INNOVATIONS IN THIN LAYER PLACEMENT SPRAY EQUIPMENT

CUSTOM NOZZLE DESIGNS & CASE STUDIES

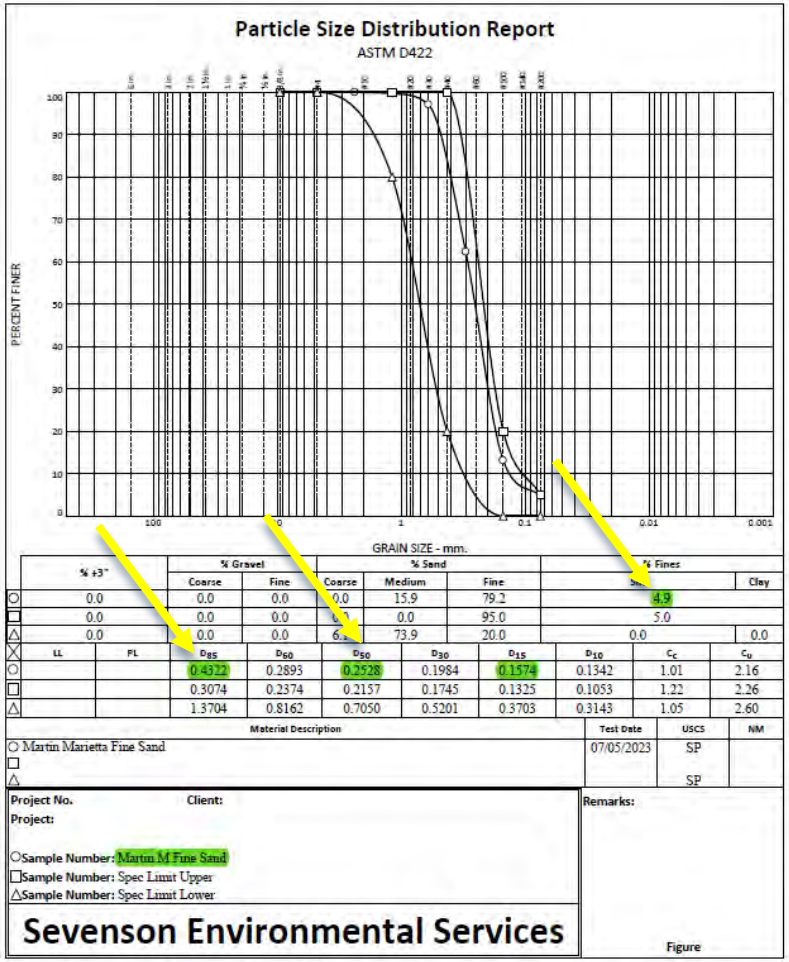
JULY 18, 2023

Sevenson Environmental Services, Inc.

EQUIPMENT EVOLUTION & PROJECTS

- Thin layer application is not a new concept
- Environmental projects requiring thin layer cap materials
- Minimize marsh disturbance – spreading contamination
- Minimize marsh restoration - replanting
- Equipment sizing
- Project 1 marsh capping – LA
- Project 2 marsh pilot system - GA
- Project 3 shallow water - DE
- Project 4 full scale marsh application - GA

SIZING EQUIPMENT



Particle Size Distribution Report

ASTM D422

PERCENT FINER

GRAIN SIZE - mm.

	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Si	Clay
○	0.0	0.0	0.0	0.0	15.9	79.2	4.9	
□	0.0	0.0	0.0	0.0	0.0	95.0	5.0	
△	0.0	0.0	0.0	6.[illegible]	73.9	20.0	0.0	0.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.4322	0.2893	0.2528	0.1984	0.1574	0.1342	1.01	2.16
□			0.3074	0.2374	0.2157	0.1745	0.1325	0.1053	1.22	2.26
△			1.3704	0.8162	0.7050	0.5201	0.3703	0.3143	1.05	2.60

	Material Description	Test Date	USCS	NM
○	Martin Marietta Fine Sand	07/05/2023	SP	
□			SP	
△				

