

SUSTAINABLE SEDIMENT MANAGEMENT AND DREDGING SEMINAR 6-8 MARCH 2019 SAUSALITO, CA

Dredged Material Management Decisions (D2M2) Matthew Bates Matthew.E.Bates@usace.army.mil (978) 318-8795







US Army Corps of Engineers®

UNCLASSIFIED

UNCLASSIFIED

DISCOVER | DEVELOP | DELIVER

Outline

- 1) Introduction to D2M2
- 2) How D2M2 can add value
- 3) Typical D2M2 process
- 4) Screenshots from case studies
- **5)** Example results & insights
- 6) Concluding thoughts

Introduction to D2M2

- D2M2 Acronym: "Dredged Material Management Decisions"
- D2M2 History:
 - Developed in 1980s by USACE HEC.
 - Code initially maintained by HEC, then by David Ford Engineers.
 - Used on the Columbia river, in the SF Bay region, & others.
 - The ERDC EL Risk & Decision Science team recently modernized & expanded the tool.
- Current POCs: Matthew Bates & Igor Linkov

Introduction to D2M2

What is it, what does it do?

- A system optimization tool for sediment dredging & placement.
- It uses multi-objective, linear programming, system network optimization.
- It finds optimal (efficient) solutions for when & where to move sediment between many dredging reaches & placement areas.
- It incorporates system operational details & constraints such as:
 - Site availability & timing, acquisition, lease renewal, resting periods
 - Volumes to be dredged over time, bulking factors, equipment types
 - Direct & O&M costs, environmental benefits, user-defined objectives

US Army Corps of Engineers • Engineer Research and Development Center

6-8 March 2019

UNCLASSIFIED

How D2M2 can add value

- Traditional approaches rely on staff experience & expert knowledge to decide how much of what to place where & when...
 - This is usually good, but perhaps not perfect.
 - D2M2's recommendations can consider all capacities, interactions, & constraints over decades, even for large, complex systems with many sites across a region (e.g., for a DMMP or capacity analysis).
 - It compares countless potential solutions, evaluating which versions even slightly outperform others.
 - If applied to the \$1B+ national dredging program, even a few % savings can be substantial.

US Army Corps of Engineers • Engineer Research and Development Center

6-8 March 2019

UNCLASSIFIED

How D2M2 can add value

- Traditional approaches typically look at few promising alternative plans...
 - This is usually good, but exploring new scenarios, variations, and alternate futures is time consuming.
 - Once the D2M2 system model is built, individual elements can easily be tweaked to explore different scenarios.
 - This quick scenario & sensitivity analysis is helpful for informing internal discussions and for dialoging with stakeholders.
 - It makes it possible to quickly estimate a cost/benefit of different management strategies, policy changes, or operational changes.
 - And it enables "what if" analysis for uncertain future conditions.

US Army Corps of Engineers • Engineer Research and Development Center

6-8 March 2019

UNCLASSIFIED

How D2M2 can add value

- D2M2 models can be single objective (e.g., minimize total cost), but are designed with multi-objective systems in mind.
- The available objectives are not hard coded, but can support any metrics for which sufficient data is available, e.g., from multiple stakeholders.
- Using a formal approach based on D2M2 adds transparency & replicability, which can to help justify the analyses & defend the results.



US Army Corps of Engineers • Engineer Research and Development Center

6-8 March 2019

UNCLASSIFIED

Typical D2M2 process

- A D2M2 model is a system network of:
 - Dredging reaches, placement sites, transfer sites, routes between site pairs, optimization criteria, specific site data, and tradeoff weights to calculate optimal and alternative solutions.
- A case study model can be built:
 - Directly through the graphical user interface of the D2M2 tool.
 - Using an ArcGIS plugin that leverages existing spatial data (e.g., national channel framework, polygons for placement areas, etc.).
 - Through an Excel upload template into which all data is copy/pasted.

