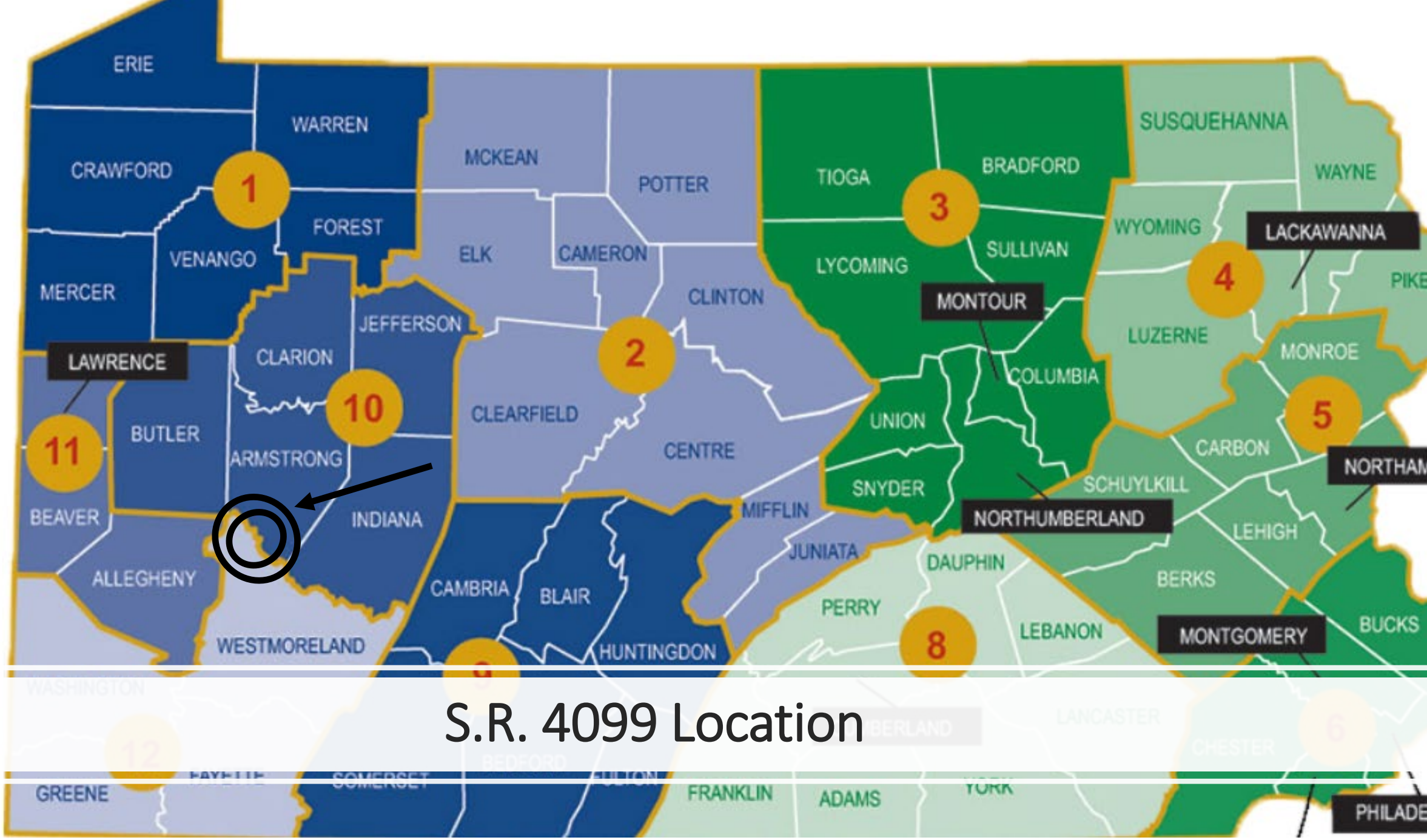

S.R. 4099 Emergency Slide Repair
Westmoreland County
Segment 40 Offset 0000-1800
VANDERGRIFT
EAST VANDERGRIFT
56
ALT 66
0056
4062
4099
4105
4034
HOLLAND ST
RD
AV
Owen Res
COMMUNITY PARK RD
HANCOCK
SHERIDAN
OKLAHOMA
Gilkerson Res
LILY ST
Project Location



S.R. 4099 Location

Evidences of Slope Movement

April 23, 1974

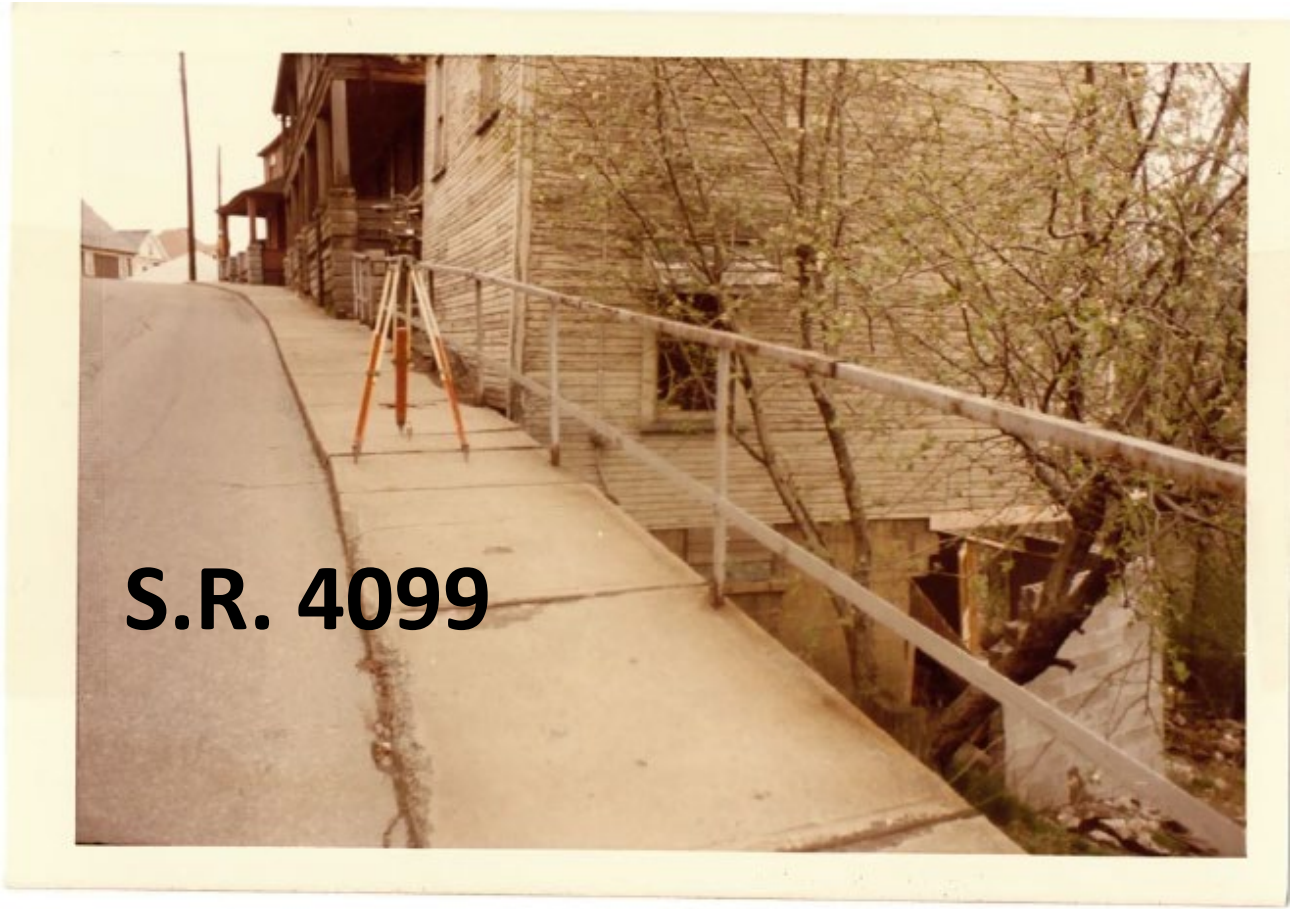
(note white house)

February 7 and 21, 2017

(note houses removed along Northeastern side)

April 23, 1974
Large foundation movement in white house near top of S.R. 4099

April 23, 1974



April 13, 2017

(Pole#1 also in photo)

Sidewalk notch out for Pole #1, slope movement obvious

December 5, 2019

February 26, 2020

December 6, 2005

December 5, 2019

(three structures removed in 14 years)

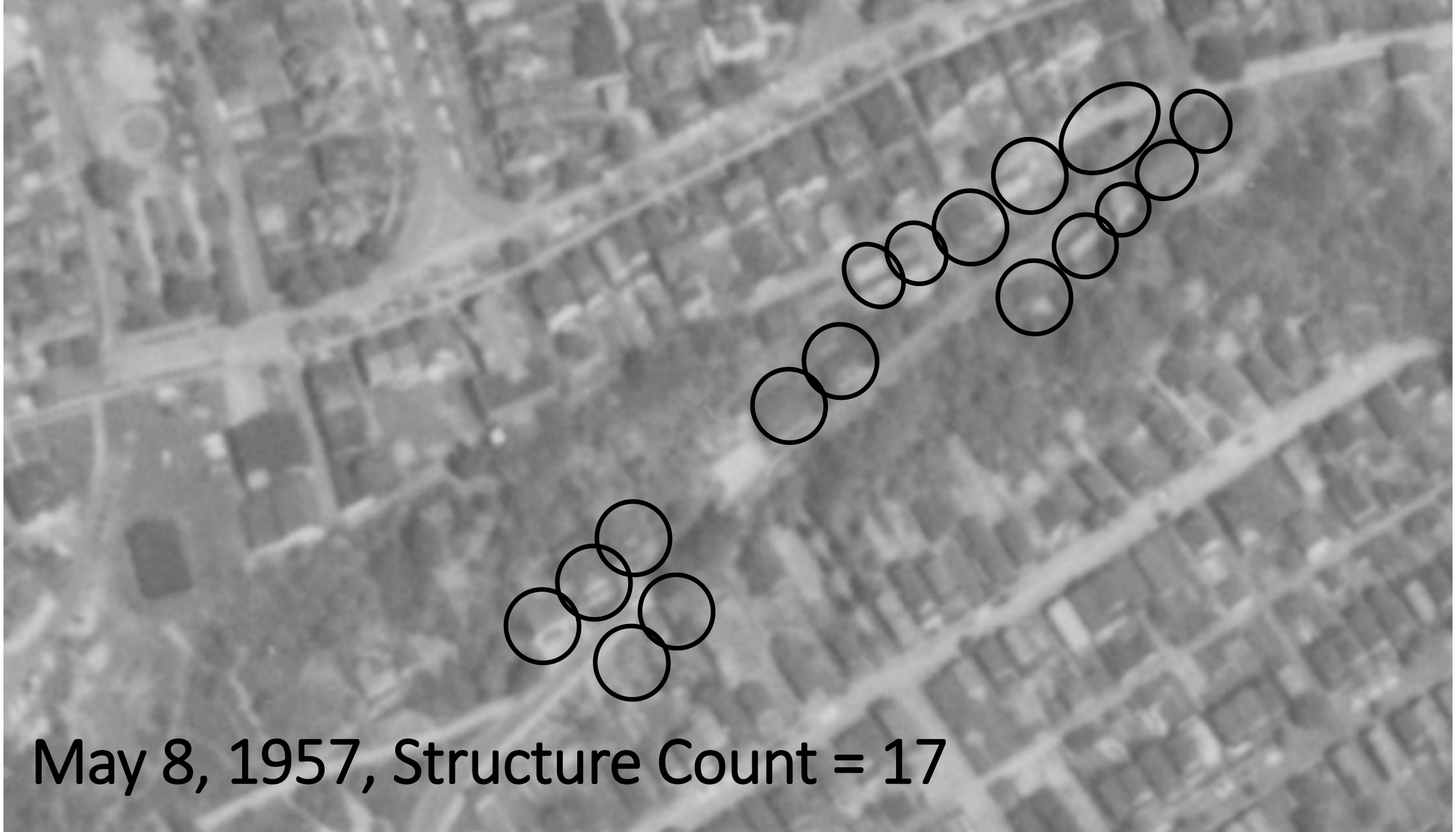
Sidewalk wall movement near F-9 Inclinometer

