CHRISTOPHER B.
BURKE
ENGINEERING, LLC

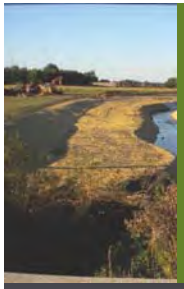
The GREATEST Spectacle in Drainage:

Dry Run Diversion Channel Improvements

Brian Meunier

INAFSM 2016

DO YOU RECOGNIZE THIS PLACE?



DO YOU KNOW WHO THIS IS?

HOW IS ANY OF THIS RELEVANT?

Diversion Ditch

Dry Run

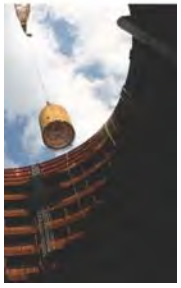
2678 ft

Google earth

Imagery Date: 10/17/2015 16 S 565698.06 m E 4405334.05 m N elev 729 ft eye alt 12298 ft



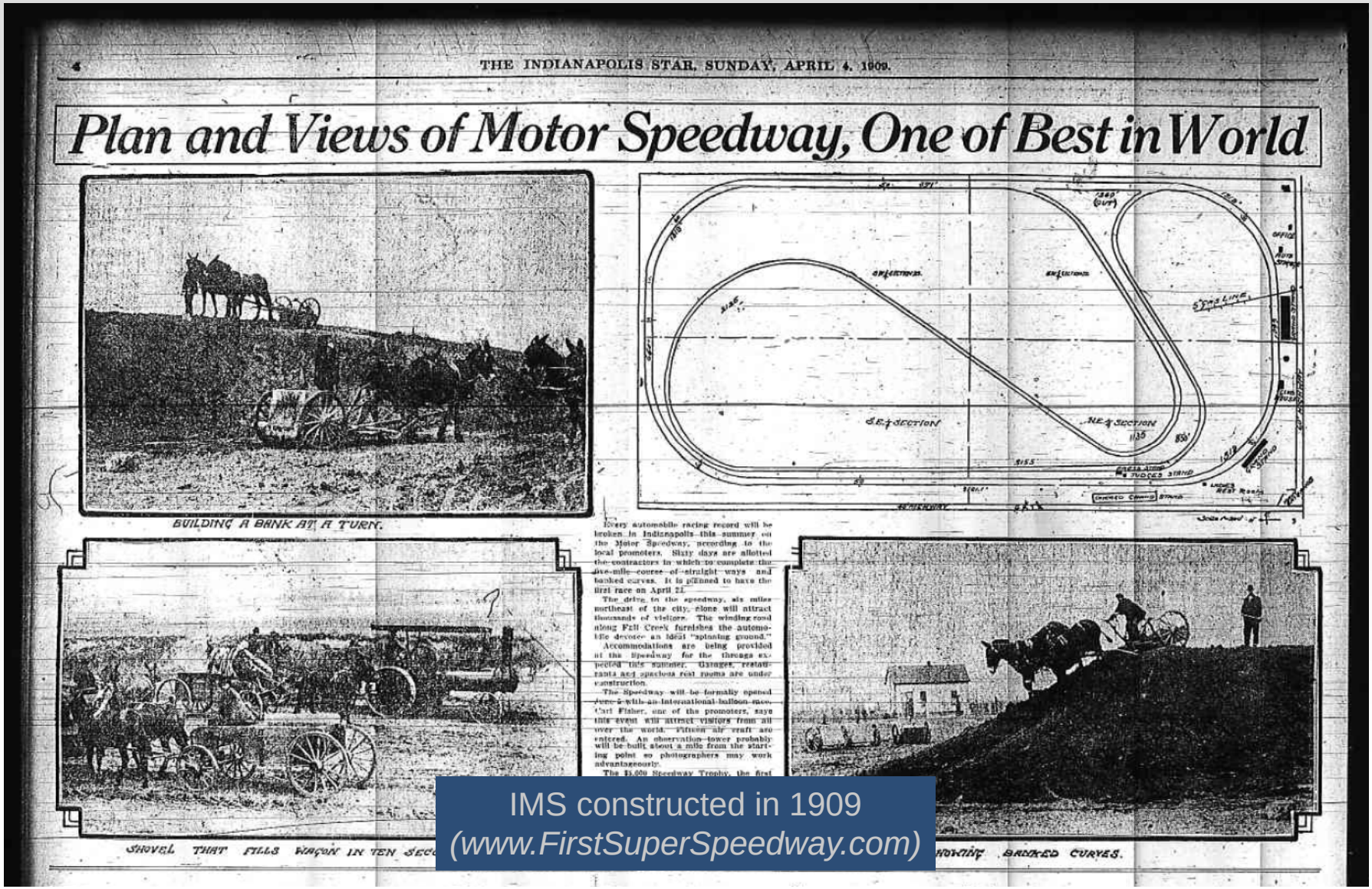




DISCUSSION OVERVIEW

1. Project History
2. Preliminary Analysis
3. Design (Hydraulic Modeling)
4. Permitting
5. Construction

HISTORY OF IMS & DRY RUN / DIVERSION DITCH



THE INDIANAPOLIS STAR, SUNDAY, APRIL 4, 1909.

Plan and Views of Motor Speedway, One of Best in World

BUILDING A BANK AT A TURN.

Every automobile racing record will be broken in Indianapolis this summer on the Motor Speedway, according to the local promoters. Sixty days are allotted the contractors in which to complete the five-mile course of straight ways and banked curves. It is planned to have the first race on April 22.

The delay to the speedway, six miles northeast of the city, alone will attract thousands of visitors. The winding road along Fall Creek furnishes the automobile devotee an ideal "spinning ground."

Accommodations are being provided at the speedway for the throngs expected this summer. Garages, restaurants and spacious rest rooms are under construction.

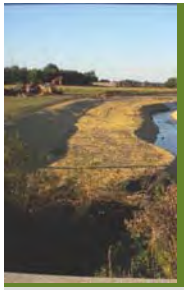
The Speedway will be formally opened June 5 with an international balloon race. Carl Fisher, one of the promoters, says this event will attract visitors from all over the world. Fifteen air craft are entered. An observation tower probably will be built about a mile from the starting point so photographers may work advantageously.

The $3,000 Speedway Trophy, the first

SHOVEL THAT FILLS WAGON IN TEN SEC

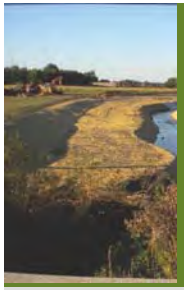
HOWING BANKED CURVES.

IMS constructed in 1909
(www.FirstSuperSpeedway.com)



HISTORY OF IMS & DRY RUN / DIVERSION DITCH

1941 Aerial Image
(Indiana Historical Society)



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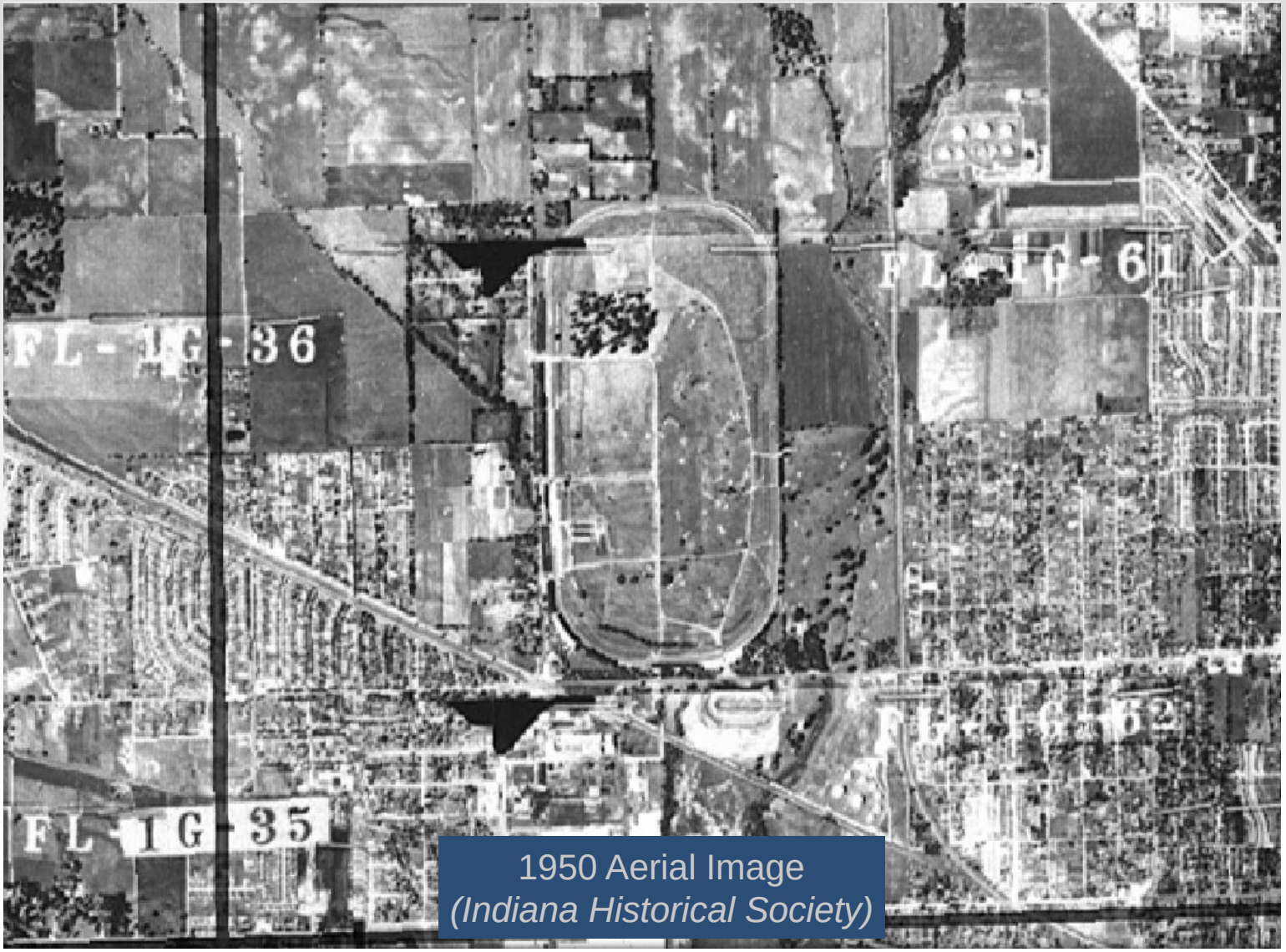

1950 Aerial Image
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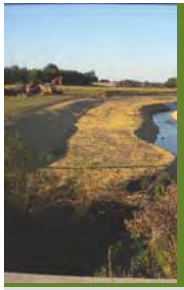

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1956 Aerial Image
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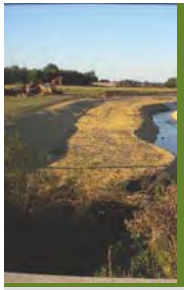

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1962 Aerial Image
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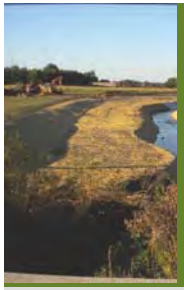

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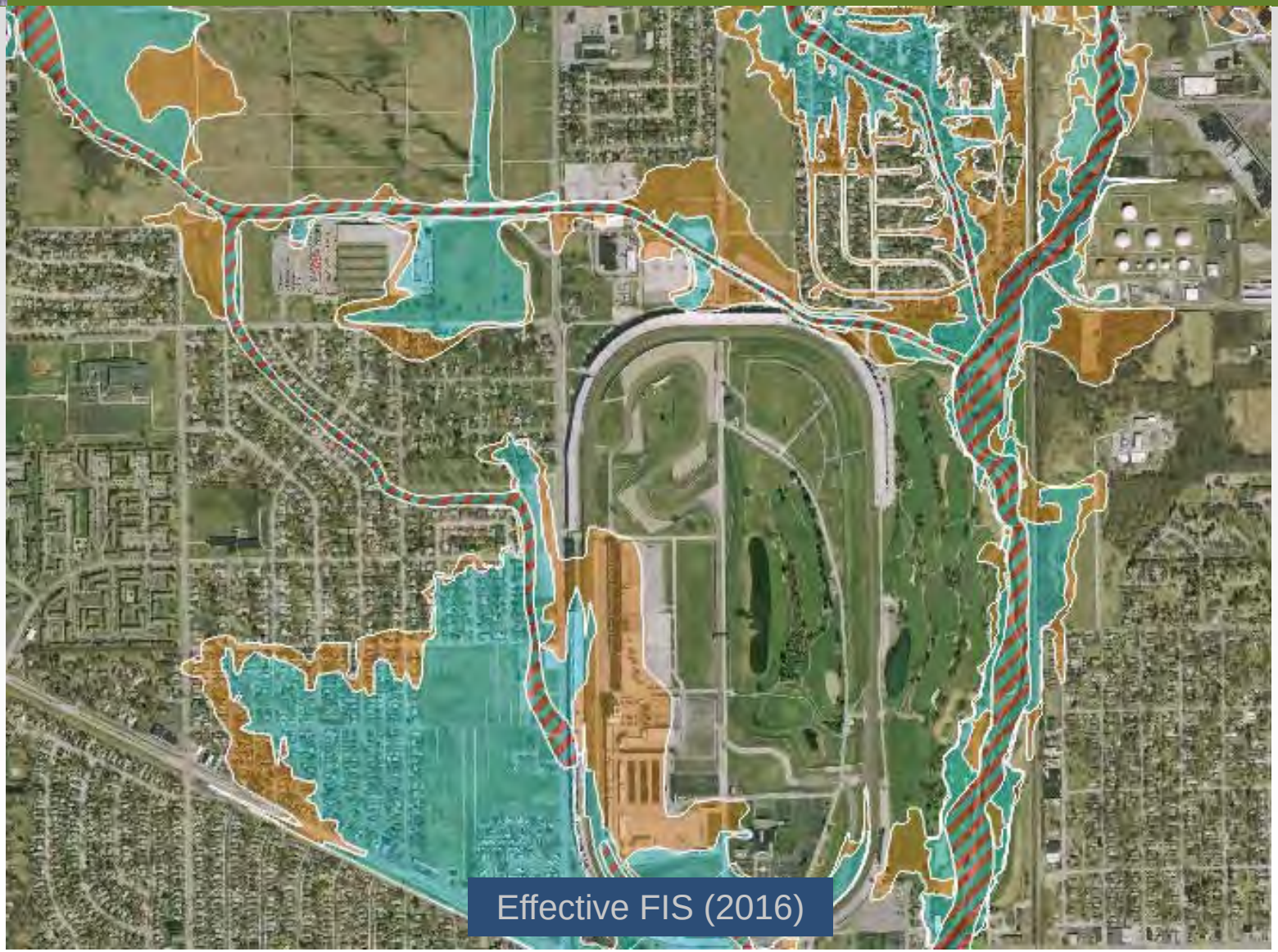
FLOODING IN SPEEDWAY, NEAR IMS



Effective FIS (2016)

FLOODPLAIN MAPPING APPEAL

- Updated model results added homes to FP

Legend

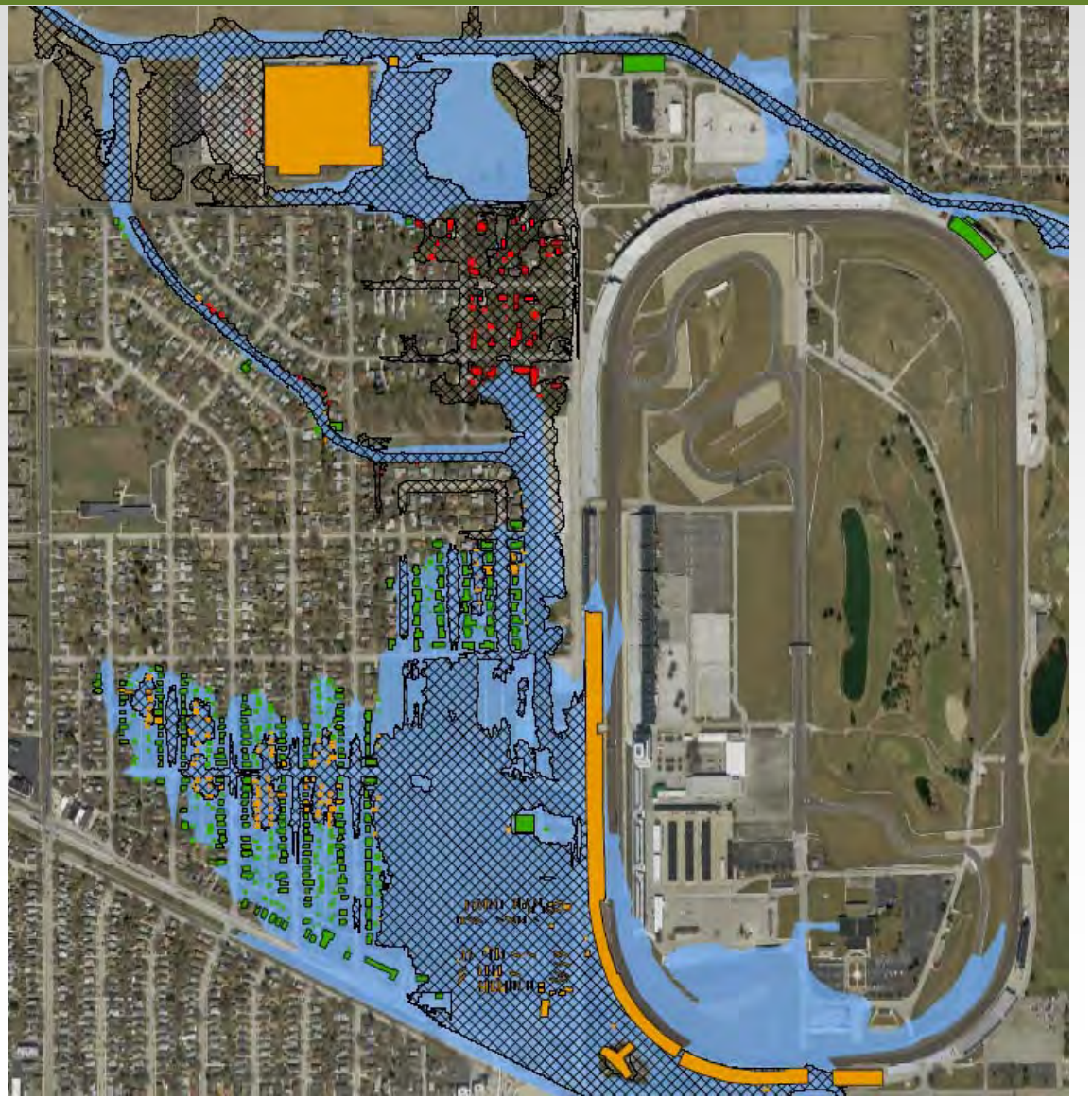
- Effective Floodplain
- Existing Condition Floodplain

