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SAN FRANCISCO FLOATING STOLPORT STUDY

Multidisciplinary Associates

Prepared for:

National Aeronautics and Space Administration

28 February 1974

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San Francisco Floating STOLport Study

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A cooperative transaction concerning the study of the feasibility of a floating STOLport on the San Francisco Bay

Collaborators

NASA-Ames Research Center
Moffet Field, California

Federal Aviation Administration
Washington, D.C.

NORCALSTOL
Greater San Francisco Chamber of Commerce
San Francisco, California

Consultants to NORCALSTOL

Multidisciplinary Associates
San Francisco, California

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NORCALSTOL was formed to encourage and study the feasibility of quiet short haul air transportation between the business centers of the Bay Area and urban centers of outlying cities of Northern California (eg., Santa Rosa, Sacramento, Stockton, Merced, Modesto, San Jose, Salinas, Fresno and Monterey). (See Figure F1.) The development of a city center to city center system could play a singularly important role in better serving the growing public needs for transportation in the Bay Area and Northern California.

In its three years of existence NORCALSTOL has conducted demonstration operations of QSTOL service which in turn has brought forth enthusiastic support. It has organized leadership throughout Northern California dedicated to pursuing QSTOL benefits. It has worked in a unique manner as a private sector organization with the full cooperation of the FAA and NASA/Ames Research Center to select QSTOL sites for San Francisco and Oakland.

NORCALSTOL was selected by the Quiet Short Haul Air Transport System Office of the FAA to work in cooperation with NASA/Ames Research Center (under the latter's reciprocal agreement for technical and support services with NORCALSTOL) to develop the Floating STOLport Study.

28 February 1974

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Errata

Page	Correction
p.26, p.27	Graphic displays for Figures F22 and F23 should be switched
p.45	F30: Auto Total Perceived Trip Cost = $25.18 at $10.00/hour
	QSTOL Total Perceived Trip Cost = Fare + $13.04 at $10.00/hour
	T4: Indirect Operating Cost = $5.00/passenger
p.79	Second paragraph, third line: **Visual Flight Rules**

p. 1-a

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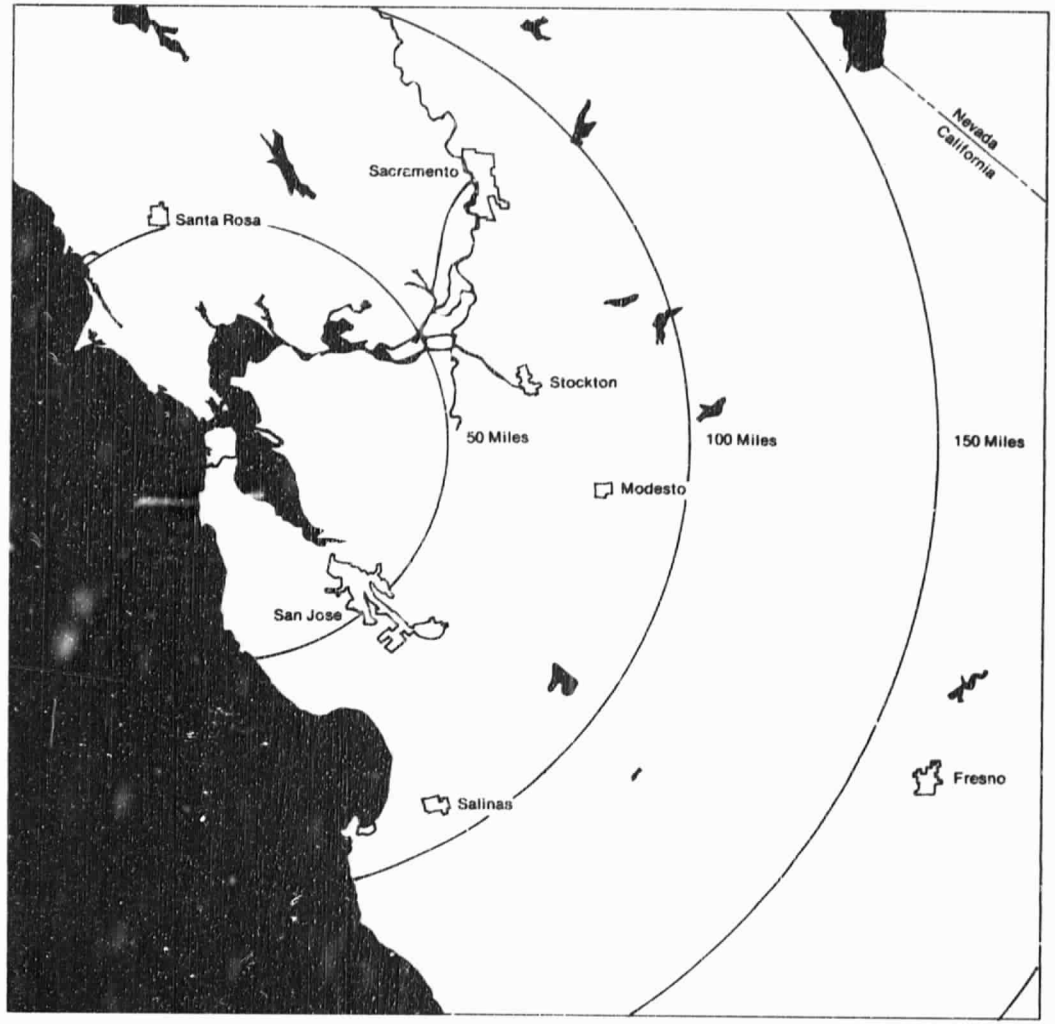
Introduction

Purpose

Under FAA's directive, NORCALSTOL has been charged with determining the operational, economic, environmental, social and engineering feasibility of utilizing deactivated maritime vessels as a waterfront QSTOL (Quiet Short Take-Off and Landing) facility to be located near the Central Business District of San Francisco. This facility would serve as the hub for a Northern California QSTOL route system. This research and development project has been a vehicle for the determination of both problems and potentials for developing such a STOLport in a highly urbanized area. Through the method developed in this study, NORCALSTOL intends to point to a way in which similar communities may investigate QSTOL site acceptability.

F1
Regional Map



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Method of Analysis and Evaluation

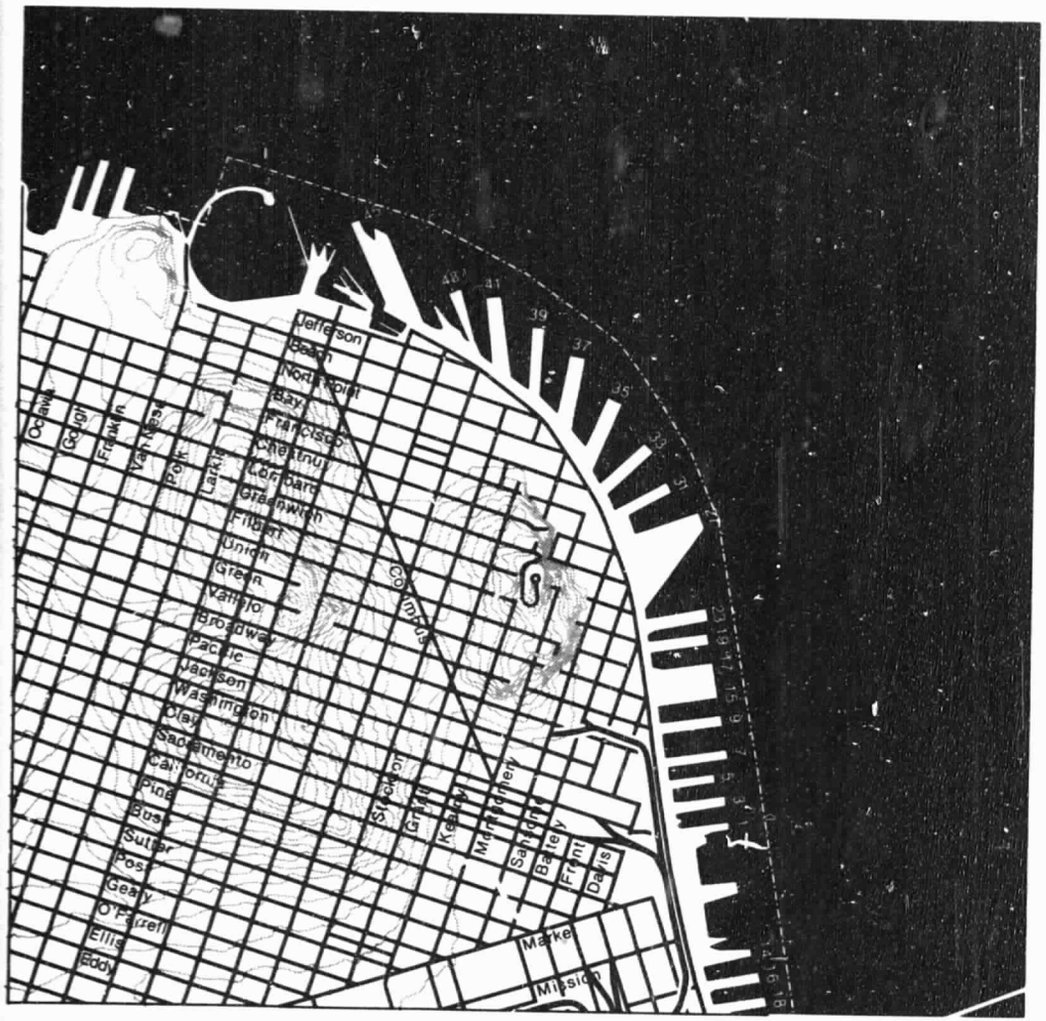
Two general areas along the San Francisco waterfront were selected for investigation in this study. One area is north of the San Francisco Bay Bridge (Figure F2) and the other south of the Bridge (Figure F3). On the basis of the various operational requirements for location, each area was successively refined to determine an optimum site in each study area. Each STOLport was assumed to use a floating structure for the runway portion of the facility.

In order to evaluate each site, a set of 11 criteria, based on social, cultural, economic, environmental, and aircraft operational requirements was developed. Minimum standards were established for each criterion, representing desirable characteristics for a STOLport.

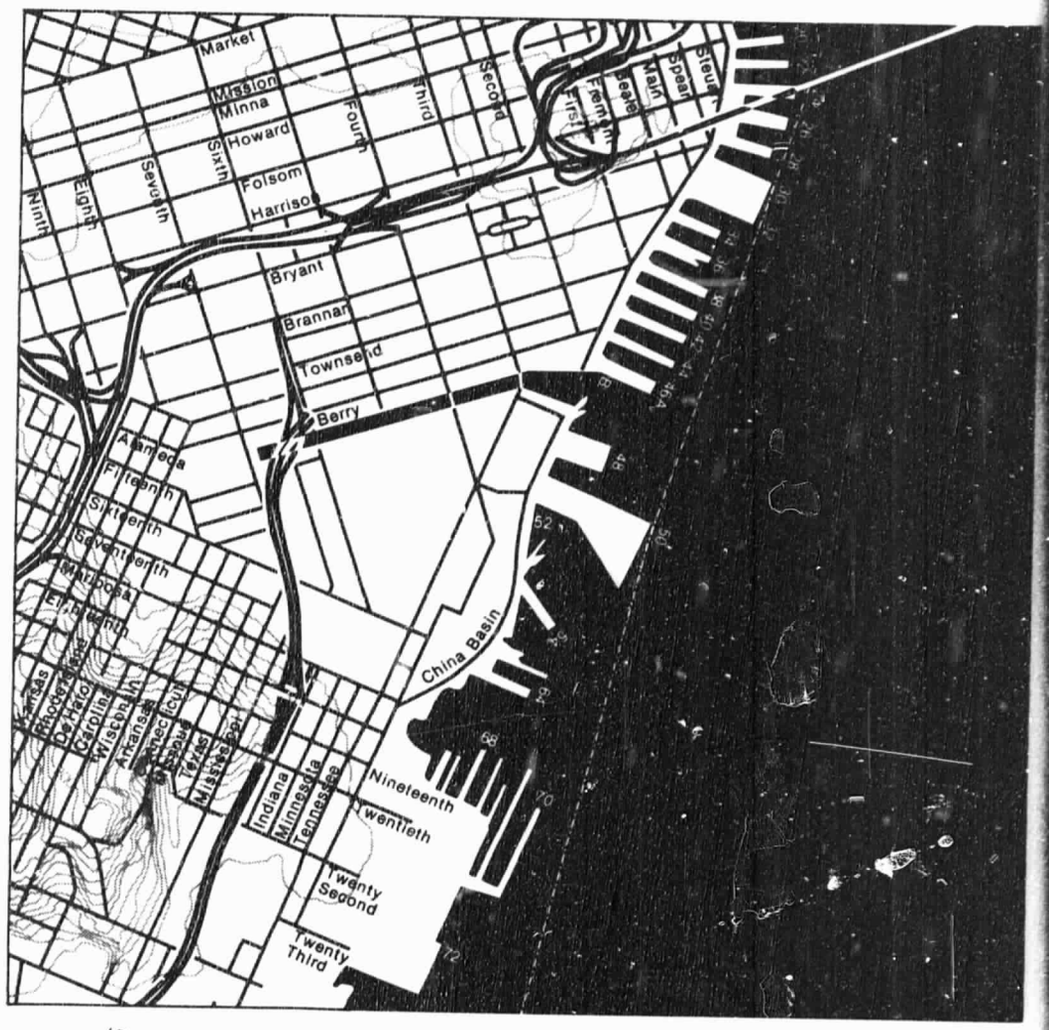
Predicted conditions at the two sites were compared to the requirements for each of the 11 criteria as a means of evaluating site performance. The criterion categories are not intended to be of equal importance to one another or to each reader. Technical and community groups are encouraged to establish their own weighting priorities based on their specific goals.

A conclusion statement at the end of each site evaluation section states the conformance or non-conformance to the corresponding set of criteria.

F2
Northern Site Study Area Map / S1



F3
Southern Site Study Area Map / S2



Summary of Planning Analysis

Conclusion Statement

The findings of this study indicate that neither Site 1 nor Site 2 is fully acceptable for STOLport development at this time.

Specifically, neither site meets current planning policies, noise criteria, nor is socially acceptable. Also, Site 2 is operationally infeasible.

Each site is evaluated according to its conformance with the following 11 study criteria:

Conclusion Matrix

Criteria	S1 Northern Site	S2 Southern Site
C1 Land Use	Unfavorable	Unfavorable
C2 Community Structure	Unfavorable	Unresolved
C3 Economic Impact	Favorable	Favorable
C4 Access	Favorable	Favorable
C5 Visual Character	Unfavorable	Favorable
C6 Noise	Unfavorable	Unfavorable
C7 Air Pollution	Favorable	Favorable
C8 Natural Environment	Unresolved	Unresolved
C9 Weather	Favorable	Favorable
C10 Air Traffic	Favorable	Unfavorable
C11 Terminal Design	Not Applicable	Favorable

Criterion

C1
Land Use

C1.1
The proposed STOLport should conform with the policies and regulations of governmental agencies which have jurisdiction.

C1.1.1
The STOLport should not cause hazards or inconvenience to navigation.
C1.1.2
The STOLport should be located within the U.S. Pier Head Line.
C1.1.3
The STOLport should minimize its requirement for Bay fill.
C1.1.4
The STOLport should help preserve and enhance the maritime character of the San Francisco waterfront.
C1.1.5
The STOLport should avoid land use conflicts.
C1.1.6
The STOLport should allow efficient operation of Port activities.

Agencies having jurisdiction over the proposed sites are: The United States Army Corps of Engineers; the United States Coast Guard; the Association of Bay Area Governments (ABAG); the San Francisco Bay Conservation and Development Commission (BCDC); the San Francisco City Planning Commission; and the San Francisco Port Commission.

Site Evaluation

S1
Northern Site

The proposed site is located across the ends of Piers 37 through 41, in a commercial use zone. The site shows minimal conflicts with the Golden Gate National Recreation Area, and Port maritime operation of Piers 9 through 35, and is within the U.S. Pier Head Line. The Northpoint residential area, Fisherman's Wharf tourist area, and general office buildings are less than ⅓ mile from the proposed runway. A STOLport in this area would be a source of conflict with existing and proposed land use. The portion of the Embarcadero bulkhead, between Piers 37 and 41 is zoned as special open space with restrictions on proposed new structures in the vicinity to provide unobstructed views of the Bay from the piers.

A recent major policy change by the City Planning Commission and the Port of San Francisco deletes aircraft uses from the Northern Waterfront Master Plan. Figure F4 illustrates proposed land use as recommended in the Northern Waterfront Plan.

At this time a STOLport at the northern site would not meet the established criteria for land use.

For detailed analysis see p.31.

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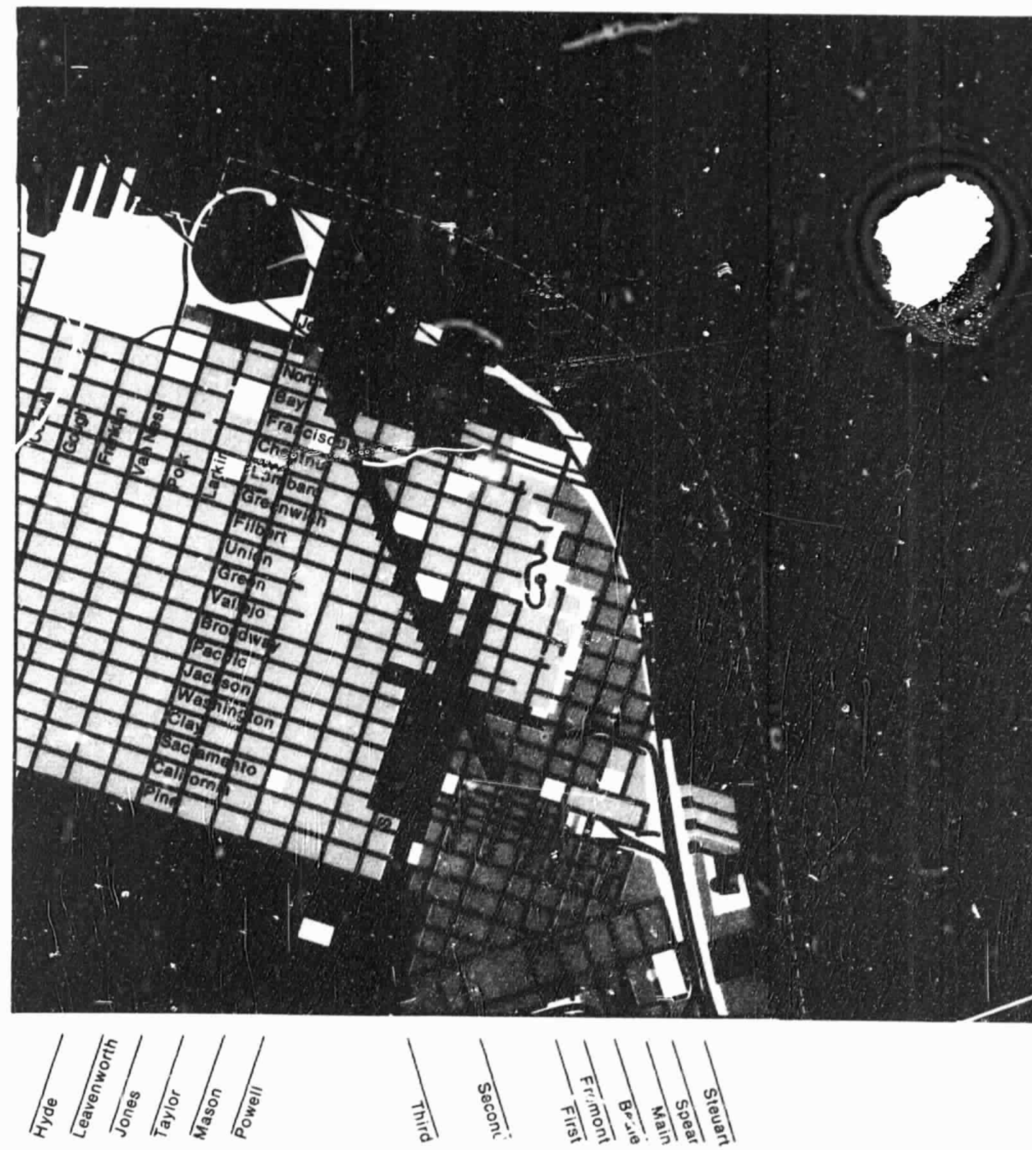
F4
Proposed Land Use / S1



S2
Southern Site

The proposed STOLport is alongside Pier 54 in an area zoned for light industrial use. The site shows minimal conflicts with Port maritime operations and is within the U.S. Pier Head Line. The closest residential zone is Potrero Hill, about 3/4 mile southwest from the site. Office buildings and a small residential area would be under the flight path. Proposed parks adjacent to the STOLport site, along the China Basin Channel, and Central Basin also would be affected by noise, and increased traffic. A recent policy change by the City Planning Commission and the Port of San Francisco deletes airports as a permissible shoreline use in this study area. Figure F5 **illustrates proposed land use in the southern site study area.**

This site does not meet the established criteria at this time.

For the detailed analysis see p.33.

F5
Proposed Land Use/S2

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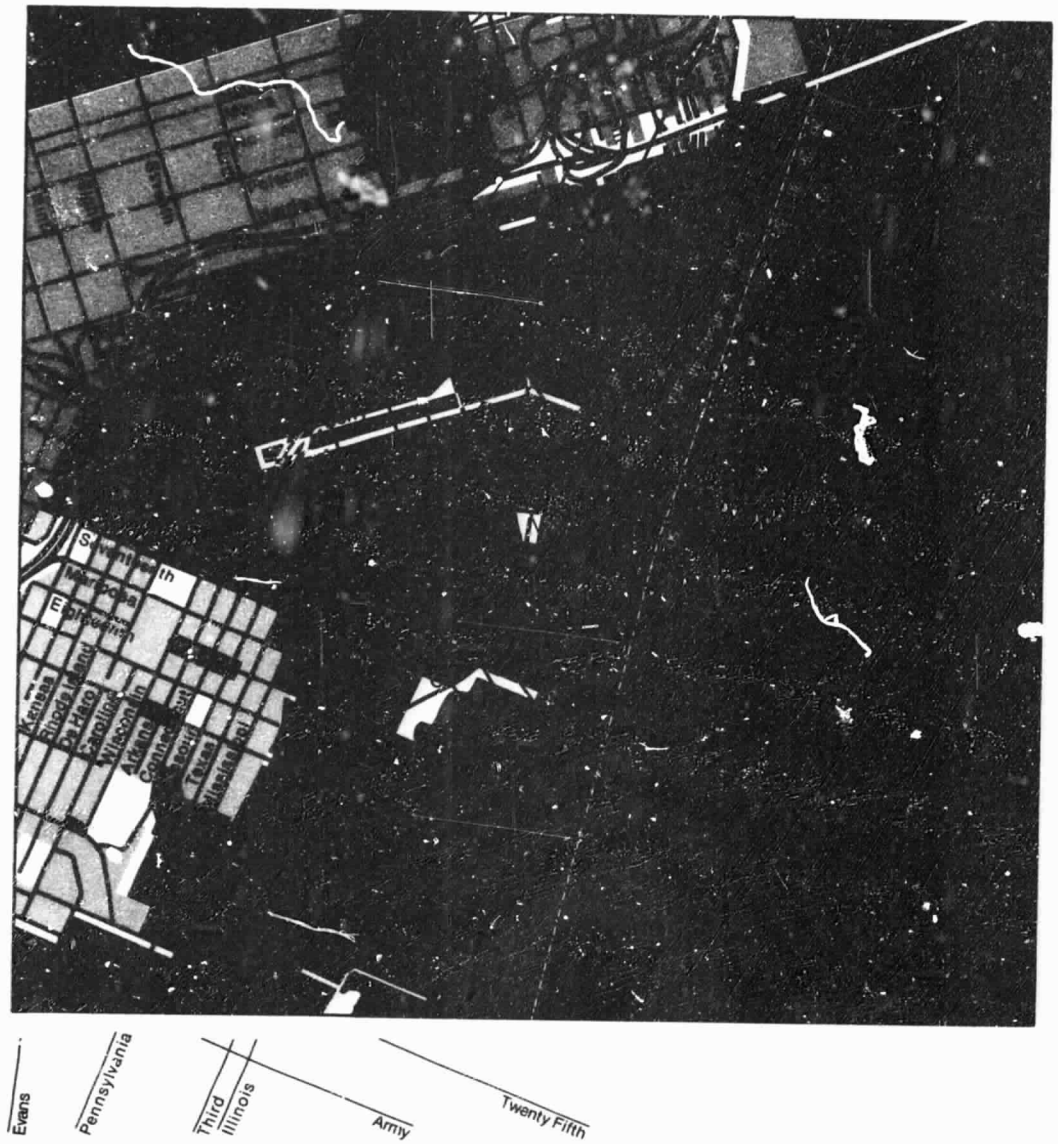


F4/F5
Legend

Orientation	⇧
Scale	Feet 0 1000 2000
Open Space/Public Institutions	
Residential	
Office/ General Commercial	
Retail/ Entertainment	
Industrial/Maritime	
Yerba Buena Redevelopment Area	

Sum

Criterion

C2
Community Structure

C2.1
The proposed STOLport should be considerate of community attitudes.

C2.2
The proposed STOLport should respect community character.

C2.2.1
STOLport development should not create a barrier between parts of a community or between the community and open space areas.
C2.2.2
Noise and air pollution should be held to acceptable levels.
C2.2.3
Displacement of residents and businesses should be avoided.

C2.3
The proposed STOLport should offer compensation for negative impacts.

C2.3.1
Employment should be offered to members of the neighboring communities.

Site Evaluation

S1
Northern Site

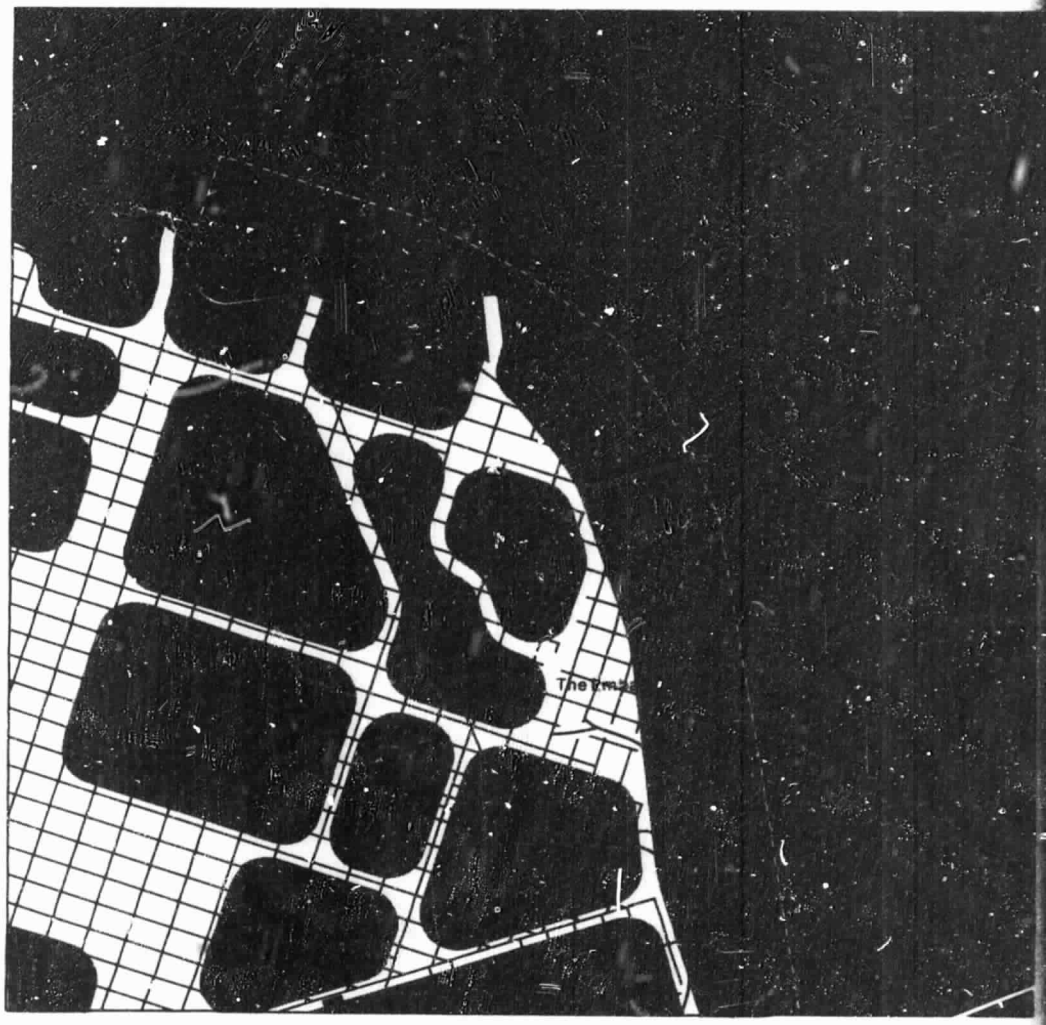
The Northpoint area, adjacent to the proposed site, is in a state of development for both upper and lower income residents. Overlooking neighborhoods of Telegraph Hill and Russian Hill are characterized by upper income professionals, with relatively few lower income persons and a moderately high population density. QSTOL development may restrict desired residential growth in this area.

Some relocation of businesses on the piers and Fisherman's Wharf may be necessary due to noise impact. Through-traffic and parking problems would be increased by QSTOL in the Northpoint community, although they would not create any new physical or psychological barriers. Public sentiment is strongly against a STOLport for this area. Figure F6 illustrates the major recognizable districts in the northern site study area.

This site does not meet established criteria for community structure at this time.

For the detailed analysis see p.39.

F6
Recognizable Districts / S1



S2
Southern Site

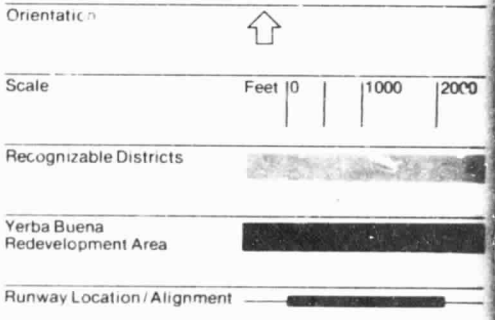
The area immediately around the proposed site and the communities of Potrero Hill, South of Market, Silver Terrace and Bayview/Hunters Point have lower population densities than the city-wide average. These areas have an average of 27.1 people per acre as compared to 34.2 people per acre for San Francisco. These areas also have large concentrations of lower income persons and greater incidence of poverty and unemployment. The proposed STOLport would create few physical or psychological barriers within existing communities. But there could be conflicts with several proposed parks along Central Basin and the Channel Street Canal. Disruption of businesses between the STOLport and Bay Bridge could be significant, especially due to noise. Public reaction is divided, with the majority interviewed against QSTOL. STOLport community ownership, and job potential are factors which could benefit the area. Figure F7 illustrates the major recognizable districts in the southern site study area.

This site could meet established criteria if issues between excessive noise, new development, and increased employment can be resolved.

For the detailed analysis see p.40.

F7
Recognizable Districts/S2

F6/F7
Legend



Sum

Criterion	Site Evaluation	
C3 *Economic Impact*	S1/S2 Northern and Southern Sites	
C3.1 *The carrier should charge a fare which will yield a reasonable return [8% to 12%] on investment.* *C3.2* *The carrier should be able to pay to the terminal a sufficient portion of the fare to amortize and maintain the floating facility.*	The economic analysis shows that the basic fare must be selected with a profit margin of at least 30% at an appropriate load factor to provide a reasonable opportunity for profitable operation. Because of the small fleet required to handle the San Francisco-Sacramento service, a unique analytical solution to match supply and demand at a specific profit level is not possible. (See regional map, Figure F1.) The result is a considerable variation possible in return on investment depending upon small variations in demand. Choosing the basic fare to yield a 30% profit margin at a 65% load factor showed a good probability of obtaining a satisfactory return. This corresponds to a 50% breakeven load factor and produces a basic fare of $11.88. It is assumed that each landing passenger pays $0.50 as a landing fee in the indirect costs in the fare. In addition, a surcharge added to the basic fare would be required to provide supplemental revenues for the QSTOL facility's maintenance and amortization. The surcharge will, of course, reduce the passenger demand. Figures F8 and F9 illustrate the potential revenues to a floating terminal operation as a function of ticket surcharge above the basic fare level at P = 1.30. The revenues are shown for passenger time values of $5/hour and $10/hour. Supportive activities located in the terminal facilities are a possible additional source of revenues. With 81% of the cost of the facility covered by the federal government and	amortization of the remainder over a period of 10 years at 7% interest, the total cost of the STOLport, approximately $20,000,000, could be covered by an annual income of $755,765. The potential revenue at a typical value of time of $6/hour is $1,600,000, allowing $840,000 per year for STOLport maintenance and operation. This is believed adequate to cover these requirements.

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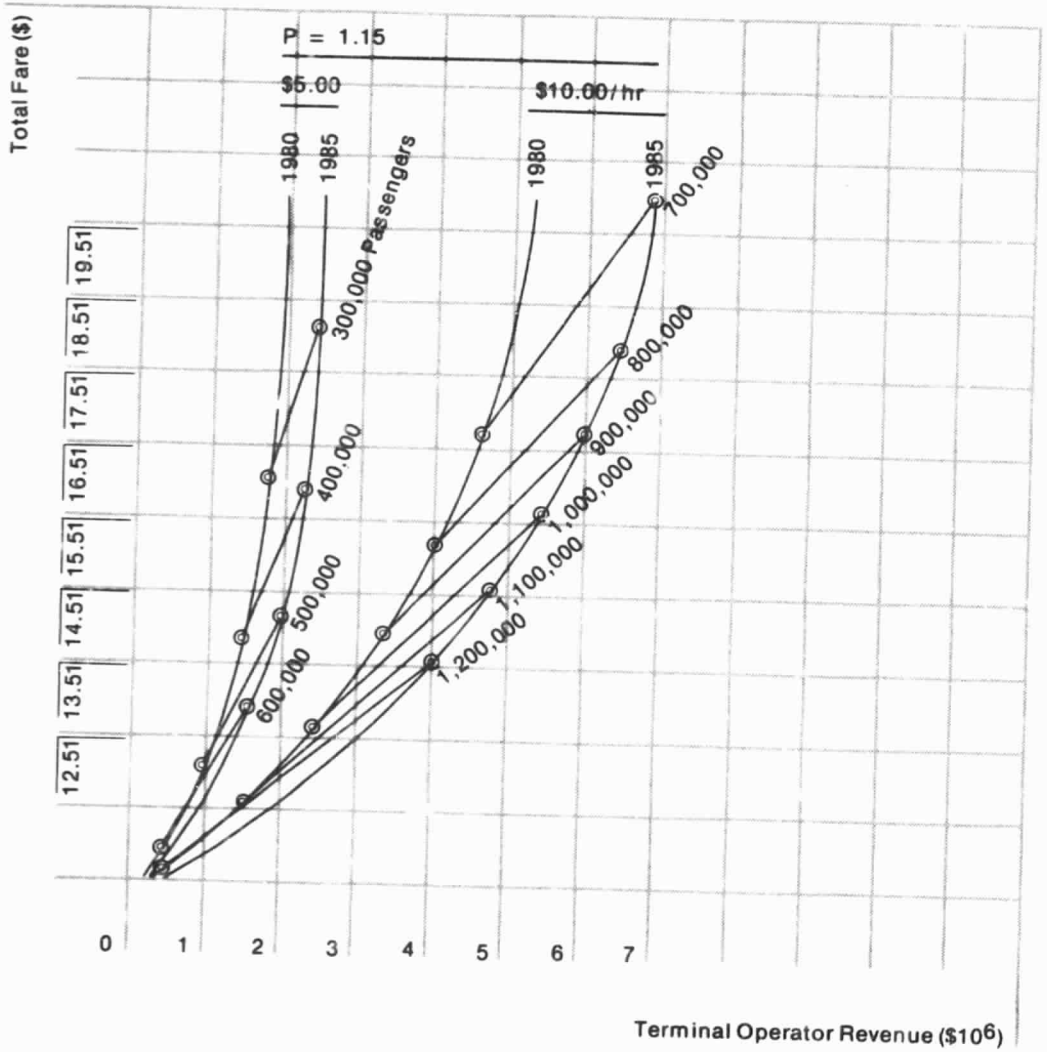
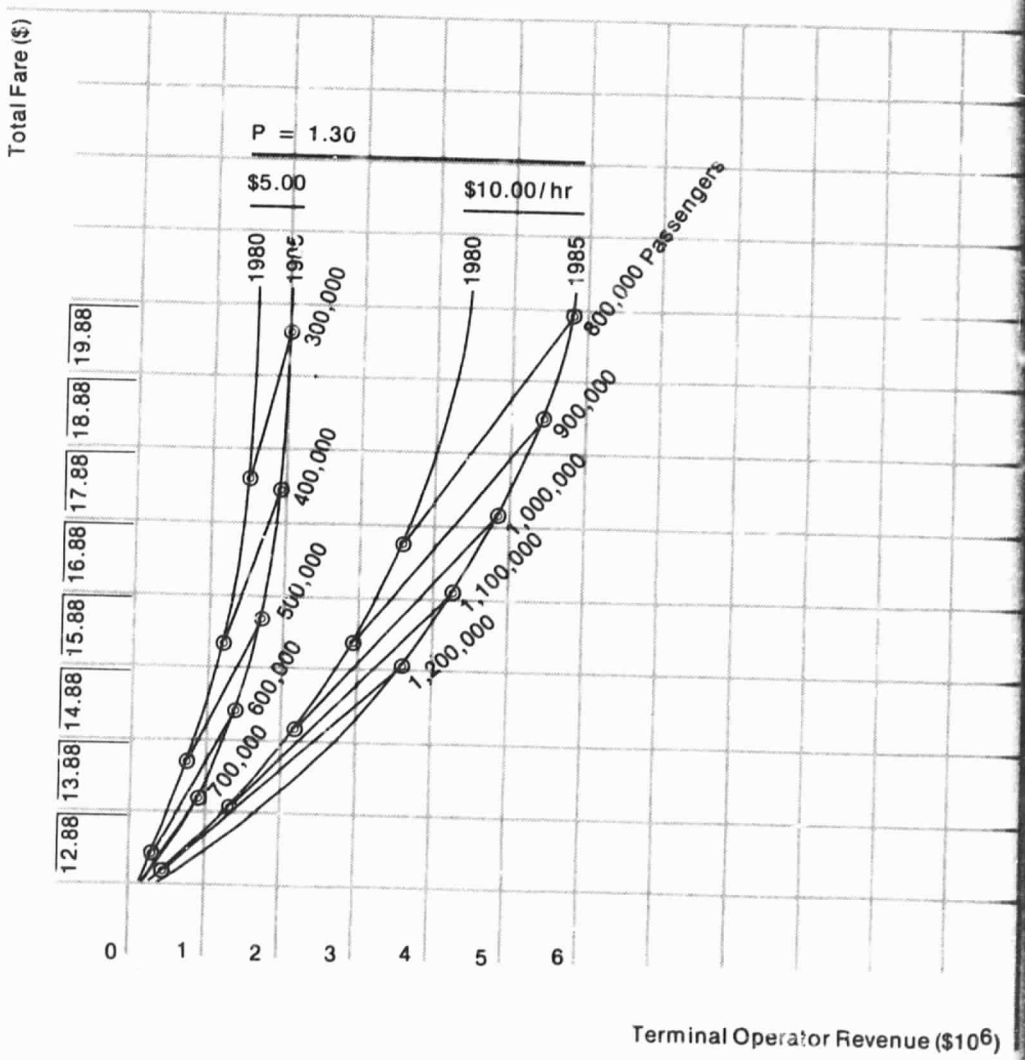
F8
Terminal Operator Revenue vs Fare and Passenger Volume/P = 1.15



F9
Terminal Operator Revenue vs Fare and Passenger Volume/P = 1.30



Sum

Criterion

C4
Access

C4.1
The proposed STOLport should provide quick and convenient ground access for its users.

