Port of San Francisco, California, After Action Report

Introduction.

A Port Risk Assessment was conducted for the port of San Francisco, California 16 – 17 November 1999. This report will provide the following information:

- Brief description of the process used for the assessment;
- List of participants;
- Numerical results from the Analytical Hierarchy Process (AHP); and
- Summary of risks and mitigations discussion.

Follow-on strategies to develop and implement unmitigated risks will be the subject of a separate report.

Process.

The risk assessment process is a disciplined approach to obtaining expert judgements on the level of waterway risk. The process also addresses the relative merit of specific types of Vessel Traffic Management (VTM) improvements for reducing risk in the port. Based on the Analytic Hierarchy Process (AHP)[1], the port risk assessment process involves convening a select group of expert/stakeholders in each port and conducting structured workshops to evaluate waterway risk factors and the effectiveness of various VTM improvements. The process requires the participation of local Coast Guard officials before and throughout the workshops. Identification of local risk factors/drivers and selecting appropriate risk mitigation measures is thus accomplished by a joint effort involving experts and stakeholders, including both waterway users and the agencies/entities responsible for implementing selected risk mitigation measures.

This methodology hinges on the development of a generic model of vessel casualty risk in a port. Since risk is defined as the product of the probability of a casualty and its consequences, the model includes variables associated with both the causes and the effects of vessel casualties. The model uses expert opinion to weight the relative contribution of each variable to the overall port risk. The experts are then asked to establish scales to measure each variable. Once the parameters have been established for each risk-inducing factor, the port's risk is estimated by inputting values for the variables specific to that port into the risk model. The model also produces an index of relative merit for five VTM levels as perceived by the local experts assembled for each port.

[1] Developed by Dr Thomas L. Saaty, et al to structure complex decision making, to provide scaled measurements, and to synthesize many factors having different dimensions.

Participants.
The following is a list of stakeholders/experts that participated in the process:

Name	Email Address
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Numerical Results.

Book 1 - Factors *(Generic Weights sum to 100))*

Fleet Composition	Traffic Conditions	Navigational Conditions	Waterway Configuration	Short-term Consequences	Long-term Consequences
13.7	8.6	8.0	6.7	27.7	35.3

Analysis:
The participants contributed the above scores to the National Model. They determined that the Long-term Consequences and the Short-term Consequences are the largest drivers of risk.

Book 2 - Risk Subfactors *(Generic Weights)*

Fleet Composition	Traffic Conditions	Navigational Conditions	Waterway Configuration	Short-term Consequences	Long-term Consequences
13.7	8.6	8.0	6.7	27.7	35.3
% High Risk Deep Draft	Volume Deep Draft	Wind Conditions	Visibility Obstructions	Volume of Passengers	Economic Impacts
8.1	2.8	2.2	2.9	7.4	9.4
% High Risk Shallow Draft	Volume Shallow Draft	Visibility Conditions	Passing Arrangements	Volume of Petroleum	Environmental Impacts
5.6	1.5	2.8	0.4	12.7	13.4
	Vol. Fishing & Pleasure Craft	Currents, Tides, Rivers	Channel and Bottom	Volume of Chemicals	Health & Safety Impacts
	1.0	2.1	1.8	7.7	12.5
	Traffic Density	Ice Conditions	Waterway Complexity		
	3.3	0.9	1.5		

Analysis:
The participants contributed the above results to the national model. Subfactors contributing the most to overall risk under each of the six major factors were:

- For the Fleet Composition factor, High-Risk Deep Draft Vessels contribute not quite two times as much risk as Shallow Draft.
- For traffic conditions, Traffic Density contributes the greatest amount of risk to the waterway.
- For Navigational Conditions, Visibility Conditions contribute the most.
- For Waterway Configuration, Visibility Obstructions contributes the most followed by Waterway Complexity.
- For Short Term Consequences, The Volume Of Petroleum contributes the most by far.
- For Long Term Consequences, Environmental Impact contributes the most.

