Dana Point Harbor Boat Traffic Study

Submitted to:

Project Dimensions, Inc.

Submitted by:

MOFFATT & NICHOL

November 2007

COUNTY OF ORANGE

DANA POINT HARBOR DEPARTMENT

Brad Gross, Director
24650 Dana Point Harbor Drive
Dana Point, CA 92629

Telephone: (949) 923-2236
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November 27, 2007

Dana Point Harbor Community:

The Dana Point Harbor Marina Improvement Project, is currently in the planning, design and environmental review phase. Proposed changes in the Marinas include a modest change to the slip mix in the Harbor, increasing the average slip length from just under 30 feet to just under 34 feet. The result will net fewer slips in the Harbor than exist today. In an effort to retain as many slips as possible, The Dana Point Harbor Department's (DPHD) Team has explored a number of design options in an effort to retain as many slips as possible. One of the design options being considered is the narrowing of the Inner Channel width and lengthening each finger to allow for more slips to be included.

In order to determine the feasibility of this option, DPHD commissioned Moffatt and Nichol, a marine engineering firm experienced in studying marina / harbor traffic conditions, to conduct a study to assess the existing traffic conditions, interview Harbor users, study the proposed designs and make recommendations regarding the feasibility of narrowing the channel as well as propose mitigation measures as needed.

Once the draft report was completed, we requested both the County of Orange Harbor Patrol and the State of California Department of Boating and Waterways (Cal Boating) to review the study and provide us with their comments and recommendations. Letters from both of these agencies are included on the following pages.

Based on the conclusions found in this study, along with the recommendations of both the Harbor Patrol and Cal Boating, DPHD will continue to pursue the narrowing of the Inner Channel in order to maximize the number of slips in the Dana Point Harbor Marina Improvement Project.

More information on the entire Dana Point Harbor Revitalization Plan is available at www.dphplan.com.

Thank you,

Brad Gross, Director
Dana Point Harbor Department

STATE OF CALIFORNIA-THE RESOURCES AGENCY ARNOLD SCHWARZENEGGER, *Governor*

DEPARTMENT OF BOATING AND WATERWAYS
2000 Evergreen Street, Suite 100
SACRAMENTO, CA 95815-3888
(916) 263-1331

November 19, 2007

Mr. Brad Gross, Director
Dana Point Harbor Department
24650 Dana Point Harbor Drive
Dana Point, California 92629

Re: Dana Point Harbor Boat Traffic Study

Dear Mr. Gross:

The California Department of Boating and Waterways (Cal Boating) received copies of the final draft version of the *Dana Point Harbor Traffic Study*. The document was reviewed by Cal Boating staff and our comments are listed below.

First, the widths achieved in the narrowing of the harbor as proposed meet Cal Boating's small craft harbor design guidelines for interior channels. Typically this would be sufficient for Cal Boating to allow such changes in the design.

Next, Cal Boating does not have expertise in boating traffic modeling so we must defer to Moffatt and Nichol engineers as the experts in this instance. Moffatt and Nichol posit that the proposed change in design would not present a significant change in traffic patterns on a regular basis and that the listed mitigation measures, specifically increased enforcement and education (Chapter 7), should be sufficient safety measures to justify the change.

Because the narrowing still meets the minimums set forth in our guidelines and because the experts (Moffatt and Nichol) have indicated that the design change will not cause a significant change to traffic on a regular basis, Cal Boating would support the Harbor Department's request to make this change to its final design.

Cal Boating concurs with Moffatt and Nichol's recommended mitigation measures and recommends that the Harbor Department follow the list.

If you have any questions please feel free to contact me at 916.263.8165 or by email at hflood@dbw.ca.gov.

Sincerely,

Harold Flood
Planning Supervisor

11-26-07A09:20 RCVD

SHERIFF-CORONER DEPARTMENT
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CALIFORNIA

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JACK ANDERSON
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DANIEL MARTINI
CHARLES WALTERS

November 14, 2007

Mr. Brad Gross, Director
DANA POINT HARBOR DEPARTMENT
24650 Dana Point Harbor Drive
Dana Point, CA 92629

RE: Dana Point Harbor – Marina Improvement Project
Boat Traffic Study

Dear Mr. Gross,

I have received and reviewed the final draft copy of the *Dana Point Harbor Boat Traffic Study* completed as part of the DPHD Marina Improvement Project. The proposal to "narrow" the existing West Basin and East Basin Inner Navigation Channels, due to marina/slip reconfiguration, was evaluated by Orange County Sheriff's Department (OCSD) Harbor Patrol staff, with user safety as the primary concern.

I concur with the comprehensive findings of the study identified in *Section 8.0 – Summary and Conclusions* regarding "existing and proposed future boating traffic issues" and OCSD Harbor Patrol agrees that a harbor public education program and/or increased enforcement efforts, as outlined in *Section 7.0 – Mitigation Measure,* should effectively reduce or eliminate most impacts of Inner Channel encroachment.

Our collaborative goal is to maintain a user friendly, safe harbor which provides an enjoyable experience for all recreational interests.

Sincerely,
ORANGE COUNTY SHERIFF'S DEPARTMENT
HARBOR PATROL DIVISION

Captain D. Bergquist
Harbormaster

DANA POINT HARBOR
BOAT TRAFFIC STUDY

Prepared for:

PROJECT DIMENSIONS, INC.
3 Park Plaza, Suite 1490
Irvine, CA 92614

Prepared by:

MOFFATT & NICHOL
3780 Kilroy Airport Way, Suite 600
Long Beach, California 90806

NOVEMBER 2007

M&N File 6231

CONTENTS

TABLES

FIGURES

EXECUTIVE SUMMARY

This report presents a study of the boat traffic conditions at the Dana Point Harbor under existing conditions and a proposed reconfiguration of the marina. The existing Inner Channel has a design width of approximately 200’ from dock to dock, but an effective navigable width of approximately 180’ due to the side-tie boats at the ends of many of the docks. The proposed plan reduces the number of slips from 2409 to a range between 1932 and 2035, increases the average boat length from 30’ to 34’, and narrows the Inner Channel width from 200’ to 160’ over the majority of both basins with a further reduction to just under 95’ near the bridge.

The analysis of the traffic conditions includes the generation of representative long-term boat traffic for the existing and proposed configurations, verification of the long-term traffic through observations, development of a boat traffic evaluation model based on highway traffic principals, interviews with existing users, review of applicable design criteria for channel dimensions, quantification of boat traffic impacts, and presentation of potential mitigation measures.

The traffic generation values for the proposed reconfiguration of the marina are slightly less than the traffic generation values for the existing marina due to the reduction in total slips.

The interviews with the Harbor users and the on-site observations indicated that there is typically little traffic congestion in the Inner Channel. Congestion and traffic conflicts tend to be the result of small Day-Use Vessels, novice boaters, and/or failure to obey the “Rules of the Road”.

The boat traffic model is based on the concept of Level-of-Service (LOS), which is a statistical approach to developing a qualitative representation of the effects of traffic on the channel user. It relates the capacity of the channel to the volume of traffic under different conditions, and is represented by a scale of service levels from A to F, with A being the best condition.

The modeling investigated various parameters including the number of boats, timing of boat arrivals/departures, holiday traffic increases, special events, channel width, average boat speed, average boat length, average boat spacing in the channel, slip orientation relative to the traffic flow, and small Day-Use Vessels. The model corroborates the general consensus that there is little to no present Inner Channel congestion, and there will be no significant change in the new configuration on a regular basis. Typical LOS values ranged from A to B, and none exceed a LOS of more than C for a few hours on a weekend day. This is considered to be a very high service level average for typical marinas. The findings of the modeling study are consistent with the interviews of the Harbor users and the on-site observations of July 14th 2007.

Potential mitigation measures identified include increased enforcement of present statues as required and additional boater education.

1.0 INTRODUCTION

1.1 Purpose

The purpose of this study is to assess the boat traffic conditions at the Dana Point Harbor under existing conditions and a proposed reconfiguration of the marina. The proposed plan reduces the number of slips from 2409 to a range between 1932 and 2035, increases the average boat length from 30' to 34', and narrows the Inner Channel width from 200' to 160' over the majority of both basins with a further reduction to just under 95' near the bridge.

Dana Point Harbor is manmade and located between Los Angeles and San Diego on the southern Orange County coast. It has traditionally been a small-craft, recreational harbor with +\- 2,400 slips, a boat ramp, and several land-based boating facilities. Presently there is an extensive waiting list for slips.
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Project Dimensions Inc. has been selected by the County of Orange as the project manager for a planned redevelopment and renovation for both the landside and waterside. URS Cash and Associates are providing marina renovation planning and engineering services. There have been several iterations of the proposed slip layout, and this study is focused on the layout called "Layout 2C.2 with Channel Encroachment."

1.2 Approach

This boat traffic study analyzes the impacts of the proposed project on existing Harbor conditions and provides measures to mitigate the impacts. The general approach for the analysis is summarized as follows:

1. Generate representative boat traffic patterns for the existing and proposed layouts for regular summer weekend conditions based on long-term observations from similar Southern California marina historical data.

2. Verify the applicability of the long-term traffic data with on-site observations and use the results of the observations to calibrate the model.

3. Conduct interviews with key Harbor users and administrative personnel to help understanding of "how the Harbor works" in terms of usage patterns, any existing congestion areas, and input on potential mitigation measures associated with the potential impacts of the proposed project.

4. Review small craft harbor design guidelines and channel design criteria that relate recommended channel widths to size of marina.

5. Quantify boat traffic impacts based upon a boat traffic simulation model.

6. Propose potential mitigation measures to avoid or reduce any significant impacts.

2.0 EXISTING FACILITIES AND BOATING ACTIVITIES

The construction of Dana Point Harbor began in the late 1960’s and the Harbor was officially dedicated on July 31, 1971. The Harbor is located in Capistrano Bay on the southern Orange County coastline, approximately half way between Los Angeles and San Diego. Dana Point Harbor is a County of Orange owned facility located within the City of Dana Point, and serves recreational boaters and County residents alike with numerous recreational and leisure activities. It is a vital commercial and community center.

Facilities within the Harbor immediately adjacent to the water include the East and West and Embarcadero Marinas containing approximately 2,500 slips, a fuel dock, bait barge, boat launch ramps, commercial fishing docks, a boatyard, guest docks, boat rental docks, yacht clubs, the Youth and Group Facility, an interior swim beach (Baby Beach), a fishing pier, and the Ocean Institute docks for tall ships and research vessels. Figure 2-1 shows the general Harbor layout; Figure 2-2 is an aerial photograph of the Harbor.

The Harbor has an active sailing community and has become a popular location for kayakers, personal watercraft (PWCs) and stand-up paddle boarders (Figure 2-3)

Figure 2-4 presents the “Proposed Layout 2C.2 with Channel Encroachment” which has been identified as the preferred alternative for this boat traffic analysis.