C4.1.1
Travel time to the proposed STOLport should be 10 minutes or less.
C4.1.2
Access should involve a minimum of transfers between transportation modes.
C4.1.3
The user should have a choice of ground access modes to the proposed STOLport.

C4.2
The proposed STOLport should support the comprehensive transportation policies of the regional and local governments.

C4.2.1
The 'city-centered' concept of the Bay Region should be strengthened by utilizing the transportation systems to guide development.
C4.2.2
Public transit should provide a convenient and efficient alternate to automobile use.

Site Evaluation

S1
Northern Site

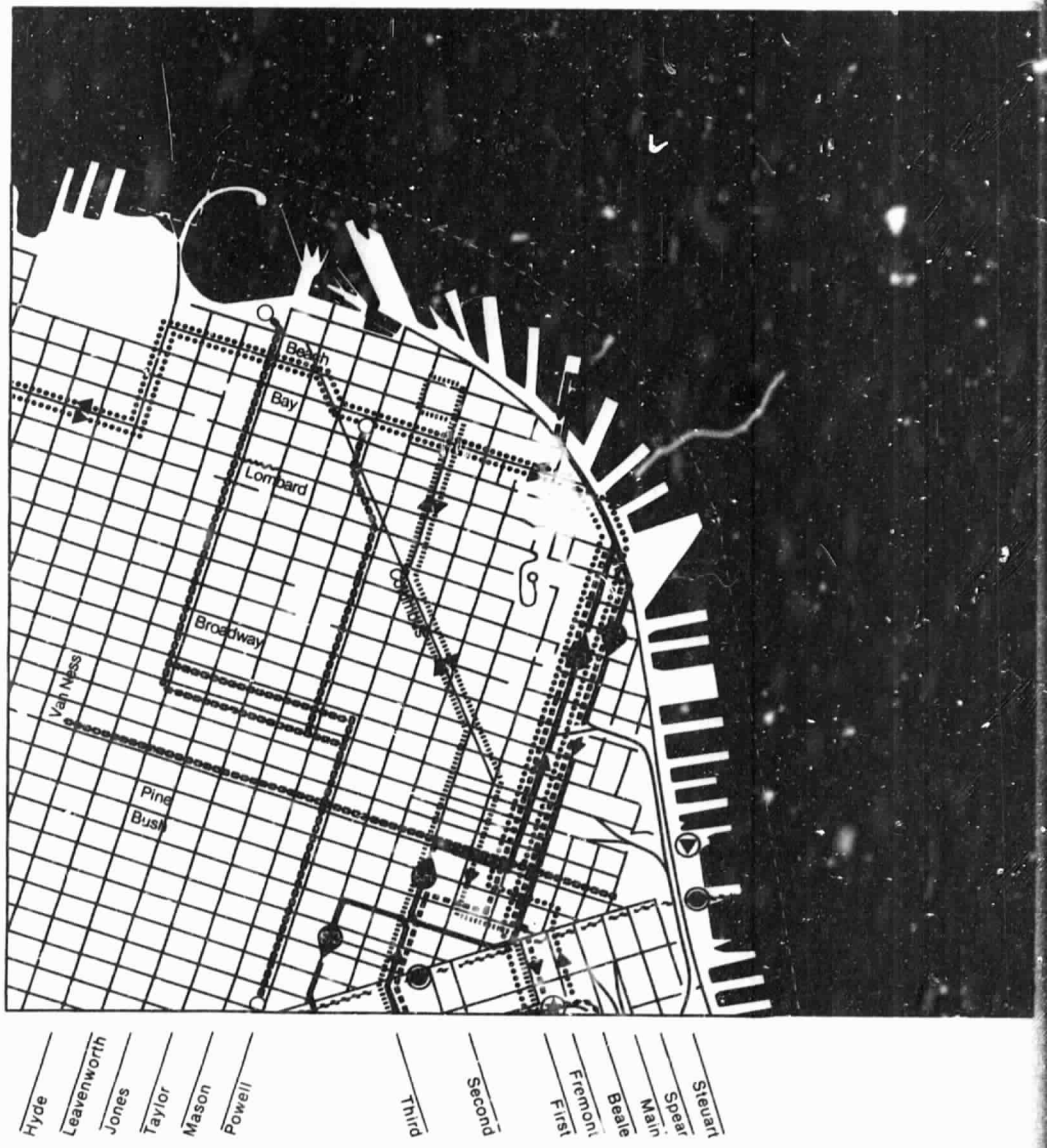
The proposed STOLport site is less than 1-½ miles from the Central Business District (CBD) along the Sansome/Battery Street one-way couple. Routing of San Francisco Municipal Railway (Muni) buses could be slightly modified to provide direct access with 8 minutes travel time from the CBD. Additional private shuttle bus service could be provided with a travel time of 6 minutes. Both Muni and the shuttle buses could provide access to the Bay Area Rapid Transit line which provides service to the East Bay and Daly City. Marin passengers would be served by Golden Gate Transit buses which would be slightly rerouted to serve the site directly. Passengers from other parts of San Francisco and Marin would increase the average access distance to 6 miles. Main streets in the area are over-capacity at peak hours and auto access would add slightly to congestion.

Figure F10 illustrates existing public transit modes and routes with the proposed shuttle service routes.

The proposed northern site presently conforms to the established set of criteria for access.

For detailed analysis see p. 49.

F10
Proposed and Existing Access/S1



S2
Southern Site

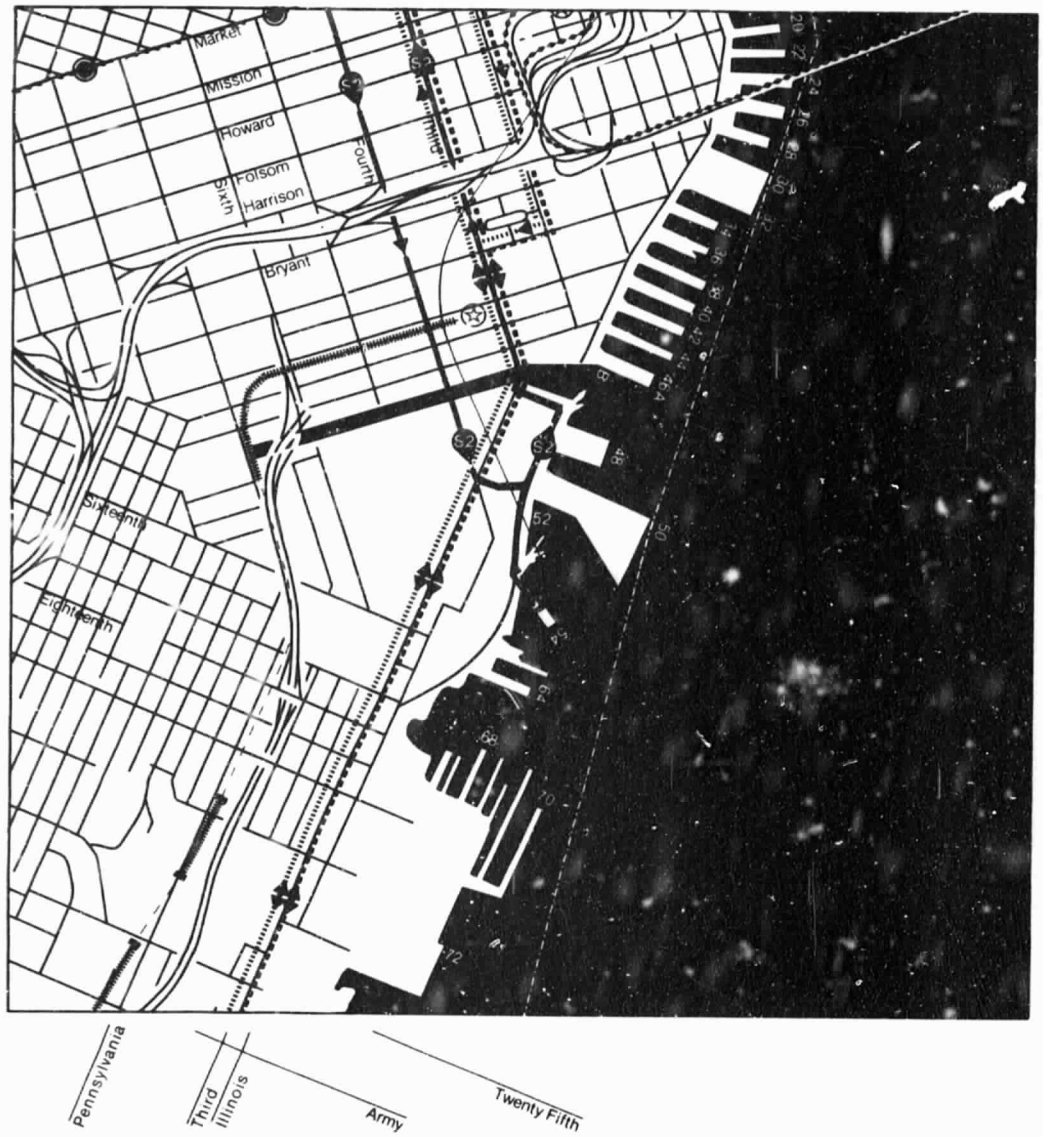
The proposed site is less than 2 miles from the Central Business District (CBD) via the 3rd/4th Street one-way couple. Muni service along 3rd Street could be slightly modified to serve the proposed STOLport's off-street terminal. Direct shuttle bus service to the CBD and the Bay Area Rapid Transit line would take 8 minutes. Muni service would be 10 minutes. Additionally, Southern Pacific commuter train service to the Peninsula is a 6 minute walk or a 1 minute ride via shuttle bus. QSTOL would generate slight increases in traffic on 3rd and 4th Streets, which are currently near capacity. Access to the regional highway network from the Southern Freeway (Hwy 280) off-ramps is very good. Limited off-street parking would be available.

Figure F11 illustrates existing public transit modes and routes with the proposed shuttle service route.

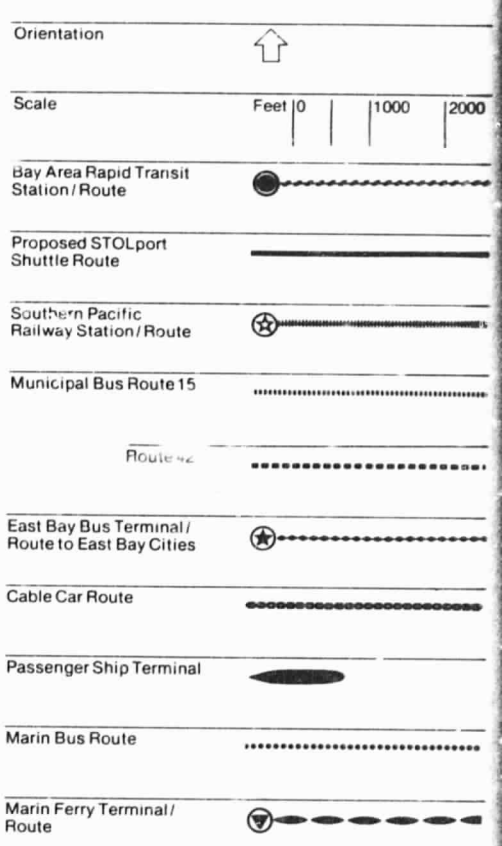
The proposed southern site meets the established criteria for access at this time.

For the detailed analysis see p.51.

F11
Proposed and Existing Access/S2



F10/F11
Legend



Sum

Criterion

C5
Visual Character

C5.1
The proposed STOLport should not create visual obstructions.

C5.1.1
STOLport development should respect major view corridors and vistas.

Particular consideration should be given to the San Francisco Bay and its shoreline as the region's most valuable visual asset. Views of landmarks and natural features should not be obscured.

C5.2
STOLport development should not diminish the visual character of, or cause visual blight to, neighboring communities.

C5.2.1
The scale, density, and intensity of use of existing buildings should be respected.
C5.2.2
Buildings and districts of exceptional architecture and historical merit should be preserved.
C5.2.3
Open space areas should be conserved.

Site Evaluation

S1
Northern Site

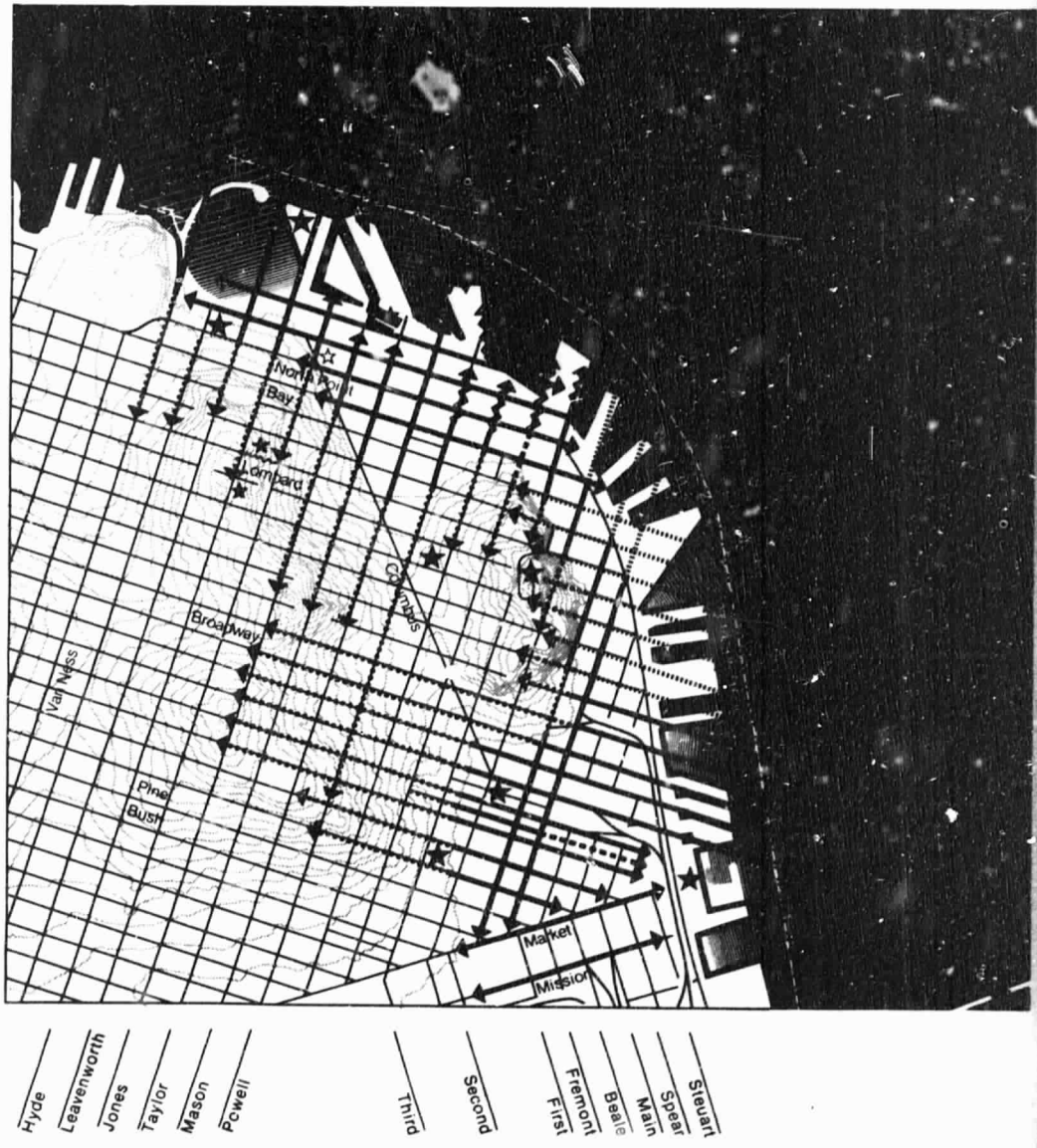
The proposed STOLport site is located in the most visually sensitive portion of San Francisco Bay. A structure of the size needed for a 2,000-ft. runway and terminal would compete visually with prominent landmarks such as Telegraph Hill. It also would block view corridors and harm the potential for a waterfront park/promenade with a sweeping panorama as recommended in the City Comprehensive Plan. The maritime character with its historical connotations is necessary to the flavor of this area. This would be visually weakened by the introduction of a QSTOL facility.

Figure F12 **portrays proposed views and existing and proposed landmarks as outlined in the Northern Waterfront Plan.**

A STOLport on the northern site would be in severe conflict with the established criteria for visual character.

For the detailed analysis see p.54.

F12
Proposed View-Sheds, View Corridors, and Existing Landmarks/S1



S2
Southern Site

The proposed STOLport could offer an improvement to the area with a well designed and landscaped facility. Despite its size, the STOLport would cause minor disruption of views from Central Basin Park and from the shoreline drive along China Basin Street, due to the runway orientation and the location of ships and structures at Piers 50 and 64, which already block views. From Potrero Hill the STOLport would appear to be half the size of Mission Rock Terminal. There are no landmarks or other structures which would be affected negatively by the visual presence of QSTOL.

Figure F13 **portrays proposed views outlined by the Northern Waterfront Plan as well as existing views and landmarks outside of the Northern Waterfront Plan.**

The southern site meets the established criteria for visual character at this time.

For the detailed analysis see p.58.

F13
Proposed View-Sheds, View Corridors, and Existing Landmarks / S2

F12 / F13
Legend

Orientation	⇧
Scale	Feet 0 1000 2000
Existing Primary Landmark	★
Existing Secondary Landmark	★
Proposed Primary Landmark	☆
Proposed Secondary Landmark	☆
Landmark Off Map	⇧
Potentially Obstructed View	
View Corridor From Hill Down Street	
View Corridor at Grade Level Down Street	
Slot View From Upper Level Above Street	
View Corridor From Upper Level Above Street	
Ground Level Panoramic View From Shoreline	

S2
Southern Site

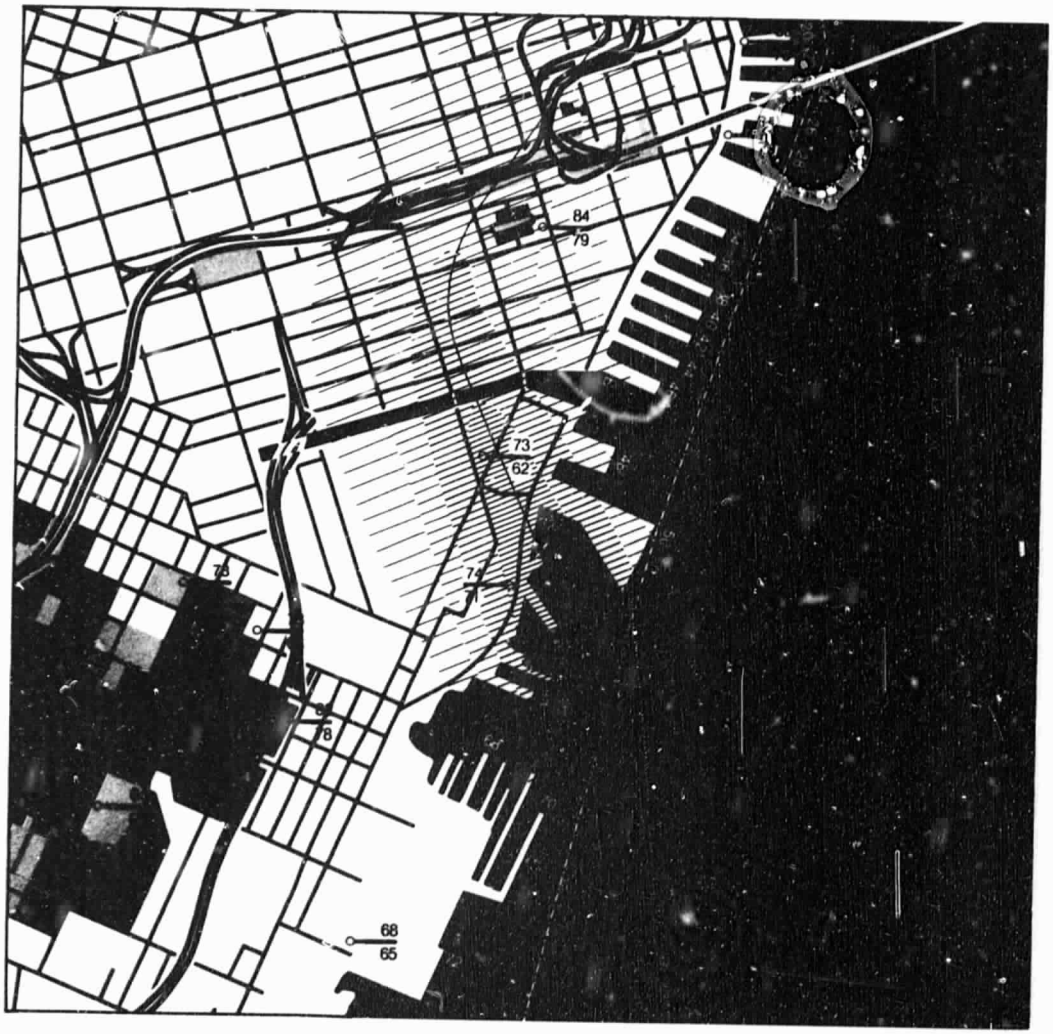
The proposed STOLport will require a limited runway orientation and curved departure flight path which passes over several office buildings and the South Park residential area. The only residential area affected is South Park where ambient noise levels would be exceeded at night by 17 dB. Daytime ambient noise standards would be exceeded on 331 acres affecting more than 9,000 people. Noise levels of 90 to 95 PNdB (21 PNdB over the ambient level) would be expected at an office building 2,500 feet out from the runway and in parts of the Central Basin Park. At night excessive noise would affect 489 acres and roughly 4,800 people. Noise disturbance would be excessive for day or night operation.

Figure F15 shows the DHC-7 footprint in the curved departure flight path, day and nighttime ambient noise levels at strategic points, with existing residential, open space, and commercial land use, in the study area.

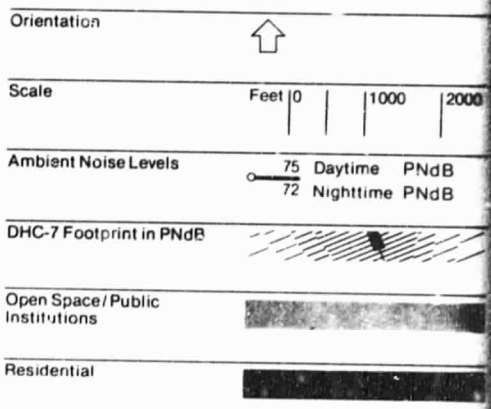
The southern site does not conform to the established noise criteria at this time.

For detailed analysis see p.65.

F15
DHC-7 Noise Footprint Contours and Day-Night Ambient Noise/S2



F14/F15
Legend



Sum

Criterion

C7
Air Pollution

C7.1
The proposed STOLport should minimize air pollution impacts on surrounding areas.

C7.1.1
Emissions from aviation sources should be minimized.

C7.2
The proposed STOLport should conform to Federal, state, regional, and local air quality standards.

C7.3
The proposed STOLport should not be located in areas of high air pollution potential.

Site Evaluation

S1
Northern Site

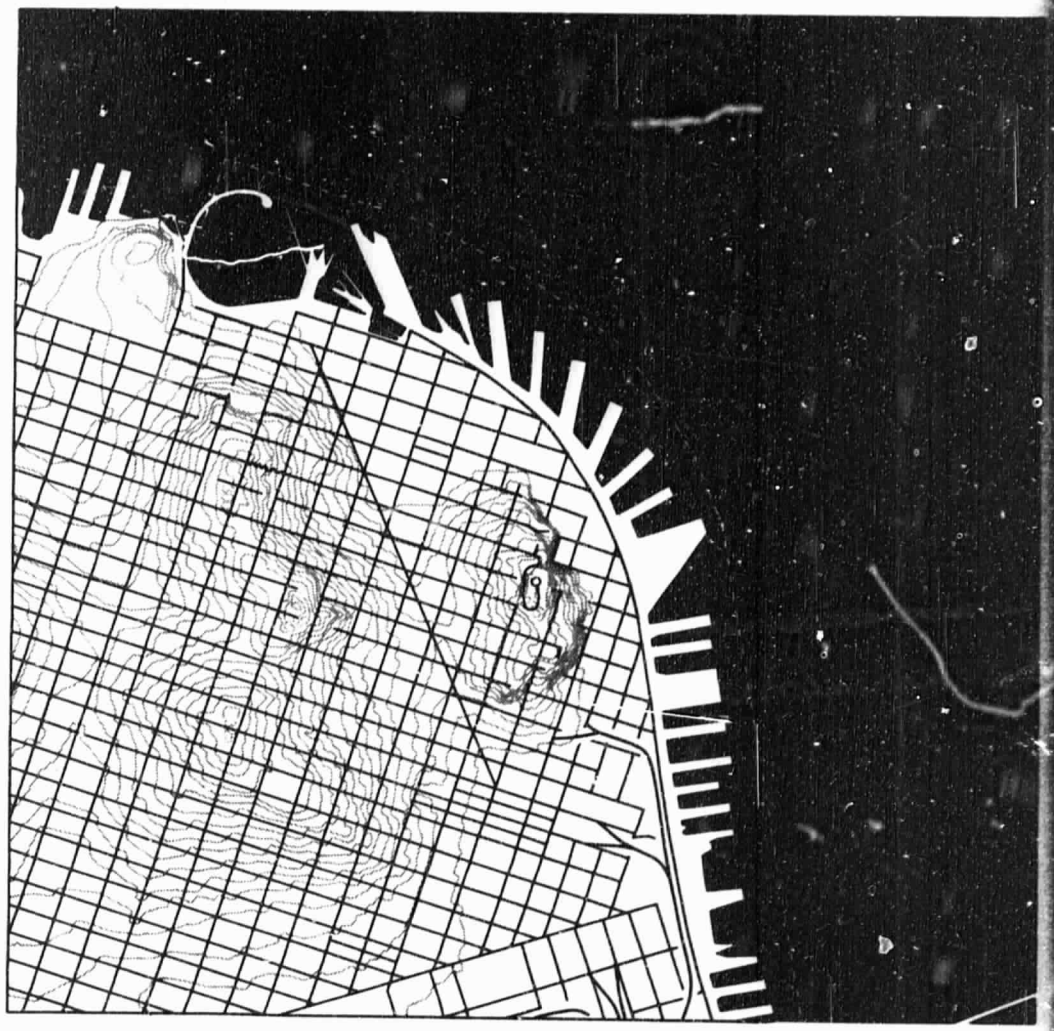
Handling 2,500 passengers in 100 flights, STOLplanes would produce about .5 ton of pollutants per day. Cars and other ground access vehicles en route to and from the STOLport would produce over 1.5 tons of pollutants per day. Because of reduced airport access distance as compared to S.F. International Airport, and reduced numbers of persons driving to inter-regional points, QSTOL at this location could reduce overall pollutants in the Bay Area by 847 tons per year. Prevailing westerly winds would disperse pollutant concentrations over the Bay. When adverse wind conditions occur, the effects to residents would be minimal. Pollution potential would be low.

Figure F16 **indicates the dispersion directions for exhaust emissions and pollutants over San Francisco Bay for the northern site.**

The northern site would meet established air pollution criteria at this time.

For the detailed analysis see p.70 .

F16
Air Pollution Dispersion/S1



S2
Southern Site

Because of limited support activities, the only aviation pollution source would be QSTOL planes which would produce about .5 tons of pollutants per day. By reducing the number of auto trips to inter-regional points and by shortening airport access distance, QSTOL can cause an overall reduction in pollutants of 832 tons per year in the Bay Area. Prevailing westerly winds would disperse pollutant concentrations over the Bay. Negative effects during easterly winds would not be noticeable in residential areas.

Figure F17 **indicates dispersion direction for exhaust emissions and pollutants over San Francisco Bay for the southern site.** Figure F17 **also indicates the length of roadway (3rd Street) in which traffic would produce amounts of pollutants comparable to STOLcraft emissions for one take-off/landing cycle.**

The southern site would meet established air pollution criteria at this time.

For the detailed analysis see p.72.

F17
Air Pollution Dispersion/S2

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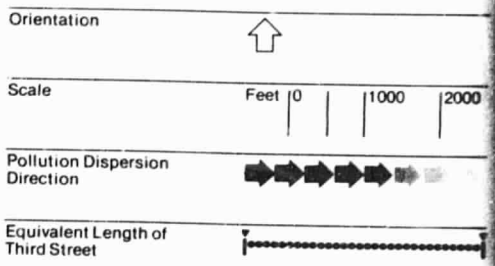
F16/F17
Legend



Sum

Criterion

C8
Natural Environment

C8.1
The proposed STOLport should minimize impacts on the natural environment and disruption of wildlife habitats.

C8.1.1
Surface coverage of San Francisco Bay should be minimized.
C8.1.2
The proposed STOLport should not cause pollution of the Bay.
C8.1.3
Floating structures should be designed to avoid increased sedimentation in San Francisco Bay.
C8.1.4
STOLport locations near ecologically sensitive areas should be avoided.

C8.2
The proposed STOLport should meet all governmental standards for protection of the natural environment.

Site Evaluation

S1
Northern Site

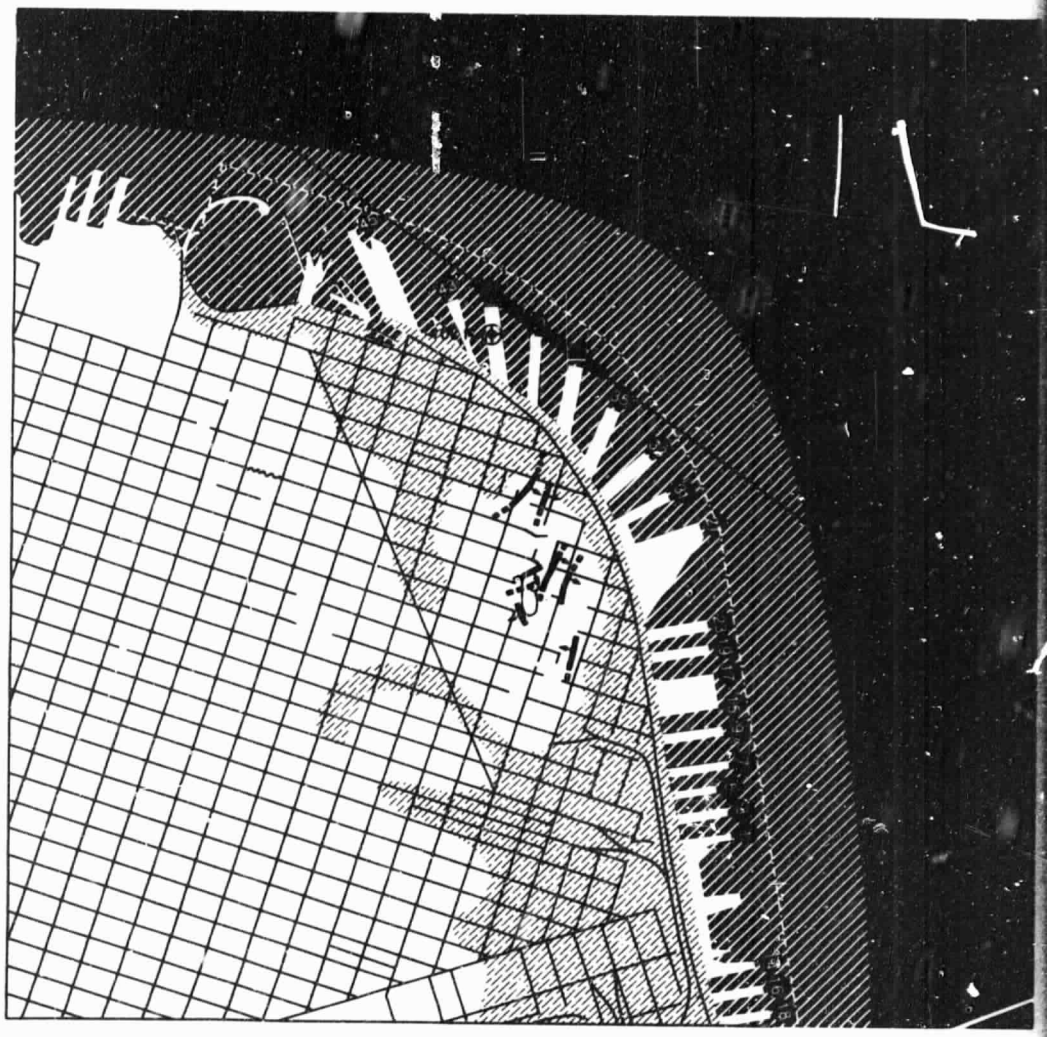
The proposed STOLport would interfere slightly with Bay oxygen content by reducing water surface area and by keeping light from marine plants. Pilings drilled into the Bay floor probably would destroy some vegetation. No rare or endangered species are threatened. All standards to prevent water pollution would be followed including adequate drainage systems, and aircraft maintenance would be prohibited except in emergency. Although currents may be strong, mooring and sedimentation problems are minimized by orientation relatively parallel to the current. Unknown and undetermined quantities of marine life may be affected.

Figure F18 shows soils of questionable bearing capacity and depth to bedrock, seismic faults and values of wildlife habitats in the northern site study area.

A determination cannot be made at this time concerning conformance or non-conformance to natural environment criteria for the northern site due to insufficient data on kinds and quantities of marine life affected. However, the impact of a floating STOLport does not appear to differ substantially from existing maritime activities in the area.

For the detailed analysis see p.75.

F18
Siesmic Conditions, Soils of Questionable Bearing Capacity, and Wildlife Habitats of Value/S1



S2
Southern Site

The proposed STOLport would interfere slightly with Bay oxygen content by reducing water surface area and by keeping light from marine plants. Undetermined quantities of marine life would be destroyed by two ships purposely sunk for mooring. No rare or endangered species are threatened. All standards to prevent water pollution would be followed, including provision of adequate drainage systems. Aircraft maintenance will be permitted only in emergency. The structure is diagonal to the expected current flow, possibly causing problems with mooring and sedimentation. A thorough study of these effects should be done if this site is selected. Insufficient data exists on quantities and kinds of marine life affected as well as on sedimentation.

