



**SR 19 OVER LITTLE LAKE HARRIS
BRIDGE I 10026 SUBSTRUCTURE REPAIR
LAKE COUNTY, FL**

PREPARED BY:

**ALBERT NEUMANN E.I.
PROJECT MANAGER**

FLORIDA DEPARTMENT OF TRANSPORTATION, DISTRICT 5

**DAVID THOMPSON P.E.
ENGINEER OF RECORD**

KISINGER CAMPO & ASSOCIATES CORP.

**AMR SALLAM, PH.D., P.E.
GEOTECHNICAL SERVICES DIRECTOR**

NODARSE & ASSOCIATES

Little Lake Harris Bridge



Bridge Location Map



Bridge Location Map



Bridge History

- SR 19 over Little Lake Harris construction was completed in 1951
- In the late 1980's slight settlement was noted in several bents.
- In 1990, the FDOT initiated annual survey of deck elevations during bridge inspections to monitor settlement of the bridge.

Bridge Information

The bridge is 3,130' long and has a width of 36'-2" to facilitate 2 lanes of traffic

- Bridge is comprised of 78 concrete spans
- Spans are constructed of Steel I-Beams 40' or 50' in length.
- Each span is supported by concrete pile bents.
- Each bent is made up of 18" square precast pilings

Areas of Settlement

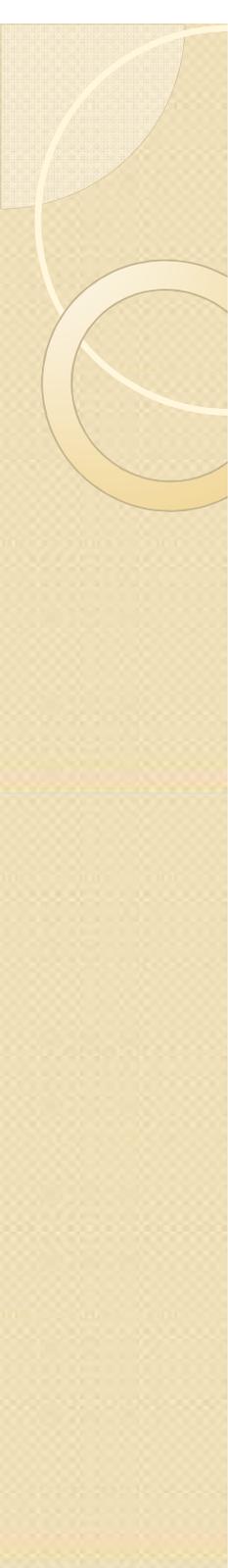


Areas of Settlement



Initial Project Information

- Settlement was noted to be gradual
- Due to the slow nature of the settlement substructure stability was not a major concern. However public concern over the settlement and increasing rough ride was noticed though complaints to the locals, state representatives and the department.
- Bridge was studied for replacement with a future widening project however initial estimate was over \$53,000,000 due to length of structure.
- Funding for the replacement project was unavailable in the department's 20 year work program.
- FDOT District 5 tasked KCA to provide a design for crutch bent remediation of the settled areas.



INITIAL BRIDGE REPAIR DESIGN

DAVID THOMPSON P.E.

STRUCTURES CHIEF DESIGN ENGINEER

KISINGER CAMPO & ASSOCIATES CORP.

Initial Design

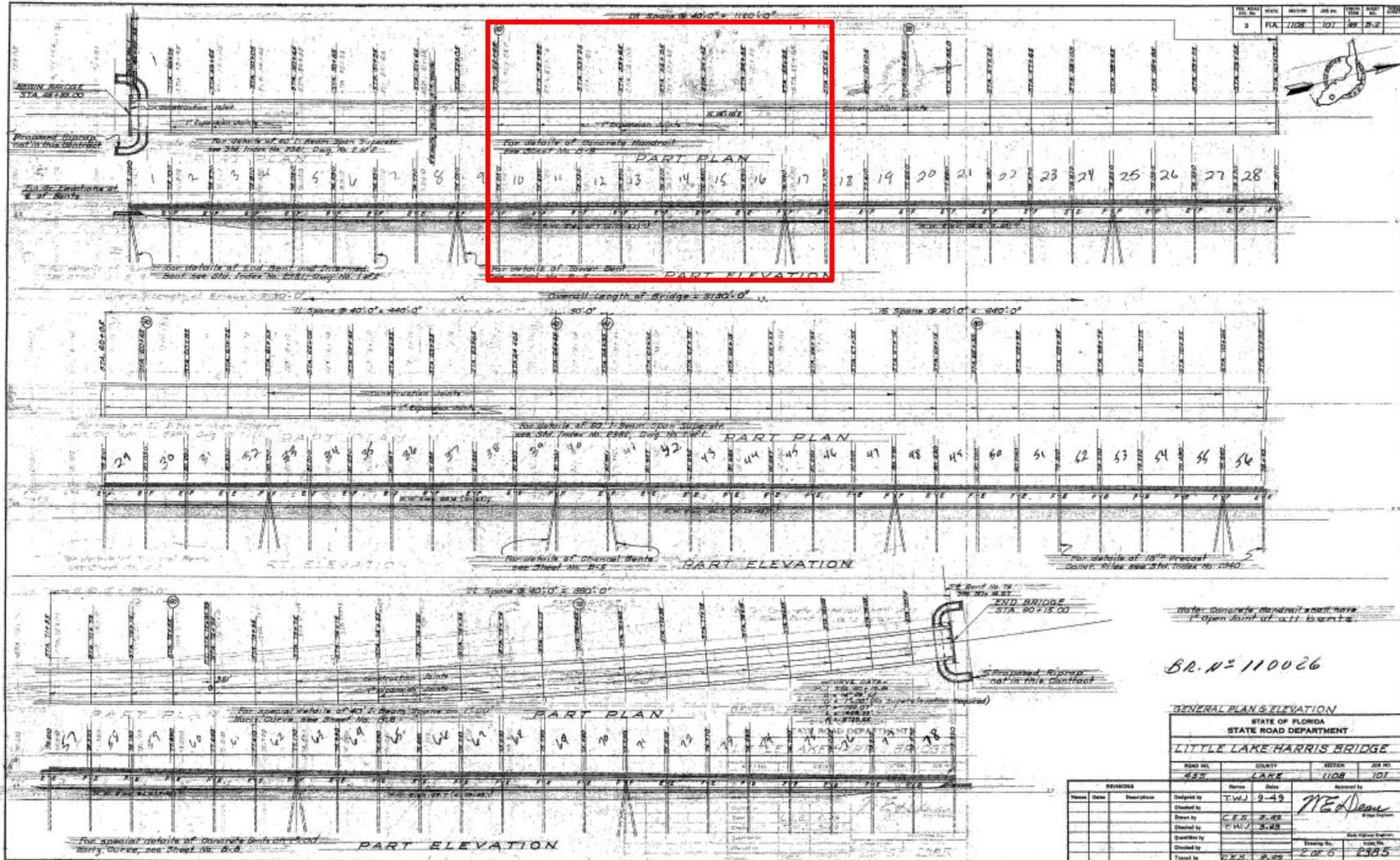
- FDOT District 5 contracted Kisinger Campo & Associates Corp. (**KCA**) to provide a repair design to correct the dips in the riding surface and prevent future settlement
- **KCA** had proposed providing “helper bents” at the areas of settlement and returning the bridge to its original elevation

Original Profile

FPN 424477-1-52-01 BX1-6

FPN 424477-1-52-01 BX1-6

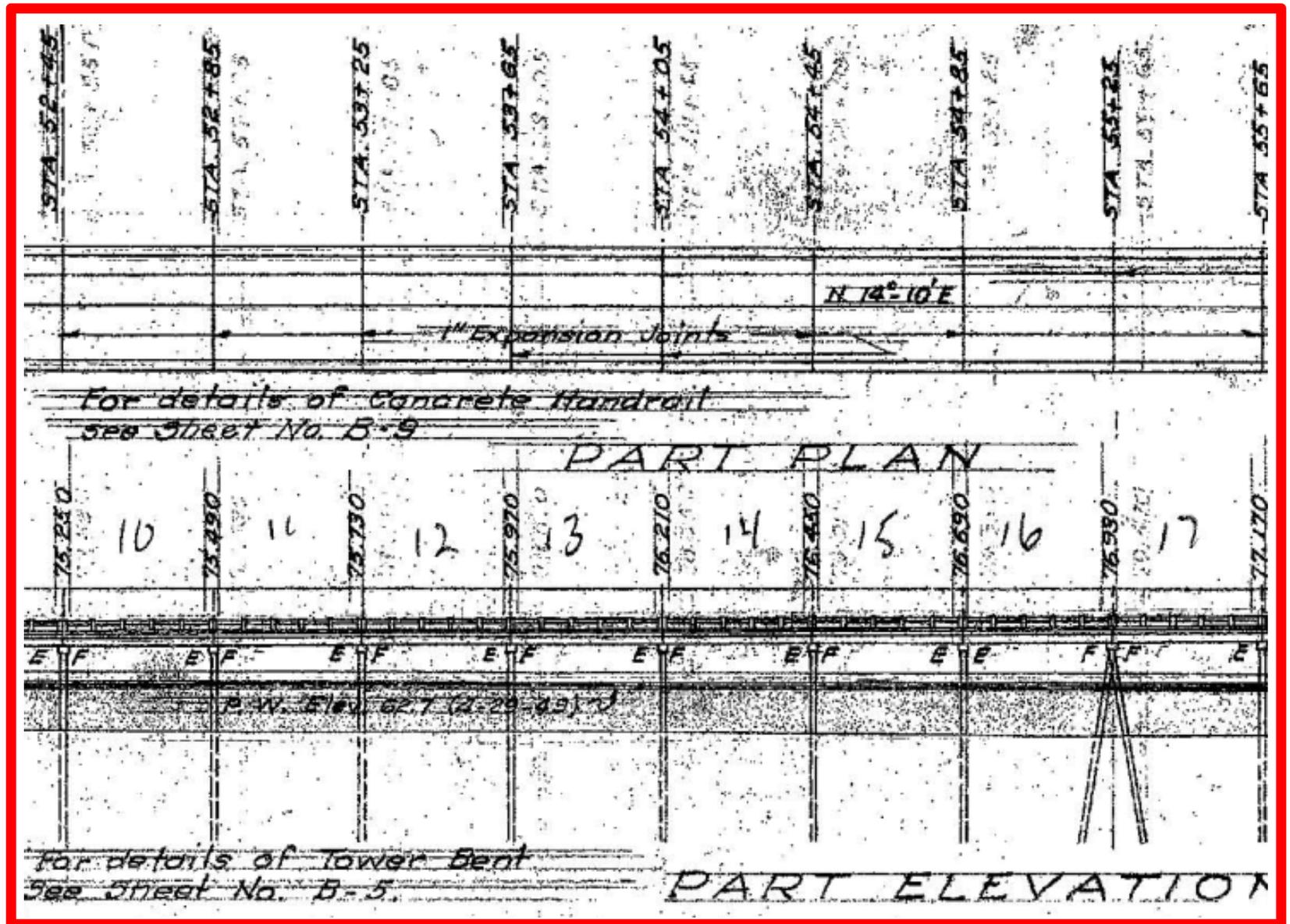
EXISTING PLANS



FPN 424477-1-52-01 BX1-6

FPN 424477-1-52-01 BX1-6

Original Profile (Detail)



