



Acquisition Directorate

Research & Development Center

Report No. CG-D-05-21

Inland ERSP Operational Environment Calculator Design Document

Distribution Statement A: Approved for public release; distribution is unlimited.

September 2021



Homeland Security

N O T I C E

This document is disseminated under the sponsorship of the Department of Homeland Security in the interest of information exchange.

For use outside the United States Government, the Government assumes no liability for its contents or use thereof.

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the objective of this report.



Mr. M. J. Lewandowski
Chief, Environment &
Waterways Branch
United States Coast Guard
Research & Development Center
1 Chelsea Street
New London, CT 06320



Inland ERSP Operational Environment Calculator Design Document

Technical Report Documentation Page

1. Report No. CG-D-05-21		2. Government Accession Number		3. Recipient's Catalog No.	
4. Title and Subtitle Inland ERSP Operational Environment Calculator Design Document				5. Report Date September 2021	
				6. Performing Organization Code Project No. 4710	
7. Author(s) Jill Rowe and Gabrielle McGrath; Dagmar Schmidt Etkin; John Joeckel; Alexander Balsley and John Freda				8. Performing Report No. RDC UDI #1791	
9. Performing Organization Name and Address U.S. Coast Guard Research and Development Center 1 Chelsea Street New London, CT 06320		RPS Group, Inc. 20405 Tomball Pkwy Ste 200 Houston, TX 77070-2284		10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. GS-10F-0438R T.O. 70Z03218F8P04K280	
12. Sponsoring Organization Name and Address COMMANDANT (CG-MER) US COAST GUARD STOP 7516 2703 MARTIN LUTHER KING JR AVE SE WASHINGTON, DC 20593				13. Type of Report & Period Covered Final	
				14. Sponsoring Agency Code Commandant (CG-MER) US Coast Guard Stop 7516 Washington, DC 20593	
15. Supplementary Notes The R&D Center's technical point of contact is Mr. Alexander Balsley, 860-865-0474, email: Alexander.Balsley@uscg.mil					
16. Abstract (MAXIMUM 200 WORDS) The Coast Guard recognized that the Offshore Estimated Recovery System Potential (ERSP) Calculator employed for mechanical oil spill recovery planning was not applicable for inland operating environments. In more confined, shallow areas with restrictions on maneuverability and variable surface water width, the offshore skimming systems with large swath width and large onboard or tethered storage solutions are less likely to be effective. To mitigate these shortcomings RDC conducted research to incorporate the inland and nearshore operating environments into the existing ERSP calculator. The intended use of the Inland ERSP Calculator is to estimate the potential mechanical oil removal capability of a skimming system under generally favorable environmental conditions. This project conducted research into inland operating-environment oil spill response planning factors, the use of selected factors to create a conceptual model, and the requirements for designing an inland operating-environment oil spill-response calculator. The purpose of this report is to provide the design of the Inland ERSP Calculator, including the overall methodology, calculator architecture, pseudocode for the calculator's algorithms, and data acquisition process. It provides the basic algorithms, data sources, and assumptions involved in the Inland ERSP Calculator and summarizes it in terms that facilitate future implementation					
17. Key Words Response planning tool, recovery potential, recovery system, design document, inland waterways, skimming systems, shoreside recovery			18. Distribution Statement Distribution Statement A: Approved for public release; distribution is unlimited.		
19. Security Class (This Report) UNCLAS//Public		20. Security Class (This Page) UNCLAS//Public		21. No of Pages 212	22. Price



(This page intentionally left blank.)



EXECUTIVE SUMMARY

Inland oil recovery can be more complex than recovering oil offshore. The Coast Guard recognized that the Offshore Estimated Recovery System Potential (ERSP) Calculator employed for mechanical oil spill recovery planning was not applicable for inland operating environments. In more confined, shallow areas with restrictions on maneuverability and variable surface water width, the offshore skimming systems with large swath width and large onboard or tethered storage solutions are less likely to be effective. To mitigate these shortcomings RDC conducted research to incorporate the inland and nearshore operating environments into the existing ERSP calculator.

This design document is the third and last report documenting the Estimated Recovery System Potential (ERSP) Calculator Design for Oil Spill Planning in Inland Waterways. The primary scope of this project was to conduct research into inland operating-environment oil spill-response planning factors, use of selected factors to create a conceptual model, and requirements for designing an inland operating-environment oil spill response calculator.

This report provides the Inland ERSP Calculator overarching design including the following components:

- 1) Overall methodology, data sources and all assumptions;
- 2) Calculator architecture in both text and simple block diagrams;
- 3) Plain pseudocode for the calculator's algorithms; and
- 4) Data acquisition and analysis description/process, meta-data, analyzed data, data recommendations to include default values, contextual guidance on parameter values selections, and any data/analysis files.

This design document provides the specifics of the basic algorithms, data sources, and assumptions involved in the Inland ERSP Calculator while also summarizing it in basic terms that will facilitate its future programming and implementation. An example of the way in which a user can apply the Inland ERSP Calculator, is to estimate the amount of recovery capability (skimming systems) needed to meet the requirements for a Maximum Most Probable Discharge for facilities in generically defined inland environments.

Responding to oil spills in an inland environment poses many challenges due to the complexity of the conditions, and the project team developed this Inland ERSP Calculator to take many of these challenges into consideration. Users can opt to use defaults provided herein as input to the calculator or may opt to add site- and situational-specific inputs for more accurate oil spill response planning.



(This page intentionally left blank.)



TABLE OF CONTENTS

EXECUTIVE SUMMARY	v
LIST OF FIGURES	ix
LIST OF TABLES	ix
LIST OF ACRONYMS AND ABBREVIATIONS	xi
1 INTRODUCTION AND OBJECTIVES	1
1.1 Background	2
1.2 Challenges of Inland Oil Spill Responses	4
2 OVERALL METHODOLOGY	7
3 CALCULATOR ARCHITECTURE	10
3.1 User Interfaces.....	11
3.1.1 User Interface for Inputs into the Inland ERSP Calculator.....	11
3.1.2 User Interface for Outputs from the Inland ERSP Calculator	13
3.1.3 Customization Module User Interfaces	14
3.2 Overall Architecture with User-Defined Inputs and Oil Behavior Module Inputs	16
4 SUMMARY OF BASIC INLAND ERSP ALGORITHMS, DATA SOURCES AND ASSUMPTIONS	16
4.1 User-Defined Oil Spill Scenario Inputs	16
4.1.1 User-Defined Spill Type (UDI 1)	16
4.1.2 User-Defined Discharge (Spill Volume) (UDI 2).....	16
4.1.3 User-Defined Oil Type (UDI 3).....	17
4.1.4 User-Defined Waterway Classification (UDI 4).....	18
4.2 User-Defined Operational or Encounter Rate Inputs	18
4.2.1 User-Defined Operating Period (<i>OP</i>) (UDI 5).....	18
4.2.2 User-Defined Start Time for Recovery Operations (<i>RST</i>) (UDI 6)	19
4.2.3 User-Defined Downtime (<i>DT</i>) (UDI 7)	20
4.2.4 User-Defined Velocity, <i>V</i> (UDI 8).....	20
4.2.5 User-Defined Workable Swath, <i>SW</i> (UDI 9).....	21
4.3 User-Defined Recovery Factors for Skimming System Inputs	22
4.3.1 User-Defined Maximum Total Fluid Recovery Rate, <i>MTFRR</i> (UDI 10).....	22
4.3.2 User-Defined Throughput Efficiency, <i>TE</i> (UDI 11).....	23
4.3.3 User-Defined Recovery Efficiency, <i>RE</i> (UDI 12)	23
4.4 Oil Behavior Module Inputs.....	24
4.5 Computations within Inland ERSP Calculator.....	25
4.5.1 Oil/Emulsion Encounter Rate (<i>ER</i>) Computation.....	27
4.5.2 Emulsion Recovery Rate (<i>ERR</i>) Computation.....	27
4.5.3 Oil Recovery Rate (<i>ORR</i>) Computation	28
4.5.4 Total Fluid Recovery Rate (<i>TFRR</i>) Computation	28
4.5.5 Rate Water Taken Onboard (<i>RWTO</i>) Computation	29
4.5.6 Computation of Water Retained Rate (<i>WRR_{day}</i>)	29
4.5.7 Computation of Skimming Time in Operating Period (<i>STO_{day}</i>)	29



TABLE OF CONTENTS (Continued)

4.5.8	Total Volume of Oil/Emulsion + Free Water Retained in Operating Period (VOEW).....	30
4.5.9	Total Volume of Free Water Recovered and Retained in Operating Period (VOFW).....	31
4.5.10	Total Volume of Oil/Emulsion Recovered in Operating Period (VOE)	31
4.5.11	Estimated Recovery System Potential (ERSP)	31
4.6	Combining Different Computations for Days 1–3.....	32
4.7	Differences between Batch and Continuous Spill Computations	32
4.8	Different Computations of Open-Water Recovery and Shoreside Recovery	32
5	OIL BEHAVIOR MODULE	33
6	CUSTOMIZATION MODULE.....	36
6.1	Customization Module Applications.....	37
6.2	Specifying Proportion of Gravel and Wetland Shoreline Categories	38
6.2.1	Application of Shoreline Apportionment to Percent Recoverable Oil (PRO _h)	39
6.2.2	Application of Shoreline Apportionment to Percent Emulsion (PE _h)	39
6.2.3	Application of Shoreline Apportionment to Thickness (TH _h).....	40
6.3	Evaluation of Oil Behavior at a Specific Hour	40
6.4	Customization Module Summary.....	40
7	CONCLUSIONS	43
8	REFERENCES.....	44
APPENDIX A.	CHALLENGES WITH INLAND WATERS.....	A-1
APPENDIX B.	SKIMMER DATA.....	B-1
APPENDIX C.	INPUTS FOR RECOVERY SYSTEM PERFORMANCE	C-1
APPENDIX D.	OPEN-WATER/SHORESIDE ALLOCATION.....	D-1
APPENDIX E.	OIL BEHAVIOR MODULE	E-1
APPENDIX F.	BOOM ANGLING FOR FAST CURRENTS.....	F-1
APPENDIX G.	ESSENTIAL ELEMENTS FOR DEVELOPMENT OF INLAND ERSP CALCULATOR ARCHITECTURE	G-1



LIST OF FIGURES

Figure 1. Example of potential (ERSP) removal capability and achieved removal for hypothetical blowout.	3
Figure 2. Examples of the variety of oil spills and oil spill responses in inland waterways.	5
Figure 3. Main component modules of the inland ERSP calculator.	7
Figure 4. Mockup of user interface for inputs for the inland ERSP calculator.	9
Figure 5. Addition of recovery systems for total recovery (open- vs confined-configuration waterway).	12
Figure 6. Mockup of user interface for outputs.	13
Figure 7. Mockup of customization module user interface for inputs.	14
Figure 8. Mockup of customization module user interface for outputs.	15
Figure 9. Relationship of times for OP, RST, STO and DT.	19
Figure 10. Connection of UDIs to inland ERSP calculator computations.	26
Figure 11. Customization module potential inputs with outputs.	42
Figure C-1. Recovery system performance based on oil type and condition for advancing skimmers.	C-3
Figure C-2. Maximum effective swath versus skimming speed for Day 1.	C-7
Figure C-3. Maximum effective swath versus skimming speed for Day 2.	C-8
Figure C-4. Maximum effective swath versus skimming speed for Day 3.	C-9
Figure D-1. Conceptual diagram of open-water versus shoreside equipment allocation.	D-2
Figure E-1. SIMAP 3-D oil fate model components and inputs flow diagram.	E-2
Figure E-2. Simulated fate processes for surface oil.	E-3
Figure F-1. Maximum boom angle for fast currents.	F-1
Figure G-1. Connection of UDIs to inland ERSP calculator computations.	G-3

LIST OF TABLES

Table 1. Summary of inland ERSP calculator user-defined inputs.	11
Table 2. Recommended operating period (OP) times by latitude and season.	19
Table 3. Differences in UDIs between open-water and shoreside recovery computations.	33
Table 4. Shoreline categories for oil behavior module and inland ERSP calculator (wetland shorelines, top and gravel shorelines, bottom).	38
Table A-1. Summary of NOAA incident database findings.	A-1
Table B-1. Skimmers identified according to application in response.	B-1
Table B-2. Advancing skimmer systems.	B-1
Table B-3. Stationary/advancing/self-propelled skimmer systems.	B-2
Table B-4. Stationary/non-advancing skimmer systems.	B-4
Table C-1. Representative nominal values for Recovery Efficiency, <i>RE</i> .	C-1
Table C-2. Estimated maximum effective swath for representative skimming systems.	C-11
Table C-3. Values for Maximum Effective Swath (<i>MES</i>) Days 1–3.	C-11
Table E-1. Oil characteristics table.	E-4
Table E-2. Shore widths and oil holding capacities by inland and coastal shore type in the U.S. east coast.	E-6
Table E-3. Shoreline categories for oil behavior module and inland ERSP calculator (wetland shorelines, top and gravel shorelines, bottom).	E-7
Table E-4. Time of no recoverable oil ($h(TH_0)$).	E-11
Table E-5. Average percent recoverable oil for Days 1–3.	E-13
Table E-6. Hourly values for Percent Recoverable Oil, PRO_h , for Day 1.	E-16
Table E-7. Hourly values for Percent Recoverable Oil, PRO_h , for Day 2.	E-19



LIST OF TABLES (Continued)

Table E-8. Hourly values for Percent Recoverable Oil, PRO_h , for Day 3.	E-23
Table E-9. Default percent recoverable oil for Days 1–3.	E-27
Table E-10. Percent emulsion by hour, PE_h , on Day 1.	E-29
Table E-11. Percent emulsion by hour, PE_h , on Day 2.	E-32
Table E-12. Percent emulsion by hour, PE_h , on Day 3.	E-36
Table E-13. Average percent emulsion for Days 1–3.	E-40
Table E-14. Default percent emulsion for Days 1–3 (oil groups III and IV) in flow waterways.	E-42
Table E-15. Average oil thickness by hour, TH_h , on Day 1.	E-43
Table E-16. Average oil thickness by hour, TH_h , on Day 2.	E-47
Table E-17. Average oil thickness by hour, TH_h , on Day 3.	E-50
Table E-18. Default average thickness for Days 1–3.	E-54
Table E-19. Average oil thicknesses for Days 1–3 by shoreline category for customization module.	E-56
Table G-1. Summary of inland ERSP calculator UDIs.	G-1
Table G-2. Summary and sequence of essential equations within basic use of inland ERSP calculator.	G-2
Table G-3. Operating period, OP, by latitude zone and season.	G-6
Table G-4. Representative nominal percent values for Recovery Efficiency, RE	G-24
Table G-5. Default percent emulsion for Days 1–3.	G-25
Table G-6. Average percent emulsion for Days 1–3 by shoreline category for customization module.	G-26
Table G-7. Default average thickness for Days 1–3.	G-28
Table G-8. Average oil thicknesses for Days 1–3 by shoreline category for customization module.	G-30
Table G-9. Average percent recoverable oil for Days 1–3 by shoreline category for customization module.	G-33
Table G-10. Hourly values for Percent Recoverable Oil, PRO_h , for Day 1.	G-35
Table G-11. Hourly values for Percent Recoverable Oil, PRO_h , for Day 2.	G-38
Table G-12. Hourly values for Percent Recoverable Oil, PRO_h , for Day 3.	G-42
Table G-13. Percent emulsion by hour, PE_h , on Day 1.	G-45
Table G-14. Percent emulsion by hour, PE_h , on Day 2.	G-49
Table G-15. Percent emulsion by hour, PE_h , on Day 3.	G-52
Table G-16. Average oil thickness by hour, TH_h , on Day 1.	G-56
Table G-17. Average oil thickness by hour, TH_h , on Day 2.	G-59
Table G-18. Average oil thickness by hour, TH_h , on Day 3.	G-63



LIST OF ACRONYMS AND ABBREVIATIONS

AMPD	Average Most-Probable Discharge
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
bbl	barrels
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulations
cP	Centipoise
DT	Downtime
EDRC	Effective Daily Recovery Capacity
EPA	Environmental Protection Agency
ER	Oil/Emulsion Encounter Rate Computation
ERR	Emulsion Recovery Rate
ERSP	Estimated Recovery System Potential
ESI	Environmental Sensitivity Index
FPL	Florida Power and Light Company
gpm	gallons per minute
HOOPS	Hoover Offshore Oil Pipeline System
kts	knots
MES	Maximum Effective Swath
MMPD	Maximum Most-Probable Discharge
MTFRR	Maximum Total Fluid Recovery Rate
NOAA	National Oceanic and Atmospheric Administration
OP	Operating Period
ORR	Oil Recovery Rate Computation
OSRO	Oil Spill Removal Organization
OSRP	Oil Spill Response Plan
PE	Percent Emulsion
PRO	Percent Recoverable Oil
RST	Recovery Start Time
RDC	United States Coast Guard Research and Development Center
RE	Recovery Efficiency
ROC	Response Options Calculator
RRT	Regional Response Team
RWTO	Rate Water Taken Onboard Computation
SIMAP	Spill Impact Model Application Package
STO	Computation of Skimming Time in Operating Period
SW	Swath Width
TE	Throughput Efficiency
TH	Thickness
TFRR	Total Fluid Recovery Rate: Total Fluid Recovery Rate Computation
UDI	User-Defined Input
USCG	United States Coast Guard
V	Speed (or velocity) of current or advancing skimmer
VOE	Total Volume of Oil/Emulsion Recovered in Operating Period
VOEW	Total Volume of Oil/Emulsion + Free Water Retained in Operating Period



LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

VOFW	Total Volume of Free Water Recovered and Retained in Operating Period
WCD	Worst-Case Discharge
WRR	Water Retention Rate



1 INTRODUCTION AND OBJECTIVES

The United States Coast Guard (USCG) Research Development Center (RDC), and contractors RPS, Environmental Research Consulting, and SEAConsult, LLC made up the project team. The primary scope of this project was to conduct research into inland operating-environment oil spill-response planning factors, the use of selected factors to create a conceptual model, and the requirements for designing an inland operating-environment oil spill-response calculator. Readers may refer to the previous RDC project deliverables:

- White Paper: Preliminary Analysis of Mechanical Oil Spill Response Planning Modeling Factors, which informed the selection of factors incorporated into the Inland Estimated Recovery System Potential (ERSP) Calculator; and
- Inland Estimated Recovery System Potential Preliminary Factors, Requirements and Conceptual Model, which provided the framework for development of the conceptual model for the Inland ERSP Calculator and provided the initial requirements for the calculator.

The purpose of this third and last calculator development report is to provide the design of the Inland ERSP Calculator, including the following components:

- Overall methodology, data sources and all assumptions;
- Calculator architecture in both text and simple block diagrams;
- Plain pseudocode for the calculator's algorithms; and
- Data acquisition and analysis description/process, meta-data, analyzed data, data recommendations to include default values, contextual guidance on parameter values selections, and any data/analysis files.

This document is organized for two types of readers: (1) the data scientist/calculator user and (2) the programmer who will ultimately develop the web-based tool.

Section 1 provides a background to the project and a summary of some of the challenges associated with oil spills occurring in inland waters.

Section 2 is a summary of the overall methodology of the Inland ERSP Calculator.

Section 3 provides the calculator architecture.

Sections 4–6 describe specifics on the basic algorithms, data sources and assumptions involved in the Inland ERSP Calculator.

Sections 7 and 8 provide conclusions and literature cited.

Appendices A-G provide additional detail for the challenges associated with inland waters; data sources for the various calculator inputs; further description of individual components of the calculator; and the essential elements for the development of the Inland ERSP Calculator architecture.



The project team recommends that the programmer who will ultimately develop the tool focus primarily on Sections 1–3 and Appendix G; while the data scientist/calculator user might focus on all aspects of the report except, perhaps, Appendix G.

1.1 Background

Mechanical oil spill recovery planning currently depends on an equation contained in the Code of Federal Regulations (CFR) which assigns an oil removal capability value to an individual oil skimmer. The Effective Daily Recovery Capacity (EDRC) calculator, which is the current standard oil spill recovery planning computation method, depends only on the skimmer’s nameplate capacity. Specifically, users calculate the EDRC by taking 20 percent of the manufacturer’s rated throughput capacity over a 24-hour period. The EDRC calculator came under heavy scrutiny as an inadequate means for vessel and facility plan holders to calculate their oil spill equipment needs in the wake of the 2010 Deepwater Horizon incident. The EDRC computation omitted factors such as the encounter rate (the actual amount of oil that skimmers take in during real world operations) and onboard storage of skimmers. These limitations led the Bureau of Safety and Environmental Enforcement (BSEE) to develop a new calculator for recovering oil in offshore environments called the Estimated Recovery System Potential (ERSP) in collaboration with the USCG.

The ERSP Calculator is based on oil encounter rate and evaluates mechanical recovery equipment as a complete “system,” as opposed to focusing on an individual component such as skimmer capacity or an intake pump. However, in many circumstances, the Offshore ERSP Calculator will “over-estimate” the amount of oil that would be recovered in a specific situation. A contractor simulated this phenomenon in a study conducted for BSEE for response capability planning for offshore blowouts (Figure 1).



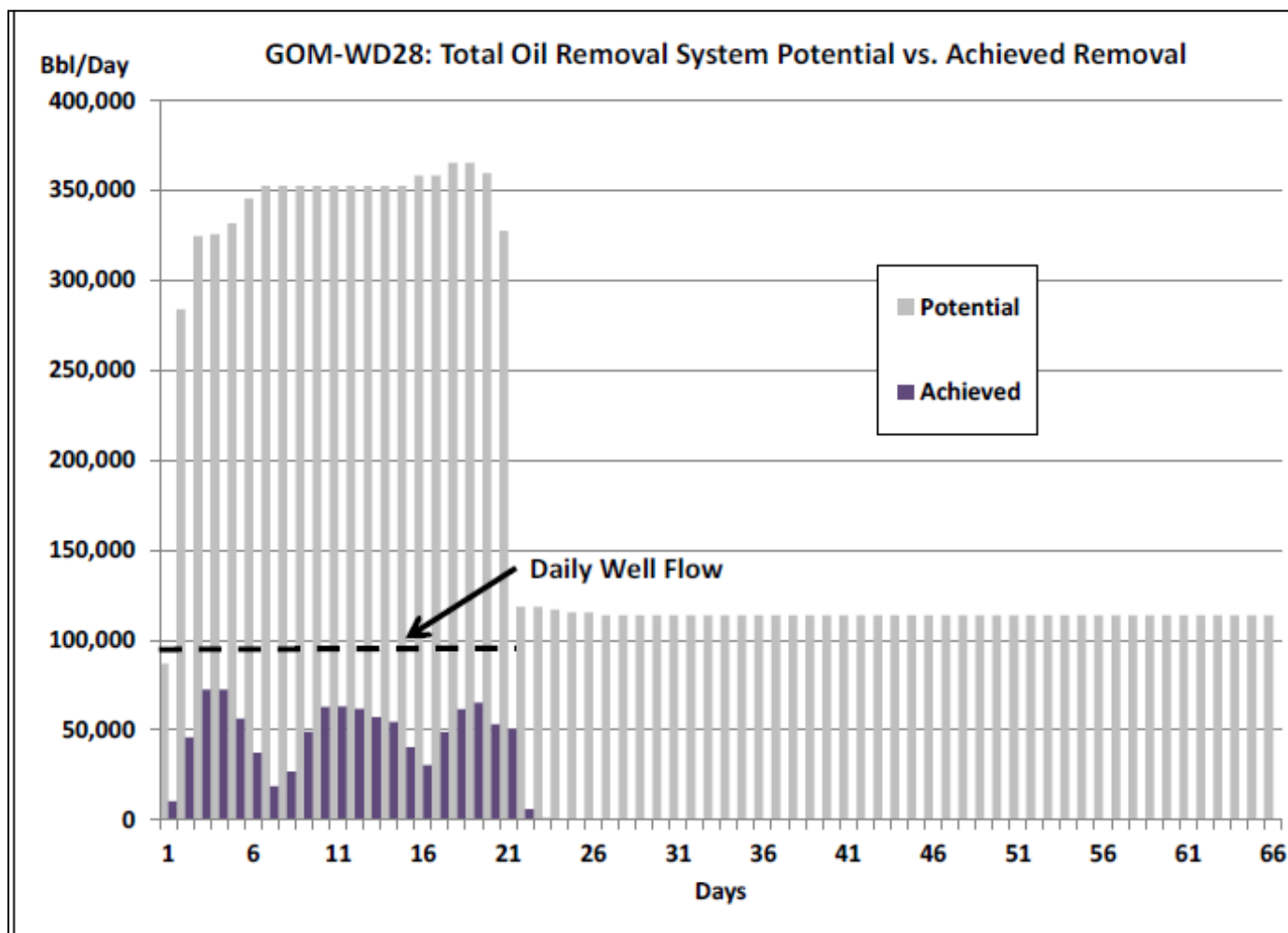


Figure 1. Example of potential (ERSP) removal capability and achieved removal for hypothetical blowout¹.

In that study, the contractor compared the estimated removal capability, as estimated by the application of the Offshore ERSP Calculator, to the achieved removal based on a simulation of the blowout scenario. The effects of environmental conditions (e.g., currents, wave height, darkness), as well as the behavior of the oil in the environment (i.e., weathering and spreading on the water surface), limited the amount of oil recovered.

The USCG recognized that the Offshore ERSP Calculator² may not be applicable for inland operating environments. In more confined, shallow areas with restrictions on maneuverability and variable surface water width, the offshore skimming systems with large swath width and large onboard or tethered storage solutions are less likely to be effective. To mitigate these shortcomings and support the ERSP calculator's possible adaptation by the USCG and/or inclusion into the regulations, RDC investigated how to incorporate the inland and nearshore operating environments into the existing ERSP calculator.

¹ From Buchholz et al., 2016.

² <https://www.bsee.gov/sites/bsee.gov/files/mechrecovery-cal.html>



Inland ERSP Operational Environment Calculator Design Document

In June 2017, RDC invited prominent industry representatives and USCG stakeholders to a workshop to explore the applicability of the ERSP calculator to the inland and nearshore operating environments. The participants brainstormed a conceptual approach to upgrade the calculator's algorithms for the inland environment. Following the workshop, RDC established this project to develop an Inland ERSP Calculator for these environments using the conceptual approach developed at the workshop.

The framework for developing the conceptual model for the Inland ERSP Calculator is based on the premise that the calculator is primarily a **response planning tool** for oil spills. The intended use of the calculator is to estimate the potential mechanical oil recovery capability of a **skimming system** based on its encounter rate, configuration, swath width, pumping rate, operating time, and storage capacity under generally favorable environmental conditions. The calculator does not account for environmental factors such as debris, ice, sediment, extreme weather conditions, site accessibility issues, or any extenuating circumstances that may significantly reduce the effectiveness of mechanical recovery operations under geo-specific field or actual operating conditions.

Neither the Inland ERSP Calculator under development nor the existing Offshore ERSP Calculator take into account uncontrollable environmental conditions that may affect recovery system effectiveness in response operations. As a response planning tool, the project team specifically did **not** design the Inland ERSP Calculator for application as a measure or predictor of actual oil spill recovery performance in the field. While users may apply the Inland ERSP Calculator in conjunction with adjunct tools, e.g., a "Customization Module" as described later, to provide better estimates of performance based on geo-specific field conditions or on certain mitigating circumstances, this is outside of the intended purpose of the tool.

An example of the way in which a user can apply a response planning tool, such as the Inland ERSP Calculator, is to estimate the amount of recovery capability (skimming systems) needed to meet the requirements for a Maximum Most Probable Discharge (MMPD) for facilities in generically-defined inland environments. Examples of additional applications for the response planning tool include: calculating the estimated recovery in a specific oil spill scenario (such as for an Oil Spill Response Plan for an inland facility or vessel); calculating the estimated recovery based on specific mobilization and transit times to a specific site; or customizing the characteristics of an inland waterway with the estimated amount of resource requirements for open-water and shoreside recovery operations.

1.2 Challenges of Inland Oil Spill Responses

One of the complexities involved with the development of an Inland ERSP Calculator is that there are many possible types of inland waterways to be considered, including lakes, rivers, tributaries, canals, and creeks. Thus, the inland environment poses significant challenges to oil spill responders. These waterways vary in their width, depth, current velocity, tidal range, shoreline material, and accessibility. All of these factors significantly impact how responders can carry out an oil spill response. Figure 2 shows oil spills and responses in a variety of inland environments.





Figure 2. Examples of the variety of oil spills and oil spill responses in inland waterways.³

Inland oil recovery is much more complex than recovering oil offshore. In an offshore scenario, boom is typically used in combination with advancing skimming systems to collect and recover the oil. In an inland oil spill response, responders are required to carry out more-complex techniques and to use a wider range of equipment; responders need snares, sorbent pads, sorbent boom, containment boom, stationary skimmers, and vacuum trucks. Responders must collect oil in small pockets and in collection points, and oil can become stranded on land as the tide moves in and out.

In order to document some of these challenges of inland oil spill response and gather lessons learned from different oil spill case studies, the project team gained access to specific applicable incident case files from the National Oceanic and Atmospheric Administration (NOAA) ResponseLink Hotline Database. After reviewing a dataset of 4,088 incidents dating from the 1980s to present for applicability to the project, the project team chose 98 case files for more detailed review. These case files included Coast Guard Situation Reports and Pollution Reports, Environmental Protection Agency Incident Reports, Incident Action Plans, NOAA Scientific Support Coordinator notes, and photographs.

³ All photographs from the NOAA ResponseLink Hotline Database.

Inland ERSP Operational Environment Calculator Design Document

Challenges and lessons learned noted in these case studies included:

- Responders do not often find trapped oil along shoreline, under docks, and in other restricted areas until days into the response.
- In some scenarios, responders need to employ rudimentary methods, such as using snare or pads, to recover oil. Some oils do not adhere well to these materials unless responders apply pressure, which makes for a difficult process.
- Oil stranded in floodplains and in source areas presents difficulties. Heavy oiling along banks in shallow release locations requires responders to perform significant excavation and long-term assessment and treatment once water levels fall.
- Areas where responders conducted oil spill cleanup after flood events, when heavy rainfall causes residual oil to refloat and deposit in other locations is problematic.
- In narrow waterways, there is less evaporation compared to larger and more open water bodies. It is difficult to model these conditions due to the number of variables involved, including varying fuel thickness and fuel penetration into organic debris and sediment. This product can remain in the sediment for months to years depending on the concentration, depth of penetration, and environmental conditions.
- Responders needed to cut marsh areas and vegetation in restricted areas in order to gain access to areas where oil must be removed.
- Ice traps oil in restricted waterways for long periods of time, reducing the ability for oil to naturally evaporate.
- High velocity currents move oil down river quickly impacting more areas and making it more difficult to recover. These high velocities cause the oil to mix into the water column more easily depending on the product.
- Responders face challenges locating and removing non-floating/submerged oils.

Appendix A contains a select list of cases that the project team reviewed for applicability to this project. These case studies illustrated the above challenges/lessons learned and provided insight to the development of the Inland ERSP Calculator design.

Many challenges for oil spill response in inland waterways are not issues that users can properly address in the Inland ERSP Calculator because they are either too incident- or geographic-specific, or they are not related to mechanical recovery operations (i.e., the use of skimming devices). The Inland ERSP Calculator takes into account the behavior of different types of floating oils (Groups I–IV) in several generic inland waterway types to focus on the recoverable oil over time and provides a means to calculate the potential recovery capability of skimming systems. Users may be able to apply the Customization Module to incorporate some aspects of incident- and geographic-specificity for planning for certain spill scenarios.



2 OVERALL METHODOLOGY

The Inland ERSP Calculator is composed of two basic parts: the Open-Water Recovery Calculator Module to estimate mechanical recovery in the open-water portions of an inland waterway (i.e., areas where an advancing skimmer can operate), and the Shoreside Recovery Estimation Tool Module, to estimate recovery in shoreside collection areas where advancing skimmers cannot operate. The Shoreside Recovery Estimation Tool Module includes two subcomponents: the Shoreside Active Collection Calculator and the Shoreside Passive Collection Calculator, which the user can apply to estimate recovery in shoreside areas with and without currents, respectively. The purpose of this tool is for the user to ***estimate recovery potential in a more general manner for generic inland waterway types for response planning.***

Developers will largely base the Open-Water Recovery Calculator on the existing Offshore ERSP Calculator and should not fully re-create it for the Inland ERSP Calculator. The user will be able to use the option to enter non-default input values in the “Customization Module” within the software, but outside of the main Inland ERSP Calculator (Open-Water Recovery Calculator and Shoreside Recovery Estimation Tool). Figure 3 shows the relationship between the various component modules of the Inland ERSP Calculator.

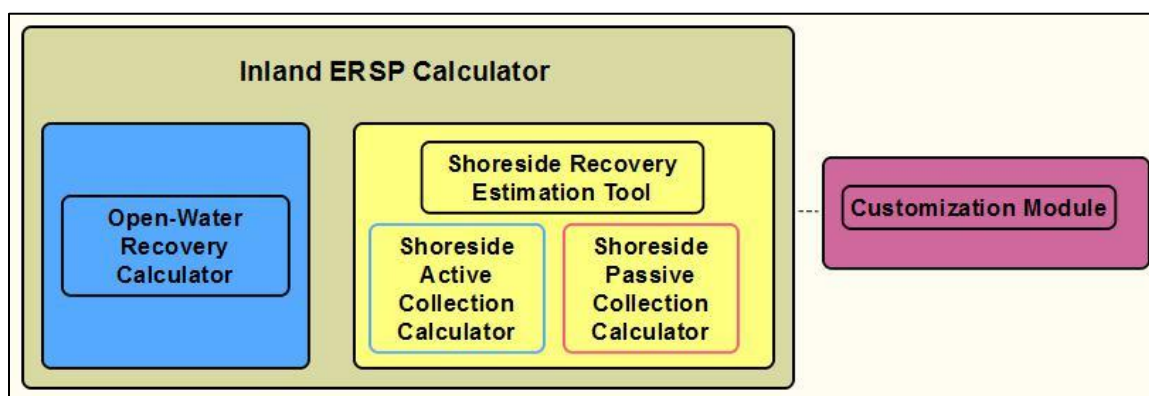


Figure 3. Main component modules of the inland ERSP calculator.

The Customization Module will modify the results of the Inland ERSP Calculator based on user-provided, geo-specific site characteristics inputs, including mobilization and transit time to the site, if desired. This module is to provide a means to estimate recovery potential for specific Oil Spill Response Plans (OSRPs).

There are several User-Defined Inputs (UDIs), i.e., inputs required of the user, to define the type of scenario, as well as UDIs to specify operational factors that affect recovery, and recovery factor UDIs for related equipment specifications and capabilities. The user needs to provide or select specific UDIs for setting up the spill scenario (oil type, waterway type, and volume category), as these are the basis of all subsequent computations. The user has options to enter specific values for operational inputs and recovery system factors as UDIs or to select default values.

In addition, within the Inland ERSP Calculator model itself, there are “inputs” from different model components that feed into components as part of the algorithm that calculates the results for the user. (This is described in Section 3.2.) In this case, “input” refers to the term used by computer programmers and coders. *The user of the Inland ERSP Calculator does not need to provide any of these inputs.*

Inland ERSP Operational Environment Calculator Design Document

A simplified description of the Inland ERSP Calculator is as follows (see also Figure 4, which shows a mockup of the user interface):

- The user selects the essential UDIs to define the scenario. The scenario-definition UDIs will set up the way in which the spilled oil behaves in the environment. An overview of these inputs is provided via schematics in Section 3. There are four UDIs for the user to identify the types of oil spills: spill type (batch or continuous), spill volume category, oil type, and generic waterway type (width and flow).
- To work in conjunction with the Inland ERSP Calculator model, the team developed an Oil Behavior Module (further described in Section 5 and Appendix E), which provides key results based on the scenario-defined UDIs for oil type, waterway type, and volume. The Oil Behavior Module outputs or results provide important internal inputs for the computations that occur within the Inland ERSP Calculator (i.e., amount of recoverable floating oil on the surface over time, emulsification rate over time and average oil thickness on the water surface over time). These computations are necessary within the main Inland ERSP Calculator and optional Customization Module. The user does not need to provide these internal inputs.
- Next, the user needs to select or specify site-specific encounter rate UDIs that will affect the degree to which oil can potentially be recovered within the operational constraints of time (start time after the spill occurs, “downtime,” and “operating period”), skimmer or waterway velocity, and workable swath width.
- The user then needs to add recovery factor UDIs, related to the skimming recovery system removing a portion of the spilled oil. There are various factors defined by the engineering specifications of the skimming system. These recovery factor UDIs for the equipment, will then, along with the scenario-definition and encounter rate UDIs, feed into the Inland ERSP Calculator to determine the recovery that can potentially occur.



Inland ERSP Operational Environment Calculator Design Document

Scenario Definition		
Waterway Classification	Configuration Select One of Each Open Confined	
	Current/Flow Flow Stagnant	
Spill Type Select One Batch Continuous		
Oil Spill Volume	If Batch, Enter Total Volume (bbl)	
	OR If Continuous, Enter Daily Release Rate (bbl/day)	
	AND If Continuous, Enter Days >1 up to 3	
	OR Select One AMPD MMPD WCD	
Oil Group Select One Group I Group II Group III Group IV		

Calculator Module for Open Configuration Waterways	
Select One	Open-Water Recovery Shoreside Recovery

Site-Specific Factors for Encounter Rate	
Operational Period	Enter hours
Recovery Time after Spill	Enter hours
Downtime	Enter hours
Speed/Velocity of Current or Advancing Skimmer	Enter knots (kts)
Swath Width	Enter feet (ft)

Skimming System Recovery Factors	
Throughput Efficiency	Enter percent (%)
Recovery Efficiency	Enter percent (%)
Nameplate Recovery Rate Maximum Total Fluid Recovery Rate	Select from pull-down menu

Figure 4. Mockup of user interface for inputs for the inland ERSP calculator.



The Inland ERSP Calculator is limited to the first three days (72 hours) of a response to coincide with the Offshore ERSP Calculator. The reasoning behind the three-day window is that after the first three days, the majority of the oil from the first day has weathered and spread to the point at which continued on-water skimming operations may be ineffective. In addition, three days after an incident has occurred, most of the necessary response resources would be on-scene or ordered, and spill specific response planning would be in place.

The project team developed the Inland ERSP Calculator for use in the same manner as the Offshore ERSP Calculator, to calculate the ERSP for specific recovery systems. The user needs to apply the Inland ERSP Calculator to one specific recovery system at a time. An Oil Spill Removal Organization (OSRO) will have a wide array of recovery systems to employ in the event of an oil spill. To determine the overall response capability of an OSRO for a particular type of inland spill, the user would need to calculate the ERSPs for each individual type of recovery system and then add the ERSPs.

Readers should refer to RDC's Conceptual Model Report (Rowe et al., 2019) for a thorough description of the Inland ERSP Calculator including (but not limited) to the following components:

- Definition of generic waterways;
- Identification of essential inputs;
- Incorporation of recovery-system factors;
- Relationship between scenario inputs, recovery factors and tools;
- Oil behavior incorporation into recovery estimations;
- Algorithm approach for open-water recovery; and
- Algorithm approach for shoreside recovery.

While the focus of this document is on the calculator architecture, underlying algorithms, data sources and assumptions, it is important to fundamentally understand the conceptual model underlying the Inland ERSP Calculator. The Conceptual Model Report provides a summary of each of the initial requirements, which include functional, user, system, security, and data requirements related to the calculator.

3 CALCULATOR ARCHITECTURE

This section of the report provides the overall architecture of the main Inland ERSP Calculator and descriptions of the information required within the User Interfaces for the main calculator and the *optional* Customization Module, which includes three parts. The user has the option of using features of the Customization Module to calculate geographic- and scenario-specific recovery rates for developing OSRPs or other custom purposes. The Inland ERSP Calculator does not require that the user apply the Customization Module.

This section outlines the User Interfaces for the UDIs and outputs derived as a result of the underlying algorithms and equations within the Inland ERSP Calculator. This section also provides a full schematic of the calculator architecture as an overview prior to going into the specifics of the user inputs and data defaults, and the step-wise equations used to derive the final calculator output.



3.1 User Interfaces

There are two User Interfaces for the basic computations of the Inland ERSP Calculator—one for inputs and one for outputs. Two additional interfaces would be contained within the Customization Module, if the user opts to include this feature. Section 6 describes the Customization Module in further detail.

3.1.1 User Interface for Inputs into the Inland ERSP Calculator

Table 1 lists the user-defined inputs into the Inland ERSP Calculator. Sections 4.1-4.3 provide a detailed description of all of the UDIs (which Table 1 summarizes) with default UDI values, where applicable.

Table 1. Summary of inland ERSP calculator user-defined inputs.

User-Defined Input (UDI)	Type of Input	Description
UDI 1	Scenario Definition	Spill type [Batch or Continuous] ⁴
UDI 2	Scenario Definition	Oil spill volume [bbl] ⁵ or OSRO Planning Standard Volume Category [AMPD, MMPD, WCD]
UDI 3	Scenario Definition	Oil type [Group I, II, III, or IV]
UDI 4	Scenario Definition	Waterway classification [Open-Flow, Open-Stagnant, Confined-Flow, Confined-Stagnant]
UDI 5	Encounter Rate	Operating period, <i>OP</i> [hours, h] ⁶
UDI 6	Encounter Rate	Recovery start time after spill, <i>RST_{day1}</i> [hours, h]
UDI 7	Encounter Rate	Downtime, <i>DT</i> [hours, h] ⁷
UDI 8	Encounter Rate	Speed (or velocity) of current or advancing skimmer, <i>V</i> [kts]
UDI 9	Encounter Rate	Swath width, <i>SW</i> [feet, ft]
UDI 10	Recovery Factors	Nameplate recovery rate (max. total fluid recovery rate), <i>MTFRR</i> [gal/min]
UDI 11	Recovery Factors	Throughput efficiency, <i>TE</i> [%]
UDI 12	Recovery Factors	Recovery efficiency, <i>RE</i> [%]

There are two separate types of computations for the Inland ERSP calculator if the user selects Open-Configuration as a waterway classification: Open-Water Recovery and Shoreside Recovery. With Open-Configuration waterway selected, the user needs to enter two sets of UDIs, one for each type of recovery (Open-Water and Shoreside). The user would enter the UDIs for each separate recovery system. Typically,

⁴ A batch spill is one that occurs instantaneously or over the course of several hours up to one day.

⁵ If the hypothetical incident is a Continuous spill, the spill rate [bbl/day] is entered.

⁶ The Operating Period is the time period each “day” when recovery operations could *potentially* occur, including the time required for “setup” at the site – generally daylight hours.

⁷ The Downtime (*DT*) is the amount of time on each day during which no skimming operations occur because response operators are setting up equipment for the day, transiting to new locations to work, or transiting and offloading recovered fluids. The transit and offloading time apply only to Open-Water Recovery. It is assumed that Downtime for offload of recovered fluids will not be required during Shoreside Recovery operations because continuous storage capability would be available. Additional time for moving to new locations and setup would be required for Shoreside Recovery operations. Therefore, for Open-Water Recovery, the default value for *DT* = 4 hours per day. For Shoreside Recovery, the default value for *DT* = 2 hours per day. (Described later in Section 4.2.3)



Inland ERSP Operational Environment Calculator Design Document

there would be two different types of recovery systems that responders would employ in Open-Configuration waterways.

The two computations, for each recovery system type (Open-Water and Shoreside), are conducted separately within the Inland ERSP Calculator. As a reminder, shoreside recovery uses stationary skimming systems supported by shoreline-based activities. For example, containment booms funnel oil to a collection point for removal by a non-advancing skimmer, which transfers the oil to shoreside portable storage. To estimate the recovery for an Open-Configuration spill scenario (i.e., the discharge of a certain volume of a particular oil type into an Open-Configuration waterway) based on all the equipment for both Open-Water and Shoreside Recovery operations, the user would add the effective recovery estimates for the two different types of recovery operations for all three days. The application of the Inland ERSP Calculator to compute shoreside recovery for a Confined-Stagnant Waterway is only possible for self-propelled or advancing skimming systems.⁸ The Inland ERSP Calculator is not designed to calculate oil recovery from the waterway by vacuum trucks or pumps that are not associated with a self-propelled or advancing skimming system. The calculator requires computing an Encounter Rate, which requires a velocity for the skimming system itself or the waterway current.

Figure 5 provides an example illustrating the way in which a user would use the Inland ERSP Calculator to compute total recovery for Open- and Confined-Configuration waterways with three hypothetical Open-Water Recovery (O) systems (denoted as O-A, O-B, and O-C in the figure) and Shoreside Recovery (S) systems (denoted as S-A, S-B, and S-C in the figure). Figure 5 shows three response systems, however, the user may conduct the computations for any number of systems that are being considered as part of the OSRO's or other response equipment cache's total response capability for the particular type of spill in question.

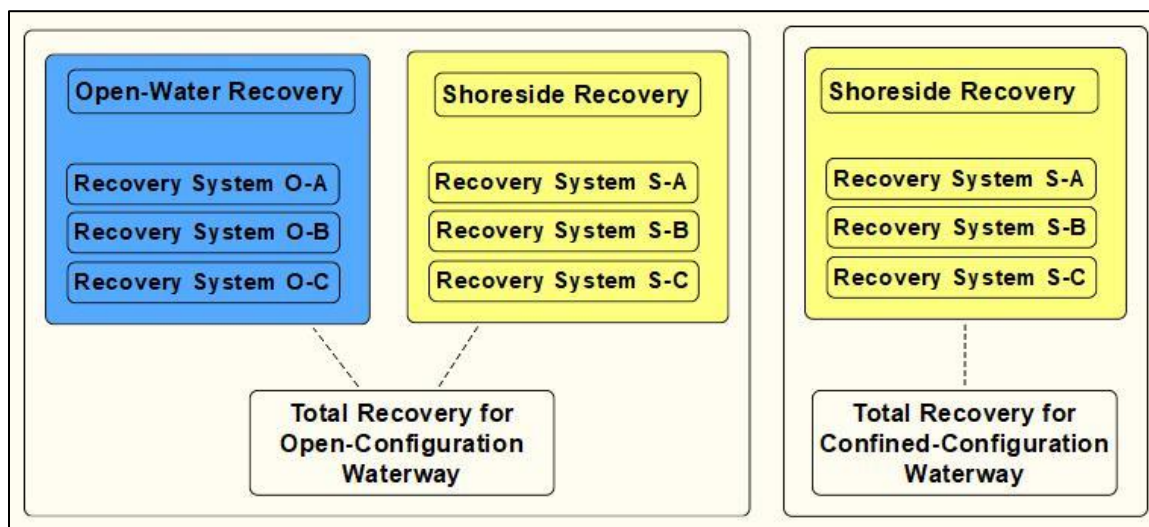


Figure 5. Addition of recovery systems for total recovery (open- vs confined-configuration waterway).

The Inland ERSP Calculator performs only one computation (Shoreside Recovery) for Confined-Configuration waterways. This would obviate the need for a user to enter UDIs for the Open-Water Recovery site-specific factors for encounter rate or the skimming system recovery factors. For Open-

⁸ In some cases, responders have used innovative approaches to this type of recovery by creating a "current" or blowing the oil towards a shoreside collection point with fans or airboats.

Inland ERSP Operational Environment Calculator Design Document

Configuration waterways, the user will need to enter inputs for both Open-Water Recovery site-specific factors and Shoreside Recovery site-specific factors. For all waterway types and scenarios, there is a separate computation for ERSP for Day 1, Day 2, and Day 3 that the ERSP calculator adds together for the entire three-day period for all the different recovery systems that the user entered into the calculator.

As previously described, there are two types of essential “inputs” into the Inland ERSP Calculator:

- UDIs actually entered by the user; and
- Oil Behavior Module inputs computed by the Oil Behavior Module.

The Oil Behavior Module (described in detail in Section 5 and Appendix E) computes three results that become important inputs for further computations within the Inland ERSP Calculator and the Customization Module. These computations include:

- Percent Emulsion, PE_{day} [%];
- Thickness, TH_{day} [inches]; and
- Percent Recoverable Oil, PRO_{day} [%].

These are not UDIs and, therefore, are not included in Table 1.

3.1.2 User Interface for Outputs from the Inland ERSP Calculator

Figure 6 shows the mockup diagram of the outputs from the Inland ERSP Calculator for a specific recovery system.

The mockup diagram, titled "Inland ERSP Calculator Outputs", is divided into two main colored sections: a blue section for "Open-Water Recovery" and a yellow section for "Shoreside Recovery". Each section contains four rows of output fields. The first three rows are for "Day 1 ERSP", "Day 2 ERSP", and "Day 3 ERSP", each followed by a text input field with a unit label (bbl for Day 1, bb for Day 2, and bbl for Day 3). The fourth row in each section is for "Total ERSP (3 Days)", followed by a text input field with a unit label (bbl). The entire interface is enclosed in a light green border.

Figure 6. Mockup of user interface for outputs.

The Inland ERSP Calculator outputs that appear in the User Interface are the per-day recovery volumes for each of the three days and the total recovery in barrels (bbl) for all three days. Since the outputs are by day, the recovery volumes also represent the bbl/day recovery rate for that day. These recoveries are shown for Open-Water and for Shoreside Recovery depending on user selection.



3.1.3 Customization Module User Interfaces

The Customization Module (Section 6) is optional and is designed for use in conjunction with the Inland ERSP Calculator. There are two additional User Interfaces—one for Inputs and one for Outputs.

Figure 7 shows a mockup of the User Interface for inputs into the Customization Module. The user can specify various UDIs for the Customization Module. Depending on UDIs, different outputs are presented. The potential UDIs in the Customization Module include:

- Customization Module Application A: Different percentages of gravel-category vs. wetland category shoreline types that differ from the default percentages;
- Customization Module Application B: Specific hour (for computation of daily recovery rate at a specific hour); and
- Customization Module Application C: Specific hour (for computation of percent and/or volume of recoverable oil present at a specific hour).

Customization Module Inputs

Application A: Varying Gravel Category vs. Wetland Category Shoreline Proportions

Gravel Category

Wetland Category

Application B: Recovery Rate at Specific Hour

ERSP by Hour

Application C: Recoverable Oil by Hour

Percent Recoverable Oil

Volume of Recoverable Oil

Figure 7. Mockup of customization module user interface for inputs.

Figure 8 shows a mockup of the User Interface for Outputs of the Customization Module. The outputs are:

- Customization Module Application A: Open-Water or Shoreside Recovery ERSP for customized waterways with gravel-category and wetland-category shorelines⁹;

⁹ The project assigned two representative habitat types: “gravel” is representative of shorelines that are generally narrow and absorb less oil (gravel, other rocky, sand, pebbled, and artificial shorelines); “wetland” is representative of shorelines that are generally wider, contain vegetation and/or mud, and can absorb more oil. See Section 6.2 for more information on habitat types.

Inland ERSP Operational Environment Calculator Design Document

- Customization Module Application B: Open-Water- or Shoreside-Recovery rates in bbl/day; or
- Customization Module Application C: Open-Water- or Shoreside Recovery-recoverable oil percentage or volume.

The inputs and outputs for the different subcomponents of the Customization Module are not interconnected. In other words, a user may opt to apply one of the subcomponents or features of the Customization Module without applying another. The computations are conducted independently. However, the user may apply both the customized waterway application in conjunction with either the recovery-rate-by-hour computation or the recoverable-oil-by-hour computation.

Customization Module Outputs

Application A: Customized Gravel Category vs. Wetland Category Shoreline Proportions

Open-Water Recovery

Day 1 ERSP

Day 2 ERSP

Day 3 ERSP

Total ERSP (3 Days)

Shoreside Recovery

Day 1 ERSP

Day 2 ERSP

Day 3 ERSP

Total ERSP (3 Days)

Application B: Recovery Rate at Specified Hour

Open-Water Recovery

Hour *h* ERSP

Shoreside Recovery

Hour *h* ERSP

Application C: Recoverable Oil at Specified Hour

Open-Water Recovery

Hour *h* Percent Recoverable Oil

Hour *h* Volume Recoverable Oil

Shoreside Recovery

Hour *h* Percent Recoverable Oil

Hour *h* Volume Recoverable Oil

Figure 8. Mockup of customization module user interface for outputs.



3.2 Overall Architecture with User-Defined Inputs and Oil Behavior Module Inputs

Appendix G outlines the connections between the inputs and outputs of the Inland ERSP Calculator. Appendix G also provides the pseudocode behind the development of the calculator architecture and other specific details and data needs for a programmer to develop this tool. Section 4 provides the details of the inputs, algorithms, and outputs from each of the features within this diagram. For all waterway types and scenarios, the user will be able to compute separate ERSP values for Day 1, Day 2, and Day 3, which are then added together for the entire three-day period.

4 SUMMARY OF BASIC INLAND ERSP ALGORITHMS, DATA SOURCES AND ASSUMPTIONS

This section provides a detailed description of the basic Inland ERSP Calculator UDIs and the data sources and default data for each input, including a discussion of 11 essential UDIs. It also outlines each algorithm, associated assumptions, and computational steps within the Inland ERSP Calculator. Following the overview of combining the computations for Days 1-3, this section also outlines the differences between batch and continuous spills, and the different computation of open-water recovery and shoreside recovery.

4.1 User-Defined Oil Spill Scenario Inputs

4.1.1 User-Defined Spill Type (UDI 1)

The user must specify the type of spill, Batch or Continuous.

A batch spill is one that occurs instantaneously or over the course of several hours up to one day. This type of spill would include pipeline spills that continue for as long as one day.

A continuous spill is one that occurs over the course of multiple days to weeks or months, so that fresh oil is continuously being added to the spill site. This type of spill would include a blowout of an inland well that occurs over several days. Continuous spills in inland environments are unusual circumstances. A continuous spill does *not* include a large release that continues for several hours that requires many weeks or months of cleanup. This category of spill is specific to the continuous addition of fresh oil to the environment.

4.1.2 User-Defined Discharge (Spill Volume) (UDI 2)

The ERSP calculator conducts most computations and provides all outputs based on barrels (bbl). This is also consistent with most USCG OSRO classifications. The user needs to convert the spill volume into bbl, if necessary. If the user wants to convert the spill volume in other units, the volumes can be converted into bbl, as in Equation 1.

$$bbl = \frac{\text{gallons}}{42}; bbl = \frac{m^3}{6.29}; bbl = \frac{\text{liters}}{0.0063}$$

Equation 1

If the spill is a batch spill, the user must specify the Volume of Release [bbl]. If the spill is a continuous spill, the user must specify the daily release rate [bbl/day] and the number of days of release. A continuous



Inland ERSP Operational Environment Calculator Design Document

release is assumed to occur over the course of at least two days. A one-day continuous release is treated as a batch spill within the Inland ERSP Calculator.

The Inland ERSP Calculator only computes for the first three days (72 hours).

Alternatively, the user may specify a Planning Volume classified as:

- Average Most-Probable Discharge (AMPD);
- Maximum Most-Probable Discharge (MMPD); or
- Worst-Case Discharge (WCD).

The Inland ERSP Calculator User Interface includes drop-down menus reminding the user of the appropriate volume based on the Planning Volume classification¹⁰ (AMPD, MMPD, or WCD) for inland environments and the spill source type (vessel, facility, pipeline, or train). These volumes are:

- AMPD: 50 bbl or 1% of facility's WCD.
- MMPD (Vessel): 2,500 bbl or 10% of fuel/cargo capacity up to 2,500 bbl.
- MMPD (Facility): 1,200 bbl or 10% of WCD.
- WCD (Vessel): Entire contents of oil cargo and/or fuel capacity.
- WCD (Facility): Entire contents of largest storage tank.
- WCD (Crude Oil Unit Train): Greater of 7,143 bbl or 15% total liquid petroleum lading.¹¹
- WCD (Pipeline): Based on WCD Pipeline formula (Equation 2):

$$WCD = (h_{shutdown} \times \frac{bbl}{h}) + bbl_{drainage}$$

Equation 2

where: h = hours; and $bbl_{drainage}$ = bbl in drainage after shutdown

4.1.3 User-Defined Oil Type (UDI 3)

The user must select an Oil Group. Select Oil Group (Group I, Group II, Group III, or Group IV)¹²:

- Group I = oils with specific gravity < 0.80 or °API¹³ 45.4 (e.g., gasoline, naphtha, some jet fuels);
- Group II = oils with specific gravity 0.80 to < 0.85 or °API 45.4 to >34.97 (e.g., diesel, No. 2 fuel, light crude oils);

¹⁰ 33 CFR Section 155.1020 defines AMPD, MMPD, and WCD.

¹¹ Note: 7,143 bbl = 10 tank cars. Each tank car is assumed to have 714.3 bbl capacity.

¹² 33 CFR Section 155.1020 describes persistent oil classifications.

¹³ American Petroleum Institute gravity is a measure of how heavy or light a petroleum liquid is compared to water. If its API gravity is greater than 10, it is lighter and floats on water; if less than 10, it is heavier and sinks.



- Group III = oils with specific gravity 0.85 to < 0.95 or °API 34.97 to >17.45 (e.g., medium crude oils); or
- Group IV = oils with specific gravity 0.95 to < 1.0 or °API 17.45 to > 10 (e.g., heavy fuel oils, intermediate fuel oils, bunker fuels, heavy crude oils).

Group V oils, Low-API-Oils with specific gravity greater than 1.0 or °API < 10 cannot be entered. The oil would sink and could not be recovered by conventional skimming systems. The user cannot use the Inland ERSP Calculator to calculate recovery for Group V oils.

4.1.4 User-Defined Waterway Classification (UDI 4)

The user must select Waterway Current/Flow (Flow OR Stagnant) *and* select Waterway Configuration (Confined OR Open).

“Stagnant” means current flow of 0 kts or a non-detectable flow.

Using this classification process results in the following four Waterway Classifications:

- Open-Flow;
- Open-Stagnant;
- Confined-Flow; or
- Confined-Stagnant.

4.2 User-Defined Operational or Encounter Rate Inputs

4.2.1 User-Defined Operating Period (OP) (UDI 5)

The user must define the Operating Period (OP). The default OP = 12 hours,¹⁴ but the user may enter a custom value for hours based on location and season, as shown in Table 2. The Operating Period is the maximum number of hours in each day that responders would be on site, normally daylight hours, when recovery operations could possibly occur. The actual recovery time is a subset of OP.

On the first day (Day 1), this time is shortened because of the time required for mobilization and transit to the spill site, as well as any “downtime” during which recovery is halted due to equipment adjustments (e.g., boom repositioning, switching storage tanks, following spreading oil) or other activities that temporarily postpone the recovery operations. In the Inland ERSP Calculator, for Day 1, Equation 3 must be solved:

$$STO_{day} = OP - RST_{day1} - DT$$

Equation 3

Where: STO_{day} = skimming time
 OP = operating period
 RST_{day1} = time for mobilization and transit to site on first day
 DT = downtime

¹⁴ The 12-hour default Operating Period (OP) is consistent with the assumptions in the Offshore ERSP Calculator.



Inland ERSP Operational Environment Calculator Design Document

The project team assumes that both OP and RST_{day} start at daybreak. If RST_{day} added to DT exceeds OP , then STO_{day} is assumed to be “zero”. STO_{day} cannot be a negative number (see Figure 9 below).

Table 2. Recommended operating period (OP) times by latitude and season.

Latitude Zone	Recommended Values for Operating Period (OP)			
	Spring	Summer	Autumn	Winter
Alaska (approximately 60° N)	15.5 hours	19 hours	15.5 hours	6 hours
Northern US (approximately 35-50° N)	14 hours	15 hours	14 hours	9 hours
Southern US (approximately 25-35° N)	13 hours	14 hours	13 hours	10.5 hours

4.2.2 User-Defined Start Time for Recovery Operations (RST) (UDI 6)

The user must define Recovery Start Time (RST) [h] as hours after spill notification and take into account the time required to mobilize and transit to the spill site. The default values for RST are:¹⁵

- 12 hours for Inland Facility;
- 24 hours for Inland Vessel;
- 6 hours for Inland Facility in High-Volume Port Area; and
- 12 hours for Inland Vessel in High-Volume Port Area.

Recovery Start Time (RST)¹⁶ is the number of hours after the spill notification when responders begin recovery operations after having mobilized and transited to spill site. The RST applies to Day 1 only. For consistency, the project team assumes that the spill notification occurs at daybreak, which is hour “0” for the Operating Period (OP) (see Figure 9).

The diagram illustrates the relationship between various time periods in the recovery process. It is organized into a sequence of boxes: 'Spill Notification' (top), 'Daylight' (input field), 'Operating Period (OP)' (input field), 'Mobilization' (input field), 'Transit to Site' (input field), 'Recovery Start Time (RST)' (input field), 'Skimming Time (STO)' (input field), and 'Downtime (DT)' (input field). The 'Recovery Start Time (RST)' box is highlighted in green, indicating its significance in the calculation.

Figure 9. Relationship of times for OP, RST, STO and DT.

¹⁵ Based on USCG OSRO Response Times in USCG 2019. The Inland ERSP Calculator does not include the Great Lakes except for connecting waterways within the region. For spills in the Great Lakes, the required response time for vessels is 18 hours. Users can apply the Offshore ERSP Calculator for response planning in the Great Lakes. These default RST values for the Inland ERSP Calculator are presented to so that the user may match the times in the OSRO Response Times for classifications under the four different inland time requirements based on the type of oil spill response plan (OSRP) that is being considered.

