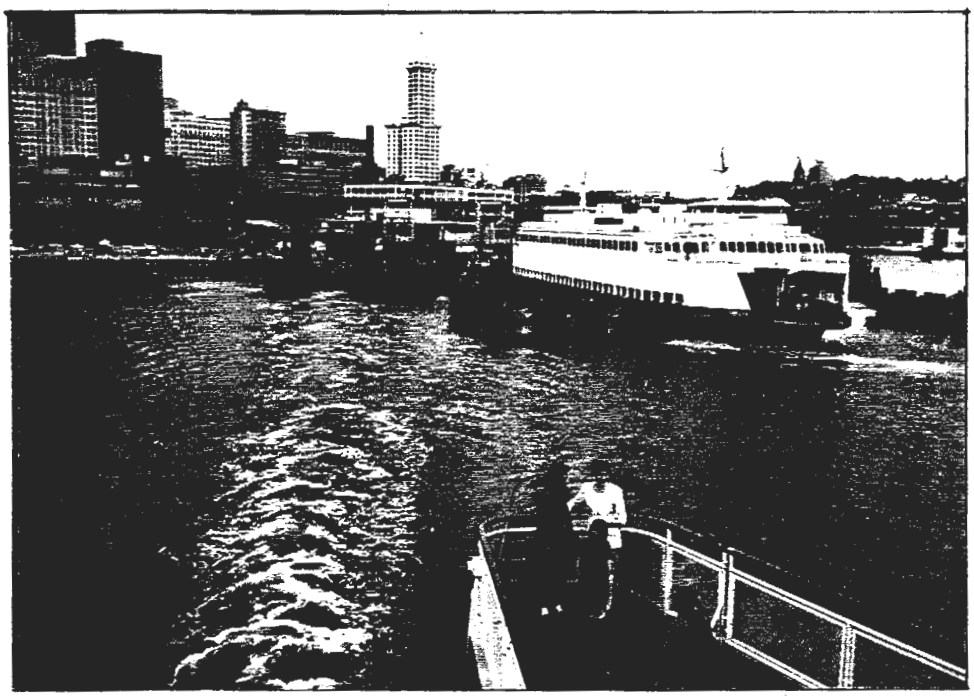
U.S. Department of Transportation
Federal Transit Administration

ASSESSMENT OF FERRIES AS ALTERNATIVES TO LAND-BASED TRANSPORTATION:

Executive Summary

Volume I of III



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Prepared For: The Office of Technical Assistance and Safety
Federal Transit Administration
U.S. Department of Transportation

Final Report
May 1994

FTA-MA-06-0197-01-03

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Technical Report Documentation Page

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Assessment of Ferries as Alternatives to Land-based Transportation
Report in Three Volumes: 1) Phase 1 Report, 2) Phase 2 Report, 3)Executive Summary

16. Abstract

1. Purpose: To assess the current and future uses ferries as altenatives to land-based transportation modes. Phase 1 consisted of a survey of 25 routes and systems in the U.S. to identify locations where ferry services have been used to provide an alternative to bridges, tunnels, highways or rail routes or construction. From the list of 25 sytems, five representative networks were selected for Phase 2 case study analysis. Phase 2 consisted of a detailed case study analysis to determine in more the various choice factors for providing water-based alternatives as well as user preferences for selecting ferries over land-based options. The analyses consisted of document research and site visits to assess the history, context, operations, landside options and other unique factors contributing to mode development and choice.

Method: Phase 1 was conducted by document search, phone interviews and personal experience of the author. Phase 2 included detailed document search and review, site visits and interviews, data compilationand draft and final reports. Since there is little comparative or descriptive literature available on the various routes studied, the site visits and interviews proved invaluable.
(continued on following page)

17. Key Words Intermodal ferry links Marine highways, Highspeed ferries, low wake/low wash, Essential/complementary/optional ferry routes.	18. Document Availability - Available to the public through the National Technical Information Service (NTIS). 5285 Port Royal Road Springfield, Virginia 22161 - telephone 703/487/4650

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Technical Report Documentation Page (Continued)

16. Abstract (continued)

3. Results/Findings: Phase 1 findings included identification of typologies of ferry service, general decision factors, and documentation and categorization of system by type and characteristic. All services tended to be multi-functional to varying degrees with the majority focussing on passenger and vehicle transport, and most serving tourism and recreation needs as well. Public transportation services ranged from lifelines serving islands, to through traffic marine highway links, to commuter vehicle transfer, to passenger commuter transit functions. Phase 1 concluded by identifying 5 representative networks as case studies for Phase 2, including ferries serving Seattle WA, Portland ME, San Francisco CA, new Orleans and the Mississippi River, and New York City.

Phase 2 case studies were evaluated in much greater detail, with a focus on characteristics such as system historical decision points, assessment of effectiveness of water routes compared to land-based alternatives, and future plans for expansion. Each system was found to have distinguishing features relating to operations, vessel technology, planning methods, environmental factors, and institutional settings. The case study locations were selected to represent a range of waterbody types, geography. climate, navigational conditions and other factors influencing route definition. Three basic ferry transportation functions were identified: 1) essential services to islands or other locations without land-based alternatives, 2) complementary services where ferries provide more efficient routes than land-based alternatives, and 3) optional services where ferries compete with land-based alternatives but provide qualitative advantages to attract riders.

All services were found to provide significant contributions to their regional transportation networks. Seattle and the Washington State Ferry System provide the largest volume passenger and vehicle system in the U.S., acts as a major tourist magnet to the Northwest, and provides a variety of complementary and essential services. The Portland-Casco Bay system is a classic example of an island lifeline type service, and is used year round by commuters, also serves seasonal vacationers, and provides essential services for which there are no landside alternatives. San Francisco's
Golden Gate Ferries set the precedent for contemporary fast ferries serving as alternatives to expanding landside highway and bridge infrastructure in the 1970's, introduced the first highspeed catamarans in the 1980's and plans expansion of routes with the next generation of faster vessels for even longer routes, while providing complementary services. The Mississippi River and New Orleans vehicle/passenger ferries continue to serve as "ferry-bridges" connecting residents with employment across the river, reducing auto trips with complementary services to the infrequent bridge and highway network. New York commuter ferries provide attractive options to the congested and unpredictable routes into Manhattan, with an innovative use of private passenger ferry links serving key commuter corridors, and helping to relieve pressure on the road, tunnel and rail systems.

4. Conclusions and Recommendations:

1. Ferries are providing cost-efficient and environmentally compatible alternatives to land-based transportation in many regions of the country.
2. Ferries are filling increasing new roles as links in intermodal transit and vehicle links across water, and are serving as integral components of regional transportation networks.
3. The number of ferry services have increased significantly in urban areas in the past decade with commensurate increases in volume of users.
4. Ferry use for recreation and tourism has also increased during the same time frame often on the same

16. Abstract (Continued)

routes and systems.
5. Lower volume, essential services continue to provide important lifeline transportation functions for island communities.
6. Complementary and optional services in urban areas appear most likely to grow by relieving pressures on landside infrastructures filled to capacity.
7. Emerging new highspeed vessel technologies will provide new more competitive longer distance route options in many areas.
8. A National Ferry Policy is recommended to recognize the expanding role of ferries as key links in intermodal regional transportation systems, and to provide expanded federal assistance through emerging ISTEA programs.

METRIC / ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in) = 2.5 centimeters (cm)
1 foot (ft) = 30 centimeters (cm)
1 yard (yd) = 0.9 meter (m)
1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2) = 6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2) = 0.09 square meter (m^2)
1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)
1 acre = 0.4 hectares (he) = 4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz) = 28 grams (gr)
1 pound (lb) = .45 kilogram (kg)
1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp) = 5 milliliters (ml)
1 tablespoon (tbsp) = 15 milliliters (ml)
1 fluid ounce (fl oz) = 30 milliliters (ml)
1 cup (c) = 0.24 liter (l)
1 pint (pt) = 0.47 liter (l)
1 quart (qt) = 0.96 liter (l)
1 gallon (gal) = 3.8 liters (l)
1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x - 32) (5/9)] °F = y °C

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm) = 0.04 inch (in)
1 centimeter (cm) = 0.4 inch (in)
1 meter (m) = 3.3 feet (ft)
1 meter (m) = 1.1 yards (yd)
1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
1 hectare (he) = 10,000 square meters (m^2) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gr) = 0.036 ounce (oz)
1 kilogram (kg) = 2.2 pounds (lb)
1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

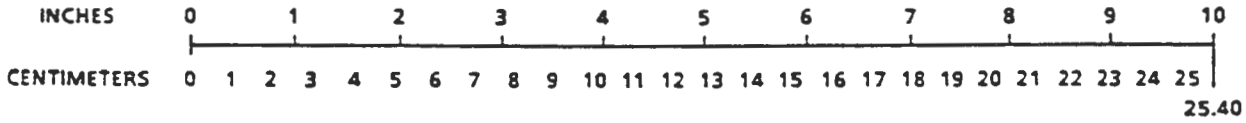
VOLUME (APPROXIMATE)

1 milliliter (ml) = 0.03 fluid ounce (fl oz)
1 liter (l) = 2.1 pints (pt)
1 liter (l) = 1.06 quarts (qt)
1 liter (l) = 0.26 gallon (gal)
1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)

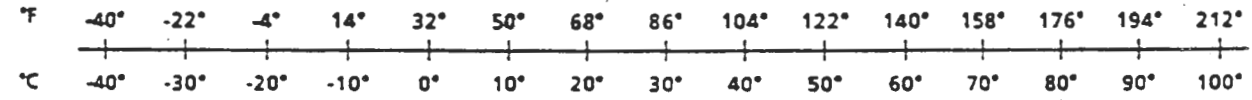
TEMPERATURE (EXACT)

[(9/5) y + 32] °C = x °F

QUICK INCH-CENTIMETER LENGTH CONVERSION



QUICK FAHRENHEIT-CELCIUS TEMPERATURE CONVERSION



For more exact and/or other conversion factors, see NBS Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50. SD Catalog No. C13 10 286.

ASSESSMENT OF FERRIES AS ALTERNATIVES TO LAND-BASED TRANSPORTATION

Executive Summary

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ASSESSMENT OF FERRIES AS ALTERNATIVES TO LAND-BASED TRANSPORTATION

Executive Summary

1. Project Purpose and Summary of Key Findings:

Waterborne ferry services have served as primary transportation links carrying passengers, goods and vehicles between shore locations since the earliest waterfront settlements in North America. While the reliance on ferry systems has greatly diminished in the United States in this century with the construction of highways, bridges, and tunnels, there remain a significant number of locations where water transportation is the most effective method of travel. Furthermore, in selected urban locations there appears to have been a resurgence in ferry service as new types of transportation pressures have surfaced during the past five years.

Purpose: The purpose of this report is to identify representative ferry transit systems, analyze the decisions which led to a choice between water-based and land-based transportation modes, and assess the effectiveness of the system in achieving particular transportation needs. By assessing a representative cross section of ferry routes serving differing transportation needs in a variety of marine and geographical settings in the United States, it is intended that new insights may be gained regarding the effectiveness of recent and proposed investments in water transportation, as well as a better understanding the range of factors which determine choice of mode for cross-water travel. In short, the intention is to learn more about where and when ferries serve as alternatives to land-based transportation, roles they may play as travel mode options in the future, and in which contexts it makes good transportation sense to pursue the "wet" route.

The primary focus of the report was to document and assess those factors, past, present and future, which have influenced decisions on choices of water-based versus land-based transportation for passenger travel across or around water bodies of various types. A typical example of such a choice might be a state or regional transportation agency deciding between competing modes for crossing a particular water body such as a river or a harbor; whether to implement a ferry connection, build a tunnel or bridge roadway link for vehicles, or to build a rail bridge or tunnel for mass transit. The system analysis was intended to consider how such choices were made in different locations, and which factors shaped those decisions. While many ferry systems serve multiple transportation functions, the concentration of the research has been on those principally serving commuter needs or providing essential connections between roadways and other points separated by water.

Methodology: In order to consider the full spectrum of ferry services nationwide, the project research was conducted in two phases; 1) a broad brush survey of ferry systems and identification of general types and characteristics, and 2) a detailed comparative analysis of five case studies of representative passenger water transportation networks and findings regarding typical decision factors.

Phase 1, entitled A Survey of Ferry System Types and Networks, provides a better understanding the broad range and variations of passenger and vehicle water transportation systems operating in the United States during the past 30 years, by categorizing the systems by type and function, and identifying those historic decision factors which affected mode choice of water versus land transportation systems. An initial ferry information base was established as, twenty-five systems were surveyed, evaluated, and categorized by type as shown in Figure 1. Nine representative systems were then screened in more detail from which the five ferry networks were selected for the Phase 2 case study analysis. The case study systems were chosen to include representative examples of the following: 1) typical transportation decision factors historically used to establish ferry networks in the United States, 2) the wide range of geographical and climate conditions in which such systems are found, and 3) newer and proposed routes which would exemplify emerging or future roles for passenger and vehicular ferry service. The five case study locations and networks selected included; Seattle/Puget Sound in Washington, Portland/Casco Bay Islands in Maine, San Francisco Bay in California, Mississippi River/New Orleans in Louisiana, and New York Harbor/Hudson River between New York and New Jersey.

Phase 2, entitled Case Studies of Five Representative Ferry Systems, was organized to assess the five selected systems through document analysis, site visits and interviews. The more detailed evaluation afforded by the site visits, made it possible to determine more specifically which factors have influenced decision choice of land or water based mode of transportation, as well as to identify those factors which are most likely to influence future ferry planning choices and trends. The case studies included detailed historical analyses of the evolution of each of the systems, and descriptions of performance characteristics of the ferry routes related to their respective regional transportation networks. The case study systems were also considered with respect to current national transportation policy objectives including those set forth in the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. Issues were identified regarding the future of public ferry transportation and recommendations made to assist in system implementation.

History and Evolution of Ferry Systems in the 20th Century:

Historically, it appears that many of the early 20th century ferries which served an essential transportation function, such as those connecting to islands, across lakes, or other wide water bodies where no landside alternatives exist have tended to endure. However, many have passed from private to public operation in order to keep the often unprofitable year round routes from disappearing. By contrast, most of the urban and rural systems which proliferated earlier in the century across narrower waterways went out of service with the opening of bridges and tunnels which were built nationwide in the post World War II era from the 1950's through the 1970's and 1980's. As the pendulum swings back towards a greater reliance on public transit, some of these routes are now being selectively restored.

