Geo3T2

GEOTECHNICAL CASE HISTORY

GROUND IMPROVEMENT TEST SECTION AND GROUND IMPROVEMENTS FOR DOWNTOWN CROSSING SECTION 1

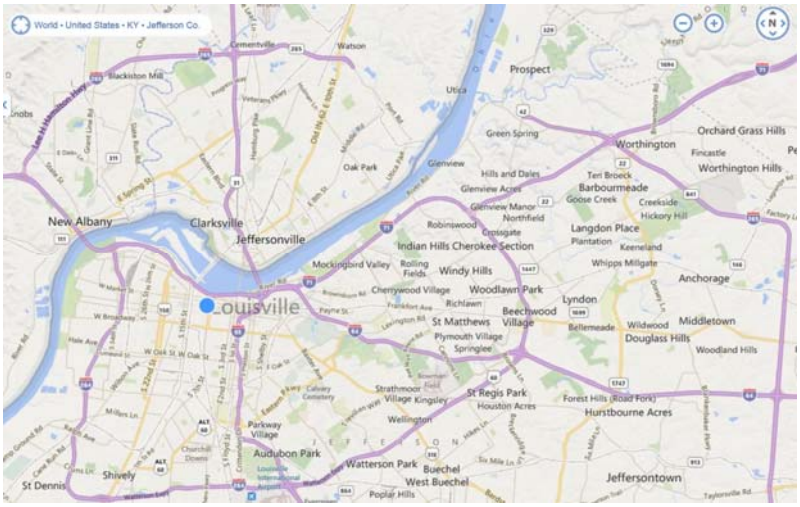
Louisville-Southern Indiana Ohio River Bridges

April 9, 2015

Michael K. Minton, P.E. HBI and John E. Reinfurt, P.E. Jacobs

Geo3T2 April 9-10, 2015

THE OHIO RIVER BRIDGES PROJECT



JACOBS THINK SAFE HAYWARD BAKER Geotechnical Construction

2

THE OHIO RIVER BRIDGES PROJECT

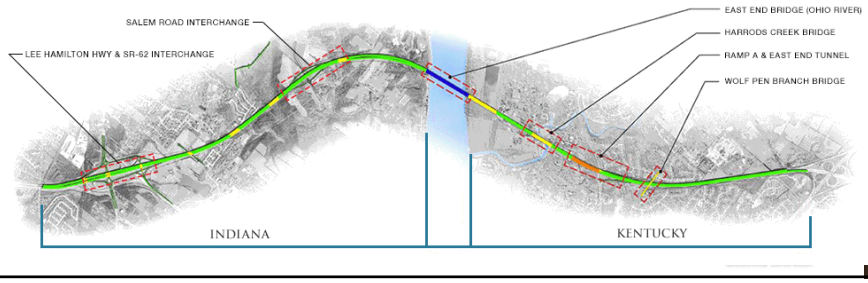
- Originally Conceived as 1 Mega Project with 2 bridge crossings
- For financial and political reasons, split into 2 separate procurements
- Downtown Crossing procured through traditional design/build by KTYC
- East End Connector procured through public/private partnership arrangement through IFA and WVB Partners
- WVB Partners to own and operate the EEC bridge and approaches for 35 years before turnover to IFA

JACOBS THINK SAFE HAYWARD BAKER Geotechnical Construction 3

Project Overview
East End Crossing

Location Map
East End Connector

- Extend I-265 to the bridge on both the Kentucky and Indiana approach
  - Kentucky approach: 1.4 mile extension
  - Indiana Approach: 4 mile extension



Project Overview
Downtown Crossing

The Downtown Pursuit Interchange Reconstruction – 41 Embankments

7

GEOTECHNICAL INVESTIGATIONS

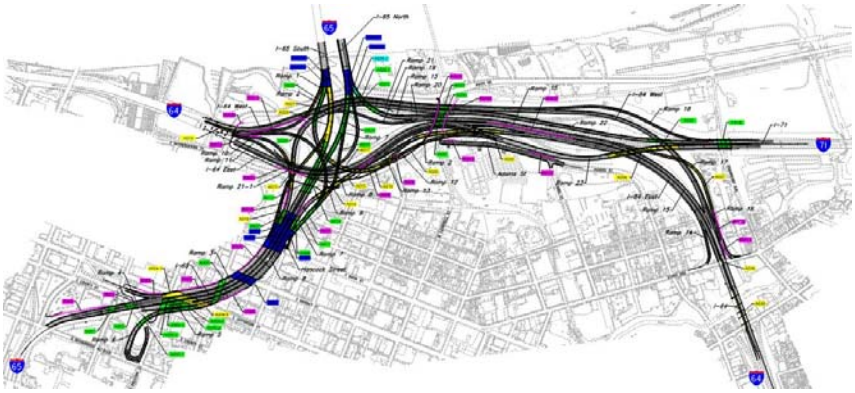
- Pre 2012 – KYTC Consultants drilled 363 borings and prepared 95 Geotechnical Reports
- Pre 2012 – No gINT Database
- Post Award - Walsh DBT drilled 109 borings and pushed 45 CPTS
- Post Award – HBI prepared gINT Database of all geotechnical data and shared with the Design Team

