Oregon International Port of Coos Bay

Proposed Section 204(f)/408
Channel Modification Project

Sub-Appendix 7
Ship Simulation

January 2024 Draft

Table of Contents

Attachments[1]

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[1] *10555174: A linked / searchable table of contents would be helpful to maneuver through this large study document. It is hard to flip through the various tables, pilot cards, and notes without a TOC*
Response: Now that each report will be an appendix - each report has a linked/searchable table of contents to help maneuver through document.

1. INTRODUCTION

The Oregon International Port of Coos Bay (OIPCB or Port) is home to the second largest deep-draft coastal harbor between San Francisco and the Puget Sound, based on the tonnage of cargo transported through the Port[2]. Access to the Port's facilities is provided by the Coos Bay Federal Navigation Channel (FNC), a federal channel that was first dredged in the early 1900s. The channel was last improved in 1998, when the channel was deepened by 2 feet (ft) from 35 ft to 37 ft. Since 1998, vessels calling at the Port have substantially increased in size.

1.1 Overview

The OIPCB proposes a Pacific Coast Intermodal Port (PCIP) project at Coos Bay, Oregon. The PCIP consists of integrated elements that would link freight arriving by container ship to the Port to Class 1 rail networks in Oregon. The in-water component of the project includes the deepening and widening of the existing FNC for deep-draft container vessels. In support of that work, the Port is conducting economic, engineering, and environmental studies preparatory to improving the Federal navigation project. These investigations are being conducted under the authority granted by Section 204 of the Water Resources Development Act (WRDA), 1986, as modified by Section 1014 of the Water Resources Reform and Development Act (WRRDA), 2014. This action will require approval by the U.S. Army Corps of Engineers under Section 14 of the Rivers and Harbors Appropriation Act of 1899, 33 United States Code 408, to modify the Federal navigation project. The Section 204/408 Report and Environmental Impact Statement (EIS) will propose modifications to the Coos Bay Navigation Channel in Coos County, Oregon, to accommodate larger deep draft vessels and provide local, state, and federal economic benefits. The USACE, Portland District is presumed to be the lead federal agency for the EIS in cooperation with the U.S. Department of Transportation's Federal Rail Administration.

1.2 Previous Coos Bay Channel Modification Studies

From 2016 to 2019, the Port evaluated alternatives for modifications to the Coos Bay Federal Navigation Project in support of a previous proposal. In support of that effort, M&N prepared 19 substantial works of engineering and design, economics, modeling, and construction planning. The USACE, Portland District comprehensively reviewed and evaluated the entirety of the Port's proposals as reflected in their Main Report and all appendices (OIPCB 2019).

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[2] 10565762: Joe Brock and Tyler Krug from Regulatory have no comment on this.
Response Acknowledgement of this comment

2. ATTACHMENT SUMMARY

This appendix includes three reports that describe the four navigation simulation studies completed in 2022 and 2023 to evaluate the ability of deep-draft container vessels and larger bulk carriers to call at OIPCB.

Attachment A: Phase 1 Screening Navigation Simulation Report [Rev 2]. This report describes a real-time screening vessel simulation study that was performed at the Moffatt & Nichol's in-house simulator located in Baltimore, MD. These simulations were performed to determine the preliminary design containership vessels for the Existing Channel and the 2017 Proposed Alteration Channel. For these simulations a Panamax Containership, a Post-Panamax Containership, and Post-Panamax Generation Three Containership were evaluated. The ship handling for this effort was performed by Captain Richard Michael, a retired captain and MITAGS ship handling expert. Setup, assumptions, run details, and results are presented.

Attachment B: Phase 2 Desktop Navigation Simulation Report [Rev 1]. This report describes a real-time vessel simulation study was performed on Moffatt & Nichol's traveling simulator at Oregon International Port of Coos Bay's office in Coos Bay, OR. These simulations were performed to evaluate the navigability and safety of the Existing Channel and the previously designed 2017 Proposed Alteration Channel for a Panamax Containership, a Post Panamax Generation Two Containership, and Post-Panamax Generation Three Containership. Shiphandling for these simulations was performed by the local Coos Bay Pilots. Setup, assumptions, run details and results are presented.

Attachment C: Full Mission Bridge Ship Simulation Report [Rev 2]. This report describes two navigation studies that were conducted. The first study was a real-time screening vessel simulation study which was performed at the Moffatt & Nichol's in-house simulator located in Baltimore, MD. These simulations were performed to determine the needed modifications to the 2017 Proposed Alteration channel to accommodate the Post-Panamax Generation Three containerships to ensure safe transits to the proposed container facility. The channel evaluated in this simulation effort was the 2023 Initial Concept Channel. The ship handling for this effort was performed by Captain Tim Petrusha, an active Coos Bay Pilot. This study was completed before the full mission bridge vessel simulation, which is the second study included in this report, to inform the proposed channel evaluated. The full mission bridge vessel simulation study was performed at the Maritime Institute of Technology and Graduate Studies (MITAGS) in Linthicum, Maryland. These simulations were performed to evaluate the navigability and safety of the Existing Channel and the 2023 Proposed Alteration Channel for the proposed design container vessels, of a Panamax Containership and a Post Panamax Generation Three Containership, respectively. Shiphandling for these simulations was primarily performed by the local Coos Bay Pilots with a handful of simulations performed by a MITAGS expert ship handler. Setup, assumptions, run details, results, and the MITAGS study report for the full mission bridge study are presented in this report.

ATTACHMENT A

Phase 1 Screening Navigation Simulations Results

OREGON INTERNATIONAL PORT OF COOS BAY CHANNEL MODIFICATION

Phase 1 Screening Navigation Simulation Report

Prepared for

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January 2024

OREGON INTERNATIONAL PORT OF COOS BAY CHANNEL MODIFICATION

Phase 1 Screening Navigation Simulation Report

Prepared by

moffatt & nichol

Version	Rev0	Rev1	Rev2	Rev3
Purpose	Initial Draft	DMA/OIPCB Review	USACE Review	Final Submittal
Date	December 2022	September 2023	January 2024	
By	G. Lawrence	G. Lawrence	G. Lawrence	
Checked	E. Smith	E. Smith	E. Smith	
Approved	J. Shelden	J. Shelden	J. Shelden	

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ACRONYMS AND ABBREVIATIONS

AtoN	aids to navigation
CF	Planned Container Facility
DNV	Det Norske Veritas
EIS	Environmental Impact Statement
ERDC	Engineering Research and Development Center (of the USACE)
FSS	Full Ship Simulation
JONSWAP	Joint North Sea Wave Project
LOA	Length Overall
MITAGS	Maritime Institute of Technology and Graduate Studies
MLLW	Mean Lower Low Water
M&N	Moffatt & Nichol
NWP	Portland District (of the USACE)
OIPCB or Port	Oregon International Port of Coos Bay
PPX2	Post Panamax Generation 2
PPX3	Post Panamax Generation 3
PA	Proposed Alteration
RFP	Roseburg Forest Products
RM	river mile
TSP	Tentatively Selected Plan
USACE or Corps	U.S. Army Corps of Engineers
WRDA	Water Resources Development Act
WRRDA	Water Resources Reform and Development Act

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1. INTRODUCTION

Moffatt & Nichol (M&N) was retained by David Miller Associates (DMA) and Oregon International Port of Coos Bay (OIPCB) to conduct real-time navigation simulations to support the ongoing navigation channel improvement project. Since M&N's previous work on the Coos Bay navigation channel permitting and design, a new container facility has been proposed. The purpose of this study is to evaluate the ability of the previously proposed design channel to facilitate containership transits to and from the new terminal.

This simulation study will be conducted in three phases. The first phase, Phase 1, is a screening study to identify the largest containerships which may use both the existing unimproved channel and the proposed deepened channel, or to identify minor modifications to the channels that may facilitate the containership service. Phase 2 will conduct real time simulations on a portable mini simulator with the Coos Bay Pilots to validate the design vessel selection and provide pilot input to the full mission bridge simulations. Phase 3 will be full mission bridge simulations at a simulation facility, where the Coos Bay pilots can test the tentatively selected plan in the same conditions used for the earlier design phases.

1.1 PURPOSE AND OBJECTIVE

This report outlines the findings for the Phase 1 screening real-time navigation simulation study. The navigation simulations were conducted from November 7th to November 11th, 2022, at the M&N in-house simulator, which is located at the M&N office in Baltimore, MD. The ship handling for this simulation effort was performed by Captain Richard Michael, a retired captain and Maritime Institute of Technology and Graduate Studies (MITAGS) ship handling expert.

The following objectives were identified for this screening study:

1. Select design containership vessel for the existing navigation channel,
2. Select design containership vessel for the proposed navigation channel,
3. Confirm the basic feasibility of maneuvering to the new container facility in the existing and previously developed widened and deepened navigation channel with a determined design vessel,
4. Preliminarily size the required turning area for the design vessels identified in (1) and (2),
5. Identify preliminary location for the containership to perform the turning evolution for the new facility,
6. Preliminary assessment of tugboat assistance for the design containerships.

2. SIMULATION INPUTS

2.1 SIMULATOR

The simulations were performed at the M&N in-house simulator (Figure 2-1) which is located in Baltimore, MD. The M&N simulator consists of an operator console and a pilot console. Captain Richard Michael sat at the pilot console and was responsible for conning the simulations (no separate helmsman). The simulator operator (an M&N engineer) supervised the simulation (e.g., controlling environmental conditions, setting up the scenarios for testing, etc.) and operated the tugs as instructed by the pilot. For these simulations, the tugs were controlled by basic commands from the simulation operator (where to connect, how hard to pull, etc.).

The simulations were conducted using the navigation simulation software Navi Trainer Pro 5000 (NTPro). NTPro simulates real time vessel maneuvers through realistic 3D renderings of harbor geometry, accounting for vessel response to wind, waves, currents, bathymetry (shallow water effects), and vessel-structure and vessel-vessel interaction. The vessel hydrodynamics are incorporated with a full six degree-of-freedom model. Vessel models used for this study were provided by MITAGS and Wärtsilä. These vessel models were validated by MITAGS.

The scene used for this study is based on the scene that was previously used for the 2017 Navigation Simulations (M&N, 2017) performed at Cal Maritime. M&N customized a version of this scene to include the proposed containership facility and associated turning basin.

Figure 2-1. Moffatt & Nichol Simulator

2.2 PROPOSED DESIGN VESSELS

Four deep draft vessels were identified for the vessel screening study: two vessels for the existing channel and two vessels for the proposed channel. The proposed vessels were determined by identifying a range of vessels which could utilize the 300-ft wide existing channel and the proposed 450-ft wide channel using PIANC (2016) channel design guidelines (Table 2-1). For each channel, one vessel was selected which fits within the PIANC recommendations plus a vessel one class larger. For the existing channel, a Subpanamax and Panamax vessel were selected. For the Proposed Channel, a Post Panamax Generation 2 and Post Panamax Generation 3 vessels were selected.

The models for simulation were based on previously-developed Wärtsilä and MITAGS vessel models, with vessel draft adjusted (if necessary) to suit the channel depth. The particulars of these design vessels models are summarized in Table 2-1. All of these vessel models were validated by MITAGS prior to the Phase 1 simulation study. The pilot cards for these vessels are provided in Appendix A.

Table 2-1. Project Wärtsilä Vessel Models Particulars

Attribute		**Existing Channel Containership Vessel Models**		**Proposed Channel Containership Vessel Models**	
Vessel Model		Containership28	Container Arthur Edgemore	Container Apollo 11	Container Kalina
Class/Capacity		Subpanamax / 2,100 TEU	Panamax / 4,500 TEU	Post Panamax Generation 2 / 8,500 TEU	Post Panamax Generation 3/ 13,000 TEU
LOA	ft	623.4	958.0	1095.8	1200.8
	m	190.0	292.0	334.0	366.0
Beam	ft	98.4	105.6	141.1	168.0
	m	30.0	32.2	43.0	51.2
Operating Draft	ft	27.9	36.0	45.0	45.0
	m	8.5	11.0	13.7	13.7

2.3 NAVIGATION CHANNELS AND TURNING AREAS

The dimensions of the existing and proposed navigation channels are listed in Table 2-2. The width of the proposed channel and bends were determined in the previous design effort (M&N, 2017) and were unchanged for the Phase 1 study, Figure 2-2. Currently, there is no turning basin sufficient for the proposed containership facility in the existing or proposed channels. For this screening simulation effort two turning basins were evaluated (Figure 2-3). The turning basin diameter was determined using the longest design vessel (Table 2-2) for each channel following USACE EM 1110-2-1613 *Hydraulic Design of Deep-Draft Navigation Project* guidance. The principal diameter of the turning area is 1.5 times the vessel length with an additional 200 ft both upstream and downstream to account for drift in the tidal currents.

Table 2-2. Channel and Turning Basin Dimensions

Channel	**Existing**	**Proposed**
Depth [ft MLLW]	-37.0	-45.0
Channel Minimum Width [ft]	300	450
Turning Basin Diameter [ft]	1,450	1,800

Figure 2-2. Coos Bay Proposed Federal Navigation Channel

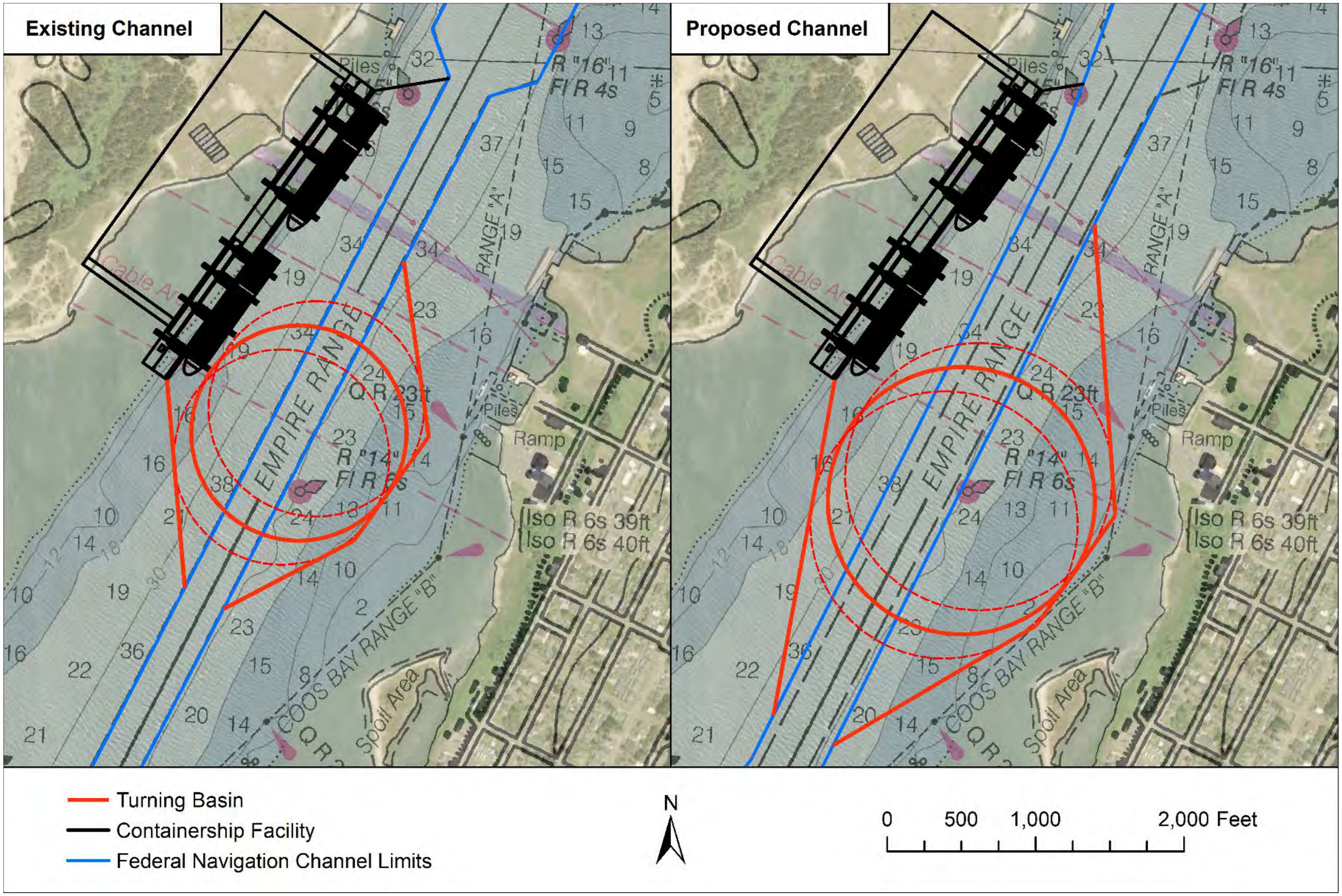

Figure 2-3. Turning Basin for Containership Facility for Existing and Proposed Channels.

2.4 TUG ASSISTANCE

Escort tugs were available during each simulation and used at the discretion of the pilot. Tugs were controlled in the simulator by the simulator operator and tug navigation will be completed by the software autopilot. Even in the auto-controlled mode the tugs are active six-degrees-of-freedom vessels in the simulation and could run aground or collide with other vessels.

Based on the previous simulation efforts performed in 2016 and 2017 (M&N 2016 & M&N 2017) in Coos Bay there is one local 50 metric ton conventional tug. For additional tugs it is assumed Azimuth Stern Drive (ASD) tractor tugs would be mobilized to Coos Bay for the containership service. Wärtsilä vessel models were used to simulate these tugs are summarized in Table 2-3. The testing matrix presented in Table 2-7 lists the tugs used for each simulation.

Table 2-3. Wärtsilä Tug Models Particulars

Wärtsilä Tug Model		**ASD Tug 12**	**ASD Tug 14**	**ASD Tug 15**	**Conventional Twin Screw Tug 9**
Tug Type		ASD	ASD	ASD	Conventional
LOA	ft	89.9	105.0	105.0	137.8
	m	27.4	32.0	32.0	42.0
Beam	ft	37.7	38.1	38.1	40.0
	m	11.5	11.6	11.6	12.2
Draft	ft	11.5	18.0	19.0	15.7
	m	3.5	5.5	5.8	4.8
Bollard Pull	mt	50	70	80	50

2.5 ENVIRONMENTAL CONDITIONS

Environmental conditions considered in the simulations were tides, currents, waves, and winds. All environmental conditions used for this screening simulation are based on the conditions previously evaluated during the navigation simulations in 2016 and 2017 (M&N 2016 & M&N 2017).

The tides, currents, and waves were generated using a fully integrated hydrodynamic model built by M&N for the Channel Modification Project. The model uses the MIKE-21 flexible mesh modeling suite. No modifications to the hydrodynamic model were implemented at this stage and therefore the current fields do not account for the turning area geometries and the approach to the container facility that vary from the previous project.

A full transit—inbound or outbound—typically takes 1 to 1.5 hours to the proposed container facility. Based on this duration, tides and tidal currents vary throughout the transit time. As a result, time and space varying tidal currents were included in the simulator to account for these effects. However, the tide level was held constant for each simulation as the software does not allow time-varying water levels.

In Coos Bay slack water at the jetty entrance typically occurs about 47 minutes after high water during a flood tide and approximately 40 minutes after low water during an ebb tide. The currently preferred operation for outgoing vessels is to start at or before high tide, so that the entrance is reached at slack tide. Incoming vessels often make use of the flood tide. The local pilots report avoiding transiting the entrance turn outbound with deep draft vessels during a fully developed ebb tide whenever possible.

A 24-hour period representing a typical spring tide condition was extracted from the hydrodynamic model. Four, one-hour time periods were selected to represent simulated approach or departure transit windows. The tidal conditions used in simulations are summarized in Table 2-4. The hour indication in the run matrix (Table 2-7) corresponds to the hour in a 24-hour cycle. For example, a time of +0 hrs corresponds to 18:00 on 7/25, whereas an offset of +9 hrs corresponds to 03:00 on 7/26. The tide levels in the model are represented as a constant level at the minimum water level that occurs during the transit. Based on the previous simulation efforts performed in 2016 and 2017 the minimum underkeel clearance for the existing channel and proposed channel design vessels (exclusive of waves or squat) should be 3.6 ft and 4.5 ft, respectively.

Table 2-4. Start time and simulated tidal elevations based on Charleston Gauge

Tidal Condition	Run Start Time (UTC)	Simulated Tide Elevation (ft)	Comment
Flood	7/25/2008 22:00	+4.5	Middle of flood tide
High Slack 1	7/26/2008 01:30	+6.75	Starts at MHHW, ends at slack tide
High Slack 2	7/26/2008 14:30	+4.5	High tide slack with lower water surface elevation
Ebb 1	7/26/2008 02:30	+5.0	Ebb tide starting at high tide slack

Waves in the vicinity of Coos Bay are generally from the west and northwest. The highest waves in the area are from the southwest. However, these occur relatively infrequently and the entrance to the Federal Navigation Channel (FNC) is sheltered from southwesterly waves by the bluffs at Cape Arago. As a result, southwest storm waves typically do not directly affect navigation in the entrance channel.

The wave conditions that were evaluated are summarized in Table 2-5. The wave conditions evaluated were the same conditions as the 2016 and 2017 studies (M&N 2016 & M&N 2017).

Wave conditions in the ship simulations are based on waves generated from a JONSWAP (Joint North Sea Wave Project) spectrum and therefore represent spectral variability in wave height and period. To account for the attenuation of the offshore wave as it progresses toward shore, a number of wave condition zones were created to represent the decreasing wave height from offshore to nearshore. The simulator operator adjusted the wave conditions according to the zones as the ships proceeded through the jetties.

Winds in Coos Bay area are typically bidirectional, with strong northerly and southerly components. The winds tend to be more northerly in the summer and more southerly in the winter. Representative seasonal wind conditions for the simulations are presented in Table 2-6, based on wind data from Cape Arago and North Bend. These winds conditions were evaluated as sustained winds.

Table 2-5. Deepwater Wave Conditions for Use in Simulations

Wave Condition	Deepwater Waves			Comment
	Significant Wave Height (ft)	**Peak Period (s)**	**Mean Wave Direction (deg, from)**	
Moderate, NW	9.0	12	320	Significant wave-induced motion (10 to 12 ft possible offshore), but little wave penetration into jettied entrance.
Swell, NW	7.0	15	305	Significant wave motion possible due to long wave period, despite relatively small wave height.
Swell, W	6.0	15	275	Swell waves can penetrate well into the jettied entrance and cause significant wave motion further upstream.

Table 2-6. Wind Conditions for Use in Ship Simulations

Wind Condition (For Modeling)	Sustained Wind at Location	
	Offshore from RM 1.0 (from Cape Arago)	**Upstream of RM 1.0 (from North Bend)**
NNW wind, high summer wind	25 knots, NNW	25 knots, NNW
NNE wind, high summer condition	25 knots, NNE	25 knots, NNE
SSW wind, high winter condition	30 knots, SSW	20 knots, SSW

2.6 AIDS TO NAVIGATION

For the existing channel Aids to Navigation Aid (ATONs) were the existing buoys, markers, and ranges. For the proposed channel, location of buoys and range lines were identical to the ATONs included in the final channel design configuration as tested in the 2017 vessel simulation study. The ATONs in the vicinity of the proposed container terminal (Buoys “14” and “15”) were relocated to avoid conflict with the terminal and turning area.

2.7 TESTING MATRIX

Table 2-7 shows the matrix of completed simulations. In total, 32 simulations were conducted to evaluate the existing and proposed channels. These simulations can be classified in the following groups:

- Pilot Familiarization & Simulator Malfunction (Simulation 1, 2, 3, 6, 11, 12, 28)
- Inbound Existing Channel (Simulation 4, 7, 21, 27, 31)

- Outbound Existing Channel (Simulation 5, 26, 30)
- Inbound Proposed Channel (Simulation 8, 9, 13, 14, 15, 16, 18, 20)
- Outbound Proposed Channel (Simulation 10, 17, 19)
- Panamax Turning Basin at Containership Facility (Simulation 21, 24, 25, 26, 29, 32)
- Post Panamax Generation 3 Turning Basin at Containership Facility (Simulation 16, 17, 18, 19, 20)
- Northern Turning Basin (Simulation 22 & 23)

The pilot chose the starting vessel speed for each simulation to align with his approach to the maneuver, the starting channel location and transit direction for the maneuver.

Table 2-7. Screening Simulation Matrix

Run ID	Channel	Vessel	Direction / Turn	Tug Power (mt)	Wind Offshore/Onshore	Waves	Tide Elev. (ft)	Tide Stage (Model Time)	RM	Run Result
1	Pilot Familiarization									○
2	Pilot Familiarization									○
3	Pilot Familiarization									○
4	Existing	Panamax	Inbound / NA	50* / 50	25kt NNE (22.5°)/25kt NNE (22.5°)	Moderate, NW	4.5	Flood (+04:00h)	-2 to 3	🟢
5	Existing	Panamax	Outbound / NA	50* / 50	25kt NNE (22.5°)/25kt NNE (22.5°)	Swell, NW	5	Ebb 1 (+08:30h)	3 to -1	🟢
6	Existing	Panamax	Inbound / NA	50* / 50	25kt NNW (337.5°)/25kt NNW (337.5°)	Swell, NW	6.5	Flood (+04:00h)	-2 to 3	○
7	Existing	Panamax	Inbound / NA	50* / 50	25kt NNW (337.5°)/25kt NNW (337.5°)	Swell, NW	6.5	Flood (+04:00h)	-2 to 3	🟢
8	Proposed	Post Panamax Generation 2	Inbound / NA	50* / 80 / 80	30kt SSW (222.5°) / 20kt SSW (222.5°)	Swell, W	4.5	Flood (+04:00h)	-2 to 3	🟢
9	Proposed	Post Panamax Generation 2	Inbound / NA	50* / 80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	Swell, NW	4.5	Flood (+04:00h)	-2 to 3	🟢
10	Proposed	Post Panamax Generation 2	Outbound / NA	50* / 80 / 80	30kt SSW (222.5°) / 20kt SSW (222.5°)	Swell, W	4.5	Ebb 1 (+08:30h)	3 to -1	🟢
11	Pilot Familiarization									○
12	Pilot Familiarization									○
13	Proposed	Post Panamax Generation 3	Inbound / NA	50* / 80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	Swell, NW	4.5	Flood (+04:00h)	-2 to 1.5	🔴
14	Proposed	Post Panamax Generation 3	Inbound / NA	50* / 80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	Swell, NW	4.5	Flood (+04:00h)	-2 to 1.5	🔴
15	Proposed	Post Panamax Generation 3	Inbound / NA	50* / 80 / 80	20kt NNE (22.5°)/20kt NNE (22.5°)	Swell, NW	4.5	Flood/Slack (+06:30h)	-2 to 1.5	🔴
16	Proposed	Post Panamax Generation 2	Inbound / Yes	50* / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Moderate, NW	4.5	Flood (+04:00h)	-2 to CF	🟢
17	Proposed	Post Panamax Generation 2	Outbound / Yes	50* / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Moderate, NW	6.75	High Slack (+07:30h)	CF to -1	🟢
18	Proposed	Post Panamax Generation 2	Inbound / Yes	50* / 80 / 80	30kt SSW (222.5°) / 20kt SSW (222.5°)	Swell, W	4.5	Flood (+04:00h)	-2 to CF	🟢
19	Proposed	Post Panamax Generation 2	Outbound / Yes	50* / 80 / 80	30kt SSW (222.5°) / 20kt SSW (222.5°)	Swell, W	6.75	High Slack (+07:30h)	CF to -1	🟢
20	Proposed	Post Panamax Generation 2	Inbound / Yes	50* / 80 / 80	20kt NNE (22.5°)/20kt NNE (22.5°)	Swell, NW	4.5	Flood (+04:00h)	-2 to CF	🟢

Run ID	**Channel**	**Vessel**	**Direction / Turn**	**Tug Power (mt)**	**Wind Offshore/Onshore**	**Waves**	**Tide Elev. (ft)**	**Tide Stage (Model Time)**	**RM**	**Run Result**
21	Existing	Post Panamax Generation 2	Inbound / Yes	50* / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Swell, NW	6.5	Flood (+04:00h)	-2 to CF	River: 🔴 TB: 🟢
22	Proposed	Post Panamax Generation 2	Inbound / Yes	50* / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	--	6.5	Flood (+06:00h)	6 to NTB	🔴
23	Existing	Panamax	Inbound / Yes	50 / 50	25kt NNW (337.5°)/25kt NNW (337.5°)	--	6.5	Flood (+06:00h)	6 to NTB	🔴
24	Existing	Panamax	Outbound / Yes	50 / 50	25kt NNW (337.5°)/25kt NNW (337.5°)	--	5	Ebb 1 (+08:30h)	CF to TB	🔴
25	Existing	Panamax	Outbound / Yes	50 / 50	25kt NNW (337.5°)/25kt NNW (337.5°)	--	5	Ebb 1 (+08:30h)	CF to TB	🔴
26	Existing	Panamax	Outbound / Yes	70 / 70	25kt NNW (337.5°)/25kt NNW (337.5°)	Moderate, NW	6.75	High Slack (+07:30h)	CF to -1	🟢
27	Existing	Panamax	Inbound / No	80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Moderate, NW	4.5	Flood (+04:00h)	-2 to TB	🟢
28	Existing	Panamax	Inbound / Yes	80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	--	8	Flood (+04:00h)	3.5 to TB	○
29	Existing	Panamax	Inbound / Yes	80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	--	8	High Slack (+07:30h)	3.5 to CF	🟢
30	Existing	Panamax	Outbound / No	80 / 80	30kt SSW (222.5°) / 20kt SSW (222.5°)	Swell, W	8	High Slack (+07:30h)	TB to -1	🟢
31	Existing	Panamax	Inbound / No	80 / 80	30kt SSW (222.5°) / 20kt SSW (222.5°)	Swell, W	8	Flood (+04:00h)	-2 to TB	🟢
32	Existing	Post Panamax Generation 2	Outbound / Yes	80 / 80 / 50	25kt NNW (337.5°)/25kt NNW (337.5°)	--	8	High Slack (+07:30h)	TB to 4	🟢

Results Legend:

○ Pilot Familiarization/Software Malfunction
🟢 Successful Run
🔴 Unsuccessful Run

* = Conventional Tug, TB = Turning Basin at Container Facility, CF = Container Facility, NTB = Northern Turning Basin

3. RESULTS & ANALAYSIS

Vessel swept paths were developed for each simulation to illustrate clearance of the vessel to the channel limits, moored vessels, and turning basin dredge limits. The swept paths are illustrated in Appendix B. The vessel profiles are shown at two-minute intervals.

3.1 EXISTING CHANNEL

In total eight simulations were performed to evaluate a containership transiting the existing navigation channel. Of these eight simulations, five were inbound (**Simulation 4, 7, 21, 27, 31**) and three were outbound (**Simulation 5, 26, 30**). All of the simulations were conducted with the Panamax containership with the exception of Simulation 21. For **Simulation 21** the Post Panamax Generation 2 containership was simulated in the existing channel. All of the inbound simulations started with flooding tidal currents and had at least 25 kts of wind either from the NNE, NNW, or SSW. The outbound simulations either started at high slack currents or ebb currents and again had at least 25 kts of wind either from the NNE, NNW, or SSW.

Overall, the Panamax transits in the existing channel were successful both inbound and outbound, therefore simulations with the Subpanamax vessel were not necessary. Two areas for the inbound transit were challenging. The first area was at the narrow point of the Entrance Range seaward of Buoy 5. The second area that was difficult was at the apex of the turn from the Entrance Range and Turn to Coos Bay Island Range on the green side of the channel at marker 7. For both of these locations a small bend widener would improve the safety of the transit. Additionally, Captain Michael recommended if a bend widener was added near marker 7 than an additional floating buoy should be placed closer to the channel limit at the apex of the turn. The tested environmental conditions, specifically the strong winds made these maneuvers challenging in the narrow existing channel. Therefore, Captain Michael recommended an upper range of wind speed at 20 to 25 kt for all containerships.

For **Simulation 21** which evaluated the Post Panamax Generation 2 containership in the existing channel the vessel ran outside the channel approximately five times with repeated attempts . The swept path of the vessel exceeds the limits of the channel at numerous points; therefore, this transit is not recommended. The channel would require significant modification to accommodate the Post Panamax Generation 2 vessel. Based on these simulations the recommended design containership for the existing channel is a Panamax class containership.

3.2 PROPOSED CHANNEL

In total eleven simulations were performed to evaluate a containership transiting the proposed navigation channel. Of these eleven simulations, eight were inbound (**Simulation 8, 9, 13, 14, 15, 16, 18, 20**) and three were outbound (**Simulation 10, 17, 19**).

For the inbound simulations, three (**Simulation 13, 14, 15**) evaluated the Post Panamax Generation 3 containership in the proposed channel. All of these simulations ended with a grounding in the entrance turn. For **Simulation 15** the environmental conditions evaluated were reduced and the same grounding result was achieved. Given the length of the vessel and wind area, the vessel was not able to achieve the rate of turn and turning radius required to successfully navigate the entrance turn. With three failed attempts it was determined that the Post Panamax Generation 3 containership was unable to safely transit the proposed channel.

The remainder of the proposed channel simulations evaluated the Post Panamax Generation 2 containership[1]. All of the inbound simulations started with flooding tidal currents and had at least 25 kts of wind either from NNE, NNW, or SSW. The outbound simulations either started at high slack currents or ebb currents with the same wind conditions as the inbound simulations. The transits with the Post Panamax Generation 2 containership were successful both inbound and outbound. With the severe environmental conditions that are typical in Coos Bay Captain Michael recommended two ASD tugs as escort tugs especially for the entrance turn. Overall, the proposed aids to navigation were well received by Captain Michael. The only recommendation would be to add a green buoy closer to the channel at green buoy “7”. Based on these simulations the recommended design containership for the proposed channel is a Post Panamax Generation 2 class containership.

3.3 PANAMAX TURNING BASIN AT CONTAINERSHIP FACILITY

In total six simulations performed the turning evolution in the turning basin at the proposed containership facility that was sized for a Panamax class vessel. Four of these simulations modeled a Panamax vessel (**Simulation 24, 25, 26, 29)**. **Simulation 24 and 25** were outbound simulations with ebbing currents and 25 kt winds from the NNW. Both of these simulations ended in grounding. Based on the feedback from Captain Michael and two failed attempts it was determined that the turning evolution in the turning basin should be avoided during ebb tidal conditions. As a result, **Simulation 26** evaluated the same conditions as the previous simulation but during high slack tidal currents. The turning evolution was successfully performed in Simulation 26. Captain Michael stated[2] that overall, the Panamax vessel was highly sensitive to tugs and difficult to control once the vessel started rotating. **Simulation 29** evaluated an inbound turning evolution with flood tidal currents and 25 kt winds from the NNW. Captain Michael had difficulty controlling the vessel in the high wind conditions and two 80-ton ASD tugs were needed. During the turning evolution there was an unrealistic rate of turn. Therefore, before Phase 2 the vessel model will be revalidated to check this high rate of turn.

The other two simulations (**Simulation 21 and 32**) in this group evaluated the Post Panamax Generation 2 containership performing the turning evolution in the smaller turning basin. **Simulation 21** was an inbound transit while **Simulation 32** was an outbound maneuver. Both of these simulations had a sustained wind of 25 kts from the NNW. With this wind condition the assist tugs had to work hard to combat the strong conditions. Captain Michael felt comfortable with this turning basin diameter with the larger Post Panamax Generation 2 containership and actually found this vessel easier to maneuver than the Panamax vessel in the turning basin.

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[1] 10555169: Is the Apollo 11 8,500TUE Containership the same as the PPX2?
There are references to the 8,500 TEU containership and a 8,000 TEU containership. If this is a typo - please fix. If these are different vessels please clarify.
The Apollo 11, 8.500 TEU and 8,000 are the same as the PPX2 - typos have been corrected in the report.

[2] 10555810: Were Model issues Addressed?:
Captain Michael stated that overall, the Panamax vessel was highly sensitive to tugs and difficult to control once the vessel started rotating... During the turning evolution there was an unrealistic rate of turn. Therefore, before Phase 2 the vessel model will be revalidated to check this high rate of turn.
...Captain Michael felt comfortable with this turning basin diameter with the larger 8,000 TEU
Containership and actually found this vessel easier to maneuver than the Panamax vessel in the turning basin.

3.4 POST PANAMAX GENERATION 3 TURNING BASIN AT CONTAINERSHIP FACILITY

In total five simulations (**Simulation 16, 17, 18, 19, 20**) evaluated turning the Post Panamax Generation 2 containership in the larger turning basin that was designed for the Post Panamax Generation 3 containership. All of these simulations were performed successfully. Captain Michael stated that with the strong typical wind conditions three ASD tugs should be available to assist the turning evolution. The total bollard pull needed to perform this turning evolution should be further evaluated in Phase 2 of this project. The general assessment was that the turning area was more than sufficient for a Post Panamax Generation 2 vessel and that the Panamax-sized basin evaluated above would suffice for the Post Panamax Generation 2 vessel.

3.5 NORTHERN TURNING BASIN

The recommended turning basin location has not yet been determined. While turning the vessels directly off the container terminal would be more operationally efficient, two simulations were also performed evaluating the existing turning basin and the previously proposed turning basin at approximately river mile marker 7. Inbound vessels, would pass the container terminal and proceed upriver to river mile 7, turn, and then proceed back downriver to the container facility.

Simulation 22 evaluated the Post Panamax Generation 2 containership performing the turning evolution in the previously proposed turning basin with flood tidal currents and a 25 kt wind from the NNW. It was determined as designed the turning basin is not large enough for the Post Panamax Generation 2 vessel and further enlargement would be needed. The principal width of the basin is the same length as the Post Panamax Generation 2 containership. Additionally, Captain Michael recommended a bend widener on the red side of the channel between red buoy 20 and buoy 22. As designed this turning evolution was difficult as the containership is completing the turn and then needs to leave the turning basin with no headway and immediately make the turn onto the Jarvis Turn Range.

Simulation 23 evaluated the Panamax Containership performing the turning maneuver in the existing chip ship turning basin with the same environmental conditions as Simulation 22. Again, it was determined that the turning basin was not sufficient size for this vessel class. The same feedback was given with regards to the need for a bend widener on the red side of the channel and the difficulty to make the turn on Jarvis Turn Range with limited headway of the containership.

4. PHASE 1 SUMMARY & CONCLUSIONS

A real-time screening vessel simulation study was performed at the M&N in-house simulator located in Baltimore, MD. These simulations were performed to determine the preliminary design containership vessels for the existing and proposed navigation channels. The ship handling for this effort was performed by Captain Richard Michael, a retired captain and MITAGS ship handling expert.

Thirty-two simulations were performed from November 7, 2022 to November 11, 2022, including six pilot familiarization simulations. Eight simulations evaluated the existing channel and eleven assessed the proposed channel. Thirteen simulations evaluated a turning evolution in either the turn basin proposed near the container facility or at a version of the existing turning basin near river mile marker 7.

The primary conclusions, recommendations, and future work from this study are as follows in the subsections below.

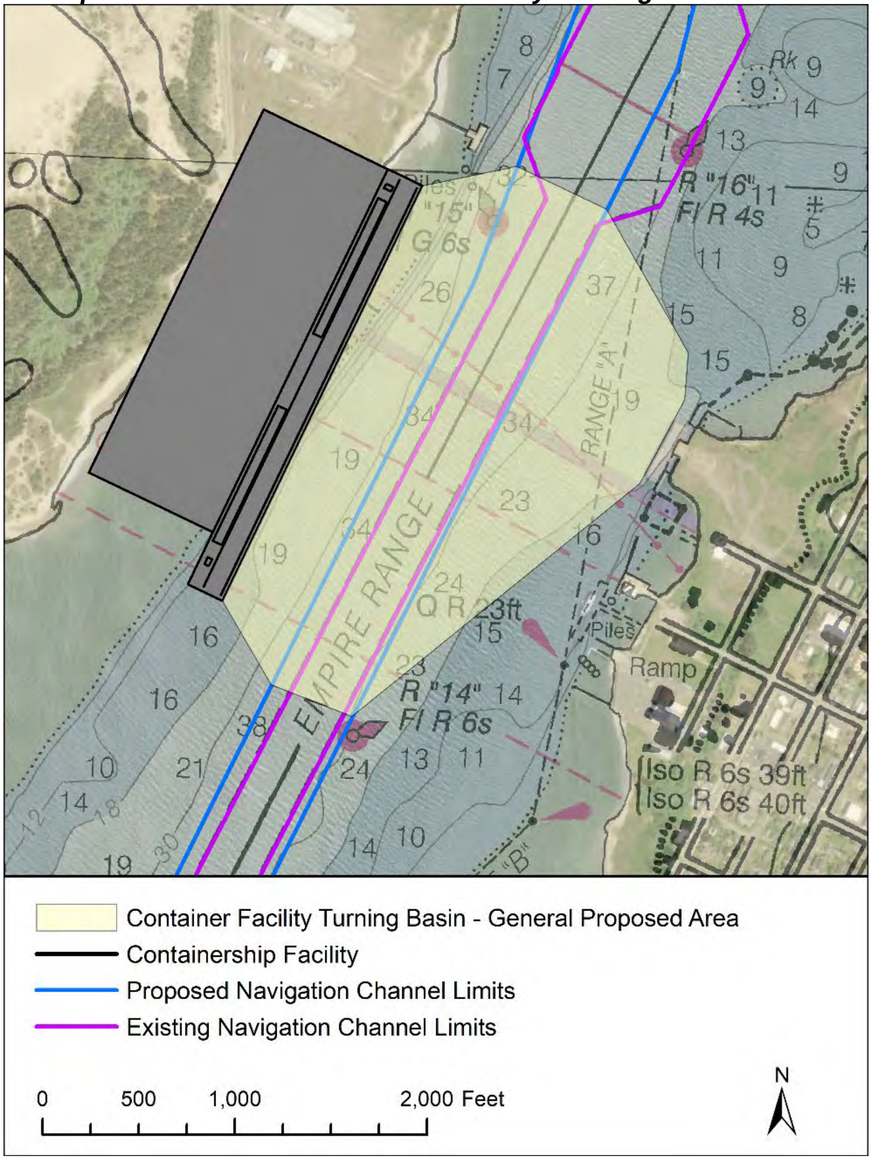
4.1 DESIGN VESSELS

- For the existing channel, the Panamax class containership is the recommended maximum design vessel which can safely navigate the channel.
- For the proposed channel, the Post Panamax Generation 2 containership is the recommended maximum design vessel which can safely navigate the channel.
- The Post Panamax Generation 3 containership was unable to safely transit the entrance turn of the proposed channel and would require redesign of the channel.
- Containerships have a higher sail area and wind exposure than bulkers and therefore for all containership classes it is recommended to limit wind during transits to 20-25 knots or less.

4.2 TURNING AREAS

- A turning area with a principal width of 1450 feet is recommended for Phase 2 testing. This width proved successful for both the Panamax and Post Panamax Generation 2 containerships and is recommended for both the existing channel and proposed channel turning areas.
- Turning while the tidal stream is running in the channel was challenging. Operationally, it is recommended that the containership berth port side to berth and perform the turning evolution on the outbound transit to better time the tidal currents. Ideally, the turn maneuver will happen near slack water.
- For Phase 2 of this project the turning basin location needs to be further evaluated with the input of the Coos Bay Pilots and OIPCB.
    - For the turning basin adjacent to the terminal, and with the recommended smaller turning area size, the proposed basin can be located at the north end of the container facility in deeper water to reduce dredging demands, as shown in Figure 4-1. A more detailed drawing of the proposed turning basin will be provided in the Phase 2 plan document.
    - For the turning basin at River Mile 7, a modified design will be proposed with additional dredging on the north side to allow turning of the design vessels.

Figure 4-1. General Proposed Area for the Container Facility Turning Basin



4.3 TUGBOATS

Similar to the conclusions for LNG carriers in the previous simulations (M&N 2016 & M&N 2017), it is recommended to have a minimum of two azimuthing stern drive (ASD) tractor tugs to escort arriving and departing containerships in the channels and for turning the vessels.

4.4 MINOR MODIFICATIONS

The Phase 1 simulation showed the navigation in the existing channel by a Panamax containership is feasible. However, the pilot provided two recommendations of potential minor modifications to improve navigation safety as listed below. These considerations will be further evaluated and discussed during Phase 2 with input from the Coos Bay Pilots.

- In the existing channel a bend widener on the green side of the channel near green buoy “5” and “7” is recommended to improve navigation safety and remove choke points in the channel.

- Regarding the existing aids to navigation, an additional floating buoy is recommended closer to the channel limits near green marker “7” to better mark the existing channel limit.

4.5 PHASE 2 SIMULATIONS

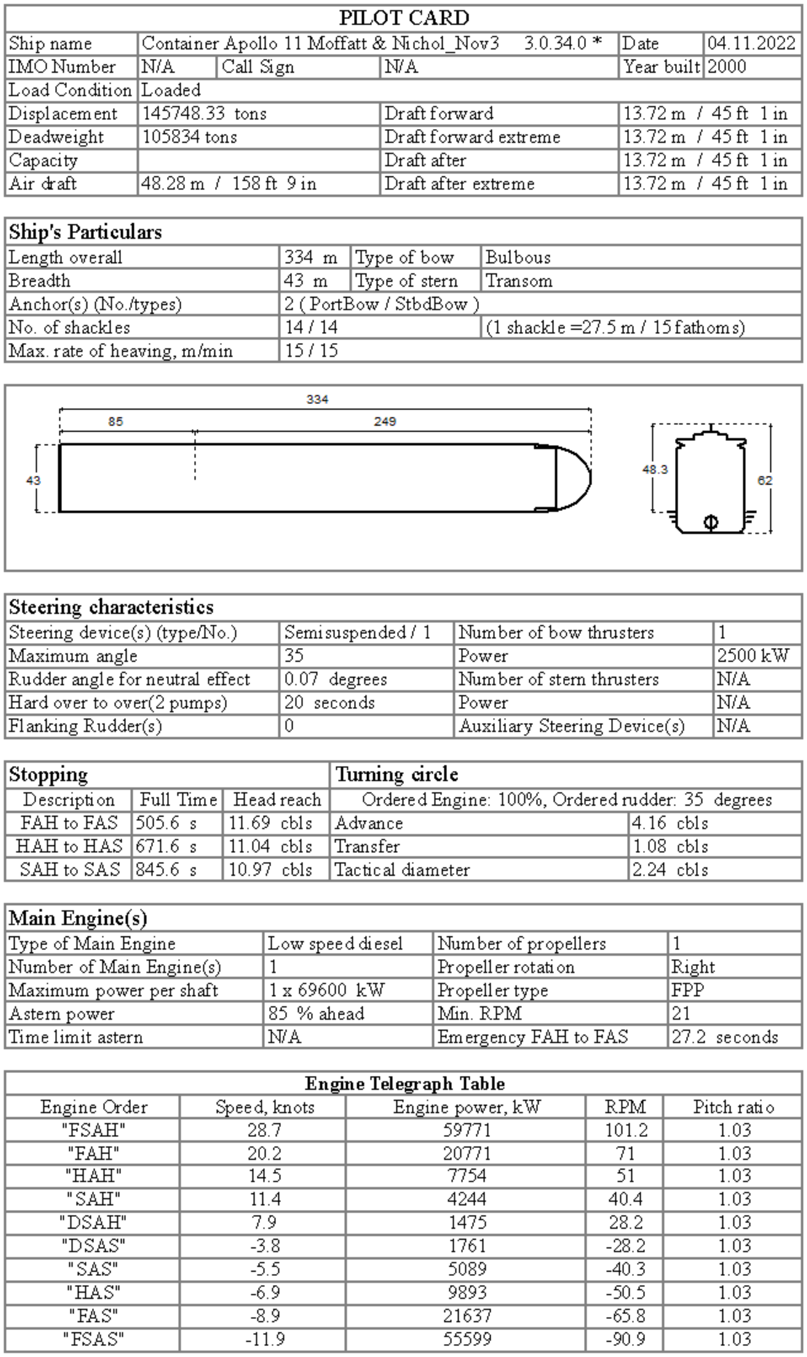
The next step of the channel evaluation will engage the Coos Bay Pilots in testing the design vessels and channel using a portable mini simulator in Coos Bay. The testing will be similar to that evaluated above but will focus on the Panamax and Post Panamax Generation 2 containerships. For the proposed channel, the lessons on turning basin size will be incorporated and channel databases will be created to include a 1450 ft turning basin at the terminal and at the northern turning basin for both the existing and proposed channels.

5. REFERENCES

Moffatt & Nichol (M&N). (2016). "Oregon International Port of Coos Bay Section 204 (f)/ 408 Report Full Ship Simulation Report."

Moffatt & Nichol (M&N). (2017). "Oregon International Port of Coos Bay Section 204 (f)/ 408 Report Supplemental Full Ship Simulation Report."

APPENDIX A. PILOT CARDS



PILOT CARD

Ship name	Container Apollo 11 Moffatt & Nichol_Nov3 3.0.34.0 *			Date	04.11.2022
IMO Number	N/A	Call Sign	N/A	Year built	2000
Load Condition	Loaded				
Displacement	145748.33 tons		Draft forward	13.72 m / 45 ft 1 in	
Deadweight	105834 tons		Draft forward extreme	13.72 m / 45 ft 1 in	
Capacity			Draft after	13.72 m / 45 ft 1 in	
Air draft	48.28 m / 158 ft 9 in		Draft after extreme	13.72 m / 45 ft 1 in	

Ship's Particulars

Length overall	334 m	Type of bow	Bulbous
Breadth	43 m	Type of stern	Transom
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	14 / 14	(1 shackle =27.5 m / 15 fathoms)	
Max. rate of heaving, m/min	15 / 15		

Steering characteristics

Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	1
Maximum angle	35	Power	2500 kW
Rudder angle for neutral effect	0.07 degrees	Number of stern thrusters	N/A
Hard over to over(2 pumps)	20 seconds	Power	N/A
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping			**Turning circle**	
Description	Full Time	Head reach	Ordered Engine: 100%, Ordered rudder: 35 degrees	
FAH to FAS	505.6 s	11.69 cbls	Advance	4.16 cbls
HAH to HAS	671.6 s	11.04 cbls	Transfer	1.08 cbls
SAH to SAS	845.6 s	10.97 cbls	Tactical diameter	2.24 cbls

Main Engine(s)

Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 69600 kW	Propeller type	FPP
Astern power	85 % ahead	Min. RPM	21
Time limit astern	N/A	Emergency FAH to FAS	27.2 seconds

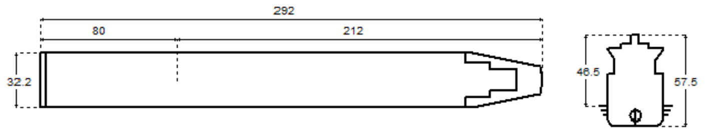
Engine Telegraph Table

Engine Order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"FSAH"	28.7	59771	101.2	1.03
"FAH"	20.2	20771	71	1.03
"HAH"	14.5	7754	51	1.03
"SAH"	11.4	4244	40.4	1.03
"DSAH"	7.9	1475	28.2	1.03
"DSAS"	-3.8	1761	-28.2	1.03
"SAS"	-5.5	5089	-40.3	1.03
"HAS"	-6.9	9893	-50.5	1.03
"FAS"	-8.9	21637	-65.8	1.03
"FSAS"	-11.9	55599	-90.9	1.03

PILOT CARD

Ship name	Container Arthur Edgemore Moffatt & Nichol_Nov3 3.0.18.0 *			Date	04.11.2022
IMO Number	N/A	Call Sign	N/A	Year built	2006
Load Condition	Full load				
Displacement	56953.92 tons		Draft forward	10.97 m / 36 ft 1 in	
Deadweight	45228 tons		Draft forward extreme	10.97 m / 36 ft 1 in	
Capacity			Draft after	10.97 m / 36 ft 1 in	
Air draft	46.53 m / 153 ft 0 in		Draft after extreme	10.97 m / 36 ft 1 in	

Ship's Particulars			
Length overall	292 m	Type of bow	Bulbous
Breadth	32.2 m	Type of stern	Transom
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	13 / 13		(1 shackle =25 m / 13.7 fathoms)
Max. rate of heaving, m/min	9.48 / 9.48		



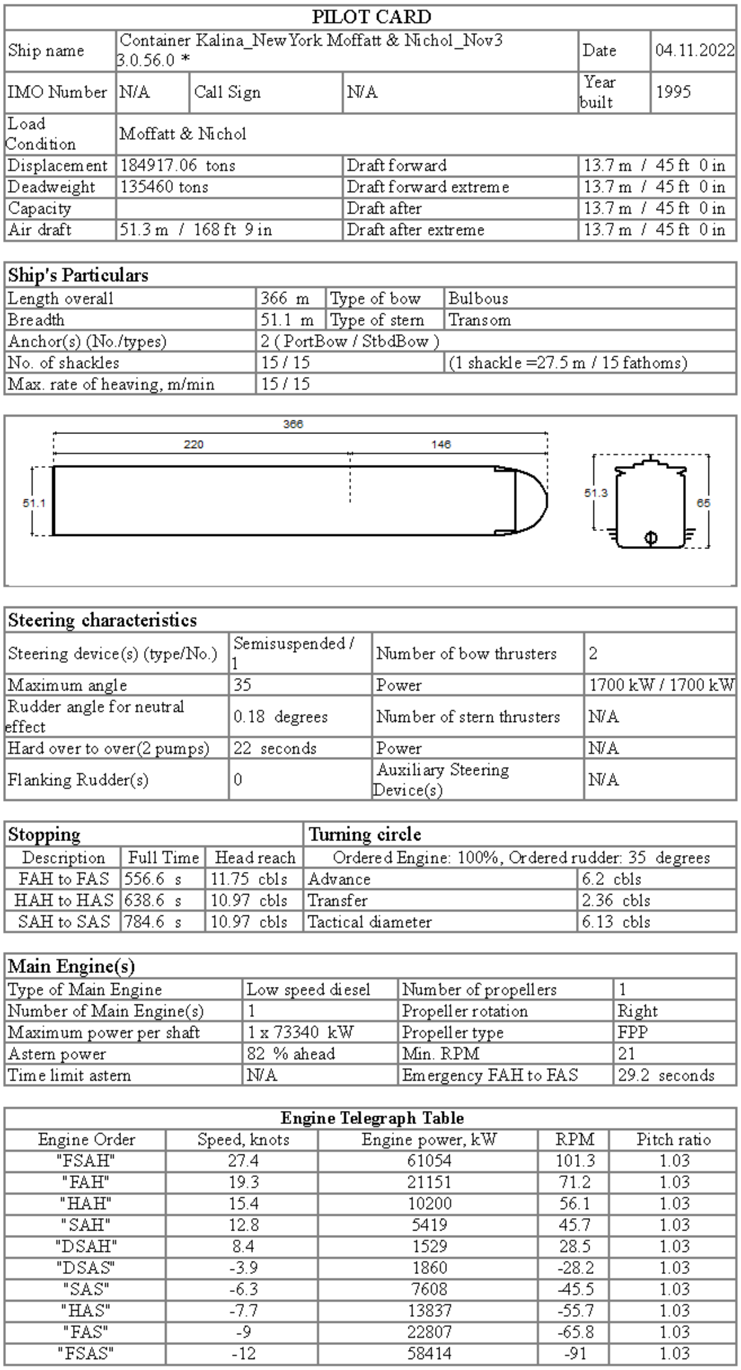
Steering characteristics			
Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	1
Maximum angle	35	Power	2000 kW
Rudder angle for neutral effect	0.28 degrees	Number of stern thrusters	1
Hard over to over(2 pumps)	6 seconds	Power	1500 kW
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping			**Turning circle**	
Description	Full Time	Head reach	Ordered Engine: 100%, Ordered rudder: 35 degrees	
FAH to FAS	278.6 s	5.64 cbls	Advance	3.88 cbls
HAH to HAS	354.6 s	5.3 cbls	Transfer	2.16 cbls
SAH to SAS	482.6 s	5.06 cbls	Tactical diameter	4.55 cbls

Main Engine(s)			
Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 43070 kW	Propeller type	FPP
Astern power	82 % ahead	Min. RPM	5.5
Time limit astern	N/A	Emergency FAH to FAS	26.2 seconds

Engine Telegraph Table

Engine Order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"FSAH"	23.5	35188	109.6	1.03
"FAH"	18.2	15901	84.7	1.03
"HAH"	13.9	7189	64.8	1.03
"SAH"	9.6	2437	44.9	1.03
"DSAH"	5.4	448	25	1.03
"DSAS"	-3.6	675	-25.3	1.03
"SAS"	-6.1	3294	-43.7	1.03
"HAS"	-8.6	7940	-62.1	1.03
"FAS"	-11.3	17555	-81.2	1.03
"FSAS"	-13.8	31714	-99.1	1.03



PILOT CARD

Ship name	Container Kalina_NewYork Moffatt & Nichol_Nov3 3.0.56.0 *			Date	04.11.2022
IMO Number	N/A	Call Sign	N/A	Year built	1995
Load Condition	Moffatt & Nichol				
Displacement	184917.06 tons		Draft forward	13.7 m / 45 ft 0 in	
Deadweight	135460 tons		Draft forward extreme	13.7 m / 45 ft 0 in	
Capacity			Draft after	13.7 m / 45 ft 0 in	
Air draft	51.3 m / 168 ft 9 in		Draft after extreme	13.7 m / 45 ft 0 in	

Ship's Particulars

Length overall	366 m	Type of bow	Bulbous
Breadth	51.1 m	Type of stern	Transom
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	15 / 15		(1 shackle =27.5 m / 15 fathoms)
Max. rate of heaving, m/min	15 / 15		

Steering characteristics

Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	2
Maximum angle	35	Power	1700 kW / 1700 kW
Rudder angle for neutral effect	0.18 degrees	Number of stern thrusters	N/A
Hard over to over(2 pumps)	22 seconds	Power	N/A
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping			**Turning circle**	
Description	Full Time	Head reach	Ordered Engine: 100%, Ordered rudder: 35 degrees	
FAH to FAS	556.6 s	11.75 cbls	Advance	6.2 cbls
HAH to HAS	638.6 s	10.97 cbls	Transfer	2.36 cbls
SAH to SAS	784.6 s	10.97 cbls	Tactical diameter	6.13 cbls

Main Engine(s)

Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 73340 kW	Propeller type	FPP
Astern power	82 % ahead	Min. RPM	21
Time limit astern	N/A	Emergency FAH to FAS	29.2 seconds

Engine Telegraph Table

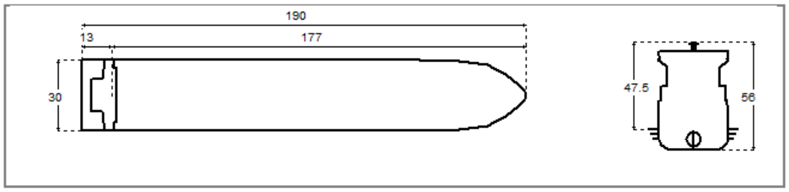
Engine Order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"FSAH"	27.4	61054	101.3	1.03
"FAH"	19.3	21151	71.2	1.03
"HAH"	15.4	10200	56.1	1.03
"SAH"	12.8	5419	45.7	1.03
"DSAH"	8.4	1529	28.5	1.03
"DSAS"	-3.9	1860	-28.2	1.03
"SAS"	-6.3	7608	-45.5	1.03
"HAS"	-7.7	13837	-55.7	1.03
"FAS"	-9	22807	-65.8	1.03
"FSAS"	-12	58414	-91	1.03

PILOT CARD

Ship name	Container ship 28 (2100 TEU) Moffatt & Nichol_Nov3 3.0.10.1 *			Date	04.11.2022
IMO Number	N/A	Call Sign	N/A	Year built	N/A
Load Condition	Full load				
Displacement	32910 tons		Draft forward	8.5 m / 27 ft 11 in	
Deadweight	21800 tons		Draft forward extreme	8.5 m / 27 ft 11 in	
Capacity			Draft after	8.5 m / 27 ft 11 in	
Air draft	47.5 m / 156 ft 3 in		Draft after extreme	8.5 m / 27 ft 11 in	

Ship's Particulars

Length overall	190 m	Type of bow	Bulbous
Breadth	30 m	Type of stern	Transom
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	12 / 12		(1 shackle =27.5 m / 15 fathoms)
Max. rate of heaving, m/min	9 / 9		



Steering characteristics

Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	1
Maximum angle	35	Power	1000 kW
Rudder angle for neutral effect	0.26 degrees	Number of stern thrusters	1
Hard over to over(2 pumps)	14 seconds	Power	1000 kW
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping			**Turning circle**	
Description	Full Time	Head reach	Ordered Engine: 100%, Ordered rudder: 35 degrees	
FAH to FAS	571.6 s	13.92 cbls	Advance	3.22 cbls
HAH to HAS	573.6 s	9.91 cbls	Transfer	1.45 cbls
SAH to SAS	690.6 s	7.68 cbls	Tactical diameter	3.39 cbls

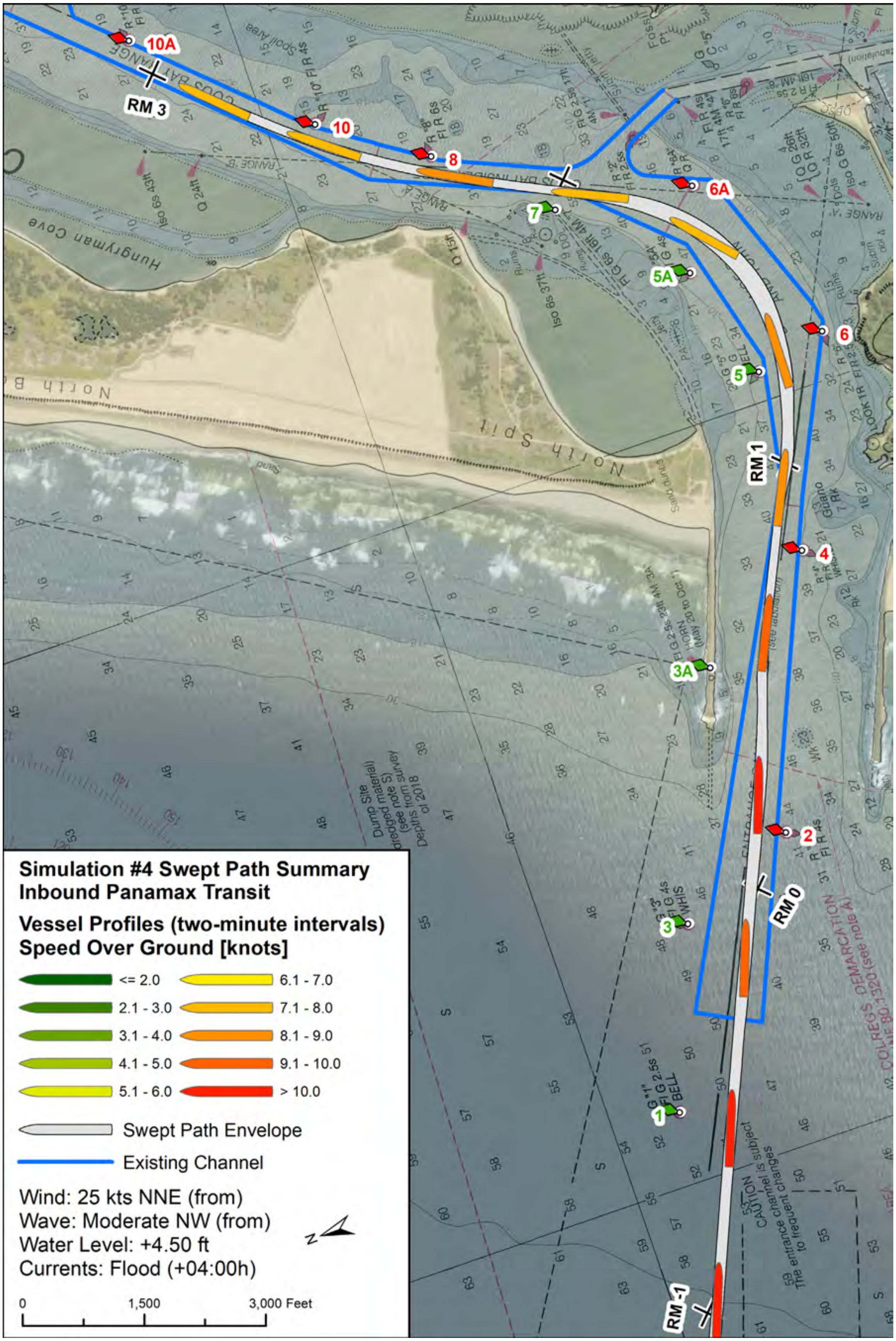
Main Engine(s)

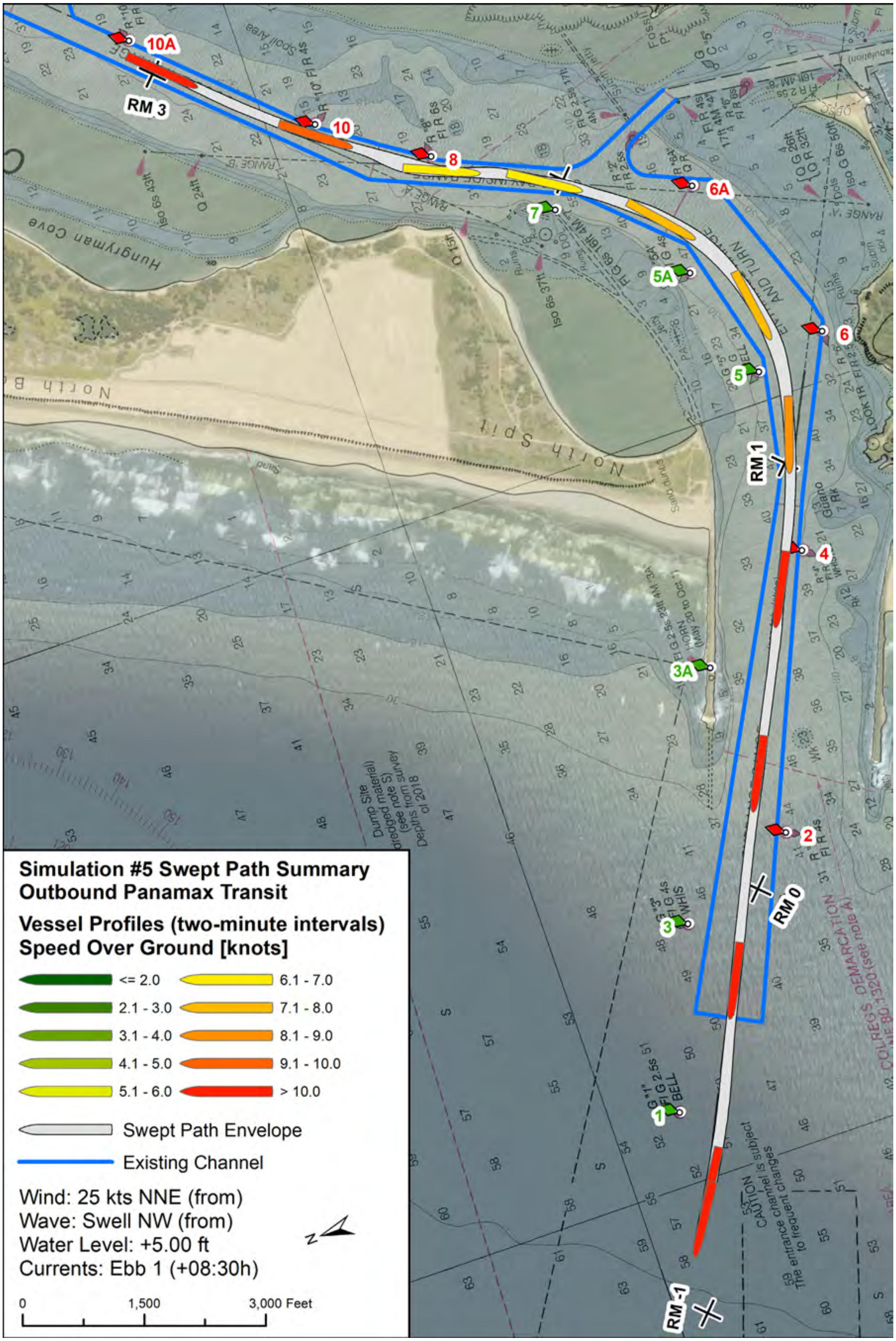
Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 17316 kW	Propeller type	FPP
Astern power	25 % ahead	Min. RPM	14
Time limit astern	N/A	Emergency FAH to FAS	174.2 seconds

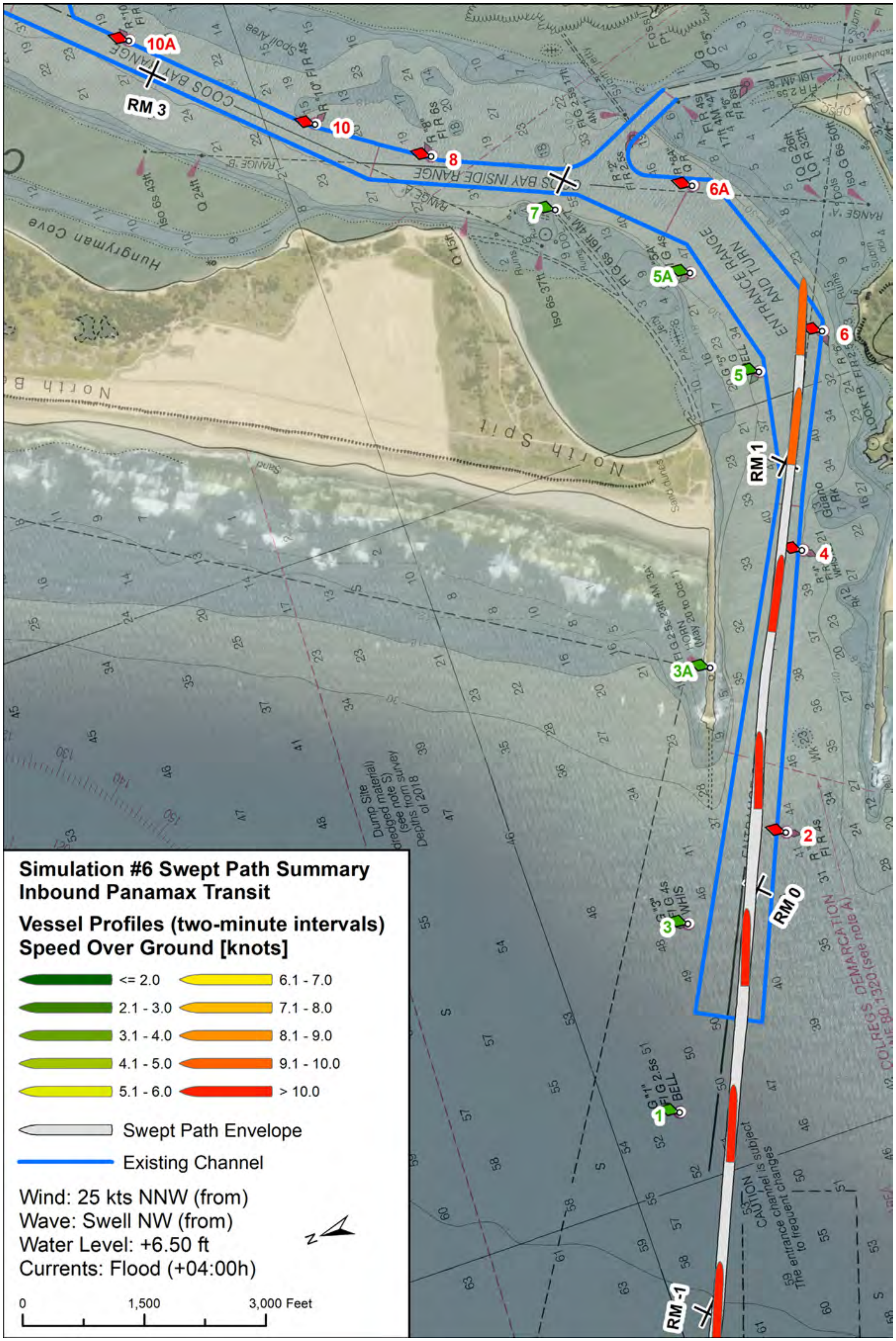
Engine Telegraph Table

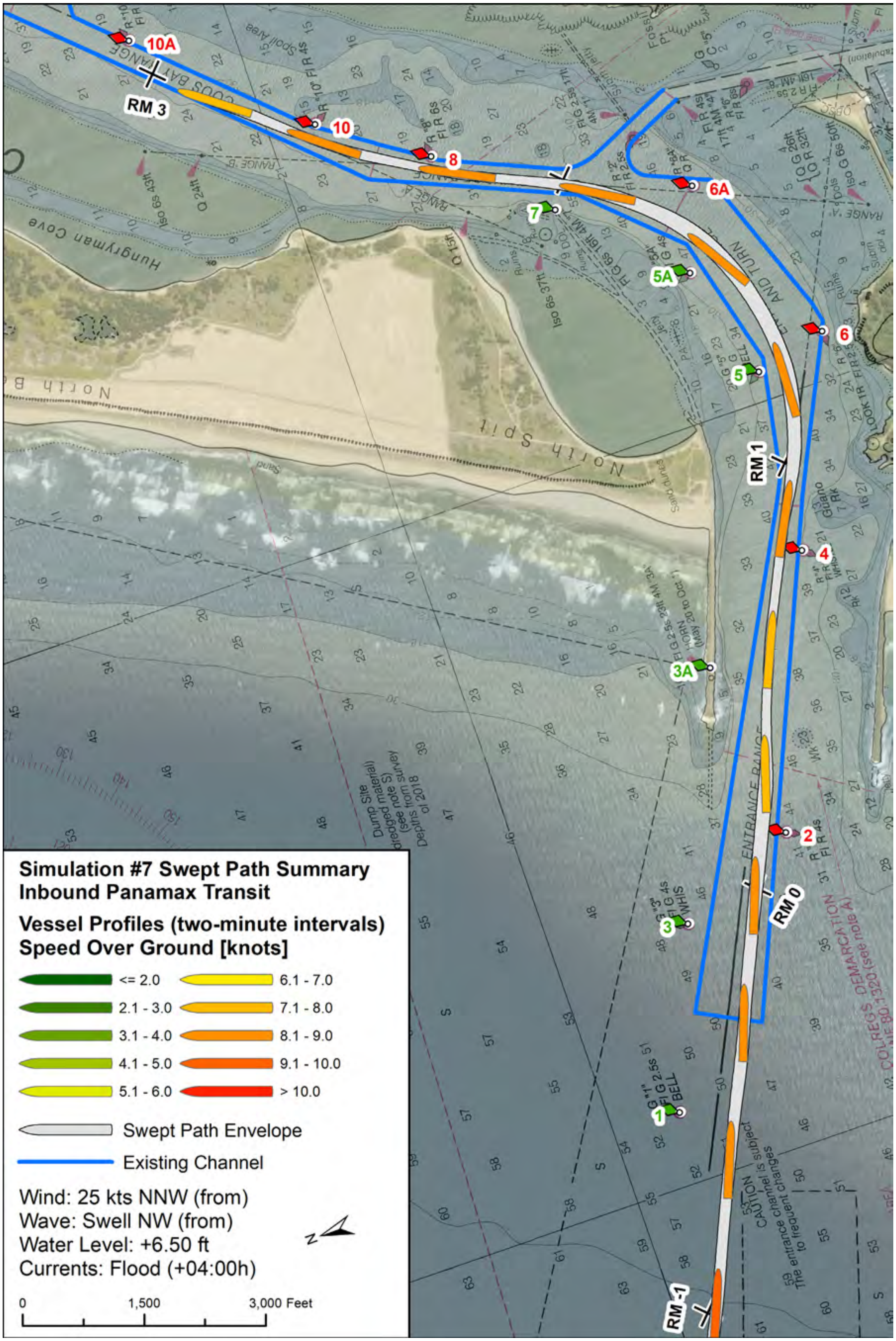
Engine Order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"100%"	22.3	15294	105.5	1.05
"80%"	18.1	8293	85.5	1.05
"60%"	13.8	4090	65.2	1.05
"40%"	9.5	1443	45.1	1.05
"20%"	5.3	295	25	1.05
"-20%"	-3	221	-22	1.05
"-40%"	-5	880	-37.1	1.05
"-60%"	-6.9	2170	-51.2	1.05
"-80%"	-8.8	4336	-65.2	1.05

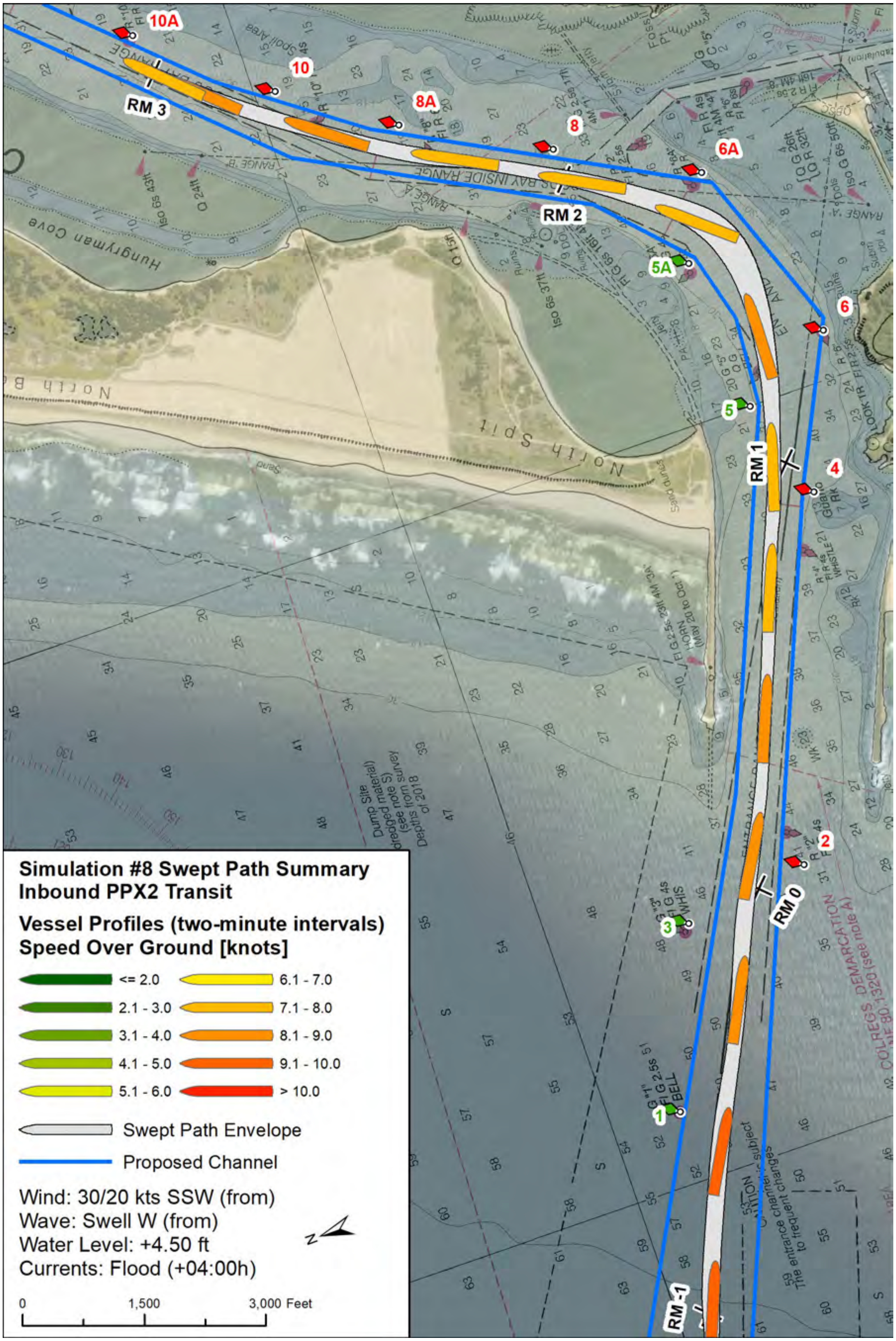
APPENDIX B. SIMULATION SWEPT PATH SUMMARY FIGURES

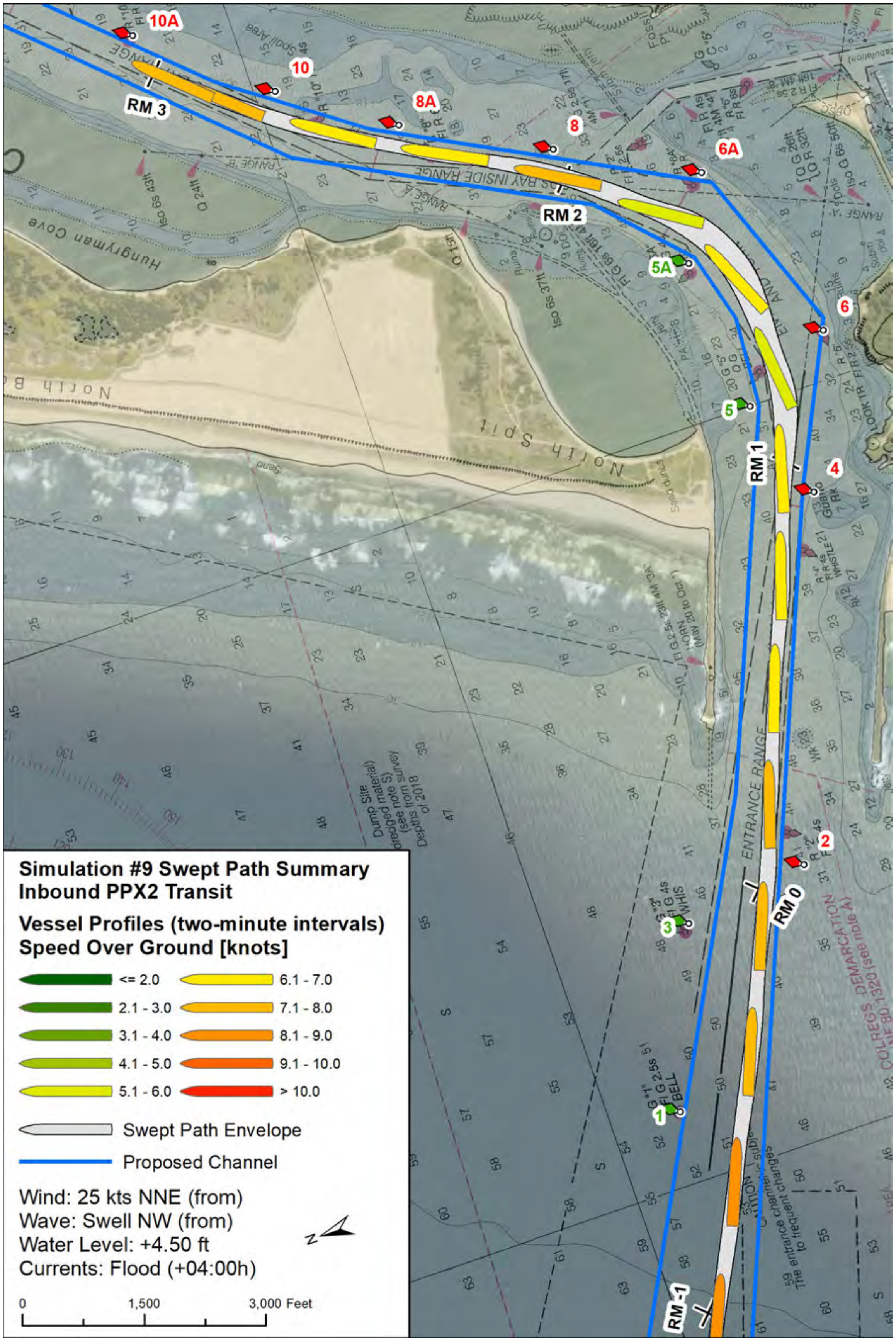

Simulation #4 Swept Path Summary
Inbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Existing Channel
Wind: 25 kts NNE (from)
Wave: Moderate NW (from)
Water Level: +4.50 ft
Currents: Flood (+04:00h)
N
0
1,500
3,000 Feet
10A
10
8
7
6A
5A
6
5
4
3A
2
3
1
RM 3
RM 1
RM 0
RM -1
Hungryman Cove
North Spit
Dump Site (dredged material) (see note S) (see from survey Depths from 2018
CAUTION The entrance channel is subject to frequent changes
COLREGS DEMARCATION LINE 80.1320 (see note A)

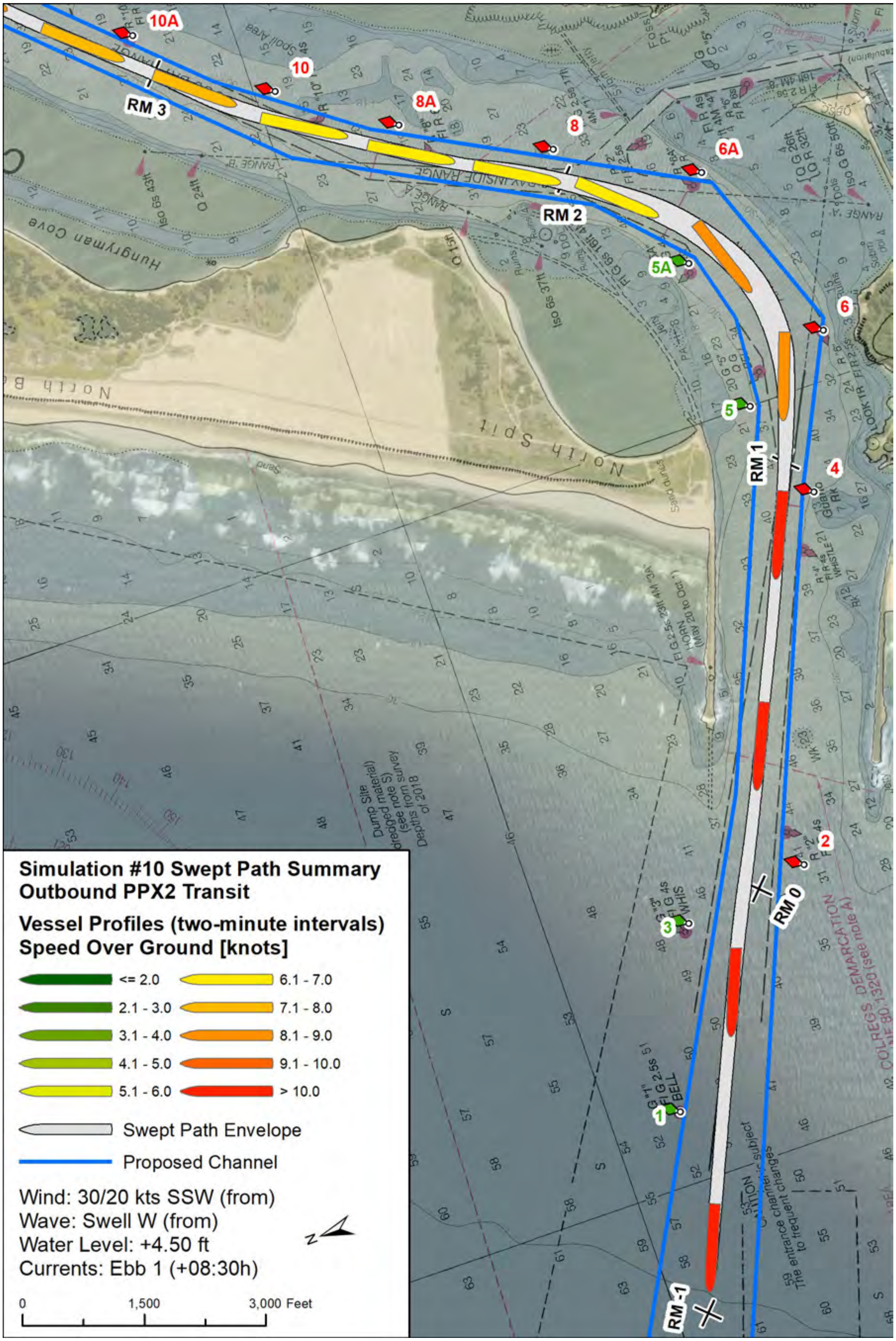

10A
RM 3
10
8
6A
7
5A
6
5
RM 1
4
3A
2
RM 0
3
1
RM -1
North Spit
Hungryman Cove
Simulation #5 Swept Path Summary
Outbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Existing Channel
Wind: 25 kts NNE (from)
Wave: Swell NW (from)
Water Level: +5.00 ft
Currents: Ebb 1 (+08:30h)
N
0
1,500
3,000 Feet

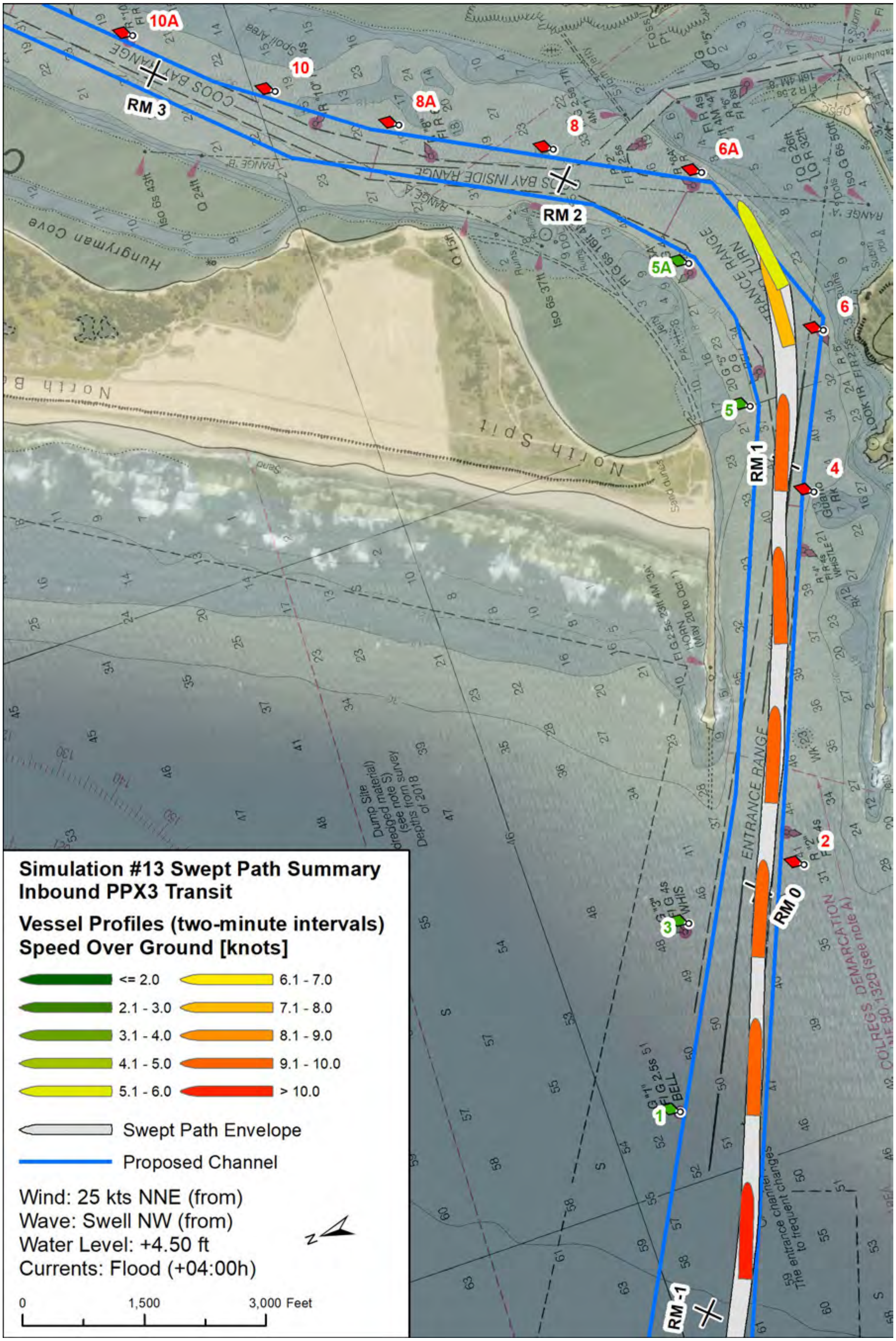

Simulation #6 Swept Path Summary
Inbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Existing Channel
Wind: 25 kts NNW (from)
Wave: Swell NW (from)
Water Level: +6.50 ft
Currents: Flood (+04:00h)
N
0
1,500
3,000 Feet
10A
10
8
7
6A
5A
6
5
4
3A
2
3
1
RM 3
RM 1
RM 0
RM -1
COOS BAY RANGE
COOS BAY INSIDE RANGE
ENTRANCE RANGE
ENTRANCE TURN
Hungryman Cove
North Spit
North B
Dump Site (dredged material) (see note S) Depths from survey of 2018
CAUTION The entrance channel is subject to frequent changes
COLREGS DEMARCATION LINE 80.1320 (see note A)

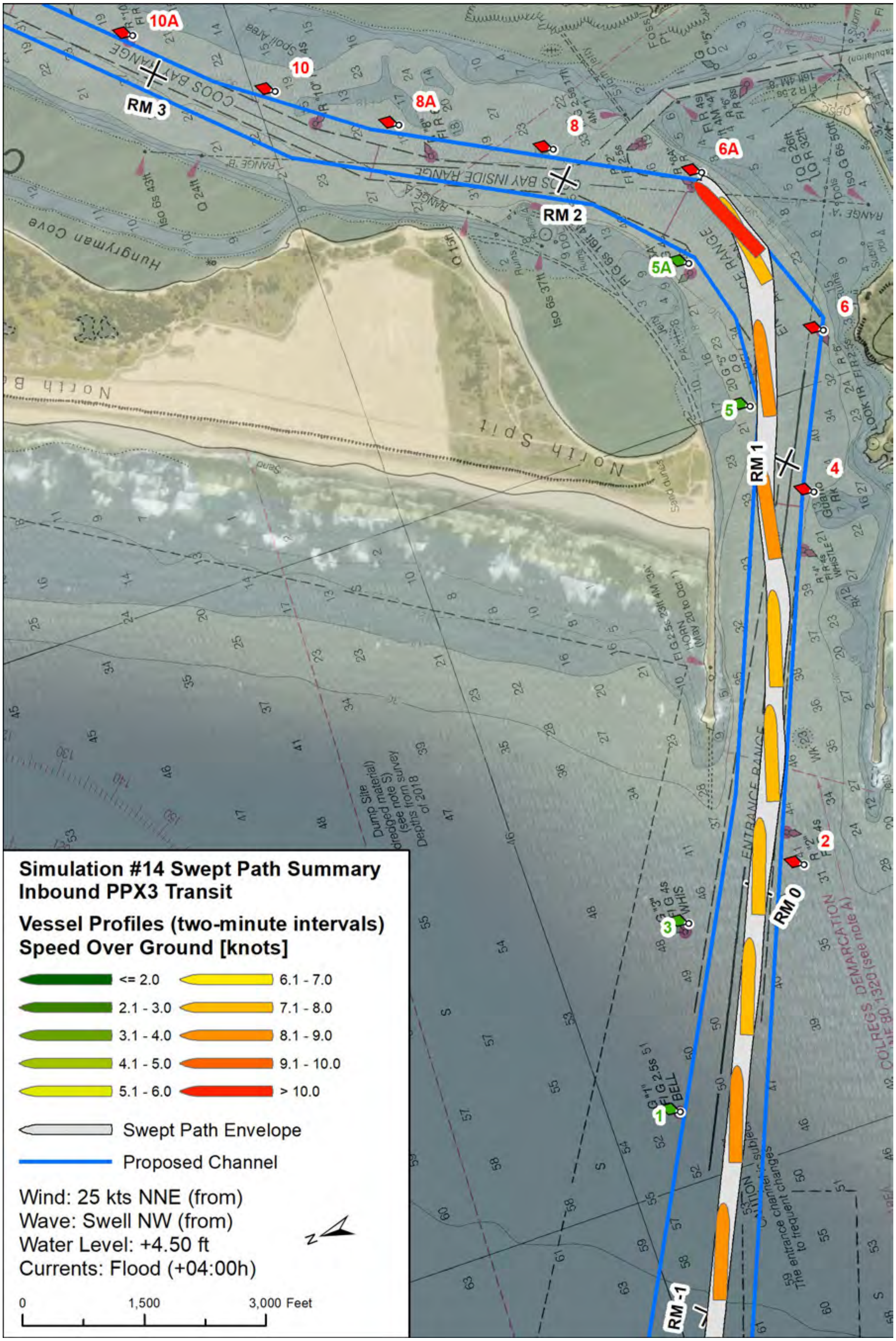

Simulation #7 Swept Path Summary
Inbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Existing Channel
Wind: 25 kts NNW (from)
Wave: Swell NW (from)
Water Level: +6.50 ft
Currents: Flood (+04:00h)
N
0
1,500
3,000 Feet
10A
10
8
7
6A
5A
6
5
RM 3
RM 1
RM 0
RM -1
4
3A
2
3
1
Hungryman Cove
North Bay
North Spit
COOS BAY RANGE
ENTRANCE RANGE
Dump Site (dredged material) (see note S) Depths from survey of 2018
CAUTION The entrance channel is subject to frequent changes
COLREGS DEMARCATION

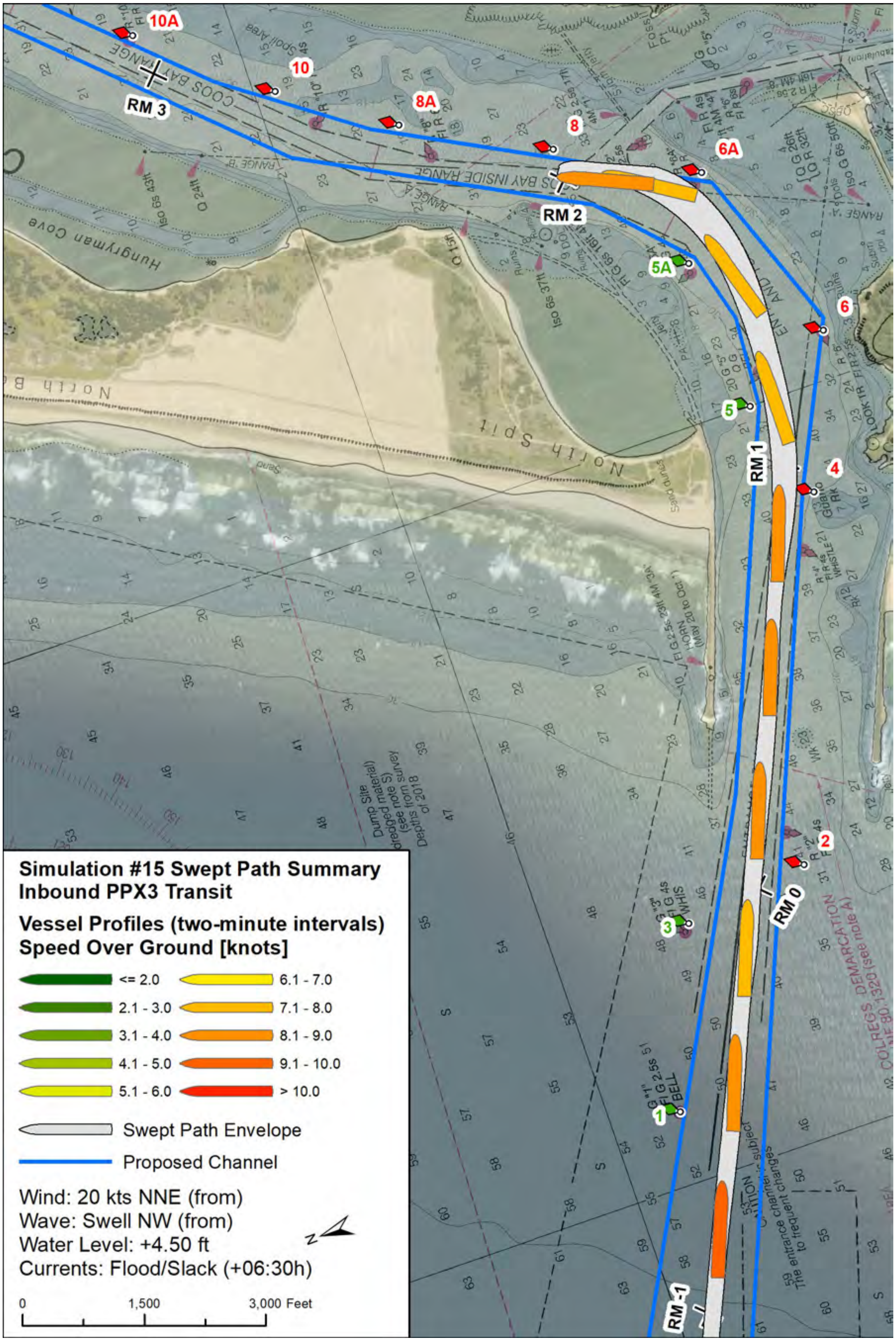

Simulation #8 Swept Path Summary
Inbound PPX2 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Proposed Channel
Wind: 30/20 kts SSW (from)
Wave: Swell W (from)
Water Level: +4.50 ft
Currents: Flood (+04:00h)
N
0
1,500
3,000 Feet
RM 3
RM 2
RM 1
RM 0
RM -1
10A
10
8A
8
6A
6
5A
5
4
3
2
1
Hungryman Cove
North Spit
North B
Dump Site (dredged material) (see note S) Depths from survey of 2018
COLREGS DEMARCATION

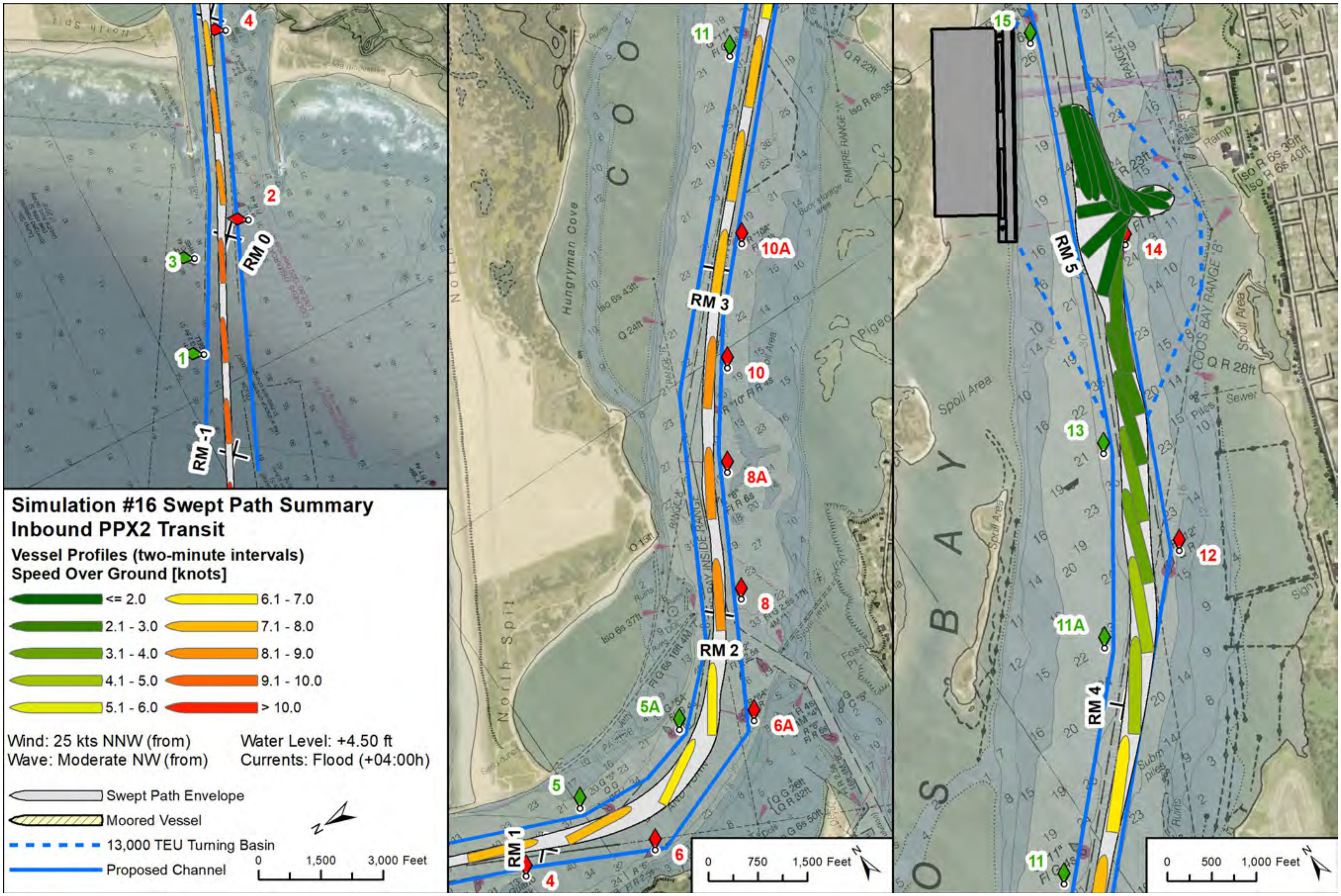

Simulation #9 Swept Path Summary
Inbound PPX2 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Proposed Channel
Wind: 25 kts NNE (from)
Wave: Swell NW (from)
Water Level: +4.50 ft
Currents: Flood (+04:00h)
0
1,500
3,000 Feet
N
RM 3
RM 2
RM 1
RM 0
RM -1
10A
10
8A
8
6A
6
5A
5
4
3
2
1
Hungryman Cove
North Spit
ENTRANCE RANGE
COOS BAY INSIDE RANGE
Dump Site (dredged material) (see note S) (see from survey of 2018
COLREGS DEMARCATION

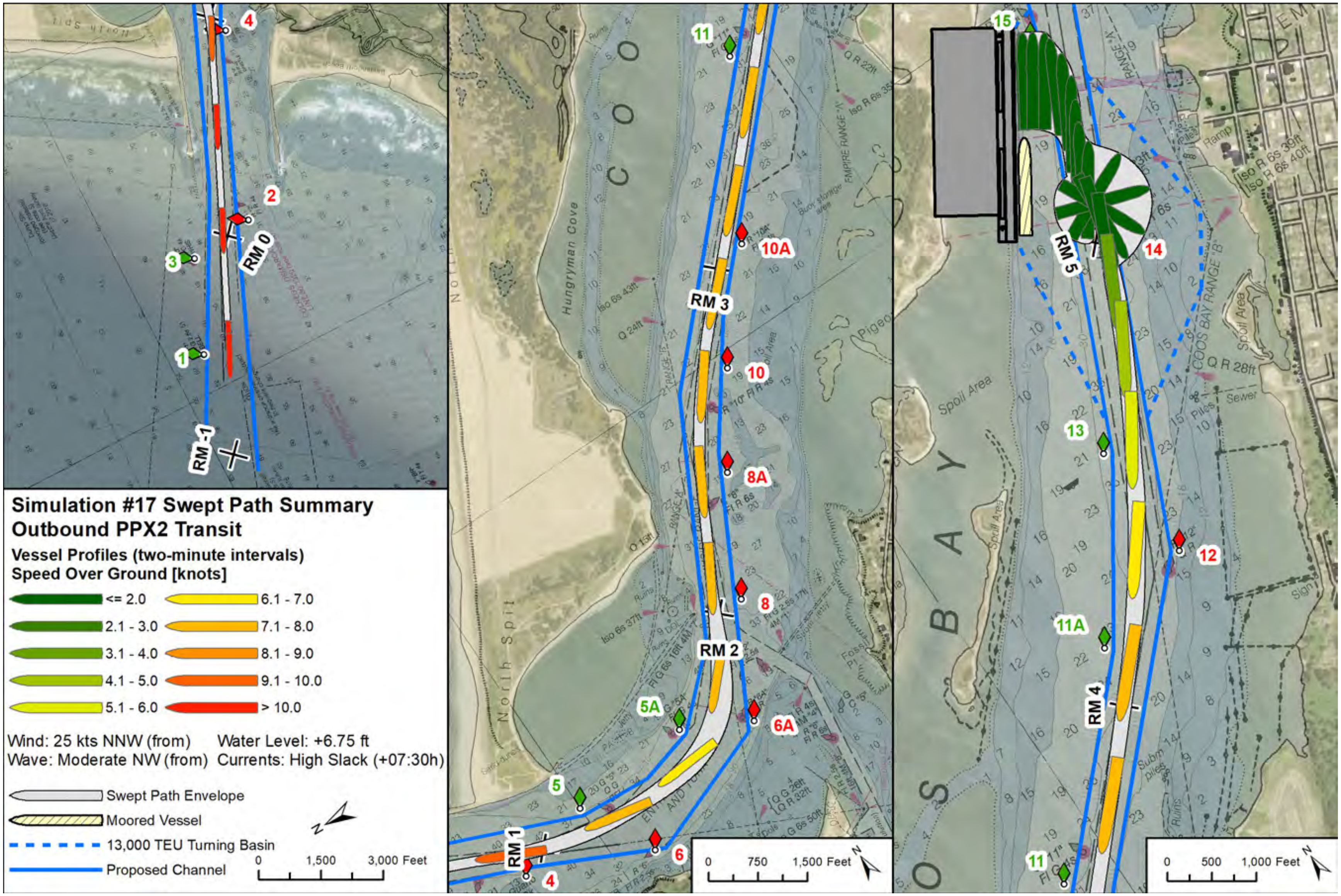

Simulation #10 Swept Path Summary
Outbound PPX2 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Proposed Channel
Wind: 30/20 kts SSW (from)
Wave: Swell W (from)
Water Level: +4.50 ft
Currents: Ebb 1 (+08:30h)
N
0
1,500
3,000 Feet
10A
10
8A
8
6A
6
5A
5
4
3
2
1
RM 3
RM 2
RM 1
RM 0
RM -1
Hungryman Cove
North Spit
Dump Site (dredged material) (see note S) (see from survey of 2018
COLREGS DEMARCATION LINE 80.1320 (see note A)
CAUTION The entrance channel is subject to frequent changes


Simulation #13 Swept Path Summary
Inbound PPX3 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Proposed Channel
Wind: 25 kts NNE (from)
Wave: Swell NW (from)
Water Level: +4.50 ft
Currents: Flood (+04:00h)
N
0
1,500
3,000 Feet
RM 3
RM 2
RM 1
RM 0
RM -1
10A
10
8A
8
6A
6
5A
5
4
3
2
1
COOS BAY RANGE
COOS BAY INSIDE RANGE
ENTRANCE RANGE
RANGE A
RANGE B
Hungryman Cove
North Spit
Spoil Area
Dump Site (dredged material) (see note S) Depths from survey of 2018
The entrance channel is subject to frequent changes
COLREGS DEMARCATION LINE 80.1320 (see note A)

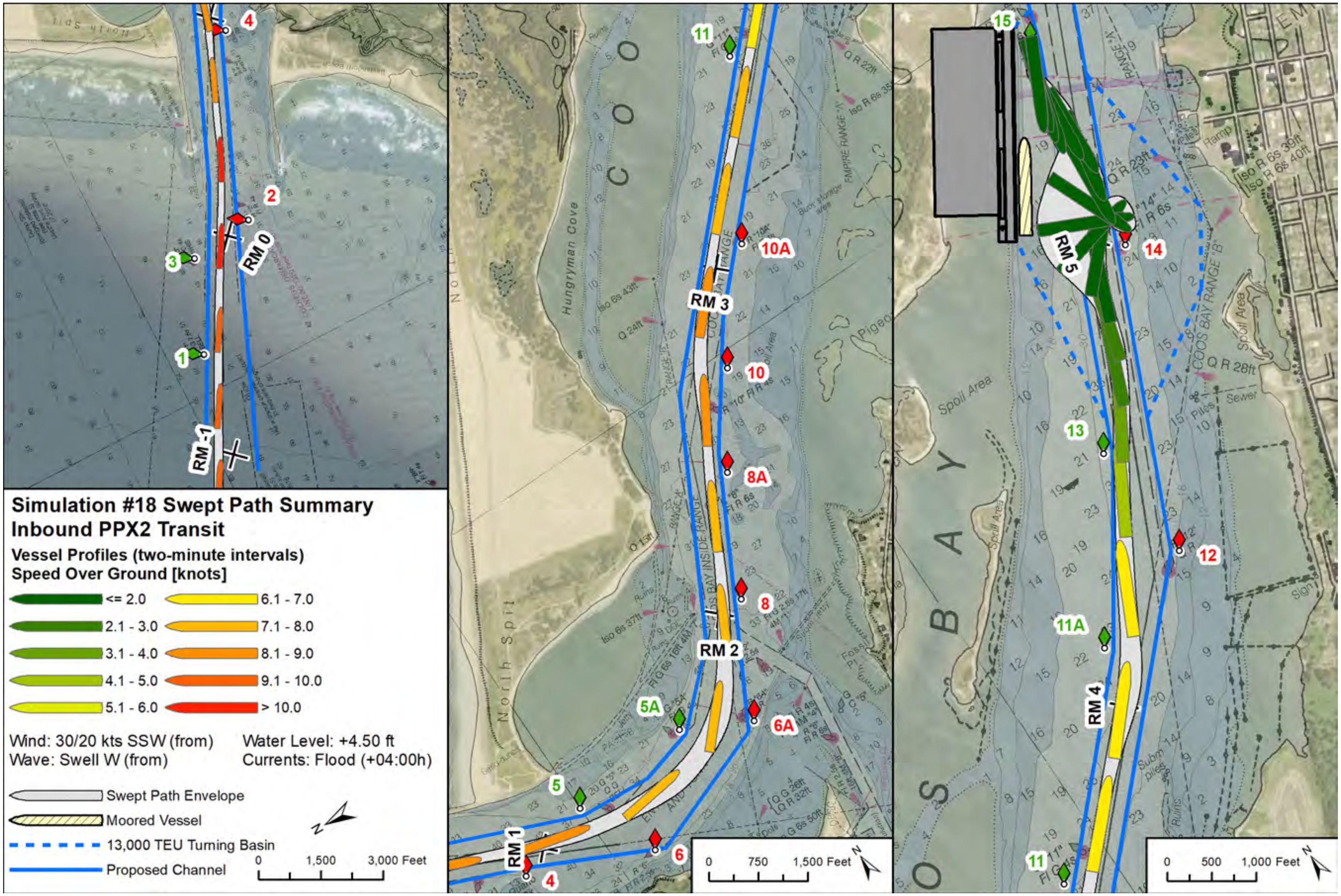

Simulation #14 Swept Path Summary
Inbound PPX3 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Proposed Channel
Wind: 25 kts NNE (from)
Wave: Swell NW (from)
Water Level: +4.50 ft
Currents: Flood (+04:00h)
N
0
1,500
3,000 Feet
RM 3
RM 2
RM 1
RM 0
RM -1
10A
10
8A
8
6A
6
5A
5
4
3
2
1
North Spit
Hungryman Cove
COOS BAY RANGE
COOS BAY INSIDE RANGE
ENTRANCE RANGE

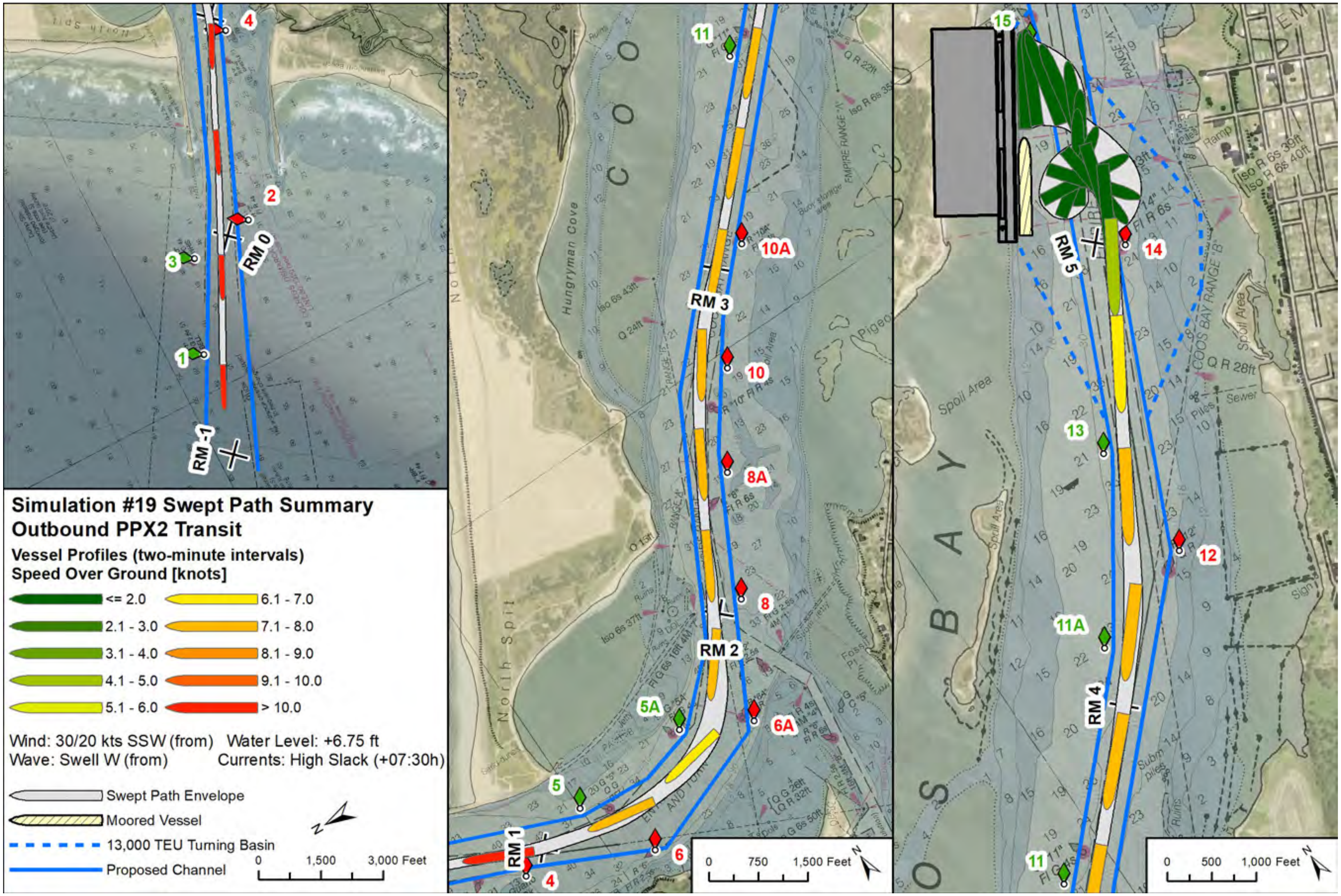

Simulation #15 Swept Path Summary
Inbound PPX3 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Proposed Channel
Wind: 20 kts NNE (from)
Wave: Swell NW (from)
Water Level: +4.50 ft
Currents: Flood/Slack (+06:30h)
0
1,500
3,000 Feet
N
RM 3
RM 2
RM 1
RM 0
RM -1
10A
10
8A
8
6A
6
5A
5
4
3
2
1
COOS BAY INSIDE RANGE
Hungryman Cove
North Spit
Dump Site
COLREGS DEMARCATION

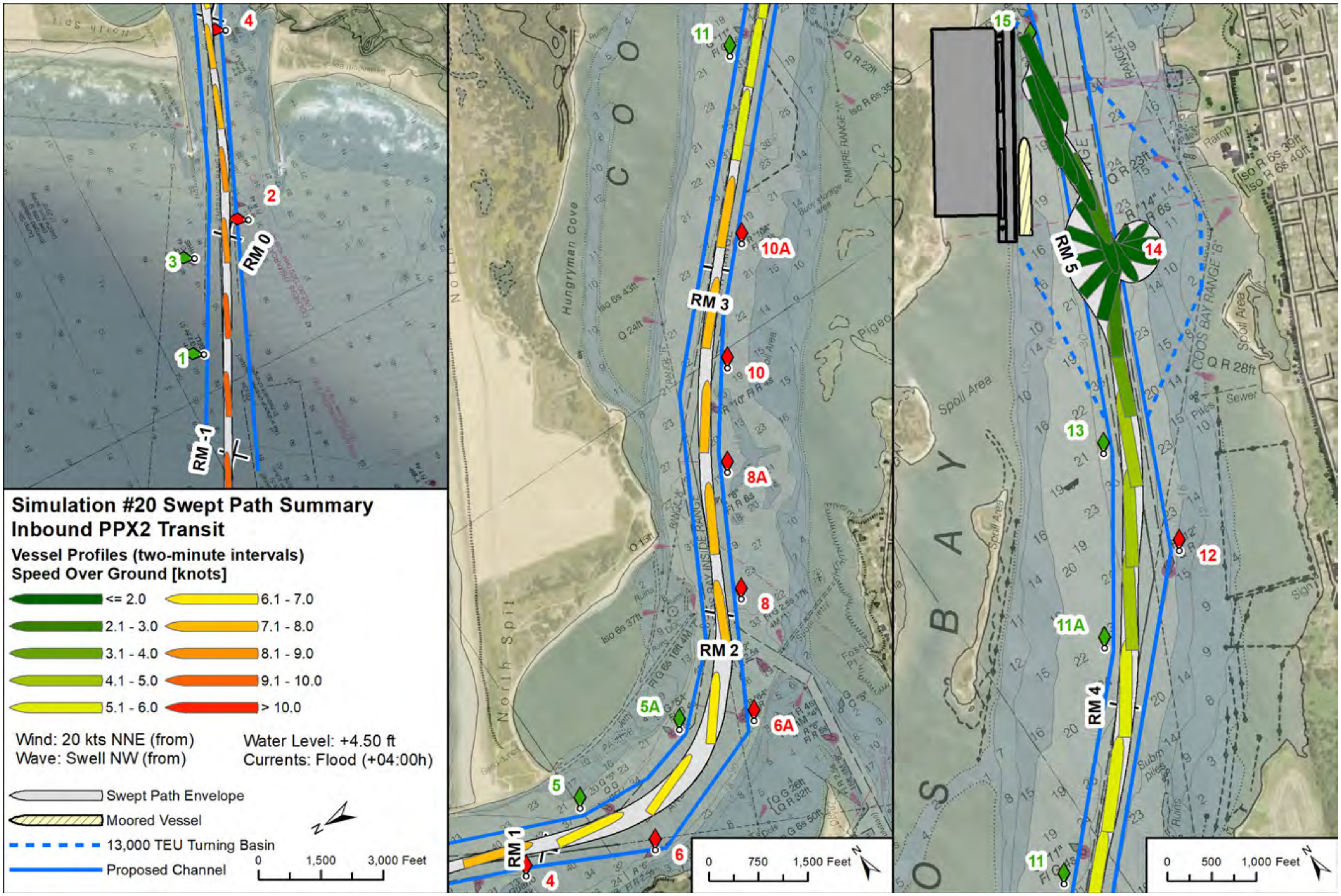

Simulation #16 Swept Path Summary
Inbound PPX2 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Wind: 25 kts NNW (from)
Wave: Moderate NW (from)
Water Level: +4.50 ft
Currents: Flood (+04:00h)
Swept Path Envelope
Moored Vessel
13,000 TEU Turning Basin
Proposed Channel
N
0
1,500
3,000 Feet
RM -1
RM 0
RM 1
RM 2
RM 3
RM 4
RM 5
1
2
3
4
5
5A
6
6A
8
8A
10
10A
11
11A
12
13
14
15
Hungryman Cove
North Spit
Spoil Area
COOS BAY
0
750
1,500 Feet
0
500
1,000 Feet



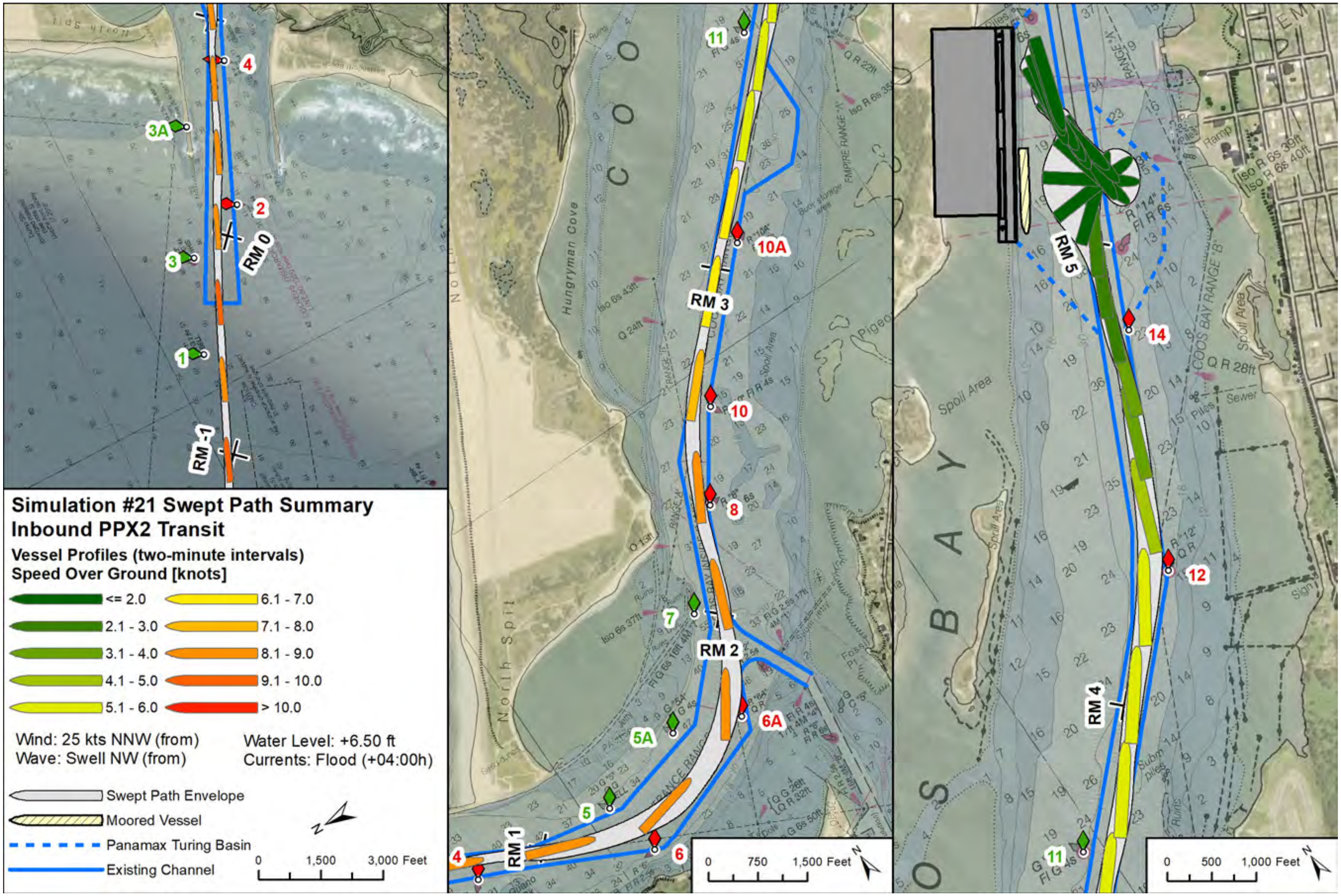
Simulation #17 Swept Path Summary
Outbound PPX2 Transit

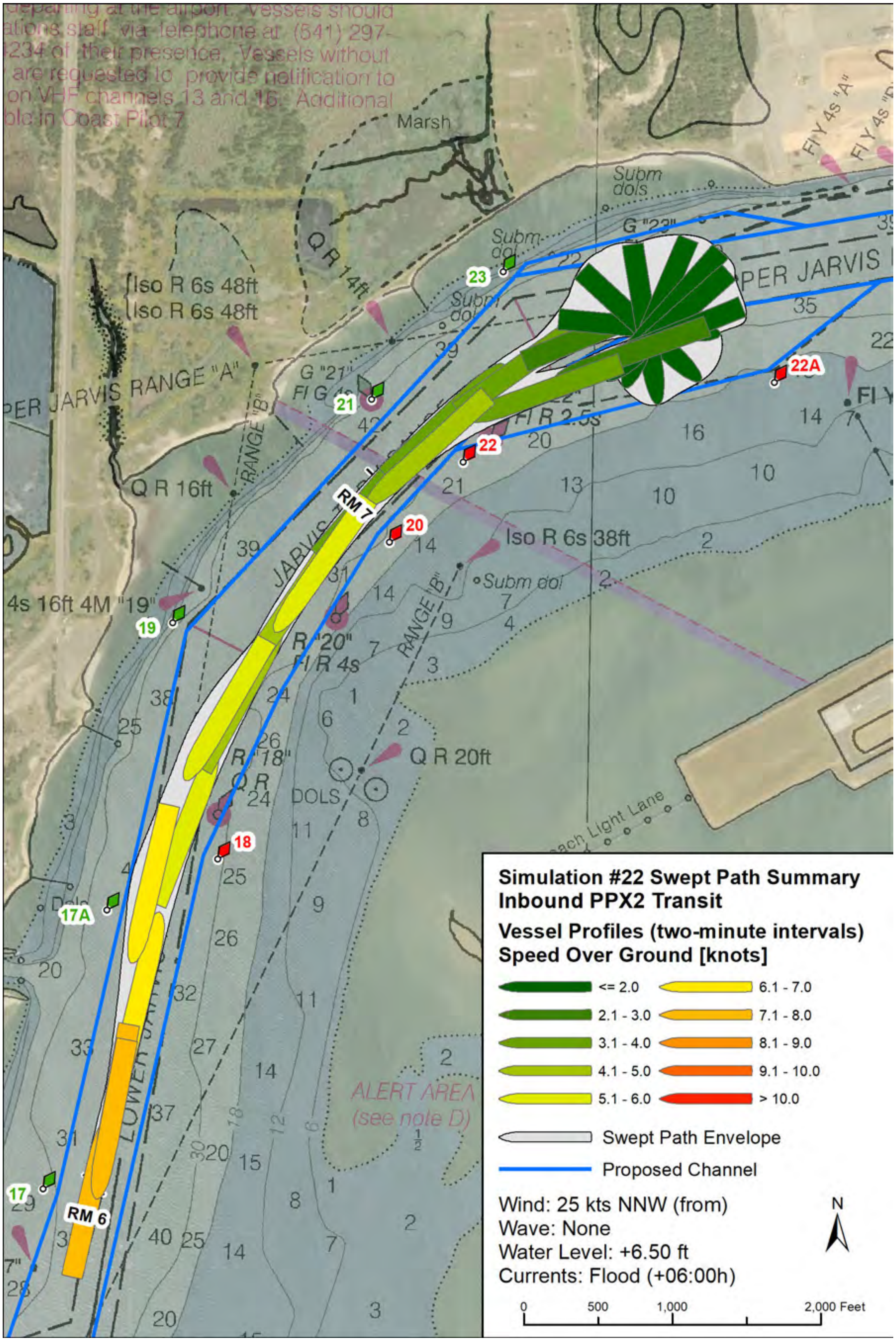

Simulation #18 Swept Path Summary
Inbound PPX2 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Wind: 30/20 kts SSW (from)
Wave: Swell W (from)
Water Level: +4.50 ft
Currents: Flood (+04:00h)
Swept Path Envelope
Moored Vessel
13,000 TEU Turning Basin
Proposed Channel
0
1,500
3,000 Feet
N
RM -1
RM 0
RM 1
RM 2
RM 3
RM 4
RM 5
1
2
3
4
5
5A
6
6A
8
8A
10
10A
11
11A
12
13
14
15
0
750
1,500 Feet
0
500
1,000 Feet
Hungryman Cove
North Spit
Spoil Area
COOS BAY INSIDE RANGE
COOS BAY RANGE "B"
EMPIRE RANGE "A"
Q R 28ft
Q R 23ft
Iso R 6s 39ft
Iso R 6s 40ft
Sewer
Ramp
Piles

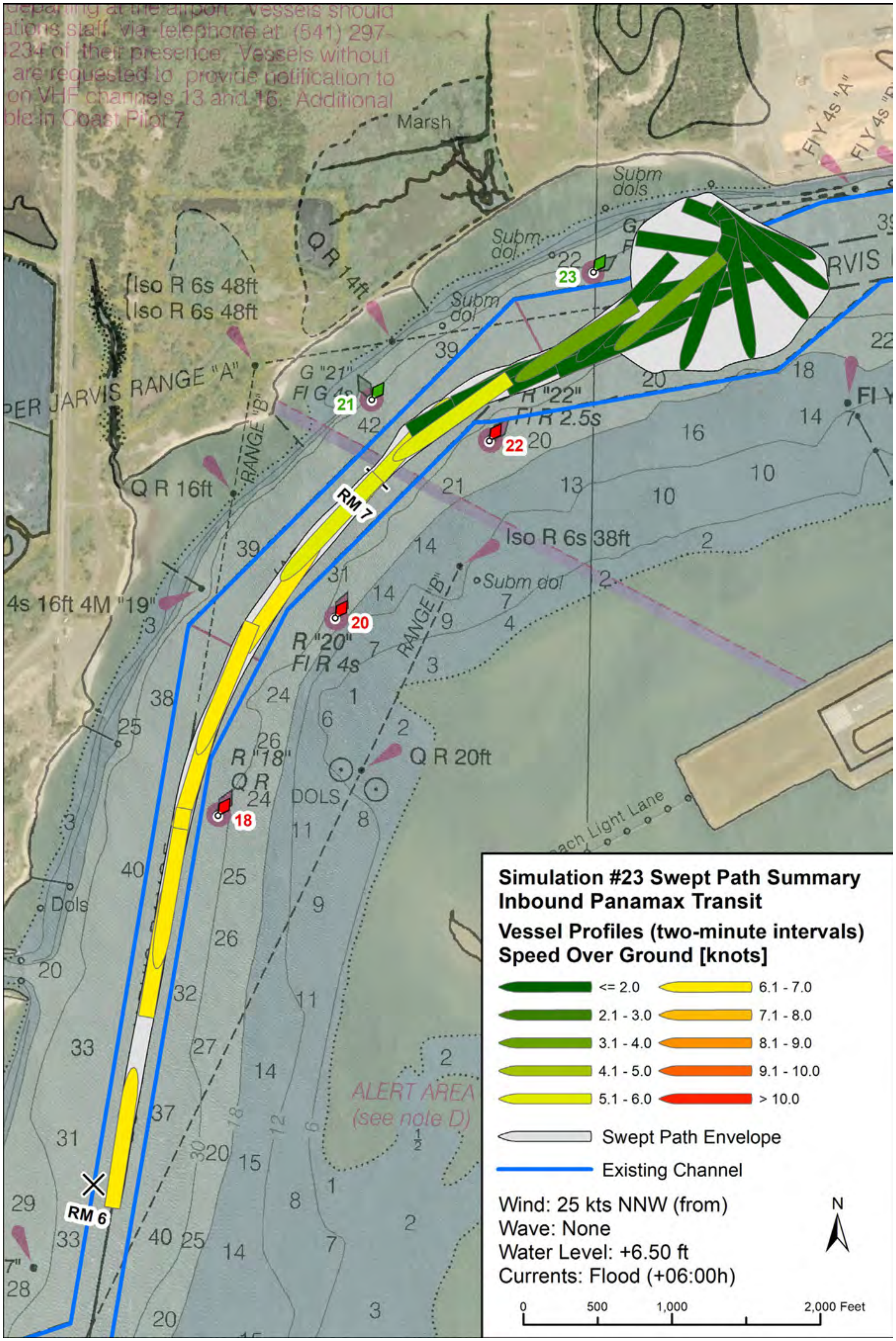

Simulation #19 Swept Path Summary
Outbound PPX2 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Wind: 30/20 kts SSW (from)
Water Level: +6.75 ft
Wave: Swell W (from)
Currents: High Slack (+07:30h)
Swept Path Envelope
Moored Vessel
13,000 TEU Turning Basin
Proposed Channel
0
1,500
3,000 Feet
N
RM -1
RM 0
RM 1
RM 2
RM 3
RM 4
RM 5
1
2
3
4
5
5A
6
6A
8
8A
10
10A
11
11A
12
13
14
15
0
750
1,500 Feet
0
500
1,000 Feet
Hungryman Cove
North Spit
Spoil Area
COOS BAY
COOS BAY RANGE "B"
EMPIRE RANGE "A"

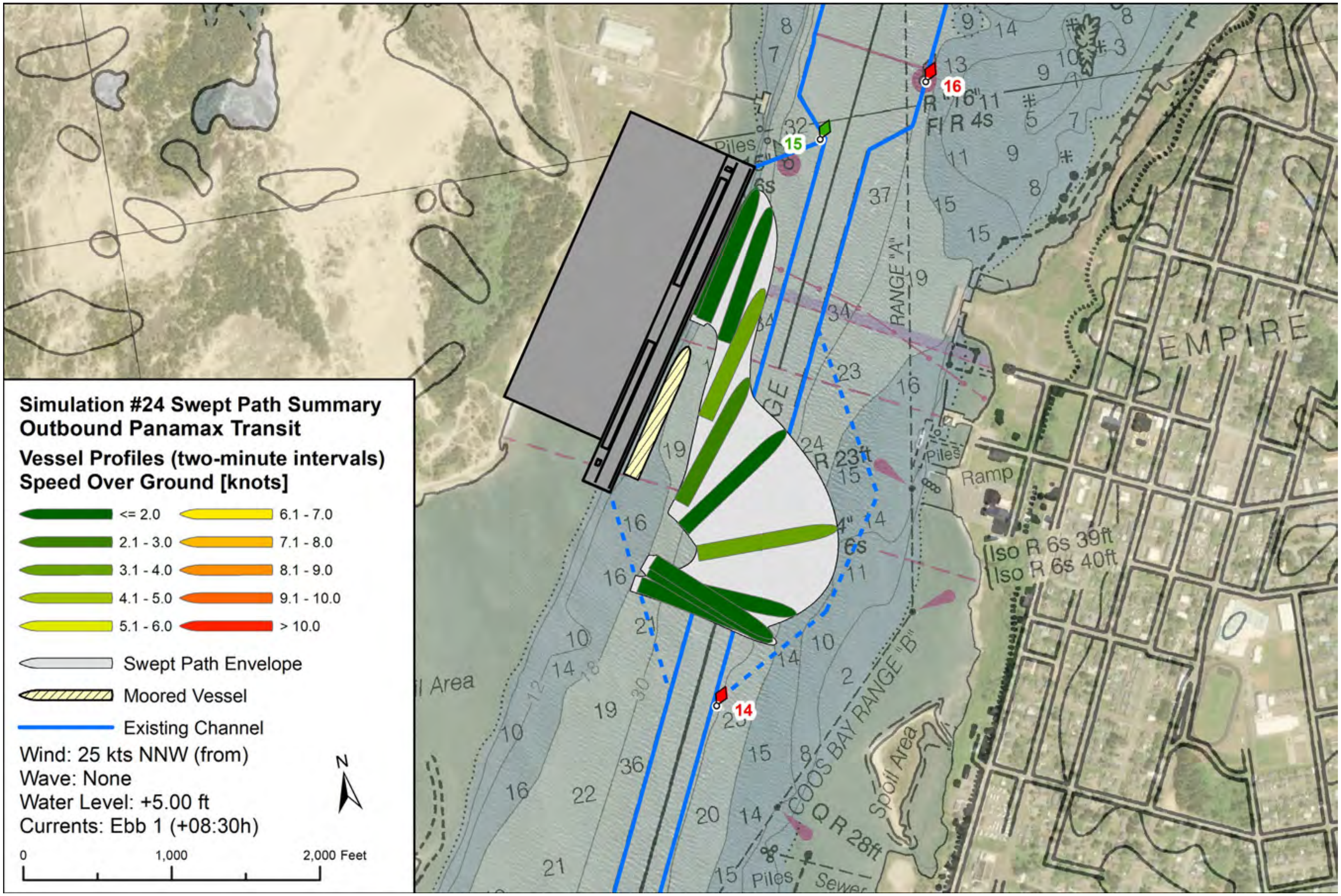


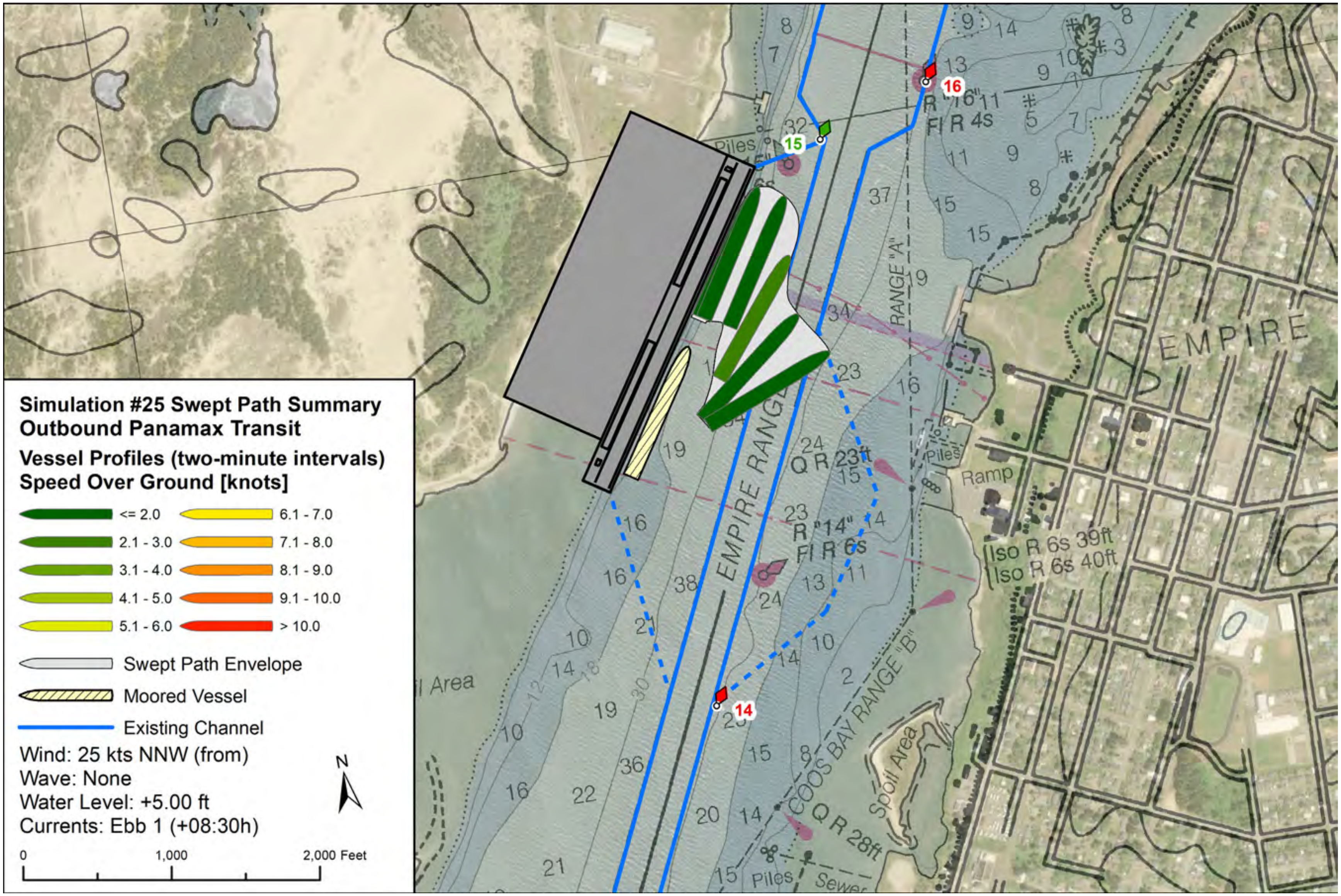
Simulation #20 Swept Path Summary
Inbound PPX2 Transit

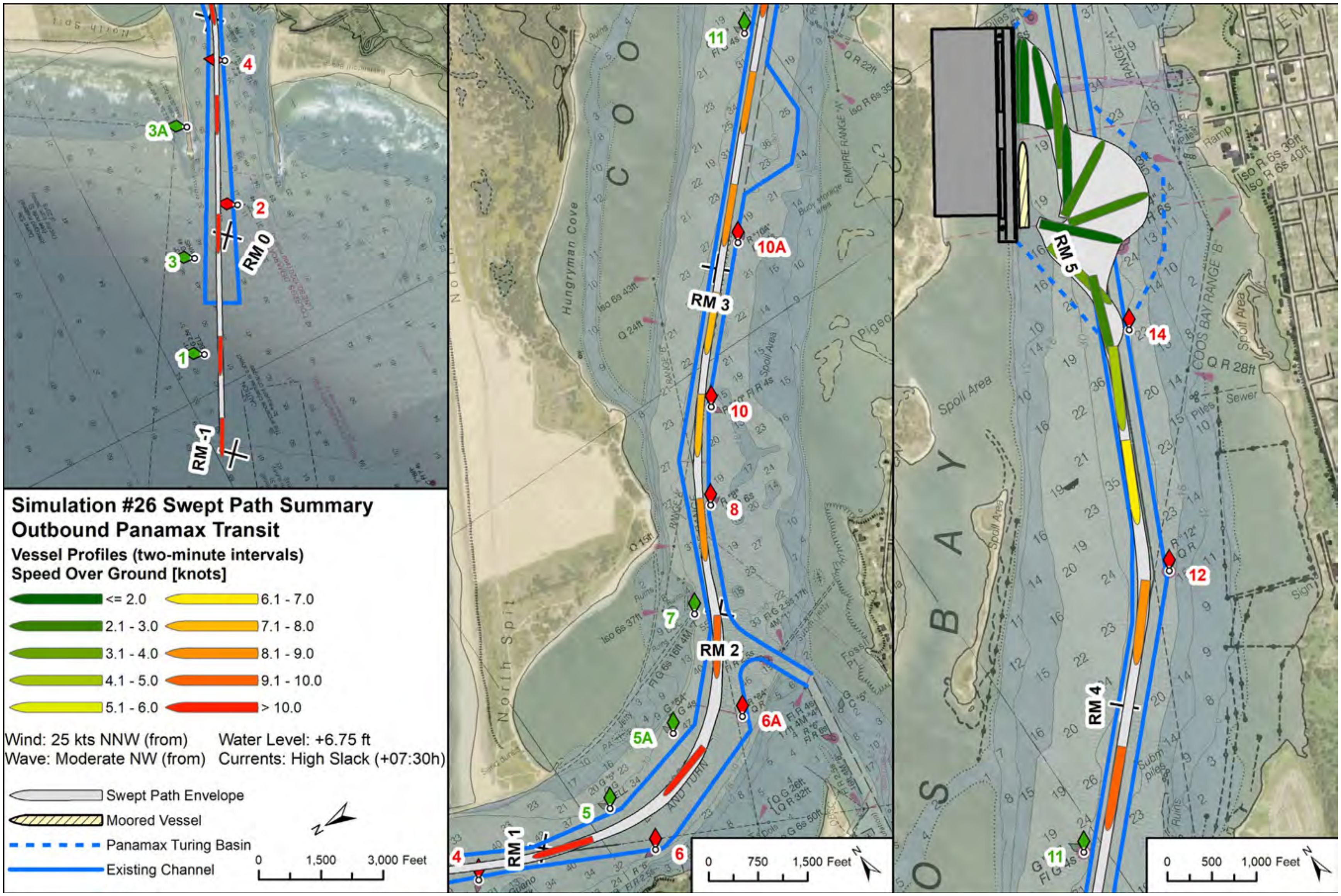

Simulation #21 Swept Path Summary
Inbound PPX2 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Wind: 25 kts NNW (from)
Wave: Swell NW (from)
Water Level: +6.50 ft
Currents: Flood (+04:00h)
Swept Path Envelope
Moored Vessel
Panamax Turing Basin
Existing Channel
0 1,500 3,000 Feet
0 750 1,500 Feet
0 500 1,000 Feet
N
RM -1
RM 0
RM 1
RM 2
RM 3
RM 4
RM 5
1
2
3
3A
4
5
5A
6
6A
7
8
10
10A
11
12
14
Hungryman Cove
North Spit
Spoil Area
COOS BAY RANGE "B"
EMPIRE RANGE "A"

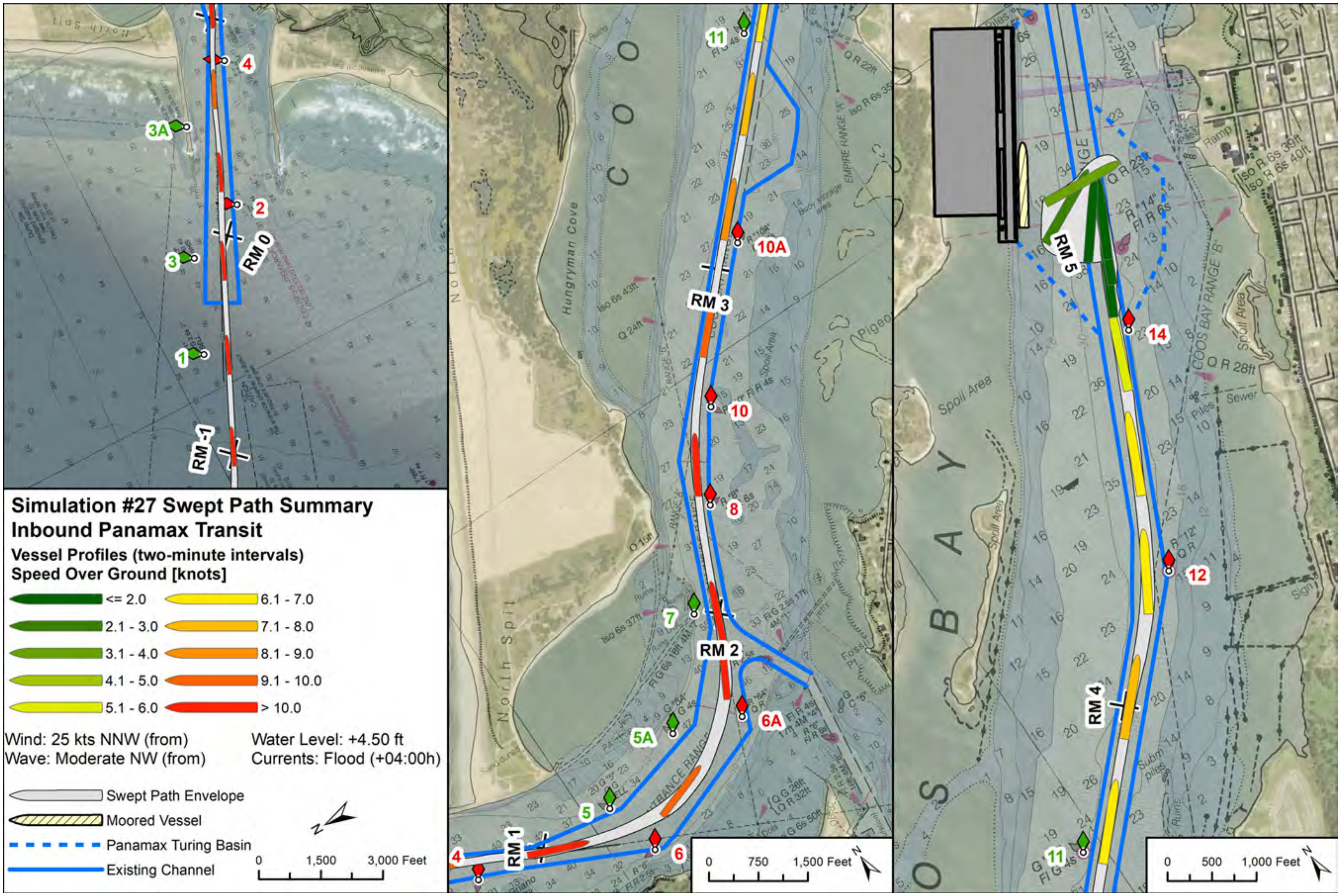

Simulation #22 Swept Path Summary
Inbound PPX2 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Proposed Channel
Wind: 25 kts NNW (from)
Wave: None
Water Level: +6.50 ft
Currents: Flood (+06:00h)
N
0
500
1,000
2,000 Feet
RM 6
RM 7
17
17A
18
19
20
21
22
22A
23
Marsh
ALERT AREA (see note D)
UPPER JARVIS RANGE "A"
RANGE "B"
Q R 14ft
Q R 16ft
Q R 20ft
Iso R 6s 48ft
Iso R 6s 38ft
Fl R 2.5s
Fl R 4s
R "18"
R "20"
G "21"
G "23"
Subm dol
DOLS
LOWER JARVIS
Beach Light Lane
Fl Y 4s "A"