Whereas in the more populous urban areas the pre-war ferry systems, often owned and operated by railroads, tended to provide essential commuter transit links to center city job locations with support from various intermodal trolley and rail connections, such as those built into the Hoboken Ferry Terminal and the corresponding Manhattan landings as shown in the 1898 map in Figure 2. As auto ownership and use increased, and as high speed metropolitan highway networks were opened, the reliance on passenger ferries for job commutes diminished. More recently, in the 1980's and '90's, the market for passenger ferries in densely populated urban waterfront cities has returned with a combination of old routes being restored and new water

Figure 1: Ferry System Locations in the U.S.

Key:

Ferry vs. Bridge or Tunnel

1. Seattle to Winslow/Bremerton/Vashon Island
3. San Diego to Coronado Bridge
4. Norfolk to Cape Charles/Bay Bridge

Ferry vs. Parallel Highway or Rail

5. Alaska Marine Highway
6. Boston to Hingham
7. San Francisco - Golden Gate Ferry
8. San Juan to Old San Juan
9. Bayshore NJ to Manhattan

Ferry to Islands

11. Cape Cod to Martha's Vineyard/Nantucket
12. Portland to Casco Bay Islands
14. San Juan Islands to Anacortes WA
19. Long Island to Shelter Island
20. Port Clinton to Put-In-Bay OH
21. Staten Island to Manhattan
23. Block Island to Pt.Judith/Newport

Ferry Plus Bridge or Tunnel

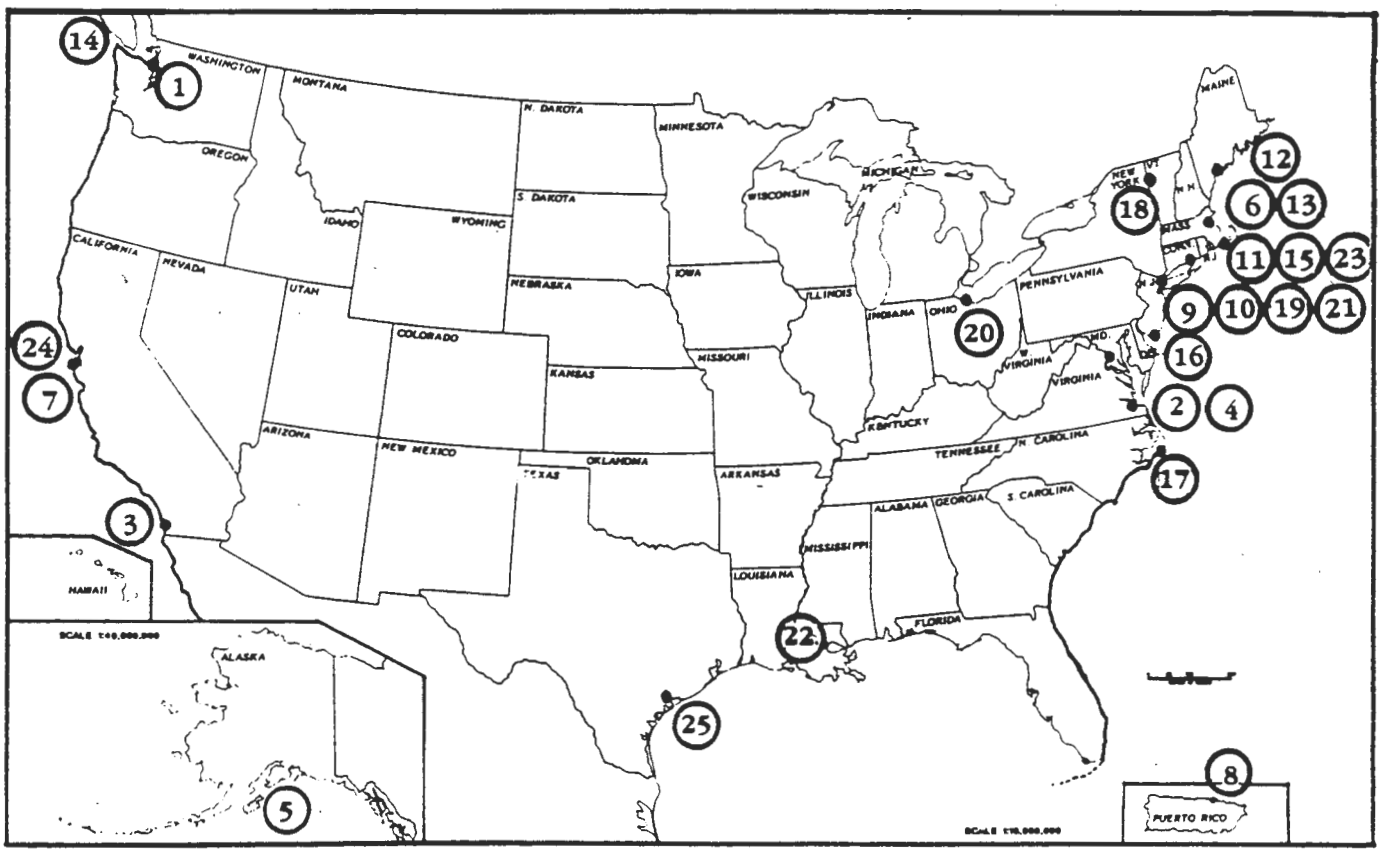
2. Norfolk to Portsmouth
10. Cross Hudson to Manhattan
13. Logan Airport to Rowes Wharf, Boston

Ferry Plus Highway or Rail

24. San Francisco to Vallejo
25. Cross Corpus Christi Bay (proposed)

Roll-on Roll-off Ferry Highway Link

15. New London to Long Island
16. Cape May to Lewes
17. North Carolina to Cape Hatteras
18. Burlington to Ft.Kent
22. Mississippi River Bridge Authority



routes being established to fill virtually emerging new transit niches. In many of these urban areas the landside transportation infrastructure is effectively complete, and has little physical room for expansion. Contributing significantly to the farebox revenue of many public and private ferry systems in the past decade, has been the dramatic increase in off-peak tourism and recreational use.

Summary of Key Findings

Initial observations regarding ferry service operations and decision factors emerged from the Phase 1 system surveys. These preliminary findings were then tested, evaluated, and expanded in the detailed ferry case study analyses of Phase 2. Based on an assessment of the history and evolution of the representative ferry systems up to the present day, the final report includes findings on the current and future roles of ferries nationwide, different operations of contemporary ferry systems, the relative importance of transportation functions of different types of systems, and other specific trends which may influence the future selection of water transportation systems. The findings and trends which emerged as critical to the understanding of how and why ferry systems provide alternatives to land-based options included the following.

1. Ferry Systems Can Provide More Efficient Transportation Connections than Land based Alternatives in Travel Time and Distance, Trip Cost and Energy Consumption: The surveys and case studies provided specific examples of how contemporary ferry systems are able to provide distinct advantages over land-based options in particular water oriented transportation contexts. The Washington State Ferries exemplify how water transportation can provide passenger and vehicular services which have much shorter trip times and distances than the land routes, and are correspondingly less expensive to the users and ultimately to the state. The Mississippi ferries and some routes in San Francisco and New York provide similar advantages. Ferry systems are also being considered by state and regional transportation agencies in terms of providing cost effective relief for over-burdened landside transit, highways, bridges, and tunnels.

2. A Small Number of Existing Ferry Systems Carry the Majority of Daily Riders: The surveys of current systems indicated that a small number (less than 10%) of commuter oriented, urban ferry systems in the U.S. carry the vast majority of passengers (more than 90%) on a yearly basis, as exemplified by the workhorse Staten Island Ferry in New York, which alone carries more than 21 million passengers per year. On the other hand by far the greater number of individual routes carry relatively small volumes of vehicles and passengers, but provide more essential transportation needs, often connecting across water areas for which there are either no alternatives such as the Casco Bay Island system in Portland, Maine, or where alternative land based routes are circuitous and time consuming, such as the services provided by the Washington State Ferry system.

3. Ferries Provide Three Basic Transportation Functions: The surveys and case studies indicated that ferry systems offer a broad range of transportation functions in a wide variety of settings. It was observed that three fundamental types of public transportation were provided by ferries in the U.S. In considering the areas served and the alternative transportation modes available, it was evident that there is a clear hierarchy of importance for the three in relation to regional transportation networks. In order of transportation priority, the three types include the following.

1. Essential Ferry Routes with No Viable Land-based Alternatives: Included are those ferry routes which provide year round services to islands or other water-isolated locations which cannot be reached by road, bridge or tunnel. Such routes are generally publicly operated and supported by state or municipal governments as integral components of their transportation networks. Such ferries serve as of lifelines or "marine highways" to off-shore communities and provide passenger, vehicle, and freight transfer. Essential ferry routes included among the case study systems were the Casco Bay Lines in Portland, and the Vashon Island and San Juan Islands services offered by the Washington State Ferries. Such routes are used for commuter, school, medical and shopping trips to the mainland from the communities served.

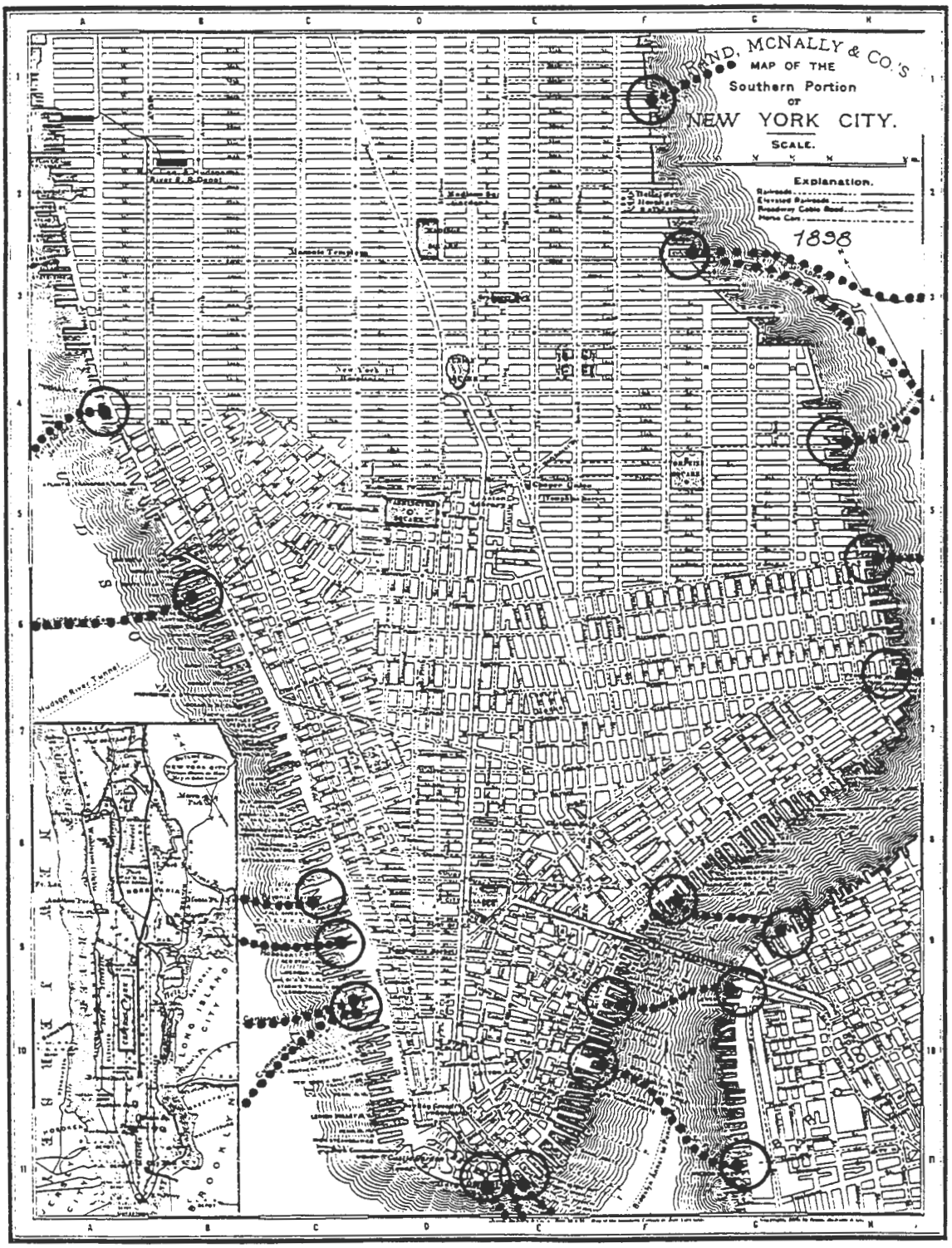
2. Complementary Ferry Routes Which are More Efficient than Land-based Alternatives: Included are ferry routes which provide substantially shorter time and distance trips across water bodies than alternative highways, bridges, tunnels or rail. They are likely to operate year round are often used for daily commuting. Such systems may be publicly operated, such as the Staten Island Ferry in New York, the parish ferries across the Mississippi River and the cross-Puget Sound routes to Seattle by WSF. Other commuter oriented services may be public/private such as the Oakland-Alameda ferry in San Francisco, or privately operated such as the Bayshore Ferry to Manhattan. These services often provide the most practical commuter travel options, since alternative land-based routes are too lengthy and/or too time consuming. Such services have been initiated or supported actively by state and regional transportation entities as integral components of their transit systems.

3. Optional Ferry Routes with Equivalent Land-based Alternatives: These routes offer commuters an option to parallel land-based alternatives, and may include one or more advantages such as trip time, cost, amenity, or reliability. Such services have expanded greatly in more dense urban settings in recent years, as local commuting patterns have changed. Publicly operated routes include the Golden Gate services from Larkspur and Sausalito to San Francisco, and the Crescent City routes from Gretna and Algiers to New Orleans. Privately operated routes include the Hoboken and Weehawken routes to Manhattan, as well as several of the proposed new New York high speed routes such as Hunters Point to Manhattan. Optional routes are often encouraged and assisted by state and municipal governments to relieve pressures on overcrowded land-based highway and/or transit commuter routes. Such optional routes may also serve as temporary mitigation measures during land side infrastructure repair.