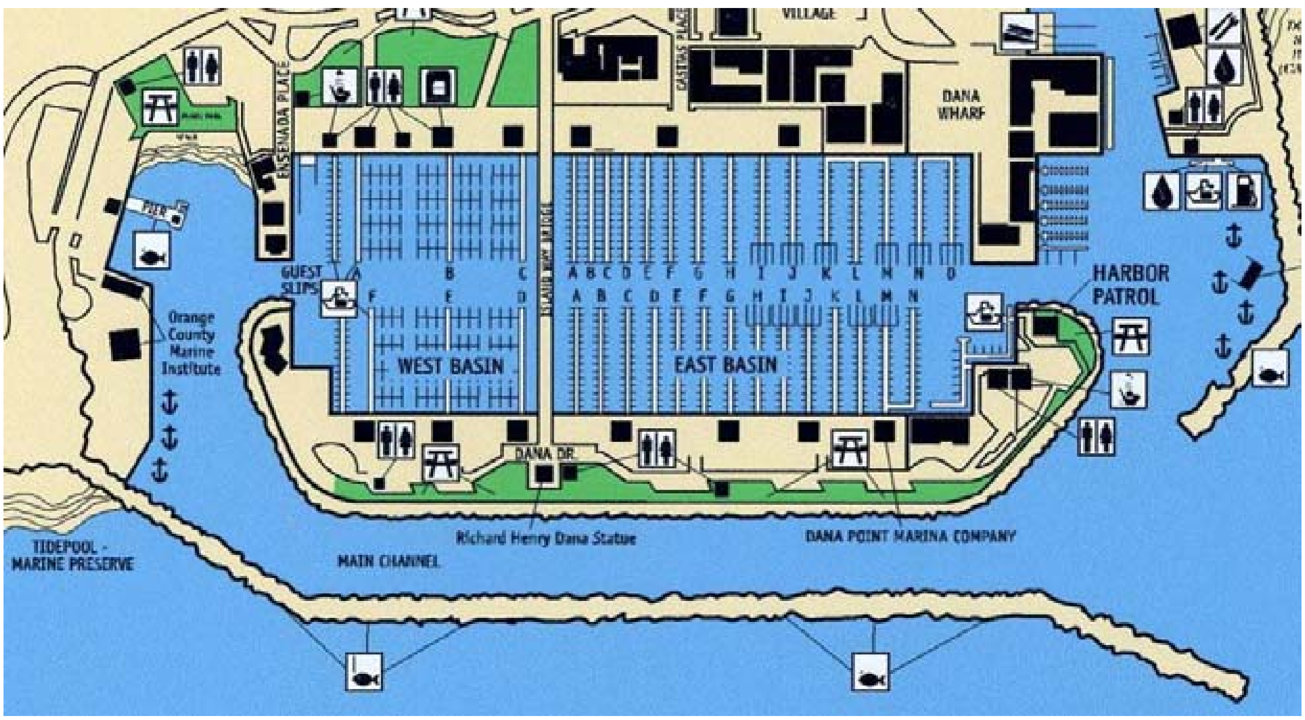
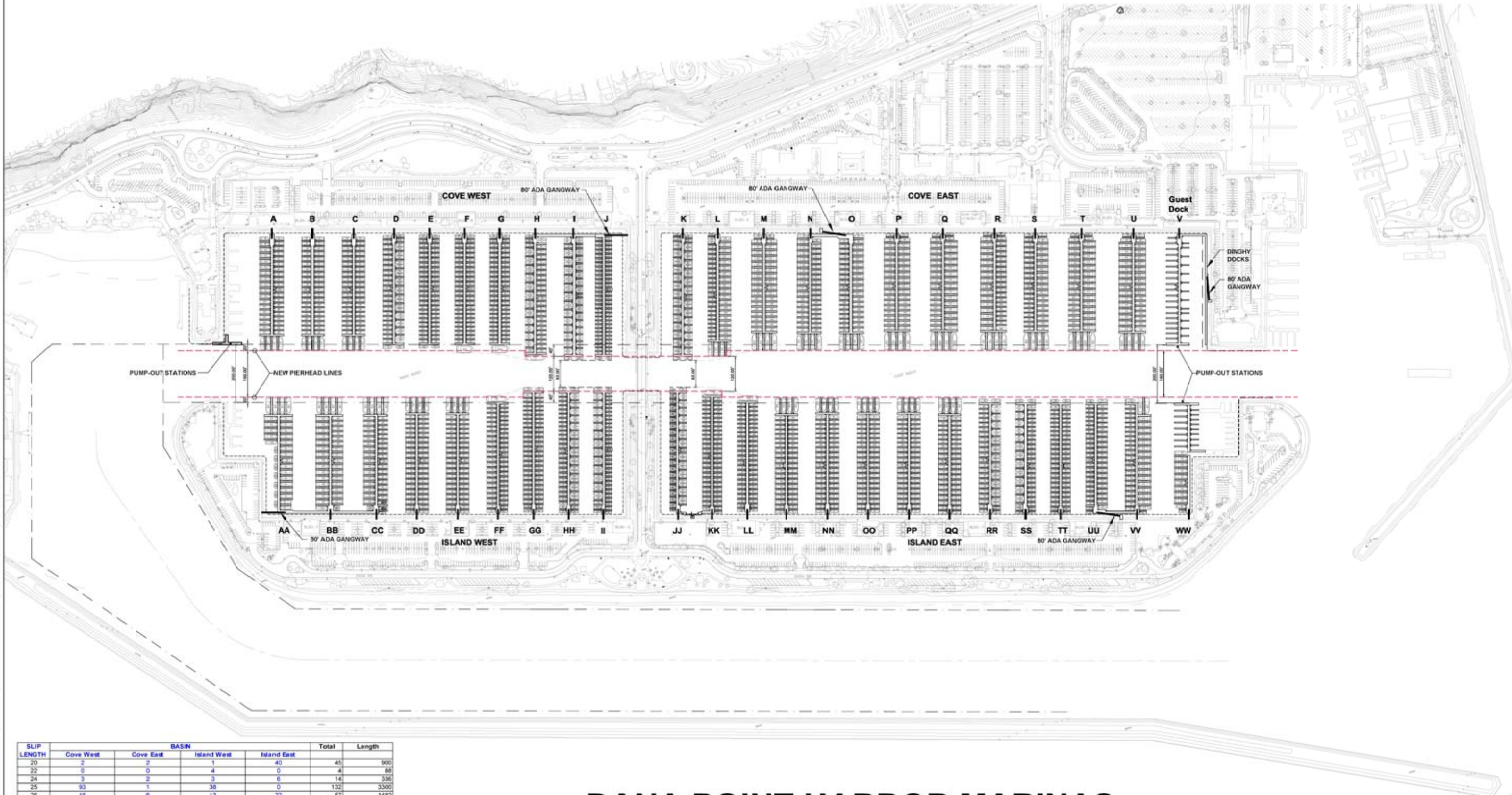


Figure 2-1 – Dana Point Harbor General Layout

Figure 2-2 – Dana Point Harbor Aerial (2004)

Figure 2-3 – East Basin Inner Channel – Navigational and Recreational Uses



SLIP LENGTH	BASIN				Total	Length	
	Cove West	Cove East	Island West	Island East			
20	2	2	1	40	45	900	
22	0	0	4	0	4	88	
24	3	2	3	6	14	336	
25	93	1	38	0	132	3300	
26	16	6	13	22	57	1482	
28	0	35	0	0	35	980	
29	5	2	3	7	17	493	
30	210	54	150	257	671	20130	975 / 2035 = 47.9% @ 30' and under
32	13	5	10	23	51	1632	
34	0	5	1	0	6	204	
35	128	70	108	238	544	19040	
36	2	13	0	0	15	540	
38	0	0	0	0	0	0	616 / 2035 = 30.3% @ 31' thru 38'
39	0	2	1	1	4	156	
40	16	175	35	1	227	9080	
45	0	58	32	23	113	5085	
49	0	0	0	0	0	0	344 / 2035 = 16.9% @ 39' thru 49'
50	12	4	0	12	28	1400	
55	0	8	8	8	24	1320	
60	0	16	12	2	30	1800	
65	0	12	0	0	12	780	
68	2	0	0	2	4	272	
73	1	0	1	0	2	146	100 / 2035 = 4.9% @ 50' and up
Total	503	470	420	642	2035	69164	
			Average Slip Length (Ft.)=			33.99	

DANA POINT HARBOR MARINAS

LAYOUT 2C.2 w/ Channel Encroachment

(34' Avg.)

PROPOSED LAYOUT

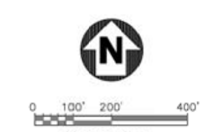


Figure 2-4 - Proposed Layout 2C.2

3.0 BOAT TRAFFIC GENERATION

Historical boat traffic data and usage patterns from similar Southern California marinas were applied to the existing and proposed marina development in order to generate a reasonable expectation of traffic to assess potential project impacts. Detailed boat count data from Marina Del Rey[1], Newport Harbor, Channel Islands Harbor[2,3] and Huntington Harbor[4] were analyzed to select appropriate boat traffic generation factors. The applicability of this historical data to the Dana Point Harbor was verified by on-site observations, which were then used to calibrate the traffic model. Sensitivity to the assumed usage patterns is addressed in Section 6.

3.1 Historical Boat Traffic Information

Summer Weekends are typically the most popular days (excluding Holidays), with up to 25% of berthed vessels in use. This ratio is termed the "daily use factor." Patterns of use during the day are a function of boat type. Power boats typically leave early in the morning and their usage is relatively spread out over the day. Sail boats typically go out for an afternoon sail when these winds pick up. Mean hourly usage as a fraction of the daily total for sail boats and power boats are shown in Figure 3-1 and 3-2, respectively.

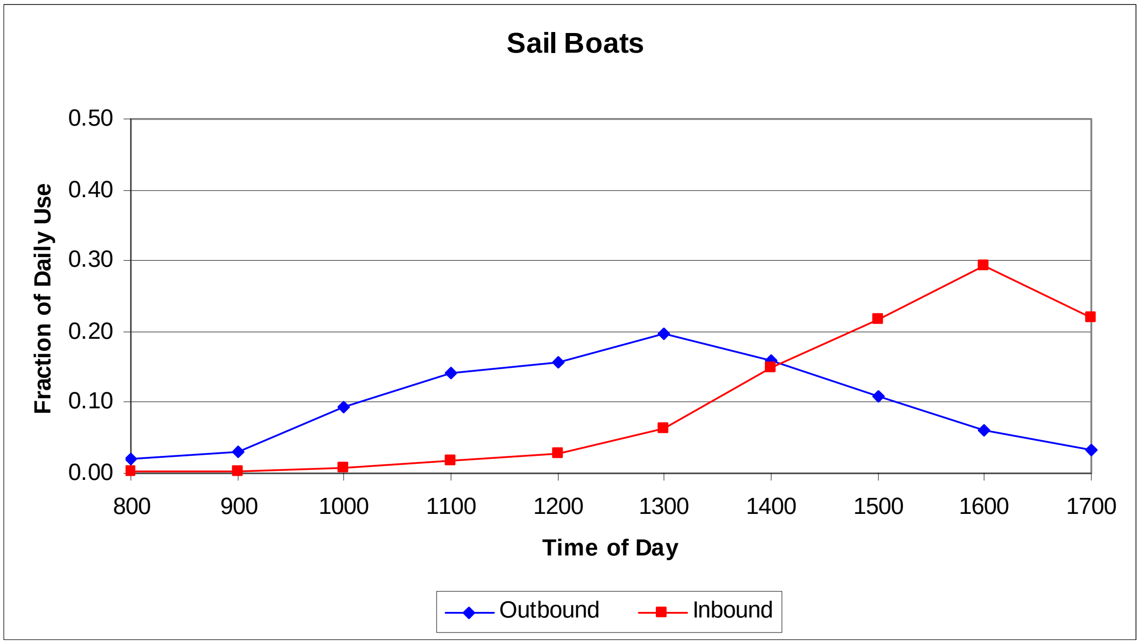


Figure 3-1 – Hourly Usage Factors – Sail boats

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[1] Williams-Kuebelbeck and Associates, Inc., *Analysis of Boat Traffic Conditions for Marina del Rey*, prepared for Summa Corporation, 1981.

[2] Moffatt & Nichol, *Channel Islands Harbor Entrance Congestion Study*, prepared for Voss Construction Company, 1980.

[3] Moffatt & Nichol, *A Study of the Effects of Waterway Expansion – Channel Islands Harbor*, prepared for County of Ventura, Department of Public Works, 1970

[4] Moffatt & Nichol, *Ordnance Pier, Naval Weapons Station Seal Beach – Functional Analysis Concept Development (Small Boat Traffic Appendix)*, prepared for Southwest Division Naval Facilities Engineering Command, 2004.

These hourly usage factors are applied to the existing and proposed layouts and slip mixes for each basin, (Table 3-1 presents the existing slip counts) creating unique sets of usage factors for both outbound and inbound directions. Figures 3-3 and 3-4 present these factors by basin and direction

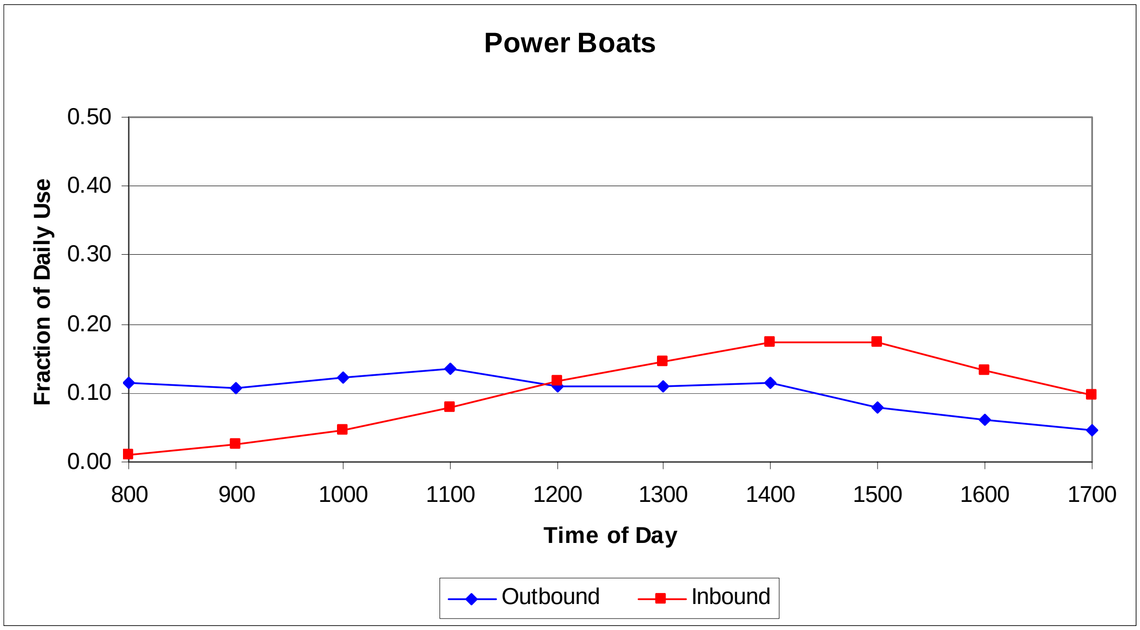

Figure 3-2 – Hourly Usage Factors – Power Boats

Table 3-1 – Existing Slip Counts

SLIP LENGTH	EXISTING
30 and under	1795
31-38	273
39-49	236
50 & Over	105
Total	2409
Average Slip Length	29.85

