APPENDIX F
NAVIGATION STUDY FOR SACRAMENTO DEEP WATER SHIP CHANNEL IMPROVEMENT DATA REPORT (2010)

ERDC/CHL

Coastal and Hydraulics Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

NAVIGATION STUDY FOR SACRAMENTO DEEP WATER SHIP CHANNEL IMPROVEMENT DATA REPORT

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June 2010

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INTRODUCTION

The Sacramento River Deep Water Ship Channel (SRDWSC), shown in Figure 1, is a 46.5-mile long channel that lies within Contra Costa, Solano, Sacramento, and Yolo Counties and serves the marine terminal facilities at the Port of West Sacramento. The project was originally authorized by the River and Harbor Act of 1946 (Pub. L. 525, 79th Congress, 2nd Session) and reauthorized in the Water Resources and Development Act of 1986. Construction of a 30-foot deep channel was completed in 1963.

The project was previously analyzed in accordance to NEPA and CEQA in a Feasibility Report and Final Environmental Impact Statement in 1980 and a General Design Memorandum (GDM) and Supplemental Environmental Impact Statement prepared in March 1986. Construction of a 35-foot deep channel was initiated in 1989, and construction from River Mile 43 to 35 (approximately 8 miles of the channel nearest the Port of West Sacramento) was completed. Work was suspended in 1990 at the request of the Port of West Sacramento, due to the inability to continue financing their share of the project costs. Two of the six construction contracts, from River Mile 43 to 35 (approximately 8 miles of the channel nearest to the Port), have been completed.

In 1998 Congress directed USACE to complete a reevaluation of the incomplete project that would serve as a basis for a possible recommendation to resume construction. San Francisco District has prepared a Project Management Plan (PMP) describing the scope of that Limited Reevaluation Report (LRR) which will primarily involve a review of the project economics, prepare environmental documentation (SEIS/SEIR), and provide an updated construction cost estimate.

The purpose of the Supplement Environmental Impact Statement/Subsequent Environmental Impact Report (SEIS/SEIR) is to resume construction of navigational improvements in the SRDWSC. The objective is to increase navigational efficiency, improve safety, and improve the economic benefits in the movement of goods by deeper draft vessels. The SEIS/SEIR will update the 1980 EIS and the 1986 SEIS and evaluate changes to the condition of the study area.

The channel design was initially developed in the USACE General Design Memorandum, dated March 1986, but was later modified based upon the computer ship simulation studies performed at USACE Waterways Experiment Station (WES) in 1988 (Webb, 1994). The design provided for dredging of the channel to -35 feet MLLW and widening of portions of the channel. The 1986 revised channel dimensions are shown in Table 1. Figures 2 and 3 show the additional widening between Rio Vista and the southern end of the man-made canal that were recommended as a result of the 1988 ship simulation study.

Table 1. Channel Dimensions

		Existing (ft)		Proposed (ft)	
Reach #	River Mile	Width	Slope	Width	Slope
Reach 1, 2, and 3	0.00 to 15.0	300	1V:4H	350	1V:4H
Reach 3	15.0 to 18.60	300	1V:3H	300	1V:3H
Reach 4	18.60 to 21.42	200	1V:3H	200	1V:3H
Reach 4	21.42 to 21.62	200	1V:3H	250(curve)	1V:3H
Reach 4	21.62 to 25.65	200	1V:3H	200	1V:3H
Reach 4	25.65 to 26.11	200	1V:3H	250(curve)	1V:3H
Reach 4 and 5	26.11 to 35.45	200	1V:3H	200	1V:3H
Reach 5	35.45 to 35.88	200	1V:3H	250(curve)	1V:3H
Reach 5	35.88 to 40.16	200	1V:3H	200	1V:3H
Reach 5	40.16 to 43.37	200	1V:3H	250(curve)	1V:3H

The design ship used in the 1988 study was the Asian Banner. The Asian Banner was a 610 ft long bulk carrier with a beam of 93 ft. The US Army Corps of Engineers District – San Francisco (SPN) wished to determine if the widening designed in 1988 would accommodate a larger ship. To assist SPN in this determination, the US Army Corps of Engineers, Engineering and Development Center (ERDC), formally WES, conducted a new ship simulator study.

RECONNAISSANCE TRIP

The Reconnaissance trip for the study was conducted December 9, 2009. The purpose of the trip was to meet with representatives of the San Francisco Bar Pilots and travel to the Port of Sacramento. The meeting with the pilots was held at their office. Captains Tom Miller and Rick Hurt represented the pilots. The Corps was represented by Anne Sturm, Dennis Webb, David Doak, and Glen Miller. The meetings purpose was to determine the pilots' particular areas of concern in the river and to discuss simulation scenarios. Four areas were listed as areas of concern by the pilots. They are as follows:

1. The approach to the Rio Vista Bridge. The bridge is not perpendicular to the navigation channel (Figure 4). This is more of an issue for upbound transits. For simulation purposes, this is referred to as Reach A.
2. Cross-currents coming from Cache Slough where it joins the ship channel. These present difficulties during all phases of the tidal cycle (Figure 4). For simulation purposes, this is referred to as Reach B. Reach B includes a larger portion of Cache Slough so that widening proposed as a result of the 1988 study could be tested.
3. The 20 degree turn in the man-made canal portion of the channel (Figure 5). For simulation purposes, this is referred to as Reach C. A widener, designed to provide additional room south of the turn is shown in Figure 6.

4. The 90 degree turn (or curve) on the approach to the turning basin. Of particular concern are two docks which may have vessels alongside (Figure 5). For simulation purposes, this is referred to as Reach D.

Following the meeting with the pilots, Ms. Sturm and Mr. Webb drove to the Port of Sacramento. They observed the project area and took digital photographs which would later be used to build the simulator's visual scene. Additional photographs of the manmade canal were collected for the same purpose on January 12, 2010 by Ms. Sturm. Ideally, this would be done from the bridge of ship transiting the project. However, a ship was not available for this study.

DATABASE DEVELOPMENT

Currents for both the existing and proposed channels were calculated by a hydrodynamicist under contract to SPN (MacWillliams, 2010). Currents were calculated for the following conditions:

1. Slack tide plus 10 year river discharge. The 10 year river discharge is approximately 4 to 5 knots at Cache Slough. This was chosen because during slack tide, the crosscurrents caused by the inflow from Cache Slough are at the most severe angle.

2. Peak spring ebb tide plus 10 year river discharge. The river discharge increases the magnitude of the ebb tide currents for all reaches south of where Cache Slough joins the ship channel.

3. Peak spring flood tide. Summer low flow river discharge was used for flood tide currents since the river flows in the opposite direction as flood tidal currents, thus reducing their magnitude.

The currents were then converted into the format required by the ERDC Ship/Tow Simulator (STS). Two different winds with magnitudes, 20 and 30 knots, were included for each reach. As suggested by the pilots, the direction of the wind was perpendicular to the channel. This provided a worst case scenario for each test reach. Databases were developed for the four test reaches as follows:

Reach A. Current databases were built for flood and ebb tides. Wind was from the northwest.

Reach B. Current databases were built for flood, ebb, and slack tides. Wind was from the west.

Reach C. Current databases were built for flood and ebb tides. Wind was from the west.

Reach D. Current databases were built for flood and ebb tides. Wind was from the south.

The visual scene was developed from the digital photographs taken during the recon trip. Figure 7 shows the visual scene as one of the Sacramento River Pilots operates the simulator.

The ship model used was the *El Gaucho*. It is a 775- x 106-ft bulk carrier. It was loaded to 30 ft for the existing channel and 35 ft for the proposed channel.

VALIDATION

Validation for Sacramento River was conducted February 22-26, 2010. Validation is a checkout of the existing condition simulation databases. An existing condition model must be successfully validated before it can be modified to reflect proposed conditions. Captains Tom Miller and Ken O'Laughlin of the San Francisco Bar Pilots Association participated in validation. The visual scene, currents, bank effects, ship models, radar and ECDIS were all successfully validated. However, the pilots felt the 10 year river discharge from Cache Slough was too severe. Therefore, the magnitude of the ebb currents south of where Cache Slough joins the ship channel were cut in half. The pilots felt this was an accurate representation of severe ebb tide currents with inflow from Cache Slough.

RESULTS

Two weeks of real-time pilot testing were undertaken for the Sacramento River Deep Water Ship Channel. Captains Mike Sweeney and Guy Kleess operated the simulator March 8 – 12, 2010 and Captains Rick Hurt and Ray Ridens operated the simulator March 22 – 26, 2010. All pilots are members of the San Francisco Bar Pilots Association. At the end of each week of testing, the pilots were given a final questionnaire to complete. These questionnaires are included in Appendix A.

Results are presented in the form of composite track plots in Appendix B, Plates 1-87. Simulation of existing conditions was undertaken in addition to simulation of the proposed conditions. This provides a baseline with which to compare the proposed condition exercises.

Test Reach A.

Results of inbound simulations in Reach A are shown in Plates 1 – 8. Only inbound runs were conducted for Reach A. The navigation concern in Reach A is the turn on the inbound approach to the Rio Vista Bridge.

Inbound, Flood Tide. Two ships in the existing condition flood tide runs left the channel while making this turn. One in 20 knots of wind, Plate 1, and the other in 30 knots of wind, Plate 3. Plots of the proposed condition flood tide runs, Plates 2 and 4, shown none

of the ships leaving the channel. Ships in the proposed condition used the additional room on the west side of the turn.

Inbound, Ebb Tide. Plots of ships transiting Reach A in ebb tide are shown in Plates 5 – 8. None of the runs, either existing or proposed, left the channel. Inbound ships are going against an ebb tide. This is regarded as an easier condition than going with a flood tide because there is more water going past the rudder. This makes the ship easier to steer. When ships go against the current, it is often referred to as a "head tide." When ships go with the current, it is often referred to as a "following tide."

It should be noted that all four pilots felt the widening south of the bridge aided them in transiting the area.

Test Reach B.

Composite plots of exercises conducted for Reach B are shown in Plates 9 – 56. Reach B is too long to show results on one plate. Therefore, plots of Reach B simulations are divided into Reach B1 (the southern half) and Reach B2 (the northern half).

Inbound, Flood Tide. Plots of the inbound, flood tide simulations are shown in Plates 9 – 16. All existing condition runs, Plates 9 and 10 and Plates 13 and 14, left the authorized channel on the east side, north of Steamboat Slough. This area is naturally deep and the 30 ft draft ships would not have run aground and this area is already part of the widening proposed for the 35 ft project. All existing condition runs also left the channel on the west side, south of the man-made Sacramento River Deep Water Ship Channel. They also went well outside the channel, on the west side, as they entered the Sacramento River Deep Water Ship Channel at it's confluence with Cache Slough and Miner Slough. One of the pilots noted that this simulation scenario was "squirrelish" in this area. Runs in the proposed condition, Plates 11 and 12 and Plates 15 and 16, did a much better job of staying within the channel on the east side, north of Steamboat Slough. They took advantage of the widener. It should be noted that this area is not naturally deep enough for the 35 ft draft ship. One ship in the 30 knot wind from the west (Plate 15) did leave the channel by about 40 ft. While approaching the mouth of the man-made canal, all ships tended to stay to the west side, as did the existing runs. All the ships used the widener. However, one ship in the 20 knot wind exercises (Plate 12) and one ship in the 30 knox wind exercises (Plate 16) left the west side of the channel by about 40 ft. Even though some of the ships crossed the channel boundary when entering the Sacramento River Deep Water Ship Channel, the plots show they had a much easier time than the existing condition runs.

Inbound, Ebb Tide. Plots of the inbound, ebb tide simulations are shown in Plates 17 – 24. For all existing condition runs, Plates 17 and 18 and Plates 21 and 22, both ships tended to go back and forth between both sides of the channel, although one pilot did so more than the others. All ships tended to stay on the west side, or go out of the west side of the channel when approaching the man-made canal. All runs had difficulty entering the man-made canal. Three runs left the channel on the west and one run left the channel

on the east. The proposed condition runs are shown in Plates 19 and 20 and Plates 23 and 24, These runs did not go side to side as much as the existing condition runs. One run in the 20 knot wind (Plate 19) barely crossed the channel line on the west side, just north of Steamboat Slough. Two runs in the 30 knot wind scenario (Plate 23) went out of the channel 70 and 100 ft at the same location. They did so despite having plenty of room on the west side of the channel. The proposed condition runs remained in the channel as they approached the Sacramento River Deep Water Ship Channel. However, all runs had difficulty entering the mouth of the man-made canal. The flow from Cache Slough obviously pushed the ships east at this point.

Inbound, Slack Tide. Plots of the inbound, ebb tide simulations are shown in Plates 25 – 32. All existing condition runs are shown in Plates 25 and 26 and Plates 29 and 30. One vessel in both the 20 and 30 knot wind conditions left the channel to the west in the naturally deep area north of Steamboat Slough. Vessels in both wind magnitudes had difficulty staying within the channel boundaries as they approached the man-made canal. However, they entered the man-made canal with much less effort than they did in both flood and ebb tides.

Outbound, Flood Tide. Plots of the outbound, flood tide simulations are shown in Plates 33 – 40. All existing condition runs, Plates 33 and 34 and Plates 37 and 38 went well out of the channel on the west after leaving the man-made canal. The vessels remained in the channel for most of the remainder of the exercise. However, one ship in the 20 knot wind (Plate 35) left the channel on the west side across from Steamboat Slough by about 70 ft. One ship operating in the 30 knot wind scenario left the same portion of the channel by about 80 ft. The proposed condition runs, Plates 35 and 36 and Plates 39 and 40 did not seem to have as much trouble leaving the man-made canal as did the existing condition runs. The runs in the 20 knot wind used the widener on the west side of the channel. The runs in the 30 knot wind (Plate 40) did not. The proposed condition runs tended to use the west side of the channel across from Steamboat Slough, as did the existing condition runs. One ship operating in the 20 knot wind scenario (Plate 35) left the channel about 30 ft. One ship operating in the 30 knot wind scenario (Plate 39) left the channel about 10 ft.

Outbound, Ebb Tide. Plots of the outbound, ebb tide simulations are shown in Plates 41 – 48. All existing condition runs, Plates 41 and 42 and Plates 45 and 46, tended to stay on the west side of the channel after leaving the man-made canal. One run in the 30 knot wind condition (Plate 46) stayed on the east side. Ships operating in both wind conditions used the east side of the channel, or went into the naturally deep area, north of Steamboat Slough. Both runs in the 20 knot wind (Plate 41) went out of the east side of the channel by about 60 ft near the mouth of Steamboat Slough. One run in the 30 knot wind (Plate 45) did the same thing.

Outbound, Slack Tide. Plots of the outbound, slack tide simulations are shown in Plates 49 – 56. The existing condition runs, Plates 49 and 50 and Plates 53 and 54 tended to stay on the west side of the channel after leaving the man-made canal. Both runs in the 20 knot wind (Plate 50) left the channel. One ship left the channel by only a slight amount and the other by about 60 ft. Both runs in the 30 knot wind (Plate 54) left the

channel by about 40 ft. All runs, in both wind conditions, stayed on the west edge of the channel near the mouth of Steamboat Slough. During the proposed condition runs, Plates 51 and 52 and Plates 55 and 56, the ships did not appear to have any difficulty leaving the man-made canal. One ship in the 20 knot wind (Plate 51) left the channel near the north end of the plate. One ship in the 30 knot wind (Plate 55) left the channel in approximately the same area.

In their questionnaires all four pilots felt that all widening in Reach B was important and useful to transiting the area. This was especially true of the triangular widener at the confluence of Cache Slough, Miner Slough, and the man-made canal.

Test Reach C.

Composite plots of exercises conducted for Reach C are shown in Plates 57 – 71.

Inbound, Flood Tide. Plots of the inbound, flood tide simulations are shown in Plates 57 – 60. Of the existing condition runs (Plates 57 and 59) ,one of the 20 knot wind runs left the channel by about 50 ft on the east side after making the turn. The proposed condition exercises (Plates 58 and 60) were successful. The pilots used the widener in the proposed condition.

Inbound, Ebb Tide. Plots of the inbound, ebb tide simulations are shown in Plates 61 – 63. Due to time constraints, there were no simulations of the proposed condition, inbound, ebb tide, with 20 knots of wind. One of the existing condition runs in 20 knot wind left the channel by about 50 ft on the east side prior to the turn. Both existing condition runs in the 30 knot wind left the channel by about 50 ft prior to the turn. One left the channel on the east, the other on the west. One pilot crossed the east channel boundary on the approach to the turn in the proposed channel (Plate 63). Another ship went about 50 ft out of the channel after making the turn.

Outbound, Flood Tide. Plots of the outbound, flood tide simulations are shown in Plates 64 – 67. The existing condition runs, Plates 64 and 66, made the turn without leaving the channel. It should be noted that there was only one run for the 20 knot wind and one run for the 30 knot wind. One of the proposed condition ships in the 20 knot (Plate 65) wind barely crossed the channel line north of the turn. Two of the four proposed runs conducted in the 30 knot wind left the channel on the west prior to the turn (Plate 67). One ship left the channel after making the turn. The pilot stated that he "overcompensated."

Outbound, Ebb Tide. Plots of the outbound, flood tide simulations are shown in Plates 68 – 71. Both existing condition 20 knot wind runs (Plate 68) left the channel north of the turn. One run crossed the channel boundary after making the turn. Both runs in the 30 knot wind (Plate 70) left the channel north of the turn. Two of the four runs conducted in the proposed channel with 20 knots wind (Plate 69) left the channel limits north of the turn. None of the ships left the channel after making the turn. Two of the ships used the widener. One of the four runs in the proposed channel with 30 knots of wind (Plate 71)

left the channel north of the turn. The same ship went over 60 ft out of the channel on the east side after making the turn. The pilot stated that he "went too deep into turn."

In their questionnaires all four pilots felt the small widening south of the 20 degree turn helped with both inbound and outbound transits.

Test Reach D.

Composite plots of exercises conducted for Reach D are shown in Plates 72 – 87. There was no widening for Reach D. The only difference between existing and proposed conditions is depth. For most of the simulations, the vessel the Asian Banner was docked at the Chemical Pier.

Inbound, Flood Tide. Plots of the inbound, flood tide simulations are shown in Plates 72 – 75. The existing condition runs are shown in Plates 72 and 74. The pilots tended to keep their ships on the outside of the turn. The track plot for the proposed condition with 20 knots of wind (Plate 73) looks very similar to the existing condition plot. The runs conducted with the 30 knots of wind (Plate 75) also stayed to the outside of the turn. However, the ships went further outside under this condition than any other.

Inbound, Ebb Tide. Plots of the inbound, flood tide simulations are shown in Plates 76 – 79. The existing condition runs are shown in Plates 76 and 78. All runs stayed to the outside of the curve. A couple of runs barely crossed the channel boundary. The proposed condition runs are shown in Plates 77 and 79. One run in the 20 knot wind condition (Plate 77) left the channel by about 60 ft in several locations. The other two runs did not leave the channel. One run in the 30 knot wind condition (Plate 79) left the channel by about 30 ft at one point. The other ship did not cross the channel limits.

Outbound, Flood Tide. Plots of the outbound, flood tide simulations are shown in Plates 80 – 83. The existing condition runs are shown in Plates 80 and 82. Runs conducted in the 20 knot wind (Plate 80) remained in the channel for the entire run. Both runs conducted in the 30 knot wind (Plate 82) left the channel by about 50 ft at several points. The proposed condition runs are shown in Plates 81 and 83. One of the runs conducted in the 20 knot wind (Plate 80) left the channel several times, once by nearly 70 ft. The remaining three runs stayed in the channel. Two of the runs conducted in the 30 knot wind (Plate 83) left the channel, once by nearly 80 ft. The other two runs stayed in the channel.

Outbound, Ebb Tide. Plots of the outbound, flood tide simulations are shown in Plates 84 – 87. The existing condition runs are shown in Plates 84 and 86. One of the runs conducted in the 20 knot wind (Plate 84) left the channel several times by as much as 40 ft. The run conducted in the 30 knot wind (Plate 86) stayed in the channel. The proposed condition runs are shown in Plates 85 and 87. Both exercises in the 20 knot wind (Plate 85) left the channel by about 40 ft. Two of the runs conducted in the 30 knot wind (Plate 87) left the channel, once by nearly 60 ft. The other two runs stayed in the channel.

CONCLUSIONS

Based upon the simulator results and the pilot's final questionnaires, the following conclusions are made for the Sacramento River improvements.

1. The widening just south of the Rio Vista Bridge aided the upbound approach to the bridge.
2. The channel widening in the Sacramento River and Cache Slough (Reach B) aided both inbound and outbound transits.
3. The triangular widening on the west side of the channel just south of the mouth of the man-made canal was of benefit for both inbound and outbound transits.
4. The widener just south of the twenty degree turn was beneficial, especially for inbound runs.

RECOMMENDATIONS

1. Based upon the simulation results and pilot comments, we recommend that proposed channel improvements be constructed.
2. One of the pilots suggested widening on the east side of the channel near Miner Slough. The additional widening may provide more relief for ships entering or leaving the man-made canal. If this widener is considered, additional simulations should be undertaken.

REFERENCES

Webb, Dennis. Ship Navigation Simulation Study, Sacramento River Deepwater Ship Channel Project, Phase II, Sacramento, California. Technical Report HL-94-13. Vicksburg, USACE, 1994.

MacWilliams, Michael, Sacramento and Stockton Deep Water Ship Channel 3-D hydrodynamic and Salinity Modeling Study, 2010 – in preparation.

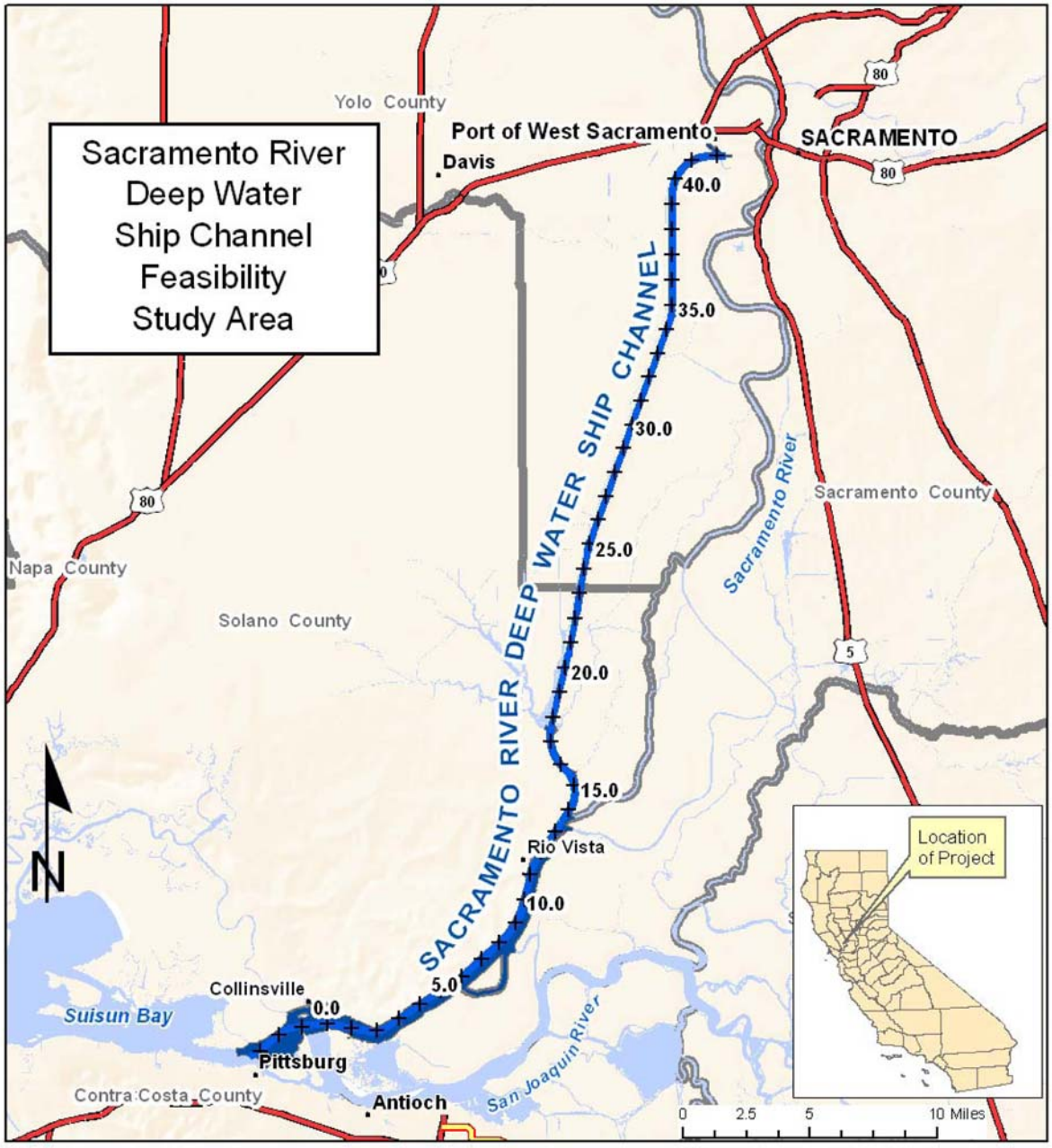


Figure 1. Sacramento River Deep Water Ship Channel

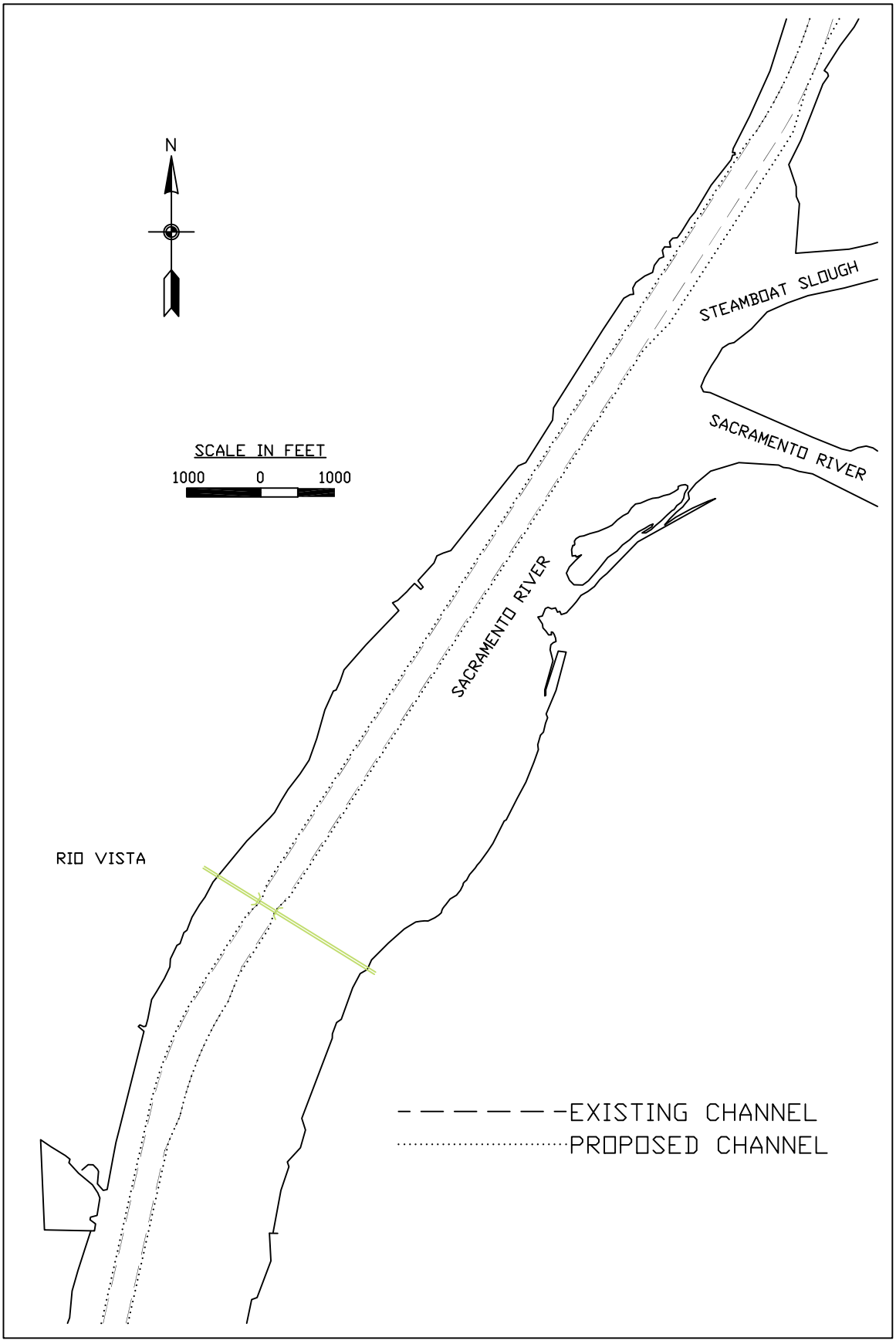


Figure 2. Proposed Channel Widening

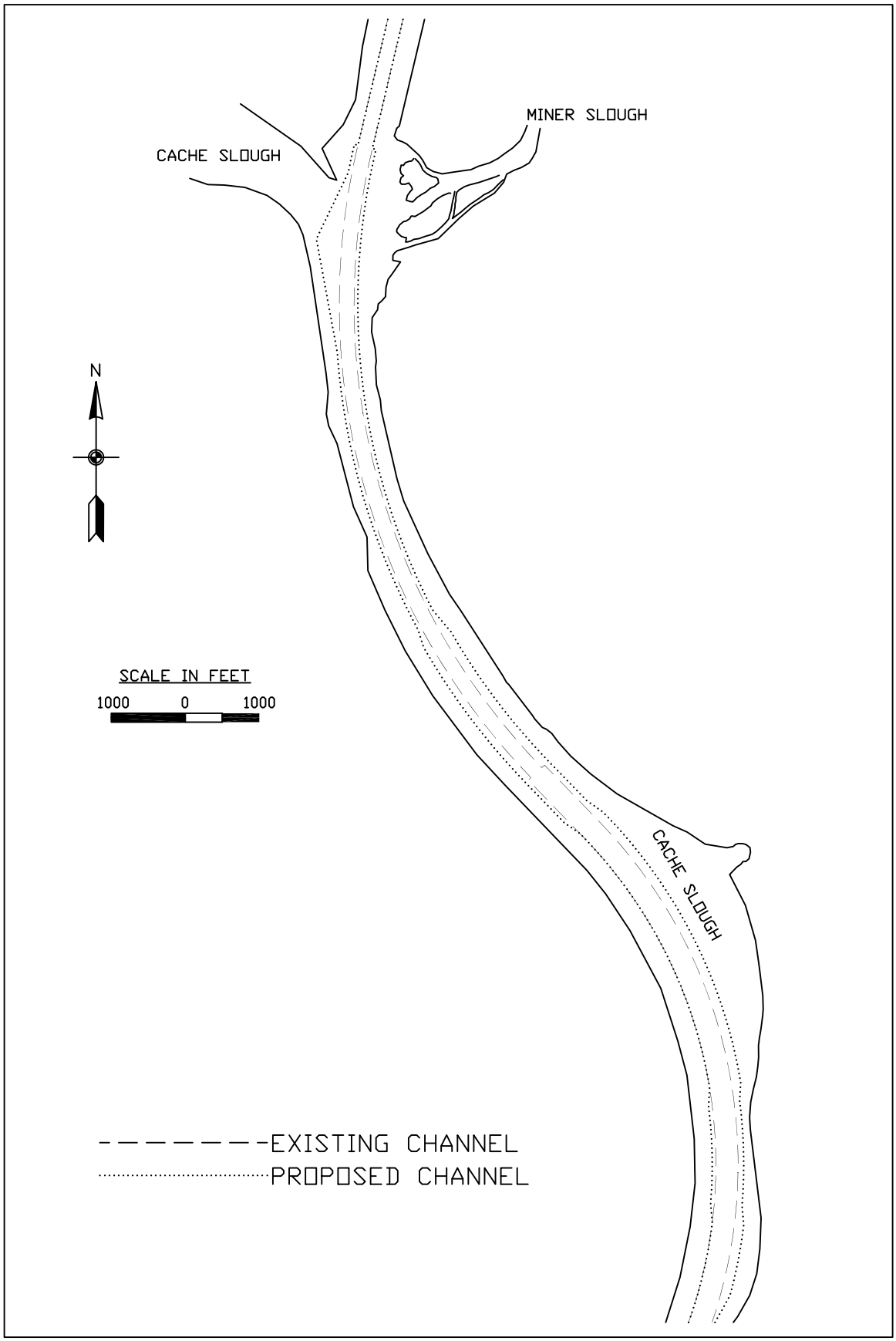


Figure 3. Proposed Channel Widening

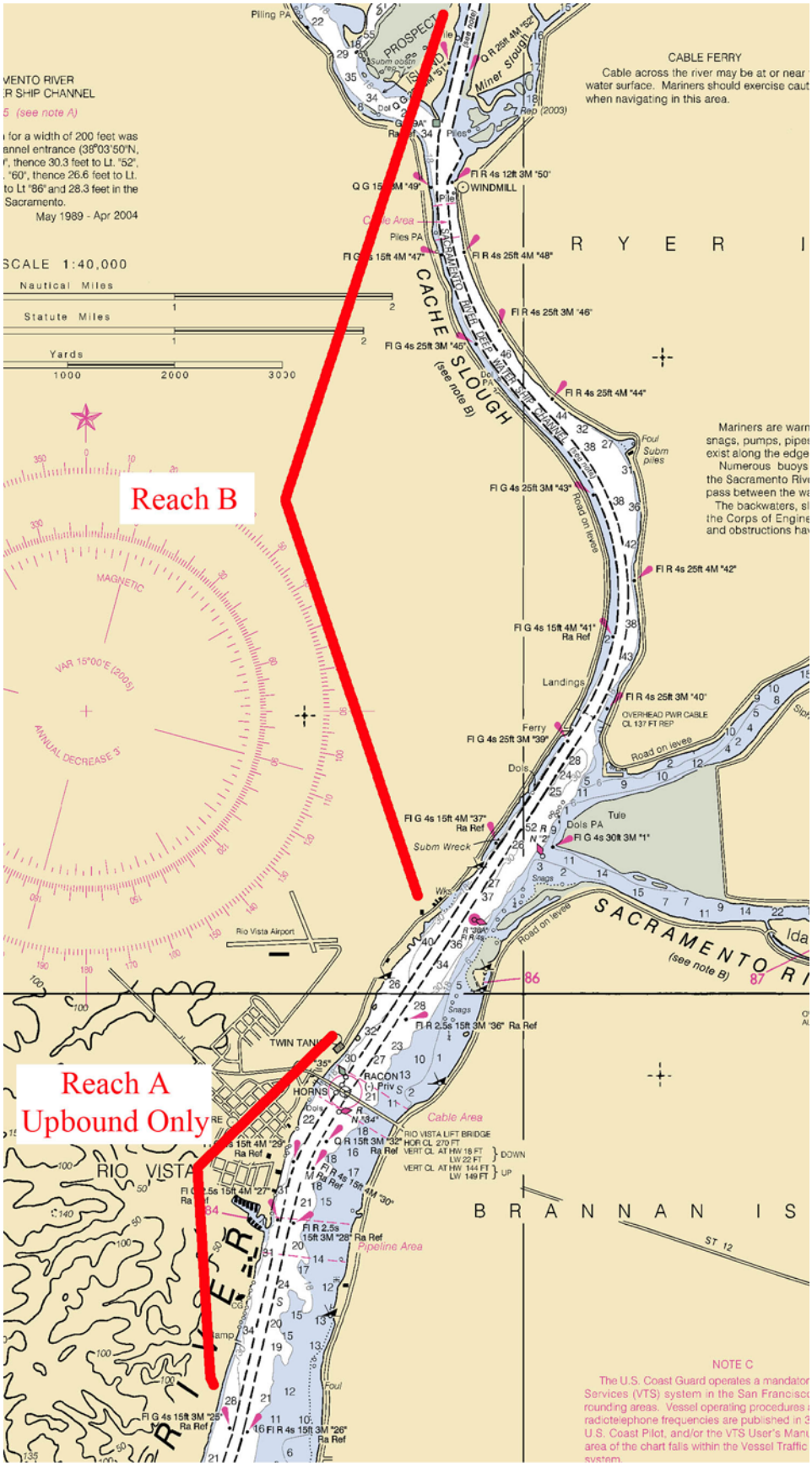


Figure 4. Areas A and B

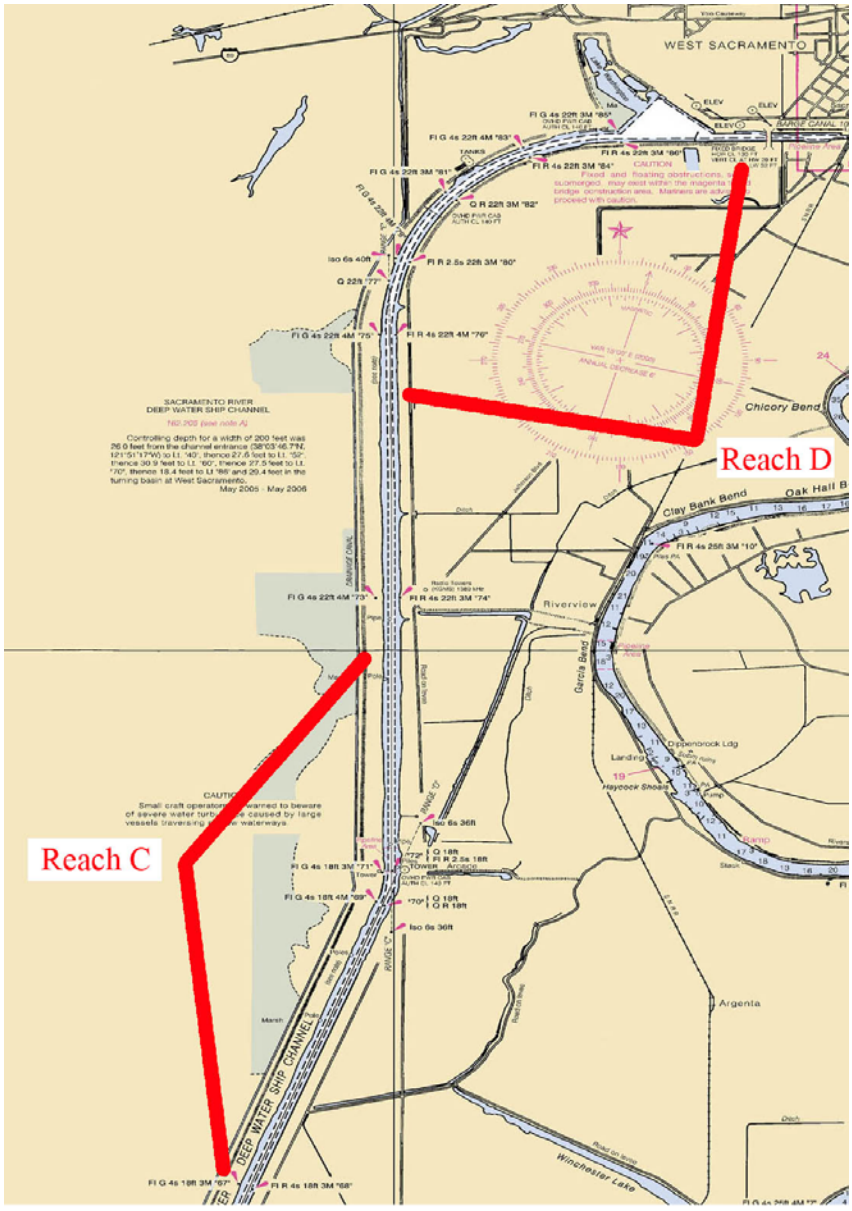


Figure 5. Areas C & D.

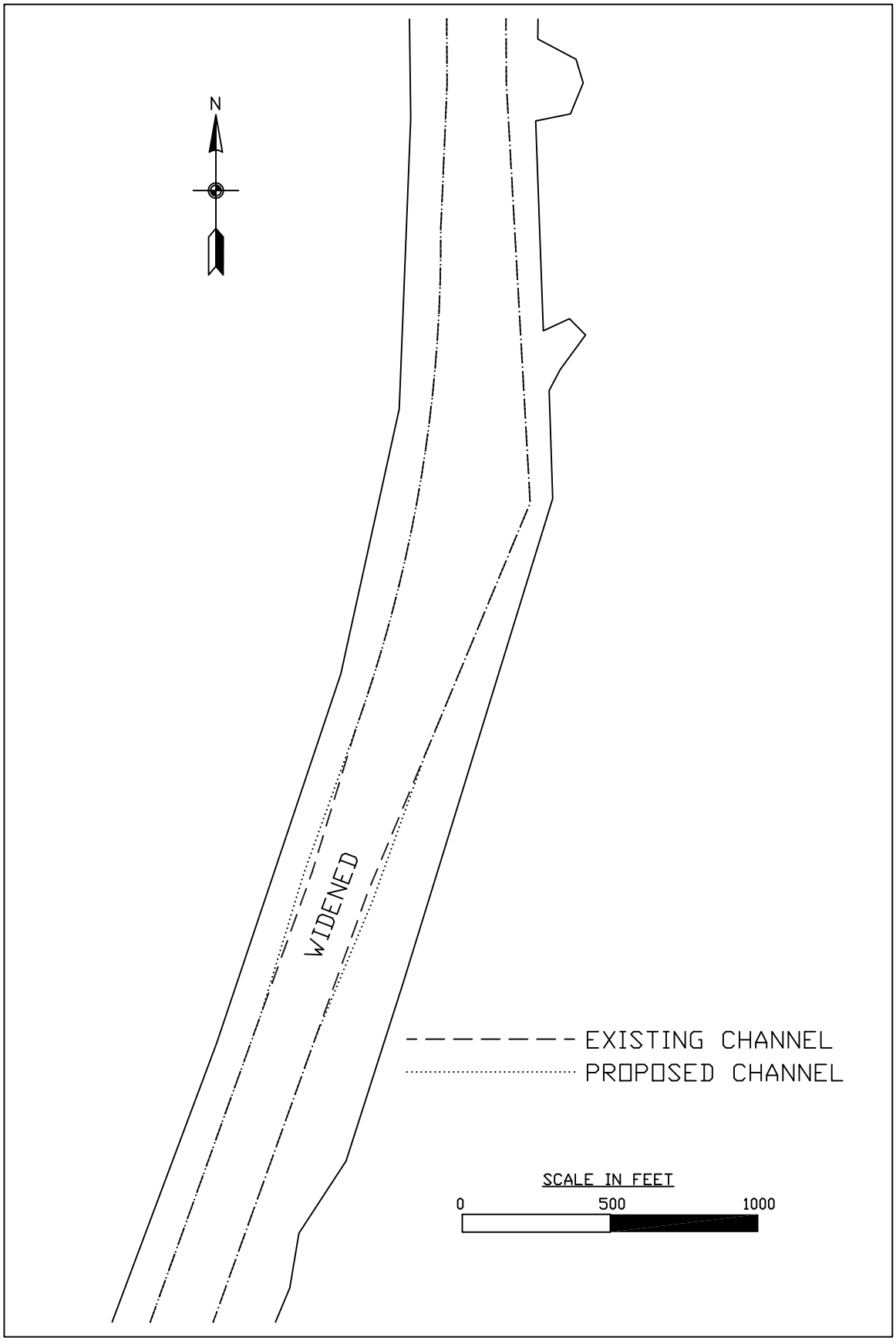


Figure 6. Proposed widening south of twenty degree turn

Figure 7. Pilot operating simulation of Sacrament Deep Water Ship Channel

APPENDIX A
PILOT QUESTIONNAIRES

Sacramento River, Final Questionnaire

Pilot: RICHARD HURT Date:

Please answer the following questions based upon your simulation runs. You may also use the attached charts to make notes. The existing 30 ft channel is in blue and the proposed 35 ft channel is red and dashed.

1. Test Reach A. Did the widening near the Rio Vista Bridge help you line up for the bridge on your northbound approach? If you ran any outbound runs through the bridge, was the widening helpful?

THE WIDENING FOR BOTH UPBOUND + DOWNBOUND TRAFFIC WOULD BE HELPFUL.

2. Test Reach B. Did the widening on the west near the confluence of Cache Slough, Steamboat Slough, and the Sacramento River help the transit?

YES IT DID, PARTICULARLY WHEN CURRENTS ARE COMING OUT OF THE SAC. RIVER

3. Test Reach B. Did the widening of Cache Slough, south of buoys 49 and 50 help the transit?

YES. THE ADDITIONAL WIDTH ALLOWED A REASONABLE MARGIN OF ERROR AT THIS CRITICAL POINT.

4. Test Reach B. Did the triangular widening at the confluence of Cache Slough and Miner Slough help you enter the man made canal? Was it helpful for outbound runs?

ABSOLUTELY.

5. Did the widening south of the 20 degree bend help make the inbound turn? Was it helpful for outbound runs?

YES

6. Were the wind, currents and bank effects realistic?

FOR THE MOST PART.

7. Any additional comments?

ADDITIONAL COMMENTS TO FOLLOW.

Sacramento River, Final Questionnaire

Pilot: Guy Kleess Date: 3/18/10

Please answer the following questions based upon your simulation runs. You may also use the attached charts to make notes. The existing 30 ft channel is in blue and the proposed 35 ft channel is red and dashed.

1. Test Reach A. Did the widening near the Rio Vista Bridge help you line up for the bridge on your northbound approach? If you ran any outbound runs through the bridge, was the widening helpful?

Inbound & Outbound – Proposed Channel Did Help. Most Noticeable Inbound Just Before The Bridge

2. Test Reach B. Did the widening on the west near the confluence of Cache Slough, Steamboat Slough, and the Sacramento River help the transit?

Yes

3. Test Reach B. Did the widening of Cache Slough, south of buoys 49 and 50 help the transit?

Yes. Of Most Benefit At Bn 40.

4. Test Reach B. Did the triangular widening at the confluence of Cache Slough and Miner Slough help you enter the man made canal? Was it helpful for outbound runs?

THIS IS WHERE THE PROPOSED CHANNEL CHANGES ARE MOST NOTICEABLE & HELPFUL, BOTH INBOUND AND OUTBOUND.

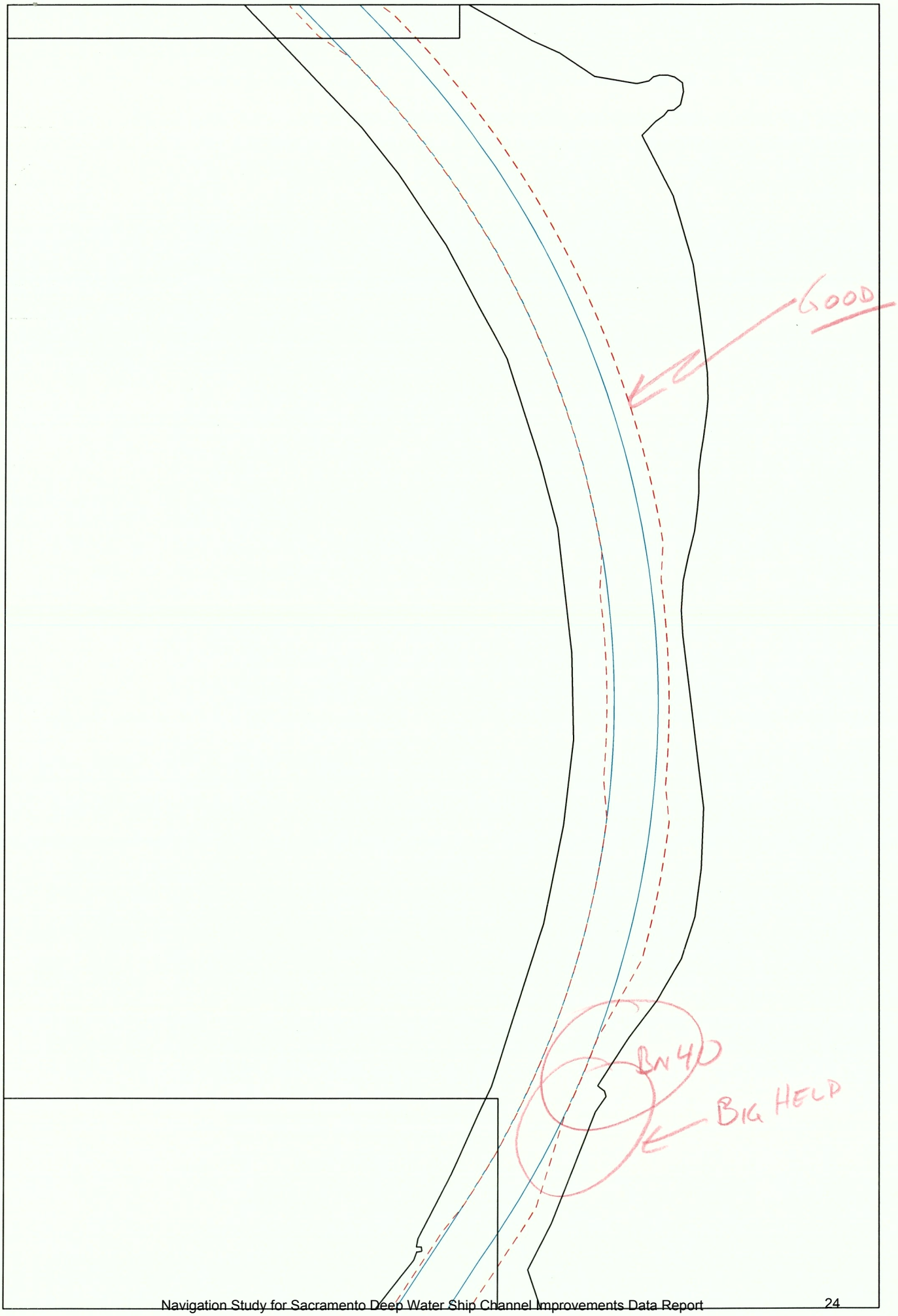
5. Did the widening south of the 20 degree bend help make the inbound turn? Was it helpful for outbound runs?

