market.

It will be seen that barges capture nearly 4 times as much traffic as rail to origins and destinations beyond the Netherlands.

Barges carry some 25% of containers to and from the Port of Rotterdam, mainly along the Rhine, a total barge traffic of over 1 million containers per annum. The River Rhine is shown on Figure 6.2. The principal inland port of loading and discharge is Duisburg, just 111 miles upstream in Germany. Barges are typically of around 200 TEU in capacity. One of the benefits of using barges is that they by-pass the cost and congestion involved in processing containers at the terminal gate. Barges provide scheduled services, visiting the major terminals.

2002 containers (excluding The Netherlands)	Total incoming lifts	Barge lifts	Barge share of total %	Rail lifts	Rail share of total lifts
Austria	7,771	3,975	51	3,437	44
Belgium	421,245	318,126	76	27,622	7
Germany	396,449	251,863	64	36,126	9
France	17,779	5,901	33	66	0
Italy	41,475	0	0	41,093	99
Luxembourg	5,263	0	0	3,315	63
Switzerland	42,947	23,361	54	19,477	45
Czechoslovakia	10,561	41	0	10,076	95
Poland	5,222	6	0	5,191	99
Other countries	1,106	22	2	643	58
Total	949,838	603,295	64	147,046	15

2002 containers (excluding The Netherlands)	Total outgoing lifts	Barge lifts	Barge share of total %	Rail lifts	Rail share of total lifts
Austria	7,778	2,224	29	5,210	67
Belgium	370,043	253,228	68	34,845	9
Germany	399,213	243,959	61	35,124	9
France	21,881	6,292	29	66	0
Italy	41,203		0	40,488	98
Luxembourg	4,403		0	2,228	51
Switzerland	41,903	27,200	65	14,316	34
Czechoslovakia	10,436	138	1	9,984	96
Poland	11,125	57	1	10,900	98
Other countries	1,783	160	9	329	18
Total	909,768	533,258	59	153,424	17

Table 8.9 Modal shares of Rotterdam Port traffic by country served

Table 8.10 presents the services available. The service frequency is between 4 and 7 times per week and barges generally have a capacity of between 150 and 300 TEU. The road distances that barges compete with vary considerably, but are generally between 100 and 400 miles. The predominate barge distance is in the 300 to 400 mile band, as shown in Figure 6.3.

For some journeys, the lengths of haul successfully operated on a purely commercial basis correspond to the distances involved between the Port and Albany. However, the volumes of cargo available are much larger. Most journeys along the Rhine are significantly longer than that to Albany, with much higher cargo volumes.

Rotterdam serves much of industrial Germany as well as other parts of Central and Eastern Europe. These economies are much larger than Rotterdam's. The keys to the success of container barge operations from Rotterdam lie in:

(i) the great volume of freight available inland
(ii) the proximity of major freight generators to the River Rhine waterway
(iii) the dominance of the North Sea ports in serving this market. Unlike the case of PONYNJ, there is less competition for deep-sea container trades from other port areas. For example, the North Italian ports are not major players in this market despite the opportunity they offer; partly a consequence of the Alps being a natural barrier.

ROUTE	PORT	SERVICE	VESSELS	AV TEU	OPERATOR	ANNUAL SERVFREQ	ANNUAL CAPACITY	ROAD MILES
RHINE MAAS	ROT/BRN/ROT	BARGE TERMINAL BORN	2	177	BARGE TERMINAL BORN	208	36816	113
MIDDLE RHINE	ROT/ANT/BNN/KBL/LUD/WTH/BNN/ANT/ROT	CCS COMBINED CONTAINER - MIDDLI	2	442	CCS COMBINED CONTAINER	365	161330	356
UPPER RHINE	ROT/ANT/GMH/LUD/WTH/KEH/SSB/MUL/WLE/BSL/BSF/ANT/ROT	CCS/HANIEL/INTERFEEDER	8	261	HAEGER & SCHMIDT	208	54288	474
MIDDLE RHINE	ANT/ROT/GMH/ROT/ANT	CSX GERMERSHEIM	5	185	CSX GERMERSHEIM	260	48100	315
LOWER RHINE	DBG/ROT/ANT/ROT/DBG	DECETE - RHINE EXPRESS	3	247	DECETE	260	64220	111
LOWER RHINE	ANT/ROT/ANT	EUROBARGE	10	198	EUROBARGE	365	72270	62
LOWER RHINE	ANT/MAZ/ANT	FRANKENBACH - 1	2	268	FRANKENBACH	156	41808	236
LOWER RHINE	ROT/MAZ/ROT	FRANKENBACH - 2	3	208	FRANKENBACH	260	54080	273
MIDDLE RHINE	ROT/ANT/BNN/GMH/BNN/ANT/ROT	HANIEL - MIDDLE	3	245	HANIEL	208	50960	355
LOWER RHINE	ROT/ANT/EMM/DBG/DSS/NEU/DMG/CLG	HANIEL/RHINECONTAINER	11	232	HANIEL	365	84680	164
LOWER RHINE	ANT/ROT/ANT	INTERFEEDER	1	512	INTERFEEDER	260	133120	62
LOWER RHINE	ANT/ROT/ANT	MTA	5	142	MTA	365	51830	62
UPPER RHINE	ANT/ROT/SSB/MUL/BSL/MUL/SSB/ROT/ANT	PENTA CONTAINER - 1	7	216	ALPINA/CNFR/CONTEBA/DANSER	208	44928	379
MIDDLE RHINE	ROT/ANT/STU/ROT	PENTA CONTAINER - 2	2	176	DANSER	104	18304	394
MIDDLE RHINE	ROT/ANT/BNN/MAZ/FKF/ANT/ROT	RHINECONTAINER - MIDDLE	5	225	RHINECONTAINER	365	82125	273
UPPER RHINE	ROT/ANT/MNN/KLR/WTH/ANT/ROT	RHINECONTAINER - UPPER	11	312		365	113880	356
UPPER RHINE	ROT/ANT/BSL/ANT/ROT	SILAG RHEIN TERMINAL	2	46	SILAG RHEIN TERMINAL	365	16790	474

BRN: Borne, Netherlands BNN: Bonn, Germany
BSL: Basel, Switzerland BSF: Birsfelden, Switzerland
CLG: Cologne, Germany DBG: Duisburg, Germany
DMG: Dormagen, Germany DSS: Dusseldorf, Germany
EMM: Emmerich, Germany FKF: Frankfurt, Germany
GMH: Gemershein, Germany KBL: Koblenz, Germany
KEH: Kehl, Germany LUD: Ludwigshafen, Germany
MAZ: Mainz, Germany MNN: Mannheim, Germany
MUL: Mulhouse-Ottmarsheim, France NEU: Neuss, Germany
SSB: Strasbourg, France STU: Stuttgart, Germany
WLE: Weil, Germany WTH: Woerth, France

Table 8.10 Barge services ex Rotterdam

8.4.3 *Case Study Two: Intermodal rail - mainland Europe*

The two principal port destinations on the North Sea coast for rail services are Rotterdam and Zeebrugge. Tables 8.11 and 8.12 list the services available by inland destination. There are 49 rail services to and from Rotterdam and 51 to and from Zeebrugge. The European freight railroad network is shown in Figure 8.4.

It will be seen that the great majority of services offered are beyond 400 miles, despite the heavy concentrations of market and population at shorter distances, which barges succeed in serving competitively. A high proportion of the total services offered are to or beyond the Alpine zone (i.e. Switzerland, Austria and Italy).

Intermodal rail services on the European mainland, operated almost entirely by State owned railroad companies, reflect a similar level of market coverage by distance as do US railroads. The railroads enjoy very limited market share under 400 miles; to a handful of major German sites (Hamburg, Duisburg, Koln) and one 'shuttle' service between the ports of Zeebrugge and Antwerp.

Term Org	COUNTRY	Term Dest	Services_per_week	Road distance (miles)
Duisburg	Germany	Rotterdam Rsc/Maasvlakte	5	134
Koln Niehl Hfn (Cts)	Germany	Rotterdam Rsc/Maasvlakte	5	164
Hamburg Billwerder	Germany	Rotterdam Rsc/Maasvlakte	5	313
Mannheim	Germany	Rotterdam Rsc/Maasvlakte	5	319
Kornwestheim	Germany	Rotterdam Rsc/Maasvlakte	3	393
Leipzig	Germany	Rotterdam Rsc/Maasvlakte	5	417
Wustermark (Berlin)	Germany	Rotterdam Rsc/Maasvlakte	5	430
Taulov	Denmark	Rotterdam Maasvlakte	5	463
Taulov	Denmark	Rotterdam Waalhaven Rsc	5	463
Basel Sbb Ct-Sbb Cont Term	Switzerland	Rotterdam Rsc/Maasvlakte	5	474
Esbjerg	Denmark	Rotterdam Maasvlakte	5	477
Esbjerg	Denmark	Rotterdam Waalhaven Rsc	5	477
Dresden	Germany	Rotterdam Rsc/Maasvlakte	5	504
Aarhus	Denmark	Rotterdam Maasvlakte	5	517
Aarhus	Denmark	Rotterdam Waalhaven Rsc	5	517
Munchen	Germany	Rotterdam Rsc/Maasvlakte	3	527
Aalborg	Denmark	Rotterdam Maasvlakte	5	586
Aalborg	Denmark	Rotterdam Waalhaven Rsc	5	586
Höje Taastrup	Denmark	Rotterdam Waalhaven Rsc	5	589
Höje Taastrup	Denmark	Rotterdam Maasvlakte	5	589
Kobenhavn	Denmark	Rotterdam Maasvlakte	5	599
Kobenhavn	Denmark	Rotterdam Waalhaven Rsc	5	599
Wels Vbf Cct	Austria	Rotterdam Rsc/Maasvlakte	4	608
Wels	Austria	Rotterdam Rsc/Maasvlakte	3	608
Salzburg	Austria	Rotterdam Rsc/Maasvlakte	3	616
Wroclaw	Poland	Rotterdam Rsc/Maasvlakte	2	626
Hirtshals	Denmark	Rotterdam Maasvlakte	5	629
Hirtshals	Denmark	Rotterdam Waalhaven Rsc	5	629
Milano Segrate	Italy	Rotterdam Rsc	5	681
Milano Segrate	Italy	Rotterdam Vopak	1	681
Oleggio-Terminal Fidia	Italy	Rotterdam Rsc	5	696
Novara Cim	Italy	Rotterdam Rsc	15	698
Novara Cim	Italy	Rotterdam Waalhaven Rsc	14	698
Villach	Austria	Rotterdam Rsc/Maasvlakte	3	723
Gliwice	Poland	Rotterdam Rsc/Maasvlakte	2	723
Wien Nw	Austria	Rotterdam Rsc/Maasvlakte	3	727
Graz	Austria	Rotterdam Rsc/Maasvlakte	3	732
Brescia	Italy	Rotterdam Waalhaven Rsc	5	735
Brescia	Italy	Rotterdam Rsc/Maasvlakte	3	735
Brescia	Italy	Rotterdam Rsc/Maasvlakte	5	735
Sopron Hatar-Sopron Cargo Combi	Hungary	Rotterdam Rsc/Maasvlakte	5	764
Verona	Italy	Rotterdam Rsc/Maasvlakte	3	776
Padova Interporto-Terminal Cemat	Italy	Rotterdam Rsc	6	823
Gadki	Poland	Rotterdam Rsc/Maasvlakte	2	867
Pruszkow	Poland	Rotterdam Rsc/Maasvlakte	2	867
Barcelona Mor.Cont-Renfe Teco	Spain	Rotterdam Rsc	5	960
Silla Cont (Val.)-Renfe Teco	Spain	Rotterdam Rsc	5	1186
Thessaloniki Term	Greece	Rotterdam Maasvlakt	1	1489
Halkali-Istanbul Cont Term	Turkey	Rotterdam Maasvlakte	3	1688

Table 8.11 Rail Services to and from Rotterdam

Term Org	COUNTRY	Term Dest	Services_per_week	Road distance (miles)
Antwerpen Zomerweg-Zomerweg Container	Belgium	Zuerich Ct-Terzag Terminal	5	74
Venissieux-Terminal Sncf	France	Zeebrugge Local-Zweedse Kaai	5	488
Padborg-Kt	Denmark	Zeebrugge Brittanniadock	5	515
Mouguerre	France	Zeebrugge Brittanniadock	2	540
Taulov-Kt	Denmark	Zeebrugge	5	575
Esbjerg-Jutlandia	Denmark	Zeebrugge Brittanniadock	5	589
Aarhus-Kt	Denmark	Zeebrugge Brittanniadock	5	628
Wels	Austria	Zeebrügge Loco	5	643
Wels	Austria	Zeebrugge Brittanniadock	5	643
Milano	Italy	Zeebrugge	6	644
Segrate-C.Intermod.Segrate	Italy	Zeebrugge Deep Sea-Flanders Cast-Seap	6	644
Segrate	Italy	Zeebrugge-Lokaal	6	644
Praha Uhrineves	Czech Republic	Zeebrugge	5	645
Praha Zizkov	Czech Republic	Zeebrugge	5	645
Melzo	Italy	Zeebrugge-Lokaal	5	645
Torino	Italy	Zeebrugge	5	658
Torino Orbassano	Italy	Zeebrugge-Lokaal	6	658
Oleggio-Terminal Fidia	Italy	Zeebrugge Deep Sea-Flanders Cast-Seap	5	660
Novara Cim	Italy	Zeebrugge Britt. Dock (Ramskapelle)	15	662
Novara Boschetto	Italy	Zeebrugge-Lokaal	15	662
Tavazzano	Italy	Zeebrugge-Lokaal	3	670
Aalborg-Kt	Denmark	Zeebrugge Brittanniadock	5	697
Hoje Taastrup	Denmark	Zeebrugge Brittanniadock	5	700
Kobenhavn Gb-Kt	Denmark	Zeebrugge Brittanniadock	5	710
Verona Quadrante Europa	Italy	Zeebrugge-Lokaal	6	740
Wien-Nordwest	Austria	Zeebrügge Loco	5	763
Wien-Nordwest	Austria	Zeebrugge Brittanniadock	5	763
Vitoria-Jundiz	Spain	Zeebrugge Brittanniadock	2	772
Perpignan St.Charl-Terminal Cts(Chart	Spain	Zeebrugge Local-North Sea Ferries	5	776
Perpignan	Spain	Zeebrugge Brittanniadock	5	776
Bologna Interporto-Term. Interporto	Italy	Zeebrugge Ramskape-Hermes Kaai (Britt	5	778
Padova Interporto-Terminal Cemat	Italy	Zeebrugge Local-Zweedse Kaai	6	786
Padova Interporto	Italy	Zeebrugge-Lokaal	6	786
Le Boulou Perthus	Spain	Zeebrugge Ramskape-Hermes Kaai (Britt	5	790
Zaragoza-Delicias	Spain	Zeebrugge	4	864
Granollers	Spain	Zeebrugge	5	888
Barcelona Mor.Cont-Renfe Teco	Spain	Zeebrugge Local-North Sea Ferries	5	904
Constanti Cont Tar-Renfe Teco	Spain	Zeebrugge Ramskape-Hermes Kaai (Britt	5	950
Gijon-El-Gijeron	Spain	Zeebrugge Brittanniadock	5	950
Tarragona Constanti	Spain	Zeebrugge Brittanniadock	5	954
Madrid-Abronigal	Spain	Zeebrugge Brittanniadock	5	1002
Pomezia S Palomba-Sgt Di Roma	Italy	Zeebrugge Local-Zweedse Kaai	6	1015
Silla	Spain	Zeebrugge Brittanniadock	5	1130
Silla Cont (Val.)-Renfe Teco	Spain	Zeebrugge Deep Sea-Flanders Cast-Seap	5	1130
Vigo-Guixar	Spain	Zeebrugge	5	1184
Murcia	Spain	Zeebrugge Brittanniadock	5	1280
Sevilla-La-Negrilla	Spain	Zeebrugge	5	1341
San-Roque-La-Linea	Spain	Zeebrugge	6	1424
Algeciras-Puerto	Spain	Zeebrugge	5	1432
Thessaloniki Term	Greece	Zeebrugge Local-Car Terminal	1	1524
Halkali-Istanbul Cont Term	Turkey	Zeebrugge Local-Car Terminal	3	1724

Table 8.12 Rail Services to and from Zeebrugge

8.4.4 *Case Study Three: Coastal Container Shipping - N Sea*

There are a number of local 'short sea' shipping services between the Benelux ports (Belgium, Netherlands and Luxemburg) and other ports on mainland Europe which compare directly with overland modes. Shipping services out of Rotterdam are given in Table 8.13. The construction of road and rail fixed links across Denmark provide direct competition to shipping from the Benelux area to Sweden. Nevertheless, services from Rotterdam to mainland European destinations together reflect an annual two-way capacity of 710,000 TEU, i.e. double the deployment figure in Table 8.13. Overall, Rotterdam handles 7 million TEU per annum to and from the sea, both short and deep sea shipping; the figures exclude containers carried by barge, rail and road.

This means that the capacity (deployment) of mainland European coastal shipping services to and from Rotterdam equates to around 10% of the port's overall maritime throughput. The overall amount of transshipment at Rotterdam is, however, much larger when one includes transshipment to services to islands (GB and Ireland), the Scandinavian peninsula and via other deep-sea services calling at other ports within Europe.

NORTH WEST EUROPEAN SHORT SEA LO-LO SERVICES

SERVICE	ROUTE	OPERATOR	Number of ships	Service frequency	Average TEU	Annual deployment (TEU)
Rotterdam (exc UK)						
CMA-CGM/ESF EUROSERVICES	EUR/BALT	CMA-CGM	3	52	853	44356
EUROFEEDERS - SP	EUR/SP	EUROFEEDERS	1	52	380	19760
HMS/OPDR/PORTLINK - 2	EUR/IB	OPDR	3	52	380	19760
MAERSK SEALAND - RUSSIA EXPRESS	EUR/BALT	MAERSK SEALAND	2	52	1083	56316
NORMARLINE - 1	EIRE/FR/NETH	NORFOLKLINE	1	52	690	35880
OOCL - SCAN BALTIC EXPRESS 1	EUR/BALT	OOCL	2	52	860	44720
PORTLINK/OPDR	EUR/SP	PORTLINK	1	52	448	23296
RENAISSANCE CONTAINERLINE	NETH/RUS	SOVCOMFLOT	1	26	128	3328
UNIFEEDER - BALT 04	EUR/BALT	UNIFEEDER	1	36	508	18288
UNIFEEDER - BALT 11	EUR/BALT	UNIFEEDER	1	36	505	18180
UNIFEEDER - RUS 3	EUR/RUS	UNIFEEDER	1	52	508	26416
UNIFEEDER - RUS 5	EUR/BALT	UNIFEEDER	1	52	508	26416
UNIFEEDER - RUS 6	EUR/BALT	UNIFEEDER	1	36	508	18288
		Total	**19**			**355004**

Source : MDS Transmodal Containership Databank - Nov 2004

Table 8.13 Coastal Shipping Services ex Rotterdam

Lo-lo[73] services dominate since they offer lower unit costs than ro-ro services. There are no ro-ro[74] services from Rotterdam and Zeebrugge to other mainland ports. The destinations served tend to be at least 500 miles (overland) from the port. However, this relatively long distance is a reflection of the distribution of economic activity; there are few major economic centers along the European mainland coast in France or North Denmark not served by deep-sea services directly. The distribution of coastal lo-lo services out of Rotterdam by competing road distances are given in Figure 6.5

It is important to remember that the major market concentrations in N.W. Europe not served by direct deep-sea container lines are generally served by inland barge services, including from Le Havre to Paris.

8.4.5 *Case Study Four: Coastal container services-British Isles*

Given the island nature of the UK and the Republic of Ireland and their membership of the European Union, it is inevitable that short sea shipping should play a major part in their port activity. Approximately 60% of all containers and ro-ro trailers entering GB ports are from the European mainland. The remaining 40% is split; 15% from Ireland and 25% deep-sea. The ports and waterways of the United Kingdom are shown in Figure 6.6.

However, over the last 3-5 years, a new trade has developed; that of 'feedering'[75] deep-sea containers between ports on the British mainland. Table 8.14 presents the current routes. Total containers carried per annum is now in excess of 100,000 TEU between GB mainland ports; almost entirely deep sea containers fed from a deep water 'hub' port to a local/regional port.

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[73] Lift-on lift-off i.e. cargo handled by crane.
[74] Roll-on roll-off i.e. cargo transported on or off the ship on trailers.
[75] Onward transport of international cargo by smaller vessel.

SERVICE	ROUTE	OPERATOR	Ships	Service frequency	Average TEU	Annual deployment TEU	Port rotation
CLYDEPORT OPS - 1	UK COASTAL	CLYDEPORT OPS	1	52	208	10816	GNK/BEL/GNK/ STN/GNK
CLYDEPORT OPS – 2	UK COASTAL	CLYDEPORT OPS	1	52	208	10816	GNK/STN/LIV/ GNK
EXCEL CONT	UK COASTAL	EXCEL CONT	1	104	195	20280	THM/FXT/GRG/ THM/GRG/THM
FEEDERLINK – COASTAL	UK COASTAL	FEEDERLINK	2	104	407	42328	FXT/TYN/GRG/ FXT/GRG/XTROT

Table 8.14 Lo-lo container feeder services between British mainland ports

These coastal lo-lo services compete with direct rail services (see case study 5). In some cases, this partly reflects the difficulty UK railways have in moving 9'6" high containers because of the height of bridges. However, shipping is generally cheaper than rail or road beyond an inland distance of around 250 miles. Distances overland between UK mainland ports are shown on Table 8.15. In the case of the service from Southampton to Irlam (Greater Manchester) which also uses an inland waterway (the Manchester Ship Canal), the maritime distance is more than twice the overland distance, and frequency is only weekly, yet the main client, P&O, finds the service meets the needs of some importers from the Far East for consumer goods.

	Greenock	Southampton	Liverpool	Irlam	Felixstowe	Grangemouth	Tyne
Greenock		460		243	447		
Southampton	460		240				
Liverpool		240		27			
Irlam	243		27				
Felixstowe						441	302
Grangemouth					441		138
Tyne					302	138	

Table 8.15 Distances overland between UK mainland ports

This case study demonstrates that in a shipping environment in which there is no restriction on the nationality of the ship and in which there is an abundance of low-cost small feeder ports, coastal shipping can attract a significant and growing proportion of the deep-sea feeder market (around 5% of the UK total) despite short distances and low service frequency. Together with rail, non-road modes carry around 30% of the 2.2m (3.5mTEU) deep-sea containers inland on an island in which 80% of the economy is within 250 miles of any of the major deep-sea ports.

Insofar as coastal shipping is concerned, it seems unlikely that there are major opportunities on the US Eastern Seaboard, at least for deep-sea container transshipment in isolation. Operating costs in Europe are far lower than in the US because of the restrictions of the Jones Act, which limits intra-US trading to US built and crewed vessels.

Container Ship Costs

Operating costs for small containers ships operating in Europe and in the USA are presented in Table 8.16. The costs have been developed for 500 TEU container ships based on daily charter rates and bunker consumption of around 10 tonnes per day for a speed of 12 knots.

Item	Ship costs Europe $	Ship costs in USA $
Charter/day	8,000	14,000[76]
Bunkers/day	2,000	2,000
Total	10,000	16,000
At 12 knots, ship cost per nautical mile	35	56
Cost at sea per container per mile 80% load factor, 1.67 TEU per box	**0.15**	**0.23**
Costs per container in port		
Ships time (20 lifts/hour and one day in port)	8,000 (One day)	14,000
Port entry charge (typical)	1,500	1,500
Total	9,500	15,500
Ship costs/container (240/sailing)	40	65
Stevedoring & wharfage – deep sea port (marginal)	20	20
Stevedoring & wharfage – short sea port	75	75
Fixed cost	**135**	**160**

Table 8.16 Typical short sea lo-lo container costs in Europe and USA (500 TEU vessel)

Local road delivery costs within the region of the feeder port could add a further $300 on a 50 mile radius. The relative costs of coastal shipping compared with truck and rail are given in Table 8.17 for a voyage of 700 nautical miles.

[76] The PIDN study identified a $5800 operating cost per day for a US flag vessel before funding the capital cost of $23 million for a 500 TEU non-geared ship. On the basis of it being bare boat chartered for 11% of its capital cost per annum, total daily charter costs would be some $12,7000; around $14,000 after taking into account inflation.

	European Costs (US$)	US Costs (US$)
Maritime cost		
Distance cost, 700 miles	105	161
Fixed cost	135	160
Local delivery	300	300
Total	**540**	**621**
Road Cost		
Distance cost, 700 miles @ $1.50	1050	1,050
Fixed cost	150	150
Total	**1200**	**1,200**
Rail Cost		
Distance cost, 700 miles	420	182
Fixed cost	125	117
Local delivery (more local than seaport)	200	200
Total	**745**	**499**

Table 8.17 European and US costs assumed for modeling: 700[77] mile journey by sea, road and rail.

This worked example shows that the impact of the Jones Act renders feeder shipping along the coast uncompetitive, even if competition is from 'short' European style trains. Furthermore, it has been seen in the case of Europe, that feeder shipping is only competitive to ports not receiving a substantial amount of deep-sea direct container services. All the major ports along the eastern seaboard receive such direct services.

8.4.6 *Case Study Five: Rail containers within Great Britain*

Currently, there are around one million containers and swapbodies moved by rail within Britain, of which over 80% are to and from the major ports (see Table 8.18). The two leading ports, Felixstowe and Southampton currently dispatch some 37 trains

[77] Distances are network distances assuming maritime length 15% longer to reflect difference between statute miles and nautical miles.

per weekday, carrying a mean of 30 containers (45 TEU) each. These trains serve the principal inland centers of Manchester, Liverpool, Glasgow, Leeds and Birmingham. Daily trains also serve Middlesbrough, Cardiff and London. The mean length of haul is around 225 miles, although some trains operate over much shorter distances (Southampton and Felixstowe to East London, 80-100 miles and Southampton to Birmingham, 125 miles). United Kingdom regions are shown on Figure 6.7 and the intermodal rail network in Figure 6.8.

	destination region											
Origin region	East Midlands	East of England	Greater London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorks & Humb	Grand Total
East Midlands	-	8.6	0.9	0.0	2.3	0.1	19.0	0.2	0.0	-	0.0	31.1
East of England	9.1	0.6	5.1	9.1	70.5	14.0	20.0	11.9	14.0	25.3	40.3	219.9
Greater London	0.6	1.7	0.5	1.8	14.0	2.4	9.3	5.7	11.0	0.5	4.0	51.6
North East	0.0	11.8	3.8	0.5	7.5	4.7	14.4	1.8	0.0	0.0	0.7	45.2
North West	1.5	37.6	18.3	7.6	1.2	4.7	42.2	3.1	2.4	0.4	1.5	120.5
Scotland	-	14.9	7.0	2.3	7.4	8.1	29.5	0.0	0.4	-	0.7	70.3
South East	15.7	26.2	29.9	7.9	58.4	18.3	17.4	8.4	11.3	33.0	35.5	262.1
South West	0.0	6.5	2.3	1.2	2.9	0.7	4.8	0.0	0.7	3.7	1.2	23.9
Wales	0.0	13.0	12.0	0.1	1.8	0.4	14.3	0.1	0.0	0.0	0.4	41.9
West Midlands	-	19.9	2.1	0.1	0.6	0.3	17.8	0.1	0.0	-	0.1	41.0
Yorks&Humb	0.0	33.0	8.9	0.6	10.4	0.3	28.1	1.0	0.6	1.3	-	84.2
Grand Total	27.0	173.8	90.6	31.2	177.1	53.9	216.7	32.4	40.5	64.2	84.3	991.7

Table 8.18 Estimated Container traffics to and from ports by rail in Britain.

Thousand Units 2003

Rail services can be viable at the very short distances shown on Table 8.19, even where local drayage is required as shown on Figure 6.9.

Port	East Midlands	East of England	Greater London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorks & Humb	Grand Total
FELIXSTOWE	17.1	0.5	3.9	18.4	90.6	17.3	13.9	12.8	22.7	43.6	68.7	309.7
SOUTHAMPTON	19.4	5.9	4.1	13.3	51.5	20.1	1.5	2.4	10.7	27.1	36.0	192.1
CHAN TUNNEL	9.0	10.5	33.8	3.9	20.8	13.2	15.6	6.3	6.8	11.8	13.4	145.1
LONDON	2.6	2.0	0.7	2.8	16.9	6.9	5.9	5.9	6.8	4.5	10.4	65.4
THAMESPORT	4.2	1.1	0.0	2.4	11.5	3.0	0.2	1.8	3.2	9.0	9.3	45.6
LIVERPOOL	1.8	7.3	14.8	1.0	0.0	5.3	4.7	3.0	2.9	0.9	0.1	41.8
MIDDLESBROUGH	0.0	0.0	0.5	0.5	2.7	3.8	0.0	0.4	0.0	0.1	0.4	8.4
HULL	0.0	0.0	0.8	0.1	4.0	0.1	0.1	0.1	0.2	0.6	-	6.3
GOOLE	-	0.0	0.0	0.2	5.2	0.0	-	-	0.2	0.0	-	5.7
IMMINGHAM	0.0	0.0	0.7	0.1	1.0	0.4	0.3	0.0	0.3	0.6	-	3.4
MEDWAY	0.3	0.1	-	0.1	0.9	0.1	0.0	0.1	0.5	0.3	0.1	2.5
GRANGEMOUTH	-	-	0.0	0.1	0.0	2.2	-	-	-	-	-	2.3
GREENOCK	-	-	1.5	0.1	0.0	0.1	-	-	-	-	0.1	1.7
AVONMOUTH	0.0	0.1	0.4	0.3	0.1	0.0	0.0	0.0	0.1	-	0.7	1.7
Grand Total	54.5	27.5	61.2	43.3	205.2	72.6	42.2	32.8	54.5	98.6	139.0	831.6

Table 8.19 Length of haul distribution for containers to/from UK ports by rail

The convention in Britain is not to deliver containers to receivers on skeletal trailers but for the truck to deliver to a very precise time schedule (+/- 15 minutes) and to wait while goods are discharged. It is therefore more cost effective to deliver from a local inland terminal to avoid the need for expensive time buffers required if deliveries are made from remote ports.

In the UK, rail market share is expanding at 5 – 6% per annum in a container market itself growing by 5% per annum and despite the fact that there is also an increased amount of feedering from European mainland ports to UK regional ports. This expansion is driven by competition between 4 different intermodal train operators all sharing the same common infrastructure. Trains are charged on the basis of a rate per gross tonne mile (around $0.05 per gross tonne mile). Terminals can be operated by the train companies or by third party private companies. Total State subsidy, based upon the 'Company Neutral Revenue Support' system is approximately $40 per container moved, although this can range from zero to $120, depending upon distance.

Rail freight in the UK had been in decline to 1994 under State ownership. Total tonne miles are now over 40% greater since privatization. Container traffic is currently the most rapidly expanding sector.

The lessons from the UK rail case study are that:

(i) a competitive framework is essential

(ii) to provide a 'local' service requires the use of small trains. In one case, the same train operator offers 4 different destinations from the same port along a highway route of only some 140 miles. Each of the terminals is more or less equidistant from that port

(iii) State funding for shorter haul movements, based upon the environmental/congestion/ highway maintenance benefits, is a key factor in generating critical mass at the ports.

The UK case is geographically similar to that of the Port. The great majority of the market for the ports of Southampton, Medway, London and Felixstowe is within 300 miles. Their overall container throughput is around 5 – 6m TEU, as compared with around 4m TEU for New York.

UK rail operators do benefit from the fact that the Greater London area, close to the ports, accounts for only a third of this market whereas New Jersey and 'metropolitan' New York account for a higher proportion of the Port's regional market. Nevertheless, the key difference with respect to the rail offer is that the train operators in Britain offer short (1,600ft long) frequent services, running at 75mph to be able to share tracks with passenger commuter services. While this may lead to higher unit costs, those higher costs may not render the service unviable.

8.4.7 *Overall Conclusion from Case Studies*

In Europe it is evident that waterborne freight can be very effective in winning market share in the deep-sea container market over relatively short distances where large traffic concentrations are available. It is possible to compete with road haulage over distances as short as 150 miles even when the cargo generators are not waterside. In some cases, the maritime distances are considerably longer than the competing road distances. However, where lines can make direct calls on the same service as to the main hub port of Rotterdam, this tends to rule out short-sea feeder services competing from a single hub port.

Insofar as rail is concerned, there are quite different lessons as between the UK and the European mainland. On the mainland, rail operations continue to be dominated by State owned operators and lengths of haul have generally to be long for rail to be viable. This mirrors the situation in the United States. In the UK, however, intermodal rail freight succeeds over much shorter hauls. Different rail traction companies compete very actively on the same infrastructure, each paying a standard tariff and being supported equally by the State on the basis of traffic carried where support is required.

Insofar as the Port is concerned, this evidence suggests that coastal barge traffic should be capable of succeeding to New England because there is an adequate concentration of traffic, and deep-sea lines do not call at Boston.

Short haul rail services could provide a regional service to such destinations as Pittsburgh, Harrisburg, Baltimore, Boston and Syracuse if financial support is available to reflect the environmental benefits gained and the railroads are prepared to operate with daily short trains designed to turn around rapidly overnight, based on the UK model.

9 Highway Improvements

9.1 *Introduction*

9.1.1 *General*

This Chapter describes the impact of Port trucks on the regional highway network, the highway corridor system surrounding the Port and the local Port terminal connector roads which link port terminals to those corridors.

One of the aims of the analysis was to determine the impact on highways of a growing but unchanged Port, the baseline case. This analysis was further developed to illustrate the difference between the baseline case and the impact with the cargo terminal improvements being put forward in the CPIP study. A baseline highway analysis was therefore carried out for the existing arrangement of Port cargo terminals together with the growth in Port throughput to 2060 described in Chapter 3. The improved Port case was then analyzed for the cargo terminal Scenarios using the same growth in Port throughput as the baseline analysis. The highway analyses were completed for the Scenarios developed in Task F. Adjustments to the original five scenarios were made in response to comments received from the CPIP Consortium and Stakeholders and in this process the original Green Scenario was deleted from further consideration. The text that follows summarizes the analyses for the Task F Scenarios including the Green Scenario. However, given the similarity of the traffic numbers across all analyzed scenarios and the fundamental assumptions regarding development phasing adopted, it was not appropriate or necessary to rerun the traffic modeling for the adjusted Task G scenarios.

A further aim of this part of the study was to define the improvements needed on the Port terminal connector roads for the baseline case and for each of the Scenarios in the improved Port case in order to assess whether the Scenarios would cause any significant increase in impact.

9.2 Baseline for Highway Analysis

9.2.1 *General*

In order to assess the impact of Port development proposals relative to an unchanged Port it was necessary to establish a baseline series of assumptions, including the way of quantifying and assigning port related traffic, the existing highway infrastructure and future changes to the regional highway network. These baseline assumptions for the CPIP study are described below.

9.2.2 *Baseline Distribution of Future Cargo by Terminal*

The future traffic generated by the Port as a whole has to be distributed to the individual terminals in the Port. A comparison of the forecast market demand and the existing capacity (as outlined in Chapters 3 and 5) indicates that demand is unlikely to exceed the overall capacity of the Port over the next 60 years. Thus it is reasonable to assume that development will be confined to the existing footprints of the terminals. Therefore the baseline assumption was that the distribution of future cargo will be proportional to existing terminal area[78].

Note that the South Brooklyn terminal is currently not operating, but is included in future development plans. For the purposes of this study it was assumed that the terminal would open in 2005 and handle half of its projected 2020 cargo volume that year, growing steadily to the 2020 forecast over the ensuing period.

The baseline assumption is that commodity and terminal splits are held constant at the 2020 level for forecasts to 2060, although it is acknowledged that this could theoretically exceed a particular terminal's capacity to accommodate such traffic.

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[78] Table E3A-2 of CPIP Task E Highway Technical Memorandum shows the detailed distribution.

Terminal	Commodity	2000	2020	2060
Newark	Containers	12.3%	14.4%	14.4%
	Autos	62.3%	54.2%	54.2%
	General	5.0%	58.1%	58.1%
	Dry Bulk	100.0%	100.0%	100.0%
	Liquid Bulk	100.0%	100.0%	100.0%
Elizabeth	Containers	61.5%	63.4%	63.4%
	Autos	11.3%	18.2%	18.2%
Howland Hook	Containers	15.1%	11.3%	11.3%
	General	7.8%	0.8%	0.8%
Global/NEAT/ BMW	Containers	9.0%	7.7%	7.7%
	Autos	26.5%	27.6%	27.6%
Red Hook	Containers	2.1%	3.2%	3.2%
	General	87.2%	10.5%	10.5%
South Brooklyn	General	0.0%	30.5%	30.5%

Note: commodity percentages sum to 100% across terminals

Table 9.1[79] **Baseline distribution of goods by commodity type to 2060**

(a) Baseline Split of Cargo between Trucks and Other Modes

Port cargo is moved by truck, rail and barge. Table 9.2 shows the modal assumptions for commodities that are moved by truck versus other modes. These estimates are based on the container terminal surveys, terminal operator and PANYNJ meetings, and the review of recent regional studies. The baseline analysis assumes that the current mode split is applied through to 2060.

[79] Table E3A-3, CPIP Task E Technical Memorandum, Vol. 3, Highways

Commodity	Truck	Other Modes
Containers	85%	15%
Automobiles	90%	10%
General Cargo	95%	5%
Dry Bulks	95%	5%
Liquid Bulks	90%	10%

Table 9.2[80] **Baseline inland transportation mode split**

9.2.3 *Volume of Traffic in Interim Baseline Years*

All interim baseline years (2005, 2010, 2015, 2030, 2040 and 2050) were interpolated from the 2000, 2020 and 2060 model outputs, using the following formula:

$$Interim\ Year\ Volume = Vol_{base} + \left(\left[\frac{(Vol_{future} - Vol_{base})}{(Year_{future} - Year_{base})} \right] \times (Year_{interim} - Year_{base}) \right)$$

This formula represents a straight line projection between 2000 and 2020, and again between 2020 and 2060. Although there may be fluctuations in the future these projections between model years are reasonable for this long-range plan. As an example, the baseline forecast change in traffic volume over time for an unchanged port arrangement at Doremus Avenue is shown in Figure 9.1.

9.2.4 *Highway Network*

(a) Introduction

The Port of New York and New Jersey is located in one of the largest metropolitan areas in the world. As a result, there is a significant amount of highway infrastructure, ranging from interstate highways to local neighborhood access routes. This Section describes the highway network[81] assumed for the CPIP analysis.

(b) Regionally Significant Routes

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[80] Based on Table E3A-4, CPIP Task E Technical Memorandum, Vol. 3, Highways

[81] For further detail see Section 3.4, CPIP Task E Technical Memorandum, Volume 3, Highways

The Federal Highway Administration (FHWA) designated National Highway System (NHS) road segments form the key components of this network, incorporating Interstates, U.S. Highways, and primary state highways. NHS ‘connectors’ provide access between key areas or facilities and the NHS. The NHS and connectors are used by the FHWA as its system-planning framework.

While the NHS and its connectors represent only a relatively small share of regional road miles, they capture the vast majority of inter-regional movements, a greater than proportional share of overall traffic, and more significantly an even greater proportional share of truck traffic.

Figure 9.2 shows the NHS roads in the port area and Appendix B lists the regionally significant highway facilities, with a brief descriptive summary of each.

(c) Major River and Channel Crossings

The area around the port includes a number of significant rivers and channels. The Hudson River, Arthur Kill, Kill van Kull, Newark Bay, New York Bay, and the East River are natural features that are traversed by a variety of bridges and tunnels, many of which are tolled. There are 13 major water crossings that accommodate port truck traffic, and these are shown in Figure 9.3.

The George Washington Bridge, which links origins and destinations between east-of-Hudson and west-of-Hudson, carries by far the largest amount of traffic of all the crossings, and indeed it is one of the most well used river crossings in the world. It is therefore not surprising that it also has the greatest absolute volume of trucks when compared to the other crossings.

(d) Port-related Truck Traffic Routes

A key aspect of the highway analysis is to highlight those highway segments that are used by port-related trucks. From analysis described later in this report it was possible to identify the routes that port-related trucks use, as shown on Figure 9.4.

Note that the thickness of the blue lines indicates the volume of port-related truck traffic assigned to particular highway segments. It can readily be seen from Figure 9.4 that Interstate highways are the key routes for port-related truck traffic.

(e) Regional Highway Corridors

CPIP corridors were determined by analyzing total freight flows throughout the port area using:

- The New Jersey Department of Transportation (NJDOT) Statewide Truck Model
- North Jersey Transportation Planning Authority (NJTPA) Travel Demand Model
- New York Metropolitan Transportation Council (NYMTC) Best Practices Model (BPM)
- NJDOT and New York State Department of Transportation (NYSDOT) traffic classifications and counts
- Port Authority of New York/New Jersey (PANYNJ) traffic study counts, and
- Pertinent local and regional agency documents (i.e. Portway, Cross Harbor, etc.).

These data sources help to define and distinguish the roadways important to port-related and other traffic.

Corridor roadway traffic was derived from several regional data sources and tools. Overall traffic volumes for each corridor roadway was derived for New York and New Jersey using the respective outputs of the NJTPA and NYMTC models. The truck and port-truck traffic estimates were derived using the CPIP trip tables within the NJDOT Truck Model.

A single corridor typically includes more than one highway[82]. For example, the 'Lower Crossing' corridor does not represent a particular bridge, but rather the traffic flow

[82] See Appendix A, CPIP Task F Technical Memorandum, Highways for a listing of roadways in a corridor.

pattern from New Jersey to Brooklyn across Staten Island, and includes most routes between those two areas that could be used for such a movement. Note also that the 'Inner Port Area' corridor represents an amalgamation of port terminal area roads in both New Jersey and New York. The corridors used in the analysis are shown in Figure 9.5.

(f) Port Terminal Connector Roads

The Port terminal connector roads provide access between the terminals and the major highway corridors. It is anticipated that these connector roads would carry the majority of port-related truck traffic and be most affected by any changes in Port-related truck movements. Therefore Port terminal connector roads are analyzed at the greatest level of detail within this plan. In some cases, the roadways are within the port properties, and others are public streets outside of the port gates. The port terminals in New Jersey have more direct links to the highway corridors (I-95, I-78, US 1&9, etc.) than their New York counterparts which must share local roadways with general use traffic.

Port terminal connector roads were identified through traffic counts, other studies, and interviews with NJTPA, NJDOT, NYMTC, NYSDOT, and PANYNJ representatives. Each site's identified connectors were as follows:

(i) Newark/Elizabeth (See Figure 9.6)

This area is located in the state of New Jersey, and includes the areas and terminals on the western side of Newark Bay. It represents the largest single area under consideration by CPIP geographically and in throughput.

The roads that provide primary access into this site are North Avenue, Port Street and Doremus Avenue. Port truck access to this location from the north (US 1&9) is via Doremus Avenue, the New Jersey Turnpike Interchange 14 is linked directly with Port Street, and North Avenue links the terminal area with the NJ Turnpike Interchange 13A. McLester Street and Corbin Streets are the main local access routes to port facilities, but do not directly link to the major road network.

The volumes and operations of the following roads were examined.

- Doremus Avenue
- Port Street
- Corbin Street
- McLester Street
- North Avenue

(ii) Port Jersey (See Figure 9.7)

Port Jersey terminals are located on the eastern coast of Upper New York Bay in Essex County, New Jersey. Port-related truck access is provided from I-78 and NJ 440 via Port Jersey Boulevard and Pulaski Street. The main access point into the terminal is located at the Port Jersey Boulevard/Pulaski Street intersection. These two roadways also serve as part of the interchange connecting NJ 440 with the Turnpike Interchange. Port-related truck traffic from Bayonne terminals will also likely use these roadways to access the highway system. The volumes and operations of the following roads were examined:

- Port Jersey Boulevard
- NJ 440
- Pulaski Street

(iii) Bayonne (See Figure 9.7)

Bayonne, formerly known as the Military Ocean Terminal at Bayonne (MOTBY), is located on the eastern coast of Upper New York Bay in Hudson County, New Jersey. Access is provided by NJ 440 and Port Terminal Road.

Access for Port trucks for Bayonne is expected to be from Port Terminal Road onto NJ 440. Traffic will use NJ 440 to go south toward I-278, or north to I-78 and NJ 440. Access from other non-port development proposed on the peninsula is expected to be from Port Terminal Road and at the intersection of Avenue E and 40th Street (Port trucks are not expected to use this access point). The volumes and operations of the following roads were examined:

- NJ 440
- Port Terminal Road

(iv) Howland Hook (See Figure 9.8)

- Gulf Avenue
- Goethals Road

(v) Red Hook (See Figure 9.9)

- Columbia Street
- Hamilton Avenue

(vi) South Brooklyn (See Figure 9.9)

- 39th Street
- 2nd Avenue

9.2.5 *Highway Improvement Programs*

(a) General

Within the baseline scenario, future years include planned improvements to the highway system, which range from minor intersection improvements to significant highway alterations.

For the purpose of this study, only projects that have a high probability of being implemented have been assumed in place for future-year analysis. They have been drawn from the NJTPA and NYMTC 2002 Transportation Improvement Programs (TIPs). The TIPs are rolling lists of committed projects that are produced annually by the Metropolitan Planning Organizations, and include regionally significant, federal and non-federal government funded projects, as well as major projects of other transportation agencies (such as the New Jersey Turnpike and the Port Authority of NY and NJ). NJTPA and NYMTC regional transportation plans (RTPs) also contain projects but in the longer term. These were also considered in the analysis to the extent that they are contained in the regional travel demand models. RTPs were also reviewed when developing project recommendations.

It is worth noting that, although included in the baseline, TIP projects are primarily focused on safety and system maintenance rather than any significant capacity adding improvements.

Appendix E of Task E Technical Memorandum, Volume 3, Highways provides a summary of the TIPs that have been assumed in place for the future years baseline analysis. The tables included in the Task E Appendix indicate the project development phase for each improvement, such as whether a scheme is currently undergoing final design or is actually under construction.

(b) Baseline Improvement Assumptions Built into Models

The NJTPA model network includes regionally significant TIP projects as defined in their 2002 Air Quality Conformity Analysis.

The NYMTC model network includes only those highways that were open to traffic in 1996. No future projects are included in the NYMTC model network. This is acceptable for future modeling as many congested areas are following a maintenance first policy with minimal new construction planned.

The NJDOT Truck Model network includes those roadways open to traffic in 2001.

While each of the three models used for the CPIP baseline have future year model networks that address planned improvements differently, the inclusion or exclusion of TIPs is not material for the analysis for reasons given in Section 9.2.5.

At the local Port terminal connector road level, highway network changes have been included if they are listed in one of the TIPs.

9.3 Methodology

9.3.1 General

This Section describes the methods used to carry out the analysis of the baseline and Port development cases for the aims described in Section 9.1.1.

The methodology included the following steps:

- Review available information and previous studies, and identify analysis tools;
- Identify the routes currently used by Port-related truck traffic and extrapolate to 2060;
- Analyze the highway network; and
- Present the results.

The initial step of identifying available analysis tools was necessary because it is not feasible, even within a study of this magnitude, to create a highway model of this complexity specifically for a single study.

Stakeholder consultation was undertaken and included regular meetings of a Technical Working Group formed from CPIP consortium members to consider the issues raised in the study.

Fact-finding meetings were held with organizations[83] involved in transportation planning and development in the study area, and a large number of sources of data and previous studies were reviewed.

9.3.2 *Steps in the Analysis*

The basic steps in the analysis were:

(a) Establish the traffic volumes on the highway network for the unchanged Port baseline case and for cargo growth between 2000 and 2060;

(b) Establish the traffic volumes on the highway network for the Port development Scenario cases and for the same cargo growth;

(c) Compare the Scenario cases with the baseline case;

(d) Determine the improvements needed in local Port terminal connector roads for the baseline case and the Scenarios, and their costs;

(e) Repeat the analysis for alternative mode split cases.

In order to assess the impact on the system of the freight moving to and from the port, traffic volumes were expressed as follows:

(f) All traffic

(g) All trucks

(h) Port-related trucks

'Port-related trucks' are defined in this study as the trucks making the initial, or primary, movement of goods with Port origins or destinations. Once the initial movement is completed, for example from the Port to an inland warehousing complex, secondary moves are considered within the 'all trucks' component.

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[83] For a list of organizations, data sources and previous studies see Sections E3A.2.3.1, 2.4.1 and 2.4.2, CPIP Task E Technical Memorandum, Volume 3, Highways.

Port trucks also include trucks that transfer goods between cargo terminals and rail terminals within the Port area.

9.3.3 *Congestion*

Unlike the general traffic flow measure, Average Daily Traffic (ADT), congestion is calculated for peak hour conditions. Congestion measures are defined as 'Below Capacity', 'Near Capacity', 'At Capacity', and 'Over Capacity'. These measures are determined by V/C (Volume/Capacity) ratios as shown below:

- 'Below Capacity' V/C <0.85
- 'Near Capacity' V/C between 0.86 and 0.92
- 'At Capacity' V/C between 0.93 and 1.0
- 'Over Capacity' V/C > 1.0

Capacity (C) for the individual roadway links were identified and compared to peak hour forecast traffic flows (V) which were obtained from model outputs. The capacity evaluation takes into consideration variables such as traffic signal density, speed limits, and truck to auto equivalency factors.

9.3.4 *Transportation Models used in the Analysis*

The following models were used in the analysis of highway traffic volumes[84]:

- NYMTC Best Practices Model (BPM);
- NJTPA Regional Travel Demand Model; and
- NJDOT Truck Model.

The NYMTC and NJTPA models cover the areas of their respective MPOs, as shown in Figure 9.10.

(a) NYMTC Best Practice Model (BPM)

[84] For further details of the models see Section E3A.2.5, CPIP Task E Technical Memorandum, Volume 3, Highways.

The NYMTC BPM is the regional travel demand model used for transportation analysis within the New York Metropolitan Transport Council's planning area. The large commercial truck component of the model was not available for this study.

(b) NJTPA Model

The NJTPA model is the travel demand model used by the North Jersey Transportation Planning Authority for transportation analysis.

The NJTPA modeling of trucks has only been set-up for consideration at a regional aggregate level. This level of freight vehicle modeling is not sufficiently detailed for the purposes of this study.

(c) Use of the NYMTC and NJTPA Models

Between them, the models cover the entire region of interest around the port, though neither does in isolation. Both models produce accepted auto volumes on major highway routes, and can produce peak period traffic flows (which is required for capacity and congestion assessments). Hence, these models are good for assessing total traffic and the regional highway network.

That neither model alone covers the entire area of interest around the port presents an interfacing issue. However, this was overcome using comparative analyses at the model boundaries to ensure reasonable consistency. Traffic counts were compared to model volumes at logical points, such as bridges and tunnels, and any inconsistencies were adjusted within the analysis.

As noted earlier, these models cannot readily be used to identify Port-related truck volumes. As a result the NJDOT model described below was used for this purpose.

(d) NJDOT

The NJDOT model covers the whole region around the port, including the whole of the state of New Jersey, parts of New York State (whole of New York City), northern Delaware and eastern Pennsylvania (including Philadelphia). The network covered is shown in Figure 9.11.

It is the truck-modeling component of the NJDOT model that is of particular use to the CPIP study. The model includes 'special generators' for locations, such as ports, which generate more trucks than would be expected from the basic input. The 'special generators' allow truck trips to be applied to the areas concerned. [85]

Port-related trips were forecast, as described in the next Section of the report, and applied to the model using the 'special generators' in the model that represent the port terminals. These trips were assigned to the highway network. Note that the Global/Auto Marine and the South Brooklyn Terminals were not part of the NJDOT model's original 'special generators', but were added to simulate movements from these areas.

The NJDOT model is a regional, strategic model with a coarse network requiring off-model analysis to consider movements close to port terminals. This was done by matching model outputs to actual traffic flows on local roads, using traffic counts from recent NJDOT and PANYNJ studies. To supplement these counts, and cover areas where information was not already available, the study team commissioned traffic counts at nine other locations[86].

Also, the NJDOT model is a 24-hour assignment model, and does not specifically identify peak-period movements. To provide peak-period figures, factors derived from the NJTPA and NYMTC models and traffic counts were used to convert from 24-hour to peak-period figures.

Hence, using the three models, with additional adjustment described above, a reasonable prediction of the Port-related truck traffic on regional, corridor and local highways was able to be produced based on cargo forecasts.

9.4 Forecast Traffic Demand

9.4.1 General

The forecasting of the input data for the model for highway traffic was based on:

- Forecasting of all traffic and overall truck traffic using population and employment data

[85] For more information see the model documentation: *Statewide Model Truck Trip Table Update Project – Model Development and Validation*, January 1999, prepared for NJDOT by URS Greiner Woodward Clyde.
[86] For more information about the traffic counts see Appendix B, CPIP Task E Technical Memorandum, Volume 3, Highways

- Forecasting of port-related truck traffic from cargo forecasts

9.4.2 *Overall Traffic Forecast*

Traffic flows are available as model outputs for forecast years of 2020, from the NYMTC Best Practices Model, and 2025, from the NJTPA travel demand model. The NJDOT Truck Model is projected to 2020. In order to estimate traffic movements in intermediate years, interpolation between the various forecast years was used. However, the CPIP time horizon also requires estimates of traffic to 2060. The NJDOT Truck Model, which was the main tool employed, uses population and employment forecasts to generate trips. Hence, to provide 2060 traffic flows, population and employment forecasts for this period, tailored to the requirements of this analysis, had to be developed[87]. Clearly, projections beyond 2020 are less certain and need to be treated accordingly.

9.4.3 *Port-related Truck Traffic Forecast*

Port-related truck trips are required to estimate the Port's effect on the highway network. This Section describes the port-related truck forecast and roadway assignment method used for the Task F Port development Scenarios. This method includes the following steps.

- Cargo Throughput – Cargo throughput was based on the forecasts described in Chapter 3;
- Terminal Split –The total volume of port goods was assigned to specific terminals based on overall demand for the date, and terminal area as defined for the cargo terminal development Scenarios.
- Mode Split – Once assigned to a terminal, the goods were then allocated to a mode of transportation using three mode split options as described below. The detailed mode split at specific terminals within a mode split option was based on relative size of terminals. The terminals' rail shares were weighted by the relative acreage of the cargo terminal. This reflects the potential for

[87] See Appendix C of CPIP Task E Technical Memorandum, Highways

greater rail economies of scale at terminals with greater rail capability and market volumes. The different cargo types are treated separately because of the differences in their handling and the space requirements for each.

- Distribution and Assignment – Port-related truck trips were applied to the NJDOT truck model, which in turn assigned vehicles and trips to the highway network. Resulting flows were also compared with recent traffic counts for accuracy and interpolated for interim forecast years.

9.4.4 *Mode Share*

The mode share for highway traffic is described in Chapter 8.

9.4.5 *Traffic Generation and Assignment*

(a) Port Trucks

Taking terminal split, cargo type and mode split into account, the distribution of port throughput going by truck from each terminal, and hence the number of trucks, was calculated for the relevant dates[88].

(b) Non-Port Trucks

To account for the growth in non-port-related traffic as well as port-related trucks, it was necessary to identify and separate these trips/vehicles within the model. Three sets of trips/vehicles were identified, allowing the study team to account for each of the purposes individually and apply discrete growth rates for each.

(c) Traffic Assignment

The NJDOT model was used to develop a port-related truck trip table. This model assigns port-related trucks to the roadway system based on trips to and from geographical zones based on zip code origin and destination data obtained from the Port Inland Distribution Network Plan.

The CPIP analysis requires an interim year analysis in five year increments between 2000 and 2020 and in ten year increments between 2020 and 2060. As a result model trip tables were developed for 2000, 2020 and 2060 and all interim years (2005, 2010,

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[88] See Appendix D, CPIP Task F Technical Memorandum, Highways

2015, 2030, 2040 and 2050) are interpolated from the resulting model data, using the formula given in Section 9.2.3.

9.5 Results of the Highway Analysis

9.5.1 Introduction

This Section presents and discusses the results of the highway analysis. Results are presented for:

- Regional Highway System;
- Regional Highway Corridors; and
- Port Terminal Connector Roads.

The goal is to define the highway system performance and to evaluate the impact of cargo terminal development Scenarios on the system.

The highway analysis as described in the Task F Technical Memorandum, Volume 2, Highways, was carried out for the baseline case and for Task F[89] cargo terminal Scenarios and the results are presented for that analysis. Subsequently the Scenarios were subject to minor adjustments as described in Task G Technical Memorandum, Port Development Proposals. However reanalysis is not justified due to the minor nature of the adjustments, and the fact that they would not make any significant changes to the Scenario evaluations.

9.5.2 Regional Highway System

The results of the regional analysis are given for the existing mode split only.

The measures used for presenting the results are:

- Vehicle Hours Traveled (VHT)
- Vehicle Miles Traveled (VMT)
- Delay (VHT/VMT)
- Average Speed (mph)

[89] As published in the CPIP Task F Technical Memorandum, Volume 1, Cargo Terminal Options

- Total Vehicle Trips
- Total Truck Trips
- Total Port truck Trips

Table 9.3 shows the comparison of the 2000, 2020 and 2060 daily regional statistics for the baseline case and the cargo terminal Scenarios.