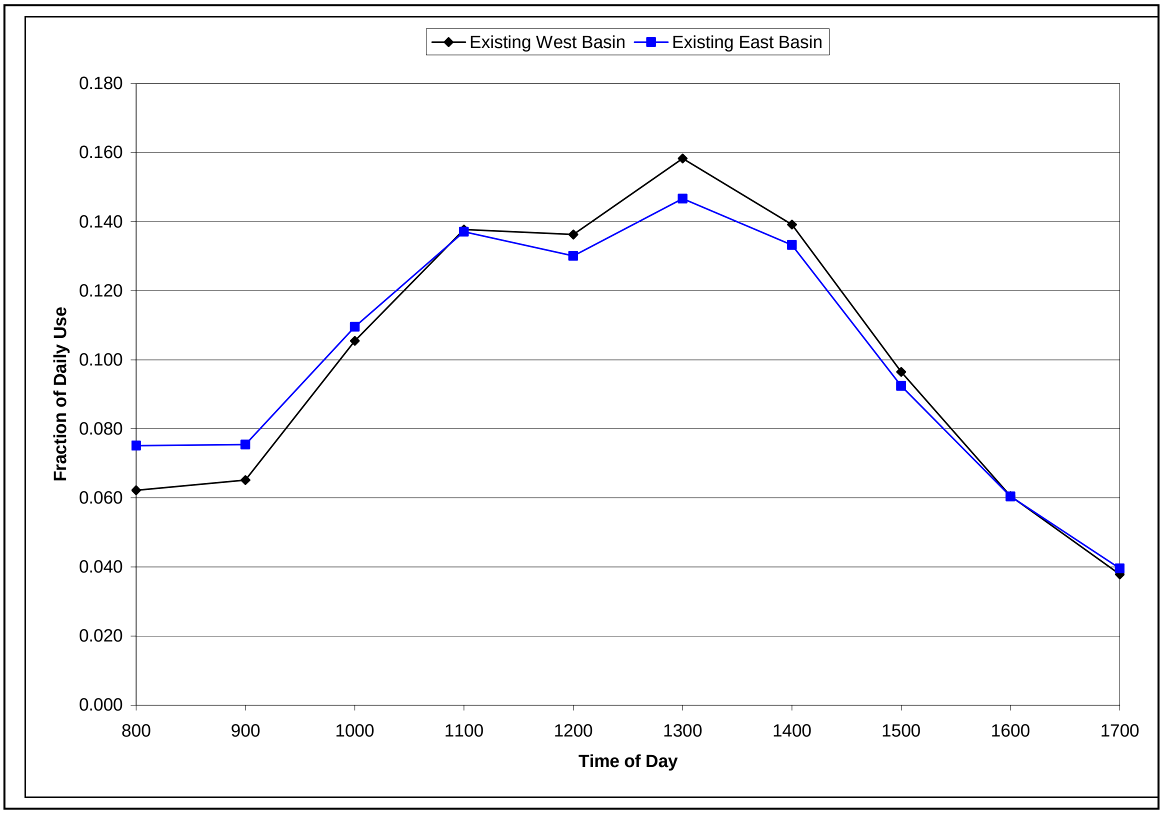

Figure 3-3 – Combined Sail and Power Outbound Usage Factors

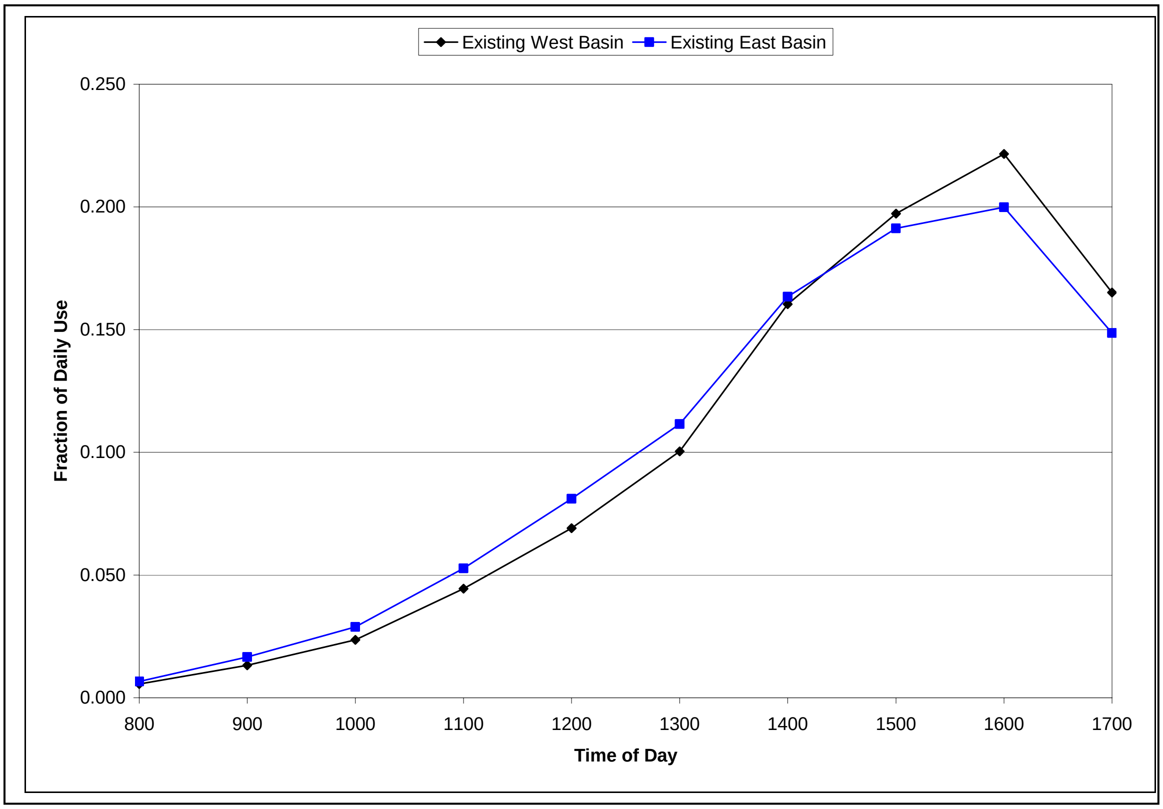

Figure 3-4 – Combined Sail and Power Inbound Usage Factors

To this point, traffic generation rates have been presented as boats per hour. In order to account for potential variations in flow rate within an hour of interest, the concept of "peak-hour factor" (PHF) is utilized. The peak hour factor relates peak rates of flow to hourly volumes. For example, 100 boats may have been observed to pass a point in a channel over a given hour. Thus the hourly flow rate is 100 boats per hour. However, 35 boats may have passed within a fifteen minute period, representing significantly greater traffic than the hourly flow volume indicates. The equivalent hourly flow over the peak 15-minute period is 140 boats per hour. The PHF is defined as the ratio of total hourly volume to the maximum 15-minute rate of flow within the hour. For this example, the PHF is 0.71. Recreational boat traffic is typically evenly distributed. A PHF of 0.67 has been calculated based on analysis of historic data and is considered appropriate for peak traffic generation associated with the proposed marina development.

The traffic flows with each basin, by configuration, and direction, are a function of the number and type of boats, daily usage factor, hourly usage factor, and peak hour factor. The actual traffic rates are presented in the subsequent sections for the various configurations. These patterns represent typical summer weekend boat traffic based on the historical information.

3.2 On-Site Observations

On-sites observations of boat traffic were made by a four person team on Saturday July 14, 2007. Observers were located at the western end of the West Basin, at the eastern end of the East Basin, and at the Bridge. Traffic observations included boat type and direction as well as Small Day-Use Vessel* traffic by direction. Observations were made from 8:00 am until 6:00 pm.

This data has been analyzed and compared to the original boat traffic modeling effort from the preliminary report for the existing conditions. The following table summarizes the results of the observations as they apply to the modeling.

Table 3-2 – Traffic Observation Results and Impacts

OBSERVATION	IMPACT ON ANALYSIS
Total number of boats significantly less than modeled.	Reduce Daily Use Factor from 25% to 18%.
Daily use of power boats is significantly higher than modeled, daily use of sailboats is significantly less than modeled.	Little influence on model due to averaging on a total boat basis. The increased maneuverability of the power boats makes the modeling conservative.
~50 Boat Sailboat race from Seal Beach Yacht Club to Dana Point Yacht Club.	Unknown influence on observed lack of sailboat usage. No change in model.
Channel-Perpendicular slip orientation had little influence on channel traffic.	Reduce influence in model. See Pitchfork Influence in Section 6.3.4.
Number of power boats passing from west basin through the bridge more than modeled.	Increase modeled bridge traffic from 10% to 20% of the total number of powerboats in the West Basin.
Number of sail boats under sail <1% of total traffic.	Reduced influence of tacking sailboat interferences.
Outbound and Inbound traffic patterns by hour were similar to the model.	No change to model. This serves as a verification of the Hourly Use Factors.
Small Day-Use Vessel traffic comprises 44% of total watercraft observed. Many Personal Watercraft (PWC) pulled over by Harbor Patrol/Police.	Add information to Small Day-Use boating section and update estimated influence.
Fishermen casting from under bridge causing boats to move to center of channel.	Add recommendation for increased enforcement of No Fishing rules.

* *Small Day-Use Vessel* traffic refers to kayaks, paddleboards, small sail boats, dinghies, personal watercraft, and all other similar vessels with out slips.

Table 3-3 and Figures 3-5 and 3-6 present a comparison of the measured (observed) traffic vs. the modeled traffic, using a daily use factor of 25%, a PHF of 0.67, and assuming 10% of the power boats in the West Basin pass through the bridge and East Basin on their way in and out of the Harbor. The results of this comparison indicate that the original modeling effort was conservative, and could be calibrated to better match the observations.

Table 3-3 – Measured vs. Modeled Comparison

	Total Boats Daily Use 25% Peak Factor 0.67 Bridge - 10% of West Basin Power Boats		
	Measured	Modeled	Difference
West Basin	461	733	59%
East Basin	948	1202	27%
Total Traffic	1409	1935	37%

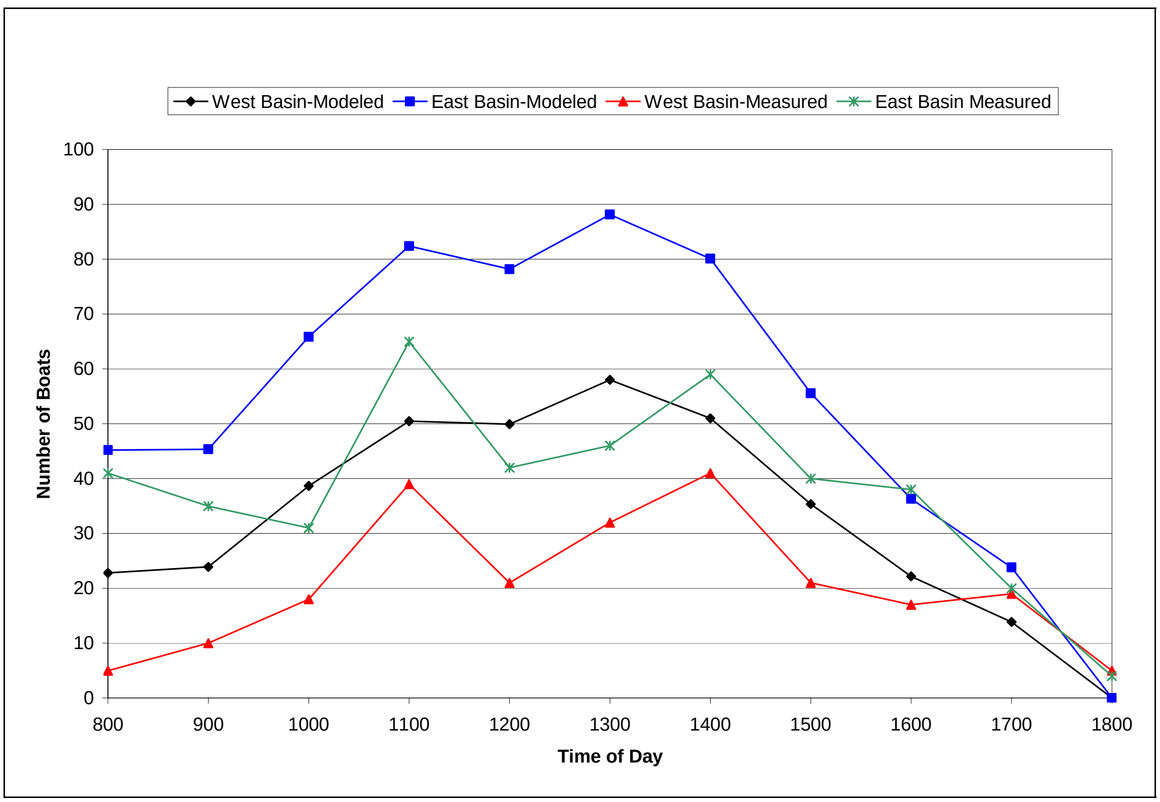

Figure 3-5 – Measured vs. Modeled Outbound Traffic

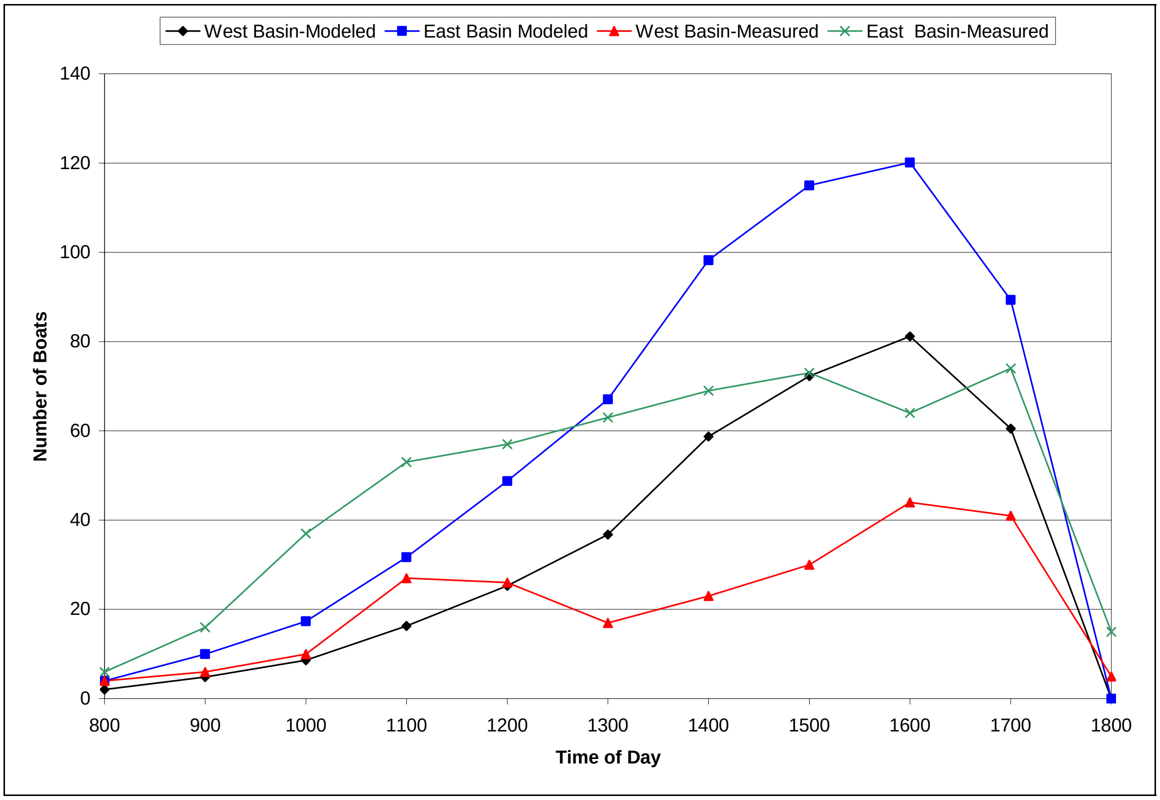

Figure 3-6 – Measured vs. Modeled Inbound Traffic

3.3 Model Calibration

Based on the observations, the daily use factor was reduced to 18% and the bridge traffic from the West Basin was increased to 20% of the number of powerboats in the West Basin. The results appear in Table 3-4 and Figures 3-7 and 3-8. Since this calibration is based on a single data set, the modeled values remain slightly conservative in the total traffic count is approximately 9% more than observed.