Structures

Change from Effective to Existing Condition

- Primary Structure Added (41)
- Secondary Structure Added (46)
- Primary Structure Removed (195)
- Secondary Structure Removed (137)
- Primary Structure within SFHA for both Scenarios (137)
- Secondary Structure within SFHA for both Scenarios (134)

Existing Condition:
FP Mapping Appeal



ALTERNATIVE ANALYSIS RESULTS

- Alternatives considered
  - Shelf / 2-stage ditch
  - Floodwall
- Shelf alternative was most effective and was selected
- Speedway was awarded $500,0000 OCRA grant

Legend

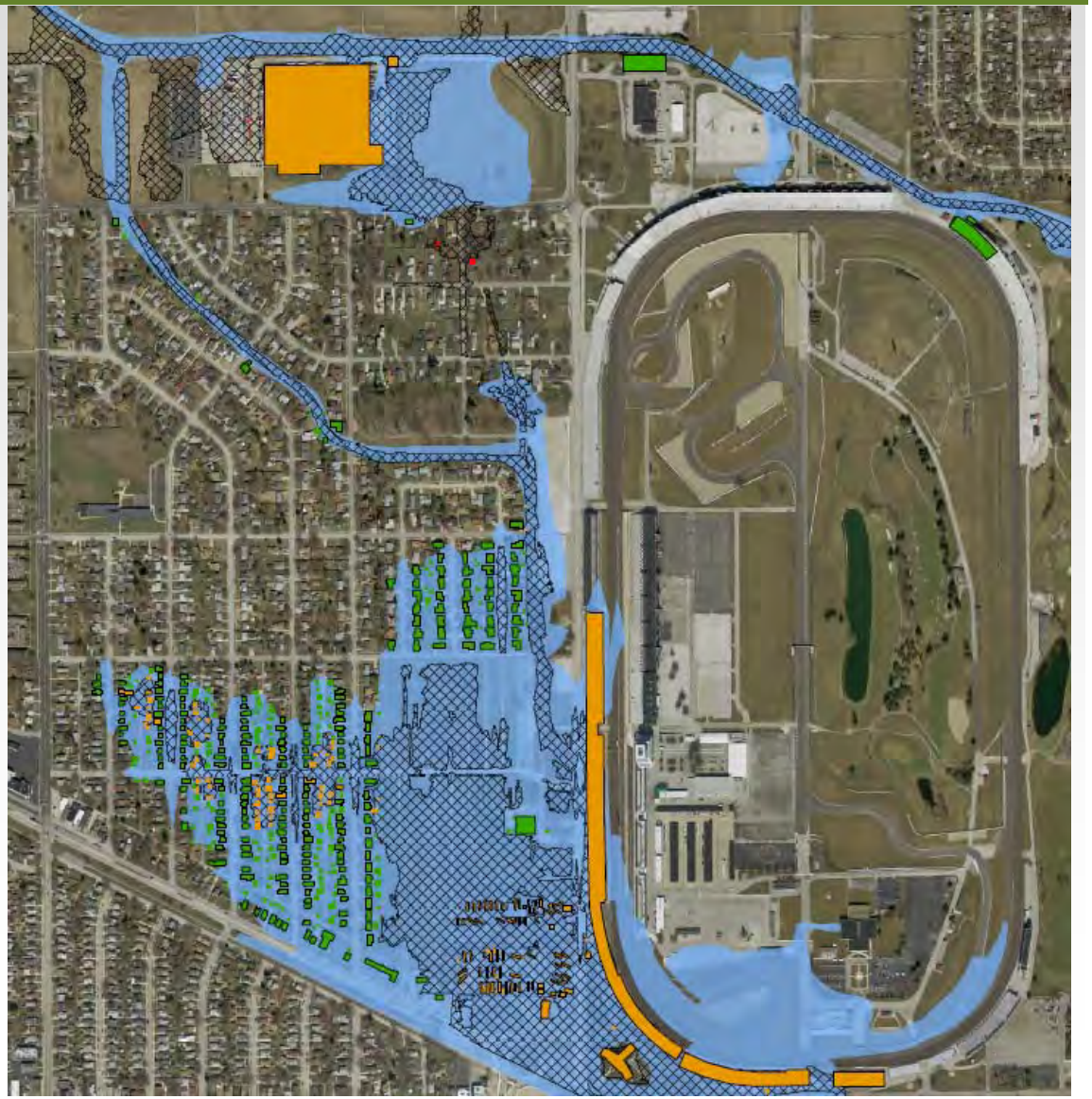
- Proposed Condition Floodplain
- Effective Floodplain (Current DFIRM)

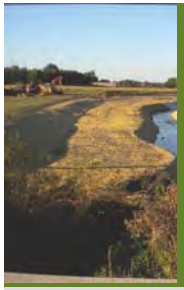
Structures

Change from Effective Floodplain to Proposed Condition Floodplain

- Primary Structure Added (0)
- Secondary Structure Added (6)
- Primary Structure Removed (238)
- Secondary Structure Removed (200)
- Primary Structure within SFHA for both Scenarios (82)
- Secondary Structure within SFHA for both Scenarios (84)

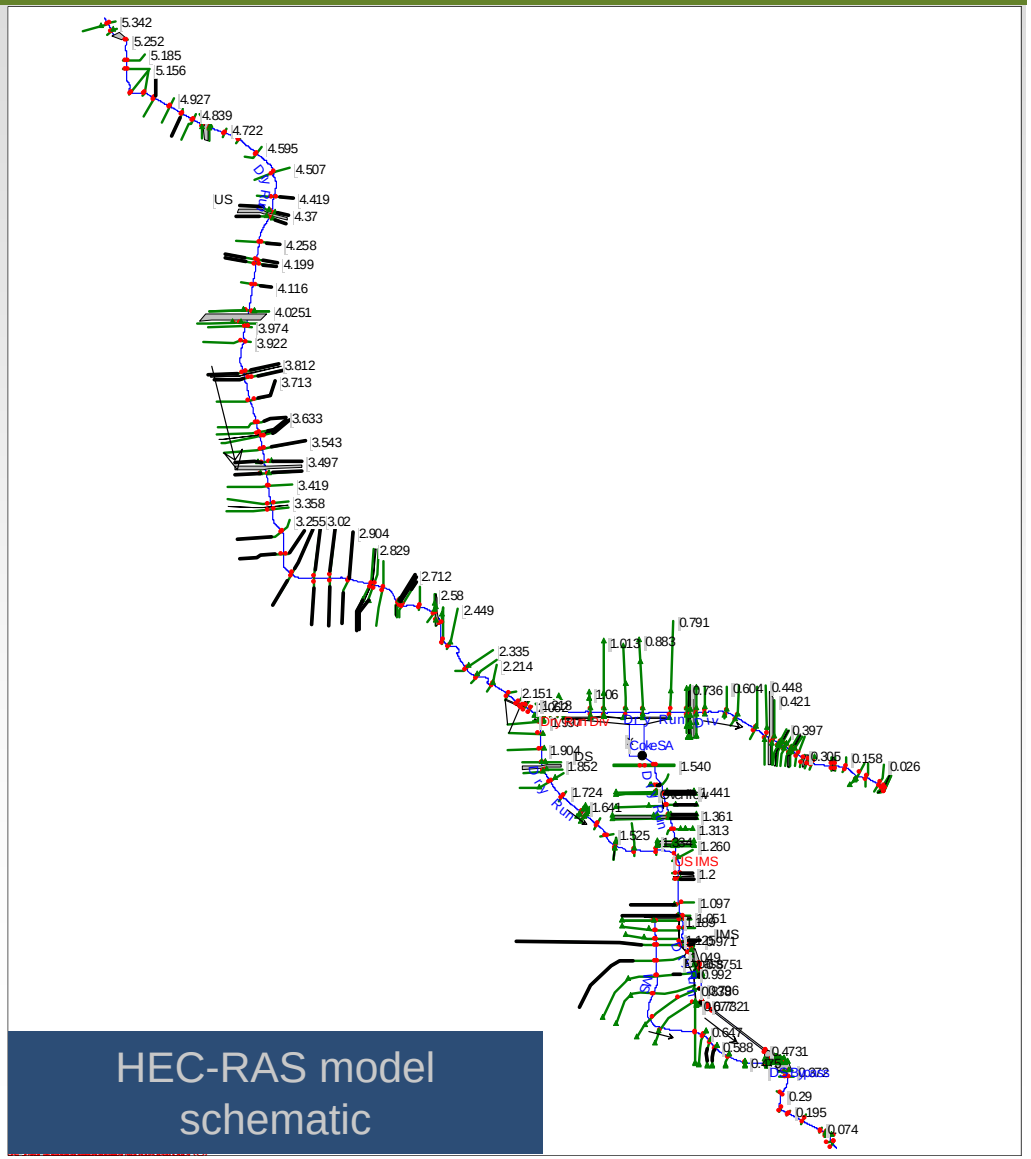
Proposed Condition from Alternative Analysis



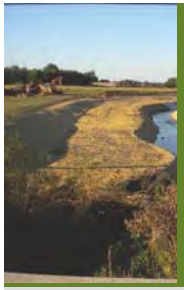


DESIGN PHASE: HYDRAULIC MODELING

- Unsteady-state HEC-RAS model
  - Better prediction of flow timing
  - Attenuation of flow
  - Allowed for consideration of impacts to downstream reaches
- Model Extent
  - US Extent: Headwater subbasins
  - DS Extent: Little Eagle Creek



HEC-RAS model schematic

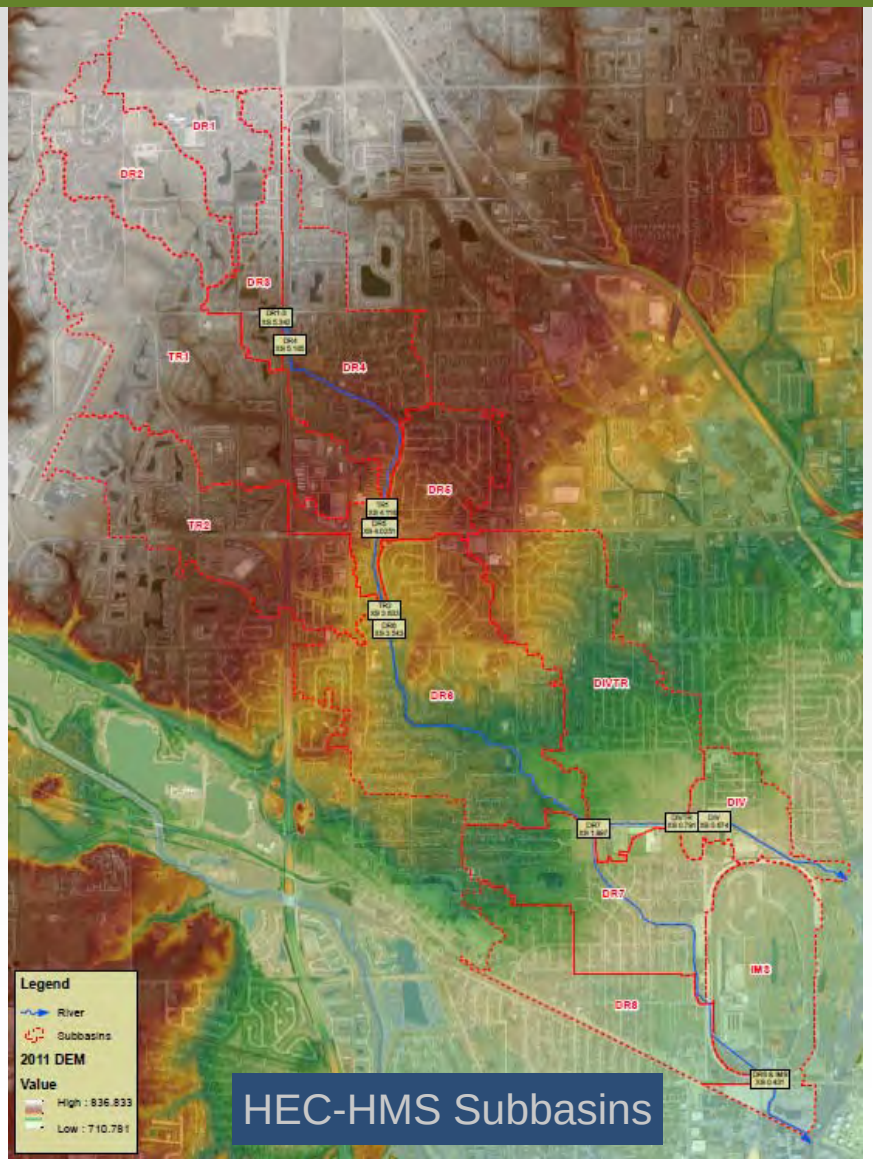


DESIGN PHASE: HYDRAULIC MODELING

- Flow Data
  - HEC-HMS hydrologic model
  - 13 subbasins (Total DA = 6.92 mi^2)
  - 10 hydrologic flow change locations (5 additional for model configuration)
  - HEC-HMS DSS file referenced for flow inputs

Select Location in table then select Boundary Condition Type

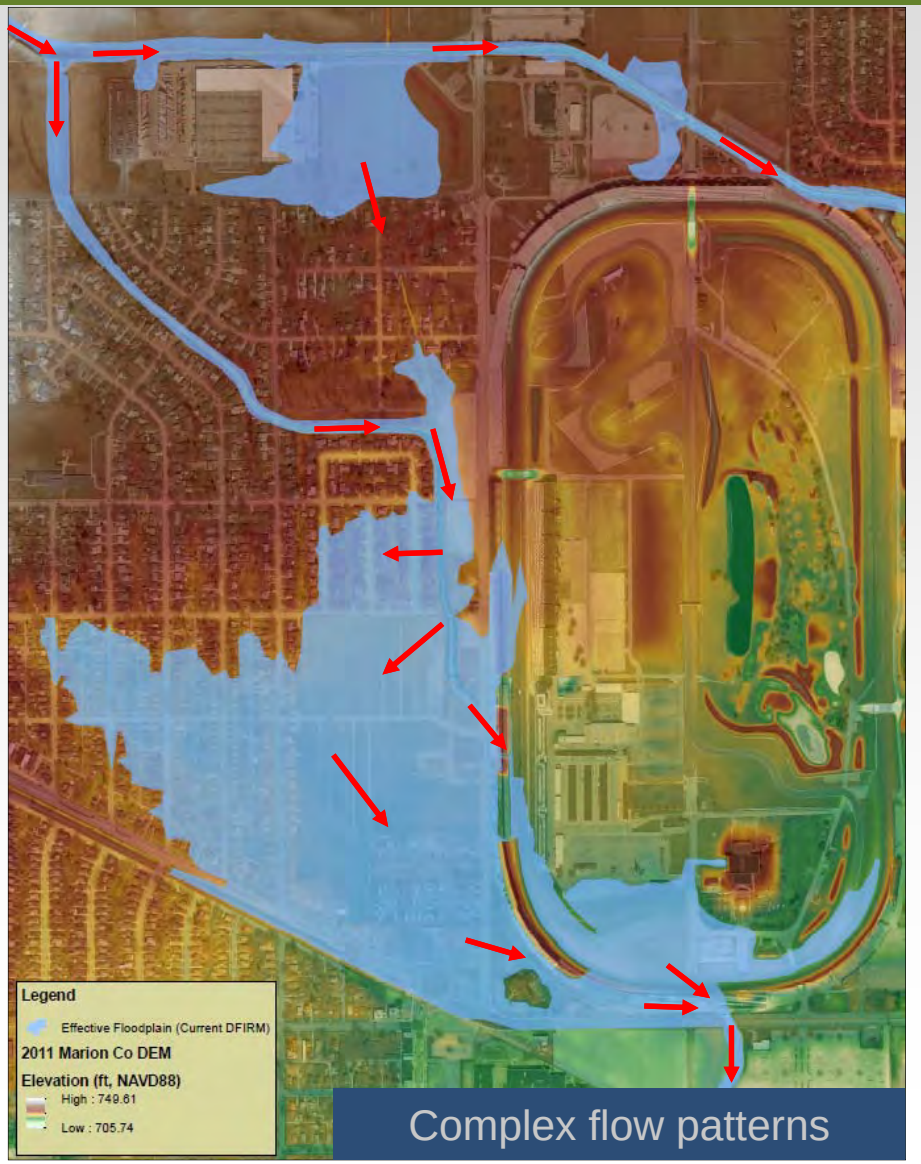
	River	Reach	RS	Boundary Condition
1	Dry Run	US	5.342	Flow Hydrograph
2	Dry Run	US	5.185	Uniform Lateral Inflow
3	Dry Run	US	4.116	Lateral Inflow Hydr.
4	Dry Run	US	4.0251	Lateral Inflow Hydr.
5	Dry Run	US	3.633	Lateral Inflow Hydr.
6	Dry Run	US	3.543	Uniform Lateral Inflow
7	Dry Run	DS	1.997	Uniform Lateral Inflow
8	Dry Run	DS	1.409	Lateral Inflow Hydr.
9	Dry Run	Overflow	1.540	Flow Hydrograph
10	Dry Run	Overflow	1.468	Lateral Inflow Hydr.
11	Dry Run	IMS	.431	Lateral Inflow Hydr.
12	Dry Run	IMS	0.4046	Lateral Inflow Hydr.
13	Dry Run	IMS	0.006	Normal Depth
14	Dry Run Div	x	0.791	Lateral Inflow Hydr.
15	Dry Run Div	x	0.674	Uniform Lateral Inflow
16	Dry Run Div	x	0.003	Normal Depth
17	IMS	Bypass	1.189	Flow Hydrograph



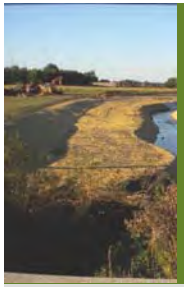
HEC-HMS Subbasins

DESIGN PHASE: QUASI-2D SCENARIO

- Multiple flow paths possible
  - Observable in DEM
  - Suggested by flooding extent in Effective mapping
- Bifurcated system modeled using:
  - Junctions
  - Lateral weirs
  - Storage areas