	2000 Baseline	2020 Baseline and Scenarios	2060 Baseline and Scenarios
VMT (million)	320	410	570
VHT (million)	14	22	49
Average Speed (mph)	22	18	12
Total trips (All vehicles-million)	32	41	52
Port-related truck trips (% of total)	.05	.06	.09

Table 9.3 Baseline results for regional highways

An important conclusion from the Table 9.3 is that although the volume of traffic increases steadily throughout the study period, and average speed drops significantly, this cannot be attributed to Port related truck trips which are projected to remain less than 0.1 percent of all traffic. As a result, there is very little impact of Port-related trucks on the regional highway network.

9.5.3 *Regional Highway Corridors*

This Section describes the results of the analysis of regionally significant corridors, described in Section 9.2.4(e), for the following performance measures:

- Average Daily Traffic (ADT) – volume of total traffic along corridor roadways;

- Average Daily Port-related Truck Traffic (ADPT) – volume of Port-related trucks along corridor roadways.

The results are shown in Table 9.4.

	Base	Blue	Green	Orange	Red	Yellow
BQE	4.9%	5.2%	5.0%	5.0%	5.0%	5.0%
I-280	1.9%	1.6%	1.9%	1.9%	1.9%	1.9%
I-287 Central	23.1%	23.1%	23.1%	23.1%	23.1%	23.1%
I-287 North	16.2%	16.2%	16.2%	16.2%	16.2%	16.2%
I-287 South	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%
I-78	18.2%	18.0%	18.2%	18.1%	18.2%	18.2%
I-80	12.7%	12.7%	12.7%	12.7%	12.6%	12.7%
I-87	27.1%	27.3%	27.1%	27.1%	27.2%	27.1%
I-87/I-287	17.6%	17.7%	17.6%	17.6%	17.6%	17.7%
I-95 Central	7.5%	7.4%	7.4%	7.5%	7.4%	7.5%
I-95 North	13.8%	14.1%	13.7%	13.9%	13.7%	13.8%
I-95 South	20.6%	20.5%	20.5%	20.5%	20.5%	20.5%
Inner Port Area	2.8%	3.0%	2.9%	3.1%	3.0%	2.7%
LIE	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
Lower Crossings	14.0%	14.1%	14.0%	14.0%	14.0%	14.0%
Manhattan Crossings	13.5%	13.7%	13.5%	13.5%	13.5%	13.5%
NJ 17	12.1%	12.1%	12.1%	12.1%	12.0%	12.0%

Table 9.4 Average Daily Traffic growth in corridors – percent change 2000 to 2020

The analysis of regional highway corridors showed that the average daily traffic (ADT) for each corridor is expected to increase over the study period by nearly the same amount regardless of whether the baseline growth case or one of the Scenarios is chosen.

Although the future volume of Port-related trucks is forecast to increase in the baseline growth case and in all the Scenarios, the impact on the corridors is small. This is illustrated in Tables 9.5 and 9.6 which show that the average number of Port-related trucks along the corridors is less than 10% in the Inner Port Corridor and less than 3% elsewhere. It is also evident on the tables that, for any given corridor, there is little difference between the baseline growth case and the Scenarios. Hence the impact of other non-port traffic is the overriding factor within the corridors. Although the relative volume of Port-related trucks varies to a small degree for specific corridors dependent on the Scenario, this is not expected to affect corridor performance one way or another.

	Base		Blue		Green		Orange		Red		Yellow	
	Port Truck	% of Total Traffic	Port Trucks	% of Total Traffic	Port Trucks	% of Total Traffic	Port Trucks	% of Total Traffic	Port Trucks	% of Total Traffic	Port Trucks	% of Total Traffic
BQE	225	0.3%	240	0.3%	233	0.3%	218	0.3%	203	0.2%	203	0.2%
I-280	270	0.2%	590	0.5%	360	0.3%	370	0.3%	390	0.3%	350	0.3%
I-287 Central	320	0.3%	90	0.1%	310	0.3%	320	0.3%	300	0.3%	330	0.3%
I-287 North	30	0.0%	30	0.0%	30	0.0%	30	0.0%	30	0.0%	30	0.0%
I-287 South	290	0.3%	280	0.3%	280	0.3%	290	0.3%	280	0.3%	310	0.4%
I-78	200	0.2%	200	0.2%	190	0.2%	210	0.2%	190	0.2%	200	0.2%
I-80	1,650	1.6%	1,490	1.4%	1,720	1.7%	1,570	1.5%	1,660	1.6%	1,670	1.6%
I-87	280	0.2%	310	0.2%	290	0.2%	260	0.2%	240	0.2%	250	0.2%
I-87/I-287	50	0.1%	140	0.3%	40	0.1%	40	0.1%	70	0.1%	50	0.1%
I-95 Central	410	0.3%	510	0.4%	430	0.3%	420	0.3%	430	0.3%	480	0.4%
I-95 North	2,980	2.9%	2,890	2.8%	2,910	2.8%	2,990	2.9%	2,910	2.8%	3,010	2.9%
I-95 South	1,010	1.6%	1,150	1.8%	940	1.5%	1,030	1.6%	940	1.5%	1,010	1.6%
Inner Port Area	1,770	1.9%	1,760	1.9%	1,740	1.9%	1,720	1.9%	1,710	1.8%	1,760	1.9%
LIE	2,340	7.8%	2,390	8.0%	2,360	7.9%	2,410	8.0%	2,370	7.9%	2,310	7.7%
Lower Crossings	550	0.3%	570	0.4%	550	0.3%	520	0.3%	510	0.3%	520	0.3%
Manhattan Crossings	240	0.2%	340	0.3%	260	0.2%	210	0.2%	250	0.2%	210	0.2%
NJ 17	1,010	0.8%	1,190	1.0%	1,030	0.9%	1,020	0.9%	1,030	0.9%	1,050	0.9%

Table 9.5 Average Daily Port related Truck Traffic in corridors - 2020

	Base		Blue		Green		Orange		Red		Yellow	
	Port Trucks	% of Total Traffic	Port Trucks	% of Total Traffic	Port Trucks	% of Total Traffic	Port Trucks	% of Total Traffic	Port Trucks	% of Total Traffic	Port Trucks	% of Total Traffic
BQE	288	0.3%	300	0.3%	152	0.3%	142	0.3%	136	0.3%	132	0.3%
I-280	440	0.3%	670	0.5%	390	0.3%	440	0.3%	430	0.3%	400	0.3%
I-287 Central	520	0.5%	510	0.5%	550	0.5%	490	0.4%	540	0.5%	520	0.5%
I-287 North	40	0.0%	40	0.0%	40	0.0%	40	0.0%	40	0.0%	40	0.0%
I-287 South	420	0.4%	480	0.5%	470	0.5%	420	0.4%	460	0.5%	450	0.4%
I-78	330	0.2%	330	0.2%	290	0.2%	320	0.2%	280	0.2%	310	0.2%
I-80	2,860	2.1%	2,510	1.9%	2,950	2.2%	2,670	2.0%	2,800	2.1%	2,820	2.1%
I-87	310	0.2%	350	0.2%	300	0.2%	270	0.2%	300	0.2%	270	0.2%
I-87/I-287	180	0.2%	340	0.4%	170	0.2%	180	0.2%	200	0.2%	180	0.2%
I-95 Central	890	0.5%	1,120	0.6%	860	0.5%	820	0.5%	840	0.5%	1,110	0.6%
I-95 North	3,280	2.4%	3,210	2.4%	3,210	2.4%	3,280	2.4%	3,110	2.3%	3,380	2.5%
I-95 South	1,360	1.8%	1,560	2.1%	1,260	1.7%	1,380	1.8%	1,250	1.6%	1,340	1.8%
Inner Port Area	1,840	1.5%	1,810	1.5%	1,740	1.4%	1,760	1.4%	1,720	1.4%	1,940	1.6%
LIE	3,490	9.2%	3,480	9.2%	3,610	9.5%	3,550	9.4%	3,620	9.5%	3,490	9.2%
Lower Crossings	520	0.3%	540	0.3%	430	0.2%	530	0.3%	420	0.2%	530	0.3%
Manhattan Crossings	1,180	0.8%	1,630	1.1%	1,100	0.7%	1,330	0.9%	1,090	0.7%	1,010	0.7%
NJ 17	1,250	0.9%	1,390	0.9%	1,130	0.8%	1,160	0.8%	1,140	0.8%	1,250	0.9%

Table 9.6 Average Daily Port related Truck Traffic in corridors – 2060

9.5.4 *Port Terminal Connector Roads*

(a) Assignment of Port-related trucks

At each port facility location, the total volume of that facility's port-related truck traffic was broken down and assigned to a port terminal connector road. These truck assignments were derived using mainline counts and turning movement counts and are shown below by port terminal area

(i) Port Newark/Elizabeth Terminal Area

Roadway	% of Terminal Trucks
Doremus Avenue	20%
Port Street	45%
North Avenue	35%

(ii) Port Jersey (Global) Terminal Area

Roadway	% of Terminal Trucks
I-78 via Port Jersey Blvd.	60%
NJ 440 North	30%
NJ 440 South	10%

(iii) Bayonne Port Area

Roadway	% of Terminal Trucks
NJ 440 North	85%
NJ 440 South	15%

(iv) Howland Hook Port Area

Roadway	% of Terminal Trucks
I-278 West	65%
I-278 East	35%

(v) Red Hook Port Area

Roadway	% of Terminal Trucks
BQE North	45%
BQE South	25%
Brooklyn-Battery Tunnel	30%

(vi) South Brooklyn Port Area

Roadway	% of Terminal Trucks
Gowanus North	75%
Gowanus South	25%

(b) Congestion Results for Terminal Connector Roads

Congestion is represented by the ratio (V/C) of the volume of traffic on a roadway to the theoretical capacity of the roadway.

Information for the Scenarios with the greatest and least Port-related traffic volumes[90] in a specific Port terminal connector roadway area are presented in this Section to demonstrate the relative impact of Scenarios on the capacity of the local roadway system. The results are given for the three mode split options.

Bayonne is included in this analysis as defined in the Peninsula report[91] without the infrastructure improvements proposed within the study. As a result, the V/C ratios are very high in the Bayonne area connector roads. The purpose of this assumption is to show the impact of the Bayonne Peninsula development, including Port and non-Port uses, on the existing infrastructure.

(i) Port Newark/Elizabeth Terminal Area

The Yellow Scenario is expected to produce the greatest number of Port-related trucks on the local port area roadways, and Green Scenario the least.

Tables 9.7 through 9.9 show the forecasted total traffic and port truck traffic volumes for the Newark/Elizabeth connector roadways for the Green and Yellow scenarios for

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[90] Data for all CPIP Task F Scenarios is given in Appendix H of CPIP Task F Technical Memorandum, Highways.

[91] *"The Peninsula at Bayonne Harbor: Local Roadway Connector Study, Final Report",* City of Bayonne, June 30, 2003. See also Appendix I of CPIP Task F Technical Memorandum, for details of the improvements proposed in the study.

each mode split option. Traffic volumes produced by the other scenarios are expected to fall between these two extremes.

Segment	Volume	2000	2020			2040			2060		
			Base	Green	Yellow	Base	Green	Yellow	Base	Green	Yellow
Doremus Ave	All Traffic	10,200	11,400	10,500	11,600	14,300	12,900	14,700	17,300	15,400	17,700
	Port Trucks	4,300	5,200	4,300	5,500	8,000	6,600	8,400	10,700	8,900	11,200
	% of all traffic	42%	46%	41%	47%	56%	51%	57%	62%	58%	63%
Port Street (NE)	All Traffic	11,100	12,600	11,700	12,800	15,400	14,100	15,800	18,200	16,500	18,700
	Port Trucks	4,000	4,900	4,100	5,200	7,600	6,300	7,900	10,200	8,500	10,700
	% of all traffic	36%	39%	35%	41%	49%	45%	50%	56%	51%	57%
Corbin Street	All Traffic	19,200	21,600	20,100	22,000	26,700	24,400	27,300	31,700	28,600	32,600
	Port Trucks	7,300	8,800	7,300	9,300	13,600	11,200	14,200	18,300	15,100	19,100
	% of all traffic	38%	41%	36%	42%	51%	46%	52%	58%	53%	59%
McLester Street	All Traffic	15,500	17,500	15,900	17,900	22,600	20,200	23,300	27,700	24,500	28,600
	Port Trucks	7,500	9,100	7,500	9,600	14,000	11,600	14,600	18,800	15,600	19,700
	% of all traffic	49%	52%	47%	53%	62%	57%	63%	68%	64%	69%
North Avenue	All Traffic	20,400	23,000	21,400	23,400	28,200	25,800	28,900	33,400	30,200	34,300
	Port Trucks	7,400	9,100	7,500	9,600	14,000	11,600	14,600	18,800	15,600	19,700
	% of all traffic	37%	40%	35%	41%	49%	45%	51%	56%	52%	57%
Port Street (NW)	All Traffic	26,000	29,300	27,300	29,900	36,100	33,000	36,900	42,800	38,700	43,900
	Port Trucks	9,600	11,700	9,700	12,300	17,900	14,900	18,800	24,200	20,000	25,300
	% of all traffic	37%	40%	35%	41%	50%	45%	51%	57%	52%	58%

Table 9.7 Newark/Elizabeth connectors - existing mode split - daily volumes

Segment	Volume	2000	2020			2040			2060		
			Base	**Green**	**Yellow**	**Base**	**Green**	**Yellow**	**Base**	**Green**	**Yellow**
Doremus Ave	All Traffic	10,200	11,400	10,000	11,100	14,300	12,200	13,800	17,300	14,400	16,600
	Port Trucks	4,300	5,200	3,800	4,900	8,000	5,900	7,500	10,700	7,900	10,100
	% of all traffic	42%	46%	38%	44%	56%	48%	54%	62%	55%	61%
Port Street (NE)	All Traffic	11,100	12,600	11,200	12,300	15,400	13,400	14,900	18,200	15,500	17,600
	Port Trucks	4,000	4,900	3,600	4,600	7,600	5,600	7,100	10,200	7,500	9,600
	% of all traffic	36%	39%	32%	38%	49%	42%	48%	56%	48%	54%
Corbin Street	All Traffic	19,200	21,600	19,200	21,100	26,700	23,100	25,900	31,700	26,900	30,600
	Port Trucks	7,300	8,800	6,500	8,300	13,600	9,900	12,700	18,300	13,400	17,200
	% of all traffic	38%	41%	34%	39%	51%	43%	49%	58%	50%	56%
McLester Street	All Traffic	15,500	17,500	15,100	17,000	22,600	18,900	21,800	27,700	22,800	26,600
	Port Trucks	7,500	9,100	6,700	8,600	14,000	10,200	13,100	18,800	13,800	17,700
	% of all traffic	49%	52%	44%	51%	62%	54%	60%	68%	61%	66%
North Avenue	All Traffic	20,400	23,000	20,500	22,400	28,200	24,500	27,400	33,400	28,500	32,300
	Port Trucks	7,400	9,100	6,700	8,600	14,000	10,200	13,100	18,800	13,800	17,700
	% of all traffic	37%	40%	32%	38%	49%	42%	48%	56%	49%	55%
Port Street (NW)	All Traffic	26,000	29,300	26,200	28,600	36,100	31,300	35,000	42,800	36,400	41,300
	Port Trucks	9,600	11,700	8,600	11,000	17,900	13,200	16,900	24,200	17,800	22,700
	% of all traffic	37%	40%	33%	38%	50%	42%	48%	57%	49%	55%

Table 9.8 **Newark/Elizabeth connectors - enhanced mode split - daily volumes**

Segment	Volume	2000	2020			2040			2060		
			Base	Green	Yellow	Base	Green	Yellow	Base	Green	Yellow
Doremus Ave	All Traffic	10,200	11,400	9,200	10,200	14,300	11,100	12,600	17,300	13,000	15,000
	Port Trucks	4,300	5,200	3,100	4,100	8,000	4,800	6,300	10,700	6,400	8,400
	% of all traffic	42%	46%	33%	40%	56%	43%	50%	62%	50%	56%
Port Street (NE)	All Traffic	11,100	12,600	10,500	11,500	15,400	12,400	13,800	18,200	14,200	16,100
	Port Trucks	4,000	4,900	2,900	3,900	7,600	4,500	5,900	10,200	6,100	8,000
	% of all traffic	36%	39%	28%	34%	49%	37%	43%	56%	43%	50%
Corbin Street	All Traffic	19,200	21,600	18,000	19,700	26,700	21,200	23,800	31,700	24,400	27,800
	Port Trucks	7,300	8,800	5,200	6,900	13,600	8,100	10,600	18,300	11,000	14,400
	% of all traffic	38%	41%	29%	35%	51%	38%	45%	58%	45%	52%
McLester Street	All Traffic	15,500	17,500	13,800	15,500	22,600	17,000	19,600	27,700	20,200	23,700
	Port Trucks	7,500	9,100	5,400	7,100	14,000	8,300	11,000	18,800	11,300	14,800
	% of all traffic	49%	52%	39%	46%	62%	49%	56%	68%	56%	62%
North Avenue	All Traffic	20,400	23,000	19,300	21,000	28,200	22,600	25,200	33,400	25,900	29,400
	Port Trucks	7,400	9,100	5,400	7,100	14,000	8,300	11,000	18,800	11,300	14,800
	% of all traffic	37%	40%	28%	34%	49%	37%	43%	56%	44%	50%
Port Street (NW)	All Traffic	26,000	29,300	24,600	26,800	36,100	28,800	32,100	42,800	33,100	37,600
	Port Trucks	9,600	11,700	6,900	9,200	17,900	10,700	14,100	24,200	14,500	19,000
	% of all traffic	37%	40%	28%	34%	50%	37%	44%	57%	44%	51%

Table 9.9 Newark/Elizabeth connectors - potential enhanced mode split - daily volumes

Tables 9.7 through 9.9 show that total traffic and Port-related truck traffic volumes are expected to increase over time for all options and show the reduction in Port-related trucks along connector roadways as the non-truck mode split is enhanced.

Table 9.10 displays the V/C ratios based on the above traffic data. The same general trends as existed with the total volumes and Port-related truck volumes are true with the V/C ratios.

Segment	Mode Split	2000	2020			2040			2060		
			Base	Green	Yellow	Base	Green	Yellow	Base	Green	Yellow
Doremus Ave	Existing			1.06	1.23		1.42	1.68		1.77	2.12
	Enhanced	1.03	1.19	0.98	1.14	1.62	1.30	1.55	2.05	1.62	1.95
	Potential Enhanced			0.87	1.02		1.14	1.36		1.41	1.70
Port Street (NE)	Existing			0.55	0.63		0.72	0.85		0.89	1.06
	Enhanced	0.53	0.61	0.51	0.59	0.82	0.67	0.79	1.02	0.82	0.98
	Potential Enhanced			0.46	0.53		0.59	0.70		0.72	0.86
Corbin Street	Existing			0.96	1.10		1.27	1.48		1.57	1.86
	Enhanced	0.93	1.07	0.90	1.03	1.44	1.17	1.38	1.80	1.44	1.72
	Potential Enhanced			0.80	0.93		1.03	1.22		1.26	1.51
McLester Street	Existing			0.85	1.00		1.16	1.39		1.47	1.77
	Enhanced	0.83	0.96	0.78	0.92	1.34	1.06	1.27	1.71	1.34	1.62
	Potential Enhanced			0.69	0.82		0.92	1.12		1.15	1.41
North Avenue	Existing			0.96	1.10		1.26	1.48		1.56	1.85
	Enhanced	0.92	1.07	0.90	1.03	1.43	1.17	1.37	1.79	1.44	1.71
	Potential Enhanced			0.81	0.93		1.04	1.22		1.26	1.50
Port Street (NW)	Existing			1.29	1.48		1.70	1.99		2.10	2.49
	Enhanced	1.24	1.44	1.21	1.39	1.93	1.57	1.85	2.41	1.93	2.30
	Potential Enhanced			1.09	1.25		1.39	1.64		1.69	2.02

Table 9.10 Newark/Elizabeth connectors - peak V/C ratios

As expected, with the increases in non-truck mode share, V/C ratios improve. In 2020, Green Scenario conditions are expected to be similar to the existing, with all connectors estimated to operate below capacity except for Port Street (NW) and

Doremus Avenue. In the Yellow Scenario, the potential enhanced mode share provides 2020 V/C ratios approximately the same as existing, but with ratios still primarily at capacity or over.

By 2040 the majority of scenarios show failing traffic conditions (excluding Port Street (NE)), with operating conditions worse than current operating conditions. Port Street (NW) V/C ratios are expected to surpass 2.00 within the Yellow Scenario in 2060.

(ii) Port Jersey Terminal Area

The Green Scenario is expected to produce the greatest number of port trucks on the port area roadways and Blue Scenario the least.

Tables 9.11 through 9.13 display the total traffic and port truck traffic volumes for the Port Jersey roadway links for the Blue and Green Scenarios for the three mode split options. Other scenarios will fall between these two extremes.

Segment	**Volume**	**2000**	**2020**			**2040**			**2060**		
			Base	**Blue**	**Green**	**Base**	**Blue**	**Green**	**Base**	**Blue**	**Green**
NJ 440 @ Pulaski Street	All Traffic	30,000	96,200	95,200	97,300	101,600	99,900	103,200	106,900	104,600	109,000
	Port Trucks	300	1,600	500	2,600	2,500	800	4,100	3,400	1,100	5,500
	% of all traffic	1%	2%	1%	3%	2%	1%	4%	3%	1%	5%
Port Jersey Blvd.	All Traffic	12,700	31,100	30,600	31,400	33,700	32,900	34,200	36,300	35,300	36,900
	Port Trucks	2,100	2,900	2,400	3,200	5,000	4,300	5,500	7,000	6,100	7,700
	% of all traffic	16%	9%	8%	10%	15%	13%	16%	19%	17%	21%
Pulaski Street west of Port Jersey Blvd.	All Traffic	10,400	28,300	27,900	28,600	30,100	29,500	30,700	32,000	31,200	32,800
	Port Trucks	300	800	400	1,200	1,300	700	1,900	1,900	1,000	2,600
	% of all traffic	3%	3%	2%	4%	4%	3%	6%	6%	3%	8%

Table 9.11 Port Jersey connectors– existing mode split - daily volumes

Segment	Volume	2000	2020			2040			2060		
			Base	Blue	Green	Base	Blue	Green	Base	Blue	Green
NJ 440 @ Pulaski Street	All Traffic	30,000	96,200	95,200	97,300	101,600	99,900	103,200	106,900	104,600	109,000
	Port Trucks	300	1,600	500	2,600	2,500	800	4,100	3,400	1,100	5,500
	% of all traffic	1%	2%	1%	3%	2%	1%	4%	3%	1%	5%
Port Jersey Blvd.	All Traffic	12,700	31,100	30,600	31,400	33,700	32,900	34,200	36,300	35,300	36,900
	Port Trucks	2,100	2,900	2,400	3,200	5,000	4,300	5,500	7,000	6,100	7,700
	% of all traffic	16%	9%	8%	10%	15%	13%	16%	19%	17%	21%
Pulaski Street west of Port Jersey Blvd.	All Traffic	10,400	28,300	27,900	28,600	30,100	29,500	30,700	32,000	31,200	32,800
	Port Trucks	300	800	400	1,200	1,300	700	1,900	1,900	1,000	2,600
	% of all traffic	3%	3%	2%	4%	4%	3%	6%	6%	3%	8%

Table 9.12 **Port Jersey connectors - enhanced mode split - daily volumes**

Segment	Volume	2000	2020			2040			2060		
			Base	Blue	Green	Base	Blue	Green	Base	Blue	Green
NJ 440 @ Pulaski Street	All Traffic	30,000	96,200	95,200	97,300	101,600	99,900	103,200	106,900	104,600	109,000
	Port Trucks	300	1,600	500	2,600	2,500	800	4,100	3,400	1,100	5,500
	% of all traffic	1%	2%	1%	3%	2%	1%	4%	3%	1%	5%
Port Jersey Blvd.	All Traffic	12,700	31,100	30,600	31,400	33,700	32,900	34,200	36,300	35,300	36,900
	Port Trucks	2,100	2,900	2,400	3,200	5,000	4,300	5,500	7,000	6,100	7,700
	% of all traffic	16%	9%	8%	10%	15%	13%	16%	19%	17%	21%
Pulaski Street west of Port Jersey Blvd.	All Traffic	10,400	28,300	27,900	28,600	30,100	29,500	30,700	32,000	31,200	32,800
	Port Trucks	300	800	400	1,200	1,300	700	1,900	1,900	1,000	2,600
	% of all traffic	3%	3%	2%	4%	4%	3%	6%	6%	3%	8%

Table 9.13 Port Jersey connectors - potential enhanced mode split - daily volumes

Every mode split forecasts total and Port truck trips in the Blue Scenario to be lower than the Base Scenario, while the Green Scenario volumes are higher. This relationship does not change with an increased non-truck share. The number of trucks removed from the roadway is expected to be minimal. It should also be noted that for these connectors and Scenarios (except Port Jersey Boulevard where the entrance to the terminal is located), port trucks remain a small percentage of all traffic.

There is a large percent increase in total traffic volumes between 2000 and 2020, particularly on NJ 440. The majority of this growth is due to the proposed non-Port development of the Bayonne Peninsula. These non-Port uses are forecasted to produce up to 80,000 daily vehicle trips on area roadways at full build out.

Segment	Mode Split	2000	2020			2040			2060		
			Base	Blue	Green	Base	Blue	Green	Base	Blue	Green
NJ 440 @ Pulaski Street	Existing	0.96	2.94	2.87	3.02	3.15	3.03	3.26	3.35	3.19	3.50
	Enhanced			2.87	3.02		3.03	3.26		3.19	3.50
	Potential Enhanced			2.87	3.02		3.03	3.26		3.19	3.50
Port Jersey Blvd.	Existing	1.09	2.25	2.18	2.29	2.60	2.50	2.67	2.95	2.81	3.04
	Enhanced			2.18	2.29		2.50	2.67		2.81	3.04
	Potential Enhanced			2.18	2.29		2.49	2.66		2.80	3.03
Pulaski Street west of Port Jersey Blvd.	Existing	0.81	1.91	1.86	1.97	2.09	2.01	2.18	2.27	2.16	2.38
	Enhanced			1.86	1.97		2.01	2.18		2.15	2.38
	Potential Enhanced			1.86	1.97		2.01	2.18		2.15	2.38

Table 9.14 Port Jersey connectors - peak V/C ratios

The peak V/C value is forecast to increase from between 0.81 and 1.09 in 2000 to almost 2.00 (over capacity) or more in 2020 and beyond. Changes in mode split have little impact as the amount of port truck trips diverted is minimal. Congestion will remain high as a result of the Peninsula of Bayonne development which is expected to add a great deal of non-port traffic on the local roadway system. This is also true for all other scenarios. It should be noted that the above results are without the infrastructure improvements proposed within the Peninsula study. In general, it appears that large scale transportation improvements will be needed to provide acceptable conditions.

(iii) Bayonne Terminal Area

As with Port Jersey, the Green Scenario is expected to produce the heaviest volume of port trucks on Bayonne connectors and Blue Scenario the least.

Tables 9.15 through 9.17 show the forecasted total traffic and port truck traffic volumes for the Bayonne connectors for the Blue and Green Scenarios for each mode split option. The volumes for the other scenarios will fall in between these examples.

Segment	Volume	2000	2020			2040			2060		
			Base	Blue	Green	Base	Blue	Green	Base	Blue	Green
NJ 440 south of Prospect Avenue / Port Terminal Road	All Traffic	27,000	41,200	41,000	41,400	45,700	45,400	46,000	50,200	49,700	50,600
	Port Trucks	300	600	400	800	1,100	700	1,400	1,500	1,000	1,900
	% of all traffic	1%	2%	1%	2%	2%	2%	3%	3%	2%	4%
Port Terminal Road at NJ 440	All Traffic	1,100	72,000	70,700	73,300	72,700	70,700	74,600	73,400	70,800	76,000
	Port Trucks	100	1,400	100	2,700	2,100	100	4,000	2,800	200	5,400
	% of all traffic	8%	2%	0%	4%	3%	0%	5%	4%	0%	7%

Table 9.15 **Bayonne connectors– existing mode split - daily volumes**

Segment	Volume	2000	2020			2040			2060		
			Base	Blue	Green	Base	Blue	Green	Base	Blue	Green
NJ 440 south of Prospect Avenue / Port Terminal Road	All Traffic	27,000	41,200	41,000	41,400	45,700	45,400	46,000	50,200	49,700	50,600
	Port Trucks	300	600	400	800	1,100	700	1,400	1,500	1,000	1,900
	% of all traffic	1%	2%	1%	2%	2%	2%	3%	3%	2%	4%
Port Terminal Road at NJ 440	All Traffic	1,100	72,000	70,700	73,300	72,700	70,700	74,600	73,400	70,800	76,000
	Port Trucks	100	1,400	100	2,700	2,100	100	4,000	2,800	200	5,400
	% of all traffic	8%	2%	0%	4%	3%	0%	5%	4%	0%	7%

Table 9.16 **Bayonne connectors - enhanced mode split - daily volumes**

Segment	Volume	2000	2020			2040			2060		
			Base	Blue	Green	Base	Blue	Green	Base	Blue	Green
NJ 440 south of Prospect Avenue / Port Terminal Road	All Traffic	27,000	41,200	41,000	41,400	45,700	45,400	46,000	50,200	49,700	50,600
	Port Trucks	300	600	400	800	1,100	700	1,400	1,500	1,000	1,900
	% of all traffic	1%	2%	1%	2%	2%	2%	3%	3%	2%	4%
Port Terminal Road at NJ 440	All Traffic	1,100	72,000	70,700	73,300	72,700	70,700	74,600	73,400	70,800	76,000
	Port Trucks	100	1,400	100	2,700	2,100	100	4,000	2,800	200	5,400
	% of all traffic	8%	2%	0%	4%	3%	0%	5%	4%	0%	7%

Table 9.17 **Bayonne Connectors - potential enhanced mode split - daily volumes**

Table 9.15 through 9.17 show significant increases in overall traffic by 2020, particularly on Port Terminal Road, as a result of the planned construction of the non-port uses at the Bayonne Peninsula. This traffic growth is expected to slow from 2020 through 2060 given the assumption that the proposed development is complete by 2020.

There is little difference in volumes between the mode split options. Blue and Green Scenario port truck changes on NJ 440 are primarily a result of changes in port truck production from the Port Jersey terminal.

Table 9.18 displays the V/C ratios based on the above traffic data. With the small percentage of port truck traffic expected on these links, the port truck volumes are not expected to change the congestion appreciably.

Segment	Mode Split	2000	2020			2040			2060		
			Base	Blue	Green	Base	Blue	Green	Base	Blue	Green
NJ 440 south of Prospect Avenue / Port Terminal Road	Existing	0.86	1.29	1.28	1.31	1.45	1.43	1.48	1.61	1.58	1.64
	Enhanced			1.28	1.31		1.43	1.48		1.58	1.64
	Potential Enhanced			1.28	1.31		1.43	1.47		1.58	1.63
Port Terminal Road at NJ 440	Existing	0.08	4.70	4.50	4.90	4.81	4.51	5.11	4.92	4.51	5.32
	Enhanced			4.50	4.90		4.51	5.11		4.51	5.32
	Potential Enhanced			4.50	4.90		4.51	5.11		4.51	5.32

Table 9.18 **Bayonne connectors - peak V/C ratios**

NJ 440 south of the main entrance is currently near capacity. With the development of Bayonne (and resulting increased through-traffic) and Port Jersey traffic, this roadway is projected to be over capacity by 2020. There are only minor differences between scenarios and mode split options.

Port Terminal Road currently operates below capacity with very little traffic generated at the site, however with the addition of the expected increase in trips from the Bayonne development and increased port usage, the ratios are forecast to be well over capacity by 2020. Port Terminal Road provides the main access into this development from NJ 440, and this analysis assumes no improvements at the entrance. There is no appreciable change in congestion between mode split options. As with the Port Jersey links, transportation improvements are necessary as a result of the Peninsula development.

(iv) Howland Hook Port Area

The Orange Scenario is expected to produce the greatest number of port trucks on port area roadways. The Red Scenario is forecast to have the fewest port truck trips.

Tables 9.19 through 9.21 show the forecasted total traffic and port truck traffic volumes for the Howland Hook connectors for the Red and Orange Scenarios. The volumes for the other scenarios will fall between these two.

Segment	Volume	2000	2020			2040			2060		
			Base	Red	Orange	Base	Red	Orange	Base	Red	Orange
Gulf Avenue east of I-278 ramp	All Traffic	2,200	2,700	2,600	2,700	3,100	3,100	3,200	3,600	3,500	3,700
	Port Trucks	600	700	700	800	1,100	1,100	1,200	1,500	1,500	1,600
	% of all traffic	28%	26%	26%	28%	36%	35%	37%	42%	41%	44%
Gulf Avenue west of I-278 ramp	All Traffic	4,700	5,700	5,600	5,800	6,400	6,300	6,500	7,100	7,000	7,300
	Port Trucks	900	1,100	1,000	1,200	1,700	1,600	1,800	2,300	2,200	2,500
	% of all traffic	20%	19%	18%	20%	26%	25%	28%	32%	31%	34%
Goethals Road east of I-278 ramp	All Traffic	2,300	2,800	2,800	2,800	3,300	3,200	3,300	3,700	3,700	3,800
	Port Trucks	600	700	700	800	1,100	1,100	1,200	1,500	1,500	1,600
	% of all traffic	27%	25%	24%	27%	34%	33%	36%	41%	40%	43%
Goethals Road west of I-278 ramp	All Traffic	4,500	5,500	5,400	5,600	6,200	6,100	6,300	6,900	6,800	7,000
	Port Trucks	900	1,100	1,000	1,200	1,700	1,600	1,800	2,300	2,200	2,500
	% of all traffic	21%	20%	19%	21%	27%	26%	29%	34%	33%	35%

Table 9.19 Howland Hook connectors – existing mode split - daily volumes

Segment	Volume	2000	2020			2040			2060		
			Base	Red	Orange	Base	Red	Orange	Base	Red	Orange
Gulf Avenue east of I-278 ramp	All Traffic	2,200	2,700	2,600	2,700	3,100	3,100	3,200	3,600	3,500	3,700
	Port Trucks	600	700	700	800	1,100	1,100	1,200	1,500	1,500	1,600
	% of all traffic	28%	26%	25%	28%	36%	34%	37%	42%	41%	44%
Gulf Avenue west of I-278 ramp	All Traffic	4,700	5,700	5,600	5,800	6,400	6,300	6,500	7,100	7,000	7,300
	Port Trucks	900	1,100	1,000	1,200	1,700	1,600	1,800	2,300	2,200	2,500
	% of all traffic	20%	19%	18%	20%	26%	25%	27%	32%	31%	34%
Goethals Road east of I-278 ramp	All Traffic	2,300	2,800	2,800	2,800	3,300	3,200	3,300	3,700	3,600	3,800
	Port Trucks	600	700	700	800	1,100	1,100	1,200	1,500	1,500	1,600
	% of all traffic	27%	25%	24%	26%	34%	33%	35%	41%	39%	42%
Goethals Road west of I-278 ramp	All Traffic	4,500	5,500	5,400	5,500	6,200	6,100	6,300	6,900	6,700	7,000
	Port Trucks	900	1,100	1,000	1,200	1,700	1,600	1,800	2,300	2,200	2,500
	% of all traffic	21%	20%	19%	21%	27%	26%	28%	34%	32%	35%

Table 9.20 **Howland Hook connectors - enhanced mode split - daily volumes**

Segment	Volume	2000	2020			2040			2060		
			Base	Red	Orange	Base	Red	Orange	Base	Red	Orange
Gulf Avenue east of I-278 ramp	All Traffic	2,200	2,700	2,600	2,700	3,100	3,100	3,200	3,600	3,500	3,600
	Port Trucks	600	700	700	700	1,100	1,000	1,100	1,500	1,400	1,600
	% of all traffic	28%	26%	25%	27%	36%	34%	36%	42%	41%	43%
Gulf Avenue west of I-278 ramp	All Traffic	4,700	5,700	5,600	5,700	6,400	6,300	6,500	7,100	7,000	7,200
	Port Trucks	900	1,100	1,000	1,100	1,700	1,600	1,700	2,300	2,200	2,400
	% of all traffic	20%	19%	18%	19%	26%	25%	27%	32%	31%	33%
Goethals Road east of I-278 ramp	All Traffic	2,300	2,800	2,700	2,800	3,300	3,200	3,300	3,700	3,600	3,800
	Port Trucks	600	700	700	700	1,100	1,000	1,100	1,500	1,400	1,600
	% of all traffic	27%	25%	24%	26%	34%	33%	35%	41%	39%	41%
Goethals Road west of I-278 ramp	All Traffic	4,500	5,500	5,400	5,500	6,200	6,100	6,200	6,900	6,700	6,900
	Port Trucks	900	1,100	1,000	1,100	1,700	1,600	1,700	2,300	2,200	2,400
	% of all traffic	21%	20%	18%	20%	27%	26%	28%	34%	32%	34%

Table 9.21 Howland Hook connectors - potential enhanced mode split - daily volumes

Howland Hook area traffic is expected to grow at a relatively steady rate from 2000 through 2060. Port truck volumes comprise a significant percentage of the total traffic volumes. There is little difference between scenarios.

Table 9.22 shows the V/C ratios based on the above traffic data.

Segment	Mode Split	2000	2020			2040			2060		
			Base	Red	Orange	Base	Red	Orange	Base	Red	Orange
Gulf Avenue east of I-278 ramp	Existing	0.19	0.22	0.22	0.23	0.29	0.28	0.30	0.35	0.34	0.37
	Enhanced			0.22	0.23		0.28	0.30		0.34	0.36
	Potential Enhanced			0.22	0.23		0.28	0.29		0.33	0.35
Gulf Avenue west of I-278 ramp	Existing	0.36	0.43	0.43	0.45	0.53	0.52	0.55	0.63	0.61	0.65
	Enhanced			0.43	0.44		0.52	0.55		0.61	0.65
	Potential Enhanced			0.42	0.44		0.52	0.54		0.61	0.64
Goethals Road east of I-278 ramp	Existing	0.19	0.23	0.23	0.24	0.30	0.29	0.31	0.36	0.35	0.37
	Enhanced			0.23	0.24		0.29	0.31		0.34	0.37
	Potential Enhanced			0.22	0.23		0.28	0.30		0.34	0.36
Goethals Road west of I-278 ramp	Existing	0.35	0.42	0.42	0.44	0.52	0.51	0.54	0.61	0.60	0.64
	Enhanced			0.41	0.43		0.50	0.53		0.59	0.63
	Potential Enhanced			0.41	0.43		0.50	0.53		0.59	0.62

Table 9.22 Howland Hook connectors – peak V/C ratios

Current and projected congestion is expected to be well below capacity. Minor improvements in ratios are seen with increasing non-truck share for all scenarios. Highway capacity improvements are not expected to be needed at this port terminal.

(v) Red Hook Port Area

The Green Scenario is expected to produce the greatest number of port trucks. There are no port truck trips in the Blue Scenario as a result of the proposal to close the terminal in that Scenario.

Tables 9.23 through 9.25 show the forecasted total traffic and port truck traffic volumes for the Red Hook connectors for the Blue and Green Scenarios. Traffic volumes for the other Scenarios will fall in between these two extremes.

Segment	Volume	2000	2020			2040			2060		
			Base	Blue	Green	Base	Blue	Green	Base	Blue	Green
Columbia Street (S. of BQE Ramp)	All Traffic	11,500	14,100	13,800	14,100	16,100	15,700	16,100	18,100	17,600	18,100
	Port Trucks	300	300	-	300	400	-	400	500	-	500
	% of all traffic	2%	2%	0%	2%	2%	0%	3%	3%	0%	3%
Columbia Street (N. of BQE Ramp)	All Traffic	13,200	16,100	16,000	16,100	18,300	18,200	18,300	20,400	20,300	20,400
	Port Trucks	70	80	-	80	110	-	110	140	-	140
	% of all traffic	1%	0%	0%	1%	1%	0%	1%	1%	0%	1%
Hamilton Avenue (WB)	All Traffic	4,400	5,300	5,200	5,300	6,000	5,800	6,100	6,800	6,500	6,800
	Port Trucks	200	200	-	200	200	-	200	300	-	300
	% of all traffic	3%	3%	0%	3%	4%	0%	4%	4%	0%	4%
Hamilton Avenue (EB)	All Traffic	6,600	8,100	7,900	8,100	9,200	8,900	9,200	10,300	9,900	10,300
	Port Trucks	200	200	-	200	300	-	300	400	-	400
	% of all traffic	3%	3%	0%	3%	3%	0%	3%	3%	0%	4%

Table 9.23 Red Hook connectors - existing mode split - daily volumes

Segment	Volume	2000	2020			2040			2060		
			Base	Blue	Green	Base	Blue	Green	Base	Blue	Green
Columbia Street (S. of BQE Ramp)	All Traffic	11,500	14,100	13,800	14,100	16,100	15,700	16,100	18,100	17,600	18,100
	Port Trucks	300	300	-	300	400	-	400	500	-	500
	% of all traffic	2%	2%	0%	2%	2%	0%	3%	3%	0%	3%
Columbia Street (N. of BQE Ramp)	All Traffic	13,200	16,100	16,000	16,100	18,300	18,200	18,300	20,400	20,300	20,400
	Port Trucks	70	80	-	80	110	-	110	130	-	140
	% of all traffic	1%	0%	0%	1%	1%	0%	1%	1%	0%	1%
Hamilton Avenue (WB)	All Traffic	4,300	5,300	5,200	5,300	6,000	5,800	6,100	6,800	6,500	6,800
	Port Trucks	150	160	-	170	220	-	240	280	-	300
	% of all traffic	3%	3%	0%	3%	4%	0%	4%	4%	0%	4%
Hamilton Avenue (EB)	All Traffic	6,600	8,100	7,900	8,100	9,200	8,900	9,200	10,300	9,900	10,300
	Port Trucks	190	210	-	220	280	-	300	360	-	380
	% of all traffic	3%	3%	0%	3%	3%	0%	3%	3%	0%	4%

Table 9.24 Red Hook connectors - enhanced mode split - daily volumes

Segment	Volume	2000	2020			2040			2060		
			Base	Blue	Green	Base	Blue	Green	Base	Blue	Green
Columbia Street (S. of BQE Ramp)	All Traffic	11,500	14,100	13,800	14,100	16,100	15,700	16,100	18,100	17,600	18,100
	Port Trucks	300	300	-	300	400	-	400	500	-	500
	% of all traffic	2%	2%	0%	2%	2%	0%	3%	3%	0%	3%
Columbia Street (N. of BQE Ramp)	All Traffic	13,200	16,100	16,000	16,100	18,300	18,200	18,300	20,400	20,300	20,400
	Port Trucks	70	80	-	80	110	-	110	140	-	140
	% of all traffic	1%	0%	0%	1%	1%	0%	1%	1%	0%	1%
Hamilton Avenue (WB)	All Traffic	4,300	5,300	5,200	5,300	6,000	5,800	6,100	6,800	6,500	6,800
	Port Trucks	150	160	-	170	220	-	240	280	-	300
	% of all traffic	3%	3%	0%	3%	4%	0%	4%	4%	0%	4%
Hamilton Avenue (EB)	All Traffic	6,600	8,100	7,900	8,100	9,200	8,900	9,200	10,300	9,900	10,300
	Port Trucks	190	210	-	220	280	-	300	360	-	380
	% of all traffic	3%	3%	0%	3%	3%	0%	3%	3%	0%	4%

Table 9.25 **Red Hook connectors - potential enhanced mode split - daily volumes**

The Green Scenario volumes only show a slight increase from the Baseline and there is no change between mode split options as a result of poor rail access. At this location, port truck volumes comprise a relatively small percentage of total traffic.

Table 9.26 shows the V/C ratios based on the above traffic data.

Segment	Mode Split	2000	2020			2040			2060		
			Base	Blue	Green	Base	Blue	Green	Base	Blue	Green
Columbia Street (S. of BQE Ramp)	Existing	0.77	0.95	0.91	0.96	1.09	1.03	1.10	1.22	1.15	1.23
	Enhanced			0.91	0.96		1.03	1.10		1.15	1.23
	Potential Enhanced			0.91	0.96		1.03	1.10		1.15	1.23
Columbia Street (N. of BQE Ramp)	Existing	0.57	0.70	0.69	0.70	0.80	0.78	0.80	0.89	0.87	0.89
	Enhanced			0.69	0.70		0.78	0.80		0.87	0.89
	Potential Enhanced			0.69	0.70		0.78	0.80		0.87	0.89
Hamilton Avenue (WB)	Existing	0.35	0.43	0.40	0.43	0.49	0.46	0.50	0.55	0.51	0.56
	Enhanced			0.40	0.43		0.46	0.50		0.51	0.56
	Potential Enhanced			0.40	0.43		0.46	0.50		0.51	0.56
Hamilton Avenue (EB)	Existing	0.33	0.41	0.39	0.41	0.47	0.44	0.47	0.52	0.49	0.53
	Enhanced			0.39	0.41		0.44	0.47		0.49	0.53
	Potential Enhanced			0.39	0.41		0.44	0.47		0.49	0.53

Table 9.26 Red Hook connectors – peak V/C ratios

As a result of limited rail access, no freight is diverted to rail and therefore the volumes and V/C ratios are the same for all mode split options.

All current and projected congestion levels on the Hamilton Avenue connectors are expected to remain below capacity. Columbia Street south of the BQE ramp is forecast to be at capacity by 2020 in the Base Scenario. The Blue Scenario results in Columbia Street congestion levels near capacity in 2020 and by 2040 is expected to be over capacity. Columbia Street north of the BQE ramp in 2060 will remain near capacity regardless of which Scenario is chosen.

(vi) South Brooklyn Port Area

The Blue Scenario is expected to produce the greatest volume of port trucks while the Green Scenario is forecast to generate the fewest port trucks. The various mode split options are expected to divert some port truck traffic to other modes for the Blue, Orange, and Red Scenarios, but will not change volumes for the Green and Yellow.

Tables 9.27 through 9.29 show the forecasted total traffic and port truck traffic for the South Brooklyn roadway links for the Green and Blue Scenarios. The volumes for the other Scenarios will fall in between these two extremes.

Segment	Volume	2000	2020			2040			2060		
			Base	Green	Blue	Base	Green	Blue	Base	Green	Blue
39th Street (West of 2nd Street)	All Traffic	1,800	2,100	2,100	2,600	2,400	2,400	3,100	2,700	2,700	3,600
	Port Trucks	-	160	120	630	190	140	860	220	160	1,100
	% of all traffic	0%	8%	6%	24%	8%	6%	28%	8%	6%	30%
2nd Avenue (N. of Gowanus Ramp)	All Traffic	5,400	6,500	6,400	6,900	7,400	7,300	8,000	8,200	8,200	9,100
	Port Trucks	-	160	120	630	190	140	860	220	160	1,100
	% of all traffic	0%	2%	2%	9%	3%	2%	11%	3%	2%	12%
2nd Avenue (S. of Gowanus Ramp)	All Traffic	6,500	7,900	7,900	8,000	8,900	8,900	9,100	10,000	10,000	10,200
	Port Trucks	-	40	30	160	50	40	220	60	40	280
	% of all traffic	0%	1%	0%	2%	1%	0%	2%	1%	0%	3%

Table 9.27 South Brooklyn connectors - existing mode split - daily volumes

Segment	Volume	2000	2020			2040			2060		
			Base	Green	Blue	Base	Green	Blue	Base	Green	Blue
39th Street (West of 2nd Street)	All Traffic	1,800	2,100	2,100	2,600	2,400	2,400	3,100	2,700	2,700	3,600
	Port Trucks	-	160	120	630	190	140	860	220	160	1,100
	% of all traffic	0%	8%	6%	24%	8%	6%	28%	8%	6%	30%
2nd Avenue (N. of Gowanus Ramp)	All Traffic	5,400	6,500	6,400	6,900	7,400	7,300	8,000	8,200	8,200	9,100
	Port Trucks	-	160	120	630	190	140	860	220	160	1,100
	% of all traffic	0%	2%	2%	9%	3%	2%	11%	3%	2%	12%
2nd Avenue (S. of Gowanus Ramp)	All Traffic	6,500	7,900	7,900	8,000	8,900	8,900	9,100	10,000	10,000	10,200
	Port Trucks	-	40	30	160	50	40	220	60	40	280
	% of all traffic	0%	1%	0%	2%	1%	0%	2%	1%	0%	3%

Table 9.28 South Brooklyn Connectors - enhanced mode split - daily volumes

Segment	Volume	2000	2020			2040			2060		
			Base	Green	Blue	Base	Green	Blue	Base	Green	Blue
39th Street (West of 2nd Street)	All Traffic	1,800	2,100	2,100	2,600	2,400	2,400	3,100	2,700	2,700	3,600
	Port Trucks	-	160	120	630	190	140	860	220	160	1,100
	% of all traffic	0%	8%	6%	24%	8%	6%	28%	8%	6%	30%
2nd Avenue (N. of Gowanus Ramp)	All Traffic	5,400	6,500	6,400	6,900	7,400	7,300	8,000	8,200	8,200	9,100
	Port Trucks	-	160	120	630	190	140	860	220	160	1,100
	% of all traffic	0%	2%	2%	9%	3%	2%	11%	3%	2%	12%
2nd Avenue (S. of Gowanus Ramp)	All Traffic	6,500	7,900	7,900	8,000	8,900	8,900	9,100	10,000	10,000	10,200
	Port Trucks	-	40	30	160	50	40	220	60	40	280
	% of all traffic	0%	1%	0%	2%	1%	0%	2%	1%	0%	3%

Table 9.29 **South Brooklyn connectors - potential enhanced mode split - daily volumes**

South Brooklyn is not currently operating and therefore there are no port truck trips shown for 2000. The Green Scenario shows little port truck traffic, reflecting the low level of activity at this site. The Blue Scenario shows port truck trips being a relatively large percentage of total traffic (24 percent in 2020). It makes little difference in traffic whichever mode split option is adopted as rail is not conveniently situated for this area.

Table 9.30 shows the V/C ratios based on the above traffic data.

Segment	Mode Split	2000	2020			2040			2060		
			Base	Green	Blue	Base	Green	Blue	Base	Green - F	Blue - F
39th Street (West of 2nd Street)	Existing	0.14	0.18	0.18	0.25	0.21	0.21	0.31	0.24	0.23	0.37
	Enhanced			0.18	0.25		0.21	0.31		0.23	0.36
	Potential Enhanced			0.18	0.25		0.21	0.31		0.23	0.36
2nd Avenue (N. of Gowanus Ramp)	Existing	0.36	0.45	0.45	0.53	0.52	0.51	0.62	0.58	0.57	0.71
	Enhanced			0.45	0.52		0.51	0.62		0.57	0.71
	Potential Enhanced			0.45	0.52		0.51	0.61		0.57	0.70
2nd Avenue (S. of Gowanus Ramp)	Existing	0.46	0.55	0.55	0.57	0.63	0.63	0.66	0.70	0.70	0.74
	Enhanced			0.55	0.57		0.63	0.66		0.70	0.74
	Potential Enhanced			0.55	0.57		0.63	0.66		0.70	0.74

Table 9.30 **South Brooklyn connectors - peak V/C ratios**

V/C ratios for the Blue Scenario are much higher than for the Green or Baseline Scenarios, reflecting a much higher level of activity at the terminal. Some reduction of congestion is obtained by non-truck mode increases in the Blue Scenario although this improvement is minor. 39th Street and 2nd Avenue are expected to operate below capacity throughout the study period.

(c) Major Findings

The physical and traffic characteristics of Port area connector roadways vary greatly between the different terminals. For example, at some locations port trucks comprise a large percentage of total traffic volumes, but at others they are only a small component. However, with few exceptions, there is only a minor difference in levels of congestion between Scenarios and between mode split options on the connector roadways.

(i) Port Newark/Elizabeth Terminal Area

Transfer of cargo to non-truck modes reduces connector truck volumes and congestion in all of the Scenarios. By 2040 congestion on most connectors is expected to be extreme.

(ii) Port Jersey Terminal Area

The Port Jersey connector roadways work in conjunction with those at Bayonne due to their close proximity. In addition to the Port uses at Port Jersey and Bayonne Peninsula, a large amount of commercial and residential development is proposed at the Peninsula development at Bayonne. If developed by 2020, congestion on all three connector roadways is expected to increase substantially, as reflected in the V/C ratios being near or over 2.00. The Green Scenario is forecast to produce the heaviest port truck volumes on these roadways, with the Blue Scenario providing the least. Little difference in truck trip volumes is expected as a result of mode split options.

It should be noted that port truck trips are a relatively small percentage of total trips on the area roadways, so changes in port truck trips will have smaller impacts on operations than at other sites. With V/C ratios in the 2.00 to 3.00+ range, improvements would be necessary for port traffic to adequately access this terminal.

(iii) Bayonne Terminal Area

As with Port Jersey, port truck trips comprise only a small percentage of total vehicle traffic on these links.

Congestion is expected to reach extreme levels in 2020 and beyond due to the large forecasted growth in traffic from development on the Peninsula. While port truck trips are only a small percentage of this traffic, transportation improvements will be necessary to allow port traffic to access the terminals.

(iv) Howland Hook Terminal Area

The Mode Split options reduce the number of port truck trips for all of the scenarios. Port trucks at this site comprise a relatively large percentage of the total traffic on the connector roadways studied, which are expected to remain under capacity through 2060.

(v) Red Hook Terminal Area

As a result of its lack of connectivity to the rail system the mode split options are not expected to have an impact on trip production from Red Hook.

All current and projected V/C ratios on the Hamilton Avenue links are shown as being below capacity. Columbia Street south of the BQE ramp is shown to be at Capacity by 2020 in the Baseline Scenario. The Blue Scenario reduces the level of congestion to Near Capacity. In 2040 and 2060, this connector is shown to be Over Capacity in all cases, with some operational improvement shown for the Blue Scenario. Columbia Street north of the BQE ramp is shown to be Near Capacity for all scenarios in 2060. If this site is operational (Scenarios other than Blue), some improvements may be needed for Columbia Street for port trucks to be able to easily access the terminal in future years.

(vi) South Brooklyn Terminal Area

The Blue Scenario will produce the greatest number of port trucks as compared to the other options, with trucks comprising a large percentage of total traffic volumes on 39th Street. The Mode Split options will divert some port truck traffic for the Blue, Orange, and Red Scenarios, but will not change volumes for the Green and Yellow Scenarios.

The level of congestion for the Blue Scenario is higher than for the Green or Baseline Scenarios, reflecting a higher level of activity at the terminal. The Blue Scenario does show very minor improvements in congestion with the increases in rail freight percentage. 39th Street and 2nd Avenue are expected to be Below Capacity, even out to 2060.

9.6 *Highway Improvements*

9.6.1 *General*

Highway improvements will be required across the highway network to reduce the delays and inconvenience of increasing volumes of traffic over the study period. However, most of the improvements will result from general background growth in traffic volumes (baseline growth) and from other development initiatives unrelated to the Port (e.g. Peninsula Project at Bayonne). Thresholds were therefore set to define whether traffic conditions were Port-related and also whether they result from cargo terminal proposals made in this Study.

In order to be considered as Port-related, an improvement requires to be on a segment of roadway on which at least ten percent of the traffic is Port-related. Using this criterion, and the output from the highway analysis, the following roads were selected:

Newark/Elizabeth: Doremus Avenue, Port Street, Corbin Street, McLester Street, North Avenue.

Port Jersey/Bayonne: Port Jersey Boulevard.

Howland Hook: Gulf Avenue, Goethals Road.

S Brooklyn: 39th Street.

In order for the need for improvement of any of the above roadways to be considered there has to be:

- An increase in traffic volume in the roadway segment of at least 5% over baseline growth values, or

- An increase in V/C ratio in the roadway segment of at least 2% over baseline growth values

In addition, any roadway seen as critical to the Port due to its strategic value was considered for improvement. On this basis the following roadways were identified:

Port Jersey/Bayonne: NJ 440 at Pulaski Street.

Red Hook: Columbia Street, Hamilton Avenue.

S Brooklyn: 2nd Avenue.

In assessing the above thresholds the existing roadway conditions were assumed as defined in the methodology described in Section 9.3. However, for the assessment of additional infrastructure, the existing roadway conditions were assumed to include:

- Port Authority/TIP projects
- Peninsula[92] projects

The need for improvements was assessed for the years 2020 and 2060. It should be noted that the improvements, although given in a relatively high degree of detail, are based on conceptual and preliminary analysis and evaluations. If actual construction is being planned it should be based on a more detailed analysis and evaluation.

Typical improvements, as derived from the Analysis of Task F Scenarios (i.e. before minor adjustment of the Scenarios), are illustrated in Chapter 6 of the Task F Technical Memorandum, Volume 2, Highways and briefly described in the following.

9.6.2 Improvements

Roadway segment improvements for 2020 were assumed to be necessary if a roadway peak hour V/C for a Scenario was 'near capacity' (0.86) or greater and for 2060 if V/C for a Scenario was 'at capacity' (0.96) or greater. Improvements comprised provision of additional lanes which can reasonably be accommodated without major disruption of adjacent facilities.

Signalized intersection improvements were triggered by the same criteria for V/C as given above. Improvements comprised either adjustment of signal operation or provision of additional turn lanes by local widening which can reasonably be accommodated without major disruption of adjacent facilities.

In no case did the proposed improvements exceed the improvement required under baseline growth conditions by more than an additional turn lane, even to the 2060 date and no major improvements such as grade separated interchanges were required. By inspection it was concluded that nothing significantly greater than the improvements illustrated in Task F would be required at any of the Port sites to handle the traffic generated by the current, adjusted, Scenarios.