Table 3-4 – Measured vs. Modeled Calibration

	Total Boats Daily Use 18% Peak Factor 0.67 Bridge 20% of West Basin Power Boats		
	Measured	Modeled	Difference
West Basin	461	528	14%
East Basin	948	1015	7%
Total Traffic	1409	1542	9%

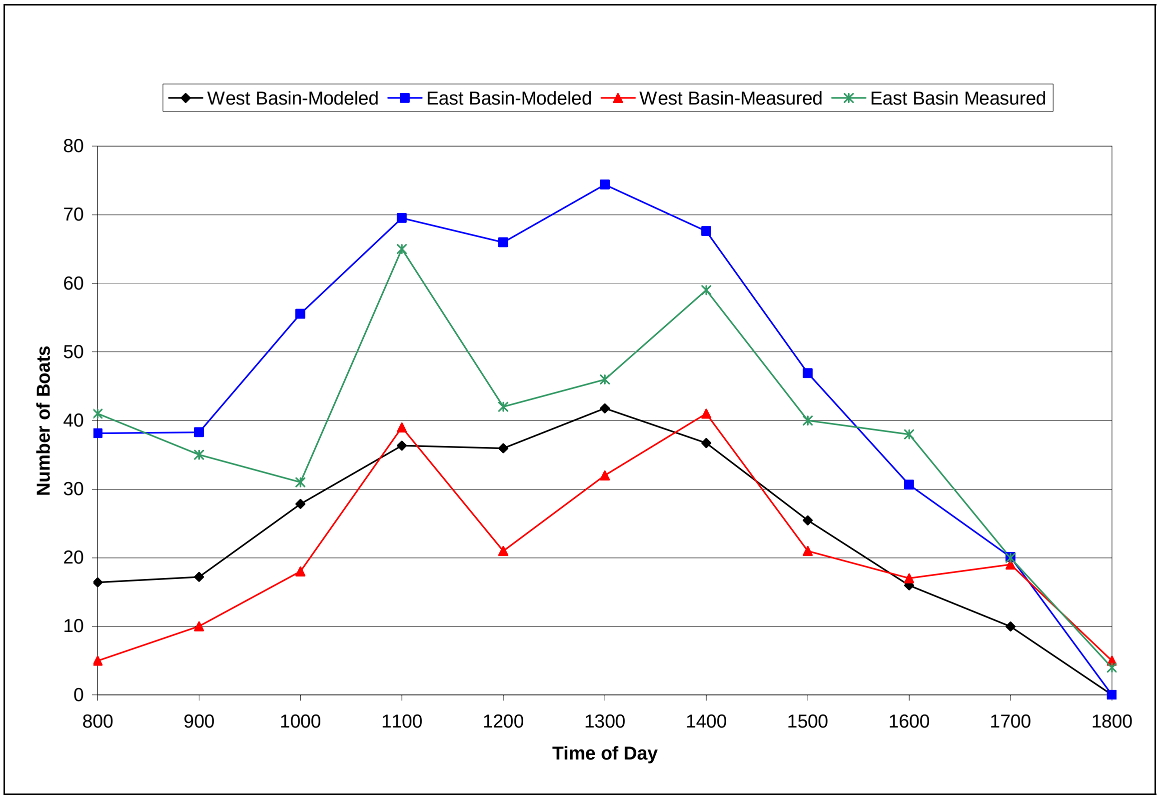

Figure 3-7 – Measured vs. Modeled Outbound Traffic Calibration

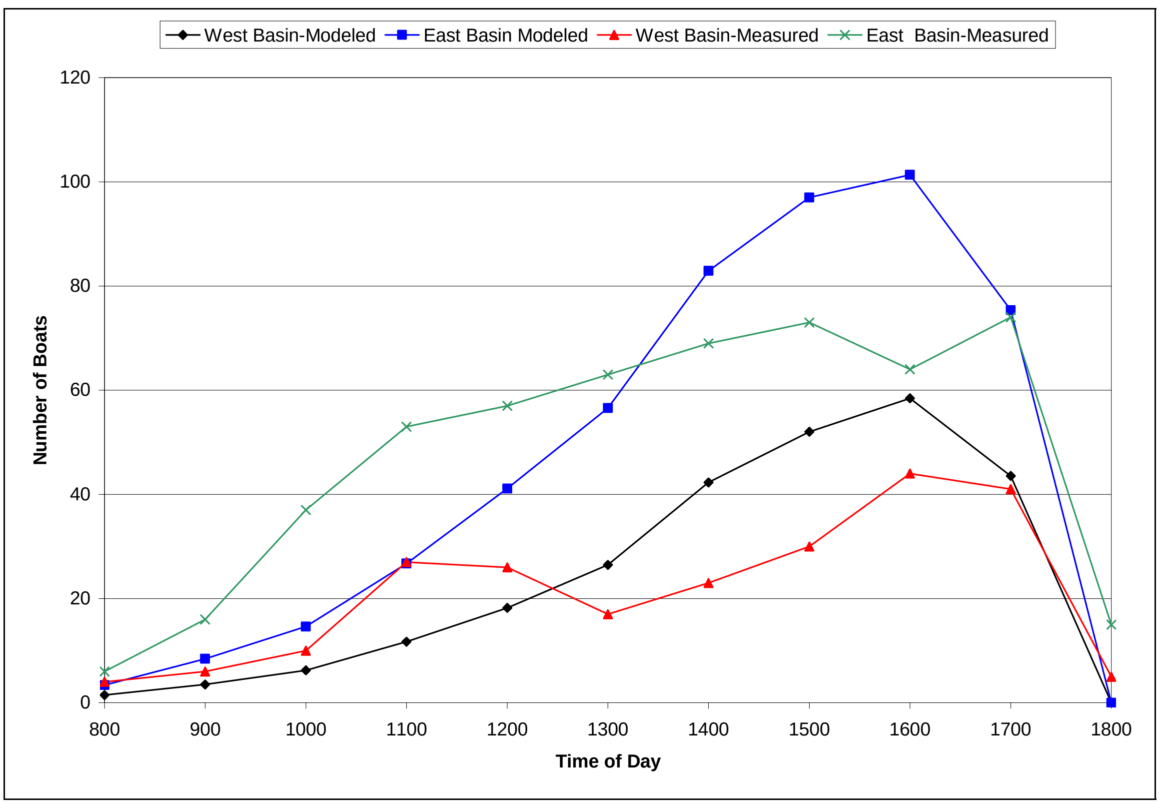

Figure 3-8 – Measured vs. Modeled Inbound Traffic Calibration

3.4 Configuration 2C.2 Traffic Generation

The proposed layout of configuration 2C.2 decreases the total number of boats, but increases the average boat length as shown in Table 3-5.

Table 3-5 – Existing and Proposed Slip Counts

SLIP LENGTH	EXISTING	PROPOSED LAYOUT 2C.2
30’ and under	1795	975
31’-38’	273	616
39’-49’	236	344
50’ & Over	105	100
Total	2409	2035
West Basin Sailboats	540	462
West Basin Power Boats	442	462
East Basin Sailboats	592	556
East Basin Power Boats	835	556
Average Slip Length	29.85’	34.00’

The calibration values - daily use factor, peak hourly factor, and % of boats passing through the bridge from the West Basin to the East Basin (determined from the on-site observations) were applied to the proposed Layout 2C.2 to generate the boat traffic as shown in Figures 3-9 and 3-10. The existing boat traffic is shown for comparison.

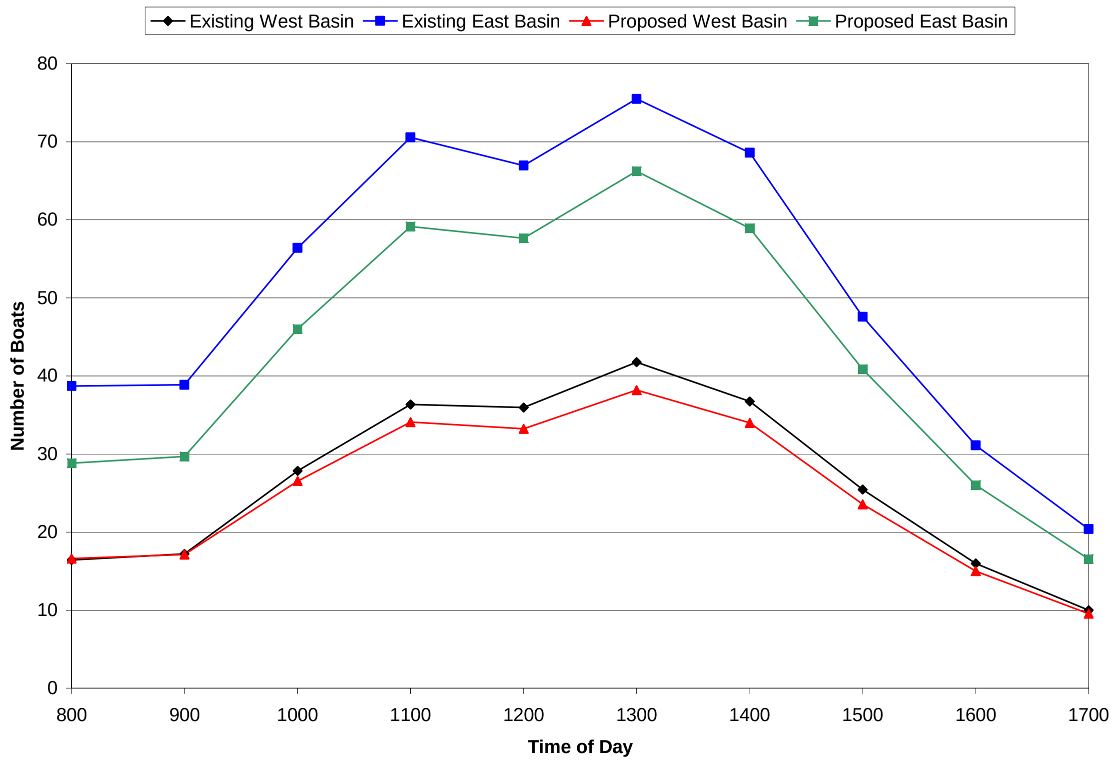

Figure 3-9 – Existing and Proposed (2C.2) Outbound Boat Traffic

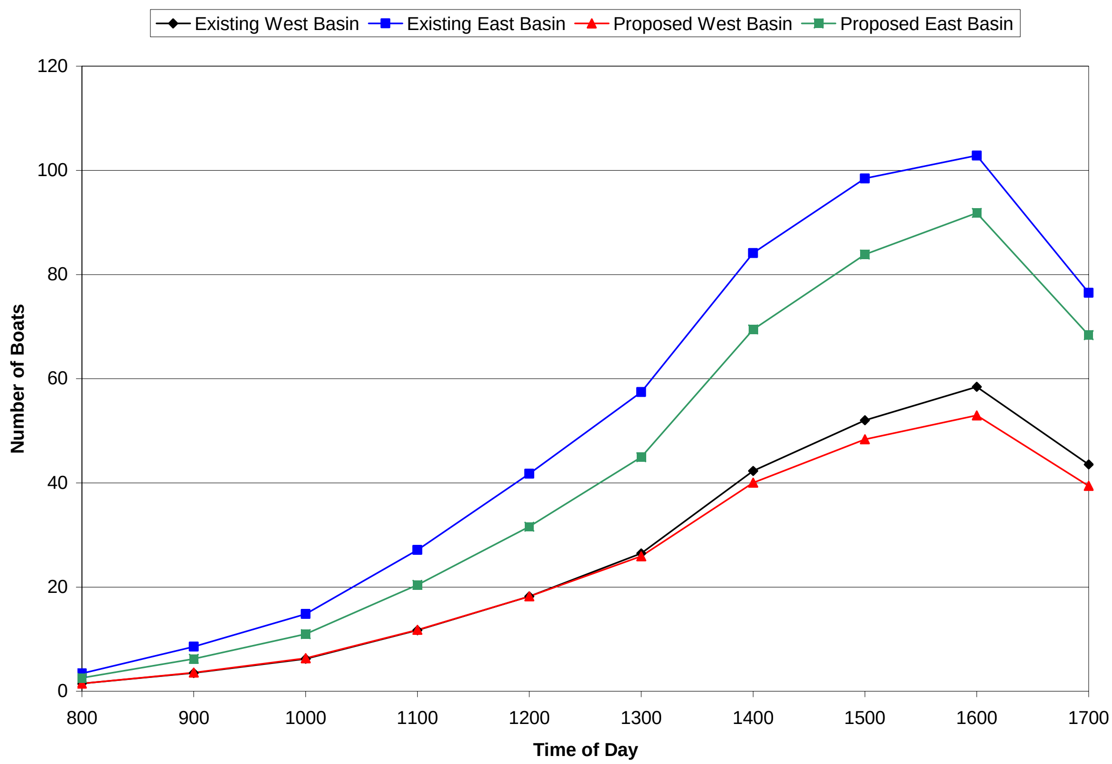

Figure 3-10 – Existing and Proposed (2C.2) Inbound Boat Traffic

4.0 INTERVIEWS

Boat traffic congestion can be a subjective topic. The degree of congestion and its impact on the Harbor function depends on the vessel operator skill and tolerance, vessel type, frequency of congested conditions and impacts of the vessel operator's use of the waterway. Interviews with both Harbor administrators and long time users provide critical information regarding workings of the Harbor including traffic patterns, coordination of multiple uses, and any existing problems related to boat traffic congestion. They also provide valuable insight regarding planning for the future marina layout and operations changes.

4.1 Harbor User Interviews

The following lists the individuals that were either interviewed or participated in meetings held as part of the boat traffic study. The intent was to contact individuals representing the various user groups as well as administrative and enforcement personnel.