Book 3 Subfactor Scales - Condition List (Generic)

	Scale Value
Wind Conditions	
a. Severe winds < 2 days / month	1.0
b. Severe winds occur in brief periods	2.3
c. Severe winds are frequent & anticipated	4.6
d. Severe winds occur without warning	9.0
Visibility Conditions	
a. Poor visibility < 2 days/month	1.0
b. Poor visibility occurs in brief periods	2.2
c. Poor visibility is frequent & anticipated	4.6
d. Poor visibility occurs without warning	9.0
Current, Tide or River Conditions	
a. Tides & currents are negligible	1.0
b. Currents run parallel to the channel	2.3
c. Transits are timed closely with tide	5.1
d. Currents cross channel/turns difficult	9.0
Ice Conditions	
a. Ice never forms	1.0
b. Some ice forms-icebreaking is rare	2.1
c. Icebreakers keep channel open	5.2
d. Vessels need icebreaker escorts	9.0
Visibility Obstructions	
a. No blind turns or intersections	1.0
b. Good geographic visibility-intersections	2.0
c. Visibility obscured, good communications	4.7
d. Distances & communications limited	9.0
Passing Arrangements	
a. Meetings & overtakings are easy	1.0
b. Passing arrangements needed-ample room	2.4
c. Meetings & overtakings in specific areas	6.4
d. Movements restricted to one-way traffic	9.0
Channel and Bottom	
a. Deep water or no channel necessary	1.0
b. Soft bottom, no obstructions	1.9
c. Mud, sand and rock outside channel	4.9
d. Hard or rocky bottom at channel edges	9.0
Waterway Complexity	
a. Straight run with NO crossing traffic	1.0
b. Multiple turns > 15 degrees-NO crossing	2.3
c. Converging - NO crossing traffic	4.6
d. Converging WITH crossing traffic	9.0

Passenger Volume

a. Industrial, little recreational boating	1.0
b. Recreational boating and fishing	3.0
c. Cruise & excursion vessels-ferries	5.4
d. Extensive network of ferries, excursions	9.0

Petroleum Volume

a. Little or no petroleum cargoes	1.0
b. Petroleum for local heating & use	2.1
c. Petroleum for transshipment inland	5.0
d. High volume petroleum & LNG/LPG	9.0

Chemical Volume

a. Little or no hazardous chemicals	1.0
b. Some hazardous chemical cargo	2.6
c. Hazardous chemicals arrive daily	5.2
d. High volume of hazardous chemicals	9.0

Economic Impacts

a. Vulnerable population is small	1.0
b. Vulnerable population is large	3.7
c. Vulnerable, dependent & small	5.6
d. Vulnerable, dependent & Large	9.0

Environmental Impacts

a. Minimal environmental sensitivity	1.0
b. Sensitive, wetlands, VULNERABLE	3.5
c. Sensitive, wetlands, ENDANGERED	6.1
d. ENDANGERED species, fisheries	9.0

Safety and Health Impacts

a. Small population around port	1.0
b. Medium - large population around port	2.5
c. Large population, bridges	5.4
d. Large DEPENDENT population	9.0

Analysis:

The participants contributed the above calibrations to the Subfactor scales for the national model. For each Subfactor above there is a low (Port Heaven) and a high (Port Hell) severity limit, which are assigned values of 1 and 9 respectively. The participants determined numerical values for two intermediate qualitative descriptions between those two extreme limits. In general, participants from this port evaluated the difference in risk between the lower limit (Port Heaven) and the first intermediate scale point as being equal to the difference in risk associated with the first and second intermediate scale points. The difference in risk between the second intermediate scale point and the upper risk limit (Port Hell) was generally 2.5 times as great.

Book 4 Risk Subfactor Ratings (San Francisco)

Fleet Composition	Traffic Conditions	Navigational Conditions	Waterway Configuration	Short-term Consequences	Long-term Consequences
% High Risk Deep Draft	Volume Deep Draft	Wind Conditions	Visibility Obstructions	Volume of Passengers	Economic Impacts
4.5	4.4	2.4	4.5	7.9	7.6
% High Risk Shallow Draft	Volume Shallow Draft	Visibility Conditions	Passing Arrangements	Volume of Petroleum	Environmental Impacts
4.2	5.5	4.8	8.0	7.4	8.4
	Vol. Fishing & Pleasure Craft	Currents, Tides, Rivers	Channel and Bottom	Volume of Chemicals	Health & Safety Impacts
	6.6	5.6	4.6	3.2	5.4
	Traffic Density	Ice Conditions	Waterway Complexity		
	6.6	1.0	8.6		