4. Essential Services will Continue to Operate with Incremental Improvements: Services such as those to the Casco Bay or San Juan Islands will continue to be needed as long as there are resident year round populations. Incremental improvements will continue to improve services through vessel and terminal upgrades as well as increased intermodal options. Financial self sufficiency will continue to be the dominant goal and will probably minimize applications of highspeed vessels as being to expensive relative to fare structures required.

5. Complementary Ferry Routes will Expand to Meet New Demands: Complementary service for which the land-side options are far less efficient than the ferries, including other Puget Sound routes to Seattle, will also continue to be in demand, particularly when clean air requirements and/or landside highway congestion so dictate. New highspeed vessel technologies

Figure 2: Historic Plan of New York City with Ferry Routes - 1898
(Source: Columbian Atlas of the World, 1898)



will open up new routes where the ferry can provide faster commutes than landside options, as well as upgrade some existing optional ferry routes, such as the Larkspur or Vallejo routes to San Francisco, which could become more time effective with faster, lower wake vessels.

6. Optional Ferry Routes will Increase to Fill New Market Niches: Optional private or public routes in urban areas where the combination of landside congestion and infrastructure limitations have created new market demands, such as the cross-Hudson routes, are likely to expand to other cities. New vessel technologies and increasing demands for off-peak excursion service should contribute to start-up of these new routes. Such routes often deserve public sector support when they assist in reducing landside auto congestion, improve air quality, or relieve pressures to expand landside infrastructure.

7. Ferries as Intermodal Transit Links will Increase: As demonstrated by several of the case study examples, addition of convenient and time saving intermodal connections can improve service and increase ridership. Inter-jurisdictional coordination is often needed to achieve such linkages. In some cases, the private sector operators have successfully provided the intermodal connections, such as the Port Imperial bus network in Manhattan, but still may require public transit connections as well, such as the NJ-DOT buses to Weehawken.

8. New Combinations of Public and Private Operations will be Adapted for Specific Routes and Functions: The varying types of routes, patrons, and roles of the individual ferry routes will dictate varying combinations of public and private funding. However, even when istensibly self-sufficient services are privately owned and operated, indirect public sector contributions are often needed. Examples include the provision of public landings at strategic sites, inclusion of ferry transportation routes as elements of the regional transportation plan, provision of the intermodal connections described above, and periodic capital improvements assistance. Locally adapted types of blended public and private operations will continue to be invented, such as the Alameda publicly owned and privately operated vessels. New and creative methods to reduce public subsidies will emerge, with performance incentives offered for increased ridership to private operators, such as the current Oakland service, or the creative minimum fare structure limits set for the Hoboken service.

9. Vessel Technology Advances are Making High Speed Ferries more Competitive with Land-based Alternatives: Fast ferries capable of safe, comfortable, long distance trips at 25 to 40 knots have been proven to be operational in Norway, Hong Kong, and Australia, as well as in several domestic applications such as the San Francisco-Vallejo and Manhattan-Bayshore services. More advanced foreign-built catamaran vessels are currently in operation internationally from Seattle to Victoria, and are in franchised construction domestically for Alameda commuter and Maine whale watch services. Offshore stabilized highspeed SWATH technologies are operational in Hawaii, and could be applied for open ocean routes in some locations. Proven Norwegian catamaran technologies are proposed for the new Staten Island to Manhattan service. The important technological trend is towards new high tech vessels which can provide faster service over the water than existing transit or auto commutes can deliver over the land, as anticipated in ferry expansion plans in New York, San Francisco and Seattle. Once accepted and proven in those markets, new commuter applications for other urban waterfront cities and routes will be possible. It is likely, however, that some of these new technologies may be applied and tested initially on excursion routes because the higher returns will offset high vessel capital costs.

10. Combined Ferry Service for Public Transportation and Tourism/Recreation will Continue to Expand: One of the more dramatic findings from the case studies and surveys was the widespread expansion of water-based recreational services in all geographic locations. While many of the recreational and tourism cruises do not serve conventional transportation needs, an increasing number of the commuter oriented services are expanding into the tourism market. Where such multi-purpose opportunities exist, flexibility should be built in to allow for the maximum use of the vessels and the routes for the broadest range of services, as long as the primary public transportation functions are still met. Economic self-sufficiency of public ferry services will need to focus in many locations on attracting as many fare paying passengers onto the routes as the vessel operating hours can accommodate.

11. Ferry System Expansion will Continue Primarily in Urban, Commuter-oriented Settings: The future ferry growth seems to be primarily with the complementary and optional routes in more urbanized areas which are experiencing limitations in ground transportation infrastructure, primarily relating to commuter trips and secondarily to through traffic vehicular needs. The expansion of services in San Francisco and New York are typical of the functional types and variety of ferry growth to be expected in other locations.

12. New Factors Influencing Choice of Mode and Ferry Growth are Transportation Infrastructure Limitations Combined with Environmental Constraints: Traffic congestion and environmental sensitivity have become increasingly important decision factors in selecting of ferries over land-based alternatives in many locations. As exemplified in Louisiana where new bridge and highway construction across the Mississippi River has been constrained during the past 20 years, and where auto usage continues to increase within the fixed highway and street network, the remaining ferry routes continue to operate as permanent substitutes for new bridges or tunnels. The full environmental benefits of ferry systems have as yet to be systematically measured. They will prove in particular applications to be as efficient or more so than many transit systems and clearly effective in reducing Vehicle Miles Traveled (VMT's), improving where air quality and reducing auto congestion.

13. Qualitative Factors will Contribute to Choice of the Ferry Mode in the Future Including Safety, Amenities, Rider Comfort, and Reliability. The amenities and quality of travel experience rank high in all ferry user polls in response to both new and older systems, although such qualitative factors are difficult to quantify. The combination of enjoyment of ride and lower stress level of ferry commuting has been instrumental in creating a dedicated ridership in most case study locations, and should be considered as another important factor in the future viability of ferry systems. Qualitative features should also be taken into account in vessel and terminal design, as well as in provision of intermodal connections. The qualitative dimension may be considered as the hidden factor in choice of land or water mode.

14. Ferry System Operations and Route Configurations will Continue to be Locally Determined: Based on the case studies which indicate a high level of contextual individuality by route, no patterns seem to exist for standardization of service operation, vessel design, or terminal configuration, from one ferry location to another. Often the market demands, vessels and route designs differ within the same water body from one corridor to the next. Variations exist in terms of trip length, environmental conditions, capital investment or volume of riders. If ferries are to find new niches in complex regional transportation networks, they often need to be tailored to the specific contextual conditions. The system histories also clearly show how ferry services need to remain flexible to adapt to changing land use and travel needs over time.

15. The Need for A National Ferry Policy: The case studies and surveys have demonstrated how ferry systems contribute in different ways and degrees as integral links in national, regional, and local transportation networks. The ferry systems to Islands along the Maine Coast, and to Vashon Island and the San Juan Islands in Washington demonstrate the importance of essential ferry links as lifelines and marine highways. The ferry systems in New York City, San Francisco, and Seattle provide compelling examples of how existing ferries play an increasingly important role in the commuter transit network, and how new systems are being planned to greatly expand that role. These case studies also demonstrated how private operations can contribute incrementally to reduce traffic congestion and improve air quality at minimal public expense in high density urban settings. Many of the most dramatic new ferry route changes and expanded transit applications have occurred during the past 10 years. While the physical systems themselves cannot be standardized, performance criteria can be established to help unify systems in different regions and allow for more consistent federal grant administration. A national ferry policy should encourage further expansion of ferry systems as cost effective alternatives to landside options in the case study locations as well as in many other urban waterfront settings such as Boston, Baltimore, Narragansett Bay, and Corpus Christi. These and other communities are currently exploring ways to better utilize water transportation to relieve congestion and ease pressures on fixed transportation infrastructures.

2. Phase 1 Summary

Comparing Ferry Systems with Land-based Transportation

The survey of ferry systems across the country in contrasting marine environments and microclimates, revealed a number of interesting use patterns and categories of service. By considering the various systems in terms of their regional transportation context, local geography, institutional settings, and other variable characteristics, the following preliminary findings were identified.

Ferry System Determinates - Variable Factors in Planning, Design and Operations:When considering the planning histories of individual ferry systems, it often seemed that there were as many different combinations of factors which contributed to their development as there were systems. In analyzing the wide range of systems, however, it does seem possible to identify factors which have historically been considered in decisions of land-based versus water-based transportation. System choice factors observed in a wide range of cases may be groups in the following categories;

1) Transportation: The primary transportation needs remain the dominant determinates as factors determining water or land based modes. Decision points and planning factors may include; traffic congestion, mass transit demand, ro-ro demand, intermodalism, interstate/state transportation systems, and legislative policy.

2) Environmental Issues: Factors such as bridge and ferry impacts on the natural or man-made environment have become increasingly important in considering transportation mode alternatives since national and regional concerns have been incorporated into the planning, permitting and regulatory processes. The constraints have become much more complex during the past 25 years since the National Environmental Protection Act was passed and put into practice. Included in required impact analysis are the following; coastal zone or other waterways issues, energy efficiency, air quality, water quality, wildlife habitats, and community impacts.

3) Cost Effectiveness: In selecting a water or land based transportation mode, cost factors are always a determinate, particularly when public funding is involved. Cost/Benefit analyses are often needed to assess the preferred mode or route, including both capital and life-cycle costs. Factors to be considered include; technological advances, capital and operating costs, and public vs. private operation.

4) Geographical Conditions: Regional and Local geographical conditions as distinct from environmental concerns have historically been major factors in water related environments. The spectrum of conditions to be considered varies dramatically by region and by water body type. The more dramatic the landscape, watersheet conditions, weather ranges, and shore conditions, the more they are likely to affect decisions on modes and systems. Basic categories include; weather patterns, waterbody type and conditions, navigation factors, tide and flood conditions, year-round vs. seasonal operation requirements.

5) Economic Development: In parallel with the other planning and decision factors are considerations of economic development opportunities, ranging from regional to site specific in scale. Included in such mode choices are the following; urban business development and employment, residential and commercial land development, recreation and tourism, and other water services such as delivery of goods and services.

Ferry System Typologies by Transportation Function and Context: In order to consider the broadest range of systems and functions a list of primary system types or typologies was prepared and matched with representative examples of U.S. ferry operations. Similarly a set of secondary system characteristics was identified and matched with representative and sometimes overlapping examples. In keeping with the project objective of focusing on ferries as components of the public transportation network, only systems primarily involved with waterborne passenger mass transit and/or roll-on roll-off vehicular transport were included. For example, excursion ferry service is included only as an ancillary aspect of point to point routes, and not as a separate category. Other types of ferry systems are excluded altogether, such as water taxis, tour routes, whale watches, or other strictly recreation oriented services. An accompanying set of system characteristics are also described which are often factors in decision-making for land-based or water-based travel. The preliminary set of ferry system typologies and characteristics considered in this study are listed and described as follows:

Ferry System Types or Typologies: Described in terms of water-based versus land-based transportation choices.

1. Ferry as alternative to Bridge or Tunnel
2. Ferry as alternative to Parallel Highway or Rail
3. Ferry to Island(s)
4. Ferry in Addition to Parallel Bridge or Tunnel
5. Ferry in Addition to Highway or Rail
6. Roll-on Roll-off(Ro-Ro) Vehicle Ferry as Highway Link

Ferry System Characteristics: Described in terms of system transportation functions, performance levels, service types, and other descriptive factors.

A. Commuter vs. Recreation/Tourism Ferry Service
B. High Volume vs. Low Volume Passenger or Highway Link
C. International vs.Interstate vs.Intrastate vs.Intercity Systems
D. Public vs. Public/Private vs.Private System Operation
E. Existing vs. Expanding vs.New System

System Evaluative Criteria:Based on the analysis of generic ferry typologies and examples of systems around the country, key criteria emerged with respect the primary study goals. The system selections for more detailed study focused on those with the following characteristics:

1. Urban Passenger Commuter Transit; Those serving as complementary or optional to other urban transit services and encouraging diminished auto use in high density areas.

2. Marine Highway Links; systems providing critical highway and transit linkages across water areas where no alternatives exist (such as connections to offshore islands), where

alternative land-based routes are lengthy or circuitous, or where topography or environmental factors preclude a parallel shore route.

3. Contributions to Economic Development; systems providing other public benefits such as expansion of tourism, waterfront redevelopment, and/or other opportunities for job creation.

4. Short or Long Term Mitigation for Environmental Purposes; including air quality improvements, relief for major landside construction project impacts, wetlands protection, or growth management in sensitive areas requiring limits on visitation or density.

5. New Ferry Technologies; new opportunities for routes and services through vessel technology advancements such as higher speed, high volume, lower wake or ocean going vessel capabilities.

6. Public-Private Partnerships; new methods and techniques for sharing start-up costs,capital expenses for terminals and vessels, and operating costs, through innovative transportation programs at various appropriatefederal, state and local levels.

7. Intermodalism; Techniques to identify and encourage new ways to combine use of ferries for multiple transport modes, and for connections to other land or water-based transport modes at terminals

Ferry System Analysis and Screening

National Survey of Ferry Systems by Type - Past, Present, and Future: The list of choice factors, typologies and system characteristics was derived through consideration of a cross section of ferry routes and systems from all regions of the country and all types of operating conditions. From the nearly 300 existing routes operating in the U.S., as well as several selected historic systems and proposed new expansion services, a representative group of 25 were surveyed and catalogued to consider decision factors, test the evaluative criteria, and then determine which systems or groups of systems might be most suitable for case studies for the more detailed analysis. The purpose was to include an inclusive and broad array of examples, with the general prerequisite that each must provide the basic transportation service of connecting passengers, with or without vehicles, across a water body.

The systems were compared in a cross referenced matrix format by system type and characteristic as well as by other factors. The primary distinction between systems was based on ferry system typology. Other comparative factors were also included such as public vs. private, passenger or ro-ro, volume of ridership, age of system, vessel technology, and other relevant general characteristics. Also included are capsule descriptions of each system summarizing historical decisions relating to land versus water-based choices. The locations of the 25 systems are shown in the U.S. map in Figure 1.