- Morrie Wilkie – Dana Point Yacht Club member, long time tenant; active sailor
- Dan Streech – Broker, longtime businessman in the Harbor; brokers power and sail
- Ed Gomez – Long time live-aboard; fireman
- Dan Brown – Has worked on boats in the Harbor for years; small boat owner
- Norma Lococo, United States Coast Guard Auxiliary
- Barry Senescu, boater, husband of former Dana Point Yacht Club Commodore
- Donna Kalez, Dana Wharf Sportfishing
- Adam Himelson, Ocean Institute and former Youth and Group sail instructor
- Dick Davidson, boater
- Dana Point Boaters Association Directors – Bruce Heyman, Ted Olson, Rodger Beard
- Sue Senescu – Former Dana Point Yacht Club Commodore
- Doug Heim, Boater
- Vaughn Morand, Dana West Yacht Club member, boater
- Dave Drenick, Boater
- Suzanne Jones, Dana Point Yacht Club Commodore
- Dave Dempsey, Boater
- Dana Point Harbor Patrol (See Pages 18-19)

Questions Posed to the Group

1. *Do you feel there is presently congestion in the West Basin Inner Channel and/or East Basin Inner Channel*
2. *If so, how would you describe congested conditions – mild, moderate or severe*
3. *How often do congested congestions occur?*
4. *What are the primary and secondary causes, for example…?*
    - *Too many boats*
    - *Tacking sailboats*
    - *Novice boaters / rental craft*
    - *Harbor cruisers*
    - *Sailing schools*
    - *Small Day-Use craft such as kayakers, PWCs, etc.*
    - *Excessive speed*
    - *Other activities such as boat parades*
5. *Any suggestions to offset either existing or potential future congestion?*

User Input

The following summarizes the input from the Harbor users.

- Concern was expressed regarding additional large boats with regards to interaction with dinghies and kayaks.
- The boat traffic study should be based on peak summer weekend traffic patterns.
- Raft-Up Parties in the Main Navigation Channel cause congestion. There is an average of 10 planned and 5 renegade events per year.
- Tacking sailboats have a 50° tacking angle (mainsail only) and presently make 12 tacks. With the reduction they will need to make 18. On race days and busy weekends, there are about 25 boats in from 14 to 30 feet long.
- On average, 2-3 tacking sailboats hit stationary boats per year.
- Visibility at the intersections is a safety issue. The perception is that it could become more of an issue with the large-boat pitchfork design.
- The bridge already effectively narrows the Inner Channels locally because boats only pass through the center set of piles. This implies that the reduction of channel width planned near the bridge will not cause adverse impacts.
- The total number of slips is the primary issue. Boat traffic should be secondary. The encroachment is an adaptation that people should be able to make. Safety is a primary concern and the responsibility of the boater – a reduced width should not increase the danger.
- The annual Holiday Boat Parade has approximately 100 boats from 60' to 15' with one 95' boat. The parade happens on two weekends. Presently, the larger boats must turn around well before the bridge due to lack of adequate depth and bridge clearance.
- The Inner Channels should be primarily used for navigation, not recreation.
- More boater education required, particularly for the smaller boats and rental kayaks.
- Large majority of the attendees favored encroachment for more slips.
- Presently there are no speed issues in the Harbor. It is well regulated by the Harbor Patrol.
- The corner near the silted area of the Main Navigation Channel can get congested at peak usage times. (This is out of the project boundary area.)
- USCG auxiliary offered to help with education programs and collateral to help educate boaters regarding the "Rules of the Road".

User Input Summary

Major traffic/safety issues:

- Small Day-Use Vessel operation and visibility.
- Boater education and lack of knowledge regarding the California Harbors and Navigation code ("Rules of the Road").
- Novice boaters.
- High winds

Recommendations

- Inner Channel encroachment is acceptable if it allows for more slips.
- More boater education is required.
- Possible limitations on recreation within the Inner Channels may have to be imposed and enforced.

4.2 Harbor Patrol Interview

In addition to the public meeting and interviews, a separate discussion was held with the Sgt. John Whitman of the Harbor Patrol. The following summarizes the discussion.

- There are 20' "channels" on each side of the Inner Channels that are used as "bike lanes" for kayaks, dinghies, personal watercraft (PWC) and paddle surfboards. There can be visibility issues at the intersections. These lanes might be lost if encroachment is allowed.
- There is a County statute (2-204B) in place that designates the Inner Channels as a "special use area" and restricts recreational uses. It is not presently enforced, but it is available for the Harbor Patrol to use if required. The Harbor Patrol notes that they may need to increase their enforcement of the statute if crowding is an issue.
- There is only one group licensed to operate kayak rentals at Baby Beach, but there are other kayak rentals in other areas of the Harbor.
- Smaller boats move more often than larger boats. I.e. 2-twenty five foot boats move much more than one-fifty foot boat, therefore a reduced slip count that has a higher average slip length may reduce total traffic.
- The existing East Basin Inner Channel may already be 160' due to existing side ties.
- The present design does not address catamarans and other specialty boats with oversized beams. These boats should not be allowed to encroach further into the Inner Channel.
- Could locate smaller, tacking sailboats closer to the entrance to reduce conflicts.
- Outrigger canoes usually go in outer Main Navigation Channel. They are typically not in the water at peak times.
- Power boaters on the eastern end of the West Basin that can fit under the bridge travel from the West Basin through the East Basin to get out.

- The pump-out area at Harbor Patrol Dock can get slightly crowded, but it is not a frequent or significant problem.

Major Traffic/Safety Issues (In order)

1. Total number of boats.
2. Tacking sailboats.
3. Novice boaters in confined areas.

5.0 CHANNEL DESIGN CRITERIA

This section addresses channel width and overall navigability criteria based on published guidelines. Although the guidelines are typically applied to entrance channels without intersections, they can be used as a rough guideline for the Dana Point Inner Channels. These provisional criteria are highly variable with little consensus on required channel width as a function of marina size, and none include the combined effects of boat size, speed, travel distance, intersections, and environmental conditions. They do, however represent relationships that have been used in the design of similar marina channels.

The existing Inner Channels have a design width of approximately 200’ from dock to dock, but an effective navigable width of approximately 180’ feet due to the side-tie boats at the ends of the docks. In certain areas, it appears that the navigable width of the East Basin Inner Channel is approximately 160’ due to a side-tied catamaran. (Scaled from Google aerial image). The proposed layout would reduce the existing design width of the channel to 160’ (150' with the inclusion of a 5ft boat overhang on both sides of the channel) over the majority of both basins and would reduce it to just under 95’ near the bridge.

A rational design approach is necessary to determine whether safe and efficient navigation of the Inner Channel will be achievable with a reduction in the design width and an increase in average boat size. Factors that must be considered are:

- Vessel size;
- Vessel maneuverability;
- Vessel speed;
- Effects of wind, waves and currents; and
- Traffic congestion.

Tobiasson and Kollmeyer[5] recommend a minimum fairway width of 1.5 times the longest boat length. They further recommend an increase to 1.75 times the longest boat length in conditions that reduce maneuverability - i.e. wind, sail boats under sail, novice boaters, etc. They also recommend an absolute minimum width of 75’, with 100’ being preferred. For Dana Point, the largest “designed” slip is 65 feet. This relationship would result in an Inner Channel width of 115 feet based on the reduced maneuverability due to traffic. However, there are several 60-75 foot boats planned for side-tie slips, which would result in channel width requirements as much as 130 feet. This standard also appears in the California Department of Boating and Waterways[6] design guidelines, along with a minimum recommended width of 75’ at the bottom of the channel.

[5] Marinas and Small Craft Harbors, Van Nostrand Reinhold, 2000
[6] Layout and Design Guidelines for Marina Berthing Facilities, CDBW 2005

The American Society of Civil Engineers (ASCE)[7] recommends a minimum width of five times the beam of the widest vessel to be berthed in the Harbor. Assuming a 20-foot beam for the maximum design vessel results in a width of 100 feet.

"Observations in Small Boat Harbors – Harbor Design Concepts"[8], presents a relationship for interior channels based on Southern California Harbor observations and the total number of boats present in the basin. The relationship is:

$$W_{INT} = (50' \textit{ to } 90') + \frac{N}{10}$$

Where
W_{INT} - Width of the interior channel in feet.
50' to 90' – Suggested minimum width regardless of boat count.
N – Number of boats in basin.

The following table presents the Inner Channel width ranges for the various configurations, based on the number of wet slips.

Table 5-1 – Channel Capacity Estimates

BASIN CONFIGURATION	CHANNEL WIDTH RANGE (Feet)
Existing West	155 – 195
Existing East	185 – 225
Proposed West	142 – 182
Proposed East	161 - 211

Note that since this particular relationship is independent of boat size, type, and speed, the proposed configurations require reduced channel widths even though the average boat size increases.

A review of the proposed Layout 2C.2 indicates that the channel widths near the bridge will be limited by the sidetie location of some of the larger vessels, although the State minimum recommended channel width would be maintained at all times; i.e., 75ft with a 15 foot buffer. This channel width limitation is not anticipated to be a problem because there is limited reason for these larger vessels to enter this area due to their inability to pass under the bridge (~ 16 feet of clearance at high water) and depth limitations.

[7] Planning and Design Guidelines for Small Craft Harbors, American Society of Civil Engineers, 2000
[8] Nichol, J.M. 1985. "Observations in Small Boat Harbors – Harbor Design Concepts," Proceedings West Coastal Regional Coastal Design Conference. American Society of Civil Engineers. Oakland, CA.,

6.0 BOAT TRAFFIC ANALYSIS

As previously discussed, boat traffic analysis and congestion can be a subjective and relative subject. It is recognized that a single, poorly operated vessel, speeding boats, loss of power/steering, or an unorganized group of kayakers can crowd a channel and reduce maneuverability, however, these are discrete events that can not be quantified in a numerical model, nor is it the purpose of this analysis. The intent of this analysis is to evaluate the over-all, long term statistical traffic and potential congestion issues for the Harbor and to focus on the change in Level-of-Service (LOS) between the existing and proposed layouts.

Roadway traffic models provide a framework for this statistical approach. Observations of boat traffic patterns in small craft harbors indicate similarities to roadway traffic with some modifications to account for lack of discrete channelization in boat channels and more general freedom of movement. Boat traffic also differs from highway traffic in that boats must make headway to maneuver and boat operator proficiency is more widely varied. The following sections summarize the LOS approach to boat traffic analysis and present comparisons of the existing and proposed marina plans.

6.1 Level-of-Service Concept

Model results are presented in terms of *Level-of-Service* (LOS) which is a concept widely used by traffic engineers to describe prevailing conditions and their effect on traffic. Level-of-Service is a qualitative measure of the effect of traffic flow factors, such as speed and travel time, interruptions, freedom to maneuver, driver comfort and convenience, and safety. The Level-of-Service of channels is analogous to the traffic engineering concept and is a direct function of usage. The levels are set based on factors including numbers and sizes of boats, their speed and maneuverability, and channel size and geometry.

This boat traffic study evaluates the existing and proposed marina layouts in the Dana Point Harbor Inner Channels. Analysis of the boat traffic capacity within these areas is analogous to roadway traffic capacity. Roadway capacity is defined as the maximum number of vehicles that can pass over a given section of a lane or roadway during a given time period under prevailing roadway and traffic conditions. It is the maximum rate of flow that has a reasonable expectation of occurring. Capacity is typically reported as an hourly volume. Level-of-Service for a roadway is related to speed and the volume/capacity ratio. Levels-of-Service for a roadway are defined in Table 5-1.

The Level-of-Service for the channels was estimated by first calculating the capacity of the channel as a function of its navigable width. Channel usage was simulated based upon statistics presented in Section 3. The usage simulation was then used to determine volume/capacity ratios within the Inner Channels throughout a typical and peak weekend day. The correlation between volume/capacity ratio and Level-of-Service developed in past boat traffic studies was assumed and evaluated for applicability.

Table 6-1 – Levels-of-Service for Roadway and Traffic Conditions

SERVICE LEVEL	DESCRIPTION
Level A - Free Flow	Low volumes and densities, high speeds. Drivers can maintain their desired speeds with little or no delay.
Level B - Stable Flow	Stable flow with operating speeds beginning to be restricted somewhat by traffic conditions. Drivers still have reasonable freedom to select their speed. Suitable for rural design standards.
Level C - Stable Flow	Stable flow but speeds and maneuverability are more closely controlled by higher volumes. Suitable for urban design standards.
Level D - High Density Flow	Approaches unstable flow, tolerable operating speeds which are, however, considerably affected by operating conditions. Drivers have little freedom to maneuver.
Level E - Unstable Flow	Unstable flow with yet lower operating speeds and, perhaps, stoppages of momentary duration. Volumes at or near capacity.
Level F - Forced Flow	Forced flow, low volumes. Both speed and volumes can drop to zero. Stoppages may occur for short or long periods. These conditions usually result from queues of vehicles backing up from a restriction downstream.

6.2 Analysis of Harbor Traffic

6.2.1 Channel Capacity

The first step in estimating the current Levels-of-Service encountered in the Inner Channels was to estimate the capacity of the channel. For boat traffic analysis purposes, boat channel capacity is defined in analogous terms to roadway capacity. It is the maximum number of boats that can pass through a given segment of channel during a given time period under prevailing traffic conditions. It is the maximum rate of flow that has a reasonable expectation of occurring.

Approximation of one-way channel capacity must consider the following parameters:

1. Equivalent lane width – Since typical channels are not separated into individual "lanes" as on the highway, assumptions must be made regarding "equivalent lane width" and the fact that boats tend to follow the rules of the road and travel in lanes. Observations and review of other channel capacity studies indicate typical vessels will navigate in equivalent lanes approximately 50 feet wide. For the Dana Point Inner Channels, the design width changes from 200' in the existing configuration to 160' in the proposed configuration, excluding side-ties. This

results in the theoretical reduction of one lane of traffic. In practice, however, boaters will tend to adjust their lateral spacing to accommodate such changes up to the point that they must start making avoidance maneuvers.

Figure 6-1 – Boats Traveling in Lanes Regardless of Width

2. Average boat spacing – An average clear spacing between boats of 2.5 boat-lengths has been observed and corroborated with other boat channel capacity studies.