Survey Data Tables

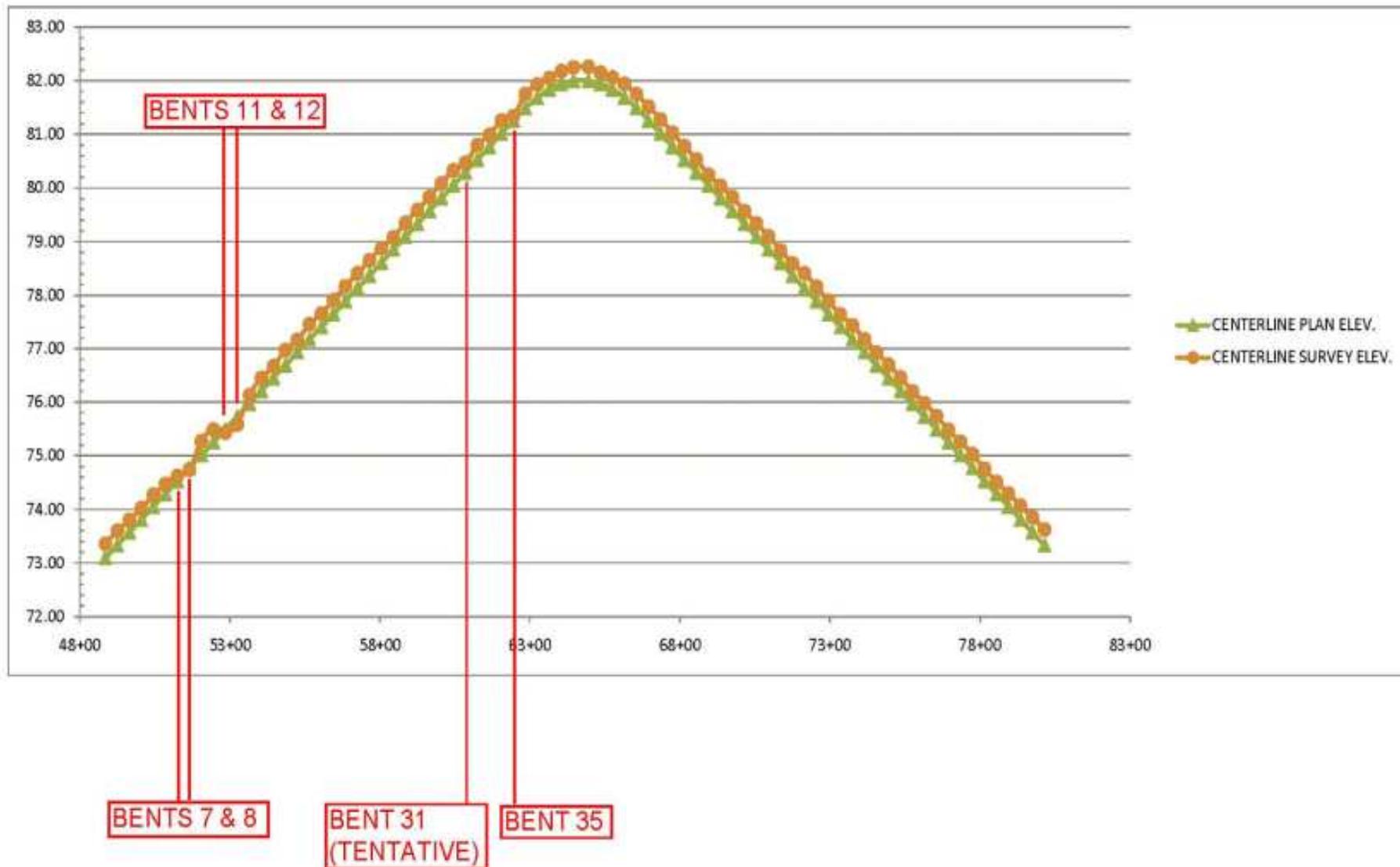
Little Lake Harris FPN 424477-1-52-01
 Survey Data
 From Echezabal & Associates

BY: SLC
 DATE: 10/8/2009

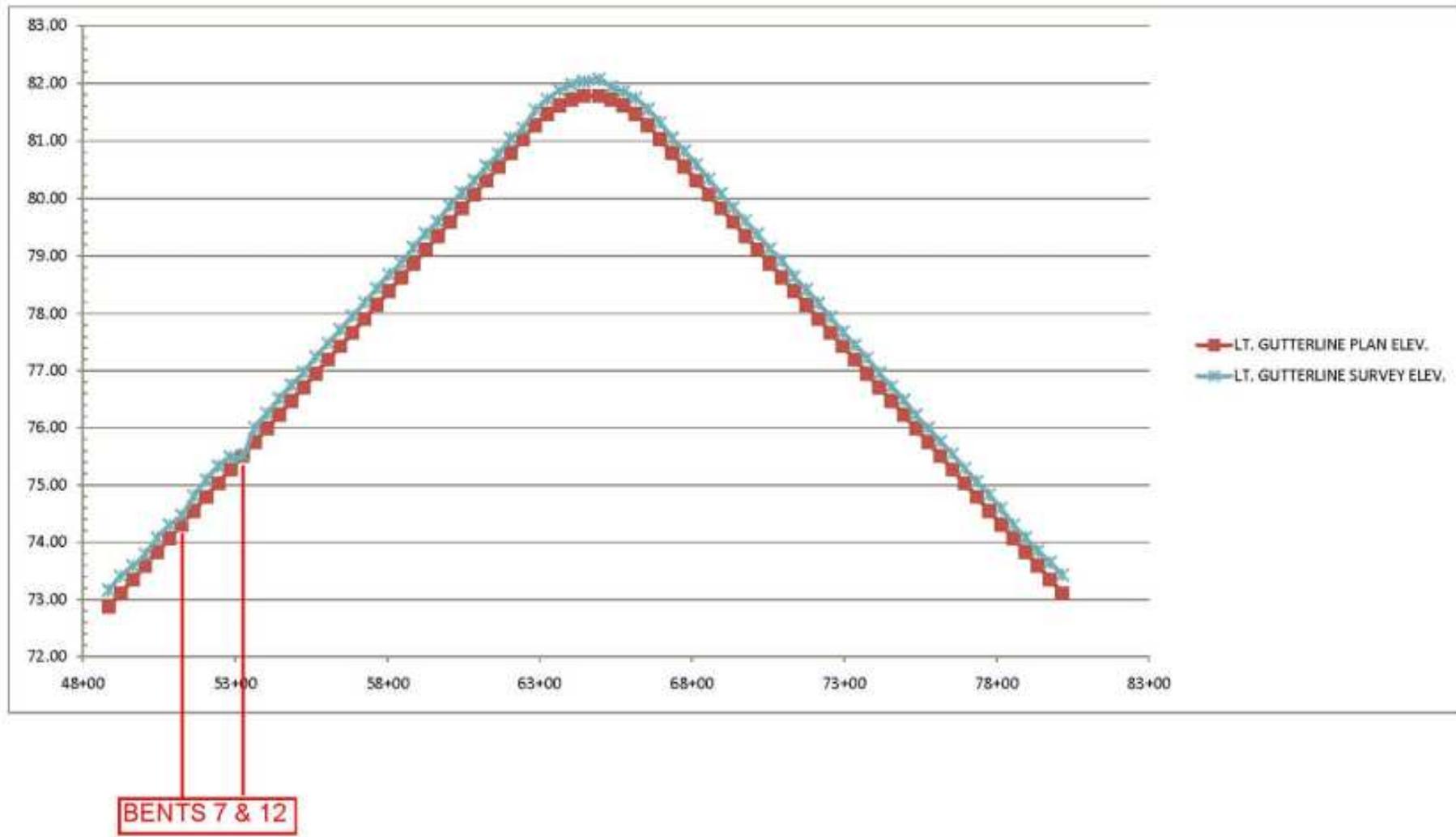
L/R Gutterline Offset from CL: 14 ft.
 Normal Crown Cross-Slope: -0.015625 (negative to L & R relative to CL)

Bent No.	STATION	L.T. GUTTERLINE PLAN ELEV.	CENTERLINE PLAN ELEV.	RT. GUTTERLINE PLAN ELEV.	L.T. GUTTERLINE SURVEY ELEV.	CENTERLINE SURVEY ELEV.	RT. GUTTERLINE SURVEY ELEV.
1	48+85	72.87	73.09	72.87	73.16	73.36	73.17
2	49+25	73.11	73.33	73.11	73.41	73.60	73.37
3	49+65	73.35	73.57	73.35	73.59	73.80	73.59
4	50+05	73.59	73.81	73.59	73.79	74.02	73.85
5	50+45	73.83	74.05	73.83	74.08	74.27	74.08
6	50+85	74.07	74.29	74.07	74.30	74.47	74.23
7	51+25	74.31	74.53	74.31	74.47	74.62	74.33
8	51+65	74.55	74.77	74.55	74.81	74.74	74.32
9	52+05	74.79	75.01	74.79	75.09	75.27	74.97
10	52+45	75.03	75.25	75.03	75.33	75.49	75.19
11	52+85	75.27	75.49	75.27	75.49	75.43	74.98
12	53+25	75.51	75.73	75.51	75.52	75.58	75.21
13	53+65	75.75	75.97	75.75	76.00	76.13	75.80
14	54+05	75.99	76.21	75.99	76.25	76.45	76.25
15	54+45	76.23	76.45	76.23	76.51	76.67	76.45
16	54+85	76.47	76.69	76.47	76.75	76.97	76.65
17	55+25	76.71	76.93	76.71	76.97	77.17	76.92
18	55+65	76.95	77.17	76.95	77.24	77.46	77.23
19	56+05	77.19	77.41	77.19	77.48	77.66	77.46
20	56+45	77.43	77.65	77.43	77.72	77.91	77.71
21	56+85	77.67	77.89	77.67	77.96	78.17	77.96
22	57+25	77.91	78.13	77.91	78.19	78.41	78.20
23	57+65	78.15	78.37	78.15	78.44	78.65	78.41
24	58+05	78.39	78.61	78.39	78.68	78.88	78.63
25	58+45	78.63	78.85	78.63	78.88	79.08	78.88
26	58+85	78.87	79.09	78.87	79.15	79.35	79.11
27	59+25	79.11	79.33	79.11	79.39	79.59	79.39
28	59+65	79.35	79.57	79.35	79.60	79.83	79.63
29	60+05	79.59	79.81	79.59	79.88	80.09	79.88
30	60+45	79.83	80.05	79.83	80.10	80.33	80.06
31	60+85	80.07	80.29	80.07	80.31	80.47	80.19
32	61+25	80.31	80.53	80.31	80.56	80.80	80.57
33	61+65	80.55	80.77	80.55	80.77	80.99	80.77
34	62+05	80.79	81.01	80.79	81.04	81.26	81.04
35	62+45	81.03	81.25	81.03	81.22	81.34	81.04
36	62+85	81.27	81.49	81.27	81.53	81.75	81.55