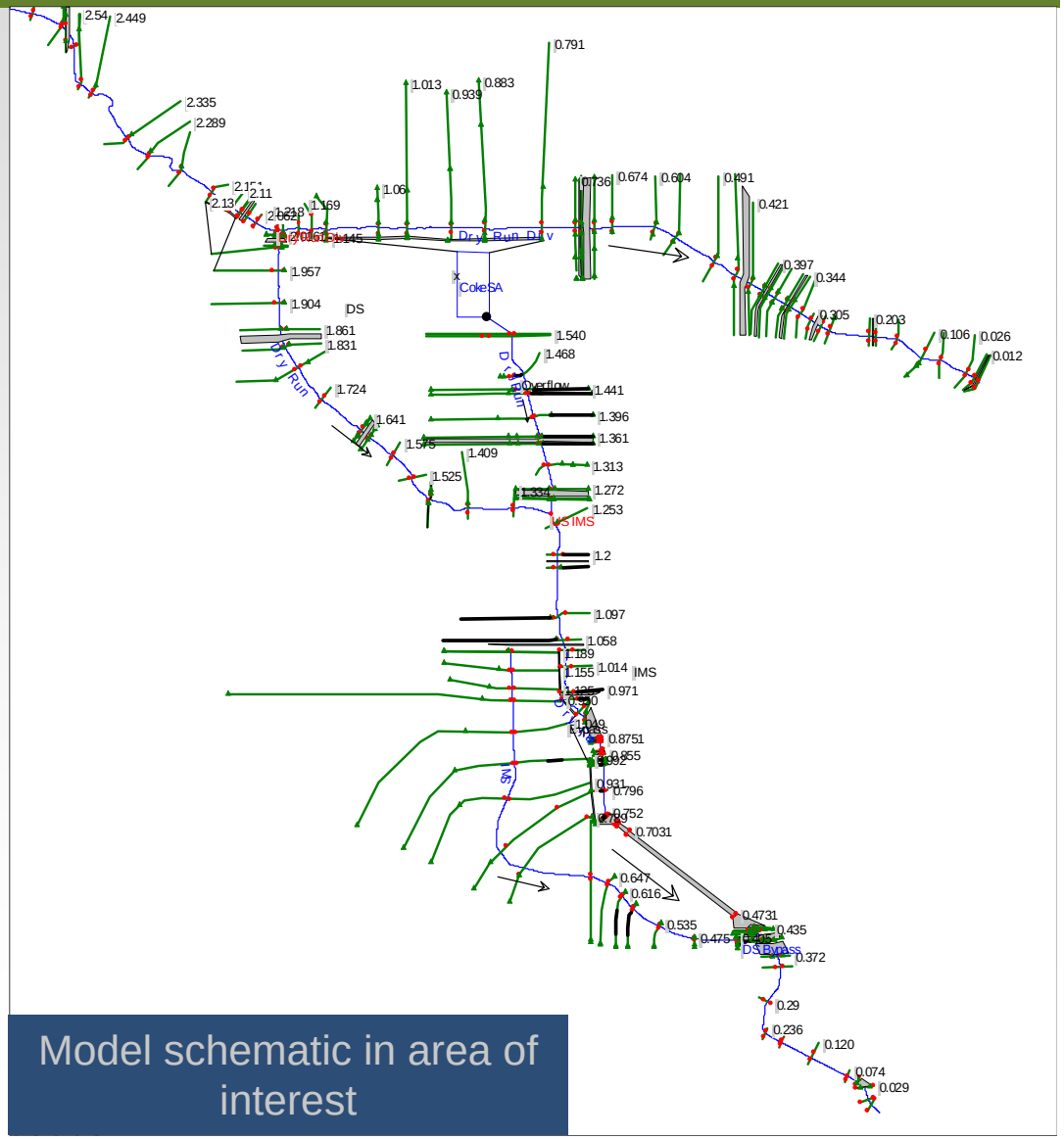


Complex flow patterns

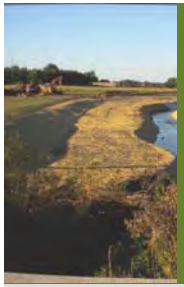


DESIGN PHASE: GEOMETRY DATA & SETUP

- Cross-sections (209)
  - Topographic survey
  - 209 total XS
- Bridges (29) / Culverts (11)
  - Structures surveyed or based on as-built drawings
  - All structures included
- Lateral Weirs (5)
  - Profiles cut from DEM / Survey
  - Iterative process to identify overflows in 1-D model
- Storage Areas (1)
  - Elevation-area curves generated from DEM / Survey
  - Used to ease flow and consider flow attenuation

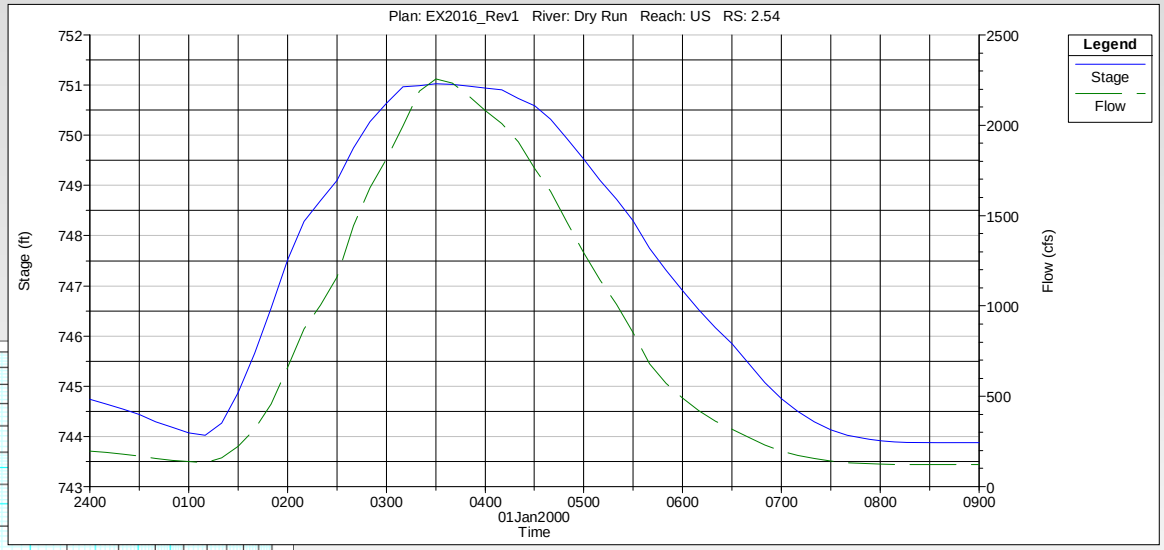


Model schematic in area of interest

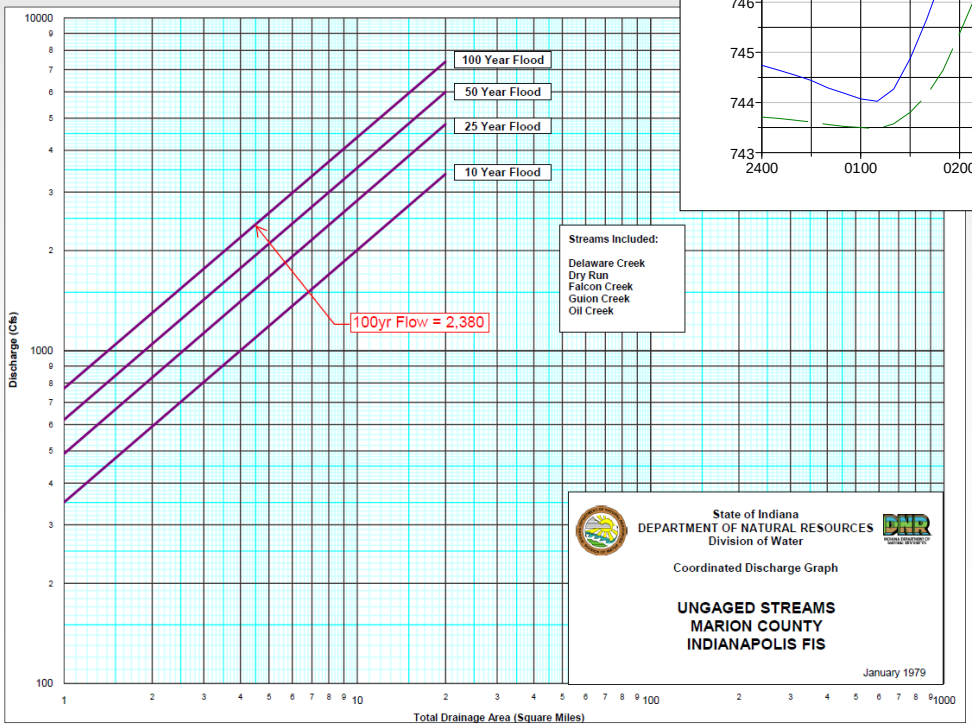


DESIGN PHASE: MODEL CALIBRATION

- No gage data available
  - Hydrologic model inputs adjusted to match Coordinated Discharge

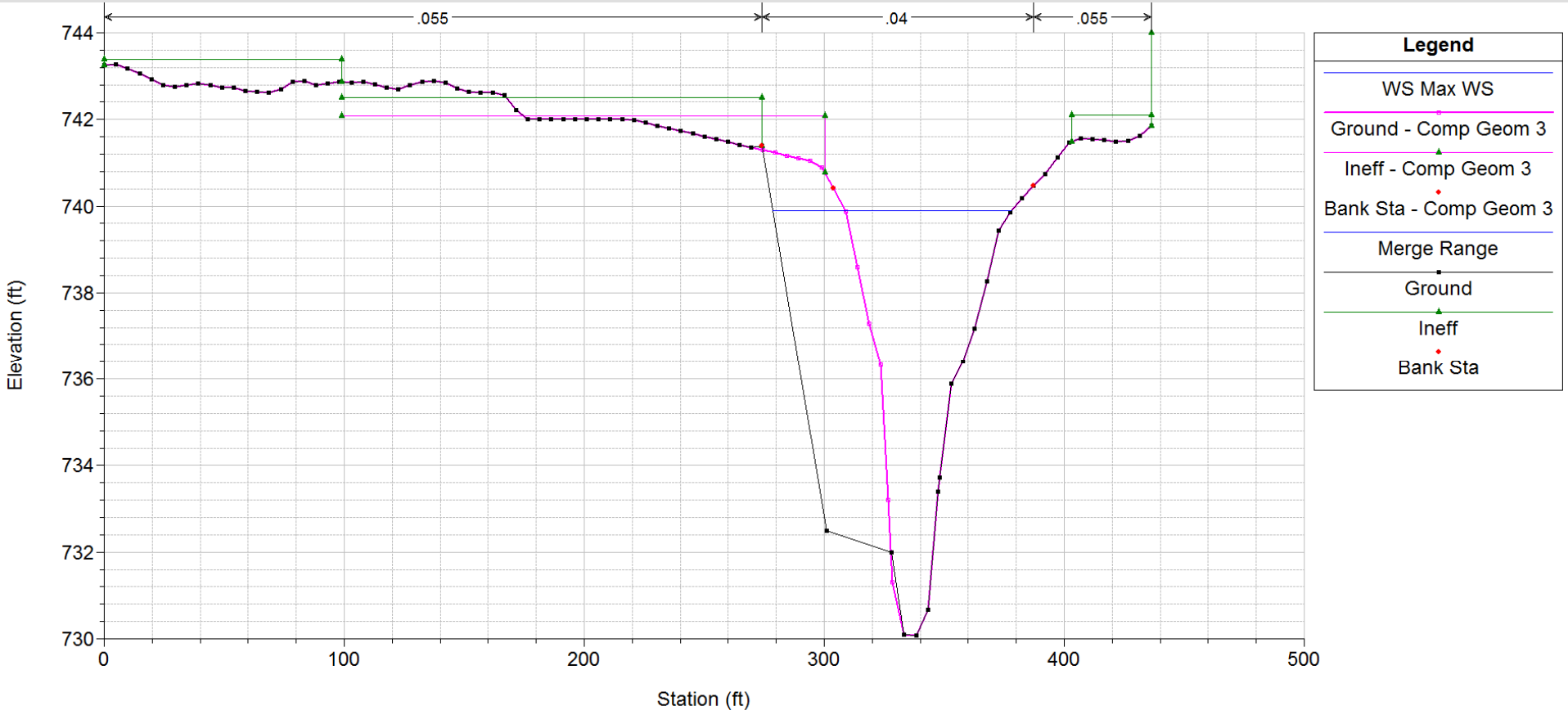


Flow hydrograph US of diversion

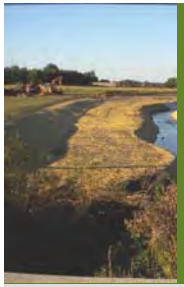


Coordinated Discharge Graph

DESIGN PHASE: EXISTING VS. PROPOSED CHANNEL

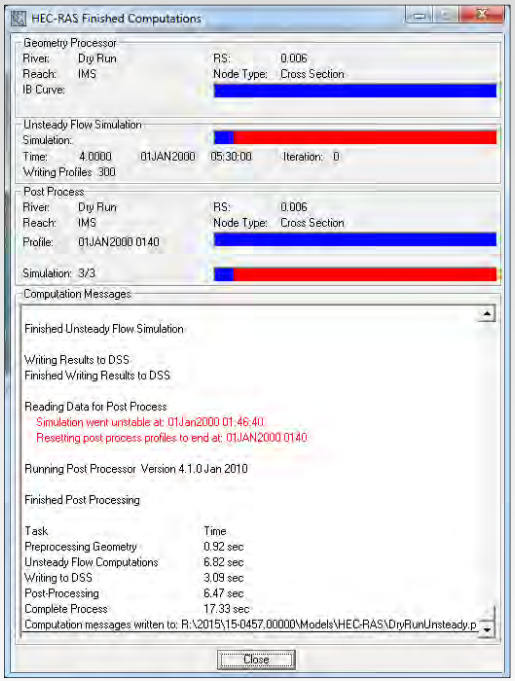


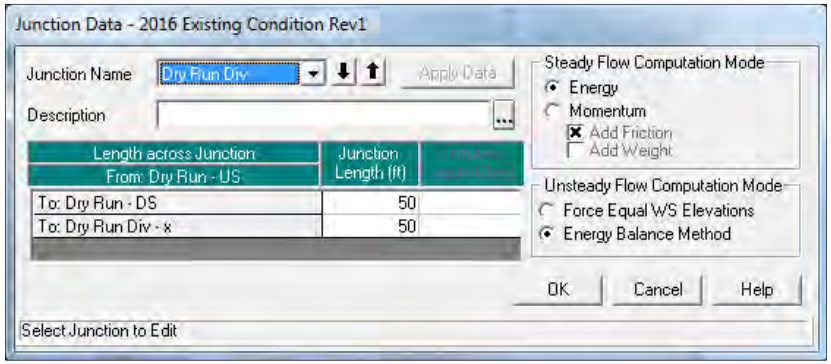
Existing vs. Proposed XS in HEC-RAS

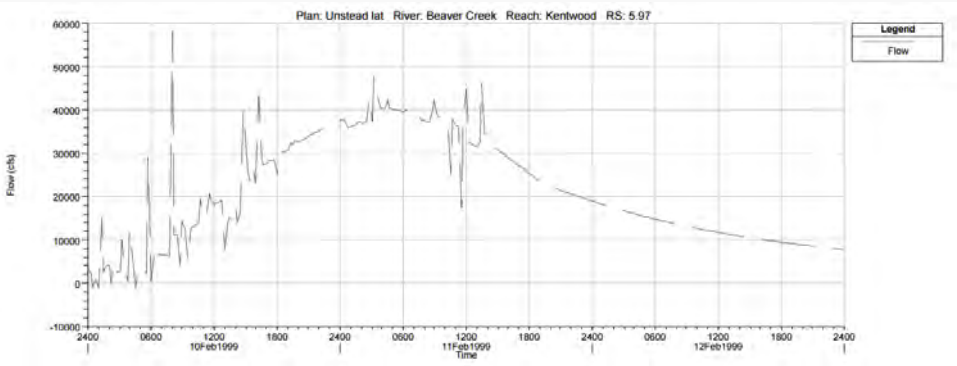


DESIGN PHASE: MODEL STABILITY ISSUES

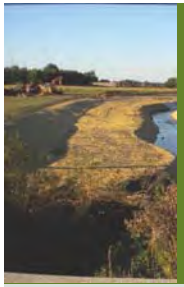
- Signs of Model Instability
  - Model solution failure
  - Irregular flow/stage hydrograph
  - High error in calculated elevations
- Sources of Model Instability
  - Not enough, or too many XS…or poor spacing of XS
  - Junctions – relative location to XS
  - Bridge modeling approach
  - Unexpected supercritical flow







Irregular hydrograph (from HEC-RAS User Manual)

