ERDC/CHL

Coastal and Hydraulics Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

NAVIGATION STUDY FOR FREEPORT, TX TURNING BASIN DATA REPORT

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INTRODUCTION

In 2004 the U.S. Army Engineer Research and Development Center (ERDC) conducted a ship simulator based navigation study of Freeport Harbor, Texas. This study was undertaken to assist the U.S. Army Engineering District – Galveston (SWG) evaluate proposed harbor improvements. These improvements consisted of combinations of deepening, widening, and enlarging a turning basin. A total of five plans were studied.

At the request of SWG, the ERDC conducted simulation testing on an additional two turning basin plans the week of January 18 – 22, 2010. Plan 6, is shown in Figure 1 and consists of a turning basin encompassing a 1200 ft diameter turning circle. Plan 7, is shown in Figure 2 and consists of a turning basin encompassing a 1350 ft diameter turning circle. Simulations were conducted with the assistance of the Brazos Pilot Association. This association provides pilotage for Port Freeport. All four members of the association, Captains James Teeter, Billy Burns, John Gunning, and Max Blanton participated in the study.

The simulations were conducted at the ERDC's Ship/Tow Simulator (STS), located in Vicksburg, MS. The simulator is "real time," meaning that vessel movements on the simulator require the same amount of time as they would in real life. The vessel is subjected to a variety of forces (wind, current, banks, etc) as it transits the project area. The mariner controls the tow with two throttles (left and right side propellers), a steering rudder, and a flanking rudder.

DATABASE DEVELOPMENT

The simulator databases from the 2004 study were modified to reflect the Plan 6 and Plan 7 turning basins. Currents are small in the turning basin area. Therefore currents from the 2004 study were adjusted for the two new plans.

The design ship for the study was a Very Large Crude Carrier (VLCC). The ship was 1087- x 195- x 24-ft. The ship was always turned on an outbound run, while empty. The pilots stated that they would not turn the ship loaded, at the end of the inbound transit. Simulations were conducted for maximum strength of both ebb and flood tides. Three wind conditions were simulated. They were 25 knots from the southeast, 25 knots from the north, and calm.

Following the study for the VLCC vessel, additional simulations were conducted for a Suez Max tanker.

RESULTS VLCC SIMULATIONS

Results will be presented in the form of composite track plots and final questionnaires.

Outbound, Ebb Tide, Southeast wind. Simulations results for the VLCC tanker turning in the Plan 6 basin with ebb tide with a 25 knot southeast wind are shown in Plate 1.

None of the pilots were able to turn the ship within the limits of the Plan 6 turning basin. One ship left the south side of the basin by nearly 200 ft. The composite track plot for runs conducted under the same conditions in the Plan 7 basin are shown in Plate 2. One of the pilots was able to turn the ship without leaving the channel. The remaining three vessels all left the channel by about 40 ft. They were better able to remain in the channel for Plan 7 than they were for Plan 6.

Outbound, Ebb Tide, North wind. Simulations results for the VLCC tanker turning in the Plan 6 basin with ebb tide with 25 knots of wind from the north are shown in Plate 3. The results are similar to those shown in Plate 1. None of the pilots were able to turn the ship within the limits of the Plan 6 turning basin. The composite track plot for runs conducted under the same conditions in the Plan 7 basin are shown in Plate 4. Only two runs were conducted. One run left the basin by about 40 ft while the other successfully remained in the basin.

Outbound, Ebb Tide, no wind. Simulations results for the VLCC tanker turning in the Plan 6 basin with ebb tide without wind are shown in Plate 5. One pilot was able to complete the turn within the basin limits. The remaining three turns all left the basin by approximately 200 ft. Three of the no wind, ebb tide runs conducted in Plan 7 were successful. These are shown in Plate 6. The ship that left the basin did so on the north side by about 130 ft.

Outbound, Flood Tide, Southeast wind. Simulations results for the VLCC tanker turning in the Plan 6 basin with flood tide with a 25 knot southeast wind are shown in Plate 7. One of the four pilots was able to complete the turn and stay within the turning basin boundaries. The other three runs left the channel by more than 100 ft. The Plan 7 runs are shown in Plate 8. Three of the runs successfully turned in the basin limits. The other run left the north side of the basin by approximately 70 ft.

Outbound, Flood Tide, North wind. Simulations results for the VLCC tanker turning in the Plan 6 basin with flood tide with 25 knots of wind from the north are shown in Plate 9. The pilots were better able to turn in this scenario that previous Plan 6 runs. Three of the four runs only left the basin by about 30 ft. The other left by over 200 ft. Plate 10 shows the composite track for the Plan 7 exercises. Three of the four runs left the south side of the basin due to the wind from the north. However, one run did successfully turn within the channel boundary.

Outbound, Flood Tide, no wind. Simulations results for the VLCC tanker turning in the Plan 6 basin with flood tide without wind are shown in Plate 11. One pilot was able to complete the turn within the basin limits and two left the basin by approximately 30 ft. The remaining Plan 6 run left the south side of the basin by over 250 ft. The composite track plot for runs conducted under the same conditions in the Plan 7 basin are shown in Plate 12. Two of the pilots were able to turn their ships within the turning basin limits. One ship left the channel by less than 20 ft and one left the north end of the basin by over 100 ft.

Pilot comments. The final questionnaires, completed by each of the four pilots, are included in Appendix A. The pilots felt that the 1350 ft wide basin (Plan 7) would provide minimum room for turning the 1087 ft long VLCC.

CONCLUSIONS VLCC SIMULATIONS

The Plan 6 turning basin did not provide adequate room to turn the VLCC. The Plan 7 turning basin (1350 ft diameter) provided minimal room to turn the VLCC. It is likely that vessels will have trouble turning in higher winds. Based upon these conclusions and further economic analysis, SWG decided to reexamine the Plan 6 turning basin with a smaller, Suez Max tanker. A model of a 922- x 164- x 28 ft Suez Max tanker was developed under contract to Computer Science Corporation (CSC), the manufacturer of the ERDC's ship/tow simulator. On June 16, 2101 simulation testing was conducted for the Suez Max ship in the Plan 6 basin. Captains John Gunning, and Max Blanton participated.

RESULTS SUEZ MAX SIMULATIONS

Outbound, Ebb Tide, Southeast wind. Simulations results for the Suez Max tanker turning in the Plan 6 basin with ebb tide with a 25 knot southeast wind are shown in Plate 13. Both pilots were able to turn their ships in the Plan 6 turning basin.

Outbound, Ebb Tide, North wind. Simulations results for the Suez Max tanker turning in the Plan 6 basin with ebb tide with 25 knots of wind from the north are shown in Plate 14. Both pilots were able to turn their ships in the Plan 6 turning basin.

Outbound, Ebb Tide, no wind. Simulations results for the Suez Max tanker turning in the Plan 6 basin with ebb tide without wind are shown in Plate 15. Both pilots were able to turn their ships successfully.

Outbound, Flood Tide, Southeast wind. Simulations results for the VLCC tanker turning in the Plan 6 basin with flood tide with a 25 knot southeast wind are shown in Plate 16. Both pilots were able to turn their ships in the Plan 6 turning basin.

Outbound, Flood Tide, North wind. Simulations results for the VLCC tanker turning in the Plan 6 basin with flood tide with 25 knots of wind from the north are shown in Plate 17. Both pilots were able to turn their ships successfully.

Outbound, Flood Tide, no wind. Simulations results for the VLCC tanker turning in the Plan 6 basin with flood tide without wind are shown in Plate 18. Both pilots were able to turn their ships successfully.

Pilot comments. The pilot comments on turning the Suez Max tanker in the Plan 6 basin were received by e-mail and are as follows:

"The vessel maneuvers simulated are possible. We recommend a larger turning basin for navigational safety."

"Possible- however a larger turning basin is required for safety of navigation."

CONCLUSIONS SUEZ MAX SIMULATIONS

The pilots were much better able to turn the Suez Max tanker in the Plan 6 turning basin that they were able to turn the VLCC in either the Plan 6 or Plan 7 basin. The pilots felt that turning the Suez Max in the Plan 6 basin was possible. However, they recommended a larger basin. If economically possible basins of 1250 and 1300 should be considered.