Project No. Client:

Project:

Remarks:

○Sample Number: Martin M Fine Sand

□Sample Number: Spec Limit Upper

△Sample Number: Spec Limit Lower

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Figure

Martin Marietta

Basic Quality Statistical Summary Report

Plant	21112-St. Marys Sand, LLC
Product	7369-FINE SAND / A3
Specification	N/A
Period	01/18/2021 - 01/18/2022

Sieve/Test	Tests	Average	St Dev	Target
#4 (4.75mm)	19	100.0	0.00	
#8 (2.36mm)	19	100.0	0.03	
#16 (1.18mm)	19	99.7	0.31	
#30 (.6mm)	19	97.1	2.50	
#50 (.3mm)	19	62.3	19.55	
#100 (.15mm)	19	13.1	9.92	
#200 (75µm)	19	0.49	0.231	
Pan	19	0.00	0.000	
Organic Plate	1	4		
Soundness (MgSO4)	1	1.4		
FM	19	1.2779	0.30145	
SE	2	65	25.5	
-#200 (75um)	19	0.45	0.221	
Absorption	2	0.7	0.71	
Total Moisture	19	8.25	3.269	
Color	9	5	1.3	
D10 (ES)	19	0.14	0.029	
D15	2	0.20	0.021	
D20	2	0.22	0.028	
D30	2	0.28	0.049	
D50	19	0.26	0.059	
D60	19	0.30	0.067	
D70	2	0.45	0.028	
D80	2	0.50	0.014	
D85	2	0.53	0.014	

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SIZING EQUIPMENT

Slurry Properties

Fluid S.G.	0.999	Large particle shape	Angular
Solids S.G.	2.641	% passing < 40 µm	1.4 %
Mixture S.G.	1.080	% passing < 200 vr	33.7 %
Concentration by volume	4.9 %	Mechanical sliding friction	0.50
Concentration by weight	12.0 %	pH	6.7
D50	250 µm	Chlorides	0 ppm
D85	450 µm	Temperature	70.0 °F
Topsize	2300 µm	Fluid dynamic viscosity	0.975 cP
Fines < 74 µm	5.0 %	Fluid w/ fines viscosity	0.981 cP
Slurry type	Settling		
Friction loss model	Four component		

Small changes in slurry density can cause large changes in pipeline friction. Whenever possible, tests on the actual slurry should be carried out in a pipeline. If this is not possible, samples should be utilized to determine the model parameter values via benchtop tests.

Pipeline Information

Section	Roughness ft	Diameter (ID) in	Length ft	Rise ft	Total 'K'
Suction	0.00007000	7.55	10.00	6.00	2.00
HDPE 8" SDR	0.00007000	7.55	1,700.00	0.00	5.00
Nozzle	0.00005000	4.00	1.00	0.71	1.00

Four Component Information

Pipe	dh µm	Passing 0.015D	VH1,s ft/s	Vsm,h ft/s	Vsm,s ft/s	vt,s ft/s
Suction	327.8	100.00%	27.86	11.17	9.71	0.59
HDPE 8" SDR	327.8	100.00%	27.86	8.39	6.93	0.59
Nozzle	327.8	100.00%	19.71	8.01	7.19	0.40

Static Head Summary

Suction elevation above sea level	20.0 ft	Pump centerline to system discharge	0.7 ft
Pump centerline to sump liquid level	6.0 ft	System discharge pressure	0.0 psi
		Total system static head	-5.3 ft

Recommended minimum flow: 1,700 GPM

HDPE 8" SDR	Flow (GPM)	j (ft slurry / ft)	Loss (ft)	Velocity (ft/s)
	0	26.611	45238.1	0.00
	150	0.082	139.1	1.07
	300	0.043	72.7	2.15
	450	0.031	53.7	3.22
	600	0.027	47.6	4.30
	750	0.027	47.6	5.37
	900	0.028	51.2	6.45
	1050	0.031	57.4	7.52
	1200	0.035	65.9	8.60
	1350	0.041	76.3	9.67
	1500	0.047	88.4	10.75
	1650	0.054	102.1	11.82
	1800	0.061	117.3	12.90