3. Average boat length and boat speed – Channel capacity, expressed in terms of boats per hour, is controlled by the average boat length and its speed. The larger the average vessel length, the lower the number of vessels that can traverse a given reach of channel for a given speed. Similarly, increased vessel velocity increases channel capacity. Table 6-2 tabulates the estimated one-way channel capacity in the channel for a range of average boat lengths and speeds.

Table 6-2 – Channel Capacity Estimates

AVG BOAT SPEED [KTS]	CHANNEL CAPACITY [BPH] AS FUNCTION OF AVERAGE BOAT LENGTH [FT]							
	25	30	35	40	45	50	55	60
3	209	174	149	130	116	104	95	87
4	278	232	199	174	155	139	126	116
5	348	290	248	217	193	174	158	145
6	417	348	298	261	232	209	190	174
7	487	406	348	304	270	243	221	203
8	556	464	397	348	309	278	253	232

As described, one-way traffic in the channels is based on a typical 50-foot wide equivalent lane and a minimum clear spacing between vessels of 2.5 vessel lengths. The average vessel length in the existing Harbor is 30 feet, and the average vessel length in the proposed layout is 34 feet. The average velocity is 5 knots. This results in a maximum traffic capacity per lane that ranges from 248 to 290 boats per hour.

6.2.2 Level-of-Service Criteria

Level-of-Service (LOS) criteria for boat channels are defined in terms of density, analogous to LOS analyses for two-lane and multilane highways. Density is a measure that quantifies the proximity to other boats in the channel. It expresses the degree of maneuverability within the channel.

LOS criteria for one-way channel traffic were approximated by using the same ratio of service level density to the density at flow capacity for multilane highway traffic and are summarized in Table 6-3. This assumption has been generally verified through model applications for a number of small craft harbors including Marina Del Rey, Channel Islands Harbor, and Huntington Harbor.

Table 6-3 – Level-of-Service Criteria for One-Way Entrance Channel Traffic

Level-of-Service (LOS)	Volume/Capacity Ratio
A	0 – 0.18
B	0.18 – 0.30
C	0.30 – 0.45
D	0.45 – 0.60
E	0.60 – 1.0

Table 6-3 gives the maximum volume/capacity (V/C) ratios that are expected to exist in traffic streams operating at the densities defined for each Level-of-Service under ideal conditions.

<u>Level-of-Service A</u> describes completely free flow conditions. Boat operations are virtually unaffected by the presence of other boats, and operations are constrained only by the geometric features of the channel and boater preferences. Boats are spaced at an average of 19 boat-lengths. The ability to maneuver within the traffic stream is high.

Minor disruptions to flow such as channel berthing operations are easily absorbed at this level without causing significant delays or queuing.

Level-of-Service B is also indicative of free flow, although the presence of other boats begins to be noticeable. Boats are spaced at an average of 12 boat-lengths. Minor disruptions are still easily absorbed at this level, although local deterioration in LOS will be more obvious.

Level-of-Service C represents a range in which the influence of traffic density on operations becomes marked. The ability to maneuver within the channel is clearly affected by the presence of other boats. The average boat spacing is 8 boat-lengths. Minor disruptions may be expected to cause significant local deterioration in services, and queues may form behind any significant traffic disruption. Severe long-term disruptions may cause the channel to operate at LOS F.

Level-of-Service D borders on unstable flow. Ability to maneuver is severely restricted due to traffic congestion. Average boat spacing is 6 boat-lengths. Only minor disruptions can be absorbed without the formation of queues and deterioration of service to LOS F.

Level-of-Service E represents operations at or near capacity, and is quite unstable. At capacity, boats are spaced at only 3.5 boat-lengths. This is the minimum spacing at which uniform flow can be maintained, and effectively defines a traffic stream with no usable gaps. Thus, disruptions cannot be damped or dissipated, and any disruption, no matter how minor, will cause queues to form and service to deteriorate to LOS F.

Level-of-Service F represents forced or breakdown flow. It occurs at a point where boats arrive at a rate greater than at which they are discharged. While operations at such points and on immediately downstream sections will appear to be at or above capacity, queues will form behind these breakdowns. Maximum boat spacing will be less than 3.5 boat-lengths.

6.2.3 Level-of-Service Base Results

The boat traffic LOS model was run for existing traffic as well as the proposed Layout 2C.2 based on the traffic generated from Section 3 that represent normal summer weekend boating patterns. Figures 6-2 through 6-6 present graphical depictions of the results. The traffic for the East Basin has been increased by 20% of the West Basin powerboat traffic to reflect boats that pass under the bridge as opposed to going around to the Main Navigation Channel.

