Lower Barataria Sediment Diversion

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The Project

- Diversion - 2 Stages
  - 10% Design Analyses
  - 25% Design Analyses
- Civil, Geotechnical, Structural and Modeling
- Environmental, Social, or Economic Impacts Not Considered

The Objective

- Identify the Most Cost Effective
- Most Environmentally Acceptable
- 50,000 cfs diversion when Mississippi River is at 1,000,000 cfs

Project Team

- ARCADIS
- Coastal Protection and Restoration Authority
- The Water Institute of the Gulf
- LSU

The Process

- 5 Sites Provided by TWI
- Key concept - Utilize Existing Data
- Minimal data collection
- 10% Design – reduce to 2 sites
- 25% Design – recommend 1 site

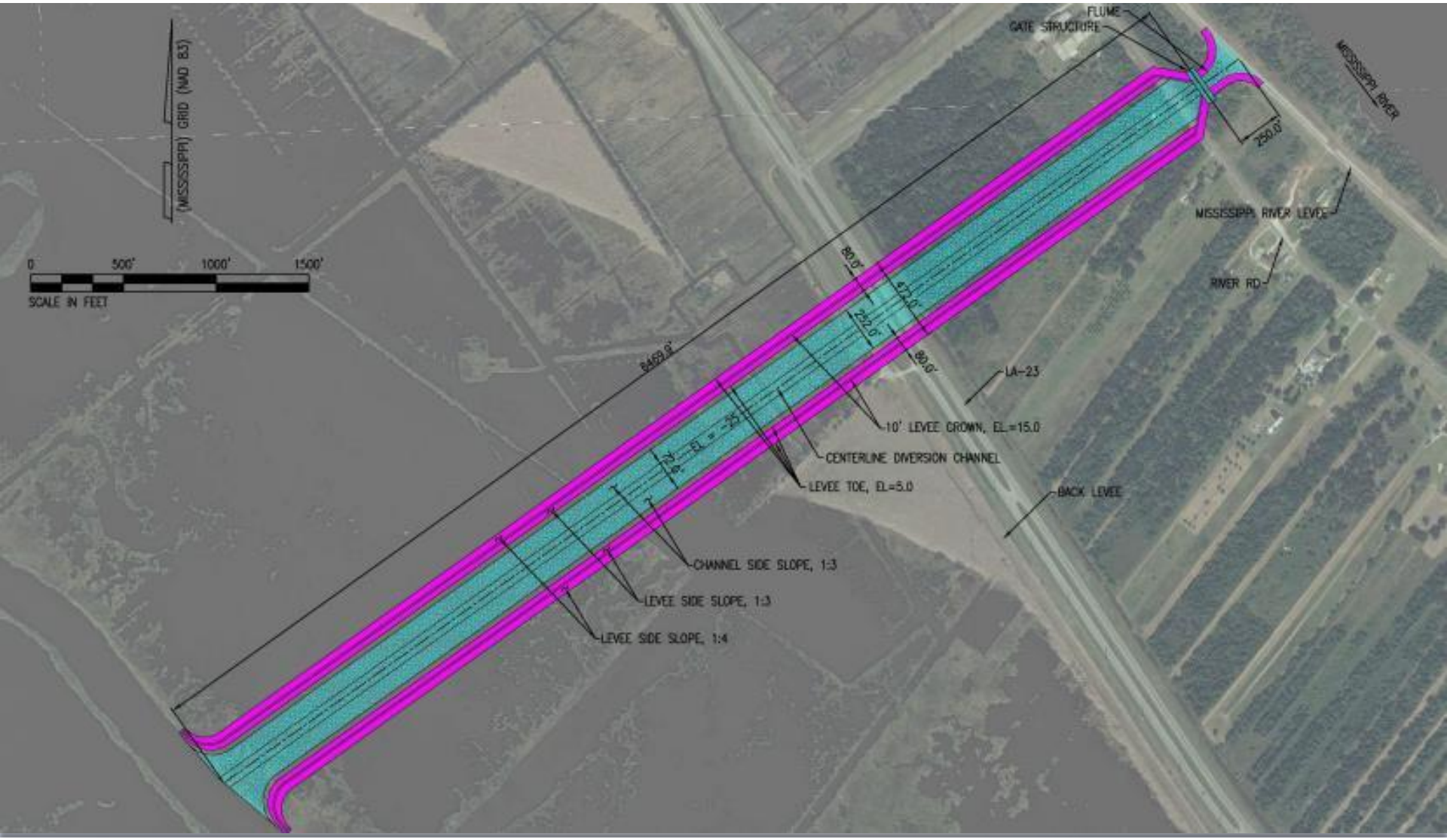
Civil Engineering

- Initial Site Layouts
- General Area of Preliminary Modeling Results
- Set Marshland Elevation/Channel Width and Length/Invert at Entrance

Figure 1. Five Potential Lower Barataria Diversion Locations

Source: The Water Institute of the Gulf.

