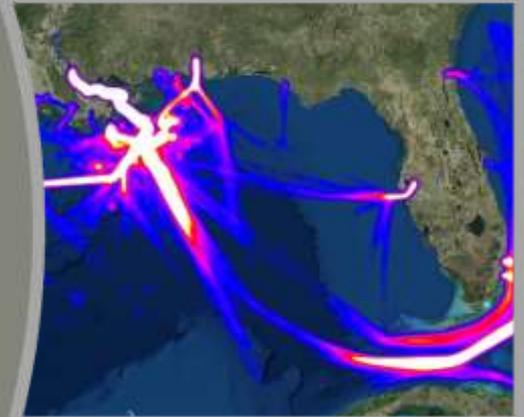


USACE Dredging Program Optimization Strategies

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US Army Corps
of Engineers®



Innovative solutions for a safer, better world

Motivation

Four questions of dredging:

1. Where to dredge?

2. How much to dredge?

3. When to dredge?

4. What do I use to dredge?

→ **Project Selection**

→ **Project Scheduling**

Optimization helps USACE and its industry partners better maintain the U.S. marine transportation system

Project Selection

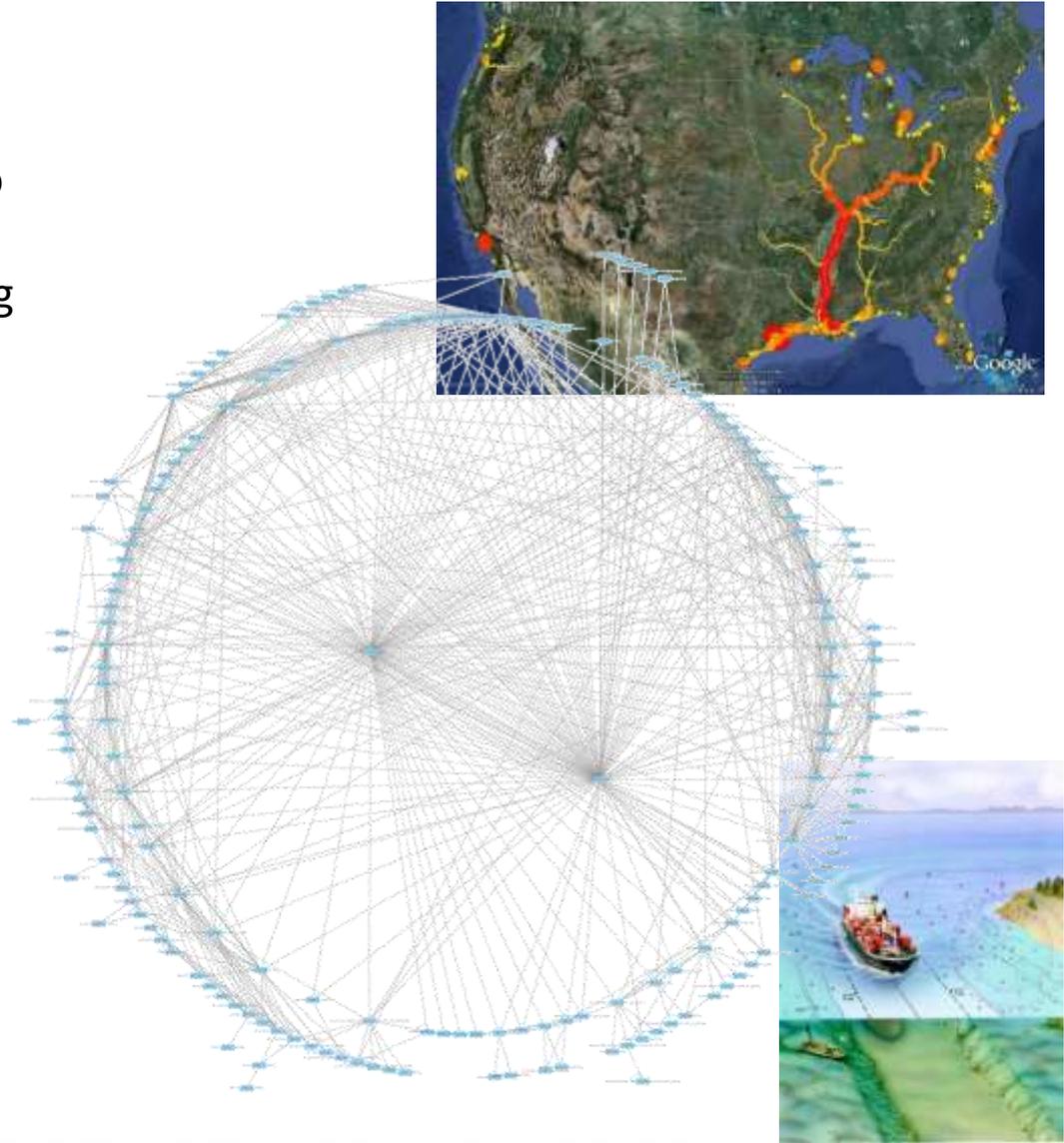
Goal: Use portfolio optimization to inform the allocation of limited resources to maintenance dredging projects nationwide