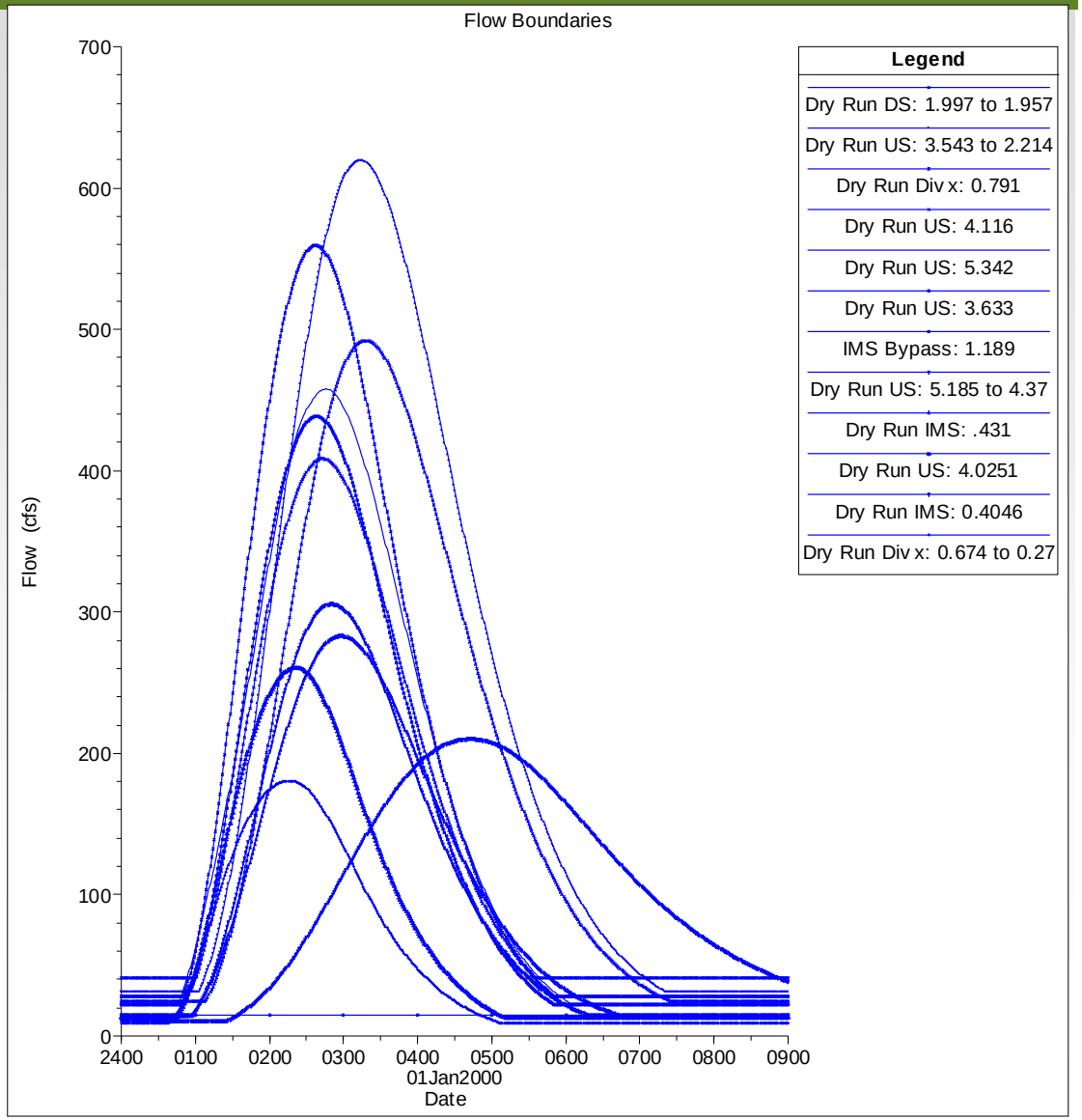


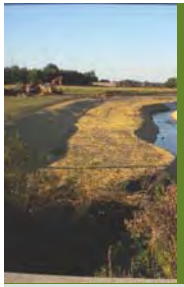
DESIGN PHASE: MODEL VALIDITY CONCERNS

- MODEL VALIDITY CONCERNS
  - Using large amounts of baseflow can hide instability issues

(NOT RECOMMENDED…or allowed)

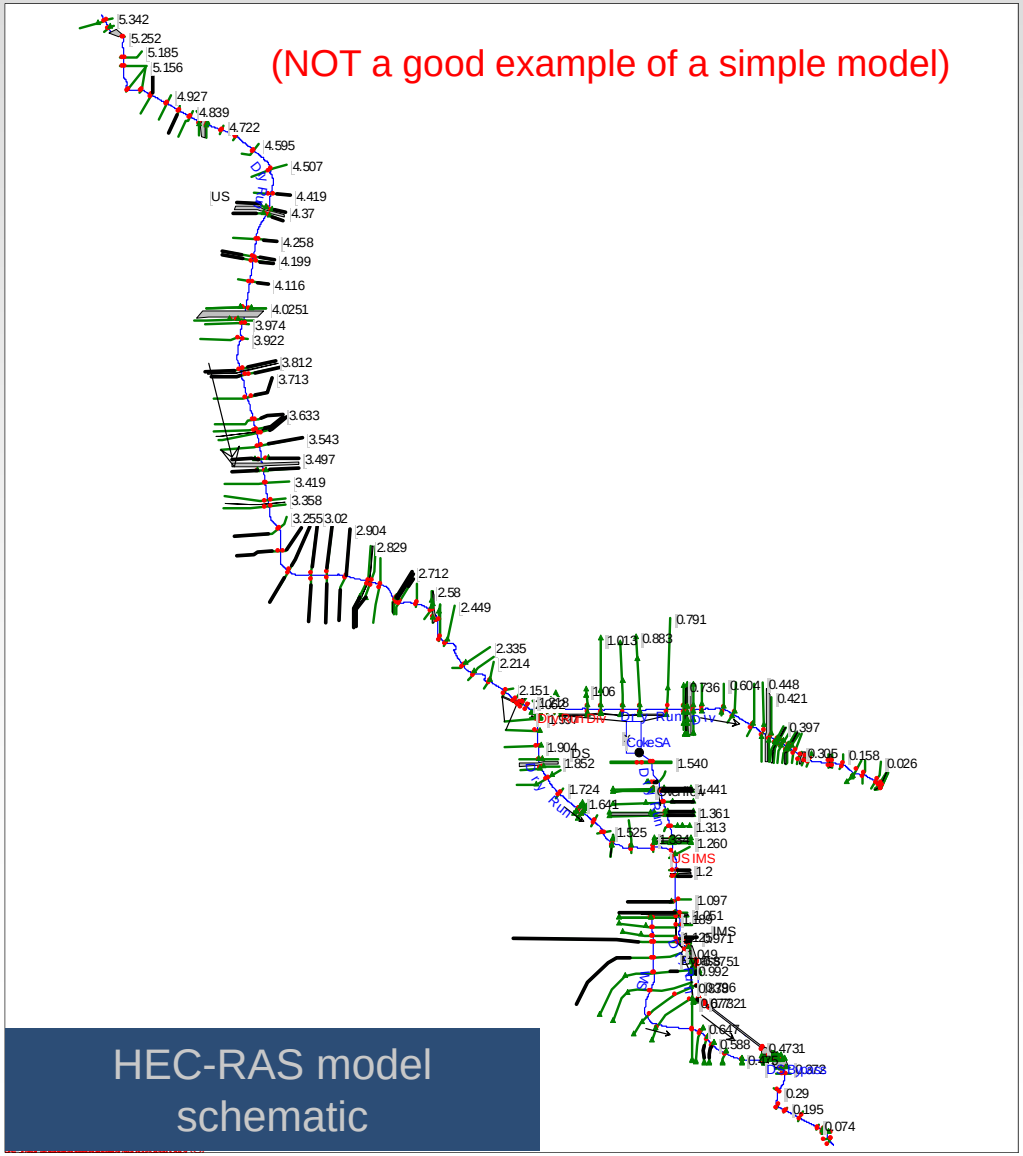
  - Unidentified overflow areas in quasi-2D situations
  - Poor junction setup

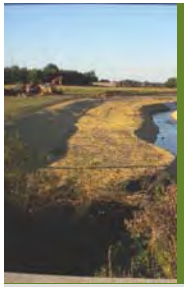




DESIGN PHASE: MODEL INSTABILITY & VALIDITY TIPS

- Tips for avoiding issues
  1. Make your model only as complex as it needs to be
  2. Adjust HTab Parameters for XS & bridges
  3. Use minimum flow to prevent immediate solution failure
  4. Make sure that hydrology (inflow hydrographs) aren't overly irregular
  5. Establish initial condition from previously computed profile
  6. Consider adjusting theta weighting factor for initial runs





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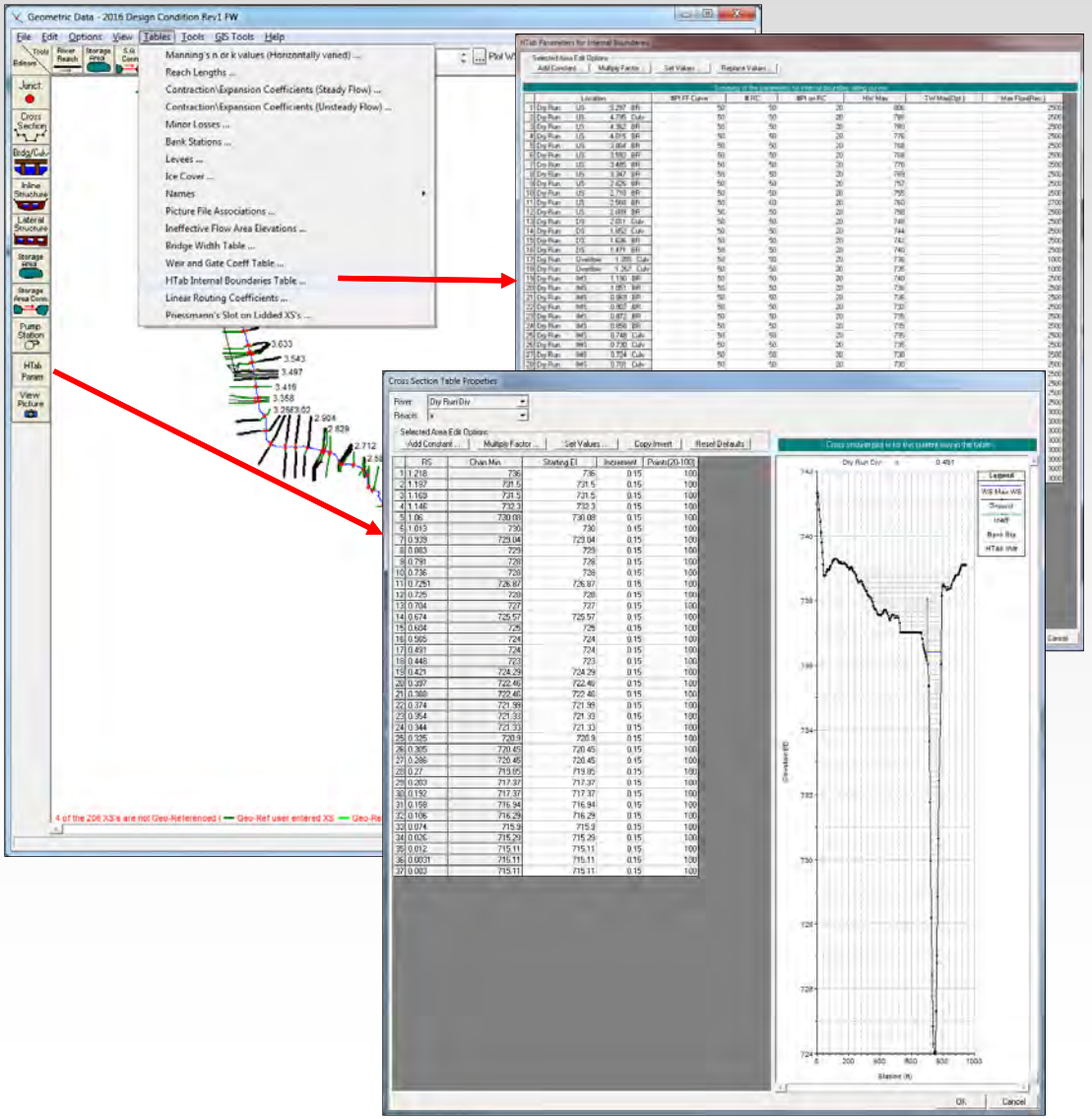

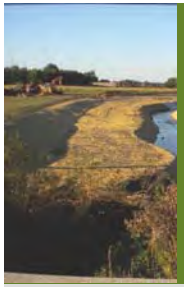

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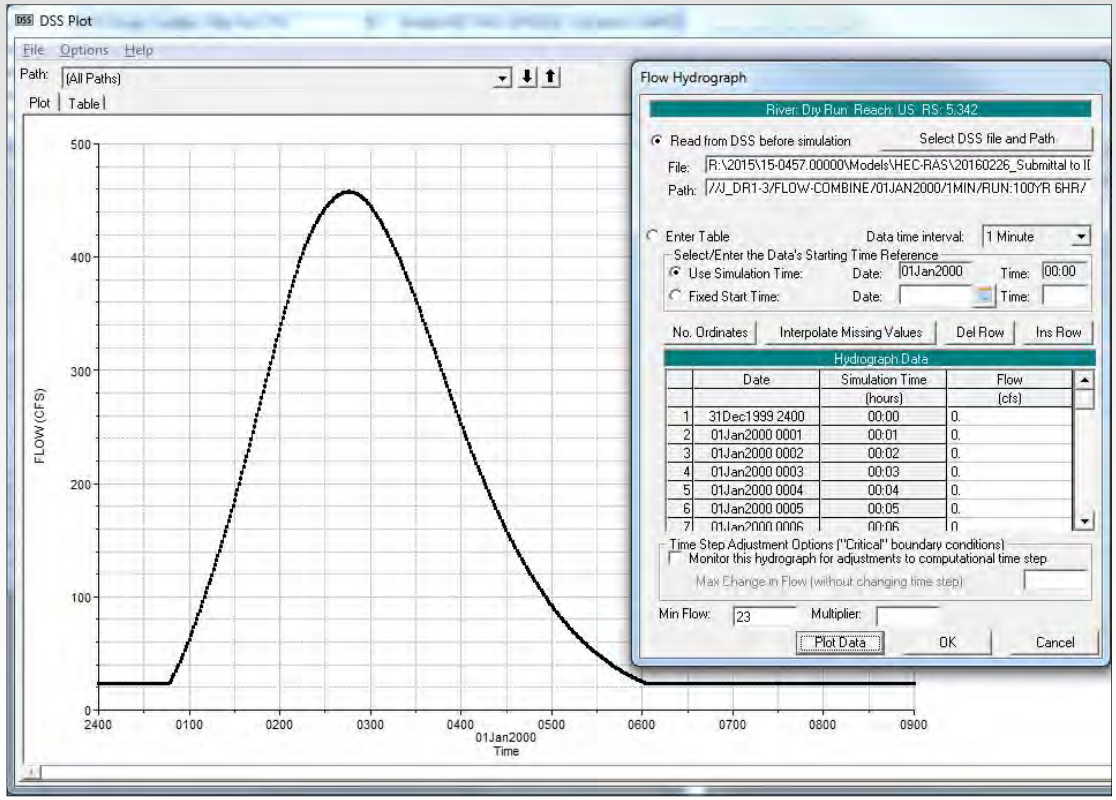

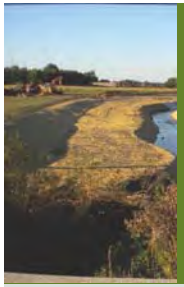

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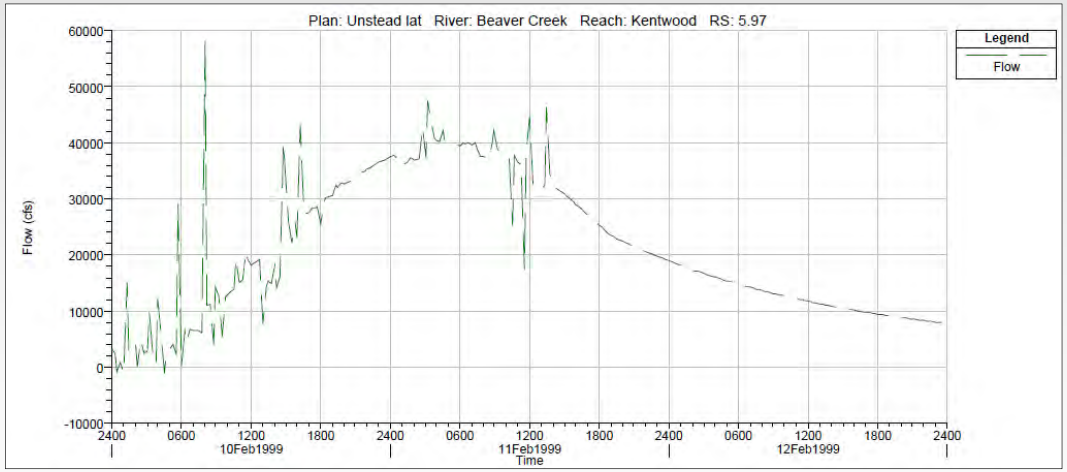

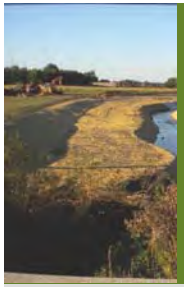

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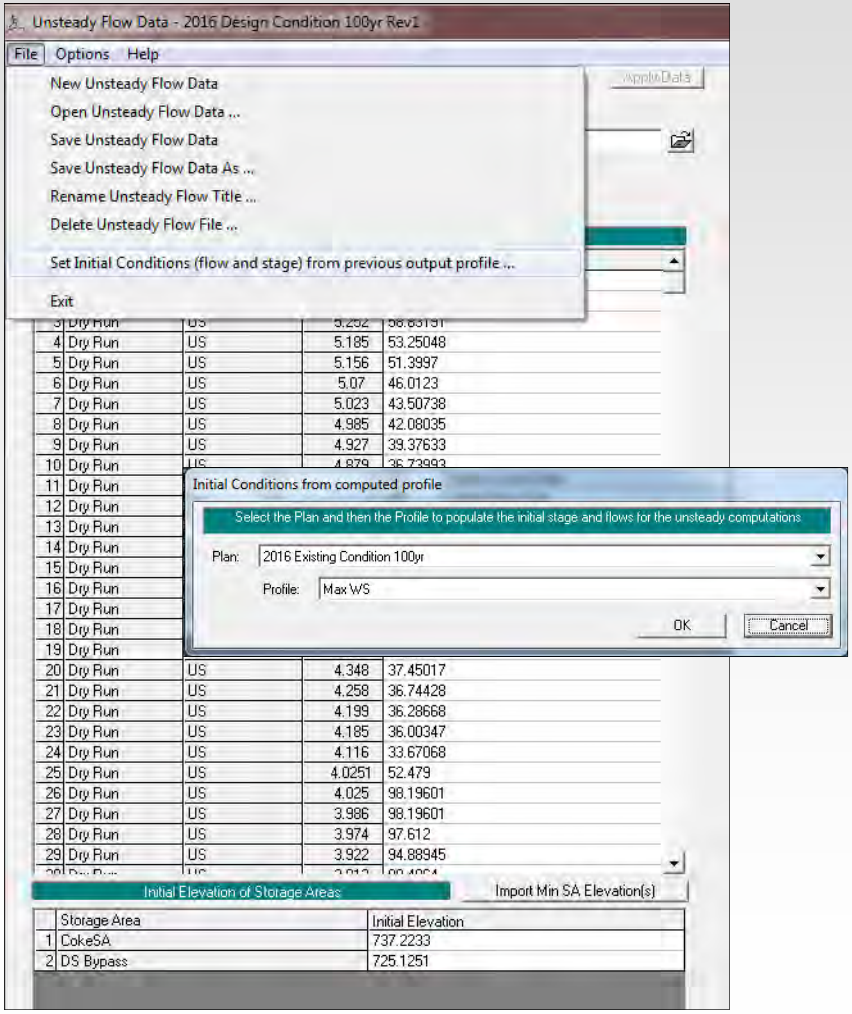