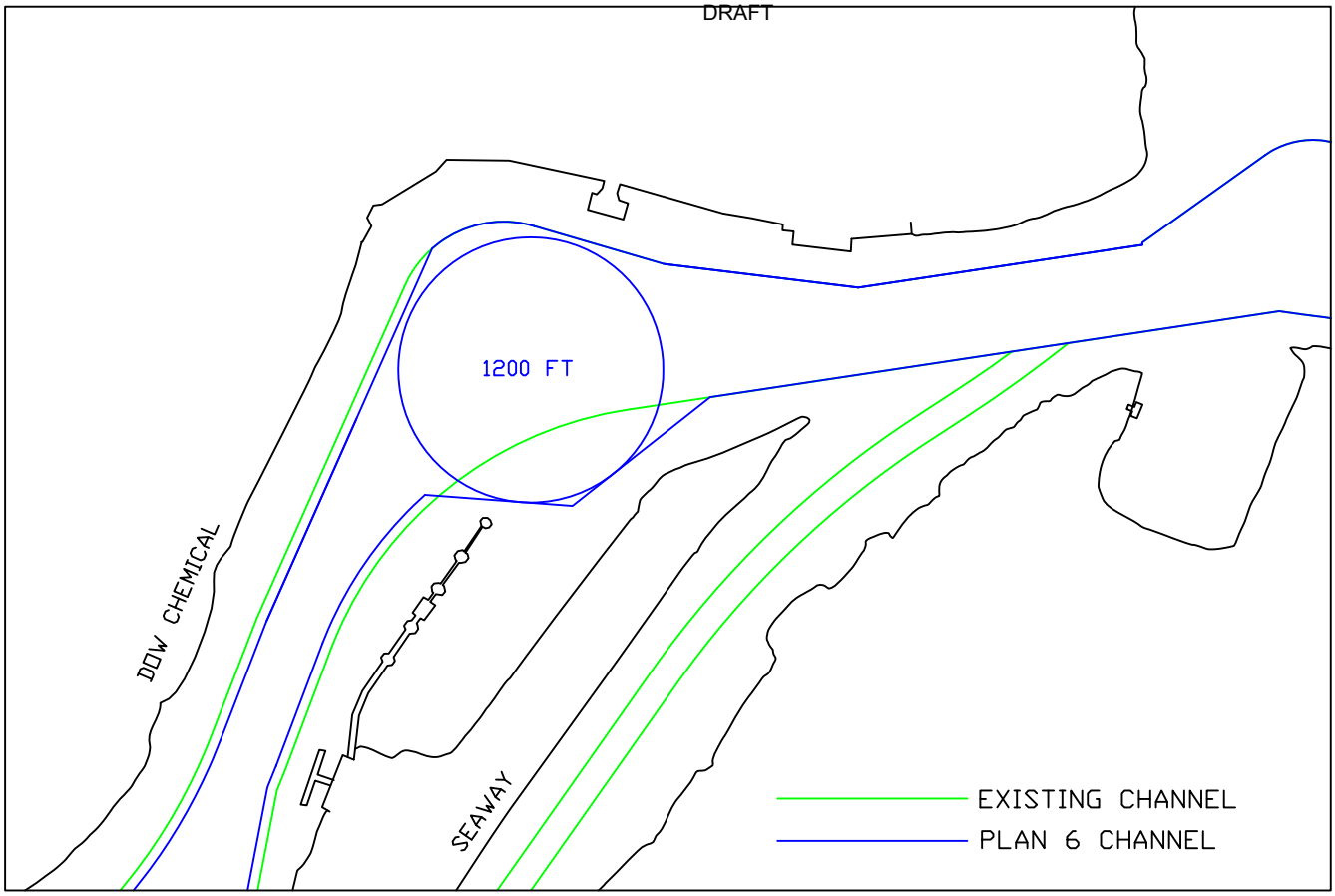


Figure 1. Plan 6 Turning Basin

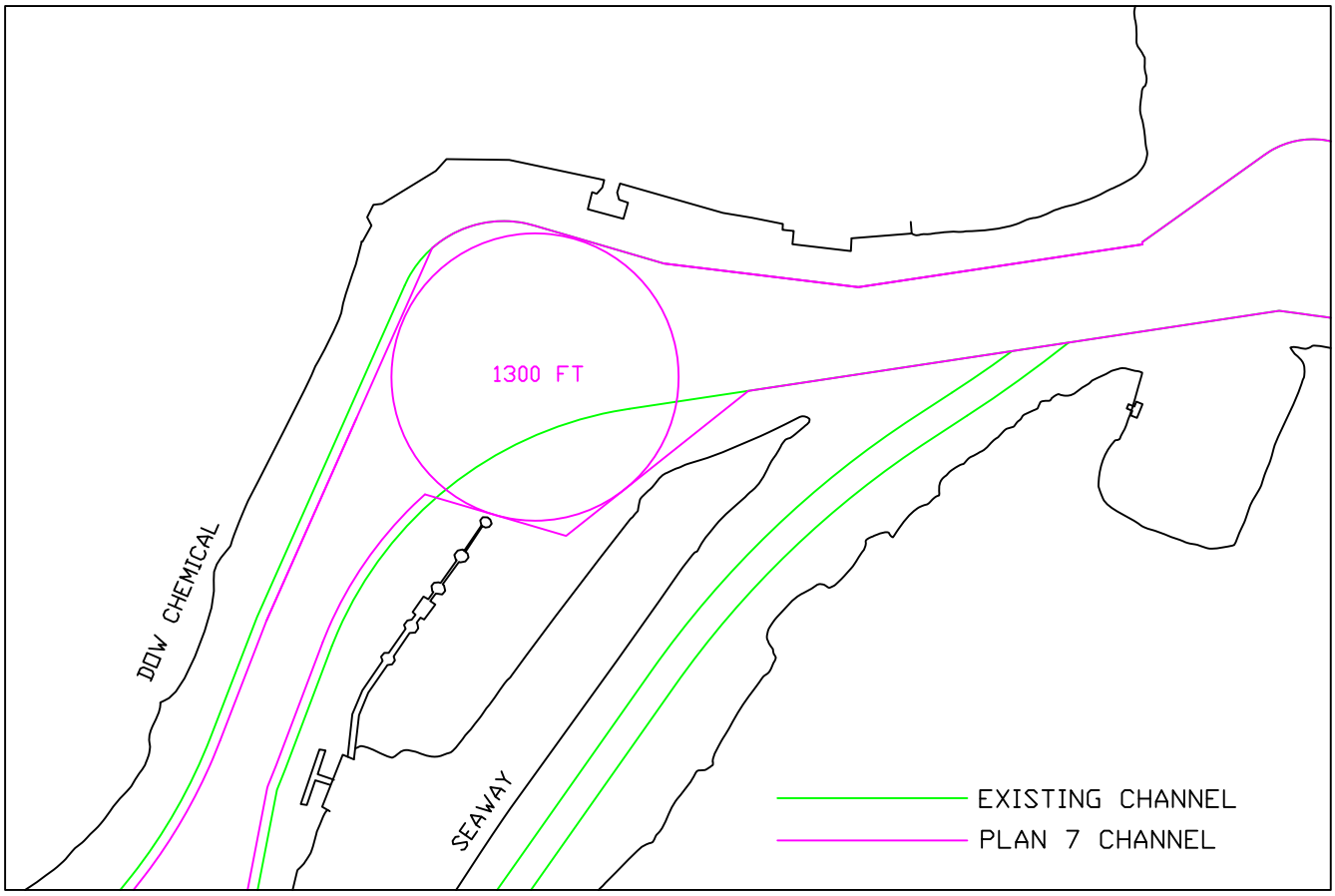


Figure 2. Plan 7 Turning Basin

APPENDIX A
QUESTIONNAIRS (VLCC ONLY)

Freeport Turning Basin

Pilot Questionnaire

Capt. John Gunning

1. Based upon your simulation runs, please comment upon the 1200 ft and 1350 ft turning basins.

The 1350' Turning basin would provide a minimum amount of room for vessels of Size Modeled. The 1200 basin does not provide adequate Margins for vessels of this Size.

2. Any other comments or concerns?

- The Tug Horsepower (aft.) was good
- The Ship was very Sluggish and required Strong astern & Ahead bells To yield Marginal responsiveness.
- Weather Conditions appeared To have the effect intended.
- With close Tolerances required - the view and instrumentation limits the ability To Perceive effects of wind, Tugs or each Maneuver.
- eliminate the wave barrier To Provide an adequate basin For this Size Vessel!!!

Freeport Turning Basin

Pilot Questionnaire

Capt. Billy Burns

1. Based upon your simulation runs, please comment upon the 1200 ft and 1350 ft turning basins.

The 1350 ft turning basins is better than the 1200 ft. Both turning basins are better than what we presently have. The bigger you can make it the better it is for ships.

2. Any other comments or concerns?

We need the 600 ft. channel bad. Like yesterday.

Freeport Turning Basin

Pilot Questionnaire

Capt. Max Blanton

1. Based upon your simulation runs, please comment upon the 1200 ft and 1350 ft turning basins.

From experience 1000' is better 750' for turning ships and thus 1350 is better than 1200. From the simulation runs the 1120'x195' VLCC is possible but very risky with ~~any~~ no room for error.

2. Any other comments or concerns?

The ship model was slow and unpredictable as to ordered speeds and speeds achieved, many of the "incidents" were probably caused by poor engine response. The tugs on the other hand were great. The overall experience became tedious due to the repetitions of the same moves and ships.