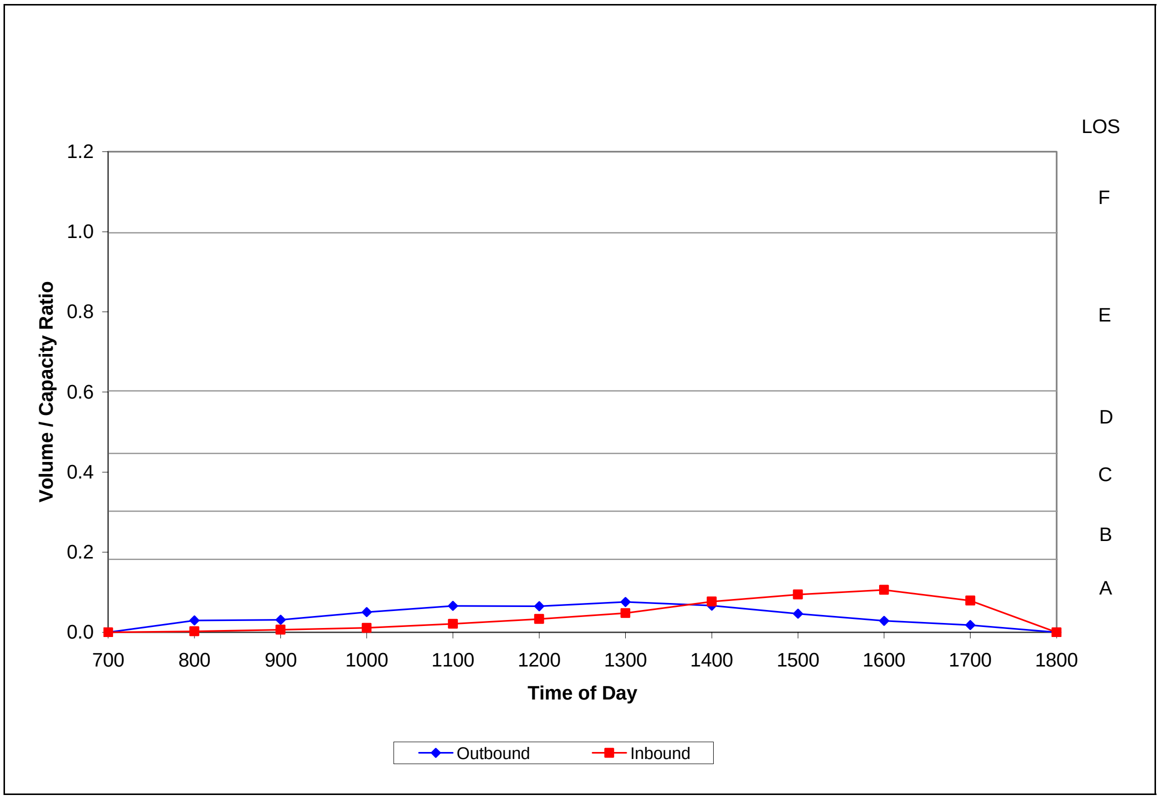

Figure 6-2 – West Basin Existing Base Level-of-Service

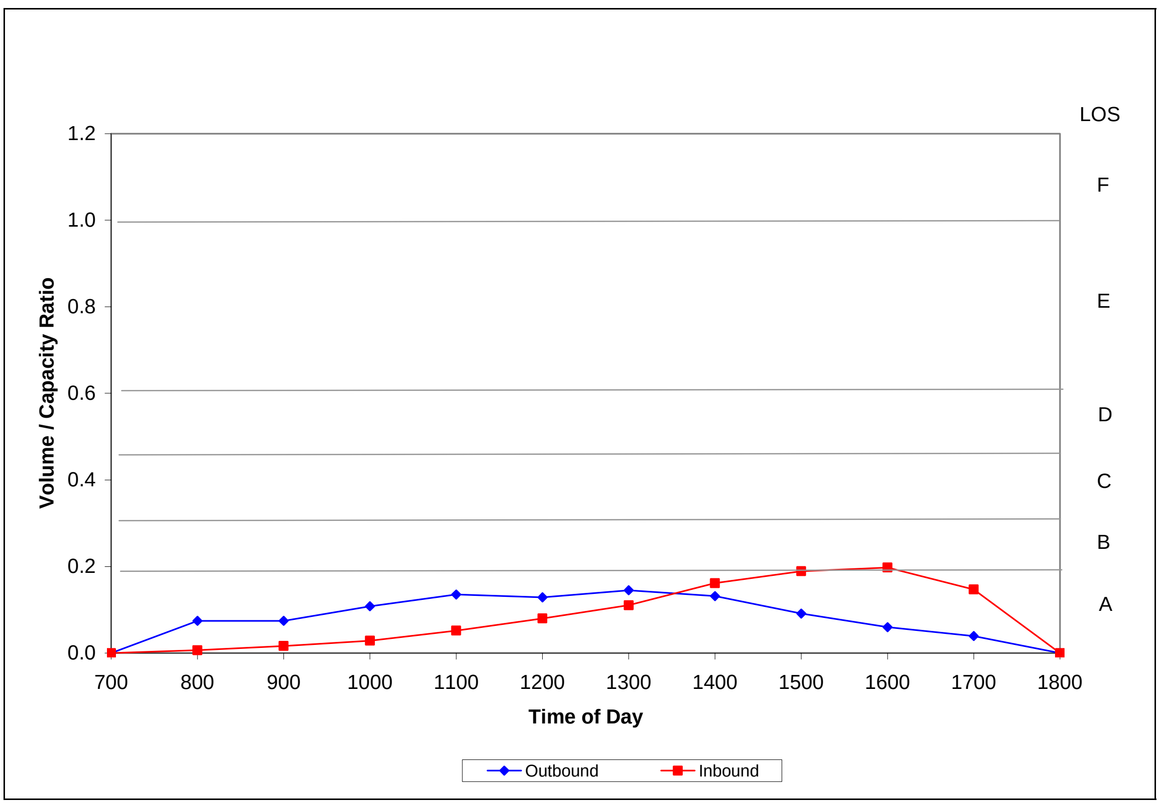

Figure 6-3 – East Basin Existing Base Level-of-Service

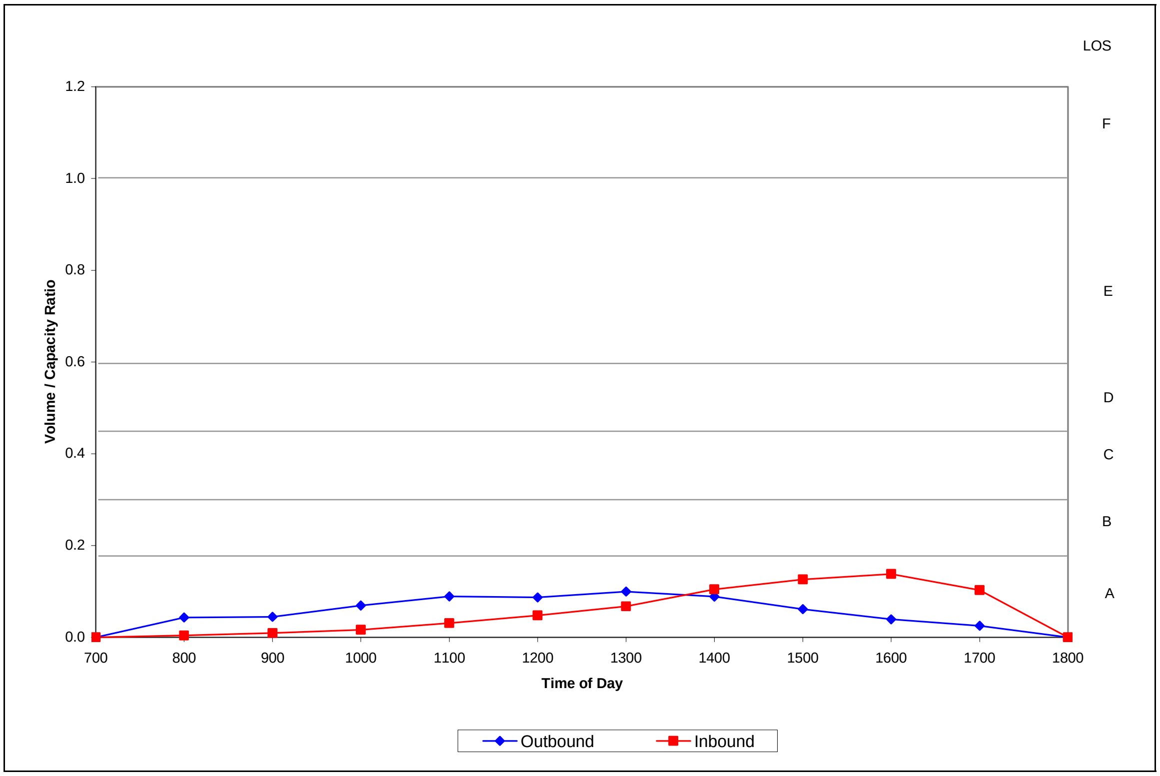

Figure 6-4 – West Basin Proposed (2C.2) Base Level-of-Service

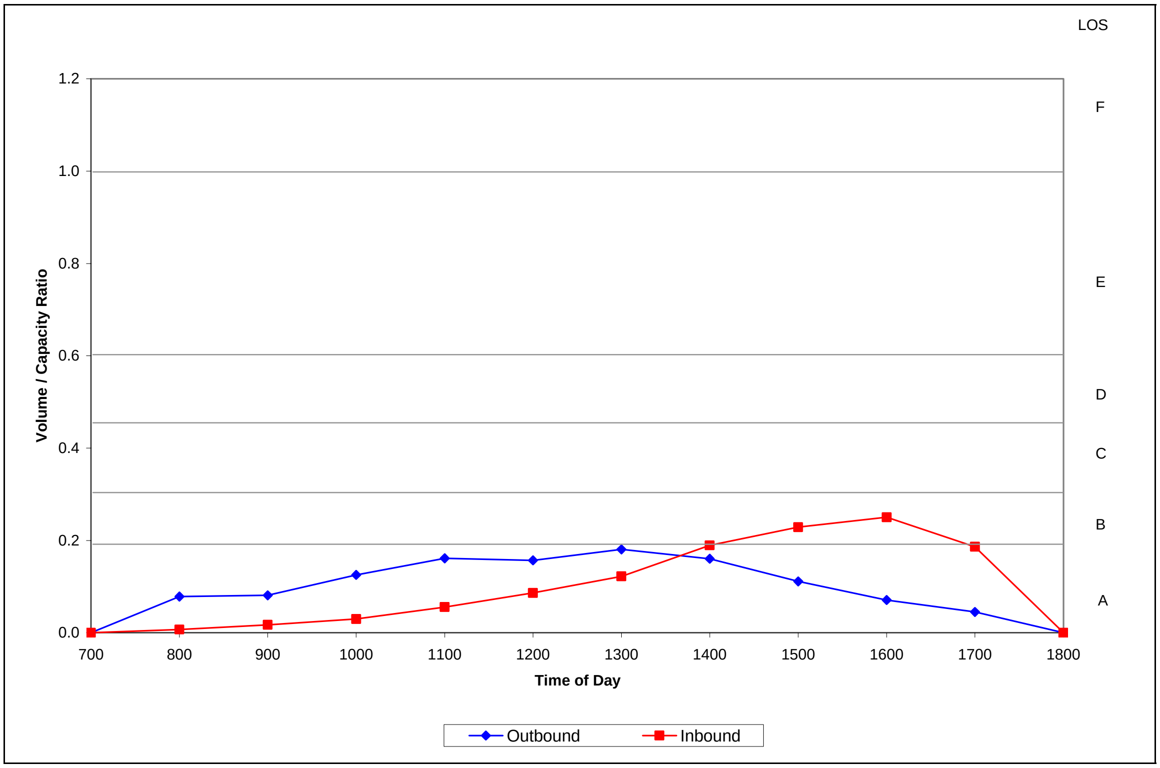

Figure 6-5 – East Basin Proposed (2C.2) Base Level-of-Service

Table 6-4 presents a numerical look at the Volume to Capacity Ratio (V/C) and LOS for each basin, in each configuration, for the peak hour of traffic. In each case, the peak hour of traffic corresponds to the inbound flow at 1500-1600 hours, and lasts for one to two hours.

Table 6-4 – Peak Hour Level-of-Service for Typical Summer Traffic Conditions

FIGURE	DESCRIPTION	V/C	LOS	Duration (Hr)
6-2	West Basin - Existing	0.09	A	10
6-3	East Basin - Existing	0.20	B A	2 8
6-4	West Basin – Proposed Layout 2C.2	0.14	A	10
6-5	East Basin – Proposed Layout 2C.2	0.25	B A	4 6

These results indicate slight declines in the LOS for both the West and East Basins. The magnitude of these changes, however are considered to be inconsequential, so the net result would be considered "no change."

6.2.4 Pitchfork Design

"Pitchfork" is the term used to describe finger piers that have their outboard docks aligned perpendicular to the Inner Channel direction. They play a significant role in traffic flow because boats are required to back in/out perpendicular to the Inner Channel flow, which requires more time and space than a boat transiting the same space and/or turning in to a fairway. Pitchfork boats modeled as the equivalent of two regular boats – one boat length for backing out/turning, and one boat length entering the main flow. This effectively doubles the number of boats from pitchfork docks in the traffic generation model. Table 6-5 presents the normalized (total length of pitchfork slips divided by the average length) number of pitchfork slips per basin, by configuration. (For example, in Layout 2C.2, the West Basin has 12 x 50', 8 x 55', and 12 x 60' slips, for a total length of 1760'. This is the equivalent of 1760/34 = 52 "average boats".)

Figures 6-6 through 6-9 present the hourly V/C ratios and LOS results, and Table 6-9 presents a summary of the analysis. The results indicate that the LOS is inversely proportional to the number of pitchfork slips in the design. For the West Basin, the number of slips is decreased, resulting in a decreased V/C ratio and a corresponding increase in LOS. For the East Basin, the number of slips is increased, resulting in an increased V/C ratio and a corresponding decrease in LOS.

Table 6-5 – Normalized Number of Pitchfork Slips

DESCRIPTION	# of PITCHFORK SLIPS
West Basin - Existing	148
East Basin - Existing	96
West Basin – Proposed Layout 2C.2	52
East Basin – Proposed Layout 2C.2	104

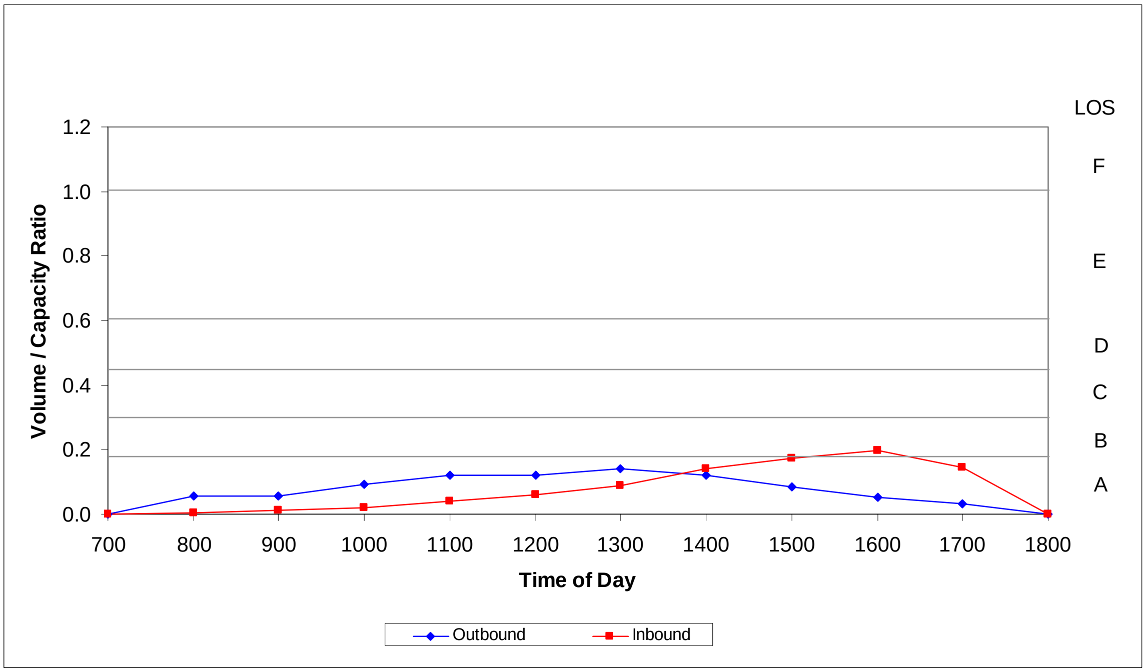

Figure 6-6 – West Basin Existing Level-of-Service with Pitchfork Influence

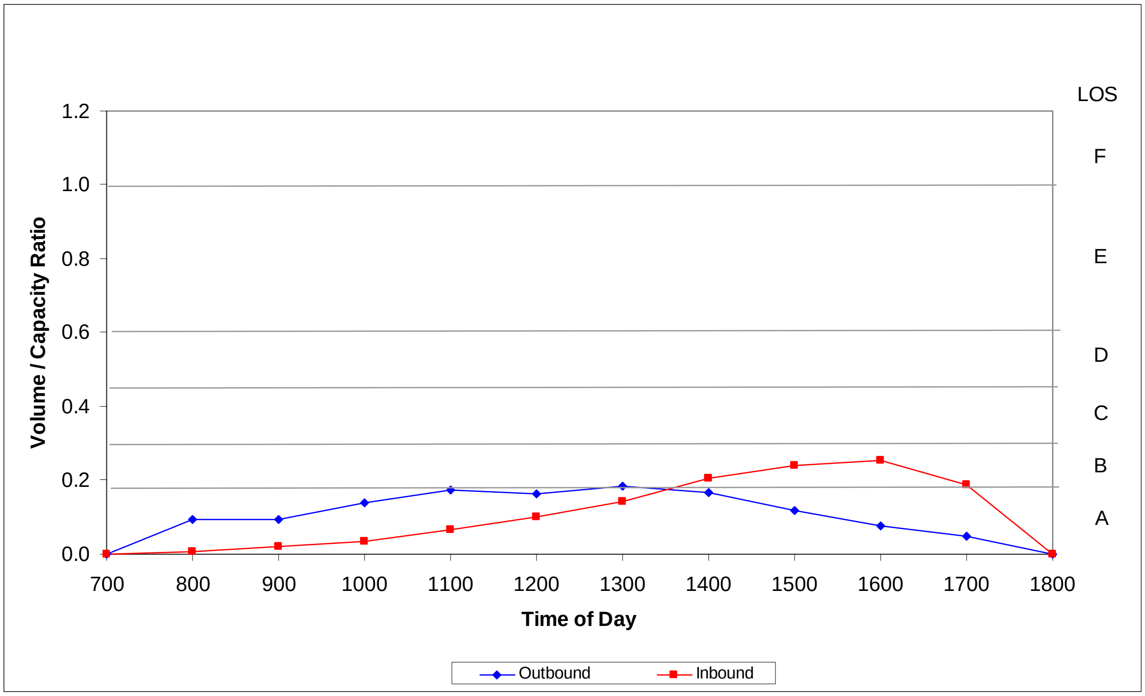

Figure 6-7 – East Basin Existing Level-of-Service with Pitchfork Influence

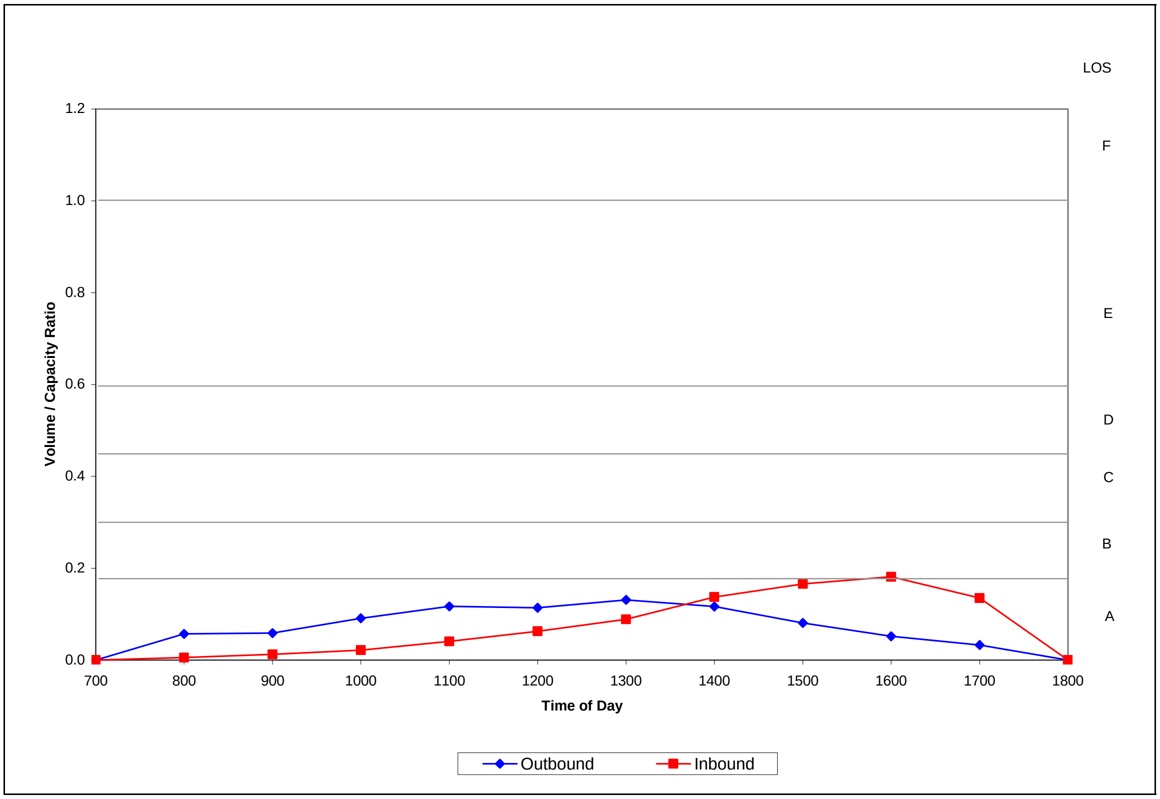

Figure 6-8 – West Basin Proposed Level-of-Service with Pitchfork Influence

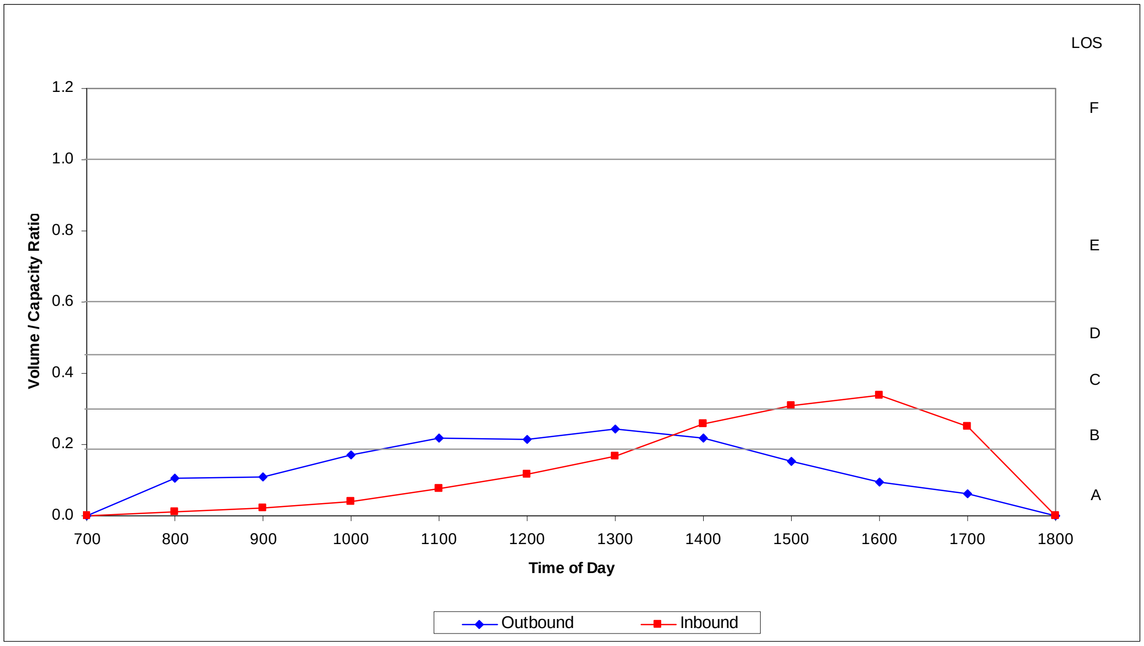

Figure 6-9 – East Basin Proposed Level-of-Service with Pitchfork Influence

Table 6-6 – Peak Hour Level-of-Service with Influence of Pitchfork Design

DESCRIPTION	TYPICAL TRAFFIC			PITCHFORK INCREASE		
	V/C	LOS	Duration (Hr)	V/C	LOS	Duration (Hr)
West Basin - Existing	0.09	A	10	0.20	B A	1 2
East Basin - Existing	0.20	B A	2 8	0.25	B A	5 5
West Basin – Proposed Layout 2C.2	0.14	A	10	0.18	B A	1 9
East Basin – Proposed Layout 2C.2	0.25	B A	4 6	0.34	C B A	2 5 3

6.3 Boat Traffic Impacts – Sensitivity Analyses

The following sections summarize impacts to Inner Channel boat traffic associated with variations in key traffic generation assumptions including:

- Peak holiday weekend traffic;
- Average vessel speed and length;
- Influence of kayaks, PWCs and other small Day-Use vessels.