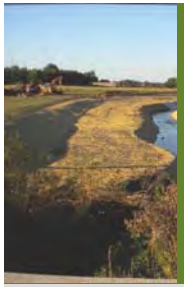

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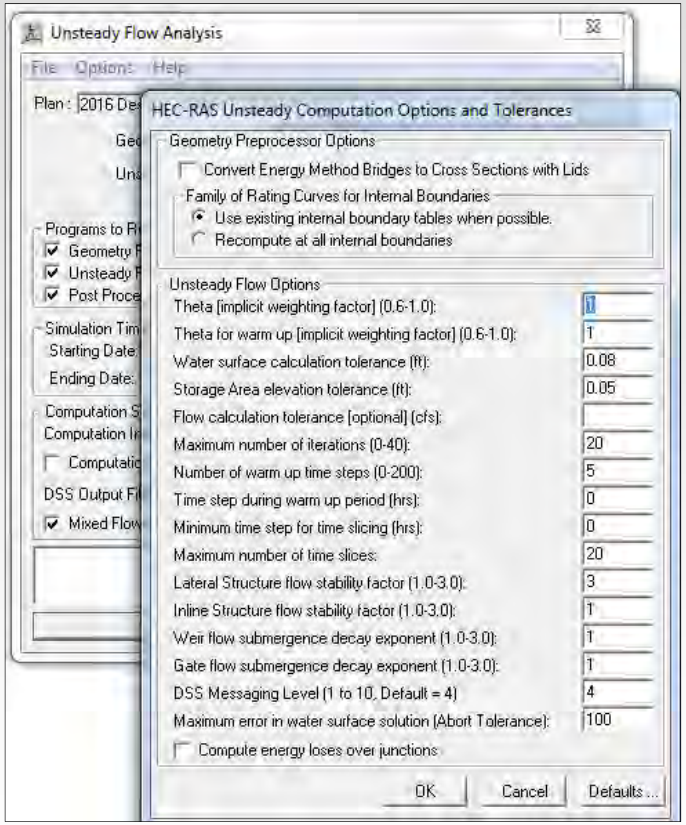

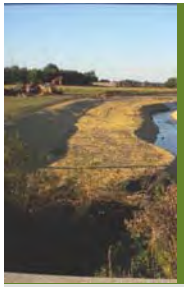

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- Tips for solving issues
  1. Try adjusting the computational time step before making geometry changes
  2. Identify location(s) where the water surface tolerance is repeatedly exceeded
  3. Review hydrographs; identify where ‘wobbling’ first appears
  4. Watch animated profile; note the event time at the beginning of unusual progression
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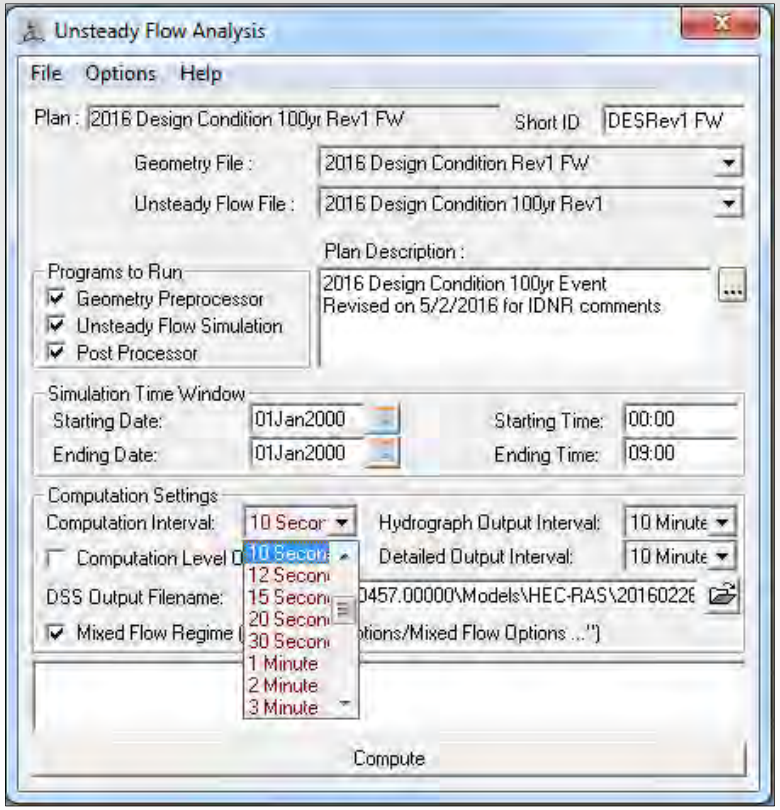

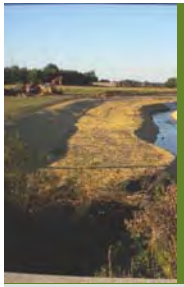

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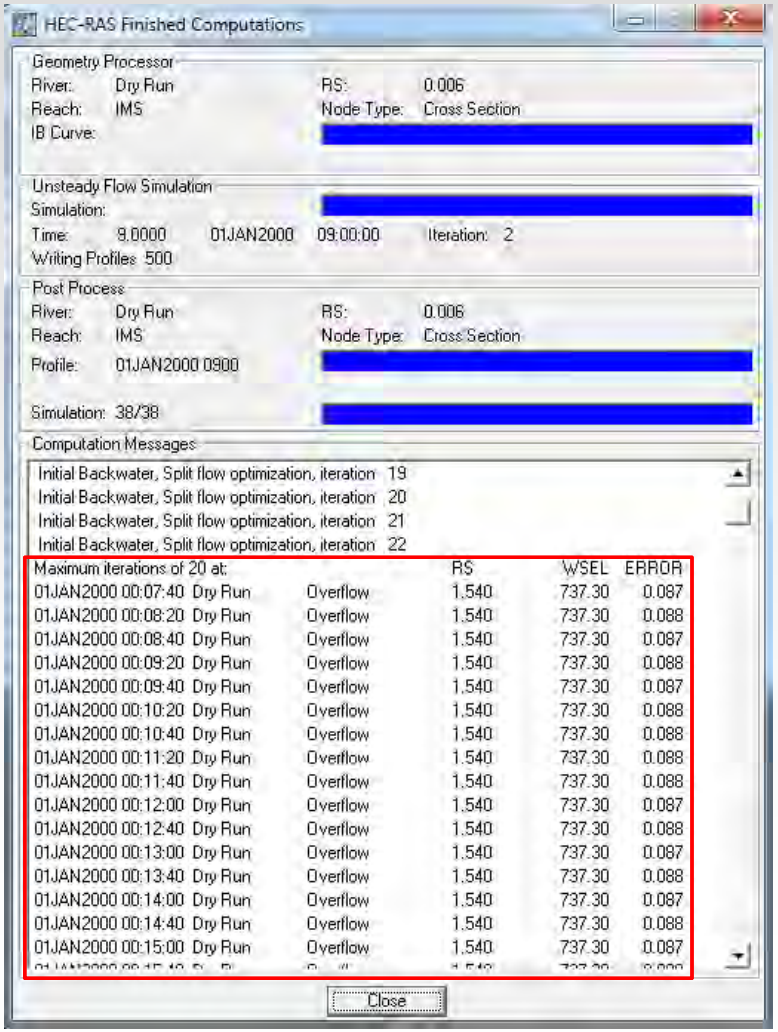

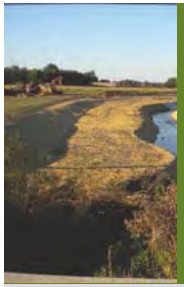

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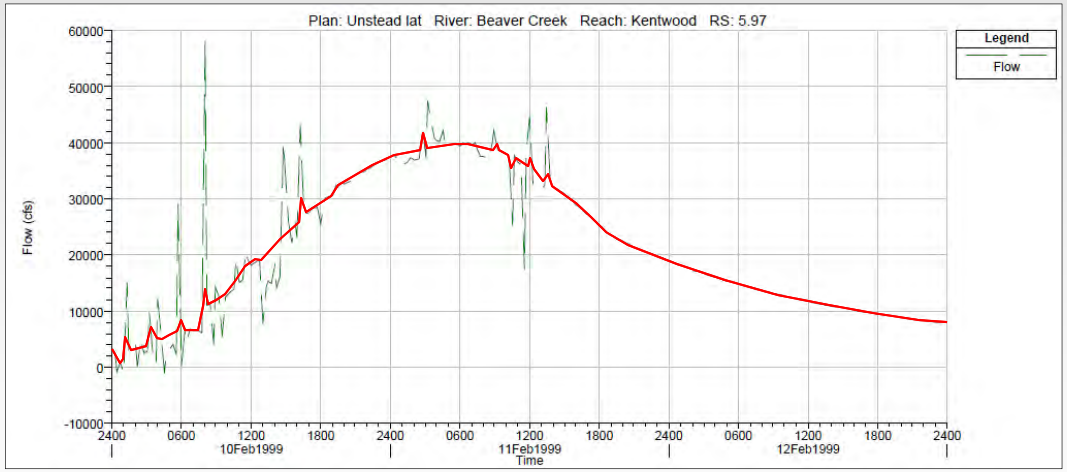

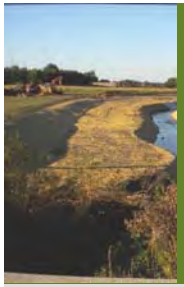

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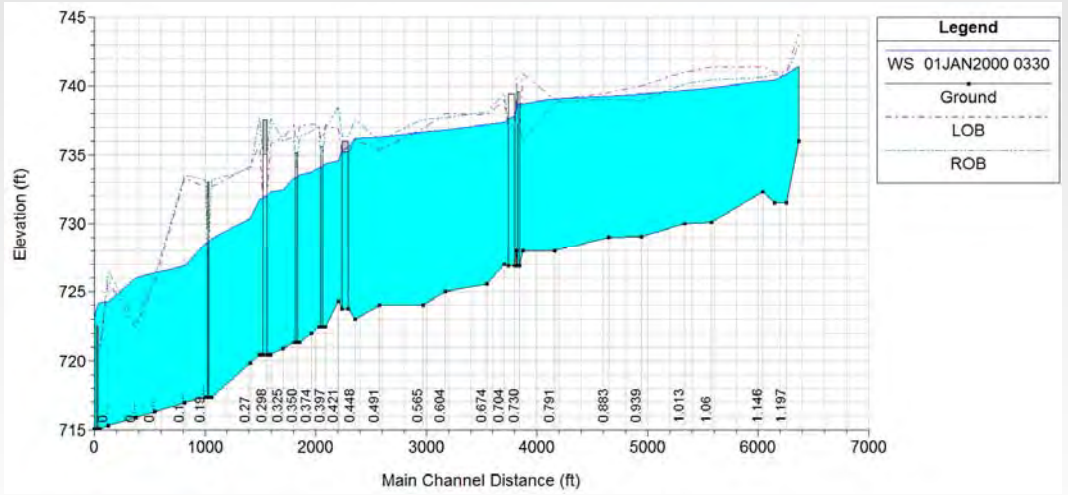

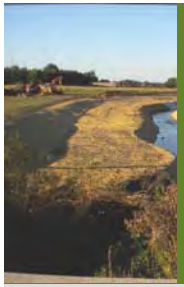

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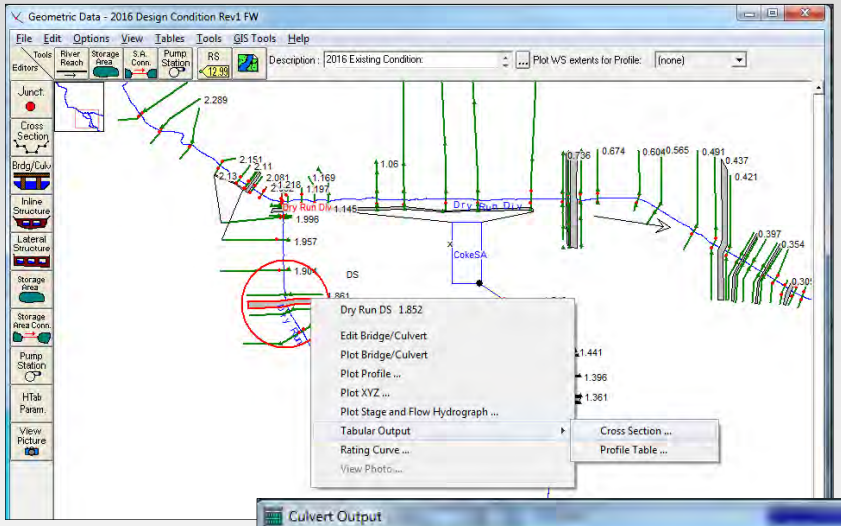
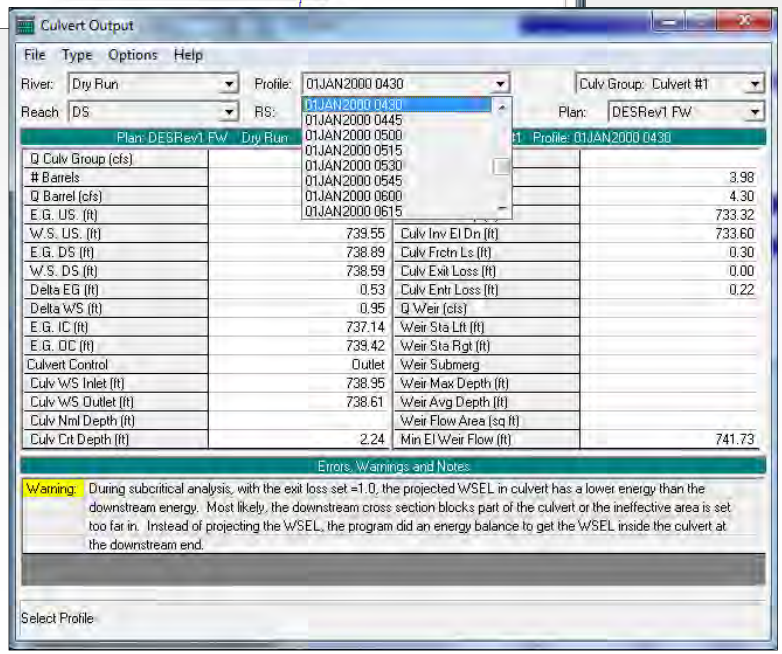
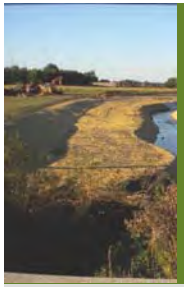






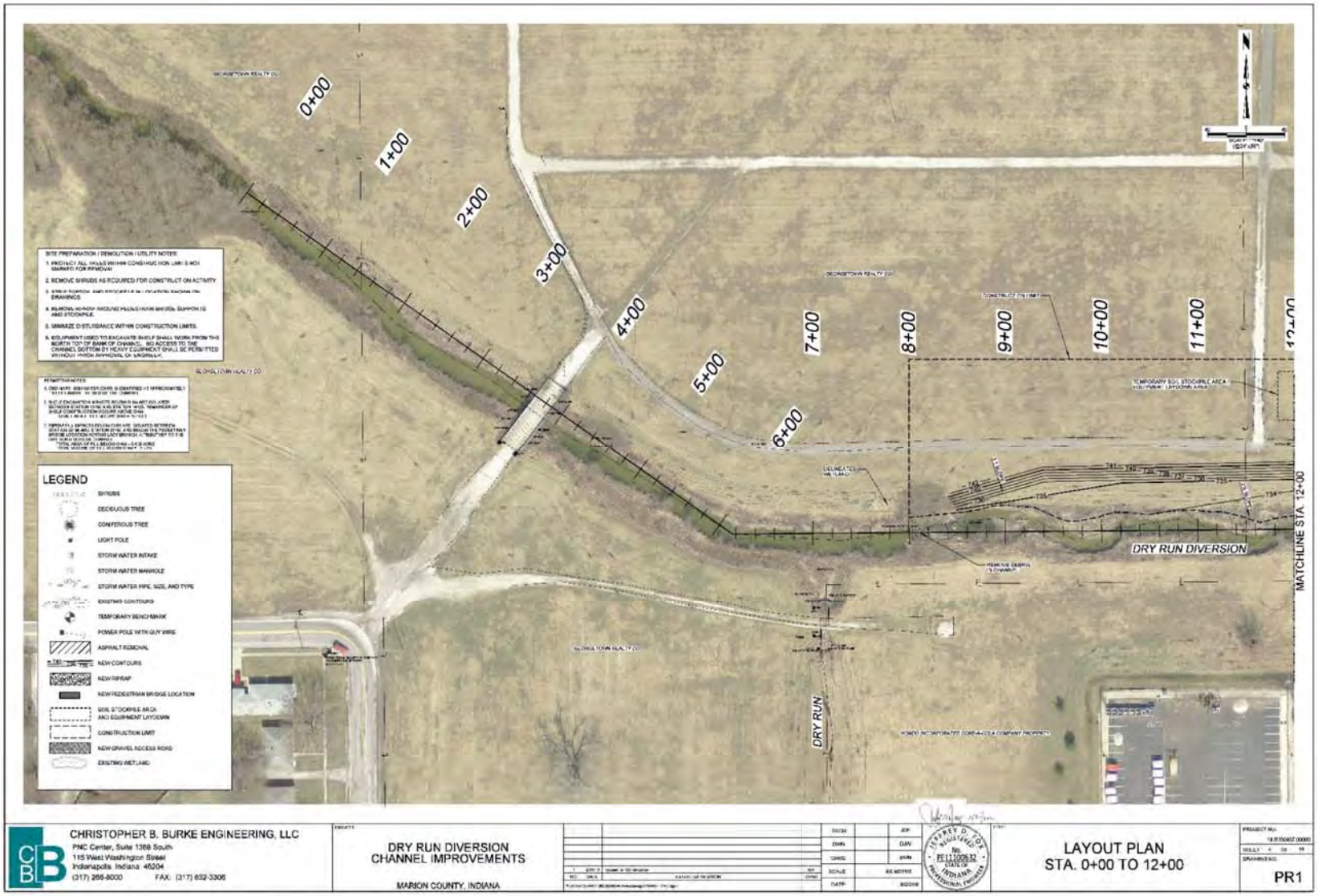
DESIGN PHASE: MODEL INSTABILITY & VALIDITY TIPS

- Consult HEC-RAS User Manual (for model setup)
- Consult HEC-RAS Hydraulic Reference Manual (for details on inputs & how the model does calculations)