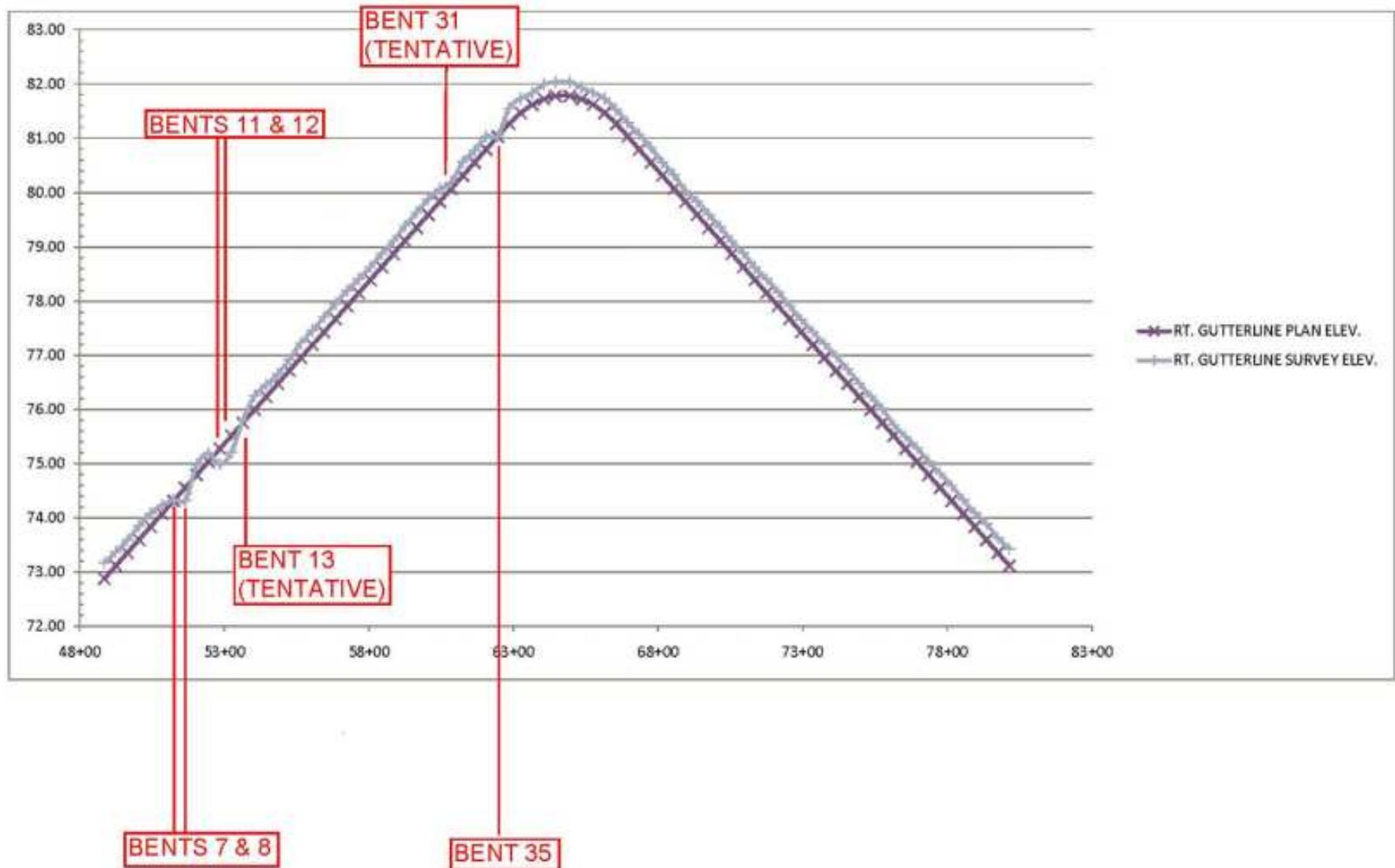
Survey Data – Centerline



Survey Data – Left Gutterline



Survey Data – Right Gutterline

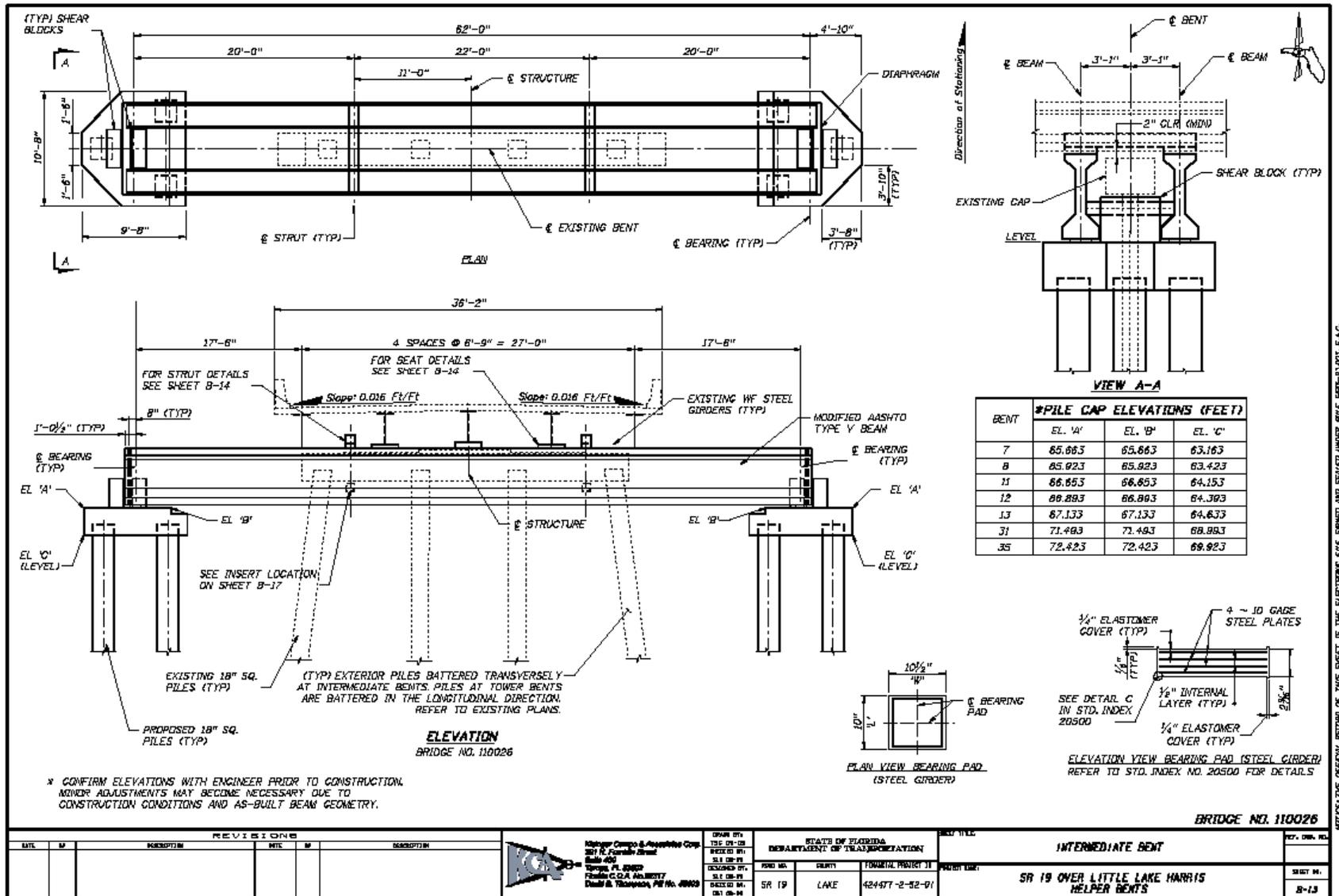


Sample Helper Bent



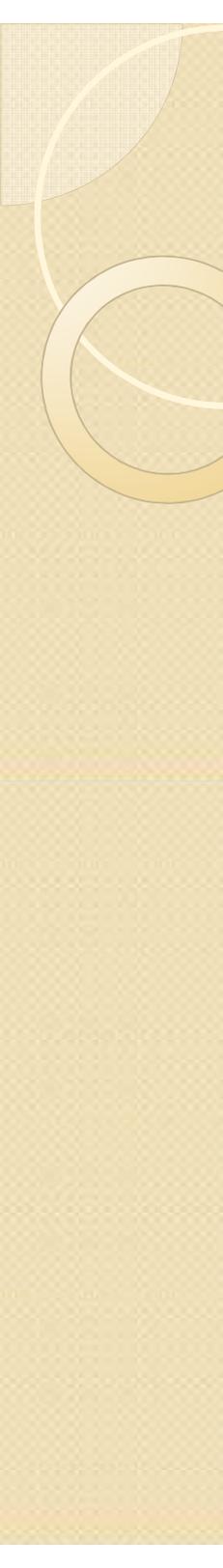
SR 528 over Sykes Creek

Proposed Helper Bent Plan



Design Considerations

- Estimated construction cost for 7 helper bents ~ \$2.7 Million
- KCA reconsidered criteria for how many of the bents should be addressed
- After discussions with the FDOT, KCA brought on geotechnical subconsultant Nodarse & Associates, Inc. to review the available geotechnical studies and provide recommendations for the extent of the proposed remediation construction



GEOTECHNICAL ENGINEERING EVALUATION

AMR SALLAM, PH.D., P.E.

GEOTECHNICAL SERVICES DIRECTOR

ADJUNCT FACULTY, UCF

NODARSE & ASSOCIATES, INC.

Purpose

- Review the as-built records provided by FDOT
- Review geotechnical report by Ardaman and Associates
- Review original and current bent loads provided by KCA
- Evaluate settled bents in an effort to understand the most probable cause of the movements
- Recommend alternatives to rehabilitate the bridge for the remaining service life

Provided Data

- Plans and as-built documents including:
 - Plans (16 sheets) dated 1949
 - Bridge elevations for few bents starting 1990
 - Shore line and LLH survey
 - Construction drawings of elevations at centerline
 - Driving records for 4 test piles and production piles for all bents
 - A copy of pile driving records with net pay length
 - Bridge inspection reports spans from 2002 to 2008

- Geotechnical report by Ardaman and Associates, Inc. dated October 29, 2009:
 - 12 SPT borings to depths of 92.5 to 140 feet below the water line
 - 33 percent fines, 2 organic content, 1 Atterberg Limits, 2 corrosion tests (soil samples), and 1 corrosion test (water sample)
 - No soft clays or organic soils were encountered within the influence zone of pile tips
 - Crutch bents were recommended to replace the piles of the settled bents
 - Capacity of multiple deep foundation systems such as H-piles and square precast concrete piles were provided

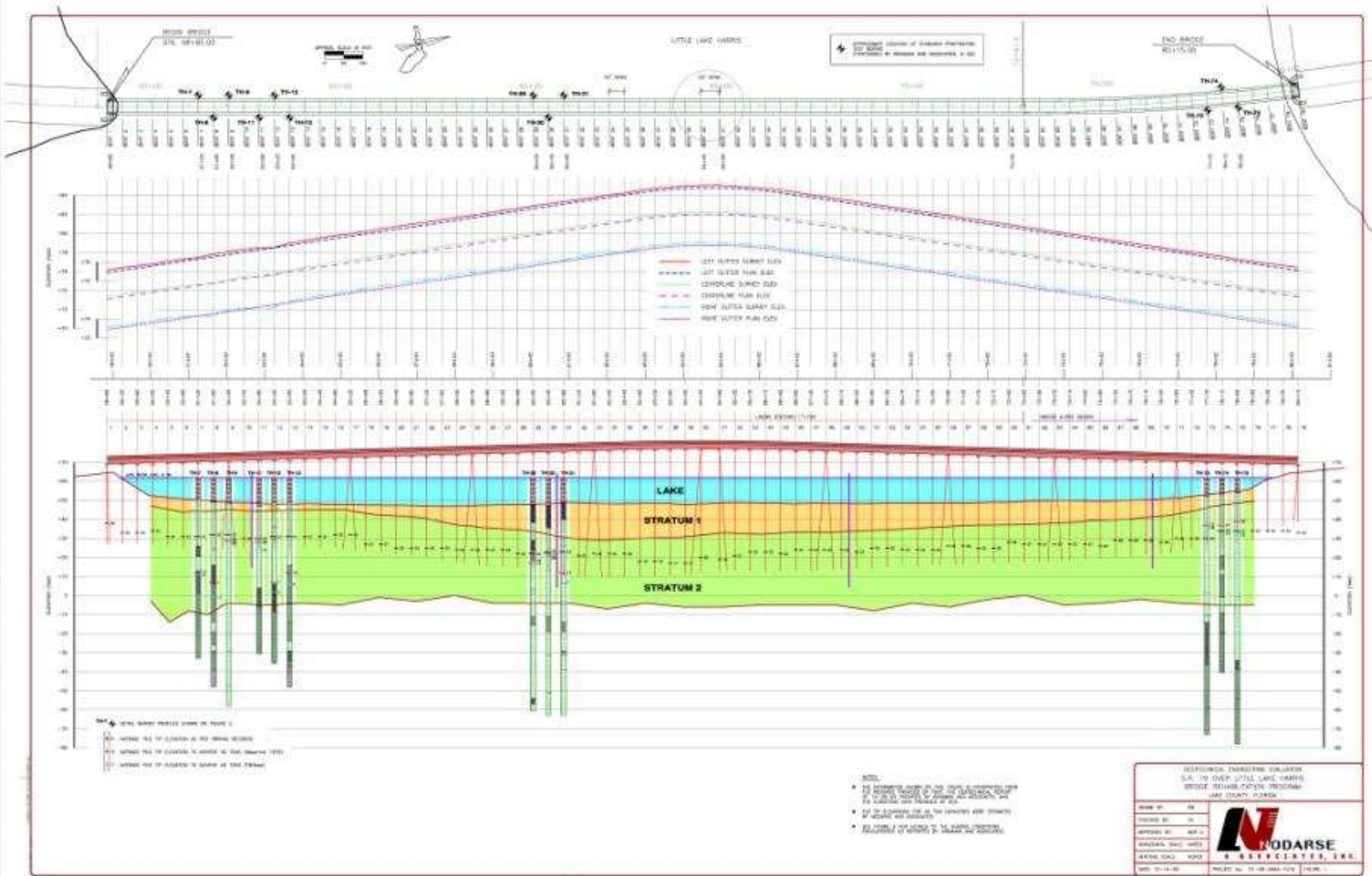
- KCA provided the results of recently performed survey for the grade elevation at the center line, left gutter, and right gutter of the bridge dated October 7, 2009.
- KCA also provided the original and the adjusted service bent loads
- Actual compression loads on the new piles of the crutch bents is about 60 tons as compared to the 40 ton design capacity