June 2017 Repair- 2’ wide, 8’ deep, 40’ long trench filled with Class C Concrete and bottom of excavation sloped towards the slope above the roadway (so as to force the concrete to ‘fall back towards the uphill side of the trench’)

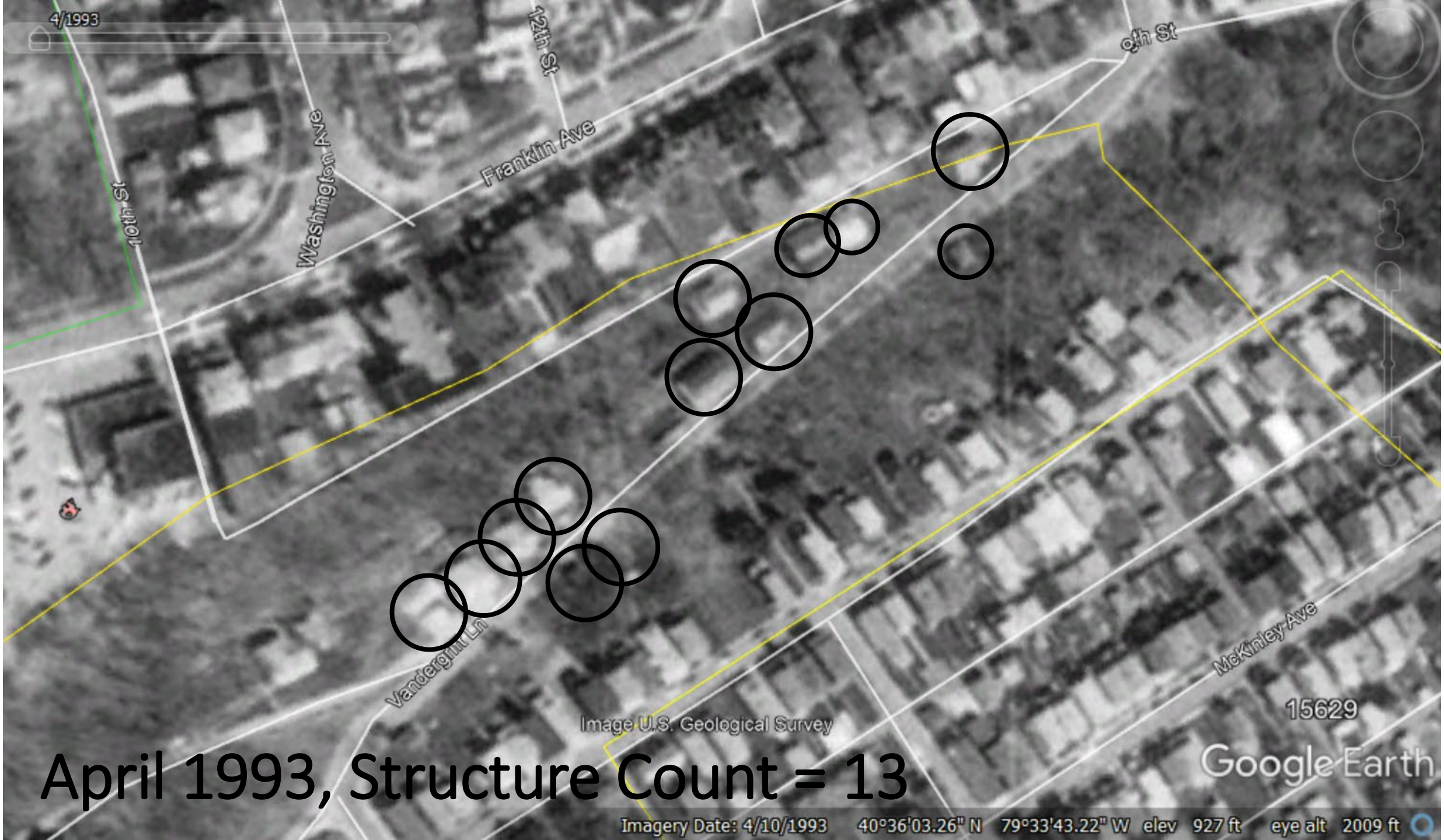
April 2014, Structure Count = 4

April 2014, Structure Count = 4


May 8, 1957, Structure Count = 17

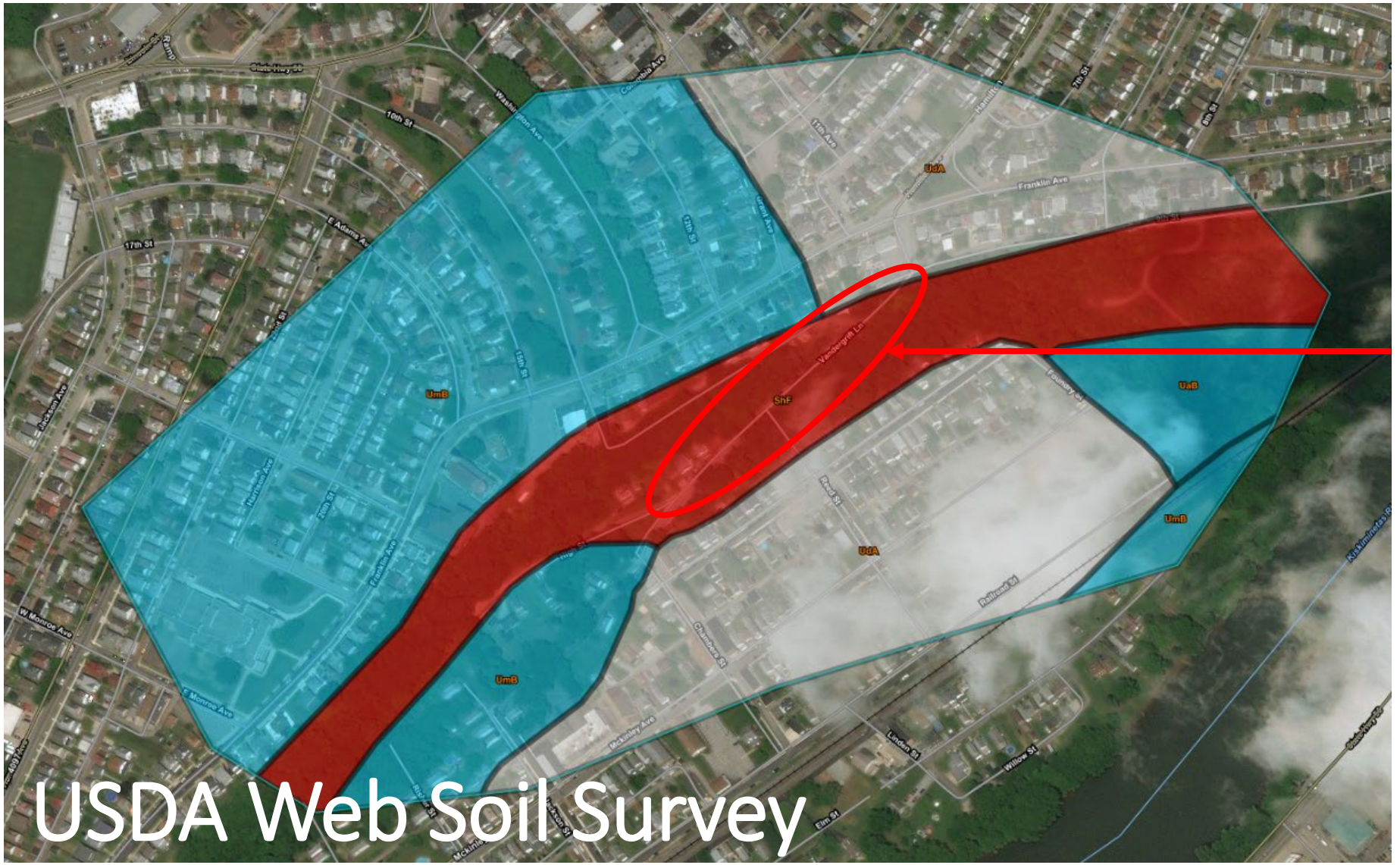

May 8, 1957, Structure Count = 17

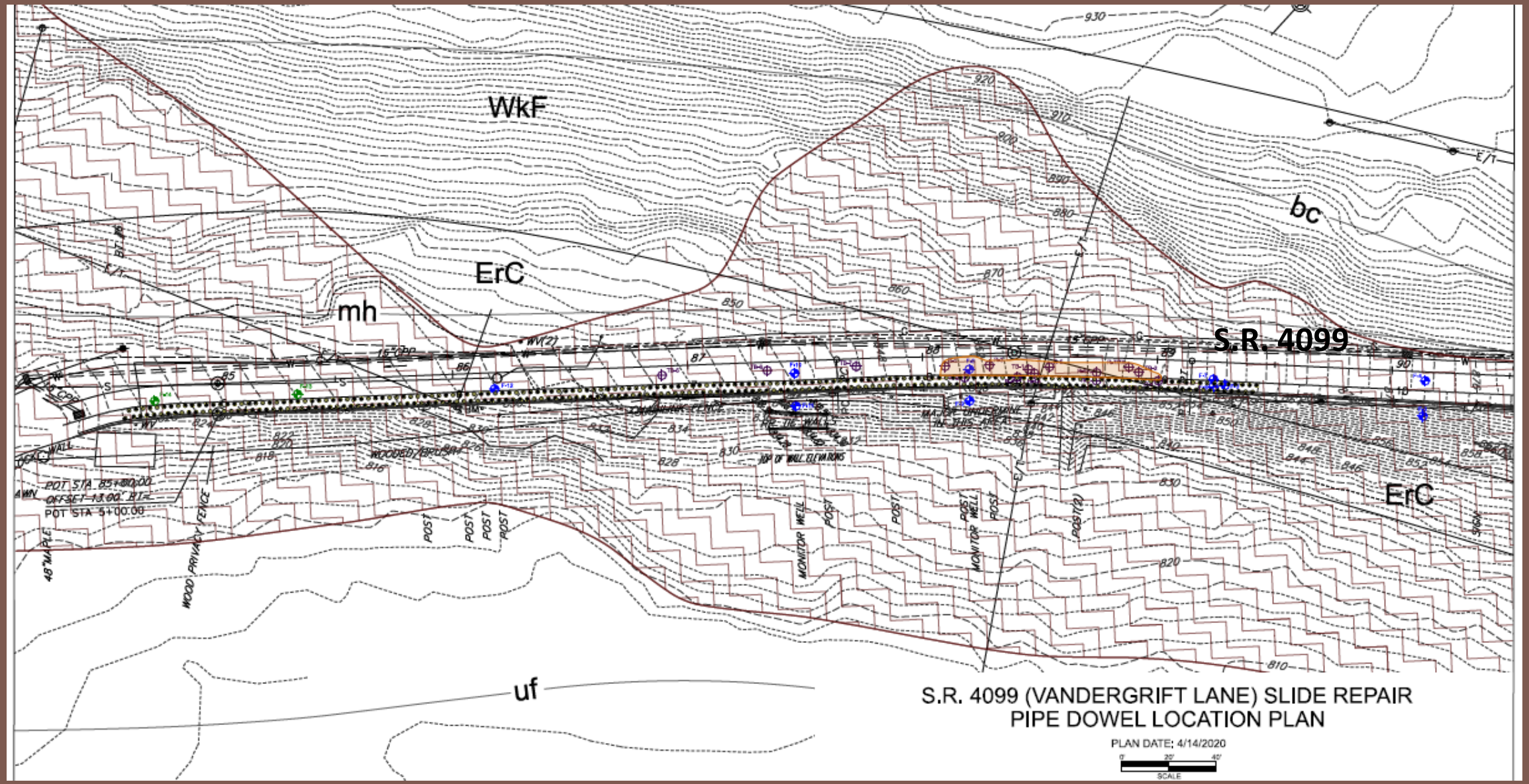
April 1993, Structure Count = 13

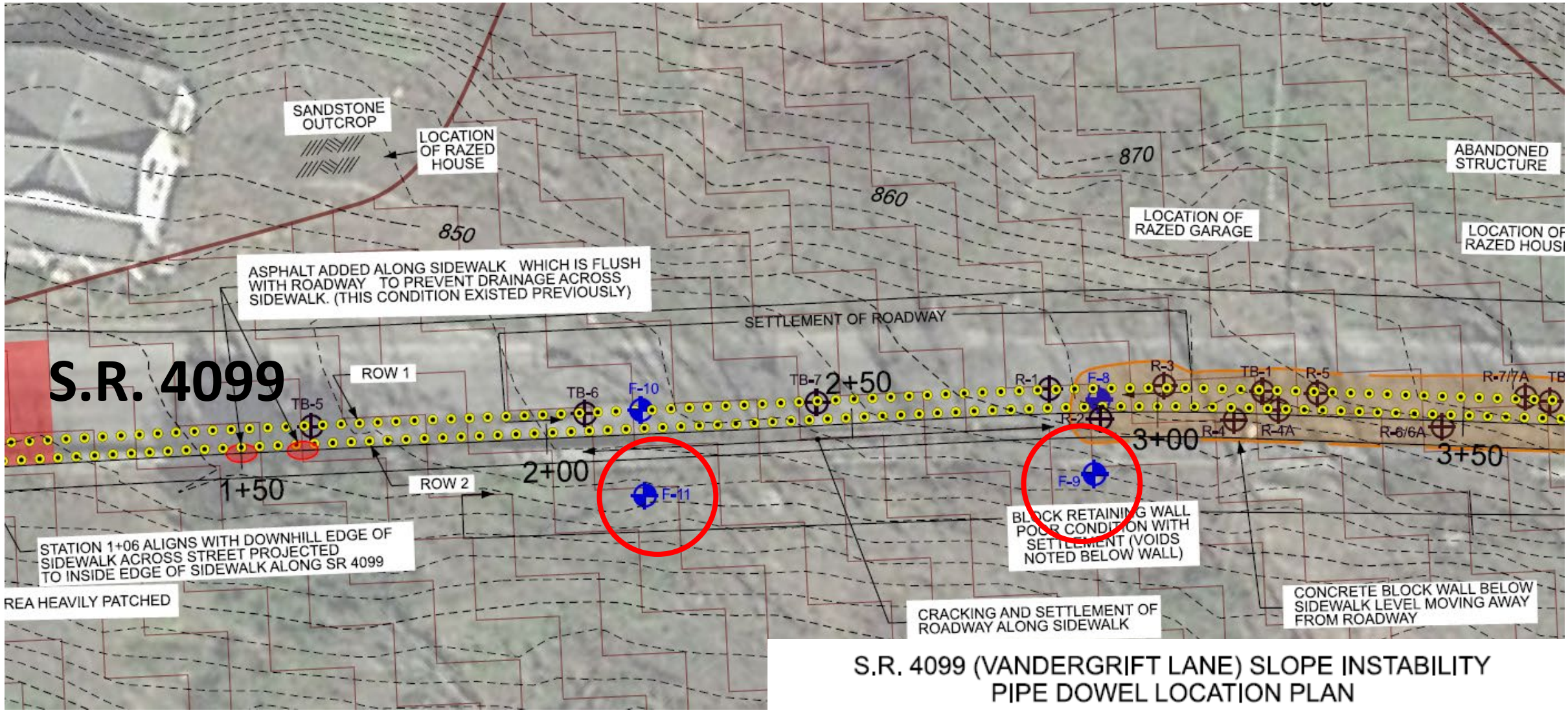


April 1993, Structure Count = 13

Soil Slippage Potential- ShF (Shelocta-Gilpin channery silt loam with High Soil Slippage Potential)




WkF
ErC
mh
bc
ErC
uf
S.R. 4099
S.R. 4099 (VANDERGRIFT LANE) SLIDE REPAIR
PIPE DOWEL LOCATION PLAN
PLAN DATE: 4/14/2020
SCALE



S.R. 4099 (VANDERGRIFT LANE) SLOPE INSTABILITY
PIPE DOWEL LOCATION PLAN

PLAN DATE: 1/13/2020

0' 20' 40'
SCALE

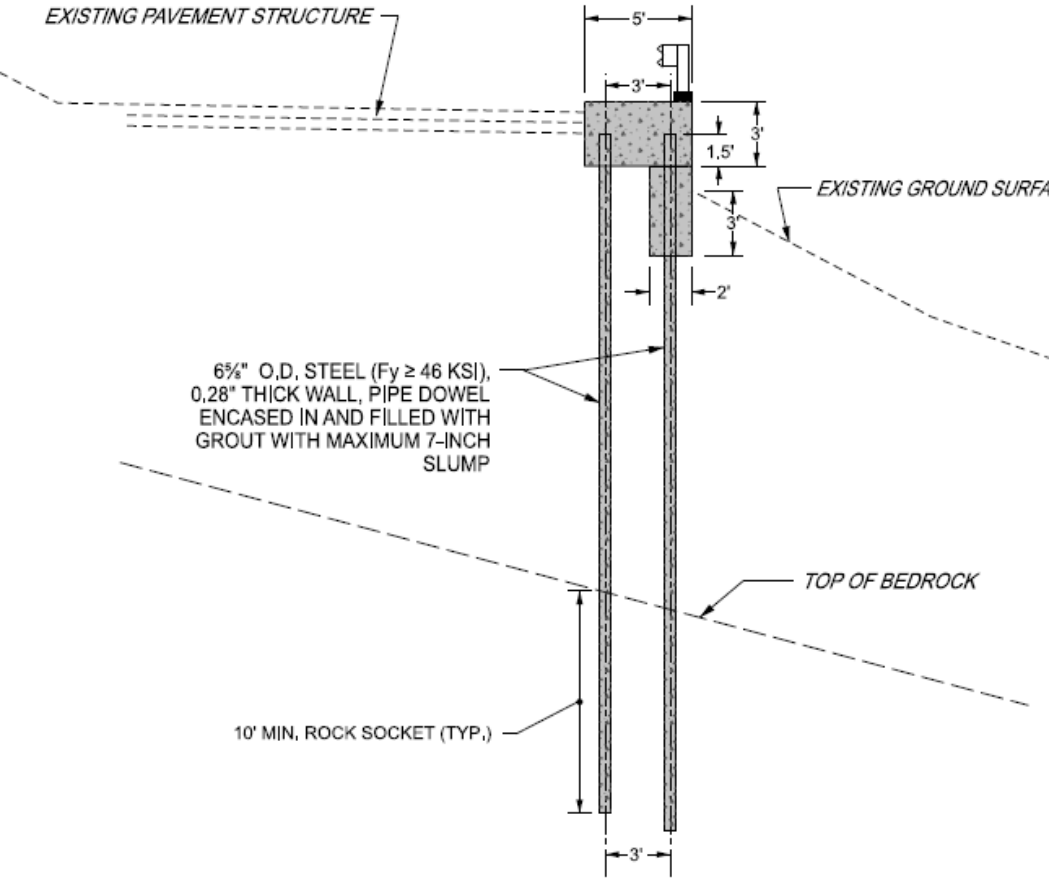
- PROPOSED PIPE DOWEL LOCATION
- TEST BORING DRILLED IN 2017
- OLDER EXISTING TEST BORING
- PREVIOUS AREA OF VOIDS ENCOUNTERED IN TEST BORINGS BENEATH ROADWAY (FILLED WITH CONCRETE BY MAINTENANCE IN JUNE 2017)
- AREA OF ANCIENT LANDSLIDE

BASE PLAN (CONTOURS AND PHOTO BACKGROUND) BASED ON 2006 DATA DOWNLOADED FROM THE PAMAP PROGRAM.
SOIL DATA IS FROM SOIL SURVEY OF WESTMORELAND COUNTY AND, COAL DATA IS FROM COAL RESOURCES OF WESTMORELAND COUNTY.
TEST BORING LOCATIONS BASED ON FIELD OBSERVATIONS AND SKETCHES RECEIVED FROM PA1240 GEOTECHNICAL UNIT.

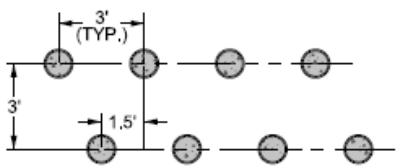
EARTH, INC.

F-9 Inclinometer in background (0.45”/year movement on top of rock up until May 2020, 4.8”/year from May to August 2020)

F-11 Inclinometer in foreground (1.025”/year movement on top of rock based on last obtainable reading in February 2020, wall was fully collapsing in May 2020)