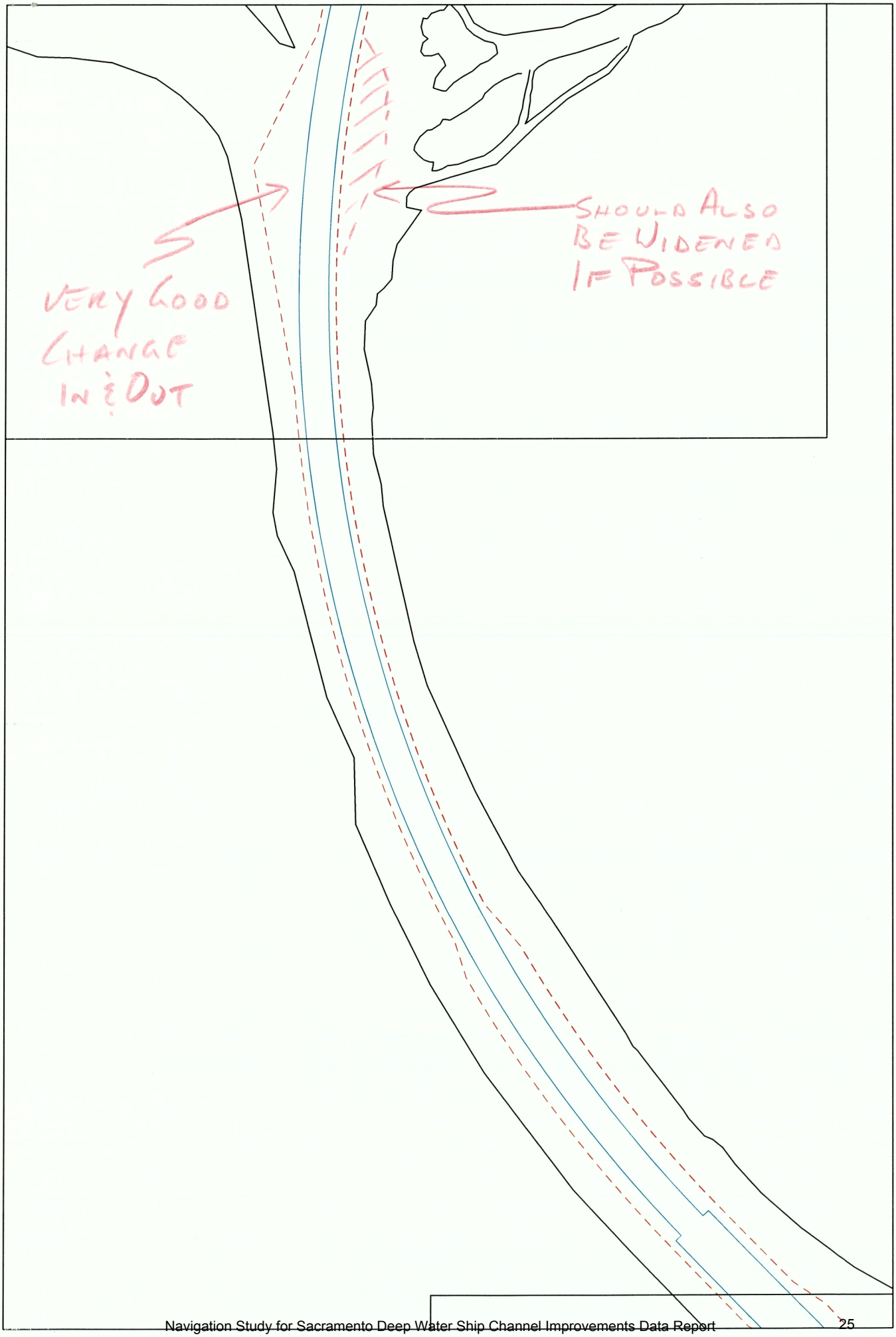
GOOD FOR BOTH IN & OUT.

6. Were the wind, currents and bank effects realistic?

YES. VERY GOOD SIMULATION.


OF MOST
BENEFIT
IN THIS
AREA


GOOD
BN 40
BIG HELP


VERY GOOD
CHANGE
IN & OUT
SHOULD ALSO
BE WIDENED
IF POSSIBLE

Sacramento River, Final Questionnaire

Pilot: RAY RIDENS Date: MAR 26 2010

SFBP #24

Please answer the following questions based upon your simulation runs. You may also use the attached charts to make notes. The existing 30 ft channel is in blue and the proposed 35 ft channel is red and dashed.

1. Test Reach A. Did the widening near the Rio Vista Bridge help you line up for the bridge on your northbound approach? If you ran any outbound runs through the bridge, was the widening helpful?

YES, I WAS LOW ON A FEW OCCASSIONS AND THE EXTRA WATER WAS NEEDED

2. Test Reach B. Did the widening on the west near the confluence of Cache Slough, Steamboat Slough, and the Sacramento River help the transit?

YES, IT HELPS THE UPBOUND APPROACH TO THE FERRY SLIP, AND PROVIDES SOME LEEWAY OUTBOUNDS

3. Test Reach B. Did the widening of Cache Slough, south of buoys 49 and 50 help the transit?

WIDENING ALWAYS HELPS YES

4. Test Reach B. Did the triangular widening at the confluence of Cache Slough and Miner Slough help you enter the man made canal? Was it helpful for outbound runs?

YES FOR BOTH OCCASSIONS, DIGGING SOME OF THE RED SIDE WOULD BE REALLY NICE

(SEE DRAWING PAGE)

5. Did the widening south of the 20 degree bend help make the inbound turn? Was it helpful for outbound runs?

HOW CAN YOU SAY NO TO MORE ROOM

6. Were the wind, currents and bank effects realistic?

WIND - SOMETIMES I WAS EXPECTING MORE LEEWAY, BUT I AM ASSUMING MORE SIDE SHELL AND HOUSE EXPOSURE TO THE WIND

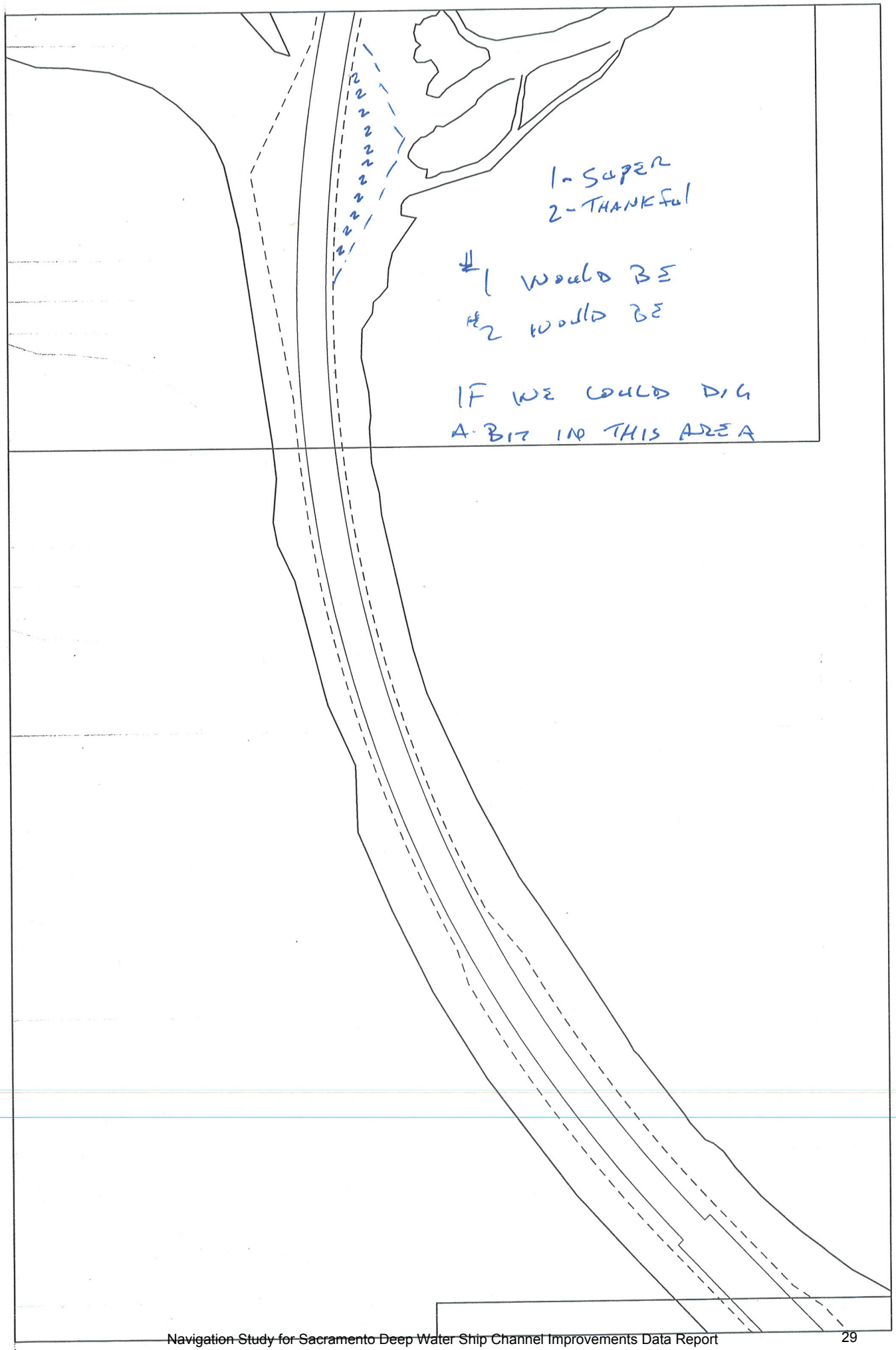
CURRENTS - SEEMED REASONABLE; RIO VISTA BRIDGE MAY HAVE HAD A STRANGE ANGLE ON THE EBB SHOULD BE MORE FAIR TO THE OPENING

BANK effects - SEEMED CORRECT

7. Any additional comments?

OVERALL A GOOD EXPERIENCE, SHIP PARTICULARS WERE GOOD, GAINING SPEED IN A TURN BY INCREASING THE ENGINE BELL MAY HAVE BEEN A BIT PRONOUNCED. LIFT AND SPEED DO NOT HAVE A DIRECT CORRELATION THANK fully.

THANKS TO THE WHOLE CREW for YOUR HOSPITALITY AND PROFESIONAL efforts.


1- SUPER
2- THANKful
#1 WOULD BE
#2 WOULD BE
IF WE COULD DIG
A BIT IN THIS AREA

Sacramento River, Final Questionnaire

Pilot: MIKE SWEENEY Date: 3-24-10

Please answer the following questions based upon your simulation runs. You may also use the attached charts to make notes. The existing 30 ft channel is in blue and the proposed 35 ft channel is red and dashed.

1. Test Reach A. Did the widening near the Rio Vista Bridge help you line up for the bridge on your northbound approach? If you ran any outbound runs through the bridge, was the widening helpful?

YES, DEFINITLY. (NOT SO MUCH BANK SUCTION)

YES, ALSO.

2. Test Reach B. Did the widening on the west near the confluence of Cache Slough, Steamboat Slough, and the Sacramento River help the transit?

YES, IT HELPED ALLEVIATE BANK SUCTION.

3. Test Reach B. Did the widening of Cache Slough, south of buoys 49 and 50 help the transit?

YES, IT DID. I HAD A BIT OF TROUBLE HERE. BUT I PROBABLY WOULD HAVE HAD BETTER LUCK IF I APPROACHED THIS AREA MORE SLOWLY. ON MY SLOWER APPROACHES, I HAD NO PROBLEM.

4. Test Reach B. Did the triangular widening at the confluence of Cache Slough and Miner Slough help you enter the man made canal? Was it helpful for outbound runs?

YES, ON BOTH COUNTS.

5. Did the widening south of the 20 degree bend help make the inbound turn? Was it helpful for outbound runs?

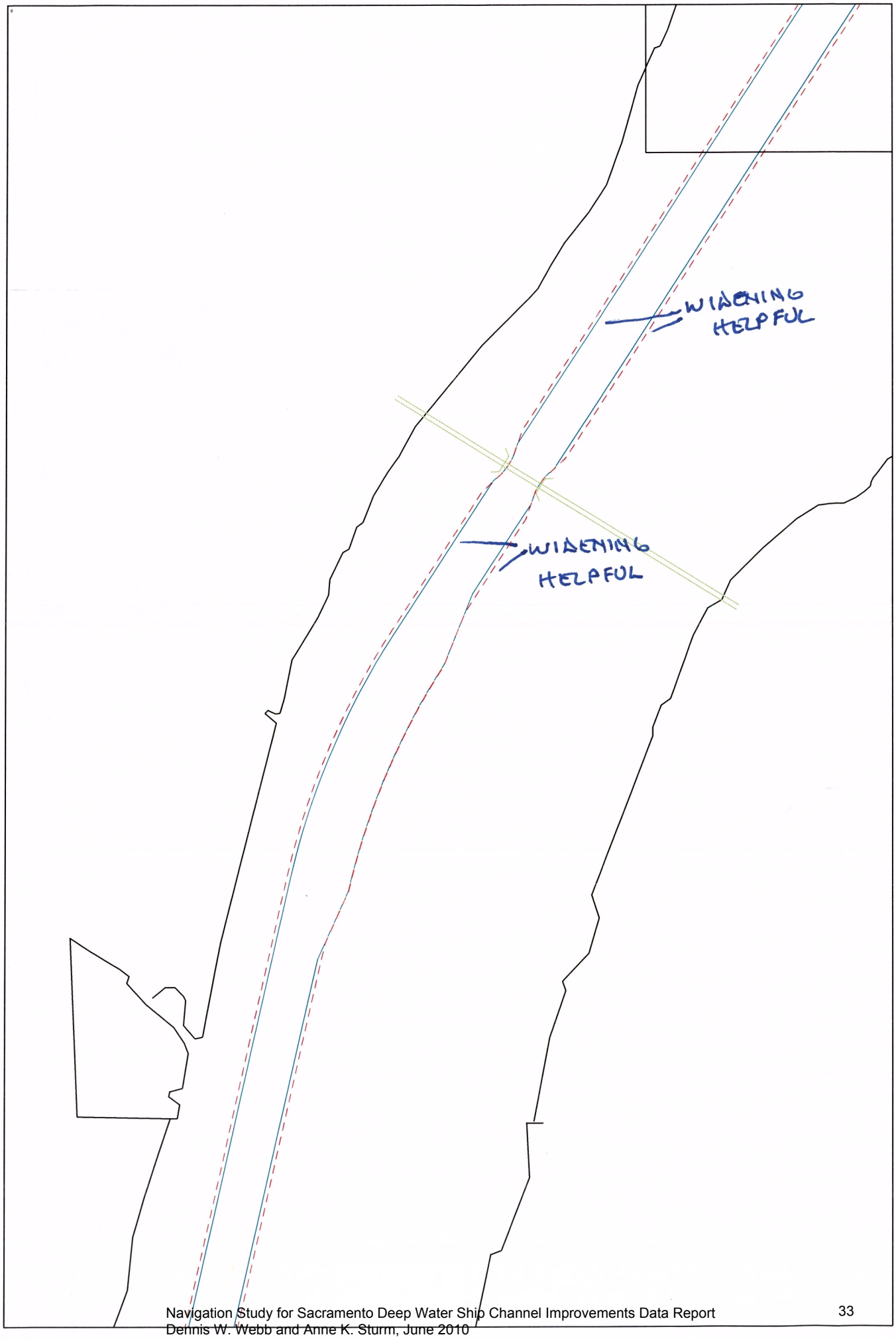
AGAIN, YES ON BOTH.

6. Were the wind, currents and bank effects realistic?

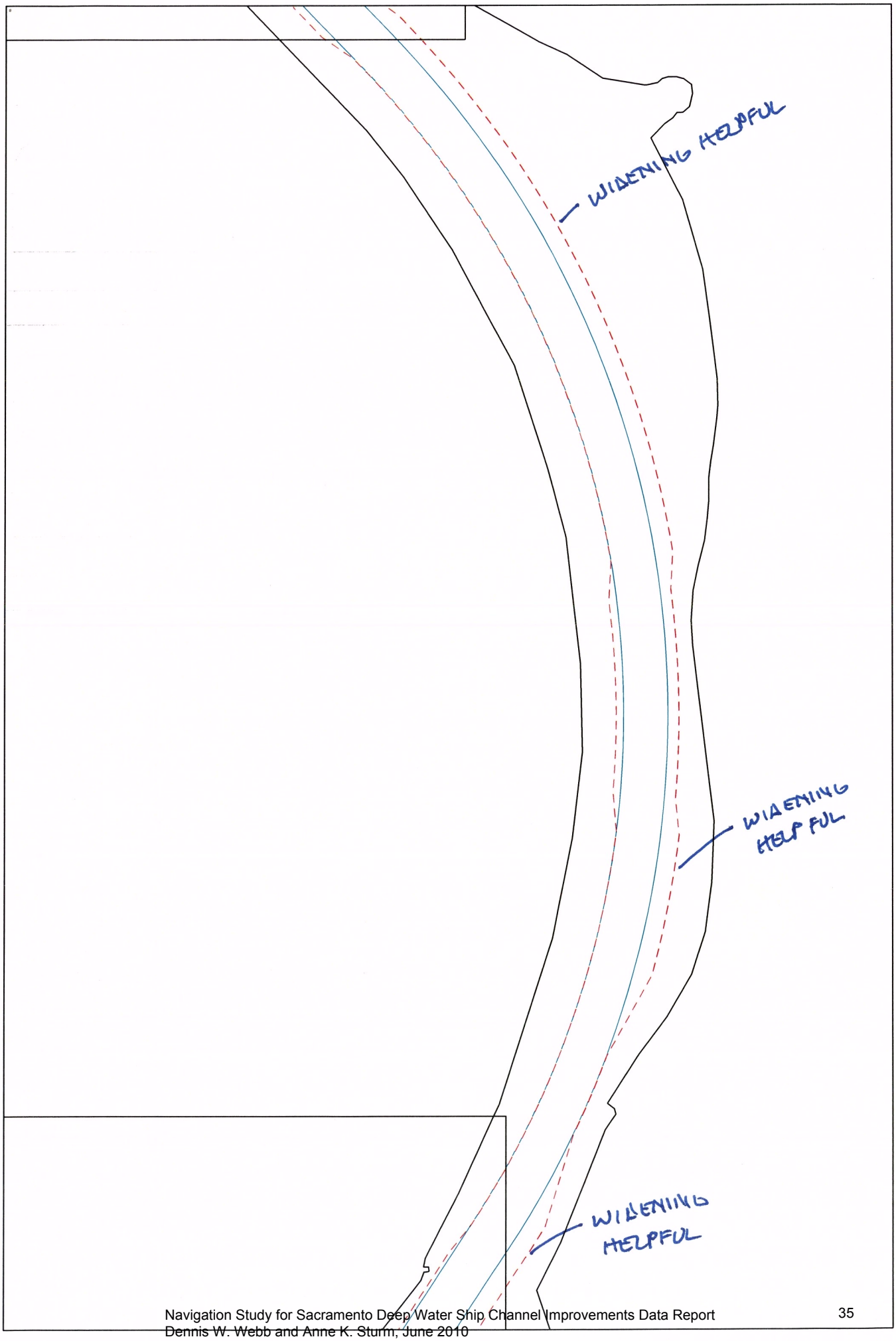
YES, THEY WERE. I WAS VERY IMPRESSED.

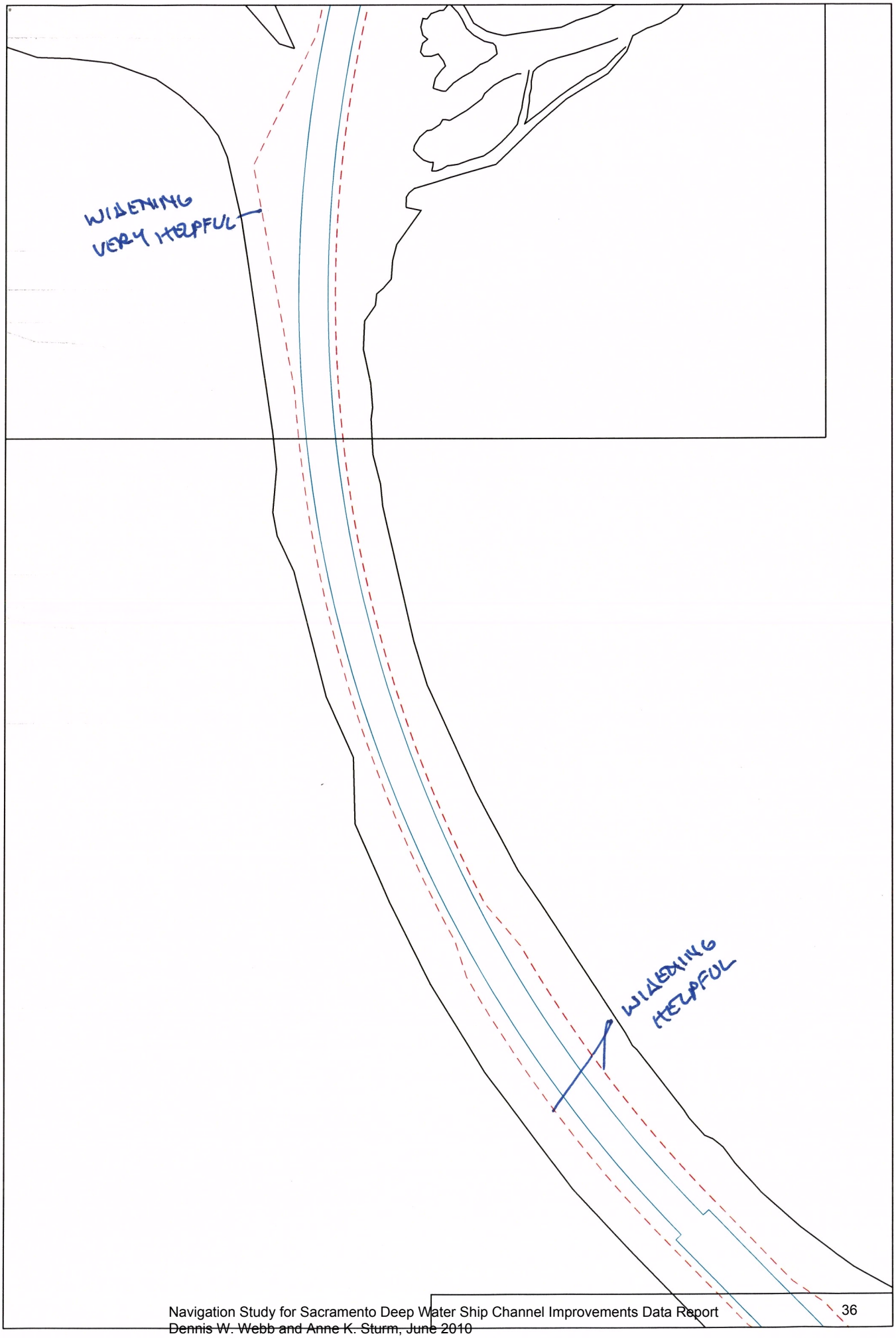
7. Any additional comments?

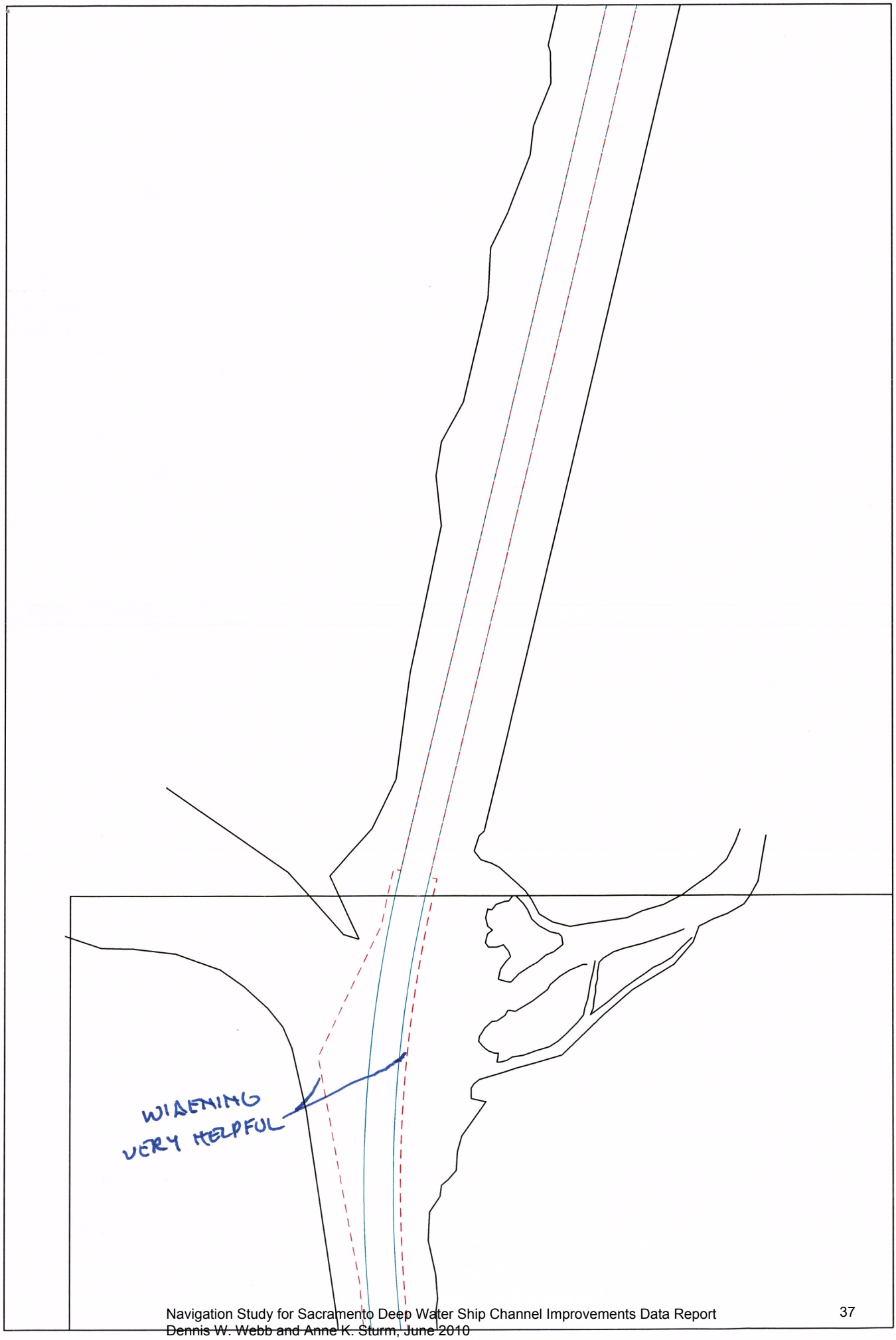
I WAS VERY IMPRESSED WITH ALL THE SIMULATIONS. I FOUND THEM TO BE MOST ACCURATE ABOUT 95% OF THE TIME, WITH REGARDS TO CURRENT, WIND, BANK SUCTION, BOW CUSHION, STEERAGE, AND LANDSCAPE.

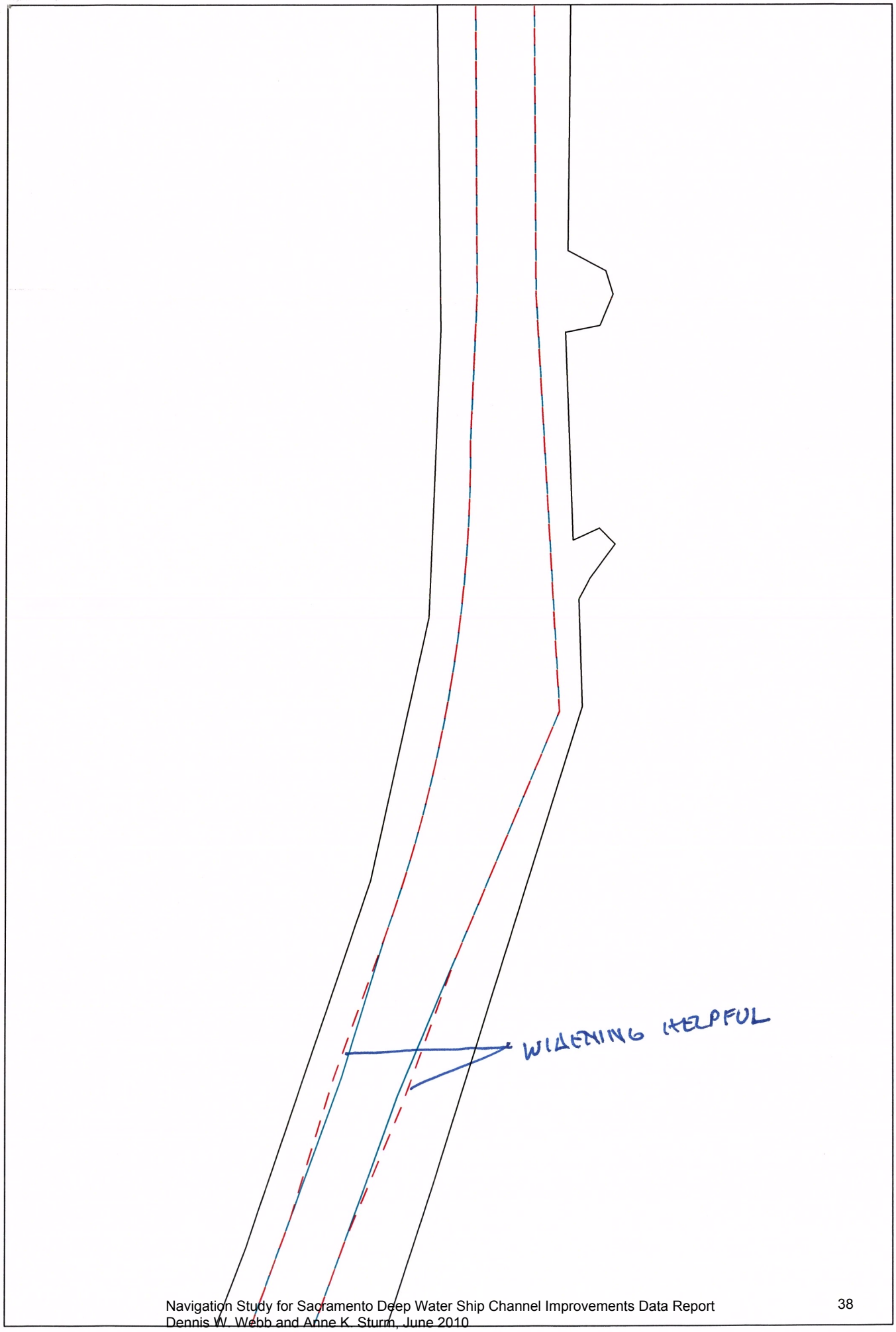

WIDENING
HELPFUL
WIDENING
HELPFUL


WIDENING
VERY HELPFUL

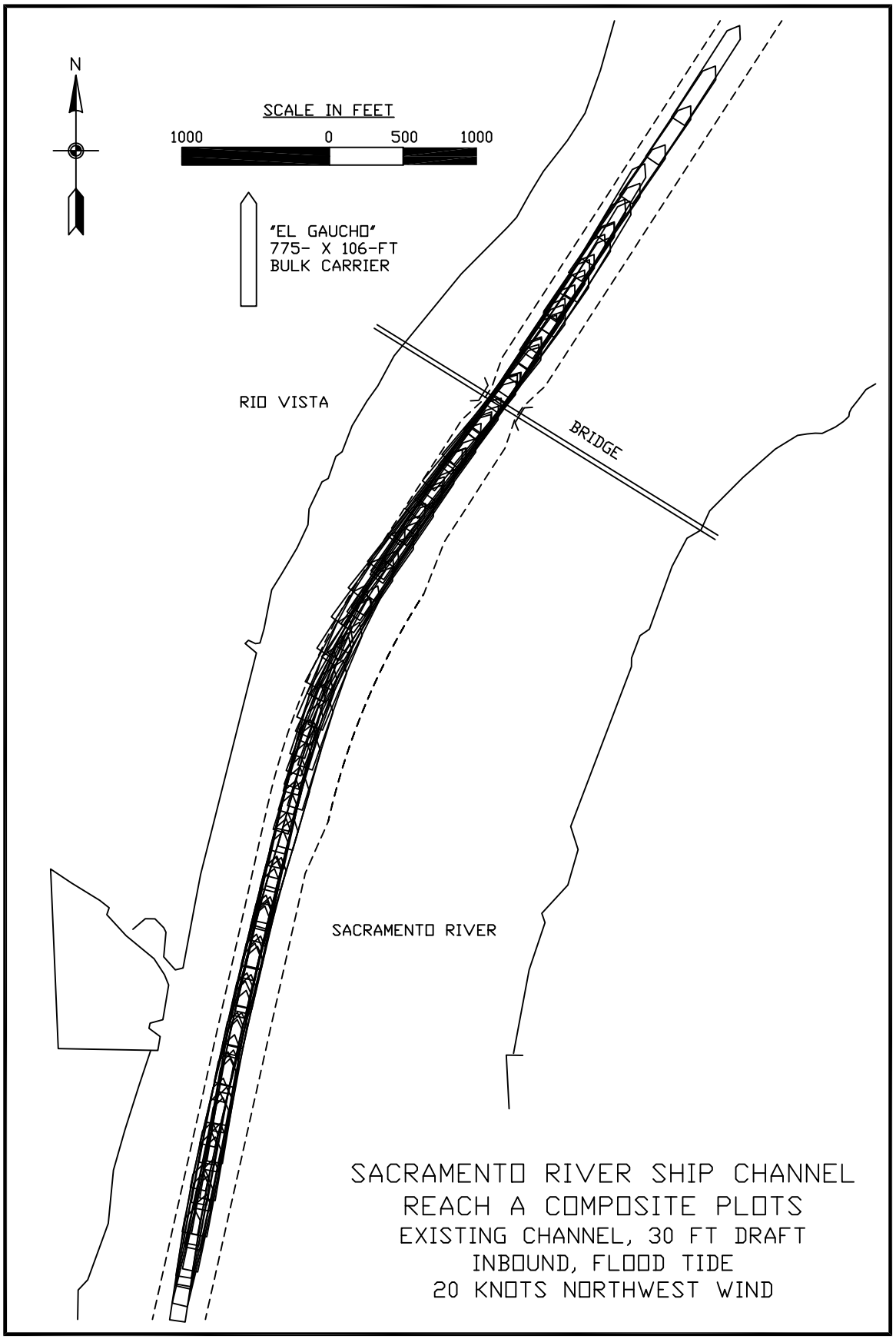

WIDENING HELPFUL
WIDENING HELPFUL
WIDENING HELPFUL


WIDENING
VERY HELPFUL
WIDENING
HELPFUL


WIDENING
VERY HELPFUL


WIDENING HELPFUL

APPENDIX B
PLATES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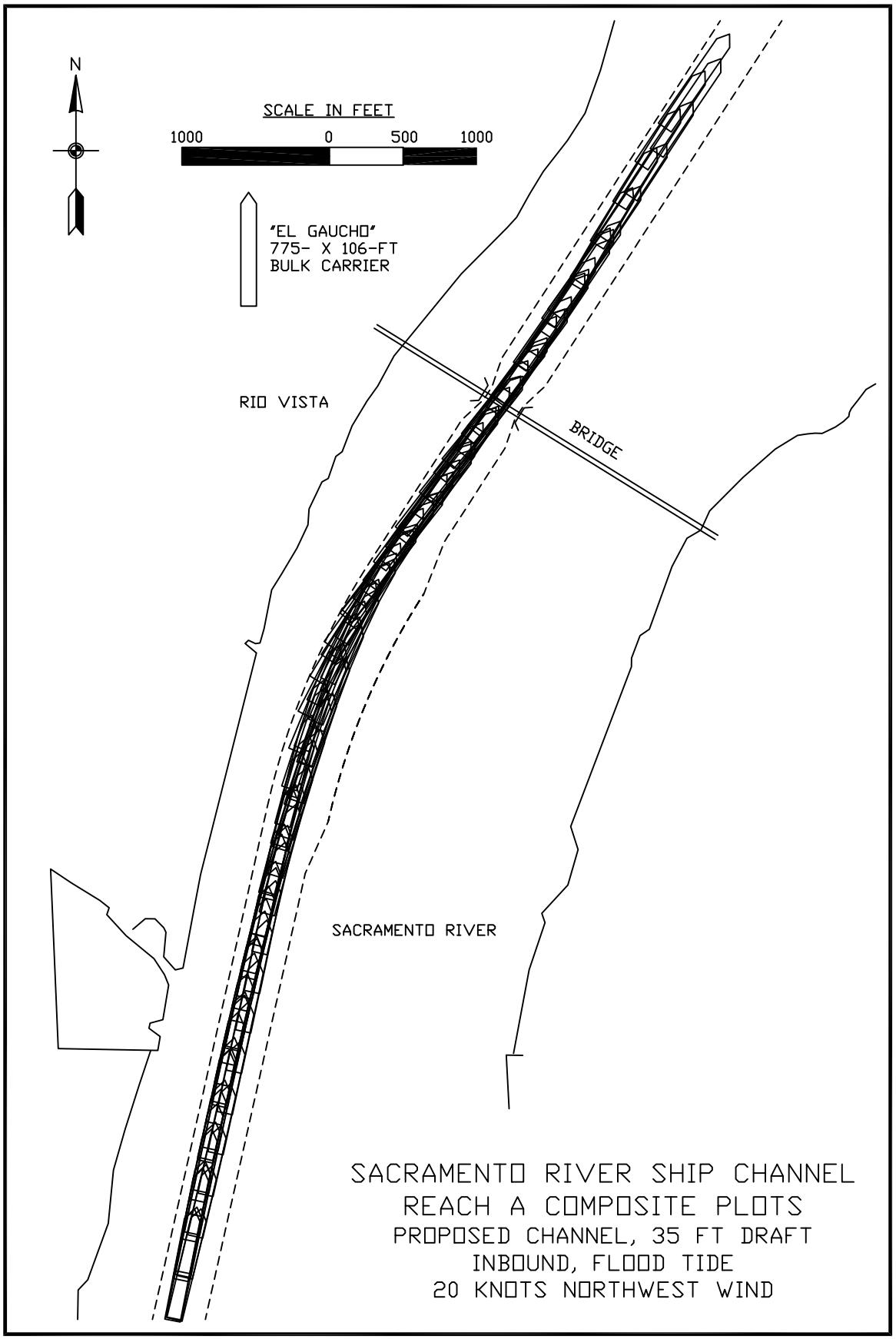
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
RIO VISTA
BRIDGE
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH A COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, FLOOD TIDE
20 KNOTS NORTHWEST WIND

PLATE 1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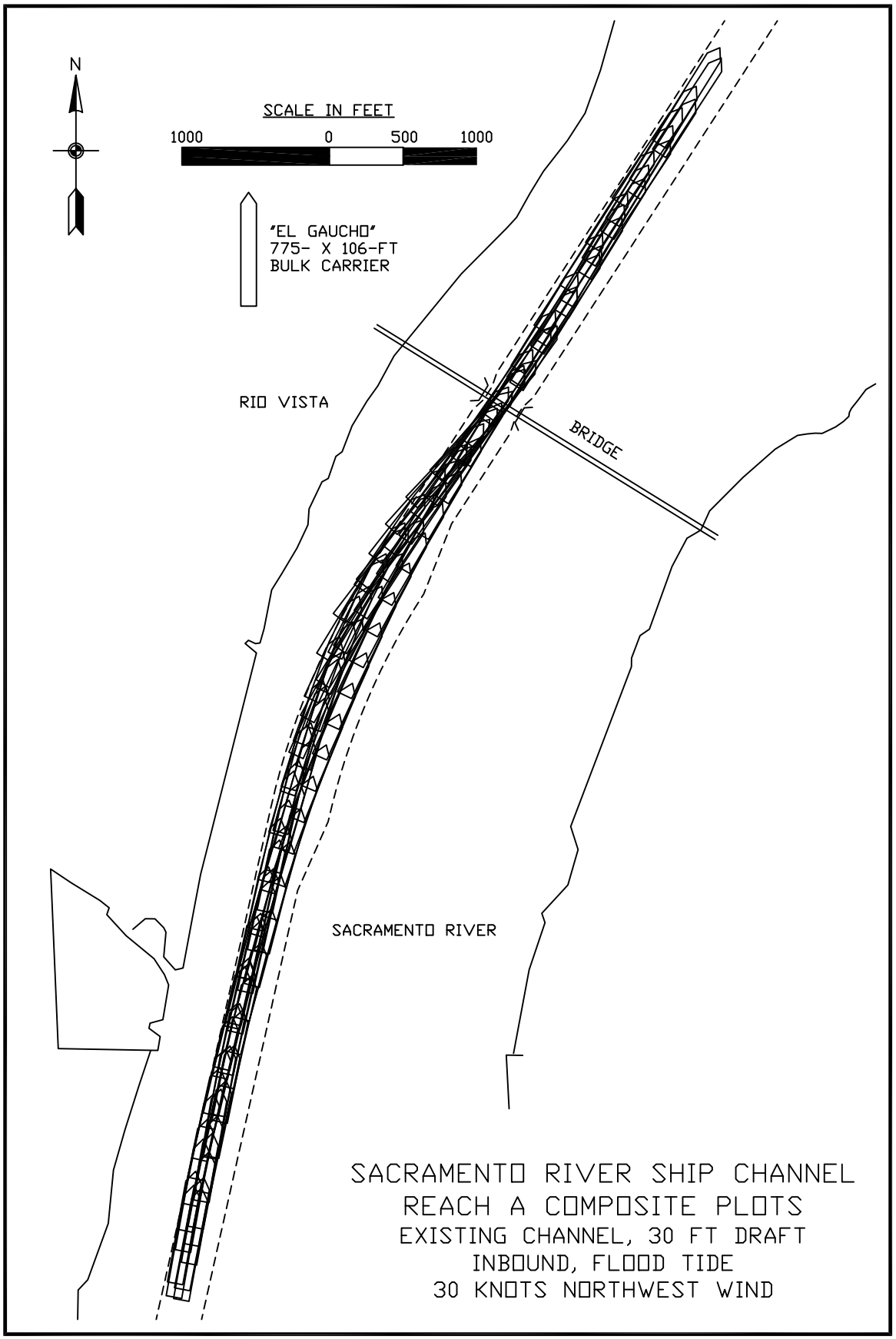
RIO VISTA
BRIDGE
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH A COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, FLOOD TIDE
20 KNOTS NORTHWEST WIND

PLATE 2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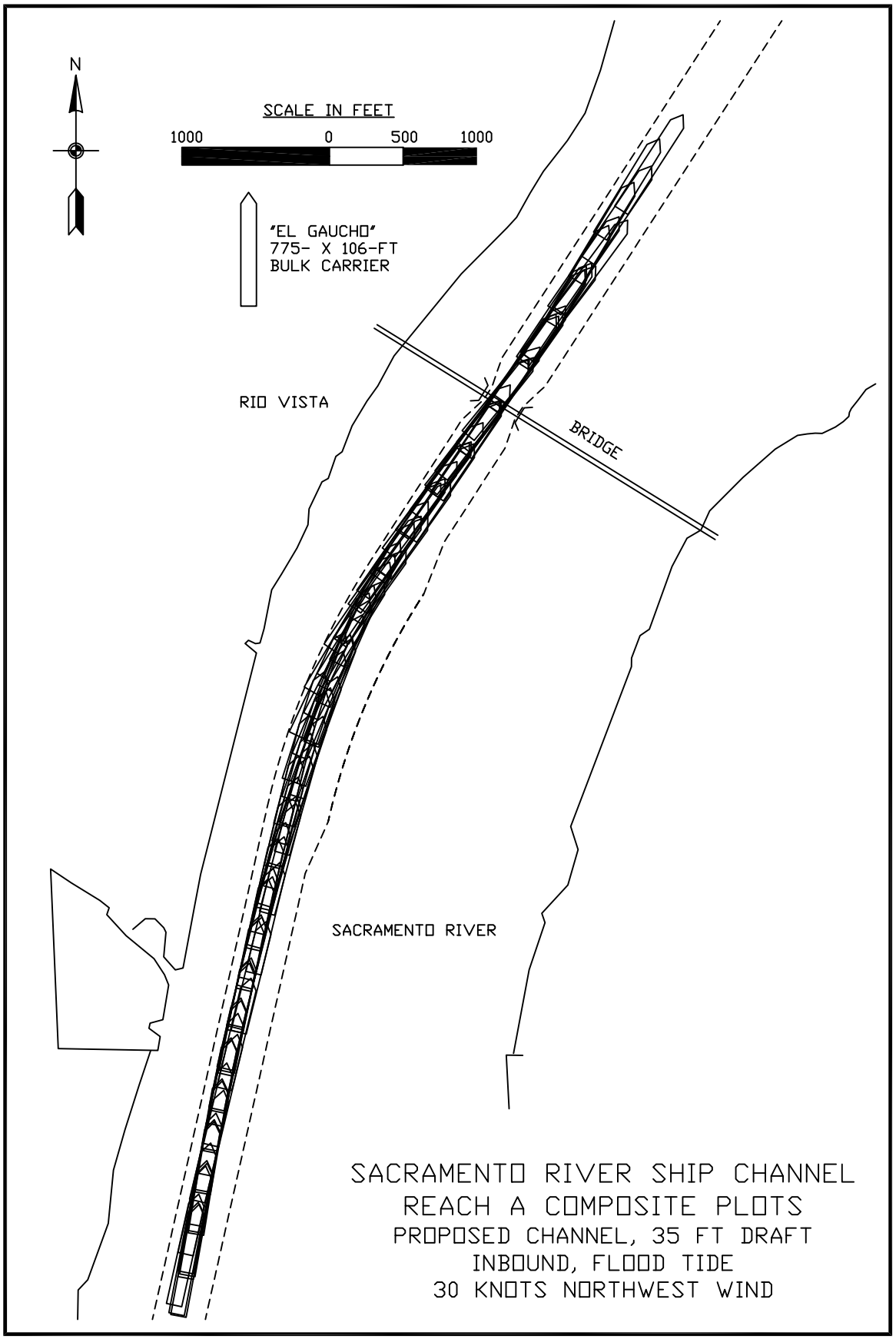
RIO VISTA
BRIDGE
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH A COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, FLOOD TIDE
30 KNOTS NORTHWEST WIND

PLATE 3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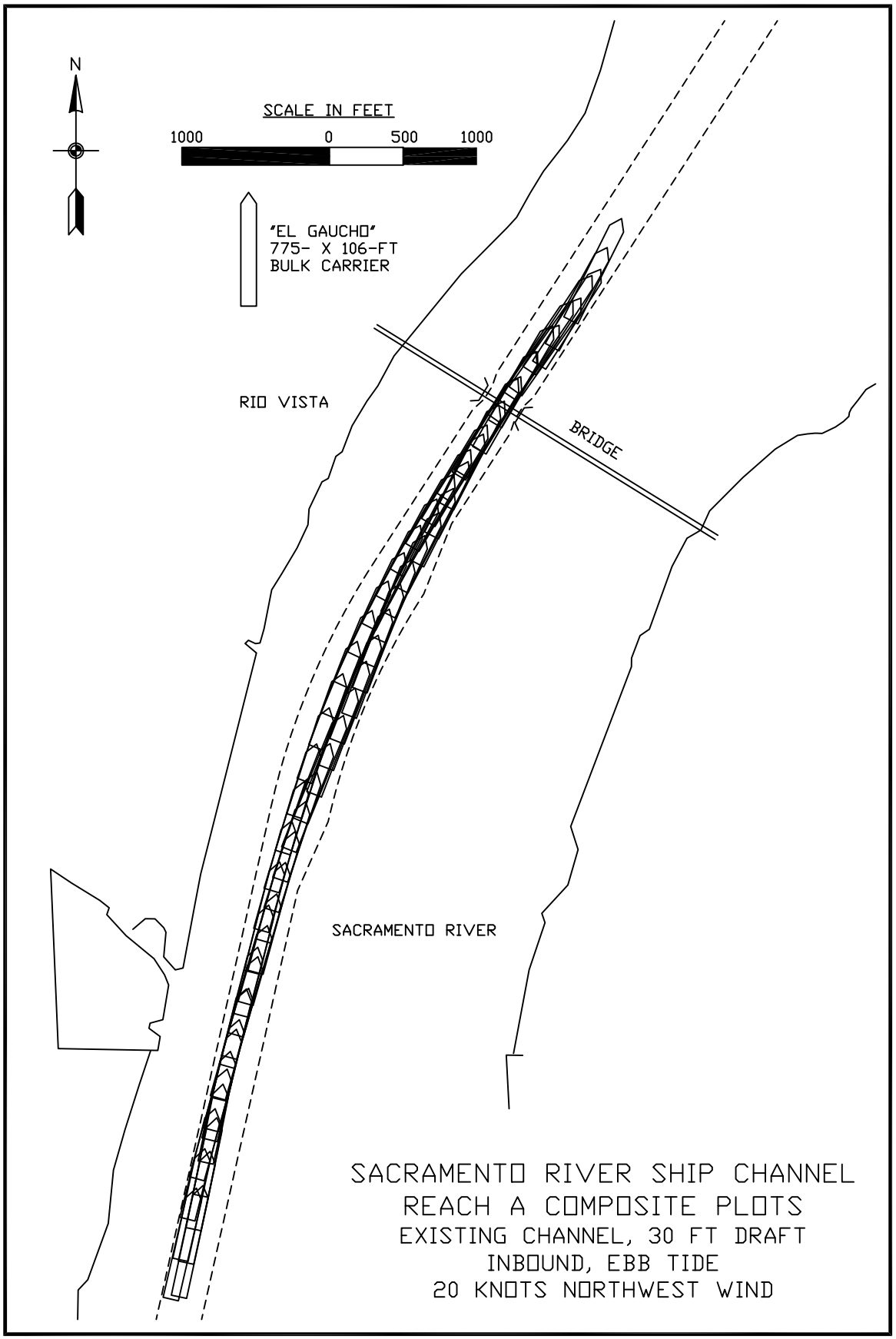
RIO VISTA
BRIDGE
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH A COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, FLOOD TIDE
30 KNOTS NORTHWEST WIND

PLATE 4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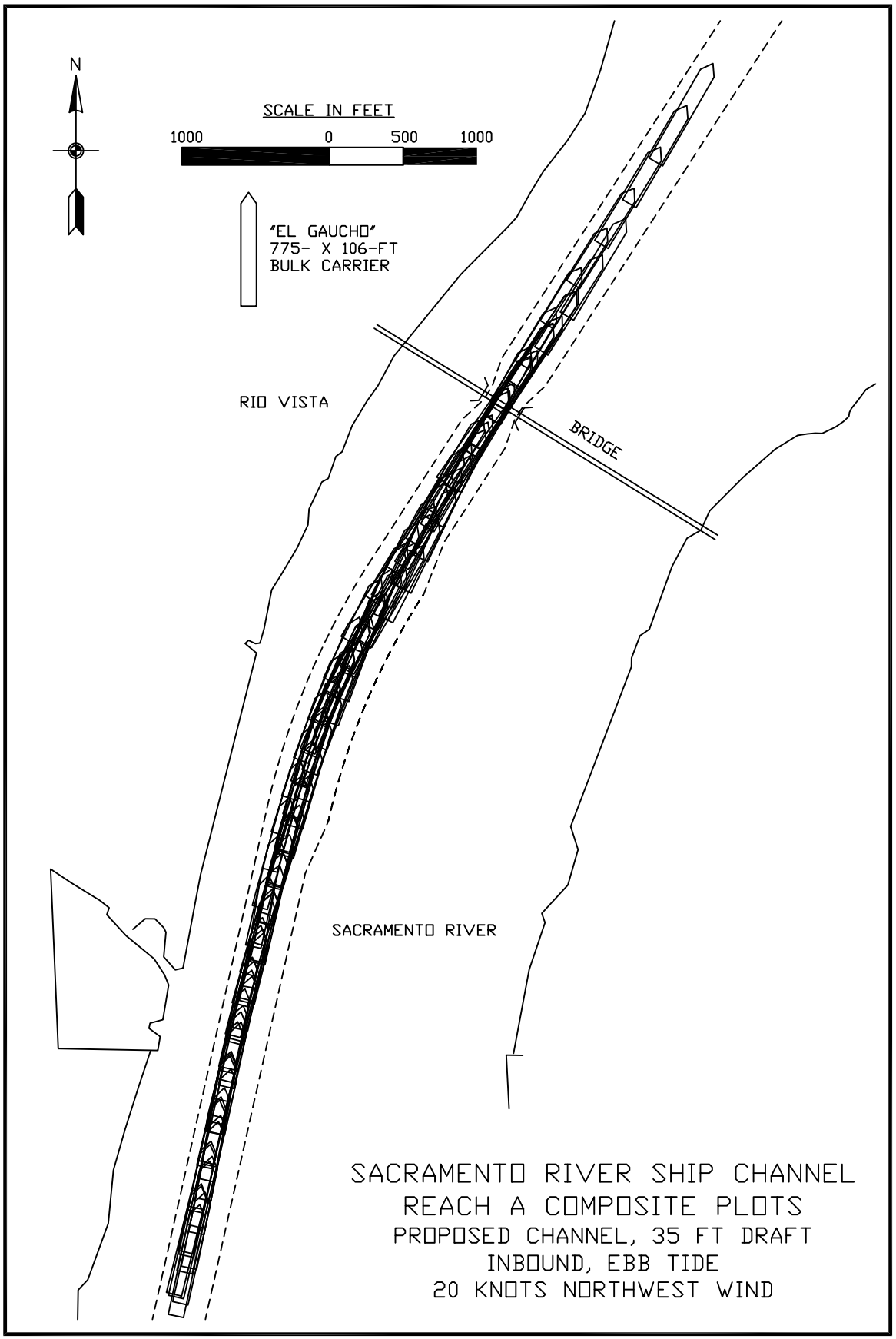
RIO VISTA
BRIDGE
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH A COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, EBB TIDE
20 KNOTS NORTHWEST WIND