Assessment of a Short List of Nine Systems and Selection of Five Case Study Candidates for Detailed Analysis: The survey list of 25 systems was evaluated in several ways to determine which ferry operations might be most usefully studied in more detail. The intention of the screening of nine selected systems was to include all typology groups and examples of the full

Table 1: Detailed Survey of Nine Systems by Type

Key:

Type:
1. Ferry/Bridge or Tunnel
2. Ferry/Parallel to High.
3. Ferry to Island(s)
4. Ferry + Bridge or Tunnel
5. Ferry + High. or Rail
6. Ro-Ro/Highway Link

Characteristic:
A. Commuter/Recreation or Tour
B. High/Low Volume
C. Int'national/Int'state/Int'city
D. Public/Private
E. New or Expanding System

Ferry System	Type	Characteristics	Pub./ Priv.	Pass./ Ro-Ro	Vol. Riders	System Age	Tech.	General Relevance
1.Seattle-Winslow/ Bremerton etc.	1,3, 5,6.	Com/Re High, Int'city, Expand.	Pub./ State	Pass. + Ro-Ro	P/6.4m V/3.3m	42 y. (1951)	Med.- Ro-Ro	No alt./ Public/ High vol./ Commuter
2.Cape May-Lewes & Norfolk-Eastern Shore	6,5	Tour, Low, Int'st.	Pub./ NJ,DE	Pass. + Ro-Ro	P/1.1m V/.36m	29 y. (1964)	Low- Ro-Ro/ ocean	Long haul ferry/ bridge highway link
3.Alaska Marine Highway	3,1,2,6	Com/Re Low Int'nat	Pub./ State	Pass. + Ro-Ro	P/0.4m V/0.11 m	24 y. (1959)	Low- Ro-Ro/ ocean	Long haul, all use ro-ro link
4.Boston-Hingham/ Logan etc.	4,5	Com.,M. Int'city Expand.	Pub./ Priv.	Pass.	P/1.1m	20 y. (1983)	Low (Crew Boats)	Expanding pub/priv., varied use
5.San Francisco/ Golden Gate, Oak.	1,2, 4,5	Com./Re High, Int'city Expand.	Pub. + Pub./ Priv.	Pass.	P/1.3m	23 y. (1970)	High- mono, cats	Model public, high vol. commuter
6.New York City/Cross Hudson, Bayshore	3,4, 5,6	Com., High Int'st. Expand.	Pub., Priv. Pub./ Priv.	Pass. + Pass./ Ro-Ro	P/23.9 m	7 y. (1986) 88 y. (Staten)	Low/ Med./ High	Highest volume, urban,new private
7.Portland/ Casco Bay	1,3	Com/Re Med.Vo.	Pub. Auth.	Pass./ Ro-Ro	P/0.6m	122 y. (1871)	Low- ocean	Oldest continuous to islands
8.Miss.River Bridge Au./ Algiers, St. Charles etc.	1,2, 6	Com./Hi Med., Int'city	Pub.	Pass./ Ro-Ro	NA	Varies by Route	Low- Ro-Ro	Ro-ro riv. highway link
9.San Juan-Old San Juan	2,5	2,5	Pub.	Pass.	P/2.1m	4 y. (1989)	High- cats	New, high tech, inter modal

spectrum of system characteristics. For the initial short list selection of nine systems, those locations which had multiple routes within a single water body or port area were combined to define a ferry "network", which could then be related to unified transportation system rather than consider individual routes in isolation. For example in New York, the three systems described in the survey, though distinct in terms of management and operation, are all serving the same basic transportation need of weekday commuting to Manhattan, and are therefore grouped as a single network. Other urban ferry routes aggregated into composite systems included Boston, Seattle, and San Francisco. As an example of a larger interstate system, the Cape May/Lewes ferry and the Norfolk/Chesapeake Bay Bridge Tunnel were combined. Since many of these urban and regional systems function directly or indirectly as integral components of larger transportation networks, it seemed appropriate to evaluate them in the context of larger decision-making and planning processes. The survey of the nine systems is summarized in Table 1.

In determining which of the nine ferry systems would prove most useful for detailed evaluation, selection criteria helped identify representative examples of systems by use type, geographical distribution, land versus water-based decision factors, institutional and operating settings public and private operations, and vessel and innovative terminal technologies. While all systems encompassed many of the representative decision factors needed, a matrix analysis assisted in finding the most representative combinations, as shown in Table 2. The list of nine systems is included in the table with the five case study selections shown in bold type.

Summary of Phase 1 Survey Findings

System Planning Determinates - Historical Decision-making Factors for Water-based versus Land-based Transportation: The detailed surveys of the nine systems combined with the general surveys of the 25 systems provided a basis for identifying the primary decision-making factors which may play affect future choices between water and land based modes. From the analysis of systems initiated during the past 40 years, it seemed instructive to distinguish between choice determinates in three general time frames. In addition to the decline and fall of ferry systems during the first half of the century, three periods were identified; 1) for historic or older systems planned before 1970, 2) for currently operating systems or those planned between 1970 and 1990, and 3) for new systems recently implemented and for future systems planned after 1990. These four periods were to be considered in more detail in the Phase 2 case study analysis.

Transportation Needs and Demand Levels: Transportation needs will continue to be the primary determinate in any process concerning choice of water or landside transit and vehicular movement. The majority of existing systems providing essential rural highway and town connections across waterways are likely to continue with periodic upgrades of vessel technology. In addition, as new high-speed vessels technologies are proven feasible and available in the U.S., new water routes for commuter and recreational passenger systems will emerge, where slower traditional vessels could not compete. The increasing emphasis on intermodal land and water transit connections should also result in new techniques for increasing ridership.

Environmental Priorities: Two new environmental factors which will continue to influence water versus land-based choices are the increasing environmental pressures to: 1) improve water quality by minimizing wetland construction, and 2) improve air quality by easing traffic congestion by providing cost efficient transit alternatives to individual auto travel. Water transportation has great potential in many waterfront settings to respond to these combined

pressures. However as the map of the 25 ferry survey sites illustrates in Figure 1, the geographic distribution of water transit settings is uneven across the U.S., which currently tends to place such initiatives at the state or regional level of decision making, rather than at a broad-based national level.

Cost Effectiveness: For ferry systems in larger urban areas there seem to be two trends affecting capital costs, operating costs, and fare structures. In cities such as New York and Boston there is a trend towards privately operated water transit as a supplement to existing landside transit, with or without public subsidy. In other waterfront cities which have public ferry operations such as San Francisco, Seattle, and San Juan, there appears to be continuing support for water transit as an integral part of the public transit system. For those areas encouraging market responsive rivate ferry systems, or public/private operations, public investments tend to be focused on facilitating the ferry systems in several ways; 1) providing and managing properly located terminal and berthing facilities such as in New York and Boston, 2) preparing and providing operators with market analysis and planning base data, as in Corpus Christi or Rhode Island, and 3) by offering economic incentives for joint development opportunities at terminal sites, such as at Rowes Wharf in Boston. For private systems, cost efficiency may mean turning a profit; for public systems it more often means minimizing subsidy needs.

Economic Development: While ferry services are rarely the primary stimulus for economic growth, they can in some cases help to sustain or enhance economic development. One type of economic contribution is that of ferries continuing to serve offshore islands reliant on such services for seasonal or year round visitation. In other instances new development may be seen as depending on water transit connections as in the case of the new hotel at Bird Island Flats at the Logan Airport, which is dependent on the water shuttle from Rowes Wharf in Boston. Another area of economic development supported by ferries is tourism and recreation as exemplified by schedule and service adaptations for off-peak and seasonal demands such as the Washington State ferries and Victoria Clipper in Seattle.

Table 2: Comparative Analysis of Nine Selected Ferry Systems by Similarities and Differences

System	Alt. Routes Yes/ No	Urban Long/ Short	Rural Long/ Short	Existing System	Expanding System	New System	Relevance
1.Seattle	**No**	**Med.& Short**	-	*	*	-	**Largest Vol.Syst. /Tourism**
2.Cape May-Norfolk	Yes (Bridge)	- Long	Long -	* *	_ -	- -	Regional Land+ Water Alt.
3.Alaska	No	-	Long	*	-	-	Longest Routes/ Marine Highway
4.Boston	Yes	Short	-	*	*	*	Commute +Shuttle as Impact Mitigation
5.San Francisco	**Yes**	**Med.& Short**	-	*	*	*	**GoldGate as High Speed Alt.to Landside**
6.New York	**Yes & No**	**Med.& Short**	-	*	*	*	**Staten Isl. /Private Route Success**
7.Portland Casco Bay	**No Islands**	**Med.& Short**	-	*	-	-	**Daily Isl. Commut. /Severe Weather**
8.Miss.Riv. Ferries	**No**	**Short**	**Short**	*	-	-	**Ro-Ro as Alt. to Bridge**
9.San Juan -Old San Juan	Yes	Short	-	*	*	-	Connects Old/New City

Note: **Five case study systems** in bold and underlined.

3. Phase 2 Summary: The Five Case Studies

Purpose and Objectives:

The surveys conducted in Phase 1 were useful in identifying general trends and directions water based transportation systems have taken with respect to land based alternatives in the past 40 years. As the focus of Phase 2, the case study analyses were intended to consider such trends as related to particular routes and operations. They were also meant to scrutinize in greater depth the particular types and shifts in transportation policy and planning which may influence choices between land and water based movement systems in the future. The Phase 1 surveys indicated that a small number of predominantly urban routes are accounting for the majority of passenger trips. The New York, Seattle and San Francisco systems provide excellent examples of these high volume, predominantly commuter oriented services. Conversely the larger number of systems, mostly non-urban, are carrying relatively few passengers on routes for which there are either no landside alternatives, or where those that exist are lengthy or circuitous. These systems are well represented by the Mississippi River routes, and the Casco Bay Island service. Since both types of systems are likely to continue to play important roles in their respective regional transportation networks, the more detailed Phase 2 case studies were selected to include these representative examples of both the higher volume urban and lower volume non-urban ferry routes.

Individual Case Study Descriptions and Findings

The case study site visits and interviews revealed greater detail and insight into existing ferry operations, including characteristics of competing land-based modes, future system expansion plans, funding and institutional arrangements, and other unique contextual information. The visits were conducted during the summer and fall of 1993. The following case study findings include critical aspects of each system's history and evolution which have helped to shape present day service, crucial decision points regarding water versus land based transportation, and future system plans. One of the key comparative findings for the systems was the categorization of individual routes as one of the three primary transportation functions. The summaries therefore include descriptions of the routes by function.

Seattle, Washington (Figure 3): Washington State Ferries (WSF) a division of the Washington State DOT operates a system of cross-Puget Sound commuter and highway link services which have been integral to the regional transportation system since the famed Mosquito Fleet was established at the turn of the century. The first of three primary decision factors which influenced the start-up of the highly successful passenger and vehicle ferry system occurred when the state acquired most of the remaining privately operated ferry franchises in the late 1940's and early 1950's, when the operators were no longer capable of meeting public demands for Puget Sound crossings. The state operated the system as a temporary highway link until the ferries were legislatively declared permanent in 1959, when an ambitious plan for cross-Sound bridges was officially abandoned. Since then the WSF system has functioned as a marine

highway link across Puget Sound, which saves commuters and through traffic substantial highway travel time compared to the congested alternative highway route through Tacoma. The long established legislation for state-wide tax support has guaranteed contributions to operating and capital costs, with the combined requirements of maintaining an affordable fare structure, but also limiting the amount of subsidy as a percentage of the farebox recovery to costs ratio. In recent years system ridership growth has allowed for WFS to meet these potentially contradictory mandates. Six vehicle and passenger routes serve the central Seattle area and carry the largest combined volume of vehicles and passengers of any system in the U.S.. With the expanding population in the Seattle metropolitan area and new residential areas on the west side of the Sound, the system has taken on a rapidly expanding role as a commuter transit link in addition to its other WFS marine highway and recreational functions. Future WFS expansion plans include cross-Sound passenger only routes and construction of new terminals and vessels. Private operators are proposing new high speed commuter ferry routes to Seattle, as alternatives to the increasingly congested eastern peninsula landside highways.

o Existing and proposed routes serve a range of basic transportation functions:

-Essential Transportation Links with No Land-based Alternatives: Vashon Island and San Juan Islands.

-Cost or Time Effective Complementary Services with Land-based Alternatives: Existing and Proposed High Speed Cross-Puget Sound Passenger Routes.

-Optional Services with Land-Based Alternatives: Proposed Private Eastern Peninsula Routes to Seattle.

o The cross-Puget Sound routes provide major savings for users in travel time, driving distance, trip cost, versus driving through Tacoma when traveling east or west high speed passenger to, through or around Seattle.

o The WSF is a model of a state run, publicly subsidized, high volume, passenger and vehicle ferry system. Economies of scale seem to contribute to the systems relatively cost efficient operations.