- Good source for troubleshooting guidance

http://www.nws.noaa.gov/oh/hrl/modelcalibration/6.%20%20Hydraulic%20Model%20Calibration/4.1%20L-11%20CommonModelStabilityProblemsInUnsteady%20FlowAnalysis.pdf

DESIGN: CONSTRUCTION DRAWINGS



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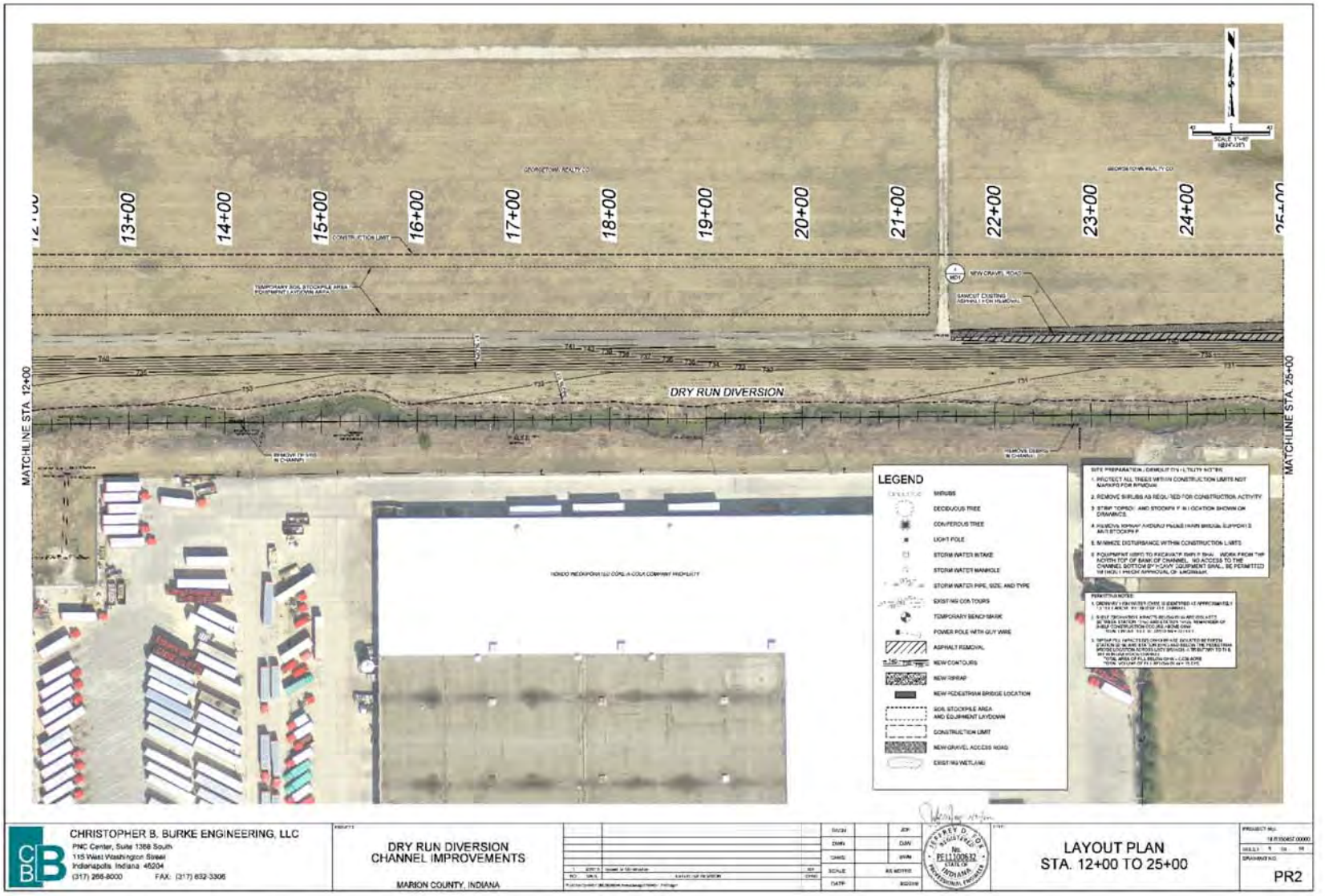

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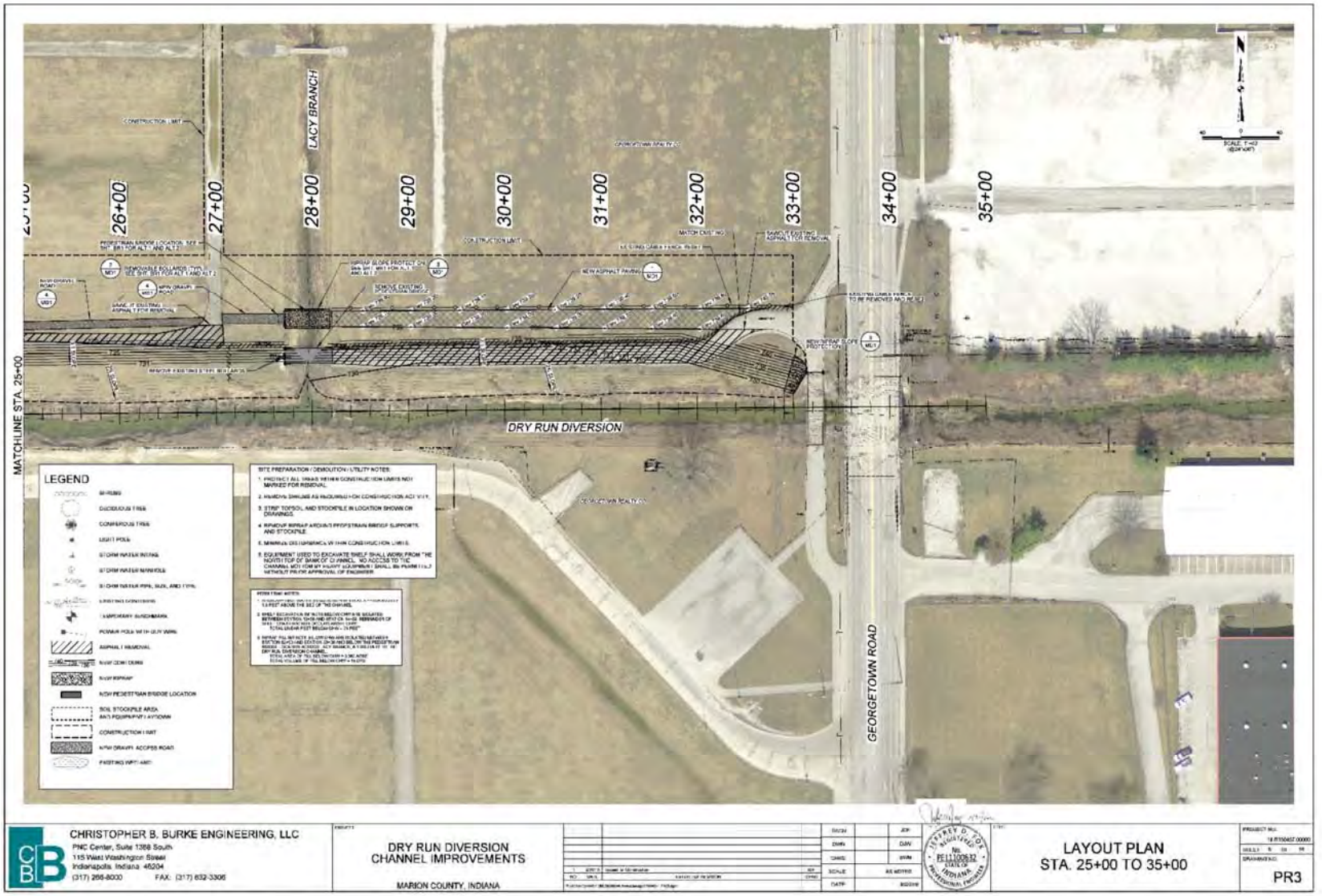

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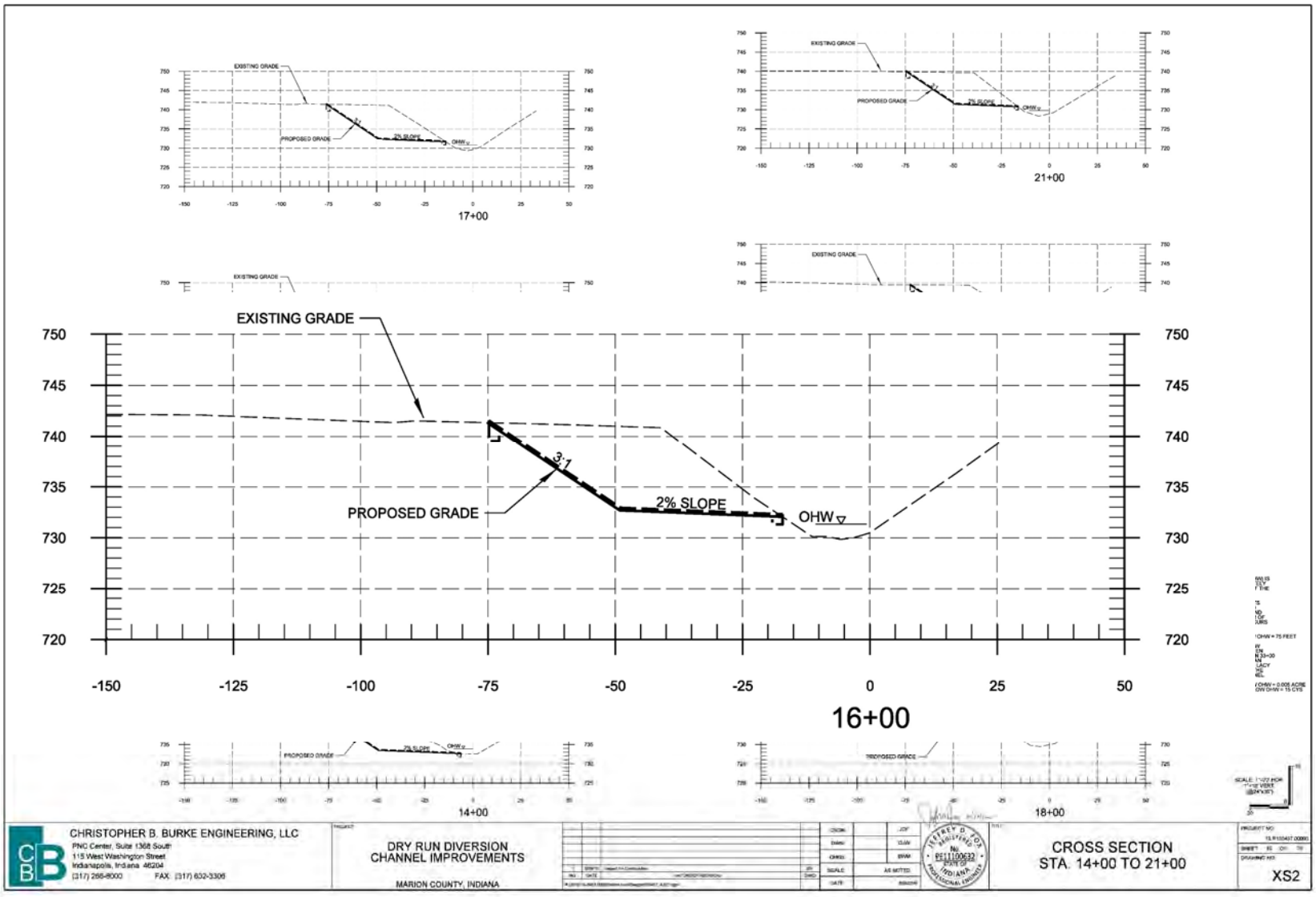
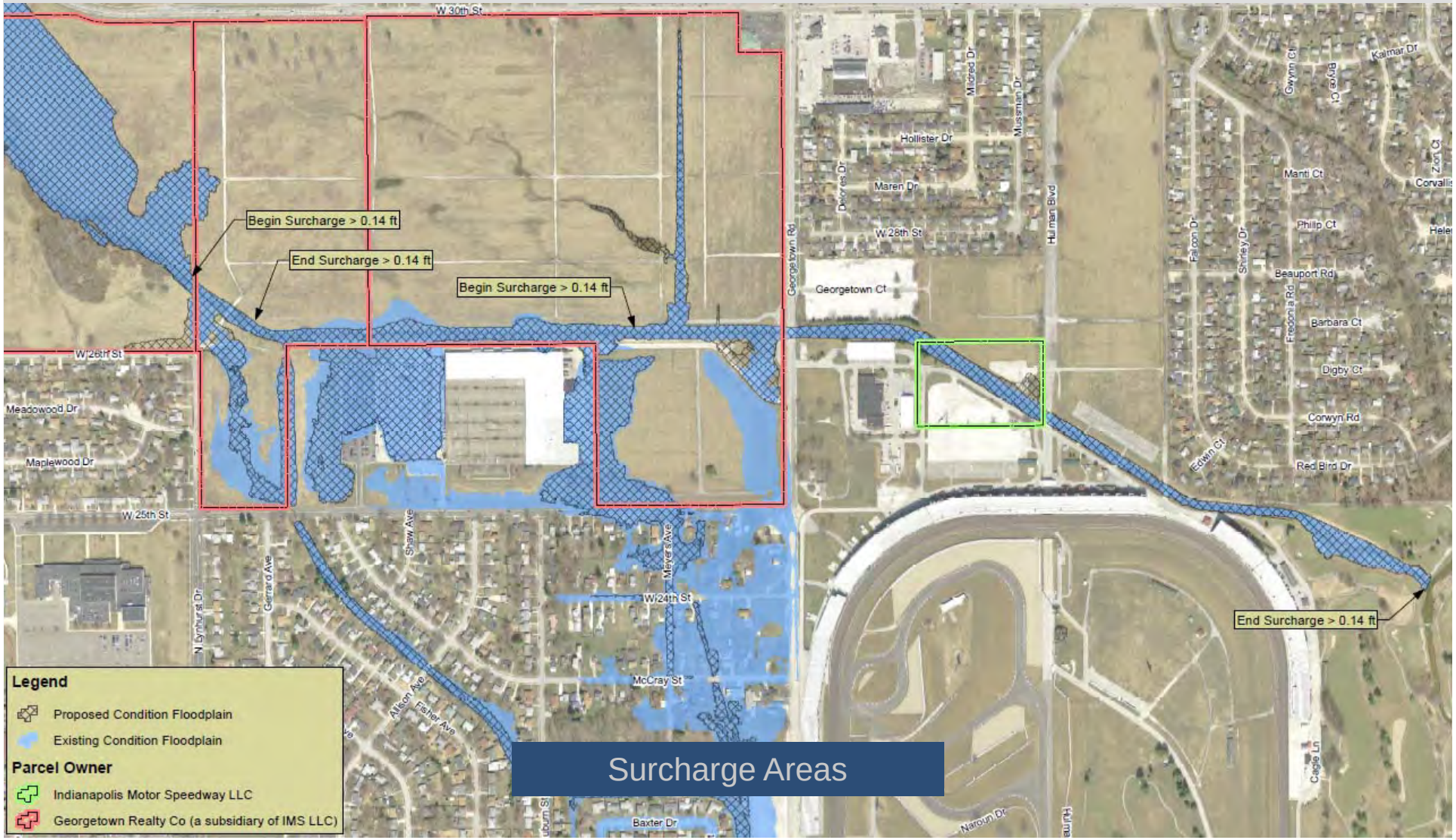


