

# Comparison of the Dispersant Mission Planner 2 (DMP2) and Estimated Dispersant System Potential (EDSP) Calculators

The DMP2 was developed by Genwest Systems, Inc. in 2006 for the NOAA Office of Response and Restoration. It is cited in 33 CFR Parts 154 and 155 and The Guidelines for the U.S. Coast Guard Oil Spill Removal Organization Classification Program. The DMP2 enables Oil Spill Removal Organizations (OSROs) to evaluate Effective Daily Application Capacities (EDAC) for different dispersant application systems, using DMP2's EDAC Mode. This allows OSROs to evaluate compliance with the dispersant application requirements in Coast Guard rules. In Operational Mode, the DMP2 provides general performance estimates for the application of dispersants involving a specified oil spill concentration, application platform, and scenario. It can be used to refine and optimize system configurations and to examine staging and logistical support.

The Estimated Dispersant System Potential (EDSP) Calculator was developed by the Bureau of Safety and Environmental Enforcement and Genwest Systems, Inc. as an update to the DMP2. The DMP2 and the EDSP use the same basic calculation algorithms that were developed by Al Allen in 1986, however, there are some differences. This document compares and describes the differences between the DMP2 and the EDSP Calculators.

- The cascade distance is the distance between the dispersant application platform's home base and the identified primary dispersant staging site. The cascade time is the summation of the notification/mobilization time, the time to travel between the home base and staging site, and a 45 minute briefing period prior to spraying dispersant. The cascade time is subtracted from the Utilization Time (UT in the DMP2, Operating Period in the EDSP) of 12 hours to calculate the time available for the platform to deliver dispersant in the first planning period of an incident. An error occurs in the DMP2 when the cascade distance is not specified. In this case there is no cascade from out-of-area but the notification/mobilization time and the 45 minute briefing time should still be used to calculate a reduced initial time period for dispersant application operations. This error is corrected in the EDSP Calculator.
- The DMP2 did not include the capability to calculate the EDAC for vessel platforms as no "standardized" vessel platforms were defined. The EDSP Calculator will calculate an EDAC for vessel platforms if the vessel platform parameters are approved by the regulatory agency.
- EDSP requires a 45 minute briefing period for all platforms at the beginning of the initial operating period even if the platform is not cascading.
- The DMP2 and the EDSP include a 10 minute check-in period with the aerial spotter aircraft prior to the start of every spray sortie for aircraft platforms. This 10 minute check-in period is not included in the EDSP for vessel platforms.
- The DMP2 output included calculation of a "theoretical" dosage range for each platform. The minimum theoretical dosage calculation uses minimum pump rate, maximum application speed, and maximum spray swath width. The maximum theoretical dosage calculation uses maximum pump rate, minimum application speed, and minimum spray swath width. The theoretical dosage range is not necessarily achievable, can be confusing, and is therefore not included in the EDSP.
- The EDSP includes a "business rule" for vessels. If a vessel has been spraying in OP1 and the dispersant remaining is less than one half the payload at the end of the OP, then the platform will transit back to the staging area to resupply. Otherwise, the

platform will stay at the spill site between operating periods and will spray the remainder of the payload at the beginning of OP2.