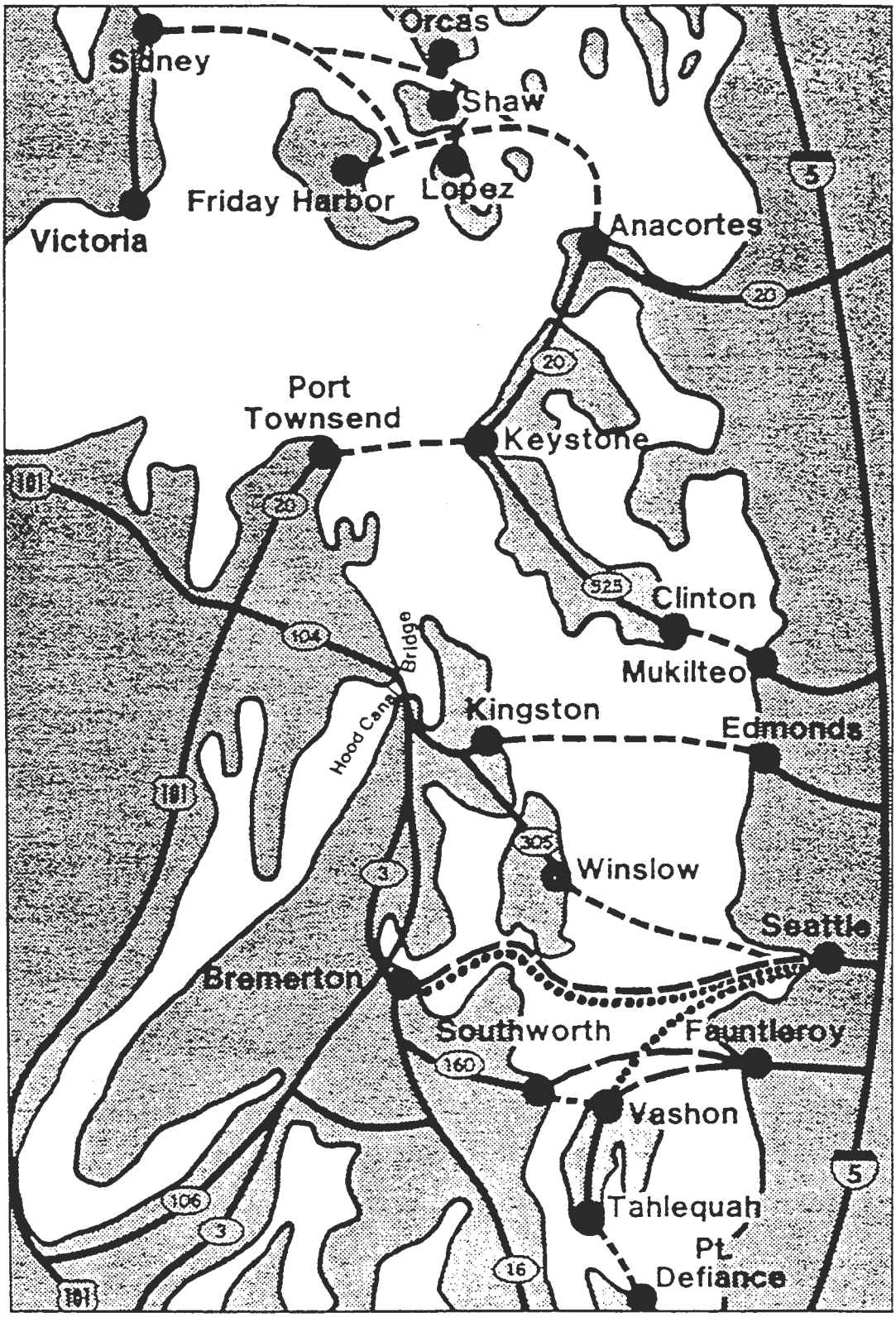
o The ferry system has become the largest tourist attraction in the state, with multiple spin-off benefits to the state economy and to system operations.

o After WSF initiated high speed passenger-only routes in 1990, private operators became interested and are now actively planning new, longer routes with advanced vessel technology parallel to land-based systems (Everett, Edmonds, Clinton and Mukilteo to Seattle)

o Seattle's major north-south land-side highway transportation infrastructure is for all intents and purposes complete and overcapacity; new passenger ferries can provide partial relief in some corridors, and, with good intermodal connections, can help reduce reliance on auto commutes.

o The WSF, the State DOT, and municipalities coordinate on transportation planning efforts, and have expanded park and ride options, HOV use and intermodal connections.

Figure 3: Seattle Ferry System Route Map



o The proposed expansion of public cross-Sound routes and private parallel passenger services seems consistent with long established state policy to provide all of the essential marine highway and transit links, while leaving new complimentary water transit routes to the private sector.

Portland, Maine (Figure 4): The Casco Bay Lines serve to connect Portland with six (6) islands four (4) of which remain within the city limits. The non-profit system is operated by the public Casco Bay Islands Transit District and is accountable to a representative Board of Directors. Maine State DOT assists with capital improvements and the City of Portland provides some operating support. All island to mainland transportation needs are provided 365 days per year including services for work and school commutes, shopping, vehicle transfer, mail and freight delivery. The comparatively low volume of year round ridership on the daily service is cross subsidized internally within the system by revenues from peak tourism and excursion use. The vessels are designed to be weather resistant, sea worthy and economical to operate in the harsh northeastern climate and Atlantic Ocean exposure. A major decision point regarding continuity of operations occurred in 1982 when a new private operator went bankrupt, and the system operations were taken over by the public transit district in order to maintain reasonable daily service to the islands.

o Existing and proposed routes serve a range of basic transportation functions:

Essential Transportation Links with No Land-based Alternatives: Casco Bay Islands provide all passenger, vehicle, freight and mail services to the islands.

o Service is typical of mainland to island ferries which provided lifelines for year round island residents. Without the daily scheduled ferry services, the islands would not be able to sustain long extablished support year round residential communities.

o Casco Bay Lines are the longest continuously running daily service in the U.S., operating since 1871.

o Incremental annualized upgrading and replacement for vessels and terminal improvements are planned. However no expansion of routes is presently required or anticipated.

o The system vessels are specifically designed for regular operation through extreme weather ranges including severe winter storms, wind, wave and tide conditions, in order to assure reliable daily service.

o By carefully balancing of the year round and peak season schedules and fare rates, the system has remained remarkably self-sufficient economically in terms of annualized matching service operation expenses to farebox and charter income. Like WSF, Casco Bay Lines relies heavily on seasonal tourism to offset winter schedule losses.

o The secession of Long Island from the City of Portland in 1993, and requested secession by two other islands may complicate the current funding balance by city and state, which is indirectly tied to Portland City property taxes.

San Francisco, California (Figure 5): The Bay Area is served by multiple public and private ferry systems and routes, and has been a major innovator in contemporary commuter systems over the past 25 years. The Golden Gate Ferry System, which serves the North Bay counties, introduced high speed commuter ferries to the US in 1970 and set an important precedent for new systems as alternatives to land based transportation infrastructure expansion. The size of San Francisco Bay and distances traveled by commuters have led to experiments with implementing longer distance high speed services such as the Vallejo route, with more in the planning stages. Historically, the primary crossings from the downtown Embarcadero to Oakland, as well as those to Sausalito and the north bay were replaced by the two major bridges. Services are primarily urban passenger commuter oriented. Expansion plans call for numerous new long distance high-speed routes supported by state capital funding, to relieve increasing pressure on land-site highway and transit. Three major decision points have helped shape the existing network of public and private services; 1) the planning and implementation of the Golden Gate ferries as a publicly endorsed intermodal transit alternative to expanding bridges and highways, 2) introduction of the first highspeed catamarans as long distance water based commuter alternatives from Vallejo, and 3) establishment of an inter-jurisdictional Regional Ferry Plan for the Bay Area by the Metropolitan Transportation Commission in 1991.

o Existing and proposed routes serve a range of basic transportation functions:

Cost or Time Effective Complementary Services with Land-based Alternatives: Golden Gate, Oakland-Alameda, Proposed East Bay and Vallejo Routes.

Optional Services with Land-Based Alternatives: Existing Vallejo Route.

o The current Bay ferries offer travel cost savings, reliability, high amenity levels and marginal time savings to users compared with landside highway, bus and transit alternatives. The systems have relieved pressures on landside alternatives to expand.

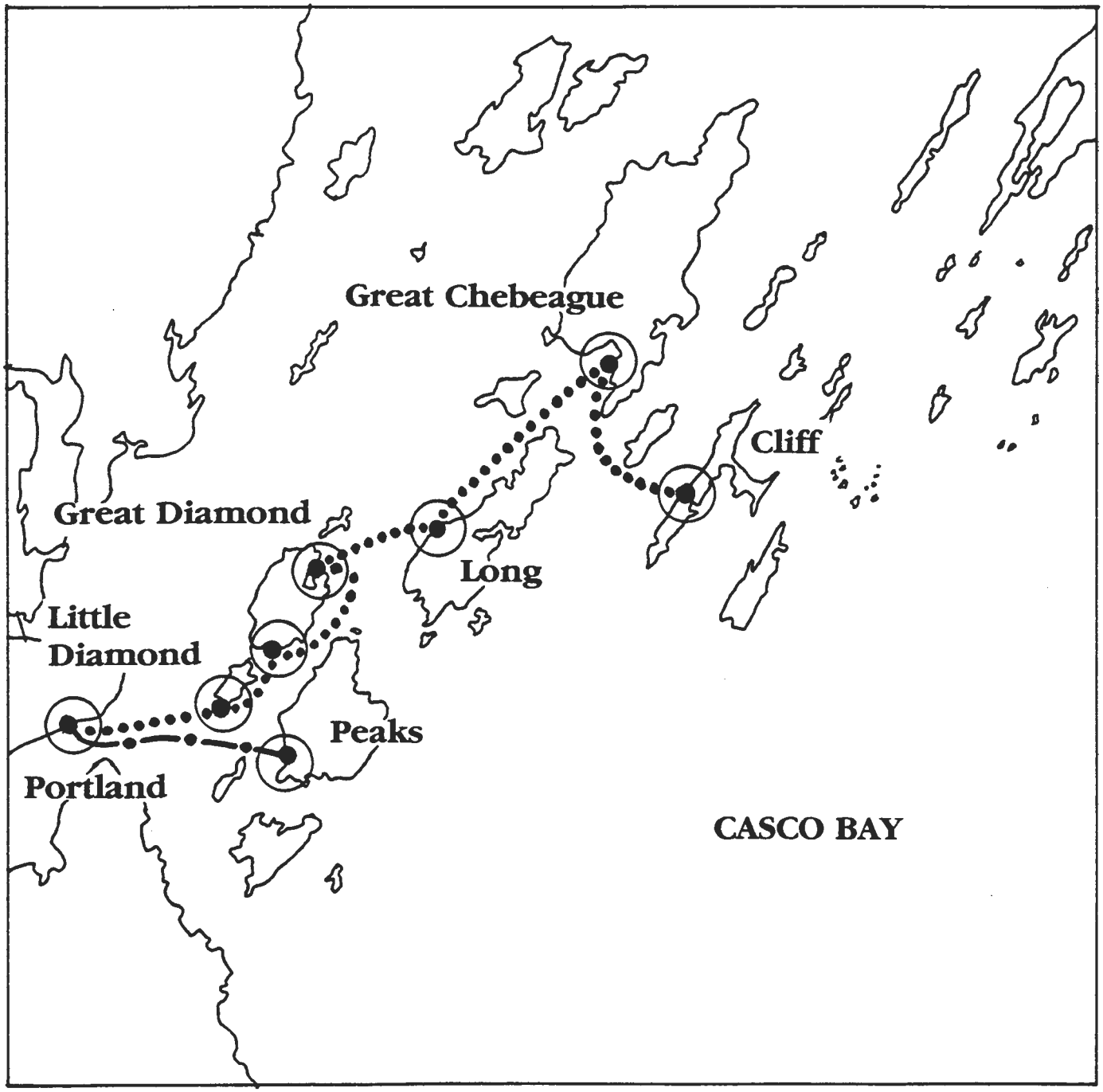
o The Golden Gate Ferry is the classic example of an early regional transportation planning process and decision to provide a publicly subsidized high speed ferry system in lieu of expanding land-side and bridge infrastructure. The system was started in 1970, and continues to increase in ridership.

o The Vallejo commuter route marked the first U.S. use of the high speed catamaran for a ferry commute too long for conventional lower speed vessels. Plans are processing to improve and expand this East Bay service.

o The privately operated, publicly subsidized routes to Vallejo and Oakland rely on off-peak or reverse flow excursion use of vessels to internally cross-subsidize routes, through intersecting contract incentives.

o The recently completed Regional Ferry Plan: San Francisco Bay was an innovative multi-jurisdictional effort by the Metropolitan Transportation Commission (MTC) to explore new ferry options to land-based highways and transit. The planning initiatives were accompanied by legislative funding commitments through a state-wide public referendum which included route proposals for Vallejo and Alameda.

Figure 4: Casco Bay Ferry System Route Map



o The public referendum mandated California state funding is for ferries dedicated to one-time expenditures for the high capital costs of vessels, but does not subsidize ongoing operations costs.

o The San Francisco landside transportation infrastructure is largely complete. The State DOT along with the Metropolitan Transit Commission are actively promoting multi-modal mechanisms for transit conversion from single auto commutes whereever possible, to try to divert Californians away from their cars and onto ferries.

Mississippi River, Louisiana (Figure 6): The cross river vehicle and passenger ferries in urban New Orleans and the vehicle ferries of rural communities up and down river in the Mississippi Delta of Louisiania serve primarily as essential highway links for commuters and other business related trips. The historic peculiarity of the Louisiania towns or parishes straddling the river with linked land-uses on opposite banks created the need for cross river ferry connections. Many of the ferry routes connecting state highways across the river are operated by The Louisiana DOT through its regional offices, while other ferries are operated by the counties or parishes with town functions on opposite banks. The system is typical of many nationwide which are long operating, low volume ferries serving areas where land and bridge trips are circuitous, time consuming and increasingly environmentally sensitive. The typical ferry route saves rural drivers an average of 60 miles and urban drivers up to 45 minutes of round trip travel, per day. Two of the three New Orleans ferries combine passenger and vehicle service. The key decision points were in the 1960's when the state DOT took over the failing private ferry systems, and continued operations of selected routes, and in the late '70's/earlly '80's when major vessel refitting and terminal reconstruction were completed.

o Existing and proposed routes serve a range of basic transportation functions:

Cost or Time Effective Complimentary Services with Land-based Alternatives:
New Orleans Routes, Up and Down River Routes

o Mississippi River ferries are classic examples of critically needed low-volume, local, cross river highway links. The ferries offer users substantial savings in travel time and distance, and trip cost, compared to highway and bridge alternatives for many home to work commutes.

o By current environmental standards, they are energy-ifficient, reduce VMT's and improve air quality.

o Louisiana delta environmental conditions have limited new bridge construction in the past 20 years and are likely to continue to do so, making the continuation of current ferry services a strong liklihood.

o The unique two-sided settlement patterns of riverside parishes combined with more recent west bank industrial employment locations have contributed to commuter vehicle ferry service needs.

o For the three New Orleans routes, ferry operation costs are linked to bridge tolls, and services are connected intermodally to land-side transit routes.

o The tourism focus of the New Orleans economy provides off-peak uses for the Algiers Ferry and future opportunities for increased utilization with the establishment of riverboat gambling locations up and down river.

o The Chalmette-Algiers ferry is a good example of an efficient highway link for urban commuters as an efficient long term substitute for the proposed construction Dixie Highway bridge which was suspended when it encountered environmental constraints.