[92] *"The Peninsula at Bayonne Harbor: Local Roadway Connector Study, Final Report",* City of Bayonne, June 30, 2003

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10 Rail Improvements

10.1 *Introduction*

This Chapter describes the work undertaken to arrive at the current and planned capacity of the regional rail transportation network and to identify effects on the rail infrastructure of port improvement options.

Section 10.2 introduces the rail infrastructure in the port terminals, adjacent to the port and further away into the port's hinterland. Section 10.3 describes the methods adopted to calculate rail infrastructure capacity and is followed in Section 10.4 by a description of rail demand and how the growth is allocated across the network. Section 10.5 introduces the analyses undertaken and the capacity results obtained. Rail infrastructure improvements to address capacity constraints are given in Section 10.6.

As for the highway analyses, the rail analyses were completed for the Scenarios developed in Task F. Adjustments to the original five scenarios were made in response to comments received from the CPIP Consortium and Stakeholders and in this process the original Green Scenario was deleted from further consideration. The text that follows summarizes the analyses for the Task F Scenarios including the Green Scenario. However, given the similarity of the rail traffic across all analyzed scenarios and the fundamental assumptions regarding development phasing adopted, it was not appropriate or necessary to rerun the rail modeling for the adjusted Task G scenarios.

10.2 *Rail Infrastructure*

10.2.1 *Introduction*

There is an extensive network of rail lines, yards and terminals around the Port. The rail freight infrastructure is divided by the Hudson River and services on the West-of-Hudson infrastructure have traditionally been superior to those on the east. Overall the freight system is constrained by clearances, weight restrictions, conflicts with passenger services and capacity pinch-points. A number of freight railroad companies serve the area:

- CSX Transportation;

- Norfolk Southern Railway;
- Consolidated Rail Corporation (Conrail);
- Canadian Pacific Railway;
- New York short lines;
- New Jersey short lines.

Conrail was created in 1976 by the Federal Government to take over the assets of various railroads serving the New York/New Jersey area that had fallen into bankruptcy. It was agreed in 1997, that CSX and Norfolk Southern would take over the assets on Conrail and create the Shared Assets Area allowing competition for access to the terminals and yards in the Port. Figure 10.1 shows the major rail freight facilities in the port area.

For the purposes of this study rail infrastructure serving the port has been split into five components:

- On dock terminals;
- Railroad yards;
- Railroad terminals;
- Conrail Shared Assets system;
- The wider railroad system.

10.2.2 *On Dock Rail Terminals*

There are several on dock rail terminals. Some of these are already well established, and in the course of further development and expansion. Others are in the process of being developed as new terminals to complement and add to existing capability. Still more are proposed in the cargo terminal Options. The established, developing and proposed terminals are summarized below:

(a) An expanded rail container yard serving two container terminals at Port

Elizabeth in New Jersey; ExpressRail II, is being developed. The ExpressRail terminal facility at Port Elizabeth is already well established and successful. Development work to create ExpressRail II provides enhanced capacity and improved rail access, including the creation of dedicated train building tracks away from the terminal. This relieves pressure on the Chemical Coast line, which has been used for train building to the detriment of rail service capacity and performance.

(b) Container and/or automotive terminals at Port Newark South in New Jersey, with a direct link to the rail container yard at the site of the existing Port Newark Container Terminal. The existing PNCT rail terminal is a relatively small facility with two loading tracks. The site has to be accessed by crossing Corbin Street, the principal highway access to the Port Newark and Port Elizabeth areas. Current plans include an expansion of the number of rail loading tracks, and a bridge from Port Newark to the rail terminal to avoid crossing Corbin Street at grade.

(c) Automotive facilities are being developed along with dry and liquid bulk terminals at Port Newark North in New Jersey, all with the capability to be rail served. Currently envisaged development options are capable of being rail connected and are expected to be sufficient to meet future demand for rail transfer.

(d) An on dock rail terminal serving Howland Hook container terminal on Staten Island, New York is planned. This site did not previously have a rail container terminal. The new development will include handling tracks, a new yard for the arrival and departure of trains at the former Arlington Yard site, and a northbound connection to the Chemical Coast line via the former Staten Island Railroad alignment. Formerly the SIRR was carried on a bridge over the Chemical Coast line making no connection to it. A second, southbound, connection to the Chemical Coast line has been proposed in the longer term.

(a) A rail terminal serving South Brooklyn, New York has been considered. There is no rail container terminal currently at South Brooklyn and a number of cargo options have been considered for this location. Bulk and general merchandise traffic will require little change to the rail infrastructure. A container terminal would require the construction of dedicated tracks and a handling area. To be successful, it is also dependent on the construction of the proposed cross-harbor rail tunnel.

(e) A rail terminal at Port Jersey serving container and automobile terminals at Port Jersey and on the Bayonne Peninsula has been considered. Port Jersey is currently occupied by container and automotive facilities, neither of which is directly rail connected. Tracks already existing are largely used for car storage by Port Jersey RR. Rail access is complicated by the existing layout and could be improved in future by creating a straighter access track. This would involve running through an area currently occupied by a warehouse, but would make terminal rail access faster and more cost-effective.

(f) North Brooklyn improvement options are not rail-connected.

10.2.3 *Railroad Terminals*

Railroad terminals are commercial rail terminals for the origination, receipt and modal transfer of rail traffic. They may encompass any or all of the traffics handled by the on dock terminals and in some cases traffic may be drayed by truck from maritime terminals to an appropriate railroad owned terminal for its onward journey by rail. Much of the traffic handled may, however, be just as likely to have originated in the area around the port, using a terminal that is in close proximity to the port as a convenient transfer point for what is in effect domestic traffic. Some of these terminals may also have warehousing or other complementary freight activity usually operated by a commercial partner, customer or sub-contractor. Some of these terminals may be located within the footprint of larger railroad yards.

Railroad terminals are listed in Appendix C.

10.2.4 *Railroad Yards*

Railroad yards are principally operational facilities for the building and breaking down of trains and traffic blocks, and the interchange of individual freight cars and blocks between trains. At some yards interchange will be taking place between the trains of different railroads. Some of these yards may specialize in handling certain types of traffic, or traffic associated with specific groups of origins and destinations. The way in which these yards are used can vary with traffic patterns both seasonally and in the longer term.

Key railroad yards serving the port area directly include:

(a) Oak Island, NJ. This Conrail yard is the closest to the New Jersey terminals and acts as a yard for traffic interchanging with Conrail, for local distribution, as well as providing access to Canadian Pacific's (CP) terminal on this site.

(b) Kearny, NJ. This is a CSX yard in North Jersey servicing the whole of this area.

(c) Croxton, NJ. This is Norfolk Southern's North Jersey Yard and is the origin and destination yard for traffic along the Southern Tier route to Buffalo.

(d) Fresh Pond, NY. This yard is operated by New York and Atlantic Railway and is an interchange point for CSX and Canadian Pacific traffic on to that system.

(e) 65th Street Brooklyn, NY. This yard is the origin and destination point for South Brooklyn traffic via the New York & Atlantic Railway. It also connects to the existing port-side rail infrastructure in South Brooklyn.

Other yards do exist and principally service interchange with industrial or commercial facilities and short lines. A good example of this would be Bayway on the Chemical Coast, which services the local chemical industry and interchanges with the switching operations of the Morristown & Erie railroad. These other yards are summarized in Appendix D.

10.2.5 Conrail Shared Assets System

The Conrail Shared Assets organization was created following the takeover of the former Consolidated Rail Corporation by CSX and Norfolk Southern (NS). The residual Conrail Shared Assets infrastructure comprises those segments of railway that it was determined could not be divided between the new owners. Conrail Shared Assets thus provides CSX and NS with equitable access to terminals and yards in its area. It covers freight rail infrastructure in New Jersey and elsewhere, though it is the New Jersey system that is of interest in this study.

10.2.6 The Wider Railroad System

This report also covers the wider system in an area bounded by Washington DC and Roanoke VA to the south, Conway, PA and Buffalo, NY to the west, the Canadian border to the north and Boston to the east. Most of this system is operated by three Class 1 railroads. CSX and Norfolk Southern have the majority of track mileage and

Canadian Pacific run north across the border to Montreal, using Norfolk Southern to gain access to North Jersey, through trackage rights agreements. CP trackage rights also exist with CSX to New York via the Hudson Line. CSX and Norfolk Southern operate broadly comparable territories, though Norfolk Southern does not have a direct access to New England markets. In some areas regionals and short lines provide connections to local markets, and can act as catalysts for the generation of traffic to the Class 1 systems. The Providence & Worcester Railroad is one such railroad serving New England and running traffic to New Jersey with CSX and New York through trackage rights over Amtrak.

10.2.7 *Corridors and Segments*

Not all of the rail infrastructure in the region is used by freight railroads servicing the Port, for example many lines are for passenger only services. For this study, the wider freight rail network was split into corridors along which most of the rail services to the Port traveled. Corridors are specific to individual railroads. A segment is a length of track/line along a corridor.

Conrail Shared Assets Area

This area was divided into key segments capable of servicing Port rail traffic. Other segments on former alignments, but now regarded by the rail industry as less suitable were not included. For example, a short link exists between Elizabeth Port and the Conrail/NJ Transit at Cranford that in principle might be used by trains leaving the Port. However, the yard on that segment is itself a bottleneck in its present form and the link on Shared Assets at Cranford puts freight into immediate competition for space with NJ Transit from that point on and requires clearances to be provided under Amtrak's Northeast Corridor at Elizabeth. Similarly the Staten Island Railroad will be reconnected not via the original Central New Jersey alignment but on to the Chemical Coast to more easily gain suitable freight routes. Shared Assets corridor segments are shown in Figure 10.2

Segments examined are as follows:

(a) Chemical Coast Terminals – Oak Island

This segment provides the access for CSX and NS via Oak Island, from where they can ultimately run south via the Lehigh Line, or north via CSX River Line or NS

Southern Tier. In recent times this segment has been the only one to and from the Newark Bay terminals. These terminals consist of Port Newark Container Terminal, (served by CSX), ExpressRail (CSX/NS), and E-Rail (owned and served by NS). A further terminal is under construction at Howland Hook on Staten Island. This will connect through Arlington yard to the Chemical Coast via a new connecting track in the Bayway area. The Chemical Coast is essentially single track. A second running track does exist for much of its length but this is in practice used to build trains. ExpressRail facilities are being upgraded, including additional reception tracks to allow trains to be built away from the Chemical Coast line.

(b) Lehigh Line /Passaic & Harsimus, Kearny/Oak Island – Bound Brook/Manville

This heavily used corridor is currently the principal route to points south and west. At Manville, CSX heads south via Trenton, while NS strikes out towards Harrisburg. Passenger service is run by New Jersey Transit from CP 'Aldene' to CP 'NK' on this segment of the Lehigh Line and then NS and CSX trains veer north at CP 'Valley' to use the Passaic and Harsimus to and from Kearny and Croxton.

(c) Chemical Coast Terminals - Port Reading – Bound Brook

Avoiding Oak Island, this freight-only route runs from the Newark Bay and Staten Island terminals south via the Chemical coast to Port Reading Junction, where it takes the Port Reading secondary to Bound Brook. It is the Port Reading Secondary that has the potential to relieve capacity on the Lehigh Line for traffic routed south and west by CSX and NS. Currently it is single track, with a passing siding at Durham on the Port Reading segment. This siding is shorter than the current maximum length and also than the minimum length assumed in the calculations. There will be a constraint on capacity at this siding until the planned upgrade is complete.

(d) National Docks Secondary Oak Island – NS Croxton and CSX Kearny

This single-track route allows trains run via Claremont and Jersey City to reach the Croxton and Kearny yards as well as the CSX River Line and NS Southern Tier. It can also handle traffic to and from Bayonne, including that for the Port Jersey and East Jersey short lines. In future it may be attractive to CSX as an alternative to the Waverley Loop for northbound trains that do not need to call at Kearny. It is cleared only to short-stack height, which enables combinations of 9ft6in and 8ft6in maritime containers on this route. Such a solution is already used by Canadian Pacific on their route and with appropriate loading and forwarding patterns should be equally possible on this segment. Given the foregoing, it has been assumed that up to half of such traffic may be routed this way; this may have to be traded off against the assumptions made for the Waverley Loop, which for the purposes of this study have been included as part of CSX's River Line. At the moment the Docks Secondary's share of such traffic is about one third.

The Wider Railroad System

This category includes all key and complementary railroad segments owned and/or operated by relevant Class 1, regional or short line freight railroads, as well as passenger rail corporations and authorities. Wider network corridor segments are shown in Figure 10.3.

(a) Amtrak / State of Connecticut / MTA, Northeast Corridor (NEC) New York – Boston

The NEC has 4 tracks from NYC to New Haven CT, with 2 tracks beyond. Passenger service is operated by Amtrak, Metro North and ConnDOT Shore Line East. Double stack clearance is not available, and not planned, since it would require extensive changes to the recently built electrification system. Freight service presently consists of two CSX daily locals and three P&W aggregates trains per week. In New York City, freight trains join and leave this route at Oak Point, where local terminals are served, and in Queens, for interchange with New York & Atlantic. The rail infrastructure is configured primarily for passenger operation given that it is Amtrak owned and that the overwhelming volume of traffic is passenger business. The main window for freight is at night. In order to run during the day, freight trains would need to be faster, shorter and/or lighter than at present. P&W does hope to run their service more frequently in future, but CSX does not expect to run additional trains.

(e) Amtrak Northeast Corridor, North Jersey – District of Columbia

This is a 4 track railway from North Jersey to Philadelphia PA with a mix of 2 and 3 tracks beyond to Washington. Again it is dominated by passenger trains, in this case operated by NJ Transit, SEPTA and MARC as well as Amtrak itself. Clearance issues are similar to those on the northern portion of the Corridor, with double stack precluded.

Both CSX (who have a parallel route) and Norfolk Southern have trackage rights, but only NS exercises them; it runs a number of locals, mainly in the nighttime window. NS has approached Amtrak to run a through freight from DC to NJ, but Amtrak believes that to achieve this goal work would be necessary at its Zoo Interlocking and NS themselves recognize the difficulties of running such a train during the daytime. The corridor is attractive to NS though as they have no other route on which to compete against CSX's dedicated route serving the same area.

In general terms Amtrak regards their railway as "at capacity" now and are not actively seeking additional freight to supplement revenues. Furthermore, the ability to run daytime freights will become increasingly constrained as work is done to progressively increase speeds for Acela trains and traditional Regionals. Any capacity and capability enhancements for the running of additional freights will have to be paid for by the freight railroad requiring the changes. As it is, freight operations will ultimately be constrained by the need to run between interlockings in a time short enough to prevent being caught by passenger trains. This favors shorter lighter trains, or running at night only.

(f) Canadian Pacific, North Jersey – Montreal

CP's route is essentially single track and runs into North Jersey from Montreal, Canada to Dupont PA on the former Delaware & Hudson route. From there it traverses the Reading, Blue Mountain and Northern Railroad to reach Norfolk Southern at Allentown. Here blocks are placed on connecting Norfolk Southern trains to North Jersey; within this study the CP service between Allentown and North Jersey has been accounted for by treating it as part of the Norfolk Southern service. CP may also interchange local traffic for New York Susquehanna & Western and for NS's Southern Tier at Binghamton.

Arrangements to interchange with CSX River Line service at Albany-Selkirk also exists but CP does not currently exploit them on the grounds that the CSX service available does not serve CP's interests as well as it did under Conrail. New Jersey traffic is now routed in co-operation with NS, as described, to reach CP's own railhead at Oak Island. CP's own trains run daily. They convey intermodal traffic 3 days per week at present, with TOFC (Trailer On Flat Car), merchandise and waste making up the difference. Double stack intermodal is the norm for CP, but the D&H line can carry only short stacks of 8ft 6in on 9ft 6in box combinations.

(g) CSX, Oak Point – Fresh Pond

This segment connects to New York & Atlantic at Fresh Pond, and to CSX via the Hudson line at Oak Point. PWRR also run as far as Fresh Pond from Amtrak NEC to interchange with NY&A. It partly runs parallel with Amtrak, who also own Hell Gate Bridge on this segment.

(h) CSX/Metro North, Hudson Line, Oak Point – Selkirk

This line comprises a single track via Harlem River Yard to Highbridge, where it joins Metro North as far as Poughkeepsie. Here ownership reverts to CSX. On Metro North freight is banned during passenger peak hours, with only locals running during the daytime. Improved boxcar clearances for Plate F[93] cars will be obtainable when planned work is carried out on a former station structure in the Westchester area. Freight service is operated by CSX and also CP using trackage rights. Trailer On Flat Car clearances are now available but double stack is not possible because of fouling of electrification equipment, the electrified third rail, and clearance obstructions. Consequently the railroads do not expect traffic comprising other than non-intermodal and TOFC. A joint group is currently examining enhancement options for this corridor. It is made up of representatives of Amtrak, Metro North, CP and CSX. In addition to freight growth, Metro North plans significant increases in service, and Amtrak is considering running a more frequent New York – Albany service.

(i) CSX, River Line, Kearny – Selkirk

This corridor is CSX's route north from New Jersey and forms the initial segment of the Water Level Route. For the purposes of this study the proposed Waverly Loop between Oak Island and Kearny has been included as part of this route. At present, CSX in particular builds trains at Kearny. For clarity this corridor is also taken to include Shared Assets trackage from CSX's Yard at Kearny, running as far as Babbitt, NJ.

The main line north is single track with sidings to Selkirk, where it connects eastbound to Boston and westbound over the Water Level route. CSX routes its New England and Chicago business this way. The geography makes overall journey times quick, and CSX is able to beat NS's routes to and from the west, and providing overnight truck-

[93] A Plate F car is the AAR's (Association of American Rairoads) designation for a Typical Template of a railcar of the general dimensions 17'-0" ATR high by 10'-8" wide

competitive service to New England via connections with Providence and Worcester RR. Growth to New England and CSX's share of growth to western destinations are therefore assumed to take this route.

(j) CSX, Water Level Route, Selkirk – Buffalo for Chicago and Toronto

This is CSX's trunk route west from both New York and New Jersey. The New Jersey end also being known as the River Line, and which is treated separately in this study. Its competitive advantage is the speed over its relatively flat terrain. It allows CSX to reach Chicago faster than Norfolk Southern and bestows a particular advantage in time sensitive markets.

(k) CSX, Selkirk – Boston

This runs from Albany (Selkirk) eastward into New England. Speed is a competitive feature allowing overnight service from New Jersey to New England destinations served. Bi-directional signals exist on this entire line but speed is limited in various segments because of curvature and a single tracking project undertaken by Conrail in the late 1980s that constrains capacity.

(l) CSX, Manville NJ – District of Columbia

This direct dedicated segment is CSX's primary route south from New Jersey. As well as destinations in the southern states traffic can make connections west into Pennsylvania via Baltimore. A current issue is very high capacity utilization in Washington DC itself, which is caused by extremely low running speeds, where a large number of street grade crossings exists.

(m) East Jersey Railroad

As the EJRR solely provides switching service in the Bayonne area, the main constraint on capacity will in practice be determined by capacity at Bayonne Yard and the CSAO segment between there and the National Docks Secondary.

(n) New York & Atlantic Railway

NY&A provides local distribution, over MTA Long Island RR trackage, for traffic that has connected from CP, CSX and PWRR at Fresh Pond, or the Cross-Harbor Railroad at Brooklyn. NY&A may face pressure on capacity if containers were to be landed at Brooklyn for rail transit to upstate New York and New England.

(o) New York Susquehanna & Western Routes

NYSW provides regional service between New Jersey, and Syracuse and Utica, NY. A significant proportion of this uses trackage rights on the NS Southern Tier route. While overflow traffic from NS or CP may be diverted over NYSW, traffic remains local and regional in character.

(p) Norfolk Southern Pennsylvania Route, Manville – Conway via Pittsburgh

This is Norfolk Southern's key route to and from New Jersey. As well as enabling NS to serve major destinations west to Chicago, the Manville – Harrisburg section also conveys blocks that are redirected at Harrisburg for the southern states and also north to Buffalo, NY. No major upgrades to the rail infrastructure are planned for this route.

(q) Norfolk Southern, Harrisburg – Hagerstown & Roanoke

This is the NS artery for traffic to the southern states. It is further inland than the CSX route and does not compete directly with it for shorter distance traffic. Any traffic of that kind will be routed via Amtrak Northeast Corridor. NS heading north had formerly to interchange with Conrail at Hagerstown to reach North Jersey. Now this is a through route for NS. However, traffic density tends to concentrate around Hagerstown, where NS meets CSX and local railroads.

(r) Norfolk Southern, Harrisburg – Buffalo

Trunk traffic north from New Jersey is routed through Pennsylvania to Harrisburg, thence via this segment.

(s) NS Southern Tier, New Jersey – Buffalo

Because of the difficult terrain this route is not favored for non-local traffic. The heavily curved and steeply graded character of the Southern Tier means that key longer distance traffic will be routed via Pennsylvania. However, the Tier retains a role as an overflow for NS and also provides trackage rights for NYSW.

(t) Port Jersey Railroad

PJRR owns the key segment connecting the CSAO Docks Secondary to the Global terminal area. The key constraint on this section generating traffic is in practice commercial rather than operational. This is because of the additional fees payable to PJRR for overhead traffic on their system, which make it proportionately less attractive to provide through service to the Global area. As an example, during a site visit to New Jersey port area the only PJRR activity in evidence was switching and car storage. Operational capacity is determined in effect by the Conrail routes linking the dock area with the wider railroad system.

(u) Providence & Worcester Railroad

PWRR's system interchanges traffic with CSX at Worcester, MA. From there it can distribute it on its own routes to Gardner, MA, Providence, RI and New London, CT. PWRR also provides the railroad connection for the Port of Worcester, and provides its own intermodal railhead, which it is in the course of expanding.

(v) Staten Island Railroad

The original Staten Island Railroad is unused and lies between Saint Georges, Staten Island, NY and the connection of the former Central Railroad of New Jersey in Cranford, NJ. Re-opened segments will comprise the Howland Hook – Arlington link and the rails from Arlington to the new connection with the Chemical Coast at Bayway Yard. The prime purpose of the re-opening will be to enable rail servicing on the Howland Hook terminal and as such there is no competition for capacity with trains reaching the chemical cost itself. Full account of impact on the Chemical Coast of all CPIP generated traffic from whichever port terminal, is accounted for under the relevant Conrail Shared Assets segments.

10.2.8 Baseline Infrastructure

The start point for the rail capacity analysis is the existing railroad system infrastructure. This includes the number of tracks and the signaling and movement control systems currently in use. However, the railroad infrastructure will not stand still over the period of port growth projections and as the analysis is being carried out for the very long term, it has been necessary to establish what changes are expected to take place as far as is foreseeable. A number of capital programs exist and are projected over the near term to deal with known capacity problems. Some are entirely funded by the railroads themselves while others are funded at least in part by public bodies in recognition of the wider benefits of freight rail, or other specific objectives. As well as a baseline analysis, capacity has also been measured while progressively adding the known improvements to the infrastructure to see what effect they have on the overall situation. These improvements are listed in Appendix E. Not all of those changes listed will have a direct effect on the rail system capacity that has needed to be measured here, but those shown make up as complete a representation of future changes as could be obtained.

10.3 Methods of Calculating Rail Capacity

10.3.1 *Introduction*

This Section describes the methods adopted to calculate the capacity of the rail infrastructure along the study corridors and segments described above. The methods are described in more detail in a Task E Technical Memorandum[94]

10.3.2 *The Nature of Rail Capacity*

While there are some theoretical tools available to assess capacity, the railroad industry itself generally will assign validity only to practical considerations of capacity based on specific scenario evaluation from an operator standpoint. An approach based on operational parameters has therefore been used, rather than attempting to use more abstract techniques or transfer methods from other transportation modes.

Trains run on a fixed infrastructure of finite capacity. They can vary greatly in their operational characteristics. These in turn influence how effectively the available capacity can be used. However, it is the design and configuration of the fixed railway infrastructure that determine how fast, how long, and how heavy a train can ultimately be; they also determines how frequently trains can run, how closely they can follow one another, and how those with differing characteristics can interact. The fact that trains work by concentrating large volumes into single movements also means that capacity and utilization changes in steps, and not gradually on a trip-by-trip basis.

10.3.3 *Calculating Capacity and Utilization*

The capacity of corridors and segments was ascertained in a spreadsheet based model. The infrastructure data used in the model included:

- Distance between intermediate points;
- Permissible headways between trains;
- Maximum permitted speed;
- Number of tracks;

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[94] CPIP Task E Technical Memorandum (Final Draft) Market Demand and Port Capacity, Volume 4 Current and Planned Capacity of Regional Transportation Network – RAIL July 2004, Section E3B.3

- Physical clearances;
- Location and length of passing sidings on single track;
- Type of signalization or dispatching system;
- Intermediate signal positions on single track lines.

Gradients are accounted for in the train service speeds. Train data were derived from schedules, as well as interviews with, and information furnished by the railroads. The model also allows inclusion of factors for length and weight, which will determine the time needed to clear a route segment and the acceleration and deceleration characteristics of the train.

These data were then fed into a formula for the calculation of train capacity. Other data are used to form judgments on parallel issues. For example, physical clearances do not restrict the number of trains, but do influence their ability to accept double stack traffic; this knowledge may determine whether the solution for a given segment is a clearance or scheduling issue.

A core formula was used to work out capacity in terms of trains per day. Formulae in the model include factors for:

- Train length, which determines train passing and segment clearance duration;
- Length of time the route is available to freight if passenger trains also operate;
- Signaling system efficiency;
- Line maximum and train service speeds;
- Number of tracks.

The formulae were applied to each segment on a corridor. The most restrictive segment(s) will tend to determine the capacity of the corridor as a whole. Theoretical capacity was modified by consideration of the efficiency of the signaling or dispatching system.

Once the practical maximum capacity has been established in this way, it is possible to express current usage as a percentage of the practical maximum capacity to yield utilization. Existing train service levels are derived from railroad freight schedules and expressed as total trains per day. The existing train service levels can then also be expressed as a simple percentage of capacity.

10.3.4 *Rail Yards and On Dock Rail Terminals*

(a) Rail Yards

The capacity of rail yards is rather harder to determine than either that of main line corridors or terminals. Historically there has been overcapacity in railroad yards, leading to considerable rationalization in places. There has also been a trend toward avoiding the intermediate switching of freight cars to save time and expense. Because the number of yards potentially affected across the area studied is large, and their configuration highly variable, an assessment was made of the likely number of additional freight cars that would be generated along the routes concerned. The railroads were then approached with those figures and asked whether they would present a problem to any of the yards the traffic may call at.

(b) On Dock Rail Terminals

The on dock terminals examined for capacity issues were rather fewer in number than the railroad system yards, and therefore a more detailed approach could be taken.

The rail capacity of an on dock terminal is defined by its physical characteristics:

- The handling methods and capacity provided and the rate of productive handling which can be sustained. In this report the container terminals are mainly assumed to use rubber tired gantries.

- The number of rail vehicles, (- and their capacity), which can be placed at the terminal positioned for loading and the time taken for completion of loading/unloading.

- Hours of work within the terminal can also be a limitation but the first possibility for improving capacity may be to provide an additional shift; thus capacity may be increased in steps.

- In some cases the times taken for trains to serve the terminal can provide a limiting factor, especially if there are constraints on access caused by other services using the line or there is significant length of single track.

At each terminal the track capacity for one setting of the terminal is calculated. This varies with the number and length of tracks and also the rail operating methods used. The interval between resettings is a function first of the terminal's handling capability (e.g. lifts per hour to and from rail) and thus of the handling and transfer methods used. At container terminals a reasonable optimum for rubber-tired gantries were assumed. The interval is also a function of the speed with which the freight cars can be removed from the terminal tracks, and new freight cars placed in their stead. This is determined by the rail and terminal layout and operational practice.

Once the capacity and number of resettings possible has been established, it can then be seen whether the terminal layout and related operational factors permit the handling of the volumes forecast over the key years being examined.

10.4 Demand and Growth

10.4.1 Introduction

Existing train service levels were derived from railroad freight schedules and other sources. Today, on the freight corridors considered there are about 1,750 freight trains scheduled per week of which about 220 are intermodal trains. Just 9% of intermodal trains are associated with the Port, equivalent to on average three intermodal trains leaving the New York New Jersey area per day.

Throughout the forecast period, CPIP growth accounts for between 4% and 5% of the overall growth in train numbers on the network. Most of the growth is associated with non intermodal traffic (about 85%) and the remainder comes from other regional intermodal growth.

10.4.2 Accounting for Traffic Growth

Traffic growth on freight railroads around the port was considered in two parts:

- Port traffic, e.g. the containers and automobiles leaving the port by train;
- Other domestic traffic, i.e. merchandise trains entering the region from other parts of the country.

The port cargo demand volumes from the forecast were converted into freight cars and trains assuming rail attracted a particular mode share. The allocation of rail growth to corridors is described in Section 10.4.3.

Growth in other domestic traffic was taken to match that of the wider economy as represented by the forecast growth in regional truck freight. The wider economy was assumed, over the CPIP study period, to grow at 3% every five years.

10.4.3 Allocation of Growth to Rail Corridors

It is very difficult to predict preferred routings for rail traffic. Much depends on the structure of the railroads and their competitive and commercial positions. However, the railroad companies did give the project team some indications of their preferred routes north, south and west from the port. It is also necessary to establish a market share for each of the railroads, which is then broken down corridor by corridor.

The two most important railroads for market share are CSX and Norfolk Southern. These Class 1s acquired the former Conrail system that had a rail monopoly in the northeastern United States. Overall 55% of traffic went to CSX, but this varied widely from sector to sector. CSX dominated Conrail's former chemicals business, while NS took most of the automotive business. In North Jersey intermodal traffic, a 50/50 split was reported by the specialist website Trains.com in January 2002. This split has been used in calculations. Information on railroad dominance in certain market areas was available, allowing conclusions about exceptions to the even split to be reached, in the states listed below. A key factor is the dominance of CSX in traffic of known current volumes in New England. This leads to a requirement to rebalance market share to other states, to maintain the overall split balance.

- Alabama. Assumed to be a 70/30 NS/CSX split, owing to the NS route being both more direct and cleared for double stack cars. CSX assumed to retain some share of containers linked to their chemicals business. (Bulk raw materials for chemical customers tend to be heavier and therefore more likely to preclude double stacking anyway, so the competitiveness of double stack is assumed to be less of an issue here. See also Pennsylvania below);

- New England. 100/0 CSX/NS, as the latter has no direct route from portside to New England;

- NY State. 49/49/2 NS/CSX/NYSW. Canadian Pacific is not counted here as to offer service here would effectively lead CP to compete with NS, whose trackage they use to access North Jersey in the first place;

- Pennsylvania. 70/30 NS/CSX. NS has the double stack clearances and serves more destinations in the state. CSX retains some share as they do have access to the Pittsburgh area and could combine some containerized bulk chemical traffic on their single stack route;

- Kentucky and S Carolina. 100/0 NS/CSX. NS has the key double stack route to the south.

In addition to the above, it is necessary to make some judgments as to the way the above shares are distributed between parallel rail segments. This is especially important on the Shared Assets area. Here there are two ways of heading south and west for both CSX and Norfolk Southern, and two ways of reaching Buffalo for NS. The key segments are:

- Port Reading Secondary vs. Lehigh Line for points south and west. At present most traffic uses the Lehigh Line. However, it can be expected that the planned enhancements on the Port Reading Secondary will make this route more attractive. In order to reflect the likely future shift in train routing this study has assumed a 50/50 split for traffic that could use either. In the present this may show the Lehigh to be less congested than it currently is, but it will be seen later that there remains the potential for, and ultimately the reality of, further congestion on that segment;

- Oak Island – Kearny (future Waverley Loop) vs. National Docks Secondary. Approximately two thirds of traffic runs on the Oak Island – Kearney route adjacent to the Northeast Corridor. It is here that the construction of the Waverley Loop is proposed, a change accounted for later in this report. The National Docks Secondary carries around one third of traffic. This is assumed to remain the split as the more significant planned enhancement will be the Waverley Loop and so railroads can be expected to continue to favor that route;

- Southern Tier vs. Harrisburg – Buffalo. For Norfolk Southern, the share of traffic for destinations northwest of the port needs to be further split between two available routes. A 50/50 split has been assumed and owing to the small volumes involved this is not expected to significantly influence the overall outcome.

In most other segments the segment volume share reflects the assumptions on the railroad's market share.

10.5 Analysis

10.5.1 *Introduction*

Two sets of analyses were completed. The first set considered the capacity of the rail infrastructure assuming all of the forecast port demand growth occurred in the baseline port terminals described in Chapter 5. The second set of analyses examined the capacity of rail infrastructure with the four Task F terminal development Scenarios.

10.5.2 *Baseline Analyses*

The spreadsheet models were run twice in the baseline analyses:

- Case A - rail infrastructure remained unchanged throughout the period being studied.
- Case B – with funded and planned rail infrastructure projects completed. These projects are described in E3B.4 of Task E Technical Memorandum, Volume 3.

10.5.3 *Terminal Scenario Analyses*

Eight analyses were undertaken to test the infrastructure capacity under the four Task F terminal development scenarios and two rail mode share options, namely:

- Orange, Red, Yellow and Blue Scenarios;
- 15% existing rail share and 23% enhanced rail share.

10.5.4 *Baseline Analyses Results – Case A*

Conrail Shared Assets Area

The baseline Case A analyses are for the situation where there have been no improvements to the rail infrastructure.

Results of the spreadsheet analyses are given in Appendix F. For ease of interpretation the output has been displayed graphically in three categories:

- Under 90% utilization;
- 90-99% utilization;
- 100% utilization and over.

The utilization plots should also be read with the train number figures shown in tables accompanying the maps in Task E Technical Memorandum, Volume 3, Appendix B. For example a segment handling ten out of a possible twelve trains is experiencing just as high a utilization level as one handling twenty out of twenty-four. However, the lower the capacity of a segment, the more urgent will be the need for change; the 12-train route can take two more before reaching its limit, but the 24-train route can handle another four.

The spreadsheets showing capacity outputs also identify the signalization, speeds, number of tracks, passing sidings and so on. Segment capacities are summarized below.

(a) Chemical Coast Terminals – Oak Island

This segment is already over capacity, running at 129% of its potential 14 trains per day. This situation continues over time in line with projected growth, so that by 2020 demand is 193% of capacity and by 2060, 336%.

(b) Passaic & Harsimus/Lehigh Line, Kearny/Oak Island – Bound Brook – Manville

Capacity around Kearny Yard is already exceeded in the present, reaching 104% utilization. This bottleneck remains and worsens over time. It also spreads to Kearny Jct, exceeding 90% in 2030 and making 104% ten years later. The section between Marion and Secaucus begins to exceed 90% by 2010, and 100% in 2020. This pattern of congestion remains fixed, although worsening in intensity through to 2060. Further out on the Lehigh Line, Potter – Bound Brook is already at 105%. This worsens to 115% by 2015 when the stretch beyond Bound Brook exceeds 96% for the first time. This reaches 118% in 2030 by which time Newark – Aldene is also exceeding 90%. This pattern fixes itself and worsens through to 2060.

(c) Chemical Coast Terminals - Port Reading Secondary – Bound Brook

The Chemical Coast is less congested heading south but does not stay that way for long. By 2005 utilization is in excess of 90% between Rahway and Port Reading Jct. and is at 107% by 2010, putting the entire Chemical Coast over its capacity. The Port

Reading Secondary remains problem free but gaining access to it effectively becomes impossible. This pattern then remains fixed through to 2060 by which time projected utilization is 271% of current capacity. At the same time the alternative route over the Lehigh Line is also becoming increasingly congested.

(d) National Docks Secondary Oak Island – NS Croxton and CSX Kearny
The National Docks branch fares rather better than the other Shared Assets segments, but is still exceeding 90% utilization south of Croxton by 2010. Ten years on in 2020 that figure rises to 100%, reaching 132% by 2060. The congested area does not expand beyond its initial limits during the period covered.

A similar case was examine in earlier work by R L Banks[95]. A number of segments in the shared assets area were identified where there were capacity constraints and the baseline analyses undertaken for this study confirmed those locations

The Wider Network

Results of the wider network analyses are given in Appendix F and summarized below.

(a) Amtrak Northeast Corridor, North Jersey – District of Columbia
In this instance a different approach was taken to capacity. It is known that Norfolk Southern is seeking to run a service over this part of the Corridor. Such a service would in principle be capable of handling containers, albeit not double stacked. Taking the assumptions made for regional traffic to destinations along this corridor, it would be reasonable to expect around half of the potential demand (i.e. Norfolk Southern's half) to fill a 2,000ft train that is capable of being threaded through a passenger service. However, the study has found a more realistic prospect in an overnight path each way between North Jersey and Washington DC. This does involve pausing to be overtaken by an Amtrak service on the southbound run, but there still appears to be sufficient space on the timetable to allow running a longer train without compromising passenger service. If the train length can be doubled in doing this, then

[95] North Jersey Shared Assets Area – Rail Freight Capacity Analysis, Final Report, August 16 2001; by RL Banks & Associates, Inc & Atlantic Rail Services, Inc.

it appears possible to grow CPIP traffic over the Northeast Corridor as far as 2020, but with no opportunity for expansion after that in Case A.

(e) Canadian Pacific, North Jersey – Montreal

Because CP runs over Norfolk Southern as far as Allentown, its share of Port growth is accounted for under Norfolk Southern's Pennsylvania route as far as Allentown. Access to Port generated business is also assumed to be constrained by the need to dray to Oak Island in the absence of trackage rights across Conrail Shared Assets, so the share of available Port related business used in the capacity model is relatively small. Canadian Pacific regard their railway as well below capacity this is borne out in the analysis until 2030. In that year 91% is reached between Taylor and Scranton PA, and also between Kingsley PA, and Binghamton NY. This pattern establishes itself over the following years until these segments reach 113% in 2050. By this time the stretch of line between them is exceeding 90% and that same applies running south of Taylor. In conclusion it is not expected that CP will have any problems for a little under three decades.

(f) CSX, River Line, Kearny – Selkirk

The River Line is already approaching or exceeding capacity along all of its length. At the present time it is already at 94% of capacity between West Nyack NJ and Kingston NY. South of West Nyack to Little Ferry capacity is already exceeded at 103%, and north of Kingston to Selkirk it is at 113%. This pattern continues until the whole route is over capacity in 2010, the central section reaching 103% at this time. This situation becomes progressively worse through to 2060.

(g) CSX, Water Level Route, Selkirk – Buffalo for Chicago and Toronto

The Water Level Route west of Selkirk does see traffic growth but existing capacity is sufficient to take the increase throughout the years being considered. By 2050 however the line between Wayneport NY and Buffalo exceeds 90% for the first time. By 2060 the utilization has reached 98% on this section, so problems may be anticipated beyond that date.

(h) CSX, Selkirk – Boston

This segment remains able to cope with projected growth until 2020. At this point a warning sign of 93% appears at Farm Road MA. However it is in 2030 that the real extent of capacity problems appears. Farm Road reaches 100% at this stage, but long stretches to the East and West register in excess of 90% utilization. In the West the stretch runs from just east of AH Smith Bridge as far as State Line Tunnel. To the East the stretch runs between Roosevelt Ave east of West Springfield and a point east of Palmer Yard. This pattern consolidates and worsens through to 2060, by which time Farm Road is at 140% and the others are both at 146% of current capacity.

(i) CSX, Manville NJ – District of Columbia

The current picture is one of a busy railroad with high utilization along much of its length. In DC itself, approximately between Riverdale MD and Potomac Yard VA the route is already over capacity. The principal issue here appears to be a very high number of grade crossings that reduce train speed significantly though this area. The utilization ranges from 108% to 153% as a result, and this situation only worsens as traffic is projected to grow. By 2020 it ranges from 125% to 176%, hitting 200% around the "Virginia" and "RO" Control Points, where it reaches 235% in 2060 and at the time 190% just north of there. Further north, much of the route begins over 90%, with short stretches from Trent to Woodbourne, at Newtown Jct., and around Huntingdon Ave MD. Between these latter two a longer stretch of high utilization railway runs from Philadelphia East Side and East Van Bibber MD. These stretches together form the core congestion pattern for this route north of DC. The shorter three segments hit or exceed 100% in 2010, with the longer segment reaching that level in 2015. Congestion then continues to rise in line with traffic growth through to 2060. However, the problem starts to widen in 2015, with Manville to Glenmore NJ, and Woodbourne to Newtown Jct. Exceeding 90% in this year, and breaching the 100% mark in 2030.

(j) New York Susquehanna & Western Routes

NYSW's traffic consists principally of local traffic and overhead business interchanged from other railroads. Its capture of Port related business is most likely to be regional in character; capacity tends not to be at a premium on such railroads, and this will be more so now that NYSW is no longer in the position of being Conrail's only competitor to some destinations from New Jersey. The growth model does show traffic for New York state, part of which NYSW could capitalize on, albeit it would have to dray traffic to its own yard, not having access over Shared Assets to the terminals. Given the competition from two Class 1 railroads it is assumed that at best NYSW will manage a one third share of the available traffic. However, even this only generates two stack cars per day on the system. If general growth trends are followed, this will make another two in 2020, and another four by 2060. None of these volumes is expected to cause capacity problems for this railroad.

(k) Norfolk Southern Pennsylvania Route, Manville – Conway via Pittsburgh
At present this route is fairly uncongested and this may be reflected in the incremental approach that Norfolk Southern prefer to take to infrastructure enhancements. The general picture is of a railroad gradually building traffic until it is heavily utilized, often in excess of its capacity, for much of its length. Two choke points are already in evidence with stretches of 100% utilization in the area of Alburtis PA and between Rutherford and Harrisburg. The latter expands towards Duncannon PA, registering 91% there in 2010 and 105% by 2030. In this year the congestion spreads further west towards Altoona at 92% utilization. North Jersey from Port Reading Jct. to Musconetcong exceeds 90% in 2010 and 100% in 2015. These patterns once established worsen over the years to 2050, when the congestion at Altoona expands west to Conpit at 95%, exceeding 100% in 2060. Similar effects are taking place by 2060 between Allentown and Alburtis and stretches west of Alburtis to Rutherford. At the western end of this route the segment west of Pittsburgh to Conway exceeds 90% in 2010, and this builds to 136% BY 2060.

(l) Norfolk Southern, Harrisburg – Hagerstown & Roanoke:
Traffic heading south with Norfolk Southern runs first to Harrisburg. Trains then peel off south towards Hagerstown and then on towards Roanoke. The key segment of this route lies between Harrisburg and Shenandoah Jct WV. Around Harrisburg itself utilization is already at 232% and progresses to 357% in 2060. There is then some respite before utilization picks up at 91% towards Hagerstown where it is 110% south to Shenandoah Jct. In 2015 the 100% mark is breached north of Hagerstown too, and in 2030 90% is exceeded all the way back to the Harrisburg choke point. By 2040 the whole segment is over 100% and this pattern continues right through to 2060.

(m) Norfolk Southern, Harrisburg – Buffalo
From the Port of New York and New Jersey this route serves a relatively local market. Traffic volumes available for growth are relatively low, and NS' share can go one of two ways, the other being the Southern Tier. The capacity was calculated on this route as NS still regard this as their primary route to Buffalo and connecting points

beyond. However, from those calculations there is clearly insufficient volume or growth to threaten capacity along this corridor.

(n) NS Southern Tier, New Jersey – Buffalo:
The Tier was not subjected to capacity calculation as Norfolk Southern do not regard it as a primary route north, in part because of its relatively difficult topography. It does function as a diversionary route, but generally its role is for local traffic. As with the Harrisburg – Buffalo route CPIP volumes are low, first because it serves only the New York / Pennsylvania state border area, and partly because the market has to be shared, not only with CSX, but also NYSW and NS' own alternative via Harrisburg. The growth model predicts one stack car equivalent at present on this basis; growth over the years will provide two in 2020 and four in 2060, none of which is likely to be a cause of concern to Norfolk Southern.

(o) Providence & Worcester Railroad
Providence & Worcester currently claim to handle around 200 intermodal units per week, which they collect at Worcester MA after arriving on an overnight CSX connection from North Jersey. PWRR are planning to expand this business five fold, and are investing, particularly in terminals, to meet that level of demand. Applying the average expected growth figures for the Port to PWRR's current volumes shows that on Port and economic growth alone that level of expansion can only be achieved by 2060, well beyond most railroad businesses' planning horizons. In this respect the effect of the Port is well within PWRR's wider aspirations. However, as noted above under CSX's River Line and its New England route, the real constraints on traffic reaching PWRR are the capacity choke points on CSX's routes.

(p) Staten Island Railroad
The SIRR is currently inoperative between Howland Hook, Arlington Yard, and the planned connection to the Chemical Coast line. When it does re-open it will be solely to serve the Howland Hook terminal, and will not provide a route to anywhere else. As such there will be no existing traffic for any new traffic to be in conflict with. The effect of additional traffic on the Chemical Coast is taken into account under that segment's heading.

10.5.5 Baseline Analyses Results - Case B

Case B analyses are for the situation where today's funded and planned infrastructure is in place.

Conrail Shared Assets Area

Results of the shared assets analyses are given in Appendix F and detailed tables are given in Task E Technical Memorandum, Volume 3, Appendix D. The results are summarized below.

(a) Chemical Coast Secondary – Port Reading – Oak Island

This segment is already over capacity, running at 129% of its potential 14 trains per day. Planned improvements include constructing 6 miles of second main track between Pike (Oak Island) and Elizabeth port between 2003 and 2005. Suggested longer- term projects, 2007 – 2012, include constructing 5.5 miles of second main track and signaling between Bayway and PD (connection to Port Reading Secondary).

These improvements relieve the pressure on the Chemical Coast Secondary until the year 2030 when the segment north of the Rahway Bridge goes over 100% capacity. Rahway Bridge south to PD (connection to Port Reading Secondary) goes to 90% in 2040 and 100% in 2060.

(b) Passaic & Harsimus Line/Lehigh Line: Kearny – Bound Brook – Manville

Capacity south from Kearny Yard is already exceeded in the present by a factor of 104%. Planned 2003 – 2005 improvements include: 1) installing TCS signaling on the P&H Line, between CP Stock and Plank, 2) constructing a mile of second main track, with signaling on the Lehigh Connecting Track, between CP Stock and CP Valley; and 3) constructing 10.7 miles of second main track with TCS signaling on the Lehigh Line, CP Potter to CP Bound Brook.

Suggested longer term improvements, 2007 – 2012, include: 1) constructing the Waverly Loop track at the site of the former Waverly Yard to expedite movement of trains between the P&H Line and the Chemical Coast Secondary; and, 2) constructing 6 miles of third main track with TCS signaling on the Lehigh Line between CP NK and CP Aldene.

These improvements, especially the second main track, CP Potter to CP Bound Brook greatly relieve the congestion on the P&H and Lehigh Lines through to the year 2030 when the segment between CP NK and CP Aldene goes over 90% capacity again. By the year 2040 this segment between CP NK and CP Aldene goes over 100% capacity, worsening to 126% by the year 2060.

(c) Port Reading – Bound Brook

The Port Reading Secondary remains problem free but gaining access to it from the north and west becomes difficult. Suggested longer-term improvements, 2007 – 2012 include: 1) upgrade the 15.9-mile, single track Port Reading Secondary between CP PD and CP Bound Brook; 2) install TCS signaling on the line; 3) upgrade and extend Durham siding into a passing siding; and, 4) extend the Port Reading Secondary one mile westward from Bound Brook to a connection with CSX at Manville. This work is more to provide an alternative to the highly congested Lehigh Line than to address congestion on the Port Reading Secondary. Even by the year 2060, this segment, between Port Reading and Bound Brook is only at 65% of capacity.

(d) National Docks Secondary: Oak Is. – Croxton; P&H Line: Kearny–Croxton

With no improvements, the National Docks reaches 132% by 2060. Short term planned improvements, 2003 – 2005, includes the Grade Separation of the County Line Road over the Nave-Croxton Running Track. Suggested longer term improvements, 2007 – 2012, include: 1) Constructing 2.4 miles of second main track on the P&H, with signaling, between Kearny and Hack 2) Constructing 0.5 miles of second main track on the Marion Running Track (connects P&H Line and Northern Branch) between Hack and St. Paul's Avenue, with signaling 3) Improving clearances at Waldo Tunnel (National Docks Secondary) and Bergen Tunnel (Nave – Croxton Running Track) to accommodate double stack rail cars.

The bottleneck at the single tracked Bergen Tunnel exceeds 90% in 2010 and achieves 100% ten years later in 2020. Improving clearances at Waldo and Bergen Tunnels allows for higher capacity trains to run but congestion remains, growing to over 130% in 2060.

The Wider Network

Results of the wider network analyses are given in Appendix F and detailed tables are given in Task E Technical Memorandum, Volume 3, Appendix E. The results are summarized below

(a) Amtrak Northeast Corridor, North Jersey – District of Columbia

As noted in Case A, a 2,000ft train, handling containers, not stacked, is capable of being threaded through the passenger service overnight each way between North Jersey and Washington DC. There may be sufficient space on the timetable to allow running a longer train without compromising passenger service. If the train length can be doubled, then it appears this high speed freight service may be able to grow with CPIP traffic over the Northeast Corridor as far as 2020, but with no opportunity for expansion after that. While Amtrak does have a Target Plan and recommendations for improving speed and capacity for their corridor south of New York, there are no funding sources for these future projects and therefore under Case B, no improvements to capacity are anticipated.

(e) Canadian Pacific, North Jersey – Montreal

Because CP runs over Norfolk Southern as far as Allentown, its share of Port growth is accounted for under Norfolk Southern's Pennsylvania route as far as Allentown. Access to Port generated business is constrained by their need to dray to Oak Island in the absence of trackage rights across Conrail Shared Assets to the Port facilities. Canadian Pacific regards their railway as well below capacity. This is borne out in analysis as the segment between Taylor and Scranton PA, and between Kingsley PA, and Binghamton NY don't reach 113% of capacity until 2050. In conclusion, it is not expected that CP will have any problems, barring an infusion of unexpected traffic, for at least three decades. Future projects beyond then may be anticipated but are not programmed as of yet.

(f) CSX, River Line, Kearny – Selkirk

As noted previously, the River Line is already approaching or exceeding capacity along all of its length. At the present time it is already at 94% of capacity between West Nyack NY, MP 24, and Kingston, NY, MP 87. South of West Nyack to Little Ferry capacity is already exceeded at 103%, and north of Kingston to Selkirk it is at 113%. The situation becomes progressively worse through to 2060. Planned 2003 – 2005 improvements include the connection, through the construction of 7.5 miles of track, of two passing sidings north of Kingston thereby creating a double track segment from MP 118 though to MP 132 on the River Line is expected to be completed in 2003. This immediate improvement will relieve the near term pressure north of Kingston to Selkirk.

(g) CSX, Water Level Route, Selkirk – Buffalo for Chicago and Toronto

The Water Level Route west of Selkirk does see traffic growth but existing capacity is sufficient to take the increase throughout the years being considered. By 2050, the line between Wayneport NY and Buffalo exceeds 90% for the first time. By 2060, the utilization has reached 98% on this section, so problems may be anticipated beyond that date. Future projects may be anticipated but are not programmed as of yet.

(h) CSX, Selkirk – Boston

This segment remains able to cope with projected growth until 2020. As noted previously, in 2030 capacity problems appear near Huntington. This pattern worsens through to 2060, by which time Huntington is at 140% and other areas are at 146% of current capacity. While no future projects have been programmed at this time, double tracking portions of track previously single tracked in the 1980s by may be anticipated.

(i) CSX, Manville NJ – District of Columbia

The current operations are high utilization along much of its length. The principal issue here appears to be a very high number of grade crossings that reduce train speed significantly though this area. The existing utilization ranges from 108% to 153% as a result. By 2020 it ranges from 125% to 176%, hitting 200% around the "Virginia" and "RO" Control Points, where it reaches 235% in 2060 and at the time 190% just north of there. Much of the route is over 90%, with short stretches from Trent to Woodbourne, and Newtown Jct., exceeding 100% in 2010, with the longer segments reaching that level in 2015. Congestion continues to rise in line with traffic growth through to 2060. Planned infrastructure improvements include clearances for Double Stacks to Philadelphia by the year 2005 and then down to Baltimore by 2008 and Washington DC by 2018. There is also planned double tracking of major segments of the Philadelphia to Trenton and Philadelphia to Washington corridors with on-going negotiations with public agencies that may not bring these projects to fruition. These projects will be completed between 2015 and 2020 and will allow for unfettered operations through to 2060.

(j) New York Susquehanna & Western Routes

As noted in Case A, NYSW's traffic consists principally of local traffic and overland business interchanged with other railroads. The growth model does show traffic for New York state, part of which NYSW could capitalize on, albeit it would have to dray traffic to and from its own yard, not having access over Shared Assets to the port terminals. If general growth trends are followed, none of the volumes expected will cause capacity problems for this railroad through to 2060.

(k) Norfolk Southern Pennsylvania Route, Manville – Conway via Pittsburgh
Proposed improvements include constructing a second main track over portions of the NS Lehigh Line between Manville, NJ and Phillipsburg, NJ by 2020. A second main track would be installed in the Reading area by 2030. Future projects may be anticipated but are not programmed as of yet. Comparing their effect with the situation in Scenario A it can be seen that there is easement of capacity problems at the eastern end of the route. However, there are no works planned or proposed to relieve the building capacity further west, which continues to build.

(l) Norfolk Southern, Harrisburg – Hagerstown & Roanoke:
Traffic heading south with Norfolk Southern runs first to Harrisburg. Trains then diverge south towards Hagerstown and then on towards Roanoke. The key segment of this route lies between Harrisburg and Shenandoah Jct. WV. Around Harrisburg itself utilization progresses to 100% in 2040 and 116% by 2060. By 2005 utilization picks up at 91% towards Hagerstown and increases to 110% south to Shenandoah Jct. Proposed construction of a second main track, Harrisburg to Front Royal, VA between 2005 and 2010 reduces utilization to the range of 20% to 40% over this segment.

(m) Norfolk Southern, Harrisburg – Buffalo
As with the NYSW and in Scenario A there is insufficient volume or growth to threaten capacity along this corridor. Future projects may be anticipated but are not programmed as of yet.

(n) NS Southern Tier, New Jersey – Buffalo:
The Tier was not subjected to capacity calculation as Norfolk Southern does not regard it as a primary route. The growth model predicts one stack car equivalent at present on this basis; growth over the years will provide two in 2020 and four in 2060, none of which is likely to be a cause of concern to Norfolk Southern. Future projects

may be anticipated but are not programmed as of yet and are unlikely to be of benefit to Port induced traffic.

(o) Providence & Worcester Railroad

As stated in Case A the capacity plans of the Providence & Worcester far exceed the expected growth induced solely by the Port. Therefore the constraint on traffic to this railroad remains the capacity situation on CSX's River Line. While no future projects have been programmed at this time, double tracking portions of track previously single tracked by Conrail in the 1980s may be anticipated.

(p) Staten Island Railroad

As in Case A when the SIRR re-opens it will be solely to serve the Howland Hook terminal, and will not provide a route to anywhere else. As such there will be no existing traffic for any new traffic to be in conflict with and the effect of additional traffic on the Chemical Coast is taken into account under that segment's heading.

10.5.6 *Terminal Scenario Results – Existing Rail Share*

Conrail Shared Assets Area

The four Task F terminal development scenarios have a minor impact on rail utilization along segments in the Shared Assets area. However, these differences are not large enough to change any of the conclusions drawn from the baseline analyses reported above.

The Wider System

The four Task F terminal development scenarios make no difference to the level of utilization in the Class 1 rail network beyond the Shared Assets area.

10.5.7 *Terminal Scenario Results – Enhanced Rail Share*

Conrail Shared Assets Area

The enhanced rail share analysis case is for 23% of container leaving the port by rail. Results of the Shared Assets analyses are given in Appendix F and the detailed tables are given in Task E Technical Memorandum, Volume 3, Appendix D. The results are summarized below.

(a) General

The enhanced rail share brings forward the occurrence of a number of pinch points, making any existing problem greater in any given year than it has been shown to be under the existing rail share. What does not appear to have happened is the occurrence of new pinch points not previously identified. The results are summarized below for Task F Scenarios. Rail corridor segments not mentioned here are not shown by the analysis to have any capacity problems.

(b) Chemical Coast Line

The northern portion of the Chemical Coast remains the busiest carrying between 26 trains per day in Red and Green scenarios and 31 trains per day in Orange and Yellow Scenarios by 2020. This equals between 98% and 111% of capacity, with three out of five of the scenarios needing additional capacity by this time. In Red and Green scenarios it may be possible put capacity enhancements off for a year or two, but probably not much longer. By 2050 there is no question of the need, with up to 45 trains using this stretch per day, using up to 151% of the current capacity.

The southern portion of the Chemical Coast is more lightly trafficked, and does not encounter problems until 2040. At this time train numbers are between 24 and 29 per day depending on scenario, representing 84-102% of capacity. Utilization is at 100% or more in Yellow and Orange scenarios in this year. Green and Red Scenarios could tolerate a modest delay to enhancement work beyond this date, but Blue is only just under the 100% utilization mark and for the purpose of programming work, should probably be treated as fully utilized at this point. The situation progresses until there are 35 trains per day at the most, a utilization rate of 124% of this segment.

(c) National Docks Secondary

From 2015, there is a steady increase in congestion on the mile long stretch between CP Nave and Croxton. In that year there are between 30 and 32 trains per day representing a utilization of between 98% and 102%. Only Green Scenario is below the full utilization mark. From this point on utilization rises to a point where up to 41 trains use this segment per day, a 131% utilization rate on current capacity.