Analysis:

Based on the input from the participants, the following top risks occur in San Francisco (in order of importance):

1. Waterway Complexity
2. Environmental Impacts
3. Passing Arrangements
4. Volume of Passengers
5. Economic Impacts

Book 5 (San Francisco)

	Risk Factors						
	Fleet Composition	**Traffic Conditions**	**Navigational Conditions**	**Waterway Configuration**	**Short-term Consequences**	**Long-term Consequences**	**Relative Merit Index**
VTS	19.0	29.3	26.3	25.1	32.2	29.4	**28.2**
VTIS	21.8	7.3	6.4	6.1	8.2	6.6	**9.1**
EAIS	24.7	17.6	26.4	14.8	19.2	21.5	**20.9**
AIS	21.3	21.3	8.4	13.5	12.0	12.7	**14.1**
Improve Current System	13.2	24.5	32.6	40.6	28.3	29.7	**27.6**

Analysis:

Given the fact that the San Francisco Bay area already has a VTS, this table shows that the participants believe that the tool of VTS and the improvements to the current system shared equal status to reduce the risks in the port area. EAIS will contribute the next greatest potential for risk mitigation given the factors that drive risk in the port of San Francisco.

The Bay area waterway systems moves many people either by ferry or by bridge. The participants deemed this a significant set of risks to mitigate.

The participants agreed that some control was needed over the communications in the port area. The frequencies are overwhelmed with voice communications. Monitoring the traffic frequency becomes a nuisance, not a help. The participants believed that EAIS would provide voiceless communications, reducing the amount of voice traffic.

Scope of the port area under consideration:	
Port area	From sea to the Pilots Station (Precautionary Area), • to San Francisco to Redwood City (Redwood Creek) in the south, • to Antioch Bridge in the east • to the north to Causeway bridge north of Mare Island Channel • excluding the Petaluma River

Risk Factors	Risks	Mitigations
Fleet Composition		
% High Risk Deep Draft Cargo & Passenger Vessels Defined in terms of poor maintenance, high accidents, type of cargo *Defined by 14 –16 foot draft; 1600 G.T., Rule 9 applicable*	1. **Propulsion casualties upon arrival**, half (6-7 last month; less than one half percent of all vessels) generally on low value cargo ships 2. **Steering casualties** upon arrival 3. Mixed crews 4. Language problems **5. Low value cargo ships** • Most are going to Stockton and Sacramento • Transit through most of the port area • Scrap iron goes to Redwood City/Oakland • 10 – 20 percent of ships 7. Relative **new trade to Far East** - relatively new ships	1. Port State Control Program • Foreign Ships • Class Societies • Owners • Mixed crews • Type of Propulsion

Risk Factors	Risks	Mitigations
%High Risk Shallow Draft Cargo & Passenger Vessels	1. Rio Vista – 700 SAR cases per year. 2. *Include pleasure craft and fishing vessels from casualty perspective…collisions, allisions, groundings. Talk about skill sets.* 3. **Obstruct** deep draft vessels 4. Tugs/barges. Not a major problem 5. Ferries. Not a major problem – good cooperation • Same number of casualties as deep draft • Have multi engines…no propulsion problems • Multitude of high speed ferries 6. Charter Boats. 7. Dinner Cruise Boats. See also ferries 8. **Commercial Fishing** Vessels • **Cannot maintain** vessels • **Obstruction** of the channel • Less regulated than other segments of the industry • Operator distracted while fishing • Crew competency is questionable • **Language barrier** sometimes • Around pier 47 – Italian • Vietnamese fishermen 9. Recreation Boats • No licensing for competency • Unregulated skill sets • Many new owners • Older boats poorly maintained • 19,000 berths in San Francisco Bay • 85% of all recreational boats not in berths (trailered) • ***Result…lots of boats and relatively few casualties***	1. New ferries will be higher quality
Traffic Conditions	Look also into the future	
Volume of Deep Draft Vessels	1. Today: • **Seems to be declining**; not as high as other ports – **will probably steady out** • 250 – 280 arrivals per month • Average just under 10 arrivals per day; varies daily from 3 - 20 • Drafts and sizes are increasing • 42 now, will increase to 50 feet draft • 50 foot ships are more constrained by channel size, time, and depth • Congestion caused by vessels awaiting pilots offshore at almost same transit time • Going through the bay into the **Carquinez Straits** to Stockton (90 per year) and Sacramento (90 per year) 2. Future: • Expect more 50 foot draft vessels due to	1.