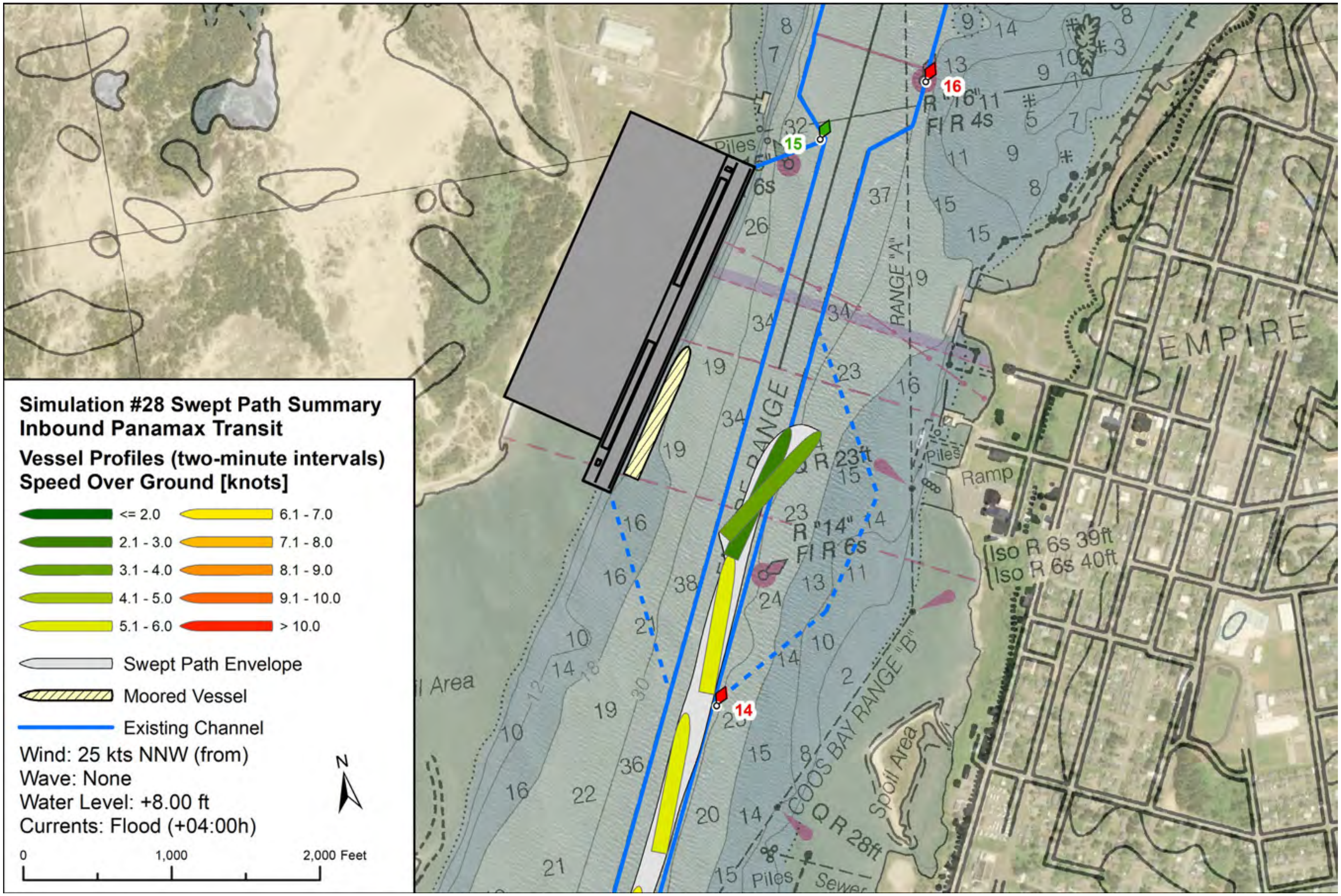

Simulation #23 Swept Path Summary
Inbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Existing Channel
Wind: 25 kts NNW (from)
Wave: None
Water Level: +6.50 ft
Currents: Flood (+06:00h)
N
0
500
1,000
2,000 Feet
RM 6
RM 7
18
20
21
22
23
Marsh
Q R 14ft
Iso R 6s 48ft
Iso R 6s 48ft
UPPER JARVIS RANGE "A"
RANGE "B"
Q R 16ft
G "21"
Fl G 4s
R "22"
Fl R 2.5s
R "20"
Fl R 4s
R "18"
Q R
Iso R 6s 38ft
Q R 20ft
DOLS
Dols
Subm dols
Subm dol
ALERT AREA
(see note D)
Fl Y 4s "A"
Fl Y 4s "B"

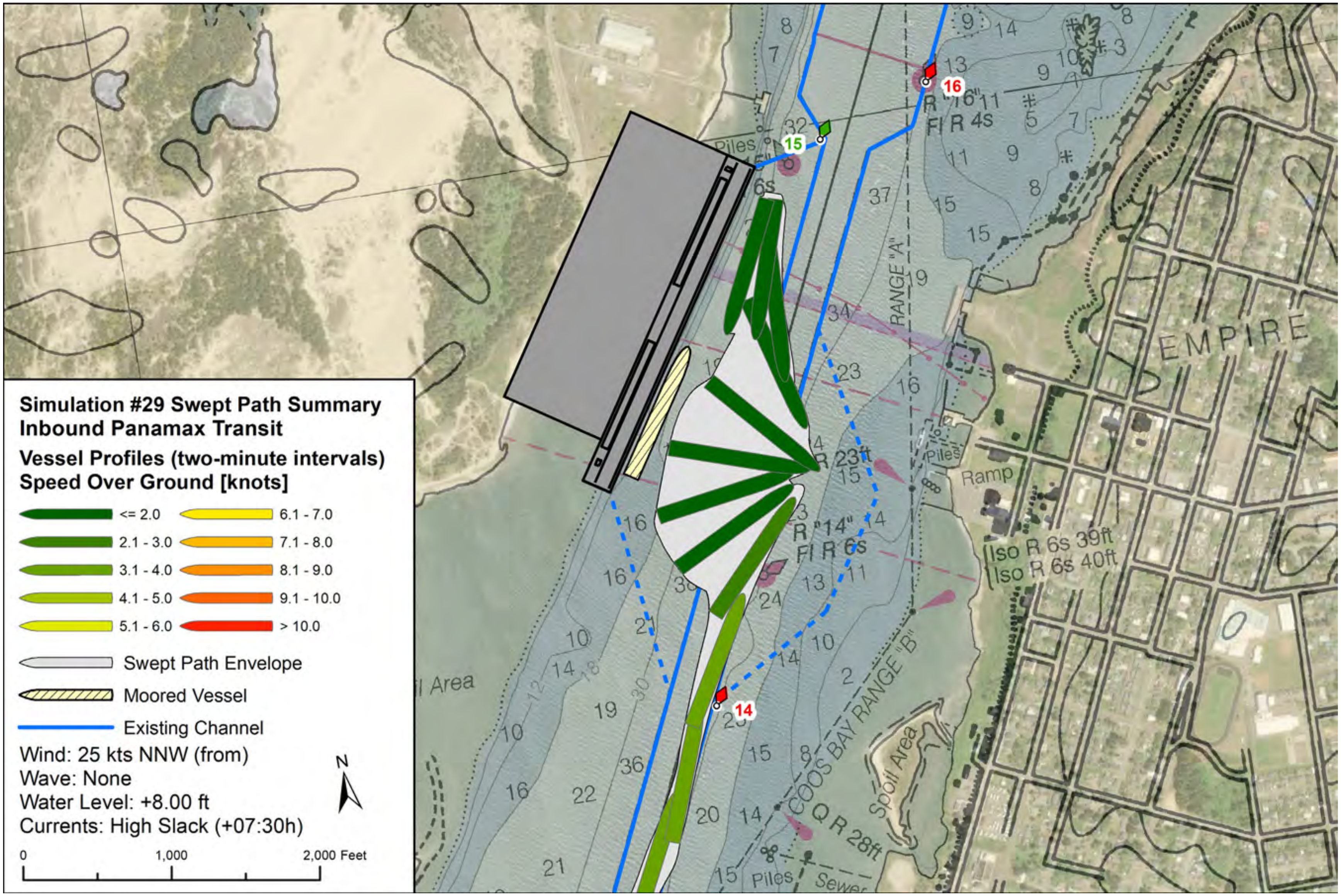

Simulation #24 Swept Path Summary
Outbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Moored Vessel
Existing Channel
Wind: 25 kts NNW (from)
Wave: None
Water Level: +5.00 ft
Currents: Ebb 1 (+08:30h)
N
0
1,000
2,000 Feet
14
15
16
R "16"
Fl R 4s
Piles
RANGE "A"
EMPIRE
Piles
Ramp
R 23ft
6s
Iso R 6s 39ft
Iso R 6s 40ft
COOS BAY RANGE "B"
Spoil Area
Q R 28ft
Piles
Sewer
Area

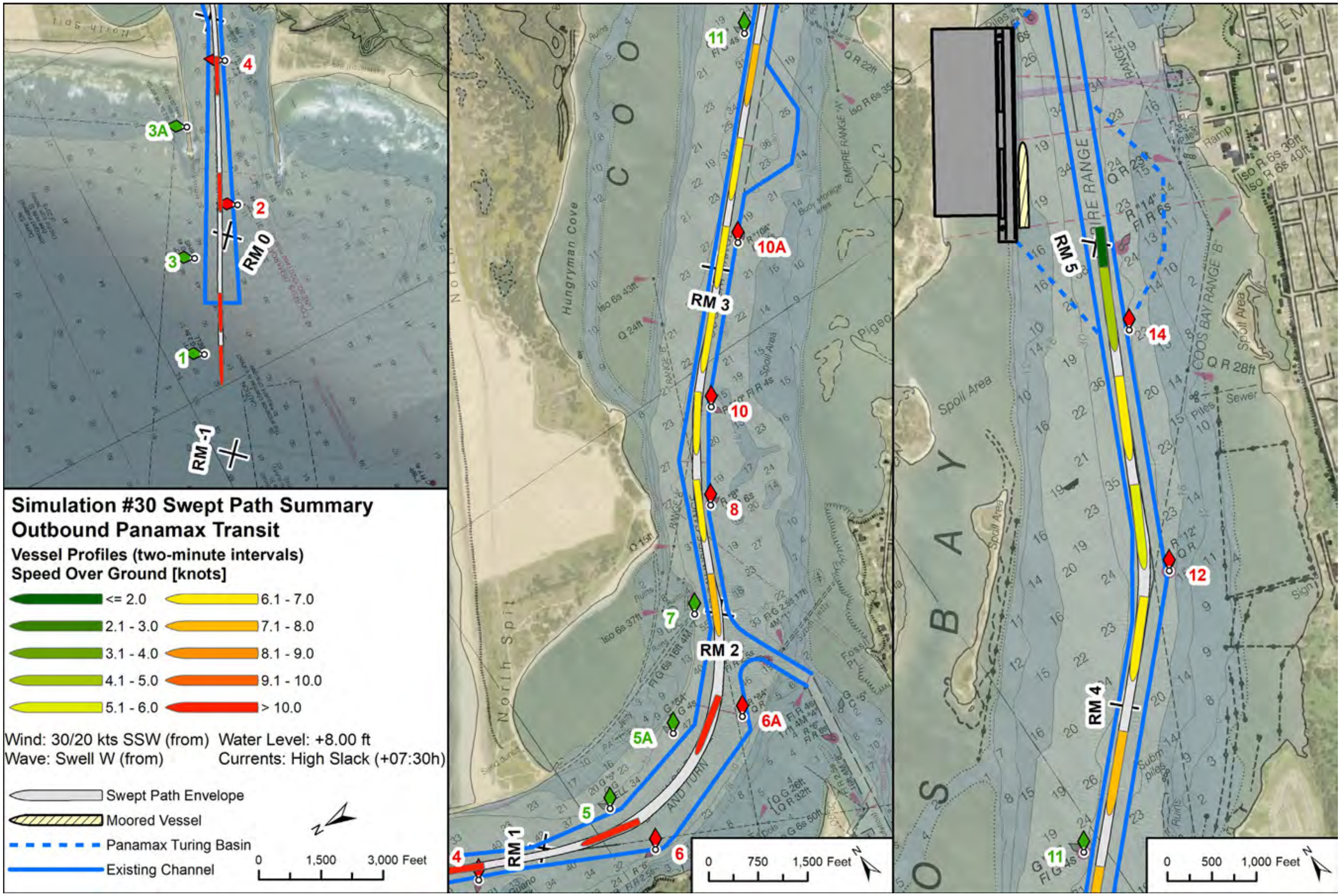

Simulation #25 Swept Path Summary
Outbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Moored Vessel
Existing Channel
Wind: 25 kts NNW (from)
Wave: None
Water Level: +5.00 ft
Currents: Ebb 1 (+08:30h)
N
0
1,000
2,000 Feet
EMPIRE
EMPIRE RANGE
RANGE "A"
COOS BAY RANGE "B"
15
16
14
R "16" Fl R 4s
R "14" Fl R 6s
Q R 23ft
Q R 28ft
Iso R 6s 39ft
Iso R 6s 40ft
Piles
Ramp
Spoil Area
Sewer


Simulation #26 Swept Path Summary
Outbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Wind: 25 kts NNW (from)
Wave: Moderate NW (from)
Water Level: +6.75 ft
Currents: High Slack (+07:30h)
Swept Path Envelope
Moored Vessel
Panamax Turing Basin
Existing Channel
N
0
1,500
3,000 Feet
0
750
1,500 Feet
0
500
1,000 Feet
RM -1
RM 0
RM 1
RM 2
RM 3
RM 4
RM 5
1
2
3
3A
4
5
5A
6
6A
7
8
10
10A
11
12
14
Hungryman Cove
North Spit
COOS BAY
Spoil Area
EMPIRE RANGE "A"
COOS BAY RANGE "B"
Sewer
Ramp

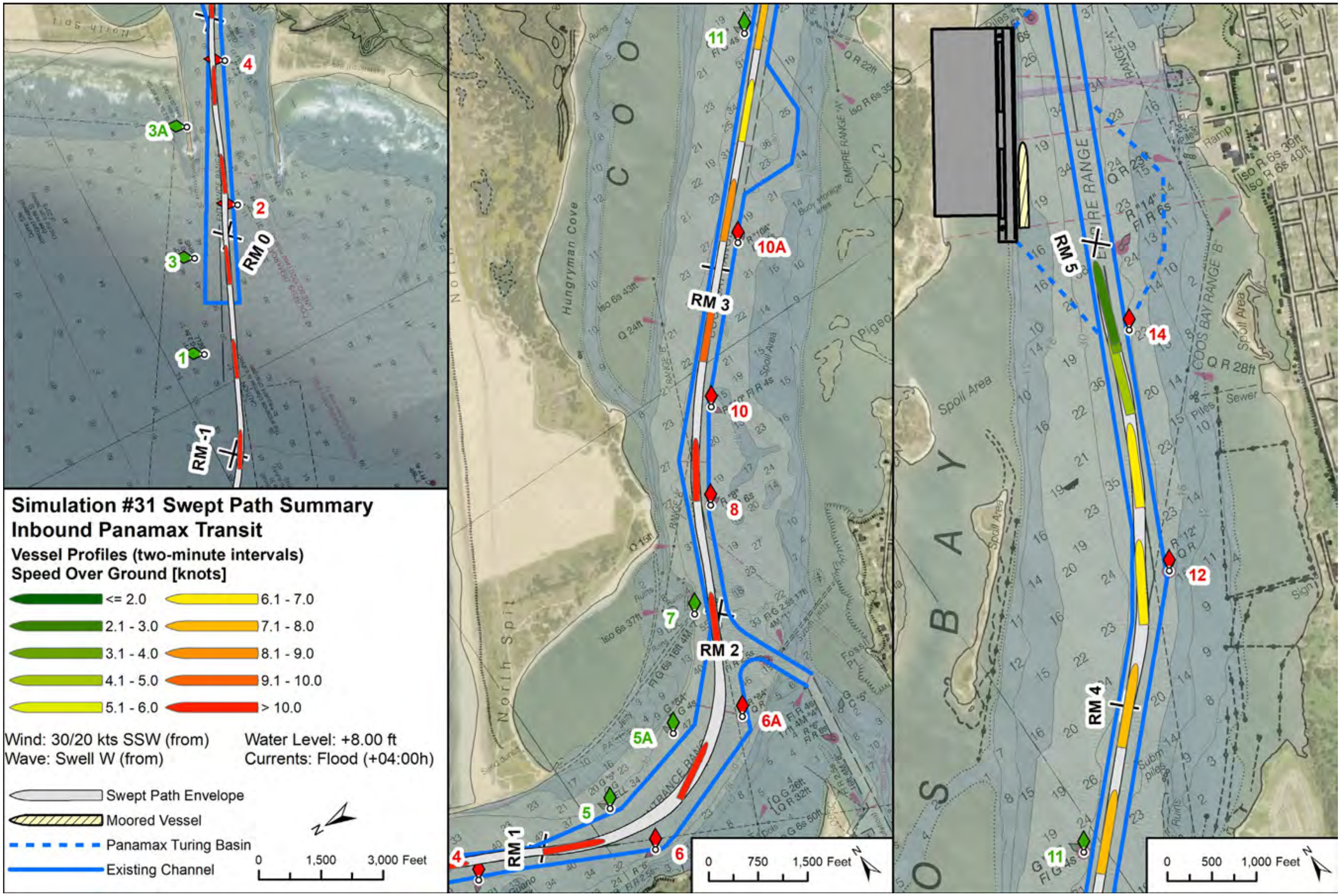

Simulation #27 Swept Path Summary
Inbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Wind: 25 kts NNW (from)
Wave: Moderate NW (from)
Water Level: +4.50 ft
Currents: Flood (+04:00h)
Swept Path Envelope
Moored Vessel
Panamax Turing Basin
Existing Channel
N
0
1,500
3,000 Feet
750
1,500 Feet
500
1,000 Feet
RM -1
RM 0
RM 1
RM 2
RM 3
RM 4
RM 5
1
2
3
3A
4
5
5A
6
6A
7
8
10
10A
11
12
14
Hungryman Cove
North Spit
Spoil Area
COOS BAY RANGE "B"
EMPIRE RANGE "A"
Q R 28ft
Iso R 6s 39ft
Iso R 6s 40ft
Sewer
Piles
Ramp
Subm piles
Ruins
Sign

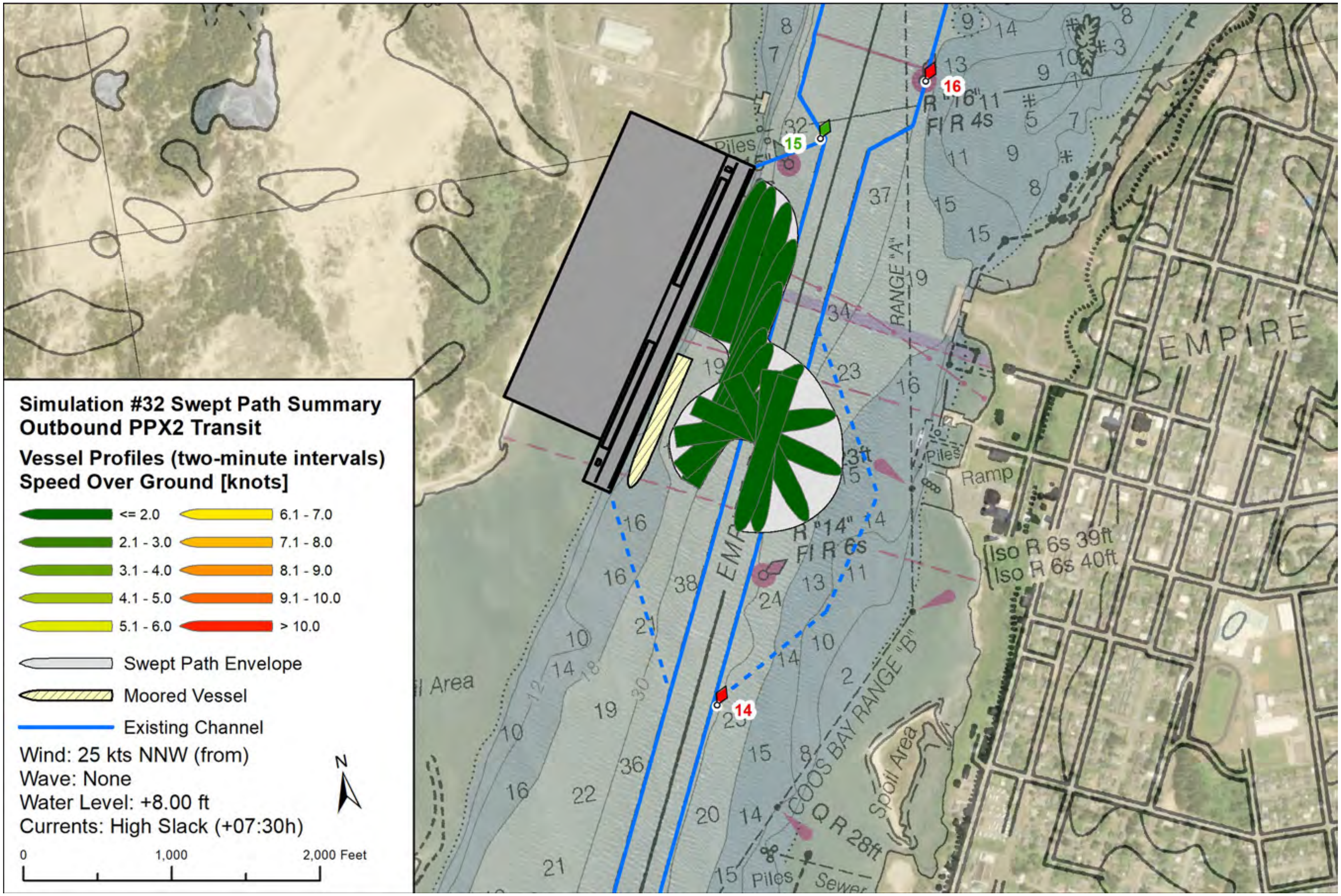

Simulation #28 Swept Path Summary
Inbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Moored Vessel
Existing Channel
Wind: 25 kts NNW (from)
Wave: None
Water Level: +8.00 ft
Currents: Flood (+04:00h)
N
0
1,000
2,000 Feet
14
15
16
EMPIRE
RANGE "A"
COOS BAY RANGE "B"
R "16" Fl R 4s
R "14" Fl R 6s
Q R 23ft
Q R 28ft
Iso R 6s 39ft
Iso R 6s 40ft
Piles
Ramp
Spoil Area
Sewer


Simulation #29 Swept Path Summary
Inbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Moored Vessel
Existing Channel
Wind: 25 kts NNW (from)
Wave: None
Water Level: +8.00 ft
Currents: High Slack (+07:30h)
N
0
1,000
2,000 Feet
EMPIRE
RANGE "A"
COOS BAY RANGE "B"
R "16" Fl R 4s
R "14" Fl R 6s
R 23ft
Q R 28ft
Iso R 6s 39ft
Iso R 6s 40ft
Piles
Ramp
Sewer
Spoil Area
16
15
14



Simulation #30 Swept Path Summary
Outbound Panamax Transit


Simulation #31 Swept Path Summary
Inbound Panamax Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Wind: 30/20 kts SSW (from)
Wave: Swell W (from)
Water Level: +8.00 ft
Currents: Flood (+04:00h)
Swept Path Envelope
Moored Vessel
Panamax Turing Basin
Existing Channel
N
0
1,500
3,000 Feet
RM -1
RM 0
RM 1
RM 2
RM 3
RM 4
RM 5
1
2
3
3A
4
5
5A
6
6A
7
8
10
10A
11
12
14
Hungryman Cove
North Spit
COOS BAY
Spoil Area
EMPIRE RANGE
COOS BAY RANGE 'B'
0
750
1,500 Feet
0
500
1,000 Feet


Simulation #32 Swept Path Summary
Outbound PPX2 Transit
Vessel Profiles (two-minute intervals)
Speed Over Ground [knots]
<= 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
> 10.0
Swept Path Envelope
Moored Vessel
Existing Channel
Wind: 25 kts NNW (from)
Wave: None
Water Level: +8.00 ft
Currents: High Slack (+07:30h)
N
0
1,000
2,000 Feet
16
15
14
R "16" Fl R 4s
R "14" Fl R 6s
RANGE "A"
COOS BAY RANGE "B"
Q R 28ft
Iso R 6s 39ft
Iso R 6s 40ft
EMPIRE
Piles
Ramp
Spoil Area
Sewer

ATTACHMENT B

Phase 2 Desktop Navigation Simulation Report

OREGON INTERNATIONAL PORT OF COOS BAY CHANNEL MODIFICATION

Phase 2 Desktop Navigation Simulation Report

Prepared for

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U.S. Army Corps of Engineers

Portland District
P.O. Box 2946
Portland, OR 97208

January 2024

OREGON INTERNATIONAL PORT OF COOS BAY CHANNEL MODIFICATION

Phase 2 Desktop Navigation Simulation Report

Prepared by

moffatt & nichol

Version	Rev0	Rev1	Rev2
Purpose	DMA/OIPCB Review	USACE Review	Final Submittal
Date	September 2023	January 2024	
By	G. Lawrence	G. Lawrence	
Checked	E. Smith	E. Smith	
Approved	J. Shelden	J. Shelden	

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ACRONYMS AND ABBREVIATIONS

AtoN	aids to navigation
CF	Planned Container Facility
DNV	Det Norske Veritas
EIS	Environmental Impact Statement
ERDC	Engineering Research and Development Center (of the USACE)
FSS	Full Ship Simulation
JONSWAP	Joint North Sea Wave Project
LOA	Length Overall
MITAGS	Maritime Institute of Technology and Graduate Studies
MLLW	Mean Lower Low Water
M&N	Moffatt & Nichol
NWP	Portland District (of the USACE)
OIPCB or Port	Oregon International Port of Coos Bay
PPX2	Post Panamax Generation 2
PPX3	Post Panamax Generation 3
PA	Proposed Alteration
RFP	Roseburg Forest Products
RM	river mile
TSP	Tentatively Selected Plan
USACE or Corps	U.S. Army Corps of Engineers
WRDA	Water Resources Development Act
WRRDA	Water Resources Reform and Development Act

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1. INTRODUCTION

In 2016 and 2017 two Full Ship Simulation (FSS) Studies were completed on behalf of the U.S. Army Corps of Engineers (USACE, or Corps), Portland District as the lead agency, and the Oregon International Port of Coos Bay (OIPCB, or Port) as part of the federal navigation project to improve the Coos Bay Federal Navigation Channel, OR. The findings of the 2016 & 2017 FSS efforts are summarized in the Moffatt & Nichol (M&N) *Full Ship Simulation Report*, dated October 21, 2016 (issued for USACE review) and M&N *Supplemental Full Ship Simulation Report*, dated May 25, 2017 (issued for USACE review). These previous investigations were conducted under the authority granted by Section 204 of the Water Resources Development Act (WRDA), 1986, as modified by Section 1014 of the Water Resources Reform and Development Act (WRRDA), 2014. This action would require permission, under Section 14 of the Rivers and Harbors Appropriation Act of 1899, 33 United States Code 408, to modify the federal navigation project. The Section 204/408 Report and Environmental Impact Statement (EIS) proposed modifications to the Coos Bay Navigation Channel in Coos County, Oregon, to accommodate larger deep draft vessels and provide net positive local, state, and federal economic and environmental benefits in an environmentally acceptable manner.

The previous simulation studies evaluated LNG Carriers and Forest Product Bulk Carriers (“Chip Ships”) based on the proposed (Jordan Cove LNG facility) and existing (Roseburg Forest Products chip facility) facilities located in Coos Bay, OR. The Jordan Cove LNG facility is no longer planned for development. However, a new container facility is proposed, hereinafter Container Facility (CF).

1.1 PURPOSE AND OBJECTIVE

This report provides the results of the Phase 2 desktop real-time navigation ship simulation study conducted January 12th to 15th, 2023 on Moffatt & Nichol’s traveling simulator at OIPCB’s office in Coos Bay, OR. Shiphandling for this simulation effort was performed by the local Coos Bay Pilots. The following objectives were identified for this study:

- Confirm the basic feasibility of maneuvering to the proposed container facility in the existing and previously developed widened and deepened navigation channel, hereinafter the 2017 Proposed Alteration Channel (2017 PA),
- Validate the preliminary design vessels for the existing and proposed channels that were concluded from Phase 1,
- Assess the channel dimensions to confirm an adequate access of vessels,
- Identify the preliminary operational limit conditions (wave, wind, currents) and strategies to manage these scenarios,
- Identify critical points in the navigation channel and optimize channel navigation aids,
- Assess the adequacy of turning areas and/or determine the best location for the containership to perform the turning evolution for this future terminal, and
- Determine the needed tug configuration and strength to perform the transit to the proposed facility.

1.2 PROJECT PARTICIPANTS

The following stakeholders were present during all or part of the navigation simulations at OIPCB:

- Coos Bay Pilots Association
    - Captain George Wales – Bar and River Pilot
    - Captain Steven Woods – Bar and River Pilot

    - Captain Tim Petrusha – Bar and River Pilot
- Oregon International Port of Coos Bay
    - Mike Dunning – Chief Port Operations Officer
- Webb Simulation Consulting
    - Dennis Webb - Observer
- Moffatt & Nichol
    - Gwen Lawrence – Simulation Director
    - Kyle Landon – Coastal Engineer

2. SIMULATION INPUTS

The primary inputs to the vessel simulations can be outlined in the following three categories: the channel geometries (Section 2.1), the vessels included in the simulation (Section 2.2), and the design environmental conditions (Section 2.3). This Ship Simulation report relies heavily on the more detailed inputs described in the USACE-approved Ship Simulation Plan for the 30 percent Design TSP Channel (M&N *Full Ship Simulation Plan,* dated February 19. 2016).

2.1 NAVIGATION CHANNELS EVALUATED

This simulation effort evaluated two channel configurations for the Coos Bay Federal Navigation Channel:

- *Without Project (WOP) Federal Navigation Channel*: Existing navigation channel dimensions, incorporating the planned Container Facility and turning basin; and

- *2017 Proposed Alteration (PA) Channel* which was the proposed channel at the conclusion of the 2016 & 2017 navigation simulation studies with the planned Container Facility and modified turning basin at RM 7.5.

The details of these channel alignments are presented in the following subsections.

2.1.1 Without Project Federal Navigation Channel

The authorized width and depth of the federal navigation channel varies throughout its extent, as depicted in Figure 2-1. In 1995, the entrance channel was deepened to 47 feet (ft) mean lower low water (MLLW) and widened to 700 ft, tapering through the Entrance Range through the jetties to a channel 37 ft deep and 300 ft wide at river mile (RM) 1. All depths in this report refer to chart datum MLLW unless otherwise noted. The inner channel from RM 1 to RM 9 is 37 ft deep by 300 ft wide, and from RM 9 to RM 15 the inner channel is 37 ft deep by 400 ft wide. Thus, for the majority of the proposed modification area, the channel is currently authorized at a nominal 37-foot depth and 300-foot width. The present condition of the federal navigation channel includes advance maintenance dredging. In the entrance up to RM 1, the advance maintenance decreases from 5 to 3 feet, and in the inner channel, the advance maintenance dredging is 1 to 2 feet. Channel widths by reach for the Without Project Condition are shown in Table 2-1.

As stated, there is a new planned container facility at RM 5.0. This container facility was included in the without project condition simulation model with the addition of a Panamax sized turning basin, as depicted Figure 2-1. The planned CF will conceptually be comprised of two berths with a total wharf length of approximately 2,400 ft. The design vessel for the planned CF with the existing navigation channel is a Panamax containership, see Section 2.2.1. Based on the design vessel the Panamax turning basin was sized to be 1,850 feet long (parallel to the channel) and 1,450 feet wide, which equates to 1.5*LOA of the design vessel with 200-ft of tidal elongation perpendicular to the channel to account for longitudinal drift per EM 110-2-1613[1]. The turning basin design has been confirmed with screening desktop simulations performed

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[1] 10567647: Phase 2 report, Section 2.1.1, second par: FWP Post Panamax TB sized at 1.3 x LOA. FWOP Panamax TB sized at 1.5 x LOA. Why was FWP TB sized 1.3 LOA versus FW)P TB sized at 1.5X LOA?
Response: This is a result of the findings from the screening Phase 1 simulations. The pilot found that Post Panamax Generation 2 vessel easier to maneuver in the turning basin than the Panamax vessel which resulted in the discrepancy in ratio of the LOA for the TB size.

by M&N in 2022. The turning basin design depth is -37 ft MLLW, the same as the existing navigation channel.

Additionally, for the without project federal navigation channel simulations the previously proposed turning basin from the 2017 studies, Figure 2-1, at approximately RM 7.5 was also evaluated as an option for turning the Panamax vessels.

The aids to navigation (AtoN) for the without project condition are those in place today, with the exception of the existing green buoys 15 and 23 and red buoy 22 which were relocated due to the turning basin to the locations as shown on Figure 2-1[2].

---

[2] 10567646: Phase 2 report, figure 2-1: Verify that FWOP FNC is correct, for FNC flare near RED 10A buoy and flare near 22R buoy.
Response: Updated figure.

Figure 2-1. Without Project Federal Navigation Channel and Planned Container Facility

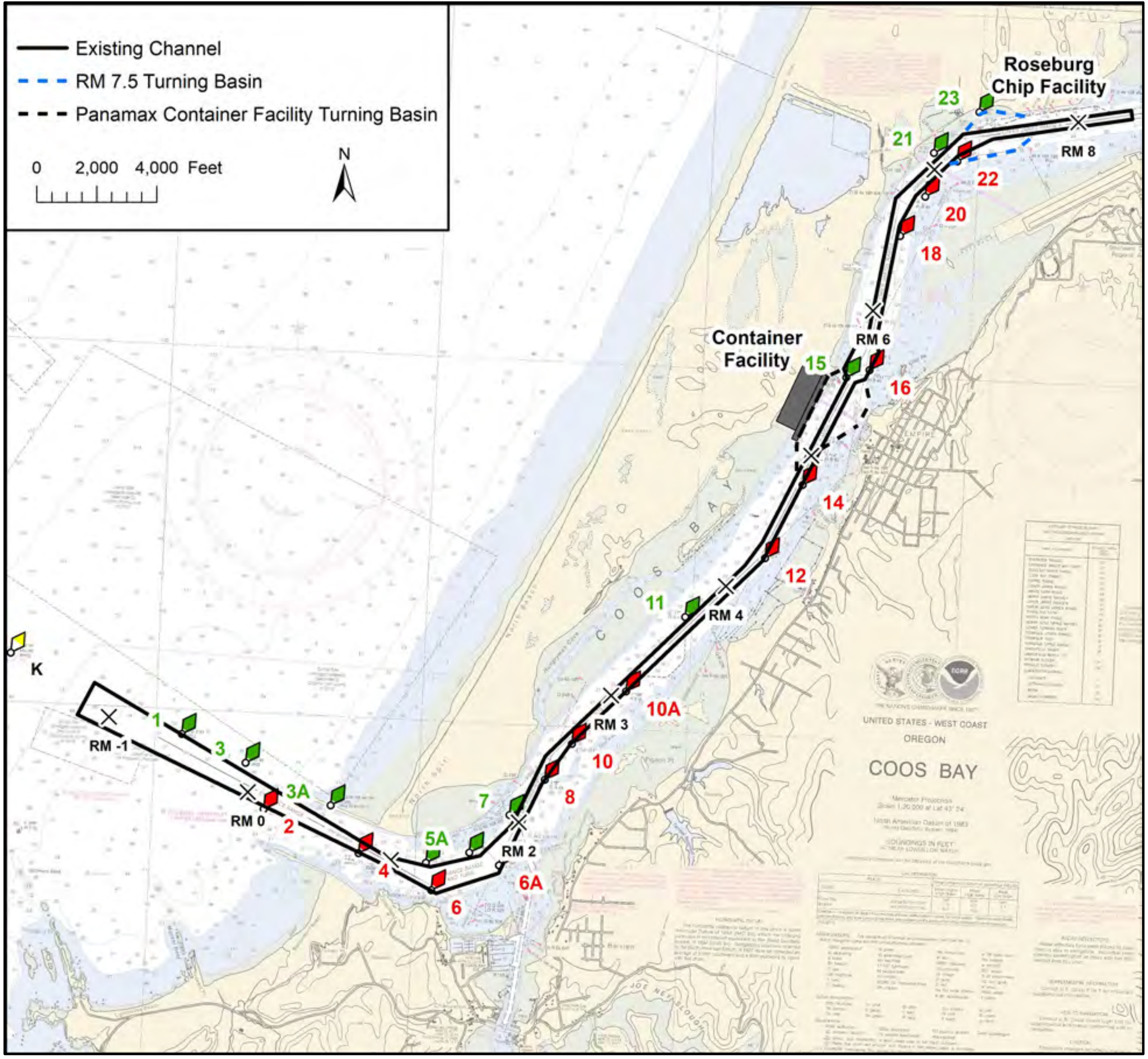


Table 2-1. Widths of Channel Reaches Included in Phase 2 Desktop Ship Simulation Study

Channel Range(s)	River Miles		Channel Width		Authorized Channel Depths	
	Start	End	WOP	2017 PA	WOP	2017 PA
Entrance Range	RM -0.8	1.0	700 to 300	1,280 to 500	47 to 37	57 to 45
Entrance Range & Turn	1.0	2.0	Up to 740	Up to 740	37	45
Inside Range	2.0	2.5	300	500	37	45
Coos Bay Range	2.5	4.3	300	450	37	45
Empire Range to Lower Jarvis Range	4.3	6.8	300	450	37	45
Panamax Turning Basin	4.7±	5.5±	1,850 x 1,450	--	37	--
PPX Turning Basin	4.7±	5.6±	--	1,850 x 1,450	--	45
Jarvis Turn	6.8	7.3	400	500	37	45
Upper Jarvis Range	7.3	7.8	300	450	37	45
Capesize Turning Basin	7.3±	7.6±	--	1,400 × 1,100	--	37

2.1.2 2017 Proposed Alteration Navigation Channel

The proposed project navigation channel for this current simulation study used the recommended channel (previously known as PA, Rossell Option B or Channel #3) from 2017 full mission bridge ship simulations as the baseline channel, as depicted in Figure 2-2. The proposed channel for this current study is hereinafter designated the 2017 Proposed Alteration (2017 PA). The design vessel for the planned CF with the 2017 PA channel is a Post-Panamax Generation Two Containership see Section 2.2.1. The modifications for the 2017 PA Channel to accommodate the new container facility are summarized as follows:

- *Post Panamax Containership Turning Basin at RM 5.0* (Figure 2-3): A turning basin at the container facility is needed to accommodate the Post-Panamax containership. Based on the design vessel, the proposed turning basin is 1,850 feet long (parallel to the channel) and 1,450 feet wide, equivalent to 1.3*LOA of the design vessel with 200-ft of tidal elongation parallel to the channel. The turning basin design has been confirmed with screening desktop simulations performed by M&N in 2022. The turning basin design depth is -45 ft MLLW, the same as the 2017 PA channel.

- *Remove LNG Facility:* The planned LNG facility and access channel and associated turning basin at RM 7.5 was removed from the proposed condition as that facility is no longer planned.

- *Capesize Turning Basin at RM 7.5* (Figure 2-4) a Capesize turning basin was added at RM 7.5 to accommodate the capesize bulk carrier and possibly the containerships. This turning basin was designed to be 1,400 feet long (parallel to the channel) and 1,100 feet wide. Due to the need to accommodate the containerships, the turning basin was deepened to -45 ft MLLW.

The overall 2017 PA channel is depicted in Figure 2-2 and channel widths by reach are shown in Table 2-1. This channel was screened prior to these desktop simulations on M&N desktop simulator as described in *Phase 1 Screening Navigation Simulation Results Memorandum (December 2, 2022)*.

Figure 2-2. Proposed Federal Navigation Channel, Terminals, and Turning Basins

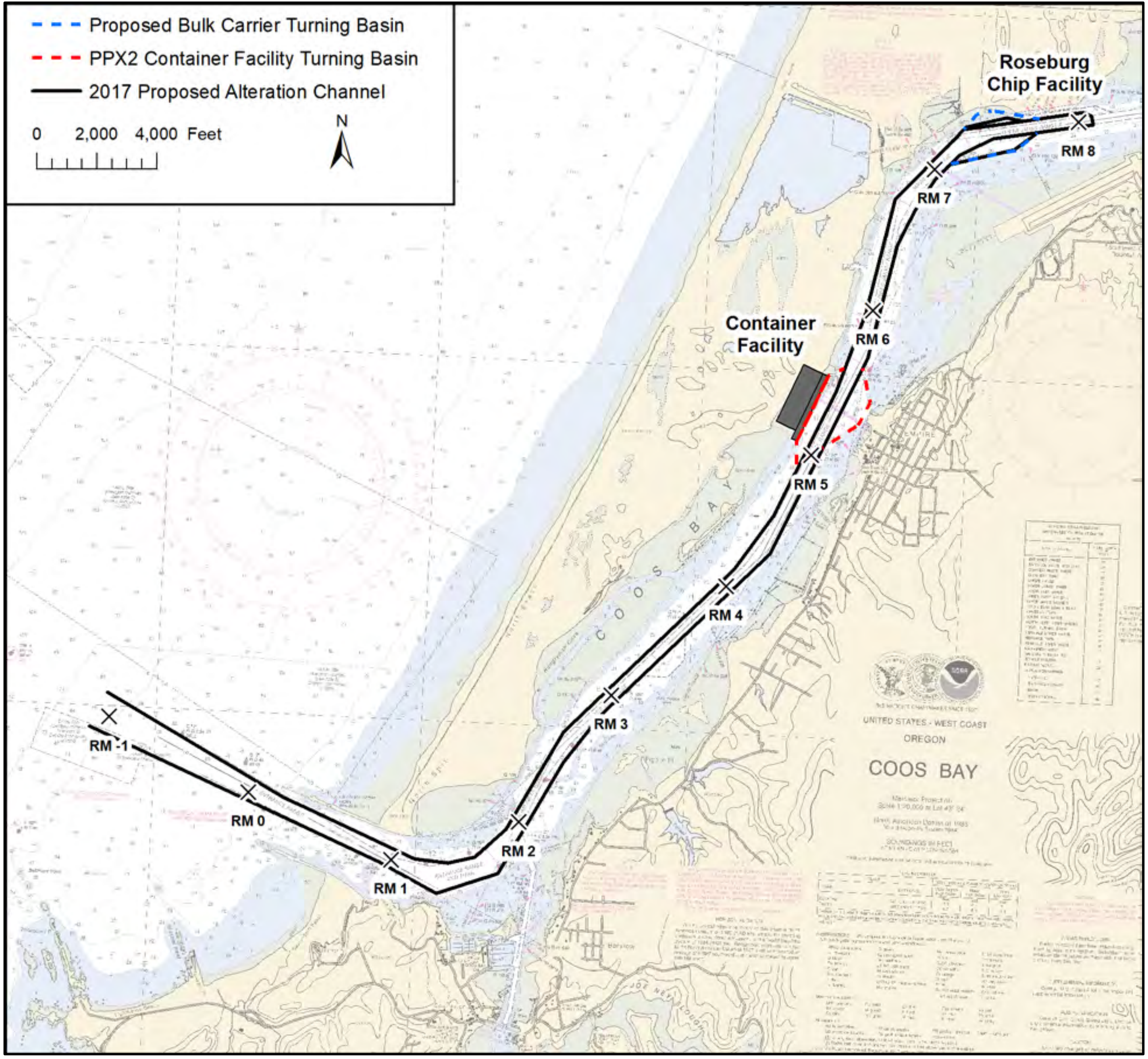


Figure 2-3. 2017 Proposed Alteration Channel Modification Post-Panamax Turning Basin

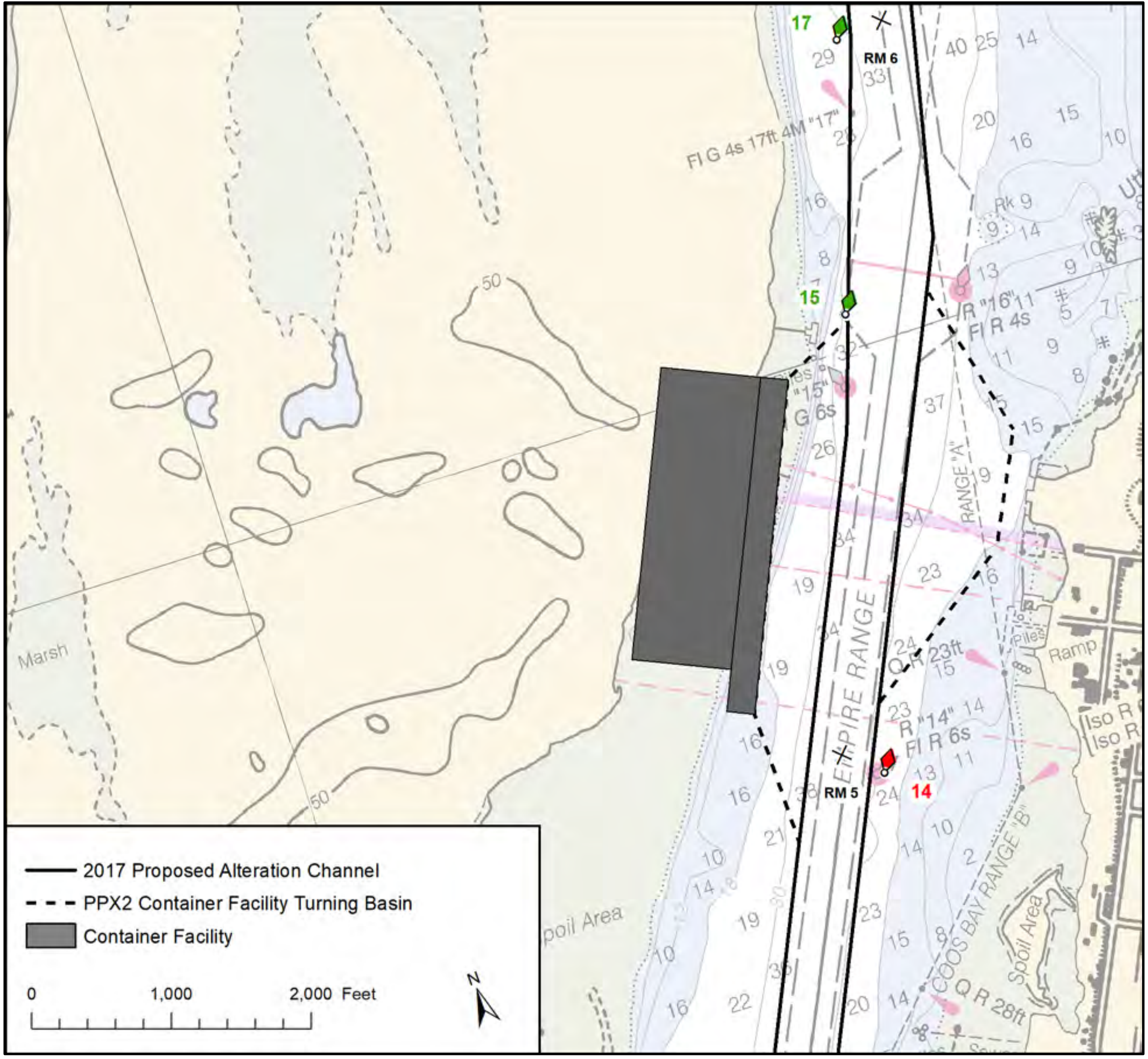
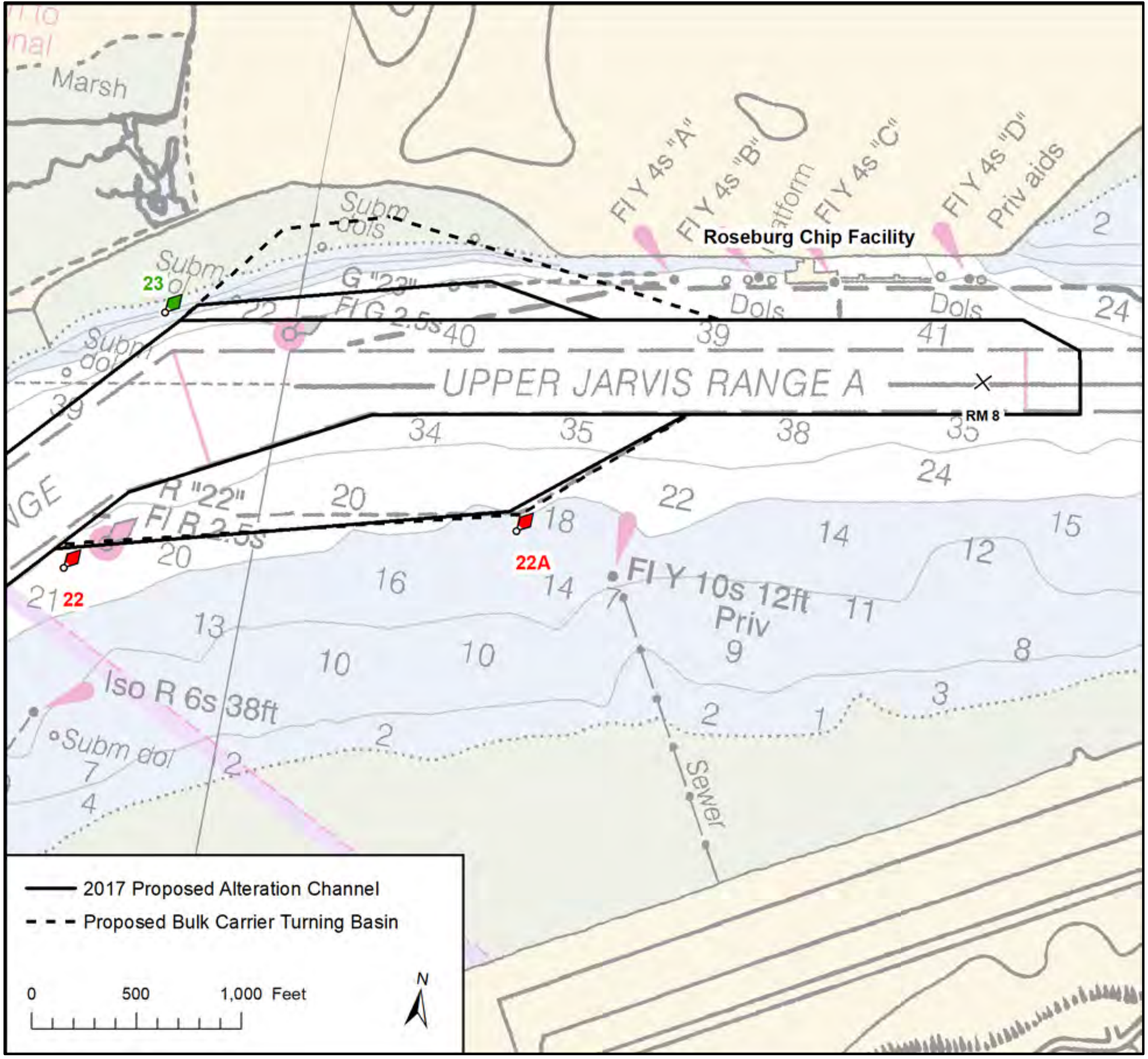


Figure 2-4. 2017 Proposed Alteration Channel Modification Capesize Turning Basin at RM 8.0



2.2 DESIGN VESSELS

This section lists all vessels that were included in the simulations. Pilot cards for each vessel are provided in Appendix A.

2.2.1 Deep Draft Vessels

Table 2-2 provides vessel particulars for the vessels that were used in this ship simulation study. These vessels are considered representative of those modeled for the desktop simulations of the proposed CF performed by M&N in 2022. The Capesize bulk carrier was simulated under loaded draft condition for inbound transits. The containerships were simulated under full operating draft for both inbound and outbound simulations. Based on the screening simulations a Post-Panamax Generation 3 (13,000 TEU) Containership was unable to safely transit the entrance turn of the 2017 PA channel and would require a redesign of the channel. However, this vessel was still simulated to confirm this finding from the screening simulations.

Table 2-2. Vessels Models Used in the Simulation (Wärtsilä NTPro Software)

Attribute		WOP Containership Vessel	2017 PA Channel Recommended Containership Vessel	2017 PA Channel Maximum Possibility of Containership Vessel	2023 PA Channel Bulk Carrier
Vessel Model		Container Arthur Edgemore	Container Apollo 11	Container Kalina	Bulk Carrier 19
Class/Capacity		Panamax / 4,500 TEU	Post Panamax Generation 2/ 8,500 TEU	Post Panamax Generation 3/ 13,000 TEU	Capesize
LOA	ft	958.0	1095.8	1200.8	837.5
	m	292.0	334.0	366.0	255.3
Beam	ft	105.6	141.1	168.0	141.1
	m	32.2	43.0	51.2	43.0
Operating Draft	ft	36.0	45.0	45.0	45.0 (loaded)
	m	11.0	13.7	13.7	13.7

2.2.2 Tugs

The following tugs were used in the simulation.

- Capesize Chip Ship: Two ASD tugs with bollard pull of 80 tonnes maximum;
- Panamax Containership: Two ASD tugs with bollard pull of 80 tonnes maximum; and
- Post Panamax Generation 2 Containership: Either two ASD tugs with bollard pull of 80 tonnes maximum and an ASD tug with bollard pull of 50 tonnes maximum or three ASD tugs with bollard pull of 80 tonnes maximum; and
- Post Panamax Generation 3 Containership: Three ASD tugs with bollard pull of 80 tonnes maximum.

Table 2-3 provides vessel particulars for the tug used in the simulation. Tugs were simulated in auto-tug mode and controlled by the simulator operator. Each tug was a hydrodynamically active six degree of freedom model.

Table 2-3. Tug to be Used in the Simulation

Tug Type	Use	Wärtsilä Tug Model	Bollard Pull (Metric tons)	LOA		Beam		Draft	
				ft	m	ft	m	ft	m
ASD Tug	Post Panamax Generation 2 Containerships	ASD Tug 12	50	89.9	27.4	37.7	11.5	11.5	3.5
ASD Tug	All Containerships & Chip Ship	ASD Tug 15	80	105.0	32.0	38.1	11.6	19.0	5.8

2.2.3 Moored Vessels

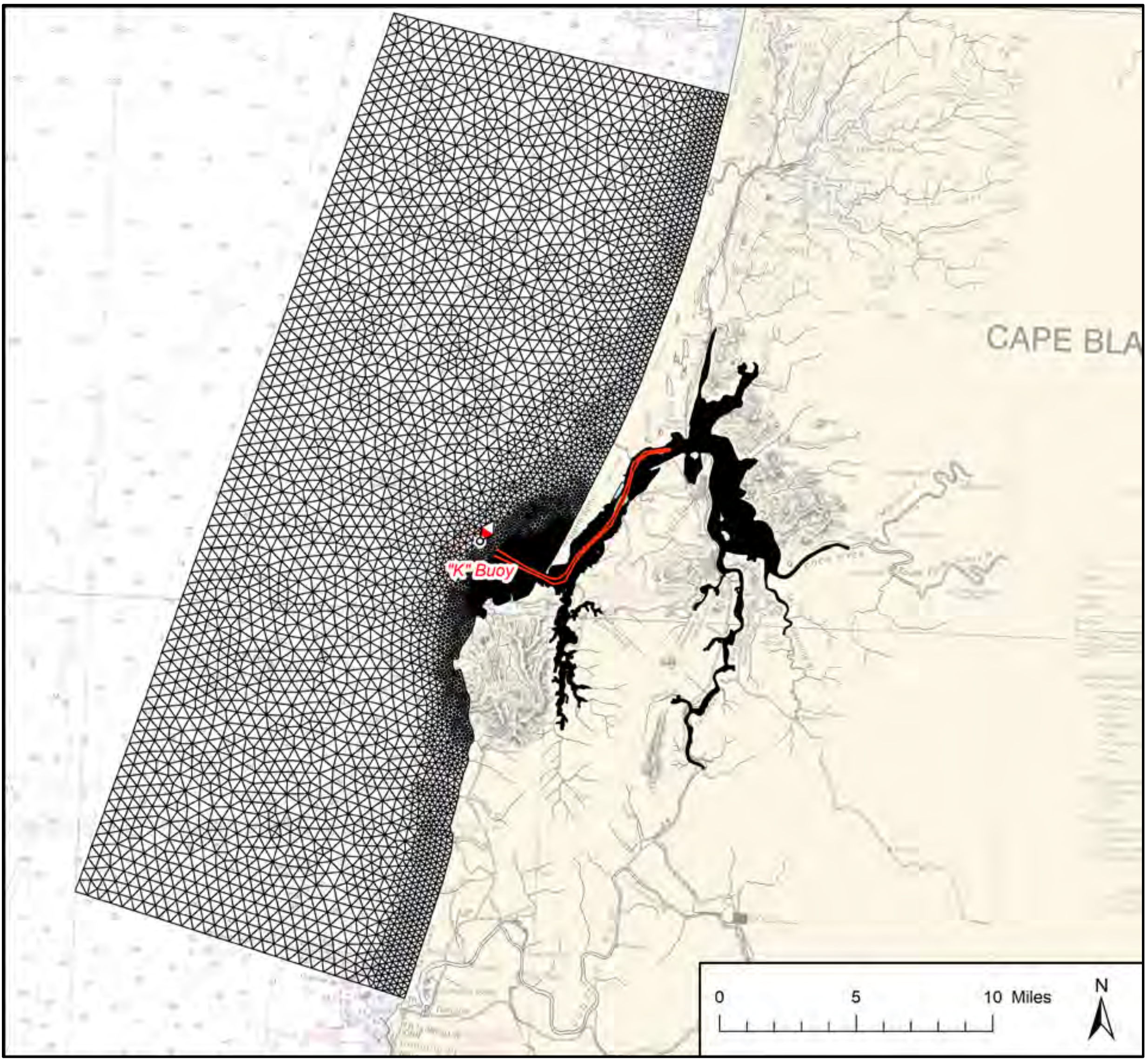
In addition to the vessels in motion during the simulations, a moored vessel was included at the container facility at the berth that was not being evaluated in each simulation. This moored vessel was included in the scene to provide a realistic representation of the maneuvering space available for the transiting vessel. The moored vessels were a visual representation and did not include hydrodynamic interaction forces with the transiting vessel. The moored vessel was the same containership model as the transiting vessel for each simulation.

2.3 ENVIRONMENTAL CONDITIONS

Environmental conditions considered in the simulations were tides, currents, waves, and winds. All environmental conditions used were based on the conditions previously evaluated during the navigation simulations in 2016 and 2017. Night-time and low visibility transits were not performed.

The tides, currents, and waves were generated using a fully integrated hydrodynamic model built by M&N for the Coos Bay Channel Modification Project. This model used the MIKE-21 flexible mesh modeling suite. The hydrodynamic model was re-run with the WOP (existing channel with the Panamax turning basin) and the 2017 PA channel and with the LNG facility and associated slip removed. The hydrodynamic modeling domain is shown in Figure 2-5.

Figure 2-5. Modeling Domain for the Hydrodynamic Model with the 2017 Proposed Alteration Channel



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2.4 TIDE AND CURRENT FIELDS

A full transit—inbound or outbound—takes approximately 1.5 hours to the planned container facility and 2.0 hours to Roseburg Chip Facility. Based on this duration, tides and tidal currents vary throughout the transit time. As a result, time and space varying tidal currents were included in the simulator to account for these effects.

In Coos Bay slack water at the jetty entrance typically occurs about 47 minutes after high water (end of flood tide) and approximately 40 minutes after low water (end of ebb tide). The currently preferred operation for incoming and outgoing vessels is to start their transit at or before high tide, so that the entrance is reached at slack tide or a reduced ebb tide. The local pilots report avoiding transiting the entrance turn outbound with deep draft vessels during a fully developed ebb tide whenever possible. A 24-hour period from the calibrated model representing the spring tide was extracted. Example time series are shown in

Figure 2-6, Figure 2-7, and Figure 2-8 at varying locations along the transit. From this time series representative times were chosen to simulate the desired condition.

The Pilots report that a cross current, normally running from north to south, forms at the tip of the North Jetty and can cause difficult navigation into the channel. For each simulated condition, the corresponding wind was modeled in the MIKE21 hydrodynamic model. For certain tides stages this results in the cross current developing (aligned with wind direction) with magnitudes of approximately 0.5 – 1.0 knots.

The tide level was held constant for each simulation at the minimum water level based on the minimum expected water level based on scenario being evaluated. The specific water level for each run is listed in the testing matrix in Section 3.4.

Figure 2-6. Time Series of Tide and Tidal Currents for the 2017 PA Channel at the Entrance Turn

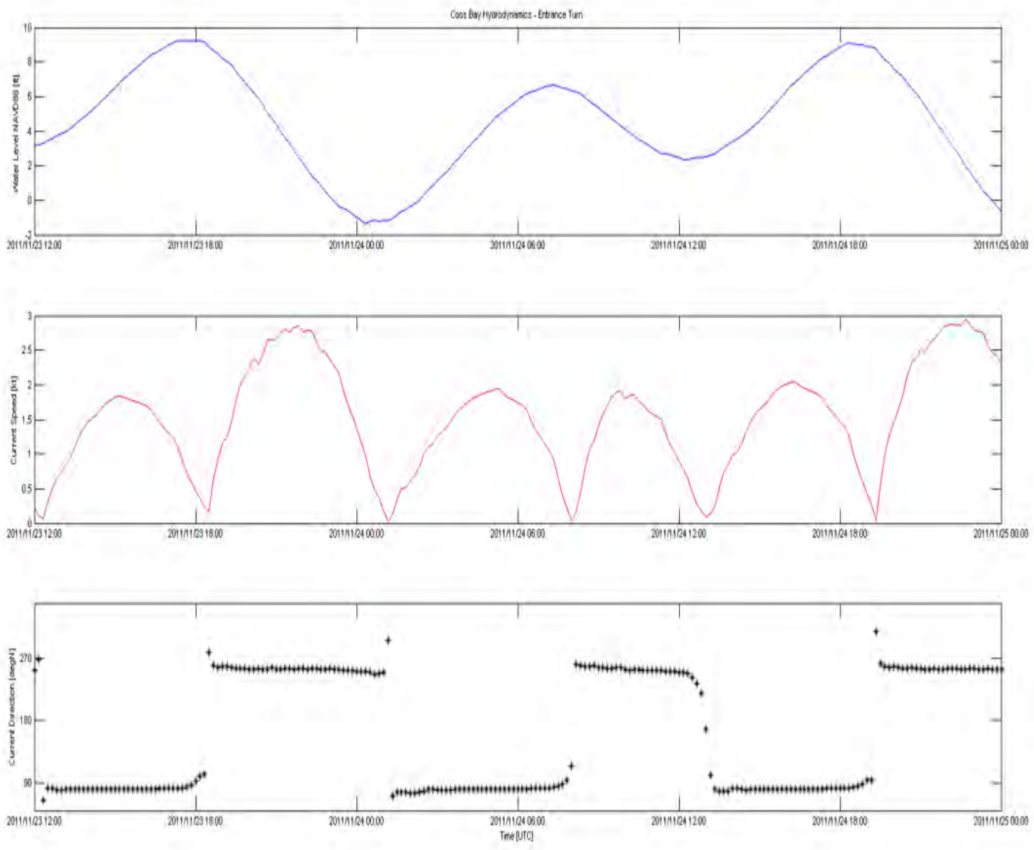


Figure 2-7. Time Series of Tide and Tidal Currents for the 2017 PA Channel at the Container Facility

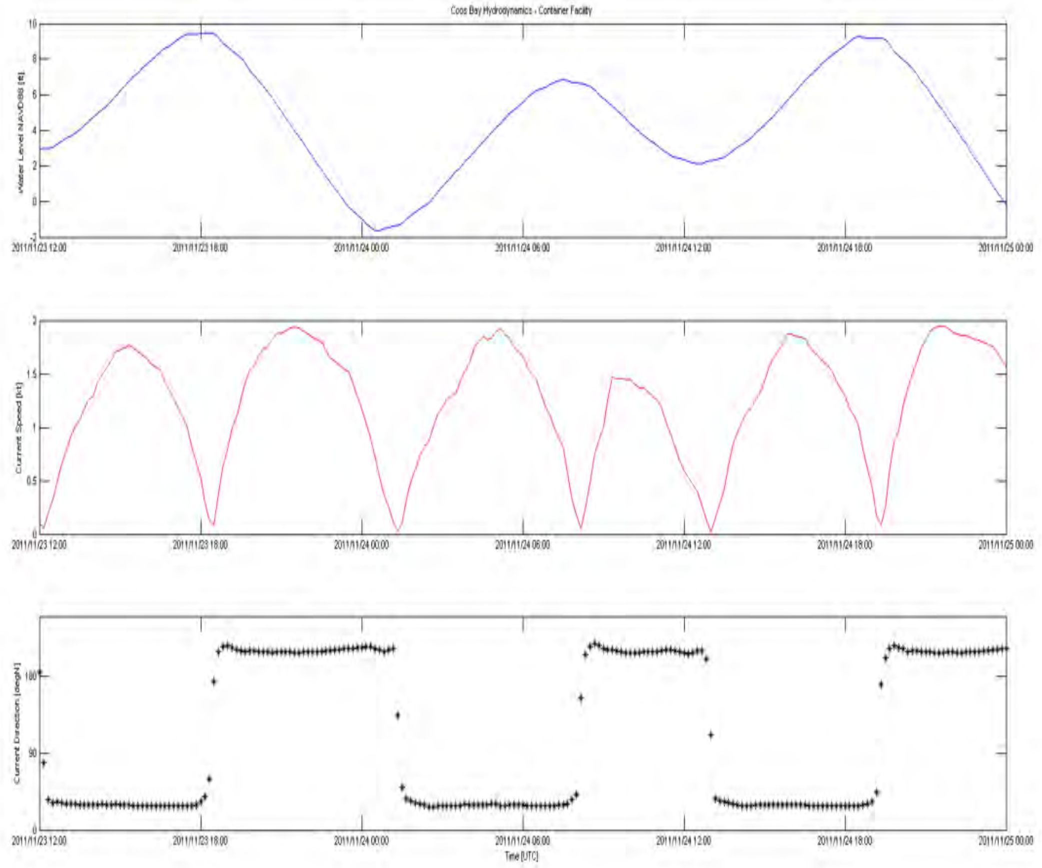
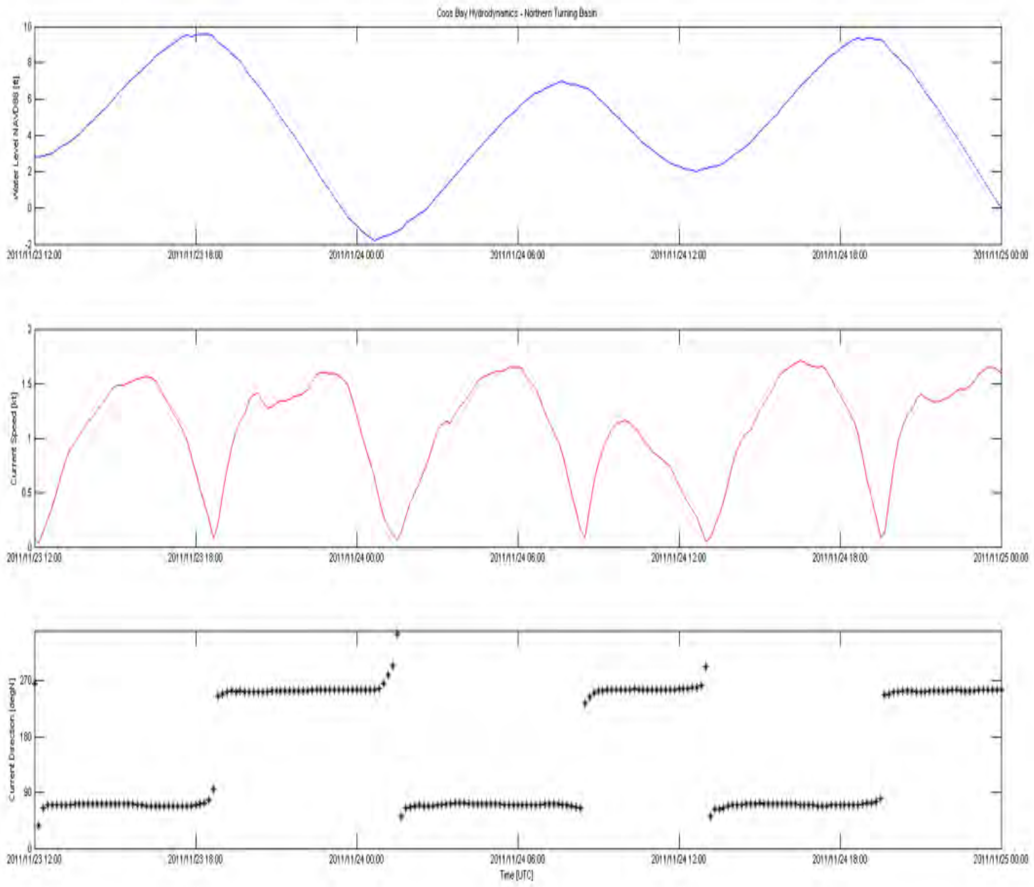


Figure 2-8. Time Series of Tide and Tidal Currents for the 2017 PA Channel at Turning Basin



2.5 WAVE FIELDS

Waves in the vicinity of Coos Bay are generally from the west and northwest. The highest waves in the area are from the southwest. However, these occur relatively infrequently, and the entrance to the Coos Bay Navigation Channel is sheltered from southwesterly waves by the bluffs at Cape Arago. As a result, SW storm waves typically do not directly affect navigation in the entrance channel and were not included in the simulation study.

The most representative wave buoy is at Port Orford, approximately 20 miles south of Coos Bay. Figure 2-9 shows wave height and wave period roses for this buoy. Port Orford was selected as it has the longest period of record and was in naturally deep water.

Shorter-period waves are generally smaller and more northerly, while longer-period waves are generally larger and from directly offshore (west to northwest). Figure 2-10 shows wave roses for four different period ranges. The offshore wave conditions used in the simulator are given in Table 2-4.

The selected waves reflect relatively common offshore wave conditions in the most common frequency bands. Wave conditions included in the simulator were based on waves generated from a JONSWAP (Joint

North Sea Wave Project) spectrum and therefore had spectral variability in wave height and period. To account for the attenuation of the offshore wave as it progresses toward shore, a number of wave condition zones were created to represent the decreasing wave height from offshore to nearshore. Appendix B provides a visual representation of the wave fields. The simulator operator adjusted the wave conditions according to the zones as the vessel proceeded through the jetties.

Figure 2-9. Wave Height and Wave Period Roses based on Port Orford Gauge (2007 – 2015)

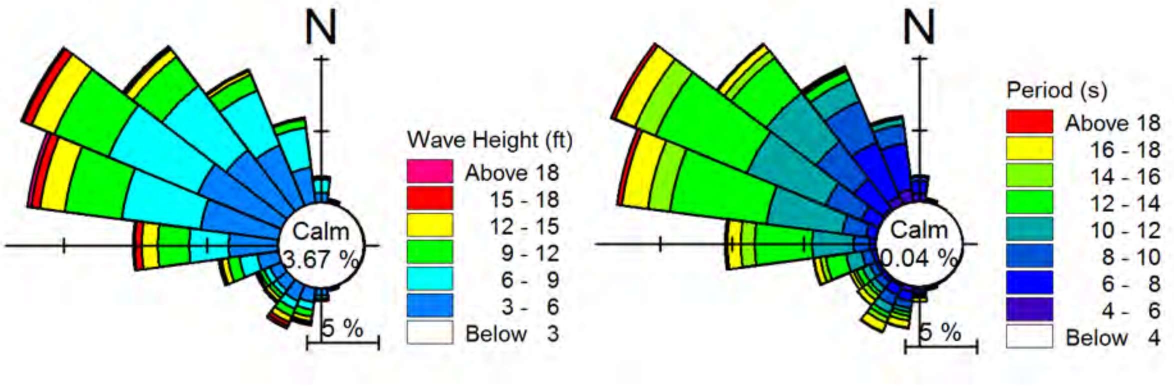


Figure 2-10. Wave Period Histogram with Wave Roses for Each Range of Wave Periods, Port Orford Gauge (2007 – 2015)

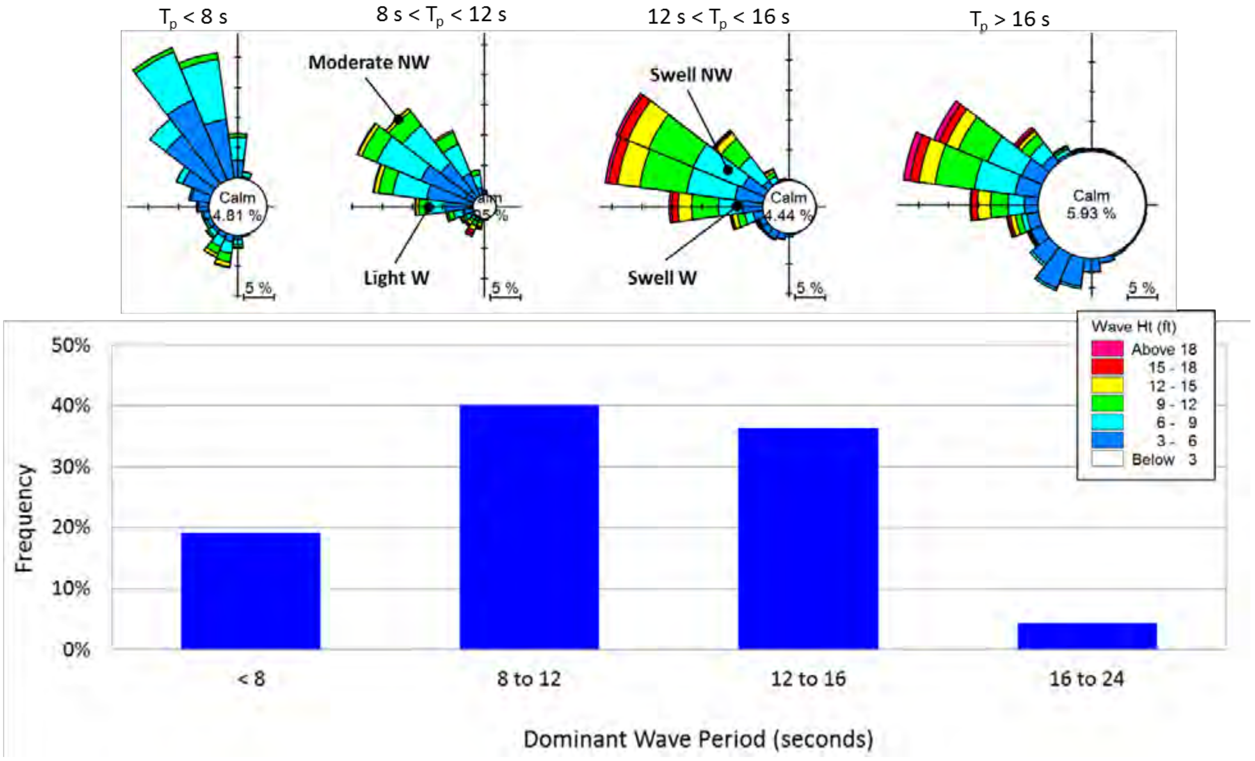


Table 2-4. Deepwater Wave Conditions Used in Ship Simulation

Wave Condition	Deepwater Waves			Comment
	Significant Wave Height (ft)	Peak Period (s)	Mean Wave Direction (deg)	
Moderate, NW	9.0	12	320	Significant wave-induced motion (10 to 12 ft possible offshore), but little wave penetration into jettied entrance.
Swell, NW	7.0	15	305	Significant wave motion possible due to long wave period, despite relatively small wave height.
Swell, W	6.0	15	275	Swell waves can penetrate well into the jettied entrance and cause significant wave motion further upstream.

2.6 WIND FIELDS

Long-term wind measurements are available at two locations, marked in Figure 2-11: Cape Arago and North Bend. Winds in the Coos Bay area are typically bidirectional, with strong northerly and southerly components. The winds tend to be more northerly in the summer and more southerly in the winter. Figure 2-12 and Figure 2-13 show seasonal wind roses for the two long-term anemometers. Based on these wind roses, winds from the northern quadrant are slightly stronger at North Bend, while winds from the southern quadrant are significantly stronger at Cape Arago. Table 2-5 gives typical to high wind conditions (not extreme storms) at the two locations. In a conversation with the Coos Bay Pilots, they stated that the south winds drop inside the jetties since the bluff to the south provides shielding.

As recommended by USACE, the winds were selected based on typical to high wind conditions when a pilot would consider bringing a vessel into port or taking a vessel from the berth to sea (excluding extreme storms) at the two anemometer locations in the area: Cape Arago and North Bend. Based on these anemometers, winds from the northern quadrant have similar speeds throughout the channel, while winds from the south have higher speeds offshore. This is consistent with pilots' observation that the south winds decrease near the jetties because the bluff at Cape Arago provides shielding.

Based on these observations, the following assignment of winds along the channel has been made:

- Outside the jetty tips at RM 1.0: winds match the Cape Arago conditions.
- Upstream of RM 1.0: winds match the North Bend conditions.
- Specific assignments are presented in Table 2-6. Wings were included in the simulator as sustained winds.

Figure 2-11. Long-term Wind Measurement Anemometer Stations

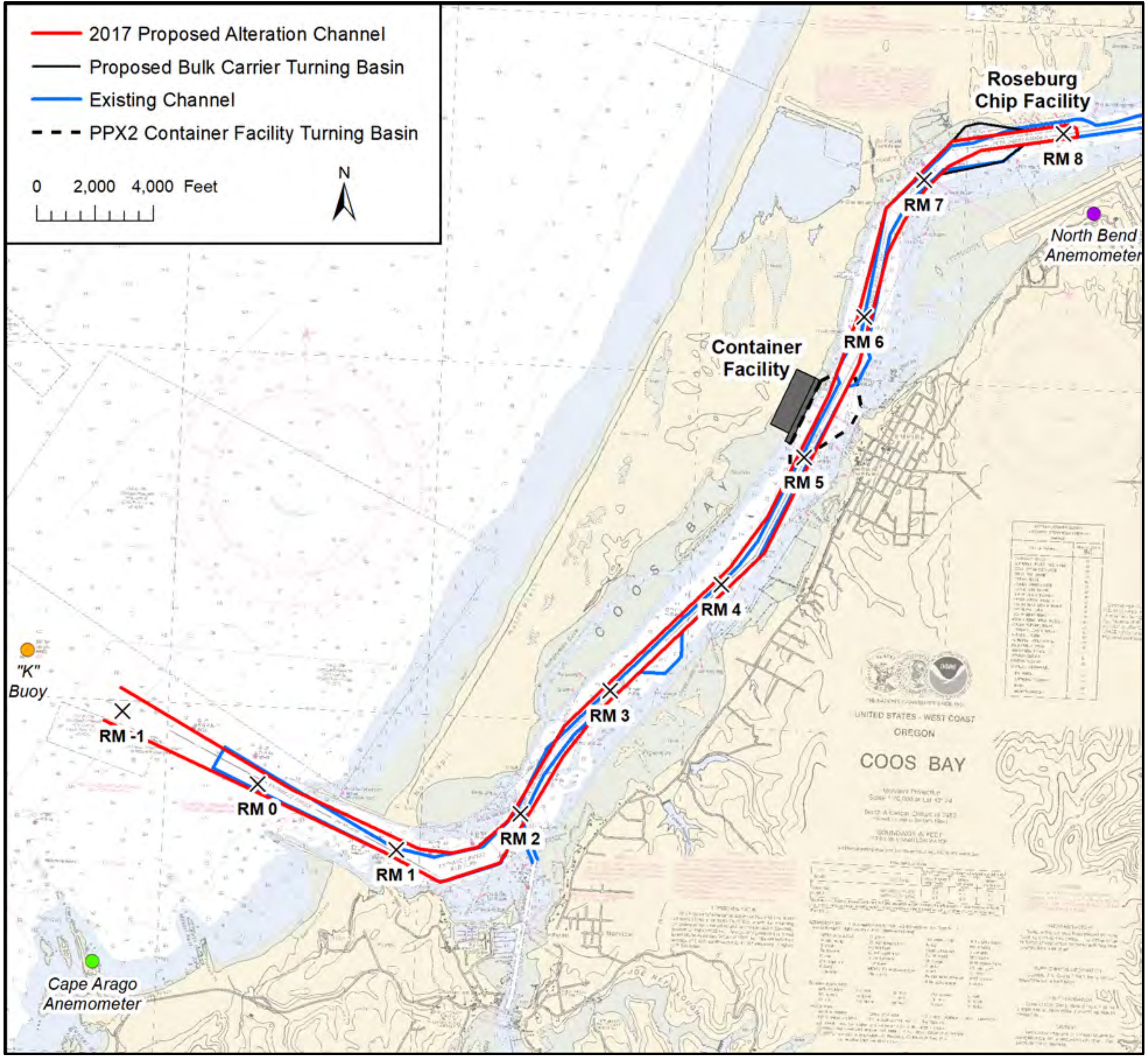


Figure 2-12. Seasonal Wind Roses at Cape Arago (Left Panel) and North Bend (Right Panel), Summer (June through August) for Hourly Mean

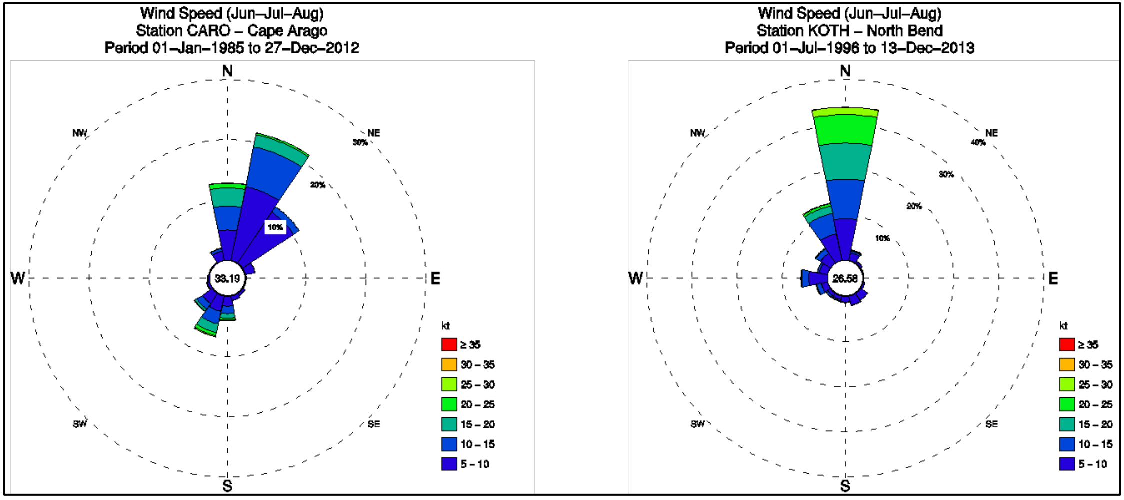


Figure 2-13. Seasonal Wind Roses at Cape Arago (Left Panel) and North Bend (Right Panel), Winter (December through January) for Hourly Mean

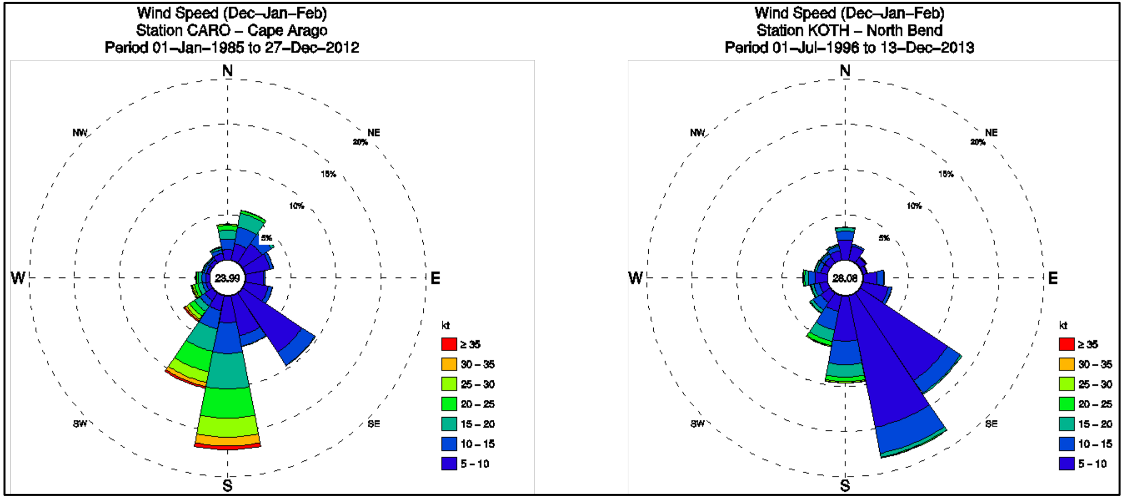


Table 2-5. Typical Wind Conditions at Long-Term Anemometers (hourly mean)

Wind Condition (General Range)	Anemometer Location	
	Cape Arago	North Bend
Typical summer wind	10-15 knots, N to NNE	15-20 knots, NNW to N
High summer wind	20 knots, N	25 knots, N
Typical winter wind	15-20 knots, SW to S	5-10 knots, S to SE
High winter wind	30 knots, SW to S	20 knots, SW to S

Table 2-6. Wind Conditions Used for Ship Simulation

Wind Condition (For Modeling)	Sustained Wind at Location	
	Offshore from RM 1.0	Upstream of RM 1.0
N25a. NNW wind, high summer wind	25 knots, NNW	25 knots, NNW
N25b. NNE wind, high summer condition	25 knots, NNE	25 knots, NNE
S30. SSW wind, high winter condition	30 knots, SSW	20 knots, SSW
Note: The winds given here are the average one-hour sustained winds for conditions when the pilots might normally consider crossing the bar.		

3. BASIS OF MANEUVERS

The maneuvers identified for this simulation effort were based on the 2016 & 2017 FSS maneuvers and the M&N 2022 desktop screening simulations performed for the planned CF. These simulations were targeted to determine the design vessel for the previously verified 2017 PA channel and existing federal channel.

The starting position of each exercise, speed of transit, and utilization of tugs were specified by the Coos Bay Pilot for each simulation.

3.1 SIMULATOR

The simulations were performed on M&N's traveling simulator which was located in Coos Bay, OR at the OIPCB's office. M&N's traveling simulator consists of an operator console and a pilot console. The local Coos Bay Pilot sat at the pilot console and was responsible for conning the simulations (no separate helmsman). The simulator operator (an M&N engineer) supervised the simulation (e.g., controlling environmental conditions, setting up the scenarios for testing, etc.) and operated the tugs as instructed by the pilot. For these simulations, the tugs were controlled by basic commands from the simulation operator (where to connect, how hard to pull, etc.).

3.2 SIMULATOR SOFTWARE

The vessel simulations described herein were conducted using the navigation simulation software Wärtsilä Navi-Trainer Profession (NTPro) 5000. For this simulation effort Version 5.4 was used.

NTPro is a vessel maneuvering software used to assess the static and dynamic forces that act on a vessel during complex maneuvers in a variety of environments, including shallow water maneuvering. Features of the model include full six-degrees-of-freedom vessel hydrodynamics, three-dimensional harbor area representation, explicit tug model behavior, vessel response to: wind, waves, currents, bathymetry, vessel-structure, and vessel-vessel interaction. Vessels are discretized to allow for force shadowing and differentiation along the ship. Ship models used in the simulators are developed and verified with data from basin tests and real-world collection schemes.

3.2.1 Visual Database

The scene for this study was based on the existing visual database of Coos Bay from the previous full mission bridge simulations. This scene was customized by M&N to include the 2017 PA Channel and the planned container facility.

3.3 SHIP HANDLERS

Ship handling for this study was performed by the local Coos Bay pilots, Captain George Wales, Captain Steven Woods, and Captain Tim Petrusha from January 12th to 15th, 2023.

3.4 TESTING MATRIX

Table 3-1 shows the matrix of the completed simulations. This matrix was based upon the test matrix included in the initial plan and modified based upon ship handler input. All changes to matrix received concurrence from the simulation observers. In total, 31 simulations were conducted to evaluate the future without project and the 2017 proposed alteration channel. The pilot used for each run is listed in Table 3-1.

Table 3-1. Simulation Matrix.

Run ID	Channel	Own Ship (1)	Moored Vessel	Direction	Turn Performed	Turning Basin Used	Tug Power (mt)	Wind (4) Offshore/Upstream	Waves	Tide Level(6) (ft/m)	Tide Stage	Start	End	Pilot	Run Result
1-3	*Pilot Familiarization*														
4	2017 PA	PPX2	--	Inbound	No	--	80 / 80 / 50	10kt NNE (22.5°)/10kt NNE (22.5°)	Swell NW	4.5/1.4	Flood (01:20)	RM -2	Entrance Turn	S. Woods	🔴
5	2017 PA	PPX2	--	Inbound	No	--	80 / 80/ 50	10kt NNE (22.5°)/10kt NNE (22.5°)	Swell NW	4.5/1.4	Flood (01:20)	RM -2	Entrance Turn	T. Petrusha	🔴
6	2017 PA	PPX2	--	Inbound	No	--	80 / 80/ 50	25kt NNE (22.5°)/25kt NNE (22.5°)	Swell NW	4.5/1.4	Flood (01:20)	RM -2	CF Turning Basin	S. Woods	🟢
7	2017 PA	PPX2	PPX2, CFS	Inbound	No	--	80 / 80 / 50	25kt NNW (337.5°)/25kt NNW (337.5°)	Moderate NW	4.5/1.4	Flood (01:20)	RM -2	G"13"	T. Petrusha	🔴
8	2017 PA	PPX2	PPX2, CFS	Outbound	Yes	CF Turning Basin	80 / 80 / 50	25kt NNW (337.5°)/25kt NNW (337.5°)	Moderate NW	6.75/2.1	High Slack (06:20)	CFS	RM -1	S. Woods	🟢
9	WOP	PNMX	PNMX, CFN	Inbound	Yes	CF Turning Basin	80 / 80 / 50	25kt NNE (22.5°)/25kt NNE 22.5°)	Swell NW	4.5/1.4	Flood (01:20)	RM -2	CFS	S. Woods	🟡
10	2017 PA	Capesize	--	Inbound	Yes	RM 7.0	80 / 80 / 50	25kt NNW (337.5°)/25kt NNW (337.5°)	--	4.5/1.4	Flood (03:00)	CFS	RM 7.0 Turning Basin	T. Petrusha	🟢
11	2017 PA	PPX3	--	Inbound	No	--	80 / 80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	Swell NW	4.5/1.4	Flood (01:20)	RM -2	Entrance Turn	S. Woods	🔴
12	2017 PA	PPX3	--	Inbound	No	--	80 / 80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	Swell NW	4.5/1.4	Flood (01:20)	RM -2	RM 3.0	T. Petrusha	🔴
13	WOP	PNMX	PNMX, CFN	Inbound	Yes	CF Turning Basin	80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Moderate NW	4.5/1.4	Flood (01:20)	RM -2	CFS	S. Woods	🟡
14	WOP	PNMX	PNMX, CFN	Inbound	Yes	CF Turning Basin	80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	Swell W	4.5/1.4	Flood (01:20)	RM -2	RM 3.0	T. Petrusha	🔴
15	WOP	PNMX	PNMX, CFN	Inbound	Yes	CF Turning Basin	80 / 80	20kt SSW (222.5°)/20kt SSW (222.5°)	Swell W	4.5/1.4	Flood (01:20)	RM 0	CFS	T. Petrusha	🟢
16	WOP	PNMX	PNMX, CFS	Inbound	Yes	CF Turning Basin	80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	--	4.5/1.4	Flood (02:00)	Buoy 10 A	CFS	S. Woods	🟢
17	WOP	PNMX	PNMX, CFS	Outbound	Yes	CF Turning Basin	80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Moderate NW	6.75/2.1	High Slack (06:20)	CFS	RM 0	S. Woods	🟢
18	WOP	PNMX	PNMX, CFN	Outbound	Yes	CF Turning Basin	80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	Swell W	6.75/2.1	High Slack (05:20)	CFS	RM 0	T. Petrusha	🟡
19	WOP	PNMX	PNMX, CFN	Inbound	Yes	RM 7.0	80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	--	4.5/1.4	Flood (02:20)	CFS	RM 7.0	T. Petrusha	🟢
20	WOP	PNMX	PNMX, CFN	Inbound	Yes	RM 7.0	80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	--	4.5/1.4	Flood (02:20)	CFS	RM 7.0	S. Woods	🟡
21	2017 PA	PPX2	PPX2, CFS	Inbound	Yes	CF Turning Basin	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Swell W	4.5/1.4	Flood (01:20)	RM -2	CFS	T. Petrusha	🟡
22	2017 PA	PPX2	--	Inbound	Yes	RM 7.0	80 / 80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	--	4.5/1.4	Flood (02:20)	CFS	RM 7.0	S. Woods	🔴
23	2017 PA	PPX2	--	Inbound	Yes	RM 7.0	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	--	4.5/1.4	Flood (02:20)	CFS	RM 7.0	S. Woods	🟡
24	2017 PA	PPX2	PPX2, CFS	Inbound	No	--	80 / 80 / 80	20kt SSW (222.5°)/20kt SSW (222.5°)	Swell W	4.5/1.4	Flood (01:20)	RM -2	CFS	G. Wales	🟢
25	2017 PA	PPX2	PPX2, CFS	Inbound	No	--	80 / 80 / 80	20kt SSW (222.5°)/20kt SSW (222.5°)	--	4.5/1.4	Flood (01:20)	CFS	CFS	G. Wales	NA
26	2017 PA	PPX2	PPX2, CFS	Inbound	Yes	CF Turning Basin	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	--	4.5/1.4	Flood (02:20)	Buoy 10 A	CFS	G. Wales	NA
27	2017 PA	PPX2	PPX2, CFS	Inbound	Yes	CF Turning Basin	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	--	4.5/1.4	Flood (02:20)	Buoy 10 A	CFS	G. Wales	NA
28	2017 PA	PPX2	--	Inbound	No	--	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	--	4.5/1.4	Flood (01:20)	RM -2	CFS	G. Wales	🟢
29	2017 PA	PPX2	PPX2, CFS	Outbound	Yes	CF Turning Basin	80 / 80 / 80	20kt SSW (222.5°)/20kt SSW (222.5°)	--	4.5/1.4	2 hours before high water (05:20)	CFS	CFS	S. Woods	NA
30	2017 PA	Capesize	--	Inbound	Yes	RM 7.0	80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	--	4.5/1.4	Flood (03:00)	CFS	RM 7.0	S. Woods	🟡
31	2017 PA	PPX2	--	Inbound	Yes	CF Turning Basin	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	--	4.5/1.4	Flood (02:20)	Buoy 10 A	CFS	G. Wales	🟢

Notes:
WOP = Without Project, 2017 PA = 2017 Proposed Alteration, PNMX = Panamax Containership, PPX2 = Post Panamax Generation 2 Containership, PPX3 = Post Panamax Generation 3 Containership, CFN = Container Facility North Berth, CFS = Container Facility South Berth
PNMX = Arthur Edgemore (958 ft x 106 ft); Capesize Chip Ship = Bulk Carrier 19 (837 ft x 141 ft); PPX3 = Kalina (1201 ft x 168 ft)
Winds are direction from, where 0 degrees is North.
Level of tide will not vary in runs. It will be modeled as the minimum required underkeel clearance.

🟢 Success. Run was well controlled with adequate clearance to channel edges and reserve of rudder and tugs.

🟡 Marginal Success. The run was completed without casualty to the vessel or tugs; however, the vessel may of have touched or exceeded channel or turning basin boundaries, came close to contact with an object, or used excessive rudder or tugs, depleting the maneuvering reserve.

🔴 Unsuccessful. Run was stopped or aborted due to exceeding allowable under keel clearance, grounding, loss of control, allision with object or shoals, or collision with another vessel; or vessel exceeded channel boundaries unintentionally.

3.5 EVALUATION CRITERIA

The primary criterion for the success of each run was pilot feedback after each simulation, Appendix C. A key component of the evaluation was the pilot assessment of overall safety and opinions as to whether specific maneuvers would be conducted in real life.

Additional variables used to critique the performance of the runs include, but are not limited to:

- *Clearance to edge of channel*. The minimum clearance to the edge of the channel and moored vessels was evaluated based on the swept path of the vessels. Acceptable clearance was determined through discussion with the Pilots.
- *Reserve engine and rudder*. The engine and rudder used during the simulation was evaluated with the aim of maintaining sufficient reserve for unanticipated maneuvering. Simulations that require sustained hard over rudder were rated as a marginal success run with consideration of the pilot feedback.
- *Reserve tug power*. To ensure sufficient reserve tug power, the tug power was tracked. The average tug power should not exceed 80 percent of full bollard pull and not more than one tug should run at full power simultaneously. Reserve tug power should be available to the pilot when maneuvering. Simulations that required sustained use of full power were rated as a marginal success run with consideration of the pilot feedback.

4. RESULTS & ANALAYSIS

Results for each of the 28 simulation runs are presented below and the overall rating of the run is tabulated in the subsections. For each simulation two plots are presented:

- **Vessel Swept Path***:* These plots were developed to illustrate clearance of the vessel to channel and turning basin limits. The vessel profiles are shown at two-minute intervals.
- **Vessel and Tug Parameter Time Series:** These time series were created to illustrate the vessel's speed over ground (SOG), rudder angle, engine revolutions per minute (RPM), rate of turn (ROT), bow thruster power (when applicable), and tug power.

Pilot feedback was recorded on pilot evaluation forms (Appendix C), along with notes and observations made by the engineers supervising the effort. For each simulation, the pilot was asked to rate the maneuver in three categories: Run Safety, Tug Adequacy, and Run Difficulty. These ratings are discussed in greater detail in the subsections below. Rating scales are as follows:

- Run Safety: 1 to 5 with "5" highest safety and "3" average safety;
- Tug Adequacy: 1 to 5 with "5" best and "3" average; and
- Difficulty: 1 to 5 with "5" most difficult and "3" average.

4.1 PANAMAX CONTAINERSHIP SIMULATIONS

In total 9 simulations were performed in the WOP channel with the Panamax containership evaluating the channel transit, turning evolution in the corresponding turning basin and maneuvering to/from the planned container facility. Of these simulations 7 were inbound and 2 were outbound. Based on discussion with the pilots on their planned timing of the inbound maneuver to the container facility, one tidal current condition was evaluated during a flood current. The outbound simulations also only evaluated a single current based on the pilot feedback.

The pilot safety, run difficulty, and tug adequacy ratings for all the Panamax containership simulations are summarized in Table 4-1. Note that three different pilots performed these simulations and performance ratings are subjective to each individual pilot. On average the inbound and outbound transits were rated as above average safety and tug adequacy and below average run difficulty.

Table 4-1. Panamax Containership Pilot Ratings for Safety, Difficulty, & Tug Adequacy

Run ID	Pilot	Run Safety	Tug Adequacy	Run Difficulty	Run Result
Inbound Maneuver					
9	S. Woods	5	5	3	🟡
13	S. Woods	5	3	2	🟡
14	T. Petrusha	-	-	-	🔴
15	T. Petrusha	5	5	3	🟢
16	S. Woods	5	5	2	🟢
19	T. Petrusha	5	5	2	🟢
20	S. Woods	5	5	3	🟡
Inbound Avg.	--	5	4.7	2.5	--
Outbound Maneuver					
17	S. Woods	5	5	1	🟢
18	S. Woods	5	5	3	🟡
Outbound Avg.	--	5	5	2	--

4.1.1 Simulation 9 – Panamax Inbound, RM-2 – CFS, WOP, NNE Wind, NW Swell, Flood Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
9	WOP	PNMX	PNMX/CFN	Inbound	Yes / CF Turning Basin	80 / 80/50	25kt NNE (22.5°)	Swell NW	4.5/1.4	Flood Tide (01:20)	RM -2	CFS	S. Woods	🟡

Simulation 9 started at approximately River Mile -2 to assess the Panamax containership transit in the existing federal channel and the turning evolution in the proposed turning basin adjacent to the container facility. The transit was conducted with a flood tidal current with strong NNE winds.

Vessel Swept Path Figure: Figure 4-1**.**

Vessel and Tug Parameter Time Series: Figure 4-2

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected, excluding the turning basin. This simulation accidentally had three assist tugs when it only should have had two tugs available. This mistake was corrected on subsequent runs. The pilot thought that in the turning basin the two bow assist tugs should have been able to combat the currents, but they were not able to. This scenario will be evaluated again in subsequent runs. This simulation was marginally successful due to a departure from the navigation channel adjacent to red Buoy “10” on the green side of the channel. The pilot stated that he started his turn too late to account for the wind and the currents. Safety and tug adequacy were rated “best”. Run difficulty was rated as average difficulty. Throughout the transit there was reserve tug power, sufficient clearance to the moored vessel, and the bow thruster was not used. The pilot would perform this transit in a real-life situation and felt that this scenario could be completed with only two tugs.

Result: A Marginal Success

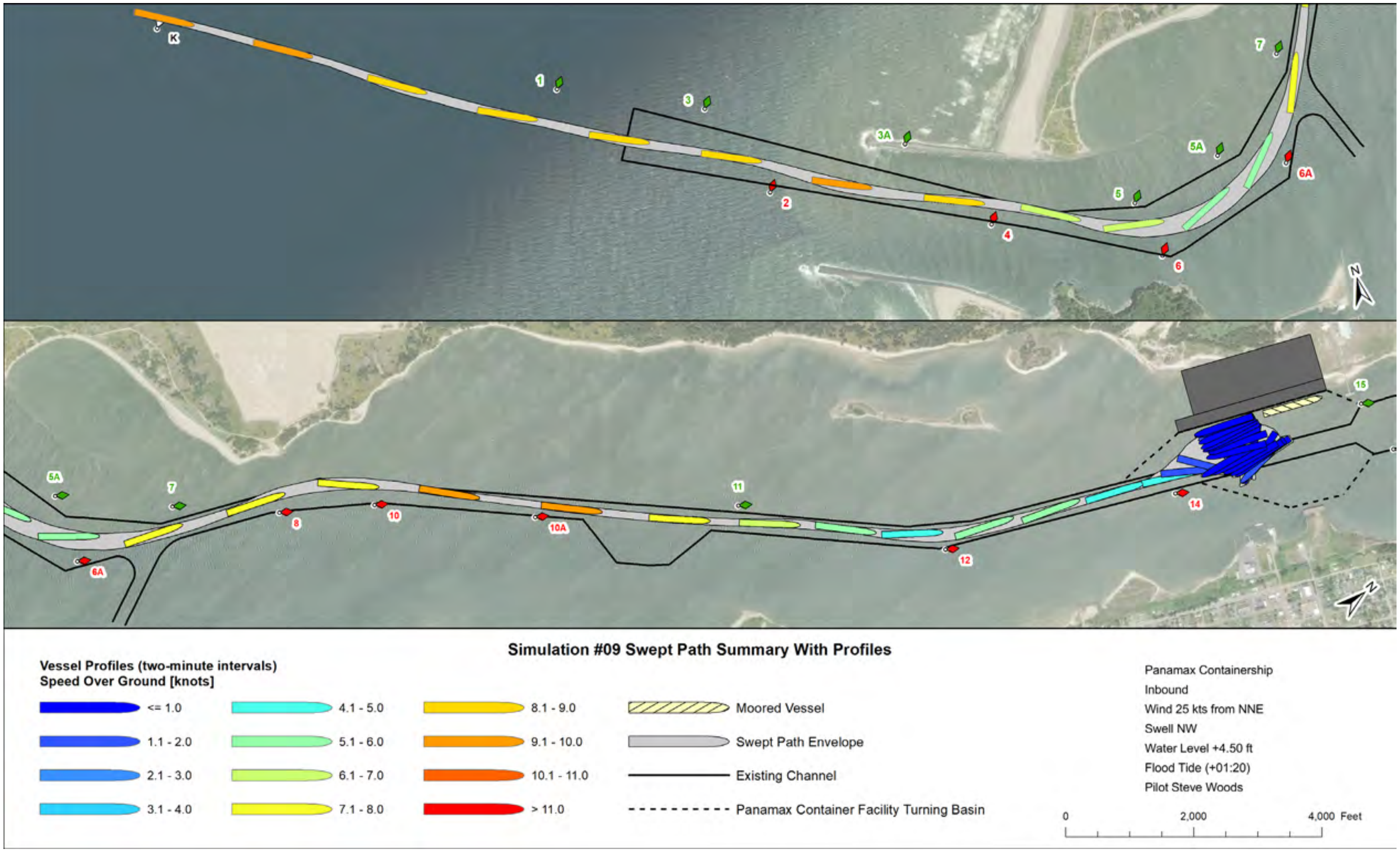


Figure 4-1. Simulation 9 Swept Path Summary with Profiles

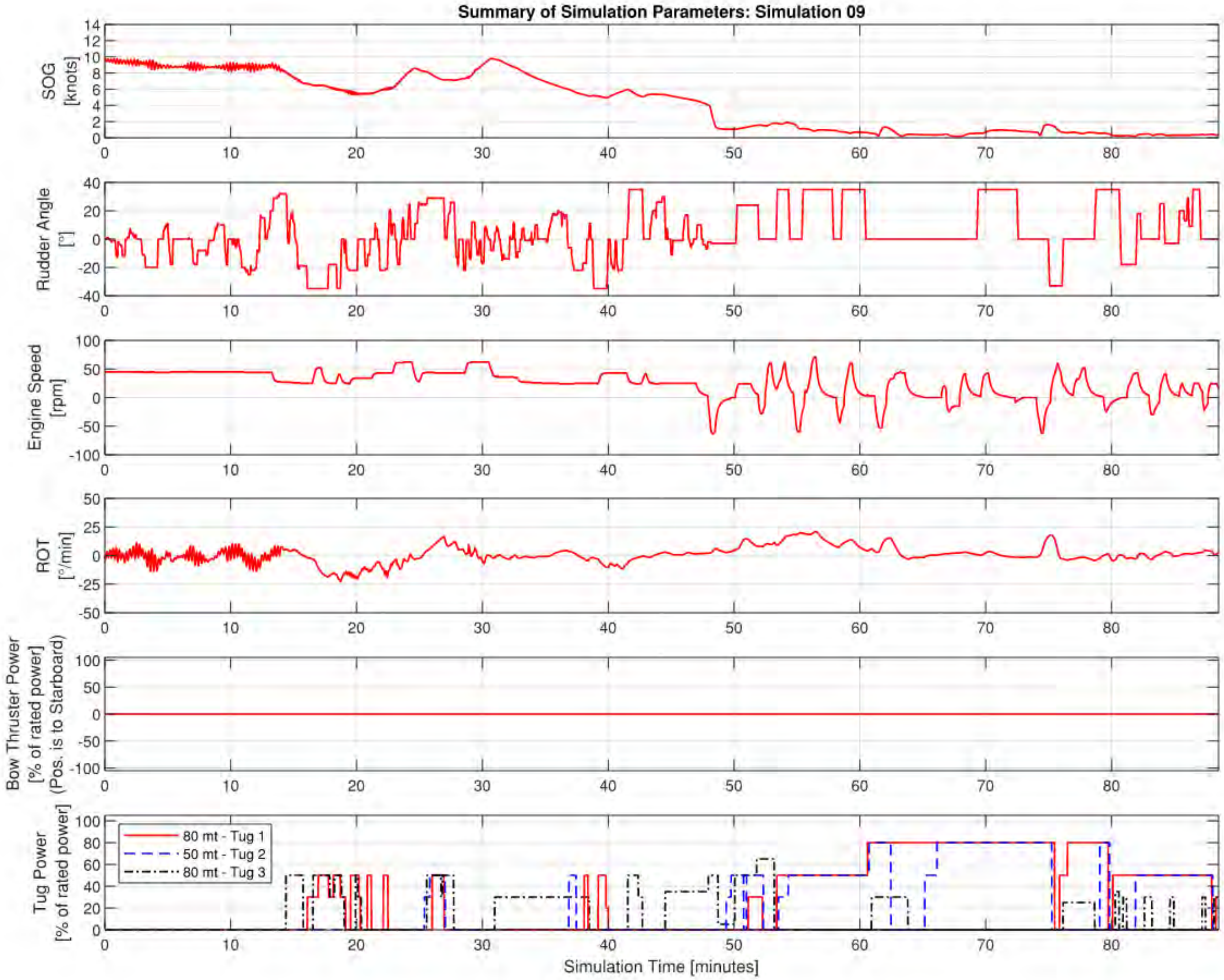


Figure 4-2. Simulation 9 Vessel and Tug Parameter Time Series

4.1.2 Simulation 13 – Panamax Inbound, RM -2 – CFS, WOP, NNW Wind, Moderate NW Waves, Flood Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
13	WOP	PNMX	PNMX/CFN	Inbound	Yes / CF Turning Basin	80 / 80	25kt NNW (337.5°)	Moderate NW	4.5/1.4	Flood Tide (01:20)	RM - 2	CFS	S. Woods	🟡

Simulation 13 started at approximately River Mile -2 to assess the Panamax containership transit in the existing federal channel and the turning evolution in the proposed turning basin adjacent to the container facility. The transit was conducted with a flood tidal current with strong NNW winds.

Vessel Swept Path Figures: Figure 4-3**.**

Vessel and Tug Parameter Time Series: Figure 4-4.

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected. This simulation had three assist tugs available but only two tugs were used. This simulation was marginally successful due to a departure from the navigation channel adjacent to red Buoy “10” on the green side of the channel. Safety was rated “best”. While tug adequacy was rated as average and run difficulty was rated as below average. Throughout the transit there was reserve tug power. During the turning maneuvering in the turning basin the stern of the vessel came within approximately 10 ft of the berth face of the container facility. The pilot would perform this transit in a real-life situation and felt that two assist tugs was sufficient.

Result: Marginal Success

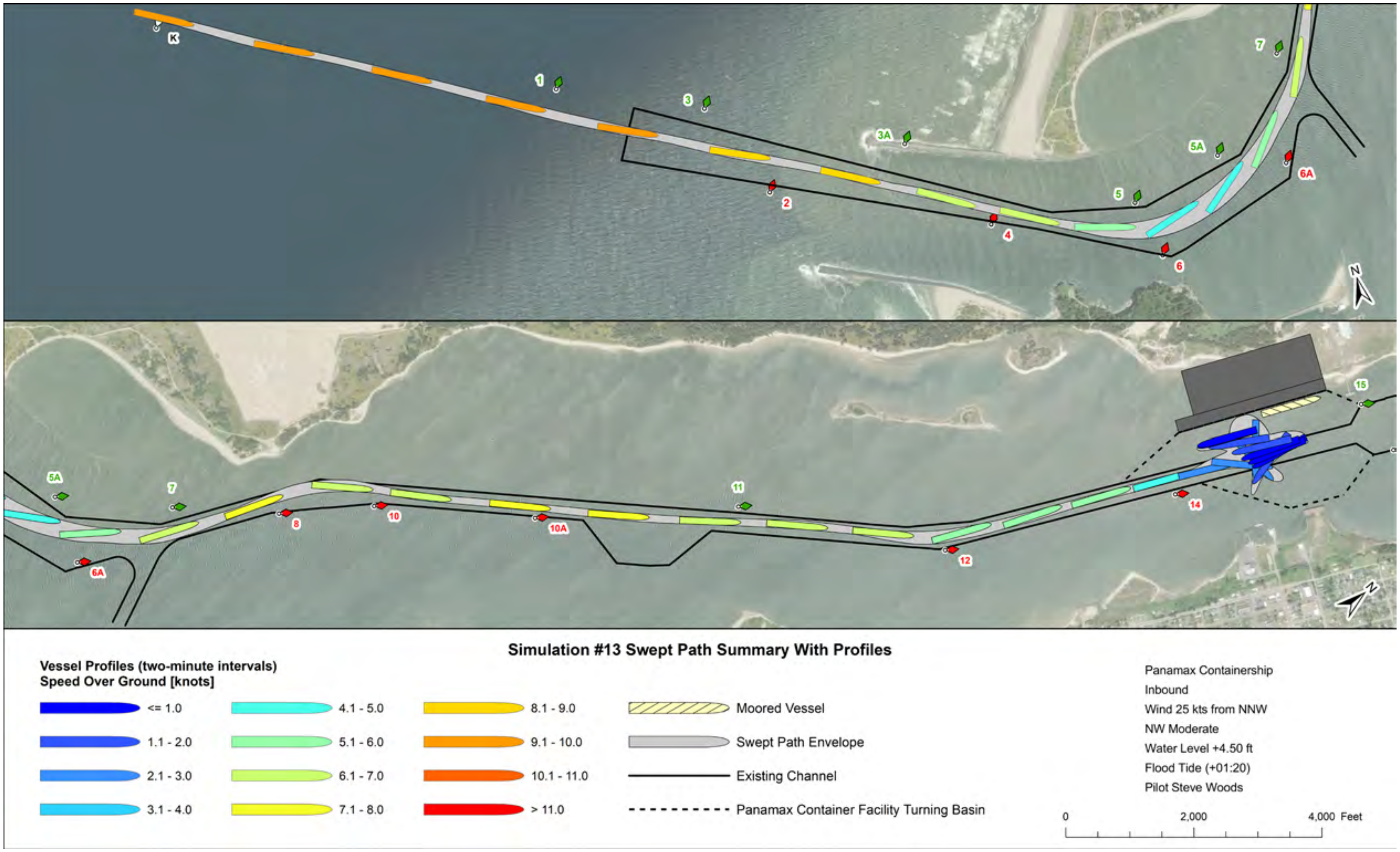


Figure 4-3. Simulation 13 Swept Path Summary with Profiles

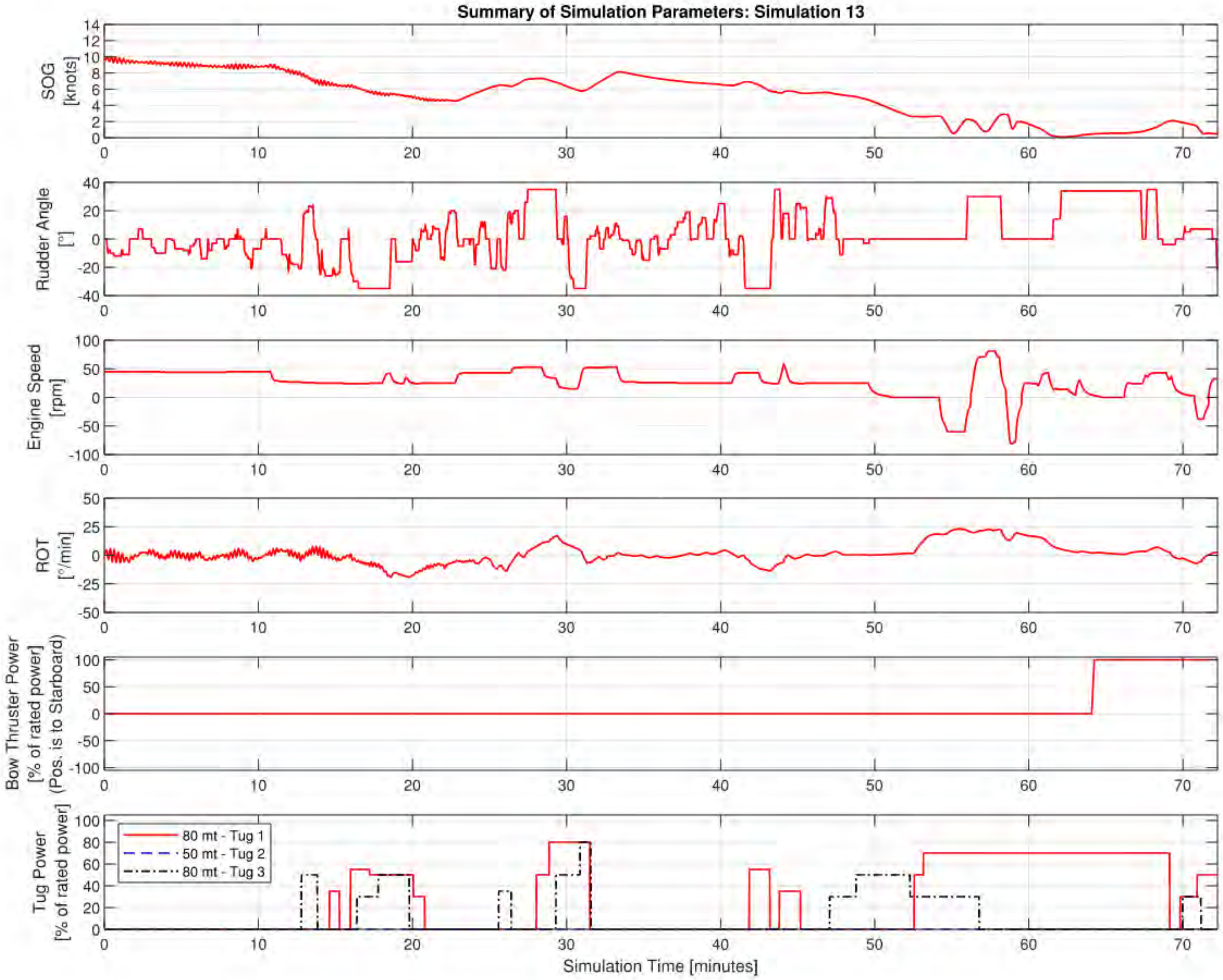


Figure 4-4. Simulation 13 Vessel and Tug Parameter Time Series

4.1.3 Simulation 14 – Panamax Inbound, RM -2 – RM 3, WOP, SSW Wind, W Swell, Flood Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
14	WOP	PNMX	PNMX, CFN	Inbound	No	80 / 80	30kt SSW (222. 5°)/20kt SSW (222.5°)	Swell W	4.5/1.4	Flood (01:20)	RM -2	RM 3	T. Petrusha	🔴

Simulation 14 started at approximately River Mile -2 to assess the Panamax containership transit in the existing federal and ended with a grounding on the green side of the channel adjacent to red buoy “10”. The transit was conducted with a flood tidal current with strong SSW winds.

Vessel Swept Path Figures: Figure 4-5**.**

Vessel and Tug Parameter Time Series: Figure 4-6.

Pilot Comments: Upon grounding the vessel on the green side of the channel adjacent to red buoy “10” the pilot requested to re-run the same scenario in **Simulation 15.**

Result: Unsuccessful

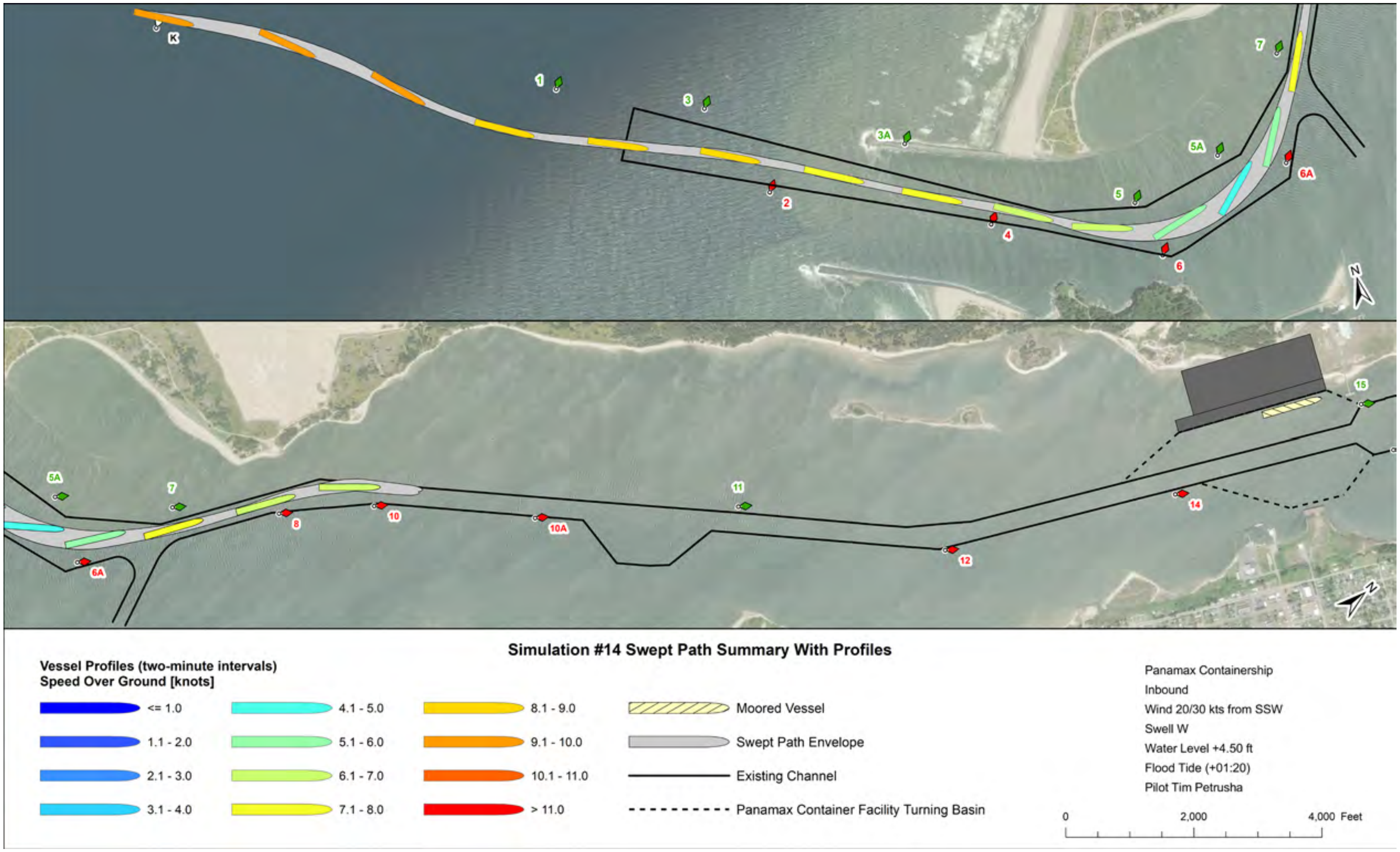


Figure 4-5. Simulation 14 Swept Path Summary with Profiles

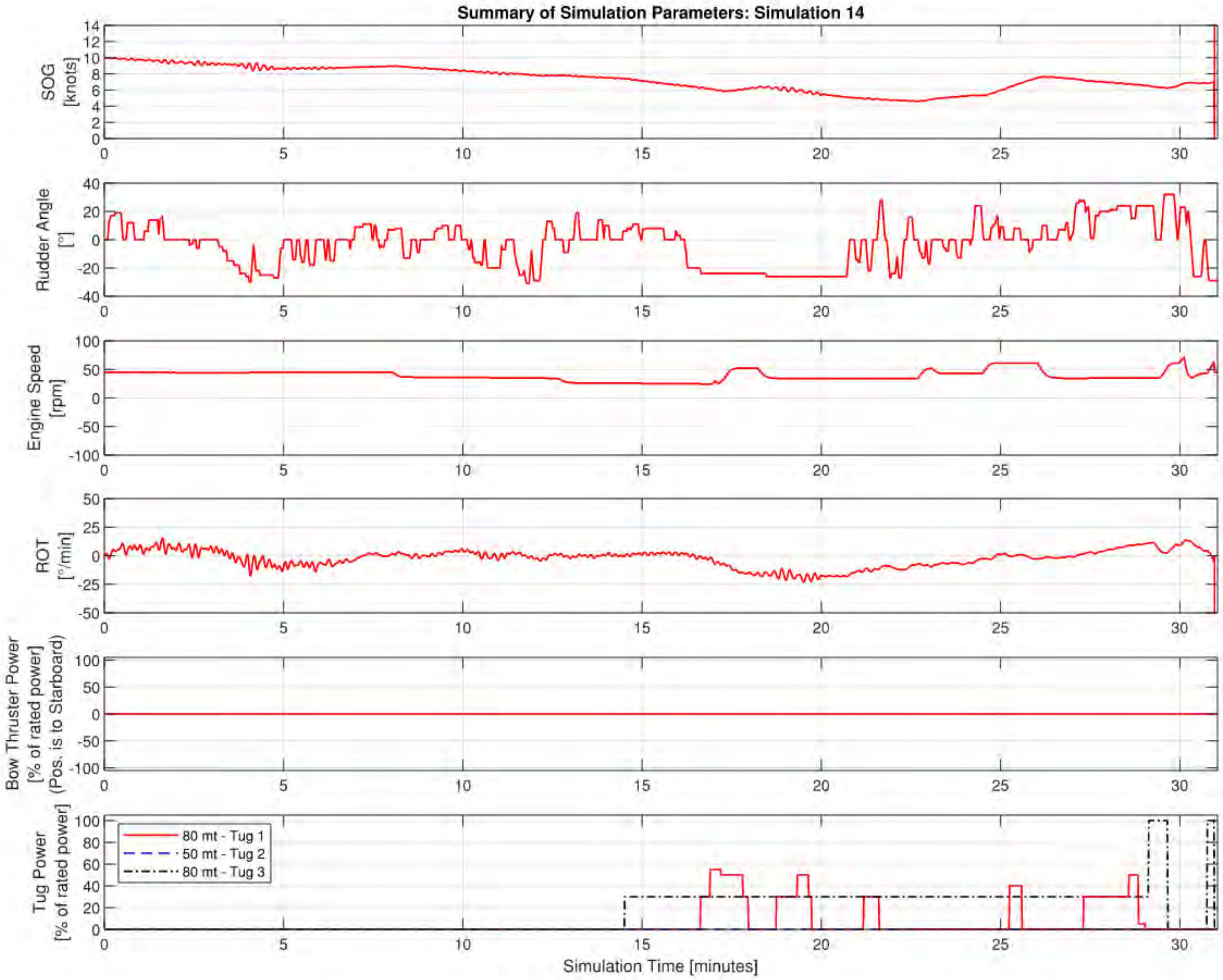


Figure 4-6. Simulation 14 Vessel and Tug Parameter Time Series

4.1.4 Simulation 15 – Panamax Inbound, RM 0 – CFS, WOP, SSW Wind, W Swell, Flood Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
15	WOP	PNMX	PNMX, CFN	Inbound	Yes / CF Turning Basin	80 / 80	20kt SSW (222.5°)	Swell W	4.5/1.4	Flood Tide (01:20)	RM 0	CFS	T. Petrusha	🟢

Simulation 15 started at approximately River Mile 0 to assess the Panamax containership transit in the existing federal channel and the turning evolution in the proposed turning basin adjacent to the container facility. The transit was conducted with a flood tidal current with strong SSW wind.

Vessel Swept Path Figures: Figure 4-7**.**

Vessel and Tug Parameter Time Series: Figure 4-8.

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected. This simulation had three assist tugs available but only two tugs were used. This simulation was successful due to the vessel remaining within the channel boundaries, having sufficient clearance to moored vessels and structures, and had reserve tug power and bow thruster power throughout the simulation. Safety and tug adequacy were rated “best”. While the run difficulty was rated as average. The pilot would perform this transit in a real-life situation and felt that two assist tugs was sufficient.

Result: Run A: Successful

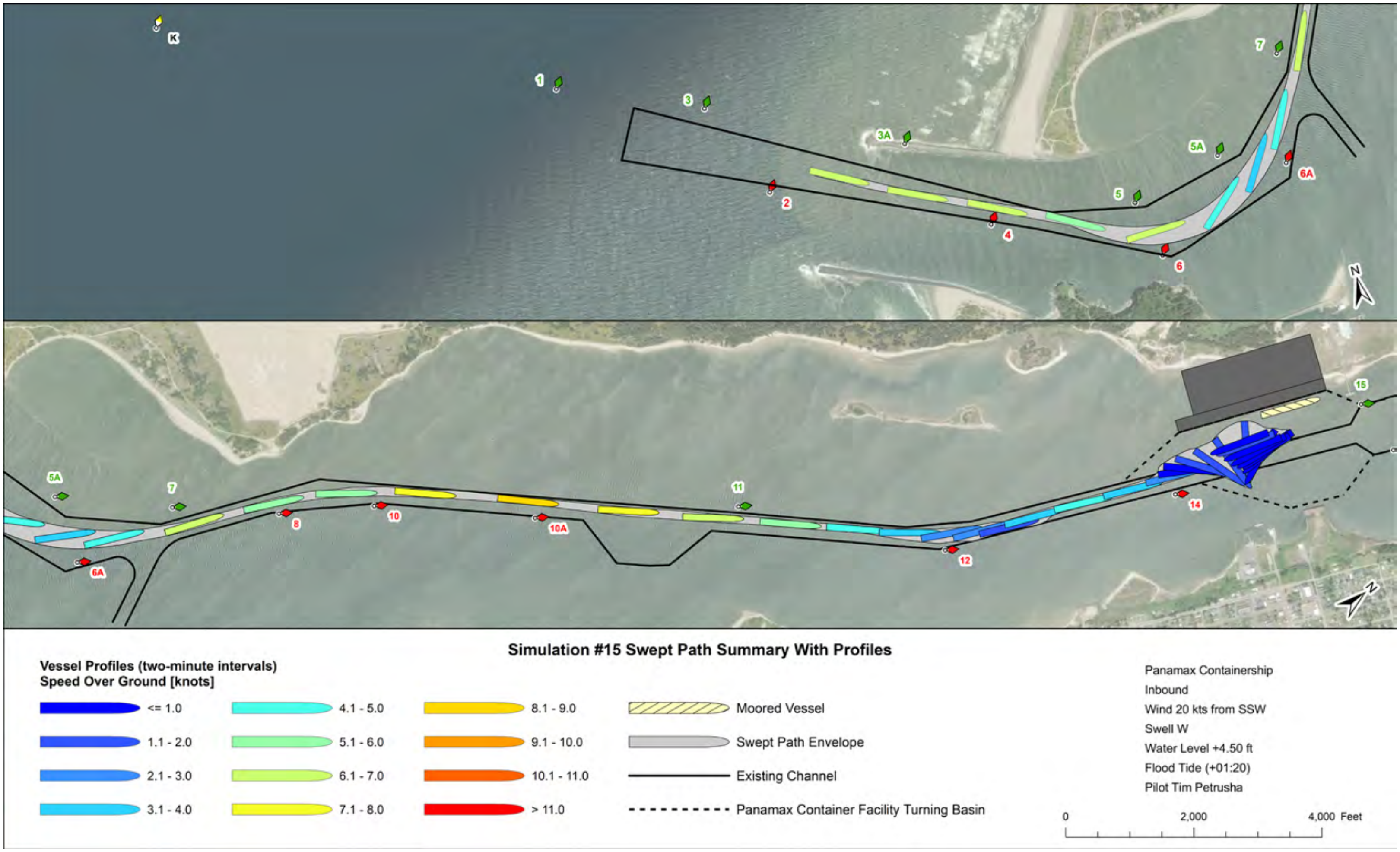


Figure 4-7. Simulation 15 Swept Path Summary with Profiles

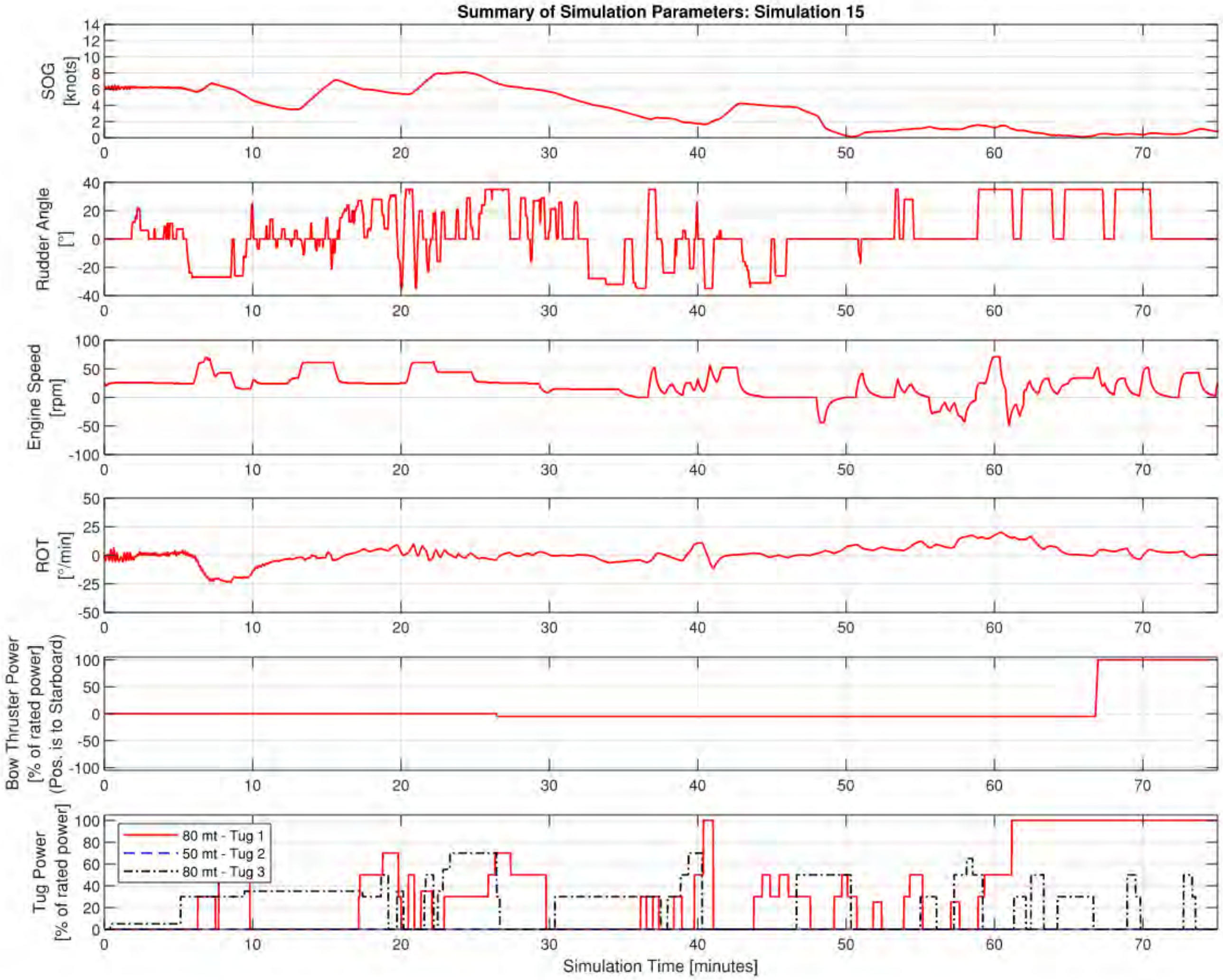


Figure 4-8. Simulation 15 Vessel and Tug Parameter Time Series

4.1.5 Simulation 16 – Panamax Inbound, Buoy 10A – CFS, WOP, NNE Wind, Flood Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
16	WOP	PNMX	PNMX, CFS	Inbound	Yes / CF Turning Basin	80 / 80	25kt NNE (22.5°)	4.5/1.4	Flood Tide (02:00)	Buoy 10A	CFS	S. Woods	🟢

Simulation 16 started at approximately red buoy “10A” to assess the Panamax containership transit to the proposed container facility in the existing federal channel and the turning evolution in the proposed turning basin adjacent to the container facility. The transit was conducted with a flood tidal current with strong NNE winds.

Vessel Swept Path Figures: Figure 4-9

Vessel and Tug Parameter Time Series: Figure 4-10.

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected for the most part. The bow of the vessel was highly affected by the currents in the turning basin. This simulation had three assist tugs available but only two tugs were used. This simulation was successful due to the vessel remaining within the channel boundaries, having sufficient clearance to moored vessels and structures, and had reserve tug power and bow thruster power throughout the simulation. Safety and tug adequacy were rated “best”. While the run difficulty was rated as below average. The pilot would perform this transit in a real-life situation and felt that two assist tugs was sufficient.

Result: Successful

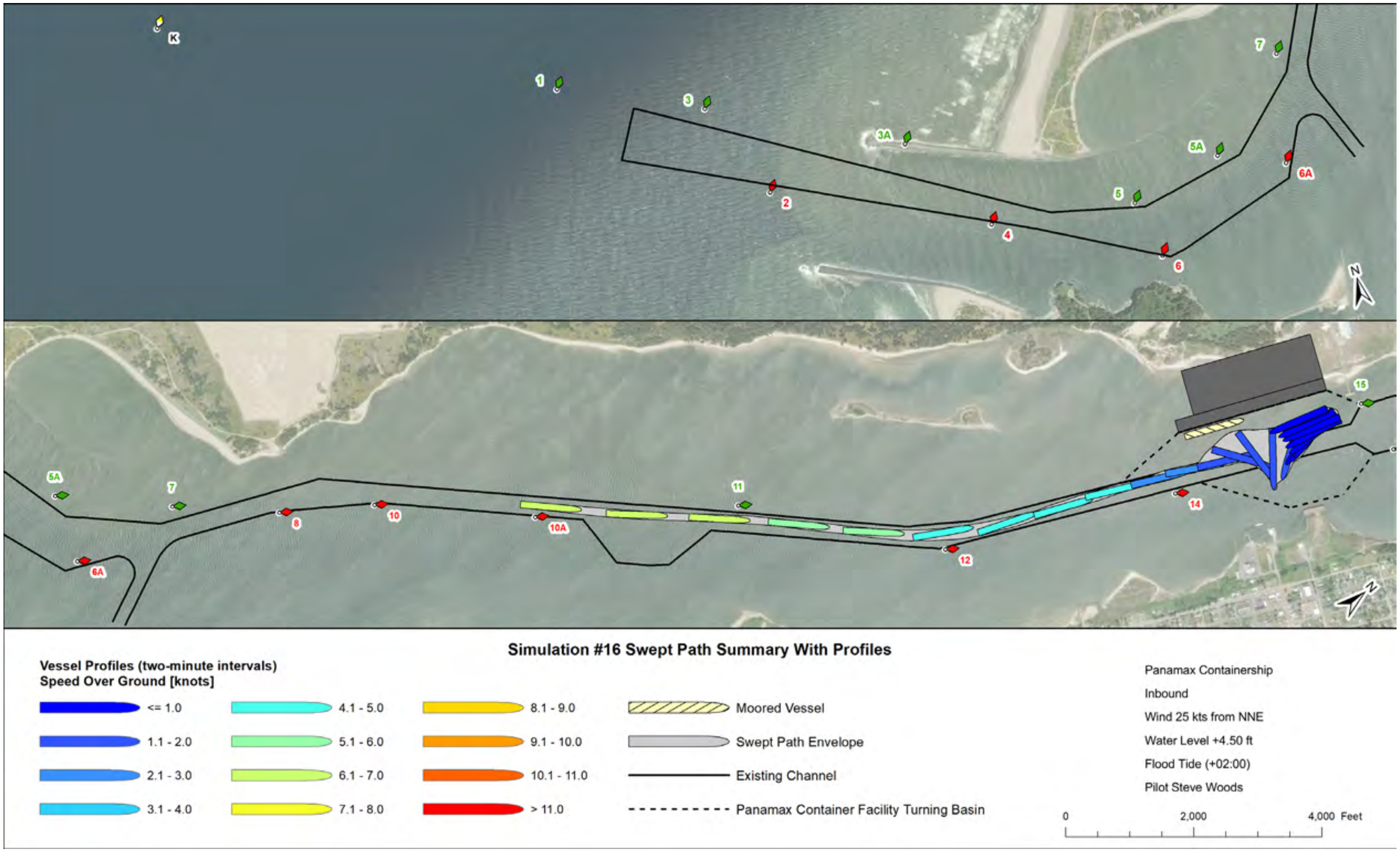


Figure 4-9. Simulation 16 Swept Path Summary with Profiles

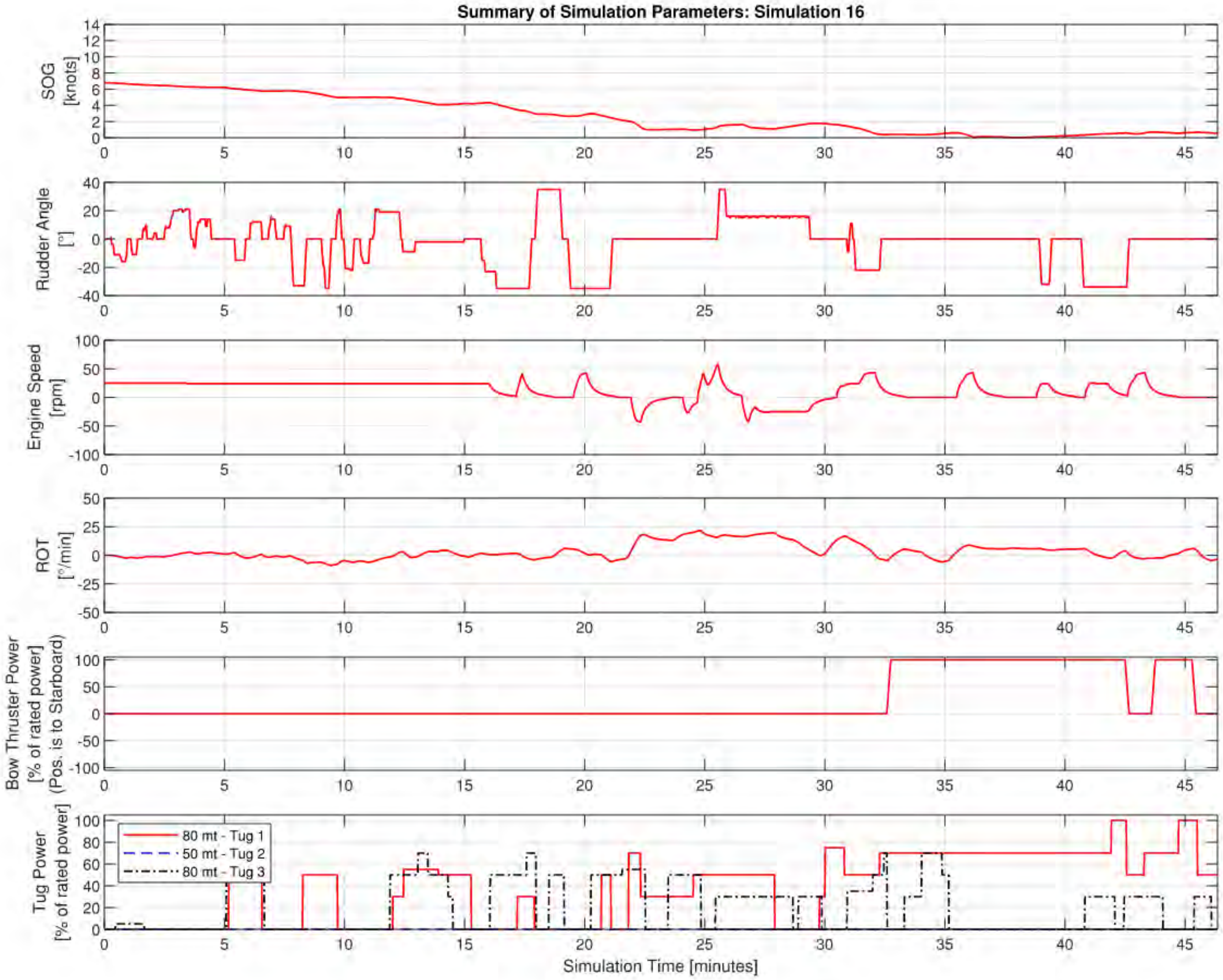


Figure 4-10. Simulation 16 Vessel and Tug Parameter Time Series

4.1.6 Simulation 17 – Panamax Outbound, CFS – RM 0, WOP, NNW Wind, Moderate NW Waves, Ebb Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
17	WOP	PNMX	PNMX, CFS	Outbound	Yes / CF Turning Basin	80 / 80	25kt NNW (337.5°)	Moderate NW	6.75/2.1	High Slack (06:20)	CFS	RM 0	S. Woods	🟢

Simulation 17 was the first outbound simulation with the Panamax containership. This simulation started with the containership departing the north berth at the proposed container facility, performing the turning maneuvering in the turning basin and then transiting the existing navigation channel to approximately green buoy “3.” The transit was conducted with the tidal current corresponding to high slack water at the container facility and strong NNW winds.

Vessel Swept Path Figure: Figure 4-11

Vessel and Tug Parameter Time Serie: Figure 4-12

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected. This simulation had three assist tugs available but only two tugs were used. This simulation was successful as the vessel remained within the channel boundaries, had sufficient clearance to moored vessels and structures, and had reserve tug power and bow thruster power throughout the simulation. Safety and tug adequacy were rated “best”. While the run difficulty was rated as the lowest difficulty. Captain Woods was concerned about a fully developed ebb tide on the bar and therefore requested that in the next outbound simulation we start the currents an hour earlier. The pilot would perform this transit in a real-life situation and felt that two assist tugs was sufficient.

Result: Successful

Figure 4-11: Simulation 17 Swept Path Summary with Profiles

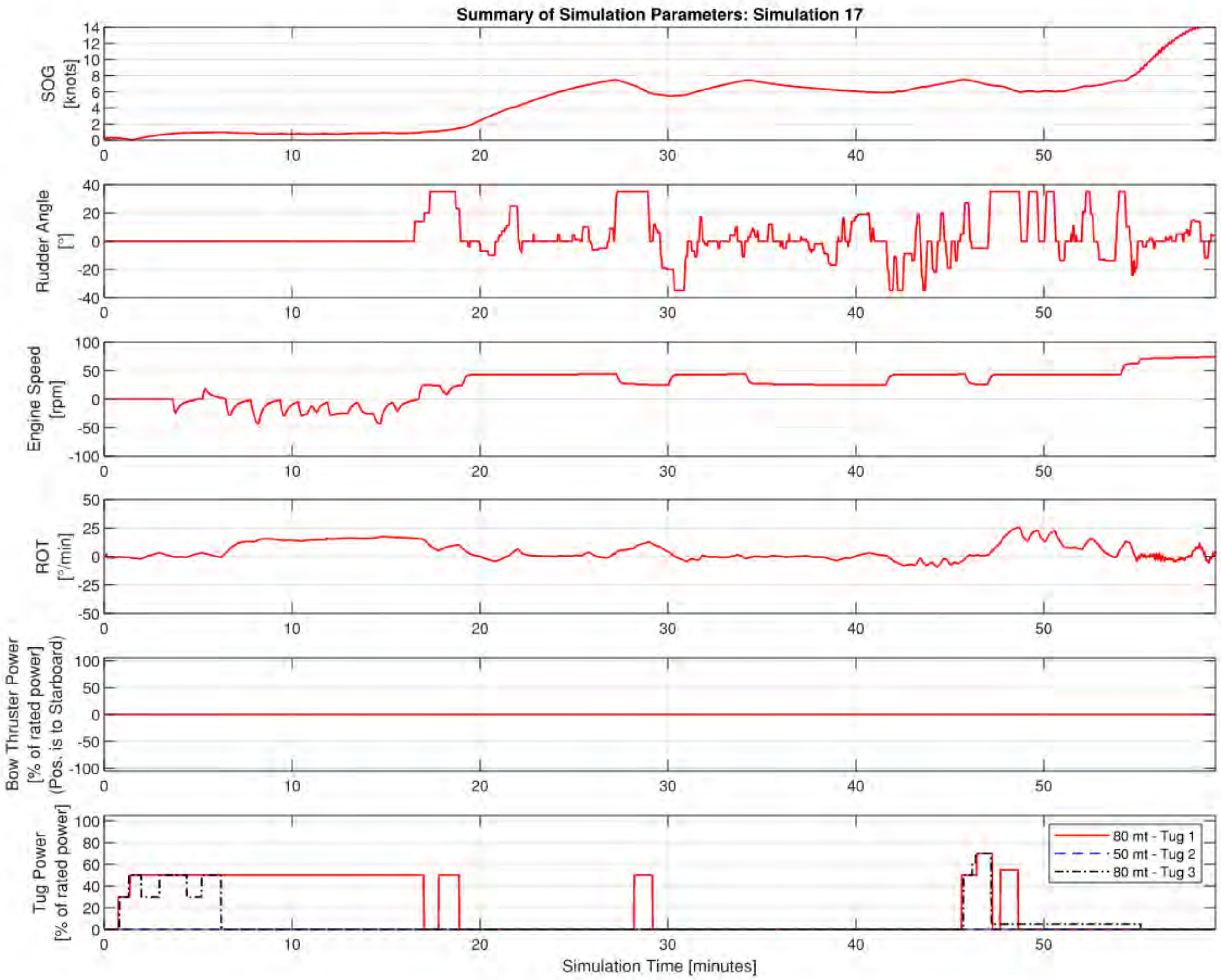


Figure 4-12: Simulation 17 Vessel and Tug Parameter Time Series

4.1.7 Simulation 18 – Panamax Outbound, CFS – RM 0, WOP, SSW Wind, W Swell, Ebb Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
18	WOP	PNMX	PNMX, CFN	Outbound	Yes / CF Turning Basin	80 / 80	30kt SSW (222. 5°)/20kt SSW (222.5°)	Swell W	6.75/2.1	High Slack (05:20)	CFS	RM 0	T. Petrusha	🟡

Simulation 18 was an outbound simulation with the Panamax containership. This simulation started with the containership departing the north berth at the proposed container facility, performing the turning maneuvering in the turning basin and then transiting the existing navigation channel to approximately red buoy “2.” The transit was conducted with the tidal current corresponding to an hour before high slack water at the container facility and strong SSW winds.