(d) Passaic & Harsimus / Northern Branch

From 2005 there is congestion around Kearny. All cargo terminal Scenarios produce similar figures here starting at 27 trains per day (=105%) in 2005 and rising to 39 trains per day (149%) in 2050. In 2030 the congestion spreads taking in a little more of the

Kearny area, 27 trains per day on the new stretch constituting 103% utilization. This rises to 31 trains, 119% in 2050. Green Scenario is a little behind the trend in the case of the spread of congestion in 2030, and so any enhancement work could conceivably be held back for a short while in that case. However in all other Scenarios the utilization is at or higher than 100% in 2030 in this case and rises to 119% (31 trains per day) in 2050.

(e) The Lehigh Line

Two portions of the Lehigh line are cause for concern in the enhanced rail share scenario. The first is between Bound Brook and Port Reading Junction where 44 trains per day are envisaged in 2005, a utilization rate of 103%, climbing to 70 trains (180%) in 2050. Beyond here towards Norfolk Southern territory the Port Reading Junction area becomes further congested in 2020, with 34 trains per day (125%) rising to 47 trains (174%) in 2050.

The second pinch point occurs between Newark and Aldene in 2030, where 57 trains per day make for a utilization of 109% on the segment which is shared with NJ Transit commuter trains. This rises to 68 trains (127%) by 2050.

The Wider System

Results of the wider network analyses for Task F Scenarios are given in Appendix F and detailed tables are given in Task E Technical Memorandum, Volume 3, Appendix E. The results are summarized below

(a) Amtrak Northeast Corridor

While observing the length limits on the Amtrak Northeast Corridor the study team has been able to find up to half a dozen paths per day for fast light intermodals, both from North Jersey to the District of Columbia, and also northeast from New York City to Boston. The latter could increase the potential for express freights from New York to New England should Blue Scenario's envisaged container terminal at South Brooklyn be developed. However, it is also clear that without enhancement to the Amtrak route, the number of trains will be limited by the number of paths identified here.

(f) CP, Allentown – Montreal

Canadian Pacific had previously told the study team that this corridor is not a major concern as far as capacity is concerned, and this is largely borne out, even where enhanced rail share is considered. However, in the later years of the study period congestion appears at two points. The first is the segment between CP 648 and Hallstead Pa, where trains reach the level of 23 per day in 2040, equal to 99% utilization, reaching 111% (27 trains per day) in 2050. This means that from shortly after 2040 the segment will become congested and some infrastructure improvement will be needed.

The second segment is between CP650 and Taylor, where the 27 trains per day will trigger a 99% utilization level, indicating that further improvement work will need to be in preparation by 2040, or very shortly thereafter.

(g) CSX, River Line, North Jersey - Selkirk

The River Line is already a heavily trafficked corridor. The analysis reconfirms this with most of its length showing as over capacity from 2005 onwards assuming enhanced rail share. In 2005 37 trains per day would be generated giving a utilization of between 103% and 124% depending on the exact segment of the route. This rises to 59 trains (163-195%) in 2050. These figures apply to the entire route from CP 22, about 2 miles from West Nyack, to CP 118, which is part way between Kingston and Selkirk.

(h) CSX, Water Level Route, Selkirk –Buffalo

During the years studied, there are no absolute requirements for capacity enhancements. However, heavy utilization does begin to appear in 2050 on the segment between Lyons NY and Buffalo, utilization reaching 92% with 83 trains per day on this busy route.

(i) CSX, Selkirk – Boston

On this corridor there are three sections which are of concern, and these become more significant as pinch points when rail share is enhanced. The first section is between CP SM, around 2 miles from AH Smith Bridge, and the State Line Tunnel. The second is between CP 123 and Farm Road. The third is between CP 52, about 3 miles from Roosevelt Ave, and CP 57, west of Worcester MA. In 2020, utilization reaches 100-103% depending on segment, as 28 trains are envisaged to be running per day. This rises by 2050 to 37 trains, giving a utilization figure varying between 131% and 136%.

(j) CSX, Manville – District of Columbia

The already planned and proposed enhancements hold good for this corridor with enhanced rail share. One stretch that remains problematic is between CP Port Reading Junction and Manville itself, which is effectively where this CSX route emerges from the Shared Assets area. This becomes congested earlier than under the existing market share. In 2015 34 trains are envisaged per day, a utilization rate of 109%. By 2050 this has risen to 44 trains, and 138%. This short segment, if not dealt with, could cause problems on both the route to DC and within the Shared Assets area itself.

There is a second short stretch that re-emerges as a pinch point, and this is around Carroll, MD in 2050, about 1.5miles from West Baltimore Junction. Here 47 trains per day bring utilization to 108%.

(k) Norfolk Southern, Pennsylvania Route, Harrisburg – Pittsburgh/Conway

With enhanced rail share, familiar pinch points occur, but the utilization levels are higher. Problems begin between Rutherford and Harrisburg Yard where a total of 35 trains per day in 2005 gives rise to a utilization level of 117%. This increases to 58 trains and 195% by 2050. But the congested area also extends westward over the latter part of these years, to just short of Duncannon in 2030 where 82 trains a day make for 109% utilization and the Altoona area in 2040 (88 trains taking it over the 100% utilization mark). By 2050 these sections are at 126% and 110% respectively.

10.5.8 Yards

The impact of traffic on railroad yards in terms of potential additional freight cars to be handled was generated from the analysis and shared with all the Class 1 railroads for their respective yards. In no case was a response received to indicate that the yards should not be able to cope. However, should any off-dock yard on the Shared Assets area become congested the study team believes that capacity issues may in the long term lead to the favoring of as much port traffic being built up into trains at or near the terminals themselves as possible. This would be achievable at both Port Elizabeth/ExpressRail and Howland Hook and where either tracks, or space to build them, exist for this purpose. This could then relieve pressure elsewhere.

Generally speaking railroads will tend to take an evolutionary approach to the way they use their yards. In recent years there has been a trend towards minimizing train switching en route as much as possible, so constrained yard capacity is generally not expected to be a problem. As railroad companies' planning horizons are somewhat shorter than the period studied for this report, it is expected that it should be possible to adapt operations to suit the emerging traffic situation.

10.5.9 *Terminals*

In situations where terminals are shown to process bulk and/or general merchandise there are no anticipated capacity problems. This is due to the different nature and volume of the traffic anticipated. The outcomes noted here mainly refer to the situation for container and automotive traffic.

(a) ExpressRail

ExpressRail's capability can be improved to keep up with customer demands, but there is a risk that it cannot completely service all demand towards the end of the study period and that solutions may lay elsewhere. Its maximum capacity can be taken to 1,500,000 TEU. Reaching the limit of this capacity could imply a change in rail operational practice to speed up train berthing and preparation for departure on the existing infrastructure as, or a further more radical change of infrastructure layout within the existing rail terminal footprint. In either case these may need to go hand in hand with a change in handling methods in the rest of the terminal. An example might be the use of rail mounted gantry cranes, which while less flexible than rubber tired gantries, can generally achieve handling rates up to 50% greater.

(b) Port Newark

As currently configured, the rate of lifting is quite low. It should be possible by the improvement of methods of working to raise throughput from the present estimate of 74,160 TEU per annum. Changes envisaged may include the speeding up of crane operations, reducing excess crane travel, and improving methods and discipline in crane and trailer movement and co-ordination. The rail infrastructure improvements proposed for PNCT will contribute much greater flexibility for trains serving the terminal. Annual capacity should be able to reach 289,000 TEU. Only in Scenario Yellow is it possible that the terminal will find difficulties coping with demand.

(c) Howland Hook

Howland Hook is expected to be capable of handling up to 988,000 TEU per year to rail, which is expected to cope with its likely demand levels.

(d) Port Jersey/Bayonne

The maximum demand forecast for Port Jersey terminal can be handled in principle but, as well as the problem discussed above, there are complications caused by the need for containers and auto traffic, which is more irregular, to share the same access route. The tedious and inflexible method of rail working imposed by the present approach layout, with short traffic blocks, will be costly and subject to congestion and interruption. As a result Port Jersey terminal will lack flexibility to handle variations and peaks in traffic demand, which are very likely with these traffic flows. The alternative to facilitate direct access for 6,000 ft trains is to have trains go direct over a new connection through the current site of a warehouse. If achieved this would resolve operational problems, except possibly in the case of the highest volumes in Red and Green scenarios after 2050.

(e) South Brooklyn

The handling of a single setting of the terminal per day would give an annual capacity of 433,836 TEU. This total covers all time horizons in Blue Scenario, which is the only one in which South Brooklyn features as a container terminal.

10.6 Infrastructure Improvements

10.6.1 Introduction

This Section describes the access improvements on the local rail infrastructure to remove the capacity constraints identified in the analyses. Cost estimates for the infrastructure projects are presented.

Capacity improvement projects are needed under both the existing rail share and an enhanced rail share. The traffic associated with an enhanced rail share along with other rail traffic simply brings forward the need for capacity improvements along congested segments.

10.6.2 Cost Estimates

Costs shown for carrying out enhancements are conceptual order-of-magnitude opinions of probable costs at 2003 prices. It should be noted that they do not have the benefit of being informed by survey or geotechnical investigations and that such work, if and when carried out, may alter the cost estimates by an amount it is not possible to predict within the scope of this report. The cost estimates include any work necessary to modify existing grade crossings where necessary because of the provision of additional tracks. They do not include any allowance for the possibility of grade separation. There may be cases where grade separation is appropriate, but to establish this for all of the corridors covered here would in itself form a substantial program of work and would affect infrastructure for which bodies are responsible that are not involved in the CPIP program. Furthermore, as is stated elsewhere in this report, in most cases the majority of rail traffic growth on corridors concerned will be attributable only in relatively small part to Port generated traffic.

10.6.3 On Dock Rail Terminal Improvements

A few rail improvements are suggested at the on dock terminals. These are described below and summarized in Table 10.1.

(a) ExpressRail

The first stage improvement is a second running track to improve access to the loading tracks. This will require approximately 3,200ft of track, two crossovers and two additional switches. It is understood that these works are at an advanced stage of planning

The second stage is the conversion of four additional loading tracks from existing locomotive return tracks. This would require about 350ft of new track, two additional switches and two single slips. Also needed would be two additional cranes with spans over both loading tracks. The total cost of these measures would be approximately $4.8m.

(b) Port Jersey

The preferred upgrading of access to Port Jersey requires the demolition of an existing warehouse along with 1,500ft of track and two switches. The cost of the relevant rail infrastructure would be approximately $1.9m including real estate costs.

(c) South Brooklyn

The South Brooklyn container terminal should ideally comprise three loading tracks of 4,000ft in length plus one locomotive return track of the same length, along with six hand-pulled switches. The costs would be in the region of $4.0m. Other associated infrastructure requirements will result not from capacity needs but from the operational requirements introduced by the construction of the Cross-Harbor Tunnel.

Location	Description	Cost[1] ($m)
1. ExpressRail (Port Elizabeth)	a) Stage One – 2nd running track b) Stage Two – Conversion of 4 return tracks to loading tracks	- 4.83
2. Howland Hook	Arlington Yard – four new tracks and switches	-
3. Port Jersey	New Rail terminal	1.88
4. South Brooklyn	New Rail terminal	3.97

[1] Cost at mid 2003 prices

[2] Costs are for track and switches only, terminal pavement and other civil costs included elsewhere. Land costs excluded.

Table 10.1 Cost of on dock rail terminal improvements

10.6.4 *Conrail Shared Assets Area Improvements*

(a) The improvements are shown on Table 10.2 and described below.

(b) 2015 - 2020 CP Croxton, National Docks Secondary

With existing rail share a second track is needed in 2020 from here to CP Nave, about 1.6 miles away on the National Docks Secondary. Under enhanced rail share this need is brought forward to 2015. By introducing the second track the capacity utilization on this segment can be reduced to below the 70% mark for the duration of the period under study, whether from 2015 or 2020. The estimated cost of this work is $75m. This includes the need to convert an existing single track tunnel. If this is deemed prohibitively expensive there is a more economical approach and it may be more appropriate to route trains via the Passaic & Harsimus / Northern Branch where utilization remains relatively low throughout the period studied, even in the enhanced rail share scenario.

(c) 2020 – 2030 PN – Rahway, Chemical Coast

An additional track will be needed on this segment in 2020 under the enhanced rail share, ten years earlier than under the existing share. This will reduce utilization to no more than 80% in the longer term. Cost is estimated to be $54m. This enhancement is difficult to avoid. It could conceivably be deferred by directing increased amounts of southbound traffic via the Port Reading Secondary. However, the route southbound on the Chemical Coast is also in need of enhancement by 2050 (see 9.4.6 below), and diverting trains in this manner would only bring that work forward instead.

(d) 2030 – 2040 Newark – Aldene, Lehigh Line

Once again the need for this enhancement would be less if more traffic were diverted via the Port Reading Secondary. However, as seen above, this only brings forward the need for other works. An alternative way of avoiding this section would be to upgrade the former Central New Jersey route through Elizabeth. This is currently used to access some transload facilities and would cause considerable engineering challenges, including the need for double stack clearances under the Northeast Corridor at a low brick arch viaduct, and where scope for lowering the existing right of way may be limited. There are also plans for light rail in this area, which may prevent such an option. Costs have not been estimated, but the extent and complexity of some of the work involved, are likely to make them prohibitively high. A third track on the Lehigh is therefore judged to be the most appropriate solution to this pinch point. It will enable capacity utilization to be no higher than the low to mid 80% range for the duration of the study period. It would cost $67m.

(e) 2040 Rahway – CP PD, Chemical Coast

This southern section of the Chemical Coast Line will require a third track under enhanced rail share in 2040 to supplement the second already foreseen. This will keep utilization at or below 80% in the years to 2050. The cost of work is estimated to be approximately $200m.

Location	Description	Cost[1] ($m)
1. CP Croxton, National Docks Secondary	2nd track, to CP Nave, required 2015/2020	75
2. PN – Rahway, Chemical Coast	Additional track on this segment, required 2020/2030	54
3. Newark – Aldene, Lehigh Line	Third track on this segment, required 2030/2040	67
4. Rahway – CP PD, Chemical Coast	Third track on this segment, required 2040	200

[1] Cost at mid 2003 prices

Table 10.2 Cost of rail improvements in Shared Assets area

10.6.5 *Wider System Improvements*

(a) The improvements are shown on Table 10.3 and described below.

(b) 2030 – 2050, Allentown – Montreal, Canadian Pacific

The need for enhancements here comes as a result of the enhanced growth case. Previously heavily used segments (above 90% utilization) now require double tracking. In 2030 the line between CP 648 and Hallstead, Pa needs a second track at a cost of about $63m, and in 2050 similar work is required between Taylor Yard, Pa and CP 650 costing around $67m. In both cases these will bring capacity utilization down to below the 60% mark until well beyond 2050.

(c) 2005- 2040, River Line, CSX

From 2005, under existing rail share, the segment between Kingston NY (milepost 90.5) and CP 118 needs to be double tracked to mitigate congestion, at a cost of $122m. This will reduce utilization from a maximum of nearly 200% to below 100% in the longest term. There is a need to also double the track between CP 24 and CP 87 in 2015 at a cost of $300m. This will have the impact of ensuring that capacity utilization does not exceed 90%. However, under the enhanced rail share both these enhancements should be carried out in 2005. It can be seen that whatever measures are taken, the River Line will continue to be a very busy corridor. It should be noted that in the above works no allowance has been made for additional tunnels, or tunnel widening. Where single track tunnels exist the line is assumed to remain single track through the tunnel with control points reverting to double track at either end.

(d) 2020 – 2040, Pennsylvania Route, Norfolk Southern

Under the existing rail share the stretch between CP Blandon and CP Laurel in Pennsylvania needs to be double tracked in 2005. This effectively brings forward work that is already planned, and so it has not been costed here.

In 2020 under the enhanced rail share a third track is required between Rockville and CP Cannon, at a cost of $31m. By 2030 the segment between Harrisburg yard, in the east of the state and CP Cannon is still expected to need a third track. These measures will keep utilization at probably no higher than 85%.

In 2040 an additional need arises. This is the long section between CP Cannon and CP Gray in the Altoona area, which will require a third track to reduce utilization to a maximum of about 75% of the new capacity created. This is difficult territory for an infrastructure solution and the most feasible approach is thought by the study team to be one that involves re-opening previously existing right of way, including a tunnel that has been out of use for some time. Because of these complications the cost of such an enhancement is estimated to be in the region of $398m

(e) 2020 – 2040, Selkirk – Boston, CSX

Under existing rail share, double tracking is required between CP 123 and CP 109 in Massachusetts in 2030 at a cost of $41m and again between CP SM and State Line Tunnel in 2040 for $76m. Also in 2040, double track is required between CP 92 and CP 64 in Massachusetts at a cost of $60m These measures will halve capacity utilization to a level of no more than 70%. Under enhanced rail share the need for all of these enhancements is brought forward to 2020.

Location	Description	Cost[1] ($m)
1. Allentown – Montreal, Canadian Pacific	a) Second track between CP648 and Hallstead, Pa; required 2030	63
	b) Second track between Taylor Yard, Pa and CP 650, required 2050	67
2. River Line, CSX	a) Second track between Kingston NY (milepost 90.5) and CP118; required 2005	122
	b) Second track between CP24 and CP87, required 2005/2015	300
3. Pennsylvania Route, Norfolk Southern	a) Second track between CP Blandon and CP Laurel, required 2005. Work already planned, and therefore not costed.	N/A
	b) Third track between Rockville and CP Cannon, required by 2020	31
	c) Third track between CP Cannon and CP Gray, required 2040. Difficult terrain.	398
4. Selkirk – Boston, CSX	a) Second track between CP123 and CP109, required 2020/2030	41
	b) Second track between CP SM and State Line Tunnel, required 2020/2040	76
	c) Second track between CP92 and CP64, required 2020/2040	60

[1] Cost at mid 2003 prices

Table 10.3 Cost of rail improvements on wider network

11 Cost, Benefit and Risk

11.1 Introduction

11.1.1 General

This Chapter gives cost estimates for the Options and Scenarios described in Chapter 7 and gives their financial and economic results. The benefits in terms of additional capacity are included in the presentation of results. Risk to the successful implementation of the Port development, and the mitigation of that risk, are also described.

11.1.2 Financial Analysis

The financial analysis is generally based on a 20-year evaluation period and takes into account:

- 20 year investment period
- 7% real discount rate;
- Investment costs in infrastructure;
- Investment costs in equipment;
- Annual maintenance costs;
- Terminal operating costs;
- Fully exploited terminal capacity at Year 10 and steady thereafter;
- Revenues based on cargo growth

All of the costs are on a project-only basis, and do not take into consideration the value of any pre-existing infrastructure and equipment or the cost of land purchase.

The results of the analysis are expressed in terms of net present value (NPV) or cost per unit of additional capacity (i.e. TEU for container terminals, units for cars and tons for other cargo), and in terms of the breakeven price per unit in order to return an NPV of zero.   This approach therefore expresses the least revenue per unit required to cover the cost of new handling capacity and can be compared to the present market rates to give a broad assessment of viability.

11.1.3 *Economic Analysis*

The economic analysis has been based on the application of multipliers for jobs and overall economic impact based on the earlier work carried out by the New York Shipping Association[96]. Individual assumptions used for each cargo type are explained in later Sections. The benefits are calculated on a project-only basis.

11.1.4 *Cost Estimates*

The preliminary cost estimates cover the infrastructure proposed for the developments and the equipment needed to cater for the demand. The estimates are provided for the purpose of making comparative evaluations of the terminal Options and development Scenarios.

The terminal cargo throughput for the conceptual cost estimates was determined on a terminal by terminal basis assuming that an existing terminal would initially have a near-future productivity as described in Chapter 6, Table 6.2, and that the demand would rise to the level of the capacity of the expanded terminal size and the forecast long-term value of productivity, over a nominal period of 10 years.

In cases where a terminal was new, i.e. with no existing throughput, a nominal start-up demand of around half of the final value was assumed on the basis that none of the proposed new terminals is exceptionally large and a single customer would be expected to provide that level of demand.

The cost estimates for infrastructure are described in Section 11.2 and the estimates for equipment are described in Section 11.3.

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[96] NYSA, Economic Impacts of the New York New Jersey Shipping Industry, August 2001

11.2 *Preliminary Cost Estimates for Infrastructure*

11.2.1 *General*

The preliminary cost estimates for the capital cost of the infrastructure required for each of the terminal Options are summarized in Table 11.1 and details are given in Appendix G.

The financial analysis also required an estimate of the costs of making no change to the infrastructure of the terminals and estimates of maintenance costs. These are given in Appendix D of the Task G report[97].

As the cost estimates are for comparative evaluation purposes only, they are based on preliminary terminal concepts without detailed consideration of specific layouts or detailed engineering issues. The major items of expenditure have been considered, with an allowance of 25% contingency in infrastructure estimates to cover the remaining items and 5% in equipment estimates to cover miscellaneous plant. The estimates are considered to be satisfactory for the purposes of comparison of alternatives but should not be considered as budgets for construction.

An allowance of 25% was made for design and site supervision. No allowance was made for owner project management or tax.

11.2.2 *Basis of the Infrastructure Cost Estimate*

(a) General

Rates for infrastructure were for mid 2003 prices and derived from the following sources:

- Rates in previous studies updated and adjusted for the current circumstances;
- Rates built up for an item by an assessment of principal quantities within the item and extension by using the rates from a USA pricing manual[98];
- Rates for similar items in the Consultant's in-house database of international construction costs updated and adjusted for local circumstances.

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[97] CPIP Task G Technical Memorandum, Port Development Proposals
[98] RS MEANS, Heavy Construction Cost Data, 17th Ed, 2003

Factors to allow for differing rates for similar items across geographic areas were based on City Index values given in the RS Means pricing manual.

Container Terminals	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
	Port Newark South	Port Newark South	Port Elizabeth	Port Elizabeth	Port Jersey	Port Jersey	Port Jersey	Bayonne Peninsula	Bayonne Peninsula	Howland Hook	Howland Hook	Port Elizabeth	Port Elizabeth	South Brooklyn
Site clearance	2.3	24.2	25.2	22.3	0.0	17.6	15.9	42.6	43.4	5.5	0.0	0.0	0.0	186.7
Berths	8.6	8.6	8.6	20.3	29.2	63.5	65.9	27.5	27.5	48.1	9.0	2.2	18.0	158.0
Paving	2.2	18.3	26.1	13.1	3.1	18.1	21.1	20.1	30.1	16.3	0.0	0.0	0.0	73.0
Buildings	0.0	7.2	11.3	0.0	7.8	10.0	17.8	11.1	16.7	6.7	2.5	4.5	0.0	33.3
Other	3.0	6.1	17.4	6.8	9.0	15.1	24.1	17.8	25.9	111.4	25.2	1.3	4.1	142.5
Contingency & design	8.1	32.2	44.3	31.3	24.5	62.2	72.4	59.5	71.8	94.0	18.3	4.0	11.0	296.7
Total $m	**24.3**	**96.6**	**133.0**	**93.8**	**73.6**	**186.5**	**217.2**	**178.5**	**215.4**	**282.1**	**55.0**	**12.0**	**33.1**	**890.1**

Auto Terminals	A1	A2	A4	A8	A9	A10	A11	A12	A13	A14	A15
	Port Newark North	Port Newark North	Port Newark South	Port Jersey	Bayonne Peninsula	Bayonne Peninsula	South Brooklyn	South Brooklyn	Port Newark South	Port Newark South	Port Newark South
Site clearance	5.5	7.0	10.3	0.0	2.9	0.9	5.8	12.8	5.6	16.4	34.9
Berths	0.0	0.0	0.0	5.4	0.0	7.4	9.1	18.2	0.0	0.0	0.0
Paving	0.0	0.0	1.4	0.0	6.0	3.7	2.6	4.3	0.3	1.0	3.6
Buildings	0.0	0.0	0.0	0.0	12.9	4.4	1.6	0.0	0.0	0.0	0.0
Other	1.9	2.4	4.2	2.1	19.9	11.3	4.4	7.1	2.4	4.6	6.4
Contingency & design	3.7	4.7	7.9	3.7	20.9	13.8	11.8	21.2	4.1	11.0	22.5
Total $m	**11.1**	**14.2**	**23.8**	**11.2**	**62.6**	**41.5**	**35.3**	**63.6**	**12.4**	**33.0**	**67.4**

General Cargo Terminals	G1	G2	G3	G4
	North Brooklyn	North Brooklyn	South Brooklyn	Port Newark South
Site clearance	5.5	18.4	4.6	10.5
Berths	64.6	127.7	25.6	85.8
Paving	0.0	0.0	2.8	1.1
Buildings	41.4	110.5	0.0	84.5
Other	4.2	5.7	5.4	6.5
Contingency & design	58.0	131.1	19.2	94.2
Total $m	**173.5**	**393.4**	**57.6**	**282.6**

Table 11.1 Summary of preliminary infrastructure capital cost estimates for terminal options (Sheet 1 of 2)

Note : Costs are quoted at 2003 constant US dollars

Dry Bulk Terminal Costs	D1 Port Newark North	D2 Port Newark North	D4 South Brooklyn
Site clearance	4.5	4.5	5.8
Berths	18.9	11.3	40.8
Paving	0.8	0.7	3.5
Buildings	0.0	0.0	0.0
Other	2.4	1.6	7.3
Contingency & design	13.3	9.0	28.7
Total $m	**39.8**	**27.1**	**86.1**

Liquid Bulk Terminal Costs	L1 Port Newark North	L2 Port Newark North	L3 Port Newark South	L4 Port Newark South
Site clearance	1.6	4.0	3.3	1.6
Berths	18.0	9.4	27.4	13.4
Paving	0.2	0.5	0.0	0.0
Buildings & Tanks	5.4	8.7	6.3	0.0
Other	1.2	1.5	0.5	0.3
Contingency & design	13.2	12.0	18.7	7.7
Total $m	**39.7**	**36.1**	**56.2**	**23.0**

Note: Costs are quoted at 2003 constant US dollars.

Table 11.1 Summary of preliminary infrastructure capital cost estimates for terminal options (Sheet 2 of 2)

The infrastructure provided for each Option was based on the land and berth requirements.

(b) Land

Procurement costs of land, either inside or outside the Port Authority boundary, were not included in the capital cost estimate on the basis that all land was assumed to be leased.

(c) Rail

New rail facilities for container terminals were provided where none currently exist, as shown in Volume 2: Toolkit, Chapter 11, Rail), except in the case of Bayonne Peninsula where rail freight access is not considered to be feasible. The cost of a new rail terminal on the peninsula at Port Jersey and at South Brooklyn were allowed for. However, the costs for Express Rail Terminal, PNCT Corbin Street Rail Terminal and Howland Hook Rail Terminal were excluded from the estimates as they are presently under construction or are in the development plans of the Port.
New on-terminal sidings for auto terminals, where required, were included in the cost estimate. The exception is at Port Jersey where due to the need for sharing the facility with the Bayonne site, the auto rail sidings are off-terminal along the northern boundary.

New rail facilities for general cargo, and bulk terminals were not provided as the cost of providing the facilities and upland connections was not considered justified relative to the market served. Options D1 and D2 have existing rail facilities

In cases where the cost of a rail terminal was included and it served more than one cargo terminal the cost was shared between the two cargo terminals in proportion to the cargo terminal capacity.

The costs of upland rail links, or upgrading between the on-site rail terminals and main line facilities, were not included.

(d) Highway

The costs of upland highway construction or improvements outside of, or between, terminals are not included.

For Option C4 at Port Elizabeth the north-western land areas are separated from the main terminal by recently constructed major highway and rail works. It was assumed that the highway tunnel under the Express Rail line can be used for access to these areas for trailer storage, for example, without significant additional highway works.

(e) Dredging

Dredging costs differentiate between rock, 'soft' HARS[99] and 'soft' non-HARS bed materials based on survey information given in the Harbor Navigation Study[100]. Dredging costs of navigation channels in the approaches and in the berthing basins were not included.

Dredging costs of deepening and extending berthing pockets at the berths were included.

Dredging maintenance costs for berthing pockets are difficult to quantify but in any case were assessed to be insignificant in relation to other costs and were not included in this preliminary estimate.

For Option C10, Howland Hook, costs of realignment of cross channel utilities in the berthing area are assumed to be included in the harbor navigation channel dredging costs that do not form part of this estimate.

(f) Waterfront Fill

The Option involving the most significant amount of waterfront fill is C14 in South Brooklyn where nearly 9 million cubic yards of fill are required. No recent experience of filling on this scale in the New York locality was available, and it is recognized that economies of scale will give a rate considerably lower than the general marine filling rate used in the other estimates. A rate reduction for Option C14 is effected in the cost estimate tables by a reduction factor in the 'City Index' column. It should be noted that the cost of dredging on this scale is sensitive to the global market and the timing of the operation relative to other local projects. Although there may be opportunities to use the output from capital dredging, the rate used assumed that no

[99] HARS designation means that the material is not contaminated and can potentially be placed in the Historic Area Remediation Site at a cheaper rate than remediating and disposing of non-HARS material elsewhere.

[100] USACE, Feasibility Report for New York and New Jersey Harbor Navigation Study, 1999, Vol I, Main Report, Table 24.

such opportunity exists at the time of implementing this Option. It would be possible to use processed fill arising from the demolition of buildings in this Option. The cost differential would be most visible in the demolition item due to the avoidance of disposal costs for debris. However, many of the buildings demolished in this Option are in commercial use and it may be that the filling would proceed ahead of the piecemeal demobilization of the buildings. Therefore reuse of processed debris on site has not been allowed for in the estimate even although it will no doubt be an objective at the time.

(g) Maintenance

Maintenance costs for infrastructure were based on the largest two items i.e. quantity of quay and paving.

(h) Site Preparation

It was assumed that contaminated sites are cleaned up by the vendor on the basis that lease costs will reflect the value of clean usable land. Therefore, no clean-up costs were included in the estimates.

Wharves in a poor state of repair at North Brooklyn were assumed to be rebuilt and the cost of rebuilding was included. The need was based on discussions held with the Port Authority of New York and New Jersey. In cases where a demolished pier had supported a warehouse, the cost of replacing the warehouse, if needed, is included.

In Options C8 and C9, Bayonne Peninsula, it was necessary to allow for replacing the Coast Guard station within the Port Jersey Channel.

An average yard level of +10ft MLLW datum was assumed for the purpose of fill quantities.

For Option C10 at Howland Hook, the level of the existing ground in the new development area was taken as +8ft MLLW datum.

In cases where auto terminals occupy land with existing warehousing, some of the warehousing is retained in excess of requirements on the basis that demolition is prohibitively expensive and some auto storage inside redundant warehousing is accepted practice. In other cases where warehouses are demolished, the floor of the warehouse is assumed satisfactory for pavement for auto storage and nominal rehabilitation has been allowed for.

For Option C14 see comments above under the heading of 'Waterfront Fill'.

(i) Utilities

The cost of electrical feeder supplies, where none currently exist, was estimated based on previous studies.

(j) Wetland

Wetland covered by fill or by new wharves was compensated for in the cost estimates on a standard basis of three times the area of wetland covered. The rate for the cost of compensation was based on land purchase cost in the same county plus a nominal amount for arranging the topography to suit the desired habitat. It should be noted that in some cases the additional costs to allow for the function and value of a particular destroyed wetland may exceed the estimates. However, the estimates are considered adequate for the purpose of comparing Options. The availability of such land in suitable locations was not confirmed. The areas of wetland were based on data supplied by the CPIP EIS Consultant. Wetland maintenance and monitoring costs are not included. In all cases the information is approximate, and subject to detailed topographic survey.

(k) Infrastructure Replacement

The period under study extends to 2060. However, the first time that any project is theoretically required even at low productivity assumptions is after 2030. As the analysis period was not more than 30 years no infrastructure replacement was allowed for except initially arising from infrastructure currently deemed to be in an unsatisfactory condition.

11.2.3 Main Influences on the Infrastructure Cost Estimate

(a) General

The relative importance of the different elements of the infrastructure cost estimate can be seen from the summary given in Table 11.1. The following provides background to the main influences on these values.

(b) Site clearance

In several Options, site clearance, which includes demolition of structures which need to be replaced due to their poor condition, is the costliest item. This is mainly due to the high cost of demolishing and disposing of the debris from warehousing and the associated floor slabs and foundations. This is seen in particular in Option C14 at South Brooklyn where site clearance is estimated to be around $187 million and in Options C8 and C9 at Bayonne Peninsula where the site clearance is estimated to be around $43 million. Site clearance also forms a high proportion of the cost in all auto Options at Port Newark South, and A12 at South Brooklyn for the same reasons.

(c) Berths

The cost of the berths required for each Option is based on the need for new berths, deepening of existing berths to suit larger, deeper-drafted ships or upgrading for the purpose of accommodating larger cranes.

The length of berth provided is normally sufficient to meet the capacity of the yard. In some cases the berths are capable of handling more than the yard capacity because berths are generally provided in whole units of berth length. However, it was assumed the excess berth length cannot be exploited. In the case of Options L2 and L4 the capacity is berth limited due to a high demand for berth space in Port Newark in the relevant Scenarios. Nevertheless, the liquid cargo capacity in those Scenarios is sufficient for the estimated demand in 2060.

For container terminals, the greatest requirement for additional or upgraded berths is in Option C14 at South Brooklyn which requires 5,200ft of new berths and in Options C6 and C7 at Port Jersey, where existing auto berths are unsuitable for container handling and need to be replaced by 2,600ft and 2,300ft of container berths respectively. Option C10 at Howland Hook requires 1,300ft of new berth in a new extension to the terminal. Option C5 at Port Jersey also requires 800ft of additional berth length and some deepening to cater for larger ships, and C8 and C9 at Bayonne Peninsula requires 2600ft of substantial upgrading of the existing ex-military structure to deepen it and provide crane rail support for quay cranes.

For auto terminals, most existing berths are adequate because of the relatively light demands of auto unloading. However, the poor condition of some berths at South Brooklyn means that for Options A11 and A12, 750ft and 1,500ft of new berth are required respectively. New berths have been provided in some Options where no berth currently exists.

For general cargo terminals, the greatest costs for berth provision are for Option G2 at North Brooklyn and Option G4 at Port Newark South where 5,600ft of berths and 4,550ft of berths are required respectively to replace existing aging and unsatisfactory structures. Option G1 at North Brooklyn also has a significant requirement for 2,350ft of replacement berths. Option G3 at South Brooklyn also requires 2,600ft of replacement and upgrading.

For dry bulk terminals, the most expensive Option is D4 at South Brooklyn, which requires 2,100ft of new berths.

For liquid bulk terminals, L3 has the greatest new provision: 1,740ft of new berths to replace aging and unsatisfactory existing structures.

The remainder of the Options include some lesser extensions and upgrading as detailed on the infrastructure capital cost spreadsheet in Appendix G.

(d) Paving

Three types of paving were considered for the estimates:

- Heavy duty surfacing for container stacking and handling.
- Light duty surfacing for truck access.
- Light duty parking surfacing for auto storage.

The cost of paving for container terminals simply reflects the area of expansion of the terminal. The highest costs are for Option C14 at South Brooklyn requiring 322 acres of new paving and for Option C9 at Bayonne Peninsula expanding from zero to 150 acres. Of these areas, 70% was considered heavy duty and 30% was considered light duty for truck access giving totals of $73 million and $30 million at C14 and C9 respectively.

For auto terminals, where several Options involve taking over the land previously occupied by buildings and other activities a judgment was made about how much of the previous surfacing was suitable for auto parking. Wherever possible the floors of existing warehouses were retained for use. This has some drawbacks such as differing site levels, disruption of storage patterns and lack of drainage falls, but the alternative of floor demolition and repaving is considered unnecessarily expensive for the purpose of parking vehicles. The greatest paving costs are $6.0m for Option A9 at Bayonne Peninsula, for Option A12 at South Brooklyn where paving costs are $4.3 and for Option A15 at Port Newark South where paving costs are $4.6m.

The paving requirements for general cargo, dry bulk and liquid bulk are generally relatively minor due to the existence of satisfactory surfacing in most existing general cargo areas and the low surfacing demands of bulk and liquid cargo handling.

The infrastructure spreadsheet in Appendix G gives details of the assumed areas to be paved for all Options.

(e) Buildings & Liquid Tanks

The requirements for buildings are described in Section 6.6. The most significant allowances for buildings were made for terminals that were expanding as in the case of the acquisition of the neighboring auto terminal for container use in C7 at Port Jersey, the new terminals C9 and A9 at Bayonne Peninsula and terminal C14 at South Brooklyn. Option G2 at North Brooklyn has $110 million for buildings due to the need to replace old piers in the northern area that currently support cargo sheds. Option G4 at Port Newark South has $84 million for new buildings as the area currently has few suitable warehouses.

Tanks for bulk liquid storage for Options L1, L2 and L3 generally have a relatively significant cost, with Option L2 costs being the greatest simply because it has the greatest increase in terminal size. Option L4 was assumed not to expand and no tank costs were included.

(f) Wetland Compensation

Wetland compensation was provided on the basis described in Section 11.2.2 and in the quantities given in Table 11.2. (In Table 11.1, wetland compensation costs are included under 'Other').

Option C3 at Port Elizabeth requires the largest area of compensation due to the acquisition of designated wetland to the south of the existing site. Option C14 has the greatest cost due to the large area of compensation for filling the shallow margins of existing derelict wharves, coupled with the high land cost for mitigation assumed for the New York City region. Option C10 at Howland Hook is also in the New York City region and has a large area of compensation due to the extension of the existing terminal into an area presently comprising marshland and river margins. Options C9, A9 and A10 at Bayonne Peninsula require a large area of compensation due to the presence of low lying land at the inner end of the Port Jersey Channel. Options C6 and C7 at Port Jersey include the filling of a marshland area presently designated as a nature reserve. Options A8 and C5 have minor areas of wetland arising from berth construction.

Although for Options A11, A12, G3, and D4 at South Brooklyn, berth construction is required, it was assumed that no wetland compensation was required on the basis that the development was on sites recently occupied by the remnants of berths. In Option C14 an allowance was made as described in the preceding paragraph due to the long time-span of the dereliction, although the same argument may be put forward.

Option	Estimated Wetland Area (acres)	Area to be Provided in Compensation (acres)	Cost ($m)
C3 **Port Elizabeth**	27	81	10.4
C5 **Port Jersey**	1	3	0.4
C6 **Port Jersey**	7	21	2.7
C7 **Port Jersey**	7	21	2.7
C9 **Bayonne Peninsula**	17	51	6.5
C10 **Howland Hook**	15	45	18.1
C14 **South Brooklyn**	14	42	17
A8 **Port Jersey**	1	3	0.4
A9 **Bayonne Peninsula**	17	51	6.5
A10 **Bayonne Peninsula**	17	51	6.5

Table 11.2 Wetland compensation costs

Note: Costs are quoted at 2003 constant US dollars.

11.3 Preliminary Cost Estimates for Equipment

11.3.1 General

The preliminary cost estimates for the capital cost and maintenance of the equipment required for each of the terminal Options for a nominal period of 30 years are summarized in Table 11.3. Although details of equipment costing is given in CPIP Task F and CPIP Task G reports, these estimates will quickly go out of date due to the purchases and replacements being made on a continuous basis by the terminal operators.

Preliminary equipment cost estimates were also determined for the 'no change' case to be used in the financial analysis[101].

11.3.2 *Basis of the Equipment Cost Estimate*

(a) General

The equipment cost estimate for each of the terminal Options was based on preliminary conceptual schedules of equipment for the type of cargo proposed to be handled at the terminal, and took account of an estimate of the existence of equipment already on site in 2001. The unit prices for provision of equipment were based on mid 2003 prices derived from the following sources:

(i) Recent quotations from equipment suppliers;

(ii) Rates for similar items in the Consultant's in-house database of international equipment supply updated and adjusted for local circumstances.

(b) Container Terminals

To determine the number of cranes required, the demand was divided by an annual productivity figure, which was a combination allowing for the differing productivities of old and new cranes. For existing container cranes a productivity of 90,000lifts per crane per year was used, and for new cranes a future productivity of 130,000lifts per year was used. At points in time where the calculations indicated too few cranes for the number of berths, additional cranes were added to allow for a minimum of six cranes at two berths or nine cranes at three berths. The remainder of the major equipment for the Option was derived on the basis of a fixed ratio of equipment per quay crane. For example, the numbers of RTG's and Straddle Carriers required for each quay crane were judged to be 3 and 5 respectively to cover ship-side and land-side handling. Yard tractors, trailers and reach stackers were assigned on a similar basis. Minor equipment such as terminal staff transport was assigned on the basis of

[101] The 'no change' case is defined as the case where the terminal throughput is held constant at the near-future values, and no new infrastructure is constructed. There is no additional equipment required but there are associated theoretical periodic replacement and maintenance costs and these are given in Appendix K of CPIP Task F Technical Memorandum, Vol. 1. The 'no change' case for general cargo was adjusted to align the investment dates with the Option investment dates. The revised details are given in Appendix G of CPIP Task G Technical Memorandum.

5% of the total of other equipment. Each item of equipment was given a life expectancy as indicated on the tables in Appendix G of Task F Technical Memorandum, Vol. 1, and replaced by new equipment when life-expired. Maintenance costs were included at a rate of 5% of the capital value.

(c) Auto Terminals

No cranes or other expensive cargo handling equipment are required for auto terminals as the cars are simply driven off the ship to the parking area. However, auto terminals at ports will include processing of vehicles on site if land is available at economic rent for that purpose. The type of processing can include accessory installation, bodywork repair, and removal of protective shipment coatings. As the extent of processing in the future is not known and the cost of the associated equipment for these operations is small, a nominal allowance based on one or two carwash lines has been made based on terminal size together with an allowance for other miscellaneous equipment. The details are given in the tables in Appendix H of CPIP Task F Technical Memorandum, Vol. 1. Maintenance costs were included at a rate of 5% of the capital value[102]. Appendix E of CPIP Task G contains updated sheets for Options A8 and A15.

(d) General Cargo Terminals

The cost estimate is unchanged from CPIP Task F. A spread of equipment for a general cargo terminal was based on the typical values given in the UN Port Development Handbook[103] with adjustments based on recent terminal designs. A typical nominal spread per berth was assumed to comprise a 20t mobile tower crane, 1.7 x 10t mobile yard cranes, 3.3 x 6t and 5 x 3.5t fork lift trucks, 5 tractors, 16.7 trailers, and other miscellaneous equipment at 15% of the cost of the main equipment. It should be noted that these figures are applicable to a collection of berths numbering 3 or more. The details are given in the tables in Appendix I of the Task F Technical Memorandum, Vol. 1[104].

[102] The 'no change' case for Option A13 in Appendix K of the CPIP Task F Technical Memorandum is applicable to Option A15.
[103] UN Conference on Trade and Development, Port Development, 2nd Ed
[104] The 'no change' case for general cargo was adjusted to align the investment dates with the Option investment dates. The revised details are given in Appendix G of CPIP Task G Technical Memorandum.

(e) Dry Bulk Terminals

The type of equipment required for bulk terminals is highly dependent on the type of cargo being handled. Some operations also rely on the ships' equipment and have only to provide relatively cheap conveyors and yard loaders. As the future uses of the terminals is unknown a representative allowance of 1 grabbing crane at a cost of $2m for every 600,000t of cargo throughput per year was made together with other equipment at 20% of the crane cost. The details are given in the tables in Appendix J of Task F Technical Memorandum, Volume 1[105].

(f) Liquid Bulk Terminals

The type of equipment used at liquid bulk terminals is generally of a fixed nature, such as tanks, loading arms, pipework etc. with tanks being by far the greatest cost element and mobile equipment being of relative insignificance. Allowance was made in the capital cost of infrastructure for such equipment, hence there is no separate equipment estimate.

11.3.3 *Main Influences on the Equipment Cost Estimate*

As seen in Table 11.3, the terminals with the highest equipment costs are container terminals followed by general cargo terminals, then dry bulk terminals and finally the auto terminals, which have very low equipment requirements. Liquid terminal equipment costs do not appear here because an allowance was made in the infrastructure costs.

[105] A small correction to the pattern of growth was made to Option D4 which is included in Appendix F of CPIP Task G Technical Memorandum.

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Port Newark South	Port Newark South	Port Elizabeth	Port Elizabeth	Port Jersey	Port Jersey	Port Jersey	Bayonne Peninsula	Bayonne Peninsula	Howland Hook	Howland Hook	Port Elizabeth	Port Elizabeth	South Brooklyn
332	432	926	861	270	294	417	294	294	445	317	708	832	490

Container Terminals

A1	A2	A4	A8	A9	A10	A11	A12	A13	A14	A15
Port Newark North	Port Newark North	Port Newark South	Port Jersey	Bayonne Peninsula	Bayonne Peninsula	South Brooklyn	South Brooklyn	Port Newark South	Port Newark South	Port Newark South
3	3	3	2	2	1	1	1	3	3	4

Auto Terminals

G1 +G3/G2/G4
N&S Brooklyn/N Brooklyn/S Brooklyn
170

General Cargo Terminals

D1	D2	D4	
Port Newark North	Port Newark North	South Brooklyn	
72	33	40	

Dry Bulk Terminals

Table 11.3 Summary of equipment capital and maintenance cost estimates for Options ($m)

Note
1. Equipment for liquid terminals included in capital costs.
2. Includes maintenance during the period.
3. 30 year period for analysis except Gen Cargo 40 years
4. Costs are quoted at 2003 constant US dollars.

11.4 Preliminary Cost Estimates for Port Scenarios

11.4.1 General

This Section considers the relative costs and benefits from the development of Scenarios and Options. The costs in this Section are the basic 2003 values without consideration of inflation or net present value.

The preliminary cost estimates for Scenarios were determined by adding together the infrastructure cost, equipment cost and maintenance costs over a 30 year period for each of the Options making up a Scenario. The results are shown in Table 11.4 which shows that the costs are dominated by the equipment for container terminals and by container terminals generally.

11.4.2 Relative Cost/Benefit of Scenarios and Options

Relative to other Scenarios, the 30 year cost of Scenario Blue is very expensive mainly because of the high cost of developing the waterfront south of the existing South Brooklyn Marine Terminal. Considered as a Scenario it delivers the highest 30 year cost per additional ton of cargo.

The relative 30 year costs of all Scenarios are close, with the highest being only 113% of the lowest. This is to be expected, as the Scenarios cater for approximately the same quantity of cargo overall, in Scenarios that have only a few fundamental differences. The highest throughput of a complete Scenario is only 108% of the lowest. The results therefore indicate that although there are a number of high cost individual terminal Options that do not deliver much increase in capacity, no overall Scenario is significantly better value, in terms of 30 year cost per ton of additional capacity, than any other. Having looked at the wider picture for Scenarios, it is useful to consider the Options which make up Scenarios in greater detail and to consider the financial results including equipment and revenue. This financial analysis is described in the following Sections.

	Orange	Red	Yellow	Blue
Infrastructure				
Container	793	739	449	1,088
Auto	133	82	140	118
General Cargo	231	231	393	283
Dry	40	113	40	40
Liquid	96	36	96	63
Maintenance (30 yrs except General Cargo, 40 yrs)	315	314	291	305
Total Infrastruct. incl. Maintenance ($m)	**1,608**	**1,515**	**1,409**	**1,897**
Equipment incl. Maintenance				
Container (30 yrs)	3,129	3,148	2,854	2,950
Auto (30 yrs)	10	7	11	10
General Cargo (40 yrs)	170	170	170	170
Dry (30 yrs)	72	73	72	72
Liquid (negligible cost)	--	--	--	--
Total Equipment incl. Maintenance ($m)	**3,381**	**3,398**	**3,107**	**3,202**
Grand Total ($m)	**4,989**	**4,913**	**4,516**	**5,099**
Proportion of cost relative to cheapest	***110%***	***109%***	***100%***	***113%***
Proportion of cargo tons[106] per year in Scenario relative to least	***108%***	***108%***	***100%***	***101%***

Note: Costs are quoted at 2003 constant US dollars

Table 11.4 Capital and maintenance cost for scenarios

[106] Containers converted at 7 tons/TEU (*ref. CPIP Task E Technical Memorandum, Volume 1, Appendix E1-D, Total Container Terminal Throughputs*), and autos at 1.693t/auto (*ref. CPIP Task E Technical Memorandum, Volume 1, Table E1-23*)

11.5 Financial Analysis - Container Terminals

11.5.1 Net Present Value of Projects

The summary results of the financial analysis for container terminal Options are shown in Table 11.5.

The estimated total cost of each terminal project includes the estimates of capital, equipment and maintenance costs given in Sections 11.2 and 11.3. The capital costs are spread over an assumed nominal 3-year construction period. All other costs are calculated for a 20-year period, this being a reasonable evaluation period for commercial projects. Equipment costs include the purchase of new equipment and replacement of equipment that reaches the end of its economic life within the 20-year period.

Estimated operating costs relate to wage costs only and are based on the following assumptions:

(a) For container terminals, operating costs are directly related to the number of jobs created by additional throughput. A round figure of $142,000 was used as a reasonable assumption of average salary costs in New York for port workers. The figure is based on NYSA annual reports on average wages for port workers over the 2000-2004 period. A basic assumption was used, that 3 million TEU of throughput requires 1,000 dockers and 1,500 other direct terminal based jobs. Therefore the additional operating cost is calculated to be $118,333 per 1,000 TEU or $118.3 per TEU. This is a simplification, which the study consultant feels is appropriate for preliminary analysis and Option comparisons, rather than undertaking a detailed analysis of job structures.

(b) Operating costs are escalated in a direct relationship with throughput and increase cumulatively year on year up to Year 10 of operation when the terminal is deemed to be operating at full capacity.

(c) For all other terminals (auto, dry bulk, liquid bulk and general cargo) an overall operating cost per unit or tonne of cargo was assumed and escalated this in a direct relationship with throughput.

Two estimates of total project costs are presented. The first presents the net present value (NPV) of estimated costs over the time taken for the project to reach its assumed maximum capacity (i.e. 3 years' construction plus 10 years of operation). This then demonstrates the NPV for developing the project to its full operating potential. The second estimate is of the total NPV of the project over 20 years and includes the cost of replacing and maintaining the equipment for a further ten years at full operating capacity.

A real discount rate of 7% is used in these calculations. This is consistent with the Cross Harbor Study[107].

The breakeven price is the revenue required per unit in order to return an NPV of zero over 20 years and is determined by the amount of expenditure required to build and operate the terminal over 20 years and the minimum revenue required per unit of cargo (TEU, tonne, vehicle unit etc.) to recover this expenditure.

The analysis also allows projects to be ranked according to the revenue per TEU required in order to return an overall NPV of zero.

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[107] Cross Harbor Freight Movement Major Investment Study, PIN X500.19, May 2000 which uses guidelines set out in Circular No.A-94 by the U.S. Office of Management and Budget.

Terminal	Unit	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Capacity															
Existing Capacity	000 TEU	1,185	1,185	2,303	3,126	658	0	658	0	0	967	967	2,303	3,126	0
Additional Capacity	000 TEU	345	1,025	1,777	1,209	200	765	965	850	1,275	843	282	672	912	2.210
Future Capacity	000 TEU	1,530	2,210	4,080	4,335	858	765	1,623	850	1,275	1,810	1,250	2,975	4,038	2,210
Cost															
NPV Total Cost (1)	$m	175	499	818	568	153	719	581	763	912	580	159	283	402	2,026
NPV Total Cost (2)	$m	274	784	1,312	906	216	941	852	1,008	1,270	817	240	473	661	2,646
NPV Cost new capacity/TEU															
(1) over construction/upgrading period	$/TEU	506	487	460	470	762	940	602	898	716	688	564	421	441	917
(2) over 20 years	$/TEU	1,804	1,729	1,695	1,710	2,163	2,400	1,856	2,340	2,051	1,968	1,845	1,666	1,697	2,280
Breakeven Price per TEU	$/TEU	157	151	146	148	213	168	174	162	156	191	168	139	143	187
Rank		7	5	3	4	14	10	11	8	6	13	9	1	2	12

Table 11.5 Financial analysis of container terminals

Notes: 1. @ NPV = 7% over 20 years 2. Costs are quoted at 2003 constant US dollars

11.5.2 *Ranking of Projects*

The analysis produces the ranking of projects shown in Table 11.6. The top ranked projects are at the existing Port Elizabeth terminals, Options C12 and C13, which are not expanded in area and which have the majority of infrastructure in place except for additional or deepened wharves to provide for increased demand and productivity. Their high-ranking position is thus to be expected. These are closely followed by the Port Elizabeth expanded terminal Options, C3 and C4. The expanded terminal at Howland Hook, C10, and unexpanded existing terminal at Port Jersey, C5, fare badly in this assessment because of the heavy investments required to deepen berths in rock at Howland Hook and to provide additional berth length at Port Jersey for larger ships with little overall increase in terminal capacity. When compared with the Port terminal charges of approximately $200[108] (ship's hold to gatehouse) the analysis shows that most projects would operate within the parameters of existing port charges. The top five projects achieve a margin of at least 25%. Only C5 is shown to be potentially sub-optimal. It should be borne in mind that the results are achieved using the assumption that terminals are operating at full capacity and therefore are achieving the maximum possible revenue.

Rank	Project		Additional capacity (000 TEU)(1)	Breakeven price per TEU (2)
1	**C12**	Port Elizabeth	672	139
2	**C13**	Port Elizabeth	912	143
3	**C3**	Port Elizabeth	1,777	146
4	**C4**	Port Elizabeth	1,209	148
5	**C2**	Port Newark South	1,025	151
6	**C9**	Bayonne Peninsula	1,275	156
7	**C1**	Port Newark South	345	157
8	**C8**	Bayonne Peninsula	850	162
9	**C11**	Howland Hook	282	168
10	**C6**	Port Jersey	765	168
11	**C7**	Port Jersey	965	174
12	**C14**	South Brooklyn	2,210	187
13	**C10**	Howland Hook	843	191
14	**C5**	Port Jersey	200	213

Table 11.6 Ranking of container terminal Options

Note: 1. Additional capacity is made up from area and productivity gains
2. Based on costs quoted at 2003 constant US dollars

The relationship of this ranking to the four development Scenarios explained in Chapter 7 is shown in Table 11.3.

108 CPIP Task E Technical Memorandum, Section E.1.4.2.2.

Project	Orange	Red	Yellow	Blue
C12			•	•
C13			•	•
C3	•	•		
C4	•	•		
C2			•	
C9		•		
C1	•	•		•
C8			•	
C11		•	•	•
C6	•			
C7		•		
C14				•
C10	•			
C5	•		•	•

Table 11.7 Relationship of container terminal Options and Scenarios

11.6 Financial Analysis - Auto Terminals

11.6.1 Ranking of Projects

The results of the financial analysis for auto terminals in the Port are summarized in Table 11.8.

The method used for calculating the NPV and ranking of each terminal is identical to that followed for container terminals, with the exception that operating costs are based on an assumed cost of $25.00 per additional unit of throughput.

A ranking of projects based on this approach is presented in Table 11.9. The top two projects, A13 and A4, both Port Newark South projects, are closely ranked together, requiring revenue per additional unit handled of approximately $35 in order to return a NPV of zero. The implication of this is that at a stevedored rate of $35 per unit for trade cars, these projects are likely to be highly uncompetitive in their present form.

Terminal A8 is an improvement project that, while involving the consolidation of lots and upgrading equipment etc. in order to achieve greater operational efficiency, does not actually deliver any new capacity and therefore using this method of calculation, does not generate any additional revenue to cover costs. None of the terminal project proposals outside of Port Newark South stand up well under this analysis; with the implication being that any development plans including them would be highly sub-optimal.

The relationship of this ranking to Scenarios Orange, Red, Yellow and Blue is shown in Table 11.10.

Terminal	Unit	A1	A2	A4	A8	A9	A10	A11	A12	A13	A14	A15
Capacity												
Existing Capacity	units	389,500	389,500	114,000	248,900	-	-	-	-	114,000	114,000	114,000
Additional Capacity (1)	units	9,500	76,000	399,000	0	285,000	95,000	95,000	152,000	247,000	228,000	522,500
Future Capacity	units	399,000	465,500	513,000	248,900	285,000	95,000	95,000	152,000	361,000	342,000	636,500
Cost												
Capital cost (2)	$	11,050,000	14,150,000	23,750,000	11,150,000	62,640,000	41,490,000	35,270,000	63,560,000	12,440,000	32,950,000	67,430,000
NPV Total Cost	$	14,351,273	27,487,774	82,703,595	12,230,507	105,616,733	53,656,126	48,215,044	83,361,331	49,716,569	64,730,527	139,337,343
Cost per unit	$	1,511	362	207	**	371	565	508	548	201	284	267
Breakeven price per unit	**$**	263	130	36	**	55	84	76	82	35	49	46
Rank		**10**	**9**	**2**	**11**	**5**	**8**	**6**	**7**	**1**	**4**	**3**

Table 11.8 Financial analysis of auto terminal projects

Note: 1. Additional capacity is made up from area gains only. 2. Costs are quoted at 2003 constant US dollars

Rank	Project		Additional capacity (units) [1]	Breakeven price per unit
1	**A13**	Port Newark South	247,000	35
2	**A4**	Port Newark South	399,000	36
3	**A15**	Port Newark South	522,000	46
4	**A14**	Port Newark South	228,000	49
5	**A9**	Bayonne Peninsula	285,000	55
6	**A11**	South Brooklyn	95,000	76
7	**A12**	South Brooklyn	152,000	82
8	**A10**	Bayonne Peninsula	95,000	84
9	**A2**	Port Newark North	76,000	130
10	**A1**	Port Newark North	9,500	263
11	**A8**	Port Jersey	0	(2)

Table 11.9 Ranking of auto terminal options

Note: 1. Additional capacity is made up from area gains only.
2. Project does not deliver any new capacity, and therefore zero revenue, therefore calculation of breakeven price is invalid

Project	Orange	Red	Yellow	Blue
A13			●	
A4	●			
A15		●		
A14				●
A9	●			●
A11	●			
A12			●	
A10			●	
A2		●		
A1	●		●	●
A8			●	●

Table 11.10 Relationship of auto terminal options and scenarios

11.7 *Other Terminals*

11.7.1 *Introduction*

The preliminary financial appraisal of general cargo, dry bulk and liquid bulk terminal Options is summarized in Tables 11.11 to 1.16.