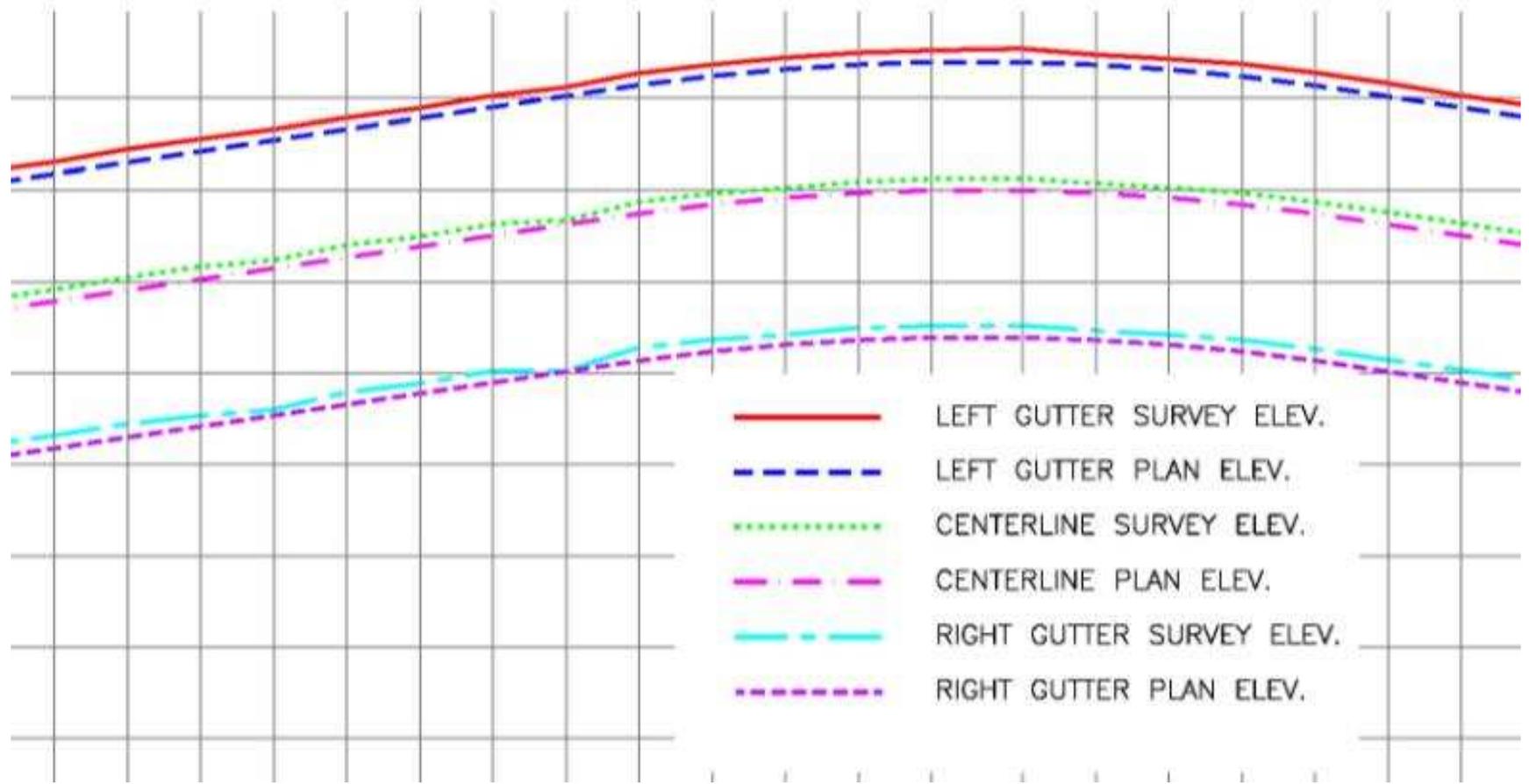
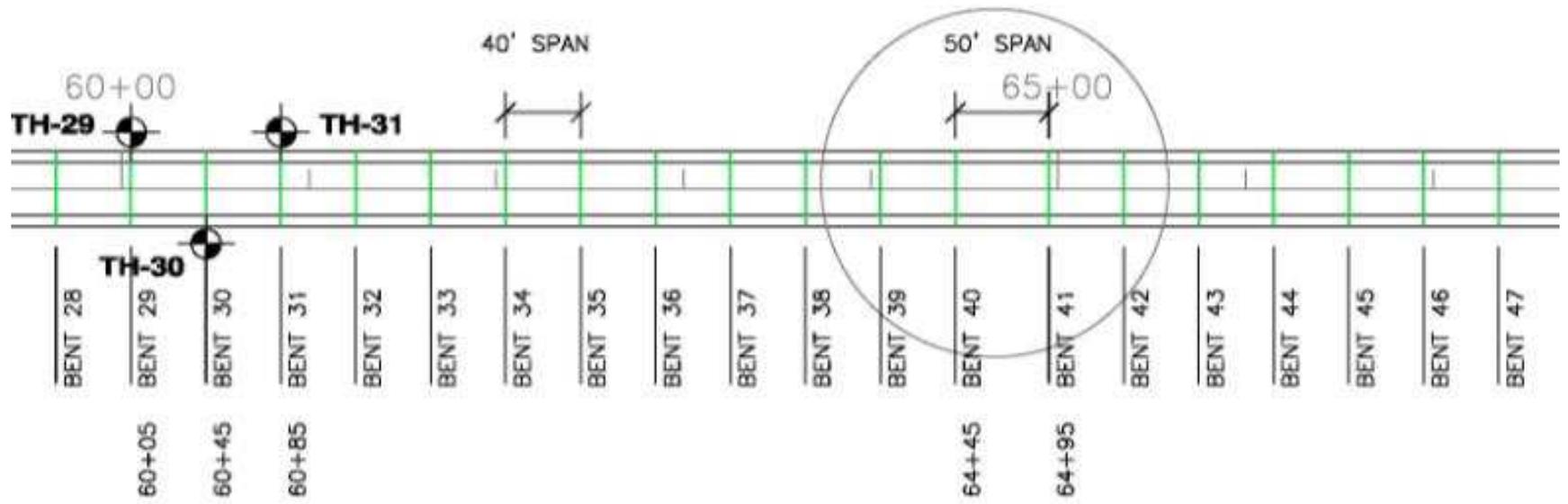
USGS Quadrangle Map



Howey In The Hill USGS Quadrangle – Florida, Lake County

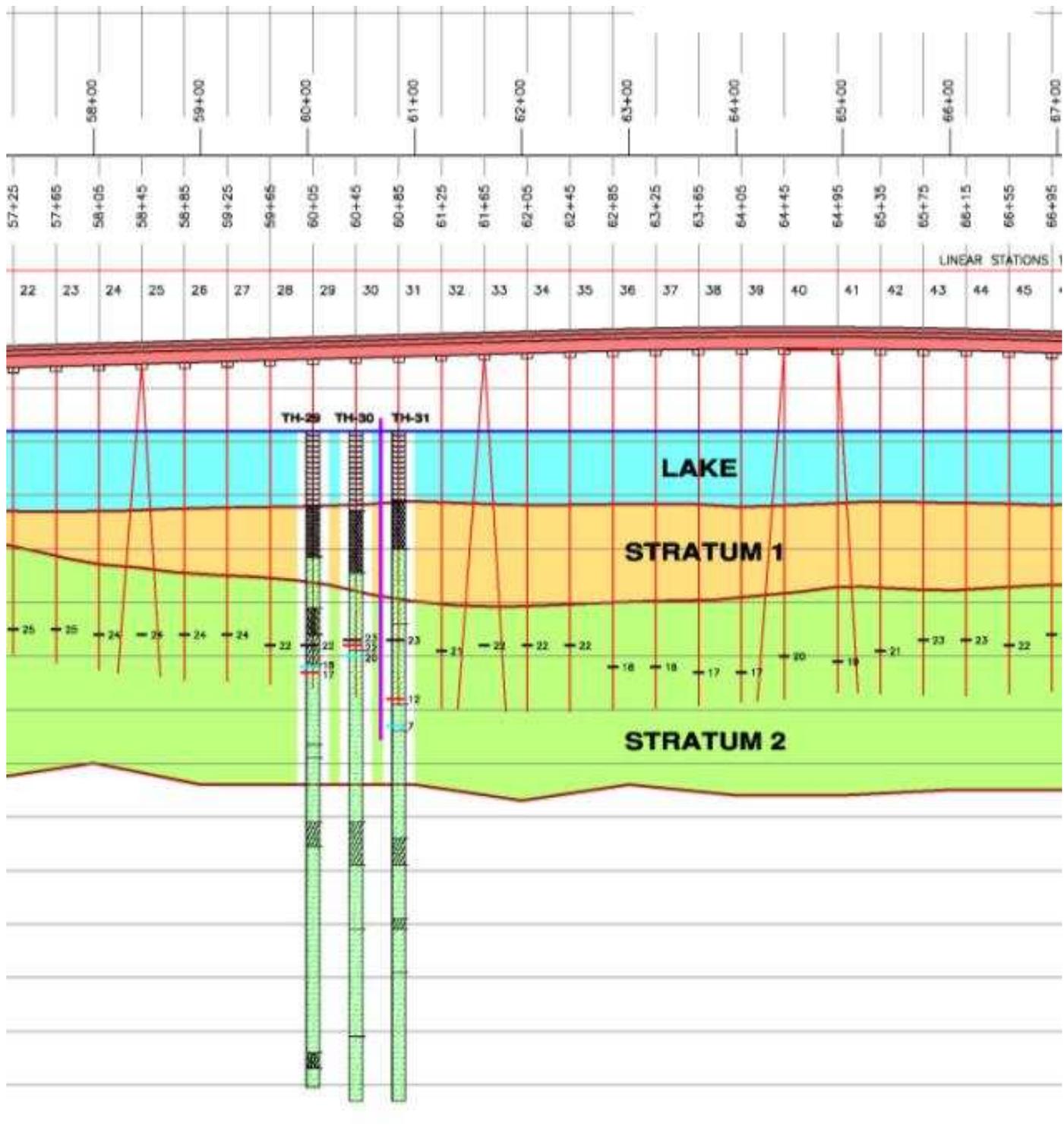
Bent #	7				8				9					
F.G. Elevation at Lt. Gutter (Plan)	74.31				74.55				74.79					
F.G. Elevation at Lt. Gutter (Survey)	74.47				74.81				75.09					
Difference in Settlement (inches)	1.92				3.12				3.60					
F.G. Elevation at CL (Plan)	74.53				74.77				75.01					
F.G. Elevation at CL (Survey)	74.62				74.74				75.27					
Difference in Settlement (inches)	1.08				-0.36				3.12					
F.G. Elevation at Rt. Gutter (Plan)	74.31				74.55				74.79					
F.G. Elevation at Rt. Gutter (Survey)	74.33				74.32				74.97					
Difference in Settlement (inches)	0.24				-2.76				2.16					
Pile Number within the bent	1	2	3	4	1	2	3	4	1	2	3	4	5	6
Design Pile Length, feet	38	38	38	38	38	38	38	38	38	38	38	38	38	38
Pile Cut Off Elevation, feet	69.45	69.45	69.45	69.45	69.73	69.69	69.69	69.70	70.00	69.93	69.94	69.98	69.98	70.00
Pile Tip Elevation (Driving Records)	31.45	31.45	31.45	31.45	31.73	31.69	31.69	31.70	32.00	31.93	31.94	31.98	31.98	32.00
Pile Tip Elevation (Plans)	24.58				25.00				25.83					
Tip to provide 40 tons (FBDeep)	11.00				-1.00				28.00					
Tip to provide 40 tons (Meyerhof 76)	11.00				7.00				30.00					
Ground Elevation, feet	50.82	50.82	50.82	50.82	50.30	50.30	50.30	50.30	50.00	50.00	50.00	50.00	50.00	50.00
Length of Pile Embedment, feet	19.37	19.37	19.37	19.37	18.57	18.61	18.61	18.60	18.00	18.07	18.06	18.02	18.02	18.00
Pile Capacity per Driving Records	42	42	48	48	42	42	48	48	75	54	67	75	54	55