Vessel Swept Path Figures: Figure 4-13

Vessel and Tug Parameter Time Series: Figure 4-14

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected. This simulation had three assist tugs available but only two tugs were used. This run was marginally successful as the vessel departed the channel boundaries in the entrance turn. The pilot noted that he approached the entrance turn at a higher speed than desired. There was reserve tug power and bow thruster power throughout the simulation. Safety and tug adequacy were rated “best”. While the run difficulty was rated as average. Captain Petrusha thought the change in the starting time with respect to the currents resulted in the desired currents in the entrance turn and would be his approach to timing in real-life. The pilot would perform this transit in a real-life situation and felt that two assist tugs was sufficient.

Result: Marginal Success

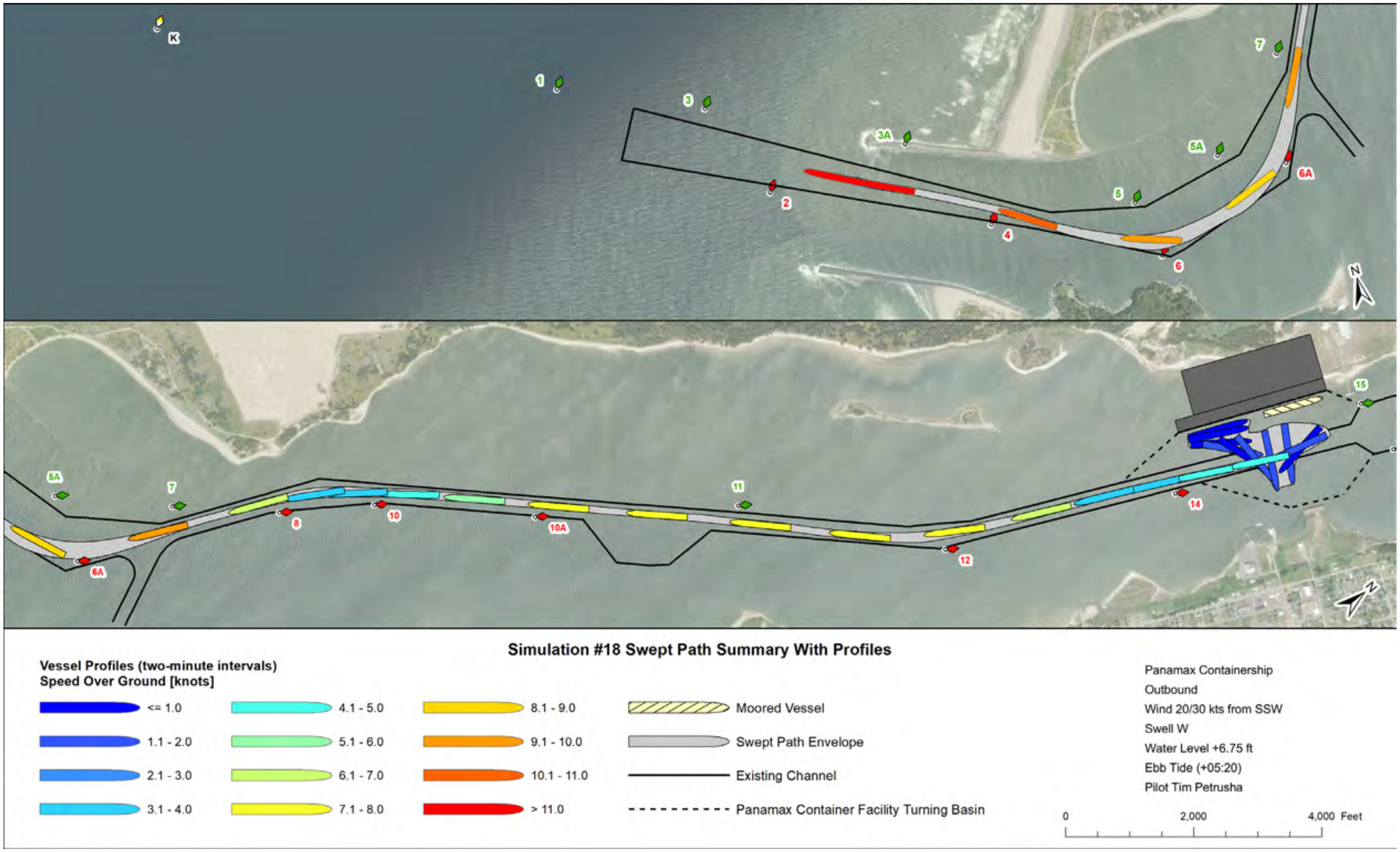


Figure 4-13: Simulation 18 Swept Path Summary with Profiles

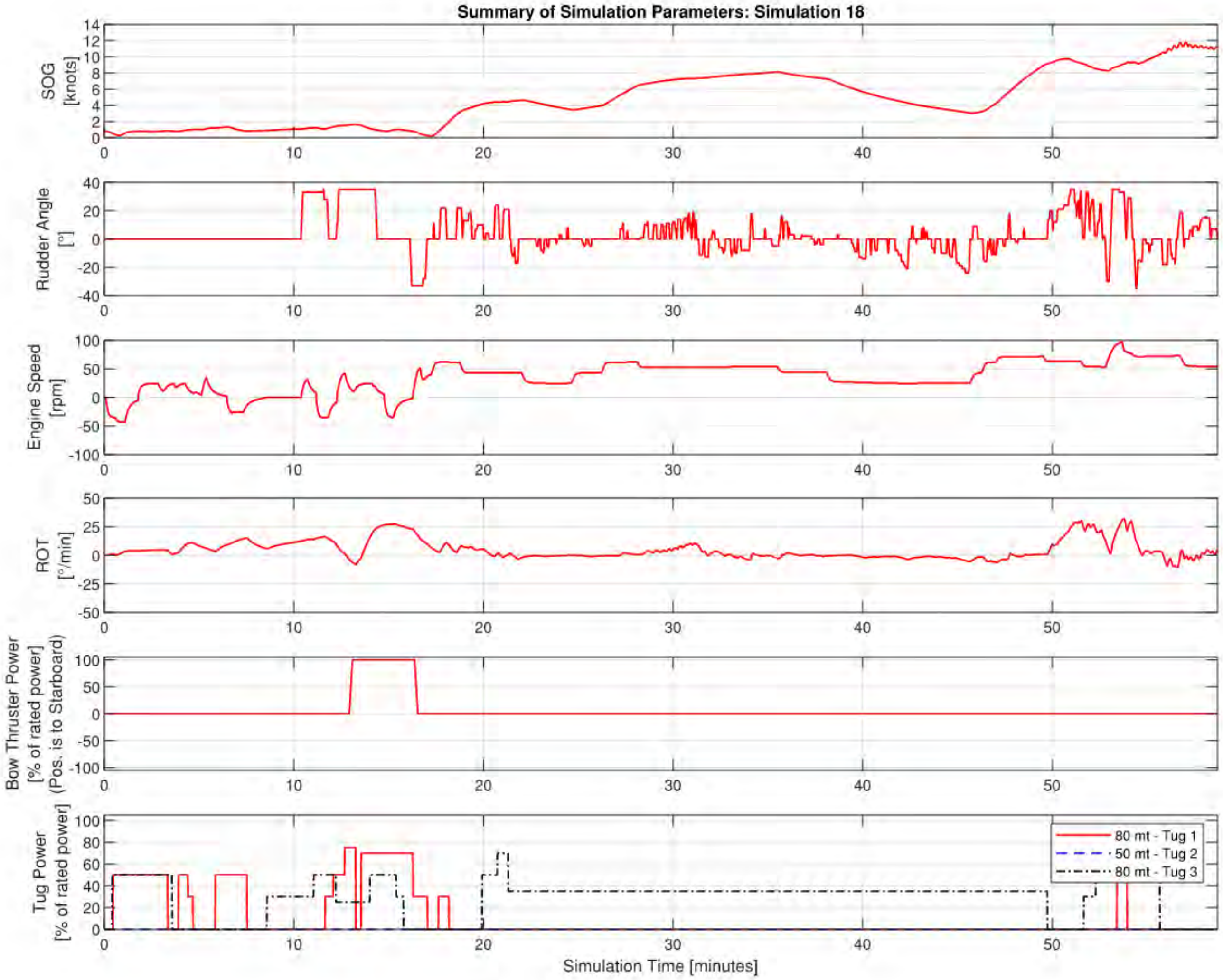


Figure 4-14: Simulation 18 Vessel and Tug Parameter Time Series

4.1.8 Simulation 19 – Panamax Inbound, CFS – RM 7.5, WOP, SSW Wind, Flood Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
19	WOP	PNMX	PNMX, CFN	Inbound	Yes / RM 7.5 Turning Basin	80 / 80	30kt SSW (222. 5°)/20kt SSW (222.5°)	4.5/1.4	Flood Tide (02:20)	CFS	RM 7	T. Petrusha	🟢

Simulation 19 started at the proposed container facility and evaluated a Panamax containership transiting the existing federal channel to the RM 7.5 turning basin, the turning evolution, and then returning to the federal channel to set up the transit back to the container facility. This simulation was performed to show proof of concept if the turning basin adjacent to the container facility is not created. The transit was conducted with a flood tidal current with strong SSW winds.

Vessel Swept Path Figures: Figure 4-15

Vessel and Tug Parameter Time Series: Figure 4-16

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Run safety and tug adequacy were rated as the “best”. Run difficulty was rated as below average. This run was successful with reserve tug power and sufficient clearances to the channel boundaries. The pilot would perform this transit in a real-world situation.

Result: Successful

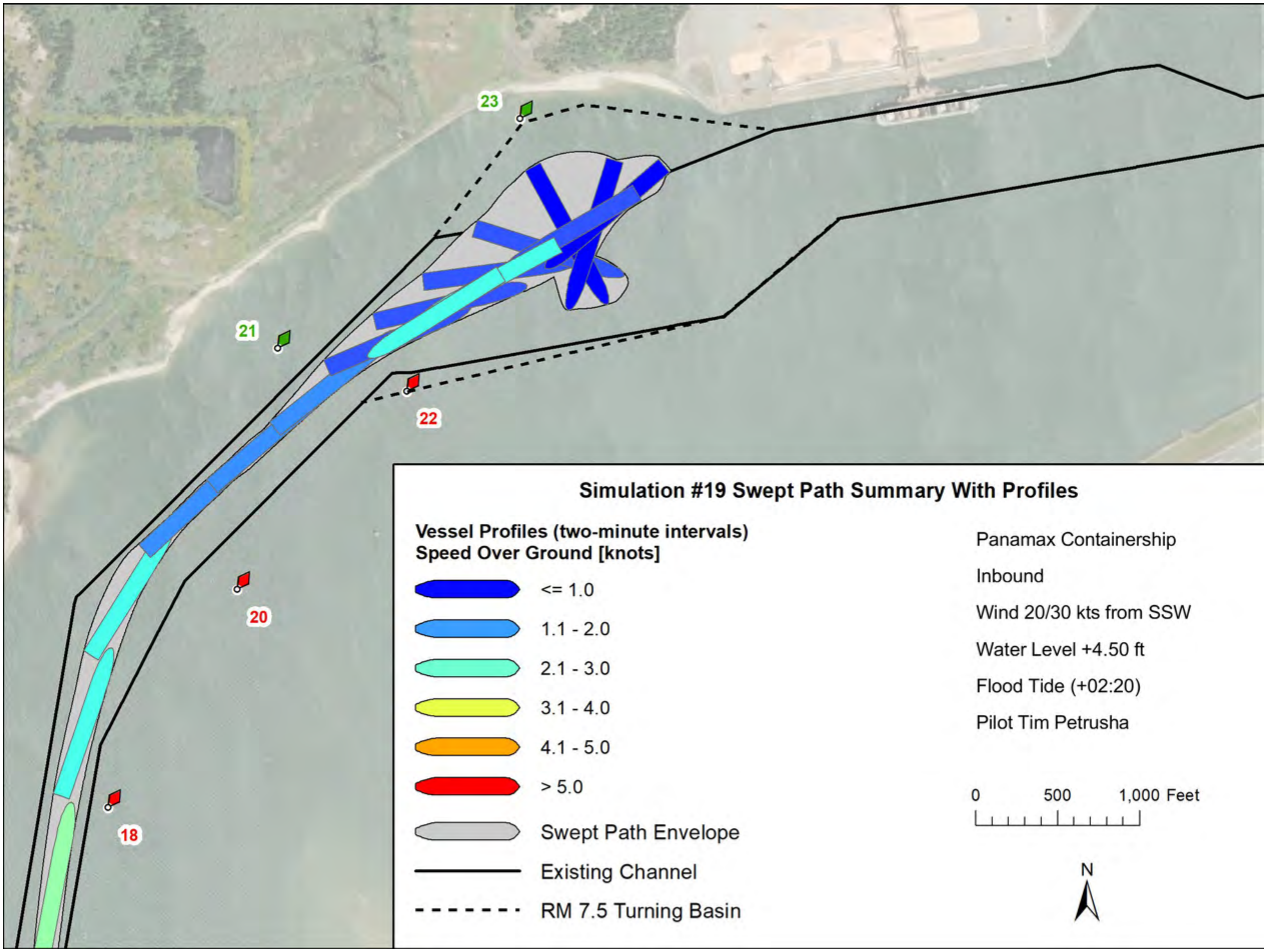


Figure 4-15: Simulation 19 Swept Path Summary with Profiles

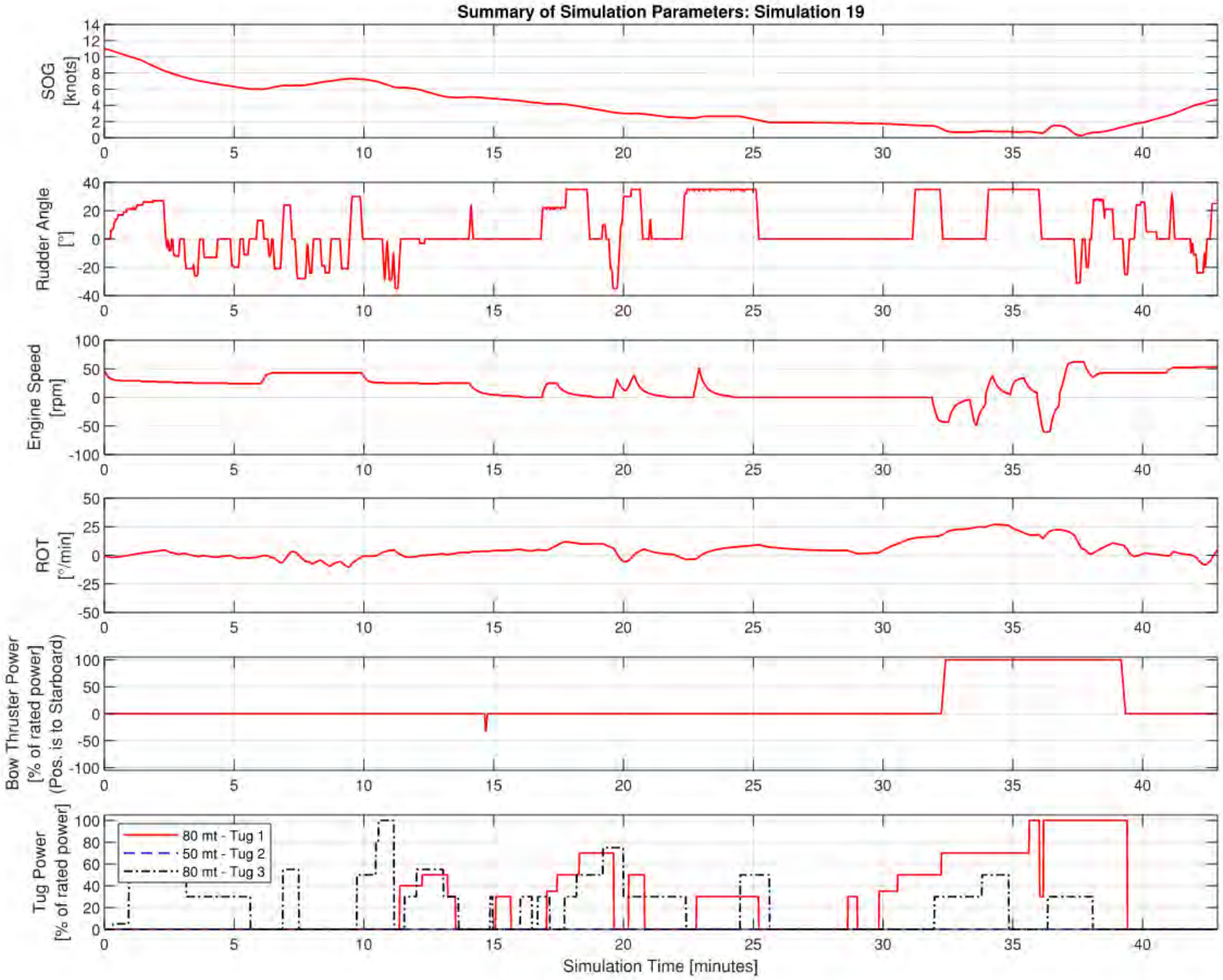


Figure 4-16: Simulation 19 Vessel and Tug Parameter Time Series

4.1.9 Simulation 20 – Panamax Inbound, CFS – RM 7.5, WOP, SSW Wind, Flood Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
20	WOP	PNMX	PNMX, CFN	Inbound	Yes / RM 7.5 Turning Basin	80 / 80	25kt NNW (337.5°)	4.5/1.4	Flood Tide (02:20)	CFS	RM 7	S. Woods	🟡

Simulation 20 started at the proposed container facility and evaluated a Panamax containership transiting the existing federal channel to the RM 7.5 turning basin, the turning evolution, and then returning to the federal channel to set up the transit back to the container facility. This simulation was performed to show proof of concept if the turning basin adjacent to the container facility is not created. The transit was conducted with a flood tidal current with strong NNW winds.

Vessel Swept Path Figures: Figure 4-17

Vessel and Tug Parameter Time Series: Figure 4-18

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Run safety and tug adequacy were rated as the “best”. Run difficulty was rated as below average. This run was marginally successful due to a slight departure of the vessel from the channel boundaries adjacent to green buoy “21.” Captain Woods stated that he commonly uses the naturally deep water outside the existing channel limits on the green side of the channel approaching the RM 7.5 turning basin. The pilot would perform this transit in a real-world situation.

Result: Marginal success

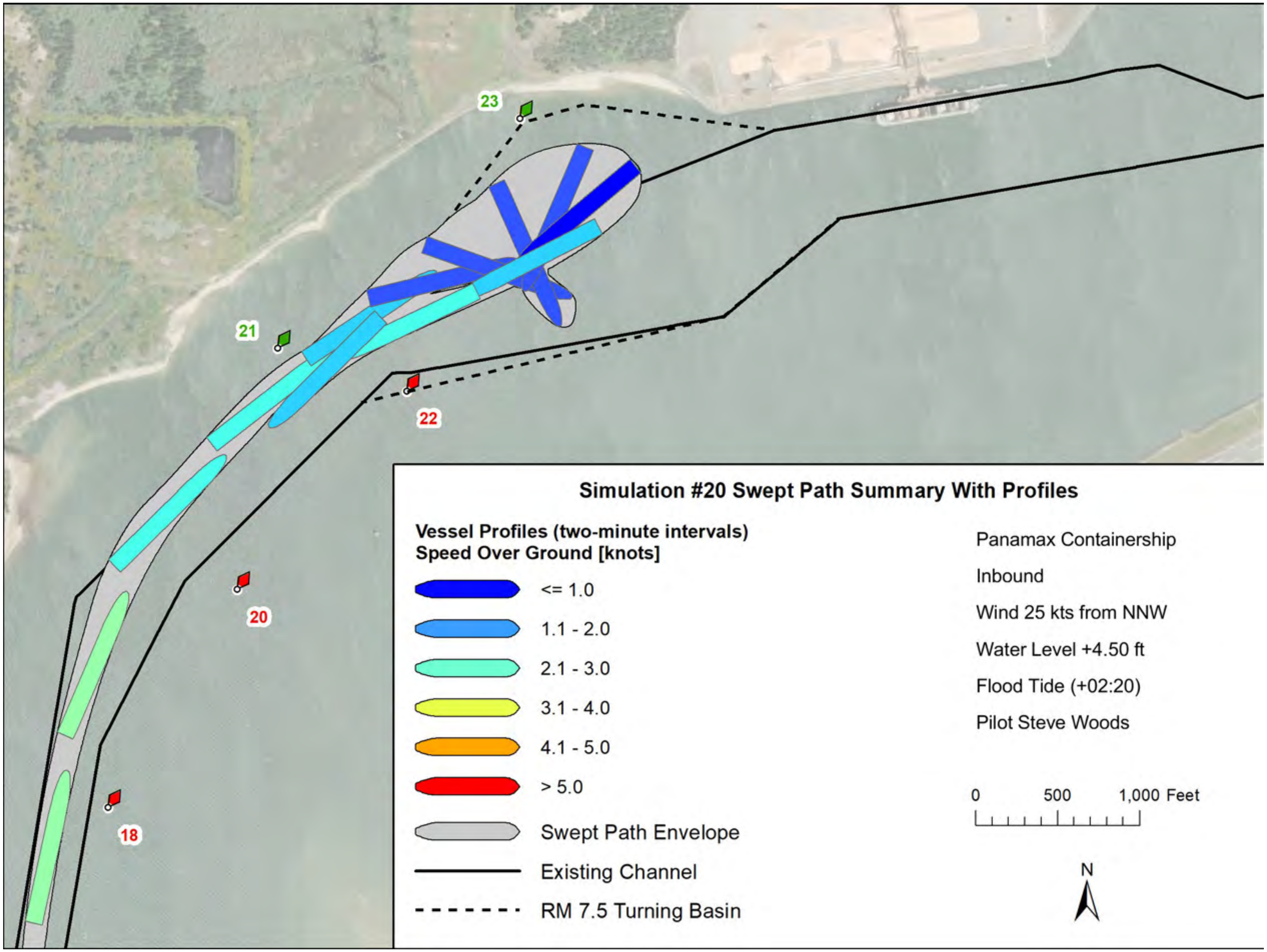


Figure 4-17: Simulation 20 Swept Path Summary with Profiles

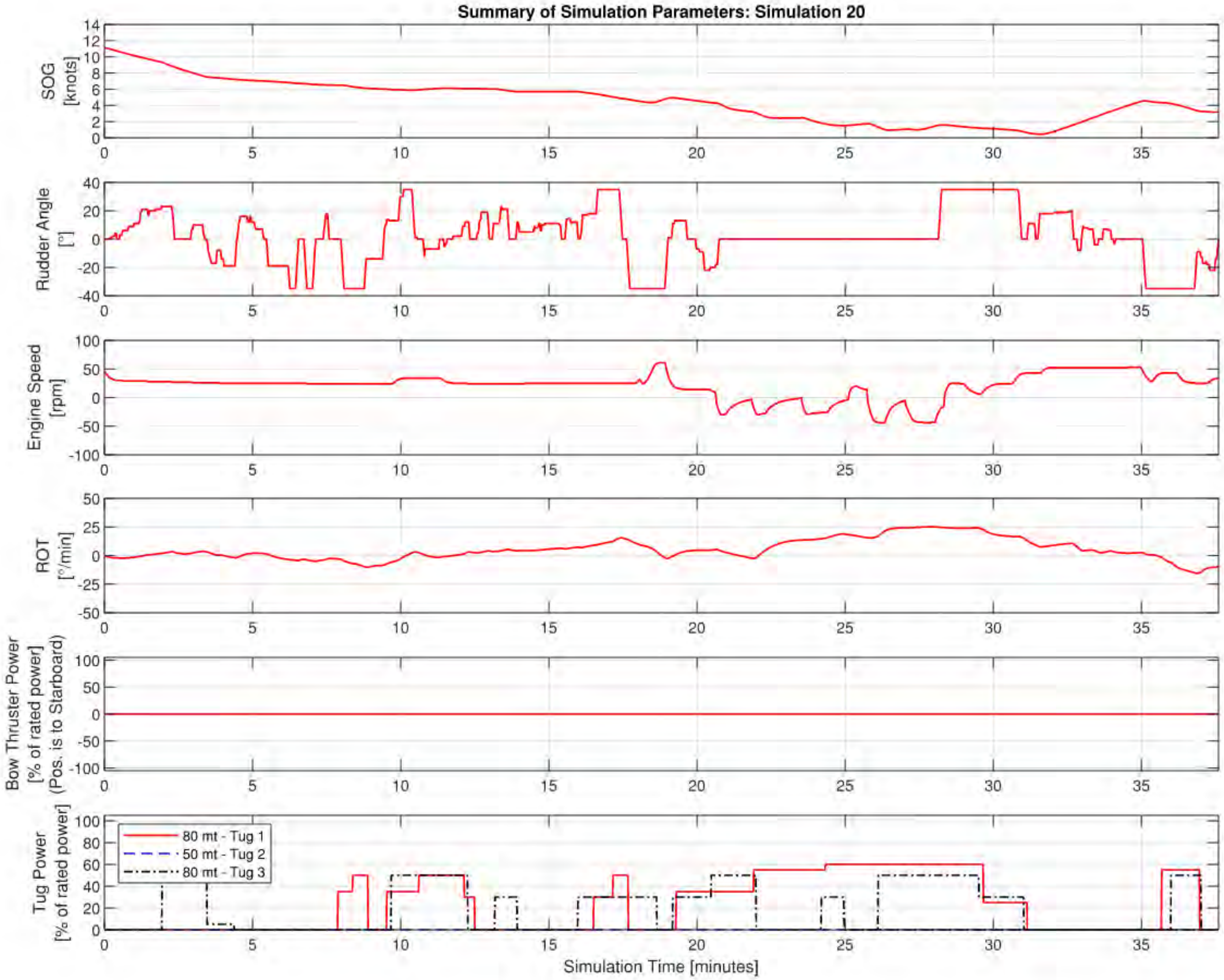


Figure 4-18: Simulation 20 Vessel and Tug Parameter Time Series

4.2 POST PANAMAX GENERATION TWO CONTAINERSHIP SIMULATIONS

In total 15 simulations were performed in the 2017 PA channel with the Post Panamax Generation Two containership evaluating the channel transit, turning evolution in the corresponding turning basin and maneuvering to/from the planned container facility. Of these simulations 13 were inbound and 2 were outbound. Based on discussion with the pilots on their planned timing of the inbound maneuver to the container facility, one tidal current condition was evaluated during a flood current. The outbound simulations also only evaluated a single current based on the pilot feedback.

The pilot safety, run difficulty, and tug adequacy ratings for all the Post Panamax Generation Two containership simulations are summarized in Table 4-2. Note that three different pilots performed these simulations and performance ratings are subjective to each individual pilot. On average the inbound and outbound transits were rated as above average safety and tug adequacy and average run difficulty.

Table 4-2. PPX2 Containership Pilot Ratings for Safety, Difficulty, & Tug Adequacy

Simulation Number	Pilot	Run Safety	Tug Adequacy	Run Difficulty	Run Result
Inbound Maneuver					
4	S. Woods	3	5	5	🔴
5	T. Petrusha	1	5	3	🔴
6	S. Woods	4	5	2	🟢
7	T. Petrusha	4	5	3	🔴
21	T. Petrusha	5	5	3	🟡
22	S. Woods	3	5	4	🔴
23	S. Woods	4	5	3	🟡
24	G. Wales	5	5	2	🟢
25	G. Wales	-	-	-	NA
26	G. Wales	-	-	-	NA
27	G. Wales	-	-	-	NA
28	G. Wales	5	5	3	🟢
31	G. Wales	4	4	3	🟢
Inbound Average	--	3.6	4.9	3.3	--
Outbound Maneuver					
8	S. Woods	5	5	3	🟢
29	S. Woods	-	-	-	NA
Outbound Average	--	5	5	3	--

4.2.1 Simulation 4 – PPX2 Inbound, RM-2 – Entrance Turn, 2017 PA, NNE Wind, NW Swell, Flood Tide

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
4	2017 PA	PPX2	Inbound	No	80 / 80/50	10kt NNE (22.5°)	Swell NW	4.5/1.4	Flood Tide (01:20)	RM -2	Entrance Turn	S. Woods	🔴

Simulation 4 started at approximately River Mile -2 to assess the post Panamax Generation Two containership transit in the 2017 Proposed Alteration channel and the turning evolution in the proposed turning basin adjacent to the container facility. The transit was conducted with a flood tidal current with reduced NNE winds.

Vessel Swept Path Figures: Figure 4-19**.**

Vessel and Tug Parameter Time Series: Figure 4-20**.**

Pilot Comments[3]: This simulation ended with a grounding in the entrance turn. The pilot stated that the rate of turn of this vessel model was unrealistic and that modifications were needed.

Result: Unsuccessful

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[3] 10555810: Were Model issues Addressed?:

Phase 2 (pg65)
Pilot Comments: This simulation ended with a grounding in the entrance turn. The pilot stated that the rate of turn of this vessel model was unrealistic and that modifications were needed.
(pg70)
Pilot Comments: This simulation ended with a grounding in the entrance turn. The pilot stated that the rate of turn of this vessel model was unrealistic and sluggish. As a result, this simulation was rated with below average safety. The tug adequacy was rated as "best" and the run difficulty was rated as average. Captain Petrusha would not perform this simulation in a real-world situation. Captain Petrusha also noted that he had not handled containerships of this size in real-life and that the rate of turn wasn't as expected but that it could be realistic. As a result, this model was used for all Post-Panamax Generation Two runs.

Response: All model issues were addressed prior to the full mission bridge simulations (Phase 3) to both Captain Michael’s and the Coos Bay Pilots standards

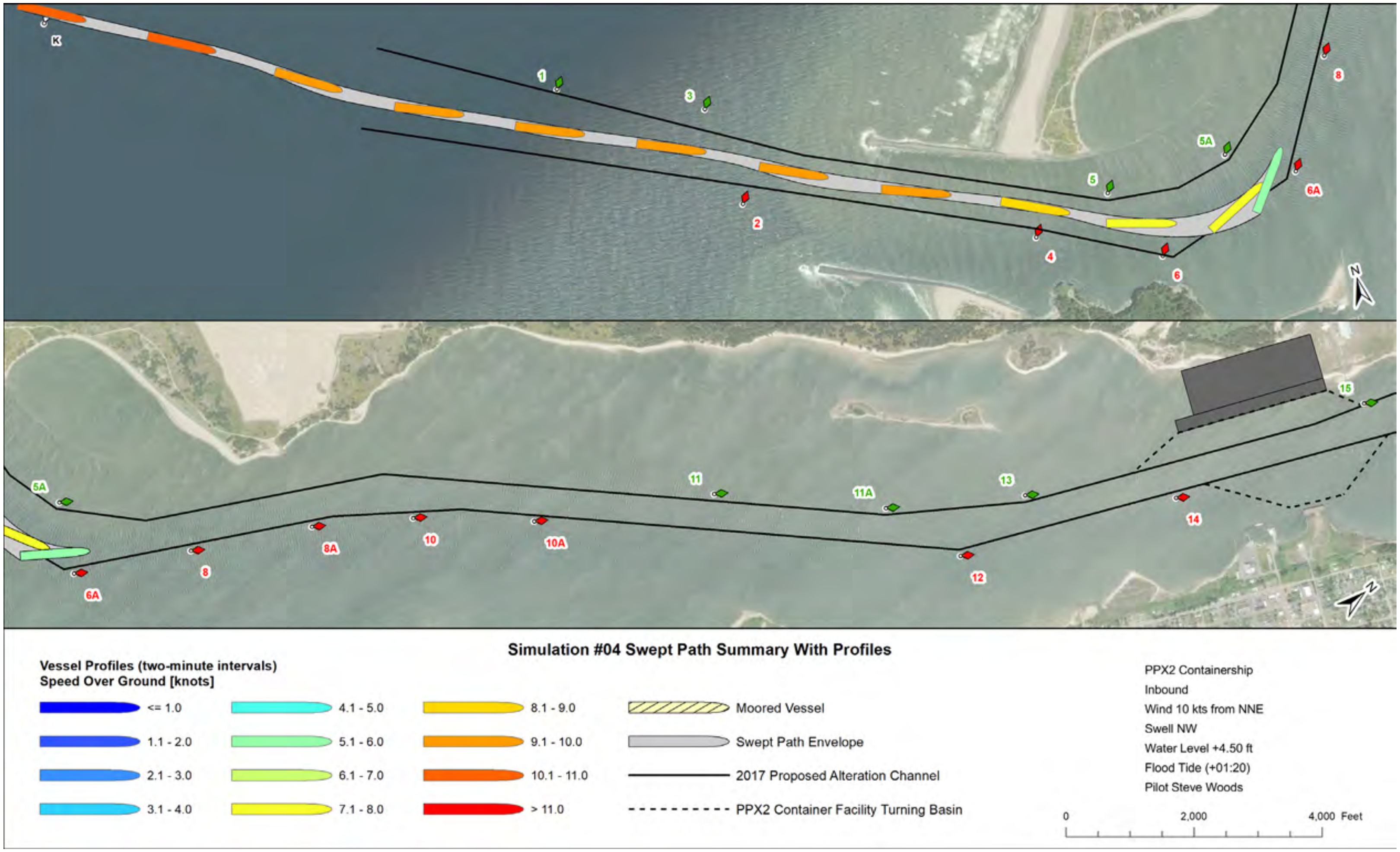

Figure 4-19: Simulation 4 Swept Path Summary with Profiles

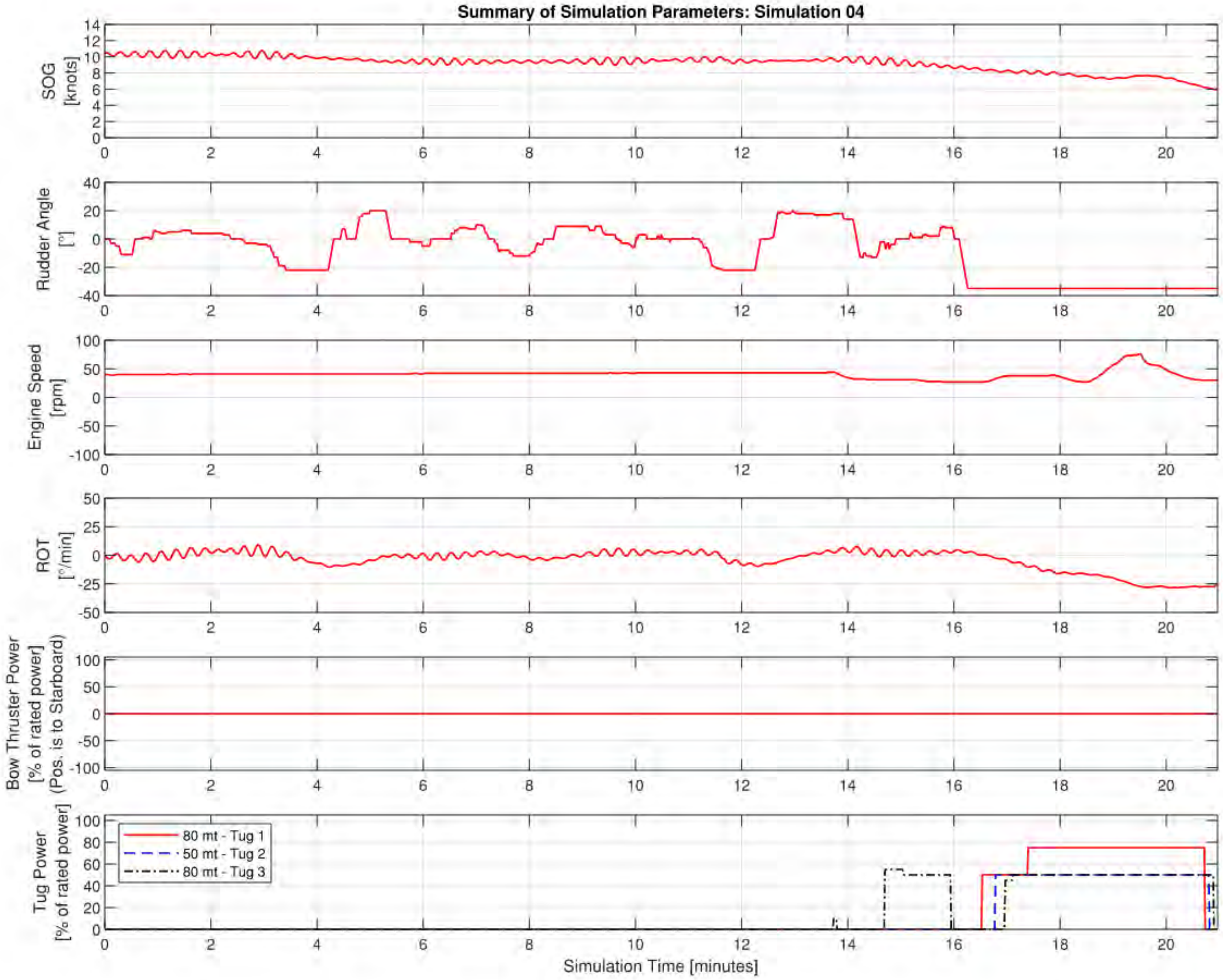

Figure 4-20. Simulation 4 Vessel and Tug Parameter Time Series

4.2.2 Simulation 5 – PPX2 Inbound, RM-2 – Entrance Turn, 2017 PA, NNE Wind, NW Swell, Flood Tide

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
5	2017 PA	PPX2	Inbound	No	80 / 80/50	10kt NNE (22.5°)	Swell NW	4.5/1.4	Flood Tide (01:20)	RM -2	Entrance Turn	T. Petrusha	🔴

Simulation 5 started at approximately River Mile -2 to assess the Post-Panamax Generation Two containership transit in the 2017 Proposed Alteration channel and the turning evolution in the proposed turning basin adjacent to the container facility. The transit was conducted with a flood tidal current with reduced NNW winds. This simulation used a different vessel model of the Post-Panamax Generation Two containership than Simulation 4.

Vessel Swept Path Figures: Figure 4-21.

Vessel and Tug Parameter Time Series: Figure 4-22**.**

Pilot Comments: This simulation ended with a grounding in the entrance turn. The pilot stated that the rate of turn of this vessel model was unrealistic and sluggish. As a result, this simulation was rated with below average safety. The tug adequacy was rated as “best” and the run difficulty was rated as average. Captain Petrusha would not perform this simulation in a real-world situation. Captain Petrusha also noted that he had not handled containerships of this size in real-life and that the rate of turn wasn’t as expected but that it could be realistic. As a result, this model was used for all Post-Panamax Generation Two runs.

Result: Unsuccessful

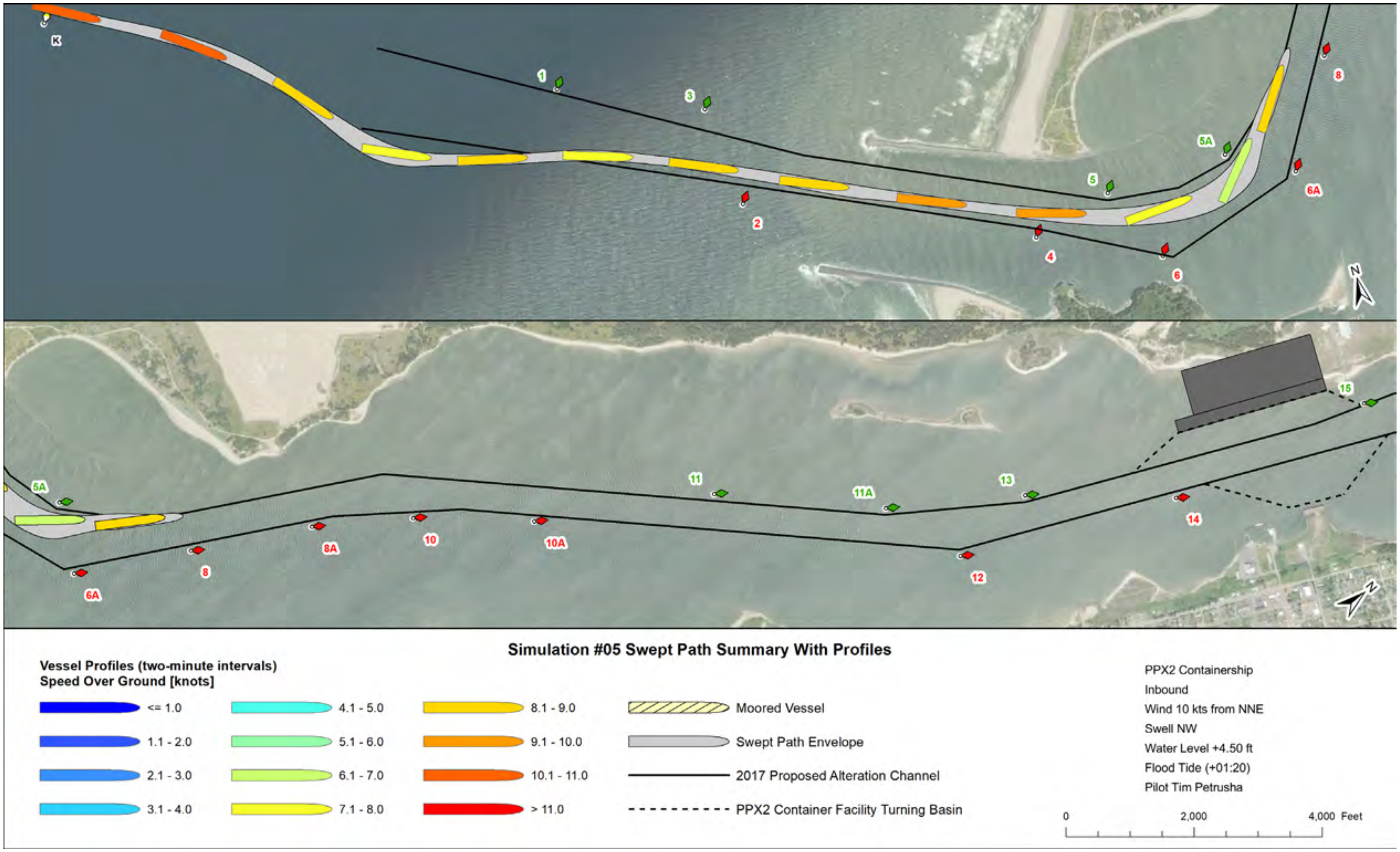

Figure 4-21: Simulation 5 Swept Path Summary with Profiles

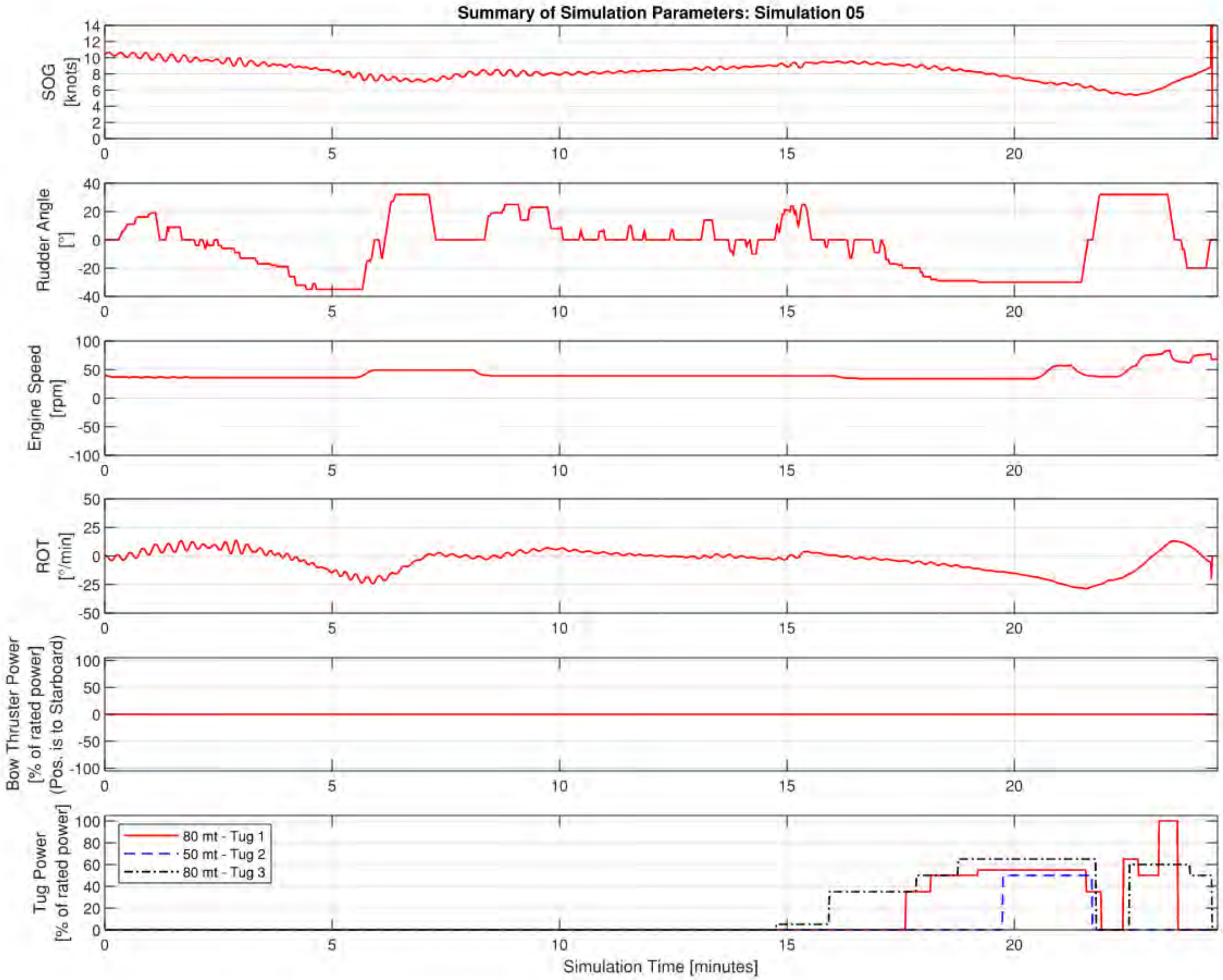

Figure 4-22: Simulation 5 Vessel and Tug Parameter Time Series

4.2.3 Simulation 6 – PPX2 Inbound, RM-2 – CFS, 2017 PA, NNE Wind, NW Swell, Flood Tide

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
6	2017 PA	PPX2	Inbound	No	80 / 80/50	25kt NNE (22.5°)	Swell NW	4.5/1.4	Flood Tide (01:20)	RM -2	CFS	S. Woods	🟢

Simulation 6 started at approximately River Mile -2 to assess the Post-Panamax Generation Two containership transit in the 2017 PA channel and the turning evolution in the proposed turning basin adjacent to the container facility. The transit was conducted with a flood tidal current with strong NNE winds.

Vessel Swept Path Figures: Figure 4-23.

Vessel and Tug Parameter Time Series: Figure 4-24.

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected. This simulation had three assist tugs available. This simulation was a successful channel transit. However, upon entering the turning basin the vessel outline on the ECDIS was off and made the pilot unaware of the vessel’s position in relationship to the container facility berth. As a result, only the channel transit was included in the rating and analysis. This simulation safety was rated as above average. While tug adequacy was rated as “best” and run difficulty was rated as below average. Throughout the transit there was reserve tug power. The pilot would perform this transit in a real-life situation.

Result: Successful

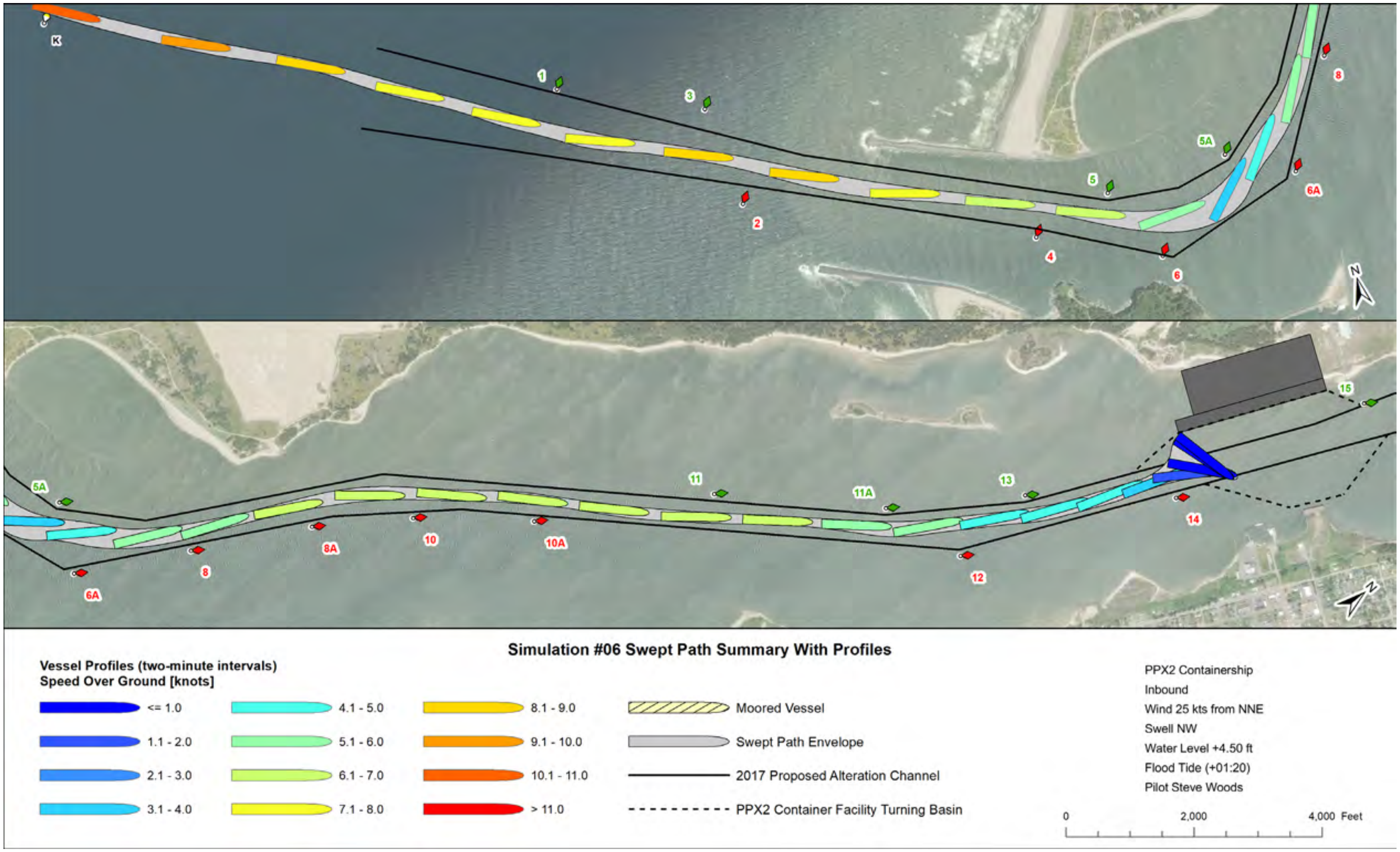

Figure 4-23: Simulation 6 Swept Path Summary with Profiles

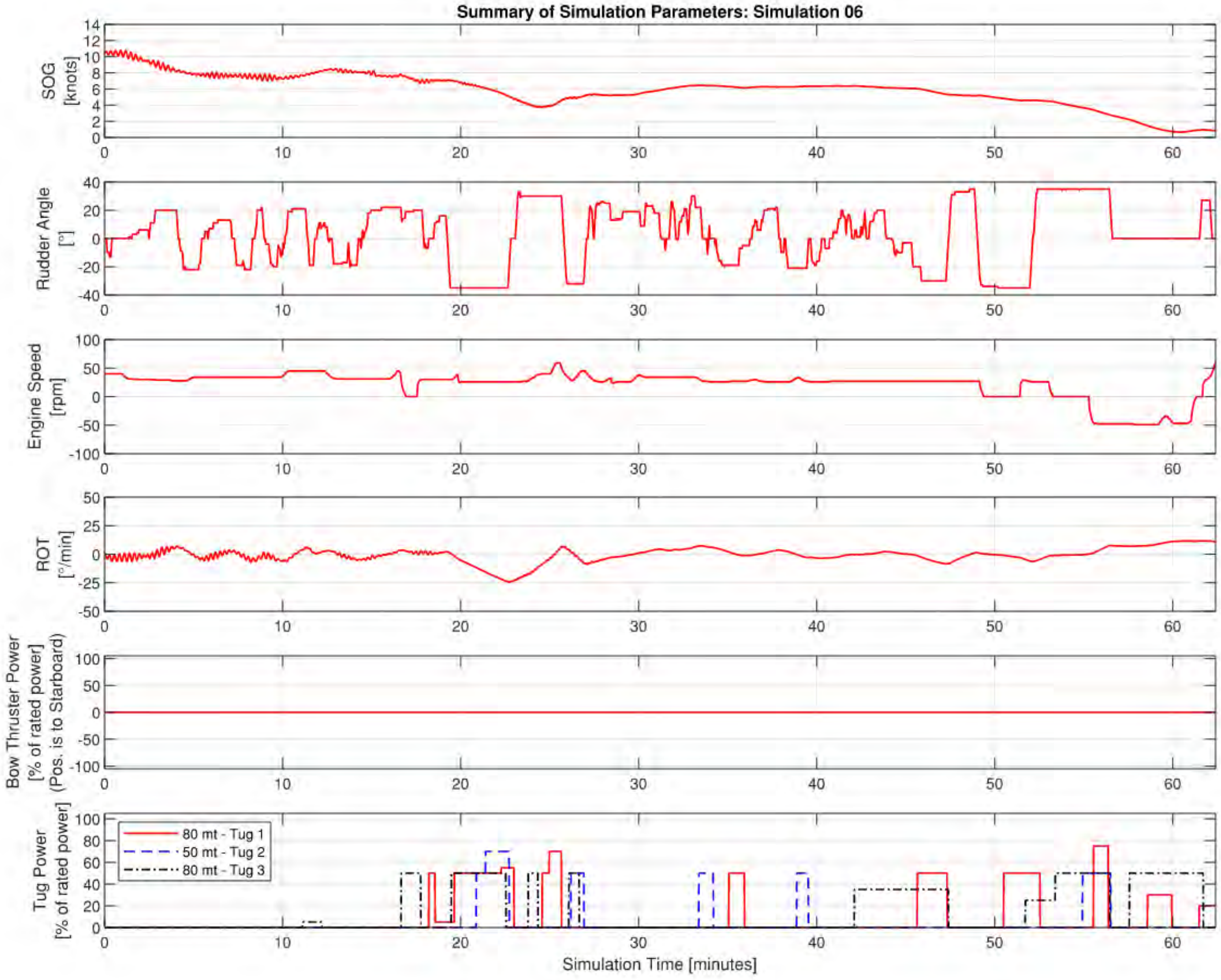

Figure 4-24: Simulation 6 Vessel and Tug Parameter Time Series

4.2.4 Simulation 7 – PPX2 Inbound, RM-2 – G”13”, 2017 PA, NNW Wind, Moderate NW Waves, Flood Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
7	2017 PA	PPX2	PPX2/CFS	Inbound	No	80 / 80/50	25kt NNW (337.5°)	Moderate NW	4.5/1.4	Flood Tide (01:20)	RM -2	G”13”	T. Petrusha	🔴

Simulation 7 started at approximately River Mile -2 to assess the Post-Panamax Generation Two containership transit in the 2017 PA channel. The transit was conducted with a flood tidal current with strong NNW winds. This simulation ended with a grounding on the red side of the channel adjacent to green buoy “13.”

Vessel Swept Path Figures: Figure 4-25.

Vessel and Tug Parameter Time Series: Figure 4-26.

Pilot Comments[4]: The pilot found the simulation to be a realistic representation and the vessel model performed as expected. This simulation was unsuccessful due to a grounding on the red side of the channel adjacent to green buoy “13.” Captain Petrusha stated that he needed more familiarity with the transit to feel comfortable performing in a real-world situation. This simulation safety was rated as above average. While tug adequacy was rated as “best” and run difficulty was rated as below average.

Result: Unsuccessful

---

[4] 10555872: Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel
model performed as expected. This simulation was unsuccessful due to a grounding on the red side
Of the channel adjacent to green buoy "13." Captain Petrusha stated that he needed more familiarity with the transit to feel comfortable performing in a real-world situation. This simulation safety was rated as above average. While tug adequacy was rated as "best" and run difficulty was rated as below average.
Result: Unsuccessful
safety was above average in a grounding?
Difficulty was below average?
Tug adequacy was 'best'?
These comments don't reflect the reality of the grounding.

Response: Understood the discrepancy between the simulation results and the pilot ratings. The pilot ratings are subjective to each pilot

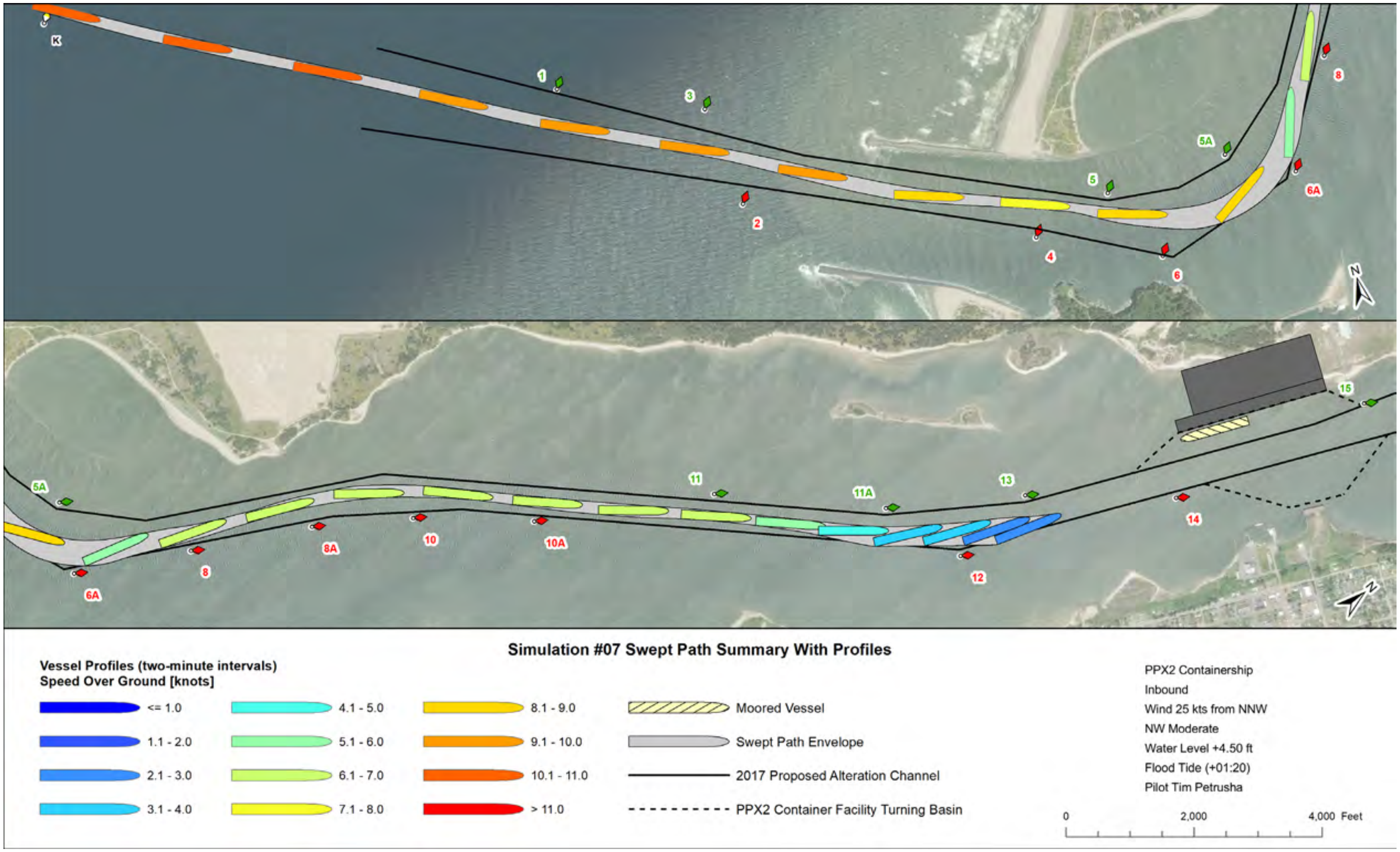

Figure 4-25: Simulation 7 Swept Path Summary with Profiles

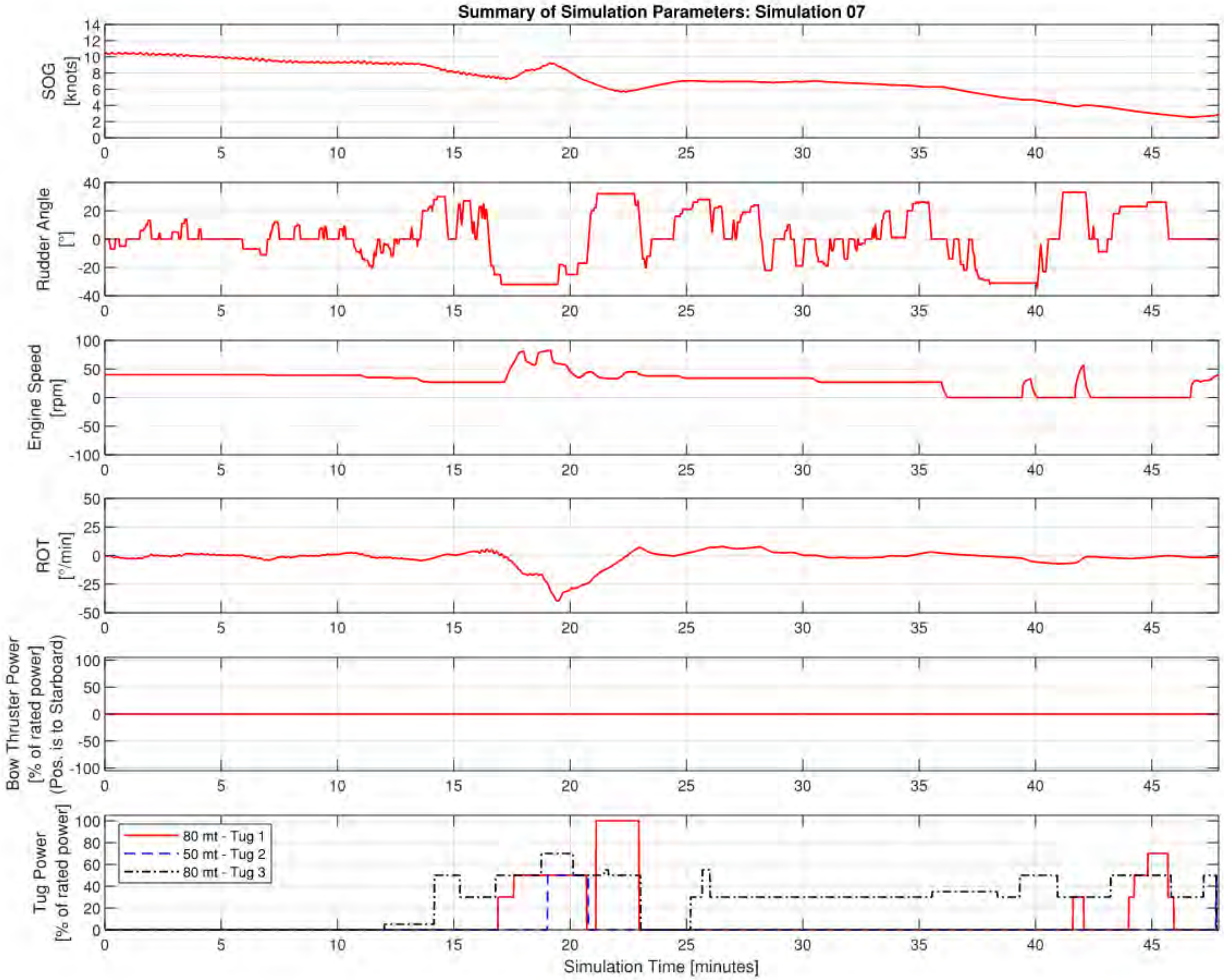

Figure 4-26: Simulation 7 Vessel and Tug Parameter Time Series

4.2.5 Simulation 8 – PPX2 Outbound, CFS – RM-1, 2017 PA, NNW Wind, Moderate NW Waves, Ebb Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
8	2017 PA	PPX2	PPX2/CFS	Outbound	Yes / CF Turning Basin	80 / 80 / 50	25kt NNW (337.5°)	Moderate NW	6.75/2.1	High Slack (06:20)	CFS	RM-1	S. Woods	🟢

Simulation 8 was the first outbound simulation with the Post-Panamax Generation Two containership. This simulation started with the containership departing the north berth at the proposed container facility, performing the turning maneuvering in the turning basin and then transiting the 2017 PA navigation channel to approximately RM -1. The transit was conducted with the tidal current corresponding to high slack water at the container facility and strong NNW winds.

Vessel Swept Path Figure: Figure 4-27.

Vessel and Tug Parameter Time Serie: Figure 4-28.

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Safety and tug adequacy were rated “best”. Run difficulty was rated as average difficulty. The vessel track stayed within the channel and turning basin boundaries. Throughout the transit there was reserve tug power, sufficient clearance to the moored vessel, and the bow thruster was not used. Captain Woods would perform this transit in a real-life situation.

Result: Successful

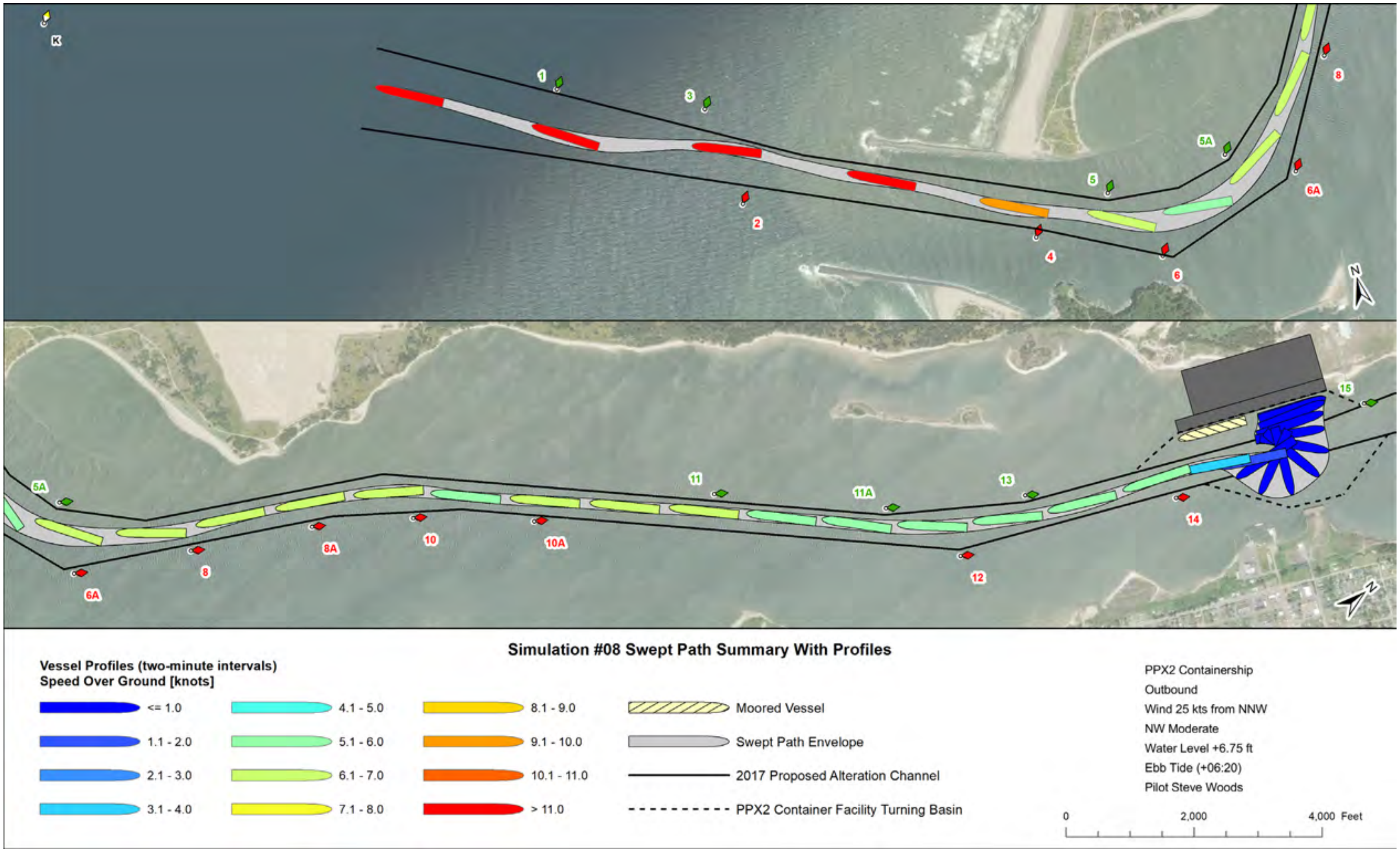

Figure 4-27: Simulation 8 Swept Path Summary with Profiles

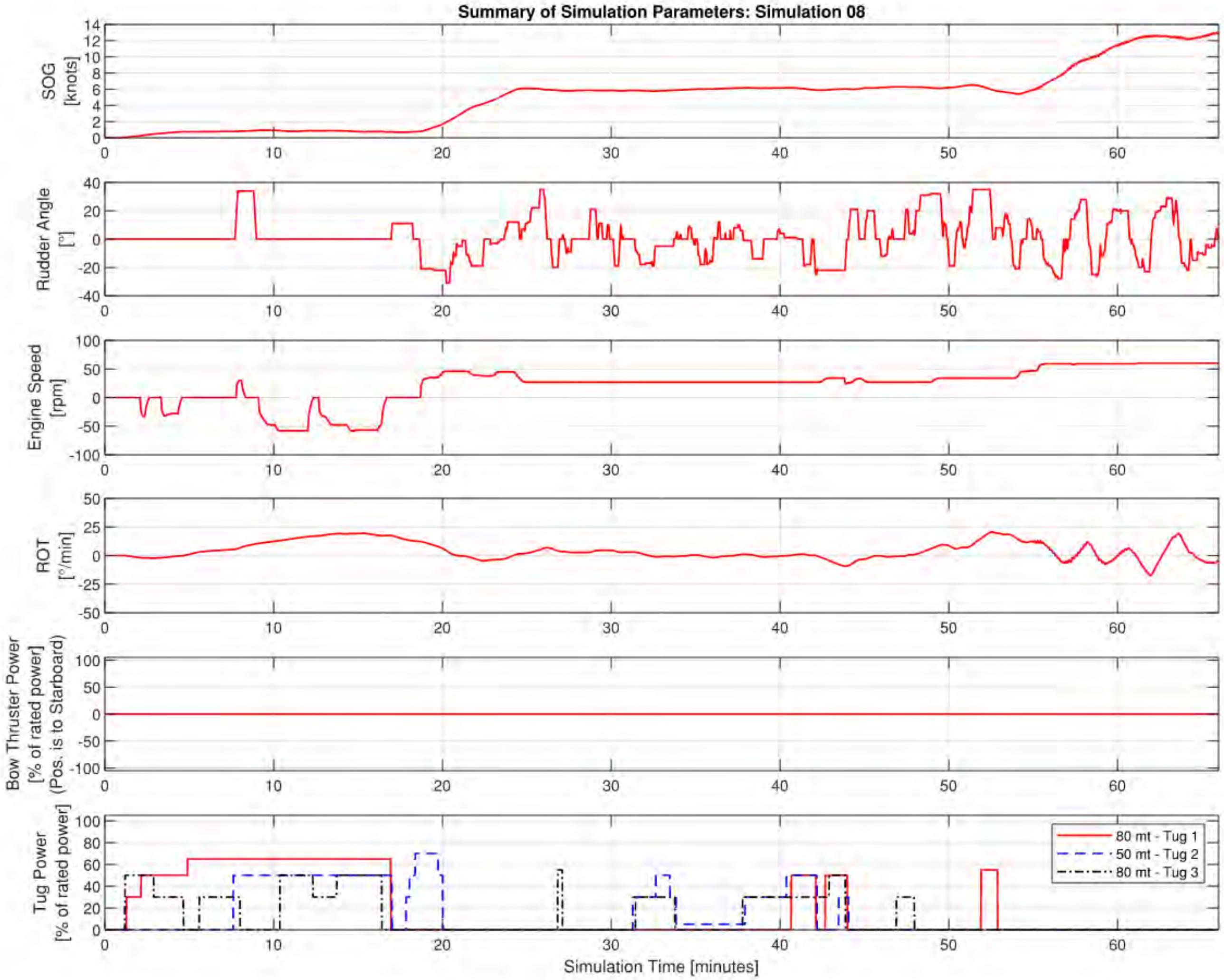

Figure 4-28: Simulation 8 Vessel and Tug Parameter Time Series

4.2.6 Simulation 21 – PPX2 Inbound, RM-2 - CFS, 2017 PA, NNW Wind, W Swell, Flood Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
21	2017 PA	PPX2	PPX2/CFS	Inbound	Yes / CF Turning Basin	80 / 80 / 80	25kt NNW (337.5°)	Swell W	4.5/1.4	Flood Tide (01:20)	RM-2	CFS	T. Petrusha	🟡

Simulation 21 started at approximately River Mile -2 to assess the Post-Panamax Generation Two containership transit in the 2017 PA channel and the turning evolution in the proposed turning basin adjacent to the container facility. The transit was conducted with a flood tidal current with strong NNW winds.

Vessel Swept Path Figure: Figure 4-29.

Vessel and Tug Parameter Time Serie: Figure 4-30.

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected. This simulation had three assist tugs available. This simulation had marginal success due to a slight departure of the vessel in the entrance turn from the proposed channel limits, and due the need to use all tugs at 100% power at the same time as the pilot thought he was to perform the turning evolution at RM 7.5 turning basin rather than at the turning basin at the container facility. This simulation safety and tug adequacy were rated as “best”. The run difficulty was rated as average. The pilot would perform this transit in a real-life situation.

Result: Marginal success

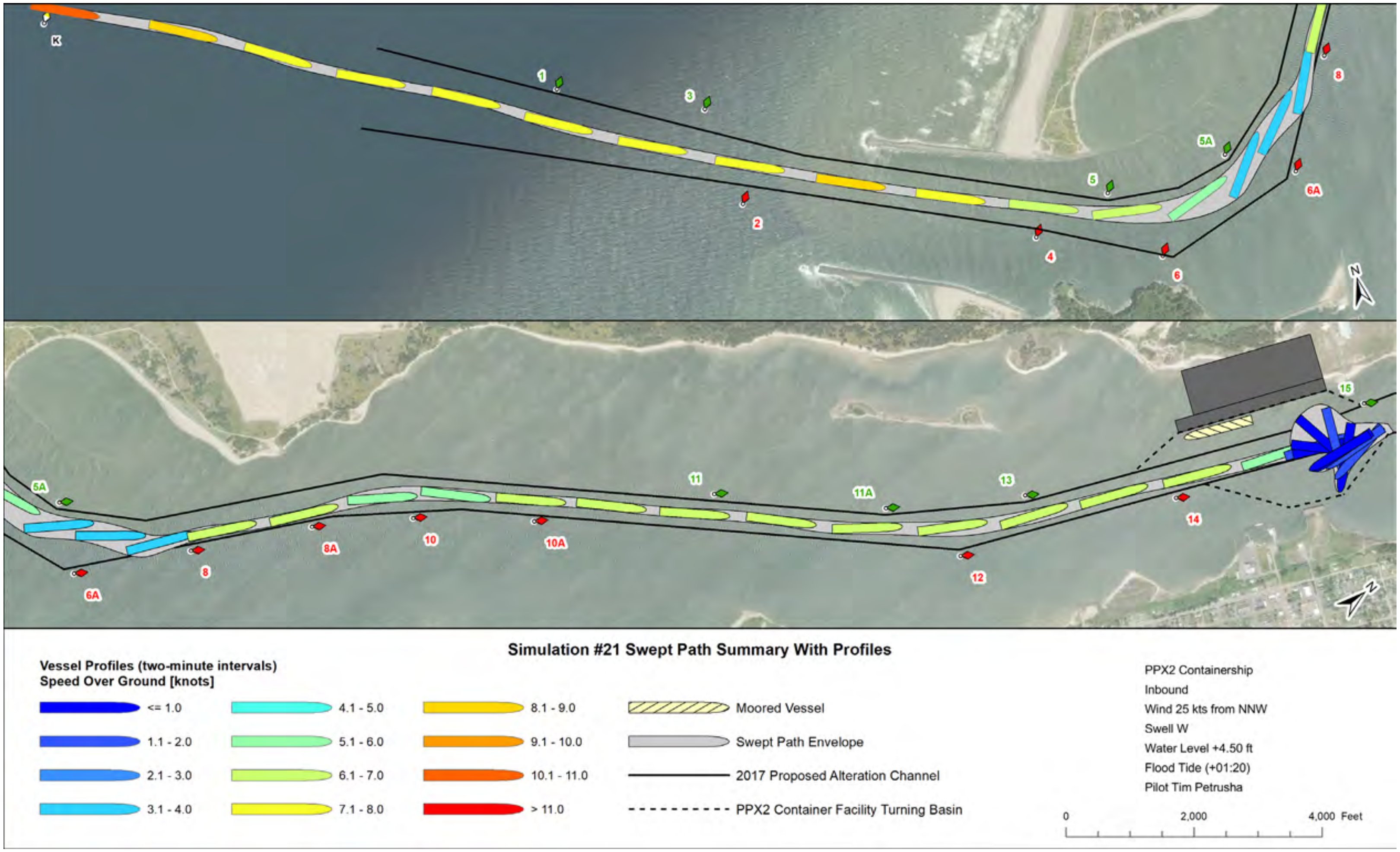

Figure 4-29: Simulation 21 Swept Path Summary with Profiles

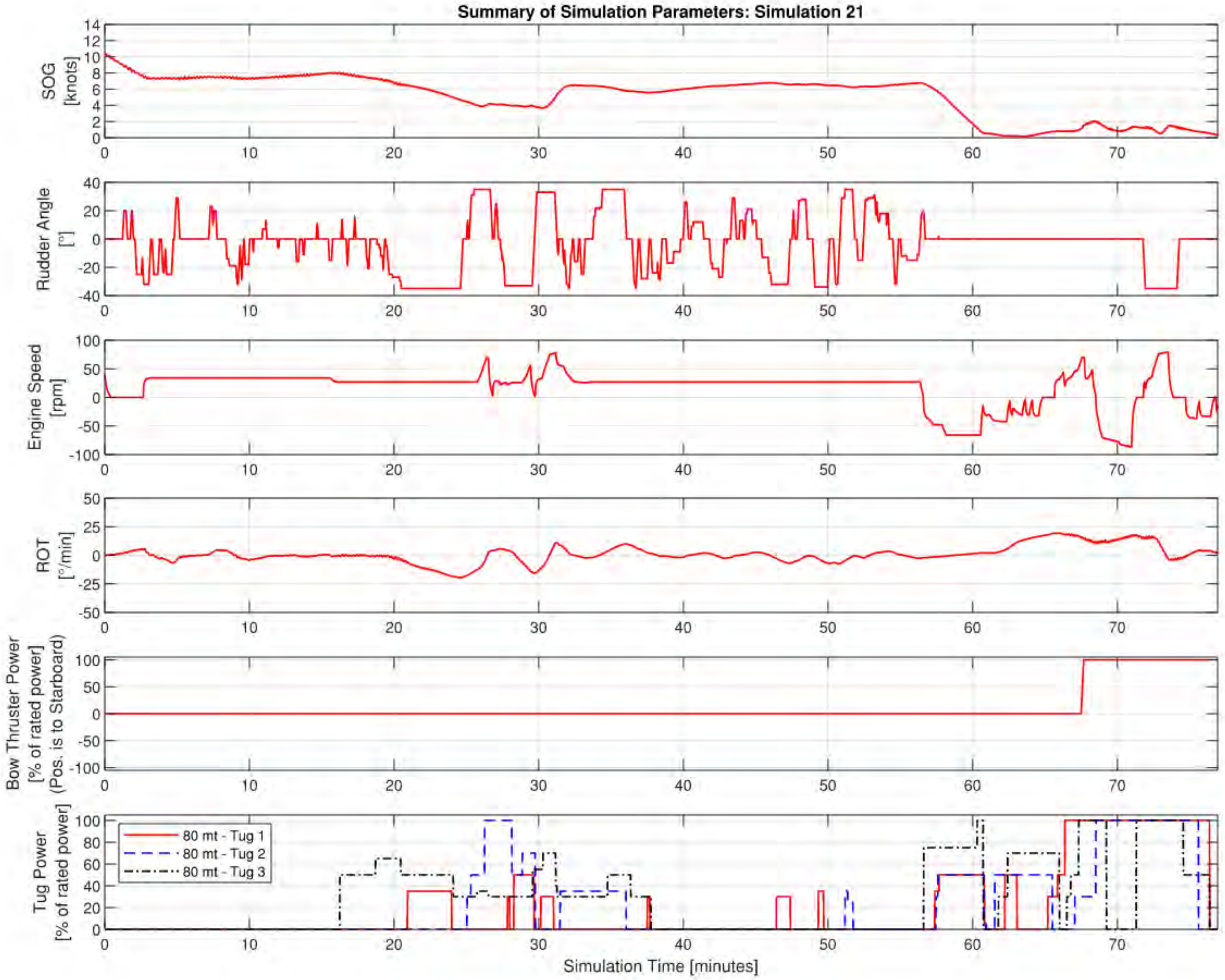

Figure 4-30: Simulation 21 Vessel and Tug Parameter Time Series

4.2.7 Simulation 22 – PPX2 Inbound, CFS – RM 7.5, 2017 PA, SSW Wind, Flood Tide

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
22	2017 PA	PPX2	Inbound	Yes / RM 7.5	80 / 80 / 80	30kt SSW (222. 5°)/20kt SSW (222.5°)	4.5/1.4	Flood Tide (02:20)	CFS	RM 7	S. Woods	🔴

Simulation 22[5] started at the proposed container facility and evaluated a Post-Panamax Generation Two containership transiting the 2017 PA channel to the RM 7.5 turning basin, the turning evolution, and then returning to the channel to set up the transit back to the container facility. This simulation was performed to show proof of concept if the turning basin adjacent to the container facility is not created. The transit was conducted with a flood tidal current with strong SSW winds.

Vessel Swept Path Figures: Figure 4-31.

Vessel and Tug Parameter Time Series: Figure 4-32.

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected. Run safety and difficulty were rated as average and above average, respectively. Tug adequacy was rated as “best”. This run ended with a grounding on the southern end of the turning basin. The pilot would perform this transit in a real-world situation but would change the approach that he took to perform the transit.

Result: Unsuccessful

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[5] 10555857: Pg 89, pg 93 of Phase 2 desktop runs
Pilots comments are almost exactly the same and one run was unsuccessful and ended in a grounding.
I would expect the safety, difficulty or tug sufficiency would be rated differently in a grounding scenario vs a successful run
Response: Reviewing the ratings and the evaluation notes:
Simulation 22 was rated as Safety: 3 (average), Tug Adequacy: 5 (best), Run Difficulty: 4 (above average difficulty)
Simulation 23 was rated as Safety: 4 (above average), Tug Adequacy: 5 (best), Run Difficulty: 4 (average difficulty)

Response: There was a slight difference in the pilot ratings between the simulations, these ratings are subjective to the pilot. In the evaluation notes for Simulation 22 which ended in a grounding the pilot stated he would take a different approach in a real-world situation and that he wasn’t able to maintain his intended track line in the turning basin. I assume he rated the simulation with the understanding of his new approach/error in the performed simulation.

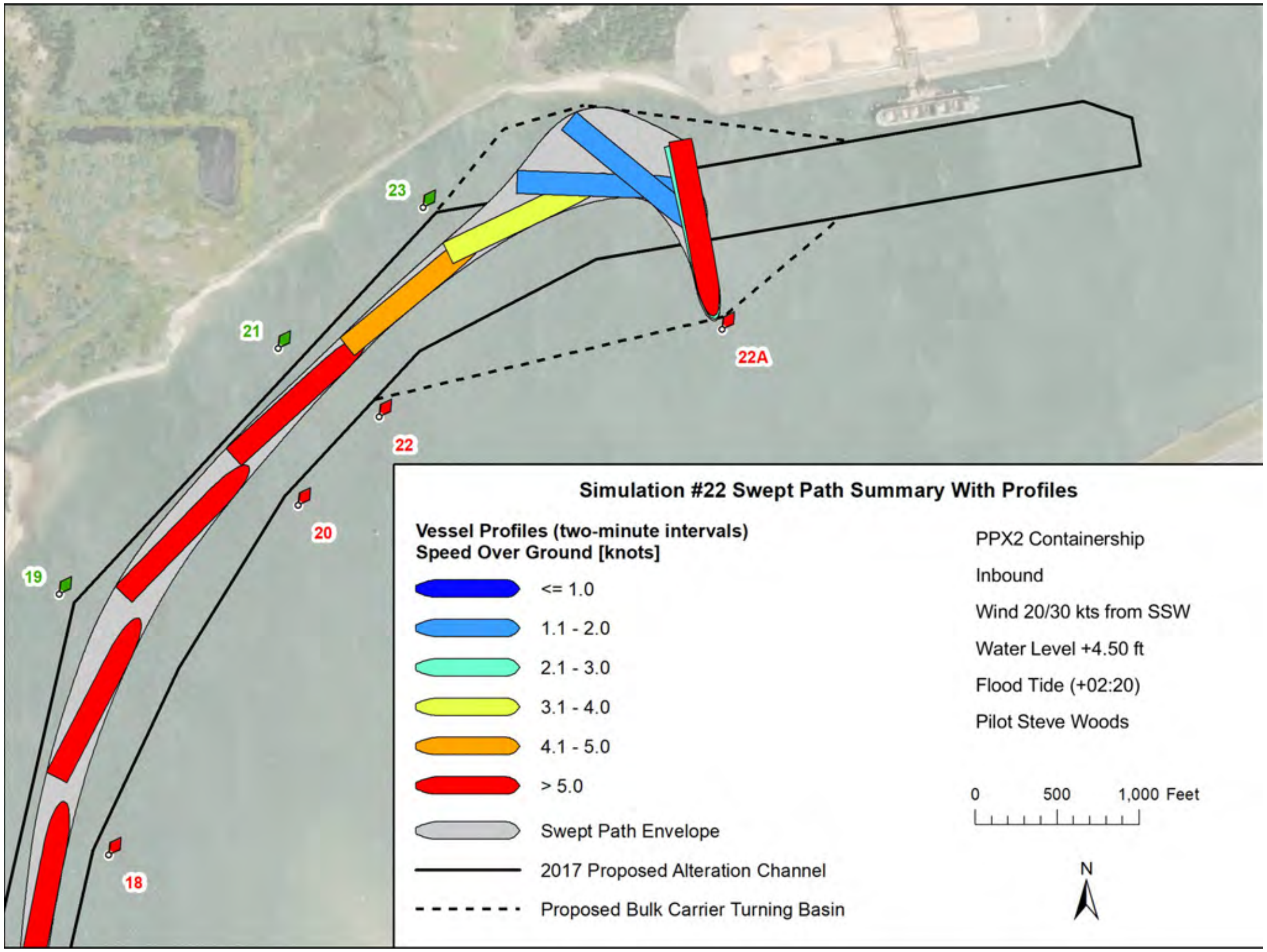

Figure 4-31: Simulation 22 Swept Path Summary with Profiles

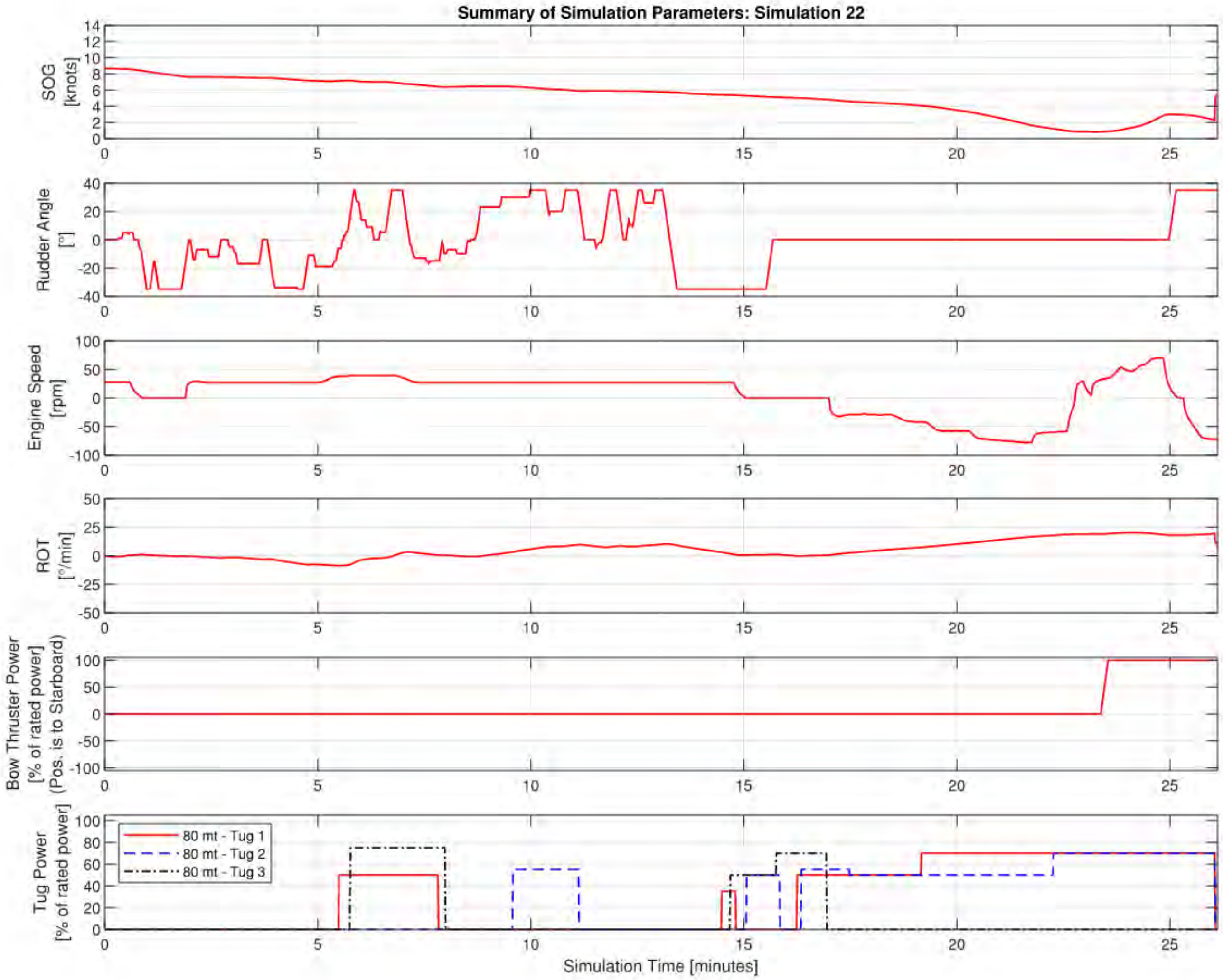

Figure 4-32: Simulation 22 Vessel and Tug Parameter Time Series

4.2.8 Simulation 23 – PPX2 Inbound, CFS – RM 7.5, 2017 PA, NNW Wind, Flood Tide

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
23	2017 PA	PPX2	Inbound	Yes / RM 7.5	80 / 80 / 80	25kt NNW (337. 5°)	4.5/1.4	Flood Tide (02:20)	CFS	RM 7	S. Woods	🟢

Simulation 23 started at the proposed container facility and evaluated a Post-Panamax Generation Two containership transiting the 2017 PA channel to the RM 7.5 turning basin, the turning evolution, and then returning to the channel to set up the transit back to the container facility. This simulation was performed to show proof of concept if the turning basin adjacent to the container facility is not created. The transit was conducted with a flood tidal current with strong SSW winds.

Vessel Swept Path Figures: Figure 4-33.

Vessel and Tug Parameter Time Series: Figure 4-34.

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected. Run safety and difficulty were rated as above average and average, respectively. Tug adequacy was rated as the “best”. This was performed successfully. The pilot would perform this transit in a real-world situation but would change the approach that he took to perform the transit.

Result: Successful

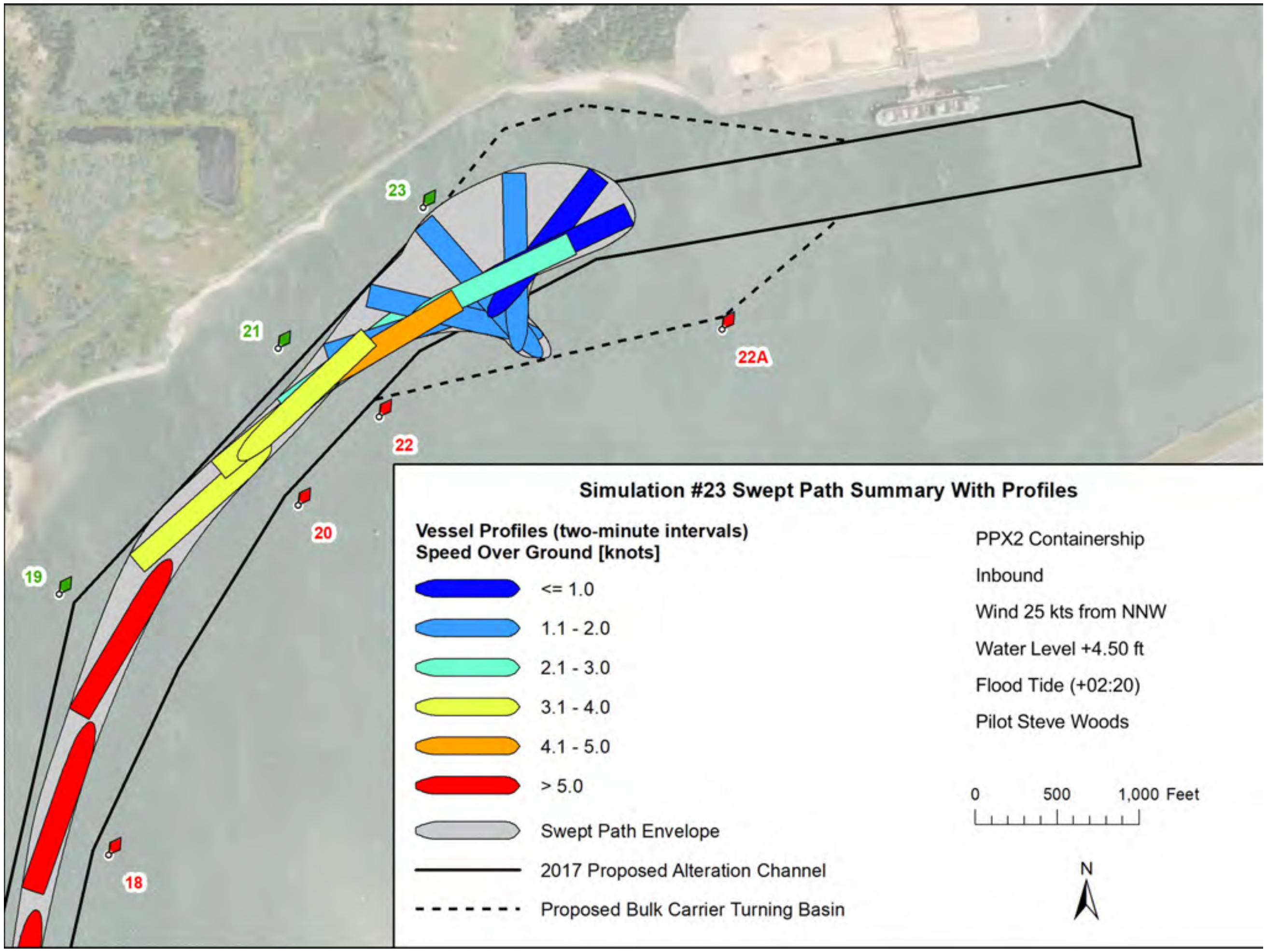

Figure 4-33: Simulation 23 Swept Path Summary with Profiles

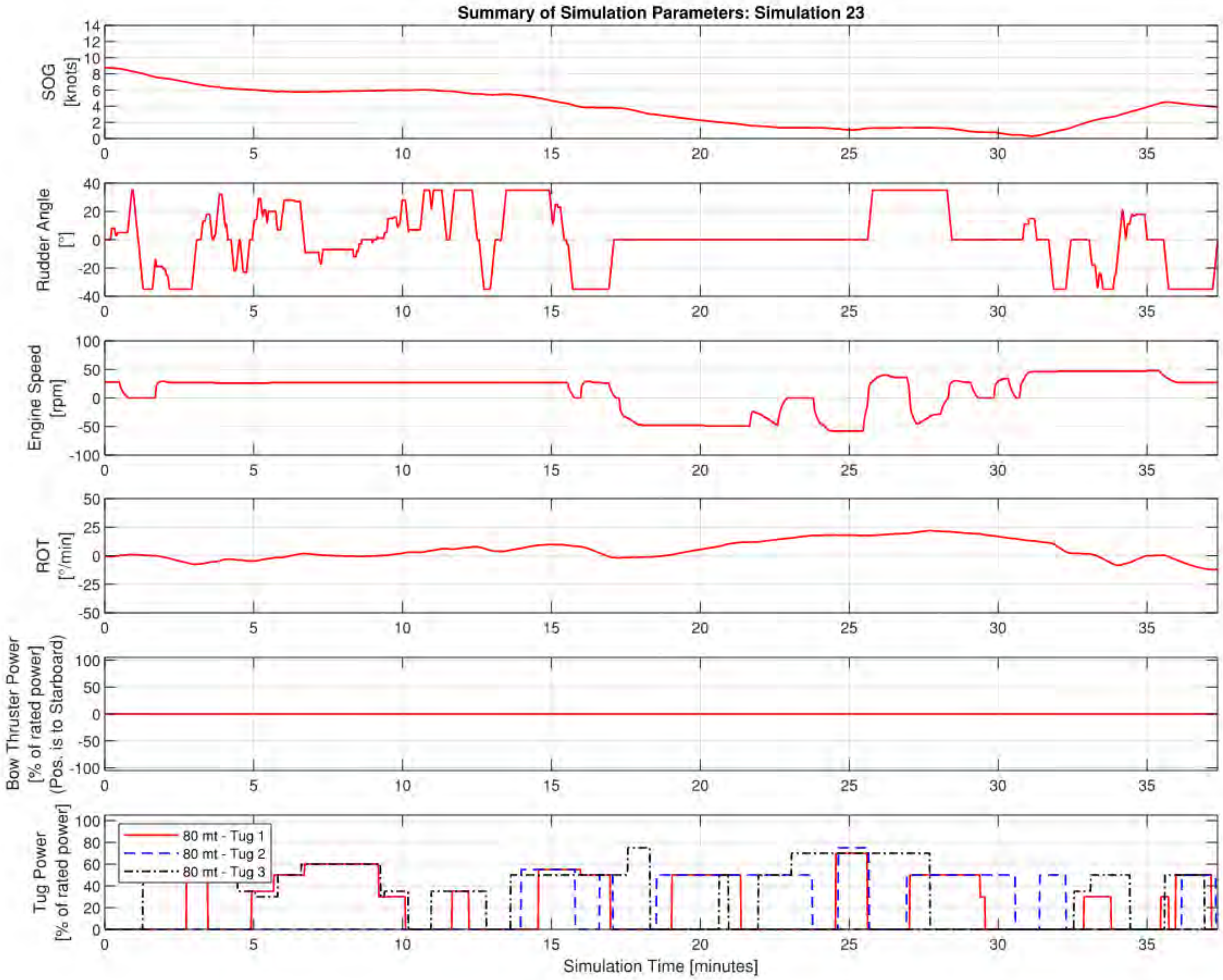

Figure 4-34: Simulation 23 Vessel and Tug Parameter Time Series

4.2.9 Simulation 24, 25, 26, 27 – PPX2 Inbound, RM-2 – CFS, 2017 PA, SSW Wind, W Swell, Flood Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
24	2017 PA	PPX2	PPX2/CFS	Inbound	No	80 / 80 / 80	20kt SSW (222. 5°)	Swell W	4.5/1.4	Flood Tide (01:20)	RM-2	CFS	G. Wales	24: 🟢 25, 26, 27: **NA**

Simulation 24 started at approximately River Mile -2 to assess the Post-Panamax Generation Two containership transit in the 2017 proposed alteration channel and the turning evolution in the proposed turning basin adjacent to the container facility. The transit was conducted with a flood tidal current with strong SSW winds. This simulation ended with a grounding in the turning basin upon giving tug commands. It is believed that this grounding was a simulation software malfunction.

Simulation 25 & 26 & 27 were a re-runs of **Simulation 24** but starting in the turning basin or approaching the turning basin to see if the software malfunction was corrected. Unfortunately, the same issue occurred, and these simulations ended with a grounding in the turning basin. It is believed that the issue was with the metacentric height of the vessel as this vessel was the vessel model used from Phase 1 simulations due to the feedback that the Phase 2 model has an unrealistic ROT. Between Phase 1 and Phase 2 the software programing changed how the metacentric height was programed for the vessel models.

Vessel Swept Path Figures: Figure 4-35**,** Figure 4-37, Figure 4-39, and Figure 4-41, respectively.

Vessel and Tug Parameter Time Series: Figure 4-36, Figure 4-38, Figure 4-40, and Figure 4-42**,** respectively.

Pilot Comments: These pilot comments and ratings are given for **Simulation 24** and only consider the channel transit. The pilot found the simulation to be a realistic representation and the vessel model performed as expected. Safety and tug adequacy were rated “best”. Run difficulty was rated as below average difficulty. The vessel track stayed within the channel and turning basin boundaries. Throughout the transit there was reserve tug power, sufficient clearances, and the bow thruster was not used. The pilot would perform this transit in a real-life situation.

Result: Successful

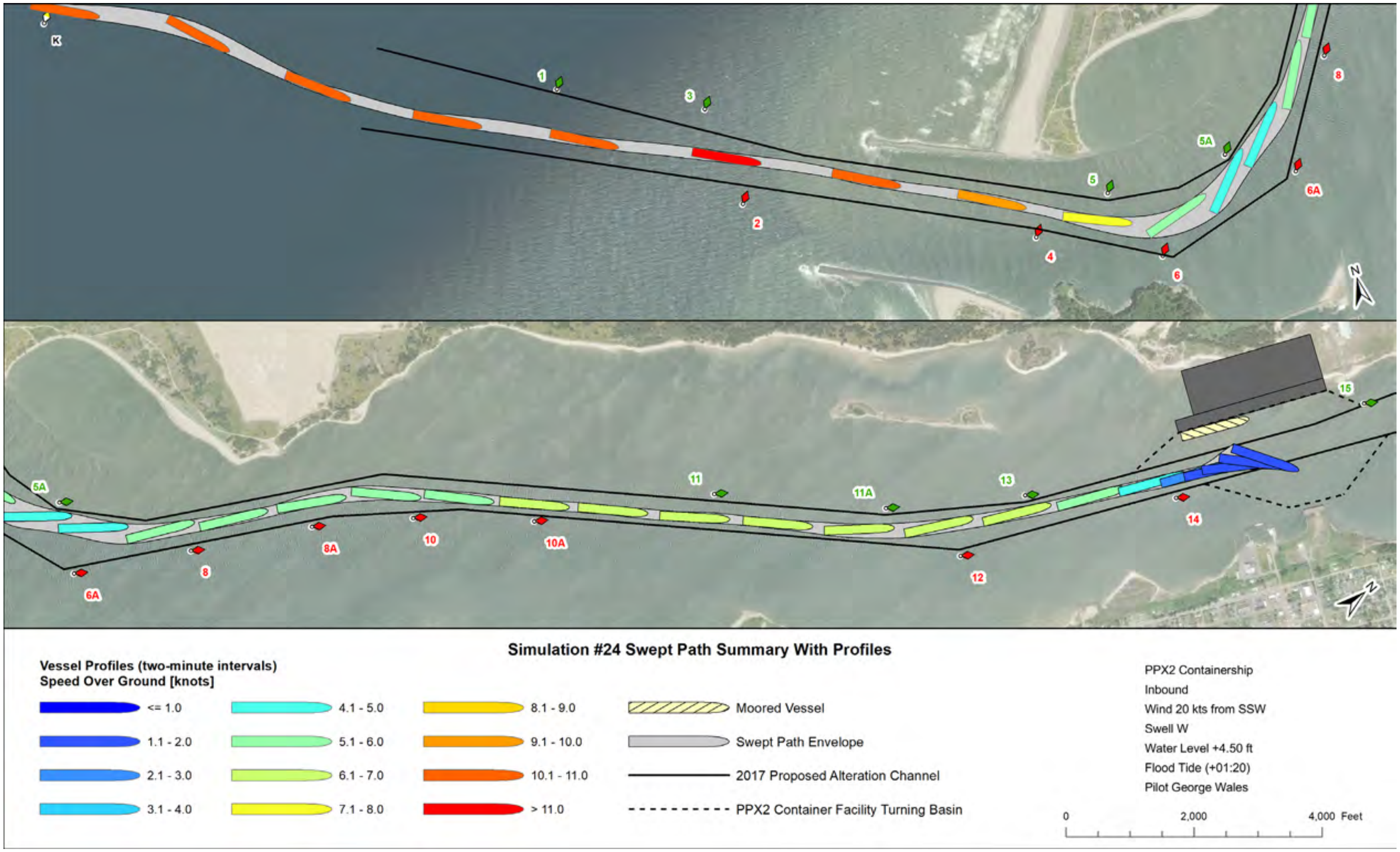

Figure 4-35: Simulation 24 Swept Path Summary with Profiles

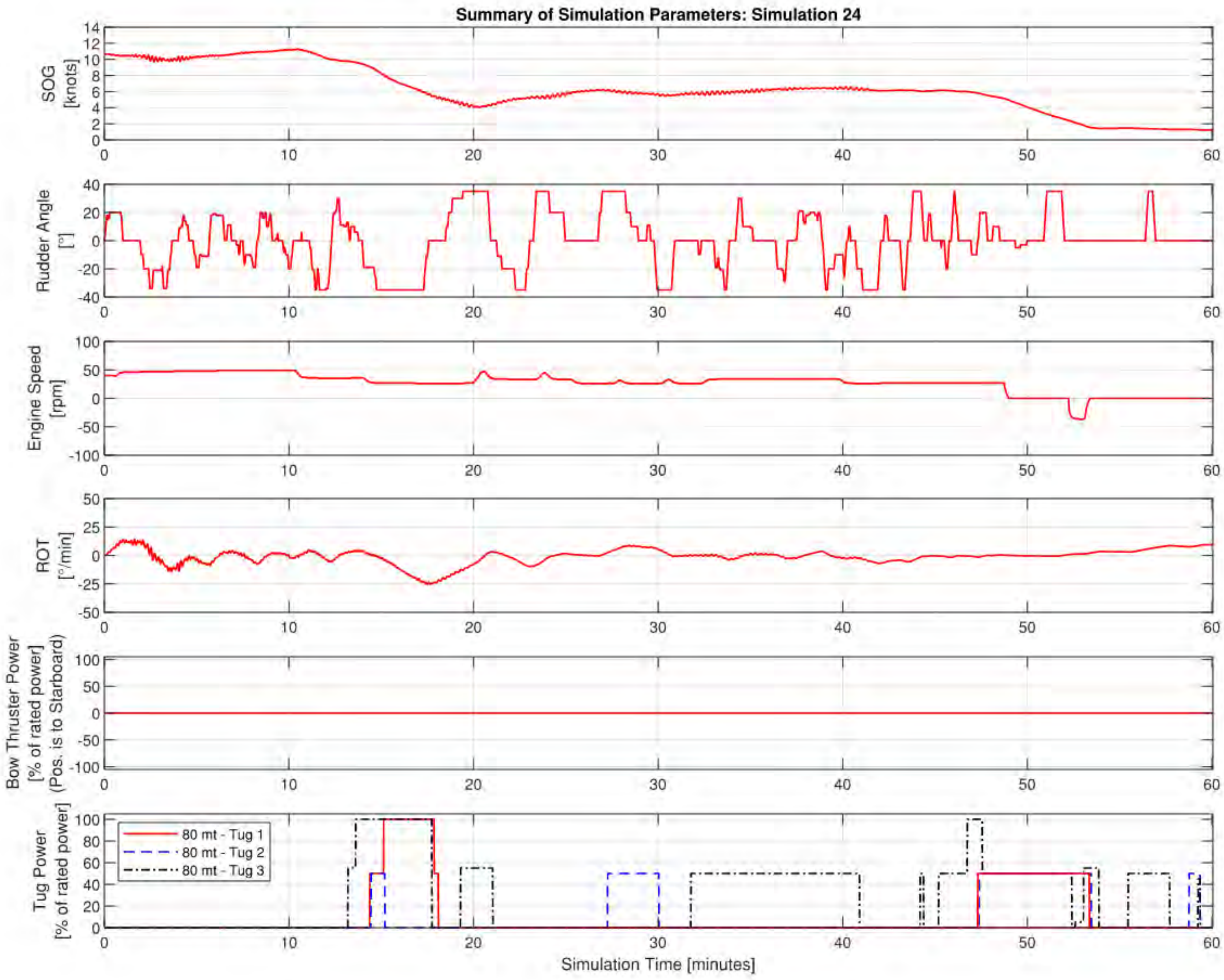

Figure 4-36: Simulation 24 Vessel and Tug Parameter Time Series

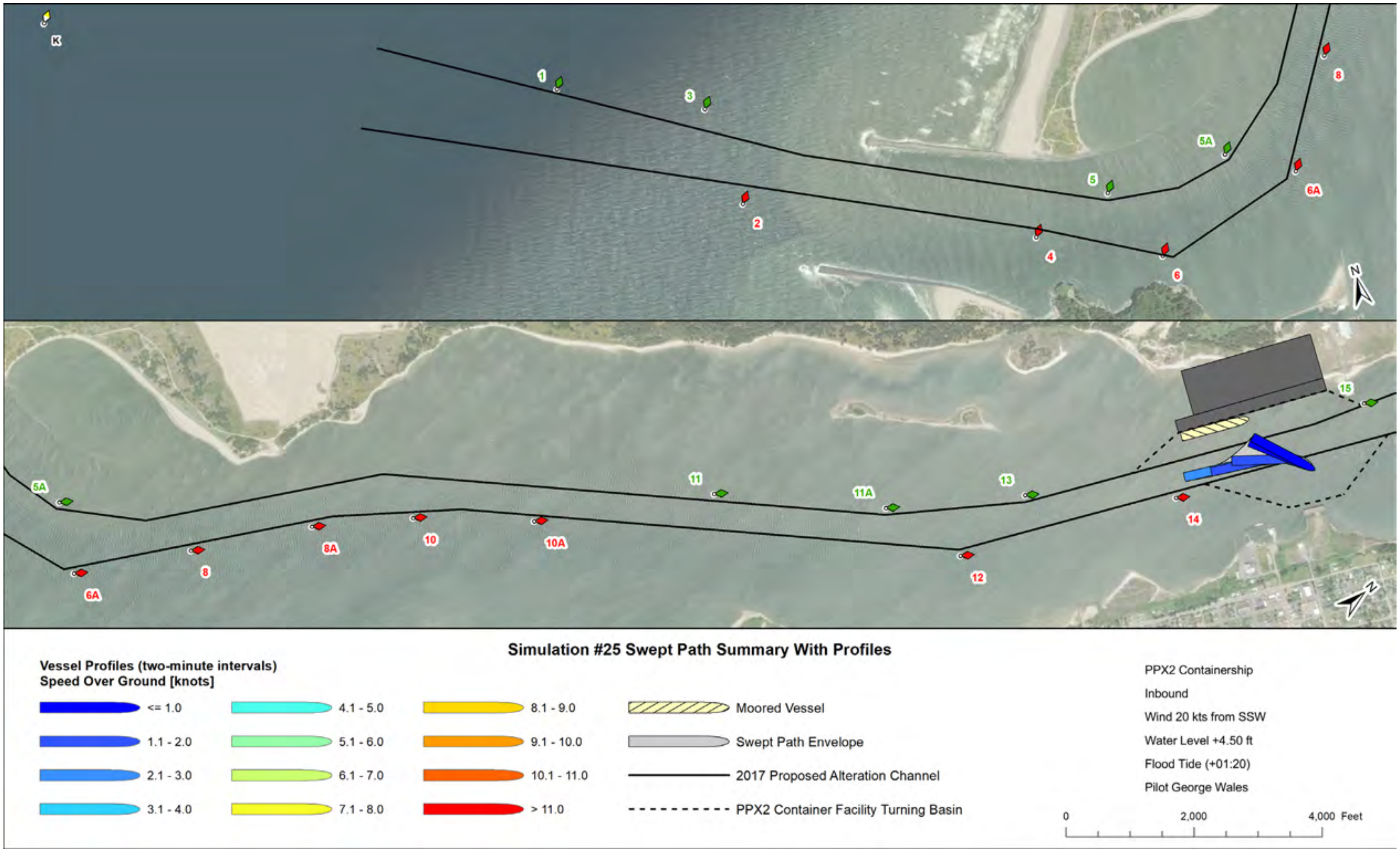

Figure 4-37: Simulation 25 Swept Path Summary with Profiles

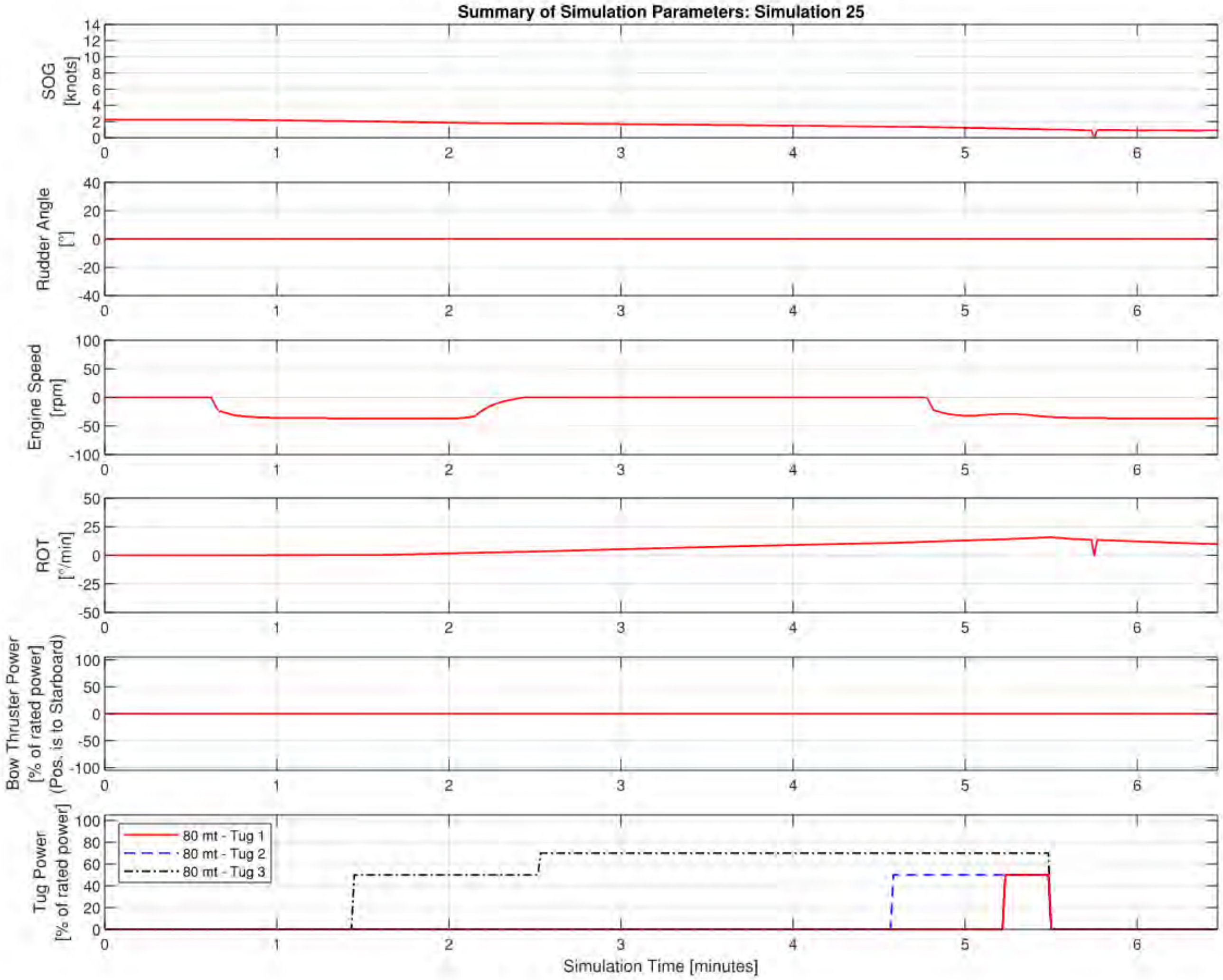

Figure 4-38: Simulation 25 Vessel and Tug Parameter Time Series

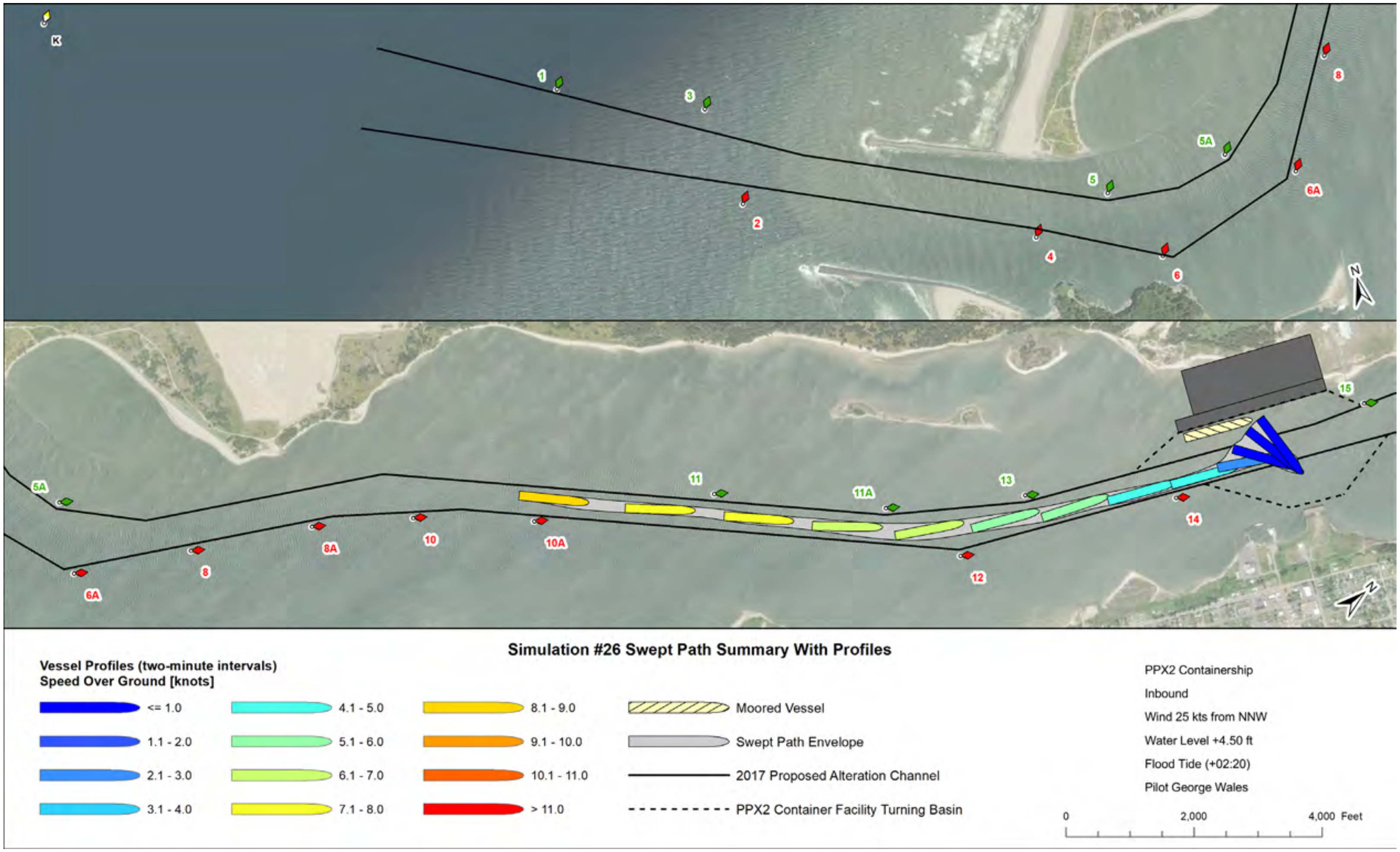

Figure 4-39: Simulation 26 Swept Path Summary with Profiles

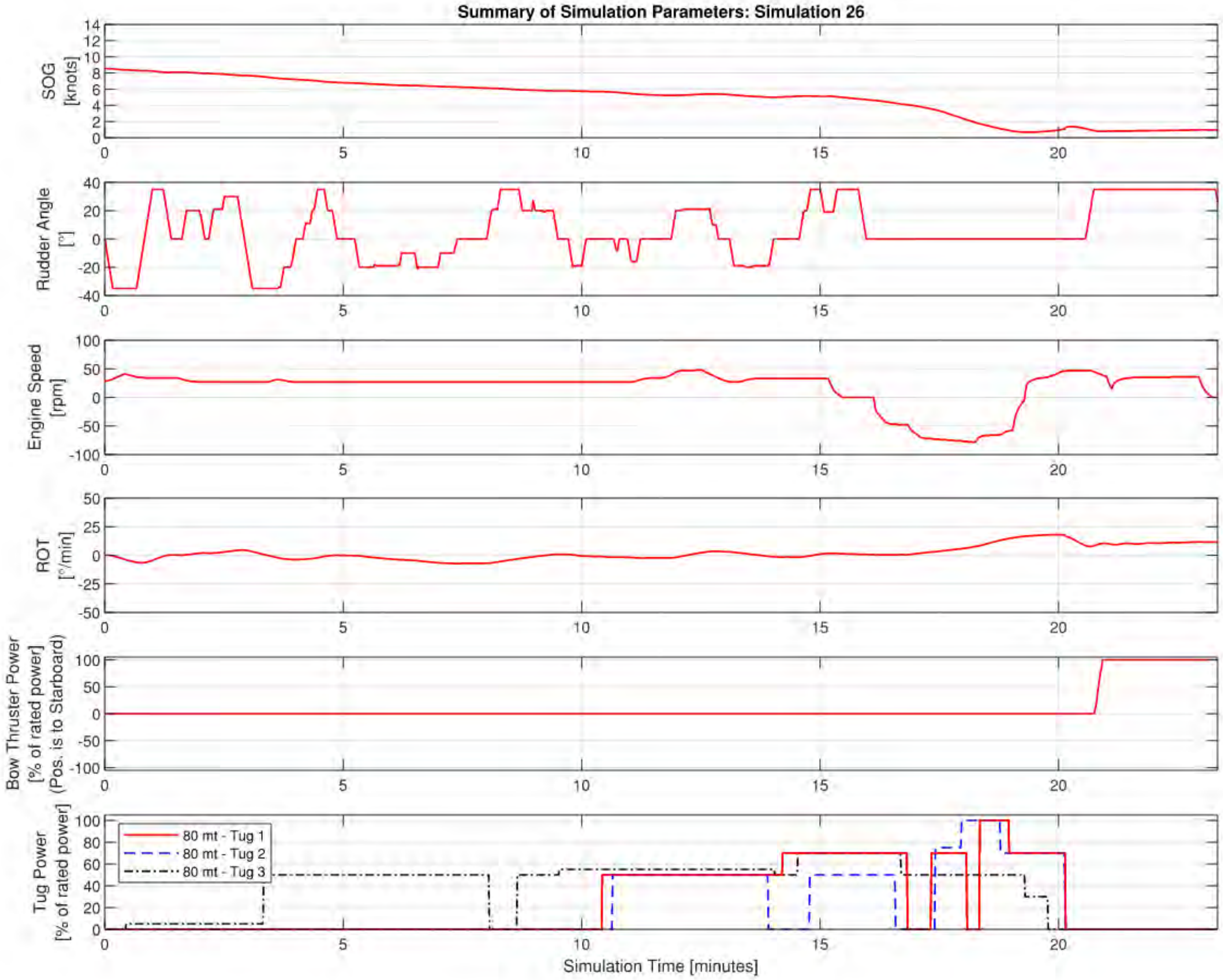

Figure 4-40: Simulation 26 Vessel and Tug Parameter Time Series

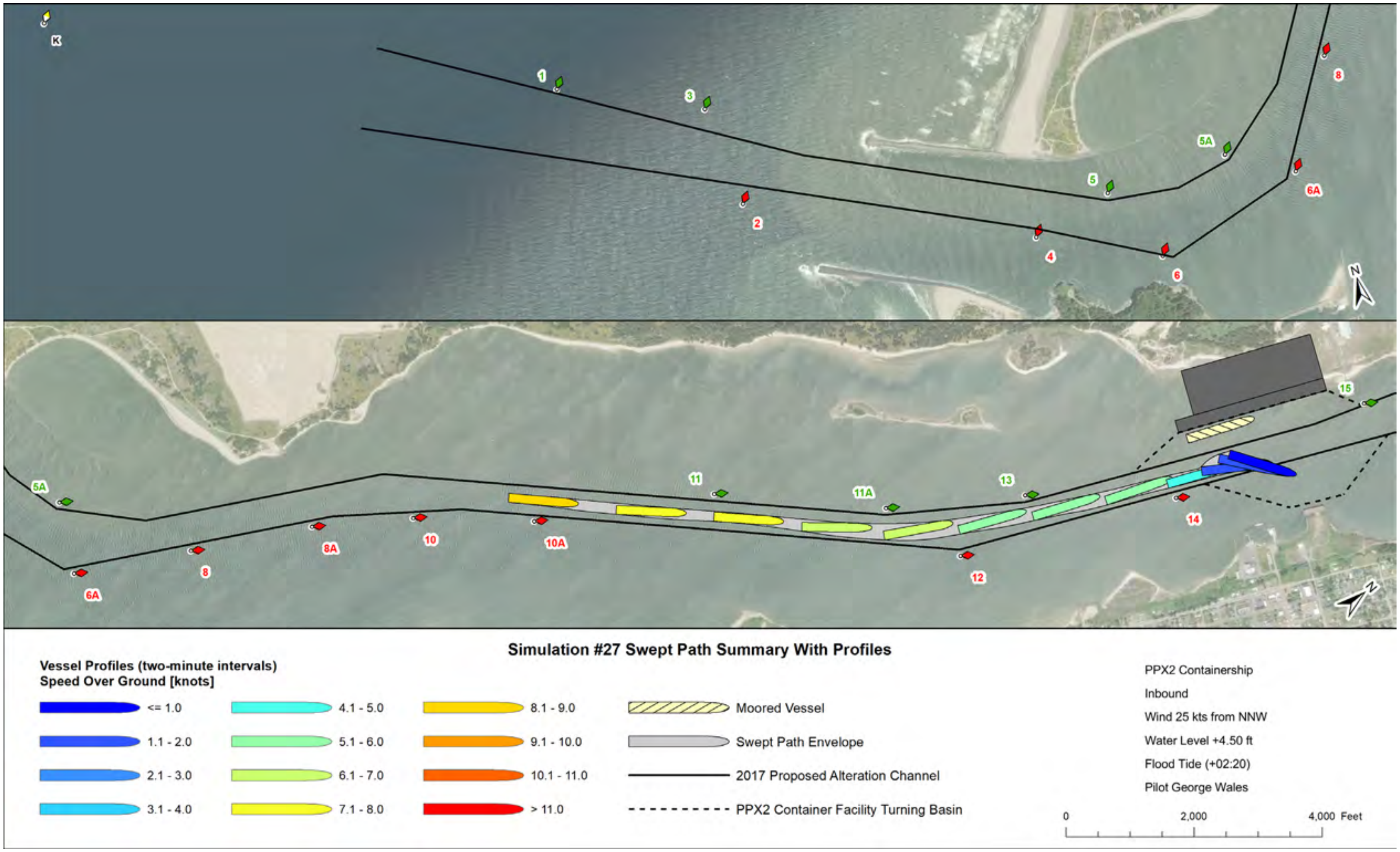

Figure 4-41: Simulation 27 Swept Path Summary with Profiles

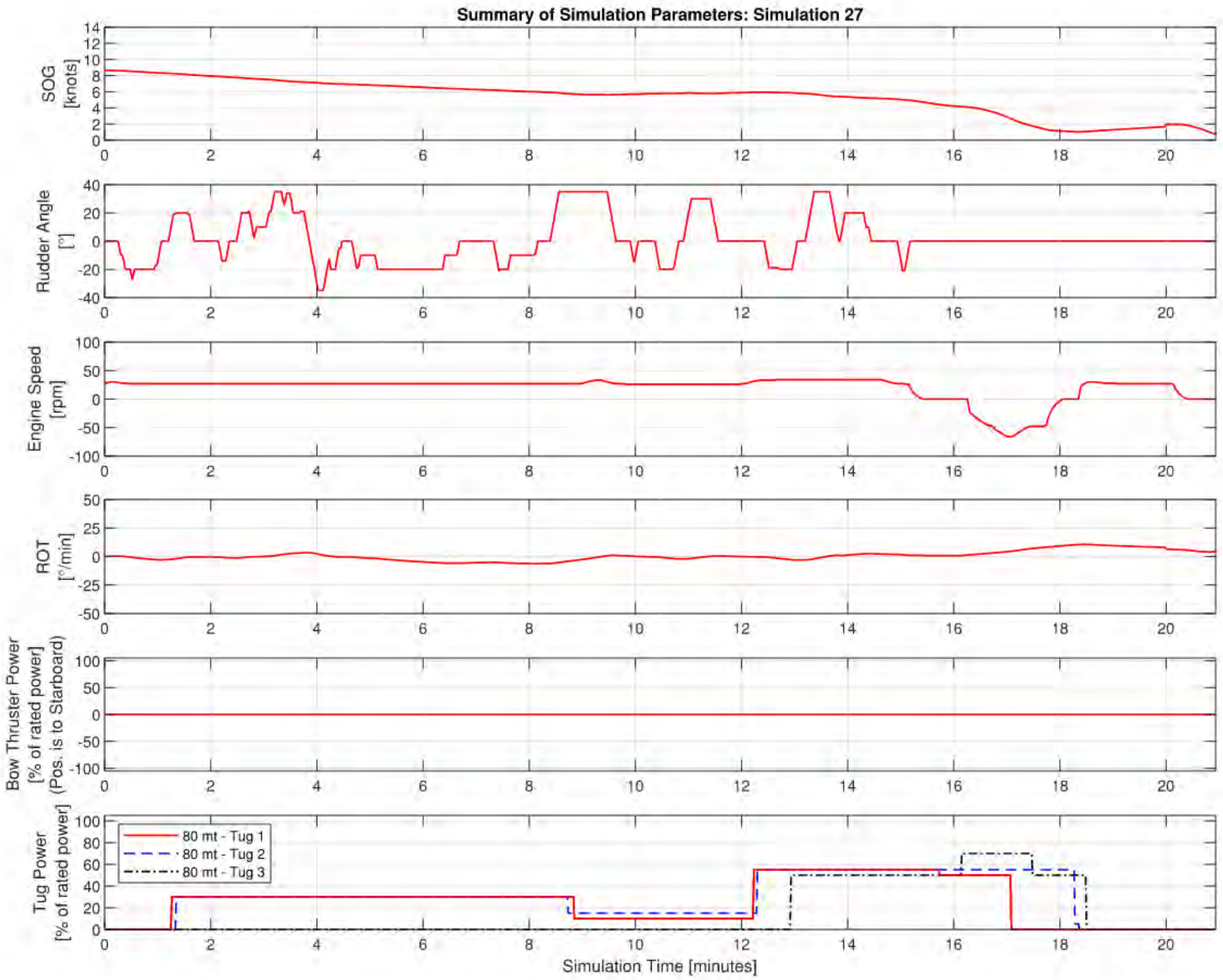

Figure 4-42: Simulation 27 Vessel and Tug Parameter Time Series

4.2.10 Simulation 28 – PPX2 Inbound, Buoy 10A – CFS, 2017 PA, NNW Wind, Flood Tide

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
28	2017 PA	PPX2	Inbound	No	80 / 80 / 80	25kt NNW (337. 5°)	4.5/1.4	Flood Tide (01:20)	RM-2	CFS	G. Wales	🟢

Simulation 28 started at approximately River Mile -2 to assess the Post-Panamax Generation Two containership transit in the 2017 proposed alteration channel to the container facility. The transit was conducted with a flood tidal current with reduced NNW winds.

Vessel Swept Path Figures: Figure 4-43.

Vessel and Tug Parameter Time Series: Figure 4-44.

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected. This simulation had three assist tugs available. This simulation was a successful channel transit. This simulation safety and tug adequacy were rated as “best”. The run difficulty was rated as average. Throughout the transit there was reserve tug power. The pilot would perform this transit in a real-life situation.

Result: Successful

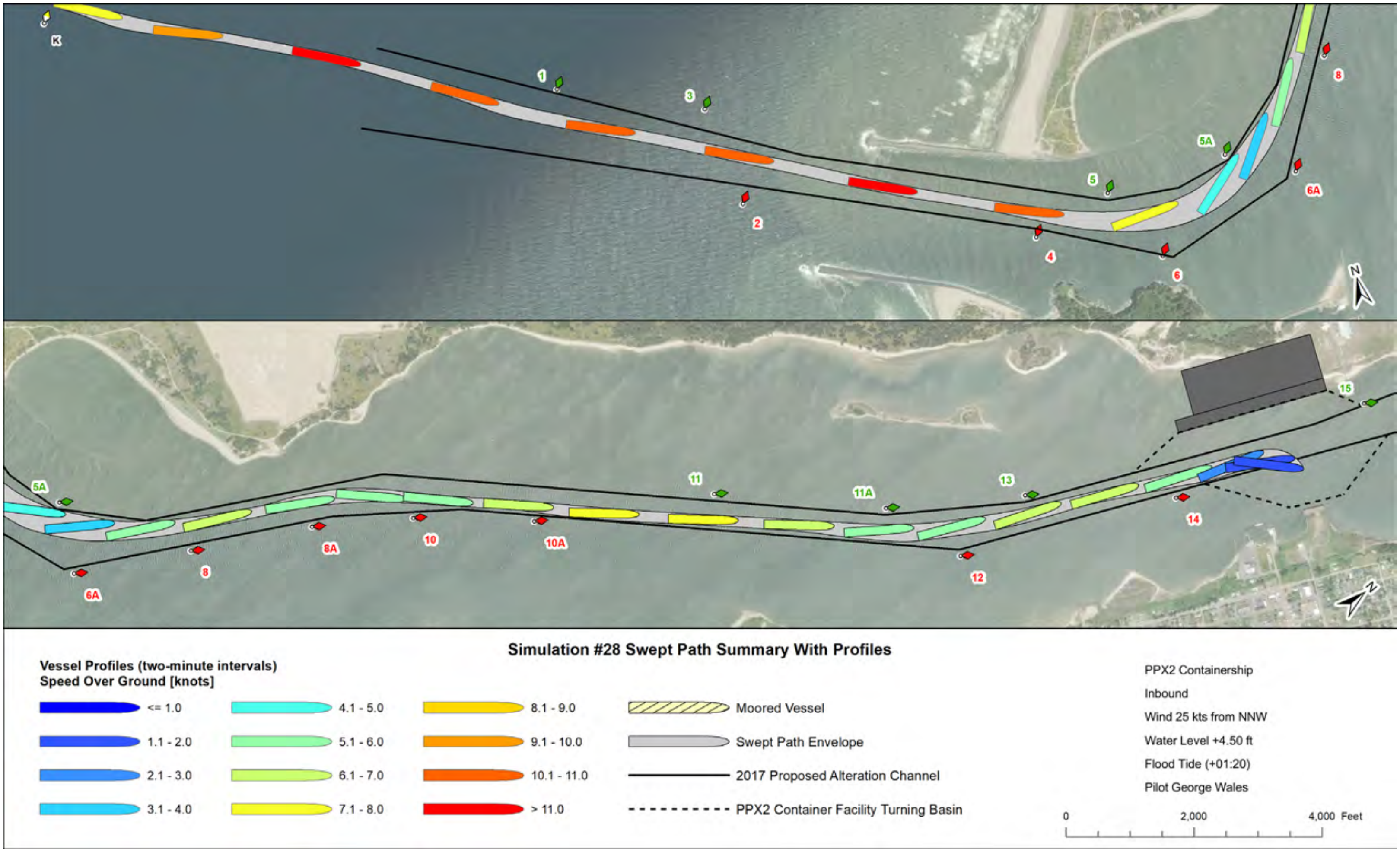

Figure 4-43: Simulation 28 Swept Path Summary with Profiles

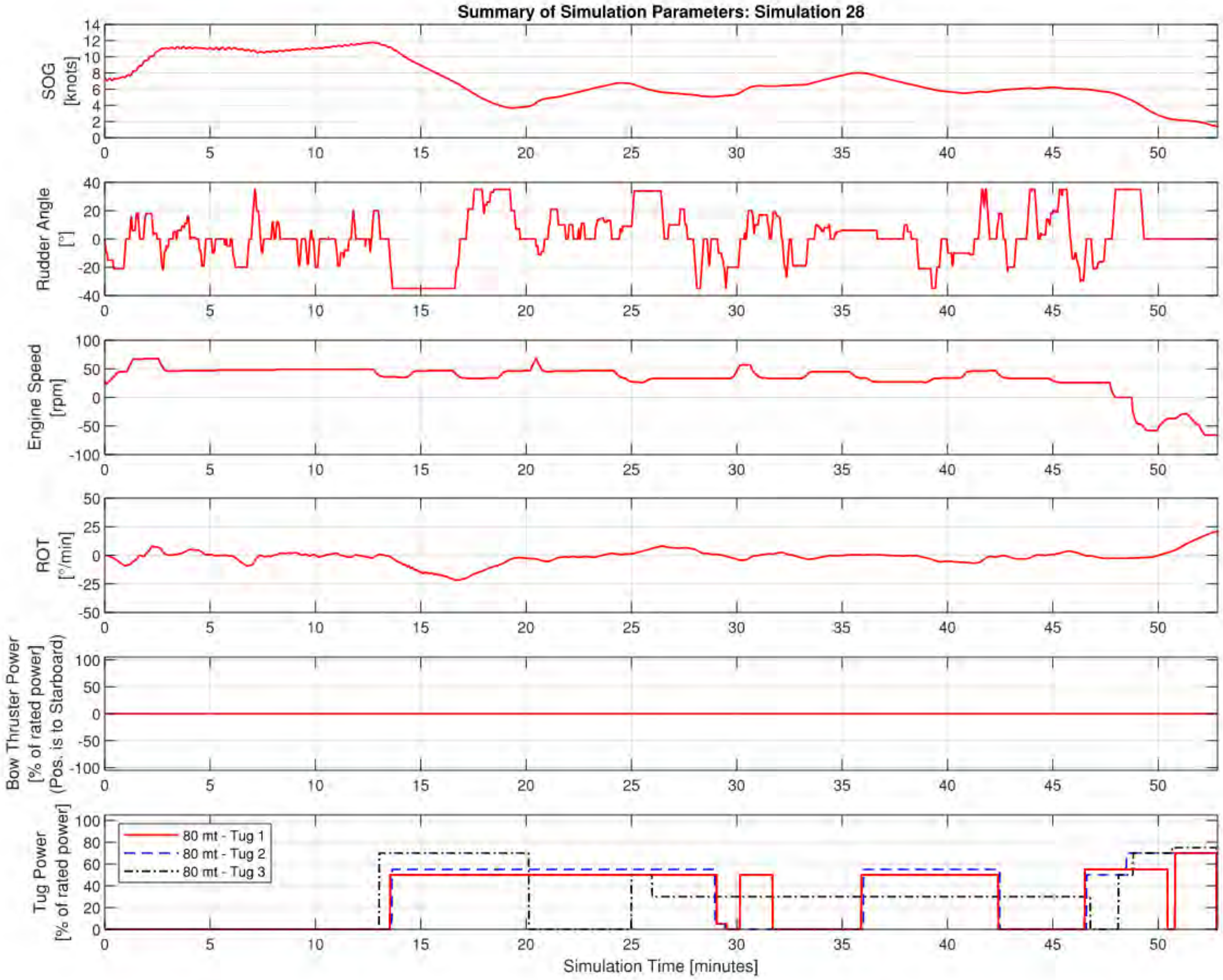

Figure 4-44: Simulation 28 Vessel and Tug Parameter Time Series

4.2.11 Simulation 29 – PPX2 Outbound, CFS – CFS, 2017 PA, SSW Wind, Ebb Tide

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
29	2017 PA	PPX2	PPX2, CFS	Outbound	Yes / CF Turning Basin	80 / 80 / 80	20kt SSW (222. 5°)	4.5/1.4	2 hours before high water (05:20)	CFS	CFS	S. Woods	NA

Simulation 29 was an outbound simulation with the Post-Panamax Generation Two containership. This simulation started with the containership departing the north berth at the proposed container facility. During the turning maneuvering the vessel grounded with what is believed to be the same software malfunction as Simulations 25, 26, and 27. The transit was conducted with the tidal current corresponding to high slack water at the container facility and strong SSW winds.

Vessel Swept Path Figures: Figure 4-45.

Vessel and Tug Parameter Time Series: Figure 4-46.

Pilot Comments: This simulation ended with a grounding in the turning basin due to software malfunction and no pilot feedback was given.

Result: NA

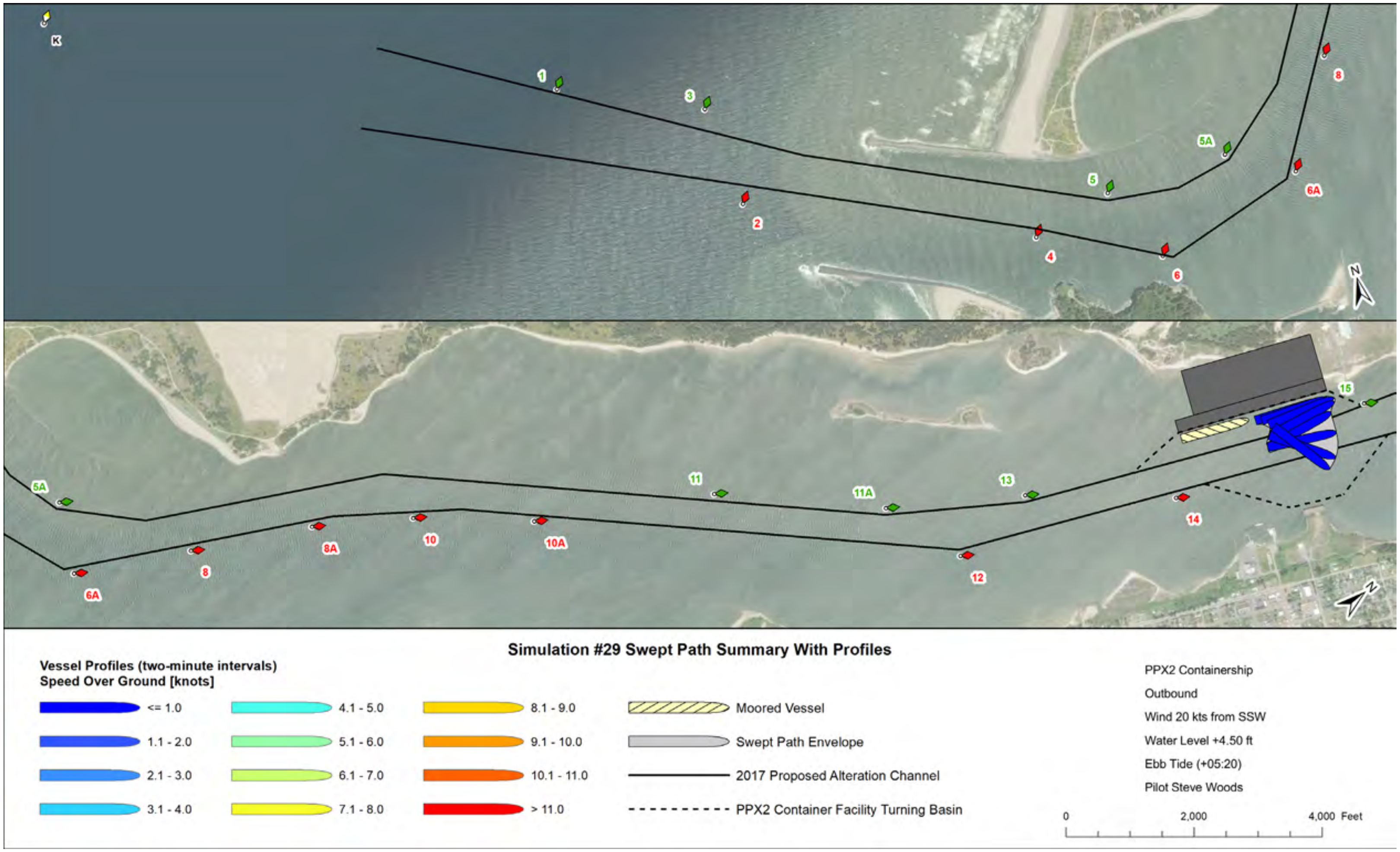

Figure 4-45: Simulation 29 Swept Path Summary with Profiles

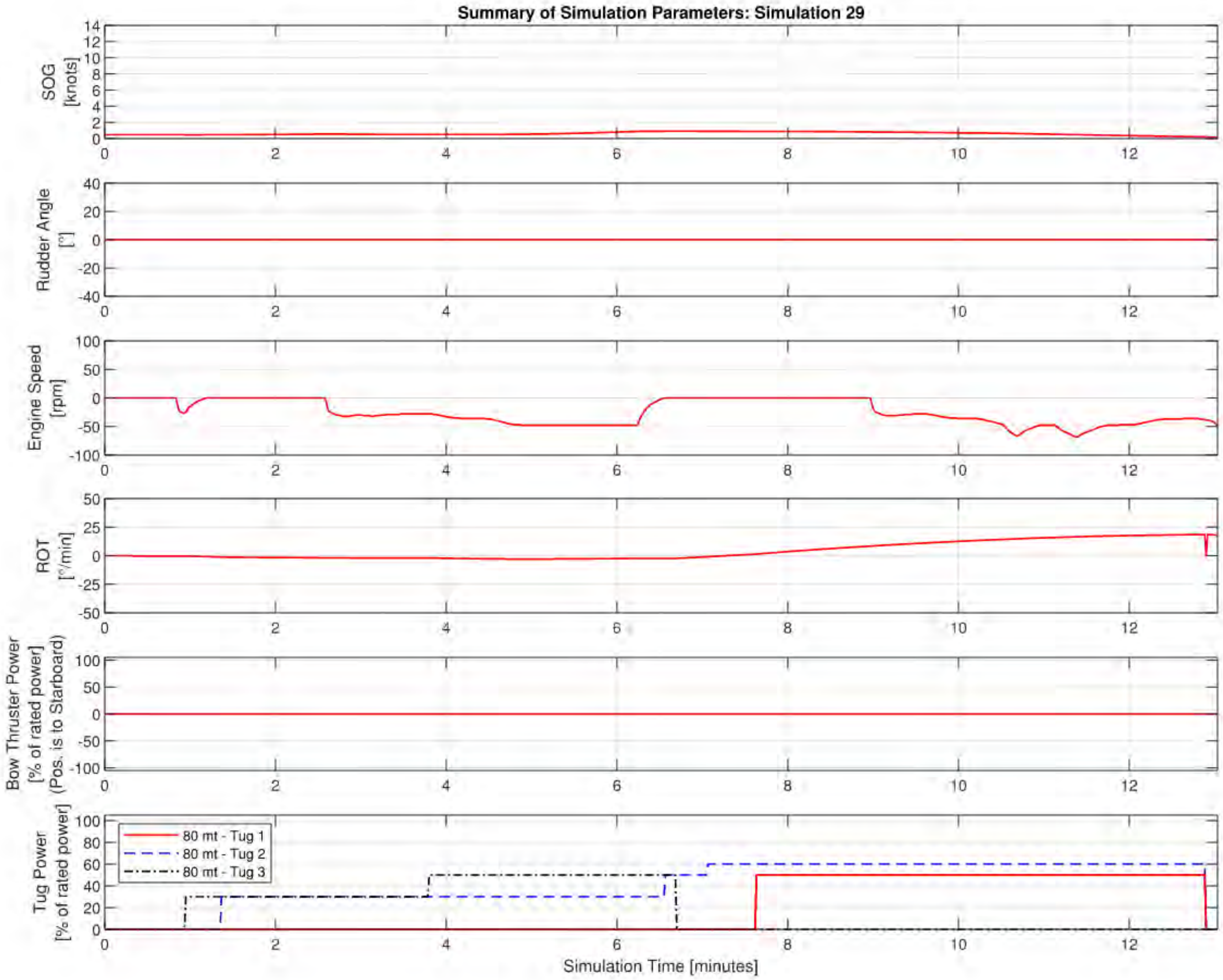

Figure 4-46: Simulation 29 Vessel and Tug Parameter Time Series

4.2.12 Simulation 31 – PPX2 Inbound, Buoy 10A – CFS, 2017 PA, NNW Wind, Flood Tide

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
29	2017 PA	PPX2	Inbound	Yes / CF Turning Basin	80 / 80 / 80	25kt NNW (337. 5°)	4.5/1.4	Flood Tide (02:20)	Buoy 10A	CFS	G. Wales	🟢

Simulation 31 was a repeat of Simulation 26 and ended with a grounding the turning basin like the previous software malfunction runs.

Vessel Swept Path Figures: Figure 4-45.

Vessel and Tug Parameter Time Series: Figure 4-46.