ELEVATION VIEW
NTS



PLAN VIEW
NTS

S.R. 4099 (VANDERGRIFT LANE)
PIPE DOWEL SLIDE REPAIR DETAIL

Designing a Pipe Dowel System

pennsylvania
DEPARTMENT OF TRANSPORTATION

INSPECTOR'S FIELD LOG

BORING NO.: F-9
SHEET 1 OF 2
ECMS #.:
O.G.ELEV.

PROJECT NAME: VANDERGRIFT DISTRICT 12 COUNTY WESTMORELAND
DATE/TIME: STARTED 5-2-17@12:30PM ENDED 5-3-17@11:55 GROUTED 5-3-17
LAT. LONG. NORTHING EASTING
SR 4099 SEC — SEG/OFFSET 0040/0000-1080 STA 2+89 OFFSET (CL)/BL 20'RT
DRILLER NAME/COMPANY GARY GREENAWALT/TBS RIG STICK (DINGO) HOLE TYPE CSPS THROUGH COAL 10'R
ROCK CORE METHOD NQ - SET INCLINOMETER CASING TYPE/SIZE DEPTH FT.
HAMMER: TYPE/CALIBRATION DATE SAFETY EFFICIENCY 0.6
WATER: INITIAL DEPTH 7.6 Ft. DATE/TIME 5-3-17@11:55AM NR ☐
FINAL DEPTH — Ft. DATE/TIME INCLINOMETER NR ☒

INSPECTOR (SIGNATURE):
CERT NO.: 267-11

GENERAL BORING REMARKS: SET INCLINOMETER
2- BOXES
6- PICTURES
BOTTOM @ 46.6'
(PAY 50' PIPE)

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PENT or TORVANE (TSF)	AASHTO / USCS Visual	MATERIAL DESCRIPTION and GENERAL SOIL/ROCK REMARKS
							TOPSOIL 0.6
1.5	S-1	1 2 3	1.0		-		CLAY AND SILT, BROWN/GRAY, SHALEY ROCK FRAG'S, LITTLE SAND, DAMP, MEDIUM TO HARD
3.0	S-2	3 4 4	0.5		-	@ 7.6	
4.5	S-3	5 4 9	0.5		-		
6.0	S-4	10 6 6	0.2		-		BLACK COAL SPECKS
7.5	S-5	4 3 5	1.5		-		
9.0	S-6	3 6 6	1.3		1.5	CL-ML	
10.5	S-7	21 18 13	1.3		-		SHALEY
12.0	S-8	13 14 21	1.5		-		
13.5	S-9	8 9 8	1.2		-		
14.4	S-10	9 50/4	0.9		-		14.4
15.0	AUGER - NO SAMPLE						SILT AND SAND, BROWN/GRAY, SHALEY WEATHERED ROCK, DAMP, HARD
15.3	S-11	50/.3	0.3		-		
16.5	AUGER - NO SAMPLE						
16.9	S-12	50/.4	0.3		-		
18.0	AUGER - NO SAMPLE						* TOOK SPOONS TO AUGER REFUSAL DUE TO PREVIOUS FINDINGS OF LOW AND NO RECOVERY WHEN CORING *
18.4	S-13	50/.4	0.4		-		
19.5	AUGER - NO SAMPLE						