US Army Corps of Engineers • Engineer Research and Development Center

Typical D2M2 process

D2M2 user interface showing a simple system network model



US Army Corps of Engineers • Engineer Research and Development Center

UNCLASSIFIED

Typical D2M2 process

Basic steps to modeling with D2M2 :

- Identify dredging sites and volumes over time.
- Identify placement sites and capacities.
- Identify any transfer sites (e.g., where material or cost curves transition).
- Identify site details related to placement & transfer site costs, benefits, timelines for availability, O&M, material reuse, constraints, etc.
- Develop links/routes between possible dredging and placement site pairs.
- Develop cost & benefit curves that estimate the results of moving sediment from site A to site B.
- Optionally, develop multiple weighting or system configuration scenarios.
- Run the model with those scenarios & visualize results.

D2M2 ArcGIS plugin building the Houston Ship Channel model from existing USACE spatial data



US Army Corps of Engineers • Engineer Research and Development Center

UNCLASSIFIED

D2M2 Excel upload template with data for the Long Island Sound model

C20)5 👻	: 🗙 🗸	f _x						~
	А	В	С	D	Е	F	G	Н	
1	D2M2 spreads	hseet temple	ate, use to bul	lk-upload data into D2	M2.				
2									
3	Link Name	Category	Distance	Maximum Volume	Equipment	Source site name	Destination site name		
	non-empty								
4	name			can be blank					
5	Link #1		40.76622159		Pump-off Hopper 1CY-BN-PH	Port Jefferson/Mount Sinai	Jacobs Beach		
6	Link #2		57.24308988		Mechanical Bucket 1CY-M-B	Port Jefferson/Mount Sinai	Norton Basin/Little Bay borrow pits		
7	Link #3		64.28445472		Mechanical Bucket 1CY-UL-B	Port Jefferson/Mount Sinai	Plum Island		
8	Link #4		21.80511604		Mechanical Bucket 1CY-CAD-B	Port Jefferson/Mount Sinai	Central Long Island Sound		
9	Link #5		27.78642366	1	Vechanical Bucket 1CY-OW-B	Port Jefferson/Mount Sinai	Western Long Island Sound		
10	Link #6		93.83370507		Pump-off Hopper 1CY-BN-PH	Port Jefferson/Mount Sinai	Westerly Municipal Beaches		
11	Link #7		43.07150429		Pump-off Hopper 1CY-BN-PH	Port Jefferson/Mount Sinai	Madison Municipal Beaches		
12	Link #8		47.26202357		Pump-off Hopper 1CY-BN-PH	Port Jefferson/Mount Sinai	Southold Municipal Beaches		
13	Link #9		114.0742115		Mechanical Bucket 5CY-UL-B	Block Island	Blydenburgh Road Landfill Complex		
14	Link #10		102.4123393		Mechanical Bucket 5CY-UL-B	Block Island	Town of Brookhaven Landfill		
15	Link #11		81.37834342		Mechanical Bucket 5CY-UL-B	Block Island	Manchester Landfill		
16	Link #12		72.86681716		Pump-off Hopper 5CY-BN-PH	Block Island	Jacobs Beach		
17	Link #13		156.9232653	1	Mechanical Bucket 5CY-M-B	Block Island	Norton Basin/Little Bay borrow pits		
18	Link #14		40.11875405		Mechanical Bucket 5CY-UL-B	Block Island	Plum Island		
19	Link #15		32.73190749		Mechanical Bucket 5CY-OW-B	Block Island	New London		
20	Link #16		51.36803653		Mechanical Bucket 5CY-OW-B	Block Island	Cornfield Shoals		
21	Link #17		87.09370468		Mechanical Bucket 5CY-CAD-B	Block Island	Central Long Island Sound		
22	Link #18		20.34116832		Pump-off Hopper 5CY-BN-PH	Block Island	Westerly Municipal Beaches		
23	Link #19		70.21978096		Pump-off Hopper 5CY-BN-PH	Block Island	Madison Municipal Beaches		
24	Link #20		55.8798041		Pump-off Hopper 5CY-BN-PH	Block Island	Southold Municipal Beaches		
25	Link #21		170.6027258		Mechanical Bucket 5CY-UL-B	Block Island	Bush Terminal Piers		
26	Link #22		157.5346934		Mechanical Bucket 5CY-UL-B	Block Island	Flushing Airport		
27	Link #23		30.59190921	1	Mechanical Bucket 250CY-UL-B	Bridgeport Area	Blydenburgh Road Landfill Complex		
	·	Dredge Site	Properties	Placement Site Prope	rties Transfer Site Properties	Transportation Link Propertie 🕂 🗄 📢			Þ