Risk Factors	Risks	Mitigations
	channel deepening project in Oakland	

Volume of Shallow Draft Vessels	1. Today: Risk of two vessels maneuvering into each other to avoid high speed ferry
	2. Future:
	• New **high speed additional ferry traffic**
	  • Into San Francisco, down to San Jose
	  • To San Leandro
	  • Down to Silicon Valley
	  • Chris-crossing from East Bay to San Francisco side
	  • Shuttles to-from airport and San Francisco and San Jose
	  • May increase significantly over time
	  • Extend ferry service to Antioch
	• Housing increasing in entire bay area
	  • mostly area east of Oakland and north of San Pablo Bay
	• Construction projects on bridges to improve seismic stability, increase tug and barge activity
	• Diminishing operator experience as demand increases
		1.

Volume of Fishing & Pleasure Craft	1. Today:
	• Trend: Should remain even for motorized vessels
	• Wind surfers off Golden Gate
	• Oakland – Alameda Estuary – Many marinas
	• Redwood Creek – rowers and wind surfers
	• Kayaks
	• Organized marine events – Alcatraz to Station Golden Gate
	• Swimmers – Alcatraz to Aquatic Park
	• Sail boats in central bay – 396 have increased to over 1000 permits per year over three years
	  • Doing a better job of tracking down events
	• Water is too rough on the San Francisco Bay for most small craft but good for sail boats
	• San Pablo Bay and toward Sacramento and San Joaquin river…growing
	• Fleet week and other activities / events bring many boats out
	  • About 1000 marine events
	2. Future: Expect marine events to stabilize
		1. Water is rough in San Francisco Bay

Risk Factors	Risks	Mitigations
Traffic Density	1. Container ship arrivals going to the same port…to meet the 0800 longshoreman start…container ships 2. Fleet week 3. **Central Bay**, around Alcatraz •Major marinas •Best place to sail in the bay •Tourist attractions •Concentration of activity •Picturesque 4. **Oakland Estuary** • Lots of recreational boats and marinas 5. **Mouth of Richmond Channel?** 6. **Carquinez Strait**…marinas and fishermen (drag nets and fish in channel)\ •Limited area 7. **Anchorage 9** •Deep draft traffic at anchor •Some recreational traffic – in future •Projected Increase in ferry •No small boat traffic today 8. **Pilot Station** 9. **Ferry Building**…Pier 1 and 39 at rush hour	1. VTS up and operating
Navigational Conditions		
Wind Conditions *Over 20 knots, problems for recreation boats; Over 25-30 knots causes problems for deep draft vessels*	1. Nov to Mar for 12 hour periods – 3 days a month – high winds when a front comes through 2. In Benecia, wind tunnel affect (heating affect), **Carquinez Strait** • Carquinez – with the channel • Regular occurrence – predictable - anticipated • East San Pablo Bay – partially across the channel 3. At Golden Gate – wind with the channel 4. Oakland Bar Channel – with southerly gale blowing across the channel 5. Redwood City – summer wind through mountain pass (Coast range)	1. Winds are usually forecast well in advance 2. PORTS system helps to be better prepared. Increased situational awareness • May be losing federal QA of data 3. WX info from LNB is helpful 4. Integrate water resource system – fresh water coming down the river 5. Use predictive model for wind speed; also for water current
Visibility Conditions	1. Fog rolls in through Golden Gate at 2-3 p.m. 2. In winter up in delta areas (Tule Fog) 3. In summer in Central Bay – gets concentrated •Tends to be patchy •Visibility different for differing height of eye • 4. Everyone slows down in the fog • Ferries slow to half distance of visibility	1. Not as bad as it used to be •Recent El Nina •Less ground moisture