Concept Plans Developed for Each



Location Summary

Site	Length (miles)	SWR (Cumulative)	Anchorage	Revetment	River Power	Road Crossings	Lane Crossings	Structures on Land	Special Features
Magnolia	1.46	1.11	Neg.	Pos.	1st	LA-23 (4 lanes) Diamond Rd (2 lanes)	6	none	
Diamond	1.88	0.99	Pos.	Neg.	2nd	LA-23 (2 lanes) River Rd (2 lanes)	4	3 mobile homes; 2 single family homes	
Port Sulphur	0.89	0.46	Pos.	Neg.	3rd	LA-23 (4 lanes)	4	mobile office trailers, metal building	existing large MR dock
Empire	0.83	0.71	Pos.	Neg.	4th	LA-23 (4 lanes) Frontages (4 lanes) Hwy 11 (2 lanes)	10	1 mobile home	existing LA-23 bridge
Buras	1.38	0.97	Neg.	Pos.	5th	LA-23 (4 lanes) Hwy 11 (2 lanes) River Rd (2 lanes)	8	2 mobile homes; 1 single family home; abandon gas station and metal bldg	

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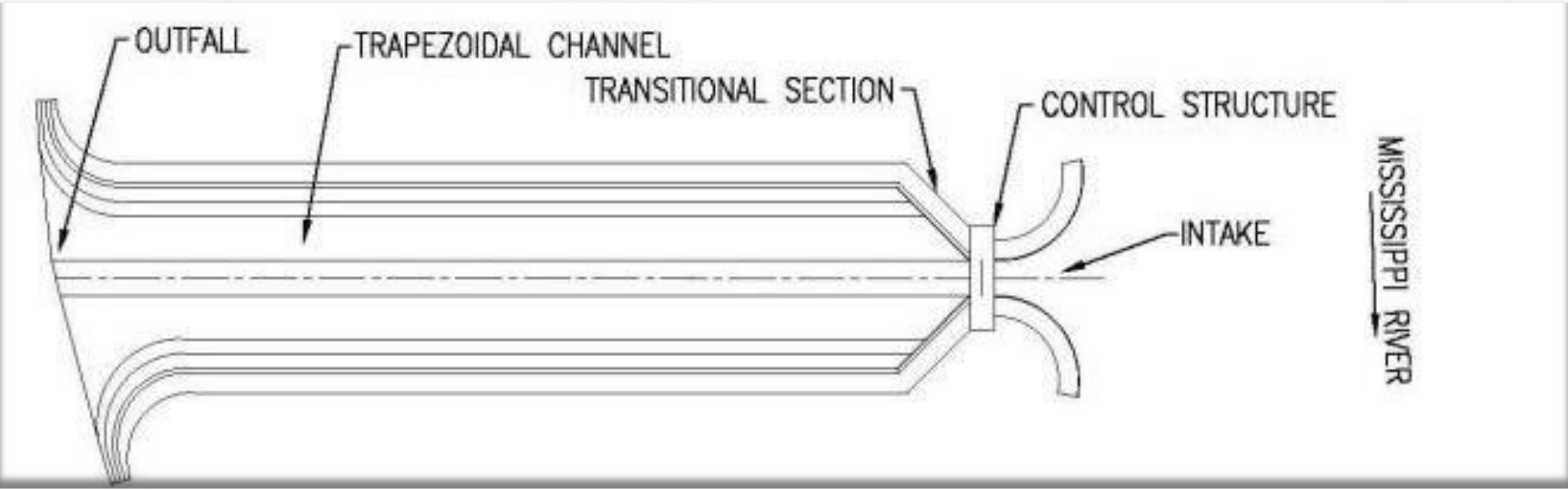
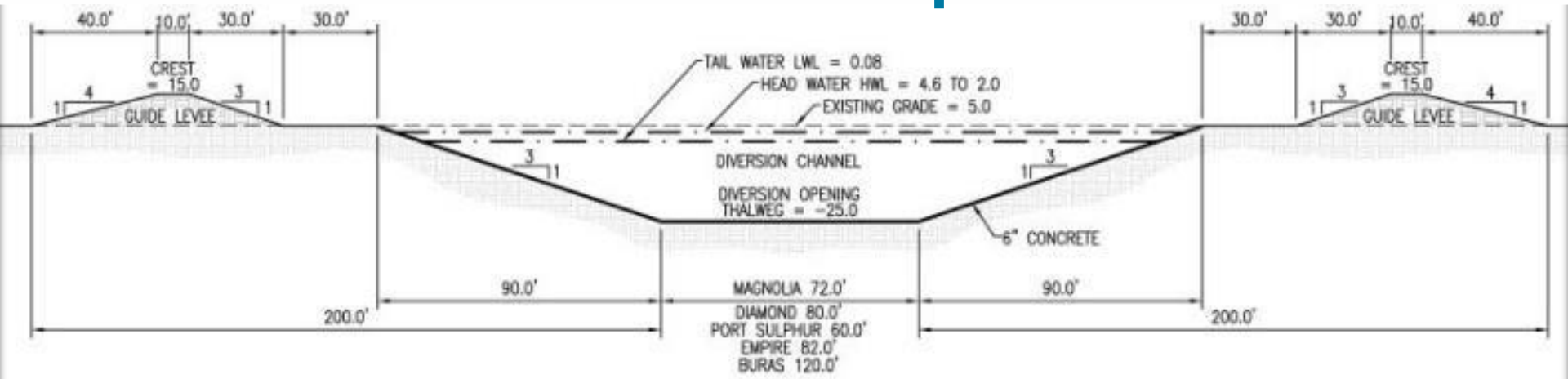
Design Criteria