US Army Corps of Engineers • Engineer Research and Development Center

6-8 March 2019

UNCLASSIFIED

D2M2 graphical user interface with an (incomplete) SF Bay model



US Army Corps of Engineers • Engineer Research and Development Center

UNCLASSIFIED

Data used (externally) to develop site scores for multiple criteria, for the **Gulf Intracoastal** Waterway model



Engineer Research and Development Center US Army Corps of Engineers •

UNCLASSIFIED

Logical site connections for the Gulf Intracoastal Waterway model



US Army Corps of Engineers • Engineer Research and Development Center

UNCLASSIFIED

Viewing & editing data for the Houston Ship Channel model

Untitled - D2M2J-LPS						- 0
ile Edit View Run Tools Help						
Explorer 🗌 😂	🕀 🗋 Table				Properties	C
Ju 🖑 2* 🛞 🛕 🟹 👘 📗	V&R Per Unit Placement Cost or Benefit	Unit Reus Acquisitio	n Earliest Ac Late	st Acq Periods Be Resting Pe	- +	
Calveston HSC Area D2M2 Ontimization	0 [0.0, 0.0, 3.0, 0.0]	[0.0, 0.0, 0 0.0	1999	0	🖻 General	
Galveston 1100 Area D2m2 Optimization	0 [0.0, 0.0, 0.0, 3.0]	[0.0, 0.0, 0 0.0	1999	0	Туре	Disposal Site
Dieuge Sites		[0.0, 0.0, 0 0.0	1999	0	Name	ATKINSON IS MAR
		[0.0, 0.0, 0 0.0	1999	0	LISACE IDPK	
Placement Sites		000000000	1999	0	Bite Cotegory	Confined Linions
Default	b [0.0, 0.0, 0.0, 0.0]	[0.0, 0.0, 0 0.0	1999	0	Sile Calegoly	Di uli vo li ul
Confined Upland	0 [0.0, 0.0, 2.0, 1.0]	[0.0, 0.0, 0 0.0	1999	0	Equipment Category	Pipeline (Cuttern
ALEXANDER ISLAND PLACEM	0 [0.0, 2.0, 0.0, 3.0]	[0.0, 0.0, 0 0.0	1999	0	Fixed-Cost Scaling I	actors
ATKINSON IS MARSH CELL M1	p [0.0, 0.0, 1.0, 3.0]	[0.0, 0.0, 0 0.0	1999	0	Fixed-Cost Scaling Fac	tc Cost; 1.0; Oyster F
CLINTON EAST PLACEMENT A	0 [0.0, 0.0, 1.0, 3.0]	[0.0, 0.0, 0 0.0	1999	0	Location	
CLINTON WEST PLACEMENT	0 [0.0, 0.0, 1.0, 3.0]	[0.0, 0.0, 0 0.0	1999	Criterion	Cost or Benefit	
FILTERBED PLACEMENT ARE	p [0.0, 0.0, 1.0, 0.0]	[0.0, 0.0, 0 0.0	1999	Cost	0.0	
GLENDALE PLACEMENT ARE/	p [0.0, 0.0, 1.0, 0.0]	[0.0, 0.0, 0 0.0	1999	Ovster Reef Imnacts	0.0	
HOUSE TRACT PLACEMENT A		0.0, 0.0, 0 0.0	1999	Spacing Spacing	0.0	
		[0.0, 0.0, 0 0.0	1999	apecies	0.0	
		[0.0, 0.0, 0 0.0	1999	Oil Gas Overlap	3.0	
MID BAY PLACEMENT AREA	[0.0, 0.0, 2.0, 1.0]	[0.0, 0.0, 0 0.0	1000			
PA 14						
PA 15						
PA 15 - PA 14 CONNECTION P					Unit Placement Cost or	E Cost; 0.0; Oyster
PEGGY LAKE PLACEMENT AR					Unit Reuse Cost or Ber	ne Cost; 0.0; Oyster
PELICAN ISLAND PLACEMENT					🖻 Reuse Data	
ROSA ALLEN PLACEMENT AR					First Period Possible	1999
SAN JACINTO PLACEMENT AR					Maximum Rate	0
SNAKE ISLAND PLACEMENT A					Site Acquisition Dat	a
SPILMAN ISLAND PLACEMENT	45	7		7	Acquicition Cost	0
T Beneficial Use					Forlight Association Dec	4000
ATKINSON IS MARSH CELL M	Diagram [] Table []				Earliest Acquisition Per	10 1999
Onen Water						
Confined Ray March	□ Notes					
 Commed Bay Marsh Linka 						
Equipment						