Nozzle	Flow (GPM)	j (ft slurry / ft)	Loss (ft)	Velocity (ft/s)
	0	18.817	18.8	0.00
	150	0.028	0.3	3.83
	300	0.050	1.0	7.66
	450	0.096	2.1	11.49
	600	0.161	3.8	15.32
	750	0.243	5.9	19.15
	900	0.342	8.5	22.98
	1050	0.459	11.6	26.81
	1200	0.592	15.2	30.64
	1350	0.743	19.2	34.47
	1500	0.911	23.7	38.30
	1650	1.095	28.7	42.13
	1800	1.297	34.1	45.96

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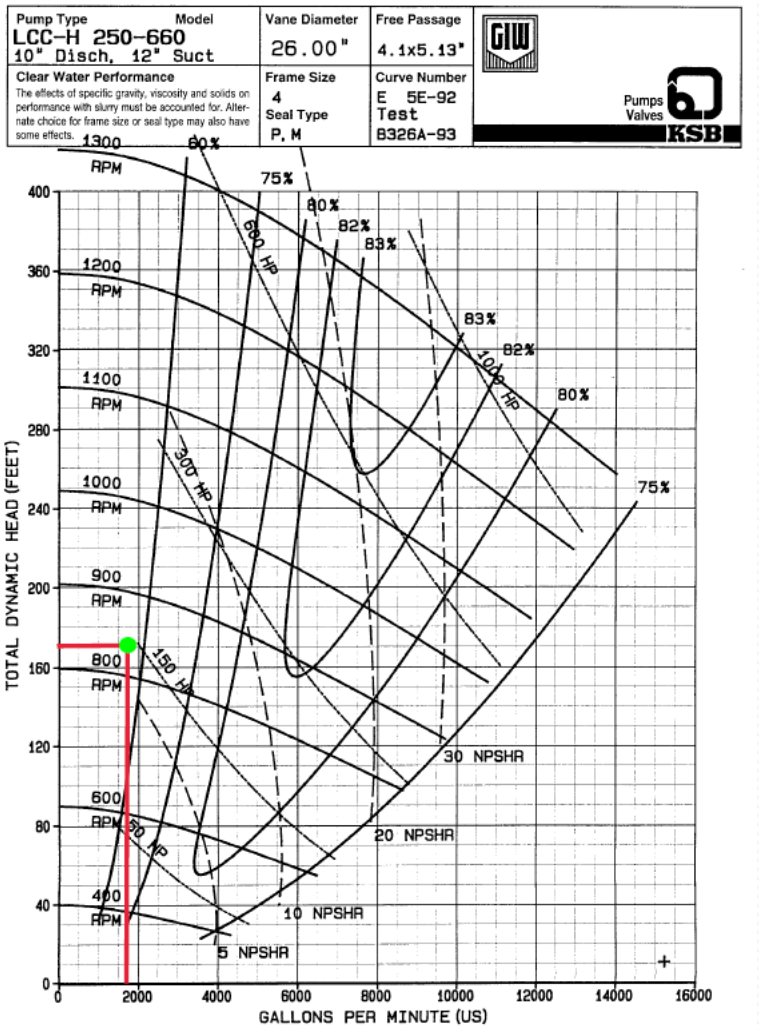
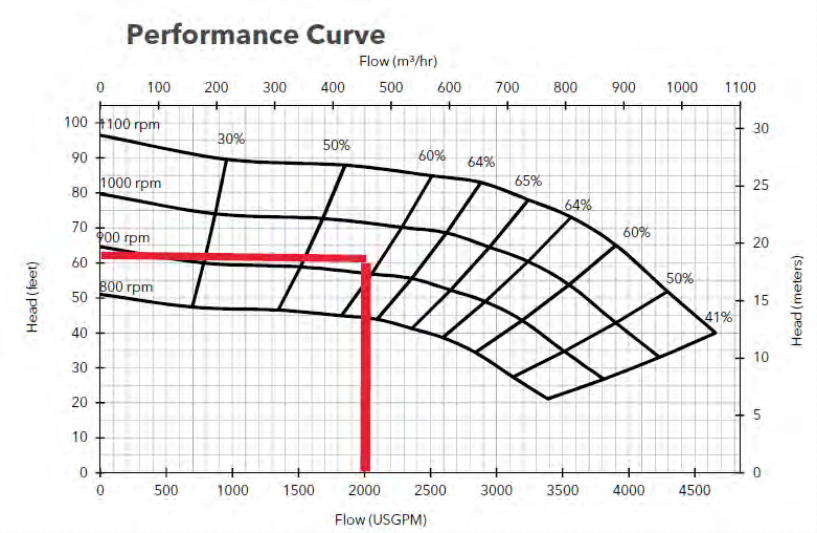
SIZING EQUIPMENT