¹⁶ 33 CFR Section 155.1050 (g) defines the Recovery Start Times for vessels.



4.2.3 User-Defined Downtime (DT) (UDI 7)

The user needs to define the Downtime, DT , in hours each day during which recovery operations cannot be conducted due to repositioning of equipment to a different location (e.g., moving to a new site where oil accumulated), setting up equipment each day, transiting and offloading of recovered fluids (oil, water, and emulsion), and transiting to work sites. The user will need to estimate this time based on the location, which in an inland waterway, is generally close to shore.

As a default for Open-Water Recovery, the project team assumes that the combined Downtime, DT , each day is 4 hours. The project team also assumes that the default for Shoreside Recovery is 2 hours, as there would generally be no downtime for offloading. Again, the project team assumes that, for Shoreside Recovery, responders will have sufficient tank trucks or other storage readily available and use them continuously. The user has the option to set a different value for DT . The default time for Downtime is based on interviews with several individuals that have experience with response in inland waterways.

The recovery of oil each day is dependent on the amount of available oil and the amount of time over which active recovery operations are underway. The actual recovery time on each day is affected by the time until there is no longer any recoverable oil on the water surface (as determined by the Oil Behavior Module). The Inland ERSP Calculator algorithm assumes that the Downtime, DT , is evenly distributed across the Operating Period, OP . If the time to no more recoverable oil occurs early on during an OP and the amount of time is subtracted for DT , there may be *little* or no recovery time that is available for active recovery on that particular day. This may occur with lighter oils that evaporate more quickly. [If the user wants to calculate how much oil recovery could conceivably occur on such a day, the Customization Module B can be used to make an adjustment to the calculation.] However, on the day that the oil becomes non-recoverable (i.e., it is too thin on the water surface to effectively recover or has largely evaporated), in practical terms the oil is becoming increasingly more difficult to recover to any measurable extent. Therefore, a calculation that involves relatively little (or even no) recovery time on this day is a reasonable simulation of the actual response situation.

4.2.4 User-Defined Velocity, V (UDI 8)

The user must define the velocity, V . For Open-Water Recovery operations, V refers to the speed at which responders tow the advancing skimmer, or how quickly the advancing skimmer propels itself. The default value is 0.75 kts. However, the user should carefully consider an appropriate value based on the waterway being assumed. If the velocity that the user enters exceeds 0.75 kts, the user will be alerted with “FAST-BOOMING REQUIRED.”

For Shoreside Recovery operations using stationary skimming systems, V is the current velocity in the waterway, the speed at which the current transports the oil towards the stationary skimmer. The default value is 0.75 kts unless responders apply fast-current booming techniques.

For Shoreside Recovery operations, if the waterway is designated as “Stagnant,” the current velocity, V , is set to 0 kts. When V is 0, the Encounter Rate (ER) will be computed as 0 (see Equation 6), and a different approach is required. The application of the Inland ERSP Calculator to compute shoreside recovery for a Confined-Stagnant Waterway is only possible for self-propelled or advancing skimming systems. The Inland ERSP Calculator is not designed to calculate oil recovery from the waterway by vacuum trucks or pumps that are not associated with a self-propelled or advancing skimming system. The calculator requires



that an Encounter Rate be computed, which requires a velocity for the skimming system itself or the waterway current. In a stagnant waterway with no current, the UDI value for V would then be set to the movement of the skimmer rather than the current velocity.

The velocity, V , must be entered in knots (kts). If the user has current velocity in meters per second (m/s), it can be converted into knots with Equation 4.

Equation 4

$$V_{kts} = V_{m/s} \cdot 1.94384$$

4.2.5 User-Defined Workable Swath, SW (UDI 9)

The user needs to define the Workable Swath, SW , which is set in feet (ft) for the particular skimming system being evaluated. SW is the width over which the skimming system encounters an oil slick. Users will need to use their best judgment in determining appropriate inputs for SW .

A reasonable input for SW is dependent on two major factors—the specifications of the skimming system itself and the dimensions and configuration of the inland waterway in which the responders would be employing the skimming system.

Many skimming systems have a “standard” swath that is operationally efficient to deploy and operate.¹⁷ These standard values may be available from the equipment manufacturer or in tactics or training manuals. Many skimming systems, especially those employed on inland waterways, have built-in or attached “sweeping arms” that hold boom in a certain “arc” configuration to capture, contain, and direct oil toward the skimmer. The workable swath may be restricted by the maneuverability of the system or the way in which it would attach to a boat, in addition to the amount of fluid that the skimmer could operationally process.

The waterway factors would be geographically-specific to a certain degree, particularly for narrower waterways. In a narrower waterway, it may be necessary to employ narrower swaths to fit the configuration of waterway or otherwise accommodate the response equipment present in the waterway in a complex operation. In waterways with high current velocity, it may be necessary to locate static/stationary skimming system collection points at downstream locations to better accommodate the boom required for high velocity currents.¹⁸ This may also limit the workable swath due to the boom/shoreside angle needed to avoid oil entrainment under the boom.

Oil recovery is highly dependent on the encounter rate (ER) of a skimming system which is dependent on the swath (SW), velocity (V), and oil thickness (TH) on the water surface. Any increase in the swath would theoretically, increase the oil recovery rate. Responders will generally try to work with as wide a swath as is practical and achievable in a field setting. However, for all skimming systems and associated booming configurations, there is a maximum swath width beyond which the system will not effectively operate from the perspective of being able to achieve the swath width and processing the oil that would be encountered.

¹⁷ BSEE and Genwest Systems 2016, p. 14.

¹⁸ In fast currents (generally exceeding 0.7 kts), boom angle should be adjusted to prevent or reduce oil entrainment (movement of oil under the boom). Refer to Appendix G and Hansen and Tebeau 2002.



To provide guidance for spill responders, as well as to users of the Inland ERSP Calculator, there are recommended maximum effective swath widths.

Based on the manual for the Offshore ERSP Calculator, the recommended Maximum Effective Swath width (*MES*) is 1,000 ft.¹⁹ This value is based on field experience with respect to operationally achievable swath widths for skimming systems and associated booming in an offshore or open-water scenario. This maximum may be appropriate for open-water recovery operations on wide inland rivers. However, the user may also need to consider other practical factors in selecting a reasonable value for *SW*.

For Shoreside Recovery, this maximum swath length would be based on practical swath widths that could be configured based on the specific type of equipment being used, the waterway configuration (especially in a confined waterway), and current velocity.

The selection of a reasonable value for *SW* that is appropriate for the skimming system and the configuration of the inland waterway that does not exceed a Maximum Effective Swath width (*MES*), requires the user to have knowledge of both factors. To provide guidance to a user that does not otherwise have reliable information on the value to set for *SW* for a particular type of equipment, and, in particular, what the *MES* would be, the Inland ERSP Calculator includes an algorithm that calculates the *MES*. The calculation is based on the user entry (UDI 10) for the Maximum Total Fluid Recovery Rate (*MTFRR*) under Skimming System Inputs.

4.3 User-Defined Recovery Factors for Skimming System Inputs

The user enters specific inputs for the skimming system based on information available from manufacturers OR selects the type of skimming system from drop-down menus that list of equipment types. Appendix C provides additional background on the inputs for Recovery System Performance.

4.3.1 User-Defined Maximum Total Fluid Recovery Rate, *MTFRR* (UDI 10)

MTFRR was formerly referred to as Nameplate Recovery Rate.²⁰ Nameplate Recovery Rate was originally often provided by skimmer manufacturers based on their own tank tests using water (sometimes a test oil and a poorly controlled range of oil thicknesses), and minimal, if any, “head” to overcome while moving water or oil from the skimming surface to onboard storage. *MES*, is calculated by solving for Equation 5:

$$MES_{day} = \frac{(MTFRR \times RE)}{(63.13 \times V \times TH_{day} \times TE)}$$

Equation 5

where: *MES* = Maximum Effective Swath [ft]; *MTFRR* = Maximum Total Fluid Recovery Rate [gpm] (UDI 10); *RE* = Recovery Efficiency [%] (UDI 12); *V* = Velocity [kts]; *TH* = thickness [inches]; and *TE* =

¹⁹ BSEE and Genwest Systems 2016, p. 15.

²⁰ Nameplate Recovery Rate was originally often provided by skimmer manufacturers based on their own tank tests using water (sometimes a test oil and a poorly controlled range of oil thicknesses), and minimal, if any, “head” to overcome while moving water or oil from the skimming surface to onboard storage. There was no consideration of Encounter Rate (based on swath, speed, and oil thickness), such as would be the case for an advancing skimmer. Also, there was rarely any measure of Throughput Efficiency (*TE*) or carefully controlled measures of Recovery Efficiency (*RE*).



Throughput Efficiency [%] (UDI 11). 63.13 is a conversion factor for knots, feet, and inches to gallons per minute.²¹ This algorithm is described in greater detail in Appendix C.

In the Inland ERSP Calculator, the user is directed to select a Nameplate Recovery Rate or *MTFRR* range from a drop-down menu:

- Low: Less than 750 gallons per minute [Default].
- Medium: 750–1,500 gallons per minute.
- High: Greater than 1,500 gallons per minute.

If the user selects “High” for the *MTFRR* value, an alert is shown “USER SHOULD VERIFY NAMEPLATE RECOVERY VALUE, HIGH VALUE IS ONLY FOR THE HIGHEST CAPACITY SYSTEMS.”

4.3.2 User-Defined Throughput Efficiency, *TE* (UDI 11)

The user needs to define the Throughput Efficiency, *TE*, for the recovery system. *TE* is the percentage of oil/emulsion taken onboard out of the oil/emulsion encountered. This value should be available with the equipment specifications (based on ASTM F631–15, *Standard Guide for Collecting Skimmer Performance Data in Controlled Environments*). Appendix B shows the testing values for *TE* for equipment by type.

According to the Offshore ERSP Calculator, the default value is 75%.²² For this, and all variables expressed as “percents” (%), the expression “percent” is used to name the variable and its value as these are the expressions that may be familiar to users in the Offshore ERSP Calculator. In the actual computations conducted in the Inland ERSP Calculator, “percents” are actually applied in decimal format. (For example, 23% = 0.23.)

For the *TE*, the user enters specific inputs for the skimming system based on information available from manufacturers OR selects the type of skimming system from drop-down menus that list of equipment types:

- Advancing Skimmer System.
- Stationary/Advancing/Self Propelled Skimmer System.
- Stationary/Non-Advancing Skimmer System.

4.3.3 User-Defined Recovery Efficiency, *RE* (UDI 12)

The user needs to define Recovery Efficiency, *RE*, for the recovery system. *RE* is the percentage of oil/emulsion recovered compared to the total fluids recovered. This value should also be in the equipment specifications based on ASTM F631–15, *Standard Guide for Collecting Skimmer Performance Data in Controlled Environments*). Appendix B presents some examples of values for *RE*.

²¹ BSEE and Genwest 2016, p. 40.

²² BSEE and Genwest Systems 2016, p. 17.



RE is based on manufacturer information, if available. In the absence of manufacturer-provided data on *RE*, default values are provided based on Oil Group (viscosity characteristics) and equipment type in Table C-1 in Appendix C for advancing skimmer types. Appendix C discusses the derivation of these default values.

For the *RE*, the user enters specific inputs for the skimming system based on information available from manufacturers OR selects the type of skimming system from drop-down menus that list of equipment types:

- Advancing Skimmer System.
- Stationary/Advancing/Self Propelled Skimmer System.
- Stationary/Non-Advancing Skimmer System.

Alternatively, the user may select a Skimmer Group from a drop-down menu:

- Skimmer Group A (Oleophilic).
- Skimmer Group B (Paddle Belt, Fixed & Moving Submersion Plane).
- Skimmer Group C (Air Conveyor, Weir, Direct Suction & Vortex).

(The values for Recovery Efficiency, *RE*, included in the Inland ERSP Calculator are shown in Appendix B.)

4.4 Oil Behavior Module Inputs

The user does not need to enter any inputs into the Inland ERSP Calculator for *PRO_{day}*, *PE_{day}*, or *TH_{day}*. The Inland ERSP calculator selects these values internally.

Based on UDI 1–4 for the Oil Spill Scenario (spill type, spill volume, oil type, and waterway classification), Oil Behavior Module inputs provide the following values to be input into the computations within the Inland ERSP Calculator:

- Percent of oil that is potentially recoverable (compared to original spill volume) over time, *PRO_{day}* [%];
- Percent Emulsion (water content of oil/water emulsion) over time, *PE_{day}* [%]; and
- Thickness of oil on water surface, *TH_{day}* [inches, in].

It is important to note that, for the purposes of the Inland ERSP Calculator, the thickness of oil on the water surface (*TH_{day}*) assumes that oil is continuously being encountered over time. It does not account for patchiness (as described in more detail in the associated Inland ERSP Calculator Conceptual Model Report and in the further description of the Oil Behavior Module in Section 5).



4.5 Computations within Inland ERSP Calculator²³

The Inland ERSP Calculator uses various UDIs to perform a number of computations for recovery. Several of these steps involve a modification of the original algorithm in the Offshore ERSP Calculator. The Inland ERSP Calculator uses the UDIs to perform the following computations:

1. Computation of Oil/Emulsion Encounter Rate (*ER*);
2. Computation of Emulsion Recovery Rate (*ERR*);
3. Computation of Oil Recovery Rate (*ORR*);
4. Computation of Total Fluid Recovery Rate (*TFRR*);
5. Computation of Rate Water Taken Onboard (*RWTO*);
6. Computation of Water Retained Rate (*WRR*);
7. Computation of Skimming Time in Operating Period (*STO*);
8. Computation of Total Volume of Oil/Emulsion + Free Water Retained in Operating Period (*VOEW*);
9. Computation of Total Volume of Free Water Recovered and Retained in Operating Period (*VOFW*);
10. Computation of Total Volume of Oil/Emulsion Recovered in Operating Period (*VOE*);
11. Computation of Estimated Recovery System Potential (*ERSP*); and
12. Combining of different *ERSP* computations for Days 1–3.

Figure 10 provides a schematic of the connection between the UDIs and those derived within the Oil Behavior Module, including the equations/algorithms within the Inland ERSP Calculator.

²³ Note that designations of variable values with the subscript “day” or, in some cases, “h” (for hour), do not indicate necessarily that this is a per-day (or per-hour) rate, only that the variable has a different value on Day 1, 2, and 3, or by the specific hour.

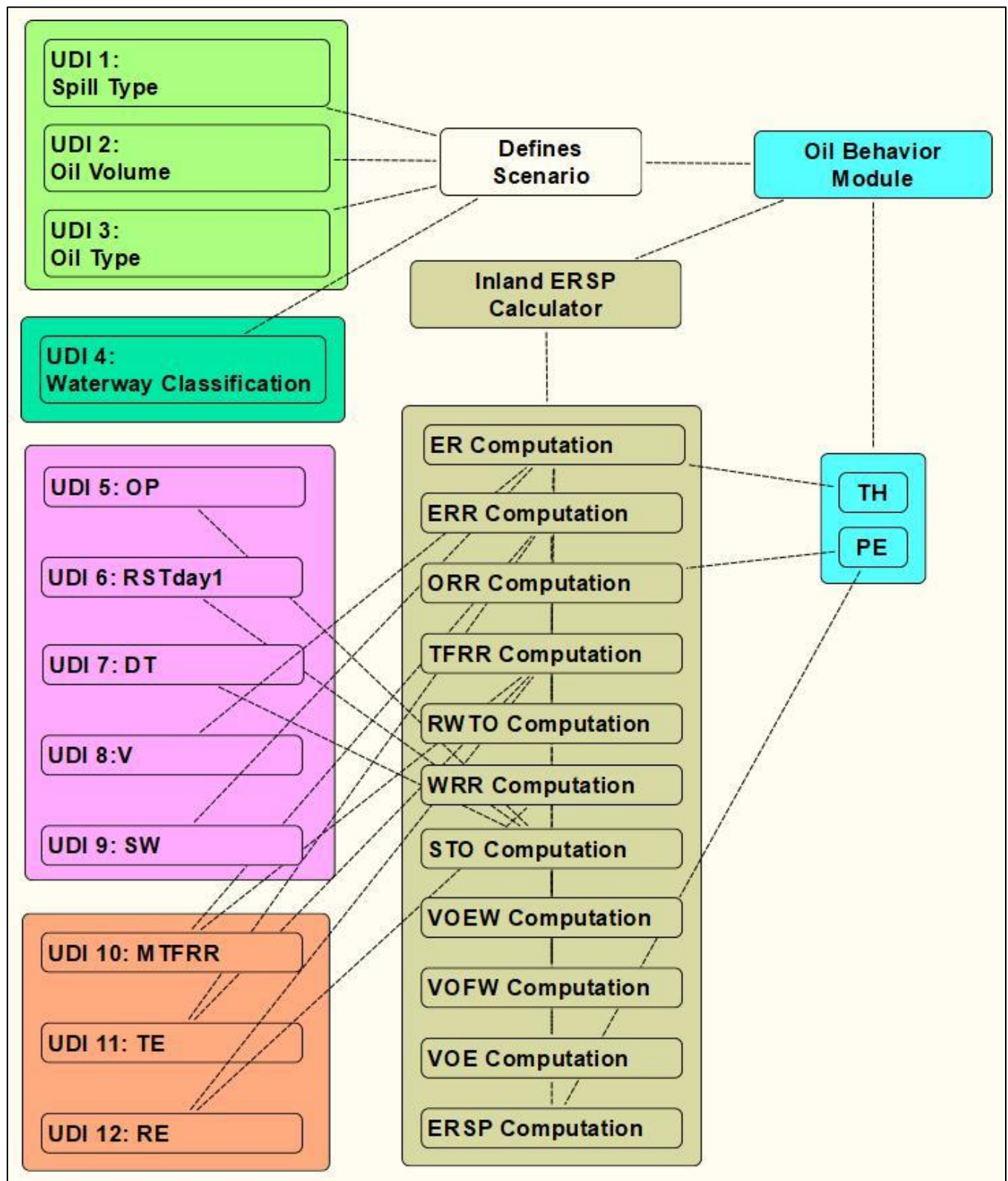


Figure 10. Connection of UDIs to inland ERSP calculator computations.

4.5.1 Oil/Emulsion Encounter Rate (ER) Computation

Based on UDI 8 (Velocity) and UDI 9 (Swath) and the Oil Behavior Module computation for Thickness (TH_{day}), the Inland ERSP Calculator computes the Oil/Emulsion Encounter Rate (ER_{day}). This is the rate at which oil/emulsion is encountered by a skimming system and is computed [gallons per minute, gpm] using Equation 6 for each day:

$$ER_{day} = 63.13 \times SW \times V \times TH_{day}$$

Equation 6

where: ER_{day} = Oil/Emulsion Encounter Rate in gpm; SW = the Workable Swath Width in feet that the user has specified for the particular recovery system taking into consideration the working environment in the inland waterway, V = the input system speed relative to the water in knots; TH = average thickness of the oil/emulsion entering the system's swath in inches (Table E-15 through Table E-17 in Appendix E), and 63.13 is a conversion factor for knots, feet, and inches to gallons per minute.²⁴

Guidance for selecting a value for SW (UDI 9 for Swath) that does not exceed Maximum Effective Swath (MES) is provided within the Inland ERSP Calculator, as previously described. V (UDI 8 for Velocity) has default values as options. TH_{day} is based on the scenario (Waterway Type-Oil Type-Volume Category) as simulated within the Oil Behavior Module. A table of average thicknesses for each day: Day 1, Day 2, and Day 3 (shown in in Table E-18 in Appendix E) provides TH_{day} values for inclusion into the Inland ERSP Calculator. Note that the values of average or hourly thicknesses (TH_{day}) provided from the Oil Behavior Module (Appendix E) are based on modeled simulations for representative waterways to help explain how oil behaves in the environment and not representative of an actual spill event. More detail on the modeling conducted for the Oil Behavior Module is provided in Appendix E.

4.5.2 Emulsion Recovery Rate (ERR) Computation

Based on the computation of ER by the Inland ERSP Calculator, the Inland ERSP Calculator computes the Emulsion Recovery Rate (ERR), the volume of emulsion recovered onboard the skimmer per unit time [gpm], using Equation 7. The computed values differ by day.

$$ERR_{day} = ER_{day} \times TE$$

Equation 7

where: ERR_{day} = emulsion recovery rate [gallons per minute, gpm]; ER_{day} = Encounter Rate (as computed in Equation 6); and TE = entered Throughput Efficiency [%] (UDI 11).²⁵

²⁴ This equation comes from BSEE and Genwest 2016, p. 37.

²⁵ This equation comes from BSEE and Genwest 2016, p. 38.



4.5.3 Oil Recovery Rate (ORR) Computation

Based on the Inland ERSP Calculator computation of ERR and the Oil Behavior Module-computed Percent Emulsion (PE), the Inland ERSP Calculator computes the Oil Recovery Rate (ORR), the rate at which encountered pure oil (i.e., excluding the water that is contained in the emulsion) is taken on board the skimming system [gallons per minute, gpm], using Equation 8. The computed values differ by day.

$$ORR_{day} = ERR_{day} \times (1 - PE_{day})$$

Equation 8

where: ORR_{day} = Oil Recovery Rate [gpm]; ERR_{day} = Emulsion Recovery Rate (as computed in Equation 7); and PE_{day} = Percent Emulsion, expressed as a decimal.²⁶ “Percent Emulsion” is used in the Offshore ERSP Calculator as this is the term that most users would likely find familiar. However, in order for the equation to be computed, the percent would need to be converted to a decimal. There is a different computation for ORR_{day} for each day.

The Oil Behavior Module (described in further detail in Section 5 and Appendix F) computes PE_h on an hourly basis. Table E-13 in Appendix E provides average values for Days 1–3 that the user can use as default inputs. Emulsification only applies to Group III and Group IV oils. Group I and II oils do not emulsify. If Oil Type = Group I or Group II, $PE = 0\%$.

The calculation of ORR is not necessarily required for the computation of $ERSP$. However, it may be of interest to some users. Therefore, the output of the ORR value itself in the calculation may be useful in addition to the calculation of $ERSP$.

4.5.4 Total Fluid Recovery Rate (TFRR) Computation

Based on UDIs (11 and 12) for TE and RE respectively, the ER computed from UDIs (8 and 9) SW and V respectively, and TH as computed within the Oil Behavior Module by the oil spill scenario, the Inland ERSP Calculator computes the Total Fluid Recovery Rate, ($TFRR$) (see Equation 9). The $TFRR$ is the rate at which the skimming systems [gallons per minute, gpm] takes on board all fluids (oil/emulsion and free water). There are different computations for each day.

$$TFRR_{day} = \frac{ER_{day} \times TE}{RE}$$

Equation 9

where: $TFRR_{day}$ = Total Fluid Recovery Rate [gpm]; ER_{day} = oil/emulsion encounter rate [gpm] (as computed in Equation 6); TE = Throughput Efficiency [%] (UDI 11); and RE = Recovery Efficiency [%] (UDI 12).²⁷

²⁶ This equation comes from BSEE and Genwest 2016, p. 38.

²⁷ This equation comes from BSEE and Genwest 2016, p. 38.



4.5.5 Rate Water Taken Onboard (RWTO) Computation

Based on the computed $TFRR$ and ERR , as computed in Equation 7 and Equation 9, respectively, the Inland ERSP Calculator computes the Rate Water Taken Onboard ($RWTO$). The $RWTO$ is the rate at which free water (water not bound up in emulsion) is taken on board the skimming system in gallons per minute [gpm]. Equation 10 computes $RWTO$. There are different computations for each day.

$$RWTO_{day} = (TFRR_{day} - ERR_{day})$$

Equation 10

where: $RWTO_{day}$ = Rate Water Taken Onboard [gpm]; $TFRR_{day}$ = rate at which all fluids are taken onboard [gpm] (as computed in Equation 7) and ERR_{day} = Emulsion Recovery Rate [gpm] (as computed in Equation 7).²⁸

4.5.6 Computation of Water Retained Rate (WRR_{day})

In the Offshore ERSP Calculator, there is an equation to compute Water Retained Rate.²⁹ The Water Retained Rate (WRR_{day}) is the rate of retention of free water taken onboard the skimming system in gallons per minute (gpm), after any decanting has been completed, as in Equation 11:

$$WRR_{day} = TFRR_{day} \times (1 - RE_{day}) \times (1 - \%decant)$$

Equation 11

where: WRR_{day} = the rate of retention of free water taken onboard the skimming system in gallons per minute (gpm); $TFRR_{day}$ = rate at which all fluids are taken onboard [gpm] (as computed in Equation 7); RE = Recovery Efficiency [%] (UDI 12); and $\%decant$ = the percent of water that is decanted. However, since decanting is not permitted in inland waterways (i.e., $\%decant = 0$), the equation becomes Equation 12:

$$WRR_{day} = TFRR_{day} \times (1 - RE_{day})$$

Equation 12

where: WRR_{day} = the rate of retention of free water taken onboard the skimming system in gallons per minute (gpm); $TFRR_{day}$ = rate at which all fluids are taken onboard [gpm] (as computed in Equation 7); and RE = Recovery Efficiency [%] (UDI 12).

The Inland ERSP Calculator utilizes Equation 12 to compute WRR_{day} . The values for WRR_{day} differ for each day.

4.5.7 Computation of Skimming Time in Operating Period (STO_{day})

The Skimming Time in Operating Period (STO_{day}) is based on the daily Operating Period, OP , minus the Recovery Start Time, RST , on Day 1, and the Downtime, DT , (UDI 7) on all three days, as shown in Figure 9. The OP , which should not be confused with an “operational period” for an Incident Action Plan, is the

²⁸ This equation comes from BSEE and Genwest 2016, p. 39.

²⁹ This equation comes from BSEE and Genwest 2016, p. 39.



length of time (in hours) each day where conditions allow a skimming system to conduct removal operations.

The assumed Operating Period (OP) [hours] is UDI 5 and the default value is 12 hours. This period is normally the hours of daylight in which skimming operations could conceivably occur. However, as an alternative, users may opt to apply hours as shown in Table 2.

The Operating Period, OP , includes some time during which no actual oil recovery occurs. This time, Downtime, DT , captures the time when skimming operations must cease while equipment is repositioned, daily equipment set-up occurs, transiting to/from sites, and/or offloading of collected fluids takes place. On the first day, the Operating Period also includes Recovery Start Time, RST_{day1} , which captures the period of time on Day 1 of the oil spill response that it takes for skimming operations to begin. The RST_{day1} is the time that is required from the point of notification of the spill incident to mobilizing, transiting to the spill site, and conducting the initial setup operations. For each day, the STO_{day} is computed by Equation 13:

$$STO_{day} = OP - RST_{day1} - DT$$

Equation 13

where: STO_{day} = Skimming Time in Operating Period [hrs]; OP = Operating Period [hrs]; RST_{day1} = Recovery Start Time on Day 1 [hrs after spill assuming that the start time occurs during daylight hours] (UDI 6); and DT = Downtime [hrs] (UDI 7).

On Day 1 of the spill response operations, the Inland ERSP Calculator adjusts OP by the Recovery Start Time,³⁰ RST_{day1} , [hrs] as determined by UDI (6). On Days 2 and 3, there is no Recovery Start Time, RST , included, because the initial mobilization, transit to the spill site, and the initial major set-up already occurred on Day 1. Downtime, DT , incorporates any additional daily equipment set-up time. The project team assumes that both OP and RST_{day} start at daybreak. If RST_{day} added to DT exceeds OP , then STO_{day} is assumed to be “zero.” STO_{day} cannot be a negative number.

4.5.8 Total Volume of Oil/Emulsion + Free Water Retained in Operating Period (VOEW)

Total Volume of Oil/Emulsion + Free Water Retained in Operating Period (VOEW) is the total volume of liquids recovered [bbl] and retained by the skimming system during each Skimming Time Operation, STO_{day} , as in Equation 14. There are different computations for each day.

$$VOEW_{day} = 1.43 \times (ERR_{day} + WRR_{day}) \times STO_{day}$$

Equation 14

where: $VOEW_{day}$ = Total Volume of Oil/Emulsion + Free Water Retained in Operating Period [bbl]; ERR_{day} = Oil/Emulsion Recovery Rate [gpm] (as computed in Equation 7); WRR_{day} = Water Retained Rate [gpm] (as computed in Equation 12); and STO_{day} = Skimming Time in Operating Period [hours] (as computed in Equation 13); and 1.43 = conversion factor for gpm to bbl/hour.

³⁰ RST_{day1} is also an input into the Oil Behavior Module to account for the behavior and fate of the oil at the point in time when the responders first arrive on the scene and begin the recovery operations on Day 1.

4.5.9 Total Volume of Free Water Recovered and Retained in Operating Period (VOFW)

Equation 15 computes the total Volume of Free Water, $VOFW$ [bbl], which is retained in the Operating Period. There are different computations for each day.

$$VOFW_{day} = 1.43 \times WRR_{day} \times STO_{day}$$

Equation 15

where: $VOFW$ = Volume of Free Water [bbl]; WRR_{day} = Water Retained Rate [gpm] (as computed in Equation 12); STO_{day} = Skimming Time in Operating Period [hours] (as computed in Equation 13); and 1.43 = conversion factor for gpm to bbl/hour.

4.5.10 Total Volume of Oil/Emulsion Recovered in Operating Period (VOE)

Equation 14 computes the Total Volume of Oil/Emulsion Recovered in Operating Period (VOE), which is the total volume of oil and emulsion recovered and retained by the skimming system during an Operating Period [in bbl]. There are different computations for each day.

$$VOE_{day} = VOEW_{day} - VOFW_{day}$$

Equation 16

where: VOE = Total Volume of Oil/Emulsion Recovered in Operating Period; $VOEW$ = Total Volume of Oil/Emulsion + Free Water Retained in OP [bbl] (as computed in Equation 14); and $VOFW$ = Total Volume of Free Water Recovered & Retained in Operating Period [bbl] (as computed in Equation 15). Again, there are different computations for each day.

Combining Equation 14 through Equation 16, creates Equation 17:

$$\begin{aligned} VOE_{day} &= VOEW_{day} - VOFW_{day} \\ VOE_{day} &= (1.43 \times STO_{day}) \times ((ERR_{day} + WRR_{day}) - WRR_{day}) \\ VOE_{day} &= 1.43 \times STO_{day} \times ERR_{day} \end{aligned}$$

Equation 17

4.5.11 Estimated Recovery System Potential (ERSP)

The Inland ERSP Calculator computes the Estimated Recovery System Potential, $ERSP$, for each day (Days 1–3) by removing the water component of the emulsion. The Oil Behavior Module (Section 5 and Appendix F) computes the Percent Emulsion, PE , which varies with time [h]. The user can enter PE as a default as an average for each of Days 1–3. Finally, Equation 18 computes the $ERSP$ for each day:

$$ERSP_{day} = VOE_{day} \times (1 - PE_{day})$$

Equation 18

where: $ERSP_{day}$ = Estimated Recovery System Potential [bbl] by Day; VOE_{day} = Total Volume of Oil/Emulsion Recovered (as computed in Equation 16); and PE_{day} = Percent Emulsion (input from Oil Behavior Module as in Table E-13 in Appendix E).

4.6 Combining Different Computations for Days 1–3

The user combines $ERSP_{day}$ for Days 1–3 to derive the $ERSP$ for the scenario, as in Equation 19:

$$ERSP_{scenario} = ERSP_{day1} + ERSP_{day2} + ERSP_{day3}$$

Equation 19

where: $ERSP_{day}$ = Estimated Recovery System Potential [bbl] by Day (as computed in Equation 18).

4.7 Differences between Batch and Continuous Spill Computations

While the majority of inland oil spills will likely be batch spills (i.e., spills that involve releases that are either relatively instantaneous or occur over the course of a few hours up to 24 hours or a single day), there may be potential continuous spills for which response planning must be considered. Continuous spills occur when oil is released at a certain rate over the course of multiple days where fresh oil is consistently added to the environment.

For continuous spills, the recovery rate is essentially the same on each day as fresh oil is continuously added, so that weathering does not significantly reduce the amount of recoverable oil over the course of the three days (72 hours) for which the Inland ERSP Calculator was designed.

The Oil Behavior Module (described further in Section 5 and Appendix F) includes simulations of batch spills and not continuous spills. For the purposes of inputs to the Inland ERSP Calculator, the Day 1 values for PE , TH , and PRO should be applied as appropriate for each of the three days (Days 1–3). The Inland ERSP Calculator only computes the estimated recovery for the first three days of a continuous spill even though for some continuous spill scenarios there may be more than three days of release.

4.8 Different Computations of Open-Water Recovery and Shoreside Recovery

Each $ERSP_{scenario}$ computation is for either Open-Water Recovery or Shoreside Recovery. The equipment specifications and operations are significantly different making this separation of computations necessary.

The concepts applied in the Open-Water and Shoreside Recovery computations are roughly analogous; however, Table 3 shows some differences in UDIs.

Inland ERSP Operational Environment Calculator Design Document

Table 3. Differences in UDIs between open-water and shoreside recovery computations.

UDI #	UDI	Differences between Open-Water and Shoreside Recovery Computations
1	Spill type [Batch or Continuous]	No difference; scenario specification
2	Oil spill volume [bbl] or OSRO Planning Standard Volume Category [AMPD, MMPD, WCD]	No difference; scenario specification
3	Oil type [Group I, II, III, or IV]	No difference; scenario specification
4	Waterway classification [Open-Flow, Open-Stagnant, Confined-Flow, Confined-Stagnant]	Scenario specification; Open waterways will include both Open-Water and Shoreside operations; Confined waterways will not include Open-Water operations.
5	Operating period, OP [hours, h]	No difference
6	Recovery start time after spill, RST_{day1} [hours, h] on Day 1, or OSRO Planning Standard Category [Inland Vessel, Inland Facility, Inland Vessel High Volume Port Area (HVPA), or Inland Facility High Volume Port Area (HVPA)]	No difference
7	Downtime, DT	Downtime is greater in Open-Water
8	Speed (or velocity) of current or advancing skimmer, V [kts]	Determined by waterway for Shoreside; determined by equipment or operational protocol for Open-Water
9	Swath width, SW [feet, ft]	Determined by equipment and waterway configurations, which will differ between Open-Water and Shoreside
10	Maximum Total Fluid Recovery Rate, MTFRR, [gal/min]	Determined by equipment, which will differ for Open-Water (advancing skimmers) and Shoreside (stationary skimmers)
11	Throughput efficiency, TE [%]	Determined by equipment, which will differ for Open-Water (advancing skimmers) and Shoreside (stationary skimmers)
12	Recovery efficiency, RE [%]	Determined by equipment, which will differ for Open-Water (advancing skimmers) and Shoreside (stationary skimmers)

The Inland ERSP Calculator very specifically separates the computations for Open-Water and Shoreside Recovery operations. In large part, oil spill responders (OSROs for example) use advancing skimming systems for Open-Water and stationary skimmers for Shoreside Recovery operations. There may be overlap with respect to the use of boom for containment and collection. In Appendix D, users can evaluate ways to allocate equipment between Open-Water and Shoreside Recovery operations for specific scenarios and geographic locations.

5 OIL BEHAVIOR MODULE

In the Inland ERSP Calculator, the estimated amount of oil available for recovery and the condition of that oil with respect to emulsification are vital components. For this reason, the project team integrated the Oil Behavior Module into the Inland ERSP Calculator. Appendix E provides more details about the basis of the Oil Behavior Module. Ultimately, it involves results of trajectory and fate modeling of representative oil spill scenarios that the project team already performed.



Inland ERSP Operational Environment Calculator Design Document

The user of the Inland ERSP Calculator does not need to provide any inputs into the Oil Behavior Module or perform any modeling to utilize the internal inputs and outputs of the module. The user's initial UDIs for oil type, waterway type, and spill volume category (UDI 1–UDI 4) as entered into the Inland ERSP Calculator interface (Figure 4) determine which hourly values for oil thickness (TH_h), Percent Emulsion (PE_h), or percent recoverable oil (PRO_h) are applied within the internal computations in the Inland ERSP Calculator.

In order to identify the appropriate oil spill scenario (one of 48 combinations of waterway type-spill volume-oil type), the user must select:

- Spill type (batch or continuous);
- Waterway classification (i.e., Confined-flow, Confined-Stagnant, Open-Flow, and Open-Stagnant);
- Specific volume of oil discharge (e.g., tens of barrels [bbl], thousands of bbl, hundreds of thousands of bbl) and/or magnitude of release (three types: AMPD, MMPD, and WCD); and
- Oil type: Oil Group I-IV.

The outputs from the Oil Behavior Module provide essential inputs into the computations that require values for:

- The amount of oil floating on the surface at a sufficient thickness to be recovered mechanically over time (PRO_h);
- The emulsification rate over time (PE_h); and
- The average oil thickness on the water surface over time (TH_h).

The user can utilize the three key Oil Behavior Module results as more site-specific inputs into the Inland ERSP Calculator and, specifically the Customization Module (if used).

The Oil Behavior Module provides the volume of oil in barrels that is floating on the water surface over time for the first 72 hours (3 days). The Oil Behavior Module compares this volume to the original spill volume to derive the percent recoverable oil. The reason for converting the volume to percent recoverable oil is so that the Inland ERSP Calculator can apply the percentage to different spill volumes for other planning scenarios.

Oil availability (or amount of recoverable oil) is a function of the degree of weathering and shoreline adhesion, which are affected by oil type, volume spilled, and waterway conditions.

The SIMAP (Spill Impact Model Application Package) oil spill modeling system³¹ addresses the availability of recoverable oil, including weathering processes and emulsification, through modeling of representative Group I-IV oils. The SIMAP three-dimensional physical fates model calculates the distribution (as mass and concentrations) of whole oil and oil components on the water surface, on shorelines, in the water column, and in sediments. Oil fate processes included are oil spreading (gravitational and by shearing), evaporation, transport, randomized dispersion, emulsification, entrainment (natural and facilitated by dispersant), dissolution, volatilization of dissolved hydrocarbons from the surface water, adherence of oil droplets to suspended sediments, adsorption of soluble and sparingly-soluble aromatics to suspended sediments, sedimentation, and degradation. The SIMAP modeling allowed for the development of formulae and coefficients that could be incorporated into the algorithms to estimate the amount of oil available for recovery over time.

³¹ French-McCay et al. 2018; French-McCay 2009. More details on SIMAP are presented in Appendix G.



The SIMAP modeling conducted did not include any oil recovery itself. In other words, the oil fate processes, as described above, are assumed to occur in the absence of any recovery (or other response operations). The oil that is present on the water surface on Day 2, for example, includes any oil that has not evaporated, dissolved, or adhered to sediments or shorelines. In an actual spill situation, if there had been recovery conducted prior to this, this oil would no longer be available for recovery on Day 2. It was not possible to simulate actual recovery, which would generally be less than “potential recovery” on any particular day for a specific spill scenario. The actual recovery (i.e., the amount of oil that would be removed from the water surface by skimming operations) would be affected by the specific operational issues, crew efficiencies, logistical issues, and a variety of environmental factors that could not be simulated in a generic manner. It would not be appropriate to subtract the calculated ERSP (the potential recovery) for Day 1 in this hypothetical case. All of the simulated scenarios are “unmitigated” spills.

The degree to which skimming systems encounter recoverable oil on the water surface depends on the oil’s distribution. This is affected by the degree of patchiness or the discontinuity of the oil slick on the water surface. There are often patches of oil on the water surface rather than a continuous slick, especially as time passes. Patchiness is difficult to quantify in a generic manner as it highly depends on geo-specific environmental conditions, such as winds. The project team opted not to include patchiness in the Inland ERSP Calculator. The issue of patchiness was discussed in the White Paper.

Based on a matrix of 72 oil spill modeling scenarios completed using SIMAP (as described in further detail in Appendix E), there are 72 underlying basic equations (also provided in Appendix E) with oil volume on the surface over time (in hours) based on the key UDIs:

- Oil Group (Groups I–IV);
- Waterway Type (based on Waterway Classifications with the addition of two types of representative shorelines [gravel and wetland/marsh] to which oil will adhere differently); and
- Volume Category (AMPD, MMPD, and WCD).

For the purposes of oil behavior modeling, the assumed values for volume were:

- AMPD = 50 bbl;
- MMPD = 2,500 bbl; and
- WCD = 155,000 bbl.

The project team applied these specific volumes to the Oil Behavior Module only for the purpose of modeling the oil behavior (weathering and sticking to shorelines), which varies by oil volume. For planning purposes, the user can apply the percentage recoverable oil (relative to the volume originally spilled) to different hypothetical spill volumes. The Volume Category (AMPD, MMPD, WCD), where AMPD = 50 bbl (or spills in the tens to hundreds of bbl); MMPD = 2,500 bbl (or spills in the thousands to ten-thousands of bbl); and WCD = 155,000 bbl (or spills in the hundred-thousand or more bbl), can define the scenarios in the Inland ERSP Calculator.

For the waterway flow conditions (Open-Flow and Confined-Flow), there are two representative shoreline types considered—wetland and gravel. The project team included this condition because oil will adhere differently to these different shore types and the widths of the shores are different. In the real world, responders will remove differing amounts of oil from the water surface; it will no longer be available for



potential recovery depending on the shoreline type. Appendix E provides more detail on the shoreline type classification.

For the Inland ERSP Calculator, there is a default combination of the computations for oil behavior based on wetland category or gravel category shorelines (Appendix E) that will be determined by the ratio of wetland (or similar habitat type, e.g., marsh, mudflat, etc.) to shorelines.

For the Customization Module (Section 6), the user can include specific start times. This addition allows the user to see how much delaying or getting to the scene faster (or transit time and/or accessibility delays) may affect recovery based on more time for weathering and shoreline adhesion. The default values are based on OSRO Guidelines for Inland Waterways by spill type and port type.

SIMAP modeling for the Oil Behavior Module also provides data on the emulsification rates by oil type. These data are vital for determining the amount of oil and emulsion available for the Encounter Rate computations (see Section 4.5 and Figure 10).

6 CUSTOMIZATION MODULE

The project team made a number of assumptions in the Inland ERSP Calculator with respect to the characteristics of the scenario. The user can utilize the Customization Module to calculate ERSP for more specific inland waterway situations. ***The use of the Customization Module is completely optional.*** The user may elect to utilize the Customization Module for Oil Spill Response Plans (OSRPs) or to make more precise ERSP computations based on deviations from default values for certain UDIs. However, use of the Customization Module is not essential to the main computations of the Inland ERSP Calculator. The user may derive results for ERSP (estimated response system potential) without the use of the Customization Module.

Using the Customization Module, the user can perform a number of computations or customize the scenario specifications to more closely match a specific geographic location or hypothetical spill scenario for the development of an OSRP. Applications include:

- Customization Module Application A: Specifying the proportion of gravel category and wetland category shoreline types in a waterway to represent a specific geographic location.
- Customization Module Application B: Calculating specific recovery rates (in bbl/day) at specific times.
- Customization Module Application C: Calculating an estimated Percent Recoverable Oil (*PRO*) on the water surface at different times during the response operations and convert that percentage to the volume of recoverable oil by multiplying by the original spill volume.

The user can utilize Customization Module Application A alone, in which case the ERSP for the specific waterway is computed, or in conjunction with either Application B or C. In the latter two cases, the module computes the results based on the waterway specifications.

The algorithms for the Customization Module are mainly based on using different values or equations rather than single values for the computations. The inputs and outputs for the different subcomponents of the Customization Module are not interconnected. In other words, a user may opt to apply one of the



subcomponents or features of the Customization Module without applying another. The computations are conducted independently.

The user may enter custom inputs into the Inland ERSP Calculator to “override” the default values provided to perform a number of custom computations. The Customization Module, with the example User Interface provided in Section 3.1.3, provides an additional level of customization and detail to a specific planning scenario.

6.1 Customization Module Applications

There are three applications within the Customization Module:

- **Customization Module Application A:** This application allows the user to specify customized proportions of gravel-category and wetland-category shorelines to better represent the characteristics of a specific waterway. The computations for ERSP would be conducted in the same manner, however, applying the relevant inputs from the Oil Behavior Module based on the way in which oil would behave given the shoreline characteristics that the user has provided. Customization Module Application A may be applied in conjunction with Application B or Application C.
- **Customization Module Application B:** This application allows the user to determine ERSP (represented in bbl/day recovery) at a specific hour. For example, a user may be interested in the recovery rate as it would be at hour 16 into the spill. The ERSP would be calculated as a bbl/day recovery rate at hour 16. If recovery were to continue at that rate, the recovery would be that many bbl recovered over the course of one day.³² Customization Module Application B may be applied in conjunction with Customization Module Application A. In that case, the recovery rate at a specific hour (in bbl/day) would be computed with the relevant inputs from the Oil Behavior Module based on the way in which oil would behave given the shoreline characteristics that the user has provided.
- **Customization Module Application C:** This application allows the user to determine the amount of recoverable oil remaining on the water surface at a specific hour after the spill. The result will be expressed as the volume of oil remaining on the water surface, as well as the percentage of the originally spilled volume that is remaining. The oil remaining at that point in time would reflect the oil weathering, shoreline adherence, natural dispersion, and dissolution that would have occurred up until that time (as modeled within the Oil Behavior Module), but not any oil recovery that theoretically might have occurred prior to this time.³³ Customization Module Application C may be applied in conjunction with Customization Module Application A. In that case, the amount of recoverable oil remaining would be computed with the relevant inputs from the Oil Behavior Module based on the way in which oil would behave given the shoreline characteristics that the user has provided.

³² An analogy might be considering the rate of speed at which an automobile is traveling, e.g., 55 mph. If the automobile continues to travel at that rate for a full hour, it will transit 55 miles.

³³ The reason that oil recovery or removal cannot be incorporated into the Oil Behavior Module is that the actual removal rate would be too spill response-specific. It would not be able to take into account the operational and environmental conditions that would affect oil removal in a specific spill case. The actual oil removal will nearly always be less than the potential removal. (See also Appendix E.)



6.2 Specifying Proportion of Gravel and Wetland Shoreline Categories

Oil spilled into an inland waterway flows downstream with the current and as blown by the wind in wider waterways. As the oil moves on the water surface, it may come in contact with shorelines where it will adhere to varying extents, depending on the nature of the shoreline. Once the oil adheres to a shoreline it tends to remain stranded. Once stranded, it is no longer floating on the water surface and no longer recoverable by skimming systems.

Different shoreline types can hold different capacities of oil. The SIMAP model incorporates this factor into its simulations of oil behavior. In the modeling for the Oil Behavior Module, the project team conducted two sets of modeling for each oil type, flowing waterway type, and volume category—one for shorelines that have a lower holding capacity (represented generically by gravel shorelines) and one for shorelines that have a higher holding capacity (represented generically by wetland shorelines). The “gravel” shoreline is representative of shorelines that are generally narrow and absorb less oil (gravel, as well as other rocky, pebbled, and artificial shorelines). The “wetland” shoreline is representative of shorelines that are generally wider, contain vegetation and/or mud and can absorb more oil (various types of wetland, as well as mud flats). Retention of oil on a shoreline depends on the shoreline type, width and angle of the shoreline, viscosity of the oil, the tidal amplitude, and the wave energy. Table 4 shows two general categories of shoreline types referenced in the Inland ERSP Calculator.

Table 4. Shoreline categories for oil behavior module and inland ERSP calculator (wetland shorelines, top and gravel shorelines, bottom).³⁴

Wetland Category Shorelines	
ESI Number	ESI Classification Description
7	Exposed Tidal Flat
9A	Sheltered Tidal Flat
9B	Sheltered, Vegetated Low Banks
10A	Salt- and Brackish-Water Marsh
10B	Freshwater Marsh
10C	Swamp
Gravel Category Shorelines	
ESI Number	ESI Classification Description
1A	Exposed Rocky
1B	Exposed, Solid Man-Made Structures
2A	Exposed Wave-Cut Platforms in Bedrock
2B	Exposed Scarps and Steep Slopes in Clay
3A	Fine- to Medium-Grained Sand Beach
3B	Scarps and Steep Slopes in Sand
4	Coarse-Grained Sand Beach
5	Mixed Sand and Gravel Beach
6A	Gravel Beach
6B	Riprap
8A	Sheltered Rocky Shore
8B	Sheltered, Solid Man-Made Structures

³⁴ Environmental Sensitivity Index (ESI) classifications from NOAA 2013.



In the Inland ERSP Calculator, for each of the two Waterway Types with Flow conditions—Open-Flow and Confined-Flow, there are two sets of values for PRO_h , PE_h , and TH_h . One is for gravel shorelines, and one is for wetland shorelines (see Appendix F for more details). Recognizing that inland waterways would typically have a variety of shorelines, the project team integrated results from both gravel- and wetland-shoreline simulations into the computations within the Inland ERSP Calculator.

The Inland ERSP Calculator has a default combination of the computations for oil behavior based on wetland category or gravel category shorelines that will be determined by the ratio of wetland to shorelines. The default values for this ratio are:

- For Open-Flow waterways: 75% gravel category: 25% wetland category; and
- For Confined-Flow waterways: 25% gravel category: 75% wetland category.

For specific waterways or situations in which the user prefers to set relative percentages of gravel- and wetland-category shorelines that differ from the default values, the user may enter custom percentage values into the Customization Module User Interface (Figure 7). For example, for a scenario in which the receiving waterway is a confined industrial canal (a Confined-Flow waterway) lined with riprap and with little vegetated shorelines, the user may opt to set the percentages to 90% gravel category: 10% wetland category. For an Open-Flow waterway that has extended shorelines with marshes and other vegetation, the user may opt to set the percentages to 10% gravel category: 90% wetland category. The user may set the percentages for either category anywhere in the range from 0% to 100%, as long as the total of the two percentages for gravel- and wetland-category shorelines totals 100%. The user may refer to ESI maps in Geographic Response Plans in conjunction with Table 4 to make an informed determination about the percentages of shoreline categories.

6.2.1 Application of Shoreline Apportionment to Percent Recoverable Oil (PRO_h)

For all equations in this section, PRO_h is the Percent Recoverable Oil at hour, h . The scenarios are denoted by [Oil, Vol, Water], meaning that SIMAP uses the scenario inputs to yield resultant values based on Oil Type, Oil Spill Volume, and Waterway Type.

PRO_h is then computed as in Equation 20:

$$PRO_h[Oil, Vol, Water] = (P_w \times PRO_h[Oil, Vol, w]) + (P_g \times PRO_h[Oil, Vol, g])$$

Equation 20

where: P_w = proportion wetland category shorelines, and P_g = proportion gravel category shorelines in a Flow waterway.

6.2.2 Application of Shoreline Apportionment to Percent Emulsion (PE_h)

PE_h is computed by Equation 21:

$$PE_h[Oil, Vol, Water] = (P_w \times PE_h[Oil, Vol, w]) + (P_g \times PE_h[Oil, Vol, g])$$

Equation 21

where P_w = proportion of wetland category shorelines, and P_g = proportion of gravel category shorelines in a Flow waterway.

6.2.3 Application of Shoreline Apportionment to Thickness (TH_h)

TH_h is computed by Equation 22:

$$TH_h [Oil, Vol, Water] = (P_w \times TH_h [Oil, Vol, w]) + (P_g \times TH_h [Oil, Vol, g])$$

Equation 22

where P_w = proportion of wetland category shorelines, and P_g = proportion of gravel category shorelines in a Flow waterway.

The hourly values for PE_h and TH_h (i.e., the values for PE_h and TH_h at the hour specified by the user) are only applied in Customization Module Applications B and C when used in conjunction with Customization Module Application A. If the user is applying Customization Module Application A to compute ERSP for three days based on solely on different shoreline apportionment, the average daily PE_{day} and TH_{day} values are taken from Table G-5 and Table G-7, respectively, in proportion to the shoreline type categories specified.

6.3 Evaluation of Oil Behavior at a Specific Hour

The default inputs from the Oil Behavior Module are averages on a daily basis for the three days. For users interested in conditions and potential recovery rates at more precise times during the days (at specific hours), the users can apply equations in Appendix E for Percent Recoverable Oil, PRO_h (Table E-6 through Table E-8), for Percent Emulsion, PE_h (Table E-10 through Table E-12), or for Thickness, TH_h (Table E-15 through Table E-17). The recovery rates (Customization Module Application B) will be expressed as bbl/day (i.e., potential bbl collected for that particular day if the oil conditions are as they are at hour, h). The recoverable oil at hour, h (Customization Module Application C) will be expressed as both a percentage value (%) and a volume (bbl) based on the percentage of recoverable oil being multiplied by the volume of the spill, as entered by the user (UDI 2).

6.4 Customization Module Summary

The optional Customization Module provides the user with the opportunity to enter modified UDIs to obtain three different types of customized outputs (as diagrammed in Figure 11). The three different subcomponents of the Customization Module are not integrated with each other. They are essentially three different modules, but for simplification, they are all considered together as the Customization Module.

By specifying customized proportions of gravel- and wetland-category shorelines for a particular waterway, all of the computations within the Inland ERSP Calculator are dependent on differently weighted values for equations within the Oil Behavior Module. This, in turn, results in a different final ERSP calculation for the recovery rates. This portion of the Customization Module essentially allows the user to “tweak” the Inland ERSP Calculator to better match with the characteristics of a specific waterway rather than apply the default generic waterway assumptions.



Inland ERSP Operational Environment Calculator Design Document

In the other two applications of the Customization Module, the user essentially extracts data from the Oil Behavior Module to represent oil conditions at a specific time within the first three days to determine the ways in which the oil behavior and condition at that time would affect either recovery rate or the amount of recoverable oil.

For the Recovery Rate at Specific Hour portion of the Customization Module, the ERSP is computed in the Inland ERSP Calculator as the situation would be at a specific time, based on the behavior and condition of the oil, as determined by the Oil Behavior Module, at the specified time.

For the Recoverable Oil by Hour portion of the Customization Module, the behavior and condition of the oil at a specified hour is derived directly from the Oil Behavior Module. In this case, there are no computations within the Inland ERSP Calculator itself (Figure 11). The outputs for Recoverable Oil by Hour will be in both Percent Recoverable Oil and Volume of Recoverable Oil. Within the Oil Behavior Module, the results are computed in percentages, which are then multiplied within the Customization Module to the spill volume specified as UDI 2 by the user to derive the Volume of Recoverable Oil. In some circumstances, knowledge of the Percent Recoverable Oil remaining at a certain time may be of value to response planners for equipment allocation. At other times, the Volume of Recoverable Oil may be more informative.



Inland ERSP Operational Environment Calculator Design Document

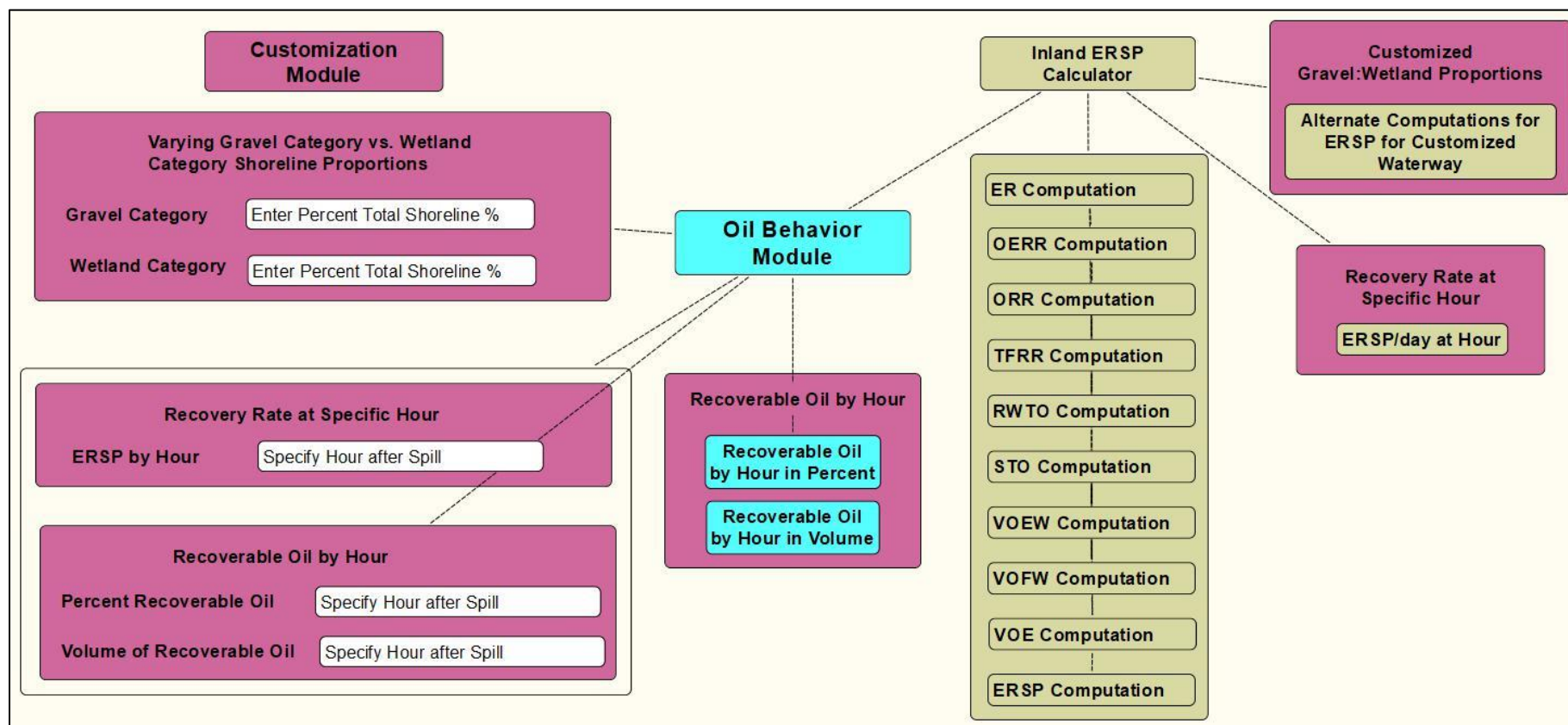


Figure 11. Customization module potential inputs with outputs.



7 CONCLUSIONS

The purpose of this report was to provide the overarching design of the Inland ERSP Calculator, including the following components:

- Overall methodology, data sources and all assumptions;
- Calculator architecture in both text and simple block diagrams;
- Plain pseudocode for the calculator's algorithms; and
- Data acquisition and analysis description/process, meta-data, analyzed data, data recommendations to include default values, contextual guidance on parameter values selections, and any data/analysis files.

The report provides the specifics of the algorithms, data sources and assumptions involved in the Inland ERSP Calculator while also summarizing it in basic terms for the programmer who would ultimately develop the tool.

While responding to oil spills in an inland environment poses many challenges due to the complexity of the conditions, the project team developed this Inland ERSP Calculator to take many of these challenges into consideration. Users can opt to use defaults provided herein as input to the calculator or may opt to add site and situational-specific inputs with the Customization Module for more accurate oil spill response planning.

8 REFERENCES

- BSEE and Genwest Systems, Inc. 2016. Estimated Recovery System Potential (ERSP) Calculator User Manual. February 2016. 42 p.
- Buchholz, K., Krieger, A., Joeckel, J., Reiter, G., Walker, A.H., Etkin, D.S., Rowe, J., French McCay, D.P., and Balouskus, R. (2016). Task 2: Oil Spill Response Equipment Capabilities Analysis (Volume II). U.S. Department of the Interior Bureau of Safety and Environmental Enforcement (BSEE). Oil Spill Response Plan (OSRP) Equipment Capabilities Review, BPA No. E14PB00072. Available on-line at: <https://www.bsee.gov/volume-ii-osrp-response-equipment-capabilities-analysis>.
- Dale, D. 2011. Response Options Calculator (ROC) Users Guide. Genwest Systems, Inc. May 2011. 72 p. plus Technical Documentation, 45 p.
- French McCay D.P. 2009. State-of-the-art and research needs for oil spill impact assessment modeling. In: Proceedings of the 32nd AMOP technical seminar, 9–11 June 2009. Emergencies Science Division, Environment Canada; Ottawa, ON, Canada. p. 601–653.
- French-McCay, D.P., Crowley, D., Rowe, J., Bock, M., Robinson, H., Wenning, R., Walker, A.H., Joeckel, J., and Parkerton, T. 2018. Comparative Risk Assessment of Spill Response Options for a Deepwater Oil Well Blowout: Part I. Oil Spill Modelling. Mar. Pollut. Bull. 133:1001–1015. <https://doi.org/10.1016/j.marpolbul.2018.05.042>.
- Hansen, K. and Tebeau, P. 2002. Oil Spill Response in Fast Currents. A Decision Tool. US Coast Guard Research and Development Center, Groton, Connecticut. Report CG-D-03-03. December 2002. 29 p.
- Genwest Systems, Inc. 2012. EDRC Project Final Report. Prepared for Bureau of Safety and Environmental Enforcement (BSEE) by Genwest Systems, Inc., Edmonds, Washington. BSEE Order #E12-PD-
- National Oceanic and Atmospheric Administration (NOAA). 2013. Shoreline Assessment Manual. 4th Edition. US Dept. of Commerce. Seattle, WA: Emergency Response Division, Office of Response and Restoration, National Oceanic and Atmospheric Administration. 73 pp + appendices.
- Rowe, J., McGrath, G., Morandi, A., Etkin, D.S, Joeckel, J., Balsley, A., and Freda, J. 2019. Inland Estimated Recovery System Potential Preliminary Factors, Requirements and Conceptual Model. US Coast Guard Research and Development Center, New London, Connecticut. November 2019. 70 p.
- US Coast Guard (USCG). 2019. Guidelines for the US Coast Guard Oil Spill Removal Organization Classification Program. US Department of Homeland Security. June 2019. 64 p.