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES

← Sliding occurring here

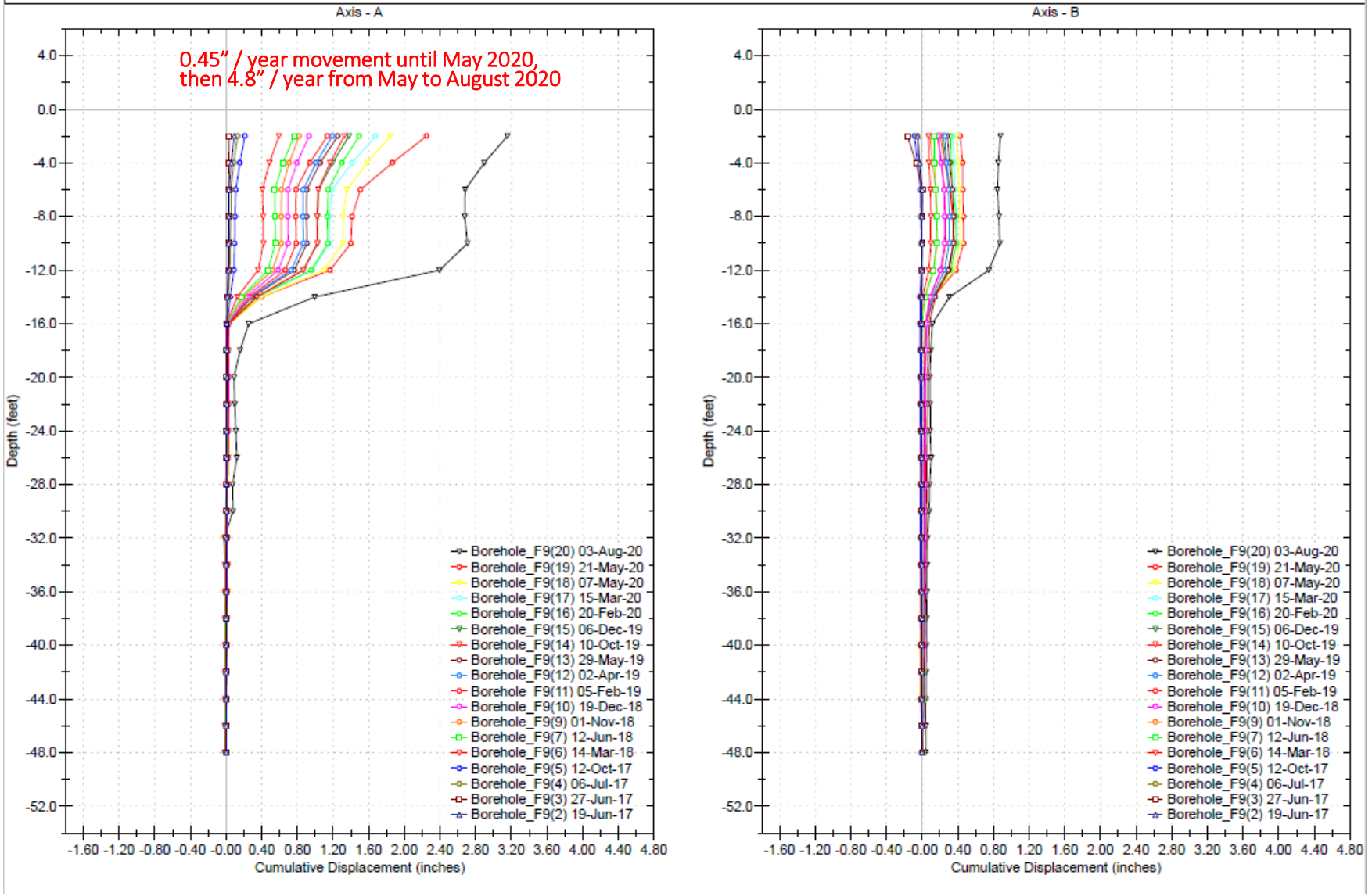
RST Instruments Ltd.

CUMULATIVE DISPLACEMENT

Inclinalysis v. 2.47.5

Borehole : F-9
Project : SR 4099_0040_000_E VANDERGRIFT
Location :
Northing :
Easting :
Collar :

Spiral Correction : N/A
Collar Elevation : 0.0 feet
Borehole Total Depth : 48.0 feet
A+ Groove Azimuth :
Base Reading : 2017 May 23 10:53
Applied Azimuth : 0.0 degrees



pennsylvania
DEPARTMENT OF TRANSPORTATION

INSPECTOR'S FIELD LOG

BORING NO.: F-11
SHEET 1 OF 2
ECMS #.:
O.G.ELEV.

PROJECT NAME: VANDERGRIFT DISTRICT 12 COUNTY WESTMORELAND
DATE/TIME: STARTED 4-28-17 @ 10:30AM ENDED 5-2-17 @ 10:25AM GROUTED 5-2-17
LAT. LONG. NORTHING EASTING
SR 4099 SEC — SEG/OFFSET 0040 | 0000-1080 STA 2+16 OFFSET (CL) BL 20' RT
DRILLER NAME/COMPANY GARY GREENAWALT / TBS RIG STICK DRILL HOLE TYPE CSPS 10' ROCK BELOW CO
ROCK CORE METHOD NQ INSTALL INCLINOMETER CASING TYPE/SIZE 4" CASING DEPTH FT.
HAMMER: TYPE/CALIBRATION DATE SAFETY EFFICIENCY 0.6
WATER: INITIAL DEPTH 10.7' Ft. DATE/TIME 5-2-17 @ 10:25AM NR ☐
FINAL DEPTH — Ft. DATE/TIME INCLINOMETER PIPE NR ☒

INSPECTOR (SIGNATURE): Claudia D. Andrews
CERT NO.: 267-11

GENERAL BORING REMARKS: SET INCLINOMETER BOTTOM @ 41.0' (PAY 50.0' PIPE)
1- BOX
3- PICTURES

DEPTH (FT)	SAMPLE NO. and TYPE / CORE RUN	BLOWS/0.5 FT ON SAMPLER	TOTAL RECOVERY (FT.)	RQD RECOVERY (FT.)	POCKET PEN or TORVANE (TSF)	AASHTO / USCS Visual	MATERIAL DESCRIPTION and GENERAL SOIL/ROCK REMARKS
1.5	S-1	1 2 1	1.0	Da	-	a-5 / OL	SILT AND SAND, W/LITTLE CLAY, ROCK FRAG'S, BLACK/TAN, ORGANICS, SOFT TO STIFF, DAMP.
3.0	S-2	3 1 1	0.4		-		
4.5	S-3	5 6 5	0.0		-		
6.0	S-4	7 7 5	0.2		-		6.0
7.5	S-5	4 3 5	1.0	Da	-	a-6 / CL-ML	CLAY AND SILT, W/SOME SAND AND GRAVEL, BROWN/GRAY; SHALEY, MEDIUM TO VERY STIFF, DAMP W/WET SPOT @ 10.0'
9.0	S-6	5 4 5	0.6		+		
10.5	S-7	5 6 6	1.1	Da W/WET SPOT	-		WET SPOT @ 10.0'
12.0	S-8	5 9 10	1.1	Da	2.5		MOTTLED
12.9	S-9	26 50/.4	0.9	D	-	—	12.0
13.5	AUGER - NO SAMPLE						SILT W/SAND AND GRAVEL, LT BROWN/BROWN, LITTLE CLAY, WEATHERED ROCK, DAMP TO DRY, VERY HARD.
14.8	S-10	15 25 50/.3	1.3	Da	-		
15.0	AUGER - NO SAMPLE						
16.5	S-11	25 36 49	1.2	D	-		
16.6	S-12	50/.1	0.1	D	-		T.O.R. 16.6'
(5.0) 21.6	R-1		0.5/10'	0.0/0'			SANDSTONE, MEDIUM, LT BROWN (LITTLE RECOVERY - NO VOIDS)

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL AND ROCK TYPES

← Sliding occurring here

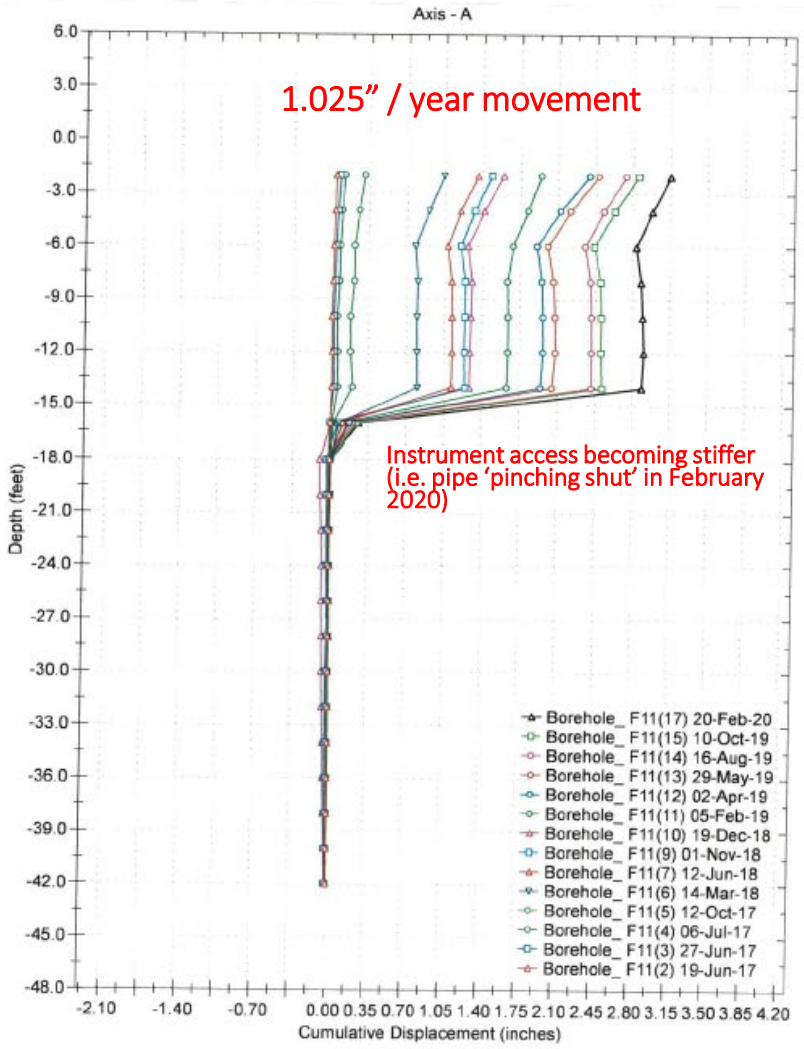
RST Instruments Ltd.

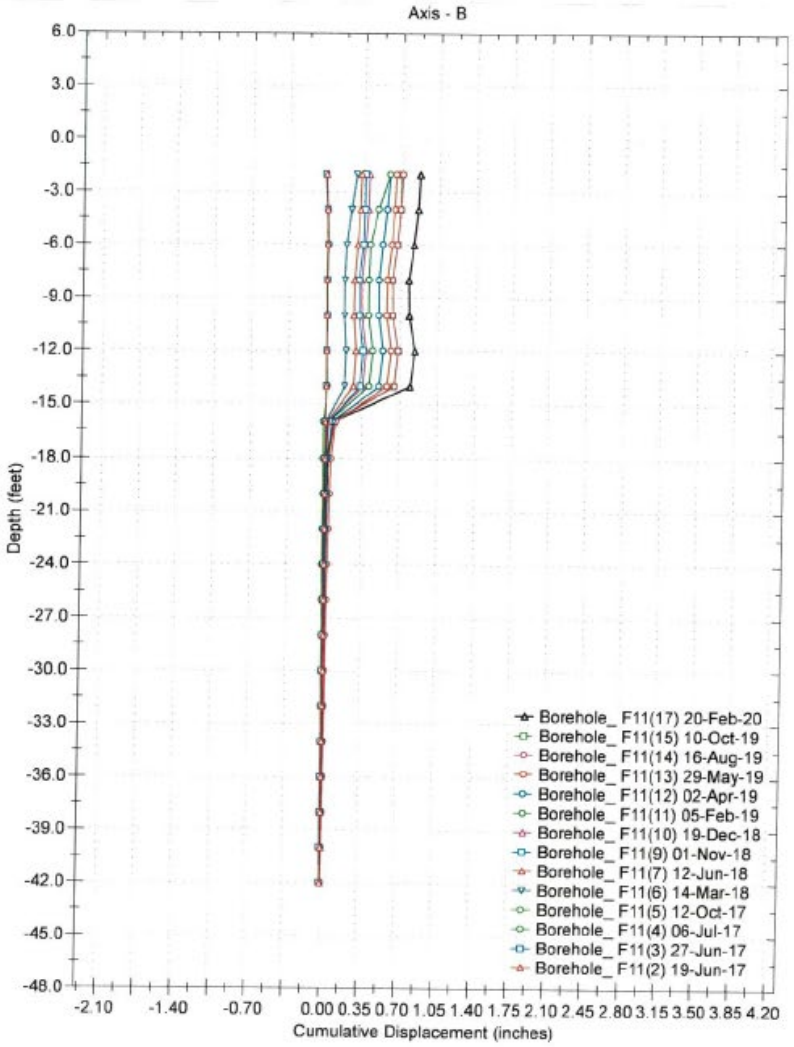
CUMULATIVE DISPLACEMENT

Inclinalysis v. 2.47.5

Borehole : F-11
Project : SR 4099_0040_000_E VANDERGRIFT
Location :
Northing :
Easting :
Collar :