US Army Corps of Engineers • Engineer Research and Development Center

UNCLASSIFIED





US Army Corps of Engineers • Engineer Research and Development Center

6-8 March 2019

UNCLASSIFIED

Sausalito, CA

Example results & insights

Output reports for the Long Island Sound model and exported data from the GIWW model results

	1 E Report				57									
	File View N	avinate			23									
						_								
			🗐 Report					23						
			File View Navigate											
	Tab	Total			48		75%							
Ontimal	Peri	od Volume Cost			• • • • •									
Drodgo sitos	Tet	20000 122120												
Port Jefferson/Mount		122139		Hempstead Harbor Area	River/Milford Area N	Iorthport Bay Roci	elle Area Little Neck E	lays						
Sinai	Site N	ame: Norwalk Area	Town of Brookhaven	0	50000	0	0 0							
Block Island		Ma	Landfill		1/1			- 11						
Bridgeport Area	Peri	Blydenburgh Road Landfill To Complex To	Westerly Municipal	0	0	0	0 0							
Cannon Westbrook Area		Volume Cost V	Beaches					- 11						
Eastchester Ray Area	1	0 0	Western Long Island Sound	2 (6	3 (4	U	5 /6							
Fishers Island	2	0 0	Total	50000	837946	200.00	0000 10000							
Fishers Island	4	0 0	Total	30000	03/940	20000	10000							
Sound/Little Narragansett	5	0 0		Montauk	New Haven Area Ne	w London Area Nia	tic Area Norwalk Ar	ea						
Greenwich Area	Tot			0	0	0	0 0							
Guilford/Branford Area			Mudenburgh Kond			· · ·	- a - riann		Seres		CENS	carring		
Hempstead Harbor	\$22510	- : <u>* f.</u>	1											
Area Housatonic	532519	A = Jx	1											
River/Milford Area	Site Sub	Report-Solution Name - Site Su	h Report-Site Nam	e 🚽 Site Si	ub Report-USAC		ib Report-Latitud	e - Site Su	h Report-Longitude - Site Sub	Report-	Site Sub Report-Table Caption	- Site Sub Br -	Period -	Volum
Vorthport Bay Area	32519 Ontimal	PA 66	b_rteport-orte_rtain	CESWO	2.1100-00006	e_lorid - Jace_s	ing_report-carreda	0		citor	Material added	2025	chod -	· · · · ·
Mamaroneck/New	22520 Optimal	PA 00		CESWO	3-0PC-00000			0	0 Disposal	sites	Material added	2005		
Manhasset and Little	22521 Optimal	PA 00		CESWO	S-0PC-00000			0	0 Disposal	sites	Material added	2033		
Veck Bays	22522 Optimal	PA 00		CESWO	S-UPC-00006			0	0 Disposal	sites	Material added	2035		
Montauk	22522 Optimal	PA 00		CESWO	S-0PC-00000			0	0 Disposal	sites	Material added	2033		
New Haven Area	22523 Optimal	PA 00		CESWO	3-0PC-00000			U	U Disposal	SILES	waterial audeu	2033		
Niantic Area	J2J24 Optimat	EA UU						0	0 Disposal	citor	Material added	2025		
INIGHIUG AVEG	22525 Ontimal	DA 66		CESWO	3-UPC-00006			0	0 Disposal	sites	Material added	2035		
Norwalk Area	32525 Optimal	PA 66		CESWG	G-UPC-00006			0	0 Disposa 0 Disposa	sites sites	Material added Material added	2035		
Norwalk Area Great and Little	32525 Optimal 32526 Optimal	PA 66 PA 66		CESWG	G-UPC-00006 G-UPC-00006 G-UPC-00006			0 0 0	0 Disposa 0 Disposa 0 Disposa	sites sites sites	Material added Material added Material added	2035 2035 2035		
Norwalk Area Great and Little Peconic Bays	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal	PA 66 PA 66 PA 66		CESWO	G-UPC-00006 G-UPC-00006 G-UPC-00006 G-UPC-00006 G-UPC-000013			0 0 0 0 0 0	0 Disposal 0 Disposal 0 Disposal 0 Disposal	sites sites sites sites	Material added Material added Material added Material added	2035 2035 2035 2035 2035	2016	
Norwalk Area Great and Little Peconic Bays Port Chester/Rye Area	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal	PA 66 PA 66 PA 66 PA 67		CESWG CESWG CESWG CESWG	G-UPC-00006 G-UPC-00006 G-UPC-00006 G-UPC-00006 G-OUA-00013			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposal 0 Disposal 0 Disposal 0 Disposal 0 Disposal 0 Disposal	sites sites sites sites sites	Material added Material added Material added Material added Material added	2035 2035 2035 2035 2035 2035	2016	