Channel segments

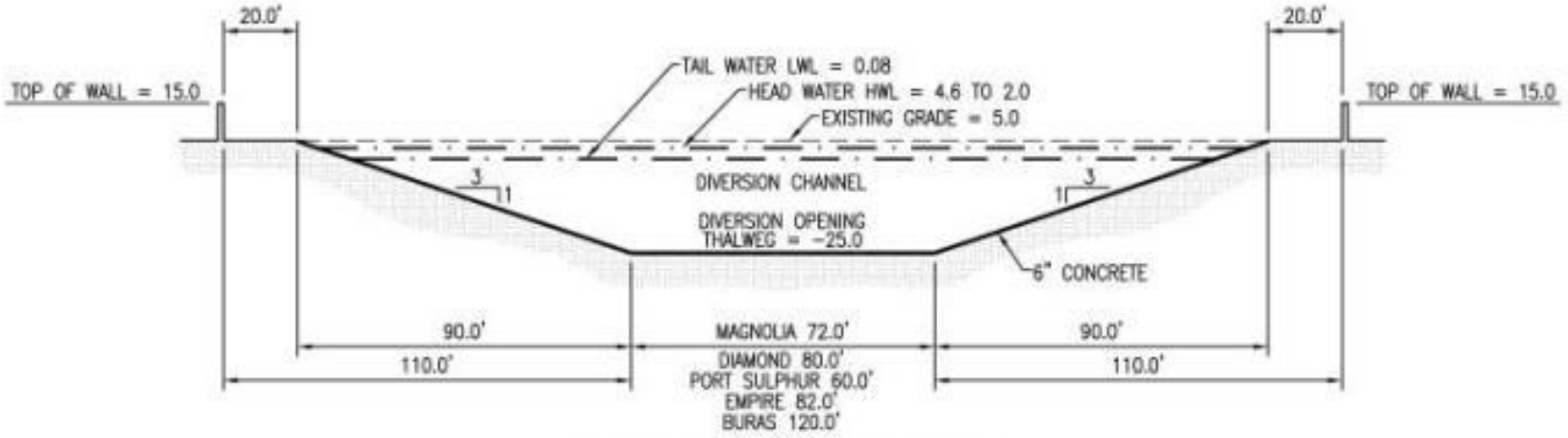
1. Intake connection to Mississippi River
2. Control structure
3. Transition to trapezoidal channel
4. Trapezoidal channel
5. Outfall



Channel Cross Section Options



DIVERSION CHANNEL WITH GUIDE LEVEE



DIVERSION CHANNEL WITH WALLS

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Outstanding Design Considerations

- Control structure at back levee?
- Bridges required at roads other than LA-23?
- Guide walls OR guide levees?
- Disposal of excavation materials?
- Work needed beyond back levee tie-in?
- Tainter gates (multiple bays) with stop log system for maintenance

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Design Assumptions

- Concrete channel lining
- Control structure with pile foundation
- Survey Data: Bathymetric data from ACOE revetment surveys along with LIDAR and USGS information will be utilized
- Hydraulic Data: Supplied by the WI.
- Guide Levee Elevation = 14.5

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Geotechnical Engineering

- Reviewed existing reports and data
- Preliminarily analyzed levee and excavation slope stability for the highlighted sites:

Location	MRL	Back Levee
Magnolia	Nov. 9	Nov. 5
Diamond	Nov. 10	No Info (Nov. 6)
Port Sulphur	Nov. 10	No Info (Nov. 6)
Empire	Nov. 16	Nov. 7
Buras	Limited Info (Nov. 11)	Nov. 7

- USACE Coordination – CPT Installation

Structural Engineering

- Obtained structural design information for similar projects:
  - ✓ White Ditch, Myrtle Grove/Mid Barataria diversions
- Reviewed proposed gate types and sizes based on USACE guidelines
- Evaluated Control Structure, Back Levee Structure and Bridge

Tainter Gates

Cost Estimating

- Determined preliminary project material and labor costs
- Divided project components and quantities
- Investigated real estate parcel boundaries and appraised values
- Contingency = 30%

Real Estate Cost Estimate – Land Value Matrix

Category	Unit	Unit Value
Unimproved Acreage	Acre	$8,000
Established Agricultural Acreage	Acre	$15,000
Acreage with Structures/Homes	Acre	$20,000
Previous Industrial Site	Acre	$20,000
Structures Above Flood Level	S.F.	$105
Structures Below Flood Level	S.F.	$35
Single Family Homes Below Flood Level	S.F.	$70
Outbuildings	S.F.	$15

- Based on research of local land values
- No public GIS database available for Plaquemines Parish

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Construction Cost Estimate – Site Summary

Site	Cost	Contingency	Total
Magnolia	$679,370,285	$203,811,086	$883,181,371
Diamond	$760,606,748	$228,182,024	$988,788,772
Port Sulphur	$614,291,835	$184,287,551	$798,579,386
Empire	$776,284,353	$232,885,306	$1,009,169,659
Buras	$837,974,496	$251,392,349	$1,089,366,845

Overall Site Ranking

Category	Wtg Fac	Magnolia		Diamond		Port Sulphur		Empire		Buras	
		Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Land Use Impacts	1.5	4	6	3	4.5	5	7.5	2	3	1	1.5
Channel Length	1	2	2	1	1	4	4	5	5	3	3
SWR	3	5	15	4	12	1	3	2	6	3	9
River Power	1	5	5	4	4	3	3	2	2	1	1
Bridges/ Structures	1	3	3	4	4	5	5	1	1	2	2
Soil Composition	2	5	10	4	8	2	4	1	2	3	6
Logistics	0.5	5	2.5	4	2	3	1.5	2	1	1	0.5
LA-23 Bypass Lane	1	4	4	3	3	5	5	1	1	2	2
Cost	2	4	8	3	6	5	10	2	4	1	2
Total Score			**55.5**		**44.5**		**43**		**25**		**27**