Projects

- 535 federal navigation projects included in initial treatment
- 155 with sufficient historic channel survey data available

Solutions

- Possible permutations = 10^{130}
- Atoms in the universe = 10^{82}



Inputs

Civil Works Identification System (CWIS)

Active Projects

Historic Project Expenditures

Relation Tables

Channel Portfolio Tool (CPT)

Cargo Routes by Port

Tonnages by Draft Increment

e-Hydro

National Channel Framework

Maintained Depths

Project Reaches

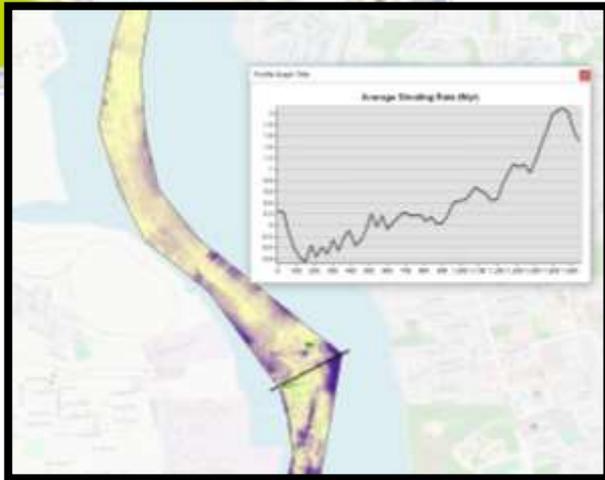
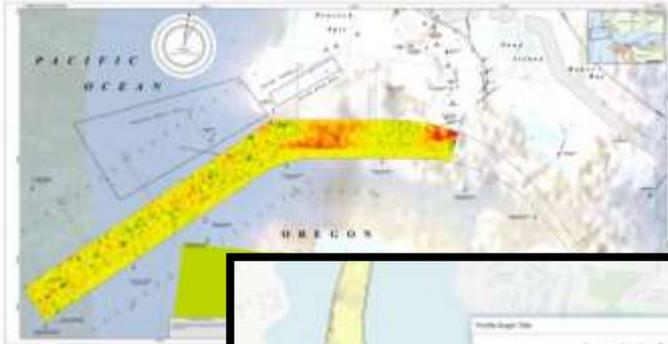
Corps Shoaling Analysis Tool (CSAT)