New York, New York (Figure 7): The New York Harbor ferry services will long be identified with the most famous of American ferries the Staten Island Ferry, which carries the most passengers on any single route in the U.S. More recently, however, in response to the over burdened transportation infrastructure, several noteworthy new private cross-Hudson services have been successfully started in the region. Since 1986 new services have provided short distance water links to Manhattan along the Weehawken and Hoboken commuting routes, and a longer commuter service from the Bayshore. The public sector has served as a catalyst through aggressive market analysis and planning, along with provision of public terminal locations for these new private routes. The city and state have had to devote limited operating resources to the highly subsidized transit and rail system as well as to the low fare Staten Island Ferry. The fact that commuting is often inter-state and intermodal seems to have fostered, to some extent, the private ferry operations which might otherwise have required complex two-state subsidies, Recent planning for expanded services within New York City by the New York State Urban Development Corporation, New York City DOT and the Port Authority has been innovative and shows signs of being a success. Within the context of intensive radial commuter patterns, a fixed transportation infrastructure and a water dominated topography, New York's ferry systems provide many useful models for future water transit in other densely populated harbor and river-front cities. Key decision points were identified which contributed to the rebirth of the New York ferries including: 1) establishment of a New York City-wide ferry policy in 1986 and opening of public terminals, 2) start-up of speculative private services in 1986-87 from the Bayshore and Port Imperial to Manhattan, 3) public sector planning and private operation of the Hoboken ferry, and 4) public sector planning for private sector design/build operations of proposed new highspeed intra-city routes.

o Existing and proposed routes serve a range of basic transportation functions:

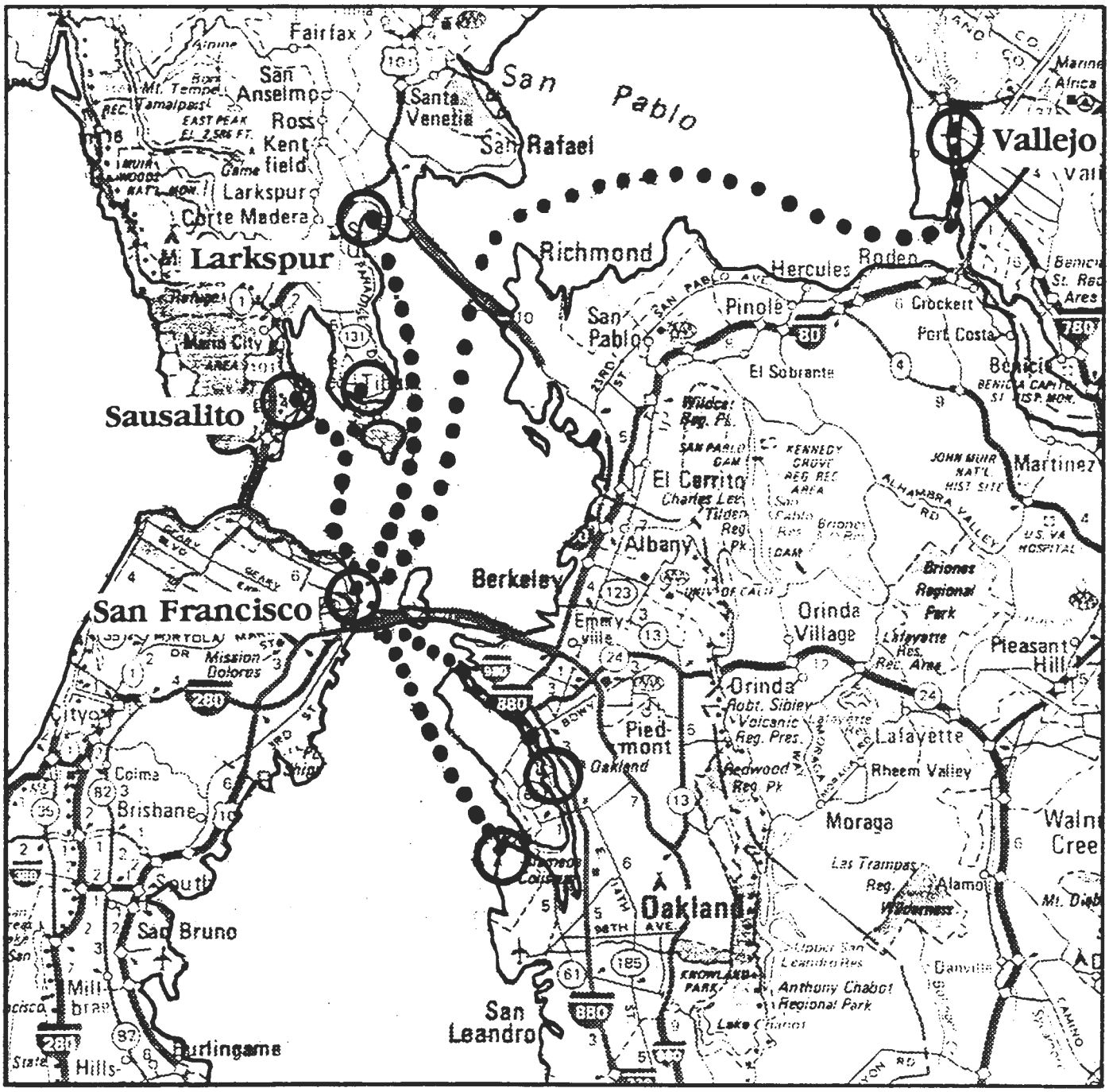
Cost or Time Effective Complementary Services with Land-based Alternatives: The Staten Island, Bayshore, and proposed High Speed Hudson River routes all provide trip time advantages.

Optional Services with Land-Based Alternatives: Port Imperial, Hoboken, and the proposed Hunters Point routes provide rehability, amenity and qualitative advantages.

o Existing cross-Hudson ferries offer commuters varying combinations of benefits over land-based options depending on the routes. Included are time/cost savings (Staten Island), time/amenity/reliability benefits (Bayshore), and amenity/reliability advantages (Weehawken and Hoboken).

o The new generation of New York commuter ferries have served to provide extra transit

Figure 5: San Francisco Bay Ferry Network



capacity complementary options for existing tunnel and bridge corridors. By diverting both auto and transit riders to ferries, the routes have prolonged use of existing highway and rail infrastructure capacity. The ferries are providing a short to mid-term alternative to building additional bridges and tunnels.

o New York's new commuter ferries are currently the ultimate example of private sector systems responding to new transit markets created by the fixed and over-extended transportation infrastructure in the largest, most densely developed U.S. city.

o The public role of facilitator/planner played by public agencies including the Port Authority, NYC DOT, NYS UDC, and NJ DOT,backed by city policy to preserve and operate Manhattan ferry terminals, has been successful in matching private services to new markets.

o The Port Imperial FerryBus has been innovative in providing new vessel technology, model service and operations, and private intermodal bus connections in Manhattan for its cross Hudson services from Weehawken and Hoboken.

o The TNT Hydrolines Bayshore Service has proven the effectiveness and niche marketability of high speed catamarans over longer distances from Monmouth County, NJ to the Wall Street district in lower Manhattan.

o The proposed new expansion franchises in the New York regional ferry plan are intended to extend route lengths and transit options by use of new high speed commuter passenger ferry service to Manhattan.

o The combined ferry networks are demonstrating innovative new ways of using employer commuter voucher systems to increase transit and park-and-ride ridership.

Comparative Analysis of Case Study Systems:

The five case study networks were assessed in terms of the six major ferry planning determinants identified in Phase I. While the findings for each are chronicled in greater detail in the Phase 2 report, the following summary highlights those case study observations which may be of most interest for new and emerging systems as well as for maintaining or expanding existing services.

1. System Response to Regional Transportation Needs: All systems studied were found to be responsive to evolving transportation needs in different settings over varying historical time frames. Transportation requirements and specific responses varied by location but in most cases also included a public transportation function combined with an excursion or recreational component. The hierarchy of transportation needs described range from those essential systems providing the only available regular transportation service to those routes offering complementary services to other existing modes, to those offering options to other available landside options.

A comparison of representative routes from the case studies by transportation function and land-based alternative is shown in Table 3.

2. Market Factors - Past, Present, and Future: The case histories demonstrate how many of

the markets for ferry services diminished to near extinction with the linked demise of rail and transit use combined with the rise of auto travel and commuting, particularly from the 1950's through the 1980's. The case studies of current services also indicate how particular ferry routes and services survived because of the particular nature of the routes and markets served. In addition the emerging new services in different regions indicate that based on urban transportation trends in more densely populated water front cities, ferry services can fill particular travel niches quite effectively in a cost efficient manner. As demonstrated by the New York ferries, they can in some cases be operated privately at a profit, or publicly with minimal subsidies where market needs are strong enough. The factors making elective ferry usage increasingly attractive in such locations include the reliability and predictability of trip time, time savings total commuter trip cost savings, and/or amenity level.

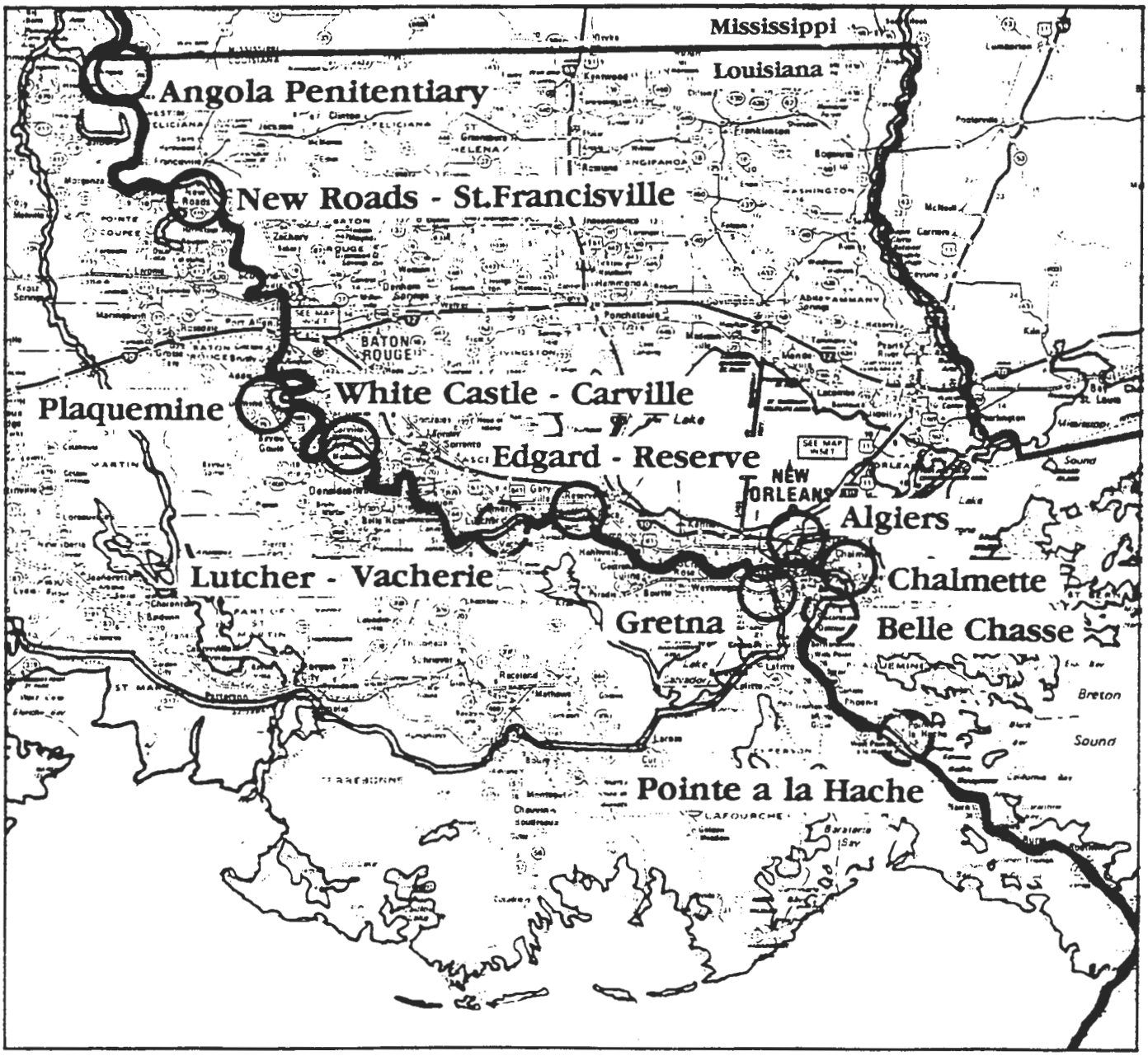
The increasing role of tourism is becoming an important contributor to public and private operators marketing and income. In all of the case study services, marketing of high season and off-peak services as integral to the regular routes has been a major break through for more efficient vessel use, while also providing a higher profile for the system, and in some cases new economic development opportunities for the terminuses.

3. Environmental Factors: The case studies revealed a variety of examples of the many positive and the few negative environmental impacts of ferry systems. In an era when water and air quality have become national priorities, the use of ferry systems would seem to provide many benefits in both categories. Most of the negative impacts of individual routes and vessels, such as wake, can be technically resolved, but as with many such factors, are subject to specific local conditions. Two categories of environmental impact which seem related to the issue of choice between land and water based transportation include: 1) physical aspects such as air and water quality, wetland considerations and vessel technologies, and 2) social factors which include such influences as land-use and growth management, sustainability, and other community related impacts.

1) Air Quality: Based on current national environmental policy objectives, the primary contribution of new ferry systems and many of the older passenger and vehicle ferries related to the improvement of national and urban air quality through the reduction of vehicle miles travelled or "VMT's". All vehicle ferry systems studied reduced auto, bus or truck trips by providing shorter alternate routes. All passenger systems and some vehicle systems such as WSF were strongly oriented to reducing or eliminating auto trips. Even predominantly vehicular routes such as those on the Mississippi provide significantly daily trip/mile reductions for their patrons, saving from 30 to 60 driving miles per person per trip.

2) Water Quality and Vessel Technology: Effects of ferries on water quality need to be considered in several ways. While the actual vessel power sources in some cases may have manageable negative impacts such as fuel leakage, the energy efficiency per passenger mile travelled is extremely high compared to single driver auto commutes. Most vessels are well equipped regarding other categories such as holding tanks for sewage, and have improved dramatically in recent years. Other types of issues such as wake and wash, which cause shore erosion, are often related to hull types and design. While great innovations have been made abroad in low-wake/low-wash designs, they are only slowly being adopted by the U.S. markets and approved by the Coast Guard.