1/22/2010 Max Blanton

Freeport Turning Basin

Pilot Questionnaire

Capt. James Teeter

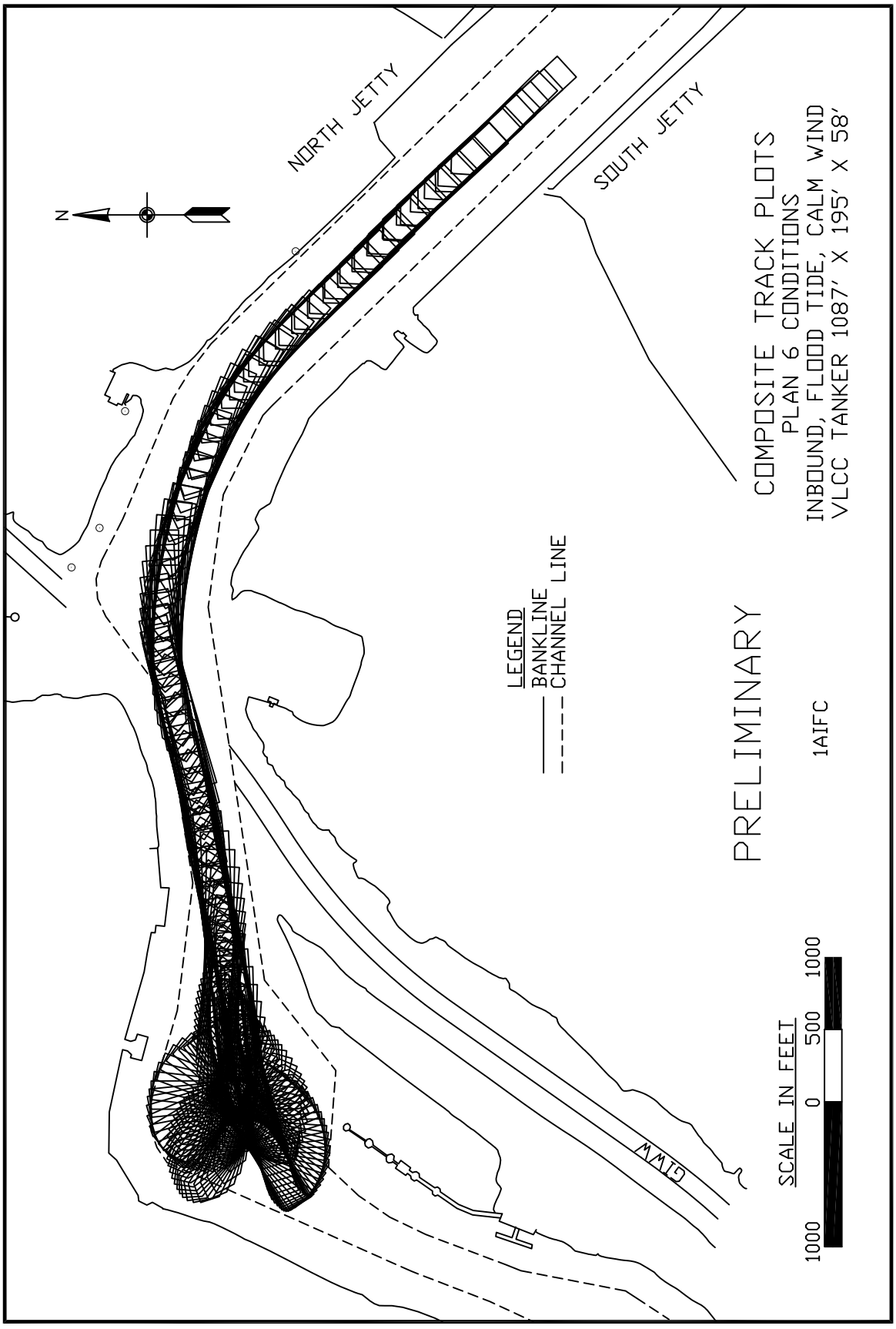
1. Based upon your simulation runs, please comment upon the 1200 ft and 1350 ft turning basins.

The 1350 ft turning basin is much better for the vessels simulated. Turning coeff. of 1.5 would be optimal but tugs allow for less room provided they are ~~capable~~ able of sufficient horse power.

2. Any other comments or concerns?

Note: Current LOA restriction exists at Seaway #2 (Dock 5 simulated) based upon design loads of existing infrastructure. Vessels are curred limited to 900 ft. With out 600 ft clearance to this basin, these vessels ~~can~~ will not be coming in at all.