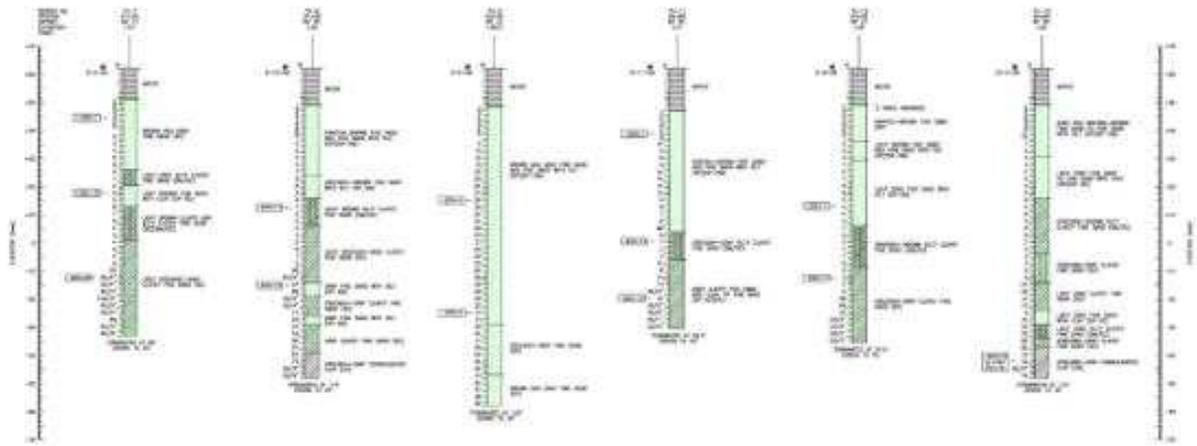




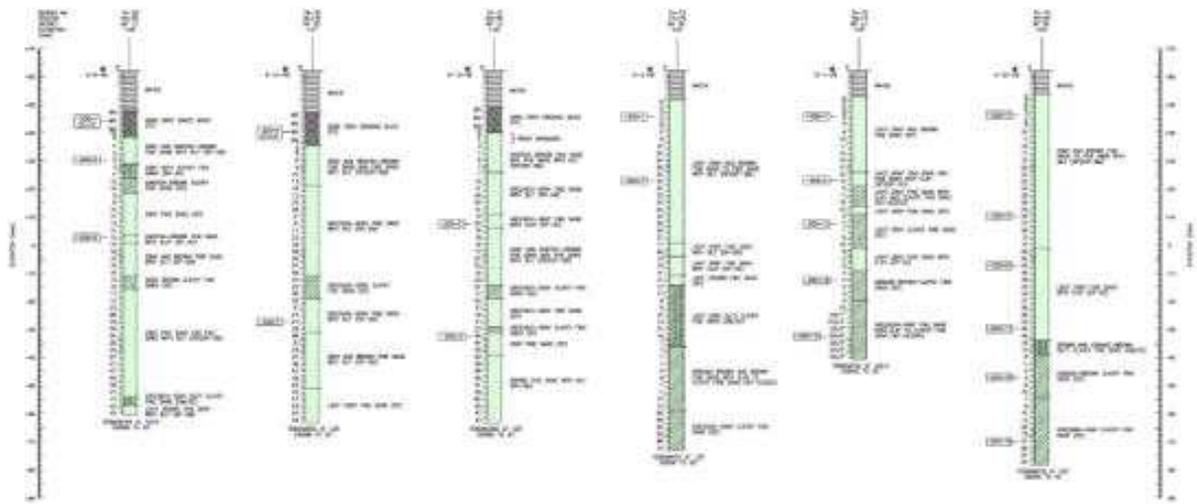
Survey & Settlement

Bent #	Scenarios	Settlement in inches (Heave in positive)		
		No shift in bench marks	Current bench mark is about 3 inches higher	Current bench mark is about 6 inches higher
7	Left gutter	1.92	-1.08	-4.08
	Centerline	1.08	-1.92	-4.92
	Right gutter	0.24	-2.76	-5.76
8	Left gutter	3.12	0.12	-2.88
	Centerline	-0.36	-3.36	-6.36
	Right gutter	-2.76	-5.76	-8.76
9	Left gutter	3.60	0.60	-2.40
	Centerline	3.12	0.12	-2.88
	Right gutter	2.16	-0.84	-3.84
11	Left gutter	2.64	-0.36	-3.36
	Centerline	-0.72	-3.72	-6.72
	Right gutter	-3.48	-6.48	-9.48
12	Left gutter	0.12	-2.88	-5.88
	Centerline	-1.80	-4.80	-7.80
	Right gutter	-3.60	-6.60	-9.60
13	Left gutter	3.00	0.00	-3.00
	Centerline	1.92	-1.08	-4.08
	Right gutter	0.60	-2.40	-5.40
29	Left gutter	3.48	0.48	-2.52
	Centerline	3.36	0.36	-2.64
	Right gutter	3.48	0.48	-2.52
30	Left gutter	3.24	0.24	-2.76
	Centerline	3.36	0.36	-2.64
	Right gutter	2.76	-0.24	-3.24
31	Left gutter	2.88	-0.12	-3.12
	Centerline	2.16	-0.84	-3.84
	Right gutter	1.44	-1.56	-4.56
73	Left gutter	3.36	0.36	-2.64
	Centerline	3.12	0.12	-2.88
	Right gutter	3.24	0.24	-2.76
74	Left gutter	3.36	0.36	-2.64
	Centerline	3.76	0.76	-2.24
	Right gutter	3.36	0.36	-2.64
75	Left gutter	2.76	-0.24	-3.24
	Centerline	2.64	-0.36	-3.36
	Right gutter	2.88	-0.12	-3.12





- 0-1.5' (CLAY)
- 1.5-3.0' (SAND)
- 3.0-4.5' (SAND)
- 4.5-6.0' (SAND)
- 6.0-7.5' (SAND)
- 7.5-9.0' (SAND)
- 9.0-10.5' (SAND)
- 10.5-12.0' (SAND)
- 12.0-13.5' (SAND)
- 13.5-15.0' (SAND)
- 15.0-16.5' (SAND)
- 16.5-18.0' (SAND)
- 18.0-19.5' (SAND)
- 19.5-21.0' (SAND)
- 21.0-22.5' (SAND)
- 22.5-24.0' (SAND)
- 24.0-25.5' (SAND)
- 25.5-27.0' (SAND)
- 27.0-28.5' (SAND)
- 28.5-30.0' (SAND)
- 30.0-31.5' (SAND)
- 31.5-33.0' (SAND)
- 33.0-34.5' (SAND)
- 34.5-36.0' (SAND)
- 36.0-37.5' (SAND)
- 37.5-39.0' (SAND)
- 39.0-40.5' (SAND)
- 40.5-42.0' (SAND)
- 42.0-43.5' (SAND)
- 43.5-45.0' (SAND)
- 45.0-46.5' (SAND)
- 46.5-48.0' (SAND)
- 48.0-49.5' (SAND)
- 49.5-51.0' (SAND)
- 51.0-52.5' (SAND)
- 52.5-54.0' (SAND)
- 54.0-55.5' (SAND)
- 55.5-57.0' (SAND)
- 57.0-58.5' (SAND)
- 58.5-60.0' (SAND)
- 60.0-61.5' (SAND)
- 61.5-63.0' (SAND)
- 63.0-64.5' (SAND)
- 64.5-66.0' (SAND)
- 66.0-67.5' (SAND)
- 67.5-69.0' (SAND)
- 69.0-70.5' (SAND)
- 70.5-72.0' (SAND)
- 72.0-73.5' (SAND)
- 73.5-75.0' (SAND)
- 75.0-76.5' (SAND)
- 76.5-78.0' (SAND)
- 78.0-79.5' (SAND)
- 79.5-81.0' (SAND)
- 81.0-82.5' (SAND)
- 82.5-84.0' (SAND)
- 84.0-85.5' (SAND)
- 85.5-87.0' (SAND)
- 87.0-88.5' (SAND)
- 88.5-90.0' (SAND)
- 90.0-91.5' (SAND)
- 91.5-93.0' (SAND)
- 93.0-94.5' (SAND)
- 94.5-96.0' (SAND)
- 96.0-97.5' (SAND)
- 97.5-99.0' (SAND)
- 99.0-100.5' (SAND)

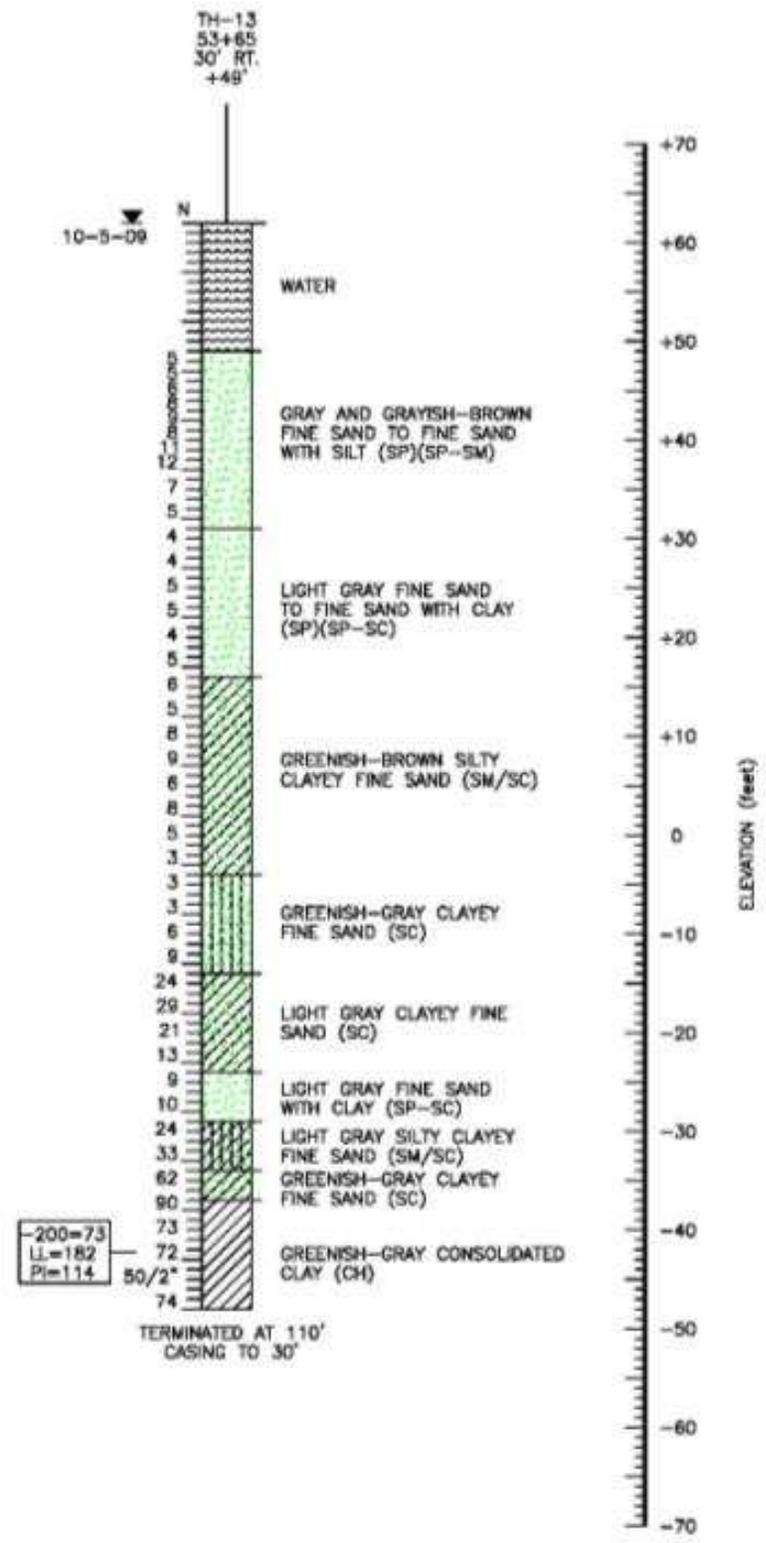
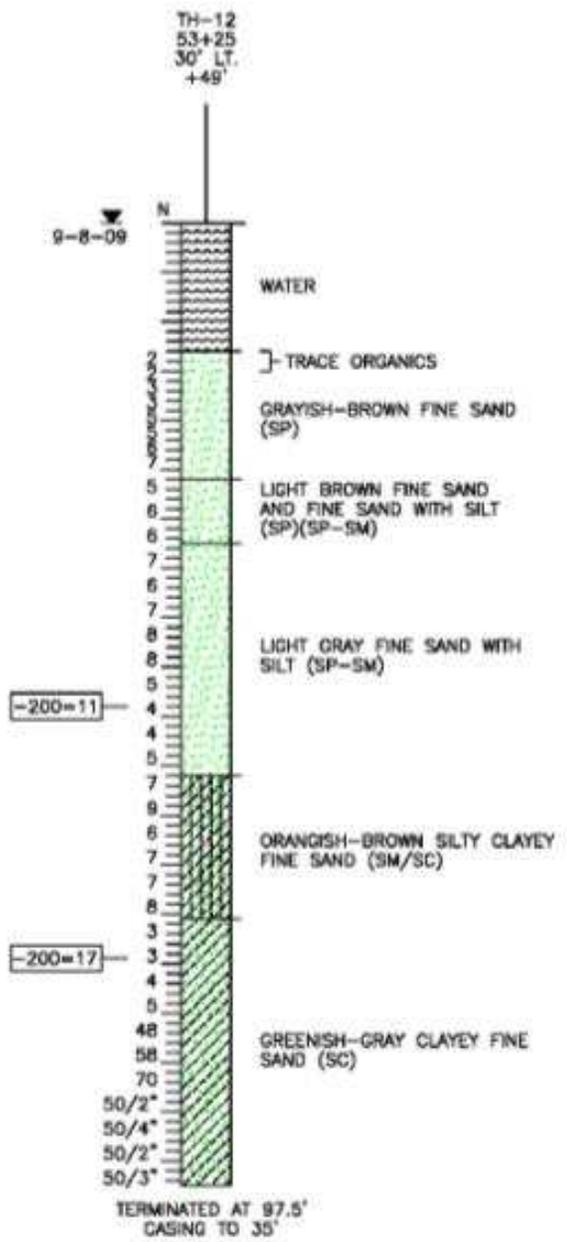