Spiral Correction : N/A
Collar Elevation : 0.0 feet
Borehole Total Depth : 42.0 feet
A+ Groove Azimuth :
Base Reading : 2017 May 23 10:37
Applied Azimuth : 0.0 degrees





S.R. 4099 (VANDERGRIFT LANE) SLIDE REPAIR
WESTMORELAND COUNTY, PA

TABLE 1 - SUMMARY OF LABORATORY SOIL TESTING RESULTS

Boring No.	Sample Depth (feet)	Type of Sample	Sample Origin	Classification		USCS Gradation			Atterberg Limits			Natural Moisture Content (%)	Natural Dry Density (pcf)	Direct Shear[1]		Direct Shear[2]	
														Effective Stress		Effective Stress	
				USCS	AASHTO	% Rock Frags. or Gravel	% Sand	% Fines	LL	PL	PI			Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)
F-13	7.0 - 9.0	Shelby Tube (ST-1)	Colluvium	CL	A-6(8)	14.5	16.2	69.3	36	23	13	22.6	99.7	-	-	0	37.0
F-14	13.5 - 15.5	Shelby Tube (ST-1)	Colluvium	SC	A-4(1)	28.2	27.8	44.0	27	18	9	15.0	116.1	217.2	38.9	0	41.3
F-14	20.0 - 24.0	Bag (B-2)	Alluvium	SM	A-2-4(0)	5.6	66.9	27.5	17	16	1	11.9	-	-	-	-	-

[1]Strength parameters based on best fit line through data points.
[2]Strength parameters based on best fit line through data points and origin.

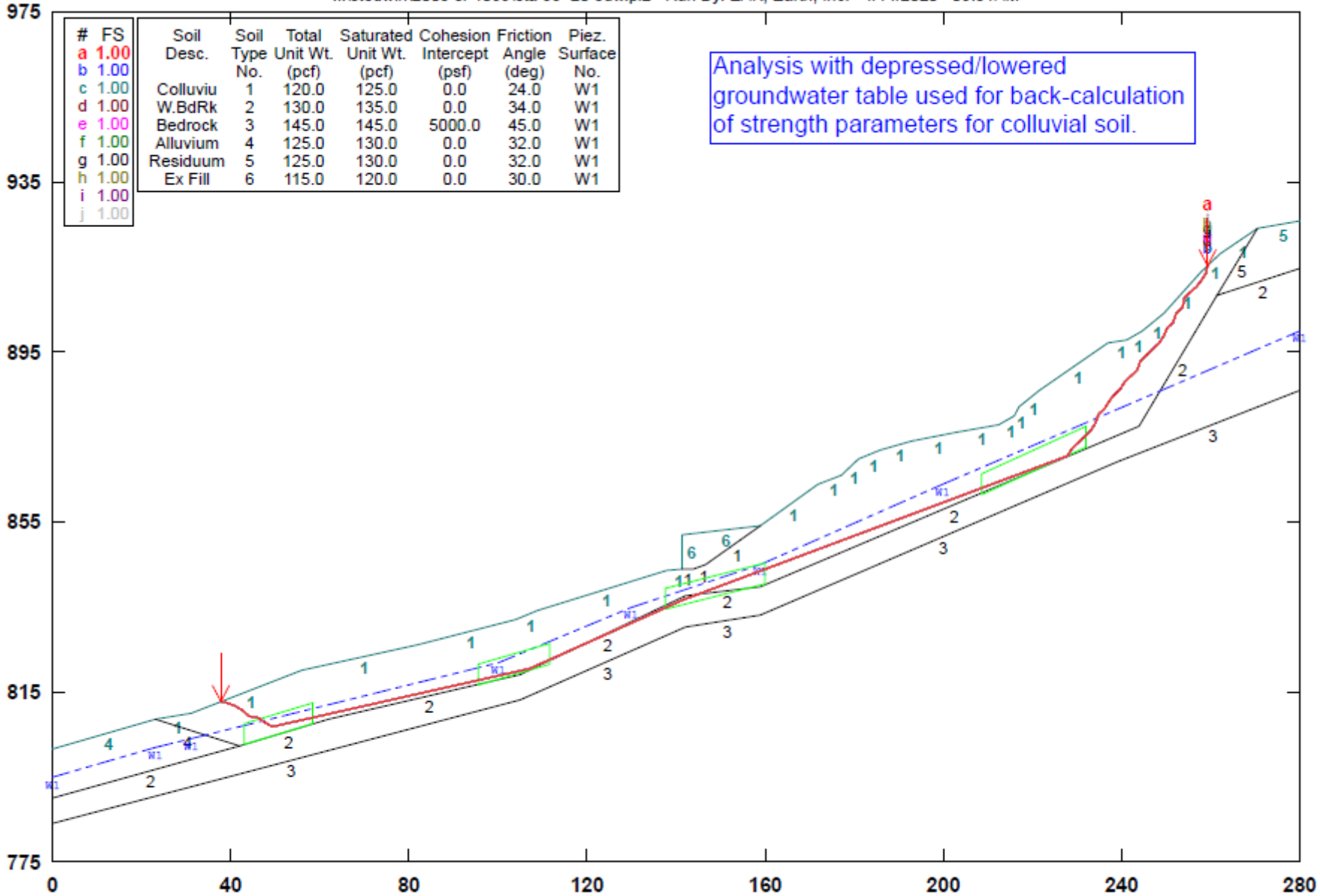
SR 4099 Slide @ Sta 88+20 - Existing Condition with Depressed Water Table

k:\stedwin\2005 sr 4099\sta 88+20 edw.pl2 Run By: EAK, Earth, Inc. 4/14/2020 09:51AM

#	FS
a	1.00
b	1.00
c	1.00
d	1.00
e	1.00
f	1.00
g	1.00
h	1.00
i	1.00
j	1.00

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Colluviu	1	120.0	125.0	0.0	24.0	W1
W.BdRk	2	130.0	135.0	0.0	34.0	W1
Bedrock	3	145.0	145.0	5000.0	45.0	W1
Alluvium	4	125.0	130.0	0.0	32.0	W1
Residuum	5	125.0	130.0	0.0	32.0	W1
Ex Fill	6	115.0	120.0	0.0	30.0	W1

Analysis with depressed/lowered groundwater table used for back-calculation of strength parameters for colluvial soil.



GSTABL7 v.2 FSmin=1.00

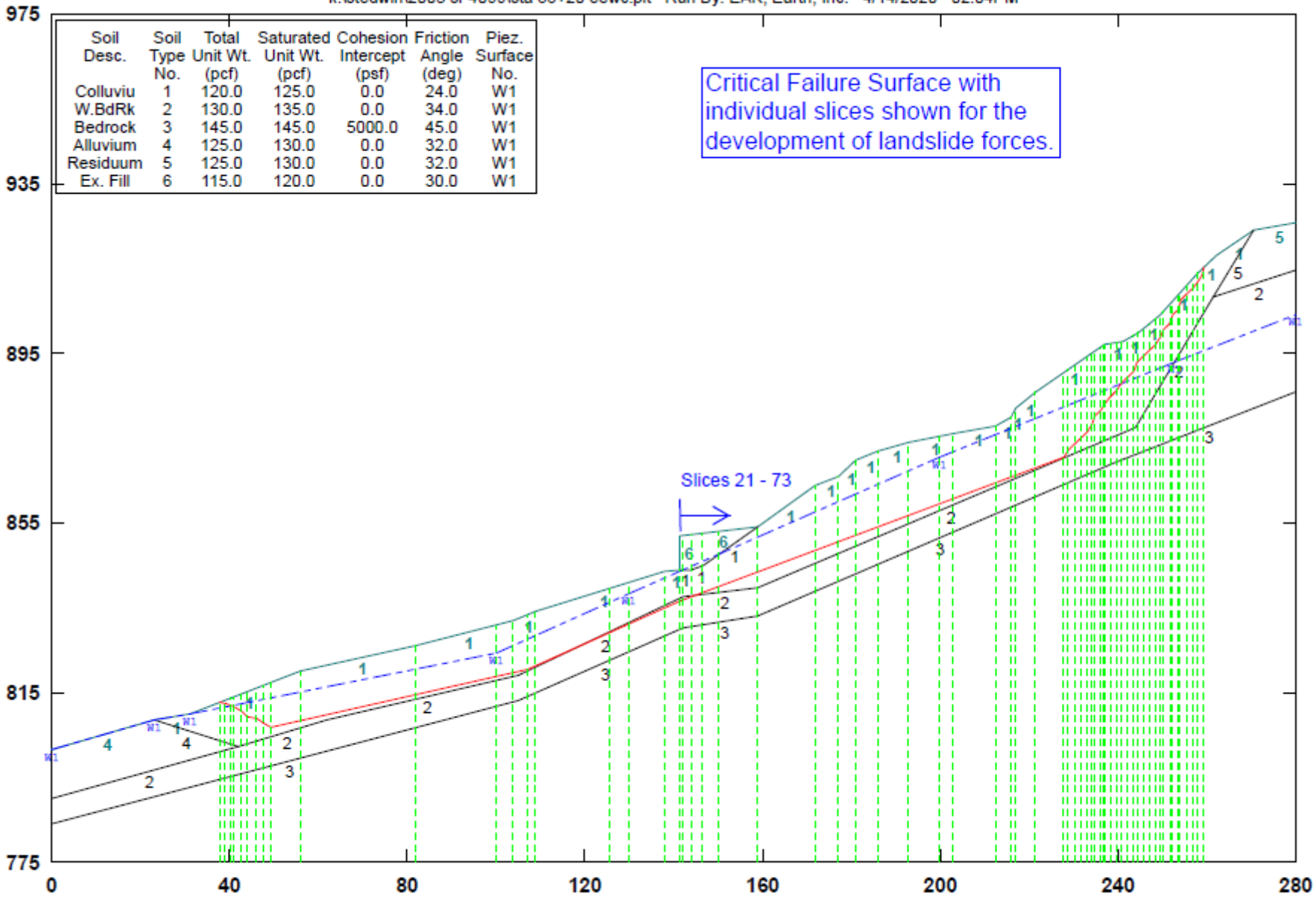
Safety Factors Are Calculated By The Simplified Janbu Method

EARTH, INC.