APPENDIX B
PLATES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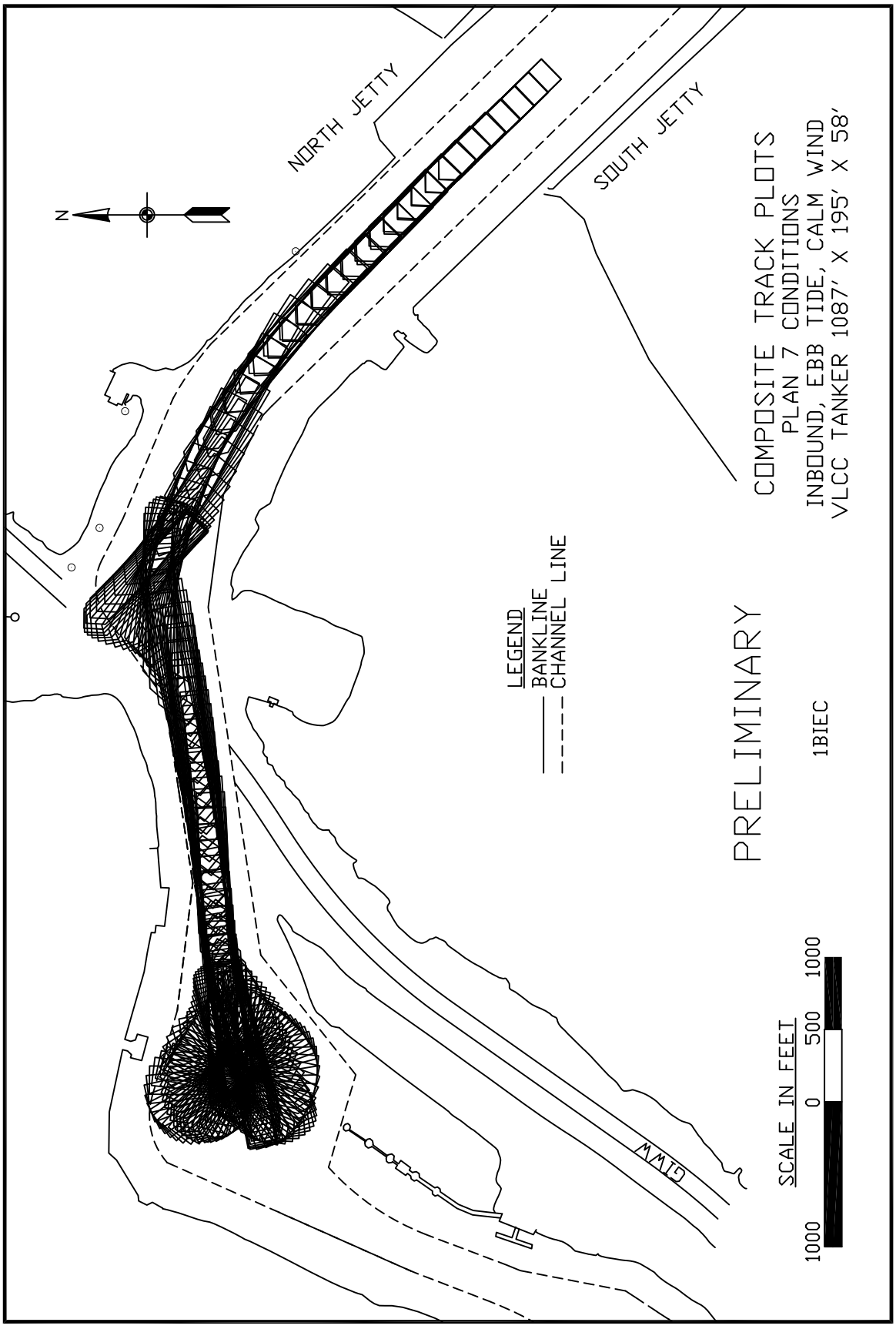
SOUTH JETTY
N
COMPOSITE TRACK PLOTS
PLAN 6 CONDITIONS
INBOUND, FLOOD TIDE, CALM WIND
VLCC TANKER 1087' X 195' X 58'
LEGEND
BANKLINE
CHANNEL LINE
PRELIMINARY
1AIFC
GIWW
SCALE IN FEET
1000 0 500 1000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COMPOSITE TRACK PLOTS
PLAN 7 CONDITIONS
INBOUND, EBB TIDE, CALM WIND
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LEGEND
BANKLINE
CHANNEL LINE
PRELIMINARY
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GIWW
SCALE IN FEET
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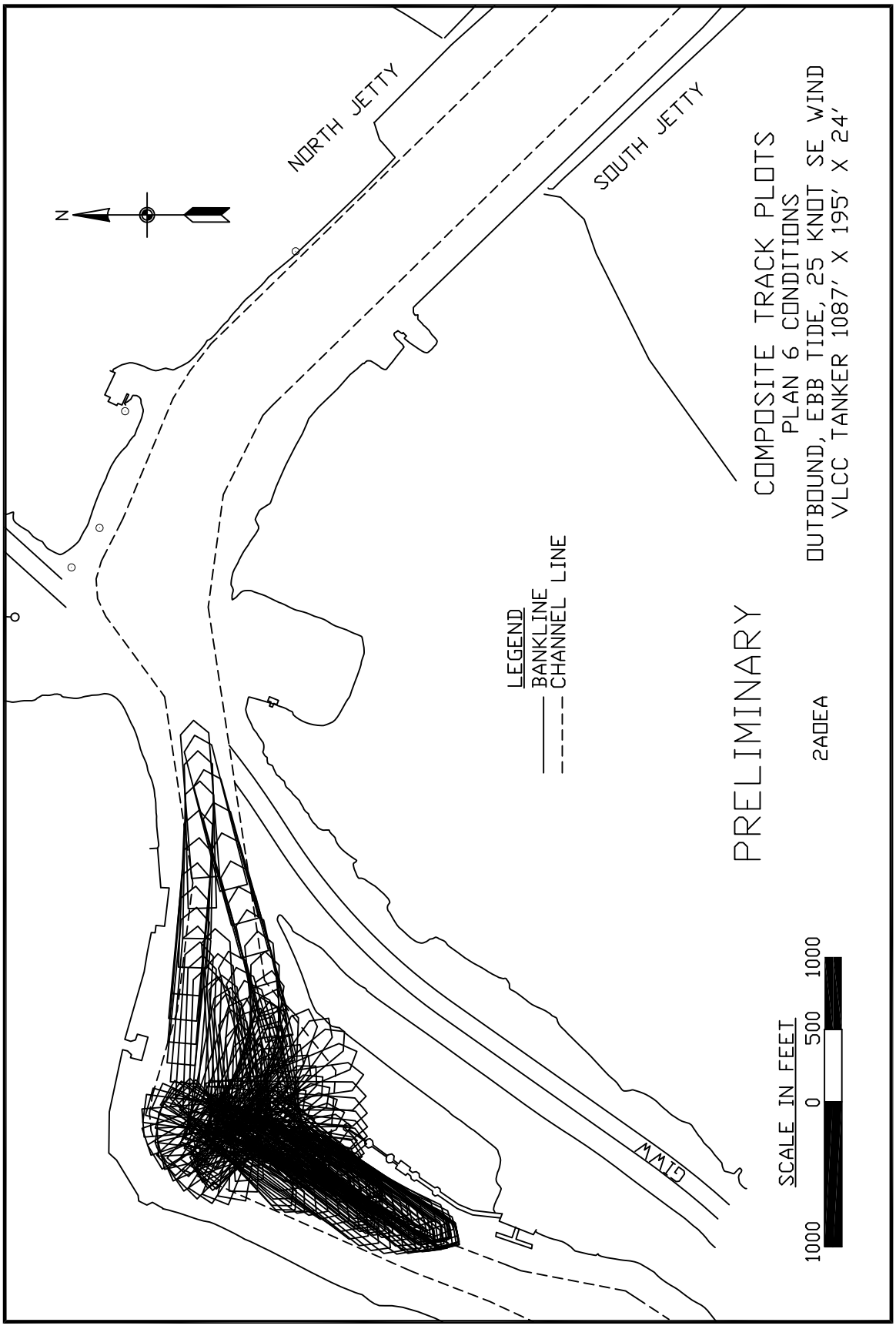
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COMPOSITE TRACK PLOTS
PLAN 6 CONDITIONS
OUTBOUND, EBB TIDE, 25 KNOT SE WIND