APPENDIX A. CHALLENGES WITH INLAND WATERS

Table A-1. Summary of NOAA incident database findings.

INCIDENT NAME	LOCATION	DESCRIPTION	RESPONSE DETAILS
MV Savage Voyager	Dennis, MS	At 1100 CST, Sept 8, 2019, USCG Nashville MSD reported a release of crude oil blend (NOS) from a barge at mile marker 411 within the Bay Springs Lock and Dam (aka Jamie Whitten L&D) on the Tombigbee River near New Site, MS. Incident occurred at 0330 AM on 8 SEPT 2019. All oil is believed to be contained within the lock. Barge sustained damage to the #1 cargo tank and is estimated to have released all 6,700 bbl (281,484 gallons). No reports of oil discharged outside the lock with exception of some sheen immediately downstream.	Response operations via skimming and vacuum. Discharge estimated at 104,000 gallons of crude oil (API 21.7). 2,000 gallons of crude recovered. 5 vacuum trucks and 2 skimmers are on scene conducting recovery operations; 24-hour recovery operations underway. Upon further inspection, it became apparent that as much as 15 inches of crude oil was located in the void space and/or wing tank of the barge next to the damaged tank. Used surface washing agent to clean walls inside lock.
UTV AMY FRANCES	MS River MM 363 Natchez, MS	At 1330, Sector LMR Memphis reported that UTV AMY FRANCES was pushing barges southbound when it struck Natchez bridge (Hwy 84) in the vicinity of MM 363, LMR. Two tanks on barge sustained damage (about 3,000 bbl per tank). Barge carrying Slurry oil. Total barge Capacity is 23,953 barrels. Unknown amount in water, some sheen observed, boom deployed at barge. Barge on left descending bank (MS side). Lightering and salvage en route, ETA 1630. Weather is rain with 35 MPH gusts and forecast for potential severe thunderstorms.	RP initiated cleanup via hand methods using snare and pads, some pumps to dewater washover ponds and recover oil. Oil in potholes/ washouts behind tree trunks was pooled fairly thick and was fresh in appearance. Rain from previous night helped consolidate oil in low spots/washover ponds/channels and left some oil floating on surface. Other areas of small tar balls scattered along the bank, some light silver sheen elsewhere. Estimate less than 1-2 bbl of oil present along shoreline/flooded area. Oil does not adhere well to pads and snare unless pressure is applied. As temperature increased, oil was more readily removed.
Genesis 8-inch pipeline	Magee, MS	Reported release from an 8-inch crude oil pipeline release near Magee, MS. Incident was discovered on 16 Feb 2016. Release volume initially reported as 50 bbl. Release secured. EPA OSC conducted onsite investigation on 17 Feb which indicated oil release occurred during high water event and significant quantities of oil encountered above bank (in floodplain) adjoining spill area. EPA mobilized GST to assist and plans SCAT survey. Impacted waterbodies- Okatoma Creek and associated wetlands.	Flood event occurred on FEB 16 (day of release discovery) causing a tree to fall on an 8- inch crude oil pipeline. Approximately 500 bbl of light crude oil were released. Impacted area consists of about 1 mile of small streams, tributaries and associated floodplain and 8-9 miles of Okatoma Creek. All bulk oil recovered from Okatoma Creek. Oil stranded in floodplain and in source area presents greatest challenge remaining. Heavy oiling of bank at release location required significant excavation and will require longer term assessment and treatment once water levels in associated tributary fall (bleeding oil from sandy bank). Initial high concentrations of BTEX at source location diminished to safe work levels. Large areas within floodplain had small pockets of pooled oil (>80-90 recovered by end of 23 FEB).
T/V Viking Osprey	Delaware River, Pennsylvania	At 1500 on September 8, 1986, the 749-foot tanker, Viking Osprey, carrying approximately 550,000 barrels of Isthmus crude oil, touched bottom just below Marcus Hook, Pennsylvania while en route to the Mobil Oil Refinery at Paulsboro, New Jersey. Approximately 270,000 gallons were released from a breach in the hull of the No. 1 center tank until midnight, when the tank was emptied at the refinery. The ship was boomed by Mobil personnel as soon as it docked.	Cleanup of Navy yard and Chevron with vac trucks, booms and crews. Shoreline cleanup along the PA shoreline. The Delbay skimmer collected waterborne oil. Cleanup of the NJ shoreline National Park.
Intermar Alliance	Marcus Hook, Pennsylvania	At approx. 1000 hrs 21 Mar 86, the T/V INTERMAR ALLIANCE struck a pier at Sun Oil Facility at Marcus Hook, PA. Initial report is a 12-foot gash, 3 feet above the water line was made in the #1 port tank. Initial report is that 1,000 bbl of Ninian Crude was spilled into the Delaware River. At approx. 1100 hours the leak was reported to have been stopped. Total time of the leak was reported to be 50 minutes. Based upon the above information, the spill would have occurred near slack water and not moved much upstream. The downstream excursion would be estimated at 5 miles for this tidal cycle. Winds reported from the NW would tend to move the floating crude oil onto the New Jersey shore in the Penns Grove areas. Recommend that Oldmans Creek receive priority attention for booming. After the tide changes, Raccon Creek should receive booming attention. Deflection booming or standby booming for the Christina River should be made available if overflight observations indicate enough oil has escaped Sun Oil's efforts at booming the spill at the source. Future planning for boom deployment downriver in the Salem River areas should be considered.	4,750 bbl; Facility personnel estimated 70% of the spilled oil was trapped by their series of boom that were placed around the vessel. Soon after the vessel hit the BP dock, this estimate of 70% reduced to 40% captured. Recovered oil as of end of day of March 23rd is reported at 83,650 gallons placed into a slop tank at the Sun Oil Facility. This oil water mixture is the decanted oil water mixture received from the vacuum trucks. Total oil recovered is some part of this mixture. The skimmer DelBay recovered a decanted oil total of 703 gallons as of the end of the day on 22 March.
Train derailment	Aliceville, Alabama	A little past 12:00 am on Friday November 8th, a 90-car unit train carrying crude oil en route from Amory, Mississippi to Walnut Hill, Florida derailed near Aliceville, Al. Twenty-six (26) tanker cars filled with crude oil derailed into a wetland slough at the head waters of on a tributary of Lubbub Creek. Lubbub Creek discharges into the Tombigbee River. Shortly after the derailment the rail cars began discharging oil, which caught fire. Approximately 11 cars were aflame. The rail line was closed from mileposts 680-685. Rail cars flashed several times during the subsequent days, hampering operations.	Oil was corralled using pumps and hoses and contained for pumping with vac trucks. The crude oil is currently contained in the wetland area, but rain is due towards the end of the week. Local residents indicated that the area floods easily with light rain. The potential for transport of oil downstream is therefore heightened.

Table A-1. Summary of NOAA incident database findings (Cont'd).

INCIDENT NAME	LOCATION	DESCRIPTION	RESPONSE DETAILS
Teppco Pipeline	Port Arthur, TX	Estimated 2,400 bbl JP-8 pipeline release just N of the Bessie Heights marsh. The released occurred two days before and an estimated 12-14 inches of rain significantly affected containment and recovery efforts during the initial response.	2400 bbl released; Recovery of 252 bbl by the skimming operations. JP-8 spilled on land and into a confined waterway such as the swell south of the release point and Anderson Gully, with significantly slower rates of evaporation. Enhanced dissolution observed in underlying waters. It is impossible to model these conditions due to the number of variables such as variable fuel thickness and fuel penetration into organic debris and sediment/soils. JP-8 residual would be expected to persist in sediment for perhaps months (maybe years depending on the concentration, depth of penetration, and environmental conditions).
W. Lake Verette	Atchafalaya Basin, Morgan City, LA	Due to an operator error, 1000 bbl of condensate crude (API gravity 47-48) was released from a facility in the Atchafalaya Basin some 8 miles NNW of Morgan City, Louisiana. The impacted area is a cypress swamp. Rapid response by both the company and a hired response company resulted in the "containment" of most of the spilled oil in a canal system within 0.5 miles of the facility. Oil in the containment area was greater than 0.5 inches thick in many locations. High levels of benzene forced the responders to take a defensive approach, but by the end of the day, two shallow water skimmers were working the edge of the spill. At dusk, additional boom was being moved to the site to enhance containment.	1500 bbl released; Belt-type skimmers used to remove pockets of heavy oil and heavily oiled vegetation; these were secured in teardrop boom configurations. Several small patches of oil (mostly emulsified oil) were identified at the fringe of adjacent cypress swamp habitat. These were removed by herding and with pads
Sun Pipeline Spill	North Louisiana	On 16 November, Louisiana Oil Spill Coordinators Office (LOSCO) reported a 750 bbl spill in N. Louisiana which resulted from a pipeline leak. The oil is contained in a rice field at approximately 32° 54' N and 91° 31' W. Burning considered as a mitigation option.	1350 bbl released. Decision made not to burn. Manual and mechanical cleanup used to recover the oil from the site. Low pressure flushing used to herd the oil to a collection area at the west end of the field where it was removed using drum skimmers and Vac-trucks. The option of land farming and the use of bioremediants was discussed as a final polishing tool. Cleanup operations focused on mechanical recovery by flooding the field using an adjacent canal and a weir skimmer to recover product pooling at the southwest corner of the field.
VPSB #46 Spill	White Lake, LA	On May 12, 2000, a spill occurred from a pipeline rupture in a marsh on the eastern side of White Lake, Louisiana. 100 bbl of crude oil released. In-situ burning considered but concerns for fire containment preclude its use.	A south wind trapped much of the oil into a small wetland area surrounded on two sides by scrub vegetation adjacent to a forested spoil bank habitat. Access to this area was extremely limited. Behind this spill area was a large tidal freshwater marsh. A survey of the tidal freshwater marsh by airboat showed no oil contamination. Most of the oil was contained in a small area estimated to contain between 30 and 40 bbl of oil.
MV Westchester	Mississippi River, mile marker 38	At 1840 CDT, 28 November 2000, MSO New Orleans was notified that while transiting the Mississippi River at Mile Marker 38, the M/V Westchester lost steerage and struck something (possibly her own anchor) and was leaking oil. It is estimated that between 9000-10000 barrels of light crude may have been spilled. Mile Marker 38 is south of New Orleans near Empire, Louisiana.	The MV Westchester, an inbound tanker lost main engines due to a crankcase explosion. With the loss of steerage, the ship's captain deployed the port anchor followed by the starboard anchor in an attempt to maintain control. Unfortunately, the vessel either struck its own anchor, struck an unidentified navigational hazard, or ran aground causing an oil release. Before the source could be controlled, the vessel lost 13,200 bbl of a Nigerian Crude oil. All of the key bayous and cuts were boomed by either a deflection or collection strategy. Skimmers worked the heavy oil accumulations. The sand flat South of the island was cleared of all stranded oil and prepared for passive collection with snares on a rope. Two barges were pushed onshore adjacent to the island to provide vacuum equipment to suck up squeegeed oil along the river side of the island. Approximately 60% of the oil was recovered off the island. A total of 39 skimmers and 16 vacuum trucks deployed.
T/V STAVANGER PRINCE	Plaquemine, Louisiana	On March 20, 1991, the Norwegian tank vessel STAVANGER PRINCE loaded with 500,000 barrels of heavy Arabian Crude, was moving up the Mississippi River to an EXXON refinery near Baton Rouge, Louisiana. The STAVANGER collided with hopper barges (in push arrangement) tended by the motor vessel JOE PAT EKSTEIN at mile marker 209, about 12 miles south of Baton Rouge, next to the village of Plaquemine, Louisiana. The 810-foot STAVANGER received a 4-foot long split in a seam 2 feet above the water line in her #5 starboard cargo tank and released an estimated 924 gallons of Arabian crude into the river. After the collision, STAVANGER moved to an anchorage nearby and the EKSTEIN moved her barges to a position about 2 miles downstream. Reportedly, oil was covering the riverbank-to-bank from mile marker 210 to 190. The Federal On-Scene Coordinator from the U.S. Coast Guard Marine Safety Office (MSO) New Orleans closed the river at 0745 for safety reasons and to allow for the unrestricted cleanup of an apparent major oil spill. Plans were made to deploy deflection booms to bring the oil near shore for recovery.	NOAA said that the river in the area of the spill was not particularly environmentally sensitive but suggested placing booms at natural collection points along the river. NOAA suggested that these collection points could be found by locating the areas with the largest deposits of flotsam. During the first day of the spill, estimates of oil on the river ranged from 1,000 to 10,000 gallons. However, soundings made by the STAVANGER verified the vessel's initial estimate of 924 gallons lost. The oil pooled at natural collection sites and is being recovered at these locations. Some shoreline staining has occurred but there is no recoverable oil associated with this staining. The removal of this oil staining will be left to natural weathering processes.

Table A-1. Summary of NOAA incident database findings (Cont’d).

INCIDENT NAME	LOCATION	DESCRIPTION	RESPONSE DETAILS
Sunken Tugs	Schuylkill River, Philadelphia, PA	On 29 July 2008 the tug Carol Wales and another unidentified tugboat sank alongside a pier at the edge of the Schuylkill River near the Girard Point Bridge. The discovery was made after someone reported a strong smell of fuel coming from the river. USCG Sector Delaware Bay responded and contractors deployed boom and recovery equipment.	The area of the sinking and subsequent spill was at the head of a U-shaped pier configuration. The oil was well contained with triple booming in place. Oil could be observed still bubbling up to the surface. There was an area under some piling where oil pooled and needed to be flushed out. In addition to hard boom, sorbent sweep was used. The main activity was vacuum skimming and sorbent pads to remove floating oil. There was some vegetation around the piers that was cut to facilitate access. The vegetation was considered land-based weeds. Shoreline cleanup was steam cleaning and sorbents.
Getty Oil Tank Truck	Albany, New York	A tractor-trailer tanker overturned on the Dunn Memorial Bridge, connecting Albany and Rensselaer, New York over the Hudson River. Approximately 11,000 gallons of unleaded gasoline spilled from the tanker into the river. The incident occurred at 1630 on January 14, 1997. The weather at the time was water temperature about 35F, air temperature about 15F, and the winds were 5 to 15 knots from the southwest. About 20 percent the river was covered with ice.	90 percent of the oil evaporated during the first 12 hours. The ice may confound the evaporation by trapping some of the oil for longer periods. The RP hired a cleanup contractor who used vacuum trucks to remove oil trapped by ice. Approximately 3,200 gallons were recovered.
Coastal Oil Eagle	Deptford, New Jersey	At 1645 on July 22, 1995, the T/V Jahre Spray parted transfer lines and manifold connections at the Coastal Eagle Point refinery in Deptford, New Jersey. The cause of the accident was reportedly strong winds during the transfer operation. Wind speeds recorded in the area were 25 knots from the east, with local tornadoes reported. Air temperature was 82F with rain. Approximately 2,000 barrels of Rabbi crude oil were released from the facility pipeline. It is estimated that 600 barrels spilled onto land containment areas and 1,400 barrels into the Delaware River.	The oil spread on the water's surface into slicks and eventually thinned into sheens. Oil adhered readily to sediments, harbor structures, and riprap. In areas where it was pooled or contained and not quickly skimmed, re-sheening and re-oiling were apparent. Due to the warm summer weather the oil did not form a mousse. The oil moved upriver to the Betsy Ross Bridge and downriver to the Commodore Barry Bridge, intermittently oiling approximately 16 miles of riverbanks on both the New Jersey and Pennsylvania sides of the river. It was estimated that 35 to 40 percent of the spilled oil evaporated. Most oil was recovered by vacuum trucks at the facility and by skimmers on the river near the facility. Approximately 60,000 gallons of oil were recovered from the secondary containment area and off the water. The original approximation of spillage was 1,000 barrels; however, due to the amount observed on the water and the amount recovered, the spill-size estimate was increased to 2,000 barrels. Before beginning transfer operations, the vessel was boomed. However, the ship was pushed more than 75 feet from the pier by high winds and the boom separated at the same time as the transfer hose and manifold separated, allowing oil to escape initial containment at the source. The facility and DBRC deployed additional boom at the facility and at Big Timer, Woodbury, Cooper, and Mantua creeks to prevent oil entering marsh areas. Simultaneously, skimmers were deployed to the locations of thickest-floating oil. Shoreline cleanup operations were conducted as mostly manual removal of oiled sediments and debris. Consolidated structures (riprap, pilings, seawalls, etc.) were power-washed with Hotsys. Absorbent boom was used to reduce re-oiling during cleanup operations. Cleanup lasted more than six weeks.
Hess Pipeline	Kearny, New Jersey	At approximately 1950 on October 8, 1994, a breach occurred in the Amerada Hess pipeline in Kearny, New Jersey. About 300 gallons of oil were spilled into the Hackensack River when a valve was left partially open after a maintenance operation. Approximately 2,300 gallons of #6 fuel oil discharged from the pipeline, part of it entering a tributary to the Hackensack River.	Approximately 2,300 gallons of #6 fuel oil discharged from the pipeline, part of it entering a tributary to the Hackensack River. The oil impacts were mainly on the mud sediments exposed at low tide and a bathtub ring along higher banks. Nearly 300 gallons were recovered by hosing down the shoreline and vacuuming water surfaces. The oil was recovered with traditional vacuuming techniques.
T/V Kentucky	Paulsboro, New Jersey	About 1155 on July 18, 1994, the T/V Kentucky was reported trailing a 400- by 6-foot blackish sheen on the Delaware River while docked at the Mobil Paulsboro, New Jersey refinery. Weather was light haze, visibility about five miles, temperature 95F, winds 12 knots from the south, and calm seas. The vessel arrived at the dock with some bottom damage. Apparently, she hit a submerged object. An estimate of 40 to 50 gallons of oil was initially thought lost. The vessel was boomed and lightering of suspected tanks (#3 port cargo tank [PCT] and #4 port ballast tank [PBT]) began. A diver's inspection reported a 2- by 10-foot breach of the hull in #3 PCT above the bilge knuckle, and 30 feet of the bilge keel missing. At 2135 on July 19 it was reported that oil had breached the containment boom and 200 to 300 barrels were in the water. It was believed that while offloading the cargo in the damaged tank, the water-bottom was upset allowing the oil to escape. Mobil response team personnel boomed the vessel. The Delaware Bay and River Cooperative (DBRC) launched two skimmers and boomed several pre-identified creeks nearby. Marine Spill Response Corporation (MSRC) responded with its skimming vessel (Delaware Responder). Three additional contractors were hired for the cleanup and a field command post was established at the Mobil refinery. The USCG COTP Philadelphia assumed the FOSC role for this incident. USCG personnel were on-scene to monitor cleanup activities. The OSC requested two forward-looking infrared radar (FLIR) overflights (one during the night of July 19; the other the next morning) to help identify the extent of oil migration in the river. The FLIR spotted the oil and helped track its progress. This response lasted about five days.	The vessel was immediately entirely boomed at the facility pier. Vacuum trucks were used to recover product contained at the site. The vessel offloaded its cargo to the facility over a 30-hour period. Precautionary protection of sensitive areas was accomplished by DBRC booming pre-designated creek mouths with pre-staged boom or boom brought to the site. This booming strategy kept the creeks free from oil. Open-water recovery was performed by three large skimmers and oil was recovered from the shoreline by several vacuum trucks. Recovered product was sent to the refinery for processing. Shoreline cleanup was not necessary because the oil evaporated rapidly and very little oil reached shore.

Table A-1. Summary of NOAA incident database findings (Cont'd).

INCIDENT NAME	LOCATION	DESCRIPTION	RESPONSE DETAILS
T/B CIBRO PHILADELPHIA	Albany, New York	At approximately 0300 EST on Friday, 12/15/89 the Barge Cibro Philadelphia experienced some leakage of #6 Fuel Oil. The estimated maximum amount spilled is 160,000 gals. The barge is currently located at the Bay Ridge Anchorage at Lat. 40 deg. 39' 37", Long. 074 deg. 02' 21". The barge is carrying approx. 4,536,000 gals. and has a 1/4-inch crack that runs for over 25 ft. around the hull and down across the bottom.	The NOAA Scientific Support Coordinator advised the Coast Guard to cut the affected marsh grass areas on the shore. Freshwater marsh grasses have deep root systems; cutting would not damage the next year's growth and would also preclude oiling of migrating waterfowl in the upcoming migration. 1000 bbl released.
Swanson Creek	Benedict, Maryland	On Friday, 7 April 2000, at approximately 6pm, a rupture was confirmed in a 12-inch diameter, 51.5-mile oil pipeline that feeds the Chalk Point Generating Station of the Potomac Electric Power Company (Pepco) in southeastern Prince George's County, Maryland. An estimated 126,000 to 139,000 gallons of oil were actually released into Swanson Creek Marsh on the Chalk Point property. The leak occurred in a section of the pipeline that supplies No. 6 fuel oil to the Chalk Point facility. The pipeline was being cleaned with an internal cleaning tool and No. 2 fuel oil when the release occurred.	Containment efforts consisted of containment boom at the mouth of Swanson Creek and around the Swanson Creek marsh. Recovery methods were beginning on April 8, 2000 when severe weather was forecasted. Additional booms were placed around the point of release, upstream of the middle of Swanson Creek and doubled at the mouth of Swanson Creek. Recovery operations were implemented around the clock. Over 800 workers and representatives from numerous local, State and Federal agencies worked on containing and removing the oil during the first few weeks of the response.
M/V Isomeria	Elizabeth River, Norfolk, Virginia	On the evening of 21 March 1994, the LPG vessel Isomeria completed delivering her cargo at Atlantic Energy on the south branch of the Elizabeth River, Norfolk, Virginia and began receiving bunkers of #6 fuel oil. At about 0200, March 22 the vessel notified the USCG that oil was leaking from a crack on the port side of the forward fuel tank. The release rate was described as similar to the flow from a garden hose. The crack was near the anchor hawse pipe, about 20 to 30 feet above the waterline. At the time of the notification, an estimated 130,000 gallons of fuel oil had been loaded in the tank above the crack. The leak slowed to a trickle by late morning. Estimates of the amount of oil in the water ranged from 1,300 gallons to 12,500 gallons.	Large response staff used harbor boom to protect St. Julian Creek and to hold the oil that stranded along the west shoreline of the Elizabeth River. Sorbent boom and sorbent pads were used to contain and remove the oil where possible. Around the Isomeria, the contractors deployed several layers of boom and used vacuum trucks to remove the contained oil. Sorbents were also used to remove the oil collected in that abandoned canal that was behind the pier used by the Isomeria. Hand equipment was used to remove stranded oil from the shoreline.
Buckeye Pipeline 1	Lima, Ohio	At 2230 on February 13, 1986, an underground pipeline running from Toledo, Ohio to Lima, Ohio, ruptured, releasing an estimated 8,700 barrels of diesel fuel into a corn field along the east branch of the Huron River, about ten miles upstream from Lake Erie and Huron, Ohio. Although most of the spilled oil remained in the field, up to 900 barrels may have drained into the Huron River. The U.S. Coast Guard Captain of the Port, Toledo, was requested by the U.S. Environmental Protection Agency (EPA) On-Scene Coordinator to deploy an icebreaker to open the Huron River, so that boom could be used to control the oil moving downstream. USCG district 3.	By March 4, cleanup crews recovered a total of 5,000 barrels of the spilled product from the cornfield and river. At the rupture site, some of the spilled oil had drained into a swale leading to the river, while a large amount seeped into the soil and began flowing along the drainage tiles to the river. To reduce contamination of the river, the cleanup crews built an underflow pipe dam across the swale, and at the outflow of the tile drainage system cut into the tiles and dug a large sump, also with an underflow dam. Icebreaking operations in the Huron River were conducted on February 20, 1986. The opening of the river prevented the diesel fuel from backing up onto the ice and flowing over the ice-covered marshes of the Huron River.
T/B LBT 62	Chalmette, Louisiana	At 0530 on December 22, 1994, USCG MSO New Orleans received notification of an oil spill at mile marker (MM) 88 on the Mississippi River. The wake from the M/V Medicine Bow forced tank barge LBT 62 onto a piling, holing the barge on the aft starboard side of tank #5. The total cargo of LBT 62 was 20,000 barrels of Alabama sweet crude oil, with 1,800 barrels in tank #5. The initial rate of release was estimated to be 10 barrels per minute. Shoreline impacts were reported by 0700; at 0730, the source of the spill was reported secured. An estimated 911 barrels had been released into the water. The USCG established a safety zone between MMs 89 and 75. On-scene weather was overcast, temperature 50F, winds north-northwest at 6 knots, and current 3 knots.	Optimal weather aided the cleanup effort; the wind held the oil against the bank in a curve in the river between MMs 83 and 79. Four collection points were established using 18,000 feet of containment boom, 8 skimmers, and 15 vacuum trucks. Protective booming was done at the Bohemia State Wildlife Management area, Pass A Loutre State Waterfowl Management area, and Delta National Wildlife Refuge. A "letter of no objection" was required from the USACOE to remove scrub brush from the levee area to provide greater access during the land-side debris removal. The RP used small bobcat tractors to remove oiled debris. The shoreline cleaning consisted of flushing the alluvial land between the river at low tide and the levee and manually removing debris with rakes and shovels as the river level dropped. The RP was required to remove all ruts on the levee caused by cleanup operations.
Tennessee River	Knoxville, Tennessee	This spill occurred sometime after midnight on February 10, 1999 when a 10-inch pipeline burst open on top of a hill overlooking Fort Loudoun Lake on the Tennessee River. When a fire truck arrived on-scene, a fountain of diesel fuel was spewing heavily onto an adjacent house and an immediate evacuation of six homes took place. Diesel flowed down an embankment to Goose Creek then into the lake and river creating a slick 60 feet wide and several miles long. The spill occurred at river mile (RM) 647.5, which is below the City of Knoxville's water intakes. Additionally, the river is controlled by a dam (Fort Loudoun Lake Dam) that shut down operations soon after notification of the spill. By midmorning, the RP and contracted response organizations boomed three locations down river. Because it was dyed red the diesel produced a very noticeable slick. The current in the area was flowing at 1 knot and a little faster in the river bend just a couple of miles downstream from Goose Creek in the area called Sequoyah Hills. From there the river opens up wider and the current drops off significantly. As the diesel spread out, rainbow sheens developed. This was prevalent between Sequoyah Hills and a mile down river to Looney Island. As the spilled diesel weathered, silver sheens became more prevalent after day two and even more on day three. Additionally, silver streaks could be seen from the air leeching off a point at RM 645. South of Looney Island to Sequoyah Park the diesel was observed to be in streaks and patches.	On shore the diesel penetrated deep into the riprap shorelines and maybe an inch into the fine-grain sand shores from Goose Creek to Sequoyah Hills. Oil film and a brown frothy mousse could be seen downstream of Sequoyah Hills. Additional shoreline impacts were at the booming site at Sequoyah Park where unweathered diesel pooled at the junction of the boom and shoreline. Some oiled debris was located at RM 639 near Maxey's Boat Dock. Fortunately, half the area is guarded by bedrock bluffs resulting in less shoreline impact and probably accounted for a high percentage of recovery noted by the RP. Officially, 45,000 gallons of diesel was released and 90% was recovered by skimmers and vacuum trucks. The initial report of the spill indicated that there had been 80,000 gallons of diesel released. In which case the mass balance breaks down to 50% recovered, 30% evaporated, 15% Goose Creek soils, and 5% other shoreline impacts.



Table A-1. Summary of NOAA incident database findings (Cont'd).

INCIDENT NAME	LOCATION	DESCRIPTION	RESPONSE DETAILS
McGrath Lake Spill	McGrath Lake, Ventura, California	On the morning of December 25, 1993, a failure of a pipeline was reported. The failure occurred below the ground near a pipe junction on the east side of Harbor Boulevard just south of Ventura, California. Approximately 2,000 barrels of a heavy crude produced from a local field, percolated through the ground to the west and underneath the road. The oil surfaced 50 yards west of Harbor Boulevard and entered a creek, traveled along this creek approximately 150 yards to the south where it entered McGrath Lake. McGrath is a freshwater lake (approximately 800 by 100 yards) situated amongst medium-coarse grained sand dunes and is located 100 to 200 yards inshore of the intertidal zone. The lake serves as a drainage basin for the surrounding agricultural fields and has no natural communication with the ocean. To control the lake level, water is routinely pumped out of the lake and into the Pacific Ocean through a pipeline running through the dunes and onto the beach. When the oil entered the lake, the pump was on and oil was discharged onto the sand beach and into the nearshore environment. Less than 100 barrels of oil entered the ocean, the majority was contained in the lake, the creek, or was saturated in the sediment. The mouth of the Santa Clara river was bermed to prevent oil from entering the estuary. To control the amount of water flowing through the spill site, water was diverted from the creek to the Santa Clara River via pumps. Underflow dams and filter fences with sorbent pompoms were installed along the creek. The vegetated shoreline of the creek and the lake, consisting mostly of tules, was heavily coated with oil. Because all pumping operations had ceased, the water level in the lake was rising and began covering over already impacted shoreline and affecting more habitat as it rose. After consulting with the Regional Water Quality Control Board, pumping the lake into the ocean began again and the water level was lowered to where it had been before the spill.	Estimates from the first day of operations indicated that 1.3 million gallons per day were being removed from the lake. The water was pumped through a pipeline into the ocean beyond the surf zone and through a diffuser. After the first day, the lake level dropped by 1.75 inches. Oiled vegetation along the shore of the lake was removed manually by crews working in small work skiffs. Oil entered a creek densely populated with tules. The tules were cut above the root structure and removed by a unique piece of machinery known as the AQUAMOG. This equipment was specifically designed to cut and remove vegetation in shallow-water areas. The AQUAMOG is equipped with wheels that can be moved to the side allowing it to float. It was brought on-scene to cut and remove vegetation in the dense growth areas of the creek where access by boats and work crews was difficult. The free-floating oil in McGrath Lake was boomed and gathered for skimming. The movement of the oil on the lake was controlled by the direction of the wind and moved throughout the containment area during the day. The local harbors were boomed initially after the oil was released into the ocean but were opened as the threat of oiling became less likely. The mouth of the Santa Clara River remained bermed for two weeks, but was then opened to allow the estuary to drain. Water had been accumulating and causing the estuary to swell beyond its normal size and was impacting the campgrounds at an adjacent state park.
Mistryski Power Plant	Detroit, Michigan	On February 9, 1994, there was a pipeline leak at the Mistryski Power Plant along the Detroit River in Detroit, Michigan. The power plant is approximately two miles downriver of the Ambassador Bridge in Detroit. The leak was continuous and occurred from approximately 2230 on February 9 to 0330 on February 10 and was described as flowing at the rate of a fire-hose discharge. Oil had broken through a corroded portion of a 10-inch supply line, ran into a storm sewer, and then traveled about 100 feet to enter the river. When the incident occurred, the Detroit River was 95 percent ice-covered. Originally the released product was thought to be a #6 oil, but laboratory analysis proved it was a #4 fuel with density of 0.93. The original estimate of 10,000 to 30,000 gallons proved a conundrum as only about 300 gallons was observed in the river. Later volume refinements had the number at officially less than 900 gallons and most likely around 300 gallons. The City of Detroit assumed responsibility for the spill and immediately hired a contractor. Only a limited response was possible due to the ice. A portion of the spilled oiled was recovered by removing the oil-stained ice accessible from the shorelines. The Detroit City Laboratory performed the first analysis on the oil, determining that it was a #4 rather than a #6, and that it was a "floater". The City immediately hired Tri-State Bird Rescue to assess the threat to nearly 5000 birds in the oiled area and to establish a rehabilitation center, if necessary. The Joint U.S./Canada contingency plan was invoked and a unified command was formed among the USCG, the City of Detroit, the State of Michigan, and the Canadian Coast Guard. All activities took place at the MSO Detroit office. The active response lasted for only four days. On the fifth and sixth days, the temperature rose into the 40s and the wind shifted to from the east allowing more of the oil-stained ice to migrate to the shoreline where it could be removed. The increased temperatures caused an ice jam that flushed all the remaining oiled ice down the Trenton Channel into still frozen Lake Erie. Only two oiled birds died as a result of the spill. USCG district 9. Keyword: none.	Oil sorbed into ice and pooled underneath. Response opted to allow oil to degrade in place. Recovery ops were determined to be too time consuming and expensive
Bristolville Crude Oil Release	Bristolville, OH	Spill originated from a 5,000 gallon above ground crude oil tank in a field in the vicinity. The tank was connected to a nearby natural gas well to collect crude oil generated in natural gas production processes. According to the well servicer, the tank was known to have held approximately 1700 gallons of crude when it was shut off in December 2012 and plugged. The tank was located approximately 20 feet from the unnamed tributary. Free product was observed all around the tank, in the soil-based containment, in the soil, and throughout an approximately 0.75 mile stretch of creek. The unnamed tributary was a small shallow creek - width ranging from 2 feet to 10 feet. Ohio EPA mobilized contractors to clean up the oil. Many dikes and booms were installed through the impacted area, and some excavation of the source area was completed. According to OH OSC, these accumulation areas were left clean every evening, and extensive product accumulated at each by the next morning. On the afternoon of May 4th, Ohio EPA requested US EPA assistance to complete the clean-up. The unnamed tributary flows north and west along several farm properties, into Baughman Creek, then into the Grand River approximately 6.25 miles from the point of discharge. Many sensitive species are known from the vicinity of the spill area, including Indiana bat, massasauga rattlesnake, and bald eagles. Bald eagles were sighted daily during the response.	ERRs RM initiated ordering more equipment and resources to remove the surfaced oil from the two accumulation points in the excavation at the source area. Approximately 100 gallons of oil and oil/water was removed by a vacuum truck. Further diking was installed at the source area. Oiled vegetation was removed from creek banks near source area. Additional boom was installed/changed out. A number of existing diked/damned areas were maintained (oil removed with pads). An equipment staging area was identified. On 5/6/2013, EPA oversaw the deployment of additional absorbent boom and pads in the creek, oil vacuuming the heavy accumulation areas with a mobile unit



Table A-1. Summary of NOAA incident database findings (Cont'd).

INCIDENT NAME	LOCATION	DESCRIPTION	RESPONSE DETAILS
Bridger Pipeline Release	Yellowstone River, Montana	On January 23, 2015, the EPA contacted ERD requesting oil fate and trajectory for the Bridger Pipeline Release. The Bridge Pipeline Release occurred on January 17, 2015, in the Yellowstone River approximately seven river miles upstream of the city of Glendive in Dawson County.	Minimal recovery ops due to ice-covered waterway
Neches River	Beaumont, TX	On October 15, 1991, between 2000 and 2200 hours (CT) an estimated 2100 gallons of waste oil was spilled on the Neches River at approximately 30-01 N 094-02 W. The spill was possibly from bilge pumping. The identity of the spiller is unknown at this time. The spilled waste oil is suspected to have been treated with bilge cleaner by the spiller. The spilled oil initially impacted approximately 2 miles of the south bank of the Neches River. The impact was in pockets along the shoreline and had moderately impacted some marshy areas associated with the small pockets of oil. The salinity of the river water in the vicinity of the spill is estimated at 0.1 ppt. The current in the area of the spill is estimated at no more than 0.5 kts. RRT members voiced concerns over the lack of an appropriate monitoring plan, the chemistry of the waste oil, the need to acquire the approval of the landowner to test on Dupont land, and the lack of a plan to handle the treated product in the event of flooding that would require Dupont to empty the waste oil and product into the Neches River.	Successful mechanical cleanup by U.S. Coast Guard (USCG) Marine Safety Office (MSO) Port Arthur personnel proved to be a minor problem because most of the spilled oil was trapped in the drainage ditch. Estimate of waste oil and oily wastewater recovered is now up to 5000 gallons (decanted-mostly oil).
Sanborn Pond	Brooks, Maine	Early morning of September 24, 2001, a tanker truck drove off highway 137, north of Brooks, Maine (44° 28.96N, 069° 08.70W) and rolled into Sanborn Pond. The tank truck destroyed a maple tree and a summer cottage, the guard rail ripped into the side of the tank and approximately 5,500 gallons of heated number 6 oil flowed into the pond. Sanborn Pond is an 87-acre, freshwater pond connected to Dutton Pond to the north and a small stream to the south. There is a dam at the south end, restricting all but a small amount of flow through to the stream. The shoreline is typical of Maine ponds during time of low water (Maine has received very little rain this summer, therefore the lakes and pond are one to two feet below their normal level) bedrock, mixed boulder/cobble, and emergent vegetation. This pond also has a short section of riprap (along the highway) and of sand (in front of the destroyed cottage, likely installed by the owner).	Boom was placed to protect the vegetation on the northwest and northeast corners and the outlet of the stream. In addition, areas where the oil had naturally collected and could be removed were boomed. On-water removal was conducted with two Maine DEP JBF skimmers, and two Maine DEP disk skimmers. In addition, cleanup contractors used snare and some very limited pressure washing on nearby bedrock.
Honey Creek	Milwaukee, Wisconsin	On October 1, 1997, a tank truck carrying 7500 gallons of #2 fuel oil overturned and caught fire at Honey Creek in the Milwaukee, Wisconsin area. The Wisconsin Department of Natural Resources (DNR) responded and estimated about 3000 gallons spilled into the creek. Honey Creek is shallow (< 0.5 meters) and about 10 feet wide.	No skimming. "The contamination is likely a "bathtub ring" effect from the spill and that continued sheening is to be expected. Gross removal of the sediment may increase erosion due to the resulting removal of vegetation. If the sheening is relatively light and only present following agitation, the net increase in impacts is not expected to be significant. Prior to gross removal of sediment, the DNR should consider manual removal of the oiled dead materials (fallen leaves, twigs, etc.) and a survey to determine if any areas of concentration exist. If areas of concentration are discovered, spot removal using hand tools might be considered. However, it is highly unlikely that these pockets will pose any threat to the creek in the coming spring, if left alone."
Island End River Mystery Spill	Boston, MA	Monday afternoon US Coast Guard, Sector Boston was notified of a release in the area of the Island End River in Boston Harbor. It is suspected that the release happened sometime on the night of Sunday January 08 and was a diesel or #2 heating oil product and the amount is somewhere between 5,000 and 10,000 gallons. Helped by slow currents and consistent west to southwest winds, a large portion of the released product pooled at the northern end of the Island End River (IER) and recovery operations focused there. Some oil sheen was reported in the Mystic River and in the Chelsea River, about a half a mile east of the IER, but none of it was deemed recoverable. Protective booming of the salt marshes at the end of the Chelsea River was deployed as an extra safety measure. The bottom sediments as well as much of the southeastern shoreline are contaminated by chronic and acute releases of the materials. The exposed coal tar on the shoreline dates back to the 1940s. The material is a byproduct of a large coal gasification facility that operated from the turn of the 19th century to sometime in the early 1960s.	USCG supervised the oil spill cleanup contractor as it used vacuum trucks and sorbents to recover trapped materials. Over 3,000 gallons (oil) were recovered thus far.

APPENDIX B. SKIMMER DATA

This appendix includes additional information on skimming systems. Table B-1 provides some key definitions and descriptions of skimmer designs. Table B-2 through Table B-4 provide available testing data that gives values for *ORR*, *RE*, and *TE* (key UDIs). This may provide some guidance to users regarding values for the key UDIs.

Table B-1. Skimmers identified according to application in response.

Skimmer Designation	Application
Stationary	Always used in a fixed location.
Advancing	Must have forward movement for oil to flow into the system.
Self-Propelled	An advancing skimmer within a dedicated skimming vessel with its own power.
Stationary/Advancing	Skimmers generally used in the stationary mode but may be used in a slowly advancing system or a system that advances to collect oil then pauses to skim.

Table B-2. Advancing skimmer systems.³⁵

Skimmer System	Oil Recovery Rate, ORR (gpm)	Recovery Efficiency RE [%]	Throughput Efficiency TE [%] ³⁶	Data Source
NOFI-Current Buster	2,712	83.0	78	Hansen and Tebeau 2002; Meyer et al. 2015
Desmi AFTI MI-2HD Disc Skimmer	8.98	95.6	75	McKinney and DeVitis 2015
Crucial C-13/24 Coated Disc Skimmer	120.99	89.5	75	McKinney and DeVitis 2015
Desmi DOP-Dual Terminator with Helix Circular Brush Skimmer	232.97	94.31	75	McKinney and DeVitis 2015
Elastec System 4 Oleophilic Discs	4,670	89.5	75	Meyer et al. 2015
NOFI Current Buster 6	2,712	83	75	Meyer et al. 2015
Koseq system V-Shaped Boom Arms	2,065	87.9	75	Meyer et al. 2015
OilShaver Technology	2,007	90.7	75	Meyer et al. 2015
Crucial System Disc Skimmer	1,888	71.3	75	Meyer et al. 2015
Lamor System Brush Skimmer	1,413	92.5	75	Meyer et al. 2015
Vor-Tek System 8 Interconnected Weirs	2,269	57.3	75	Meyer et al. 2015
OilWhale Weir System	1,021	42.8	75	Meyer et al. 2015
PPR System	962	92.1	75	Meyer et al. 2015
Voraxial® Separator	693	49.2	75	Meyer et al. 2015
ZRV Rope Mop	71.5	55	72	Schulze 1998
Sorbent Belt MARCO Class V	44.34	60	46.9	Schulze 1998
BOW Collector LBC-2 C Chain Brush	361.2	90	75	Potter et al. 2017
BOW Collector LBC-3 C Chain Brush	541.8	90	75	Potter et al. 2017
BOW Collector LBC-6 B Brush Belt	140.7	90	75	Potter et al. 2017

³⁵ *ORR* = Oil Recovery Rate (in gallons per minute, gpm); *RE* = Recovery Efficiency [%]; *TE* = Throughput Efficiency [%]. Percent values must be converted to decimals for computation within Inland ERSP Calculator.

³⁶ If no Throughput Efficiency, *TE*, was provided in the reference, it was assumed to be 75%.



Inland ERSP Operational Environment Calculator Design Document

Table B-2. Advancing skimmer systems (Cont'd).

Skimmer System	Oil Recovery Rate, ORR (gpm)	Recovery Efficiency RE [%]	Throughput Efficiency TE [%] ³⁷	Data Source
Built in Oil Recovery System LORS 2C Chain Brush	361.2	90	75	Potter et al. 2017
Side Collector LSC 2C Chain Brush	361.2	90	75	Potter et al. 2017
Oilaway Multipurpose Belt Brush	525	90	75	Potter et al. 2017
LORS-4C Chain Brush	722.4	90	75	Potter et al. 2017
LORS-5C Chain Brush	903	90	75	Potter et al. 2017
LORS-#C Chain Brush	N/A	90	75	Potter et al. 2017
LORS-2C Chain Brush	361.2	90	75	Potter et al. 2017
LORS-3C Chain Brush	541.8	90	75	Potter et al. 2017
LORS-#W 1800 Chain Brush	N/A	90	75	Potter et al. 2017
Side Collector LSC-3C Chain Brush	541.8	90	75	Potter et al. 2017
Side Collector LSC-3W Brush Wheel	266	90	75	Potter et al. 2017
Side Collector LBC-4C Chain Brush	721	90	75	Potter et al. 2017
LSS 12 Chain Brush/Weir	721	90	75	Potter et al. 2017
LSS 15 Chain Brush/Weir	903	90	75	Potter et al. 2017
LAMOR Catamaran LCAT-#C Chain Brush	1083.6	90	75	Potter et al. 2017
Skimming Barrier: Vikoma	140-210	40	75	Schulze 1998
Skimming Barrier: Sirene	86.8	32	90.7	Schulze 1998
Skimming Barrier: Scoop	9.03	44	81.5	Schulze 1998
Advancing Weir: Sweeping Arm	69.1	14.3	83.73	Schulze 1998
Lori-LSC-2 Brush	2.03	75	75	Schulze 1998
RST Advancing Weir	74.55	50.5	75	Schulze 1998
Weir Integral Pump Destroil	63	65	75	Schulze 1998

Table B-3. Stationary/advancing/self-propelled skimmer systems.

Skimmer System	Oil Recovery Rate, ORR (gpm)	Recovery Efficiency RE%	Throughput Efficiency TE% ³⁸	Data Source
DIP 1002 Submersion Moving Plane	17.96	35	55.6	Schulze 1998
DIP 2001 Submersion Moving Plane	9.84	41	91.5	Schulze 1998
TDS 150 Weir	N/A	75	75	Potter et al. 2017
TDS 200 Weir	N/A	75	75	Potter et al. 2017
TDS 250 Weir	N/A	75	75	Potter et al. 2017
DIP 400/420 Submersion Moving Plane	157.5	95	99	Potter et al. 2017
DIP 402 VOSS Submersion Moving Plane	439.6	95	99	Potter et al. 2017

³⁷ If no Throughput Efficiency, TE, was provided in the reference, it was assumed to be 75%.

³⁸ If no Throughput Efficiency, TE, was provided in the reference, it was assumed to be 75%.



Inland ERSP Operational Environment Calculator Design Document

Table B-3. Stationary/advancing/self-propelled skimmer systems (Cont'd).

Skimmer System	Oil Recovery Rate, ORR (gpm)	Recovery Efficiency RE%	Throughput Efficiency TE% ³⁹	Data Source
Lamor LWS 500\GTA50 Weir Skimmer	264.04	92.1	75	McKinney and DeVitis 2015
DIP 500 VOSS Submersion Moving Plane	770	95	99	Potter et al. 2017
DIP 600 VOSS Submersion Moving Plane	1,855	95	99	Potter et al. 2017
RBS Triton 300 Brush, Disc, Drum	1,331.4	98	75	Potter et al. 2017
RBS Triton 35 Brush, Disc, Drum	166.6	98	75	Potter et al. 2017
RBS Triton 60 Brush, Disc, Drum	275.1	98	75	Potter et al. 2017
SEAHUNTER	157.5	95	99	Potter et al. 2017
LWS 500 Weir	308	80	90	Potter et al. 2017
LWS 800 Weir	616	80	75	Potter et al. 2017
LWS 1300 Weir Brush Adapter	875	80	75	Potter et al. 2017
Minimax 12 W	52.5	95	98	Potter et al. 2017
Minimax 25	109.9	95	75	Potter et al. 2017
Multiskimmer LMS Brush Wheel	266	95	75	Potter et al. 2017
Multiskimmer LMS Disc	196	95	75	Potter et al. 2017
Multiskimmer LMS Drum	140	95	75	Potter et al. 2017
C Disc 13/24		95	75	Potter et al. 2017
RBS Triton 150 Brush, Disc, Drum	665.7	98	75	Potter et al. 2017
RBS Triton 150T Brush, Disc, Drum	1,358.57	98	75	Potter et al. 2017
Desmi Terminator Weir Skimmer	336.82	93.5	75	McKinney and DeVitis 2015
DESMI Alligator 50 Belt/Brush	132.3	98	75	Potter et al. 2017
DESMI Alligator 100 Belt/Brush	263.9	98	75	Potter et al. 2017
DIP 2600 Submersion moving plane	157.5	95	99	Potter et al. 2017
DIP 2900 Submersion moving plane	308.7	95	99	Potter et al. 2017
DIP 4500 Submersion moving plane	770	95	99	Potter et al. 2017
Weir Integral Pump GT-185	46.2	35	75	Schulze 1998
Induced Flow Weir W-2 Vortex	8.82-21.98	17-47	75	Schulze 1998
Elastec TDS 118G Drum Skimmer Oleophilic	99.59	88.24	75	McKinney and DeVitis 2015
Crucial Mop C-14D Oleophilic Wringer System	9.74	99.91	75	McKinney and DeVitis 2015
DIP 4500 Submersion Moving Plane	439.6	95	99	Potter et al. 2017
DIP 6001 Submersion Moving Plane	879.2	95	99	Potter et al. 2017
Stationary Oleophilic Disk Skimmer	850	84.0	75	DeVitis et al. 2015
DIP 2600 Submersion Moving Plane	157.5	95	99	Potter et al. 2017
DIP 2900 Submersion Moving Plane	308.7	95	99	Potter et al. 2017
C-Disc 88/30	859.6	95	75	Potter et al. 2017

³⁹ If no Throughput Efficiency, TE, was provided in the reference, it was assumed to be 75%.



Inland ERSP Operational Environment Calculator Design Document

Table B-3. Stationary/advancing/self-propelled skimmer systems (Cont'd).

Skimmer System	Oil Recovery Rate, ORR (gpm)	Recovery Efficiency RE%	Throughput Efficiency TE% ⁴⁰	Data Source
RBS Triton 35 Brush, Disc, Drum	166.6	98	75	Potter et al. 2017
RBS Triton 60 Brush, Disc, Drum	277.2	98	75	Potter et al. 2017
RBS Triton 100 Brush, Disc, Drum	440.3	98	75	Potter et al. 2017
Lori Drum Brush	7	83	75	Schulze 1998
Circular Weir-12"	36.4	71	75	Potter et al. 2017
DIP 5001 Submersion Moving Plane	439.6	95	99	Potter et al. 2017
RF Series Weir	549.5	49	75	Potter et al. 2017
VSP-3 Weir	549.5	49	75	Potter et al. 2017
VSP-4 Weir	945	49	75	Potter et al. 2017
Oil Recovery Bucket LRB 150 W Brush/Wheel	399	49	75	Potter et al. 2017
Advancing Weir: Sweeping Arm	69.1	14.3	83.73	Schulze 1998
Skimming Barrier: Vikoma	140-210	40	75	Schulze 1998
Skimming Barrier: Sirene	86.8	32	90.7	Schulze 1998
Skimming Barrier: Scoop	9.03	44	81.5	Schulze 1998
Vacuum Truck	9.1	11	75	Schulze 1998
Vacuum Truck	14.7	21	75	Schulze 1998
Vactor 2045: Air Conveyor	19.6	60	75	Schulze 1998
Weir Integral Pump Destroil	63	65	75	Schulze 1998
Weir Integral Pump Destroil	63	63	75	Schulze 1998
Weir Integral Pump GT-185	46.2	35	75	Schulze 1998
Induced Flow Weir W-2 Vortex	8.82-21.98	17-47	75	Schulze 1998
RST Advancing Weir	74.55	50.5	75	Schulze 1998
DESMI MINI-MAX Weir-Self Adjusting	219.8	49	75	Potter et al. 2017
DESMI Terrapin Weir-Self Adjusting	44.1	49	75	Potter et al. 2017
DBD2 Disc/Brush, Drum	9.1	49	75	Potter et al. 2017
DBD5 Disc/Brush, Drum	21.7	49	75	Potter et al. 2017
DBD16 Disc/Brush, Drum	65.8	49	75	Potter et al. 2017
DBD13-4 Disc Drum	57.4	95-98	75	Potter et al. 2017

Table B-4. Stationary/non-advancing skimmer systems.

Skimmer System	Oil Recovery Rate, ORR (gpm)	Recovery Efficiency RE%	Throughput Efficiency TE% ⁴¹	Data Source
Elastec TDS 118G Drum Skimmer Oleophilic	99.59	88.24	75	McKinney and DeVitis 2015
Crucial Mop C-14D Oleophilic Wringer System	9.74	99.91	75	McKinney and DeVitis 2015
DIP 4500 Submersion Moving Plane	439.6	95	99	Potter et al. 2017

⁴⁰ If no Throughput Efficiency, TE, was provided in the reference, it was assumed to be 75%.

⁴¹ If no Throughput Efficiency, TE, was provided in the reference, it was assumed to be 75%.



Inland ERSP Operational Environment Calculator Design Document

Table B-4. Stationary/non-advancing skimmer systems (Cont'd).

Skimmer System	Oil Recovery Rate, ORR (gpm)	Recovery Efficiency RE%	Throughput Efficiency TE% ⁴²	Data Source
DIP 6001 Submersion Moving Plane	879.2	95	99	Potter et al. 2017
Stationary Oleophilic Disk Skimmer	850	84.0	75	DeVitis et al. 2015
DIP 2600 Submersion Moving Plane	157.5	95	99	Potter et al. 2017
DIP 2900 Submersion Moving Plane	308.7	95	99	Potter et al. 2017
C-Disc 88/30	859.6	95	75	Potter et al. 2017
RBS Triton 35 Brush, Disc, Drum	166.6	98	75	Potter et al. 2017
RBS Triton 60 Brush, Disc, Drum	277.2	98	75	Potter et al. 2017
RBS Triton 100 Brush, Disc, Drum	440.3	98	75	Potter et al. 2017
Lori Drum Brush	7	83	75	Schulze 1998
Circular Weir-12"	36.4	71	75	Potter et al. 2017
DIP 5001 Submersion Moving Plane	439.6	95	99	Potter et al. 2017
RF Series Weir	549.5	49	75	Potter et al. 2017
VSP-3 Weir	549.5	49	75	Potter et al. 2017
VSP-4 Weir	945	49	75	Potter et al. 2017
Oil Recovery Bucket LRB 150 W Brush/Wheel	399	49	75	Potter et al. 2017
Advancing Weir: Sweeping Arm	69.1	14.3	83.73	Schulze 1998
Skimming Barrier: Vikoma	140-210	40	75	Schulze 1998
Skimming Barrier: Sirene	86.8	32	90.7	Schulze 1998
Skimming Barrier: Scoop	9.03	44	81.5	Schulze 1998
Vacuum Truck	9.1	11	75	Schulze 1998
Vacuum Truck	14.7	21	75	Schulze 1998
Vactor 2045: Air Conveyor	19.6	60	75	Schulze 1998
Weir Integral Pump Destroil	63	65	75	Schulze 1998
Weir Integral Pump Destroil	63	63	75	Schulze 1998
Weir Integral Pump GT-185	46.2	35	75	Schulze 1998
Induced Flow Weir W-2 Vortex	8.82-21.98	17-47	75	Schulze 1998
RST Advancing Weir	74.55	50.5	75	Schulze 1998
DESMI MINI-MAX Weir-Self Adjusting	219.8	49	75	Potter et al. 2017
DESMI Terrapin Weir-Self Adjusting	44.1	49	75	Potter et al. 2017
DBD2 Disc/Brush, Drum	9.1	49	75	Potter et al. 2017
DBD5 Disc/Brush, Drum	21.7	49	75	Potter et al. 2017
DBD16 Disc/Brush, Drum	65.8	49	75	Potter et al. 2017
DBD13-4 Disc Drum	57.4	95-98	75	Potter et al. 2017
DBD13-4 Brush Drum	132.3	95-98	75	Potter et al. 2017
Brush Adapter LBA-Q Brush Wheel	175	50-90	75	Potter et al. 2017
ECO-MS20 Drum, Disc & Drum	91	90	90	Potter et al. 2017
ECO-MS50 Drum, Disc & Drum	217	90	90	Potter et al. 2017
ECO-MS150 Drum, Brush & Disc	658	90	90	Potter et al. 2017

⁴² If no Throughput Efficiency, TE, was provided in the reference, it was assumed to be 75%.



B.1 Appendix B References

- DeVitis, D. W. Schmidt, and J-E. Delgado. 2015. Use of the Newly Developed ASTM Standard F2709 (Standard Test Methods for Determining Nameplate Recovery Rates of Stationary Oil Skimmer System). OHMSETT, Leonardo, New Jersey. August 2015. 6 p.
- Meyer, P., B. Schmidt, D. DeVitis, and J-E. Delgado. 2015. High Capacity Advancing Oil Recovery System Performance Testing at OHMSETT for the Wendy Schmidt Oil Cleanup X Challenge. OHMSETT, Leonardo, New Jersey. August 2015.
- McKinney, K., and D. DeVitis. 2015. ASTM F2709-08 Testing of Skimmer Systems at OHMSETT Facility. Bureau of Safety and Environmental Enforcement. 21 p.
- Potter, S., and J. Morrison. 2017. World Catalog of Response Products. 11th Edition. SL Ross Environmental Research Ltd.
- Schulze, R. 1998. Response Performance Review of Skimmers. American Society for Testing and Materials (ASTM) Manual Series. November 1998. 161 p.



APPENDIX C. INPUTS FOR RECOVERY SYSTEM PERFORMANCE

This appendix provides further background information on the inputs for the recovery system performance.

C.1 Recovery Efficiency (*RE*) Inputs

Recovery Efficiency, *RE*, [%] is one of the essential UDIs into the Inland ERSP Calculator. *RE* is the percentage of oil/emulsion recovered compared to the total fluids recovered. Validated test data provide the best values. Appendix C presents *RE* values for specific skimmers. Users may also input their own values, if known.

As an alternative, and as a default in the absence of more definitive data, the project team computed representative nominal values for basic skimmer types based on previous research in the development of the Response Options Calculator and the Offshore ERSP Calculator, as shown in Table C-1.⁴³ These values were based on Figure C-1, which summarizes the data for calm water conditions, as would generally be the assumed conditions for inland waterways relative to offshore conditions. The values vary by skimmer and oil type. These data are for advancing skimmer groups. There are no analogous data for stationary skimmers. For stationary skimmers, users should reference the test data in Appendix B. Future research and testing of equipment may yield more definitive values for Recovery Efficiency.

Table C-1. Representative nominal values for Recovery Efficiency, *RE*.

Oil Type	Recovery Efficiency (<i>RE</i>) by Advancing Skimmer Type ⁴⁴		
	Skimmer Group A	Skimmer Group B	Skimmer Group C
	Oleophilic	Paddle Belt, Fixed & Moving Submersion Plane	Air Conveyor, Weir, Direct Suction & Vortex
Oil Group I	0.88	0.85	0.65
Oil Group II	0.87	0.84	0.63
Oil Group III	0.90	0.73	0.47
Oil Group IV	0.82	0.55	0.22

⁴³ Dale 2011 and Genwest Systems 2012.

⁴⁴ RE values are expressed in decimals.



(This page intentionally left blank.)



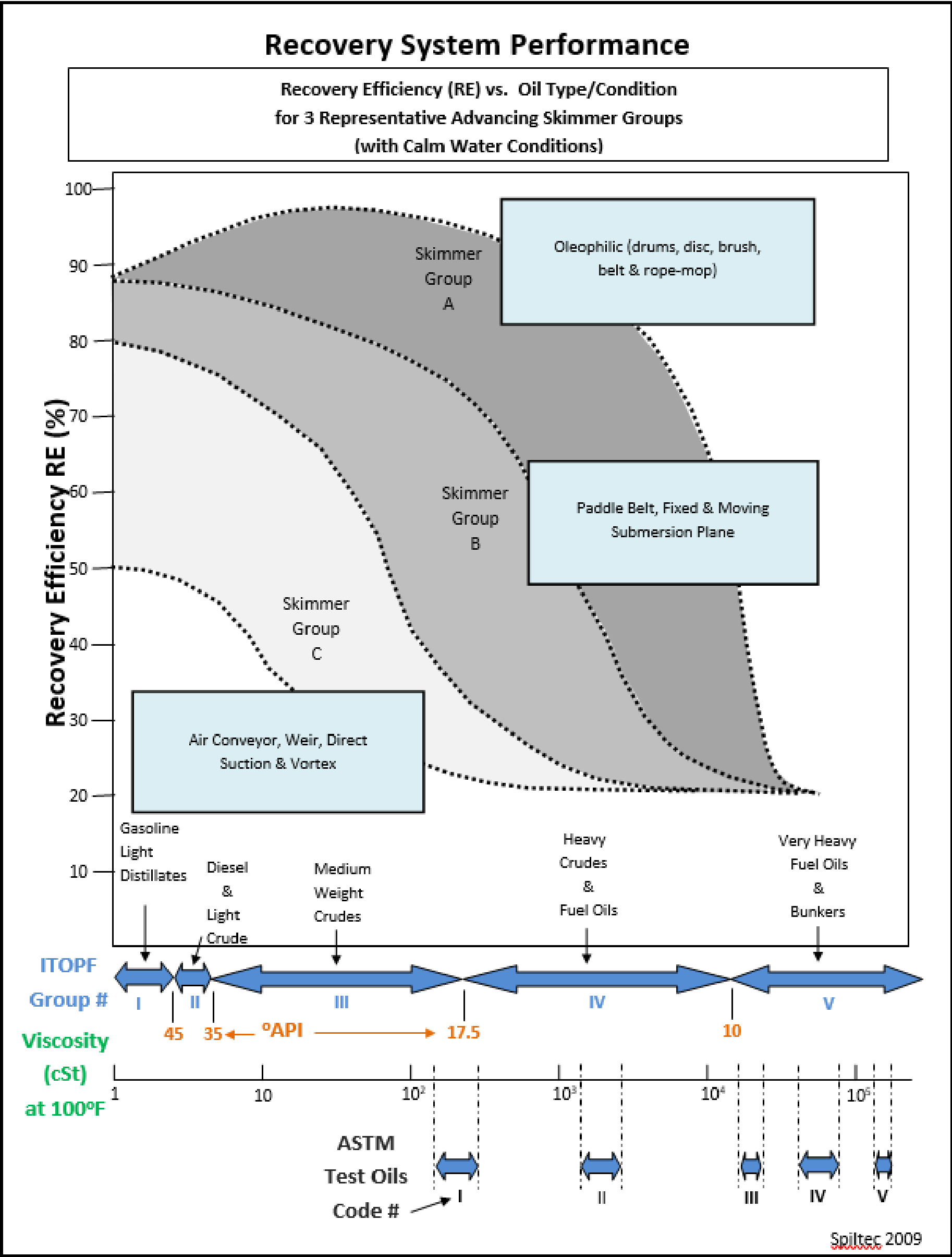


Figure C-1. Recovery system performance based on oil type and condition for advancing skimmers.⁴⁵

⁴⁵ Source: Dale 2011.