Norwalk Area Great and Little Peconic Bays Port Chester/Rye Area Shelter sland/Gardiners Bay	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32529 Optimal 32529 Optimal	PA 66 PA 66 PA 66 PA 67 PA 67 PA 67		CESWG CESWG CESWG CESWG CESWG	S-UPC-00006 S-UPC-00006 S-UPC-00006 S-UPC-00006 S-OUA-00013 S-OUA-00013 S-OUA-00013			0 0 0 0 0 0	0 Disposal 0 Disposal 0 Disposal 0 Disposal 0 Disposal 0 Disposal 0 Disposal	sites sites sites sites sites sites	Material added Material added Material added Material added Material added Material added	2035 2035 2035 2035 2035 2035 2035	2016 2017	
Norwalk Area Great and Little Peconic Bays Port Chester/Rye Area Shelter sland/Gardiners Bay Stamford Area	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32529 Optimal 32530 Optimal 32531 Optimal	PA 66 PA 66 PA 67 PA 67 PA 67 PA 67		CESWG CESWG CESWG CESWG CESWG CESWG CESWG	S-UPC-00006 S-UPC-00006 S-UPC-00006 S-UPC-00006 S-OUA-00013 S-OUA-00013 S-OUA-00013			0 0 0 0 0 0 0	0 Disposal 0 Disposal 0 Disposal 0 Disposal 0 Disposal 0 Disposal 0 Disposal 0 Disposal	sites sites sites sites sites sites sites	Material added Material added Material added Material added Material added Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018	
Norwalk Area Great and Little Peocnic Bays Port Chester/Rye Area Shelter Stant/Gardiners Bay Stantford Area Disposal sites	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32529 Optimal 32530 Optimal 32531 Optimal 32531 Optimal	PA 66 PA 66 PA 66 PA 67 PA 67 PA 67 PA 67		CESWG CESWG CESWG CESWG CESWG CESWG CESWG				0 0 0 0 0 0 0 0	0 Disposa 0 Disposa 0 Disposa 0 Disposa 0 Disposa 0 Disposa 0 Disposa 0 Disposa 0 Disposa	sites sites sites sites sites sites sites sites	Material added Material added Material added Material added Material added Material added Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019	
Norwalk Area Great and Little Percinic Bays Port Chester/Rye Area Sheiter Sland/Gardiners Bay Stamford Area Disposal sites Biydenburgh Road andfill Complex	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32529 Optimal 32530 Optimal 32531 Optimal 32532 Optimal	PA 55 PA 66 PA 66 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67		CESWG CESWG CESWG CESWG CESWG CESWG CESWG CESWG	S-UPC-00006 S-UPC-00006 S-UPC-00006 S-UPC-00006 S-UUA-00013 S-OUA-00013 S-OUA-00013 S-OUA-00013 S-OUA-00013			0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa 0 Disposa 0 Disposa 0 Disposa 0 Disposa 0 Disposa 0 Disposa 0 Disposa 0 Disposa	sites sites sites sites sites sites sites sites sites sites	Material added Material added Material added Material added Material added Material added Material added Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020	
Norwalk Area Great and Little Seconic Bays Port Chester/Rye Area Shelter sland/Gardiners Bay Stamford Area Disposal sites Biydenburgh Road andfill Complex Town of Brockhaven	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32530 Optimal 32530 Optimal 32531 Optimal 32532 Optimal 32533 Optimal 32534 Optimal	PA 66 PA 66 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67		CESWG CESWG CESWG CESWG CESWG CESWG CESWG	S-UPC-00006 S-UPC-00006 S-UPC-00006 S-UPC-00006 S-OUA-00013 S-OUA-00013 S-OUA-00013 S-OUA-00013 S-OUA-00013 S-OUA-00013 S-OUA-00013			0 0 0 0 0 0 0 0 0 0	0 Disposal 0 Disposal	sites sites sites sites sites sites sites sites sites sites	Material added Material added Material added Material added Material added Material added Material added Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021	