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PRELIMINARY
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LEGEND
BANKLINE
CHANNEL LINE
GLW
SCALE IN FEET
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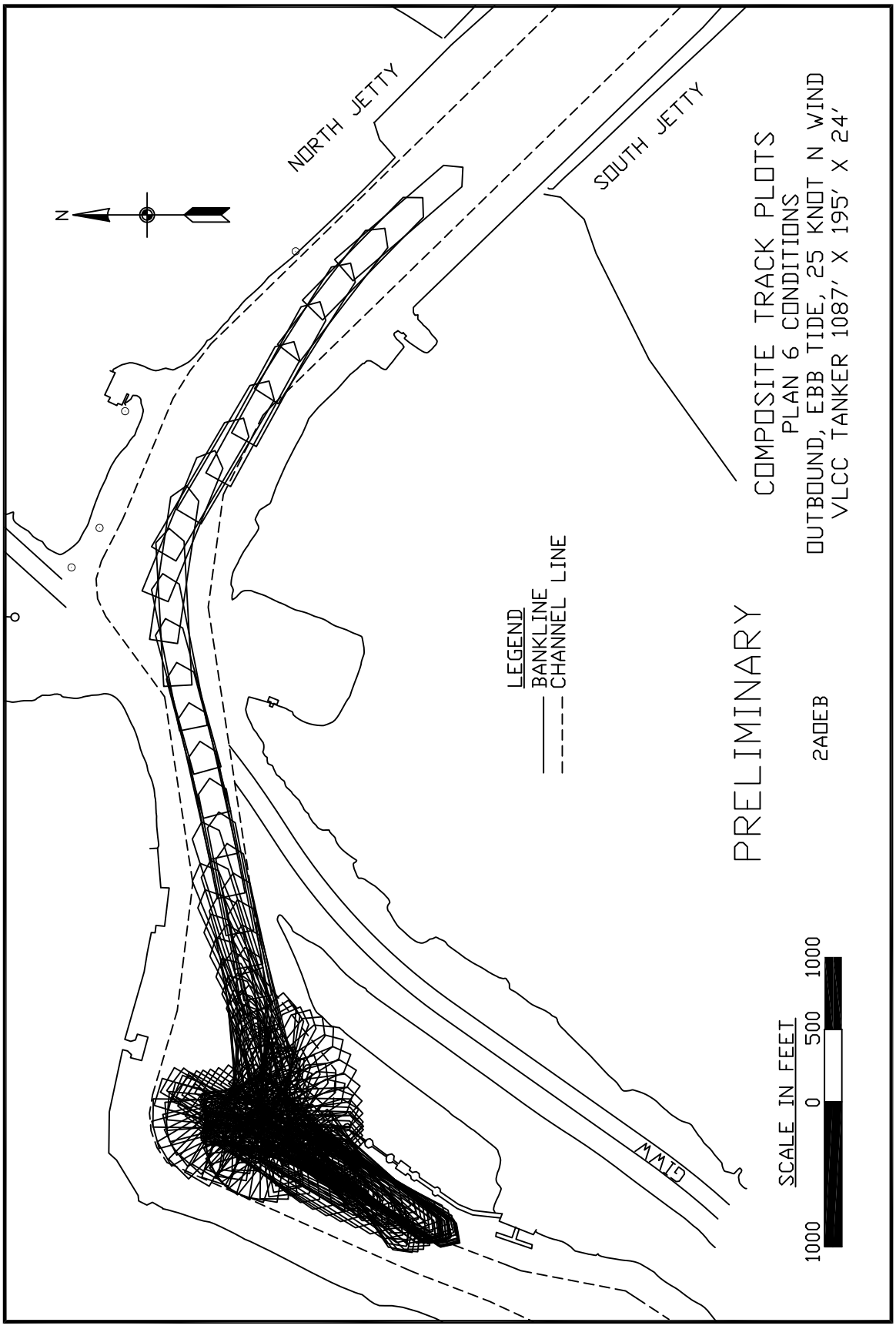
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COMPOSITE TRACK PLOTS
PLAN 6 CONDITIONS
OUTBOUND, EBB TIDE, 25 KNOT N WIND
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PRELIMINARY
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LEGEND
BANKLINE
CHANNEL LINE
SCALE IN FEET
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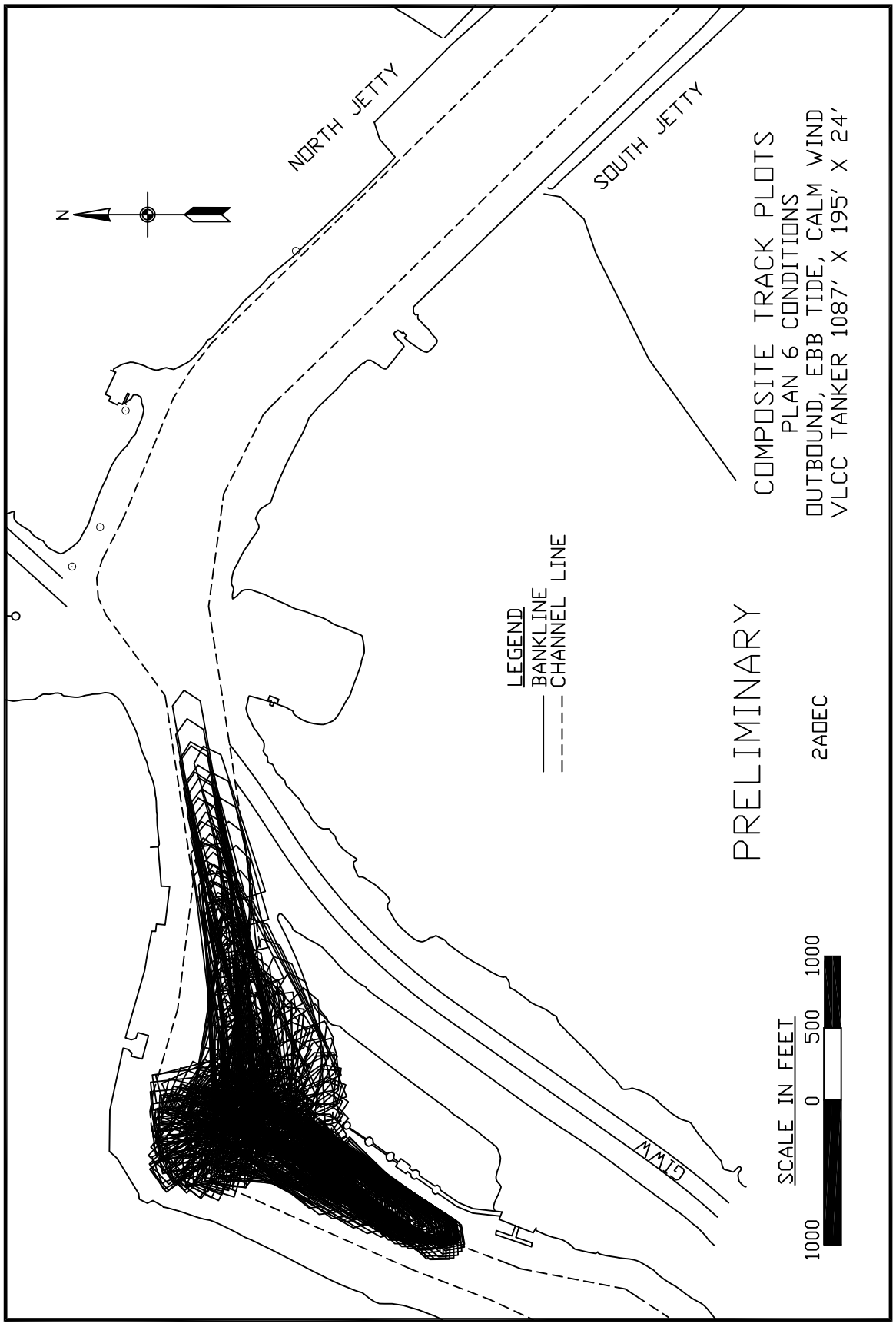
GLW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COMPOSITE TRACK PLOTS
PLAN 6 CONDITIONS
OUTBOUND, EBB TIDE, CALM WIND
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BANKLINE
CHANNEL LINE