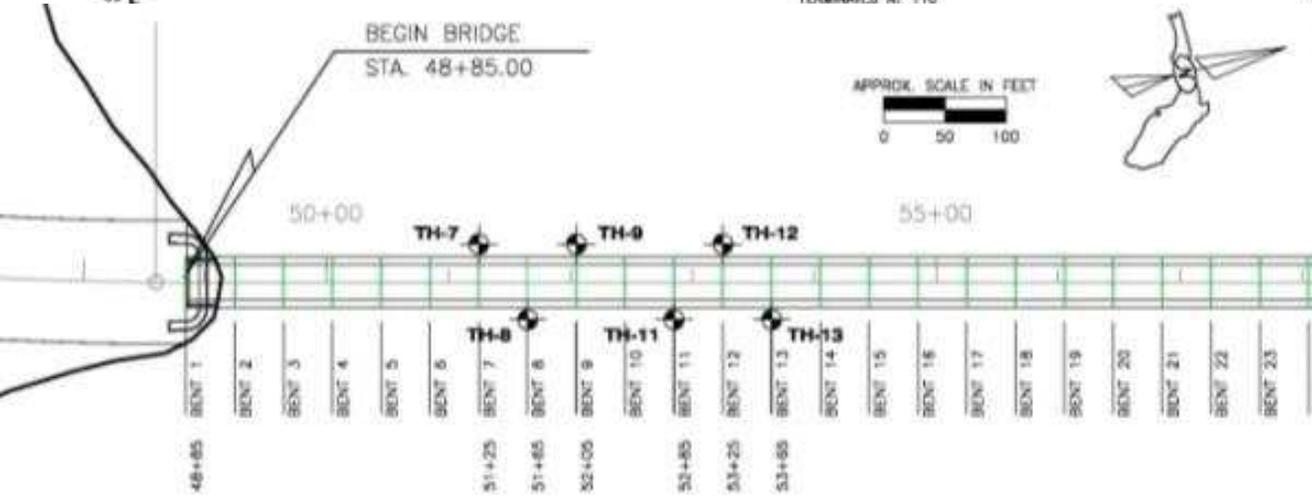
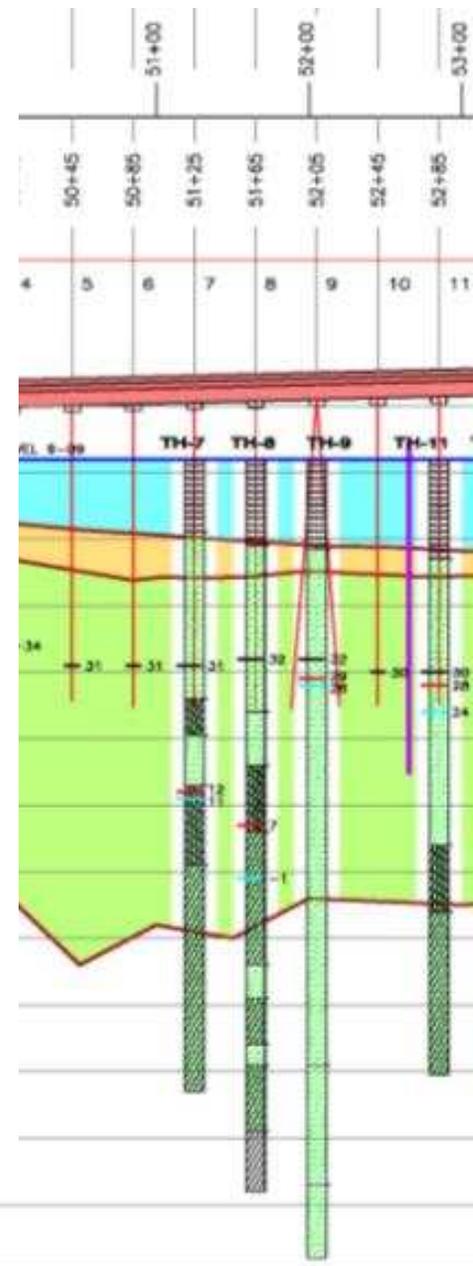
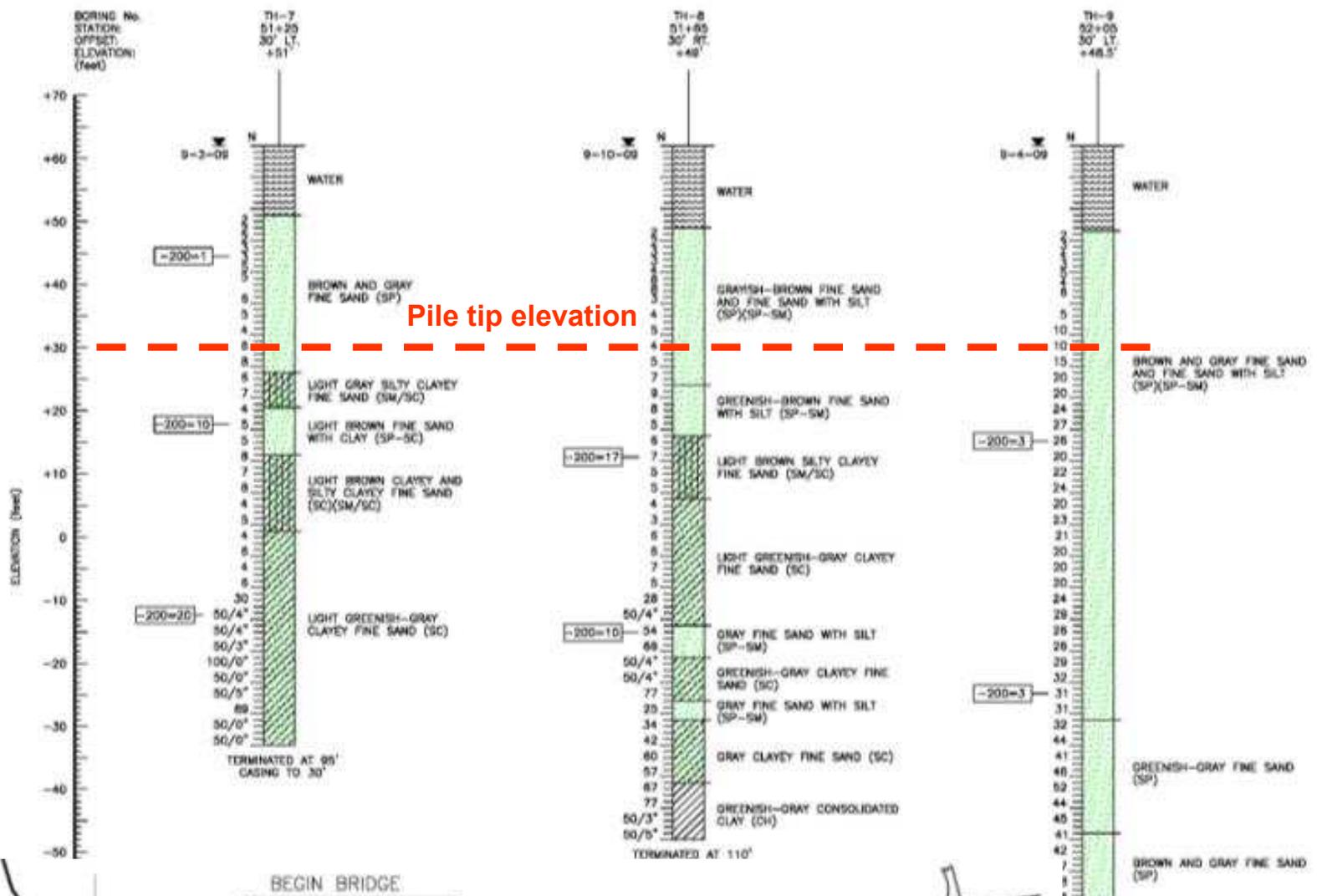
GEOTECHNICAL ENGINEERING CONSULTANTS
 U.S. IS (DEEP) LITTLE LARK FARMS
 BRIDGE REINVESTIGATION PROGRAM
 EAST TOWNSHIP, ILLINOIS

DATE: 01/18/08	NO.
DRAWN BY: M.S.	NO.
PROJECT NO.: 0801.01	NO.
DESIGNER: M.S.	NO.
CLIENT: ILLINOIS	NO.
SCALE: 1"=10'	NO.

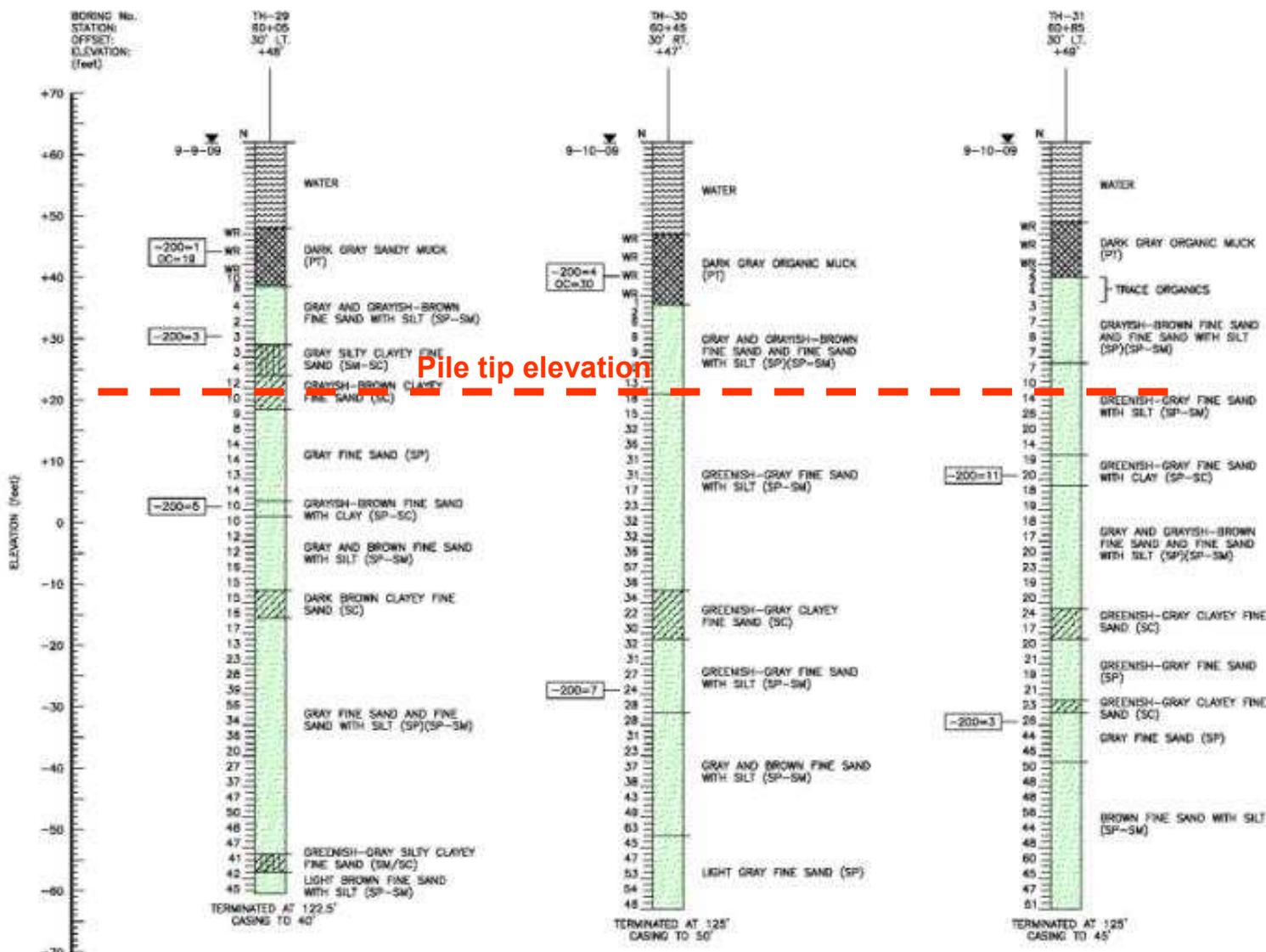


NODARSE
 CONSULTANTS, INC.