Norwalk Area Great and Little Great and Little Beconic Bays Port Chester/Rye Area Shefter Stanfford Area Disposal sites Biydanburgh Road andfill Compiex Town of Brockhaven andfill Southold Municipal	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32530 Optimal 32530 Optimal 32531 Optimal 32533 Optimal 32533 Optimal 32534 Optimal 32535 Optimal	PA 66 PA 66 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67		CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC	S-UPC-00006 S-UPC-00006 S-UPC-00006 S-UPC-00006 S-0UA-00013 S-0UA-00013 S-0UA-00013 S-0UA-00013 S-0UA-00013 S-0UA-00013 S-0UA-00013 S-0UA-00013			0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites sites sites sites sites sites sites sites sites sites	Material added Material added Material added Material added Material added Material added Material added Material added Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021 2022 2022	
Norwalk Area Great and Little Great and Little econic Bays Port Chester/Rye Area Shelter Stamford Area Disposal sites Biydenburgh Road andfill Complex Town of Brookhaven andfill Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32530 Optimal 32530 Optimal 32531 Optimal 32532 Optimal 32534 Optimal 32535 Optimal 32535 Optimal	PA 66 PA 66 PA 66 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67		CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00005 UPC-00005 UPC-00013 UPC-00013 UPC-00013 UPC-00013 UPC-00013 UPC-00013 UPC-00013 UPC-00013 UPC-00006 UPC-00013 UPC			0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites sites sites sites sites sites sites sites sites sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021 2022 2023 2024	
Norwalk Area Great and Little Great and Little Port Chester/Rye Area Sheiter Slant/Gardiners Bay Stamford Area Disposal sites Biydenburgh Road andfill Complex Town of Brookhaven andfill Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32530 Optimal 32530 Optimal 32531 Optimal 32532 Optimal 32534 Optimal 32535 Optimal 32535 Optimal 32536 Optimal	PA 66 PA 66 PA 66 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67 PA 67		CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00005 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites sites sites sites sites sites sites sites sites sites sites sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021 2022 2023 2024	120
Norwak Area Great and Little Great and Little Beconic Bays Port Chester/Rye Area Shelter Stanford Area Disposal sites Biydenburgh Road Biydenburgh Road andfill Complex Town of Brookhaven Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32529 Optimal 32530 Optimal 32531 Optimal 32532 Optimal 32533 Optimal 32534 Optimal 32535 Optimal 32535 Optimal 32536 Optimal 32539 Optimal	PA 66 PA 66 PA 67 PA 67		CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00006 UDA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposal 0 Disposal	sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2025	138
Norwak Area Great and Little Great and Little Jeconic Bays Port Chester/Fye Area Shefter Stanfford Area Disposal sites Blydenburgh Road andfill Comgets Tot of Brockhaven Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32530 Optimal 32530 Optimal 32531 Optimal 32533 Optimal 32534 Optimal 32535 Optimal 32536 Optimal 32538 Optimal 32539 Optimal 32539 Optimal 32539 Optimal	PA 66 PA 66 PA 67 PA 67		CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00006 UDA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013 OUA-00013			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2025	138