PLATE 5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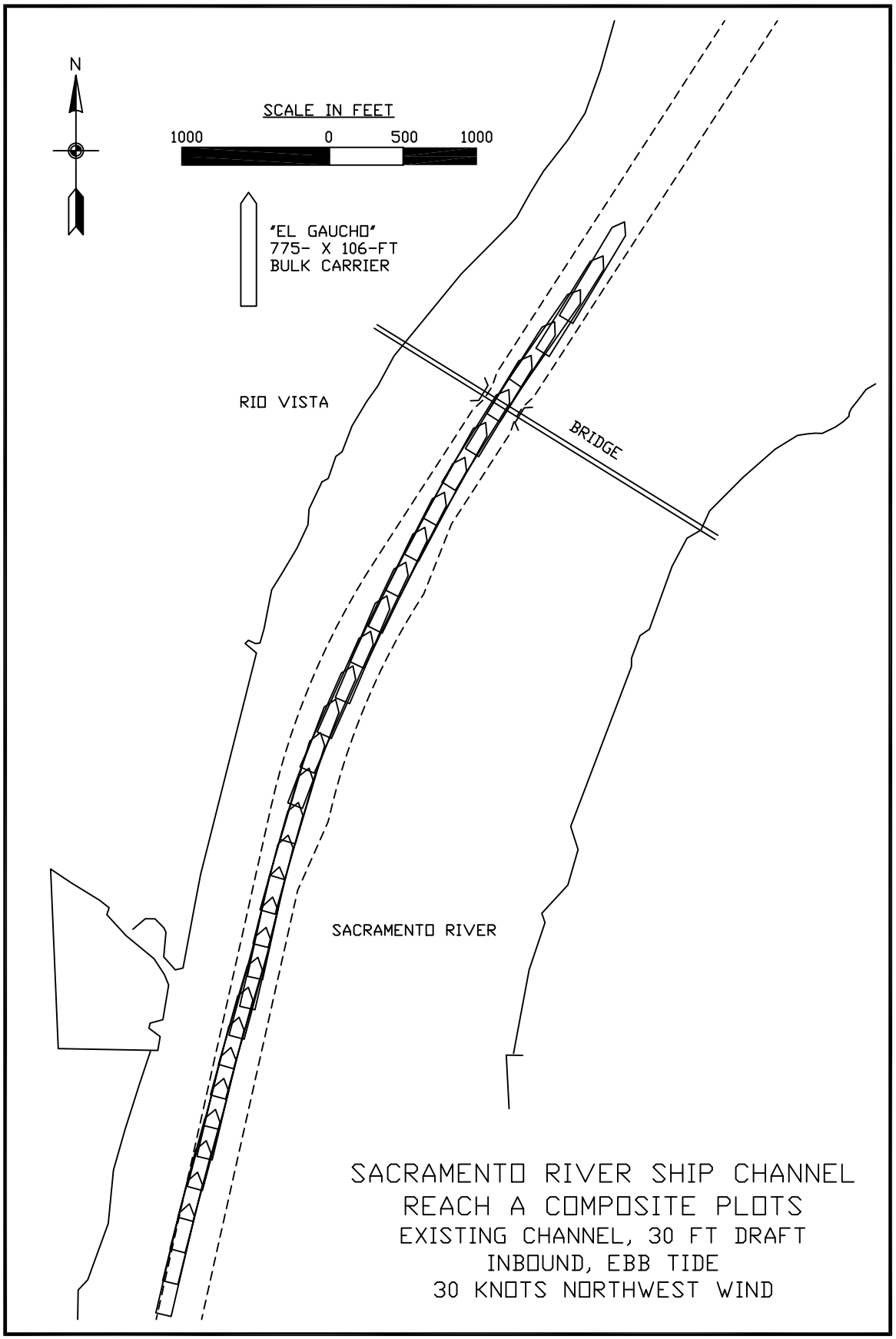
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH A COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, EBB TIDE
20 KNOTS NORTHWEST WIND

PLATE 6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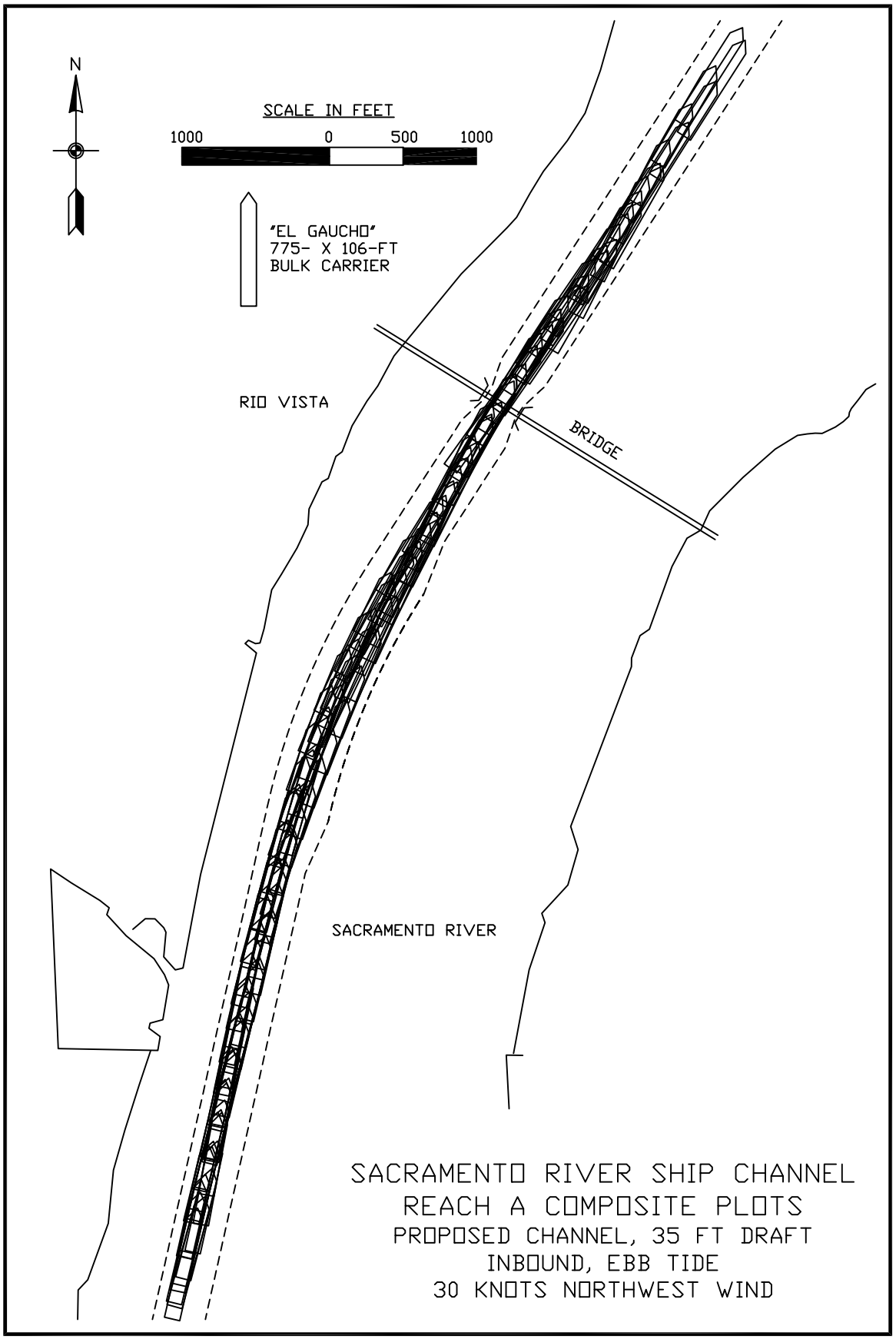
BULK CARRIER
RIO VISTA
BRIDGE
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH A COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, EBB TIDE
30 KNOTS NORTHWEST WIND

PLATE 7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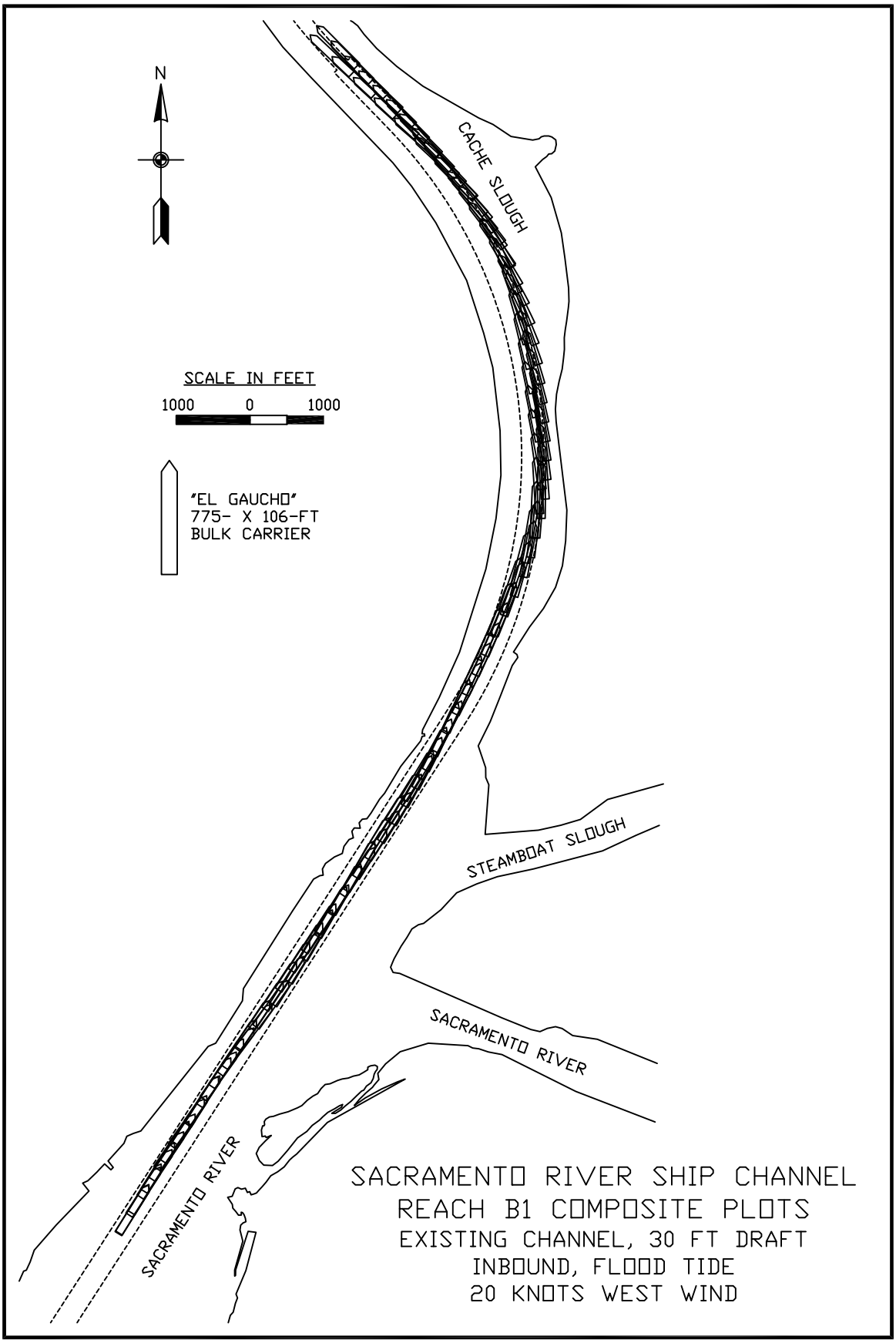
RIO VISTA
BRIDGE
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH A COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, EBB TIDE
30 KNOTS NORTHWEST WIND

PLATE 8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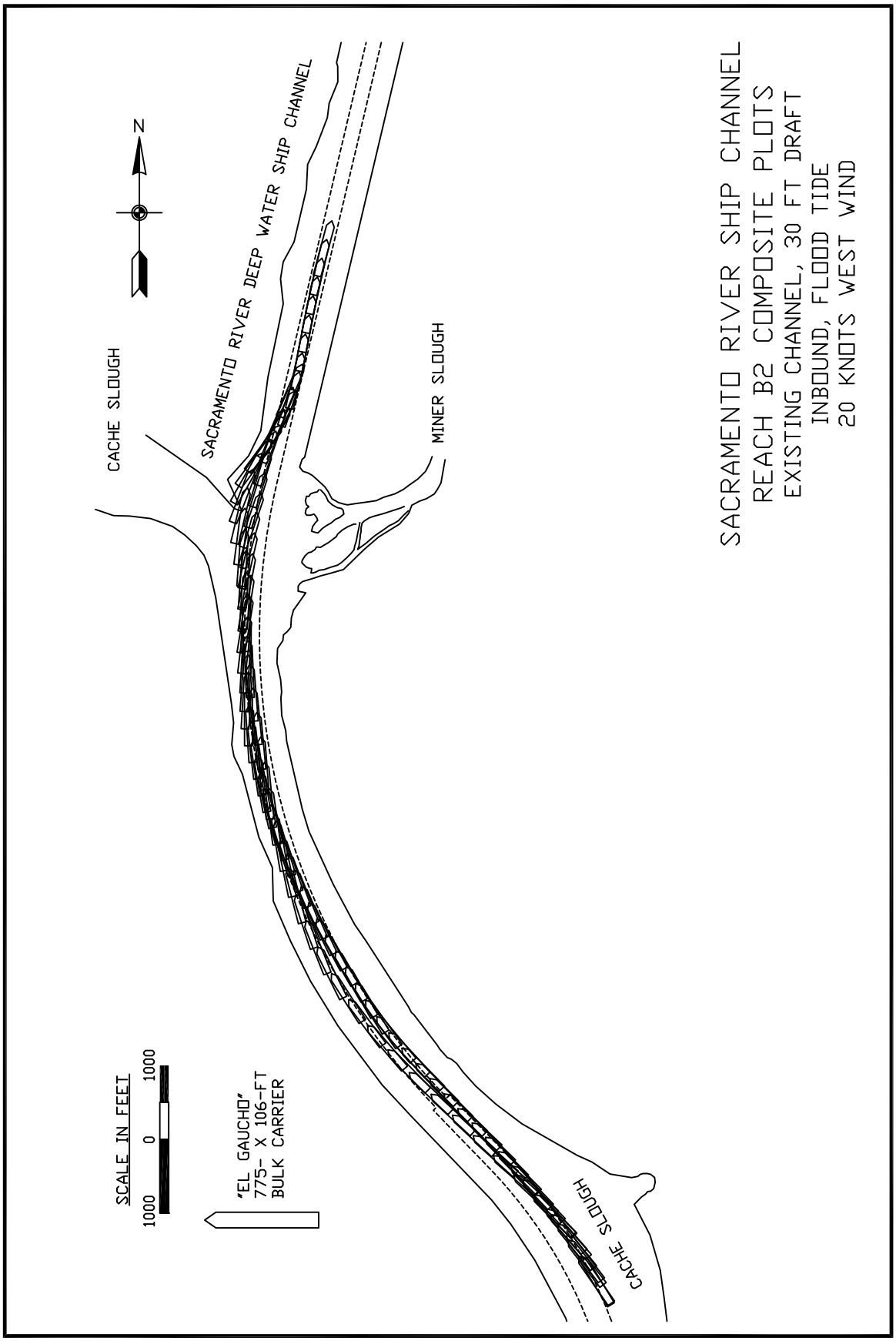
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, FLOOD TIDE
20 KNOTS WEST WIND

PLATE 9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REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, FLOOD TIDE
20 KNOTS WEST WIND
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SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
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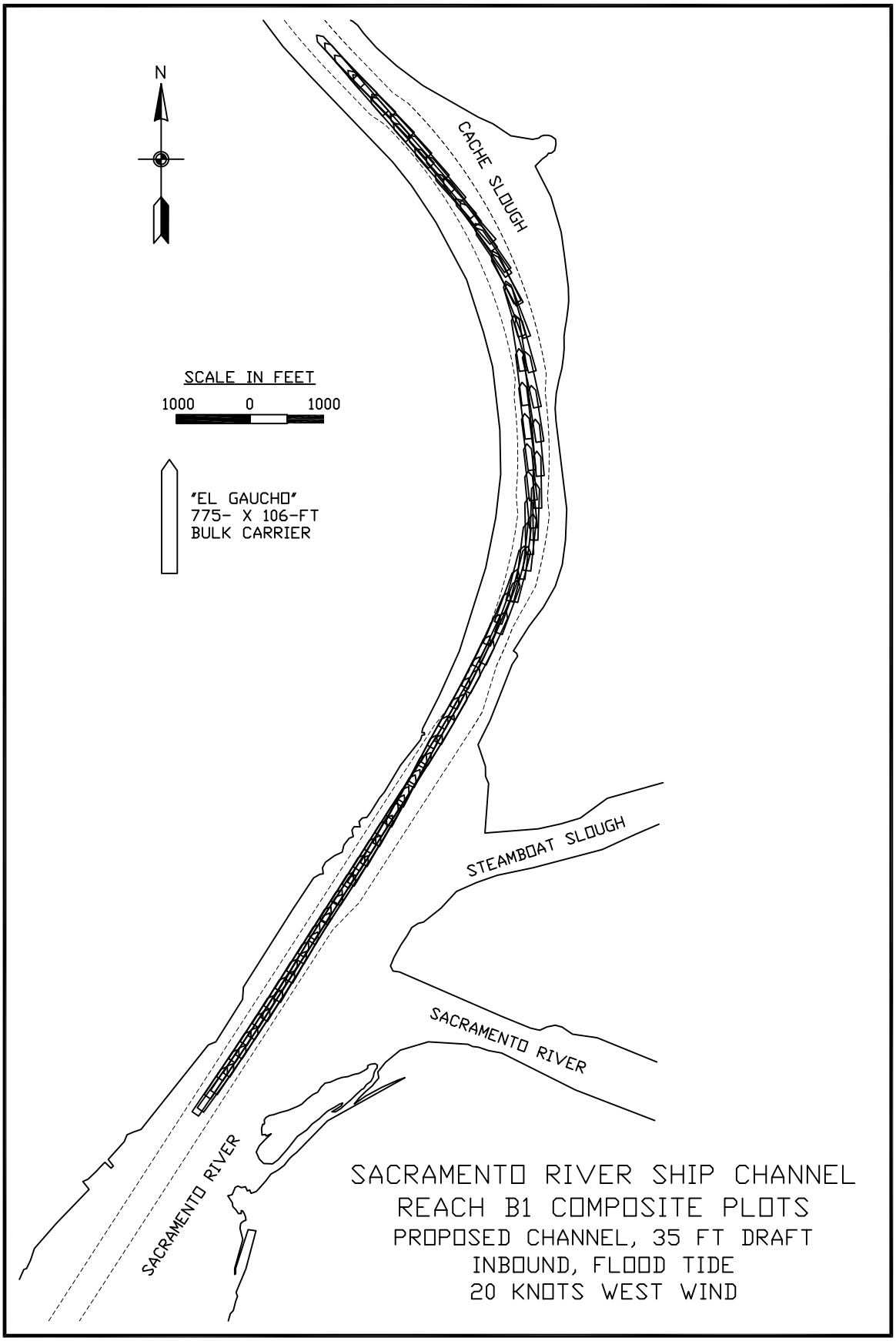
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 10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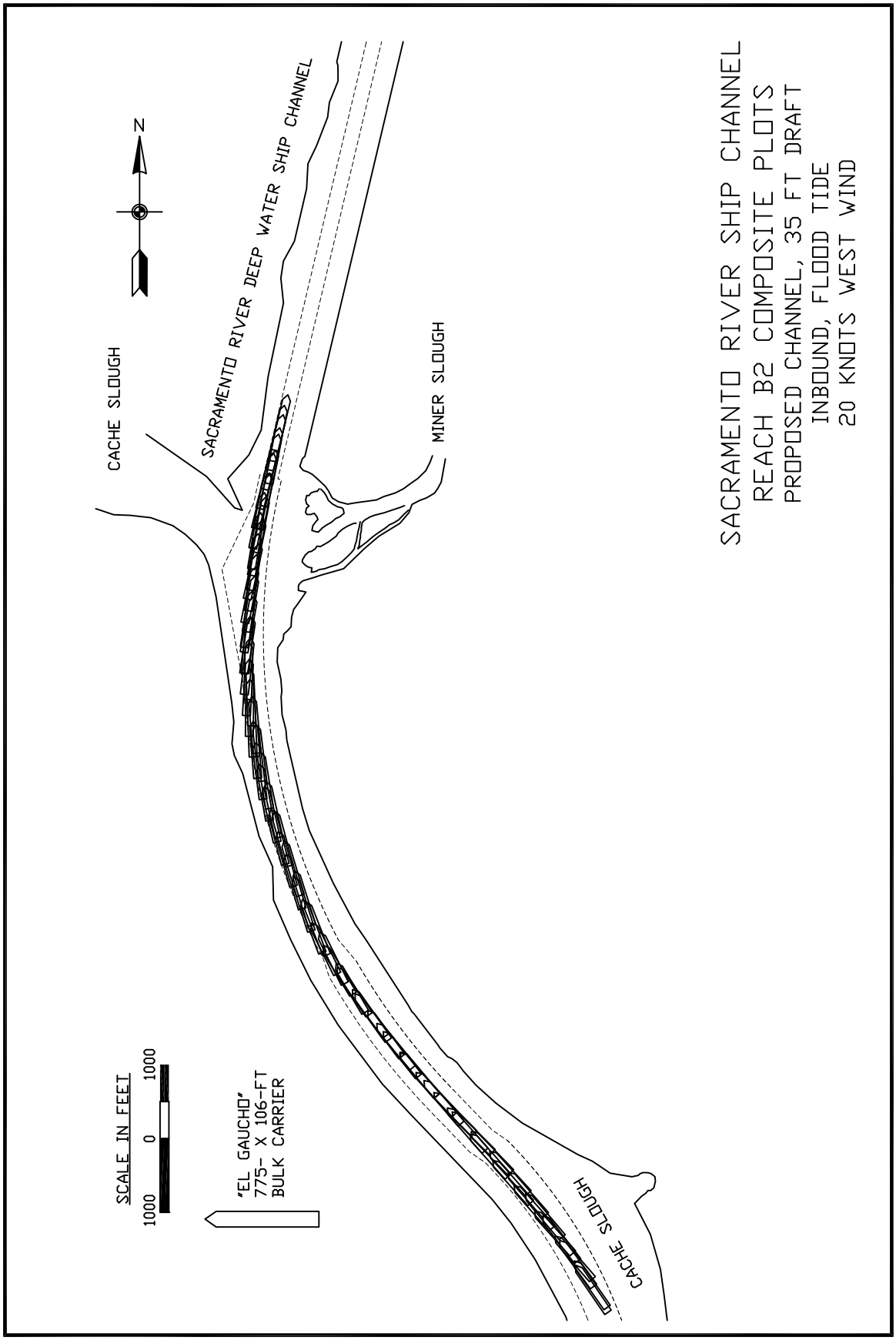
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, FLOOD TIDE
20 KNOTS WEST WIND

PLATE 11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REACH B2 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, FLOOD TIDE
20 KNOTS WEST WIND
N
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SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
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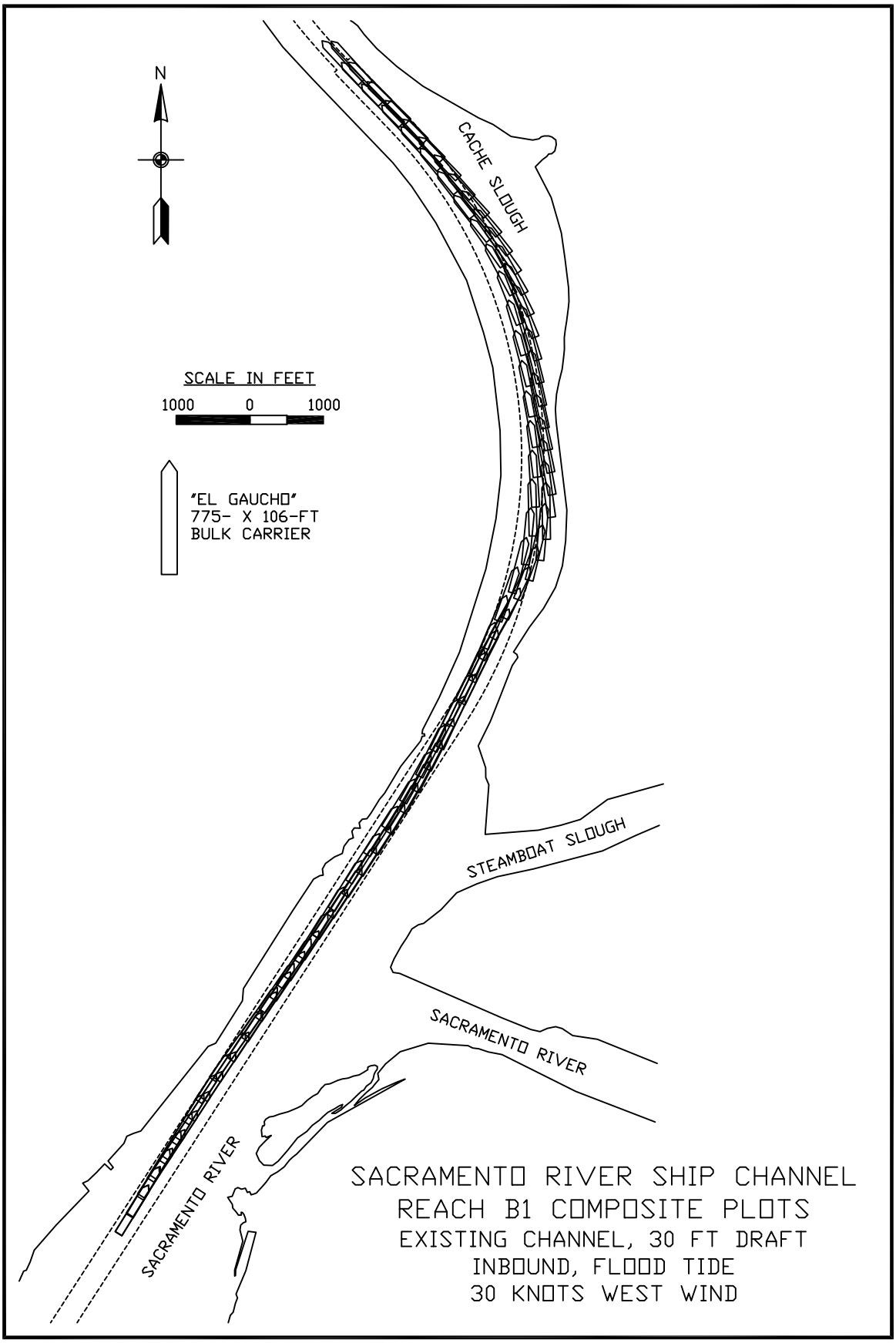
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 12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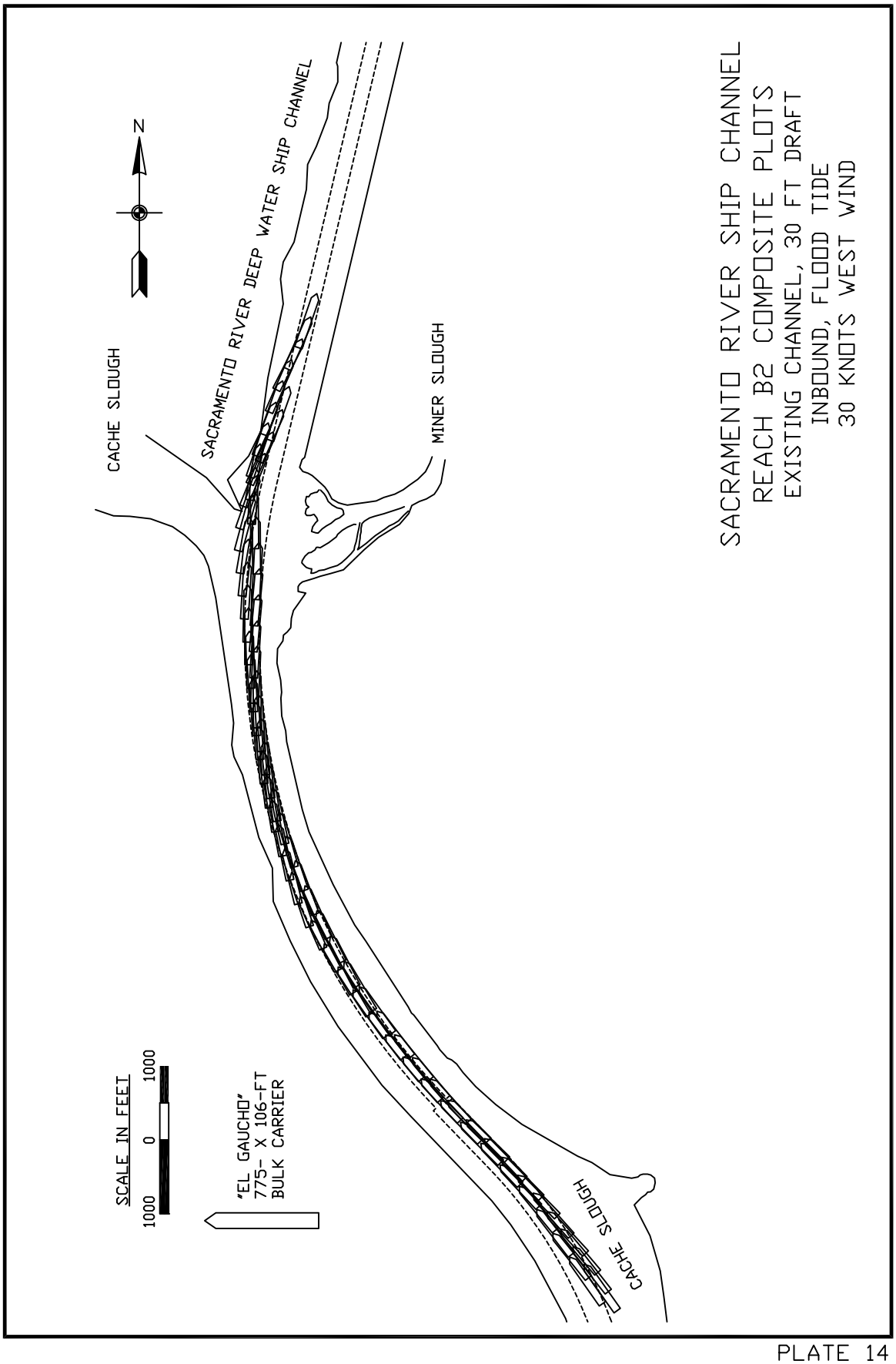
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, FLOOD TIDE
30 KNOTS WEST WIND

PLATE 13


SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, FLOOD TIDE
30 KNOTS WEST WIND
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CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
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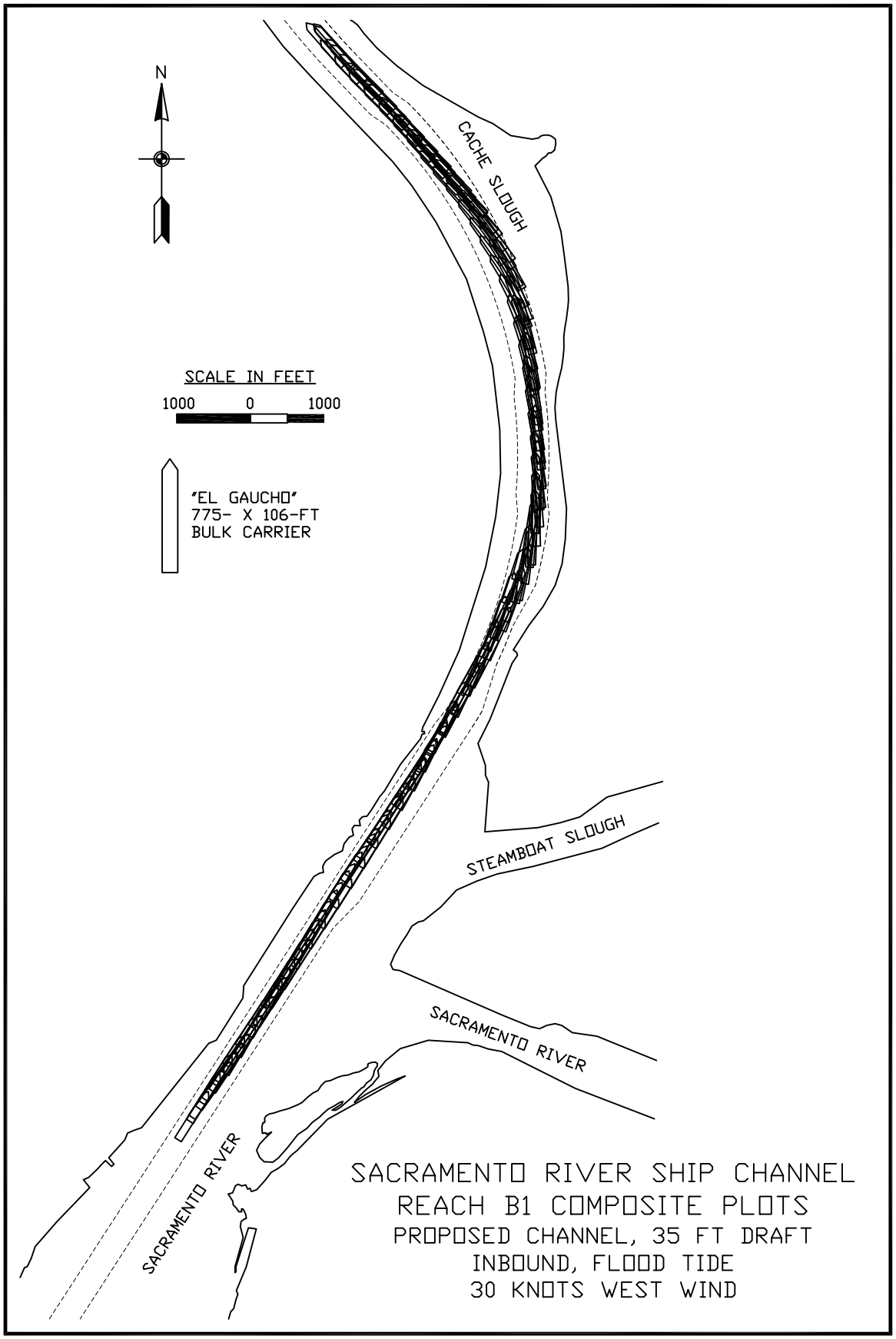
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 14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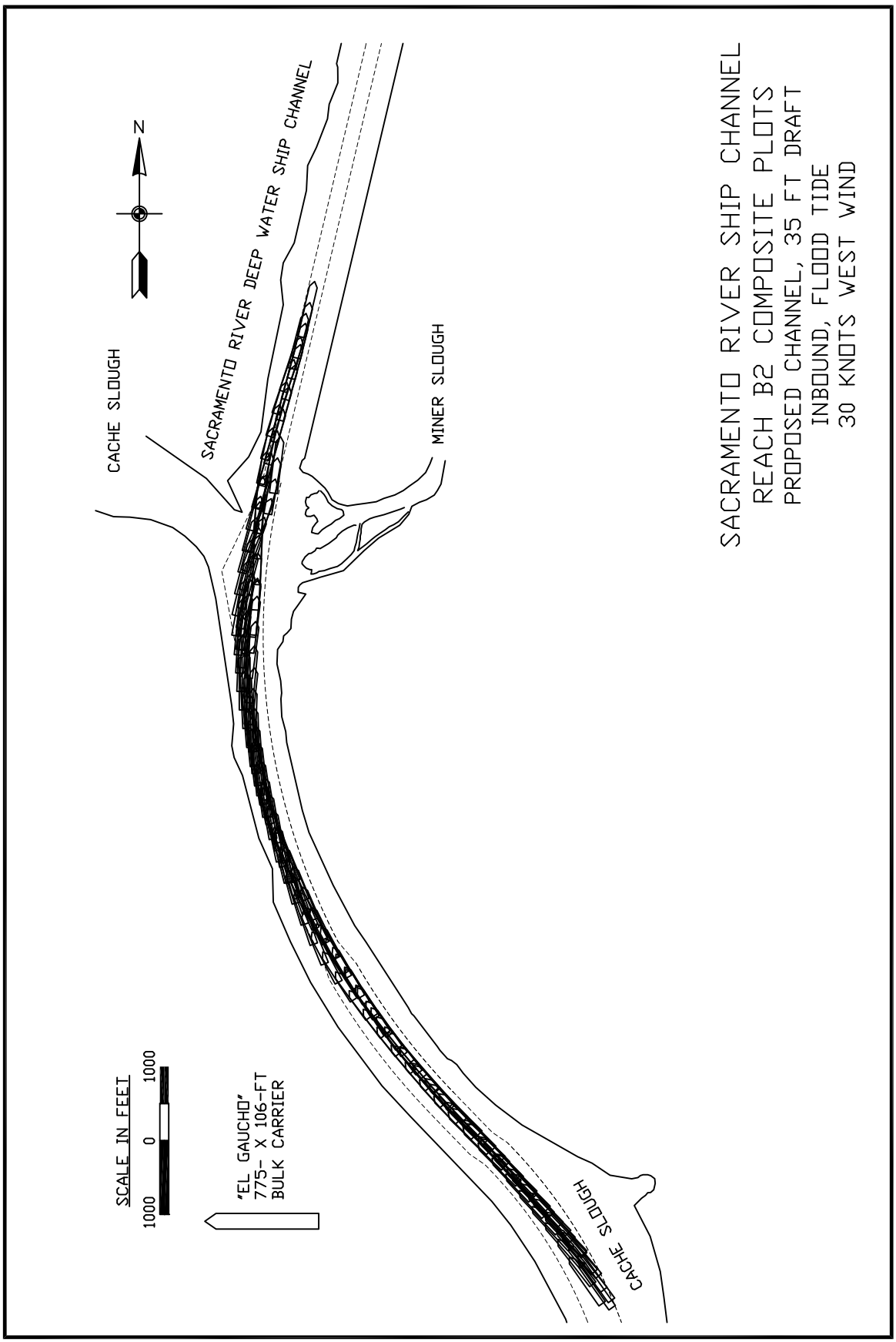
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, FLOOD TIDE
30 KNOTS WEST WIND

PLATE 15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REACH B2 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, FLOOD TIDE
30 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
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775- X 106-FT
BULK CARRIER
SCALE IN FEET
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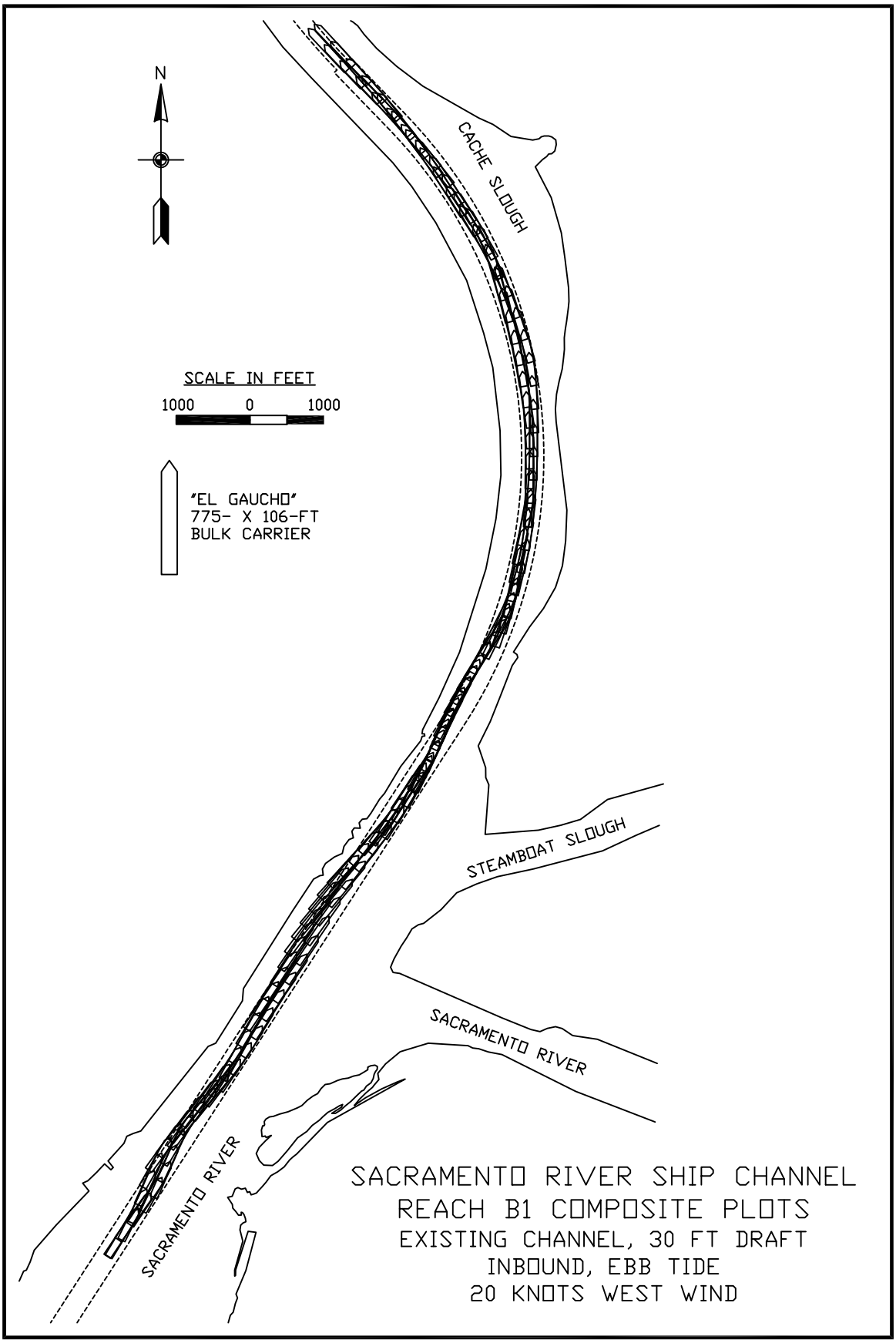
PLATE 16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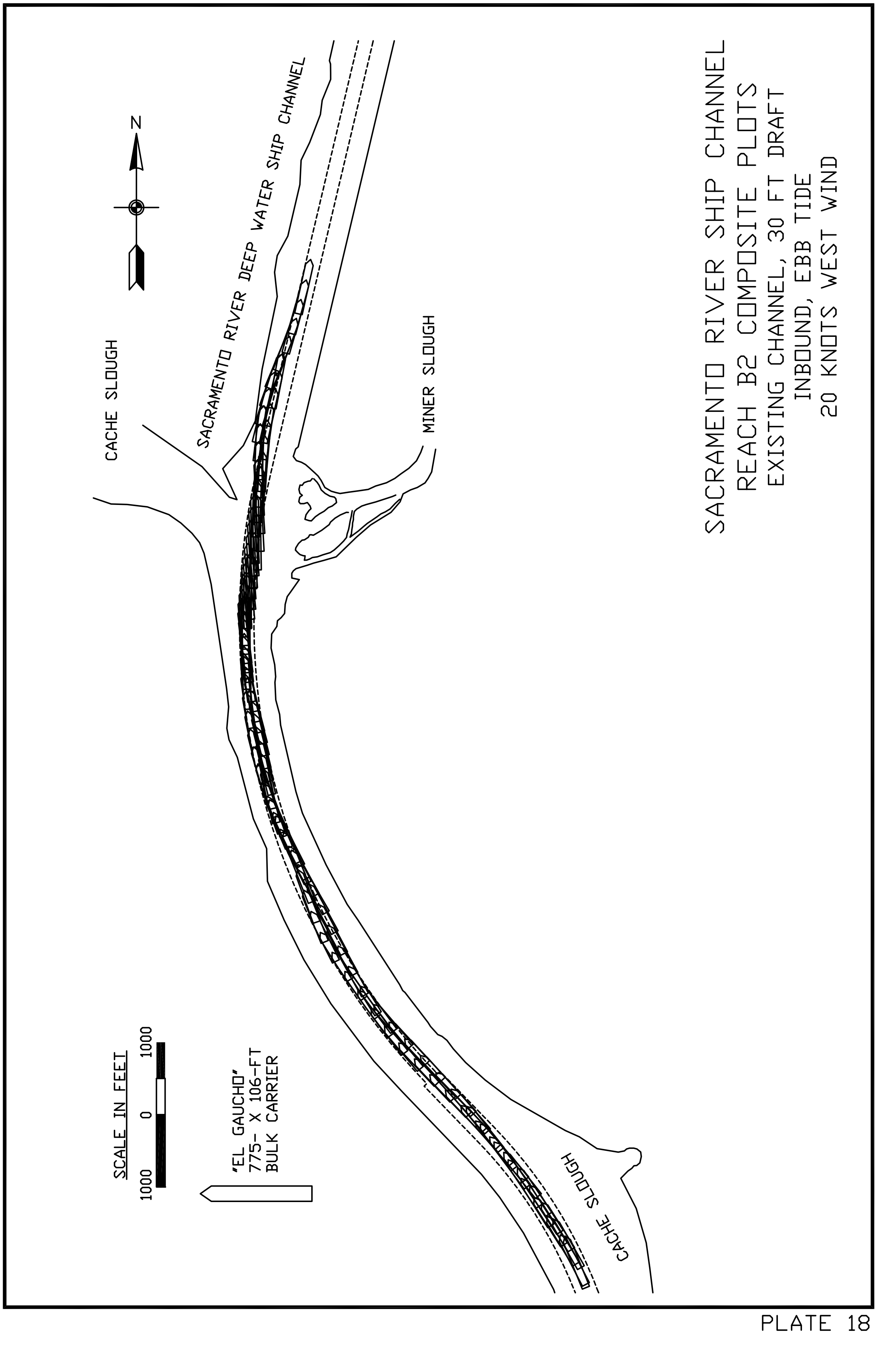
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, EBB TIDE
20 KNOTS WEST WIND

PLATE 17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REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, EBB TIDE
20 KNOTS WEST WIND
N
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
CACHE SLOUGH
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
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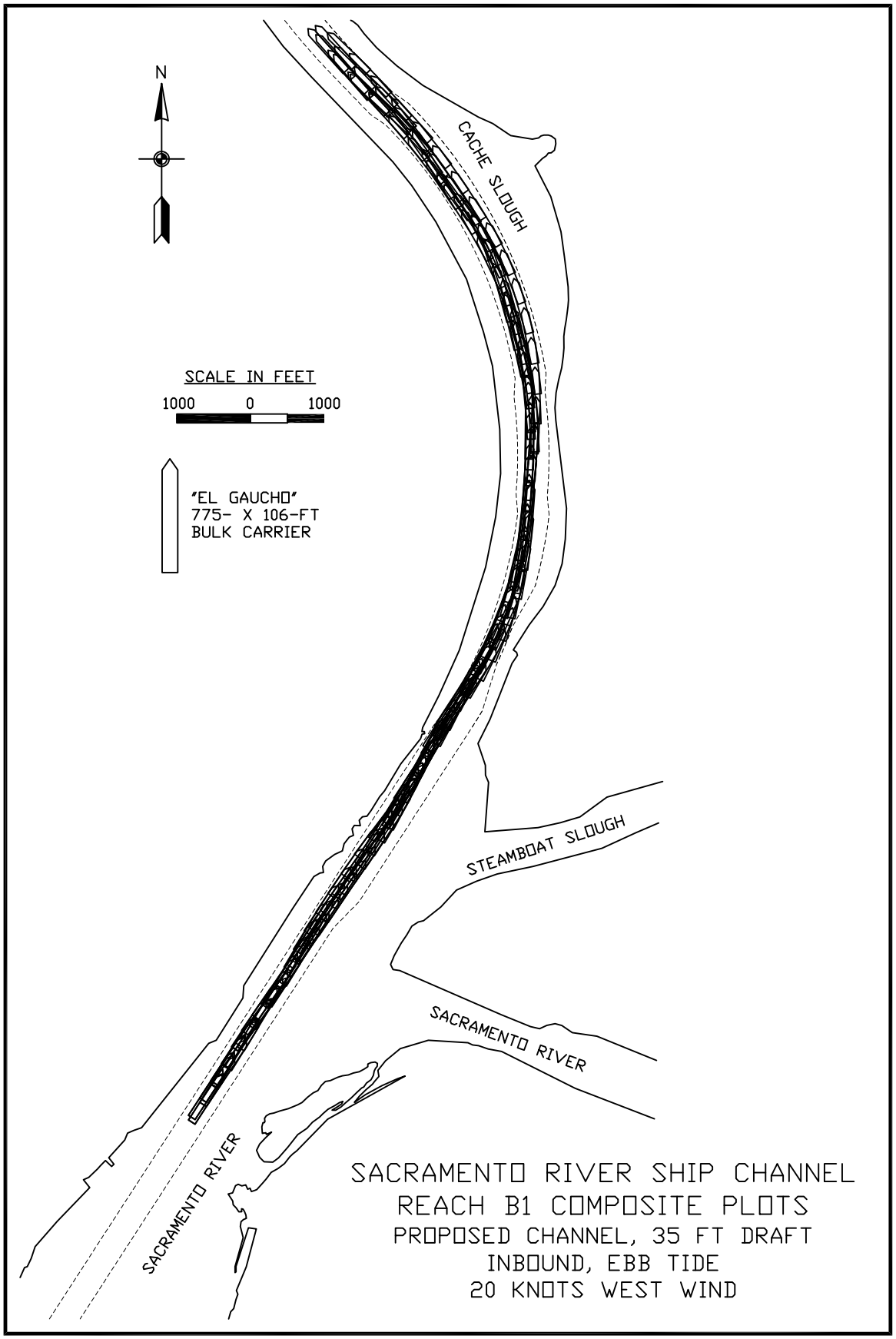
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 18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BULK CARRIER
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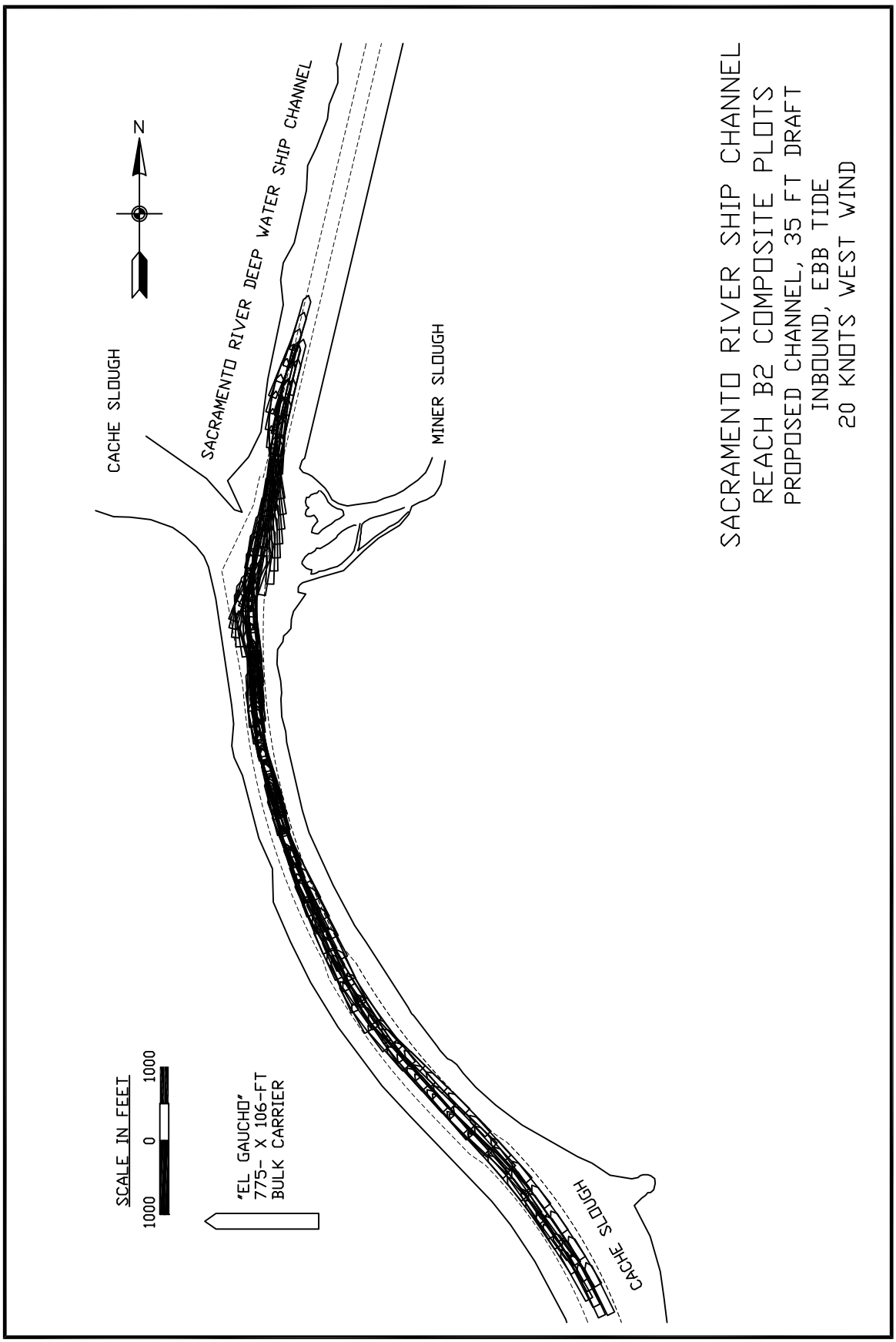
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, EBB TIDE
20 KNOTS WEST WIND