Basic assumptions have been used relating to operating costs. These have been calculated on the basis of $5/ton for all terminals. In all cases operating costs are a product of incremental throughput assuming that all new capacity is fully utilized.

11.7.2 *General Cargo*

The analysis shows that the construction of the new terminal G4 is the most successful of the three Options under consideration and is able to return a breakeven NPV result at an average income of $22 per tonne of cargo handled. The other two Options, G2 and the combined alternative of G1 and G3, are extremely costly to achieve in relation to the additional capacity (and therefore potential revenue) that they provide. It is concluded that in their present form these projects would be unviable.

Terminal	Unit	G2	G1+G3	G4
Capacity				
Existing Capacity	tonnes	1,366,800	1,366,800	-
Additional Capacity (1)	tonnes	623,100	623,100	1,989,000
Future Capacity	tonnes	1,989,900	1,989,900	1,989,900
Cost				
Capital cost (2)	$	393,410,000	231,000,000	282,590,000
NPV Total Cost	$	373,206,212	232,548,814	303, 575,900
Cost per tonne	$	599	373	153
Breakeven price per unit	$	167	104	22
Rank		3	2	1

Table 11.11 Ranking of general cargo terminal options

Note: 1. Additional capacity is made up from area gains only.
2. For 20 years. The general cargo only has one or two facilities and growth is slow, so at 20 years the capacity is less than the full terminal capacity. Other terminals eg for containers have full build-out in 10 years.
3. Costs are quoted at 2003 constant US dollars

Project	Orange	Red	Yellow	Blue
G4				•
G1 + G3	•	•		
G2			•	

Table 11.12 Relationship of general cargo terminal options and scenarios

11.7.3 *Dry Bulk*

The comparison of dry bulk terminal Options shows that all those Options proposed for Port Newark North (D1 and D2) return reasonable results. Option D4 falters as it involves high investment costs relative to the additional capacity delivered.

Terminal	Unit	D1	D2	D4
Capacity				
Existing Capacity	units	715,000	715,000	-
Additional Capacity (1)	units	5,505,500	2,145,000	3,575,000
Future Capacity	units	6,220,500	2,860,000	3,575,000
Cost				
Capital cost (2)	$	39,790,000	27,080,000	86,130,000
NPV Total Cost	$	147,416,644	68,578,799	171,102,401
Cost per tonne	$	27	32	48
Breakeven price per unit	**$**	8	9	11
Rank		1	2	3

Table 11.13 Ranking of dry bulk terminal options

Note: 1. Additional capacity is made up from area gains only.
2. Costs are quoted at 2003 constant US dollars

Project	Orange	Red	Yellow	Blue
D1	●		●	●
D2		●		
D4		●		

Table 11.14 Relationship of dry bulk terminal options and scenarios

11.7.4 *Liquid Bulk*

The analysis of liquid bulk terminal Options indicates that Option L4 in Port Newark South (Blue Scenario) represents the best terminal Option. This Option is unusual in that it results in a net reduction of capacity of 1 million tonnes per annum and therefore returns a negative overall cost as a result of the associated reduction in operating costs.

Comparison of demand with existing capacity shows that an increase in liquid bulk capacity at the Port will not be required within the CPIP 60-year time horizon; therefore projects that bring about a reduction of capacity may be worthy of consideration.

Terminal	Unit	L1	L2	L3	L4
Capacity					
Existing Capacity	units	2,850,000	2,850,000	2,850,000	2,850,000
Additional Capacity (1)	units	2,280,000	3,644,000	2,850,000	- 1,050,000
Future Capacity	units	5,130,000	6,494,000	5,700,000	1,800,000
Cost					
Capital cost (2)	$	39,680,000	36,090,000	56,170,000	22,980,000
NPV Total Cost	$	77,203,492	98,826,259	101,956,528	2,193,577
Cost per unit	$	34	27	36	-2
Breakeven price per unit	$	9	8	10	-1
Rank		3	2	4	1

Table 11.15 Ranking of liquid bulk terminal options

Note: 1. Additional capacity is made up from area gains only.
2. Costs are quoted at 2003 constant US dollars

Project	Orange	Red	Yellow	Blue
L4				•
L3	•		•	
L1	•		•	•
L2		•		

Table 11.16 Relationship of liquid bulk terminal options and scenarios

11.8 Economic Impacts of Options

This Section identifies the total economic impacts of different terminal Options for the Port. The analysis is preliminary and is limited to the consideration of container and automobile terminal Options. The method used to calculate impacts has been based on earlier work carried out by the New York Shipping Association[109] (NYSA). Table 11.17 presents the economic coefficients for the 26-county Port Region implied by the NYSA's earlier work, based on Port throughput figures for 2000 (Containers 3,630,289 TEU, vehicles 667,700 units).

[109] Economic Impacts of the New York/New Jersey Port Industry', August 2001

Handling Type	Direct Jobs (no of jobs)	Jobs in Other Industries (no of jobs)	GDP ($m)	Income ($m)	Federal Taxes ($m)	State Taxes ($m)	Local taxes ($m)
Containerized	12,874	16,867	1,635.0	989.8	208.8	66.2	96.3
Auto	709	1,007	106.8	65.2	13.3	4.2	6.3
Co-efficient	**jobs/000 units**	**jobs/000 units**	**$/unit**	**$/unit**	**$/unit**	**$/unit**	**$/unit**
Containerized (per TEU)	3.5	4.6	450.4	272.7	57.5	18.2	26.5
Auto	1.1	1.5	160.0	97.6	19.9	6.3	9.4

Table 11.17 Implied economic coefficients, 26-county Port region

Note: Costs are quoted at 2003 constant US dollars.

The above coefficients have been applied to the incremental throughput capacity of the various terminal Options to indicate the overall potential benefits of different projects. The results are summarized in Tables 11.18 and 11.19. It follows that since these impacts are functions of throughput, those projects offering greatest additional capacity potentially will have the greatest benefits. Hence for containers, the best performing projects in economic terms are terminals C14, C3, C9, C4, and C2, all of which offer more than 1 million TEU of incremental capacity. For Automobile terminals, the best projects are A15 and A4 (both Port Newark South projects).

Tables 11.18 and 11.19 also identify the total additional capacity that is required by the CPIP program as indicated by the base case forecasts for these two commodities. Hence for containerized cargo, there is a requirement for the Port to provide sufficient capacity to handle an additional 2.7 million TEU, being the difference between the projected 11.3 million TEU of demand in 2060, compared with existing (potential) capacity of 8.6 million TEU (at a productivity rate of 3,871 lifts per acre per year). The implication is that building to provide such capacity would potentially generate 22,000 jobs in the Port Region. For automobiles there is an additional capacity requirement for 430,000 units, which would yield approximately 1,100 jobs in the Port Region.

Terminal project	Unit	C1 Port Newark South	C2 Port Newark South	C3 Port Elizabeth	C4 Port Elizabeth	C5 Port Jersey	C6 Port Jersey	C7 Port Jersey	C8 Bayonne Peninsula	C9 Bayonne Peninsula	C10 Howland Hook	C11 Howland Hook	C12 Port Elizabeth	C13 Port Elizabeth	C14 South Brooklyn	CPIP Total
Additional TEU	TEU	345,474	1,025,474	1,776,755	1,209,168	200,430	765,000	965,430	850,000	1,275,000	843,137	282,137	671,755	911,668	2,210,000	2,723,000
Employment		2,830	8,401	14,556	9,906	1,642	6,267	7,909	6,964	10,445	6,907	2,311	5,504	7,469	18,107	22,308
Direct	jobs	1,225	3,637	6,301	4,288	711	2,713	3,424	3,014	4,521	2,990	1,001	2,382	3,233	7,837	9,657
In other industries	jobs	1,605	4,765	8,255	5,618	931	3,554	4,486	3,949	5,924	3,917	1,311	3,122	4,236	10,270	12,652
Gross State Product	($m)	155.6	461.9	800.2	544.6	90.3	344.5	434.8	382.8	574.2	379.7	127.1	302.6	410.6	995.4	1,226.4
Income	($m)	94.2	279.6	484.4	329.7	54.6	208.6	263.2	231.8	347.6	229.9	76.9	183.2	248.6	602.7	742.4
Federal taxes	($m)	19.9	59.0	102.2	69.5	11.5	44.0	55.5	48.9	73.3	48.5	16.2	38.6	52.4	127.1	156.6
State taxes	($m)	6.3	18.7	32.4	22.0	3.7	14.0	17.6	15.5	23.3	15.4	5.1	12.2	16.6	40.2	49.7
Local taxes	($m)	9.2	27.2	47.1	32.1	5.3	20.3	25.6	22.5	33.8	22.4	7.5	17.8	24.2	58.6	72.2
Rank		12	5	2	4	14	10	6	8	3	9	13	11	7	1	

Table 11.18 Economic impacts of container terminal options on the Port region

Note: Costs are quoted at 2003 constant US dollars.

Terminal project / Location	Unit	A1 Port Newark North	A2 Port Newark North	A4 Port Newark South	A8 Port Jersey	A9 Bayonne Peninsula.	A10 Bayonne Peninsula	A11 South Brooklyn	A12 South Brooklyn	A13 Port Newark South	A14 Port Newark South	A15 Port Newark South	CPIP Total
Additional capacity	units	9,500	76,000	399,000	0	285,000	95,000	95,000	152,000	247,000	228,000	522,500	430,086
Employment		24	195	1,025	0	732	244	244	391	635	586	1,343	1.105
Direct	jobs	10	81	424	0	303	101	101	161	262	242	555	457
In other industries	jobs	14	115	602	0	430	143	143	229	376	344	788	649
GDP	($m)	1.5	12.2	63.8	0.0	45.6	15.2	15.2	24.3	39.5	36.5	83.6	68.7
Income	($m)	0.9	7.4	39.0	0.0	27.8	9.3	9.3	14.8	24.1	22.3	51.0	42.0
Federal taxes	($m)	0.2	1.5	7.9	0.0	5.7	1.9	1.9	3.0	4.9	4.5	10.4	8.6
State taxes	($m)	0.1	0.5	2.5	0.0	1.8	0.6	0.6	1.0	1.6	1.4	3.3	2.7
Local taxes	($m)	0.1	0.7	3.8	0.0	2.7	0.9	0.9	1.4	2.3	2.1	4.9	4.1
	($m)												
Rank		9	10	2	11	3	8	7	6	4	5	1	

Table 11.19 Economic impacts of automobile terminal options on the Port region

Note: Costs are quoted at 2003 constant US dollars.

11.9 Risk

An assessment of risk, and suggested risk mitigation, for the successful implementation of the Comprehensive Port Improvement Plan is shown in Table 11.20

#	Description	Risk	Risk Mitigation
1	Demand	Forecast demand too low or too high Panama Canal is widened	Review at regular intervals and when assumptions change, for example when the Panama Canal is widened Review development progress
2	Capacity	Failure to meet land productivity values assumed in the analysis.	Monitor against world standards and put in place mechanisms to encourage upgrading of handling systems.
3	Sites – General	Land allocated for non port terminal use, for example Ikea. Contaminated land found Ground conditions make construction expensive Commercial plans of railroads removes access to terminals Existing acreage within port boundary not released for terminal space	Manage development. Undertake appropriate site investigations prior to development Undertake appropriate site investigations prior to development Liaise with railroads Manage lease arrangements
4	Port Newark North	Airport approach path restrictions tightened. Bayonne Bridge air draft restriction	Liaise with appropriate authorities Monitor plans for raising bridge and future ship design parameters
5	Port Newark South	Bayonne Bridge air draft restriction	Monitor plans for raising bridge and future ship design parameters

#	Description	Risk	Risk Mitigation
6	Port Elizabeth	Bayonne Bridge air draft restriction.	Monitor plans for raising bridge and future ship design parameters
7	Port Jersey	Failure to obtain approval to fill wetland Rail Roads' plans for access.	Manage permitting process Liaise with Rail Roads
8	Bayonne Peninsula	BLRA Master Plan changes	Liaise with BLRA
9	Howland Hook	Expansion into Arlington Marsh becomes necessary.	Develop Options to avoid expansion.
10	North Brooklyn	Area set aside for non port use.	Manage development process
11	South Brooklyn	Blue Scenario – Failure to get timely approval for major reclamation. Blue Scenario - Cross Harbor Tunnel never constructed to get rail boxes out on to the rail system Conflicting proposed land uses for waterfront areas	Manage permitting process Coordinate port development with tunnel development Liaise with appropriate planning bodies and stakeholders

#	Description	Risk	Risk Mitigation
12	Highways	Highways reach capacity as a result of regional traffic limiting the movements of port goods by truck. Improvement funding sources not available. Public concerns over port truck traffic on local streets. Driver shortage. Fuel cost instability.	Monitor the capacity of the regional highway infrastructure and provide capacity enhancements or mode alternatives where necessary. Provide policy support for the provision of funds where appropriate. Continued public involvement during port improvement implementation phases Monitor and provide policy and other support for workforce stability. Monitor and provide policy and other support for fuel cost stability and alternative fuels development and use.
13	Rail	Railroads concentrate on alternative business opportunities to port traffic. Railroads service offer insufficient to increase rail's market share of port traffic. Funding not identified for infrastructure enhancements or other funding support required for establishment, maintenance or improvement of rail capability and service offer. Railroad merger acquisition and commercial restructuring forces changes in traffic routing.	Review rail demand and developments at regular intervals. Provide policy and other support for service innovation. Provide policy and lobbying support for the provision of funds where appropriate. Review changes that occur for any significant impact on the utilization of congested and near-congested railroad segments, in consultation with the railroad corporations.

#	Description	Risk	Risk Mitigation
		Rail access to terminals becomes constrained by other activities or development on port or railroad property.	Review development and business activity periodically.
14	Barge	No startup support provided	Identify sources of funding
15	Stakeholder Issues	No highway & rail infrastructure improvements are implemented Stakeholders, especially elected officials, do not support improvement Options Environmental Impact Statement is not conducted. Security measures are not adequately accounted for in the final improvement Option. Rail & highway improvement Options are not implemented Perception of high volume of Port-related truck traffic on the highway network.	Monitor planned and funded improvement projects, continue stakeholder dialogue Brief elected officials & Community Boards on the improvement Options prior to meeting Stakeholders. Clarify with stakeholders during Stakeholder Committee meetings the reasons an EIS is not required. Examine and include anticipated security structures, procedures and personnel. Keep stakeholders informed of all port access improvements Stress that Port-related truck traffic is an extremely low percentage of the overall truck volume on the highway network and remains low to the year 2060.
15	Implementation	CPIP planning ignored Plan overtaken by events outside the control of the Consortium.	Convene body with port-wide planning oversight. Build flexibility and review processes into the plan.

Table 11.20 Risk assessment

12 Environmental Issues

12.1 *Introduction*

This Section discusses a broad range of general environmental issues pertaining to the development of Ports; the impacts and effects of various container terminals on many different parts of the environment, the effects of warehousing demands needed to accommodate today's Ports, and finally the various opportunities which can be followed to implement Green Port Planning. The aforementioned are described in detail in Sections 12.2, 12.3, and 12.4 respectively.

This report has been prepared in conjunction with an environmental assessment by others. The development of the environmental assessment is described in Section 2.1.

12.2 *Cargo Terminal Impacts*

12.2.1 *Introduction*

This Section describes the main environmental issues that affected the Consultant's choice of Options and Scenarios in qualitative, general terms and discusses their relevance to the selection of terminal Options. It should be noted that no site measurements or surveys have been made and that this appraisal is not intended to constitute a formal assessment of Environmental Impact under any relevant regulations.

The main environmental issues that were expected when the study commenced were in connection with the anticipated need for substantial areas of waterfront fill which had been identified in previous studies. As this need for fill was shown to be superseded by recent advances in cargo handling efficiencies at container terminals, the main environmental issues did not emerge.

The following is therefore an appraisal of the important but less significant issues relating to the environs of the present Port.

12.2.2 *Light*

The presence of terminal lighting adjacent to other public areas such as residences or retail activities can cause unwanted effects if there is intrusive light or glare. The effect of lighting on natural habitats can also have unwanted effects. The main light sources of significance are described below.

Container terminals are lit using area lighting on high masts typically 80 to 120ft high. The quay cranes that load and unload ships are also very high and have lighting to illuminate the operational area and can also have aircraft warning lights at heights up to around 350ft above ground level. Compared to normal street lighting, the intensity and height of the terminal area lighting and equipment lighting can be intrusive particularly where sites have previously been undeveloped, or used for purposes requiring only low height lighting poles and low intensity lighting.

Auto terminals require relatively lower levels of light than required by other cargo handling terminals and the lighting poles can be the normal street lighting height of around 35ft, although high masts similar to those at container terminals are also used. The auto ships themselves have the most significant visual effect although the operational areas of the ship are largely enclosed and the intensity of lighting external to the ship is low except in the area of the vehicle discharge ramps.

General cargo terminals also have area lighting but usually on lower masts than container terminals. The ships are usually unloaded by ships' gear that requires effective lighting of the cargo handling area, but the ship's cranes are much lower than container handling cranes.

The type of operation used at dry bulk terminals varies considerably depending on the type of cargo and its storage and handling method. Most products do not require high mast lighting. Some unloaders such as grab cranes will be at a high level and require lighting for their operation but others such as pneumatic unloaders can have a relatively low profile with little lighting required. Lighting on truck loading hoppers can be typically at elevations up to about 150ft but the degree of lighting at that height will depend on maintenance and operational requirements on the hopper itself and would often be insignificant unless used for area lighting. Heaps of product in the open that are handled by bulldozers and front loading shovels will typically be provided with some medium high mast lighting, as the normal poles would be too numerous and vulnerable to accidental collision by the heavy mobile equipment.

Liquid bulk ships are unloaded using articulated arms and operational lighting is required at the manifold connections on the ship. General background lighting is required around the terminal with some localized high levels of lighting at operational flow control locations. Tank storage can be typically up to about 150ft high but there is generally no need for lighting on the upper tank levels except for occasional maintenance.

12.2.3 *Noise*

Noise from terminals can be a source of annoyance to neighbors and can disturb wildlife.

Container terminals are regarded as noisy environments as the containers are made of steel and a large proportion of the containers are empty resulting in un-deadened noise. Noise sources include impact sounds made during the handling process and safety beepers from reversing mobile plant or traversing cranes. The diesel engines of container handling mobile equipment are also a significant source of noise. Large numbers of refrigerated containers (reefers) are stored on the terminal and these require refrigeration compressor units to keep the temperature at the required level. At some terminals the refrigerated containers are stored in high stacks that can cause the compressor noise to be heard from a long distance.

The noise level at auto terminals is similar to normal street levels.

General cargo is diverse, ranging through timber and steel products, and the noise level will depend on the type of cargo being handled. However, the noise levels are generally less than those at container terminals.

Dry bulk terminals also handle a diverse range of products. In some cases there may be intermittent noise from loading equipment scraping product from concrete slabs and general background noise of conveyors and machinery.

Liquid bulk terminals generally have low noise levels.

12.2.4 *Dust and Odors*

Dust can be transported out of the terminal by the wind and can cause inconvenience and health concerns to neighbors. The main risk of dust is from dry bulk handling terminals, although modern methods of cargo handling and storage can virtually eliminate the problem, if efficiently maintained and operated. In the other terminals the levels of dust can be controlled by general site housekeeping.

Some liquid bulk handling operations can create widespread odor from uncontrolled tank venting, or spillage, whereas others may have emission control facilities or may handle odorless product. The general odors caused by terminal equipment exhaust emissions are generally sufficiently dissipated at the terminal boundary to prevent odor nuisance.

12.2.5 *Air Quality*

Air quality is affected by the emissions from several sources at ports.

Increased road traffic at a location, arising from port terminals, can cause an increase in emissions as well as inconvenience and health and safety concerns to the general public and other road users.

For a given site area, container terminals will usually create the most overall traffic, both inside and outside the terminal. A dry or liquid bulk terminal that discharges directly to trucks or that has a low product dwell time may induce peaks in the traffic flow but more normally there are storage facilities on the site. The general level of internal traffic is low. Autos are generally processed to some degree on site and are then loaded on transporters that carry several autos. The flow can therefore be more evenly distributed. The level of auto traffic on the site is sporadically quite high but with small engines. All modes of cargo are subject to peaks and troughs in the external traffic flow due to industry preferences and opening times of terminals.

The number of port related trucks and hence the level of emissions from them is relatively insignificant compared to the general background levels except on some of the port connector roads prior to joining the main highway system.

Further sources of emissions at ports include ships at berth, diesel cranes and cargo handling equipment. These sources are described in Section 12.4.8. At terminals with rail facilities the rail loading equipment and locomotive power units also contribute to the overall impact on air quality.

12.2.6 *Wildlife Habitat*

Using the information shown on Volume 2: Toolkit, Figures 2.6, 3.6, 4.6, 5.6, 6.6, 7.6, 8.6, 9.6 and 10.6 the following sites within the Scenarios were identified.

- Inland of South Elizabeth Channel, designated as national wetland inventory. Proposed for acquisition for container terminal use in Option C3 in Scenarios Orange and Red.

- Small lot in NEAT terminal, at Port Jersey designated as national wetland inventory and presently a nature conservation area. Proposed for container terminal use in Scenarios Orange, and Red. In addition some foreshore wetland will be filled to create additional berth length in all Scenarios at Port Jersey

- Inland of Port Jersey Channel on the Bayonne Peninsula site, designated as national wetland inventory. Proposed for use in all Scenarios.

- At the extension to Howland Hook the foreshore is designated as national wetland inventory and wetland will be used in Option C10.

For a summary of wetland areas in each Option see Table 12.1

Option	Estimated Wetland Area (acres)	Area to be Provided in Compensation (acres)	Cost ($m)
C3 **Port Elizabeth**	27	81	10.4
C5 **Port Jersey**	1	3	0.4
C6 **Port Jersey**	7	21	2.7
C7 **Port Jersey**	7	21	2.7
C9 **Bayonne Peninsula**	17	51	6.5
C10 **Howland Hook**	15	45	18.1
C14 **South Brooklyn**	14	42	17
A8 **Port Jersey**	1	3	0.4
A9 **Bayonne Peninsula**	17	51	6.5
A10 **Bayonne Peninsula**	17	51	6.5

Table 12.1 Wetland compensation costs.

Note: Areas provided by CPIP EIS Consultant. Costs are quoted at 2003 constant US dollars.

The regulations require mitigation for the loss of wetland specifying that more mitigation land must be provided than the wetland destroyed. The ratio varies based on location. For the purposes of this study the ratio of mitigation land to lost wetland is standardized at 3 to 1. Waterfront filling, on the other hand does not necessarily require mitigation. Mitigation is based on loss of habitat, not merely the act of filling. The total areas of wetland vary depending on the Scenarios, as shown in Table 12.2.

Scenario	Area of Wetland (acres)
Orange	67
Red	51
Yellow	19
Blue	33

Table 12.2 Areas of wetland in scenarios

12.2.7 *Public Waterfront Access*

In addition to their commercial potential for port related activity, waterfront areas are valued in terms of their recreational use and hence contribution to quality of life. However, cargo terminals are dangerous environments for untrained members of the general public and therefore, for safety and security reasons the two uses must be segregated. The practicality of providing separate areas of waterfront access at sites needs to be considered on a site-by-site basis. Waterfront access in this context generally refers to public access to a prepared waterfront area providing views over water and also where appropriate incorporating landscaping, nature trails and recreational facilities.

This review only considers the practicality of including waterfront access within the proposed development areas.

It should be noted that in the proposed Scenarios, none of the waterfront proposed for incorporation within the terminal Options is currently accessible to the public.

At this stage, it appears impractical and perhaps undesirable to provide waterfront access at Port Newark North, Port Newark South and Port Elizabeth as:

- The waterfront is far from community residential areas;
- There are large numbers of heavy trucks maneuvering on the local streets;
- Container, auto and liquid facilities all require a high level of security.

There is a viewing platform at Port Jersey accessed by a road running along the edge of the peninsula, although the waterfront itself is not developed for public access. Despite the location of the proposed rail terminal, it should be possible to retain access to this platform along the edge of the shoreline by rearranging the present road and rail layout and incorporating some of the remaining space into the proposed rail terminal.

At Bayonne it would be possible to incorporate public access to the wetland area at the inner end of the Port Jersey Channel, although it has been observed that the area is posted as containing hazardous materials. In addition, there is a large well-developed waterfront park within 3 miles at Liberty State Park

At Howland Hook the whole of the proposed waterfront extension in Scenario Orange is required for berth space. However the neighboring Arlington Marsh, which is of substantial size, is undeveloped and could provide potential area for appropriately designed waterfront access proposals.

In North and South Brooklyn some of the wharf lengths are not used for berthing and could be considered for public access if segregation from port operational areas and suitable safety and security facilities are provided. A waterfront access proposal has been studied by NYCEDC[110] for the Sunset Park area that lies to the South of the Port Authority land at the South Brooklyn Marine Terminal (SBMT). Although these plans are still at the conceptual stage the land has been reserved for this purpose in the Blue Scenario.

Further consideration of this topic is included in Section 12.4, where Green Port Planning is discussed.

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[110] New York City Economic Development Corporation

12.3 Warehousing

12.3.1 General

Some cargo entering the Port will be destined for warehousing in the Port region. This Section describes the investigation undertaken to define the future requirements for warehouse space and specifically to demonstrate that the warehousing related to ocean borne cargo does not require the use of wetlands.

A warehouse is a large covered building which holds finished and semi-finished goods in storage before re-distribution to the next stage in the supply chain. In addition other 'value-added' activities increasingly form part of a warehouse's function. These can include packaging, labeling and bar-coding of goods held in storage before re-distribution. Warehouses can be categorized as being private warehouses or public warehouses.

This Section is based on a study presented in more detail in a CPIP Technical Memorandum[111].

12.3.2 Private and Public Warehouses

(a) Private Warehouses - A private warehouse is dedicated to one organization and its supply chain. They are used by companies handling large regular volumes of goods, such as a retailer or importer. Private warehouses can either be owned and managed 'in-house' or contracted out to a third party logistics provider (3PL). The 3PL option is increasingly the preferred solution. In addition to managing the actual warehouse, the 3PL might provide a package of management functions across the supply chain. These might include managing the transport to/from the warehouse, IT tracking systems and added value activities. By combining these activities, 3PLs are able to achieve economies of scale, and hence offer cost savings compared to in-house provision.

Private warehouses will normally have a national or regional hinterland. Those with a national hinterland (sometimes called National Distribution Centers or NDCs) act as inventory holding points for imported and domestically sourced goods, before re-distribution to other stages in the supply chain. As the name suggests, they are termed

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[111] CPIP Technical Memorandum, Warehousing Study

'national' because they serve the whole of the USA from the one site. They normally serve:

- Manufacturers, often integral to the actual production facility or located close by.

- Suppliers to the retail industry, such as importers of electrical goods, beers/wines/spirits or clothing. Suppliers can also be the overseas distribution arm of a manufacturer.

- Retailers. A retailer's NDC generally holds slower moving lines (seasonal items such as garden furniture, Christmas trees etc.) or goods with long supply lead times (such as DVD players manufactured in Taiwan).

Private warehouses with a regional hinterland (sometimes called Regional Distribution Centers or RDCs) are similar to NDCs in that they receive, hold and then re-distribute goods to other stages in the supply chain. However there are a number of important differences. They have a regional hinterland e.g. North East USA, and are normally associated with retailers or their suppliers. More importantly their primary role is to consolidate and re-distribute goods in shorter periods of time, rather than acting as inventory holding locations. Consequently the dwell times of goods are shorter at a RDC. Normally, goods are received in 'bulk' from NDCs and then split into smaller consignments for re-distribution in mixed loads i.e. with other smaller consignments to stores. This is a process commonly called 'cross docking'. For faster moving lines, this may take place within 24-48 hours. RDCs will therefore receive inward goods from a large number of origins, whereas a NDC will generally have fewer sources of supply.

(b) Private Warehouses in North East USA - The preferred locations for private warehouses which serve the North East USA are south of the Port, close to exits on the I-95/New Jersey Turnpike and in Pennsylvania (Harrisburg, York). The reasons behind these preferred locations include:

- High land costs either in or close to the port estate. Competition for land with other uses, for example retail and Newark Airport, means that the cost of land in and around the port is high compared to other east coast locations;

- Labor rates away from New York/New Jersey appear to be more competitive than locations at or near the port;

- Workforces are perceived to be more flexible at locations away from the port;

- Congestion in and around the port terminals.

As a result, containers which do not need to be opened and stripped at the port are dispatched directly inland. As most private warehouses in the North East USA will predominantly handle domestically sourced cargo, goods in imported containers can be cross docked with the domestically sourced cargo and re-distributed from these same sites.

(c) Public Warehouses **-** Public warehouses are normally owned and operated by 3PLs. A shipper/distributor of goods will 'rent' space within a warehouse owned/operated by a 3PL to store their goods. Also the shipper will potentially buy other supply chain functions from the warehouse's operators. Consequently public warehouses (or shared user warehousing), as the name suggests, will be used by a number of organizations at any one time for storage and re-distribution functions. They can serve both a national or regional hinterland at the same time. Public warehouses are normally utilized by organizations moving fluctuating and small to medium sized consignments that do not justify a large dedicated private warehouse e.g. distributors and wholesalers specializing in particular commodities such as fresh produce and beverages. It is cheaper to distribute goods through a shared user facility who can manage storage and the onward transport for the shipper.

(d) Public Warehouses on the Port Estate **-** There is a sizable market for public warehouse services operating within the Port estate. Most of this activity is focused on the Port Newark/Elizabeth terminal area, and to a lesser extent around the Global Marine terminal. Public warehouses within the Port estate are essentially only utilized under one or more of the following circumstances:

- Heavy containers - This is where a container that arrives at the Port is too heavy for transportation on the public highways outside the Port estate because many shippers will load containers to their maximum permitted container weight rather than the maximum allowable highway weight. Consequently the goods in the containers need to be unstuffed and reloaded to road semi trailers or rail cars for inland transportation

- Some food products may need to be inspected prior to onward distribution inland. Again, if the goods in the container need to be removed it avoids double handling to also store and re-distribute from the port estate.

- If containers need to be inspected for security reasons before they leave the port estate, it can be cheaper to load to store and re-load to road vehicle/rail cars at the same location.

- When there is a requirement to store goods/hold inventory before order and delivery to customers. This can be cheaper when undertaken at the port, particularly if the 3PL provider is handling similar types of commodities and can consolidate loads

- When containers have cargo destined for more than more location, including moving cargo from more than one shipper (consolidated cargo/groupage).

12.3.3 *Warehouse Operations*

Despite ownership, functional and location differences, warehouses have a number of common features with regards to their operation. A warehouse can be divided into four operational zones:

- Loading/unloading docks. This is the zone where goods are unloaded from or loaded to road semi trailers (including containers on chassis) and rail cars.

- Storage. This is where the goods are held in storage before their re-

- distribution to the next stage in the supply chain.

- Added Value and Picking zone. An area where any added value activities would occur. Also a temporary holding area where goods can be held for short periods of time between being 'picked' from storage and loaded to a transport vehicle of some form

- Offices. This is where warehouse management and their associated IT systems are located.

The most common form of storing goods in a warehouse, and the most efficient, is on pallets. A pallet is a wooden platform upon which goods can be stacked. A pallet is designed to be lifted easily by forklift/reach truck type equipment. This enables multiple numbers of goods to be moved around a warehouse in one move. A standard pallet measures approximately 4ft x 3ft. The exception to palletized storage would be, for example, bulky large items, such as large reels of news print and hanging garments. Special systems are used to handle these products.

12.3.4 *Warehouse Capacity*

Pallets are stored in warehouses in pallet racking systems. These are large 'shelving systems' running along the length of a warehouse on which pallets stacked with goods are placed. They normally have aisles between them to allow access by forklift trucks. Modern racking systems are very efficient in that they can allow pallets to be stacked 5-6 high. The capacity of a warehouse, in terms of the amount of goods it can hold at any one time, is normally defined in terms of the number of pallets they can accommodate ('pallet spaces') rather than the overall floor space, the type of commodity or the weight/volume of goods. Therefore space allocated to pallets is independent of the commodity stacked on them. The number of pallet spaces available in a warehouse will depend on a number of factors. These include:

- The area of floor space in a warehouse allocated to storage functions. This will in turn be dependant on the areas allocated for picking, vehicle loading/unloading and office functions

- The height of the warehouse, thus the height to which pallet racking systems can be constructed

- The area required to allow access by forklift/reach trucks

- The types of products being handled. The storage areas may need to be chilled or frozen, and as a result the refrigeration units and insulating walls required will be at the expense of racking.

- The type of racking systems employed

Modern 'high bay' warehouses, which are up to 65ft (20m) high, have an average storage capacity of around 0.14 pallets per square foot. However, standard height warehouses, probably similar to those employed in and around the Port area, have an average storage capacity of around 0.05 to 0.10 pallets per square foot.

For this study an average figure of 0.07 pallets per square foot has been used.

12.3.5 Forecast Import Containers

The analysis described in Section 3 yielded the numbers of containers entering the Port and their destination in 1999 and in the 2020 and 2060 forecast years.

Forecast container numbers imported via the Port have been converted to demand for warehouse floor space. These have then been compared to actual 1999 import volumes (and their associated demand for warehouse floor space) to ascertain the additional land that will be required to cater for growing imports. The data analysis also allowed the container volumes to be differentiated by commodity type. Containers exported through the Port have not been considered because, generally, export goods are loaded into containers at the point of production and moved direct to ports, and not via warehouses.

Container volumes were subsequently further disaggregated to show imports destined for the 16 County Port Area. The sixteen counties are Bergen, Essex, Hudson, Middlesex, Monmouth, Morris, Passaic, Union, Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, and Westchester..

Not all container imports will be destined for a warehouse. Finished goods are likely to be moving direct to warehouses for storage pending re-distribution to the next stage in the supply chain e.g. beverages, tobacco, telecommunication and audio equipment, textiles and fabrics. However, semi-finished goods and raw materials are usually destined directly for a production/manufacturing facility e.g. crude rubber, paper and pulp, iron and steel. Each commodity type was designated as either being destined for a warehouse (public or private) or to an 'other' location. Table 12.3 summarizes the split of containers between warehouses and other facilities for 1999 and the forecast years on 2020 and 2060.

Imports (TEU's)	Warehouse	Other	Total	Warehouse %
1999 Actual Total	862,637	784,236	1,646,873	52%
1999 Actual Port Area	185,893	168,998	354,892	52%
2020 Forecasted Total	1,326,136	1,241,048	2,567,184	52%
2020 Forecasted Port Area	294,324	275,440	569,764	52%
2060 Forecasted Total	2,568,139	2,580,640	5,148,779	50%
2060 Forecasted Port Area	557,116	559,827	1,116,943	50%

Table 12.3 Percentage of containers in warehouses

12.3.6 *General and Bulk Cargo*

The study has only considered unitized imports through the Port because the destination of non-unitized imports is generally not a warehouse:

- Imported trade cars would normally be parked on the quayside immediately after discharge from a vessel and before transportation to an inland storage/distribution facility.
- Liquid bulks would be discharged direct to some form of specialist storage facility i.e. tanks
- Dry bulks would be discharged directly to a specialist storage facility e.g. grain silo, or directly onto the quayside e.g. aggregates and salt.
- The ultimate destination of bulk traffics i.e. the manufacturing/processing stage are often located on or close to the quayside e.g. oil refinery or flour mill
- Many semi-bulk imports are stored directly in the open e.g. timber

Semi-bulk imports, e.g. forest products or bags of cocoa, can be destined for some form of covered storage facility. However these are generally not considered as warehouses.

12.3.7 *Warehouse Demand*

The figures in Table 12.3 have subsequently been converted to demand for warehouse floor space on the following basis:

- 12 Pallets per TEU – a 20ft container will hold 12 standard 4ft x 3ft pallets single stacked

- Warehouse capacity of 0.07 pallets per square foot.

- 12 'stock turns' per annum

Warehouse floor space demand resulting from ocean borne containers imported via the Port is currently, and will be as shown in Table 12.4.

Year	Warehouse Floor Demand Port (million square feet)	Warehouse Floor Demand 16 County Port Area (million square feet)
1999	12.4	2.7
2020	18.9	4.2
2060	36.7	8.0

Table 12.4 Warehouse floor space demand

12.3.8 *Land Requirements*

The warehouse floor space demand tabulated above corresponds to the 'covered' space in the warehouses and not the total amount of land that will be required. The actual area of land required for a warehouse facility will be larger than the area required for the storage of goods.

Space is required outside the actual warehouse building for truck parking, staff car parking and rail wagons if the facility can accommodate railroad traffics. Based on industry norms, the covered floor space of a warehouse will account for around 40% of the total area of a warehouse facility, i.e. a multiplier of 2.5 is used to convert warehouse area to total site area.

Year	Land area required for warehousing (acres)	Additional land required since 1999 (acres)
1999	152	
2020	241	89
2060	457	305

Table 12.5 Land requirements for warehousing

12.3.9 *Land Supply*

New Jersey Department of Transportation's Bureau of Freight Management and Intermodal Coordination have prepared a database of Freight Opportunity Sites in the New Jersey towns around the Port. The database was compiled from NJDEP's[112] list of Known Contaminated Sites and in a visual inspection of apparently derelict sites along the main New Jersey highways approaching the port. The sites are shown on Figure 12.1.

Some of the Freight Opportunity Sites overlap wetland sites and the overlapping area has been taken away from the area available for warehouse development.

Description	Area (acres)
Freight Opportunity Site area	4,852
Wetland area	681
Area available for warehouse development	4,171

Table 12.6 Freight opportunity site areas

Eighty-five sites were identified ranging in size from just under three acres to just over four hundred acres. Over 50% of the sites are between 20 and 100 acres in size. The distribution of plot sizes is given in Table 12.7. The total acreage in the database possibly available for warehouse development amounts to 4,171 acres and the additional land requirements for warehousing of 89 acres in 2020 and 305 acres in 2060 represent just 2% and 6% of the total Freight Opportunity Site acreage respectively.

A 250,000 square feet warehouse requires a plot size of about 15 acres and a 1,000,000 square feet warehouse a plot of about 60 acres based on the relationship presented in Chapter 4 of the warehouse study report [113]. Providing the additional warehousing through to 2060 in the smaller size units would require in the order of twenty 15 acre plots and providing all the extra warehouse space in 1,000,000 square feet units requires just 5 larger plots. The new warehousing will range in size but it is apparent by reviewing the available plot sizes in the database that the demand can be readily catered for in the Freight Opportunity Sites.

[112] New Jersey Department of Environmental Protection 1986, http://www.nj.gov/dep/gis/wetshp.html
[113] CPIP Technical Memorandum, Warehousing Study

Unfortunately, for the purposes of this study, the analysis of land supply remains necessarily confined to New Jersey, as a comprehensive list or database of potential sites for warehouse development (freight opportunity sites and/or brownfield sites) does not yet exist for the New York State counties near the Port. This should not be construed as an implication that efforts are not being made in New York State to identify and develop former industrial sites for warehousing or other uses. There are numerous pilot programs, studies and projects underway, including efforts by the NYS Department of Environmental Conservation (Brownfields Coordination Section), the New York Metropolitan Transportation Council (Regional Freight Plan), and the Port Authority of NY & NJ (currently converting existing buildings on the former Proctor and Gamble site on Staten Island into a 500,000 sq.ft. warehousing facility as part of a voluntary clean-up agreement).

12.3.10 *Conclusion*

The analysis has demonstrated that warehousing related to ocean borne cargo does not require the use of wetlands.

Plot Size (acres)	Number of Plots
0 – 10	12
10 – 20	18
20 – 50	29
50 – 100	16
100 – 200	6
200 – 300	2
300 – 400	1
> 400	1

Table 12.7 Freight opportunity sites - plot sizes

12.4 *Green Port Planning Opportunities*

12.4.1 *Introduction*

"Green" port initiatives involve environmentally sound actions that comply with, or exceed, existing regulatory requirements. Ports today are conscious of the desirability of minimizing the environmental impacts of port development. Consequently, a number of ports throughout the U.S. and the world have adopted green port initiatives[114]. The following is a summary of green port initiatives pertinent to CPIP planning. The use of green port initiatives is an emerging practice; hence documentation of case histories is somewhat limited. Moreover, there are currently no industry standards for green port initiatives. However, they are developing on a local level in various regions of the country. Subjects considered in this Chapter include the following, taken from the terms of reference:

- Fill avoidance and minimization;
- Ecosystem restoration;
- Dredging avoidance and minimization;
- Brownfields;
- Community/tenant relations and environmental stewardship;
- Waterfront access;
- Air quality and emissions reduction;
- Green buildings;
- Alternative construction materials and recycling;
- Stormwater discharges.

Additional subjects considered in this Chapter include:

- Oil spills;
- Ship and port-generated solid waste;
- Beneficial landscaping;
- Threatened and endangered species.

[114] "Green Ports, Environmental Management and Technology at U.S. Ports," Urban Harbors Institute, University of Massachusetts, Boston, March, 2000 (US EPA Award No. X 825706-01-0)

12.4.2 *Fill Avoidance and Minimization*

(a) General

Many ports throughout the world have been developed through land reclamation (e.g., Port Newark, Port of Rotterdam, Port of Los Angeles, Port of Long Beach, to name just a few). Fill may destroy or cover existing submerged or subaerial land. It has become an increasingly common practice to restore impacted habitats or create new additional habitats to replace impacted acreage. In recent years, there have been a number of large scale environmental restoration projects. The Port of Los Angeles, for example, restored the Batiquitos Lagoon to compensate for land reclamation at Pier 400 (See Figures 12.2 and 12.3) and the Port of Long Beach restored a Naval Weapons Station wetlands as compensation for their Pier J expansion in the late 1990's. While desirable from many points of view, this practice is expensive and has not been implemented in every case. In some cases, focus has been placed on maximizing existing terminal throughput in an effort to avoid or eliminate the need for fill. This focus can result in lower costs for port and restoration development and avoidance of filling marine waters. It may, however, reduce opportunities for large-scale environmental restoration projects in connection with port development and result in the inevitable requirement for more port land.

With respect to the Port of New York and New Jersey, there are two principal advantages to avoiding fill:

- avoiding loss of existing harbor water and wetland areas;
- minimizing port development costs.

(b) Port of New York and New Jersey

Fill in waterfront areas has only been considered in Scenarios for container terminal expansion at Howland Hook, South Brooklyn and Port Jersey.

12.4.3 *Ecosystem Restoration*

(a) General

Proper design of new or restored habitats can provide significant environmental benefits such as improved water quality, biodiversity, reduced siltation, and shoreline stability. Beneficial use of dredged material has become a widespread practice, both to restore and to create artificial habitats. Similarly, beneficial reuse of construction materials and debris has been used to create artificial reef habitats, e.g. the use of dredged rock for artificial reefs.

(b) Port of Los Angeles

The Port of Los Angeles' restoration of Batiquitos Lagoon mentioned above re-established marine resources by restoring tidal flushing in the 600 acre lagoon, preserving habitats and protecting sensitive species in the area. Beneficial reuse of dredge material was used in this effort to construct nesting sites and nourish local beaches.

(c) Port of Long Beach

The Port of Long Beach developed a Relocation Plan for a black-crowned night heron nesting colony as part of an expansion process on existing land. Preparation of the 8.5 acre Gull Park involved relocation of trees and planting of additional ones to support nesting activity.

(d) Port of Houston

As part of a channel widening and deepening project, the Port of Houston investigated construction of six separate 20 acre oyster reefs in Galveston Bay using coal combustion byproducts (CCBs). Highly favorable results from test reefs indicated that CCBs could serve as environmentally safe and biologically sound artificial reef material, while also providing a cost- and space-effective alternative to disposal of the CCBs. Owing to several permitting issues, the CCB reefs were never fully constructed.

Ultimately, 118 acres of oyster reef pads were created with limestone within Galveston Bay near the ship channel. This acreage was equal to that necessary to compensate for the deepening project.

(e) South Jersey Port Corporation

The South Jersey Port Corporation successfully created artificial fish habitats to enhance spawning in a portion of the Delaware River. Used tires (added to a pier expansion) served as shelter and feeding habitat for nursery fish, which are in turn grazed by anadromous fish. This project cost only 10 percent of an equivalent traditional wetland while also recycling waste products.

12.4.4 *Dredge Avoidance/Minimization*

(a) General

Capital dredging can be avoided or minimized by placing terminal expansion as close as possible to existing deep water. Maintenance dredging can be avoided or minimized by locating terminal expansion in naturally deep water or by implementing measures to reduce sedimentation at the terminal. The terminal development scenarios considered for CPIP involved expansion of existing terminals. Accordingly, there is little opportunity to further minimize capital dredging. There are some opportunities, however, for reducing maintenance dredging as described below.

Sedimentation in navigation channels gives rise to the need for maintenance dredging with associated construction activities and dredge material placement issues. This fact has given rise to sedimentation minimization efforts at ports throughout the world.

Basic approaches to minimization of sedimentation in a channel or harbor area are:

- keep sediment moving through the area, and
- keep sediment from entering the area in the first place.

Methods following the first approach include flow training structures such as submerged dikes or sills, augmentation of flow through channel realignment, channel diversion, or application of scour and propeller jets.

The second approach involves construction of permanent barriers (dikes or sills), harbor entrance modifications (narrow entrance, training structures, shallow entrance, horizontal eddy reduction, gates and curtains, pneumatic barriers or air curtains), construction of sedimentation basins and advanced maintenance dredging.

In all of these measures it is important to know where the sediment that has been diverted will finally settle and to avoid unwanted effects.

(b) Scour/Propeller Jets

Scour/propeller jets were installed to reduce sedimentation at Gray's Harbor, WA. This system has been in operation since 1996.

(c) Flow Training Wall

A flow training wall was installed at the Port of Hamburg for the same purpose, as shown in Figure 12.4. A similar flow training structure is planned for the Port of Antwerp.

(d) Dredged Material Management Plan

Sedimentation reduction systems have been developed for several Port Authority of New York and New Jersey terminals. The work was conducted for the U.S. Army Corps of Engineers, New York District as part of the Dredged Material Management Plan[115]. The sites considered for sediment minimization are shown in Figure 12.5.

An example scheme for Newark Bay is shown in Figure 12.6.

Net present value analyses (considering capital/operating costs and reduced maintenance dredging costs) were prepared for a large number of options throughout the harbor consisting of flow training devices and entrance modifications. Breakeven dredging costs per cubic yard were computed in order to evaluate the cost-effectiveness of various schemes relative to status quo. The range of breakeven dredging costs ranged from $23 to $150 per cubic yard (1997 prices). The lower cost schemes showed promise relative to the cost of upland placement (about $38 per cubic yard at that time), however, no further study of these schemes has been conducted.

(e) Disposal of Dredged Material

Even if sedimentation is minimized, the remaining clean and/or contaminated dredged sediments must be placed at a safe site. The most common options for dredged material placement are open-water disposal, confined disposal, and beneficial reuse.

Open-water disposal involves the placement of dredged material in oceans, rivers, estuaries and/or lakes, and may involve capping with clean isolating material as a control measure.

Confined disposal facilities (CDFs) are diked nearshore or upland sites carefully designed to retain dredged material and control potential contaminant release. A CDF was recently developed within Newark Bay. There are plans to place dredged sediment in excavated pits located in the navigation channels east of Port Newark/Elizabeth.

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[115] "Sedimentation Reduction/Mitigation Methods," prepared for U.S. Army Corps of Engineers, Moffatt & Nichol Engineers, 1997.

Beneficial reuses of dredged material have included habitat restoration/enhancement, beach nourishment and shoreline stabilization. Construction of waterfront facilities using dredged material for landfill has been common practice for marine terminals, as demonstrated by the Port of Los Angeles' 562 acres of land reclamation as part of the Pier 400 expansion. The Port of Long Beach has many fills utilizing the CDF concept for imported and in-port contaminated materials. The Orion Project in Elizabeth, New Jersey was a successful example of innovative dredged material management. The project involved mixing dredged material with cement-based admixtures in a pugmill. 1.5 million cubic yards of unsuitable dredged sediment were processed so that the material could be used as foundation fill for a 60 acre upland parking lot.

Further examples of the transformation of dredged material into beneficial use include the Jersey Gardens Mall and the Bayonne Golf Course.

12.4.5 *Brownfields*

(a) General

Brownfields are defined by the EPA as "abandoned, idled or under-used industrial or commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination that can make redevelopment of the property financially or logistically prohibitive". It should be noted that it is also common to refer to any idle industrial site as brownfield whether or not it has been contaminated.

(b) National Examples of Brownfield Developments

Ports have received a number of US EPA brownfields assessment pilot grants and have successfully remediated several properties. Representative projects include:

- The Port of Long Beach's cleanup of 31 acres of the TCL Corporation Site, which is currently operated as an international vehicle distribution center,
- The Port of Chicago's conversion of two former landfill sites into the 458 acre Harborside International Golf Center, and
- The industrial property cleanup and marine terminal development of the Southwest Harbor by the Port of Seattle.

(c) Port of New York and New Jersey Examples

Part of the current and future terminal expansion at Howland Hook is proposed to be on the property immediately east of the existing terminal where the industrial facilities for Proctor and Gamble once stood.

Scenarios in this study propose terminal development at the former Military Ocean Terminal at Bayonne which is a vacated brownfield site.

The Port Newark Container Terminal is presently cleaning up and renovating a 15 acre abandoned scrap yard and shipyard adjacent to its recently completed terminal development[116].

(d) Brownfield Economic Redevelopment Study

The North Jersey Transportation Planning Authority and New Jersey Institute of Technology presented findings of their three-year joint study in January of 2003. This effort resulted in key policy recommendations concerning redevelopment of abandoned and underutilized industrial sites in and around the Port of New York and New Jersey. The federally funded effort examined ways to transform brownfields into productive, tax-paying facilities that will allow the region to reap maximum economic benefits from rapidly increasing international trade. The study also considered ways to steer this flow of goods to avert further congestion on the region's already heavily traveled transportation network.

The study indicated that thousands of acres of brownfield sites exist near the port, airport and rail terminals, offering tremendous potential development value. Many sites are ideally located for use as warehouses and distribution centers for freight handling and value-added processing, and could employ hundreds of workers in final assembly, packaging, order fulfillment and other tasks. A selection of six case studies was examined in detail, ranging from the Arsynco site in Carlstadt to the Carteret Properties in Middlesex County. Each case study evaluated the effect of various factors on site desirability, including transportation, environmental and real estate market concerns.

Key recommendations of the study included:

- Use taxes, fees, a quota system or local zoning to reduce or eliminate storage of empty containers on sites in the port district that can be redeveloped;
- Make redevelopment easier for potential developers by streamlining the approval process and providing financial incentives;

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[116] "Port Newark Container Terminal's Expansion Plans Are Environmentally Friendly," Shipping Digest, March 31, 2003.

- Supplement public funding for freight infrastructure with a modest fee on container movements or other port activities;

- Create a new body or designate an existing agency to be responsible for comprehensive planning in the Port district;

- Support public-private partnerships to link brownfield site reuse with trade growth to satisfy growing market demand.

12.4.6 *Community Relations and Environmental Stewardship*

(a) General

Most ports are surrounded by residential communities and commercial facilities. Recognizing the needs of these communities, U.S. ports have worked closely with them to assure that ports are developed and operated so as to minimize community and environmental impacts. Many ports have initiated new programs to further manage port tenants, facilities, and operations in connection with environmental issues. They have also been active in public outreach.

(b) Port of New York and New Jersey

The Port Authority of New York and New Jersey was recently honored by the American Association of Port Authorities for community/public involvement in connection with a program entitled "Green Ports Tenant Environmental Awareness Training".[117] This program focused on environmental awareness for the seaport community. Topics included review of environmental aspects affecting tenant business operations including regulatory requirements, best management practices, pollution prevention, "green" design and construction, permitting requirements, and grants and financial incentives.

(c) Port of Houston

The Port of Houston annually hosts a number of free informational fairs and seminars to allow vendors to present the latest environmental innovations and technologies to tenants. The Port also conducts yearly tenant site audits, which involve distribution of operational handbooks and questionnaires.

(d) Port of Los Angeles

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[117] "2003 Environmental Improvement Winners", American Association of Port Authorities, www.aapa-ports.org.

The Port of Los Angeles regularly meets with tenants to identify potential recycling/reuse opportunities as part of a comprehensive solid waste management program. The Port of Los Angeles also sponsors open house presentations to allow guest speakers and vendors to address tenants and the public on environmental issues.

(e) Port of San Diego

The Port of San Diego is active in public education and outreach, particularly in the area of stormwater management. Partnering with local schools, the Port has addressed more than 14,000 students and adults regarding stormwater management issues.

(f) Port of Long Beach

The Port of Long Beach has an Environmental Review Program to implement Best Management Practices and conducts annual site inspections at all participating facilities.

(g) Port of Stockton

The Port of Stockton has a comprehensive environmental management program focusing on Best Management Practices. The program educates their tenants as well as representatives from other ports in green approaches; their program has been replicated elsewhere.

12.4.7 *Public Waterfront Access*

Port development has had a tendency to block or restrict public access to the waterfront, particularly in urban areas. Prior to the terrorist attacks of September 11 2001, there was a trend towards increasing public access opportunities in and around existing ports. With an increased focus on security at ports, the opportunities for increased on-site public access may be limited. Opportunities for increased public access to the waterfront in connection to port development remain. The current trend of that access, however, is to develop access away from operating terminals in order to assure marine terminal security.

There are two examples of port public access initiatives within the Port of New York and New Jersey that more or less bracket the range of opportunities. The first is a relatively small-scale, but utilitarian, public access viewing area that is featured on the north side of the Northeast Auto Terminal (NEAT) at Port Jersey. This area is shown in Figure 12.7. Although the existing facility includes a raised platform, a more modest facility could, as illustrated, comprise an access road, a small parking area, seating, and lighting. Typical costs associated with such facilities would be on the order of $50,000 excluding the access road.

At the other end of the spectrum, a conceptual design has been developed by New York City Economic Development Corporation for the Bush Terminal area of the Brooklyn waterfront. This design is summarized in Figure 12.8 and features parkland, athletic fields, a bird conservancy, a bike-path and promenade, and various recreational facilities. The estimated cost for this proposed development is about $66,000,000.

12.4.8 Air Quality and Emissions Reduction

(a) General

Air quality is an increasingly important issue for ports. Sources of air pollutants relative to port operations include emissions from ships, diesel-powered trucks and container moving equipment (e.g., diesel-powered cranes, rubber tire gantries, straddle carriers, forklifts, top picks, yard hustlers, etc.). Other related activities include painting/cleaning at vessel maintenance facilities, fuel distribution and industrial processes (e.g., petroleum refining and power plants). Air quality mitigation or management programs have been introduced at several ports including the Ports of Oakland, Los Angeles, Long Beach, Houston, and New York and New Jersey. The air quality mitigation/management is directed towards meeting or exceeding legally mandated emissions requirements. Typical management approaches to reducing emissions include alternative fuels, engine replacement, emission controls, and energy conservation. Experience at several U.S. ports is discussed below. The referenced cases serve as examples and are not intended to be a comprehensive survey of every U.S. port. Several of the ports cited participated in the 2001 Waterfront Diesel Emission Conference[118].

The various port air quality programs have been directed toward reducing pollutants of concern, namely, hydrocarbons (HC), carbon monoxide (CM), nitrogen oxide (NO) and particulate matter (PM). Emphasis has been placed on the latter two pollutants. The pie charts of Figures 12.9 and 12.10 show sources of emissions for various port activities for the Port of Oakland and summarize the relative importance of various sources.

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[118] "Waterfront Diesel Emission Conference," hosted by the Pacific Maritime Association, Long Beach California, October, 2001.

The figures show that ships and cargo-handling equipment account for more than 65% of particulate and NOx emissions followed by on-road trucks, vehicles and tug boats. Ports seldom own or directly control any of the above sources of port-related emissions. Accordingly, the ports must work together with operators, truck, and rail companies to achieve emission reductions.

(b) Reducing Ship Emissions

Actions have been taken at several ports to reduce emissions from ships. Ships calling at the Ports of Los Angeles and Long Beach participate in a voluntary commercial ship speed reduction program. This program urges vessels to travel 5-10 knots slower (target 12 knots) within 20 miles of the Ports with a concomitant reduction in NOx emissions (about 3 tons per day at 90% compliance rate)[119]. Current compliance is approximately 50% with NOx reduction of about 1 ton per day. The Port of Houston is also considering ship speed reductions.

The Port of Long Beach studied the feasibility of ships using electric power rather than their own engines while at berth ("cold ironing")[120]. The data presented by the study covered case studies of 12 vessels berthing at different terminals in the Port of Long Beach, and has been converted into emissions and costs for a single berth, with an annual utilization of 70%, as shown in Table 12.8.