- EDSP incorporates the ability for vessel platforms to “Resupply On Scene.” If Resupply On Scene is “Yes”, then after every payload delivery, the vessel platform will resupply at the spill site, negating the need for Transit Time between sorties. This means that the second Operating Period will always begin with spray operation. If Resupply On Scene is set to “No” then OP2 will start with a transit.
- In order to get reasonable results from the EDSP Calculator for multiday cascades, if a dispersant delivery vessel will take multiple days to cascade on scene, then only the final day of cascade, either full or partial, should be used for entry into the calculator. For example, a vessel with a Mobilization Time of 4 hrs, a cascade distance (Distance to Staging Site) of 500 miles and a Cascade Transit Speed of 5 kts would give a total Cascade and Mobilization Time of 54 hours (2 days, 6 hours). To correctly simulate this in the calculator, remove 2 full days (48hrs) from the Cascade and Mobilization Time, resulting in a 6 hour difference. Enter this difference of 6 hours into the Mobilization Time and leave the Distance to Staging Site blank. This will result in Operating Period 1 capturing the day of arrival on scene and the calculated output for the second Operating Period reflecting an estimated system potential that is repeatable for the remaining days of the response.
- The aircraft platform database for both the DMP2 and the EDSP contain cascade speed data for both cascading with payload and cascading without payload which may or may not be different depending on the platform. The EDSP makes use of both speeds, the DMP2 uses cascade speed with no payload.
- The aerial platform database created from the Dispersant Aircraft Capability Forms has been corrected and updated for use in the EDSP
- The Transit Time (blue bar in Dispersant Spraying Cycle Timeline) for aircraft in the EDSP includes Taxi-Takeoff Time.
- The DMP2 incorrectly calculates the maximum One-Way Transit Distance for an aircraft platform to deliver a full Payload. In the EDSP the correct maximum One-Way Transit Distance is displayed when it is exceeded by the entry in the One-Way Transit Distance, staging to-from spill input field.
- The DMP2 provides estimates for one Utilization Time (Operating Period). The EDSP provides estimates for two Operating Periods, allowing for mobilization/cascading in the first OP and without the time restrictions of mobilization and cascading in the second OP for those scenarios where cascading can be accomplished in the first OP.
- The EDSP includes a visual timeline of dispersant operations, the Dispersant Spraying Cycle Timeline, which can be very useful in estimating the potential of a dispersant application system in different scenarios.

The Estimated Dispersant System Potential (EDSP) and the DMP2 are both very sensitive to certain kinds of scenarios. This sensitivity extends to the ERSP and EBSF as well. The important consideration in all of these calculators can be summed up by the following question. “What is the platform doing at the end of the operating period in the specified scenario?” Case in point is the following Dispersant Spraying Cycle Timeline.

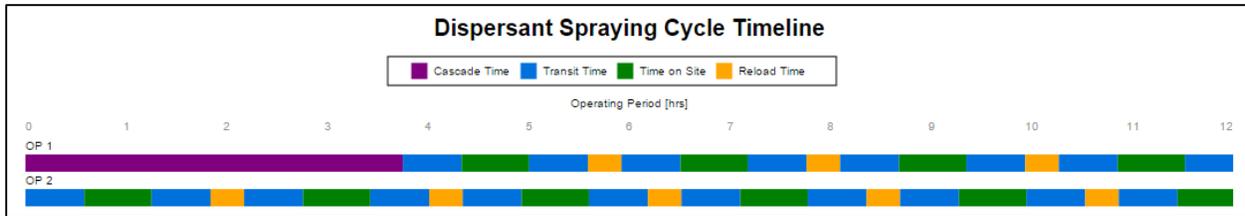


Figure 1. EDSP Dispersant Spraying Cycle Timeline

Note the end of OP1 in the timeline. The bar color is blue indicating that the platform is transiting, in this case, back to staging for a reload of dispersant. The number of payloads delivered in OP1 is exactly four. Modification of the platform parameters in this case, unless carried to extreme, would have no effect on the estimated payload delivery in OP1.

Now look at the green timeline color at the end of OP2 indicating that the platform is on scene and spraying. The calculated pump rate for the platform in this scenario (details below) is 262 gallons per minute in both the DMP2 and the EDSP. Any kind of modification in the platform parameters that would cause in a change of 1 minute in the 12 hour operating period would result in a change of 262 gallons in the estimated dispersant delivery volume if the platform were actually spraying at the end of the OP (not approaching, departing, or turning).

What this means is that what the timeline is showing at the end of an operating period can be an indicator of “how good is the estimate of the potential?” For those who would “game” the calculators, a green timeline at the end of an operating period for a specific scenario would be the place to do it.

The following is a comparison of DMP2, EDSP, and hand calculations using the equations in Section 6 of the EDSP User Manual. Here is the scenario:

Platform - C-130 A with internal dispersant tank.

Mobilization Time – 3 hours

Cascade Distance – 1500 nautical miles, with payload. Range with payload is 1400 nautical miles, therefore cascade will require two legs.

One-way Transit Distance – 100 nautical miles.