PLATE 19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PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, EBB TIDE
20 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
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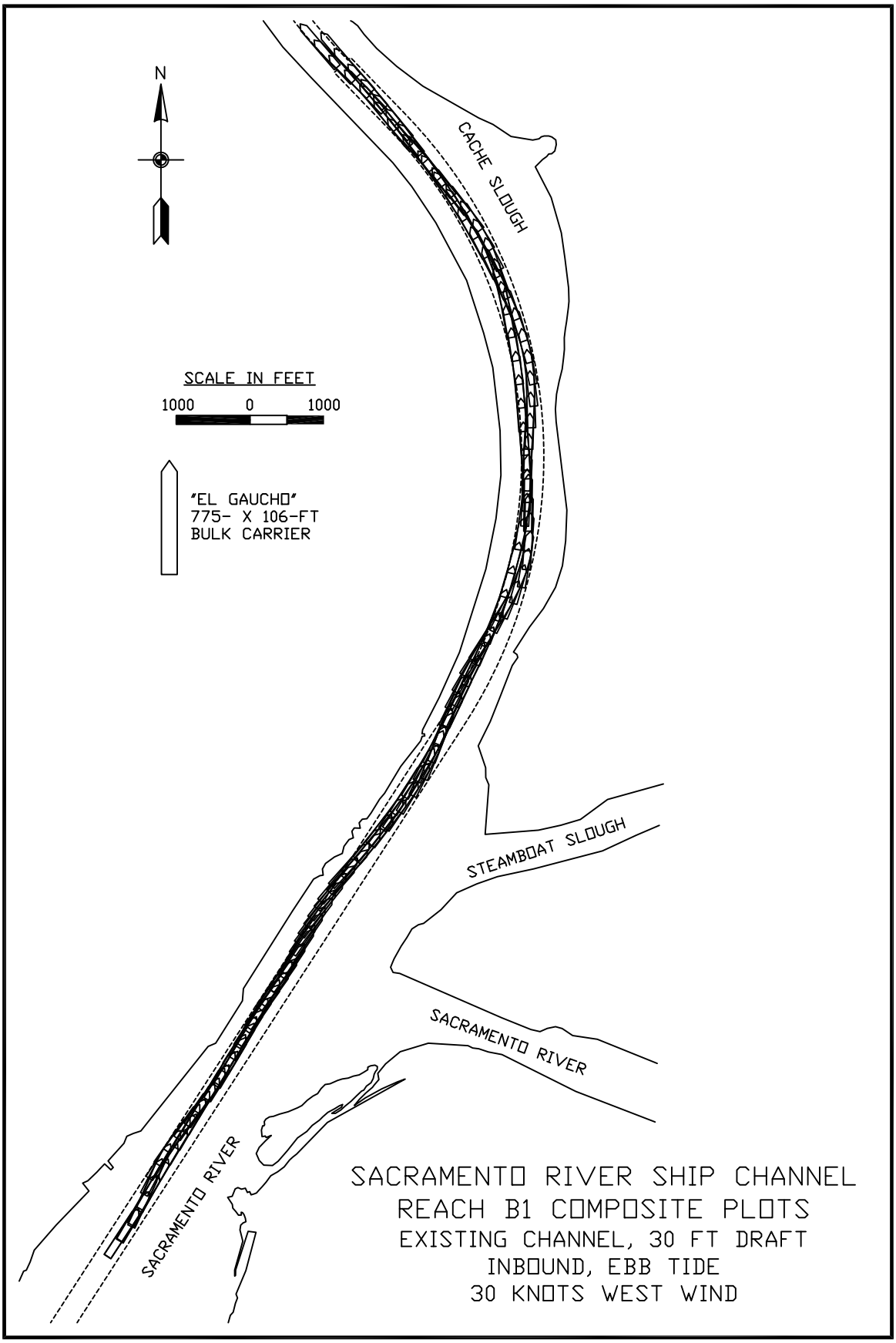
PLATE 20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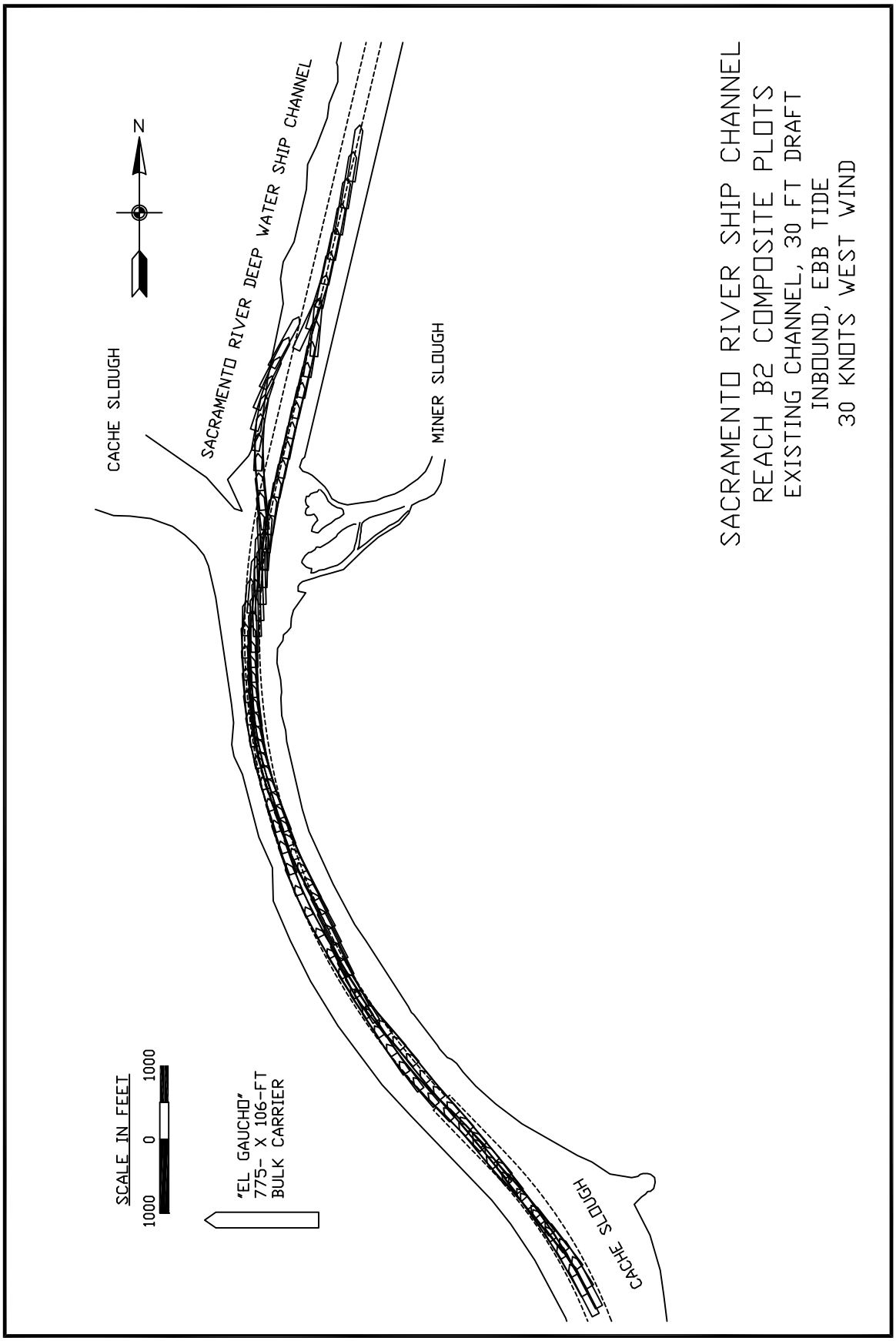
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, EBB TIDE
30 KNOTS WEST WIND

PLATE 21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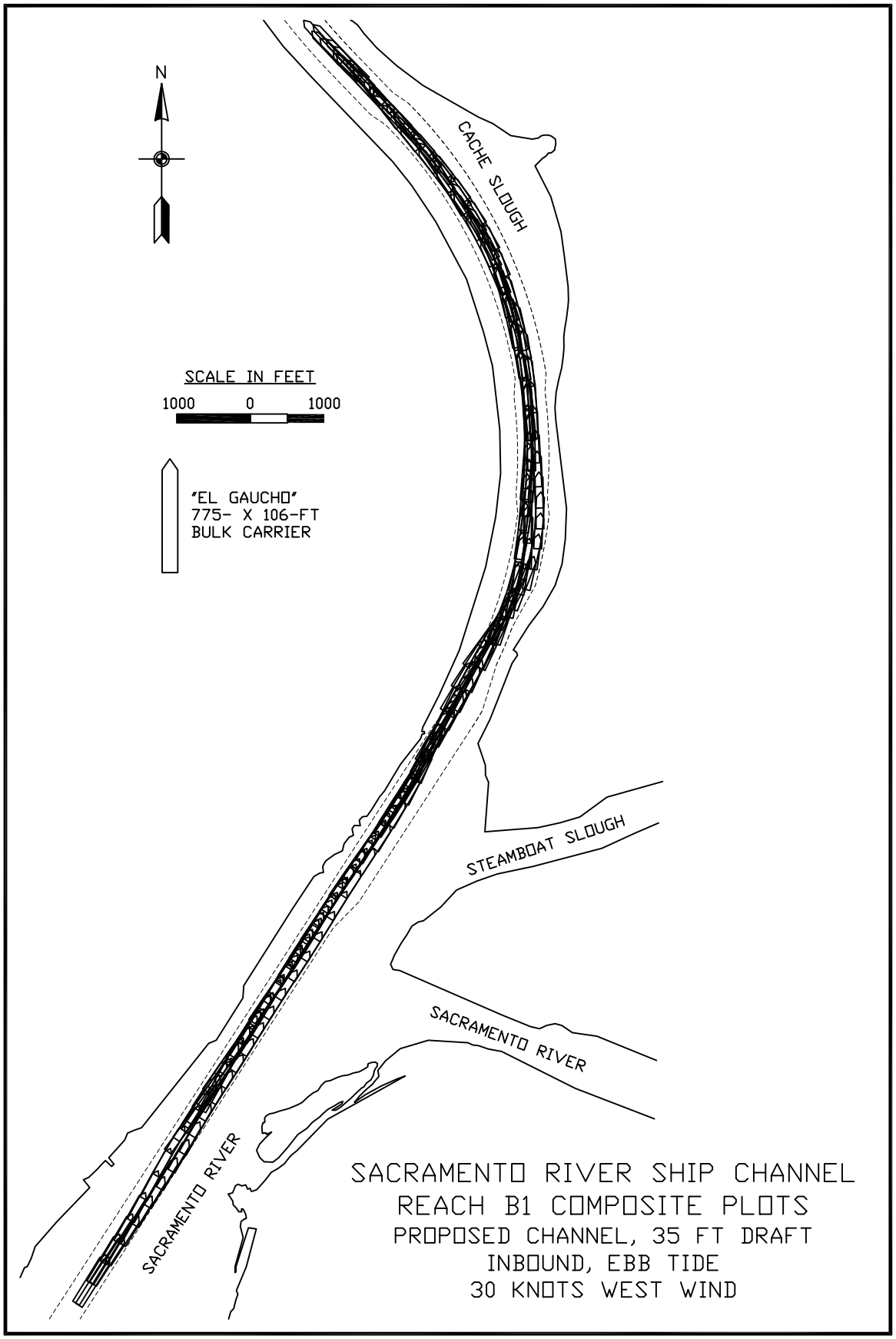
REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, EBB TIDE
30 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
1000 0 1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 22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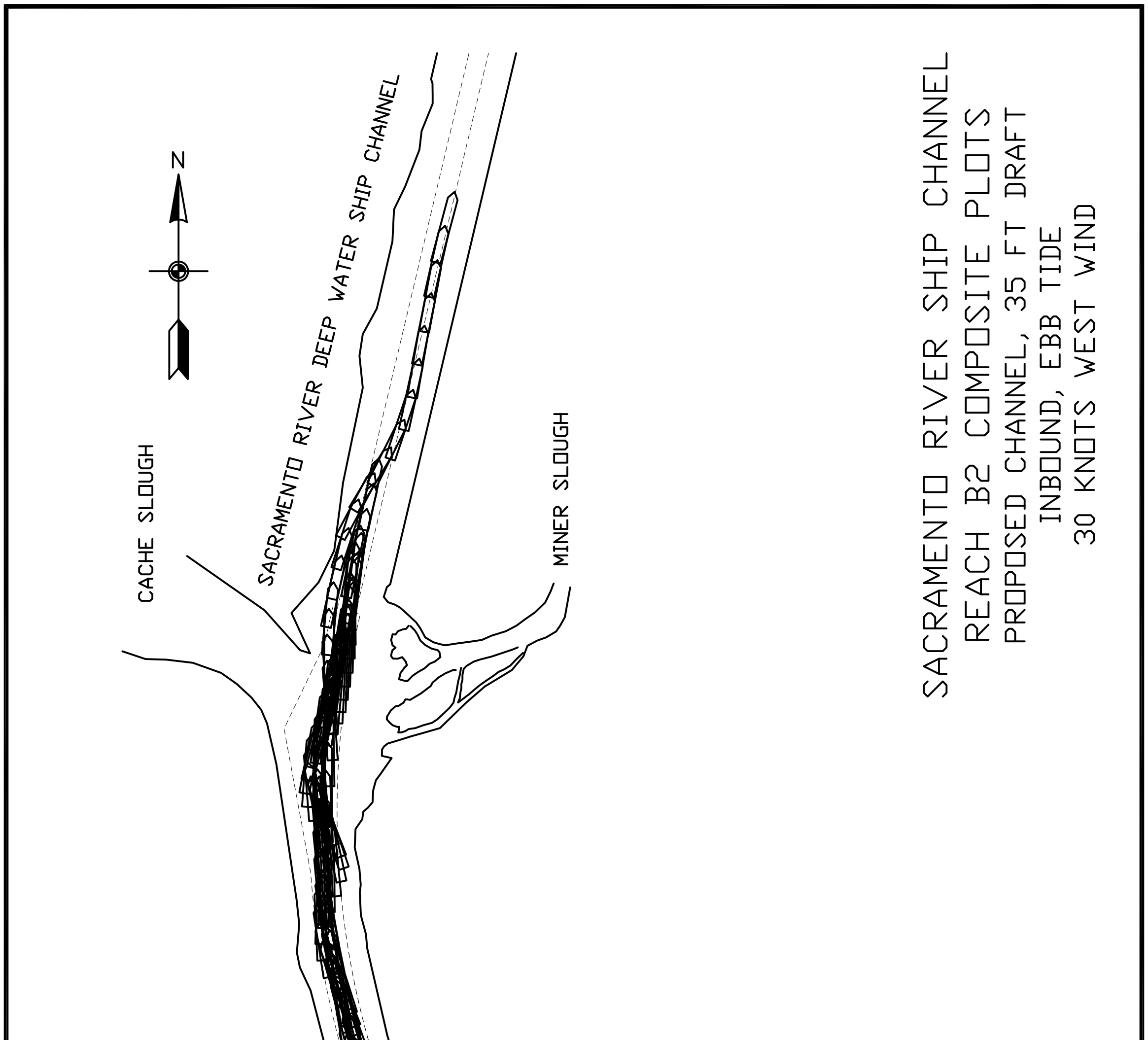
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, EBB TIDE
30 KNOTS WEST WIND

PLATE 23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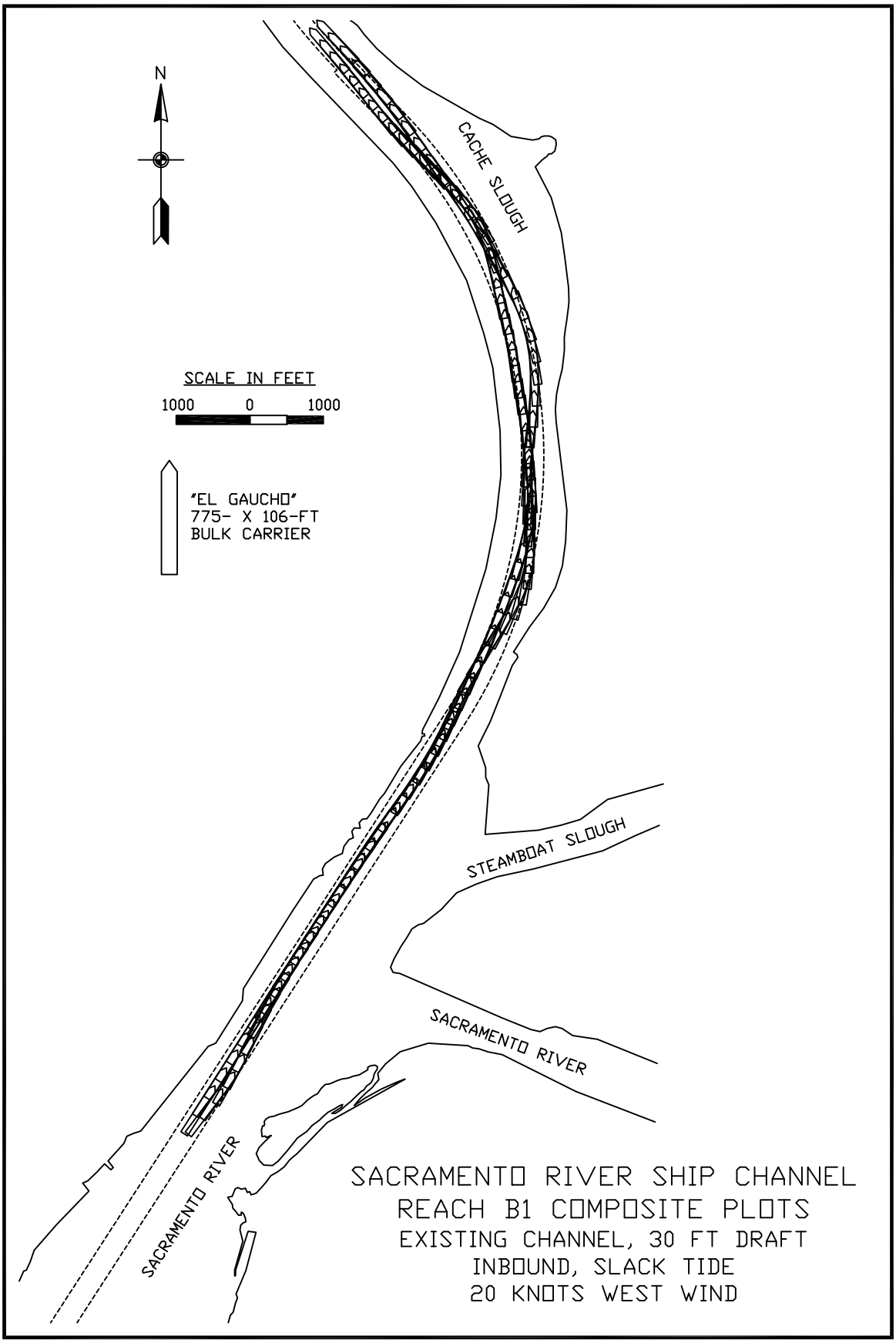
REACH B2 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, EBB TIDE
30 KNOTS WEST WIND
N
SCALE IN FEET
1000 0 1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH

PLATE 24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SCALE IN FEET
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775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, SLACK TIDE
20 KNOTS WEST WIND

PLATE 25

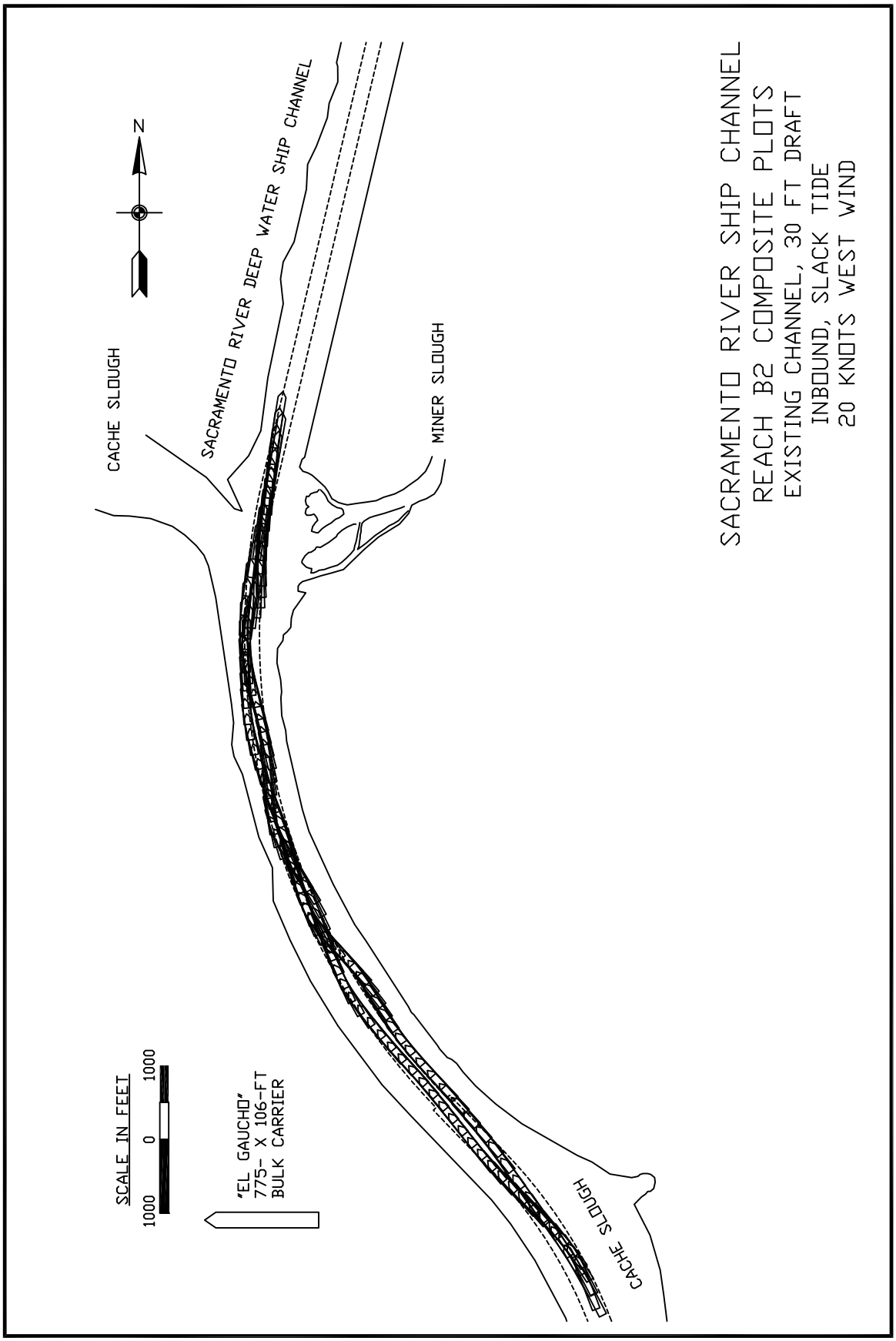
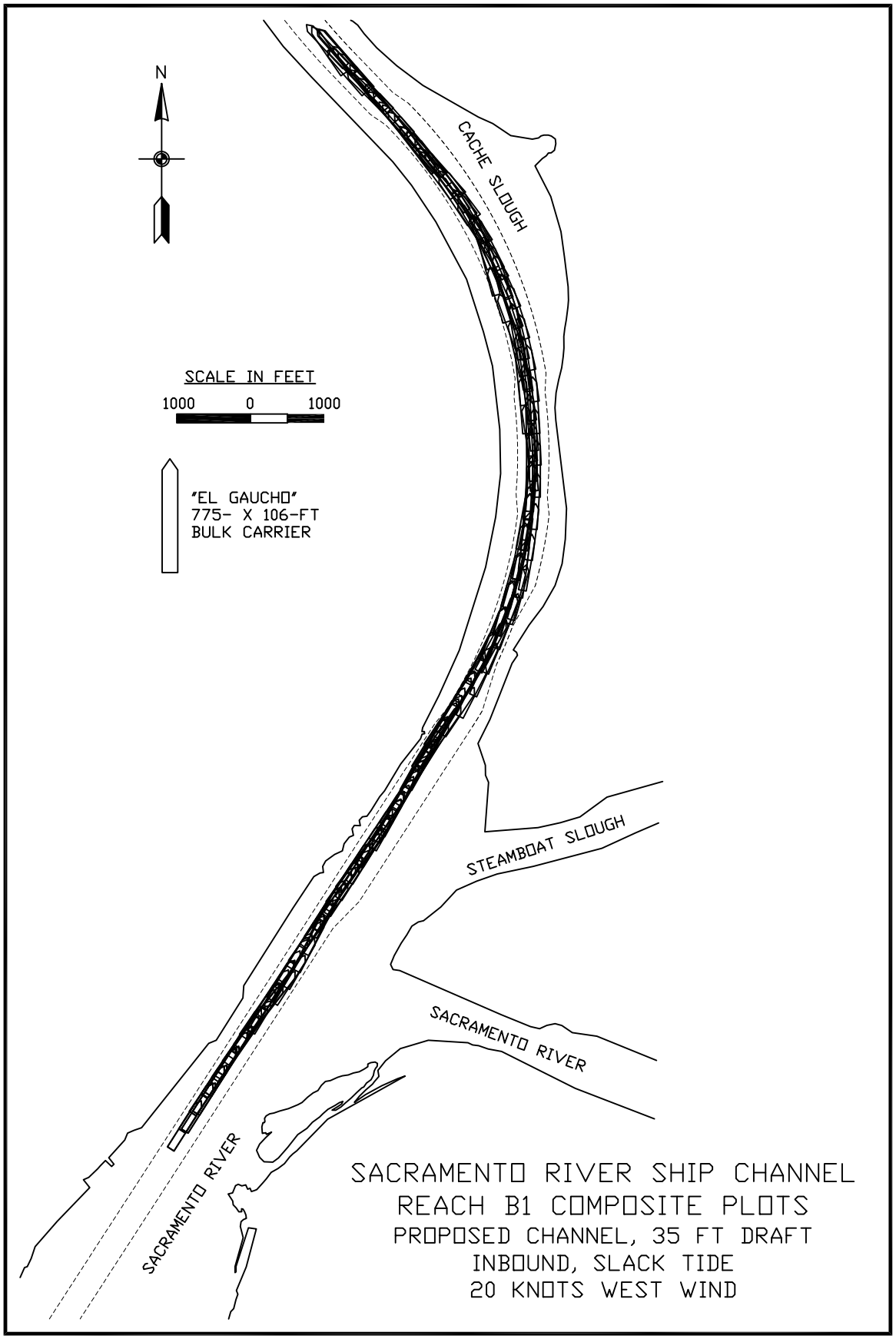

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, SLACK TIDE
20 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
1000 0 1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 26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CACHE SLOUGH
SCALE IN FEET
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"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, SLACK TIDE
20 KNOTS WEST WIND

PLATE 27

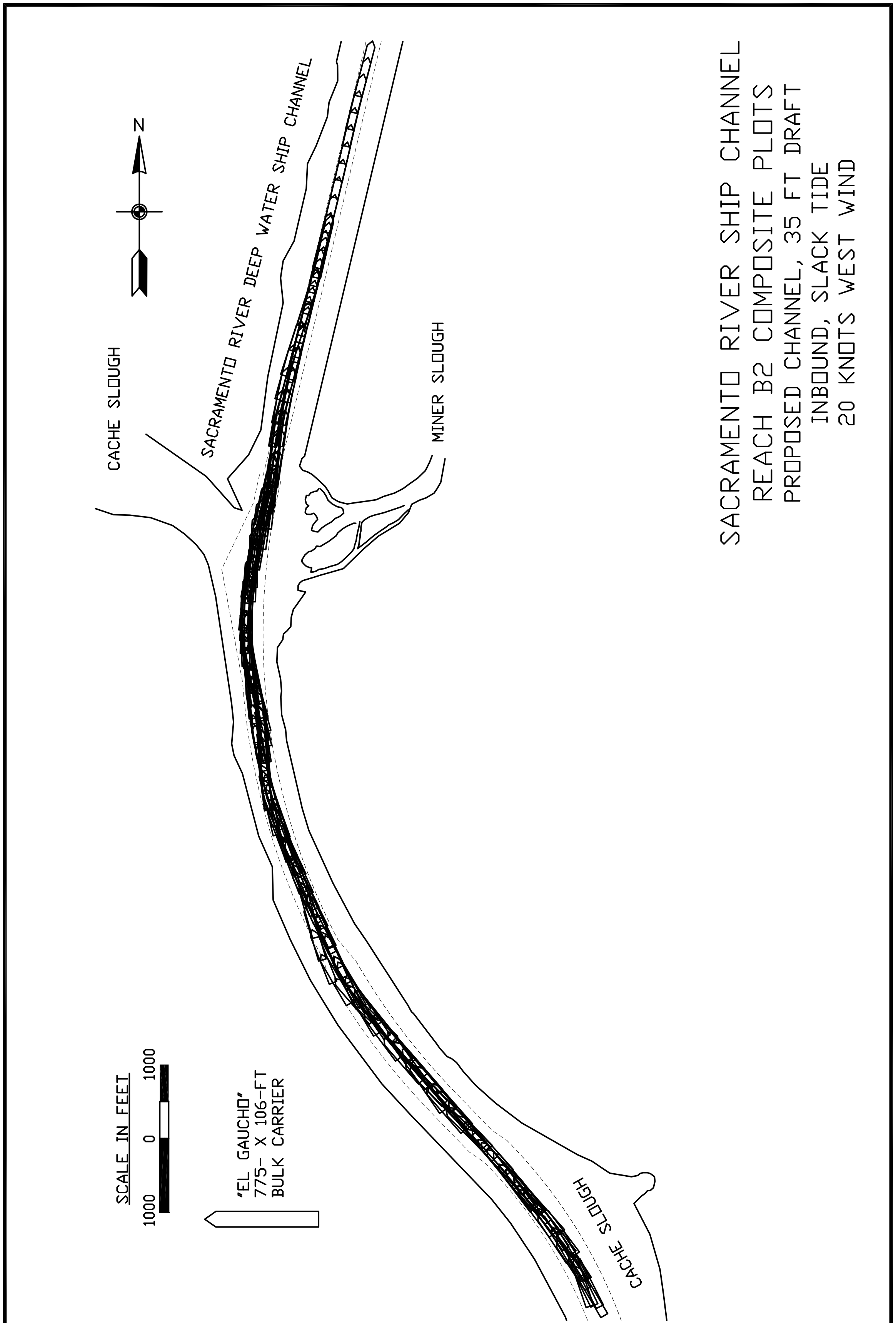
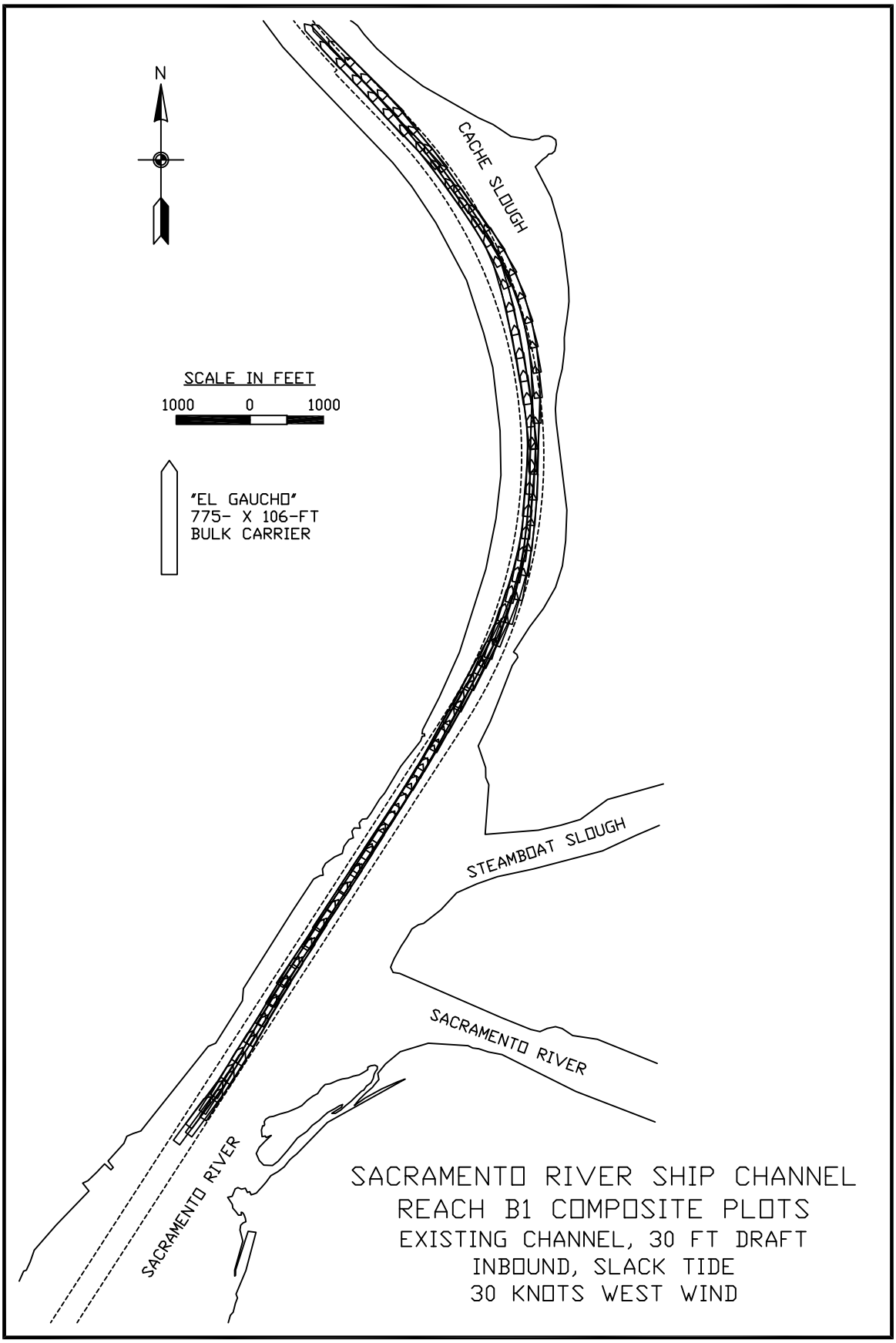

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, SLACK TIDE
20 KNOTS WEST WIND
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
CACHE SLOUGH
MINER SLOUGH
CACHE SLOUGH
N
SCALE IN FEET
1000
0
1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 28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CACHE SLOUGH
SCALE IN FEET
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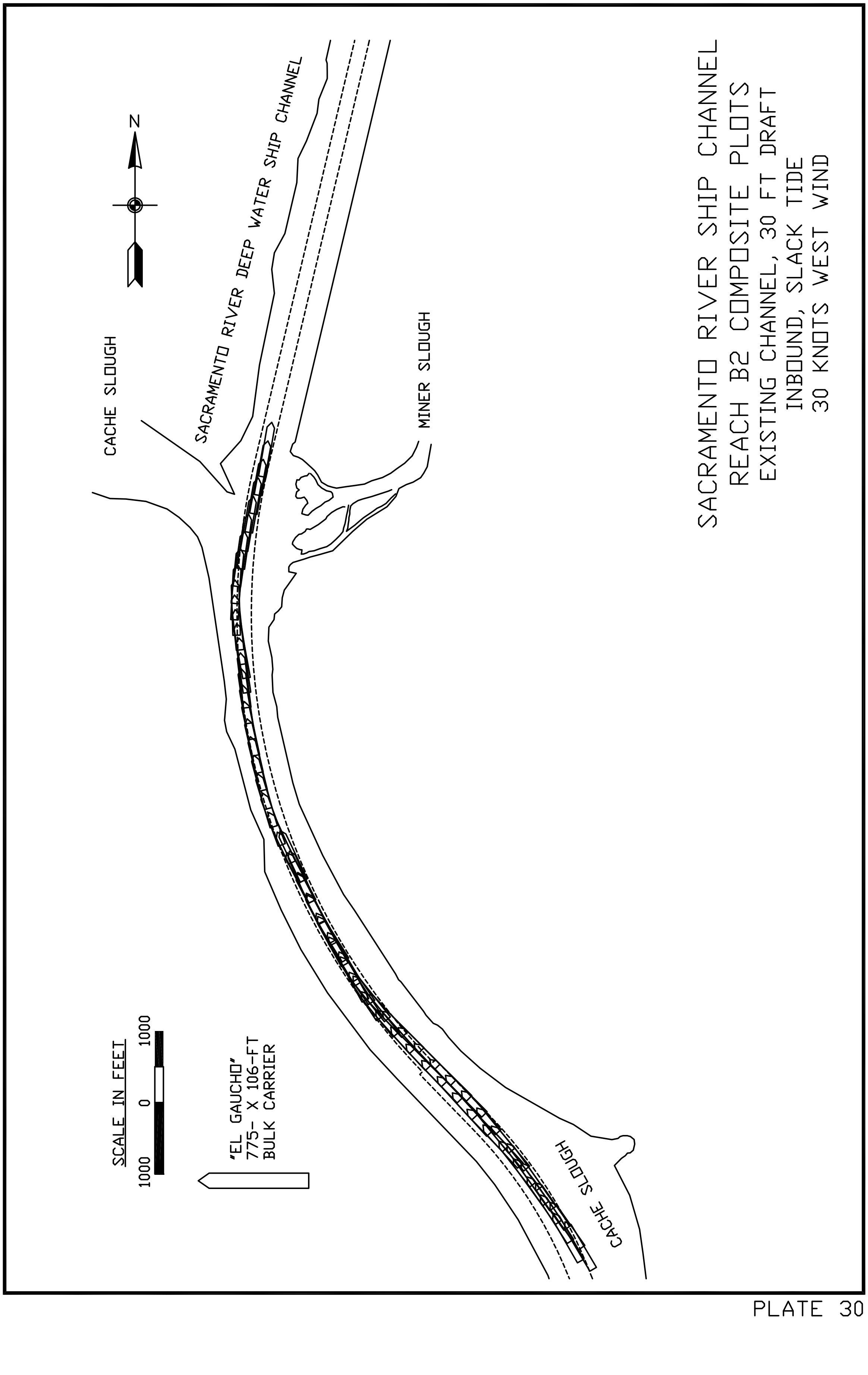
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, SLACK TIDE
30 KNOTS WEST WIND

PLATE 29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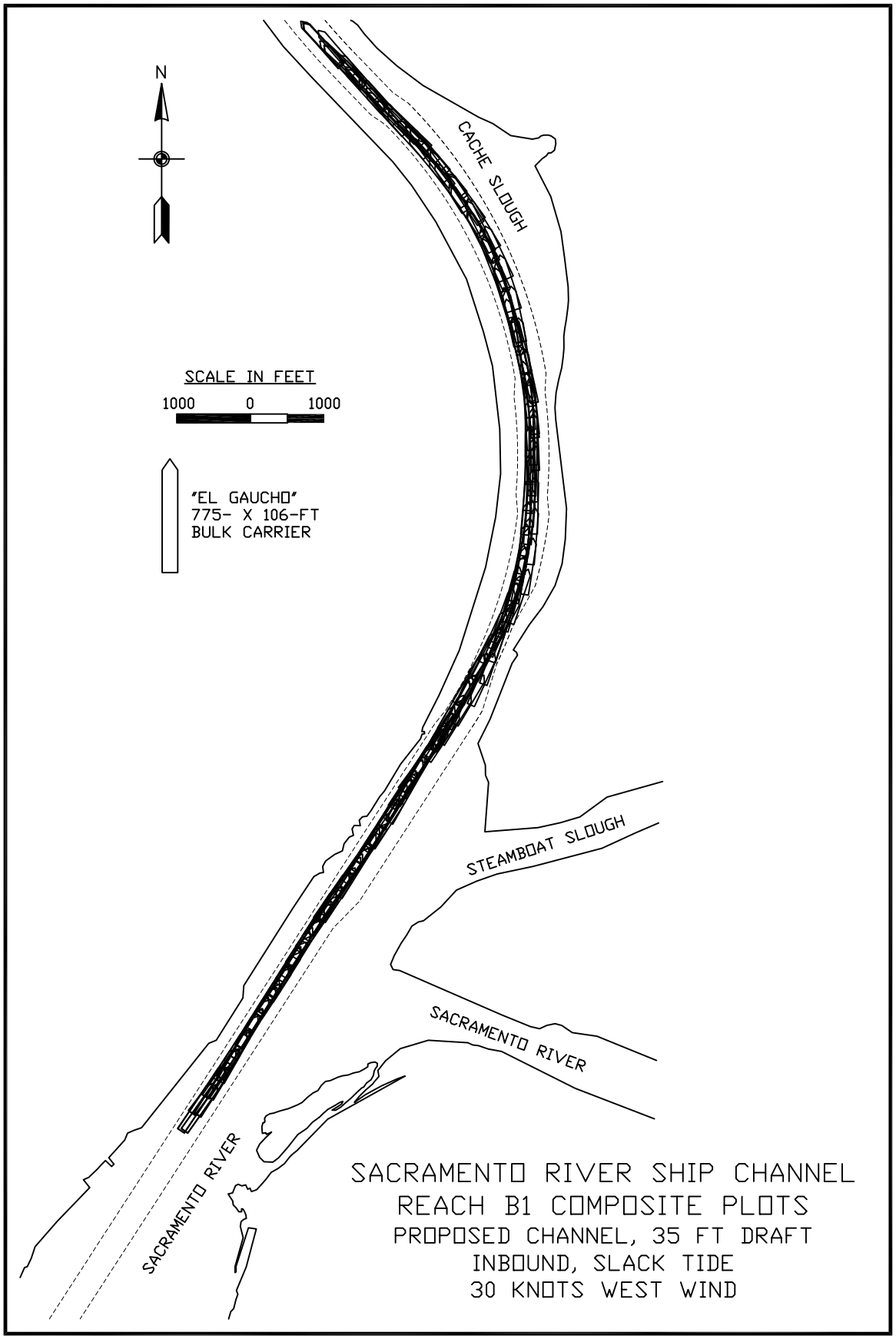
REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, SLACK TIDE
30 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
SCALE IN FEET
1000
0
1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
CACHE SLOUGH

PLATE 30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CACHE SLOUGH
SCALE IN FEET
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"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, SLACK TIDE
30 KNOTS WEST WIND

PLATE 31

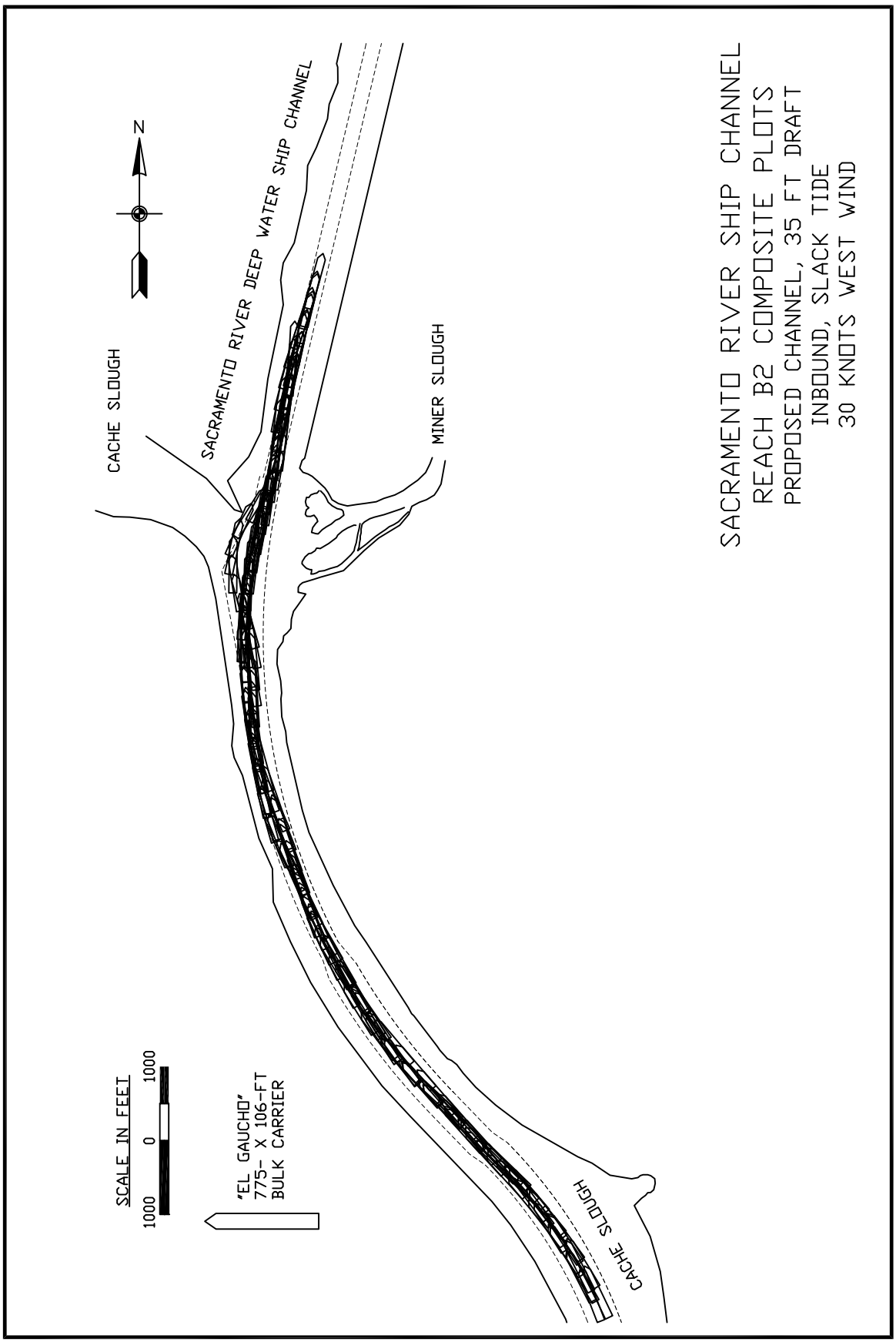
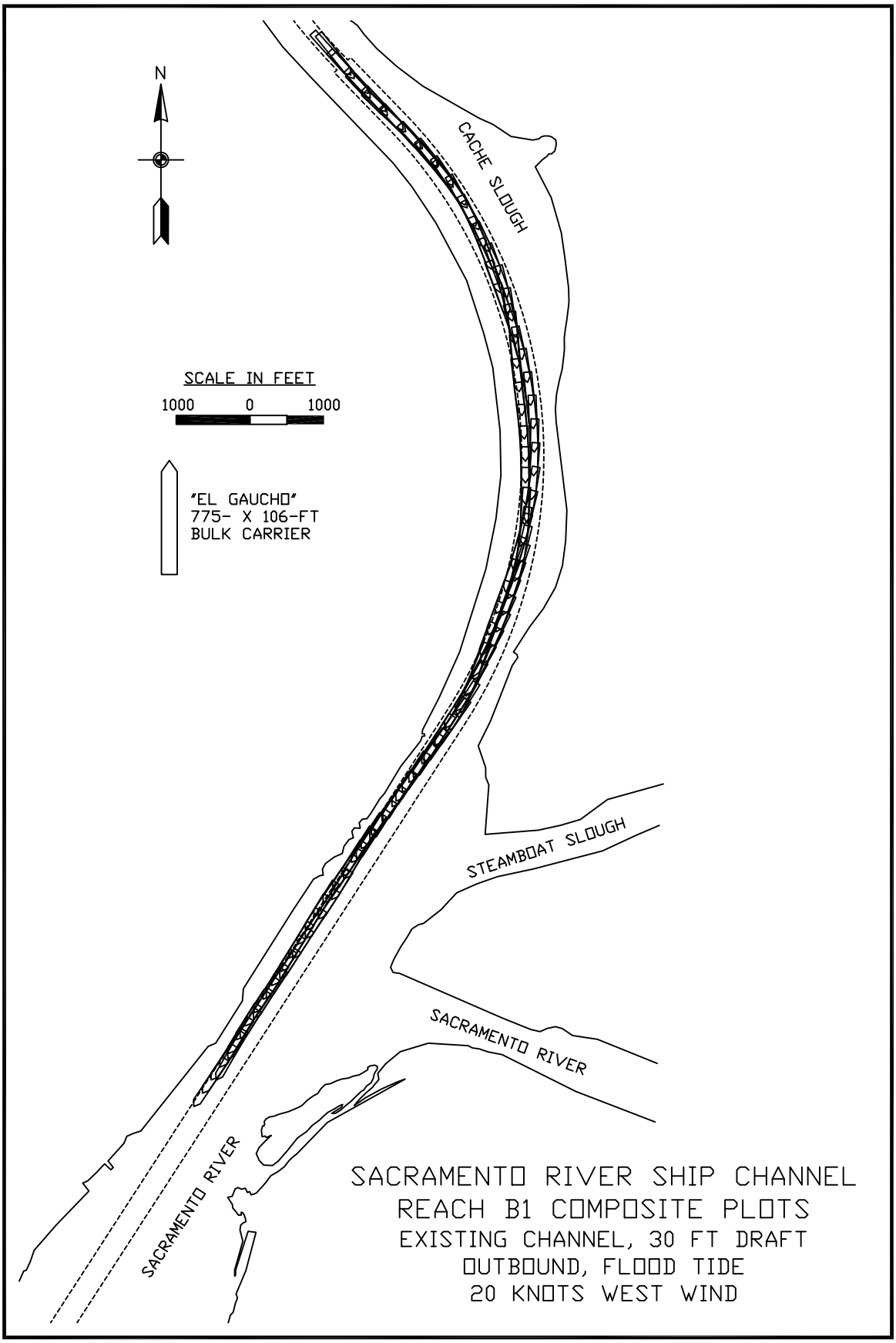