8

GEOTECHNICAL INVESTIGATIONS

- **Post Award – 25 Geotechnical MSE Reports/Plans, 37 Geotechnical Bridge Reports, 9 Ground Improvement Plans/Geotechnical Reports and 7 Ramp/Embankment Geotechnical Reports**
- **Post Award – HBI prepares 30 Shop Drawing packages**

JACOBS PRE-BID EFFORT



JACOBS PRE-BID EFFORT

Section 1 Retaining Walls
Settlement Data and Potential Ground Improvements

Retaining Wall #	Wall Height (ft)	Total Settlement (in)	Settlement Time (days) (w/o improvements)	Potential Environmental Area	Potential Ground Improvement
1	25	2	170	No	Stone Columns
2	15	6	90	No	Stone Columns
3	26	4	60	Yes	Grouted Stone Columns
4	28	7	45	No	Stone Columns
5	26	6	120	No	Stone Columns
6	38	9	190	No	Stone Columns
7	19	3	350	No	Stone Columns
8	13	13	1095	Yes	Controlled Modulus Columns
9	23	10	180	Yes	Controlled Modulus Columns
10	25	5	30	Yes	Grouted Stone Columns
11	17	5	80	No	Stone Columns
12	7	5	100	No	Stone Columns
13	9	5	30	No	Stone Columns
14	25	5	60	Yes	Grouted Stone Columns
16	10	5	180	No	Stone Columns
19	12	3	290	No	Controlled Modulus Columns
20	9	6	400	No	Stone Columns
21	10	7	1825	No	Stone Columns
22	15	6	200	No	Stone Columns
23	30	10	35	Yes	Grouted Stone Columns
24	29	10	35	No	Stone Columns

Section 1 Embankments
Settlement Data and Potential Ground Improvements

Ramp	Max. Fill Height (ft)	Total Settlement (in)	Settlement Time (days) (w/o improvements)	Potential Environmental Area	Potential Ground Improvement
1	33	6	1300	No	Stone Columns
2	30	8	850	No	Stone Columns
8	20	5	225	Yes	Grouted Stone Columns
9	35	22	3300	No	Stone Columns
10	19	8	1050	No	Stone Columns
11	32	12	1200	No	Stone Columns
12/13	26	6	160	Yes	Grouted Stone Columns
15	20	5	150	No	Stone Columns
17	32	6	150	No	Stone Columns
19	19	7	1300	Yes	Grouted Stone Columns
21	23	6	900	No	Stone Columns

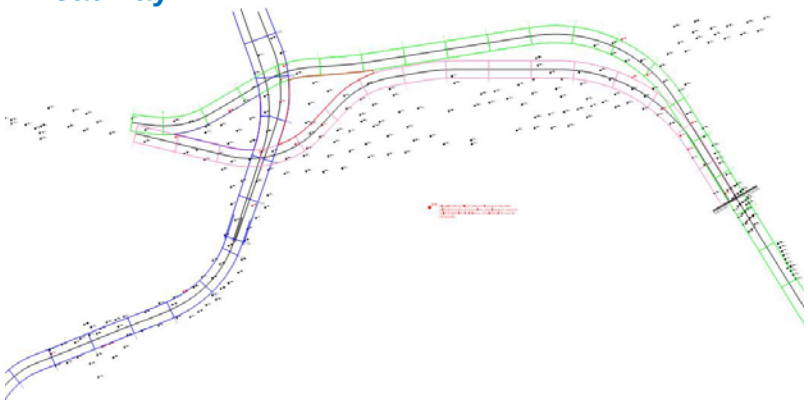
THINK SAFE

HAYWARD BAKER

11

HBI PRE-BID EFFORT

- **HBI reduced available geotechnical data into average subsurface profiles for every 500 feet of roadway.**