Figure F19 **shows soils of questionable bearing capacity, depth to bedrock, seismic faults and values of wildlife habitats in the southern site study area.**

A determination cannot be made at this time concerning conformance or non-conformance to natural environment criteria for the southern site due to insufficient data on kinds and quantities of marine life potentially affected. However, the impact of a floating STOLport does not appear to differ substantially from existing maritime activities in the area.

For the detailed analysis see p.75.

F19
Siesmic Conditions, Soils of Questionable Bearing Capacity, and Wildlife Habitats of Value/S2

F18/F19
Legend

Orientation	⇧
Scale	Feet 0 1000 2000
Depth to Bedrock	-100 ft
Wildlife Habitat of Low Value	
Soils of Questionable Bearing Capacity	
Fault Showing Relative Movement	
Concealed Fault	
Approximate Location of Fault	

Sum

Criterion	Site Evaluation
C9 ***Weather***	**S1** **Northern Site**

C9.1
The proposed STOLport should be located such that undesirable crosswinds and fog concentrations are minimized.

C9.1.1
Excessive crosswinds should not exceed 2% of annual operating time. Operations could be affected when crosswinds exceed:
20 mph in dry weather
15 mph in wet weather

C9.1.2
Below-Minimum [BM] visibility conditions should not exceed 2% of annual operating time. Below-Minimum conditions halt operations when:

Decision height	***≤***	***200 feet***
Runway visual range	***≤***	***2,400 feet***

C9.2
QSTOL operations should conform to Federal Aviation Administration Visual Flight Rules [VFR] and Instrument Flight Rules [IFR] for cloud ceiling and visibility.

VFR in effect:	***ceiling***	***>***	***1,000 feet***
	visibility	***>***	***3 miles***
IFR in effect:	***ceiling***	***≤***	***1,000 feet***
	visibility	***≤***	***3 miles***

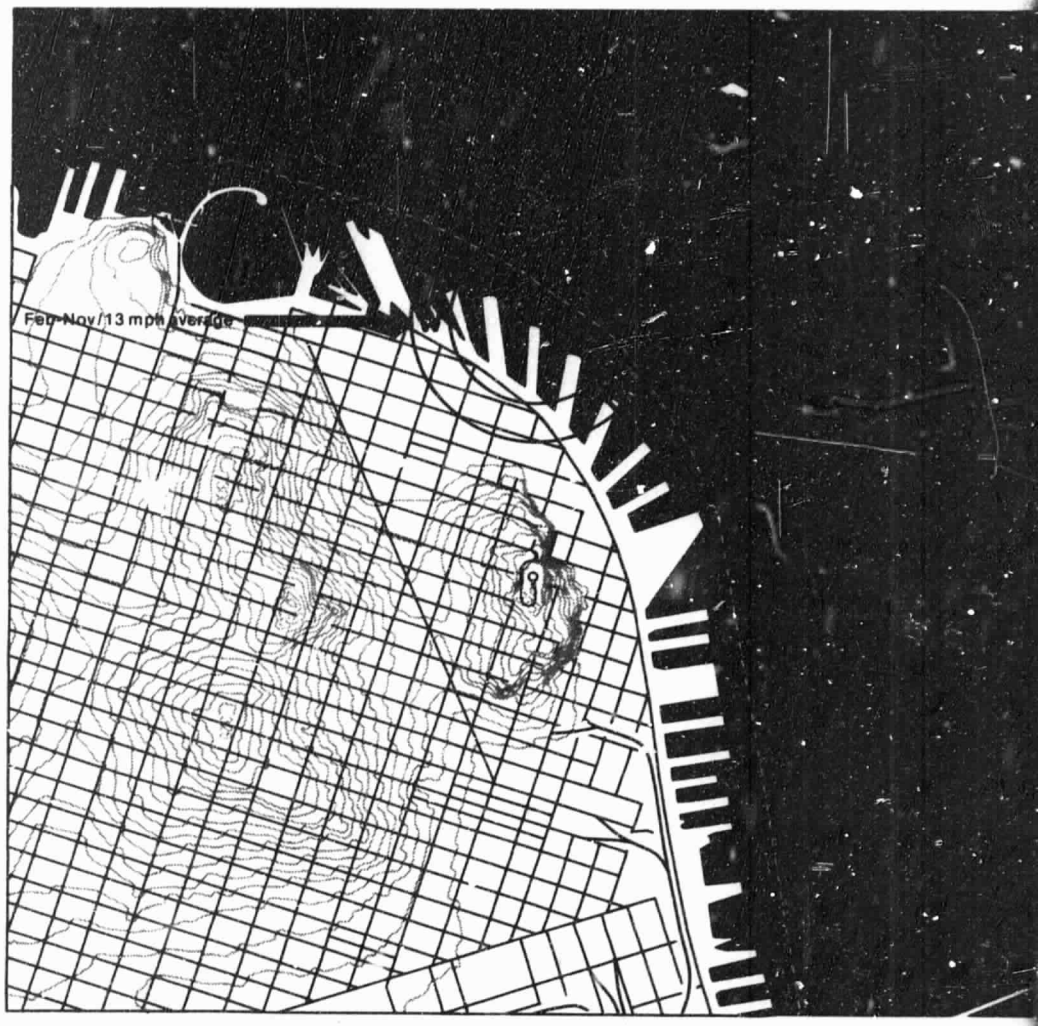
Prevailing westerly winds, during operating hours for 10 months of the year, average 13 mph. Southeasterly winds for December and January average 11 mph. Crosswinds would disrupt service about 0.2% of the time during dry weather and 0.9% during wet weather. Visibility conditions would require the following flight procedure:
VFR during 86% of all operating hours
IFR during 13% of all operating hours
Below-minimum conditions would halt operations 1.0% of the time.

Figure F20 **illustrates yearly average distribution of predominant wind directions and their magnitude interpolated for the northern site.**

This site meets the criteria for weather.

For the detailed analysis see p.77.

F20
Wind Direction/S1



S2
Southern Site

During the February-to-November operating hours, prevailing winds are from the west at a 12 mph average. In December they are from the north at 7 mph and in January they are from the southeast at 8 mph. Crosswinds should disrupt service about 0.2% of the time during dry weather and 0.8% during wet weather. Visibility conditions should impose the following flight limitations:

- **VFR during 91% of all operating hours**
- **IFR during 9% of all operating hours**
- **Below minimum conditions should halt operations 0.7% of the time.**

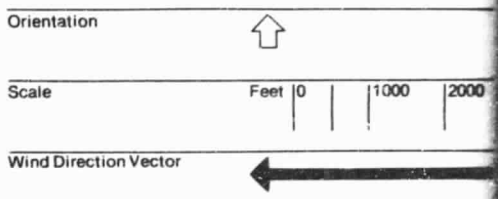
Figure F21 **shows yearly average distribution of predominant wind directions and their magnitudes interpolated for the southern site.**

This site meets the criteria for weather.

For the detailed analysis see p.79.

F21
Wind Direction/S2

F20/F21
Legend



Sum

Criterion

C10
Air Traffic/Flight Operations

C10.1
The proposed STOLport should be compatible with the existing air traffic control system, and should meet Federal Aviation Administration [FAA] safety requirements.

C10.1.1
Safety Clearance Zones should provide obstacle-free air space for approach and departure.
C10.1.2
Instrument landings and departures should be possible in at least one direction.
C10.1.3
QSTOL aircraft should meet all performance requirements for safe operation at the proposed STOLport.
C10.1.4
QSTOL flight paths should not cause major conflicts with operations at other airports.

Site Evaluation

S1
Northern Site

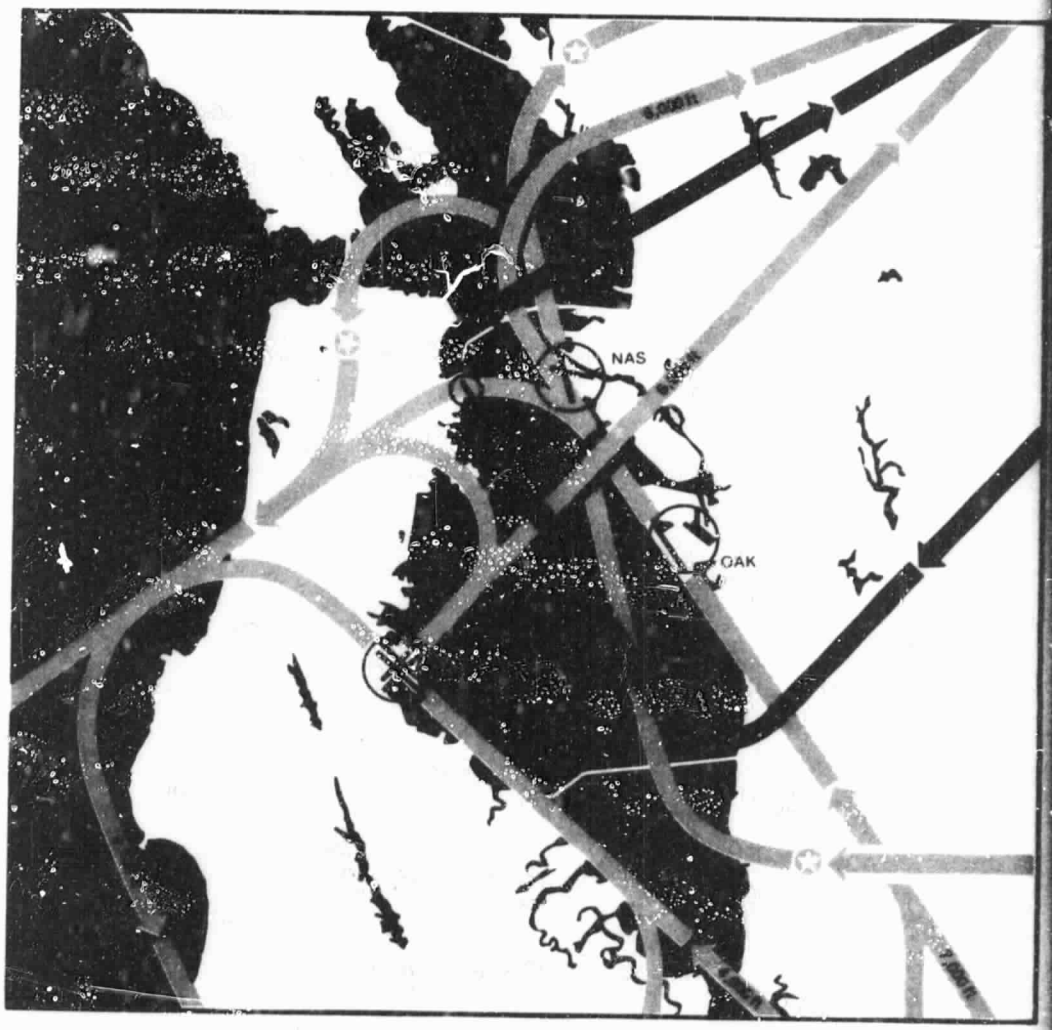
Obstacles which may penetrate approach and departure clearance zones would be ships' masts in adjacent navigation lanes and in berths at Pier 35. Instrument landings would be possible from either direction with either DeHavilland DHC-6 or DHC-7 STOLcraft. Conflicts in a straight-in QSTOL final approach would be with departures from Alameda Naval Air Station Runway 31, and with Oakland International Runway 09. Sequencing would be necessary with these departures and with San Francisco-to-Marin helicopter traffic. A curved approach from the north would only require sequencing with left-turn flights from Alameda Runway 31.

Figure F22 portrays air space conflicts between the proposed QSTOL facility's flight pattern and existing flight patterns for the three major airports in the vicinity.

The northern site presently would meet the criteria for air traffic and flight operation under the condition that approach and departure sequencing with existing airports is worked out.

For the detailed analysis see p.81.

F22
Air Traffic Conflicts/S1



S2
Southern Site

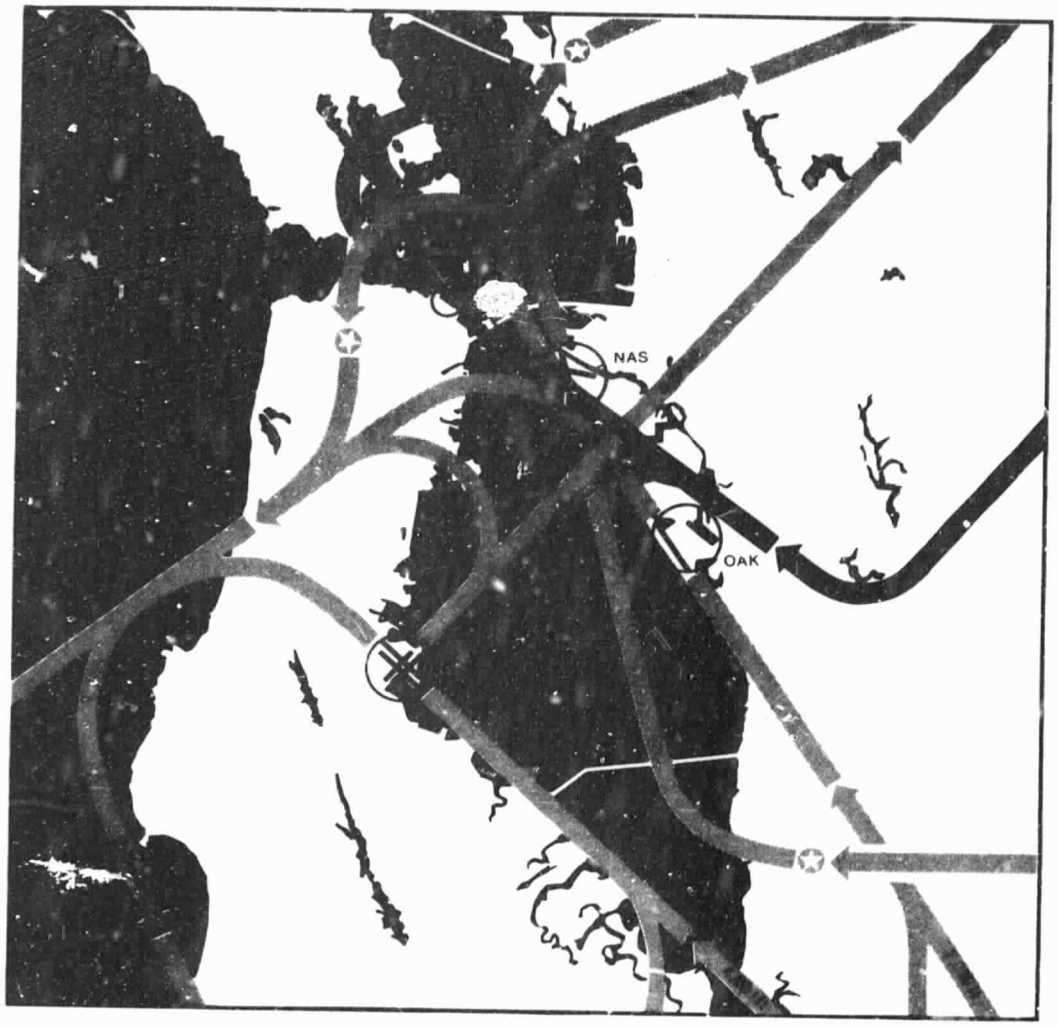
The operation of the DeHavilland DHC-6 from this site would be adversely affected by obstructions in the clearance zone. The DeHavilland DHC-7 could successfully operate. Instrument approaches and departures to the northwest would probably be restricted to a ceiling of 700 feet due to obstructions in the clearance zone. An instrument approach to the southeast could be established using a 6% glide slope and unrestricted instrument departures could be established in that direction. Numerous conflicts would occur between instrument operations at the STOLport and those at other major airports in the Bay Area. QSTOL instrument approach and departure routes could not be efficiently segregated from those at Alameda Naval Air Station, Oakland International Airport and San Francisco International Airport regardless of which runway configurations are used at the various airports. In addition, independent transition routes between the instrument departure and arrival procedures and the enroute system do not appear feasible at this time.

Figure F23 illustrates air space conflicts between the proposed QSTOL facility's flight pattern and existing flight pattern for the three major airports in the vicinity.

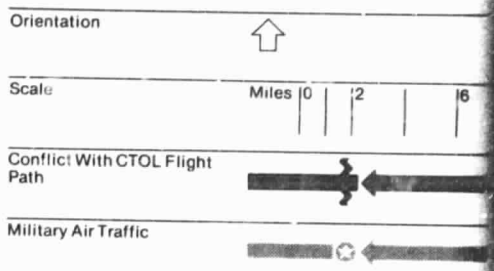
STOLport operation at the southern site would not meet the present established criteria for air traffic and flight operations at this time.

For the detailed analysis see p.82.

F23
Air Traffic Conflicts/S2



F22/F23
Legend



Sum

Criterion

C11
Terminal Design

p. 28

C11.1
The terminal Plan should conform to applicable local and regional planning policy.

C11.1.1
The proposed STOLport should minimize interference with Port maritime activities.
C11.1.2
The proposed STOLport should minimize disruption of views from Central Basin and from along China Basin Street.
C11.1.3
The proposed STOLport should stay inside the U.S. Pier Head Line.
C11.1.4
The proposed STOLport should meet recommended FAA criteria for STOLport layout.

C11.2
The Terminal Plan should conform to San Francisco zoning ordinances and building codes.

C11.2.1
The allowable building height of 40 feet and bulk restrictions should be strictly adhered to.
C11.2.2
Requirements for adequate egress should be adhered to.

C11.3
The Terminal Plan should strongly reflect STOLport projected advantages over Conventional Take-Off and Landing [CTOL] facilities.

C11.3.1
Public transit and shuttle services to and from the Central Business District should take priority over taxi and auto circulation in the plan.
C11.3.2
Passenger transfer from all surface access modes to ticketing, baggage handling and boarding areas should be expeditious as a result of the design.
C11.3.3
Later expansion of terminal areas to include additional aircraft boarding gates and appropriate supportive activities should be possible.

C11.4
The Terminal Plan should take into account future conversion and use by the Port.

C11.4.1
As much of the facility as possible should be transportable to another site.
C11.4.2
Large areas should be able to accommodate trucks and containerized cargo.

Evaluation

S2
Southern Site Terminal Design

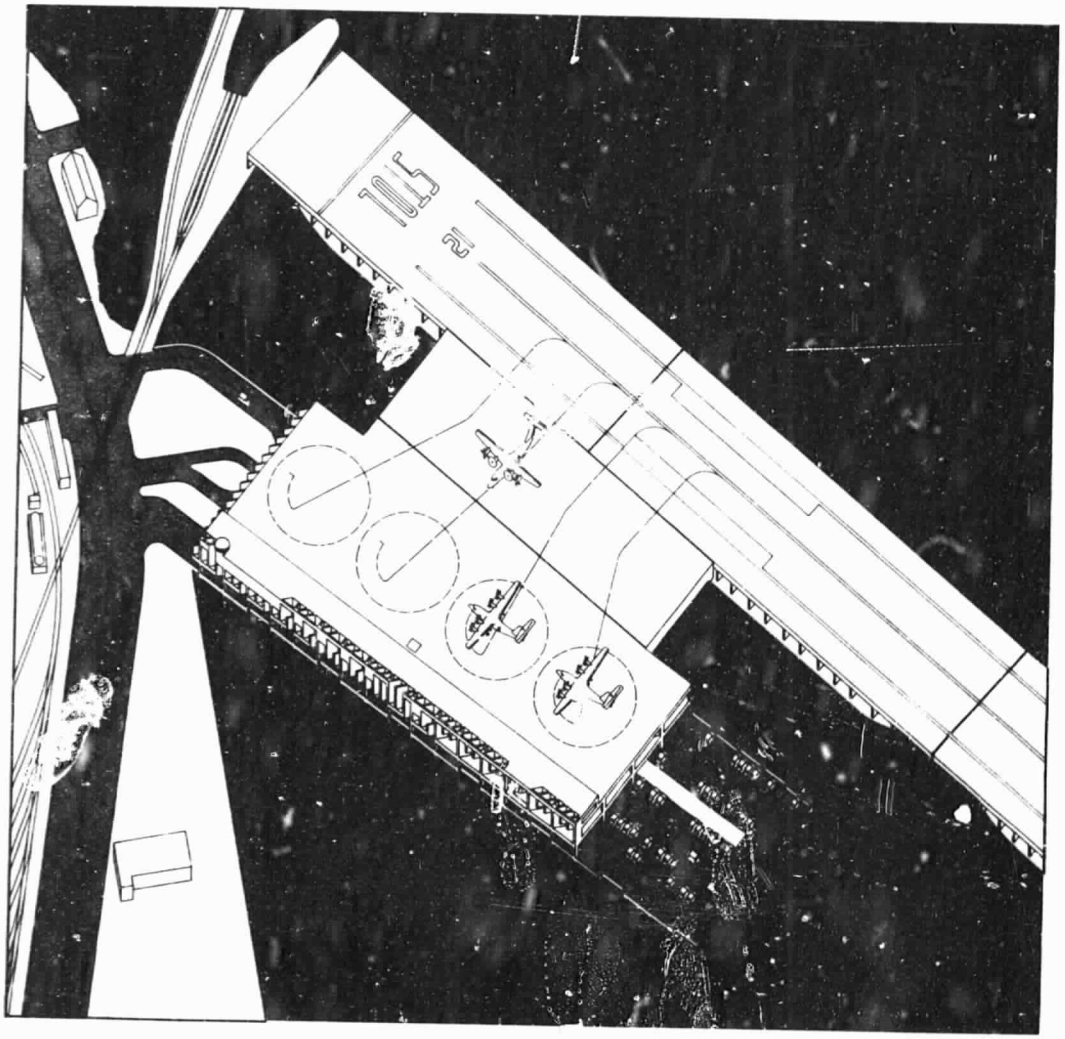
After evaluating three unacceptable alternatives which included variations on the concept of two aircraft carriers in tandem adjacent to Pier 54 at Site 2, a divergent concept was inspected and eventually adopted. The fourth alternative uses eight "Liberty Ship" hulls of World War II vintage tied together with a large new superstructure for a runway. At heading 302° it is adjacent and attached by a ramp to a completely reconstructed Pier 54. The pier houses all terminal and ancillary facilities. At the first level are located all surface modal access drop-off stations and parking, shipping and receiving, and mail handling areas. The second level includes ticket counters, baggage claim and handling, access to spaces in the Liberty Ship hulls, a restaurant, conference spaces and rental office area. The Third level/roof contains STOLport operations, air traffic control, boarding lounges, a cocktail lounge, aircraft boarding gates and ramp access to the runway.

Figure F24 illustrates by axonometric view the overall runway and terminal design.

This facility meets the criteria for terminal design established in this report.

For the detailed analysis and design see Figures F57, F58, and F59, p.85-92.

F24
Terminal Design / S2



Detailed Planning Analysis

Criterion

C1
Land Use

An airport or STOLport is more compatible with some land uses than others. It is not always possible for an existing airport to control surrounding land use short of ownership of such land. When it is possible to select a suitable site, land use compatibility should be considered as a major determinant of location.

Compatible land uses for the immediate vicinity of STOLports might be industrial, commercial, transportation, water and military installations. Uses incompatible with STOLport operations include residential, education, health care and other noise-sensitive activities.

The concept of a floating STOLport offers certain advantages over a land-based site, such as possible approach and/or departure over water, minimizing noise and safety problems for populated areas, and reducing the amount of land area needed. There are also some disadvantages in that more stringent, and sometimes conflicting, jurisdictional requirements must be satisfied, the process of policy review and public hearings is longer and more complex, and problems such as hazards to marine and air navigation may become more pronounced.

C1.1
The proposed STOLport should conform with the policies and regulations of governmental agencies which have jurisdiction.

C1.1.1
The STOLport should not cause hazards or inconvenience to navigation.
C1.1.2
The STOLport should be located within the U.S. Pier Head Line.

National Planning Guidelines:
The U.S. Army Corps of Engineers has jurisdiction over matters involving marine navigation and environmental quality. It would study the impacts on local water traffic and major navigation. Development of a floating STOLport also would require an environmental impact statement and public hearings before a permit would be granted.

The U.S. Coast Guard has jurisdiction in several areas which affect the proposed STOLport. Any structure, floating or fixed, on or over the Bay and of a permanent nature is classed as a "Waterfront Facility" and comes under Coast Guard regulations and inspections. At public hearings, conducted by the Army Corps of Engineers, the Coast Guard would make specific recommendations considering safety and navigation. Aviation fuel and parked automobiles are both classed as "dangerous cargo". Inclusion of these within the floating structure would make Coast Guard approval more difficult. Projection beyond the U.S. Pier Head Line and obstructions to navigation would mean a change in the Vessel Traffic System requiring Congressional action. It is suggested that agreements between QSTOL officials and tug and ferry operators in the area be reached before the hearings.

The Coast Guard would also review plans for modifying the vessels to ensure safe design.

C1.1.3
The STOLport should minimize its requirement for Bay fill.

Regional Planning Guidelines:
A principal objective of the Association of Bay Area Governments (ABAG) in its Regional Plan 1970-1990 is to achieve a "city-centered" Bay Region through development of urban centers which are linked by a multiple-mode transportation system (6). The aviation element of the plan further recommends these policies relating to surface land use:
1
Provide for maximum safety between aviation activity and other land and water uses.
2
Minimize Bay fill.
3
Assure compatibility of airport operations with public parks, recreation areas, wildlife sanctuaries, habitats of unique species, and aesthetic features where appreciable adverse effects are likely to be long-term or irreversible.

The San Francisco Bay Conservation and Development Commission (BCDC) is responsible for enforcing its plan for the conservation of the water areas and development of the shoreline of San Francisco Bay. Shoreline land uses which BCDC has deemed acceptable are water-related industry, ports, airports, and recreation. BCDC has assumed that a system of STOLports, or "reliever airports," will be created to siphon off short haul traffic from the larger international airports. Airports on the shores of the Bay will be permitted to include, within their premises, passenger terminals, cargo and parking areas, and supporting transportation facilities (21). No Bay fill would be permitted, except for runway construction, and then only if no feasible alternative is available. A floating STOLport would be considered as Bay fill because of its fixed location. Therefore, parking and non-water-oriented activities would not be permitted on the floating portion of the facility. BCDC also would consider the type of structure, the type of mooring, the area of water covered and disturbance of the Bay floor.

C1.1.4
The STOLport should help preserve and enhance the maritime character of the San Francisco waterfront.
C1.1.5
The STOLport should avoid land use conflicts.

Local Planning Standards:
The San Francisco Department of City

Planning is responsible for the preparation of land use and zoning regulations for all areas under its jurisdiction. Its development regulations also define limits on building height, mass and bulk. Areas zoned for high structures may interrupt clearance zone requirements, while on the other hand, height, bulk, land use and zoning controls may limit the configuration of the STOLport development.

City Planning regulations are part of the City Planning Code and are law. One regulation, relating to a floating STOLport, states that any development south of China Basin and beyond the sea wall requires a conditional use permit, and/or consideration as a Planned Unit Development (PUD) for multiple land use (34, sec 240). Conditional use and PUD permits require a public hearing prior to project approval for implementation.

The City Planning Commission requires that all major development projects, which would include a STOLport, submit an environmental impact statement.

Elements of the San Francisco Comprehensive Plan have been prepared setting forth objectives and policies for urban design, open space, residence and transportation. Many of the current policy recommendations call for more parks, open space, and improving the quality of existing shoreline recreation areas which recognize the resource potential of the Bay. Other recommendations, particularly in the Northern Waterfront Plan, include the preservation and enhancement of the maritime character of the San Francisco waterfront, the efficient operation of Port activities, and the preservation of view corridors towards the Bay. QSTOL development may conflict with many of these policies.

A citizen participation process is included in the modification and adoption of planning policies. References to QSTOL, in the City Comprehensive Plan, have been specifically deleted because of citizen pressure and a policy prohibiting airports from shoreline areas was recently proposed (27, p. 12). Neither of the proposed sites for a floating STOLport would be able to meet this condition.

To change or modify this policy requires a public hearing process and a vote of the City Planning Commission.

C1.1.6
The STOLport should allow efficient operation of Port activities.

Both sites being considered fall within the jurisdiction of the San Francisco Port Commission. The Port is committed to development of maritime activities, because of the catalytic effect shipping has on the job market and economic development of San Francisco. The Port also recognizes the value of commercial and non-maritime activities, and of citizen desires for open space and public access to the Bay (17).

The current Port Master Plan and the Northern Waterfront Plan call for concentration and intensive development of maritime facilities south of the Bay Bridge. The area between Pier 9 and Pier 35 would remain for active shipping for at least 20 years. Other areas would be developed for commercial and residential activities, and open space according to the City's Comprehensive Plan.

Special Interests:
While citizen groups, business associations and labor unions might not have direct control over land use policy, they have considerable influence both in the planning process and in approval for specific projects which require public hearing. Leaders of potentially affected community neighborhood associations, business associations and labor unions were interviewed for their reactions to the proposed STOLport sites. Opinions expressed were assumed to be generally representative of their memberships. All these groups are concerned with aspects of noise, pollution, visual impact, safety and employment, although with differing amounts of emphasis. Each of these concerns help determine land use suitability of the project for each study area.

Site Evaluation

S1
Northern Site

The waterfront area is zoned mostly for C-2 commercial use with an M-1 industrial zone extending from Pier 9 to Pier 35. Residential zones are all inland. If differences between the San Francisco City Planning Department and the Bay Conservation and Development Commission (BCDC) can be resolved, housing would be permitted on the piers, as is recommended in the Northern Waterfront Plan. Also, a public open space zone is in the bulkhead area of Piers 37, 39 and 41.

Aircraft use has been deleted from the Northern Waterfront Master Plan by a joint decision of the San Francisco Port Commission and the City Planning Commission. Conditional use permits are unavailable for airport construction. Since it was possible that this situation may be reversed, site selection continued.

The first site subarea investigated was along the ends of Piers 31, 33 and 35. (See Figure F25.) These piers are presently used by the Port for cargo handling and passenger facilities. Sites parallel to the shore and further south were eliminated because of proximity to the Bay Bridge. This location halves the capacity of the Port's passenger terminal at Pier 35. It also significantly reduces the capacity of an important and active maritime area. Because of its commitment to shipping and its policy of allowing public access to the Bay, the Port Commission would not permit a STOLport at this location.

Telegraph Hill and Northpoint residential

p. 32

areas are within ½ mile of the site. To minimize impacts on Port activities and on the Telegraph Hill area the STOLport was shifted further north off the ends of Piers 37, 39 and 41. These piers are currently used for parking and occasional maritime activity. Because of the high volume of water-borne traffic in this area, and proximity to the Vessel Precautionary Zone, an attempt was made to keep the STOLport structure near the existing pier heads. This second proposal takes into account the Port's Master Plan policy of keeping active Piers 9 through 35, and the implication by some members of the Port staff that Piers 37 to 41 are still necessary for service craft. (See Figure F25.) Attachment of one end of the STOLport to Pier 37, with the other end 200 feet off the head of Pier 41, would allow tugs, ferries and other service craft to use the insides of Piers 39 to 41, and larger vessels to use the outsides of Piers 37 to 41. Extension of the runway beyond the U.S. Pier Head Line would have made acquisition of permits difficult.

When it later became apparent that mooring for service craft was not essential to this area, the "free" end of the STOLport was brought alongside Pier 41 and within the U.S. Pier Head Line. This improved access to the structure and simplified problems of mooring. (See Figure F25.)

The City's Comprehensive Plan had proposed a park and a pedestrian promenade at the foot of Pier 37 through 41 whose major asset was to be a panoramic view of the Bay (25, p. 10). This was emphasized by classification of the area along the Embarcadero as "Special Open Space" which would prohibit structures blocking Bay views from street level (34, sec 240). A STOLport would directly conflict with this regulation. Further conflict was evident in the existing and proposed land use between the close proximity and incompatability of residential uses with QSTOL.

If the Port were to modify its policy and allow a STOLport in the northern study area, the City Planning Commission would prohibit such an operation because of the effect the STOLport would have in separating the City from the Bay, and because of a recommended planning policy eliminating airports as a permissible shoreline use. Reversal of these policies would not be possible without considerable public support.

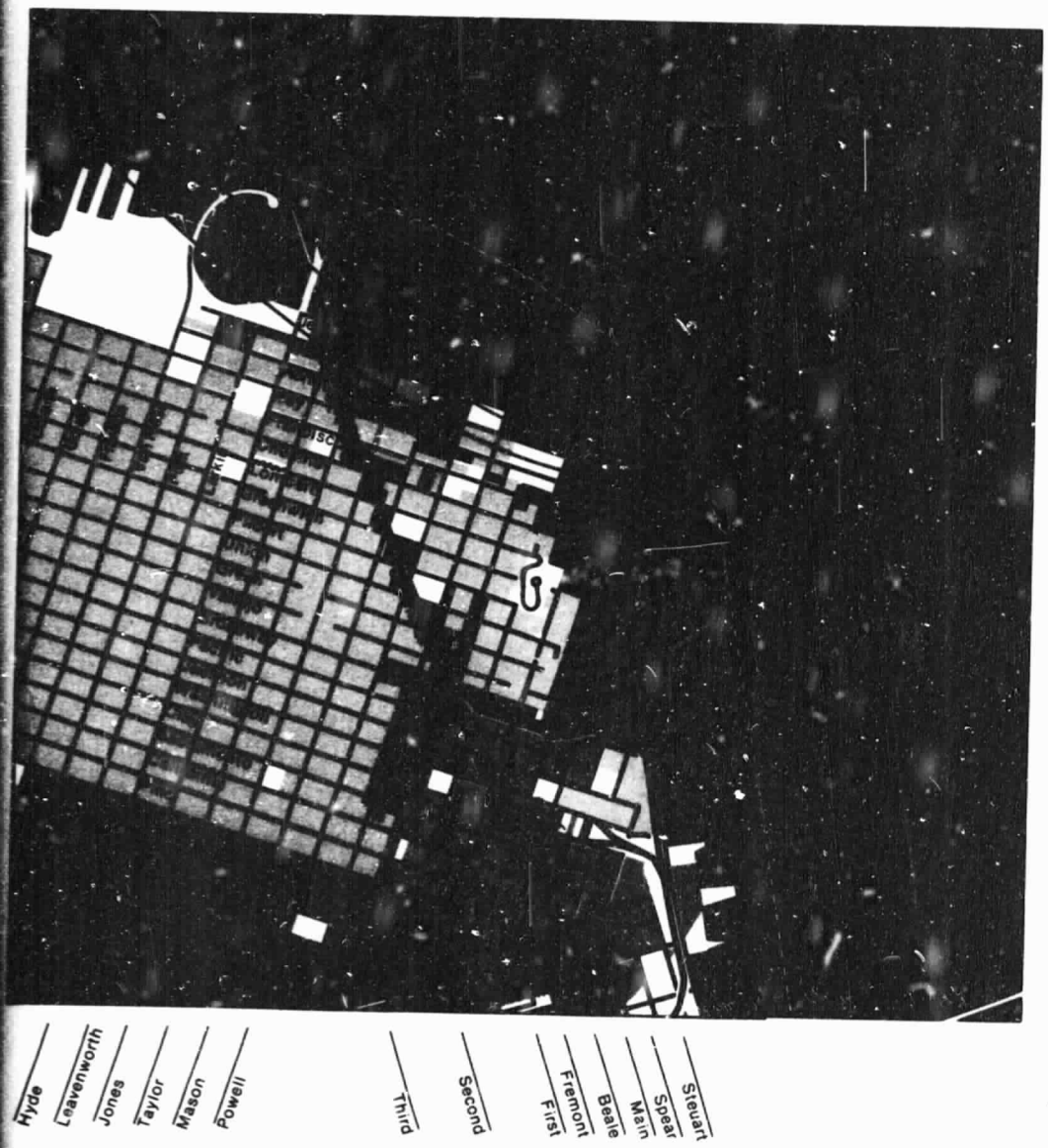
Representatives of People for a Golden Gate Recreation Area, Marina Civic Improvement and Property Owners Association, Fisherman's Wharf Merchants Association, North Waterfront Improvement Association, Russian Hill Improvement Association, Telegraph Hill Dwellers Association, San Francisco Planning and Urban Renewal Association (SPUR), American Institute of Merchant Shipping, and the International Longshoremen and Warehousemen's Union, Local 10, all expressed negative reactions towards a STOLport at this site. The reluctance of these agencies and groups to show support for QSTOL also would make BCDC permit approval most difficult.

According to those interviewed, noise, pollution, increased street traffic and visual character impacts would not be offset by employment or increased patronage of commercial facilities. The community is unwilling to accept a STOLport in any of the areas proposed, and would block the granting of permits. Figure F25 also illustrates existing land uses in the northern site study area.

Issues of City Planning policy, Port needs, and community attitudes all conflict with STOLport development and cannot be resolved at this time.