		Maximum	Minimum	Average
EMISSIONS SAVED per berth				
Net NOx per year	(tons)	680	31	210
Net PM per year	(tons)	61	0.61	23
ESTIMATED COST per berth				
Capital cost of utility supply	($m)	3.0	0.50	1.20
Capital cost of shore works	($m)	2.6	0.32	1.70
Capital cost of ship conversion	($m)	1.1	0.20	0.51
Annual net energy	($m)	9.0	0.57	3.10
Annual operating & maintenance	($m)	1.0	0.01	0.35

Table 12.8 Costs and benefits of shore power supply

Note: Costs are quoted at 2003 constant US dollars.

[119] "Ships To Slow Down Near LA-Long Beach in Bid To Curb Pollution," Journal of Commerce, November 21, 2000.

[120] Cold Ironing Cost Effectiveness Study, Port of Long Beach, Environ International Corporation, March 30 2004

The study looked at a range of different types of ship, including four container vessels, and estimated the values of the parameters listed in Table 12.8 for the particular vessels and terminals in the study. As seen from the table there is such a wide range of possible costs and benefits that it is questionable whether using an average value is valid. However, for illustration purposes the average has been used in Section 12.4.13 where the costs and benefits of Green Port initiatives are quantified. It must be recognized that any proposal to adopt 'cold iron' at a berth must be tested for the actual ship and circumstances. In the table, the annual net energy cost is the difference between providing expensive shore-based power and cheap ship-based power. The shore-based energy cost is calculated at California rates which tend to be higher than other states, although New York rates are also presently at the upper end of the scale.

A third of emissions occur while the vessel is at berth as vessels use auxiliary diesel and steam engines to power refrigeration, lights, pumps, and other functions. Replacing engines with on-shore electrical power could significantly reduce emissions. This approach is also being pursued at the Port of Los Angeles for container ships with "cold ironing" infrastructure recently installed at the port's newest Berth 100. This concept is also being considered at the Port of Houston for cruise ships and the Port of Oakland for tug boats.

The time that ships spend at a terminal can be minimized by unloading/loading the ship as quickly as possible. This increase in productivity is in the interest of the terminal operator and will also serve to reduce emissions. Productivity has increased in U.S. ports in recent years, a trend that is expected to continue into the future.

(c) Reducing Cargo Handling Equipment Emissions

The Port of Oakland has worked with its six marine terminal operators to replace older diesel engines with new cleaner engines. The port has also installed emission controls (particulate filters or oxidation catalysts) on 310 pieces of equipment and facilitated a switch to ultra-low sulfur fuel (used by 50% of terminal operators as of June 2001). The port set up an incentive system where funding is provided for emission reductions. Estimated emission reductions are 18 tons/year of PM, 143 tons/year of NOx, 35 tons/year of HC and 122 tons/year of CM[121]. The container terminal equipment program will reduce HC, CM, NOx, and PM by 80%, 70%, 30% and 70%, respectively.

[121] "Port Improvements Clean the Air," Bay Area Monitor, April/May, 2001.

In early 2003[122], the Port of Los Angeles announced that it would install diesel oxidation catalysts (DOCs) in marine terminal equipment engines and cut emissions in half. The fuel being used is Proformix™. The DOCs will be installed on yard tractors, side and top picks, forklifts, and transtainers. About 600 DOCs were ordered and the port will reimburse tenants $100 per installation. In combination with emulsified diesel fuel, the DOCs will serve to reduce NOx by 20% and PM by 50%. This equates to a yearly reduction of 250 tons of NOx and 24 tons of PM. The DOCs cost about $1,500 apiece and provide an average reduction of NOx and PM of 0.4 and .04 tons per year, respectively. The Port of Los Angeles now makes use of alternative fuels a requirement of new tenant leases.

The Port of Los Angeles, working with a grant from California Air Resources Board, provided $2.0 million in 2002 to use in reducing emissions. Of that amount, about $800,000 has been earmarked for reimbursing terminal operators for the incremental cost of using lower-emission emulsified diesel fuel. The cost differential is about $0.30 per gallon. The remaining $1.2 million is for the cost of DOC's in equipment.

The Port of Long Beach has a similar program to the Port of Los Angeles. By the end of 2003 the port expected many of their tenants to be using alternative diesel fuel and to have outfitted all terminal equipment with DOC's (590 pieces). The port has also planned a pilot project to evaluate liquefied natural gas or liquefied petroleum gas for terminal equipment such as yard tractors and mobile cranes. They are also developing a tariff requiring tenants to prepare plans to reduce air emissions. This tariff will encourage the use of alternative fuels, retrofits and other measures with a recommended goal to achieve. The method of achievement would be left to the tenant to determine.

The Port of Houston also has a similar program that uses alternative fuels (e.g. Lubrizol's PuriNOx, propane) and selective catalytic reducer (SCR). Lubrizol's PuriNOx was tested in 2 yard tractors and found to reduce NOx and PM by 25 and 30%, respectively. Currently, a portion of the yard equipment at the port is fueled by PuriNOx. The Port of Houston plans to purchase 5 propane powered yard tractors. Similarly, forklifts will be propane powered. SCR's have the potential to reduce NOx by 70-90%.

[122] "Port of Los Angeles Introduces New Equipment To Improve Air Quality," Port of Los Angeles Press Release, May 7, 2003.

U.S. ports have been switching over from diesel to electric cranes, with an attendant reduction in on-site air emissions. One example is the installation of new electric cranes at the Port Newark Container Terminal.

Electrically operated rail mounted gantries are not as widely used in container terminals as rubber tired gantries and straddle carriers, and conversion from one handling system to another is generally impractical. However, rail mounted gantries are suited to exploitation of automation, and whether automatically controlled or not, also offer a reduction in on-site emissions where they can be implemented.

There are other 'soft' approaches to reducing emissions by decreasing the distances traveled by terminal equipment. The modern tools available to help the port operator make most efficient use of the cargo handling equipment include:

- satellite based positioning systems (DGPS) so that at any time the position of cargo and equipment is known;
- software such as Cosmos and Navis so that the cargo stacks can be planned and controlled;
- continuous and interactive real time software so that management can observe and intervene online as necessary;
- automated equipment control linked to yard planning decisions;
- mathematical optimization methods which automatically allocate yard slots in real time to minimize resource usage;
- mathematical optimization methods which automatically instruct equipment so that equipment routes are minimized.

The software and sophisticated communications hardware needed to react in real time to equipment and cargo movements are not cheap to create and maintain. However, automation is increasingly being used in ports as the additional costs can be offset against savings in operational costs. It is reported[123] that using such a system the proportion of empty straddle carrier moves at Hamburg's Burchardkai decreased from 41% of all moves to 28% of all moves, and the proportion of moves which linked

[123] Steenken D, Optimizing Straddle Carrier Operations to Achieve High Productivity, Terminal Operators' Conference Europe, 2002

export and import transports likewise increased from 4% to 14%. The overall effects of mathematical optimization and control were reported as a saving of 50,000km per year, plus other productivity benefits.

(d) Reducing Vehicle and On-Road Truck Emissions

The Port of Oakland has found it challenging to devise a system that will promote re-powering and retrofitting of truck engines. Starting in 2001, the port implemented a demonstration project involving 25 trucks using cleaner aqueous diesel fuel. They also installed diesel oxidation catalysts on three trucks. They plan to fund replacement and retrofitting of diesel truck engines over time. At the Port of Los Angeles they have already retrofitted 10 heavy duty trucks and 30 light duty vehicles from their port fleet with liquefied natural gas burning engines and they are requiring the rest of their diesel fleet to use ultra low sulfur fuel.

The South Coast Air Quality Management District in Southern California initiated the Carl Moyer Memorial Air Quality Standards Attainment Program. This program provides a subsidy to promote companies to convert trucks to clean fueled models. The subsidy covers the cost difference between a new diesel engine and a clean-fueled version. The subsidy ranges between $30,000 and $50,000[124]. Southern California ports are working within this framework to promote cleaner burning trucks.

Another program to help reduce air pollution in Southern California is the Gateway Cities Clean Air Program created to provide financial incentives for commercial truck owners who trade in their older diesel trucks for newer models with cleaner-burning engines. Participants in the program are partially reimbursed for the cost of purchasing newer diesel trucks that are more reliable, cleaner, and fuel efficient. This is part of a pilot program that is exploring a variety of ways to reduce diesel emissions in southeast Los Angeles County and throughout the South Coast Air Basin.

The program compensates owners of 1983 or older trucks when they buy a 1994 or newer used diesel truck. An average grant is between $20,000 to $25,000, but will vary depending on how old the truck is and how many miles it has been driven in the past two years. As an example, a typical used diesel truck costs about $35,000. Under the Clean Air Program, an owner could be reimbursed $25,000 of the purchase price, reducing the cost of the new truck to the grant recipient to only $10,000.

[124] "Los Angeles County Fighting To Clean Its Air," The Earth Times, August 16, 2001.

To qualify, owners must meet eligibility requirements and be able to demonstrate that their old truck has been used commercially in the South Coast Air Basin for the past two years. Funding preference may be given to applicants that operate predominantly in the port and/or the region of the Gateway Cities Council of Governments of Southeast Los Angeles County.

There are multiple participating truck dealers in the region who can assist owners with trade-ins, purchases and program requirements and applications.

The Clean Air Program is managed by the Gateway Cities Council of Governments of Southeast Los Angeles County in partnership with the Port of Long Beach, the California Air Resources Board and the United States Environmental Protection Agency. Additionally, the Port of Los Angeles has contributed $5 million to this program and is committed to an additional $5 million.

The Port of Houston has purchased demonstration propane trucks and has plans to install fueling stations to support these trucks.

As discussed in the previous Section, new terminal automation technologies can also reduce the time that on-road trucks spend in terminals, with an associated reduction in air emissions. Whilst these measures have not necessarily been implemented as "green" measures, automation can reduce truck congestion, trip mileage and attendant emissions. Hence, automation can produce air quality benefits.

In California legislation was passed requiring terminal operators to pay a fine if trucks are kept idling in line for more than a specified time. This was done to encourage operators to schedule appointments or otherwise speed up their gate processing time.

Regarding, container tracking, a website operated by eModal allows terminals throughout the U.S. to notify trucking companies that a specific container is available for pick-up. This technology serves to minimize the time that a truck spends at the marine terminal. Current participants include: 4 terminals in the Port of New York and New Jersey; 4 at the Port of Los Angeles; 6 at the Port of Long Beach; 3 in the Port of Charleston; 5 at the Port of Norfolk; 5 at the Port of Oakland; 2 each at the Ports of Seattle, Tacoma and Everglades; and 1 each at the Ports of Miami, Jacksonville, and Savannah. Additionally, several domestic ports now use handheld computers with scanners to speed up handling and processing operations. Other international container terminals with state-of-the-art information technology systems in place to track and dispatch cargo include the Port of Vancouver, BC; the Port of Hamburg; the Port of Rotterdam; the Port of Antwerp and the Port of Montreal.

With regard to gate operations, the Port of Hong Kong utilizes an automated "virtual gate" system to preprocess customs documents, inspect cargoes, identify drivers and schedule pickup times to ensure the quickest possible process. Heavily reliant on Electronic Data Interchange, the system improves productivity and reduces truck idling associated with gate queues.

(e) Reducing Tug-Boat Emissions

The Port of Oakland provided a subsidy to replace two engines on a single tug with new low-emission engines. This effort reduces emissions by 1 ton/year of PM and 27.5 ton/year of NOx.

The Port of Los Angeles has similarly retrofitted one tugboat in a pilot project with ultra-low emission diesel engines. Subsequently all tugs in the Ports of Los Angeles and Long Beach have been repowered by their owners via the previously mentioned Carl Moyer program. This amounts to about 40 boats. The Port of Oakland has installed power plug-ins on a tugboat wharf so that the tugboats can shut down their engines while at berth. The Port Authority of New York and New Jersey has initiated a tugboat engine replacement project which includes the replacement of two engines on each of two tugboats[125]. The cost of the replacement is $600,000 and produces a reduction of 50 tons per year or $12,000 tons per ton of NOx.

(f) Reducing Train Emissions

The Ports of Los Angeles and Long Beach are working with the Pacific Harbor Line and regulatory agencies to replace railroad locomotives with cleaner-burning diesel engines. Every new engine will reduce NOx emissions by 20 tons per year.

(g) Reducing Construction Equipment Emissions

The Port of Long Beach is identifying and implementing strategies to reduce emissions from port construction projects. As a first step, the port requires all construction equipment fueled on-site to use ultra-low sulfur diesel fuel. At the Port of Los Angeles construction equipment in a recent project was required to use emulsified fuel.

[125] "Initiatives Are Part of An Award-Winning Environmental Program," Press Release, Port Authority of New York and New Jersey, September 29, 2003.

12.4.9 *Green Buildings*

The EPA defines a green building as "a building that is 'environmentally friendly'". Green buildings are "designed to reduce direct and indirect environmental consequences associated with building construction, occupancy, operation, maintenance and decommissioning." Green buildings are generally sensitive to the environment and specifically in resource and energy consumption, impact on people (quality and healthiness of work environment) and finances, as described in a California study [126]. The first reference to green architecture in the U.S. dates to a 1990 article in Architecture magazine[127]. Accordingly, green building design is an emerging field of practice.

In the context of port development the relevant buildings would include warehouses, and administration, maintenance, and gate buildings.

The United States Green Building Council has developed a rating system for green buildings in 2002 entitled Leadership in Energy and Environmental Design (LEED). This system is used to rate new and existing buildings (commercial, institutional, and high-rise) according to environmental and sustainable features. Criteria used in the rating system include: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation/design process. The four levels of LEED certification in order of increasing sustainability are: Certified (26-32 points), Silver (33-38 points), Gold (39-51 points) and Platinum (more than 52 points). The LEED rating system was first used in 2000 starting with 12 buildings and has grown to 100 million square feet in 2003. As of October 2003 there are 30 and 18 LEED registered buildings in the states of New York and New Jersey, respectively.

The initial capital cost of a Green building exceeds that of a conventional building. The cost premium has been estimated to range from 2% to 15% in the California study. A reasonably detailed assessment of the increased costs associated with 33 LEED buildings has been developed and is reported in the previously mentioned 2003 California study. The 33 buildings were constructed during the 1995-2004 period and consisted of 25 office buildings and 8 school buildings located throughout the country. None of the 33 buildings are located in or near a port. Two of the 33 buildings are located in New York City; a LEED Silver building with a cost premium of 7.5% and a

[126] "The Costs and Financial Benefits of Green Buildings", A Report to California's Sustainable Building Task Force, October, 2003.
[127] Nathan Engstrom, "The Rise of Environmental Awareness in American Architecture: From the Bruntland Commission to LEED," Fall 2002.

Platinum with 6.5%. None of the 33 were located in New Jersey. This cost assessment is judged by the study authors to be the most reliable to date as detailed costs were available. The California study authors conclude that a meaningful assessment of a green building cost premium can only be made for the same building. Thus, they conclude there is very little solid data to support conclusions regarding the initial cost premium for a green building design. This finding stems from the infancy of the green building design practice. For the purposes of the present study, a 7% cost premium for green building design in a marine terminal is judged to be reasonable and is consistent with the New York buildings evaluated in the 33 building cost evaluations.

It is important to emphasize that the financial benefits of a green building are associated with reduced life-cycle costs. These reduced costs, it is postulated, serve to pay back the initial cost premium. Reduced life cycle costs are reported to include:

- lower energy, waste disposal, water, and environmental and emissions costs
- increased employee productivity and health in a green building.

The former benefit is quantifiable, the latter, not as easy to quantify. Nonetheless, the California study draws the conclusion that the life-cycle financial benefits of a green building are 10-fold based on a 20-year present value analysis. In terms of the more easily quantified benefits enumerated above, energy/water savings are 1.6 times the initial cost premium. Most of the 10-fold benefits are associated with increased productivity and health. The applicability of this analysis to port buildings is not reported.

Green building technologies may be applicable to port buildings in the areas of energy efficiency, indoor quality and environmentally responsible technology. Energy efficiency measures include the following LEED goals:

- integrated design where building systems are evaluated in total;
- high performance lighting design including efficient lighting, task lighting;
- daylight harvesting;
- increased ventilation effectiveness designed to cut peak air conditioning load;
- underfloor air distribution systems to lower air conditioning load;

- systematic building commissioning to assure designed performance;
- heat island reduction measures using roof reflectivity;
- computer-controlled building automation for peak performance;
- improved insulation and air tightness;
- solar power; and
- high efficiency boilers and motors.

Methods for reducing water demand in green buildings include:

- better design of potable water supply;
- capture and reuse of gray waste water;
- storm water capture;
- groundwater recharge;
- recycled/reclaimed water use.

Nationwide, 25 to 45% of total solid waste is associated with construction and demolition debris[128]. This volume can be reduced through reuse of demolished materials on site or placement of same at recycling facilities. Building lifetime waste can be reduced through recycling, design for deconstruction, and reusable building components (moveable walls, raised floors, modular furniture, etc.)

LEED design practices promoting healthier work environments include:

- lower source emissions (appropriate air supply locations, less toxic materials, low-emitting adhesives/sealants/paints/carpets/wood, indoor chemical/pollutant source control);
- improved lighting quality including daylighting;

[128] "Construction and Demolition Waste Manual," City of New York, Department of Design and Construction, May 2003.

- improved ventilation;
- better commissioning.

Finally, the State of New York has offered a green building tax credit to building owners and tenants who invest in increased energy efficiency, recycled and recyclable materials and improved indoor air quality (http://www.dec.state.ny.us/website/ppu/grnbldg/).

12.4.10 *Alternative Construction Materials and Recycling*

Many ports recycle or reuse materials where practicable. Construction and building demolition materials such as rock, asphalt, concrete, brick, glass and clay, have been used in port construction. It is common in the Port of New York and New Jersey, for example, to reuse pavement millings (i.e., layers of pavement removed during demolition) as a base for new pavement construction. This approach has been taken in recent construction projects at the Port Newark Container Terminal and at the APM Terminal in Port Elizabeth. This approach results in construction savings on the order of $3 per square yard of pavement and, in addition, significantly reduces the volume and cost of disposal of demolished pavement in an offsite landfill. It should be further noted, that it is not uncommon for pavement millings from port sites to be recycled for offsite pavement construction.

The Port of Portland, OR has an extensive recycling and waste reduction program in place. This program has resulted in reuse of demolition material, including terminal warehouse timber, which was incorporated into the Port's new headquarters and area housing. The Ports of Los Angeles and Long Beach, and other ports, have saved significantly by recycling existing asphalt pavement, eliminating the need to dispose of the millings. The Port of Oakland has reused waste tires in playground equipment, resulting in mutual benefit for the port and the surrounding community. Of course, crushing asphalt and unreinforced concrete for reuse is a normal construction practice all over to reduce cost and off-site disposal.

Alternative construction materials are being used with increasing frequency to save costs, both in order to reduce maintenance requirements and as a form of recycling. Fiber-Reinforced-Polymer (FRP) is being used in lieu of traditional materials in some pier and wharf construction. FRP composite elements offer high strength, durability in the harsh maritime environment and corrosion resistance. Other potential benefits include lower life-cycle costs, use of recycled plastics, and avoidance of chemical timber preservatives. Example successful projects include FRP fender piles at Port Newark, a FRP catwalk platform at Port Hueneme, CA. FRP rebars have also been used in concrete structures.

12.4.11 *Stormwater Discharges*

Some 80% of problematic marine environment pollutants result as a byproduct of land-based activities. These pollutant sources can be roughly categorized into episodic events and chronic events. Episodic causes (e.g., oil spills) give rise to immediate impacts. Chronic events more typically have gradual impacts. Point sources (e.g., sewage outfalls) and non-point sources (e.g., surface runoff) provide the bulk of chronic pollution activity.

Ports must be designed to comply with Federal, State and local stormwater discharge/quality requirements. Complying with such requirements can be a challenge for marine terminals, especially auto, container and other terminals that feature large paved areas. In many cases, stormwater discharge/quality requirements are met by storing/treating a relatively large volume of "first flush" stormwater runoff on site (e.g. ½" of rainfall, 2-year, 24-hour rainfall, etc.) Land is at a premium within industrial ports so conventional use stormwater detention ponds are problematic. Moreover, many port sites have relatively high groundwater levels and relatively poor soils. Accordingly, innovative methods are often needed to meet the requirements. Such methods include both engineered construction and public outreach to educate port users on minimizing stormwater quality problems. Engineering designs for ports with impervious pavements often include a network of surface drain inlets and underground pipes directed to retention structures or ponds. The inlets, pipes, and ponds hold the water for a time, allowing the sediment to settle, and slowly release the remaining water. These structures accumulate sediment over time and have to be cleaned periodically with the removed sediment stored offsite (e.g. at a landfill.)

The Port Authority of New York and New Jersey has tested 15,000 square feet of porous pavement system at Howland Hook Marine Terminal. This permeable pavement features openings filled with granular material comprising some 10% to 12% of the total drainage area. The permeable pavement system was chosen because it captures the "first flush" which in this case was the first 30-60 minutes of rainfall (0.5-

1")[129]. The runoff from the initial portion of the rainstorm has the highest concentration of pollutants. This portion of runoff is subject to regulation by state environmental laws through the use of Best Management Practices. For New York, designs should capture the first 0.5 inches, and for New Jersey, the first 1.25 inches over two hours. The permeable pavement at Howland Hook has sufficient permeability to absorb the stipulated "first flush" as stormwater runoff filters through the porous surface into the subgrade or into storm drains. The technique was chosen because of its ability to infiltrate and reduce the concentration of pollutants by filtering and oxidizing. The soil subgrade was an old gypsum landfill area. The runoff was treated in the base of the pavement section. The installation has apparently worked reasonably well. However, detailed assessment of its water quality benefits has not been completed. It should be noted that the pavements have to be routinely vacuumed to prevent fines from clogging the open pavement matrix. Pavements of this type may not be suitable for all applications since the open matrix allows for consolidation where high repetition and high loads are involved. This consolidation leads to deformation of the surface and loss of permeability.

The Virginia Port Authority and Tampa Port Authority are incorporating an innovative wharf structure design that also serves as a means for storing "first flush" rainfall volumes[130]. The Virginia Port Authority design relies upon the collection and holding of the runoff for a specific period as the suspended solids settle. The Tampa Port Authority design utilizes a sand filter and underdrain system to remove the sediments and contaminants.

The Ports of Long Beach and Houston have utilized the Stormceptor System, a gravity-based device that removes oil and suspended solids from water entering the drainage system. The Port of Charleston, SC incorporated a 17 acre detention pond into an expansion of their container yard. Stormwater is collected and directed into this pond, where it is gradually filtered into the surrounding land area.

Ports throughout the U.S. have found that education efforts are an important key to increasing stormwater discharge quality. Accordingly, ports have emphasized the use of comprehensive water quality management programs. As stated earlier in this Section, these programs disseminate best management practices and teach

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[129] "Permeable Pavements Now in First Application," Interlocking Concrete Pavement Institute, Volume 9, Number 3, August, 2002.
[130] Timothy Reid, PE, Moffatt & Nichol Engineers, 2003.

environmental awareness. The programs provide equipment product information that can reduce the levels of pollutants draining to receiving waters. Terminal features that reduce polluted runoff including landscape buffer zones, leaching basins and porous material are also encouraged in these programs.

Ports use different strategies to manage stormwater discharge. The Port of Houston Authority provides educational information to tenants regarding Best Management Practices, but insists that tenants hold their own stormwater permits, as does the Port of Los Angeles. The Port of Long Beach, on the other hand, holds all stormwater permits on behalf of their tenants and gets involved with their tenant's practices through a comprehensive Environmental Review Program. Other ports with comprehensive stormwater programs in place include the Port of Stockton, CA and the Port of Corpus Christi, TX.

Stormwater water quality measures require maintenance to function effectively. Each site has to be evaluated to determine which method of treatment best fits the client/owner needs while also meeting regulatory agency requirements. A properly engineered system is critical to reduce operational impacts and costs associated with maintenance of these items.

12.4.12 *Other Green Port Initiatives*

(a) Oil Spill Response

The Oil Pollution Act of 1990 is the primary federal law governing oil spills and spill response affecting navigable U.S. waters. Part of this Act, the National Response System provides Federal and State resources for oil spill cleanup. Ports participate by creating an Area Contingency Plan that provides comprehensive steps toward implementing guidelines and details an emergency response plan. In addition, several ports have also instituted efforts to reduce smaller scale oil spills via used oil collection points (Port of Cordova, AK) and oil and oil filter recycling programs (Port of Newport, OR).

(b) Ship and Port Generated Solid Waste

Solid waste can be produced as a result of ship or port operations. Management options generally fall into three categories: source reduction, recycling or proper disposal. One previously discussed and particularly valuable means of recycling is beneficial reuse. Examples have been given where used tires and their rubber have been successfully converted into playground equipment and as fish habitats.

Relatively simple measures can be easily implemented to reduce the potential for ship- or port-generated solid waste reaching the marine environment. These include provision of an adequate number of refuse collection bins placed in easily accessible areas, education of port users in the potentially damaging nature of their refuse, and implementation of office product recycling efforts

(c) Beneficial Landscaping

Beneficial landscaping forms a buffer between a port and surrounding communities. Properly designed landscaping protects existing natural areas while selecting native plants that contribute positively to biodiversity and create additional wildlife habitat. Additional benefits include potential for runoff filtering and evapotransporation, flood control, reduction in heating/cooling needs, reduction in noise pollution, and light reduction.

(d) Threatened and Endangered Species

More than 1,000 species are currently on the U.S. threatened or endangered list; other species may be added in the future. Natural and man-made habitats exist at port locations throughout the U.S. As a result, ports have been active in protecting endangered species endemic to surrounding habitat areas.

Port Everglades, FL and Port Canaveral, FL have both instituted programs aimed at protecting the manatee, including physical modifications to fenders to provide clearance between vessels and bulkheads, grating of existing outfalls, and lagoon modifications to avoid stranding of manatees at low water levels. At the Port of Boston, MassPort has taken a role in the protection of the Northern Right Whale, with a primary focus on educating mariners. The Port of Los Angeles has played an active role in protecting least tern nesting and feeding areas within the port.

12.4.13 *Costs and Benefits*

(a) Quantifiable Green Port Initiatives.

This Section examines green port initiatives that are quantifiable, in terms of measurable costs and benefits, for the terminal Options identified in Section 7.4. The initiatives considered were:

- Green Buildings;
- Pavement Recycling;
- Emissions Reduction.

(b) Green Buildings

Section 12.4.9 identified a 7% cost premium for Green Buildings.

For each terminal Option, the cost of providing standard buildings is set out in the Infrastructure Cost Estimates, contained in Appendix G. The additional costs for providing Green Buildings, at 7% of the building cost (excluding contingency, design and supervision), are set out in Table 12.10.

(c) Pavement Recycling

Section 12.4.10 identified a cost saving of $3 per square yard for new pavement construction, through reuse of the existing pavement material removed during demolition. This figure excludes the additional savings for reduced disposal of debris, which have not been quantified.

The savings for each of the terminal Options are set out in Table 12.10 , for each of the different terminal types.

(d) Air Quality and Emissions Reduction

As the number of pieces of equipment running on diesel engines at container terminals is high in comparison to other types of terminal (auto, general, liquid and dry bulk), only container terminals have been included in the comparison.

The following costs and benefits were identified in Section 12.4.8:

i) Reductions, achievable through provision of diesel oxidation catalysts (DOC) in yard equipment engines, and use of emulsified fuel:

- 0.4 tons per year NOx (nitrogen oxides) per DOC used;
- 0.04 tons per year PM (particulate matter) per DOC used.

ii) DOCs cost approximately $1,500/unit, and have no maintenance/running costs.

iii) Emulsified fuel costs approximately $0.30 per gallon more than standard fuel.

The following table outlines the order-of-magnitude cost effectiveness associated with applying emission reduction measures to the recent situation in the Port of New York and New Jersey(PONYNJ). The costs and emissions reductions of various measures are taken from published accounts of PONYNJ emissions[131] and information gleaned from west coast ports as described above.

[131] "The Port of New York and New Jersey Emissions Inventory for Container Terminal Cargo Handling Equipment, Automarine Terminal Vehicles, and Associated Locomotives," Prepared for the Port Authority of New York and New Jersey, U.S. Army Corps of Engineers, New York District, Starcrest Consulting Group, LLC, June, 2003.

Summary of Potential Emissions Reduction Measures For Container Handling Equipment (PONYNJ)	NOx Emissions (tons/year)	% Total Container	Number	Nox Reduction Measure[1]	% Reduction	Capital Cost[2]	Operating Cost[3]	Capital Cost per ton of Nox Reduced
Terminal Tractors	1,139.26	46%	411	227.85	20%	616,500	$ 0.30	$ 2,706
Rubber Tire Gantries/Straddle Carriers	543.66	22%	151	108.73	20%	226,500	$ 0.30	$ 2,083
Wharf Crane	342.16	14%	16	342.16	100%	12,000,000	N/A	$ 35,071
Side/Top Picks	296.17	12%	147	59.23	20%	220,500	$ 0.30	$ 3,723
Fork Lifts	21.89	1%	94	4.38	20%	141,000	$ 0.30	$ 32,206
Sub-Total	2,343.14	94%	819	742.36	32%	1,228,500	N/A	$ 1,655
Other	151.28	6%	55		0%	-	N/A	
Total Container Terminal Emissions	2,494.42	100%	1,693	1,484.71	60%	14,433,000	N/A	$ 9,721

1. Install diesel oxidation catalyst (DOC) in combination with alternative fuel (20% reduction per POLA data)
For Terminal Tractors, Rubber Tire Gantries/Straddle Carriers, Side/Top Picks and Fork Lifts.
Replace Wharf cranes with electric cranes.

2. Order of Magnitude DOC cost of $1,500 each, Crane Conversion cost of $750,000; 2003 dollars

3. Increased cost of $0.30 per gallon for alternative fuel: 2003 dollars

Sources:
"The PONYNJ Emissions Inventory For Container Terminal Cargo Handling Equipment, Automarine Terminal Vehicles and Associate Locomotives," Starcrest Consulting Group, June 2003.

Port of Los Angeles Communications

Table 12.9 Port of New York and New Jersey potential container terminal emissions

Note: The above table is from a published source and the cost information is assumed to relate approximately to the date of publication. The CPIP Consultant has estimated the following additional information: Annual increased operating (fuel) cost per machine for RTG's is $8,000, for straddle carriers is $10,000, for tractors is $6,000 and for side top pick is $8,000.

The benefits, in terms of the reduction in tons of pollutant per year, and cost, in terms of fitting DOCs and using emulsified fuel, have been estimated and quantified for each container terminal Option. The estimate is based on the number of pieces of yard equipment, and a number of other assumptions listed below. There is no need to look at the costs and benefits of diesel crane conversion for all the Options because there are few diesel cranes existing at the port and all new cranes are expected to be electric. However, for reference, the cost and benefit for a crane conversion is stated in Table 12.9.

It should be noted that the indicative costs and benefits have been prepared on the basis of limited data, and should be used for comparative purposes only.

The resulting indicative costs and benefits, for the CPIP container terminal Options, are based on the following assumptions:-

- Yard plant working 21hrs per day, 360 days per year, at 80% utilization;

- Average fuel consumption rates of 4.2 gallons/hr for RTGs; 5.3 gallons/hr for Straddle Carriers; 3.2 gallons/hr for Yard Tractors and 4.2 gallons/hr for Stackers;

- Equipment type and allocation to each terminal is as set out in Task F;

- 'Cold ironing costs are based on additional substations, cabling, switchgear and sockets for shore-based power supply at the berth;

- 'Cold ironing' power supply is assumed to be brought to the site boundary from about 4 miles;

- The cost of converting ships to accept shore-based power is shown in Table 12.8 but in Table 12.10 only the terminal's costs are included;

- Typical ship emissions are based on NOx and particulate matter per working day while at berth. Working time is calculated using a berth occupancy of 70%, i.e. an average of 256 berth-days per year overall;

- Emissions at the utility generating source have been included but typically are only 0.3% to 0.8% of ship-generated NOx and 3% to 17% of ship-generated particulate matter.

Table 12.10 sets out a comparison of the estimated reduction in tons of both NOx and PM, and also estimated purchase & annual running costs, for each of the CPIP container terminal Options.

Container Terminals			C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
Green Buildings	Cost ($m)	Capital cost of green initiatives	n/a	0.5	0.8	n/a	0.5	0.7	1.2	0.8	1.2	0.5	0.2	0.3	n/a	2.3
	Benefit ($m)	20 year present value overall savings[1]	n/a	5	8	n/a	5	7	12	8	12	5	2	3	n/a	23
Air Quality & Emission Reductions	Cost ($m)	Diesel Oxidation Catalyst equipment	0.1	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1
		Annual Fuel Cost	0.4	0.6	1.1	1.1	0.3	0.3	0.5	0.3	0.3	0.5	0.3	0.8	1.0	0.6
	Benefit	Annual reduction in NOx (tons)	20	26	72	51	23	23	34	23	23	34	23	53	48	38
		Annual reduction in PM[3] (tons)	2.0	2.6	7.2	5.1	2.3	2.3	3.4	2.3	2.3	3.4	2.3	5.3	4.8	3.8
	Cost ($m) [4]	Capital cost 'Cold Iron' shore power	8.70	8.70	14.5	15.1	5.80	5.80	8.70	5.80	5.80	8.70	5.80	11.6	14.50	11.60
		Annual cost of fuel and O&M	10.4	10.4	17.3	17.9	6.9	6.9	10.4	6.9	6.9	10.4	6.9	13.8	17.3	13.8
	Benefit [4]	Annual reduction in NOx ('000tons)	0.630	0.630	1.050	1.09	0.42	0.42	0.63	0.42	0.42	0.63	0.42	0.84	1.05	0.84
		Annual reduction in PM[3] (tons)	69	69	115	120	46	46	69	46	46	69	46	92	115	92
Construction Material Recycling	Cost ($m)	Reuse of pavement millings	0	0	0	0	0	0	0	0	0	0	n/a	n/a	n/a	0
	Benefit ($m)	Reuse of pavement millings	0.2	1.3	1.9	0.9	0.2	1.2	1.4	1.5	2.2	1.0	n/a	n/a	n/a	4.7
Auto Terminals			**A1**	**A2**	**A4**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**	**A14**	**A15**			
Green Buildings	Cost ($m)	Capital cost of green initiatives	n/a	n/a	n/a	n/a	0.9	0.3	0.1	n/a	n/a	n/a	n/a			
	Benefit ($m)	20 year present value overall savings	n/a	n/a	n/a	n/a	9	3	1	n/a	n/a	n/a	n/a			
Air Quality & Emission Reductions	Cost ($m) [4]	Capital cost 'Cold Iron' shore power	5.80	8.70	8.70	5.80	5.80	2.90	2.90	5.80	5.80	5.80	8.7			
		Annual cost of fuel and O&M	6.90	10.4	10.4	6.90	6.90	3.45	3.45	6.90	6.90	6.90	10.35			
	Benefit [4]	Annual reduction in NOx ('000tons)	0.42	0.63	0.63	0.42	0.42	0.21	0.21	0.42	0.42	0.42	0.63			
		Annual reduction in PM[3] (tons)	46	69	69	46	46	23	23	46	46	46	69			
Construction Material Recycling	Cost ($m)	Reuse of pavement millings	n/a	n/a	0	n/a	0	0	0	0	0	0	0			
	Benefit ($m)	Reuse of pavement millings	n/a	n/a	0.3	n/a	1.0	0.7	0.4	0.6	0.1	0.2	0.5			
Other terminals			**G1**	**G2**	**G3**	**G4**		**D1**	**D2**	**D4**		**L1**	**L2**	**L3**	**L4**	
Green Buildings	Cost ($m)	Capital cost of green initiatives	2.9	7.7	n/a	5.9		n/a	n/a	n/a		n/a	0.003	n/a	n/a	
	Benefit ($m)	20 year present value overall savings	29	77	n/a	59		n/a	n/a	n/a		n/a	0.03	n/a	n/a	
Air Quality & Emission Reductions	Cost ($m) [4]	Capital cost 'Cold Iron' shore power	29	34.8	11.6	34.8		14.5	8.7	8.7		5.8	5.8	5.8	2.9	
		Annual cost of fuel and O&M	34.5	41.4	13.8	41.4		17.3	10.4	10.4		6.9	6.9	6.9	3.45	
	Benefit [4]	Annual reduction in NOx ('000 tons)	2.10	2.52	0.84	2.52		1.05	0.63	0.63		0.42	0.42	0.42	0.21	
		Annual reduction in PM[3] (tons)	230	276	92	276		115	69	69		46	46	46	23	
Construction Material Recycling	Cost ($m)	Reuse of pavement millings	n/a	n/a	0	0		0	0	0		0	0	n/a	n/a	
	Benefit ($m)	Reuse of pavement millings	n/a	n/a	0.3	0.1		0.1	0.1	0.4		0.03	0.03	n/a	n/a	

Table 12.10 Indicative costs and benefits for Green Port initiatives

Notes 1. Based on a single study of non port buildings including water, energy, health and productivity benefits. 2. n/a : the initiative is not applicable to the terminal Option. 3. PM = particulate matter 4. Values refer to typical average situation. Each site & vessel should be investigated individually

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13 Linkages to Policy and Plans

13.1 Introduction

A list of transportation policies and plans, relevant to the Comprehensive Port Improvement Plan, to be reviewed by the Consultant was agreed with the CPIP Consortium. This Chapter describes the policies and plans and comments on the linkages.

13.2 Cross Harbor Freight Movement Study

13.2.1 Introduction

An important consideration at South Brooklyn is the influence, on container terminal development proposals, of the findings of the Cross Harbor Freight Movement Major Investment Study. This Section describes the study and the four alternatives for the improvement of goods movement across the Hudson. The origin and destination of international containers entering the port terminals are summarized and the interdependencies between a new container terminal in South Brooklyn and a cross harbor rail freight tunnel are discussed.

13.2.2 Cross Harbor Freight Movement Study

The New York City Economic Development Corporation (EDC) is undertaking a study to develop a strategy for improving the region's movement of goods from one side of the Hudson River to the other. The primary movement of goods across the Hudson River is currently limited to two highway bridge crossings; the George Washington and the Verrazano-Narrows Bridges. The Major Investment Study (MIS) was completed in May 2000[132] and the associated Draft Environmental Impact Statement (DEIS) was published in April 2004[133]

The MIS confirmed that a new, direct rail freight link would have dramatic positive impacts, decreasing the region's dependence on trucking, improving air quality and lessening wear and tear on the highway infrastructure.

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[132] Cross Harbor Freight Movement Major Investment Study, PIN X500.19, May 2000
[133] http://www.crossharborstudy.com

The EIS has evaluated:

- no action;
- transportation systems management;
- expanded cross harbor rail float operations; and
- a cross harbor rail freight tunnel.

The cross harbor rail freight tunnel could comprise a single or double tunnel system with one of the following alignments:

- New Jersey to Brooklyn - connecting the Bay Ridge Line to the West of Hudson rail network near Greenville Yard in Jersey City.
- Staten Island to Brooklyn - connecting the Bay Ridge Line to the right-of-way of the Staten Island Railroad.

13.2.3 Origins and Destinations of International Containers

When considering the impact of a cross harbor tunnel on the operations of a new container terminal in South Brooklyn it is important to understand the origins and destinations of the containers passing through the new terminal.

Port Inland Distribution Network (PIDN) studies, and analysis undertaken during Task E of the CPIP study conclude that:

- the primary market for the Port of New York and New Jersey is a 13 State[134] area within a 400 mile radius of the Port;
- containers are predominately transported to and from these States by truck[135];
- four mid-west States[136] form an extended Port of New York and New Jersey Region outside the 400 mile radius;

[134] The 13 States are Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and Virginia.
[135] Port Inland Distribution Network, Executive Summary, Progress Report #1, March 2001 page 1-5
[136] The four states in the extended region are Illinois, Indiana, Michigan and Ohio.

- these four States are typically served by rail.

The distribution of import and export containers through the Port is summarized in Table 13.1.

Area	Percentage
13 neighboring States (*by truck*)	74%
4 mid-west States (*by rail*)	7%
Wider catchment (*by rail*)	19%
TOTAL	100%

Table 13.1 Import and export container distribution (PONYNJ 1999[137])

Container origins and destinations can also be split to locations east and west of the Hudson and it is generally accepted[138] that about 30% of all containers entering the Port are for locations east of the Hudson.

13.2.4 *Container Terminals at South Brooklyn*

The origin and destination of containers that would pass through a new terminal in South Brooklyn would be very similar to the origin and destination of containers landed at any other terminal in the Port. Ships are unlikely, for cost and schedule reasons, to sort their cargo for east and west of the Hudson and then call at two terminals in the Port.

Of say 100 international containers handled at a terminal, such as South Brooklyn, east of the Hudson, 70 of those containers would need to cross the Hudson. For 100 containers handled at a terminal west of the Hudson only 30 containers need to cross the Hudson. A new terminal at South Brooklyn therefore increases the number of containers crossing the Hudson. Whether or not these additional crossings would be by road or rail is discussed in Volumes 2 and 3 of the Task F Technical Memorandum.

[137] From CPIP Task E Technical Memorandum Volume 1 Table E1-63 Source PIERS
[138] Strategic Plan for the Redevelopment of the Port of New York – Task 1.2 Figure 3.2

However, it is not expected that the existence of the Cross Harbor tunnel will encourage much more than the typical proportion (currently around 14%) of containers onto rail unless as part of a special arrangement such as a rail shuttle serving a road and rail inland container depot west of the Hudson.

13.2.5 Linkages to CPIP

The MIS states[139] that the development of a major container port in the Sunset Park area of Brooklyn is not a precondition for the development of the rail tunnel. Tunnel construction is justified on domestic freight demand alone[140] and the diversion of interregional freight from long-haul trucking to rail. A rail tunnel is therefore not dependent on the existence of a container terminal at South Brooklyn.

It is expected that any modern container terminal will have a rail terminal and that a significant and growing proportion of containers will go by rail. Without a rail tunnel, the rail connections to west of the Hudson from South Brooklyn are considered to be unsatisfactory. A container terminal at South Brooklyn is therefore dependent on the existence of a cross harbor tunnel.

Assuming that a rail tunnel were built, there are nonetheless a number of disadvantages of the South Brooklyn site that would make development of a container terminal unattractive:

- highway access, for the majority of containers that will leave by truck, is unsatisfactory
- development costs are the highest of all Options studied
- the development includes a significant area of marine fill
- the development area is bisected by a waterfront recreation area

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[139] Cross Harbor Freight Movement Major Investment Study, PIN X500.19, May 2000 page 4-5
[140] CPIP – Cross Harbor Coordination meeting November 4, 2004, 225 Park Avenue South

13.3 Portway

13.3.1 General

The New Jersey Department of Transportation (NJDOT) has undertaken Portway (Phase I)[141] to plan for port linked improvements to support intermodal and roadway connections, relieve congestion, meet future travel demands, promote economic development, and improve access to brownfields. Portway includes 11 projects designed to improve access to and between the Newark-Elizabeth Air/Seaport Complex, intermodal rail facilities, trucking and warehousing/transfer facilities, and the regional surface transportation system. The projects include:

- Doremus Avenue from south of Port Street to north of Wilson Avenue, Newark. (completed December 2003).
- Doremus Avenue from north of Wilson Avenue to north of Raymond Boulevard, Newark (under construction).
- Charlotte & Tonnelle Circles, Jersey City (under construction).
- Route 1&9T (25) St. Paul's Viaduct Replacement; Jersey City (final design).
- Route 7 Wittpenn Bridge, Kearney, Jersey City (final design).
- New NJ Turnpike interchange, Newark (feasibility).
- Doremus Avenue Interchange with Route 1&9 Truck, Newark (feasibility)
- New Passaic River Bridge Crossing, Kearny; Newark (feasibility).
- Central Avenue and Route 1&9T interchange, Kearny (feasibility).
- Pennsylvania Avenue and Fish House Road, Kearny (feasibility).
- Northern Extension from St. Pauls Avenue to Secaucas Road, Jersey City (feasibility).

The NJDOT Portway Extensions Concept Development Study (2003)[142] identified container/goods movement issues in addition to those addressed by the original

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[141] http://www.state.nj.us/transportation/works/portway/projects.ntm
[142] Portway Extensions Concept Development Study, NJDOT September 2003.

Portway Phase I projects, and recommended extensions that facilitate goods/container movements from northern New Jersey's ports to their next destination.

The Portway Extensions study area includes port facilities in Newark, Elizabeth, Jersey City and Bayonne, and the major intermodal rail facilities in Newark, South Kearny, Secaucus and Jersey City. These areas represent centers of intermodal commerce and regional congestion.

Over the next ten years, New Jersey plans to invest nearly $750 million to improve essential elements of the transportation infrastructure that serve the Portway Extensions study area and fall under the following categories:

(a) Systems / Operational Improvements

- ITS system architecture
- Off-peak freight operations
- Container management strategies

(b) Non-Roadway Infrastructure

- Elimination of height, weight, other capacity constraints
- Short line/short haul rail corridors
- Intermodal yard connectivity
- PIDN rail /barge

(c) Selected Roadway Enhancements

- Truck priority / truck-only facilities
- NJTPK interchange enhancements
- Last-mile and major facility connectors

- Bridges (new or improved)

13.3.2 *Linkages to CPIP*

Portway infrastructure projects have helped to alleviate port related congestion. These improvements, if fully developed, will not only assist in the movement of port goods but in some circumstances in the movement of other regional traffic. Future Portway concepts should be developed in conjunction with the implementation of CPIP.

13.4 NYMTC Regional Freight Plan

13.4.1 *General*

The purpose of the New York Metropolitan Transportation Council (NYMTC) Regional Freight Plan[143] is to develop a roadmap for improving freight transportation in the NYMTC region. The freight plan presents multimodal capital projects, operational improvements, and policy changes for short term (one to three years), mid term (three to 10 years), and long term (more than 10 years) implementation.

The Regional Freight Plan's recommendations were formulated to meet the following objectives:

- Reduce future truck volumes on some roadways;
- Improve traffic operations on some roadways;
- Increase rail mode share in the region;
- Improve environmental quality; and
- Create a more efficient and cost-effective freight delivery system.

These objectives are expected to be met with four guiding goals and accompanying strategies and actions. These include:

- Goal #1 – Improve the Transportation of Freight by Removing Burdensome Government Regulations and Restrictions

[143] NYMTC Regional Freight Plan, An element of the Regional Transportation Plan, Public Draft, April 2004.

- Goal #2 – Improve the Physical Infrastructure of the Transportation System for Freight-Related Transport between Shipping and Receiving Points
- Goal #3 – Improve the Reliability and Overall Movement of Freight in the Region by Encouraging Expedient and Multimodal Shipment of Freight
- Goal #4 – Improve the Reliability and Overall Movement of Freight in the Region by Expanding Alternatives for Trucks and Other Vehicles

The strategies associated with these goals are described below.

13.4.2 *Goal #1*

Improve the Transportation of Freight by Removing Burdensome Government Regulations and Restrictions

Strategy: Facilitate Truck Movements by Better Managing Truck Routes

- Action: Complete NYCDOT's Truck Route Management and Community Impact Reduction Study.
- Action: Address alternatives for providing greater access to national standard 53-foot tractor trailers on the region's highways

Strategy: Improve the Management of Commercial Vehicle Loading and Unloading Zones

- Action: Expand NYCDOT's Commercial Vehicle Parking Program

Strategy: Expand the Application of Intelligent Transportation Systems (ITS) to Commercial Vehicle Operations

- Action: Automate the commercial vehicle permitting, credentialing, and enforcement systems
- Action: Expand the region's Integrated Incident Management System (IIMS)

- Action: Develop a corridor-wide commercial vehicle real time traveler information network

- Action: Pricing strategies

13.4.3 *Goal #2*

Goal #2 – Improve the Physical Infrastructure of the Transportation System for Freight-Related Transport between Shipping and Receiving Points

Strategy: Use Marine Connections to Enhance Access to Key Distribution Points

- Action: Expand the Port Inland Distribution Network

- Action: Freight ferries

Strategy: Use Rail Connections to Enhance Access to Key Distribution Points

- Action: Restore the Staten Island Railroad

- Action: Improve rail tracks on First Avenue in the South Brooklyn Waterfront

13.4.4 *Goal #3*

Goal #3 – Improve the Reliability and Overall Movement of Freight in the Region by Encouraging Expedient and Multimodal Shipment of Freight

Strategy: Reduce Physical Barriers to East-of-Hudson Rail Service

- Action: Provide a minimum of 17-foot six-inch trailer-on-flatcar clearance on the East-of-Hudson Rail Network and reduce other physical barriers.

- Action: Reduce operational conflicts between passenger and freight services on the Region's railroads

Strategy: Evaluate the Further Expansion of Freight Yards and Warehouse/Industry Clusters (Freight Villages)

- Action: Develop freight villages at critical rail links

Strategy: Improve Cross-Hudson Rail Service

- Action: Improve existing float services between New Jersey and Brooklyn
- Action: Complete Cross Harbor Tunnel and ancillary facilities DEIS

13.4.5 *Goal #4*

Goal #4 – Improve the Reliability and Overall Movement of Freight in the Region by Expanding Alternatives for Trucks and Other Vehicles

Strategy: Address Deficiencies in Select Regional Freight Corridors

- Action: The Northern Crossing Corridor – Conduct a regional analysis
- Action: The Southern Crossing Corridor – Coordinate proposed improvements
- Action: Eastern (I-278) Corridor – Conduct a regional study
- Action: JFK Airport and Industrial Access Corridor – Conduct a regional study

13.4.6 *Linkages to CPIP*

As a specific type of freight movement, port goods will be influenced by all freight planning by the regional MPOs. The achievement of the NYMTC Regional Freight Plan goals will improve the movement of Port and other goods through and within the region. The specific strategies developed in the plan will have varying degrees of applicability to CPIP goods movement.

13.5 Port Inland Distribution Network (PIDN)

13.5.1 *General*

The Port Inland Distribution Network is a new system for distributing containers moving through the Port of New York and New Jersey. PIDN followed on from the completion of the Port Authority of New York and New Jersey's Port Development and Investment Planning Report 1999[144] which identified a number of critical development objectives for the Port. PIDN's primary goals were conceived to meet some of the plan's objectives:

Primary Goals

- Reduce inland distribution costs
- Reduce truck trips (i.e. vehicle miles traveled -VMTs)
- Improve air quality
- Increase throughput capacity
- Increase market share

A number of additional benefits were also identified:

- Significant conservation of energy
- Decentralization of development impact
- Economic development of feeder ports and hinterlands
- Value-added distribution opportunities

13.5.2 Analysis

The PIDN study examined the origin and destination of containers entering the United States through the Port and concluded that nearly all of the Port's demand was generated in a seventeen state region. This region was then broken into two; a sub-region of four states in the mid-west over 400 miles from the Port and served predominately by rail and, secondly, a sub region comprising the remaining thirteen states generally within 400 miles of the Port and served predominately by truck. The thirteen state sub-region accounts for about 75% of the trade flowing to and from the wider region.

[144] The Port Authority of New York and New Jersey, Port Development and Investment Planning Report June 1999, Frederic R. Harris, Inc.

Inside the thirteen state sub-region, nine centers of trade around major cities (trade clusters) were identified. Eighty-two percent of the container market within the thirteen state area is found with a 50 mile radius of these trade clusters, at:

- Buffalo, NY
- Rochester, NY
- Syracuse, NY
- Albany, NY
- Pittsburgh, PA
- Hanover, PA – Hanover, MD
- Reading, PA – Camden NJ
- Springfield, MA – East Hartford, CT
- Framingham, MA – Worchester, MA

13.5.3 *Proposed Services*

Traditionally containers destined to and originating from these clusters were transported by truck. PIDN examined the feasibility of using alternative modes to transport containers for the trade clusters. A series of barge and train services to inland terminals were proposed, and of these, the following were deemed to provide the greatest margin of savings over truck to the clusters:

(a) Rail services

(i) to Pittsburgh, PA

(ii) towards the Great Lakes to Syracuse, Rochester and Buffalo.

(b) Barge routes

(i) a New England service to Connecticut and Rhode Island,

(ii) a Hudson River service to Albany, NY

(iii) to the Port of Camden in New Jersey.

13.5.4 *Existing Service*

In mid 2004, the Albany ExpressBarge service was operating a once weekly service to Albany from New York[145]. The barge called at all of the container terminals, except Red Hook, on a request basis and started its journey from New York at the beginning of the week to match ship calling patterns. The journey up to Albany took 16 hours and was operated by Columbia Coastal Shipping.

The PIDN requires a public/private partnership to ensure full development and the ExpressBarge service has benefited from a CMAQ[146] grant and ongoing support from the Port Authority. There is an expectation that service support will be required for up to twelve years.

A barge service from New York to Boston has been operating since 1990. However, there has been a drop in business in recent years and in 2003 only about 13,000 containers were handled, a 70% drop from the peak volume.

13.5.5 *Upcoming Services*

Four PIDN type services are under development with a view to the services starting in 2005:

(a) A chassis-on-barge service to Bridgeport, CT
(b) A lo–lo barge service to Providence, R
(c) Rail or barge links to Camden, NJ
(d) A rail service to CSX's yard at Buffalo, NY in which intermodal containers would be added to existing trains.

13.5.6 *Linkages to CPIP*

Strategies to increase the proportion of container traffic leaving the port by non-road modes are described in Chapter 8. These strategies are applied to rail services to non-traditional rail markets, i.e. closer than 300 miles, and barge services to Albany and locations up the coast to Boston. The services and markets identified in Chapter 8 are similar to those already identified in the PIDN analysis.

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[145] Notes of meeting June 4, 2004, PA 233 Park Avenue South, New York, NY 10003
[146] Congestion Mitigation and Air Quality Improvement Program, jointly administered by the Federal Highway Administration/Federal Transit Administration.

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14 Realization of the Plan

14.1 *Introduction*

This Chapter gives the background to what was originally expected of the Comprehensive Port Improvement Plan (the Plan) and how this original idea was modified as a result of the early findings of the CPIP study. The context in which the Plan will be used is explained together with the difficulties of anticipating when and where development might take place.

The ways of financing port development are described and examples of port operating structures are given along with worldwide examples of recent port development and restructuring, including the influence of private landlords and operators.

As crucial to the success of the Port as the deep navigation channels now being dredged are the transport connections between the Port and the hinterland. Therefore a brief review of public and private funding of transportation projects is also included in this Chapter.

14.2 *Preferred Plan*

The Terms of Reference for the CPIP study originally envisaged that a Technical Memorandum would be prepared identifying the preferred Port improvement proposal. However, as there was found to be no requirement for a major infilling of waterfront area, no such projects were identified. Instead, the study examined the options for development within the present footprint to evaluate their relative merit in terms of port operations, financial and economic performance, transport access and the environment. As a result of the findings of the evaluation it became clear that even on this basis there would be no preferred proposal. This report therefore presents a Plan in the form of a summary of the entire study and a toolkit which presents a ready reference and framework for appraisal of future proposals at the various Port sites.

14.3 *Port Development*

The Port development sites relevant to the study are:

- Port Newark
- Port Elizabeth
- Port Jersey

- Bayonne Peninsula
- Howland Hook
- North Brooklyn
- South Brooklyn

The terminals on these sites are partly in public and partly in private ownership. All are leased to private operating companies, some on long leases, some on short and some presently unused. The driving force for development comes therefore from a diverse range of sources including public and private bodies with different goals. No one agency has control over the type or pace of development except in the permitting process, which examines proposals based on their conformance with local and regional policies and environmental legislation. However, this Plan has no regulatory authority.

It is therefore hoped that the Plan will provide a useful resource for both the private and public sector in the development of proposals and in the initial identification of the issues relating to proposals.

14.4 Phasing of Terminal Development

As explained above, no one agency has control over the pace of cargo terminal development. This will be determined by the variations in demand and the success of certain operators in attracting business to their terminals. It is therefore not possible for the Plan to prescribe a pattern of phased implementation of projects. The Plan goes no further than identifying where development might take place and confirming the possible footprint required for the Port in 2060.

The demand which drives the development process is itself a product of theoretical predictions and is subject to local, regional, national and global influences which may or may not follow the assumptions used in this report. Developers will inevitably make their own assessments of demand and will decide for themselves how the market is growing.

The Plan provides a guide for these deliberations, with the caution that the actual circumstances will likely change as time passes.

14.5 Port Operating Structures

14.5.1 Introduction

This Section introduces various port operating structures.

In the past, port ownership and operations were dominated by the public sector. Ports were viewed as a conduit for imports and exports and as such had a strong bearing on a country's economic performance. Governments were therefore keen to fund these operations in order to facilitate the growth in the import/export trade.

Since the early 1990s, however, the shipping market has undergone significant change, which has exerted enormous pressure on public ports to modernize or allow private sector involvement. Perhaps the key factors in this process were the growth in world trade over the period, the subsequent growth in the container market and the emergence of a limited number of global shipping lines with significant market power. These factors combined to put political pressure on port authorities to improve efficiency and restructure to meet user-demands.

The result of these changes saw public ports seeking to bring in private sector expertise to modernize their operations and improve efficiencies. The degree of private sector involvement has varied around the world with some countries choosing to exclusively pass all regulatory, development and operating roles to the private sector, with others choosing to retain the two former roles within the public sector.

14.5.2 Private sector involvement in ports

The recent influx of private sector involvement in ports is generally a result of underlying inefficiencies in existing port operations. This Section looks at the reasons behind these inefficiencies and how incorporating the private sector can provide improvements.

(a) Problems for public ports

Whilst a large proportion of ports across the world remain publicly-owned, relatively few are now publicly-operated. The change in operational structure has come about as a result of the difficulties faced by the public sector to deliver the requirements of a modern port.