Risk Factors	Risks	Mitigations
Currents, Tides and Rivers Ice	1. Spring runoff down the Sacramento River – over two knots; common 2 knots, can run 4 – 6 knots. 2. Cross channel currents • Oakland – departing estuary • Off Richmond long wharf going into the port of Richmond • Up in Suison Bay (across Bulls Head reach), across the flats, current sets to 2 knots • More than 2 knots in San Pablo Bay, sometimes to 6 knots • ACOE controls the dam releases that use sometimes cause the current to be high 3. **UP railroad bridge.** Don't approach on following current. May not open 4. **Bay Bridge**…can get set onto towers 5. **Alcatraz** – across the face of the pier. 6. Currents in **Central Bay** can set you on to Blossom Rocks. 7. Increase current due to runoff from USACOE and State dams	1. State Water Resources and USACOE need to coordinate release of water. No effort to control; efforts to communicate. Relieves pressure on the levees.
Waterway Configuration		
Visibility Obstructions	1. All bridges are obstructions for seeing small vessels • Point Blunt on Angel Is – obstructs to eastbound and southbound channels • Yerba Buena Island obstructs inbound from outbound from Richmond area • **Carquinez Strait** near Dillon Pt**.** – can obstruct traffic due to bends • **Benecia Bridge** – adding a third bridge • **New Highway bridge** - • Pt. San Pablo…not a high risk 2. Background lighting in Oakland outer harbor and anchorage 5 3. Approaching Oakland outer harbor – Background lighting 4. Blind Communications – San Pablo Bay 5. No VTS radar past the Carquinez Bridge	1.

Risk Factors	Risks	Mitigations
Passing Arrangements ***This was the second highest risk factor***	1. **Carquinez Strait** – trying to hold for traffic at bridges 2. **San Pablo Bay Channel** – 300 feet wide • One way traffic Panole Shoal • Can pick up pipeline (gas) • Channel changes due to sand erosion 3. **Suison Bay Channel** – Can pass at port Chicago 4. **South Hampton Shoal Channel** 5. **New York Slough,** beyond NY Point 6. Dredging • San Pablo • Oakland • Carquinez Strait • Redwood • Product (sand) dredging	1. Existing Aids to Navigation 2. VTS imposes order 3. Pilotage Rules and/or operating procedures 4. Provide information on location and speed of meeting vessel. 5. Richmond long wharf could use a laser range 6.
Channel and Bottom	1. **San Pablo Bay Channel** – soft bottom 2. **Suison Bay Channel** – soft bottom 3. **Blossom Rock** 4. **Shag Rock** 5. **Invincible Rock** 6. **Whiting Rock** 7. **Harding Rock** 8. Ferry, if stuck in soft bottom, blocks cooling water pipe…disables vessel 9. Bridge abutments – narrow – high current 10. Redwood City area…general silting of the area requires extra dredging 11. Availability of soundings – results of surveys not released by ACOE for 6 months 12. Pipelines throughout the bay but mostly in Carquinez 13. Airdraft restrictions • Bridges and retrofits construction to seismic adjustments 14. Earthquakes • Effect bridges – can collapse into channel 15. Isolated rock outcroppints (Blossom Rock and others)	1.