Reduced Sites to 2 Locations

Phase 2 – 25% Design Analyses

- 2 Sites – Magnolia and Diamond
- Flow 3D and HEC –RAS Modeling
- Refining Channel Components
- Refining Cost Estimating

Phase 2 – 25% Design Analyses

- Analyzed hydraulics to optimize sediment transport and minimize the size of control structures

- Evaluated cost-effective construction methods and innovative design to install the control structures and tie-in walls

Modeling Refinement

- Utilized HEC-RAS analyses to size the projects so they will convey the correct amount of flow for the specified design operation conditions.
- Simulated the entrance and exit conditions to confirm capacity.
- Used Flow-3D to improve the design of the approach or inlet and to simulate the flow exiting the diversion and to confirm the HEC-RAS results

Calculated Sediment Water Ratios

Location	Invert Elevation (ft.)		SWR
	Approach Channel	Discharge Channel	
Diamond Port Sulphur	-40	-30	1.44
	-38	-28	1.39
	-36	**-26**	**1.35**
	-34	-24	0.61
	-30	-20	0.51

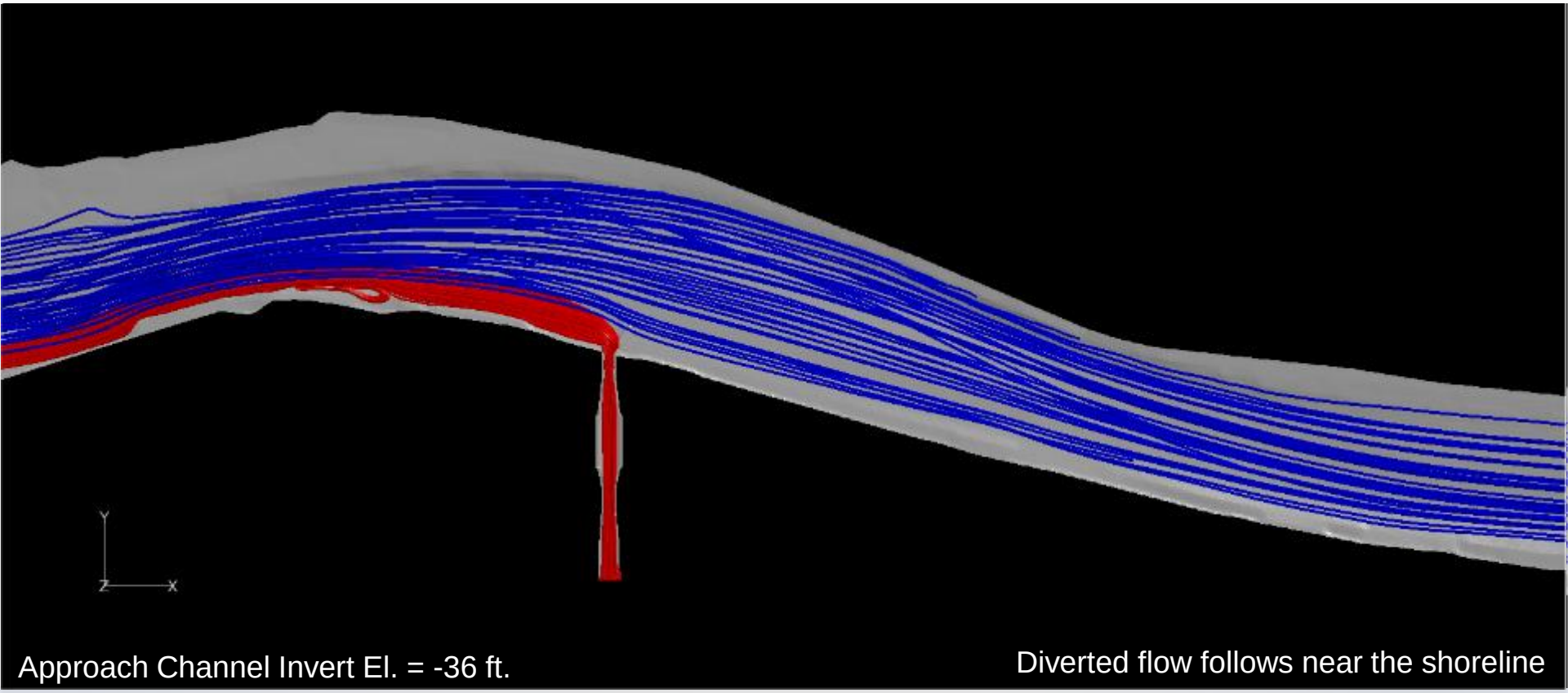
Flow Condition: River Flow Rate = 1 Million CFS
Diversion Flow Rate = 50,000 CFS

Sediment Transport:

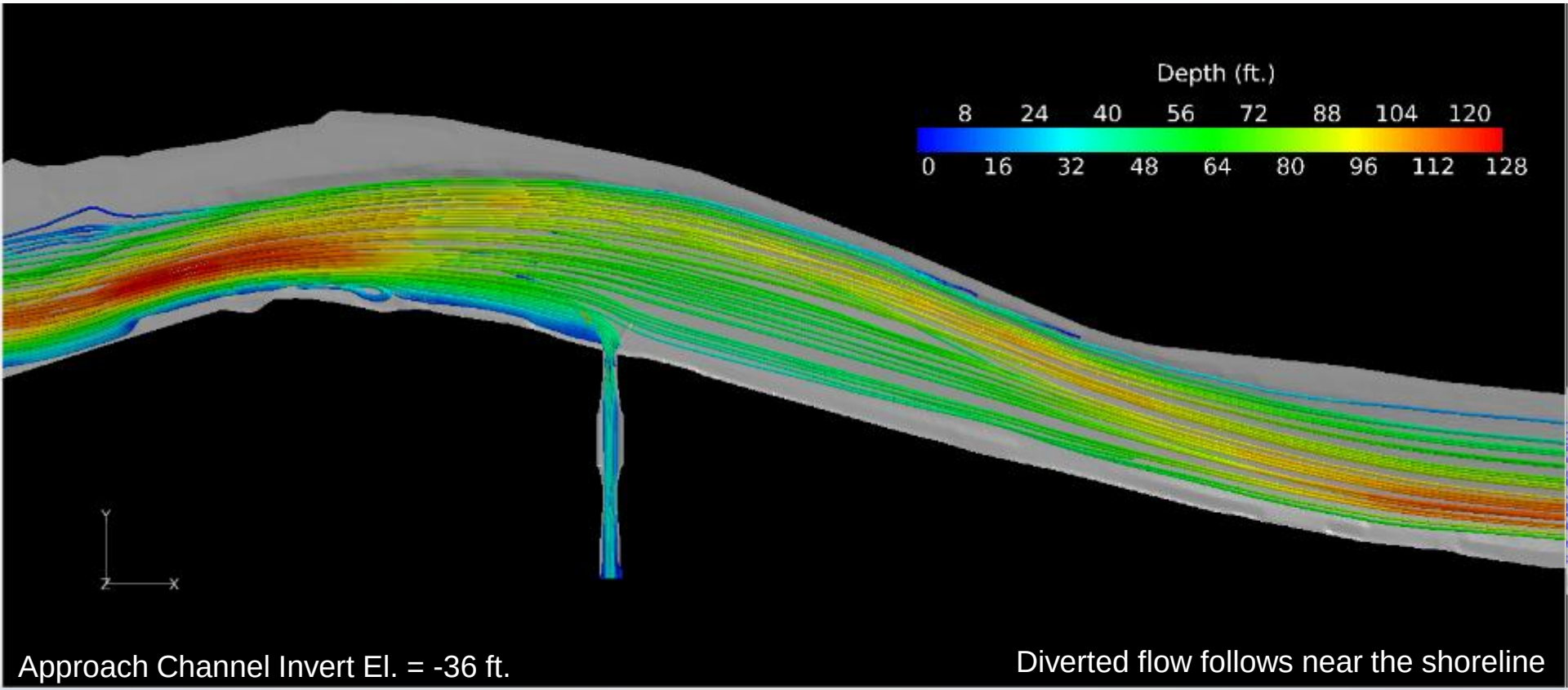
Size Class (microns)	83.33	166.67	333.33
Descriptor	Very Fine Sand	Fine Sand	Medium Sand

$$\textbf{SWR} = \frac{\left(\frac{sum\ of\ sediment\ load\ (83-333\ micron) in\ the\ intake\ channel}{sum\ of\ sediment\ load\ (83-333\ micron) in\ the\ river}\right)}{\left(\frac{flow\ diverted\ in\ the\ intake\ channel}{flow\ in\ the\ river}\right)}$$