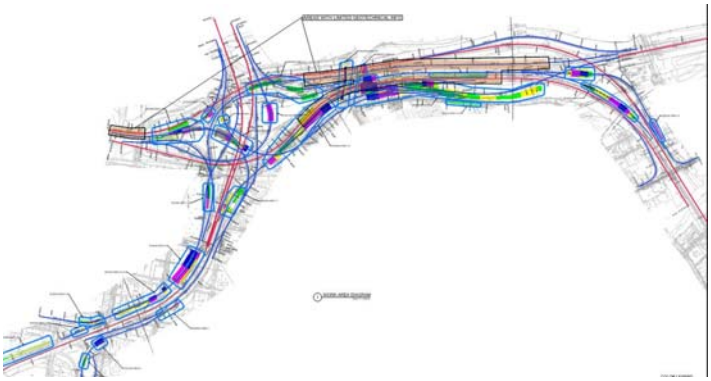
THINK SAFE

HAYWARD BAKER

12

HBI PRE-BID EFFORT

- Based on available roadway geometry plans, grading plans, and average profiles - HBI determined a rough ground improvement scope.



POST AWARD - GROUND IMPROVEMENT DESIGN AND CONSTRUCTION PROCESS

- Stantec - Site Characterization
- Jacobs – Define deficiencies, specify criteria, prepare plans and specs, and define deficient areas
- HBI – Design ground improvement elements (spacing, size, depth and areal extent) and prepare shop drawings
- Jacobs/HBI – jointly agree on design parameters, areal extent, and selection of treatment

GROUND IMPROVEMENT PERFORMANCE CRITERIA

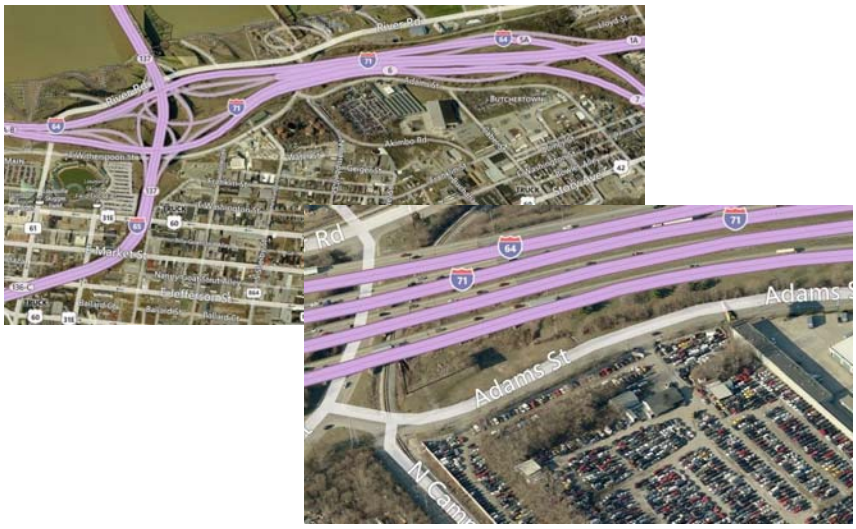
- Pavement installation can't proceed until settlement is less than ¼" for 3 consecutive weeks
- Total Settlement After Paving < 1"
- Maximum long-term settlement at MSE walls < 1"
- Angular distortion of paved areas < 1:500
- Areas deficient for global/external stability – meet KYTC/AASHTO minimum requirements

QA/QC – "How do we know your system will work?"

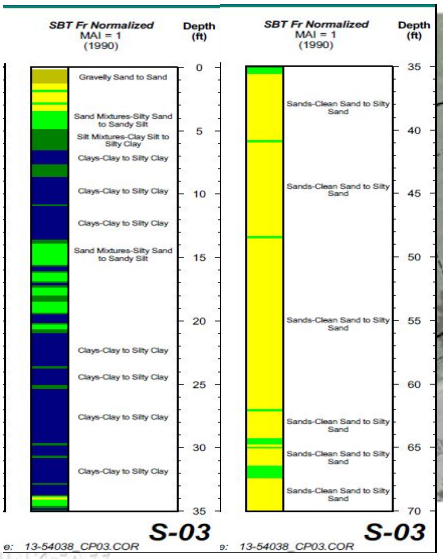
PRE-PRODUCTION TEST EMBANKMENT

- The plan: Simulate "Full Scale" loading conditions for the project
- Overall purpose of test embankment is a comprehensive validation of HBI design and construction procedures
- Test embankment will occur before any production work
- 6 more production sections will be instrumented and monitored during the project