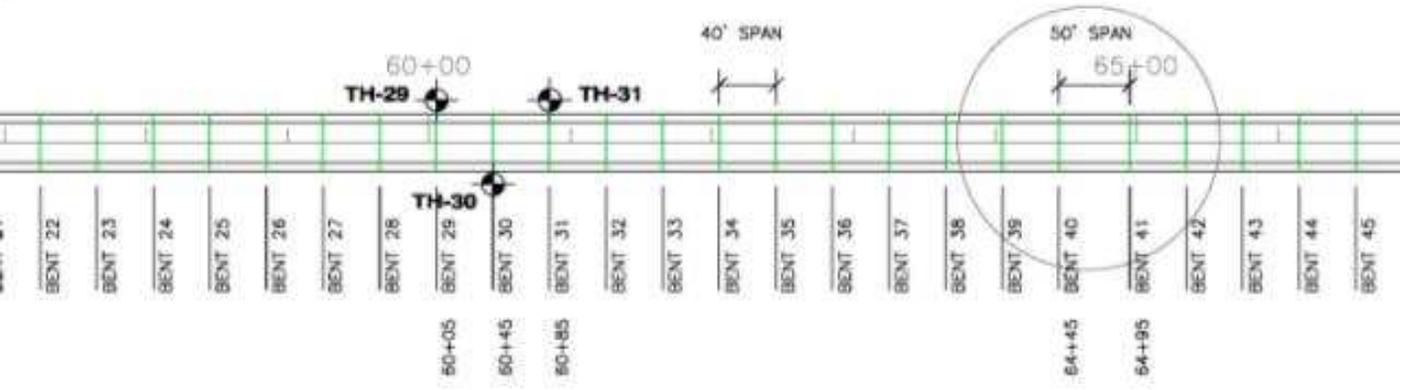
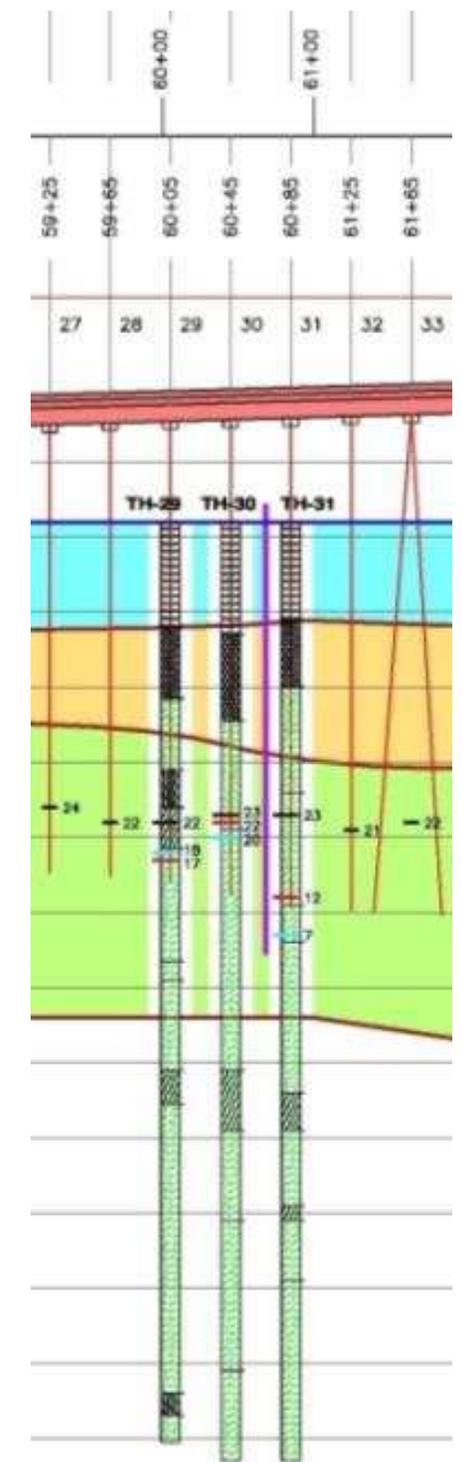




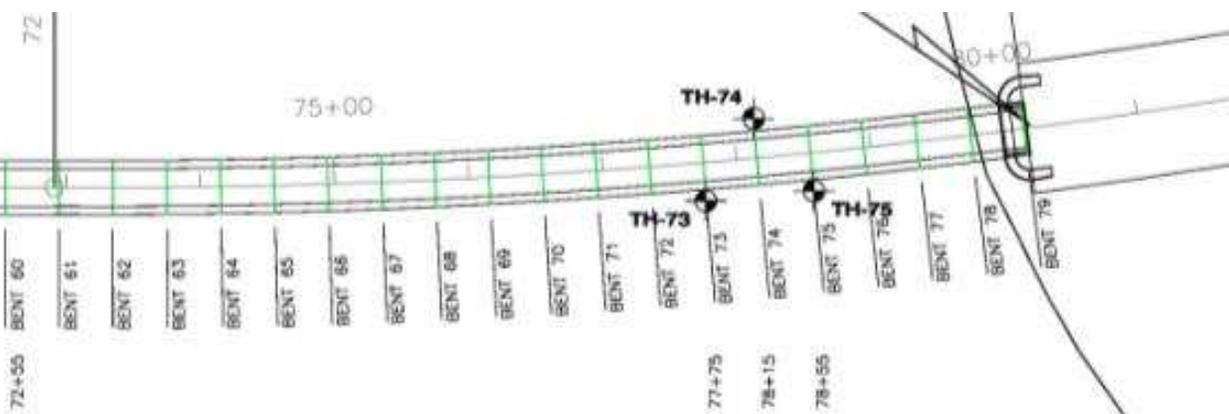
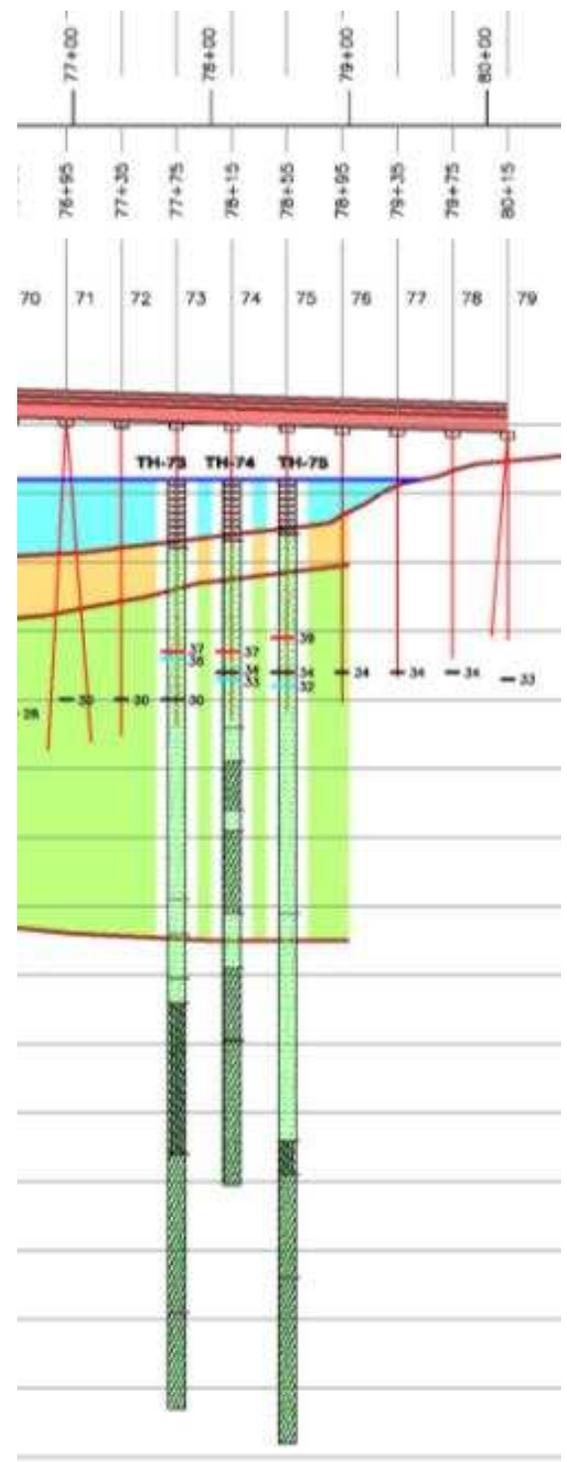
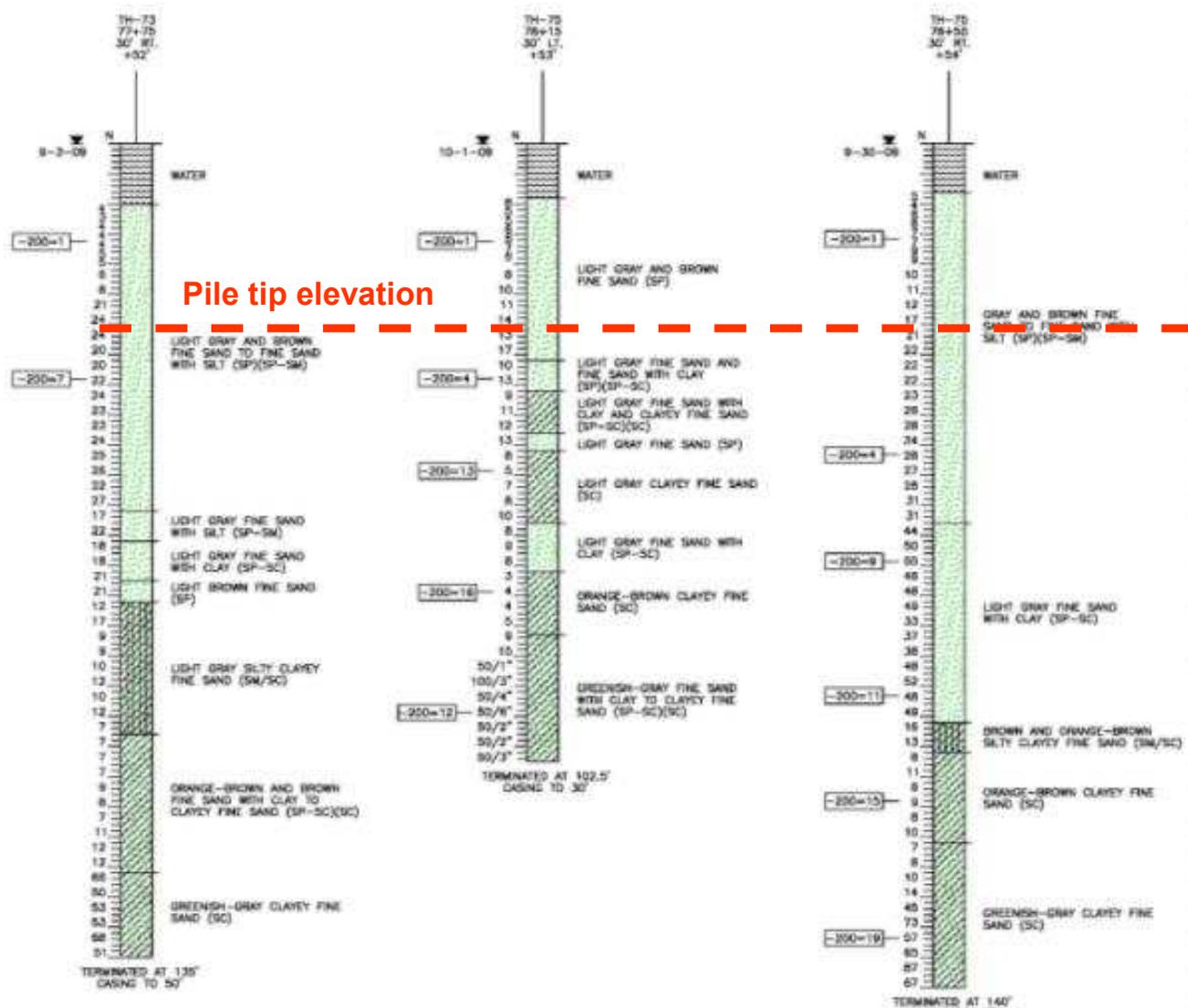
- TH-7** DETAIL BORING PROFILES SHOWN ON FIGURE 2.
- 31 AVERAGE PILE TIP ELEVATION AS PER DRIVING RECORDS.
 - 12 AVERAGE PILE TIP ELEVATION TO ACHIEVE 40 TONS (Meyerhof)
 - 11 AVERAGE PILE TIP ELEVATION TO ACHIEVE 40 TONS (PBD eep)