SR 4099 Slide @ Sta 88+20 - Existing Condition with Elevated Water Table

k:\stedwin\2005 sr 4099\sta 88+20 eewc.plt Run By: EAK, Earth, Inc. 4/14/2020 02:04PM

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Colluviu	1	120.0	125.0	0.0	24.0	W1
W.BdRk	2	130.0	135.0	0.0	34.0	W1
Bedrock	3	145.0	145.0	5000.0	45.0	W1
Alluvium	4	125.0	130.0	0.0	32.0	W1
Residuum	5	125.0	130.0	0.0	32.0	W1
Ex. Fill	6	115.0	120.0	0.0	30.0	W1



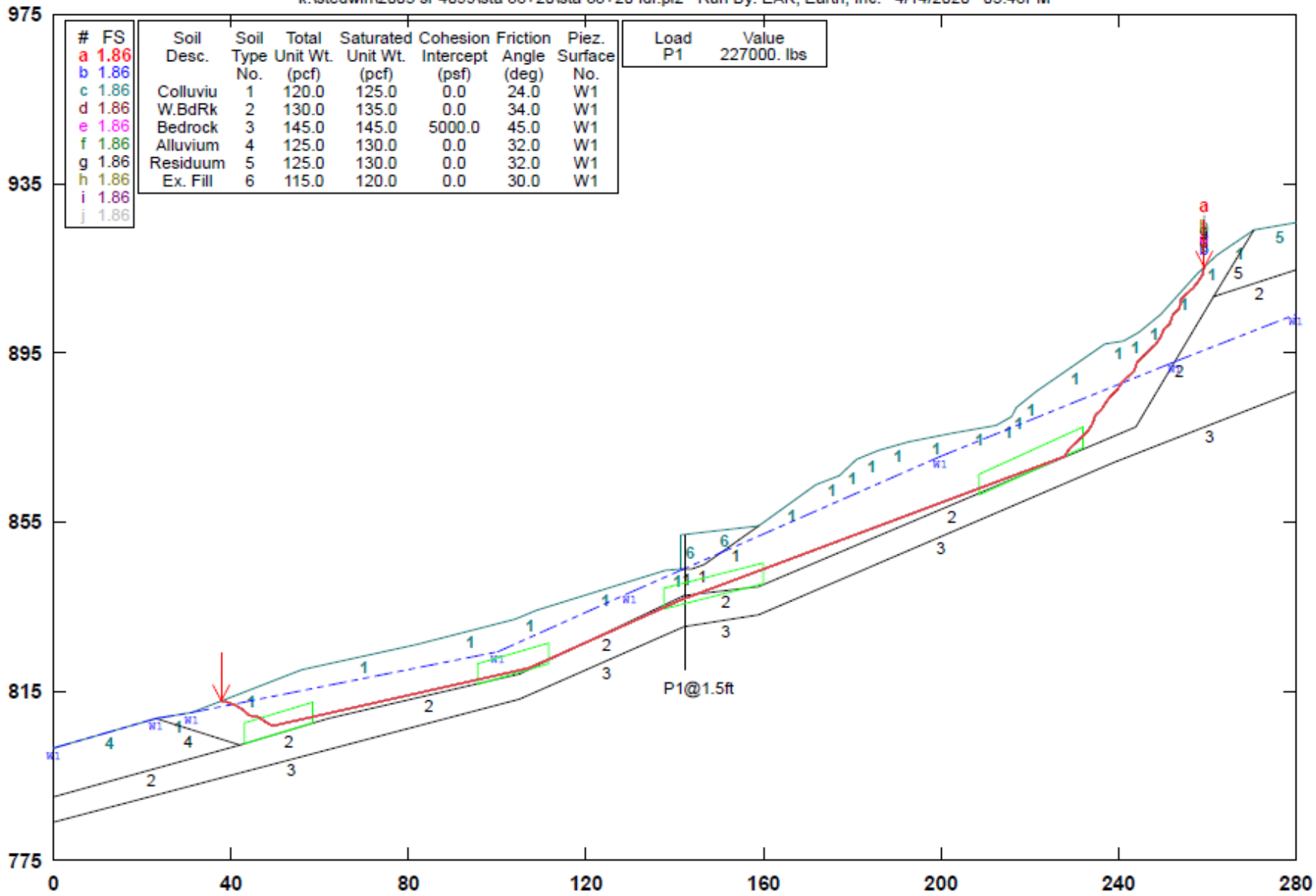
GSTABL7 v.2 FSmin=0.79

Factor Of Safety Is Calculated By The Simplified Janbu Method

EARTH, INC.

SR 4099 Slide @ Sta 88+20 - Final Condition with Pipe Dowel System

k:\stedwin\2005 sr 4099\sta 88+20\sta 88+20 fdr.pl2 Run By: EAK, Earth, Inc. 4/14/2020 03:48PM



#	FS
a	1.86
b	1.86
c	1.86
d	1.86
e	1.86
f	1.86
g	1.86
h	1.86
i	1.86
j	1.86

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Colluviu	1	120.0	125.0	0.0	24.0	W1
W.BdRk	2	130.0	135.0	0.0	34.0	W1
Bedrock	3	145.0	145.0	5000.0	45.0	W1
Alluvium	4	125.0	130.0	0.0	32.0	W1
Residuum	5	125.0	130.0	0.0	32.0	W1
Ex. Fill	6	115.0	120.0	0.0	30.0	W1

Load	Value
P1	227000. lbs

GSTABL7 v.2 FSmin=1.86

Safety Factors Are Calculated By The Simplified Janbu Method

EARTH, INC.

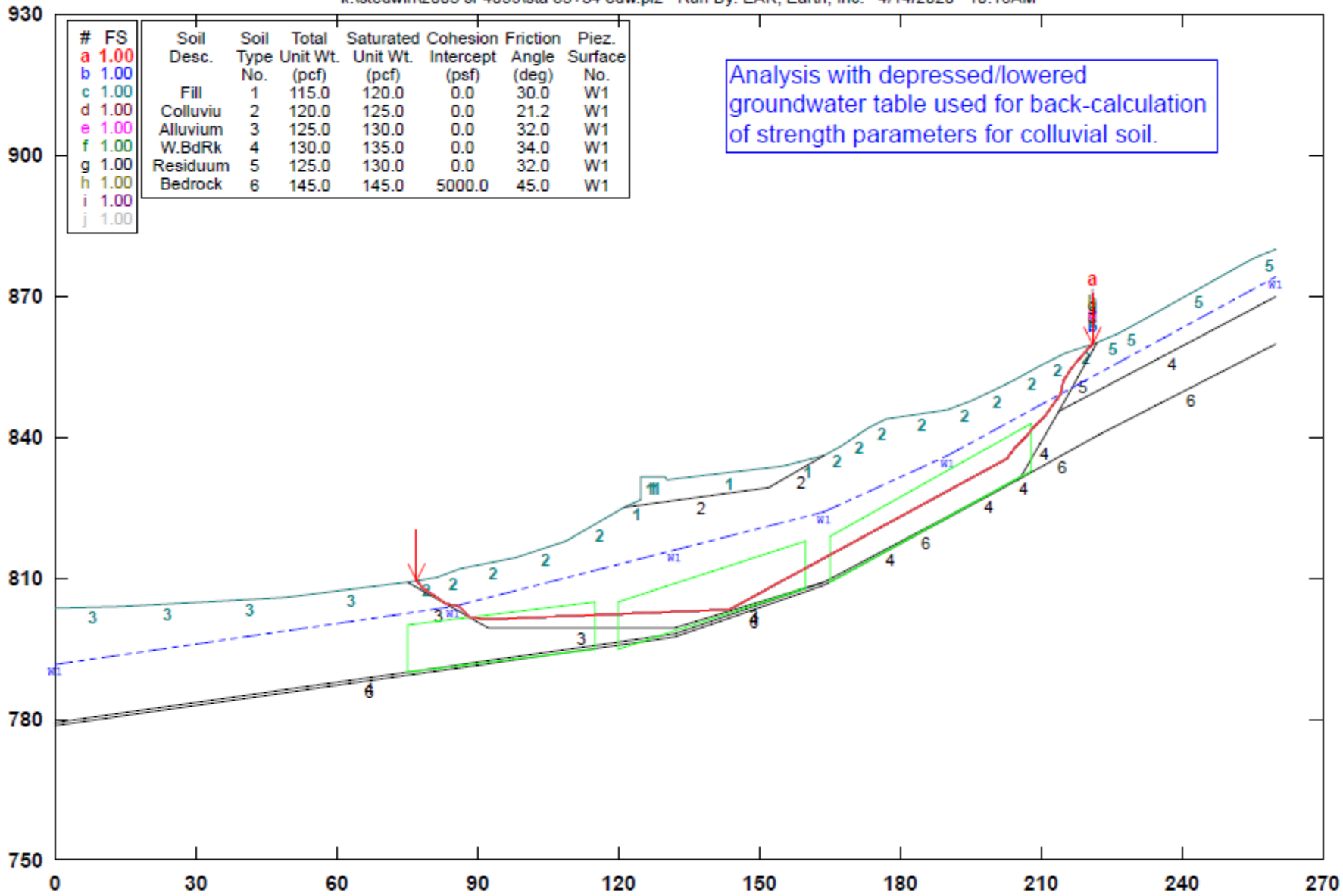
SR 4099 Slide @ Sta 85+34 - Existing Condition with Depressed Water Table

k:\stedwin\2005 sr 4099\sta 85+34 edw.pl2 Run By: EAK, Earth, Inc. 4/14/2020 10:16AM

#	FS
a	1.00
b	1.00
c	1.00
d	1.00
e	1.00
f	1.00
g	1.00
h	1.00
i	1.00
j	1.00

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	115.0	120.0	0.0	30.0	W1
Colluviu	2	120.0	125.0	0.0	21.2	W1
Alluvium	3	125.0	130.0	0.0	32.0	W1
W.BdRk	4	130.0	135.0	0.0	34.0	W1
Residuum	5	125.0	130.0	0.0	32.0	W1
Bedrock	6	145.0	145.0	5000.0	45.0	W1

Analysis with depressed/lowered groundwater table used for back-calculation of strength parameters for colluvial soil.



GSTABL7 v.2 FSmin=1.00

Safety Factors Are Calculated By The Simplified Janbu Method

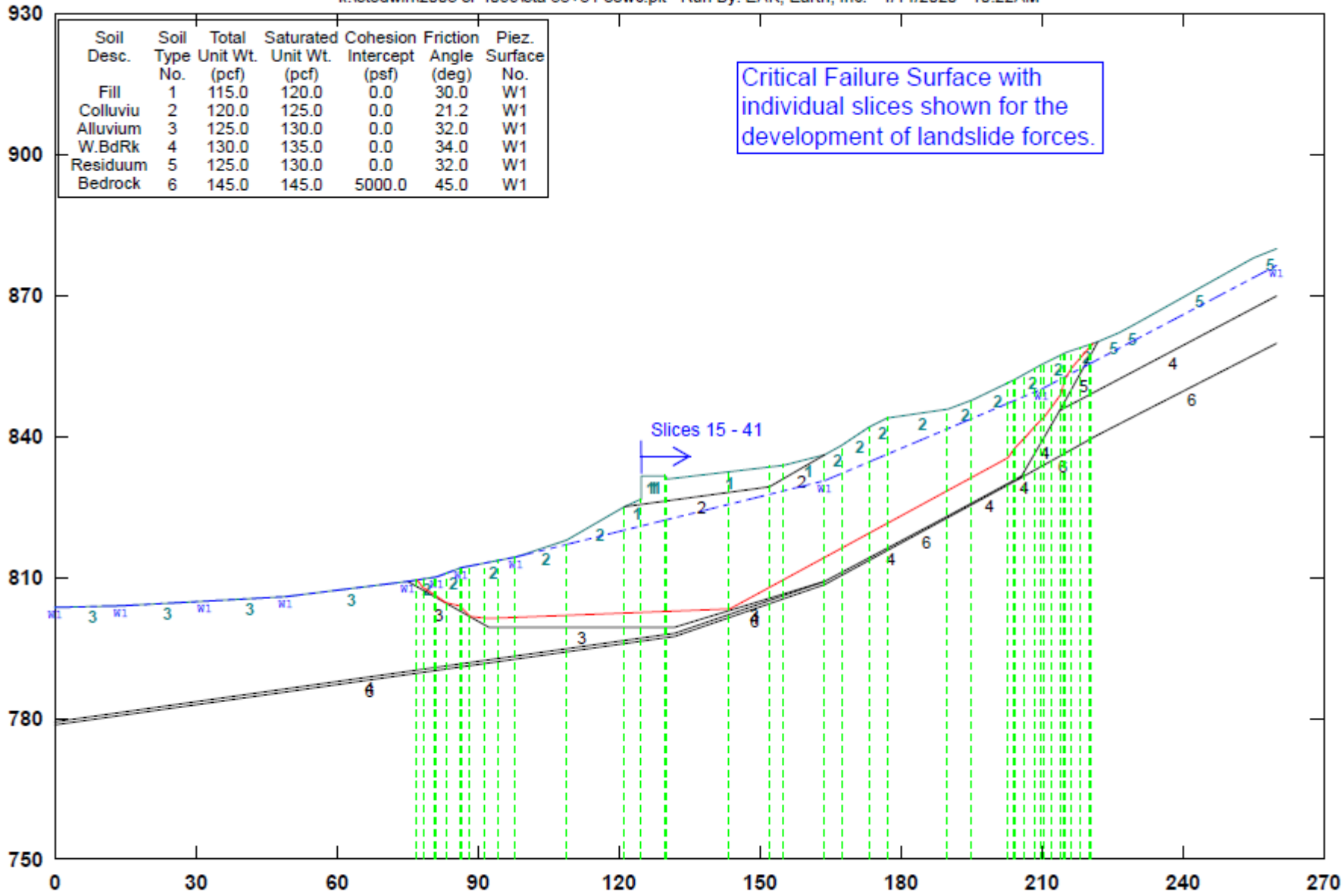
EARTH, INC.