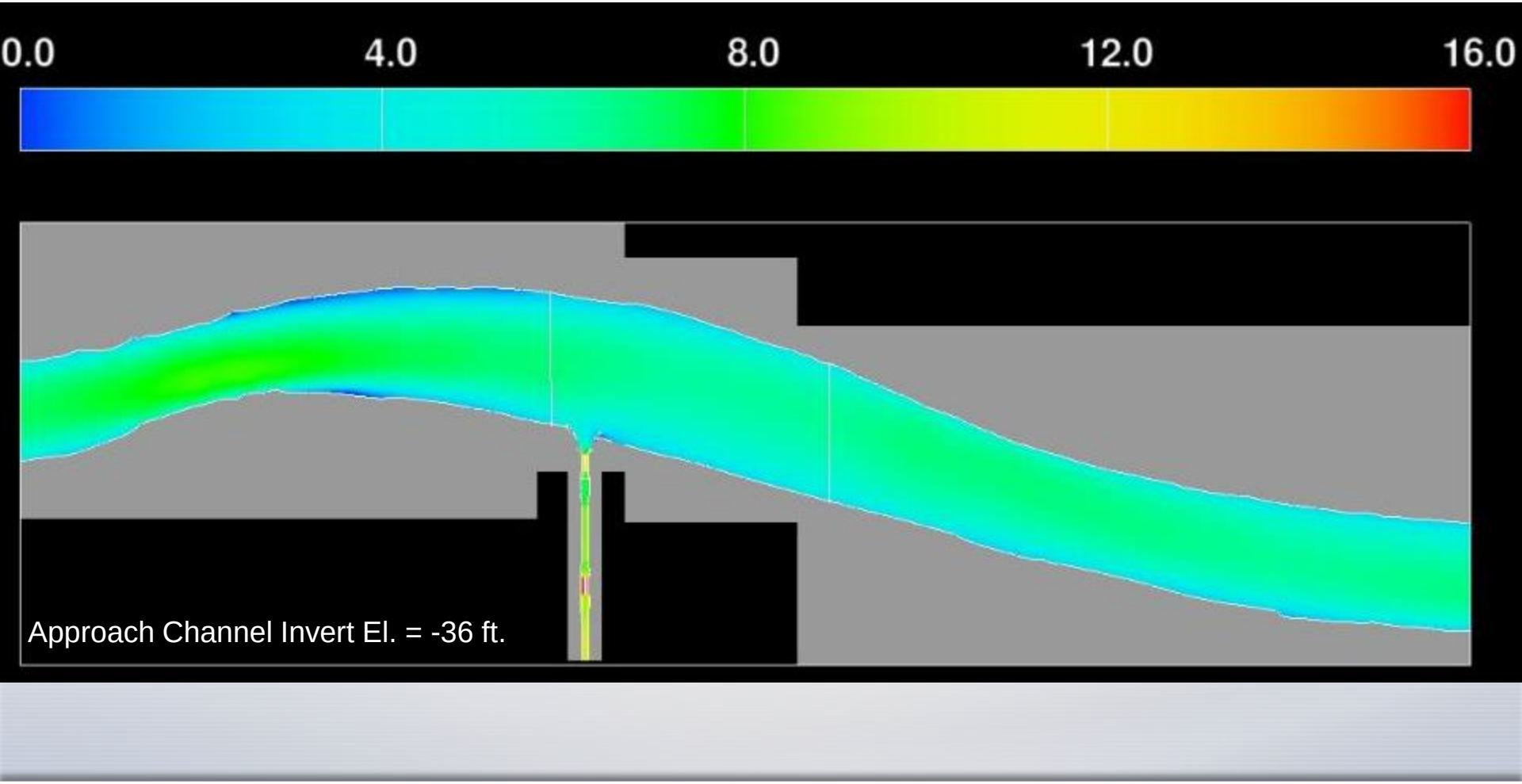
Streamlines Colored by Fate



Streamlines Colored by Depth



Velocity Contours (ft/s)
(Slice plane cut at elevation = -20 ft)



Structural Design Refinement

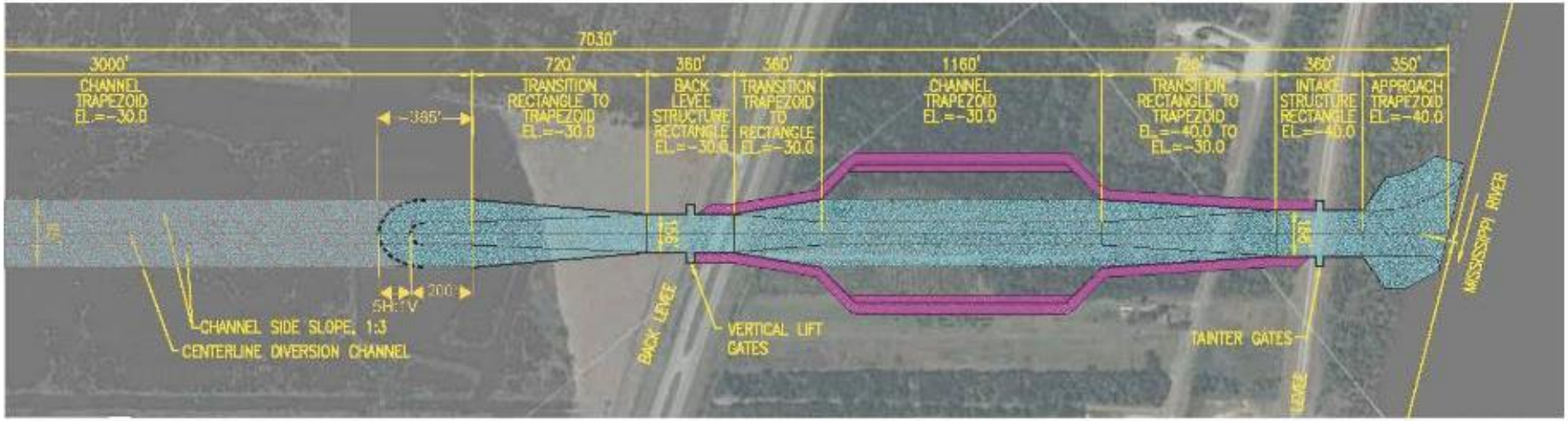
- Refined design so that only 2 Tainter Gates would be required instead of 4.