Shoaling Forecasts

Channel Prisms

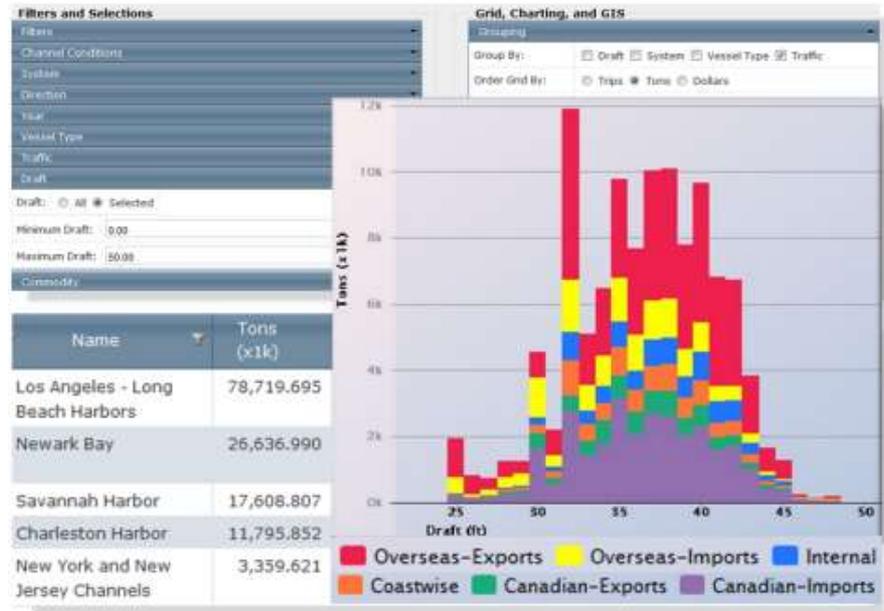
Historic Pre/Post Dredge Surveys

Inputs

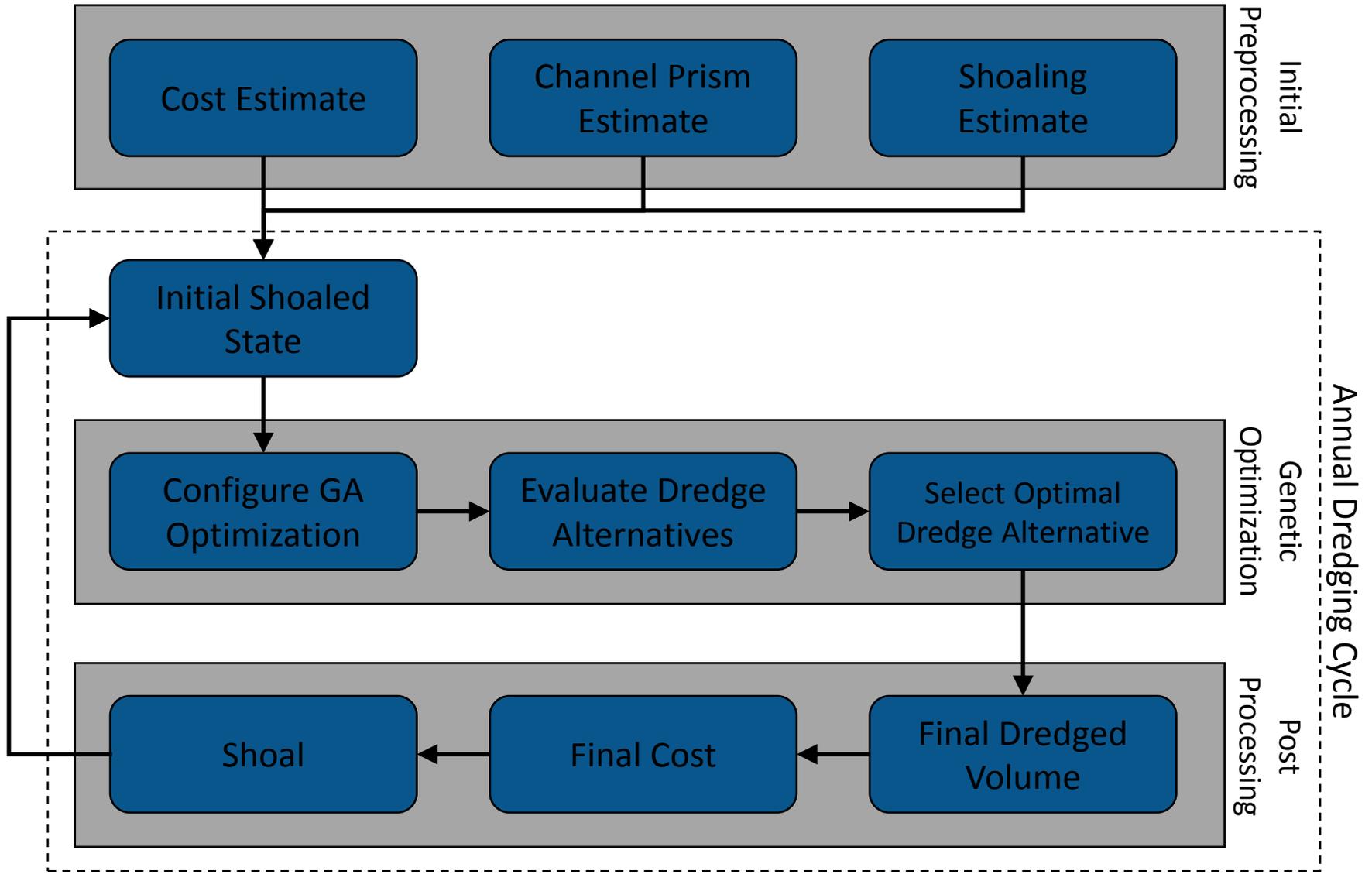


Channel Shoaling Analysis Tool (CSAT)

Channel Portfolio Tool (CPT)