Pilot Comments: The pilot gave his feedback for the portion of the simulation that was able to be performed before the grounding. Captain Wales found the simulation to be a realistic representation and the vessel model performed as expected. Safety and tug adequacy were rated as above average. Run difficulty was rated as average difficulty. The vessel track stayed within the channel boundaries. The pilot stated that he would perform this transit in a real-life situation.

Result: Successful

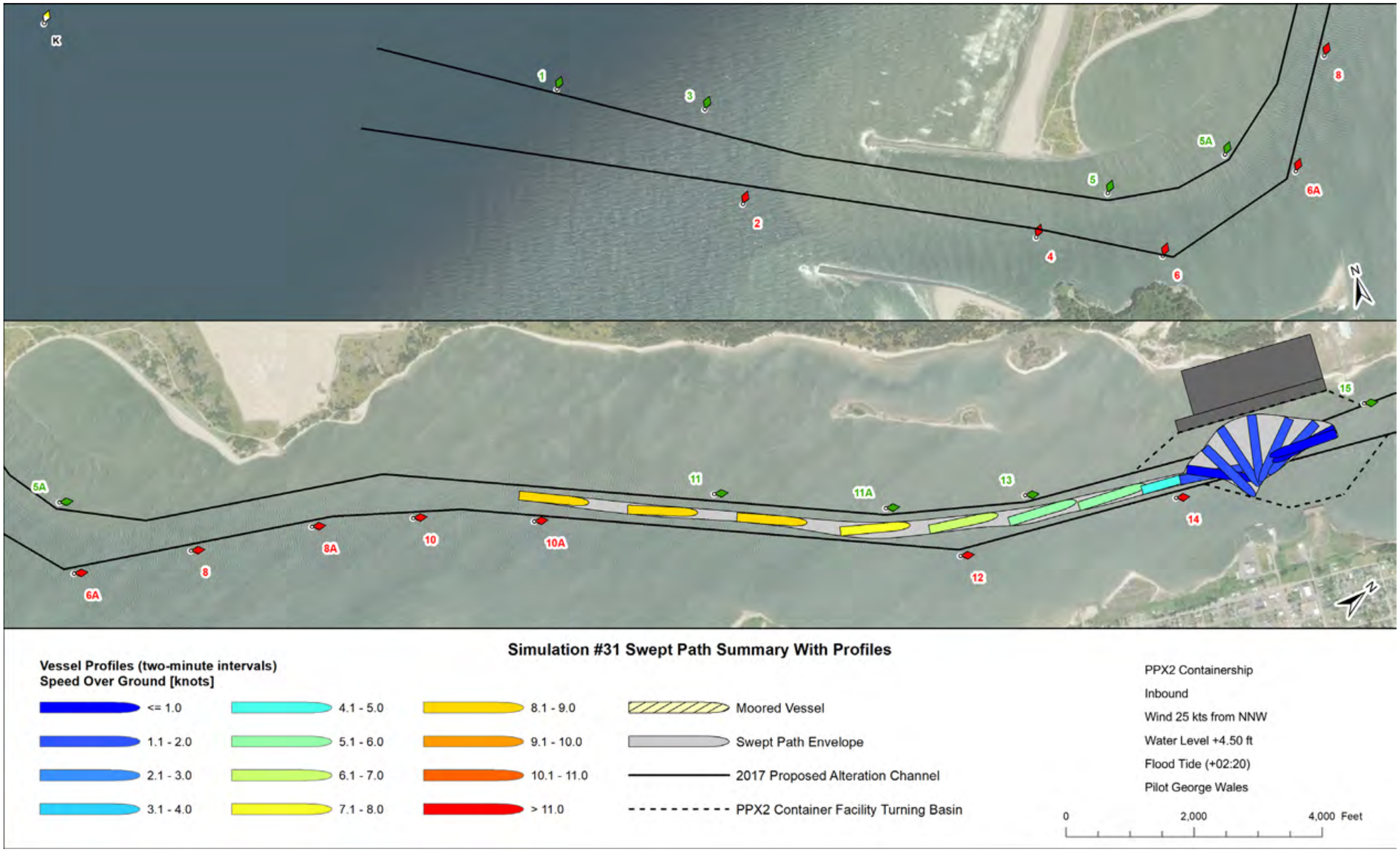

Figure 4-47: Simulation 31 Swept Path Summary with Profiles

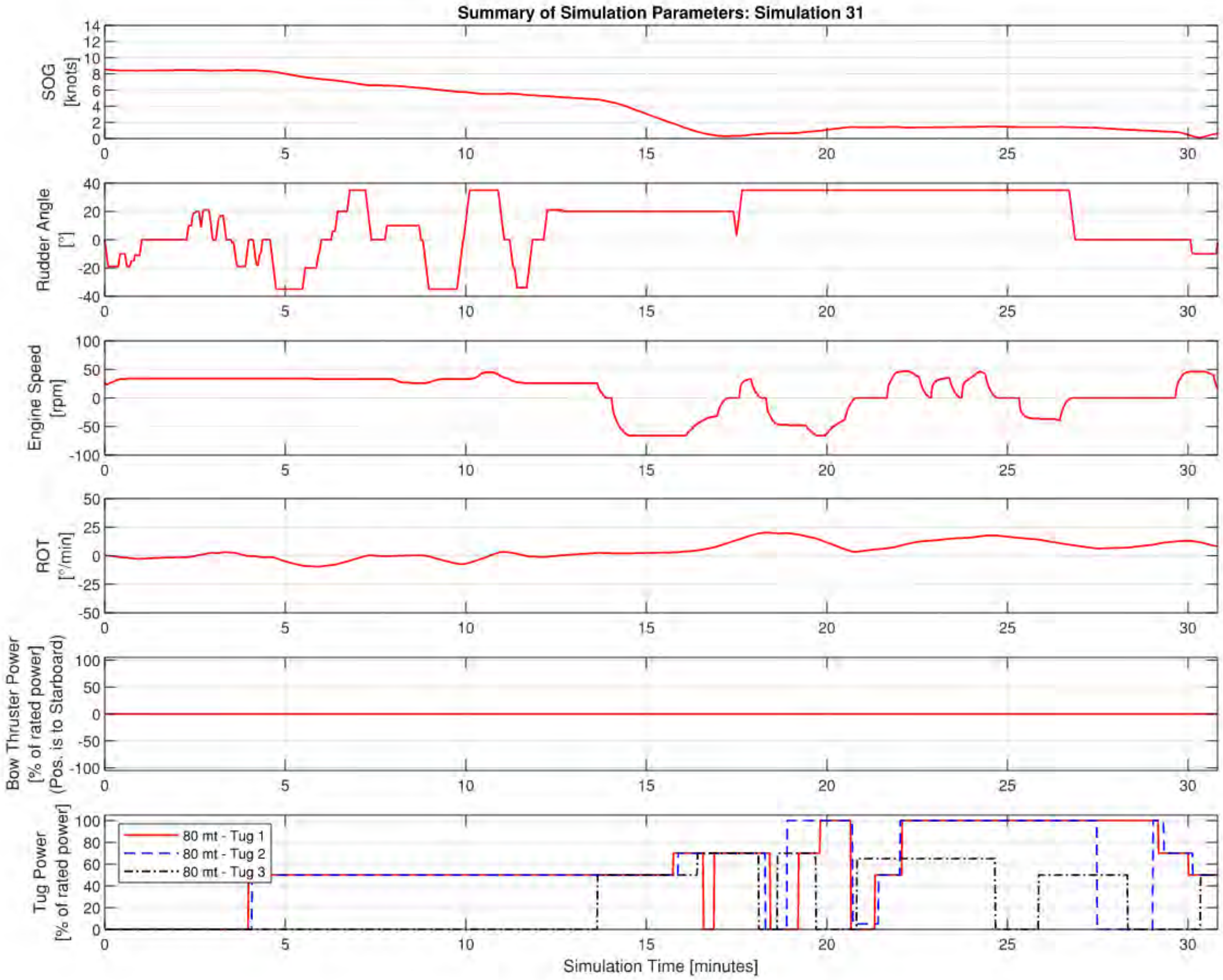

Figure 4-48: Simulation 31 Vessel and Tug Parameter Time Series

4.3 POST PANAMAX GENERATION THREE CONTAINERSHIP SIMULATIONS

In total 2 simulations were performed in the 2023 PA channel with the PPX3 containership evaluating the 2017 PA channel transit. These simulations were both inbound and had the same environmental conditions.

The pilot safety, run difficulty, and tug adequacy ratings for all the PPX3 containership simulations are summarized in Table 4-3. On average the inbound transits were rated as lowest safety, average tug adequacy, and the highest difficulty.

Table 4-3. PPX3 Containership Pilot Ratings for Safety, Difficulty, & Tug Adequacy

Simulation Number	Pilot	Run Safety	Tug Adequacy	Run Difficulty	Run Result
Inbound Maneuver					
11	S. Woods	1	2	5	🔴
12	T. Petrusha	1	5	5	🔴
Inbound Average	--	1.0	3.5	5.0	--

4.3.1 Inbound Maneuvers

4.3.1.1 Simulation 11 & Simulation 12 – PPX3 Inbound, RM -2 – Entrance Turn, 2017 PA, NNE Wind, NW Swell, Flood Tide

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
11	2017 PA	PPX3	Inbound	No	80 / 80 / 80	25kt NNE (22.5°)	Swell NW	4.5/1.4	Flood Tide (01:20)	RM - 2	Entrance Turn	S. Woods	🔴

Simulations 11 and 12 started at the pilot buoy to assess the 2017 PA channel transit with the Post-Panamax Generation Three containership. The transit was conducted with a flood tidal current with strong NNE winds.

Vessel Swept Path Figures: Figure 4-49 and Figure 4-51, respectively.

Vessel and Tug Parameter Time Series: Figure 4-50 and Figure 4-52, respectively.

Pilot Comments: Both of these simulations ended with a grounding in the entrance turns. Overall, the feedback was that in order to safely transit a Post-Panamax Generation Three containership to the proposed container facility channel modifications in the entrance turns would need to be made.

Result: Unsuccessful

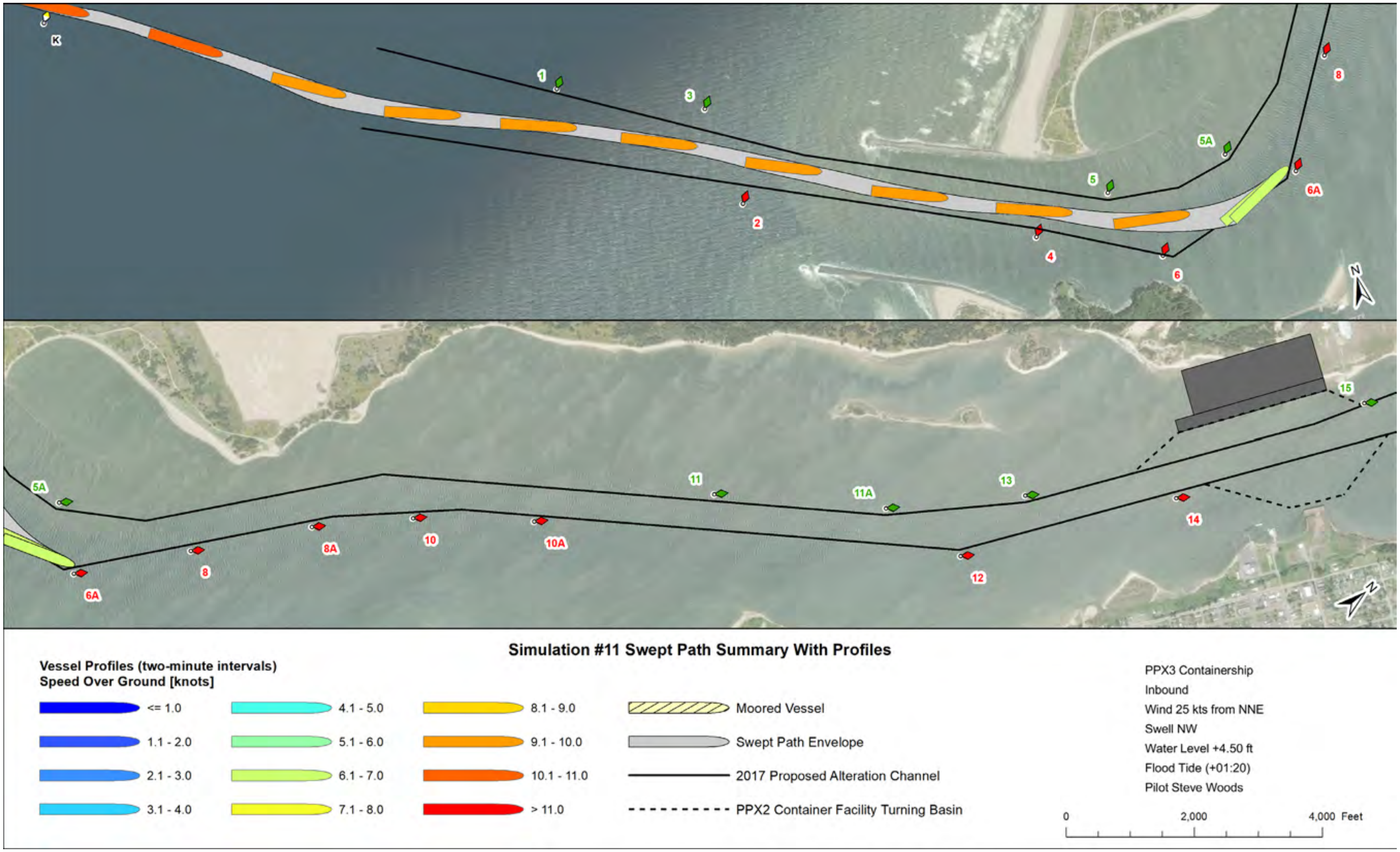

Figure 4-49: Simulation 11 Swept Path Summary with Profiles

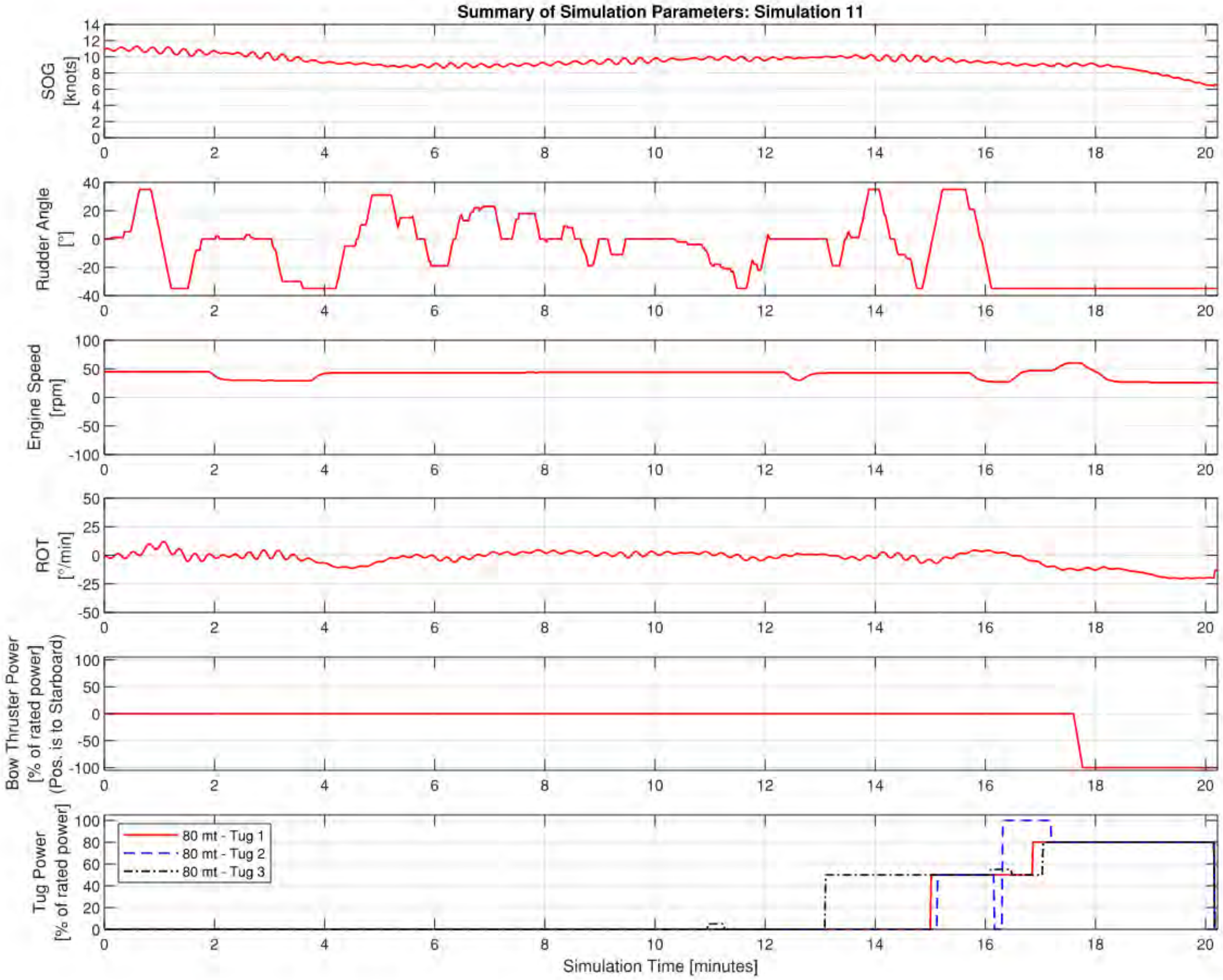

Figure 4-50: Simulation 11 Vessel and Tug Parameter Time Series

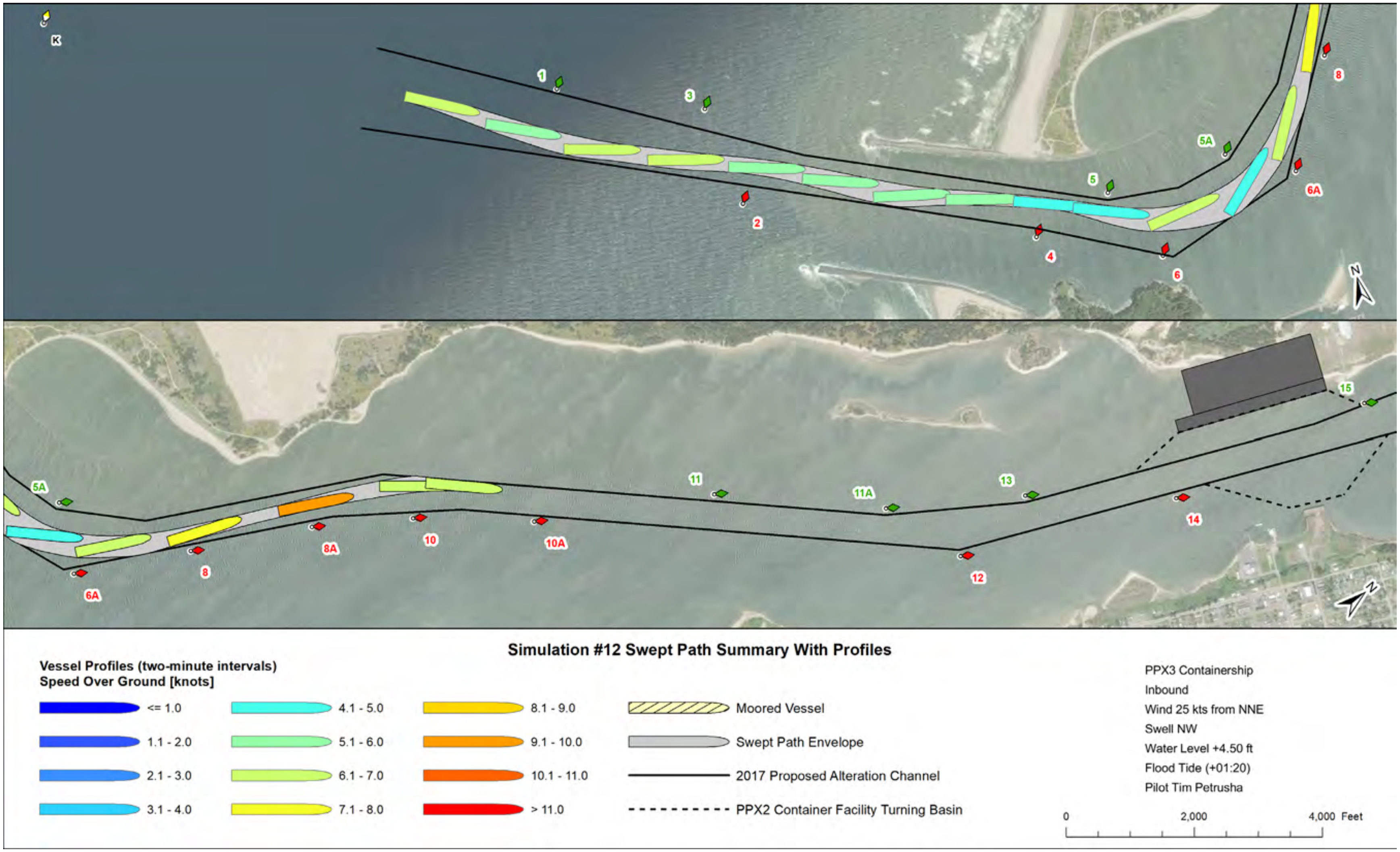

Figure 4-51: Simulation 12 Swept Path Summary with Profiles

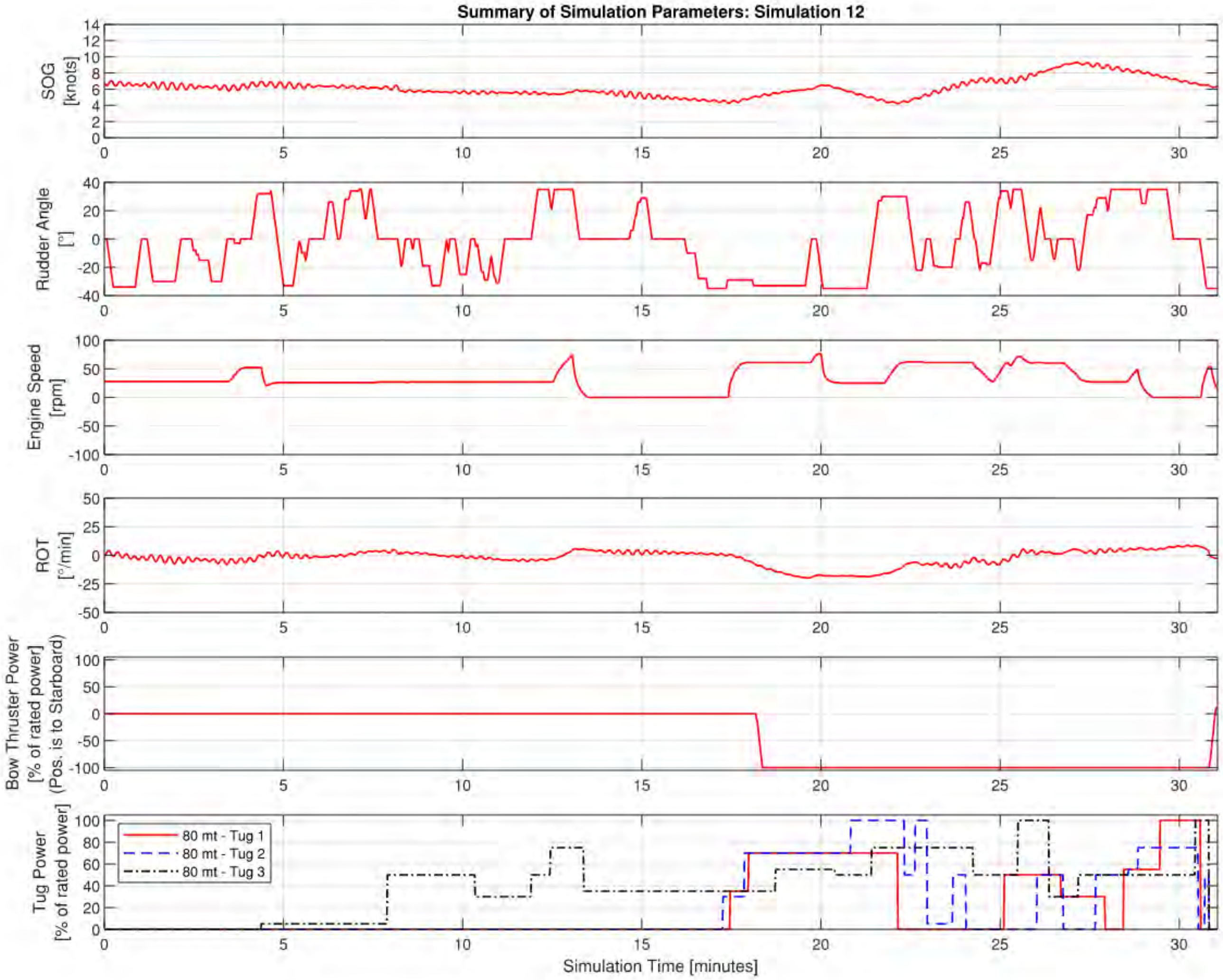

Figure 4-52: Simulation 12 Vessel and Tug Parameter Time Series

4.4 CAPESIZE BULK CARRIER SIMULATIONS

In total 2 simulations were performed in the 2017 PA channel with the capesize bulk carrier to evaluate the proposed turning basin at RM 7.5 for the larger bulk carriers calling at Roseburg Chip Facility. Operationally the bulk carriers always arrive in ballast condition and perform the turning evolution during the inbound transit. However, for this simulation effort a ballast bulk carrier was not available and as a result a loaded capesize bulk carrier was evaluated.

The pilot safety, run difficulty, and tug adequacy ratings for all the capesize bulk carrier simulations are summarized in Table 4-4. On average these transits were rated as the highest safety, above average tug adequacy, and below average run difficulty.

Table 4-4. Capesize Bulk Carrier Pilot Ratings for Safety, Difficulty, & Tug Adequacy

Simulation Number	**Pilot**	**Run Safety**	**Tug Adequacy**	**Run Difficulty**	**Run Result**
Inbound Maneuver					
10	T. Petrusha	5	5	3	🟢
30	S. Woods	5	3	2	🟡
Inbound Average	--	5.0	4.0	2.5	--

4.4.1 Simulation 10 – Capesize Inbound, CFS – RM 7.5 Turning Basin, 2017 PA, NNW Wind, Flood Tide

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
10	2017 PA	Capesize	Inbound	Yes / RM 7.5	80 / 80 / 50	25kt NNW (337.5°)	4.5/1.4	Flood Tide (03:00)	CFS	RM 7.5 Turning Basin	T. Petrusha	🟢

Simulation 10 started at the proposed container facility and evaluated a loaded capesize bulk carrier transiting the 2017 PA channel to the RM 7.5 turning basin and the turning evolution. The transit was conducted with a flood tidal current with strong NNW winds.

Vessel Swept Path Figure: Figure 4-53

Vessel and Tug Parameter Time Series: Figure 4-54

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected for a loaded bulk carrier. Run difficulty was rated as average. Tug adequacy and run safety were rated as the "best". This was performed successfully. The pilot would perform this transit in a real-world situation.

Result: Successful

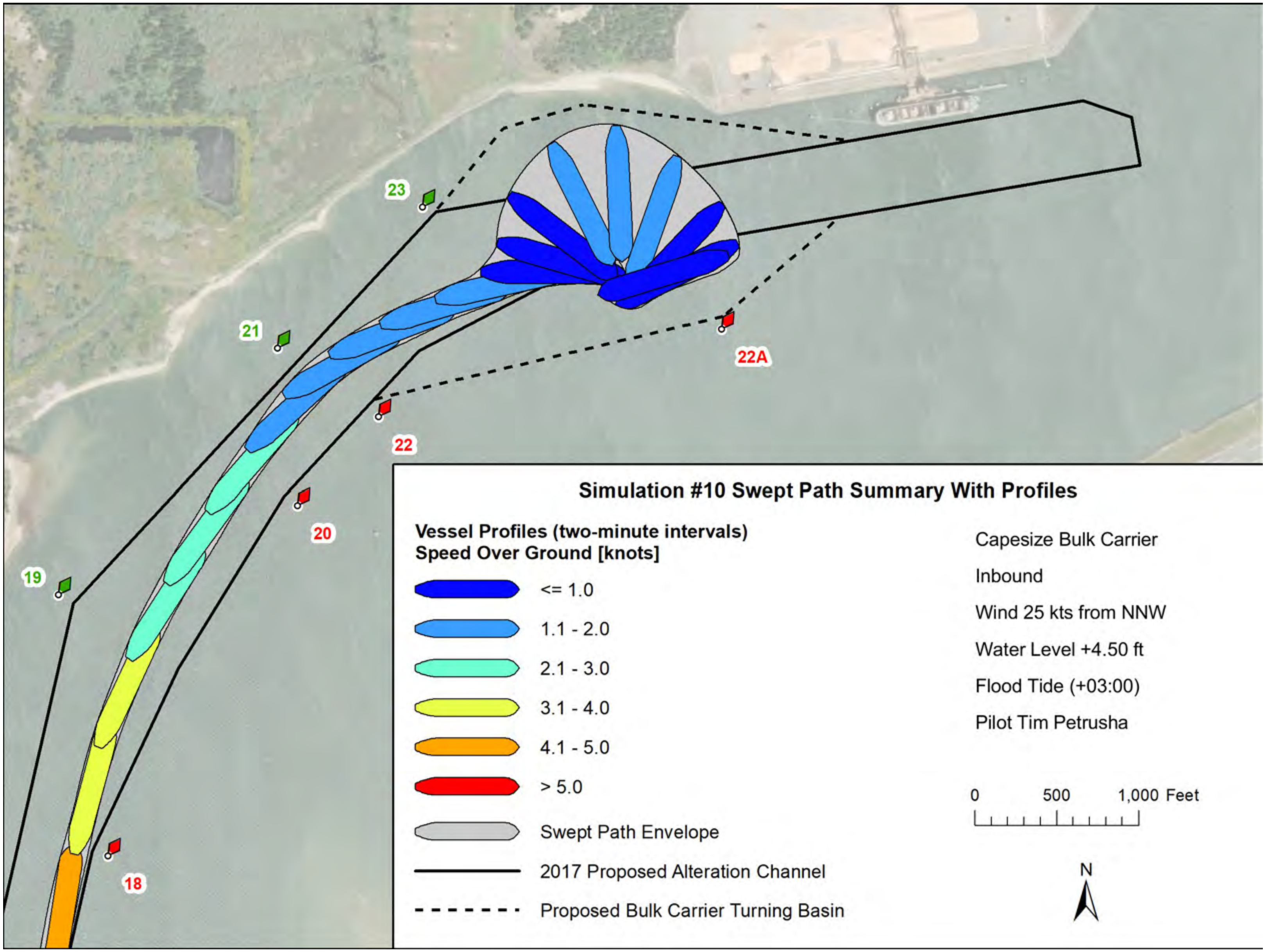

Figure 4-53: Simulation 10 Swept Path Summary with Profiles

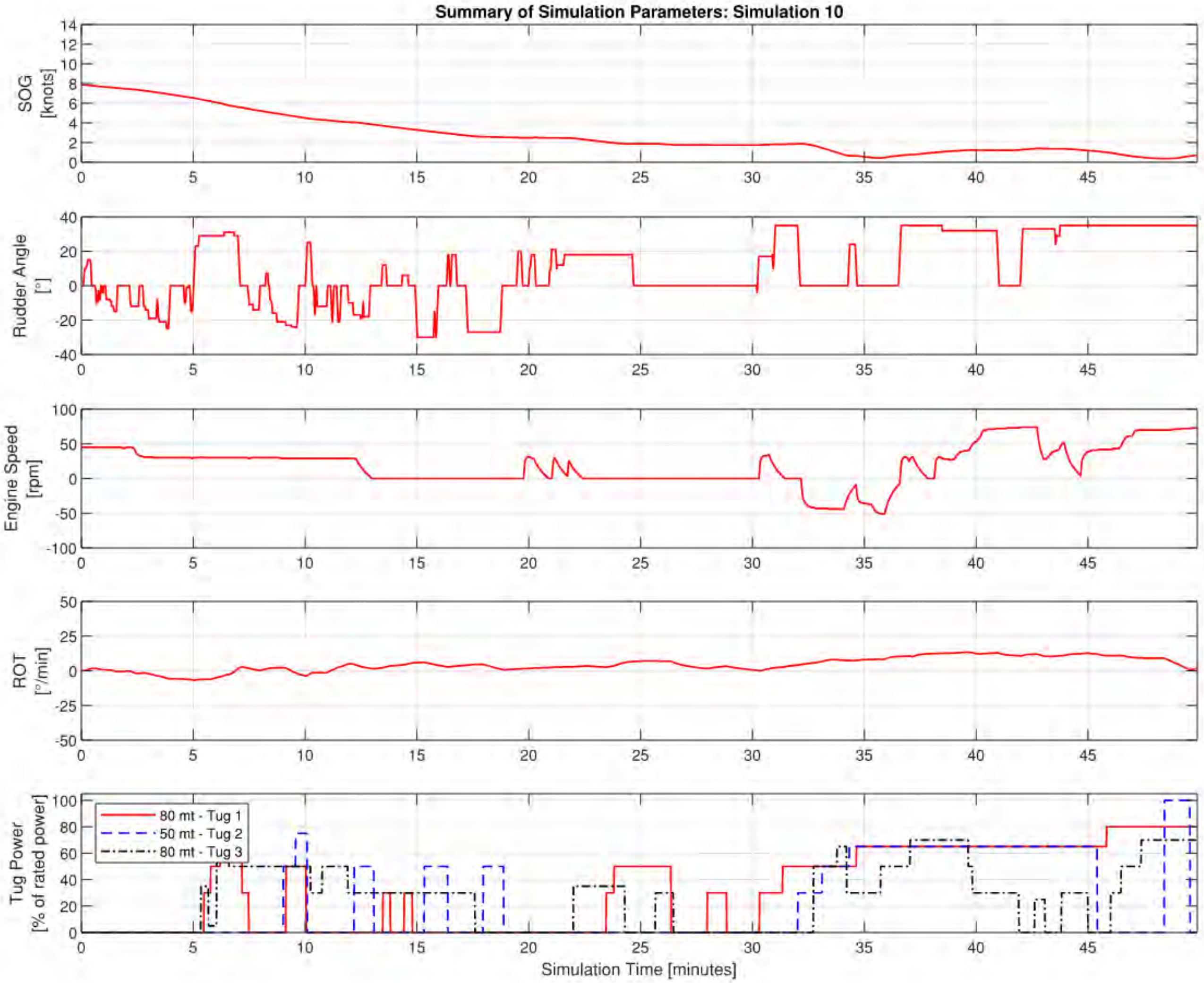

Figure 4-54: Simulation 10 Vessel and Tug Parameter Time Series

4.4.2 Simulation 30 – Capesize Inbound, CFS – RM 7.5, 2017 PA, NNW Wind, Flood Tide

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
30	2017 PA	Capesize	Inbound	Yes / RM 7.5	80 / 80	25kt NNW (337.5°)	4.5 /1.4	Flood Tide (03:00)	CFS	RM 7.5	S. Woods	🟡

Simulation 30 started at the proposed container facility and evaluated a loaded capesize bulk carrier transiting the 2017 PA channel to the RM 7.5 turning basin and the turning evolution. The transit was conducted with a flood tidal current with strong NNW winds.

Vessel Swept Path Figure: Figure 4-55.

Vessel and Tug Parameter Time Series: Figure 4-56**.**

Pilot Comments: The pilot found the simulation to be a realistic representation and the vessel model performed as expected for a loaded bulk carrier. Run difficulty and tug adequacy were rated as below average and average, respectively. Run safety was rated as the highest safety. This simulation had marginal success due to a departure of the vessel from the navigation channel in an area where the pilot commonly uses naturally deep water. The pilot would perform this transit in a real-world situation. However, for a loaded vessel the pilot would request three assist tugs with the third tug being a conventional tug.

Result: Marginal success

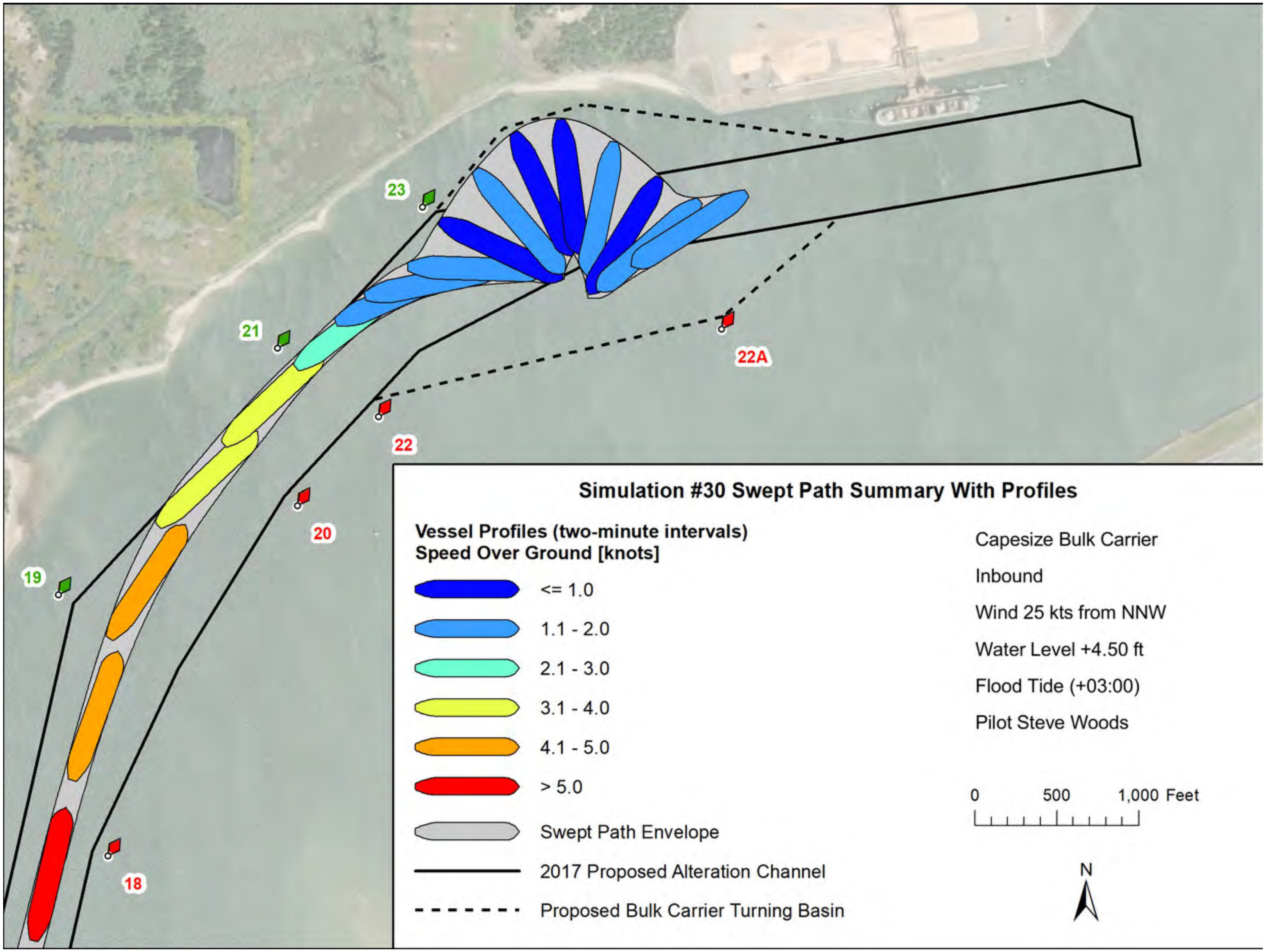

Figure 4-55: Simulation 30 Swept Path Summary with Profiles

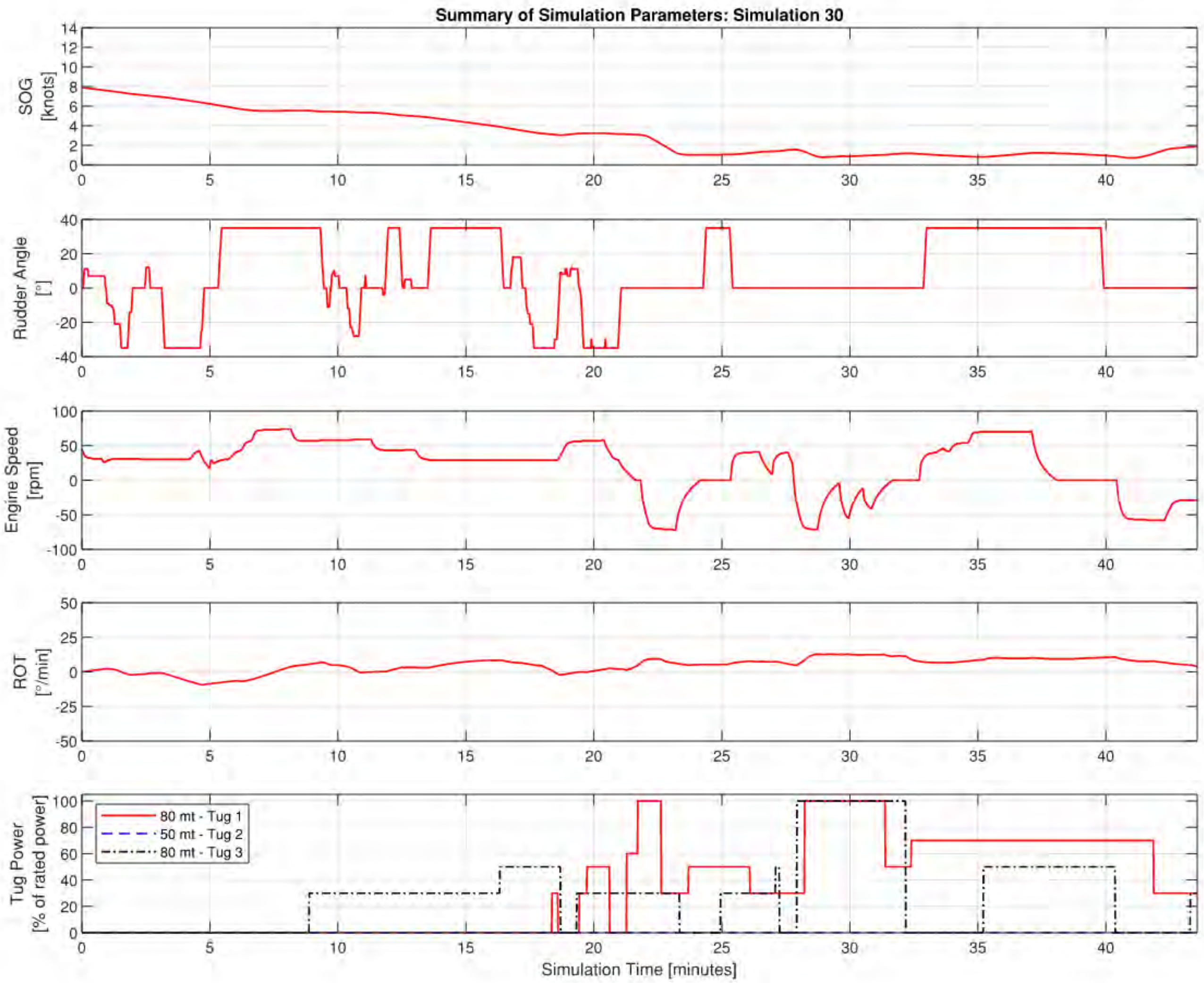

Figure 4-56: Simulation 30 Vessel and Tug Parameter Time Series

5. SUMMARY & CONCLUSIONS

A real-time vessel simulation study was performed on Moffatt & Nichol's traveling simulator at OIPCB's office in Coos Bay, OR. These simulations were performed to evaluate the navigability and safety of the existing navigation channel and the previously designed 2017 proposed alteration channel for the proposed design container vessels. Shiphandling for these simulations was performed by the local Coos Bay Pilots.

Twenty-eight simulations were performed over four simulation days, January 12 – 15, 2023. These simulations included maneuvers evaluating:

- The channel transit and turning basin maneuvers for a Panamax containership in the WOP channel,
- the proposed RM 7.5 turning basin for the Capesize bulk carriers calling at Roseburg Chip Facility and both the Panamax and Post-Panamax Generation Two containerships, and
- the channel transit and turning basin maneuvers for a Post-Panamax Generation 2 containership in the 2017 PA channel.

Nine simulations evaluated the without project channel and the remaining nineteen simulations evaluated the 2017 proposed alteration channel.

The primary conclusions and recommendations from this study are provided in the subsections below.

5.1 DESIGN VESSELS

- For the existing channel, the Panamax class containership is the recommended maximum design vessel which can safely navigate the channel.
- For the proposed channel, the Post-Panamax Generation Two containership is the recommended maximum design vessel which can safely navigate the channel.
- The Post-Panamax Generation Three containership was unable to safely transit the entrance turn of the proposed channel and would require redesign of the channel.
- Containerships have a higher sail area and wind exposure than bulkers and therefore for all containership classes it is recommended to limit wind during transits to 20-25 knots or less.

5.2 TURNING AREAS

- A turning area that is 1,850 feet long (parallel to the channel) and 1,450 feet wide is recommended for the container facility turning basin for both the Panamax and Post-Panamax Generation Two design vessels[6].

- For the turning evolutions that were performed successfully, turning while the tidal stream is running in the channel was challenging. Operationally, it is recommended that the containership berth port side to berth and perform the turning evolution on the outbound transit to better time the tidal currents. Ideally, the turn maneuver will happen near slack water.

5.3 TUGBOATS

Similar to the conclusions for LNG carriers in the previous simulations (M&N 2016 & M&N 2017), it is recommended to have a minimum of two azimuthing stern drive (ASD) tractor tugs to escort arriving and

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[6] 10567648: Phase 2 report, Section 5.2, first par: What is the TB recommended length for Panamax and post-Panamax design vessels ? Add declaration for TB length.
Response: Length added for the recommended turning basin.

departing Panamax containerships in the channels and for turning the vessels. For the Post-Panamax containerships it is recommended to have a minimum of three ASD tractor tugs.

5.4 PHASE 3 SIMULATIONS

The next step of the channel evaluation will bring Phase 1 & 2 findings to a full mission bridge ship simulation facility to allow the Coos Bay Pilots to test the design vessels and channels in a more realistic setting. Prior to the Phase 3 simulations the location of proposed container facility and associated turning basin will be verified with the FAA surfaces to ensure the facility does not impact the airport traffic.

APPENDIX A. PILOT CARDS

APPENDIX B. WAVE FIELDS

APPENDIX C. PILOT EVALUATION FORMS[7]

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[7] 10555155: Appendix C - Pilot Evaluation Forms: Some of the safety and difficulty ratings don't make sense. If you are running aground the safety is poor and the difficulty was obviously higher. If you have three tugs and still run aground - are the tugs really adequate?
Some of these runs with groundings are rated 5 for safety (5 being the safest).
Also - why are some runs ending in groundings marked "exclude" with no rating and no notes? Seems relevant that you had so many groundings.
Response: Understood about ratings not making sense. These ratings are subjective to the pilot feedback in which the engineering team doesn't typically question as we don't want to affect their given ratings. Numerous groundings (21, 24, 25, 26, 27, 28, 29, 31) occurred in the turning basin as a result of software malfunction which was believed to be an issue was with the metacentric height of the vessel model - as a result the turning basin evolution needed to be re-evaluated during Phase 3/Full Mission Bridge simulations

ATTACHMENT C

Full Mission Bridge Ship Simulation Report

OREGON INTERNATIONAL PORT OF COOS BAY CHANNEL MODIFICATION

Full Mission Bridge Ship Simulation Report

Prepared for

Oregon International Port of Coos Bay
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P.O. Box 1215
Coos Bay, OR 97420

U.S. Army Corps of Engineers
Portland District
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January 2024

OREGON INTERNATIONAL PORT OF COOS BAY CHANNEL MODIFICATION

Full Mission Bridge Ship Simulation Report

Prepared by

moffatt & nichol

Version	Rev0	Rev1	Rev2	Rev3
Purpose	Initial Draft without Appendix Reports	DMA/OIPCB Review	USACE Review	Final Submittal
Date	June 2023	September 2023	January 2024	
By	G. Lawrence	G. Lawrence	G. Lawrence	
Checked	E. Smith	E. Smith	E. Smith	
Approved	J. Shelden	J. Shelden	J. Shelden	

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ACRONYMS AND ABBREVIATIONS

AtoN	aids to navigation
CF	Planned Container Facility
DNV	Det Norske Veritas
EIS	Environmental Impact Statement
ERDC	Engineering Research and Development Center (of the USACE)
FMSS	Full Ship Mission Simulation
JONSWAP	Joint North Sea Wave Project
LOA	Length Overall
MITAGS	Maritime Institute of Technology and Graduate Studies
MLLW	Mean Lower Low Water
M&N	Moffatt & Nichol
NWP	Portland District (of the USACE)
OIPCB or Port	Oregon International Port of Coos Bay
PPX3	Post Panamax Generation 3
PA	Proposed Alteration
RFP	Roseburg Forest Products
RM	river mile
TSP	Tentatively Selected Plan
USACE or Corps	U.S. Army Corps of Engineers
WRDA	Water Resources Development Act
WRRDA	Water Resources Reform and Development Act

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1 INTRODUCTION

In 2016 and 2017 two Full Mission Ship Simulation (FMSS) Studies were completed on behalf of the U.S. Army Corps of Engineers (USACE, or Corps), Portland District as the lead agency, and the Oregon International Port of Coos Bay (OIPCB, or Port) as part of the federal navigation project to improve the Coos Bay Federal Navigation Channel, OR. The findings of the 2016 & 2017 FMSS efforts are summarized in the Moffatt & Nichol (M&N) *Full Ship Simulation Report*, dated October 21, 2016 (issued for USACE review) and M&N *Supplemental Full Ship Simulation Report*, dated May 25, 2017 (issued for USACE review). These previous investigations were conducted under the authority granted by Section 204 of the Water Resources Development Act (WRDA), 1986, as modified by Section 1014 of the Water Resources Reform and Development Act (WRRDA), 2014. This action would require permission, under Section 14 of the Rivers and Harbors Appropriation Act of 1899, 33 United States Code 408, to modify the federal navigation project. The Section 204/408 Report and Environmental Impact Statement (EIS) proposed modifications to the Coos Bay Navigation Channel in Coos County, Oregon, to accommodate larger deep draft vessels and provide net positive local, state, and federal economic and environmental benefits in an environmentally acceptable manner.

The previous simulation studies evaluated LNG Carriers and Forest Product Bulk Carriers ("Chip Ships") based on the proposed (Jordan Cove LNG facility) and existing (Roseburg Forest Products chip facility) facilities located in Coos Bay, OR. The Jordan Cove LNG facility is no longer planned for development. However, a new container facility is proposed, hereinafter Container Facility (CF).

To evaluate[1] the proposed CF and the associated containerships calling at OIPCB four navigation simulation studies were conducted in 2022 and 2023. These four studies are summarized below:

- *Phase 1 – Screening Real-Time Desktop Navigation Simulations:* A real-time screening vessel simulation study was performed at the Moffatt & Nichol's in-house simulator located in Baltimore, MD. These simulations were performed to determine the preliminary design containership vessels for the Existing Channel and the 2017 Proposed Alteration Channel. For these simulations a Panamax Containership, a Post-Panamax Containership, and Post-Panamax Generation Three Containership were evaluated. The ship handling for this effort was performed by Captain Richard Michael, a retired captain and MITAGS ship handling expert.

- *Phase 2 – Screening Real-Time Desktop Navigation Simulations:* A real-time vessel simulation study was performed on Moffatt & Nichol's traveling simulator at Oregon International Port of Coos Bay's office in Coos Bay, OR. These simulations were performed to evaluate the navigability and safety of the Existing Channel and the previously designed 2017 Proposed Alteration Channel

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[1] 10567649: Phase 3 report, Section 1.1: Recommend that the phase 3 report summarize the how phase 1, phase 2, and phase 2b were conducted to revise/screen initial TB concepts for evaluation in phase 3. This will help document recent ship-sim work performed in preparation of phase 3, increasing
confidence in phase 3 approach, objective, and results.
Also note how phase 2b was needed to refine the 2017 PA channel to enable Panamax G3 vessels to transit the entrance channel and gain access to the proposed TB at Northpoint.
Response: Added text to address comment giving high level overview of the navigation studies completed for the containerships.

for a Panamax Containership, a Post-Panamax Containership, and Post-Panamax Generation Three Containership. Shiphandling for these simulations was performed by the local Coos Bay Pilots.

- *Phase 2B – Screening Real-Time Desktop Navigation Simulations:* A real-time screening vessel simulation study was performed at the Moffatt & Nichol's in-house simulator located in Baltimore, MD. These simulations were performed to determine the needed modifications to 2017 Proposed Alteration channel to accommodate the Post-Panamax Generation Three containerships to ensure safe transits to the proposed container facility. The channel evaluated in this simulation effort was the 2023 Initial Concept Channel. The ship handling for this effort was performed by Captain Tim Petrusha, an active Coos Bay Pilot.

- *Phase 3 – Full Mission Bridge Navigation Simulations:* A real-time full mission bridge vessel simulation study was performed at the Maritime Institute of Technology and Graduate Studies in Linthicum, Maryland. These simulations were performed to evaluate the navigability and safety of the Existing Channel and the 2023 Proposed Alteration Channel for the proposed design container vessels, of a Panamax Containership and a Post Panamax Generation Three Containership, respectively. Shiphandling for these simulations was primarily performed by the local Coos Bay Pilots with a handful of simulations performed by a MITAGS expert ship handler.

1.1 OBJECTIVE

This report provides the results of the full mission bridge ship simulation study (Phase 3) conducted April 6 – 7 and April 10 – 14, 2023 at Maritime Institute of Technology and Graduate Studies (MITAGS) located in Linthicum Heights, Maryland.

The objective of this study was to evaluate the navigability and safety of a modified channel design for the proposed design container vessels, herein 2023 Proposed Alteration (2023 PA) channel. Results of this full mission bridge ship simulation study will be used as the basis for adjustments to the previously adopted 2017 Proposed Alteration (2017 PA) channel to further improve safety.

The ship simulation study considered the following channel conditions:

- *Without Project Federal Navigation: Used to Test Without Project Condition and Test Navigability and Safety of Containership to new Containership Facility.* This includes the existing channel in its current configuration with the addition of a Panamax sized turning basin at RM 5.0 (Section 2.1.1).
- *2023 Proposed Alteration (2023 PA): Used to Test Navigability and Safety*. This is a modification of the nominal 450-ft channel alternative at -45 ft MLLW with the two additional turning basins at the RM 5.0 and at RM 8.0 (Section 2.1.2).

1.2 PROJECT PARTICIPANTS

The following stakeholders were present during all or part of the full mission bridge simulations at MITAGS:

- Coos Bay Pilots Association
    - Captain George Wales – Bar and River Pilot
    - Captain Steven Woods – Bar and River Pilot

- Oregon International Port of Coos Bay (OIPCB)
    - Mike Dunning – Chief Port Operations Officer
- USACE Portland District (NWP)
    - Rachel Stolt - Observer
- USACE Engineer Research and Development Center (ERDC)
    - Kiara Pazan - Observer
    - Shannon Stever – Observer
- Webb Simulation Consulting
    - Dennis Webb - Observer
- David Miller & Associates
    - Jerry Diamantides - Observer
- MITAGS
    - Colleen Schaffer – Project Lead
    - Shayan Gholami – Naval Architect
    - Captain Richard Michael – SHS Consultant
    - Captain Larry Bergin – SHS Consultant
    - Mike Dimon – Helmsperson
    - Matt Holliday – Simulator Operator
- Moffatt & Nichol
    - Gwen Lawrence – Simulation Director
    - Eric Smith – Simulation Principal

2 SIMULATION INPUTS

The primary inputs to the vessel simulations can be outlined in the following three categories: the channel geometries (Section 2.1), the vessels included in the simulation (Section 2.2), and the design environmental conditions (Section 2.3). This Ship Simulation report relies heavily on the more detailed inputs described in the USACE-approved Ship Simulation Plan for the 30 percent Design TSP Channel (M&N *Full Ship Simulation Plan*, dated February 19, 2016).

2.1 NAVIGATION CHANNELS EVALUATED

This simulation effort evaluated two channel configurations for the Coos Bay Federal Navigation Channel:

- *Without Project Federal Navigation Channel*: Existing navigation channel dimensions, incorporating the planned Container Facility and turning basin; and

- *2023 Proposed Alteration Channel* which is a modification of the 2017 Proposed Alteration Channel with the planned Container Facility and turning basin and modified turning basin at Roseburg dock.

The details of these channel alignments are presented in the following subsections.

2.1.1 WITHOUT PROJECT FEDERAL NAVIGATION CHANNEL

The authorized width and depth of the federal navigation channel varies throughout its extent, as depicted in Figure 2-1. In 1995, the entrance channel was deepened to 47 feet (ft) mean lower low water (MLLW) and widened to 700 ft, tapering through the Entrance Range through the jetties to a channel 37 ft deep and 300 ft wide at river mile (RM) 1. All depths in this report refer to chart datum MLLW unless otherwise noted. The inner channel from RM 1 to RM 9 is 37 ft deep by 300 ft wide, and from RM 9 to RM 15 the inner channel is 37 ft deep by 400 ft wide. Thus, for the majority of the proposed modification area, the channel is currently authorized at a nominal 37-foot depth and 300-foot width. The present condition of the federal navigation channel includes advance maintenance dredging. In the entrance up to RM 1, the advance maintenance decreases from 5 to 3 feet, and in the inner channel, the advance maintenance dredging is 1 to 2 feet. Channel widths by reach for the Without Project Condition are shown in Table 2-1.

As stated, there is a new planned container facility at RM 5.0. This container facility was included in the without project condition simulation model with the addition of a Panamax sized turning basin, as depicted in Figure 2-1. The planned CF will have two berths with a total wharf length of approximately 2,800 ft. The berth line is the focus of the simulation study – the footprint of marine infrastructure and landside container facility is conceptual and subject to modification in the final design process. The design vessel for the planned CF with the existing navigation is a Panamax containership, see Section 2.2.1. Based on the design vessel the Panamax turning basin is 1,850 feet long (parallel to the channel) and 1,450 feet wide. The turning basin dimensions 1.5*LOA of the design vessel with 200-ft of tidal elongation perpendicular to the channel to account for longitudinal drift per EM 1110-2-1613, which has been confirmed with screening desktop simulations performed by M&N in 2022 and 2023. The turning basin design depth is -37 ft MLLW, the same as the existing navigation channel.

The aids to navigation (AtoN) for the without project condition are those in place today, with the exception of the existing green buoy G “15” which will be relocated outside the RM 5.0 turning basin as shown on Figure 2-1.

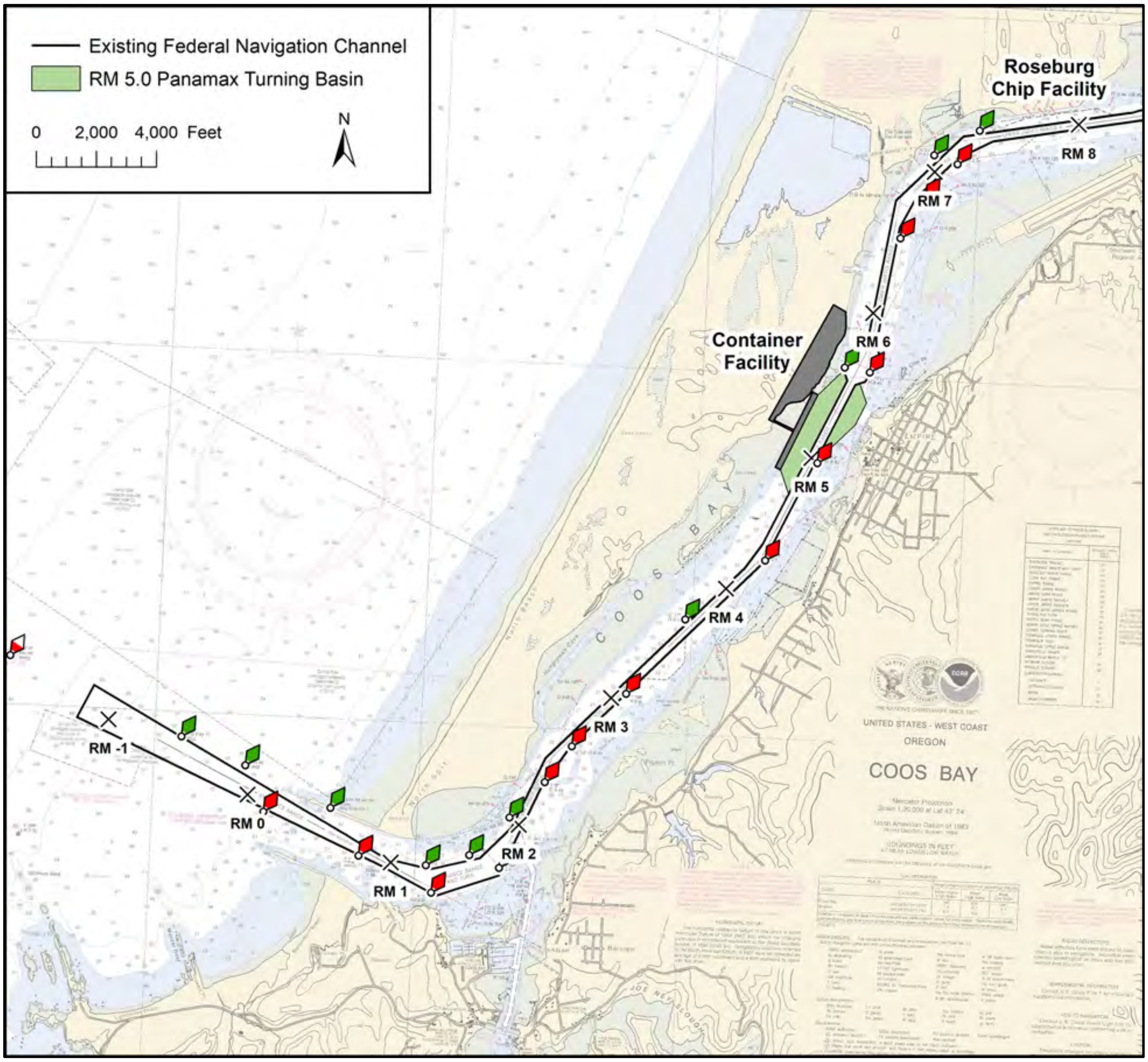

Figure 2-1. Without Project Federal Navigation Channel and Planned Container Facility

Table 2-1. Widths of Channel Reaches Included in Full Mission Bridge Ship Simulation

Channel Range(s)	River Miles		Channel Width		Authorized Channel Depths	
	Start	End	WOP	2023 PA	WOP	2023 PA
Entrance Range	RM -0.8	1.0	700 to 300	1,280 to 600	47 to 37	57 to 45
Entrance Range & Turn	1.0	2.0	Up to 740	Up to 1140	37	45
Inside Range	2.0	2.5	300	500	37	45
Coos Bay Range	2.5	4.3	300	450	37	45
Empire Range to Lower Jarvis Range	4.3	6.8	300	450	37	45
Panamax Turning Basin	4.7±	5.5±	1,850 x 1,450	--	37	--
PPX3 Turning Basin	4.7±	5.6±	--	2,000 x 1,600	--	45
Jarvis Turn	6.8	7.3	400	500	37	45
Upper Jarvis Range	7.3	7.8	300	450	37	45
Capesize Turning Basin	7.6±	8.0±	--	2,000 × 1,100	--	37

2.1.2 MODIFICATIONS TO 2017 PROPOSED ALTERATION NAVIGATION CHANNEL

The proposed project navigation channel for this current simulation study used the recommended channel (previously known as PA, Rossell Option B or Channel #3) from the 2017 full mission bridge ship simulations as the baseline channel, as depicted in Figure 2-2. The proposed channel for this current study is hereinafter designated the 2023 Proposed Alteration (2023 PA). The design vessel for the planned CF with the 2023 PA channel is a Post Panamax Generation 3 (PPX3) containership, see Section 2.2.1. The modifications for the 2023 PA Channel from the 2017 PA channel to accommodate the new design deep draft vessels (Section 2.2.1) are summarized as follows:

- *Coos Bay Inside Range* (Figure 2-3[2]): the channel from RM 1.3 to RM 2.8 on the red side of the channel was widened as shown. The range heading of the Coos Bay Inside Range was changed by 1° from 28.0° - 208.0° to 27.0° - 207.0°. From the 2017 PA channel AtoN locations Buoy R”6A”,

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[2] 10567650: Phase 3 report, figure 2-3: The proposed re-aligned 2023 alteration FNC near 6R buoy appears to extend into shallower area (than the 2017 PA) which will require capital dredging. The 2017 proposed alteration FNC did not extend into shallows at this location. Has the project's supporting. documentation fully expressed this revision and need for added dredging within other evaluations and report documents ?What will be implications for this added channel cut?
Response: The ship simulation analyses performed for the PPX3 containerships showed the need for this additional dredging to allow safe transits of the vessels. The revised channel was used in the numerical modeling analyses. The documentation has/is being updated to reflect this revision. Please see the other engineering sub-appendices for this information.

R”8”, R”8A”, and R”10” had to be relocated for the 2023 PA channel to the locations shown in Figure 2-3.

- *Bend Widener at RM 4.0* (Figure 2-4): a bend widener was included to the 2023 PA channel to add an additional 50 ft on the green side in the turn from Coos Bay Range to Empire Range. From the 2017 PA channel AtoN locations Buoy G”11A” and G”13” were relocated to the locations shown in Figure 2-4.

- *Post Panamax Generation 3 Containership Turning Basin at RM 5.0* (Figure 2-5): A larger turning basin at the container facility is needed to accommodate the PPX3 containership. Based on the design vessel, the proposed turning basin is 2,000 feet long (parallel to the channel) and 1,600 feet wide, equivalent to 1.3*LOA of the design vessel with 200-ft of tidal elongation parallel to the channel. This turning basin design has been confirmed with screening desktop simulations performed by M&N in 2022 and 2023. The turning basin design depth is -45 ft MLLW, the same as the 2017 PA channel and the 2023 PA channel.

- *Remove LNG Facility:* The previously planned LNG facility and access channel and associated turning basin at RM 7.5 was removed from the proposed condition as that facility is no longer planned.

- *Capesize Turning Basin at RM 8.0* (Figure 2-6) a Capesize turning basin was added at RM 8.0 to replace the turning basin that was removed at RM 7.5. Originally, as stated in the simulation plan, this turning basin was designed to be 1,400 feet long (parallel to the channel) and 1,100 feet wide. However, prior to simulating this turning basin the Coos Bay Pilot’s requested a larger turning basin to simulate. This turning basin was elongated to the west, such that the southern boundary parallel to the navigation channel was 1,450 ft compared to 800 ft in the original design. Operationally, this turning basin will be used by inbound empty vessels. Therefore, the turning basin’s design depth is -37 ft MLLW. The deeper navigation channel (450-ft wide at -45 ft MLLW) continues through the length of the turning basin. Buoy R”22A” was relocated and an additional buoy was added, R”22B” to the locations shown in Figure 2-6 to mark the turning basin.

The overall 2023 PA channel is depicted in Figure 2-2 and channel widths by reach are shown in Table 2-1. This channel was screened prior to these full mission bridge simulations on the M&N desktop simulator as described in Appendix A.

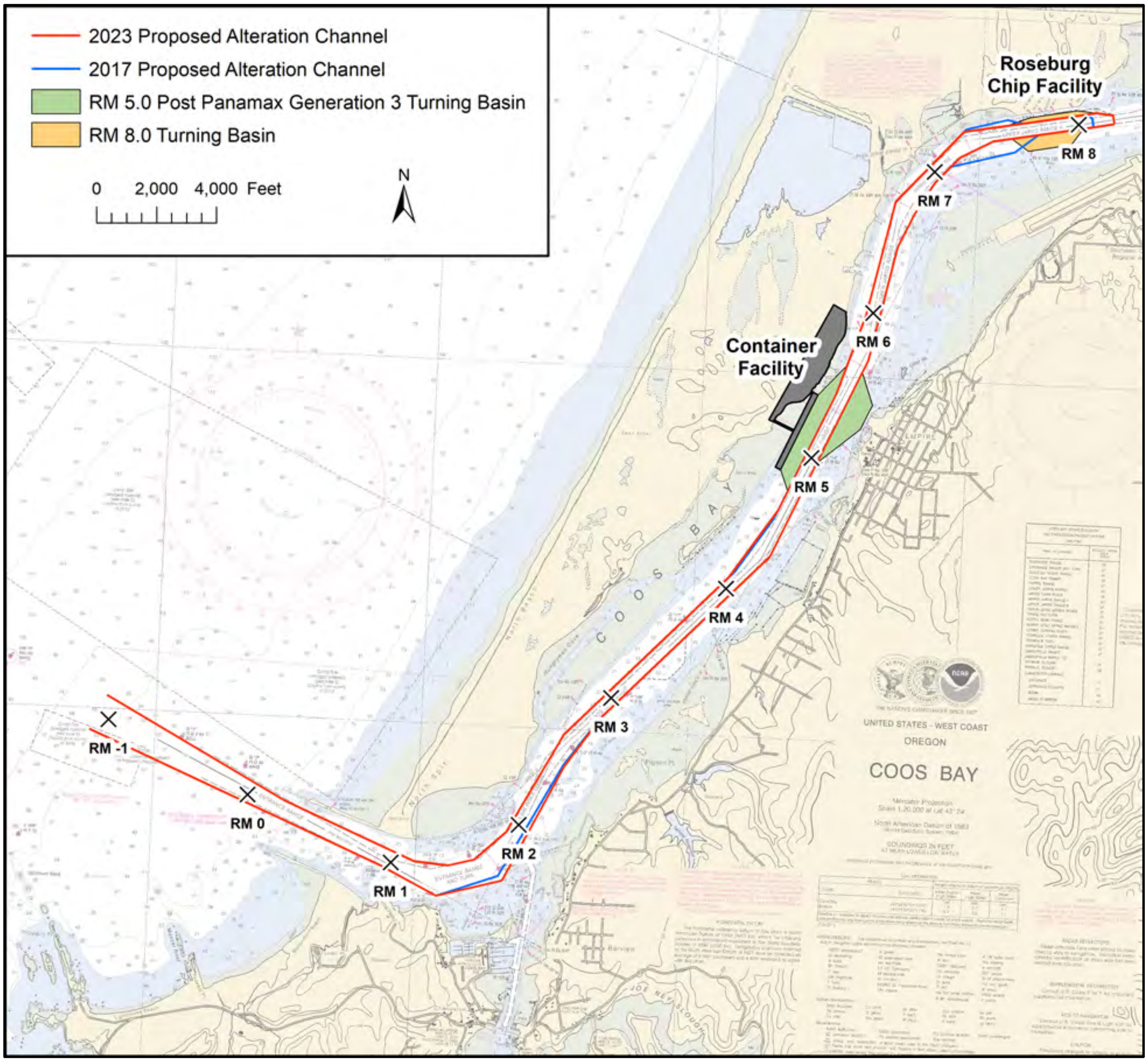


Figure 2-2. Proposed Federal Navigation Channel, Terminals, and Turning Basins

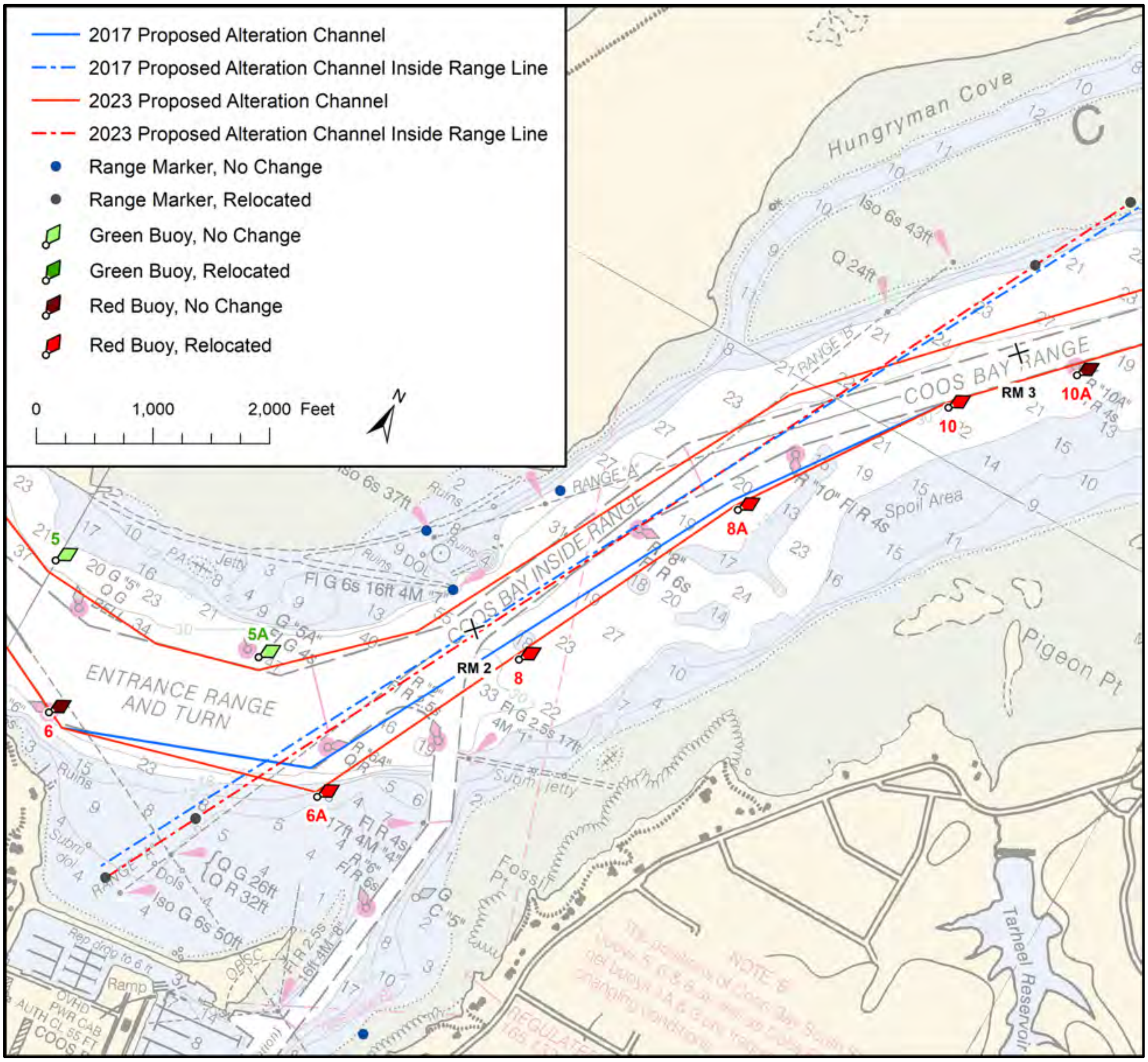


Figure 2-3. 2023 Proposed Alteration Channel Inside Range Modification from 2017 Proposed Alteration Channel

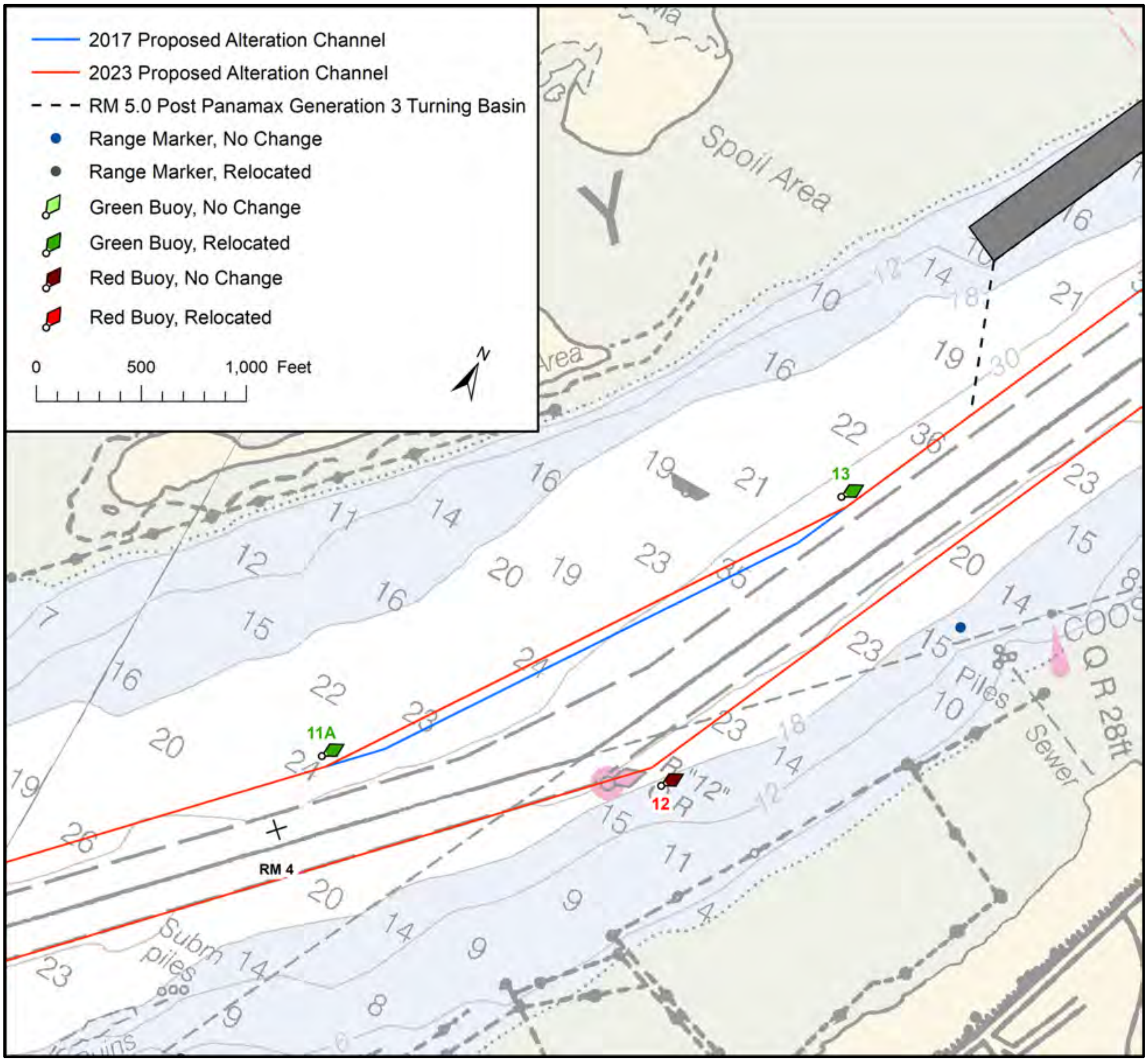


Figure 2-4. 2023 Proposed Alteration Channel Modification RM 4.0 Bend Widener

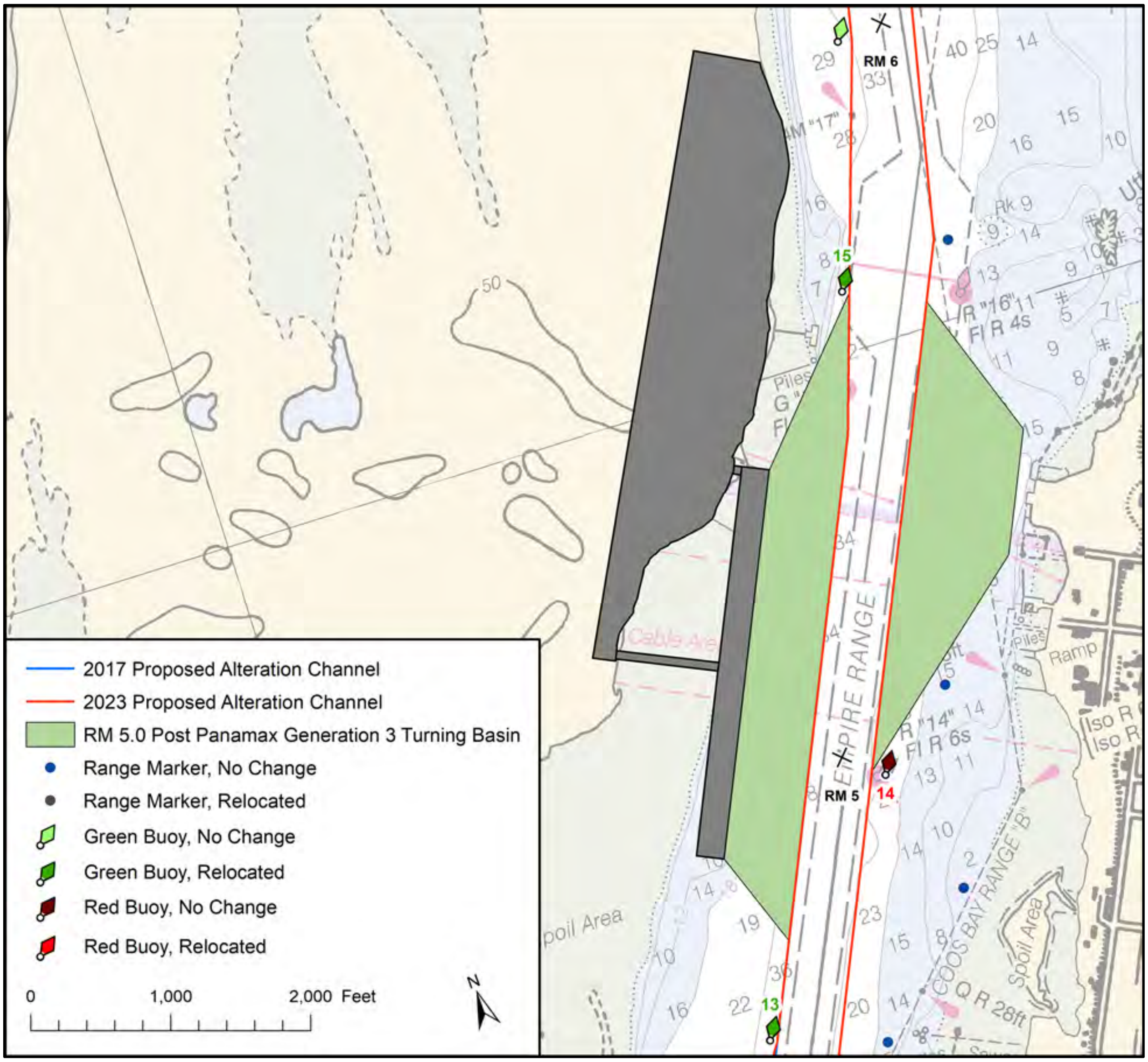


Figure 2-5. 2023 Proposed Alteration Channel Modification PPX3 Turning Basin

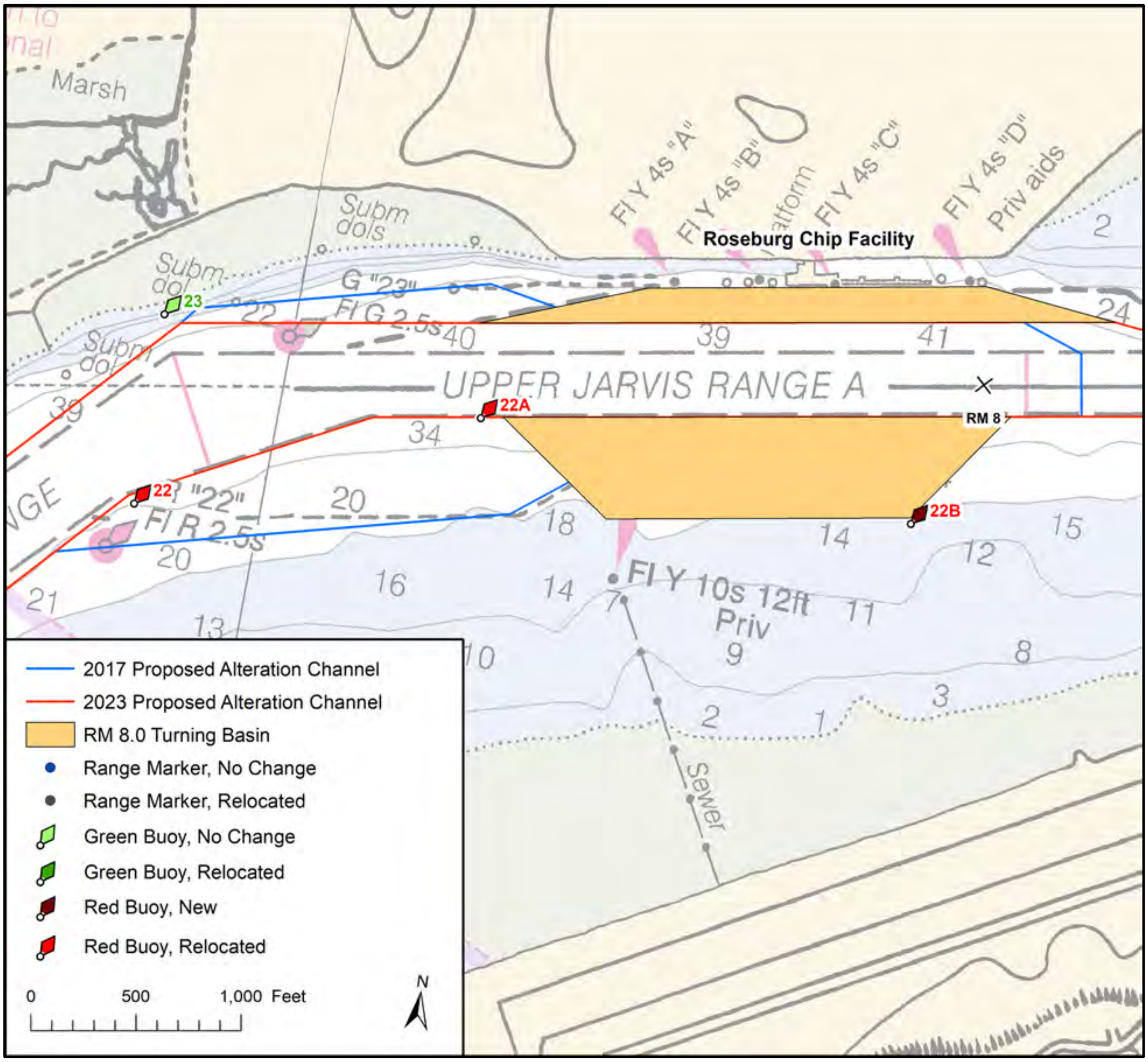


Figure 2-6. 2023 Proposed Alteration Channel Modification Capesize Turning Basin at RM 8.0

2.2 DESIGN VESSELS

This section lists all vessels that were included in the simulations. Pilot cards for each vessel are provided in Appendix B.

2.2.1 DEEP DRAFT VESSELS

Table 2-2 provides vessel particulars for the vessels that were used in the full mission bridge ship simulation. These vessels are considered representative of those modeled for the desktop simulations of the proposed CF performed by M&N in 2022 and 2023. The Capesize bulk carrier was simulated under ballast draft condition for inbound transits. The containerships were simulated under full operating draft for both inbound and outbound simulations.

Table 2-2. Vessels Models Used in the Simulation (Wärtsilä NTPro Software)

Attribute		WOP Containership Vessel	2023 PA Channel Containership Vessel	2023 PA Channel Bulk Carrier
Vessel Model		Container Arthur Edgemore	Container Kalina	Bulk Carrier 19
Class/Capacity		Panamax / 4,500 TEU	Post Panamax Generation 3/ 13,000 TEU	Capesize
LOA	ft	958.0	1200.8	837.5
	m	292.0	366.0	255.3
Beam	ft	105.6	167.7	141.1
	m	32.2	51.1	43.0
Operating Draft	ft	36.0	45.0	34.0 (ballast)
	m	11.0	13.7	10.4

2.2.2 TUGS

The following tugs were used in the simulation.

- Capesize Chip Ship: Two ASD tugs with bollard pull of 80 tonnes maximum;
- Panamax Containership: Two ASD tugs with bollard pull of 80 tonnes maximum; and
- Post Panamax Generation 3 Containership: Three ASD tugs with bollard pull of 80 tonnes maximum.

Table 2-3 provides vessel particulars for the tug used in the simulation. Tugs were simulated in auto-tug mode and controlled by the simulator operator Each tug was a hydrodynamically active six degree of freedom model.

Table 2-3. Tug to be Used in the Simulation

Tug Type	Use	Wärtsilä Tug Model	Bollard Pull (tonnes)	LOA		Beam		Draft	
				ft	m	ft	m	ft	m
ASD Tug	Containership & Chip Ship	ASD Tug 15	80	105.0	32.0	38.1	11.6	14.2	4.3

2.2.3 MOORED VESSELS

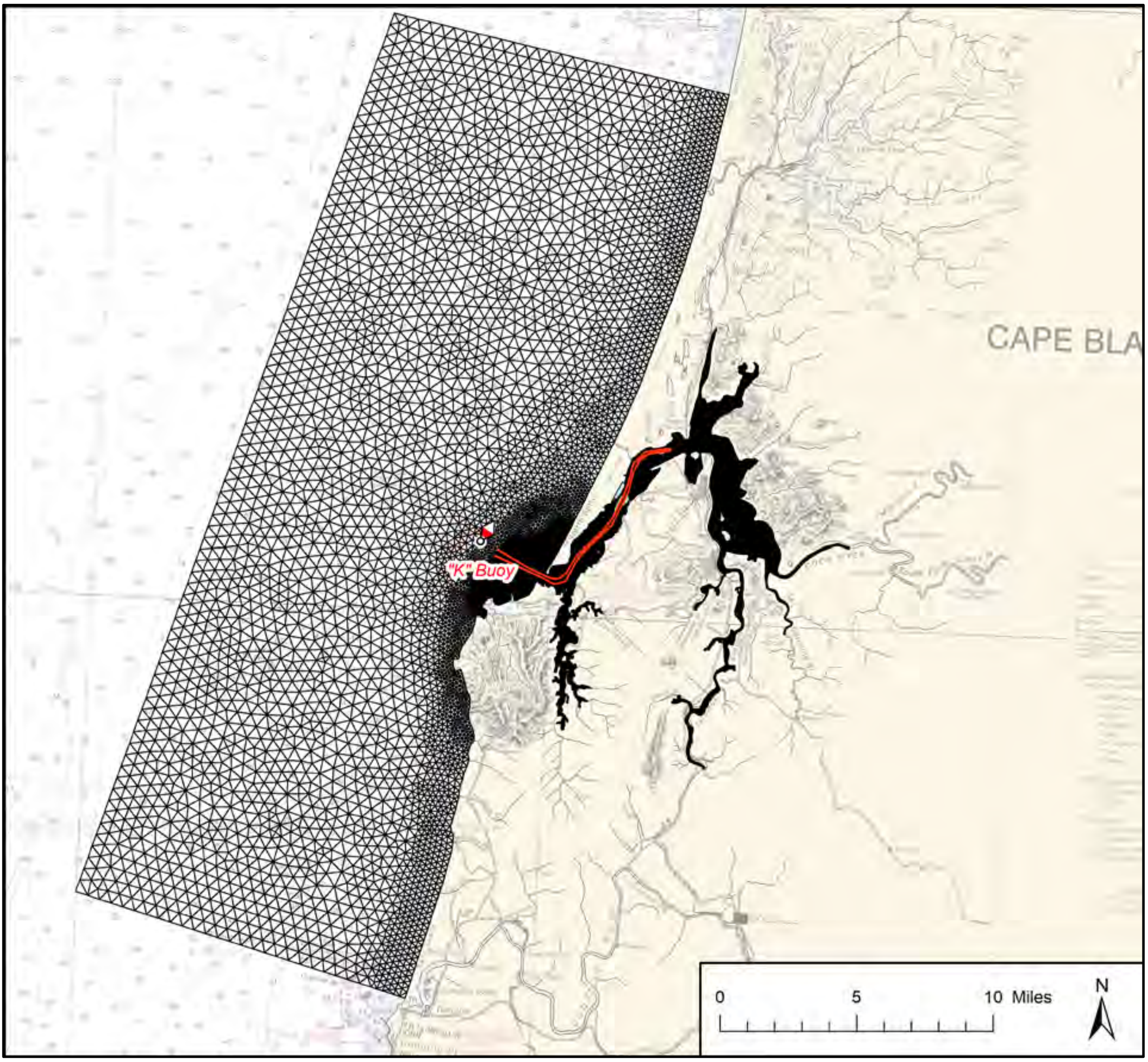
In addition to the vessels in motion during the simulations, a moored vessel was included at the container facility berth that was not being evaluated in each simulation. This moored vessel was included in the scene to provide a realistic representation of the maneuvering space available for the transiting vessel. The moored vessels were a visual representation and did not include hydrodynamic interaction forces with the transiting vessel. The moored vessel was the same containership model as the transiting vessel for each simulation.

2.3 ENVIRONMENTAL CONDITIONS

Environmental conditions considered in the simulations were tides, currents, waves, and winds. All environmental conditions used were based on the conditions previously evaluated during the navigation simulations in 2016 and 2017. Night-time and low visibility transits were not performed.

The tides, currents, and waves were generated using a fully integrated hydrodynamic model built by M&N for the Coos Bay Channel Modification Project. This model used the MIKE-21 flexible mesh modeling suite. The hydrodynamic model was re-run with the WOP (existing channel with the Panamax turning basin) and the 2023 PA channel and with the LNG facility and associated slip removed. The hydrodynamic modeling domain is shown in Figure 2-7.

Figure 2-7. Modeling Domain for the Hydrodynamic Model with the 2023 Proposed Alteration Channel



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2.4 TIDE AND CURRENT FIELDS

A full transit—inbound or outbound—takes approximately 1.5 hours to the planned container facility and 2.0 hours to Roseburg Chip Facility. Based on this duration, tides and tidal currents vary throughout the transit time. As a result, time and space varying tidal currents were included in the simulator to account for these effects.

In Coos Bay slack water at the jetty entrance typically occurs about 47 minutes after high water (end of flood tide) and approximately 40 minutes after low water (end of ebb tide). The currently preferred operation for incoming and outgoing vessels is to start their transit at or before high tide, so that the entrance is reached at slack tide or a reduced ebb tide. The local pilots report avoiding transiting the entrance turn outbound with deep draft vessels during a fully developed ebb tide whenever possible. A 24-hour period from the calibrated model representing the spring tide was extracted. Example time series are shown in Figure 2-8, Figure 2-9, and Figure 2-10 at varying locations along the transit. From this time series representative times were chosen to simulate the desired condition.

The Pilots report that a cross current, normally running from north to south, forms at the tip of the North Jetty and can cause difficult navigation into the channel. For each simulated condition, the corresponding wind was modeled in the MIKE21 hydrodynamic model. For certain tides stages this results in the cross current developing (aligned with wind direction) with magnitudes of approximately 0.5 – 1.0 knots.

The tide level was held constant for each simulation at the minimum water level based on the minimum required underkeel clearance – the simulator software does not have the capacity to include time varying water levels. Based on the previous simulation studies (2016 & 2017) performed, the minimum underkeel clearance for the existing channel and proposed channel design vessels are 3.6 ft and 4.5 ft, respectively.

Figure 2-8. Time Series of Tide and Tidal Currents for the 2023 PA Channel at the Entrance Turn

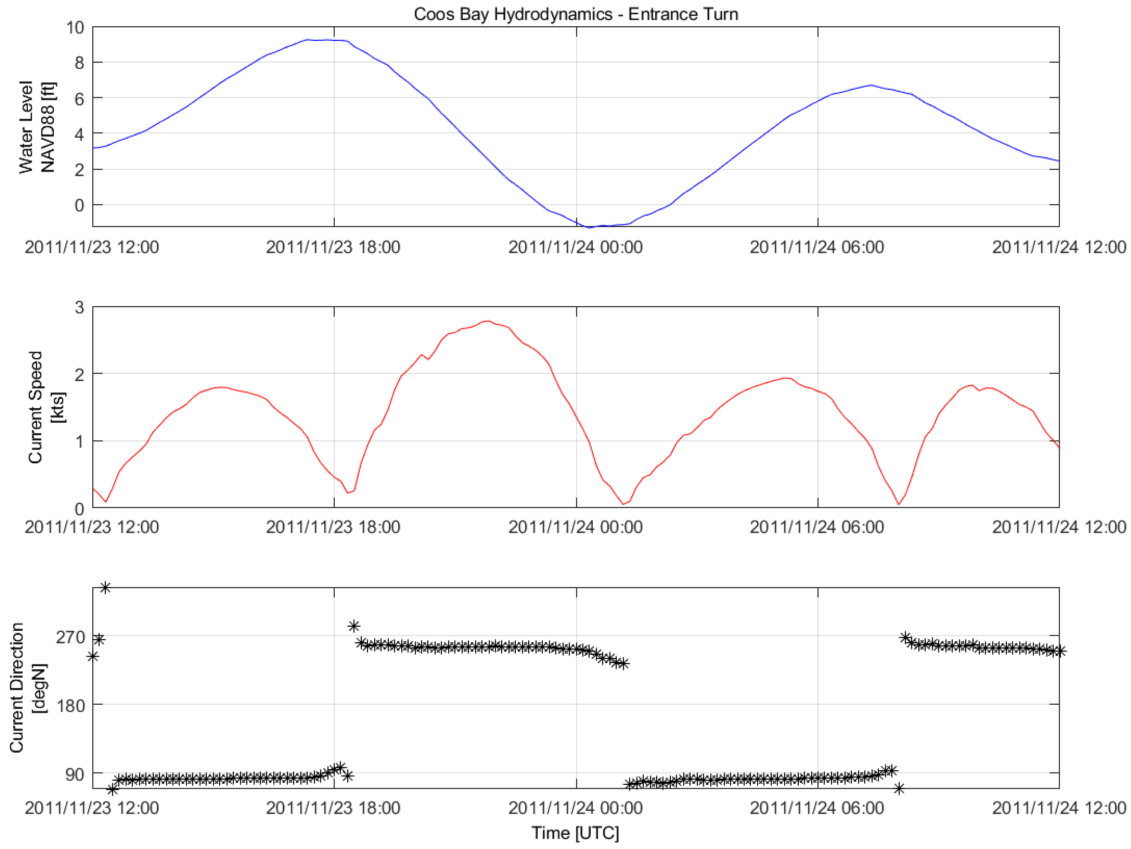


Figure 2-9. Time Series of Tide and Tidal Currents for the 2023 PA Channel at the Container Facility

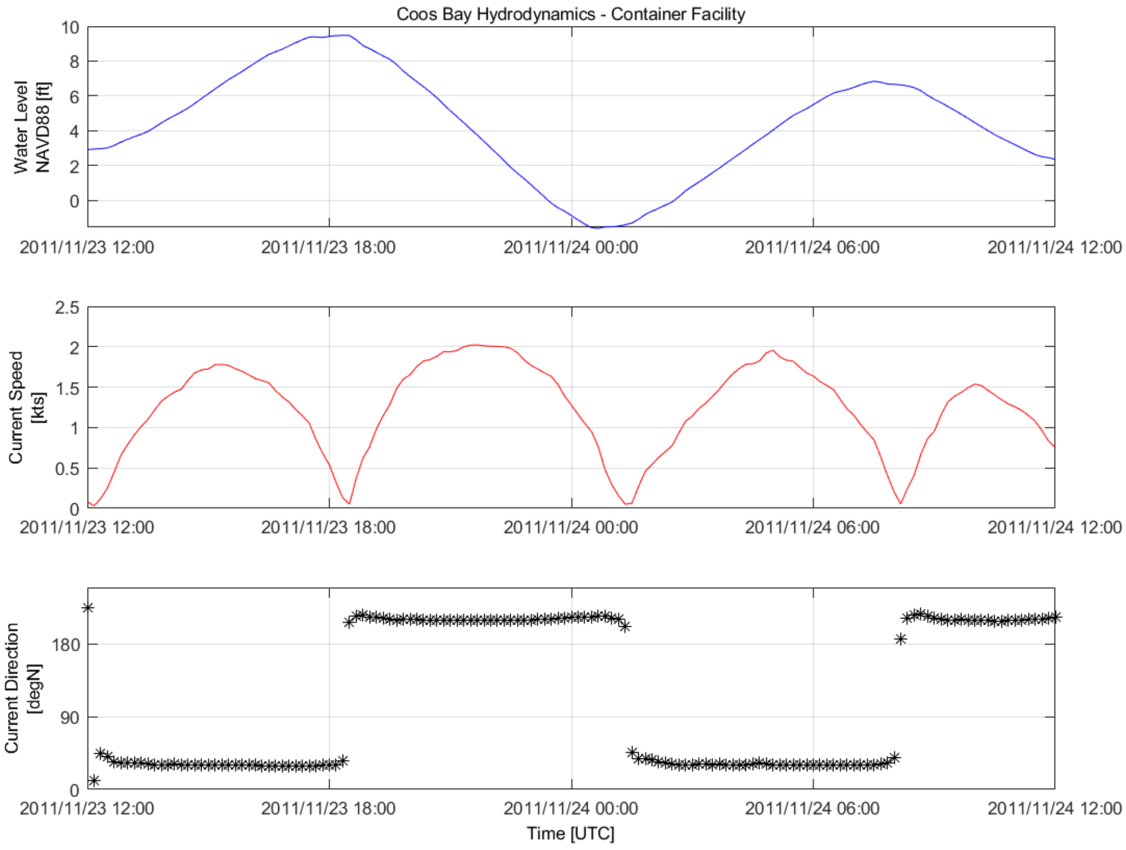
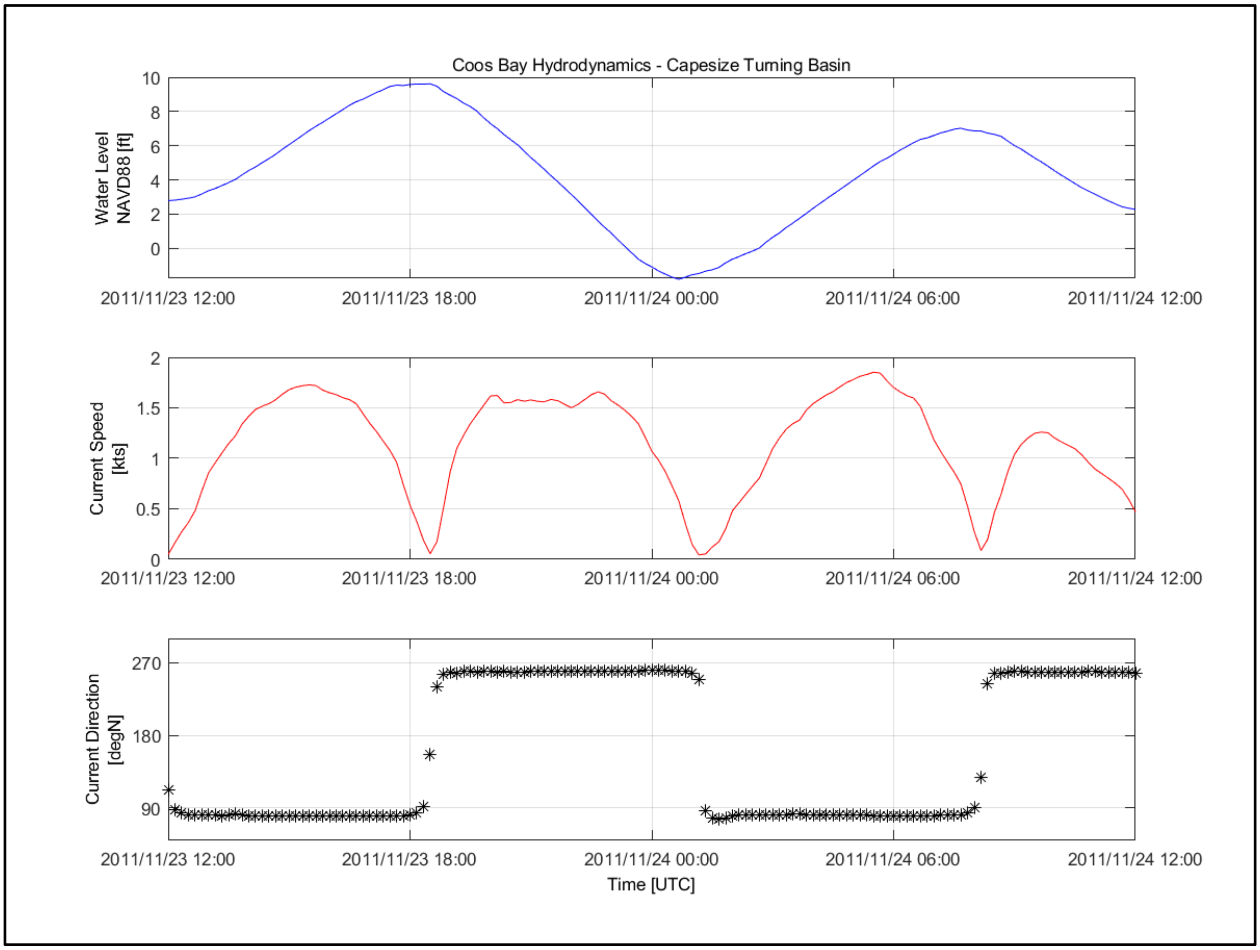


Figure 2-10. Time Series of Tide and Tidal Currents for the 2023 PA Channel at RM 8.0 Turning Basin



2.5 WAVE FIELDS

Waves in the vicinity of Coos Bay are generally from the west and northwest. The highest waves in the area are from the southwest. However, these occur relatively infrequently, and the entrance to the Coos Bay Navigation Channel is sheltered from southwesterly waves by the bluffs at Cape Arago. As a result, SW storm waves typically do not directly affect navigation in the entrance channel and were not included in the simulation study.

The most representative wave buoy is at Port Orford, approximately 20 miles south of Coos Bay. Figure 2-11 shows wave height and wave period roses for this buoy. Port Orford was selected as it has the longest period of record and was in naturally deep water.

Shorter-period waves are generally smaller and more northerly, while longer-period waves are generally larger and from directly offshore (west to northwest). Figure 2-12 shows wave roses for four different period ranges. The three wave conditions used in the full mission bridge ship simulation are given in Table 2-4.

The selected waves reflect relatively common offshore wave conditions in the most common frequency bands. Wave conditions included in the simulator were based on waves generated from a JONSWAP (Joint North Sea Wave Project) spectrum and therefore had spectral variability in wave height and period. To account for the attenuation of the offshore wave as it progresses toward shore, a number of wave condition zones were created to represent the decreasing wave height from offshore to nearshore. Appendix C provides a visual representation of the wave fields. The simulator operator adjusted the wave conditions according to the zones as the vessel proceeded through the jetties.

Figure 2-11. Wave Height and Wave Period Roses based on Port Orford Gauge (2007 – 2015)

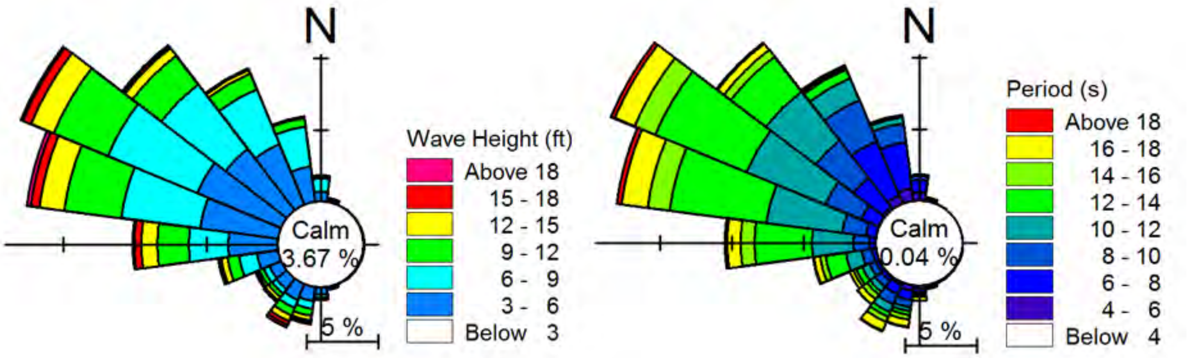


Figure 2-12. Wave Period Histogram with Wave Roses for Each Range of Wave Periods, Port Orford Gauge (2007 – 2015)

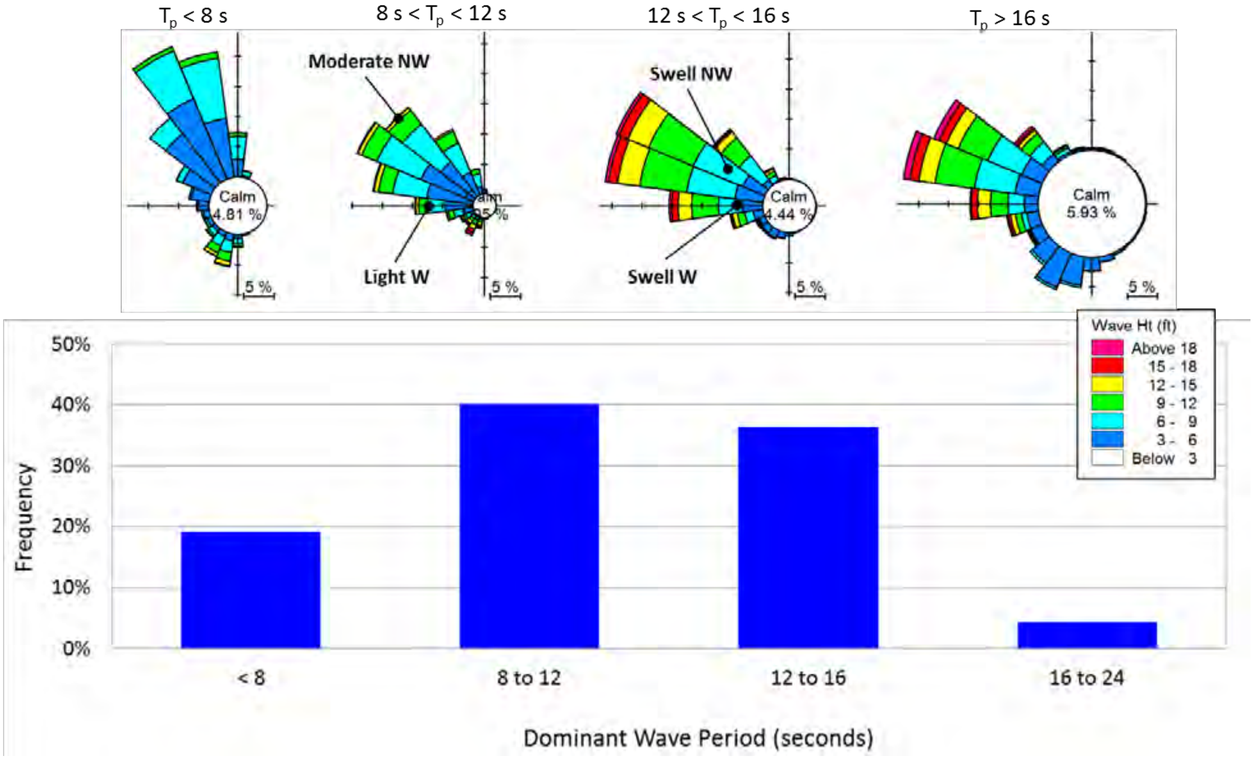


Table 2-4. Deepwater Wave Conditions Used in Full Mission Bridge Ship Simulation

Wave Condition	**Deepwater Waves**			**Comment**
	Significant Wave Height (ft)	**Peak Period (s)**	**Mean Wave Direction (deg)**	
Moderate, NW	9.0	12	320	Significant wave-induced motion (10 to 12 ft possible offshore), but little wave penetration into jettied entrance.
Swell, NW	7.0	15	305	Significant wave motion possible due to long wave period, despite relatively small wave height.
Swell, W	6.0	15	275	Swell waves can penetrate well into the jettied entrance and cause significant wave motion further upstream.

2.6 WIND FIELDS

Long-term wind measurements are available at two locations, marked in Figure 2-13: Cape Arago and North Bend. Winds in the Coos Bay area are typically bidirectional, with strong northerly and southerly components. The winds tend to be more northerly in the summer and more southerly in the winter. Figure 2-14 and Figure 2-15 show seasonal wind roses for the two long-term anemometers. Based on these wind roses, winds from the northern quadrant are slightly stronger at North Bend, while winds from the southern quadrant are significantly stronger at Cape Arago. Table 2-5 gives typical to high wind conditions (not extreme storms) at the two locations. In a conversation with the Coos Bay Pilots, they stated that the south winds drop inside the jetties since the bluff to the south provides shielding.

As recommended by USACE, the winds were selected based on typical to high wind conditions when a pilot would consider bringing a vessel into port or taking a vessel from the berth to sea (excluding extreme storms) at the two anemometer locations in the area: Cape Arago and North Bend. Based on these anemometers, winds from the northern quadrant have similar speeds throughout the channel, while winds from the south have higher speeds offshore. This is consistent with pilots' observation that the south winds decrease near the jetties because the bluff at Cape Arago provides shielding.

Based on these observations, the following assignment of winds along the channel has been made:

- Outside the jetty tips at RM 1.0: winds match the Cape Arago conditions.
- Upstream of RM 1.0: winds match the North Bend conditions.

Specific assignments are presented in

Table 2-6. Winds were included in the simulator as sustained winds.

Figure 2-13. Long-term Wind Measurement Anemometer Stations

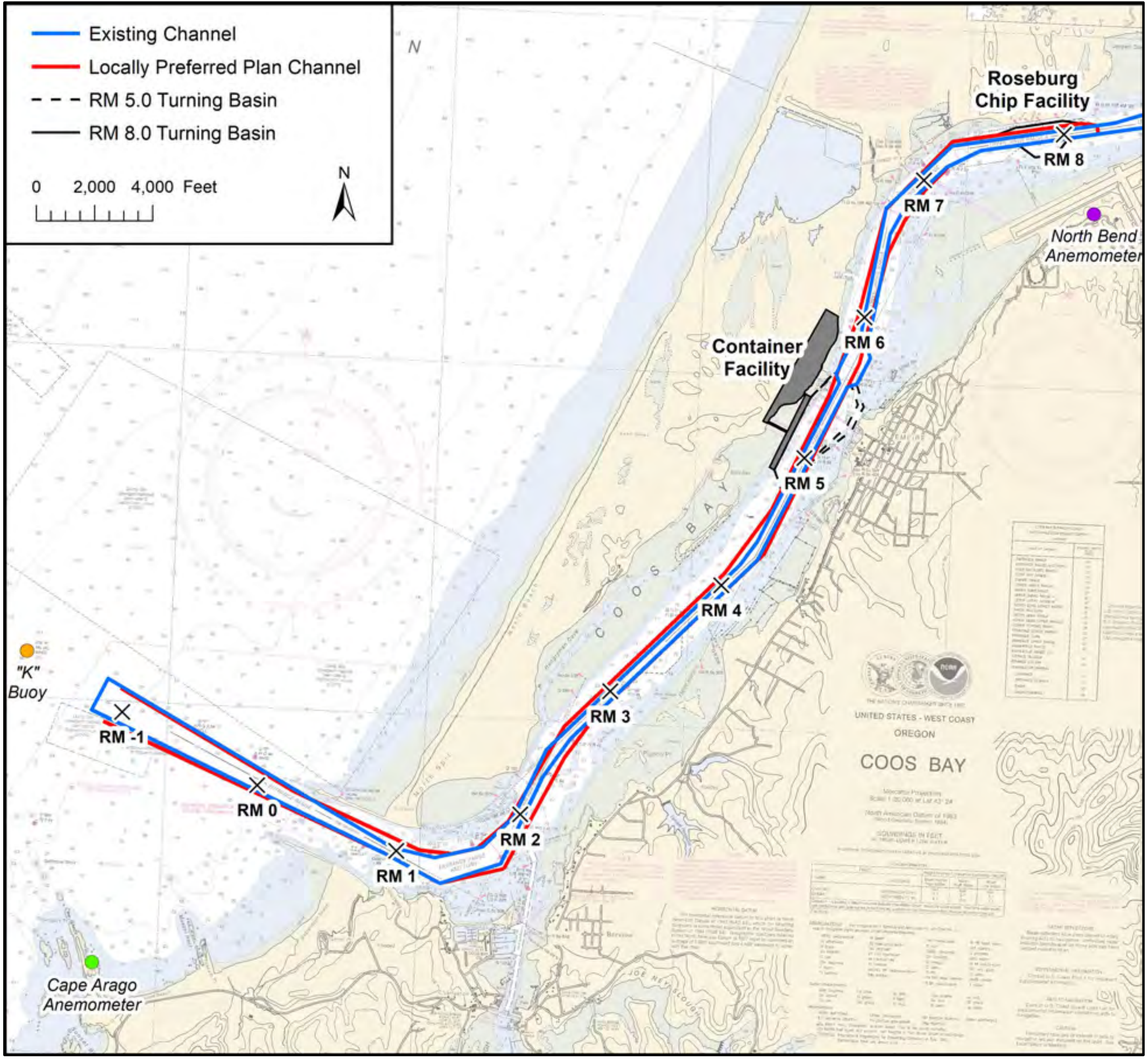


Figure 2-14. Seasonal Wind Roses at Cape Arago (Left Panel) and North Bend (Right Panel), Summer (June through August) for Hourly Mean

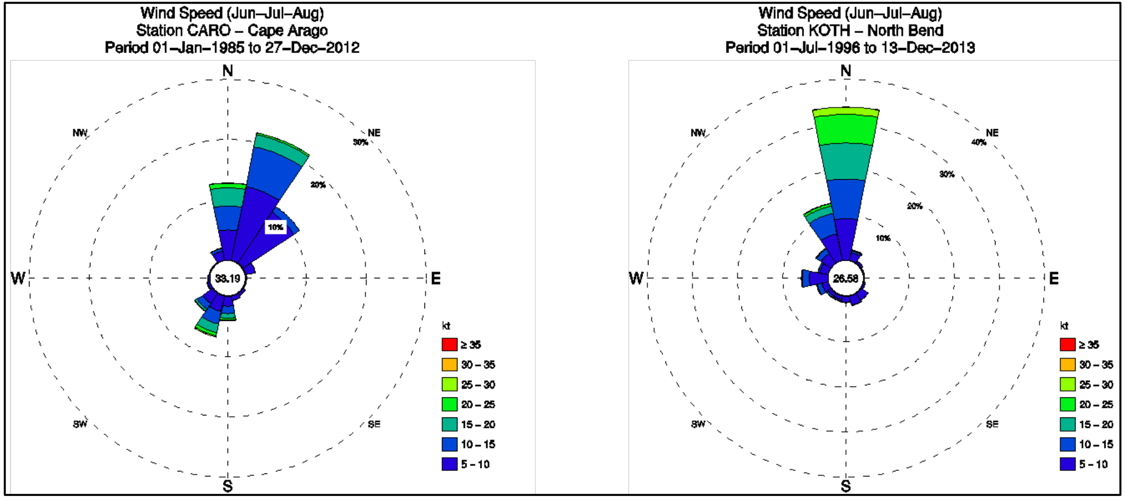


Figure 2-15. Seasonal Wind Roses at Cape Arago (Left Panel) and North Bend (Right Panel), Winter (December through January) for Hourly Mean

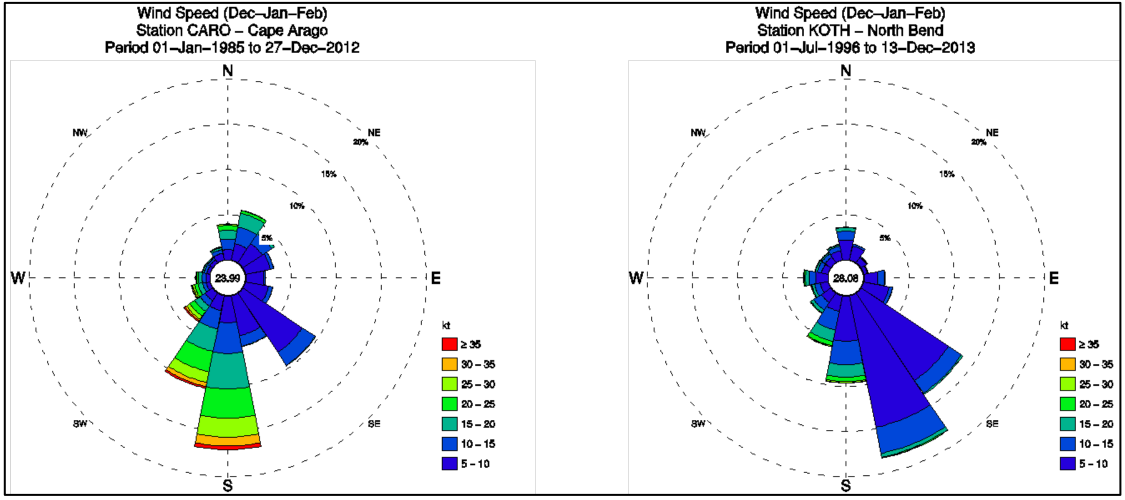


Table 2-5. Typical Wind Conditions at Long-Term Anemometers (hourly mean)

Wind Condition (General Range)	Anemometer Location	
	Cape Arago	North Bend
Typical summer wind	10-15 knots, N to NNE	15-20 knots, NNW to N
High summer wind	20 knots, N	25 knots, N
Typical winter wind	15-20 knots, SW to S	5-10 knots, S to SE
High winter wind	30 knots, SW to S	20 knots, SW to S

Table 2-6. Wind Conditions Used for Ship Simulation

Wind Condition (For Modeling)	Sustained Wind at Location	
	Offshore from RM 1.0	Upstream of RM 1.0
N25a. NNW wind, high summer wind	25 knots, NNW	25 knots, NNW
N25b. NNE wind, high summer condition	25 knots, NNE	25 knots, NNE
S30. SSW wind, high winter condition	30 knots, SSW	20 knots, SSW

Note:
The winds given here are the average one-hour sustained winds for conditions when the pilots might normally consider crossing the bar.

3 BASIS OF MANEUVERS

The maneuvers identified for this simulation effort were based on the 2016 & 2017 FMSS maneuvers and the M&N 2022 & 2023 desktop screening simulations performed for the planned CF. These simulations were targeted to verify the modifications included in the 2023 PA channel from the previously verified 2017 PA channel.

The starting position of each exercise, speed of transit, and utilization of tugs were specified by the Coos Bay Pilot for each simulation. For each simulation a Coos Bay Pilot and a helmsman were present on the bridge.

3.1 SIMULATOR FACILITY

This full mission bridge ship simulation study was performed at MITAGS in Linthicum Heights, Maryland. MITAGS is certified as a Maritime Training Provider by Det Norske Veritas (DNV-GL). MITAGS is also compliant with criteria set forth by the United States Coast Guard, the STCW Code, the Military Sealift Command (MSC), the International Lighthouse Authority (IALA), the American Pilots' Association, the Maryland Higher Education Commission (MHEC), and the Washington State Workforce Training, Education, and Coordinating Board.

MITAGS East offers two (2) Full-Mission Shiphandling Simulators [SHS #1 and SHS #2], three (3) 300° Bridge Tug Simulators [SHS #3, SHS #5, SHS #6], and one (1) 120° Bridge Tug Simulator [SHS#4]. SHS #1 and SHS #2 are Full-Mission Shiphandling Simulators that are housed within 360° curved projection screens that measure eighty (80) feet in diameter and thirty (30) feet in height. SHS #3, SHS #5, and SHS #6 are Full-Mission Bridge Tug Simulators that utilizes a 300° horizontal field of view and 42° vertical field of view. SHS #4 is a Bridge Tug Simulator that offers 120° of visuals and the ability to change the view to any location.

For this simulation effort Full-Mission Shiphandling Simulator SHS#2 was used. The Full-Mission bridge is equipped with controls for conventional, azipod, and Z-drive vessels, full suite of instrumentation, and navigation and communication gear, including Electronic Chart Display and Information Systems (ECDIS). The MITAGS facility provides an effective simulation by providing pilots a realistic experience.

3.2 SIMULATOR SOFTWARE

The vessel simulations described herein were conducted using the navigation simulation software Wärtsilä Navi-Trainer Profession (NTPro) 5000. For this simulation effort Version 5.4 was used.

NTPro is a vessel maneuvering software use to assess the static and dynamic forces that act on a vessel during complex maneuvers in a variety of environments, including shallow water maneuvering. Features of the model include full six-degrees-of-freedom vessel hydrodynamics, three-dimensional harbor area representation, explicit tug model behavior, vessel response to: wind, waves, currents, bathymetry, vessel-structure, and vessel-vessel interaction. Vessels are discretized to allow for force shadowing and differentiation along the ship. Ship models used in the simulators are developed and verified with data from basin tests and real-world collection schemes.

3.2.1 VISUAL DATABASE

The scene for this study was based on the existing visual database of Coos Bay from the previous full mission bridge simulations. This scene was customized by M&N to include the 2023 PA Channel and the planned container facility.

3.3 SHIP HANDLERS

Ship handling for this study was performed by the local Coos Bay pilots, Captain George Wales and Captain Steven Woods, from April 10th to April 14th, 2023. On April 6th and April 7th, 2023, Captain Richard Michael, a MITAGS expert ship handler, performed the ship handling.

3.4 TESTING MATRIX

Table 3-1 shows the matrix of the completed simulations. This matrix was based upon the test matrix included in the initial plan and modified based upon ship handler input. All changes to matrix received concurrence from the simulation observers. In total, 31 simulations were conducted to evaluate the future without project and the 2023 proposed alteration channel.

USACE protocols call for each run to be performed twice, using different pilots. To fulfill this requirement, each simulation was performed twice, with at least one of the runs performed by a Coos Bay Pilot. The pilot used for each run is listed in Table 3-1.

Table 3-1. Simulation Matrix

Run ID	Channel	Own Ship (1)	Moored Vessel	Direction	Turn Performed	Turning Basin Used	Tug Power (mt)	Wind (4) Offshore/Upstream	Waves	Tide Level(6) (ft/m)	Tide Stage	Start	End	Pilot		Run Result	
														A	B	A	B
1	WOP	PNMX	PNMX, CFN	Inbound	Yes	RM 5.0 - PNMX	80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	--	3.6/1.1	High Water into Ebb (07:20)	RM 3	CFS	R. Michael	G. Wales	🟢	🟢
2	WOP	PNMX	PNMX, CFN	Inbound	Yes	RM 5.0 - PNMX	80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	--	3.6/1.1	High Water into Ebb (07:20)	RM 3	CFS	R. Michael	S. Woods	🟡	🟡
3	WOP	PNMX	PNMX, CFN	Inbound	Yes	RM 5.0 - PNMX	80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	--	3.6/1.1	Flood (02:10)	RM 3	CFS	R. Michael	G. Wales	🟡	🟢
4	WOP	PNMX	PNMX, CFN	Outbound	Yes	RM 5.0 - PNMX	80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	--	3.6/1.1	1 Hour Before High Water (05:20)	CFS	RM 5	R. Michael	S. Woods	🟢	🟢
5	WOP	PNMX	PNMX, CFN	Outbound	Yes	RM 5.0 - PNMX	80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	--	3.6/1.1	Run A: 1 Hour Before High Water (05:20) Run B: 1.5 Hour Before High Water (05:00)	CFS	RM 5	R. Michael	G. Wales	🟢	🟢
6	2023 PA	Capesize	--	Inbound	Yes	RM 8.0	80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	--	3.6/1.1	Flood (02:20)	RM 7	RCF	G. Wales	S. Woods	B: 🟢	D: 🟢
7	2023 PA	Capesize	--	Inbound	Yes	RM 8.0	80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	--	3.6/1.1	Flood (02:20)	RM 7	RCF	G. Wales	S. Woods	🟢	🟡
8	2023 PA	PPX3	PPX3, CFN	Inbound	Yes	RM 5.0 - PPX3	80 / 80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	Swell W	4.5/1.4	High Water into Ebb (06:30)	RM -2	CFS	S. Woods	G. Wales	🟢	🟢
9	2023 PA	PPX3	PPX3, CFN	Inbound	Yes	RM 5.0 - PPX3	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Swell NW	4.5/1.4	High Water into Ebb (06:30)	RM -2	CFS	S. Woods	G. Wales	🟢	🟡
10	2023 PA	PPX3	PPX3, CFN	Inbound	Yes	RM 5.0 - PPX3	80 / 80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	--	4.5/1.4	High Water into Ebb (07:20)	RM 3	CFS	S. Woods	G. Wales	🟢	🟢
11	2023 PA	PPX3	PPX3, CFN	Outbound	Yes	RM 5.0 - PPX3	80 / 80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	Swell W	4.5/1.4	1.5 Hour Before High Water (05:00)	CFS	RM -1	S. Woods	G. Wales	🟢	🟢
12	2023 PA	PPX3	PPX3, CFN	Outbound	Yes	RM 5.0 - PPX3	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Swell NW	4.5/1.4	1.5 Hour Before High Water (05:00)	CFS	RM -1	S. Woods	G. Wales	🟢	🟢
13	2023 PA	PPX3	PPX3, CFN	Outbound	Yes	RM 5.0 - PPX3	80 / 80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	--	4.5/1.4	1.5 Hour Before High Water (05:00)	CFS	RM 5	G. Wales	S. Woods	🟡	🟢
14	2023 PA	PPX3	PPX3, CFN	Inbound	Yes	RM 5.0 - PPX3	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Swell NW	4.5/1.4	Flood (01:20)	RM -2	CFS	S. Woods	G. Wales	🟢	🟡
15	2023 PA	PPX3	PPX3, CFN	Inbound	Yes	RM 5.0 - PPX3	80 / 80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	Swell W	4.5/1.4	Flood (01:20)	RM -2	CFS	S. Woods	G. Wales	A: 🔴 B: 🟢	C: 🟡

Notes:

1. WOP = Without Project, 2023 PA = 2023 Proposed Alteration, PNMX = Panamax Containership, PPX3 = Post Panamax Generation 3 Containership, CFN = Container Facility North Berth, CFS = Container Facility South Berth
2. PNMX = Arthur Edgemore (958 ft x 106 ft); Capesize Chip Ship = Bulk Carrier 19 (837 ft x 141 ft); PPX3 = Kalina (1201 ft x 168 ft)
3. Winds are direction from, where 0 degrees is North.
4. Level of tide will not vary in runs. It will be modeled as the minimum required underkeel clearance.

🟢 Success. Run was well controlled with adequate clearance to channel edges and reserve of rudder and tugs.

🟡 Marginal Success. The run was completed without casualty to the vessel or tugs; however, the vessel may of have touched or exceeded channel or turning basin boundaries, came close to contact with an object, or used excessive rudder or tugs, depleting the maneuvering reserve.

🔴 Unsuccessful. Run was stopped or aborted due to exceeding allowable under keel clearance, grounding, loss of control, allision with object or shoals, or collision with another vessel; or vessel exceeded channel boundaries unintentionally.

3.5 EVALUATION CRITERIA

The primary criterion for the success of each run was pilot feedback after each simulation, Appendix D. A key component of the evaluation was the pilot assessment of overall safety and opinions as to whether specific maneuvers would be conducted in real life.

Additional variables used to critique the performance of the runs include, but are not limited to:

- *Clearance to edge of channel*. The minimum clearance to the edge of the channel and moored vessels was evaluated based on the swept path of the vessels. Acceptable clearance was determined through discussion with the Pilots.
- *Reserve engine and rudder*. The engine and rudder used during the simulation was evaluated with the aim of maintaining sufficient reserve for unanticipated maneuvering. Simulations that require sustained hard over rudder were rated as a marginal success run with consideration of the pilot feedback.
- *Reserve tug power*. To ensure sufficient reserve tug power, the tug power was tracked. The average tug power should not exceed 80 percent of full bollard pull and not more than one tug should run at full power simultaneously. Reserve tug power should be available to the pilot when maneuvering. Simulations that required sustained use of full power were rated as a marginal success run with consideration of the pilot feedback.
- *Swept path density*: The use of the channel width was evaluated by looking at swept path density figure which illustrates which areas of the channel were used in more or fewer simulations. The density figures were developed by compositing the path of multiple runs and evaluating the number of tracks that use a particular area of the channel. This provides information on how vessels track around bends (e.g., inside of the curve vs. outside of the curve).

4 RESULTS & ANALAYSIS

Results for each of the 31 simulation runs are presented below and the overall rating of the run is tabulated in the subsections. The combined results of the (A) and (B) runs are presented together to compare the similarities and differences for each pilot. The simulation report prepared by MITAGS can be found in Appendix E.

For each simulation two plots are presented:

- **Vessel Swept Path***:* These plots were developed to illustrate clearance of the vessel to channel and turning basin limits. The vessel profiles are shown at two-minute intervals.
- **Vessel and Tug Parameter Time Series:** These time series were created to illustrate the vessel's speed over ground (SOG), rudder angle, engine revolutions per minute (RPM), rate of turn (ROT), bow thruster power, and tug power.

Pilot feedback was recorded on pilot evaluation forms (Appendix D), along with notes and observations made by the engineers supervising the effort. For each simulation, the pilot was asked to rate the maneuver in three categories: Run Safety, Tug Adequacy, and Run Difficulty. These ratings are discussed in greater detail in the subsections below. Rating scales[3] are as follows:

- Run Safety: 1 to 5 with “5” highest safety and “3” average safety;
- Tug Adequacy: 1 to 5 with “5” best and “3” average; and
- Difficulty: 1 to 5: with “5” most difficult and “3” average.

4.1 PANAMAX CONTAINERSHIP SIMULATIONS

In total 10 simulations were performed in the WOP channel with the Panamax containership evaluating the turning evolution in the corresponding turning basin and maneuvering to/from the planned container facility. Of these simulations 6 were inbound and 4 were outbound. Based on discussion with the pilots on their planned timing of the inbound maneuver to the container facility, two tidal current conditions were evaluated, during an ebb current and a flood current. The outbound simulations only evaluated a single current, starting approximately a couple of hours before slack water, based on the pilot feedback.

The pilot safety, run difficulty, and tug adequacy ratings for all the Panamax containership simulations are summarized in Table 4-1. Note that three different pilots performed these simulations and performance ratings are subjective to each individual pilot. On average the inbound and outbound transits were rated as above average safety and tug adequacy and below average run difficulty.

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[3] 10555722: Rating scales shown are 1 to 10
Actual pilot ratings are on a scale of 1 to 5.
Response: Updated scales

Table 4-1. Panamax Containership Pilot Ratings for Safety, Difficulty, & Tug Adequacy

Simulation Number	Pilot	Run Safety	Tug Adequacy	Run Difficulty	Run Result
Inbound Maneuver					
1A	R. Michael	5	5	2	🟢
1B	G. Wales	5	5	2	🟢
2A	R. Michael	3	5	3	🟡
2B	S. Woods	5	5	3	🟡
3A	R. Michael	2	1	5	🟡
3B	G. Wales	4	5	2	🟢
Inbound Average	--	4.0	4.3	2.8	--
Outbound Maneuver					
4A	R. Michael	4	5	2	🟢
4B	S. Woods	5	5	1	🟢
5A	R. Michael	4	5	3	🟢
5B	G. Wales	5	4	2	🟢
Outbound Average	--	4.5	4.8	2.0	--

4.1.1 SIMULATION 1 – PANAMAX INBOUND, RM 3 – CFS, WOP, NNE WIND, EBB TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
1A	WOP	PNMX	PNMX, CFN	Inbound	Yes / RM 5.0 - PNMX	80 / 80	25kt NNE (22.5°)	3.6/1.1	High Water into Ebb (07:20)	RM 3	CFS	R. Michael	🟢
1B												G. Wales	🟢

Simulation 1 started at approximately River Mile 3 to assess the approach and turning maneuver in the proposed WOP turning basin. The transit was conducted with an ebb tidal current with strong NNE winds.

Vessel Swept Path Figures: Figure 4-1 and Figure 4-3.

Vessel and Tug Parameter Time Series: Figure 4-2 and Figure 4-4

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Safety and tug adequacy were rated “best”. Run difficulty was rated as below average difficulty. The vessel track stayed within the channel and turning basin boundaries. Throughout the transit there was reserve tug power, sufficient clearance to the moored vessel, and the bow thruster was not used. Both pilots would perform this transit in a real-life situation.

Result: Run A: Successful **Run B:** Successful

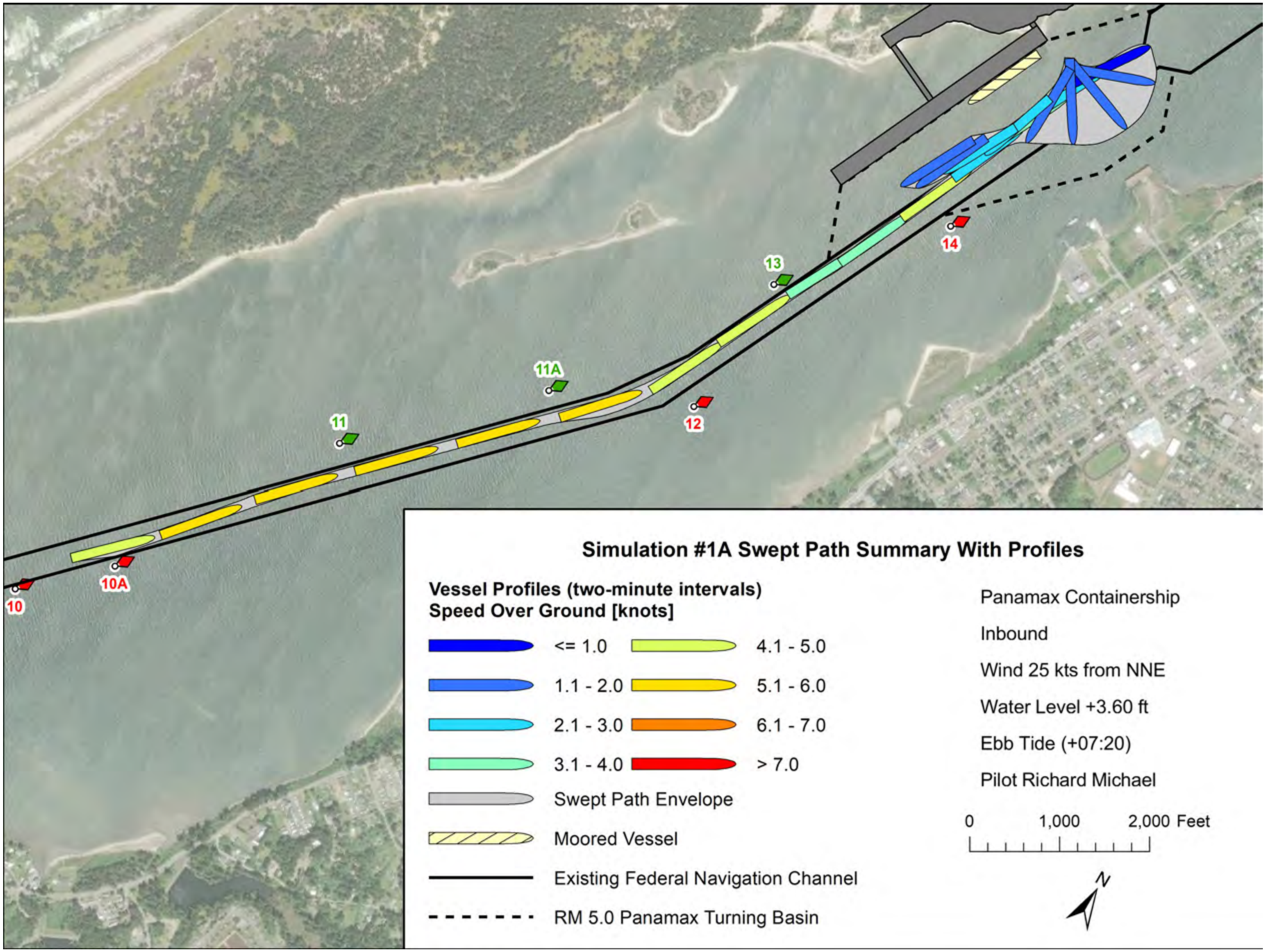

Figure 4-1. Simulation 1A Swept Path Summary with Profiles

Figure 4-2. Simulation 1A Vessel and Tug Parameter Time Series

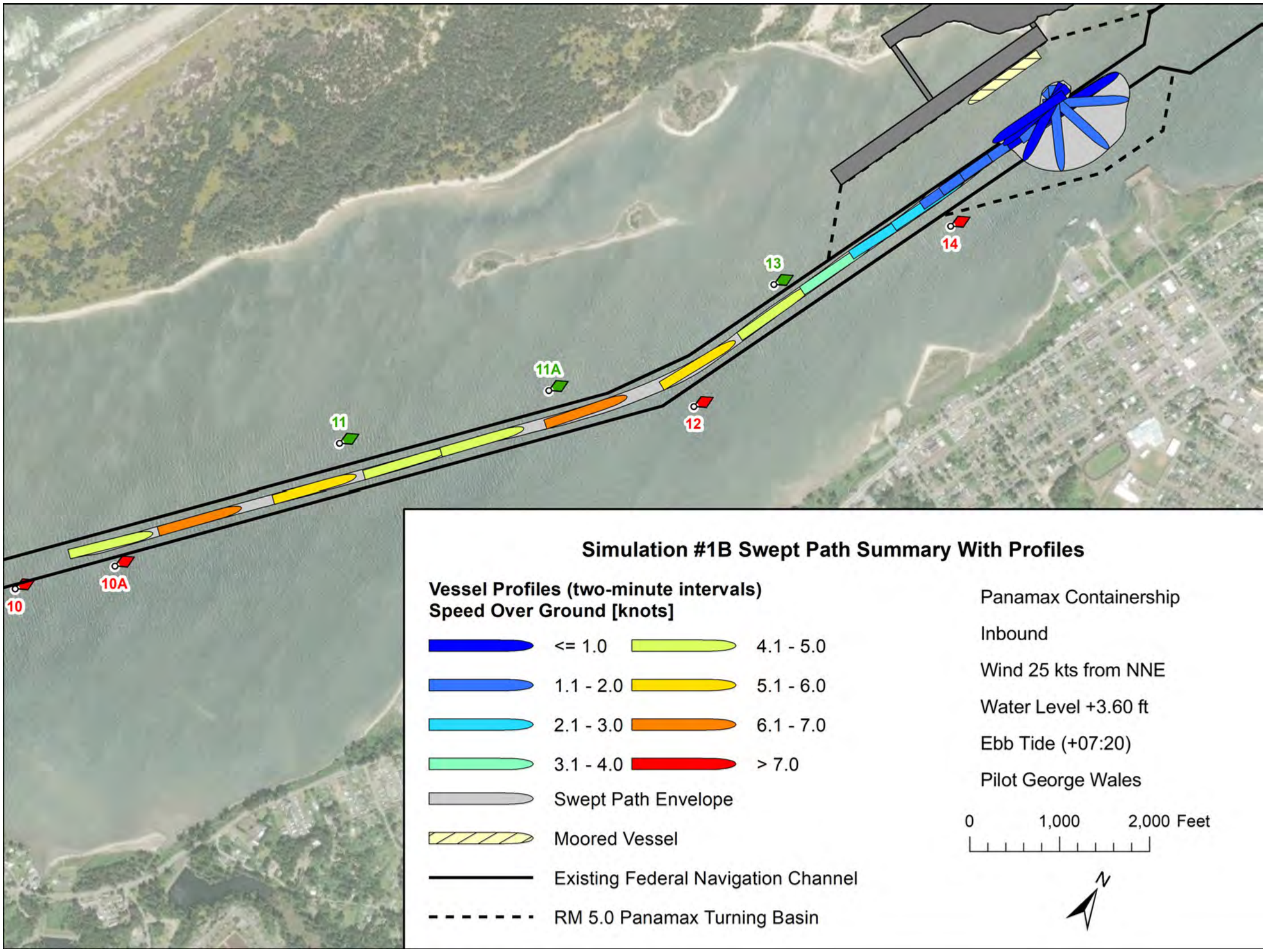

Figure 4-3. Simulation 1B Swept Path Summary with Profiles

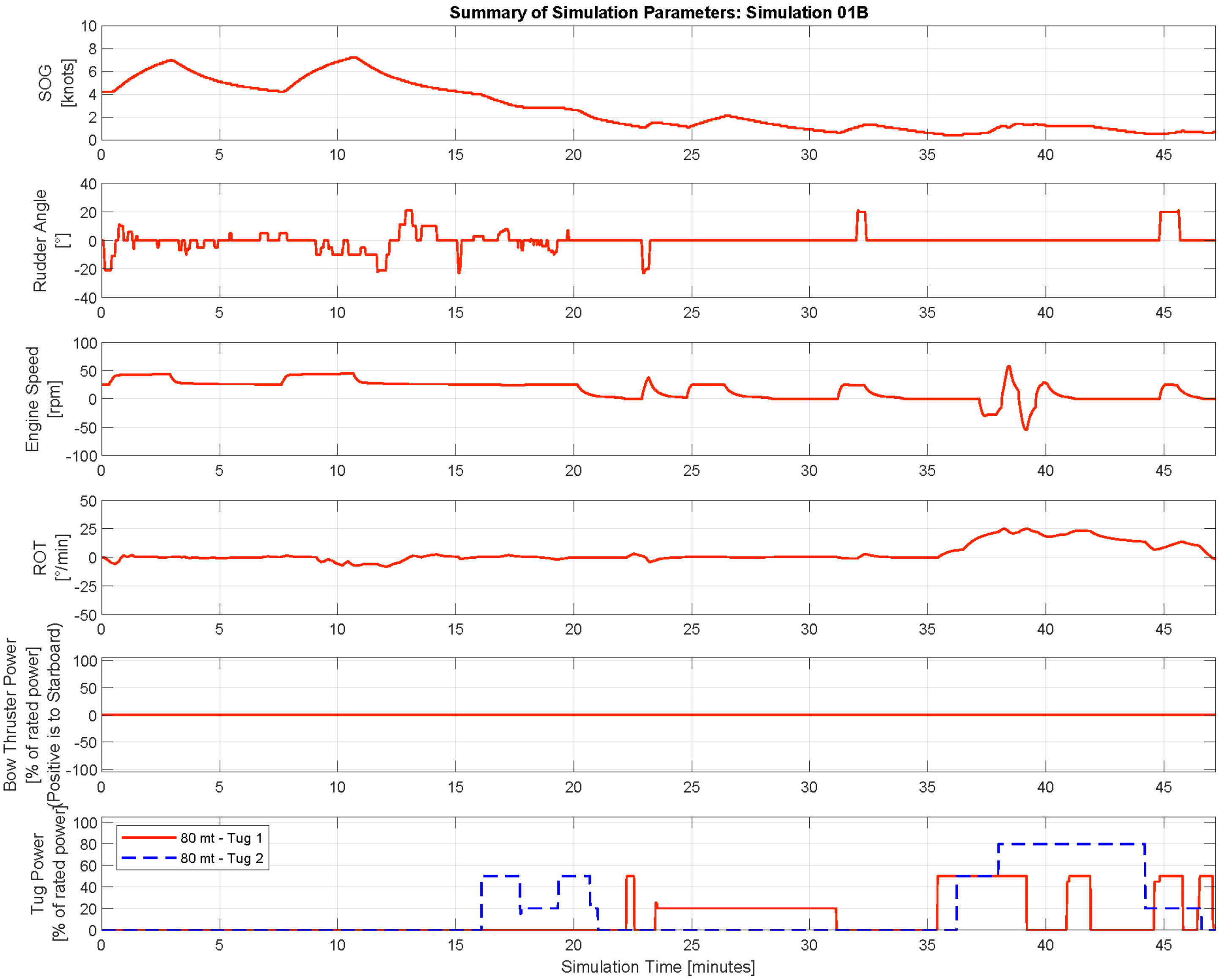

Figure 4-4. Simulation 1B Vessel and Tug Parameter Time Series

4.1.2 SIMULATION 2 – PANAMAX INBOUND, RM 3 – CFS, WOP, SSW WIND, EBB TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
2A	WOP	PNMX	PNMX, CFN	Inbound	Yes / RM 5.0 - PNMX	80 / 80	20kt SSW (222.5°)	3.6/1.1	High Water into Ebb (07:20)	RM 3	CFS	R. Michael	🟡
2B												S. Woods	🟡

Simulation 2 started at approximately River Mile 3 to assess the approach and turning maneuver in the proposed WOP turning basin. The transit was conducted with an ebb tidal current with strong SSW winds.

Vessel Swept Path Figures: Figure 4-5 and Figure 4-7.

Vessel and Tug Parameter Time Series: Figure 4-6 and Figure 4-8.

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Safety was rated as average or better. The tug adequacy was rated with this highest adequacy. Run difficulty was rated as average. Both runs were marginally successful due to slight departure from the navigation channel near green buoy “13” for **Simulation 2A** and **2B**. Captain Woods stated that he thought the SSW wind would have had more of an effect on the vessel approaching the turning basin. Throughout the transit there was reserve tug power. Both pilots would perform this transit in a real-world situation.