DESIGN: SURCHARGE DETERMINATION

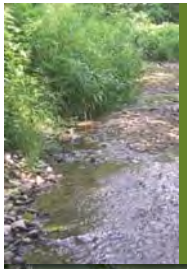
LOCATION DESCRIPTION		PUBLISHED OR EFFECTIVE DATA (Ft, NAVD) (N/A)	MODELING RESULTS				COMPARISONS			NOTES
Model Cross Section Station	Location Description		Duplicate Effective Model (ft, NAVD88)	Corrected Effective Model (ft, NAVD88)	Existing Conditions Model (ft, NAVD88)	Proposed Conditions Model (ft, NAVD88)	Cumulative Impacts w/o Project (6) - (5)	Cumulative Impacts with Project (7) – (5)	Project Impacts (7) – (6)	
1.218	Dry Run Div x			742.12	742.12	741.52	0.00	-0.60	-0.60	
1.197	Dry Run Div x			741.99	741.99	740.99	0.00	-1.00	-1.00	
1.169	Dry Run Div x			741.8	741.8	740.51	0.00	-1.29	-1.29	
1.146	Dry Run Div x			741.44	741.44	740.44	0.00	-1.00	-1.00	
1.145	Dry Run Div x			0	0	0	-	-	-	Lateral Structure
1.060	Dry Run Div x			740.68	740.68	739.9	0.00	-0.78	-0.78	
1.013	Dry Run Div x			740.12	740.12	739.71	0.00	-0.41	-0.41	
0.939	Dry Run Div x			739.48	739.48	739.45	0.00	-0.03	-0.03	
0.883	Dry Run Div x			739.13	739.13	739.32	0.00	0.19 *	0.19 X	
0.791	Dry Run Div x			738.65	738.65	739.1	0.00	0.45 *	0.45 X	Flood Easement Prepared
0.736	Dry Run Div x			738.31	738.31	738.74	0.00	0.43 *	0.43 X	Flood Easement Prepared
0.730	Dry Run Div x			0	0	0	-	-	-	Ped Bridge US of Georgetown Rd.
0.725	Dry Run Div x			738.05	738.05	738.71	0.00	0.66 *	0.66 X	Flood Easement Prepared
0.725	Dry Run Div x			737.83	737.83	738.45	0.00	0.62 *	0.62 X	Flood Easement Prepared
0.722	Dry Run Div x			0	0	0	-	-	-	Georgetown Rd. Bridge
0.704	Dry Run Div x			736.43	736.43	737.45	0.00	1.02 *	1.02 X	Surcharge contained within channel banks.
0.674	Dry Run Div x			736.23	736.23	737.27	0.00	1.04 *	1.04 X	Surcharge contained within channel banks.
0.604	Dry Run Div x			735.82	735.82	736.88	0.00	1.06 *	1.06 X	Surcharge contained within channel banks.
0.565	Dry Run Div x			735.67	735.67	736.74	0.00	1.07 *	1.07 X	Surcharge contained within channel banks.
0.491	Dry Run Div x			735.32	735.32	736.4	0.00	1.08 *	1.08 X	Flood Easement Prepared
0.448	Dry Run Div x			735.19	735.19	736.28	0.00	1.09 *	1.09 X	Flood Easement Prepared
0.437	Dry Run Div x			0	0	0	-	-	-	Hulman Blvd. Bridge
0.421	Dry Run Div x			733.78	733.78	734.64	0.00	0.86 *	0.86 X	Surcharge contained within channel banks.
0.397	Dry Run Div x			733.55	733.55	734.4	0.00	0.85 *	0.85 X	Surcharge contained within channel banks.
0.393	Dry Run Div x			0	0	0	-	-	-	Track Crossing #3 Bridge
0.388	Dry Run Div x			733.31	733.31	734.13	0.00	0.82 *	0.82 X	Surcharge contained within channel banks.
0.374	Dry Run Div x			732.96	732.96	733.8	0.00	0.84 *	0.84 X	Surcharge contained within channel banks.
0.354	Dry Run Div x			732.84	732.84	733.67	0.00	0.83 *	0.83 X	Surcharge contained within channel banks.
0.350	Dry Run Div x			0	0	0	-	-	-	Track Crossing #2 Bridge
0.344	Dry Run Div x			732.58	732.58	733.39	0.00	0.81 *	0.81 X	Surcharge contained within channel banks.
0.325	Dry Run Div x			731.73	731.73	732.53	0.00	0.80 *	0.80 X	Surcharge contained within channel banks.
0.305	Dry Run Div x			731.55	731.55	732.37	0.00	0.82 *	0.82 X	Surcharge contained within channel banks.
0.298	Dry Run Div x			0	0	0	-	-	-	Track Crossing #1 Bridge
0.286	Dry Run Div x			731.02	731.02	731.86	0.00	0.84 *	0.84 X	Surcharge contained within channel banks.
0.270	Dry Run Div x			729.67	729.67	730.51	0.00	0.84 *	0.84 X	Surcharge contained within channel banks.
0.203	Dry Run Div x			728.12	728.12	729	0.00	0.88 *	0.88 X	Surcharge contained within channel banks.
0.198	Dry Run Div x			0	0	0	-	-	-	Golf Course #2 Bridge
0.192	Dry Run Div x			727.77	727.77	728.63	0.00	0.86 *	0.86 X	Surcharge contained within channel banks.
0.158	Dry Run Div x			726.27	726.27	726.98	0.00	0.71 *	0.71 X	Surcharge contained within channel banks.
0.106	Dry Run Div x			725.75	725.75	726.48	0.00	0.73 *	0.73 X	Surcharge contained within channel banks.
0.074	Dry Run Div x			725.37	725.37	726.11	0.00	0.74 *	0.74 X	Surcharge contained within channel banks.
0.026	Dry Run Div x			723.59	723.59	724.35	0.00	0.76 *	0.76 X	Surcharge contained within channel banks.
0.012	Dry Run Div x			723.55	723.55	724.32	0.00	0.77 *	0.77 X	Surcharge contained within channel banks.
0.009	Dry Run Div x			0	0	0	-	-	-	Golf Course #1 Bridge
0.003	Dry Run Div x			722.54	722.54	723.16	0.00	0.62 *	0.62 X	Surcharge contained within channel banks.
0.003	Dry Run Div x			722.54	722.54	723.15	0.00	0.61 *	0.61 X	Surcharge contained within channel banks.

Project Evaluation Table
(Diversion Ditch Only)

PERMITTING: IDNR CONSTRUCTION IN A FLOODWAY



Surcharge Areas



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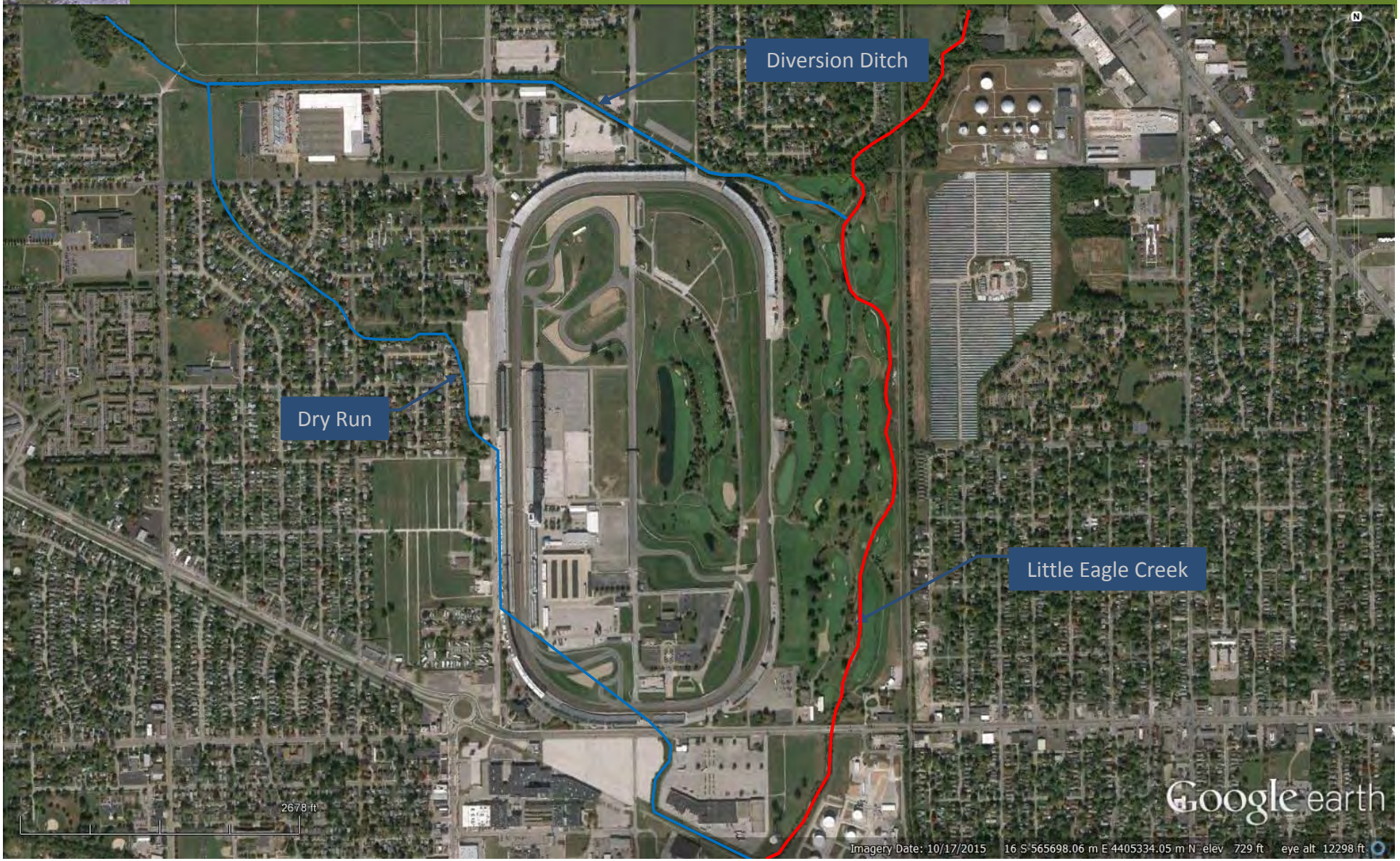
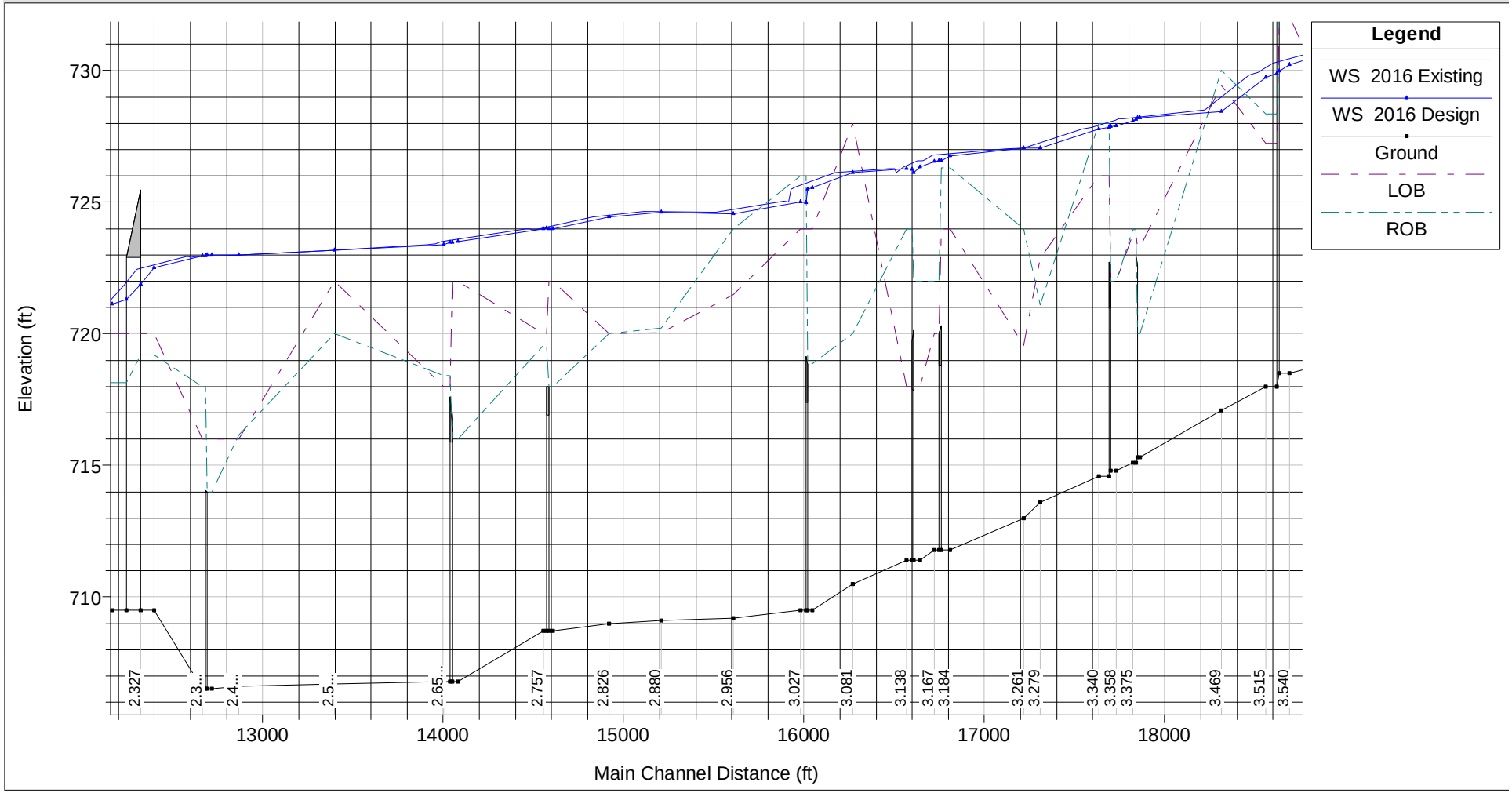


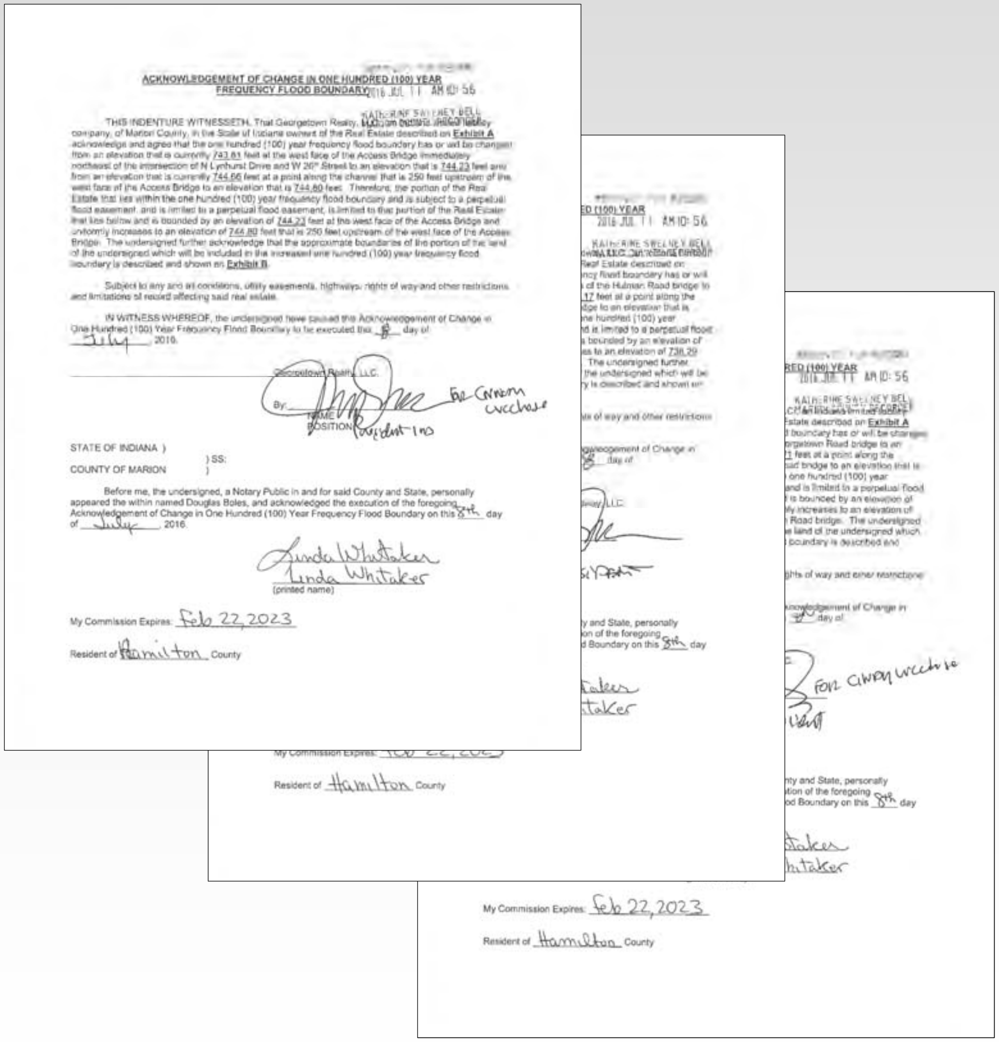
PERMITTING: IDNR CONSTRUCTION IN A FLOODWAY

- Evaluation of potential for increased flooding along Little Eagle Ck
  - Decreased WSE at the US end; increase WSE at the DS end (all under 0.04 ft)



PERMITTING: IDNR CONSTRUCTION IN A FLOODWAY

- Flood Easements Required
  - Where surcharges exceed 0.14 ft
  - Must have legal description and permanent flood easement recorded with property deed



ACKNOWLEDGEMENT OF CHANGE IN ONE HUNDRED (100) YEAR FREQUENCY FLOOD BOUNDARY

2016 JUL 11 AM 10: 56

KATHERINE SWEENEY BELL

THIS INDENTURE WITNESSETH, That Georgetown Realty, LLC, an Indiana limited liability company, of Marion County, in the State of Indiana owners of the Real Estate described on **Exhibit A** acknowledge and agree that the one hundred (100) year frequency flood boundary has or will be changed from an elevation that is currently 743.81 feet at the west face of the Access Bridge immediately northeast of the intersection of N Lynhurst Drive and W 26th Street to an elevation that is 744.23 feet and from an elevation that is currently 744.66 feet at a point along the channel that is 250 feet upstream of the west face of the Access Bridge to an elevation that is 744.80 feet. Therefore, the portion of the Real Estate that lies within the one hundred (100) year frequency flood boundary and is subject to a perpetual flood easement, and is limited to a perpetual flood easement, is limited to that portion of the Real Estate that lies below and is bounded by an elevation of 744.23 feet at the west face of the Access Bridge and uniformly increases to an elevation of 744.80 feet that is 250 feet upstream of the west face of the Access Bridge. The undersigned further acknowledge that the approximate boundaries of the portion of the land of the undersigned which will be included in the increased one hundred (100) year frequency flood boundary is described and shown on **Exhibit B**.

Subject to any and all conditions, utility easements, highways, rights of way and other restrictions and limitations of record affecting said real estate.

IN WITNESS WHEREOF, the undersigned have caused this Acknowledgement of Change in One Hundred (100) Year Frequency Flood Boundary to be executed this 8 day of July, 2016.

Georgetown Realty, LLC

By: ______

NAME

POSITION President Inc

STATE OF INDIANA)
) SS:
COUNTY OF MARION)

Before me, the undersigned, a Notary Public in and for said County and State, personally appeared the within named Douglas Boles, and acknowledged the execution of the foregoing Acknowledgement of Change in One Hundred (100) Year Frequency Flood Boundary on this 8th day of July, 2016.