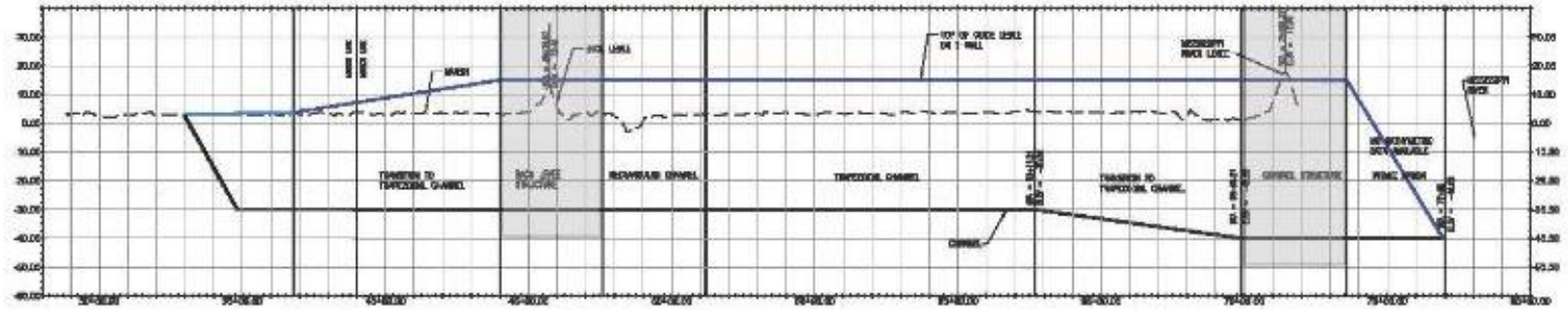
- Reduced the material cost, the excavation footprint, and the temporary retaining structure

Phase 2 – 25% Design Analyses

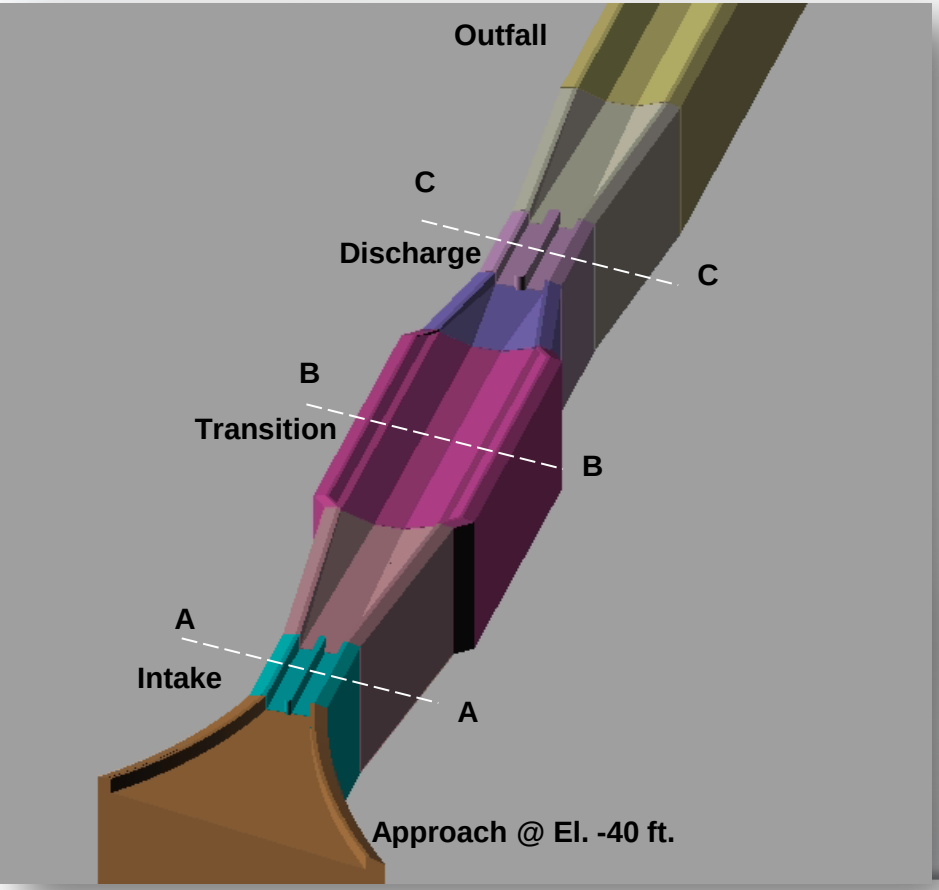
- Analyzed the lining of the inlet, outlet, and conveyance channels
- Evaluated impacts to the navigation and drainage
- Broke down the cost components to more accurately determine the overall costs