Process

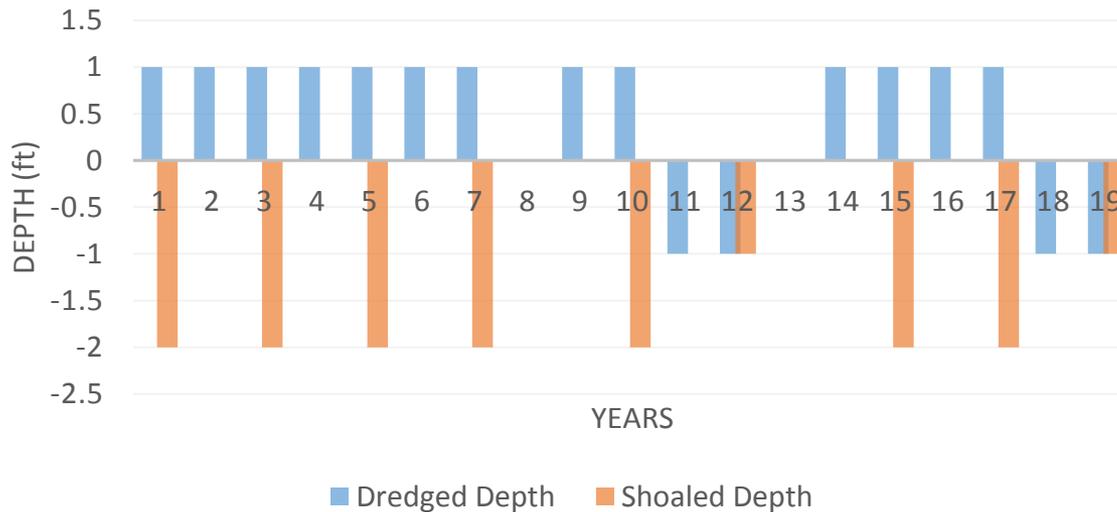


Output

Project Rankings

- Disrupted tonnages
- Shoaled depths
- Shoaled volumes
- Cost

Project	Cost	Volume (CY)
A	\$10,000,000	3,000,000
B	\$8,500,000	1,000,000
C	\$3,000,000	500,000
D	\$1,000,000	100,000



Forecasts

- Project dredge frequency
- Project shoaling rate
- Dredge cycles

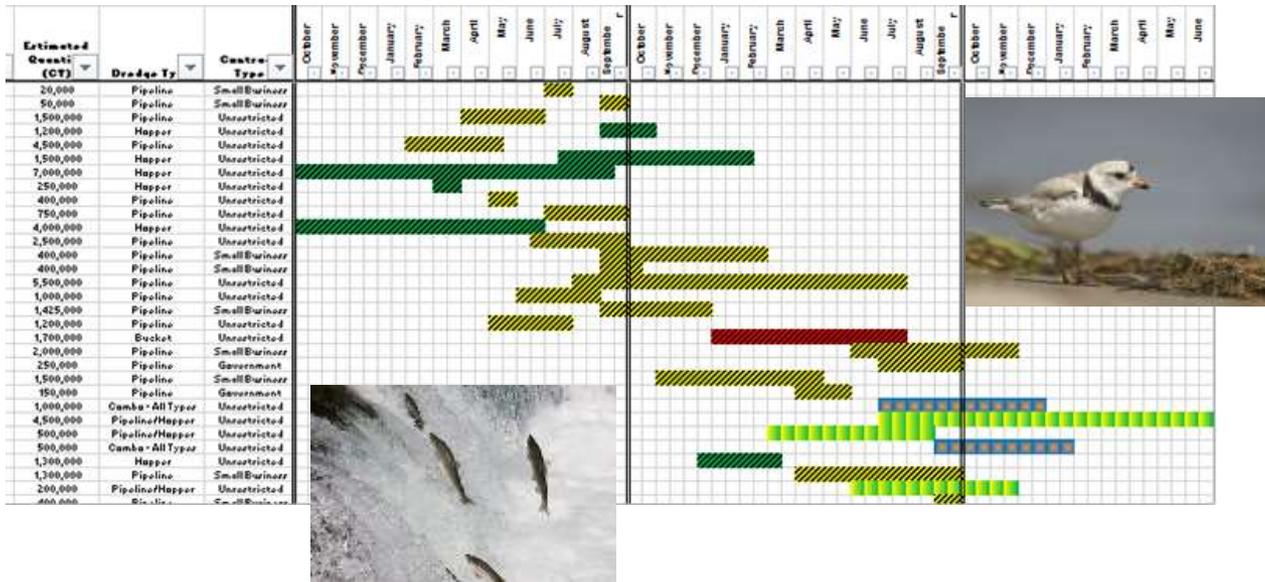
Project Scheduling

Goal

Determine optimal sequencing and assignment of dredging fleet assets to project portfolio, while complying with seasonal work restrictions.