Norwalk Area Great and Little Great and Little Jeconic Bays Port Chester/Kye Area Shelter Sland/Gardiners Bay Stamford Area Disposal sites Blydenburgh Road andfill Complex Town of Brockhaven andfill Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32530 Optimal 32531 Optimal 32531 Optimal 32532 Optimal 32535 Optimal 32535 Optimal 32535 Optimal 32537 Optimal 32539 Optimal 32539 Optimal 32539 Optimal	PA 66 PA 66 PA 66 PA 67 PA 67		CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC CESWC	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00006 			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2026	138
Norwalk Area Great and Little Percinic Bays Port Chester/Fye Area Shelter Slant/Gardiners Bay Stamford Area Disposal sites Biydenburgh Road andfill Complex Town of Brookhaven andfill Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32529 Optimal 32530 Optimal 32531 Optimal 32532 Optimal 32533 Optimal 32534 Optimal 32535 Optimal 32536 Optimal 32537 Optimal 32538 Optimal 32539 Optimal 32530 Optimal 32531 Optimal 32532 Optimal 32534 Optimal 32535 Optimal 32536 Optimal 32537 Optimal 32538 Optimal 32540 Optimal 32541 Optimal	PA 66 PA 66 PA 67 PA 67		CESWC CESWC	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-000013 OUA-00013 OU			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029	138
Norwak Area Great and Little Great and Little econic Bays Port Chester/Rye Area Shefter Stanfford Area Disposal sites Blydanburgh Road andfill Compix Town of Brookhaven andfill Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32529 Optimal 32530 Optimal 32530 Optimal 32531 Optimal 32532 Optimal 32534 Optimal 32535 Optimal 32535 Optimal 32537 Optimal 32539 Optimal 32539 Optimal 32540 Optimal 32540 Optimal 32540 Optimal 32540 Optimal	PA 66 PA 66 PA 67 PA 67		CESWC CESWC	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-000013 OUA-00013 OU			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2029	138
Norwalk Area Great and Little Great and Little econic Bays Port Chester/Fye Area Shelter Stamford Area Disposal sites Biydenburgh Road andfill Complex Town of Brookhaven andfill Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32529 Optimal 32531 Optimal 32532 Optimal 32533 Optimal 32534 Optimal 32535 Optimal 32536 Optimal 32537 Optimal 32538 Optimal 32539 Optimal 32534 Optimal 32535 Optimal 32536 Optimal 32537 Optimal 32538 Optimal 32540 Optimal 32541 Optimal 32542 Optimal 32542 Optimal	PA 66 PA 66 PA 67 PA 67		CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO CESWO	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-000013 OUA-00013 OU			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030	138
Norwalk Area Great and Little Great and Little Percinic Bays Shelter Sland/Gardiners Bay Stamford Area Disposal sites Blydenburgh Road andfill Complex Town of Brookhaven andfill Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32529 Optimal 32530 Optimal 32531 Optimal 32532 Optimal 32533 Optimal 32534 Optimal 32535 Optimal 32536 Optimal 32537 Optimal 32538 Optimal 32539 Optimal 32540 Optimal 32541 Optimal 32542 Optimal 32544 Optimal 32544 Optimal 32540 Optimal 32540 Optimal 32541 Optimal 32542 Optimal 32543 Optimal 32544 Optimal 32545 Optimal 32540 Optimal 32540 Optimal	PA 66 PA 66 PA 67 PA 67		CESWC CESWC	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-000013 OUA-00013 OU			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2031	138