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, SLACK TIDE
30 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000
0
1000
1000

PLATE 32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SCALE IN FEET
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"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, FLOOD TIDE
20 KNOTS WEST WIND

PLATE 33

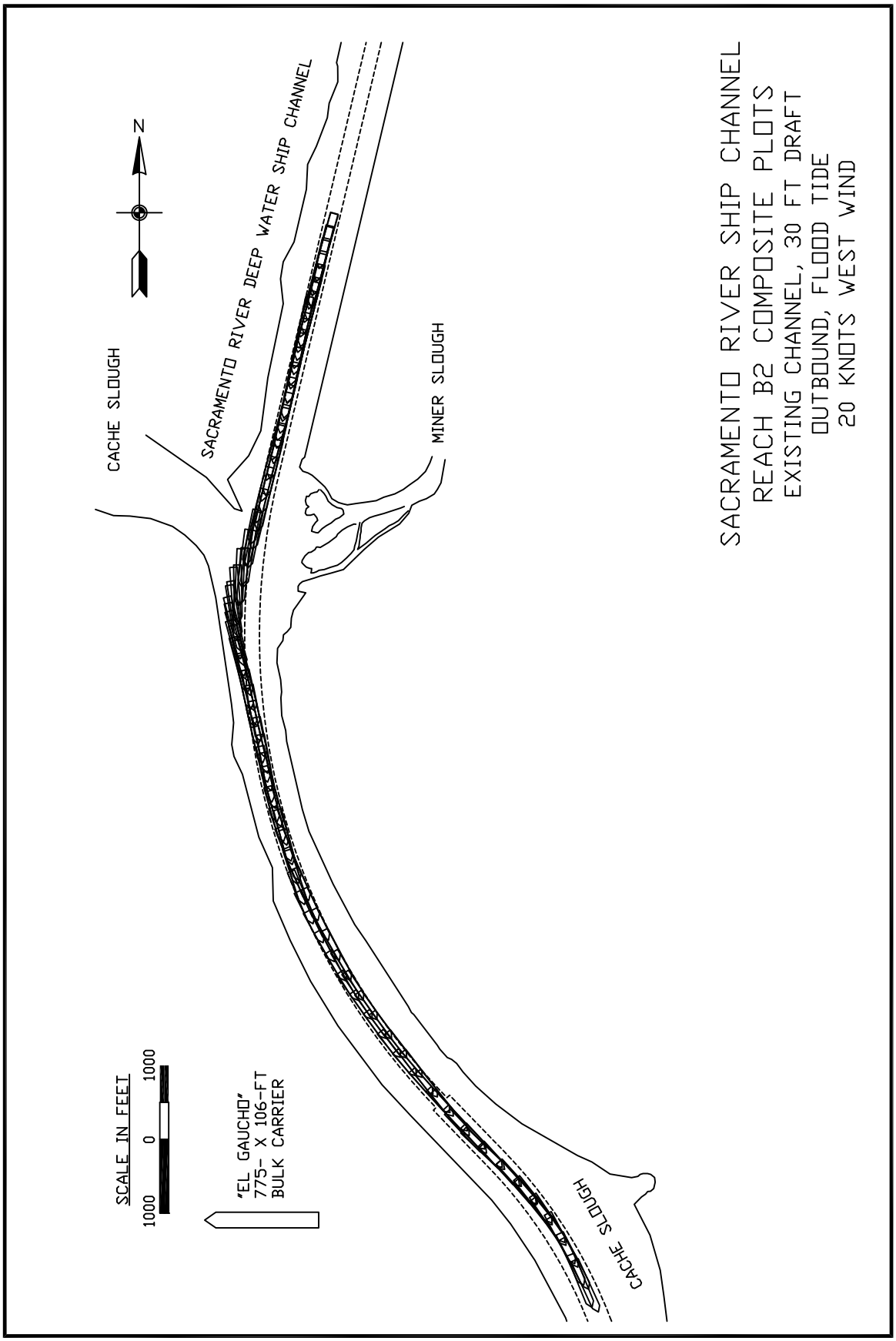
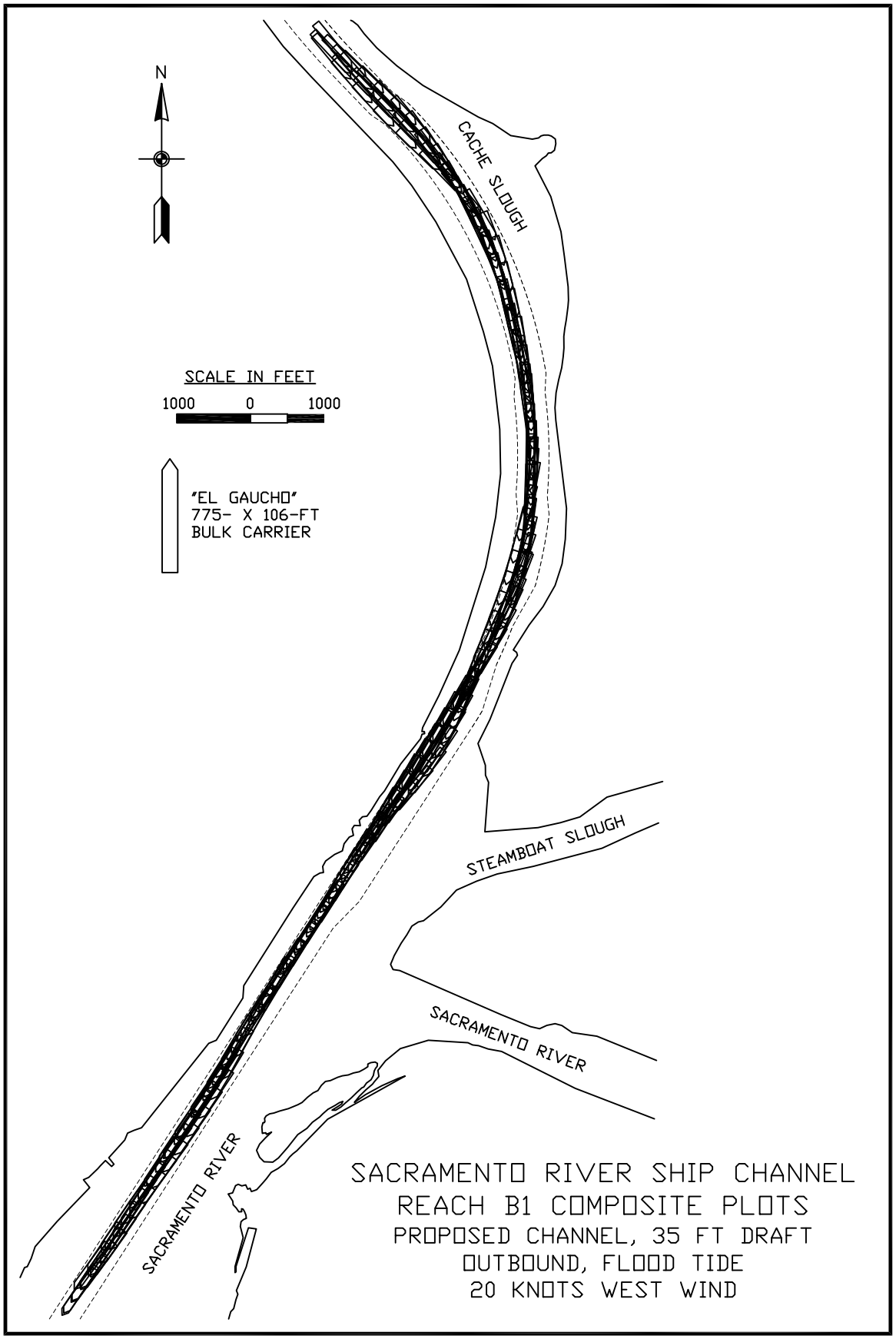

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, FLOOD TIDE
20 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
1000 0 1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 34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CACHE SLOUGH
SCALE IN FEET
1000 0 1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, FLOOD TIDE
20 KNOTS WEST WIND

PLATE 35

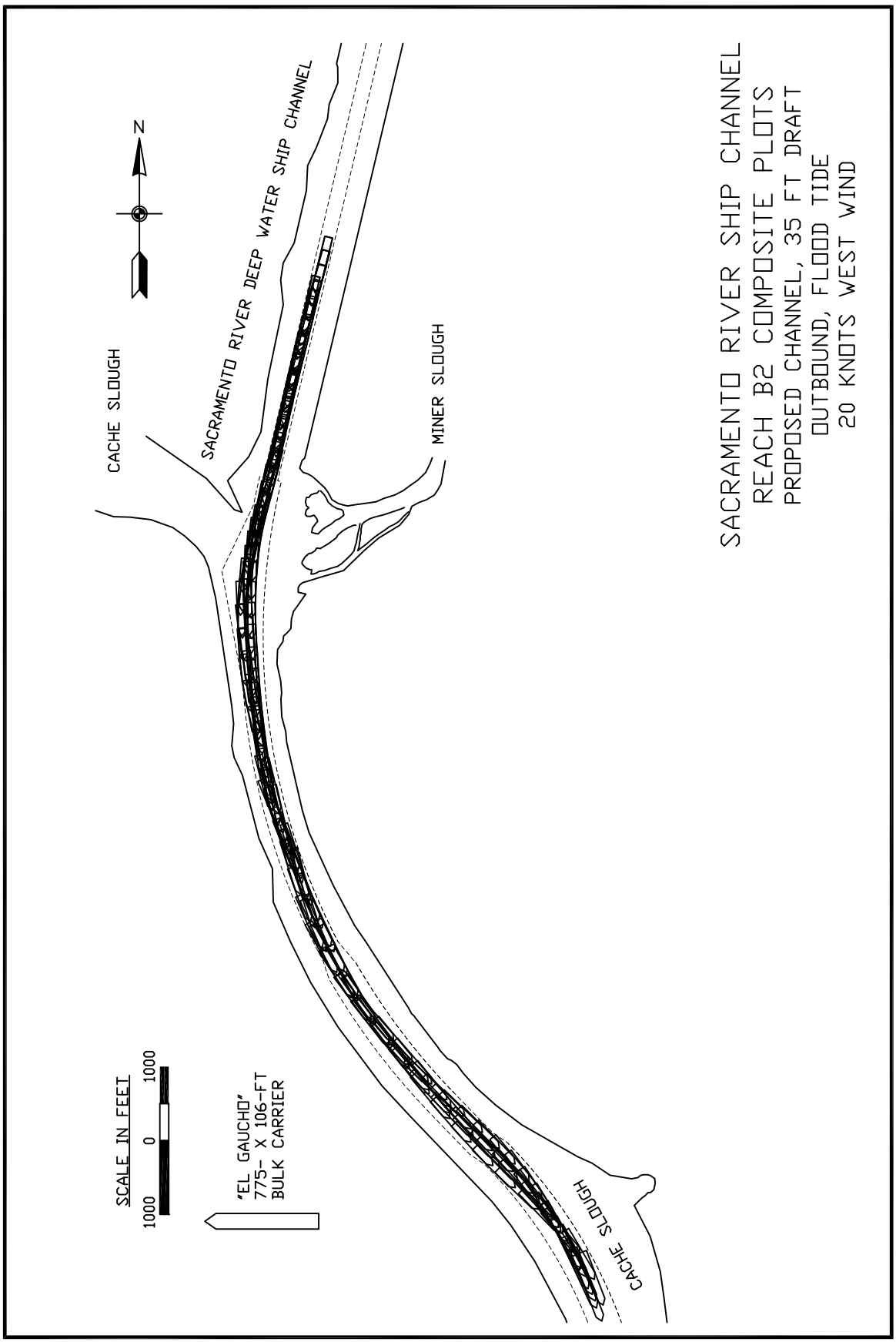
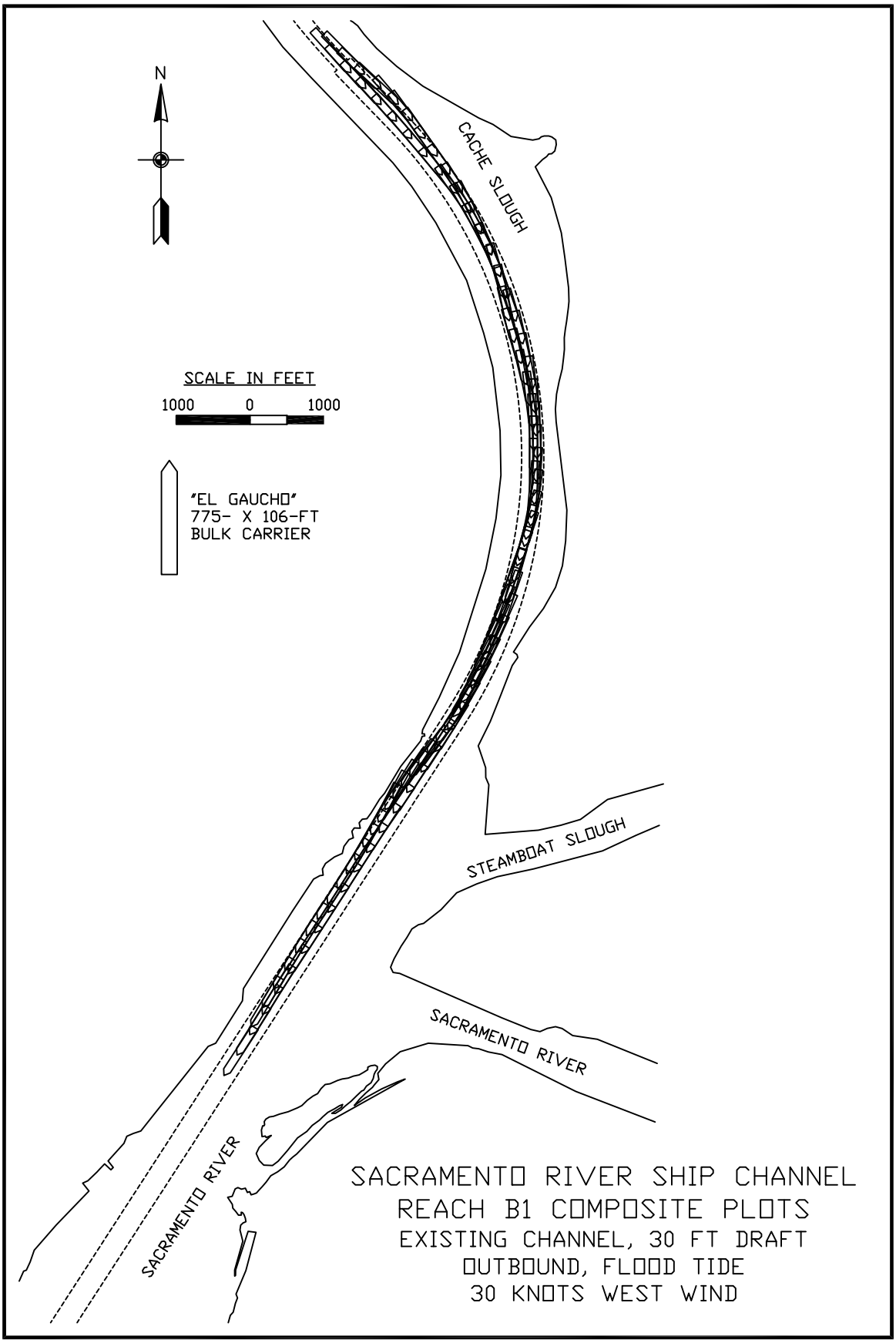

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, FLOOD TIDE
20 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
1000 0 1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 36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CACHE SLOUGH
SCALE IN FEET
1000 0 1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, FLOOD TIDE
30 KNOTS WEST WIND

PLATE 37

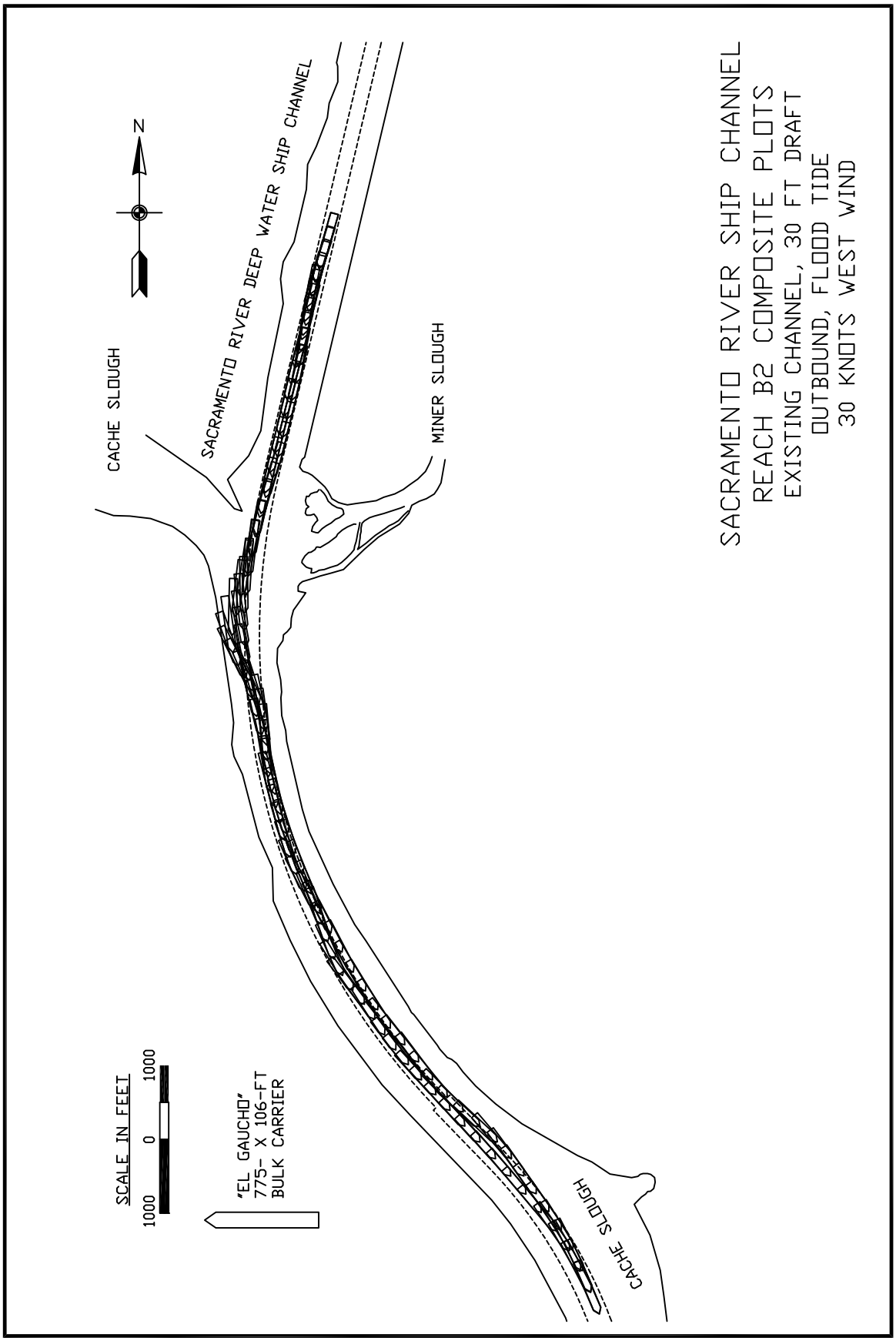
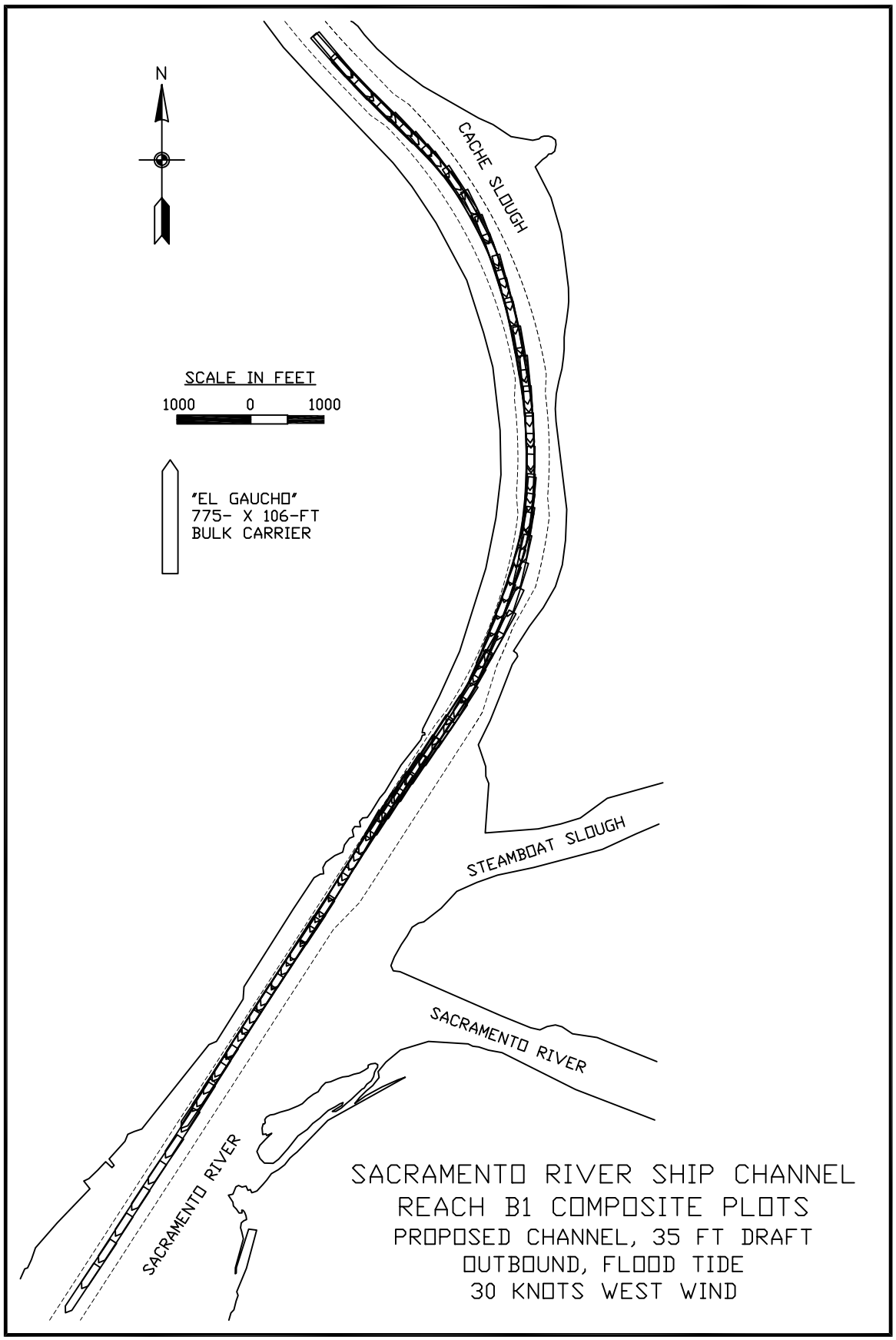

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, FLOOD TIDE
30 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
1000 0 1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 38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CACHE SLOUGH
SCALE IN FEET
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"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, FLOOD TIDE
30 KNOTS WEST WIND

PLATE 39

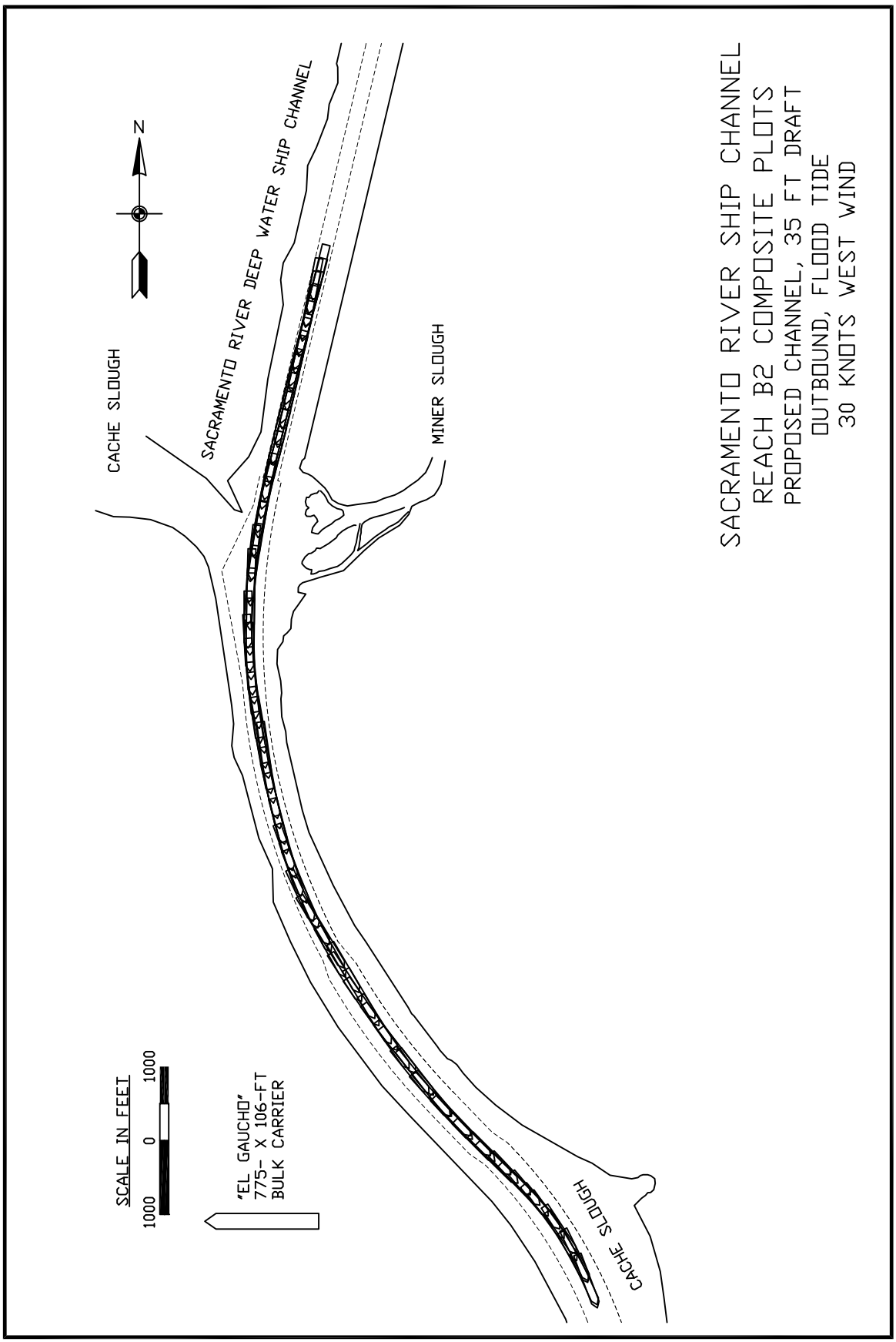
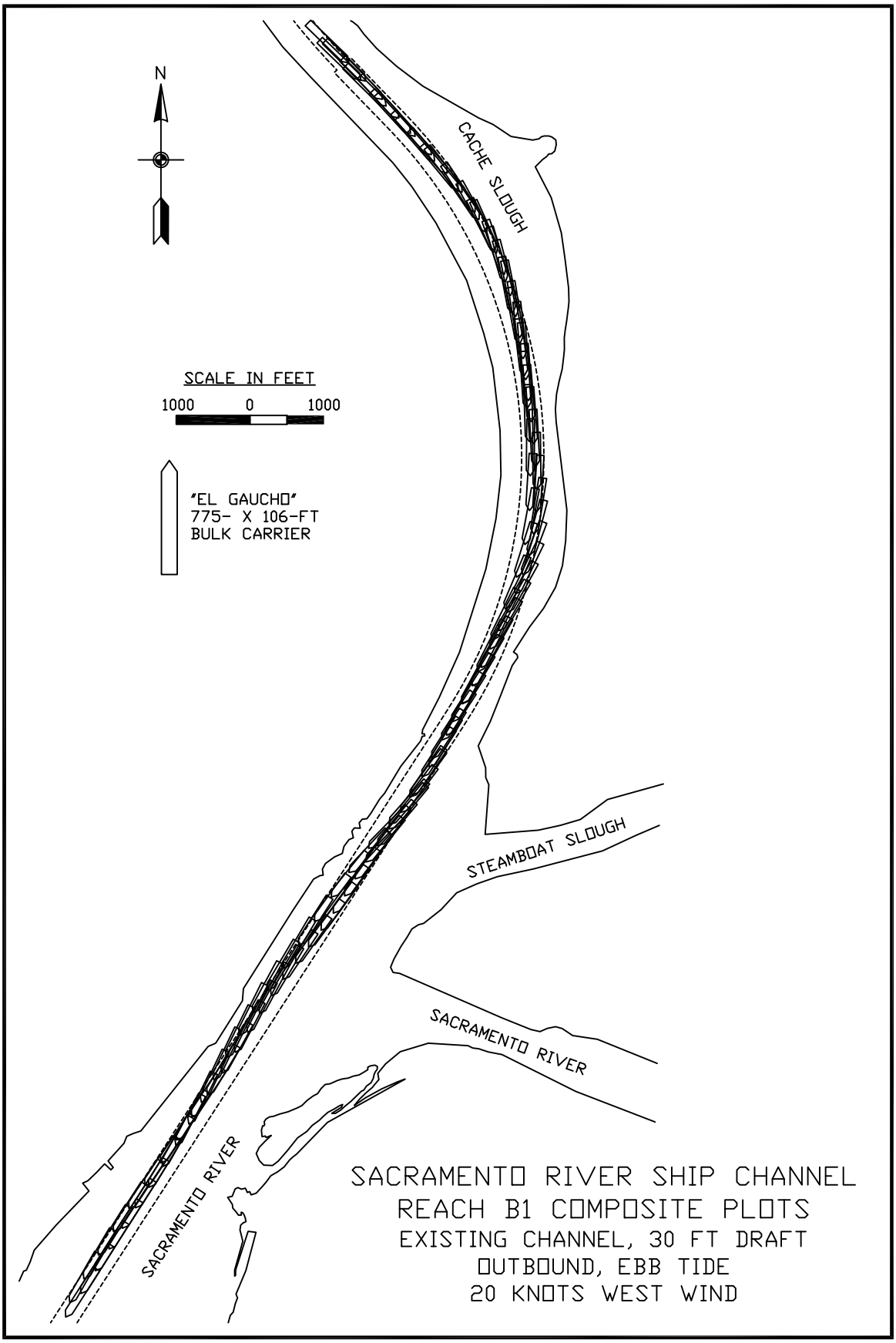

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, FLOOD TIDE
30 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
1000 0 1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 40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CACHE SLOUGH
SCALE IN FEET
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"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, EBB TIDE
20 KNOTS WEST WIND

PLATE 41

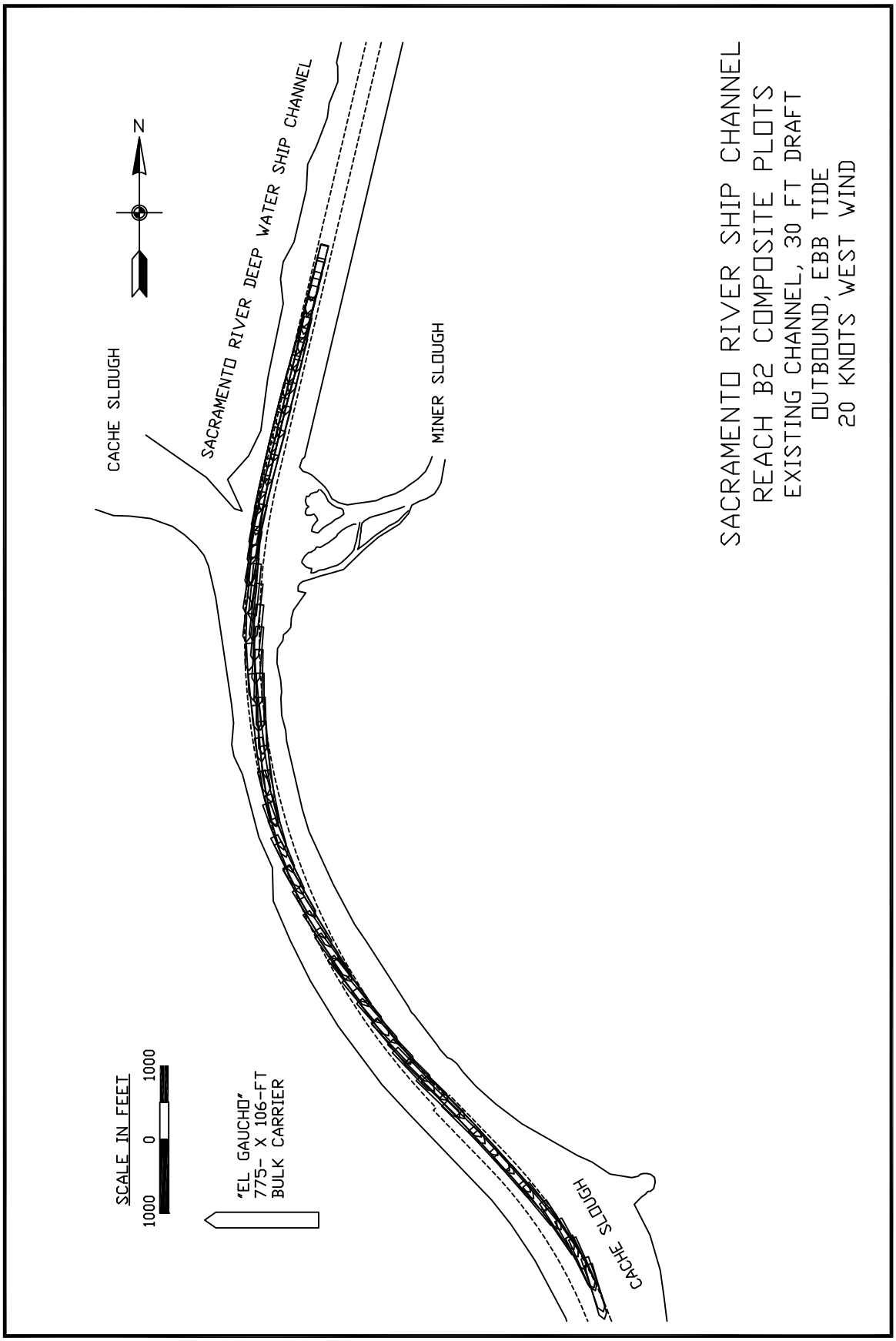
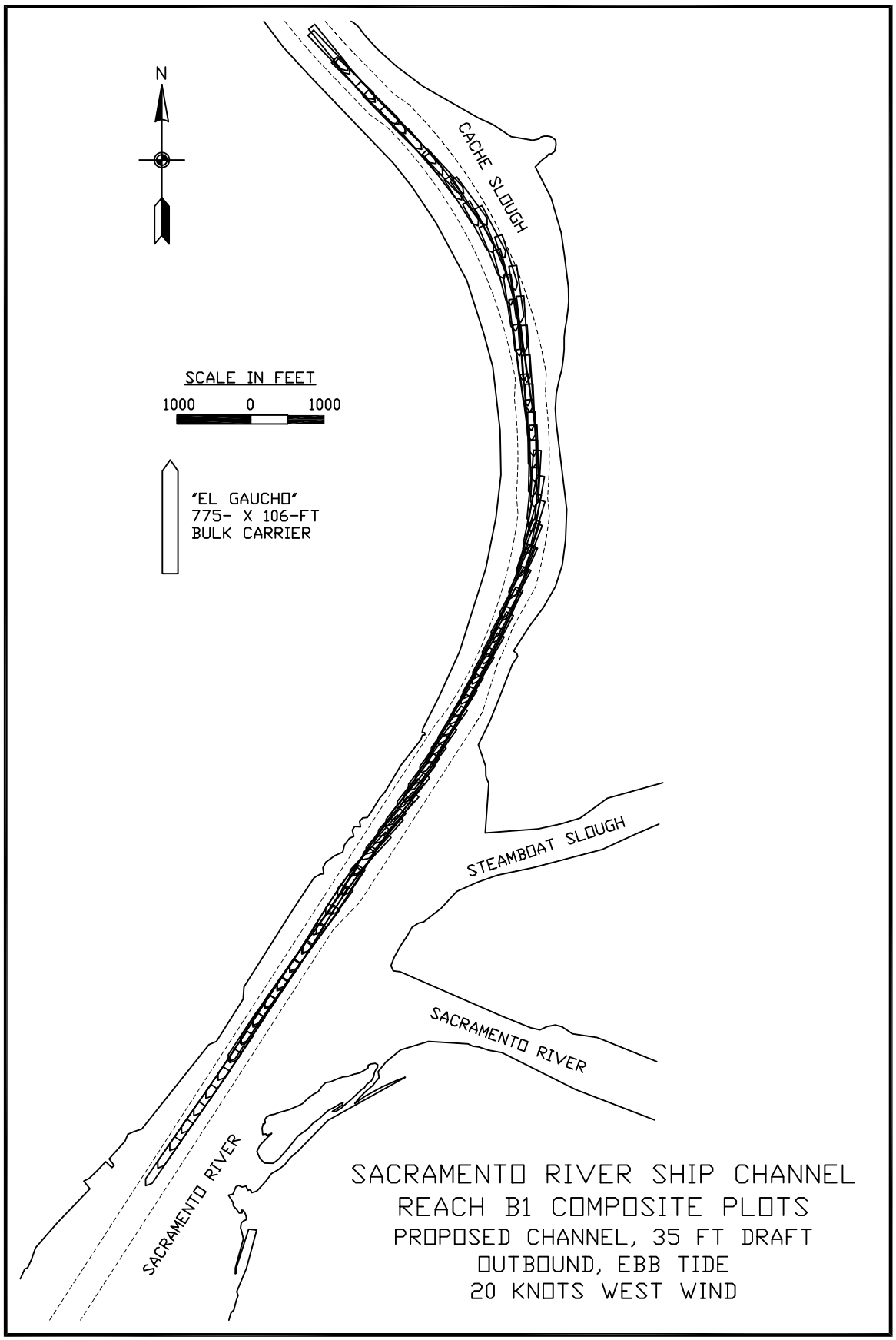

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, EBB TIDE
20 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
1000 0 1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 42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SCALE IN FEET
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"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, EBB TIDE
20 KNOTS WEST WIND

PLATE 43

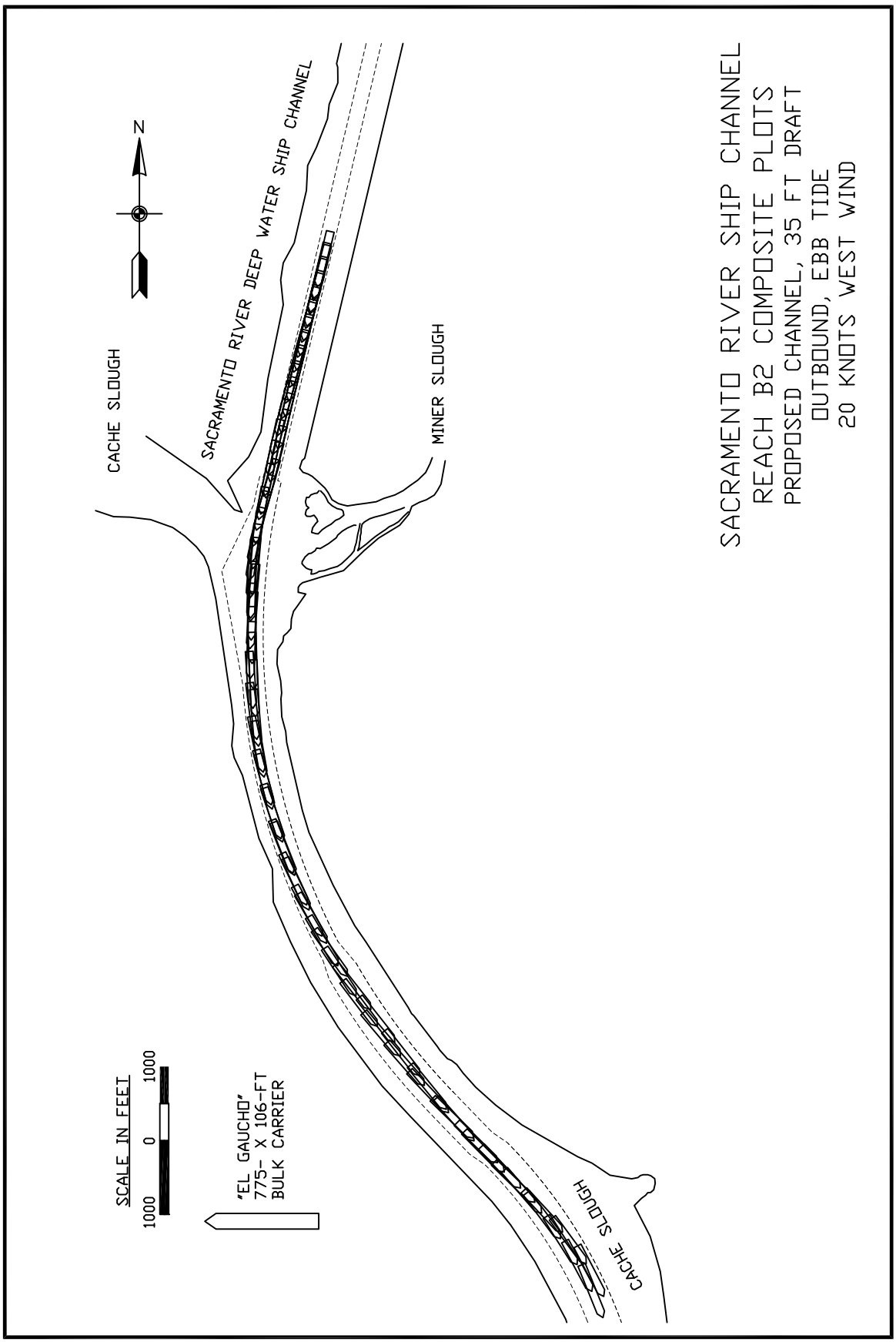
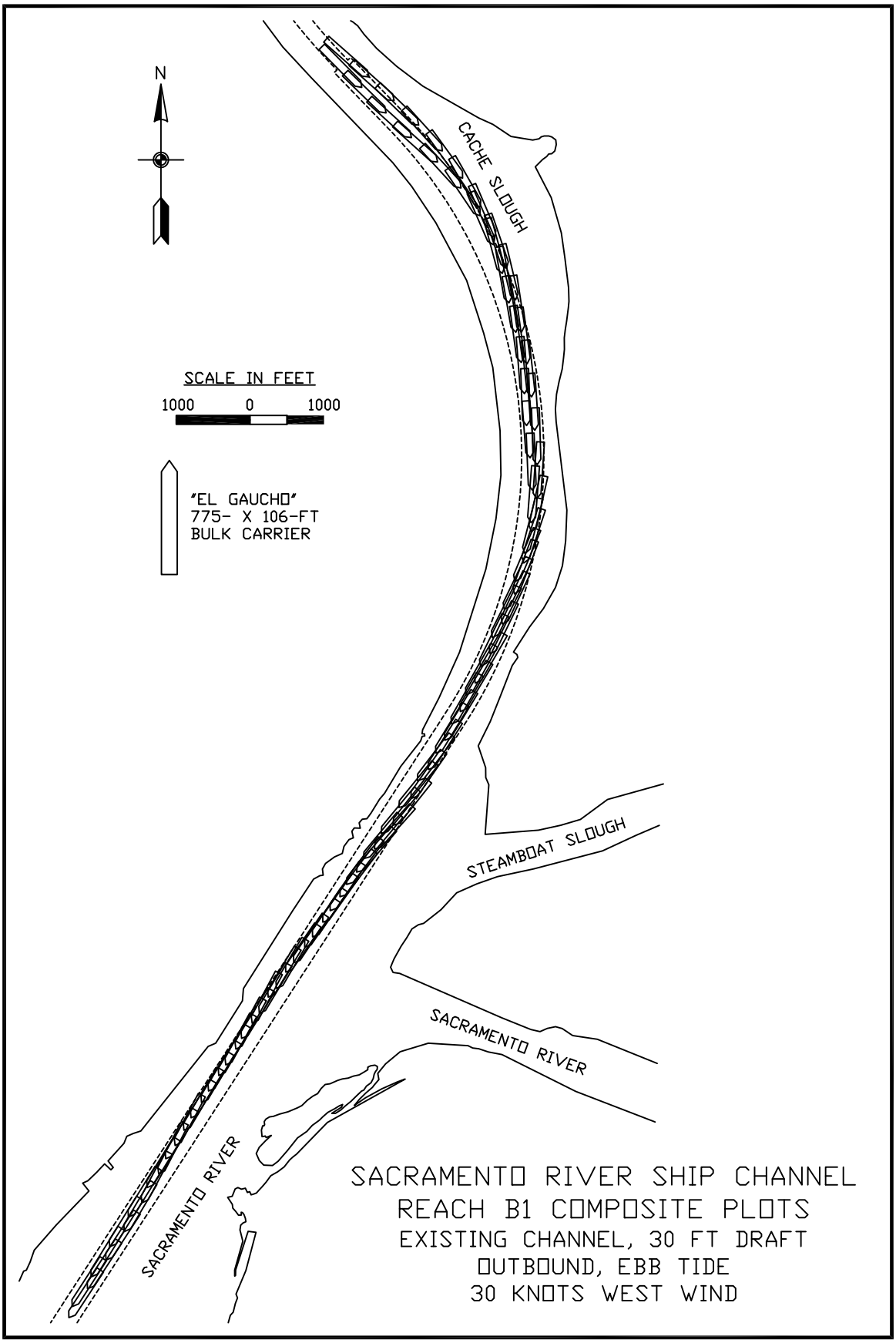

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, EBB TIDE
20 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000
0
1000
1000

PLATE 44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SCALE IN FEET
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"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, EBB TIDE
30 KNOTS WEST WIND

PLATE 45

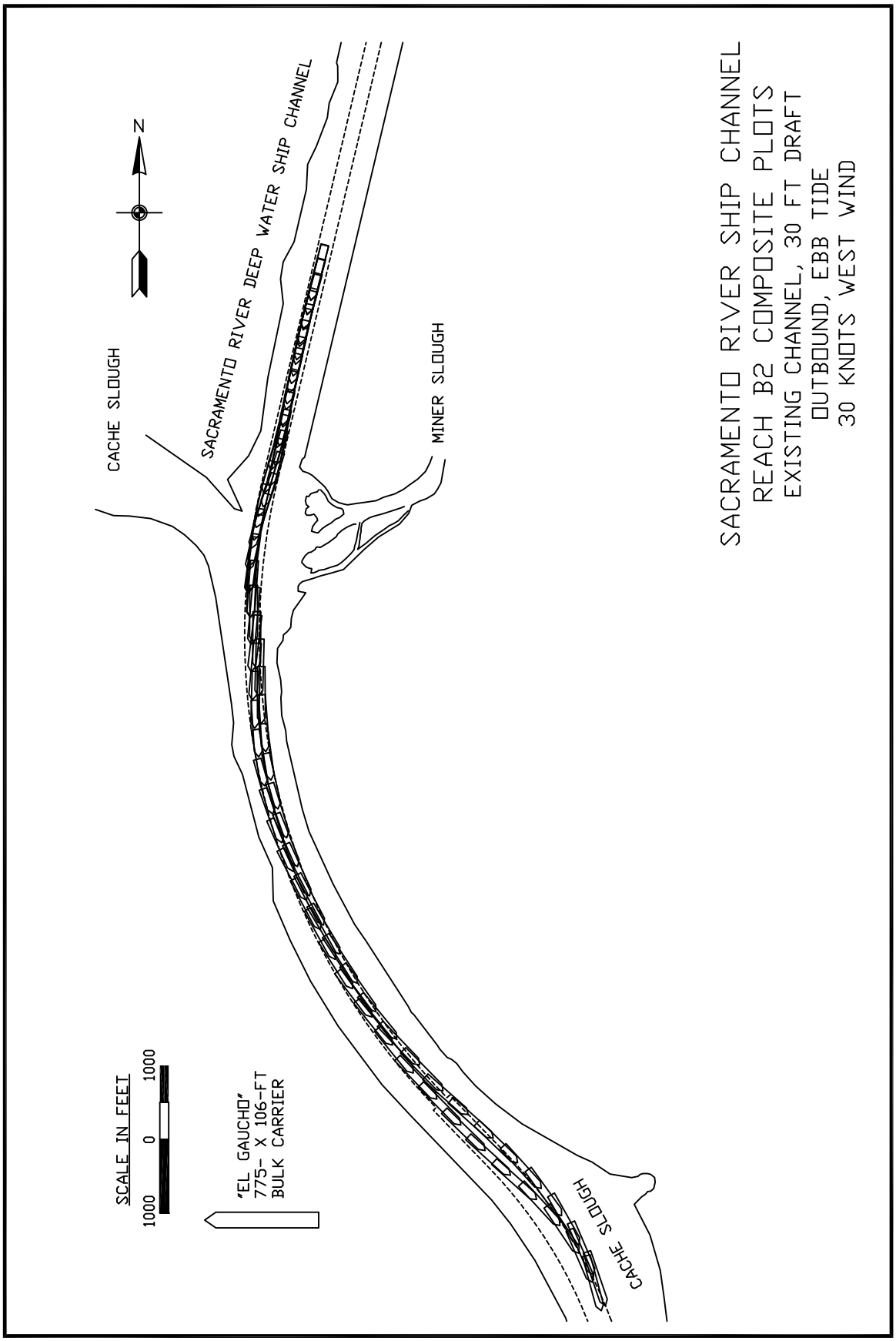
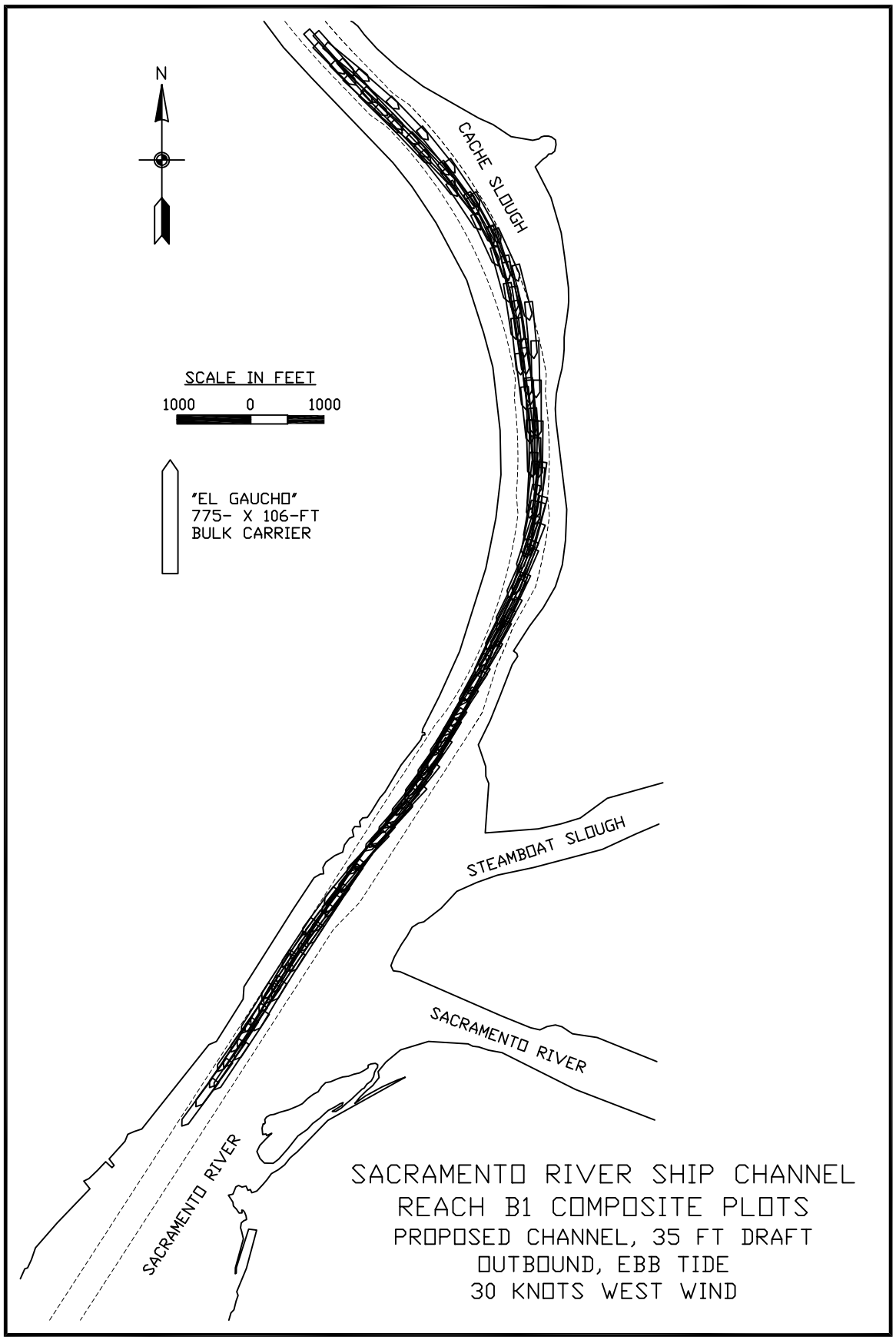