Prior Applications

- West Coast Hopper Fleet since FY15
- South Atlantic Division – Regional Sediment Management Mega-Pilot
- USACE Hopper Fleet Recapitalization Report



Project Scheduling

Inputs

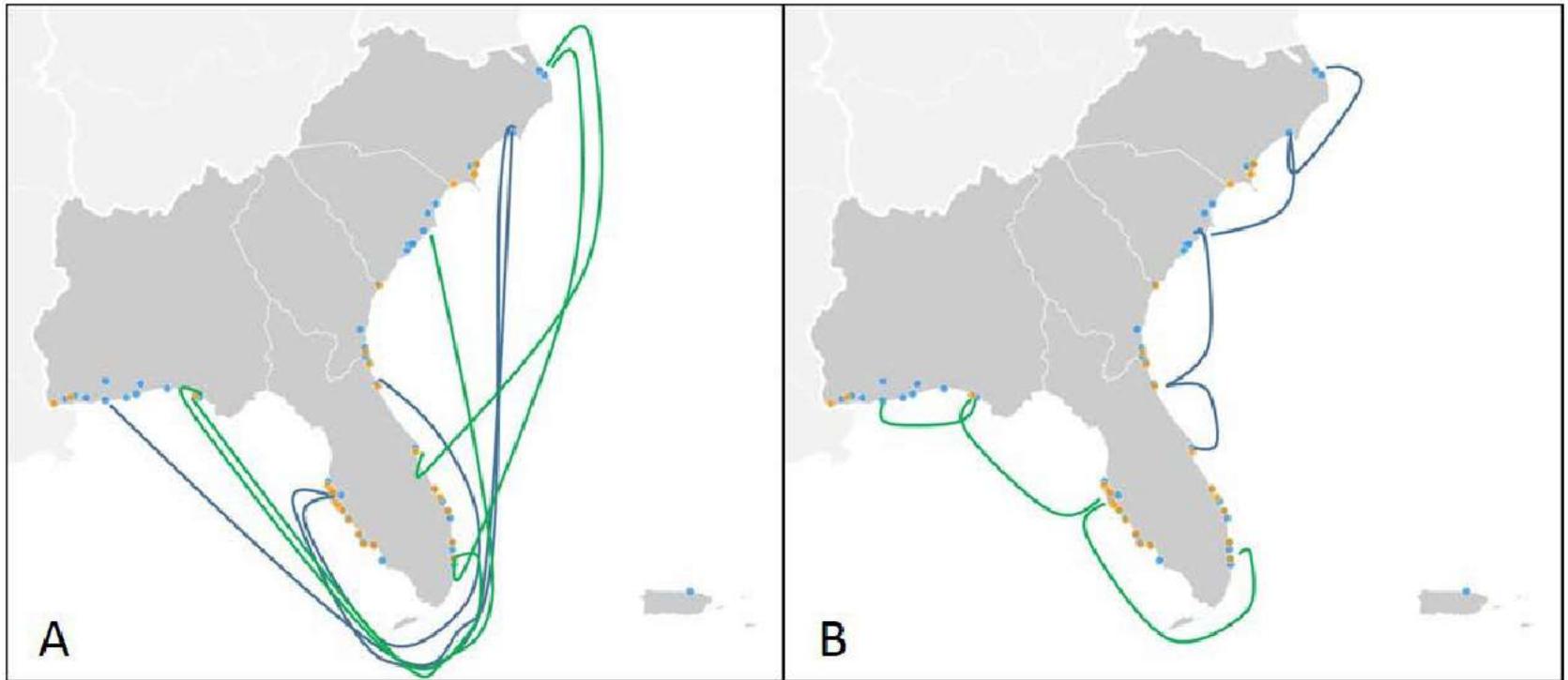
- Dredge fleet configuration (number, types)
- Dredging requirements (CY, available budget)
- Historic production rates and unit costs at each project
- Environmental and/or seasonal work restrictions
- Distance matrix

Outputs

- Dredge assignments
- Optimal sequencing of work
- Inferred groupings of projects for potential regional contract mechanisms