At this time a STOLport at the northern site would not meet the requirements for land use.

F25
Existing Land Use and Site Location Alternatives / S1



S2
Southern Site

The entire area is zoned M-2 industrial, except for the Potrero Hill R-3 residential area, which is west of the Southern Freeway. Small residential areas east of the freeway and around South Park are within M-1 or M-2 zones. Public parks proposed or under construction along the China Basin Channel and Central Basin shoreline are also not specifically zoned.

Open water areas of the Bay are zoned R-1-D residential, to restrict development. An aircraft runway is permissible as a conditional use upon approval of the City Planning Commission and a public hearing process (34, sec 240). The navigational traffic lane in this area was wide enough to permit some latitude in location.

The STOLport was first located off the end of Pier 50 (Mission Rock Terminal) to allow landing and take-off over water and piers. Since this pier is actively used by the Port for container freight and is one of the most valuable in terms of revenue, the structure was located far enough off the end of the pier to allow ships to use the end berths. A people-mover was proposed to convey passengers and baggage over the tops of warehouse sheds and across to the STOLport. This would not allow full use of the marine terminal, especially in regards to crane operation and would cause difficulties in berthing large ships. An additional change in transportation modes would be less convenient for QSTOL passengers. Also, location outside the U.S. Pier Head Line would complicate permit procedures. The Port's reaction towards use of this site was unfavorable. (See Figure F26.)

In addition to the problems noted for Pier 50, a similar orientation off the end of Pier 70 (part of the Bethlehem Steel Shipyard) proved even less desirable because of approaches over the Hunters Point residential area. There was a likelihood of interference with cranes and ships' masts at the Army Street Terminal and/or Mission Rock Terminal. (See Figure F26.) Furthermore, the Port plans to develop the entire area of Pier 70 as a container facility in the near future. A north-south orientation, which would be required, was less desirable from the standpoint of crosswind than an orientation into the wind.

The only area the Port was willing to consider was Pier 54, currently used as a warehouse since it was outside the Port's current 10-year budget. A STOLport at Pier 54 would require an approach over water and take-off over land with a 90 degree turn to avoid flying over the downtown area. The entire facility could be located within the U.S. Pier Head Line. (See Figure F26.) Land use in the area is primarily industrial with the nearest residential units approximately 4,000 feet away. There are conflicts with a proposed park and fishing pier in Central Basin and with proposed parks and an office building along Channel Street. This site would not conflict with vessel access to repair facilities at Pier 64,

or to berths at Pier 50. The STOLport would require relocation of a small office building off the end of the runway. In addition, relocation of a larger office building, about 2,500 feet from the end of the runway, might also be necessary.

Representatives of Potrero Hill Residents and Homeowners Council, San Francisco Planning and Urban Renewal Association (SPUR), American Institute of Merchant Shipping, and American President Lines expressed negative reactions towards a STOLport in this vicinity. Bayview/ Hunters Point Model Cities representatives were concerned over noise and safety problems and generally sided with Potrero Hill residents. However, the potential for generation of employment was noted. The representative of the International Longshoremen and Warehousemen's Union, Local 10, was definitely interested in the employment potential.

Community opposition appears stronger or at least more vocal than community support. Obtaining a conditional use permit would not be possible without considerable public support. Even if other agencies were to approve a STOLport at this site, BCDC would find it difficult to approve because of its role in planning the Central Basin Park, and the conflicts which a QSTOL facility would cause.

Figure F26 also illustrates existing land uses in the southern site study area.

A STOLport at the southern site would not meet the land use criteria unless the problems of relocation can be minimized and a conditional use permit obtained.

F26
Existing Land Use and Site Location Alternatives/S2

F25/F26
Legend

Orientation	⇧
Scale	Feet 0 1000 2000
Open Space/Public Institutions	
Residential	
Office/ General Commercial	
Retail/ Entertainment	
Industrial/Maritime	
Yerba Buena Redevelopment Area	

Det

Criterion

C2
Community Structure

Elements of community structure considered were: social profile and community values. These factors were studied in terms of the way each relates to such issues as land development, type of STOLport ownership, displacement of persons, and employment.

Social profile describes statistical data on racial makeup, income levels, labor skills and population. The information was compiled from 1970 census tract data, and translated into densities and percentage units in order to compare tracts. (See Table T1.)

C2.1
The proposed STOLport should be considerate of community attitudes.

Community attitudes indicate how segments of the population view themselves, how they perceive their needs, and how they try to fulfill those needs.

Citizen attitudes were largely determined by a study of reactions to various elements of the City's Comprehensive Plan, and by personal interviews with members of citizen groups which were representative of each area.

Community attitudes are often formalized into city planning policies through the citizen review process. San Francisco citizens recognize their potential and position for joint determination, with the City Planning Department, of planning policies which ultimately affect the community structure. The possibilities for QSTOL development in San Francisco depend, in part, on public acceptance.

C2.2
The proposed STOLport should respect community character.

C2.2.1
STOLport development should not create a barrier between parts of community or between the community and open space areas.
C2.2.2
Noise and air pollution should be held to acceptable levels.
C2.2.3
Displacement of residents and businesses should be avoided.

Several policies, defined in the Urban Design Plan, are concerned with physically defining each neighborhood as a distinct place. Further concern embraces the protection and enhancement of each neighborhood. For example, planning freeways and major arterials around rather than through each neighborhood, buffering residential from industrial uses, providing for social and economic diversity, and intensifying residential densities where it is appropriate are all important policies which preserve a community from harmful change. QSTOL should take these policies into account in its overall design.

Concerns of citizens for San Francisco and their communities fall into four basic issues.

1
City Pattern:
Disruption of the visual pattern that gives an overall character and image to San Francisco and to its distinctive districts.
2
Conservation:
Loss or dilution of irreplaceable resources with ecological, historic, aesthetic or formgiving values.
3
Major New Development:
Intrusion of new development which, through its visual dominance, height, or excessive size, weakens or destroys important city or neighborhood qualities.
4
Neighborhood Environment:
Erosion of the immediate environment that closely affects the daily lives of residents, through dangers to health and safety, deterioration of streets and properties and lack of comfort or fulfilling experiences (23, p 10).

QSTOL sites which would cause extensive displacement of people should be avoided, particularly if they involve residential areas. Site planning of STOLport facilities should be restricted to land which would not alter a community's plan for overall community development.

C2.3
The proposed STOLport should offer compensation for negative impacts.

C2.3.1
Employment should be offered to members of the neighboring communities.

The proposed STOLport should benefit community development. QSTOL may be used to provide incentives for business and industrial growth. the STOLport facility alone represents a capital investment of 10-20 million dollars for the floating runway and terminal facilities. This amount represents only a fraction of the possible economic development that would accrue to the community through QSTOL-generated development.

STOLports may be owned and operated by local communities through community development corporations which would have rights to determine revenue allocation.

An alternative type of community development corporation would concentrate on developing the space needed for activities generated by STOLport development such as restaurants, hotels and convention facilities. Economic assistance may be available from various sources to assist these development programs, including federal matching grants and revenue sharing.

STOLports should provide and generate additional employment for members of the local community, particularly minority, low-skilled, and poverty-level persons. This employment should include all levels of jobs available at a QSTOL facility and provide job training programs.

T1
Statistical Abstracts of Census Tracts

Census Tract	Population Density					Minority and Income as Percentage of Population					Distribution of Job Skills as Percentage of Employed			
	Area (Acres)	Daytime Population	Daytime Density (Persons Per Acre)	Nighttime Population	Nighttime Density (Persons Per Acre)	Residents Interviewed	Black % of Population	Spanish Surname Population	Spanish Surname % of Population	Poverty Level % of Population	Employed Population	White Collar %	Skilled %	Service %
101	139.8	8,354	59.8	2,713	19.4	2,692	10.7	215	8.0	16.1	2,062	73.8	09.0	17.1
102	149.6	8,508	56.9	6,124	40.9	4,364	0.3	200	4.6	9.2	4,127	85.0	05.5	10.5
103	66.9	3,760	56.2	5,200	77.7	4,935	0.2	137	2.8	9.1	3,776	64.6	17.5	17.9
104	83.1	2,927	35.2	5,500	66.2	5,547	0.3	220	4.0	9.5	4,163	66.0	18.0	16.0
105	60.7	4,542	74.8	1,749	28.8	45	—	18	40.0	25.0	—	—	—	—
106	46.1	4,703	102.0	4,950	107.4	4,404	1.0	79	1.8	14.2	2,980	47.3	31.6	21.0
115	38.8	11,381	293.3	1,500	38.7	982	1.8	14	1.4	29.2	523	31.4	18.9	49.7
116	62.3	8,428	135.3	2,950	47.4	1,967	3.2	29	1.5	7.9	1,731	89.8	05.0	06.5
117	139.1	117,515	844.8	7,415	53.3	1,776	2.0	64	3.6	19.4	1,261	60.7	15.3	24.0
126	276.9	7,298	26.4	8,200	29.6	3,819	0.3	100	2.6	5.4	3,034	87.9	06.2	05.9
127	160.5	2,449	15.3	4,300	26.8	4,351	—	224	5.1	5.3	3,614	87.9	04.3	11.0
128	121.5	2,771	22.6	5,563	45.8	4,895	0.4	224	4.6	8.1	4,001	85.2	03.0	09.9
129	133.3	7,236	54.3	6,944	52.1	6,136	0.4	187	3.0	10.4	5,787	82.8	07.1	10.1
176	292.8	93,320	318.7	10,205	34.9	4,832	5.1	338	7.0	26.2	1,970	36.3	18.3	45.4

T1
(continued)

Census Tract	Population Density					Minority and Income as Percentage of Population					Distribution of Job Skills as Percentage of Employed			
	Area (Acres)	Daytime Population	Daytime Density (Persons Per Acre)	Nighttime Population	Nighttime Density (Persons Per Acre)	Residents Interviewed	Black % of Population	Spanish Surname Population	Spanish Surname % of Population	Poverty Level % of Population	Employed Population	White Collar %	Skilled %	Service %
178	178.6	14,743	82.5	4,826	27.0	3,863	21.0	604	15.6	31.6	1,755	36.4	26.8	36.8
179	272.4	15,154	55.6	7,900	29.0	7,097	9.2	319	4.5	17.2	838	56.4	10.0	33.5
180	244.2	17,084	70.0	3,114	12.8	1,645	40.6	234	14.2	30.7	309	21.4	33.0	45.6
226	284.2	8,265	29.1	2,625	9.2	605	57.4	120	19.8	40.2	285	49.5	26.7	23.8
227	415.6	9,082	21.9	9,531	22.9	9,340	29.2	1,545	16.5	22.3	4,845	59.1	20.3	20.6
230	332.6	5,070	15.2	6,350	19.1	8,823	55.3	1,107	12.5	10.8	5,229	43.9	24.0	32.1
231	461.4	5,757	12.5	7,900	17.1	9,152	89.6	171	1.9	39.8	2,773	36.5	24.5	39.0
232	219.5	4,998	22.8	9,100	41.5	3,967	79.6	116	2.9	17.3	2,339	38.6	22.6	38.8
607	432.2	8,600	19.9	1,100	2.5	—	8.3	—	—	—	—	—	—	—
608	383.8	1,200	3.1	100	0.3	235	83.3	17	7.2	25.8	63	34.9	30.2	34.9
609	520.3	11,701	22.5	2,700	5.2	239	86.0	45	18.8	70.2	49	73.5	—	26.5
Citywide Average			34.2		27.3		13.4		11.6	14.0		65.7	15.8	18.5

S1
Northern Site

The Northpoint area, immediately adjacent to the proposed site, has a moderately high population density during the day (59.8 persons per acre average), due to employment concentrations, and a relatively low density at night (19.4 persons per acre average) (See Table T1), although the nighttime population is increasing due to apartment construction and active development of the area.

Neighborhoods which overlook the proposed site include Telegraph Hill and Russian Hill which have a moderately high population density both day and night (60.1 persons per acre and 57.9 persons per acre average) (See Figure F27). These areas are characterized by upper income professionals and a very low percentage of minority persons.

The Northpoint area, because of several concentrations of public housing, has a higher percentage of black, Spanish surname, and Chinese populations, a higher poverty level and greater unemployment than its surrounding neighborhoods. The addition of new housing is expected to increase both upper income and low income populations. QSTOL, with its opportunities for employment, could help the minority persons in this area.

The Fisherman's Wharf area is a highly important tourist attraction, the second largest in the West, following Disneyland. Its businesses and facilities should be preserved or upgraded in keeping with the maritime theme.

Noise problems could cause displacement of light industry and commercial facilities at Fisherman's Wharf, and housing in the Northpoint area. Arterial streets are currently congested at peak travel times. The proposed STOLport would cause additional surface traffic along the Embarcadero, and on Bay Street. The additional traffic would not create new traffic barriers within the community, but it would help reinforce existing barriers.

Community reaction has been strongly against this QSTOL facility site, not only from local citizens groups and business associations, but from groups outside the impact area who feel this area is of regional importance.

Groups interviewed include, People for a Golden Gate National Recreation Area, Marina Civic Improvement and Property Owners Association, Fisherman's Wharf Merchants Association, North Waterfront Improvement Association, Russian Hill Improvement Association, Telegraph Hill Dwellers Association, San Francisco Planning and Urban Renewal Association (SPUR), American Institute of Merchant Shipping, and the International Longshoremen's and Warehousemen's Union, Local 10.

Residents are opposed to STOLport development at this site on the basis of noise and air pollution, some of which they have experienced through helicopter operation from Fisherman's Wharf. Other objections are on blockage of Bay views, spoiling the character of the area and questions of safety. The issues of community ownership, stimulation of local business and employment could not be expected to offset these objections.

This site does not meet the established criteria for community structure at this time.

F27
Population Density Average for Residential Areas/S1

Daytime

Census Tract	Population	Acres
102	8,508	149.6
103	3,760	66.9
104	2,927	83.1
105	4,542	60.7
106	4,703	46.1
Total	24,440	406.4

24,440 ÷ 406.4 = 60.1 persons/acre

Nighttime

Census Tract	Population	Acres
102	6,124	149.6
103	5,200	66.9
104	5,500	83.1
105	1,749	60.7
106	4,950	46.1
Total	23,523	406.4

23,523 ÷ 406.4 = 57.9 persons/acre

S2
Southern Site

The area around the proposed site has a relatively low population density (19.9 persons per acre average) (See Table T1), primarily because of the large surrounding areas utilized by rail yards and industrial acitivities.

The most populated residential areas are Potrero Hill, South of Market, Silver Terrace, and Bayview/Hunters Point. Generally, these areas also have a population density (27.1 persons per acre) lower than the city average of 34.2 persons per acre, with black and Spanish surname populations accounting for 48.6% and 9.5% of the total respectively. (See Figures F28 and F29.)

This area also includes a higher concentration of low-income and unemployed persons than the city average. Residents of the area are predominantly employed in service-related, unskilled and skilled blue-collar jobs. (See Table T1.)

Most residents would like to maintain the low population density and racial mixture, and solve problems of unemployment and low job-skill level. QSTOL could be an asset in this respect; limiting development to areas outside the affected neighborhoods but at the same time offering employment and other economic incentives.

Access to the site would be along the 4th Street and 3rd Street one-way couple and from 4th Street and 18th Street off-ramps of the Southern Freeway (Hwy. 280). There should be no additional traffic in existing residential areas due to QSTOL

Displacement of households would be minimal. However, a number of offices and light industrial facilities would require either relocation or extensive modifications for sound control.

Despite its physical separation by the Southern Freeway, the Potrero Hill community feels an integral identity with the Central Waterfront and the working Port. Resident groups working with the Port, BCDC and the City Planning Department have developed a plan for public access to waterfront areas. One of the suggested and soon-to-be-developed parks is in Central Basin about 2,000 feet from the proposed STOLport. The runway would cause disruption of the view. Noise levels would be between 70 and 95 PNdb causing considerable conflict.

Representatives of Potrero Hill Residents and Homeowner's Council, Bayview/Hunters Point Model Cities and San Francisco Planning and Urban Renewal Association (SPUR) were opposed to QSTOL in this area, because of conflicts with the proposed parks, excessive noise and the large flyover of urbanized land. Representatives of the American Institute of Merchant Shipping and American President Lines were opposed on the basis of possible interference with maritime activity. International Longshoremen's and Warehousemen's Union, Local 10, and Bayview/Hunters Point Model Cities representatives were interested in the employment opportunities and economic potential.

Community reactions are divided. The disadvantages of excessive noise may be offset by new development and increased employment.

This site could meet established criteria if issues between excessive noise, new development, and increased employment can be resolved.

F28
Daytime Population Density Average for Residential Areas/S2

Census Tract	Population	Acres
178	14,743	178.6
179	15,154	272.4
180	17,084	244.2
266	8,265	284.2
227	9,082	415.6
230	5,070	332.6
231	5,757	461.4
232	4,998	219.5
607	8,600	437.2
608	1,200	383.8
609	11,701	520.3
Total	101,654	3,744.8

101,654 ÷ 3,744.8 = 27.1 persons/acre

F29
Percentage of Population: Black or Spanish Surname

Census Tract	Pop. Sample	Black %	Black No.	Spanish No.
178	3,863	21.0	811	604
179	7,097	9.2	653	319
180	1,645	40.6	668	234
226	605	57.4	347	120
227	9,340	29.2	2,727	1,545
230	8,823	55.3	4,879	1,107
231	9,152	89.6	8,200	171
232	3,967	79.6	3,158	116
608	235	83.3	196	17
609	239	86.0	206	45
Total	44,966		21,845	4,278

Black
21,845 ÷ 44,966 = 48.6% of population

Spanish Surname
4,278 ÷ 44,966 = 9.5% of population

Criterion

C3
Economic Impact

The economic analysis of any proposed transportation system requires the determination of passenger demand at fare levels sufficient to generate revenues to amortize and maintain the systems as well as provide an acceptable profit margin.

C3.1
The air carrier should charge a fare which will yield a reasonable return [8% to 12%] on investment.

C3.2
The carrier should be able to pay the terminal a sufficient portion of the fare to amortize and maintain the floating facility.

Evaluation

S1/S2
Northern and Southern Sites

In examining travel from a San Francisco downtown airport facility it is immediately apparent that the major portion of the traffic will be on the San Francisco to Sacramento route. While Monterey, Fresno, Stockton, and Santa Rosa provide other possible sources of traffic, the magnitude of such demand is relatively small. It was, therefore, decided to base the economic study on the Sacramento route with the thought that not including service to these other destinations would make the study somewhat conservative.

This investigation of a QSTOL system between a floating San Francisco STOLport and Sacramento comprises development of passenger demand as a function of fare level for 1980 and 1985, and calculation of the fare levels needed to provide profit factors of 15% and 30% as a function of total patronage. These relationships are compared and the pre-tax return on investment of the system is calculated. The potential of the system (or covering infrastructure maintenance, operating and amortization expense) also is illustrated.

System Demand:
The estimate of the future demand for a QSTOL system is based on work performed at Stanford University by graduate students in a course on Short Haul Transportation. The method is discussed in bibliography reference 40.

The fraction of total Bay Area - Sacramento traffic originating in an appropriate patronage area for a STOLport located in the downtown waterfront area of San Francisco has been obtained by calculating the San Francisco County portion of total Bay Area traffic and then applying the percentages of San Francisco traffic originating in BASAR (Bay Area Study of Aviation Requirements) zones 1-5 and 7-10 derived in bibliography Reference 40. **The traffic from these nine BASAR zones which make up the STOLport patronage area represents the demand for all modes of transportation between that CBD area and Sacramento in 1970, and is shown in** Table T2.

Projection of demand figures for 1980 and 1985 was accomplished by using a gravity model to estimate the increased levels of total Bay Area - Sacramento demand in those years, and the revised ratios of BASAR zone traffic to San Francisco Bay Area traffic developed in bibliography reference 40. **The resultant demand figures are shown in** Table T3.

This total demand is divided between private auto, conventional aircraft (CTOL), and short take-off and landing (QSTOL) floating STOLport systems using the modal split method illustrated in Figure F30. **Access costs are charged to the air systems at the rate of $2.50 for mileage and parking at San Francisco International Airport (SFO) for the CTOL system, $1.10 in San Francisco for the STOLport access, and $1.10 for both systems in Sacramento, Total trip time is assumed to be 125 minutes for auto, 85 minutes for CTOL, and 65 minutes for QSTOL. The total perceived trip cost and the share of the traffic attracted by the QSTOL system is shown as a function of ticket cost for travelers valuing their time at $5/hour and $10/hour in** Figures F31 and F32 **respectively and in** Table T3.

System Operating Costs:
The system operating cost plus some profit margin determines the necessary fare which can be expressed as:

Fare = P (DOC + IOC)/(fm)

where DOC is the annual direct operating cost of all aircraft in the system, including such items as fuel, crew, etc. . .
IOC is the annual indirect operating cost of the system, including facilities, sales reservations, advertising, etc. . .
f is the average load factor
m is the maximum number of passengers/year
P is the profit factor

QSTOL service is expected to be primarily a commuter service similar to that conducted by Pacific Southwest Airlines (PSA). PSA data indicate an IOC of about $4.50 per passenger. Because of inflation this value has been increased to $5.00 per passenger.

The DOC estimates used in this study assume the use of DeHavilland of Canada DHC-7 tuboprop QSTOL aircraft. Based on 3,000 hours per year utilization, the

manufacturer estimates a DOC of $0.034 per available seat mile at this stage length (57). As each aircraft can provide 360,000 seat-trips over the 79-mile distance per year, the system DOC per aircraft will be $967,000.

The choice of profit factor has a profound influence on both the revenue generation and patron attractiveness of the system. The appropriate fare for the two profit factors investigated, 1.15 and 1.30 was determined by assuming a 65% load factor which is generally taken to be the maximum consistent with a good peak hour service.

It should be noted that this maximum load factor is used in determining the necessary fleet size as well. These required fares may be obtained from the following relationship:

$$\text{Fare} = P\left(\frac{n \times 967{,}000 + 5.00 \times fm}{fm}\right)$$

$$= P\left(\frac{967{,}000}{360{,}000} \times \frac{1}{f} + 5.00\right)$$

$$= P\left(\frac{2.69}{f} + 5.00\right)$$

where: n = fleet size
m = $n \times 360{,}000$

Solutions of this equation for values of the load factor, f, from 0.25 to 1.00 are shown in Table T4 for profit factors of 1.00 (breakeven), 1.15 and 1.30. The resulting values of fare are plotted as a function of demand in passengers per year. When the load factor exceeds 65%, an additional aircraft is obtained causing the discontinuous curves. Required number of aircraft are shown on the abscissa. The fare charged by the carrier yielding 15% and 30% profit factors at 65% load factors are $10.51 and $11.88 respectively.

Using these fares the pre-tax return on investment may be calculated as a function of load factor. It is assumed that the initial cost of each aircraft is $2 million and that an additional 30% must be invested in spares and equipment, for a total of $2.6 million per aircraft.

Return on Investment:

$$\text{ROI} = \frac{\left[\text{actual fare} - \text{breakeven fare (at actual f)}\right] \times (fm)}{n \times 2{,}600{,}000}$$

$$= \frac{360{,}000 \times f \left[\text{actual fare} - \text{breakeven fare}\right]}{2{,}600{,}000}$$

$$= .138f\ (10.52 - \text{breakeven fare}) \text{ for a desired } P = 1.15$$

$$= .138f\ (11.88 - \text{breakeven fare}) \text{ for a desired } P = 1.30$$

The assumptions of cost have presumed pre-existing facilities, which is obviously not the case of a Central Business District (CBD) STOLport. An important question therefore is that of system potential for generation of revenues to support operation of such a new facility. This has been investigated by calculating the effect of adding a simple surcharge to the basic fare charged to passengers who pass through the CBD STOLport. The basic fare, either $10.51 or $11.88, is assumed to include as part of the ICC a $0.50 landing fee, so an average of $0.25 per passenger would accrue to the terminal operator even in the absence of any surcharge. (See Figures F8 and F9, p.13.)

Addition of a surcharge on each arriving or departing passenger has the effect of increasing the terminal operator's revenues, while depressing the demand of the system. The results of a schedule of possible surcharges on total demand, terminal operator revenue and carrier ROI are shown in Table T5 (P = 1.15) and Table T6 (P = 1.30). The discontinuities in ROI are a result of the reduction of demand to the point where one less aircraft is required to accomodate the demand without exceeding the 65% average load factor. Potential terminal operator revenues are displayed as a function of surcharge in Figures F8 and F9.

Conclusions:
Examination of Figures F31 and F32 (p.47) reveals the fact that there is not generally a matching of supply and demand due to the small fleet needed to handle the San Francisco - Sacramento QSTOL service demand, and the lack of a plausible connecting route structure. Demand in the absence of surcharge is generally sufficient to require an average load factor in excess of 65%, or operation of an additional aircraft at reduced yield. A more likely alternative is, of course, the addition of a surcharge to the basic fare to absorb excess demand and create necessary revenues for the STOLport operator.

Perusal of Table T5 clearly shows that the margin between the maximum 65% and breakeven 56.5% load factors at a fare of $10.51 is inadequate to provide an adequate degree of corporate security. A fare of $11.88 results in a breakeven average load factor of 50.0% and this margin results in substantially more acceptable ROI, as may be seen in Table T6.

Figure F9, p.13, shows the potential revenue to the floating terminal operator as a function of ticket surcharge above the basic $11.88 level. In 1980, these revenues level out at $1.55 million/year with an average value of time of $5/hour, and $4.25 million with a time value of $10/hour.

Since the average time value is probably closer to $5/hour than $10/hour, the maximum revenue to the STOLport is probably of the order of $2 million/year. When a basic fare of $11.88 is charged, 1980 traffic is reduced by one-half upon imposition of a $5.50 surcharge with a $5/hour time value, and an $8.00 surcharge with the time value is $10/hour.

With a $6/hour value of time, and a $3.50 surcharge, the traffic in 1980 would be about 490,000 passengers per year. This could be served by two or three aircraft. Terminal revenue would be $1,600,000.

In addition to the potential revenues to the STOLport discussed above, there are sizable possible additional sources of income. These include some traffic from other city pairs not specifically included in this analysis, parking fees, rental from food service and bar concession facilities, and taxi fees.

Funds permitting, the Department of Transportation ADAP program is expected to provide up to 81% of the development cost of those portions of the STOLport which are considered as the landing facility. The total capital cost of the floating STOLport has been estimated at about $22,500,000 of which $17,080,000 qualifies for ADAP funds. The remaining cost to be amortized is $5,420,000. If the amortization period is assumed as 10 years at 7% interest, the annual cost is $755,765. With an income of $1,600,000, about $840,000 per year would be available to cover STOLport maintenance and operation.

It must be concluded that with the anticipated federal government support, the floating STOLport would meet the criteria established for economic impact.

T2
Projected Traffic Demand: Bay Area to Sacramento and QSTOL Area to Sacramento

Year	Total Bay Area-Sacramento Demand (One-way Trips)	QSTOL Area-Sacramento Demand (One-way Trips)
1970	13,096,000	1,969,600
1980	22,280,000	3,431,000
1985	29,811,000	4,472,000

T3
Total Perceived Trip Cost: QSTOL

Value of Time		QSTOL Annual Demand ($\times 10^6$)			
$5/hr	$10/hr	$5/hr		$10/hr	
		1980	1985	1980	1985
13.62	19.37	1.238	1.614	1.761	2.296
15.62	21.37	.916	1.194	1.493	1.946
17.62	23.37	.681	.888	1.257	1.639
19.62	25.37	.513	.668	1.056	1.377
21.62	27.37	.391	.510	.887	1.157
23.62	29.37	.303	.395	.747	.974
25.62	31.37	.239	.311	.631	.823
27.62	33.37	.191	.248	.536	.698

F30

Representative Modal Split Calculation: San Francisco Civic Center to Sacramento State Capital

$$\% \text{ QSTOL} = \left[1 + \left(\frac{\$\text{QSTOL}}{k\,\$\text{AUTO}}\right)^{\gamma} + \left(\frac{\$\text{QSTOL}}{\$\text{CTOL}}\right)^{\gamma}\right]^{-1}$$

where: $\gamma = 3.2$; $k = 0.83$

Auto Total Perceived Trip Cost	= \$AUTO = (\$0.0425/mile)(102 miles) + (time values)(125/60) = \$4.335 + 2.083 (time value) = \$14.75 at \$5.00/hour = \$28.18 at \$10.00/hour
CTOL Total Perceived Trip Cost	= \$CTOL = Fare + S.F. access cost + SAC access cost + (time value)(85/60) = \$8.00 + \$2.50 + \$1.10 + (time value)(85/60) = \$18.68 at \$5.00/hour = \$25.77 at \$10.00/hour
QSTOL Total Perceived Trip Cost	= \$QSTOL = Fare + 2 (access cost) + (time value)(65/60) = Fare + \$2.20 + (time value)(65/60) = Fare + \$7.62 at \$5.00/hour = Fare + \$13.37 at \$10.00/hour

For a time value of \$5.00/hour and a fare of \$8.00 for the QSTOL:

$$\% \text{ QSTOL} = \left[1 + \left(\frac{15.62}{.83 \times 14.75}\right)^{3.2} + \left(\frac{15.62}{18.68}\right)^{3.2}\right]^{-1}$$

$$= [1 + (1.276)^{3.2} + (0.836)^{3.2}]^{-1} = [3.74]^{-1}$$

$$\% \text{ QSTOL} = 0.267 = 26.7\%$$

T4

Fares Determined by Load Factor, f, and Profit Factor, P.

Direct Operating Cost = \$967,000/aircraft/year
Indirect Operating Cost = \$5,000/passenger

Load Factor, f	Passengers/ Aircraft/ Year	Fare according to Profit Factor		
		P = 1.00	P = 1.15	P = 1.30
.25	90,000	15.76	18.12	20.37
.30	108,000	13.97	16.06	18.16
.35	126,000	12.69	14.59	16.50
.40	144,000	11.73	13.48	15.25
.45	162,000	10.98	12.62	14.27
.50	180,000	10.38	11.94	13.49
.55	198,000	9.89	11.37	12.86
.60	216,000	9.48	10.91	12.32
.65	234,000	9.14	10.51	11.88
.70	252,000	8.84	10.17	11.49
.75	270,000	8.59	9.87	11.17
1.00	360,000	7.69	8.84	10.00

T5
Effect of Surcharge on Total Passenger Demand, Terminal Operator Revenues and Carrier Return on Investment. (P = 1.15)

Basic fare is $10.51 which, without surcharge, yields a 15% carrier profit factor (12.3% ROI) at 65% load factor.

Time Value = $5/hour

Surcharge	Passenger Demand (10^6)		Terminal Revenues (10^6)		% ROI	
($)	1980	1985	1980	1985	1980	1985
0.00	.640	.831	.160	.208	7.9	6.7
0.50	.595	.772	.446	.579	4.7	3.6
1.50	.513	.668	.898	1.169	- 1.1	9.9
2.50	.448	.590	1.232	1.623	10.1	4.3
3.50	.391	.510	1.466	1.913	4.1	- 1.3
4.50	.340	.452	1.615	2.147	- 1.3	10.6
5.50	.303	.395	1.742	2.271	- 5.2	4.6
6.50	.272	.351	1.836	2.369	- 8.5	- 0.1
7.50	.239	.311	1.852	2.410	-12.0	- 4.3
8.50	.214	.275	1.873	2.406	8.0	- 8.2
9.50	.191	.248	1.862	2.418	3.2	-11.1

Time Value = $10/hour

($)	1980	1985	1980	1985	1980	1985
0.00	1.205	1.576	.301	.394	5.2	10.4
0.50	1.154	1.510	.866	1.133	11.6	8.4
1.50	1.056	1.377	1.848	2.410	7.5	11.3
2.50	.972	1.266	2.673	3.482	3.9	7.4
3.50	.887	1.157	3.326	4.339	9.7	11.7
4.50	.819	1.059	3.890	5.030	6.1	7.5
5.50	.747	.974	4.295	5.601	2.3	4.0
6.50	.687	.891	4.637	6.014	11.2	9.9
7.50	.631	.823	4.890	6.378	7.2	6.3
8.50	.581	.760	5.083	6.650	3.7	3.0
9.50	.536	.698	5.226	6.806	0.5	12.0

T6
Effect of Surcharge on Total Passenger Demand, Terminal Operator Revenues and Carrier Return on Investment. (P = 1.30)

Basic fare is $11.88 which, without surcharge, yields a 30% carrier profit factor (24.6% ROI) at 65% load factor.

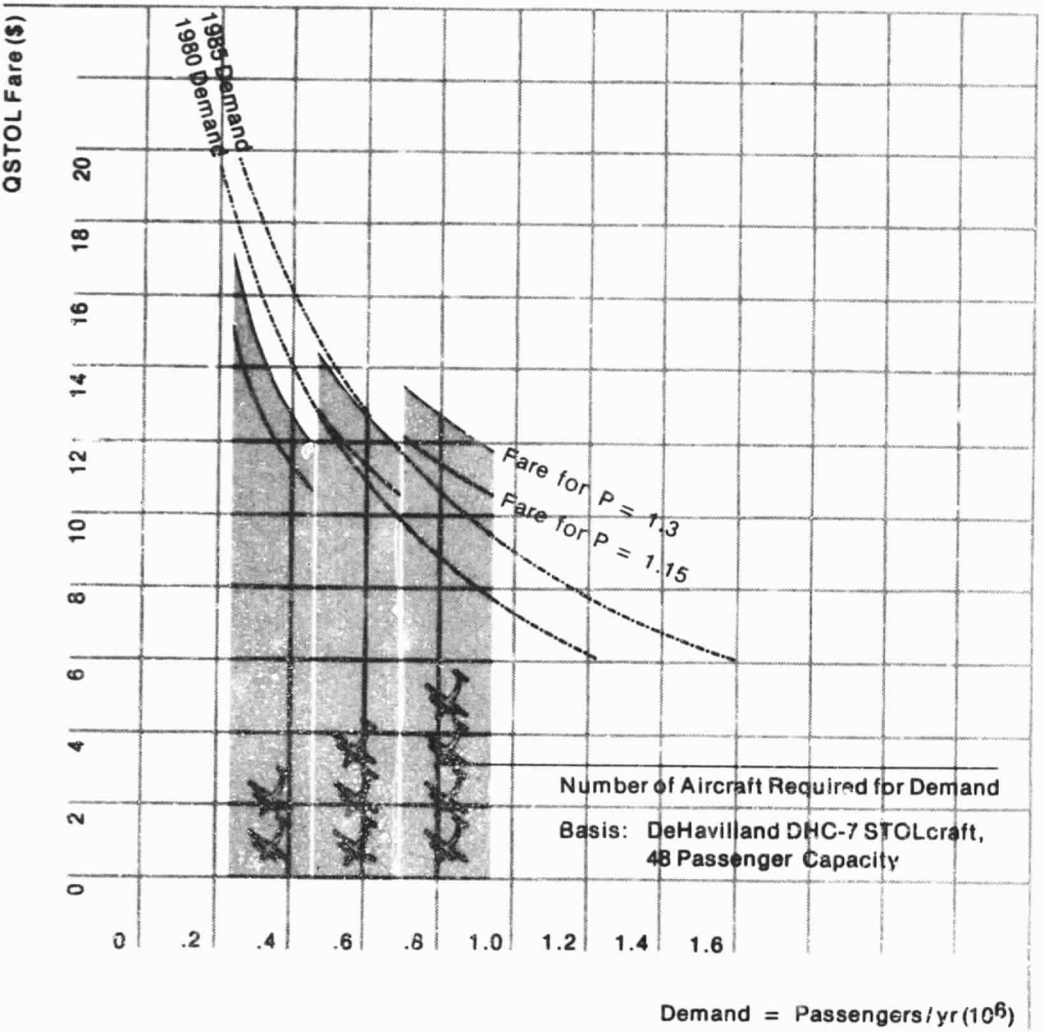
Time Value = $5/hour

Surcharge	Passenger Demand (10^6)		Terminal Revenues (10^6)		% ROI	
($1)	1980	1985	1980	1985	1980	1985
0.00	.522	.685	.131	.171	8.7	23.1
0.50	.486	.639	.366	.479	5.8	19.1
1.50	.421	.560	.737	.980	18.4	12.1
2.50	.370	.490	1.018	1.348	11.7	6.0
3.50	.325	.430	1.219	1.613	5.7	19.6
4.50	.289	.380	1.373	1.805	0.9	13.0
5.50	.260	.336	1.495	1.932	- 3.0	7.1
6.50	.229	.294	1.546	1.985	23.3	1.5
7.50	.202	.261	1.566	2.023	16.2	- 2.9

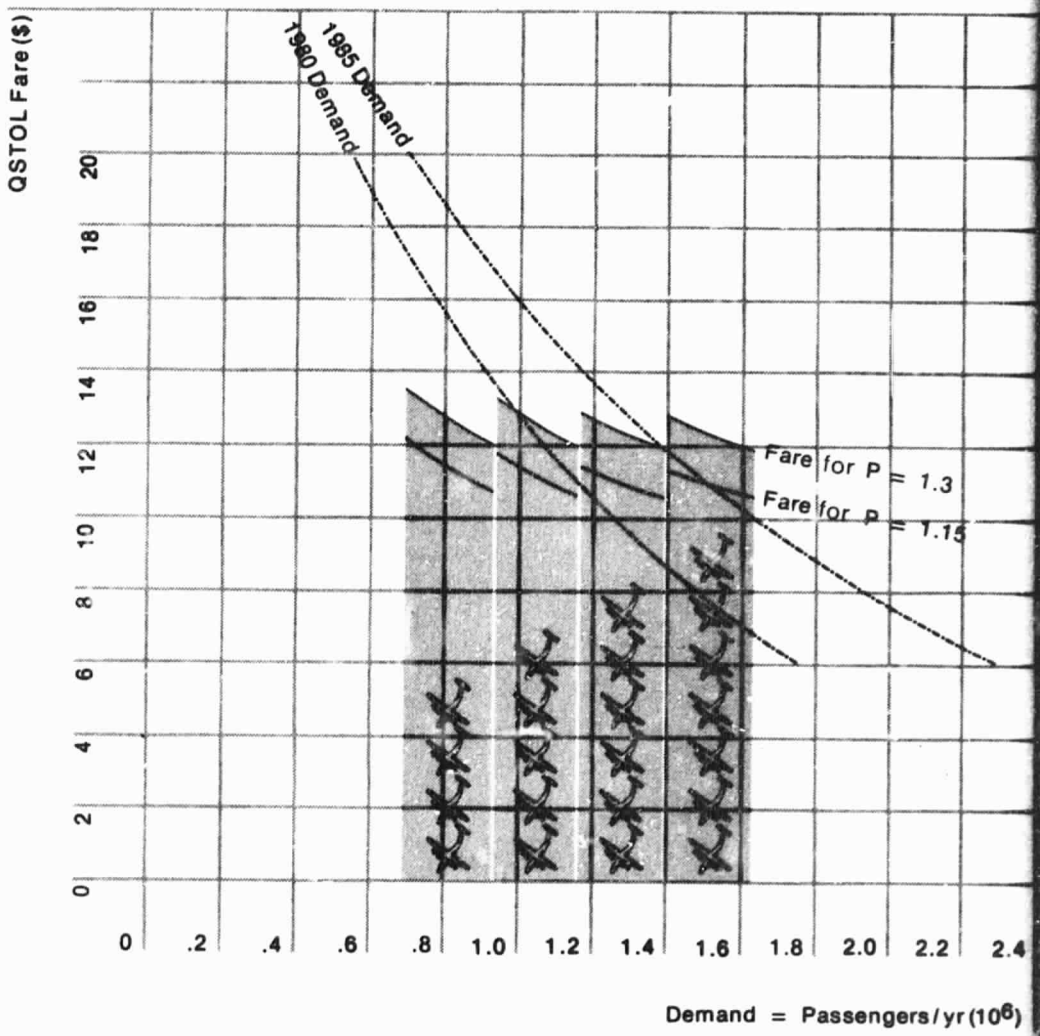
Time Value = $10/hour

($)	1980	1985	1980	1985	1980	1985
0.00	1.070	1.398	.268	.350	19.3	24.4
0.50	1.026	1.338	.770	1.004	17.0	21.7
1.50	.940	1.223	1.645	2.140	12.4	16.6
2.50	.860	1.120	2.365	3.080	19.6	22.0
3.50	.794	1.021	2.978	3.829	15.3	16.7
4.50	.753	.940	3.434	4.465	10.6	12.4
5.50	.667	.865	3.835	4.974	21.6	20.0
6.50	.610	.800	4.118	5.400	16.5	15.7
7.50	.568	.736	4.402	5.704	12.8	11.4

F31
QSTOL Fare vs Demand for Time Value = $5.00/hr



F32
QSTOL Fare vs Demand for Time Value = $10.00/hr



Det

Criterion

C4
Access

C4.1
The proposed STOLport should provide quick and convenient ground access for its users.