Efficiency is one the main arguments advanced for private sector involvement in port operations, leading to greater cost effectiveness. Private entities are driven by market forces and thus have to respond to changing market conditions in order to maintain profitability. This is a major criticism of public-operated ports in that they can often be slower to react to changes in user requirements and technology and thus they do not make efficient capital investment decisions. Public sector ports are often unable to generate sufficient funds to finance the required capital investments.

(b) Implications of private participation

Some of the reasons for incorporating private sector participation in ports have already been introduced in the previous Section. The main aim is to bring commercial awareness to the development and operation of ports and to subsequently improve efficiency. Private companies bring commercial expertise with them to the industry along with private sector management skills and techniques. Their market driven approach should enhance the quality of service provided to customers as operators are flexible to port-user requirements and adopt new policies to reflect changes.

Examples of enhanced service operations include integrated logistic services, whereby port operators offer additional elements of the supply chain.

Another advantage of private sector involvement is that it allows the mobilization of private financing for the development of public infrastructure. This can help reduce the financial demands upon government funds to support the development requirements of ports. The previous objectives of publicly-owned organizations often revolved around maximizing the economic benefits from port investment. This can be to the detriment of financial objectives, and the fiscal burden on the government of loss-making state enterprises can become considerable. Private sector involvement ensures that development investments are focused on the financial benefits for the port. Private firms will aim to optimize the level of investment to maximize its utilization.

Implementation of private sector values of maximizing returns within port operations can increase revenue streams from the port whilst cost items, such as equipment, are minimized. Private firms will also seek to establish a competitive edge within the market place. All these factors can help the port become more self-sustaining and allow greater investment through project financing.

The rates of return on capital investment that private operators expect are generally likely to be in excess of those typically accepted by the public sector. Such are the elements of risk involved in port investment and their long-term nature, private entities will demand much higher percentage returns. This can make the cost of financing investment much higher than traditional government sources.

In extreme instances competition could result in monopolistic behavior. Strong regulation is then required to avoid abuse of this position, for example from high tariff rates and excessive profiteering.

(c) Bringing private sector operating principles to ports

The transformation of public ports to private ports can be undertaken in a number of different forms and to varying degrees. The most appropriate method will depend upon overall government strategies, financial objectives, and the local social and political environment.

The degree of private sector involvement, or influence, can be split into three types: commercialization; corporatization; and privatization. The two former types involve restructuring public sector entities to operate under private sector conditions. The last advocates full-scale private sector involvement and ownership.

(i) Commercialization involves the introduction of commercial principles to a publicly-owned entity. The port remains under public ownership but there is a clear emphasis on the introduction of commercial ideals and an appreciation of market forces. Legally, however, the entity remains detached from the private sector.

(ii) Corporatization is a legal process of restructuring a publicly-owned entity as a for-profit business enterprise as depicted under the country's company law. As with commercialization the port remains publicly owned however there is now a clear legal distinction between the operation of the port and the government. The corporation will operate as a private firm with the same tax liabilities and with profit targets.

(iii) Privatization involves the transfer of public asset to the private sector through either sale of long-term lease. This therefore brings full private sector involvement to the operational aspects of the port.

There are a number of ways that the private sector can participate within investments in ports. The type of investment will depend upon the structure of privatization employed. These structures are discussed below.

14.5.3 *Port ownership/operator structures*

There are various models of port ownership/operation that advocate different levels of private sector involvement. The key models are summarized in the Sections below. Before assessing these models, however, it is useful to appreciate the various aspects of port operation. In simplistic terms it can be broken down into three distinct functions:

regulator, landlord and operator. Table 14.1 depicts a basic matrix structure, developed by Baird[147], to show the various forms of public and private sector involvement in port operations.

Port Model	Regulator	Landlord	Operator
Public	Public	Public	Public
Public/private	Public	Public	Private
Private/public	Public	Private	Private
Private	Private	Private	Private

Table 14.1 Baird's port function privatization matrix

Four models of port structure are described below, with tables indicating where they sit within Baird's port function privatization matrix.

(a) Landlord model (Table 14.2)

A large proportion of modern container terminals are run using the landlord model. The general structure is to have a port authority that owns the land but leases the operational aspect of the terminal to private sector companies. The type and amount of port-controlled against tenant-controlled operations varies from port to port. This is the model generally adopted in the terminals on the Port Authority's land, i.e. Port Newark Container Terminal.

It is generally the case that the port authority remains a publicly-owned entity, however there are examples, as in the UK, where they are privately owned. Even under the former arrangement it is usually the case that the port authority is structured as a separate entity from the government, established through specific legislation.

The port authority will have the capacity to run all aspects of the port, subject to government limits, which will include establishing terminal operation leases, or

[147] Baird A J (2000), Port Privatization: Objectives, Extent, Process and the UK Experience, International Journal of Maritime Economics, Table 1, p. 180

concessions, to private operators. In general these concessions give private operators specific privileges to use the wharf, container yard, buildings and sometimes equipment. For this right the private operator will pay the port authority a lease charge and/or a royalty charge.

Port Model	Regulator	Landlord	Operator
Public/private	Public	Public	Private

Table 14.2 Landlord model within Baird's matrix

The port authority remains responsible for basic port infrastructure construction, sea and land access, business sites and general amenities, and nautical control. In addition the port authority will consider environmental issues, safety, competition, as well as maintaining an overriding power to control the movement of vessels in and out of the port. The port authority should also be entitled to establish and enforce tariff ceilings.

The concessions often take the form of an agreement over a specific period of time, generally in the form of a long-term lease. Alternatively an operator's license may be issued or, in the case of terminals that require significant development, as a Build Operate Transfer (BOT) arrangement. A variation on the latter form is the Build Own Operate Transfer (BOOT).

The concessionaire (terminal operator) will be responsible for all operating costs and in some instances, in particular for BOT and BOOT arrangements, will be required to undertake capital investment. Revenue is generated through tariffs collected from shipping lines or from sub-leases, although, as has already been mentioned, the port authority retains the right to set maximum tariff rates.

The landlord model has been successfully adopted around the world as it offers a number of substantial benefits. It allows the private sector to be engaged in port operation, and in some cases port development, and thus brings commercial efficiency as well as private sector expertise. Having the same entity owning cargo-handling equipment and running terminal operations allows for successful planning and responsiveness to changing market pressures. At the same time it allows the port to remain connected to government through the port authority and ensures that the port remains in public sector ownership.

The negotiated lease or rent also provides cash flow to the government, or port authority, throughout the entire length of the concession. The actual value of the land asset should also increase with the implementation of the project, which will benefit the government.

In order to be successful, however, the landlord model requires a strong concession agreement. Key issues are that they must by straightforward, yet robust, and allow for minor changes in scope. They should also be established with a view to securing maximum funding. In other words the concession must be attractive to investors and not be overburdened with risk.

Even with strong concession agreements the landlord model still has some disadvantages. One is that government can continue to exert political/social pressures on the port. The port authority is also in a position where it has mandatory day-to-day powers but it has no influence over strategic development of the port. The private terminal operators may make commercial decisions for their short-term benefit, rather than the long-term development of the port. With more than one entity involved in the port there is also a danger of duplication/inefficiencies within areas such as marketing.

(b) Resource port (Table 14.3)

This is similar to the landlord model in that the government maintains ownership of the land and the port authority has responsibility for infrastructure provision. In addition however the port authority also owns all fixed equipment and provides common-user berths. The port authority then rents out the equipment and space to cargo-handling companies and commercial operators on a short-term basis.

This structure effectively provides the port authority with the responsibility for the long-term development of the port. It also ensures that there should be little duplication in terms of investment in infrastructure or equipment as this is all planned by the port authority. Private sector involvement is limited, and short-term, and therefore will be driven by profit maximization. There is a danger that this type of operation leads to fragmentation and subsequently conflict between the various port entities. This type of structure is also likely to be influenced by social and political pressures from government.

Port Model	**Regulator**	**Landlord**	**Operator**

Public/private	Public	Public	Private

Table 14.3 Resource model within Baird's matrix

(c) Operating ("All in one hand") model (Table 14.4)

The operating port model advocates having a single company operating the entire port. This includes the management and administration of the port, responsibility for all infrastructure, nautical control, terminal/stevedoring services, and port services. This is a clear distinction from the Landlord model where the roles of regulator/administrator and operator are specifically separated.

The port itself may be publicly or privately owned, the latter is also known as the market model. If publicly-owned, the port is liable to operate without any commercial considerations.

Port Model	**Regulator**	**Landlord**	**Operator**
Public	Public	Public	Public

Table 14.4 Operating model (publicly-owned) within Baird's matrix

The strength of the publicly-owned model is that having all the development and operation aspects arranged by a single entity should provide a coherent approach. However, without any private sector involvement and no competition there is likely to be inefficient management, lack of innovation and services that are not market driven. There is also a dependence upon government funding which may be a fiscal burden.

(d) Market model (Table 14.5)

The market model is a specific variation of the operating model where the port authority is definitively a private company. The port authority may still set up concessions or lease agreements with other private firms to undertake some or all terminal operations.

The government's role becomes that of regulator and provider of hinterland transport access. This type of model is employed in English ports.

Port Model	Regulator	Landlord	Operator
Private/public	Public	Private	Private

Table 14.5 Market model within Baird's matrix

The benefits of the market model are that, as it suggests, port operations are "driven" by market forces. The involvement of the private sector throughout the port brings professional expertise and management efficiencies. The port also becomes independent of social and political pressures.

The disadvantages of this type of structure are that there can be a tendency for the port to be operated for short-term profit rather than long-term development. Government is distanced from any active involvement in the port, particularly in strategic planning. Whilst it can be argued that the private sector has an interest in maintaining the long-term viability of the port, the reality is that short-term profit objectives for shareholders will always limit this interest.

(e) Private service model (Table 14.6)

The private service model is a further variation on the market model where the government no longer has any interest in port activities, even in a regulatory function.

Port Model	Regulator	Landlord	Operator
Private	Private	Private	Private

Table 14.6 Private service model within Baird's matrix

This model structure is used in many ports in the UK. However, many observers consider it must be used with care as it could result in monopolistic behavior. In particular when privatizing the regulatory aspect, many feel that this should be outsourced to an entity outside the port industry.

Examples of its application have, however, shown it to result in flexible port operations and development and in tariffs which are very much market driven.

(f) A "new" model

The last model depicted here is a variation on the resource and landlord models in that it advocates public ownership for the port authority. The government owns 100% of the port, whilst the port authority is structured as an independent business unit or public corporation. The port authority then controls the level of private sector involvement in port operation.

The port authority is established through legislation as a separate publicly-owned entity. It has its own operating budgets, clearly depicted within a business plan, which also defines investment budgets for the port over a fixed period. The business plan is the key aspect to the model as it is this functionality that is supposed to bring market forces into the operation of the port authority.

This model has been advocated as the ideal solution in comparison to privatization. The port authority is "driven" by market forces, is separate from the political and social issues of government but maintains a relationship with government that allows it to invest in the port with the best long-term strategy.

However, the proposition that the port authority is "driven" by market forces remains open to debate. Whilst the imposition of business plans and budgets may motivate management to perform, the absence of shareholders means that there are not the same financial incentives as for private companies. The separation between government and the port authority is also not definitive and may work better in some countries than others.

14.5.4 Contractual arrangements - private sector

Some of the contractual arrangements available for private sector involvement in ports are discussed within the previous Section. Below is a list of the options available and the objectives of each.

(a) Operating licenses and contracts

Operating licenses and contracts are where the public port authority contracts with a private firm or provides a license for the operation of a proportion, or all, of the port operations. Only the operating rights are transferred to the private operator, not the ownership of the asset.

Management contracts are a particular variation where the public port authority contracts with a private firm to manage the port operations. The operator is paid a management fee, which in some instances is linked to performance. The port authority continues to make provision for the operating costs and investments.

The problems with management contracts generally relate to conflicts of interest between private management and public ownership. Private operators also do not have an equity stake in the port which may reduce their commitment to performance. Linking the management fee to profit is one method of overcoming this problem.

In addition to the management fee the public sector must also be aware of the financial cost associated with regulating and monitoring the private operator.

(b) Leases

Leases provide the private operator with the right to use and profit from the asset over a specified time period. In return the operator pays a rental value. The port authority retains ownership of the port infrastructure. Long-term leases are often favored as they offer stability within port operations.

Equipment leasing is where the port authority retains ownership of both the port infrastructure and the fixed-equipment and leases the latter to the private sector operator. This arrangement tends to be relatively short-term and so can lead to instability.

Operating Leases are generally short-term leases for which rental payments are made by the lessee for undertaking port operations and full ownership rights are kept by the port authority. The private company will generally be responsible for the provision of equipment.

Capital Leases are long-term leases where a private operator will be responsible for specific capital investment within the port. In some circumstances where the lease of the asset is for nearly all of its useful life this, in effect, represents a purchase of the asset by the private company. If after the lease expires the asset retains a value then it reverts back to the PA.

(c) Concession

Concessions differ from leases in that the private sector is responsible for capital expenditure and investment. Governments with public fund shortages prefer these types of arrangements over leases.

Concessions can represent a high level of risk for private investors due to the frequent requirement for considerable investment. As a result private companies will generally require a high rate of return. Potential concessionaires are usually also cautious about committing in sectors and countries with high political or economic risk.

There are several forms of concession, the main ones being Build Operate Transfer (BOT), Build Own Operate Transfer (BOOT), Lease Develop Operate (LDO), and Build Own Operate (BOO).

Important characteristics of concessions are that they should:

(i) be long-term, clear, transparent and fair;
(ii) have a strong project sponsor and government commitment;
(iii) have a flexible tariff as the basis of a robust financial structure;
(iv) have good terminal provision;
(v) have an acceptable regulatory framework; and
(vi) have a workable arbitration process.

In addition the market must be well understood, with realistic expectation of traffic flows and a suitable investment schedule to match.

There are various separate reasons why concessions can fail. Unrealized market expectations are a common problem with ramp-up periods longer than anticipated, un-forecast changes in traffic flows, and product cyclicality. Other issues range through financially weak project sponsors, labor union unrest, and poor management.

(d) Joint ventures

Joint ventures are often the result of a trade-off between the interested parties. Private entities may offer financial resources and operational skills of particular relevance to the proposed development. The port authority fills its financing gap whilst the private organization is introduced to an attractive location.

Joint ventures can offer advantages to both the state and the private partners. Private sector benefits include access to local markets and to government contacts with local market knowledge; entry into previously restricted markets; and a reduction in risk of funding the development.

The advantages for government include access to international networks, foreign capital and commercial management expertise.

Joint ventures are not, however, suitable in every case. As noted earlier, the legal framework and government policy clearly have an influence on their acceptability. Thus, where a port is a wholly owned public facility it is difficult for joint ventures to be formulated, whereas for a corporatized port it may be more straightforward.

(e) Sale of major assets or port

As an alternative to contracts, leases, concessions or joint ventures the port authority have the options to sell off some or all of the major assets to private entities. This transfers all responsibility for future maintenance and developments of the assets to the private sector and releases the public sector of the financial burden.

The retention of selected assets allows the port authority to maintain some level of interest in the future operation and development of the port, with the associated financial risk.

Transferring all assets to the private sector to produce a private port will eliminate all operating subsidies and reduce government deficits. However the port authority will also lose all regulatory powers which can leave the port susceptible to monopolistic tendencies.

(f) Publicly-traded stock company

A publicly-traded stock company is where shares in the port's assets are traded on the stock exchange. For this to be successful the port is generally required to be in a healthy financial state.

14.5.5 Port authority cost recovery methods

For those agreements that transfer the right to use an asset from the port authority to a private entity a payment structure will need to be established. This provides the means to fund infrastructure maintenance and to service any debt associated with the capital infrastructure programs.

The operators of the port will generally collect the tariffs from the port users. This provides the source of income to compensate the port owner for use of the infrastructure and land. The method of payment can involve some combination of up-front fees, annual rents and royalties based on volume of traffic or gross revenue. It is important that the scale of these payments reflects the service provided by the port owner.

Initial payments from the private entity can be described as a guarantee, a payment for the assets transferred or a franchise fee. Generally, it is recommended that this should be avoided for projects that involve new ventures requiring capture of market share.

Annual rental payment can be fixed or escalating across the life-span of the agreement. Whilst rents are generally a specified amount within an agreement, royalties, by contrast, are based on the physical amount of cargo handled or percentage of revenue. For the private entity, payment through royalties therefore represents less commercial risk than a rental payment.

In some instances the port owner and private sector may simply share the tariff revenues accumulated from the port users.

14.5.6 *Private sector participants*

With the advent of privatization within the ports industry the range of investors in the container terminal market has grown significantly. The most significant players remain the major stevedores and terminal operators such as Hutchison Port Holdings, P&O Ports, ICTSI, PSA Corp, and Stevedoring Services of America.

Other entities, both within the industry and outside, are increasingly becoming involved in port investment. The shipping lines, in particular, now have significant portfolios of container port investment. Companies such as Maersk, American President Lines, Evergreen, Uniglory and Yangming not only have dedicated terminal facilities but also have investments in common-use ports.

These shipping lines are investing in ports as a result of:

- the increasingly high levels of competition in the shipping industry that have led to falling profit margins;
- the significant potential return from port investment.

Through diversification they are able to cross-subsidize their shipping operations. It also enables them to enhance the services they offer to customers with increased potential for integrated supply-chain management and better knowledge of customer requirements.

14.5.7 *Assessment of risk - return profiles*

Potential private sector investors in ports will require detailed operational and financial assessments of future performance. It can often be the case that there is conflicting evidence on issues such as port capacities and throughputs. Investors will look for 20% to 30% returns on large capital expenditure, which will be justified by the extent of the risk.

Variables that investors will wish to consider are:

- quay length (in relation to capacity);
- drivers of demand (import/export market, transshipment); and
- performance factors (port operation structure, equipment).

The relative risk of investment is generally assessed over a range of areas including:

- political and economic risk of the country;
- demand risk involving an assessment of the percentage of throughput that is 'origin' cargo, the percentage that is 'destination' cargo and the remainder that is transshipment;
- tariff risk;
- currency fluctuations; and
- environmental risk.

14.5.8 *The case for continued public sector involvement*

Whilst it is inevitable that as the private sector involvement in port operations increases the role of the public sector will diminish, there are certain functions which remain suited to public sector involvement.

Regulatory functions are perhaps the most obvious role through which the public sector can maintain involvement. This can encompass a number of elements ranging from general government port regulation, health and safety and environmental issues through to ensuring fair trade and competition.

More tangible involvement of the public sector within port operations would be through land ownership and the provision of basic infrastructure. Many of the public/private partnership models outlined within this Chapter advocate continued public sector land ownership. However, retention of public sector land ownership need not cover the whole port. There can simply be benefits from government maintaining ownership of the foreshores and immediate back-up areas around the port in order to protect them from non-port based development. In this way governments can protect future development options for the port.

Public sector involvement in the provision and maintenance of basic infrastructure can also offer long-term development benefits and sustainability for a port. Infrastructure such as breakwaters, navigation channels, wharves and road and rail access are all assets with considerable life-spans. As such the return on these investments only accrues in the long-run. They are also cost items that are often difficult to recover through charges. There are thus considerable reasons for maintaining a public sector role in the construction of this infrastructure.

Public sector involvement in capital investment, even as a joint venture, allows the risks associated with long-term investments for the private sector to be reduced. In this way the rates of return required by the private sector investors are also likely to fall. Involvement also minimizes the problem of limited competition amongst private financers wishing to fund public infrastructure programs. Continued public sector financing of infrastructure, with private financing of equipment and superstructure, removes this issue.

14.6 Sources of Finance - Ports

14.6.1 Introduction

This section investigates the sources of finance available for container terminal investment. Methods of financing traditionally differ around the world with the level of public sector involvement often reflecting political and social considerations.

Section 14.5 has already highlighted the fact that terminal infrastructure projects often require significant capital investment but that the returns are only accrued over the long term. There is often a duration of 8-10 years simply to cover the infrastructure construction period. As such, the level of risk associated with such investment can be considerable.

The basic concept for all investors is to maximize development values whilst minimizing risk.

With the exception of Hong Kong, the UK and a few other global examples, governments nearly always take the risk of funding breakwaters, capital dredging and quay walls.

Private financing for land-based infrastructure is generally through commercial loans and shareholder equity

14.6.2 *Traditional port financing*

Historically there has been a well established approach to port financing. It was traditionally public funded and as such was often driven by economic criteria with little ethos for profit maximization or efficiency. Public financing sources would primarily assess the wider economic multiplier effects of port investment rather than directly assessing the rate of return from the port operation. Governments would see port development as an opportunity to stimulate economic growth within the wider economic region.

The absence of financial criteria in development decisions often led to ports becoming a large burden on government finances. The public sector would often be left with a long-term debt from huge construction costs but with significant shortfalls in tariff revenue to cover the debt.

(a) Private sector involvement

With a change in emphasis in the way that the ports industry operates over the last 10 years, with a much greater commercial focus, there has been a substantial increase in the availability of private finance.

Commercialization and corporatization has meant that, despite retaining publicly-owned status, such entities now operate within a commercial environment and follow financial investment criteria. The advent of private sector contracts, leasing arrangements and concessions has meant that private financing has increased significantly.

(b) Project funding

Funding for port developments can be secured in two ways. If a project can be shown to be self-financing over its duration then the project sponsor will generally be able to secure long-term finance against the projected cash-flows that will be generated. This is known as project financing.

If the project cash-flow of a project is insufficient to finance the project then an alternative is for the sponsor to enter into an asset-based agreement with the funding secured against existing assets. This second option is not favored by private companies as it will affect their ability to borrow in other areas of their business and as such privately financed container terminal projects are usually only financed on merit alone.

The Sections below detail the main types of funding available for port development.

14.6.3 *Types of funding*

(a) Own reserves

Perhaps the simplest form of funding is utilizing an entity's own financial reserves. However, it is not often that a corporation or company will have sufficient funds to be able to finance the type of capital infrastructure generally required for port development. This source of funding is therefore often only suitable for small-scale developments and will generally not be used for new ports.

A variation of this type of funding is the sale of non-critical assets to release funds. For ports this could represent the sale of land or facilities that are not core to the corporation/company in order to fund a more critical development program.

(b) Equity and Debt

Equity and debt financing is where investors provide funds in return for interest payments and/or dividends. In the case of equity the lender has the opportunity to generate wealth in the event that the value of the project increases over time.

The rates of interest offered by investors will be influenced by the credit rating of borrower and the risk–return valuation of the project.

Equity can take various forms including subscriptions and ordinary or preference shares. Debt financing often takes the form of bonds.

(i) Share Offerings

Public share offerings involve the sale of shares in a company. In the case of the ports industry it may be the sale of shares in a corporatized, joint venture or private operating company or an associated firm that holds some form of equity within the port operations, e.g. parent companies. In some instances lenders may underwrite share issues stating that they will purchase shares at a future date.

This source of financing is often used as a method of raising finance for the expansion of a port. If the value of a port can be built up and then a proportion of shares are floated on the stock exchange the original owner can often make significant returns to help fund future investment. This mechanism has been used in privatized ports, often in the form of a management buy-out, but also in public ports through joint ventures.

In terms of developing new port facilities this method of raising funding is relatively rare.

(ii) Bonds

One form of debt financing is through the issue of bonds. Bonds are certificates that are issued either by government or a corporation confirming the amount of money invested by individuals and, in some cases, the interest payable at stated intervals. Bonds are considered to be a relatively stable form of financing when backed by government. As such the returns for investors are relatively low meaning that they can be a cheap source of financing. In some circumstance bonds can have withdrawal clauses written into them which are dependant upon either particular eventualities occurring or financial payoffs. The Port Authority issues bonds to finance improvements to their leaseholds although they can not be used for the direct benefit of tenants or other private organizations. For example, the Port Authority funds berths strengthening but tenants provide yard equipment.

(c) Loans and Debentures

Loans and debentures are forms of finance that can be tailored to meet the specific needs of a project. They are typically secured against the project sponsors assets but can also be secured against future revenue streams accrued from lease payments, tariffs or taxes. In some instances this form of finance can be converted into shares or equity.

(d) Debenture Stock

Whilst debentures are generally a popular form of debt, they have had limited use within the port industry. It is a form of finance promoted separately from, and in addition to, the shares forming capital. The additional money is borrowed and debentures are issued to make up the loan capital. The holders of debentures are given a low rate of fixed interest. They are generally redeemable after an agreed period of time, although in some cases they can be irredeemable.

The main benefits from debentures are that they offer a lower rate of interest for the borrower to repay and they offer long-term stability but also have flexible repayment schedules.

The main disadvantages are the up-front costs associated with establishing the debenture and the time that is often required to prepare the issue. There can also be exposure to foreign exchange fluctuations.

(i) Limited Recourse Commercial Loans

Limited recourse loans are where the amount of recourse, or the ability for a lender to seek payment against an investor, is restricted to either a particular amount or a particular security or asset. This means that in the event of an investor seeking to claim reimbursement for an outstanding loan they may only lay claim to a limited payment or particular asset.

(ii) Guaranteed Loans

Guaranteed loans are where an entity, such as government, guarantees a loan amount rather than lending the money directly. The loan itself is provided by an alternative financial institution, such as a commercial bank. The guarantor takes on-board an element of the risk associated with the loan but does not have the up-front fiscal burden. In effect the guarantor provides credence to a project and thus allows the project sponsor access to financing.

The guarantor may choose to cover all or partial risk, depending upon the nature of the project or the terms required from the financial institutions providing the loan.

14.6.4 *Sources of funding*

(a) Commercial banks

Commercial banks have a tendency to offer funding over relatively short time-periods. As a result this does not always make them particularly practical sources for large-scale port developments that have extended construction periods. As such commercial banks often require the investment to be funded within a different structure. This may mean that the project sponsor is required to provide greater equity or that the debt is to be structured in a manner whereby it can be re-financed after a specified period.

Commercial banks are more likely to become involved in projects where there are significant guarantees available.

(b) Venture capital

Venture capital is a fund raising technique for companies who are willing to exchange equity in the company in return for money to grow or expand the business. Venture capital firms often want a high rate of return (20%+). A venture capitalist differs from a more traditional investor in terms of wanting greater control of the company and a quicker return on investment. For the higher rates of return the venture capitalists are prepared to take a greater level of risk.

In some instances this may be an easier form of financing to secure as the lender will require less in the way of guarantees against risk. However, the trade-off is that the expected rates of return will be significantly higher.

(c) Institutional Investors

Pension funds, insurance companies, and investment funds are increasingly taking equity within container terminal investments. This has been widely used within Latin America and is a form of passive investment where the investor does not play an active role in the business.

Established operators tend not to use this source as they already have established financial sources and would gain no benefits from a passive investor. These investors therefore are likely to have a role in larger concessions where there may be multiple investors.

14.7 Global Activities of Container Terminal Operators

14.7.1 *Introduction*

This Section presents worldwide examples of port operational structures in practice and the sources of finance that have been used to fund container terminals. In addition it presents an assessment of the major port operators/stevedoring companies and how they conduct their business.

14.7.2 *Examples of worldwide port operations*

(a) Hong Kong

For a long period the model for private management of port facilities in the East Asia/Pacific region has been Hong Kong. Port management in Hong Kong has a three-tier hierarchy. The government maintains ownership of the land and leases sites to four private operators. These private operators then have the responsibility to purchase and operate all container terminal facilities and perform all container-handling activities. The third tier is the Marine Department that acts in the role of the port authority performing regulatory functions and assisting in strategic planning.

Through the inclusion of private companies such as Hutchison Whampoa, Hong Kong has been able to introduce market forces to the construction and operation aspects of the container terminals. Government however maintains a stakehold in the port by retaining the land-ownership rights.

The development of Container Terminal 9 was a joint venture project. An agreement was signed between the government, Asia Container Terminals Limited, Modern Terminals Limited and Hong Kong International Terminals Limited. Under the agreement, the Terminal companies would all share the construction and development costs of Container Terminal 9, anticipated to be around US$437 million. The tenure for the project was a maximum of 12 years. The deal represented the first major limited recourse financing for a port development

(b) Singapore

Container terminal operation in Singapore has a corporatization structure. The PSA Corporation, that operates all facilities, remains state-owned despite the intention to float the company on the stock exchange in 2001/2002. The initial public offering was to have been between 20%-25% and it was estimated that it would have raised around US$2.2 Billion. A combination of poor industry conditions and an uncertain stock market were the initial reasons given for postponing the floatation but subsequently the escalation in competition from Malaysian ports appears to have been particularly influential.

Singapore lost two major shipping lines, Maersk in 2000 and Evergreen in 2002, to the Malaysian Port of Tanjung Pelepas (PTP). Whilst Singapore remains a substantially busier port than PTP, the defections are thought to have affected confidence amongst investors as to the long-term strategy of the port.

(c) Malaysia

Malaysian Ports began the process of privatization in the early 1980s. The Port of Kelang was originally privatized in 1986. A 21-year lease contract was issued to manage and develop container facilities to an Australian/Malaysian consortium, Kelang Container Terminal (KCT). The government maintained a 20% equity share in the company. The public sector retained ownership of infrastructure and superstructure.

Subsequently, in the early 1990s the remaining bulk operational facilities were privatized with a concession awarded to Klang Port Management (KPM). In 1998 KCT and KPM merged to become KDSB so as to be able to take advantage of economies of scale and cost-effectiveness.

More recently KDSB was appointed by Port Kelang Authority (PKA), to design, build, complete and finance the development of a 1,000-acre land site in Pulau Indah, into a Transshipment Megahub/Port Klang Free Zone. Under the development agreement and supplemental agreements signed in February 2003 and March 2004, respectively, the development of the Transshipment Megahub/Port Klang Free Zone will encompass office blocks, transshipment facilities, light and medium industry facilities and warehouses.

Total project costs are estimated at $350 million. An agreed payment schedule from PKA to KDSB was established for the course of the project. An initial payment of $26 million was made to KDSB in July 2004, with the balance of the payments payable on a deferred payment basis. This amounts to $60 million per annum from 2007 to 2011. A final payment in 2012 comprises the interest accrued on the balance payable to KDSB (at 7.5% per annum), professional fees and any variation orders, which will be assigned to the bondholders and CP/MTN holders.

KDSB established a 'special purpose company' named Transshipment Megahub Berhad (TMB), with the aim of assisting in this further development of the port. TMB has the principal activity of issuing serial bonds and commercial papers/medium-term notes to finance the development of the Transshipment Megahub/Port Klang Free Zone.

Design and construction risks, relating to the development works, are considered manageable given the moderate technical nature of such works. However, to mitigate construction risk and minimize cash flow leakages for the port authority, the payments to KDSB are controlled by the requirement to submit invoices/ documentary evidence on works completed, which are to be certified by a consultant on a monthly basis. Given that the contract was signed for a fixed sum, any cost overruns will also be assumed by KDSB, rather than the public sector.

In the event of non-performance by the appointed contractor, TMB has the right to appoint a substitute contractor to resume, complete and deliver the site to PKA. TMB have step-in-rights to rectify defaults by way of assignments and power of attorney for such assignments.

A further recent development within Klang has been the Westport Terminal. Hutchison Ports secured a 30% stake hold in the business.

The development of the Port of Tanjung Pelepas (PTP) under a BOT privatization agreement was concluded in the mid 1990s. A concession was signed for 60 years, with an additional 30 years available. PTP has been marketed to compete with Singapore for business in what is one of the major shipping lanes in the world.

Maersk bought a 30% stake in the port in 2000, relocating its shipping business from Singapore in the process. PTP also managed to recruit Evergreen Marine Corp from Singapore in 2002.

(d) Malta

Historically the port of Malta had problems with poor investment in port infrastructure. In 1988 the port was brought back to the public sector but given the structure to operate as a commercialized entity. The newly formed Malta Freeport Corporation Ltd (MFC) set about the rehabilitation of terminal one to improve its operation and the subsequent re-development of terminal two. It did this with both public and private finance. The terminal two project required substantial investment for which the required funding was raised on the International Capital Market through global registered notes. The original bond issue was subsequently re-financed via a 30-year bullet bond (i.e. a bond not able to be redeemed until its maturity date).

Malta Freeport Terminals Ltd (MFT) was established in 2001 to ensure there was a clear distinction between the authority and the operator.

In 2004 the Government of Malta signed an agreement with CMA-CGM group granting it a 30-year concession to operate and develop Malta Freeport. CMA-CGM is one of the fastest growing shipping lines in the world and is currently fifth in the global traffic rankings. As a result of the agreement the government has sold all its shares in MFT Ltd and entered into an agreement to lease the port facilities and to grant a license for the operation of the port. The government, however, maintains the ownership of the site.

Through the concession CMA-CGM will be responsible for all necessary investment to improve facilities and equipment. The port must remain a common-user facility. CMA-CGM has appointed Port Synergy, a joint venture between CMA-CGM and P&O Ports, to run the operation.

(e) South Korea

Privatization has occurred at a number of key container ports in South Korea. Korea is working to create a northeast Asia hub role for itself, with particular attention on China and Japan.

Incheon Container Terminal, a joint venture development between PSA and Samsung Corporation, was awarded the concession to build, transfer and operate the terminal in 2001. This represented the first foreign investment in the port and the first company to take part in the Social Overhead Capital Project for port development in the country. The investment from ICT was more than US$200 million.

In 2003, Busan was the world's third largest container port after Hong Kong and Singapore. Significantly, 41 percent of all cargo was goods in transit, a measure of the importance of its hub-port role. Business was anticipated to increase as the government reduced cargo entrance fees, created harbor support areas and privatized new container terminals.

South Korea's Busan Newport Co. Ltd. arranged for financing to go ahead with an expansion of the port, adding a container terminal with six berths and 5,500 feet of quayside and intermodal facilities. The offshore portion was estimated to be in the region of $276 million, with an onshore cost of $200 million. The idea was to partly finance Phase 1-1 of the Busan Northern Container Port. The total cost of just over $1 billion was to be financed through a combination of equity, government subsidies and commercial banking facilities.

Busan Newport is a joint venture among some of Korea's largest industrial conglomerates, led by Samsung Group and Hanjin Group and backed by the Korea Container Terminal Authority. CSX World Terminals has a stake in the company and is contracted as the operation and maintenance provider. CSX also operates a terminal and logistics company in Hong Kong.

(f) The Netherlands

At the beginning of 2004 the Port of Rotterdam undertook the process of corporatization of the port authority. This change was undertaken in order to create an organizational structure that would allow a market-driven business process, whilst maintaining political and administrative accountability and allowing scope for participation from other authorities. Previously the Rotterdam Municipal Port Authority (RMPA) acted as a public landlord port.

The Port of Rotterdam has three divisions, the commercial division, the division of port infrastructure and the division of the Rotterdam Port Authority. An executive board overseas all three. The purpose of the commercialization is not to segregate the authorities from the port authority but to remove the day-to-day operation of the port away from the public sector and to introduce more commercial ways of operation.

The Port Authority division remains responsible for safety and the efficient management and navigation of shipping traffic throughout the region in an environmentally friendly manner. The commercial division has responsibility for all financial participants, joint ventures and partnership of the port. The infrastructure division has responsibility for optimizing the development, construction, design and management of the port area.

(g) Belgium

In 2004 P&O Ports, as part of Antwerp Gateway consortium, signed a 40-year concession with the Antwerp Port Authority to equip and operate the east-side container terminal at Antwerp Port. P&O ports will manage the terminal and thus the new project, with an estimated development cost of $600 Million. The other members of the consortium are P&O Nedlloyd and Duisport.

(h) Italy

Privatization of ports in Italy began in the mid 1990s. Considerable overseas investment has come into the ports with global operators such as PSA Corporation procuring shares in facilities in Genoa and Venice.

The Medcentre Container Terminal is one of six ports in Italy that is controlled by Contship Italia, a holding company controlled by Eurokai Group of Hamburg, Eurogate and Maersk. It has been suggested that the success of the port is because Contship operates a range of activities within the transport chain, thus improving supply chain management. Their interests include trucking and rail services, port feeder services and a container freight station.

Voltri Terminal Europa, Genoa is an early example of a joint venture in terminal operations. PSA Corp signed an agreement with Sinport in 1998 to purchase a majority stake in their operations. Sinport owned 95% of Voltri Terminal Europa, the company that operates the largest container terminal in Genoa.

(i) Portugal

Privatization of some of Portugal's ports has led to increased investment. In 2000, a 20 year concession for the Santa Apolonia Container Terminal was awarded to Sotagus, with an option for a further 10 years. Sotagus is a joint venture between the stevedoring company Serico Portugues de Contentures, Multiterminal and Manicarges. Prior to this Multiterminal and Manicarges handled the vast majority of container operations at the port, thus giving them a distinct advantage in the bidding process.

The privatization process brought about additional infrastructure investment with a new 450m quay and additional container stacking areas. The terminal also now has new gate management technology in operation.

The management of Leixoes Container Terminal transferred from the port authority to the privately owned TCL consortium in 2000. TCL is a consortium of Leixoes based stevedoring companies. During the 25 year concession TCL have committed to US$154 of investment, much of which will occur within the first 10 year period. Most of this is to be spent upon equipment and new technology.

Port of Sines awarded PSA the concession agreement to develop, manage and operate Terminal XX1 in 1999. Under the agreement PSA are responsible for the construction and management of the new terminal, whilst the government would develop the breakwaters and road/rail connections. The operations at the terminal are a collaborative venture between PSA and Sines Port authority.

(j) Spain

Many of the main ports have some private sector involvement. However, widespread privatization has not occurred to date. Most of the private companies involved in port operations are Spanish-based.

At Bilbao until recently two box terminals dominated container traffic; the MacAndrews Euroterminal; and Terminales Maritimas de Bilbao. However, in 2001 the MacAndrews Euroterminal sold out to a consortium of MSC, SPL-Dragados and SLP, who subsequently secured a concession for an expansion of the container terminal onto reclaimed land in the outer harbor. Since then a second new container concession has also been put forward.

In 2001 Algeciras port authority announced a planned 15-year concession to operate the box handling facility on Isla Verde. Despite concerns at one stage that no serious bids would be received the subsequent success highlighted a changing trend in private sector involvement in Spanish ports.

In 2003 the Port Authority of Algeciras Bay (APBA) opened bidding for an Outer Isla Verde. APBA budgeted $160 million for the initial phase to be completed by 2006. In total all the phases of the work are anticipated to amount to around $670 million making it the largest public works project ever undertaken in the bay.

(k) UK

UK ports represent a relatively unique approach to port management. The majority of major ports are now solely in private hands after the privatization process that started back in the early 1980s. Associated British Ports, encompassing 19 ports at that time, was floated on the stock exchange with 49% of the shares put up for sale. The continued expansion of ABP highlighted this process as a success and led to further privatization.

UK ports are not subject to price regulation and as such tariffs are determined by market forces. All commercial and competition issues are dealt with by the Office of Fair Trading and the Monopolies and Mergers Commission.

14.7.3 *Examples of the globalization of major operators*

(a) P&O Ports

P&O Ports is a leading cargo handling service provider and port operator throughout world. It has a presence in 27 container terminals and 100 logistics operations, within 18 countries.

Container handling has become the company's core activity with operations in North America, Europe, East Asia, South Asia, Australia, South America and Africa.

In 2004, the company signed new concession deals with the Port Authority of Le Havre, Antwerp Port Authority and Vancouver Port Authority.

(b) PSA Corporation

PSA was formerly the Port Authority of Singapore, a statutory board that regulated, developed, and operated Singapore terminals. In 1997 PSA became the corporate successor to the port authority, although the regulatory function remained as a separate entity. PSA is 100% owned by Temasek Holdings, the investment arm of the government of Singapore.

PSA now has investments with 16 port projects in 11 countries. Its main terminal operations are in Europe (5 terminals), South East Asia and Japan (4 terminals), China (3 terminals), Korea and India.

Recent ventures include the opening of the Incheon Container Terminal in South Korea and the Sines Container Terminal I Portugal where PSA have long-term concession agreements to construct and then operate the terminals.

(c) ICTSI

International Container Terminal Services Inc. is involved in worldwide container port and terminal operations. ICTSI's flagship operation is the Manila International Container Terminal (MICT) in the Philippines, where it took over operations in 1988 having won a 25-year concession. From this base it launched a worldwide expansion program in the mid-1990s.

It now has operations throughout the Philippines (4 terminals), and in Brazil and Poland.

14.8 Highways Funding

14.8.1 Background & Purpose

Historically, highway construction and improvements have been publicly funded using a combination of state and federal funds. The advent of the Interstate Highway System starting in the 1950s has contributed greatly to the economic well-being of the United States. Various transportation funding packages have been formulated since then and the strategies remained consistent through the 1980s. These strategies focused on adding new roads to increase access to developed and emerging areas of the country.

In 1991, however, the Intermodal Surface Transportation Efficiency Act (ISTEA) and its successor the Transportation Efficiency Act for the 21st Century (TEA-21) in 1998 changed this focus of building new infrastructure. The highway building boom of the 1950s, 60s, and 70s created infrastructure that, by the 1990s, needed greater levels of repair and maintenance. Funding streams underwent significant change and required state DOTs and MPOs to weigh projects in terms of importance and impact to the region or community. Maintaining the existing system in good condition is currently the policy of many MPOs including NYMTC and NJTPA.

This Section of the report assesses the benefits of the varying levels of public and private sector highway funding. It illustrates the approach taken to identify funding streams, both traditional and non-traditional, to finance the highway infrastructure improvements identified in the CPIP study. In addition, institutional issues and innovative financing approaches are discussed, and funding recommendations are summarized.

14.8.2 Approach

The CPIP plan considers port operations and terminal facilities vital to the economic well-being of the region. The highway improvements identified have the purpose of accommodating all traffic growth including that from the Port. The improvements, however, are not yet included in the long range plans (LRP) or transportation improvement programs (TIP) of either state or the MPO regions.

14.8.3 Highway Improvement Summary

Highway improvements proposed include these project types:

- Intersection signalization improvements
- Intersection approach roadway widening
- Roadway widening
- Interchange ramp modifications
- Grade-separated structure widening

In addition, some recommended improvements entail enhancements to existing proposed projects (i.e. additional turning lanes). Table 14.7 summarizes the recommended improvements in the years 2020 and 2060 to accommodate forecasted traffic growth.

Project Type	Description	Number of Projects[1]		Total Estimated Costs	
		2020	2060	2020	2060
Intersection Signalization Improvements	Installing signals at unsignalized intersections. Upgrading existing traffic signals to accommodate widening/additional lanes. Implementing timing changes or new controllers at existing signalized intersections.	22	6	$6,600,000	$1,800,000
Intersection Approach Roadway Widening	Widening intersection approach/departure roadways for additional turn or thru lanes.	6	4	$7,200,000	$4,800,000
Roadway Widening	Constructing additional travel lanes on mainline roadway segments.	14	4	$54,874,800	$15,120,000
Interchange Ramp Modifications	Modifying or constructing new ramps at existing grade–separated interchanges.	3	1	$3,340,000	$1,050,000
Grade-Separated Structure Widening	Bridge widening to provide additional travel lanes for roadway segments on structure.	3	0	$3,024,000	$0

Table 14.7 Highway improvement summary
Costs at 2003 constant US dollars

[1] Some locations have more than one type of project.

Tables 14.8 and 14.9 show the number, types, and costs of the projects for each state.

Project Type	New Jersey		New York	
	Number of Projects[1]	**Total Estimated Costs (in Year 2003 $$)**	**Number of Projects[1]**	**Total Estimated Costs (in Year 2003 $$)**
Intersection Signalization Improvements	19	$5,700,000	3	$900,000
Intersection Approach Roadway Widening	3	$5,400,000	3	$1,800,000
Roadway Widening	12	$50,490,000	2	$4,384,800
Interchange Ramp Modifications	3	$3,340,000	0	$0
Grade-Separated Structure Widening	3	$3,024,000	0	$0
TOTAL	**40**	**$67,954,000**	**8**	**$7,084,800**

Table 14.8 2020 highway improvement summary
Costs at 2003 constant US dollars

[1] Some locations have more than one type of project.

Project Type	New Jersey		New York	
	Number of Projects[1]	Total Estimated Costs	Number of Projects[1]	Total Estimated Costs
Intersection Signalization Improvements	2	$600,000	4	$1,200,000
Intersection Approach Roadway Widening	0	$0	4	$4,800,000
Roadway Widening	3	$15,000,000	1	$120,000
Interchange Ramp Modifications	1	$1,050,000	0	$0
Grade-Separated Structure Widening	0	$0	0	$0
TOTAL	**6**	**$16,650,000**	**9**	**$6,120,000**

Table 14.9 2060 highway improvement summary

Costs at 2003 constant US dollars

[1] Some locations have more than one type of project.

14.8.4 *General Principles for the Overall Funding Strategy*

(a) Overview

The total cost of CPIP related highway improvements is relatively low as far as multi-year regional investment initiatives go. That being said, it is equally recognized that transportation improvement funding is highly competitive and that bona fide needs greatly exceed resources.

The following principles could provide the guidance needed to choose the appropriate course of action to balance the need for funding of highway projects which are important to the Port and other needs within the region:

- (i) Integrate/mainstream the CPIP related highway needs into the existing planning and programming processes of the two states and the two MPOs;
- (ii) Encourage the use of economic and multimodal criteria to bolster the likelihood of funding these improvements in a timely manner;
- (iii) Establish a consistent programmatic direction in the respective LRTPs and TIPs that promotes packaging of projects according to an agreed upon timetable;
- (iv) Encourage, wherever feasible, the use of innovative financing principles, primarily user/impact fees and public-private partnerships that package highway improvements with Port Development (terminals, etc.) projects as part of the overall funding strategy.
- (v) Consider the feasibility of a federal "earmark" for the ~~CPIP~~ highway program based on its critical international commerce and multimodal implications and impacts.
- (vi) Consider the appropriate use of debt-financing tools including floating bonds for these improvements, but determine the appropriate revenue sources for servicing the debt, including, but not limited to the impact/user fees concepts noted above.

(b) Planning and Programming

With long range planning such as CPIP's 2060 forecast year, regional planning must be formulated in such a way that improvements do not get lost in the near term.

The Transportation Improvement Program (TIP) is a prioritized, multi-year program for the implementation of transportation improvement projects for an MPO region. It serves as a management tool to ensure the most effective use of funding for transportation improvements. It is also necessary for two other reasons. First, the TIP is a requirement of the transportation planning process as most recently legislated by TEA-21 and second, a transportation improvement is not eligible for Federal funding unless it is listed on the TIP.

The TIP must include a certification by the MPO that the process is in conformance with various applicable Federal regulations. Certification ensures the region's continued eligibility to receive federal funds for highway projects.

The funding programs of the two MPOs and PANYNJ are described below.

(i) North Jersey Transportation Planning Authority (NJTPA).

More than $1 billion in the upcoming fiscal year (FY 2005) will be spent for road, bridge and related projects and programs overseen by the New Jersey Department of Transportation (NJDOT) within the NJTPA region. A maintenance-first policy allows for less than one percent of the funds in the program to be dedicated to roadway expansion, with the vast majority of highway dollars going to system management and preservation.

In FY 2005, NJDOT highway projects and programs are funded with $578 million in federal funds and $494 million in state and other non-federal funds. The Transportation Trust Fund (TTF) is the major source of state funding, and is due for renewal in FY 2006.

(ii) New York Metropolitan Transportation Council (NYMTC).

The existing federal fiscal year 2004-2006 NYMTC TIP identifies over $18.6 billion in transportation improvements with $6.5 billion in 2005 alone. Roadway funding throughout the life of the TIP is expected to make up about 18% of this funding with transit to receive over 81%. This prioritization along with other project needs makes funding any new highway construction projects extremely difficult.

(iii) Port Authority of New York/New Jersey (PANYNJ).

The PANYNJ receives revenues from its operations of 5 aviation facilities, 8 bridges and tunnels, PATH rail system, 8 port facilities and 8 development areas. Gross operating revenues from these sources are expected to be $2.9 billion in 2005 with operating and capital expenditures expected to reach the same. The PANYNJ assumes the costs of those roadways it owns, such as those surrounding Port Newark/Elizabeth.

(c) Institutional Funding Options Overview

The following funding options are those that have been used in the past as perennial sources of funds for highway infrastructure projects. These sources have historically provided the bulk of funding for the types of highway improvements identified.

The Intermodal Surface Transportation Efficiency Act (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21)

ISTEA and its successor TEA-21 changed the way the country thought about transportation funding. Passed into law in 1991 and 1998 respectively, the bills set out "To develop a National Intermodal Transportation System that is economically efficient, environmentally sound, provides the foundation for the Nation to compete in the global economy, and will move people and goods in an energy-efficient manner."

The current TEA-21 legislation has been prolonged under a continuing resolution since 2004 which provides funding at the 2004 levels. The reauthorization of a transportation funding bill is expected in 2005.

Applicability to CPIP: The projects currently being federally funded fall under this legislation, however this legislation is nearing its end. Any new federal project funding will be provided by other sources.

Safe, Accountable, Flexible and Efficient Transportation Equity Act (SAFETEA)

The proposed $247 billion, six-year bill is expected to authorize a total of $9.1 billion ($6.1 billion for transit) for New York State and $4.8 billion ($2.1 billion) for New Jersey. The legislation is currently being finalized. The programs within it are expected be similar to its predecessors however total authorizations for specific programs are under negotiation.

Applicability to CPIP: Earmarks in the bill would provide a dedicated source of funding for port projects. In addition, the bill includes freight specific highway programs such as freight transportation gateways, freight intermodal connections, transportation Infrastructure Finance and Innovations Act (TIFIA), and commercial vehicle information systems and networks. These initiatives, when passed, should be reviewed for applicability to CPIP related projects.

Section 129 Loans

Section 129 of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) provided for federal loans to States for projects with dedicated revenue streams such as tolls, excise taxes, sales taxes, real property taxes, motor vehicle taxes, incremental property taxes, or other beneficiary fees.

States can make loans to a public or private entity to construct either a toll project that is eligible for federal-aid funding or a non-toll highway project that has a revenue source specifically dedicated to support the project. The amount loaned by the state is considered an eligible Federal-aid project cost.

<u>Applicability to CPIP:</u> CPIP highway projects could be tailored to dedicate a portion of its port operation revenue stream to these projects. With this source identified a Section 129 Loan could be acquired. This method would only be feasible for those roadway improvements within the PANYNJ oversight. Projects proposed on other roadways would require a similar identification of a dedicated funding stream.

Toll Credits

The Intermodal Surface Transportation Efficiency Act (ISTEA) and TEA-21 permitted states to substitute certain previous toll-financed investments for State matching funds on current Federal-aid projects. This means that the non-federal share of a project's cost may be met through a "soft match" of toll credits. This allows states to use toll revenues when other state highway funds are not available to meet non-federal share matching requirements.

Toll credits are earned when the state, a toll authority, or a private entity makes a capital transportation investment with toll revenues earned on existing toll facilities (excluding revenues needed for debt service, returns to investors, or the operation and maintenance of toll facilities). The amount of credit earned equals the amount of excess toll revenues spent on non-federal highway capital improvement projects.

The New Jersey DOT is using a soft match to help finance the construction of a southbound viaduct over the Waverly Yards in Newark. New Jersey DOT is expediting construction by applying $15 million in toll credits toward its share of the project costs.

<u>Applicability to CPIP:</u> Just as the NJDOT is expediting construction of the viaduct, congestion pricing within port areas could provide the tolls necessary to establish the soft match for Port connector road improvements.

Traditional Bond Financing

Bond financing provides government with funds now in exchange for future revenues. Issuing bonds is useful when a project requires more money up front than is generated by a taxing district's immediate revenues and reserves and where it is desirable to spread the cost equitably over the project's useful life.

Applicability to CPIP: A bond issue from one of the following agencies would provide the necessary funding for Port related projects: New Jersey Department of Transportation, New York State Department of Transportation, Port Authority of New York/New Jersey, New York City Industrial Development Agency, New Jersey Economic Development Authority, or other regional agency with bonding authority.

Motor Fuels Tax

State highway revenues are primarily generated from Motor Fuels Taxes. New York's provided $513 million in revenue in 2001. New Jersey's tax generated $516 million the same year. This revenue along with general state funds are the primary source for the state funding share for highway projects.

Applicability to CPIP: Regardless of which funding option is chosen for Port related improvements, a portion of funds generated from the respective states' motor fuels tax would most likely be necessary for the state matching funds. As this is the traditional source of highway funding, it will likely be a primary source for Port related improvements.

GARVEE Bonds

For several years states, municipalities, and authorities have raised funds by issuing grant anticipation notes (GANs), which allow governmental entities to fund projects based on anticipated future revenues. Grant Anticipation Revenue Vehicles (GARVEE) bonds employ federal highway funds in the same way to repay the debt for road projects. These guidelines apply to bond financing a single large scale Federal-aid eligible project or multiple eligible projects.

GARVEE bonds are loans pledged with a portion of future federal funds, sometime backed by dedication of a portion of state fuel taxes. The Federal Highway

Administration (FHWA) views these bonds as a safe approach for states since federal funding for roads and bridges traditionally increases year to year.

Applicability to CPIP: GARVEE bonds are for a project, or group of projects, that are of significance to an area but no dedicated funding sources are known. Highway improvements for the Port connectors may be bundled into one GARVEE bond issue that can be leveraged against future federal revenues.

(d) Innovative Funding Options

The following funding options are those that have the potential to source highway improvements of benefit to the Port.

CMAQ

The primary purpose of the Congestion Mitigation and Air Quality Improvement Program (CMAQ) is to fund projects and programs in air quality non-attainment and maintenance areas for ozone, carbon monoxide (CO), and small particulate matter (PM-10) which reduce transportation related emissions.

The program provides flexibility for public/private partnerships by allowing States to allocate CMAQ funds to private and non-profit entities for land, facilities, vehicles and project development activities. CMAQ does not allow for funds to be used for nongovernmental partnerships on projects that are required under the Clean Air Act, the Energy Policy Act or other Federal laws.

Applicability to CPIP: Projects may be eligible for CMAQ funding if the delay reduced as a result is shown to reduce transportation related emissions. Air quality is a critical policy issue nationally (especially the eastern US) and transportation funding programs will increasingly be focused on achieving attainment of air quality standards.

State Infrastructure Banks (SIBs)

A State Infrastructure Bank (SIB) is a revolving fund mechanism for financing a wide variety of highway projects through loans and credit enhancement. SIBs are intended to complement the traditional Federal-aid highway programs by supporting certain projects with dedicated repayment streams that can be financed in whole or in part with loans, or that can benefit from the provision of credit enhancements. As loans are repaid, or the financial exposure implied by a credit enhancement expires, the SIB initial capital is replenished and can be used to support a new cycle of projects.

Applicability to CPIP: Both New York and New Jersey have established SIBs. As with Section 129 Loans and Toll Credits, dedicated funding streams must be identified for repayment of the loan. The difference is that SIBs fund a wide variety of infrastructure improvements which could include Port connector highway improvements. SIBs may be especially appropriate where highway projects have some private sector funding participation.

TIFIA

The Transportation Infrastructure Finance and Innovation Act of 1998 (TIFIA), enacted as part of TEA-21, established a new Federal program to provide credit assistance to major surface transportation projects of national or regional significance. The goal is to leverage future Federal funding and stimulate capital investment in transportation infrastructure by providing credit rather than grants to projects of critical importance to the nation's transportation system.

The TIFIA credit program offers three distinct types of financial assistance, designed to address the varying requirements of projects throughout their life cycles:

(i) Direct loans with flexible repayment terms and provide combined construction and permanent financing of capital costs.
(ii) Loan guarantees that provide full-faith-and-credit guarantees by the Federal government to institutional investors, such as pension funds, which make loans for projects.
(iii) Standby lines of credit that represent secondary sources of funding in the form of contingent Federal loans which may be drawn upon to supplement project revenues during the first 10 years of project operations.

Applicability to CPIP: TIFIA assistance requires that a project cost $100 million or more ($30 million for ITS projects). Because Port connector improvement costs are well below this level, the program might not be relevant. However, it could a funding source if some logical project bundling were permitted.

Public/Private Partnerships

Improvements to highway infrastructure benefit both private businesses and the public at large. Specifically, port operators and shippers within the Port benefit from the expeditious movement of goods to and from terminals. Sharing in the costs of alleviating congestion could benefit private interests to the point that they would be willing to assist in funding the infrastructure projects.

Applicability to CPIP: Forging partnerships between port shippers/operators and the regional public agencies could assist in the sharing of costs for certain specific types of improvements.

Congestion Pricing

Congestion pricing is a toll, fee or surcharge levied for using a highway or bridge during peak periods. The goal of this method is to help alleviate capacity problems by shifting trips to off-peak periods, and/or shift traffic to less congested routes, thereby spreading out demand for congested corridors. Advances in technology and the limits of historic transportation funding approaches will make congestion pricing an ever more feasible and acceptable option.

Applicability to CPIP: Although this method generates revenue, it is estimated that the costs of implementing this service would be far more than the revenue generated for Port connector road improvements. In addition, the goal of the congestion pricing is to reduce traffic, which would require fewer infrastructure improvements. As a result of these factors, congestion pricing would not be an effective revenue generator.

Interstate Tolling

Adding tolls to interstates other than the New Jersey Turnpike would generate addition revenue that could be put back into the roadway infrastructure. Tolling roadways charges the actual user of the facility a fee to be used for maintenance of the facility.

Applicability to CPIP: Because none of the Port connector roads are located along interstates, this type of tolling would not provided the needed revenue.

Energy Tax/Mileage Based Revenue Schemes

Regardless of what Scenario becomes reality, it is estimated that there will be over 400 million vehicle miles traveled within the region in 2020. If each operator were charged 0.5 cents per mile the region would generate $200 million daily, compared to the $1 billion generated annually from the current gas tax. In addition, as vehicles become more fuel efficient or alternative energy powered vehicles become the norm, the gas tax will not provide the revenue necessary for the maintenance of the highway system.