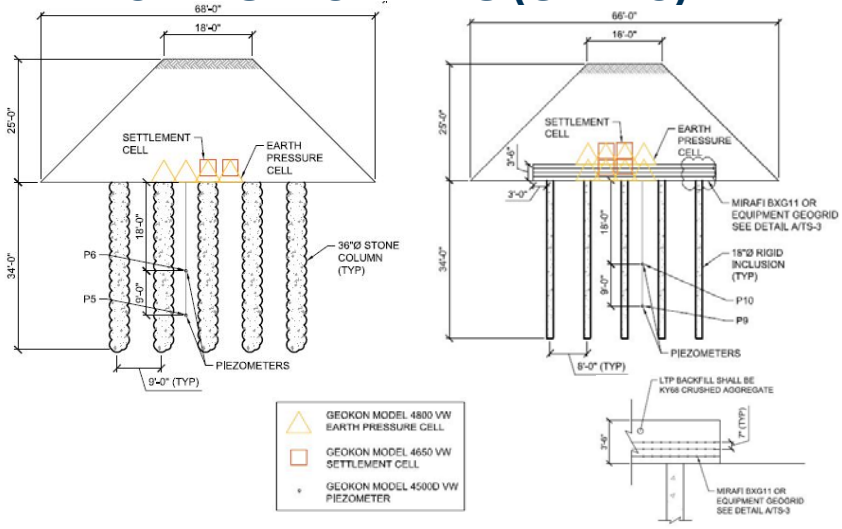
TEST EMBANKMENT - LOCATION



TEST EMBANKMENT CPTU PLAN



TEST EMBANKMENT AND SELECTION OF INSTRUMENTS (GETEC)



19

TEST EMBANKMENT – LAYOUT

20

TEST EMBANKMENT – IMPLEMENTATION

TEST EMBANKMENT – IMPLEMENTATION

TEST EMBANKMENT – IMPLEMENTATION

THINK SAFE

HAYWARD BAKER

23

TEST EMBANKMENT – IMPLEMENTATION

THINK SAFE

HAYWARD BAKER

24

TEST EMBANKMENT – IMPLEMENTATION

TEST EMBANKMENT – IMPLEMENTATION

DATA COLLECTION BOX

THINK SAFE

HAYWARD BAKER

27

BUILDING THE EMBANKMENT

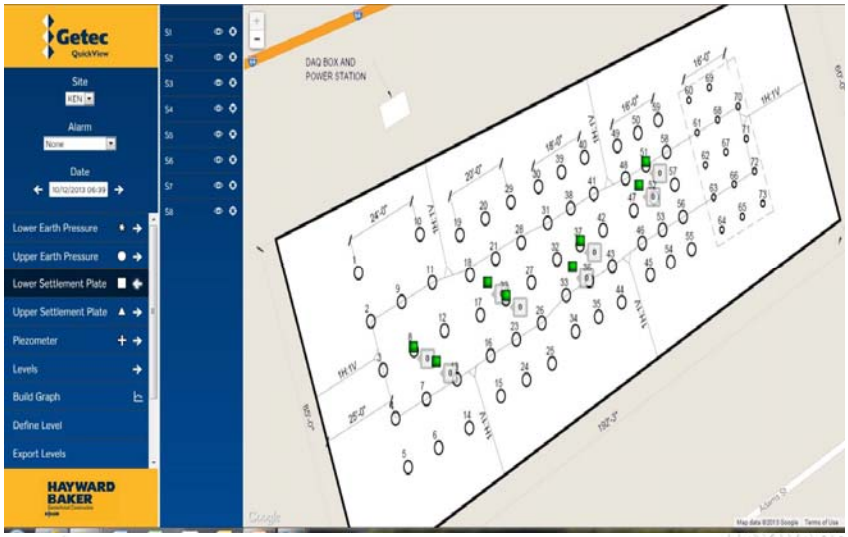
THINK SAFE

HAYWARD BAKER

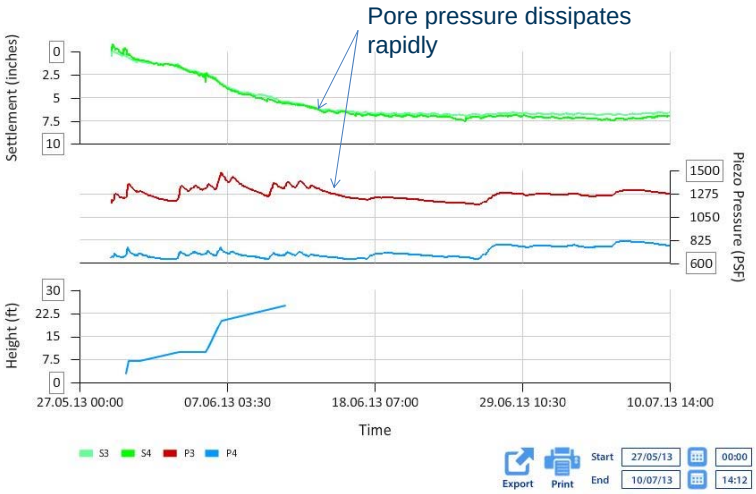
28

TEST EMBANKMENT COMPETE!!