(This page intentionally left blank.)



C.2 Approach for Estimating Maximum Effective Swath (*MES*) Based on Maximum Total Fluid Recovery Rate (*MTFRR*)

The calculation of *MES* is part of the Inland ERSP Calculator algorithm. This section describes the algorithm.

The Workable Swath Width (*SW*) is an essential input into the Inland ERSP Calculator. Along with the factors of Velocity (*V*), which is a user input (UDI 8), and Thickness (*TH*), which is an output from the Oil Behavior Module, it determines the Encounter Rate (*ER*).

Ideally, the user will enter a value for *SW* based on manufacturer information or guidance from tactical manuals regarding the use of a particular type of skimming system. A user may also apply expert judgment based on experience and knowledge of the use of the skimming system in particular types of inland waterways. In any case, the value specified for *SW* should not exceed the Maximum Effective Swath (*MES*).

If the user does not have access to appropriate manufacturer data or otherwise cannot estimate *SW* so that it does not exceed *MES*, an alternate approach is to calculate *MES* from the Maximum Total Fluid Recovery Rate (*MTFRR*). *MTFRR*, is calculated by solving for Equation 23:

$$MES_{day} = \frac{(MTFRR \times RE)}{(63.13 \times V \times TH_{day} \times TE)}$$

Equation 23

where: *MES* = Maximum Effective Swath [ft]; *MTFRR* = Maximum Total Fluid Recovery Rate [gpm]; *RE* = Recovery Efficiency [%] (UDI 11); *V* = Velocity [kts]; *TH* = thickness [inches]; and *TE* = Throughput Efficiency [%] (UDI 10). 63.13 is a conversion factor for knots, feet, and inches to gallons per minute.⁴⁶

MTFRR was formerly referred to as Nameplate Recovery Rate. Nameplate Recovery Rate was originally often provided by skimmer manufacturers based on their own tank tests using water (sometimes a test oil and a poorly controlled range of oil thicknesses), and minimal, if any, “head” to overcome while moving water or oil from the skimming surface to onboard storage. There was no consideration of Encounter Rate (based on swath, speed, and oil thickness), such as would be the case for an advancing skimmer. Also, there was rarely any measure of Throughput Efficiency (*TE*) or carefully controlled measures of Recovery Efficiency (*RE*).

MTFRR is a value of great uncertainty for many skimmers. One could use the often-misleading estimate of a skimmer’s daily recovery potential based on 20% of its best available Nameplate Recovery Rate (which is the estimate for Effective Daily Recovery Capacity or EDRC).⁴⁷ However, the operational value of such a computation is minimal, at best.

In the absence of good field trials under realistic test conditions, consideration might be given to the use of “representative nominal” recovery rates for a given skimming system. The most accurate *MTFRR* values would clearly depend upon more than encounter rate, *TE* and *RE* measurements. The best estimates would

⁴⁶ BSEE and Genwest 2016, p. 40.

⁴⁷ Genwest Systems 2012.



include the type of oil/emulsion encountered, wind/sea conditions, and even the nearly impossible-to-assess influence of vessel/equipment operator experience.

In researching this topic, the project team was advised by subject matter experts (SMEs) that the interrelationship between the Maximum Total Fluid Recovery Rate (*MTFRR*), Encounter Rate (*ER*), and Maximum Effective Swath (*MES*) is complex enough that it may merit convening a multi-day workshop or expert panel to provide better guidance to responders, as well as to users of the Inland ERSP Calculator (and the Offshore ERSP Calculator).

In the interim, the project team suggests a range of values for *MES* based on *MTFRR*. The only readily available guidance for determining these values is from a research study conducted in the development of the Offshore ERSP Calculator.⁴⁸ The data for the Offshore ERSP Calculator are in the form of three graphs (Figure C-2–Figure C-4).

Figure C-2 shows the relationship between skimming speed (*V*) and *MES* for Day 1 when it is assumed that the average oil thickness (*TH*) is 0.1 inch. The calculated values also assume that the *TE* equals the *RE*. This would mean that the system is working at its highest efficiency. The recommended value for *MES*, based on *V*, varies by different Nameplate Recovery Rates (the equivalent of *MTFRR*), which are shown as a range from 250 gpm to 2,500 gpm. The range of common skimming speeds (*V*)—0.5 to 0.75 kts—is shown in dark gray.

The *MES* values on the Y axis are presented on a logarithmic scale. The higher the Nameplate Recovery Rate, the higher the calculated *MES*. In other words, skimming systems that have higher Nameplate Recovery Rates (or *MTFRR*) can operate with a larger *MES*. As the oil spreads out, the *MES* increases because the system is actually encountering less oil. The *MES* values in the graphs (those in shown by the blue lines) for the different *MTFRR* values are based on Equation 23.

There are similar figures for Day 2 (Figure C-3) and Day 3 (Figure C-4), when it is assumed that the oil will have spread out to a lower average thickness. For Day 2, the assumed average thickness is 0.05 inch. For Day 3, the assumed average thickness is 0.025 inch. Note that these thicknesses are relatively arbitrary and are not based on modeling, such as was conducted for the Oil Behavior Module for different oil types, spill volumes, and waterway types for application within the Inland ERSP Calculator.

⁴⁸ Genwest Systems 2012.



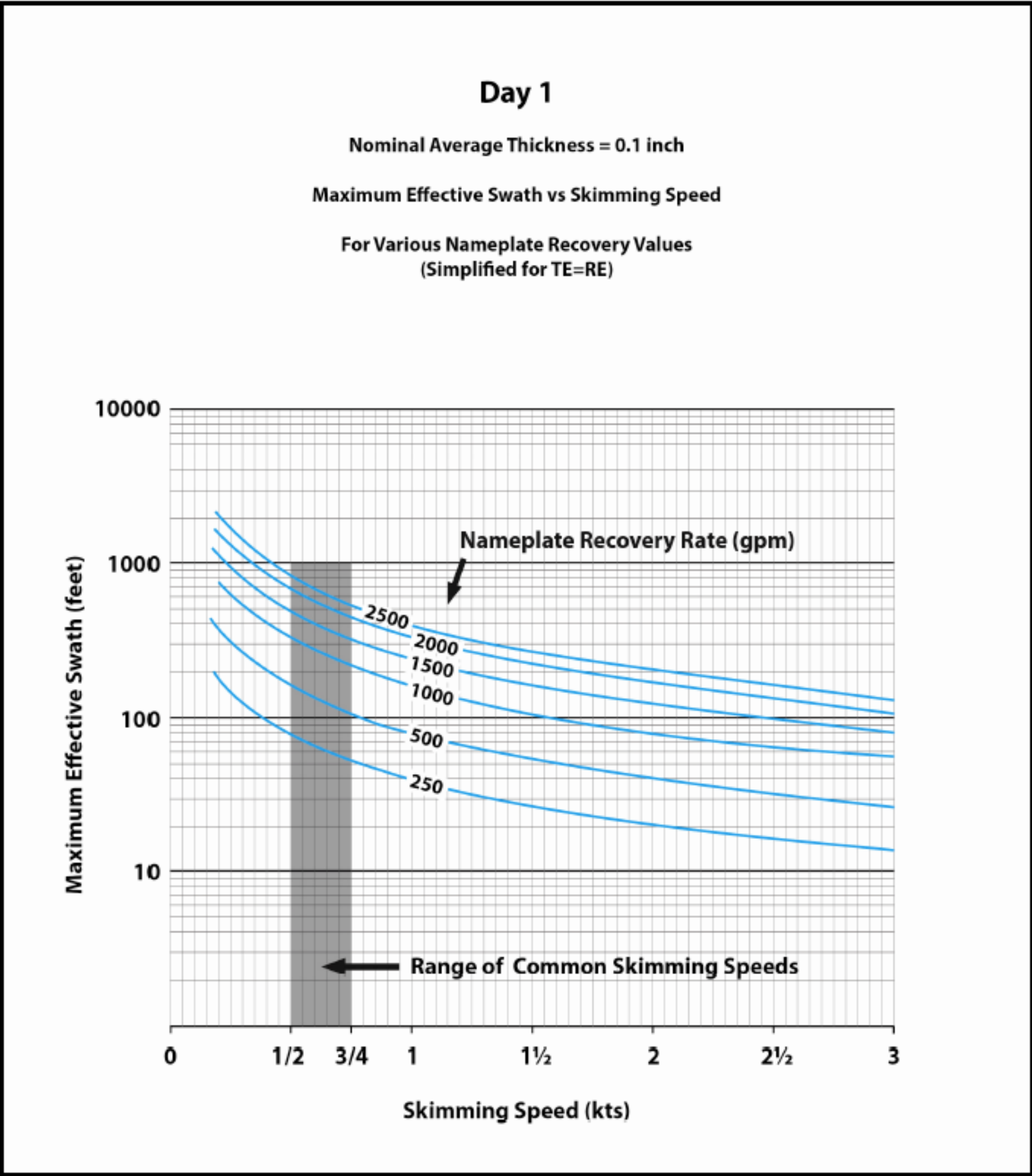


Figure C-2. Maximum effective swath versus skimming speed for Day 1.⁴⁹

⁴⁹ Source: Genwest Systems 2012. (Note the logarithmic scale.)



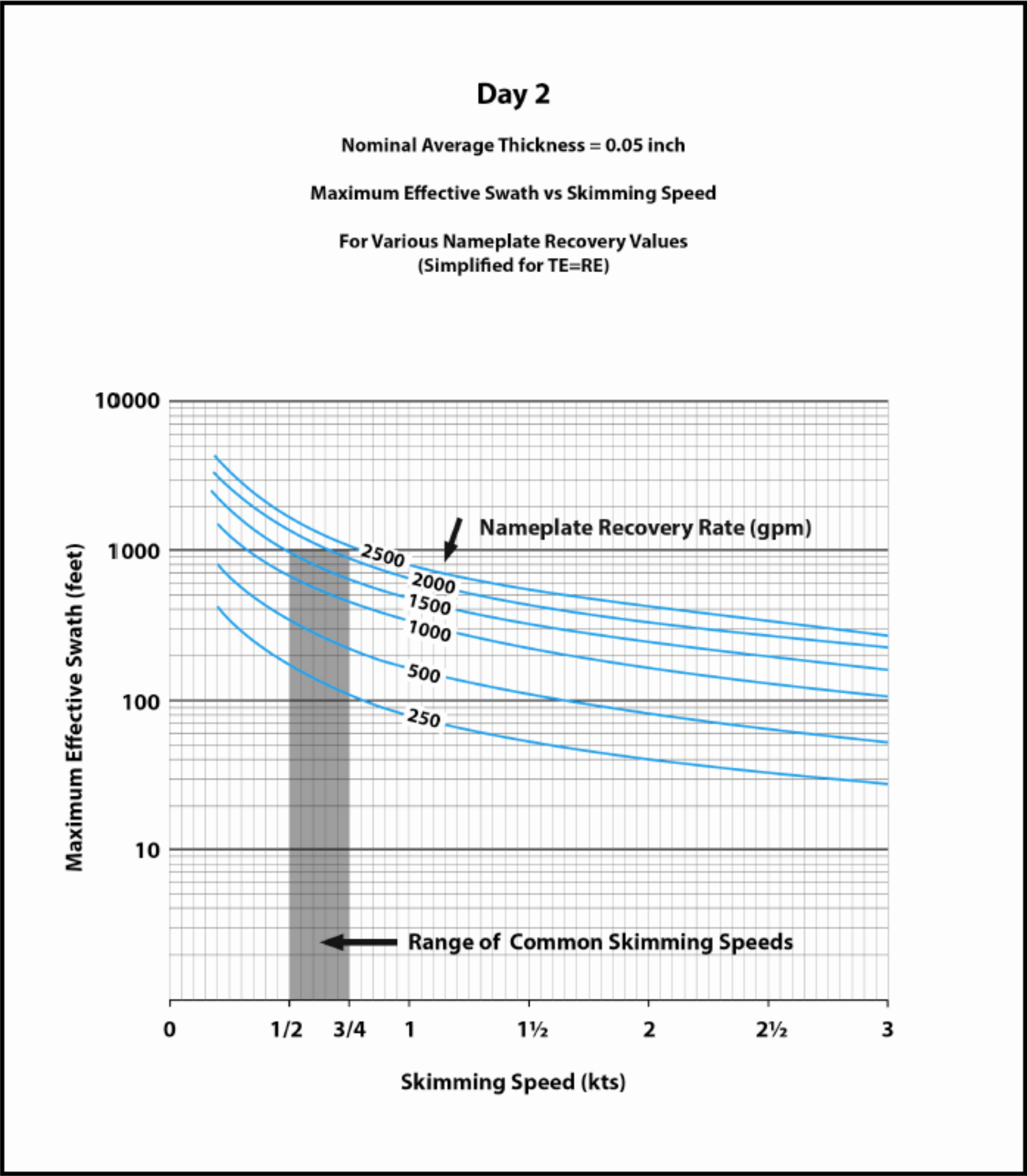


Figure C-3. Maximum effective swath versus skimming speed for Day 2.⁵⁰

⁵⁰ Source: Genwest Systems 2012.



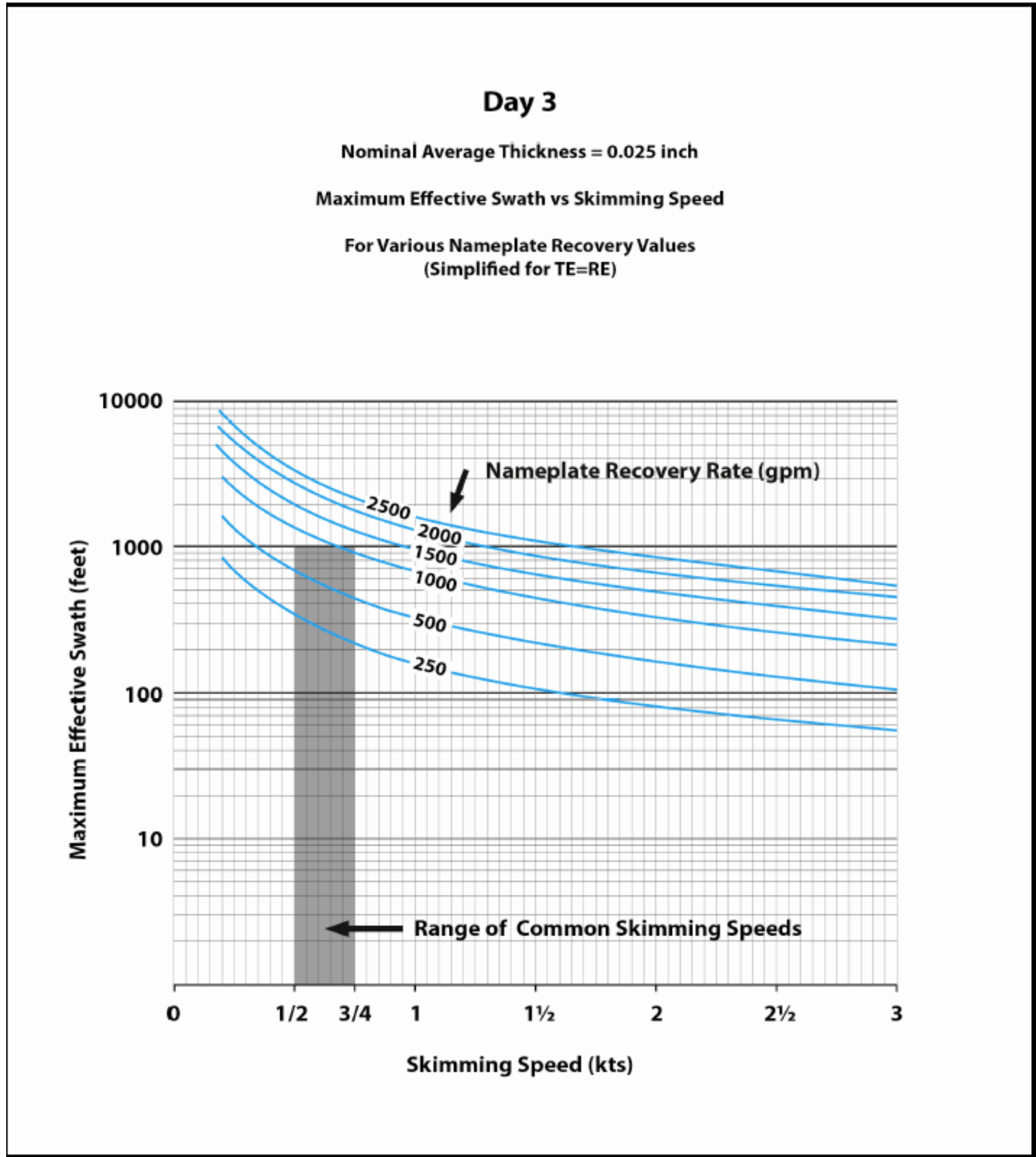


Figure C-4. Maximum effective swath versus skimming speed for Day 3.⁵¹

⁵¹ Source: Genwest Systems 2012.



(This page intentionally left blank.)



Inland ERSP Operational Environment Calculator Design Document

Based on the assumed oil thickness (TH_{day}) for each of the three days, the assumption that RE is the equivalent of TE , and that V is between 0.5 and 0.75 kts, the project team estimated the values for MES_{day} for three representative Nameplate Recovery Rates or Maximum Total Fluid Recovery Rate ($MTFRR$) of 250 gpm, 1,000 gpm, and 2,500 gpm, from Figure C-2 through Figure C-4, and by applying Equation 23, as shown in Table C-2. The maximum value for MES is 1,000 ft regardless of the values in the Figure C-2 through Figure C-4, because this is the greatest swath generally considered to be operationally feasible with currently available equipment.

Table C-2. Estimated maximum effective swath for representative skimming systems⁵²

Skimming System Nameplate Recovery Rate ($MTFRR$)	Estimated Maximum Effective Swath (MES) (feet)		
	Day 1	Day 2	Day 3
250 gpm	63	127	253
1,000 gpm	253	507	1,000
2,500 gpm	634	1,000	1,000

The values in Table C-2 (and in Figure C-2 through Figure C-4) are based on assumed oil thicknesses for the three days. Since the Oil Behavior Module provides a more accurate estimate for the daily oil thickness (TH_{day}) based on the Oil Group (UDI 3), Waterway Type (UDI 4), and Spill Volume (UDI 2), the TH_{day} values for each day may be applied to Equation 23 to derive a value for MES_{day} that more accurately reflects the oil conditions in the waterway.

The results of those computations, as shown in Table C-3, provide guidance to the user with respect to maximum values for workable swath (SW), i.e., Maximum Effective Swath (MES), that can be entered as UDI 9. ***The maximum recommended value for MES is 1,000 ft. However, the user must exercise judgment with respect to whether responders would be able to achieve this width in a specific inland waterway setting given the dimensions and configuration of the waterway, as well as operational constraints related to the Maximum Total Fluid Recovery Rate ($MTFRR$).***

Table C-3. Values for Maximum Effective Swath (MES) Days 1–3.

Waterway	Oil	Volume	Default Maximum Effective Swath (MES) For Skimming Systems with Low, Medium, and High Nameplate Recovery Rates ⁵³ ($MTFRR$)								
			Day 1			Day 2			Day 3		
			Low	Medium	High	Low	Medium	High	Low	Medium	High
Open-Flow	I	AMPD	1,000	1,000	1,000	1,000	0	0	1,000	0	0
Open-Flow	I	MMPD	333	1,000	1,000	333	0	0	333	0	0
Open-Flow	I	WCD	75	301	752	75	1,000	1,000	75	1,000	1,000

⁵² Based on assumed thickness of 0.1 inch on Day 1, 0.05 inch on Day 2, and 0.025 inch on Day 3 with velocity = the midpoint between 0.5 and 0.75 kts.

⁵³ “Low” Nameplate Recovery Rate ($MTFRR$) is less than 750 gpm; “Medium” $MTFRR$ is 750–1,500 gpm; and “High” $MTFRR$ is greater than 1,500 gpm.



Inland ERSP Operational Environment Calculator Design Document

Table C-3. Values for Maximum Effective Swath (MES) Days 1–3. (Cont'd).

Waterway	Oil	Volume	Default Maximum Effective Swath (MES) For Skimming Systems with Low, Medium, and High Nameplate Recovery Rates ⁵⁴ (MTFRR)								
			Day 1			Day 2			Day 3		
			Low	Medium	High	Low	Medium	High	Low	Medium	High
Open-Flow	II	AMPD	1,000	1,000	1,000	1,000	0	0	1,000	0	0
Open-Flow	II	MMPD	128	512	1,000	128	1,000	1,000	128	1,000	1,000
Open-Flow	II	WCD	57	226	565	57	1,000	1,000	57	1,000	1,000
Open-Flow	III	AMPD	1,000	1,000	1,000	1,000	0	0	1,000	0	0
Open-Flow	III	MMPD	109	438	1,000	109	1,000	1,000	109	1,000	1,000
Open-Flow	III	WCD	30	121	302	30	231	820	30	231	820
Open-Flow	IV	AMPD	295	1,000	1,000	295	0	0	295	0	0
Open-Flow	IV	MMPD	75	299	748	75	205	386	75	205	386
Open-Flow	IV	WCD	26	106	265	26	213	404	26	213	404
Open-Stagnant	I	AMPD	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Open-Stagnant	I	MMPD	344	1,000	1,000	344	1,000	1,000	344	1,000	1,000
Open-Stagnant	I	WCD	74	297	744	74	1,000	1,000	74	1,000	1,000
Open-Stagnant	II	AMPD	773	1,000	1,000	773	1,000	1,000	773	1,000	1,000
Open-Stagnant	II	MMPD	119	475	1,000	119	1,000	1,000	119	1,000	1,000
Open-Stagnant	II	WCD	33	130	326	33	370	1,000	33	370	1,000
Open-Stagnant	III	AMPD	576	1,000	1,000	576	1,000	1,000	576	1,000	1,000
Open-Stagnant	III	MMPD	106	424	1,000	106	905	1,000	106	905	1,000
Open-Stagnant	III	WCD	30	119	298	30	215	733	30	215	733
Open-Stagnant	IV	AMPD	70	279	697	70	126	251	70	126	251
Open-Stagnant	IV	MMPD	66	265	661	66	158	297	66	158	297
Open-Stagnant	IV	WCD	26	105	262	26	214	404	26	214	404
Confined-Flow	I	AMPD	1,000	1,000	1,000	1,000	1,000	0	1,000	1,000	0

⁵⁴ “Low” Nameplate Recovery Rate (MTFRR) is less than 750 gpm; “Medium” MTFRR is 750–1,500 gpm; and “High” MTFRR is greater than 1,500 gpm.



Inland ERSP Operational Environment Calculator Design Document

Table C-3. Values for Maximum Effective Swath (MES) Days 1–3. (Cont'd).

Waterway	Oil	Volume	Default Maximum Effective Swath (MES) For Skimming Systems with Low, Medium, and High Nameplate Recovery Rates ⁵⁵ (MTFRR)								
			Day 1			Day 2			Day 3		
			Low	Medium	High	Low	Medium	High	Low	Medium	High
Confined-Flow	I	MMPD	344	1,000	1,000	344	1,000	0	344	1,000	0
Confined-Flow	I	WCD	74	297	744	74	1,000	1,000	74	1,000	1,000
Confined-Flow	II	AMPD	773	1,000	1,000	773	1,000	0	773	1,000	0
Confined-Flow	II	MMPD	120	482	1,000	120	1,000	1,000	120	1,000	1,000
Confined-Flow	II	WCD	33	130	326	33	377	1,000	33	377	1,000
Confined-Flow	III	AMPD	576	1,000	1,000	576	1,000	0	576	1,000	0
Confined-Flow	III	MMPD	106	424	1,000	106	1,000	1,000	106	1,000	1,000
Confined-Flow	III	WCD	30	119	298	30	227	987	30	227	987
Confined-Flow	IV	AMPD	70	278	696	70	201	0	70	201	0
Confined-Flow	IV	MMPD	66	265	661	66	226	1,000	66	226	1,000
Confined-Flow	IV	WCD	26	105	262	26	191	348	26	191	348
Confined-Stagnant	I	AMPD	1,000	1,000	1,000	1,000	0	0	1,000	0	0
Confined-Stagnant	I	MMPD	344	1,000	1,000	344	0	0	344	0	0
Confined-Stagnant	I	WCD	75	299	747	75	0	0	75	0	0
Confined-Stagnant	II	AMPD	823	1,000	1,000	823	0	0	823	0	0
Confined-Stagnant	II	MMPD	126	504	1,000	126	0	0	126	0	0
Confined-Stagnant	II	WCD	33	130	326	33	374	1,000	33	374	1,000
Confined-Stagnant	III	AMPD	640	1,000	1,000	640	0	0	640	0	0
Confined-Stagnant	III	MMPD	115	459	1,000	115	0	0	115	0	0
Confined-Stagnant	III	WCD	30	120	299	30	223	786	30	223	786
Confined-Stagnant	IV	AMPD	69	277	693	69	0	0	69	0	0
Confined-Stagnant	IV	MMPD	73	291	728	73	0	0	73	0	0
Confined-Stagnant	IV	WCD	26	105	263	26	217	398	26	217	398

⁵⁵ “Low” Nameplate Recovery Rate (MTFRR) is less than 750 gpm; “Medium” MTFRR is 750–1,500 gpm; and “High” MTFRR is greater than 1,500 gpm.



(This page intentionally left blank.)



APPENDIX D. OPEN-WATER/SHORESIDE ALLOCATION

The Inland ERSP Calculator very specifically separates the computations for Open-Water and Shoreside Recovery operations. In large part, oil spill responders (e.g., OSROs) use advancing skimming systems for Open-Water and stationary skimmers for Shoreside Recovery operations. There may be overlap with respect to the use of boom for containment and collection. Users can evaluate ways to allocate equipment between Open-Water and Shoreside Recovery operations for specific scenarios and geographic locations using the Customization Module).

In the Inland ERSP Calculator, the project team assumes that the recovery capability of Open-Water and Shoreside Recovery systems will be considered separately. For an actual spill situation, responders will need to allocate the equipment and level of effort depending on the specific conditions for that spill. For response planning purposes, responders will categorize each inland waterway by its characteristics with respect to the potential allocation of Open-Water Recovery (advancing skimming systems) versus Shoreside Recovery (stationary skimming systems).

According to 33 CFR 154.1045 and 155.1050, OSROs need to allocate 20% of response equipment operating in shallow waters (six feet or less) for rivers/canals and inland operating areas. The user can apply this percentage of equipment as a default for the Shoreside Recovery equipment, assuming that the six-foot water depth criteria match up with the area in which Shoreside Recovery operations would be conducted.

The mathematical summation of Open-Water Recovery capability and Shoreside Recovery capability, as respectively computed by the Inland ERSP Calculator, is not particularly useful for general response planning purposes. However, for a more specific spill scenario in a geographically-specific inland waterway, the relative allocation of types of equipment to Open-Water and Shoreside Recovery operations may be roughly estimated using Equation 24 for Open-Water Percent and Equation 25 for Shoreside Percent based on the width of the shoreside area in which Shoreside Recovery operations would be expected to occur:

$$P_{open} = \frac{Width_{waterway} - (2 \times Width_{shoreside})}{Width_{waterway}}$$

Equation 24

$$P_{shoreside} = \frac{(2 \times Width_{shoreside})}{Width_{waterway}}$$

Equation 25

where: P_{open} = the percentage of the waterway that would be considered “Open-Water”; $P_{shoreside}$ = percentage of waterway that would be considered “Shoreside”; $Width_{waterway}$ = overall width of waterway; $Width_{shoreside}$ = width of Shoreside Recovery Area. The measurement units (feet, meters, yards) are immaterial although they need to be the same for all the width measurements.

The project team assumes that the oil is evenly distributed across the waterway and that the Shoreside Recovery Area will be fairly restricted by the equipment and waterway configurations. The project team also assumes that the Shoreside Recovery Areas would be similar on both sides of the hypothetical waterway. (They can be computed separately, if appropriate.) Figure D-1 shows the overall concept.



Inland ERSP Operational Environment Calculator Design Document

If the Shoreside Recovery Areas are fairly constant, they will take up more of the overall Waterway Width in a narrower waterway, and, thus, Shoreside Recovery would generally make up a greater percentage of the overall response effort in the first three days. Figure D-1 shows a diagram that is a highly simplified representation of an inland waterway to illustrate the concepts behind Equation 24 and Equation 25.

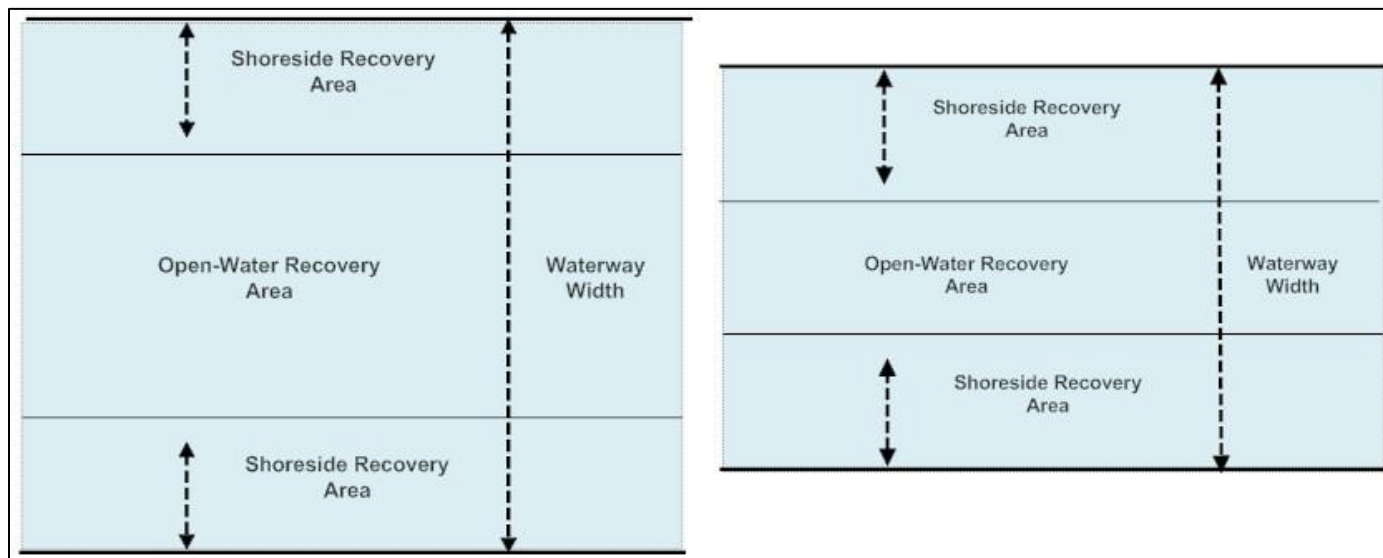


Figure D-1. Conceptual diagram of open-water versus shoreside equipment allocation.

Each inland waterway is uniquely configured with significant variations in width and shoreline configuration in different geographic locations. This diagram shows the general concept that, in an open waterway, the user can consider a certain percentage of the area for Shoreside Recovery and the rest for Open-Water Recovery.

If the user would like to anticipate differential allocation of equipment based on the overall general percentage of Shoreside versus Open-Water area, the user can apply this approach.

As an alternative to using Equation 24, Equation 25, and Figure D-1, the user may opt to enter estimates of percentage of allocation of different types of equipment needs for Open-Water and Shoreside Recovery.



APPENDIX E. OIL BEHAVIOR MODULE

Appendix E describes the modeling conducted to develop the equations in the Oil Behavior Module to, in turn, provide inputs to the computations in the Inland ERSP Calculator, as well as to portions of the Customization Module. The description of the SIMAP model in Appendix E is intended for programmers and developers. An understanding of the model is not integral for the typical user of the Inland ERSP Calculator itself. However, the programmer should understand that all table values in Appendix E are the results of running the SIMAP model with oil spill scenario variables (Oil Type, Volume Category, Waterway Type, and Shore Type) as inputs.

As described in Section 5, the main purpose for the Oil Behavior Module is to estimate the amount of oil available for recovery. This process involves the results of trajectory and fate modeling of representative oil spill scenarios that the project team already performed. Again, it is important to note that modeled simulations are for representative waterways to help explain how oil behaves in the environment and not representative of an actual spill event. This modeling derived values to be used as more site-specific inputs into the Inland ERSP Calculator and, specifically, the Customization Module. Therefore, the Oil Behavior Module provides three key results that then become important inputs for further computations in the Inland ERSP Calculator and for the Customization Module:

- The amount of oil floating on the surface at a sufficient thickness to be recovered mechanically over time;
- The emulsification rate over time; and
- The average oil thickness on the water surface over time.

E.1 Overview of Oil Spill Modeling

The project team addressed the availability of recoverable oil, including weathering processes and emulsification by modeling of representative Group I–IV oils with SIMAP (Spill Impact Model Application Package), a computer modeling software application that estimates physical fates of releases of oil and petroleum products⁵⁶. The project team applied the model to a variety of marine and freshwater environments for use in response and contingency planning, risk assessment, and training. The model is fully three-dimensional in space and time-varying, using Lagrangian elements to track the oil. The project team couples it to a simplified geographic information system (GIS), which contains environmental and geographical data, and to physical-chemical properties in an oil database containing necessary model inputs.

Figure E-1 shows the SIMAP oil fate model design. The physical fate model estimates trajectory and fate of an oil release using input data from the sources indicated. A separate (not part of SIMAP) hydrodynamic model calculates and supplies currents that transport oil and its components. Alternatively, the user can use field measurement-based current data sets. Environmental, physical-chemical, and geographical databases supply required information to the model. The user supplies information about the spill (time, place, oil type, and amount spilled) and environmental conditions at the time (such as temperature and wind data). The user can use an interactive GIS to display and manipulate a large amount of environmental and geographic data.

⁵⁶ French-McCay et al. 2018; French-McCay 2009.



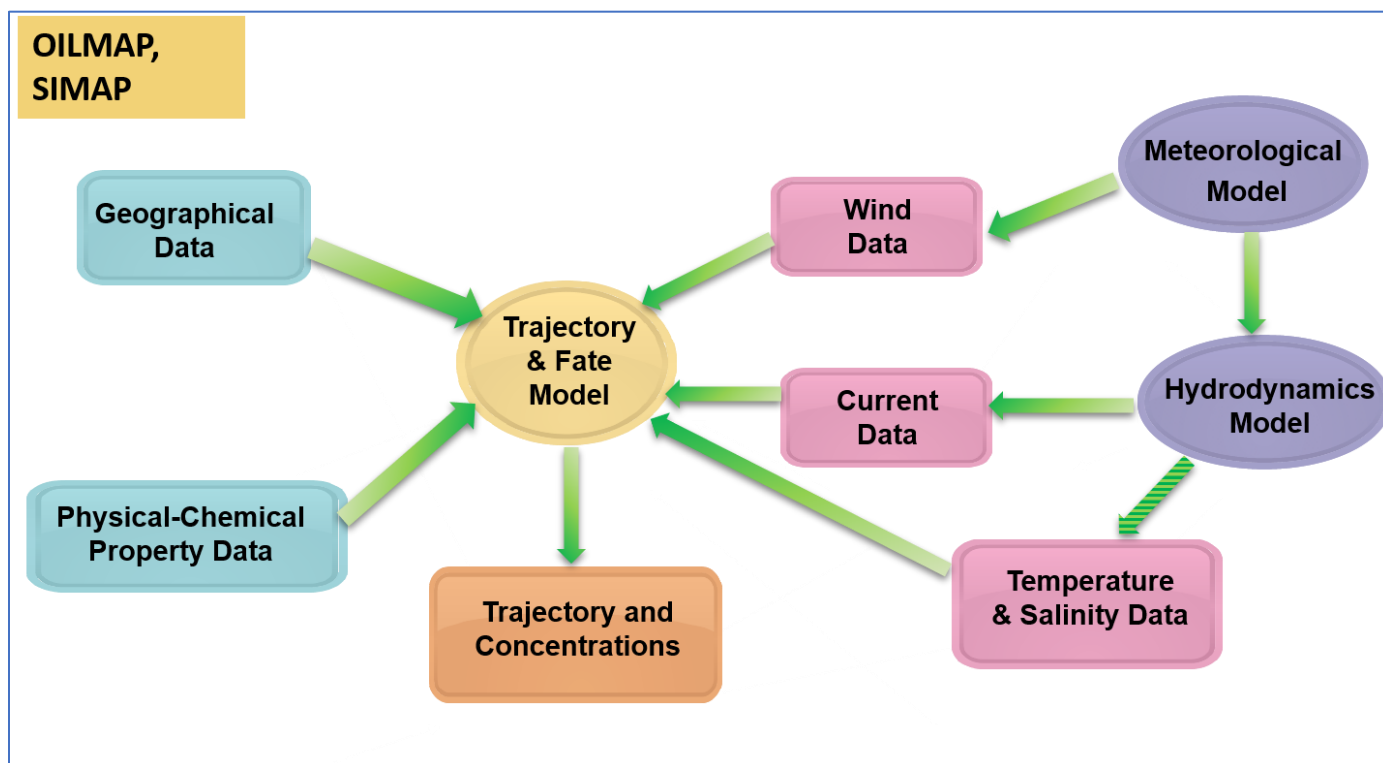


Figure E-1. SIMAP 3-D oil fate model components and inputs flow diagram.

The schematic in Figure E-2 shows oil fate processes simulated in the model. Because oil contains many chemicals with varying physical-chemical properties, and the environment is spatially and temporally variable, the oil rapidly separates into different phases and parts of the environment:

- Oil droplets suspended in the water column;
- Oil adhered to suspended particulate matter (SPM) in the water;
- Dissolved lower molecular weight components, including mono-aromatic hydrocarbons (MAHs), polycyclic aromatic hydrocarbons (PAHs), and other soluble components) in the water column;
- Oil on and in the bottom sediments;
- Dissolved lower molecular weight components (MAHs, PAHs, and other soluble components) in the sediment pore water; and
- Oil on and in the shoreline sediments and water surface.

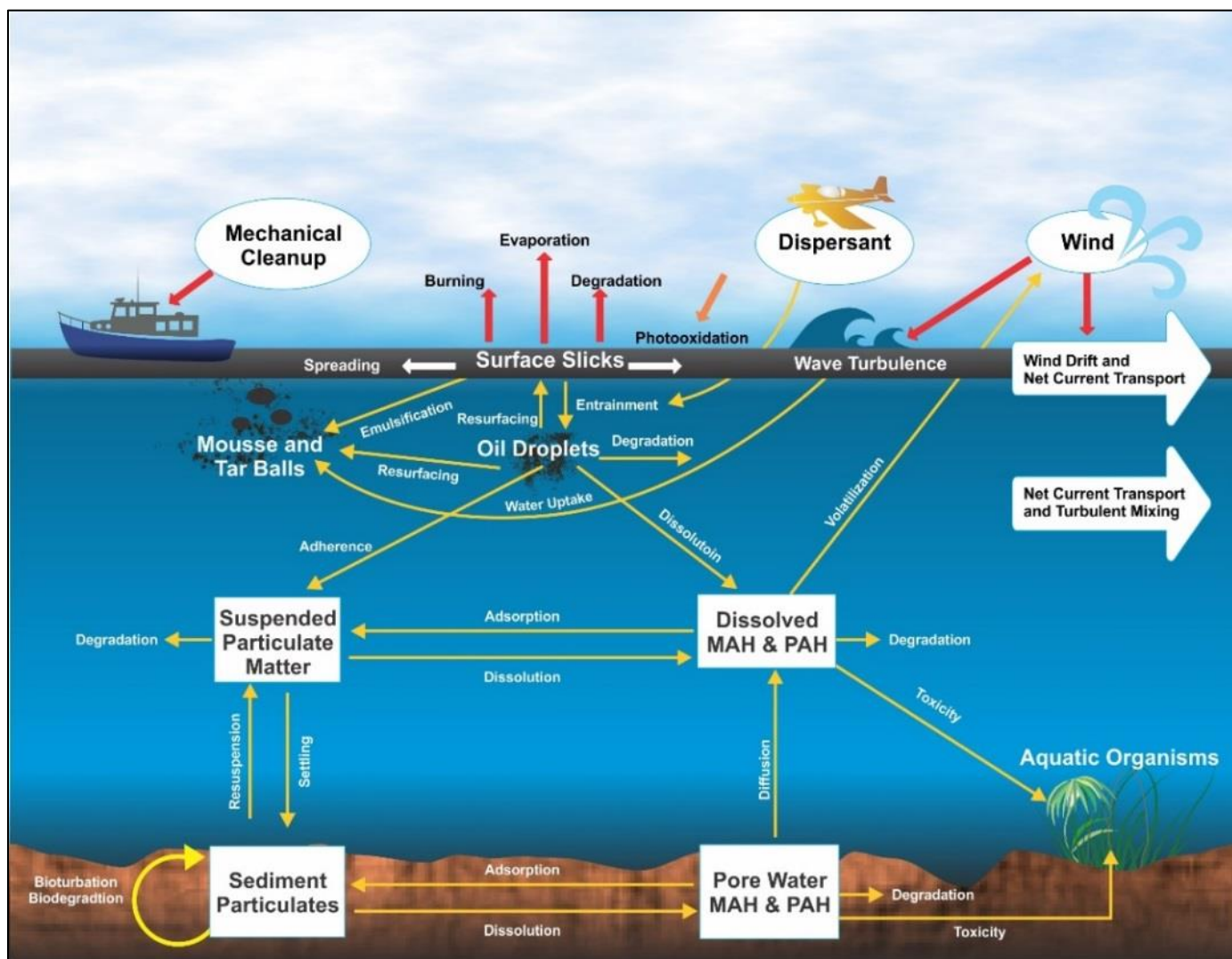


Figure E-2. Simulated fate processes for surface oil.

E.1.1 Scenario Matrix

The deterministic mode of SIMAP modeled a total of 72 representative oil spill scenarios to derive basic equations with volume on the water surface over time (in hours). The scenario matrix included:

- 4 oil types: Groups I-IV (gasoline, diesel, crude, heavy fuel oil).
- 6 river conditions:
 - Open-Flow Wetland–tidal with wetland shore;
 - Open-Flow Gravel–tidal with gravel shore;
 - Open-Stagnant–slow quiescent/stagnant with gravel shore;
 - Confined-Flow Wetland–downstream movement with wetland shore;
 - Confined-Flow Gravel–downstream movement with gravel shore; and

- Confined-Stagnant–slow quiescent/stagnant with wetland shore.⁵⁷
- 3 spill volumes: AMPD, MMPD, WCD.

Understanding there are many complexities with assessing oil spills within the inland environment, the project team derived this scenario matrix to be representative of the varied oil spill cases that may occur. While Section 5 provides the basis behind the three spill volumes used in this representative oil spill modeling, this section provides an explanation of the other aspects of these representative oil spill scenarios.

E.1.2 Representative Oil Types

The project team simulated four representative groups of oils through the oil spill modeling as a basis for the Oil Behavior Module. The project team selected representative oils within the SIMAP oil database containing the physical and chemical properties necessary for simulating the fate (weathering) of the spill. Table E-1 provides the basic characteristics of these oils. Section 4.1.3 provides additional detail as to the basis of these representative oils.

Table E-1. Oil characteristics table.

Oil Group	Oil Name	Density (g/cm ³)	API	Viscosity (cP ⁵⁸)	Max Water Content (%)
Group I	Gasoline (unleaded)	0.800 @ 25°C	45.4	0.51 @ 25°C	0.0
Group II	Diesel	0.831 @ 25°C	38.8	2.76 @ 25°C	0.0
Group III	HOOPS ⁵⁹ 1X Blend Crude Oil	0.854 @ 16°C	34.2	8.43 @ 20°C	59.0
Group IV	Heavy Fuel Oil - FPL ⁶⁰	0.975 @ 25°C	12.3	3180 @ 25°C	30.0

E.1.3 Representative River Conditions

As discussed in detail in RDC's report titled, "Inland Estimated Recovery System Potential Preliminary Factors, Requirements and Conceptual Model Report," the project team divided waterway dimension into two main types:

- "Confined," in which the configuration and depth of the waterway could not reasonably accommodate open-water recovery operations (e.g., a small creek or stream, or a small pond); and
- "Open-water," in which there is sufficient space and depth to accommodate open-water recovery operations with boats and advancing skimmers (e.g., a wide river like the Hudson River or Ohio River, or a moderate-sized lake).

Waterway flow was divided into two main types:

- Flow, in which there is generally some degree of detectable current; and

⁵⁷ In the Inland ERSP Calculator for Confined-Stagnant waterways, it is only possible to conduct calculations for self-propelled and advancing skimmer systems. While responders may use other forms of recovery (e.g., vacuum trucks and pumps that are not associated with a skimming system), these forms of recovery cannot be computed by the Inland ERSP Calculator. However, for the incorporating the oil behavior in a confined stagnant (quiescent) waterway, these scenarios were simulated. The oil behavior would not be affected by any current within the waterway. However, the oil recovery would need to have some form of "velocity" from the recovery systems themselves. Likewise, for an open-water stagnant waterway, the oil behavior is affected by the absence of current in the waterway but is not affected by the velocity of the advancing skimming systems.

⁵⁸ Centipoise

⁵⁹ Hoover Offshore Oil Pipeline System

⁶⁰ Florida Power and Light Company



- Stagnant, in which the water is not generally moving (e.g., a small pond or creek with virtually no current).

This section provides the environmental conditions (specifically currents and winds) used for each of these representative river conditions.

E.1.3.1 Open-flow/Tidal River

The project team used the Delaware River as representative of an open-flow or tidal river condition. A boundary-fitted coordinate hydrodynamic model (BFHYDRO)⁶¹ generated current data for the Delaware River, which produces applicable hydrodynamic data sets suitable for use in the SIMAP model system. The Delaware River and bay system is predominantly well-mixed vertically, so the project team applied BFHYDRO in the two-dimensional mode. Freshwater inflow and tidal forcing drive the model to predict the currents over tidal cycles and time. The river is tidal all the way up to the dam at Trenton, NJ, which was the upper boundary of the hydrodynamic model. The project team used the USGS stream flow gauging station above the dam (<http://waterdata.usgs.gov/>) to estimate annual mean river flow. The six major harmonic constituents (M2, S2, N2, K1, O1, and P1) derived from Tides and Currents time series (Tides & Currents Pro for Windows, Version 3.0. Nautical Software Inc.) applied the tidal forcing functions.

For this river condition, the project team assumed winds to be 5 knots with randomized direction over time with a 3% surface wind drift and 0-degree angle⁶².

E.1.3.2 Confined-flow/Downstream River

The project team used St. Johns River, FL as a representative of a confined-flow river condition. It is a long river with flow rate varying along the river. The project team used a 2-dimensional hydrodynamic model⁶³ to derive currents for the Upper St. Johns River using the considerable USGS flow rate data along the river. The model ensures that mass and momentum are conserved in calculating velocities throughout the river (i.e., flow will speed up in constrictions and slowdown in wide areas, rather than be uniform throughout). The project team used Astor USGS gage (209 km upriver) to form a base flow rate. The Sanford Plant is in the pure freshwater section of the river, and under no tidal influence. Therefore, the currents that the project team used covers Lake George to Lake Monroe and includes the Sanford Plant, without tidal component.

For this river condition, the project team assumed winds to be 5 knots with randomized direction over time with a 1% surface wind drift and 0-degree angle.

⁶¹ RPS's proprietary model; Spaulding (1984), Muin (1993), Muin and Spaulding (1997a, b), Spaulding et al. (1999), and Sankaranarayanan and Spaulding (2003) describe in details the hydrodynamic model's governing equations and validation. The boundary-fitted grid is a mesh of quadrilateral cells of varying size and included angles, which are capable of handling variable geometry and flow regimes. The boundary-fitted coordinate system in BFHYDRO uses general curvilinear coordinates to map the model grid to the shoreline of the water body being studied. It also allows enormous versatility in grid sizing so that many of the smaller features may be resolved, along with the larger features, without being penalized by an excessive grid size (number of cells).

⁶² Surface wind drift of oil was observed in the field to be 1–6% (average 3–4%) of wind speed, in some direction 0–30 degrees to the right (in the northern hemisphere) of the down-wind direction (ASCE 1996). In restricted or near shore waters with little fetch, or when wind changes directions within a few hours of the time of drift, the angle tends to be near zero. In open waters, the angle develops over time (hours) to be 20–30° to the right of the downwind direction.

⁶³ RPS's proprietary model.



E.1.3.3 Open and Confined Stagnant/Slow Quiescent

For the open and confined stagnant or slow quiescent river conditions, no currents were applied to drive the oil. The project team assumed that light winds (5 knots with randomized direction over time) would move oil around gridded domains representing either a larger, open area (e.g., lake) or smaller, confined area (e.g., stagnant pond). Following a series of sensitivity tests to determine the movement of oil with 72 hours, a 5 nm by 5 nm grid was used for open stagnant water conditions and a 5 nm by 1 nm grid was used for confined stagnant scenarios.

E.1.4 Shoreline Oil Retention

For each of the river conditions (i.e., waterway type-flow condition combination), the project team assigned a representative habitat type. The “gravel” shoreline is representative of shorelines that are generally narrow and absorb less oil (gravel, as well as other rocky, pebbled, and artificial shorelines). The “wetland” shoreline is representative of shorelines that are generally wider, contain vegetation and/or mud and can absorb more oil (various types of wetland, as well as mud flats).

Retention of oil on a shoreline depends on the shoreline type, width and angle of the shoreline, viscosity of the oil, the tidal amplitude, and the wave energy. In the NRDAM/CME oil spill model (French et al. 1996), shore holding capacity was based on observations from the *Amoco Cadiz* spill in France and the *Exxon Valdez* spill in Alaska (based on Gundlach 1987; Reed et al. 1989) and later work summarized in French et al. (1996). The project team used this approach and data (Table E-2) in the present study.

Table E-2. Shore widths and oil holding capacities by inland and coastal shore type in the U.S. east coast.

Type of Shore	Width (m)	Oil Holding Capacity (mm)		
		Oil Viscosity < 30 cSt	Oil Viscosity 30–2,000 cSt	Oil Viscosity > 2,000 cSt
Rocky Shore	2.0	1.0	2.0	2.0
Gravel Beach	3.0	2.0	9.0	15.0
Sand Beach	10.0	4.0	17.0	25.0
Mud Flat (Seaward)	10.0	6.0	6.0	10.0
Mud Flat (Landward)	140.0	3.0	30.0	40.0
Wetland (Saltmarsh)	140.0	6.0	30.0	40.0
Intertidal Macroalgal	2.0	1.0	2.0	2.0
Human-Altered Shore	0.1	1.0	2.0	2.0

E.2 Apportionment of Wetland and Gravel Shorelines for Flow Scenarios

For each of the two Waterway Types with Flow conditions—Open-Flow and Confined-Flow, there are two formulae for calculating PRO_h , PE_h , and TH_h . One formula is for gravel shorelines and one formula is for wetland Shorelines. Table E-3 shows the two general categories of shoreline types referenced in the Inland ERSP Calculator.

Most inland waterways contain a variety of shoreline types and, in the event of an oil spill, floating oil would move with current (and wind) and adhere to these different shorelines. Once the oil adheres to the



Inland ERSP Operational Environment Calculator Design Document

shorelines, it generally stops moving downstream and is no longer available for mechanical recovery. In other words, it is no longer “recoverable oil.”

For the Inland ERSP Calculator, there is a default combination of the computations for oil behavior based on wetland category (w) or gravel category (g) shorelines that will be determined by the ratio of wetland to shorelines. The default values for this ratio are:

- For Open-Flow waterways: 75% gravel category and 25% wetland category; and
- For Confined-Flow waterways: 25% gravel category and 75% wetland category.

These ratios do not apply to Stagnant waterways. For Open-Stagnant, the project team assumes that the entire waterway is gravel category. For Confined-Stagnant, the project team assumes that the entire waterway is wetland category. These assumptions are based on expert judgment after a review of representative waterways. Table E-3 shows the shoreline types that are included in each of the two categories.

Table E-3. Shoreline categories for oil behavior module and inland ERSP calculator (wetland shorelines, top and gravel shorelines, bottom)⁶⁴

Wetland Category Shorelines	
ESI Classification Description	ESI Number
Exposed Tidal Flat	7
Sheltered Tidal Flat	9A
Sheltered, Vegetated Low Banks	9B
Salt- and Brackish-Water Marsh	10A
Freshwater Marsh	10B
Swamp	10C
Gravel Category Shorelines	
ESI Classification Description	ESI Number
Exposed Rocky	1A
Exposed, Solid Man-Made Structures	1B
Exposed Wave-Cut Platforms in Bedrock	2A
Exposed Scarps and Steep Slopes in Clay	2B
Fine- to Medium-Grained Sand Beach	3A
Scarps and Steep Slopes in Sand	3B
Coarse-Grained Sand Beach	4
Mixed Sand and Gravel Beach	5
Gravel Beach	6A
Riprap	6B
Sheltered Rocky Shore	8A
Sheltered, Solid Man-Made Structures	8B

⁶⁴ Environmental Sensitivity Index (ESI) classifications from: NOAA 2013.



E.2.1 Application of Shoreline Apportionment to Percent Recoverable Oil (PRO_h)

For all equations in this section, PRO_h is the Percent Recoverable Oil at hour, h . The scenarios are denoted by [Oil, Vol, Water], meaning that SIMAP yields resultant PRO_h values as a function of Oil Type, Oil Spill Volume, and Waterway Type.

Applying the default values for Open-Flow waterways, Equation 26 computes the PRO_h :

$$PRO_h[Oil, Vol, OpenFlow] = (0.25 \times PRO_h[Oil, Vol, w]) + (0.75 \times PRO_h[Oil, Vol, g])$$

Equation 26

Applying the default values for Confined-Flow waterways, Equation 27 computes the PRO_h :

$$PRO_h[Oil, Vol, ConfFlow] = (0.75 \times PRO_h[Oil, Vol, w]) + (0.25 \times PRO_h[Oil, Vol, g])$$

Equation 27

For the Customization Module, the user is able to select different percentages/ratios of wetland category or gravel category.

The PRO_h are then computed as in Equation 28:

$$PRO_h[Oil, Vol, Water] = (P_w \times PRO_h[Oil, Vol, w]) + (P_g \times PRO_h[Oil, Vol, g])$$

Equation 28

where: P_w = proportion wetland category shorelines, and P_g = proportion gravel category shorelines in a Flow waterway.

E.2.2 Application of Shoreline Apportionment to Percent Emulsion (PE_h)

For all of the equations in this section, PE_h = Percent Emulsion at hour, h . “Percent Emulsion” is used in the Offshore ERSP Calculator as this is the term that most users would likely find familiar. However, in order for the equation to be computed, the percent would need to be converted to a decimal. The scenarios are denoted by [Oil, Vol, Water] meaning the Oil Type, Spill Volume, and Waterway Type.

Applying the default values for Open-Flow waterways, Equation 29 computes the PE_h :

$$PE_h[Oil, Vol, OpenFlow] = (0.25 \times PE_h[Oil, Vol, w]) + (0.75 \times PE_h[Oil, Vol, g])$$

Equation 29

Applying the default values for Confined-Flow waterways, Equation 30 computes the PE_h :

$$PE_h[Oil, Vol, ConfFlow] = (0.75 \times PE_h[Oil, Vol, w]) + (0.25 \times PE_h[Oil, Vol, g])$$



Equation 30

For the Customization Module, the user is able to select different percentages/ratios of wetland category or gravel category. For this the PE_h is the computed by Equation 31:

$$PE_h[Oil, Vol, Water] = (P_w \times PE_h[Oil, Vol, w]) + (P_g \times PE_h[Oil, Vol, g])$$

Equation 31

Where P_w = proportion wetland category shorelines, and P_g = proportion gravel category shorelines in a Flow waterway.

E.2.3 Application of Shoreline Apportionment to Thickness (TH_h)

For all of the equations in this section, TH_h = Oil Thickness [inches] at hour, h . The scenarios are denoted by [Oil, Vol, Water] meaning the Oil Type, Spill Volume, and Waterway Type.

Applying the default values for Open-Flow waterways, Equation 32 computes the TH_h :

$$TH_h[Oil, Vol, OpenFlow] = (0.25 \times TH_h[Oil, Vol, w]) + (0.75 \times TH_h[Oil, Vol, g])$$

Equation 32

Applying the default values for Confined-Flow waterways, Equation 33 computes the TH_h :

$$TH_h[Oil, Vol, ConfFlow] = (0.75 \times TH_h[Oil, Vol, w]) + (0.25 \times TH_h[Oil, Vol, g])$$

Equation 33

For the Customization Module, the user is able to select different percentages/ratios of wetland category or gravel category. For this application, the TH_h is computed by Equation 34:

$$TH_h[Oil, Vol, Water] = (P_w \times TH_h[Oil, Vol, w]) + (P_g \times TH_h[Oil, Vol, g])$$

Equation 34

E.3 Oil Behavior Module Equations for Percent Recoverable Oil (PRO)

The Oil Behavior Module Equations for Percent Recoverable Oil (PRO) are based on the scenario specifications:

- Oil Group (I–IV)—represented as *I*, *II*, *III*, or *IV*.
- Volume Category (AMPD, MMPD, WCD)—where AMPD = 50 bbl (or spills of tens to hundreds of bbl); MMPD = 2,500 bbl (or spills of thousands to ten-thousands of bbl); and WCD = 155,000 bbl (or spills of hundred-thousand or more bbl)—represented as *A*, *M*, or *W*.
- Waterway Type (Configuration-Flow Type)-Shoreline Type:
 - Open-Flow-Wetland—represented as *ofw*;
 - Open-Flow-Gravel—represented as *ogw*;



- Open-Stagnant-Gravel—represented as *osg*;
- Confined-Flow-Wetland—represented as *cfw*;
- Confined-Flow-Gravel—represented as *cfg*;
- Confined-Stagnant-Wetland—represented as *csw*.

The proportion of wetland to gravel for the Open-Flow and Confined-Flow waterways are set at a pre-determined default value with options to set the proportion in the Customization Module. As stated earlier, the pre-determined default values are: 75% gravel category and 25% wetland category for open-flow waterways and 25% gravel category and 75% wetland category for Confined-Flow waterways

Surface oil volume represents the volume of oil available for recovery, as determined by the SIMAP modeling. The project team converts this volume to percentage of original spill volume, so that it can be applied to a variety of oil spill scenarios.

Equation 35 provides the format for the equations for the Inland ERSP Calculator to provide the percent of spilled oil still available for recovery (PRO_h) at each hour:

$$PRO_h [oil, volume, waterway] = a \times e^{bh}$$

Equation 35

where: PRO_h = percent recoverable oil at hour, h (hours into spill). The variables a and b are SIMAP output values based on the oil spill scenario (Oil Type-Volume Category-Waterway Type-Shore Type).

E.3.1 Time of No Recoverable Oil ($h(TH_0)$)

For a number of the oil spill scenarios, the oil becomes so thin on the water surface within the first 72 hours (three days) that there is no longer any *recoverable* oil. At this point, the PRO_h is 0%. This does not mean that there is no longer any oil in the environment. Some of the oil will evaporate, disperse, or dissolve. The oil may also strand on or adhere to shorelines, including on wetland vegetation, where the responders may potentially remove with shoreline cleanup measures. However, it is no longer on the water surface at a sufficient thickness for mechanical recovery.

The time at which SIMAP determines PRO_h to be 0% is designated as " $h(TH_0)$." If there is still oil on the water surface at the end of 72 hours (i.e., the end of the Inland ERSP Calculator timeframe), $h(TH_0)$ is set to 73. Table E-4 shows the $h(TH_0)$ values by scenario. The project team assumed that the minimum thickness for recoverable oil was 10 microns, which is the equivalent of 0.0004 inches.



Inland ERSP Operational Environment Calculator Design Document

Table E-4. Time of no recoverable oil ($h(TH_0)$).

Scenario	Time of No Recoverable Oil ($h(TH_0)$) ⁶⁵
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	2
GROUP I-AMPD-CONFINED-STAGNANT-GRAVEL	2
GROUP I-AMPD-OPEN-FLOW-GRAVEL	2
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	2
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	38
GROUP II-AMPD-CONFINED-STAGNANT-GRAVEL	21
GROUP II-AMPD-OPEN-FLOW-GRAVEL	11
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	73
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	38
GROUP III-AMPD-CONFINED-STAGNANT-GRAVEL	22
GROUP III-AMPD-OPEN-FLOW-GRAVEL	2
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	73
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	73
GROUP III-MMPD-CONFINED-STAGNANT-GRAVEL	23
GROUP III-MMPD-OPEN-FLOW-GRAVEL	73
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	73
GROUP III-WCD-CONFINED-FLOW-GRAVEL	73
GROUP III-WCD-CONFINED-STAGNANT-GRAVEL	73
GROUP III-WCD-OPEN-FLOW-GRAVEL	73
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	73
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	62
GROUP II-MMPD-CONFINED-STAGNANT-GRAVEL	23
GROUP II-MMPD-OPEN-FLOW-GRAVEL	70
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	73
GROUP II-WCD-CONFINED-FLOW-GRAVEL	73
GROUP II-WCD-CONFINED-STAGNANT-GRAVEL	73
GROUP II-WCD-OPEN-FLOW-GRAVEL	73
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	73
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	39
GROUP I-MMPD-CONFINED-STAGNANT-GRAVEL	23
GROUP I-MMPD-OPEN-FLOW-GRAVEL	11
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	73
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	39
GROUP IV-AMPD-CONFINED-STAGNANT-GRAVEL	23
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	11
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	73
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	73
GROUP IV-MMPD-CONFINED-STAGNANT-GRAVEL	23

⁶⁵ Hours after spill at which time there is no recoverable oil on the water surface. If designated as “73,” there is still recoverable oil after 72 hours. The assumption is that oil needs to be at least 10 μm (0.000393701 inches) to be recovered with skimmers.