C4.1.1
Travel time to the proposed STOLport should be 10 minutes or less.
C4.1.2
Access should involve a minimum of transfers between transportation modes.
C4.1.3
The user should have a choice of ground access modes to the proposed STOLport.

A main promise for the viability of QSTOL for urban areas is in quick and easy access between user origin and destination points. This is one area where QSTOL must offer a clear advantage over conventional air service in order to be competitive. Because QSTOL planes considered here are slower than conventional aircraft, time savings to the passenger must occur in access and check-in/boarding procedures. Access time to San Francisco International is between 20 and 45 minutes from the Central Business District. To overcome a slightly longer flight time plus offer an incentive for use, access time to the STOLport should be 10 minutes or less.

The pattern of use would have an effect on average access distance: such as where each traveler started his trip and which type of ground transit he used. Origin and destination points outside the Central Business District probably would cause access distance and time to increase. Beyond an access range of 25 minutes, passengers would probably seek service at other airports or drive to their destination point. The proposed STOLport should be located convenient to the largest number of potential users. It has been assumed that greatest patronage would be generated during weekdays by business located in the San Francisco Central Business District. However, other potential sources of passengers have been considered, such as upper income residents who might use QSTOL for recreational travel during off-peak hours and weekends.

C4.2
The proposed STOLport should support comprehensive transportation policies of the regional and local governments.

C4.2.1
The 'city-centered' concept of the Bay Region should be strengthened by utilizing the transportation systems to guide development.
C4.2.2
Public transit should provide a convenient and efficient alternate to automobile use.

In the San Francisco Bay Area and the City of San Francisco, there are a number of agencies responsible for transportation operations and planning, including the Metropolitan Transportation Commission (MTC), the San Francisco Public Utilities Commission, and the San Francisco City Planning Commission.

Basically, their policies respect the use of the transportation system to strengthen the Association of Bay Area Governments 'city-centered' concept for the Bay Region, with preference for public transit over private. Public transit should provide a convenient and efficient alternate to automobile use. This concept can be aided by intensifying transit service in the central area, clarifying routing, encouraging privately operated transit, providing transit between residential areas and employment centers outside the downtown area, and by establishment of 'transit centers' at off-street terminals (30).

Furthermore, design of the transportation system can be used to guide development, control noise and air pollution and preserve and protect views and natural landscape. Through traffic should be kept out of residential areas, and should be discouraged near parks and recreation areas.

The QSTOL system supports the concept of 'city-centered' development by creating a positive, direct link between major downtown areas of various cities, and by offering an incentive of convenient transportation service to businesses located in these areas.

At the regional service level, QSTOL should interface, where possible, with the Bay Area Rapid Transit (BART), Golden Gate Transportation District, Southern Pacific, and other regional transit systems. QSTOL should become an integral part of a multi-modal transportation system with STOLports located at key interchange points and transportation hubs of the inter-regional system.

Public transit and QSTOL shuttle bus should provide direct, frequent and convenient service between the Central Business District and the STOLport. Service to other major destination areas also should be provided. By increasing the convenience of mass transit, the use of private automobiles can be reduced.

Careful location of QSTOL, with respect to the reigional highway network (particularly freeway interchange points) and arterial streets, can aid QSTOL users from inside and outside the City as well as reduce impacts on local residents. Capacities and traffic volumes should be considered on streets where significant increases in traffic are expected to create or add to congestion.

Site Evaluation

S1
Northern Site

The proposed site is located less than 1-1/2 miles from the San Francisco Central Business District with access via the Sansome/Battery Street one-way couple that could be served easily by several existing public transit modes. With minor modifications in routing, both the Golden Gate Bridge Highway and Transportation District (GGBHTD) and the San Francisco Municipal Railway (Muni) could provide direct connecting bus service. The Muni's Route 42 along Sansome and Battery Streets could be extended two blocks at its northern turnaround, so that no transfers would be necessary from the Central Business District. Changes in GGBHTD routing to and from Marin County would be equally minor. Taxis and private autos would follow similar routing along the Sansome/Battery Street couple or the Embarcadero. QSTOL probably would provide a shuttle bus along these routes timed with flights to further the use of mass transit. Travel time would be about 6 minutes with auto or QSTOL shuttle, and about 8 minutes on Muni buses. Both Muni and QSTOL shuttle buses would provide direct service to the Bay Area Rapid Transit (BART) stations for regional access. (See Figure F10, p.14.)

Vehicular access from Marin County and many upper income areas of northwest San Francisco neighborhoods would be along Bay Street. Passengers from these areas are expected to increase the average access distance to 6 miles. This compares favorably to the average access distance of 21 miles to San Francisco International Airport.

Along Battery Street, the 24-hour traffic flow is 9,093 vehicles traveling towards the Central Business District, with 8,008 vehicles traveling away from the CBD on Sansome Street. The proposed STOLport would generate an additional 700 vehicles on each of these streets, which is within their capacities. The assumption that a majority of QSTOL passengers would travel along these streets in mass transit vehicles accounts for the low number of additional vehicles. (See Figure F33 for traffic volumes on major access routes.)

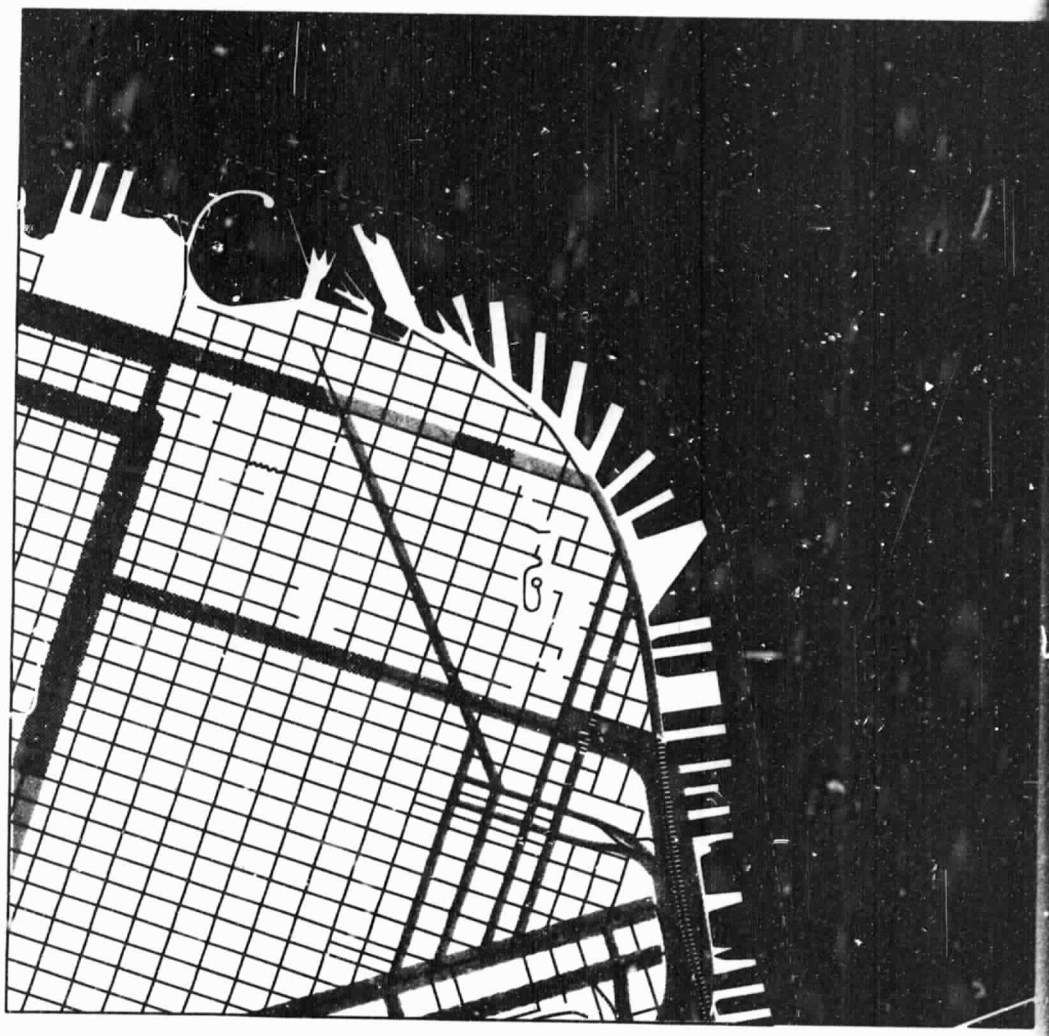
The current 24-hour traffic flow along Bay Street and the Embarcadero is 17,000 vehicles. A STOLport in the proposed location might generate another 1,000-1,500 vehicles per day. This would be especially undesirable along Bay Street because of the road width and the large amount of residential frontage. Because Bay Street is already over capacity at peak hours, the addition of QSTOL generated traffic is not desirable.

Figure F34 illustrates major one and two-way traffic in the northern site study area.

Limited parking would be provided on the piers adjacent to the STOLport. This would be necessary because of the already difficult parking problems in this area.

The proposed northern site meets the established criteria for access at this time.

F33
Traffic Volumes/S1



F33
Legend

Orientation

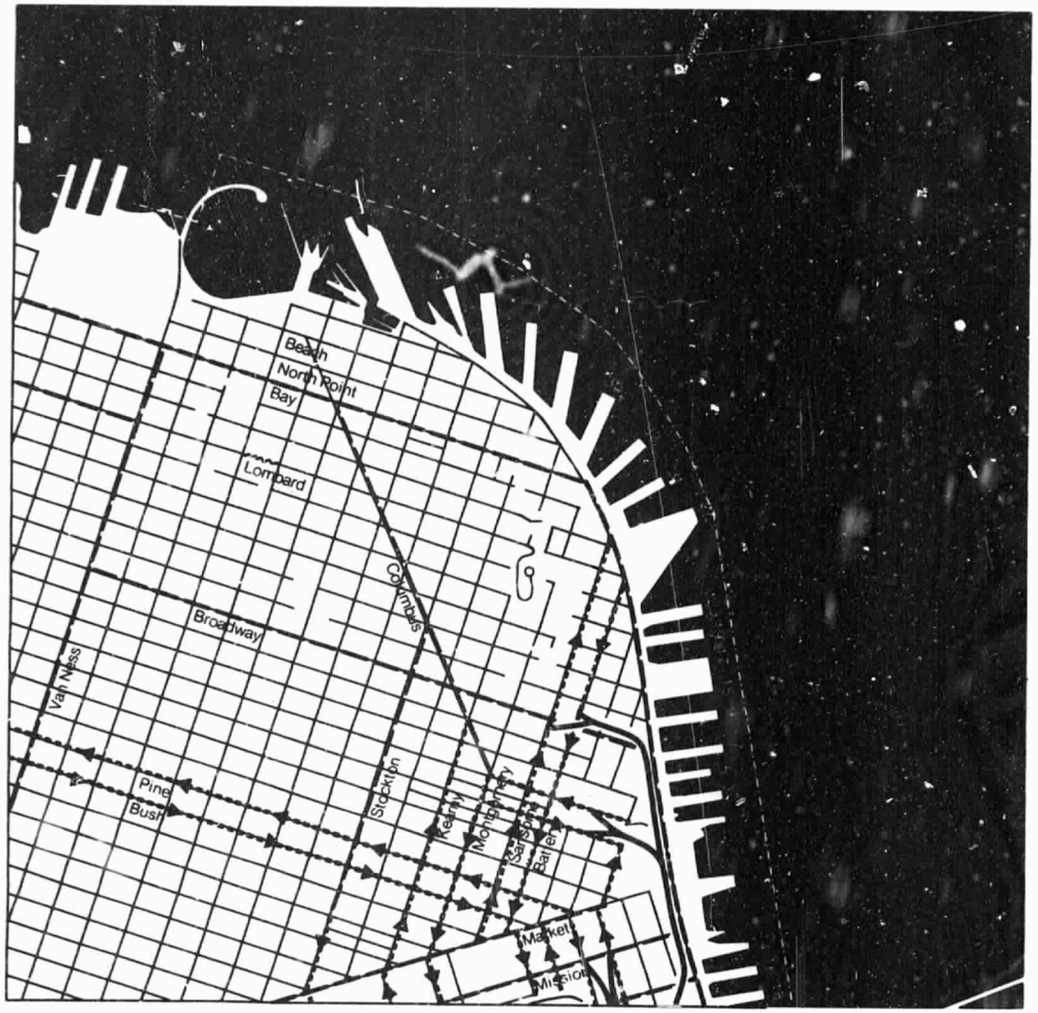
Scale — Feet 0 | 1000 | 2000

Residential Frontages

Peak Hour Traffic Volumes (10^3)

0
20
50
100

F34
Major One-Two Way Traffic / S1



F34
Legend

Orientation

Scale — Feet 0 | 1000 | 2000

Major One-Way Traffic

Major Two-Way Traffic

Freeway

S2
Southern Site

The proposed site is less than 2 miles from the San Francisco Central Business District (CBD) via the 3rd/4th Street one-way couple. The San Francisco Municipal Railway (Muni) currently provides service along 3rd Street and eventually this line will become an express feeder to the Montgomery Street BART Station. The existing 15 and 42 Muni routes could be altered to include the off-street terminal at the proposed STOLport. A private STOLport shuttle bus could provide additional direct access to BART, transbay terminals, the Financial District, and other key points. Travel time from the CBD would be 8 minutes by auto or shuttle bus, and about 10 minutes by Muni. Shuttle buses could be coordinated with QSTOL flights for maximum efficiency. (See Figure F11, p.15.)

The new Southern Pacific railroad station at 4th and Townsend with commuter service to the Peninsula is a 6-minute walk from the proposed site, but 1-minute shuttle service could be made available.

Southern Freeway (Hwy. 280) on-ramps at 4th Street and 18th Street would provide access to the regional highway system from the southern site. Traffic arriving from this source and from the 3rd/4th Street couple would have no impact on residential areas and only minor impact on the proposed Central Basin Park. In keeping with public transportation policies, public transit would be given priority in design of the QSTOL facility. However, limited automobile parking would be available at the outer portion of the pier to encourage use from areas where public transit is inadequate.

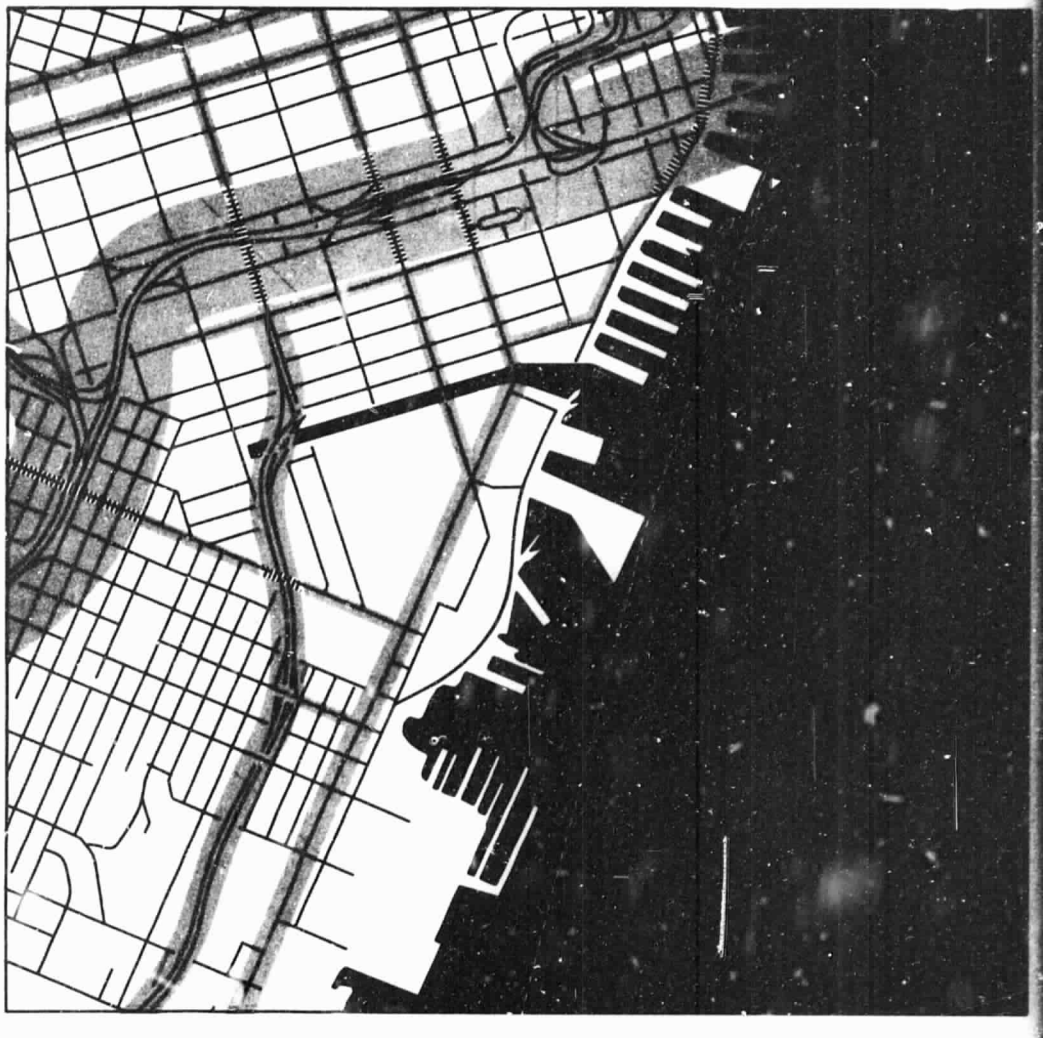
The current 24-hour traffic flow along 3rd Street is 27,800 vehicles traveling towards the CBD, with 17,961 vehicles traveling on 4th Street towards the STOLport. QSTOL would generate 1,000 additional vehicles on each of the streets, still within their capacities.

Traffic generated by the STOLport on 18th Street would be about 300 cars in addition to the 10,040 which already travel on it daily. (See Figure F35 for traffic volumes on major access routes.)

Figure F36 illustrates major one and two-way traffic in the southern site study area.

The proposed southern site meets the established criteria for access at this time.

F35
Traffic Volumes/S2



F35
Legend

Orientation

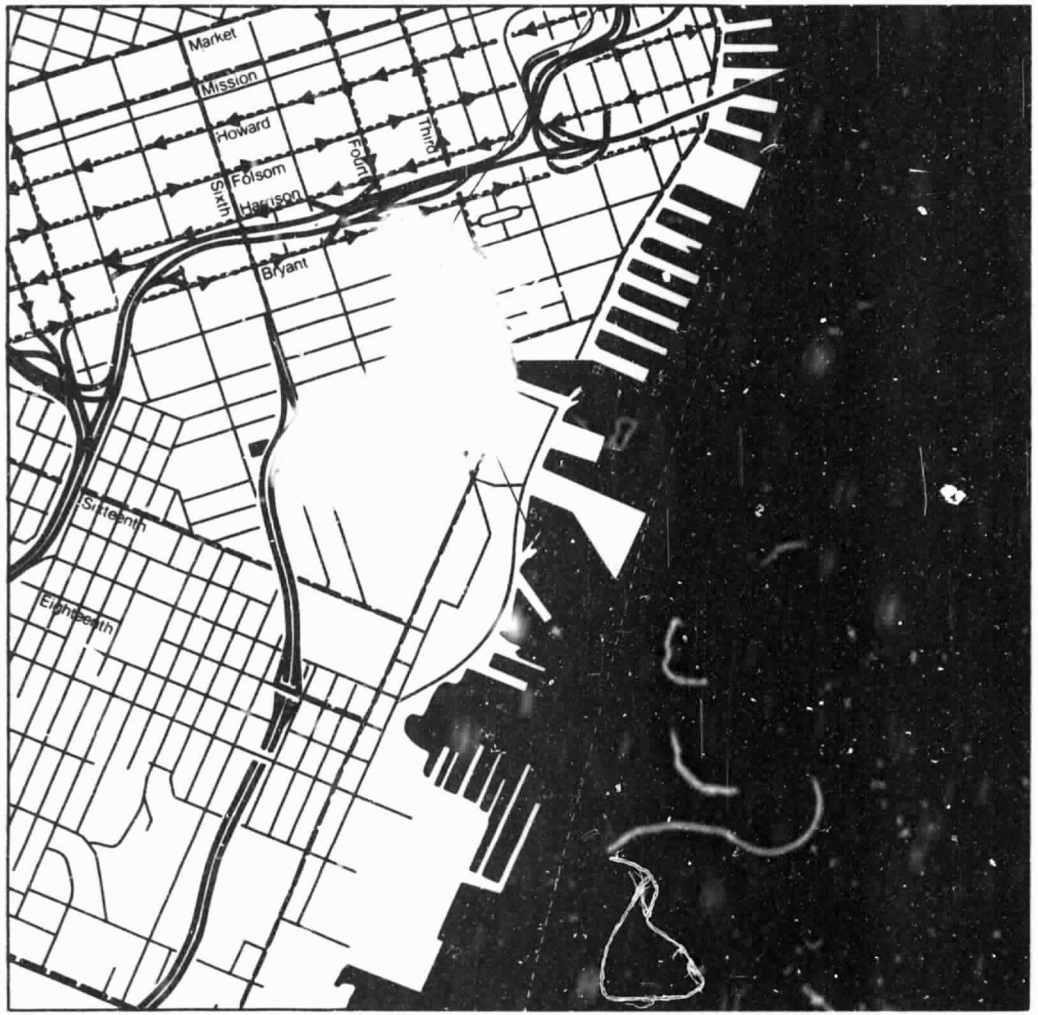
Scale — Feet 0 | 1000 | 2000

Residential Frontages

Peak Hour Traffic Volumes (10^3)

0
20
50
100

F36
Major One-Two Way Traffic / S2



F36
Legend

Orientation

Scale — Feet 0 | 1000 | 2000

Major One-Way Traffic

Major Two-Way Traffic

Freeway

Det

Criterion

C5
Visual Character

C5.1
The proposed STOLport should not create visual obstructions.

C5.1.1
STOLport development should respect major view corridors and vistas.

Particular consideration should be given to the San Francisco Bay and its shoreline as the region's most valuable visual asset. Views of landmarks and natural features should not be obscured.

San Francisco Bay is the single most unifying element of the entire Bay Region. It is considered a scenic resource of high value and an open space of special quality. Many planning policies reflect the importance of the Bay, especially the use of its shoreline. Views should not only be from the hills, but from lower levels as well, particularly along the Embarcadero. Major view corridors and broad vistas should both be respected (23). Maritime activities also should be considered as a source of visual interest. A working port, considered beautiful by some, provides a certain atmosphere and character that is appealing. It also gives a sense of history and tradition which more modern technologies may not. STOLport development should respect the policies which seek to protect these resources.

Preservation of significant features of the natural environment is important if QSTOL is to be accepted by a community which is aware of, and protective of, its visual surroundings.

C5.2
STOLport development should not diminish the visual character of, or cause visual blight to, neighboring communities.

C5.2.1
The scale, density, and intensity of use of existing buildings should be respected.
C5.2.2
Buildings and districts of exceptional architectural and historical merit should be preserved.
C5.2.3
Open space areas should be conserved.

San Francisco landmarks of architectural merit and historical interest, as well as entire districts of special character, should be preserved. Most communities are comprised of, and should maintain, a compatible scale and density of structures and intensity of use, so that when seen together they produce a total effect which characterizes that area. New developments should be harmonious with the existing visual fabric.

A structure of the potential size and bulk of a metropolitan STOLport should be located and designed to avoid creating physical or psychological barriers within a community. The STOLport's size should be compatible with that of nearby structures. And visually interesting areas should not be segregated or dominated by the presence of a STOLport.

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Site Evaluation

S1
Northern Site

The proposed site is situated in one of the most visually important areas of the San Francisco Bay. Treasure Island, Alcatraz Island, Telegraph Hill and the Golden Gate give even stronger visual definition to this already important area. Because of the size and bulk of the structure necessary for a STOLport, the visual character of this area would be negatively affected. A STOLport in this location would lessen the prominence of existing landmarks.

The location and orientation required, across the ends of the piers, and the 2,000 foot length conflict directly with urban design policy of the City's Comprehensive Plan, City Planning Policies and City Planning Code (23). These generally seek to open views of the Bay between the piers, especially along view corridors, and specifically in this area to eliminate the piers and create a waterfront park promenade with broad vistas. A STOLport here would visually block the view corridor down Stockton Street to the Bay, would partially obscure existing views from Fisherman's Wharf and would block development of the panoramic view called for in the Northern Waterfront Plan. (See Figure F12, p.16.)

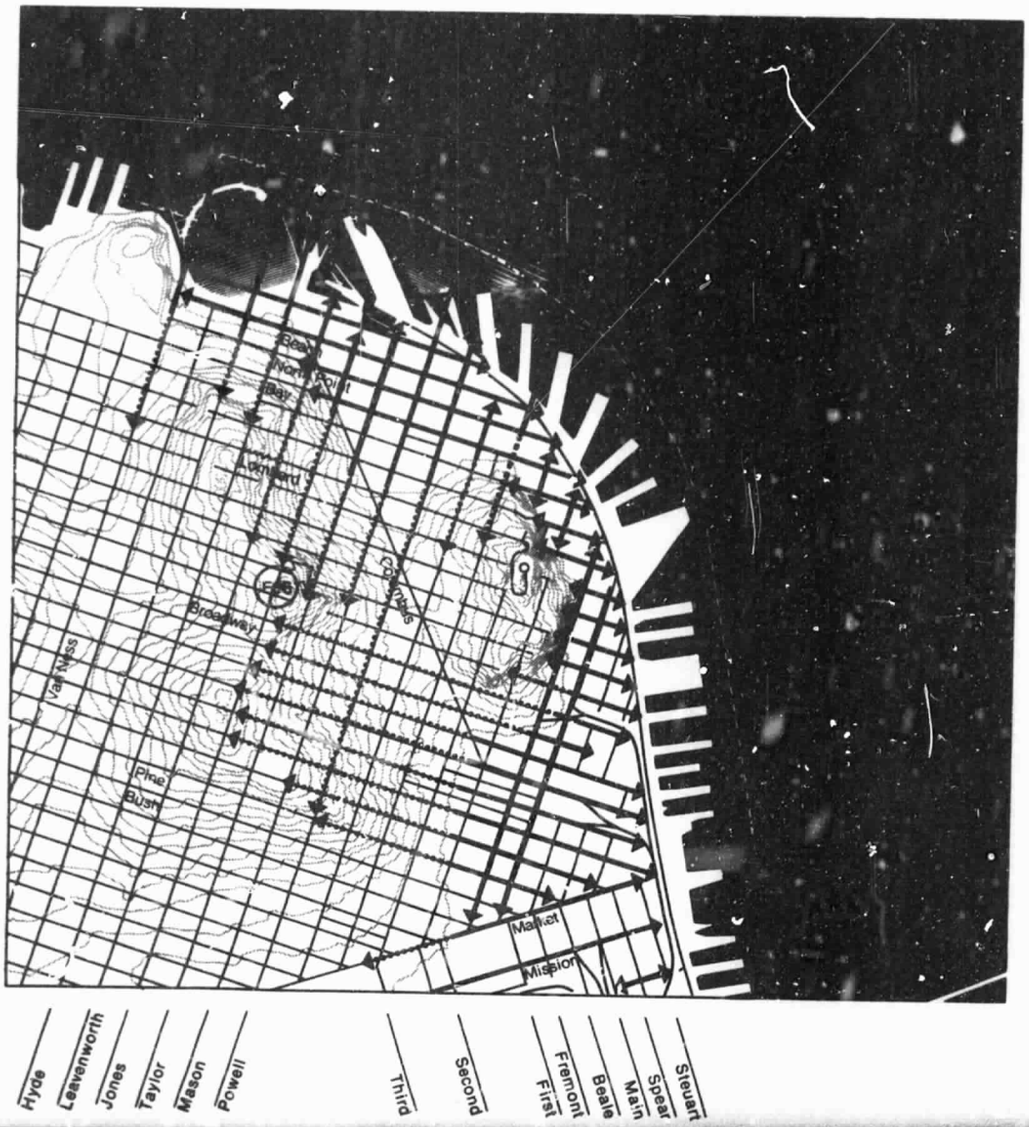
The proposed STOLport would also impair views from Telegraph Hill and Russian Hill residences and apartments. (See Figure F37.) The site area is comprised of a conglomeration of building types, restaurants, commercial facilities, railyards, and new apartments and offices. The only unifying factor seems

to be the maritime character of the wharf, the fishing boats, and old sailing ships. A conscious effort is being made to capitalize on that visual image and historical background. The modern technological character of a STOLport facility might provide an interesting juxtaposition of old and new, but more likely it would weaken the aesthetic and visual character of the area.

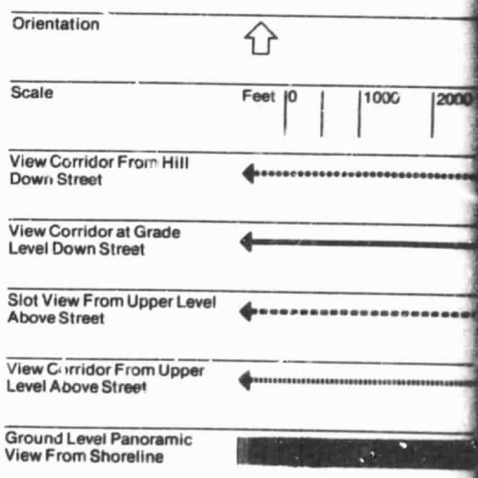
Figure F37 illustrates the existing view-sheds and view-corridors found in the northern site study area. Figure F38 a,b compares the existing view from Russian Hill with the view proposed.

The northern site is not compatible with the criteria for visual character at this time due to potential visual competition with existing landmarks, negative effects on the overall character of the area, and impairment of major views.