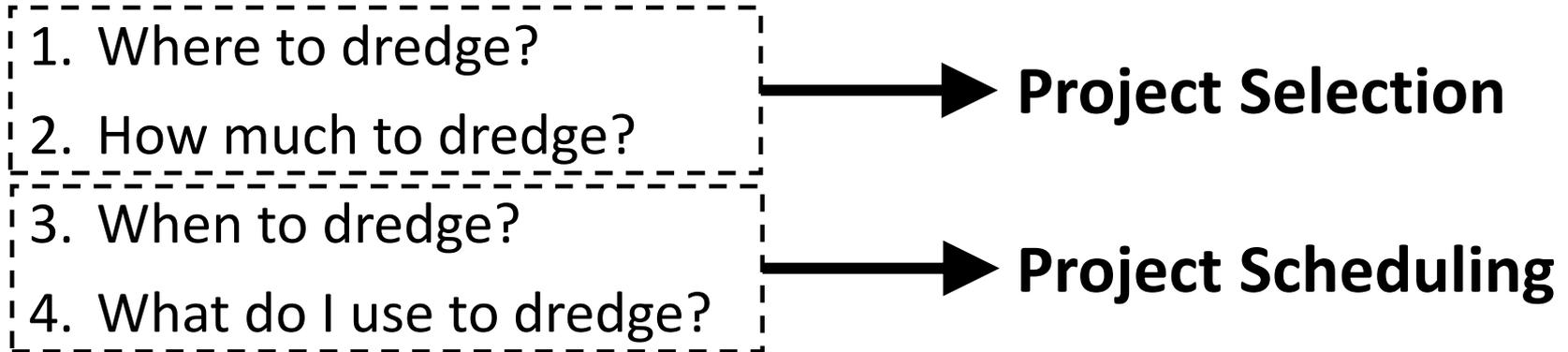
Project	Vessel	Start	Duration	End
Wilmington_Various_Middl	Large_Hopper_1	1-Oct-16	13	14-Oct-16
Savannah_0_24_ODMDS	Large_Hopper_1	31-Oct-16	5	5-Nov-16
Savannah_08_60B_ODMDS	Large_Hopper_1	30-Nov-16	17	17-Dec-16
Savannah_08_60B_nearshor	Large_Hopper_1	17-Dec-16	4	21-Dec-16
Charleston_Entrance	Large_Hopper_1	22-Dec-16	25	16-Jan-17
Kings_Bay_Beach_Quality	Large_Hopper_1	17-Jan-17	4	21-Jan-17
Kings_Bay_Nearshore_Qual	Large_Hopper_1	22-Jan-17	6	28-Jan-17
Morehead_City_Ranges_CB	Large_Hopper_1	30-Jan-17	19	18-Feb-17
Port_Everglades_Mgmt_Qui	Large_Hopper_3	1-Oct-16	6	7-Oct-16
Jax_Harbor_Nearshore_Qua	Large_Hopper_3	8-Oct-16	5	13-Oct-16
Mobile_Bar_to_Sand_Island	Large_Hopper_3	19-Oct-16	15	3-Nov-16
Mobile_River_to_ODMDS	Large_Hopper_3	4-Nov-16	5	9-Nov-16
Gulfport_Bar_Channel_to_I	Large_Hopper_3	10-Nov-16	3	13-Nov-16
Gulfport_Channel_to_ODMI	Large_Hopper_3	14-Nov-16	63	16-Jan-17
Jax_Harbor_Mgmt_Quality	Large_Hopper_3	22-Jan-17	7	29-Jan-17
Morehead_City_Range_A	Large_Hopper_3	1-Feb-17	6	7-Feb-17
Town_Creek_Inner	Medium_Hopper_1	1-Oct-16	3	4-Oct-16
Wilmington_Baldhead_Sho	Medium_Hopper_1	5-Oct-16	21	26-Oct-16
Gulfport_Anchorage_Basin	Medium_Hopper_1	2-Nov-16	64	5-Jan-17
Pascagoula_Bar_to_ODMDS	Medium_Hopper_1	6-Jan-17	23	29-Jan-17
Mobile_Bay_to_ODMDS	Medium_Hopper_3	1-Oct-16	134	12-Feb-17
Pensacola_Inner_Harbor_Ch	Medium_Hopper_3	13-Feb-17	3	16-Feb-17

Output



Summary

Four questions of dredging:

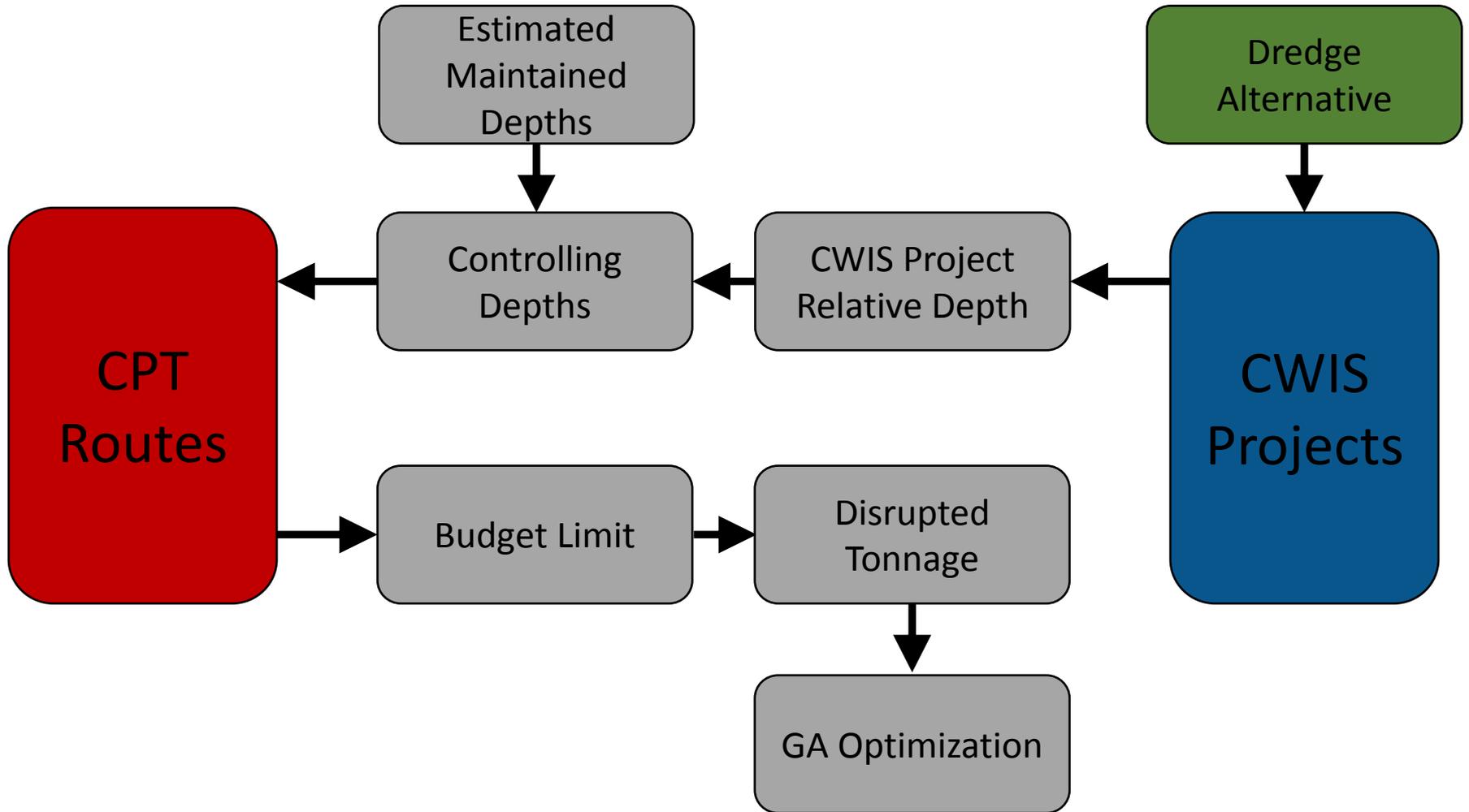


Questions?

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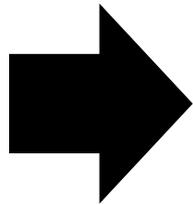
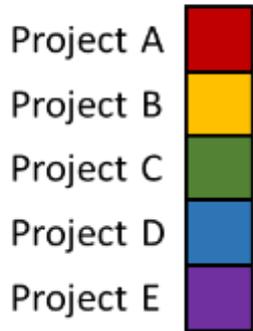
Ned Mitchell, PhD
kenneth.n.mitchell@usace.army.mil
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Alternative Evaluation

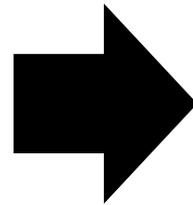


Genetic Optimization

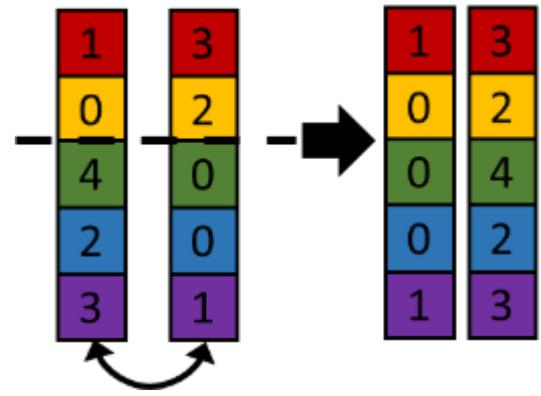
Chromosome Representation



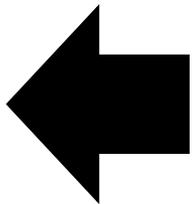
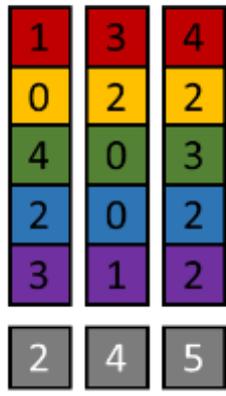
Initial Alternatives