Spraying is Bidirectional and Dispersant/Fuel Loads are Simultaneous.

$$\text{Cascade Transit Time for leg 1} = \frac{1400 \text{ nautical miles}}{298 \text{ knots}} = 4.7 \text{ hr} \text{ or } 282 \text{ minutes}$$

$$\text{Cascade Transit Time for leg 2} = \frac{100 \text{ nautical miles}}{298 \text{ knots}} = .336 \text{ hr} \text{ or } 20 \text{ minutes}$$

Total Cascade Time then equals:

|                    |      |             |
|--------------------|------|-------------|
| Mobilization Time  | 3 hr | 180 minutes |
| Taxi Takeoff Time  |      | 15 minutes  |
| Transit Time leg 1 |      | 282 minutes |

|                             |                            |
|-----------------------------|----------------------------|
| Land Taxi Time              | 15 minutes                 |
| Refuel Time                 | 20 minutes                 |
| Taxi Takeoff Time           | 15 minutes                 |
| Transit Time leg 2          | 20 minutes                 |
| Land Taxi Time              | 15 minutes                 |
| Incident Initial Brief Time | <u>45 minutes</u>          |
| <br>                        |                            |
| Total Cascade Time          | 607 minutes or 10.12 hours |

The DMP2 and the EDSP agree on this cascade time and both estimate that 1 payload or 3250 gallons of dispersant can be delivered in the first operating period. The second operating period requires a separate calculation run for the DMP2, this time with no cascade.

Here are the calculations for the second operating period:

$$\text{Pump Rate [gpm]} = \frac{\text{Dosage [gal per acre]} \times \text{App Speed [kts]} \times \text{Swath Width [ft]}}{430}$$

= 5 x 150 x 150/430 = 261.63 or 262 gallons per minute, in agreement with DMP2 and EDSP

$$\text{Spray Time/Sortie [minutes]} = \frac{\text{Payload [gallons]}}{\text{Pump Rate [gpm]}} = \frac{3250}{262} = 12.42 \text{ minutes}$$

Both DMP2 and EDSP show 12.4 minutes.

$$\text{Spray Time/Pass [minutes]} = \frac{\text{Average Pass Length [NM]} \times 60}{\text{Application Speed [kts]}} = \frac{4 \times 60}{150} = 1.6 \text{ minutes}$$

Both DMP2 and EDSP show 1.6 minutes for a complete spray pass.

$$\# \text{ of Passes/Sortie} = \frac{\text{Spray Time per Sortie [min]}}{\text{Spray Time for One Pass [min]}} = \frac{12.42}{1.6} = 7.76$$

Both DMP2 and EDSP calculate 7.8 which means there are 7 complete passes and a partial last pass in each sortie. The flight path for this sortie include a transit out to the spill site, a check-in period with the spotter aircraft followed an approach, a spray pass, a departure, and a U turn for each complete pass. After the last partial pass, the C-130 transits back to the staging site to reload. There will be 6 U Turns and 22 Approaches and Departures for this sortie.

One-way Transit Time (including Taxi + Takeoff/Landing)

$$= \text{Taxi Takeoff Time [min]} + \frac{\text{Transit Distance [nm]}}{\text{Transit Speed [kts]}} \times 60 = 15 + \frac{100}{298} \times 60 = 35 \text{ minutes}$$

DMP2 Transit Time of 20 minutes + 15 minutes for Taxi Takeoff = 35 minutes. EDSP Transit Time = 35 minutes.

$$\text{Time for Approaches and Departures [min]} = \frac{\text{Distance [nm]}}{\text{Reposition Speed [kts]}} \times 60 = 0.4 \text{ minutes}$$

Total time for approaches and departures is 22 x 0.4 minutes = 8.8 minutes

The flight path for one sortie or payload delivery is depicted below in Figure 2.