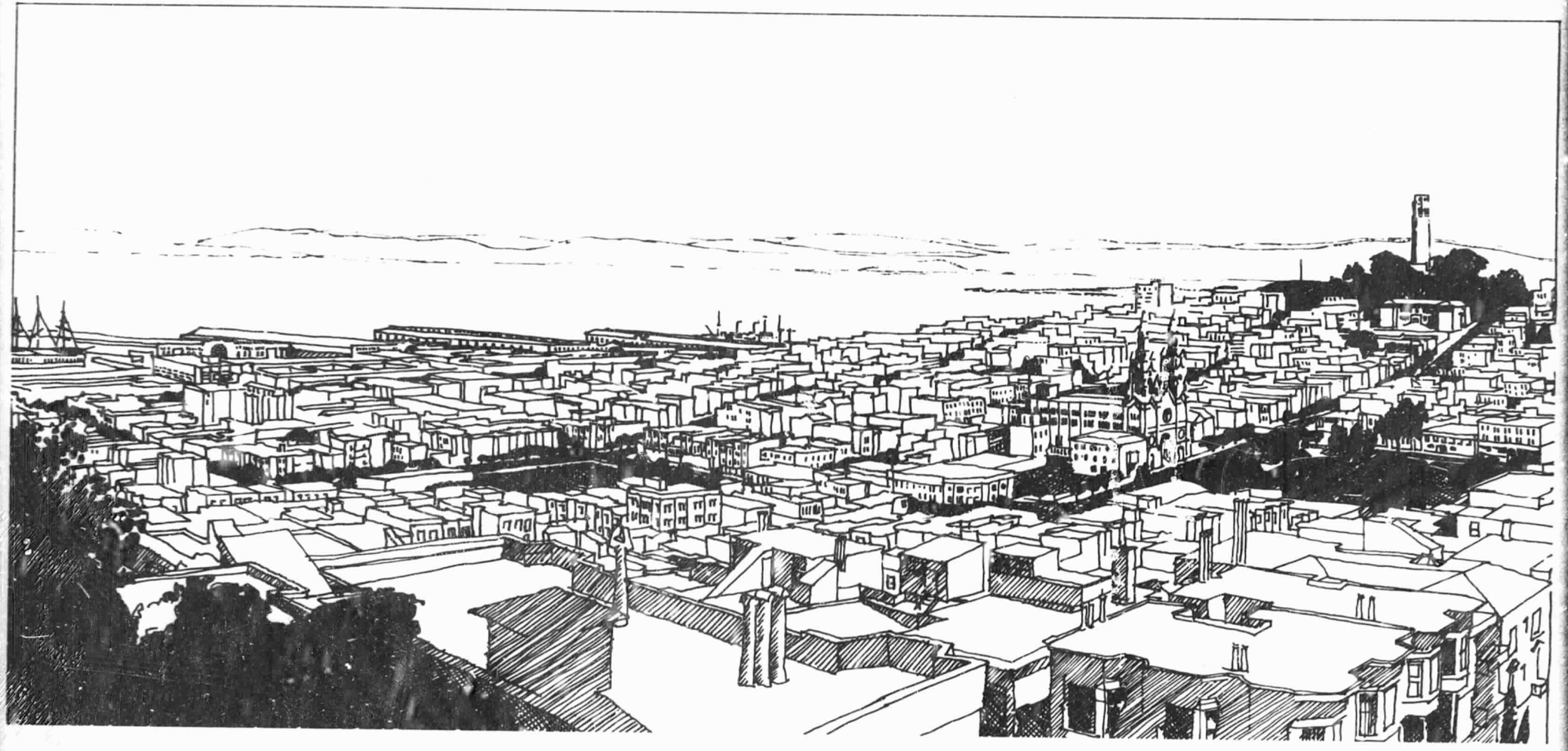
F37
Existing View-Sheds and View Corridors / S1



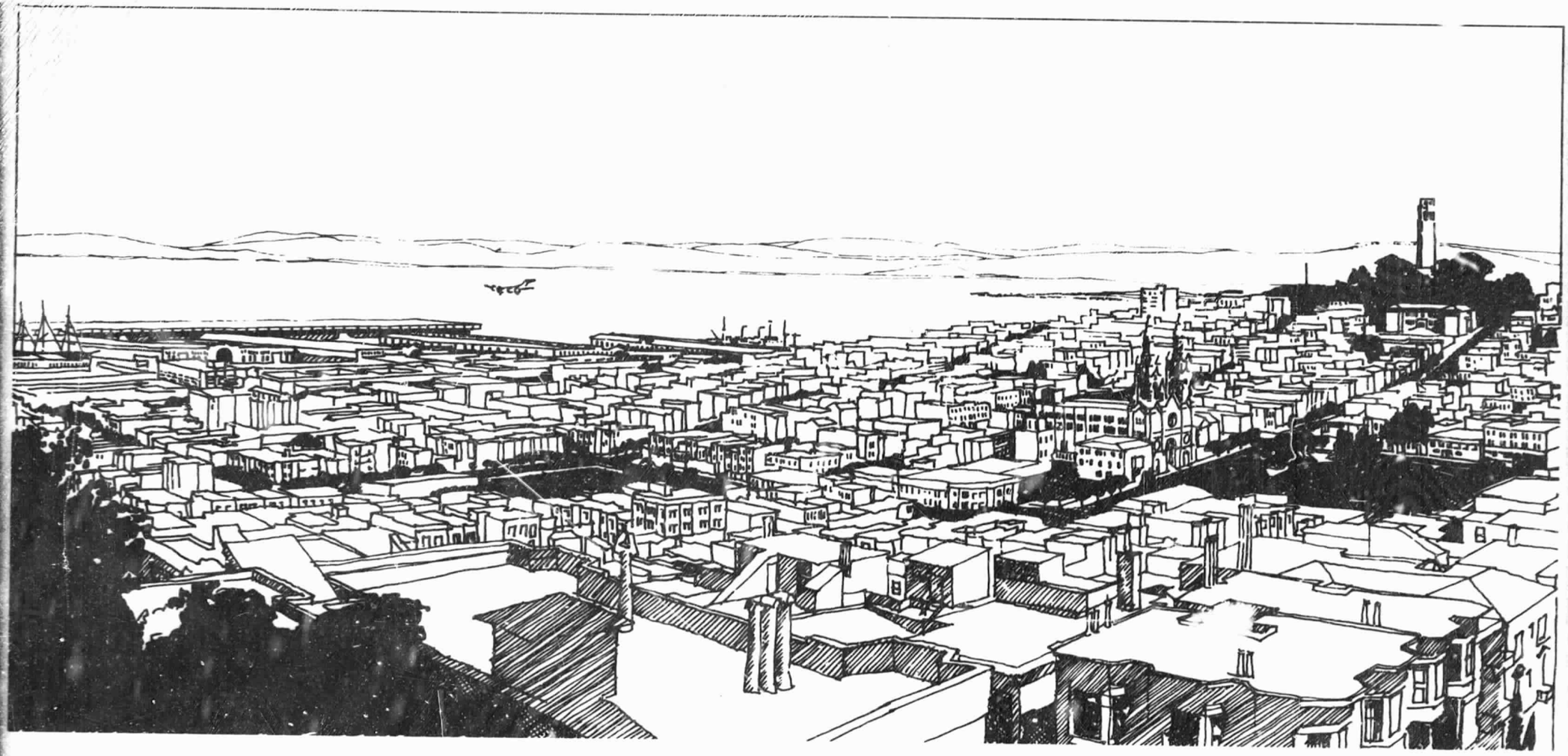
F37
Legend



F38a
Existing View of Northern Site From Russian Hill
(See Figure F37.)



F38b
Proposed View of Northern Site From Russian Hill
(See Figure F37.)



S2
Southern Site

The proposed site is located in an area of relatively low visual importance and definition. Railyards, warehouses, working piers and ship repair facilities are characteristic. A STOLport in the suggested orientation would cause slight disruption of views from Central Basin and China Basin Street. A well designed and landscaped STOLport facility could improve the appearance of the area along China Basin Street.

Because of its unique recreation potential, a 12-acre public park is being developed in Central Basin, about 1/3 mile from the proposed STOLport. The position of the runway would minimize any disruption of views from the park since ships and structures on Piers 50 and 54 already impair the view to the north. Views from a segment of the shoreline drive along China Basin Street would be reduced but not completely blocked. (See Figure F13, p.17.)

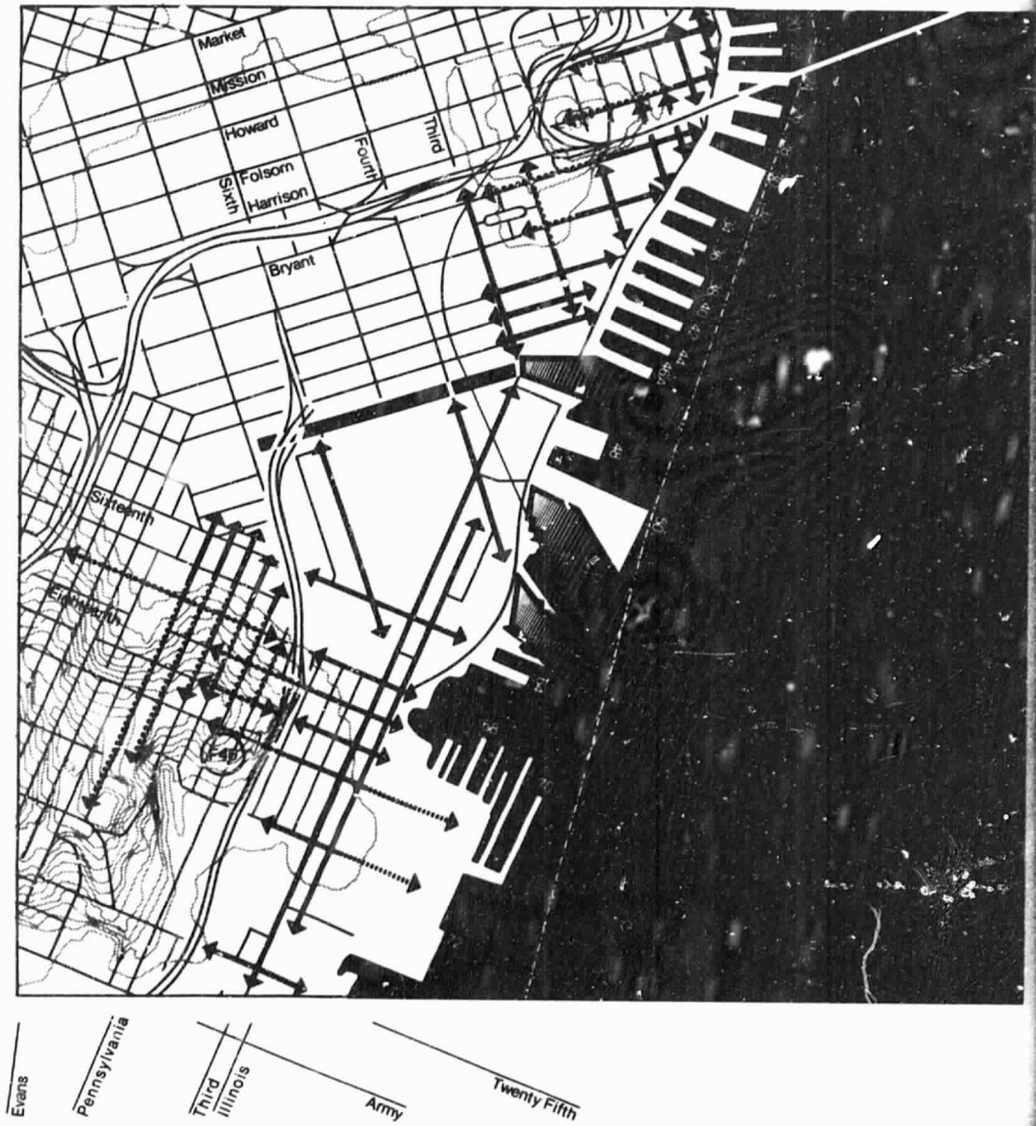
The proposed STOLport would be visible from Potrero Hill and the Southern Freeway but would be visually less significant than the nearby Mission Rock Terminal (Pier 50). (See Figure F39.) Pier 50 occupies 18 acres as opposed to 11 acres for the proposed STOLport. Height of structures for the two areas is equivalent, between 30 and 40 feet above the curb.

There are no significant structures or landmarks which would be visually affected by a STOLport at this site. The scale of other existing structures is visually compatible with that of a QSTOL facility. The slight disruption of views from China Basin Street would not be sufficient for the proposed STOLport to be classed as a major visual obstruction.

Figure F39 illustrates the existing view-sheds and view-corridors found in the southern site study. Figure F40 a,b compares the existing view from Potrero Hill with the view proposed.

The southern site meets the criteria for visual character at this time.

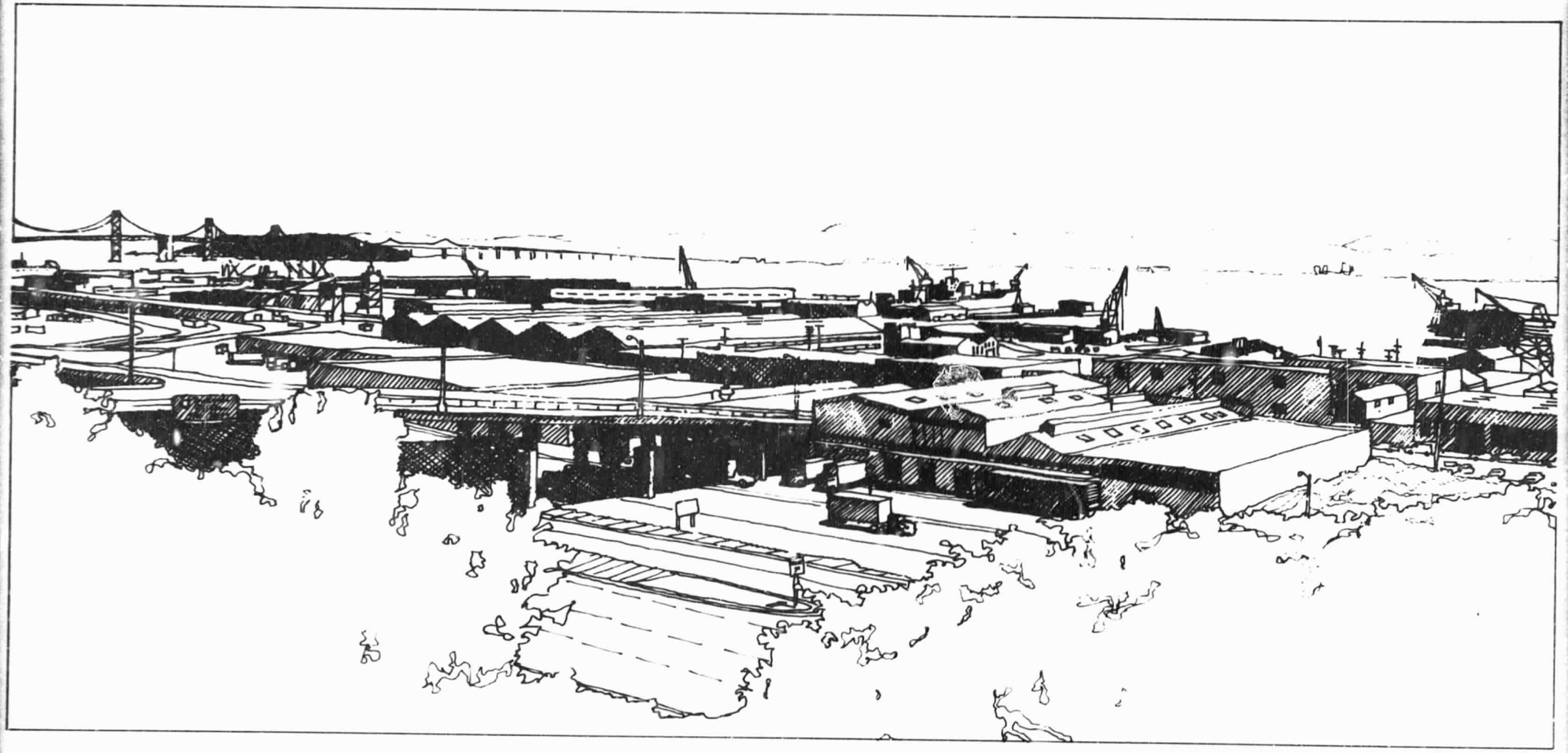
F39
Existing View-Sheds and View Corridors / S2



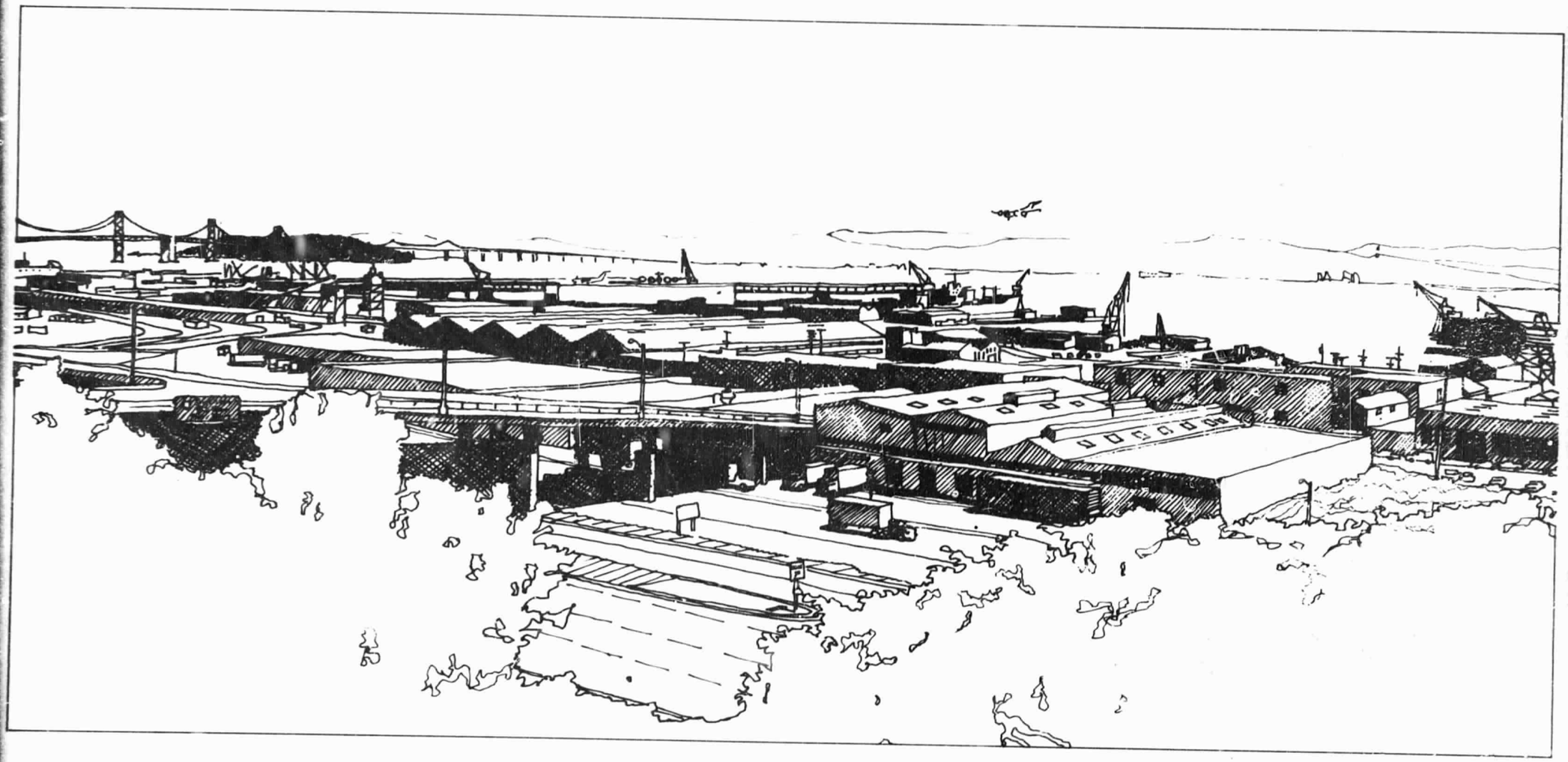
F39
Legend

Orientation	⇧
Scale	Feet 0 1000 2000
View Corridor From Hill Down Street	
View Corridor at Grade Level Down Street	
Slot View From Upper Level Above Street	
View Corridor From Upper Level Above Street	
Ground Level Panoramic View From Shoreline	

F40a
Existing View of Southern Site From Potrero Hill
(See Figure F39.)



F40b
Proposed View of Southern Site From Potrero Hill
(See Figure F39.)



Det

Criterion

C6
Noise

Noise is an unwanted by-product of most transportation systems, particularly aviation. Until recently, improvements in service and speed for the air traveler have been made at the expense of increased noise. Government regulations and new technological breakthroughs have produced aircraft which are significantly quieter. STOLcraft are among these new aircraft. However, STOLports face an additional problem of trying to locate in metropolitan centers where noise problems are more acute. The questions are: what noise limits are necessary or desirable for urban environments and are these requirements possible for QSTOL to achieve?

The effects of noise on public health and welfare is an area of important concern. Sound levels of 85 PNdB (Perceived Noise in Decibels) or over may be damaging to hearing, yet people are constantly subjected to levels higher than this in their daily lives. Maximum noise levels, commonly experienced, have been raising at the rate of 1 dB per year for the past 25 years. Noise from household appliances, especially in the kitchens easily produce from 90 to 100 PNdB, and traffic noises range from 85 to over 120 PNdB (11, p9). Continued exposure to high noise levels is not only annoying, it can become a health hazard.

C6.1
The proposed STOLport should avoid exposure of developed areas to excessive noise.

C6.1.1
QSTOL aircraft should be selected on the basis of minimum noise impact on urban areas.
C6.1.2
QSTOL aircraft should use noise abatement procedures to minimize effects to ground areas.
C6.1.3
The proposed STOLport and aircraft flight patterns should not be located near noise-sensitive areas.

One of the only quiet STOLcraft, which may be available by 1976, is the DeHavilland DHC-7 a 4-engine, turbo-prop aircraft, seating 48 passengers. Its sideline noise at take-off is 75 PNdB at 3,600 feet. The DHC-6 is a twin-engine turbo-prop with 19 passenger capacity and is quieter than conventional commercial aircraft. Because of its quieter noise characteristics, and larger capacity requiring fewer flights, the DHC-7 would be the preferable of the two aircraft.

Even with "quiet" aircraft, the noise impact on ground areas can be considerable, especially if flyover of urbanized land is involved. The advantages of small land area needed for the STOLport may be cancelled by the exposure of larger urbanized land areas to excessive noise. Location of the STOLport and its flight paths should be carefully considered to minimize noise impacts on developed areas.

C6.2
The proposed STOLport should meet all governmental regulations pertaining to aircraft noise.

C6.2.1
Noise levels should not exceed the background or ambient noise level by more than 5 dB.
C6.2.2
Noise levels should not exceed the limits for various zoning districts.

San Francisco Municipal Code

Zone	PNdB Max.	Time
Residential	62 to 72 PNdB	Depending on zone and time of day
Commercial	82 PNdB 72 PNdB	Daytime Nighttime
Industrial M-1 M-2	82PNdB 87 PNdB	Anytime Anytime

Various branches of the Federal government and state and local governments have set standards for maximum noise levels, emanating from aircraft, airports and other sources. The most restrictive, in this study area, is the noise ordinance of the San Francisco Municipal Code, which defines excessive as the noise level exceeding the background or ambient noise level by 5dB measured on the "A" scale. A 5 dB noise level difference is small but audible, while a 15 dB difference would be most annoying. The ordinance also sets maximum noise levels for each zoning district ranging from 62 PNdB to 87 PNdB. Although it does not specifically mention aircraft, the intent is clear (35).

There are two ways to control noise: reduction of noise at its source; and, alteration of the sound path by shielding or by distance. STOLcraft designers have made full use of technological capabilities to produce quiet aircraft. Current aircraft design enables noise abatement procedures utilizing steep climb and descent gradients to minimize the ground area affected. Control of the number of flights, hours of operation, and other procedures also can reduce noise perceived by the community. Careful location of the STOLport is the most effective control.

There are lesser noise related effects of QSTOL operation as well. Weather patterns, topographic features and placement of buildings may influence the way noise travels. The type of access mode and its routing or other supportive activities also may generate noise. Increased travel demand may affect the frequency of flights. All these factors must be taken into account, and any new noise sources must be able to meet government restrictions.

For this study, the ambient noise level

was measured on the "A" scale of a type II Simpson Model 885 sound level meter.

Noise level readings were taken for daytime and nighttime conditions on both weekdays and weekends. For comparison, all "A" scale readings were converted to PNdB by adding a factor of 13 dB. This scale is more clearly related to a person's day to day noise experiences. DHC-7 noise contours were overlaid on a map of ambient noise to determine how many acres of land were affected by excessive noise levels. 1970 census tract data were utilized to determine population density averages which were then used to approximate the number of persons affected for each time of day.

Site Evaluation

S1
Northern Site

Of the two aircraft considered for this study, the DeHavilland DHC-7 was selected on the basis of much quieter operation, and larger load capacity, and a satisfactory obstacle clearance capability at take off for the southern site. The higher capacity reduces noise impact at a STOLport by minimizing the number of flights necessary. Noise abatement procedures would additionally reduce the ground area affected.

The runway and flight paths for the proposed site are set as far as possible from land areas without interfering with navigational traffic. Despite this effort, the Northpoint residential area is less than 2,000 feet from the runway, and Fisherman's Wharf is less than 1,000 feet. Several new office buildings are also within the immediate area. (See Figure F14, p. 18.)

Daytime ambient noise levels range from 72 PNdB, in the residential zone, to 82 PNdB along the Embarcadero. QSTOL operations would exceed these levels by more than 5 PNdB for 47 acres, mostly on piers and along the waterfront, and a 6 acre portion of the Golden Gate National Recreation area. (See Figure F41.) Daytime population densities of close to 60 people/acre, for most of this area, cause approximately 2,784 persons to be affected. (See Figure F42.) STOLcraft would also slightly exceed the maximum permissible level for R-4 zones of 72 PNdB and for C-2 zones of 82 PNdB. Purchase of affected land areas or financial compensation would be prohibitively expensive because of the high property values. A noise variance may be possible for daytime operation.

Nighttime ambient noise levels of 68 to 73 PNdB would be exceeded by 5 dB over 163 acres. With a lower nighttime density of around 22 persons per acre, 3527 people would be affected. The R-4 zoning noise limit of 67 PNdB and the C-2 limit of 72 PNdB would be exceeded by 10 dB, although automobile traffic would mask the noise of the aircraft.

The northern site does not meet the criteria for noise at the present time.

F41
Areas Exceeding 5 dB Over Ambient With Day-Night Population Densities/S1

F41
Legend

Orientation ⇧

Scale Feet 0 1000 2000

F42
Estimate of Persons Subjected to Excessiv
Noise/S1

Daytime

Tract	Density	Acres Affected	Persons Affected
101	59.8	36	2,158
102	56.9	11	626
Total		47	2,784

Nighttime

101	19.4	137	2,464
102	40.9	26	1,063
Total		163	3,527

S2
Southern Site

The proposed runway location and flight paths cause considerable flyover of land, including office buildings between the Channel Street Canal and the Ferry Building, and the South Park residential area. (See Figure F15, p.19.)

Daytime operations would not be audible on Potrero Hill due to sufficient distance from the site and the masking effect by the Southern Freeway (Hwy. 280). Ambient noise on Potrero Hill is 73 PNdB. This level is 5 dB above the noise of a QSTOL aircraft taking off from the site perceived at the same location on Potrero Hill. (See Figure F44.)

Take-offs would be to the north, passing directly over an office building and exposing it to more than 90 PNdB. Considerable expense would be involved in relocating the office or in modifying the building to withstand that much noise. Further out, as the plane turns, it would pass over a small residential area in South Park which has a very high ambient noise level (84 PNdB); generated mostly by auto traffic on an elevated freeway and approaches to the Bay Bridge. Noise from QSTOL would be within 3 decibels of the background noise, about as noticeable as a passing car at 50 feet.

Noise levels within the new Central Basin Park would range from 70 PNdB to as high as 95 PNdB, at the end of the fishing pier, during a take-off. This exceeds the ambient noise level by 21 dB, and is considered excessive.

During the day, 331 acres would be subject to excessive noise. Population density for most of the area is around 27 people per acre, rising markedly towards the Central Business District and the Bay Bridge. Over 9,020 people would be affected by daytime operations. (See Figure F43.)

Noise limits for M-1 and M-2 zones would be exceeded by as much as 10 dB for both day and night.

Nighttime noise from QSTOL would be barely audible at Potrero Hill and would not exceed noise limits. At South Park, ambient noise falls to 79 PNdB at night, making aircraft noise of 86 PNdB clearly audible, even within dwelling units.

While nighttime ambient noise standards would be exceeded on 489 acres, only about 4,780 people would be affected due to drastic population drop at night.

Because of the large land areas and large numbers of people affected, the noise disturbance by QSTOL operations would be considered excessive for either day or night.

The southern site does not conform to the criteria for noise at the present time.

F43
Estimate of Persons Subjected to Excessive Noise/S2

Daytime

Tract	Density	Acres Affected	Persons Affected
179	55.6	50	2,780
180	70.0	10	700
226	29.1	16	466
607	19.9	255	5,076
Total		331	9,022

Nighttime

179	29.0	100	2,900
180	12.8	49	627
226	9.2	60	552
607	2.5	280	700
Total		489	4,779

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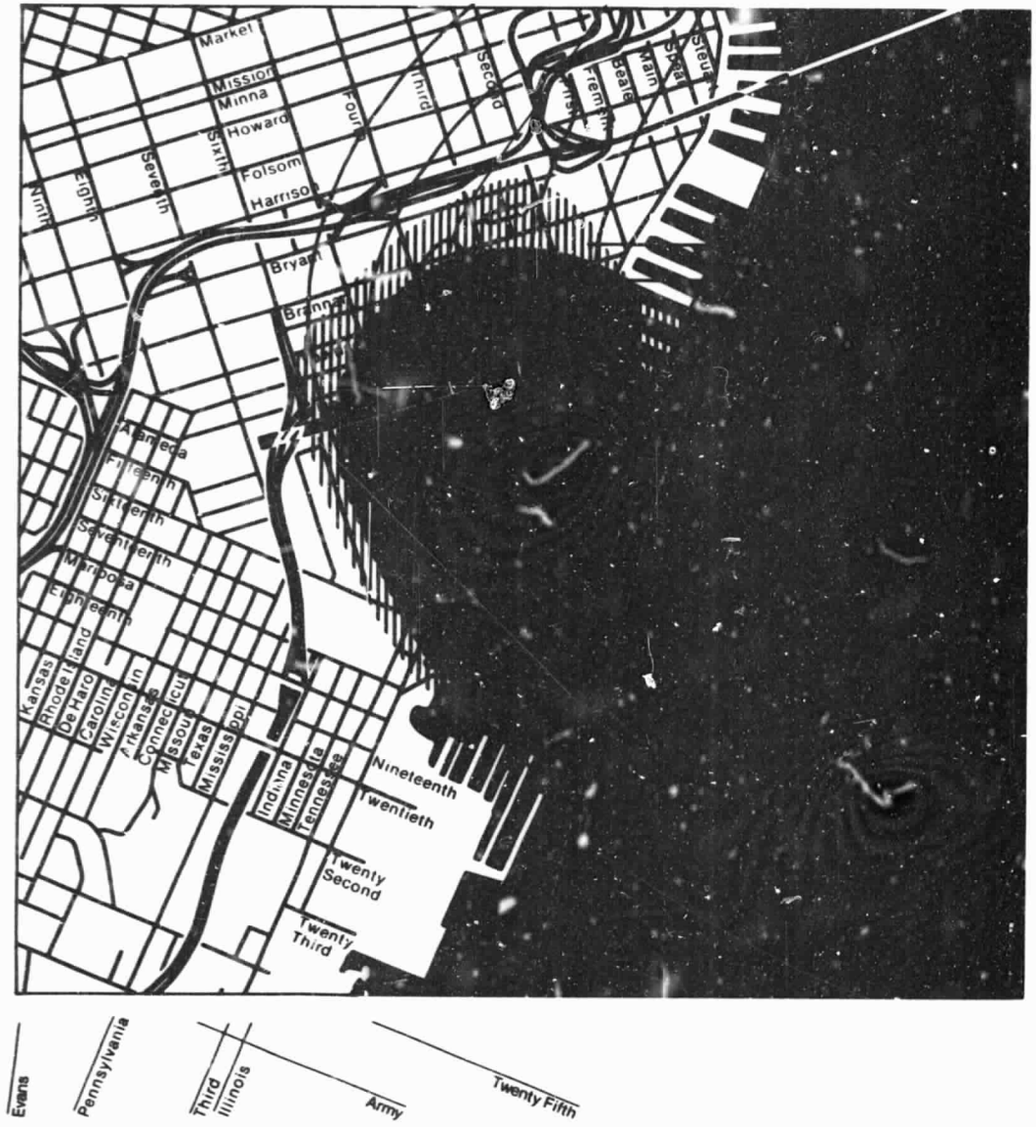
F44
Areas Exceeding 5dB Over Ambient With Day-Night Population Densities / S2



F44
Legend

Orientation

Scale Feet 0 1000 2000

Det

Criterion

C7
Air Pollution

There are many sources of air pollution. The aviation industry is responsible for about 1.5% of the total, far less than most other transportation modes. (2, pII-42) Nevertheless, pollutants attributable to QSTOL operation should be minimized. Related sources, such as ground access vehicles, will be limiting pollutant emissions according to government regulations. QSTOL will follow similar regulation.

Air pollution is caused mainly by imperfect combustion. This is due to fuel impurities, poor oxygen/fuel ratios, and combustion temperatures which are either too high or too low. Less significant sources of air pollution include finely ground particles, and gases caused by vaporization of liquids.

The atmosphere, given sufficient time, can cleanse itself of pollutants by precipitation, oxidation, and absorption into bodies of water. However, the gases and particles, which are washed out of the air, damage plants and buildings onto which they fall. Some primary pollutants interact to form more dangerous secondary pollutants such as photochemical smog. Physiologically these pollutants impair upper respiratory functioning and are responsible for heart and circulatory system problems, as well as irritability, discomfort and personal inconvenience.

Nationwide, over half of the total air pollutants, by tonnage, come from transportation sources. Over 40% of the total is from the internal combustion engines of cars, buses and trucks (45, p14).

There are differing opinions as to whether pollutants will increase or diminish from this source. Despite design of lower compression engines and exhaust control systems, increasing numbers of cars may cause overall pollutants to rise. Also, engine and adjustments to control one pollutant may increase other pollutants.

To reduce overall pollutants, more efficient transportation systems should be utilized. A comparison of emissions for various transportation modes indicates that automobile travel produces 52 pounds of pollutants per 1,000 seat miles; a diesel train produces about 9 pounds per 1,000 seat miles; and an aircraft produces 3 pounds per 1,000 seat miles, according to 1975 regulations. (A seat mile is an available passenger seat for a distance of one mile.) (2, pIII-47) Thus, automobiles produce about 17 times more pollutants per passenger mile than do aircraft.

C7.1
The proposed STOLport should minimize air pollution impacts on surrounding areas.

C7.1.1
Emissions from aviation sources should be minimized.

Aircraft emissions:
Emission specifications for the DHC-6 and DHC-7, furnished by DeHavilland Aircraft Company, are shown in Tables T7 and T8. From the data, average daily pollution generation was calculated assuming 100 operations per day.

Other aviation related air pollutants are a result of evaporation from aircraft fueling and maintenance. When these preflight activities are necessary, they should be performed in a manner to minimize evaporation.

Ground vehicle emissions:
Auto, bus and truck emissions are substantially higher per passenger mile than are aircraft emissions. QSTOL service can help reduce polutants from those sources by decreasing the average ground access trip distance to the STOLport.

For the Bay Region, estimates of the average auto access trip to existing airports range between 21.4 miles and 46.0 miles (2). An average distance between QSTOL and its users of 20 miles or less would cause a reduction in overall pollutants. Currently, only one-fifth of air travelers use mass transit for airport access. Greater encouragement of mass transit use, by offering frequent and convenient service, also can reduce air pollutants.

The most effective pollutant reductions can be seen at the larger scales. Interregional travelers, who take QSTOL rather than drive, would reduce overall pollutants in both areas of origin and destination.

C7.2
The proposed STOLport should conform to Federal, state, regional and local air quality standards.

In order to evaluate alternative transportation systems, the U.S. Department of Transportation has asked each state's Governor's office to describe rail, highway, and aviation systems in terms of three contaminants:

Hydrocarbons	(HC)
Carbon Monoxide	(CO)
Nitrogen Oxides	(NO)

To conform with the format of the 1974 State Transportation Plans, the above contaminants are used in the analysis of this criterion section.

There are additional standards for emissions from each engine regulating the amount of pollutants per pound of fuel. STOLcraft should be able to meet all government standards.

Particulates, nitrogen oxides, and oxidants are the main contaminants reducing visibility. These are prone to forming on warm, sunny days when ventilation is low. Contaminant gases tend to stay close to where they are emitted on

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days of low ventilation, so that accumulations near airports or STOLports can be expected. The South Bay and Santa Clara Valley are "Collecting Basins" for smog and consistently have the most restricted visibility on poor ventilation days (5). QSTOL should not cause pollutants to increase beyond state and Federal standards in these areas.

Prevailing winds should move pollutant concentrations away from populated areas and disperse them. For either of the study areas considered, most contaminants would be dispersed over the Bay.

Moderate wind velocities are necessary for adequate dilution, but even with moderate winds, concentrations of pollutants may occur when runway orientations are directly into the wind. During light winds below 7 mph, the situation deteriorates resulting in much higher pollutant levels. On these low ventilation days, part of the contaminants would be added to concentrations in the South Bay. Any increase of pollutants that QSTOL would add should be kept to a minimum.

C7.3
The proposed STOLport should not be located in areas of high air pollution potential.

The Regional Airport Systems Study has established a rating scale for air pollution potential on the basis of meterological conditions and projected contaminant emission levels. The rating scale has a range of I, for negligible air pollution potential, to V, for severe air pollution potential. No new airports will be permitted in rating V areas. The proposed STOLport should be located in areas rated I or II. Existing airports in rating II areas are Alameda NAS and San Francisco International (5).

T7
Engine Emissions: DHC-7

Data from UACL based on PT6A-41 engine burning JP-4 fuel

	Time (min.)	Fuel* (lb.)	U.H.C. (lb.)	CO (lb.)	NO_x (lb.)	Total (lb.)
Starting & taxi (low idle)	5	30	.621	2.319	.029	2.969
Take-off	1	44	.007	.030	.156	.193
Climb to 3000' (cruise)	2	60	.017	.069	.21	.296
Descent from 3000' (cruise)	2.6	60	.014	.059	.18	.253
Land & taxi (low idle)	5	30	.621	2.319	.029	2.969
Unload & load pas. & servicing (low idle)	10	30 +	.621	2.319	.029	2.969
Total			1.901	7.115	.633	9.649

* 4 engines

\+ 2 engines operation

Note: United Aircraft of Canada is presently devoting effort to decreasing emissions of the PT6A engine. Until the results of this effort are published the above table is in effect.

T8
Engine Emissions: DHC-6

Data from UA^L based on PT6A-27 engine burning JP-4 fuel.

	Time (min.)	Fuel* (lb.)	U.H.C. (lb.)	CO (lb.)	NO_x (lb.)	Total (lb.)
Starting & taxi (low idle)	5	12.5	.191	.434	.016	.641
Take-off	1	14.3	.009	.020	.061	.09
Climb to 3000' (cruise)	2	22.6	.016	.030	.111	.165
Descent from 3000' (cruise)	2.6	23.6	.015	.033	.099	.147
Land & taxi (low idle)	5	12.5	.191	.434	.016	.641
Unload & load pas. & servicing (low idle)	5	6.25 +	.096	.216	.008	.321
Total			.517	1.177	.311	2.004

* Both engines

\+ Single engine operation

Site Evaluation

S1
Northern Site

Because of restrictions by the San Francisco Bay Conservation and Development Commission and the U.S. Coast Guard, only emergency fuel handling and engine maintenance would be permitted at the proposed STOLport, thereby limiting possible sources of air pollution. The DHC-7 is expected to produce the following amounts of pollutants for a 100 operation day:

Carbon monixide	712 pounds
Nitrogen oxides	63 pounds
Hydrocarbons	190 pounds

One operation includes approach from 3,000 feet, landing, ground taxiing, take-off and climb to 2,000 feet.