PRELIMINARY
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GLW
SCALE IN FEET
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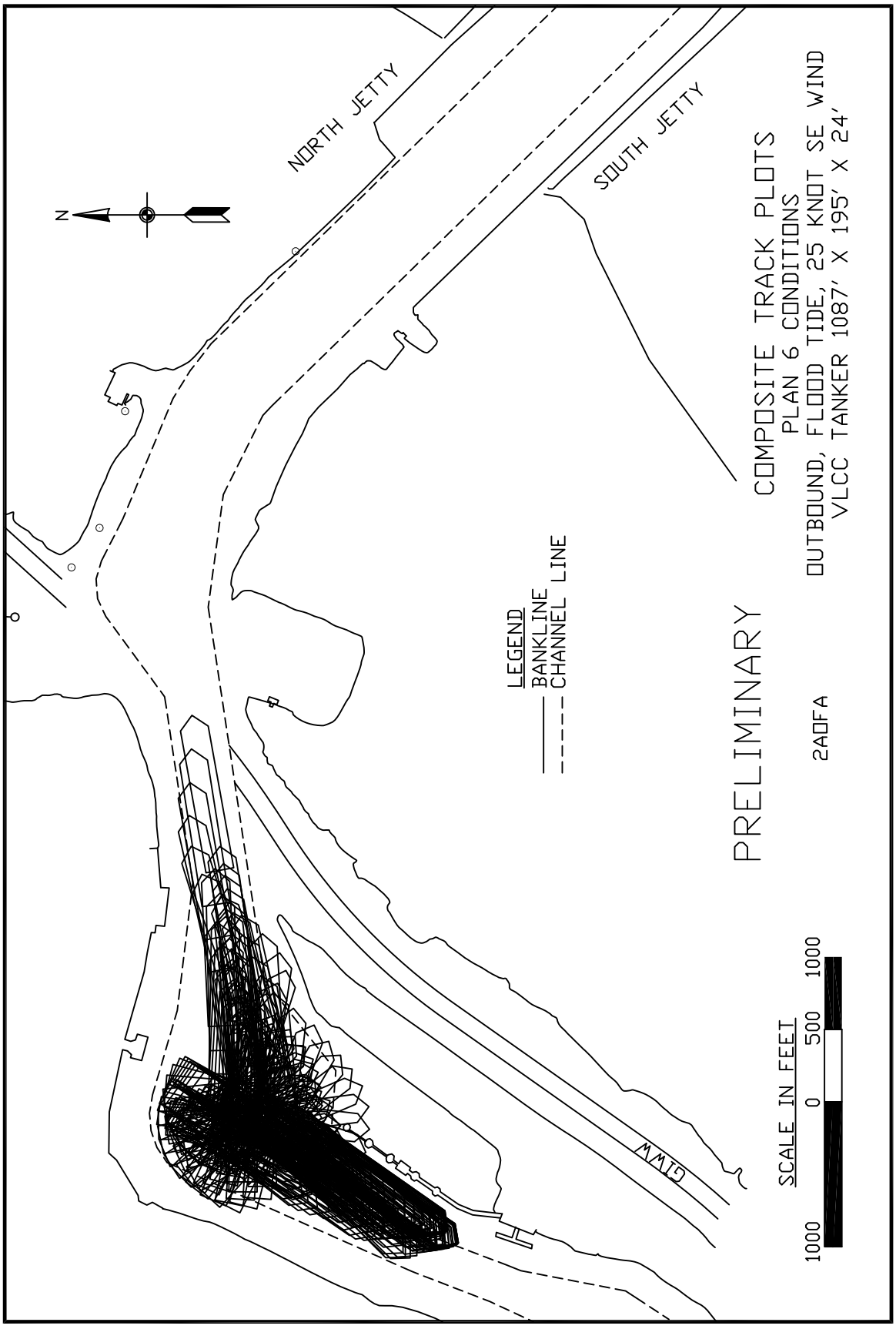
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COMPOSITE TRACK PLOTS
PLAN 6 CONDITIONS
OUTBOUND, FLOOD TIDE, 25 KNOT SE WIND
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LEGEND
BANKLINE
CHANNEL LINE
GIWW
SCALE IN FEET
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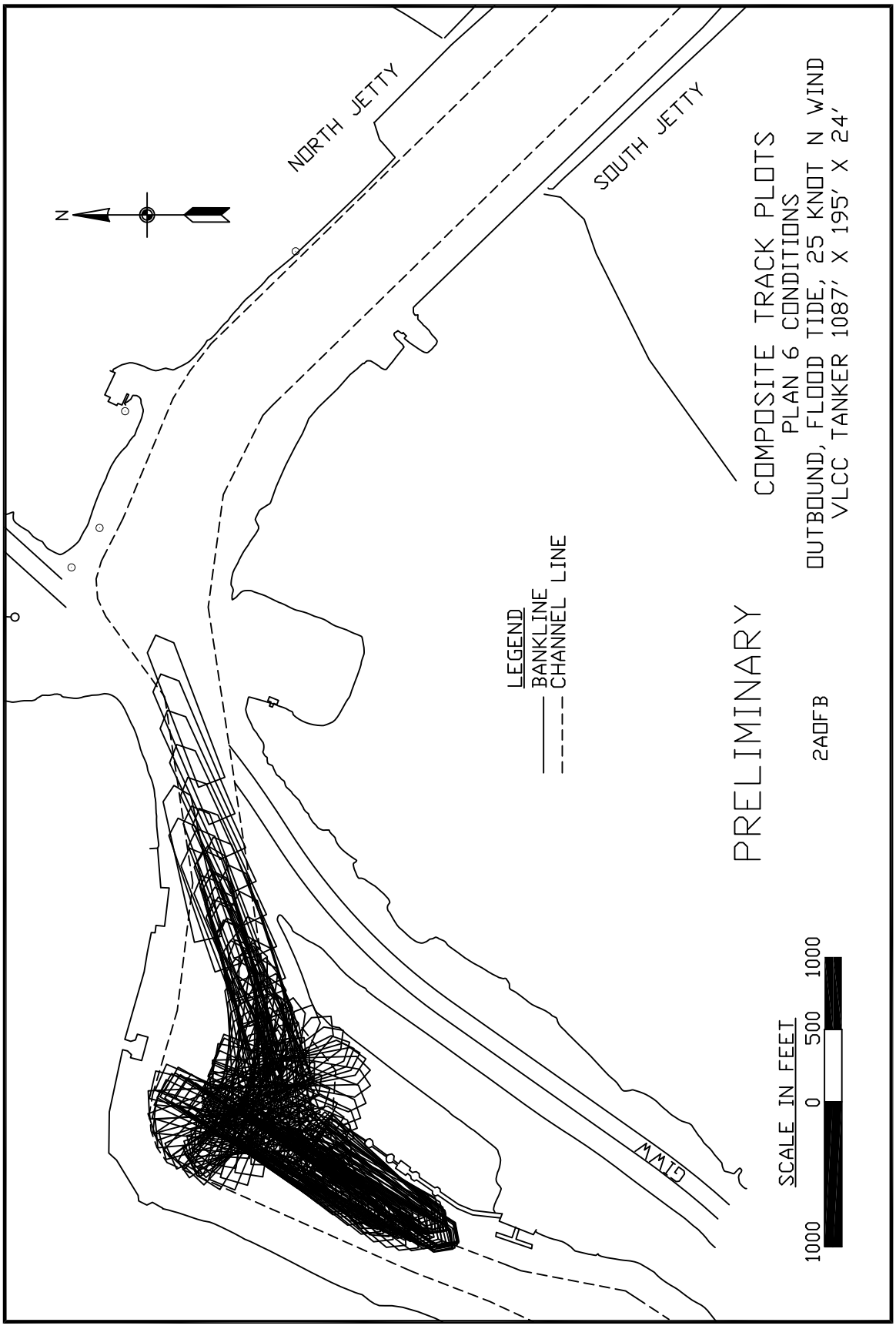
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COMPOSITE TRACK PLOTS
PLAN 6 CONDITIONS
OUTBOUND, FLOOD TIDE, 25 KNOT N WIND
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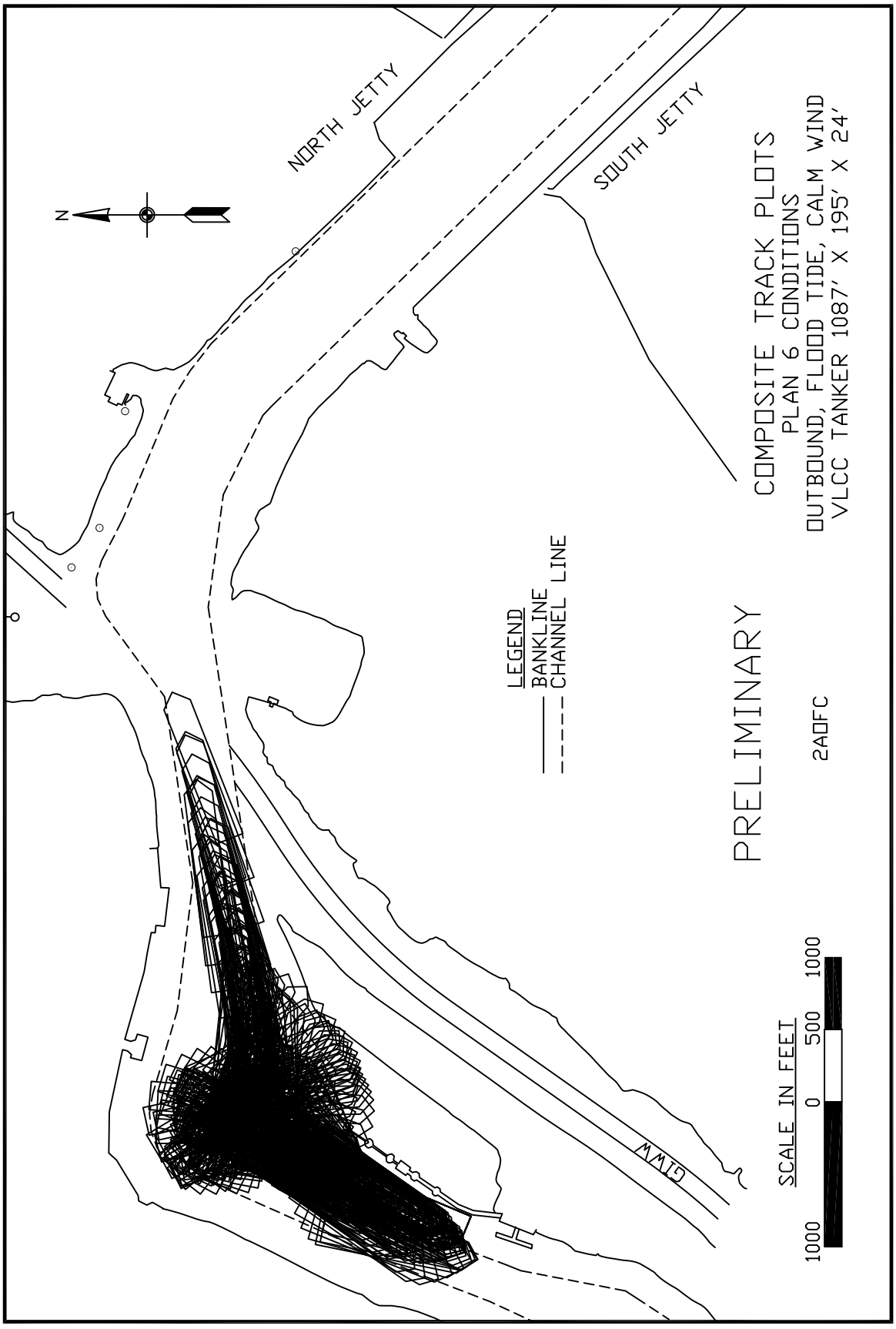
PRELIMINARY
2 OF 8
LEGEND
BANKLINE
CHANNEL LINE
GIWW
SCALE IN FEET