Result: Run A: Marginal Success **Run B:** Marginal Success

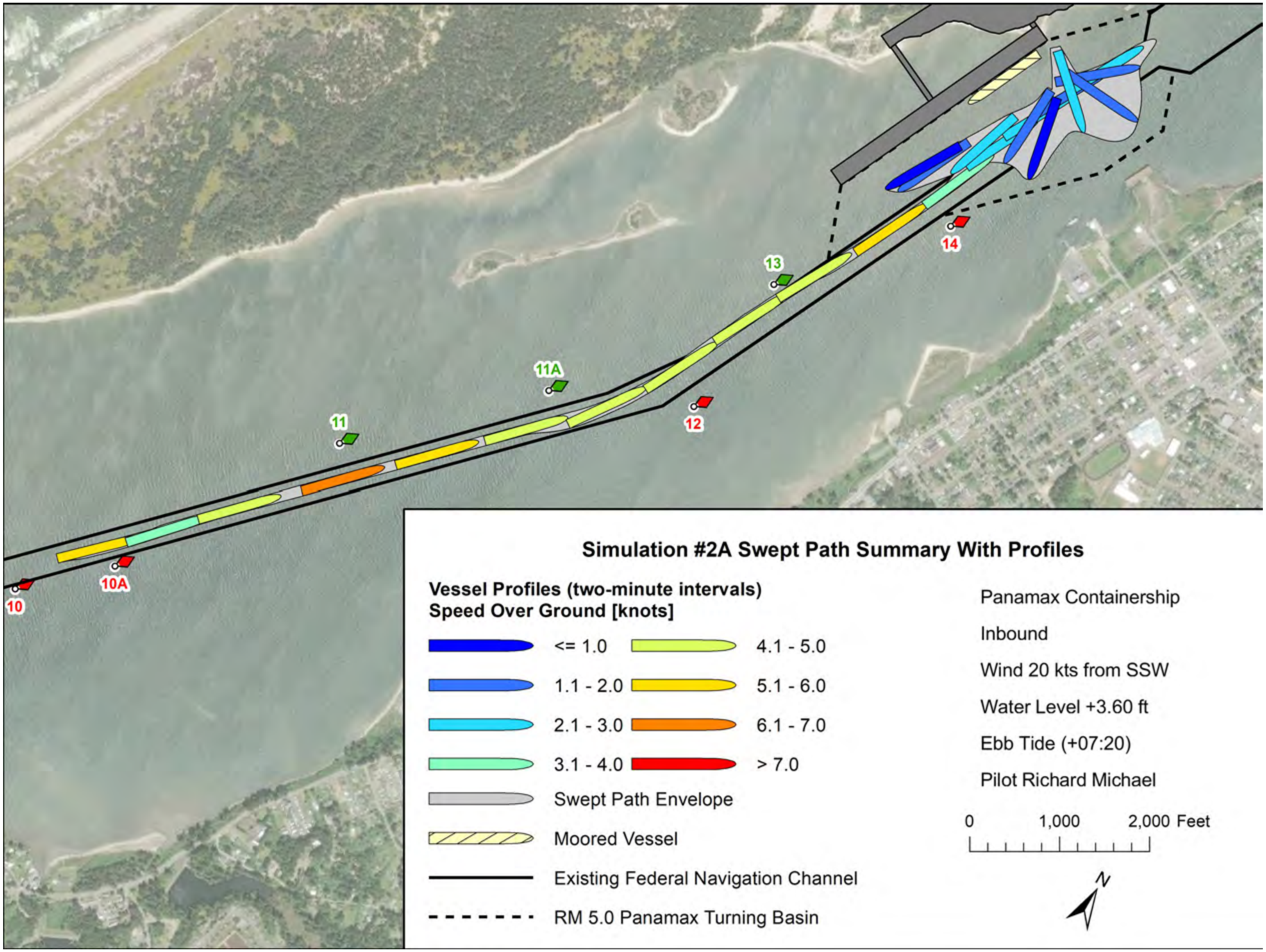

Figure 4-5. Simulation 2A Swept Path Summary with Profiles

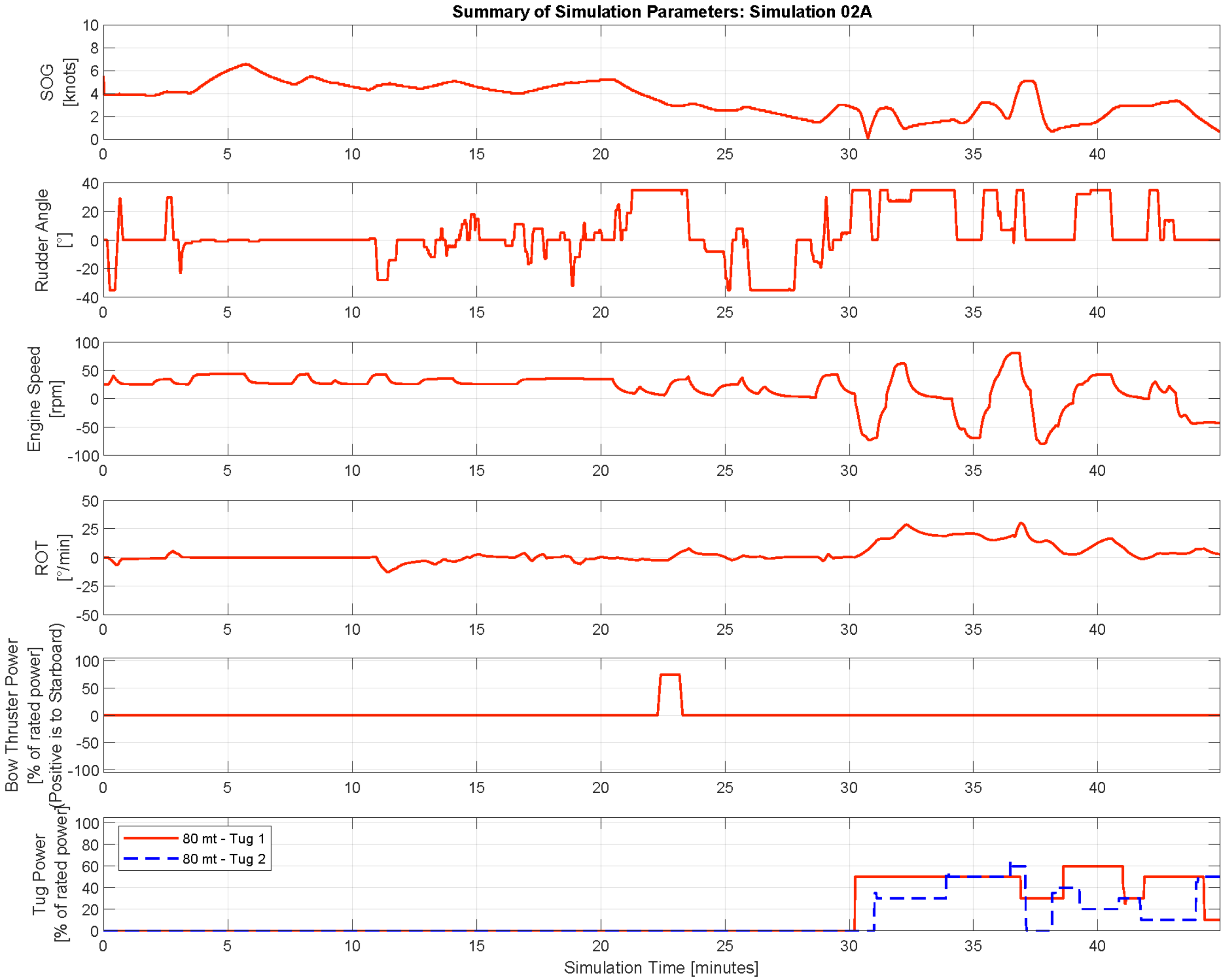

Figure 4-6. Simulation 2A Vessel and Tug Parameter Time Series

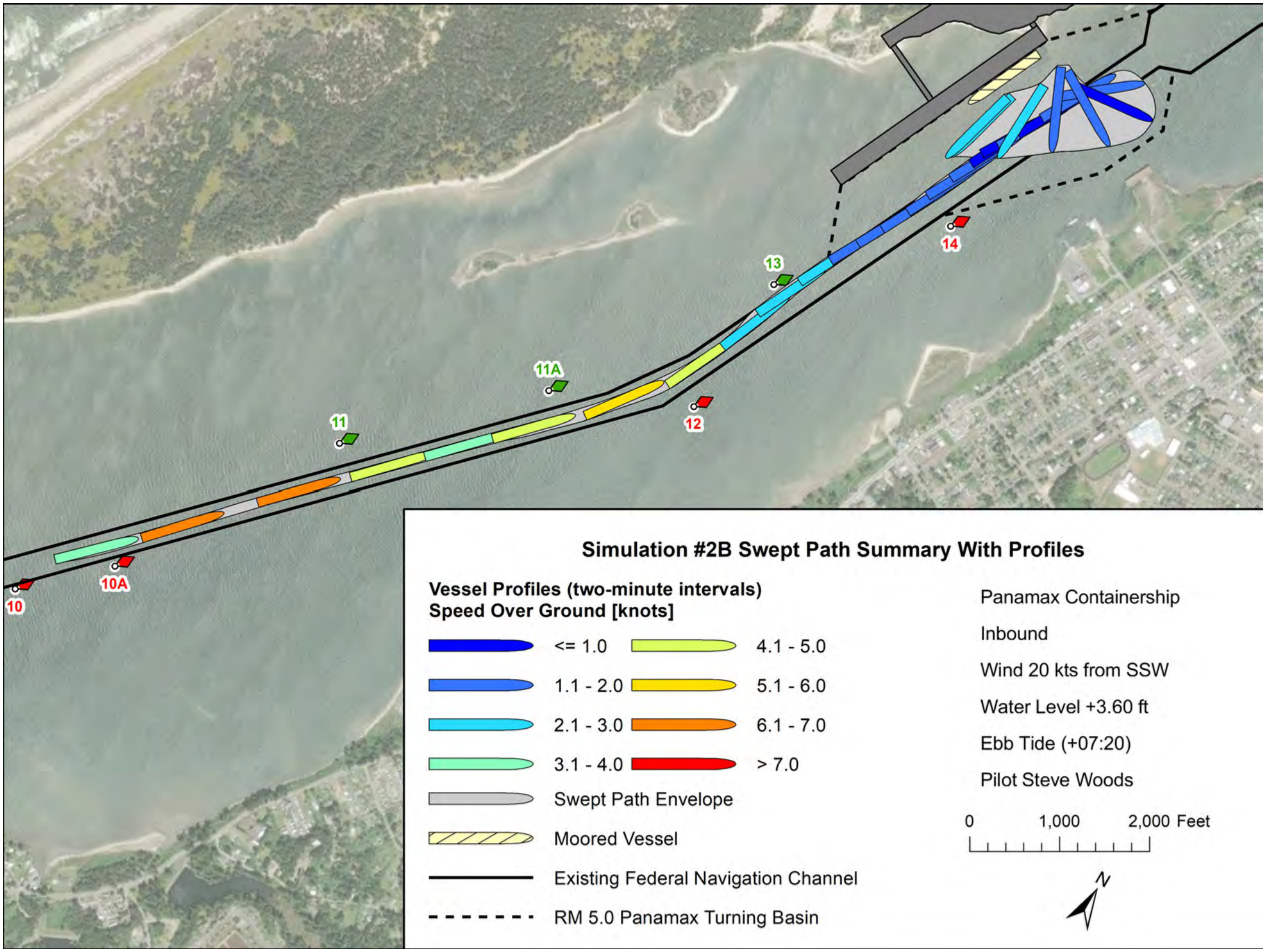

Figure 4-7. Simulation 2B Swept Path Summary with Profiles

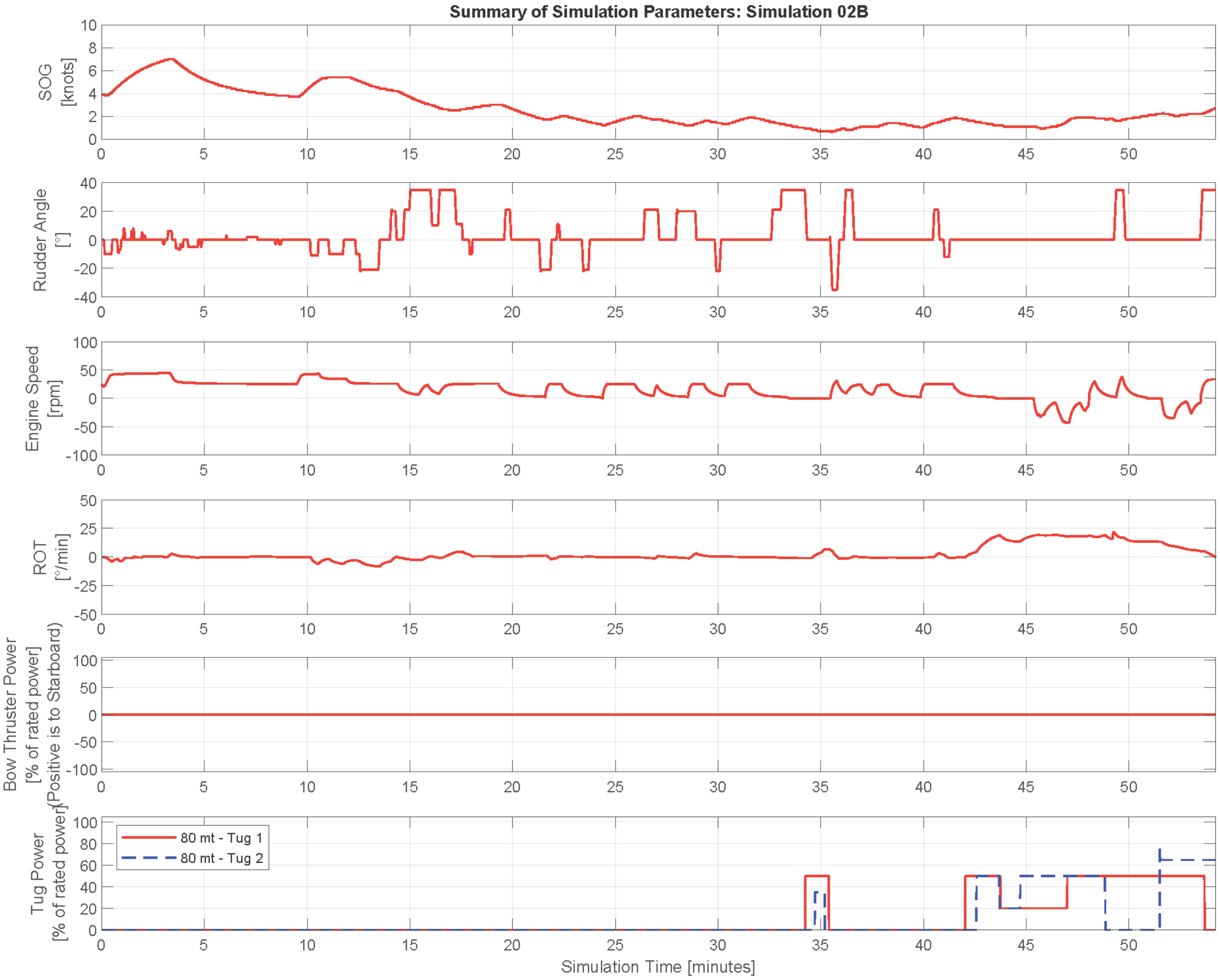

Figure 4-8. Simulation 2B Vessel and Tug Parameter Time Series

4.1.3 SIMULATION 3 – PANAMAX INBOUND, RM 3 – CFS, WOP, SSW WIND, FLOOD TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
3A	WOP	PNMX	PNMX, CFN	Inbound	Yes / RM 5.0 - PNMX	80 / 80	20kt SSW (222.5°)	3.6/1.1	Flood (02:10)	RM 3	CFS	R. Michael	🟡
3B												G. Wales	🟢

Simulation 3 started at approximately River Mile 3 to assess the approach and turning maneuver in the proposed WOP turning basin. The transit was conducted with a flood tidal current with strong SSW winds.

Vessel Swept Path Figures: Figure 4-9 and Figure 4-11**.**

Vessel and Tug Parameter Time Series: Figure 4-10 and Figure 4-12

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Captain Michael, the MITAGS expert ship handler, performed the ship handling for **Simulatio**n **3A.** He rated this simulation as below average safety, not adequate tug power, and the highest difficulty. This simulation had marginal success due to the vessel track going slightly outside the channel boundaries on the red side of the channel adjacent to red buoy “12”. The pilot commented that with the wind and tidal current in the same direction resulted in a challenging transit. To perform this simulation in a real-world situation the pilot should have significant experience with the transit in reduced environmental before maneuvering in the conditions tested or that the wind or current condition need to be limited. There was reserve tug power throughout this simulation and the bow thruster was not used.

Simulation 3B was performed by Captain George Wales, Coos Bay Pilot. He rated the run safety as above average and the tug adequacy as the most adequate. Run difficulty was rated as below average difficulty. The vessel track stayed within the channel and turning basin boundaries. Throughout the transit there was reserve tug power, sufficient clearance to the moored vessel, and the bow thruster was not used. Captain Wales would perform this transit in a real-life situation and recommended an additional green buoy at the southern flare of the container facility berth pocket approximately 75 ft from the apex.

Result: Run A: Marginal Success **Run B:** Successful

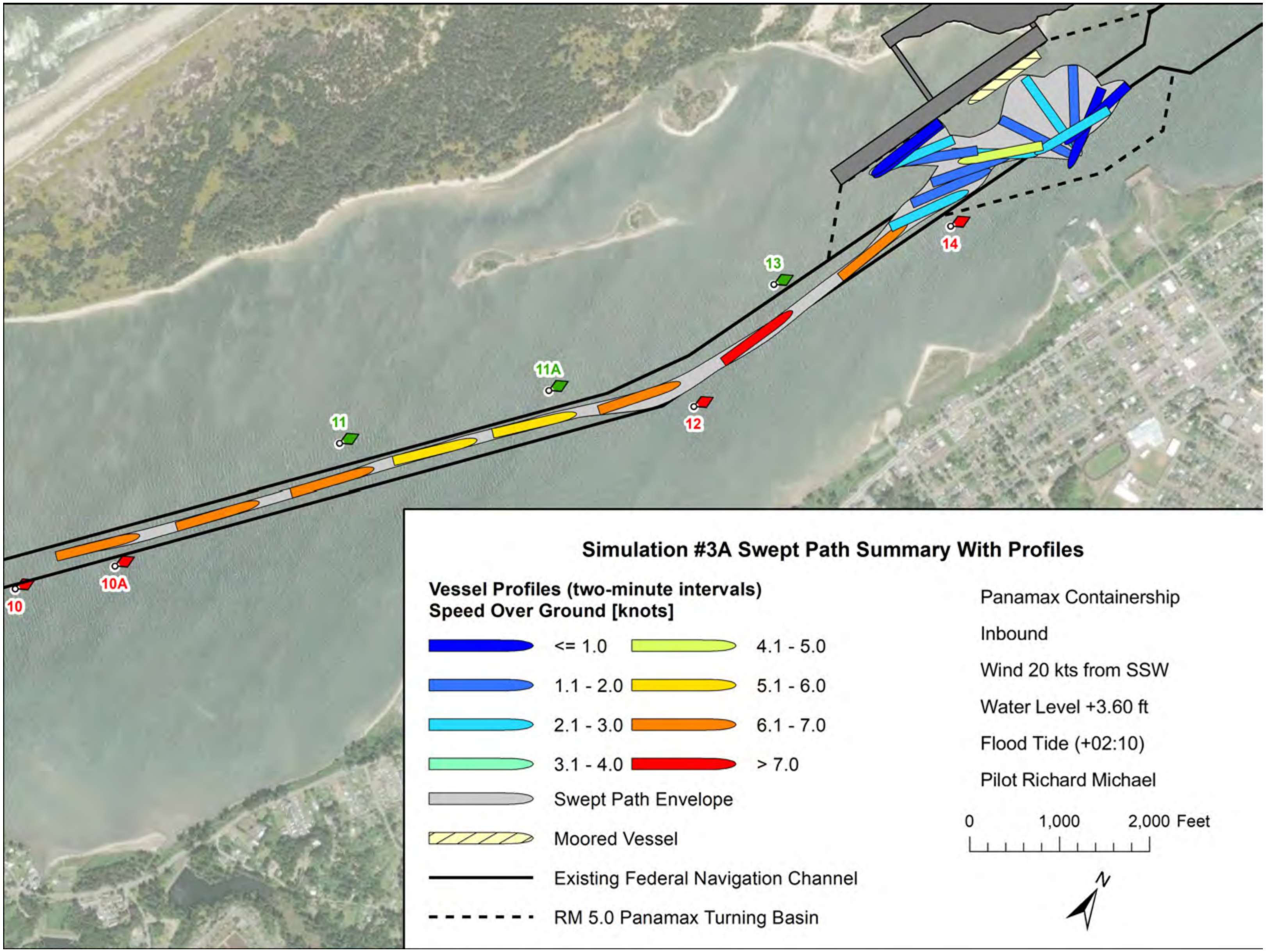

Figure 4-9. Simulation 3A Swept Path Summary with Profiles

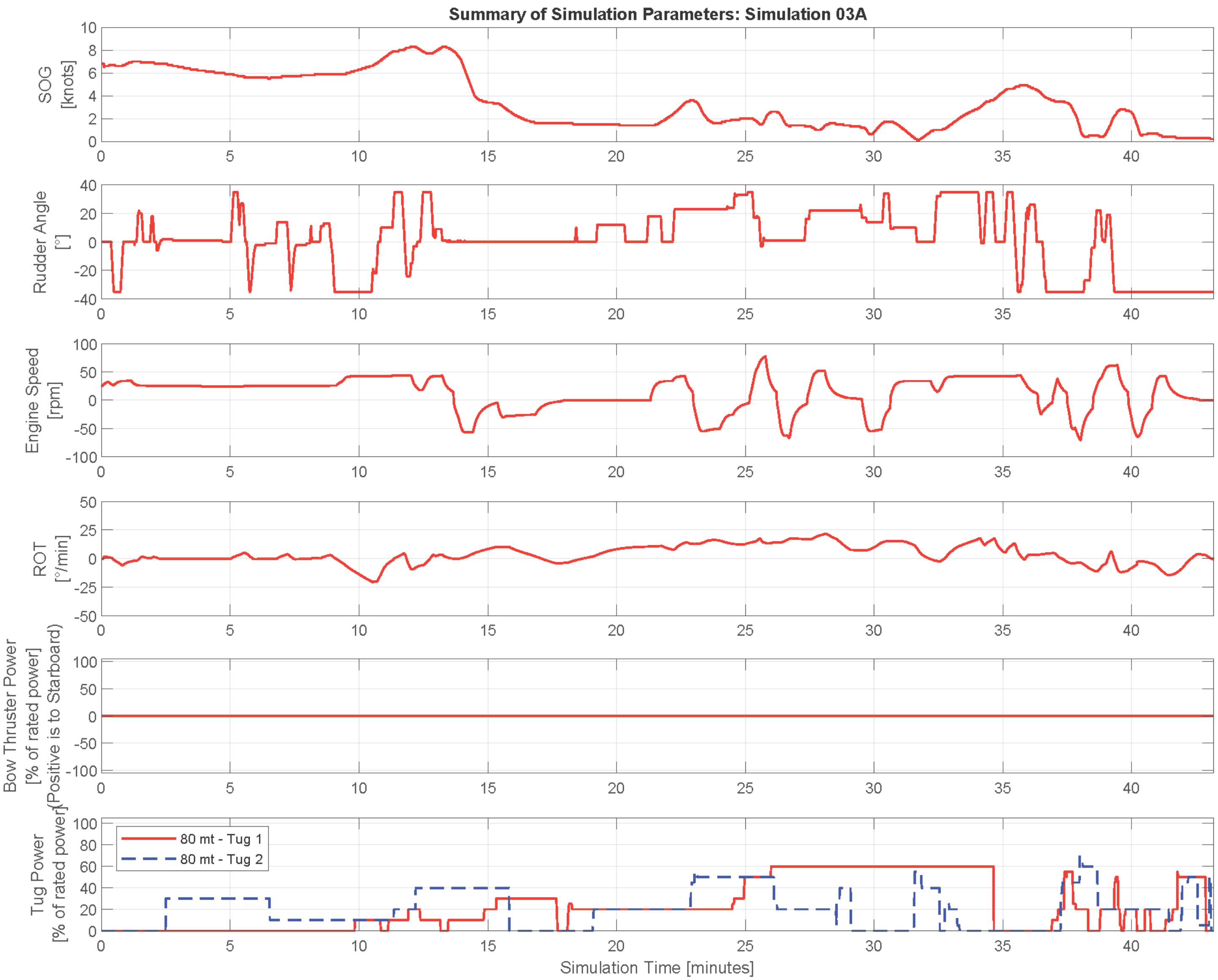

Figure 4-10. Simulation 3A Vessel and Tug Parameter Time Series

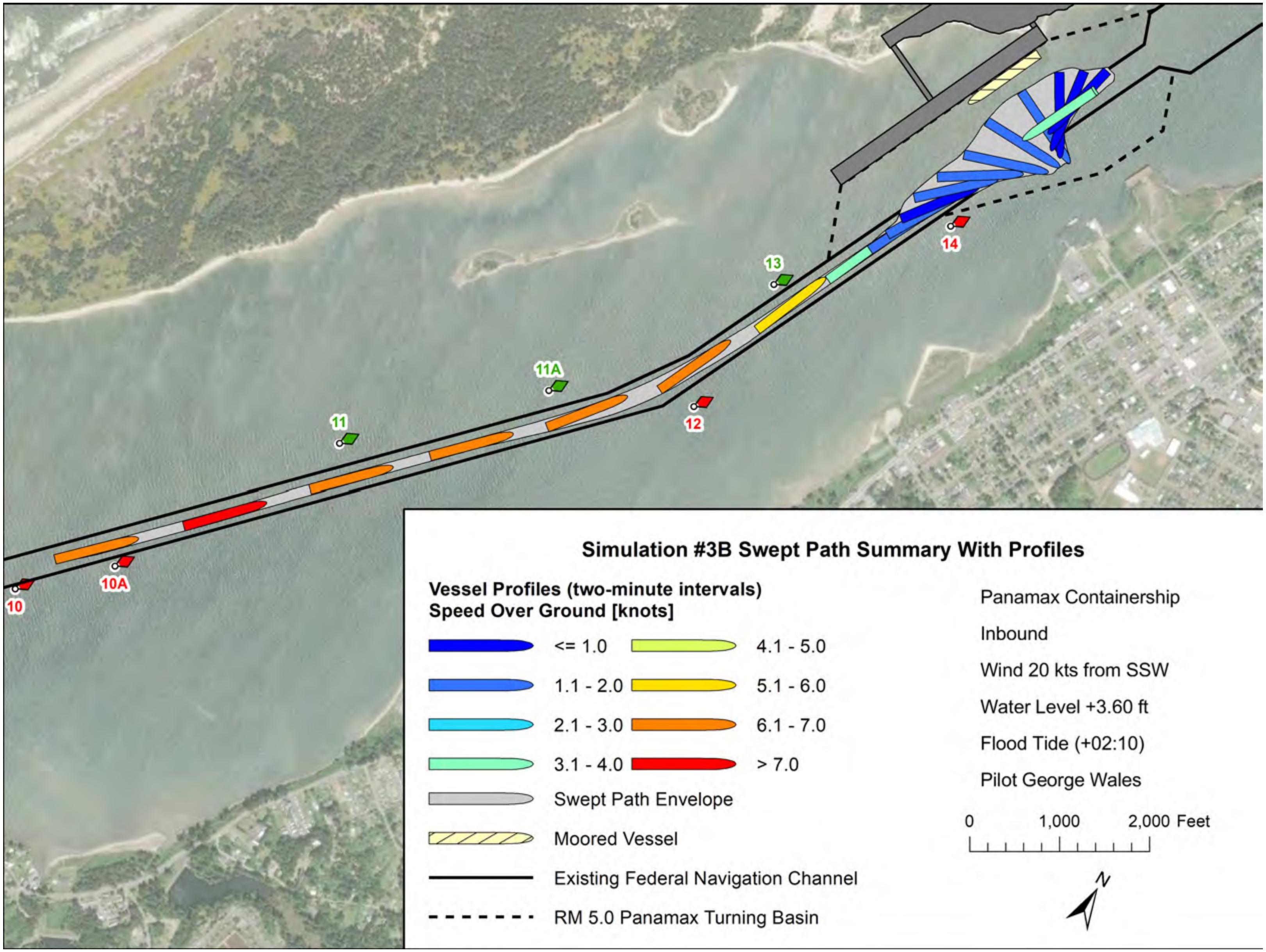

Figure 4-11. Simulation 3B Swept Path Summary with Profiles

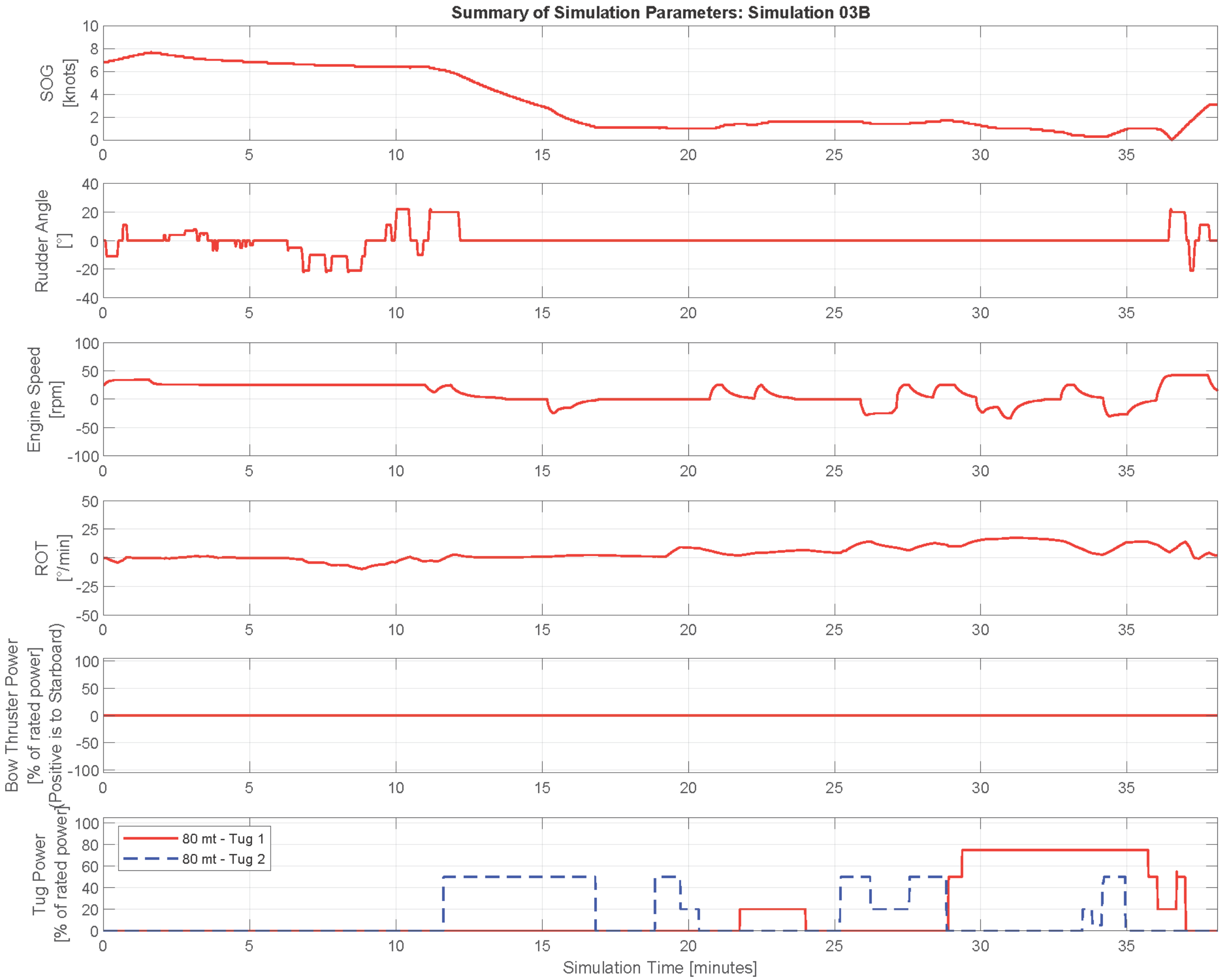

Figure 4-12. Simulation 3B Vessel and Tug Parameter Time Series

4.1.4 SIMULATION 4 – PANAMAX OUTBOUND, CFS – RM 5, WOP, SSW WIND, EBB TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
4A	WOP	PNMX	PNMX, CFN	Outbound	Yes / RM 5.0 - PNMX	80 / 80	20kt SSW (222.5°)	3.6/1.1	1 Hour Before High Water (05:20)	CFS	RM 5	R. Michael	🟢
4B												S. Woods	🟢

Simulation 4 started at the southern berth of the container facility. The purpose of this simulation was to assess the departure from the berth and turning maneuver in the proposed WOP turning basin. The transit was conducted with the tidal current corresponding to 1 hour before high water at the container facility and strong SSW winds.

Vessel Swept Path Figures: Figure 4-13 and Figure 4-15.

Vessel and Tug Parameter Time Series: Figure 4-14 and Figure 4-16.

Pilot Comments: Both pilots found the simulation to be a realistic representation and the vessel model performed as expected. Safety was rated as above average or better. The tug adequacy was rated with the highest adequacy. Run difficulty was rated as below average. Both of these runs were successful with reserve tug power throughout and both pilots stating that they would perform a similar transit in a real-world scenario.

Result: Run A: Successful **Run B:** Successful

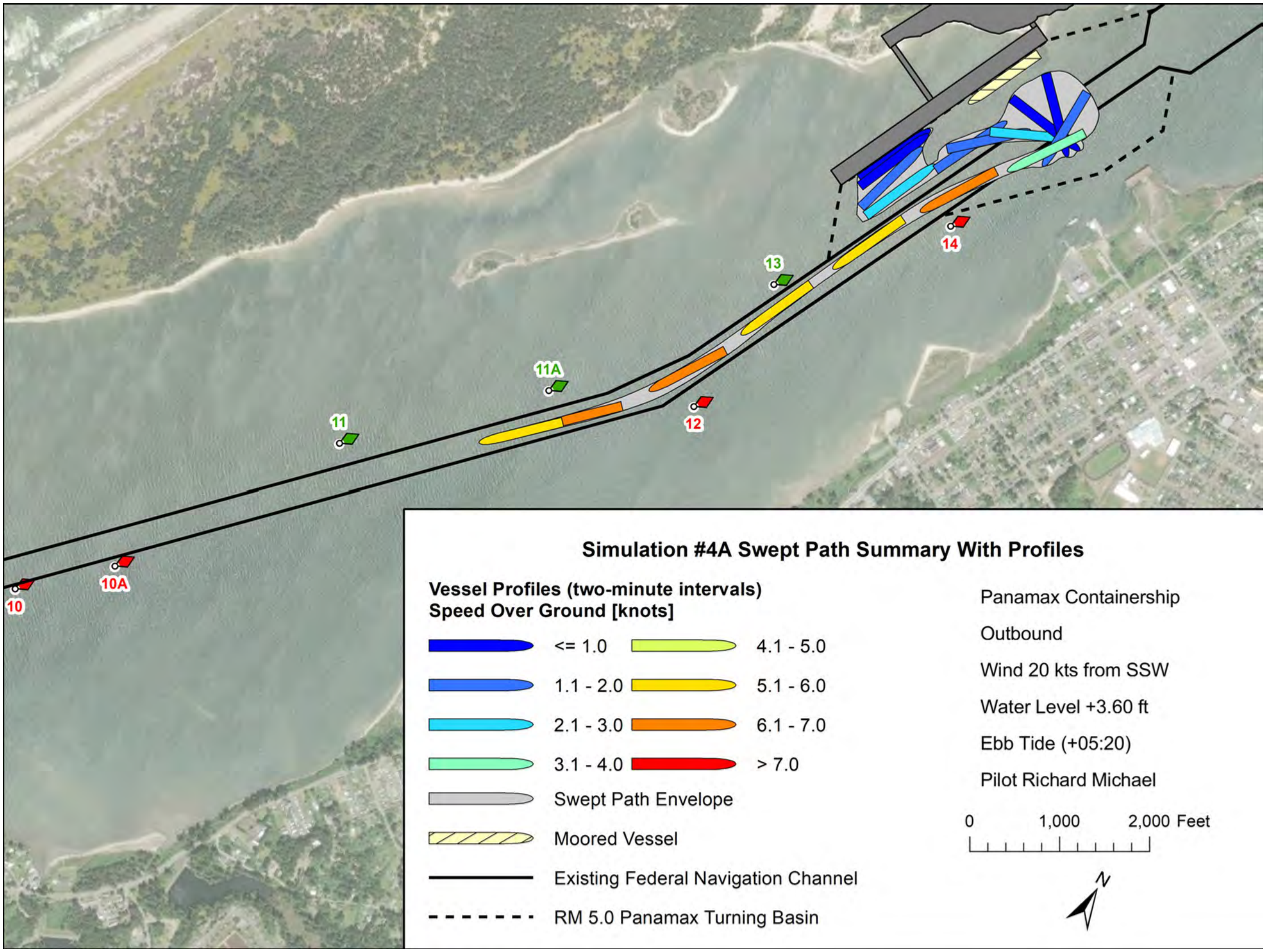

Figure 4-13. Simulation 4A Swept Path Summary with Profiles

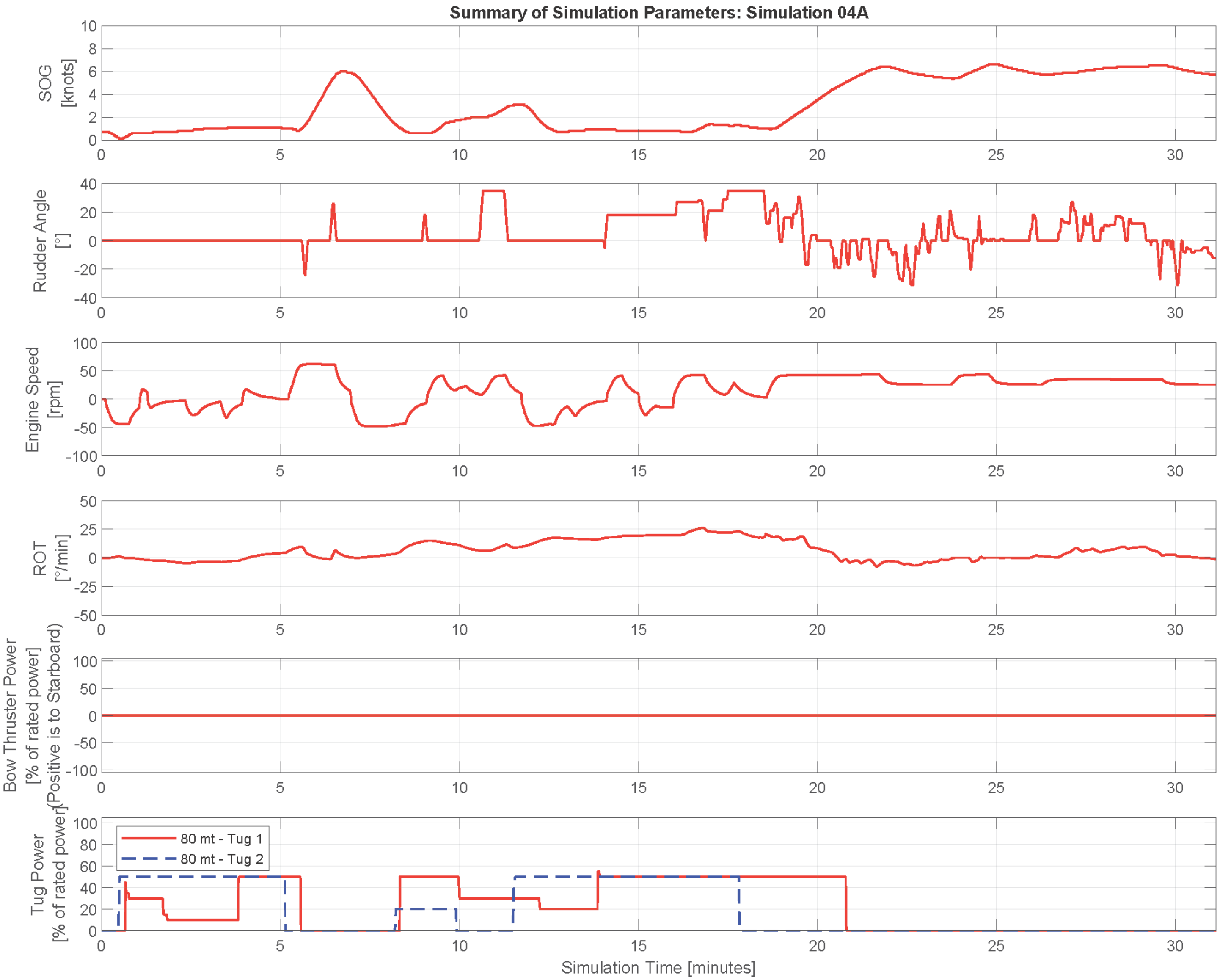

Figure 4-14. Simulation 4A Vessel and Tug Parameter Time Series

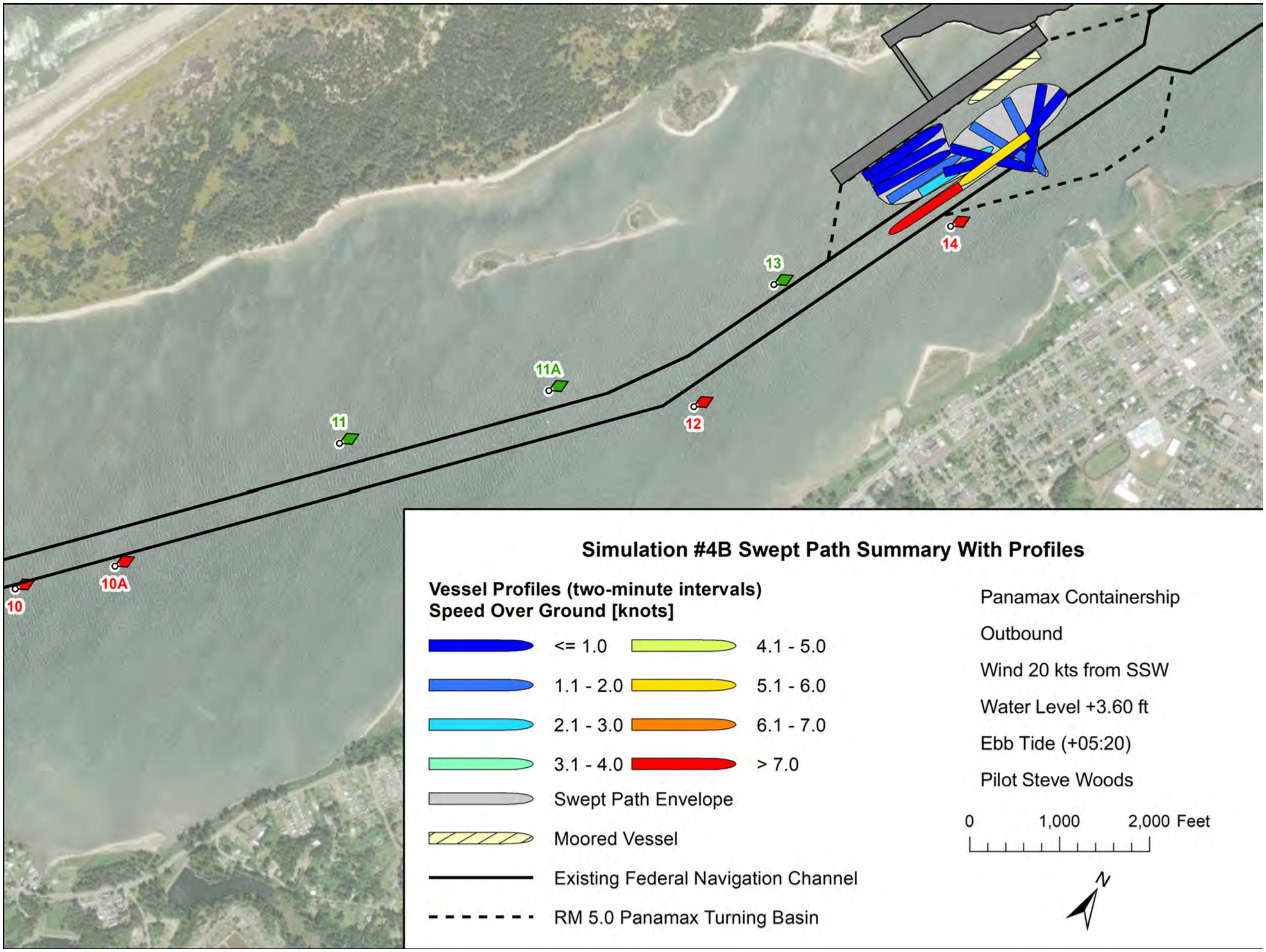

Figure 4-15. Simulation 4B Swept Path Summary with Profiles

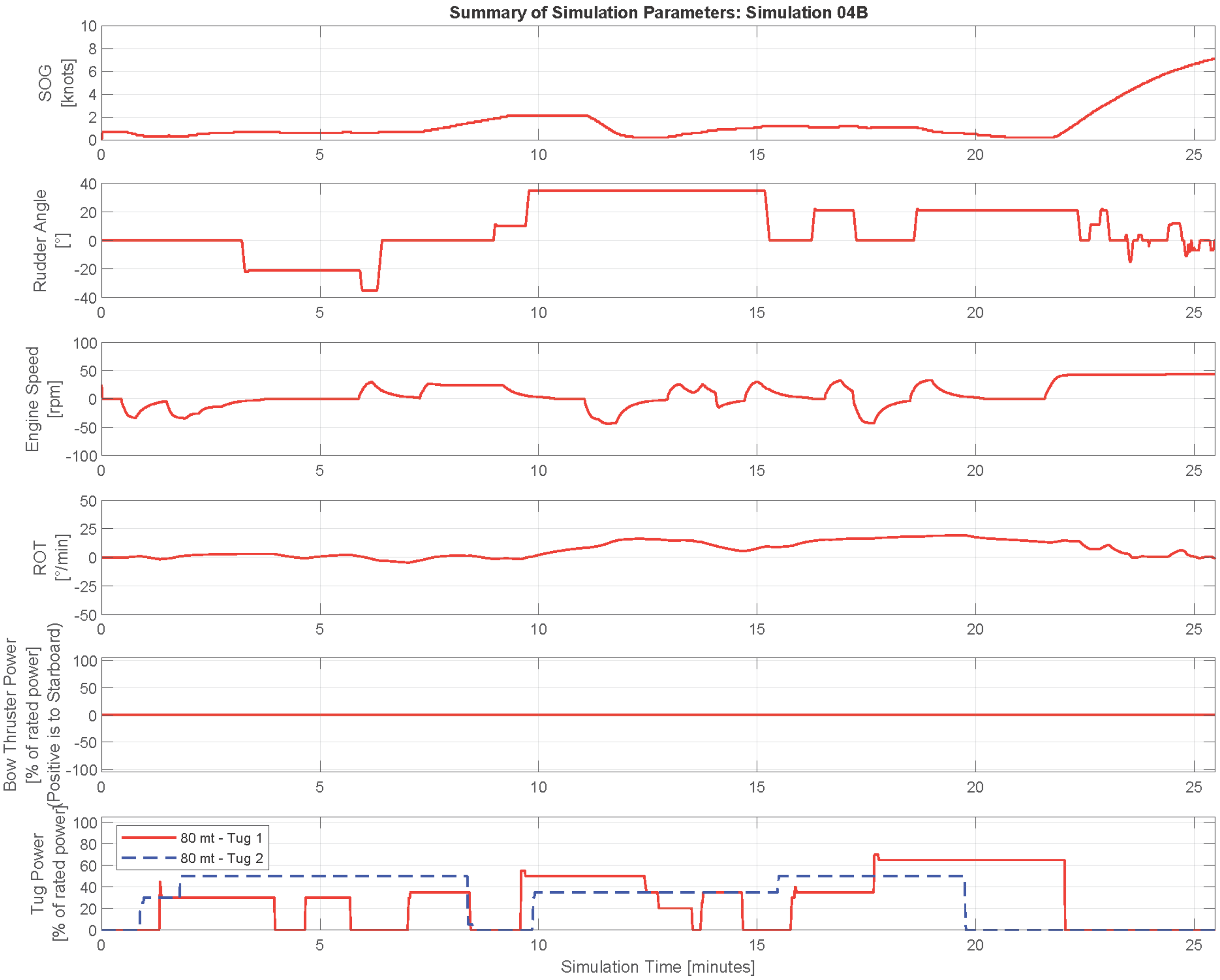

Figure 4-16. Simulation 4B Vessel and Tug Parameter Time Series

4.1.5 SIMULATION 5 – PANAMAX OUTBOUND, CFS – RM 5, WOP, NNE WIND, EBB TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
5A	WOP	PNMX	PNMX, CFN	Inbound	Yes / RM 5.0 - PNMX	80 / 80	25kt NNE (22.5°)	3.6/1.1	1 Hour Before High Water (05:20)	CFS	RM 5	R. Michael	🟢
5B									1.5 Hour Before High Water (05:00)			G. Wales	🟢

Simulation 5 started at the southern berth of the container facility. The purpose of this simulation was to assess the departure from the berth and turning maneuver in the proposed WOP turning basin. The transit was conducted with the tidal current corresponding to 1/1.5 hour before high water at the container facility and strong NNE winds. The change in the tidal current condition came from Captain George Wales to better align with his planned operational practice.

Vessel Swept Path Figures: Figure 4-17 and Figure 4-7.

Vessel and Tug Parameter Time Series: Figure 4-18 and Figure 4-20.

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Run safety and tug adequacy were rated as above average or better. Run difficulty was rated as average or below average. Captain Michael rated the difficulty as average as result of needing to combat the wind to get into the turning basin. Both of these runs were successful and there was reserve tug power throughout the simulation. Both pilots would perform this transit in a real-world situation.

Result: Run A: Successful **Run B:** Successful

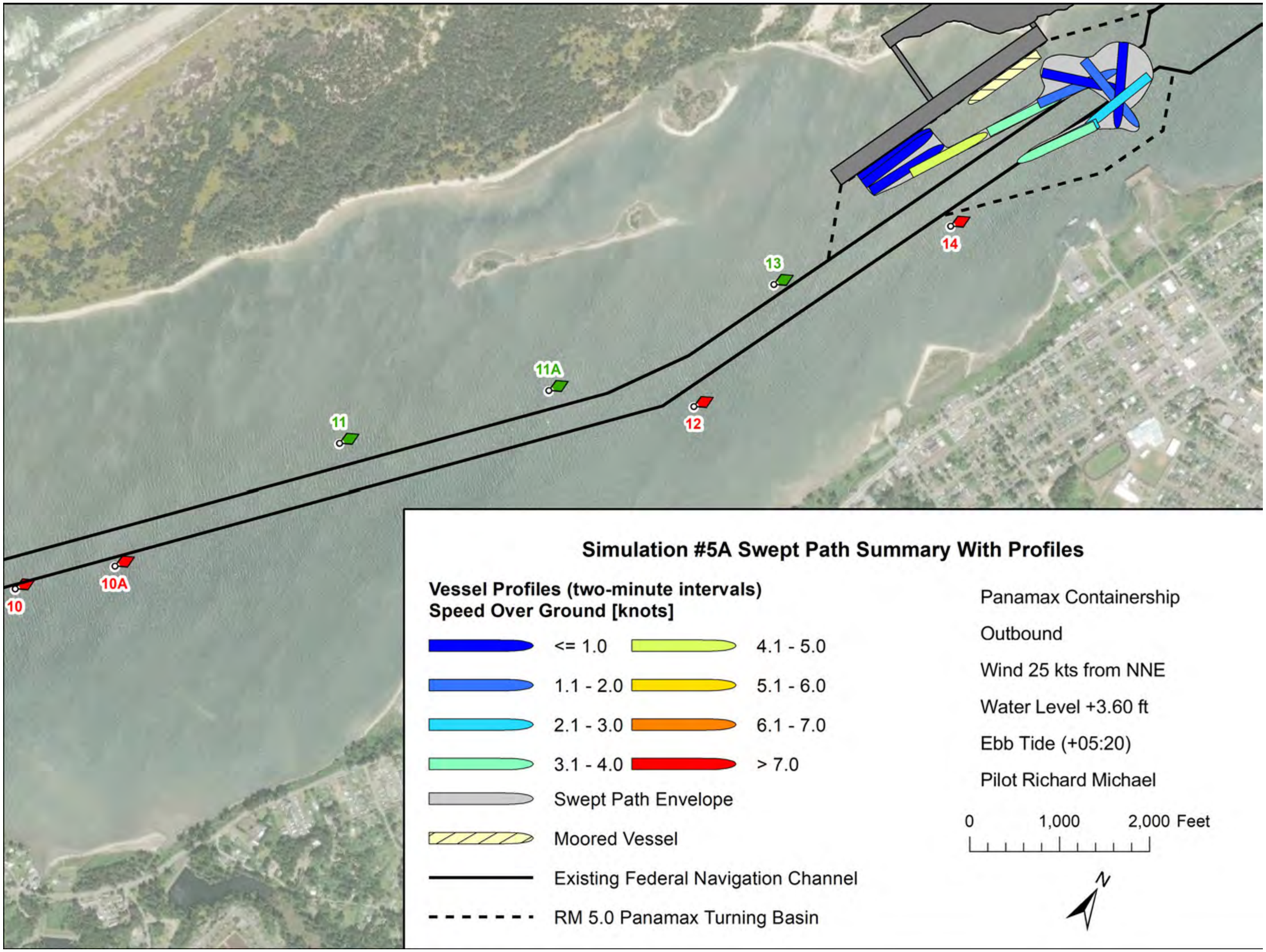

Figure 4-17. Simulation 5A Swept Path Summary with Profiles

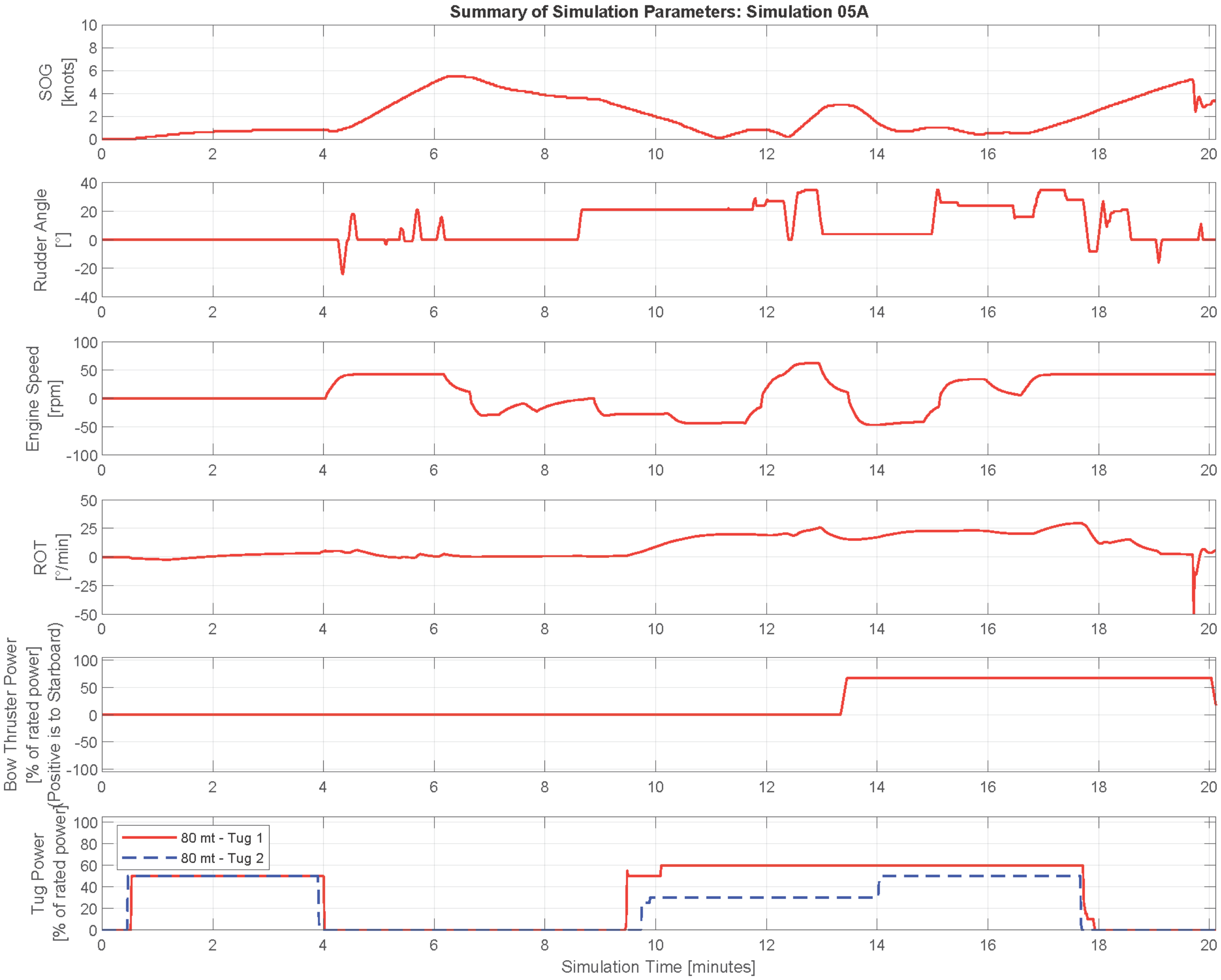

Figure 4-18. Simulation 5A Vessel and Tug Parameter Time Series

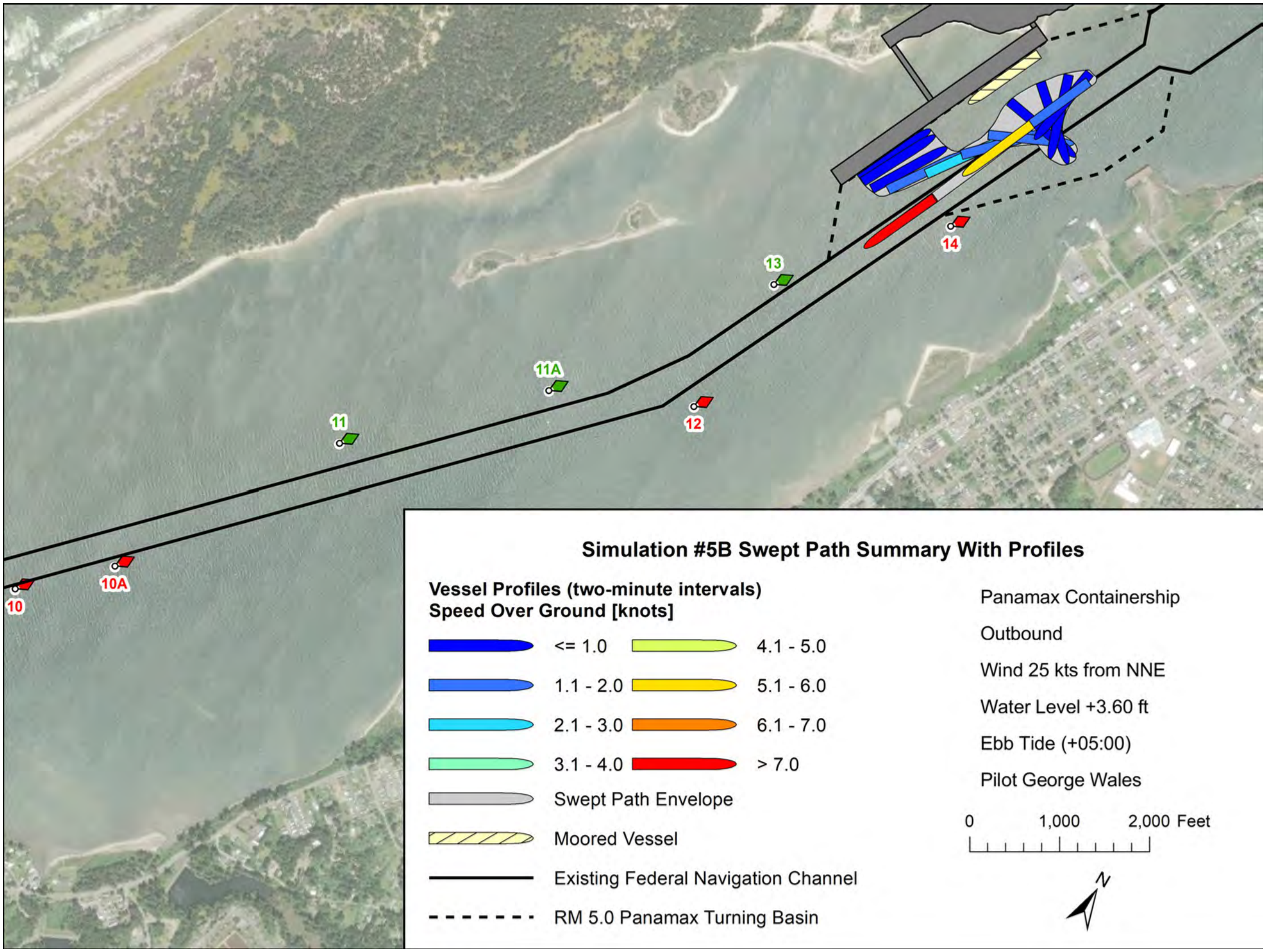

Figure 4-19. Simulation 5B Swept Path Summary with Profiles

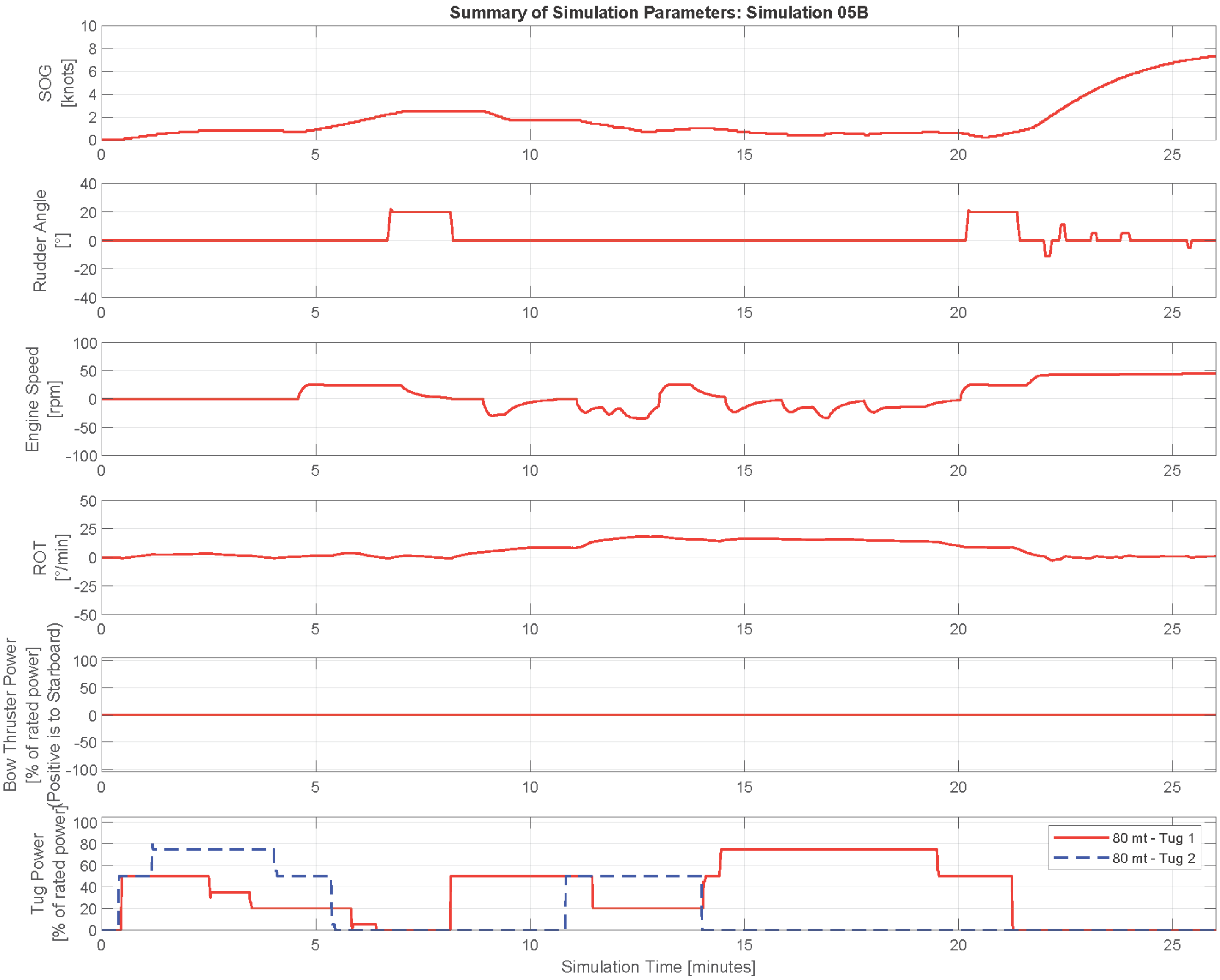

Figure 4-20. Simulation 5B Vessel and Tug Parameter Time Series

4.2 CAPESIZE BULK CARRIER SIMULATIONS

In total 4 simulations were performed in the 2023 PA channel with the capsize bulk carrier to evaluate the proposed turning basin at RM 8.0 for the larger bulk carriers calling at Roseburg Chip Facility. Operationally the bulk carriers always arrive in ballast condition and perform the turning evolution during the inbound transit. As a result, all four simulations evaluated those conditions.

The pilot safety, run difficulty, and tug adequacy ratings for all the capsize bulk carrier simulations are summarized in Table 4-2. On average these transits were rated as above average safety, the highest adequacy, and below average run difficulty.

Table 4-2. Capesize Bulk Carrier Pilot Ratings for Safety, Difficulty, & Tug Adequacy

Simulation Number	Pilot	Run Safety	Tug Adequacy	Run Difficulty	Run Result
Inbound Maneuver					
6B	G. Wales	5	5	1	🟢
6D	S. Woods	5	5	3	🟢
7A	G. Wales	5	5	1	🟢
7B	S. Woods	4	5	3	🟡
Inbound Average	--	4.8	5.0	2.0	--

4.2.1 SIMULATION 6 – CAPESIZE INBOUND, RM 7 – RCF, 2023 PA, SSW WIND, FLOOD TIDE

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
6B	2023 PA	Capesize	Inbound	Yes / RM 8.0	80 / 80	20kt SSW (222.5°)	3.6/1.1	Flood (02:20)	RM 7	RCF	G. Wales	🟢
6D											S. Woods	🟢

Simulation 6 started at approximately River Mile 7 to assess the approach and turning maneuver in the RM 8.0 turning basin with a capsize bulk carrier. The transit was conducted with a flood tidal current with strong SSW winds.

Vessel Swept Path Figures: Figure 4-21 and Figure 4-23**.**

Vessel and Tug Parameter Time Series: Figure 4-22 and Figure 4-24

Pilot Comments: The pilots found the simulation to be a realistic representation. The vessel model used for this simulation performed as expected to evaluate the design of the RM 8.0 turning basin. Safety and tug adequacy were rated with the highest rating. Run difficulty was rated as either average or the least difficulty. The vessel track stayed within the channel and turning basin boundaries. Throughout the transit there was reserve tug power. Both pilots would perform this transit in a real-life situation. During debrief both pilots stated that the turning basin footprint could be reduced by shifting the southern boundary approximately 75 to 100 ft to the north. Figure 4-21 and Figure 4-23 show the turning basin reduced by 75 ft.

Result: Run B: Successful **Run D:** Successful

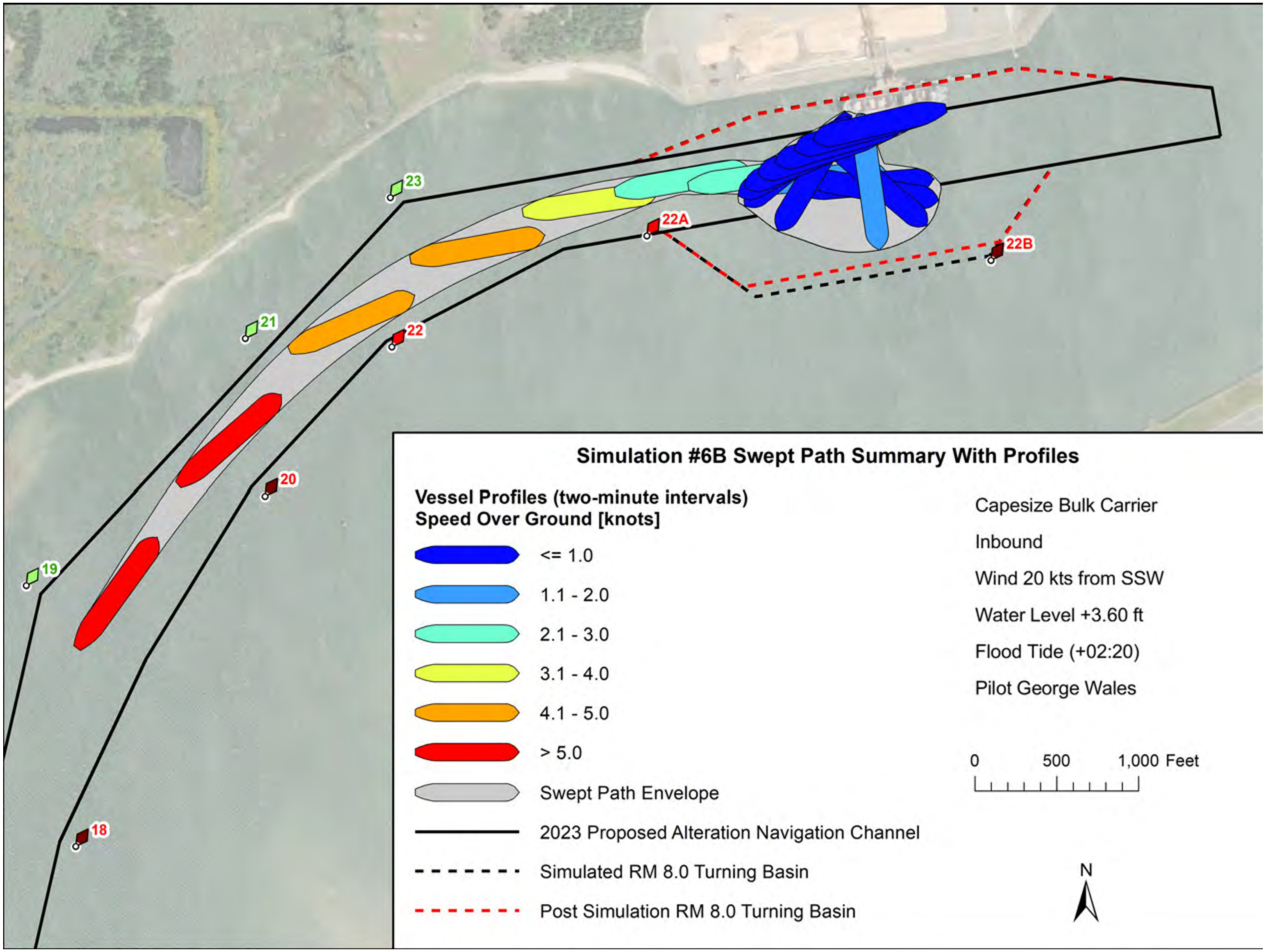

Figure 4-21. Simulation 6B Swept Path Summary with Profiles

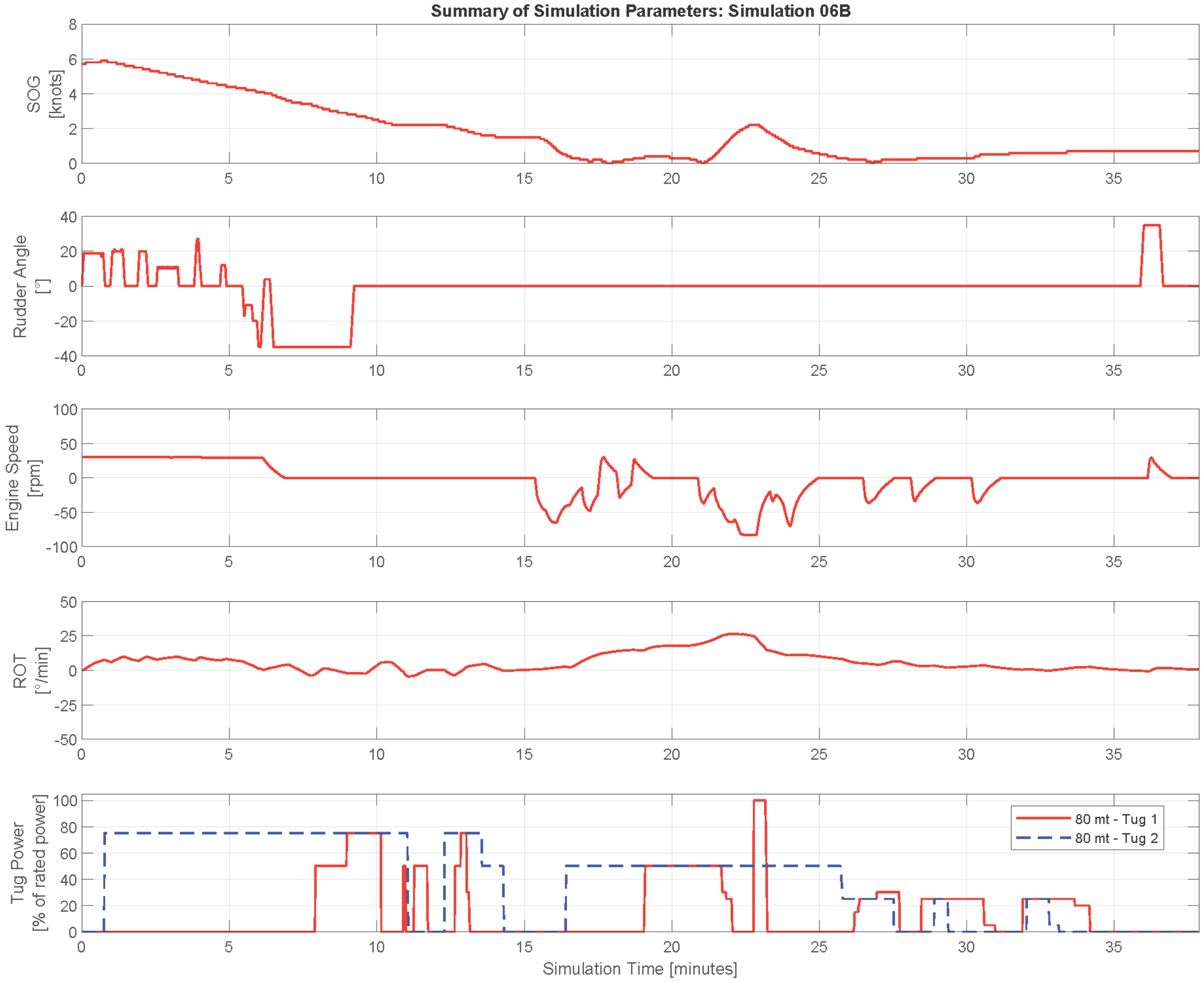

Figure 4-22. Simulation 6B Vessel and Tug Parameter Time Series

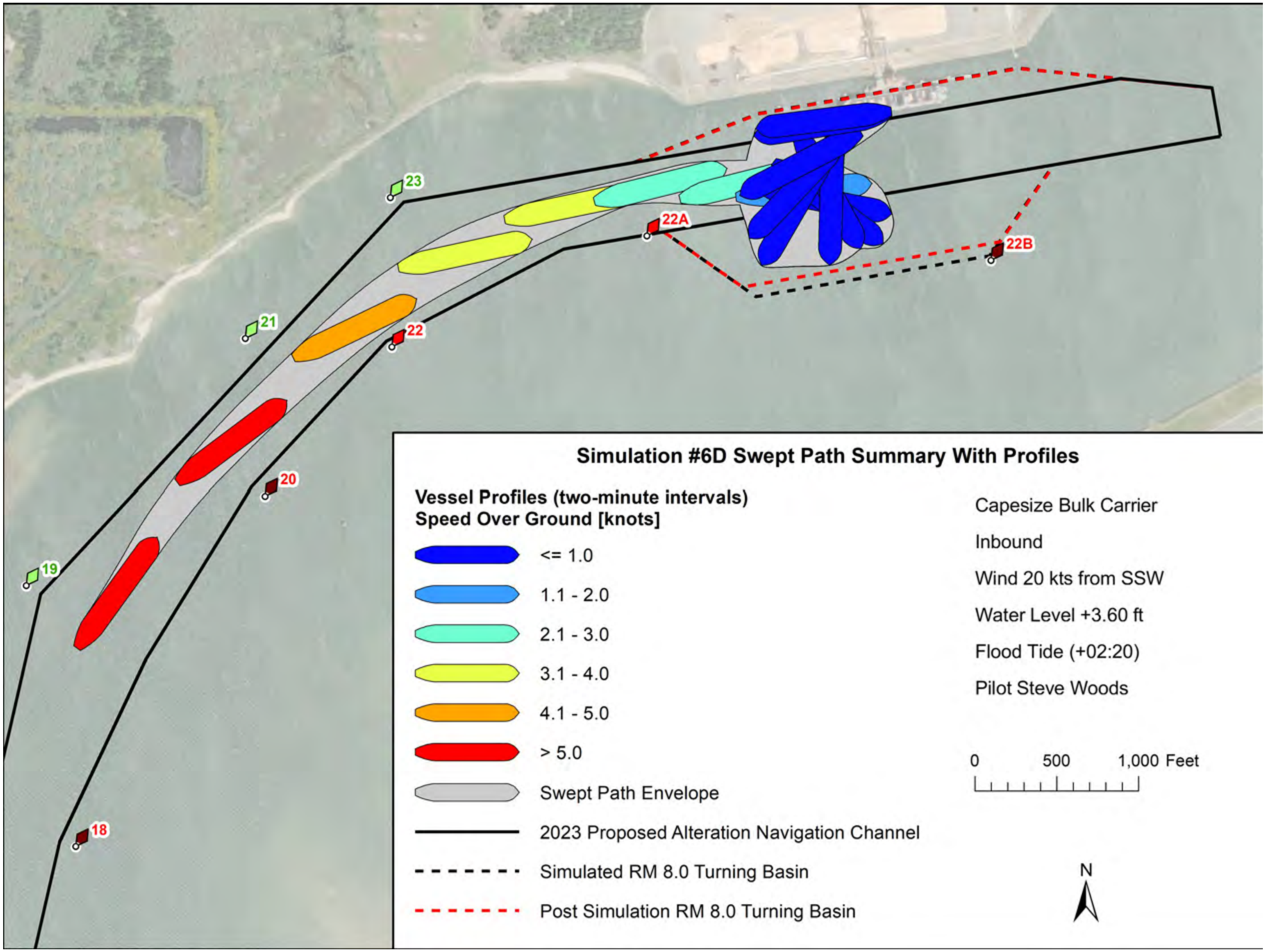

Figure 4-23. Simulation 6D Swept Path Summary with Profiles

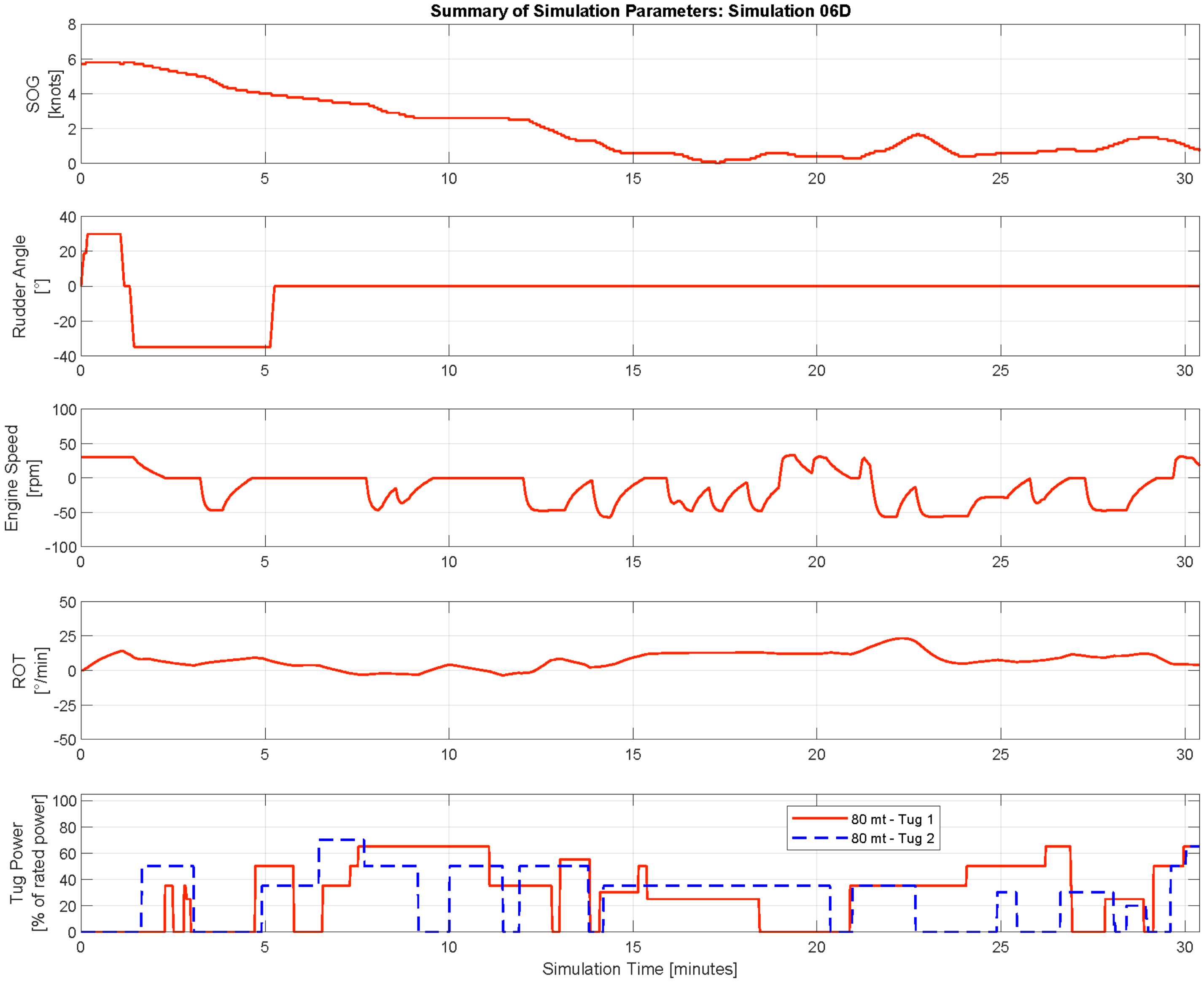

Figure 4-24. Simulation 6D Vessel and Tug Parameter Time Series

4.2.2 SIMULATION 7 – CAPESIZE INBOUND, RM 7 – RCF, 2023 PA, NNE WIND, FLOOD TIDE

Run ID	Channel	Own Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
7A	2023 PA	Capesize	Inbound	Yes / RM 8.0	80 / 80	25kt NNE (22.5°)	3.6/1.1	Flood (02:20)	RM 7	RCF	G. Wales	🟢
7B											S. Woods	🟡

Simulation 7 started at approximately River Mile 7 to assess the approach and turning maneuver in the RM 8.0 turning basin with a capsize bulk carrier. The transit was conducted with a flood tidal current with strong NNE winds.

Vessel Swept Path Figures: Figure 4-25 and Figure 4-27.

Vessel and Tug Parameter Time Series: Figure 4-26 and Figure 4-28.

Pilot Comments: Both pilots found the simulation to be a realistic representation and the vessel model performed as expected. Safety was rated as above average or better. The tug adequacy was rated with the highest adequacy. Run difficulty was rated as average or the least difficulty. **Simulation 7B** had marginal success due to a slight departure from the turning basin boundary. For both of these runs there was reserve tug power throughout and both pilots stated that they would perform a similar transit in a real-world scenario. The pilots confirmed in the run debrief that the turning basin width can be reduced by 75 ft – 100 ft even though the vessel track uses this area for **Simulation 7B,** Figure 4-25 and Figure 4-27**.**

Result: Run A: Successful **Run B:** Marginal Success

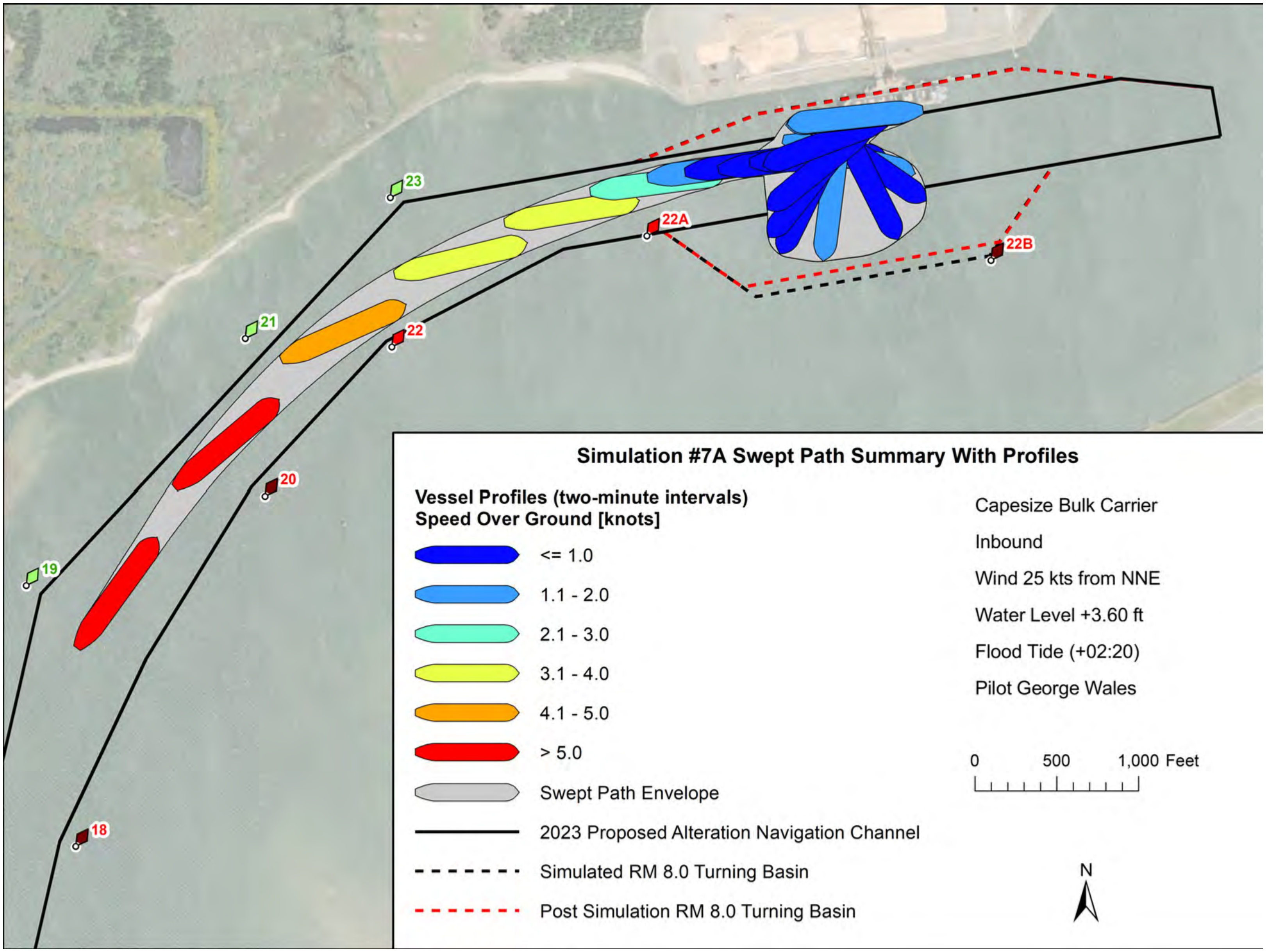

Figure 4-25. Simulation 7A Swept Path Summary with Profiles

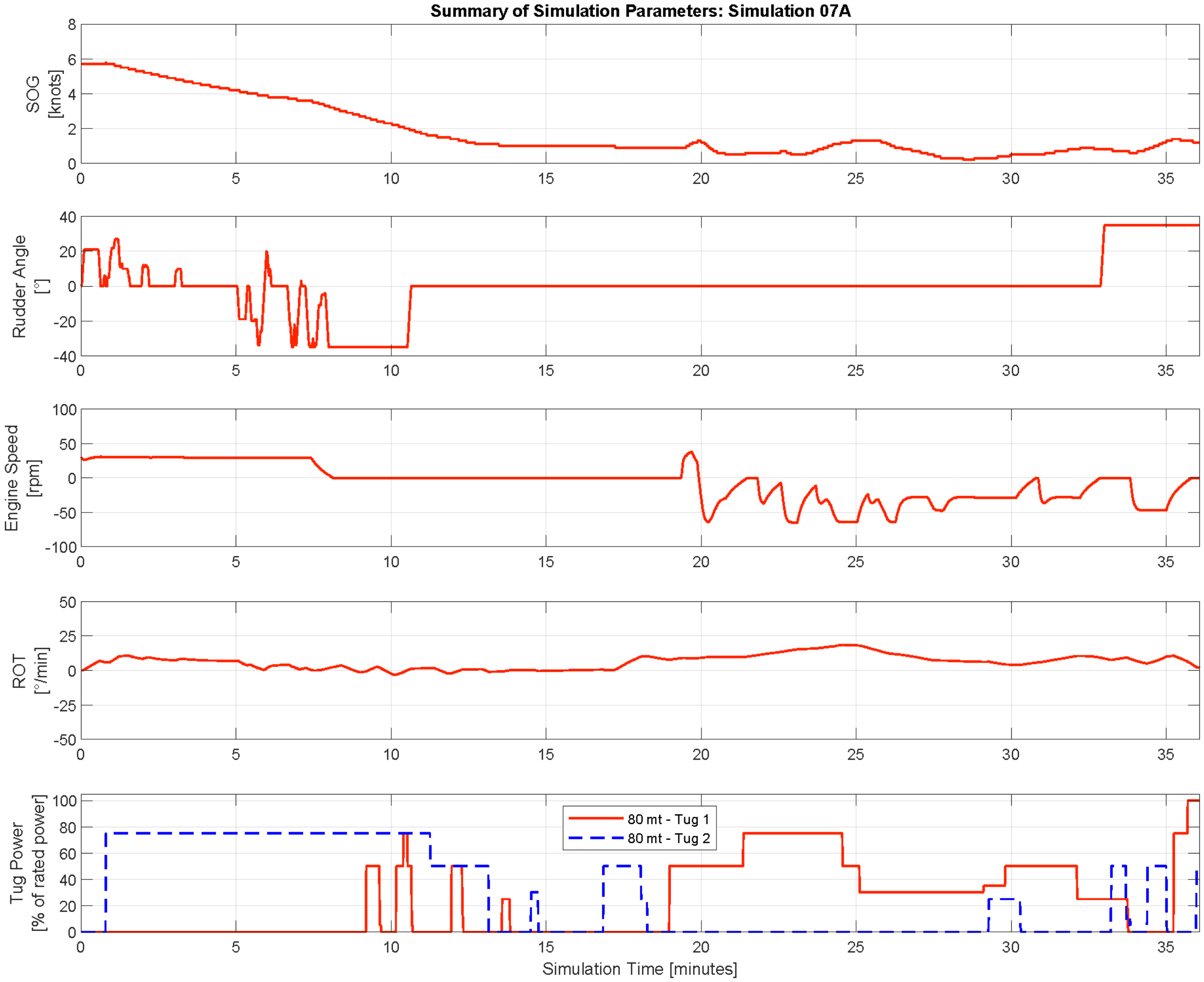

Figure 4-26. Simulation 7A Vessel and Tug Parameter Time Series

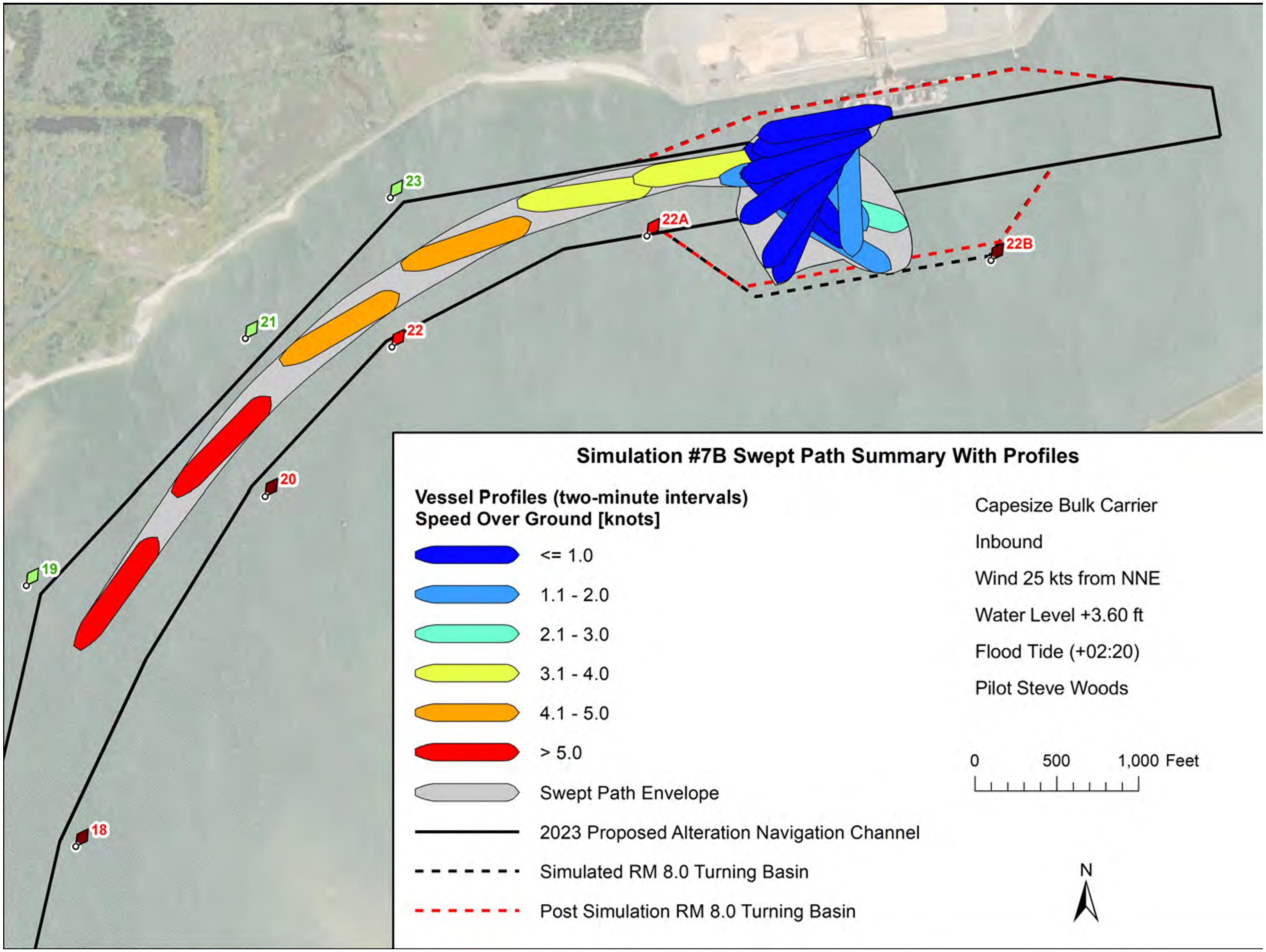

Figure 4-27. Simulation 7B Swept Path Summary with Profiles

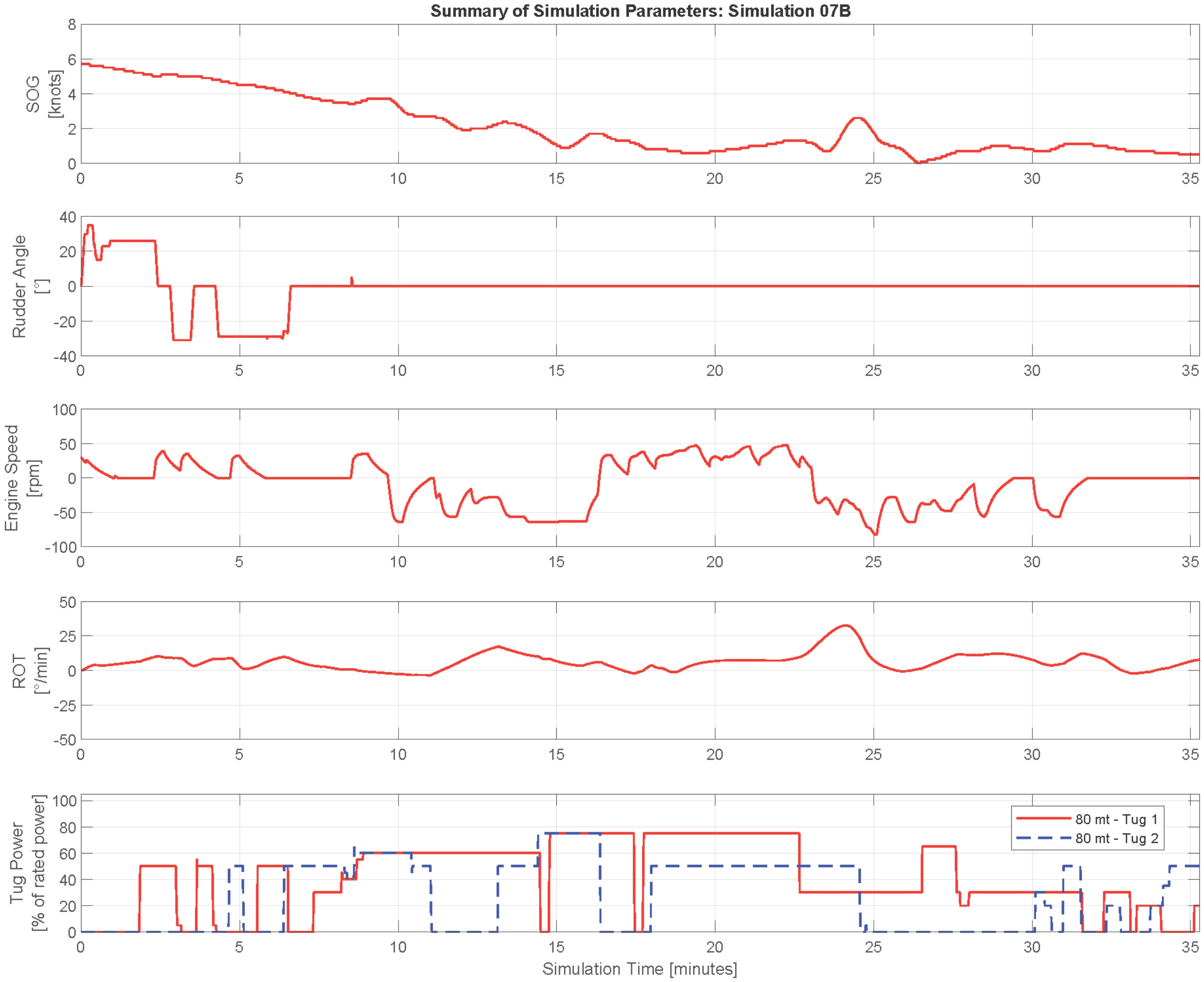

Figure 4-28. Simulation 7B Vessel and Tug Parameter Time Series

4.3 POST PANAMAX GENERATION THREE CONTAINERSHIP SIMULATIONS

In total 17 simulations were performed in the 2023 PA channel with the PPX3 containership evaluating the channel transit, the turning evolution in the corresponding turning basin, and maneuvering to/from the planned container facility. Of these simulations 11 were inbound and 6 were outbound. Based on discussion with the pilots on their planned timing of the inbound maneuver to the container facility two tidal current conditions were evaluated, during an ebb current and a flood current. The outbound simulations only evaluated a single current, starting approximately a couple of hours before slack water, based on the pilot feedback.

The pilot safety, run difficulty, and tug adequacy ratings for all the PPX3 containership simulations are summarized in Table 4-3. On average the inbound transits were rated as average safety, above average tug adequacy, and average difficulty. The outbound transits were rated as above average safety and tug adequacy and below average run difficulty.

Table 4-3. PPX3 Containership Pilot Ratings for Safety, Difficulty, & Tug Adequacy

Simulation Number	Pilot	Run Safety	Tug Adequacy	Run Difficulty	Run Result
Inbound Maneuver					
8A	S. Woods	5	5	3	🟢
8B	G. Wales	2	5	4	🟢
9A	S. Woods	5	5	3	🟢
9B	G. Wales	3	4	4	🟡
10A	S. Woods	5	5	3	🟢
10B	G. Wales	4	5	3	🟢
14A	S. Woods	5	5	3	🟢
14B	G. Wales	2	3	4	🟡
15A	S. Woods	2	5	5	🔴
15B	S. Woods	4	5	4	🟢
15C	G. Wales	2	2	4	🟡
Inbound Average	--	3.5	4.5	3.6	--
Outbound Maneuver					
11A	S. Woods	5	5	2	🟢
11B	G. Wales	5	5	2	🟢
12A	S. Woods	5	5	2	🟢
12B	G. Wales	5	5	3	🟢
13A	G. Wales	4	3	4	🟡
13B	S. Woods	5	5	2	🟢
Outbound Average	--	4.8	4.7	2.5	--

4.3.1 SIMULATION 8 – PPX3 INBOUND, RM -2 – CFS, 2023 PA, SSW WIND, W SWELL, EBB TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
8A	2023 PA	PPX3	PPX3, CFN	Inbound	Yes / RM 5.0 – PPX3	80 / 80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	Swell W	4.5/1.4	High Water into Ebb (06:30)	RM -2	CFS	S. Woods	🟢
8B													G. Wales	🟢

Simulation 8 started at the pilot buoy to assess the full channel transit and turning maneuver in the 2023 PA channel and the RM 5.0 proposed turning basin. The transit was conducted with an ebb tidal current with strong SSW winds.

Vessel Swept Path Figures: Figure 4-29 and Figure 4-31**.**

Vessel and Tug Parameter Time Series: Figure 4-30 and Figure 4-32

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. One pilot rated the safety as the safest while the other pilot rated the safety as below average. This below average rating was due to the pilot's approach to the maneuver, in subsequent runs he would alter his approach. Both pilots rated the tug adequacy with the highest adequacy. Run difficulty was rated as average or above average difficulty. The vessel track stayed within the channel and turning basin boundaries. Throughout the transit there was reserve tug power, sufficient clearance to the moored vessel, and the bow thruster was not used. During **Simulation 8B** in the entrance turn two of the tugs were used at 100% for approximately 5 minutes. However, the third tug had reserve power. The pilot stated that in subsequent runs he would change his approach in the entrance turn to slow the vessel more and delay the start of the turn. Both pilots would perform this transit in a real-life situation. Regarding the aids to navigation, one pilot stated that he didn't believe red buoy "10A" was in an effective location.

Result: Run A: Successful **Run B:** Successful

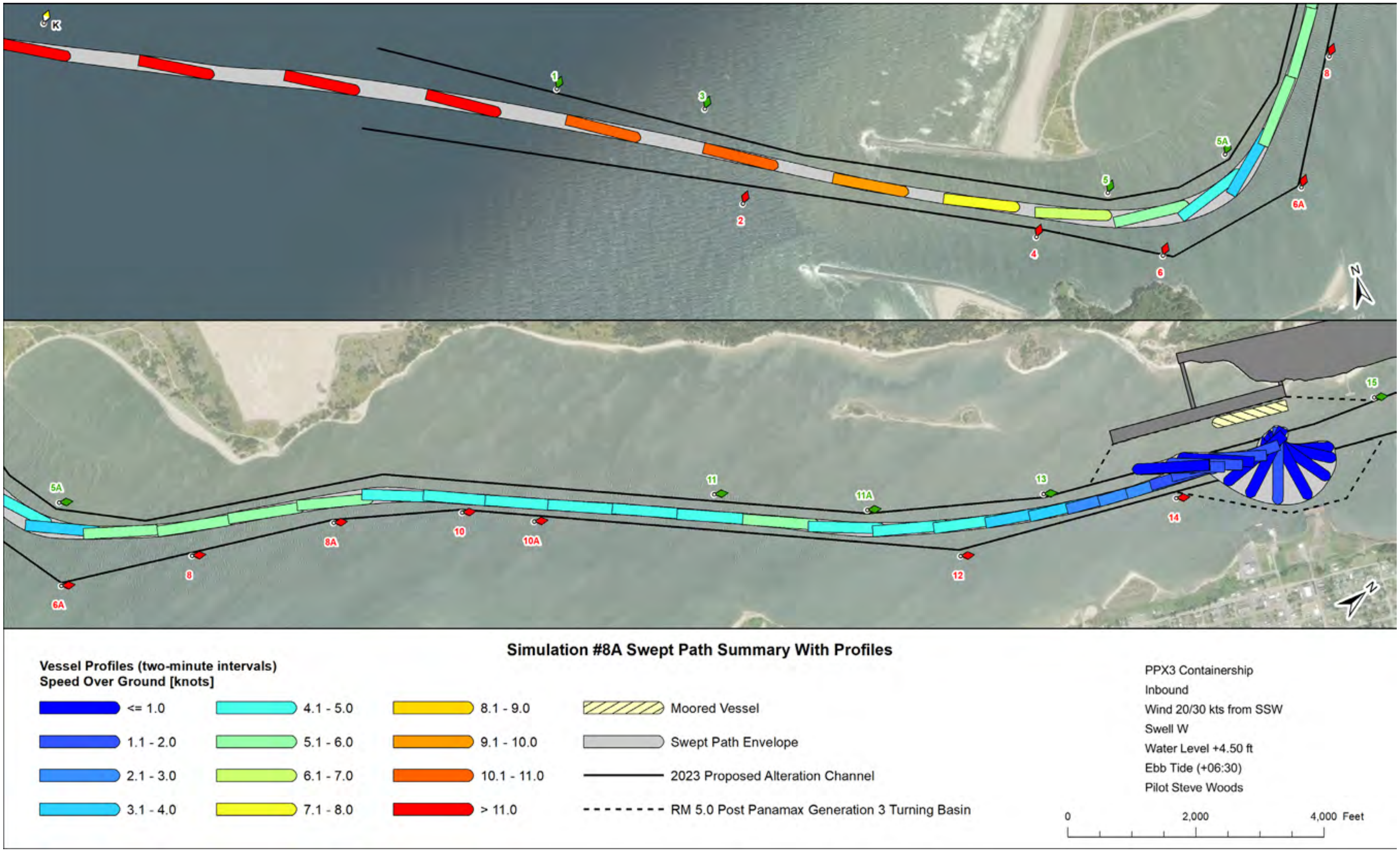

Figure 4-29. Simulation 8A Swept Path Summary with Profiles

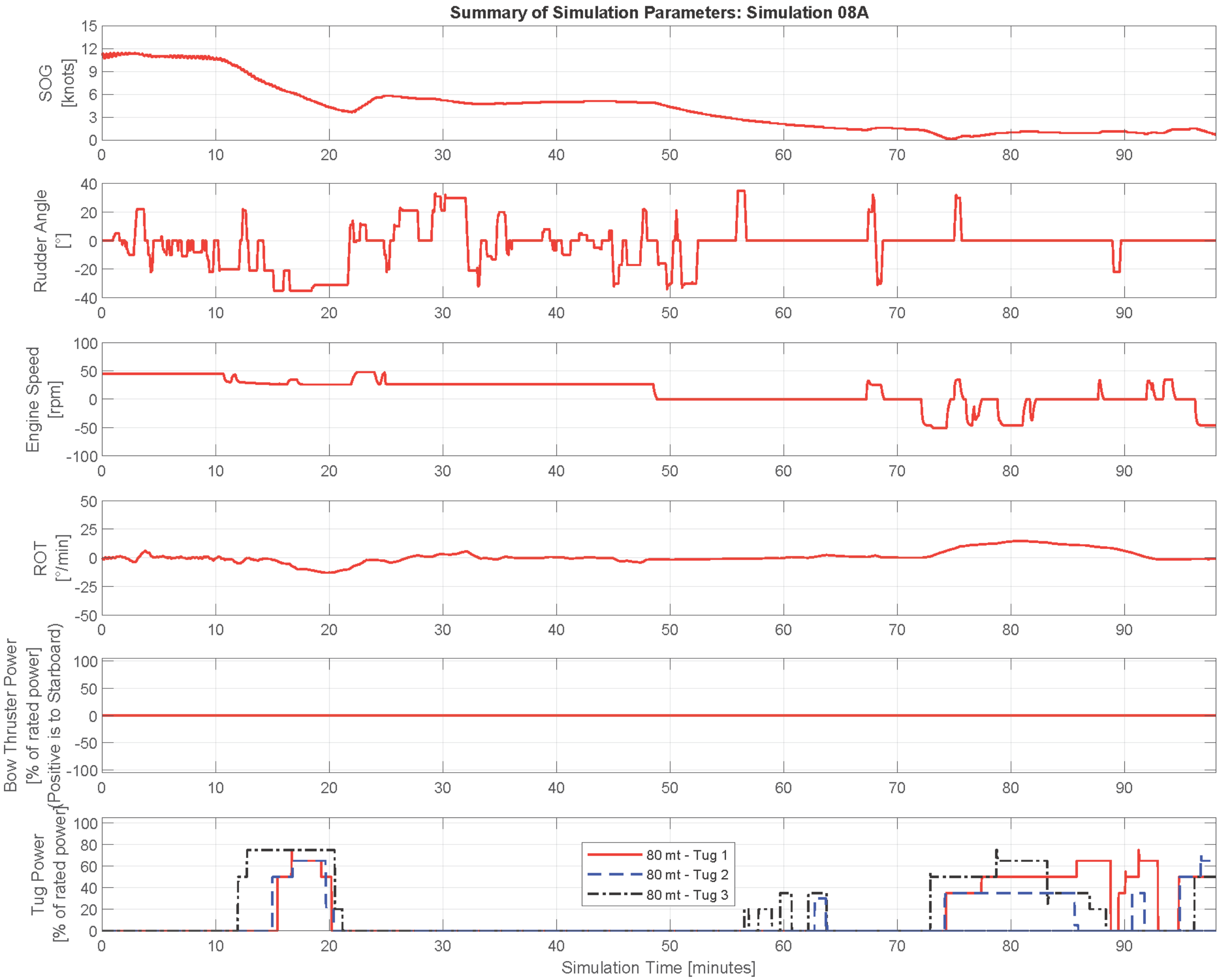

Figure 4-30. Simulation 8A Vessel and Tug Parameter Time Series

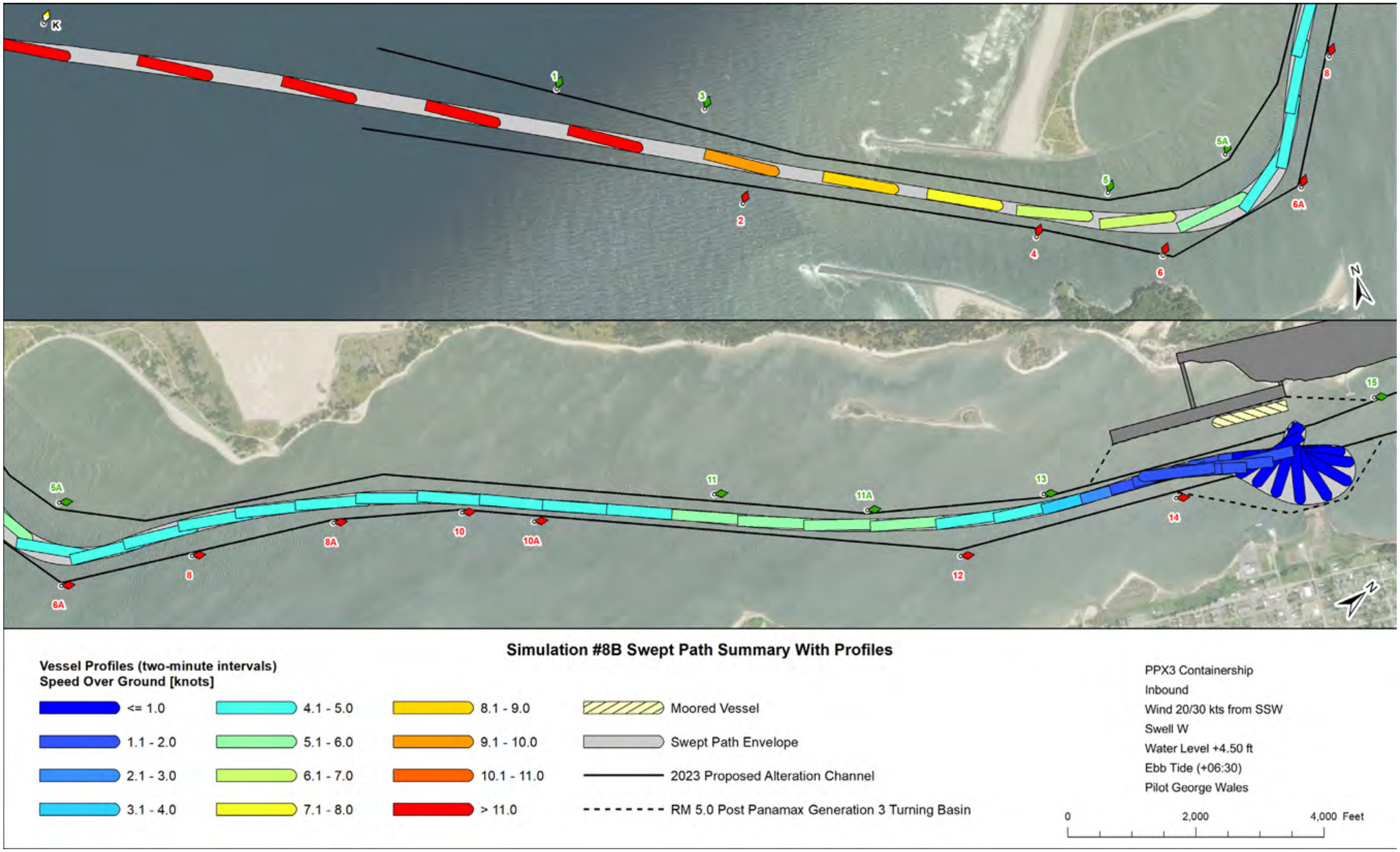

Figure 4-31. Simulation 8B Swept Path Summary with Profiles

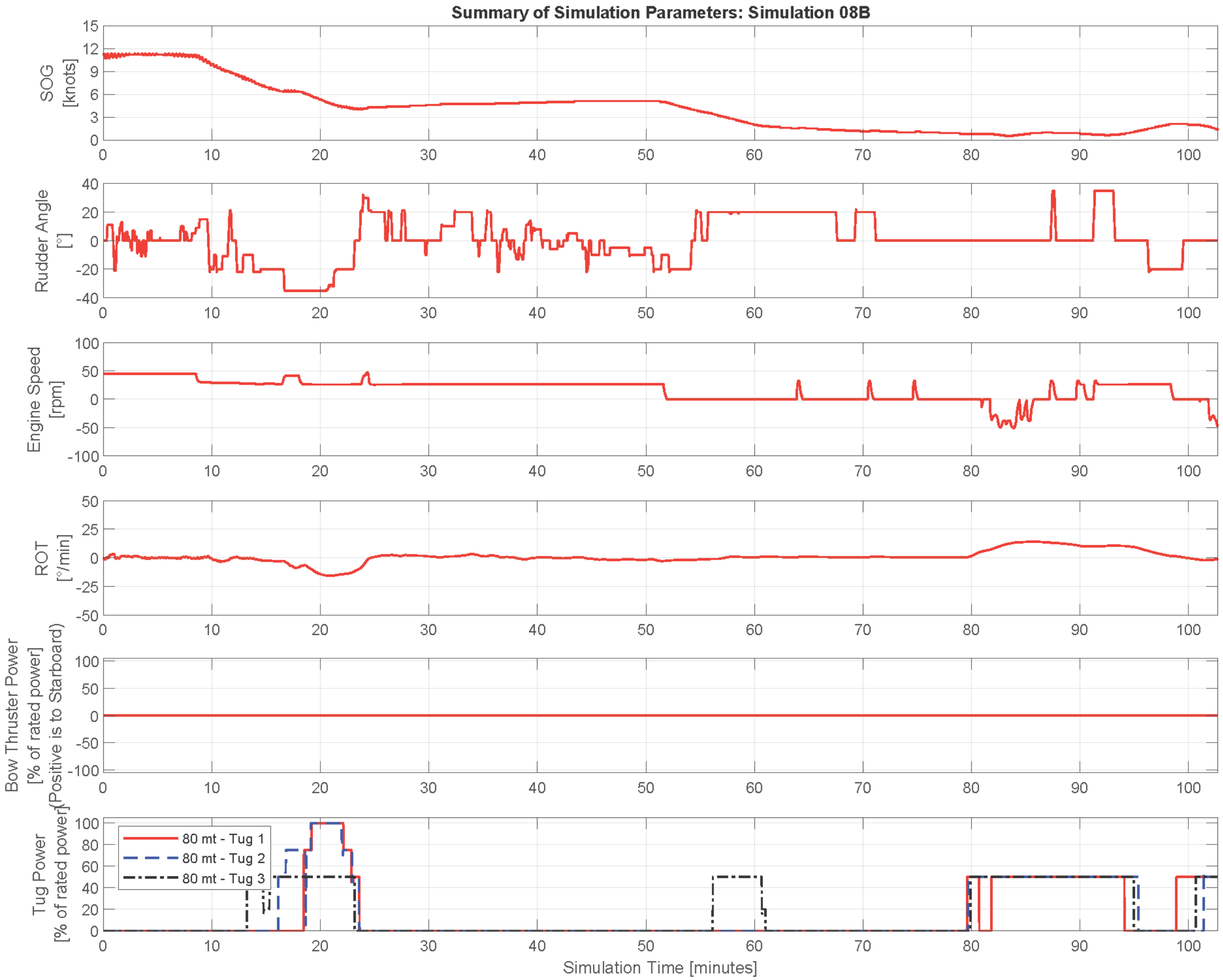

Figure 4-32. Simulation 8B Vessel and Tug Parameter Time Series

4.3.2 SIMULATION 9 – PPX3 INBOUND, RM -2 – CFS, 2023 PA, NNW WIND, NW SWELL, EBB TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
9A	2023 PA	PPX3	PPX3, CFN	Inbound	Yes / RM 5.0 – PPX3	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Swell NW	4.5/1.4	High Water into Ebb (06:30)	RM -2	CFS	S. Woods	🟢
9B													G. Wales	🟡

Simulation 9 started at the pilot buoy to assess the full channel transit and turning maneuver in the 2023 PA channel and the RM 5.0 proposed turning basin. The transit was conducted with an ebb tidal current with strong NNW winds.

Vessel Swept Path Figures: Figure 4-33 and Figure 4-35**.**

Vessel and Tug Parameter Time Series: Figure 4-34 and Figure 4-36

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Run safety was rated as average and the highest safety. Tug adequacy was rated at least above average. Run difficulty was rated as average and above average difficulty. Both pilots stated that with the NNW wind the entrance turn was more challenging compared to the SSW wind and as result more tug power was needed. The vessel track for **Simulation 9A** stayed within the channel and turning basin boundaries. During the turning maneuver in **Simulation 9B** the bow of the vessel left the turning basin boundaries which resulted in the rating of marginal success. The pilot stated he had left the projectors on the ECDIS which made it challenging to see the boundaries. Throughout the transit there was reserve tug power and sufficient clearance to the moored vessel. Both pilots would perform this transit in a real-life situation.

Result: Run A: Successful **Run B:** Marginal Success

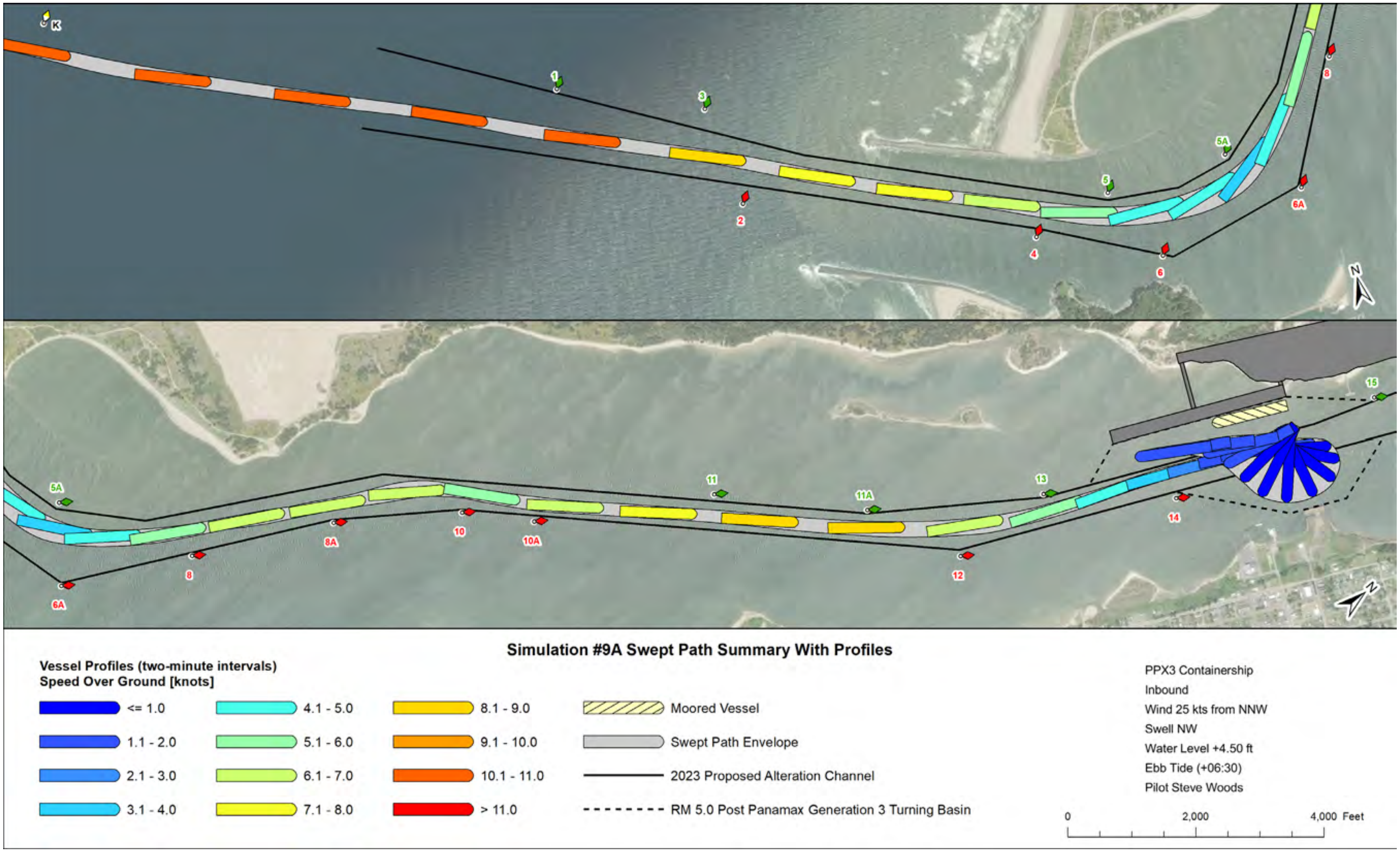

Figure 4-33. Simulation 9A Swept Path Summary with Profiles

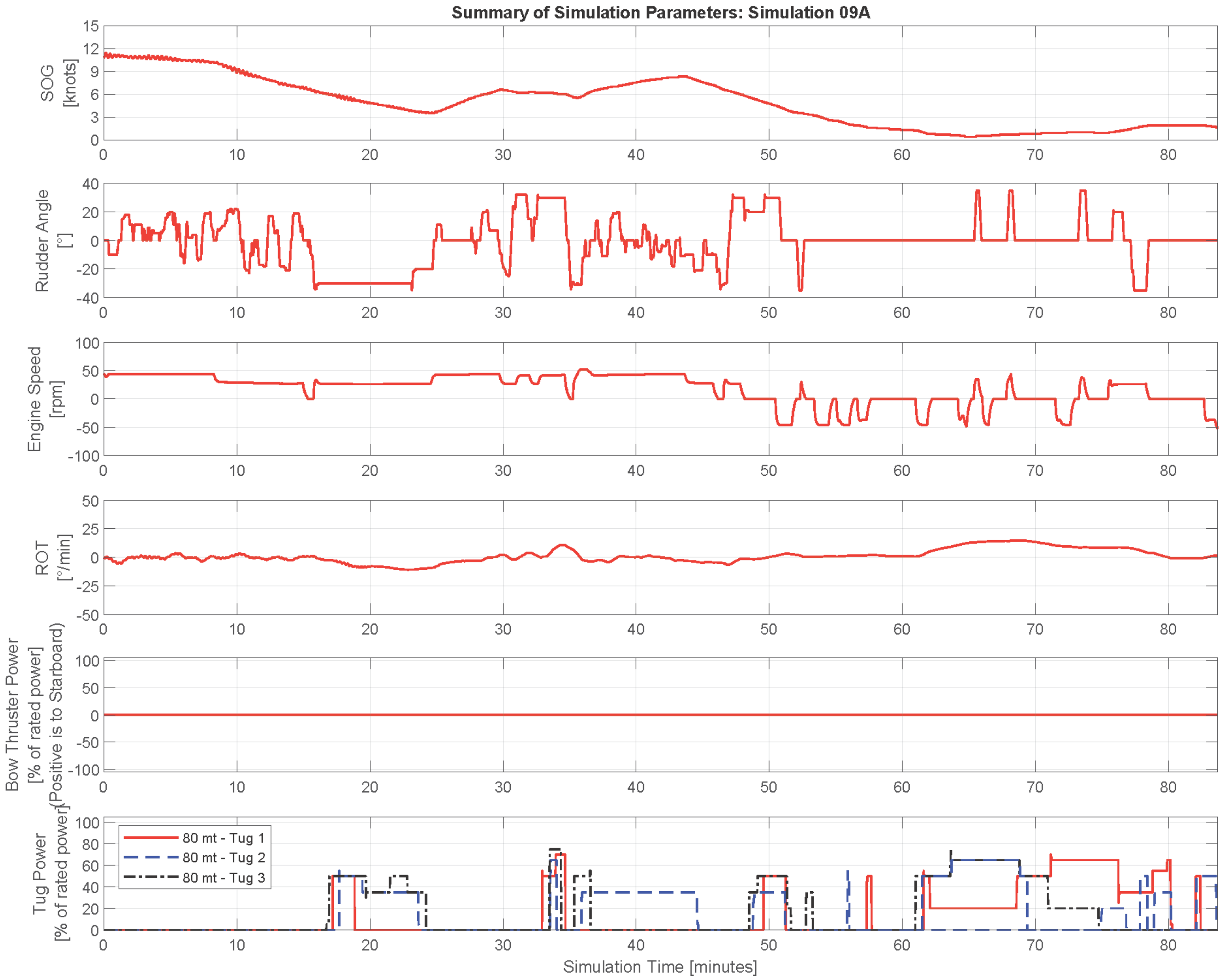

Figure 4-34. Simulation 9A Vessel and Tug Parameter Time Series

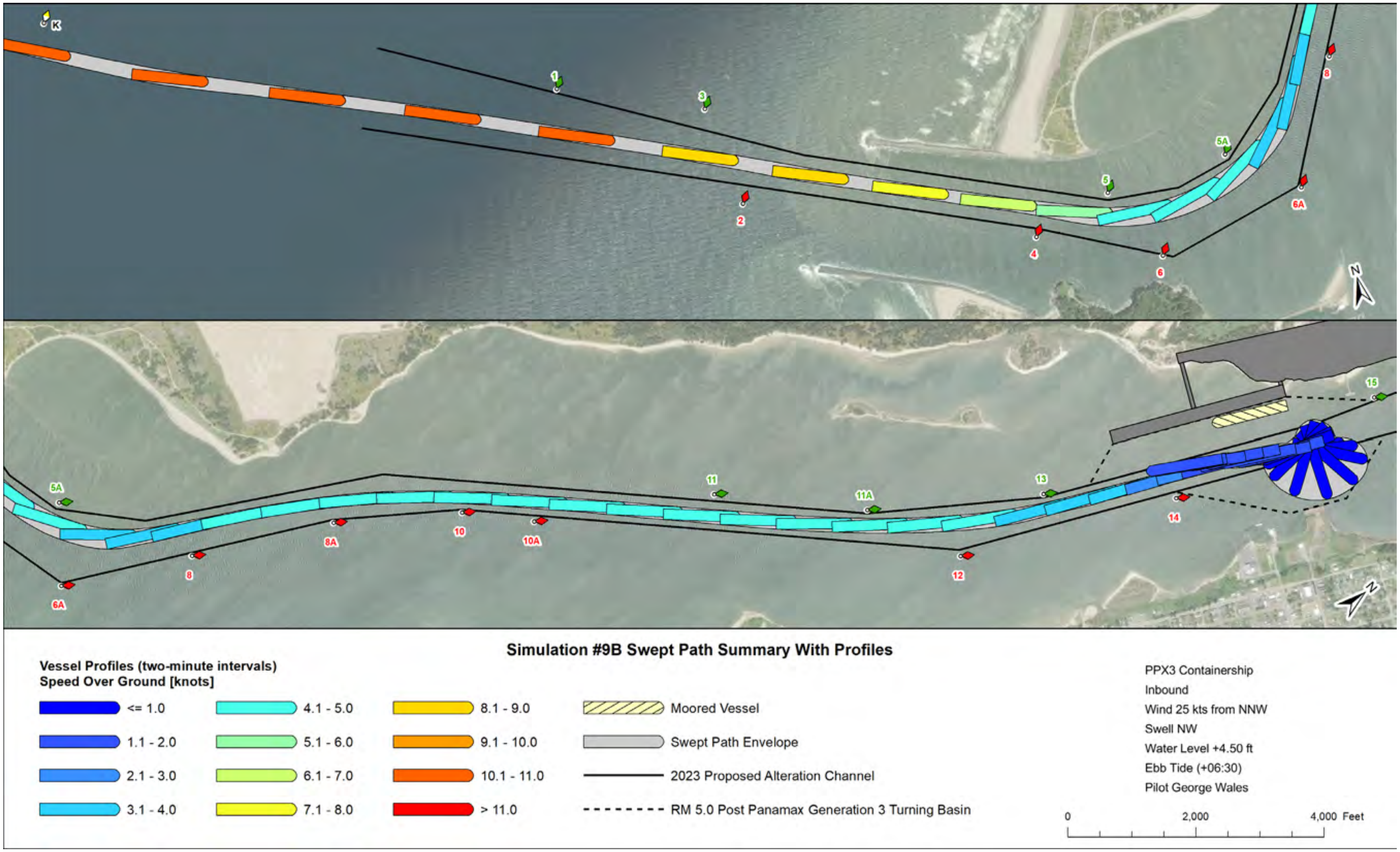

Figure 4-35. Simulation 9B Swept Path Summary with Profiles

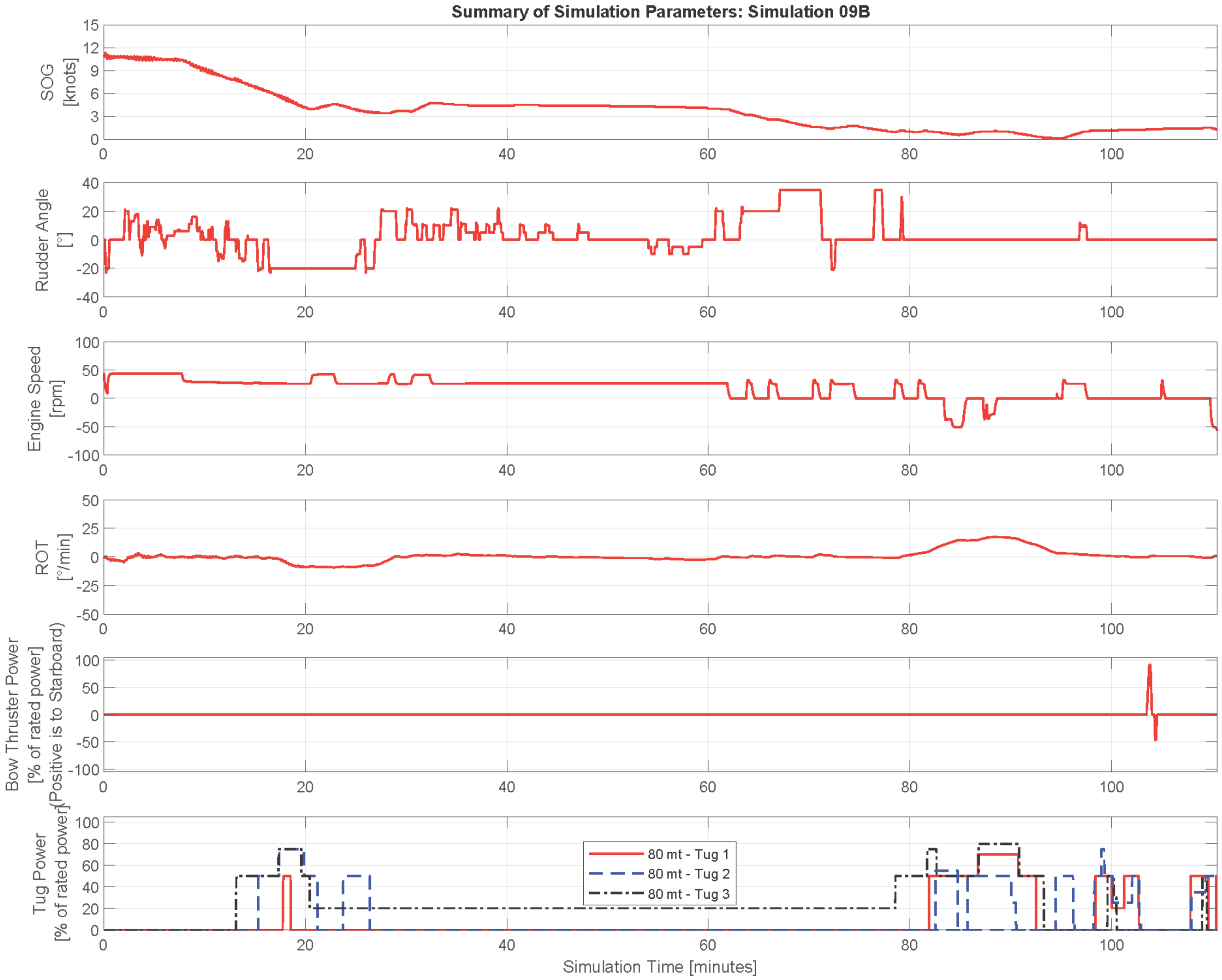

Figure 4-36. Simulation 9B Vessel and Tug Parameter Time Series

4.3.3 SIMULATION 10 – PPX3 INBOUND, RM 3 – CFS, 2023 PA, NNE WIND, EBB TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
10A	2023 PA	PPX3	PPX3, CFN	Inbound	Yes / RM 5.0 – PPX3	80 / 80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	4.5/1.4	High Water into Ebb (07:20)	RM 3	CFS	S. Woods	🟢
10B												G. Wales	🟢

Simulation 10 started at the RM 3 to assess the approach and turning maneuver in the 2023 PA channel and the RM 5.0 turning basin. The entrance turn was not evaluated as the NNW wind would be the controlling condition, which was evaluated in Simulation 9. Simulation 10 was conducted with an ebb tidal current with strong NNE winds.

Vessel Swept Path Figures: Figure 4-37 and Figure 4-39**.**

Vessel and Tug Parameter Time Series: Figure 4-38 and Figure 4-40

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Safety and tug adequacy were rated as above average or greater. Run difficulty was rated as average difficulty. The vessel track stayed within the channel and turning basin boundaries. One pilot noted to avoid the limited clearance to the southern boundary in the turning basin that he would get deeper into the turning basin in subsequent runs prior to starting the turning evolution. Throughout the transit there was reserve tug power, sufficient clearance to the moored vessel, and the bow thruster was not used. Both pilots would perform this transit in a real-life situation.

Result: Run A: Successful **Run B:** Successful

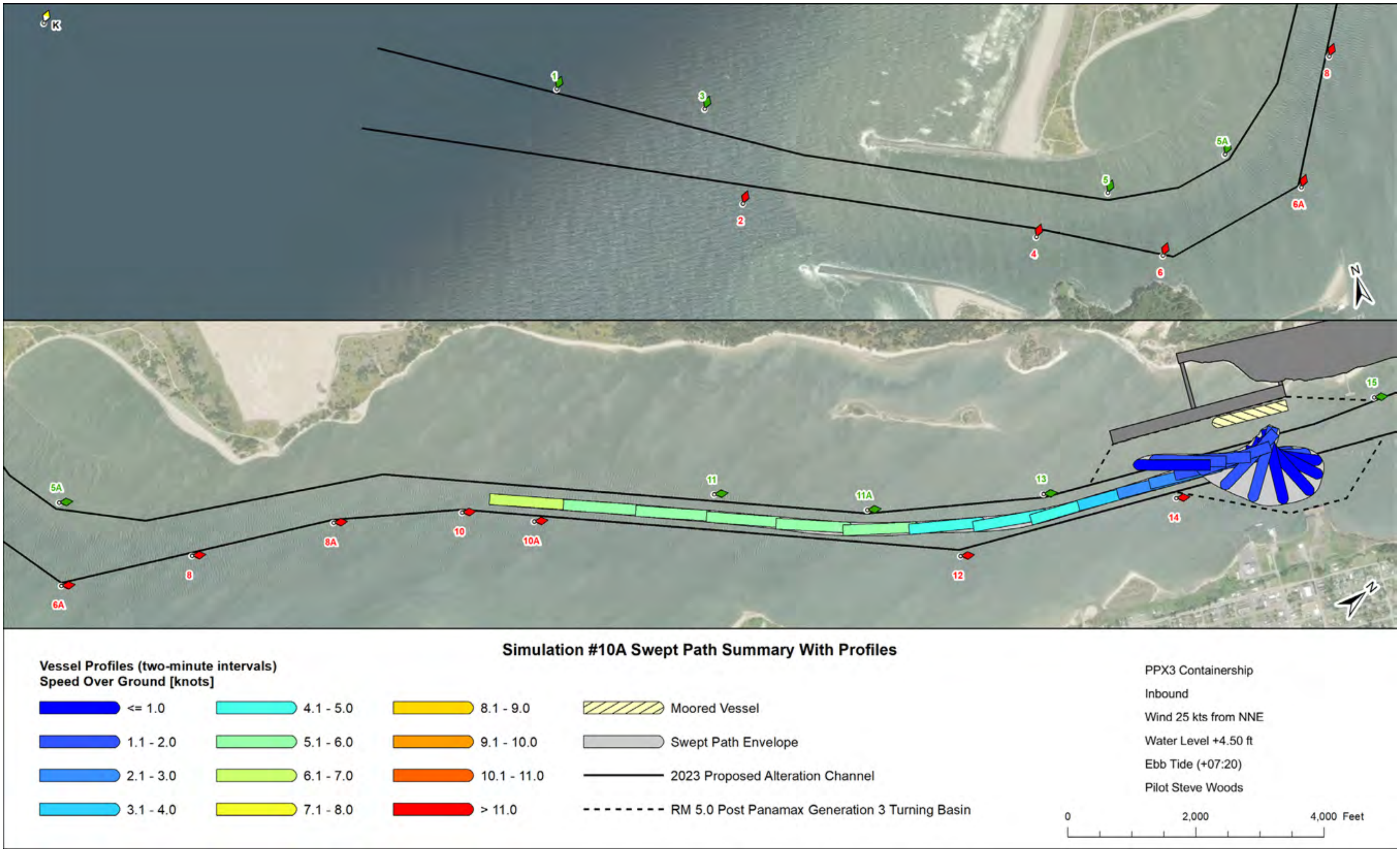

Figure 4-37. Simulation 10A Swept Path Summary with Profiles

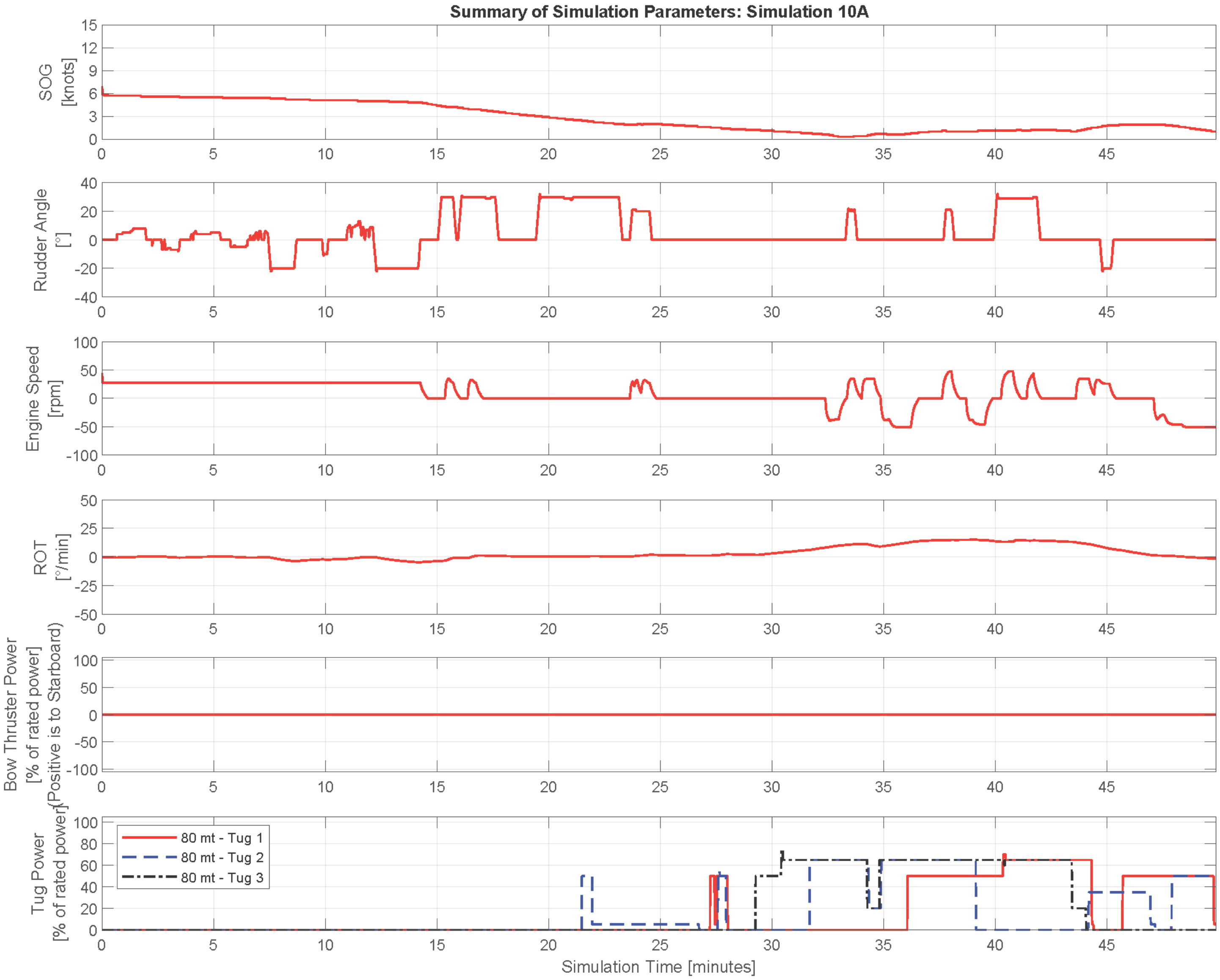

Figure 4-38. Simulation 10A Vessel and Tug Parameter Time Series

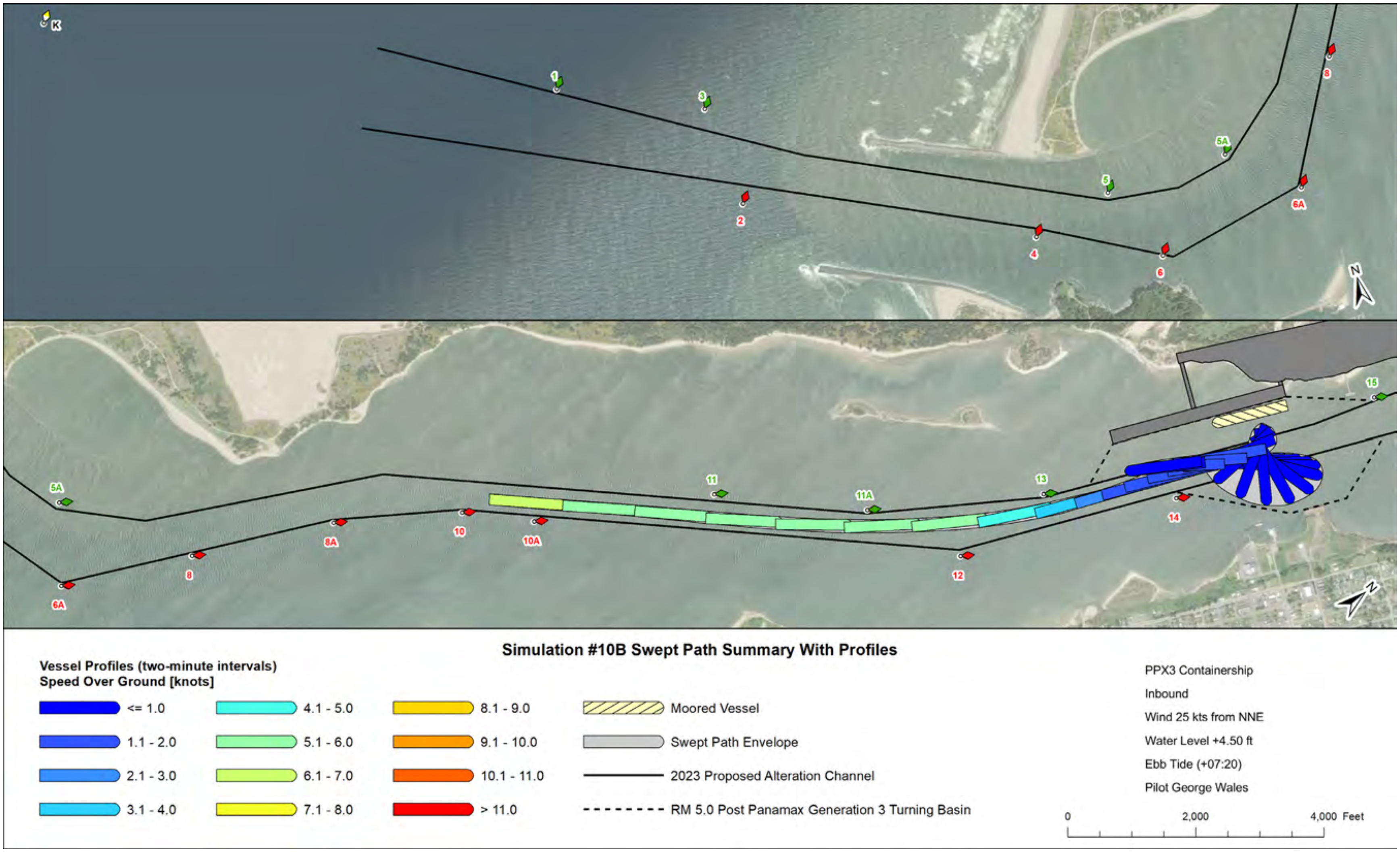

Figure 4-39. Simulation 10B Swept Path Summary with Profiles

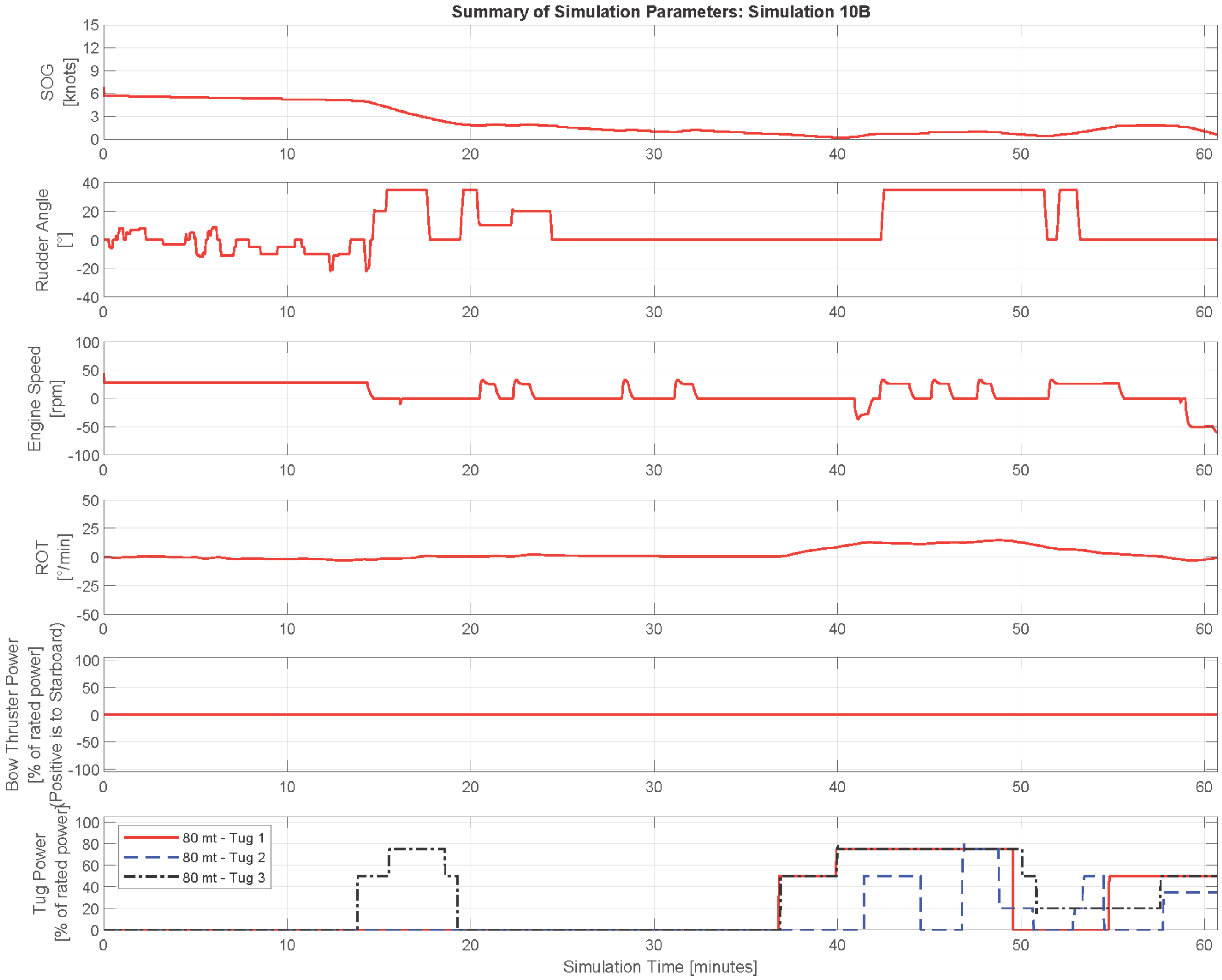

Figure 4-40. Simulation 10B Vessel and Tug Parameter Time Series

4.3.4 SIMULATION 14 – PPX3 INBOUND, RM -2 – CFS, 2023 PA, NNW WIND, NW SWELL, FLOOD TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
14A	2023 PA	PPX3	PPX3, CFN	Inbound	Yes / RM 5.0 – PPX3	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	4.5/1.4	Flood (01:20)	RM -2	CFS	S. Woods	🟢
14B												G. Wales	🟡

Simulation 14 started at the pilot buoy to assess the full channel transit and turning maneuver in the 2023 PA channel and the RM 5.0 proposed turning basin. The transit was conducted with a flood tidal current with strong NNW winds.