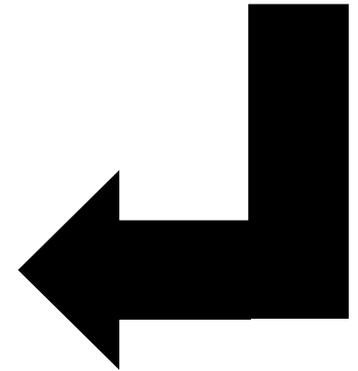
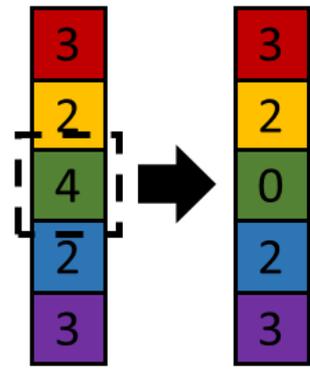
Recombine



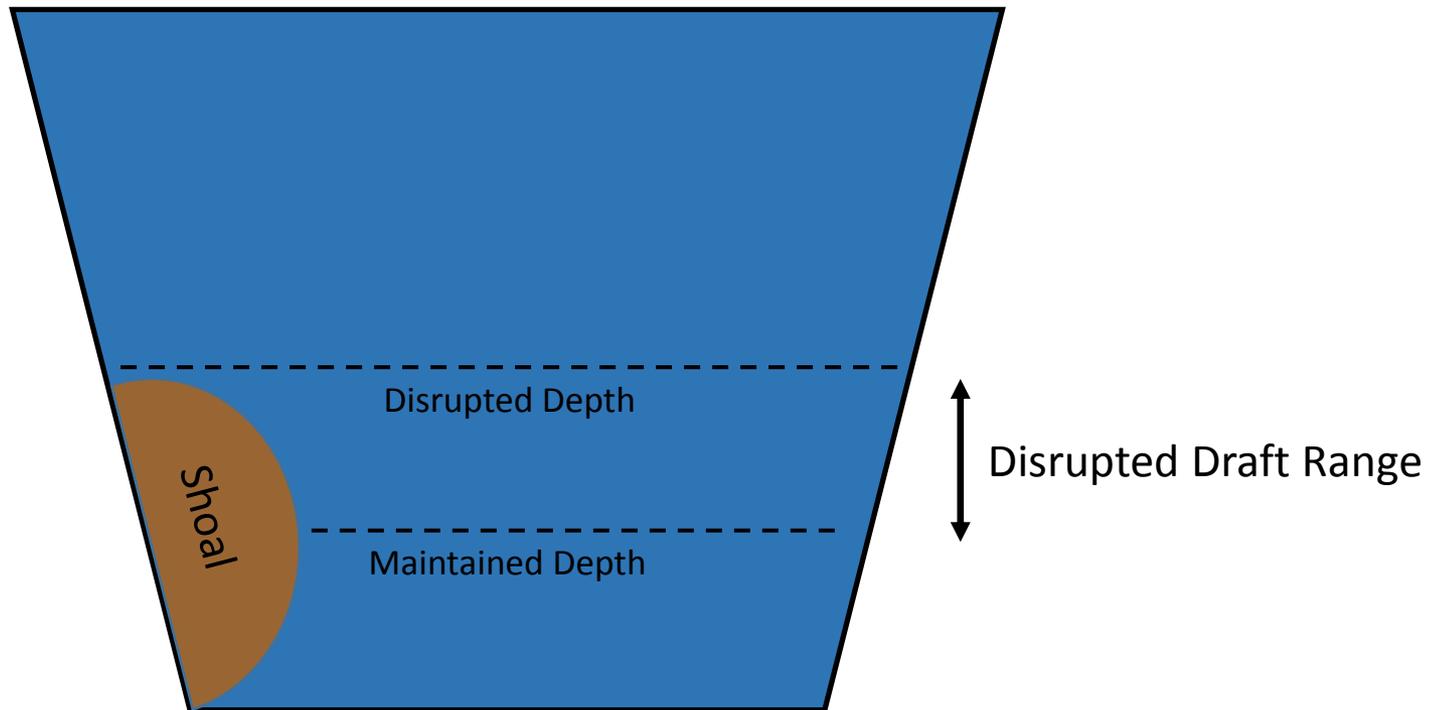
Evaluate



Mutate



Shoaling Process



Draft (ft)	Passing Tonnage	Disrupted Tonnage
15	10	30
16	20	20
17	30	10
18	40	0
19	40	0