Taxing an individual's use of the road or tying taxes to energy used rather than gas/diesel specifically will provide a consistent stream of revenue.

Applicability to CPIP: Although this is a broader concept than would apply to the Port connector roads, the revenue generated could assist in providing funding.

Advance Construction

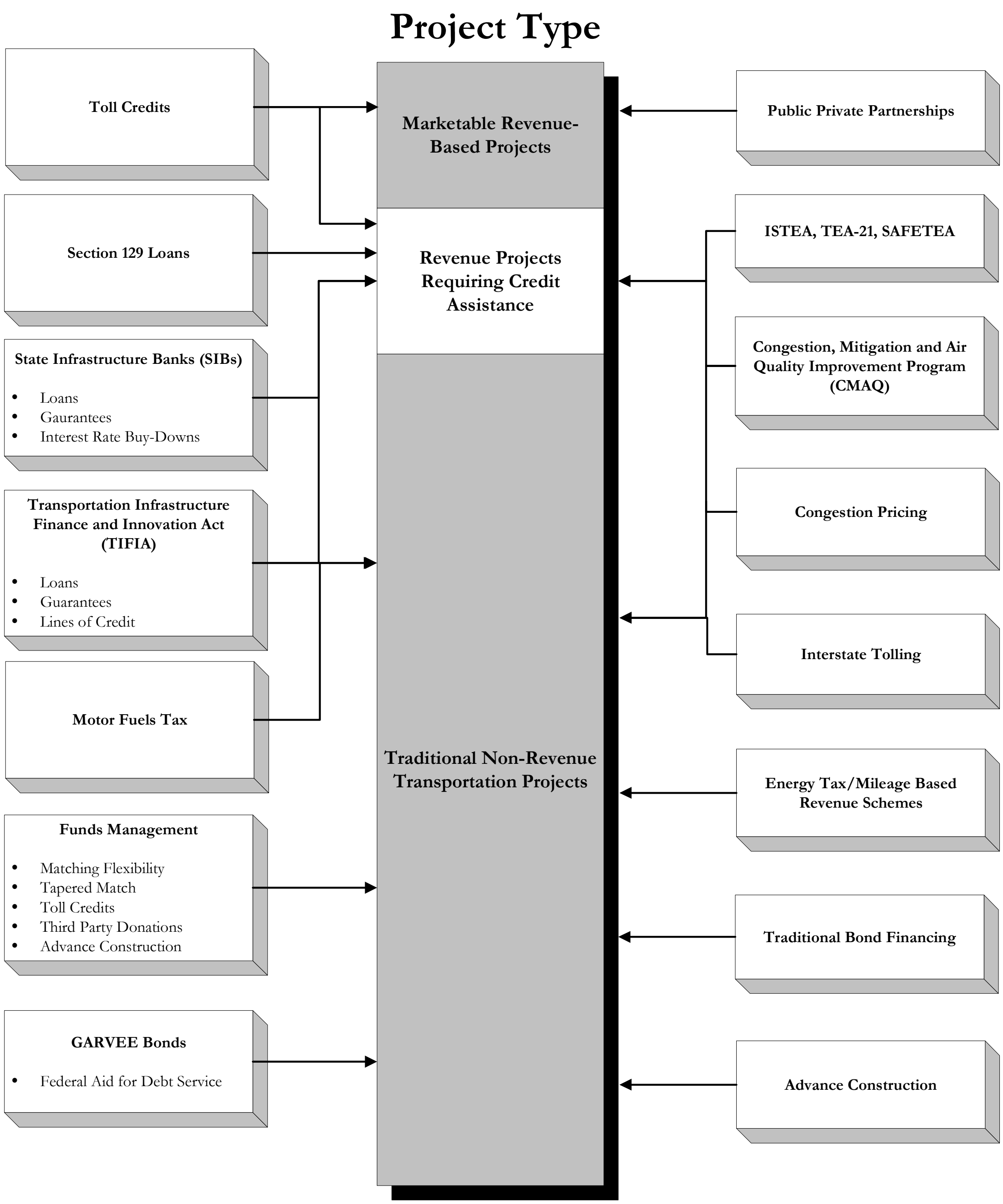
Under Advance Construction, a state may use non-federal funds to advance a Federal-aid project while preserving its eligibility to receive Federal-aid reimbursements in the future. Advance Construction eliminates the need to set aside full obligational authority before starting projects. As a result, a state can undertake a greater number of concurrent projects than would otherwise be possible. In addition, Advance Construction helps facilitate construction of large projects, while maintaining obligational authority for smaller ones.

Partial conversion of Advance Construction is when a state converts, obligates, and receives reimbursement for only a portion of the Federal share of project costs. This removes any requirement to wait until the full amount of obligational authority is available. The state can therefore convert an Advance-Constructed project to a Federal-aid project in stages, based on cash flow requirements and availability of obligational authority, rather than all at once on a single future date. This flexibility enables a state to begin some projects earlier, delivering the benefits to the public sooner.

Applicability to CPIP: The result of using Advance Construction is the flexibility of funds that could assist in constructing Port connector road improvements more quickly. This tool may be especially useful from a cash flow standpoint for the participating DOTs.

(e) Funding Mechanism Summary

The drawing below shows the different mechanisms and programs that are used to finance both revenue and non-revenue projects.



14.8.5 *Conclusion*

When financing Port related roadway projects it is imperative that those projects are supported by current regional planning efforts. The projects proposed are consistent with the NYMTC Freight Plan and the NJTPA Regional Capital Investment Strategies as well as Portway and the Bayonne Redevelopment Plan. Consideration should be given to designating "Port Related Roadway" as an LRTP and TIP category assuming such formal recognition would help to prioritize projects

Funding mechanisms must also be in line with the current capacity of region to take on new projects. Although $85 million over the next twenty years for Port related highway projects is a relatively small investment, they still require resources that are becoming scarcer. Tried and true funding mechanisms such as freight programs within the authorization of SAFETEA or a bond issue would most likely hold the most promise for funding Port related projects. However, specialized sources such as earmarks or State Infrastructure Bank financing could also fund these projects efficiently if the conventional funding mechanisms are deemed inappropriate.

Funding large projects at the regional level that don't have direct impact to the Port facilities would assist the movement of Port goods along with other traffic. Projects that ease the movement of port goods on a regional scale should also be considered in the future plans for the Port. Regional congestion issues and freight needs go hand in hand when considering the economic development of the region. The impacts of large scale regional projects and other regional truck generators on port goods movement should be considered.

14.9 Rail Funding

14.9.1 *Introduction*

Rail shipping is vital to the operations of the Port. Since the deregulation of the rail industry in the 1980s the privately held railroads are required to make infrastructure investments solely for the purpose of benefiting their shareholders. However, shareholder benefits do not necessarily coincide with public benefits.

It is generally accepted that increasing rail mode share benefits the region by reducing truck VMTs, helping alleviate highway capacity issues, improving air quality and reducing highway infrastructure maintenance costs. The value of these regional benefits enables public funds to be used for the provision of new infrastructure on the private railroad system. However, in contrast to publicly funded highway and bridge improvements, no established process or established funding stream exists for rail freight improvements

This rail funding section is organized in two parts. The funding strategy section addresses a recommended process for funding CPIP related rail improvements. The second part identifies rail freight project funding sources.

14.9.2 Rail Improvement Summary

Rail improvements were developed at the following three system levels:

- On-dock Rail Improvements
- Conrail Shared Assets Area
- The Wider System

Table 14.10 provides a summary of the Port related rail improvements.

System Level	Location	Cost[148]
On-Dock Improvements	ExpressRail (Port Elizabeth)	$4,830,000
	Howland Hook	--
	Port Jersey	$1,880,000
	South Brooklyn	$3,970,000
Conrail Shared Assets Area	CP Croxton, National Docks Secondary	$75,000,000
	PN – Rahway, Chemical Coast	$54,000,000
	Newark – Aldene, Lehigh Line	$67,000,000
	Rahway – CP PD, Chemical Coast	$200,000,000
The Wider System	Allentown – Montreal, Canadian Pacific	$130,000,000
	River Line, CSX	$422,000,000
	Pennsylvania Route, Norfolk Southern	$429,000,000
	Selkirk – Boston, CSX	$177,000,000

Table 14.10 Rail improvements summary

Most of the capacity improvements listed above are not needed for many years, although works on the River Line are required in the next decade.

[148] Costs in 2003 dollars

14.9.3 *Rail Improvement Funding Strategy*

Because Port related rail improvements are likely to be beyond the means of both the rail operators and the regional MPOs or state DOTs, Port related rail improvements will probably be financed by a mix of funding sources. They will be delivered in public-private partnership arrangements and the development of an agreed process is essential to the success of projects.

A strategic framework for financing the rail improvements would include six major process steps:

- Organize to Advance Regional Freight Rail Funding Direction.
- Distinguish Public vs. Private Benefits.
- Identify/Inventory the Full Range of Rail Freight Funding Sources.
- Develop a Program of Phased Improvements (formally recognized in the region).
- Synchronize Rail Capital Planning and Public Planning and Programming.
- Formalize and Communicate Port Rail Funding Commitments.

The underlying assumptions critical to the funding strategy being effectively carried out are as follows:

- That implementation will require a strong and well organized private-public partnership approach.
- That the ultimate rail improvements will be packaged as part of a recognized Port Rail Program—a "programmatic" approach is essential in order to ensure that appropriate priority and recognition is given to any of the rail projects that do advance, particularly those that are publicly funded in part or in total.
- That enhanced mode-split will remain an underlying policy objective to foster and sustain public support for the rail improvements.

Railroads are open to participating in the public-private area provided there is a fundamental respect for their business objectives. Railroads continue to recognize their role within an integrated intermodal transportation system as demonstrated by their participation in projects like the Pennsylvania Double Stack Clearance Program and the Mid-Atlantic Rail Operations Study (MAROPS)[149]. These projects also demonstrate how railroads and public agencies increasingly collaborate on joint capital funding efforts.

Reconciliation and synchronization of the capital plans of public bodies and the railroads will be essential to the success of the public-private partnership. Railroads tend to have shorter term capital investment plans, probably five to ten years, in contrast to the twenty five year Long Range Plans of DOTs and MPOs or a sixty year CPIP Plan. The CPIP related rail improvement projects would be formalized in the long range plans of relevant DOTs and MPOs.

14.9.4 Rail Project Funding Sources

The following is a brief list of potential rail project funding sources. A table follows the descriptions that relate these funding sources to rail project purposes and benefits.

(a) Railroad Rehabilitation and Improvement Financing Program (RRIF).
The RRIF is a Federal Railroad Administration program established by TEA-21 to provide direct loans and guarantees to freight railroads up to $3.5 billion. Potential uses are acquisition or rehabilitation of intermodal rail equipment or facilities, including track, bridges and yards, buildings or shops. Eligible borrowers include railroads, state and local governments, authorities, and joint ventures that include at least one railroad.

<u>Applicability to CPIP:</u> CPIP improvements could be funded through this program with the cooperation of the railroads and at least one regional or state entity.

(b) Transportation Infrastructure Finance and Innovation Act of 1998 (TIFIA).
TIFIA is a Federal Highway Administration program that provides credit assistance to large scale projects of regional or national significance that might otherwise not be undertaken due to cost or complexity. There are three forms of assistance available –

[149] See the following website for details: http://freight.transportation.org/doc/3.

secured loans, loan guarantees, and lines of credit – for any type of significant capital investment. Eligible uses for freight rail improvements include enhancements to publicly-owned freight transfer facilities on or adjacent to the National Highway System (NHS).

<u>Applicability to CPIP:</u> Freight facilities under the PANYNJ's ownership would be candidates for TIFIA funding, but improvement must be adjacent to the NHS.

(c) Congestion Mitigation and Air Quality (CMAQ).
The CMAQ program provides funding to State DOTs, MPOs and transit agencies for projects that reduce air pollutants from transportation-sources. Demonstration of regional air quality benefits at the project level is normally required for a successful application.

<u>Applicability to CPIP:</u> The Delaware Valley Regional Planning Commission (DVRPC) in Philadelphia has successfully used the CMAQ program to fund various rail projects. These funds are generally in small amounts up to about $2 million.

(d) State Infrastructure Banks (SIB).
An SIB may provide loans (at or below market rates), loan guarantees, bond insurance, lines of credit or another other type of non-grant assistance to public or private project sponsors.

<u>Applicability to CPIP:</u> SIB programs are specifically targeted for highway projects and the eligibility of rail projects would be questionable. It seems reasonable, however, that future SIB programs may allow such projects if dedicated funding streams are set aside for loan repayment.

(e) National Corridor Planning & Development Program (CORBOR).
The CORBOR program is administered by FHWA and was developed to provide funding for planning, project development, construction and operation of projects that serve either border regions near Canada or Mexico or for high priority corridors throughout the U.S. States and MPOs are eligible for discretionary grants, especially as they relate to multi-state coordination.

<u>Applicability to CPIP:</u> These funds are generally for highway infrastructure projects at border crossings. Awarded funding to date has been exclusively for these types of projects.

(f) New York State Empire State Economic Development Corporation Qualified Empire Zone Enterprises (QEZE).

Qualified Enterprise Zone benefits offered by the State of New York are a package of real property and business tax credits offered to companies that increase employment in NY's Enterprise Zones. Benefits include utility rate savings, wage tax credits, sales tax exemptions and credit for real property taxes.

Applicability to CPIP: The QEZE program is not an infrastructure program per se, but a bolstering of tax abatement zones to include more benefits to companies that increase their employment. This program does not lend itself directly to funding CPIP rail improvements.

(g) New Jersey Department of Community Affairs Office of Smart Growth (DCA).

The New Jersey DCA offers a variety of tax incentives, financial assistance and grant programs that comply with the New Jersey State Plan to encourage investment in targeted state areas. The Business Employment Incentives Grant program provides cash grants to businesses based upon the number and types of jobs they create in New Jersey's designated growth areas and industries.

Applicability to CPIP: Like the QEZE program this is generally a business incentive program based upon the employment created and would be of limited use for CPIP rail improvements.

The purpose of Table 14.11 is to identify potential funding sources (public and private) that could potentially be used to finance Port related rail improvements. The purpose and benefits of each ultimate rail improvement would be the starting point for determining the most appropriate funding mix.

		Private Sector		Public Sector					
Broad Purposes of Rail Improvements	**Benefits**	**Railroads**	**Terminal Operators**	**PANYNJ**	**Fed. Gov.**	**State DOTs**	**State and Local EDCs**	**MPOs**	**Potential Funding Sources**
Expanded Rail Service	• Capacity to accommodate growing rail freight traffic • Inducement for increased local and international rail freight • Potential to decrease freight-passenger rail conflicts	X		X	X	X		X	• Railroad Rehabilitation and Improvement Financing (RRIF) • Transportation Infrastructure Finance and Innovation Act (TIFIA) • Congestion Mitigation and Air Quality (CMAQ) • State Infrastructure Banks (SIB) • State Capital Budgets/Bond Financing
Provide For On Dock Rail Improvements and Rail Terminals and Equipment	• Increased convenience and lower costs for shippers • Innovative technology opportunities	X	X	X	X		X		• National Corridor Planning & Development Program (CORBOR) • TIFIA • Economic Development Funding for site development
Promote Economic Development Using Rail	• Reduced traffic congestion • Supports the economic position of rail-served industries			X	X	X	X	X	• NYSEDC Empire Zone Benefits (QEZEs) • Tax Increment Financing concepts • NJ Dept. of Community Affairs (DCA) Office of Smart Growth
Support Mode Shift Goals	• Highway preservation • Highway system capacity and safety enhanced • Improved air quality and fuel costs			X	X	X		X	• CMAQ • SIBs • Per container subsidies to promote rail shipment
Increase Public-Private Partnerships	• Maximize and leverage available funding • Ensure that investments reflect both public and private benefits	X	X	X	X	X	X	X	• NYSESDC QEZE • NJDCA Smart Growth

Table 14.11 Rail Project Potential Capital and Operating Funding Sources

14.9.5 *Conclusion*

Rail projects are not similar to highway projects. The complicated arrangement of private rail operators, shared asset areas, and public benefits make funding mechanisms difficult if they exist at all. However, creative partnerships between the railroads and public funding sources would enable improvement projects to be successfully completed.

A strategy of stakeholder involvement, inventorying projects and funding sources, as well as defining proposed projects in terms of public or private benefit will help the region to develop a rail funding program. This program will assist those organizations in making rail funding decisions with more certainty.

Because CPIP related rail improvements are beyond the means of both the rail operators and the regional MPOs or state DOTs, it is likely that CPIP related rail improvements will need to be funded by a mix of funding sources. The key to moving these improvements from recommendations to fundable projects is following the principles discussed earlier in a multi-organizational framework.

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15 Evaluation

15.1 *Introduction*

This evaluation refers to the terminal Options and Scenarios as presented in Volume 2: Toolkit.

In order to evaluate the terminal Options and Scenarios the procedure used was:

- Establish a set of evaluation criteria;
- Describe the relative merits of Options and Scenarios for each criterion;
- Illustrate the relative merits of Options on a chart using colored squares;
- Put together the charts of Options into Scenarios and create a chart illustrating the relative merits of Scenarios.

15.2 *Evaluation Criteria*

Evaluation criteria cover those aspects of relevance to the selection of terminal Options and Scenarios, mainly covering:

- port planning;
- transport links;
- financial and economic analysis;
- qualitative environmental issues.

Port planning criteria are based on the Consultant's opinion of the main port planning issues relevant to the port development and include criteria based on the goals and objectives as published for the CPIP project.

The comparative evaluation criteria are listed in Table 15.1 and described in Sections 15.3 to 15.6 together with specific comments on terminal Options and Scenarios.

	Criterion
	Port planning
P1	Phasing, plan flexibility and relationship to existing land and berth use
P2	Appropriateness of land shape for cargo handling
P3	Ease of navigation to site along the main approach channels
P4	Space in the adjacent waterway for ship maneuvering to the berth
P5	Effects of operations on neighboring port operations
	Financial and Economic
F1	Financial analysis – breakeven price
F2	Economic impact – job creation
F3	Economic impact – tax revenue creation
	Environmental Issues
E1	Light
E2	Noise
E3	Dust and odors
E4	Traffic
E5	Wildlife habitat
E6	Waterfront access
	Transport Issues
T1	Highway access
T2	Local highway congestion
T3	Local highway improvement cost
T4	Rail access
T5	Rail on-site terminal - availability
T6	Rail on-site terminal - cost

Table 15.1 Comparative evaluation criteria

15.3 Port Planning Criteria

15.3.1 P1: Land and Berth Use

Phasing and Plan Flexibility: Sites that can easily be phased in steps from their present use to the 2060 Options were given a high rating.

In several Options the future intended use is the same as the present. In these cases, ease of phasing and plan flexibility will be at their highest.

In other cases a carefully managed and monitored transition that ensures continuity of operations, access and utilities will be required, resulting in a poor rating.

It is anticipated that the gradual phased transition of auto terminals from the present layout to the proposed Options will be accomplished over time without difficulty due to the flexible nature of automobile storage. This situation occurs in all Options at Port Newark North and South.

Where existing warehouse space is incorporated into other areas as proposed in all Options at Port Newark North and South, and Port Elizabeth, the ease of transition will depend on lease arrangements. However, it should be possible to remove the buildings over time, by taking advantage of the expiry of short leases and the expected redundancy of old style warehouse space from time to time. Conversion of warehousing space to dry bulk storage would be a less flexible transition as relatively large areas of warehousing would need to be cleared to make room for a viable bulk terminal. It could prove difficult to match the timing of these changes.

Conversion of disused, redundant and unoccupied land to terminal use will require planning permits and, in some cases, environmental studies of loss of existing habitat. This situation occurs at Port Elizabeth, Port Jersey, Bayonne Peninsula, Howland Hook and South Brooklyn. However, in general terms there should be no significant phasing difficulties except at South Brooklyn south of the Marine Terminal, where there are large warehouses and a rail terminal.

Scenarios that have an overprovision of capacity were seen as able to respond more flexibly to an increase in demand than Scenarios that are sized to be just adequate. This aspect is illustrated in Table 15.2 where it can be seen which Scenarios have combinations of terminals that exceed the required demand in 2060.

	Container (million TEU/year)	Auto (million units/year)	General Cargo (million tons/year)	Dry Bulk (million tons/year)	Liquid Bulk (million tons/year)
Orange	13.4/11.3	1.3/1.1	2.6/2.5	6.2/6.2	10.8/5.1
Red	14.1/11.3	1.1/1.1	2.6/2.5	6.4/6.2	6.5/5.1
Yellow	12.2/11.3	1.3/1.1	2.6/2.5	6.2/6.2	10.8/5.1
Blue	12.9/11.3	1.3/1.1	2.6/2.5	6.2/6.2	6.9/5.1

Table 15.2 Ratio of scenario capacity to demand

Relationship to existing land and berth use: Sites whose present use relates closely to the future physical requirements, or that can easily be converted to the proposed use, were given a high rating.

The proposed liquid bulk terminals in all Options make use of the existing tank farm facilities found at Port Newark North and South although in Red Scenario the tank farm at Port Newark South is converted to auto terminal use.

15.3.2 *P2: Land Shape*

For safe and efficient cargo handling, terminals need to be well proportioned in relation to the requirements of the cargo handling methods and equipment used for the types of cargo proposed. For security it is also desirable to have compact terminals with well-defined boundaries and limited public accessibility to the environs. Sites that have well proportioned, efficient terminal layouts or that handle adaptable cargoes were given a high rating.

The most adaptable type of cargo in terms of storage requirements is bulk liquid, which can easily be pumped long distances and which can be stored in tanks in any reasonable plan arrangement, not necessarily adjacent to the berths. For safety and security reasons hazardous materials should be stored remote from public access and preferably with a good separation distance from concentrations of human activity. In this respect the liquid bulk terminal Options proposed for Port Newark South are more isolated than those at Port Newark North.

Dry bulk terminals require enough space to stack material in sheds, silos or in the open in heaps. It is not expected that large stacker-reclaimer equipment will be used for the envisaged throughputs, so this cargo can, like bulk liquid be considered as relatively adaptable. In all the Scenarios except Red, the dry bulk terminals are located in Port Newark North where a single zone has been created. In Scenario Red a bulk area is also proposed at South Brooklyn. In most cases the bulk materials likely to be handled do not pose a safety or security risk.

General cargo facilities require space near the berths for the cargo sheds that provide covered storage, together with some open storage areas that should be reasonably close to the berths. Scenario Blue has a large general cargo area at Port Newark South which although split in two by the liquid bulk terminal should be able to operate reasonably efficiently due to the overall size of each part. In all other Scenarios there are conveniently shaped areas proposed at North Brooklyn and in all other Scenarios except Yellow and Blue there are also suitably shaped areas proposed for South Brooklyn.

Container terminals require enough space behind the berths to accommodate stacking arrangements for the different types of handling equipment. To be efficient, the terminal should have large rectangular areas and all the berths in one continuous straight line. Some oddly shaped parts of a terminal can be utilized for various activities, but in general curved and angled boundaries will result in reduced productivity. The distance between the berth line and the rear fence of a terminal needs to be sized to accommodate the container crane, the backreach of the crane, the stacks and maneuvering space for equipment. Sufficient yard area directly behind the berths is required, to minimize unnecessarily long haulage distances between the stack and the berth.

In all Scenarios the terminals at Port Newark South, Port Elizabeth and Port Jersey are reasonably well proportioned although the north western corner of the southern terminal at Port Elizabeth is somewhat remote from the waterfront. At the Port Elizabeth southern terminal the berths are distributed around a corner that prevents sharing of cranes between the two lengths of wharf. This can be solved by a special corner rail arrangement but the technical difficulties are significant and the maneuvering of the cranes takes additional time.

The shape of the proposed terminal at Bayonne Peninsula in Scenarios Red and Yellow is too narrow for efficient container handling and has insufficient space at the rear of the terminal to accommodate a rail loading yard.

The elongated and narrow container yard in the extension of Howland Hook in Scenario Orange is also inefficient because of the relatively long distance between the front and back of the terminal. A further disadvantage of the Howland Hook terminal is that because of the isolation of the new berth created by the drainage creek there is a single berth in the extension that cannot share cranes with the existing Howland Hook berths.

In the Blue Scenario, the waterfront at South Brooklyn has been allocated to two container terminal areas with a waterfront recreation area between as shown on existing plans. It would be more efficient for the operation of the terminals if they could be combined into one long unit with a waterfront recreation area at the north or south end.

Auto terminals can be almost any shape and, as is evident from current practice, can be dispersed around an area in relatively small lots. However, for reasons of efficiency and security it is better if the storage areas are consolidated and near the berths. In all Scenarios it is proposed to consolidate the terminal areas and to have the berths adjacent to, or close to, the storage. There is little to choose between the shapes adopted for all the auto terminal Options. The auto terminal at Bayonne Peninsula in Scenario Yellow and South Brooklyn in Scenarios Orange and Yellow are small and their viability may be in question. Multi-level parking structures could possibly be used in those locations but were not assumed for the study.

15.3.3 P3: Navigation depths

(a) Inner Approach Channels

Access to Port Newark/Elizabeth and Howland Hook is by the Kill van Kull Channel whose present depth of 45ft requires it be deepened as planned to 50ft to accommodate container ships in all Scenarios.

Access to Howland Hook also involves navigating a short stretch of the Arthur Kill Channel whose present depth of 41ft requires it be deepened to 50ft to accommodate container ships in all Scenarios.

Access to Port Jersey is by the Upper New York Bay stretch of the Anchorage Channel whose present depth of 45ft requires it be deepened to 50ft as planned to accommodate container ships in all Scenarios. The route also uses the open sea part of the Port Jersey Channel, which links the Port Jersey berthing channel with the Anchorage Channel.

Access to North Brooklyn is by the Upper New York Bay stretch of the Anchorage Channel above Port Jersey, and the Buttermilk Channel that has 35ft depth on the western half of the channel and 40ft on the eastern half. No deepening of these channels is required for any of the Scenarios.

Access to the South Brooklyn proposed development area is by the Anchorage Channel and the Bay Ridge Channel whose present depth of 40ft is adequate for all Scenarios except Blue. Deepening to 50ft has been planned for Bay Ridge Channel, possibly in anticipation of the 'cross harbor link' and a desire to handle container ships in Brooklyn. The deepening of these channels is only relevant for the Blue Scenario.

The potential air draft restriction in the future at the Bayonne Bridge is an issue for container terminals at Port Newark South, Port Elizabeth and Howland Hook. All Scenarios would be affected.

(b) Berthing channel depths

Port Newark Channel's present and future planned depths of 36ft are inadequate for all Scenarios that require a depth of 37ft to accommodate auto carriers and 40ft to accommodate dry and liquid bulk ships.

Port Elizabeth Channel's present depth of 39 ft requires it be deepened to 50ft as planned, to accommodate container ships in all Scenarios.

Elizabeth Pierhead's present depth of 35ft requires it be deepened to 50ft as planned to accommodate container ships in all Scenarios.

South Elizabeth Channel's present depth of 39.5ft requires it be deepened as planned to 50ft to accommodate container ships in all Scenarios.

Howland Hook's present depth in the Arthur Kill channel off the berths of around 38ft (41ft authorized) requires it be deepened to 50ft as planned to accommodate container ships in all Scenarios.

Port Jersey Channel's present depth of 41ft requires it be deepened to 50ft as planned to accommodate container ships in all Scenarios.

North Brooklyn's present depth of 40ft in the Buttermilk Channel off the berths is adequate for all Scenarios.

South Brooklyn's present depth of 40ft in the Bay Ridge Channel off the berths is adequate for all Scenarios except Blue Scenario, where the planned depth of 50ft is needed for container ships.

(c) Berth pockets

Sites that can easily be accessed by the largest expected ships without further dredging, beyond what has been set in the baseline described in Chapter 5, were given a high rating.

15.3.4 *P4: Ship Maneuvering at the Berths*

There should be sufficient space near the berths for the largest expected ships to turn so that they are facing the correct way for departure. In addition, if ships have to be pulled into a basin or channel between piers, the basin should be of adequate width for a ship to pass between ships moored at the berths on both sides of the basin. It is preferable also that the basin be straight and not excessively long.

Port Newark Channel has adequate width, although it is less than ideal, for all Scenarios. There are flight path height restrictions at the inner end of the channel which could limit the size of ship and type of unloading operations, and in all Scenarios bulk ships have to transit the whole length of the channel to its inner end.

Elizabeth Channel has adequate width for all Scenarios.

South Elizabeth Channel only has berths on one side and is therefore adequate for all Scenarios.

Port Jersey Channel is adequate at the entrance for all Scenarios but its width of 620ft at the narrowest point is barely adequate for container ships and auto carriers to be berthed opposite one another. The auto berth locations have therefore been located at the inshore end of the Channel.

Howland Hook only has berths on one side of the channel and is therefore adequate for all Scenarios.

All the Scenarios at North Brooklyn have berthing channels that do not require ships to pass moored ships as there is only one berth on each side of the channel. It is suggested that the required width is 3 x ship beam. This gives a requirement of 264ft. The existing widths are adequate for all Scenarios.

The channels proposed to be used at South Brooklyn are adequate for all Scenarios.

Sites that have large maneuvering areas and easy access for the anticipated ship size were given a high rating.

15.3.5 *P5: Effects of Operations on Neighboring Operations*

If there is a risk of dust being deposited by dry bulk handling facilities adjacent to auto storage a low rating was given to both terminals depending on the plan arrangement and length of the shared boundary. Operations that have no impact on neighboring operations were given a high rating.

15.4 F1, F2, F3 : Financial and Economic Criteria

The results of the financial and economic impact analysis are given in Chapter 11. Criterion F1, Breakeven Price, uses the breakeven prices per unit of cargo for each of the Options. F2 and F3 use the job and tax creation aspects of the Options. As taxes are directly proportional to jobs created, the results are the same for criterion F1 and F2.

15.5 Environmental Criteria

15.5.1 *E1: Environmental Issues – Light*

Although container terminals have potentially the greatest impact this is lessened in most cases by the absence of residential property in the surrounding areas. At Bayonne Peninsula, although residences are possibly going to be present in the future, this is not certain and the assessment was based on the present non-residential situation. At South Brooklyn there are residences close to the boundary.

15.5.2 *E2: Environmental Issues – Noise*

The impact of the noise from terminals is similar to light in that container terminals are likely to create the most noise and the absence of residences lessens the impact.

15.5.3 *E3: Environmental Issues – Dust and Odors*

Liquid terminals are the likeliest source of odor, but in all cases are remote from public areas. The likeliest sources of dust are bulk terminals although the terminal at South Brooklyn (D4) is the only one which has residences in the general area.

15.5.4 *E4: Environmental Issues – Traffic*

In the Port Newark and Port Elizabeth area the connector roads are mainly dedicated to Port use, with little through traffic. However, at Port Jersey, and more so at Bayonne, some of the connector roads will be adjacent to residences, unless new connector roads are constructed. At North and South Brooklyn the connector roads use local routes and the impact is therefore high given the present configurations.

15.5.5 *E5: Environmental Issues – Wildlife Habitat*

The qualitative impact of the terminal development on wildlife habitat, either directly or indirectly, was assessed and rated. The impact was assessed on the estimate of acreage of wetland destroyed by the development as described in Section 12.2.6. Any Option with an amount above 5 acres of wetland destroyed was given the worst rating and the best rating was reserved for projects assessed as having no wetland destroyed.

15.5.6 *E6: Environmental Issues – Waterfront Access*

The opportunity for including waterfront access in the development proposals was assessed and rated. Significant waterfront access was included only in the Blue Scenario. However, the existing viewing platform at Port Jersey was assumed to be retained at a nearby location.

15.5.7 *Transportation Issues: General*

The following transportation evaluation criteria are based on the effects of the Port terminal Options on congestion and the cost of highway improvements necessary to relieve that congestion, as described in Chapter 9. As noted in Chapter 9, the cost of highway improvements that are already planned at Bayonne[150] are excluded from the cost estimates.

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[150] The Peninsula at Bayonne Harbor: Local Roadway Connector Study, Final Report, City of Bayonne, June 30, 2003, Project Alternative 4.

15.5.8 *T1: Highway Access*

The great majority of Port truck traffic travels west of the Hudson River and a high proportion of that traffic heads south on the I-95 Interstate Highway. It has also been demonstrated that the delay for all the corridors connecting Port terminals to the I-95 corridor are significant. For a plan of the location of corridors see Figure 9.5. As a measure of accessibility of the Port to its wider market it is therefore reasonable to consider the distance of each Port terminal from the I-95 corridor.

Port trucks to/from terminals in Port Newark/Elizabeth can access the I-95 directly from local roads.

Port trucks from terminals in Port Jersey/Bayonne Peninsula need to use the very highly congested Inner Port Area corridor but over distances of only 5 to 10 miles before reaching the I-95.

Port trucks from the terminal at Howland Hook need to travel less than 5 miles on the Lower Crossings corridor to reach the I-95.

Port trucks from terminals in North and South Brooklyn need to use the heavily congested Brooklyn Queens Expressway, and Lower Crossings corridors, over distances of approximately 15 miles before reaching the I-95.

The resulting highway access characteristics of the various Port Cargo Terminal Options are shown in Table 15.3.

Cargo terminal Option	**Location**	**Corridor connecting to the I95**	**Distance**
C1 – C4 , C12, C13, A1, A2, A4, A13-A15, G4, D1, D2, L1 – L4	Port Newark/ Elizabeth	Direct access	Nil
C5 – C9, A8 – A10	Port Jersey/Bayonne	Inner Port	~5-10 miles
C10, C11	Howland Hook	Lower Crossings	< 5 miles
C14, A11, A12, G1 – G3, D4	North and South Brooklyn	BQE and Lower Crossings	~15 miles

Table 15.3 Highway access

15.5.9 *T2: Local Highway Congestion*

As described in Chapter 9, the effects of cargo terminal Options on the local highways were investigated and it was concluded that the improvements required were relatively minor. However of equal importance is the ability of local roads to handle all traffic, including Port traffic, without undue waiting in traffic queues. The measure used in the traffic analysis to illustrate the adequacy of the local roads was the Volume-Capacity (V/C) ratio, where a value of 0.93 to 1.0 represents an 'at capacity' situation. It should be noted that V/C values higher than 1.0 can be tolerated, but with the disadvantage of greater travel times. The results of the analysis are given in Chapter 9 and a summary for the terminals served by these local roads is given in Table 15.4 The figures are given for the base case in 2020, as analysis beyond that date is less certain.

Cargo terminal Option	Location	V/C (2020)
C1 – C4 , C12, C13, A1, A2, A4, A13-A15, G4, D1, D2, L1 – L4	Port Newark/ Elizabeth	Average 1.1
C5 – C9, A8 – A10	Port Jersey/Bayonne	Average 2.2
C10, C11	Howland Hook	Average 0.3
C14, A11, A12, G1 – G3, D4	North and South Brooklyn	Average 0.5

Table 15.4 Local highway congestion

15.5.10 *T3: Local Highway Improvement Cost*

The cost of local highway improvements reflects the relative congestion level and the difficulty of making improvements. Planning level costs were estimated in the Task F Highway Technical Memorandum and are shown for cargo terminal Options in Table 15.5. The cost includes road widening and intersection improvements, the former being the predominant cost. The figures are given for the base case in 2020 as analysis beyond that date is less certain.

Cargo Terminal Option	Location	Cost in 2020(US$m)
C1 – C4 , C12, C13, A1, A2, A4, A13-A15, G4, D1, D2, L1 – L4	Port Newark/ Elizabeth	39
C5 – C9, A8 – A10	Port Jersey/Bayonne	22
C10, C11	Howland Hook	<1
C14, A11, A12, G1 – G3, D4	North and South Brooklyn	5

Table 15.5 Local highway improvement cost

Note: Costs do not include right-of-way acquisition. Cost estimates for Bayonne are in addition to projects planned as part of the Peninsula at Bayonne Harbor development. Costs at 2003 constant dollars.

15.5.11 *T4: Rail Access*

Table 15.6 shows the general connectivity of rail terminals to the railroad system, indicating whether, and when, congestion on the connecting segments may be experienced. The rail system around the port rail terminals is so arranged that trains serving any of the terminals should be able to approach from and depart in any direction necessary. In some cases routes are configured for movements to be made directly, and in others the train may need to be reversed as part of the process of entering and leaving the terminal. Either method is encompassed in normal railroad operating practice. Where congestion at the port rail terminal connection is not an issue, there may still be other congestion issues further afield. On corridors where port terminal trains run alongside other services, then all trains will be affected by this unless action is taken to ease the pinch points concerned. This being so, congestion which occurs away from terminal connections is only referred to in this table where it applies predominately to Port rail terminal related trains.

15.5.12 *T5: Rail Terminal On-Site - Availability*

It is seen as essential for successful freight terminals that they should have access to rail facilities either on site or very close to it. This criterion assesses the availability of a rail terminal either on-site or close to the site of terminal Options. A summary of the rail terminal proposals for each Option is given in Table 15.7

Cargo Terminal Option	Location	Railroad system connection	Year in which congestion first occurs	Other Notes
A4, A13, A14, A15, C1, C2, G4, L3, L4	Port Newark South	Conrail, Chemical Coast	2015 – 2020	
A1, A2, D1, D2, L1, L2	Port Newark North	Conrail, Chemical Coast	2015 - 2020	
C3, C4, C12, C13	Port Elizabeth	Conrail, Chemical Coast	2015 - 2020	
A8, C5, C6, C7	Port Jersey	Conrail, National Docks Secondary	none	Some congestion 2005 – 2015 approaching Croxton, 2015 – 2020 around Oak Island, and by 2030 on Lehigh Valley
A9, A10, C8, C9	Bayonne Peninsula	Conrail, National Docks Secondary	none	Some congestion 2005 – 2015 approaching Croxton, 2015 – 2020 around Oak Island, and by 2030 on Lehigh Valley
C10, C11	Howland Hook	Conrail, Chemical Coast	2015 – 2020	Congestion From 2005 southbound on Chemical Coast between Rahway Bridge and Port Reading
A11, A12, D4, G3, C14	S Brooklyn	New York & Atlantic, Bay Ridge Line / Cross-Harbor Railroad tunnel	none	Double stack clearance available only via Cross-Harbor tunnel. Some congestion 2005 – 2015 approaching On NJ side, Croxton, 2015 – 2020 around Oak Island, and by 2030 on Lehigh Valley

Table 15.6 Connectivity of rail terminals

Cargo terminal Option	Location	Rail terminal
C1	Port Newark South	Existing terminal across Corbin Street
C2	Port Newark South	
C3	Port Elizabeth	Express Rail on site
C4	Port Elizabeth	Express Rail on site
C5	Port Jersey	New on-site terminal proposed. Not in baseline.
C6	Port Jersey	
C7	Port Jersey	
C8	Bayonne Peninsula	Use Port Jersey remotely
C9	Bayonne Peninsula	
C10	Howland Hook	New on-site terminal proposed
C11	Howland Hook	
C12	Port Elizabeth	Express Rail on site
C13	Port Elizabeth	
C14	S Brooklyn	New on-site terminal proposed. Not in baseline.
A1	Port Newark North	Siding on site
A2	Port Newark North	Siding on site
A4	Port Newark South	Siding on site
A8	Port Jersey	Siding on site
A9	Bayonne	Siding on site
A10	Bayonne	Siding on site
A11	S Brooklyn	Siding near site
A12	S Brooklyn	Siding near site
A13	Port Newark South	Siding on site
A14	Port Newark South	Siding on site
A15	Port Newark South	Siding on site

Cargo terminal Option	Location	Rail terminal
G1	N Brooklyn	No rail proposed
G2	N Brooklyn	
G3	S Brooklyn	Siding near site
G4	Port Newark South	Siding on site
D1	Port Newark North	Siding on site
D2	Port Newark North	Siding on site
D4	S Brooklyn	Siding near site
L1	Port Newark North	Siding on site
L2	Port Newark North	Siding on site
L3	Port Newark South	Siding on site
L4	Port Newark South	Siding on site

Table 15.7 Summary of proposed rail terminals for cargo terminal Options

15.5.13 *T6: Rail Terminal On-Site Cost*

The criterion for the cost of rail terminals takes into account the need for new rail terminals which are not in the project baseline, i.e. they are not in the process of being built at present and there is no budget allocated for them. On this basis Port Jersey needs a new container rail terminal, shared with Bayonne Peninsula, and South Brooklyn also needs a new container rail terminal. As auto terminals only require simple sidings for loading of autos the criterion reflects whether lines onto or near the site exist.

15.6 Results of Evaluation of Adjusted Scenarios

15.6.1 *General*

The results of the evaluation are presented in chart form in Appendix G. Each evaluation criterion was assessed on the basis of being a best, indifferent or worst case in comparison to the other Options under consideration. This is clearly a qualitative procedure and any conclusions to be drawn need to keep that aspect in mind. The purpose of the procedure was to identify which Options and Scenarios appear to be outstandingly better or worse than the alternatives.

15.6.2 *Option Evaluation*

The evaluation of criteria was carried out by assigning a color-coded square for each criterion of each Option:

- Yellow – Best performance under the particular criterion;
- Blue - Indifferent performance under the particular criterion;
- Red - Worst performance under the particular criterion.

It should be noted that the dividing line between each color was chosen in a qualitative way and that the blue color can best be thought of as a buffer to separate the best from the worst. Within each criterion the decisions on color choice between different Options were as consistent as possible within the limits of deciding different effects in different locations for different cargo types. No weighting system was used so the relative importance of criteria are not reflected in the charts. The charts therefore provide a qualitative impression of the worst and best aspects of Options and Scenarios and highlight the attractive features.

The results show that the criteria that performed consistently well were E3, Dust and Odors and P5, Effects of Operations on Neighboring Port Operations. This is unsurprising as most of the terminals are not expected to produce dust and odors and there are few occurrences of the risk of dust nuisance between bulk and auto terminals. The criteria that performed consistently badly were E6, Waterfront Access and T3, Local Highway Improvement Cost. These can be traced to the lack of significant waterfront access proposals (with the exception of that in Option C14) and to the works necessary on local roads to avoid congested travel conditions for Port trucks.

The chart in Appendix H, page H1,was created by collecting the similar types of cargo terminals together and by putting the Options in order of the most yellow squares (best features).

This shows that:

- The best overall rated Container terminals are C12 and C13 (Port Elizabeth), and the worst are C5 (Port Jersey) and C9 (Bayonne Peninsula);
- The best overall rated Auto terminals are A4 and A13 (Port Newark South) and the worst are A9 and A10 (Bayonne Peninsula);
- The best General Cargo terminal is G4 (Port Newark South);
- The marginally better bulk terminals are D1 and D2 (Port Newark North);
- Liquid terminals cannot be significantly differentiated.

15.6.3 *Scenario Evaluation*

The charts in Appendix H, page H2, were created by assembling the Options into Scenarios.

Although the charts are not identical, they show no significant advantages between the different Scenarios. In addition, given the generally qualitative nature of the evaluation, any small difference should be ignored.

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16 Conclusions

16.1 *General*

The conclusions given are for the present expectation of the situation in 2060. In view of the long time period analyzed, it will be essential after a suitable time period has elapsed to update the forecasts, assess the prevailing conditions in the Port and revise the findings accordingly.

16.2 *Terminal Options and Scenarios*

Options were devised and arranged into four Scenarios: Orange, Red, Yellow and Blue, with overall capacity as shown in Table 16.1.

All Scenarios would cater for the whole demand with spare capacity of varying amounts.

	Containers (TEU)	Autos (units)	General Cargo (tons)	Dry Bulk (tons)	Liquid Bulk (tons)
Orange	13.4m	1.29m	2.61m	6.22m	10.8m
Red	14.1m	1.10m	2.61m	6.44m	6.5m
Yellow	12.2m	1.26m	2.61m	6.22m	10.8m
Blue	12.9	1.27	2.61m	6.22m	6.93m
Required	*11.3m*	*1.10m*	*2.53m*	*6.17m*	*5.09m*

Table 16.1 Scenario capacity

16.3 Warehousing

The analysis has demonstrated that warehousing related to ocean borne cargo does not require the use of wetlands.

16.4 Linkages to Policies and Plans

16.4.1 *Cross Harbor Freight Movement Study*

It is concluded from earlier Cross Harbor studies that a rail tunnel is not dependent on the existence of a container terminal at South Brooklyn and that a container terminal at South Brooklyn is dependent on the existence of a cross harbor tunnel.

Assuming that a rail tunnel were built, there are nonetheless a number of disadvantages of the South Brooklyn site that would make development of a container terminal there unattractive:

- highway access, for the majority of containers that will leave by truck, is unsatisfactory;
- development costs are the highest of all Options studied;
- the development includes a significant area of marine fill;
- the development area is bisected by a waterfront recreation area.

16.4.2 *Portway*

Portway infrastructure projects have helped to alleviate port related congestion. These improvements, if fully developed, will not only assist in the movement of port goods but in some circumstances in the movement of other regional traffic. Future Portway concepts should be developed in conjunction with the CPIP.

16.4.3 *NYMTC Regional Freight Plan*

As a specific type of freight movement, port goods will be influenced by all freight planning by the regional MPOs. The achievement of the NYMTC Regional Freight Plan goals will improve the movement of these and other goods through and within the region. The specific strategies developed in the plan will have varying degrees of applicability to Port goods movement.

16.4.4 *Port Inland Distribution Network (PIDN)*

The PIDN initiative promotes strategies to increase the proportion of container traffic leaving the port by non-road modes and is consistent with mode shift strategies developed as part of the Plan.

16.5 ***Strategy for Mode Shift***

It will be particularly challenging to achieve a non-road mode share of 33% given the forecast size and distribution of markets for barge and rail transport. The principal reasons are:-

(a) barge traffic is unlikely to reach above 5% of throughput because of the distribution of cargo using the Port. However, evidence from European experience suggests that coastal barge traffic should be capable of succeeding to New England because there is an adequate concentration of traffic, and deep-sea lines do not call at Boston;

(b) rail traffic is currently limited to longer distance traffic suitable for the long trains which American railroads traditionally operate;

(c) experience in both the UK and the European continental mainland indicates that much higher non-road modal share is feasible but to achieve higher modal shares requires a de-regulated waterborne industry and short haul/short train services appropriate to regional distribution.

Adoption of short haul services, start-up grants for barge services and financial support to reflect the societal benefits of transfer of traffic from road to rail and barge could raise the Port non-road modal share.

16.6 ***Highway Improvements***

16.6.1 Regional Highway Impact

There is very little impact of Port-related trucks on the regional highway network.

16.6.2 Regional Highway Corridors

Although the future volume of Port-related trucks is forecast to increase, the impact on the corridors is small. The average number of Port-related trucks along the corridors is less than 10% in the Inner Port Corridor and less than 3% elsewhere. It is also evident that, for any given corridor, there is little difference between the baseline growth case and the cargo terminal development Scenarios. Hence the impact of other non-port traffic is the overriding factor within the corridors. Although the relative volume of Port-related trucks varies to a small degree for specific corridors dependent on the Scenario, this is not expected to affect corridor performance one way or another.

16.6.3 *Port Connector Roads*

With few exceptions, there is only a minor difference in levels of congestion between Scenarios and between mode split options on the connector roadways.

(a) Port Newark/Elizabeth Terminal Area

By 2040, without improvements, congestion on most connectors is expected to be extreme.

(b) Port Jersey Terminal Area

Port truck trips comprise only a small percentage of total vehicle traffic on these links. By 2020, congestion on all three connector roadways is expected to increase substantially. Highway improvements would be necessary for port traffic to adequately access this terminal.

(c) Bayonne Terminal Area

As with Port Jersey, port truck trips comprise only a small percentage of total vehicle traffic on these links. Congestion is expected to reach extreme levels in 2020 and beyond due to the large forecasted growth in traffic from development on the Peninsula. Highway improvements will be necessary to allow port traffic to access the terminals.

(d) Howland Hook Terminal Area

Port trucks at this site comprise a relatively large percentage of the total traffic on the connector roadways studied, which are expected to remain under capacity through 2060. This would be alleviated by a greater use of rail.

(e) Red Hook Terminal Area

As a result of its lack of connectivity to the rail system the mode split options are not expected to have an impact on trip production from Red Hook.

If this site is operational (Scenarios other than Blue), some improvements may be needed for Columbia Street for port trucks to be able to easily access the terminal in future years.

(f) South Brooklyn Terminal Area

39th Street and 2nd Avenue are expected to be below capacity, even out to 2060.

16.6.4 *Highway Improvements*

Improvements comprised either adjustment of signal operation or provision of additional turn lanes by local widening which can reasonably be accommodated without major disruption of adjacent facilities.

In no case did the proposed improvements calculated in Task F exceed the improvement required under baseline growth conditions by more than an additional turn lane, even to the 2060 date and no major improvements such as grade separated interchanges were required. By inspection it was concluded that nothing significantly greater than the improvements illustrated in Task F would be required at any of the Port sites to handle the traffic generated by the current, adjusted, Scenarios.

The highway improvements attributable to Port growth, under either baseline growth conditions or conceivable Scenarios, are relatively insignificant in planning terms.

16.7 ***Rail Improvements***

16.7.1 *Utilization of the Network*

Not all of the rail infrastructure in the region is used by freight railroads servicing the Port, for example many lines are for passenger only services.

As shown in the illustrations of utilization in Appendix F, many parts of the Conrail Shared Assets and the wider network reach an over capacity condition during the period of analysis and some by 2005 irrespective of the Scenario or Case being examined.

In no case was a response received from the railroad operators to indicate that rail yards would not be able to cope with the rail freight volume.

The ExpressRail terminal at Port Elizabeth may need a change in handling methods to handle the volumes of containers expected towards the end of the study period.

The Port Newark terminal is expected to be able to handle all of the future container volume to 2060 except in the case of the Option C2 expansion of the Port Newark Container Terminal.

The proposed Howland Hook rail terminal is expected to cope with all of the future demand.

A new rail terminal proposed for Port Jersey is restricted, not by the terminal size, but by the access arrangements. If they are resolved this terminal would handle all but the highest expected volumes.

If a container terminal is developed at South Brooklyn, the new rail terminal suggested for that site would be able to handle the expected volumes.

16.7.2 *Infrastructure Improvements*

Capacity improvements are needed under the existing or increased rail share. The increased rail share cases simply bring forward the date at which improvements are required.

Improvements within a cost of $5 million each have been suggested for the on dock rail terminals at ExpressRail, Port Jersey and South Brooklyn, all of which depend on the development that actually takes place.

Improvements comprising additional tracks for segements of the Conrail Shared Assets Area ranging from $54 million to $200 million and for the wider network ranging up to $400 million have been suggested.

16.8 Preliminary Financial Analysis and Economic Impact

16.8.1 *Introduction*

This Section refers to the financial analysis and economic impact of cargo terminal development.

16.8.2 *Cargo Terminal Cost Estimates*

(a) Demolition

In several Options, demolition of structures which need to be replaced due to their poor condition, is the costliest item. This is mainly due to the high cost of demolishing and disposing of the debris from warehousing.

(b) Berths

Although there is no increase in container terminal acreage proposed between now and 2060, the expected improvements in capacity lead to greater throughputs and hence a requirement for up to 6,000ft of additional container berths and the upgrading of several of the existing berths.

For auto terminals, most existing berths are structurally adequate because of the relatively light demands of auto unloading. It is estimated that 750ft to 1,500ft of new auto berths may be required by 2060.

For general cargo terminals, the greatest costs for berth provision are for Option G4 (Port Newark South, 4,550ft) and for Option G2 (North Brooklyn, 5,600ft) where berths are required to replace existing aging and unsatisfactory structures together with 2,850ft of upgrading at North Brooklyn. Option G1 at North Brooklyn also has a significant requirement for 2,350ft of replacement berths and 2,850ft of upgrading. Option G3 at South Brooklyn requires 650ft of new berths and 1,950ft of upgrading.

For dry bulk terminals, the most expensive Option is D4 at South Brooklyn, which requires 2,100ft of new berths.

For liquid bulk terminals, L3 at Port Newark South has the greatest requirement: 1,740ft of new berths to replace aging and unsatisfactory existing structures.

(c) Paving

For container terminals the greatest expansion was at South Brooklyn where the terminal area increases from zero to 322 acres.

The paving requirements for autos, general cargo, dry bulk and liquid bulk are generally relatively minor due to the presence of satisfactory surfacing in most existing general cargo areas and the low surfacing demands of autos, bulk and liquid cargo handling.

(d) Buildings

The most significant requirements for new buildings are in terminals requiring expansion such as Option G4 in Port Newark South or terminals requiring the replacement of old piers which support general cargo sheds, such as Option G2 at North Brooklyn.

(e) Wetland Compensation

Wetland compensation has a significant influence on the infrastructure cost of Options C3 at Port Elizabeth, C10 at Howland Hook and C14 at South Brooklyn.

16.8.3 *Financial and Economic Analysis*

(a) Container Terminals

Options C12 and C13 at the existing Port Elizabeth terminals are highly ranked because they are not expanded in area and have the majority of infrastructure in place except for additional or deepened wharves. These are closely followed by the Port Elizabeth expanded terminal Options, C3 and C4. The expanded terminal at Howland Hook, C10, and unexpanded existing terminal at Port Jersey, C5, fare badly in this assessment because of the heavy investments required to deepen berths in rock at Howland Hook and to provide additional berth length at Port Jersey for larger ships with little overall increase in terminal capacity. The analysis shows that most projects would operate within the parameters of existing port charges. Only C5 is shown to be potentially sub-optimal.

(b) Auto Terminals

The top two projects, A4 and A13, both Port Newark South projects, are closely ranked together, but are likely to be highly uncompetitive in their present form.

(c) General Cargo

Option G4 is the most successful and is able to return a breakeven NPV result at an average income of $22 per tonne of cargo handled. The other two Options, G2 and the combined alternative of G1 and G3, would be unviable.

(d) Dry Bulk

The Options proposed for Port Newark North (D1 and D2) return reasonable results. Option D4 falters as it involves high investment costs relative to the additional capacity delivered.

(e) Liquid Bulk

Option L4 in Port Newark South (Blue Scenario) returns the best result compared to other liquid bulk Options.

In economic terms in the Port region the additional port capacity required in 2060 would potentially generate 22,000 jobs associated with containers and 1,100 jobs associated with automobiles.

16.9 Plan Realization and Funding

16.9.1 Preferred Plan

There was found to be no requirement for major infilling of waterfront area. Therefore no preferred plan for achieving major infilling was required.

Options for development of cargo terminals within the existing Port footprint were evaluated and it was concluded that any of a number of Scenarios could happen and have similar merit.

In addition to these findings it is the case that the driving force for development comes from a diverse range of sources including public and private bodies with different goals, and no one agency has control over the type or pace of development. In the absence of statutory authority for the Plan or a single governing Agency it is not possible to prescribe a pattern of phased development for the Plan.

Although this Plan has no regulatory authority it is hoped that the information presented in the Plan will provide a useful resource for both the private and public sector in the development of proposals and in the initial identification of the issues relating to proposals.

16.9.2 Highway Funding

Funding for Port related highway improvements must be in line with the current capacity of the region to take on new projects. Although $85 million over the next twenty years for Port related highway projects is a relatively small investment, they still require resources that are becoming scarcer. Conventional funding mechanisms such as freight programs within the authorization of SAFETEA or a bond issue would most likely hold the most promise for funding Port related projects. However, specialized sources such as earmarks or State Infrastructure Bank financing could also be used.

Even though Port traffic is an insignificant contributor to congestion at the regional level, the funding of large projects at the regional level would assist the movement of Port goods along with other traffic. Therefore the impacts of large scale regional projects and other regional truck generators on port goods movement should be considered.

16.9.3 Rail Funding

The complicated arrangement of private rail operators, shared asset areas, and public benefits make funding mechanisms difficult if they exist at all. However, creative partnerships between the railroads and public funding sources would enable improvement projects to be successfully completed.

A strategy of stakeholder involvement, inventorying projects and funding sources, as well as defining proposed projects in terms of public or private benefit will help the region to develop a rail funding program.

Because Port related rail improvements are beyond the means of both the rail operators and the regional MPOs or state DOTs, it is likely that Port related rail improvements will need to be funded by a mix of funding sources.

16.10 Comparative Evaluation of Options and Scenarios

An evaluation system was devised using color coding of the relative merits of the Options.

The clearest results obtained from the evaluation were in relation to Option comparisons. The results indicated :

- The best overall rated Container terminals are C12 and C13 (Port Elizabeth), and the worst are C5 (Port Jersey) and C9 (Bayonne Peninsula);
- The best overall rated Auto terminals are A4 and A13 (Port Newark South) and the worst are A9 and A10 (Bayonne Peninsula);
- The best General Cargo terminal is G4 (Port Newark South);
- The marginally better bulk terminals are D1 and D2 (Port Newark North);
- Liquid terminals cannot be significantly differentiated.

Scenario comparisons did not provide a clear result. The charts show no significant advantage between the different Scenarios. In addition, given the generally qualitative nature of the evaluation, any small difference should be ignored.

16.11 *Overall Conclusion*

The evaluation shows that no one cargo terminal development Scenario is significantly better than the others. However, within Scenarios there are examples of terminal Options which did not perform well against some of the criteria.

It is not possible to present a single preferred Master Plan for development of the Port of New York and New Jersey. Instead a Toolkit has been provided in Volume 2 as an aid to development decisions.

The Comprehensive Port Improvement Plan is presented in this report, and has sufficient flexibility to accommodate changes in demand and physical requirements for a long period provided that there is regular updating and revision of the plan into the future.