Risk Factors	Risks	Mitigations
Waterway Complexity ***This is sub factor with highest level of concern***	RISK IS HIGHER THAN WE WOULD LIKE IT TO BE 1. UP Railroad bridge will not open on demand 2. Seismic retrofits on bridge • Air draft and width problem 3. Crossing traffic 4. Merging waterways 5. Twisting and turning waterways 6. Central bay, east of Alcatraz – most complex 7. South Bay 8. Carquinez - Leave pilings from old bridge in place 9. Between Bay Bridge and setting up for Oakland Channel; little room to maneuver • Is now an RNA 10. Future: Deeper draft ships may require the need for a deepwater traffic lane south of Alcatraz 11. Tug assist to tankers adds more tugs and vessels to the waterway system 12. Most hazmat vessels do not require tug assist 13. Leaving bridge supports in place after bridge removal	1. Have established Regulated Navigation Areas (RNAs) 2. Bridge maintenance is better 3. Increased horizontal clearance on new Benecia highway bridge 4. Permitting process for marine events in place 5. VTS advises traffic; helps with info management and flow • May need to add to VTS capability • EAIS would benefit user 6. EAIS may be able to help – voiceless exchange of information, bridge to bridge 7. COTP using coordination to reduce risk • Talking to AMTRAC • Talking to bridge operators • Talks in RNAs, using COTP authority 8. COTP conducting outreach project with recreational boating community • Violations of rule 9 will disqualify a racing vessel – by yacht club 9. Pilotage rules 10. Rules of the Road 11. Consider adding some rules 12. Remove hazardous rocks (result of widening the channel) 13. Consider dedicated ferry transit lanes 14. Consider WAMS of ATON configuration 15. Consider the boundaries of anchorage areas 16. How to simplify • Improve communications around Angel Island • Reduce the voice traffic on Channel 14 • Consider AIS • Strategy – Call landline whenever possible • Coordinate via cell phone • Create a new radio channel
Short Term Consequences		
Number of People on Waterway ***This was the fourth greatest***	1. Many people crossing the Bridges • Earthquakes 2. Ferry Operations – more people during rush hour	1. For the ferry operations, • Set up planned routes for Ferry Traffic • Converging traffic may be

Risk Factors	Risks	Mitigations
fourth greatest concern	• Dodging high speed traffic 3. Cruise ship operations – through the Precautionary area, under Golden Gate, to pier 32, south of Bay bridge 4. Time of day – Rush hour for ferries 5. Day of the week – recreational traffic 6. Special Events – New Years eve – Prom Season – major holidays	more risk • Educate other vessel classes • Use AIS on the high speed ferry • Participate with VTS; currently done • Equipment is more than required • Extend RNA requirements to the ferry industry
Volume of Petroleum Cargoes	1. Tank ship of 200,000 tons – largest coming in – enroute to long wharf in Richmond and Carquinez Strait – Benicia after lightering 2. Lighter off at anchorage 9 3. Container carriers bunkers – large quantity of petroleum product (up to 5,000 barrels)	1.

Volume of Hazardous Chemical Cargoes	1. Not much cargo moving through
	2. Steady – 2 anhydrous ammonia carriers per month going to Sacramento and Stockton. Other hazardous materials cargoes go through the port to Pittsburgh and New York Point
	• In a high population area where population increasing
	• Cargoes include
	  • Anhydrous Ammonia
	  • Caustic Soda
	  • Sulfuric Acid
	  • Explosives
	3. Spent nuclear fuel going to Concord
	4. Many hazardous materials cargo now containerized – smaller volumes
	5. DOD mobilization port
	6. Tug escort requirement create 'fleet' of vessels instead of one
		1. Most hazardous material is containerized

<u>Long-Term Consequences</u>		
Economic Impacts ***This is the fifth important risk factor***	1. Oil facilities are on 2-7 day turn around schedule • Crude oil comes in on ship; out in pipe/trucks for the most part • Located in **Carquinez Straits** down to Richmond 2. Containers on a tight schedule. Have a lot of just in time deliveries. Automobile assembly and Wal-Mart type of products. How long: 2-3 days • Panic in the stores…not getting the products 3. Recreation resources • People unable to use boats • Communities around marinas will be unemployed	

Risk Factors	Risks	Mitigations
	• Tourists industry will be affected • Six packs taking out sport fishermen cannot go out • Daily Alcatraz industry 4. Ferries • People unable to get to work • Ferry industry itself	
Environmental Impacts ***This was the third most important risk factor***	1. Whole bay is environmentally sensitive area. 85% of the bay is wetlands 2. 85% of remaining California wetlands is in Bay •Pilings are archeological sites •Riprap is site for herring eggs 3. Political risks 4. Acquatic Nuance Species 5. Bay does not self clean in the shallow area • Back eddy in San Pablo Bay does not flush • South Bay has no flushing	1. Clean up contractors are prepared and willing to respond. 2. Environmentalists and industry do NOT agree on level of acceptability of mitigation efforts
Health and Safety Impacts	1. Major metro area adjacent to water; many people impacted by activity on the water. •Entire bay in rimmed with people •Entire bay is megatropolis •People are living right on the water	