SR 4099 Slide @ Sta 85+34 - Existing Condition with Elevated Water Table

k:\stedwin\2005 sr 4099\sta 85+34 eewc.plt Run By: EAK, Earth, Inc. 4/14/2020 10:22AM

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	115.0	120.0	0.0	30.0	W1
Colluviu	2	120.0	125.0	0.0	21.2	W1
Alluvium	3	125.0	130.0	0.0	32.0	W1
W.BdRk	4	130.0	135.0	0.0	34.0	W1
Residuum	5	125.0	130.0	0.0	32.0	W1
Bedrock	6	145.0	145.0	5000.0	45.0	W1

Critical Failure Surface with individual slices shown for the development of landslide forces.



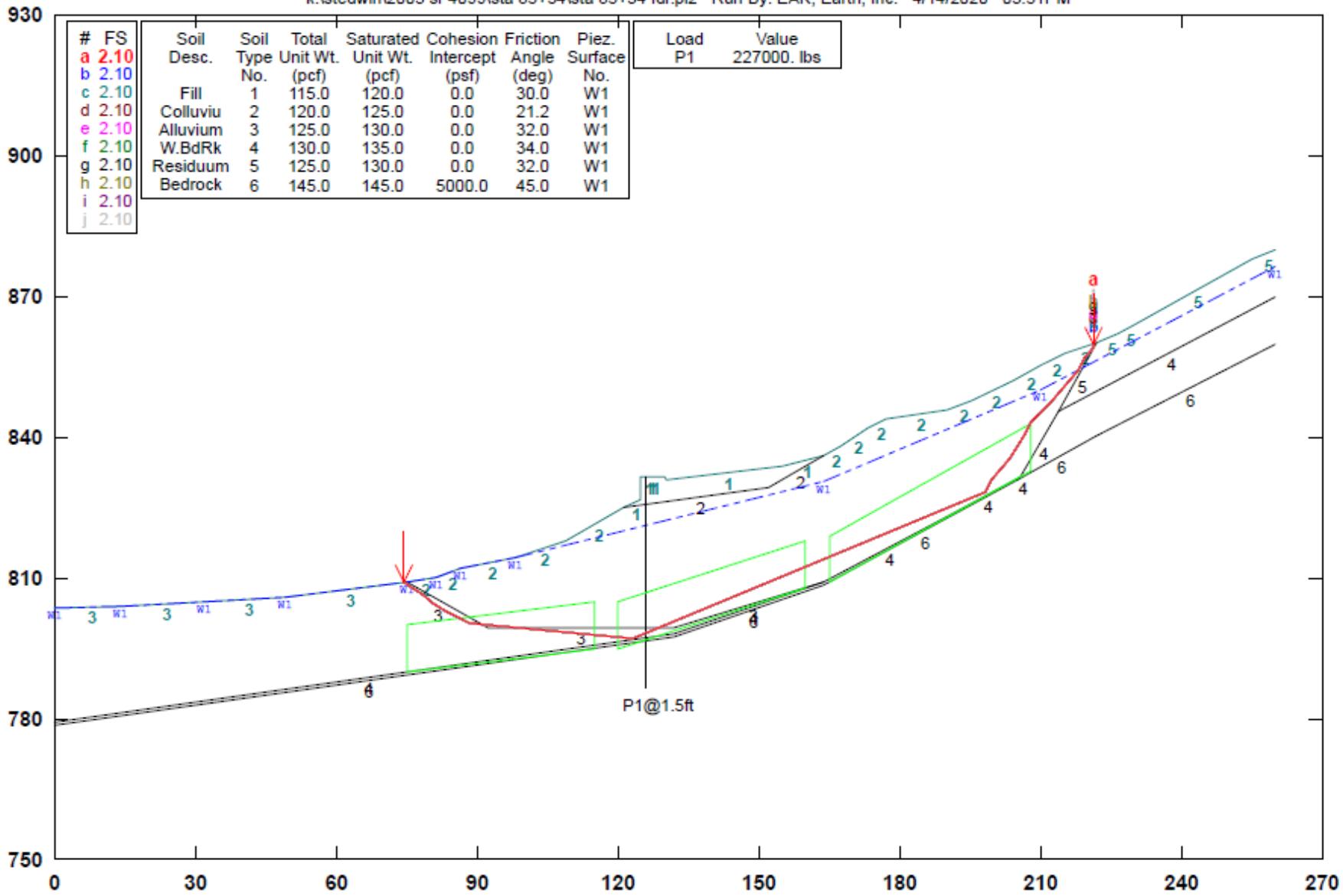
GSTABL7 v.2 FSmin=0.78

Factor Of Safety Is Calculated By The Simplified Janbu Method

EARTH, INC.

SR 4099 Slide @ Sta 85+34 Final Condition with Pipe Dowel System

k:\stedwin\2005 sr 4099\sta 85+34\sta 85+34 fdr.pl2 Run By: EAK, Earth, Inc. 4/14/2020 03:51PM



#	FS
a	2.10
b	2.10
c	2.10
d	2.10
e	2.10
f	2.10
g	2.10
h	2.10
i	2.10
j	2.10

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Fill	1	115.0	120.0	0.0	30.0	W1
Colluviu	2	120.0	125.0	0.0	21.2	W1
Alluvium	3	125.0	130.0	0.0	32.0	W1
W.BdRk	4	130.0	135.0	0.0	34.0	W1
Residuum	5	125.0	130.0	0.0	32.0	W1
Bedrock	6	145.0	145.0	5000.0	45.0	W1

Load	Value
P1	227000. lbs

GSTABL7 v.2 FSmin=2.10

Safety Factors Are Calculated By The Simplified Janbu Method

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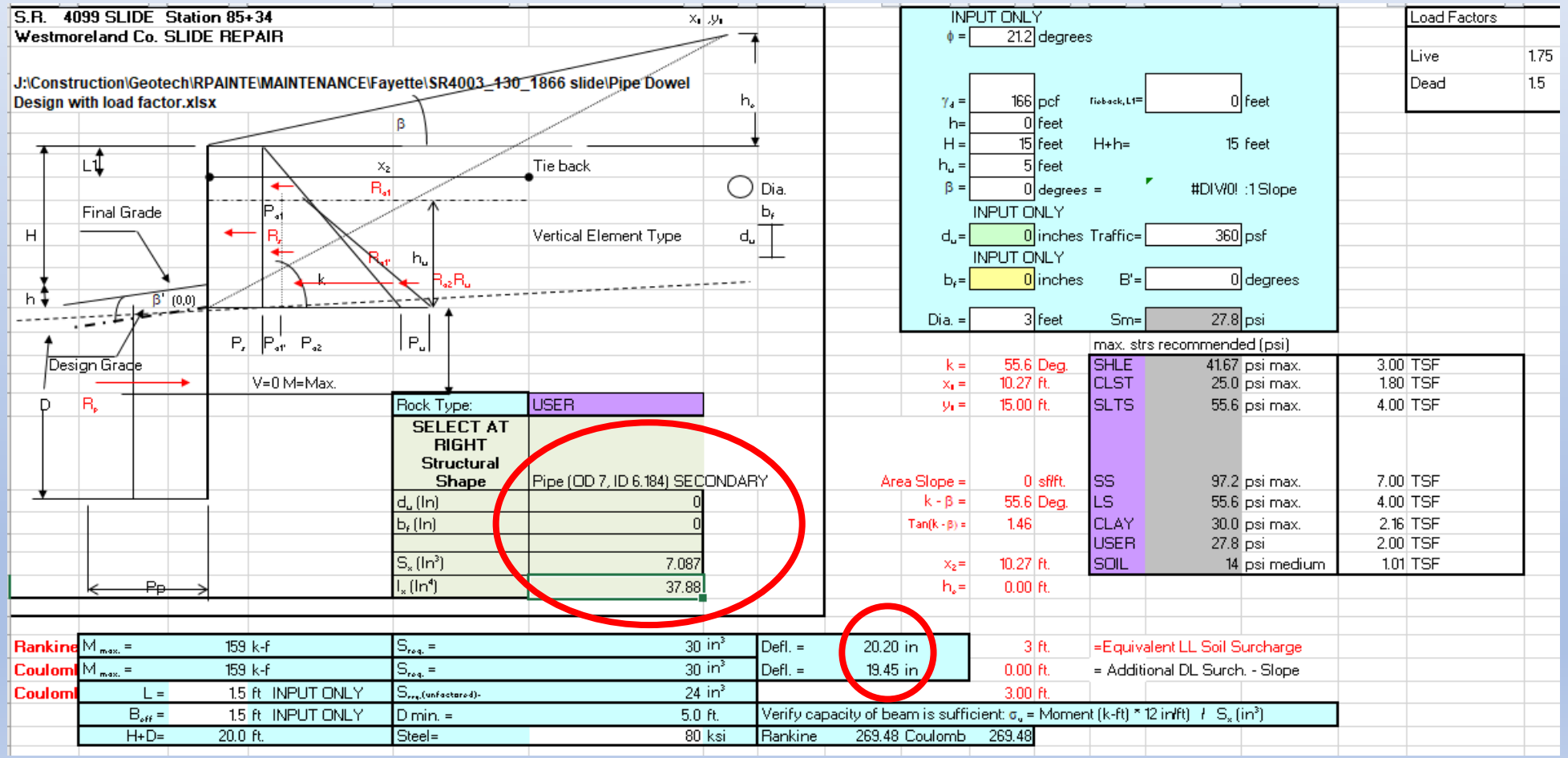
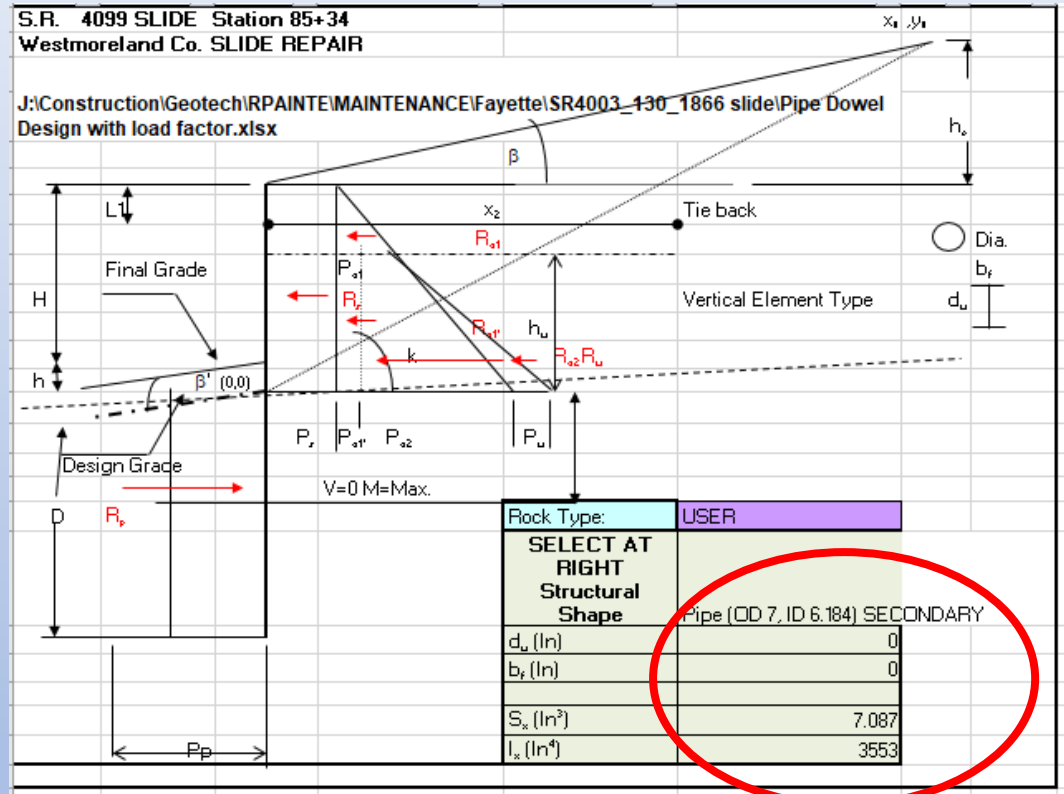
Tops of Pipes not connected: 20” deflection