1000 0 500 1000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COMPOSITE TRACK PLOTS
PLAN 6 CONDITIONS
OUTBOUND, FLOOD TIDE, CALM WIND
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SCALE IN FEET
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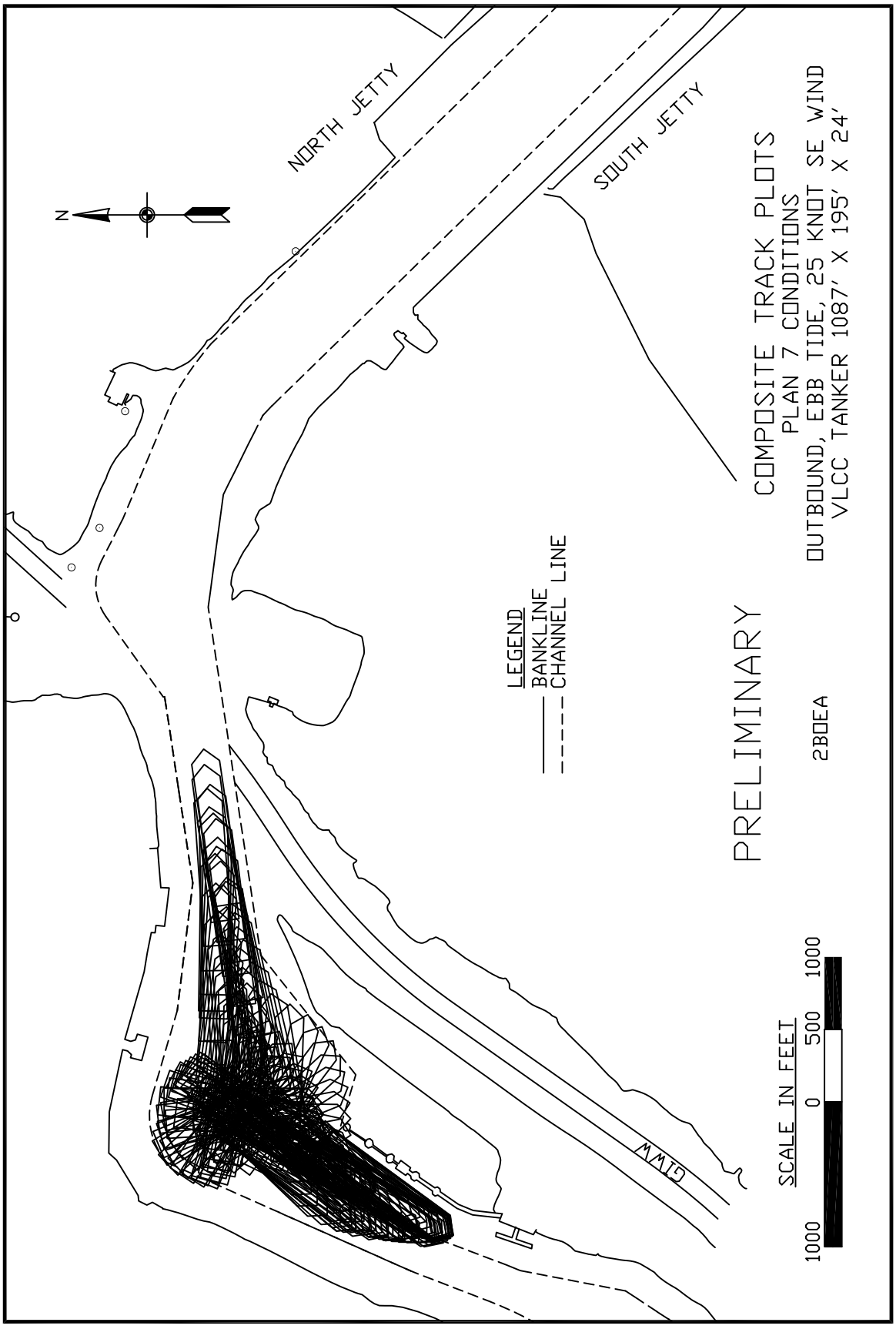
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COMPOSITE TRACK PLOTS
PLAN 7 CONDITIONS
OUTBOUND, EBB TIDE, 25 KNOT SE WIND
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CHANNEL LINE
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MLW
SCALE IN FEET
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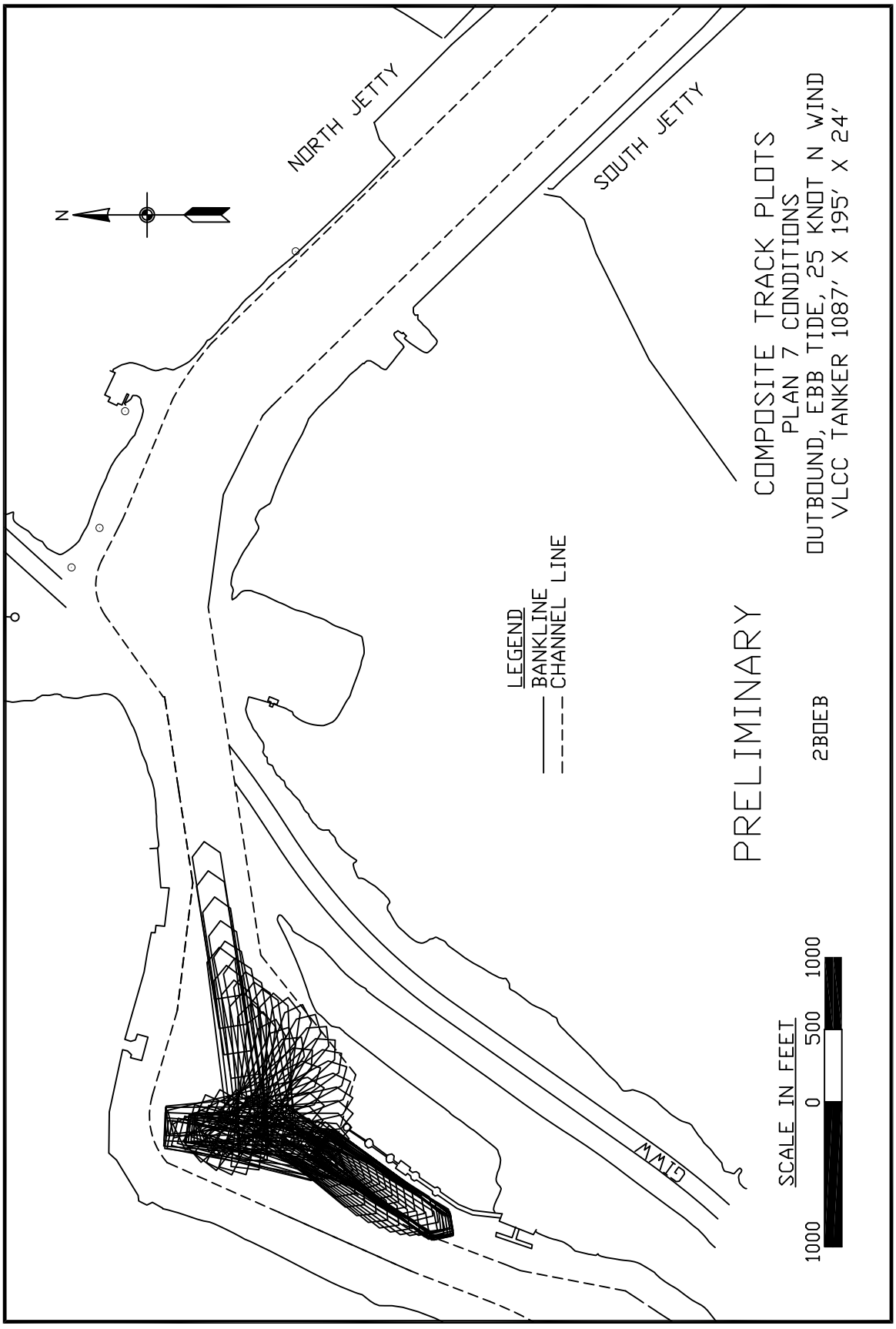
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LEGEND
BANKLINE
CHANNEL LINE
MLW
SCALE IN FEET
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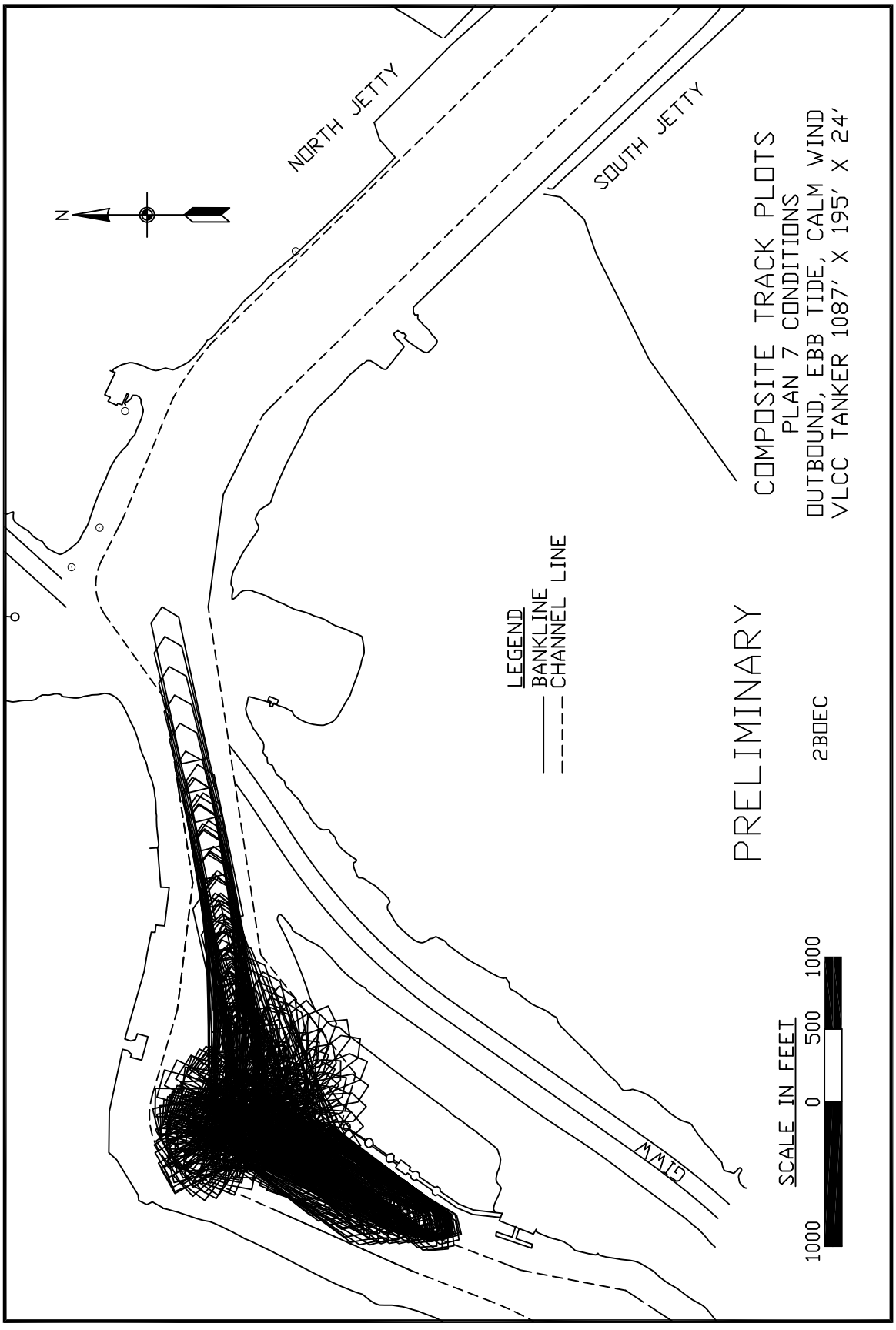