By comparison, an equivalent amount of CO would be produced by auto traffic along a 6,864 foot section of Third Street, 63 pounds of NO_x would be produced in 255 feet of roadway, and 190 pounds of hydrocarbons would be produced in 2,855 feet of roadway. (See Table T9 and Figure F16.) All pollutant levels are far less than those for other local airports.

Based on an average access distance to the STOLport of 6 miles to serve 100 operations per day at 50% load factor, 5,000 ground vehicle trips would produce 1-1/2 tons of pollutants per day.

Compared with the 1975 total Bay Area pollutants per day of 6,717 tons or the 164 tons from aviation sources, the 2 ton daily QSTOL emission figure is quite minor (3, pII-2). If 500 passengers per day would use QSTOL service rather than similar service at San Francisco International Airport, 57.8 fewer pollutant tons would be emitted annually because of shortened ground access. (See Figure F45.)

Additional pollutant reductions of 789 tons per year could take place if 1,000 automobile passengers per day could be transferred to QSTOL for interregional trips (3). (See Figure F46.)

Pollutant increases would occur with generation of new passenger trips: people who would not have made the trip by other means, but who would find the convenience and short travel time of QSTOL an incentive. It is expected that no more than 10% of QSTOL passengers would fall within this category, accounting for 8 tons of pollutants per year.

By using a load factor of 60% rather than 50%, and by encouraging greater use of mass transit for access, even more significant pollutant reductions could take place.

Prevailing westerly winds would disperse pollutant concentrations from the STOLport out over the Bay. (See Figure F16 p.20.) Pollutants would be blown toward residential and commercial areas less than 12% of the time. Winds from the north tend to be gusty so that adequate dispersion should take place. Periods of calm would be of more concern for these

areas, especially during temperature inversions when available air for dilution is limited, although pollutant levels would still be low. This may occur 7% of the year. State and Federal air quality standards would not be exceeded.

Because of the good ventilation characteristics of this site, a pollution potential rating of between I and II would be reasonable. This rating indicates the area can tolerate additional airport construction as far as air pollution is concerned. This site presently meets the criteria for air pollution.

T9
Pollutants Per Vehicle Mile

For the following automobile and truck performance parameters:

Assume test year 1975
Assume average age of autos and trucks = 3 yrs
Assume average performance for 1972 vehicles 3 years old
Assume average speed of vehicles on Highway 280 = 35 mph
Assume average speed of vehicles on 3rd Street = 12.5 - 15 mph
Assume age factor for vehicles by pollutant:
Carbon Monoxide (CO) = 1.2
Nitrogen Oxides (NO_x) = 1.2
Hydrocarbons (HC) = 1.75
Assume traffic survey for August 4, 1971 = 16,596
Assume modal split - autos = 80% = 13,600
trucks = 20% = 3,400

		Daily Emissions Per Mile			Yearly Emissions Per Mile		
		CO (lbs.)	NO_x (lbs.)	HC (lbs.)	CO (lbs.)	NO_x (lbs.)	HC (lbs.)
3rd Street at 12.5-15 mph	Autos	.145	.0120	.0120	1,970	163	163
	Trucks	.360	.0254	.0635	1,260	85.5	218
	Total	.505	.0374	.0755	3,230	249.5	381
Hwy. 280 at 35 mph	Autos	.0605	.0120	.0060	824	163	81.5
	Trucks	.1700	.0254	.0322	580	86.5	109
	Total	.2305	.0374	.0382	1,404	249.5	190.5

F45
Comparison of Yearly Pollutants from Ground Access Vehicles / S1

Assume average trip to San Francisco International is 21 miles
Assume average speed to SFO is greater than 35 mph
Assume average 500 trips per day (Persons who would switch to QSTOL service)
Assume average trip to STOLport is 6 miles
Assume average speed to STOLport is 12.5 to 15 mph

	CO (lbs.)	NO_x (lbs.)	HC (lbs.)
Pollutants/ trip to SFO	.127	.0252	.0126
Pollutants/ trip to QSTOL	.087	.0072	.0072
Pollutant savings/trip	.040	.0180	.0054
Pollutant savings/year due to QSTOL	73,000	32,800	9,800

F46
Comparison of Yearly Pollutants: STOLcraft vs. Automobile

Yearly STOLcraft Pollutants

Assume a trip from San Francisco to Sacramento (90 miles).
Assume 1,000 passengers per day would require 40 flights per day of DHC-7s with a 50% load factor.

Pollutants	Pollutants/ LTO.- Lbs.	Flights	Days per Year	Lbs. of Pollutant	
CO	7.12	40	365	104,000	
NO_x	.63	40	365	9,200	
HC	1.90	40	365	28,000	
Yearly total				141,200	or 70.6 tons

Yearly Automobile Pollutants

Assume average speed of automobile trip = 50 mph
Assume driving distance S.F.- Sacramento = 90 miles
Assume average age of auto = 3 years old in 1975
Assume trip ends on both modes traveled by car, therefore, comparison over only the portions handled by different modes = 90 miles
Assume 1,000 trips per day x 365 = 365,000 trips/year
Assume 1.5 average of persons per auto

Pollutants	Pollutants/ Mile - Lbs.	Trips	Miles	Passenger Factor	Lbs. of Pollutant	
CO	.0605	365,000	90	.67	1,385,000	
NO_x	.012	365,000	90	.67	262,000	
HC	.006	365,000	90	.67	131,400	
Yearly total					1,718,400	or 859.2 tons

S2
Southern Site

Because of restrictions by the San Francisco Bay Conservation and Development Commission and the U.S. Coast Guard, only emergency fuel handling and engine overhaul would be permitted at the proposed STOLport thereby limiting possible sources of air pollution. QSTOL planes would produce about 965 pounds of pollutants per day. (See site 1.)

Ground vehicle trips would produce less than 2 tons of pollutants per day, based on a 7 mile average access distance and a 50 passenger STOLcraft flying 100 operations a day at 50% load factor. The 2-1/2 tons of pollutants per day attributable to QSTOL would be very minor compared to the 1975 Bay Area total of 6,717 tons per day or the 164 tons from all aviation sources. Ground access trips to QSTOL could save 42.8 tons per year from being emitted by passengers who now drive to San Francisco International Airport. (See Figure F47.) Additional pollutant reductions of 789 people per day would take QSTOL rather than drive on inter-regional trips. (See Figure F46.)

Pollutant increases would occur with generation of new passengers who would not otherwise be travelling but who find advantages in traveling by QSTOL. New passenger trips would account for no more than 10% of QSTOL service. Pollutants due to this factor would be 8 tons per year.

Prevailing westerly winds would disperse pollutant concentrations out over the Bay. (See Figure F17, p. 21.)

Pollutants would be blown towards residential areas about 7% of the time, but would be so dispersed as to be practically unnoticeable. During periods of calm, about 9% of the time and particularly during temperature inversions, pollutants may build up in the areas immediately adjacent to the site. The Bay Region would experience lower pollution levels because of QSTOL. This is mainly due to smaller amounts of pollutants from ground access vehicles. At no time would state or Federal air quality standards be exceeded because of QSTOL.

Ventilation characteristics are good for this area, and the pollution potential might be rated II. This is an acceptable rating for new airport construction.

This site presently meets the criteria for air pollution.

F47
Comparison of Yearly Pollutants From Ground Access Vehicles / S2

Assume average trip to San Francisco International is 21 miles
Assume average speed to SFO is greater than 35 mph
Assume average 500 trips per day
Assume average trip to STOLport 7 miles
Assume average speed to STOLport is 12.5 to 15 mph

	CO (lbs.)	NO_x (lbs.)	HC (lbs.)
Pollutants/ trip to SFO	.127	.0252	.0126
Pollutants/ trip to QSTOL	.101	.0084	.0084
Pollutant savings/trip	.026	.0168	.0042
Pollutant savings/year due to QSTOL	47,300	30,600	7,600

Site Evaluation

S1
Northern Site

Because the STOLport would be floating in the Bay it would also decrease and shade areas of water not now covered. This would cause a reduction in the oxygen content of the Bay by limiting surface mixing and by keeping light from reaching oxygen-producing marine plants.

Water pollution would be controlled by limiting use of harmful substances. Aircraft maintenance, washing, painting, or overhaul should not be permitted except in emergencies. An adequate runway drainage system, to prevent oil and grease run-off, would be provided in addition to ordinary sewage lines. And all standards of the State Water Quality Control Board would be adhered to.

Water depth at this location is 31 feet or more providing at least 5 feet of clearance to the bottom of the aircraft carrier hulls. Also, the structure is parallel to the current flow which would minimize current changes. Together these factors mean that sedimentation should be insignificant, although a more thorough study should be undertaken if this site is selected.

The site is in an area of relatively low importance as far as rare or endangered species are concerned. There are, however, many non-critical species of marine life and birds which would be affected. Marine life would be destroyed in a number of small areas, where pilings would be drilled for mooring. A thorough investigation should determine more precise ecological effects. (See Figure F18, p. 22.)

A determination as to the northern site's conformance to natural environment criteria cannot be made at this time. Further detailed investigation into the effects of shading on marine life densities and populations is needed.

S2
Southern Site

A floating STOLport would decrease and shade areas of water not now covered. This would cause a reduction in the oxygen content of the Bay by limiting surface mixing and by keeping light from reaching oxygen-producing marine plants.

Pollution should be controlled by limiting use of harmful substances. Aircraft maintenance, washing, painting or overhaul should not be permitted except in emergency situations. An adequate runway drainage system, to prevent oil and grease run-off, would be provided in addition to ordinary sewage lines. And all standards of the State Water Quality Control Board would be adhered to.

Water depth at this location varies between 22 and 36 feet. Clearance to the bottoms of the Liberty Ship hulls would be as little as 2 feet. The main problem, in regards to tidal action, appears to be the angling of the structure from the shoreline. Due to the channeling of water a change in the siltation patterns could be expected.

The site is in an area of relatively low importance as far as rare or endangered species are concerned. There are, however, many non-critical species of marine life and birds which would be affected. Marine life would be destroyed in two 100 x 300-foot areas, where ships would be purposely sunk for mooring. A thorough investigation should determine more precise ecological effects if this site is selected. (See Figure F19, p. 23.)

A determination as to the southern site's conformance to the natural environment criteria cannot be made at this time. Further detailed investigation into the effects of shading on marine life densities and populations is needed.

Det

Criterion

C9
Weather

C9.1
The proposed STOLport should be located such that undesirable crosswinds and fog concentrations are minimized.

The general patterns of airflow, inversions, temperature and precipitation establish the meteorological base for the San Francisco Bay Area basin. The portion of this basin, which includes the urban centers of San Francisco, Oakland with their respective airports, is the area of study for the proposed sites.

Marine air intrusion through the Golden Gate is typical, as are low stratus clouds and low level inversions during summer months. Beyond this, conditions can be quite varied depending on topography, location with respect to water surfaces and built-up versus heavily vegetated areas (3). For aviation purposes, wind frequency and visibility are important considerations. Wind is also important for dispersion of air pollutants, as are inversion patterns, temperature patterns and precipitation, which determine visibility. Prevailing winds for the study area are westerly most of the year and from the southeast during winter months. Differences in speed and direction are related to airflow patterns over topography. For instance, at San Francisco International Airport, wind is channelled through the San Bruno Gap to produce a strong west-northwest component. The proposed sites would not be affected as dramatically.

Surface wind information was obtained from the U.S. Weather Bureau (San Francisco downtown station), the Alameda Naval Station and Oakland International Airport. It was assumed that weather information from the San Francisco downtown station and from Oakland International would be applicable to the southern site. Wind information from Alameda Naval Air Station was assumed to be applicable to the northern site. This was because wind recordings over water are more consistent over greater distances than winds that blow over land and become subject to local topography and frictional drag.

C9.1.1
Excessive crosswinds should not exceed 2% of annual operating time. Operations could be affected when crosswinds exceed:
20 mph in dry weather
15 mph in wet weather

Current STOLcraft are unable to tolerate a large crosswind during landing or take-off. This is a particular concern on an elevated runway where greater precision is required. For safe operation, the runway should be temporarily shut down when interference crosswinds exceed the above limits.

When crosswinds exceed the aircraft's safe operational limitations, flight could be diverted to other airports or suspended. To maintain reliable service, crosswind interference should not exceed 2% of annual STOLport operating time or 100 hours (50).

C9.1.2
Below-Minimum [BM] visibility conditions should not exceed 2% of annual operating time. Below-Minimum conditions halt operations when:

Decision height	***≤ 200 feet***
Runway visual range	***≤ 2,400 feet***

Several varied processes are involved in limiting visibility. One group of processes is called temperature inversion; another is coastal fog. A temperature inversion is basically a layer of cooler air trapped by warmer air.

This situation limits the air available for dilution of pollutants. Summer inversions are formed by air being heated as it moves downward along the Pacific. Winter surface inversions are generated on cold nights by radiation of the earth's heat to the air. This often contains some fog, which, like smog, affects visibility equally throughout the area.

Coastal fog affects various sites differently. It is created by moisture-laden marine air as it approaches the California coast from the west. As it travels it is cooled by the cold ocean current until it condenses. This fog is usually stopped by the coastal mountain range. Often it funnels through the Golden Gate far enough to blanket the Presidio. At other times, it travels across the Bay in a narrow band to the Berkeley-Oakland Hills where it spreads to fill the rest of the Bay basin (3).

Occasionally, the fog is so dense that planes cannot land safely, even when using their instruments. This occurs when visibility is Below-Minimum:
BM when decision height is equal to or less than 200 feet
Runway visual range is equal to or less than 2,400 feet

Below-Minimum flight conditions should not exceed 2% of annual STOLport operating time or 100 hours, if reliable service is to be maintained.

C9.2
QSTOL operations should conform to Federal Aviation Administration Visual Flight Rules [VFR] and Instrument Flight Rules [IFR] for cloud ceiling and visibility.

VFR in effect:	***ceiling***	***≥ 1,000 feet***
	visiblity	***≥ 3 miles***
IFR in effect:	***ceiling***	***≤ 1,000 feet***
	visibility	***≤ 3 miles***

The Federal Aviation Administration has established flight procedures which take visibility into account.

These are visual flight rules (VFR) and instrument flight rules (IFR). VFR apply when the weather is clear enough for aircraft to be operated by visual reference to the ground. IFR are used when visibility is limited or the ceiling

drops below the values prescribed for VFR.

The rules vary according to type of aircraft. For QSTOL they are suggested as above (48).

Site Evaluation

S1
Northern Site

Prevailing westerly winds, for 10 months of the year, average 13 mph during the assumed operating hours of 7 a.m. to 10 p.m. During December and January winds are from the southeast with an 11 mph average (18). Winds fluctuate between strong gusty conditions and calm. All but a very small percentage of the winds are below 24 mph (41). Fog may occur here more frequently than protected locations because of direct exposure to the Golden Gate. (See Figure F20, p.24.)

Based on ceiling visibility data aircraft could operate on Visual Flight Rules 86% of the time. Instrument Flight Rules would be necessary 13% of the time. And Below-Minimum conditions would halt operations about 1% of the year. Below-Minimum conditions would occur most frequently in December and January with over 3% disruption of service (41).

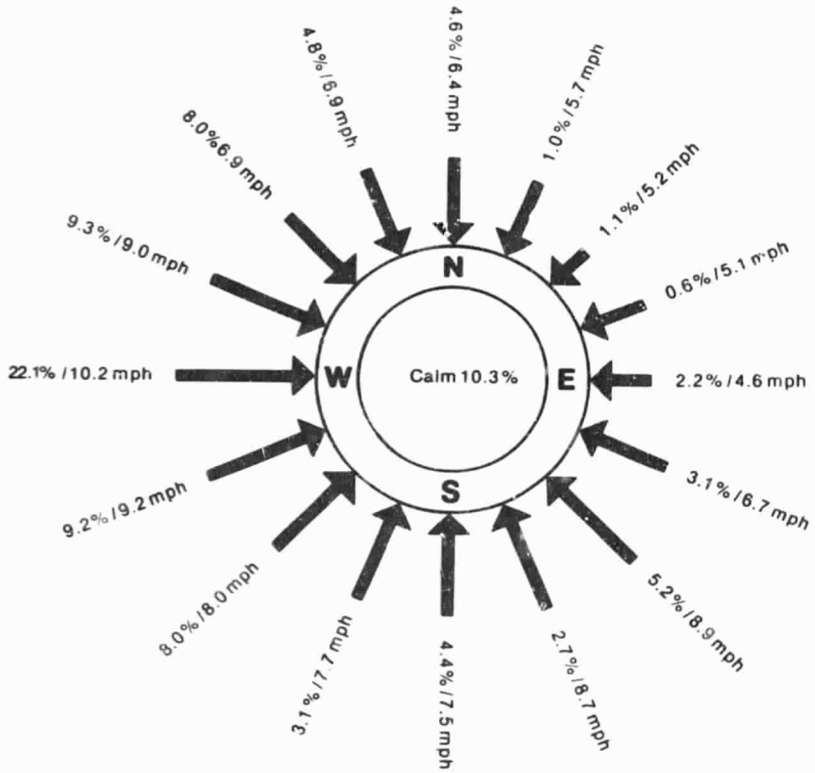
With a west-northwest/east-southeast orientation, crosswind components would disrupt service about 0.2% of the time during dry weather and 0.9% during wet weather (41). This is far below the criterion maximum.

Figure F48 illustrates the yearly average wind rose for the Alameda Naval Air Station.

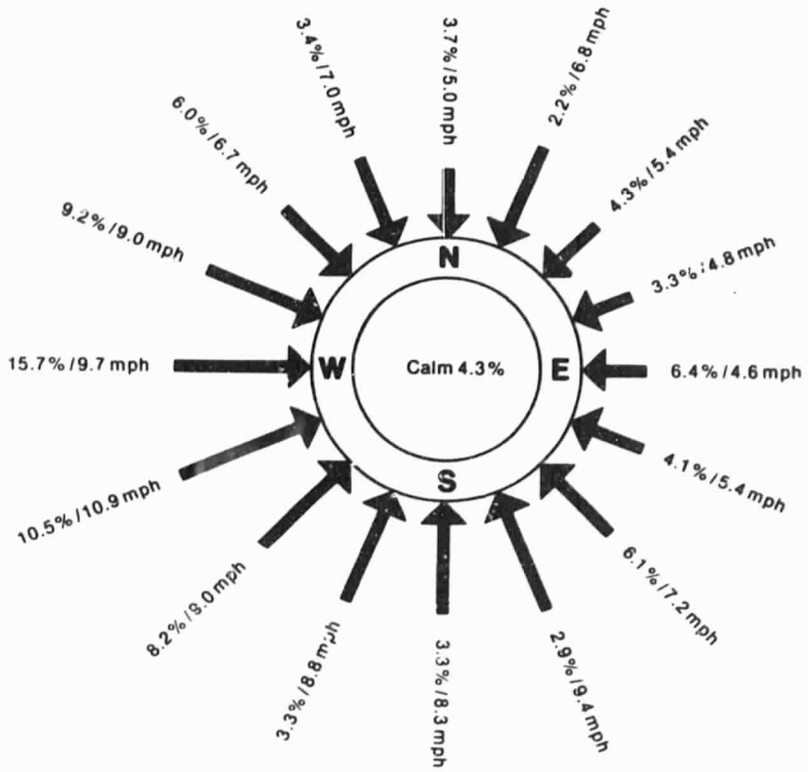
Figure F49 is the yearly average wind rose from Oakland International Airport.

Weather conditions in this area are compatible with criteria for aircraft operations. This site meets the criteria for weather.

F48
Wind Rose: Alameda Naval Air Station



F49
Wind Rose: Oakland International Airport



S2
Southern Site

The prevailing westerly winds average 12 mph for the February-to-November period during the assumed operating hours of 7 a.m. to 10 p.m. In December the prevailing winds are from the north, averaging 7 mph, and for January they average 8 mph from the southeast (18). These particular winds in winter vary over a large range and fluctuate between calm periods and strong gusty storms. Winds above 30 mph are rare although they do occur (41). Visibility information was found to be very similar between U.S. Weather Bureau Stations at Oakland International Airport, San Francisco International Airport and downtown San Francisco.

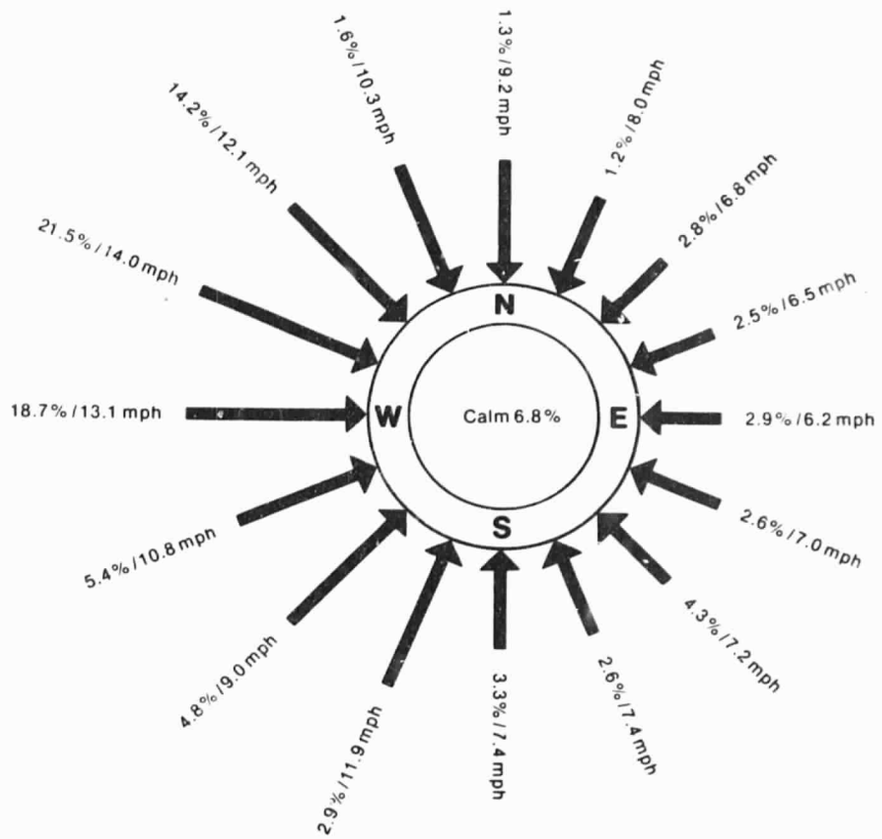
Ceiling versus visibility criteria gave percentage figures for operations of 91% for Visula Flight Rules; 9% on Instrument Flight Rules and Below-Minimum conditions of 0.7% (18). Disruption of service due to poor visibility would occur most frequently in December and January, although these levels may be tolerable (3).

A northwest/southeast runway orientation works well even though it was dictated by other factors. Crosswind components are well below the recommended maximums; 0.2% disruption of service during dry weather and 0.8% during wet weather (3).

Figure F50 depicts the yearly average wind rose for San Francisco International Airport.

Weather conditions are suitable for aircraft operation more than 98% of the year at the southern site. This site meets the criteria for weather.

F50
Wind Rose: San Francisco International Airport



Det

Criterion

C10
Air Traffic/Flight Operations

C10.1
The proposed STOLport should be compatible with the existing air traffic control system, and should meet Federal Aviation Administration [FAA] safety requirements.

The operational feasibility of a particular site is determined by four areas of FAA regulation. These are: determination of safety clearance zones, instrument approach, aircraft performance characteristics, and air traffic conflicts. Operational usability with regards to climatological conditions is discussed under weather.

C10.1.1
Safety Clearance Zones should provide obstacle-free air space for approach and departure.

Because of STOLcraft capabilities for steep gradient approach and take-off climb, STOLport obstruction clearance requirements are quite different from those for conventional aircraft and airports. On the basis of operational tests utilizing instrument landing equipment, imaginary protection surfaces have been defined. These protection surfaces provide an obstruction free zone in which the aircraft can maneuver safely. The proposed STOLport should be located such that obstacles do not penetrate the protection surfaces.

The runway width for QSTOL is 100 feet. Additional safety margins of 100 feet on each side are required to keep aircraft from striking obstacles or running over the sides of elevated structures (50). In order to reduce this width, lateral restraint systems are being developed which would halt an aircraft if it veered from the runway.

The length of the runway is determined solely by the performance of the aircraft. No credit is give to arrestment systems. There must be room for the aircraft to accelerate to lift-off speed, and stop if the pilot decides that there may be difficulties. An arrestment system is essential for an elevated STOLport to prevent the catastrophic consequences of an aircraft excursion outside the confines of the runway area. For planning purposes, a runway length of 1,800 feet was assumed with a 100 foot safety area at each end. (See Figure F24, p.29.)

C10.1.2
Instrument landings and departures should be possible in at least one direction.

A microwave instrument landing system may be utilized when Instrument Flight Rules (IFR) are imposed, that is when visibility is too low for Visual Flight Rules (VFR). (See weather conditions.) Ideally, this would be for landings in either direction. Advanced instrument landing systems will permit landings in a curved path. However, because of differences in obstructions some STOLports may be restricted to instrument landings from one direction. It is possible that a plane could approach on IFR and switch to VFR for a landing in the opposite direction.

Instrument flight operations for QSTOL is still a developing field. Tests indicate that QSTOL aircraft have take-off and landing performance, steep climb and descent capabilities, slow speed maneverability, and safety specifications which are consistent with helicopter airspace criteria (20).

C10.1.3
QSTOL aircraft should meet all peformance requirements for safe operation at the proposed STOLport.

Each aircraft must be able to meet the safety standards for the site where service is intended. The planes under consideration are the DHC-6 series 300, and the yet to be produced DHC-7, both by DeHavilland Aircraft. The DHC-6 series 300S is a twin engine turbo-prop with 20 pasenger capacity. Since a number of them are currently in use, accurate operating data are avaiable. The DHC-7 will be a larger, 4 engine turbo-prop, 48 passenger capacity, and have greater performance. It will be the quieter of the two craft. Figure F51 compares the DHC-7 and 6 QSTOL aircraft with the Boeing 737 in size and passenger capacity.

C10.1.4
QSTOL flight paths should not cause major conflicts with operations at other airports.

Aircraft are separated vertically and horizontally by the air traffic controller, on the basis of the volume of air space they occupy. The air space varies according to type and mission of the aircraft, the aircraft's distance from the end of the runway, and the flight path direction. For example, commercial aircraft must maintain a lateral IFR separation of at least 3 miles. When approach or departure paths cross, there is a conflict in which planes must be sequenced by a controller. Because of time lapses involved in sequencing, runway utilization is decreased. For this reason, flight path conflicts should be minimized.

San Francisco International Airport (SFO) Alameda Naval Air Station (NGZ) and Oakland International Airport (OAK) are located close together such that sequencing is necessary for flights at NGZ and OAK. The proposed STOLport should particularly avoid existing conflict areas.

Between cities, commercial QSTOL aircraft would use conventional air navigation space where practical, or would create their own air space system.

F51
Comparison: DeHavilland DHC-6, DHC-7, and Boeing 737 Aircraft

Site Evaluation

S1
Northern Site

Both approach and departure from the proposed site are acceptable with regard to clearance zones. There are no permanent obstructions penetrating the protection surfaces. However, masts of ships in the adjacent navigation lanes may pass through the clearance zone. In the case of aircraft carriers, these masts are as high as 220 feet. This sould be a particular problem at the southeast end of the runway where ships which were docking might tie up flight operations for 30 minutes at a time. It is also possible that superstructures and masts of passenger ships at Pier 35 might penetrate the clearance zone while they are docked.

Instrument landing would be possible from both directions since approaches are clear and meet safety standards. A 5° offset from the southeasterly approach would be desirable to avoid flyover of Alameda Naval Air Station.

There are sufficient navigation aids appropriately located in the vicinity of the proposed site to provide pilot-controlled transitions from the enroute phase to the final approach phase. Also dual radar in the Air Traffic Control facility assures continuous vectoring capability.

Both the DHC-6 series 300S and the DHC-7 would have no problem in operating from this location, since both approach and departure are over water.

A STOLport straight in final approach for air traffic on 290° magnetic would conflict with departures from Alameda Naval Air Station (NGZ) Runway 31. The QSTOL runway is almost directly in line with NGZ flight paths such that departing NGZ aircraft would be in conflict with approaching STOLcraft for a distance of 3 miles. Descent angles, less than 5°, would cause a longer conflict zone. (See Figure F22, p.26.)

Approaching STOLcraft also would be in conflict with right-turn departures from Oakland International Airport (OAK) Runway 09. QSTOL approaches would have to be sequenced with departures from both Oakland and Alameda.

Presently, curved approach procedures have not been approved for IFR QSTOL operations. However, projects currently in progress are investigating the feasibility of establishing procedures for curved approaches. If it is approved that OSTOL aircraft could enter the area from the north and make a curved approach to the runway, sequencing QSTOL arrivals with N67 Runway 31 left-turn departures.

This site would meet the criteria for air traffic flight operations if curved approach approval from FAA is obtained as well as sequencing agreements between FAA and Navy officials are worked out.

p. 82

S2
Southern Site

Both approach/departure directions meet the FAA recommended criteria for clearance zones. However, take-off in the northwesterly direction requires a 90° right turn to avoid the downtown office area. The southeasterly approach may have slight interruptions due to ships passing through its clearance zone. Although the navigational channel is wide at this point, many ships will be heading directly for facilities close to the proposed site. Ships maneuvering into Piers 50 and 64 may penetrate the sides of the clearance zone, but once they are berthed they will present no problem. (See Terminal Design, Figure F56.)

Instrument landing would be straight in from the southeast, but a curved approach would be required from the northwest to avoid flying over the City.

There are sufficient navigation aids appropriately located in the vicinity of the proposed site to provide pilot-controlled transitions from the enroute phase to the final approach phase. Also dual radar in the Air Traffic Control facility assures continuous vectoring capability.

On the basis of performance criteria with one engine failed, the DHC-6 series 300S would not clear obstructions. Buildings 10,000 feet straight out from the runway are 603 feet above mean sea level. The aircraft could only climb 460 feet within this distance. Turns to either side would present other obstacles. A 90° right turn inside the San Francisco-Oakland Bay Bridge would have to be executed at 150 feet above sea level for safe operation.

The DHC-7 with its 4-engine confituration would have no difficulties meeting the standards, either for straight-out or turn departing patterns.

STOLport air traffic would interfere with either of the Bay Area's 2 air traffic flow patterns. The STOLcraft final approach of 300° magnetic would conflict with all San Francisco Runway 01 departures in regards to altitude and IFR radar separation. Air space is insufficient for QSTOL approach and San Francisco departures to be operated simultaneously by controllers. There would be no conflict with departures from San Francisco Runway 28 if the QSTOL descent angle did not exceed the planned 6°.

Due to a lateral separation less than 3 miles, QSTOL approaches must be sequenced with Oakland IFR departures. Alameda Naval Air Station Runway 31 arrivals would be vertically below the QSTOL final approach if an angle of 6° was used. During IFR weather helicopters on route A, between Hunters Point and the Bay Bridge would be in conflict with QSTOL arrivals and departures. Sequencing would be necessary. (See Figure F23, p9.)

STOLport departures to the northwest, with a 90° right turn, would also have to be sequenced with departures from Alameda Naval Air Station (NGZ) Runway 13.

If the northwest bound approach is used into the STOLport at the southern site, the final leg, at five miles from the runway, would be crossed by the San Francisco Instrument Landing System (ILS) Runway 191 and at 9 to 10 miles by the San Francisco, Sacramento and Lindon Standard Instrument Departure (SID) systems. Even if it could be assumed that the cited San Francisco arrival and departure would be below the QSTOL final approach leg, there is no practical air space plan that could be used for maneuvering QSTOL to the final approach course from the enroute segment. The QSTOL final leg is also in direct conflict with all NGZ departures, and Oakland VHF omni-directional range-Runway 9R and localizer back course 11 approaches.

It is not possible to segregate QSTOL traffic from CTOL traffic in the area.

The southern site does not meet the criteria for air traffic/Flight operations at the present time.

Det

Criterion

C11
Terminal Design

C11.1
The Terminal Plan should conform to applicable local and reigonal planning policy.

C11.1.1
The proposed STOLport should minimize interference with Port maritime activities.
C11.1.2
The proposed STOLport should minimize disruption of views from Central Basin and from along China Basin Street.
C11.1.3
The proposed STOLport should stay inside the U.S. Pier Head Line.
C11.1.4
The proposed STOLport should meet recommended FAA criteria for STOLport layout.

C11.2
The Terminal Plan should conform to San Francisco zoning ordinances and building codes.

C11.2.1
The allowable building height of 40 feet and bulk restrictions should be strictly adhered to.
C11.2.2
Requirements for adequate egress should be adhered to.

C11.3
The Terminal Plan should strongly reflect STOLport projected advantages over Conventional Take-off and Landing [CTOL] facilities.

C11.3.1
Public transit and shuttle services to and from the Central Business District should take priority over taxi and auto circulation in the plan.
C11.3.2
Passenger transfer from all surface access modes to ticketing, baggage handling and boarding areas should be expeditious as a result of the design.
C11.3.3
Later expansion of terminal areas to include additional aircraft boarding gates and appropriate supportive activities should be possible.

C11.4
The Terminal Plan should take into account future conversion and use by the Port.

C11.4.1
As much of the facility as possible should be transportable to another site.
C11.4.2
Large areas should be able to accomodate trucks and containerized cargo.

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T10
Terminal Design: Basic Program

	Activity Areas	Sq. Ft.
1	Metered parking for 150-200 autos @ 300 square feet each	45,000 - 60,000
2	Auto drop-off station space for 8 autos and appropriate pedestrian circulation	3,500 - 4,500
3	Taxi drop-off station space for 8 taxis and appropriate pedestrian circulation	3,500 - 4,500
4	Bus and shuttle drop-off station with space for 4 San Francisco Municipal Railway buses and appropriate pedestrian circulation	6,000 - 8,000
5	Baggage, shipping and receiving, mail delivery area, loading dock and storage (holding area) for four 3-ton trucks at vehicle circulation level	8,000 - 9,000
6	Ticketing and baggage claim areas	600
7	Shipping, receiving, mail handling area at ticketing level	4,400 - 5,000
8	Restaurant, kitchen and cocktail lounge	15,000 - 18,000
9	Conference spaces; two 5000-square foot areas	10,000 - 14,000
10	Airport operations and air traffic control	3,200 - 4,000
11	4 passenger boarding lounges @ 500 square feet each	2,000 - 2,400
12	4 aircraft boarding gates @ 12,270 square feet each and necessary aircraft taxi area and safety aprons	75,000 - 90,000
	Total	176,200 - 220,000

S2
Terminal Design

Architectural Program:
The concept of a floating STOLport has two advantages over a land based facility. First it requires a minimum acquisition of land already in use. Secondly, it could be transported and reused elsewhere when more permanent facilities are established.

The disadvantages are: the requirements for periodic hull maintenance; tidal action and currents which make anchoring and attachment to shore facilities a concern; and, the uncertainties of development cost, particularly where extensive modifications would be required to existing vessels.

Selection of a terminal design for the northern site was not attempted due to unresolvable land use conflicts, sharp unacceptance by affected communities, as well as discord in other criterion areas.

Table T10 is one STOLport architectural program which was synthesized for use at the southern site from projected patronage use figures; aircraft operational requirements; accepted planning and architectural building standards, codes, and ordinances; economic feasibility, navigational and naval architectural considerations and forecasts for second life use of Pier 54 by the Port.

Description of Alternative Design Concepts:
Four architectural designs for the STOLport terminal facility and runway at the southern site were considered.

The first scheme linked two "Essex Class" aircraft carriers stern to stem for the runway, with greater part of the STOLport terminal in remodeled spaces below decks. One end of this long arrangement, heading 312°, was located at the end of Pier 54. The pier would house parking and bus, taxi and auto drop-off areas. (See Figure F52.)

The major problem encountered in this scheme was that two carriers with enough bridging to provide a 2,000-foot runway did not have the capability of handling any more than one plane at a time. Passenger loading below the runway deck would be impossible since the size of the untried DeHavilland DHC-7 prohibited the use of the carrier's outside elevators. The DHC-6, operationally unfeasible for carriers at this site, would fit the elevators. This meant that if a plane became disabled, operations would have to be suspended until it was repaired. It also would limit the number of operations per hour to uneconomical levels. This scheme was evaluated to be less viable than the remaining three.