Inland ERSP Operational Environment Calculator Design Document

Table E-4. Time of no recoverable oil (h(TH0)) (Cont'd).

Scenario	Time of No Recoverable Oil (h(TH0)) ⁶⁶
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	73
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	73
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	73
GROUP IV-WCD-CONFINED-STAGNANT-GRAVEL	73
GROUP IV-WCD-OPEN-FLOW-GRAVEL	73
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	73
GROUP I-WCD-CONFINED-FLOW-GRAVEL	73
GROUP I-WCD-CONFINED-STAGNANT-GRAVEL	73
GROUP I-WCD-OPEN-FLOW-GRAVEL	73
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	73
GROUP I-AMPD-CONFINED-FLOW-WETLAND	2
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	2
GROUP I-AMPD-OPEN-FLOW-WETLAND	2
GROUP I-AMPD-OPEN-STAGNANT-WETLAND	2
GROUP II-AMPD-CONFINED-FLOW-WETLAND	38
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	21
GROUP II-AMPD-OPEN-FLOW-WETLAND	11
GROUP II-AMPD-OPEN-STAGNANT-WETLAND	73
GROUP III-AMPD-CONFINED-FLOW-WETLAND	39
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	22
GROUP III-AMPD-OPEN-FLOW-WETLAND	11
GROUP III-AMPD-OPEN-STAGNANT-WETLAND	73
GROUP III-MMPD-CONFINED-FLOW-WETLAND	41
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	23
GROUP III-MMPD-OPEN-FLOW-WETLAND	11
GROUP III-MMPD-OPEN-STAGNANT-WETLAND	73
GROUP III-WCD-CONFINED-FLOW-WETLAND	73
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	73
GROUP III-WCD-OPEN-FLOW-WETLAND	70
GROUP III-WCD-OPEN-STAGNANT-WETLAND	73
GROUP II-MMPD-CONFINED-FLOW-WETLAND	42
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	23
GROUP II-MMPD-OPEN-FLOW-WETLAND	11
GROUP II-MMPD-OPEN-STAGNANT-WETLAND	73
GROUP II-WCD-CONFINED-FLOW-WETLAND	73
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	73
GROUP II-WCD-OPEN-FLOW-WETLAND	70
GROUP II-WCD-OPEN-STAGNANT-WETLAND	73

⁶⁶ Hours after spill at which time there is no recoverable oil on the water surface. If designated as “73,” there is still recoverable oil after 72 hours. The assumption is that oil needs to be at least 10 µm (0.000393701 inches) to be recovered with skimmers.



Inland ERSP Operational Environment Calculator Design Document

Table E-4. Time of no recoverable oil ($h(TH_0)$) (Cont'd).

Scenario	Time of No Recoverable Oil ($h(TH_0)$) ⁶⁷
GROUP I-MMPD-CONFINED-FLOW-WETLAND	39
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	23
GROUP I-MMPD-OPEN-FLOW-WETLAND	11
GROUP I-MMPD-OPEN-STAGNANT-WETLAND	73
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	39
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	23
GROUP IV-AMPD-OPEN-FLOW-WETLAND	11
GROUP IV-AMPD-OPEN-STAGNANT-WETLAND	73
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	40
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	23
GROUP IV-MMPD-OPEN-FLOW-WETLAND	11
GROUP IV-MMPD-OPEN-STAGNANT-WETLAND	73
GROUP IV-WCD-CONFINED-FLOW-WETLAND	73
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	73
GROUP IV-WCD-OPEN-FLOW-WETLAND	70
GROUP IV-WCD-OPEN-STAGNANT-WETLAND	73
GROUP I-WCD-CONFINED-FLOW-WETLAND	39
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	73
GROUP I-WCD-OPEN-FLOW-WETLAND	11
GROUP I-WCD-OPEN-STAGNANT-WETLAND	73

E.3.2 Average Percent Recoverable Oil (PRO_h) for Days 1–3

As an alternative to applying the equations for PRO_h , developers can apply the average percent recoverable oil for Day 1–3 (PRO_{day1} , PRO_{day2} , PRO_{day3}) (see Table E-5). Developers may apply these values in the Customization Module. The below PRO_h numbers are SIMAP output values based on Oil Type, Oil Spill Volume, and Waterway Type.

Table E-5. Average percent recoverable oil for Days 1–3.

Waterway-Shoreline Type	Oil	Volume	Average Percent Recoverable Oil		
			Day 1 PRO_{day1}	Day 2 PRO_{day2}	Day 3 PRO_{day3}
Open-Flow-Wetland	I	AMPD	0.84%	0.00%	0.00%
Open-Flow-Gravel	I	AMPD	0.84%	0.00%	0.00%
Open-Flow-Wetland	I	MMPD	10.32%	0.00%	0.00%
Open-Flow-Gravel	I	MMPD	10.32%	0.00%	0.00%
Open-Flow-Wetland	I	WCD	18.99%	0.00%	0.00%
Open-Flow-Gravel	I	WCD	19.93%	1.30%	1.05%
Open-Flow-Wetland	II	AMPD	26.46%	0.00%	0.00%
Open-Flow-Gravel	II	AMPD	26.46%	0.00%	0.00%

⁶⁷ Hours after spill at which time there is no recoverable oil on the water surface. If designated as “73,” there is still recoverable oil after 72 hours. The assumption is that oil needs to be at least 10 μ m (0.000393701 inches) to be recovered with skimmers.



Inland ERSP Operational Environment Calculator Design Document

Table E-5. Average percent recoverable oil for Days 1–3 (Cont'd).

Waterway-Shoreline Type	Oil	Volume	Average Percent Recoverable Oil		
			Day 1 <i>PRO_{day1}</i>	Day 2 <i>PRO_{day2}</i>	Day 3 <i>PRO_{day3}</i>
Open-Flow-Wetland	II	MMPD	36.43%	0.00%	0.00%
Open-Flow-Gravel	II	MMPD	58.08%	16.62%	8.07%
Open-Flow-Wetland	II	WCD	70.56%	40.63%	15.89%
Open-Flow-Gravel	II	WCD	19.93%	1.30%	1.05%
Open-Flow-Wetland	III	AMPD	28.42%	0.00%	0.00%
Open-Flow-Gravel	III	AMPD	0.84%	0.00%	0.00%
Open-Flow-Wetland	III	MMPD	33.93%	0.00%	0.00%
Open-Flow-Gravel	III	MMPD	54.56%	30.55%	21.66%
Open-Flow-Wetland	III	WCD	49.57%	17.40%	8.02%
Open-Flow-Gravel	III	WCD	72.13%	56.51%	50.63%
Open-Flow-Wetland	IV	AMPD	44.54%	0.00%	0.00%
Open-Flow-Gravel	IV	AMPD	44.54%	0.00%	0.00%
Open-Flow-Wetland	IV	MMPD	44.97%	0.00%	0.00%
Open-Flow-Gravel	IV	MMPD	77.95%	56.12%	42.18%
Open-Flow-Wetland	IV	WCD	65.99%	33.89%	17.49%
Open-Flow-Gravel	IV	WCD	97.04%	93.12%	90.17%
Open-Stagnant-Gravel	I	AMPD	0.84%	0.00%	0.00%
Open-Stagnant-Gravel	I	MMPD	11.23%	1.63%	1.55%
Open-Stagnant-Gravel	I	WCD	20.13%	1.67%	1.61%
Open-Stagnant-Gravel	II	AMPD	43.24%	29.61%	27.88%
Open-Stagnant-Gravel	II	MMPD	64.07%	33.03%	28.90%
Open-Stagnant-Gravel	II	WCD	79.21%	57.15%	42.50%
Open-Stagnant-Gravel	III	AMPD	55.54%	48.22%	45.71%
Open-Stagnant-Gravel	III	MMPD	64.58%	49.36%	46.45%
Open-Stagnant-Gravel	III	WCD	72.41%	57.17%	51.78%
Open-Stagnant-Gravel	IV	AMPD	95.28%	90.94%	86.12%
Open-Stagnant-Gravel	IV	MMPD	96.35%	91.45%	87.47%
Open-Stagnant-Gravel	IV	WCD	97.46%	93.98%	91.82%
Confined-Flow-Wetland	I	AMPD	0.84%	0.00%	0.00%
Confined-Flow-Gravel	I	AMPD	0.84%	0.00%	0.00%
Confined-Flow-Wetland	I	MMPD	11.21%	0.43%	0.00%
Confined-Flow-Gravel	I	MMPD	11.21%	0.43%	0.00%
Confined-Flow-Wetland	I	WCD	20.13%	0.45%	0.00%
Confined-Flow-Gravel	I	WCD	20.13%	1.23%	0.80%
Confined-Flow-Wetland	II	AMPD	43.19%	8.02%	0.00%
Confined-Flow-Gravel	II	AMPD	43.19%	7.86%	0.00%
Confined-Flow-Wetland	II	MMPD	63.71%	9.77%	0.00%
Confined-Flow-Gravel	II	MMPD	63.73%	13.92%	0.42%
Confined-Flow-Wetland	II	WCD	79.07%	38.70%	2.27%



Inland ERSP Operational Environment Calculator Design Document

Table E-5. Average percent recoverable oil for Days 1–3 (Cont'd).

Waterway-Shoreline Type	Oil	Volume	Average Percent Recoverable Oil		
			Day 1 <i>PRO_{day1}</i>	Day 2 <i>PRO_{day2}</i>	Day 3 <i>PRO_{day3}</i>
Confined-Flow-Gravel	II	WCD	79.21%	56.95%	41.74%
Confined-Flow-Wetland	III	AMPD	55.40%	12.89%	0.00%
Confined-Flow-Gravel	III	AMPD	55.40%	12.95%	0.00%
Confined-Flow-Wetland	III	MMPD	64.44%	13.49%	0.00%
Confined-Flow-Gravel	III	MMPD	64.47%	28.90%	12.34%
Confined-Flow-Wetland	III	WCD	72.26%	27.76%	3.68%
Confined-Flow-Gravel	III	WCD	72.40%	56.87%	51.17%
Confined-Flow-Wetland	IV	AMPD	95.05%	24.37%	0.00%
Confined-Flow-Gravel	IV	AMPD	95.05%	24.01%	0.00%
Confined-Flow-Wetland	IV	MMPD	96.08%	24.29%	0.00%
Confined-Flow-Gravel	IV	MMPD	96.10%	55.47%	27.72%
Confined-Flow-Wetland	IV	WCD	97.14%	39.68%	5.02%
Confined-Flow-Gravel	IV	WCD	97.44%	93.44%	91.01%
Confined-Stagnant-Wetland	I	AMPD	0.84%	0.00%	0.00%
Confined-Stagnant-Wetland	I	MMPD	10.69%	0.00%	0.00%
Confined-Stagnant-Wetland	I	WCD	19.53%	0.00%	0.00%
Confined-Stagnant-Wetland	II	AMPD	33.55%	0.00%	0.00%
Confined-Stagnant-Wetland	II	MMPD	49.45%	0.00%	0.00%
Confined-Stagnant-Wetland	II	WCD	78.06%	53.26%	29.28%
Confined-Stagnant-Wetland	III	AMPD	39.70%	0.00%	0.00%
Confined-Stagnant-Wetland	III	MMPD	47.08%	0.00%	0.00%
Confined-Stagnant-Wetland	III	WCD	68.99%	46.40%	35.38%
Confined-Stagnant-Wetland	IV	AMPD	65.46%	0.00%	0.00%
Confined-Stagnant-Wetland	IV	MMPD	66.77%	0.00%	0.00%
Confined-Stagnant-Wetland	IV	WCD	92.76%	76.55%	64.35%



Inland ERSP Operational Environment Calculator Design Document

E.3.3 Percent Recoverable Oil (PRO_h) by Hour

Table E-6 through Table E-8 provide the hourly values for the Percent Recoverable Oil (PRO_h) by oil spill scenario (Oil Type-Volume Category-Waterway Type-Shore Type) for each of the three days.

Table E-6. Hourly values for Percent Recoverable Oil, PRO_h , for Day 1.

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.377	0.365	0.340	0.327	0.327	0.315	0.315	0.315	0.315	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.289
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.377	0.365	0.340	0.327	0.327	0.315	0.315	0.315	0.315	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.289
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.377	0.352	0.340	0.327	0.315	0.302	0.264	0.201	0.138	0.088	0.050	0.025	0.013	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.365	0.315	0.201	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.365	0.315	0.201	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.377	0.365	0.340	0.327	0.327	0.315	0.315	0.315	0.315	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.742	0.705	0.692	0.679	0.642	0.616	0.604	0.579	0.566	0.554	0.541	0.528	0.516	0.516	0.516	0.503	0.503	0.503	0.503	0.503	0.503	0.503	0.491	0.491	0.491	0.491	0.478
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.742	0.705	0.692	0.679	0.642	0.616	0.604	0.579	0.566	0.554	0.541	0.528	0.516	0.516	0.516	0.503	0.503	0.503	0.503	0.503	0.503	0.503	0.491	0.491	0.491	0.491	0.478
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.742	0.705	0.692	0.679	0.642	0.616	0.604	0.579	0.566	0.541	0.541	0.528	0.516	0.516	0.503	0.478	0.415	0.327	0.239	0.151	0.076	0.038	0.013	0.013	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.742	0.705	0.692	0.679	0.642	0.616	0.604	0.579	0.566	0.554	0.528	0.465	0.302	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.742	0.705	0.692	0.679	0.642	0.616	0.604	0.579	0.566	0.554	0.541	0.528	0.516	0.516	0.516	0.503	0.503	0.503	0.503	0.503	0.503	0.503	0.503	0.503	0.491	0.491	0.491



Inland ERSP Operational Environment Calculator Design Document

Table E-6. Hourly values for Percent Recoverable Oil, PROh, for Day 1 (Cont'd).

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.658	0.647	0.638	0.628	0.619	0.610	0.601	0.593	0.585	0.578	0.571	0.564	0.558	0.551	0.545	0.540	0.533	0.524	0.512
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.658	0.647	0.638	0.628	0.619	0.610	0.601	0.593	0.585	0.578	0.571	0.564	0.558	0.551	0.545	0.537	0.531	0.523	0.508
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.657	0.646	0.636	0.623	0.612	0.601	0.589	0.555	0.480	0.384	0.271	0.164	0.086	0.036	0.014	0.004	0.001	0.000	0.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.658	0.647	0.615	0.555	0.536	0.445	0.438	0.431	0.425	0.411	0.376	0.371	0.365	0.361	0.357	0.352	0.349	0.345	0.340
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.658	0.647	0.615	0.547	0.341	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.658	0.647	0.638	0.628	0.619	0.610	0.601	0.593	0.585	0.578	0.571	0.564	0.558	0.552	0.546	0.541	0.536	0.531	0.527
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.710	0.696	0.685	0.677	0.670	0.664	0.658	0.653	0.648	0.643	0.639	0.634	0.630	0.626	0.622	0.618	0.614	0.611
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.710	0.696	0.685	0.677	0.670	0.664	0.658	0.653	0.648	0.643	0.639	0.634	0.630	0.625	0.621	0.616	0.607	0.587
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.709	0.694	0.681	0.671	0.663	0.650	0.612	0.594	0.568	0.563	0.559	0.556	0.552	0.548	0.545	0.541	0.538	0.535
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.709	0.695	0.684	0.673	0.666	0.660	0.654	0.649	0.643	0.638	0.634	0.629	0.625	0.621	0.617	0.613	0.609	0.605
GROUP III-WCD-OPEN-FLOW-WETLAND	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.709	0.677	0.609	0.514	0.248	0.245	0.243	0.240	0.236	0.220	0.208	0.204	0.202	0.200	0.198	0.196	0.194	0.193
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.710	0.696	0.686	0.677	0.670	0.664	0.658	0.653	0.648	0.643	0.639	0.635	0.630	0.626	0.623	0.619	0.615	0.611
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.974	0.944	0.915	0.887	0.817	0.784	0.761	0.741	0.721	0.700	0.680	0.659	0.639	0.618	0.598	0.578	0.559	0.540	0.521	0.503	0.486	0.470	0.454	0.439	0.422	0.407	0.391
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.974	0.944	0.915	0.887	0.817	0.784	0.761	0.741	0.721	0.700	0.680	0.659	0.639	0.618	0.598	0.578	0.559	0.540	0.521	0.503	0.486	0.470	0.454	0.439	0.423	0.406	0.385
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.974	0.944	0.915	0.888	0.818	0.784	0.760	0.740	0.720	0.699	0.679	0.659	0.638	0.615	0.588	0.542	0.468	0.371	0.259	0.157	0.079	0.036	0.013	0.005	0.002	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.974	0.944	0.915	0.888	0.818	0.783	0.760	0.740	0.720	0.700	0.665	0.630	0.603	0.560	0.541	0.522	0.503	0.467	0.447	0.430	0.415	0.400	0.356	0.238	0.229	0.221	0.213
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.974	0.944	0.915	0.888	0.818	0.783	0.760	0.740	0.720	0.700	0.652	0.578	0.365	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.974	0.944	0.915	0.886	0.817	0.782	0.760	0.740	0.720	0.701	0.681	0.661	0.641	0.621	0.601	0.582	0.563	0.544	0.526	0.509	0.492	0.476	0.460	0.446	0.432	0.419	0.407
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.992	0.983	0.973	0.963	0.923	0.888	0.859	0.835	0.817	0.803	0.792	0.782	0.773	0.765	0.757	0.749	0.741	0.734	0.726	0.719	0.711	0.703	0.696	0.688	0.680	0.673	0.665
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.992	0.983	0.973	0.963	0.923	0.888	0.859	0.835	0.817	0.803	0.792	0.782	0.773	0.765	0.757	0.749	0.741	0.734	0.726	0.719	0.711	0.703	0.694	0.685	0.674	0.663	0.647
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.992	0.983	0.973	0.963	0.924	0.888	0.859	0.836	0.817	0.802	0.790	0.779	0.767	0.758	0.743	0.732	0.718	0.710	0.703	0.694	0.687	0.679	0.672	0.664	0.656	0.649	0.641



Inland ERSP Operational Environment Calculator Design Document

Table E-6. Hourly values for Percent Recoverable Oil, PROh, for Day 1 (Cont'd).

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.035	0.031	0.028	0.024	0.022	0.021	0.020	0.018	0.017	0.016	0.015	0.015	0.015	0.014	0.014	0.014	0.014
GROUP II-WCD-OPEN-FLOW-WETLAND	0.992	0.983	0.973	0.963	0.923	0.888	0.859	0.836	0.817	0.801	0.764	0.720	0.695	0.635	0.628	0.620	0.613	0.579	0.558	0.550	0.544	0.538	0.531	0.521	0.515	0.508	0.500
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.992	0.983	0.973	0.963	0.924	0.888	0.859	0.836	0.817	0.803	0.792	0.782	0.773	0.765	0.757	0.749	0.741	0.734	0.726	0.718	0.711	0.703	0.696	0.688	0.680	0.673	0.665
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.870	0.712	0.553	0.404	0.085	0.033	0.026	0.022	0.020	0.018	0.018	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.016	0.016
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.870	0.712	0.553	0.404	0.085	0.033	0.026	0.022	0.020	0.018	0.018	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.016	0.016
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.870	0.712	0.554	0.404	0.085	0.033	0.026	0.022	0.020	0.018	0.018	0.017	0.017	0.017	0.017	0.015	0.014	0.011	0.008	0.005	0.003	0.002	0.001	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.870	0.712	0.553	0.405	0.086	0.033	0.026	0.022	0.020	0.018	0.017	0.015	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.870	0.712	0.553	0.405	0.086	0.033	0.026	0.022	0.020	0.018	0.017	0.015	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.870	0.712	0.553	0.404	0.086	0.033	0.026	0.022	0.020	0.018	0.018	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.956	0.956	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.931	0.931	0.931	0.918	0.893
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.956	0.956	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.931	0.931	0.931	0.918	0.893
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.956	0.944	0.944	0.944	0.918	0.868	0.767	0.616	0.440	0.277	0.151	0.076	0.038	0.013	0.013	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.931	0.843	0.541	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.931	0.843	0.541	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.956	0.956	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.931	0.931	0.931	0.931	0.931
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.969	0.966	0.964	0.961	0.959	0.957	0.955	0.953	0.952	0.950	0.949	0.947	0.946	0.943	0.940	0.936	0.924	0.906
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.969	0.966	0.964	0.961	0.959	0.957	0.955	0.953	0.952	0.950	0.949	0.947	0.946	0.943	0.940	0.936	0.924	0.903
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.969	0.965	0.962	0.957	0.953	0.939	0.882	0.778	0.655	0.479	0.303	0.168	0.088	0.042	0.013	0.004	0.000	0.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.967	0.934	0.845	0.821	0.671	0.670	0.668	0.667	0.655	0.594	0.590	0.588	0.587	0.586	0.585	0.584	0.582	0.582
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.967	0.934	0.842	0.527	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.969	0.966	0.964	0.961	0.959	0.957	0.955	0.953	0.952	0.950	0.949	0.948	0.946	0.945	0.944	0.943	0.942	0.940



Inland ERSP Operational Environment Calculator Design Document

Table E-6. Hourly values for Percent Recoverable Oil, PRO_h , for Day 1 (Cont'd).

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.978	0.976	0.974	0.973	0.972	0.970	0.969	0.968	0.967	0.965	0.964	0.963	0.962	0.961	0.960	0.958	0.956	0.955
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.978	0.976	0.974	0.973	0.972	0.970	0.969	0.968	0.967	0.965	0.964	0.961	0.959	0.957	0.953	0.950	0.938	0.915
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.978	0.974	0.973	0.968	0.963	0.953	0.906	0.885	0.859	0.857	0.855	0.854	0.853	0.852	0.851	0.850	0.849	0.847
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.977	0.975	0.972	0.967	0.966	0.965	0.963	0.961	0.959	0.958	0.957	0.955	0.954	0.953	0.952	0.951	0.949	0.948
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.975	0.947	0.845	0.756	0.429	0.428	0.427	0.427	0.425	0.386	0.363	0.358	0.358	0.357	0.356	0.355	0.354	0.354
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.978	0.976	0.974	0.973	0.972	0.970	0.969	0.968	0.967	0.965	0.964	0.963	0.962	0.961	0.960	0.959	0.958	0.956
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.036	0.032	0.030	0.028	0.026	0.024	0.023	0.022	0.021	0.020	0.019	0.019	0.018	0.018	0.018	0.018	0.017
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.036	0.032	0.030	0.028	0.026	0.024	0.023	0.022	0.021	0.020	0.019	0.019	0.018	0.018	0.018	0.017	0.017
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.036	0.032	0.030	0.027	0.025	0.023	0.019	0.014	0.010	0.006	0.003	0.001	0.001	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.035	0.031	0.028	0.024	0.022	0.021	0.020	0.018	0.017	0.016	0.015	0.015	0.015	0.014	0.014	0.014	0.014
GROUP I-WCD-OPEN-FLOW-WETLAND	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.035	0.029	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.036	0.032	0.030	0.028	0.026	0.024	0.023	0.022	0.021	0.020	0.019	0.019	0.018	0.018	0.018	0.018	0.017

Table E-7. Hourly values for Percent Recoverable Oil, PRO_h , for Day 2.

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-7. Hourly values for Percent Recoverable Oil, PRO_h , for Day 2. (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.277	0.264	0.252	0.239	0.214	0.189	0.151	0.113	0.088	0.050	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.277	0.264	0.252	0.239	0.226	0.189	0.164	0.126	0.088	0.050	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.453	0.415	0.390	0.377	0.352	0.315	0.252	0.201	0.151	0.088	0.063	0.038	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.453	0.415	0.390	0.377	0.352	0.315	0.264	0.201	0.138	0.088	0.050	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.497	0.482	0.469	0.457	0.440	0.415	0.382	0.354	0.319	0.291	0.267	0.246	0.229	0.221	0.212	0.203	0.196	0.191	0.185	0.181	0.178	0.177	0.174	0.172
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.484	0.450	0.420	0.395	0.364	0.327	0.263	0.208	0.143	0.090	0.049	0.027	0.012	0.004	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.334	0.320	0.318	0.317	0.314	0.309	0.308	0.307	0.306	0.305	0.304	0.302	0.302	0.301	0.300	0.300	0.299	0.299	0.298	0.298	0.298	0.298	0.297	0.297
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.523	0.519	0.516	0.513	0.510	0.506	0.502	0.500	0.497	0.493	0.490	0.489	0.487	0.486	0.485	0.484	0.483	0.483	0.482	0.481	0.481	0.480	0.480	0.479
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.607	0.603	0.599	0.596	0.592	0.589	0.585	0.582	0.578	0.575	0.572	0.569	0.566	0.563	0.560	0.557	0.554	0.551	0.549	0.546	0.543	0.541	0.538	0.536
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.570	0.549	0.530	0.511	0.479	0.445	0.408	0.369	0.324	0.281	0.252	0.224	0.203	0.178	0.164	0.153	0.143	0.136	0.133	0.130	0.127	0.122	0.117	0.115



Inland ERSP Operational Environment Calculator Design Document

Table E-7. Hourly values for Percent Recoverable Oil, PRO_h , for Day 2. (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.532	0.529	0.524	0.517	0.511	0.504	0.487	0.484	0.482	0.479	0.477	0.474	0.471	0.469	0.467	0.463	0.450	0.431	0.418	0.403	0.397	0.393	0.390	0.386
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.601	0.598	0.595	0.591	0.588	0.584	0.581	0.578	0.575	0.572	0.569	0.566	0.563	0.559	0.556	0.553	0.551	0.548	0.545	0.543	0.540	0.538	0.536	0.533
GROUP III-WCD-OPEN-FLOW-WETLAND	0.191	0.189	0.187	0.185	0.183	0.181	0.180	0.179	0.178	0.177	0.176	0.175	0.173	0.172	0.169	0.168	0.167	0.166	0.165	0.165	0.164	0.163	0.162	0.162
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.608	0.604	0.601	0.597	0.594	0.590	0.587	0.584	0.581	0.578	0.575	0.571	0.569	0.566	0.563	0.560	0.558	0.555	0.553	0.550	0.548	0.546	0.543	0.541
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.368	0.344	0.327	0.309	0.282	0.255	0.232	0.205	0.176	0.147	0.116	0.097	0.082	0.070	0.057	0.046	0.038	0.034	0.030	0.028	0.026	0.024	0.024	0.023
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.360	0.331	0.305	0.286	0.262	0.227	0.190	0.145	0.098	0.064	0.038	0.021	0.011	0.006	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.206	0.192	0.187	0.183	0.178	0.175	0.172	0.169	0.167	0.165	0.164	0.162	0.160	0.159	0.157	0.157	0.156	0.156	0.155	0.155	0.154	0.154	0.154	0.153
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.396	0.385	0.376	0.367	0.359	0.352	0.345	0.338	0.333	0.328	0.324	0.321	0.318	0.315	0.313	0.311	0.310	0.308	0.307	0.306	0.305	0.304	0.304	0.303
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.657	0.649	0.641	0.634	0.626	0.618	0.610	0.602	0.594	0.587	0.579	0.572	0.564	0.557	0.550	0.542	0.535	0.528	0.521	0.514	0.507	0.500	0.494	0.487
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.627	0.606	0.587	0.570	0.543	0.519	0.493	0.463	0.438	0.403	0.377	0.358	0.346	0.334	0.315	0.301	0.291	0.280	0.267	0.259	0.249	0.237	0.223	0.205
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.633	0.625	0.616	0.606	0.593	0.585	0.578	0.571	0.564	0.556	0.549	0.542	0.534	0.528	0.520	0.512	0.494	0.484	0.469	0.461	0.454	0.445	0.437	0.428
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.014	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
GROUP II-WCD-OPEN-FLOW-WETLAND	0.489	0.470	0.463	0.457	0.449	0.443	0.436	0.431	0.425	0.419	0.413	0.407	0.402	0.396	0.388	0.383	0.378	0.372	0.367	0.362	0.357	0.353	0.348	0.343
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.657	0.649	0.642	0.634	0.626	0.619	0.611	0.603	0.596	0.588	0.581	0.573	0.566	0.559	0.552	0.545	0.538	0.531	0.524	0.518	0.511	0.504	0.498	0.492
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.015	0.014	0.013	0.013	0.012	0.010	0.009	0.007	0.005	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.015	0.014	0.013	0.013	0.012	0.011	0.009	0.007	0.005	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-7. Hourly values for Percent Recoverable Oil, PRO_h , for Day 2. (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.017	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.868	0.805	0.755	0.717	0.679	0.604	0.465	0.340	0.239	0.138	0.076	0.038	0.025	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.843	0.805	0.755	0.717	0.667	0.579	0.478	0.365	0.264	0.176	0.101	0.050	0.038	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.931	0.931	0.931	0.918	0.918	0.918	0.918	0.918	0.918	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.893	0.893	0.893	0.893	0.893
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.880	0.853	0.830	0.817	0.776	0.741	0.712	0.673	0.622	0.581	0.534	0.495	0.472	0.461	0.446	0.418	0.407	0.392	0.381	0.375	0.371	0.363	0.359	0.354
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.862	0.796	0.744	0.716	0.663	0.584	0.462	0.364	0.263	0.170	0.103	0.059	0.030	0.010	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.581	0.569	0.568	0.568	0.567	0.565	0.565	0.564	0.564	0.563	0.563	0.560	0.560	0.558	0.557	0.557	0.556	0.556	0.556	0.555	0.555	0.555	0.554	0.554
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.936	0.935	0.933	0.931	0.926	0.924	0.922	0.917	0.915	0.914	0.914	0.911	0.909	0.909	0.908	0.908	0.907	0.906	0.906	0.905	0.904	0.904	0.903	0.903
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.953	0.952	0.950	0.948	0.947	0.945	0.943	0.941	0.938	0.937	0.935	0.933	0.932	0.931	0.929	0.928	0.927	0.926	0.925	0.924	0.923	0.922	0.921	0.920
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.883	0.846	0.807	0.783	0.752	0.680	0.616	0.560	0.492	0.418	0.336	0.297	0.262	0.234	0.213	0.193	0.174	0.161	0.153	0.145	0.136	0.130	0.128	0.125
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.846	0.845	0.841	0.838	0.834	0.819	0.799	0.789	0.788	0.788	0.787	0.785	0.784	0.783	0.782	0.774	0.757	0.718	0.699	0.671	0.665	0.663	0.660	0.657
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.946	0.945	0.944	0.943	0.942	0.940	0.939	0.938	0.937	0.936	0.935	0.933	0.930	0.928	0.926	0.925	0.924	0.923	0.921	0.920	0.919	0.919	0.917	0.916
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.351	0.349	0.348	0.347	0.342	0.342	0.341	0.341	0.340	0.340	0.340	0.338	0.337	0.336	0.336	0.335	0.335	0.335	0.334	0.334	0.334	0.333	0.333	0.333
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.955	0.953	0.952	0.951	0.949	0.948	0.947	0.945	0.944	0.942	0.941	0.939	0.938	0.937	0.936	0.935	0.934	0.933	0.932	0.931	0.930	0.929	0.929	0.928
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.017	0.017	0.016	0.016	0.016	0.015	0.015	0.014	0.014	0.013	0.012	0.012	0.011	0.011	0.011	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.016	0.015	0.014	0.013	0.012	0.010	0.009	0.007	0.005	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-7. Hourly values for Percent Recoverable Oil, PRO_h , for Day 2. (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.014	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.016	0.016	0.016

Table E-8. Hourly values for Percent Recoverable Oil, PRO_h , for Day 3.

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.277	0.252	0.214	0.164
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-8. Hourly values for Percent Recoverable Oil, PRO_h , for Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.465	0.465	0.465	0.440	0.403	0.340	0.264
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.169	0.166	0.162	0.154	0.148	0.141	0.132	0.125	0.122	0.120	0.119	0.116	0.114	0.113	0.112	0.110	0.108	0.107	0.106	0.106	0.105	0.104	0.103	0.102
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.297	0.297	0.297	0.296	0.296	0.296	0.296	0.296	0.296	0.292	0.243	0.240	0.215	0.205	0.204	0.153	0.153	0.149	0.145	0.138	0.123	0.094	0.091	0.091
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.479	0.479	0.478	0.478	0.478	0.477	0.477	0.477	0.476	0.476	0.476	0.476	0.475	0.475	0.475	0.475	0.475	0.473	0.472	0.464	0.453	0.423	0.391	0.372
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.534	0.531	0.529	0.527	0.524	0.522	0.520	0.518	0.516	0.515	0.513	0.511	0.510	0.508	0.506	0.505	0.504	0.502	0.501	0.500	0.498	0.497	0.496	0.495
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.110	0.103	0.098	0.072	0.053	0.044	0.035	0.030	0.028	0.026	0.025	0.024	0.023	0.022	0.022	0.022	0.021	0.021	0.020	0.018	0.017	0.017	0.017	0.016
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.383	0.382	0.380	0.375	0.368	0.363	0.362	0.360	0.358	0.357	0.356	0.354	0.353	0.352	0.351	0.350	0.349	0.348	0.347	0.344	0.335	0.324	0.323	0.321
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.531	0.528	0.526	0.524	0.522	0.520	0.519	0.517	0.514	0.511	0.508	0.507	0.505	0.502	0.499	0.498	0.496	0.494	0.493	0.491	0.490	0.487	0.486	0.485
GROUP III-WCD-OPEN-FLOW-WETLAND	0.161	0.160	0.160	0.159	0.158	0.158	0.157	0.157	0.156	0.155	0.119	0.058	0.049	0.042	0.038	0.010	0.009	0.007	0.006	0.004	0.001	0.000	0.000	0.000
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.539	0.537	0.535	0.533	0.531	0.529	0.527	0.525	0.523	0.521	0.520	0.518	0.516	0.515	0.513	0.512	0.510	0.509	0.507	0.505	0.503	0.502	0.501	0.499
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.022	0.020	0.018	0.014	0.011	0.007	0.005	0.003	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.152	0.150	0.109	0.080	0.070	0.065	0.062	0.008	0.008	0.006	0.003	0.003	0.002	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-8. Hourly values for Percent Recoverable Oil, PRO_h , for Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.302	0.302	0.302	0.301	0.301	0.301	0.300	0.300	0.300	0.300	0.300	0.299	0.299	0.299	0.299	0.299	0.299	0.298	0.297	0.291	0.280	0.258	0.218	0.191
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.480	0.473	0.467	0.460	0.453	0.448	0.442	0.437	0.431	0.426	0.421	0.416	0.412	0.407	0.403	0.398	0.394	0.390	0.386	0.382	0.378	0.375	0.371	0.368
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.182	0.143	0.060	0.045	0.030	0.021	0.013	0.010	0.008	0.007	0.005	0.005	0.004	0.003	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.421	0.409	0.328	0.324	0.320	0.316	0.312	0.308	0.304	0.300	0.295	0.292	0.288	0.284	0.281	0.278	0.275	0.272	0.269	0.266	0.256	0.239	0.211	0.181
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.012	0.011	0.011	0.011	0.010	0.010	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008
GROUP II-WCD-OPEN-FLOW-WETLAND	0.338	0.334	0.330	0.325	0.321	0.317	0.313	0.309	0.304	0.295	0.203	0.116	0.100	0.085	0.076	0.014	0.011	0.009	0.007	0.005	0.001	0.000	0.000	0.000
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.486	0.479	0.473	0.468	0.462	0.456	0.451	0.445	0.440	0.435	0.430	0.425	0.420	0.416	0.411	0.407	0.403	0.398	0.393	0.388	0.384	0.380	0.377	0.373
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.015	0.014	0.012	0.009
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.881	0.881	0.843	0.793	0.679	0.516
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.352	0.348	0.343	0.335	0.326	0.319	0.301	0.287	0.281	0.272	0.267	0.264	0.261	0.259	0.255	0.253	0.249	0.247	0.245	0.241	0.240	0.239	0.237	0.236
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-8. Hourly values for Percent Recoverable Oil, PRO_h , for Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP IV-MMPD- CONFINED-STAGNANT- WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN- FLOW-GRAVEL	0.553	0.553	0.553	0.552	0.552	0.552	0.551	0.551	0.550	0.541	0.456	0.448	0.439	0.422	0.422	0.328	0.328	0.319	0.313	0.285	0.243	0.205	0.203	0.203
GROUP IV-MMPD-OPEN- FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN- STAGNANT-GRAVEL	0.902	0.902	0.901	0.900	0.900	0.899	0.899	0.898	0.897	0.897	0.896	0.896	0.895	0.895	0.894	0.894	0.892	0.892	0.890	0.873	0.834	0.782	0.750	0.716
GROUP IV-WCD-CONFINED- FLOW-GRAVEL	0.919	0.919	0.918	0.917	0.916	0.915	0.914	0.913	0.912	0.912	0.911	0.910	0.909	0.909	0.908	0.907	0.907	0.906	0.905	0.905	0.904	0.903	0.903	0.902
GROUP IV-WCD-CONFINED- FLOW-WETLAND	0.120	0.119	0.114	0.100	0.084	0.071	0.058	0.054	0.049	0.046	0.042	0.040	0.036	0.034	0.032	0.030	0.026	0.025	0.024	0.021	0.020	0.020	0.020	0.019
GROUP IV-WCD-CONFINED- STAGNANT-WETLAND	0.656	0.654	0.653	0.653	0.652	0.652	0.651	0.651	0.649	0.647	0.645	0.642	0.640	0.639	0.639	0.639	0.638	0.638	0.637	0.636	0.634	0.634	0.633	0.633
GROUP IV-WCD-OPEN- FLOW-GRAVEL	0.916	0.915	0.914	0.913	0.913	0.912	0.911	0.911	0.909	0.907	0.905	0.905	0.904	0.902	0.897	0.896	0.893	0.892	0.891	0.891	0.889	0.887	0.886	0.885
GROUP IV-WCD-OPEN- FLOW-WETLAND	0.333	0.332	0.332	0.332	0.332	0.331	0.331	0.331	0.331	0.330	0.239	0.167	0.146	0.132	0.125	0.023	0.019	0.013	0.009	0.008	0.005	0.000	0.000	0.000
GROUP IV-WCD-OPEN- STAGNANT-GRAVEL	0.927	0.926	0.926	0.925	0.924	0.923	0.923	0.922	0.921	0.921	0.920	0.919	0.919	0.918	0.917	0.917	0.916	0.914	0.913	0.911	0.911	0.910	0.909	0.907
GROUP I-WCD-CONFINED- FLOW-GRAVEL	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
GROUP I-WCD-CONFINED- FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED- STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW- GRAVEL	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.012	0.011	0.011	0.011	0.010	0.010	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008
GROUP I-WCD-OPEN-FLOW- WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN- STAGNANT-GRAVEL	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.015	0.015	0.014	0.014	0.014



E.3.4 Default Values for Percent Recoverable Oil (PRO) for Days 1–3

Developers can use the values in Table E-9 to apply the default apportioned values (by default percentage of wetland category and gravel category shorelines) for Flow waterways. For Open-Stagnant waterways, the project team assumes the shorelines to be gravel category and for Confined-Stagnant waterways, the project team assumes shorelines to be wetland category.⁶⁸

Table E-9. Default percent recoverable oil for Days 1–3.

Scenario	Average Recoverable Oil (in Decimal Fraction)		
	Day 1 <i>PRO_{day1}</i>	Day 2 <i>PRO_{day2}</i>	Day 3 <i>PRO_{day3}</i>
GROUP I-AMPD-CONFINED-FLOW	0.004194	0.000000	0.000000
GROUP I-AMPD-CONFINED-STAGNANT	0.008389	0.000000	0.000000
GROUP I-AMPD-OPEN-FLOW	0.004194	0.000000	0.000000
GROUP I-AMPD-OPEN-STAGNANT	0.008389	0.000000	0.000000
GROUP II-AMPD-CONFINED-FLOW	0.215948	0.039904	0.000000
GROUP II-AMPD-CONFINED-STAGNANT	0.335459	0.000000	0.000000
GROUP II-AMPD-OPEN-FLOW	0.132319	0.000000	0.000000
GROUP II-AMPD-OPEN-STAGNANT	0.432363	0.296125	0.278825
GROUP III-AMPD-CONFINED-FLOW	0.276989	0.064540	0.000000
GROUP III-AMPD-CONFINED-STAGNANT	0.396963	0.000000	0.000000
GROUP III-AMPD-OPEN-FLOW	0.108094	0.000000	0.000000
GROUP III-AMPD-OPEN-STAGNANT	0.555378	0.482200	0.457033
GROUP III-MMPD-CONFINED-FLOW	0.322232	0.086723	0.015429
GROUP III-MMPD-CONFINED-STAGNANT	0.470756	0.000000	0.000000
GROUP III-MMPD-OPEN-FLOW	0.247008	0.114552	0.081228
GROUP III-MMPD-OPEN-STAGNANT	0.645767	0.493633	0.464500
GROUP III-WCD-CONFINED-FLOW	0.361466	0.175196	0.077778
GROUP III-WCD-CONFINED-STAGNANT	0.689856	0.463971	0.353808
GROUP III-WCD-OPEN-FLOW	0.332433	0.233674	0.199884
GROUP III-WCD-OPEN-STAGNANT	0.724093	0.571654	0.517821
GROUP II-MMPD-CONFINED-FLOW	0.318573	0.054048	0.000530
GROUP II-MMPD-CONFINED-STAGNANT	0.494452	0.000000	0.000000
GROUP II-MMPD-OPEN-FLOW	0.263338	0.062322	0.030267
GROUP II-MMPD-OPEN-STAGNANT	0.640685	0.330329	0.289025
GROUP II-WCD-CONFINED-FLOW	0.395536	0.216318	0.060676
GROUP II-WCD-CONFINED-STAGNANT	0.780615	0.532592	0.292771
GROUP II-WCD-OPEN-FLOW	0.162924	0.055643	0.023786
GROUP II-WCD-OPEN-STAGNANT	0.792100	0.571542	0.424988
GROUP I-MMPD-CONFINED-FLOW	0.056072	0.002166	0.000000
GROUP I-MMPD-CONFINED-STAGNANT	0.106889	0.000000	0.000000
GROUP I-MMPD-OPEN-FLOW	0.051606	0.000000	0.000000

⁶⁸ For Open-Flow waterways: 75% gravel category and 25% wetland category; and for Confined-Flow waterways: 25% gravel category and 75% wetland category.



Table E-9. Default percent recoverable oil for Days 1–3 (Cont’d).

Scenario	Average Recoverable Oil (in Decimal Fraction)		
	Day 1 <i>PRO</i> _{day1}	Day 2 <i>PRO</i> _{day2}	Day 3 <i>PRO</i> _{day3}
GROUP I-MMPD-OPEN-STAGNANT	0.112322	0.016333	0.015483
GROUP IV-AMPD-CONFINED-FLOW	0.475239	0.121404	0.000000
GROUP IV-AMPD-CONFINED-STAGNANT	0.654619	0.000000	0.000000
GROUP IV-AMPD-OPEN-FLOW	0.222706	0.000000	0.000000
GROUP IV-AMPD-OPEN-STAGNANT	0.952807	0.909396	0.861217
GROUP IV-MMPD-CONFINED-FLOW	0.480435	0.160426	0.034644
GROUP IV-MMPD-CONFINED-STAGNANT	0.667681	0.000000	0.000000
GROUP IV-MMPD-OPEN-FLOW	0.348506	0.210445	0.158178
GROUP IV-MMPD-OPEN-STAGNANT	0.963467	0.914483	0.874717
GROUP IV-WCD-CONFINED-FLOW	0.486057	0.265620	0.132602
GROUP IV-WCD-CONFINED-STAGNANT	0.927600	0.765450	0.643492
GROUP IV-WCD-OPEN-FLOW	0.446372	0.391551	0.360015
GROUP IV-WCD-OPEN-STAGNANT	0.974552	0.939800	0.918217
GROUP I-WCD-CONFINED-FLOW	0.100629	0.003202	0.000997
GROUP I-WCD-CONFINED-STAGNANT	0.195333	0.000000	0.000000
GROUP I-WCD-OPEN-FLOW	0.098471	0.004856	0.003925
GROUP I-WCD-OPEN-STAGNANT	0.201330	0.016679	0.016050

E.4 Percent Emulsion (PE)

Of the recoverable oil computed in the above formulae, a certain portion will be emulsified. This situation will only pertain to Group III and Group IV oils. *Group I and Group II oils do not generally emulsify. Therefore, this computation does not apply to those oils.*

The modeling for the development of the Oil Behavior Module included emulsification (mousse formation). In order to calculate the Percent Emulsion (PE_h), at hour, h , Equation 36 computes the difference in overall volume of recoverable oil on the water surface at a sufficient thickness of greater than 10µm (0.0004 inch):

$$PE_h = \frac{Vol_{mousse} - Vol_{oil}}{Vol_{mousse}}$$

Equation 36

where: PE_h = Percent Emulsion at hour, h ; Vol_{mousse} = volume of emulsified oil (mousse); and Vol_{oil} = volume of oil (without water).

Again, the formulae are identified by the Waterway Type (Configuration-Flow)-Shoreline Type. There would be no recoverable oil for some of the scenarios within the 72-hour time frame of the Inland ERSP Calculator. The time at which PRO_h becomes 0% is designated as “ $h(TH_0)$.” If there is still oil on the water surface at the end of 72 hours (i.e., the end of the Inland ERSP Calculator timeframe), $h(TH_0)$ is set to 73. Table E-4 shows the $h(TH_0)$ values by scenario.



Inland ERSP Operational Environment Calculator Design Document

E.4.1 Percent Emulsion (PE) by Hour

Table E-10 through Table E-12 provide the hourly values for Percent Emulsion (PE) by oil spill scenario (Oil Type-Volume Category-Waterway Type-Shore Type). Group I and II oils do not generally emulsify. For these oils, the PE would always be 0.000.

Table E-10. Percent emulsion by hour, PE_h , on Day 1.

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.182	0.727	0.191	0.143	0.179	0.215	0.241	0.259	0.300	0.328	0.339	0.359	0.385	0.394	0.412	0.423	0.429	0.444	0.452	0.473	0.480	0.487	0.494	0.493
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.182	0.727	0.191	0.143	0.179	0.215	0.241	0.259	0.300	0.328	0.339	0.359	0.385	0.394	0.412	0.423	0.429	0.444	0.452	0.473	0.480	0.487	0.494	0.493
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.182	0.727	0.191	0.143	0.179	0.215	0.246	0.259	0.288	0.317	0.328	0.355	0.367	0.400	0.491	0.424	0.429	0.500	0.500	0.667	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.018	0.073	0.109	0.143	0.179	0.211	0.241	0.263	0.302	0.314	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.018	0.073	0.109	0.143	0.179	0.211	0.241	0.263	0.302	0.314	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.182	0.727	0.191	0.143	0.179	0.215	0.241	0.259	0.300	0.328	0.339	0.349	0.385	0.394	0.412	0.423	0.437	0.444	0.452	0.460	0.474	0.494	0.500	0.563



Inland ERSP Operational Environment Calculator Design Document

Table E-10. Percent emulsion by hour, PE_h , on Day 1 (Cont'd).

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.119	0.571	0.991	0.138	0.173	0.256	0.236	0.263	0.289	0.312	0.334	0.354	0.373	0.390	0.450	0.419	0.433	0.445	0.456	0.466	0.476	0.485	0.493
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.119	0.571	0.991	0.138	0.173	0.256	0.236	0.263	0.289	0.312	0.334	0.354	0.373	0.390	0.450	0.419	0.433	0.445	0.456	0.466	0.476	0.485	0.493
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.119	0.571	0.988	0.137	0.173	0.251	0.235	0.263	0.289	0.312	0.334	0.354	0.372	0.389	0.449	0.419	0.432	0.443	0.455	0.464	0.500	1.000	1.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.119	0.571	0.988	0.137	0.173	0.250	0.235	0.263	0.288	0.312	0.334	0.354	0.372	0.389	0.447	0.419	0.432	0.444	0.456	0.466	0.476	0.484	0.493
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.119	0.571	0.988	0.137	0.173	0.250	0.235	0.263	0.288	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.119	0.571	0.988	0.137	0.173	0.251	0.235	0.263	0.289	0.312	0.334	0.353	0.372	0.389	0.446	0.419	0.432	0.444	0.456	0.466	0.476	0.484	0.493
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.463	0.889	0.128	0.164	0.198	0.228	0.257	0.283	0.368	0.329	0.349	0.368	0.385	0.411	0.416	0.429	0.442	0.453	0.464
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.463	0.889	0.128	0.164	0.198	0.228	0.257	0.283	0.368	0.329	0.349	0.368	0.385	0.411	0.416	0.429	0.442	0.453	0.464
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.461	0.886	0.128	0.164	0.197	0.228	0.256	0.282	0.361	0.328	0.349	0.367	0.385	0.470	0.415	0.429	0.441	0.453	0.464
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.461	0.886	0.128	0.164	0.197	0.228	0.256	0.282	0.361	0.328	0.349	0.367	0.385	0.470	0.415	0.429	0.441	0.453	0.464
GROUP III-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.461	0.886	0.128	0.164	0.197	0.228	0.256	0.282	0.362	0.328	0.349	0.367	0.385	0.470	0.415	0.429	0.441	0.453	0.464
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.461	0.886	0.128	0.164	0.197	0.228	0.256	0.282	0.361	0.328	0.349	0.367	0.385	0.470	0.415	0.429	0.441	0.453	0.464
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-10. Percent emulsion by hour, PE_h , on Day 1 (Cont'd).

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.125	0.250	0.370	0.488	0.833	0.115	0.135	0.174	0.192	0.200	0.217	0.225	0.242	0.250	0.257	0.265	0.272	0.272	0.279	0.279	0.279	0.279	0.289	0.289	0.289	0.291	0.297
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.125	0.250	0.370	0.488	0.833	0.115	0.135	0.174	0.192	0.200	0.217	0.225	0.242	0.250	0.257	0.265	0.272	0.272	0.279	0.279	0.279	0.279	0.289	0.289	0.289	0.291	0.297
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.125	0.250	0.370	0.488	0.833	0.115	0.135	0.174	0.192	0.200	0.217	0.235	0.242	0.242	0.263	0.266	0.274	0.269	0.278	0.293	0.294	0.333	0.250	0.500	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.013	0.025	0.037	0.049	0.083	0.115	0.135	0.174	0.192	0.200	0.213	0.221	0.246	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.013	0.025	0.037	0.049	0.083	0.115	0.135	0.174	0.192	0.200	0.213	0.221	0.246	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.125	0.250	0.370	0.488	0.833	0.115	0.135	0.174	0.192	0.200	0.217	0.225	0.242	0.250	0.257	0.265	0.272	0.272	0.279	0.279	0.279	0.279	0.286	0.295	0.295	0.295	0.295
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.167	0.186	0.237	0.218	0.233	0.247	0.250	0.257	0.264	0.269	0.274	0.278	0.289	0.284	0.286	0.288	0.291	0.292	0.293	0.294
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.167	0.186	0.237	0.218	0.233	0.247	0.250	0.257	0.264	0.269	0.274	0.278	0.289	0.284	0.286	0.288	0.291	0.292	0.293	0.294
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.166	0.186	0.234	0.218	0.230	0.244	0.249	0.257	0.263	0.269	0.274	0.278	0.289	0.283	0.286	0.289	0.284	0.286	1.000	1.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.231	0.245	0.250	0.257	0.263	0.269	0.274	0.278	0.288	0.284	0.286	0.288	0.290	0.292	0.293	0.294
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.230	0.246	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.166	0.186	0.234	0.218	0.232	0.246	0.249	0.257	0.263	0.269	0.274	0.277	0.289	0.284	0.286	0.288	0.290	0.292	0.293	0.294



Inland ERSP Operational Environment Calculator Design Document

Table E-10. Percent emulsion by hour, PE_h , on Day 1 (Cont'd).

Scenario	Hour on Day 1																											
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.167	0.187	0.235	0.218	0.233	0.247	0.250	0.257	0.264	0.269	0.274	0.278	0.289	0.284	0.286	0.288	0.290	0.292	0.293	0.294	
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.167	0.187	0.235	0.218	0.233	0.247	0.250	0.257	0.264	0.269	0.274	0.278	0.289	0.284	0.286	0.288	0.290	0.292	0.293	0.294	
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.230	0.245	0.249	0.257	0.263	0.269	0.274	0.277	0.288	0.284	0.286	0.288	0.290	0.292	0.293	0.294	
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.230	0.245	0.249	0.257	0.263	0.269	0.274	0.277	0.288	0.284	0.286	0.288	0.290	0.292	0.293	0.294	
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.230	0.245	0.249	0.257	0.263	0.269	0.274	0.277	0.288	0.284	0.286	0.288	0.290	0.292	0.293	0.294	
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.230	0.245	0.249	0.257	0.263	0.269	0.274	0.277	0.288	0.284	0.286	0.288	0.290	0.292	0.293	0.294	
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Table E-11. Percent emulsion by hour, PE_h , on Day 2.

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-11. Percent emulsion by hour, PE_h , on Day 2 (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.568	0.522	0.523	0.531	0.541	0.528	0.546	0.529	0.539	0.588	0.500	0.500	0.667	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.568	0.522	0.523	0.524	0.525	0.528	0.533	0.529	0.560	0.563	0.556	0.600	0.667	0.667	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.513	0.513	0.519	0.524	0.531	0.531	0.536	0.536	0.553	0.553	0.558	0.558	0.558	0.563	0.563	0.563	0.568	0.568	0.568	0.573	0.573	0.573	0.573	0.573
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.530	0.571	0.514	0.519	0.525	0.530	0.535	0.539	0.543	0.546	0.549	0.553	0.555	0.558	0.560	0.563	0.564	0.566	0.568	0.570	0.578	0.572	0.574	0.574
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.510	0.570	0.513	0.519	0.525	0.530	0.534	0.539	0.542	0.546	0.549	0.551	0.559	0.556	0.556	0.556	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.500	0.570	0.514	0.519	0.524	0.530	0.534	0.539	0.542	0.546	0.549	0.552	0.555	0.558	0.560	0.562	0.564	0.566	0.568	0.569	0.579	0.572	0.573	0.575
GROUP III-MMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.500	0.569	0.513	0.519	0.524	0.530	0.534	0.538	0.542	0.546	0.549	0.552	0.555	0.558	0.560	0.562	0.564	0.566	0.568	0.569	0.571	0.572	0.573	0.575
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.474	0.483	0.498	0.499	0.555	0.512	0.518	0.524	0.529	0.533	0.538	0.542	0.545	0.549	0.552	0.555	0.557	0.560	0.562	0.564	0.566	0.568	0.569	0.576
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.474	0.483	0.498	0.499	0.555	0.512	0.518	0.524	0.529	0.533	0.538	0.542	0.545	0.549	0.552	0.555	0.557	0.560	0.562	0.564	0.566	0.568	0.569	0.576
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.473	0.482	0.496	0.498	0.552	0.512	0.518	0.523	0.528	0.533	0.537	0.541	0.545	0.548	0.551	0.554	0.557	0.559	0.562	0.564	0.566	0.567	0.569	0.575



Inland ERSP Operational Environment Calculator Design Document

Table E-11. Percent emulsion by hour, PE_h , on Day 2 (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.473	0.482	0.496	0.498	0.553	0.512	0.518	0.523	0.528	0.533	0.537	0.541	0.545	0.548	0.552	0.554	0.557	0.559	0.562	0.564	0.566	0.567	0.569	0.575
GROUP III-WCD-OPEN-FLOW-WETLAND	0.473	0.482	0.496	0.498	0.553	0.512	0.518	0.523	0.528	0.533	0.537	0.541	0.545	0.548	0.552	0.554	0.557	0.559	0.562	0.564	0.566	0.567	0.569	0.575
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.473	0.482	0.496	0.498	0.553	0.512	0.518	0.523	0.528	0.533	0.537	0.541	0.545	0.548	0.551	0.554	0.557	0.559	0.562	0.564	0.566	0.567	0.569	0.575
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-11. Percent emulsion by hour, PE_h , on Day 2 (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.296	0.297	0.323	0.349	0.290	0.294	0.319	0.290	0.296	0.313	0.333	0.400	0.333	0.500	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.321	0.297	0.294	0.349	0.293	0.330	0.296	0.395	0.276	0.300	0.333	0.333	0.250	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.295	0.295	0.295	0.298	0.298	0.298	0.298	0.298	0.291	0.310	0.310	0.310	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.339	0.339	0.339	0.339	0.339
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.299	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.298	0.300	0.330	0.318	0.293	0.286	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.299	0.298	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-MMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-11. Percent emulsion by hour, PE_h , on Day 2 (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table E-12. Percent emulsion by hour, PE_h , on Day 3.

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000



Inland ERSP Operational Environment Calculator Design Document

Table E-12. Percent emulsion by hour, PE_h , on Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.573	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.589	0.589	0.580	0.588	0.590	0.585	0.580
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.575	0.577	0.577	0.578	0.580	0.580	0.585	0.581	0.581	0.583	0.583	0.583	0.583	0.583	0.584	0.584	0.585	0.585	0.585	0.586	0.585	0.586	0.586	0.586
GROUP III-MMPD-CONFINED-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.576	0.577	0.577	0.578	0.579	0.580	0.583	0.581	0.581	0.582	0.583	0.583	0.583	0.584	0.584	0.585	0.585	0.585	0.585	0.585	0.586	0.586	0.586	0.586
GROUP III-MMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.576	0.577	0.578	0.578	0.579	0.580	0.583	0.581	0.582	0.582	0.583	0.583	0.584	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586	0.586	0.586	0.586
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.582	0.582	0.582	0.583	0.583	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.581	0.582	0.583	0.583	0.583	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.581	0.582	0.582	0.583	0.583	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.582	0.582	0.583	0.583	0.583	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586
GROUP III-WCD-OPEN-FLOW-WETLAND	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.582	0.582	0.582	0.583	0.583	0.584	0.584	0.584	0.585	0.585	1.000	1.000	1.000
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.581	0.582	0.582	0.583	0.583	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-12. Percent emulsion by hour, PE_h , on Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.339	0.339	0.339	0.339	0.339	0.339	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.369	0.293	0.321	0.300	0.299	0.293
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.300	0.300	0.300	0.320	0.300	0.320	0.320	0.300	0.300	0.310	0.320	0.300	0.300	0.320	0.300	0.330	0.310	0.300	0.320	0.340	0.300	0.300	0.300	0.300
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000



Inland ERSP Operational Environment Calculator Design Document

Table E-12. Percent emulsion by hour, PE_h , on Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP IV-MMPD- CONFINED-STAGNANT- WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-OPEN- FLOW-GRAVEL	0.300	0.300	0.300	0.310	0.300	0.310	0.300	0.300	0.300	0.310	0.320	0.310	0.300	0.310	0.300	0.320	0.300	0.300	0.320	0.310	0.330	0.320	0.340	0.310
GROUP IV-MMPD-OPEN- FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-OPEN- STAGNANT-GRAVEL	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.310	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.310	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED- FLOW-GRAVEL	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED- FLOW-WETLAND	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED- STAGNANT-WETLAND	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-OPEN- FLOW-GRAVEL	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-OPEN- FLOW-WETLAND	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	1.000	1.000	1.000
GROUP IV-WCD-OPEN- STAGNANT-GRAVEL	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP I-WCD-CONFINED- FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED- FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED- STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW- GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW- WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN- STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



E.4.2 Average Percent Emulsion (PE) for Days 1–3

As an alternative to applying the hourly values for PE_h , developers may apply the average Percent Emulsion for Day 1–3 (PE_{day1} , PE_{day2} , PE_{day3}) (see Table E-8). If Oil Type = Group I or Group II, PE is set to equal 0%. If designated as “N/A,” there is no longer recoverable oil on the water surface at the start of this day. (The term N/A is used rather than 0%, because 0% would imply that there is no emulsification of the remaining oil rather than that there is no recoverable oil on the water surface.) The ER (Effective Recovery) computation will result in $ER = 0$ because the thickness (TH) will be 0.0000, which is less than the minimum thickness of 10 microns (the equivalent of 0.0004 inches) (as in Table E-13).

Table E-13. Average percent emulsion for Days 1–3.