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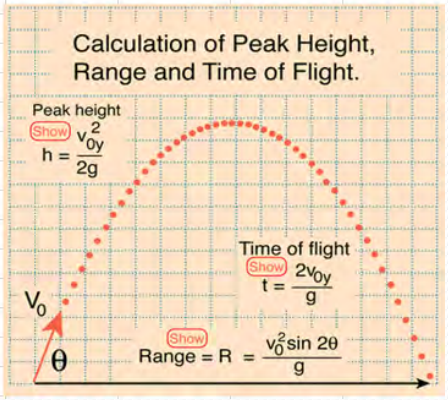
SIZING EQUIPMENT

Flow	1,800	GPM
Nozel ID	4	Inch
Flow	4.01	CFS
Nozzel Area	0.087	SF
Velocity	46.0	Ft/Sec
Takeoff Angle	45	Degrees
Discharge Angle	0.79	Radians
Range	65.7	FT



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NOZZLE TYPES

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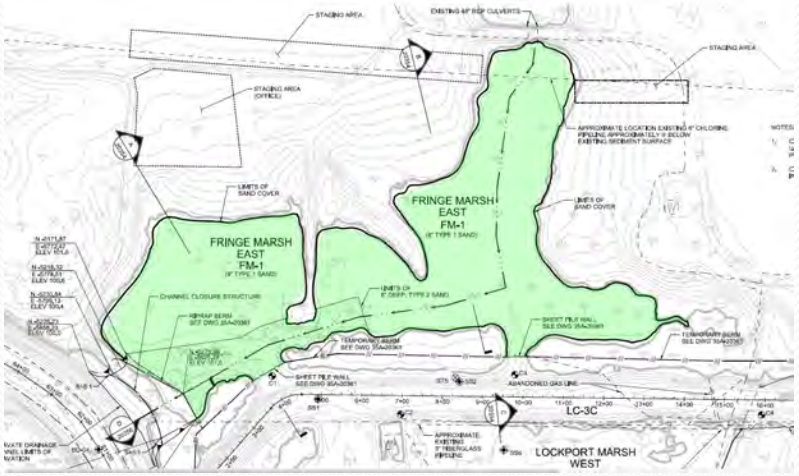
PROJECT 1 – SAND COVER

- Lake Charles, LA
- 9 acres
- Sand cover 8 inch min
- Actual 11.75 inch
- 25,000 Tons
- Materials place timer/feed rate
- Thickness verified by cores
- 900 tons a day
- Could not walk on cap



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PROJECT 1 – SAND COVER

June 2016

July 2016

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PROJECT 2 - Pilot

- Brunswick, GA
- 0.75 acres
- Test thin layer equipment
- Place 700 tons sand
- Place 700 tons topsoil
- Limit marsh intrusion and repairs
- 6 inch and 9 inch minimum
- 10,000 plants installed
- Topsoil “ran”
- Sand materials were placed uniform

PROJECT 2 - Pilot

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PROJECT 3 – SHALLOW CAP

- Delaware City, DE
- 5 acres of cap in water 0 to 20 inches deep
- Caps 6 inches and 12 inches
  - Sand 12,000 tons
  - GAC 330 tons
  - Magnesium oxide 66 tons
  - Crushed limestone 546 tons
- Shallow draft barge and cable system
- Placed sand, sand/GAC, limestone, magnesium oxide