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BANKLINE
CHANNEL LINE
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SCALE IN FEET
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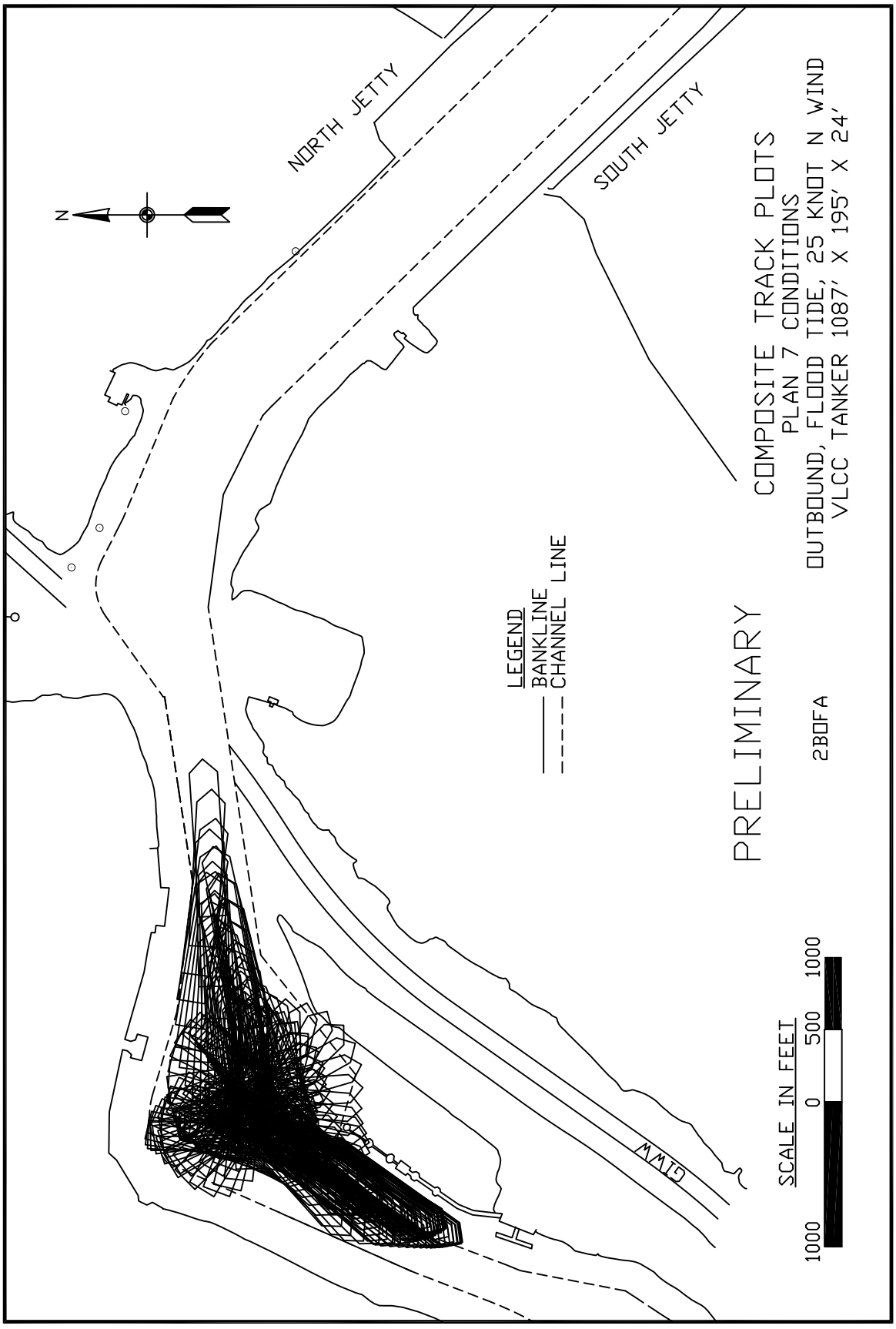
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PLAN 7 CONDITIONS
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CHANNEL LINE
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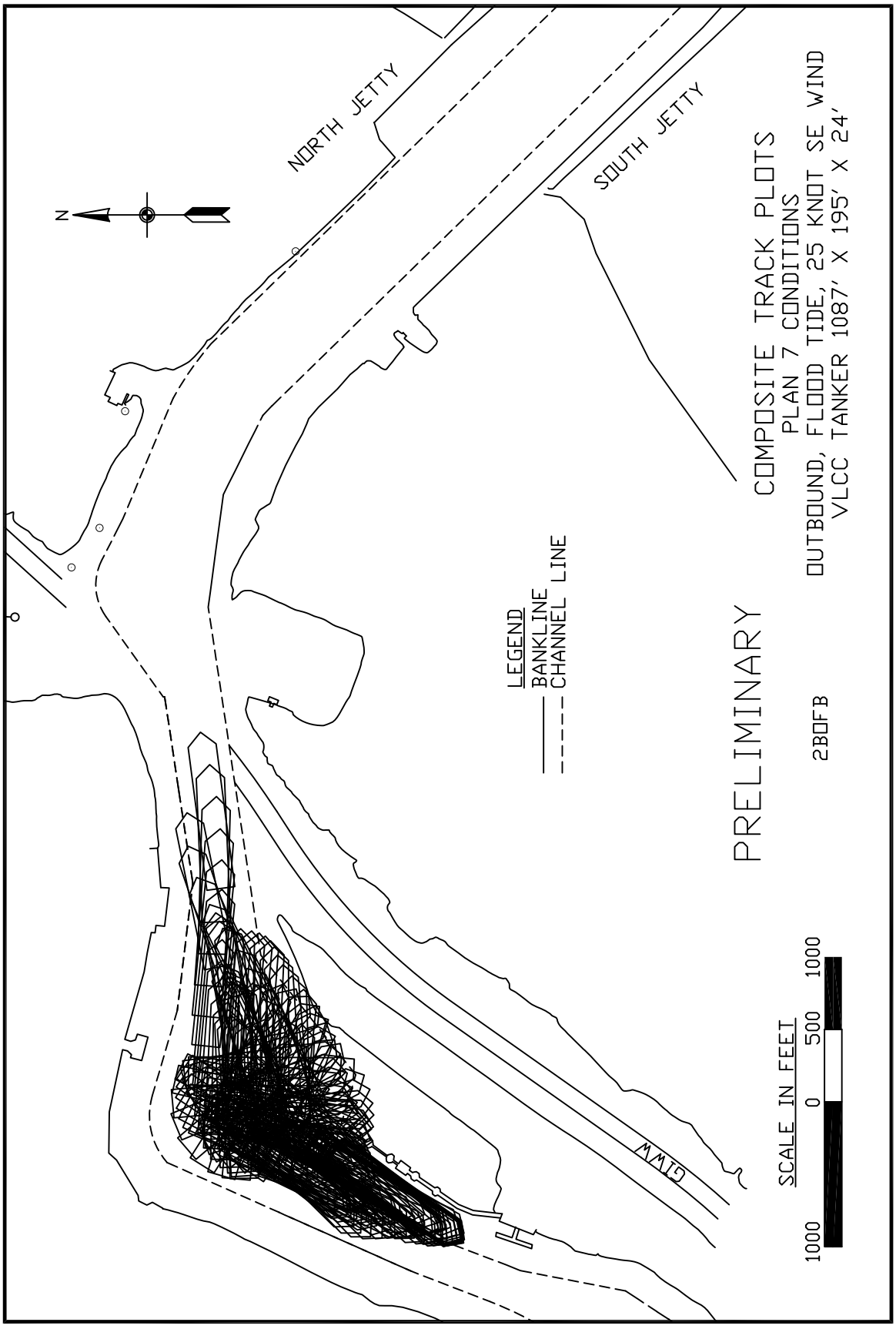
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CHANNEL LINE
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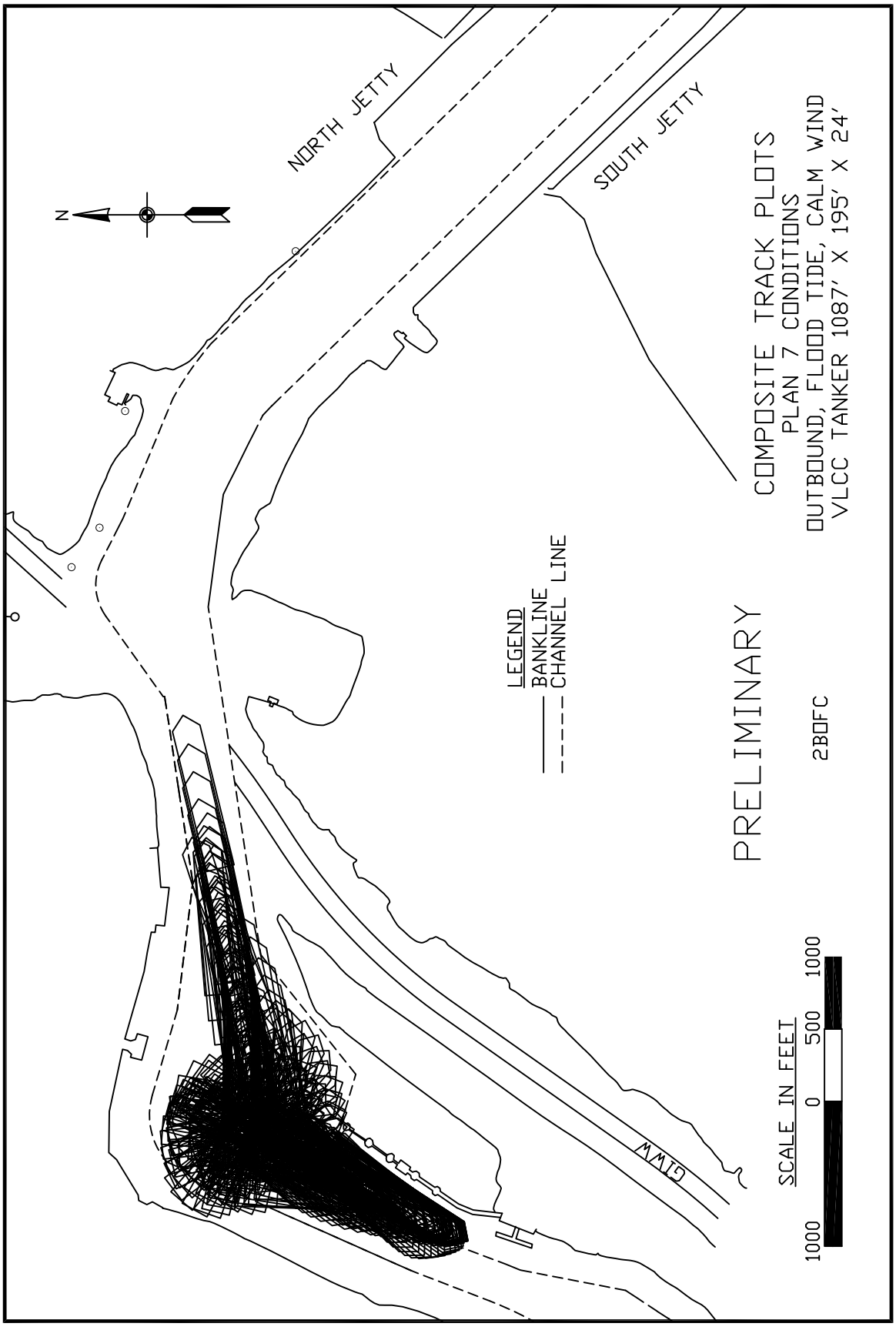
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OUTBOUND, FLOOD TIDE, CALM WIND
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LEGEND
BANKLINE
CHANNEL LINE
PRELIMINARY
2BOFC
GLW
SCALE IN FEET
1000 0 500 1000