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, EBB TIDE
30 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
SCALE IN FEET
1000 0 1000
"EL GAUCHO"
775- X 106-FT
BULK CARRIER

PLATE 46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SCALE IN FEET
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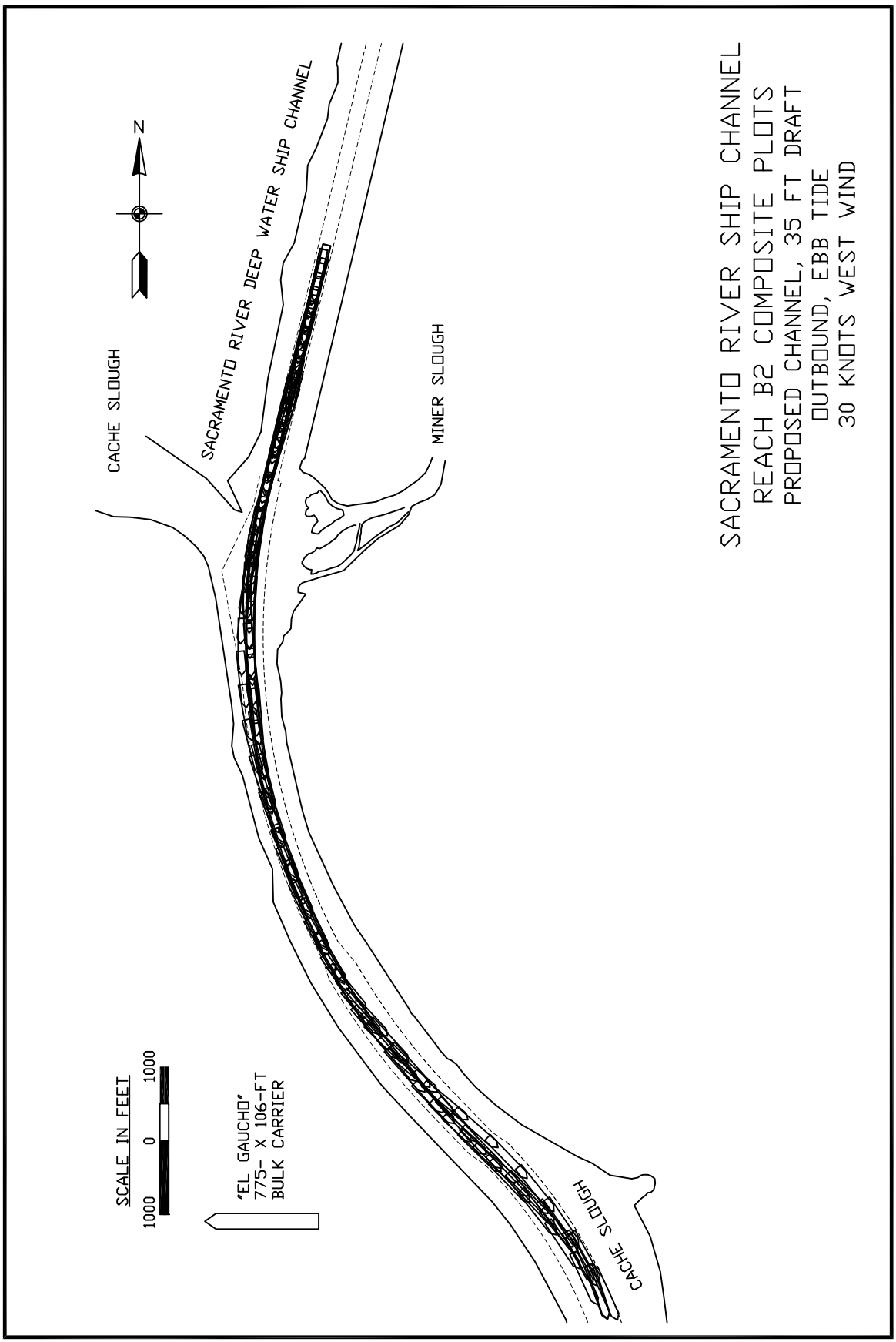
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, EBB TIDE
30 KNOTS WEST WIND

PLATE 47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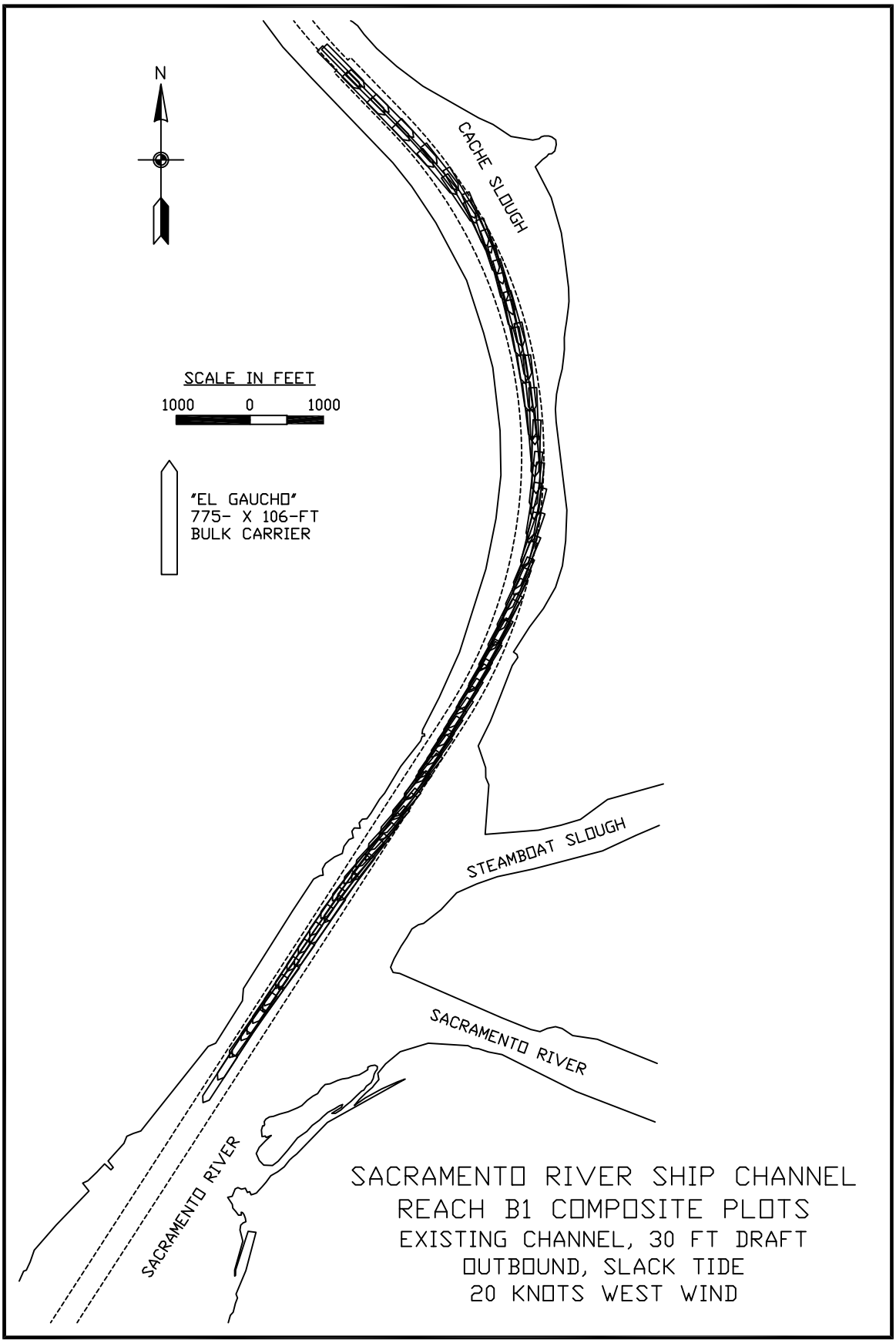
REACH B2 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, EBB TIDE
30 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000
0
1000

PLATE 48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CACHE SLOUGH
SCALE IN FEET
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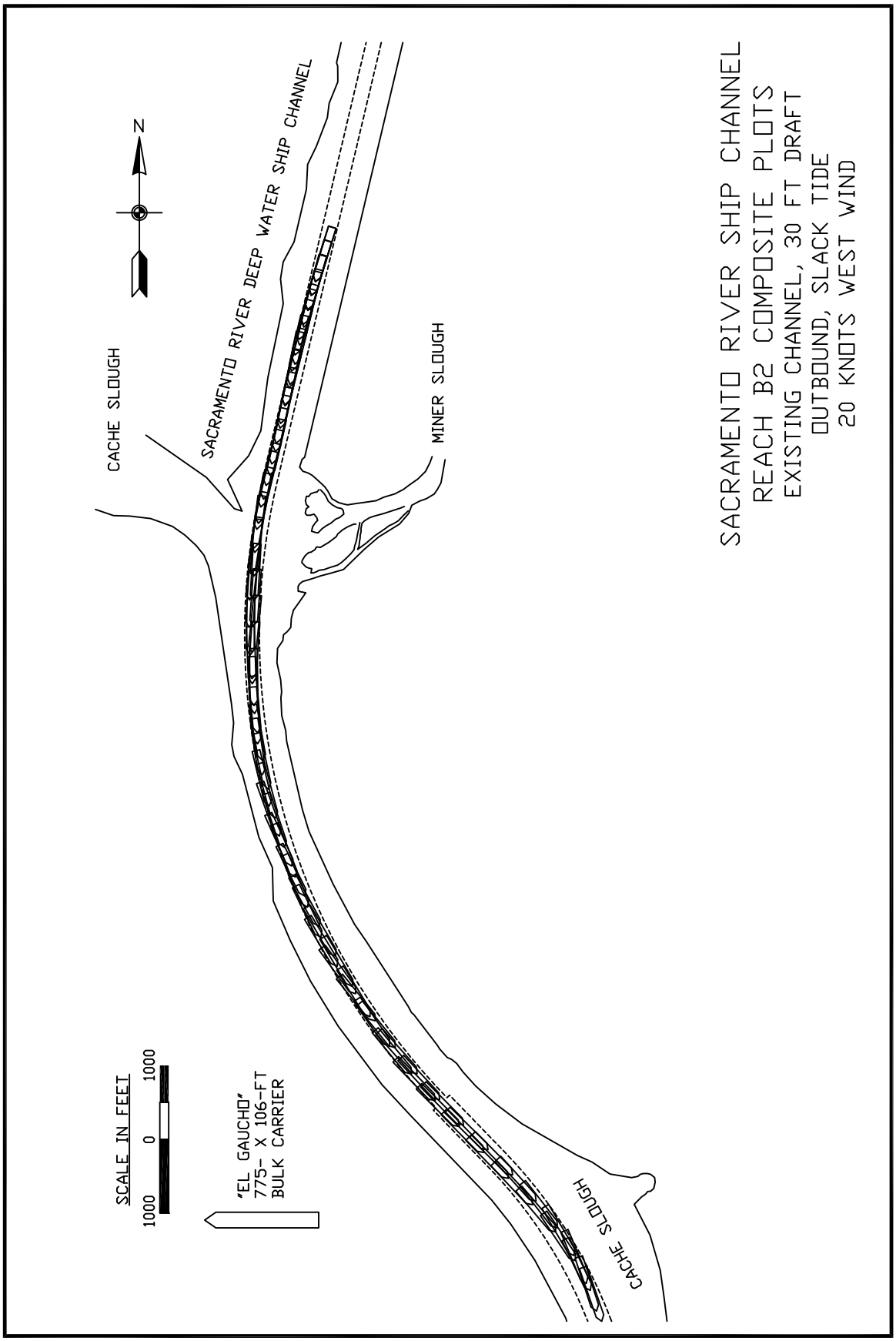
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, SLACK TIDE
20 KNOTS WEST WIND

PLATE 49


SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, SLACK TIDE
20 KNOTS WEST WIND
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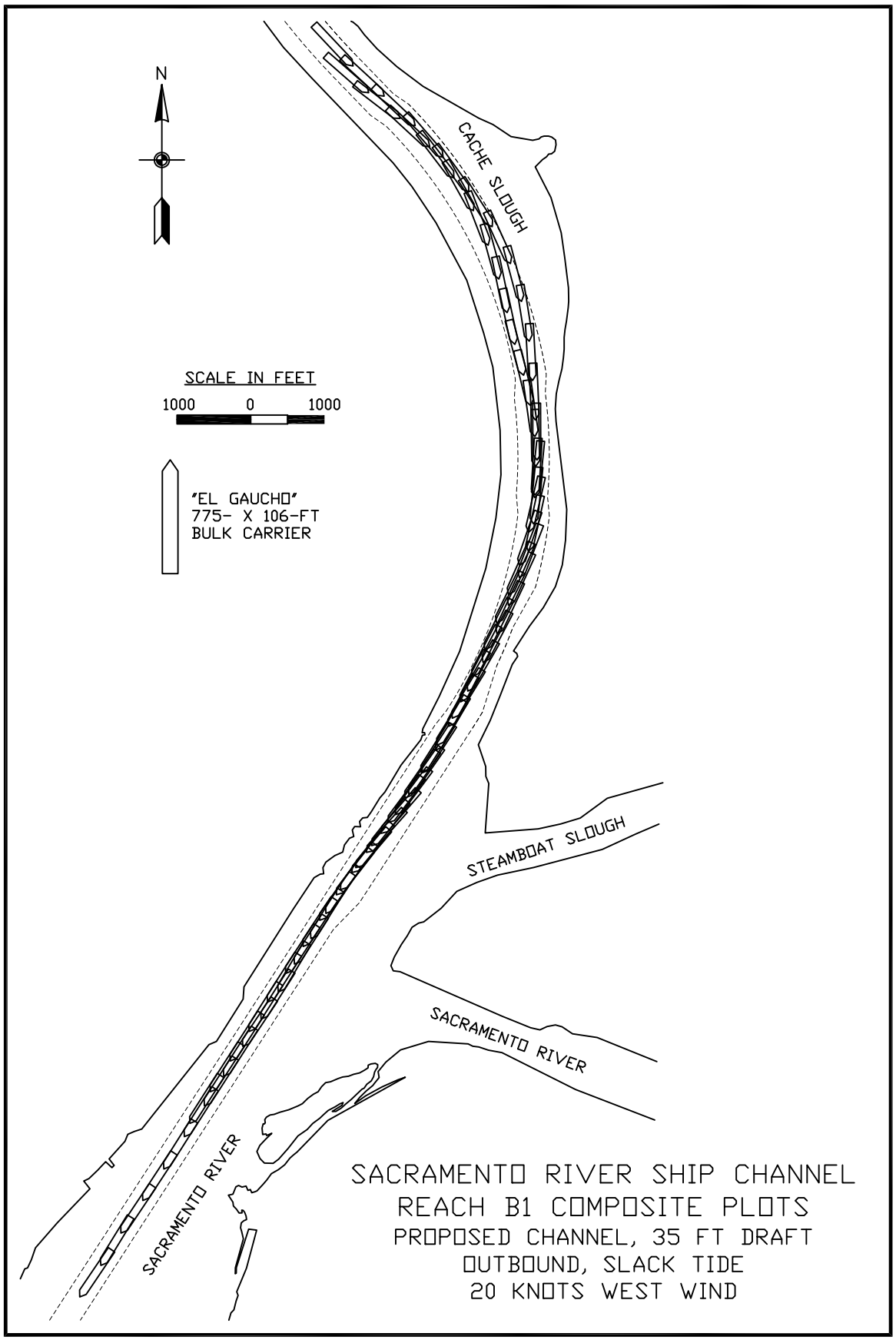
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000
0
1000
1000

PLATE 50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775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, SLACK TIDE
20 KNOTS WEST WIND

PLATE 51

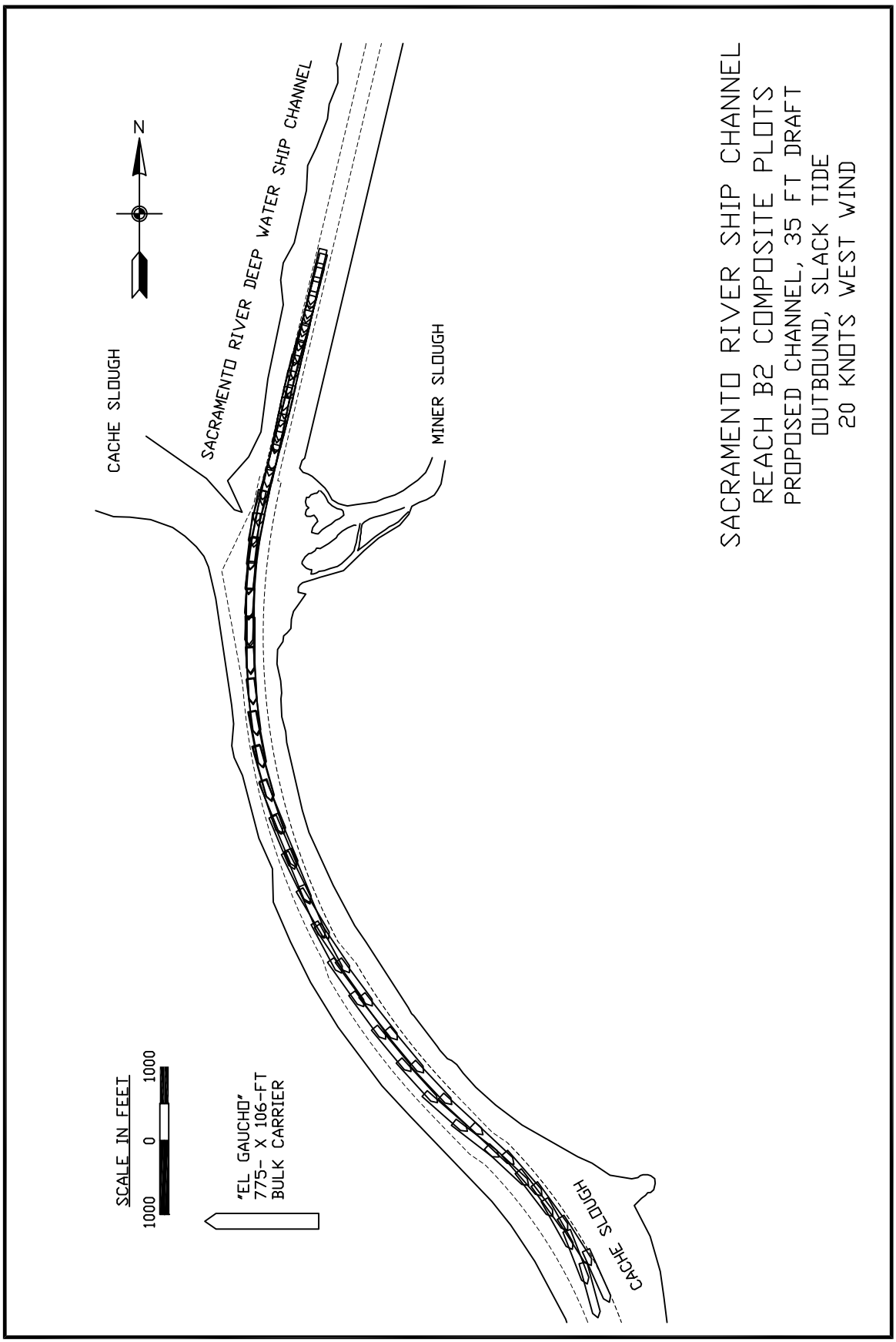
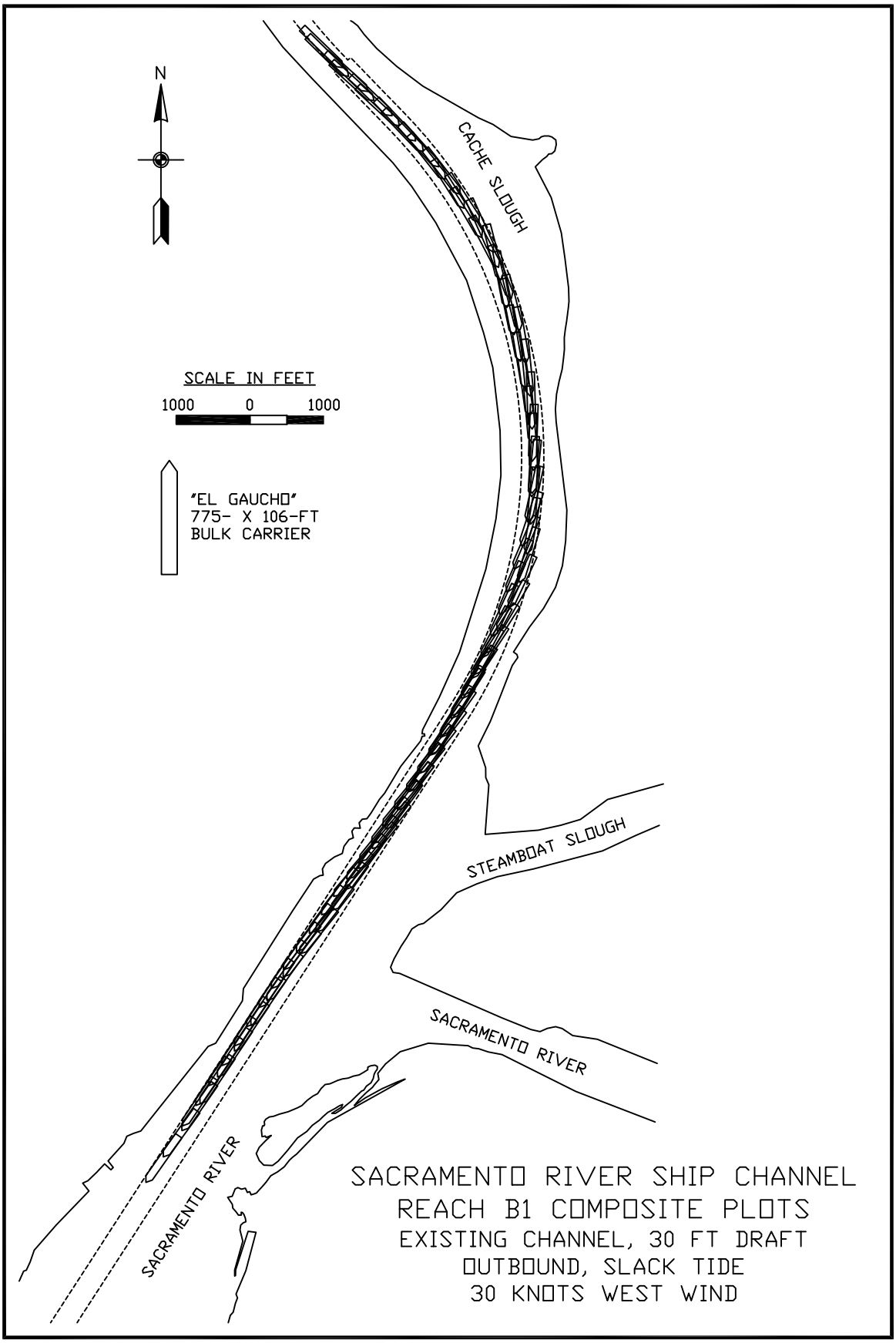

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, SLACK TIDE
20 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000
0
1000

PLATE 52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SCALE IN FEET
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"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, SLACK TIDE
30 KNOTS WEST WIND

PLATE 53

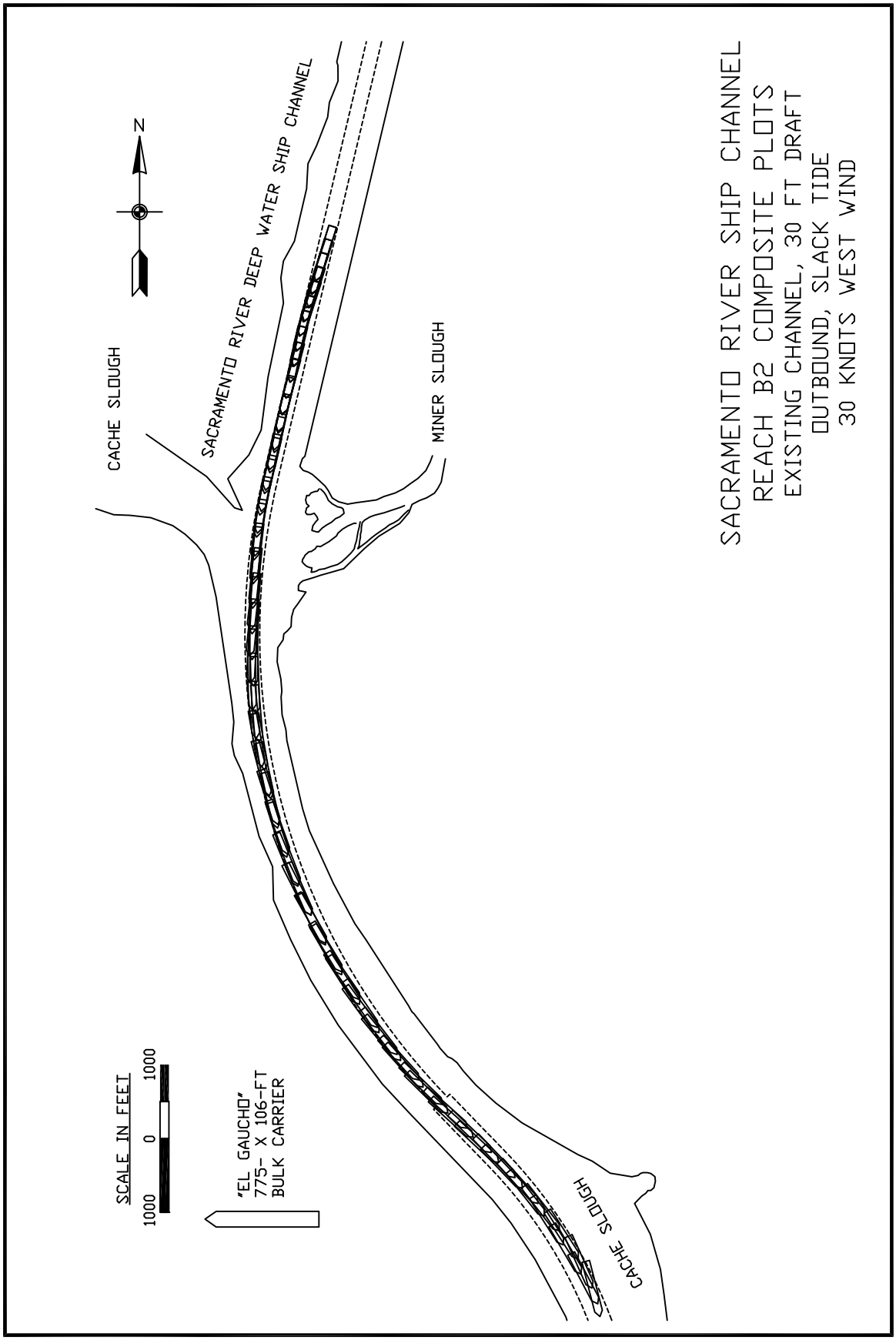
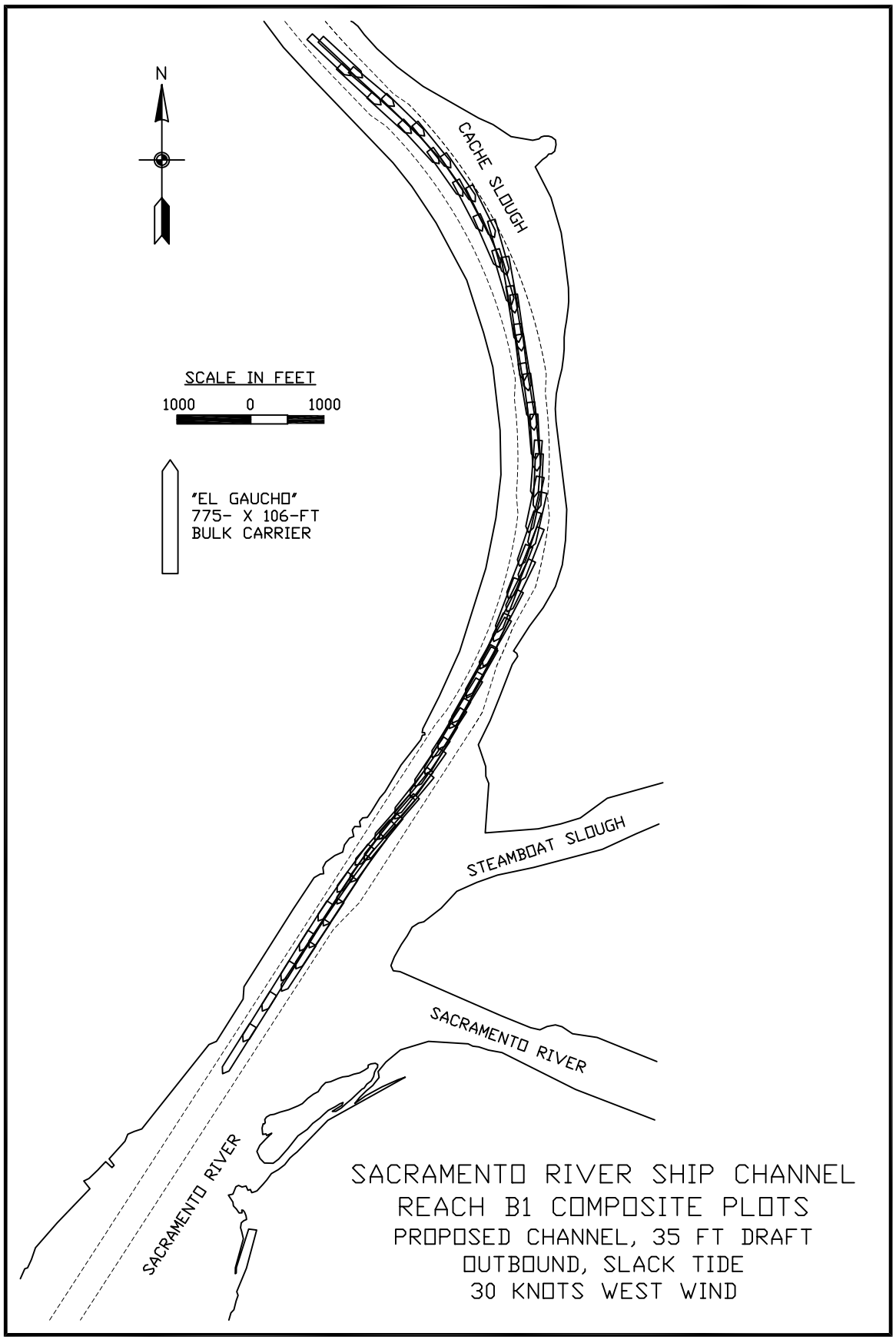

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, SLACK TIDE
30 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000

PLATE 54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SCALE IN FEET
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"EL GAUCHO"
775- X 106-FT
BULK CARRIER
STEAMBOAT SLOUGH
SACRAMENTO RIVER
SACRAMENTO RIVER
SACRAMENTO RIVER SHIP CHANNEL
REACH B1 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, SLACK TIDE
30 KNOTS WEST WIND

PLATE 55

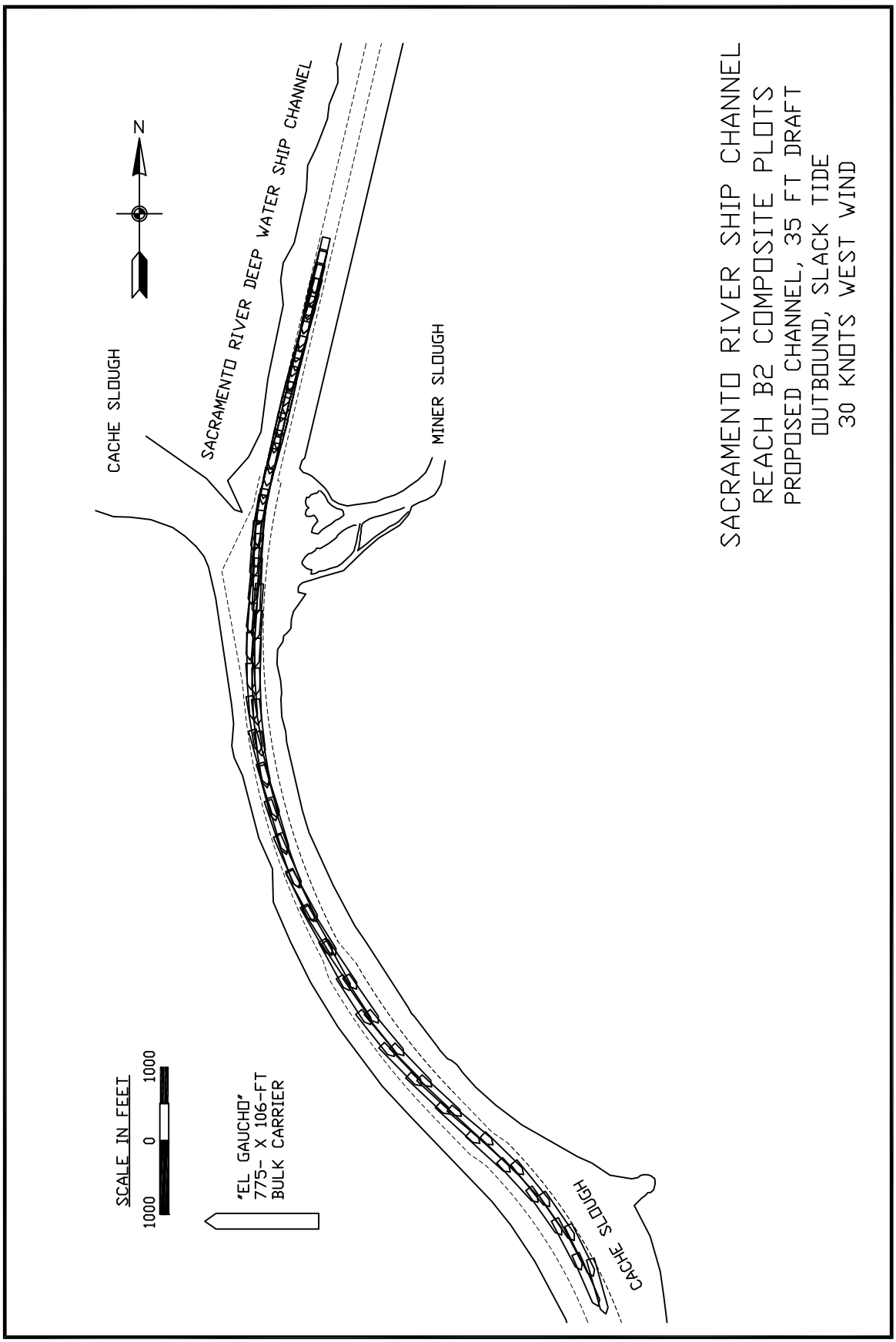
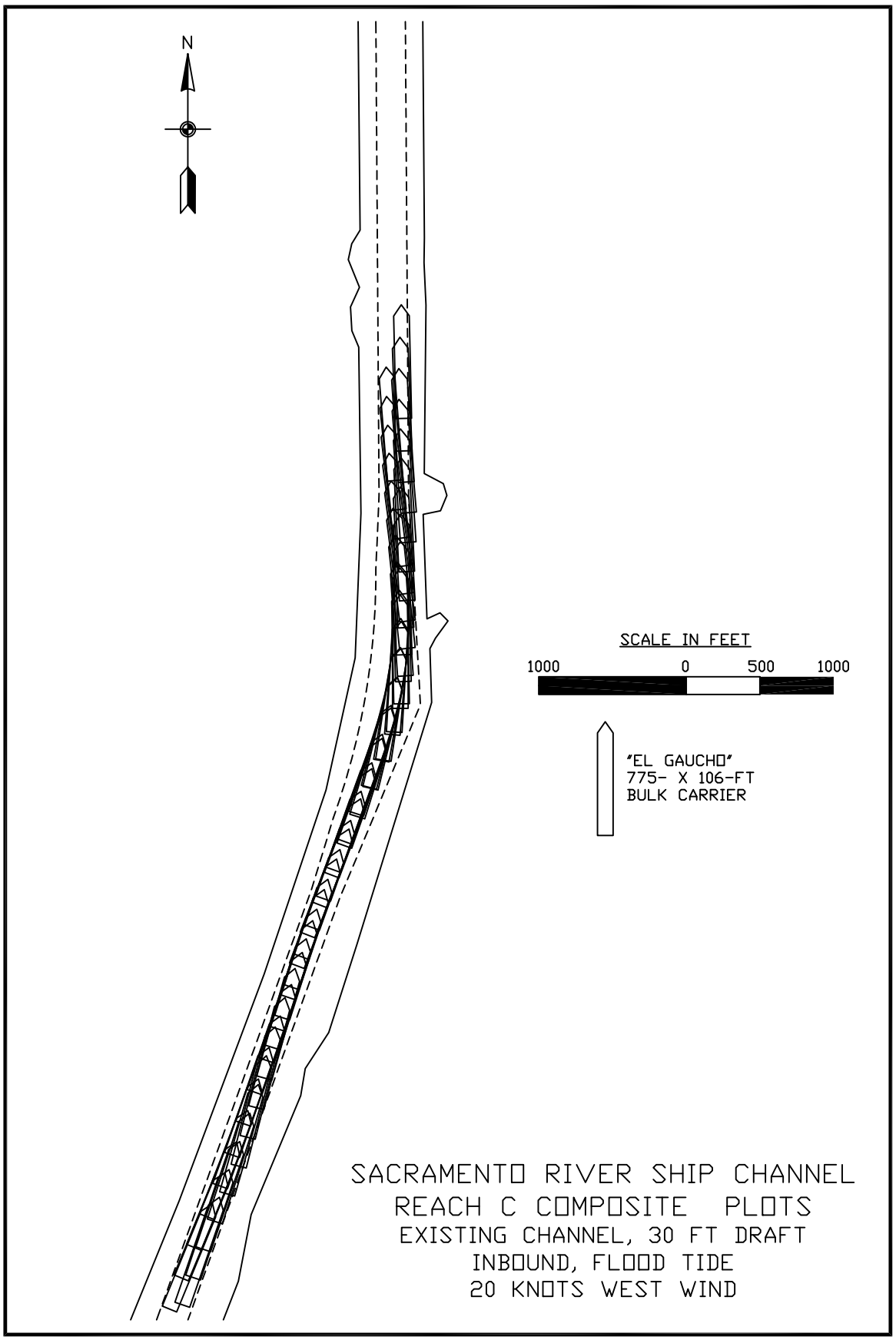

SACRAMENTO RIVER SHIP CHANNEL
REACH B2 COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, SLACK TIDE
30 KNOTS WEST WIND
N
CACHE SLOUGH
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
MINER SLOUGH
CACHE SLOUGH
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000
0
1000

PLATE 56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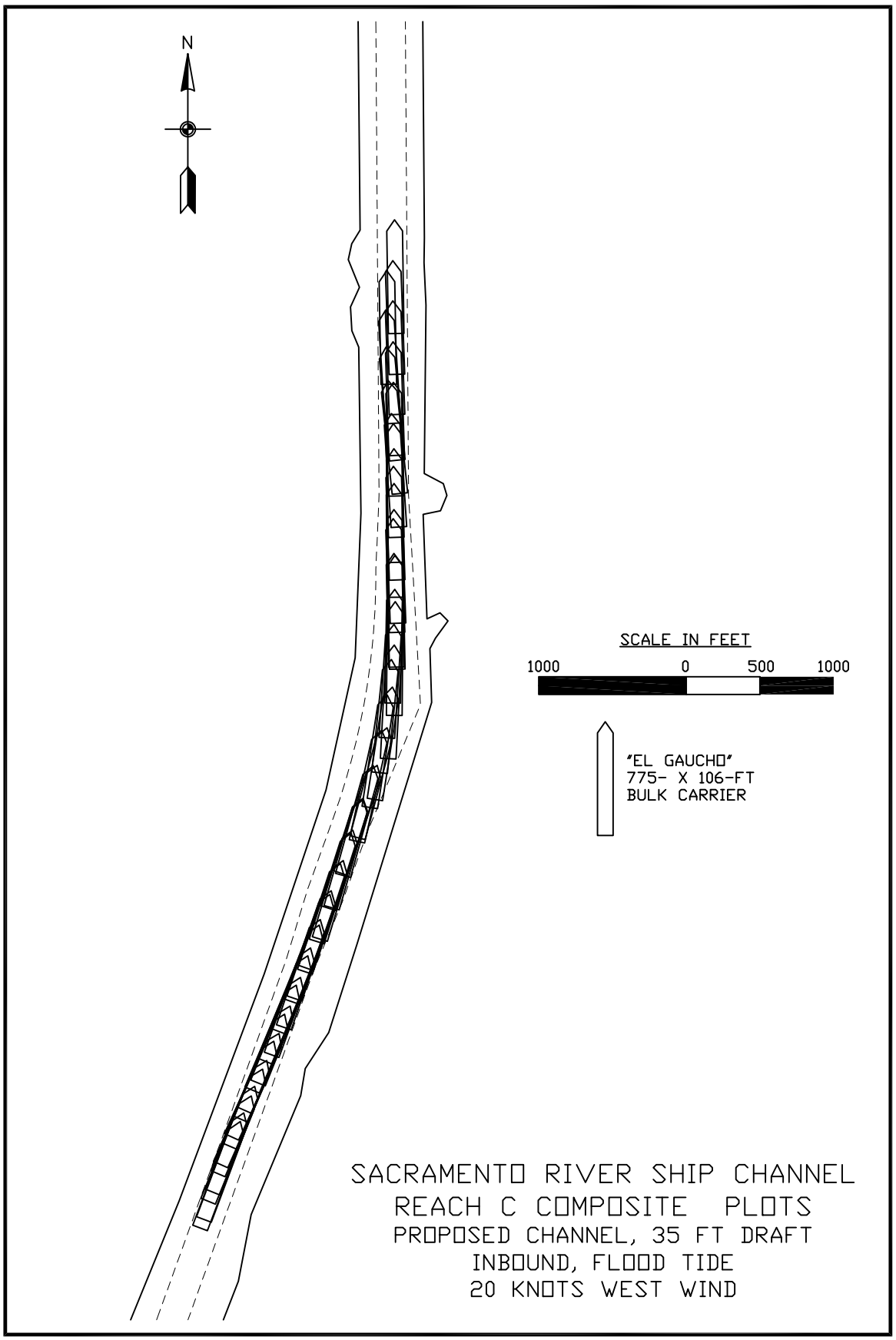
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, FLOOD TIDE
20 KNOTS WEST WIND

PLATE 57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BULK CARRIER
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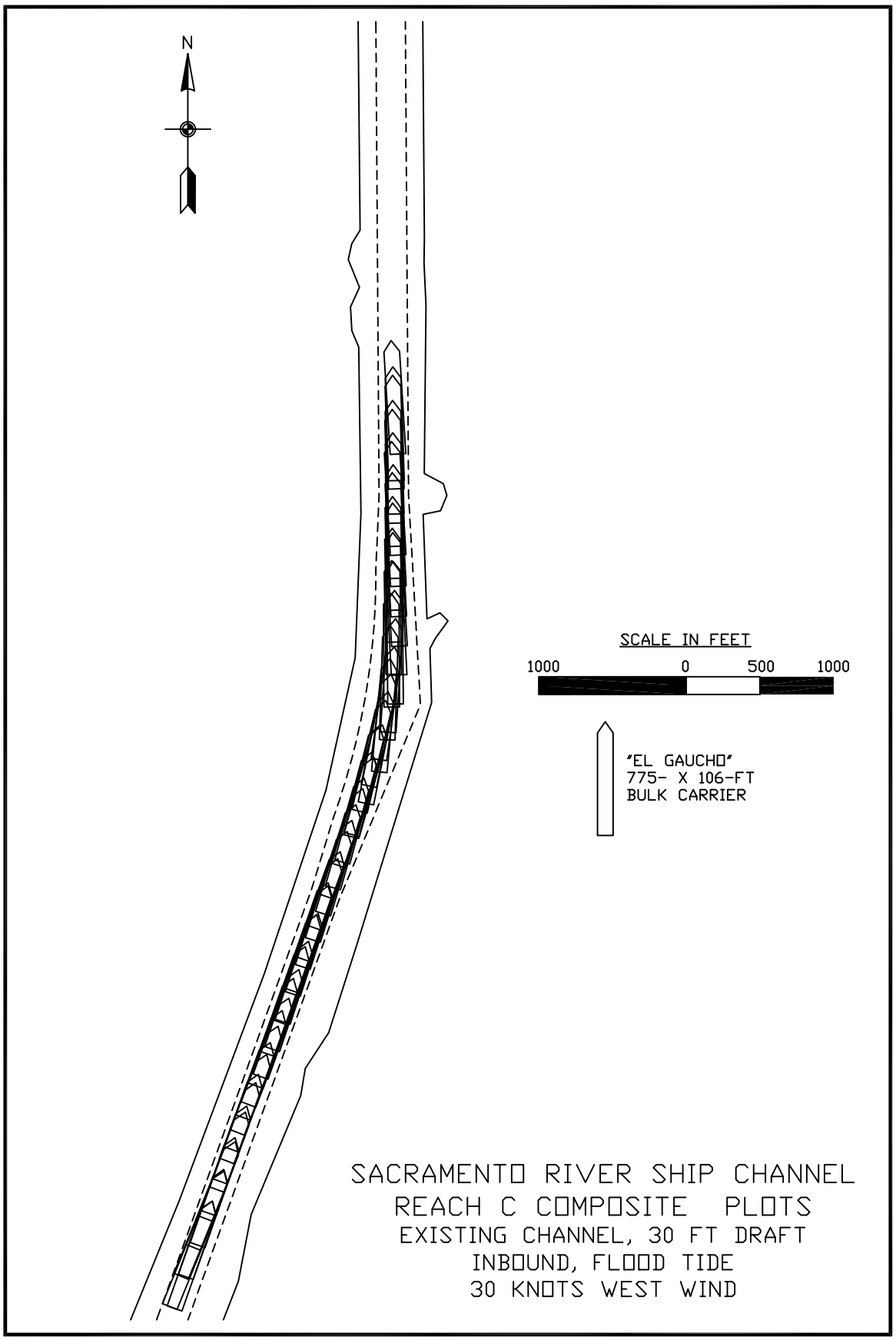
REACH C COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, FLOOD TIDE
20 KNOTS WEST WIND

PLATE 58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BULK CARRIER
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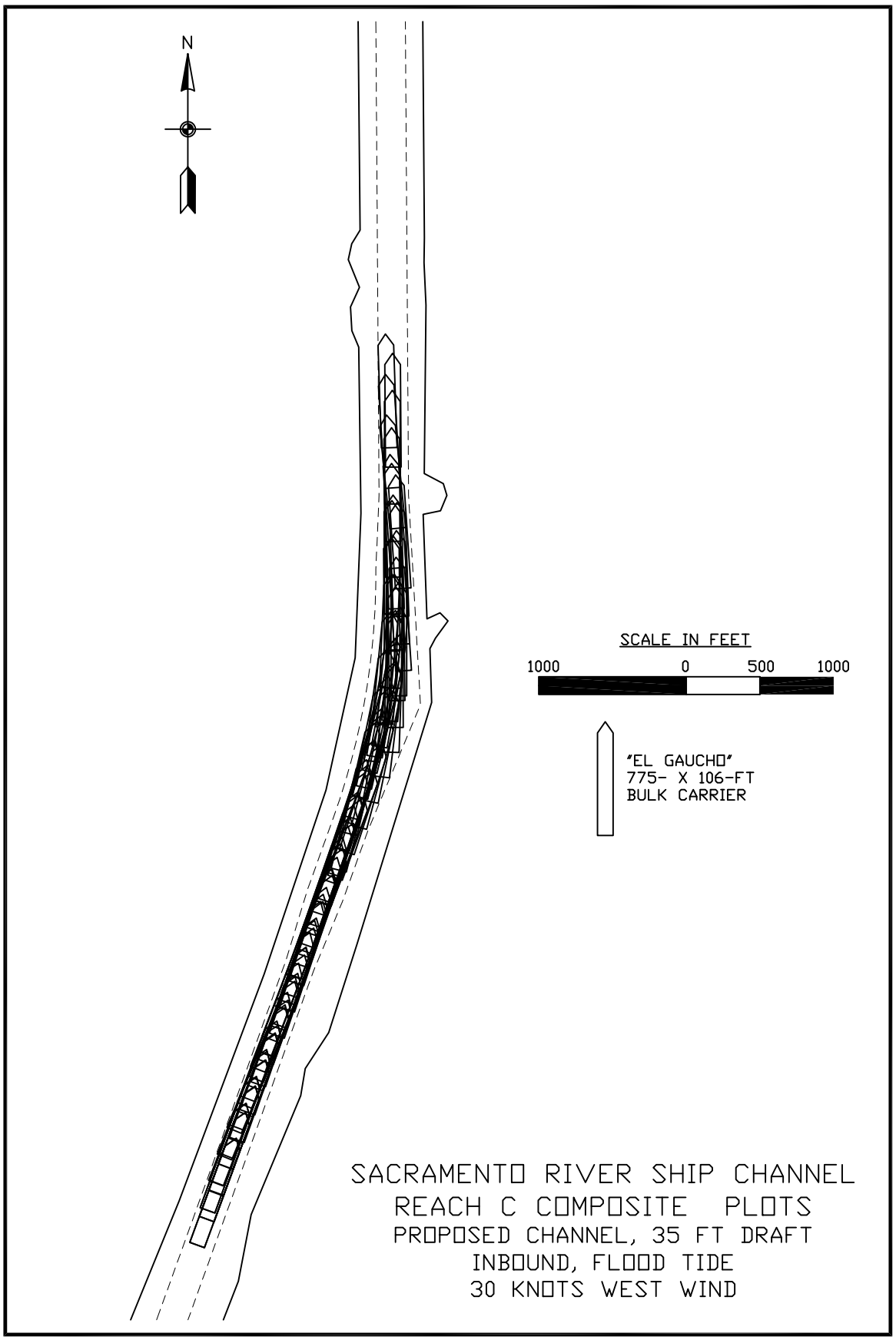
REACH C COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, FLOOD TIDE
30 KNOTS WEST WIND