The second scheme combined 2 aircraft carriers, again in tandem, adjacent and attached to the north side of Pier 54. Major reconstruction of the pier, in this design, would be necessary to provide complete terminal and ancillary facilities: automobile parking areas and drop-off stations for all surface access modes at the street level, ticketing, baggage, restaurants, shipping and mail rooms, holding areas, convention and conference rooms and rental office space at the space at the second level: and, passenger boarding lounges, a cocktail lounge, airport operations, air traffic control, and aircraft boarding gates at the top level. (See Figure F53.)

The third alternative is a variation on scheme one: three carriers at heading 312° adjacent to the north side of Pier 54. The third carrier, located on the north side of the 2 in tandem, would be able to provide as many as 6 aircraft boarding gates at the flight deck level with terminal facilities directly below decks. The pier, as in the first alternative, would be used for surface modal access. This scheme probably would have been the least expensive solution in terms of initial development costs; but, it would have crowded maritime activities to the north and to the south of the site. (See Figure F54.)

Anchoring for each aircraft carrier concept would be an enormous task since perimeter containment pilings would have to be driven 150 feet to bedrock as well as be placed not to interfere with shipping activities very close to the proposed site.

In these schemes, the pre-existing levels below deck in the carriers would be utilized for ticketing, parking, baggage, mail shipping and receiving, etc. Interior uses of the carriers are limited by the San Francisco Bay Conservation and Development Commission (BCDC) to terminal facilities and water-oriented activities only. Parking is specifically excluded and non-maritime related activities discouraged. The prospect of finding sufficient water-oriented, labor-intensive activities which would be suitable for the interior of the carriers appeared difficult.

Other severe constraints on all three of the carrier-in tandem concepts are water depth and allowable building height. The draft of the proposed carriers is about 26 feet where a water depth of 19.5 feet at extreme low-water is available. This would mean dredging the area close to Pier 54, requiring a permit from BCDC, and creates the risk of undermining adjacent piers. Assuming that this could be accomplished safely, the flight deck would be 57 feet above the water. Since the STOLport is regarded as a permanent structure, the 40-foot height limit imposed by the San Francisco City Planning Commission would apply. This probably would be interpreted by zoning officials as 40 feet above the nearest curb at mean tide. The nearest curb is about 10 feet above the mean tide level, so that the carriers would be 47 feet above the curb. This exceeds the 40 foot height limit. A zoning variance would be very difficult to get in view of current public opinion against higher building height limits. In view of the height, water depth and anchorage problems of the 3 carrier schemes, 3 directions leading toward a solution to these issues seemed apparent.

The first would be to lower the flight deck by 7 feet. This would require extensive modifications to the carriers. Even if such alternatives were economically feasible, the Navy would probably not allow them to take place as a condition of their sale.

The second direction would sink one of the carriers permanently in the mud. Although this idea probably would improve anchorage and resolve the height conflict, it would create a legal problem with BCDC. A structure of this size and fixed in this manner would be considered almost as undesirable as permanent land fill, decreasing the likelihood of getting a permit. Besides, a ballasting system, designed at great expense, would have to work continuously to keep the flight deck level. The third direction, considered more realistic, was to explore a different solution, and not use aircraft carriers.

The fourth scheme utilized "Liberty Ship" hulls, circa World War II, tied together in a column of twos to support a new runway superstructure overhead. This arrangement would then be placed at heading 302° adjacent and attached to the north side of a reconstructed Pier 54 by a wide ramp, at the pier's roof for aircraft access to the boarding gates. (See Figures F55 and F59.)

The runway heading of 302 degrees was selected because of considerations for air traffic clearance, keeping within the U.S. Pier Head Line, preservation of views from Central Basin, and navigational access to Piers 50 and 64.

The position and orientation of the obstruction clearance zone would allow full use of Pier 50 to the north and 64 to the south with no restrictions on cranes and ships' mast heights for ships which are berthed. (See Figure F56.) There may be some penetration of the transitional surface by ships which are maneuvering into their berths.

At extreme low water of 19.5 feet the Liberty Ship hulls would clear bottom. The ships are readily available and there are no restrictions on alterations or color. Based on the Floating Interim Manhattan STOLport Study, the flight deck would be 44 feet above the water or 34 feet above the nearest curb at mean tide, thereby the structure would conform to the San Francisco Planning Commission's 40 foot height limit. Anchoring would be to two refloatable sunken vessels. The greatest apparent drawback would be developmental cost. The construction costs of structural support and new runway, inherently provided by the aircraft carriers in schemes 1, 2, and 3, would become prohibitive without strong supportive uses. Nevertheless, the Liberty Ship concept has a better opportunity to be accepted and is therefore adopted for the purpose of this study.

From the floating runway, STOLcraft would ramp to the upper deck of a permanent structure on Pier 54. This pier is currently dilapidated and in need of replacement for utilization. Such terminal facility could be designed so that it would eventually become part of the Port maritime development when permanent QSTOL facilities are located elsewhere.

Initially the terminal would provide 3 aircraft gates. A fourth and fifth gate would be added in stages, as required. This would be the practical limit of growth since there is no available area for taxiways or runway.

At street level the terminal would contain off-street public transit and private bus service, taxi, and auto drop-off stations. Limited parking and a freight loading dock also would be available at this level. (See Figure F56.)

The second level would contain general terminal facilities such as ticket counters, a restaurant and conference spaces, as well as rental office area. (See Figure F57.)

The top level would have boarding lounges air traffic control and aircraft operations, and aircraft boarding gates. (See Figure F58. See also Figure F59 for overall axonametric view of the terminal facility.)

This configuration would allow eventual Port use for containerized storage at street level and on the roof, with office space remaining the primary use at the second level.

The interior spaces of the Liberty Ships could be utilized depending on whether suitable maritime uses could be found.

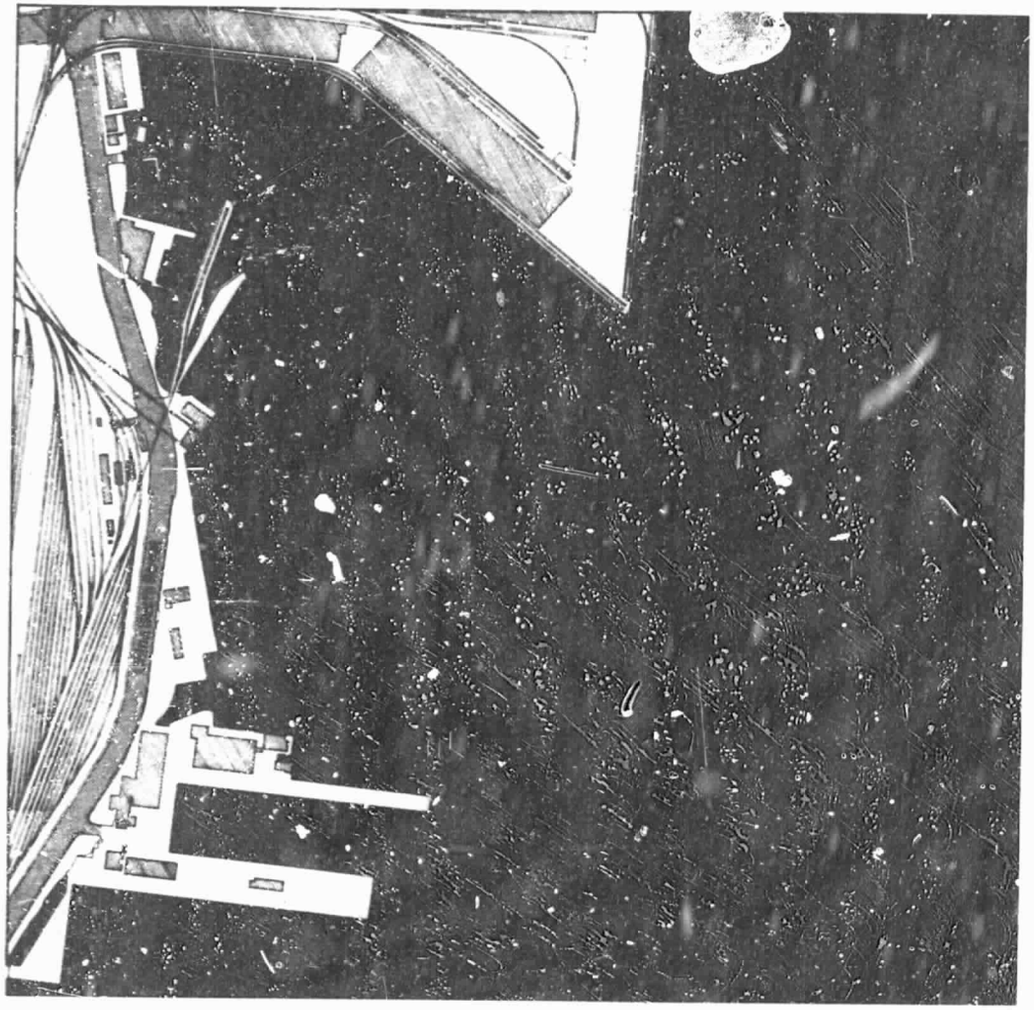
Access ramps from street level or the second floor level would be provided.

Table T11 is a detailed program of the fourth scheme.

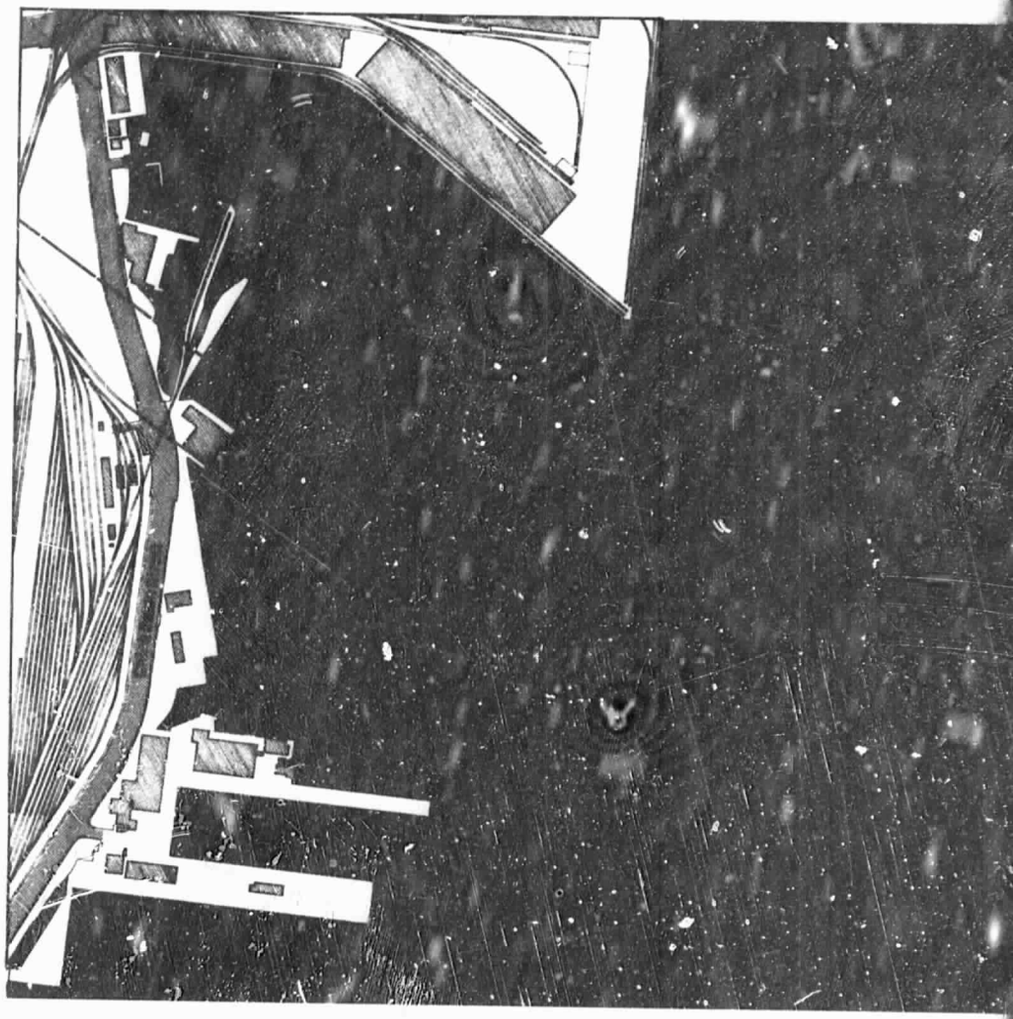
T11
Terminal Design: Program as Designed

Activity Areas	Supplementary Program: Scheme Four	Program: Scheme Four	Basic Program Sq. Ft.	Scheme Four Sq. Ft.
1 Metered parking for 150-200 autos at 300 square feet each		153 autos	45,000 - 60,000	68,250
2 Auto drop-off station space for 8 autos and appropriate pedestrian circulation		8 autos	3,500 4,500	3,800
3 Taxi drop-off station space for 8 taxis and appropriate pedestrian circulation			3,500 - 4,500	3,800
4 Bus and shuttle drop-off station with space for 4 San Francisco Municipal Railway buses and appropriate pedestrian circulation		4 buses	6,000 - 8,000	6,650
5 Baggage, shipping and receiving, mail delivery area, loading dock and storage (holding area) for four 3-ton trucks at vehicle circulation level		5 trucks	8,000 - 9,000	8,300
	General vehicle circulation, structure, mechanical, area for future port use		45,000 - 60,000	59,650
6 Ticketing and baggage claim			600	600
	General pedestrian circulation		18,000 - 24,000	22,940
7 Shipping, receiving and mail handling area at ticketing level			4,400 - 5,000	4,800
8 Restaurant, kitchen and cocktail lounge	Separate cocktail lounge	250 seats (restaurant)	15,000 - 18,000	17,250
	Outdoor terrace for restaurant	100 seats	2,000 - 4,000	4,280
9 Conference spaces; two 5,000-square foot areas		2 conference rooms	10,000 - 14,000	10,000
	Rental office space			50,000
	Structure, mechanical, other		5,000 - 8,000	5,145
10 Airport operations and air traffic control			3,200 - 4,000	3,900
11 4 passenger boarding at 500 square feet each		4 lounges	2,000 - 2,400	2,100
12 4 aircraft boarding gates at 12,270 square feet each and necessary aircraft taxi area and safety aprons		4 boarding lounges	75,000 - 90,000	93,735
	Structure, mechanical, other			500
Total area of permanent structure			246,200 - 366,500	365,700
	Total area of floating runway structure and connecting bridge to Pier 54			354,000

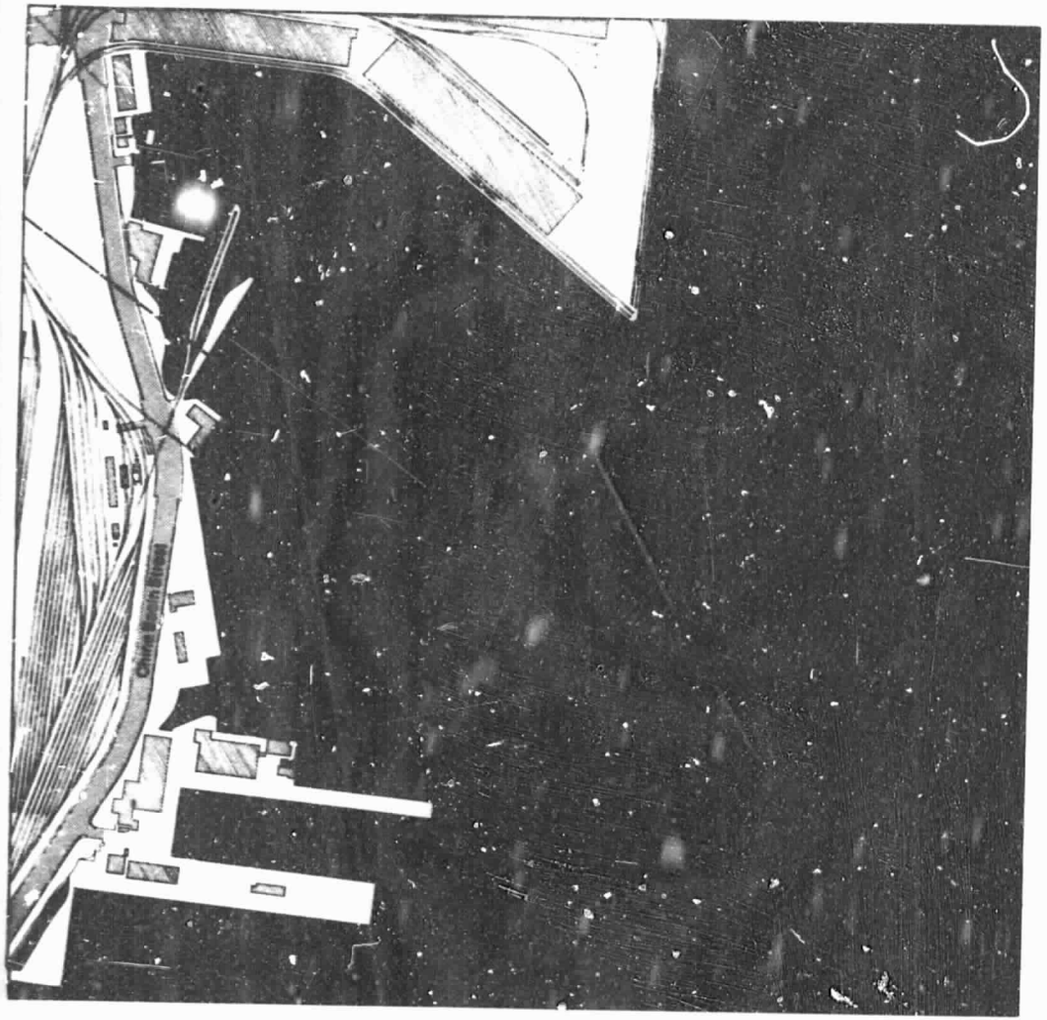
F52
Terminal Design / Scheme 1 / S2



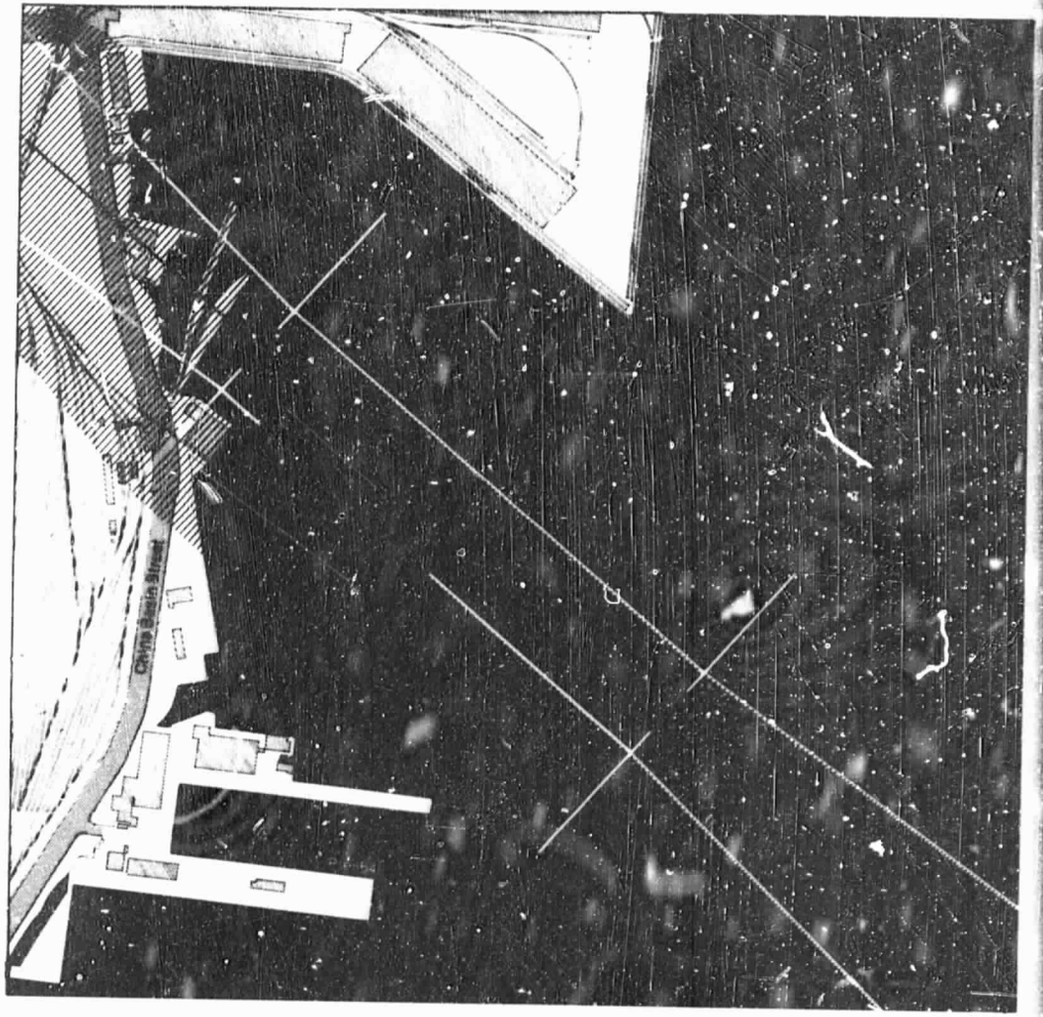
F53
Terminal Design / Scheme 2 / S2



F54
Terminal Design / Scheme 3 / S2



F55
Terminal Design and Ship Mast Penetration of Clearance Zones / Scheme 4 / S2



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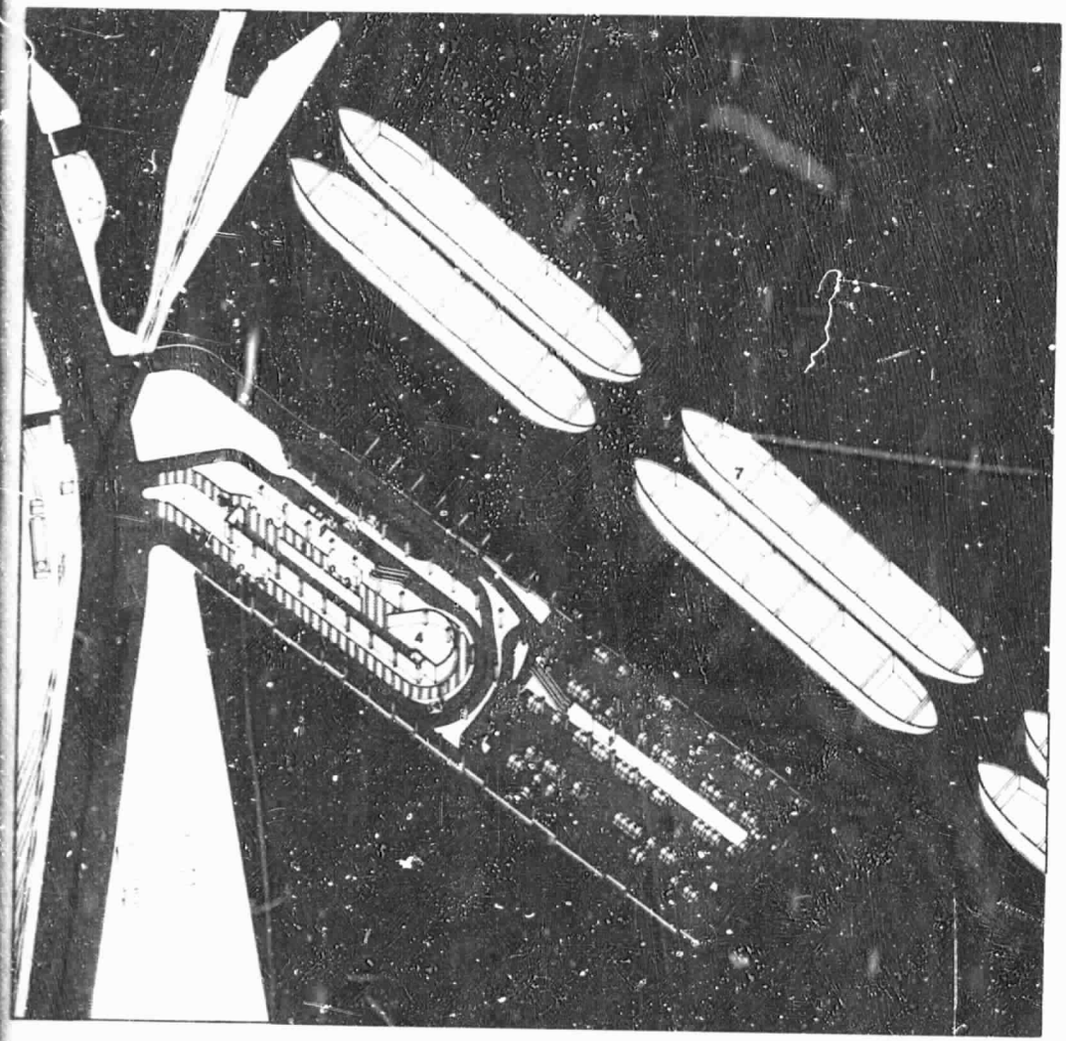
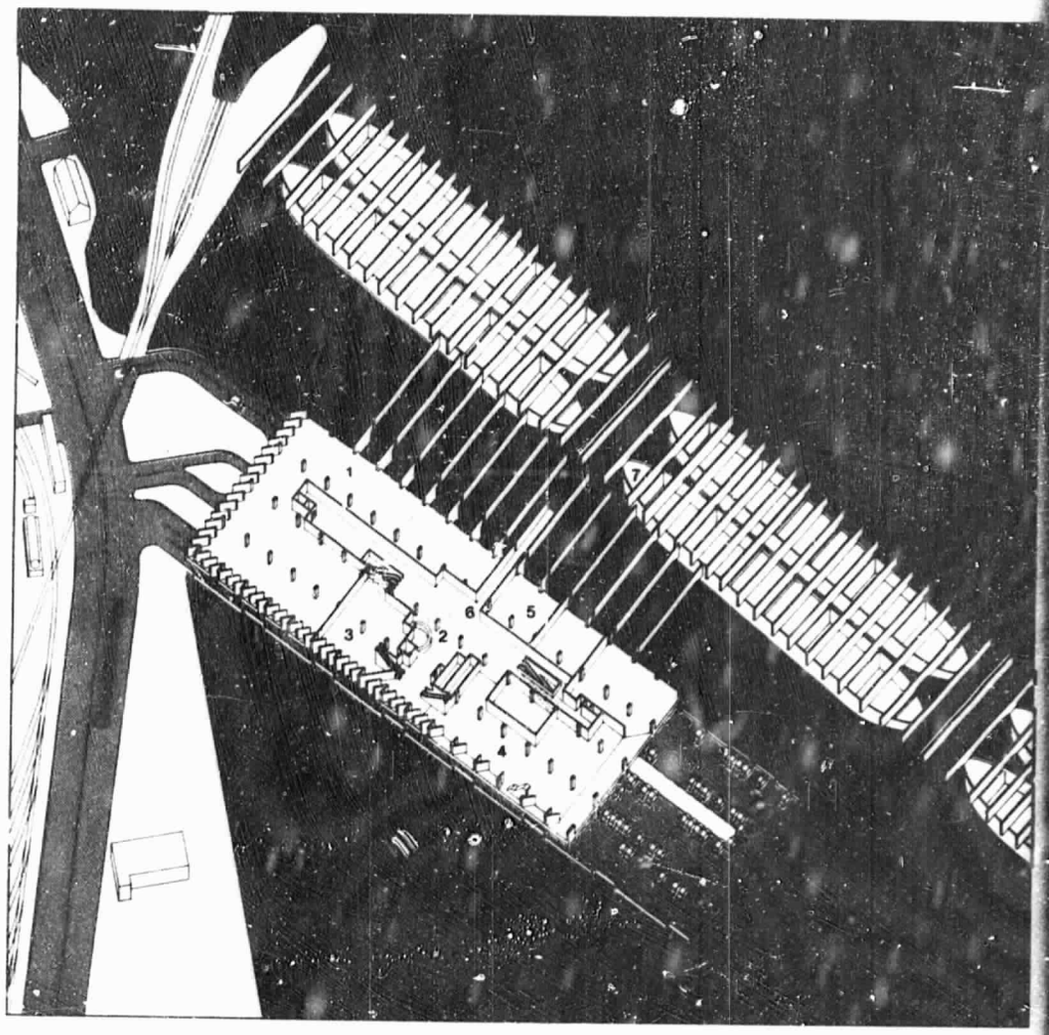
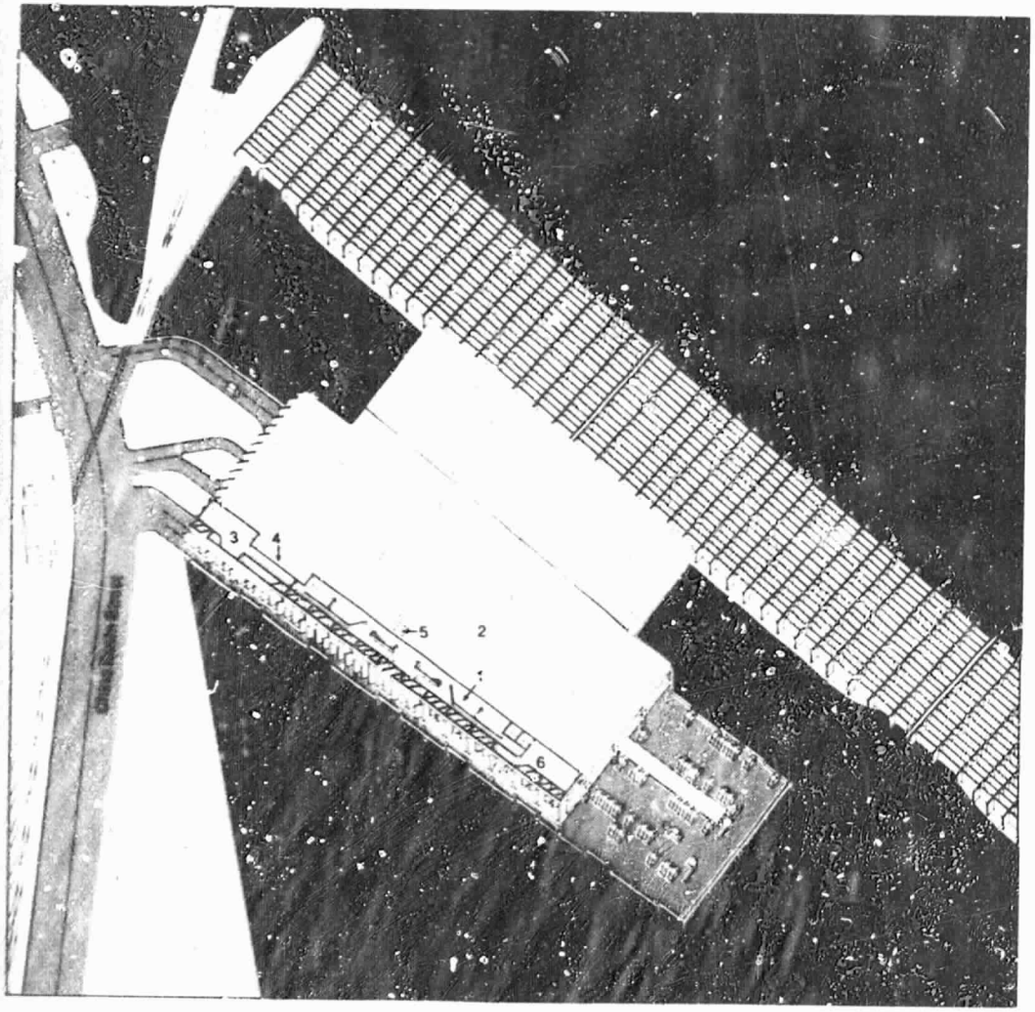
F56
Terminal Design / Scheme 4: First Level Plan



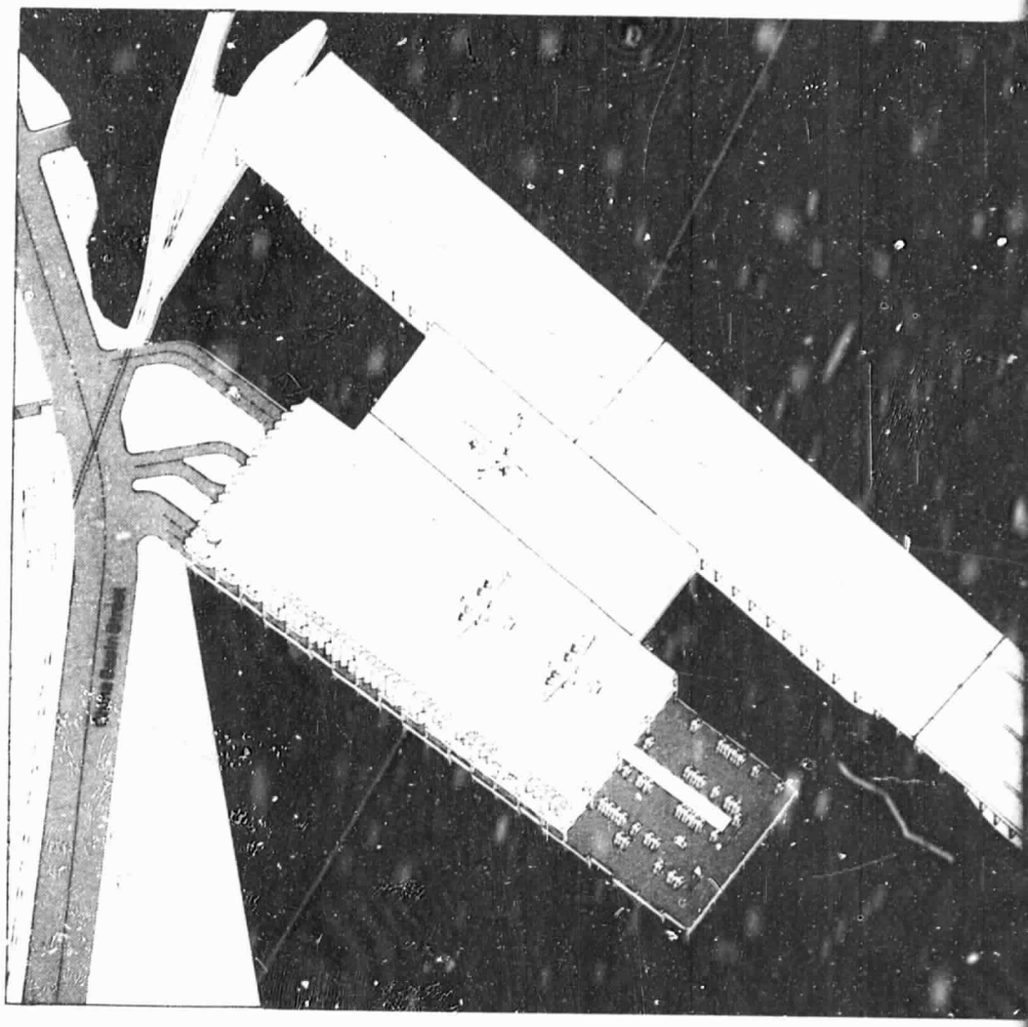
F57
Terminal Design / Scheme 4: Second Level Plan



F58
Terminal Design / Scheme 4: Third Level Plan



F59
Terminal Design / S2



F55
Legend

Orientation	⇧
Scale	Feet 0 200 400
Clearance Zone	
Areas of Potential Ship Mast Penetration	

F56
Legend

Orientation	⇧
Scale	Feet 0 100 200
1	Bus Drop-Off
2	Taxi Drop-Off
3	Private Auto Drop-Off
4	Receiving
5	Parking
6	Sunken Mooring Vessel
7	Typical Liberty Ship Hull

F57
Legend

1	Rental Office Space
2	Ticketing / Baggage Claim
3	Baggage Handling / Mail
4	Restaurant
5	Conference Rooms
6	Access to Liberty Ships
7	Liberty Ship Hull

F58
Legend

1	Boarding Lounges
2	Boarding Gate
3	Air Traffic Control
4	Fire / Emergency Station
5	Elevator to 1st-2nd Levels
6	Cocktail Lounge

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4 Carrier Air Park

Mr. John Kelly

5 Fisherman's Wharf Merchant Association

Mr. Al Baccari

6 The Greater San Francisco Chamber of Commerce

Mr. Lex Byers, Mgr. Economic Development

7 International Longshoremen and Warehousemen's Union, Local 10

Mr. Tom Lupher, Business Agent

8 Marina Civic Improvement and Property Owners Association, Inc.

Miss Virginia Fusco, Secretary

9 People for a Golden Gate National Recreation Area

Mrs. Amy Meyer

Mr. Don Rubenstein

10 Port of San Francisco

Mssrs. Charles Vickers, Acting Port Engineer

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11 Potrero Hill Residents and Homeowners Council

Mrs. Elaine Sundahl

12 Russian Hill Improvement Association

Mrs. Frank Hinman

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Mr. John Jacobs, Executive Director

16 Telegraph Hill Dwellers Association

Mr. Robert Katz

17 United States Coast Guard

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