Pile tip elevation



Pile tip elevation



Evaluations & Recommendations

- A Bathymetric Survey for the current LLH bottom at the bridge location is needed to evaluate if any loss of skin friction and end bearing loads occurs
- The whole bridge has settled throughout its lifetime of about 60 years
- The actual settlement could not be compared to the our estimations due to the discrepancy between the as-built and the current survey data
- Bents showed substantial settlement had weaker subsoil conditions than neighboring bents
- Additional borings are needed to explore the subsoil under rest of the bridge with no settlement

Evaluations & Recommendations

- The un-even settlement/heave across some of the studied bents may be attributed to substantial difference in subsoil conditions at both ends of the cap, which was not explored
- The main reason for the observed settlement is the relatively weak/loose subsoil conditions at specific bent locations
- This resulted in initial settlement of the pile foundations causing a small dip

Evaluations & Recommendations

- Once developed, the impact of the heavy truck load caused cyclic vibration/compression waves both vertically and horizontally
- The vibrations compacted the loose sands resulting in more pronounced dip/settlement
- Since the bridge has been in operation for about 60 years, settlement due to compaction of the loose sands might have already occurred
- Minor future settlement may be experienced
- Future consolidation settlement should be minimal
- Four Alternatives were recommended:

I- Lifting the settled bents to an acceptable level and monitor

- Hydraulic jacks to lift the targeted bents
- Shims should be added to the existing bearings or replacement of bearings to maintain the bridge profile
- Once the bridge is restored, a monitoring program should be implemented
- Few fixed points at the lifted bents should be monitored monthly for a minimum of one year
- A settlement threshold has to be established
- If the settlement threshold is approached, installing crutch bents, which 100% plans should be ready, should start immediately at the location reached the threshold
- Neoprene bearings may be used at the lifted locations

2- Pressure-grout loose sands around pile tips of the settled bents

- Bents 7, 8, 12, 13, and 31
- Pressure grouting will increase the point bearing resistance of the pile and reduce future settlement
- Care should be taken not to result in heaving the neighboring piles
- This alternative will still involve lifting the settled portion of the bridge to acceptable grades

3- Install crutch bents at all settled bents

- Although expensive, it is the ultimate solution
- Although crutch bents will eliminate future settlement at the treated bents, they will result in a few very rigid supports along the bridge with almost zero settlement
- The remainder of the bridge is still supported on short piles that might still experience future settlement due to compacting of loose sands under cyclic car/truck loads
- In few years, the bridge may experience differential settlement between the crutch bents and the neighboring bents
- The settled bents still may need to be lifted

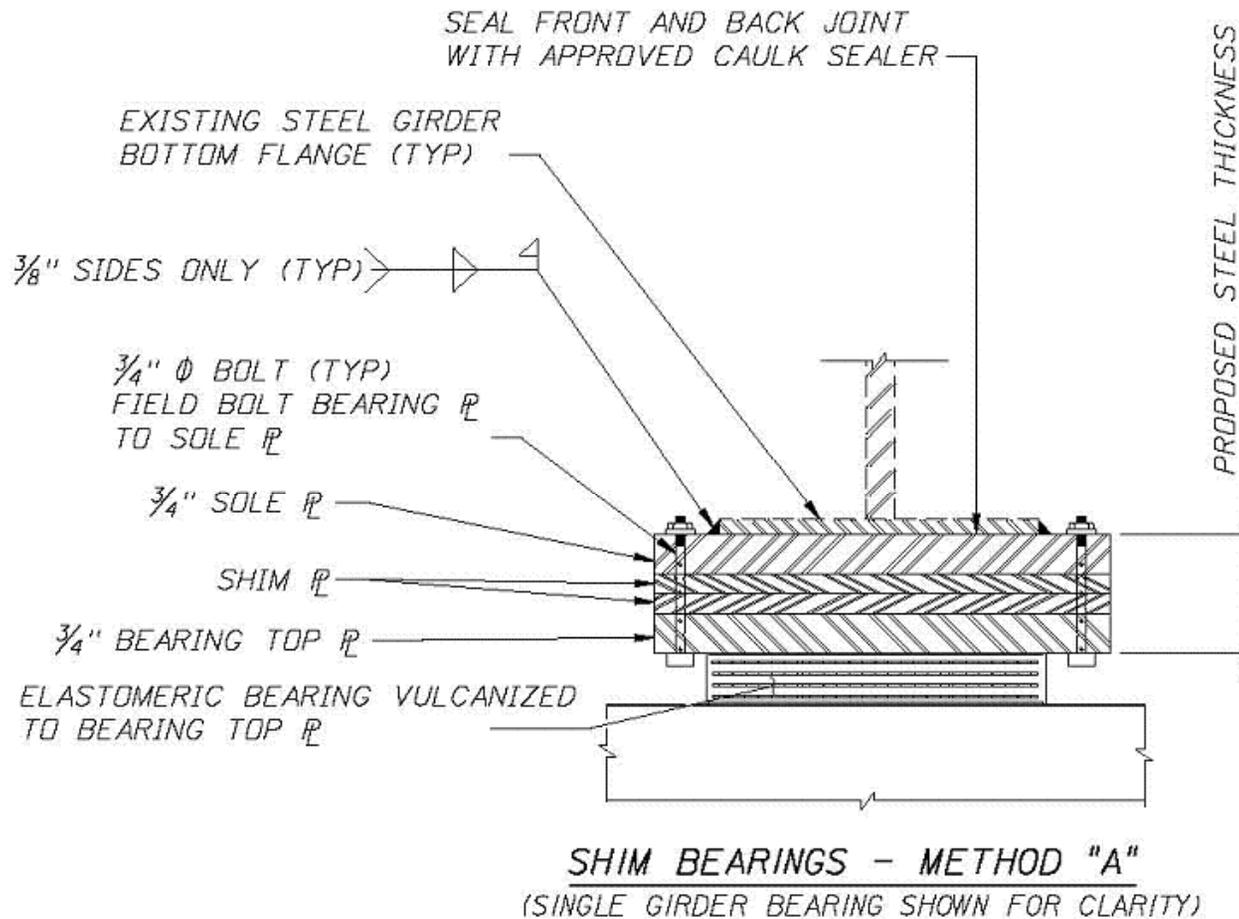
4- Install crutch bents only at the worst locations

- These include 7 bents instead of the proposed twelve bents
- Same anticipated differential settlement in Alternative 3 is expected to occur here
- Again, the settled portion of the bridge may still need to be lifted

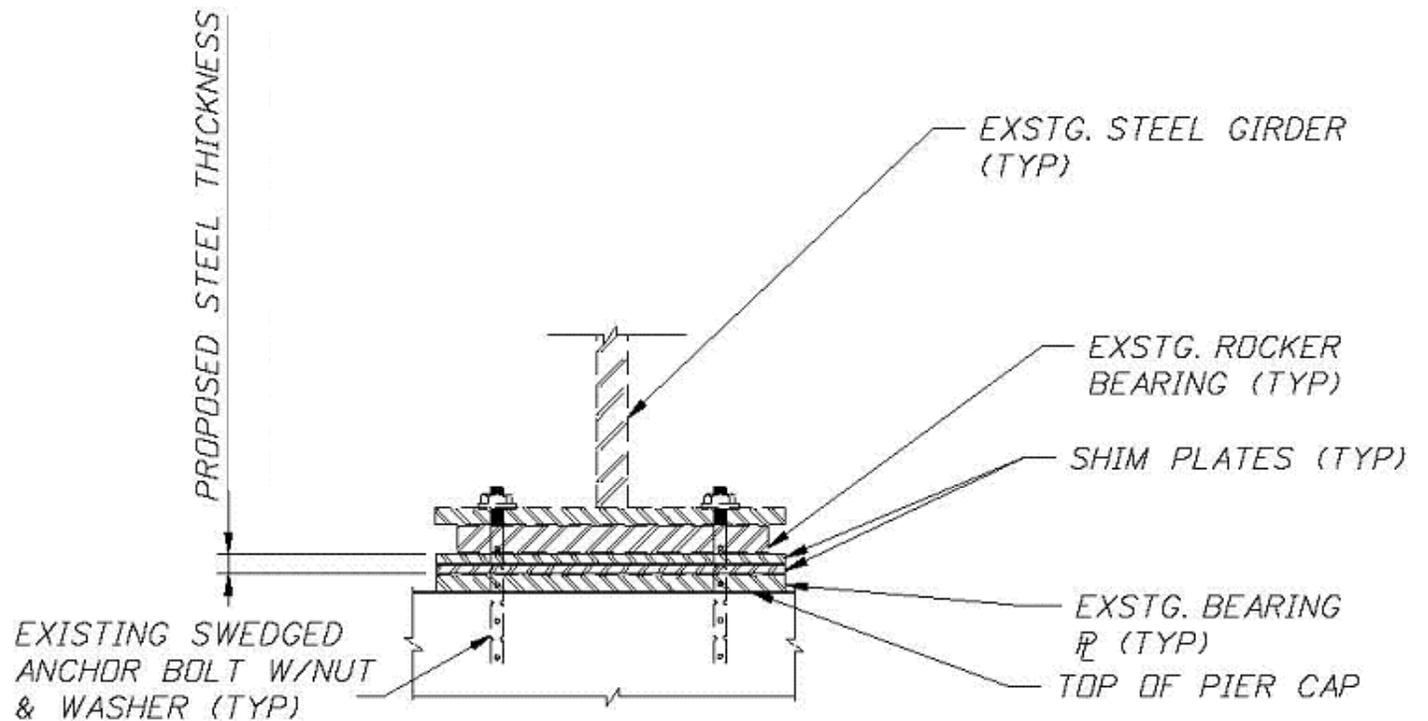
Final Design

- Based on the geotechnical assessment, KCA followed up with a repair design to correct the dips in the riding surface by jacking of the superstructure and shimming to original elevations
- Estimated cost of shimming ~ \$350,000

Proposed Shimming Plan



Proposed Shimming Plan



SHIM BEARINGS - METHOD "B"
(SINGLE GIRDER BEARING SHOWN FOR CLARITY)

Sample Jacking



56th St over the Hillsborough River

Post Design

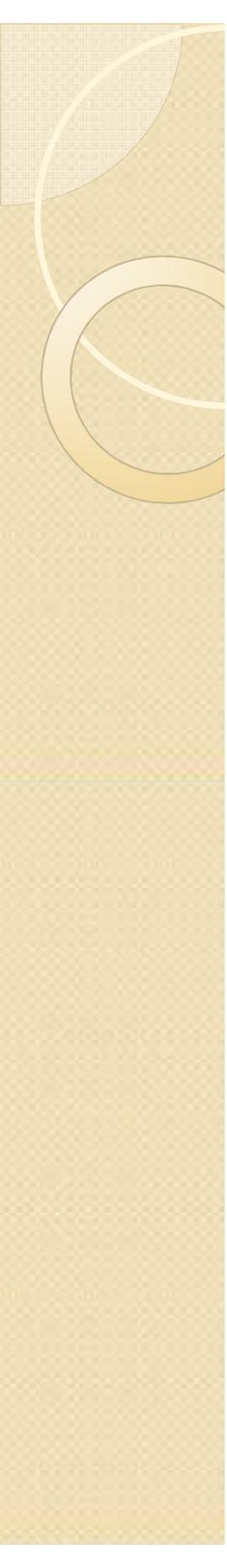
- Post construction survey will be carried out regularly to ensure assumptions are correct and settling has stabilized
- If differential settling continues, helper bents can be constructed with “shelved” plans that are immediately accessible

Project Schedule

- **Completion of Design:** **March 2010**
- **Advertisement for Bid:** **May 2010**
- **Construction:** **September 2010**

Lessons Learned

- Establish a reliable benchmark with surveyors when measuring settlement of structure
- Flexibility in scope during design
- Involve geotechnical group early on all settlement issues.
- Conduct pre- design geotechnical investigations
- Utilize district PIO office early to manage public expectations



Any Questions?

Thank you for your attention