Waterway-Shoreline Type	Oil	Volume	Average Percent Emulsion in Decimal Fraction ⁶⁹		
			Day 1 PE_{day1}	Day 2 PE_{day2}	Day 3 PE_{day3}
Open-Flow-Wetland	I	AMPD	0.0000	0.0000	0.0000
Open-Flow-Gravel	I	AMPD	0.0000	0.0000	0.0000
Open-Flow-Wetland	I	MMPD	0.0000	0.0000	0.0000
Open-Flow-Gravel	I	MMPD	0.0000	0.0000	0.0000
Open-Flow-Wetland	I	WCD	0.0000	0.0000	0.0000
Open-Flow-Gravel	I	WCD	0.0000	0.0000	0.0000
Open-Flow-Wetland	II	AMPD	0.0000	0.0000	0.0000
Open-Flow-Gravel	II	AMPD	0.0000	0.0000	0.0000
Open-Flow-Wetland	II	MMPD	0.0000	0.0000	0.0000
Open-Flow-Gravel	II	MMPD	0.0000	0.0000	0.0000
Open-Flow-Wetland	II	WCD	0.0000	0.0000	0.0000
Open-Flow-Gravel	II	WCD	0.0000	0.0000	0.0000
Open-Flow-Wetland	III	AMPD	0.1425	N/A	N/A
Open-Flow-Gravel	III	AMPD	0.1425	N/A	N/A
Open-Flow-Wetland	III	MMPD	0.1130	N/A	N/A
Open-Flow-Gravel	III	MMPD	0.2705	0.5479	0.5824
Open-Flow-Wetland	III	WCD	0.2121	0.5357	0.5075
Open-Flow-Gravel	III	WCD	0.2121	0.5357	0.5807
Open-Flow-Wetland	IV	AMPD	0.1309	N/A	N/A
Open-Flow-Gravel	IV	AMPD	0.1309	N/A	N/A
Open-Flow-Wetland	IV	MMPD	0.1307	N/A	N/A
Open-Flow-Gravel	IV	MMPD	0.2073	0.2986	0.3000
Open-Flow-Wetland	IV	WCD	0.2073	0.2986	0.3000
Open-Flow-Gravel	IV	WCD	0.2073	0.2986	0.3000
Open-Stagnant-Gravel	III	AMPD	0.2935	0.5516	0.5799
Open-Stagnant-Gravel	III	MMPD	0.2705	0.5478	0.5824
Open-Stagnant-Gravel	III	WCD	0.2121	0.5356	0.5806
Open-Stagnant-Gravel	IV	AMPD	0.2075	0.2979	0.2992
Open-Stagnant-Gravel	IV	MMPD	0.2073	0.2986	0.2999

⁶⁹ If designated as “N/A,” there is no longer recoverable oil on the water surface at the start of this day.



Inland ERSP Operational Environment Calculator Design Document

Table E-13. Average percent emulsion for Days 1–3.

Waterway-Shoreline Type	Oil	Volume	Average Percent Emulsion in Decimal Fraction ⁷⁰		
			Day 1 <i>PE_{day1}</i>	Day 2 <i>PE_{day2}</i>	Day 3 <i>PE_{day3}</i>
Open-Stagnant-Gravel	IV	WCD	0.2073	0.2960	0.3000
Confined-Flow-Wetland	III	AMPD	0.2933	0.5424	N/A
Confined-Flow-Gravel	III	AMPD	0.2933	0.5729	N/A
Confined-Flow-Wetland	III	MMPD	0.2708	0.5363	N/A
Confined-Flow-Gravel	III	MMPD	0.2708	0.5480	0.5824
Confined-Flow-Wetland	III	WCD	0.2124	0.5358	0.5807
Confined-Flow-Gravel	III	WCD	0.2124	0.5358	0.5807
Confined-Flow-Wetland	IV	AMPD	0.2070	0.2994	N/A
Confined-Flow-Gravel	IV	AMPD	0.2070	0.3700	N/A
Confined-Flow-Wetland	IV	MMPD	0.2074	0.2967	N/A
Confined-Flow-Gravel	IV	MMPD	0.2074	0.2986	0.3000
Confined-Flow-Wetland	IV	WCD	0.2074	0.2986	0.3000
Confined-Flow-Gravel	IV	WCD	0.2074	0.2986	0.3000
Confined-Stagnant-Wetland	III	AMPD	0.2704	N/A	N/A
Confined-Stagnant-Wetland	III	MMPD	0.2539	N/A	N/A
Confined-Stagnant-Wetland	III	WCD	0.2121	0.5356	0.5806
Confined-Stagnant-Wetland	IV	AMPD	0.3070	N/A	N/A
Confined-Stagnant-Wetland	IV	MMPD	0.1999	N/A	N/A
Confined-Stagnant-Wetland	IV	WCD	0.2073	0.2986	0.3000

E.4.3 Default Values for Percent Emulsion for Days 1–3 (Oil Groups III and IV)

Developers can use the values in Table E-14 to apply the default apportioned values (by default percentage of wetland category and gravel category shorelines) for Flow waterways.⁷¹ For Open-Stagnant waterways, the project team assumes shorelines to be gravel category, and for Confined-Stagnant waterways, the project team assumes shorelines to be wetland category.

For the Customization Module application in which the relative shoreline proportions are custom designated to differ from the default values, the weighted values are added together as in Equation 37:

$$PE_{day}[Waterway, Oil, Volume] = (P_w \cdot PE_{day}[w]) + (P_g \cdot PE_{day}[g])$$

$$P_w + P_g = 1$$

Equation 37

where $PE_{day}[Waterway, Oil, Volume]$ = thickness on day for a particular Waterway/Oil/Volume scenario; $PE_{day}[w]$ = thickness on day for wetland-category shorelines; $PE_{day}[g]$ = thickness on day for gravel-category shorelines; P_w = proportion of waterway with wetland-category shoreline (in decimal format); and

⁷⁰ If designated as “N/A,” there is no longer recoverable oil on the water surface at the start of this day.

⁷¹ For Open-Flow waterways: 75% gravel category and 25% wetland category; and for Confined-Flow waterways: 25% gravel category and 75% wetland category.



Inland ERSP Operational Environment Calculator Design Document

P_g = proportion of waterway with gravel-category shoreline (in decimal format). The sum of P_w and P_g must equal 1. The value is calculated separately for each day.

Table E-14. Default percent emulsion for Days 1–3 (oil groups III and IV) in flow waterways.

Waterway	Oil	Volume	Default Percent Emulsion ⁷²			Time of No Recoverable Oil ($h(THo)$) ⁷³
			Day 1	Day 2	Day 3	
Open-Flow	III	AMPD	0.1425	N/A	N/A	11
Open-Flow	III	MMPD	0.2424	N/A	N/A	11
Open-Flow	III	WCD	0.2121	0.5449	0.5637	70
Open-Flow	IV	AMPD	0.1309	N/A	N/A	11
Open-Flow	IV	MMPD	0.1882	N/A	N/A	11
Open-Flow	IV	WCD	0.2073	0.2986	0.3000	70
Open-Stagnant	III	AMPD	0.2935	0.5516	0.5799	73
Open-Stagnant	III	MMPD	0.2705	0.5478	0.5824	73
Open-Stagnant	III	WCD	0.2121	0.5356	0.5806	73
Open-Stagnant	IV	AMPD	0.2075	0.2979	0.2992	73
Open-Stagnant	IV	MMPD	0.2073	0.2986	0.2999	73
Open-Stagnant	IV	WCD	0.2073	0.2960	0.3000	73
Confined-Flow	III	AMPD	0.2933	0.5500	N/A	40
Confined-Flow	III	MMPD	0.2708	0.5392	N/A	40
Confined-Flow	III	WCD	0.2124	0.5358	0.5807	73
Confined-Flow	IV	AMPD	0.2070	0.3171	N/A	39
Confined-Flow	IV	MMPD	0.2071	0.3522	N/A	40
Confined-Flow	IV	WCD	0.2074	0.2986	0.3000	73
Confined-Stagnant	III	AMPD	0.2704	N/A	N/A	22
Confined-Stagnant	III	MMPD	0.2539	N/A	N/A	23
Confined-Stagnant	III	WCD	0.2121	0.5356	0.5806	73
Confined-Stagnant	IV	AMPD	0.3070	N/A	N/A	23
Confined-Stagnant	IV	MMPD	0.1999	N/A	N/A	23
Confined-Stagnant	IV	WCD	0.2073	0.2986	0.3000	73

⁷² If designated as “N/A,” there is no longer recoverable oil on the water surface at the start of this day.

⁷³ Hours after spill at which time there is no recoverable oil on the water surface. If designated as “73,” there is still recoverable oil after 72 hours. The assumption is that oil needs to be at least 10 μm (0.000393701 inches) to be recovered with skimmers.



E.5 Average Oil Thickness on Water Surface (TH_h)

E.5.1 Average Oil Thickness by Hour (TH_h)

Table E-15 through Table E-17 provides the equations for calculating the Average Oil Thickness on Water Surface (TH) by oil spill scenario (Oil Type-Volume Category-Waterway Type-Shore Type). Developers may use these equations in the Customization Module.

Table E-15. Average oil thickness by hour, TH_h , on Day 1.

Scenario	Average Thickness (inches) by Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.010	0.008	0.008	0.007	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.003	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.009	0.008	0.008	0.007	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.004
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.008	0.008	0.007	0.006	0.005	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-15. Average oil thickness by hour, TH_h , on Day 1 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.046	0.044	0.043	0.042	0.041	0.040	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.046	0.044	0.043	0.042	0.041	0.040	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.046	0.044	0.043	0.042	0.040	0.039	0.038	0.036	0.034	0.031	0.027	0.021	0.015	0.000	0.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.045	0.043	0.042	0.040	0.039	0.038	0.037	0.036	0.035	0.034	0.033	0.032	0.032	0.031	0.030
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.046	0.044	0.043	0.042	0.041	0.040	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.169	0.166	0.163	0.161	0.159	0.157	0.155	0.153	0.152	0.150	0.148	0.146	0.145	0.143	0.141	0.139
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.169	0.166	0.163	0.161	0.159	0.157	0.155	0.153	0.152	0.150	0.148	0.146	0.145	0.143	0.141	0.139
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.168	0.165	0.163	0.161	0.158	0.156	0.154	0.152	0.150	0.148	0.146	0.144	0.142	0.140	0.138	0.136
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.168	0.165	0.163	0.161	0.159	0.157	0.155	0.153	0.151	0.150	0.148	0.146	0.144	0.143	0.141	0.139
GROUP III-WCD-OPEN-FLOW-WETLAND	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.168	0.164	0.158	0.151	0.145	0.140	0.136	0.132	0.128	0.124	0.121	0.118	0.115	0.112	0.110	0.108
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.168	0.165	0.163	0.161	0.159	0.157	0.155	0.153	0.151	0.150	0.148	0.146	0.144	0.143	0.141	0.139
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.192	0.153	0.130	0.115	0.084	0.071	0.062	0.056	0.050	0.046	0.043	0.040	0.037	0.034	0.032	0.030	0.028	0.027	0.025	0.024	0.023	0.022	0.021	0.020	0.019	0.018	0.017
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.192	0.153	0.130	0.115	0.084	0.071	0.062	0.056	0.050	0.046	0.043	0.040	0.037	0.034	0.032	0.030	0.028	0.027	0.025	0.024	0.023	0.022	0.021	0.020	0.019	0.018	0.017
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.192	0.153	0.130	0.115	0.083	0.070	0.061	0.055	0.050	0.046	0.043	0.040	0.037	0.034	0.032	0.030	0.029	0.027	0.025	0.023	0.021	0.019	0.017	0.014	0.011	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.192	0.153	0.130	0.115	0.084	0.070	0.062	0.056	0.051	0.047	0.043	0.040	0.038	0.035	0.033	0.031	0.029	0.027	0.025	0.024	0.022	0.021	0.020	0.019	0.018	0.017	0.016
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.192	0.153	0.130	0.115	0.084	0.070	0.062	0.056	0.051	0.047	0.043	0.040	0.037	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.192	0.153	0.130	0.115	0.084	0.071	0.063	0.057	0.052	0.047	0.044	0.041	0.038	0.036	0.033	0.031	0.030	0.028	0.026	0.025	0.024	0.023	0.021	0.021	0.020	0.019	0.018
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.520	0.469	0.429	0.398	0.314	0.264	0.232	0.208	0.191	0.177	0.166	0.157	0.149	0.142	0.136	0.130	0.125	0.121	0.116	0.113	0.109	0.105	0.102	0.099	0.096	0.094	0.091
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.520	0.469	0.429	0.398	0.314	0.264	0.232	0.208	0.191	0.177	0.166	0.157	0.149	0.142	0.136	0.130	0.125	0.121	0.116	0.113	0.109	0.105	0.102	0.099	0.096	0.094	0.091



Inland ERSP Operational Environment Calculator Design Document

Table E-15. Average oil thickness by hour, TH_h , on Day 1 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.520	0.469	0.429	0.398	0.314	0.265	0.232	0.208	0.191	0.177	0.166	0.157	0.149	0.142	0.136	0.130	0.125	0.121	0.116	0.112	0.109	0.105	0.102	0.099	0.096	0.093	0.091
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.005
GROUP II-WCD-OPEN-FLOW-WETLAND	0.520	0.469	0.429	0.398	0.314	0.265	0.232	0.208	0.190	0.177	0.166	0.156	0.148	0.141	0.134	0.129	0.123	0.118	0.114	0.110	0.106	0.102	0.099	0.096	0.093	0.090	0.087
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.520	0.469	0.429	0.398	0.314	0.264	0.232	0.208	0.191	0.177	0.166	0.157	0.149	0.142	0.136	0.130	0.125	0.121	0.117	0.113	0.109	0.106	0.102	0.099	0.097	0.094	0.091
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.172	0.119	0.084	0.058	0.011	0.004	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.172	0.119	0.084	0.058	0.011	0.004	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.172	0.119	0.084	0.058	0.011	0.004	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.172	0.119	0.084	0.058	0.012	0.004	0.004	0.003	0.003	0.002	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.172	0.119	0.084	0.058	0.012	0.004	0.004	0.003	0.003	0.002	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.172	0.119	0.084	0.058	0.012	0.004	0.004	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.088	0.095	0.102	0.109	0.116	0.122	0.128	0.134	0.139	0.144	0.148	0.153	0.157	0.161	0.165
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.088	0.095	0.102	0.109	0.116	0.122	0.128	0.134	0.139	0.144	0.148	0.153	0.157	0.161	0.165
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.087	0.095	0.102	0.109	0.116	0.122	0.128	0.134	0.139	0.144	0.150	0.155	0.159	0.164	0.169
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.087	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.087	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.087	0.095	0.102	0.109	0.116	0.122	0.128	0.133	0.139	0.144	0.148	0.153	0.157	0.161	0.165
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.060	0.066	0.072	0.078	0.083	0.089	0.094	0.099	0.103	0.108	0.112	0.116	0.120	0.124
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.060	0.066	0.072	0.078	0.083	0.089	0.094	0.099	0.103	0.108	0.112	0.116	0.120	0.123
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.060	0.066	0.072	0.078	0.083	0.089	0.094	0.099	0.104	0.109	0.113	0.118	0.000	0.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.062	0.069	0.074	0.079	0.086	0.091	0.097	0.102	0.105	0.110	0.116	0.120	0.124	0.128
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-15. Average oil thickness by hour, TH_h , on Day 1 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.060	0.066	0.072	0.078	0.083	0.089	0.094	0.098	0.103	0.107	0.112	0.116	0.120	0.123
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.214	0.205	0.197	0.190	0.183	0.177	0.172	0.167	0.162	0.157	0.153	0.149	0.146	0.142	0.139	0.136
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.214	0.205	0.197	0.190	0.183	0.177	0.172	0.167	0.162	0.157	0.153	0.149	0.146	0.142	0.139	0.136
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.214	0.205	0.197	0.190	0.183	0.177	0.171	0.165	0.160	0.156	0.151	0.147	0.143	0.140	0.137	0.134
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.214	0.206	0.198	0.191	0.184	0.178	0.173	0.168	0.163	0.159	0.155	0.151	0.147	0.144	0.141	0.138
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.213	0.203	0.191	0.179	0.169	0.161	0.154	0.147	0.141	0.135	0.130	0.126	0.122	0.118	0.115	0.112
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.214	0.205	0.197	0.190	0.183	0.177	0.172	0.167	0.162	0.157	0.153	0.149	0.146	0.142	0.139	0.136
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005
GROUP I-WCD-OPEN-FLOW-WETLAND	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005



Inland ERSP Operational Environment Calculator Design Document

Table E-16. Average oil thickness by hour, TH_h , on Day 2.

Scenario	Average Thickness (inches) by Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.002	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.002	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.006	0.005	0.004	0.004	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.006	0.006	0.005	0.005	0.004	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.024	0.024	0.023	0.023	0.022	0.022	0.022	0.021
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.028	0.028	0.027	0.025	0.024	0.022	0.019	0.015	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-16. Average oil thickness by hour, TH_h , on Day 2 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.022	0.022	0.021
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.029	0.028	0.028	0.028	0.027	0.027	0.027	0.026	0.026	0.026	0.025	0.025	0.025	0.025	0.024
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.137	0.136	0.134	0.132	0.130	0.129	0.127	0.125	0.123	0.122	0.120	0.118	0.116	0.115	0.113	0.112	0.110	0.108	0.107	0.105	0.104	0.103	0.101	0.100
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.137	0.135	0.133	0.131	0.129	0.127	0.125	0.122	0.120	0.117	0.114	0.111	0.109	0.106	0.103	0.100	0.097	0.094	0.092	0.089	0.087	0.085	0.083	0.081
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.134	0.132	0.130	0.128	0.127	0.125	0.123	0.121	0.119	0.117	0.116	0.114	0.112	0.110	0.109	0.107	0.106	0.104	0.102	0.101	0.099	0.098	0.096	0.095
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.137	0.135	0.134	0.132	0.130	0.128	0.126	0.125	0.123	0.121	0.120	0.118	0.116	0.115	0.113	0.111	0.110	0.108	0.107	0.105	0.104	0.102	0.101	0.100
GROUP III-WCD-OPEN-FLOW-WETLAND	0.105	0.103	0.101	0.099	0.097	0.095	0.093	0.092	0.090	0.088	0.087	0.085	0.084	0.082	0.081	0.080	0.078	0.077	0.076	0.074	0.073	0.072	0.071	0.070
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.137	0.136	0.134	0.132	0.130	0.129	0.127	0.125	0.123	0.122	0.120	0.118	0.116	0.115	0.113	0.112	0.110	0.109	0.107	0.106	0.104	0.103	0.101	0.100
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.017	0.016	0.015	0.015	0.015	0.014	0.014	0.013	0.013	0.013	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.009	0.009
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.017	0.016	0.015	0.015	0.014	0.014	0.014	0.013	0.013	0.013	0.012	0.012	0.011	0.010	0.010	0.008	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.016	0.015	0.014	0.014	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.017	0.017	0.016	0.016	0.015	0.015	0.014	0.014	0.014	0.013	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.011	0.011
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.089	0.086	0.084	0.082	0.080	0.078	0.076	0.074	0.073	0.071	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.089	0.086	0.084	0.082	0.080	0.078	0.076	0.074	0.072	0.070	0.068	0.066	0.065	0.063	0.062	0.060	0.058	0.057	0.056	0.054	0.053	0.052	0.050	0.049
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.088	0.086	0.084	0.082	0.080	0.078	0.076	0.074	0.072	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.060	0.059	0.058	0.057	0.055	0.054	0.053	0.052
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP II-WCD-OPEN-FLOW-WETLAND	0.085	0.082	0.080	0.078	0.076	0.074	0.072	0.070	0.068	0.066	0.065	0.063	0.062	0.060	0.059	0.057	0.056	0.055	0.054	0.053	0.051	0.050	0.049	0.048
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.089	0.087	0.084	0.082	0.080	0.078	0.076	0.075	0.073	0.071	0.070	0.068	0.066	0.065	0.064	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053



Inland ERSP Operational Environment Calculator Design Document

Table E-16. Average oil thickness by hour, TH_h , on Day 2 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.169	0.172	0.176	0.179	0.182	0.185	0.188	0.191	0.194	0.197	0.200	0.203	0.206	0.209	0.211	0.214	0.218	0.221	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.169	0.172	0.176	0.179	0.182	0.185	0.188	0.191	0.194	0.197	0.200	0.203	0.205	0.208	0.211	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.169	0.172	0.176	0.179	0.182	0.185	0.188	0.191	0.194	0.196	0.199	0.202	0.204	0.207	0.209	0.211	0.214	0.216	0.218	0.220	0.223	0.225	0.227	0.229
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.127	0.131	0.135	0.139	0.142	0.145	0.149	0.152	0.156	0.159	0.163	0.167	0.171	0.175	0.178	0.181	0.184	0.187	0.190	0.192	0.195	0.198	0.201	0.204
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.127	0.131	0.134	0.137	0.140	0.144	0.147	0.150	0.153	0.156	0.159	0.161	0.164	0.167	0.171	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.131	0.134	0.137	0.141	0.144	0.148	0.151	0.154	0.157	0.159	0.162	0.165	0.167	0.170	0.172	0.175	0.177	0.180	0.182	0.184	0.187	0.189	0.191	0.193
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.127	0.131	0.134	0.137	0.140	0.143	0.146	0.149	0.152	0.155	0.158	0.160	0.163	0.165	0.168	0.170	0.173	0.175	0.178	0.180	0.182	0.184	0.187	0.189
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.134	0.131	0.131	0.131	0.131	0.131	0.131	0.132	0.132	0.133	0.133	0.134	0.134	0.135	0.135	0.135	0.136	0.136	0.137	0.137	0.138	0.138	0.139	0.139
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.133	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.132	0.132	0.132	0.132	0.133	0.132	0.133	0.134	0.136	0.138
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.131	0.128	0.125	0.123	0.120	0.118	0.116	0.114	0.112	0.110	0.108	0.107	0.105	0.104	0.105	0.108	0.110	0.113	0.116	0.119	0.122	0.125	0.128	0.130



Inland ERSP Operational Environment Calculator Design Document

Table E-16. Average oil thickness by hour, TH_h , on Day 2 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.135	0.133	0.130	0.128	0.125	0.123	0.122	0.120	0.118	0.116	0.114	0.113	0.111	0.110	0.109	0.110	0.112	0.115	0.118	0.121	0.123	0.126	0.128	0.131
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.109	0.107	0.105	0.102	0.100	0.098	0.096	0.097	0.100	0.103	0.106	0.109	0.112	0.115	0.118	0.121	0.124	0.127	0.129	0.132	0.134	0.137	0.140	0.142
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.134	0.131	0.128	0.126	0.123	0.122	0.120	0.118	0.116	0.114	0.113	0.111	0.110	0.108	0.107	0.107	0.110	0.113	0.115	0.118	0.121	0.123	0.126	0.128
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

Table E-17. Average oil thickness by hour, TH_h , on Day 3.

Scenario	Average Thickness (inches) by Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-17. Average oil thickness by hour, TH_h , on Day 3 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.019	0.018	0.018	0.018	0.017	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.015
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.021	0.021	0.021	0.020	0.020	0.020	0.020	0.020	0.019	0.019	0.019	0.019	0.019	0.018	0.018	0.018	0.018	0.017	0.017	0.017	0.017	0.016	0.016	0.016
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.024	0.024	0.024	0.023	0.023	0.023	0.023	0.022	0.022	0.022	0.022	0.022	0.021	0.021	0.021	0.021	0.021	0.020	0.020	0.020	0.020	0.020	0.020	0.019
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.099	0.097	0.096	0.095	0.094	0.092	0.091	0.090	0.089	0.088	0.087	0.086	0.085	0.084	0.083	0.082	0.082	0.081	0.080	0.079	0.078	0.078	0.077	0.076
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.079	0.077	0.075	0.073	0.071	0.069	0.066	0.064	0.062	0.059	0.057	0.056	0.054	0.052	0.051	0.049	0.048	0.047	0.046	0.044	0.043	0.042	0.041	0.040
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.093	0.092	0.091	0.089	0.088	0.087	0.086	0.085	0.084	0.082	0.081	0.080	0.079	0.078	0.078	0.077	0.076	0.075	0.074	0.073	0.073	0.072	0.071	0.070
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.098	0.097	0.096	0.095	0.093	0.092	0.091	0.090	0.089	0.088	0.087	0.086	0.085	0.084	0.083	0.082	0.081	0.081	0.080	0.079	0.078	0.077	0.077	0.076
GROUP III-WCD-OPEN-FLOW-WETLAND	0.069	0.068	0.067	0.066	0.065	0.064	0.064	0.063	0.062	0.061	0.061	0.060	0.058	0.057	0.056	0.054	0.052	0.049	0.046	0.043	0.041	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-17. Average oil thickness by hour, TH_h , on Day 3 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.099	0.097	0.096	0.095	0.094	0.093	0.091	0.090	0.089	0.088	0.087	0.086	0.085	0.084	0.083	0.083	0.082	0.081	0.080	0.079	0.078	0.078	0.077	0.076
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.009	0.009	0.009	0.008	0.008	0.008	0.007	0.007	0.006	0.005	0.003	0.004	0.004	0.003	0.003	0.004	0.004	0.003	0.003	0.003	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.007	0.007	0.007	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.041	0.040	0.039	0.039	0.038	0.038	0.037	0.037	0.036	0.036
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.048	0.047	0.046	0.044	0.042	0.040	0.038	0.036	0.034	0.032	0.030	0.029	0.027	0.025	0.024	0.022	0.021	0.019	0.018	0.016	0.014	0.013	0.012	0.011
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.035	0.034
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP II-WCD-OPEN-FLOW-WETLAND	0.047	0.046	0.046	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.035	0.034	0.032	0.031	0.029	0.027	0.000	0.000	0.000
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.052	0.051	0.050	0.049	0.048	0.047	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.041	0.040	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.036
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table E-17. Average oil thickness by hour, TH_h , on Day 3 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.231	0.233	0.235	0.237	0.239	0.241	0.243	0.244	0.246	0.248	0.250	0.252	0.253	0.255	0.257	0.258	0.260	0.262	0.263	0.265	0.267	0.268	0.270	0.271
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.206	0.209	0.212	0.215	0.217	0.220	0.223	0.225	0.228	0.230	0.233	0.236	0.238	0.240	0.242	0.245	0.247	0.250	0.252	0.255	0.257	0.259	0.262	0.265
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.196	0.198	0.200	0.202	0.204	0.206	0.208	0.210	0.212	0.213	0.216	0.218	0.220	0.221	0.223	0.226	0.228	0.230	0.232	0.234	0.236	0.238	0.240	0.242
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.191	0.193	0.195	0.197	0.199	0.201	0.203	0.205	0.207	0.209	0.211	0.213	0.215	0.216	0.218	0.220	0.222	0.224	0.225	0.227	0.229	0.231	0.233	0.234
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.139	0.140	0.140	0.143	0.145	0.148	0.151	0.153	0.156	0.158	0.160	0.163	0.165	0.167	0.169	0.172	0.174	0.176	0.178	0.180	0.182	0.184	0.186	0.188
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.140	0.143	0.148	0.152	0.157	0.164	0.171	0.176	0.183	0.189	0.186	0.186	0.191	0.192	0.196	0.199	0.202	0.206	0.207	0.218	0.223	0.227	0.231	0.236
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.133	0.135	0.138	0.140	0.143	0.145	0.147	0.150	0.152	0.154	0.156	0.159	0.161	0.163	0.165	0.167	0.169	0.171	0.173	0.175	0.177	0.179	0.181	0.183
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.133	0.135	0.138	0.140	0.142	0.145	0.147	0.149	0.151	0.154	0.157	0.159	0.162	0.163	0.166	0.168	0.170	0.172	0.174	0.176	0.178	0.181	0.183	0.184
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.144	0.147	0.149	0.152	0.154	0.156	0.158	0.161	0.163	0.165	0.165	0.167	0.170	0.172	0.175	0.182	0.188	0.194	0.201	0.204	0.186	0.000	0.000	0.000
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.131	0.133	0.136	0.138	0.140	0.143	0.145	0.147	0.149	0.152	0.154	0.156	0.158	0.160	0.162	0.164	0.166	0.168	0.171	0.173	0.175	0.177	0.179	0.181
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005



E.5.2 Default Values for Average Thickness for Days 1–3

As an alternative to applying the equations for TH_h , developers may apply the average thicknesses for Day 1–3 (TH_{day1} , TH_{day2} , TH_{day3}), as in Table E-18. Developers can use the values in Table E-18 to apply the default apportioned values (by default percentage of wetland category and gravel category shorelines)⁷⁴ for Flow waterways and appropriate values for Stagnant waterways. For Open-Stagnant waterways, the project team assumes shorelines to be gravel category, and for Confined-Stagnant waterways, the project team assumes shorelines to be wetland category. Note that the project team assumed that the minimum thickness for oil recovery is 10 microns, which is the equivalent of 0.0004 inches.

Table E-18. Default average thickness for Days 1–3.

Waterway	Oil	Volume	Default Average Thickness (inches)		
			Day 1 TH_{day1}	Day 2 TH_{day2}	Day 3 TH_{day3}
Open-Flow	I	AMPD	0.0004	0.0000	0.0000
Open-Flow	I	MMPD	0.0190	0.0000	0.0000
Open-Flow	I	WCD	0.0843	0.0039	0.0037
Open-Flow	II	AMPD	0.0056	0.0000	0.0000
Open-Flow	II	MMPD	0.0495	0.0088	0.0057
Open-Flow	II	WCD	0.1121	0.0198	0.0122
Open-Flow	III	AMPD	0.0062	0.0000	0.0000
Open-Flow	III	MMPD	0.0579	0.0187	0.0140
Open-Flow	III	WCD	0.2095	0.1096	0.0773
Open-Flow	IV	MMPD	0.0215	0.0000	0.0000
Open-Flow	IV	WCD	0.0847	0.1234	0.1641
Open-Flow	IV	WCD	0.2395	0.1191	0.1567
Open-Stagnant	I	AMPD	0.0006	0.0003	0.0003
Open-Stagnant	I	MMPD	0.0184	0.0021	0.0020
Open-Stagnant	I	WCD	0.0852	0.0052	0.0050
Open-Stagnant	II	AMPD	0.0082	0.0039	0.0032
Open-Stagnant	II	MMPD	0.0534	0.0134	0.0105
Open-Stagnant	II	WCD	0.1946	0.0685	0.0430
Open-Stagnant	III	AMPD	0.0110	0.0075	0.0059
Open-Stagnant	III	MMPD	0.0597	0.0280	0.0215
Open-Stagnant	III	WCD	0.2125	0.1178	0.0864
Open-Stagnant	IV	MMPD	0.0909	0.2014	0.2520
Open-Stagnant	IV	WCD	0.0958	0.1603	0.2133
Open-Stagnant	IV	WCD	0.2414	0.1183	0.1567
Confined-Flow	I	AMPD	0.0006	0.0002	0.0000
Confined-Flow	I	MMPD	0.0184	0.0013	0.0000

⁷⁴ For Open-Flow waterways: 75% gravel category: 25% wetland category; and for Confined-Flow waterways: 25% gravel category: 75% wetland category.



Table E-18. Default average thickness for Days 1–3 (Cont'd).

Waterway	Oil	Volume	Default Average Thickness (inches)		
			Day 1 TH_{day1}	Day 2 TH_{day2}	Day 3 TH_{day3}
Confined-Flow	I	WCD	0.0852	0.0039	0.0012
Confined-Flow	II	AMPD	0.0082	0.0027	0.0000
Confined-Flow	II	MMPD	0.0526	0.0097	0.0011
Confined-Flow	II	WCD	0.1945	0.0672	0.0323
Confined-Flow	III	AMPD	0.0110	0.0048	0.0000
Confined-Flow	III	MMPD	0.0597	0.0197	0.0044
Confined-Flow	III	WCD	0.2125	0.1115	0.0642
Confined-Flow	IV	MMPD	0.0910	0.1260	0.0000
Confined-Flow	IV	WCD	0.0958	0.1119	0.0590
Confined-Flow	IV	WCD	0.2414	0.1326	0.1822
Confined-Stagnant	I	AMPD	0.0006	0.0000	0.0000
Confined-Stagnant	I	MMPD	0.0184	0.0000	0.0000
Confined-Stagnant	I	WCD	0.0848	0.0000	0.0000
Confined-Stagnant	II	AMPD	0.0077	0.0000	0.0000
Confined-Stagnant	II	MMPD	0.0503	0.0000	0.0000
Confined-Stagnant	II	WCD	0.1944	0.0678	0.0417
Confined-Stagnant	III	AMPD	0.0099	0.0000	0.0000
Confined-Stagnant	III	MMPD	0.0552	0.0000	0.0000
Confined-Stagnant	III	WCD	0.2116	0.1136	0.0806
Confined-Stagnant	IV	MMPD	0.0914	0.0000	0.0000
Confined-Stagnant	IV	WCD	0.0870	0.0000	0.0000
Confined-Stagnant	IV	WCD	0.2407	0.1166	0.1590

E.5.3 Average Thicknesses for Days 1–3 for Customization Module (Custom Shorelines)

In the Customization Module, for custom specifications of the relative proportion of wetland-category and gravel-category shorelines that differ from the default values (Open-Flow waterways: 75% gravel category: 25% wetland category; and Confined-Flow waterways: 25% gravel category: 75% wetland category), developers should apply the values from Table E-19 with based on the custom weighted percentages, as in Equation 38:

$$TH_{day}[Waterway, Oil, Volume] = (P_w \times TH_{day}[w]) + (P_g \times TH_{day}[g])$$

$$P_w + P_g = 1$$

Equation 38

Where $TH_{day}[Waterway, Oil, Volume]$ = thickness on day for a particular Waterway/Oil/Volume scenario; $TH_{day}[w]$ = thickness on day for wetland-category shorelines; $TH_{day}[g]$ = thickness on day for gravel-



Inland ERSP Operational Environment Calculator Design Document

category shorelines; P_w = proportion of waterway with wetland-category shoreline (in decimal format); and P_g = proportion of waterway with gravel-category shoreline (in decimal format). The sum of P_w and P_g must equal 1. The value is calculated separately for each day.

For example, if 90% of the shoreline in an Open-Flow waterway is wetland-category, and 10% is gravel-category, the computation for a Group II oil, WCD scenario is:

$$TH_{day1} = (0.9 \times 0.19304) + (0.1 \times 0.08516) = 0.182252$$

$$TH_{day2} = (0.9 \times 0.06384) + (0.1 \times 0.00526) = 0.057972$$

$$TH_{day3} = (0.9 \times 0.03381) + (0.1 \times 0.00499) = 0.030928$$

Equation 39

Table E-19. Average oil thicknesses for Days 1–3 by shoreline category for customization module.

Waterway-Shoreline Type	Oil	Volume	Average Thickness (inches)		
			Day 1 TH_{day1}	Day 2 TH_{day2}	Day 3 TH_{day3}
Open-Flow-Wetland	I	AMPD	0.00041	0.00000	0.00000
Open-Flow-Gravel	I	AMPD	0.00041	0.00000	0.00000
Open-Flow-Wetland	I	MMPD	0.01729	0.00000	0.00000
Open-Flow-Gravel	I	MMPD	0.01729	0.00000	0.00000
Open-Flow-Wetland	I	WCD	0.08184	0.00000	0.00000
Open-Flow-Gravel	I	WCD	0.08516	0.00516	0.00499
Open-Flow-Wetland	II	AMPD	0.00564	0.00000	0.00000
Open-Flow-Gravel	II	AMPD	0.00564	0.00000	0.00000
Open-Flow-Wetland	II	MMPD	0.04009	0.00000	0.00000
Open-Flow-Gravel	II	MMPD	0.05261	0.01172	0.00764
Open-Flow-Wetland	II	WCD	0.19304	0.06384	0.03381
Open-Flow-Gravel	II	WCD	0.08516	0.00516	0.00499
Open-Flow-Wetland	III	AMPD	0.00616	0.00000	0.00000
Open-Flow-Gravel	III	AMPD	0.00616	0.00000	0.00000
Open-Flow-Wetland	III	MMPD	0.03993	0.00000	0.00000
Open-Flow-Gravel	III	MMPD	0.05857	0.02499	0.01861
Open-Flow-Wetland	III	WCD	0.20079	0.08563	0.05110
Open-Flow-Gravel	III	WCD	0.21240	0.11755	0.08607
Open-Flow-Wetland	IV	AMPD	0.02152	0.00000	0.00000
Open-Flow-Gravel	IV	AMPD	0.02152	0.00000	0.00000
Open-Flow-Wetland	IV	MMPD	0.04682	0.00000	0.00000
Open-Flow-Gravel	IV	MMPD	0.09729	0.16456	0.21878
Open-Flow-Wetland	IV	WCD	0.23124	0.11522	0.14805
Open-Flow-Gravel	IV	WCD	0.24221	0.12040	0.15955
Open-Stagnant-Gravel	I	AMPD	0.00059	0.00034	0.00034
Open-Stagnant-Gravel	I	MMPD	0.01843	0.00212	0.00204
Open-Stagnant-Gravel	I	WCD	0.08518	0.00517	0.00501



Inland ERSP Operational Environment Calculator Design Document

Table E-19. Average oil thicknesses for Days 1–3 by shoreline category for customization module (Cont'd).

Waterway-Shoreline Type	Oil	Volume	Average Thickness (inches)		
			Day 1 <i>TH_{day1}</i>	Day 2 <i>TH_{day2}</i>	Day 3 <i>TH_{day3}</i>
Open-Stagnant-Gravel	II	AMPD	0.00817	0.00393	0.00319
Open-Stagnant-Gravel	II	MMPD	0.05340	0.01338	0.01052
Open-Stagnant-Gravel	II	WCD	0.19460	0.06851	0.04300
Open-Stagnant-Gravel	III	AMPD	0.01097	0.00754	0.00585
Open-Stagnant-Gravel	III	MMPD	0.05967	0.02800	0.02153
Open-Stagnant-Gravel	III	WCD	0.21249	0.11783	0.08639
Open-Stagnant-Gravel	IV	AMPD	0.09088	0.20138	0.25200
Open-Stagnant-Gravel	IV	MMPD	0.09578	0.16031	0.21329
Open-Stagnant-Gravel	IV	WCD	0.24140	0.11832	0.15670
Confined-Flow-Wetland	I	AMPD	0.00059	0.00018	0.00002
Confined-Flow-Gravel	I	AMPD	0.00059	0.00018	0.00002
Confined-Flow-Wetland	I	MMPD	0.01839	0.00131	0.00000
Confined-Flow-Gravel	I	MMPD	0.01839	0.00136	0.00000
Confined-Flow-Wetland	I	WCD	0.08516	0.00344	0.00000
Confined-Flow-Gravel	I	WCD	0.08516	0.00516	0.00497
Confined-Flow-Wetland	II	AMPD	0.00824	0.00266	0.00000
Confined-Flow-Gravel	II	AMPD	0.00824	0.00266	0.00000
Confined-Flow-Wetland	II	MMPD	0.05256	0.00889	0.00000
Confined-Flow-Gravel	II	MMPD	0.05256	0.01222	0.00454
Confined-Flow-Wetland	II	WCD	0.19451	0.06678	0.02877
Confined-Flow-Gravel	II	WCD	0.19451	0.06833	0.04283
Confined-Flow-Wetland	III	AMPD	0.01097	0.00481	0.00000
Confined-Flow-Gravel	III	AMPD	0.01097	0.00480	0.00000
Confined-Flow-Wetland	III	MMPD	0.05968	0.01733	0.00000
Confined-Flow-Gravel	III	MMPD	0.05969	0.02669	0.01749
Confined-Flow-Wetland	III	WCD	0.21253	0.10942	0.05688
Confined-Flow-Gravel	III	WCD	0.21253	0.11777	0.08625
Confined-Flow-Wetland	IV	AMPD	0.09095	0.11920	0.00000
Confined-Flow-Gravel	IV	AMPD	0.09095	0.14642	0.00000
Confined-Flow-Wetland	IV	MMPD	0.09583	0.09333	0.00000
Confined-Flow-Gravel	IV	MMPD	0.09583	0.16753	0.23618
Confined-Flow-Wetland	IV	WCD	0.24141	0.13199	0.18852
Confined-Flow-Gravel	IV	WCD	0.24143	0.13428	0.16321
Confined-Stagnant-Wetland	I	AMPD	0.00055	0.00002	0.00000
Confined-Stagnant-Wetland	I	MMPD	0.01837	0.00000	0.00000
Confined-Stagnant-Wetland	I	WCD	0.08475	0.00000	0.00000
Confined-Stagnant-Wetland	II	AMPD	0.00772	0.00000	0.00000
Confined-Stagnant-Wetland	II	MMPD	0.05033	0.00000	0.00000
Confined-Stagnant-Wetland	II	WCD	0.19443	0.06783	0.04170



Inland ERSP Operational Environment Calculator Design Document

Table E-19. Average oil thicknesses for Days 1–3 by shoreline category for customization module (Cont'd).

Waterway-Shoreline Type	Oil	Volume	Average Thickness (inches)		
			Day 1 <i>TH_{day1}</i>	Day 2 <i>TH_{day2}</i>	Day 3 <i>TH_{day3}</i>
Confined-Stagnant-Wetland	III	AMPD	0.00989	0.00000	0.00000
Confined-Stagnant-Wetland	III	MMPD	0.05515	0.00000	0.00000
Confined-Stagnant-Wetland	III	WCD	0.21160	0.11356	0.08060
Confined-Stagnant-Wetland	IV	AMPD	0.09141	0.00000	0.00000
Confined-Stagnant-Wetland	IV	MMPD	0.08704	0.00000	0.00000
Confined-Stagnant-Wetland	IV	WCD	0.24065	0.11660	0.15896

E.6 Appendix E References

- ASCE Task Committee on Modeling Oil Spills. 1996. State-of-the-art review of modeling transport and fate of oil spills. Water Resources Engineering Division, ASCE, *J. Hydraul. Eng.* 122(11): 594–609.
- French D, Reed M, Jayko K, Feng S, Rines H et al. 1996. The CERCLA type A natural resource damage assessment model for coastal and marine environments (NRDAM/CME), Technical Documentation, Vol. I–V. Final Report. Washington (DC): USDOJ. April 1996. Report No.: PB96-501788. Contract No.: Available from: NTIS, Springfield, VA 22161.
- French McCay DP. 2009. State-of-the-art and research needs for oil spill impact assessment modeling. In: Proceedings of the 32nd AMOP technical seminar, 9–11 June 2009. Emergencies Science Division, Environment Canada; Ottawa, ON, Canada. p. 601–653.
- French-McCay, D., D. Crowley, J. Rowe, M. Bock, H. Robinson, R. Wenning, A. H. Walker, J. Joeckel, and T. Parkerton. 2018. Comparative Risk Assessment of Spill Response Options for a Deepwater Oil Well Blowout: Part I. Oil Spill Modelling. *Mar. Pollut. Bull.* 133:1001–1015.
<https://doi.org/10.1016/j.marpolbul.2018.05.042>.
- Gundlach ER. 1987. Oil holding capacities and removal coefficients for different shoreline types to computer simulate spills in coastal waters. In: Proceedings of the 1987 Oil Spill Conference; 6–9 April 1987. American Petroleum Institute; Washington, DC. p. 451–457.
- Reed, M., E. Gundlach and T. Kana. 1989. A coastal zone oil spill model: development and sensitivity studies. *Oil & Chemical Pollution* 5, 411-449.
- Muin, M. 1993. A Three-Dimensional Boundary Fitted Circulation Model in Spherical Coordinates, Ph.D. Dissertation, Department of Ocean Engineering, University of Rhode Island, Kingston, RI.
- Muin, M. and M. Spaulding. 1997a. Three-dimensional Boundary-fitted Circulation Model. *Journal of Hydraulic Engineering* 123(1): 2-12.
- Muin, M. and M. Spaulding. 1997b. Application of Three-dimensional Boundary-fitted Circulation Model to the Providence River. *Journal of Hydraulic Engineering* 123(1): 13-20.



Inland ERSP Operational Environment Calculator Design Document

- NOAA. 2013. Shoreline Assessment Manual. 4th Edition. U.S. Dept. of Commerce. Seattle, WA: Emergency Response Division, Office of Response and Restoration, National Oceanic and Atmospheric Administration. 73 pp + appendices.
- Sankaranarayanan, S. and M. L. Spaulding. 2003. A Study of the Effects of Grid Non-orthogonality on the Solution of Shallow Water Equations in Boundary-fitted Coordinate Systems. *Journal of Computational Physics* 184(1): 299-320.
- Spaulding, M.L., 1984. A Vertically Averaged Circulation Model using Boundary-fitted Coordinates. *J. Phys. Oceanography* 14: 973.
- Spaulding, M. L., D. Mendelsohn, and J. C. Swanson. 1999. WQMAP: An Integrated Three-dimensional Hydrodynamic and Water Quality Model System for Estuarine and Coastal Applications. *Marine Technology Society Journal*, invited paper, Special issue on state of the art in ocean and coastal modeling, Vol. 33, No. 3, p. 38-54.



(This page intentionally left blank.)



APPENDIX F. BOOM ANGLING FOR FAST CURRENTS

This appendix provides further detail on how in fast currents (generally exceeding 0.7 kts), boom angle should be adjusted to prevent or reduce oil entrainment (movement of oil under the boom). Users may refer to Figure F-1 to determine the maximum boom angle for boom deployments based on current velocity.

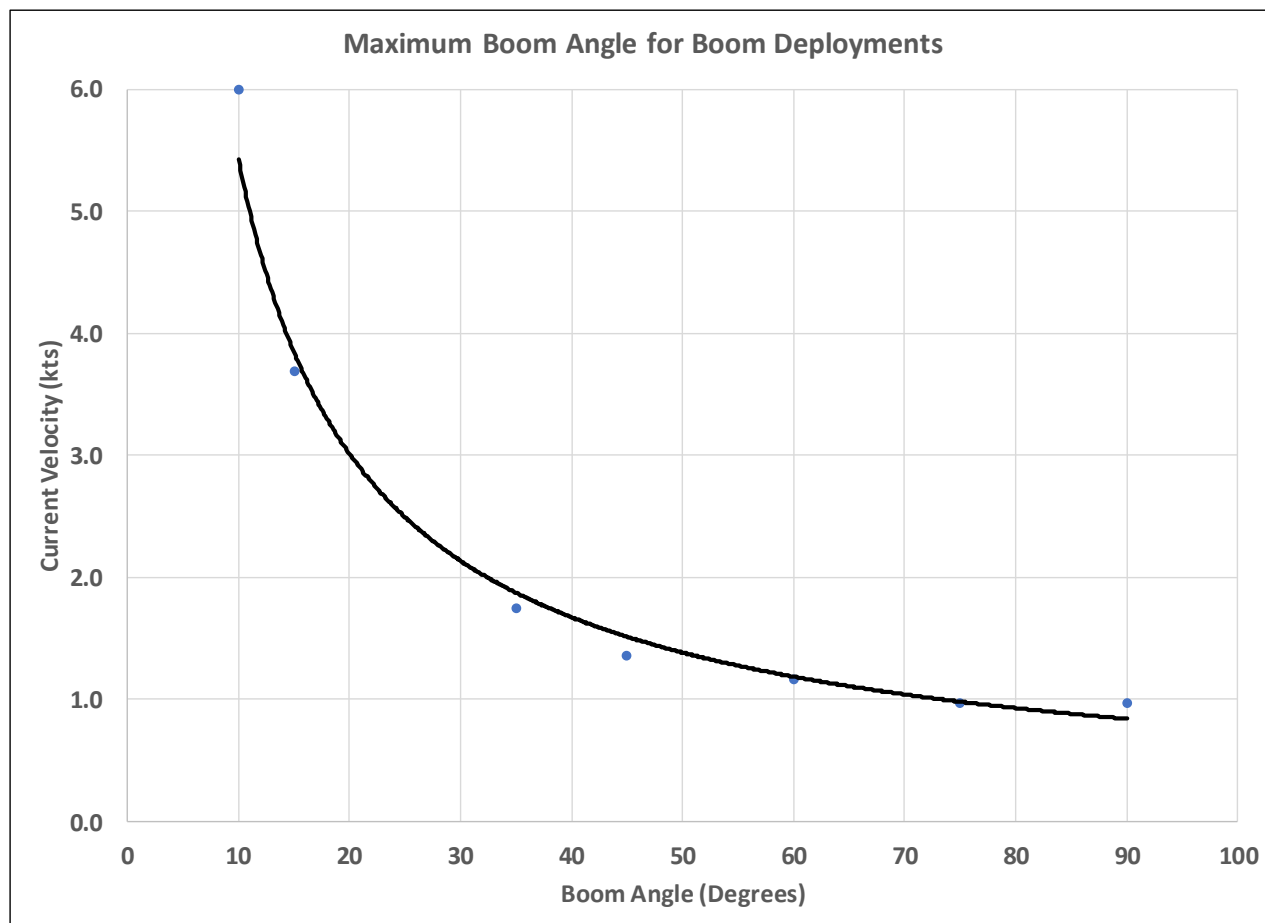


Figure F-1. Maximum boom angle for fast currents.⁷⁵

F.1 Appendix F References

Hansen, K. and P. Tebeau. 2002. *Oil Spill Response in Fast Currents. A Decision Tool*. US Coast Guard Research and Development Center, Groton, Connecticut. Report CG-D-03-03. December 2002. 29 p.

⁷⁵ Based on Hansen and Tebeau 2002.



(This page intentionally left blank.)



APPENDIX G. ESSENTIAL ELEMENTS FOR DEVELOPMENT OF INLAND ERSP CALCULATOR ARCHITECTURE

This Appendix provides the essential elements a programmer would need to develop the Inland ERSP Calculator architecture and, ultimately, the subsequent web-based tool. The following details of calculator development include:

- 1) Summary of UDIs;
- 2) Summary of essential equations using UDIs;
- 3) Interconnections between UDIs and Inland ERSP Calculator computations;
- 4) Simple pseudocode for Inland ERSP Calculator architecture; and
- 5) Essential look-up tables for inputs to Inland ERSP Calculator.

G.1 User-Defined Inputs (UDIs)

The UDIs for the Inland ERSP Calculator are shown in Table G-1.

Table G-1. Summary of inland ERSP calculator UDIs.

User-Defined Input (UDI)	Type of Input	Description
UDI 1	Scenario Definition	Spill type [Batch or Continuous]
UDI 2	Scenario Definition	Oil spill volume [bbl] ⁷⁶ or OSRO Planning Standard Volume Category [AMPD, MMPD, WCD]
UDI 3	Scenario Definition	Oil type [Group I, II, III, or IV]
UDI 4	Scenario Definition	Waterway classification [Open-Flow, Open-Stagnant, Confined-Flow, Confined-Stagnant]
UDI 5	Encounter Rate	Operating period, <i>OP</i> [hours, h] ⁷⁷
UDI 6	Encounter Rate	Recovery start time after spill, <i>RST_{day}</i> [hours, h]
UDI 7	Encounter Rate	Downtime, <i>DT</i> [hours, h] ⁷⁸
UDI 8	Encounter Rate	Speed (or velocity) of current or advancing skimmer, <i>V</i> [kts]
UDI 9	Encounter Rate	Swath width, <i>SW</i> [feet, ft]
UDI 10	Recovery Factors	Nameplate recovery rate (max. total fluid recovery rate), <i>MTFRR</i> [gal/min]
UDI 11	Recovery Factors	Throughput efficiency, <i>TE</i> [%]
UDI 12	Recovery Factors	Recovery efficiency, <i>RE</i> [%]

⁷⁶ If the hypothetical incident is a Continuous spill, the spill rate [bbl/day] is entered.

⁷⁷ This is the time period each day in which recovery operations could potentially occur, including the time required for “setup” at the site – generally daylight hours. The default value is 12 hours. Longer or shorter times may be appropriate based on geographic location and time of year.

⁷⁸ The Downtime (*DT*) is the amount of time on each day during which no skimming operations occur because response operators are setting up equipment, transiting to new work sites, or transiting to offload recovered fluids. The transit and offload times apply only to Open-Water Recovery. It is assumed that, for Shoreside Recovery operations, additional time is not needed for offloading recovered fluids because continuous storage capability would be available. Only additional time for moving to new locations and setup are assumed for Shoreside Recovery operations. For Open-Water Recovery, the default value for *DT* = 4 hours per day. For Shoreside Recovery, the default value for *DT* = 2 hours per day.



Inland ERSP Operational Environment Calculator Design Document

G.2 Essential Equations

The sequence of equations performed within Inland ERSP Calculator using the UDIs is shown in Table G-2.

Table G-2. Summary and sequence of essential equations within basic use of inland ERSP calculator.

Order of Sequence	Equation Name	Equation
1	Oil/Emulsion Encounter Rate (ER) Computation	$ER_{day} = 63.13 \times SW \times V \times TH_{day}$
2	Emulsion Recovery Rate (ERR) Computation	$ERR_{day} = ER_{day} \times TE$
3	Oil Recovery Rate (ORR) Computation	$ORR_{day} = ERR_{day} \times (1 - PE_{day})$
4	Total Fluid Recovery Rate ($TFRR$) Computation	$TFRR_{day} = \frac{ER_{day} \times TE}{RE}$
5	Rate Water Taken Onboard ($RWTO$) Computation	$RWTO_{day} = (TFRR_{day} - ERR_{day})$
6	Water Retained Rate (WRR) Computation	$WRR_{day} = TFRR_{day} \times (1 - RE_{day})$
7	Computation of Skimming Time in Operating Period (STO_{day})	$STO_{day} = OP - RST_{day} - DT$
8	Total Volume of Oil/Emulsion + Free Water Retained in Operating Period ($VOEW$)	$VOEW_{day} = 1.43 \times (ERR_{day} + WRR_{day}) \times STO_{day}$
9	Total Volume of Free Water Recovered and Retained in Operating Period ($VOFW$)	$VOFW_{day} = 1.43 \times RTWO_{day} \times STO_{day}$
10	Total Volume of Oil/Emulsion Recovered in Operating Period (VOE)	$VOE_{day} = VOEW_{day} - VOFW_{day}$
11	Estimated Recovery System Potential ($ERSP$)	$ERSP_{day} = VOE_{day} \times (1 - PE_{day})$
12	Combining Different Computations for Days 1–3	$ERSP_{scenario} = ERSP_{day1} + ERSP_{day2} + ERSP_{day3}$



G.3 Interconnection between UDIs and Equations in Inland ERSP Calculator

The interconnection between the UDIs and Oil Behavior Module outputs with the equations within the Inland ERSP Calculator to perform the various computations to ultimately provide the estimate of recovery system potential (ERSP) is depicted in Figure G-1.

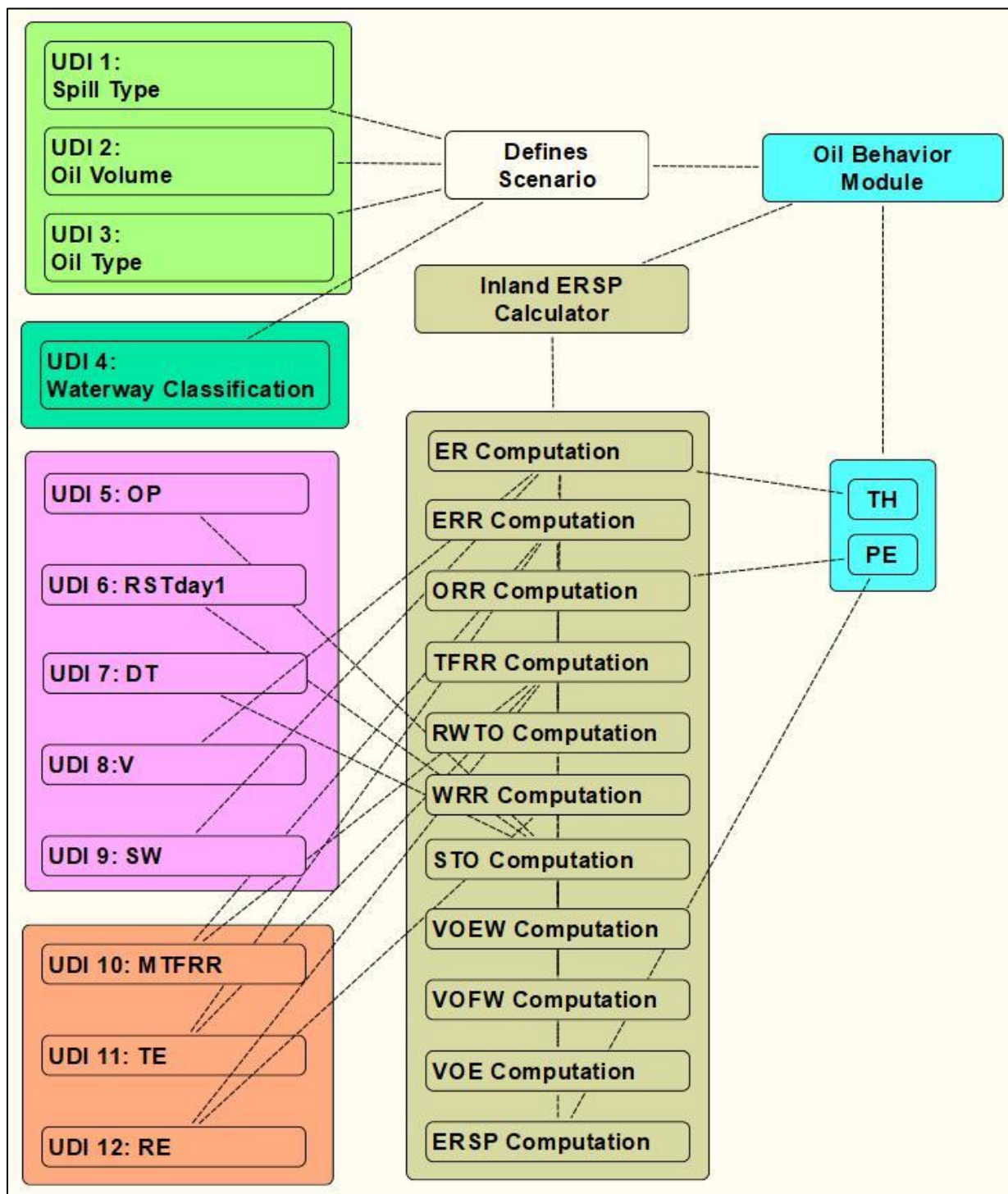


Figure G-1. Connection of UDIs to inland ERSP calculator computations.



G.4 Simple Pseudocode for Inland ERSP Calculator Architecture

This section provides simple pseudocode/steps for the programmer to follow to develop the Inland ERSP Calculator Architecture. It is divided into four sections to outline the specifics of the following:

1. Basic Use of the Inland ERSP Calculator without the use of the Customization Module.
2. Basic Use of the Inland ERSP Calculator with Customization Module Application A.
3. Basic Use of the Inland ERSP Calculator with Customization Module Application B.
4. Basic Use of the Inland ERSP Calculator with Customization Module Application C.

There is repetition in some of the pseudocode outlined in the following subsections in order to be transparent in the steps involved in the distinct uses of the Inland ERSP Calculator. However, during development of the actual calculator, the programmer will not need to repeat these steps and will likely be able to refer to earlier code in the process. Additionally, the steps outlined for each use of the calculator are described as follows: BU for Basic Use, CMA for Customization Module Application A, CMB for Customization Module Application B, and CMC for Customization Module Application C.

Additionally, all of the tables outlined in Appendix G will be provided in a separate Excel spreadsheet as a final deliverable of this project. This spreadsheet will be available to the programmer for reference and can be linked in the code to draw specific values and/or equations during development of the calculator.

G.4.1 Basic Use (BU) of Inland ERSP Calculator without Customization Module

Note: UDI = User-Defined Inputs, as outlined in Table G-1.

Step BU-1: User enters UDI 1–Spill Type

User selects one from drop-down menu:

- Batch.
- Continuous.

Step BU-2: User enters UDI 2–Spill Volume

If UDI 1 = Batch, user enters volume of release value (in bbl)

Context box states:

- AMPD, default = 50 bbl; if else, then enter value (in bbl).
- MMPD, default = 2,500 bbl; if else, then enter value (in bbl).
- WCD (Vessel): Entire contents of oil cargo and/or fuel capacity.
- WCD (Facility): Entire contents of largest storage tank.
- WCD (Pipeline): Based on WCD Pipeline formula.

$$WCD = (h_{\text{shutdown}} \times \frac{bbl}{h}) + bbl_{\text{drainage}}$$

where: h = hours; and bbl_{drainage} = bbl in drainage after shutdown



Inland ERSP Operational Environment Calculator Design Document

- WCD (Crude Oil Unit Train): Greater of 7,143 bbl or 15% total liquid petroleum lading [7,143 bbl = 10 tank cars. Each tank car is assumed to have 714.3 bbl capacity.]

*Note the user would do the calculation for WCD (Pipeline) outside of the calculator.

If UDI 1 = Continuous, user enters release rate (bbl/day) and enters number (#) of days [# = 2 or 3]

Step BU-3: User selects UDI 3–Oil Group

User selects one from drop-down menu:

- Group I.
- Group II.
- Group III.
- Group IV.

Step BU-4: User selects UDI 4–Waterway Classification

User selects one Waterway Flow from drop-down menu:

- Flow/Current.
- Stagnant.

AND

User selects one Waterway Dimension from drop-down menu:

- Confined.
- Open.

Step BU-5: User selects Calculator Mode for Open-Water or Shoreside Recovery

If UDI 4 = Open, user selects one:

- Open-Water Recovery (for open-water advancing skimming systems): mode = open-water
- Shoreside Recovery (for stationary skimming systems): mode = shoreside

If UDI 4 = Confined, user may only select:

- Shoreside Recovery (for stationary skimming systems): mode = shoreside

Note to programmers: UDI 1–6 values will be the same regardless of Open-Water Recovery (mode = open-water) or Shoreside Recovery (mode = shoreside) and equipment type. Autofill those values entered for each piece of equipment being entered.

Step BU-6: User enters UDI 5–Operating Period (OP)

User selects Latitude Zone from drop-down menu:

- Alaska (60°N).
- Northern US (40–50°N).
- Southern US (25–40°N).



Inland ERSP Operational Environment Calculator Design Document

And User selects Season from drop-down menu:

- Spring.
- Summer.
- Autumn.
- Winter.