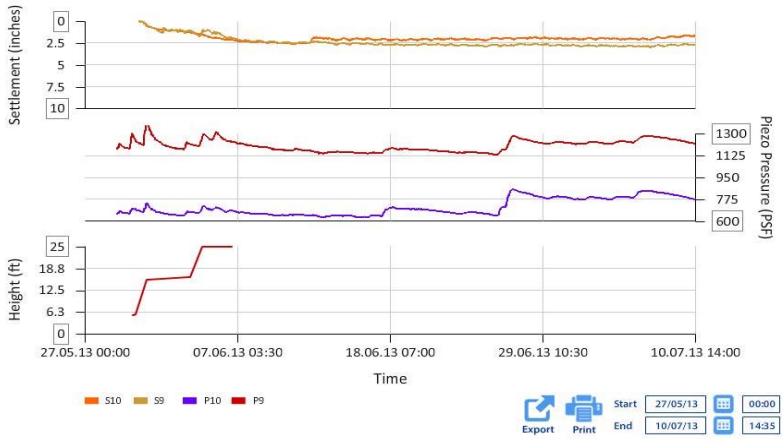
TEST EMBANKMENT – MONITORING WEBSITE



KEY FINDINGS



KEY FINDINGS



RI's effective at limiting total settlement

KEY FINDINGS

Cell	Element Spacing	Predicted Pre-Treatment Settlement	Predicted Post-Treatment Settlement	Observed Settlement from Instruments	% Diff Predicted/ Observed
12 x 12 SC	12' Square	9.32"	6.88"	6.13"	-11%
10 x 10 SC	10' Square	9.56"	6.56"	6.97"	+6%
9 x 9 SC	9' Square	11.99"	7.02"	5.99"	-14%
8 x 8 SC	8' Square	10.71"	5.91"	6.93"	+17%
8 x 8 RI	8' Square	11.80"	2.26"	2.40"	+6%

THINK SAFE

HAYWARD BAKER

33

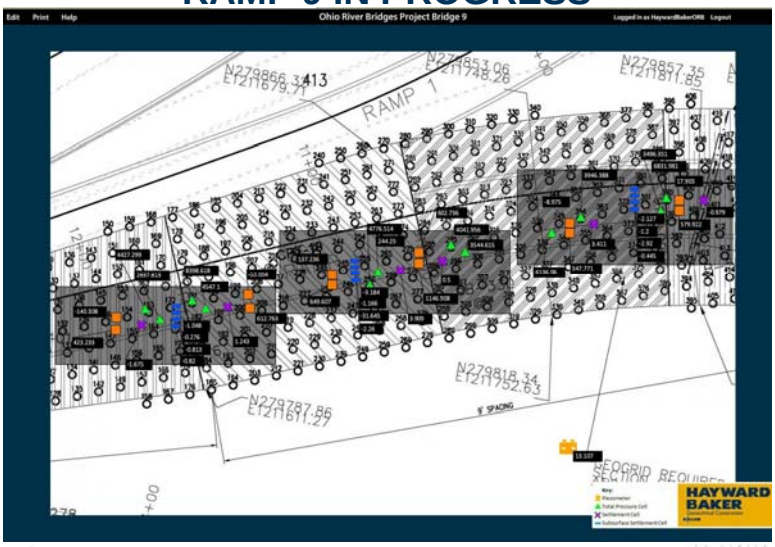
PROJECT ONGOING – INSTRUMENTATION AT RAMP 9 IN PROGRESS

THINK SAFE

HAYWARD BAKER

34

PROJECT ONGOING – INSTRUMENTATION AT RAMP 9 IN PROGRESS



PROJECT ONGOING - TIGHT WORKING QUARTERS

PROJECT ONGOING – SCHEDULED COMPLETION OF MAY 2016

PROJECT ONGOING – SCHEDULED COMPLETION OF MAY 2016