Vessel Swept Path Figures: Figure 4-41 and Figure 4-43**.**

Vessel and Tug Parameter Time Series: Figure 4-42 and Figure 4-44

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Captain Woods who performed the ship handling for **Simulation 14A** rated the transit as the highest safety and tug adequacy and average difficulty. This simulation was successful and the vessel track stayed within the boundaries. Captain Wales rated **Simulation 14B** as below average safety, average tug adequacy, and above average difficulty. This run was marginally successful due to the bow slightly exceeding the turning basin boundary on the eastern boundary. During the turning evolution for **Simulation 14B** one tug was used at full power for approximately 2 minutes and the two other tugs were at 75% during this period along with full bow thruster. As a result, during the pilot debrief Captain Wales stated in a real-world situation he would request a fourth tug, which could be a conventional tug, for the turning maneuver as there was limited reserve power. With familiarity with this maneuver the fourth tug may not be required. Comparatively, Captain Woods stated that he would prefer the NNW with a flood current in the turning basin as the two forces counteract and the ebb current with the SSW wind for the same reason. However, he prefers the ebb current in the entrance turn due to the ability to stem the current.

Result: Run A: Successful **Run B:** Marginal Success

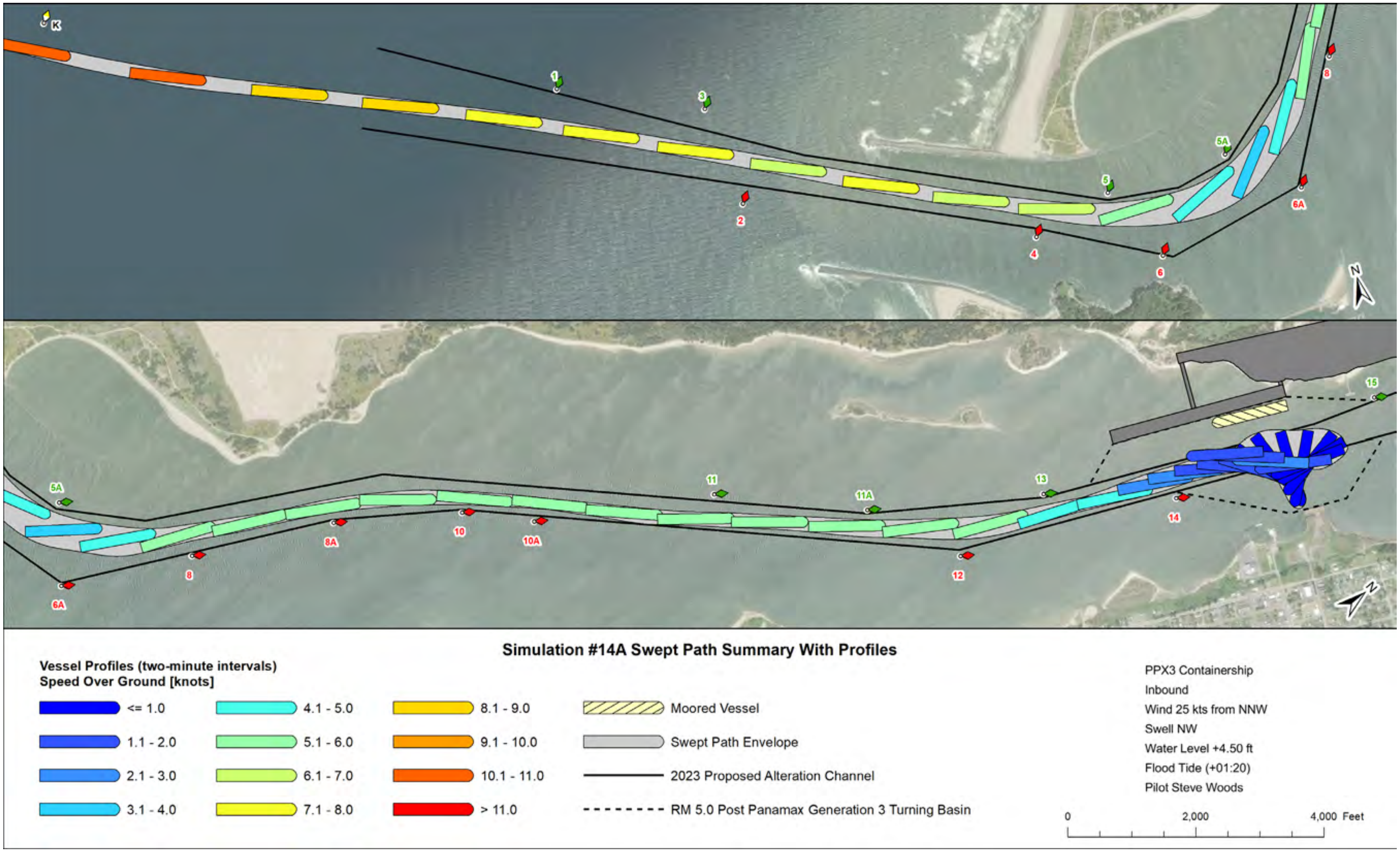

Figure 4-41. Simulation 14A Swept Path Summary with Profiles

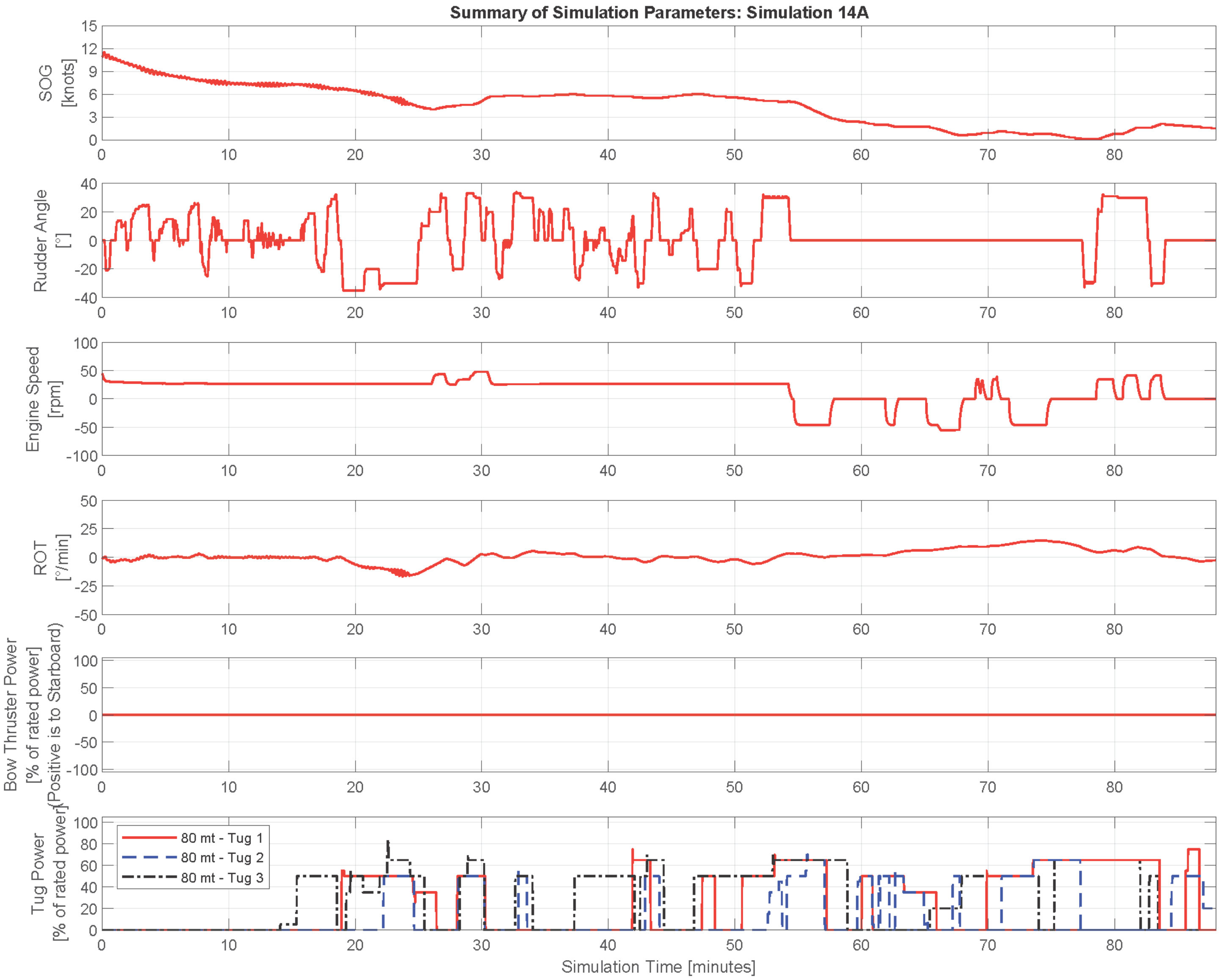

Figure 4-42. Simulation 14A Vessel and Tug Parameter Time Series

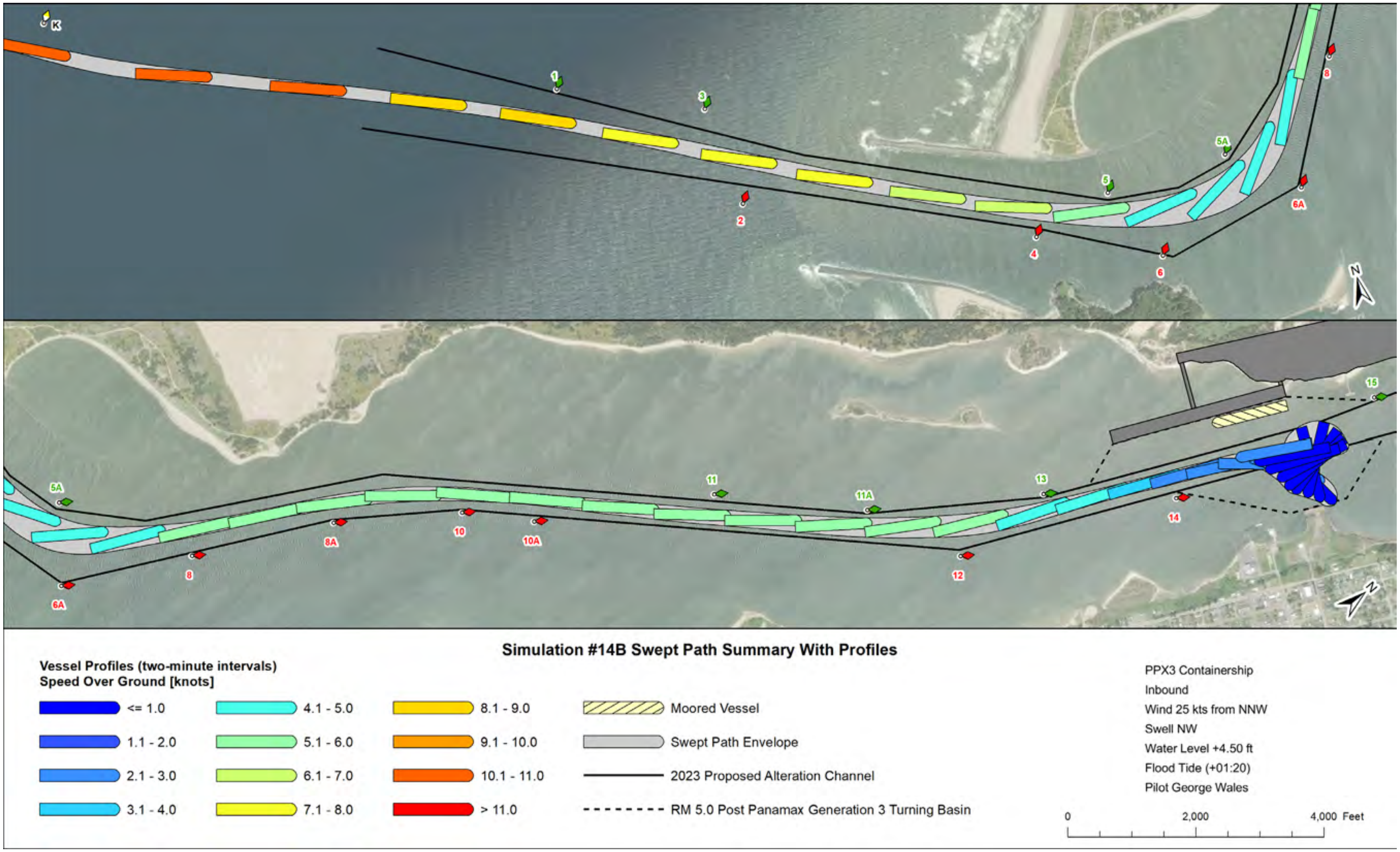

Figure 4-43. Simulation 14B Swept Path Summary with Profiles

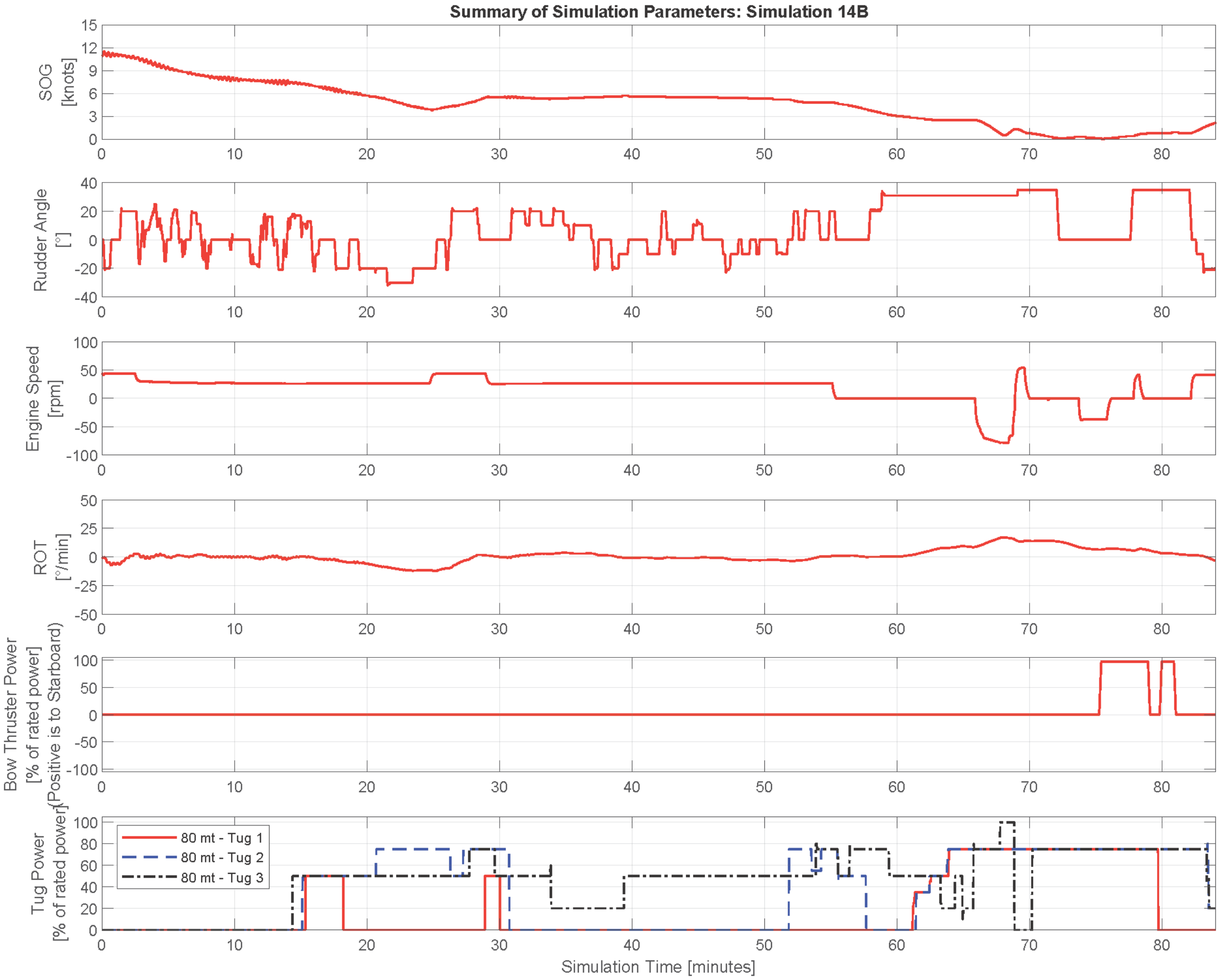

Figure 4-44. Simulation 14B Vessel and Tug Parameter Time Series

4.3.5 SIMULATION 15 – PPX3 INBOUND, RM -2 – CFS, 2023 PA, SSW WIND, W SWELL, FLOOD TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
15A	2023 PA	PPX3	PPX3, CFN	Inbound	No	80 / 80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	Swell W	4.5/1.4	Flood (01:20)	RM -2	RM 2	S. Woods	🔴
15B					Yes / RM 5.0 – PPX3							CFS		🟢
15C													G. Wales	🟡

Simulation 15 started at the pilot buoy to assess the full channel transit and turning maneuver in the 2023 PA channel and the RM 5.0 proposed turning basin. The transit was conducted with a flood tidal current with strong SSW winds.

Vessel Swept Path Figures: Figure 4-45, Figure 4-47, and Figure 4-49.

Vessel and Tug Parameter Time Series: Figure 4-46, Figure 4-48, and Figure 4-50

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. **Simulation 15A** ended with a grounding in the entrance turn. This was the first time Captain Woods was given the flood tide with the PPX3 vessel. Overall, he would change his approach to slow the vessel significantly prior to the entrance turn, however, would still start the turn in the same location. Captain Woods attempted this transit again in **Simulation 15B** successfully. **Simulation 15B** was rated as above average safety, the highest tug adequacy, and above average difficulty. Captain Woods would perform this transit in a real-life situation. However, he noted that the flood current was more challenging than the ebb current.

Captain Wales rated **Simulation 15C** as below average safety and tug adequacy and above average difficulty. This run had marginal success due to the starboard side of the vessel slightly leaving the channel boundaries upon the approach to the RM 5.0 turning basin. Under these environmental conditions Captain Wales would request a fourth tug in the turning basin. During this transit there were three occurrences of at least one tug needing to use full power. If these conditions were present in a real-world scenario Captain Wales would want to berth the vessel port-side to and perform the turning maneuver on the outbound.

Result: Run A: Failure **Run B:** Successful **Run C:** Marginal Success

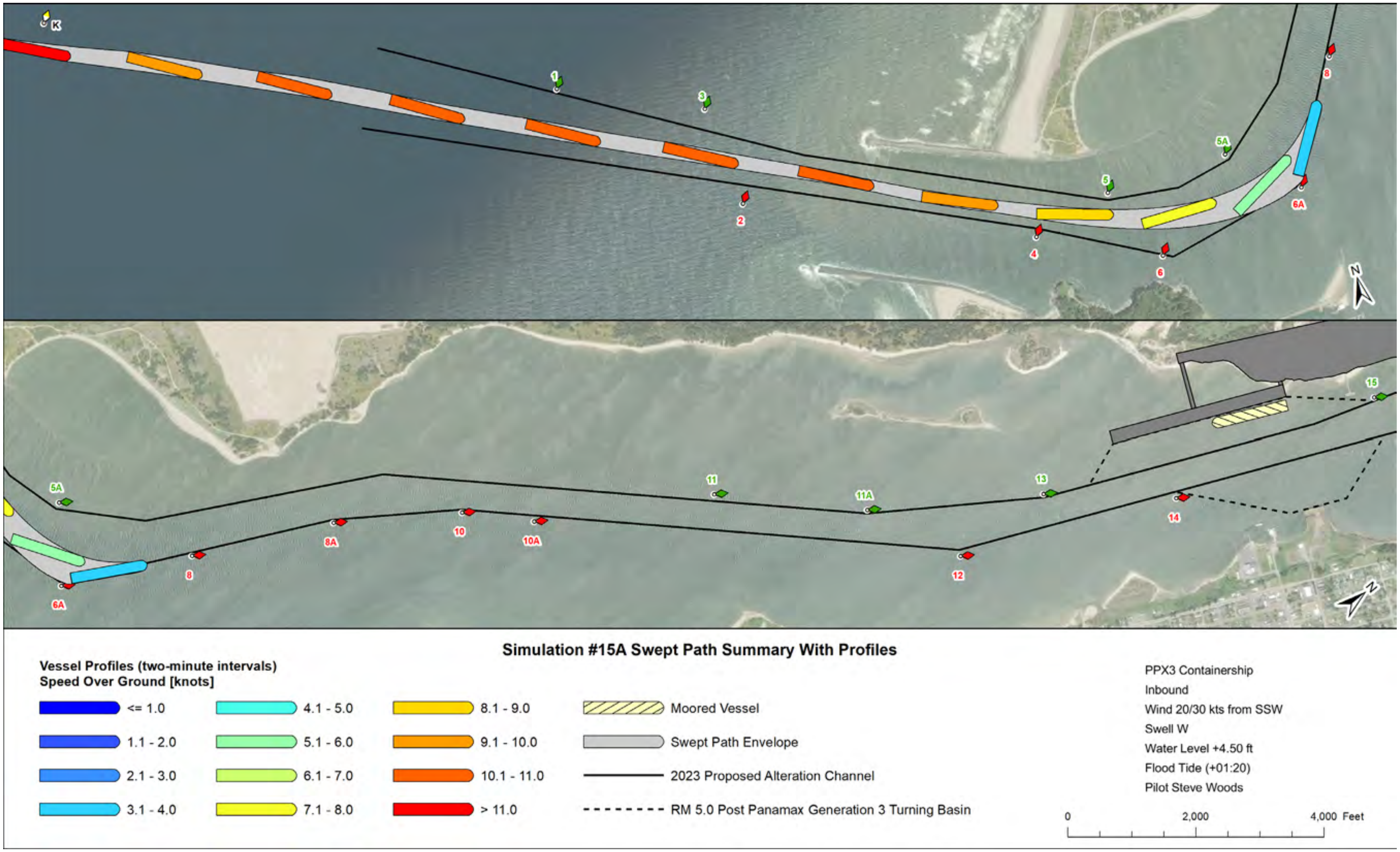

Figure 4-45. Simulation 15A Swept Path Summary with Profiles

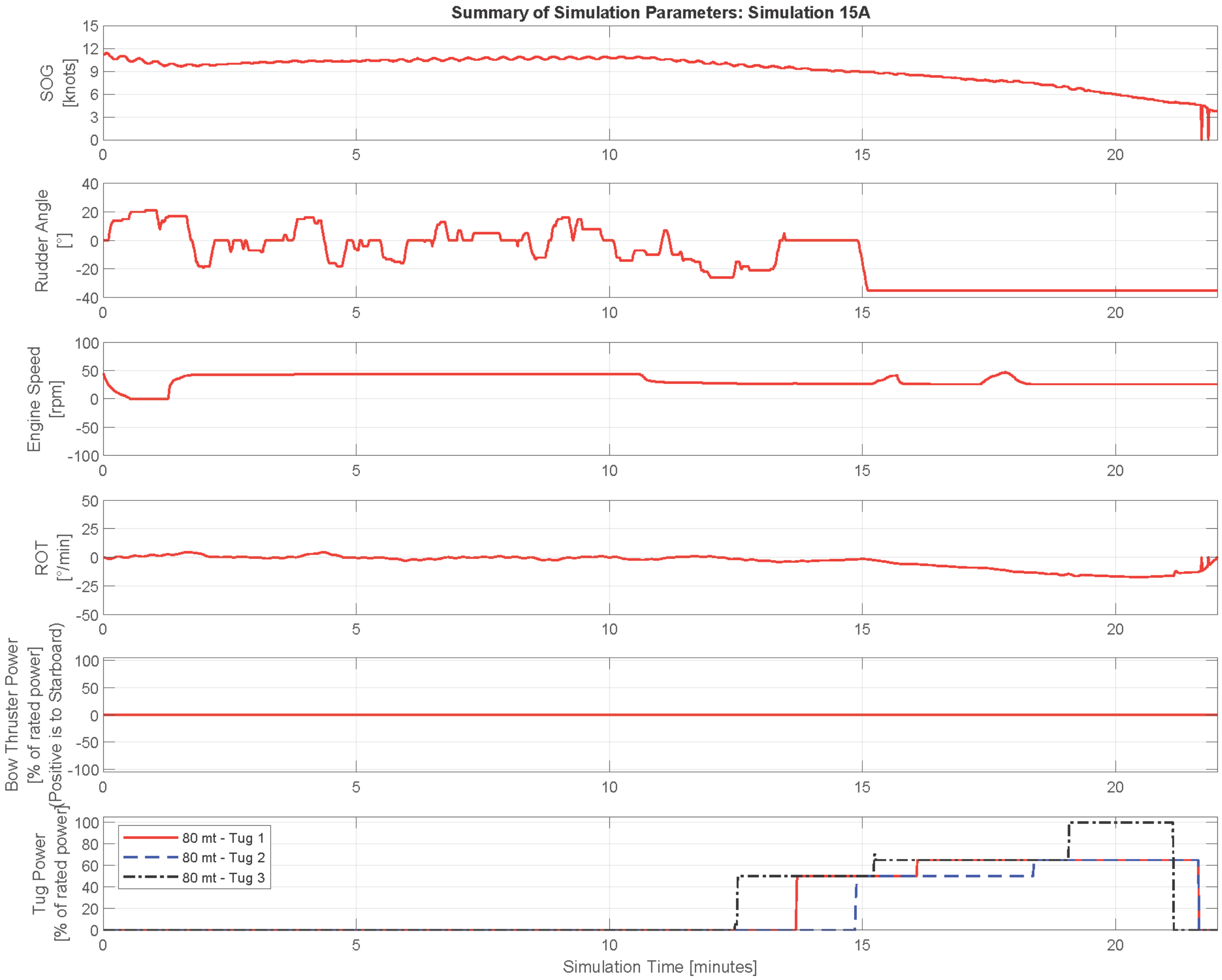

Figure 4-46. Simulation 15A Vessel and Tug Parameter Time Series

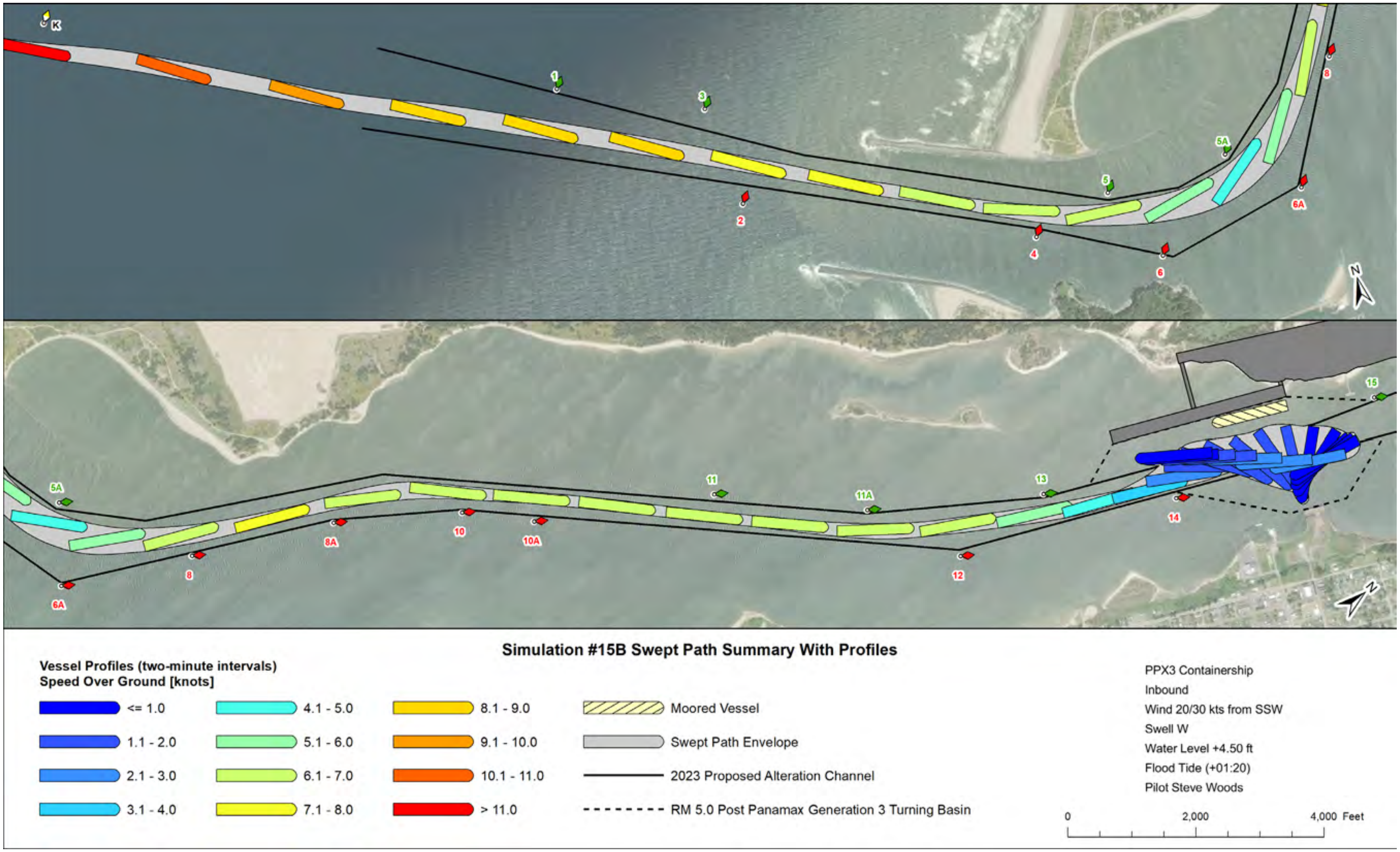

Figure 4-47. Simulation 15B Swept Path Summary with Profiles

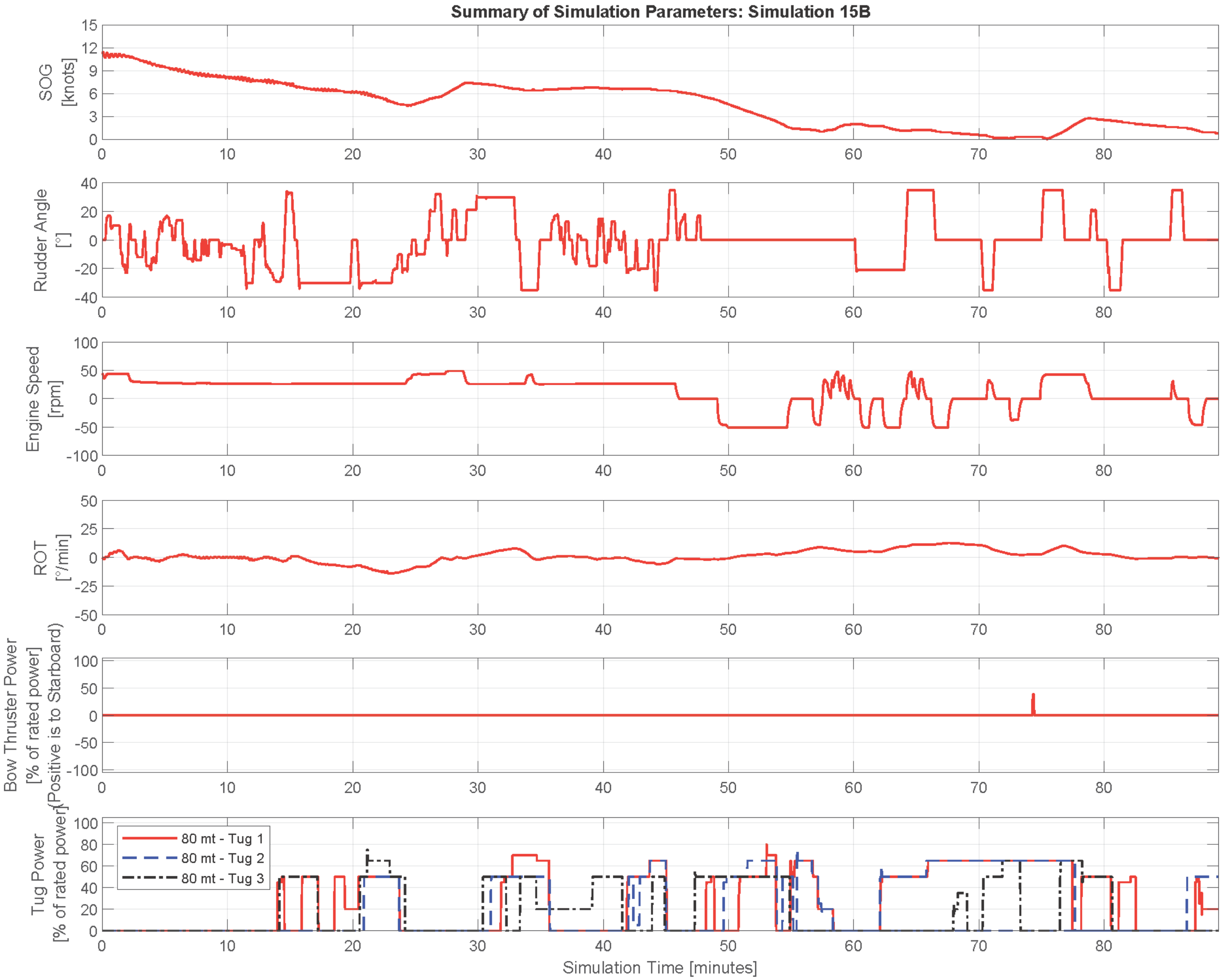

Figure 4-48. Simulation 15B Vessel and Tug Parameter Time Series

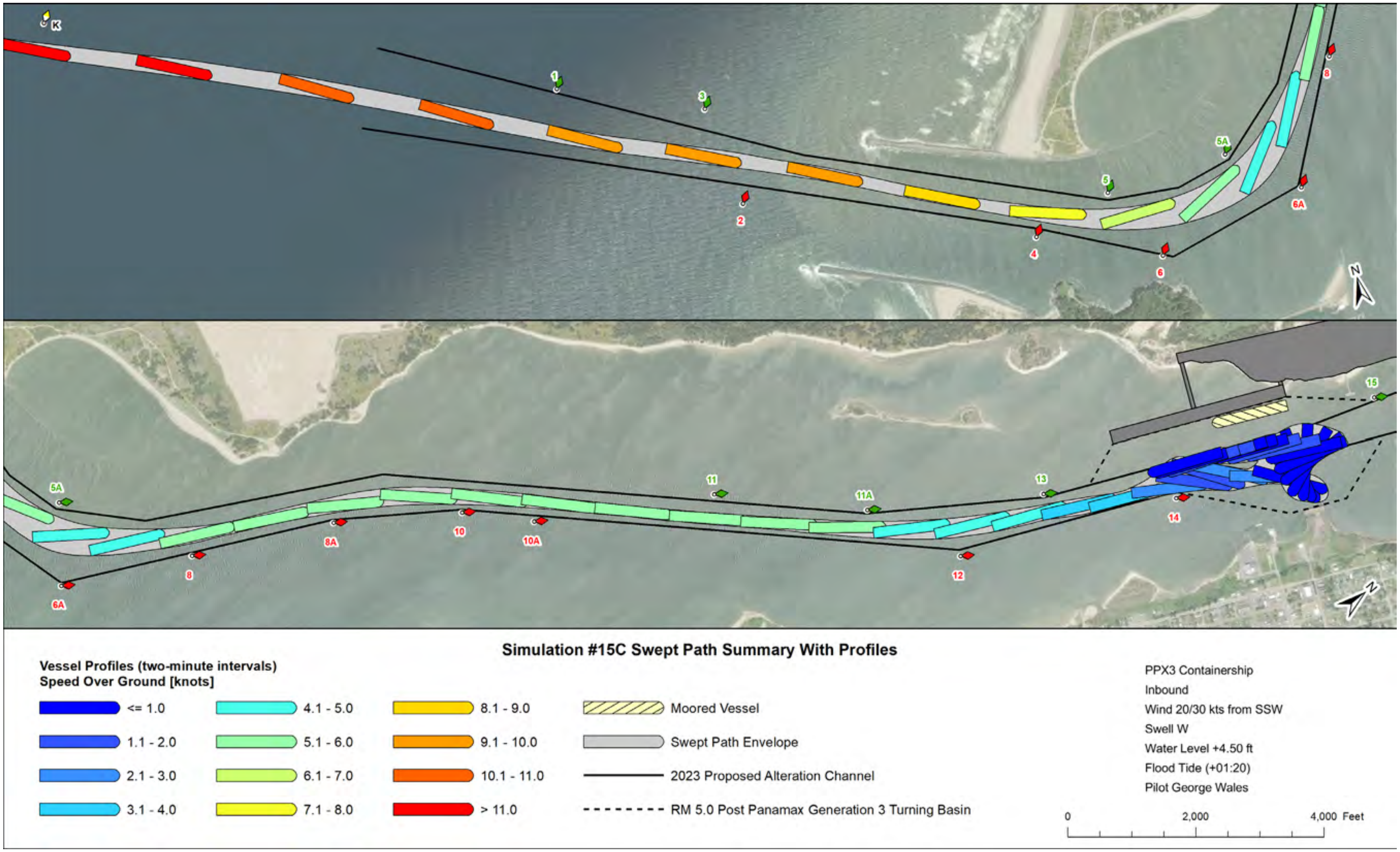

Figure 4-49. Simulation 15C Swept Path Summary with Profiles

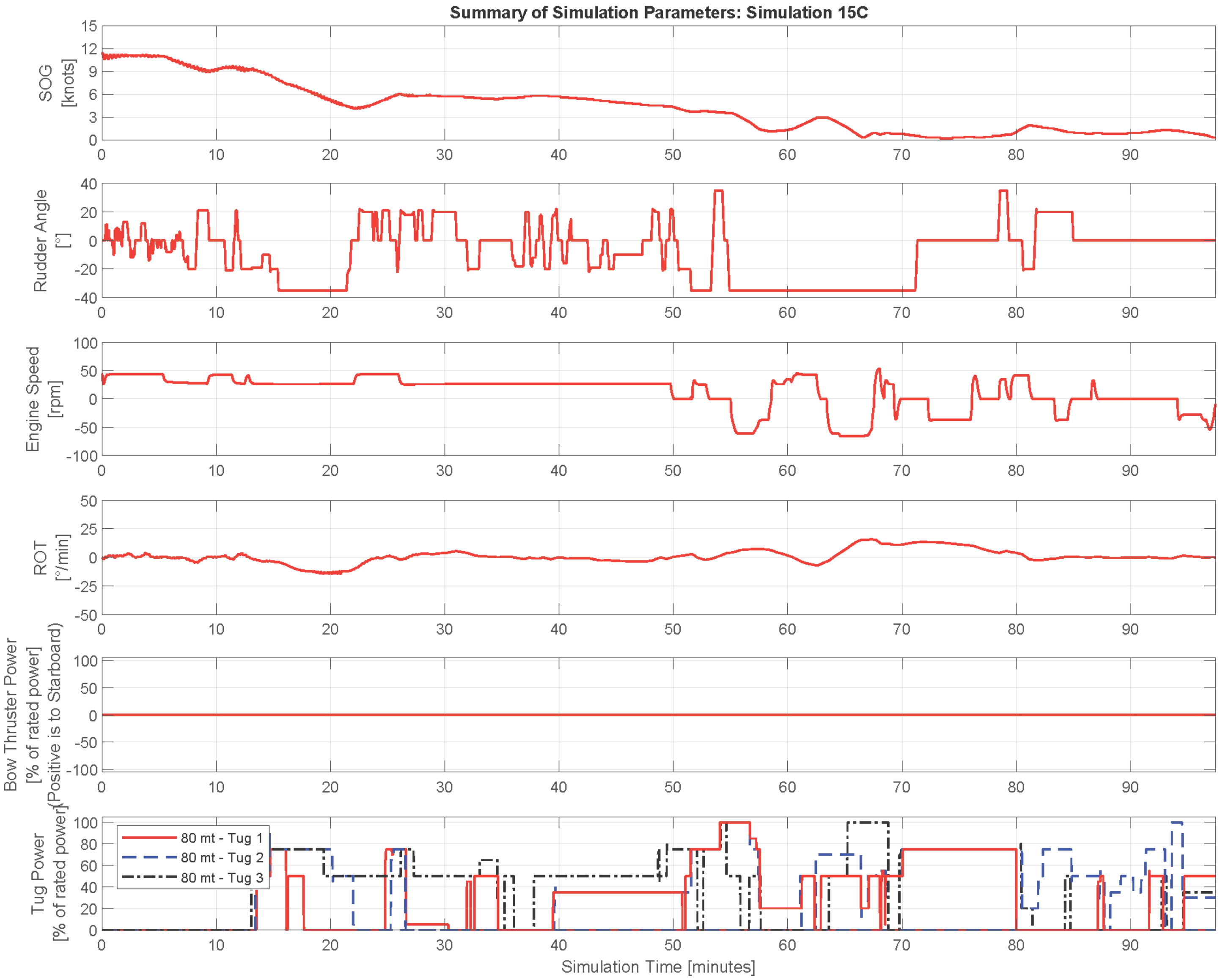

Figure 4-50. Simulation 15C Vessel and Tug Parameter Time Series

4.3.6 SIMULATION 11 – PPX3 OUTBOUND, CFS – RM -1, 2023 PA, SSW WIND, W SWELL, EBB TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
11A	2023 PA	PPX3	PPX3, CFN	Outbound	Yes / RM 5.0 – PPX3	80 / 80 / 80	30kt SSW (222.5°)/20kt SSW (222.5°)	Swell W	4.5/1.4	1.5 Hour Before High Water (05:00)	CFS	RM -1	S. Woods	🟢
11B													G. Wales	🟢

Simulation 11 started at the southern berth of the container facility. The purpose of this simulation was to assess the departure from the berth, the turning maneuver, and the channel transit in the 2023 PA channel and RM 5.0 turning basin. The transit was conducted with a starting tidal current corresponding to 1.5 hours before high water at the container facility and strong SSW winds.

Vessel Swept Path Figures: Figure 4-51 and Figure 4-53

Vessel and Tug Parameter Time Series: Figure 4-52 and Figure 4-54

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Safety and tug adequacy were rated the highest rating. Run difficulty was rated as below average difficulty. The difficulty was not rated the lowest rating due to the need to use assist tugs in the entrance turn. The vessel track stayed within the channel and turning basin boundaries. Throughout the transit there was reserve tug power, sufficient clearance to the moored vessel, and the bow thruster was not used. Both pilots would perform this transit in a real-life situation.

Result: Run A: Successful **Run B:** Successful

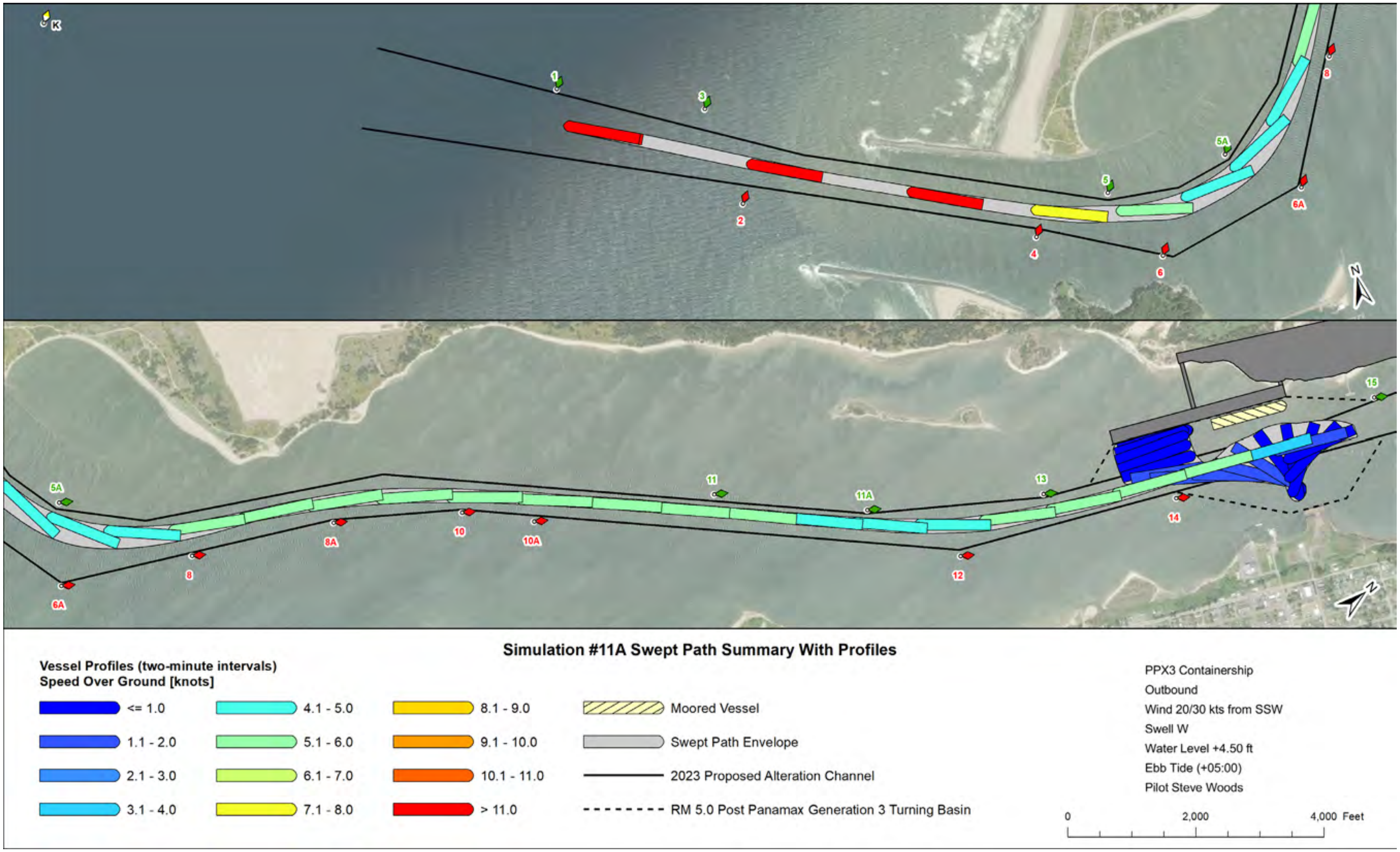

Figure 4-51. Simulation 11A Swept Path Summary with Profiles

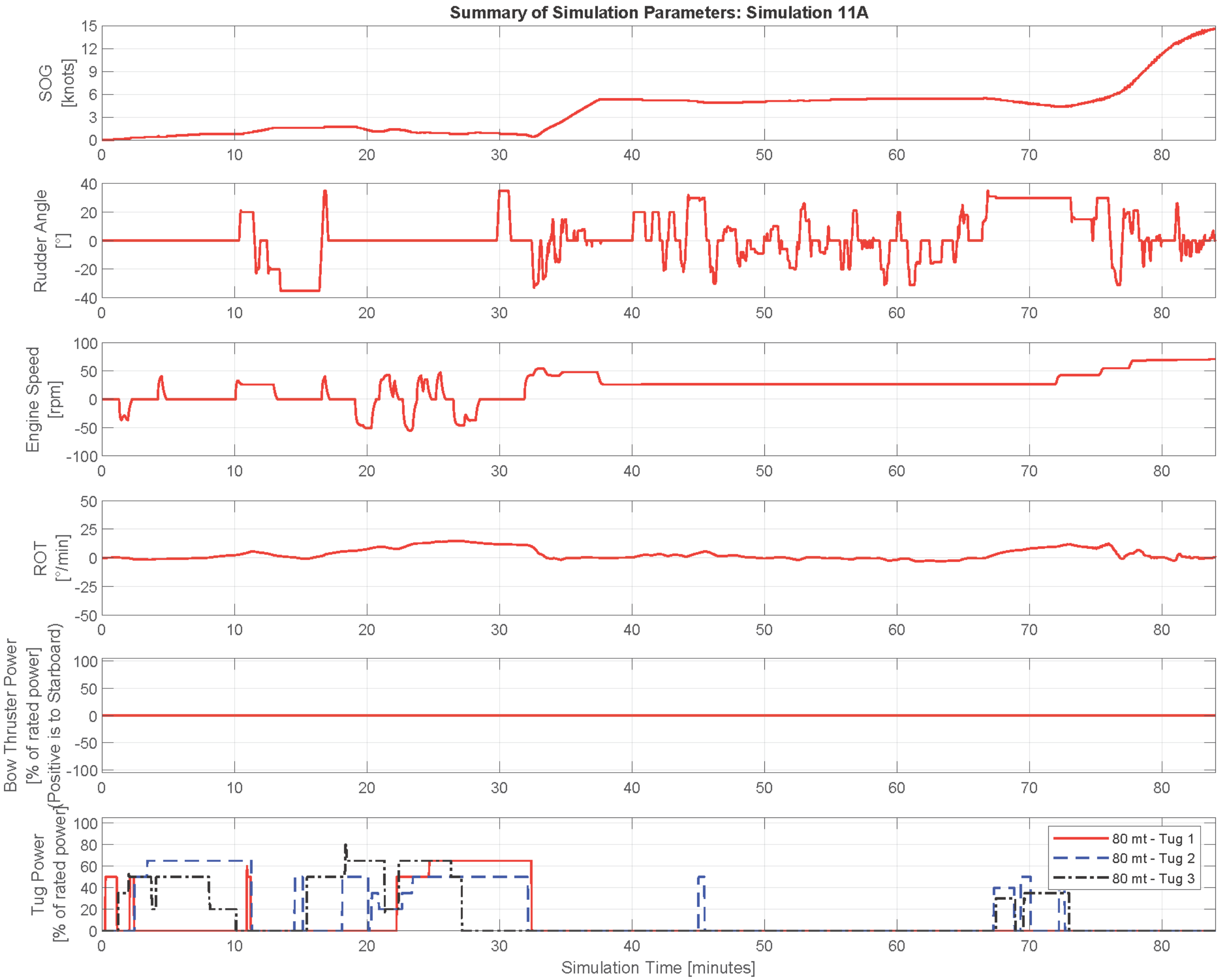

Figure 4-52. Simulation 11A Vessel and Tug Parameter Time Series

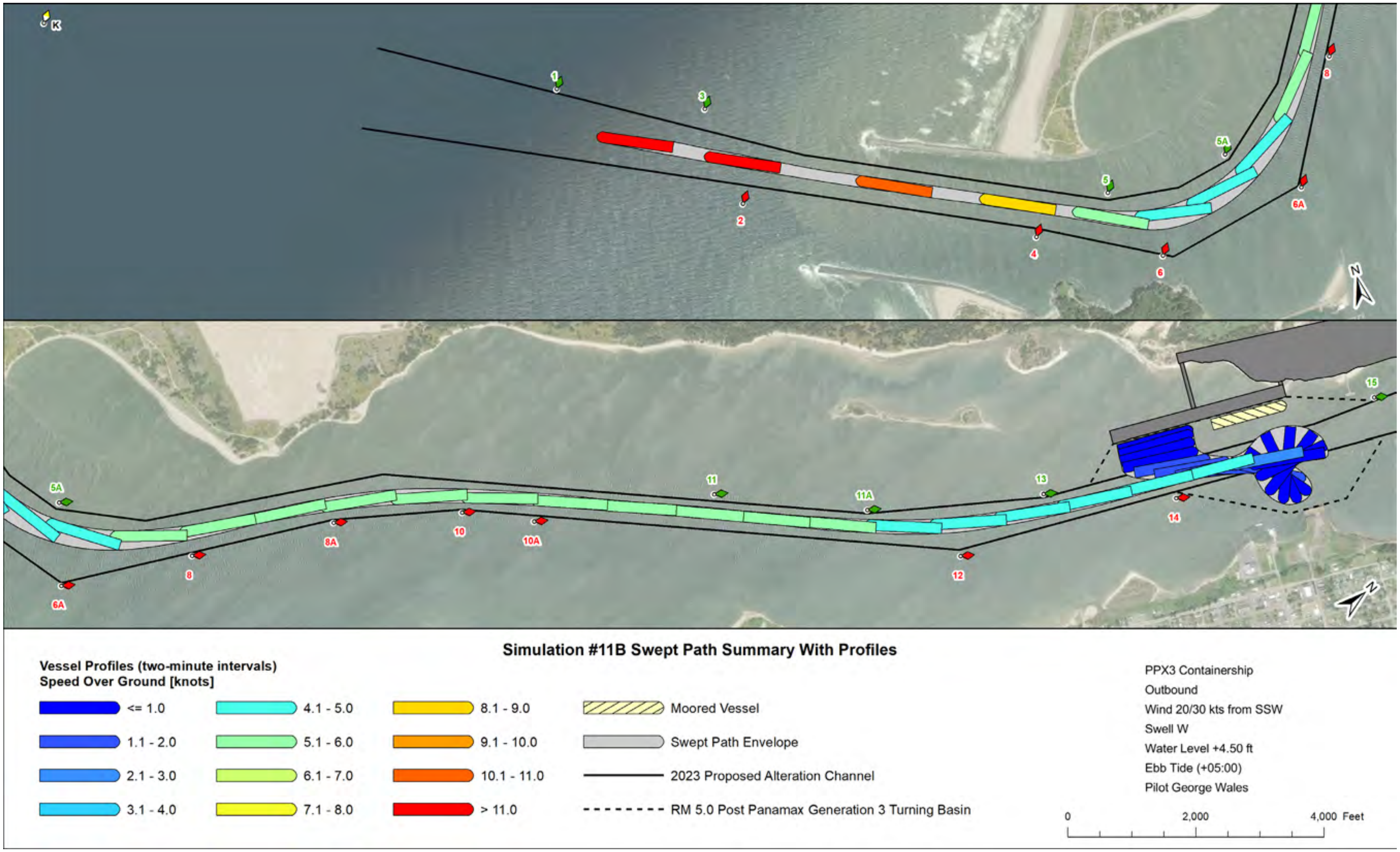

Figure 4-53. Simulation 11B Swept Path Summary with Profiles

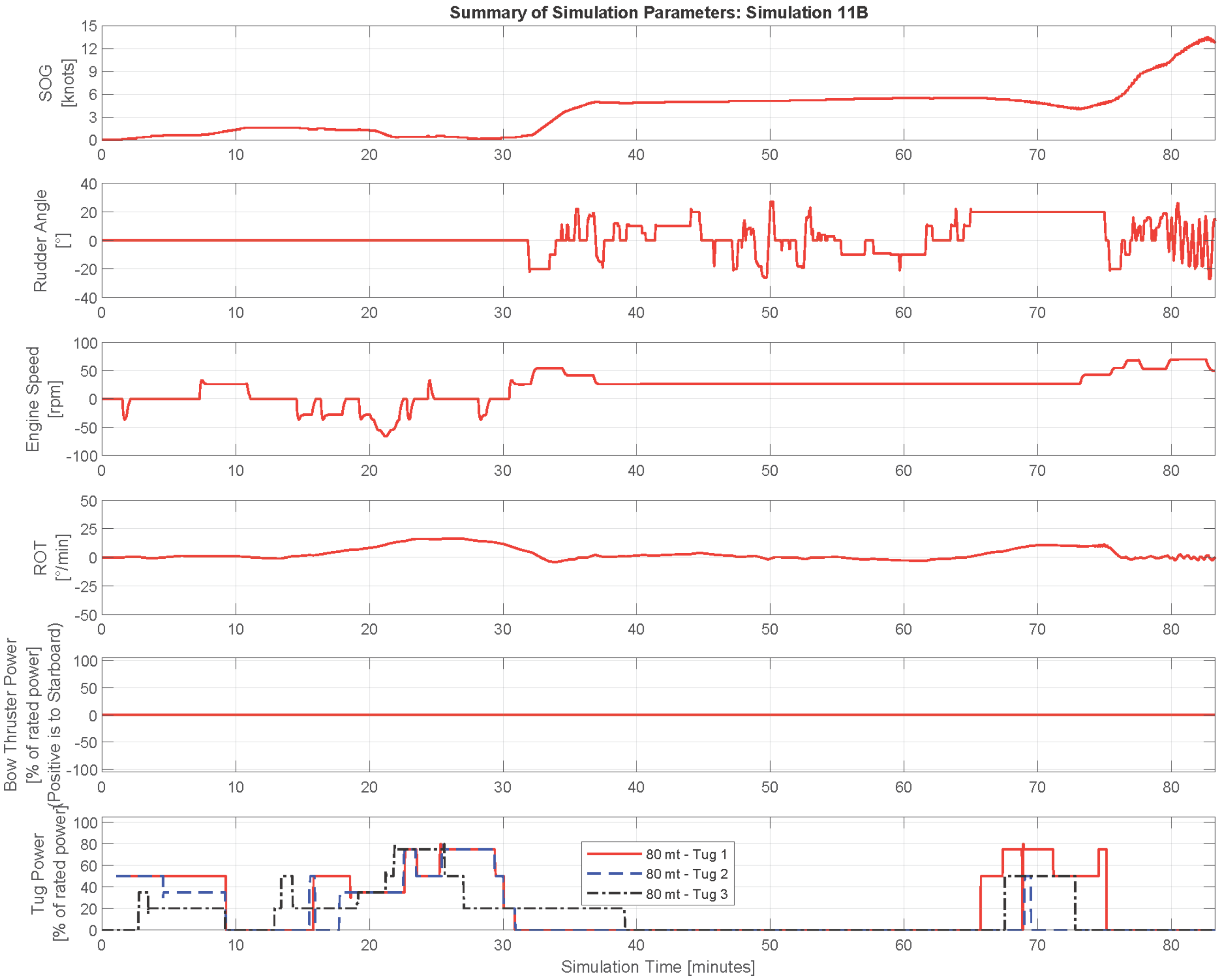

Figure 4-54. Simulation 11B Vessel and Tug Parameter Time Series

4.3.7 SIMULATION 12 – PPX3 OUTBOUND, CFS – RM -1, 2023 PA, NNW WIND, NW SWELL, EBB TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Waves	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
12A	2023 PA	PPX3	PPX3, CFN	Outbound	Yes / RM 5.0 – PPX3	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Swell NW	4.5/1.4	1.5 Hour Before High Water (05:00)	CFS	RM -1	S. Woods	🟢
12B													G. Wales	🟢

Simulation 12 started at the southern berth of the container facility. The purpose of this simulation was to assess the departure from the berth, the turning maneuver, and the channel transit in the 2023 PA channel and RM 5.0 turning basin. The transit was conducted with a starting tidal current corresponding to 1.5 hours before high water at the container facility and strong NNW winds.

Vessel Swept Path Figures: Figure 4-55 and Figure 4-57**.**

Vessel and Tug Parameter Time Series: Figure 4-56 and Figure 4-58

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. Safety and tug adequacy were rated the highest rating. Run difficulty was rated as below average or average difficulty. The difficulty rating was due to needing to use assist tugs in the entrance turn. The vessel track stayed within the channel and turning basin boundaries. Throughout the transit there was reserve tug power, sufficient clearance to the moored vessel, and the bow thruster was not used. Both pilots would perform this transit in a real-life situation.

Result: Run A: Successful **Run B:** Successful

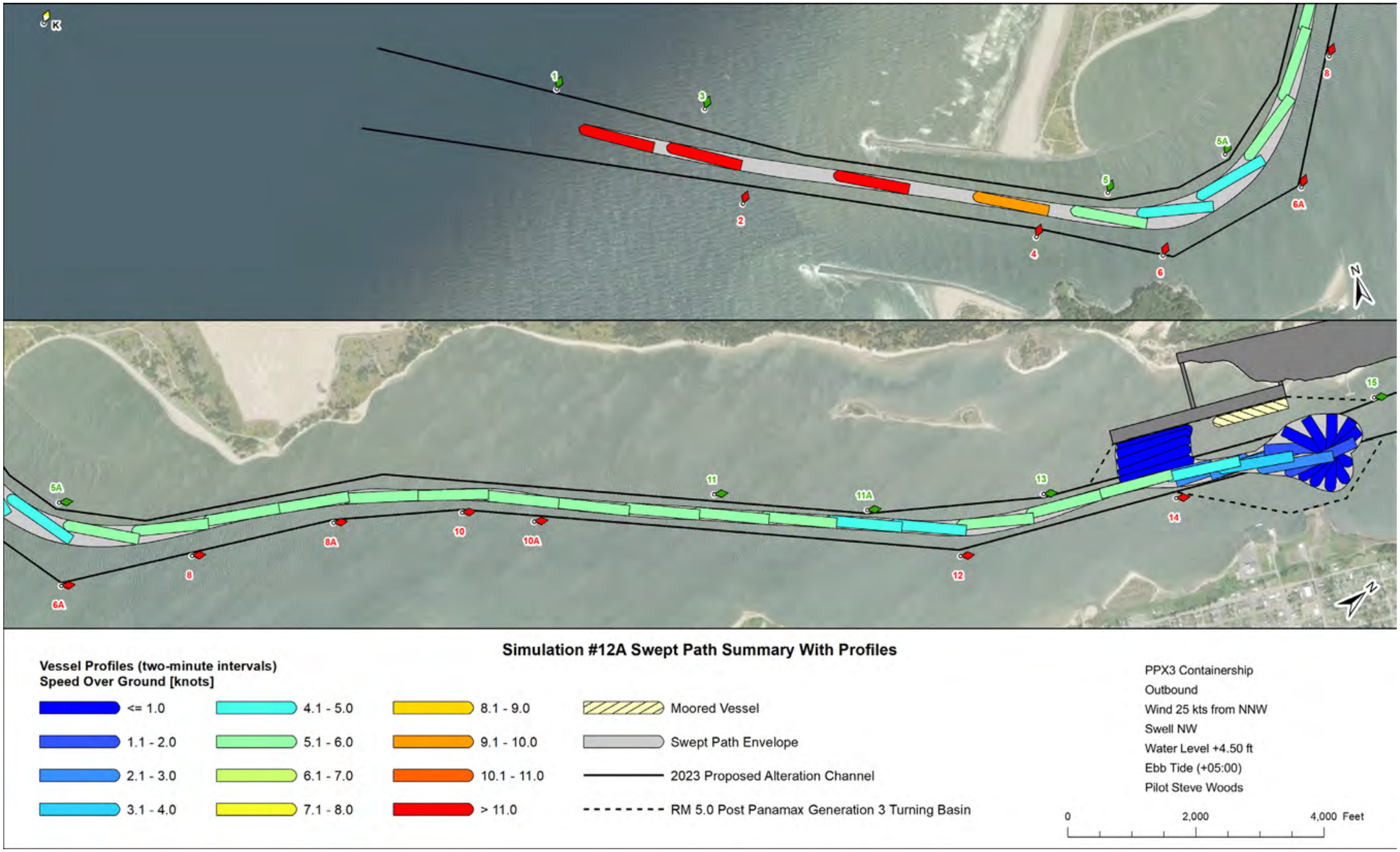

Figure 4-55. Simulation 12A Swept Path Summary with Profiles

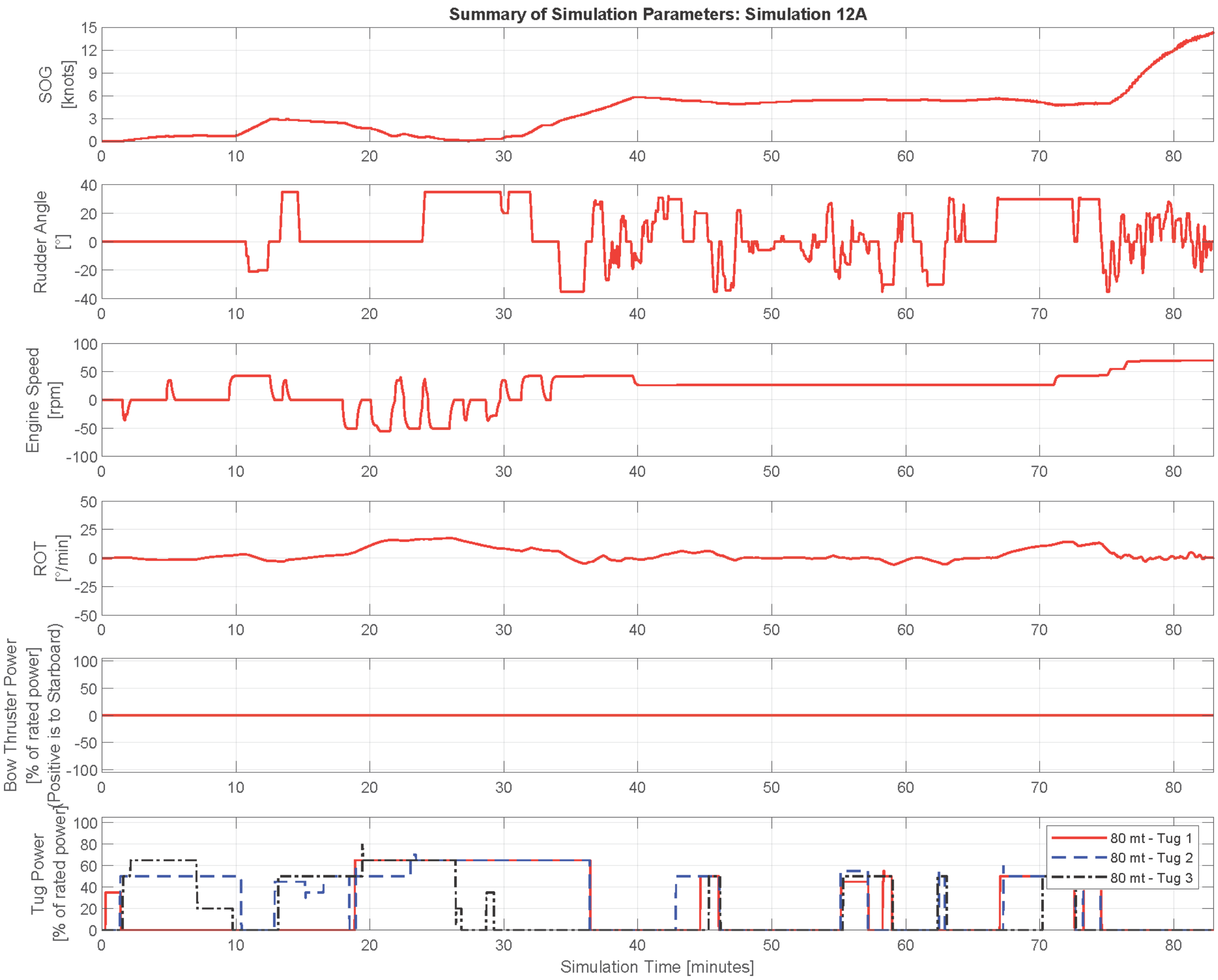

Figure 4-56. Simulation 12A Vessel and Tug Parameter Time Series

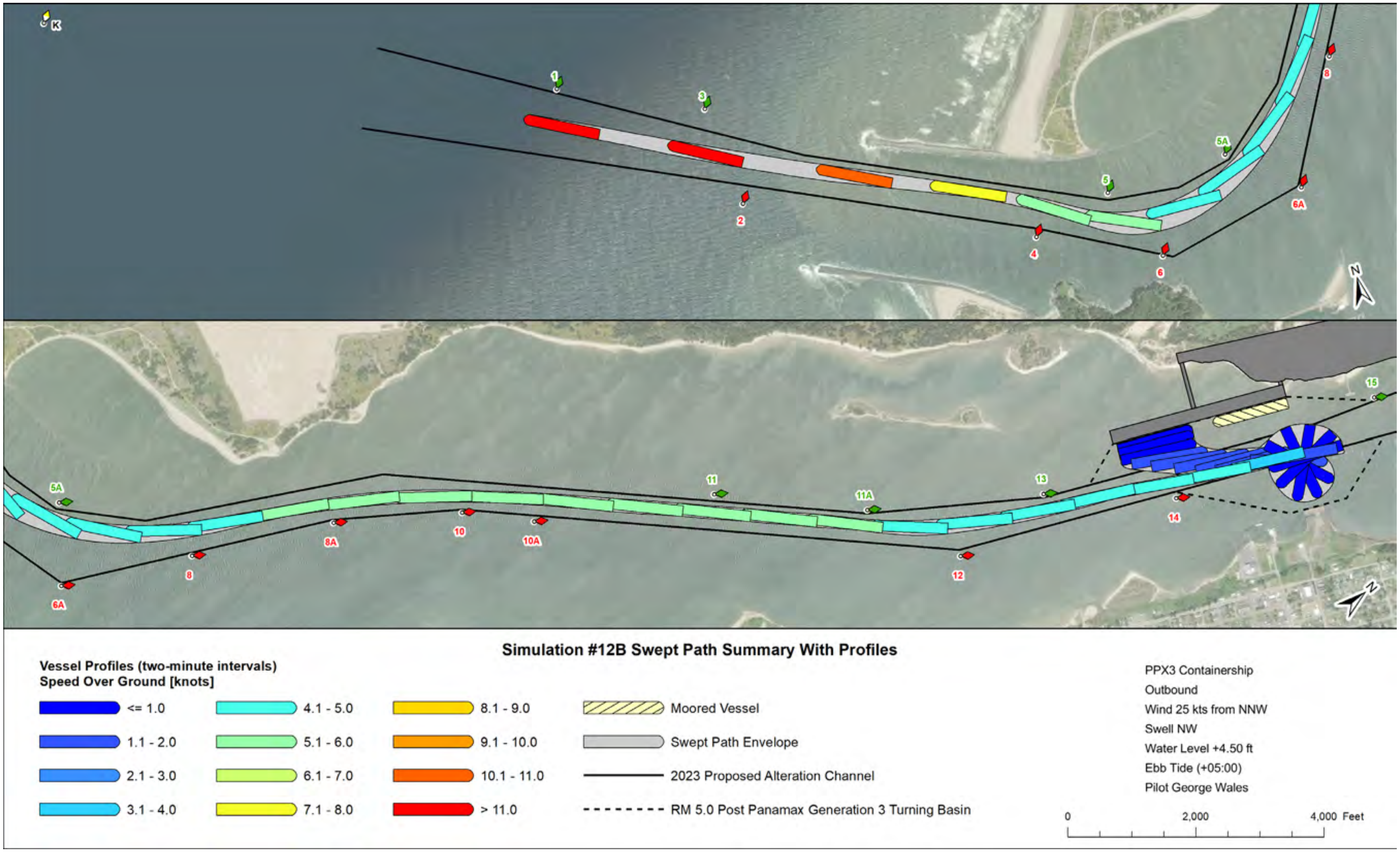

Figure 4-57. Simulation 12B Swept Path Summary with Profiles

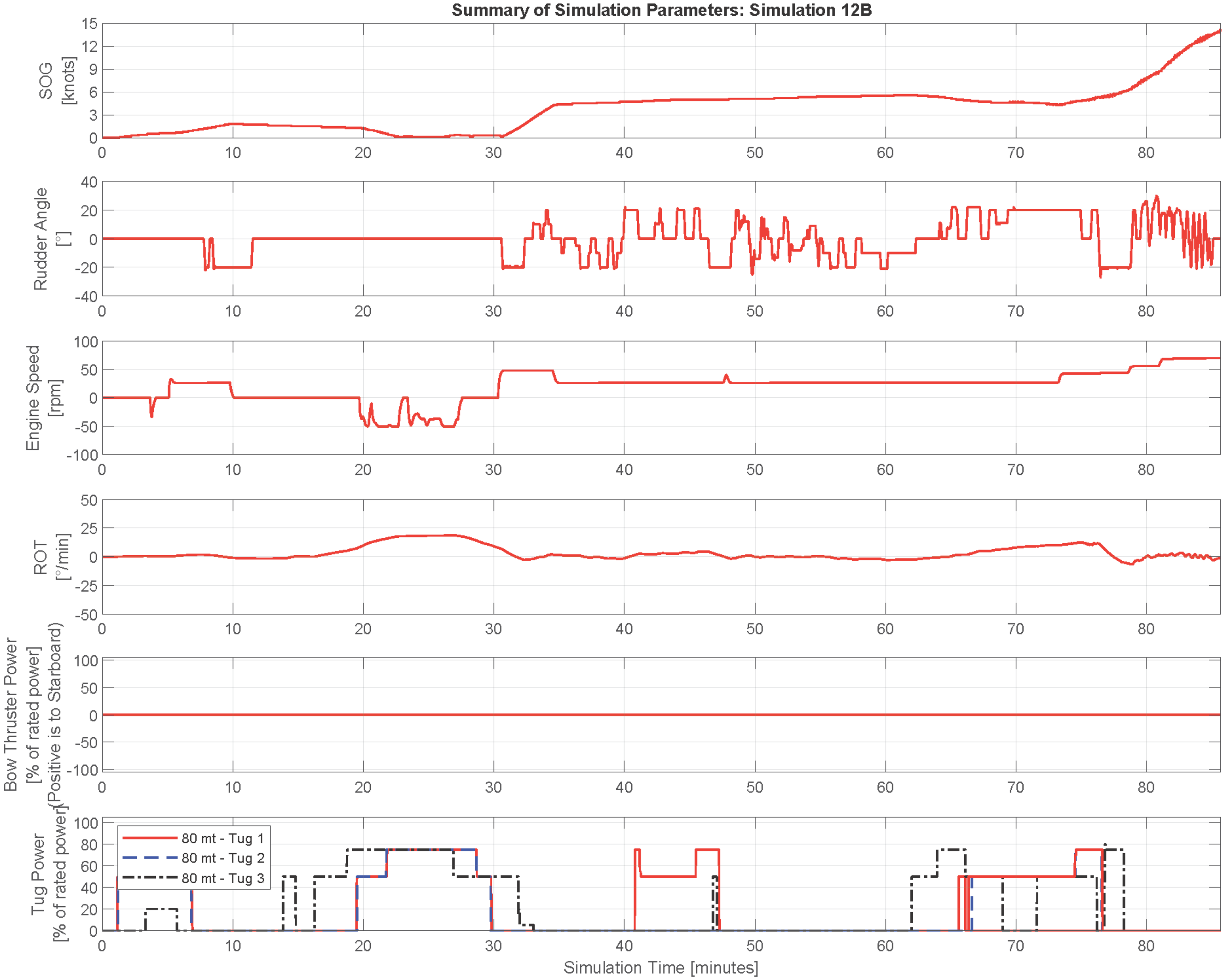

Figure 4-58. Simulation 12B Vessel and Tug Parameter Time Series

4.3.8 SIMULATION 13 – PPX3 OUTBOUND, CFS – RM 5, 2023 PA, NNE WIND, EBB TIDE

Run ID	Channel	Own Ship	Moored Ship	Direction	Turn Performed / Turning Basin Used	Tug Power (mt)	Wind Offshore/Upstream	Tide Level (ft/m)	Tide Stage	Start	End	Pilot	Result
13A	2023 PA	PPX3	PPX3, CFN	Outbound	Yes / RM 5.0 – PPX3	80 / 80 / 80	25kt NNE (22.5°)/25kt NNE (22.5°)	4.5/1.4	1.5 Hour Before High Water (05:00)	CFS	RM 5	G. Wales	🟡
13B												S. Woods	🟢

Simulation 13 started at the southern berth of the container facility. The purpose of this simulation was to assess the departure from the berth and the turning maneuver. The channel transit was not evaluated as the NNW and SSW winds will be the controlling condition. Simulation 13 was conducted with a starting tidal current corresponding to 1.5 hours before high water at the container facility and strong NNW winds.

Vessel Swept Path Figures: Figure 4-59 and Figure 4-61**.**

Vessel and Tug Parameter Time Series: Figure 4-60 and Figure 4-62

Pilot Comments: Pilots found the simulation to be a realistic representation and the vessel model performed as expected. **Simulation 13A** was rated as above average safety, average tug adequacy, and above average difficulty. In the turning basin maneuver, there was a period when two tugs were at full power, the third tug at 90% power, and the bow thruster was at 100% power. During this period the vessel drifted more than expected and the rotation stopped. As a result, Captain Wales stated that he would not perform this scenario in a real-world situation and that this would be beyond the wind limit in the turning basin for a NNE wind. **Simulation 13B** was rated as the highest safety and tug adequacy and below average difficulty. Captain Woods would perform this transit in a real-life situation. Throughout this transit there was reserve tug power, sufficient clearance to the moored vessel, and the bow thruster was not used.

Result: Run A: Marginal Success **Run B:** Successful

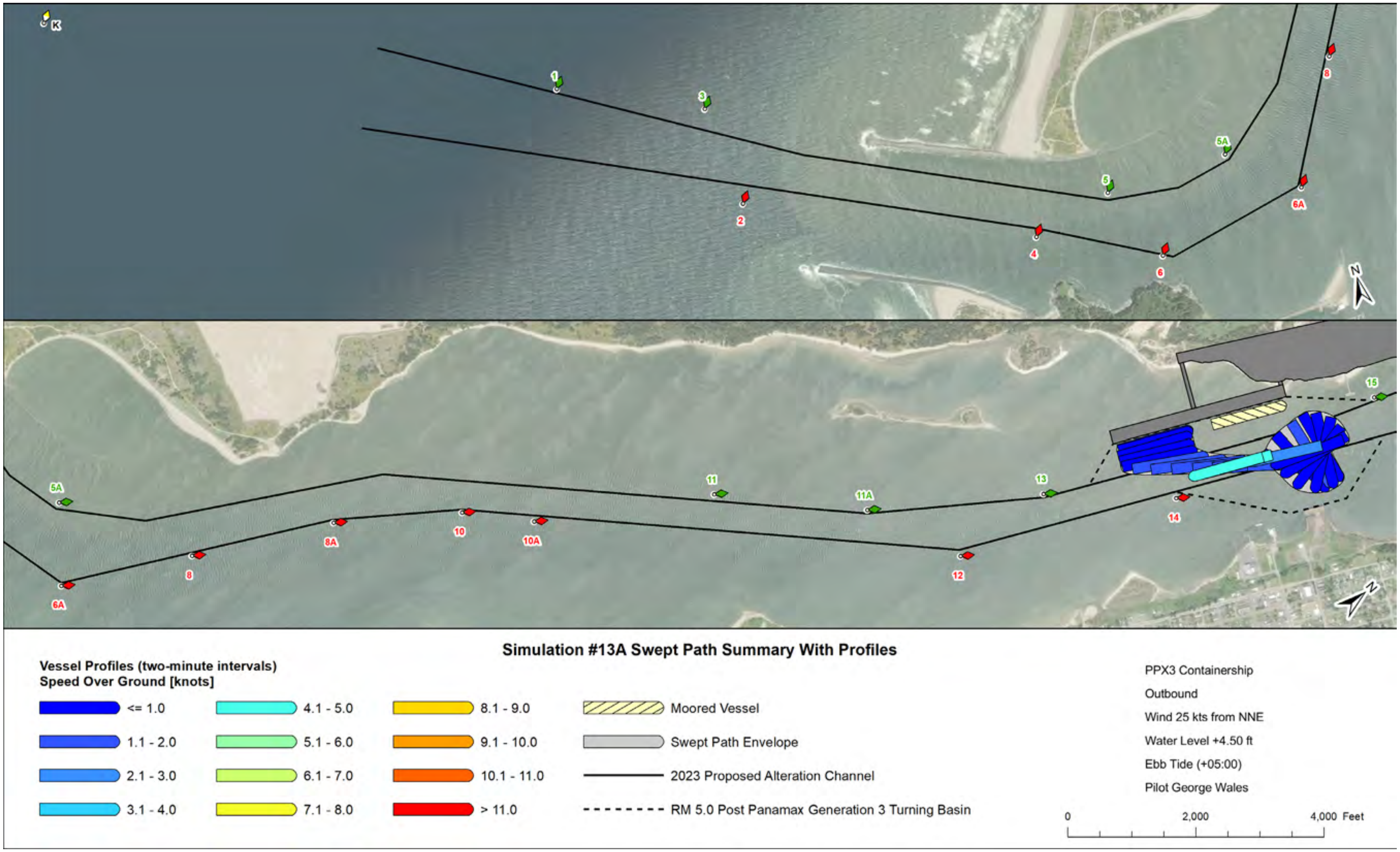

Figure 4-59. Simulation 13A Swept Path Summary with Profiles

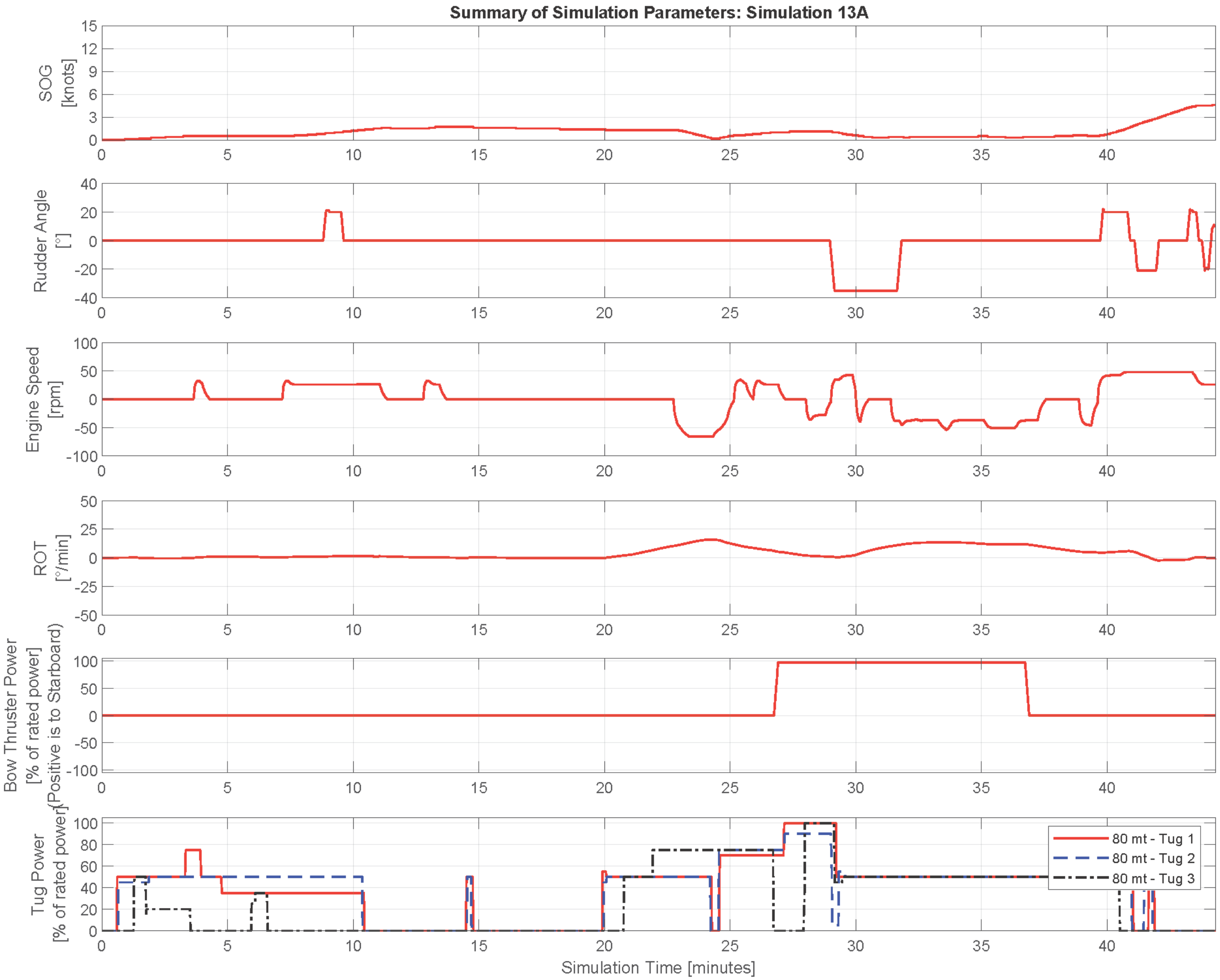

Figure 4-60. Simulation 13A Vessel and Tug Parameter Time Series

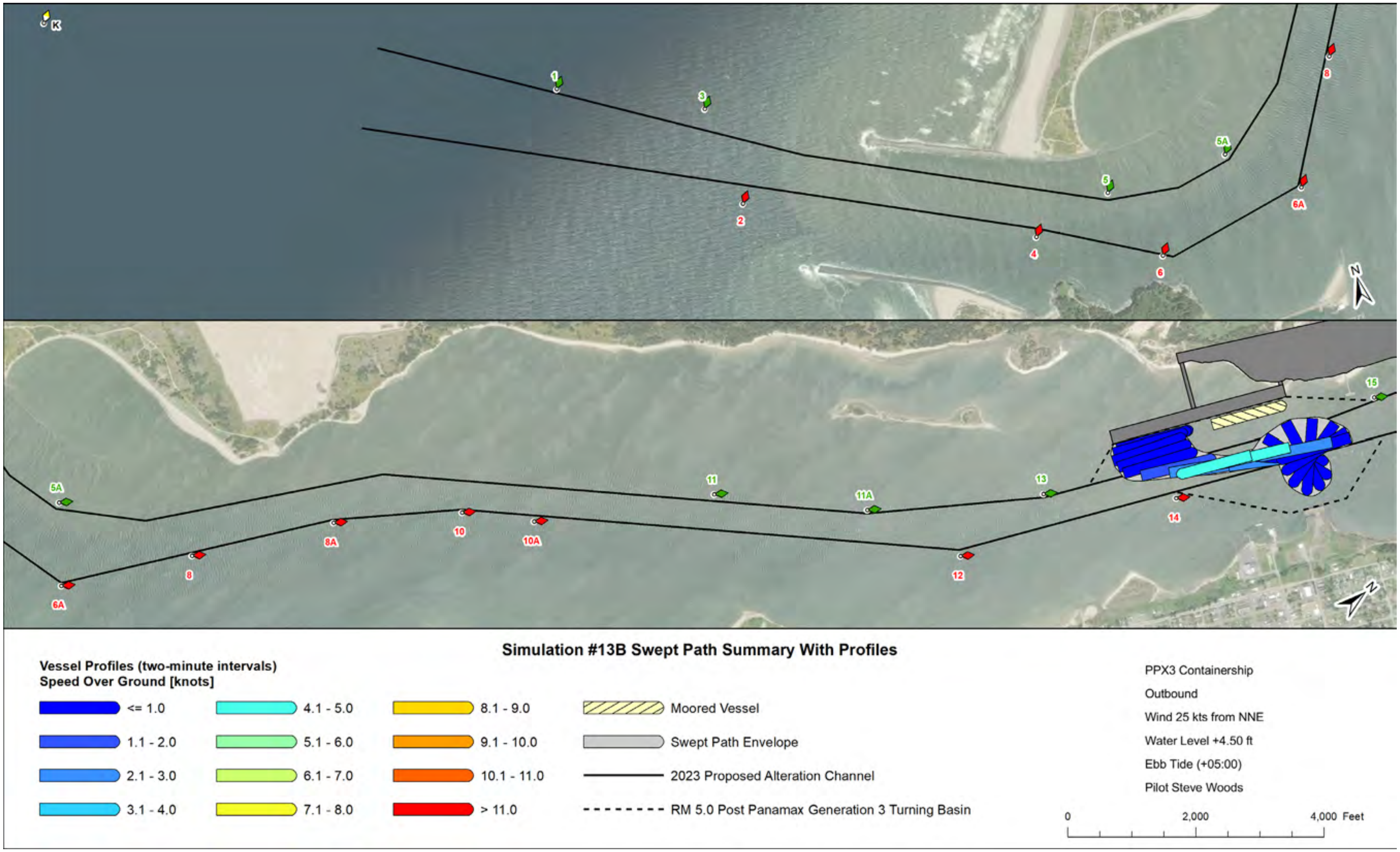

Figure 4-61. Simulation 13B Swept Path Summary with Profiles

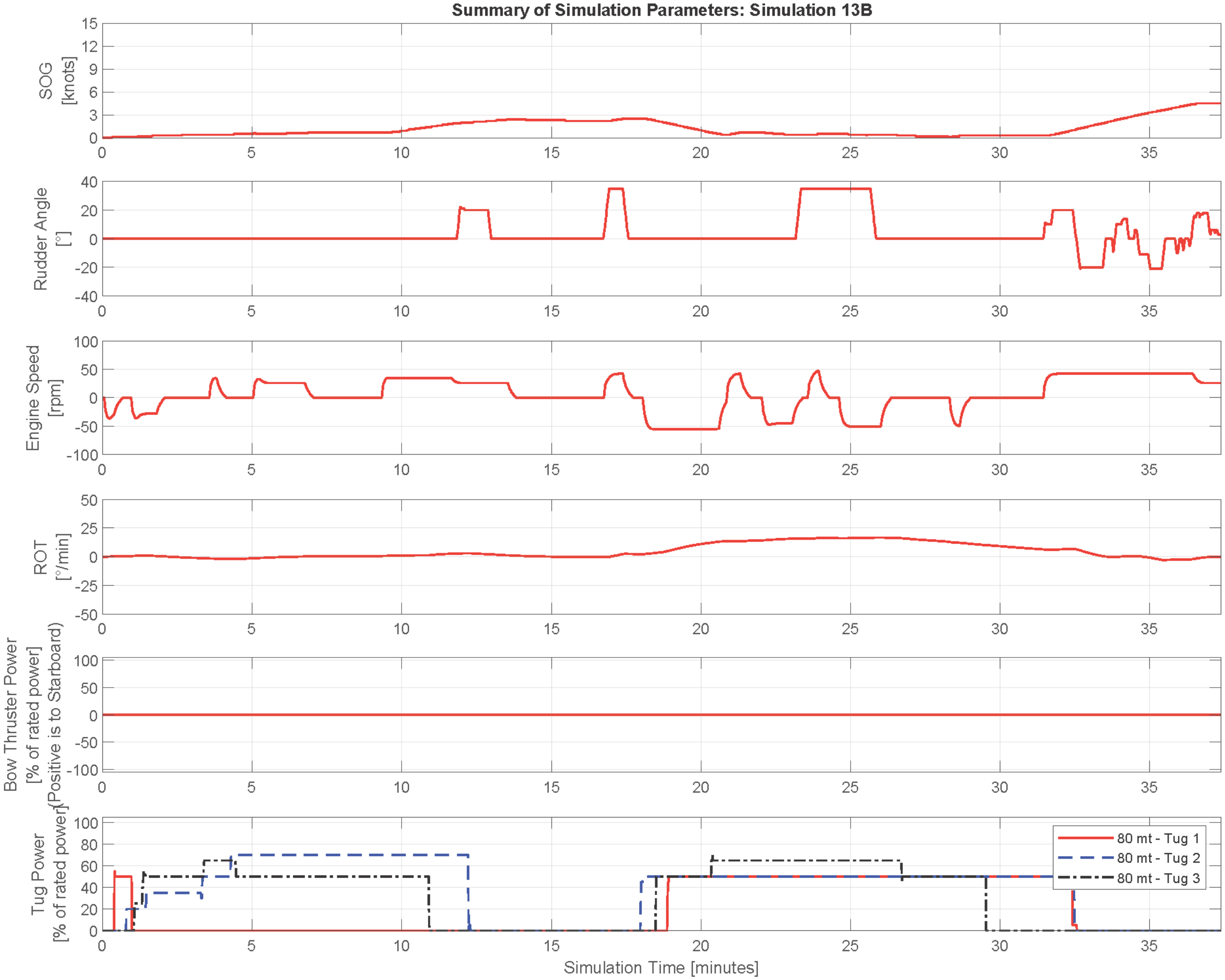

Figure 4-62. Simulation 13B Vessel and Tug Parameter Time Series

5 SUMMARY & CONCLUSIONS

A real-time vessel simulation study was successfully performed at the Maritime Institute of Technical and Graduate Studies (MITAGS) in Linthicum, Maryland. These simulations were performed to evaluate the navigability and safety of a modified channel design for the proposed design container vessels[4]. Shiphandling for these simulations was primarily performed by the local Coos Bay Pilots with a handful of simulations performed by a MITAGS expert ship handler.

Thirty-one simulations were performed over seven simulation days, April 6 – 7 and April 10 – 14, 2023. These simulations included maneuvers evaluating:

- The turning basin for a Panamax containership in the WOP channel
- The proposed RM 8.0 turning basin for the Capesize bulk carriers calling at Roseburg Chip Facility,
- The channel transit and turning basin maneuvers for a Post Panamax Generation 3 containership in the 2023 PA channel.

Ten simulations evaluated the without project channel, four assessed the proposed RM 8.0 turning basin, and the remaining seventeen simulations evaluated the 2023 proposed alteration channel. Figure 5-1, Figure 5-2, and Figure 5-3 display heat map density plots for the Panamax containership runs, the Capesize bulk carrier runs, and the Post Panamax Generation 3 containership runs, respectively. These heat maps illustrate how many vessels made use of each channel area.

The primary conclusions and recommendations from this study are provided in the subsections below.

5.1 CHANNEL DESIGN

5.1.1 WITHOUT PROJECT (WOP) CHANNEL

- The existing federal channel is sufficient with no modifications to allow a Panamax class containership to transit to the proposed container facility.

5.1.2 2023 PROPOSED ALTERATION (PA) CHANNEL

- The 2023 PA channel is sufficient with no additional modifications to allow a Post Panamax Generation Three class containership to transit to the proposed container facility.
- The modifications from the 2017 proposed alteration channel were well received by the Coos Bay Pilots and required to allow safe transits with the design vessels to the proposed container facility and Roseburg Chip Facility.
- In the entrance turn the wind from the NNW was the most challenging wind condition simulated.
- Comparatively, the ebb tide created an easier inbound maneuver than the flood tide in the entrance turn. With the ebb tide the vessel could stem the current allowing better control of the vessel. Therefore, the preference would be to time the currents to be an ebb current in the entrance turn on the inbound transit.

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[4] 10567653: Phase 3 report, 2023 PA Entrance Channel: Was the suitability of the 2023 PA channel sufficient to provide dynamic underkeel clearance for the PP-G3 design vessel, including safety clearance in accordance with USAE guidance?
Has UKC been fully evaluated/documented for the present project design vessels to reliably confirm the 2023 PA channel and assumed design vessel operations through the project's entrance channel?
Response: This analysis is/will be provided in sub-appendix 4.

5.2 TURNING BASIN

5.2.1 WOP – RM 5.0

- The proposed turning basin for the Panamax class containership was well received by the Coos Bay Pilots.
- Based on the heat map, Figure 5-1, the designed turning basin was well utilized.
- The turning area with a principal width of 1450 feet, as simulated, is recommended for moving forward with design.

5.2.2 2023 PA – RM 8.0

- The simulated turning basin for the Capesize bulk carrier was well received by the Coos Bay Pilots.
- Based on the heat map, Figure 5-2, the design turning basin was well utilized. However, the Coos Bay Pilots stated that the turning basin footprint could be reduced by 75 to 100 ft by shifting the southern boundary to the north[5]. Based on the swept paths it is recommended to reduce the simulated turning basin by 75 ft as shown in Figure 5-4.

5.2.3 2023 PA – RM 5.0

- The proposed turning basin for the Post Panamax Generation Three class containership was well received by the Coos Bay Pilots.
- Based on the heat map, Figure 5-3, the designed turning basin was well utilized.
- The turning area[6] with a principal width of 1600 feet and 2,000 feet long (parallel to the channel), as simulated, is recommended as the design forward.
- Operationally, turning the vessel was difficult while the tidal stream is running. Therefore, it is recommended that the containership berth port side to berth and perform the turning evolution on the outbound transit to better time the tidal currents.
- Environmentally, with a NNW wind, a flood current is preferred as the two forces will counteract. When a SSW wind is present then an ebb current is preferred in the turning basin. Comparatively, the flood current in the turning basin was more challenging than the ebb current based on the pilot feedback.

5.3 TUGBOATS

- For the Panamax class containership transits, it is recommended to have a minimum of two azimuthing stern drive (ASD) tractor tugs with each tug having a minimum of 80 mt bollard pull rating to escort arriving and departing containerships in the channel and for turning the vessels.
- For the Capesize bulk carrier transits it is recommended to have a minimum of two azimuthing stern drive (ASD) tractor tugs with each tug having a minimum of 80 mt bollard pull rating to turn the vessels.
- For the Post Panamax Generation Three class containership transits it is recommended to have a minimum of three azimuthing stern drive (ASD) tractor tugs with each tug having a minimum of

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[5] 10567651: Phase 3 report, section 5.2.2: The design turning basin width is recommended to be reduced by 75 ft, yet the vessel transit plots appear to indicate that the entire TB design width is needed for vessel maneuvering. The proposed 75 ft width reduction for the designed TB does not appear justified.
Response: This reduction was based on the Coos Bay Pilots recommendations. Of the four simulations of this turning basin, three of them stayed within the newly proposed footprint. For the one simulation that did not stay within the proposed boundaries the pilot was asked if he supported the reduction and the response was "yes" confidently

[6] 10567652: Phase 3 report, section 5.2.3: What is the TB recommended length for post-Panamax G3 design vessels? Add declaration for TB length.
Response: TB recommended length for PPX3 design vessel included.

80 mt bollard pull rating to escort arriving and departing containerships in the channel. For the turning maneuver of the PPX3 class containership it is recommended that an additional conventional tug with 4000 to 5000 horsepower be present in addition to the escort tugs in the simulated environmental conditions.

5.4 AIDS TO NAVIGATION

- The simulated aids to navigation were well received for both the WOP and the 2023 PA, with the exception of red buoy “10A” for the 2023 PA channel. As simulated buoy “10A” was ineffective. It is recommended as the project progresses that a further discussion with the Coos Bay Pilots and the United States Coast Guard occur to discuss the best location for this buoy considering limited visibility conditions.
- The pilots requested an additional green AtoN at the southern flare of the container facility berth pocket approximately 75 ft from the apex of the boundaries.

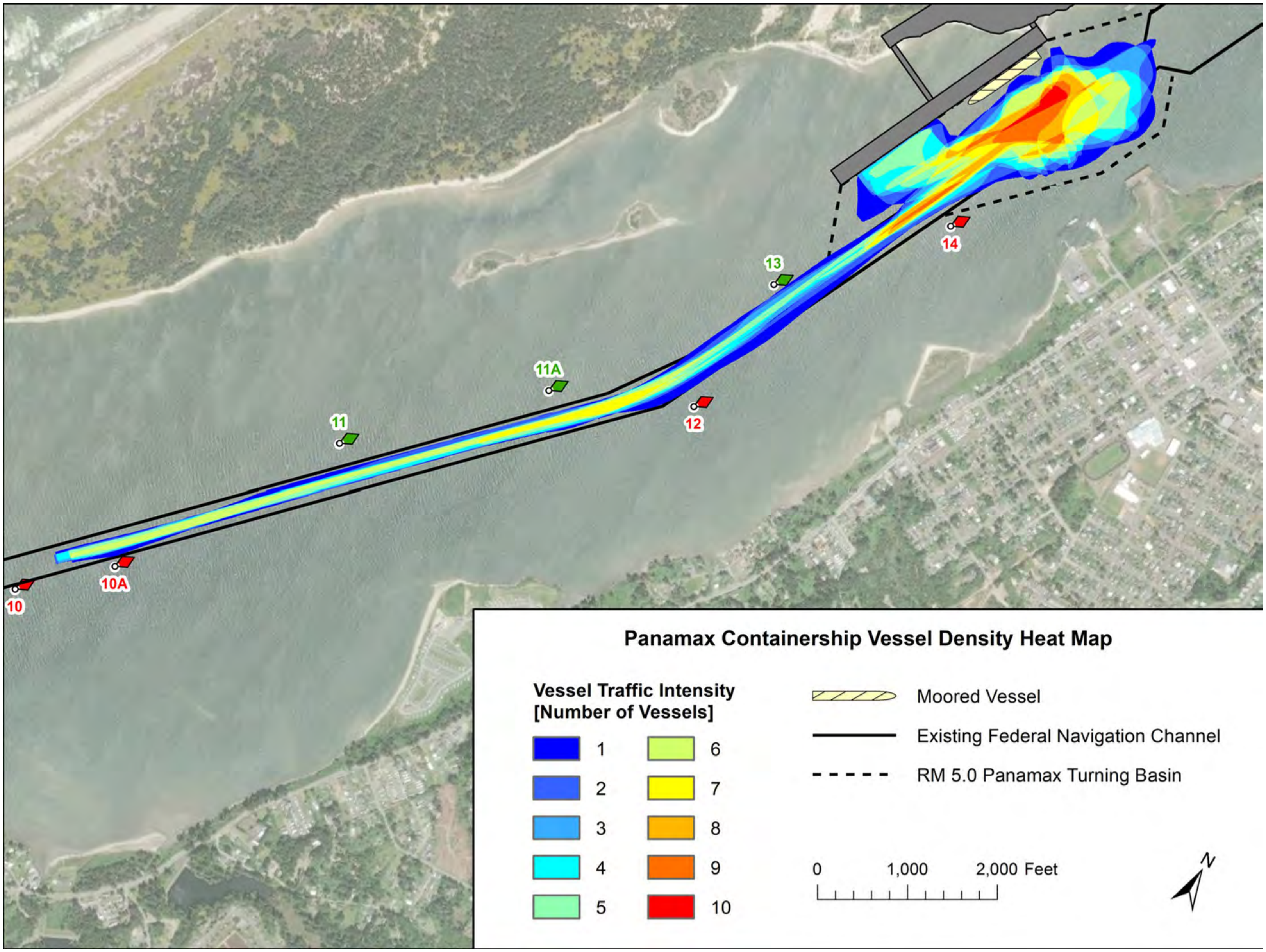


Figure 5-1. Panamax Containership Vessel Density Heat Map

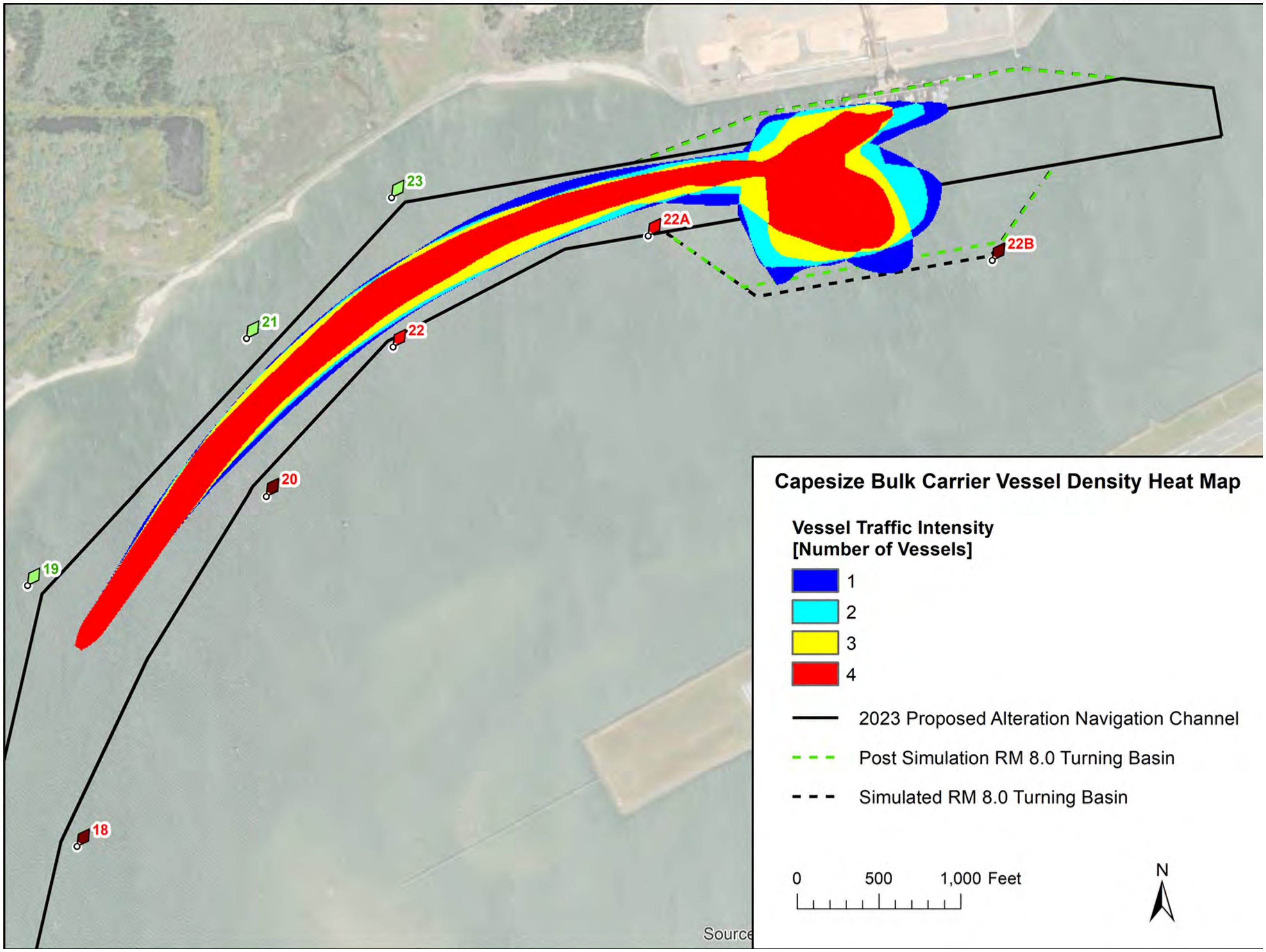


Figure 5-2. Capesize Bulk Carrier Vessel Density Heat Map

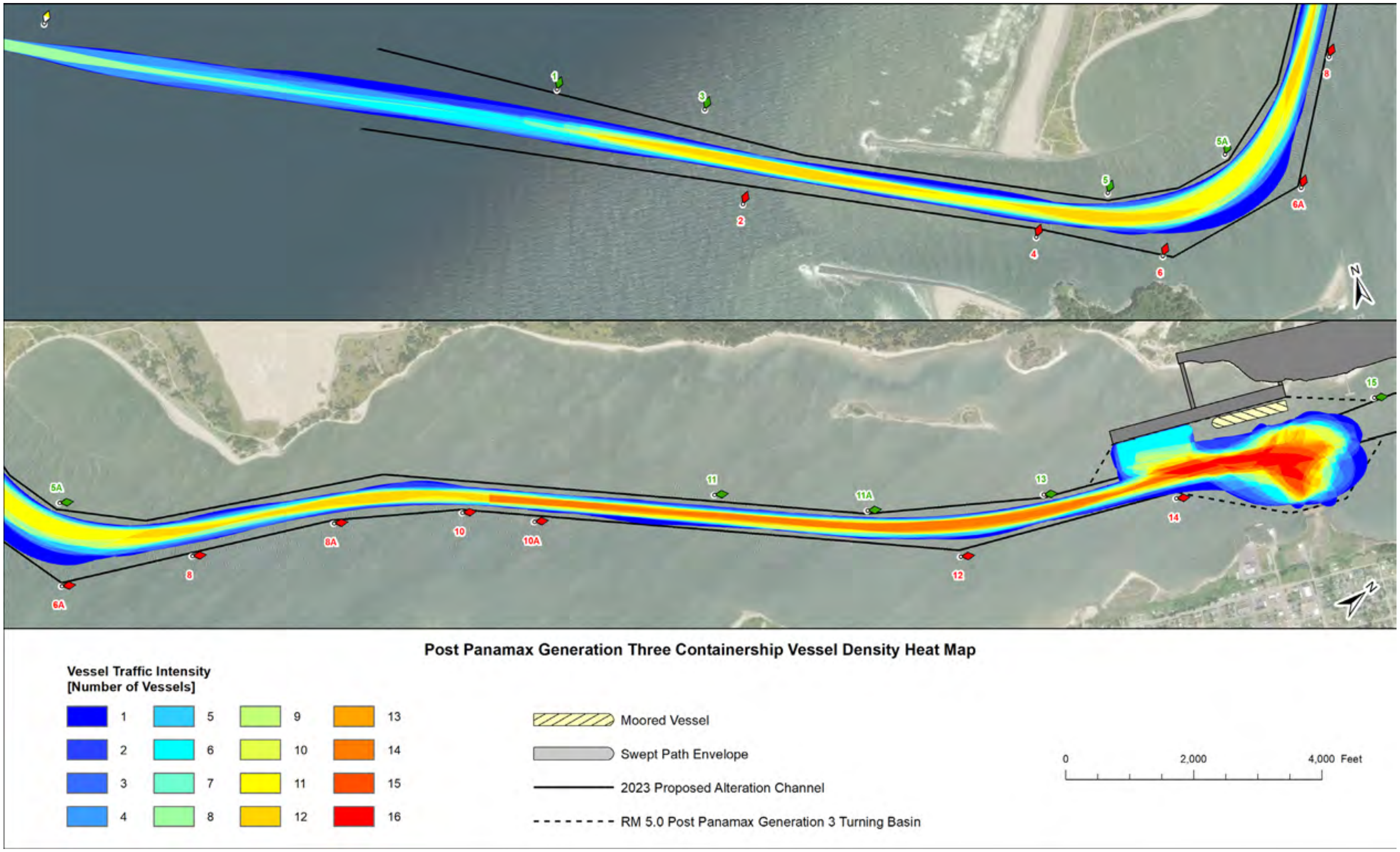


Figure 5-3. Post Panamax Generation Three Containership Vessel Density Heat Map

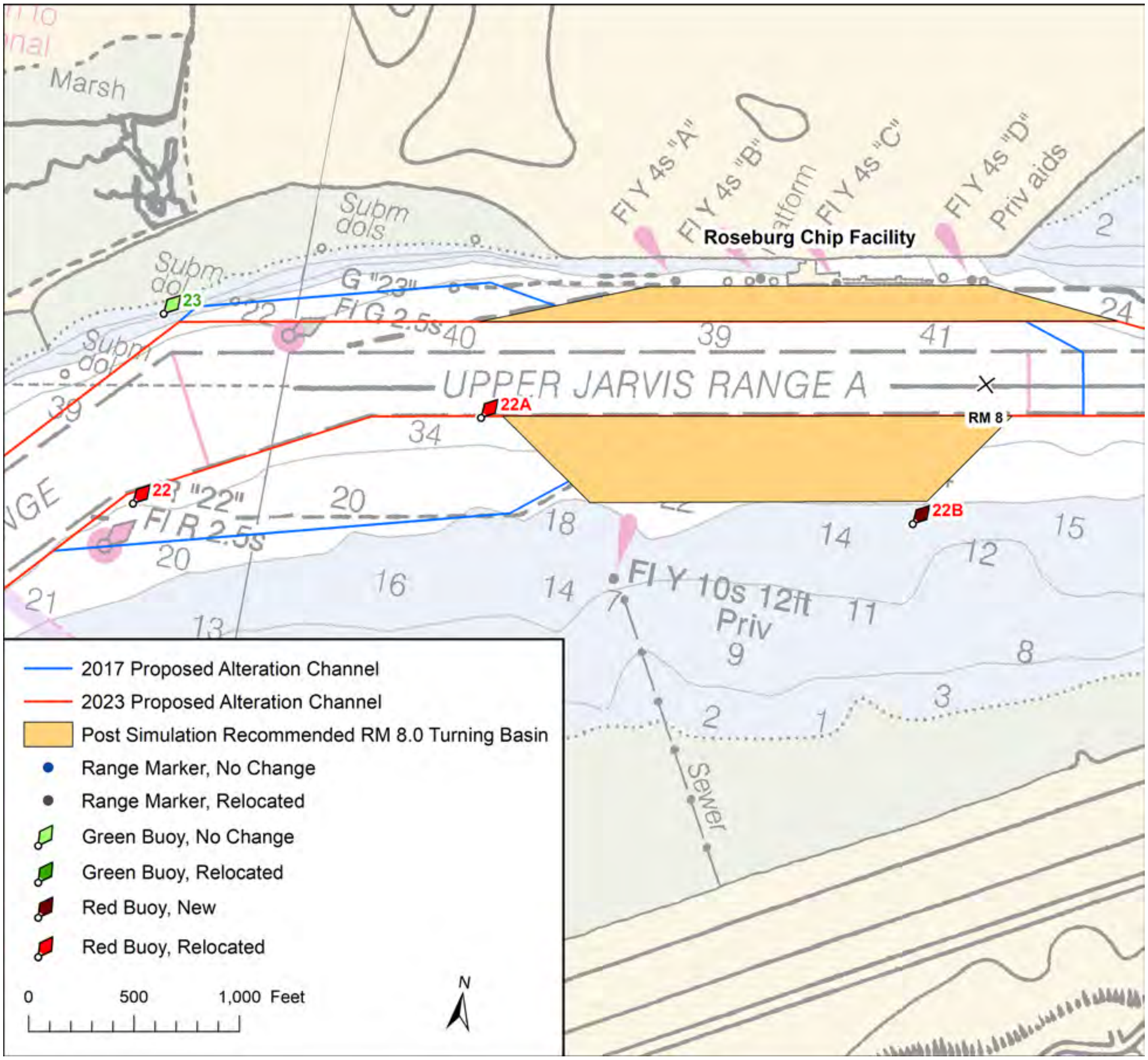


Figure 5-4. 2023 Proposed Alteration Channel Post Simulation Modification Capesize Turning Basin at RM 8.0

APPENDIX A. M&N DESKTOP SCREENING SIMULATIONS

Moffatt & Nichol (M&N) was retained by David Miller Associates (DMA) and Oregon International Port of Coos Bay (OIPCB) to conduct real-time navigation simulations to support the ongoing navigation channel improvement project. In 2022 M&N started a three-phase navigation simulation study to evaluate the channel improvement project for containerships. This report is to document a screening simulation study that was conducted following the phase one and two navigation simulation studies (*M&N Phase 1 Screening Navigation Simulations Results Memorandum* and *M&N Phase 2 Desktop Navigation Simulation Report*, respectively) and prior to phase three, the full mission bridge ship simulation study. Henceforth, this phase will be known as Phase 2B Navigation Simulations. The purpose of this screening study was to determine a modified proposed channel that would allow safe transits of the Post-Panamax Generation Three containerships to the newly proposed container facility.

A.1 PURPOSE AND OBJECTIVES

This memo outlines the findings for the Phase 2B screening real-time navigation simulation study. The navigation simulations were conducted from February 21st to February 22nd, 2023, at the M&N in-house desktop simulator at the M&N office in Baltimore, MD. The ship handling for this simulation effort was performed by Coos Bay Pilot Tim Petrusha. The objective of this screen study was to confirm the feasibility of the proposed channel modifications to the 2017 Proposed Alteration Channel for the Post-Panamax Generation Three containerships to safely maneuver to the proposed container facility.

A.2 SIMULATOR

The simulations were performed at the M&N in-house simulator (Figure A-1) which is located in Baltimore, MD. The M&N simulator consists of an operator console and a pilot console. Captain Tim Petrusha sat at the pilot console and was responsible for conning the simulations (no separate helmsman). The simulator operator (an M&N engineer) supervised the simulation (e.g., controlling environmental conditions, setting up the scenarios for testing, etc.) and operated the tugs as instructed by the pilot. For these simulations, the tugs were controlled by basic commands from the simulation operator (where to connect, how hard to pull, etc.).

The simulations were conducted using the navigation simulation software Navi Trainer Pro 5000 (NTPro). NTPro simulates real time vessel maneuvers through realistic 3D renderings of harbor geometry, accounting for vessel response to wind, waves, currents, bathymetry (shallow water effects), and vessel-structure and vessel-vessel interaction. The vessel hydrodynamics are incorporated with a full six degree-of-freedom model. Vessel models used for this study were provided by MITAGS and Wärtsilä. This containership vessel model was validated by MITAGS.

The scene used for this study is based on the scene that was previously used for the 2017 Navigation Simulations (M&N, 2017) performed at Cal Maritime. M&N customized a version of this scene to include the proposed containership facility, associated turning basin, and the proposed channel modifications.

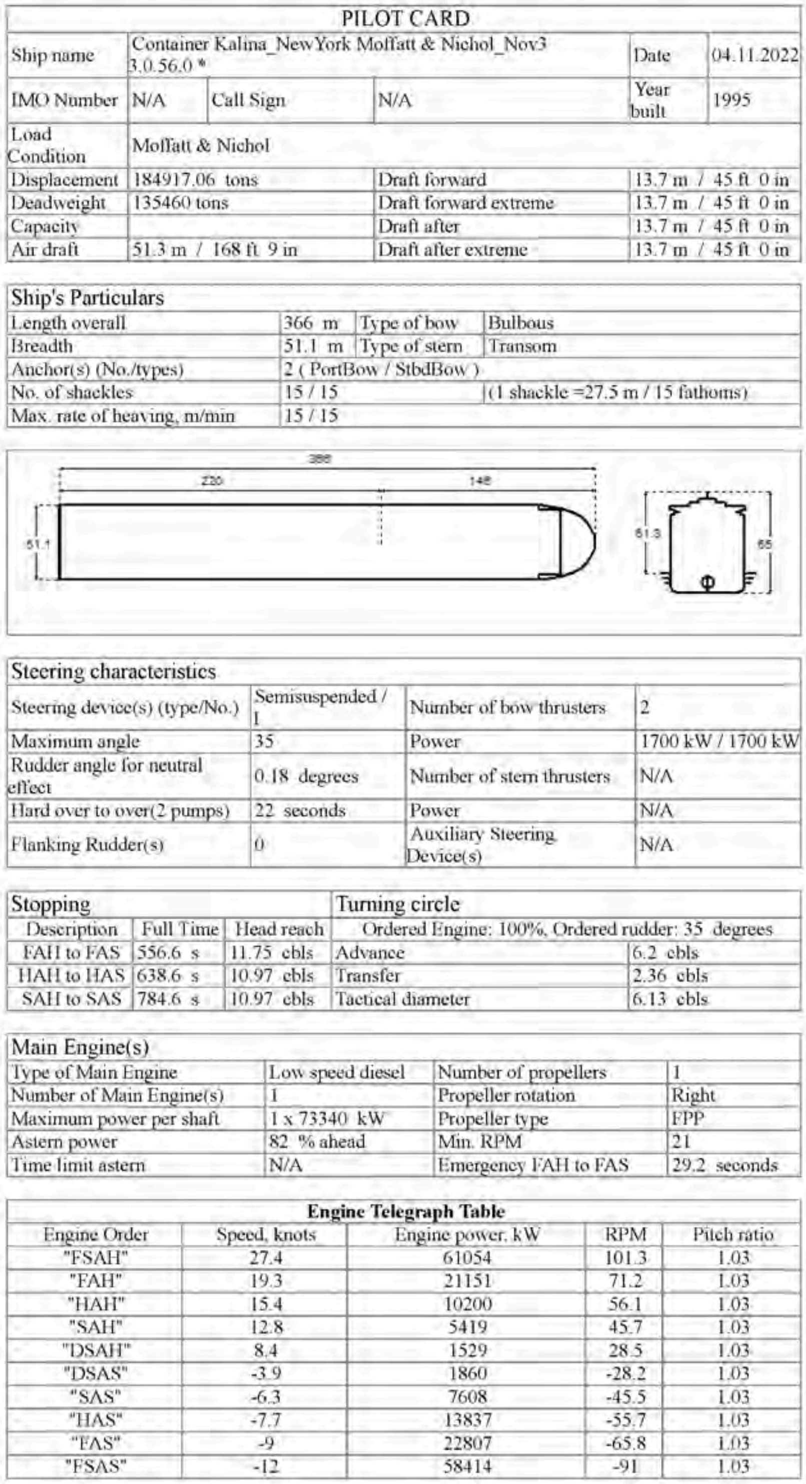
Figure A-1: Moffatt & Nichol Simulator

A.3 PROPOSED DESIGN VESSEL

For this screening study a single deep draft design vessel was identified as a Post-Panamax Generation Three containership. The model for simulation was based on previously developed MITAGS vessel models, with vessel draft adjusted to suit the channel depth. The particulars of this design vessel model is summarized in Table A-1. This vessel model was validated by MITAGS prior to the Phase 2 simulation study. The pilot card for this vessel is shown in Figure A-2.

Table A-1: Vessel Models Particulars

Attribute		Proposed Channel Containership Vessel Model
Vessel Model		Container Kalina
Class/Capacity		Post Panamax Generation 3/ 13,000 TEU
LOA	ft	1200.8
	m	366.0
Beam	ft	167.7
	m	51.1
Operating Draft	ft	45.0
	m	13.7



PILOT CARD

Ship name	Container Kalina_NewYork Moffatt & Nichol_Nov3 3.0.56.0 *			Date	04.11.2022
IMO Number	N/A	Call Sign	N/A	Year built	1995
Load Condition	Moffatt & Nichol				
Displacement	184917.06 tons		Draft forward	13.7 m / 45 ft 0 in	
Deadweight	135460 tons		Draft forward extreme	13.7 m / 45 ft 0 in	
Capacity			Draft after	13.7 m / 45 ft 0 in	
Air draft	51.3 m / 168 ft 9 in		Draft after extreme	13.7 m / 45 ft 0 in	

Ship's Particulars

Length overall	366 m	Type of bow	Bulbous
Breadth	51.1 m	Type of stern	Transom
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	15 / 15	(1 shackle =27.5 m / 15 fathoms)	
Max. rate of heaving, m/min	15 / 15		

Steering characteristics

Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	2
Maximum angle	35	Power	1700 kW / 1700 kW
Rudder angle for neutral effect	0.18 degrees	Number of stern thrusters	N/A
Hard over to over(2 pumps)	22 seconds	Power	N/A
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping			Turning circle	
Description	Full Time	Head reach	Ordered Engine: 100%, Ordered rudder: 35 degrees	
FAH to FAS	556.6 s	11.75 cbls	Advance	6.2 cbls
HAH to HAS	638.6 s	10.97 cbls	Transfer	2.36 cbls
SAH to SAS	784.6 s	10.97 cbls	Tactical diameter	6.13 cbls

Main Engine(s)

Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 73340 kW	Propeller type	FPP
Astern power	82 % ahead	Min. RPM	21
Time limit astern	N/A	Emergency FAH to FAS	29.2 seconds

Engine Telegraph Table

Engine Order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"FSAH"	27.4	61054	101.3	1.03
"FAH"	19.3	21151	71.2	1.03
"HAH"	15.4	10200	56.1	1.03
"SAH"	12.8	5419	45.7	1.03
"DSAH"	8.4	1529	28.5	1.03
"DSAS"	-3.9	1860	-28.2	1.03
"SAS"	-6.3	7608	-45.5	1.03
"HAS"	-7.7	13837	-55.7	1.03
"FAS"	-9	22807	-65.8	1.03
"FSAS"	-12	58414	-91	1.03

Figure A-2: Design Vessel Model Pilot Card

A.4 PROPOSED NAVIGATION CHANNEL

For this screening simulation study a modified channel, henceforth 2023 Initial Concept Channel (2023 IC), of the proposed navigation channel was simulated. This channel used the 2017 proposed alteration channel as the baseline with changes based on the Coos Bay Pilot feedback and the findings of Phase One and Two navigation simulations. The 2023 IC Channel is shown in Figure A-3. Two modifications were made to the 2017 PA Channel for the 2023 IC Channel:

- *Entrance Turn and Coos Bay Inside Range* (Figure 2-3): the channel from RM 1.3 to RM 2.8 on the red side of the channel was widened as shown. From the 2017 PA channel AtoN locations Buoy R”6A”, R”8”, R”8A”, and R”10” had to be relocated for the 2023 IC channel to the locations shown in Figure A-3.

- *Bend Widener at RM 4.0* (Figure 2-4): a bend widener was included to the 2023 IC channel to add an additional 50 ft on the green side in the turn from Coos Bay Range to Empire Range. From the 2017 PA channel AtoN locations Buoy G”11A” and G”13” were relocated to the locations shown in Figure A-3.

Figure A-3: 2023 Initial Concept Channel Layout

A.5 TUG ASSISTANCE

Escort tugs were available during each simulation and used at the discretion of the pilot. Tugs were controlled in the simulator by the simulator operator and tug navigation will be completed by the software autopilot. Even in the auto-controlled mode the tugs are active six-degrees-of-freedom vessels in the simulation and could run aground or collide with other vessels.

Based on the previous simulation efforts performed in 2022 and 2023 for Coos Bay and based on discussions with the pilots, there are two 80 metric ton ASD tugs available as assist tugs. The Wärtsilä tug model used to simulate these tugs is summarized in Table A-2. The testing matrix presented in Table A-3 lists the tugs used for each simulation.

Table A-2: Wärtsilä Tug Models Particulars

Wärtsilä Tug Model		**ASD Tug 15**
Tug Type		ASD
LOA	ft	105.0
	m	32.0
Beam	ft	38.1
	m	11.6
Draft	ft	19.0
	m	5.8
Bollard Pull	mt	80

A.6 ENVIRONMENTAL CONDITIONS

Environmental conditions considered in the simulations were tides, currents, waves, and winds. All environmental conditions used for this screening simulation are based on the conditions previously evaluated during the navigation simulations in 2016, 2017, 2022, and 2023. The exact conditions tested are list in the simulation matrix, Table A-3.

A.7 TESTING MATRIX

Table A-3 shows the matrix of completed simulations. In total, 13 simulations were conducted to evaluate the 2023 initial concept channel for the Post-Panamax Generation Three containerships. These simulations can be classified in the following groups:

- Pilot Familiarization (Simulation 1 & 2)
- Inbound Flood Currents (Simulation 3, 4, 6, 7, & 13)
- Inbound Ebb Currents (Simulation 9, 10, 11, & 12)
- Outbound (Simulation 5 & 8)

The pilot chose the starting vessel speed for each simulation to align with his approach to the maneuver, the starting channel location and transit direction for the maneuver. The pilot familiarization runs will not be included in the analysis.

Table A-3: Simulation Matrix.

Run ID	Channel	Own Ship (1)	Moored Vessel	Direction	Turn Performed	Turning Basin Used	Tug Power (mt)	Wind (4) Offshore/Upstream	Waves	Tide Level(6) (ft/m)	Tide Stage	Start	End	Pilot	Run Result
1	2023 IC	PPX3	PPX3, CFN	Inbound	No	--	80 / 80 / 80	25kt NNW (337.5°) / 25kt NNW (337.5°)	Moderate NW	5.0/1.5	Flood Tide (01:20)	RM -2	Entrance Turn	T. Petrusha	🔴
2	2023 IC	PPX3	PPX3, CFN	Inbound	No	--	80 / 80 / 80	25kt NNW (337.5°) / 25kt NNW (337.5°)	Moderate NW	5.0/1.5	Flood Tide (01:20)	RM -2	Entrance Turn	T. Petrusha	🔴
3	2023 IC	PPX3	PPX3, CFN	Inbound	Yes	CF Turning Basin	80 / 80 / 80	25kt NNW (337.5°) / 25kt NNW (337.5°)	Moderate NW	5.0/1.5	Flood Tide (01:20)	RM -2	CF Turning Basin	T. Petrusha	🔴
4	2023 IC	PPX3	PPX3, CFN	Inbound	Yes	CF Turning Basin	80 / 80 / 80	25kt NNW (337.5°) / 25kt NNW (337.5°)	--	5.0/1.5	Flood Tide (02:20)	R”10A”	CFS	T. Petrusha	🟡
5	2023 IC	PPX3	PPX3, CFN	Outbound	Yes	CF Turning Basin	80 / 80 / 80	30kt SSW (222.5°) / 20kt SSW (222.5°)	Swell W	5.0/1.5	2 Hours Before High Water (05:20)	CFS	RM -1	T. Petrusha	🟢
6	2023 IC	PPX3	PPX3, CFN	Inbound	Yes	CF Turning Basin	80 / 80 / 80	30kt SSW (222.5°) / 20kt SSW (222.5°)	Swell W	5.0/1.5	Flood Tide (01:20)	RM -2	CFS	T. Petrusha	🟢
7	2023 IC	PPX3	PPX3, CFN	Inbound	Yes	CF Turning Basin	80 / 80 / 80	25kt NNE (22.5°) / 25kt NNE (22.5°)	Swell NW	5.0/1.5	Flood Tide (01:20)	RM -2	CFS	T. Petrusha	🟢
8	2023 IC	PPX3	PPX3, CFN	Outbound	Yes	CF Turning Basin	80 / 80 / 80	25kt NNW (337.5°)/25kt NNW (337.5°)	Moderate NW	5.0/1.5	2 Hours Before High Water (05:20)	CFS	RM 0	T. Petrusha	🟢
9	2023 IC	PPX3	PPX3, CFN	Inbound	No	--	80 / 80 / 80	25kt NNW (337.5°) / 25kt NNW (337.5°)	Moderate NW	5.0/1.5	High Water into Ebb (06:30)	RM -2	CF Turning Basin	T. Petrusha	🟢
10	2023 IC	PPX3	PPX3, CFN	Inbound	Yes	CF Turning Basin	80 / 80 / 80	25kt NNW (337.5°) / 25kt NNW (337.5°)	--	5.0/1.5	High Water into Ebb (07:15)	R”10A”	CFS	T. Petrusha	🔴
11	2023 IC	PPX3	PPX3, CFN	Inbound	Yes	CF Turning Basin	80 / 80 / 80	25kt NNW (337.5°) / 25kt NNW (337.5°)	--	5.0/1.5	High Water into Ebb (07:15)	R”10A”	CFS	T. Petrusha	🔴
12	2023 IC	PPX3	PPX3, CFN	Inbound	Yes	CF Turning Basin	80 / 80 / 80	25kt NNW (337.5°) / 25kt NNW (337.5°)	--	5.0/1.5	High Water into Ebb (07:15)	R”10A”	CFS	T. Petrusha	🔴
13	2023 IC	PPX3	PPX3, CFN	Inbound	No	--	80 / 80 / 80	25kt NNW (337.5°) / 25kt NNW (337.5°)	Moderate NW	5.0/1.5	Flood Tide (01:20)	RM -2	CF Turning Basin	T. Petrusha	🟡

Notes:

1. 2023 IC = 2023 Initial Concept, PPX3 = Post Panamax Generation 3 Containership, CFN = Container Facility North Berth, CFS = Container Facility South Berth
2. PPX3 = Kalina (1201 ft x 168 ft)
3. Winds are direction from, where 0 degrees is North.
4. Level of tide will not vary in runs. It will be modeled as the minimum required underkeel clearance.

🟢 Success. Run was well controlled with adequate clearance to channel edges and reserve of rudder and tugs.

🟡 Marginal Success. The run was completed without casualty to the vessel or tugs; however, the vessel may of have touched or exceeded channel or turning basin boundaries, came close to contact with an object, or used excessive rudder or tugs, depleting the maneuvering reserve.

🔴 Unsuccessful. Run was stopped or aborted due to exceeding allowable under keel clearance, grounding, loss of control, allision with object or shoals, or collision with another vessel; or vessel exceeded channel boundaries unintentionally.

A.8 RESULTS & ANALAYSIS

Vessel swept paths were developed for each simulation to illustrate clearance of the vessel to the channel limits, moored vessels, and turning basin dredge limits. The vessel profiles are shown at two-minute intervals. These figures are included in the subsections below. In addition, vessel and tug parameter time series were created to illustrate the vessel's speed over ground (SOG), rudder angle, engine revolutions per minute (RPM), rate of turn (ROT), bow thruster power, and tug power.

Pilot feedback was recorded on pilot evaluation forms (included at the end of this appendix), along with notes and observations made by the engineers supervising the effort. For each simulation, the pilot was asked to rate the maneuver in three categories: Run Safety, Tug Adequacy, and Run Difficulty. Table A-4 list these ratings for each run and are discussed in greater detail in the subsections below. Rating scales are as follows:

- Run Safety: 1 to 5 with "5" highest safety and "3" average safety;
- Tug Adequacy: 1 to 5 with "5" best and "3" average; and
- Difficulty: 1 to 5 with "5" most difficult and "3" average.

Table A-4: Panamax Containership Pilot Ratings for Safety, Difficulty, & Tug Adequacy

Simulation Number	Pilot	Run Safety	Tug Adequacy	Run Difficulty	Run Result
Inbound Maneuver Flood Currents					
3	T. Petrusha	4	5	5	🟡
4	T. Petrusha	4	5	5	🟢
6	T. Petrusha	4	5	3	🟢
7	T. Petrusha	4	5	4	🟢
13	T. Petrusha	3	5	5	🟢
Average	--	3.8	5.0	4.4	--
Inbound Maneuver Ebb Currents					
9	T. Petrusha	4	5	2	🟢
10	T. Petrusha	--	--	--	🟡
11	T. Petrusha	--	--	--	🟡
12	T. Petrusha	--	--	--	🟡
Average	--	4.0	5.0	2.0	--
Outbound Maneuver					
5	T. Petrusha	4	5	3	🟢
8	T. Petrusha	4	5	2	🟢
Average	--	4.0	5.0	2.5	--

A.8.1 PPX3 INBOUND FLOOD CURRENTS (SIMULATION 3, 4, 6, 7, & 13)

In total five simulations were performed with the PPX3 containership in 2023 Initial Concept Channel with flood currents. These simulations evaluated the same tidal condition that was evaluated in Phase 1 and 2 for the inbound transits. The swept path figures for these simulations are shown in Figure A-4 to Figure A-8. The time series figures for these simulations are shown in Figure A-9 to Figure A-13.

Overall, these simulations were rated as above average safety and the highest tug adequacy rating. The average run difficulty was rated as above average difficulty. The one area of common issue throughout these simulations was on the red side of the channel at buoy R”14”. The pilot thought that these simulations were feasible but difficult. With familiarity and practice the pilot would perform a similar transit in a real-world situation.

A.8.2 PPX3 INBOUND EBB CURRENTS (SIMULATION 9, 10, 11, & 12)

In total four simulations were performed to evaluate the PPX3 containership inbound in the 2023 IC channel with ebb currents. This change in approach came at the request of the pilot to allow the vessel to stem the tide in the entrance turn. The swept path figures for these simulations are shown in Figure A-14 to Figure A-17. The time series figures for these simulations are shown in Figure A-18 to Figure A-21.

Overall, these simulations were rated as above average safety and the highest tug adequacy rating. The average run difficulty was rated as below average difficulty. This was an improvement from the inbound flood current simulations. The pilot stated that the channel transit with the ebb currents was easier than the flood current transits. However, the turning basin maneuver with the ebb currents was a challenge and each turning evolution with the ebb tidal currents ended with a grounding. Therefore, the recommendation would be to transit the channel during the ebb currents and berth port-side to on the inbound to avoid the turning maneuver during a fully developed ebb current. As a result, the vessel would be turned on the outbound when the departure time and currents in the turning basin can be controlled.

A.8.3 PPX3 OUTBOUND (SIMULATION 5 & 8)

In total two simulations were performed to evaluate the PPX3 containership outbound transit in the 2023 IC channel. These simulations evaluated the same tidal condition that was evaluated in Phase 1 and 2 for the outbound transits. The swept path figures for these simulations are shown in Figure A-22 and Figure A-23. The time series figures for these simulations are shown in Figure A-24 to Figure A-25.

Overall, these simulations were rated as above average safety and the highest tug adequacy rating. The average run difficulty was rated as below average difficulty. Both of these outbound simulations were successful with no issues noted. Captain Petrusha would perform this scenario in a real-world scenario.