PLATE 59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BULK CARRIER
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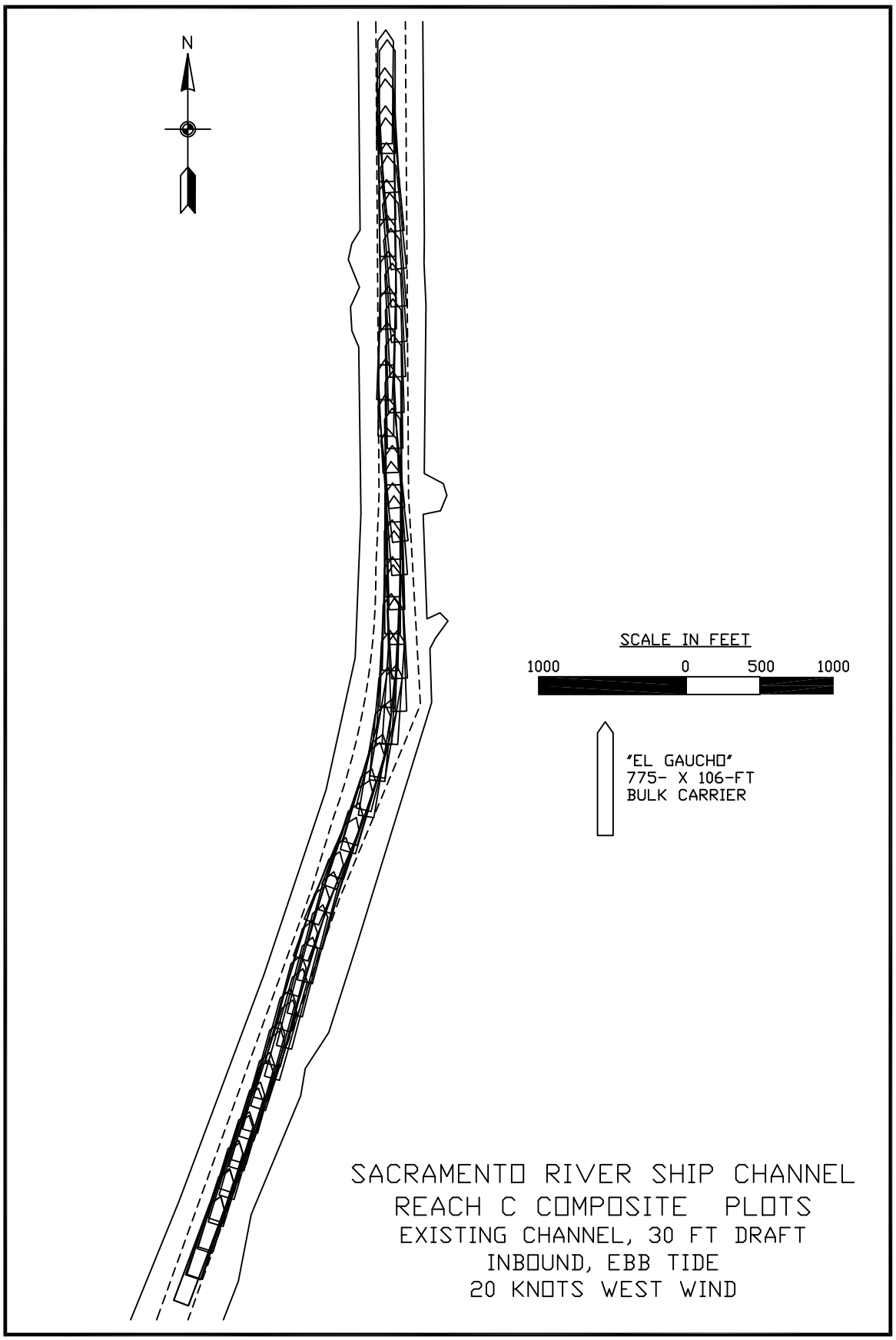
REACH C COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, FLOOD TIDE
30 KNOTS WEST WIND

PLATE 60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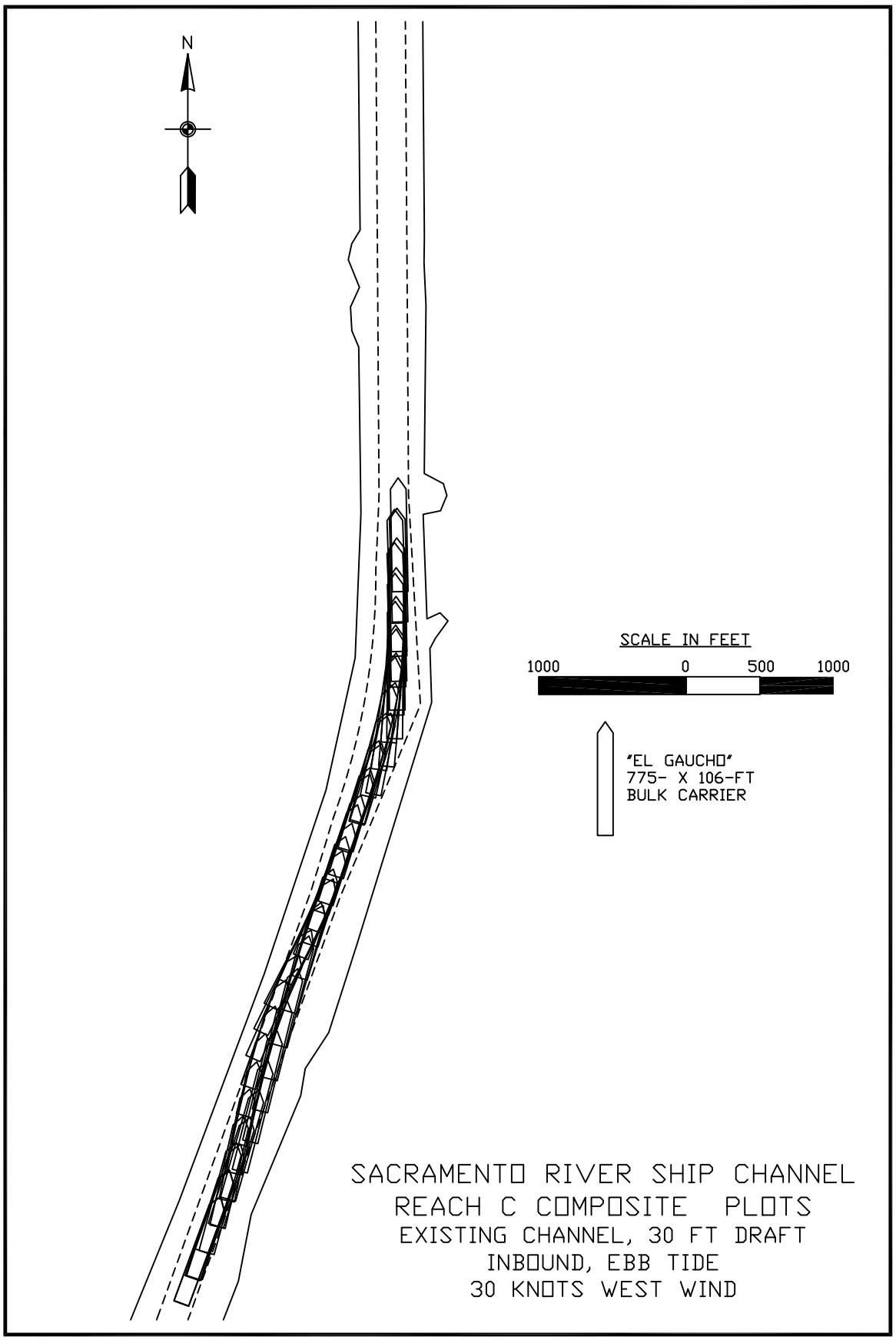
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, EBB TIDE
20 KNOTS WEST WIND

PLATE 61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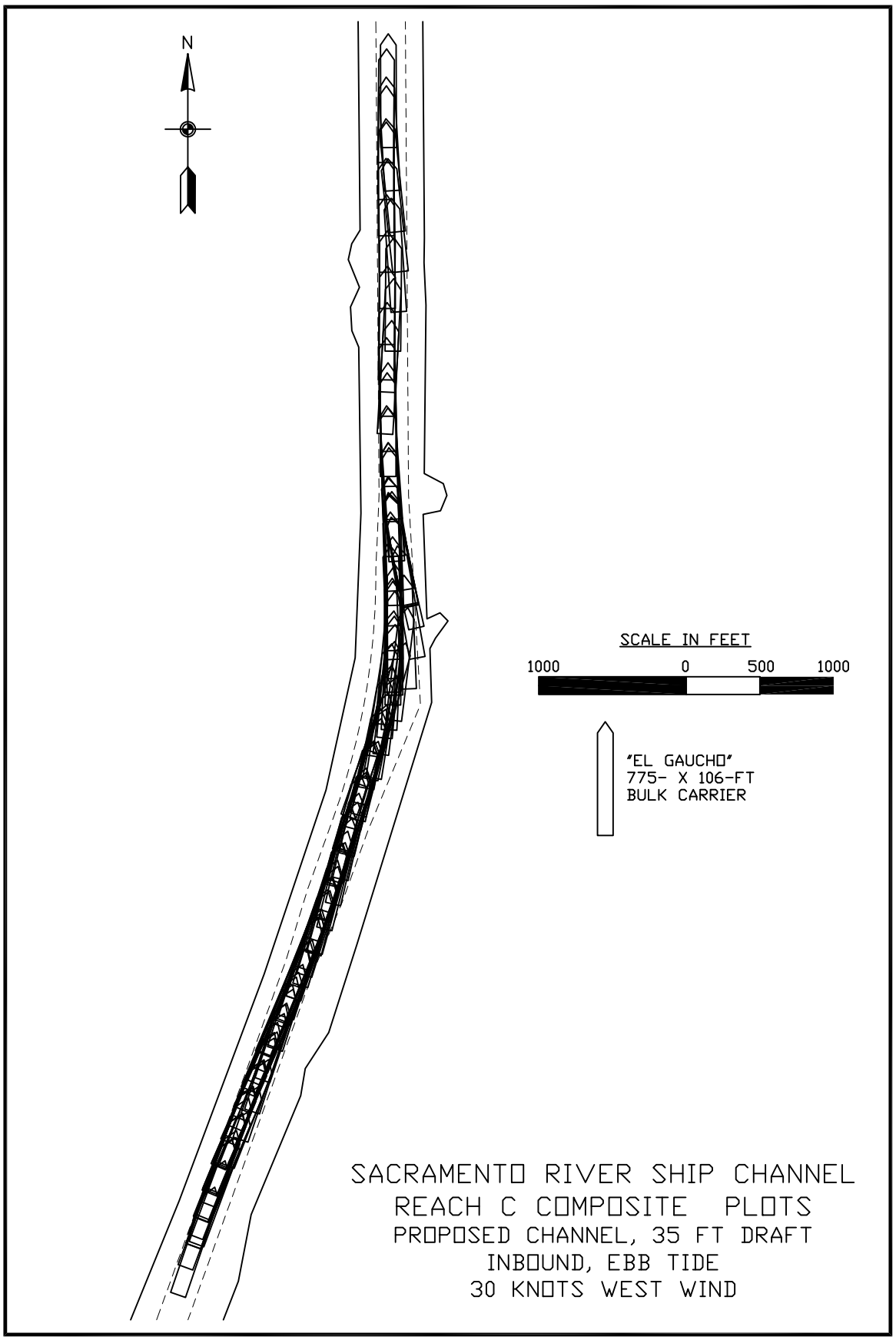
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, EBB TIDE
30 KNOTS WEST WIND

PLATE 62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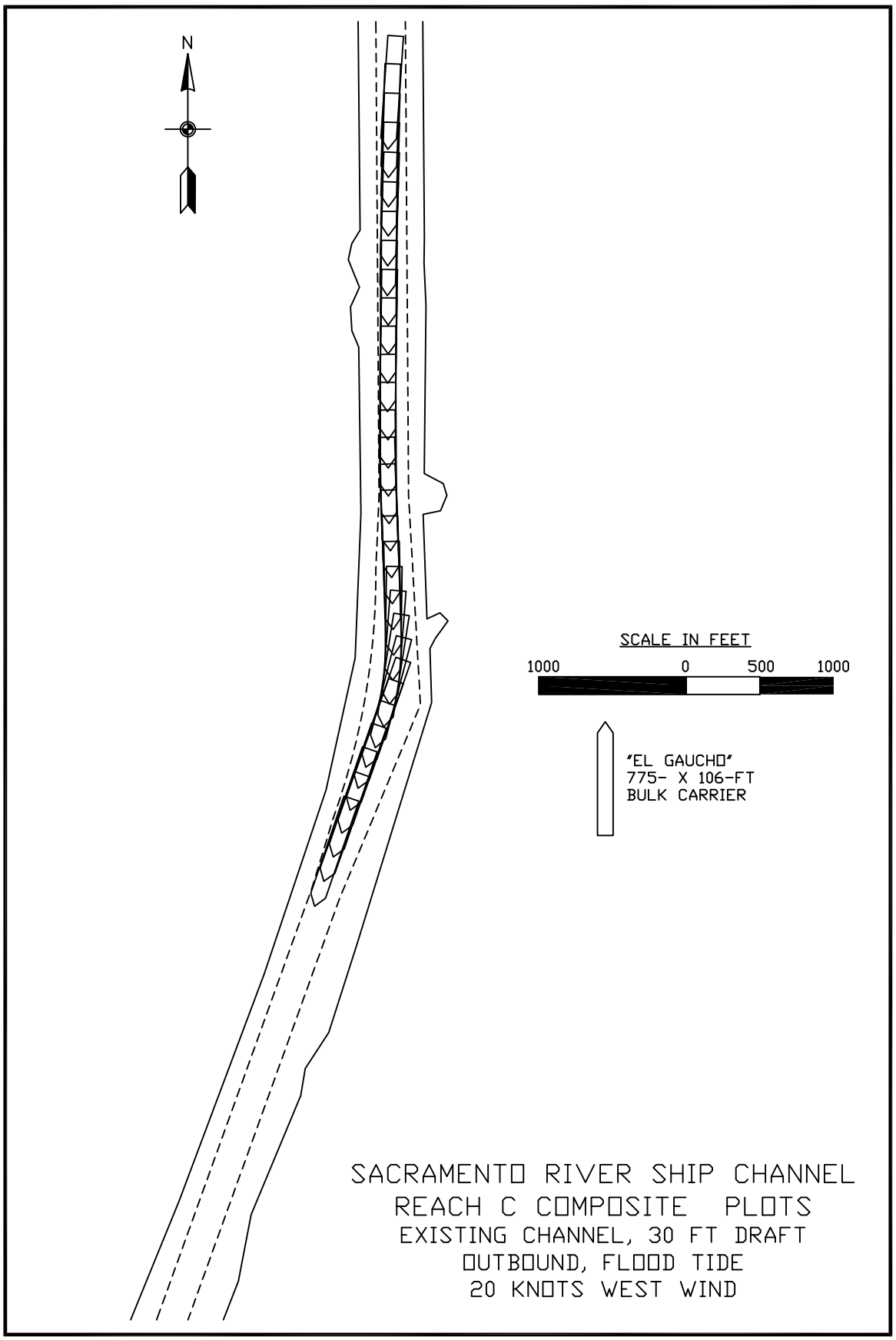
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, EBB TIDE
30 KNOTS WEST WIND

PLATE 63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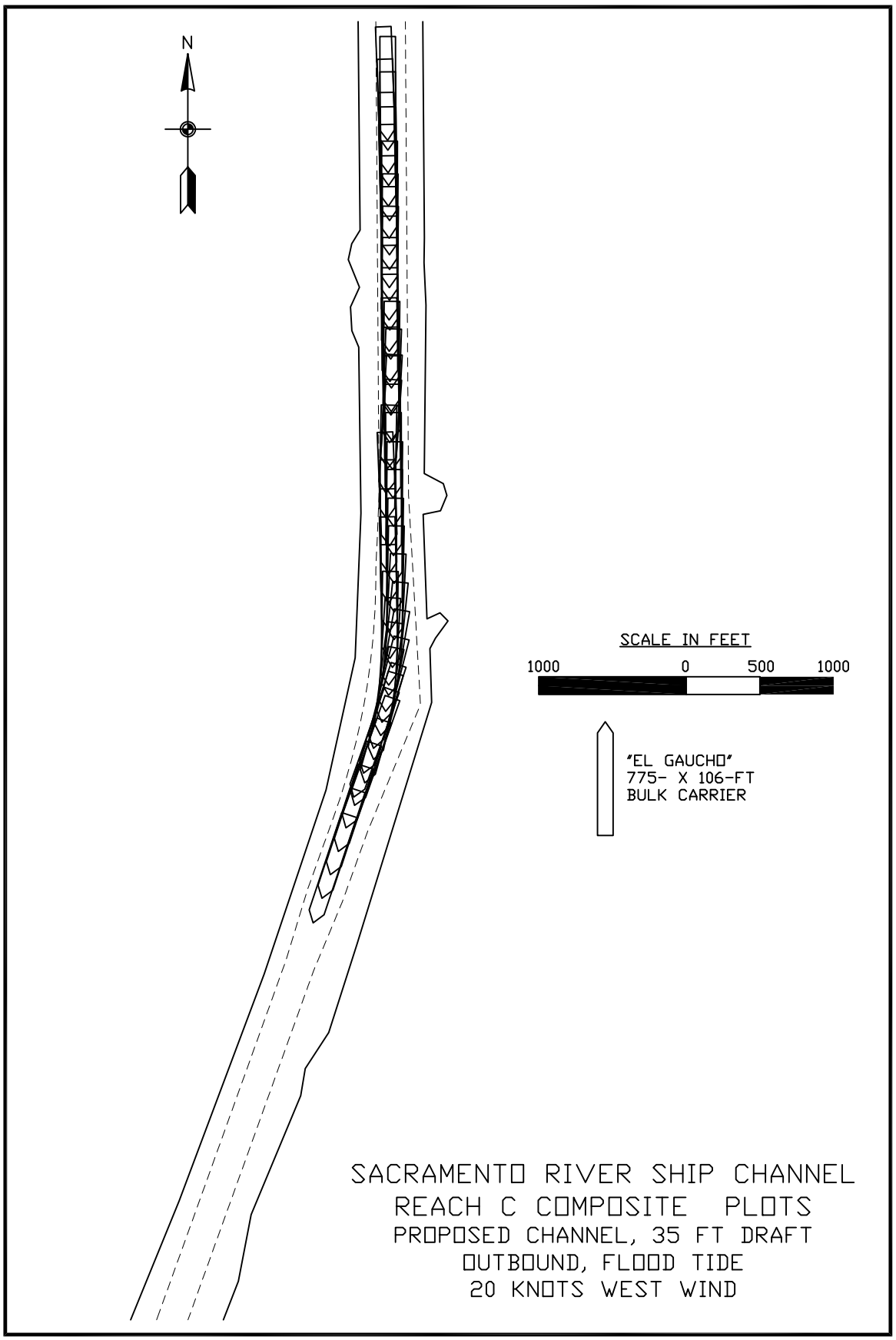
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, FLOOD TIDE
20 KNOTS WEST WIND

PLATE 64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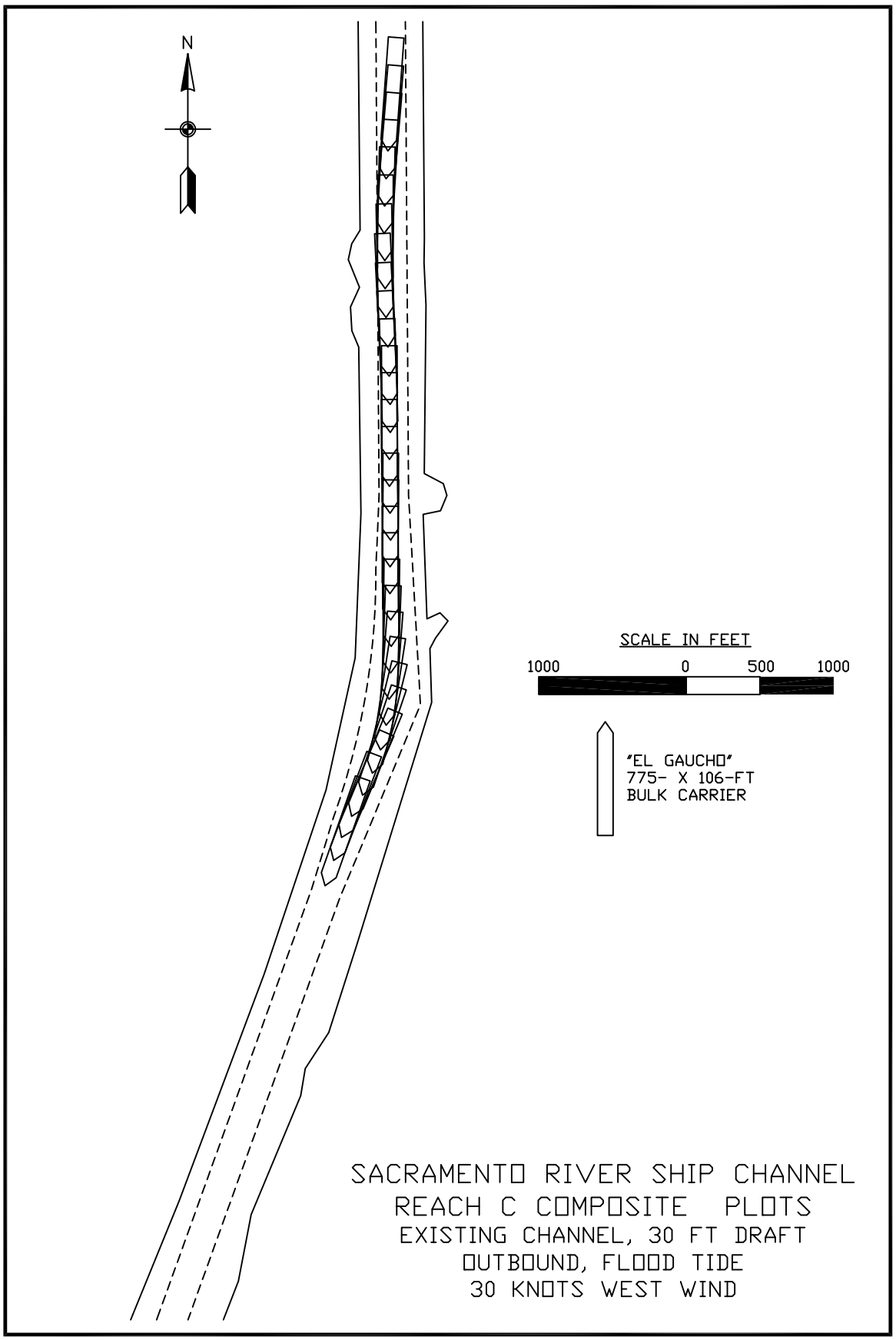
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, FLOOD TIDE
20 KNOTS WEST WIND

PLATE 65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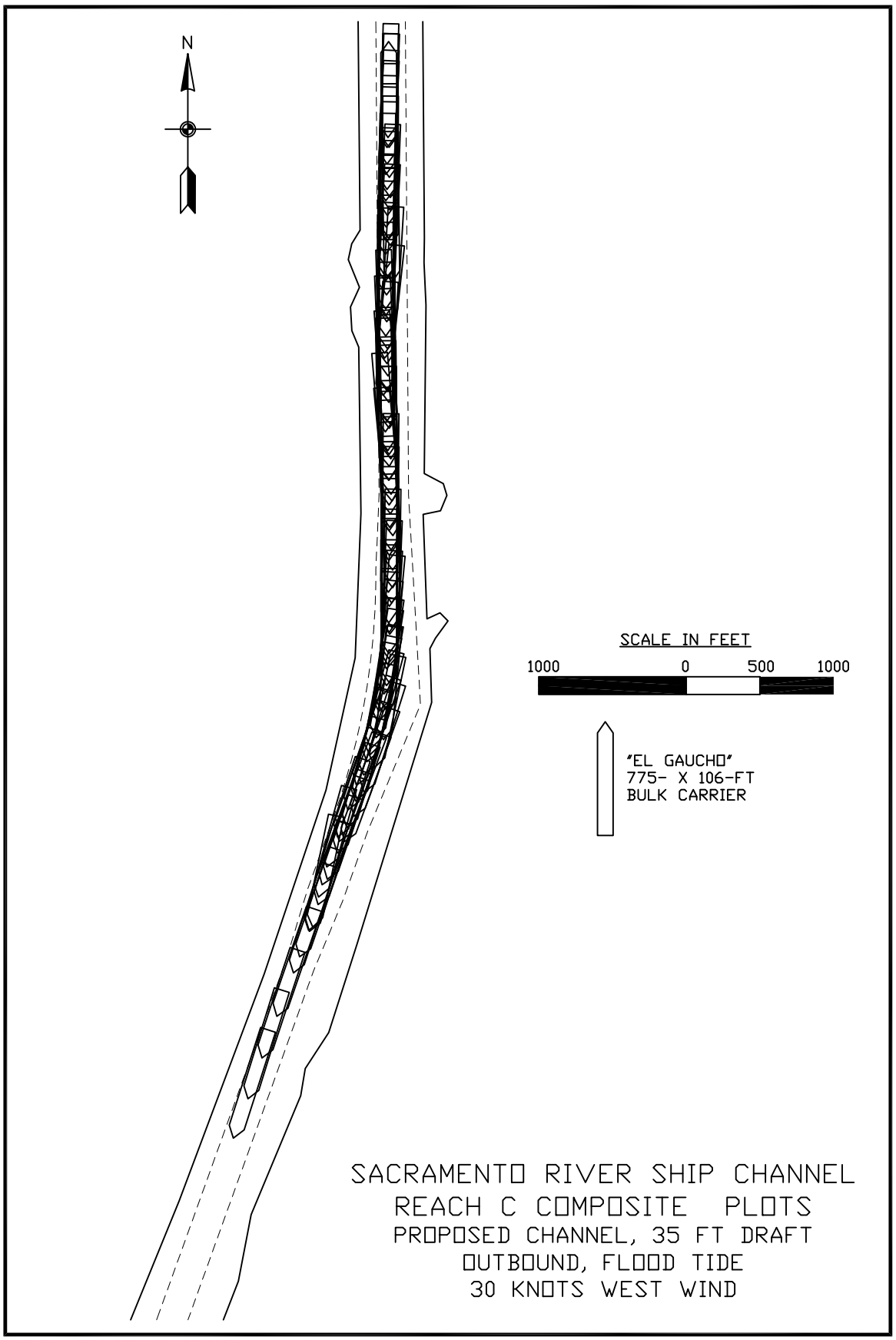
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, FLOOD TIDE
30 KNOTS WEST WIND

PLATE 66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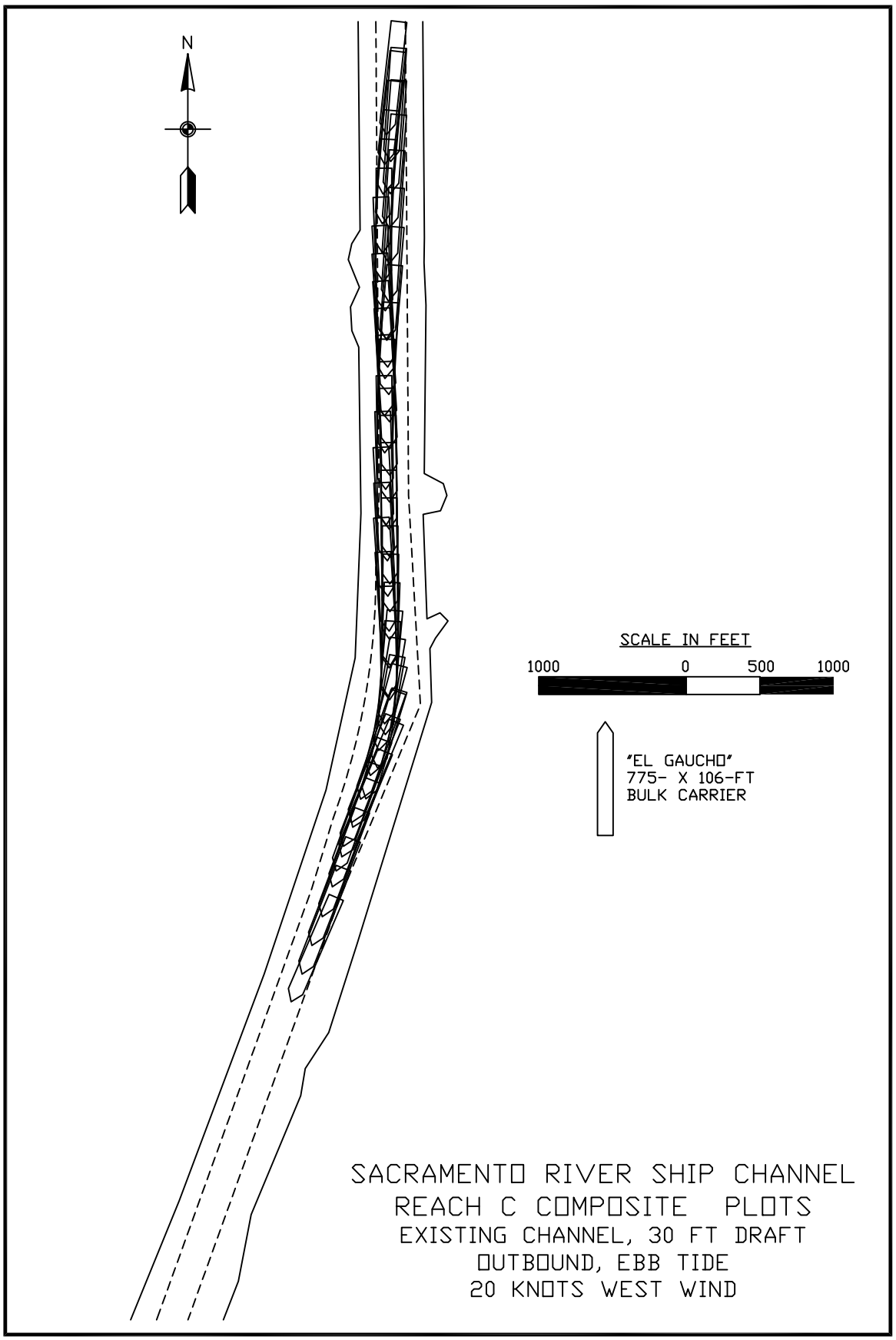
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, FLOOD TIDE
30 KNOTS WEST WIND

PLATE 67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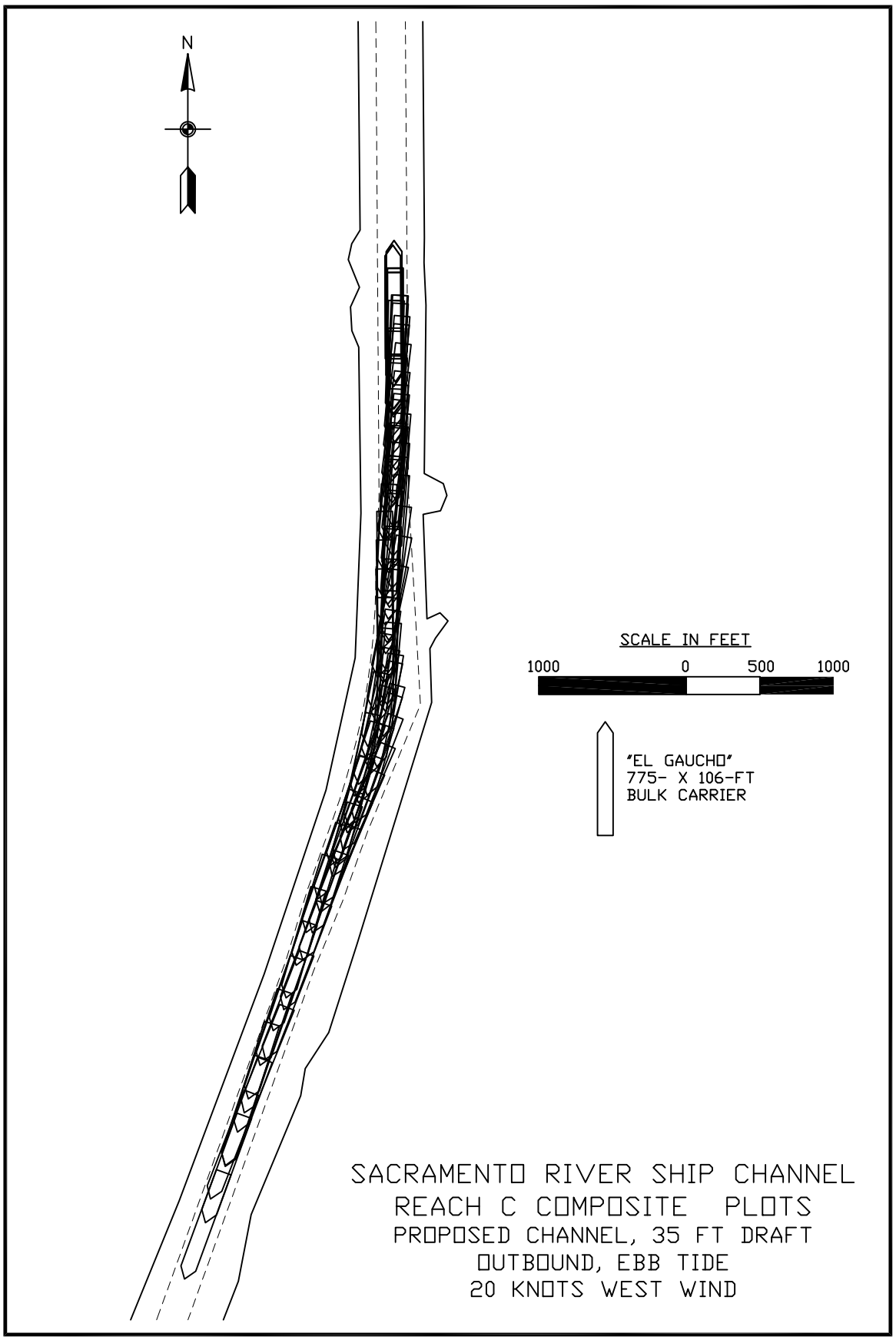
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, EBB TIDE
20 KNOTS WEST WIND

PLATE 68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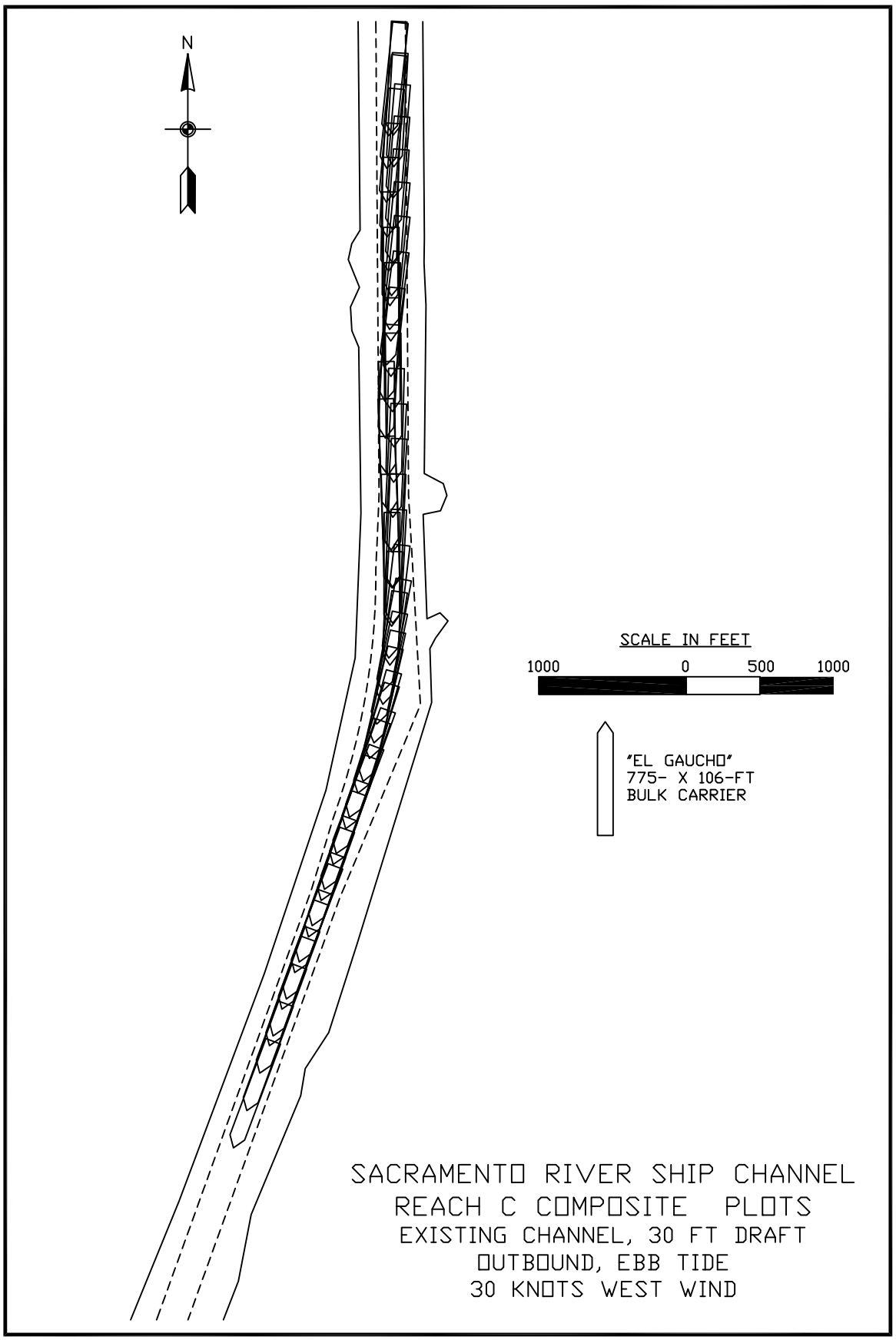
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, EBB TIDE
20 KNOTS WEST WIND

PLATE 69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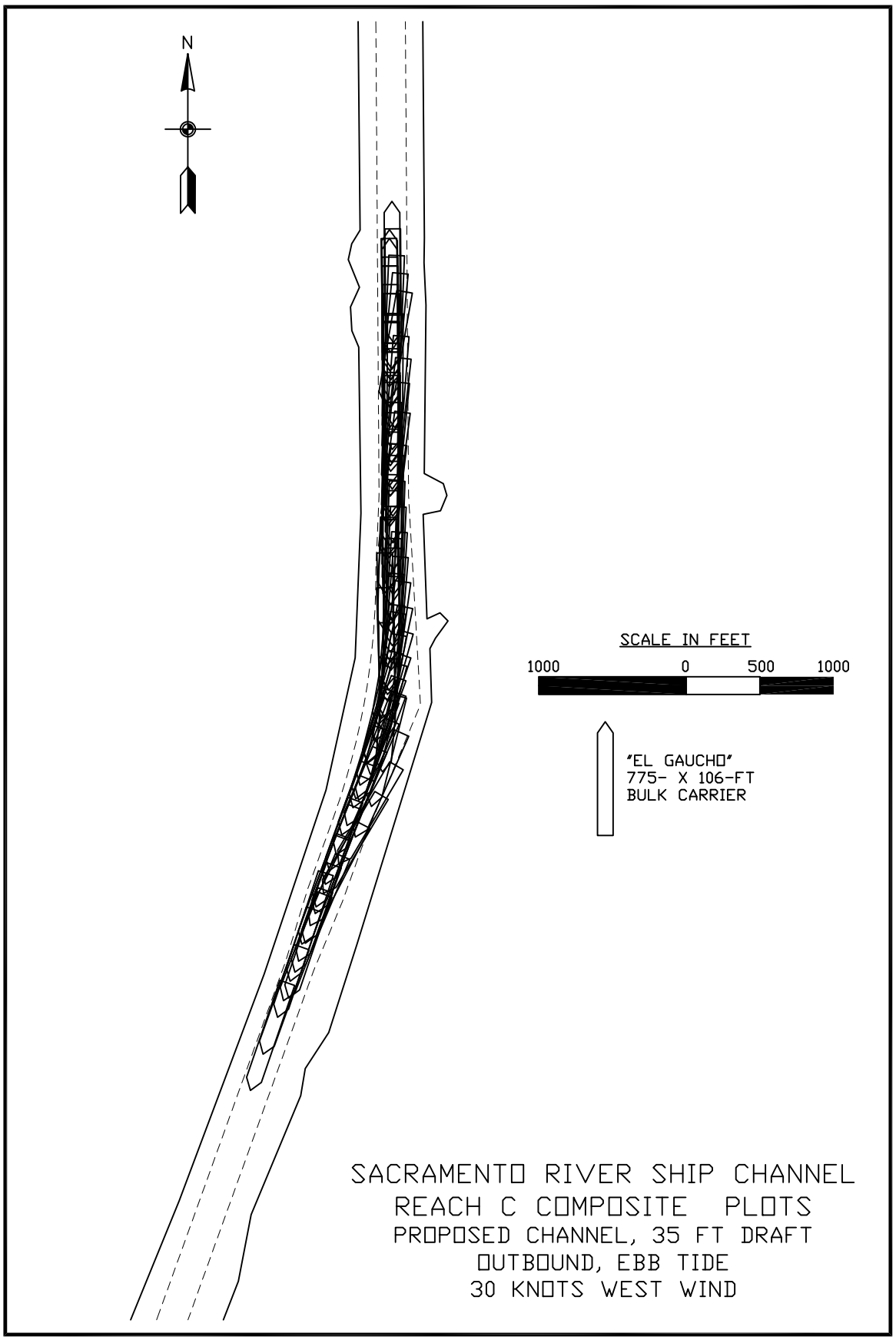
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, EBB TIDE
30 KNOTS WEST WIND

PLATE 70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"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SACRAMENTO RIVER SHIP CHANNEL
REACH C COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, EBB TIDE
30 KNOTS WEST WIND

PLATE 71

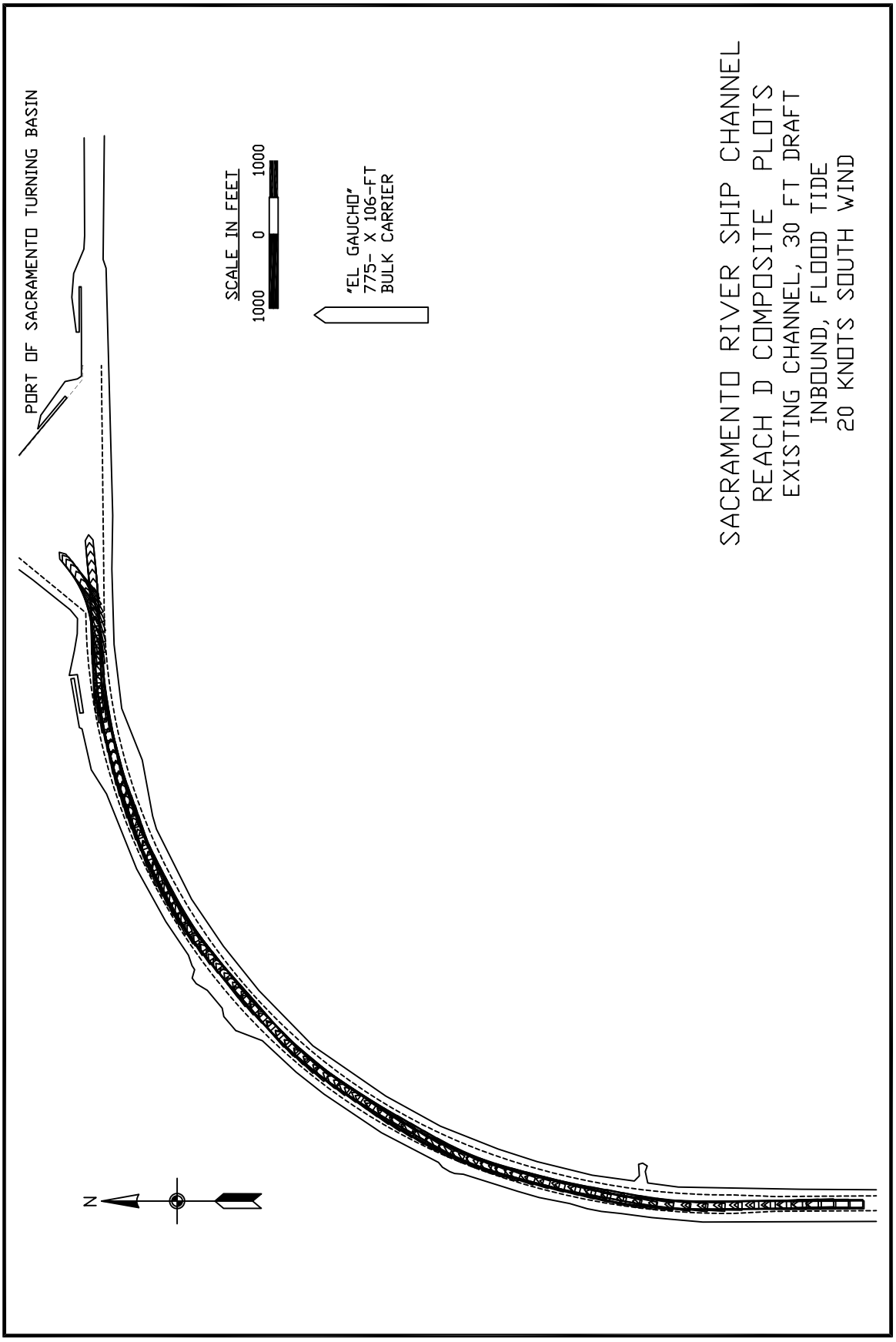
SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, FLOOD TIDE
20 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 72

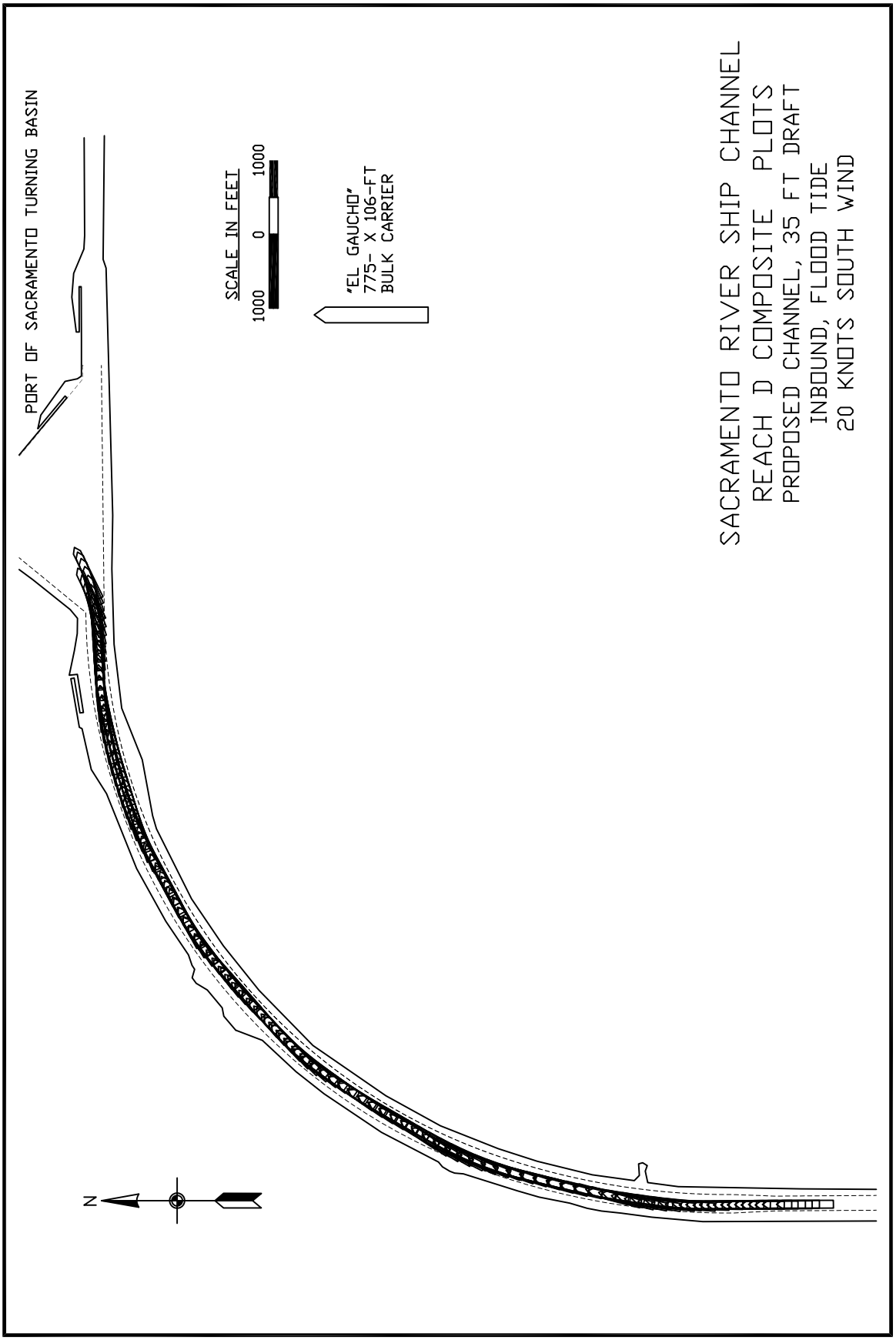
SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, FLOOD TIDE
20 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 73