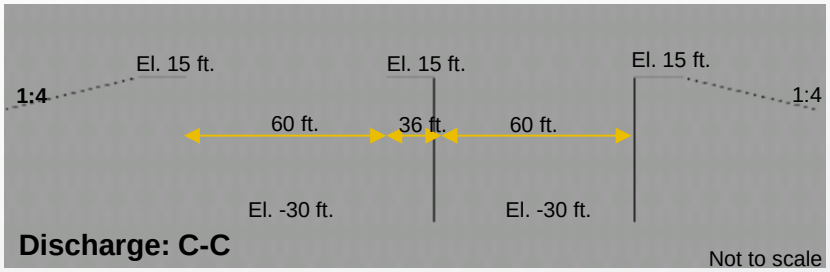
Cost Reduction – Shortened Outfall

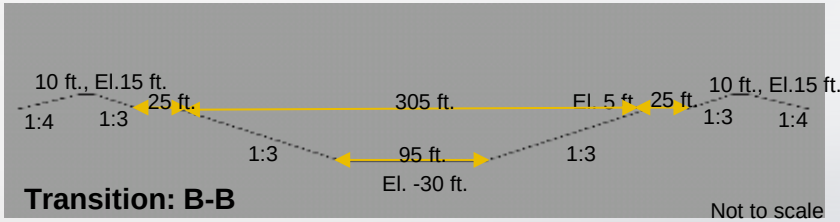


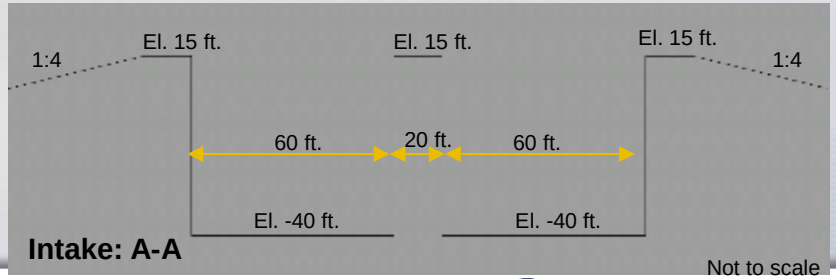


Cost Reduction – Channel Sizing

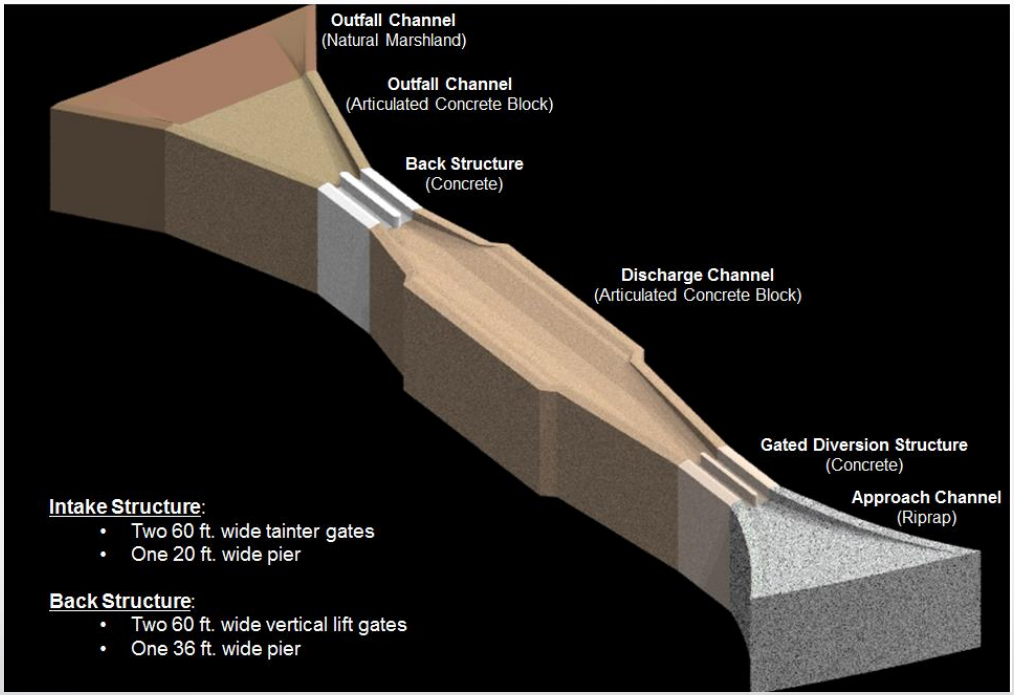








Final Configuration



Location Summary

Site	Length (miles)	Anchorage	Revetment	Lane Crossings	Road Crossings	Structures On Site	Special Features
Magnolia	0.65	Yes	No	4	LA 23 (four lanes)	None	No back levee is present
Diamond	0.70	No	Yes	2	LA 23 (two lanes)	None	Existing borrow pits

Revised Cost Considerations 25% Design

Cost Estimating

- ✓ 50% Concrete, 28% Earthwork, 12% Steel (Piles)
- ✓ Re-evaluating 5 unit prices (90% of construction costs)

<u>First Priority (70%)</u>

- Concrete (50%)
  - ✓ Intake Structure (12%)
  - ✓ T-Walls (12%)
  - ✓ Channel Lining (10%)
  - ✓ Outfall Structure (8%)
  - ✓ Stabilization Slabs (8%)
- Excavation (20%)

<u>Second Priority (20%)</u>

- Pipe Piles (7%)
- Sheet Pile (5%)
- Fill (5%)
- Dewatering (3%)

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Construction Cost Estimate

Element	Magnolia		Diamond	
	Estimated Cost	Approximate % of Construction Cost	Estimated Cost	Approximate % of Construction Cost
Control Structures	$170,000,000	45%	$175,000,000	45%
Retaining Walls	$80,000,000	20%	$100,000,000	25%
Channels	$90,000,000	25%	$90,000,000	20%
Bridges/ Roadways	$30,000,000	10%	$15,000,000	5%
Drainage	$0	0%	$6,000,000	1%
Utility Relocations	$1,250,000	<1%	$1,250,000	<1%
Other	$16,000,000	5%	$16,000,000	5%

Overall cost reduced by 40%
$400M - $500M

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Final Observations

- Magnolia site currently has no back levee
- Magnolia site is located in a Federal Anchorage
- Diamond site will sever about 450 acres in drainage district
- Magnolia site is outside back levee protection system
- Overall Cost is within 5% for each alternative

Additional Considerations

- Confirm the approach elevation – can it be raised to EL -36
- Additional hydraulic analyses with take into account sea level rise
- Sediment supply studies accounting for future river management schemes
- A comprehensive study of flows exiting the LBSD is recommended

Questions/Comments