Norwak Area Great and Little Great and Little Cecnic Bays Port Chester/Rye Area Shelter SlamfOrd Area Disposal sites Biydenburgh Road andfil Complex Town of Brockhaven andfil Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32529 Optimal 32530 Optimal 32530 Optimal 32531 Optimal 32532 Optimal 32534 Optimal 32535 Optimal 32535 Optimal 32539 Optimal 32530 Optimal 32540 Optimal 32541 Optimal 32541 Optimal 32542 Optimal 32542 Optimal 32542 Optimal 32543 Optimal 32544 Optimal	PA 66 PA 66 PA 67 PA 67		CESWC CESWC	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-000013 OUA-00013 OU			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2032	138 217 38
Norwak Area Great and Little Great and Little econic Bays Port Chester/Fye Area Shefter Stamford Area Disposal sites Biydenburgh Road andfil Comgets Tot of Brockhaven Tot of Brockhaven Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32529 Optimal 32530 Optimal 32531 Optimal 32532 Optimal 32533 Optimal 32534 Optimal 32535 Optimal 32536 Optimal 32537 Optimal 32538 Optimal 32540 Optimal 32541 Optimal 32542 Optimal 32543 Optimal 32544 Optimal 32543 Optimal 32540 Optimal 32541 Optimal 32542 Optimal 32543 Optimal 32544 Optimal 32545 Optimal 32546 Optimal 32547 Optimal 32548 Optimal	PA 66 PA 66 PA 67 PA 67		CESWC CESWC	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-000013 OUA-00013 OU			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2029 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2030 2031 2032 2033	138 217 38
Norwalk Area Great and Little Great and Little econic Bays Port Chester/Fye Area Shelter Stamford Area Disposal sites Biydenburgh Road andfill Complex Town of Brookhaven andfill Southold Municipal Beaches	32525 Optimal 32526 Optimal 32527 Optimal 32528 Optimal 32529 Optimal 32530 Optimal 32531 Optimal 32532 Optimal 32533 Optimal 32534 Optimal 32535 Optimal 32536 Optimal 32537 Optimal 32538 Optimal 32539 Optimal 32540 Optimal 32541 Optimal 32542 Optimal 32543 Optimal 32544 Optimal 32545 Optimal 32546 Optimal 32545 Optimal 32546 Optimal 32547 Optimal	PA 66 PA 66 PA 67 PA 67		CESWC CESWC	UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-00006 UPC-000013 OUA-00013 OU			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 Disposa 0 Disposa	sites sites	Material added Material added	2035 2035 2035 2035 2035 2035 2035 2035	2016 2017 2018 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2030 2031 2032 2033 2034 2034	138 217 38 117 217

6-8 March 2019

UNCLASSIFIED

Sausalito, CA

Example results & insights

Linear costs but nonlinear potential resource impacts in the LIS model results



US Army Corps of Engineers • Engineer Research and Development Center

UNCLASSIFIED

Example results & insights

Costs, environmental impacts, and beneficial use scores across six model scenarios with different sites included and weighting.







US Army Corps of Engineers • Engineer Research and Development Center

UNCLASSIFIED

C Q Search

Placement Area Optimizati... ×

155.82.164.219/DMMP

Example results & insights

Placement sites used under two different GIWW weightings.



Concluding thoughts

- What value do you see D2M2 adding to your work?
- What barriers to you see to using D2M2 at your district?
- What value and barriers do you see for promoting the use of D2M2 at the national level?
- I would be happy to teach you how to use D2M2 or build a D2M2 model of your region with/for you.

- Thank you!
- Matthew.E.Bates@usace.army.mil

US Army Corps of Engineers • Engineer Research and Development Center

6-8 March 2019

UNCLASSIFIED