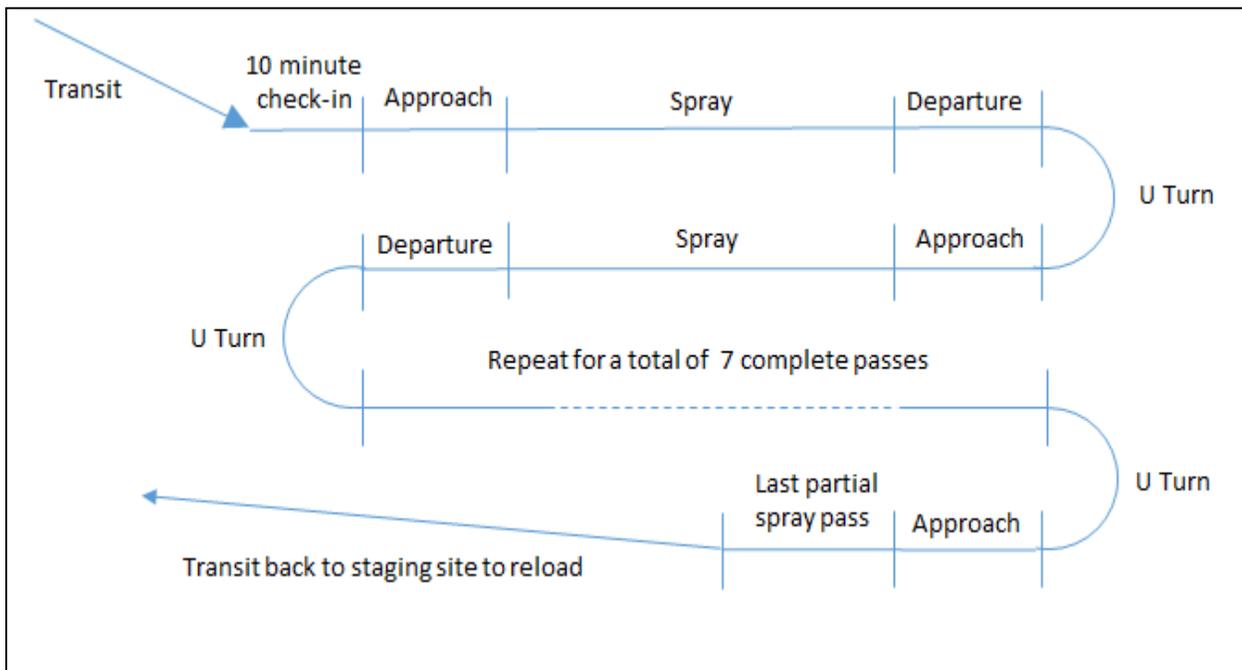


Figure 2. C-130 Flight Path for One Complete Sortie

The Total Time/Sortie for complete sorties equals

|                          |                                    |
|--------------------------|------------------------------------|
| One-way Transit Time     | 35 minutes                         |
| Check-in Time            | 10 minutes                         |
| U Turns – 6 @ 1.67 min   | 10 minutes                         |
| Approaches & Departures  | 8.8 minutes                        |
| Spray Time               | 12.4 minutes                       |
| One-way Transit Time     | <u>35 minutes</u>                  |
| <b>Total Time/Sortie</b> | <b>111.2 minutes or 1.85 hours</b> |

The DMP2 calculates 1.8 hours and the EDSP calculates 110.4 minutes.

There are 5.8 deliveries estimated in the EDSP and 5.77 in the DMP2. The DMP2 calculates a dispersant delivery of 18762 gallons and the EDSP calculates 18739 gallons, a difference of only 23 gallons for this scenario.

Exit DMP2
**Aircraft Calculation Page**
Print Page Documentation

**1 Specify Scenario (UT, Transit Distance, Pass Length) Using a DOR of 1:20**

Desired dispersant: **Dosage** 5.0 Gallons/Acre ( 46.8 Liters/Hectare) Utilization Time (UT): 12 Hours

One Way Transit Distance: 100 Nautical Miles Average Pass Length: 4 Nautical Miles

**2 Specify Platform**

Hercules C130A with internal tank

Double click to view Platform Reference

|                             | Max | Min |
|-----------------------------|-----|-----|
| Pump Rate: (Calculated) GPM | 523 | 60  |
| Swath Width: 150 Ft         | 150 | 100 |
| Application Speed: 150 Kts  | 200 | 150 |
| Transit Speed: 298 Kts      | 298 | 230 |
| Reposition Speed: 150 Kts   |     |     |
| U Turn Time: 1.67 Min       |     |     |
| Approach: 1 NM              |     |     |
| Departure: 1 NM             |     |     |
| Dispersant Load: 20 Min     |     |     |
| Fuel Load Time: 20 Min      |     |     |
| Max Op Time: 4.7 Hr         |     |     |
| Payload: 3250 Gal           |     |     |
| Taxi, Land, Depart: 30 Min  |     |     |
| Always Refuel?: No          |     |     |