OP by Latitude Zone/Season as in Table G-3.

Table G-3. Operating period, OP, by latitude zone and season.

Latitude Zone-Season	OP (hours)
Alaska (60° N)-SPRING	15.5
Northern US (40-50° N)-SPRING	14
Southern US (25-40° N)-SPRING	13
Alaska (60° N)-SUMMER	19
Northern US (40-50° N)-SUMMER	15
Southern US (25-40° N)-SUMMER	14
Alaska (60° N)-AUTUMN	15.5
Northern US (40-50° N)-AUTUMN	14
Southern US (25-40° N)-AUTUMN	13
Alaska (60° N)-WINTER	6
Northern US (40-50° N)-WINTER	9
Southern US (25-40° N)-WINTER	10.5

if else, user enters value (in hours)

Hours must not exceed 24.

Step BU-7: UDI 6–Start Time for Recovery Operations (RST)

User selects one Default from drop-down menu:

- 6 hours for Inland Facility in High-Volume Port Area.
- 12 hours for Inland Vessel in High-Volume Port Area.
- 12 hours for Inland Facility.
- 24 hours for Inland Vessel.

if else, user enters value (in hours)

Hours must not exceed 24.

Step BU-8: User enters UDI 7–Downtime (DT)

If mode = open-water

DT = default (4)



if else, user enters value (in hours)

If mode = shoreside

DT = default (2)

if else, user enters value (in hours)

Step BU-9: User enters UDI 8–Velocity (V)

If mode = open-water

V = default (0.75)

if else, user enters value (in hours)

If mode = shoreside and UDI 4 = Flow/Current,

V = default (0.75)

if else, user enters value (in hours)

If mode = shoreside and UDI 4 = Stagnant

V = default (0)

If $V > 0.75$, user message “FAST-BOOMING REQUIRED”

Step BU-10: User enters UDI 9–Workable Swath (SW)

SW = maximum 1,000 ft

Context box states:

- For Open-Water Recovery, length is often based on “standard” for specific types of skimming systems.
- For Shoreside Recovery, length based on practical swath width that could be configured based on equipment used, waterway configuration (especially in confined waterway) and current velocity.
- SW is limited by Maximum Effective Swath (MES) as in Step BU-11

Step BU-11: User enters UD-10 Maximum Total Fluid Recovery Rate (MTFRR)

MES is calculated:

$$MES_{day} = \frac{(MTFRR \times RE)}{(63.13 \times V \times TH_{day} \times TE)}$$

If $MES > SW$ (UDI 9), user message “EXCEEDS MAXIMUM EFFECTIVE SWATH FOR NAMEPLATE RECOVERY AND SCENARIO”

Step BU-12: User enters UDI 11–Throughput Efficiency (TE)

TE = default (75%)

if else, user enters value (in %)

User may select Skimmer Type and Skimmer System from drop-down menus:



Skimmer Type:

- Advancing Skimmer System.
- Stationary/Advancing/Self Propelled Skimmer System.
- Stationary/Non- Advancing Skimmer System.

TE by Skimmer System (in Tables B-2, B-3, and B-4)

Step BU-13: User enters UDI 11–Recovery Efficiency (RE)

User enters value for RE (in %) OR

User selects Skimmer Group from drop-down menu for default value:

- Skimmer Group A.
- Skimmer Group B.
- Skimmer Group C.

Based on Skimmer Group selection and UDI 3 entry, use default RE values = Table G-3.

OR User may select Skimmer Type and Skimmer System from drop-down menus:

Skimmer Type:

- Advancing Skimmer System
- Stationary/Advancing/Self Propelled Skimmer System
- Stationary/Non- Advancing Skimmer System

RE by Skimmer System (in Tables B-2, B-3, and B-4)

Step BU-14: Calculator Determines Categories for Key Tables based on Entries for UDI 1–4

Place spill volume from UDI 2 into Oil Behavior Module spill volume categories.

If UDI 2 $\leq 1,000$ bbl: use AMPD for PE_{day} and TH_{day} .

If UDI 2 = $1,000 < 10,000$ bbl: use MMPD for PE_{day} and TH_{day} .

If UDI 2 $\geq 10,000$: use WCD scenarios for PE_{day} and TH_{day} .

If UDI 3 = Group I or Group II, then $PE_{day} = 0$

If UDI 3 = Group III or Group IV, read PE_{day} [%] for Day 1, Day 2 and Day 3 from Table G-4

Note to programmers: disregard entries of N/A in Table G-4. There is no recoverable oil on the water surface at the start of that day, so PE_{day} is void. $TH_{day} = 0$, so $ER_{day} = 0$. If it is a continuous spill and days = 3, use PE_{day1} and TH_{day1} for each daily calculation. If it is a continuous spill and days = 2, use PE_{day1} and TH_{day1} for days 1 and 2, and use PE_{day2} and TH_{day2} for day 3.

Read TH_{day} [inches] for Day 1, Day 2, and Day 3 from Table G-6.

Step BU-15: Calculator Sets up to Compute Total ERSP

If UDI 4 = Open, compute Total Open-Water ERSP OR



Inland ERSP Operational Environment Calculator Design Document

If UDI 4 = Open, compute Total Shoreside ERSP

If UDI 4 = Confined, compute Total Shoreside ERSP

Note to programmers: Equations same for Open-Water ERSP and Shoreside ERSP. Computed separately for each equipment type entered for UDI 1–12.

Note to programmers: ERSP is calculated separately for each Day (Day 1, Day 2, and Day 3). The resulting ERSP for each Day is added together at the end. Steps BU-16 to BU-27 are repeated for each of three days. In Step BU-28, the results are added together.

Step BU-16: Calculator Computes Oil/Emulsion Encounter Rate (ER) for each Day (Day 1–3)

$$ER_{day} = 63.13 \times SW \times V \times TH_{day}$$

Step BU-17: Calculator Computes Compute Maximum Effective Swath (MES) for each day (Day 1–3)

$$MES_{day} = \frac{(MTFRR \cdot RE)}{(63.13 \times V \times TH_{day} \times TE)}$$

Step BU-18: Calculator Computes Emulsion Recovery Rate (ERR) for each day (Day 1–3)

$$ERR_{day} = ER_{day} \times TE$$

Step BU-19: Calculator Computes Oil Recovery Rate (ORR) for each day (Day 1–3)

$$ORR_{day} = ERR_{day} \times (1 - PE_{day})$$

Step BU-20: Calculator Computes Total Fluid Recovery Rate (TFRR) for each day (Day 1–3)

$$TFRR_{day} = \frac{ER_{day} \times TE}{RE}$$

Step BU-21: Calculator Computes Rate Water Taken Onboard (RWTO) for each day (Day 1–3)

$$RWTO_{day} = (TFRR_{day} - ERR_{day})$$

Step BU-22: Calculator Computes Water Retained Rate (WRR) for each day (Day 1–3)

$$WRR_{day} = TFRR_{day} \times (1 - RE_{day})$$

Step BU-23: Calculator Computes Skimming Time in Operating Period (STO_{day}) for each day (Day 1–3)

$$STO_{day} = OP - RST_{day1} - DT$$

If Day 2 or Day 3, RST = 0.



Inland ERSP Operational Environment Calculator Design Document

Step BU-24: Calculator Computes Total Volume of Oil/Emulsion + Free Water Retained in Operating Period (VOEW) for each day (Day 1–3)

$$VOEW_{day} = 1.43 \times (ERR_{day} + WRR_{day}) \times STO_{day}$$

Step BU-25: Calculator Computes Total Volume of Free Water Recovered and Retained in Operating Period (VOFW) for each day (Day 1–3)

$$VOFW_{day} = 1.43 \times WRR_{day} \times STO_{day}$$

Step BU-26: Calculator Computes Total Volume of Oil/Emulsion Recovered in Operating Period (VOE) for each day (Day 1–3)

$$VOE_{day} = VOEW_{day} - VOFW_{day}$$

Step BU-27: Calculator Computes Estimated Recovery System Potential (ERSP) for each day (Day 1–3)

$$ERSP_{day} = VOE_{day} \times (1 - PE_{day})$$

Step BU-28: Calculator Combines Different ERSP Computations for Days 1-3 to Derive ERSP (total recovery) for the scenario

$$ERSP_{scenario} = ERSP_{day1} + ERSP_{day2} + ERSP_{day3}$$

Step BU-29: Report Results

Report Total $ERSP_{scenario}$

If UDI 4 = Confined, report Total Shoreside $ERSP_{scenario}$

If UDI 4 = Open and mode = open water, user must enter new UDIs to repeat for Total Shoreside $ERSP_{scenario}$ OR

If UDI 4 = Open and mode = shoreside, user must enter new UDIs to repeat for Total Open-Water $ERSP_{scenario}$

G.4.2 Basic Use of Inland ERSP Calculator with Customization Module Application A

Note to programmers: Steps CMA-1 to CMA-13 are identical to Steps BU-1 to BU-13, and are repeated here. Customization Module Application A (CMA) allows the user to specify custom proportions of gravel- and wetland-category shoreline types, which means the Calculator selects values from different tables and applies a proportion to the two values. Step CMA-0 is added at beginning as user needs to define proportions.

Step CMA-0: User enters Custom Shoreline Proportions (UDI CMA 1)

User enters proportion [%] for wetland-category shoreline AND

Calculator defines proportion [%] gravel-category shoreline as = 100% - wetland-category.



Step CMA-1: User enters UDI 1–Spill Type

User selects one from drop-down menu:

- Batch.
- Continuous.

Step CMA-2: User enters UDI 2–Spill Volume

If UDI 1 = Batch, user enters volume of release value (in bbl)

Context box states:

- AMPD, default = 50 bbl; if else, then enter value (in bbl).
- MMPD, default = 2,500 bbl; if else, then enter value (in bbl).
- WCD (Vessel): Entire contents of oil cargo and/or fuel capacity.
- WCD (Facility): Entire contents of largest storage tank.
- WCD (Pipeline): Based on WCD Pipeline formula.

$$WCD = (h_{shutdown} \times \frac{bbl}{h}) + bbl_{drainage}$$

where: h = hours; and $bbl_{drainage}$ = bbl in drainage after shutdown

- WCD (Crude Oil Unit Train): Greater of 7,143 bbl or 15% total liquid petroleum lading [7,143 bbl = 10 tank cars. Each tank car is assumed to have 714.3 bbl capacity.]

*Note the user would do the calculation for WCD (Pipeline) outside of the calculator.

If UDI 1 = Continuous, user enters release rate (bbl/day) and enters number (#) of days [# = 2 or 3]

Step CMA-3: User selects UDI 3–Oil Group

User selects one from drop-down menu:

- Group I.
- Group II.
- Group III.
- Group IV.

Step CMA-4: User selects UDI 4–Waterway Classification

User selects one Waterway Flow from drop-down menu:

- Flow/Current.
- Stagnant.

AND

User selects one Waterway Dimension from drop-down menu:



- Confined.
- Open.

Step CMA-5: User selects Calculator Mode for Open-Water or Shoreside Recovery

If UDI 4 = Open, user selects one:

- Open-Water Recovery (for open-water advancing skimming systems): mode = open-water
- Shoreside Recovery (for stationary skimming systems): mode = shoreside

If UDI 4 = Confined, user may only select:

- Shoreside Recovery (for stationary skimming systems): mode = shoreside

Note to programmers: UDI 1–6 values will be the same regardless of Open-Water Recovery (mode = open-water) or Shoreside Recovery (mode = shoreside) and equipment type. Autofill those values entered for each piece of equipment being entered.

Step CMA-6: User enters UDI 5–Operating Period (OP)

User selects Latitude Zone from drop-down menu:

- Alaska (60°N).
- Northern US (40–50°N).
- Southern US (25–40°N).

And User selects Season from drop-down menu:

- Spring.
- Summer.
- Autumn.
- Winter.

OP by Latitude Zone/Season as in Table G-3.

if else, user enters value (in hours)

Hours must not exceed 24.

Step CMA-7: UDI 6–Start Time for Recovery Operations (RST)

User selects one Default from drop-down menu:

- 6 hours for Inland Facility in High-Volume Port Area.
- 12 hours for Inland Vessel in High-Volume Port Area.
- 12 hours for Inland Facility.
- 24 hours for Inland Vessel.

if else, user enters value (in hours)

Hours must not exceed 24.



Step CMA-8: User enters UDI 7–Downtime (DT)

If mode = open-water

DT = default (4)

if else, user enters value (in hours)

If mode = shoreside

DT = default (2)

if else, user enters value (in hours)

Step CMA-9: User enters UDI 8–Velocity (V)

If mode = open-water

V = default (0.75)

if else, user enters value (in hours)

If mode = shoreside and UDI 4 = Flow/Current,

V = default (0.75)

if else, user enters value (in hours)

If mode = shoreside and UDI 4 = Stagnant

V = default (0)

If $V > 0.75$, user message “FAST-BOOMING REQUIRED”

Step CMA-10: User enters UDI 9–Workable Swath (SW)

SW = maximum 1,000 ft

Context box states:

- For Open-Water Recovery, length is often based on “standard” for specific types of skimming systems.
- For Shoreside Recovery, length based on practical swath width that could be configured based on equipment used, waterway configuration (especially in confined waterway) and current velocity.
- SW is limited by Maximum Effective Swath (MES) as in Step CMA-11

Step CMA-11: User enters UD-10 Maximum Total Fluid Recovery Rate (MTFRR)

MES is calculated:

$$MES_{day} = \frac{(MTFRR \times RE)}{(63.13 \times V \times TH_{day} \times TE)}$$

If $MES > SW$ (UDI 9), user message “EXCEEDS MAXIMUM EFFECTIVE SWATH FOR NAMEPLATE RECOVERY AND SCENARIO”

Step CMA-12: User enters UDI 11–Throughput Efficiency (TE)



TE = default (75%)

if else, user enters value (in %)

User may select Skimmer Type and Skimmer System from drop-down menus:

Skimmer Type:

- Advancing Skimmer System.
- Stationary/Advancing/Self Propelled Skimmer System.
- Stationary/Non- Advancing Skimmer System.

TE by Skimmer System (in Tables B-2, B-3, and B-4)

Step CMA-13: User enters UDI 11–Recovery Efficiency (RE)

User enters value for RE (in %) OR

User selects Skimmer Group from drop-down menu for default value:

- Skimmer Group A.
- Skimmer Group B.
- Skimmer Group C.

Based on Skimmer Group selection and UDI 3 entry, use default RE values = Table G-3.

OR User may select Skimmer Type and Skimmer System from drop-down menus:

Skimmer Type:

- Advancing Skimmer System.
- Stationary/Advancing/Self Propelled Skimmer System.
- Stationary/Non- Advancing Skimmer System.

RE by Skimmer System (in Tables B-2, B-3, and B-4)

Step CMA-14: Calculator Determines Categories for Key Tables based on Entries for UDI 1–4

Place spill volume from UDI 2 into Oil Behavior Module spill volume categories.

If UDI 2 $\leq 1,000$ bbl: use AMPD for PE_{day} and TH_{day} .

If UDI 2 = $1,000 < 10,000$ bbl: use MMPD for PE_{day} and TH_{day} .

If UDI 2 $\geq 10,000$: use WCD scenarios for PE_{day} and TH_{day} .

Step CMA-15: Calculator Retrieves PE Values Based on UDI 1–4 and UDI CMA 1 (Step CMA-0)

If UDI 3 = Group I or Group II, then $PE_{day} = 0$

If UDI 3 = Group III or Group IV, read $PE_{day}(g)$ [%] and $PE_{day}(w)$ [%] from Table G-5 and computes with P_w = UDI CMA 1 and $P_g = 100\% - P_w$ for Day 1, Day 2, and Day 3:

$$PE_{day} [Oil, Vol, Water] = (P_w \times PE_{day}(w) [Oil, Vol, w]) + (P_g \times PE_{day}(g) [Oil, Vol, g])$$



Step CMA-15: Calculator Retrieves TH Values Based on UDI 1–4 and (UDI CMA 1)

Read $TH_{day}(g)$ [inches] and $TH_{day}(w)$ [inches] from Table G-7 and computes with $P_w = \text{UDI CMA 1}$ and $P_g = 100\% - P_w$ for Day 1, Day 2, and Day 3:

$$TH_h[Oil, Vol, Water] = (P_w \times TH_h(w)[Oil, Vol, w]) + (P_g \times TH_h(g)[Oil, Vol, g])$$

Step CMA-16: Calculator Sets up to Compute Total ERSP

If UDI 4 = Open, compute Total Open-Water ERSP OR

If UDI 4 = Open, compute Total Shoreside ERSP

If UDI 4 = Confined, compute Total Shoreside ERSP

Note to programmers: Equations same for Open-Water ERSP and Shoreside ERSP. Computed separately for each equipment type entered for UDI 1–11.

Note to programmers: ERSP is calculated separately for each Day (Day 1, Day 2, and Day 3). The resulting ERSP for each Day is added together at the end. Steps CMA-17 to CMA-28 are repeated for each of three days. In Step CMA-30, the results are added together.

Step CMA-17: Calculator Computes Oil/Emulsion Encounter Rate (ER) for each Day (Day 1–3)

Apply TH_{day} from Step CMA-15:

$$ER_{day} = 63.13 \times SW \times V \times TH_{day}$$

Step CMA-18: Calculator Computes Emulsion Recovery Rate (ERR) for each day (Day 1–3)

$$ERR_{day} = ER_{day} \times TE$$

Step CMA-19: Calculator Computes Oil Recovery Rate (ORR) for each day (Day 1–3)

Apply PE_{day} from Step CMA-14:

$$ORR_{day} = ERR_{day} \times (1 - PE_{day})$$

Step CMA-20: Calculator Computes Total Fluid Recovery Rate ($TFRR$) for each day (Day 1–3)

$$TFRR_{day} = \frac{ER_{day} \times TE}{RE}$$

Step CMA-21: Calculator Computes Rate Water Taken Onboard ($RWTO$) for each day (Day 1–3)

$$RWTO_{day} = (TFRR_{day} - ERR_{day})$$

Step CMA-22: Calculator Computes Water Retained Rate (WRR) for each day (Day 1–3)

$$WRR_{day} = TFRR_{day} \times (1 - RE_{day})$$



Inland ERSP Operational Environment Calculator Design Document

Step CMA-23: Calculator Computes Skimming Time in Operating Period (STO_{day}) for each day (Day 1–3)

$$STO_{day} = OP - RST_{day1} - DT$$

If Day 2 or Day 3, $RST = 0$.

Step CMA-24: Calculator Computes Total Volume of Oil/Emulsion + Free Water Retained in Operating Period ($VOEW$) for each day (Day 1–3)

$$VOEW_{day} = 1.43 \times (ER_{day} + WRR_{day}) \times STO_{day}$$

Step CMA-25: Calculator Computes Total Volume of Free Water Recovered and Retained in Operating Period ($VOFW$) for each day (Day 1–3)

$$VOFW_{day} = 1.43 \times WRR_{day} \times STO_{day}$$

Step CMA-26: Calculator Computes Total Volume of Oil/Emulsion Recovered in Operating Period (VOE) for each day (Day 1–3)

$$VOE_{day} = VOEW_{day} - VOFW_{day}$$

Step CMA-27: Calculator Computes Estimated Recovery System Potential ($ERSP$) for each day (Day 1–3)

Apply PE_{day} from Step CMA-14:

$$ERSP_{day} = VOE_{day} \times (1 - PE_{day})$$

Step CMA-28: Calculator Combines different ERSP computations for Days 1-3 to derive ERSP (total recovery) for the scenario

$$ERSP_{scenario} = ERSP_{day1} + ERSP_{day2} + ERSP_{day3}$$

Step CMA-29: Report Results

Report Total $ERSP_{scenario}$

If UDI 4 = Confined, report Total Shoreside $ERSP_{scenario}$

If UDI 4 = Open and mode=open water, user must enter new UDIs to repeat for Total Shoreside $ERSP_{scenario}$
OR

If UDI 4 = Open and mode=shoreside, user must enter new UDIs to repeat for Total Open-Water $ERSP_{scenario}$

G.4.3 Basic Use of Inland ERSP Calculator with Customization Module Application B

Note to programmers: for the Customization Module Application B, Steps CMB-1 to CMB-13 are identical to Steps BU-1 to BU-12, and are repeated here. In Steps CMB-14 and CMB-15, the values are based on the



user-specified hour (h). Customization Module Application B allows the user to specify a specific hour (h). Step CMB-0 is added at the beginning as the user needs to define hour (h).

The computations are conducted in the same manner as in the Basic Use of the Inland ERSP Calculator except that the inputs for PE and TH are derived from solving for equations in Table G-10 and Table G-11, respectively, with default proportions for gravel- and wetland-category proportions (P_g and P_w). If the user also opts to simultaneously apply Customization Module Application A, the calculations are conducted based on the specified proportions (P_g and P_w). The user specifies these proportions in Step 0, if applicable.

The calculation is only conducted for one Day. If the specified hour (h) is ≤ 24 hours, the Day 1 calculation is conducted. If h is > 24 hours, the Day 2 calculation is conducted.

Step CMB-0: User enters Specified Hour (UDI CMB 1) and Custom Shoreline Proportions (UDI CMA 1)

User enters specified hour (h) after spill onset with $h < 73$ hours (UDI CMB 1).

User selects Shoreline Proportion (UDI CMA 1):

- Default values, OR
- User enters proportion [%] for wetland-category shoreline, AND
- Calculator defines proportion [%] gravel-category shoreline as = 100% - wetland-category.

Step CMB-1: User enters UDI 1–Spill Type

User selects one from drop-down menu:

- Batch.
- Continuous.

Step CMB-2: User enters UDI 2–Spill Volume

If UDI 1 = Batch, user enters volume of release value (in bbl)

Context box states:

- AMPD, default = 50 bbl; if else, then enter value (in bbl).
- MMPD, default = 2,500 bbl; if else, then enter value (in bbl).
- WCD (Vessel): Entire contents of oil cargo and/or fuel capacity.
- WCD (Facility): Entire contents of largest storage tank.
- WCD (Pipeline): Based on WCD Pipeline formula.

$$WCD = (h_{\text{shutdown}} \times \frac{bbl}{h}) + bbl_{\text{drainage}}$$

where: h = hours; and bbl_{drainage} = bbl in drainage after shutdown

- WCD (Crude Oil Unit Train): Greater of 7,143 bbl or 15% total liquid petroleum lading [7,143 bbl = 10 tank cars. Each tank car is assumed to have 714.3 bbl capacity.]

*Note the user would do the calculation for WCD (Pipeline) outside of the calculator.



Inland ERSP Operational Environment Calculator Design Document

If UDI 1 = Continuous, user enters release rate (bbl/day) and enters number (#) of days [# = 2 or 3]

Step CMB-3: User selects UDI 3–Oil Group

User selects one from drop-down menu:

- Group I.
- Group II.
- Group III.
- Group IV.

Step CMB-4: User selects UDI 4–Waterway Classification

User selects one Waterway Flow from drop-down menu:

- Flow/Current.
- Stagnant.

AND

User selects one Waterway Dimension from drop-down menu:

- Confined.
- Open.

Step CMB-5: User selects Calculator Mode for Open-Water or Shoreside Recovery

If UDI 4 = Open, user selects one:

Open-Water Recovery (for open-water advancing skimming systems): mode = open-water

Shoreside Recovery (for stationary skimming systems): mode = shoreside

If UDI 4 = Confined, user may only select:

Shoreside Recovery (for stationary skimming systems): mode = shoreside

Note to programmers: UDI 1–6 values will be the same regardless of Open-Water Recovery (mode = open-water) or Shoreside Recovery (mode = shoreside) and equipment type. Autofill those values entered for each piece of equipment being entered.

Step CMB-6: User enters UDI 5–Operating Period (OP)

User selects Latitude Zone from drop-down menu:

- Alaska (60°N).
- Northern US (40–50°N).
- Southern US (25–40°N).

And User selects Season from drop-down menu:

- Spring.

- Summer.
- Autumn.
- Winter.

OP by Latitude Zone/Season as in Table G-3.

if else, user enters value (in hours)

Hours must not exceed 24.

Step CMB-7: UDI 6–Start Time for Recovery Operations (RST)

User selects one Default from drop-down menu:

- 6 hours for Inland Facility in High-Volume Port Area.
- 12 hours for Inland Vessel in High-Volume Port Area.
- 12 hours for Inland Facility.
- 24 hours for Inland Vessel.

if else, user enters value (in hours)

Hours must not exceed 24.

Step CMB-8: User enters UDI 7–Downtime (DT)

If mode = open-water

DT = default (4)

if else, user enters value (in hours)

If mode = shoreside

DT = default (2)

if else, user enters value (in hours)

Step CMB-9: User enters UDI 8–Velocity (V)

If mode = open-water

V = default (0.75)

if else, user enters value (in hours)

If mode = shoreside and UDI 4 = Flow/Current,

V = default (0.75)

if else, user enters value (in hours)

If mode = shoreside and UDI 4 = Stagnant

V = default (0)

If $V > 0.75$, user message “FAST-BOOMING REQUIRED”

Step CMB-10: User enters UDI 9–Workable Swath (SW)

SW = maximum 1,000 ft



Context box states:

- For Open-Water Recovery, length is often based on “standard” for specific types of skimming systems.
- For Shoreside Recovery, length based on practical swath width that could be configured based on equipment used, waterway configuration (especially in confined waterway) and current velocity.
- SW is limited by Maximum Effective Swath (MES) as in Step CMB-11.

Step CMB-11: User enters UD-10 Maximum Total Fluid Recovery Rate (MTFRR)

MES is calculated:

$$MES_{day} = \frac{(MTFRR \times RE)}{(63.13 \times V \times TH_{day} \times TE)}$$

If $MES > SW$ (UDI 9), user message “EXCEEDS MAXIMUM EFFECTIVE SWATH FOR NAMEPLATE RECOVERY AND SCENARIO”

Step CMB-12: User enters UDI 11–Throughput Efficiency (TE)

TE = default (75%)

if else, user enters value (in %)

User may select Skimmer Type and Skimmer System from drop-down menus:

Skimmer Type:

- Advancing Skimmer System.
- Stationary/Advancing/Self Propelled Skimmer System.
- Stationary/Non- Advancing Skimmer System.

TE by Skimmer System (in Tables B-2, B-3, and B-4)

Step CMB-13: User enters UDI 11–Recovery Efficiency (RE)

User enters value for RE (in %) OR

User selects Skimmer Group from drop-down menu for default value:

- Skimmer Group A.
- Skimmer Group B.
- Skimmer Group C.

Based on Skimmer Group selection and UDI 3 entry, use default RE values = Table G-3.

OR User may select Skimmer Type and Skimmer System from drop-down menus:

Skimmer Type:

- Advancing Skimmer System.
- Stationary/Advancing/Self Propelled Skimmer System.



- Stationary/Non- Advancing Skimmer System.

RE by Skimmer System (in Tables B-2, B-3, and B-4)

Step CMB-14: Calculator Determines Categories for Key Tables based on Entries for UDI 1–4

Place spill volume from UDI 2 into Oil Behavior Module spill volume categories.

If UDI 2 $\leq 1,000$ bbl: use AMPD for PE_h and TH_h .

If UDI 2 = $1,000 < 10,000$ bbl: use MMPD for PE_h and TH_h .

If UDI 2 $\geq 10,000$: use WCD scenarios for PE_h and TH_h .

Step CMB-15: Calculator Retrieves PE Values Based on UDI 1–4 and (UDI CMA 1)

If UDI 3 = Group I or Group II, then $PE_h = 0$

If UDI 3 = Group III or Group IV AND

If user selected default proportions:

If UDI 4 = Open, default $P_w = 0.25$ and default $P_g = 0.75$

If UDI 4 = Confined, default $P_w = 0.75$ and default $P_g = 0.25$

If user specified UDI CMA 1, apply $P_w = \text{UDI CMA-1}$ and $P_g = 100\% - P_w$

Calculator retrieves Percent Emulsion, $PE_h(g)$ [%] and $PE_h(w)$ [%] by solving equations in Table G-10 and applying default P_w and P_g or calculated P_w and P_g :

$$PE_{day}[Oil, Vol, Water] = P_w \times PE_h(w)[Oil, Vol, w] + (P_g \times PE_h(g)[Oil, Vol, g])$$

Step CMB-16: Calculator Retrieves TH Values Based on UDI 1–4 and (UDI CMA-1)

If user selected default proportions:

If UDI 4 = Open, default $P_w = 0.25$ and default $P_g = 0.75$

If UDI 4 = Confined, default $P_w = 0.75$ and default $P_g = 0.25$

If user specified UDI CMA 1, apply $P_w = \text{UDI CMA-1}$ and $P_g = 100\% - P_w$

Calculator retrieves Thickness, $TH_h(g)$ and $TH_h(w)$ [%] by solving equations in Table G-11 and applying default P_w and P_g or calculated P_w and P_g :

$$TH_{day}[Oil, Vol, Water] = (P_w \times TH_h(w)[Oil, Vol, w]) + (P_g \times TH_h(g)[Oil, Vol, g])$$

Step CMB-17: Calculator Sets up to Compute Total ERSP

If UDI 4 = Open, compute Total Open-Water ERSP OR

If UDI 4 = Open, compute Total Shoreside ERSP

If UDI 4 = Confined, compute Total Shoreside ERSP

Note to programmers: Equations same for Open-Water ERSP and Shoreside ERSP. Computed separately for each equipment type entered for UDI 1–12.



Step CMB-18: Calculator Computes Oil/Emulsion Encounter Rate (ER) for one day

Apply TH_{day} from Step CMB-15:

$$ER_{day} = 63.13 \times SW \times V \times TH_{day}$$

Step CMB-19: Calculator Computes Emulsion Recovery Rate (ERR) for one day

$$ERR_{day} = ER_{day} \times TE$$

Step CMB-20: Calculator Computes Oil Recovery Rate (ORR) for one day

Apply PE_{day} from Step CMB-14:

$$ORR_{day} = ERR_{day} \times (1 - PE_{day})$$

Step CMB-21: Calculator Computes Total Fluid Recovery Rate (TFRR) for one day

$$TFRR_{day} = \frac{ER_{day} \times TE}{RE}$$

Step CMB-22: Calculator Computes Rate Water Taken Onboard (RWTO) for one day

$$RWTO_{day} = (TFRR_{day} - ERR_{day})$$

Step CMB-23: Calculator Computes Water Retained Rate (WRR) for one day

$$WRR_{day} = TFRR_{day} \times (1 - RE_{day})$$

Step CMB-24: Calculator Computes Skimming Time in Operating Period (STO_{day}) for one day

$$STO_{day} = OP - RST_{day1} - DT$$

If Day 2 or Day 3, RST = 0.

If $h(TH_0)$ (as per Table E-4) is >24 and <48, DT = 0 on Day 2. If $h(TH_0)$ (as per Table E-4) is >48 and <72, DT = 0 on Day 3.

Step CMB-25: Calculator Computes Total Volume of Oil/Emulsion + Free Water Retained in Operating Period (VOEW) for one day

$$VOEW_{day} = 1.43 \times (ERR_{day} + WRR_{day}) \times STO_{day}$$

Step CMB-26: Calculator Computes Total Volume of Free Water Recovered and Retained in Operating Period (VOFW) for one day

$$VOFW_{day} = 1.43 \times WRR_{day} \times STO_{day}$$



Step CMB-27: Calculator Computes Total Volume of Oil/Emulsion Recovered in Operating Period (VOE) for one day

$$VOE_{day} = VOEW_{day} - VOFW_{day}$$

Step CMB-28: Calculator Computes Estimated Recovery System Potential (ERSP) for one day

Apply PE_{day} from Step CMB-14:

$$ERSP_{day} = VOE_{day} \times (1 - PE_{day})$$

Step CMB-29: Report Results

Report ERSP for day.

If UDI 4 = Confined, report Shoreside $ERSP_{scenario}$

If UDI 4 = Open and mode = open water, user must enter new UDIs to repeat for Shoreside $ERSP_{scenario}$ OR

If UDI 4 = Open and mode = shoreside, user must enter new UDIs to repeat for Open-Water $ERSP_{scenario}$

G.4.4 Customization Module Application C

Note to programmers: This application does not require any computations within the Inland ERSP Calculator. The application merely requires a computation of two values in Table G-9 through Table G-11 based on the proportions of gravel- and wetland-category shorelines with a specific hour (h) value to derive the Percent Recoverable Oil, PRO [%]. Table G-9 through Table G-11 provide hourly values for Percent Recoverable Oil, PRO [%] presented in decimal format for Days 1 through 3. The user specifies the hour and proportions in Step CMC-0.

The output from solving for the two weighted values from Table G-9 through Table G-11 is in percent (%). The percent value is also applied to the volume entered as UDI 2.

The calculation is only conducted for one Day.

Step CMC-0: User enters Specified Hour (UDI CMC 1) and Custom Shoreline Proportions (UDI CMA 1)

User enters specified hour (h) after spill onset with $h < 73$ hours (UDI CMC 1).

User selects Shoreline Proportion (UDI CMA 1):

- Default values, OR
- User enters proportion [%] for wetland-category shoreline, AND
- Calculator defines proportion [%] gravel-category shoreline as = 100% - wetland-category.

Step CMC-1: Calculator Computes Percent Recoverable Oil, PRO , at Specified Hour

The Calculator solves equations for Percent Recoverable Oil (PRO_h) [%] at hour, h (UDI CMC 1) based on proportions specified by UDI CMA 1 or default values:

- If UDI 4 = Open, default $P_w = 0.25$ and default $P_g = 0.75$
- If UDI 4 = Confined, default $P_w = 0.75$ and default $P_g = 0.25$



Solve for Equations in Table G-9 based on specified hour (h) and proportions (P_w and P_g):

$$PRO_h[Oil, Vol, Water] = (P_w \times PRO_h[Oil, Vol, w]) + (P_g \times PRO_h[Oil, Vol, g])$$

Report computed PRO_h

Multiply PRO_h by Volume (UDI 2)

Report result (volume remaining)

G.5 Essential Lookup Tables for Inputs to Inland ERSP Calculator

This section provides the default data values for several components of the Inland ERSP Calculator.

G.5.1 User-Defined Recovery Efficiency, RE (UDI 11)

Recovery Efficiency, RE , is the percentage of oil/emulsion recovered compared to the total fluids recovered. This value should also be in the listing of equipment (based on ASTM F631–15, *Standard Guide for Collecting Skimmer Performance Data in Controlled Environments*). Appendix C presents some examples of values for RE . Note that “percentage” is entered as decimals in the computation within the Inland ERSP Calculator.

This value is based on manufacturer information, if available. Table G-4 shows the default values based on Oil Group (viscosity characteristics) and equipment type.

Table G-4. Representative nominal percent values for Recovery Efficiency, RE .

Oil Type	Advancing Skimmer Type		
	Skimmer Group A	Skimmer Group B	Skimmer Group C
	Oleophilic	Paddle Belt, Fixed & Moving Submersion Plane	Air Conveyor, Weir, Direct Suction & Vortex
Oil Group I	0.88	0.85	0.65
Oil Group II	0.87	0.84	0.63
Oil Group III	0.90	0.73	0.47
Oil Group IV	0.82	0.55	0.22

G.5.2 Default Percent Emulsion, PE

Table G-5 shows the default values for Percent Emulsion, PE_{day} . The values differ by Waterway Type, Oil Group, and Day. For Group I and Group II oils, the PE_{day} is 0, as there is no emulsification. The designation “N/A” indicates that there is no recoverable oil on the water surface. (This value is designated as “N/A” opposed to 0%, because the latter would imply that there is no emulsification in the existing oil rather than there is no existing oil.) With surface thickness, TH_{day} , equaling 0, the encounter rate is also 0, and there is no recovery possible. Note that “percentage” is entered as decimals in the computation within the Inland ERSP Calculator.



Inland ERSP Operational Environment Calculator Design Document

Table G-5. Default percent emulsion for Days 1–3.⁷⁹

Scenario	Default Percent Emulsion		
	Day 1	Day 2	Day 3
GROUP I-AMPD-CONFINED-FLOW	0.000000	0.000000	0.000000
GROUP I-AMPD-CONFINED-STAGNANT	0.000000	0.000000	0.000000
GROUP I-AMPD-OPEN-FLOW	0.000000	0.000000	0.000000
GROUP I-AMPD-OPEN-STAGNANT	0.000000	0.000000	0.000000
GROUP II-AMPD-CONFINED-FLOW	0.000000	0.000000	0.000000
GROUP II-AMPD-CONFINED-STAGNANT	0.000000	0.000000	0.000000
GROUP II-AMPD-OPEN-FLOW	0.000000	0.000000	0.000000
GROUP II-AMPD-OPEN-STAGNANT	0.000000	0.000000	0.000000
GROUP III-AMPD-CONFINED-FLOW	0.163472	0.373308	0.500000
GROUP III-AMPD-CONFINED-STAGNANT	0.415015	1.000000	1.000000
GROUP III-AMPD-OPEN-FLOW	0.334720	0.500000	0.500000
GROUP III-AMPD-OPEN-STAGNANT	0.329200	0.551692	0.579900
GROUP III-MMPD-CONFINED-FLOW	0.165188	0.329241	0.447820
GROUP III-MMPD-CONFINED-STAGNANT	0.368411	1.000000	1.000000
GROUP III-MMPD-OPEN-FLOW	0.202432	0.331559	0.343438
GROUP III-MMPD-OPEN-STAGNANT	0.329648	0.550433	0.582508
GROUP III-WCD-CONFINED-FLOW	0.130076	0.269210	0.290563
GROUP III-WCD-CONFINED-STAGNANT	0.261637	0.538000	0.581096
GROUP III-WCD-OPEN-FLOW	0.130823	0.269027	0.297039
GROUP III-WCD-OPEN-STAGNANT	0.261637	0.538042	0.581104
GROUP II-MMPD-CONFINED-FLOW	0.000000	0.000000	0.000000
GROUP II-MMPD-CONFINED-STAGNANT	0.000000	0.000000	0.000000
GROUP II-MMPD-OPEN-FLOW	0.000000	0.000000	0.000000
GROUP II-MMPD-OPEN-STAGNANT	0.000000	0.000000	0.000000
GROUP II-WCD-CONFINED-FLOW	0.000000	0.000000	0.000000
GROUP II-WCD-CONFINED-STAGNANT	0.000000	0.000000	0.000000
GROUP II-WCD-OPEN-FLOW	0.000000	0.000000	0.000000
GROUP II-WCD-OPEN-STAGNANT	0.000000	0.000000	0.000000
GROUP I-MMPD-CONFINED-FLOW	0.000000	0.000000	0.000000
GROUP I-MMPD-CONFINED-STAGNANT	0.000000	0.000000	0.000000
GROUP I-MMPD-OPEN-FLOW	0.000000	0.000000	0.000000
GROUP I-MMPD-OPEN-STAGNANT	0.000000	0.000000	0.000000
GROUP IV-AMPD-CONFINED-FLOW	0.137948	0.311645	0.500000
GROUP IV-AMPD-CONFINED-STAGNANT	0.364319	1.000000	1.000000
GROUP IV-AMPD-OPEN-FLOW	0.290759	0.500000	0.500000
GROUP IV-AMPD-OPEN-STAGNANT	0.276367	0.306296	0.311363
GROUP IV-MMPD-CONFINED-FLOW	0.137538	0.248232	0.413583
GROUP IV-MMPD-CONFINED-STAGNANT	0.326507	1.000000	1.000000

⁷⁹ If designated as “N/A,” there is no longer recoverable oil on the water surface at the start of this day, so disregard.



Inland ERSP Operational Environment Calculator Design Document

Table G-5. Default percent emulsion for Days 1–3 (Cont'd).

Scenario	Default Percent Emulsion		
	Day 1	Day 2	Day 3
GROUP IV-MMPD-OPEN-FLOW	0.184057	0.236963	0.240920
GROUP IV-MMPD-OPEN-STAGNANT	0.274767	0.298554	0.300771
GROUP IV-WCD-CONFINED-FLOW	0.137454	0.149292	0.149983
GROUP IV-WCD-CONFINED-STAGNANT	0.274519	0.298571	0.299979
GROUP IV-WCD-OPEN-FLOW	0.137259	0.149283	0.160926
GROUP IV-WCD-OPEN-STAGNANT	0.274519	0.298567	0.299979
GROUP I-WCD-CONFINED-FLOW	0.000000	0.000000	0.000000
GROUP I-WCD-CONFINED-STAGNANT	0.000000	0.000000	0.000000
GROUP I-WCD-OPEN-FLOW	0.000000	0.000000	0.000000
GROUP I-WCD-OPEN-STAGNANT	0.000000	0.000000	0.000000

G.5.3 Percent Emulsion, PE, for Customization Module with Specified Shorelines

Table G-6 shows the values for Average Percent Emulsion, PE_{day} , by shoreline category (wetland or gravel) for Days 1–3 to be applied in specified proportions (where % wetland + % gravel = 100%) for the Customization Module Application A.

Table G-6. Average percent emulsion for Days 1–3 by shoreline category for customization module.

Scenario	Average Percent Emulsion ⁸⁰		
	Day 1 PE_{day1}	Day 2 PE_{day2}	Day 3 PE_{day3}
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.00000	0.00000	0.00000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.00000	0.00000	0.00000
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.00000	0.00000	0.00000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.00000	0.00000	0.00000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.00000	0.00000	0.00000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.00000	0.00000	0.00000

⁸⁰ If designated as “N/A,” there is no longer recoverable oil on the water surface at the start of this day.



Inland ERSP Operational Environment Calculator Design Document

Table G-6. Average percent emulsion for Days 1–3 by shoreline category for customization module (Cont'd).

Scenario	Average Percent Emulsion ⁸¹		
	Day 1 <i>PE_{day1}</i>	Day 2 <i>PE_{day2}</i>	Day 3 <i>PE_{day3}</i>
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.00000	0.00000	0.00000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.00000	0.00000	0.00000
GROUP I-WCD-OPEN-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP II-WCD-OPEN-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.00000	0.00000	0.00000
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.00000	0.00000	0.00000
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.00000	0.00000	0.00000
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.00000	0.00000	0.00000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.00000	0.00000	0.00000
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.00000	0.00000	0.00000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.58714	1.00000	1.00000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.58152	1.00000	1.00000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.58714	1.00000	1.00000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.58152	1.00000	1.00000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.32920	0.55169	0.57990
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.27637	0.30630	0.31136
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.32694	0.75340	1.00000
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.27590	0.60967	1.00000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.32694	0.74435	1.00000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.27590	0.62783	1.00000
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.41501	1.00000	1.00000
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.36432	1.00000	1.00000
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.63050	1.00000	1.00000
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.64857	1.00000	1.00000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.32965	0.55083	0.58250
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.27463	0.29857	0.30912
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.32965	0.55043	0.58251
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.27477	0.29855	0.30077
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.33037	0.55219	0.58256
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.27507	0.29855	0.30867

⁸¹ If designated as “N/A,” there is no longer recoverable oil on the water surface at the start of this day.



Inland ERSP Operational Environment Calculator Design Document

Table G-6. Average percent emulsion for Days 1–3 by shoreline category for customization module (Cont'd).

Scenario	Average Percent Emulsion ⁸²		
	Day 1 <i>PE_{day1}</i>	Day 2 <i>PE_{day2}</i>	Day 3 <i>PE_{day3}</i>
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.33038	0.69391	1.00000
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.27508	0.56243	1.00000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.36841	1.00000	1.00000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.32651	1.00000	1.00000
GROUP III-WCD-OPEN-FLOW-WETLAND	0.26167	0.53805	0.63295
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.27452	0.29857	0.38747
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.26164	0.53805	0.58112
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.27452	0.29857	0.29998
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.26164	0.53804	0.58110
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.27452	0.29857	0.29998
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.26015	0.53842	0.58112
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.27491	0.29859	0.29998
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.26015	0.53842	0.58113
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.27491	0.29858	0.29996
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.26164	0.53800	0.58110
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.27452	0.29857	0.29998

G.5.4 Default Average Thickness, *TH*

Table G-7 shows the default values for average thickness, *TH_{day}*, by Waterway Type, Oil Type, and Volume Category for each of the three days.

Table G-7. Default average thickness for Days 1–3.

Scenario	Default Average Thickness (inches)		
	Day 1 <i>TH_{day1}</i>	Day 2 <i>TH_{day2}</i>	Day 3 <i>TH_{day3}</i>
GROUP I-AMPD-CONFINED-FLOW	0.000296	0.000091	0.000010
GROUP I-AMPD-CONFINED-STAGNANT	0.000555	0.000019	0.000002
GROUP I-AMPD-OPEN-FLOW	0.000209	0.000000	0.000000
GROUP I-AMPD-OPEN-STAGNANT	0.000594	0.000343	0.000337
GROUP II-AMPD-CONFINED-FLOW	0.004119	0.001329	0.000000
GROUP II-AMPD-CONFINED-STAGNANT	0.007716	0.000000	0.000000
GROUP II-AMPD-OPEN-FLOW	0.002818	0.000000	0.000000
GROUP II-AMPD-OPEN-STAGNANT	0.008172	0.003928	0.003193
GROUP III-AMPD-CONFINED-FLOW	0.005484	0.002405	0.000000
GROUP III-AMPD-CONFINED-STAGNANT	0.009892	0.000000	0.000000
GROUP III-AMPD-OPEN-FLOW	0.004451	0.000000	0.000000
GROUP III-AMPD-OPEN-STAGNANT	0.010967	0.007543	0.005849
GROUP III-MMPD-CONFINED-FLOW	0.029842	0.009834	0.002186

⁸² If designated as “N/A,” there is no longer recoverable oil on the water surface at the start of this day.



Inland ERSP Operational Environment Calculator Design Document

Table G-7. Default average thickness for Days 1–3 (Cont'd).

Scenario	Default Average Thickness (inches)		
	Day 1 <i>TH_{day1}</i>	Day 2 <i>TH_{day2}</i>	Day 3 <i>TH_{day3}</i>
GROUP III-MMPD-CONFINED-STAGNANT	0.055151	0.000000	0.000000
GROUP III-MMPD-OPEN-FLOW	0.026954	0.009371	0.006977
GROUP III-MMPD-OPEN-STAGNANT	0.059675	0.028002	0.021533
GROUP III-WCD-CONFINED-FLOW	0.106264	0.055754	0.032111
GROUP III-WCD-CONFINED-STAGNANT	0.211596	0.113562	0.080604
GROUP III-WCD-OPEN-FLOW	0.104751	0.054784	0.038664
GROUP III-WCD-OPEN-STAGNANT	0.212492	0.117830	0.086395
GROUP II-MMPD-CONFINED-FLOW	0.026281	0.004860	0.000567
GROUP II-MMPD-CONFINED-STAGNANT	0.050330	0.000000	0.000000
GROUP II-MMPD-OPEN-FLOW	0.024742	0.004397	0.002865
GROUP II-MMPD-OPEN-STAGNANT	0.053396	0.013382	0.010522
GROUP II-WCD-CONFINED-FLOW	0.097256	0.033582	0.016142
GROUP II-WCD-CONFINED-STAGNANT	0.194426	0.067825	0.041699
GROUP II-WCD-OPEN-FLOW	0.056067	0.009913	0.006096
GROUP II-WCD-OPEN-STAGNANT	0.194598	0.068511	0.043000
GROUP I-MMPD-CONFINED-FLOW	0.009194	0.000662	0.000000
GROUP I-MMPD-CONFINED-STAGNANT	0.018370	0.000000	0.000000
GROUP I-MMPD-OPEN-FLOW	0.008643	0.000000	0.000000
GROUP I-MMPD-OPEN-STAGNANT	0.018430	0.002119	0.002038
GROUP IV-AMPD-CONFINED-FLOW	0.045477	0.063002	0.000000
GROUP IV-AMPD-CONFINED-STAGNANT	0.091412	0.000000	0.000000
GROUP IV-AMPD-OPEN-FLOW	0.010758	0.000000	0.000000
GROUP IV-AMPD-OPEN-STAGNANT	0.090882	0.201376	0.251997
GROUP IV-MMPD-CONFINED-FLOW	0.047913	0.055941	0.029522
GROUP IV-MMPD-CONFINED-STAGNANT	0.087038	0.000000	0.000000
GROUP IV-MMPD-OPEN-FLOW	0.042338	0.061709	0.082043
GROUP IV-MMPD-OPEN-STAGNANT	0.095778	0.160306	0.213295
GROUP IV-WCD-CONFINED-FLOW	0.120707	0.066283	0.091095
GROUP IV-WCD-CONFINED-STAGNANT	0.240646	0.116597	0.158957
GROUP IV-WCD-OPEN-FLOW	0.119735	0.059553	0.078336
GROUP IV-WCD-OPEN-STAGNANT	0.241403	0.118322	0.156700
GROUP I-WCD-CONFINED-FLOW	0.042582	0.001936	0.000622
GROUP I-WCD-CONFINED-STAGNANT	0.084753	0.000000	0.000000
GROUP I-WCD-OPEN-FLOW	0.042166	0.001933	0.001870
GROUP I-WCD-OPEN-STAGNANT	0.085179	0.005170	0.005012



Inland ERSP Operational Environment Calculator Design Document

G.5.5 Average Thickness, TH , for Customization Module with Specified Shorelines

Table G-8 shows the values for Average Oil Thickness, TH_{day} , by shoreline category (Wetland or gravel) for Days 1–3 to be applied in specified proportions (where % Wetland + % gravel = 100%) for the Customization Module Application A.

Table G-8. Average oil thicknesses for Days 1–3 by shoreline category for customization module.

Scenario	Average Thickness (inches)		
	Day 1 TH_{day1}	Day 2 TH_{day2}	Day 3 TH_{day3}
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.00041	0.00000	0.00000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.00041	0.00000	0.00000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.01729	0.00000	0.00000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.01729	0.00000	0.00000
GROUP I-WCD-OPEN-FLOW-WETLAND	0.08184	0.00000	0.00000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.08516	0.00516	0.00499
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.00564	0.00000	0.00000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.00564	0.00000	0.00000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.04009	0.00000	0.00000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.05261	0.01172	0.00764
GROUP II-WCD-OPEN-FLOW-WETLAND	0.19304	0.06384	0.03381
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.08516	0.00516	0.00499
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.00616	0.00000	0.00000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.00616	0.00000	0.00000
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.03993	0.00000	0.00000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.05857	0.02499	0.01861
GROUP III-WCD-OPEN-FLOW-WETLAND	0.20079	0.08563	0.05110
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.21240	0.11755	0.08607
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.02152	0.00000	0.00000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.02152	0.00000	0.00000
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.04682	0.00000	0.00000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.09729	0.16456	0.21878
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.23124	0.11522	0.14805
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.24221	0.12040	0.15955
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.00059	0.00034	0.00034
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.01843	0.00212	0.00204
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.08518	0.00517	0.00501
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.00817	0.00393	0.00319
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.05340	0.01338	0.01052
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.19460	0.06851	0.04300
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.01097	0.00754	0.00585
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.05967	0.02800	0.02153
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.21249	0.11783	0.08639
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.09088	0.20138	0.25200



Inland ERSP Operational Environment Calculator Design Document

Table G-8. Average oil thicknesses for Days 1–3 by shoreline category for customization module (Cont'd).

Scenario	Average Thickness (inches)		
	Day 1 <i>TH_{day1}</i>	Day 2 <i>TH_{day2}</i>	Day 3 <i>TH_{day3}</i>
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.09578	0.16031	0.21329
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.24140	0.11832	0.15670
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.00059	0.00018	0.00002
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.00059	0.00018	0.00002
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.01839	0.00131	0.00000
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.01839	0.00136	0.00000
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.08516	0.00344	0.00000
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.08516	0.00516	0.00497
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.00824	0.00266	0.00000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.00824	0.00266	0.00000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.05256	0.00889	0.00000
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.05256	0.01222	0.00454
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.19451	0.06678	0.02877
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.19451	0.06833	0.04283
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.01097	0.00481	0.00000
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.01097	0.00480	0.00000
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.05968	0.01733	0.00000
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.05969	0.02669	0.01749
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.21253	0.10942	0.05688
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.21253	0.11777	0.08625
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.09095	0.11920	0.00000
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.09095	0.14642	0.00000
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.09583	0.09333	0.00000
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.09583	0.16753	0.23618
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.24141	0.13199	0.18852
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.24143	0.13428	0.16321
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.00055	0.00002	0.00000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.01837	0.00000	0.00000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.08475	0.00000	0.00000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.00772	0.00000	0.00000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.05033	0.00000	0.00000
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.19443	0.06783	0.04170
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.00989	0.00000	0.00000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.05515	0.00000	0.00000
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.21160	0.11356	0.08060
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.09141	0.00000	0.00000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.08704	0.00000	0.00000
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.24065	0.11660	0.15896



G.5.6 Percent Recoverable Oil (PRO_h) for Customization Module with Specified Shorelines

Table G-9 shows the values for Average Percent Recoverable Oil, PRO_{day} , by shoreline category (wetland or gravel) for Days 1–3 to be applied in specified proportions (where % wetland + % gravel = 100%) for the Customization Module Application A.



Inland ERSP Operational Environment Calculator Design Document

Table G-9. Average percent recoverable oil for Days 1–3 by shoreline category for customization module.

Scenario	Average Recoverable Oil (in Decimal Fraction)		
	Day 1 <i>PRO_{day1}</i>	Day 2 <i>PRO_{day2}</i>	Day 3 <i>PRO_{day3}</i>
GROUP I-AMPD-CONFINED-FLOW	0.004194	0.000000	0.000000
GROUP I-AMPD-CONFINED-STAGNANT	0.008389	0.000000	0.000000
GROUP I-AMPD-OPEN-FLOW	0.004194	0.000000	0.000000
GROUP I-AMPD-OPEN-STAGNANT	0.008389	0.000000	0.000000
GROUP II-AMPD-CONFINED-FLOW	0.215948	0.039904	0.000000
GROUP II-AMPD-CONFINED-STAGNANT	0.335459	0.000000	0.000000
GROUP II-AMPD-OPEN-FLOW	0.132319	0.000000	0.000000
GROUP II-AMPD-OPEN-STAGNANT	0.432363	0.296125	0.278825
GROUP III-AMPD-CONFINED-FLOW	0.276989	0.064540	0.000000
GROUP III-AMPD-CONFINED-STAGNANT	0.396963	0.000000	0.000000
GROUP III-AMPD-OPEN-FLOW	0.108094	0.000000	0.000000
GROUP III-AMPD-OPEN-STAGNANT	0.555378	0.482200	0.457033
GROUP III-MMPD-CONFINED-FLOW	0.322232	0.086723	0.015429
GROUP III-MMPD-CONFINED-STAGNANT	0.470756	0.000000	0.000000
GROUP III-MMPD-OPEN-FLOW	0.247008	0.114552	0.081228
GROUP III-MMPD-OPEN-STAGNANT	0.645767	0.493633	0.464500
GROUP III-WCD-CONFINED-FLOW	0.361466	0.175196	0.077778
GROUP III-WCD-CONFINED-STAGNANT	0.689856	0.463971	0.353808
GROUP III-WCD-OPEN-FLOW	0.332433	0.233674	0.199884
GROUP III-WCD-OPEN-STAGNANT	0.724093	0.571654	0.517821
GROUP II-MMPD-CONFINED-FLOW	0.318573	0.054048	0.000530
GROUP II-MMPD-CONFINED-STAGNANT	0.494452	0.000000	0.000000
GROUP II-MMPD-OPEN-FLOW	0.263338	0.062322	0.030267
GROUP II-MMPD-OPEN-STAGNANT	0.640685	0.330329	0.289025
GROUP II-WCD-CONFINED-FLOW	0.395536	0.216318	0.060676
GROUP II-WCD-CONFINED-STAGNANT	0.780615	0.532592	0.292771



Inland ERSP Operational Environment Calculator Design Document

Table G-9. Average percent recoverable oil for Days 1–3 by shoreline category for customization module (Cont'd).

Scenario	Average Recoverable Oil (in Decimal Fraction)		
	Day 1 <i>PRO_{day1}</i>	Day 2 <i>PRO_{day2}</i>	Day 3 <i>PRO_{day3}</i>
GROUP II-WCD-OPEN-FLOW	0.162924	0.055643	0.023786
GROUP II-WCD-OPEN-STAGNANT	0.792100	0.571542	0.424988
GROUP I-MMPD-CONFINED-FLOW	0.056072	0.002166	0.000000
GROUP I-MMPD-CONFINED-STAGNANT	0.106889	0.000000	0.000000
GROUP I-MMPD-OPEN-FLOW	0.051606	0.000000	0.000000
GROUP I-MMPD-OPEN-STAGNANT	0.112322	0.016333	0.015483
GROUP IV-AMPD-CONFINED-FLOW	0.475239	0.121404	0.000000
GROUP IV-AMPD-CONFINED-STAGNANT	0.654619	0.000000	0.000000
GROUP IV-AMPD-OPEN-FLOW	0.222706	0.000000	0.000000
GROUP IV-AMPD-OPEN-STAGNANT	0.952807	0.909396	0.861217
GROUP IV-MMPD-CONFINED-FLOW	0.480435	0.160426	0.034644
GROUP IV-MMPD-CONFINED-STAGNANT	0.667681	0.000000	0.000000
GROUP IV-MMPD-OPEN-FLOW	0.348506	0.210445	0.158178
GROUP IV-MMPD-OPEN-STAGNANT	0.963467	0.914483	0.874717
GROUP IV-WCD-CONFINED-FLOW	0.486057	0.265620	0.132602
GROUP IV-WCD-CONFINED-STAGNANT	0.927600	0.765450	0.643492
GROUP IV-WCD-OPEN-FLOW	0.446372	0.391551	0.360015
GROUP IV-WCD-OPEN-STAGNANT	0.974552	0.939800	0.918217
GROUP I-WCD-CONFINED-FLOW	0.100629	0.003202	0.000997
GROUP I-WCD-CONFINED-STAGNANT	0.195333	0.000000	0.000000
GROUP I-WCD-OPEN-FLOW	0.098471	0.004856	0.003925
GROUP I-WCD-OPEN-STAGNANT	0.201330	0.016679	0.016050

G.5.7 Percent Recoverable Oil by Hour (*PRO_h*) for Customization Module with Specified Shorelines

Table G-10 through Table G-12 provide the hourly values for the Percent Recoverable Oil (*PRO_h*) by oil spill scenario (Oil Type-Volume Category-Waterway Type-Shore Type) for each of the three days.



Inland ERSP Operational Environment Calculator Design Document

Table G-10. Hourly values for Percent Recoverable Oil, PRO_h , for Day 1.

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.377	0.365	0.340	0.327	0.327	0.315	0.315	0.315	0.315	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.289
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.377	0.365	0.340	0.327	0.327	0.315	0.315	0.315	0.315	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.289
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.377	0.352	0.340	0.327	0.315	0.302	0.264	0.201	0.138	0.088	0.050	0.025	0.013	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.365	0.315	0.201	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.365	0.315	0.201	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.830	0.780	0.755	0.730	0.667	0.604	0.541	0.491	0.453	0.415	0.377	0.365	0.340	0.327	0.327	0.315	0.315	0.315	0.315	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.742	0.705	0.692	0.679	0.642	0.616	0.604	0.579	0.566	0.554	0.541	0.528	0.516	0.516	0.516	0.503	0.503	0.503	0.503	0.503	0.503	0.503	0.491	0.491	0.491	0.491	0.478
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.742	0.705	0.692	0.679	0.642	0.616	0.604	0.579	0.566	0.554	0.541	0.528	0.516	0.516	0.516	0.503	0.503	0.503	0.503	0.503	0.503	0.503	0.491	0.491	0.491	0.491	0.478
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.742	0.705	0.692	0.679	0.642	0.616	0.604	0.579	0.566	0.541	0.541	0.528	0.516	0.516	0.503	0.478	0.415	0.327	0.239	0.151	0.076	0.038	0.013	0.013	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.176	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.742	0.705	0.692	0.679	0.642	0.616	0.604	0.579	0.566	0.554	0.528	0.465	0.302	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.742	0.705	0.692	0.679	0.642	0.616	0.604	0.579	0.566	0.554	0.541	0.528	0.516	0.516	0.516	0.503	0.503	0.503	0.503	0.503	0.503	0.503	0.503	0.503	0.491	0.491	0.491
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.658	0.647	0.638	0.628	0.619	0.610	0.601	0.593	0.585	0.578	0.571	0.564	0.558	0.551	0.545	0.540	0.533	0.524	0.512
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.658	0.647	0.638	0.628	0.619	0.610	0.601	0.593	0.585	0.578	0.571	0.564	0.558	0.551	0.545	0.537	0.531	0.523	0.508
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.657	0.646	0.636	0.623	0.612	0.601	0.589	0.555	0.480	0.384	0.271	0.164	0.086	0.036	0.014	0.004	0.001	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-10. Hourly values for Percent Recoverable Oil, PRO_h , for Day 1 (Cont'd).