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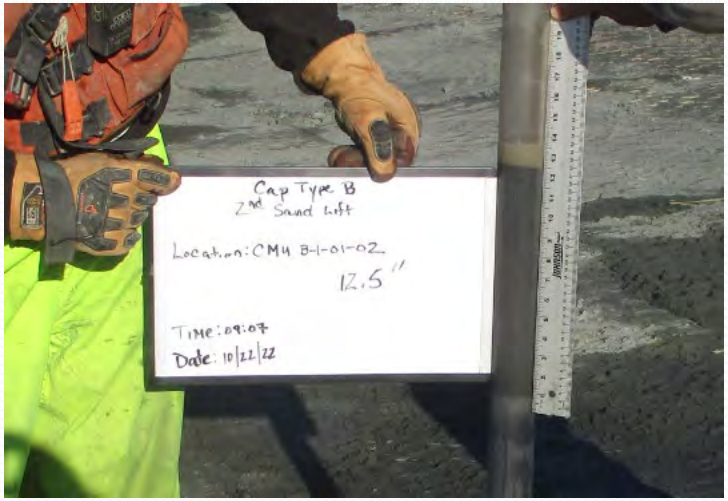
PROJECT 3 – SHALLOW CAP



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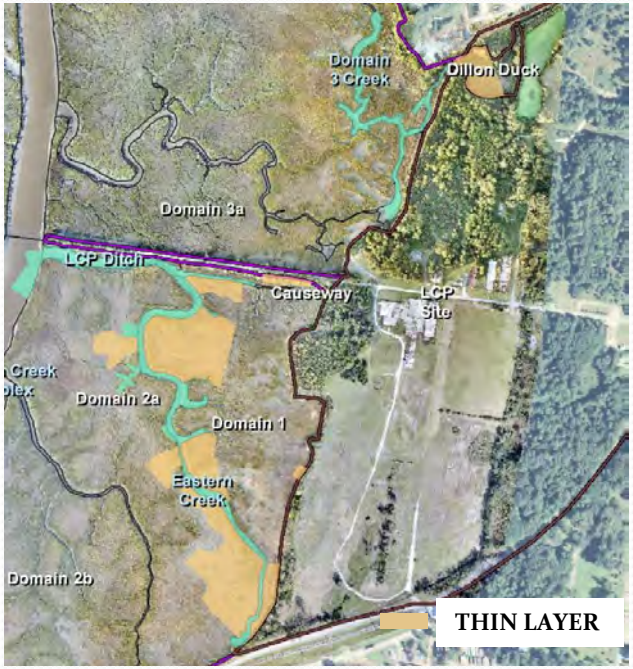
PROJECT 4 – MARSH THIN LAYER

- Brunswick, GA
- 11 acres thin layer sand placement in marsh
- Minimize intrusion and repair of marsh
- 21,000 tons of fine sand
- Pump up to 2,500 FT
- Marsh mats for access



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PROJECT 4 – MARSH THIN LAYER

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SUMMARY

- Two nozzle system worked
- Splitting the flow, if something clogged one side, flow was pushed to the other nozzle
- Nozzle could be isolated

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SUMMARY

- Remote hydraulically controlled “Cannon”
- Used for high flow rates – 3,000 GPM
- Tough to reach spots in quarry where barge could not reach
- Would cause marsh disturbance if used

SUMMARY

- Flat nozzle spreads the materials evenly
- Operator consistent arc motion
- Small excavator on mat system works well
- Vary distance with booster pump control

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SUMMARY

- Vertical riser pipe ideal for low energy placement
- Worked well with topsoil in marsh
- Used in contaminated area where minimal mudline distance was allowed

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SUMMARY

- Rainbowing sand – consideration for some ground disturbance
- Pilot project and current GA project, marsh is growing though a thin layer of sand – 6 inches
- Placement tons per hour relative to flow/pipe size
- Placement 50 tons to 200 tons a work hour
- Consideration of wind direction during placement

Questions?

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