**Resulting Platform/Scenario Values**

Theoretical Dosage Range: 0.9 to 15.0 Gallons/Acre  
8.0 to 140.2 Liters/Hectare

Calculated Pump Rate: 262 GPM  
One-way Transit Time: 20 Min  
Areal Coverage Rate: 52.3 Acres/Min 21.2 Hectares/Min  
Time On Station/Sortie: 40.1 Min  
Spray Time/Sortie: 12.4 Min  
Spray Time/Pass: 1.6 Min  
# of Passes per Sortie: 7.8

**3 If Cascading, Specify Mobilization Time and Cascade Distance**

Adjusted Utilization Time: Hr

Range (No Payload): 2086 NM  
Range (With Payload): 1400 NM

Taxi Time (Takeoff): 15 Min  
Taxi Time (Landing): 15 Min

Cascade Transit Speed: 298 Kts  
Staging Area Briefing: 45 Min

Clear Cascade

**4 Calculate Performance**

Bidirectional    Loading of fuel and dispersant:  
 Unidirectional     Simultaneous     Separate

Set EDAC Calculate Pie Chart

**Max Transit Distance** 525 Nautical Miles  
**Time Per Sortie** 1.8 Hr  
**Payload deliveries/UT** 5.77

**Dispersant Applied** 18762 Gal 71013 Liters  
**Oil Treated** 8934 BBL 1420.5 Cu M  
**Total Area Covered** 3752 Acres 1519 Hectares

Figure 3. DMP2 C-130 Scenario

Note that the C-130 default U Turn Time has been changed from 1.75 minutes to 1.67 minutes to conform to the Dispersant Aircraft Capability Form for the Hercules C-130A with internal dispersant tank dated Feb 2, 2007.

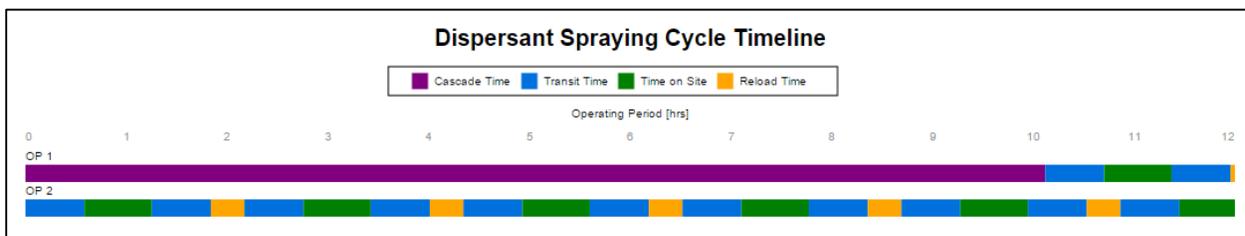


Figure 4. EDSP C-130 Scenario Timeline

| <b>Results for Each Operating Period</b>  | <b>OP 1</b>    | <b>OP 2</b> |
|---|----------------|-------------|
| Cascade Time  | 10.12 hrs      | 0 hrs       |
| Time On Scene to Commence Spray Operations for OP 1 (Cascade Time + One Way Transit Time) | 10.7 hrs       | N/A         |
| Adjusted OP Time  | 1.88 hrs       | 12 hrs      |
| Payload Deliveries  | 1              | 5.8         |
| Dispersant Applied (Computed EDAC)  | 3250 gal       | 18739 gal   |
| Total Area Coverage   | 649 acres      | 3743 acres  |
| Oil Treated (EDSP)  | 1548 bbl       | 8923 bbl    |
| <b>Results per Sortie for a Complete Payload Application</b>                              |                |             |
| One-way Transit Time (Including Taxi + Takeoff/Landing for Aircraft)                      | 35 min         |             |
| Calculated Pump Rate  | 262 gpm        |             |
| Spray Time/Pass   | 1.6 min        |             |
| # of Passes/Sortie  | 7.8            |             |
| Spray Time/Sortie   | 12.4 min       |             |
| Total Time/Sortie   | 110.4 min      |             |
| Areal Coverage Rate   | 52.3 acres/min |             |
| Area Covered/Sortie   | 649 acres      |             |

Figure 5. EDSP C-130 Scenario Tabular Results