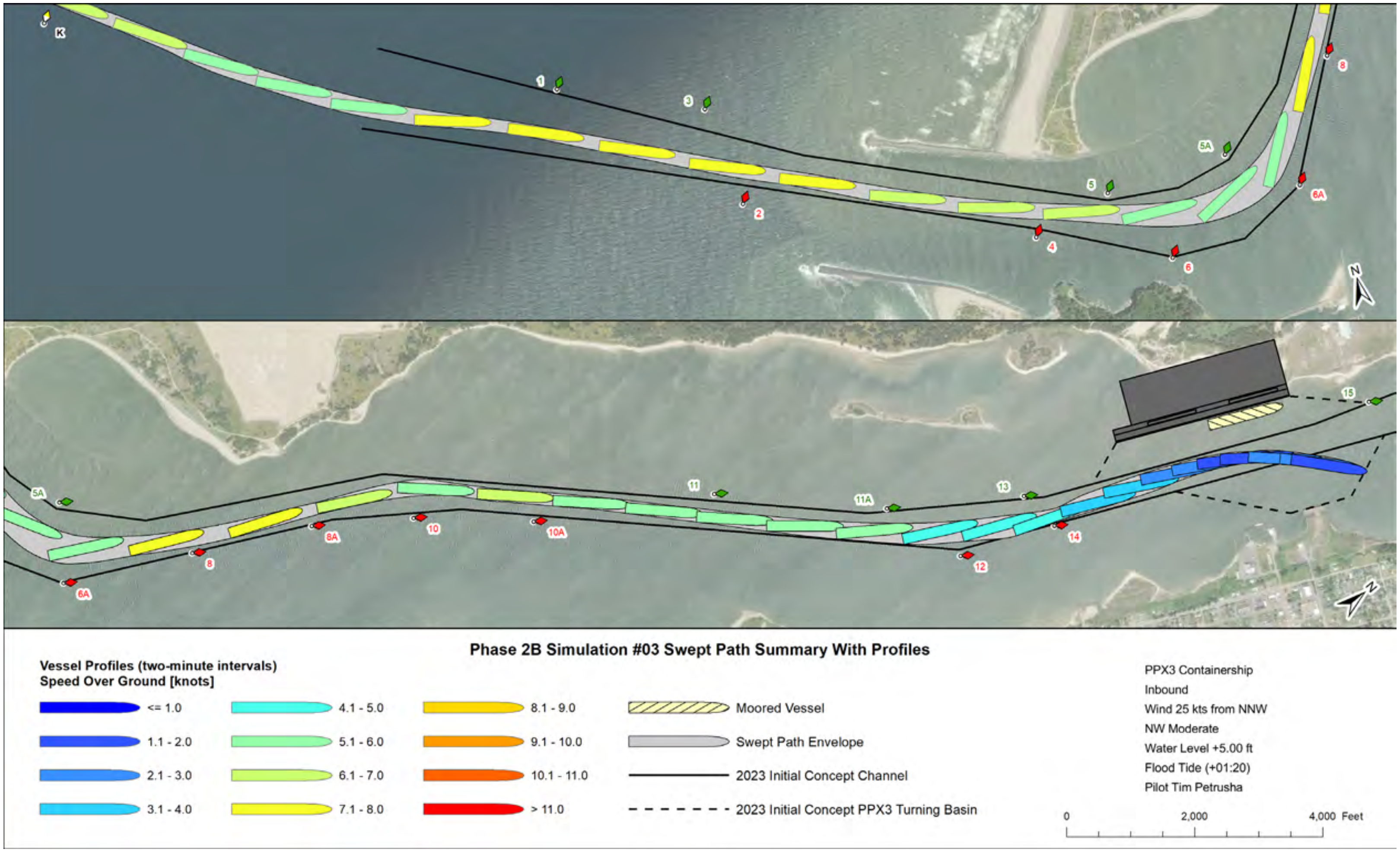


Figure A-4: Simulation 3 Swept Path Summary with Profiles

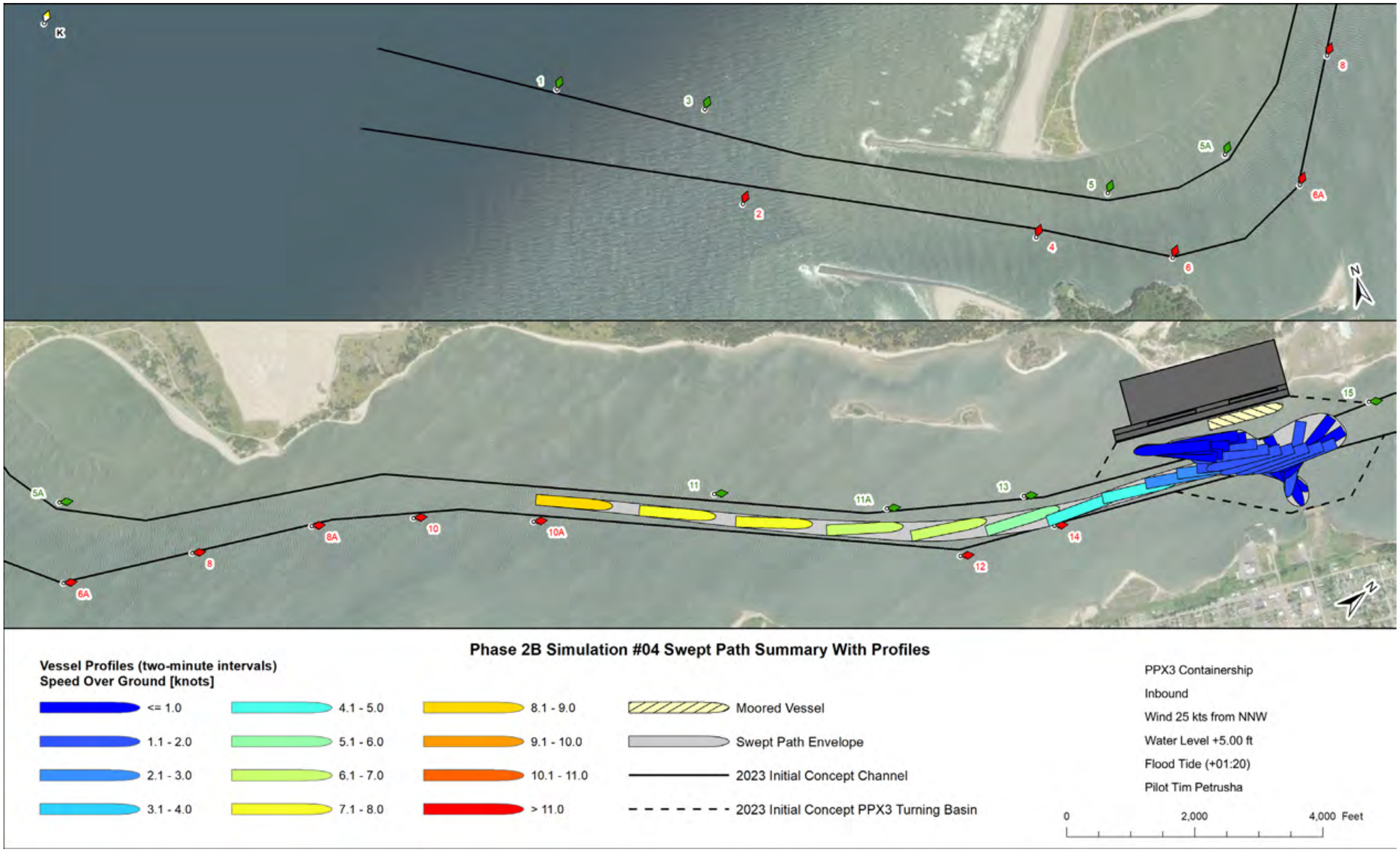


Figure A-5: Simulation 4 Swept Path Summary with Profiles

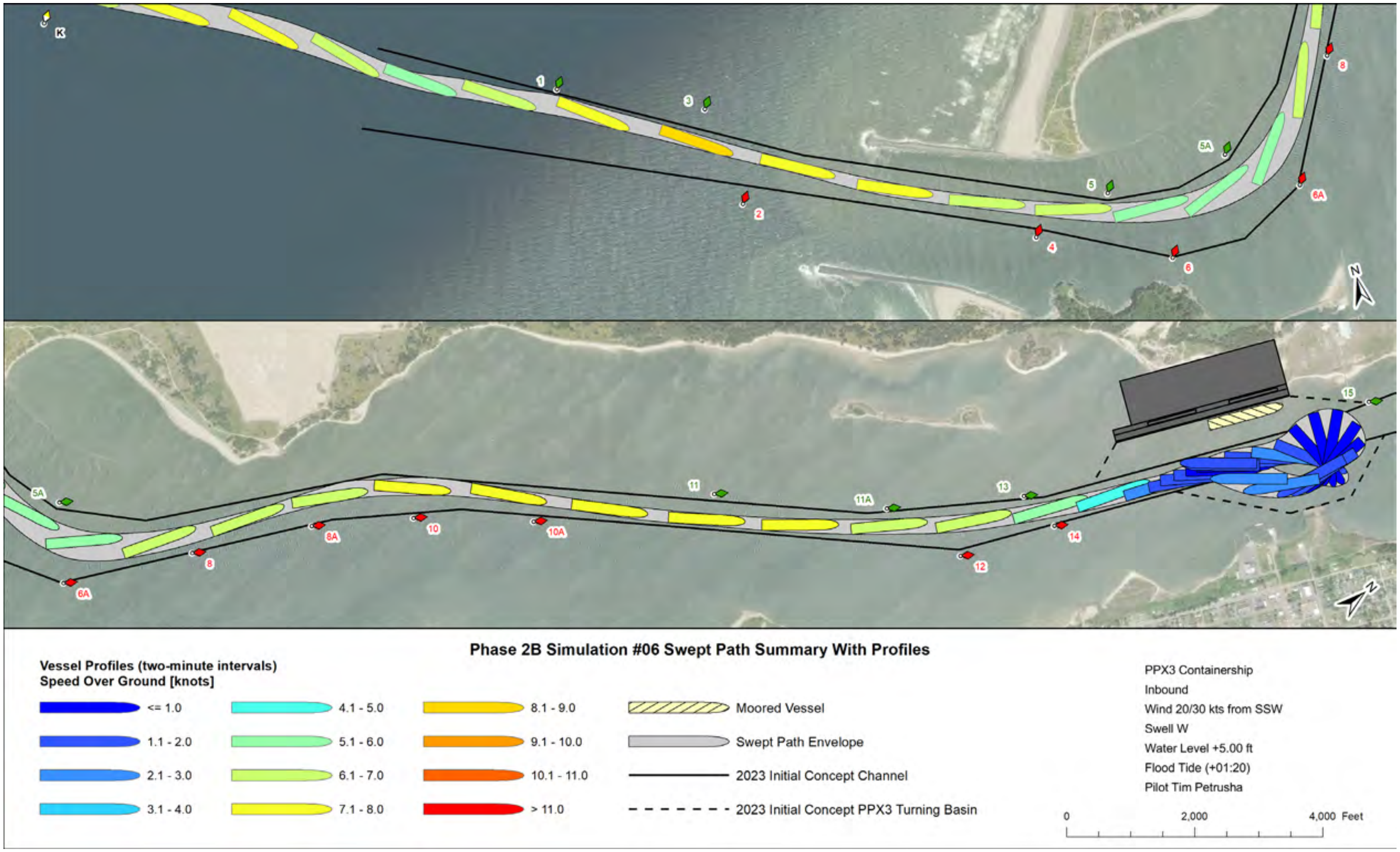


Figure A-6: Simulation 6 Swept Path Summary with Profiles

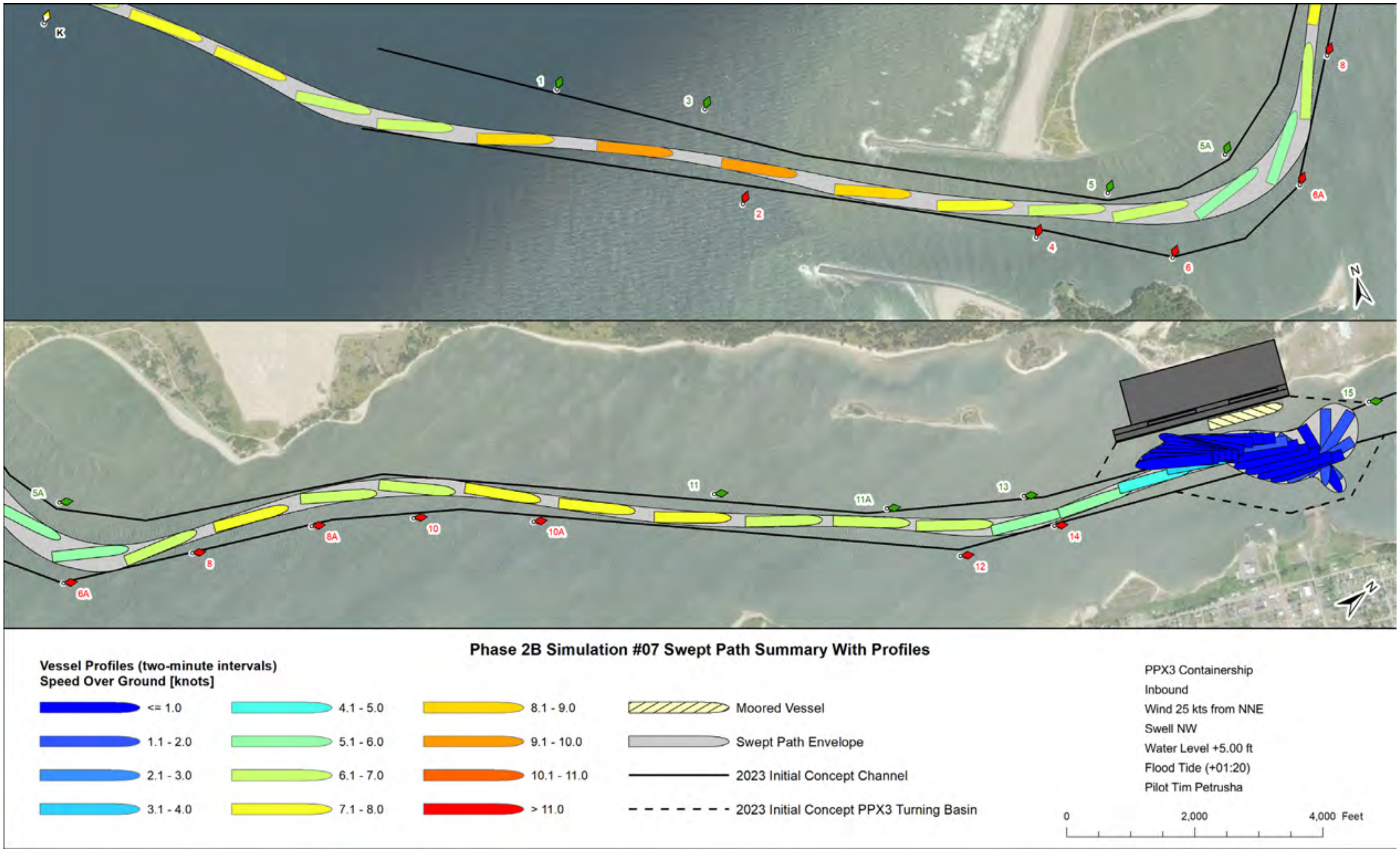


Figure A-7: Simulation 7 Swept Path Summary with Profiles

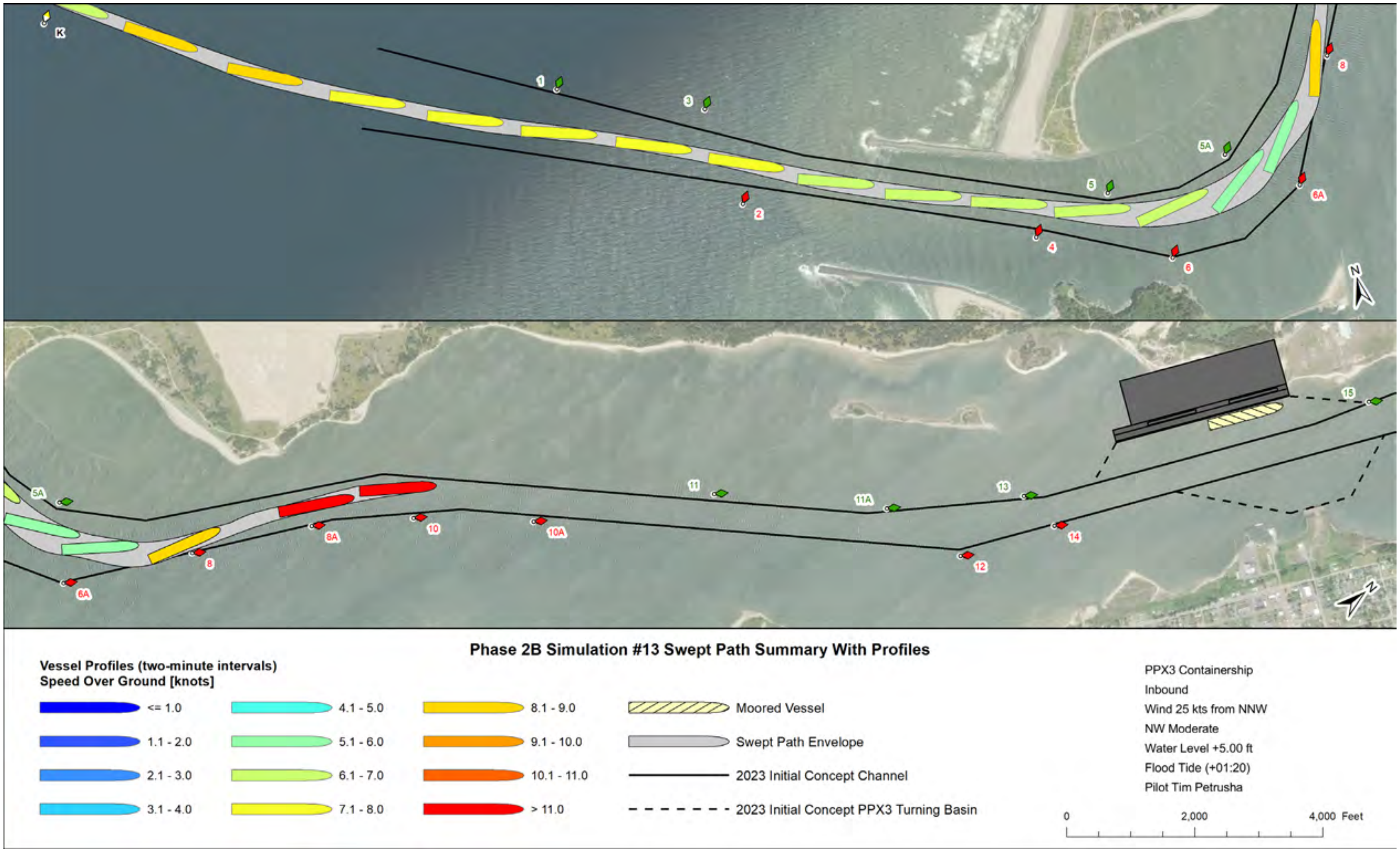


Figure A-8: Simulation 13 Swept Path Summary with Profiles

Figure A-9: Simulation 3 Vessel and Tug Parameter Time

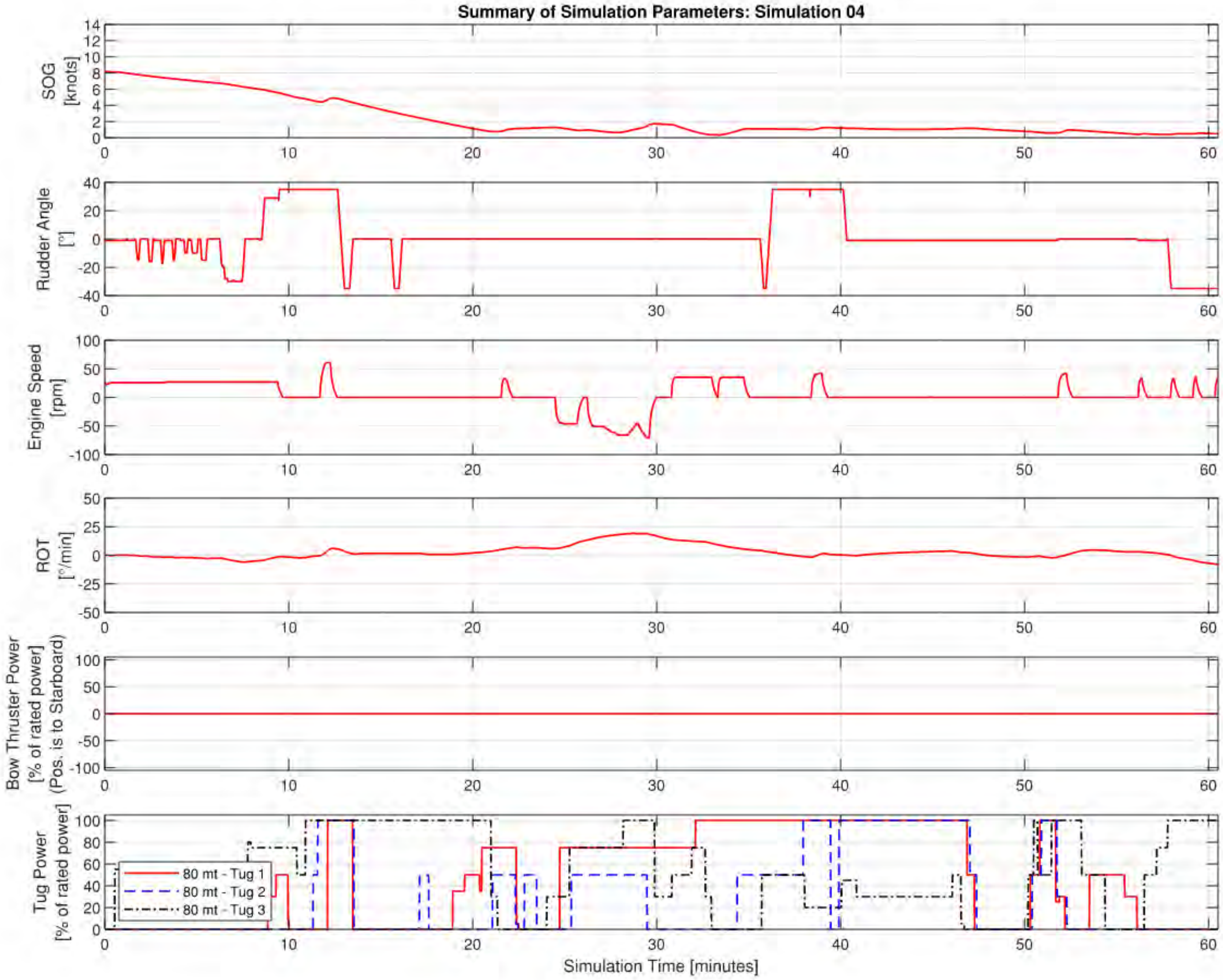


Figure A-10: Simulation 4 Vessel and Tug Parameter Time

Figure A-11: Simulation 6 Vessel and Tug Parameter Time

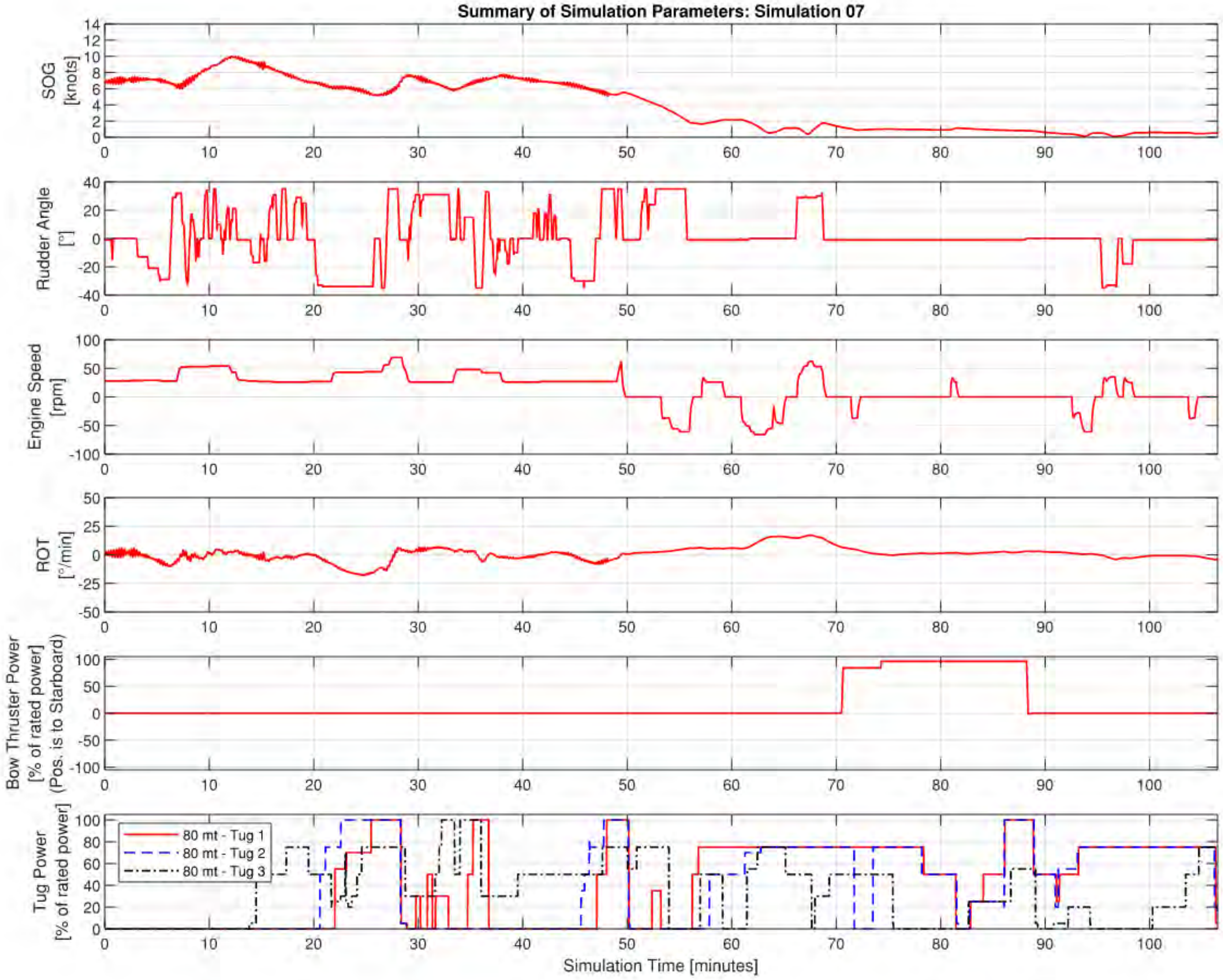


Figure A-12: Simulation 7 Vessel and Tug Parameter Time

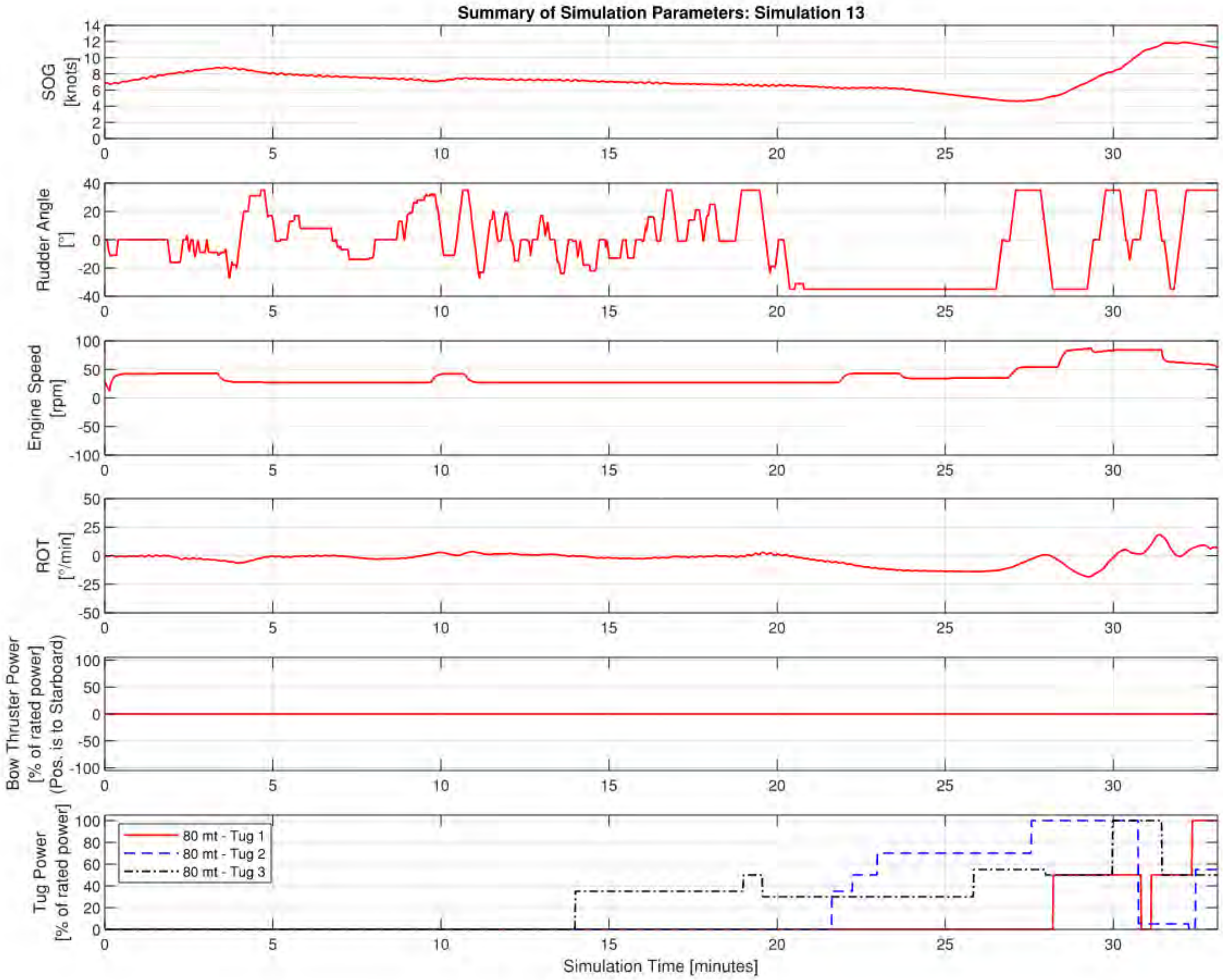


Figure A-13: Simulation 13 Vessel and Tug Parameter Time

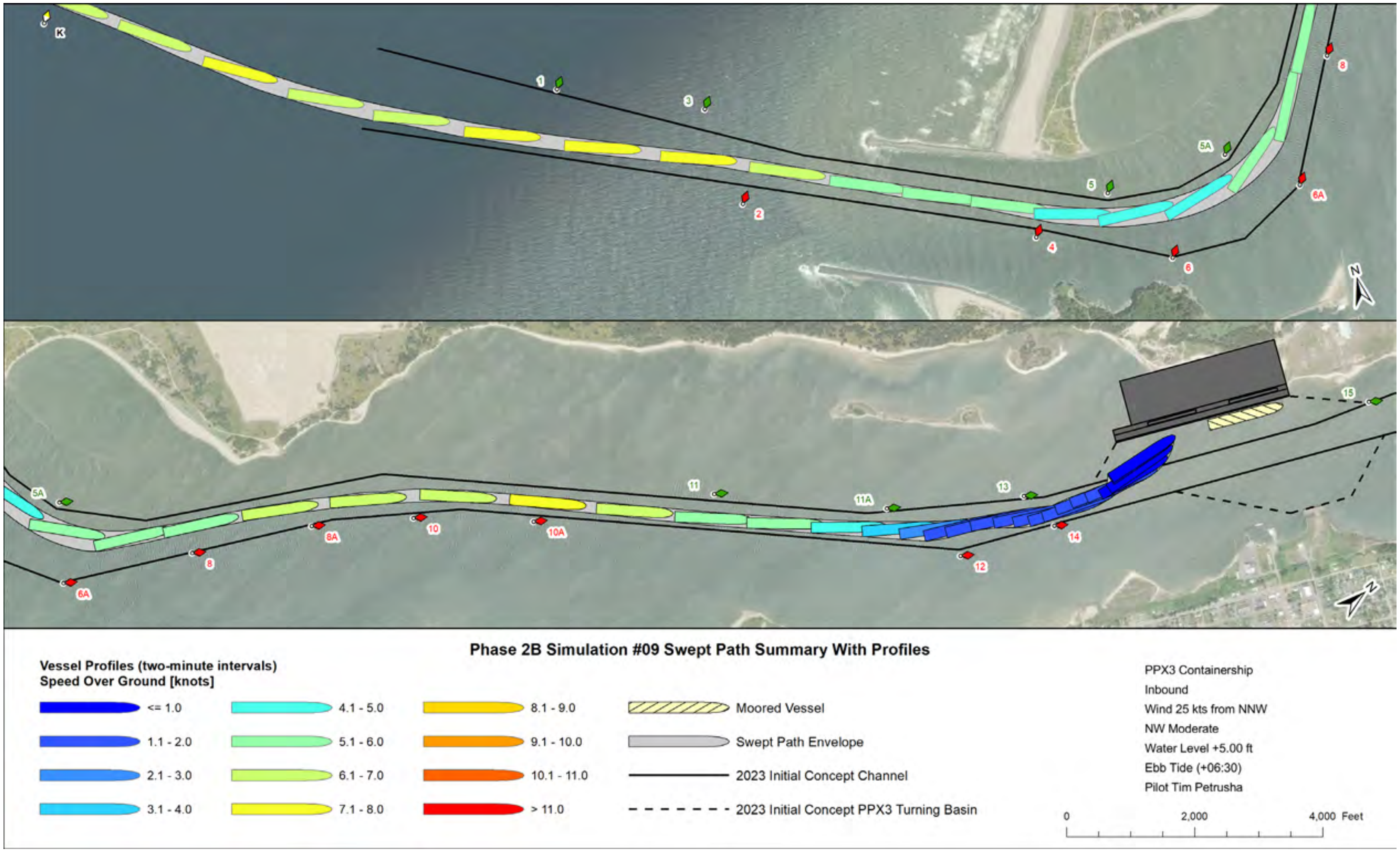


Figure A-14: Simulation 9 Swept Path Summary with Profiles

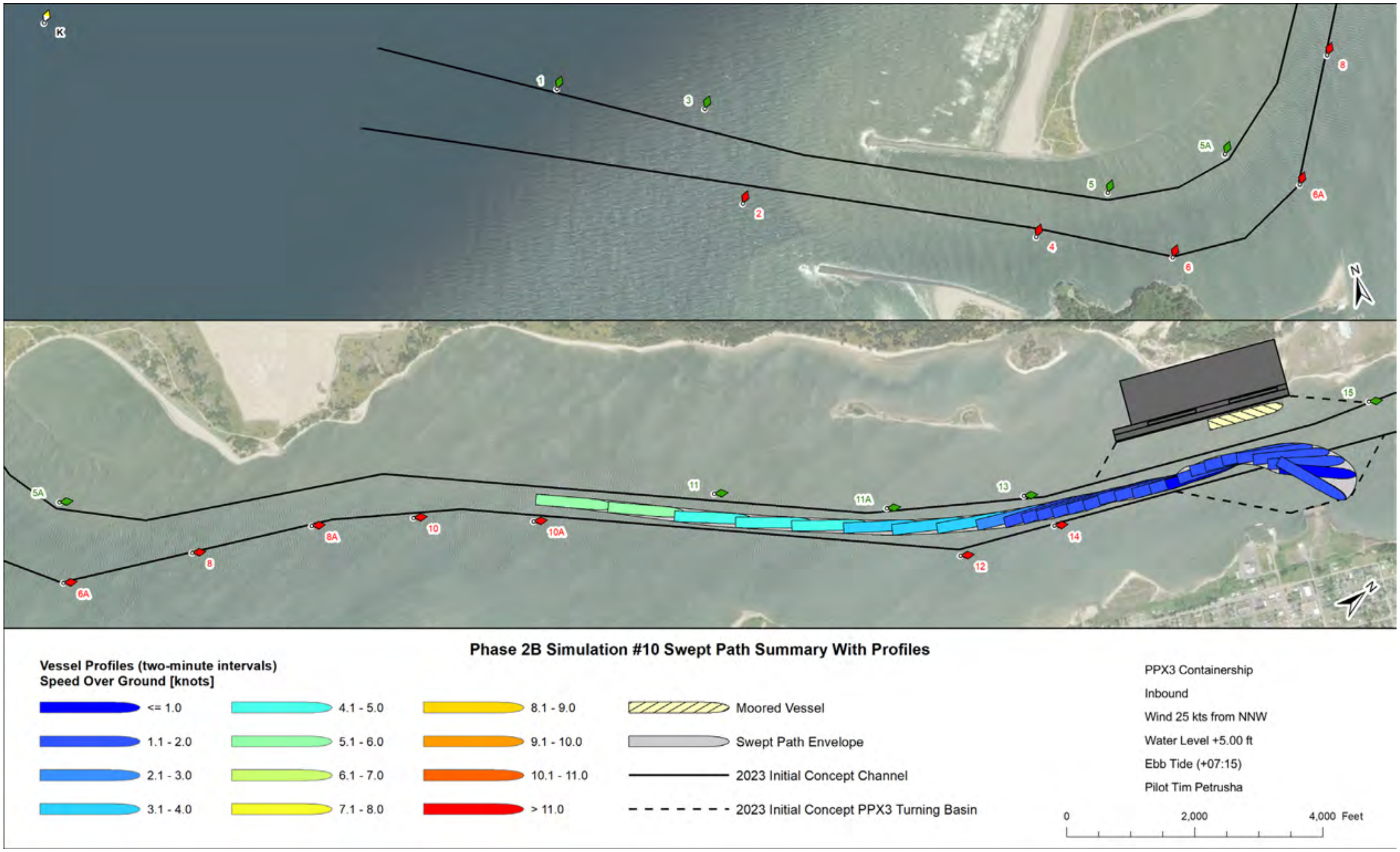


Figure A-15: Simulation 10 Swept Path Summary with Profiles

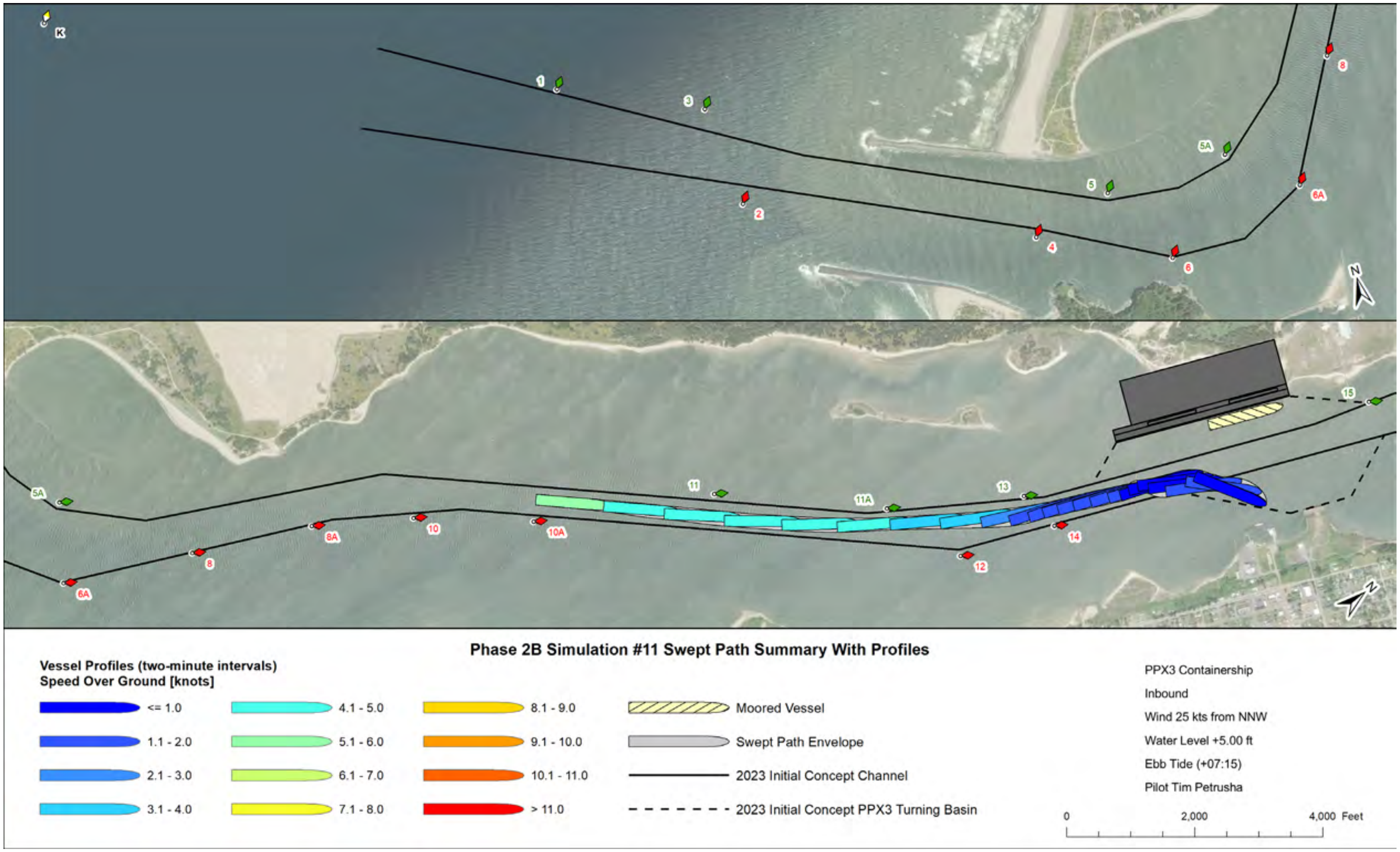


Figure A-16: Simulation 11 Swept Path Summary with Profiles

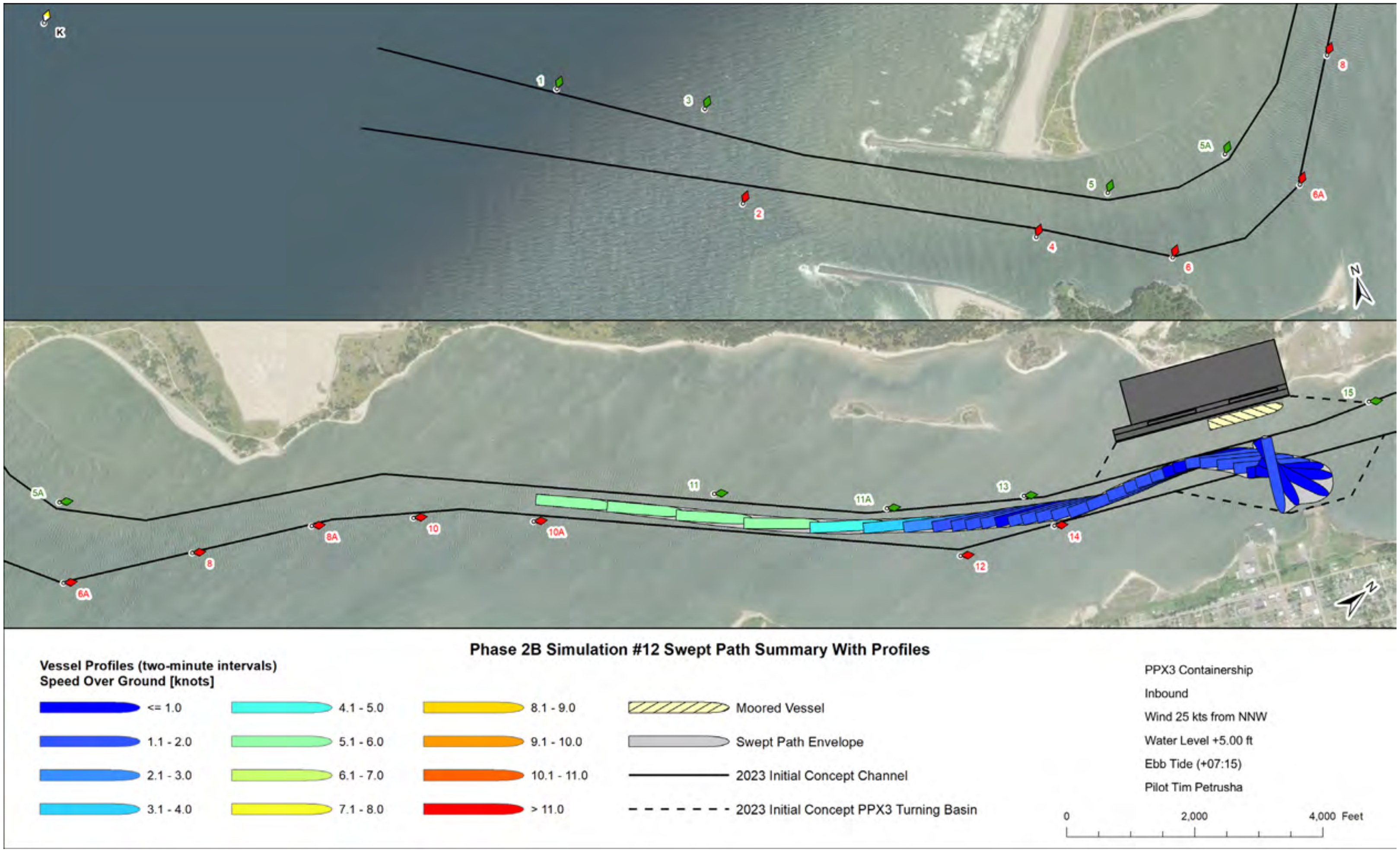


Figure A-17: Simulation 12 Swept Path Summary with Profiles

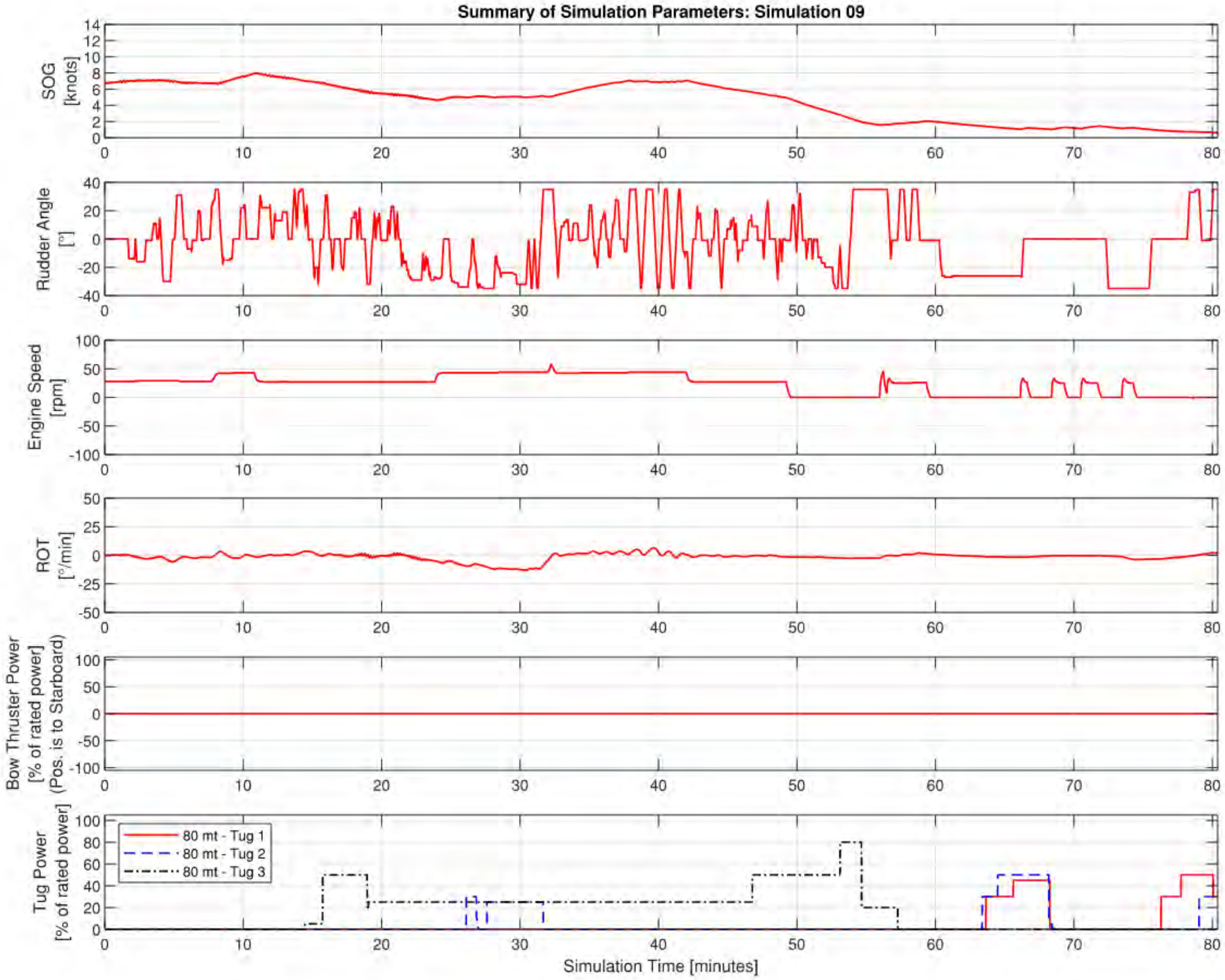


Figure A-18: Simulation 9 Vessel and Tug Parameter Time

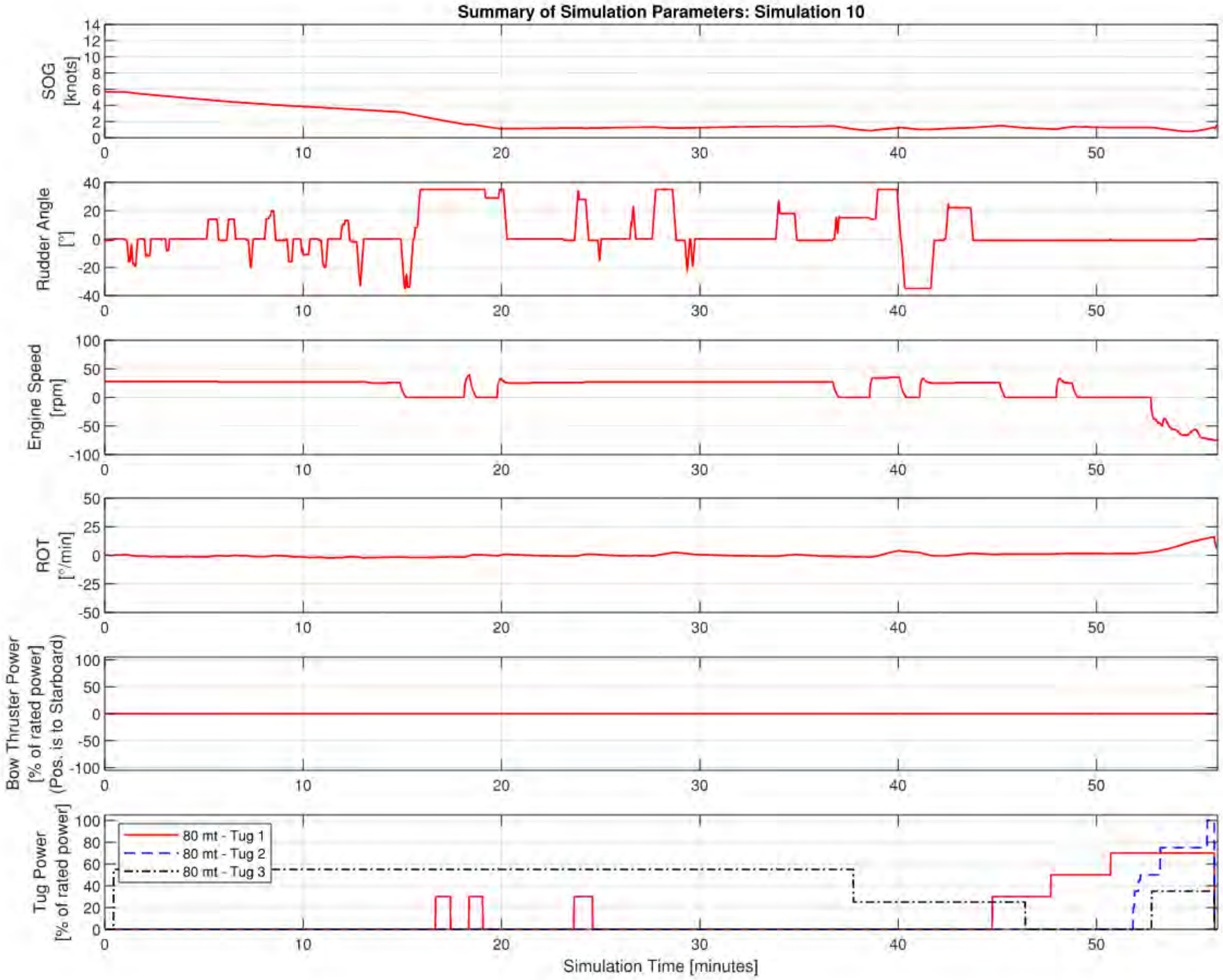


Figure A-19: Simulation 10 Vessel and Tug Parameter Time

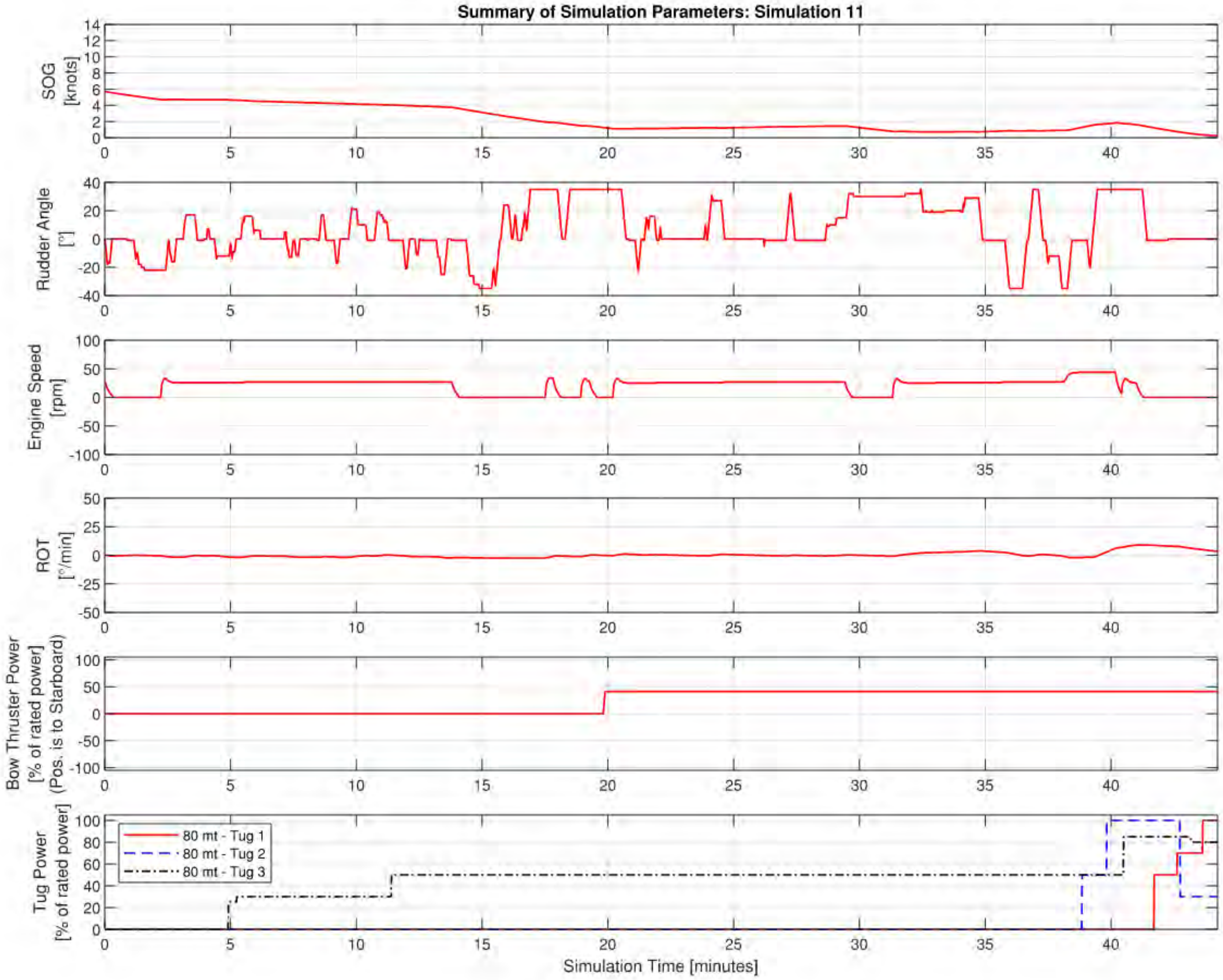


Figure A-20: Simulation 11 Vessel and Tug Parameter Time

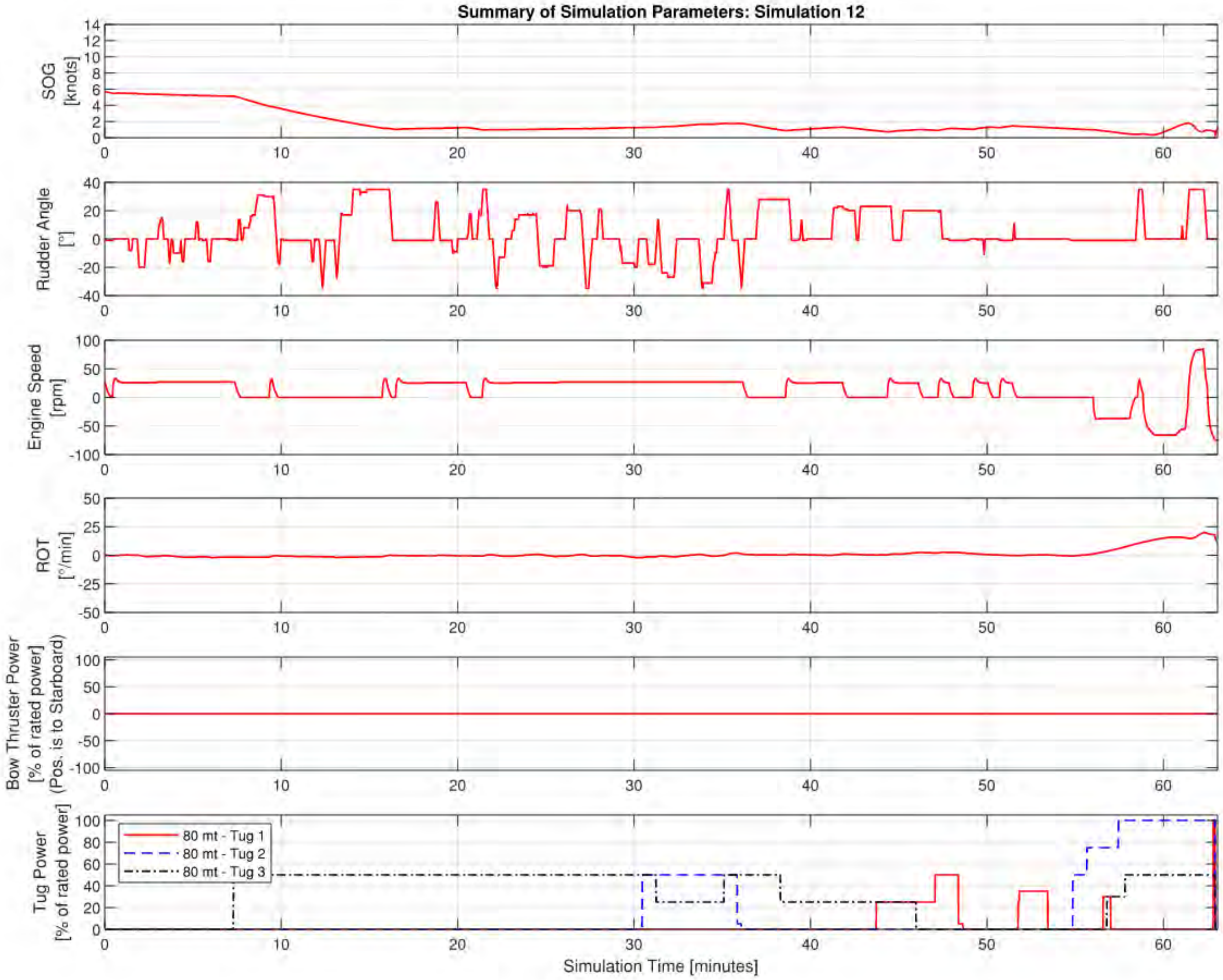


Figure A-21: Simulation 12 Vessel and Tug Parameter Time

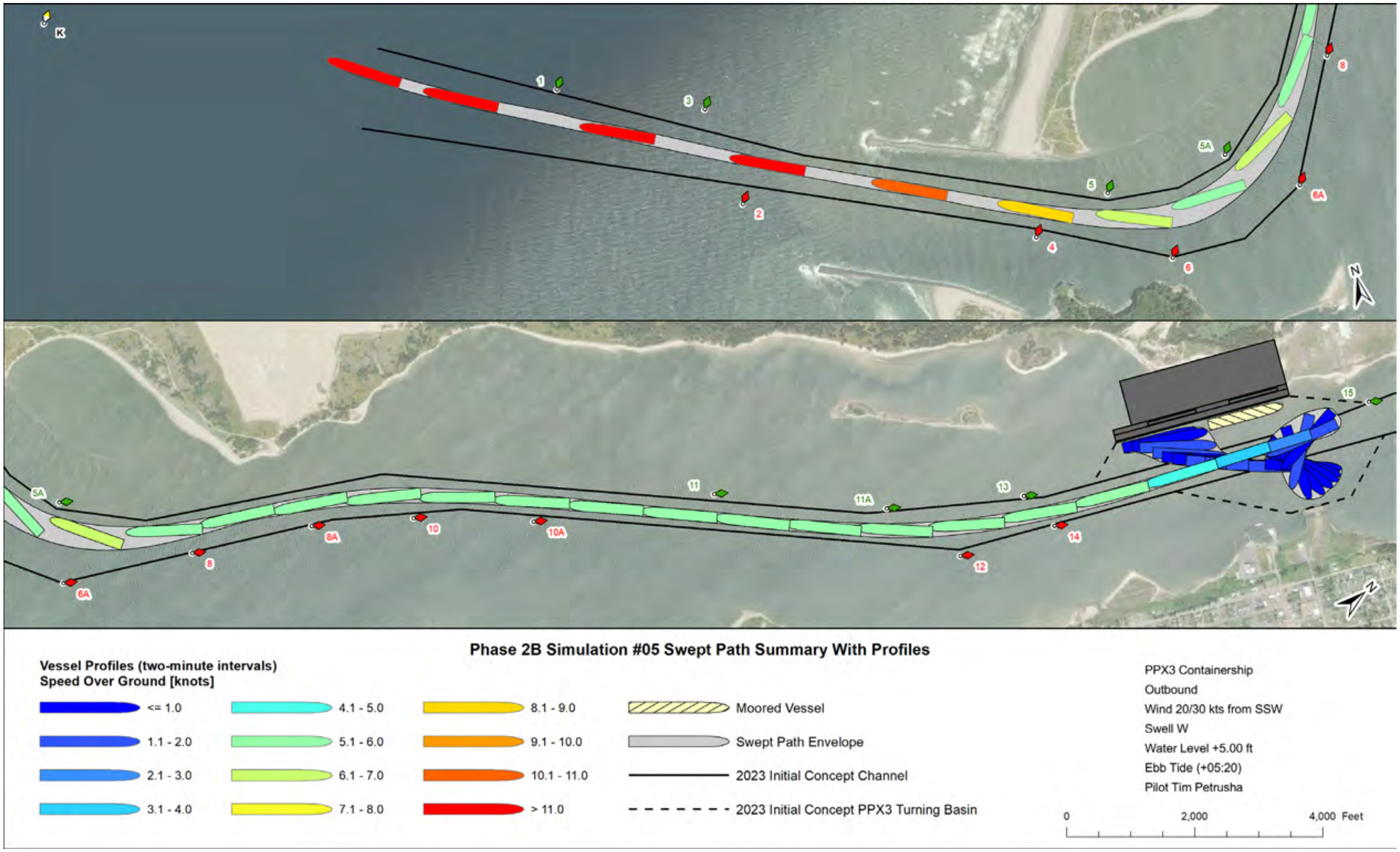


Figure A-22: Simulation 5 Swept Path Summary with Profiles

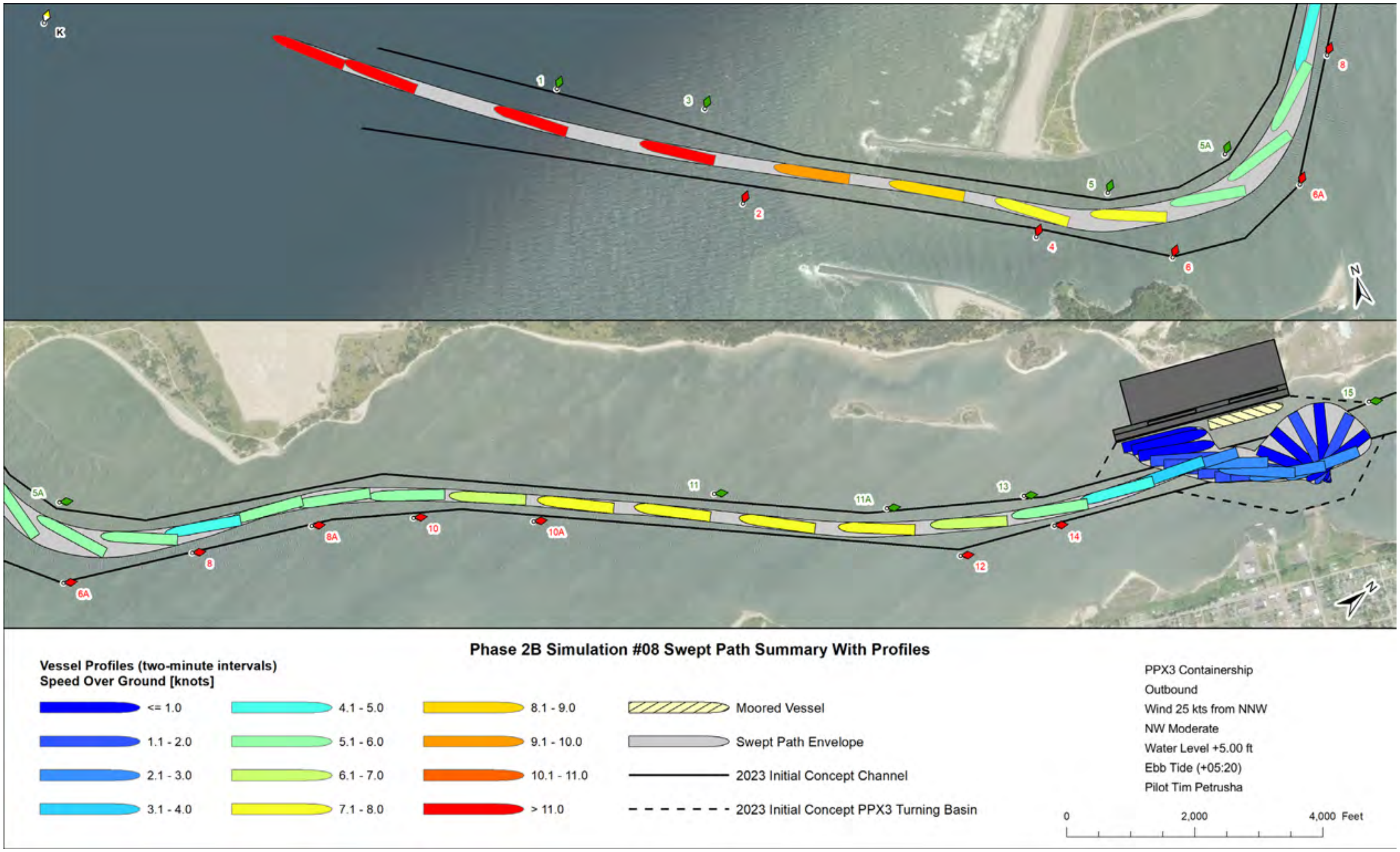


Figure A-23: Simulation 8 Swept Path Summary with Profiles

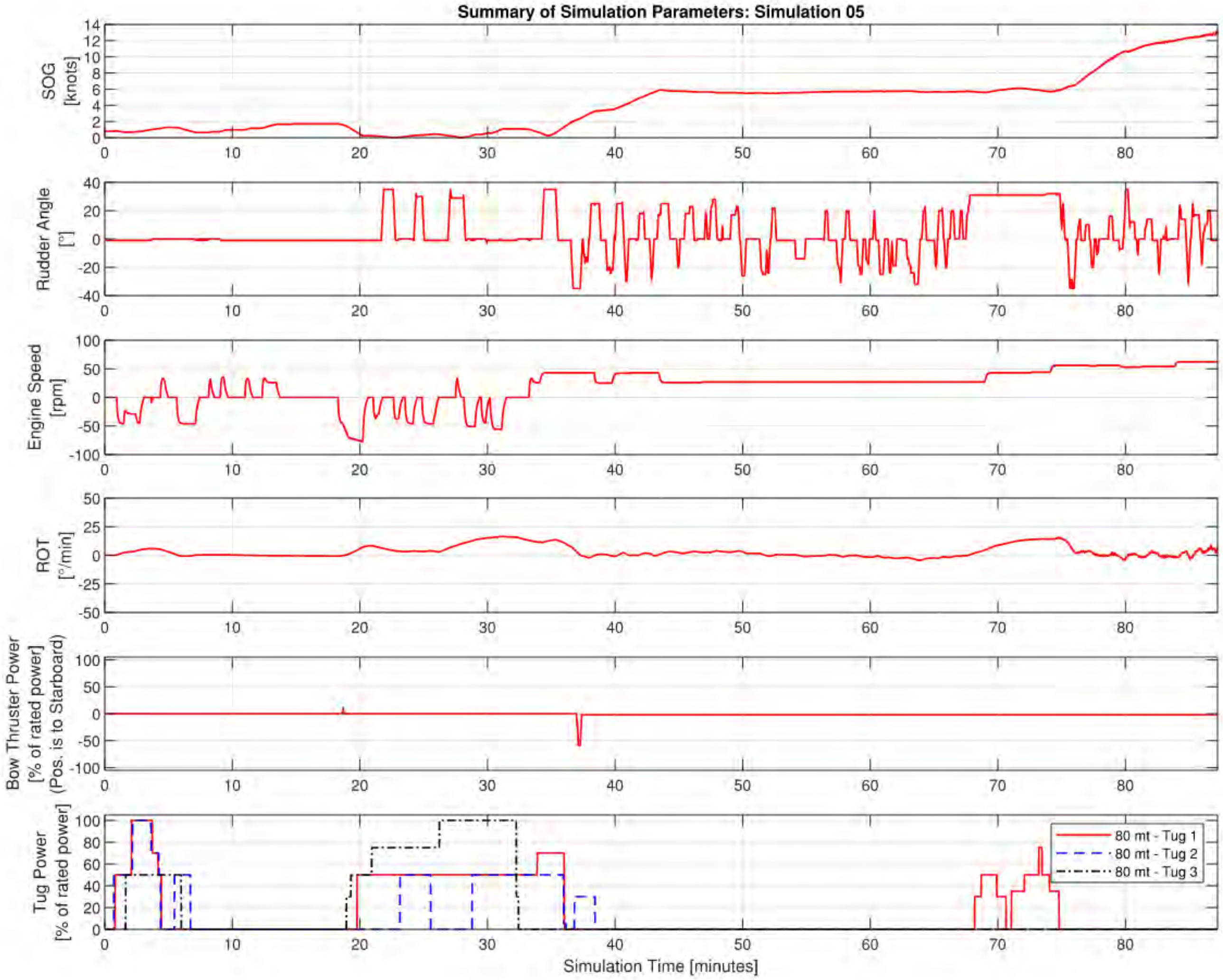


Figure A-24: Simulation 5 Vessel and Tug Parameter Time

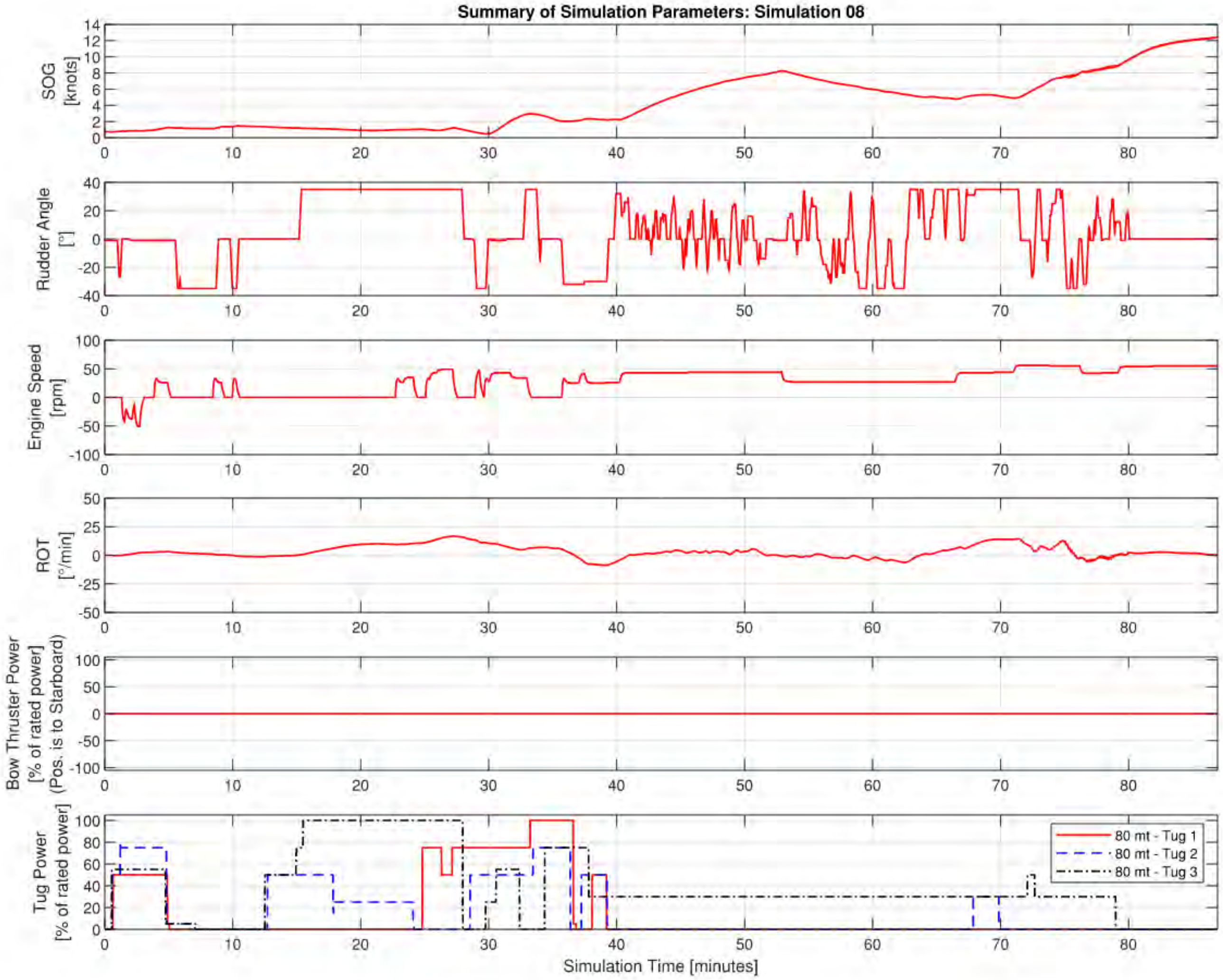


Figure A-25: Simulation 8 Vessel and Tug Parameter Time

A.9 CONCULSIONS & SUMMARY

A real-time screening vessel simulation study was performed at the M&N in-house simulator located in Baltimore, MD. These simulations were performed to determine the needed modifications to 2017 PA channel to accommodate the Post-Panamax Generation Three containerships to ensure safe transits to the proposed container facility. The ship handling for this effort was performed by Captain Tim Petrusha, an active Coos Bay Pilot.

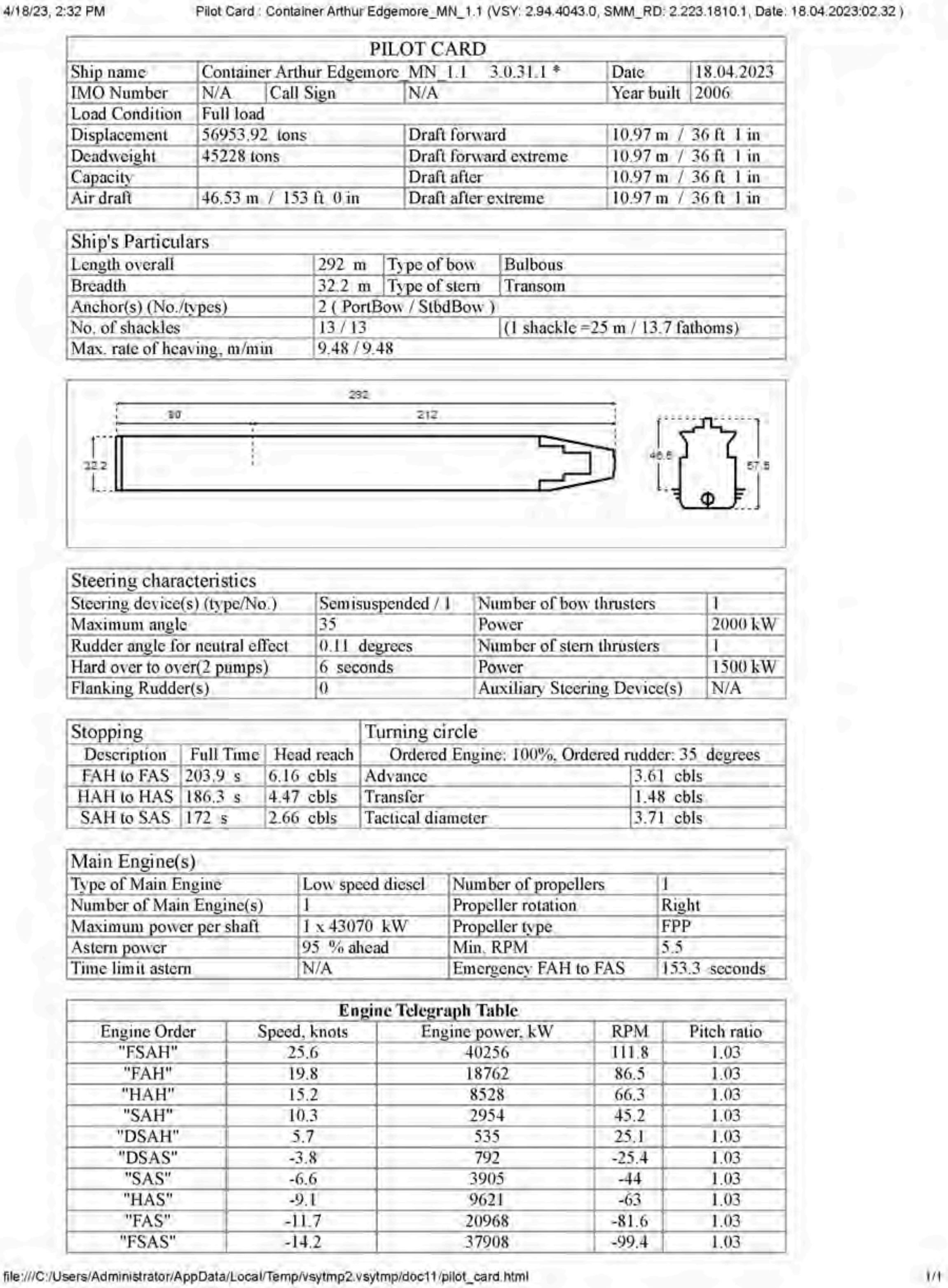
Thirteen simulations were performed from February 21st to February 22nd, 2023, including two pilot familiarization simulations. All of the simulations evaluated the 2023 initial concept channel. Nine simulations evaluated an inbound transit, five with flood tidal currents and four with ebb tidal currents. Two simulations evaluated the outbound transit with a PPX3 containership.

The primary conclusions, recommendations, and future work from this study are as follows:

- The 2023 initial concept channel is sufficient to safely transit a Post Panamax Generation Three class containership to the proposed container facility. Based on these simulations in the apex of the entrance turn between red buoy R”6” and R”6A” the channel widening can be reduced as show in Figure A-26 as the 2023 Proposed Alteration Channel. This widening was not used during the Phase 2B simulations. Overall the 2023 initial concept channel was well received by the Coos Bay Pilot.
- The 2023 Proposed Alteration Channel will be the channel evaluated during the full mission bridge simulations planned in Phase 3.
- It is recommended that the ebb tidal currents be evaluated in the full mission bridge simulations for the inbound transit. As Captain Petrusha found the ebb tide created an easier maneuver than the flood tide in the entrance turn. With the ebb tide the vessel could stem the current allowing better control of the vessel. Therefore, the preference would be to time the currents to be an ebb current in the entrance turn.
- During full mission bridge simulations further investigation on timing of the turning maneuver needs to be completed. Based on this study the recommendation would be to transit the channel in the ebb currents and berth the vessel port-side to and then perform the turning maneuver on the outbound to allow better control of the currents in the turning basin.

Figure A-26: Phase 2B Post Simulations Channel Layouts

APPENDIX B. PILOT CARDS



4/18/23, 2:32 PM Pilot Card : Container Arthur Edgemore_MN_1.1 (VSY: 2.94.4043.0, SMM_RD: 2.223.1810.1, Date: 18.04.2023 02.32)

PILOT CARD

Ship name	Container Arthur Edgemore_MN_1.1 3.0.31.1 *			Date	18.04.2023
IMO Number	N/A	Call Sign	N/A	Year built	2006
Load Condition	Full load				
Displacement	56953.92 tons		Draft forward	10.97 m / 36 ft 1 in	
Deadweight	45228 tons		Draft forward extreme	10.97 m / 36 ft 1 in	
Capacity			Draft after	10.97 m / 36 ft 1 in	
Air draft	46.53 m / 153 ft 0 in		Draft after extreme	10.97 m / 36 ft 1 in	

Ship's Particulars

Length overall	292 m	Type of bow	Bulbous
Breadth	32.2 m	Type of stern	Transom
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	13 / 13		(1 shackle =25 m / 13.7 fathoms)
Max. rate of heaving, m/min	9.48 / 9.48		

Steering characteristics

Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	1
Maximum angle	35	Power	2000 kW
Rudder angle for neutral effect	0.11 degrees	Number of stern thrusters	1
Hard over to over(2 pumps)	6 seconds	Power	1500 kW
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping			Turning circle	
Description	Full Time	Head reach	Ordered Engine: 100%, Ordered rudder: 35 degrees	
FAH to FAS	203.9 s	6.16 cbls	Advance	3.61 cbls
HAH to HAS	186.3 s	4.47 cbls	Transfer	1.48 cbls
SAH to SAS	172 s	2.66 cbls	Tactical diameter	3.71 cbls

Main Engine(s)

Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 43070 kW	Propeller type	FPP
Astern power	95 % ahead	Min. RPM	5.5
Time limit astern	N/A	Emergency FAH to FAS	153.3 seconds

Engine Telegraph Table

Engine Order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"FSAH"	25.6	40256	111.8	1.03
"FAH"	19.8	18762	86.5	1.03
"HAH"	15.2	8528	66.3	1.03
"SAH"	10.3	2954	45.2	1.03
"DSAH"	5.7	535	25.1	1.03
"DSAS"	-3.8	792	-25.4	1.03
"SAS"	-6.6	3905	-44	1.03
"HAS"	-9.1	9621	-63	1.03
"FAS"	-11.7	20968	-81.6	1.03
"FSAS"	-14.2	37908	-99.4	1.03

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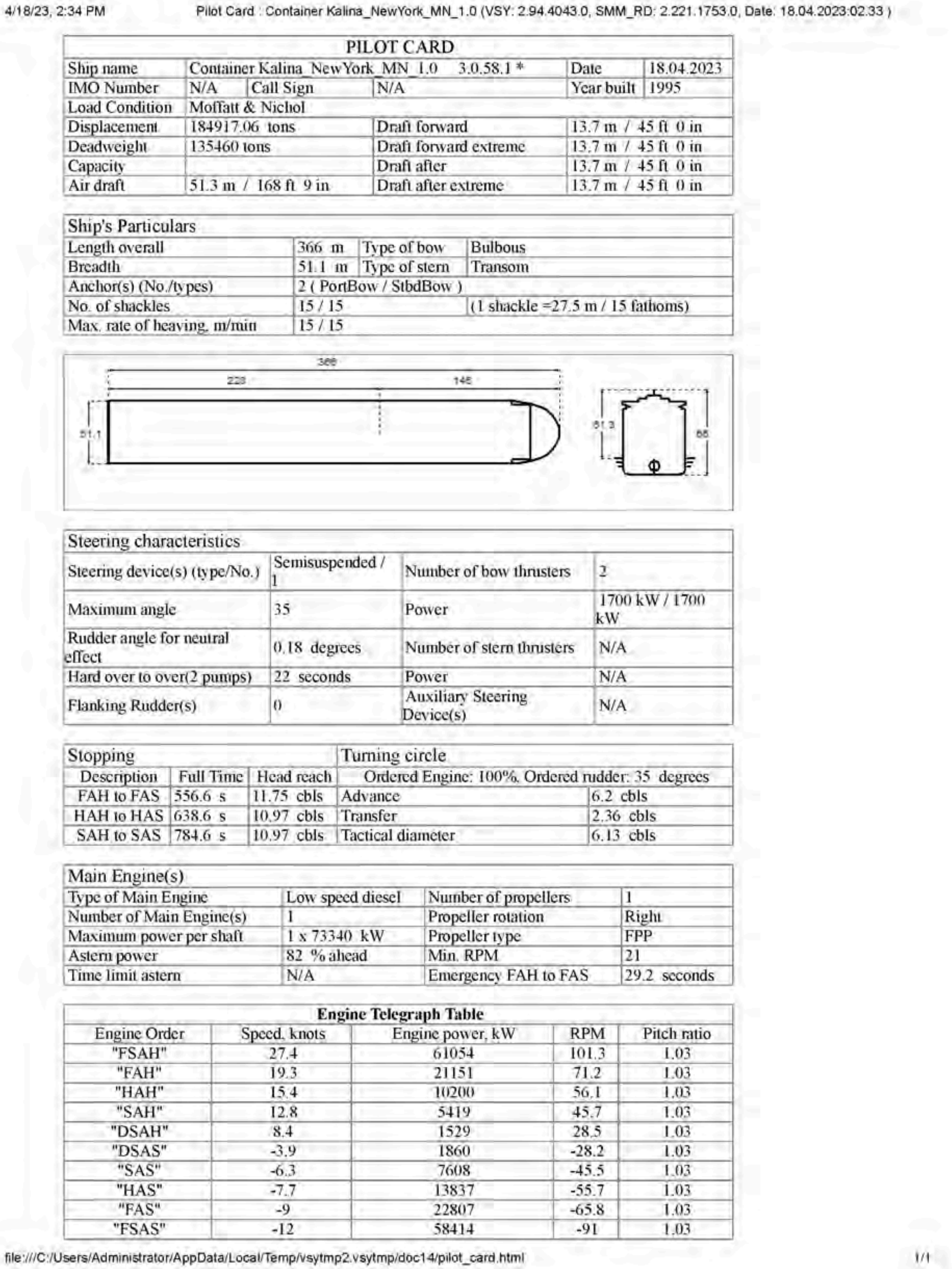


PILOT CARD

Ship name	Container Kalina_NewYork_MN_1.0 3.0.58.1 *			Date	18.04.2023
IMO Number	N/A	Call Sign	N/A	Year built	1995
Load Condition	Moffatt & Nichol				
Displacement	184917.06 tons		Draft forward	13.7 m / 45 ft 0 in	
Deadweight	135460 tons		Draft forward extreme	13.7 m / 45 ft 0 in	
Capacity			Draft after	13.7 m / 45 ft 0 in	
Air draft	51.3 m / 168 ft 9 in		Draft after extreme	13.7 m / 45 ft 0 in	

Ship's Particulars			
Length overall	366 m	Type of bow	Bulbous
Breadth	51.1 m	Type of stern	Transom
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	15 / 15		(1 shackle =27.5 m / 15 fathoms)
Max. rate of heaving, m/min	15 / 15		

Steering characteristics			
Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	2
Maximum angle	35	Power	1700 kW / 1700 kW
Rudder angle for neutral effect	0.18 degrees	Number of stern thrusters	N/A
Hard over to over(2 pumps)	22 seconds	Power	N/A
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

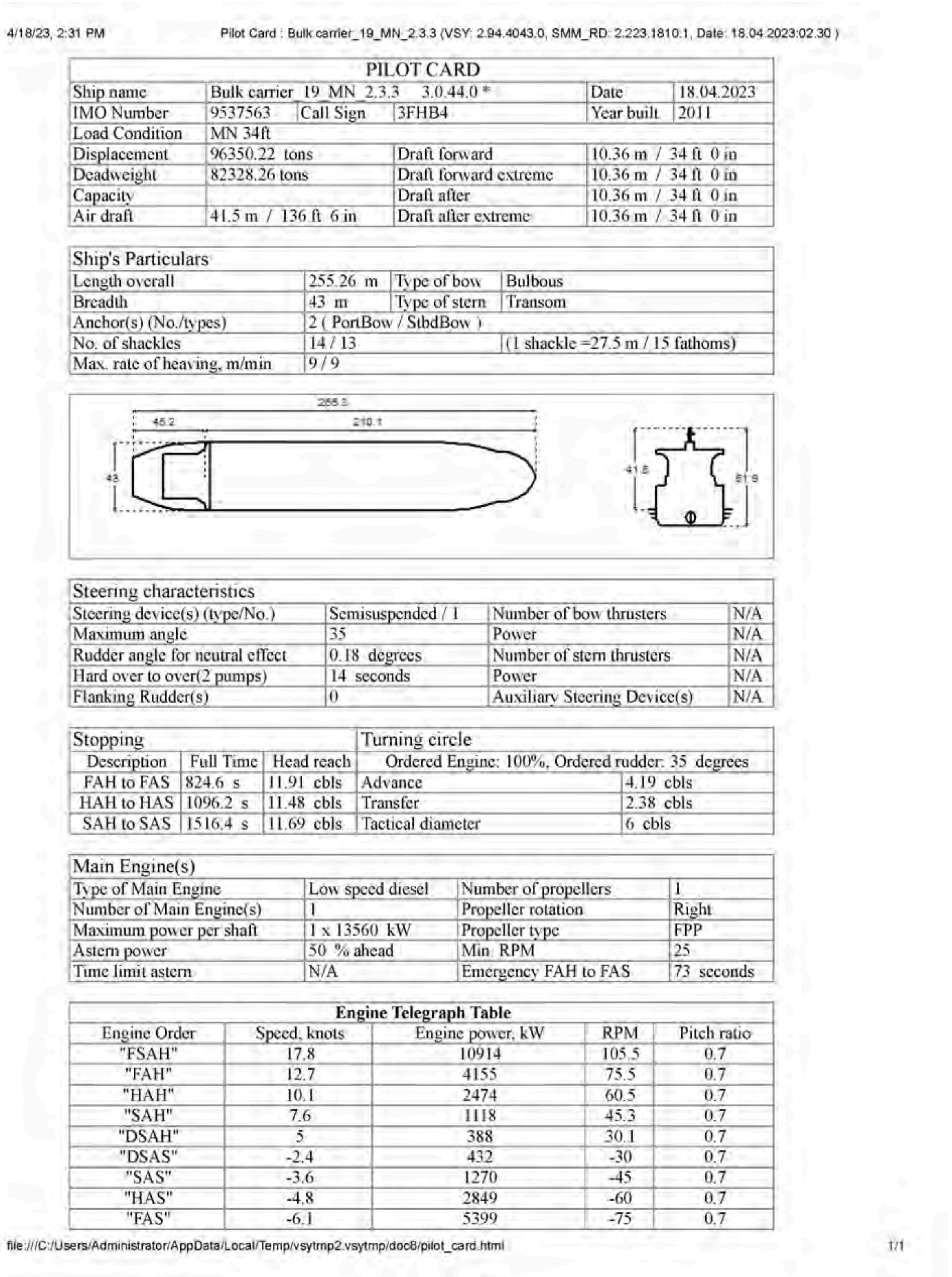
Stopping		
Description	Full Time	Head reach
FAH to FAS	556.6 s	11.75 cbls
HAH to HAS	638.6 s	10.97 cbls
SAH to SAS	784.6 s	10.97 cbls

Turning circle	
Ordered Engine: 100%, Ordered rudder: 35 degrees	
Advance	6.2 cbls
Transfer	2.36 cbls
Tactical diameter	6.13 cbls

Main Engine(s)			
Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 73340 kW	Propeller type	FPP
Astern power	82 % ahead	Min. RPM	21
Time limit astern	N/A	Emergency FAH to FAS	29.2 seconds

Engine Telegraph Table

Engine Order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"FSAH"	27.4	61054	101.3	1.03
"FAH"	19.3	21151	71.2	1.03
"HAH"	15.4	10200	56.1	1.03
"SAH"	12.8	5419	45.7	1.03
"DSAH"	8.4	1529	28.5	1.03
"DSAS"	-3.9	1860	-28.2	1.03
"SAS"	-6.3	7608	-45.5	1.03
"HAS"	-7.7	13837	-55.7	1.03
"FAS"	-9	22807	-65.8	1.03
"FSAS"	-12	58414	-91	1.03



4/18/23, 2:31 PM Pilot Card : Bulk carrier_19_MN_2.3.3 (VSY: 2.94.4043.0, SMM_RD: 2.223.1810.1, Date: 18.04.2023:02.30)

PILOT CARD

Ship name	Bulk carrier_19_MN_2.3.3 3.0.44.0 *			Date	18.04.2023
IMO Number	9537563	Call Sign	3FHB4	Year built	2011
Load Condition	MN 34ft				
Displacement	96350.22 tons		Draft forward	10.36 m / 34 ft 0 in	
Deadweight	82328.26 tons		Draft forward extreme	10.36 m / 34 ft 0 in	
Capacity			Draft after	10.36 m / 34 ft 0 in	
Air draft	41.5 m / 136 ft 6 in		Draft after extreme	10.36 m / 34 ft 0 in	

Ship's Particulars			
Length overall	255.26 m	Type of bow	Bulbous
Breadth	43 m	Type of stern	Transom
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	14 / 13	(1 shackle =27.5 m / 15 fathoms)	
Max. rate of heaving, m/min	9 / 9		

Steering characteristics			
Steering device(s) (type/No.)	Semisuspended / 1	Number of bow thrusters	N/A
Maximum angle	35	Power	N/A
Rudder angle for neutral effect	0.18 degrees	Number of stern thrusters	N/A
Hard over to over(2 pumps)	14 seconds	Power	N/A
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping			Turning circle	
Description	Full Time	Head reach	Ordered Engine: 100%, Ordered rudder: 35 degrees	
FAH to FAS	824.6 s	11.91 cbls	Advance	4.19 cbls
HAH to HAS	1096.2 s	11.48 cbls	Transfer	2.38 cbls
SAH to SAS	1516.4 s	11.69 cbls	Tactical diameter	6 cbls

Main Engine(s)			
Type of Main Engine	Low speed diesel	Number of propellers	1
Number of Main Engine(s)	1	Propeller rotation	Right
Maximum power per shaft	1 x 13560 kW	Propeller type	FPP
Astern power	50 % ahead	Min. RPM	25
Time limit astern	N/A	Emergency FAH to FAS	73 seconds

Engine Telegraph Table

Engine Order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"FSAH"	17.8	10914	105.5	0.7
"FAH"	12.7	4155	75.5	0.7
"HAH"	10.1	2474	60.5	0.7
"SAH"	7.6	1118	45.3	0.7
"DSAH"	5	388	30.1	0.7
"DSAS"	-2.4	432	-30	0.7
"SAS"	-3.6	1270	-45	0.7
"HAS"	-4.8	2849	-60	0.7
"FAS"	-6.1	5399	-75	0.7

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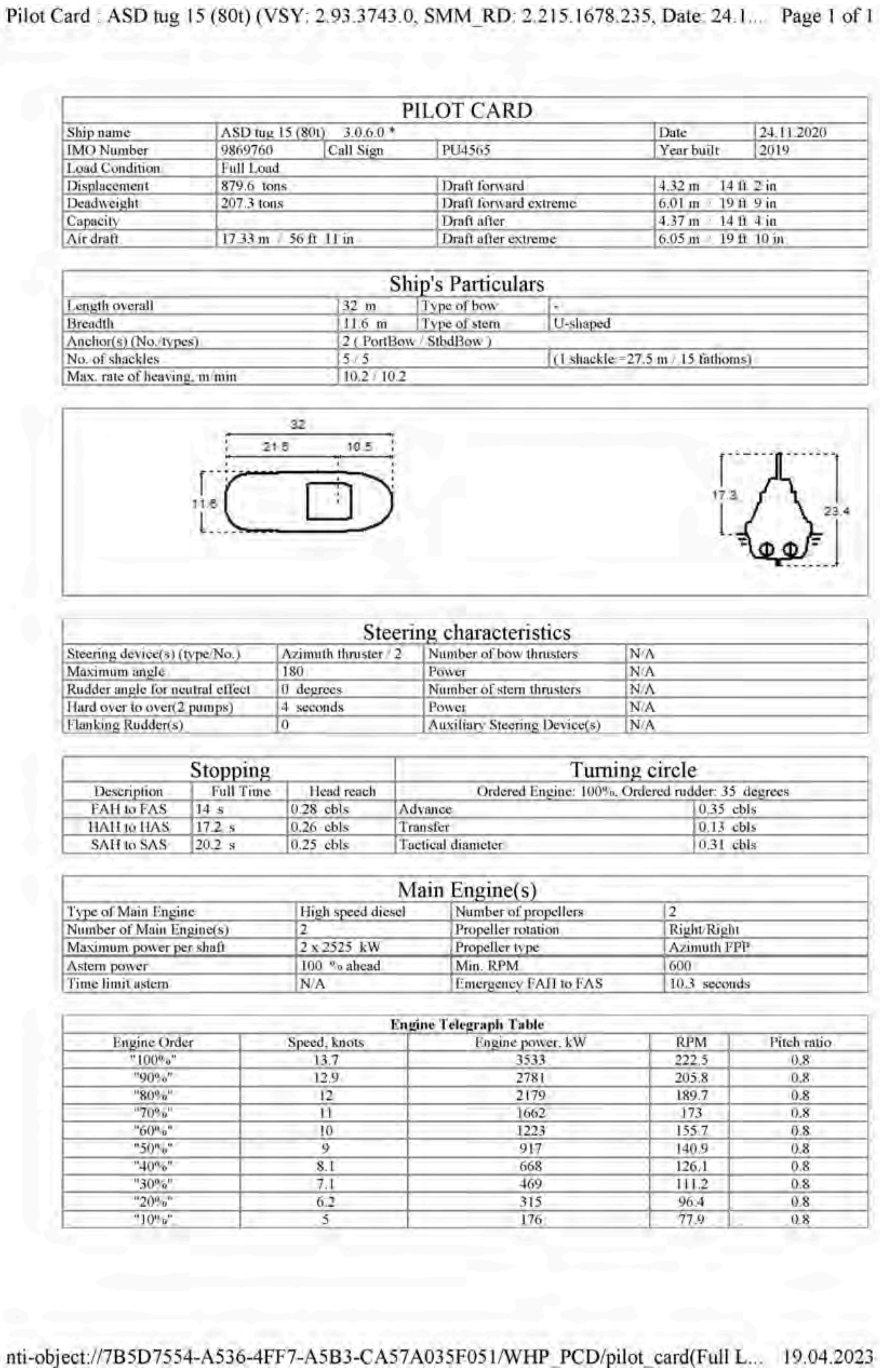

Pilot Card : ASD tug 15 (80t) (VSY: 2.93.3743.0, SMM_RD: 2.215.1678.235, Date: 24.1... Page 1 of 1

PILOT CARD

Ship name	ASD tug 15 (80t) 3.0.6.0 *			Date	24.11.2020
IMO Number	9869760	Call Sign	PU4565	Year built	2019
Load Condition	Full Load				
Displacement	879.6 tons		Draft forward	4.32 m / 14 ft 2 in	
Deadweight	207.3 tons		Draft forward extreme	6.01 m / 19 ft 9 in	
Capacity			Draft after	4.37 m / 14 ft 4 in	
Air draft	17.33 m / 56 ft 11 in		Draft after extreme	6.05 m / 19 ft 10 in	

Ship's Particulars

Length overall	32 m	Type of bow	-
Breadth	11.6 m	Type of stern	U-shaped
Anchor(s) (No./types)	2 (PortBow / StbdBow)		
No. of shackles	5 / 5		(1 shackle =27.5 m / 15 fathoms)
Max. rate of heaving, m/min	10.2 / 10.2		

Steering characteristics

Steering device(s) (type/No.)	Azimuth thruster / 2	Number of bow thrusters	N/A
Maximum angle	180	Power	N/A
Rudder angle for neutral effect	0 degrees	Number of stern thrusters	N/A
Hard over to over(2 pumps)	4 seconds	Power	N/A
Flanking Rudder(s)	0	Auxiliary Steering Device(s)	N/A

Stopping			Turning circle	
Description	Full Time	Head reach	Ordered Engine: 100%, Ordered rudder: 35 degrees	
FAH to FAS	14 s	0.28 cbls	Advance	0.35 cbls
HAH to HAS	17.2 s	0.26 cbls	Transfer	0.13 cbls
SAH to SAS	20.2 s	0.25 cbls	Tactical diameter	0.31 cbls

Main Engine(s)

Type of Main Engine	High speed diesel	Number of propellers	2
Number of Main Engine(s)	2	Propeller rotation	Right/Right
Maximum power per shaft	2 x 2525 kW	Propeller type	Azimuth FPP
Astern power	100 % ahead	Min. RPM	600
Time limit astern	N/A	Emergency FAH to FAS	10.3 seconds

Engine Telegraph Table

Engine Order	Speed, knots	Engine power, kW	RPM	Pitch ratio
"100%"	13.7	3533	222.5	0.8
"90%"	12.9	2781	205.8	0.8
"80%"	12	2179	189.7	0.8
"70%"	11	1662	173	0.8
"60%"	10	1223	155.7	0.8
"50%"	9	917	140.9	0.8
"40%"	8.1	668	126.1	0.8
"30%"	7.1	469	111.2	0.8
"20%"	6.2	315	96.4	0.8
"10%"	5	176	77.9	0.8

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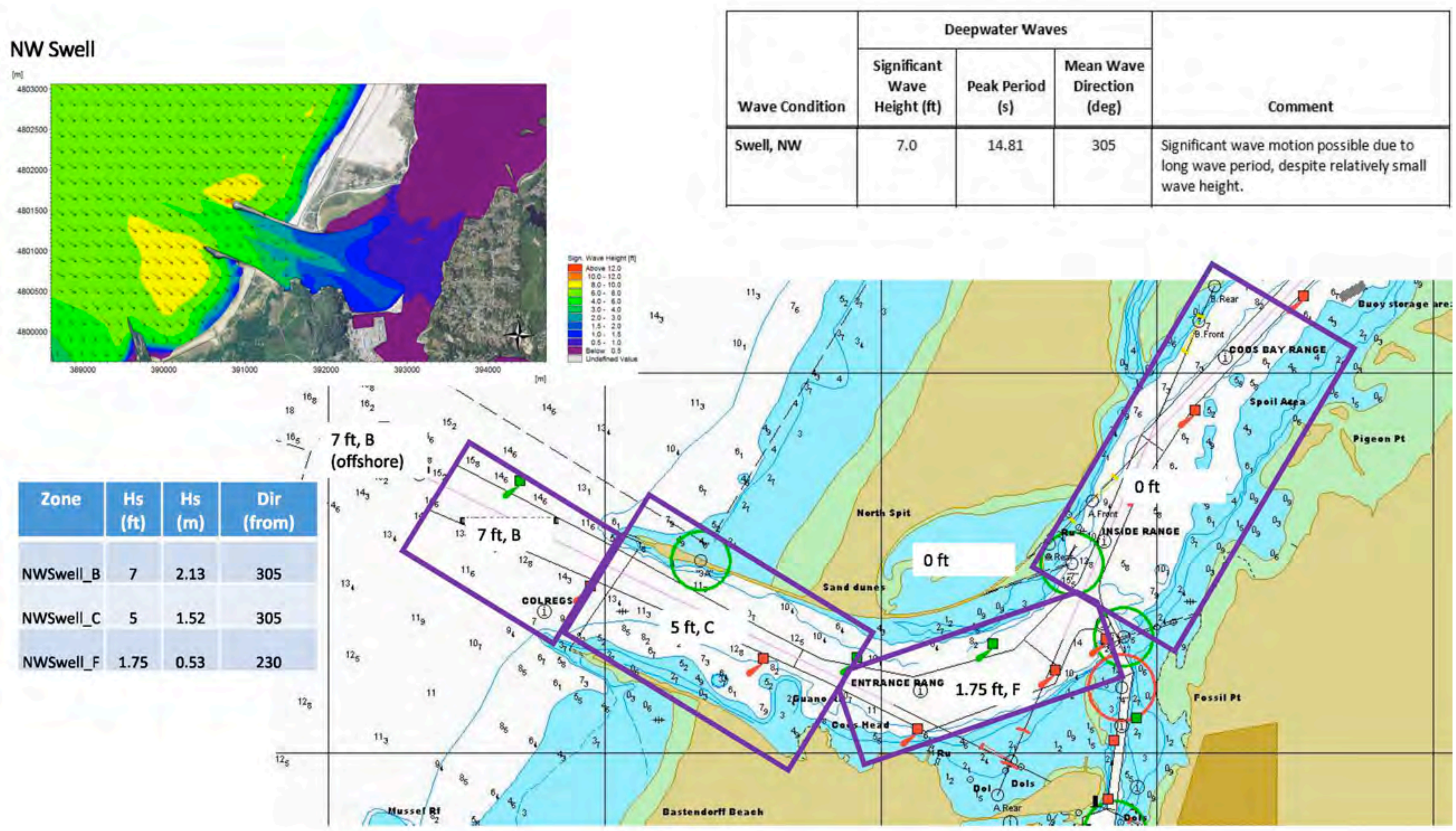
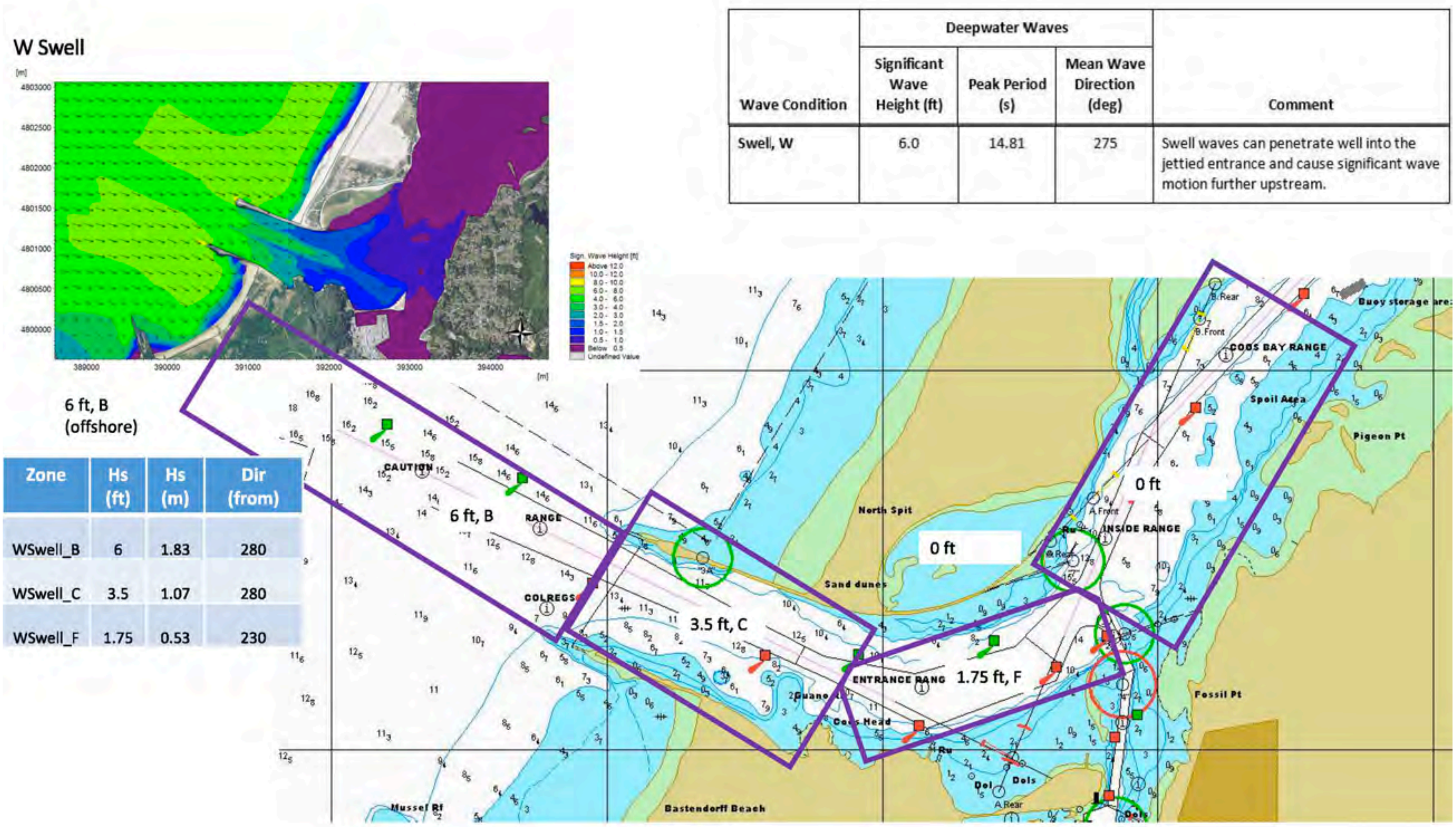
APPENDIX C. WAVE FIELDS



	Deepwater Waves			
Wave Condition	Significant Wave Height (ft)	Peak Period (s)	Mean Wave Direction (deg)	Comment
Swell, NW	7.0	14.81	305	Significant wave motion possible due to long wave period, despite relatively small wave height.

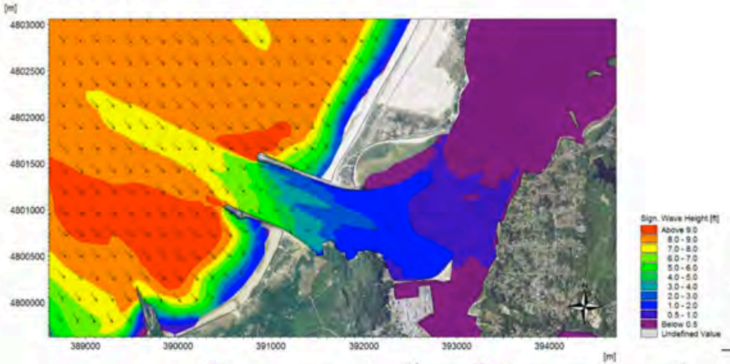
Zone	Hs (ft)	Hs (m)	Dir (from)
NWSwell_B	7	2.13	305
NWSwell_C	5	1.52	305
NWSwell_F	1.75	0.53	230



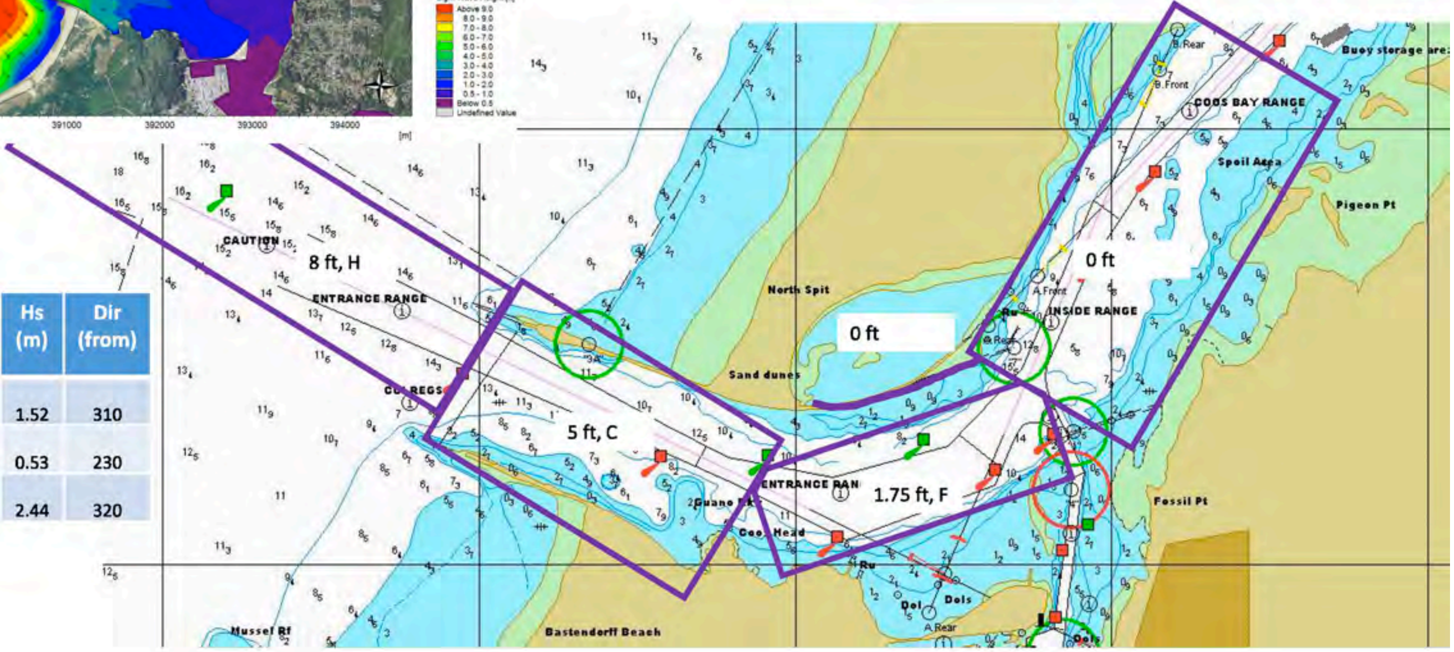
Wave Condition	Deepwater Waves			Comment
	Significant Wave Height (ft)	Peak Period (s)	Mean Wave Direction (deg)	
Swell, W	6.0	14.81	275	Swell waves can penetrate well into the jettied entrance and cause significant wave motion further upstream.

Zone	Hs (ft)	Hs (m)	Dir (from)
WSwell_B	6	1.83	280
WSwell_C	3.5	1.07	280
WSwell_F	1.75	0.53	230

NW Moderate

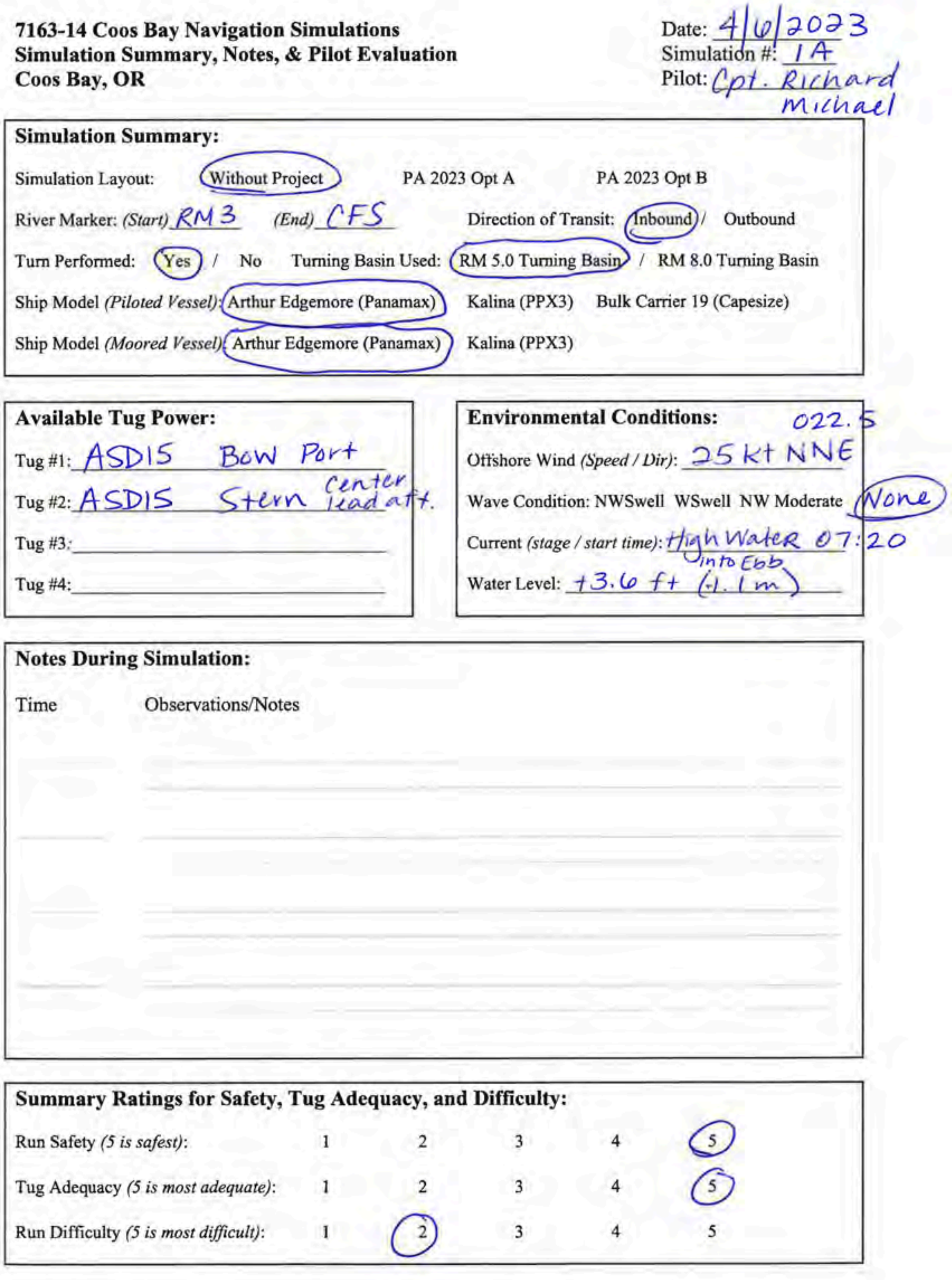


Wave Condition	Deepwater Waves			Comment
	Significant Wave Height (ft)	Peak Period (s)	Mean Wave Direction (deg)	
Moderate, NW	9.0	11.43	320	Significant wave-induced motion (10 to 12 ft possible offshore), but little wave penetration into jettied entrance.



Zone	Hs (ft)	Hs (m)	Dir (from)
NWModerate_C	5	1.52	310
NWModerate_F	1.75	0.53	230
NWModerate_H	8	2.44	320

APPENDIX D. PILOT EVALUATION FORMS



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/6/2023
Simulation #: 1A
Pilot: Cpt. Richard Michael

Simulation Summary:

Simulation Layout: [✓ Without Project] PA 2023 Opt A PA 2023 Opt B

River Marker: *(Start)* RM 3 *(End)* CFS Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3) Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3)

Available Tug Power:

Tug #1: ASD15 Bow Port
Tug #2: ASD15 Stern center lead aft.
Tug #3:
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 25 kt NNE 022.5
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: High Water into Ebb 07:20
Water Level: +3.6 ft (+1.1 m)

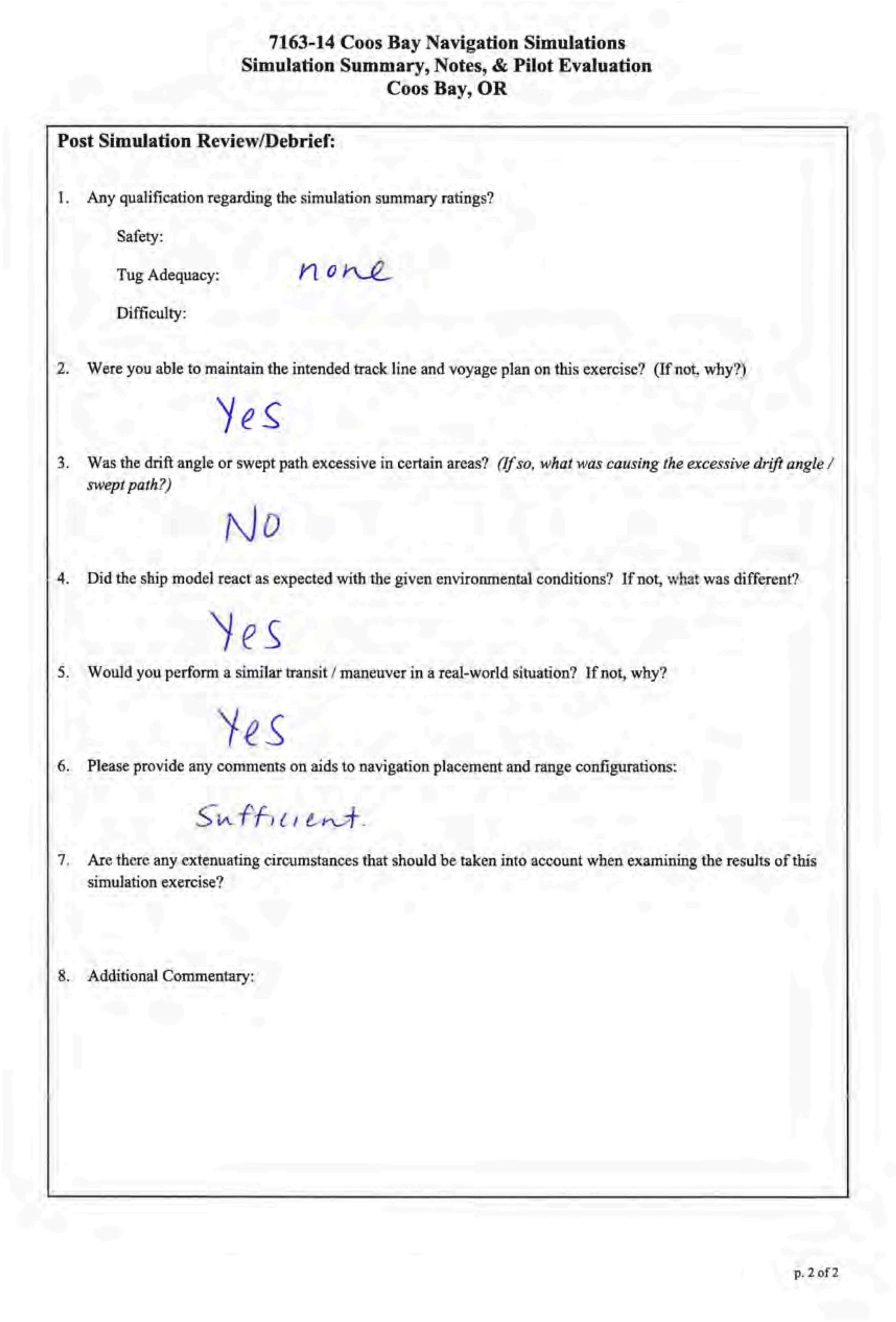
Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	3	4	[✓ 5]
Tug Adequacy *(5 is most adequate)*:	1	2	3	4	[✓ 5]
Run Difficulty *(5 is most difficult)*:	1	[✓ 2]	3	4	5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy: none

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

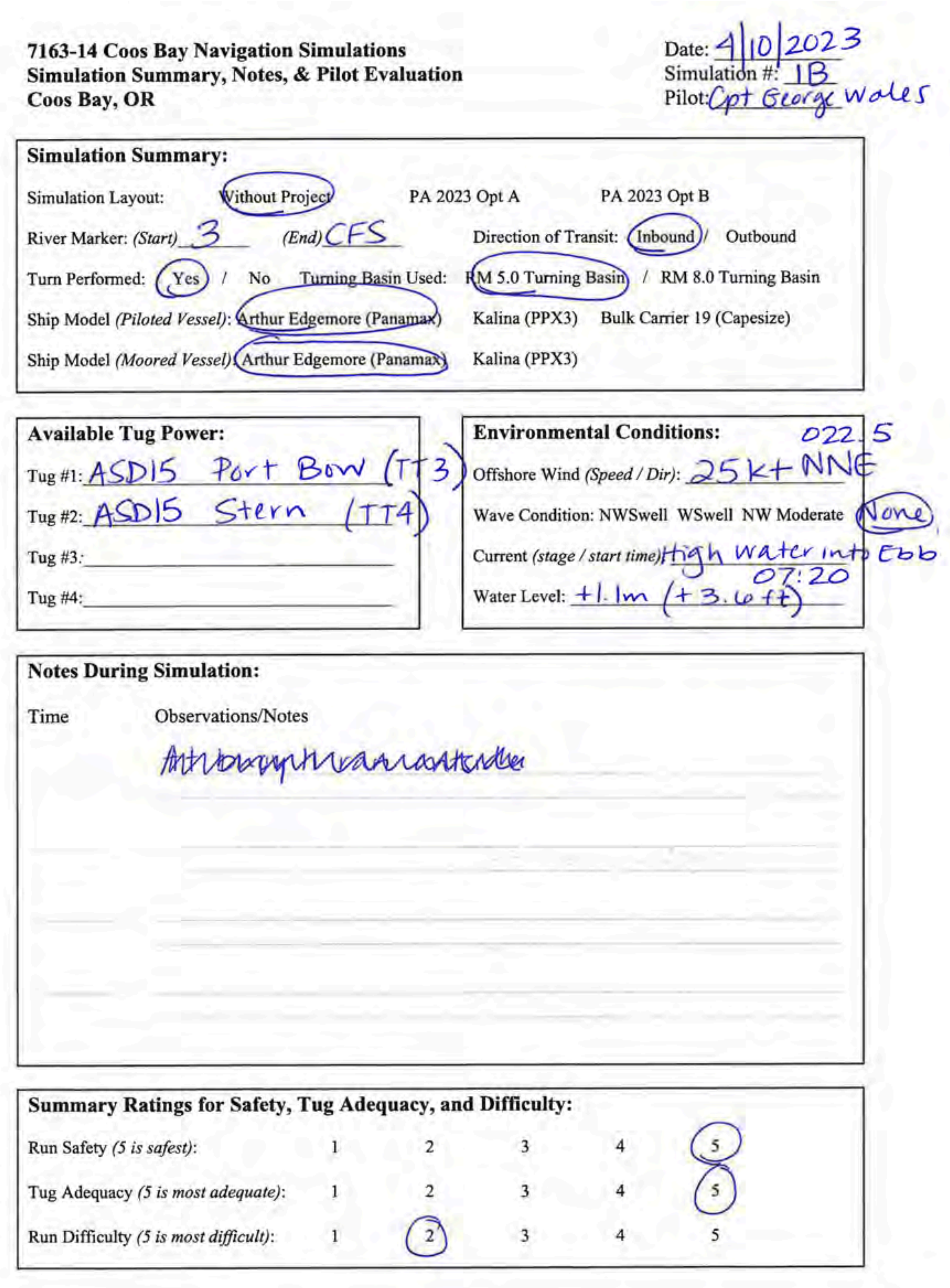
6. Please provide any comments on aids to navigation placement and range configurations:

   Sufficient.

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/10/2023
Simulation #: 1B
Pilot: Cpt George Wales

Simulation Summary:

Simulation Layout: [✓ Without Project] PA 2023 Opt A PA 2023 Opt B

River Marker: *(Start)* 3 *(End)* CFS

Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No

Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3) Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3)

Available Tug Power:

Tug #1: ASD15 Port Bow (TT3)
Tug #2: ASD15 Stern (TT4)
Tug #3:
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 25kt NNE 022.5

Wave Condition: NWSwell WSwell NW Moderate [✓ None]

Current *(stage / start time)*: High water into Ebb 07:20

Water Level: +1.1m (+3.6ft)

Notes During Simulation:

Time	Observations/Notes
	[illegible]

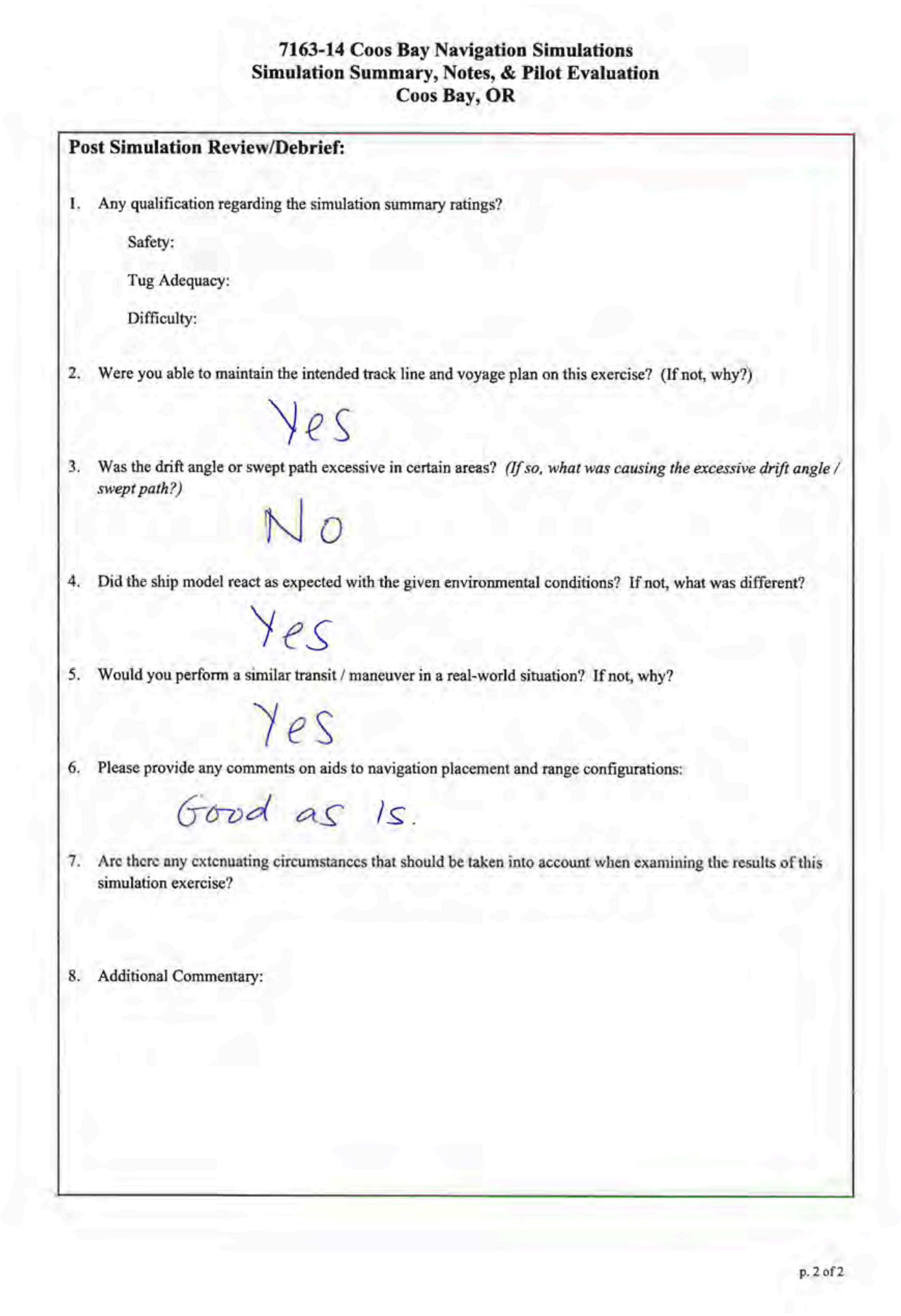
Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 4 [✓ 5]

Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]

Run Difficulty *(5 is most difficult)*: 1 [✓ 2] 3 4 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

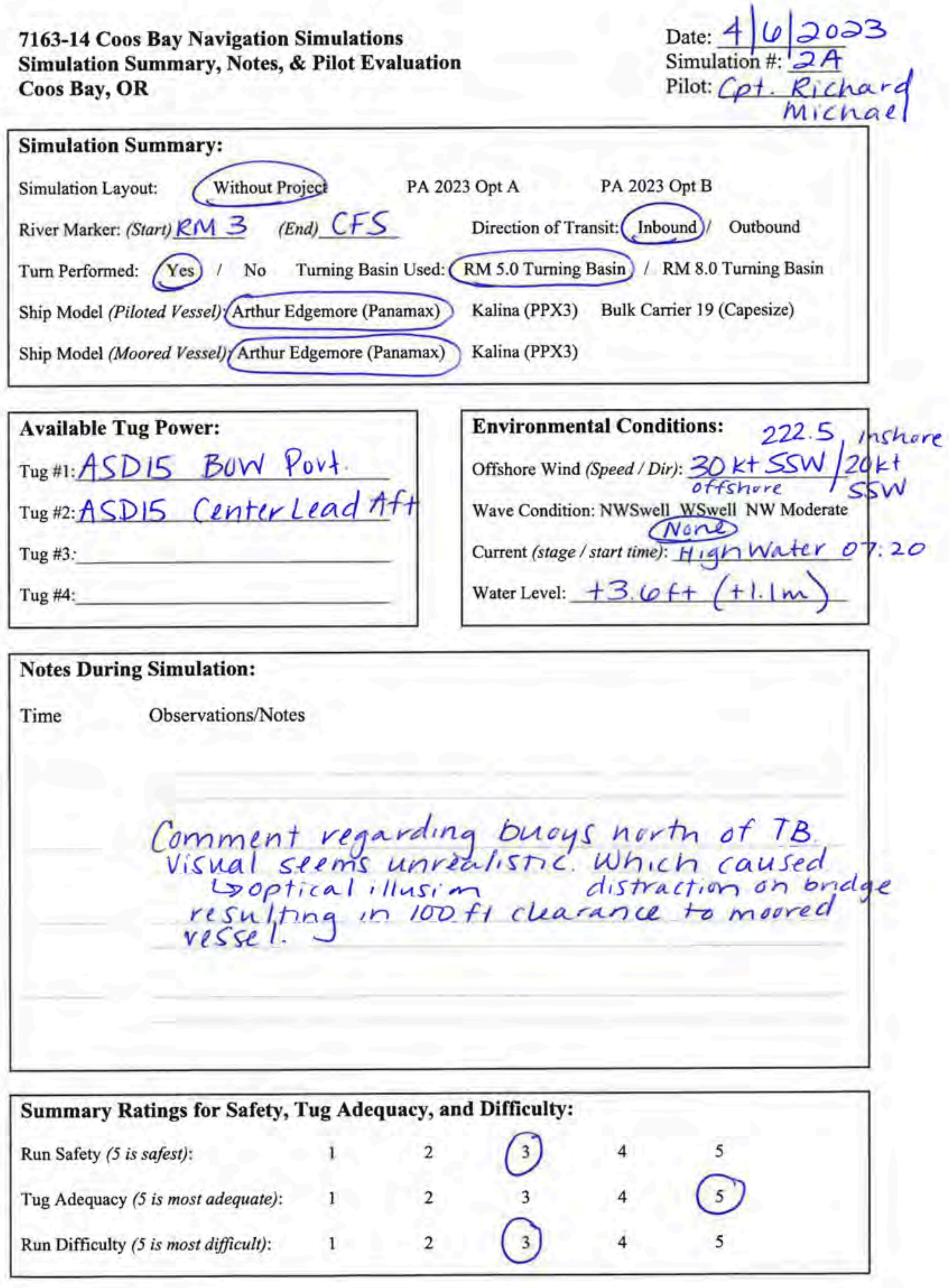
   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

   Good as Is.

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/6/2023
Simulation #: 2A
Pilot: Cpt. Richard Michael

Simulation Summary:

Simulation Layout: [✓ Without Project] PA 2023 Opt A PA 2023 Opt B

River Marker: *(Start)* RM 3 *(End)* CFS Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3) Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3)

Available Tug Power:

Tug #1: ASD15 Bow Port.
Tug #2: ASD15 Center Lead Aft
Tug #3:
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 30 kt SSW offshore / 20kt SSW 222.5, inshore
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: High Water 07:20
Water Level: +3.6ft (+1.1m)

Notes During Simulation:

Time Observations/Notes

Comment regarding buoys north of TB.
Visual seems unrealistic. Which caused
↳optical illusion distraction on bridge
resulting in 100 ft clearance to moored
vessel.

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 [✓ 3] 4 5
Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]
Run Difficulty *(5 is most difficult)*: 1 2 [✓ 3] 4 5

p. 1 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

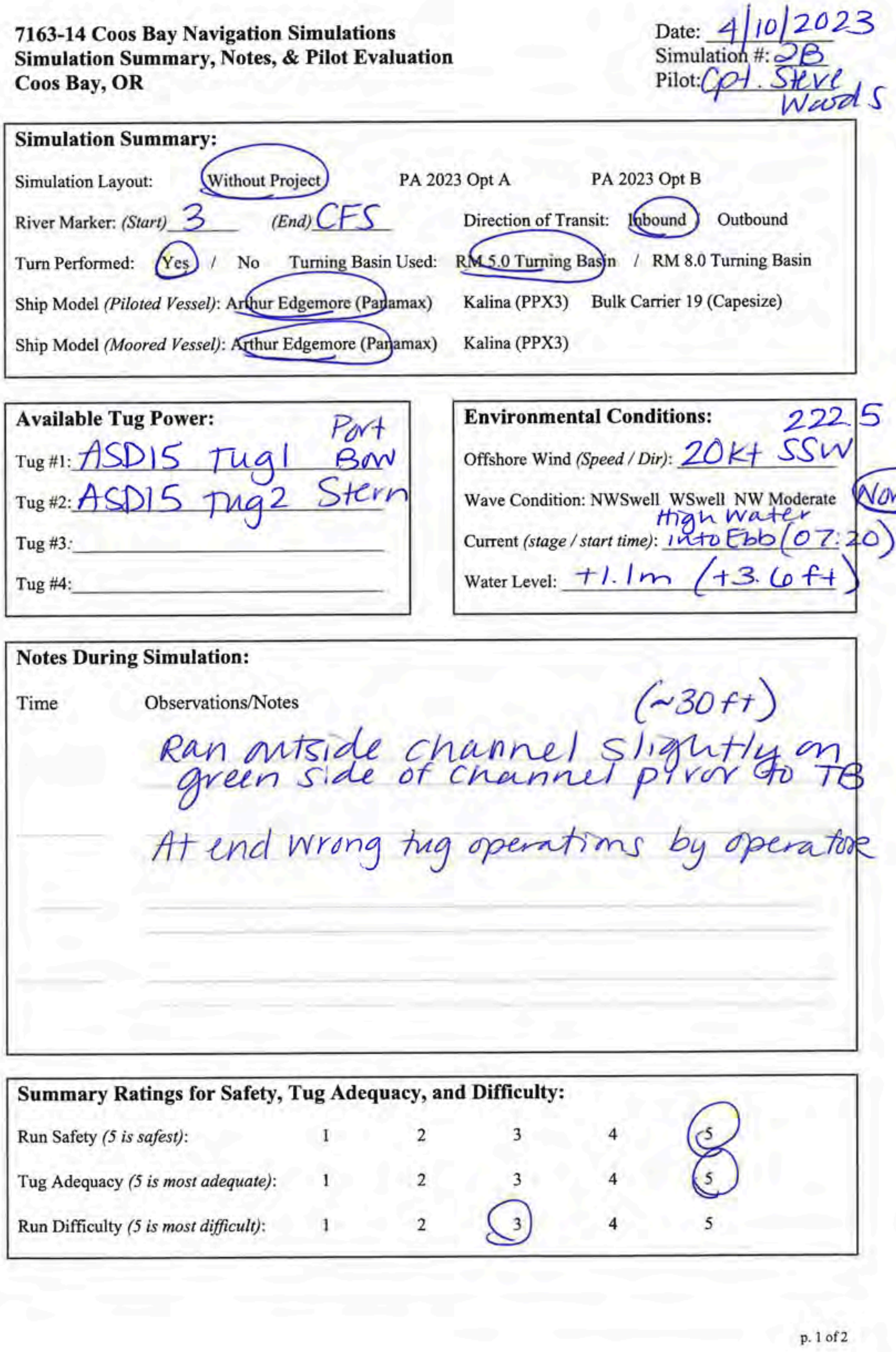
   —

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

   No feedback

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/10/2023
Simulation #: 2B
Pilot: Cpt. Steve Woods

Simulation Summary:

Simulation Layout: [✓ Without Project] PA 2023 Opt A PA 2023 Opt B
River Marker: *(Start)* 3 *(End)* CFS Direction of Transit: [✓ Inbound] Outbound
Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin
Ship Model *(Piloted Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3) Bulk Carrier 19 (Capesize)
Ship Model *(Moored Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3)

Available Tug Power:

Tug #1: ASD15 Tug1 Port Bow
Tug #2: ASD15 Tug2 Stern
Tug #3:
Tug #4:

Environmental Conditions:

222.5
Offshore Wind *(Speed / Dir)*: 20kt SSW
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: High water into Ebb (07:20)
Water Level: +1.1m (+3.6ft)

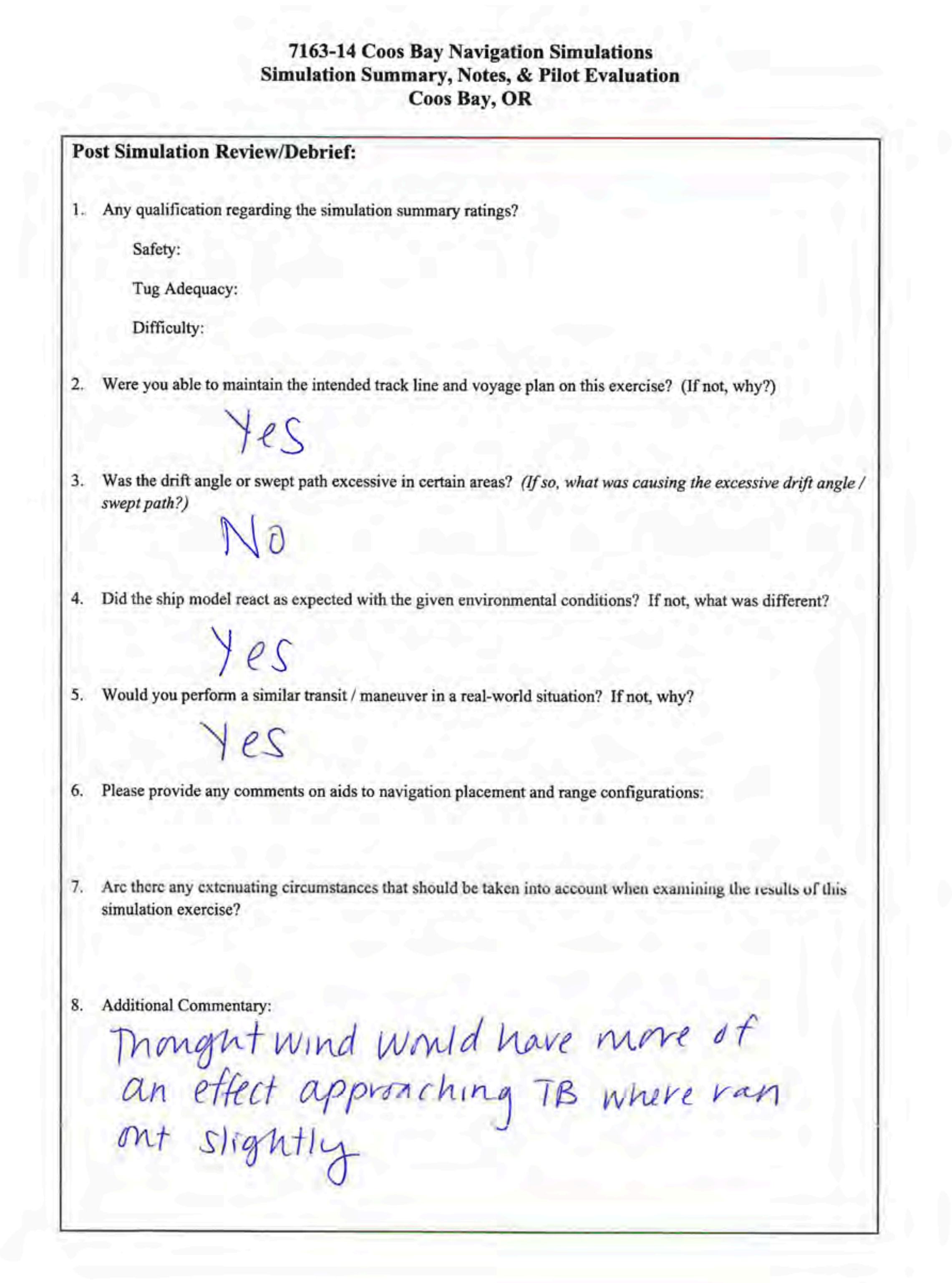
Notes During Simulation:

Time	Observations/Notes
	(~30 ft) Ran outside channel slightly on green side of channel prior to TB
	At end wrong tug operations by operator

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	3	4	[✓ 5]
Tug Adequacy *(5 is most adequate)*:	1	2	3	4	[✓ 5]
Run Difficulty *(5 is most difficult)*:	1	2	[✓ 3]	4	5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

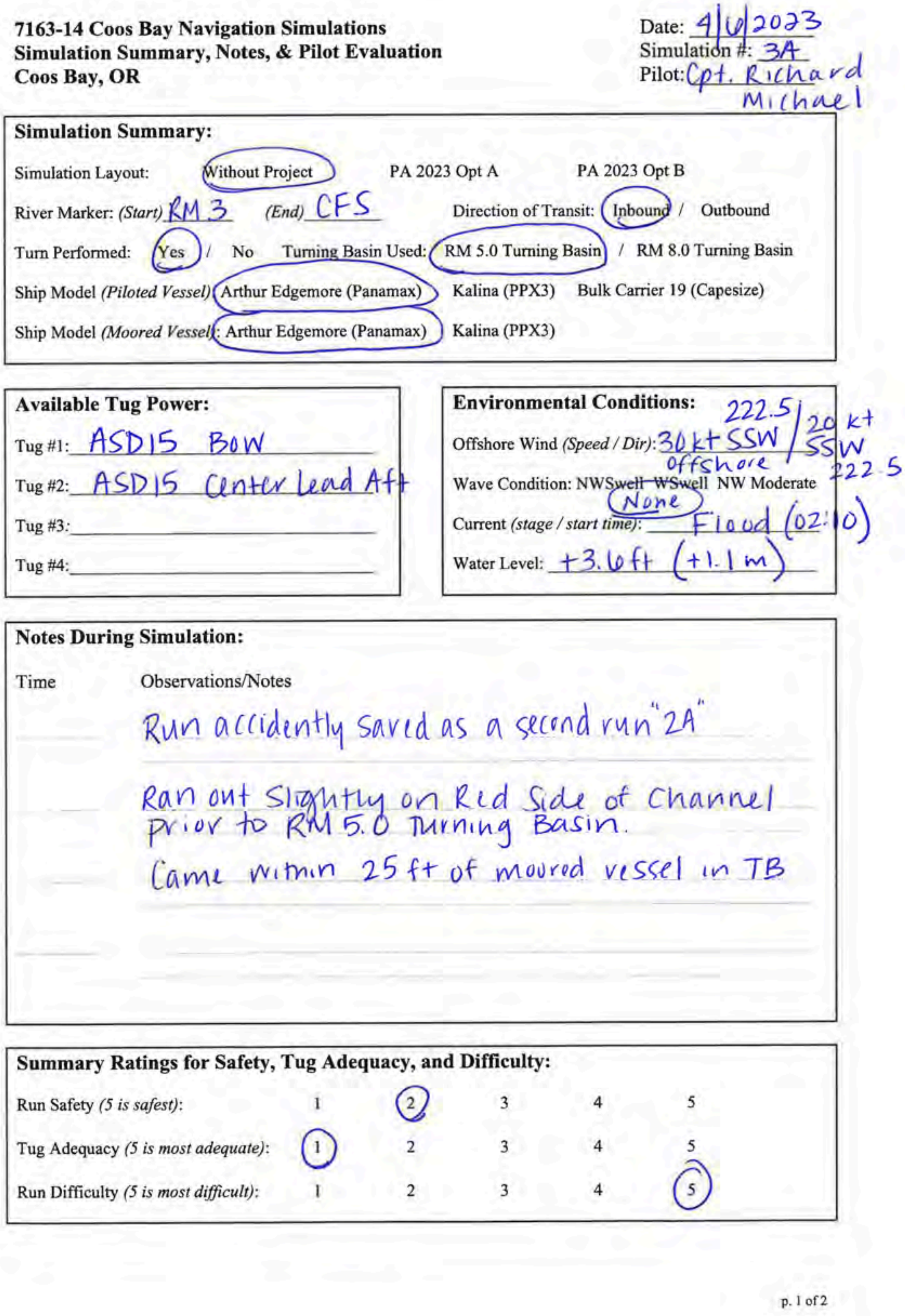
6. Please provide any comments on aids to navigation placement and range configurations:

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

   Thought wind would have more of an effect approaching TB where ran out slightly

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/6/2023
Simulation #: 3A
Pilot: Cpt. Richard Michael

Simulation Summary:

Simulation Layout: [✓ Without Project] PA 2023 Opt A PA 2023 Opt B

River Marker: *(Start)* RM 3 *(End)* CFS

Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No

Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3) Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3)

Available Tug Power:

Tug #1: ASD15 Bow
Tug #2: ASD15 Center Lead Aft
Tug #3:
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 30 kt SSW 222.5 offshore / 20 kt SSW 222.5
Wave Condition: NWSw~~ell WS~~well NW Moderate [✓ None]
Current *(stage / start time)*: Flood (02:10)
Water Level: +3.6 ft (+1.1 m)

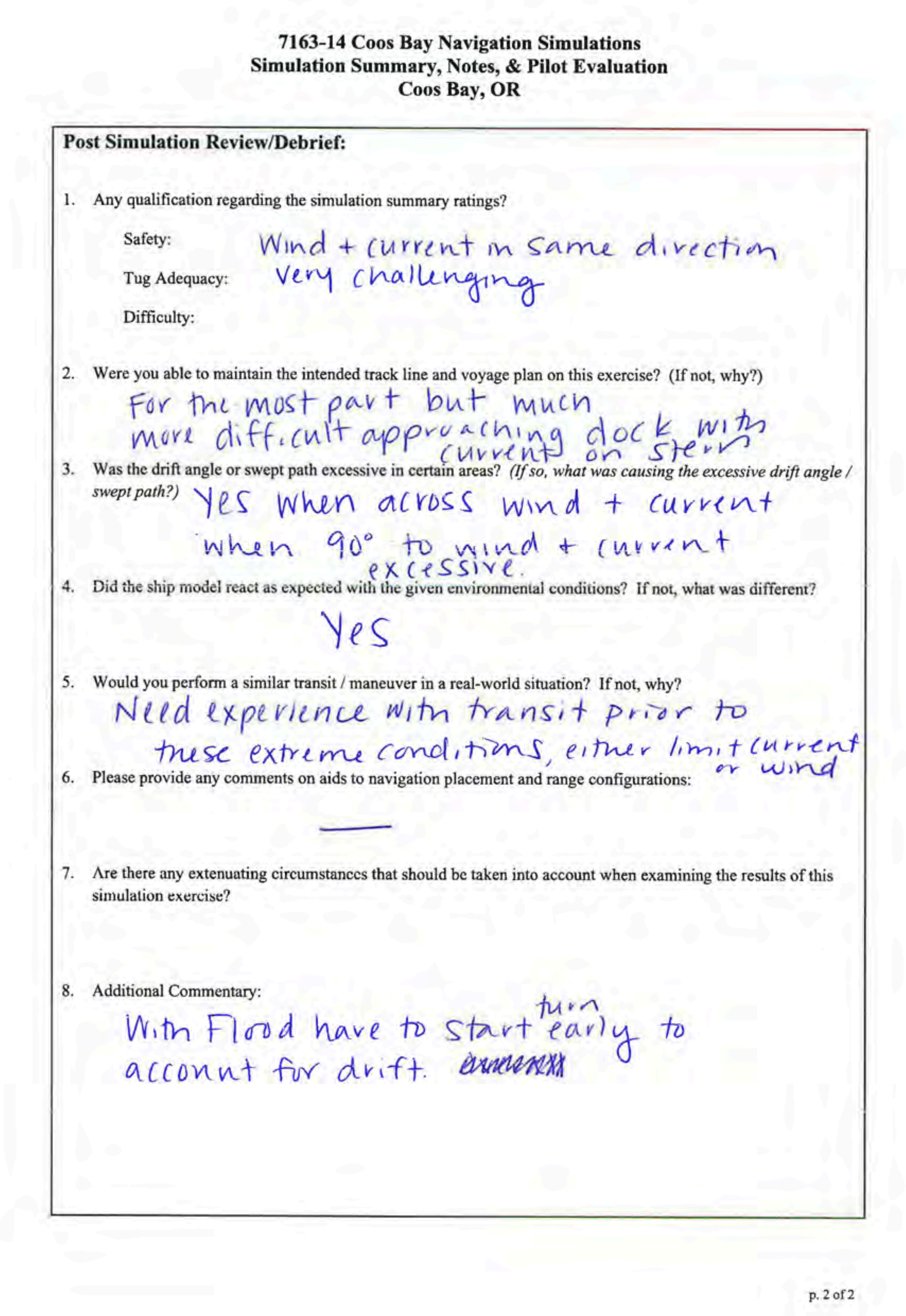
Notes During Simulation:

Time	Observations/Notes
	Run accidently saved as a second run "2A"
	Ran out slightly on Red Side of Channel prior to RM 5.0 Turning Basin.
	Came within 25 ft of moored vessel in TB

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 [✓ 2] 3 4 5
Tug Adequacy *(5 is most adequate)*: [✓ 1] 2 3 4 5
Run Difficulty *(5 is most difficult)*: 1 2 3 4 [✓ 5]

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

Safety: Wind + current in same direction
Tug Adequacy: very challenging
Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

For the most part but much more difficult approaching dock with current on stern

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

Yes when across wind + current when 90° to wind + current excessive.

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

Need experience with transit prior to these extreme conditions, either limit current or wind

6. Please provide any comments on aids to navigation placement and range configurations:

—

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

With Flood have to start turn early to account for drift.

p. 2 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/11/2023
Simulation #: 3B
Pilot: Cpt George Wales

Simulation Summary:

Simulation Layout: [✓ Without Project] PA 2023 Opt A PA 2023 Opt B

River Marker: *(Start)* 3.0 *(End)* CFS Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3) Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3)

Available Tug Power:

Tug #1: ASD15 Tug 1 Port Bow
Tug #2: ASD15 Tug 2 Stern
Tug #3:
Tug #4:

Environmental Conditions: 222 S

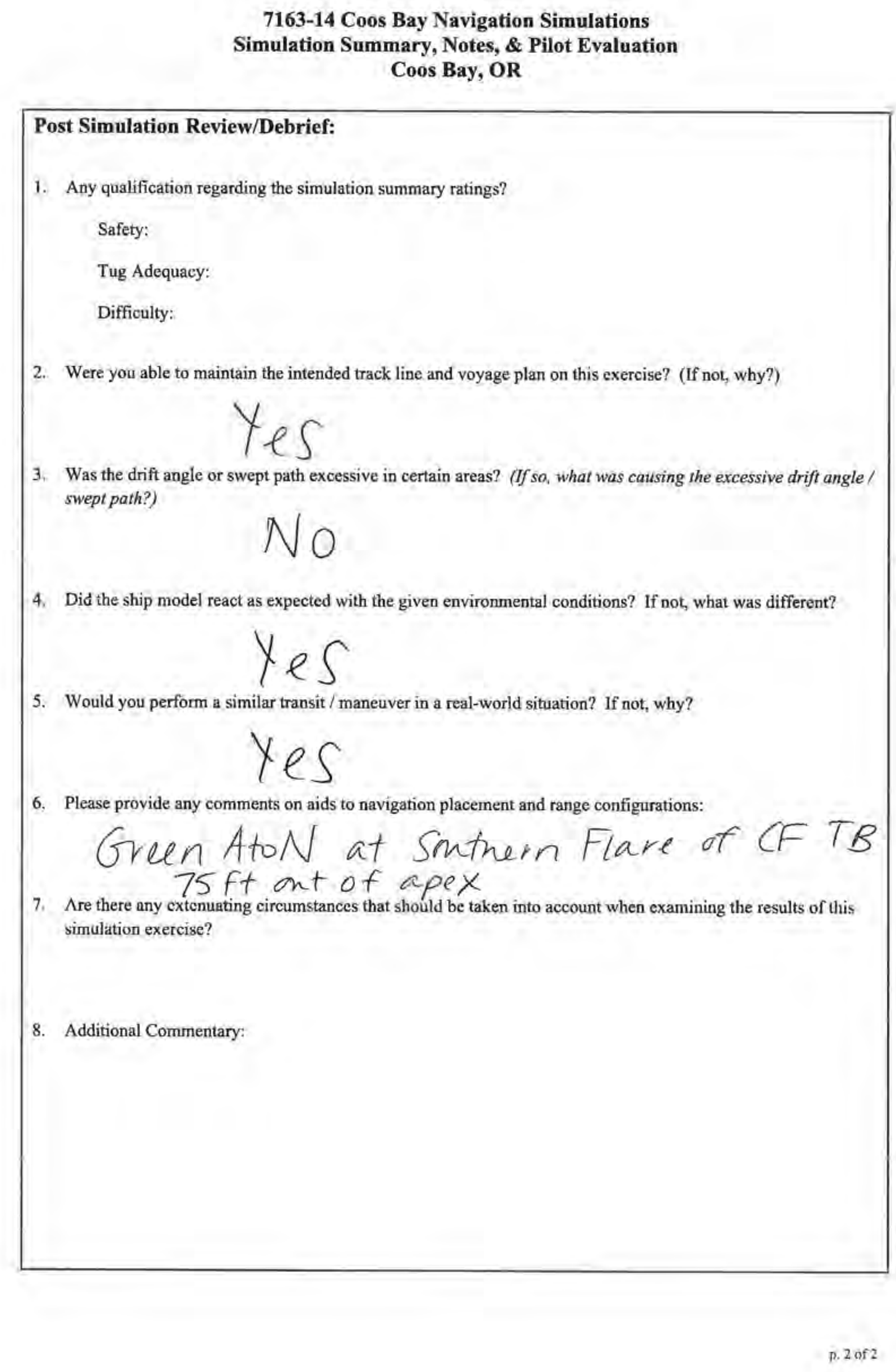
Offshore Wind *(Speed / Dir)*: 20 kts SSW
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: Flood 02:10
Water Level: +1.1m (+3.6 ft)

Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	3	[✓ 4]	5
Tug Adequacy *(5 is most adequate)*:	1	2	3	4	[✓ 5]
Run Difficulty *(5 is most difficult)*:	1	[✓ 2]	3	4	5



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

Safety:

Tug Adequacy:

Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

Yes

6. Please provide any comments on aids to navigation placement and range configurations:

Green AtoN at Southern Flare of CF TB
75 ft out of apex

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/6/2023
Simulation #: 4A
Pilot: Cpt. Richard Michael

Simulation Summary:

Simulation Layout: [✓ Without Project] PA 2023 Opt A PA 2023 Opt B

River Marker: *(Start)* CFS *(End)* RM 3 Direction of Transit: Inbound / [✓ Outbound]

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3) Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3)

Available Tug Power:

Tug #1: ASD 15
Tug #2: ASD15
Tug #3:
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 222.5 SSW 30 kts offshore / 222.5 SSW 20 kts

Wave Condition: NWSwell WSwell NW Moderate [✓ None]

Current *(stage / start time)*: hour before high water 05:20

Water Level: +1.1m +3.6ft

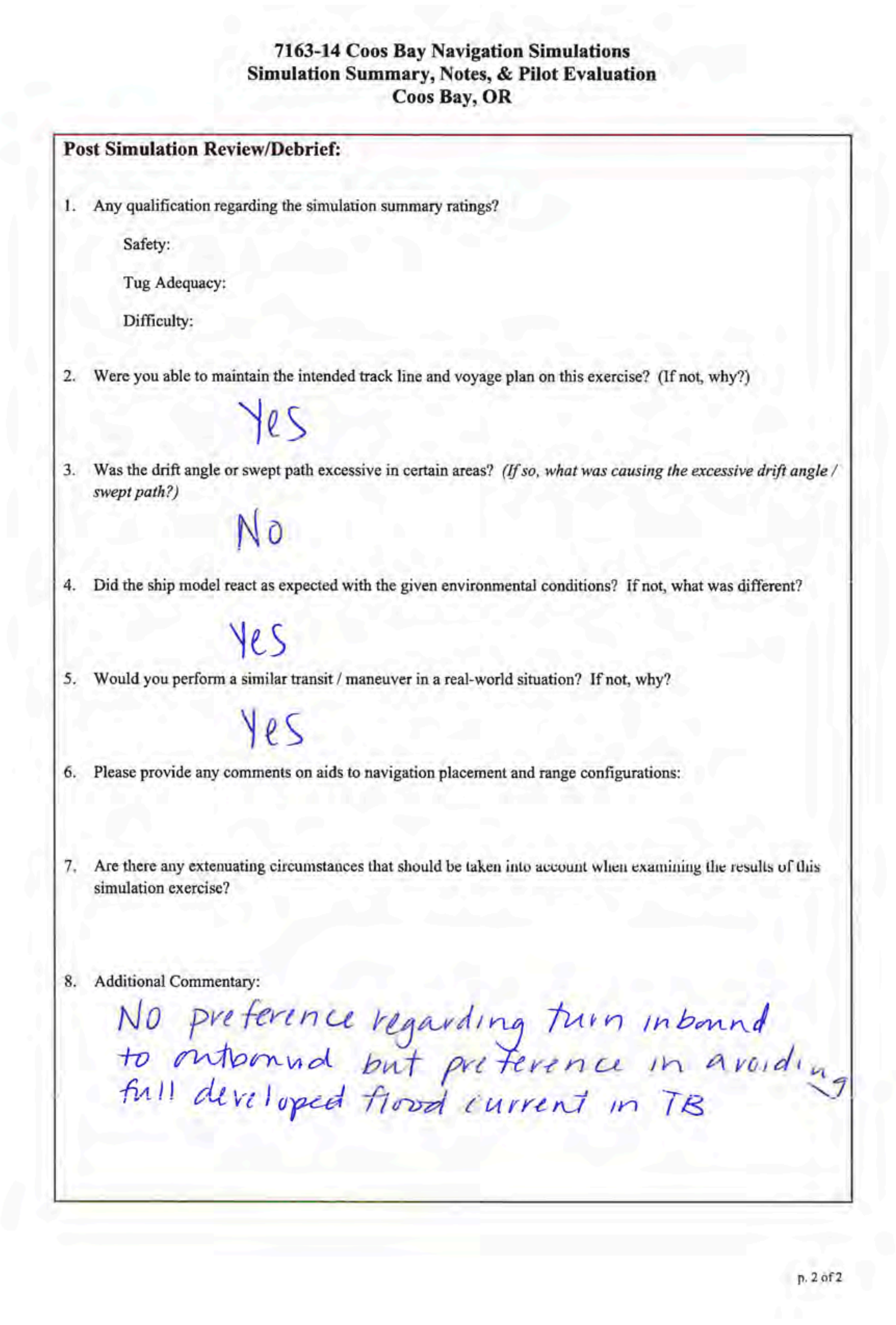
Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	3	[✓ 4]	5
Tug Adequacy *(5 is most adequate)*:	1	2	3	4	[✓ 5]
Run Difficulty *(5 is most difficult)*:	1	[✓ 2]	3	4	5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

   No preference regarding turn inbound to outbound but preference in avoiding full developed flood current in TB

p. 2 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/11/2023
Simulation #: 4B
Pilot: Cpt. Steve Woods

Simulation Summary:

Simulation Layout: [✓ Without Project] PA 2023 Opt A PA 2023 Opt B

River Marker: *(Start)* ~~3.0~~ CFS *(End)* ~~CFS~~ Buoy 14 Direction of Transit: ~~Inbound~~ / [✓ Outbound]

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3) Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3)

Available Tug Power:

Tug #1: ASD15 Tug1 Starboard bow
Tug #2: ASD15 Tug 2 Stern (Starboard quarter)
Tug #3: ____
Tug #4: ____

Environmental Conditions: 222.5

Offshore Wind *(Speed / Dir)*: 20 kt SSW
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: 1 Hour Before High Water 05:20
Water Level: +1.1m (+3.6ft)

Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	3	4	[✓ 5]
Tug Adequacy *(5 is most adequate)*:	1	2	3	4	[✓ 5]
Run Difficulty *(5 is most difficult)*:	[✓ 1]	2	3	4	5

p. 1 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

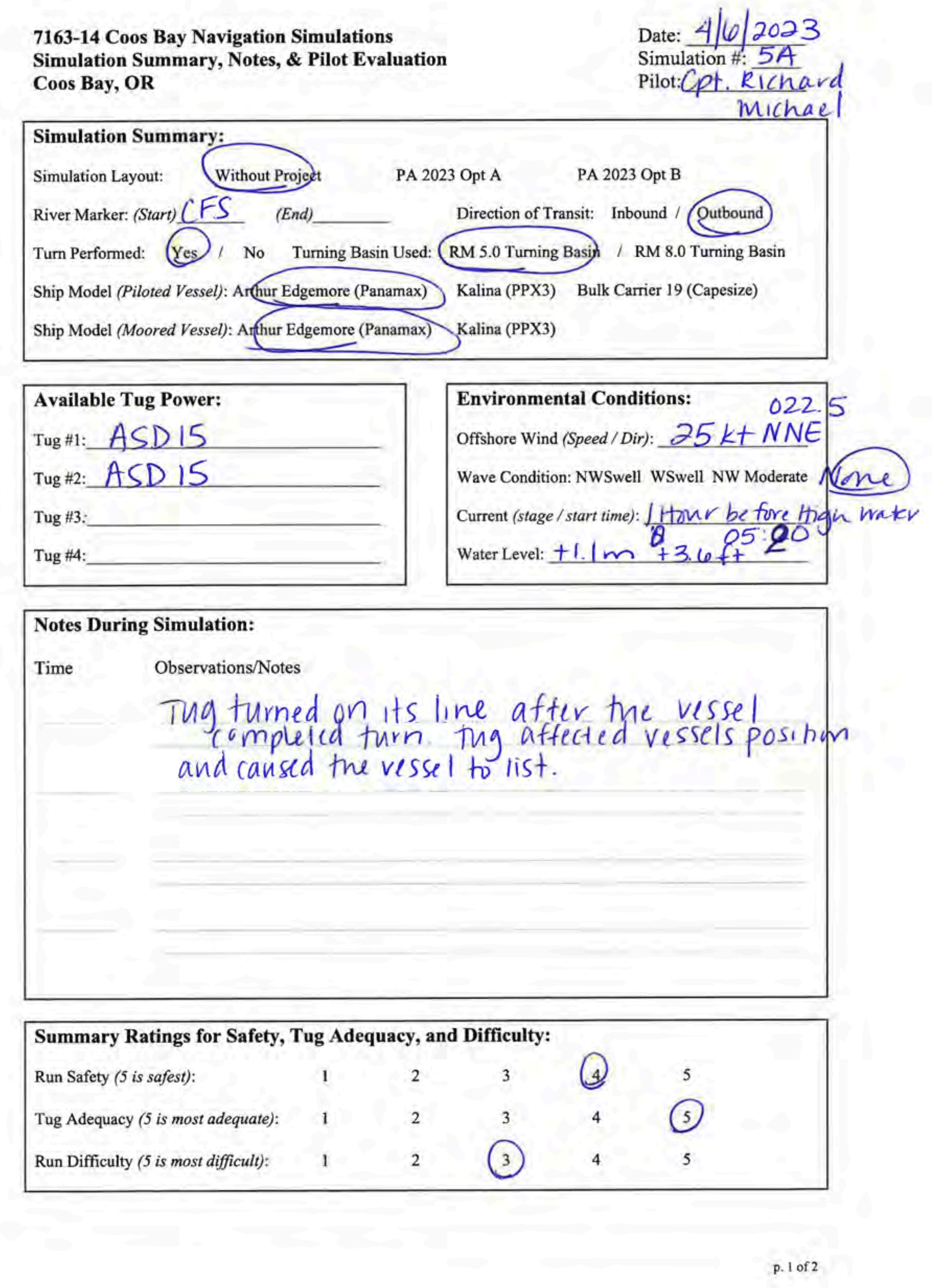
5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/6/2023
Simulation #: 5A
Pilot: Cpt. Richard Michael

Simulation Summary:

Simulation Layout: [✓ Without Project] PA 2023 Opt A PA 2023 Opt B

River Marker: *(Start)* CFS *(End)*_______ Direction of Transit: Inbound / [✓ Outbound]

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3) Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3)

Available Tug Power:

Tug #1: ASD15
Tug #2: ASD 15
Tug #3:_______
Tug #4:_______

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 25 kt NNE 022.5
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: 1 Hour before High water 05:20
Water Level: +1.1m +3.6ft

Notes During Simulation:

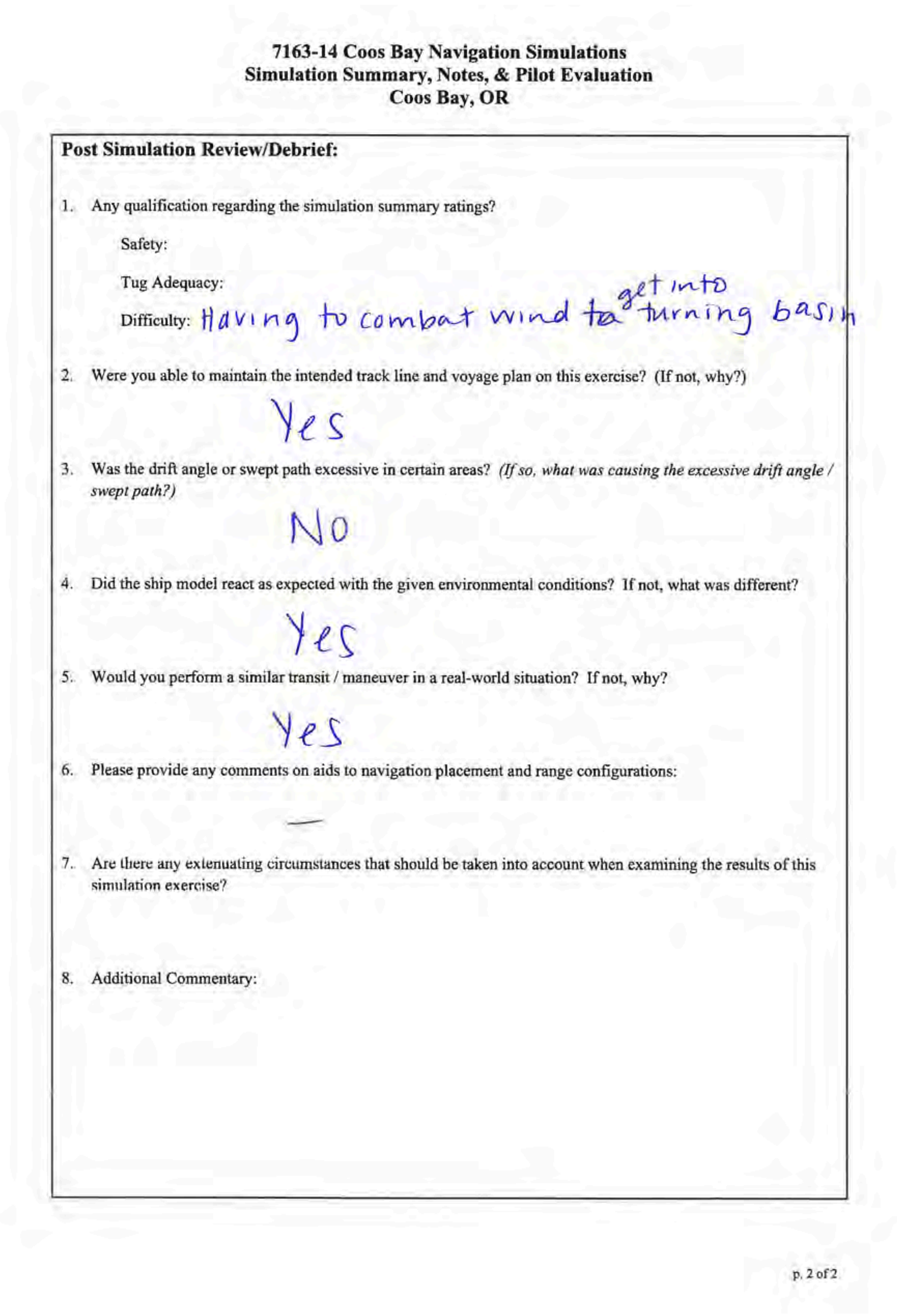
Time Observations/Notes

Tug turned on its line after the vessel completed turn. Tug affected vessels position and caused the vessel to list.