Figure 6: Mississippi River/New Orleans Ferry Network



3) Wetland Issues: Post-NEPA regulation, the impacts of land-based water crossings such as bridges and tunnels on wetlands required detailed analysis and extensive mitigation prior to construction in areas of great environmental sensitivity. The lower Mississippi Delta, for example, consists of swamps, bayous and other wetland resources which have precluded major new highway and bridge corridors since the 1970's. In some instances where bridge and highway construction were not permitted, such as the Dixie Highway in New Orleans, ferry routes have been provided as environmentally preferable alternatives. Similar choices have been influenced by environmental concerns in Puget Sound, and parts of San Francisco Bay for new ferry crossings.

4. Cost-Effectiveness of Ferries as Alternatives to Land-based Transportation: Each ferry system and use would require a separate cost-effectiveness analysis because of the different settings, uses and competing modes. One way of comparing systems regarding subsidized versus non-subsidized service, or public versus private service, is to consider examples by the route functions described above in the market analysis discussion. The majority of ferry systems used for passenger commuting and public marine highway functions are currently publicly subsidized to some degree and are generally likely to remain so. In many cases ferry subsidies are equal or less than land based transit.

5. Economic Development: The case study systems demonstrated support of economic development in regions in two ways; in some cases ferry services sustain existing land development and real estate patterns, while in other areas the systems support new land-uses and regional economic development.

1) Support of Existing Land-Use and Community Patterns: In the older urban and rural settlements on the east coast and gulf states, the ferries tend to support existing land-use and commuting patterns at various levels, from the lower volume examples like the Mississippi River or Casco Bay island routes, to the high volume New York ferries.

2) Support of New Waterfront Land-Use and Development: On the west coast in the newer cities with suburban development continuing to spread further away from the central employment areas and lengthy residence to work trip distances the norm, the ferries have tended to provide support for new residential development as well as connect older areas to the city centers. The Larkspur to San Francisco ferry provides an example of how a terminus with little initial surrounding development has over 20 years become a mini-center for mixed use office, commercial and residential development. For several of the Puget Sound routes, the ferries have helped sustain a lower density residential option for those preferring to live on the western peninsula or Vashon Island and commute to work in Seattle.

3) Emerging Tourism and Recreation Markets: A third major area of ferry-induced economic development may prove to be the most important. In all of the case studies, the dramatic increase in tourism use of ferries was notable as a means of improving operation revenues, and assisting regional economies. The increasing trend towards combining commuter transit and transportation services with off-peak and season recreational uses of the vessels has enhanced both public and private farebox recovery rates while also solidifying the roles of ferry systems. The principle of achieving maximum utilization of flexible use vessels has led to an aggressive expansion of ferries into excursion and recreation services.

6. Geographical Factors - All Ferry Systems are Highly Adapted to Local Conditions: The geographical context is often the primary determinate of a given ferry system in two ways; 1) historically in terms of settlement and land-use patterns, and 2) currentlyin terms of what types of routes and services across water areas are feasible and can meet emerging local transportation needs. The wide range of contextual settings and their specific influences on water transportation lead to the finding that all ferry systems are determined in large measure by the local conditions, and that the design and operation of most systems is highly particular to given waterway and transit need.

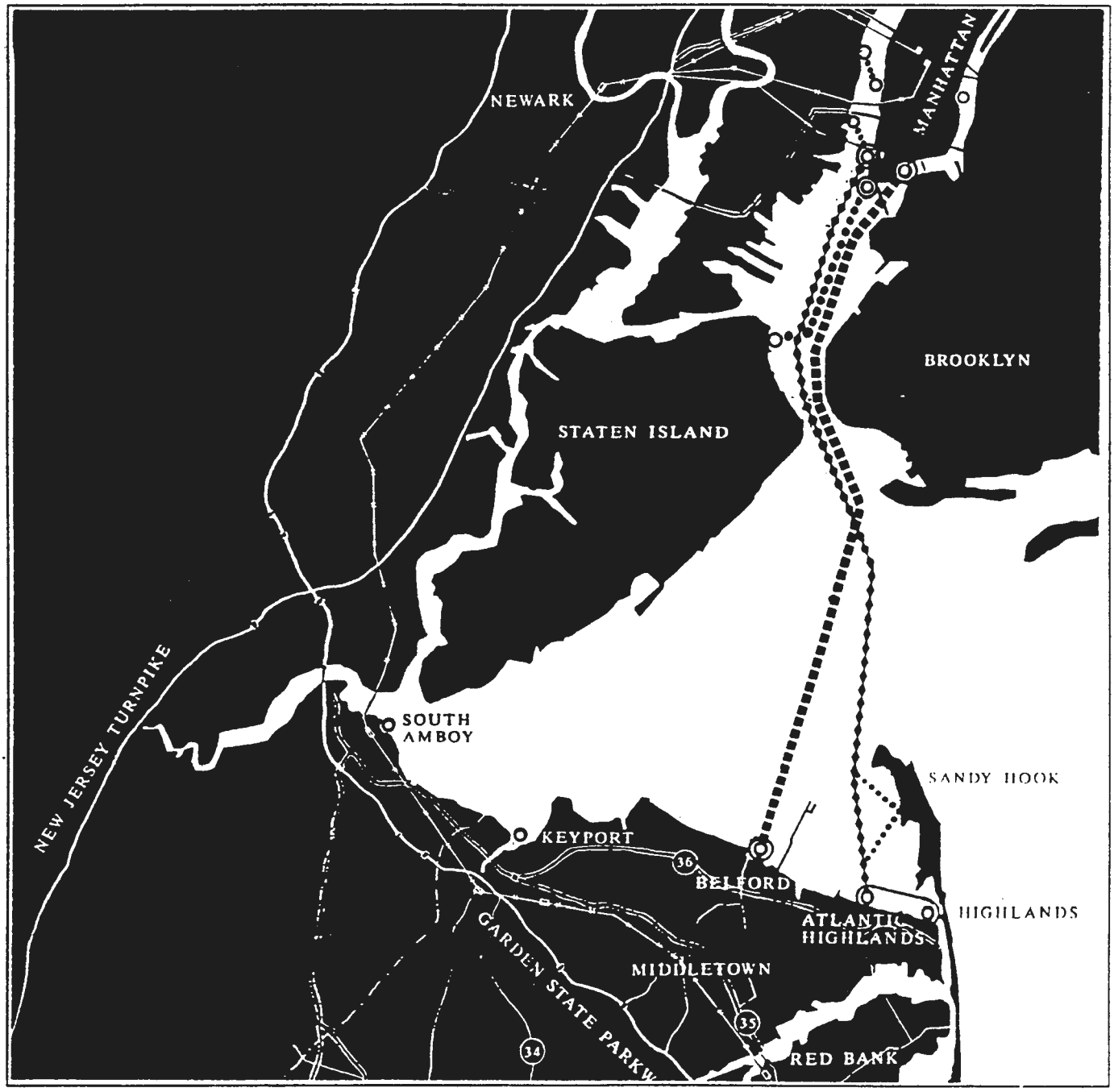
1. Water and Land Topography: The five case studies represented a wide spectrum of port cities and their respective natural and man-made geography. Each harbor setting was selected historically because of a combination of water access and land development opportunities. For example, the two east coast ports were established in the 17th century as major protected deep-water harbors, strategically situated for coastal and international trade. New York Harbor was distinct because it had such exceptional natural protection combined with deep water access. Finger piers and ferry slips could be located freely along the Hudson and East River shores, and vessels needed minimal freeboard in the flat waterways traveled. Portland Harbor on the other hand was much more exposed to the open ocean, and periodic wave action. The location of piers and vessel designs were determined accordingly. The island piers needed to be on the lee and protected side, and vessels required higher freeboard to contend with the complexity of wave, tide and current patterns of Casco Bay.

In each of the port cities considering expansion of ferry services, New York, San Francisco and Seattle, the protected waterways present one of the few remaining options for increasing transportation system capacity across water areas, coming full circle from the earliest periods when they were the only available transportation option.

2. Navigation: The case study systems were also influenced by navigation opportunities and constraints. Varying tide ranges and currents affect all settings. Even the Mississippi River experiences major level changes in excess of 20 feet during the average year. The currents and available navigation channels, particularly in more confined harbor locations are also factors which allow or preclude routes. For example, shoal water conditions such as those on the Larkspur approach may require dredging, slower vessel speeds, or low-wake vessels thereby affecting route times. Exposure to bay entrances such as San Francisco's Golden Gate, or the approaches to Portland Harbor, can affect routes and vessel design as well. Vessel licenses regulated by the Coast Guard are also related to the types of water conditions in which a vessel operates with protected (New York Harbor), semi-protected (San Francisco) or exposed (Portland) determining the vessel hull shape, stability and other design factors.

3. Climate and Seasons: The case studies also demonstrate the wide range of climate and seasonal ranges which affect ferry operations, design and route selection. The Portland weather conditions represent extremes in terms of temperature range and exposure to winter storms. Operating conditions in ice and cold present major extremes for vessel design, terminal configuration, and crew skills. The New York Harbor, though in a milder climate can experience icing problems in shoal areas like the New Jersey Bayshore terminal locations. Mississippi River conditions in the summer often include blinding tropical rain squalls which complicate cross river navigation in reaches where

Figure 7: New York City Ferry Network



heavy shipping is moving down river at considerable speed. The ferry vessels therefore require considerable auxiliary power, as well as radar and communication devices.

4. Vessel Technology: In general the design of vessels and training of crew need to be highly responsive to local weather, climate and navigation patterns. At present, only the highspeed catamaran designs seem to have some degree of transferability between geographical locations. Other historical examples include the early applications of catamaran technology for the Mississippi River ferries, which needed to be able to navigate quickly across the swift currents. The catamaran hulls reduced water area resistance, and allowed for the wide platforms needed to accommodate the side loading of vehicles. The monohull designs of the Casco Bay ferries with their high sides and protected cabins allow for maximum ability to deal with open ocean wave and wind effects, while also permitting multi-deck loading to deal with tidal variations.

Much more research is necessary on new vessel types and speeds for emerging ferry markets. Special vessel designs for different ports and different regions are likely to continue as is evidenced by the case study examples. But new urban routes are more likely to incorporate aspects of the higher speed and lower wake ferries now operating in Scandinavia, England and Australia. A major design requirement in future vessel layouts and terminal designs will be meeting ADA access requirements. Such regulations for vessels are being formulated nationally, while terminal access requirements are to be set by states.

4 Conclusions and Recommendations

Study Findings and Conclusions:

The case study and survey assessments have provided examples of how particular ferry routes serve as alternatives to land-based transportation in a variety of locations and specific applications. The detailed analyses identified the basic transportation functions provided by the different routes, and interpreted the historical decision-making processes which have resulted in the continuation or expansion of on-going systems and the start-up of new ones. The conclusions are summarized in the following sequence; 1) identification of four periods of 20th century ferry service, 2) critical decision factors for water or land-based mode choice, and 3) examples of ferry planning and implementation techniques which may be useful to future systems. The recommendations for a National Ferry Policy. The findings are illustrated by examples from the case studies augmented by references to other domestic and foreign systems as needed.

Historic Periods of 20th Century Ferry Service

An important step in understanding how contemporary ferry systems have evolved is to consider their individual histories and relationship to national and regional transportation trends. Each of the case study settings has a long and varied history of ferry service. All of the historical services were found at one time or another to be critical to their respective transportation networks and regional development patterns. Those locations with essential island ferry services, including Portland and Puget Sound, tend to have had continuous operations, as have some areas with complementary services, such as the Staten Island Ferry and the Mississippi River parish routes. Other complementary and optional ferry services tend to be more recent, either as new routes or as replacements of previously abandoned routes. Four general periods of modern ferry service evolution were considered and helped in understanding the shifting balance of passenger water transportation and land-based alternatives.

1. The Decline and Fall - 1900 to 1950: The golden age of ferries may have peaked around the turn of the 20th Century, when the burgeoning urban populations relied primarily on the rail and ferry transit networks largely provided by the rail companies. With the construction of bridges and tunnels initially for the trains and subways and later for cars and trucks, the ferry systems were gradually replaced, often along the same corridors. In New York alone, it is estimated that there were nearly 50 different routes across the Hudson and East Rivers as late as 1910, all of which were linked to trolleys at their Manhattan terminals to deliver commuters to their final work destinations. While a few of the rail ferries continued to serve commuters to New York into the 1960's, the majority had been replaced by 1950 by land-based subway and rail tunnels, and vehicle tunnels and bridges. In San Francisco the ferries were eclipsed by construction of the Golden Gate and Bay Bridges, and as in New Orleans, where most of the urban river ferries were replaced by two new bridges.

2. Survival of Remaining Systems - 1950 to 1970: The only systems which tended to survive were those which provided essential services, such as to islands, or complementary services with long and circuitous landside alternatives. This period was also marked by extensive highway and bridge construction as related to the Interstate Highway program, and the major shift by the

Table 3: Comparative Analysis of Individual Routes by Transportation Function and Land-based Alternative:

Location and Route:	1.Trans. Essent'l Link	2.Trans. Complement'ry	Trans. Optional	Land/ Alts.	Approx dist. Ferry/ Land	Instit'l	Gen'l
Seattle							
o Cross Sound	-	Yes	-	Br/High	10/70m.	Public	Tacoma
o San Juan Isls.	Yes	-	-	None	-	Pub/Priv	NoAlts
o New HiSpeed	-	Yes	Yes	Br/High Hi/Bus	10/70m. =	Pub/Priv	Tacoma N.Sea.
Portland/ Casco Bay Isl.							
o Peaks	Yes	-	-	None	-	Public	NoAlts
o Outer Isls.	Yes	-	-	None	-	Public	Noalts
San Francisco							
o Golden Gate	-	Yes	-	Br/Bus	=	Public	Upgrad
o Vallejo	-	-	Yes	Br/BAR	6/25m.	Pub/Priv	Upgrad
o New HiSpeed	-	Yes	_	Br/Bus	25/35m.	Pub/Priv	New
Mississippi River							
o New Orleans	-	Yes	-	Br/High	1/20m.	Public	NoBr.
o Parish Links	-	Yes	-	Br/High	1/50m.	Public	TolBr.
New York Harbor							
o Staten Island	-	Yes	-	Br/Bus	5/15m.	Public	ManyAlt
o FerryBus	-	-	Yes	AllMode	=	Private	"
o Bayshore	-	Yes	-	AllMode	18/40	Private	"
o New HiSpeed	-	Yes	Yes	AllMode	=	Private	"

american public to auto commuting from transit. The state of Washington, which had purchased and operated the cross-Puget Sound system initially as a holding action until a massive bridge program could be implemented, eventually decided in 1959 to expand the ferry system and abandon the much more costly land-based bridge system. The Casco Bay service in Portland continued to operate, as did the city-run Staten Island Ferry in New York. With the exception of Tiburon to San Francisco, few new commuter services were introduced during this period.