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.658	0.647	0.615	0.555	0.536	0.445	0.438	0.431	0.425	0.411	0.376	0.371	0.365	0.361	0.357	0.352	0.349	0.345	0.340
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.658	0.647	0.615	0.547	0.341	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.960	0.914	0.870	0.830	0.733	0.697	0.681	0.669	0.658	0.647	0.638	0.628	0.619	0.610	0.601	0.593	0.585	0.578	0.571	0.564	0.558	0.552	0.546	0.541	0.536	0.531	0.527
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.710	0.696	0.685	0.677	0.670	0.664	0.658	0.653	0.648	0.643	0.639	0.634	0.630	0.626	0.622	0.618	0.614	0.611
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.710	0.696	0.685	0.677	0.670	0.664	0.658	0.653	0.648	0.643	0.639	0.634	0.630	0.625	0.621	0.616	0.607	0.587
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.709	0.694	0.681	0.671	0.663	0.650	0.612	0.594	0.568	0.563	0.559	0.556	0.552	0.548	0.545	0.541	0.538	0.535
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.709	0.695	0.684	0.673	0.666	0.660	0.654	0.649	0.643	0.638	0.634	0.629	0.625	0.621	0.617	0.613	0.609	0.605
GROUP III-WCD-OPEN-FLOW-WETLAND	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.709	0.677	0.609	0.514	0.248	0.245	0.243	0.240	0.236	0.220	0.208	0.204	0.202	0.200	0.198	0.196	0.194	0.193
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.988	0.973	0.958	0.943	0.883	0.830	0.788	0.756	0.729	0.710	0.696	0.686	0.677	0.670	0.664	0.658	0.653	0.648	0.643	0.639	0.635	0.630	0.626	0.623	0.619	0.615	0.611
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.974	0.944	0.915	0.887	0.817	0.784	0.761	0.741	0.721	0.700	0.680	0.659	0.639	0.618	0.598	0.578	0.559	0.540	0.521	0.503	0.486	0.470	0.454	0.439	0.422	0.407	0.391
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.974	0.944	0.915	0.887	0.817	0.784	0.761	0.741	0.721	0.700	0.680	0.659	0.639	0.618	0.598	0.578	0.559	0.540	0.521	0.503	0.486	0.470	0.454	0.439	0.423	0.406	0.385
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.974	0.944	0.915	0.888	0.818	0.784	0.760	0.740	0.720	0.699	0.679	0.659	0.638	0.615	0.588	0.542	0.468	0.371	0.259	0.157	0.079	0.036	0.013	0.005	0.002	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.974	0.944	0.915	0.888	0.818	0.783	0.760	0.740	0.720	0.700	0.665	0.630	0.603	0.560	0.541	0.522	0.503	0.467	0.447	0.430	0.415	0.400	0.356	0.238	0.229	0.221	0.213
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.974	0.944	0.915	0.888	0.818	0.783	0.760	0.740	0.720	0.700	0.652	0.578	0.365	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.974	0.944	0.915	0.886	0.817	0.782	0.760	0.740	0.720	0.701	0.681	0.661	0.641	0.621	0.601	0.582	0.563	0.544	0.526	0.509	0.492	0.476	0.460	0.446	0.432	0.419	0.407
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.992	0.983	0.973	0.963	0.923	0.888	0.859	0.835	0.817	0.803	0.792	0.782	0.773	0.765	0.757	0.749	0.741	0.734	0.726	0.719	0.711	0.703	0.696	0.688	0.680	0.673	0.665
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.992	0.983	0.973	0.963	0.923	0.888	0.859	0.835	0.817	0.803	0.792	0.782	0.773	0.765	0.757	0.749	0.741	0.734	0.726	0.719	0.711	0.703	0.694	0.685	0.674	0.663	0.647
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.992	0.983	0.973	0.963	0.924	0.888	0.859	0.836	0.817	0.802	0.790	0.779	0.767	0.758	0.743	0.732	0.718	0.710	0.703	0.694	0.687	0.679	0.672	0.664	0.656	0.649	0.641
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.035	0.031	0.028	0.024	0.022	0.021	0.020	0.018	0.017	0.016	0.015	0.015	0.015	0.014	0.014	0.014	0.014
GROUP II-WCD-OPEN-FLOW-WETLAND	0.992	0.983	0.973	0.963	0.923	0.888	0.859	0.836	0.817	0.801	0.764	0.720	0.695	0.635	0.628	0.620	0.613	0.579	0.558	0.550	0.544	0.538	0.531	0.521	0.515	0.508	0.500
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.992	0.983	0.973	0.963	0.924	0.888	0.859	0.836	0.817	0.803	0.792	0.782	0.773	0.765	0.757	0.749	0.741	0.734	0.726	0.718	0.711	0.703	0.696	0.688	0.680	0.673	0.665



Inland ERSP Operational Environment Calculator Design Document

Table G-10. Hourly values for Percent Recoverable Oil, PRO_h , for Day 1 (Cont'd).

Scenario	Hour on Day 1																									
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.870	0.712	0.553	0.404	0.085	0.033	0.026	0.022	0.020	0.018	0.018	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.016	0.016
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.870	0.712	0.553	0.404	0.085	0.033	0.026	0.022	0.020	0.018	0.018	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.016	0.016
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.870	0.712	0.554	0.404	0.085	0.033	0.026	0.022	0.020	0.018	0.018	0.017	0.017	0.017	0.017	0.015	0.014	0.011	0.008	0.005	0.003	0.002	0.001	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.870	0.712	0.553	0.405	0.086	0.033	0.026	0.022	0.020	0.018	0.017	0.015	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.870	0.712	0.553	0.405	0.086	0.033	0.026	0.022	0.020	0.018	0.017	0.015	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.870	0.712	0.553	0.404	0.086	0.033	0.026	0.022	0.020	0.018	0.018	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.956	0.956	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.931	0.931	0.931	0.918
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.956	0.956	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.931	0.931	0.931	0.918
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.956	0.944	0.944	0.944	0.918	0.868	0.767	0.616	0.440	0.277	0.151	0.076	0.038	0.013	0.013	0.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.931	0.843	0.541	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.931	0.843	0.541	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.994	0.981	0.981	0.981	0.969	0.969	0.969	0.956	0.956	0.956	0.956	0.956	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.931	0.931	0.931
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.969	0.966	0.964	0.961	0.959	0.957	0.955	0.953	0.952	0.950	0.949	0.947	0.946	0.943	0.940	0.936	0.924
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.969	0.966	0.964	0.961	0.959	0.957	0.955	0.953	0.952	0.950	0.949	0.947	0.946	0.943	0.940	0.936	0.924
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.969	0.965	0.962	0.957	0.953	0.939	0.882	0.778	0.655	0.479	0.303	0.168	0.088	0.042	0.013	0.004	0.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.967	0.934	0.845	0.821	0.671	0.670	0.668	0.667	0.655	0.594	0.590	0.588	0.587	0.586	0.585	0.584	0.582
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.967	0.934	0.842	0.527	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.998	0.996	0.994	0.992	0.986	0.981	0.978	0.975	0.972	0.969	0.966	0.964	0.961	0.959	0.957	0.955	0.953	0.952	0.950	0.949	0.948	0.946	0.945	0.944	0.943	0.942
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.978	0.976	0.974	0.973	0.972	0.970	0.969	0.968	0.967	0.965	0.964	0.963	0.962	0.961	0.960	0.958	0.955
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.978	0.976	0.974	0.973	0.972	0.970	0.969	0.968	0.967	0.965	0.964	0.961	0.959	0.957	0.953	0.950	0.938
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.978	0.974	0.973	0.968	0.963	0.953	0.906	0.885	0.859	0.857	0.855	0.854	0.853	0.852	0.851	0.850	0.849



Inland ERSP Operational Environment Calculator Design Document

Table G-10. Hourly values for Percent Recoverable Oil, PRO_h , for Day 1 (Cont'd).

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.977	0.975	0.972	0.967	0.966	0.965	0.963	0.961	0.959	0.958	0.957	0.955	0.954	0.953	0.952	0.951	0.949	0.948
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.975	0.947	0.845	0.756	0.429	0.428	0.427	0.427	0.425	0.386	0.363	0.358	0.358	0.357	0.356	0.355	0.354	0.354
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.999	0.998	0.997	0.996	0.992	0.988	0.985	0.982	0.980	0.978	0.976	0.974	0.973	0.972	0.970	0.969	0.968	0.967	0.965	0.964	0.963	0.962	0.961	0.960	0.959	0.958	0.956
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.036	0.032	0.030	0.028	0.026	0.024	0.023	0.022	0.021	0.020	0.019	0.019	0.018	0.018	0.018	0.018	0.017
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.036	0.032	0.030	0.028	0.026	0.024	0.023	0.022	0.021	0.020	0.019	0.019	0.018	0.018	0.018	0.017	0.017
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.036	0.032	0.030	0.027	0.025	0.023	0.019	0.014	0.010	0.006	0.003	0.001	0.001	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.035	0.031	0.028	0.024	0.022	0.021	0.020	0.018	0.017	0.016	0.015	0.015	0.015	0.014	0.014	0.014	0.014
GROUP I-WCD-OPEN-FLOW-WETLAND	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.035	0.029	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.961	0.913	0.863	0.811	0.599	0.401	0.240	0.134	0.079	0.048	0.036	0.032	0.030	0.028	0.026	0.024	0.023	0.022	0.021	0.020	0.019	0.019	0.018	0.018	0.018	0.018	0.017

Table G-11. Hourly values for Percent Recoverable Oil, PRO_h , for Day 2.

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.277	0.264	0.252	0.239	0.214	0.189	0.151	0.113	0.088	0.050	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.277	0.264	0.252	0.239	0.226	0.189	0.164	0.126	0.088	0.050	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-11. Hourly values for Percent Recoverable Oil, PRO_h , for Day 2 (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.302	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.453	0.415	0.390	0.377	0.352	0.315	0.252	0.201	0.151	0.088	0.063	0.038	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.453	0.415	0.390	0.377	0.352	0.315	0.264	0.201	0.138	0.088	0.050	0.025	0.013	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.491	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.497	0.482	0.469	0.457	0.440	0.415	0.382	0.354	0.319	0.291	0.267	0.246	0.229	0.221	0.212	0.203	0.196	0.191	0.185	0.181	0.178	0.177	0.174	0.172
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.484	0.450	0.420	0.395	0.364	0.327	0.263	0.208	0.143	0.090	0.049	0.027	0.012	0.004	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.334	0.320	0.318	0.317	0.314	0.309	0.308	0.307	0.306	0.305	0.304	0.302	0.302	0.301	0.300	0.300	0.299	0.299	0.298	0.298	0.298	0.298	0.297	0.297
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.523	0.519	0.516	0.513	0.510	0.506	0.502	0.500	0.497	0.493	0.490	0.489	0.487	0.486	0.485	0.484	0.483	0.483	0.482	0.481	0.481	0.480	0.480	0.479
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.607	0.603	0.599	0.596	0.592	0.589	0.585	0.582	0.578	0.575	0.572	0.569	0.566	0.563	0.560	0.557	0.554	0.551	0.549	0.546	0.543	0.541	0.538	0.536
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.570	0.549	0.530	0.511	0.479	0.445	0.408	0.369	0.324	0.281	0.252	0.224	0.203	0.178	0.164	0.153	0.143	0.136	0.133	0.130	0.127	0.122	0.117	0.115
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.532	0.529	0.524	0.517	0.511	0.504	0.487	0.484	0.482	0.479	0.477	0.474	0.471	0.469	0.467	0.463	0.450	0.431	0.418	0.403	0.397	0.393	0.390	0.386
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.601	0.598	0.595	0.591	0.588	0.584	0.581	0.578	0.575	0.572	0.569	0.566	0.563	0.559	0.556	0.553	0.551	0.548	0.545	0.543	0.540	0.538	0.536	0.533
GROUP III-WCD-OPEN-FLOW-WETLAND	0.191	0.189	0.187	0.185	0.183	0.181	0.180	0.179	0.178	0.177	0.176	0.175	0.173	0.172	0.169	0.168	0.167	0.166	0.165	0.165	0.164	0.163	0.162	0.162



Inland ERSP Operational Environment Calculator Design Document

Table G-11. Hourly values for Percent Recoverable Oil, PRO_h , for Day 2 (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.608	0.604	0.601	0.597	0.594	0.590	0.587	0.584	0.581	0.578	0.575	0.571	0.569	0.566	0.563	0.560	0.558	0.555	0.553	0.550	0.548	0.546	0.543	0.541
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.368	0.344	0.327	0.309	0.282	0.255	0.232	0.205	0.176	0.147	0.116	0.097	0.082	0.070	0.057	0.046	0.038	0.034	0.030	0.028	0.026	0.024	0.024	0.023
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.360	0.331	0.305	0.286	0.262	0.227	0.190	0.145	0.098	0.064	0.038	0.021	0.011	0.006	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.206	0.192	0.187	0.183	0.178	0.175	0.172	0.169	0.167	0.165	0.164	0.162	0.160	0.159	0.157	0.157	0.156	0.156	0.155	0.155	0.154	0.154	0.154	0.153
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.396	0.385	0.376	0.367	0.359	0.352	0.345	0.338	0.333	0.328	0.324	0.321	0.318	0.315	0.313	0.311	0.310	0.308	0.307	0.306	0.305	0.304	0.304	0.303
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.657	0.649	0.641	0.634	0.626	0.618	0.610	0.602	0.594	0.587	0.579	0.572	0.564	0.557	0.550	0.542	0.535	0.528	0.521	0.514	0.507	0.500	0.494	0.487
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.627	0.606	0.587	0.570	0.543	0.519	0.493	0.463	0.438	0.403	0.377	0.358	0.346	0.334	0.315	0.301	0.291	0.280	0.267	0.259	0.249	0.237	0.223	0.205
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.633	0.625	0.616	0.606	0.593	0.585	0.578	0.571	0.564	0.556	0.549	0.542	0.534	0.528	0.520	0.512	0.494	0.484	0.469	0.461	0.454	0.445	0.437	0.428
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.014	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
GROUP II-WCD-OPEN-FLOW-WETLAND	0.489	0.470	0.463	0.457	0.449	0.443	0.436	0.431	0.425	0.419	0.413	0.407	0.402	0.396	0.388	0.383	0.378	0.372	0.367	0.362	0.357	0.353	0.348	0.343
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.657	0.649	0.642	0.634	0.626	0.619	0.611	0.603	0.596	0.588	0.581	0.573	0.566	0.559	0.552	0.545	0.538	0.531	0.524	0.518	0.511	0.504	0.498	0.492
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.015	0.014	0.013	0.013	0.012	0.010	0.009	0.007	0.005	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.015	0.014	0.013	0.013	0.012	0.011	0.009	0.007	0.005	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.017	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.868	0.805	0.755	0.717	0.679	0.604	0.465	0.340	0.239	0.138	0.076	0.038	0.025	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.843	0.805	0.755	0.717	0.667	0.579	0.478	0.365	0.264	0.176	0.101	0.050	0.038	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-11. Hourly values for Percent Recoverable Oil, PRO_h , for Day 2 (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.931	0.931	0.931	0.918	0.918	0.918	0.918	0.918	0.918	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.893	0.893	0.893	0.893	0.893
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.880	0.853	0.830	0.817	0.776	0.741	0.712	0.673	0.622	0.581	0.534	0.495	0.472	0.461	0.446	0.418	0.407	0.392	0.381	0.375	0.371	0.363	0.359	0.354
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.862	0.796	0.744	0.716	0.663	0.584	0.462	0.364	0.263	0.170	0.103	0.059	0.030	0.010	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.581	0.569	0.568	0.568	0.567	0.565	0.565	0.564	0.564	0.563	0.563	0.560	0.560	0.558	0.557	0.557	0.556	0.556	0.556	0.555	0.555	0.555	0.554	0.554
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.936	0.935	0.933	0.931	0.926	0.924	0.922	0.917	0.915	0.914	0.914	0.911	0.909	0.909	0.908	0.908	0.907	0.906	0.906	0.905	0.904	0.904	0.903	0.903
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.953	0.952	0.950	0.948	0.947	0.945	0.943	0.941	0.938	0.937	0.935	0.933	0.932	0.931	0.929	0.928	0.927	0.926	0.925	0.924	0.923	0.922	0.921	0.920
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.883	0.846	0.807	0.783	0.752	0.680	0.616	0.560	0.492	0.418	0.336	0.297	0.262	0.234	0.213	0.193	0.174	0.161	0.153	0.145	0.136	0.130	0.128	0.125
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.846	0.845	0.841	0.838	0.834	0.819	0.799	0.789	0.788	0.788	0.787	0.785	0.784	0.783	0.782	0.774	0.757	0.718	0.699	0.671	0.665	0.663	0.660	0.657
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.946	0.945	0.944	0.943	0.942	0.940	0.939	0.938	0.937	0.936	0.935	0.933	0.930	0.928	0.926	0.925	0.924	0.923	0.921	0.920	0.919	0.919	0.917	0.916
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.351	0.349	0.348	0.347	0.342	0.342	0.341	0.341	0.340	0.340	0.340	0.338	0.337	0.336	0.336	0.335	0.335	0.335	0.334	0.334	0.334	0.333	0.333	0.333
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.955	0.953	0.952	0.951	0.949	0.948	0.947	0.945	0.944	0.942	0.941	0.939	0.938	0.937	0.936	0.935	0.934	0.933	0.932	0.931	0.930	0.929	0.929	0.928
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.017	0.017	0.016	0.016	0.016	0.015	0.015	0.014	0.014	0.013	0.012	0.012	0.011	0.011	0.011	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.016	0.015	0.014	0.013	0.012	0.010	0.009	0.007	0.005	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.014	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.016	0.016	0.016



Inland ERSP Operational Environment Calculator Design Document

Table G-12. Hourly values for Percent Recoverable Oil, PRO_h , for Day 3.

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.277	0.252	0.214	0.164
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.478	0.465	0.465	0.465	0.440	0.403	0.340	0.264
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.169	0.166	0.162	0.154	0.148	0.141	0.132	0.125	0.122	0.120	0.119	0.116	0.114	0.113	0.112	0.110	0.108	0.107	0.106	0.106	0.105	0.104	0.103	0.102
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.297	0.297	0.297	0.296	0.296	0.296	0.296	0.296	0.296	0.292	0.243	0.240	0.215	0.205	0.204	0.153	0.153	0.149	0.145	0.138	0.123	0.094	0.091	0.091



Inland ERSP Operational Environment Calculator Design Document

Table G-12. Hourly values for Percent Recoverable Oil, PRO_h , for Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.479	0.479	0.478	0.478	0.478	0.477	0.477	0.477	0.476	0.476	0.476	0.476	0.475	0.475	0.475	0.475	0.475	0.473	0.472	0.464	0.453	0.423	0.391	0.372
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.534	0.531	0.529	0.527	0.524	0.522	0.520	0.518	0.516	0.515	0.513	0.511	0.510	0.508	0.506	0.505	0.504	0.502	0.501	0.500	0.498	0.497	0.496	0.495
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.110	0.103	0.098	0.072	0.053	0.044	0.035	0.030	0.028	0.026	0.025	0.024	0.023	0.022	0.022	0.022	0.021	0.021	0.020	0.018	0.017	0.017	0.017	0.016
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.383	0.382	0.380	0.375	0.368	0.363	0.362	0.360	0.358	0.357	0.356	0.354	0.353	0.352	0.351	0.350	0.349	0.348	0.347	0.344	0.335	0.324	0.323	0.321
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.531	0.528	0.526	0.524	0.522	0.520	0.519	0.517	0.514	0.511	0.508	0.507	0.505	0.502	0.499	0.498	0.496	0.494	0.493	0.491	0.490	0.487	0.486	0.485
GROUP III-WCD-OPEN-FLOW-WETLAND	0.161	0.160	0.160	0.159	0.158	0.158	0.157	0.157	0.156	0.155	0.119	0.058	0.049	0.042	0.038	0.010	0.009	0.007	0.006	0.004	0.001	0.000	0.000	0.000
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.539	0.537	0.535	0.533	0.531	0.529	0.527	0.525	0.523	0.521	0.520	0.518	0.516	0.515	0.513	0.512	0.510	0.509	0.507	0.505	0.503	0.502	0.501	0.499
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.022	0.020	0.018	0.014	0.011	0.007	0.005	0.003	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.152	0.150	0.109	0.080	0.070	0.065	0.062	0.008	0.008	0.006	0.003	0.003	0.002	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.302	0.302	0.302	0.301	0.301	0.301	0.300	0.300	0.300	0.300	0.300	0.299	0.299	0.299	0.299	0.299	0.299	0.298	0.297	0.291	0.280	0.258	0.218	0.191
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.480	0.473	0.467	0.460	0.453	0.448	0.442	0.437	0.431	0.426	0.421	0.416	0.412	0.407	0.403	0.398	0.394	0.390	0.386	0.382	0.378	0.375	0.371	0.368
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.182	0.143	0.060	0.045	0.030	0.021	0.013	0.010	0.008	0.007	0.005	0.005	0.004	0.003	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.421	0.409	0.328	0.324	0.320	0.316	0.312	0.308	0.304	0.300	0.295	0.292	0.288	0.284	0.281	0.278	0.275	0.272	0.269	0.266	0.256	0.239	0.211	0.181
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.012	0.011	0.011	0.011	0.010	0.010	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008
GROUP II-WCD-OPEN-FLOW-WETLAND	0.338	0.334	0.330	0.325	0.321	0.317	0.313	0.309	0.304	0.295	0.203	0.116	0.100	0.085	0.076	0.014	0.011	0.009	0.007	0.005	0.001	0.000	0.000	0.000
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.486	0.479	0.473	0.468	0.462	0.456	0.451	0.445	0.440	0.435	0.430	0.425	0.420	0.416	0.411	0.407	0.403	0.398	0.393	0.388	0.384	0.380	0.377	0.373
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-12. Hourly values for Percent Recoverable Oil, PRO_h , for Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.015	0.014	0.012	0.009
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.893	0.881	0.881	0.843	0.793	0.679	0.516
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.352	0.348	0.343	0.335	0.326	0.319	0.301	0.287	0.281	0.272	0.267	0.264	0.261	0.259	0.255	0.253	0.249	0.247	0.245	0.241	0.240	0.239	0.237	0.236
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.553	0.553	0.553	0.552	0.552	0.552	0.551	0.551	0.550	0.541	0.456	0.448	0.439	0.422	0.422	0.328	0.328	0.319	0.313	0.285	0.243	0.205	0.203	0.203
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.902	0.902	0.901	0.900	0.900	0.899	0.899	0.898	0.897	0.897	0.896	0.896	0.895	0.895	0.894	0.894	0.892	0.892	0.890	0.873	0.834	0.782	0.750	0.716
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.919	0.919	0.918	0.917	0.916	0.915	0.914	0.913	0.912	0.912	0.911	0.910	0.909	0.909	0.908	0.907	0.907	0.906	0.905	0.905	0.904	0.903	0.903	0.902
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.120	0.119	0.114	0.100	0.084	0.071	0.058	0.054	0.049	0.046	0.042	0.040	0.036	0.034	0.032	0.030	0.026	0.025	0.024	0.021	0.020	0.020	0.020	0.019
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.656	0.654	0.653	0.653	0.652	0.652	0.651	0.651	0.649	0.647	0.645	0.642	0.640	0.639	0.639	0.639	0.638	0.638	0.637	0.636	0.634	0.634	0.633	0.633
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.916	0.915	0.914	0.913	0.913	0.912	0.911	0.911	0.909	0.907	0.905	0.905	0.904	0.902	0.897	0.896	0.893	0.892	0.891	0.891	0.889	0.887	0.886	0.885
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.333	0.332	0.332	0.332	0.332	0.331	0.331	0.331	0.331	0.330	0.239	0.167	0.146	0.132	0.125	0.023	0.019	0.013	0.009	0.008	0.005	0.000	0.000	0.000
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.927	0.926	0.926	0.925	0.924	0.923	0.923	0.922	0.921	0.921	0.920	0.919	0.919	0.918	0.917	0.917	0.916	0.914	0.913	0.911	0.911	0.910	0.909	0.907



Inland ERSP Operational Environment Calculator Design Document

Table G-12. Hourly values for Percent Recoverable Oil, PRO_h , for Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.012	0.011	0.011	0.011	0.010	0.010	0.009	0.009	0.009	0.008	0.008	0.008	0.008	0.008	0.008
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.015	0.015	0.014	0.014

G.5.8 Equations for Percent Emulsion (PE)

Table G-13 through Table G-15 provide the hourly values for Percent Emulsion (PE) by oil spill scenario (Oil Type-Volume Category-Waterway Type-Shore Type). Group I and II oils do not generally emulsify. For these oils, the PE would always be 0.000.

Table G-13. Percent emulsion by hour, PE_h , on Day 1.

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-13. Percent emulsion by hour, PE_h , on Day 1 (Cont'd).

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.182	0.727	0.191	0.143	0.179	0.215	0.241	0.259	0.300	0.328	0.339	0.359	0.385	0.394	0.412	0.423	0.429	0.444	0.452	0.473	0.480	0.487	0.494	0.493
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.182	0.727	0.191	0.143	0.179	0.215	0.241	0.259	0.300	0.328	0.339	0.359	0.385	0.394	0.412	0.423	0.429	0.444	0.452	0.473	0.480	0.487	0.494	0.493
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.182	0.727	0.191	0.143	0.179	0.215	0.246	0.259	0.288	0.317	0.328	0.355	0.367	0.400	0.491	0.424	0.429	0.500	0.500	0.667	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.018	0.073	0.109	0.143	0.179	0.211	0.241	0.263	0.302	0.314	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.018	0.073	0.109	0.143	0.179	0.211	0.241	0.263	0.302	0.314	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.182	0.727	0.191	0.143	0.179	0.215	0.241	0.259	0.300	0.328	0.339	0.349	0.385	0.394	0.412	0.423	0.437	0.444	0.452	0.460	0.474	0.494	0.500	0.563
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.119	0.571	0.991	0.138	0.173	0.256	0.236	0.263	0.289	0.312	0.334	0.354	0.373	0.390	0.450	0.419	0.433	0.445	0.456	0.466	0.476	0.485	0.493
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.119	0.571	0.991	0.138	0.173	0.256	0.236	0.263	0.289	0.312	0.334	0.354	0.373	0.390	0.450	0.419	0.433	0.445	0.456	0.466	0.476	0.485	0.493
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.119	0.571	0.988	0.137	0.173	0.251	0.235	0.263	0.289	0.312	0.334	0.354	0.372	0.389	0.449	0.419	0.432	0.443	0.455	0.464	0.500	1.000	1.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.119	0.571	0.988	0.137	0.173	0.250	0.235	0.263	0.288	0.312	0.334	0.354	0.372	0.389	0.447	0.419	0.432	0.444	0.456	0.466	0.476	0.484	0.493
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.119	0.571	0.988	0.137	0.173	0.250	0.235	0.263	0.288	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.119	0.571	0.988	0.137	0.173	0.251	0.235	0.263	0.289	0.312	0.334	0.353	0.372	0.389	0.446	0.419	0.432	0.444	0.456	0.466	0.476	0.484	0.493
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.463	0.889	0.128	0.164	0.198	0.228	0.257	0.283	0.368	0.329	0.349	0.368	0.385	0.411	0.416	0.429	0.442	0.453	0.464
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.463	0.889	0.128	0.164	0.198	0.228	0.257	0.283	0.368	0.329	0.349	0.368	0.385	0.411	0.416	0.429	0.442	0.453	0.464
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.461	0.886	0.128	0.164	0.197	0.228	0.256	0.282	0.361	0.328	0.349	0.367	0.385	0.470	0.415	0.429	0.441	0.453	0.464
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.461	0.886	0.128	0.164	0.197	0.228	0.256	0.282	0.361	0.328	0.349	0.367	0.385	0.470	0.415	0.429	0.441	0.453	0.464
GROUP III-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.461	0.886	0.128	0.164	0.197	0.228	0.256	0.282	0.362	0.328	0.349	0.367	0.385	0.470	0.415	0.429	0.441	0.453	0.464



Inland ERSP Operational Environment Calculator Design Document

Table G-13. Percent emulsion by hour, PE_h , on Day 1 (Cont'd).

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.461	0.886	0.128	0.164	0.197	0.228	0.256	0.282	0.361	0.328	0.349	0.367	0.385	0.470	0.415	0.429	0.441	0.453	0.464
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.125	0.250	0.370	0.488	0.833	0.115	0.135	0.174	0.192	0.200	0.217	0.225	0.242	0.250	0.257	0.265	0.272	0.272	0.279	0.279	0.279	0.279	0.289	0.289	0.289	0.291	0.297
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.125	0.250	0.370	0.488	0.833	0.115	0.135	0.174	0.192	0.200	0.217	0.225	0.242	0.250	0.257	0.265	0.272	0.272	0.279	0.279	0.279	0.279	0.289	0.289	0.289	0.291	0.297



Inland ERSP Operational Environment Calculator Design Document

Table G-13. Percent emulsion by hour, PE_h , on Day 1 (Cont'd).

Scenario	Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.125	0.250	0.370	0.488	0.833	0.115	0.135	0.174	0.192	0.200	0.217	0.235	0.242	0.242	0.263	0.266	0.274	0.269	0.278	0.293	0.294	0.333	0.250	0.500	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.013	0.025	0.037	0.049	0.083	0.115	0.135	0.174	0.192	0.200	0.213	0.221	0.246	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.013	0.025	0.037	0.049	0.083	0.115	0.135	0.174	0.192	0.200	0.213	0.221	0.246	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.125	0.250	0.370	0.488	0.833	0.115	0.135	0.174	0.192	0.200	0.217	0.225	0.242	0.250	0.257	0.265	0.272	0.272	0.279	0.279	0.279	0.279	0.286	0.295	0.295	0.295	0.295
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.167	0.186	0.237	0.218	0.233	0.247	0.250	0.257	0.264	0.269	0.274	0.278	0.289	0.284	0.286	0.288	0.291	0.292	0.293	0.294
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.167	0.186	0.237	0.218	0.233	0.247	0.250	0.257	0.264	0.269	0.274	0.278	0.289	0.284	0.286	0.288	0.291	0.292	0.293	0.294
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.166	0.186	0.234	0.218	0.230	0.244	0.249	0.257	0.263	0.269	0.274	0.278	0.289	0.283	0.286	0.289	0.284	0.286	1.000	1.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.231	0.245	0.250	0.257	0.263	0.269	0.274	0.278	0.288	0.284	0.286	0.288	0.290	0.292	0.293	0.294
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.230	0.246	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.120	0.232	0.345	0.448	0.829	0.115	0.143	0.166	0.186	0.234	0.218	0.232	0.246	0.249	0.257	0.263	0.269	0.274	0.277	0.289	0.284	0.286	0.288	0.290	0.292	0.293	0.294
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.167	0.187	0.235	0.218	0.233	0.247	0.250	0.257	0.264	0.269	0.274	0.278	0.289	0.284	0.286	0.288	0.290	0.292	0.293	0.294
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.167	0.187	0.235	0.218	0.233	0.247	0.250	0.257	0.264	0.269	0.274	0.278	0.289	0.284	0.286	0.288	0.290	0.292	0.293	0.294
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.230	0.245	0.249	0.257	0.263	0.269	0.274	0.277	0.288	0.284	0.286	0.288	0.290	0.292	0.293	0.294
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.230	0.245	0.249	0.257	0.263	0.269	0.274	0.277	0.288	0.284	0.286	0.288	0.290	0.292	0.293	0.294
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.230	0.245	0.249	0.257	0.263	0.269	0.274	0.277	0.288	0.284	0.286	0.288	0.290	0.292	0.293	0.294
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.119	0.233	0.343	0.448	0.829	0.115	0.143	0.166	0.186	0.233	0.218	0.230	0.245	0.249	0.257	0.263	0.269	0.274	0.277	0.288	0.284	0.286	0.288	0.290	0.292	0.293	0.294
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-14. Percent emulsion by hour, PE_h , on Day 2.

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.568	0.522	0.523	0.531	0.541	0.528	0.546	0.529	0.539	0.588	0.500	0.500	0.667	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.568	0.522	0.523	0.524	0.525	0.528	0.533	0.529	0.560	0.563	0.556	0.600	0.667	0.667	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.513	0.513	0.519	0.524	0.531	0.531	0.536	0.536	0.553	0.553	0.558	0.558	0.558	0.563	0.563	0.563	0.568	0.568	0.568	0.573	0.573	0.573	0.573	0.573
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.530	0.571	0.514	0.519	0.525	0.530	0.535	0.539	0.543	0.546	0.549	0.553	0.555	0.558	0.560	0.563	0.564	0.566	0.568	0.570	0.578	0.572	0.574	0.574
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.510	0.570	0.513	0.519	0.525	0.530	0.534	0.539	0.542	0.546	0.549	0.551	0.559	0.556	0.556	0.556	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.500	0.570	0.514	0.519	0.524	0.530	0.534	0.539	0.542	0.546	0.549	0.552	0.555	0.558	0.560	0.562	0.564	0.566	0.568	0.569	0.579	0.572	0.573	0.575



Inland ERSP Operational Environment Calculator Design Document

Table G-14. Percent emulsion by hour, PE_h , on Day 2 (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP III-MMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.500	0.569	0.513	0.519	0.524	0.530	0.534	0.538	0.542	0.546	0.549	0.552	0.555	0.558	0.560	0.562	0.564	0.566	0.568	0.569	0.571	0.572	0.573	0.575
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.474	0.483	0.498	0.499	0.555	0.512	0.518	0.524	0.529	0.533	0.538	0.542	0.545	0.549	0.552	0.555	0.557	0.560	0.562	0.564	0.566	0.568	0.569	0.576
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.474	0.483	0.498	0.499	0.555	0.512	0.518	0.524	0.529	0.533	0.538	0.542	0.545	0.549	0.552	0.555	0.557	0.560	0.562	0.564	0.566	0.568	0.569	0.576
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.473	0.482	0.496	0.498	0.552	0.512	0.518	0.523	0.528	0.533	0.537	0.541	0.545	0.548	0.551	0.554	0.557	0.559	0.562	0.564	0.566	0.567	0.569	0.575
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.473	0.482	0.496	0.498	0.553	0.512	0.518	0.523	0.528	0.533	0.537	0.541	0.545	0.548	0.552	0.554	0.557	0.559	0.562	0.564	0.566	0.567	0.569	0.575
GROUP III-WCD-OPEN-FLOW-WETLAND	0.473	0.482	0.496	0.498	0.553	0.512	0.518	0.523	0.528	0.533	0.537	0.541	0.545	0.548	0.552	0.554	0.557	0.559	0.562	0.564	0.566	0.567	0.569	0.575
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.473	0.482	0.496	0.498	0.553	0.512	0.518	0.523	0.528	0.533	0.537	0.541	0.545	0.548	0.551	0.554	0.557	0.559	0.562	0.564	0.566	0.567	0.569	0.575
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-14. Percent emulsion by hour, PE_h , on Day 2 (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.296	0.297	0.323	0.349	0.290	0.294	0.319	0.290	0.296	0.313	0.333	0.400	0.333	0.500	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.321	0.297	0.294	0.349	0.293	0.330	0.296	0.395	0.276	0.300	0.333	0.333	0.250	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.295	0.295	0.295	0.298	0.298	0.298	0.298	0.298	0.291	0.310	0.310	0.310	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.339	0.339	0.339	0.339	0.339
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.299	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.298	0.300	0.330	0.318	0.293	0.286	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.299	0.298	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-MMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300



Inland ERSP Operational Environment Calculator Design Document

Table G-14. Percent emulsion by hour, PE_h , on Day 2 (Cont'd).

Scenario	Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.295	0.296	0.296	0.297	0.297	0.298	0.298	0.298	0.299	0.299	0.299	0.299	0.299	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table G-15. Percent emulsion by hour, PE_h , on Day 3.

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-15. Percent emulsion by hour, PE_h , on Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.573	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.578	0.589	0.589	0.580	0.588	0.590	0.585	0.580
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.575	0.577	0.577	0.578	0.580	0.580	0.585	0.581	0.581	0.583	0.583	0.583	0.583	0.583	0.584	0.584	0.585	0.585	0.585	0.586	0.585	0.586	0.586	0.586
GROUP III-MMPD-CONFINED-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.576	0.577	0.577	0.578	0.579	0.580	0.583	0.581	0.581	0.582	0.583	0.583	0.583	0.584	0.584	0.585	0.585	0.585	0.585	0.585	0.586	0.586	0.586	0.586
GROUP III-MMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.576	0.577	0.578	0.578	0.579	0.580	0.583	0.581	0.582	0.582	0.583	0.583	0.584	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586	0.586	0.586	0.586
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.582	0.582	0.582	0.583	0.583	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.581	0.582	0.583	0.583	0.583	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.581	0.582	0.582	0.583	0.583	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.582	0.582	0.583	0.583	0.583	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586
GROUP III-WCD-OPEN-FLOW-WETLAND	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.582	0.582	0.582	0.583	0.583	0.584	0.584	0.584	0.585	0.585	1.000	1.000	1.000
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.572	0.573	0.574	0.575	0.576	0.577	0.578	0.579	0.580	0.583	0.589	0.581	0.582	0.582	0.583	0.583	0.584	0.584	0.584	0.585	0.585	0.585	0.585	0.586
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-15. Percent emulsion by hour, PE_h , on Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000



Inland ERSP Operational Environment Calculator Design Document

Table G-15. Percent emulsion by hour, PE_h , on Day 3 (Cont'd).

Scenario	Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.339	0.339	0.339	0.339	0.339	0.339	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.369	0.293	0.321	0.300	0.299	0.293
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.300	0.300	0.300	0.320	0.300	0.320	0.320	0.300	0.300	0.310	0.320	0.300	0.300	0.320	0.300	0.330	0.310	0.300	0.320	0.340	0.300	0.300	0.300	0.300
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.300	0.300	0.300	0.310	0.300	0.310	0.300	0.300	0.300	0.310	0.320	0.310	0.300	0.310	0.300	0.320	0.300	0.300	0.320	0.310	0.330	0.320	0.340	0.310
GROUP IV-MMPD-OPEN-FLOW-WETLAND	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.310	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.310	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	1.000	1.000	1.000
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

G.5.9 Average Oil Thickness (TH) by Hour

Table G-16 through Table G-18 provides the equations for calculating the Average Oil Thickness on Water Surface (TH) by oil spill scenario (Oil Type-Volume Category-Waterway Type-Shore Type). Developers may use these equations in the Customization Module.

Table G-16. Average oil thickness by hour, TH_h , on Day 1.

Scenario	Average Thickness (inches) by Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.004	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.010	0.008	0.008	0.007	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.004	0.003	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.019	0.018	0.017	0.016	0.014	0.012	0.011	0.009	0.008	0.008	0.007	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.004
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.008	0.008	0.007	0.006	0.005	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.017	0.016	0.015	0.015	0.014	0.013	0.012	0.012	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009



Inland ERSP Operational Environment Calculator Design Document

Table G-16. Average oil thickness by hour, TH_h , on Day 1 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.046	0.044	0.043	0.042	0.041	0.040	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.046	0.044	0.043	0.042	0.041	0.040	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.046	0.044	0.043	0.042	0.040	0.039	0.038	0.036	0.034	0.031	0.027	0.021	0.015	0.000	0.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.045	0.043	0.042	0.040	0.039	0.038	0.037	0.036	0.035	0.034	0.033	0.032	0.032	0.031	0.030
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.190	0.149	0.125	0.109	0.077	0.067	0.061	0.057	0.054	0.051	0.049	0.047	0.046	0.044	0.043	0.042	0.041	0.040	0.039	0.038	0.037	0.036	0.036	0.035	0.034	0.034	0.033
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.169	0.166	0.163	0.161	0.159	0.157	0.155	0.153	0.152	0.150	0.148	0.146	0.145	0.143	0.141	0.139
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.169	0.166	0.163	0.161	0.159	0.157	0.155	0.153	0.152	0.150	0.148	0.146	0.145	0.143	0.141	0.139
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.168	0.165	0.163	0.161	0.158	0.156	0.154	0.152	0.150	0.148	0.146	0.144	0.142	0.140	0.138	0.136
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.168	0.165	0.163	0.161	0.159	0.157	0.155	0.153	0.151	0.150	0.148	0.146	0.144	0.143	0.141	0.139
GROUP III-WCD-OPEN-FLOW-WETLAND	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.168	0.164	0.158	0.151	0.145	0.140	0.136	0.132	0.128	0.124	0.121	0.118	0.115	0.112	0.110	0.108
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.518	0.464	0.423	0.390	0.303	0.251	0.217	0.194	0.184	0.177	0.172	0.168	0.165	0.163	0.161	0.159	0.157	0.155	0.153	0.151	0.150	0.148	0.146	0.144	0.143	0.141	0.139
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.192	0.153	0.130	0.115	0.084	0.071	0.062	0.056	0.050	0.046	0.043	0.040	0.037	0.034	0.032	0.030	0.028	0.027	0.025	0.024	0.023	0.022	0.021	0.020	0.019	0.018	0.017
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.192	0.153	0.130	0.115	0.084	0.071	0.062	0.056	0.050	0.046	0.043	0.040	0.037	0.034	0.032	0.030	0.028	0.027	0.025	0.024	0.023	0.022	0.021	0.020	0.019	0.018	0.017
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.192	0.153	0.130	0.115	0.083	0.070	0.061	0.055	0.050	0.046	0.043	0.040	0.037	0.034	0.032	0.030	0.029	0.027	0.025	0.023	0.021	0.019	0.017	0.014	0.011	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.192	0.153	0.130	0.115	0.084	0.070	0.062	0.056	0.051	0.047	0.043	0.040	0.038	0.035	0.033	0.031	0.029	0.027	0.025	0.024	0.022	0.021	0.020	0.019	0.018	0.017	0.016
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.192	0.153	0.130	0.115	0.084	0.070	0.062	0.056	0.051	0.047	0.043	0.040	0.037	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.192	0.153	0.130	0.115	0.084	0.071	0.063	0.057	0.052	0.047	0.044	0.041	0.038	0.036	0.033	0.031	0.030	0.028	0.026	0.025	0.024	0.023	0.021	0.021	0.020	0.019	0.018
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.520	0.469	0.429	0.398	0.314	0.264	0.232	0.208	0.191	0.177	0.166	0.157	0.149	0.142	0.136	0.130	0.125	0.121	0.116	0.113	0.109	0.105	0.102	0.099	0.096	0.094	0.091
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.520	0.469	0.429	0.398	0.314	0.264	0.232	0.208	0.191	0.177	0.166	0.157	0.149	0.142	0.136	0.130	0.125	0.121	0.116	0.113	0.109	0.105	0.102	0.099	0.096	0.094	0.091
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.520	0.469	0.429	0.398	0.314	0.265	0.232	0.208	0.191	0.177	0.166	0.157	0.149	0.142	0.136	0.130	0.125	0.121	0.116	0.112	0.109	0.105	0.102	0.099	0.096	0.093	0.091



Inland ERSP Operational Environment Calculator Design Document

Table G-16. Average oil thickness by hour, TH_h , on Day 1 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.005	
GROUP II-WCD-OPEN-FLOW-WETLAND	0.520	0.469	0.429	0.398	0.314	0.265	0.232	0.208	0.190	0.177	0.166	0.156	0.148	0.141	0.134	0.129	0.123	0.118	0.114	0.110	0.106	0.102	0.099	0.096	0.093	0.090	0.087
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.520	0.469	0.429	0.398	0.314	0.264	0.232	0.208	0.191	0.177	0.166	0.157	0.149	0.142	0.136	0.130	0.125	0.121	0.117	0.113	0.109	0.106	0.102	0.099	0.097	0.094	0.091
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.172	0.119	0.084	0.058	0.011	0.004	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.172	0.119	0.084	0.058	0.011	0.004	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.172	0.119	0.084	0.058	0.011	0.004	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.172	0.119	0.084	0.058	0.012	0.004	0.004	0.003	0.003	0.002	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.172	0.119	0.084	0.058	0.012	0.004	0.004	0.003	0.003	0.002	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.172	0.119	0.084	0.058	0.012	0.004	0.004	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.088	0.095	0.102	0.109	0.116	0.122	0.128	0.134	0.139	0.144	0.148	0.153	0.157	0.161	0.165
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.088	0.095	0.102	0.109	0.116	0.122	0.128	0.134	0.139	0.144	0.148	0.153	0.157	0.161	0.165
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.087	0.095	0.102	0.109	0.116	0.122	0.128	0.134	0.139	0.144	0.150	0.155	0.159	0.164	0.169
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.087	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.087	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.023	0.022	0.022	0.021	0.022	0.030	0.038	0.046	0.055	0.063	0.071	0.080	0.087	0.095	0.102	0.109	0.116	0.122	0.128	0.133	0.139	0.144	0.148	0.153	0.157	0.161	0.165
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.060	0.066	0.072	0.078	0.083	0.089	0.094	0.099	0.103	0.108	0.112	0.116	0.120	0.124
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.060	0.066	0.072	0.078	0.083	0.089	0.094	0.099	0.103	0.108	0.112	0.116	0.120	0.123
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.060	0.066	0.072	0.078	0.083	0.089	0.094	0.099	0.104	0.109	0.113	0.118	0.000	0.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.062	0.069	0.074	0.079	0.086	0.091	0.097	0.102	0.105	0.110	0.116	0.120	0.124	0.128
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.199	0.164	0.144	0.130	0.100	0.086	0.077	0.070	0.065	0.061	0.058	0.055	0.054	0.060	0.066	0.072	0.078	0.083	0.089	0.094	0.098	0.103	0.107	0.112	0.116	0.120	0.123



Inland ERSP Operational Environment Calculator Design Document

Table G-16. Average oil thickness by hour, TH_h , on Day 1 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 1																										
	0.25	0.5	0.75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.214	0.205	0.197	0.190	0.183	0.177	0.172	0.167	0.162	0.157	0.153	0.149	0.146	0.142	0.139	0.136
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.214	0.205	0.197	0.190	0.183	0.177	0.172	0.167	0.162	0.157	0.153	0.149	0.146	0.142	0.139	0.136
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.214	0.205	0.197	0.190	0.183	0.177	0.171	0.165	0.160	0.156	0.151	0.147	0.143	0.140	0.137	0.134
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.214	0.206	0.198	0.191	0.184	0.178	0.173	0.168	0.163	0.159	0.155	0.151	0.147	0.144	0.141	0.138
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.213	0.203	0.191	0.179	0.169	0.161	0.154	0.147	0.141	0.135	0.130	0.126	0.122	0.118	0.115	0.112
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.530	0.486	0.453	0.426	0.356	0.315	0.287	0.266	0.249	0.236	0.224	0.214	0.205	0.197	0.190	0.183	0.177	0.172	0.167	0.162	0.157	0.153	0.149	0.146	0.142	0.139	0.136
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.005
GROUP I-WCD-OPEN-FLOW-WETLAND	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.504	0.437	0.384	0.341	0.217	0.135	0.078	0.043	0.025	0.015	0.011	0.010	0.009	0.009	0.008	0.008	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.005

Table G-17. Average oil thickness by hour, TH_h , on Day 2.

Scenario	Average Thickness (inches) by Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-17. Average oil thickness by hour, TH_h , on Day 2 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.002	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.002	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.006	0.005	0.004	0.004	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.006	0.006	0.005	0.005	0.004	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.009	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.025	0.025	0.024	0.024	0.023	0.023	0.022	0.022	0.022	0.021
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.033	0.032	0.031	0.031	0.030	0.030	0.029	0.028	0.028	0.027	0.025	0.024	0.022	0.019	0.015	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.030	0.029	0.029	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.022	0.022	0.021
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.029	0.028	0.028	0.028	0.027	0.027	0.027	0.026	0.026	0.026	0.025	0.025	0.025	0.025	0.024
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.137	0.136	0.134	0.132	0.130	0.129	0.127	0.125	0.123	0.122	0.120	0.118	0.116	0.115	0.113	0.112	0.110	0.108	0.107	0.105	0.104	0.103	0.101	0.100
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.137	0.135	0.133	0.131	0.129	0.127	0.125	0.122	0.120	0.117	0.114	0.111	0.109	0.106	0.103	0.100	0.097	0.094	0.092	0.089	0.087	0.085	0.083	0.081
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.134	0.132	0.130	0.128	0.127	0.125	0.123	0.121	0.119	0.117	0.116	0.114	0.112	0.110	0.109	0.107	0.106	0.104	0.102	0.101	0.099	0.098	0.096	0.095



Inland ERSP Operational Environment Calculator Design Document

Table G-17. Average oil thickness by hour, TH_h , on Day 2 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.137	0.135	0.134	0.132	0.130	0.128	0.126	0.125	0.123	0.121	0.120	0.118	0.116	0.115	0.113	0.111	0.110	0.108	0.107	0.105	0.104	0.102	0.101	0.100
GROUP III-WCD-OPEN-FLOW-WETLAND	0.105	0.103	0.101	0.099	0.097	0.095	0.093	0.092	0.090	0.088	0.087	0.085	0.084	0.082	0.081	0.080	0.078	0.077	0.076	0.074	0.073	0.072	0.071	0.070
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.137	0.136	0.134	0.132	0.130	0.129	0.127	0.125	0.123	0.122	0.120	0.118	0.116	0.115	0.113	0.112	0.110	0.109	0.107	0.106	0.104	0.103	0.101	0.100
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.017	0.016	0.015	0.015	0.015	0.014	0.014	0.013	0.013	0.013	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.009	0.009
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.017	0.016	0.015	0.015	0.014	0.014	0.014	0.013	0.013	0.013	0.012	0.012	0.011	0.010	0.010	0.008	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.016	0.015	0.014	0.014	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.017	0.017	0.016	0.016	0.015	0.015	0.014	0.014	0.014	0.013	0.013	0.013	0.013	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.011	0.011
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.089	0.086	0.084	0.082	0.080	0.078	0.076	0.074	0.073	0.071	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.089	0.086	0.084	0.082	0.080	0.078	0.076	0.074	0.072	0.070	0.068	0.066	0.065	0.063	0.062	0.060	0.058	0.057	0.056	0.054	0.053	0.052	0.050	0.049
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.088	0.086	0.084	0.082	0.080	0.078	0.076	0.074	0.072	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.060	0.059	0.058	0.057	0.055	0.054	0.053	0.052
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP II-WCD-OPEN-FLOW-WETLAND	0.085	0.082	0.080	0.078	0.076	0.074	0.072	0.070	0.068	0.066	0.065	0.063	0.062	0.060	0.059	0.057	0.056	0.055	0.054	0.053	0.051	0.050	0.049	0.048
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.089	0.087	0.084	0.082	0.080	0.078	0.076	0.075	0.073	0.071	0.070	0.068	0.066	0.065	0.064	0.062	0.061	0.060	0.058	0.057	0.056	0.055	0.054	0.053
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002



Inland ERSP Operational Environment Calculator Design Document

Table G-17. Average oil thickness by hour, TH_h , on Day 2 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.169	0.172	0.176	0.179	0.182	0.185	0.188	0.191	0.194	0.197	0.200	0.203	0.206	0.209	0.211	0.214	0.218	0.221	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.169	0.172	0.176	0.179	0.182	0.185	0.188	0.191	0.194	0.197	0.200	0.203	0.205	0.208	0.211	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.169	0.172	0.176	0.179	0.182	0.185	0.188	0.191	0.194	0.196	0.199	0.202	0.204	0.207	0.209	0.211	0.214	0.216	0.218	0.220	0.223	0.225	0.227	0.229
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.127	0.131	0.135	0.139	0.142	0.145	0.149	0.152	0.156	0.159	0.163	0.167	0.171	0.175	0.178	0.181	0.184	0.187	0.190	0.192	0.195	0.198	0.201	0.204
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.127	0.131	0.134	0.137	0.140	0.144	0.147	0.150	0.153	0.156	0.159	0.161	0.164	0.167	0.171	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.131	0.134	0.137	0.141	0.144	0.148	0.151	0.154	0.157	0.159	0.162	0.165	0.167	0.170	0.172	0.175	0.177	0.180	0.182	0.184	0.187	0.189	0.191	0.193
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.127	0.131	0.134	0.137	0.140	0.143	0.146	0.149	0.152	0.155	0.158	0.160	0.163	0.165	0.168	0.170	0.173	0.175	0.178	0.180	0.182	0.184	0.187	0.189
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.134	0.131	0.131	0.131	0.131	0.131	0.131	0.132	0.132	0.133	0.133	0.134	0.134	0.135	0.135	0.135	0.136	0.136	0.137	0.137	0.138	0.138	0.139	0.139
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.133	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.132	0.132	0.132	0.132	0.133	0.132	0.133	0.134	0.136	0.138
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.131	0.128	0.125	0.123	0.120	0.118	0.116	0.114	0.112	0.110	0.108	0.107	0.105	0.104	0.105	0.108	0.110	0.113	0.116	0.119	0.122	0.125	0.128	0.130
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.135	0.133	0.130	0.128	0.125	0.123	0.122	0.120	0.118	0.116	0.114	0.113	0.111	0.110	0.109	0.110	0.112	0.115	0.118	0.121	0.123	0.126	0.128	0.131
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.109	0.107	0.105	0.102	0.100	0.098	0.096	0.097	0.100	0.103	0.106	0.109	0.112	0.115	0.118	0.121	0.124	0.127	0.129	0.132	0.134	0.137	0.140	0.142
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.134	0.131	0.128	0.126	0.123	0.122	0.120	0.118	0.116	0.114	0.113	0.111	0.110	0.108	0.107	0.107	0.110	0.113	0.115	0.118	0.121	0.123	0.126	0.128
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-17. Average oil thickness by hour, TH_h , on Day 2 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 2																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

Table G-18. Average oil thickness by hour, TH_h , on Day 3.

Scenario	Average Thickness (inches) by Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP I-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-AMPD-OPEN-STAGNANT-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-AMPD-OPEN-STAGNANT-GRAVEL	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
GROUP III-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-18. Average oil thickness by hour, TH_h , on Day 3 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP III-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-AMPD-OPEN-STAGNANT-GRAVEL	0.007	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005
GROUP III-MMPD-CONFINED-FLOW-GRAVEL	0.021	0.021	0.020	0.020	0.020	0.019	0.019	0.019	0.018	0.018	0.018	0.017	0.017	0.017	0.017	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.015
GROUP III-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-FLOW-GRAVEL	0.021	0.021	0.021	0.020	0.020	0.020	0.020	0.020	0.019	0.019	0.019	0.019	0.019	0.018	0.018	0.018	0.018	0.017	0.017	0.017	0.017	0.016	0.016	0.016
GROUP III-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP III-MMPD-OPEN-STAGNANT-GRAVEL	0.024	0.024	0.024	0.023	0.023	0.023	0.023	0.022	0.022	0.022	0.022	0.022	0.021	0.021	0.021	0.021	0.021	0.020	0.020	0.020	0.020	0.020	0.020	0.019
GROUP III-WCD-CONFINED-FLOW-GRAVEL	0.099	0.097	0.096	0.095	0.094	0.092	0.091	0.090	0.089	0.088	0.087	0.086	0.085	0.084	0.083	0.082	0.082	0.081	0.080	0.079	0.078	0.078	0.077	0.076
GROUP III-WCD-CONFINED-FLOW-WETLAND	0.079	0.077	0.075	0.073	0.071	0.069	0.066	0.064	0.062	0.059	0.057	0.056	0.054	0.052	0.051	0.049	0.048	0.047	0.046	0.044	0.043	0.042	0.041	0.040
GROUP III-WCD-CONFINED-STAGNANT-WETLAND	0.093	0.092	0.091	0.089	0.088	0.087	0.086	0.085	0.084	0.082	0.081	0.080	0.079	0.078	0.078	0.077	0.076	0.075	0.074	0.073	0.073	0.072	0.071	0.070
GROUP III-WCD-OPEN-FLOW-GRAVEL	0.098	0.097	0.096	0.095	0.093	0.092	0.091	0.090	0.089	0.088	0.087	0.086	0.085	0.084	0.083	0.082	0.081	0.081	0.080	0.079	0.078	0.077	0.077	0.076
GROUP III-WCD-OPEN-FLOW-WETLAND	0.069	0.068	0.067	0.066	0.065	0.064	0.064	0.063	0.062	0.061	0.061	0.060	0.058	0.057	0.056	0.054	0.052	0.049	0.046	0.043	0.041	0.000	0.000	0.000
GROUP III-WCD-OPEN-STAGNANT-GRAVEL	0.099	0.097	0.096	0.095	0.094	0.093	0.091	0.090	0.089	0.088	0.087	0.086	0.085	0.084	0.083	0.083	0.082	0.081	0.080	0.079	0.078	0.078	0.077	0.076
GROUP II-MMPD-CONFINED-FLOW-GRAVEL	0.009	0.009	0.009	0.008	0.008	0.008	0.007	0.007	0.006	0.005	0.003	0.004	0.004	0.003	0.003	0.004	0.004	0.003	0.003	0.003	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-GRAVEL	0.010	0.010	0.010	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.008	0.008	0.007	0.007	0.007	0.000	0.000	0.000
GROUP II-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP II-MMPD-OPEN-STAGNANT-GRAVEL	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010



Inland ERSP Operational Environment Calculator Design Document

Table G-18. Average oil thickness by hour, TH_h , on Day 3 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP II-WCD-CONFINED-FLOW-GRAVEL	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.041	0.040	0.039	0.039	0.038	0.038	0.037	0.037	0.036	0.036
GROUP II-WCD-CONFINED-FLOW-WETLAND	0.048	0.047	0.046	0.044	0.042	0.040	0.038	0.036	0.034	0.032	0.030	0.029	0.027	0.025	0.024	0.022	0.021	0.019	0.018	0.016	0.014	0.013	0.012	0.011
GROUP II-WCD-CONFINED-STAGNANT-WETLAND	0.051	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.039	0.038	0.038	0.037	0.036	0.036	0.035	0.035	0.034
GROUP II-WCD-OPEN-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP II-WCD-OPEN-FLOW-WETLAND	0.047	0.046	0.046	0.045	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.035	0.034	0.032	0.031	0.029	0.027	0.000	0.000	0.000
GROUP II-WCD-OPEN-STAGNANT-GRAVEL	0.052	0.051	0.050	0.049	0.048	0.047	0.047	0.046	0.045	0.044	0.043	0.043	0.042	0.041	0.041	0.040	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.036
GROUP I-MMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-MMPD-OPEN-STAGNANT-GRAVEL	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
GROUP IV-AMPD-CONFINED-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-GRAVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-AMPD-OPEN-STAGNANT-GRAVEL	0.231	0.233	0.235	0.237	0.239	0.241	0.243	0.244	0.246	0.248	0.250	0.252	0.253	0.255	0.257	0.258	0.260	0.262	0.263	0.265	0.267	0.268	0.270	0.271
GROUP IV-MMPD-CONFINED-FLOW-GRAVEL	0.206	0.209	0.212	0.215	0.217	0.220	0.223	0.225	0.228	0.230	0.233	0.236	0.238	0.240	0.242	0.245	0.247	0.250	0.252	0.255	0.257	0.259	0.262	0.265
GROUP IV-MMPD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Inland ERSP Operational Environment Calculator Design Document

Table G-18. Average oil thickness by hour, TH_h , on Day 3 (Cont'd).

Scenario	Average Thickness (inches) by Hour on Day 3																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
GROUP IV-MMPD-OPEN-FLOW-GRAVEL	0.196	0.198	0.200	0.202	0.204	0.206	0.208	0.210	0.212	0.213	0.216	0.218	0.220	0.221	0.223	0.226	0.228	0.230	0.232	0.234	0.236	0.238	0.240	0.242
GROUP IV-MMPD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP IV-MMPD-OPEN-STAGNANT-GRAVEL	0.191	0.193	0.195	0.197	0.199	0.201	0.203	0.205	0.207	0.209	0.211	0.213	0.215	0.216	0.218	0.220	0.222	0.224	0.225	0.227	0.229	0.231	0.233	0.234
GROUP IV-WCD-CONFINED-FLOW-GRAVEL	0.139	0.140	0.140	0.143	0.145	0.148	0.151	0.153	0.156	0.158	0.160	0.163	0.165	0.167	0.169	0.172	0.174	0.176	0.178	0.180	0.182	0.184	0.186	0.188
GROUP IV-WCD-CONFINED-FLOW-WETLAND	0.140	0.143	0.148	0.152	0.157	0.164	0.171	0.176	0.183	0.189	0.186	0.186	0.191	0.192	0.196	0.199	0.202	0.206	0.207	0.218	0.223	0.227	0.231	0.236
GROUP IV-WCD-CONFINED-STAGNANT-WETLAND	0.133	0.135	0.138	0.140	0.143	0.145	0.147	0.150	0.152	0.154	0.156	0.159	0.161	0.163	0.165	0.167	0.169	0.171	0.173	0.175	0.177	0.179	0.181	0.183
GROUP IV-WCD-OPEN-FLOW-GRAVEL	0.133	0.135	0.138	0.140	0.142	0.145	0.147	0.149	0.151	0.154	0.157	0.159	0.162	0.163	0.166	0.168	0.170	0.172	0.174	0.176	0.178	0.181	0.183	0.184
GROUP IV-WCD-OPEN-FLOW-WETLAND	0.144	0.147	0.149	0.152	0.154	0.156	0.158	0.161	0.163	0.165	0.165	0.167	0.170	0.172	0.175	0.182	0.188	0.194	0.201	0.204	0.186	0.000	0.000	0.000
GROUP IV-WCD-OPEN-STAGNANT-GRAVEL	0.131	0.133	0.136	0.138	0.140	0.143	0.145	0.147	0.149	0.152	0.154	0.156	0.158	0.160	0.162	0.164	0.166	0.168	0.171	0.173	0.175	0.177	0.179	0.181
GROUP I-WCD-CONFINED-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP I-WCD-CONFINED-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-CONFINED-STAGNANT-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-FLOW-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
GROUP I-WCD-OPEN-FLOW-WETLAND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
GROUP I-WCD-OPEN-STAGNANT-GRAVEL	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