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	3	[✓ 4]	5
Tug Adequacy *(5 is most adequate)*:	1	2	3	4	[✓ 5]
Run Difficulty *(5 is most difficult)*:	1	2	[✓ 3]	4	5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

Safety:

Tug Adequacy:

Difficulty: Having to combat wind to get into turning basin

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

Yes

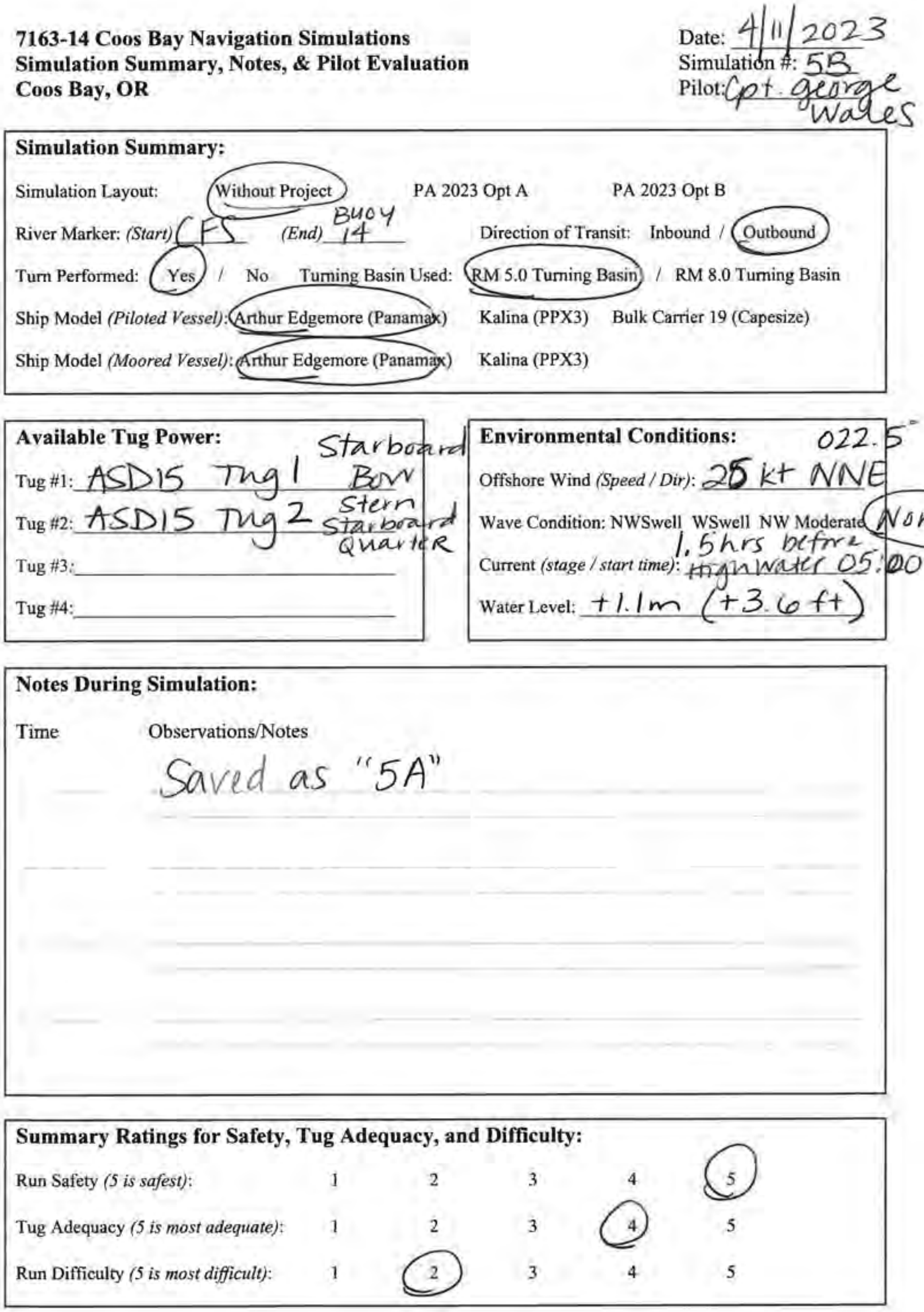
6. Please provide any comments on aids to navigation placement and range configurations:

—

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/11/2023
Simulation #: 5B
Pilot: Cpt. George Wales

Simulation Summary:

Simulation Layout: [✓ Without Project] PA 2023 Opt A PA 2023 Opt B

River Marker: *(Start)* CF *(End)* Buoy 14 Direction of Transit: Inbound / [✓ Outbound]

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3) Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: [✓ Arthur Edgemore (Panamax)] Kalina (PPX3)

Available Tug Power:

Tug #1: ASD15 Tug 1 Starboard Bow
Tug #2: ASD15 Tug 2 Stern Starboard Quarter
Tug #3:
Tug #4:

Environmental Conditions: 022.5°

Offshore Wind *(Speed / Dir)*: 25 kt NNE
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: 1.5hrs before High water 05:00
Water Level: +1.1m (+3.6ft)

Notes During Simulation:

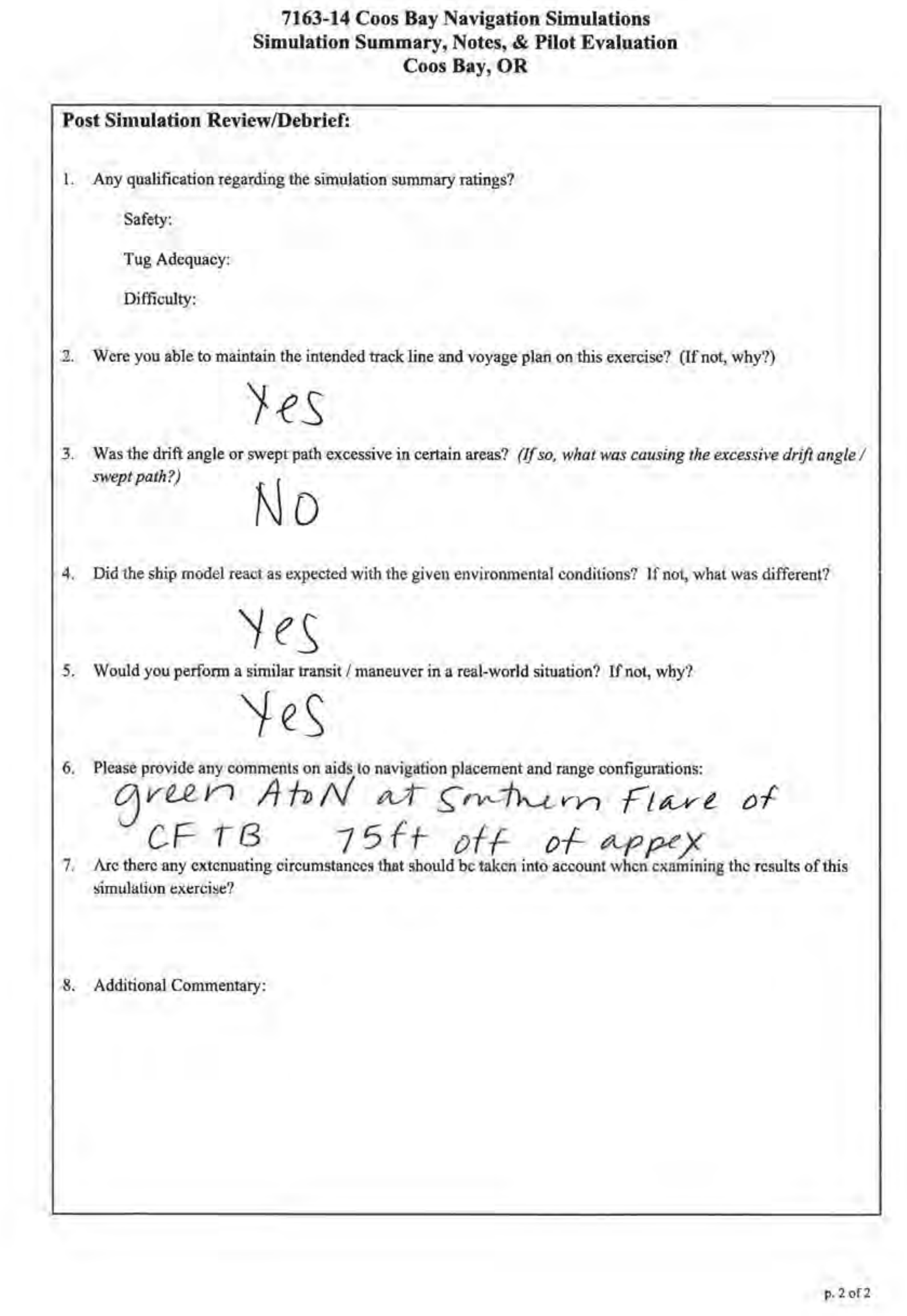
Time Observations/Notes

Saved as "5A"

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	3	4	[✓ 5]
Tug Adequacy *(5 is most adequate)*:	1	2	3	[✓ 4]	5
Run Difficulty *(5 is most difficult)*:	1	[✓ 2]	3	4	5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

   green AtoN at Southern Flare of CF TB 75ft off of appex

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/14/2023
Simulation #: 6B_~~Steve~~ George
Pilot: Cpt. ~~Steve~~ ~~[illegible]~~ george wales

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] v5 PA 2023 Opt B

River Marker: *(Start)* Upper ~~[illegible]~~ Jarvis *(End)* Roseburg Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: RM 5.0 Turning Basin / [✓ RM 8.0 Turning Basin]

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) Kalina (PPX3) [✓ Bulk Carrier 19 (Capesize)]

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) Kalina (PPX3)

Available Tug Power: TT1 Port Bow

Tug #1: Edward Moran 83t → ~~reduced to 80~~

Tug #2: Edward Moran 83t → ~~reduced to 80~~ TT2 center led aft.

Tug #3:

Tug #4:

Environmental Conditions: 222.5

Offshore Wind *(Speed / Dir)*: 20kt SSW

Wave Condition: NWSwell WSwell NW Moderate [✓ None]

Current *(stage / start time)*: Flood 02:20

Water Level: [illegible] +1.1m (3.6 ft)

Notes During Simulation:

Time Observations/Notes

Tug 2 replaced with TT3

Model Bulk Carrier 19 MN 2.3.3

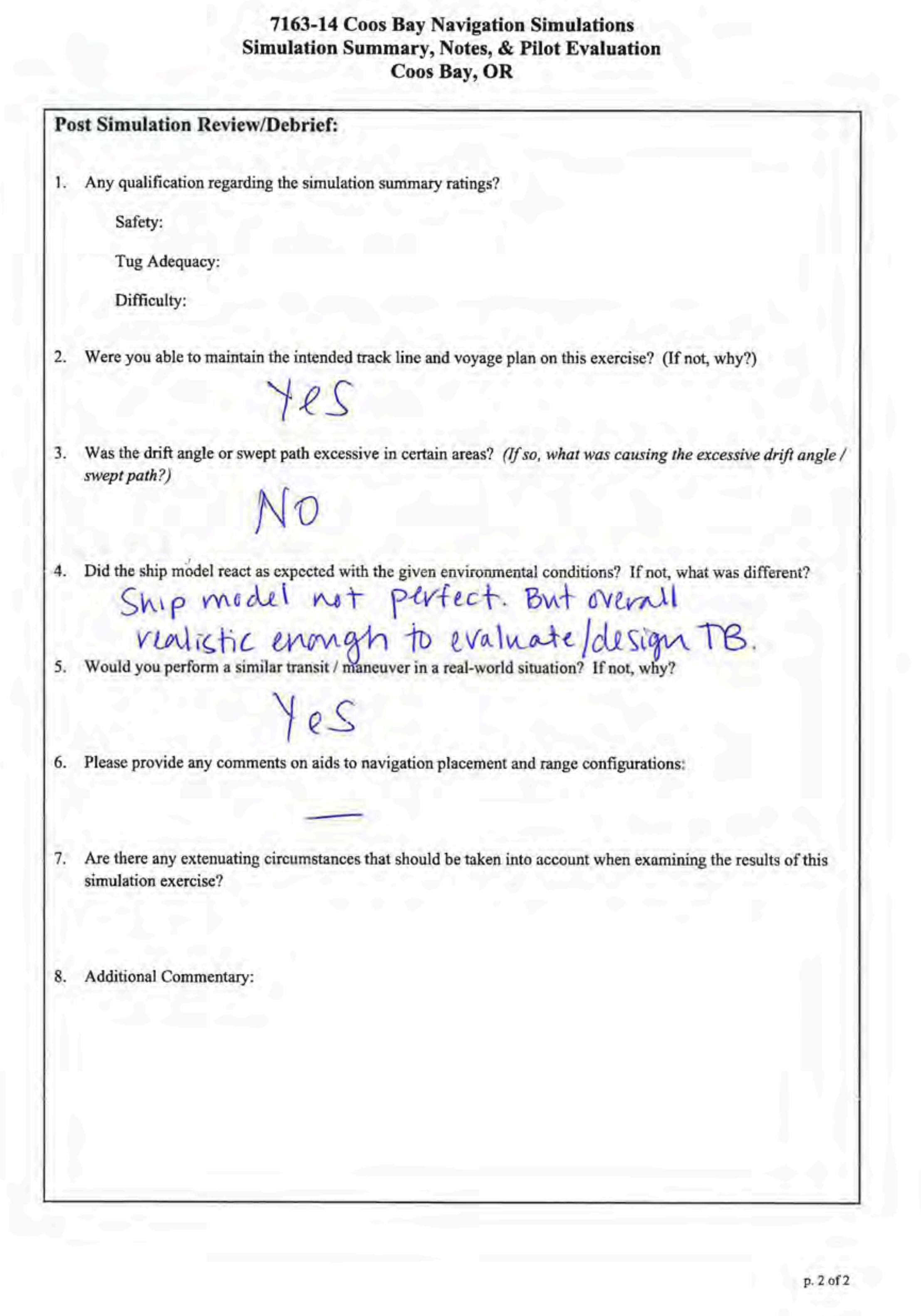
Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 4 [✓ 5]

Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]

Run Difficulty *(5 is most difficult)*: [✓ 1] 2 3 4 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Ship model not perfect. But overall realistic enough to evaluate/design TB.

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

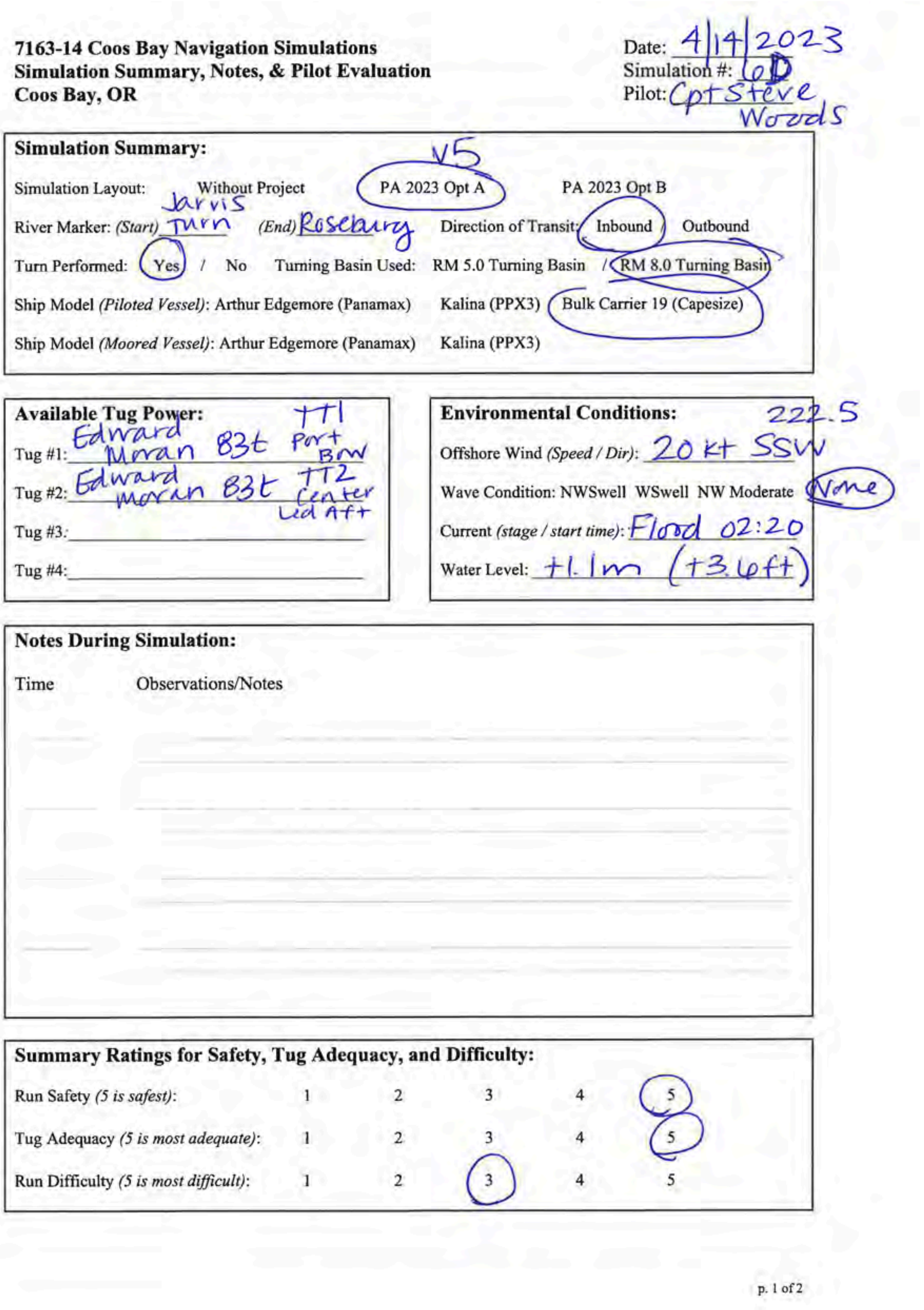
6. Please provide any comments on aids to navigation placement and range configurations:

   —

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4|14|2023
Simulation #: 6D
Pilot: Cpt Steve Woods

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] v5 PA 2023 Opt B

River Marker: *(Start)* Jarvis Turn *(End)* Roseburg Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: RM 5.0 Turning Basin / [✓ RM 8.0 Turning Basin]

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) Kalina (PPX3) [✓ Bulk Carrier 19 (Capesize)]

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) Kalina (PPX3)

Available Tug Power:

Tug #1: Edward Moran 83t TT1 Port Bow
Tug #2: Edward Moran 83t TT2 Center Lead Aft
Tug #3:
Tug #4:

Environmental Conditions: 222.5

Offshore Wind *(Speed / Dir)*: 20 kt SSW
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: Flood 02:20
Water Level: +1.1m (+3.6ft)

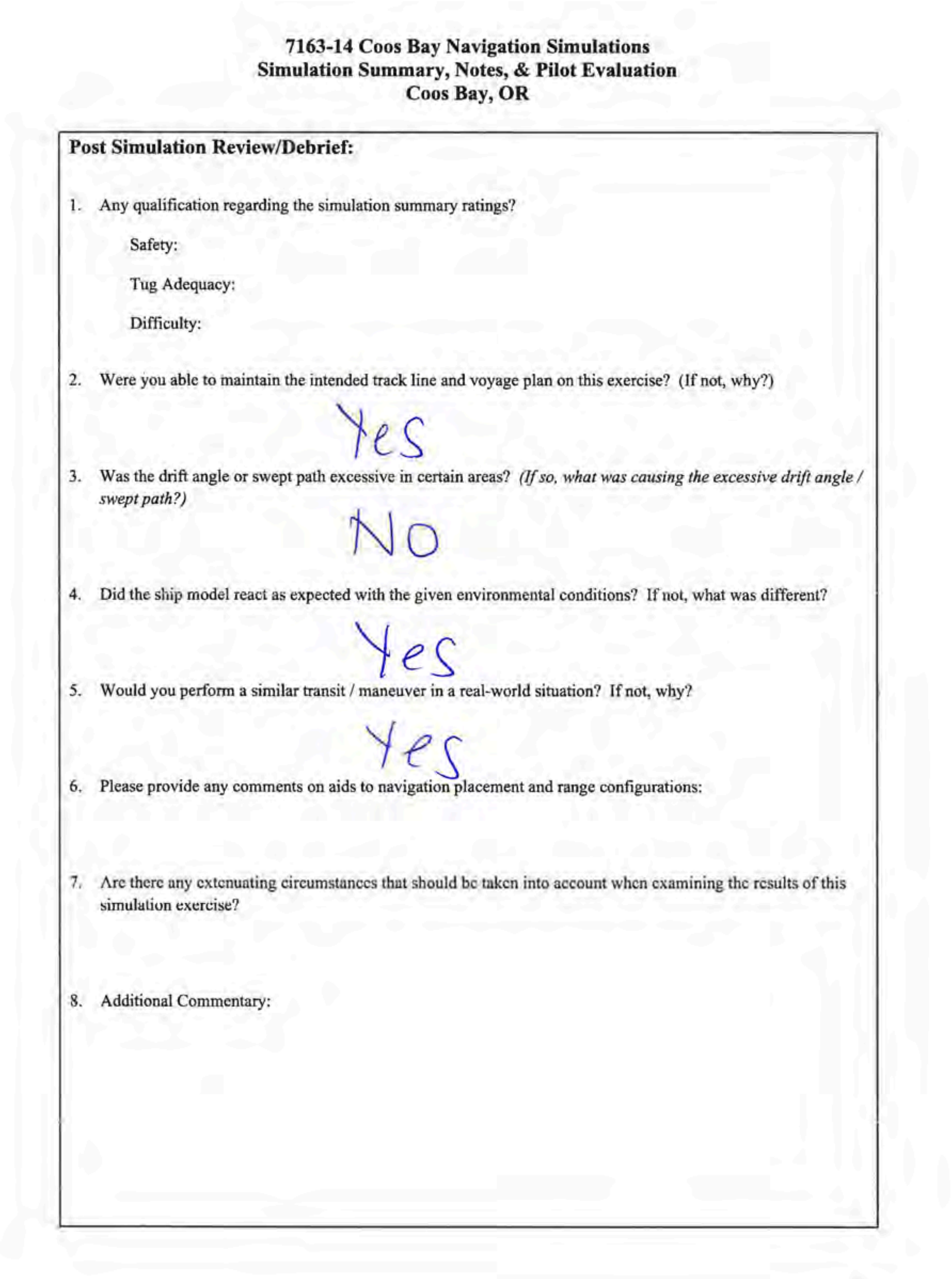
Notes During Simulation:

Time	Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 4 [✓ 5]
Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]
Run Difficulty *(5 is most difficult)*: 1 2 [✓ 3] 4 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

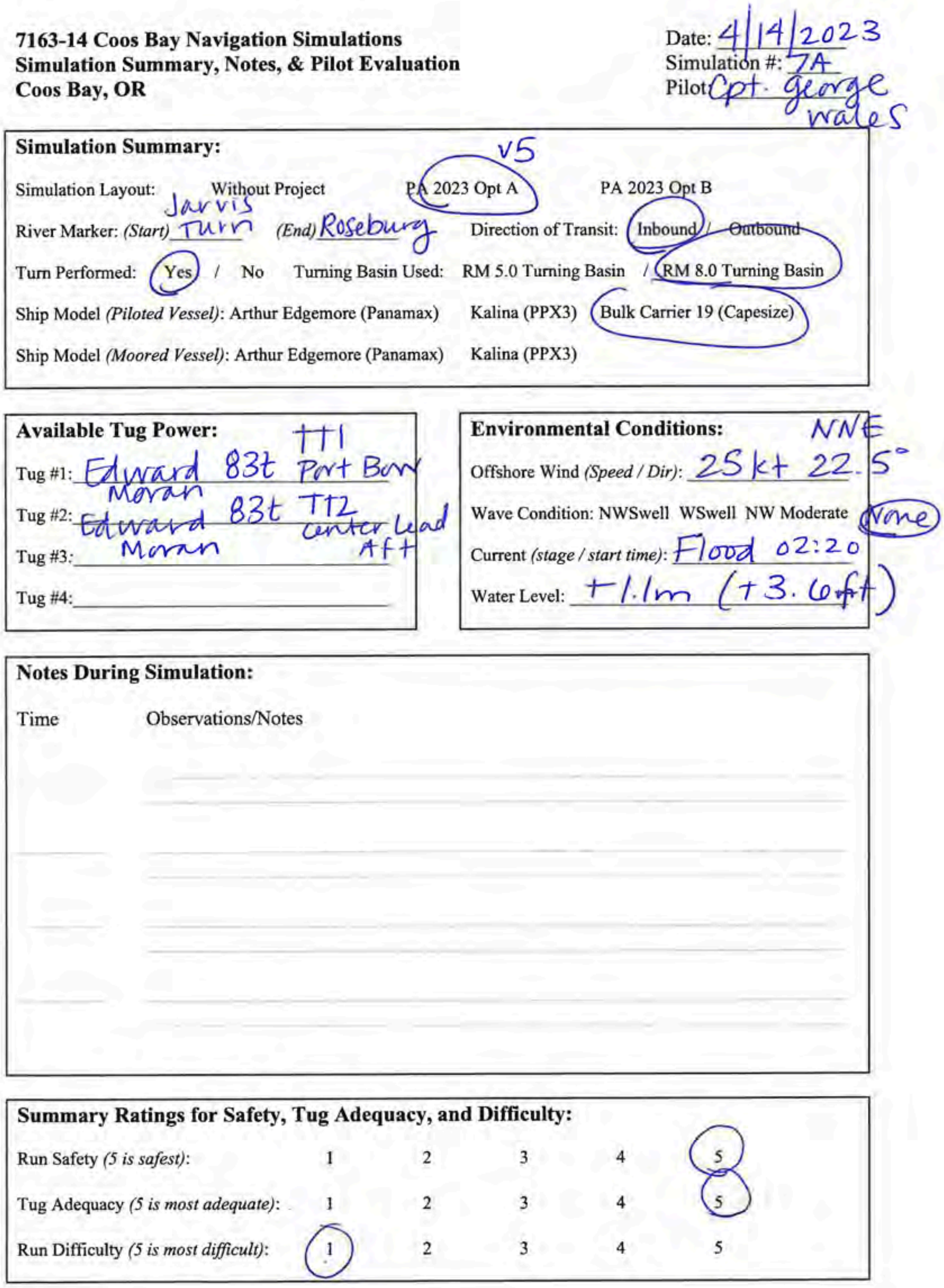
   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/14/2023
Simulation #: 7A
Pilot: Cpt. George Wales

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] v5 PA 2023 Opt B

River Marker: *(Start)* Jarvis Turn *(End)* Roseburg Direction of Transit: [✓ Inbound] / ~~Outbound~~

Turn Performed: [✓ Yes] / No Turning Basin Used: RM 5.0 Turning Basin / [✓ RM 8.0 Turning Basin]

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) Kalina (PPX3) [✓ Bulk Carrier 19 (Capesize)]

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) Kalina (PPX3)

Available Tug Power:

Tug #1: Edward Moran 83t TT1 Port Bow
Tug #2: Edward Moran 83t TT2 center Lead Aft
Tug #3:
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 25kt 22.5° NNE
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: Flood 02:20
Water Level: +1.1m (+3.6ft)

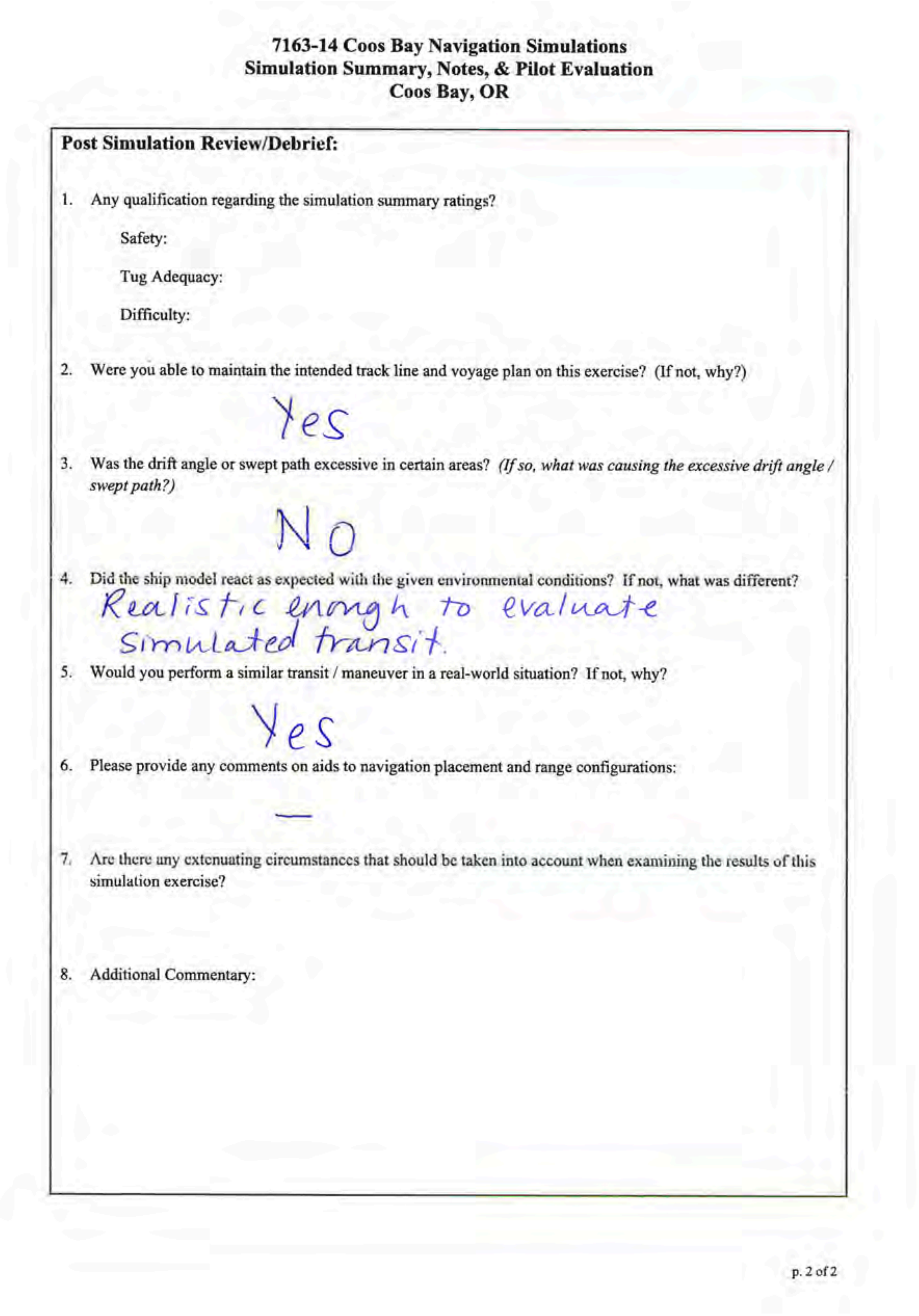
Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 4 [✓ 5]
Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]
Run Difficulty *(5 is most difficult)*: [✓ 1] 2 3 4 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Realistic enough to evaluate simulated transit.

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

   —

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/14/2023
Simulation #: 7B
Pilot: Cpt ~~George~~ ~~Waters~~ Steve Woods

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] v5 PA 2023 Opt B

River Marker: *(Start)* Jarvis Turn *(End)* Roseburg Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: RM 5.0 Turning Basin / [✓ RM 8.0 Turning Basin]

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) Kalina (PPX3) [✓ Bulk Carrier 19 (Capesize)]

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) Kalina (PPX3)

Available Tug Power:

Tug #1: Edward Moran 83t TT1 Port Bow

Tug #2: Edward Moran 83t TT2 ~~Starboard~~ Center lead aft + Port quarter

Tug #3:

Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 25 kt 22.5 NNE

Wave Condition: NWSwell WSwell NW Moderate [✓ None]

Current *(stage / start time)*: Flood 02:20

Water Level: +1.1m (+3.6ft)

Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	3	[✓ 4]	5
Tug Adequacy *(5 is most adequate)*:	1	2	3	4	[✓ 5]
Run Difficulty *(5 is most difficult)*:	1	2	[✓ 3]	4	5

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   NO

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

   —

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

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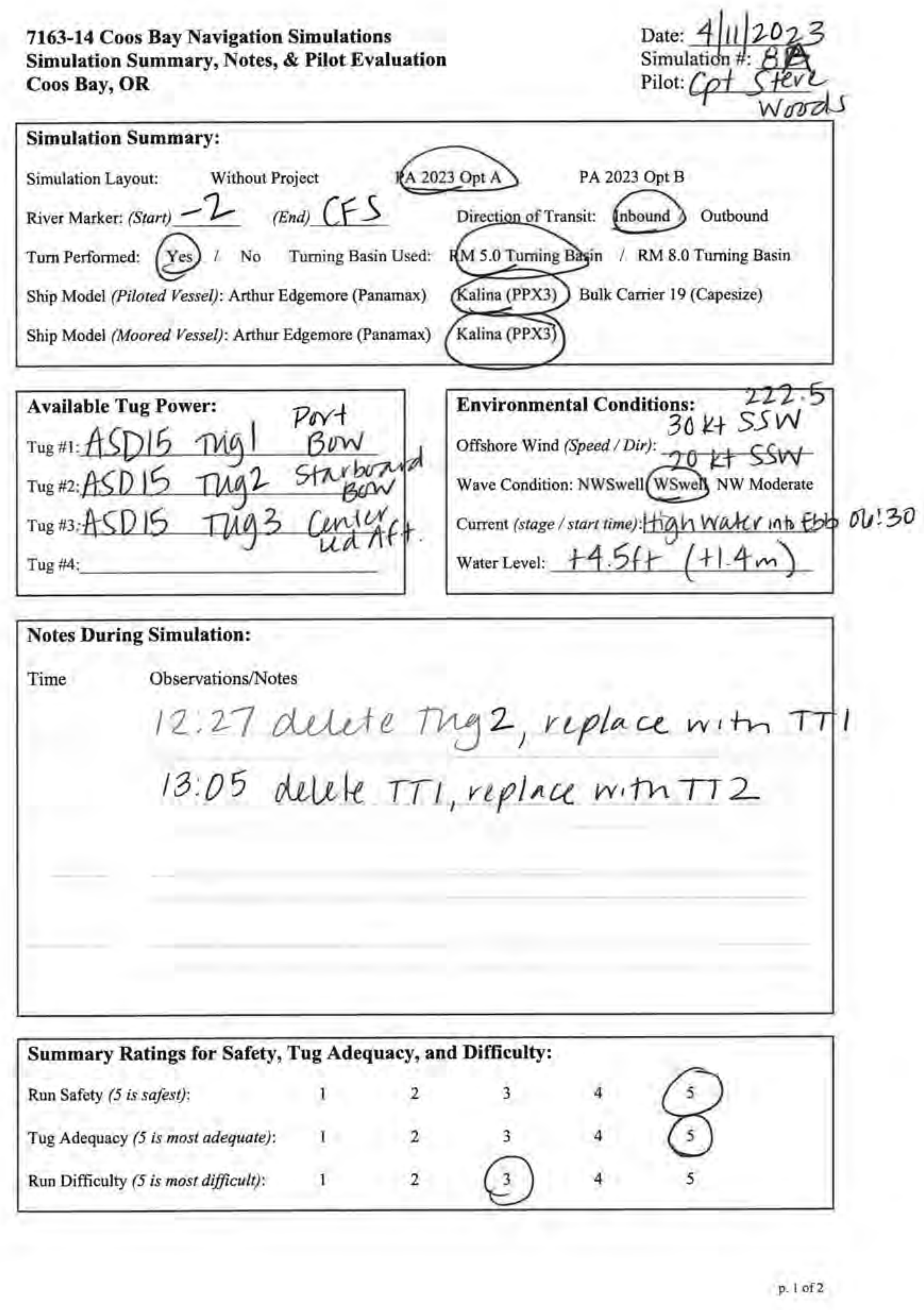


7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/11/2023
Simulation #: 8A
Pilot: Cpt Steve Woods

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* -2 *(End)* CFS

Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No

Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Tug1 Port Bow
Tug #2: ASD15 Tug2 Starboard Bow
Tug #3: ASD15 Tug3 Center and Aft.
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: ~~20 kt SSW~~ 30 kt SSW 222.5
Wave Condition: NWSwell [✓ WSwell] NW Moderate
Current *(stage / start time)*: High Water into Ebb 06:30
Water Level: +4.5ft (+1.4m)

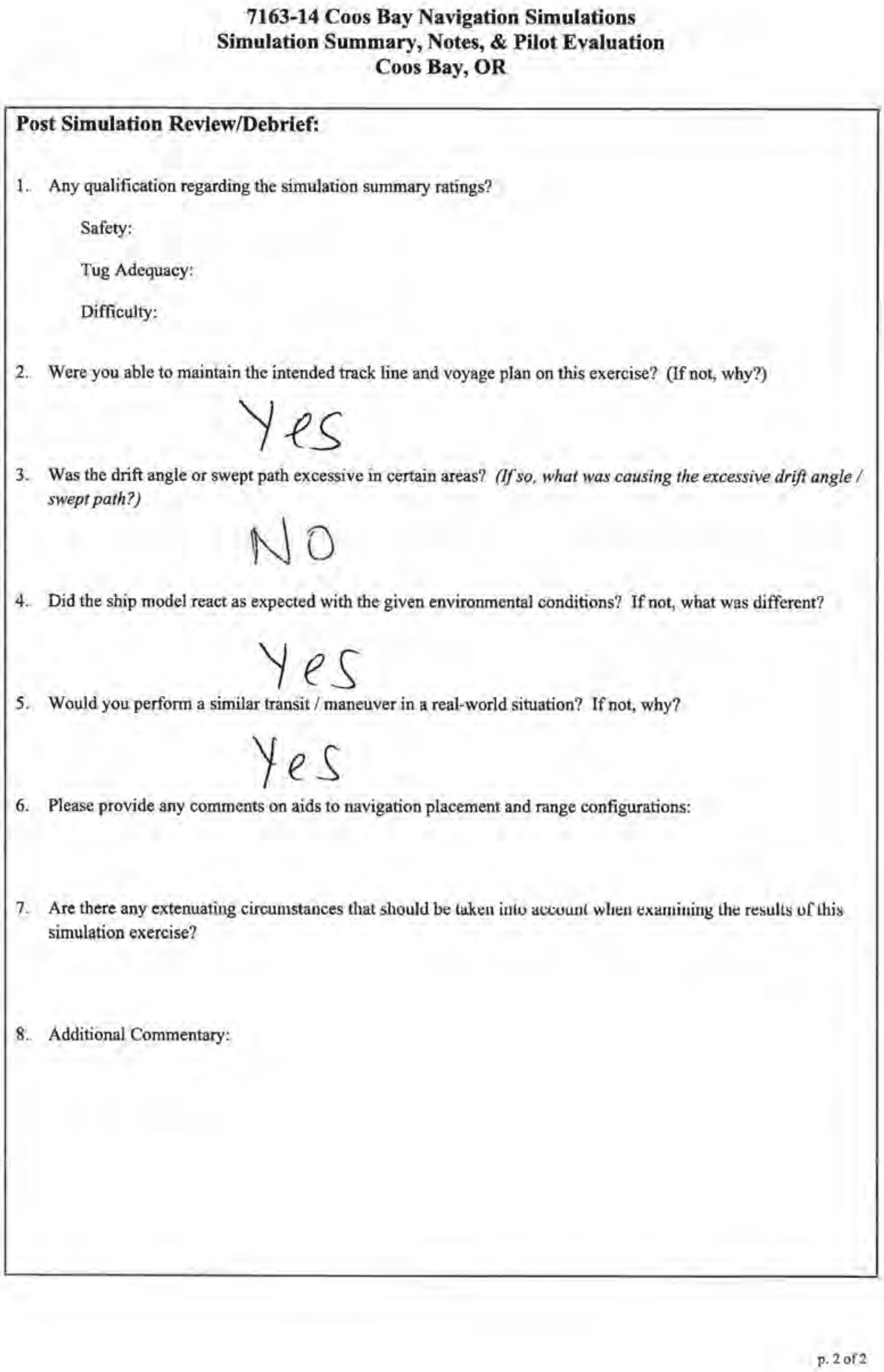
Notes During Simulation:

Time	Observations/Notes
	12:27 delete Tug2, replace with TT1
	13:05 delete TT1, replace with TT2

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	3	4	[✓ 5]
Tug Adequacy *(5 is most adequate)*:	1	2	3	4	[✓ 5]
Run Difficulty *(5 is most difficult)*:	1	2	[✓ 3]	4	5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   NO

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

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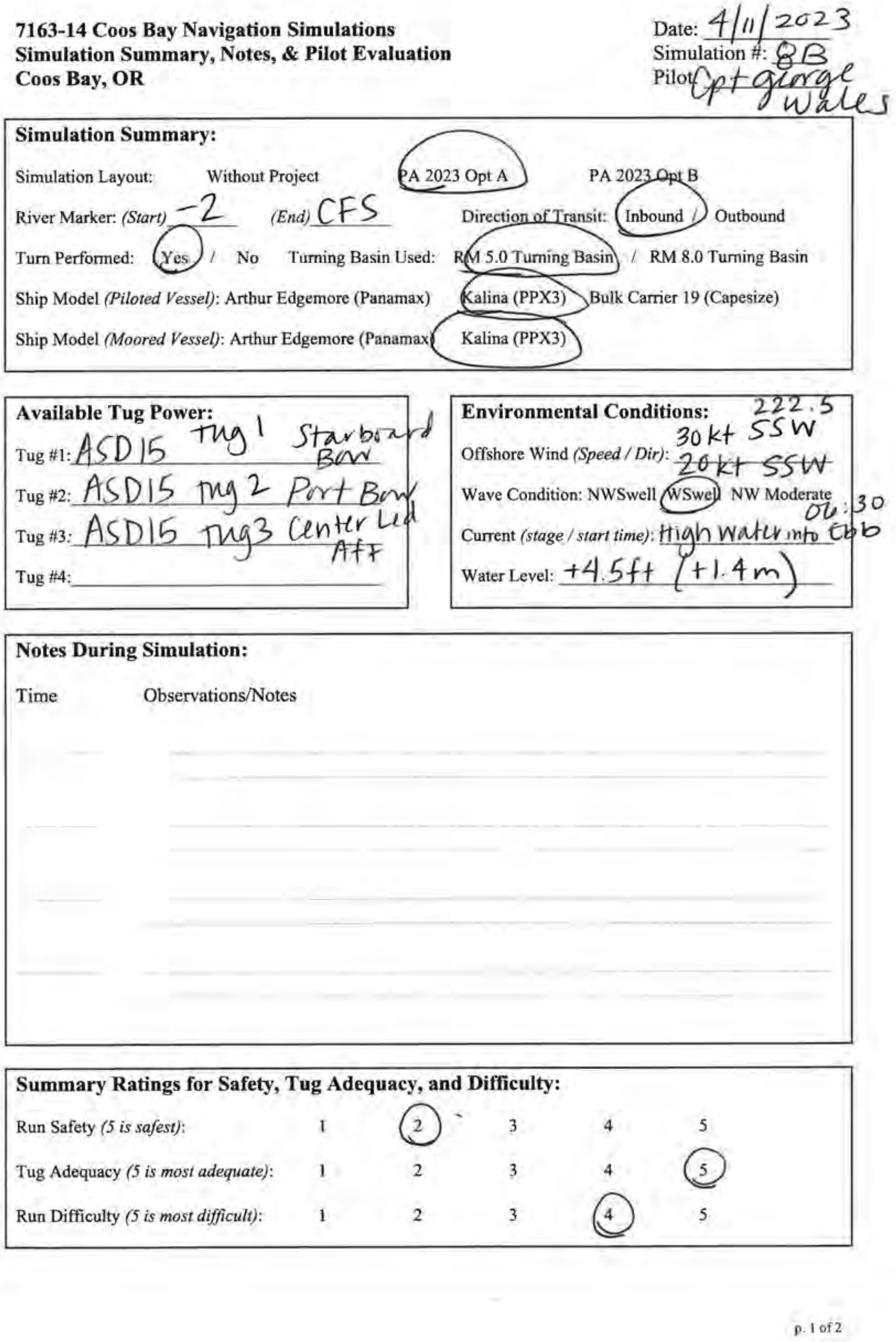


7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/11/2023
Simulation #: 8B
Pilot: Cpt george wales

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* -2 *(End)* CFS

Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No

Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Tug 1 Starboard Bow

Tug #2: ASD15 Tug 2 Port Bow

Tug #3: ASD15 Tug3 Center Lead Aft

Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 222.5 30 kt SSW ~~20 kt SSW~~

Wave Condition: NWSwell / [✓ WSwell] NW Moderate

Current *(stage / start time)*: High water into Ebb 06:30

Water Level: +4.5ft (+1.4m)

Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	[✓ 2]	3	4	5
Tug Adequacy *(5 is most adequate)*:	1	2	3	4	[✓ 5]
Run Difficulty *(5 is most difficult)*:	1	2	3	[✓ 4]	5

p. 1 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

Safety:

Tug Adequacy:

Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

Yes with familiarity

6. Please provide any comments on aids to navigation placement and range configurations:

10A not sure in an affective location

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

Ratings influenced by pilot approach

8. Additional Commentary:

Came into entrance turn too fast. and Started turn too early

Overall Pilot would take different approach to maneuver.

p. 2 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/12/2023
Simulation #: 9A
Pilot: Cpt. Steve Woods

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* -2 *(End)* CFS

Direction of Transit [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No

Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Tug1 Port Bow
Tug #2: ASD15 Tug2 Starboard Bow
Tug #3: ASD 15 Tug3 Center Lead Aft
Tug #4:

Environmental Conditions:

337.5

Offshore Wind *(Speed / Dir)*: 25kt NNW

Wave Condition [✓ NWSwell] WSwell NW Moderate

Current *(stage / start time)*: High Water into Ebb 06:30

Water Level: +1.4m (+4.5ft)

Notes During Simulation:

Time Observations/Notes

Tug 2 replaced with TT1 in turning basin

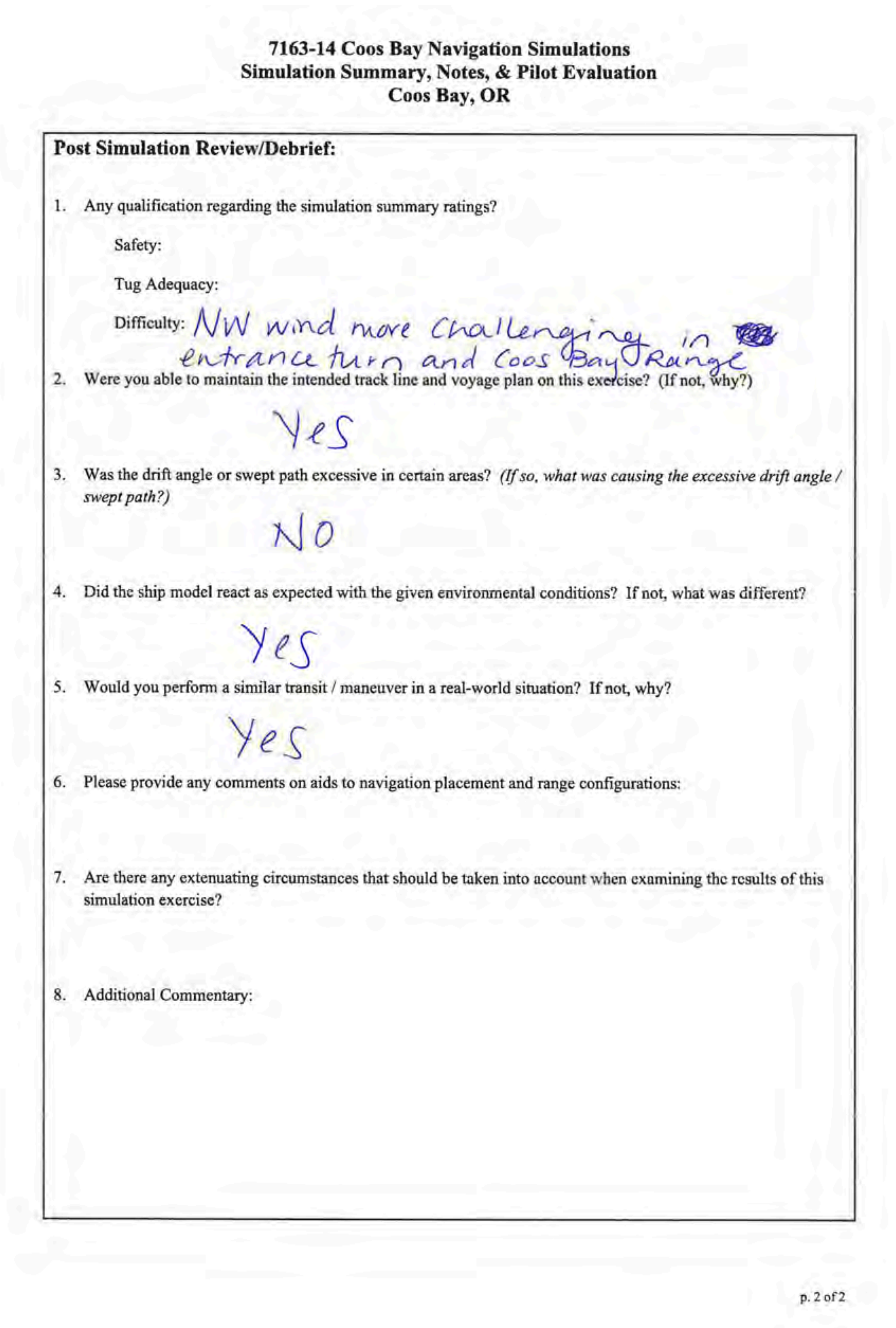
Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 4 [✓ 5]

Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]

Run Difficulty *(5 is most difficult)*: 1 2 [✓ 3] 4 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty: NW wind more challenging in entrance turn and Coos Bay Range

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   NO

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

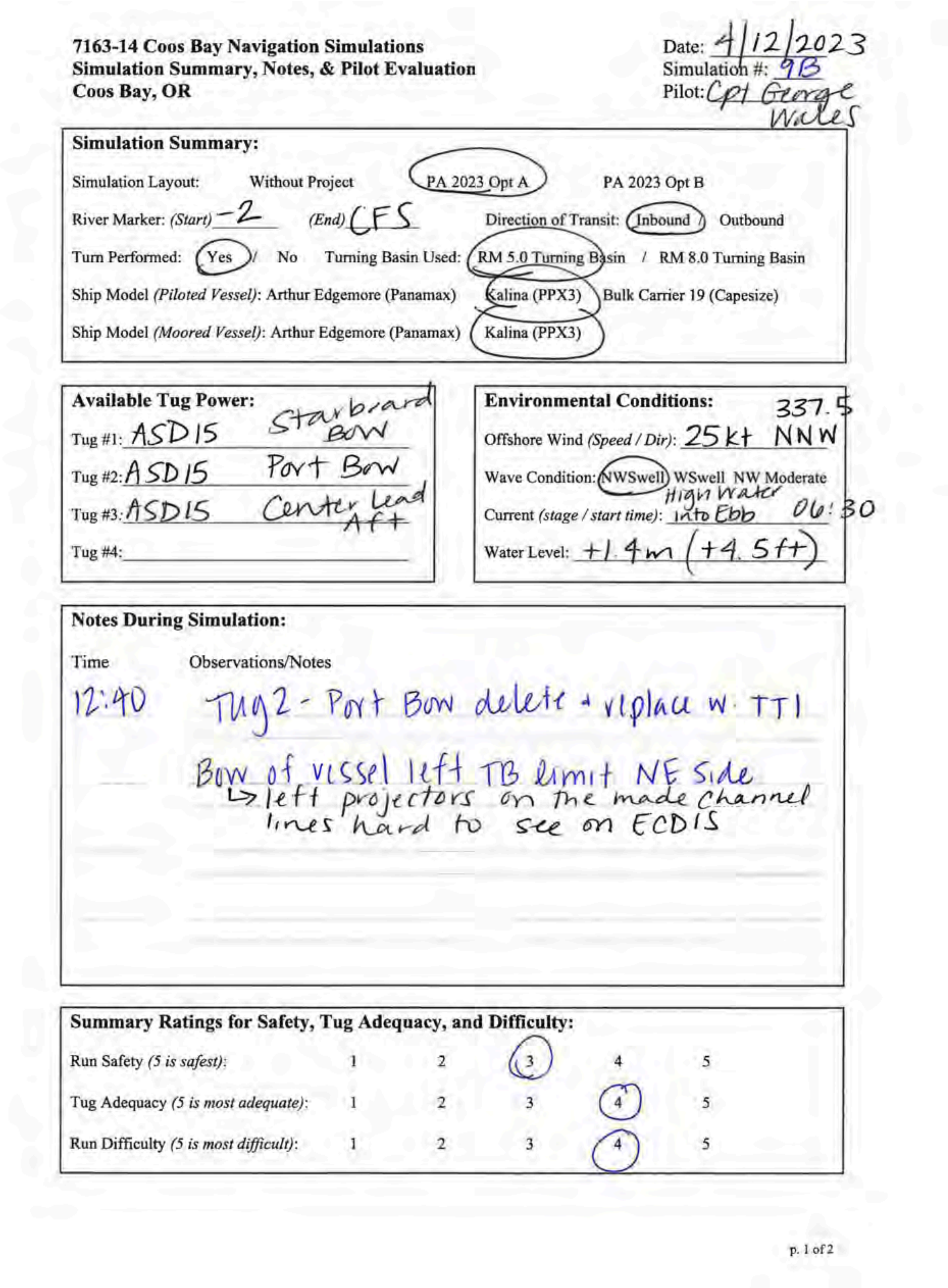
   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/12/2023
Simulation #: 9B
Pilot: Cpt George Wales

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* -2 *(End)* CFS

Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No

Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Starbroard Bow
Tug #2: ASD15 Port Bow
Tug #3: ASD15 Center Lead Aft
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 25 kt NNW 337.5

Wave Condition: [✓ NWSwell] WSwell NW Moderate

Current *(stage / start time)*: High Water into Ebb 06:30

Water Level: +1.4m (+4.5ft)

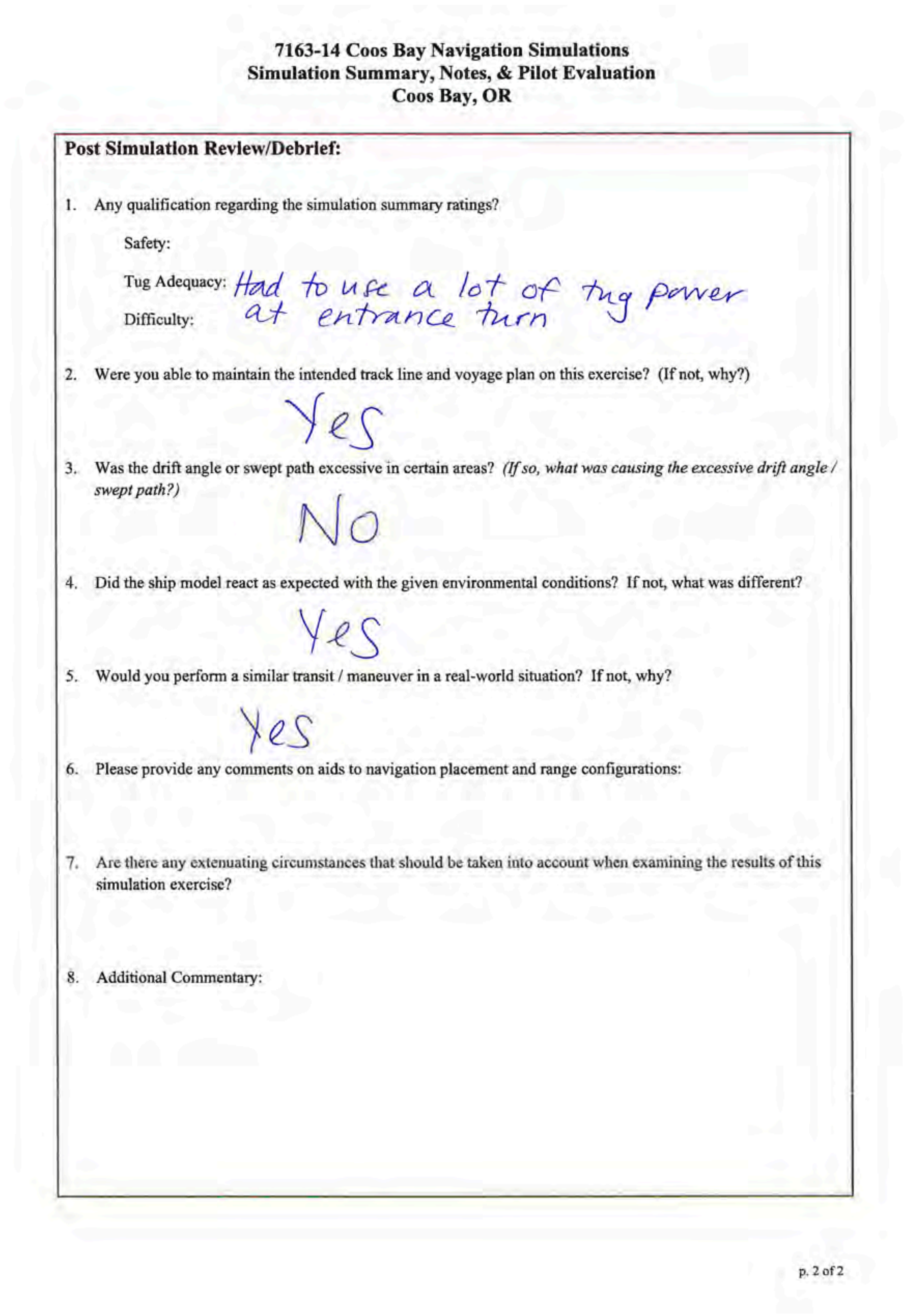
Notes During Simulation:

Time	Observations/Notes
12:40	Tug2 - Port Bow delete + replace w. TT1
	Bow of vessel left TB limit NE Side ↳ left projectors on the made channel lines hard to see on ECDIS

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	[✓ 3]	4	5
Tug Adequacy *(5 is most adequate)*:	1	2	3	[✓ 4]	5
Run Difficulty *(5 is most difficult)*:	1	2	3	[✓ 4]	5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy: Had to use a lot of tug power at entrance turn

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

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7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/11/2023
Simulation #: 10A
Pilot: Cpt Steve Woods

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* 3 *(End)* CFS Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Tug 1 Port Bow
Tug #2: ASD15 Tug 2 Starboard Bow
Tug #3: ASD15 Tug 3 Center Lead Aft
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 25kt NNE 022.5
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: High Water into Ebb 07:20
Water Level: +1.4m (+4.5ft)

Notes During Simulation:

Time Observations/Notes

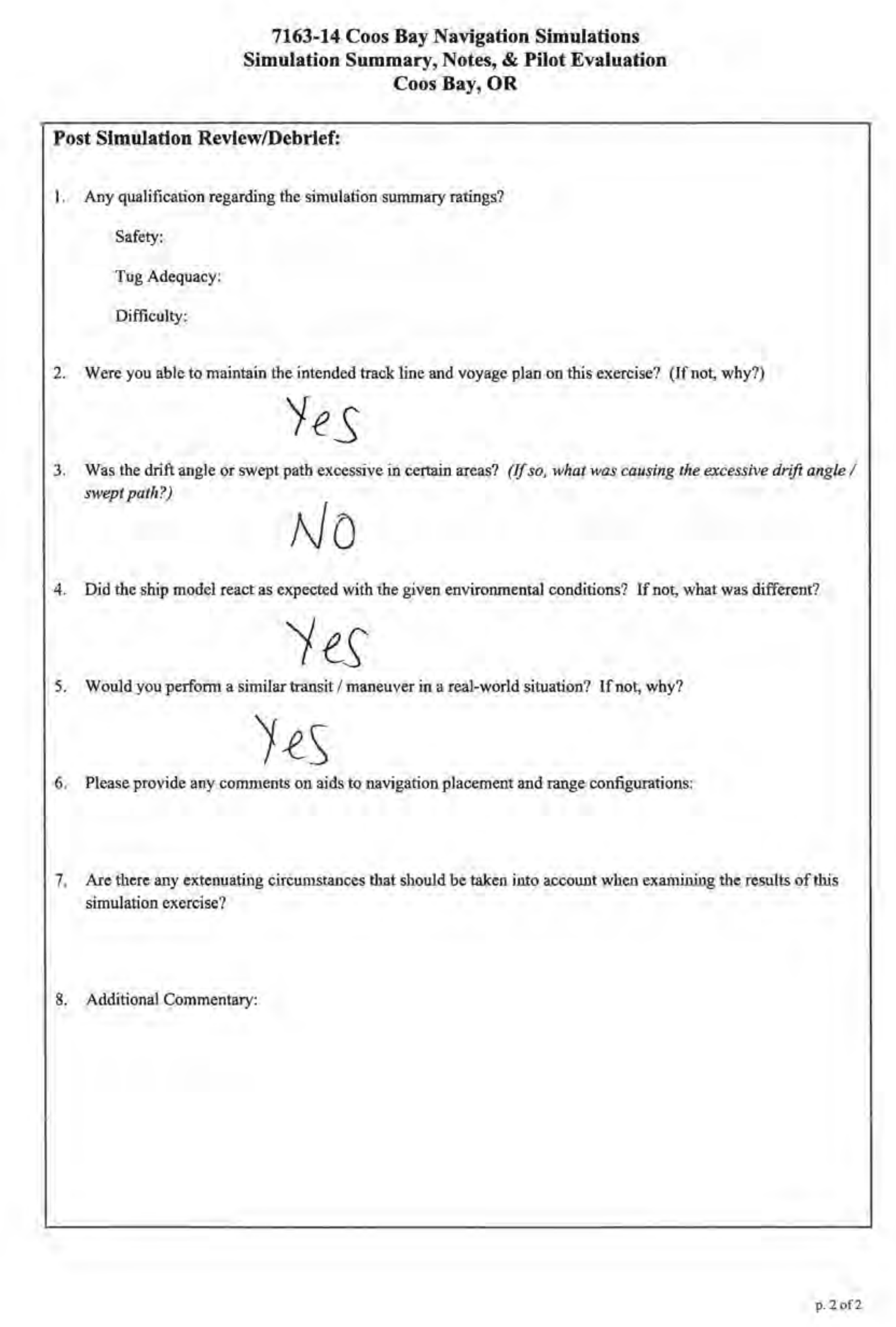
Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 4 [✓ 5]

Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]

Run Difficulty *(5 is most difficult)*: 1 2 [✓ 3] 4 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   NO

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

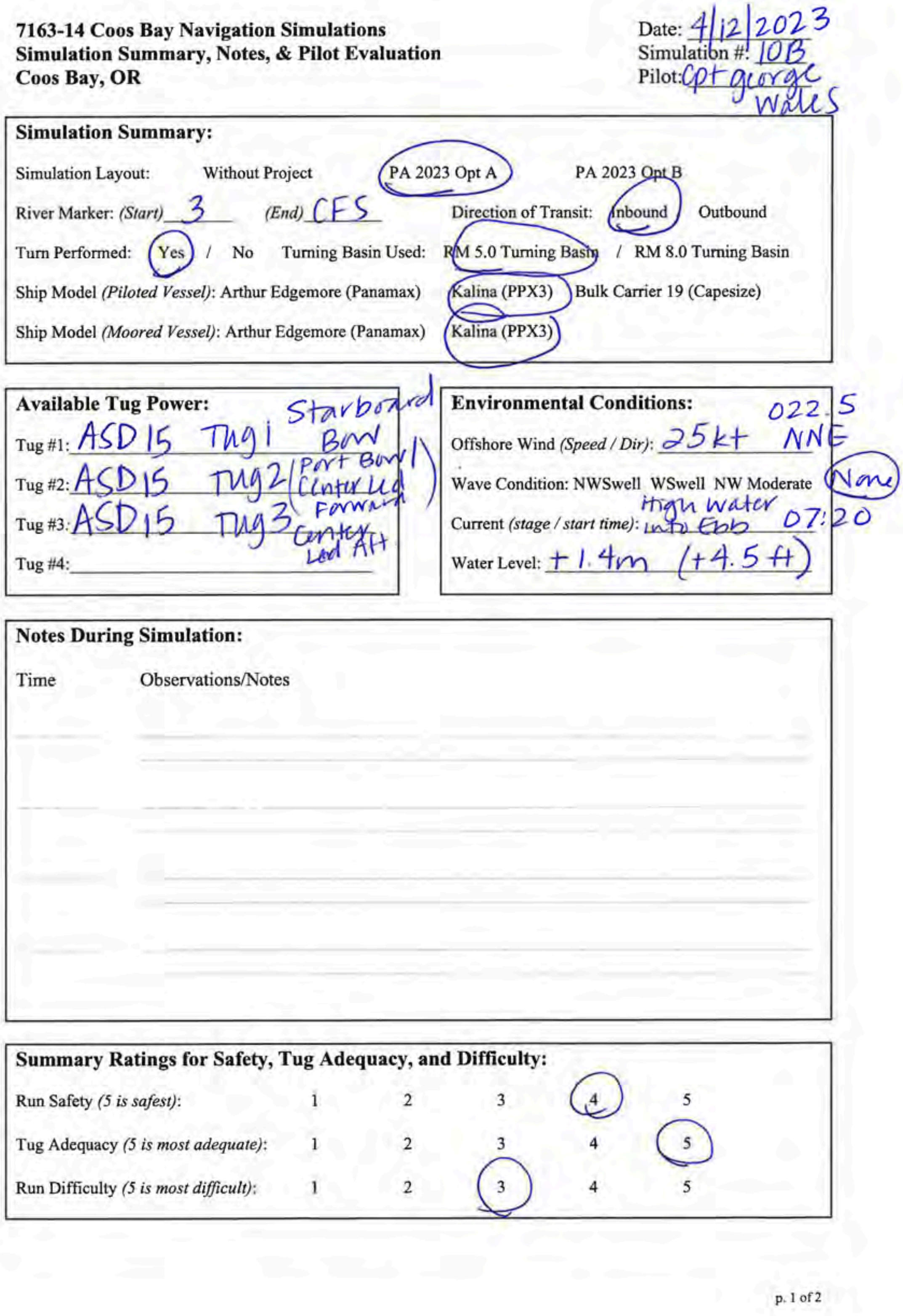
   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/12/2023
Simulation #: 10B
Pilot: Cpt george Wales

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* 3 *(End)* CFS Direction of Transit: [✓ Inbound] Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD 15 Tug 1 Starboard Bow
Tug #2: ASD 15 Tug 2 (Port Bow / Center Lead)
Tug #3: ASD 15 Tug 3 Forward Center Lead Aft
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 25 kt NNE 022.5
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: High water into Ebb 07:20
Water Level: +1.4m (+4.5 ft)

Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 [✓ 4] 5
Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]
Run Difficulty *(5 is most difficult)*: 1 2 [✓ 3] 4 5

p. 1 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

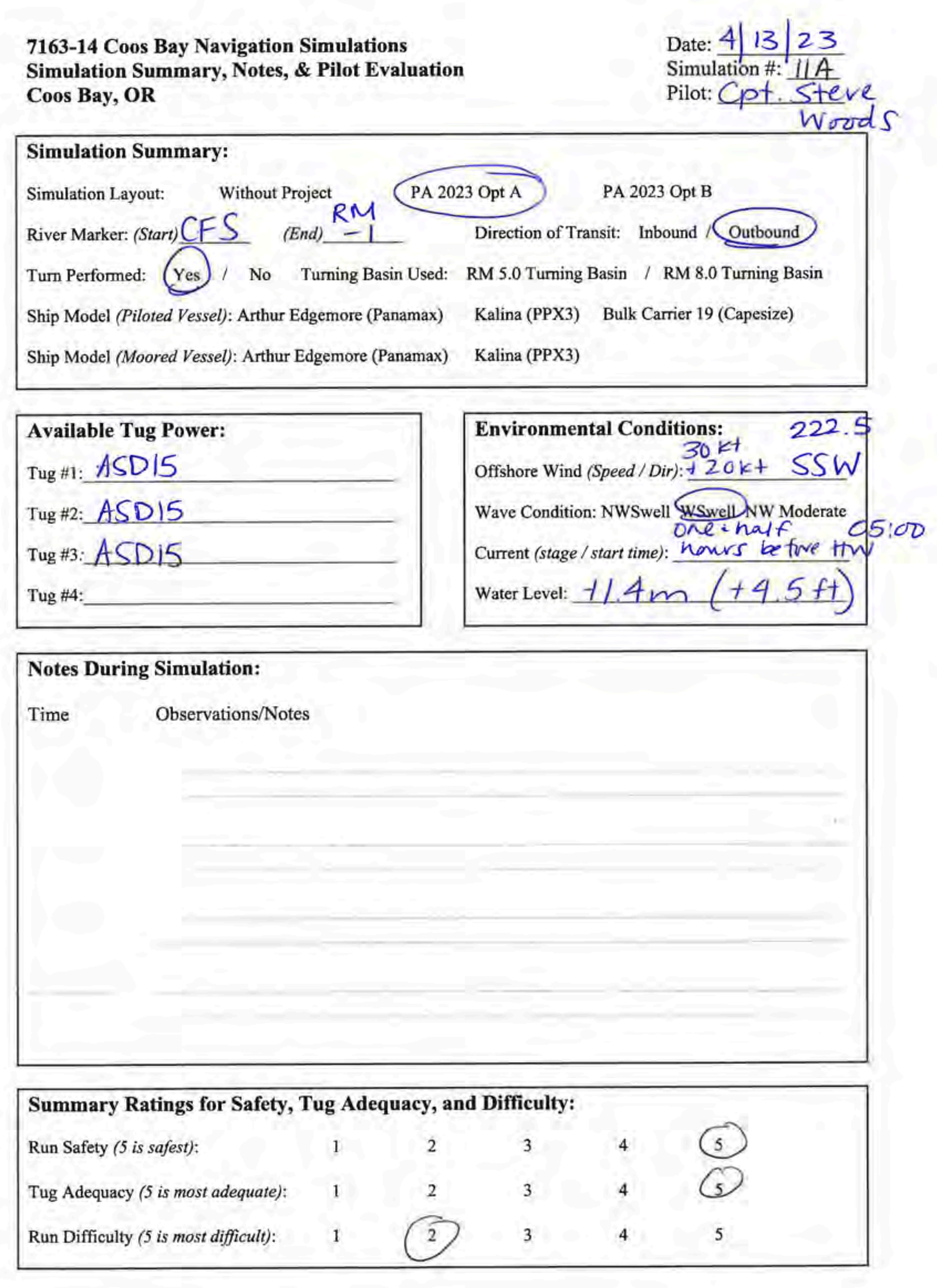
   —

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

   Pilot would have tried to get
   deeper into TB in subsequent runs
   to avoid limit clearance

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4|13|23
Simulation #: 11A
Pilot: Cpt. Steve Woods

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* CFS *(End)* RM -1 Direction of Transit: Inbound / [✓ Outbound]

Turn Performed: [✓ Yes] / No Turning Basin Used: RM 5.0 Turning Basin / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) Kalina (PPX3) Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) Kalina (PPX3)

Available Tug Power:

Tug #1: ASD15
Tug #2: ASD15
Tug #3: ASD15
Tug #4:

Environmental Conditions: 222.5

Offshore Wind *(Speed / Dir)*: 30 kt + 20kt SSW

Wave Condition: NWSwell [✓ WSwell] NW Moderate

Current *(stage / start time)*: one & half hours before HW 05:00

Water Level: +1.4m (+4.5ft)

Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	3	4	[✓ 5]
Tug Adequacy *(5 is most adequate)*:	1	2	3	4	[✓ 5]
Run Difficulty *(5 is most difficult)*:	1	[✓ 2]	3	4	5

p. 1 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   yes.

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   no.

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   yes.

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   yes.

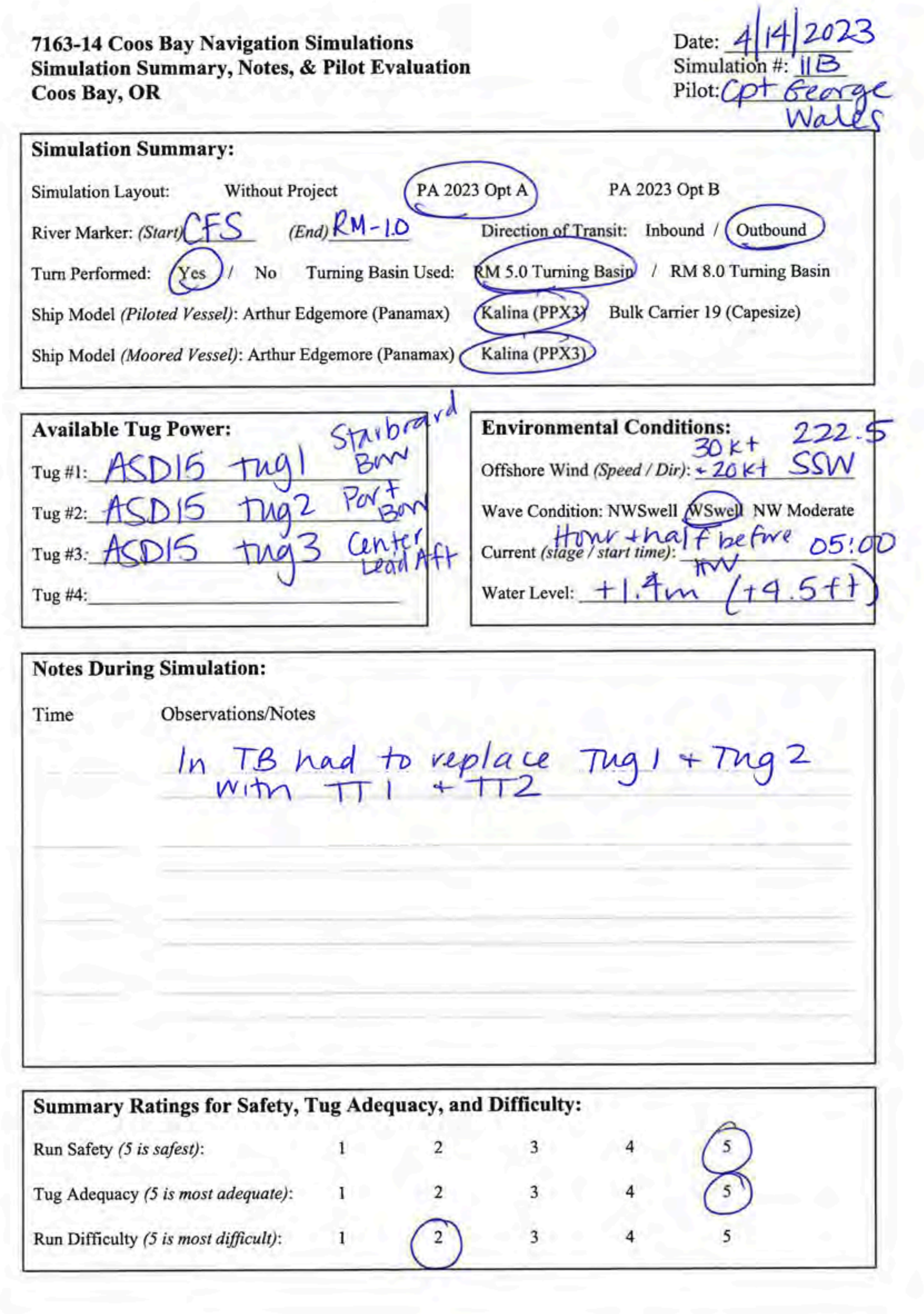
6. Please provide any comments on aids to navigation placement and range configurations:

   No

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

   No.

8. Additional Commentary:



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/14/2023
Simulation #: 11B
Pilot: Cpt George Wales

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B
River Marker: *(Start)* CFS *(End)* RM-1.0 Direction of Transit: Inbound / [✓ Outbound]
Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin
Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)
Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 tug1 Starbrard Bow
Tug #2: ASD15 tug2 Port Bow
Tug #3: ASD15 tug3 Center Lead Aft
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 30 kt + 20 kt 222.5 SSW
Wave Condition: NWSwell [✓ WSwell] NW Moderate
Current *(stage / start time)*: Hour + half before HW 05:00
Water Level: +1.4m (+4.5ft)

Notes During Simulation:

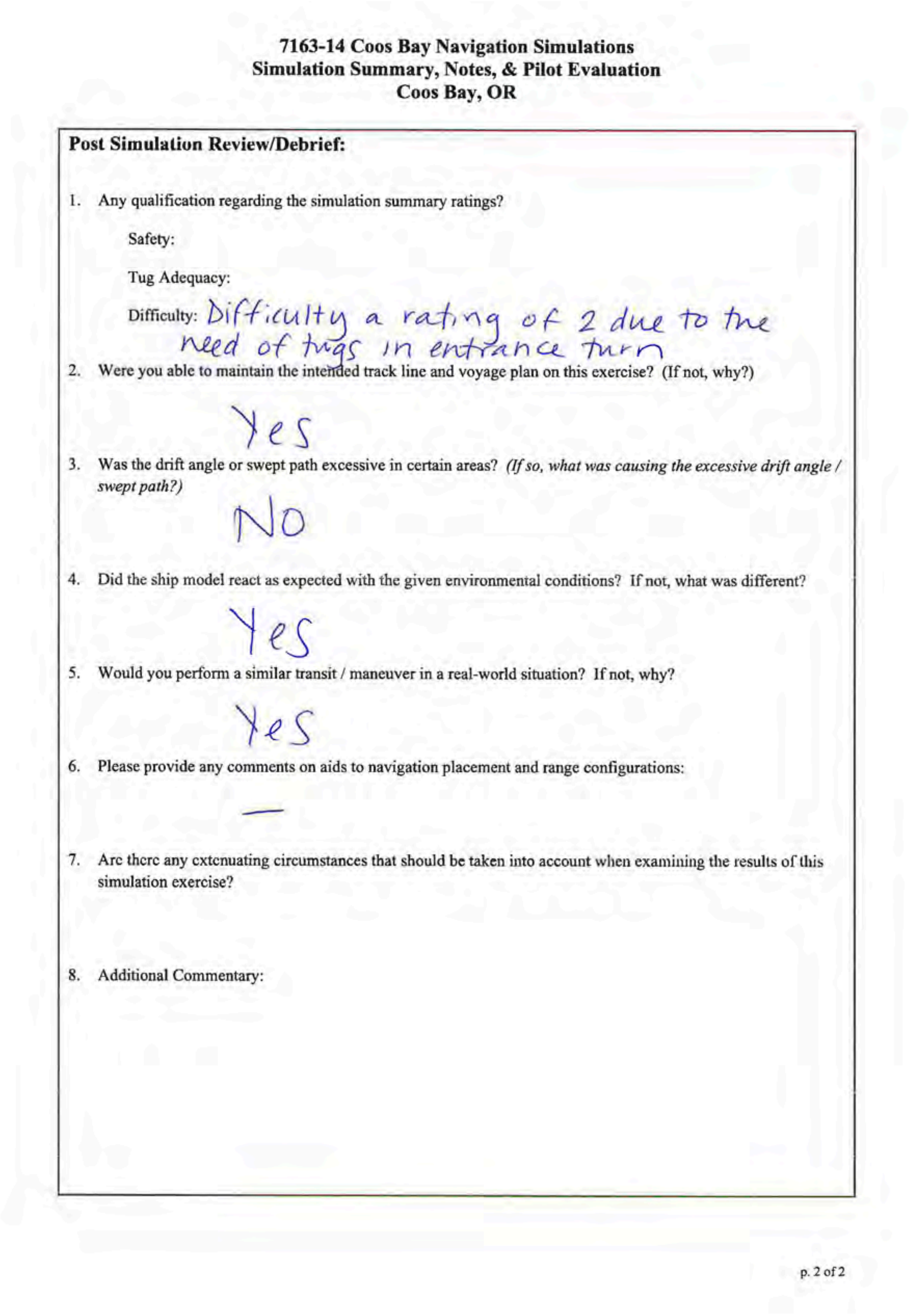
Time Observations/Notes

In TB had to replace Tug 1 + Tug 2 with TT1 + TT2

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 4 [✓ 5]
Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]
Run Difficulty *(5 is most difficult)*: 1 [✓ 2] 3 4 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty: Difficulty a rating of 2 due to the need of tugs in entrance turn

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

   —

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/14/2023
Simulation #: 12A
Pilot: Cpt. Steve Woods

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* CFS *(End)* RM -1.0 Direction of Transit: Inbound / [✓ Outbound]

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15
Tug #2: ASD15
Tug #3: ASD15
Tug #4:

Environmental Conditions:

337.5
Offshore Wind *(Speed / Dir)*: 25kt NNW
Wave Condition: [✓ NWSwell] WSwell NW Moderate
Current *(stage / start time)*: one and half hour before high water 05:00
Water Level: +1.4m (4.5ft)

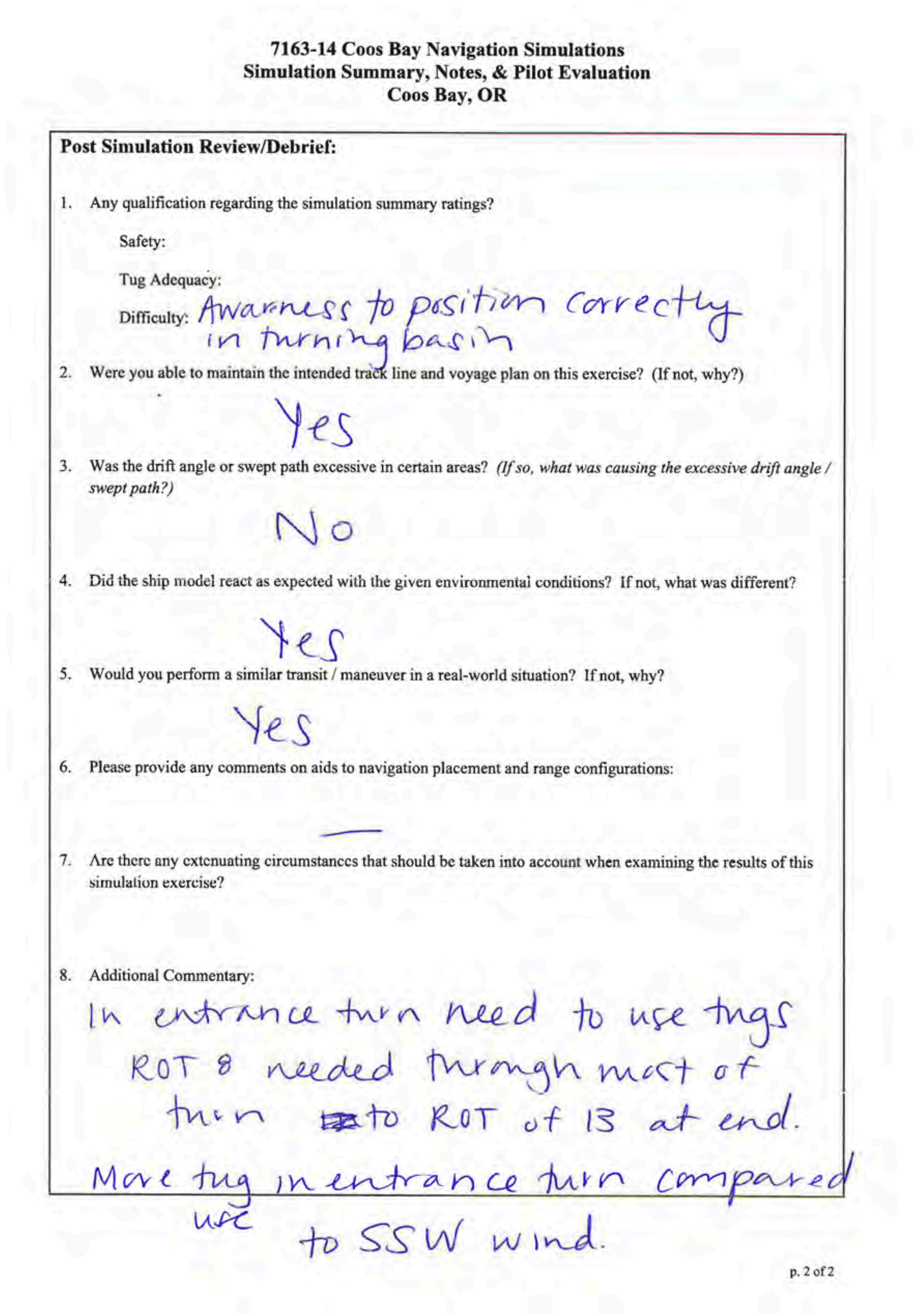
Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 4 [✓ 5]
Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]
Run Difficulty *(5 is most difficult)*: 1 [✓ 2] 3 4 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

Safety:

Tug Adequacy:

Difficulty: Awarness to position correctly
in turning basin

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

Yes

6. Please provide any comments on aids to navigation placement and range configurations:

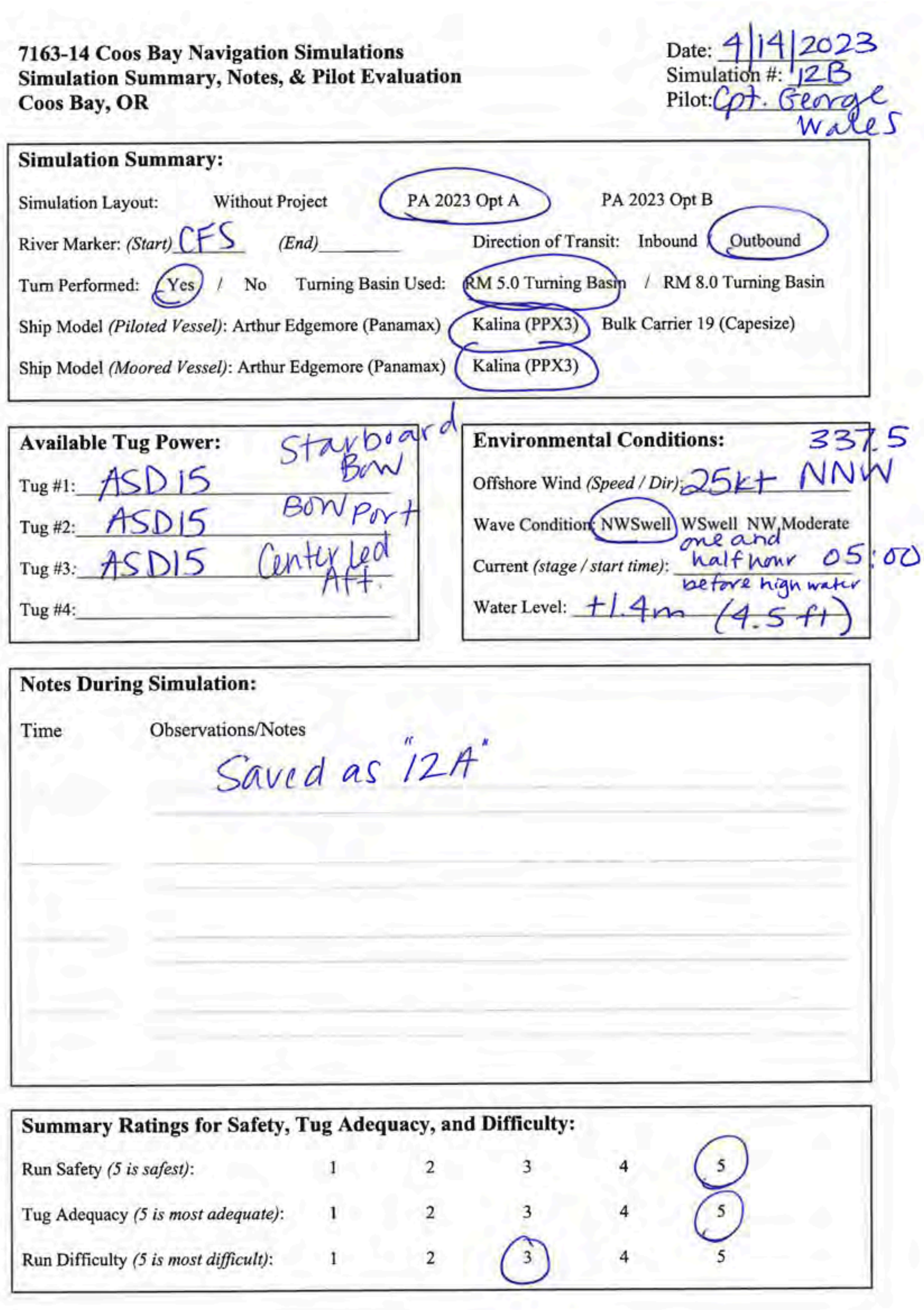
—

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

In entrance turn need to use tugs
ROT 8 needed through most of
turn to ROT of 13 at end.
More tug in entrance turn compared
use
to SSW wind.

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4|14|2023
Simulation #: 12B
Pilot: Cpt. George Wales

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* CFS *(End)*______ Direction of Transit: Inbound [✓ Outbound]

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Starboard Bow
Tug #2: ASD15 Bow Port
Tug #3: ASD15 Center Led Aft.
Tug #4:______

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 25kt NNW 337.5
Wave Condition: [✓ NWSwell] WSwell NW Moderate
Current *(stage / start time)*: one and half hour before high water 05:00
Water Level: +1.4m (4.5ft)

Notes During Simulation:

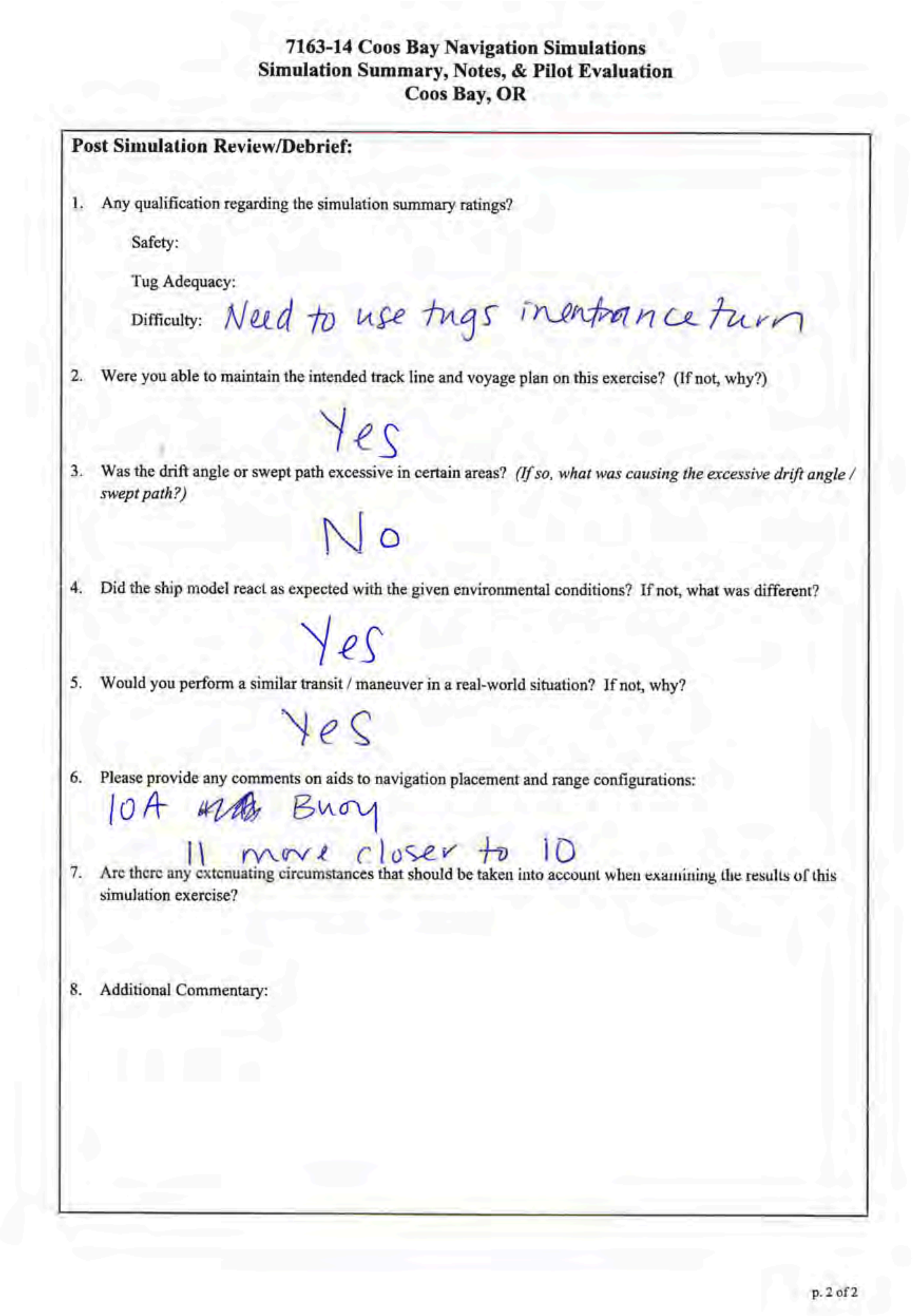
Time Observations/Notes

Saved as "12A"

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 4 [✓ 5]
Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]
Run Difficulty *(5 is most difficult)*: 1 2 [✓ 3] 4 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty: Need to use tugs inentrance turn

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

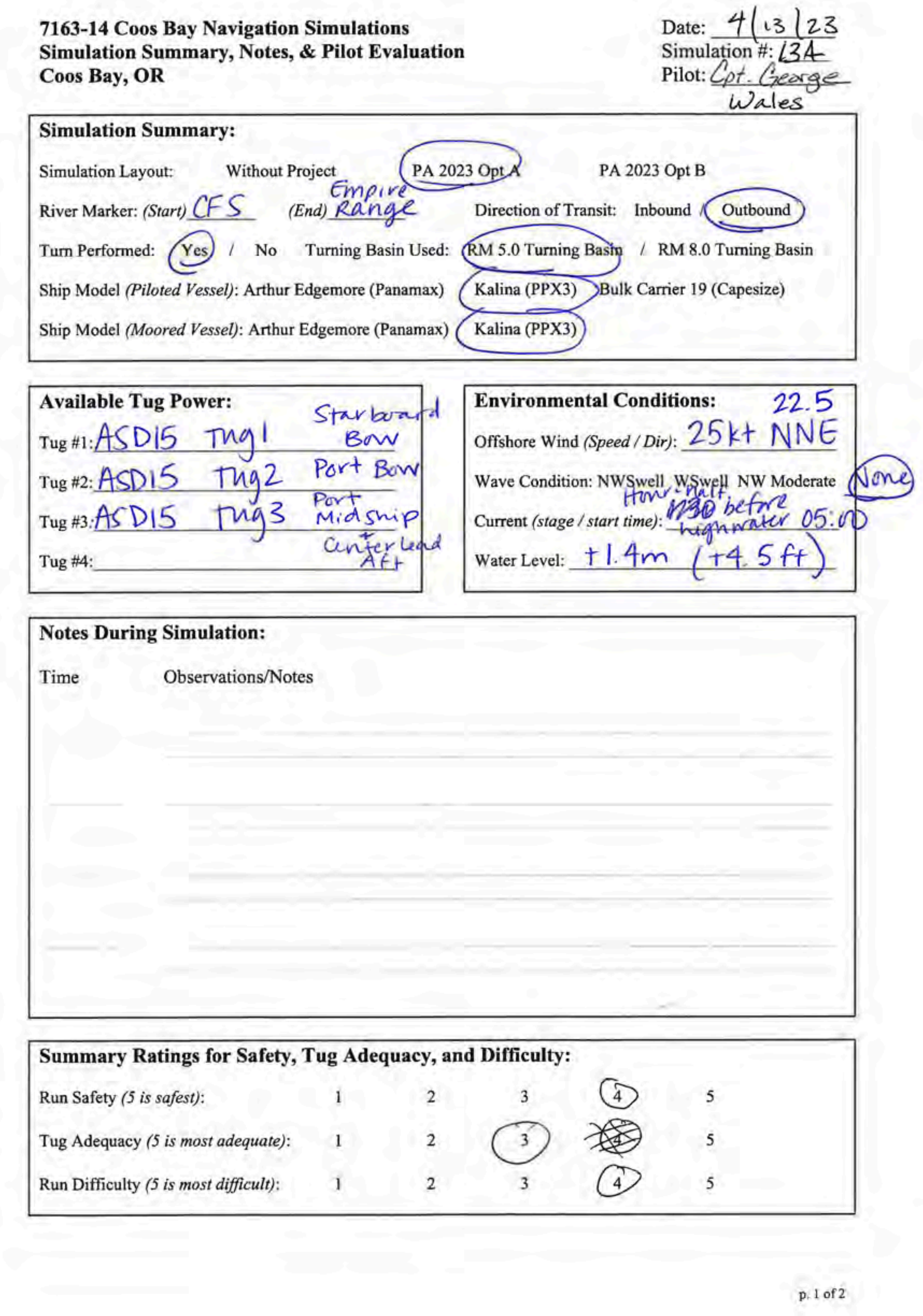
6. Please provide any comments on aids to navigation placement and range configurations:

   10A Buoy
   11 move closer to 10

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/13/23
Simulation #: 13A
Pilot: Cpt. George Wales

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* CFS *(End)* Empire Range Direction of Transit: Inbound / [✓ Outbound]

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Tug1 Starboard Bow
Tug #2: ASD15 Tug2 Port Bow
Tug #3: ASD15 Tug3 Port Midship + Center lead Aft
Tug #4:

Environmental Conditions: 22.5

Offshore Wind *(Speed / Dir)*: 25kt NNE
Wave Condition: NWSwell WSwell NW Moderate [✓ None]
Current *(stage / start time)*: Hour-half ~~1130~~ before highwater 05:00
Water Level: +1.4m (+4.5ft)

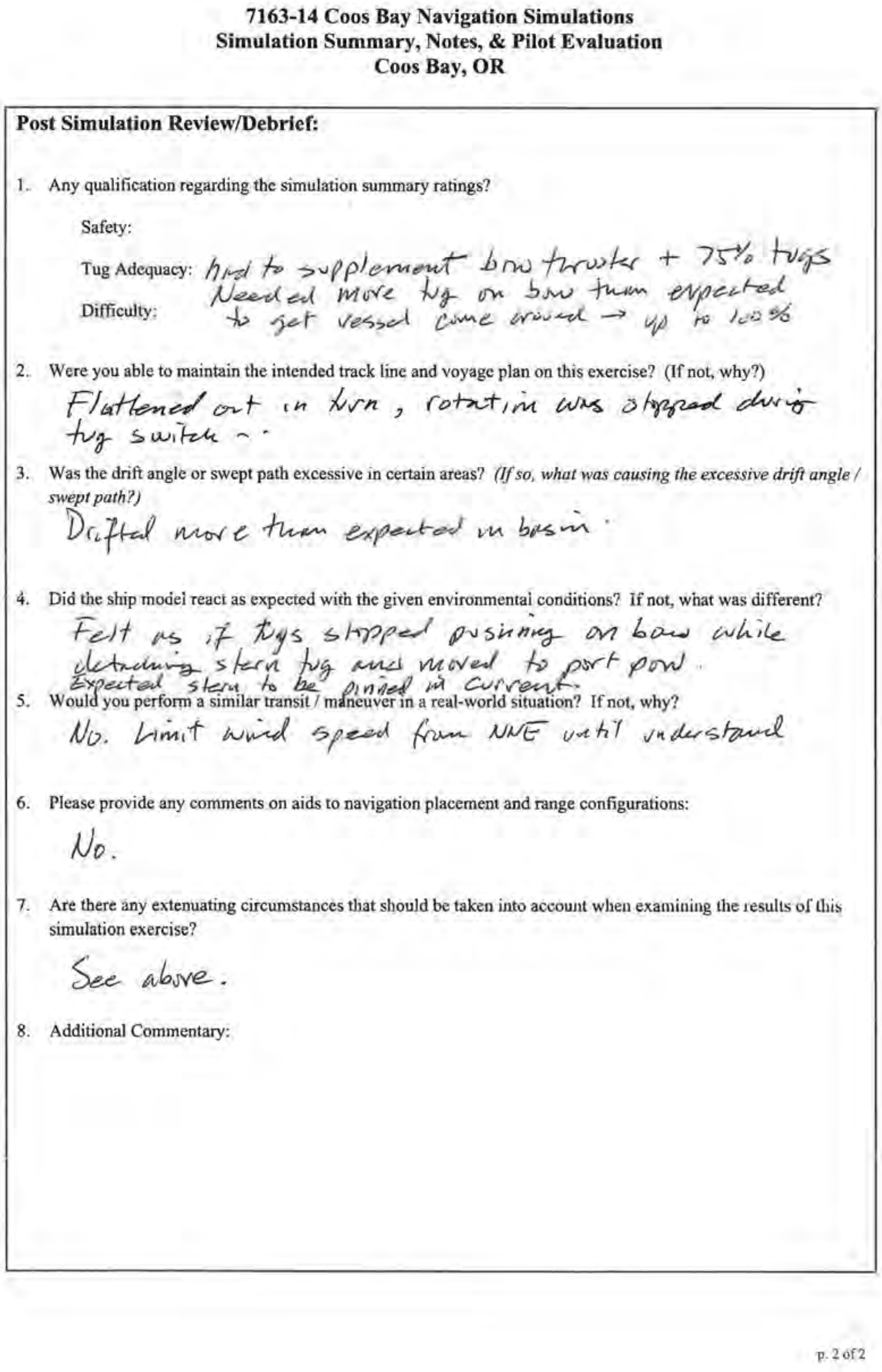
Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 [✓ 4] 5
Tug Adequacy *(5 is most adequate)*: 1 2 [✓ 3] ~~4~~ 5
Run Difficulty *(5 is most difficult)*: 1 2 3 [✓ 4] 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

Safety:

Tug Adequacy: had to supplement bow thruster + 75% tugs

Difficulty: Needed more tug on bow than expected to get vessel come around → up to 100%

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

Flattened out in turn, rotation was stopped during tug switch ~.

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

Drifted more than expected in basin.

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

Felt as if tugs stopped pushing on bow while detaching stern tug and moved to port bow. Expected stern to be pinned in current.

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

No. Limit wind speed from NNE until understand

6. Please provide any comments on aids to navigation placement and range configurations:

No.

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

See above.

8. Additional Commentary:

p. 2 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4|14|2023
Simulation #: 13B
Pilot: Cpt. Steve Woods

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* CFS *(End)* Empire Range

Direction of Transit: Inbound / [✓ Outbound]

Turn Performed: [✓ Yes] / No

Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Tug 1 Port Bow

Tug #2: ASD15 Tug 2 Starboard Bow

Tug #3: ASD15 Tug 3 Center Lead Aft.

Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 22.5 25 kt NNE

Wave Condition: NWSwell WSwell NW Moderate [✓ None]

Current *(stage / start time)*: hour and half befre high water 05:00

Water Level: (+1.4m) +4.5ft

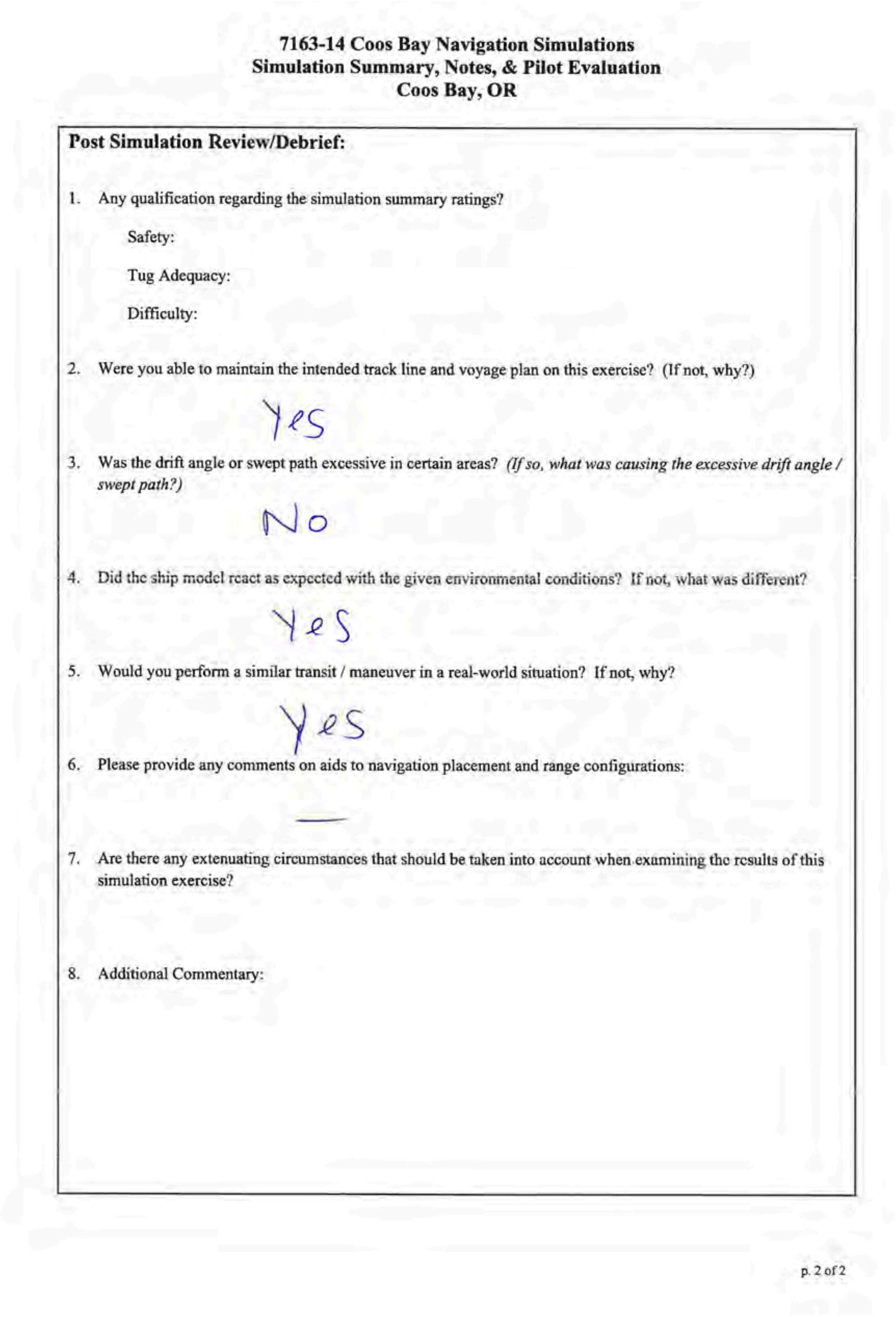
Notes During Simulation:

Time Observations/Notes

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*:	1	2	3	4	[✓ 5]
Tug Adequacy *(5 is most adequate)*:	1	2	3	4	[✓ 5]
Run Difficulty *(5 is most difficult)*:	1	[✓ 2]	3	4	5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

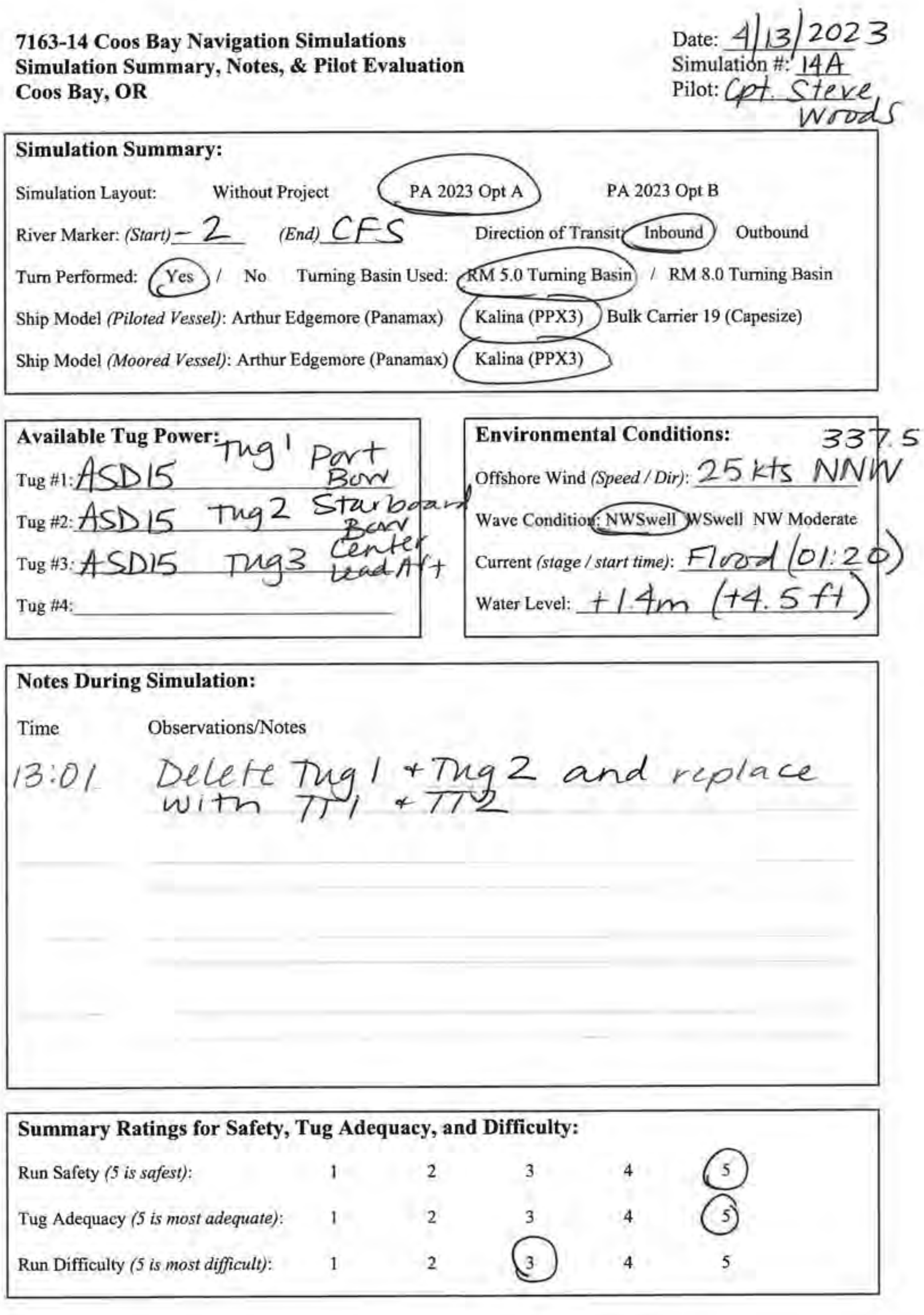
6. Please provide any comments on aids to navigation placement and range configurations:

   —

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/13/2023
Simulation #: 14A
Pilot: Cpt. Steve Woods

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* –2 *(End)* CFS Direction of Transit: [✓ Inbound] Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Tug1 Port Bow

Tug #2: ASD15 Tug2 Starboard Bow

Tug #3: ASD15 Tug3 Center Lead Aft

Tug #4:

Environmental Conditions: 337.5

Offshore Wind *(Speed / Dir)*: 25 kts NNW

Wave Condition: [✓ NWSwell] WSwell NW Moderate

Current *(stage / start time)*: Flood (01:20)

Water Level: +1.4m (+4.5ft)

Notes During Simulation:

Time	Observations/Notes
13:01	Delete Tug1 + Tug2 and replace with TT1 + TT2

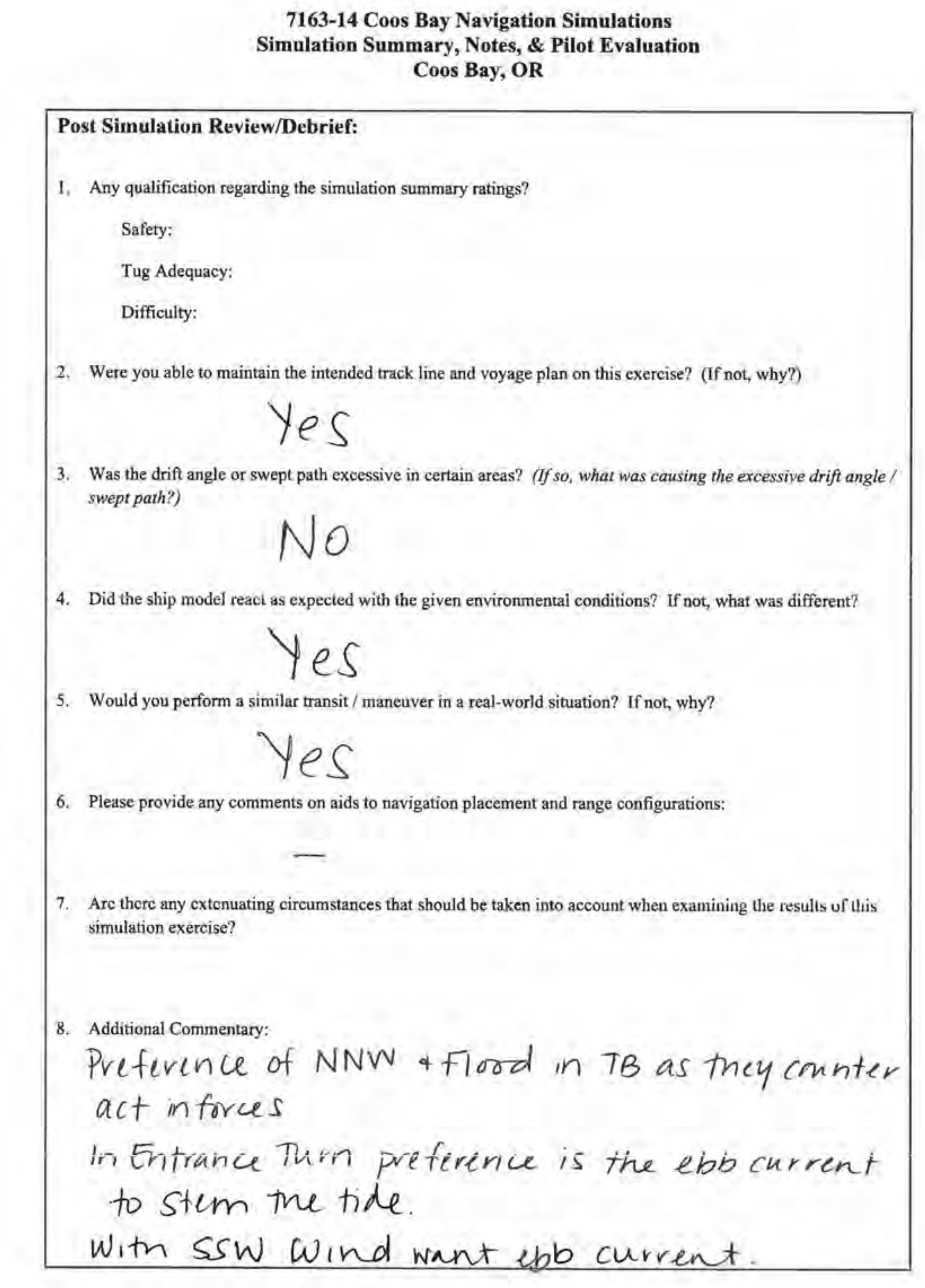
Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 4 [✓ 5]

Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]

Run Difficulty *(5 is most difficult)*: 1 2 [✓ 3] 4 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

6. Please provide any comments on aids to navigation placement and range configurations:

   —

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

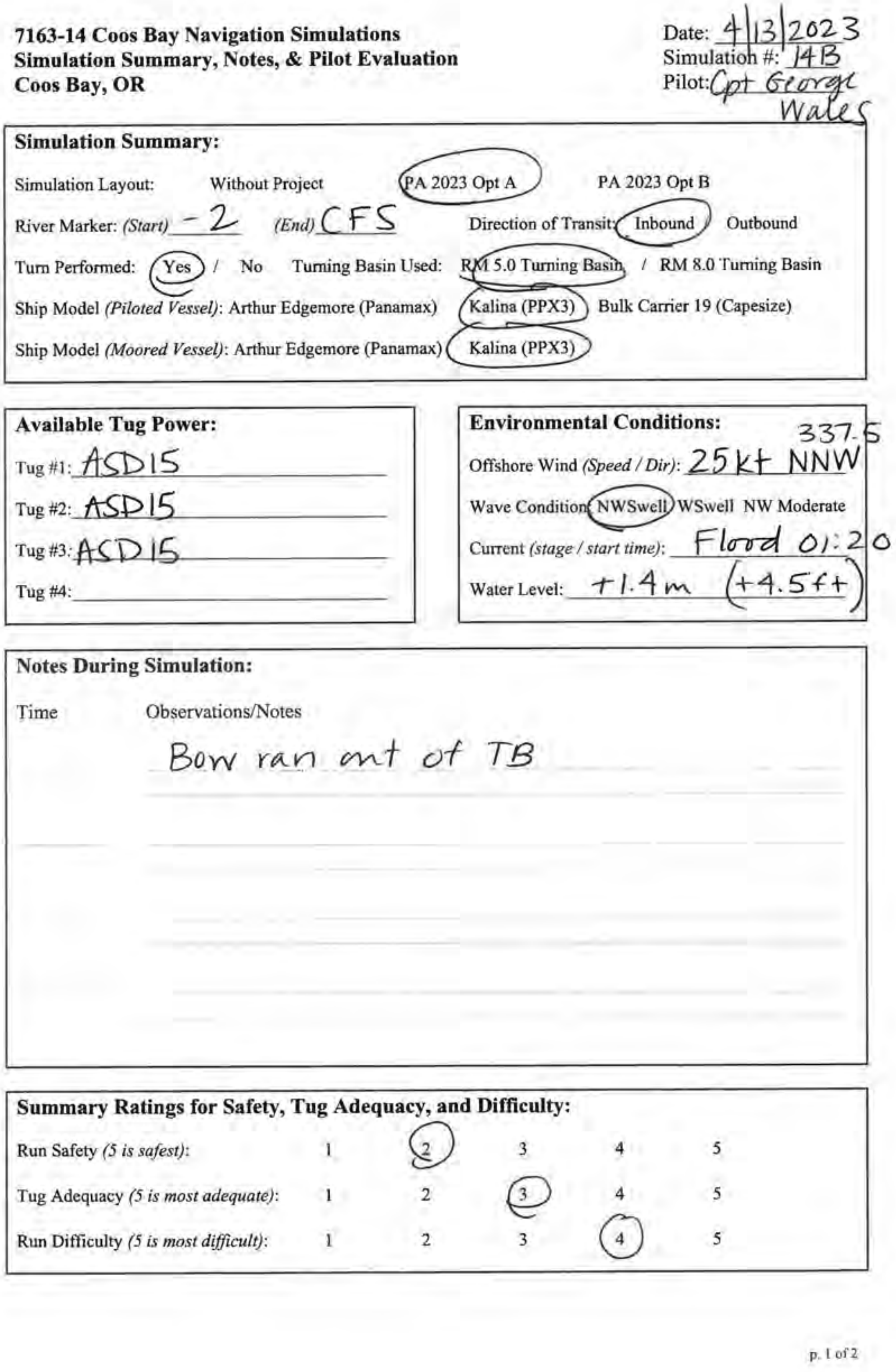
8. Additional Commentary:

   Preference of NNW + Flood in TB as they counter act inforces

   In Entrance Turn preference is the ebb current to stem the tide.

   With SSW Wind want ebb current.

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4|13|2023
Simulation #: 14B
Pilot: Cpt George Wales

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* -2 *(End)* CFS Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15
Tug #2: ASD15
Tug #3: ASD15
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 25kt NNW 337.5

Wave Condition: [✓ NWSwell] WSwell NW Moderate

Current *(stage / start time)*: Flood 01:20

Water Level: +1.4m (+4.5ft)

Notes During Simulation:

Time Observations/Notes

Bow ran out of TB

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 [✓ 2] 3 4 5

Tug Adequacy *(5 is most adequate)*: 1 2 [✓ 3] 4 5

Run Difficulty *(5 is most difficult)*: 1 2 3 [✓ 4] 5

p. 1 of 2

7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy: Tugs at 3/4 power with bow thruster.

   Difficulty: Would request 4th conventional tug
   Limit margin for error or loss of tug

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)* Turn into empire range when lossing speed, in future would keep speed until TB

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

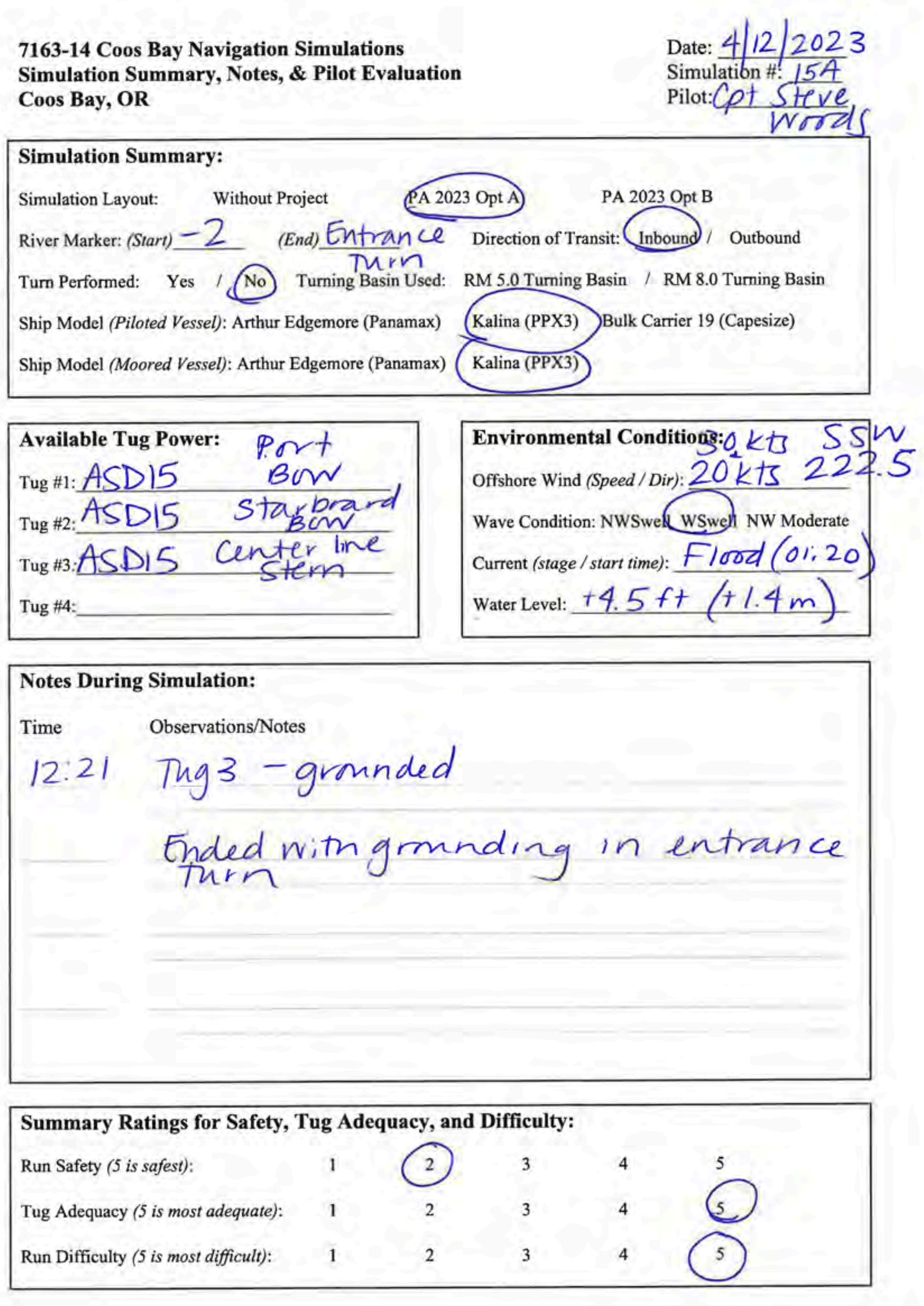
6. Please provide any comments on aids to navigation placement and range configurations:

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

   With familiarity may not require 4th tug

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/12/2023
Simulation #: 15A
Pilot: Cpt Steve Woods

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* -2 *(End)* Entrance Turn Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: Yes / [✓ No] Turning Basin Used: RM 5.0 Turning Basin / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Port Bow
Tug #2: ASD15 Starbrard Bow
Tug #3: ASD15 Center line Stern
Tug #4:

Environmental Conditions: 30 kts SSW

Offshore Wind *(Speed / Dir)*: 20 kts 222.5

Wave Condition: NWSwell [✓ WSwell] NW Moderate

Current *(stage / start time)*: Flood (01:20)

Water Level: +4.5 ft (+1.4 m)

Notes During Simulation:

Time	Observations/Notes
12:21	Tug 3 - grounded
	Ended with grounding in entrance Turn

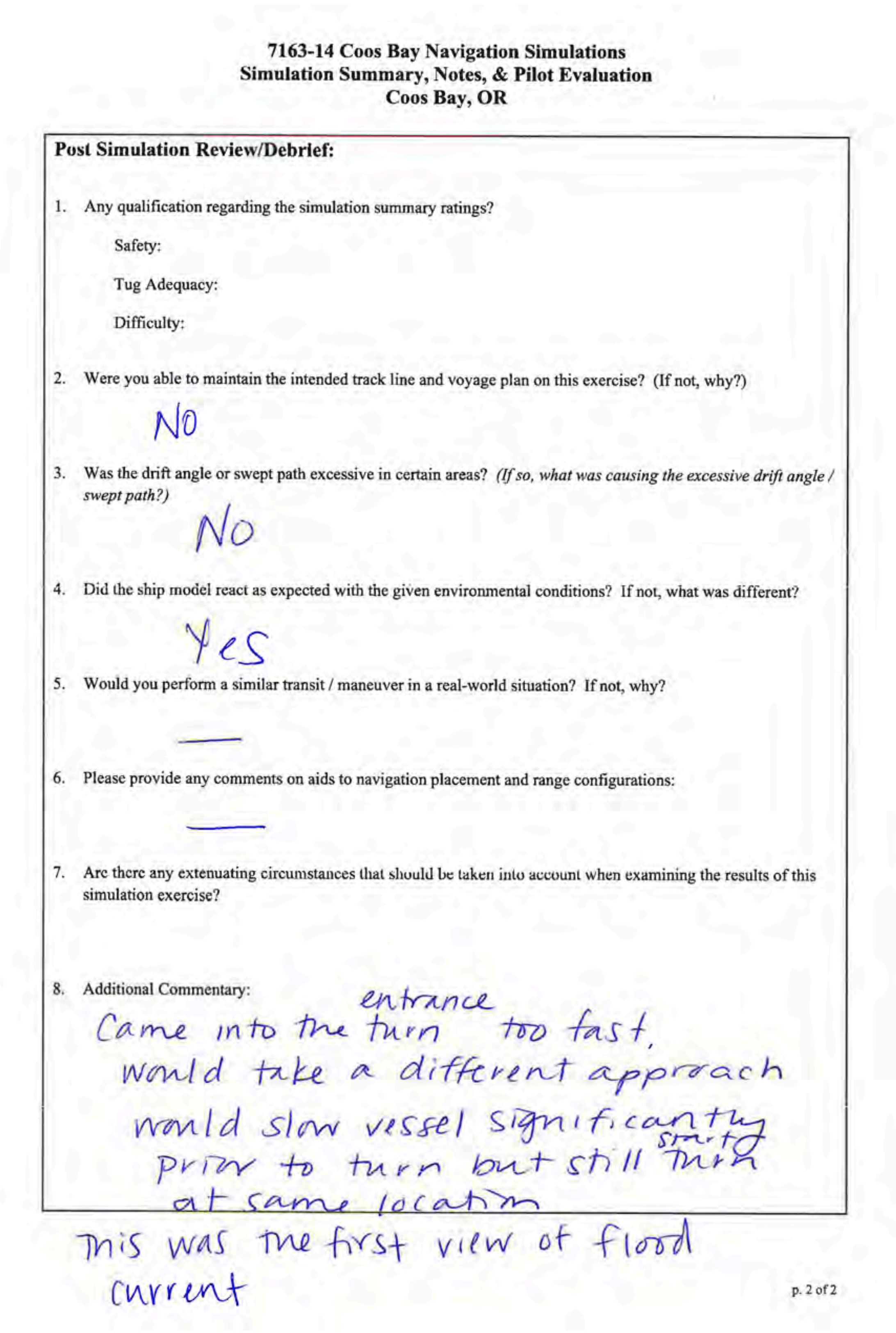
Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 [✓ 2] 3 4 5

Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]

Run Difficulty *(5 is most difficult)*: 1 2 3 4 [✓ 5]

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty:

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   NO

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   —

6. Please provide any comments on aids to navigation placement and range configurations:

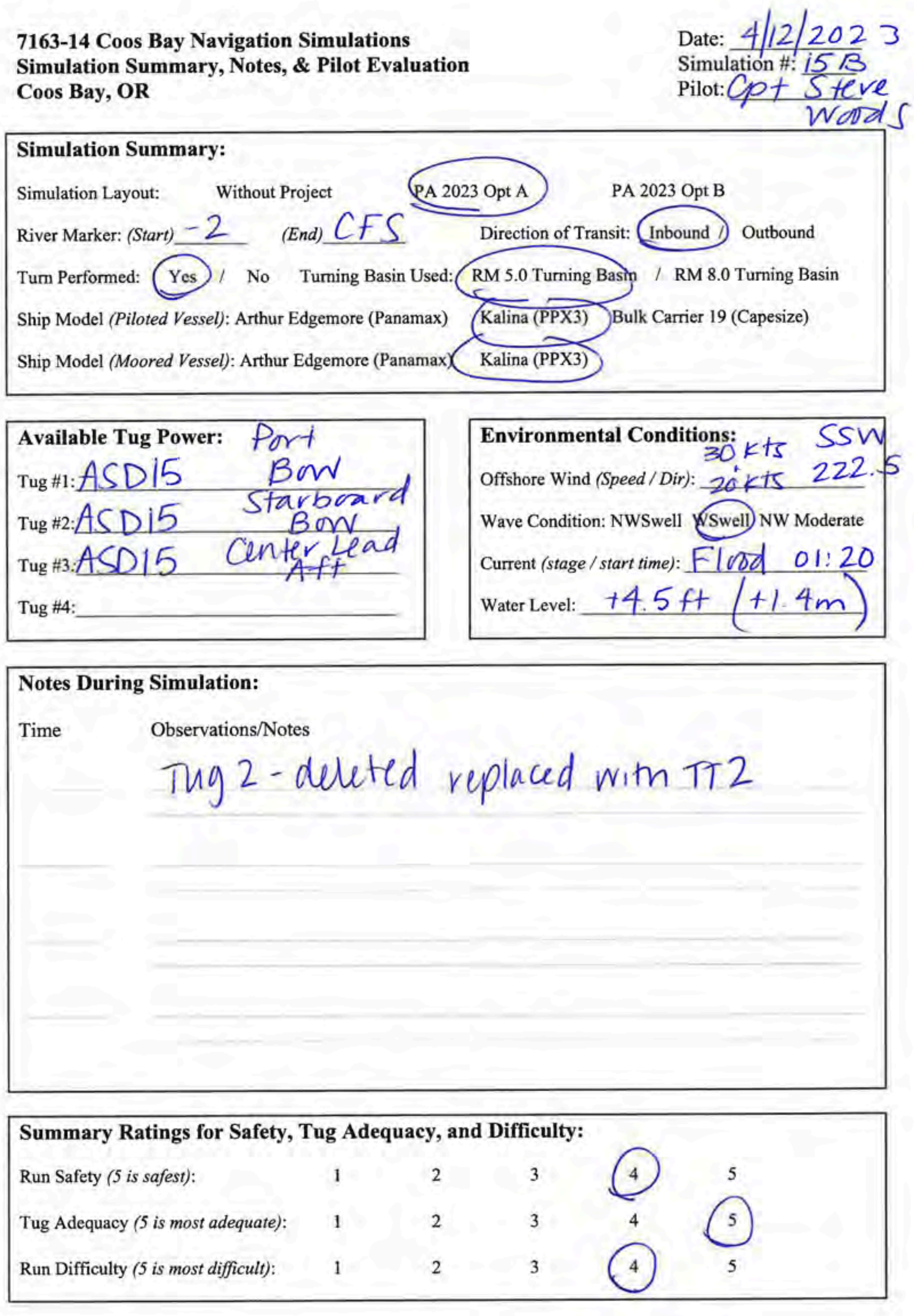
   —

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

Came into the entrance turn too fast,
would take a different approach
would slow vessel significantly
prior to turn but still start turn
at same location
This was the first view of flood
current

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/12/2023
Simulation #: 15B
Pilot: Cpt Steve Woods

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* -2 *(End)* CFS Direction of Transit: [✓ Inbound] / Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Port Bow
Tug #2: ASD15 Starboard Bow
Tug #3: ASD15 Center Lead Aft
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 30 kts SSW 20 kts 222.5

Wave Condition: NWSwell [✓ WSwell] NW Moderate

Current *(stage / start time)*: Flood 01:20

Water Level: +4.5ft (+1.4m)

Notes During Simulation:

Time Observations/Notes

Tug 2 - deleted replaced with TT2

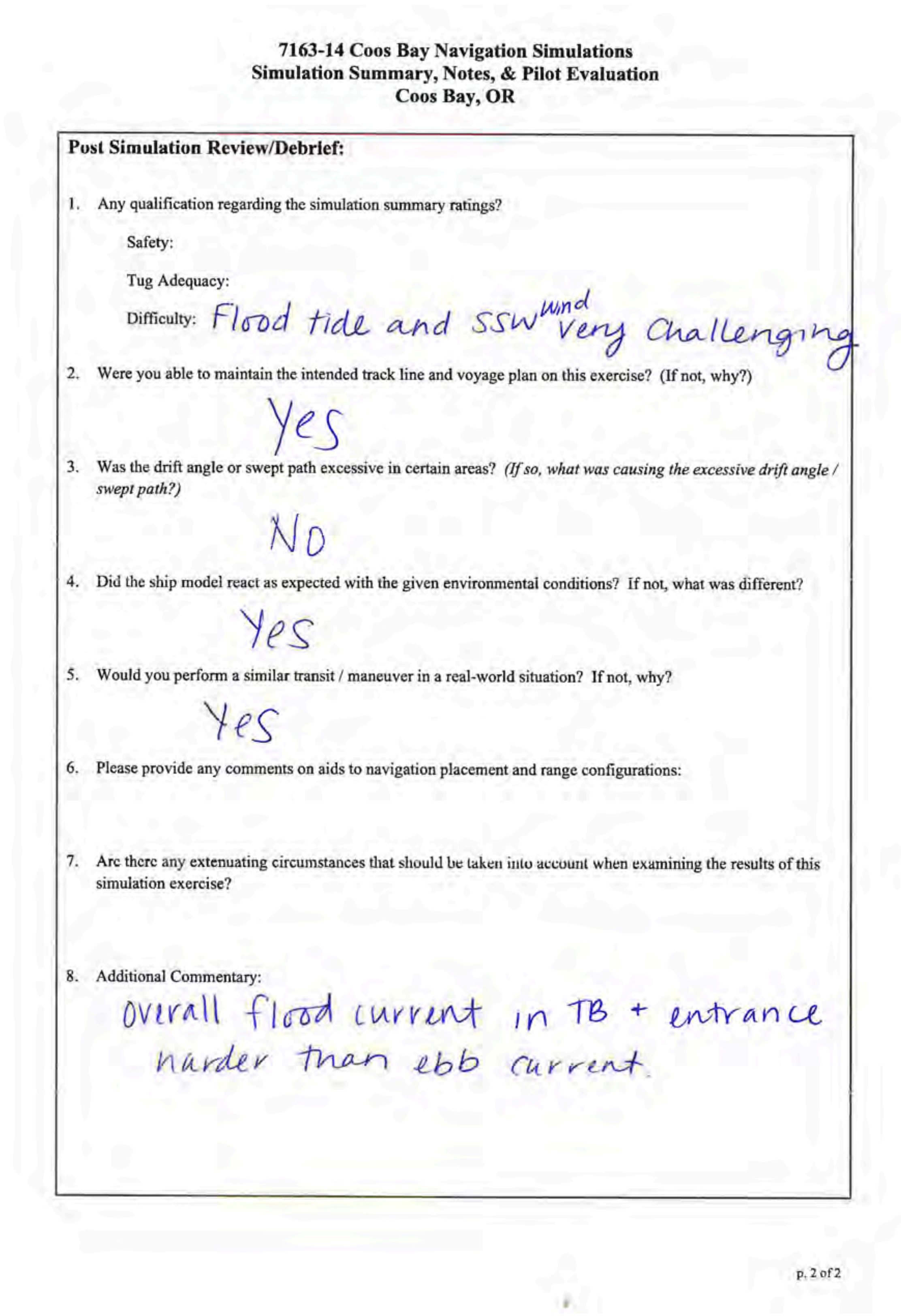
Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 2 3 [✓ 4] 5

Tug Adequacy *(5 is most adequate)*: 1 2 3 4 [✓ 5]

Run Difficulty *(5 is most difficult)*: 1 2 3 [✓ 4] 5

p. 1 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

   Safety:

   Tug Adequacy:

   Difficulty: Flood tide and SSW wind very Challenging

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

   Yes

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

   No

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

   Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

   Yes

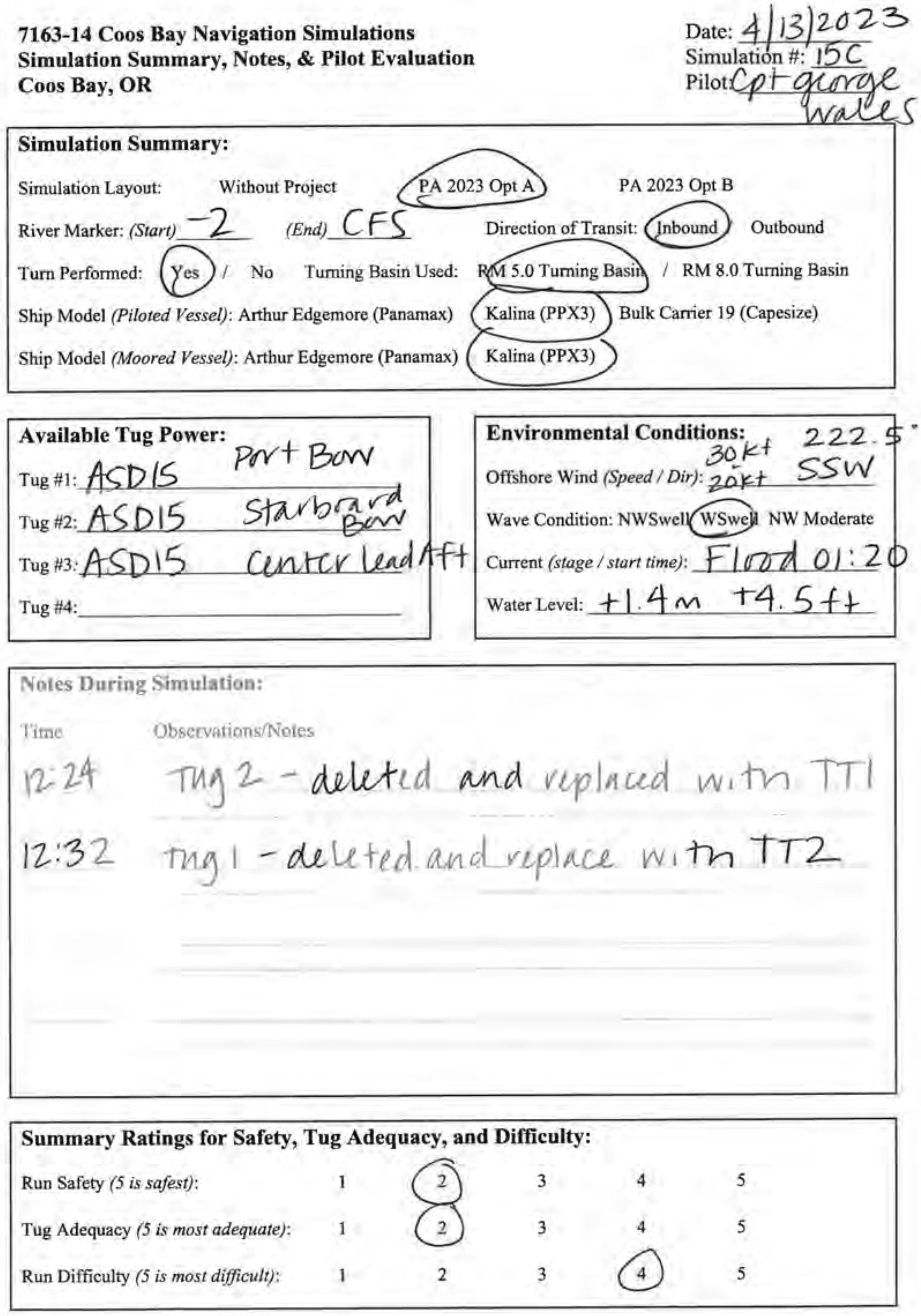
6. Please provide any comments on aids to navigation placement and range configurations:

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

   overall flood current in TB + entrance harder than ebb current

p. 2 of 2



7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Date: 4/13/2023
Simulation #: 15C
Pilot: Cpt george wales

Simulation Summary:

Simulation Layout: Without Project [✓ PA 2023 Opt A] PA 2023 Opt B

River Marker: *(Start)* -2 *(End)* CFS Direction of Transit: [✓ Inbound] Outbound

Turn Performed: [✓ Yes] / No Turning Basin Used: [✓ RM 5.0 Turning Basin] / RM 8.0 Turning Basin

Ship Model *(Piloted Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)] Bulk Carrier 19 (Capesize)

Ship Model *(Moored Vessel)*: Arthur Edgemore (Panamax) [✓ Kalina (PPX3)]

Available Tug Power:

Tug #1: ASD15 Port Bow
Tug #2: ASD15 Starboard Bow
Tug #3: ASD15 Center lead Aft
Tug #4:

Environmental Conditions:

Offshore Wind *(Speed / Dir)*: 30kt 20kt 222.5° SSW
Wave Condition: NWSwell [✓ WSwell] NW Moderate
Current *(stage / start time)*: Flood 01:20
Water Level: +1.4m +4.5ft

Notes During Simulation:

Time	Observations/Notes
12:24	Tug 2 - deleted and replaced with TT1
12:32	tug 1 - deleted and replace with TT2

Summary Ratings for Safety, Tug Adequacy, and Difficulty:

Run Safety *(5 is safest)*: 1 [✓ 2] 3 4 5
Tug Adequacy *(5 is most adequate)*: 1 [✓ 2] 3 4 5
Run Difficulty *(5 is most difficult)*: 1 2 3 [✓ 4] 5

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7163-14 Coos Bay Navigation Simulations
Simulation Summary, Notes, & Pilot Evaluation
Coos Bay, OR

Post Simulation Review/Debrief:

1. Any qualification regarding the simulation summary ratings?

Safety:

Tug Adequacy: Would want 4th tug in turning basin

Difficulty: 4th tug can be conventional 4000-5000hp

Needed to combat environmentals constantly

2. Were you able to maintain the intended track line and voyage plan on this exercise? (If not, why?)

Barely in approach to TB
Rest of transit yes.

3. Was the drift angle or swept path excessive in certain areas? *(If so, what was causing the excessive drift angle / swept path?)*

NO

4. Did the ship model react as expected with the given environmental conditions? If not, what was different?

Yes

5. Would you perform a similar transit / maneuver in a real-world situation? If not, why?

Would want 4th tug in turning basin

6. Please provide any comments on aids to navigation placement and range configurations:

—

7. Are there any extenuating circumstances that should be taken into account when examining the results of this simulation exercise?

8. Additional Commentary:

With these environmentals would want to go Port Side to berth vs turn in turning basin

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APPENDIX E. MITAGS SIMULATION REPORT