Linda Whitaker
Linda Whitaker
(printed name)

My Commission Expires: Feb 22, 2023

Resident of Hamilton County

Flood Easements

PERMITTING: IDNR CONSTRUCTION IN A FLOODWAY

- Flood Control Project
  - Property must be owned or guaranteed the ability to be maintained
  - Typically only relevant for municipalities or other governmental bodies
- Floodway Regulation
  - Unsteady-state modeling & floodway issues
  - City of Indianapolis must regulate floodway according to revised project prior to LOMR

Floodway regulation

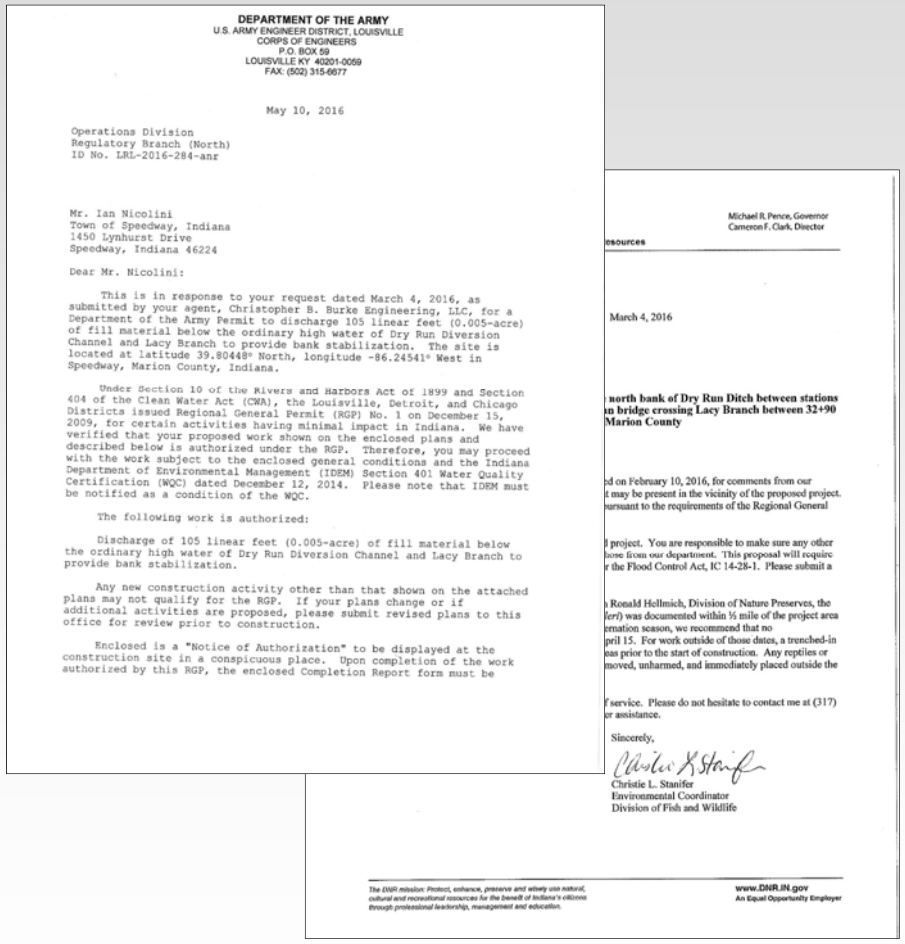
PERMITTING: IDEM 401 / USACE 404 PERMIT

Thamnophis butleri
(Butler’s garter snake)

PERMITTING: IDEM 401 / USACE 404 PERMIT

- USACE Section 404 & IDEM Section 401
  - Very limited disturbance below OHWM
  - Regional General Permit (RGP)

- Implications of ETR Determination
  - Presence of garter snake in 1927 imposes time constraints on construction
  - No digging/excavation from Oct 1 – Apr 15
  - For work outside of those dates, additional trenched-in silt fence is required



DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE KY 40201-0059
FAX: (502) 315-6677

May 10, 2016

Operations Division
Regulatory Branch (North)
ID No. LRL-2016-284-anr

Mr. Ian Nicolini
Town of Speedway, Indiana
1450 Lynhurst Drive
Speedway, Indiana 46224

Dear Mr. Nicolini:

This is in response to your request dated March 4, 2016, as submitted by your agent, Christopher B. Burke Engineering, LLC, for a Department of the Army Permit to discharge 105 linear feet (0.005-acre) of fill material below the ordinary high water of Dry Run Diversion Channel and Lacy Branch to provide bank stabilization. The site is located at latitude 39.80448° North, longitude -86.24541° West in Speedway, Marion County, Indiana.

Under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act (CWA), the Louisville, Detroit, and Chicago Districts issued Regional General Permit (RGP) No. 1 on December 15, 2009, for certain activities having minimal impact in Indiana. We have verified that your proposed work shown on the enclosed plans and described below is authorized under the RGP. Therefore, you may proceed with the work subject to the enclosed general conditions and the Indiana Department of Environmental Management (IDEM) Section 401 Water Quality Certification (WQC) dated December 12, 2014. Please note that IDEM must be notified as a condition of the WQC.

The following work is authorized:

Discharge of 105 linear feet (0.005-acre) of fill material below the ordinary high water of Dry Run Diversion Channel and Lacy Branch to provide bank stabilization.

Any new construction activity other than that shown on the attached plans may not qualify for the RGP. If your plans change or if additional activities are proposed, please submit revised plans to this office for review prior to construction.

Enclosed is a "Notice of Authorization" to be displayed at the construction site in a conspicuous place. Upon completion of the work authorized by this RGP, the enclosed Completion Report form must be

Michael R. Pence, Governor
Cameron F. Clark, Director

esources

March 4, 2016

north bank of Dry Run Ditch between stations
n bridge crossing Lacy Branch between 32+90
Marion County

d on February 10, 2016, for comments from our
t may be present in the vicinity of the proposed project.
ursuant to the requirements of the Regional General

l project. You are responsible to make sure any other
hose from our department. This proposal will require
r the Flood Control Act, IC 14-28-1. Please submit a

Ronald Hellmich, Division of Nature Preserves, the
ferl) was documented within ½ mile of the project area
ernation season, we recommend that no
pril 15. For work outside of those dates, a trenched-in
eas prior to the start of construction. Any reptiles or
moved, unharmed, and immediately placed outside the

service. Please do not hesitate to contact me at (317)
r assistance.

Sincerely,

Christie L. Stanifer
Environmental Coordinator
Division of Fish and Wildlife

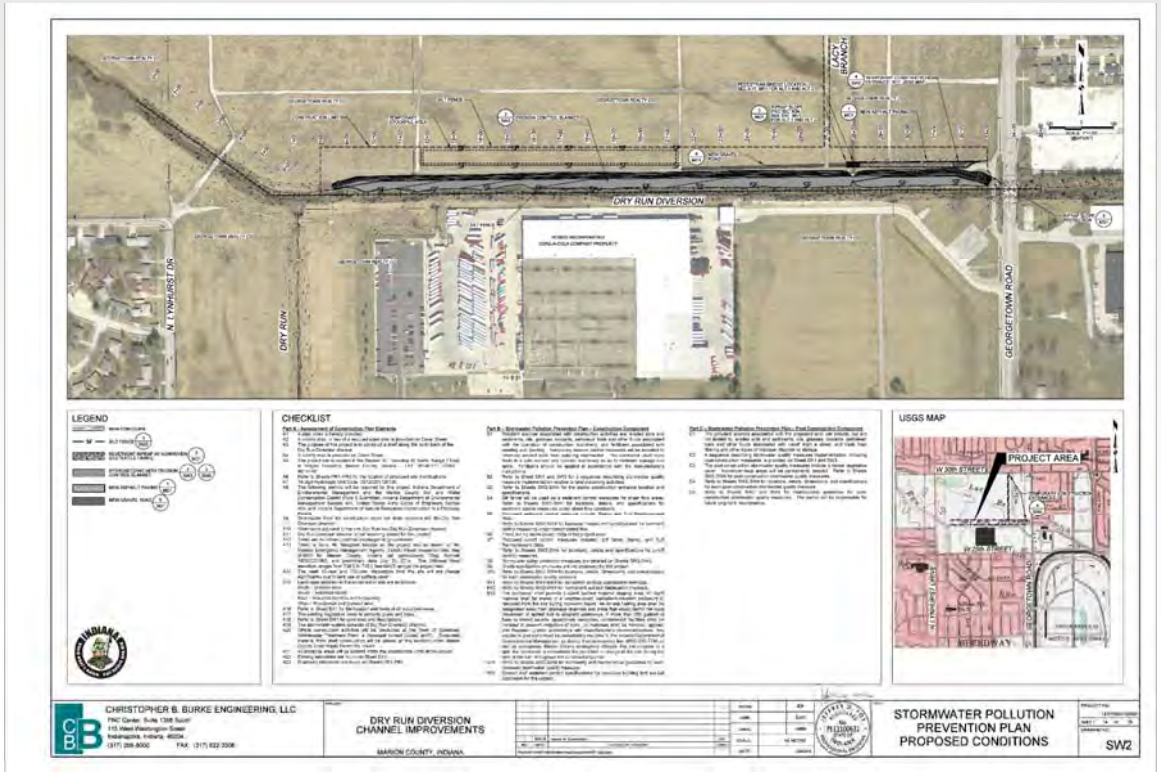
The DNR mission: Protect, enhance, preserve and wisely use natural, cultural and recreational resources for the benefit of Indiana's citizens through professional leadership, management and education.

www.DNR.IN.gov
An Equal Opportunity Employer

USACE RGP Approval & ETR Letter

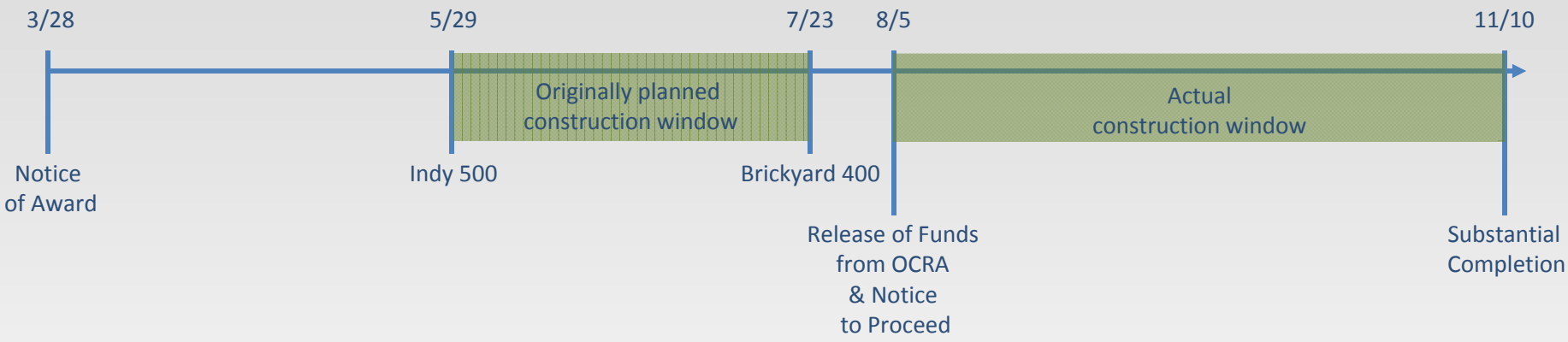
PERMITTING: IDEM RULE 5

- IDEM Rule 5
  - No extraordinary circumstances
  - Inclusion of spoil stockpile area
- Erosion Control Measures
  - ECB, TRM, silt fence, riprap
  - Silt fence can be tricky in channels



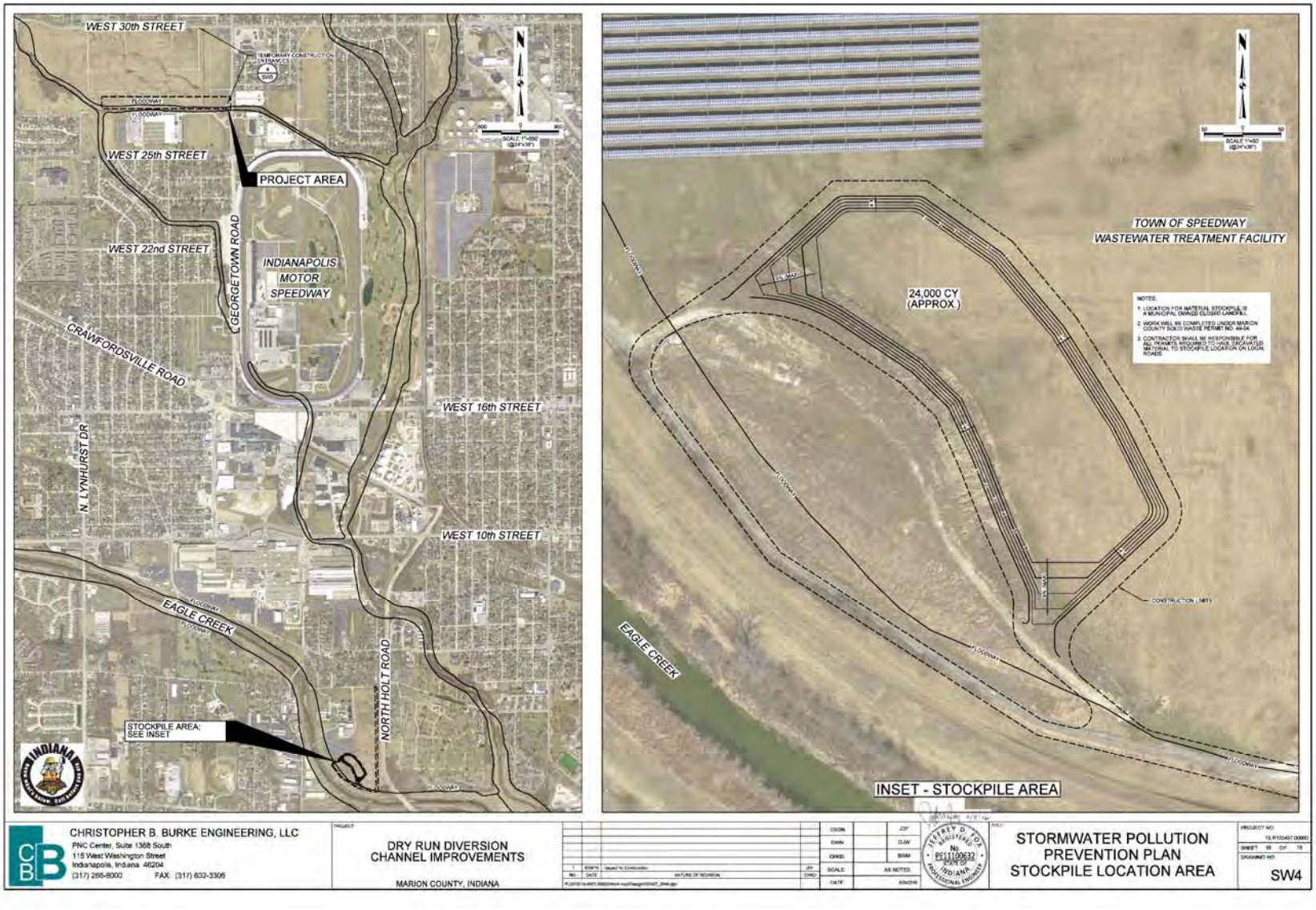
Silt fence installation

CONSTRUCTION: TIMELINE



- Project Delays:
  - IDNR Construction in a Floodway Permit
  - Execution & recording of flood easements
  - Release of OCRA funds

CONSTRUCTION: SPOIL STOCKPILE SITE

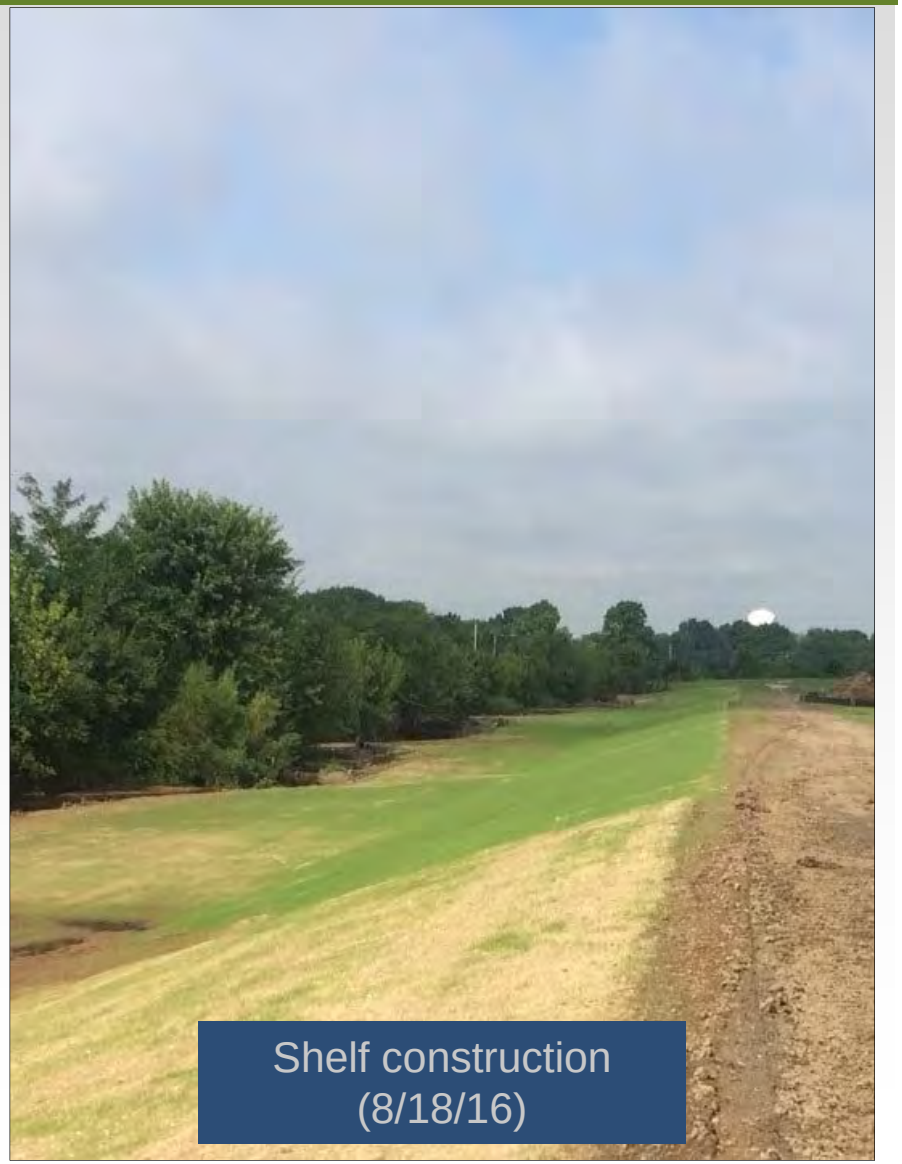


CONSTRUCTION: GROUNDWATER ISSUES

- Groundwater issues:
  - Above average rainfall during construction period
  - Depression of groundwater table by shelf excavation

CONSTRUCTION: ESTABLISHING VEGETATION

Shelf construction
(8/11/16)



Shelf construction
(8/18/16)

CONSTRUCTION: ESTABLISHING VEGETATION

Shelf construction
(8/16/16)

CONSTRUCTION: ESTABLISHING VEGETATION

Shelf construction
(8/25/16)

CONSTRUCTION: CURENT PROGRESS

CONSTRUCTION: CURENT PROGRESS

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