The impacts are evaluated based on the peak hour Level-of-Service with pitchfork influence as presented in Table 6-6.

6.3.1 Sensitivity to Peak Holiday Weekend Traffic

Sensitivity of traffic conditions for the proposed marina to a 25 percent increase above typical summer weekend levels to represent peak summer Holiday weekend conditions was also investigated. Holiday traffic conditions are known causes of surges in boat traffic conditions, and users tend to be more tolerant of congestion during these few peak summer Holiday weekends. The results are also summarized in Table 6-7.

The results indicate that the proposed 2C.2 Layout improves the peak holiday traffic LOS in the West Basin, but decreases the peak holiday traffic LOS in the East Basin. A LOS level "C", for 5 hours on a holiday weekend is very acceptable because a majority of boaters recognize that there is going to be holiday traffic and either modify their schedule or increase their tolerance level for slow-downs.

Table 6-7 – Peak Hour Level-of-Service for Peak Holiday Traffic Conditions

DESCRIPTION	PEAK HOLIDAY		
	V/C	LOS	Duration (Hr)
West Basin - Existing	0.24	B A	3 7
East Basin - Existing	0.32	C B A	3 5 3
West Basin – Proposed Layout 2C.2	0.23	B A	2 8
East Basin – Proposed Layout 2C.2	0.42	C B A	5 3 2

6.3.2 Sensitivity to Average Boat Speed and Spacing

As discussed in Section 6.3.1, assumptions are also required in the traffic model for average boat length and speed, since these directly affect the channel traffic capacity. Table 6-8 summarizes the impacts to volume capacity ratio and LOS associated with increasing the average spacing from 2.5 to 3 boat lengths, reducing the average boat speed from 5 knots to 4 knots, and combining the spacing increase and speed decrease for the proposed East Basin (highest V/C). The results indicate sensitivity to the spacing and speed length assumptions that would be noticeable to the average boater if combined. The impact of these assumptions for the comparison of configurations can be minimized by using the same criteria for the existing and proposed layouts.

Table 6-8 – Sensitivity to Average Boat Speed and Length Peak Hour Level-of-Service

DESCRIPTION	TYPICAL TRAFFIC			LENGTH/SPEED IMPACT		
	V/C	LOS	Duration (Hr)	V/C	LOS	Duration (Hr)
East Basin – Proposed 3.0 Boat Length Spacing	0.34	C B A	2 5 3	0.39	C B A	2 6 2
East Basin – Proposed 4 Knot Average Speed	0.34	C B A	2 5 3	0.42	C B A	5 2 2
East Basin – Proposed 3.0 Boat Length Spacing & 4 Knot Average Speed	0.34	C B A	2 5 3	0.48	D C B A	1 6 1 2

6.4 Boat Traffic Impacts – Additional Issues

There are several additional factors that influence the boat traffic in the Dana Point Harbor. The most significant of which is the frequent use of the Harbor by small Day-Use Vessels.

6.4.1 Small Day-Use Vessel Influences

From conversations with the Harbor Patrol and other users, these small Day-Use vessels tend to stay to the edges of the Inner Channels when there are significant boats present. This situation can be simulated with the model by assuming that the small Day-Use vessels take up half of a potential traffic lane on each side of the channel, effectively reducing the total number of traffic lanes by one. The results indicate that the presence of small Day-Use Vessels within the Harbor has a significant influence on the modeled traffic patterns, and that the proposed Layout 2C.2 is better able to absorb the lane reduction and maintain the LOS in the West Basin but not in the East Basin. This is consistent with the results of the interviews with the Harbor users. Figure 6-10 presents an example of congestion caused by small Day-Use vessels in the channel.

Table 6-9 – Peak Hour Level-of-Service with Small Day-Use Vessels Occupying One Lane of Traffic

DESCRIPTION	TYPICAL TRAFFIC			LOSS OF ONE LANE		
	V/C	LOS	Duration (Hr)	V/C	LOS	Duration (Hr)
West Basin - Existing	0.20	B A	1 2	0.27	B A	5 5
East Basin - Existing	0.25	B A	5 5	0.35	C B A	2 6 2
West Basin – Proposed Layout 2C.2	0.18	B A	1 9	0.27	B A	5 5
East Basin – Proposed Layout 2C.2	0.34	C B A	2 5 3	0.51	D C B A	2 5 1 2

Figure 6-10 – East Basin Crowding

6.4.2 Bridge Area

There is an additional area of encroachment on the channel planned for the area near the bridge. This additional encroachment results in a reduction of the channel width; however this is offset by the reduced traffic generation near the bridge. (This is due to the fact that there are only 5-6 finger channels in each basin adjacent to the reduced area, there is limited bridge through traffic and there are limited numbers of "cruising boats" that circulate through the bridge.) The results appear in Table 6-10 and indicate that this area has a low V/C ratio and a very high LOS, equal to or better than the typical traffic case for the rest of the channel.

Table 6-10 – Peak Hour Level-of-Service with Influence of Channel Narrowing at Bridge

DESCRIPTION	CHANNEL NARROWING		
	V/C	LOS	Duration (Hr)
West Basin – Existing	0.20	B A	1 2
East Basin – Existing	0.25	B A	5 5
West Basin – Proposed Layout 2C.2	0.19	B A	1 9
East Basin – Proposed Layout 2C.2	0.19	B A	1 9

6.4.3 Boat Parades, Etc.

During the Holiday season, there are several boat parades that utilize the main channels with an unusually high number of boats. It is understood that this is a special occasion where the speeds are probably reduced and the navigation proceeds in an orderly, linear manner with no cross-traffic. The reduction in the navigable width of the channels near the bridge may require that the larger boats turn around before reaching the constriction, however this is not considered to be a significant impact since the channel is shallower in this area and it would be prudent for the larger boats to be turning anyway.

7.0 MITIGATION MEASURES

The findings of this boat traffic study indicate that in general, there are presently very limited boat traffic issues in the Dana Point Harbor, and that the new "2C.2 Layout with Channel Encroachment" configuration will not cause significant changes. The following provides a list of potential mitigation measures that could effectively reduce or eliminate any perceived negative impacts of Inner Channel encroachment.

1. As seen from the results of the interviews and the traffic sensitivity study, small Day-Use vessels operations within the Harbor can be one of the larger influences on traffic flow. It should be recalled that a harbor is designed as a safe haven to "park" and store boats in the water. The design intent never included using the Inner Channels as recreational areas, as evidenced by the existing (albeit not enforced) statute that prohibits using the Inner Channels for recreational activities. If the Harbor Patrol recognizes that these recreational uses are interfering with the primary function of the Harbor, then they may need to start enforcing this statute. Individual education for day rental kayakers may be required as they tend to be less aware of typical boating considerations than more experienced operators.

2. The Harbor Patrol is presently enforcing and maintaining a "slow speed/no wake" environment within the Harbor, which should continue for safety reasons. However; the speeds in the Inner Channel need to be maintained at a steady rate of 4-5 knots to maintain flow and steerage. There should be no stopping in the main channel in high traffic conditions except to back into a pitchfork slip. An active harbor patrol is the most effective tool for traffic control in a harbor.

3. In addition to enforcement activities, an effective mitigation measure for potential traffic congestion is to educate new and existing boaters on rules of the road and boating etiquette. Educating boaters about the wide range of harbor users and their usage patterns and characteristics should be an important element of the program. In addition, all boats leaving the fairways and entering the Inner Channel should be instructed to come to a stop before proceeding to merge in to the channel. This is especially important at the locations with "pitchfork" docks where visibility, especially of kayaks, may be reduced.

4. Signage can also be an effective educational tool, cautioning boaters to be aware of both traffic and ocean conditions before leaving the Harbor.

5. If multi-hull vessels are allowed to occupy end ties within the Harbor, their location and width should be carefully considered in order to minimize impacts to boat traffic through the Inner Channel.

6. Larger boats in the boat parades should be skippered by professional crew and there may be a need to buoy the areas near the bridge to direct and allow the vessel turn-around area to be placed at the maximum width of the channel, some distance from the bridge. The boat speed in the parade should be reduced from

the assumed daily average of 5 knots and the parades should be overseen by the Harbor Patrol.

8.0 SUMMARY AND CONCLUSIONS

This study presents an evaluation of the existing and proposed future boat traffic issues at the Dana Point Harbor. The following summarizes the general findings and study conclusions.

1. The existing Inner Channel has a design width of approximately 200' from dock to dock, but an effective navigable width of approximately 180' feet due to the side-tie boats at the ends of many of the docks.

2. In certain areas, the navigable width of the East Basin Inner Channel is approximately 160' due to a side-tied catamaran.

3. On-site observations of boat traffic on a typical summer weekend indicate that:

    - Daily usage levels were less than historical trends.
    - Hourly usage patterns were similar to historical trends.
    - Power boat usage is double sailboat usage.
    - Sailboats under sail represent <1% of the total traffic.
    - 20% of the powerboats in the West Basin pass through the bridge and East Basin.
    - Small Day-Use vessels represent 44% of the total watercraft observed.

4. The proposed layout would reduce the existing design width of the channel to 160' (150' with the inclusion of a 5ft boat overhang on both sides of the channel) over the majority of both basins and would reduce it to just under 95' near the bridge.

5. The highest rate of traffic is typically inbound in the late afternoon.

6. Interviews with Harbor users do not indicate traffic congestion problems and there is little change anticipated if the layout is changed and the Inner Channels are narrowed. The major factors that influence congestion are kayakers, PWCs, uneducated boaters, and total boat count.

7. Perceptions of boat traffic and congestion can be influenced by isolated events such as a poorly operated vessel, speeding boats, loss of power/steering, or an unorganized group of kayakers or PWCs, which can crowd a channel and reduce maneuverability. The intent of the modeling is not to try and quantify discrete events but to evaluate the over-all, long term statistical traffic and potential congestion issues relative to the change in marina slip count and configuration.

8. Presently the Dana Point Harbor Inner Channels have no significant traffic congestion problems.

9. A Level-of-Service (LOS) boat traffic analysis was applied to help quantify the impacts of the proposed change to Layout 2C.2. The model corroborates the general consensus that there is no present Inner Channel congestion, and there will be no significant change in the new configuration on a regular basis. Typical LOS values ranged from A to B, and none exceed a LOS of more than C for a few hours on a weekend day. This is considered to be a very high service level average for typical marinas.

10. The influence of the "pitchfork" slips at the end of the docks is significant. In the West Basin, there is a reduction in the equivalent number of slips and an increase in service level with the proposed configuration. In the East Basin there is an increase in the number of equivalent slips, and a small decrease in the LOS in the new configuration.

11. The results indicate that the proposed 2C.2 Layout improves the peak holiday traffic LOS in the West Basin, but decreases the peak holiday traffic LOS in the East Basin. A LOS value of "C", for 5 hours on a holiday weekend is very acceptable because a majority of boaters recognize that there is going to be holiday traffic and either modify their schedule or increase their tolerance for slow-downs.

12. Average boat spacing and length assumptions in the model have the potential to influence the ultimate LOS for the basins. The results indicate sensitivity to the spacing and speed length assumptions that would be noticeable to the average boater if combined. The impact of these assumptions for the comparison of configurations can be minimized by using the same criteria for the existing and proposed layouts.

13. Small Day-Use vessels have the potential for reducing the LOS and causing congestion for the existing and proposed marina layouts. The results indicate that the presence of small Day-Use vessels within the Harbor has a significant influence on the modeled traffic patterns, and that the proposed 2C.2 Layout is better able to absorb the lane reduction and maintain the LOS in the West Basin but not in the East Basin. Managing this traffic should be a priority for the Harbor Patrol to maintain an acceptable LOS.

14. The reduction of navigable width at the bridge has little impact on the channel LOS.

15. Boat Parades represent special events and should be monitored by the Harbor Patrol for speed and maintenance of linear traffic. Larger boats may need to turn around before the channel constriction area due to turning radius and depth considerations.

16. The findings of the modeling study are consistent with the on-site observations and those of the Harbor users and Harbor Patrol.

17. Mitigation measures for potential impacts include increased enforcement of present statues as required and additional boater education.