3. Initial Expansion Period - 1970 to 1985: As new highway and bridge programs tapered off or neared completion, some expansion and new ferry networks began to be implemented. in San Francisco, the Golden Gate ferry system was introduced after the precedent setting regional corridor planning process which recommended new high speed ferries and bus routes as an alternative to widening the Golden Gate Bridge or building an arm of the new BART transit system. The WSF system was expanded and refined to better serve auto and park-and-ride commuters across the Sound. Of significance during this period were the introduction of the National Environmental Protection Act (NEPA), and the Clean Air Act, both of which set the stage for the next period by placing new environmental constraints on highway and bridge expansion in many of the study regions.

4. Current and Future Expansion - 1985 to 2000: The current period was influenced by three factors; 1) the introduction of new highspeed ferry technology in San Francisco, Seattle and New York, 2) the completion of major segments of the Interstate highway network and other regional transportation systems, and 3) a return to public transit usage by urban commuters. The first generation of reliable new vessel technologies, highspeed catamarans, allowed for longer ferry routes to be competitive time-wise with land-based routes. New water-based commuter links were introduced such as the privately operated Weehawken and Hoboken ferries and provided attractive alternatives to autos or buses in congested tunnels, or overcrowded subway and commuter rail links. The second generation of fast ferries is now being built and applied to existing and new routes as faster and more reliable than parallel land-based alternatives in San Francisco, Seattle and New York. The period was also marked by a series of innovative comprehensive ferry planning processes which considered routes as integral to regional intermodal transportation objectives.

Critical Decision Factors for Water or Land-based Mode Choice

The case study assessments describe the particular decisions made on land or water based routes along a particular corridor. It was noted that for any given waterfront city or town, there are a limited number of useful ferry routes for point to point public transit, even though there are often multiple excursion routes for tourism and recreation. The factors influencing the public transportation services are often more narrowly focused than are the recreational determinates. The following decision factors for choice water over land-based modes seem to vary in degrees of importance depending on the characteristics of the individual location and routes considered.

1. Transportation Needs: By definition, the transportation needs were always found to be the first and foremost determinate of routes and service. In each of the systems analyzed, the historical routes were either replaced when more efficient land-based systems were built, or continued to serve when there were no alternatives introduced. For new ferry systems, services have been established either when the land-based alternatives were found to be no longer capable of meeting the daily transportation needs, or when new origins and destinations needed

to be connected over water, with or without competing land-side options. Publicly sponsored systems have been created to meet either essential and complementary service needs when those routes have been determined to be necessary to the regional transportation network. In recent years ferry options have been increasingly considered as alternatives along heavily traveled transportation corridors with parallel waterways, particularly as they may offer cost or environmental advantages. New, or perhaps re-invented, roles for ferries have been identified in many urban settings to provide water links connecting to transit and/or park-and-ride facilities in intermodal transportation systems.

2. Geographical Context - "All Ferry Systems are Local": Historically, individual ferry operations, vessels and routes have always been tailored to localized geographic factors. The case studies represented a broad range of physical settings, including such factors as climate, tide or other water level changes, waterway and navigation conditions, dock or terminal locations, shoreline characteristics, and historic land-use patterns. In discussing with the operators the factors determining their services and narrow margins between success or failure, all indicated that the major decisions had to do with local conditions of the physical environment and fine tuned travel needs of their patrons. Vessel technology design and route characteristics, for example, have always been carefully adapted to the specific setting.

3. Environmental Priorities: Since 1970, the NEPA and Clean Air Act have exerted increasingly greater pressure on coordinating transportation and land-use development, which in combination have particularly affected waterfront communities and cross water travel choices. In urbanized port or riverfront communities, new limitations have been placed on building road, bridge or rail connections across wetlands or the waterways themselves, as has been particularly apparent along the Mississippi in Louisiana, and may be even more so after the recent flooding experiences of 1993. Water transportation can often provide an environmentally more benign mode of travel in many contexts when compared with the construction of new landside infrastructure options. On the other hand, high-speed ferry technologies need to be designed to reduce wake and wash impacts when operating near areas with sensitive shorelines.

4. Market Demand: Market demands for new ferry services are often hard to predict, particularly in areas which may not have had water transit for 50 to 75 years. However, many of the newer case study routes have been initiated based on conventional land-based transportation demand modelling which managed to identify markets define start-up services, and adapt the systems as the needs become better known. With an increasing number of contemporary case histories in different locations, and the forecasting and planning methods developed in San Francisco starting with the Golden Gate Ferries, followed by those for newer routes in Seattle, Boston, and New York. Another method which has proven effective has been to start systems on a trial basis to address a short term mitigation need, and continue the service if it builds up a dedicated ridership. In comparative cases for varied types of service, several years of operation seem to be required to test the waters, adjust the service if needed, and determine if a solid market base exists.

5. Economic Development and Tourism: During the same period of recent growth of ferries as components of regional transportation systems, parallel expansion has taken place in the use of ferries for economic development, particularly as it relates to tourism, and often combining public water transit and recreation services using the same vessels and routes. While the Washington State Ferries represent the most dramatic example of combining peak hour transportation with off-peak tourist use, many other public and private systems have expanded

trips and services to meet and/or promote such new recreation demands. While the services have multiple economic benefits such as bringing new visitors to a city or region, perhaps the most important direct benefit is the cross subsidy of the scheduled transit service by the often more lucrative off-peak tourism, helping public systems to break even and private operations to operate at a profit.

6. Institutional Context: The case study states all seem to have different levels of commitment to ferry system operation and public financial support, much of which seems to be hereditary from earlier experiences. Those states which have continuously operated public ferry routes as integral links in the state transportation network, such as Maine, Louisiana, and Washington, have developed legislative, funding and institutional frameworks through their state transportation departments to perpetuate and refine the ferry services. Other states such as New York and New Jersey, and California which have for centuries relied on private sector support, have dedicated public sector efforts as leveraged catalysts to provide indirect support for those operations through public terminal construction and management, planning and development incentives and in some cases contributions to capital construction funding.

New Planning Techniques and Institutional Frameworks:

In considering the application of ferries as alternatives to land-side options, the planning and implementation process employed by public and/or private sector providers can be critical to the success of the system. However, with the exception of those states which have a continuous history of publicly supported water transportation and already have such processes institutionalized, the start-up of ferry routes providing public transit services can seem like re-inventing the wheel, since there is not likely to be legislative support or transportation agency understanding of the water mode. The case studies provided a variety of good examples of useful planning, funding and implementation approaches.

1. Existing Ferry Expansion as Integral Components of Regional Transportation Plans: Certainly an implicit component of ISTEA policy, the inclusion of expanded or new ferry routes as components of regional or metropolitan transportation systems has been demonstrated in the recent planning initiatives including the New York Highspeed Ferry Plan (1993), the Bayshore Ferry Study (1991), the San Francisco Bay Area Regional Ferry Plan (1991), and the Washington State Ferries ongoing biennial planning process. These plans offer a variety of useful techniques for demand forecasting, cost effectiveness analysis, and institutional/operational models.

2. Corridor Planning to Include Ferry Routes as Alternatives to Expanding Land-based Infrastructure: Similar to the above approach, but dealing with a more limited segment or individual routes of a system, the corridor analysis is usually needed as a component of the larger regional transportation plan. Examples of corridor plans involving ferry options, are the plan for the Golden Gate Ferry System, the Trans-Hudson Study/Hoboken Ferry Plan, and the privately conducted Mosquito Fleet Plan in Seattle. These studies evaluated the trade-offs between new ferry service and increased landside infrastructure.

3. Temporary Ferry Services as Mitigation for Landside Infrastructure Repair or Construction: One variation of the corridor ferry plan, is the use of ferries as mitigation measures during landside construction. As a component of the New York Highspeed Ferry Plan, two new routes were identified as providing relief for the planned reconstruction of a parallel

highway. In 1980, a new ferry was planned and implemented from Hingham to Boston to relieve commuter delays during the repair of a parallel commuter highway. More recently ferries were immediately deployed to move commuters in the aftermath of the San Francisco earthquake of 1990 while bridges and highways were being repaired, and for the cross-Hudson Hoboken route when the PATH transit system was disabled following the World Trade Center bombing.

4. Institutional Options for Public and Private Partnering for Ferry Services: During the recent period from 1985 to 1994, several innovative examples have occurred which are worth noting. Combined public and private services have been successfully used in San Francisco on the Vallejo and Oakland/Alameda routes. In New York, the Hoboken service is private but grew out of a public planning and RFP process and utilizes public landings and intermodal connections.

5. Innovative Regional Planning and Inter-Jurisdictional Arrangements for Intermodal Services: Intermodal transit connections are vital for successful commuter ferry operations, as well as coordinated vehicular routes for park and ride users. The provision of coordinated intermodal connections to ferry services often requires inter-jurisdictional coordination by separate transportation districts. All case study systems demonstrated specific applications consistent with the ISTEA policies to increase intermodal travel opportunities.Through the planning initiatives of the Port Authority of New York and New Jersey, the recent cross-Hudson planning effort demonstrates how two states and multiple municipalities have been able to improve transit connections and schedules, providing new transit options for commuters using the Hoboken and Weehawken ferries. The San Francisco Metropolitan Transportation Commission has also initiated efforts to coordinate several key transit connections for the 19 different overlapping transportation jurisdictions, including intermodal links for existing and proposed ferry routes.

6. New Funding and Financial Models: While the essential ferry systems seem to require state or municipal subsidies, new complementary and optional ferry routes seem to demand more innovative funding and operations. The ferry systems which compete with parallel land-side travel options, particularly transit, often seem to have difficulty attracting operating subsidies from metropolitan transportation programs which are invariably already over-burdened financially in providing essential or required landside services carrying much higher volumes of riders. In response to these limitations the ferry operations have attracted funds through new combinations of public/private funding. The California water transportation referendum recognized the importance of local public control of the ferry system and high start-up costs by providing public funds for capital construction of terminals and vessels, but not operating subsidies, leaving the private sector and municipalities to negotiate ways of making the routes work economically and operationally. The New York Highspeed Ferry planning initiative, after conducting a thorough study, concluded that based on high user demand along selected routes similar to the recently successful Hoboken experience, it was possible to solicit a totally private initiative for capital and operating funding, as long as the operators were given franchises for the specific routes. With respect to ongoing public ferry systems, the Washington State ferries, Casco Bay Lines, Golden Gate Ferries and Crescent City Connection are all increasingly dependent on seasonal tourism to help offset commuter service subsidies, and have sought to improve those services and increase ridership. Financial self-sufficiency will continue to be a major objective for public as well as private services, and an important factor in assessing cost-effectiveness of ferry routes compared to landside options.

National Ferry Policy Issues and Needs:

The need for a National Ferry Policy has been raised by the Transportation Research Board (TRB) Ferry Transportation Sub-Committee during the past several years, and was described in a draft statement prepared by Dr. Charles T. Jahren, P.E., at their January 1994 meeting. The case study and survey findings strongly support the need for establishing a specific ferry transit component of National Transportation Policy. As the current ISTEA legislation is slated for revision and re-enactment as ISTEA II by 1997, the opportunity exists to formally recognize the role of ferries as essential links in intermodal passenger transportation. The recommendations therefore include the principles of the 5 point core program proposed by the TRB Ferry Transportation Sub-Committee, to establish a National Ferry Policy.

1. Recognition of Ferries as Integral Components of the National Transportation System: The case studies identified three fundamental transportation functions of ferry systems contributing to regional transportation networks including essential, complementary optional services, and numerous examples of each type. Currently ferry systems tend to be identified as either marine highways for vehicle transport or waterborne transit systems for passengers.

2. Encourage More Efficient Use of Ferries Within National, Regional and Local Transportation Systems: By utilizing ferries more effectively in their respective transportation roles, they can provide enhanced intermodal passenger and vehicular travel option, and relieve increasing pressures on existing land-side infrastructure. The case studies demonstrated how the more successful routes have optimized intermodal connections to attract new riders including park-and-ride facilities, transit connections, safe pedestrian paths and bicycle links. New vessel technologies have also increased ferry efficiency, particularly on medium and longer routes.

3. Establish Industry Performance Standards for Vessels, Terminals and Operations: The specific design characteristics of different ferry systems vary widely depending on geographic, climate, waterway conditions and other local factors. However, there are enough commonalities among successful systems of the three functional types to develop performance standards which may be used commonly for most systems. Currently standards are set by Coast Guard vessel regulations and general industry conventions regarding passenger vessel operations. New standards will be emerging for vessels and terminals as a result of ADA regulations, and revised Coast Guard requirements for vessel licensing categories.

4. Establish Uniform Safety Regulations and Procedures: Just as the Federal Aeronautics Administration (FAA) sets clear standards for public air travel, a National Ferry Board could be responsible for ensuring continued safety in ferry operations. It should be noted that in the 20th Century, ferry passenger safety records have been outstanding, and should be encouraged to remain so, especiall in response with the marked growth of the ferry industry, nationwide.

5. Encourage and Facilitate Coordinated Ferry Research on a National Level: The case studies have also demonstrated how useful comparative examples can be documented nationally and how useful one ferry systems's lessons can be to other emerging or evolving systems. For example, vessel technology, terminal access, and operation cross-subsidy techniques can be exchanged readily from one system to another to the benefit of both. A central research center and information network would be useful to those areas starting new systems. Organizations such as the International Marine Transit Association (IMTA), the Passenger Vessel Association (PVA) and the TRB sub-committee capably fill this function at present, on an informal basis, but

could use assistance in the future. ISTEA has assisted in the funding of a number of excellent planning efforts during the past 5 years for different cities and regions. These could be collected in a central location and made available to the ferry community along with periodic information exchanges in the form of a national news letter.

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