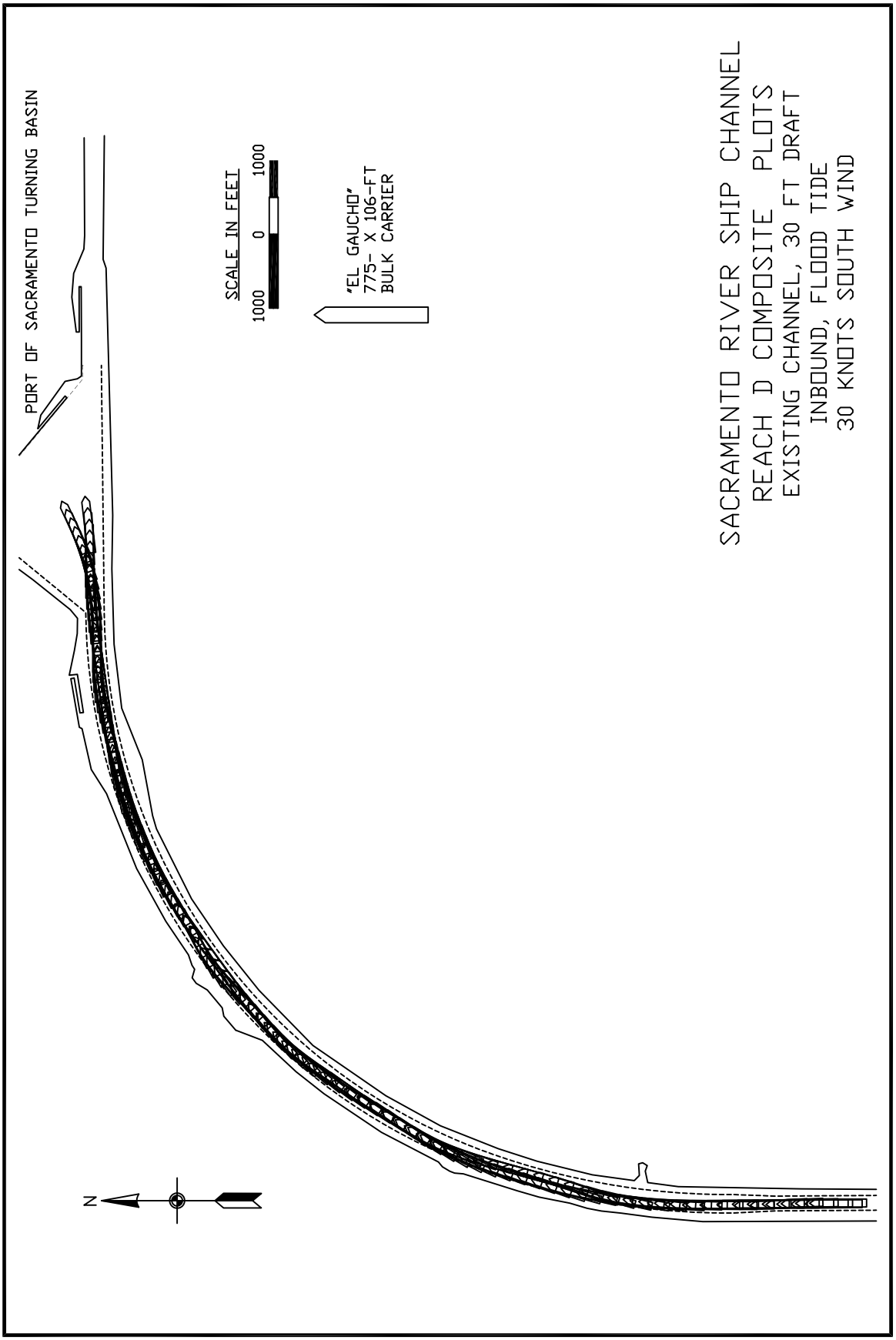
SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, FLOOD TIDE
30 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 74

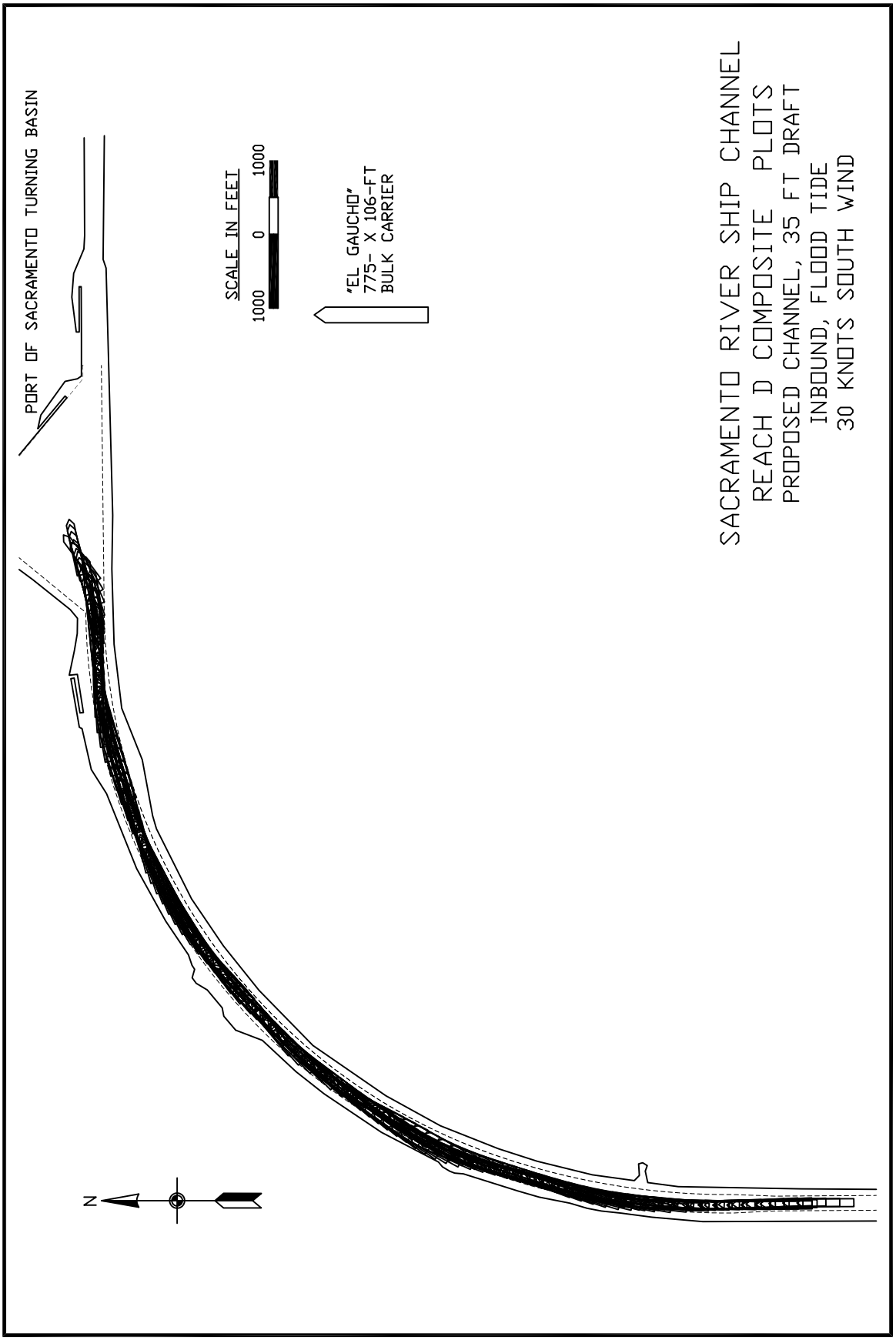
SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, FLOOD TIDE
30 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 75

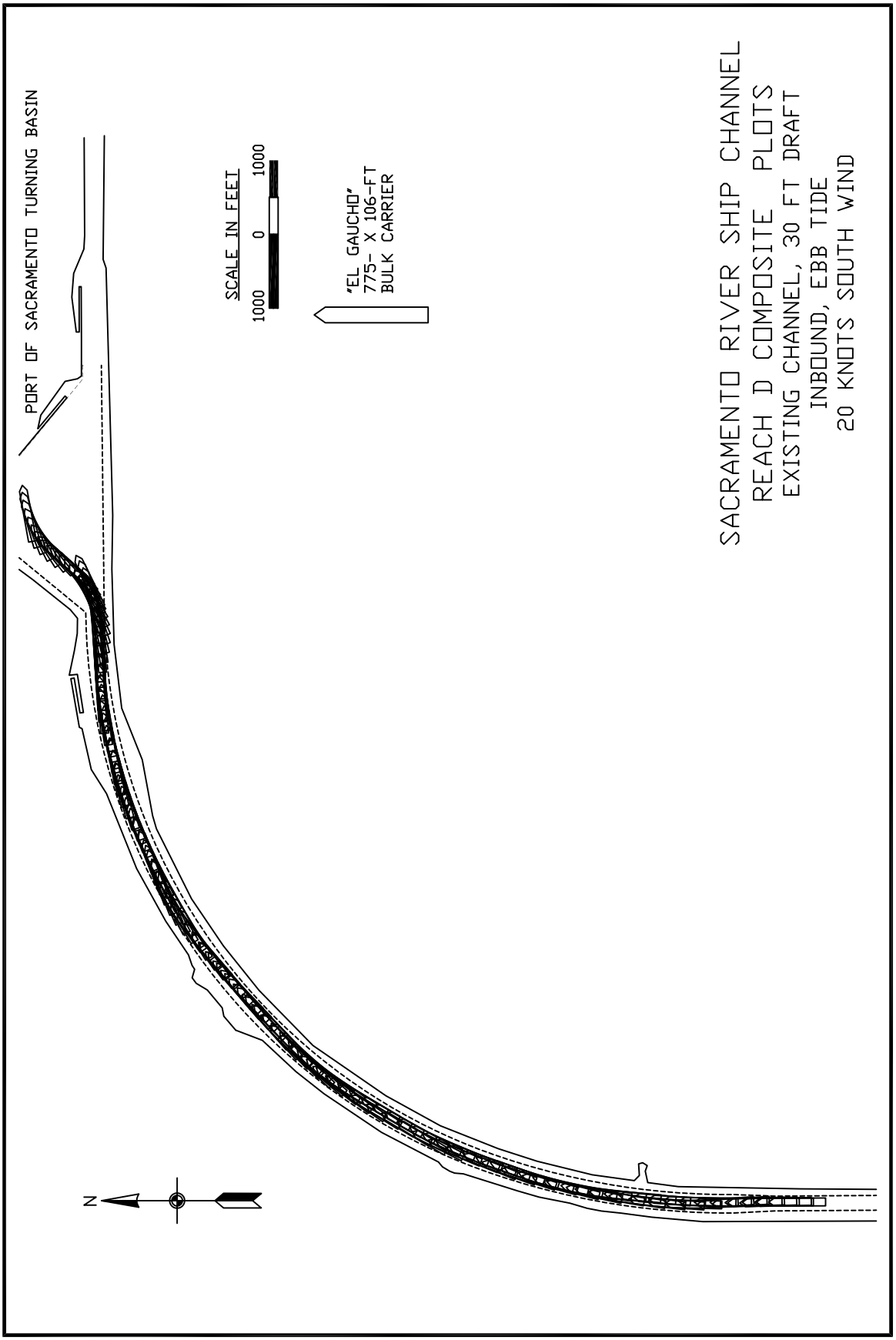
SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, EBB TIDE
20 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 76

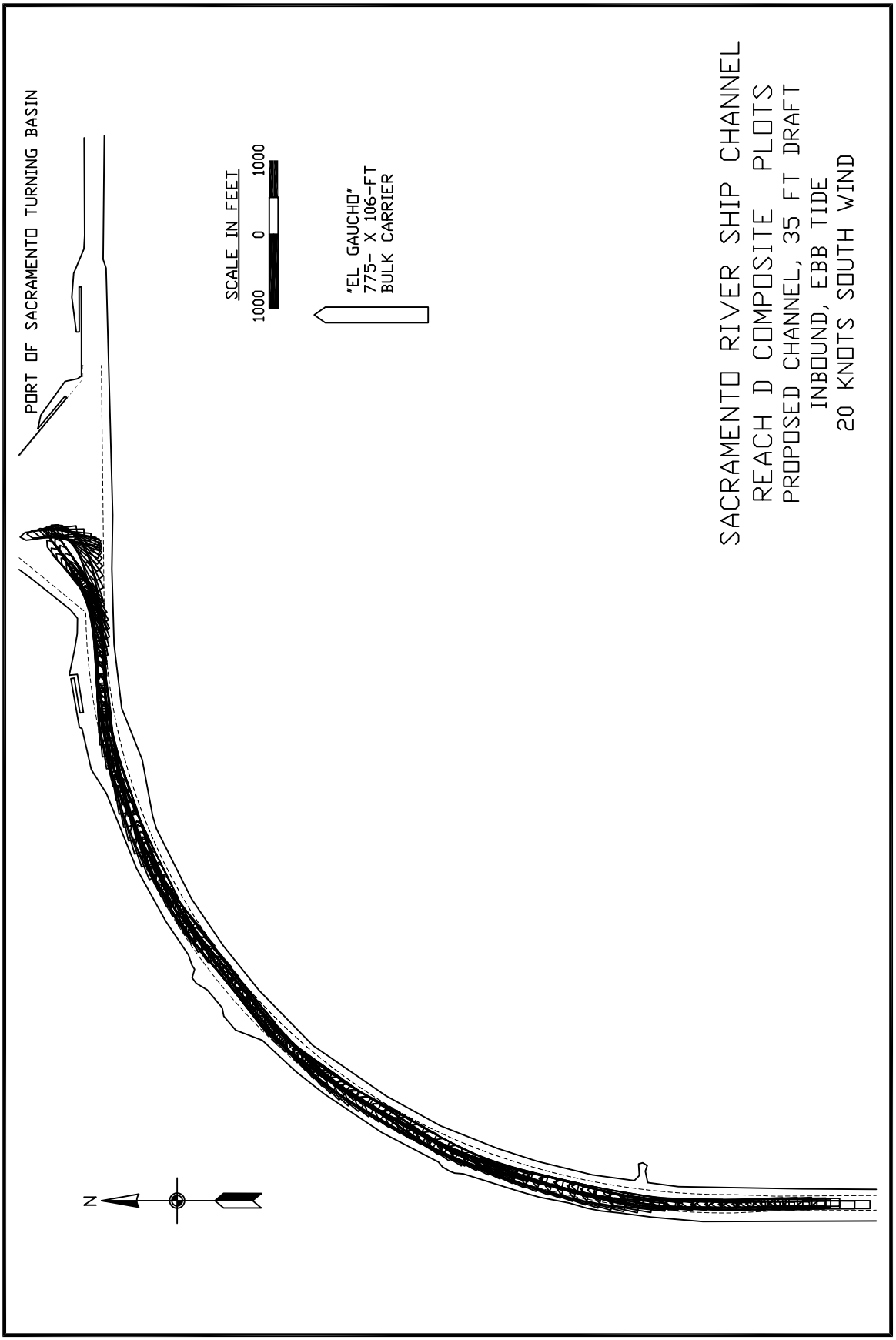
SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, EBB TIDE
20 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 77

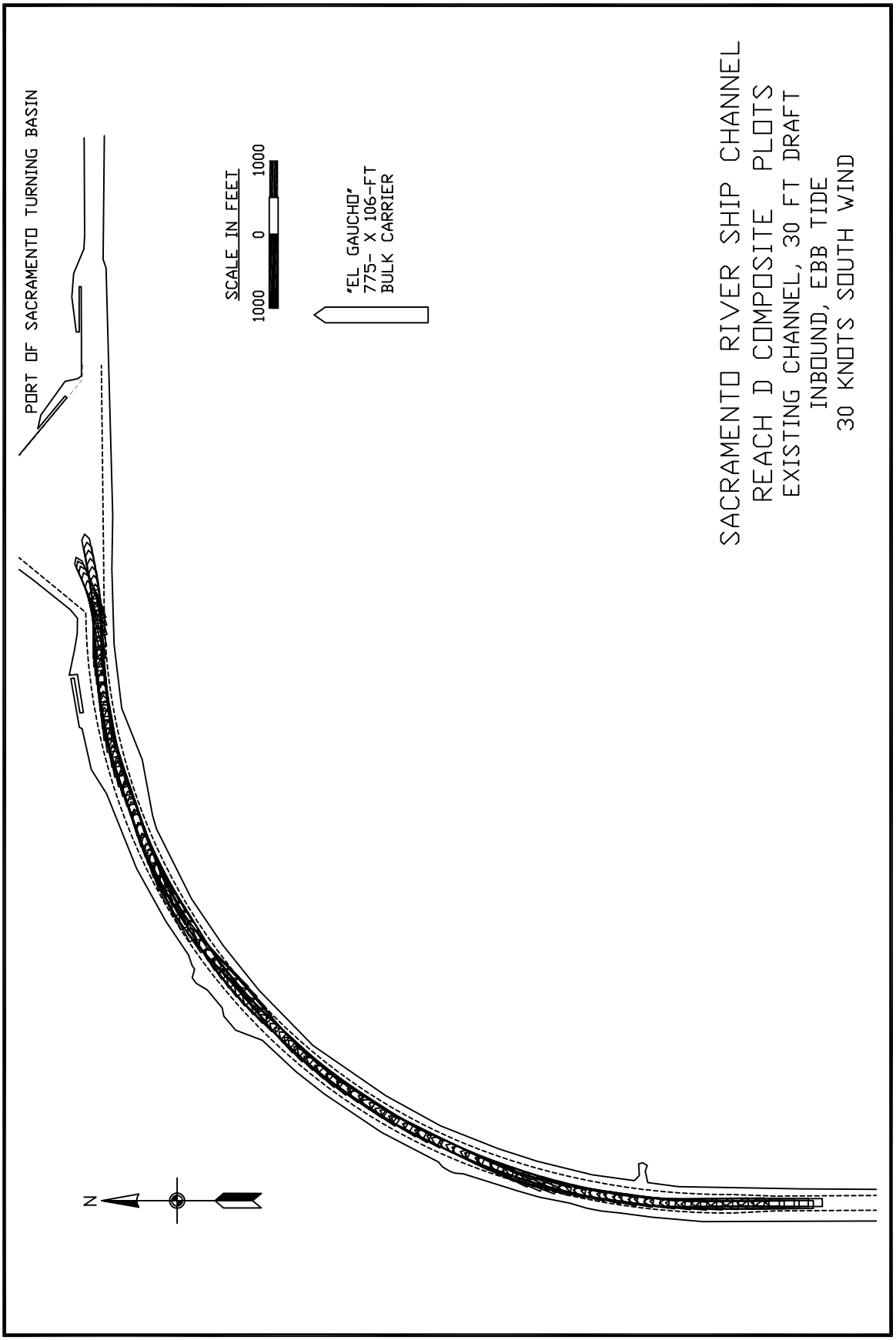
SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
INBOUND, EBB TIDE
30 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
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PLATE 78

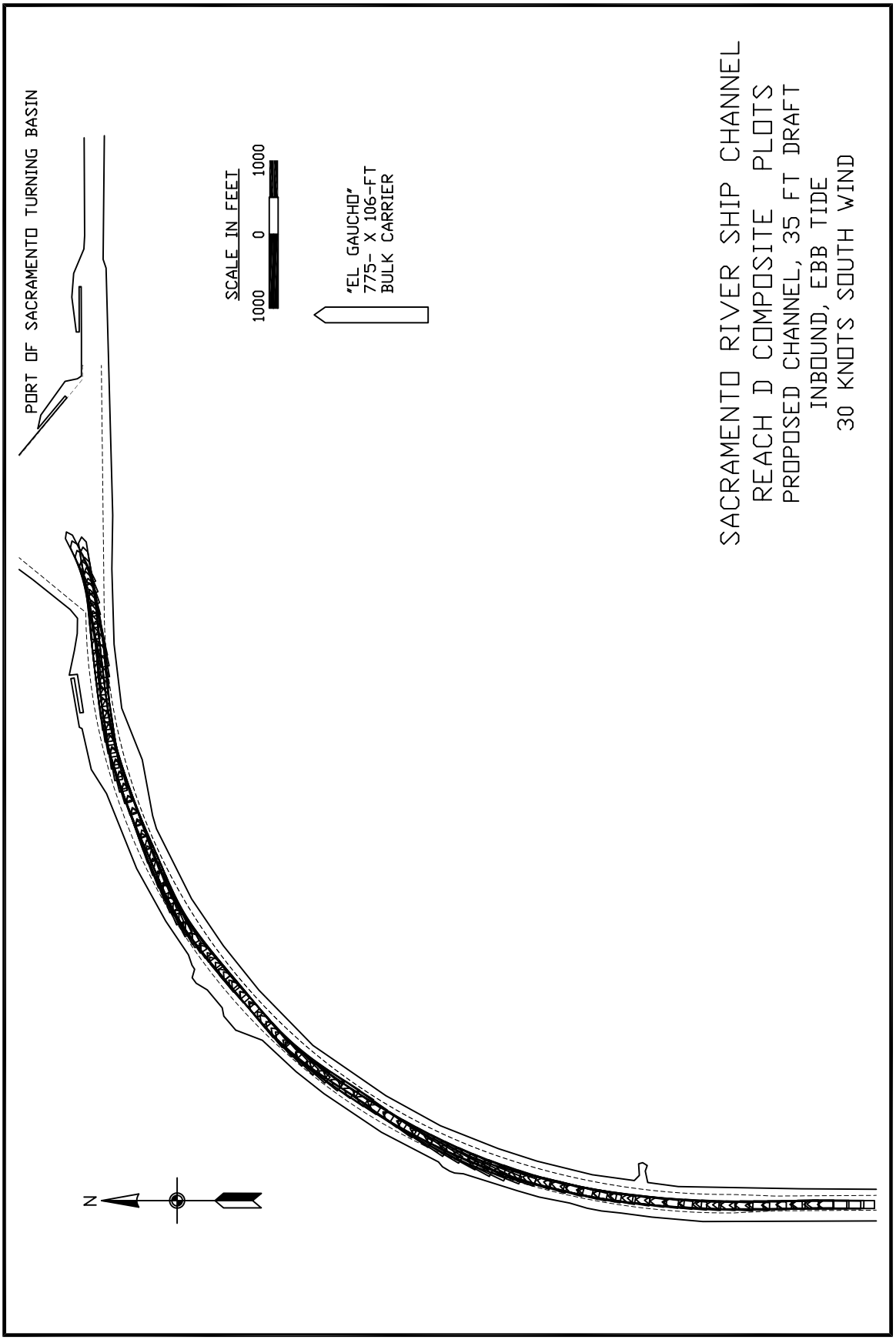
SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
INBOUND, EBB TIDE
30 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
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PLATE 79

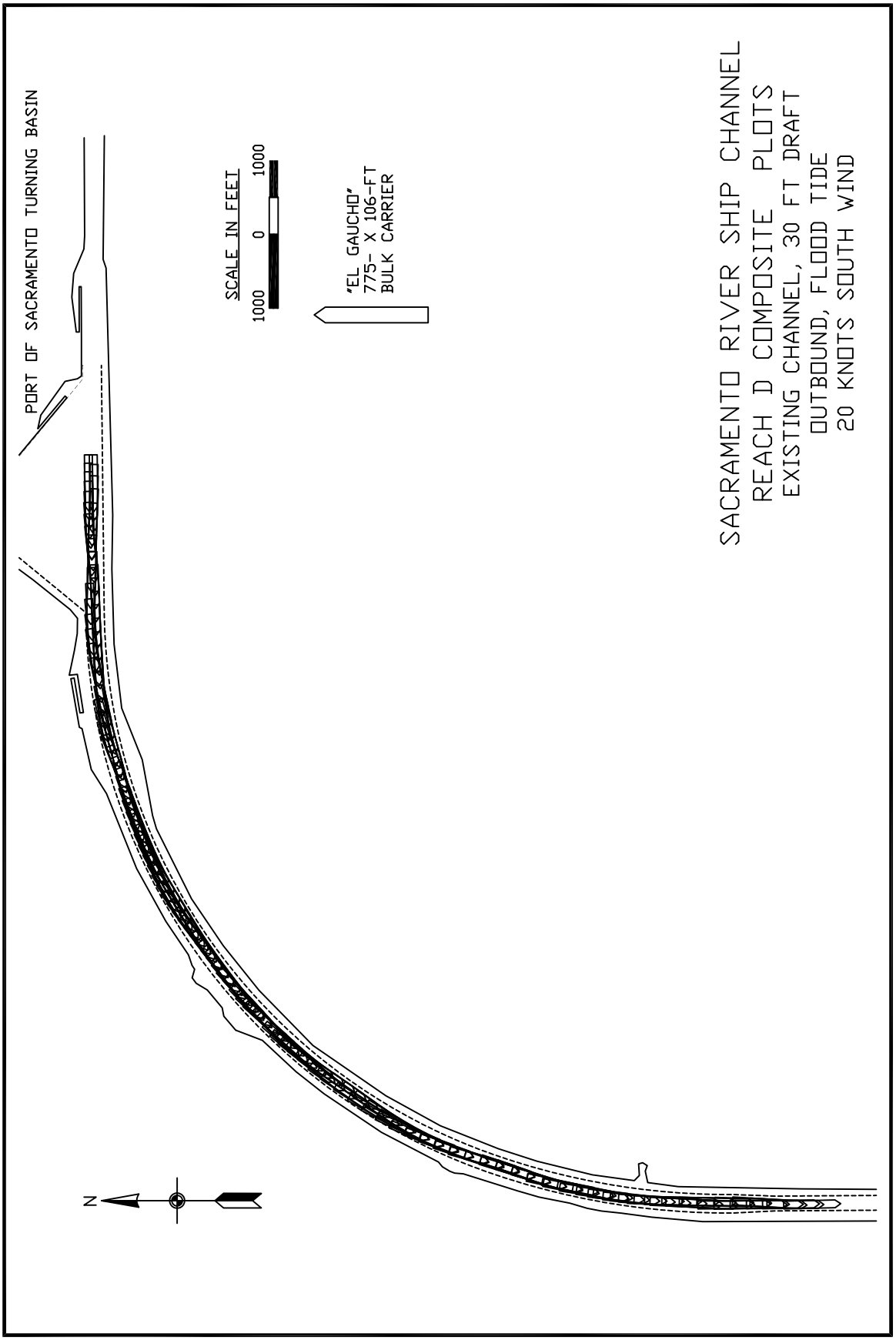

SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, FLOOD TIDE
20 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 80

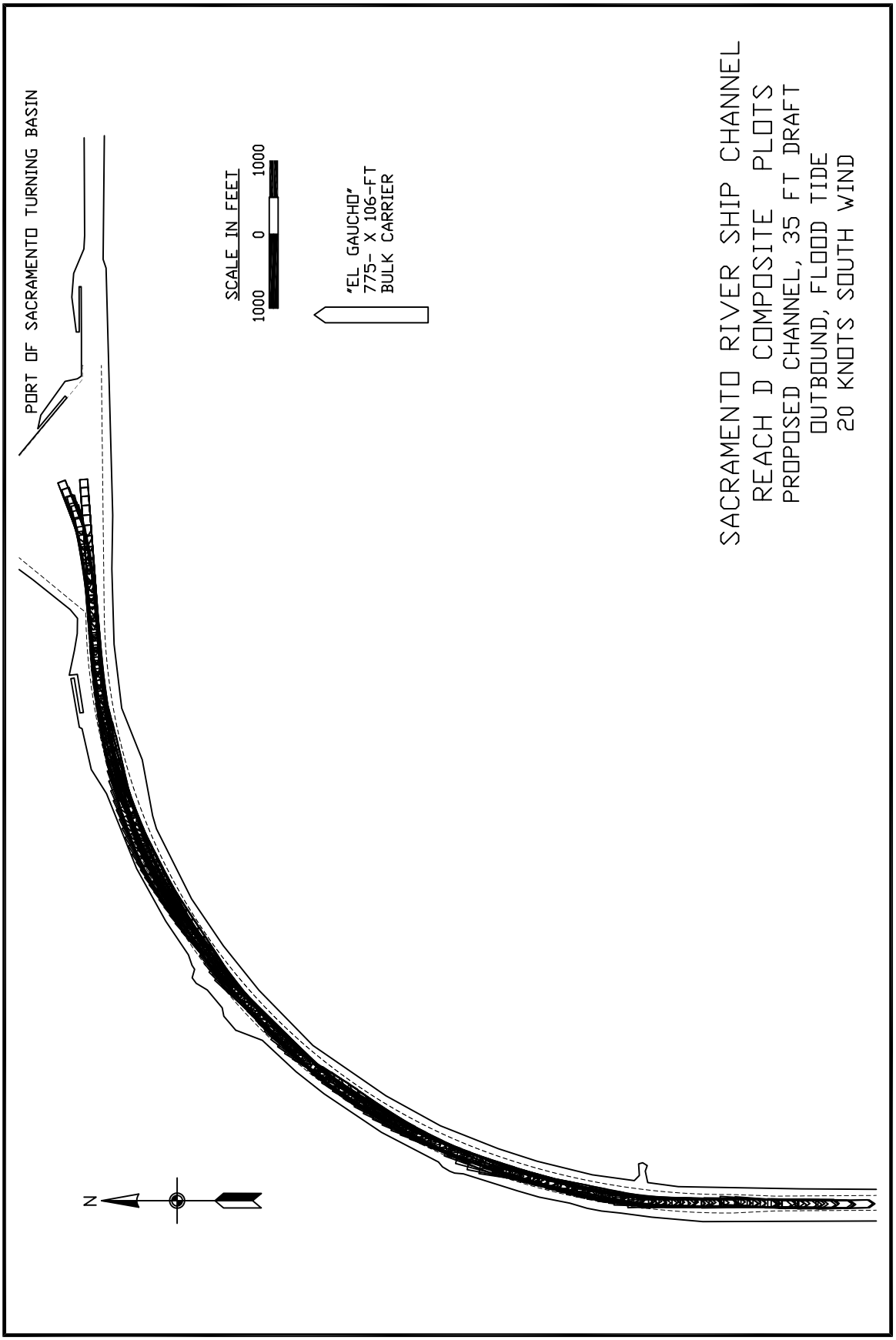

SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, FLOOD TIDE
20 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 81

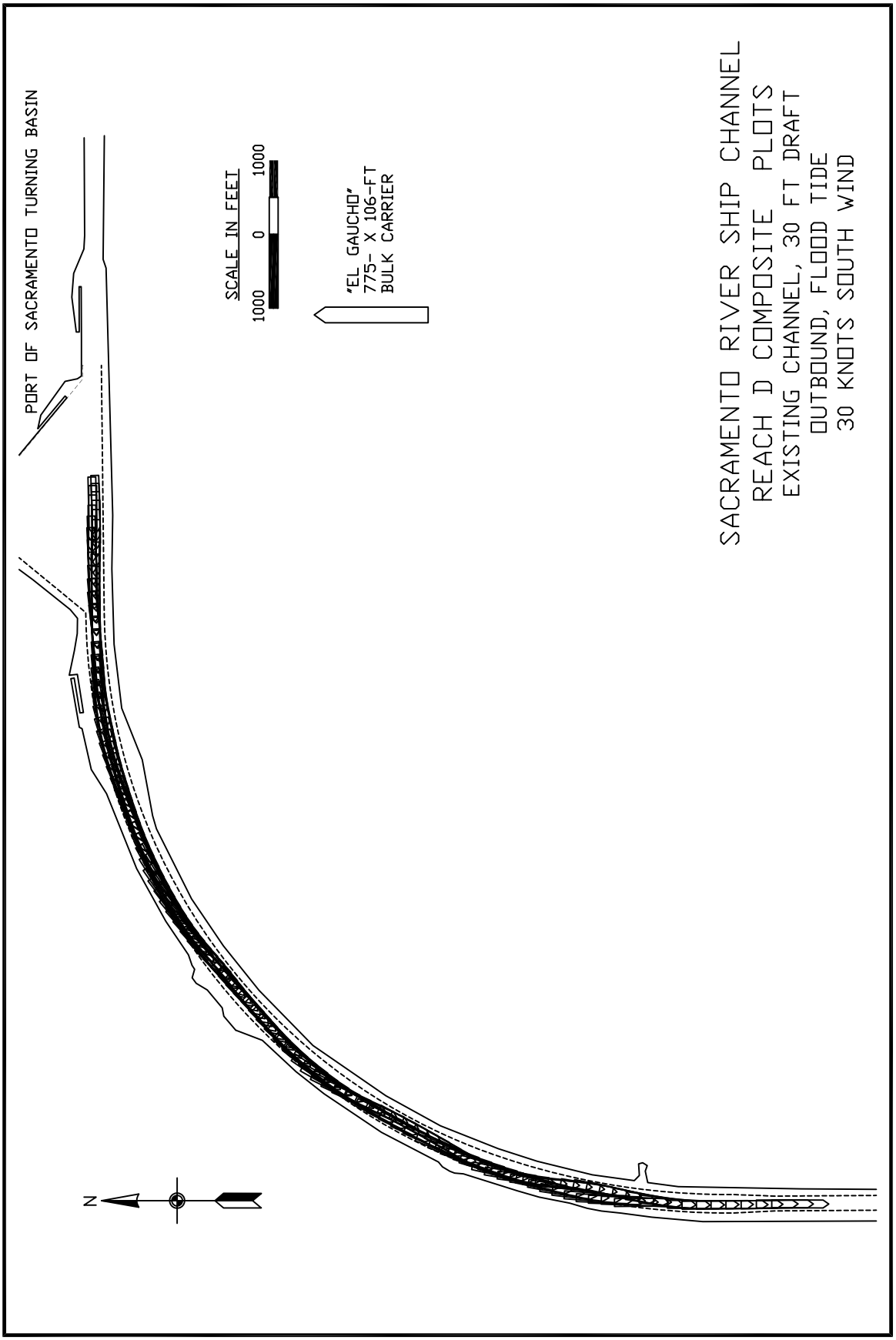

SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, FLOOD TIDE
30 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 82

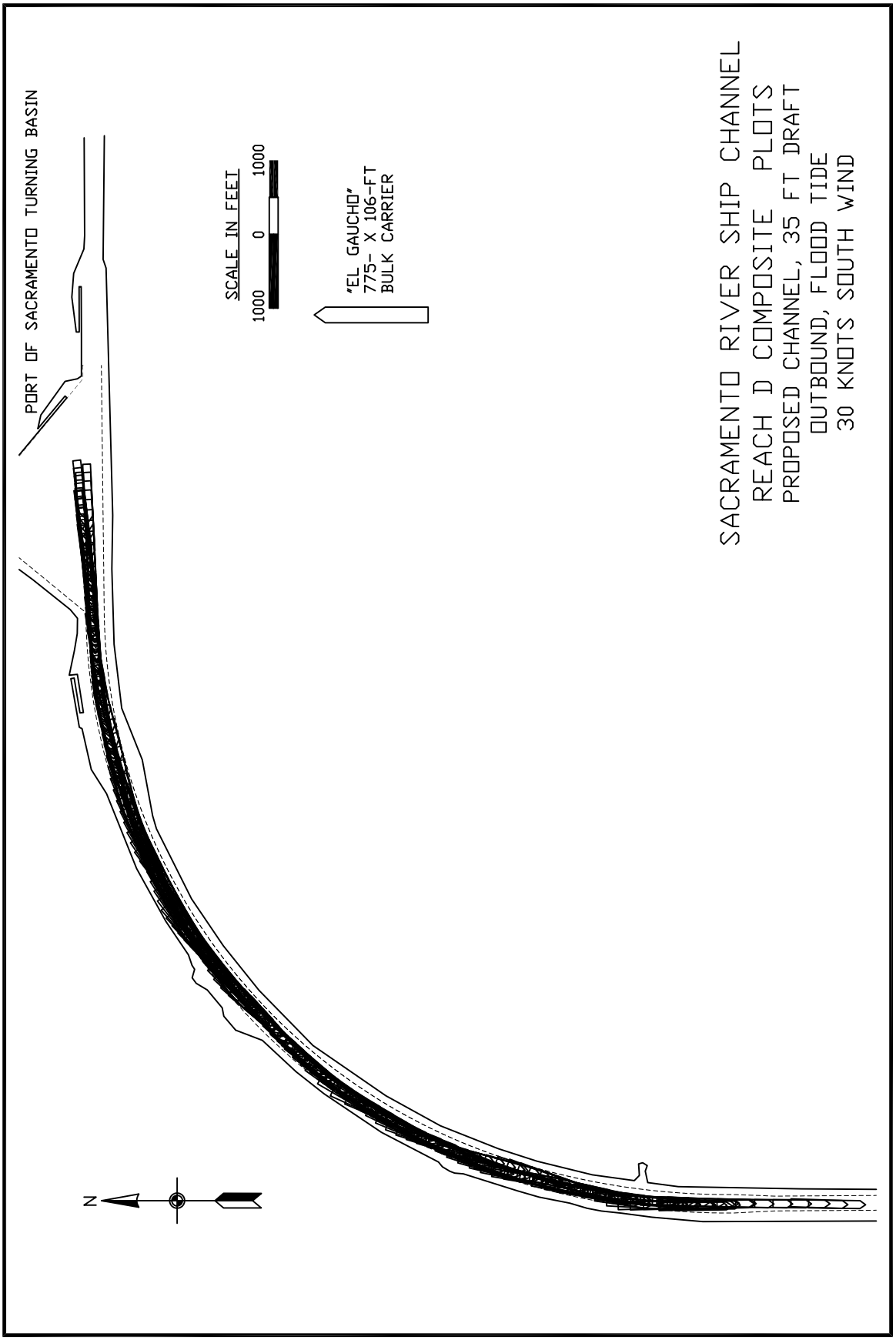
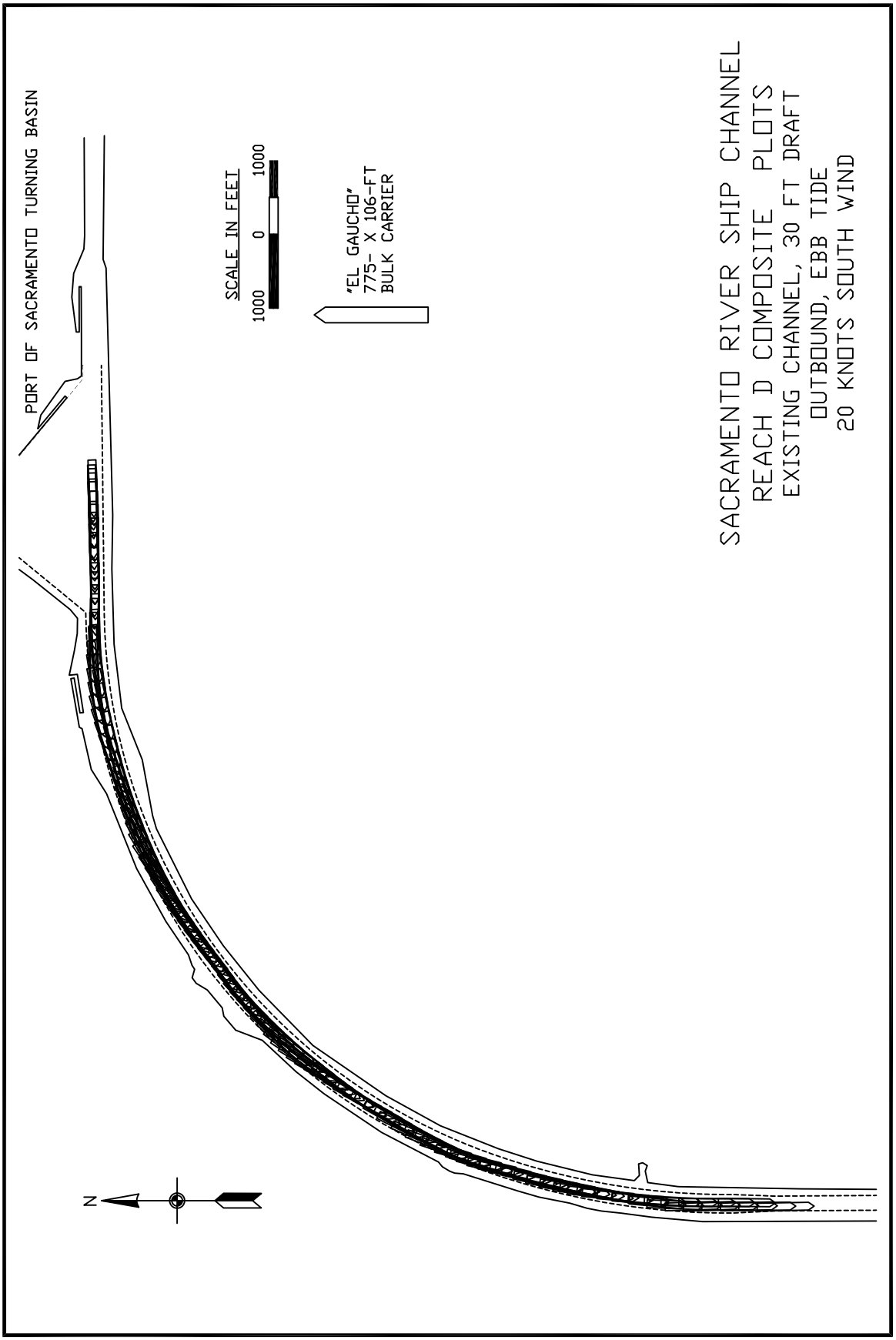

SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, FLOOD TIDE
30 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 83


SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, EBB TIDE
20 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
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PORT OF SACRAMENTO TURNING BASIN
N

PLATE 84

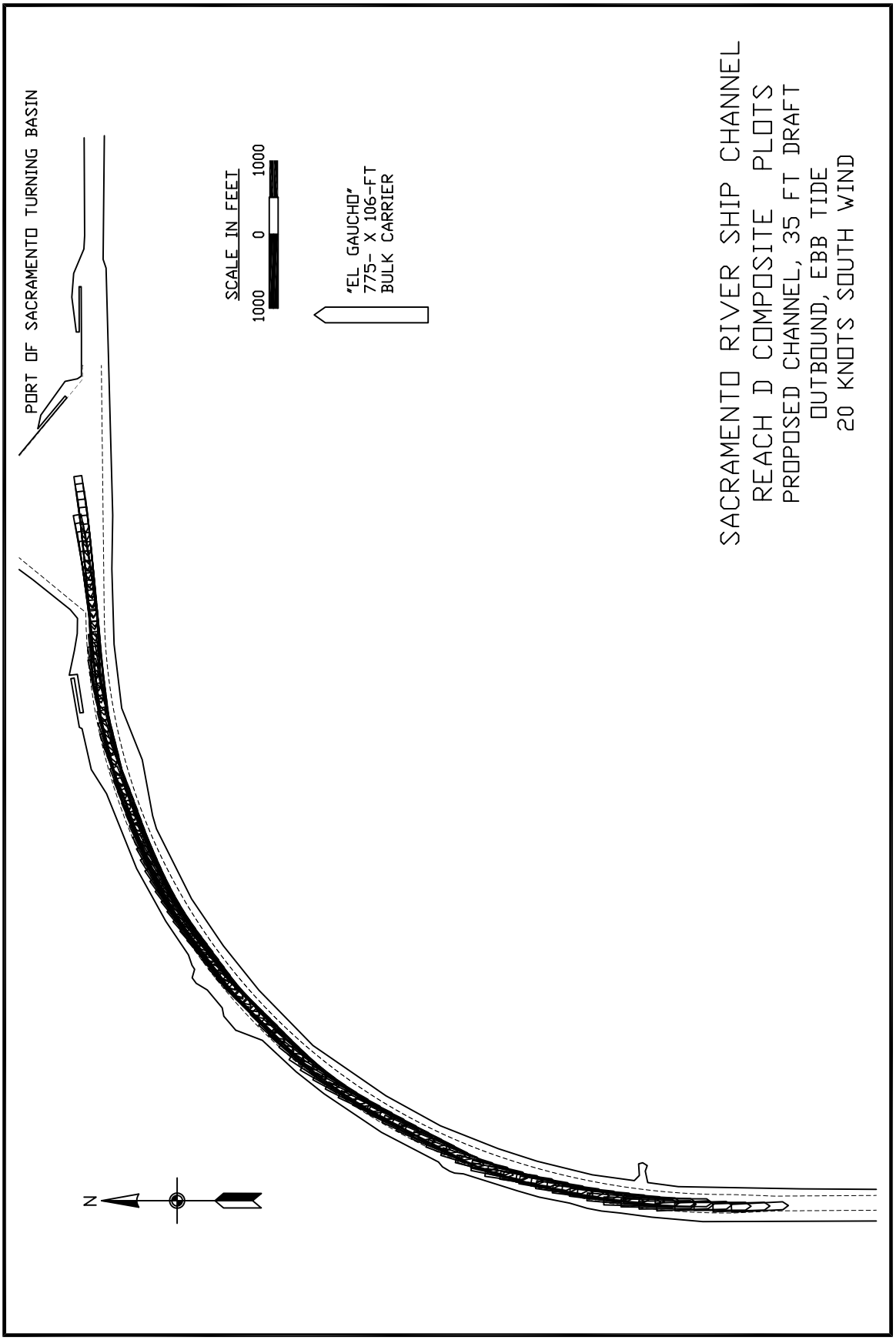
SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, EBB TIDE
20 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 85

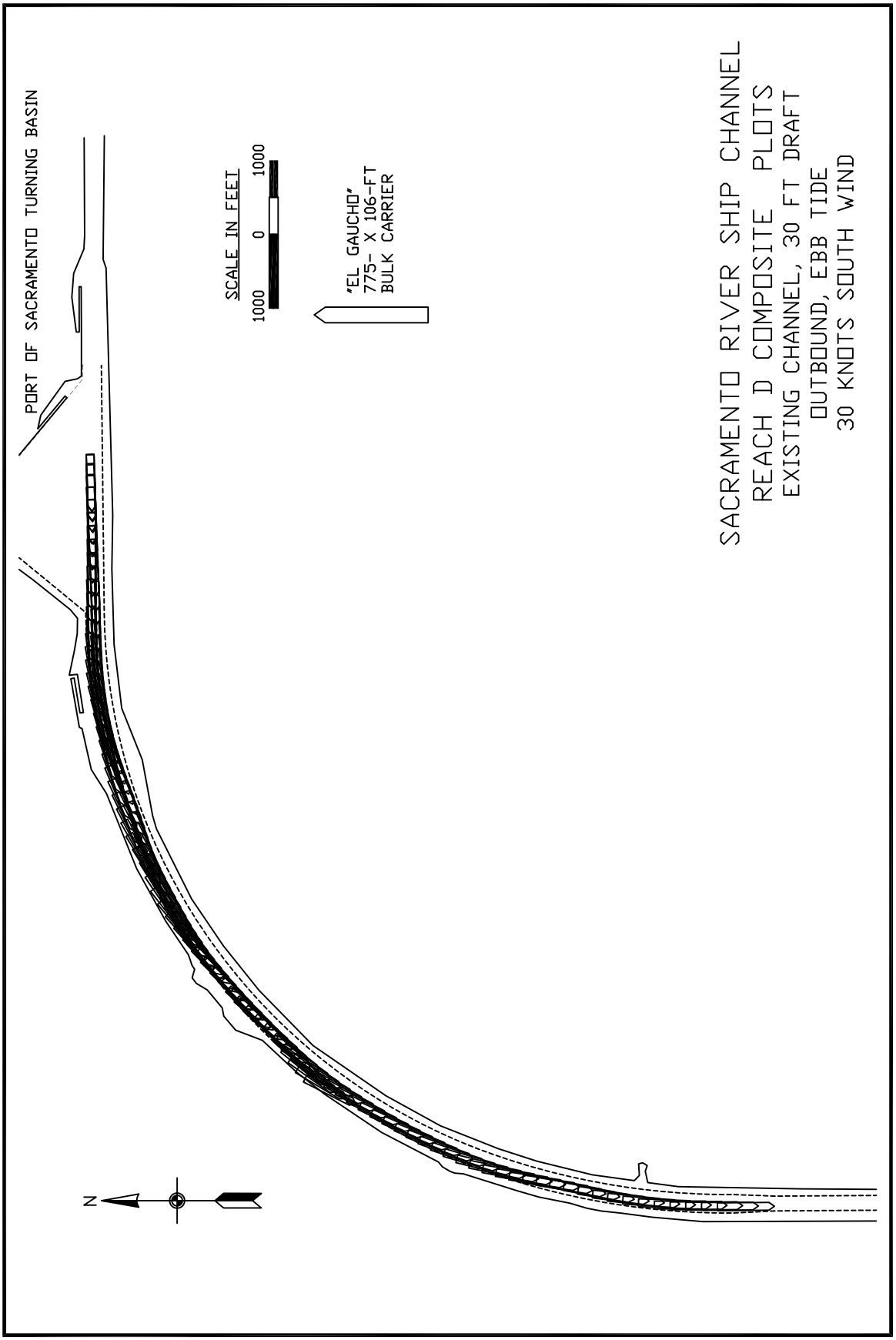
SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
EXISTING CHANNEL, 30 FT DRAFT
OUTBOUND, EBB TIDE
30 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 86

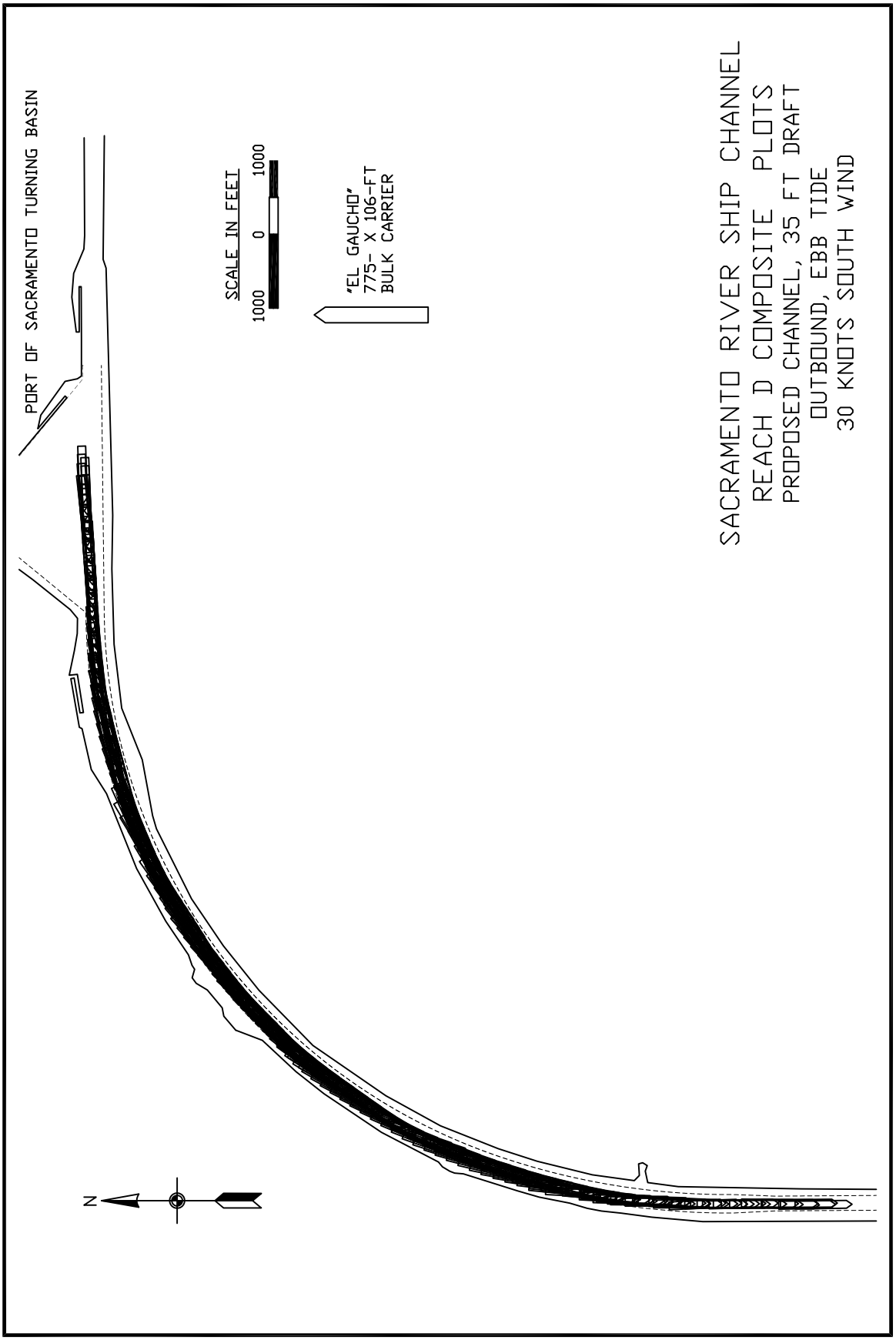
SACRAMENTO RIVER SHIP CHANNEL
REACH D COMPOSITE PLOTS
PROPOSED CHANNEL, 35 FT DRAFT
OUTBOUND, EBB TIDE
30 KNOTS SOUTH WIND
"EL GAUCHO"
775- X 106-FT
BULK CARRIER
SCALE IN FEET
1000 0 1000
PORT OF SACRAMENTO TURNING BASIN
N

PLATE 87