Tops of Pipes connected: 0.20” deflection



Rock Type:	USER
SELECT AT RIGHT Structural Shape	Pipe (OD 7, ID 6.184) SECONDARY
d_u (In)	0
b_f (In)	0
S_x (In^3)	7.087
I_x (In^4)	3553

INPUT ONLY

ϕ =	21.2	degrees			
γ_d =	166	pcf	fieback, Lt=	0	feet
h=	0	feet			
H =	15	feet	H+h=	15	feet
h_u =	5	feet			
β =	0	degrees =		#DIV/0!	:1 Slope
INPUT ONLY					
d_u =	0	inches	Traffic=	360	psf
INPUT ONLY					
b_f =	0	inches	B'=	0	degrees
Dia. =	3	feet	Sm=	27.8	psi

Load Factors	
Live	1.75
Dead	1.5

k =	55.6	Deg.	max. strs recommended (psi)			
x_s =	10.27	ft.	SHLE	41.67	psi max.	3.00 TSF
y_s =	15.00	ft.	CLST	25.0	psi max.	1.80 TSF
			SLTS	55.6	psi max.	4.00 TSF
Area Slope =	0	sf/ft.	SS	97.2	psi max.	7.00 TSF
k - β =	55.6	Deg.	LS	55.6	psi max.	4.00 TSF
Tan(k - β) =	1.46		CLAY	30.0	psi max.	2.16 TSF
			USER	27.8	psi	2.00 TSF
x_2 =	10.27	ft.	SOIL	14	psi medium	1.01 TSF
h_s =	0.00	ft.				

Rankine	$M_{max.}$ =	159 k-f	$S_{req.}$ =	30 in^3	Defl. =	0.22 in	3 ft. =Equivalent LL Soil Surcharge
Coulomb	$M_{max.}$ =	159 k-f	$S_{req.}$ =	30 in^3	Defl. =	0.21 in	0.00 ft. = Additional DL Surch. - Slope
Coulomb	L =	1.5 ft INPUT ONLY	$S_{req.(unfactored)}$ =	24 in^3			3.00 ft.
	B_{eff} =	1.5 ft INPUT ONLY	D min. =	5.0 ft.	Verify capacity of beam is sufficient: σ_u = Moment (k-ft) * 12 in/ft) / S_x (in^3)		
	H+D=	20.0 ft.	Steel=	80 ksi	Rankine	269.48 Coulomb	269.48

Pipe Dowel Properties

Pipe Dowels: Outside Dia., $d_o = 7.0"$
Inside Dia., $d_i = 6.184"$
Wall Thickness, $t = 0.408"$

} See attached Nucor Skyline threaded secondary casing for micropile data sheet

- Assume 1/16" deduction in dowel section to account for corrosion during service life.

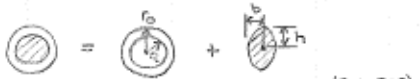
$d_o = 7.0" - 2(1/16") = 6.875"$

$t = 0.408" - 1/16" = 0.345"$

Min. Yield Strength, $F_y = 80$ ksi

Neat Cement Grout: Min. Yield Strength, $f'_c = 4{,}000$ psi

Moment of Inertia of Concrete-Filled Pipe Dowel:



= Steel Transformed Section + Concrete (Ellipse)

$E_s = 29 \times 10^6$ psi

$E_c = 57{,}000\sqrt{f'_c}$

$E_c = 57{,}000\sqrt{4{,}000\ psi} = 3.6 \times 10^6$ psi

$n = E_s/E_c = \frac{29 \times 10^6\ psi}{3.6 \times 10^6\ psi} = 8.06$

$I_s = 1/4\ \pi (r_o^4 - r_i^4)$ for steel pipe

$I_s = 1/4\ \pi (3.4375^4 - 3.092^4) = 37.88\ in^4$

$I_c = 1/4\ \pi\ b\ h^3$ for concrete (ellipse)

where $b = h/n$

$h = 3.092"$

$b = 3.092"/8.06 = 0.384"$

$I_c = 1/4\ \pi (0.384\ in)(3.092\ in)^3 = 8.92\ in^4$

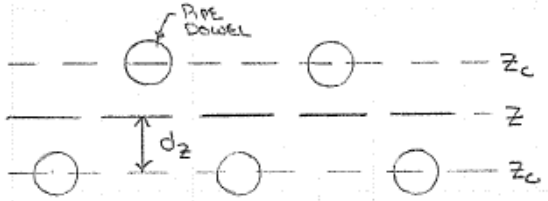
$I = I_s + I_c = 37.88\ in^4 + 8.92\ in^4 = 46.8\ in^4$

EARTH, INC.
CONSULTING ENGINEERS
THE GRISTMILL - SUITE 100
101 BELLEVUE ROAD
PITTSBURGH, PA 15229
(412) 931-6393
FAX: (412) 931-2820

CONTRACT: 2005 SR 4049 Slide Repair	DATE: 4/13/20	SHT: 3/54
	BY: PEB	CKD: EAK
	Pipe Dowels	

BENDING CAPACITY

DETERMINE THE BENDING CAPACITY OF THE PIPE DOWEL SYSTEM/REINFORCED SOIL MASS. TREAT THE SYSTEM AS A COMPOSITE SECTION AND DETERMINE THE MOMENT OF INTERIA BASED ON THE PARALLEL AXIS THEOREM.



$$I_z = \Sigma (I_{z_c} + A d_z^2)$$

REF: THE CIVIL ENGINEERING HANDBOOK p. 1399, Eq. 44.53b

$d_z = 18''$

$I_{z_c} = 46.8\ in^4$

$A = 10.82\ in^2$

FOR 3' SECTION (2 DOWELS)

$$I_{3'} = (2 \times 46.8\ in^4) + (2)(10.82\ in^2)(18\ in)^2$$

$$I_{3'} = 7{,}105\ in^4$$

FOR 1.5' SECTION

$$I_{1.5'} = I_{3'}/2$$

$$I_{1.5'} = 7{,}105\ in^4/2 = 3{,}553\ in^4$$

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CONTRACT: 2005 SR 4099 SLIDE REPAIR

DATE: 4/13/20

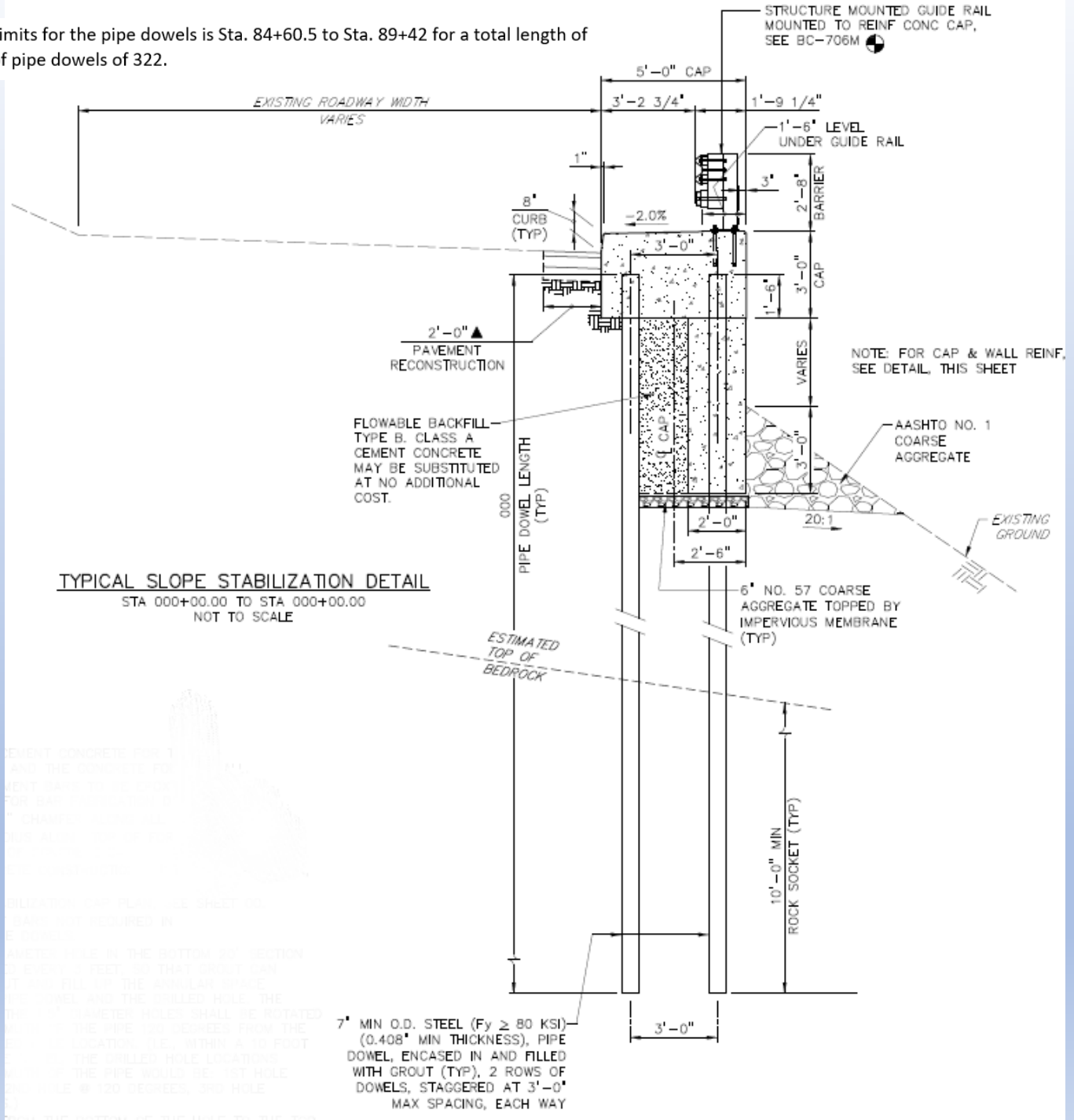
SHT: 3/54

BY: PEB

CKD: EAK

PIPE DOWELS

The recommended station limits for the pipe dowels is Sta. 84+60.5 to Sta. 89+42 for a total length of 481.5' and a total number of pipe dowels of 322.



TYPICAL SLOPE STABILIZATION DETAIL

STA 000+00.00 TO STA 000+00.00
NOT TO SCALE

NOTES:

1. USE CLASS A CEMENT CONCRETE FOR THE CONCRETE CAP AND THE CONCRETE FORMED WALL.
2. ALL REINFORCEMENT BARS TO BE EPOXY-COATED, SEE BC-736M FOR BAR FABRICATION DETAILS.
3. PROVIDE 1" x 1" CHAMFER ALONG ALL CONCRETE EDGES.
4. PROVIDE 1" RADIUS ALONG TOP OF FORMED CURB ON ROADWAY SIDE OF CONCRETE CAP.
5. PROVIDE CONCRETE CONSTRUCTION JOINTS AT 45'-0" MAX, SEE BC-735M.
6. FOR SLOPE STABILIZATION CAP PLAN, SEE SHEET 00.
7. REINFORCEMENT BARS NOT REQUIRED IN THE 80 KSI PIPE DOWELS.
8. DRILL A 1.5" DIAMETER HOLE IN THE BOTTOM 20' SECTION OF PIPE, SPACED EVERY 3 FEET, SO THAT GROUT CAN EASILY FLOW OUT AND FILL UP THE ANNULAR SPACE BETWEEN THE PIPE DOWEL AND THE DRILLED HOLE. THE LOCATIONS OF THE 1.5" DIAMETER HOLES SHALL BE ROTATED ALONG THE AZIMUTH OF THE PIPE 120 DEGREES FROM THE PREVIOUS DRILLED HOLE LOCATION. (I.E., WITHIN A 10 FOOT SECTION OF THE DOWEL, THE DRILLED HOLE LOCATIONS ALONG THE AZIMUTH OF THE PIPE WOULD BE: 1ST HOLE @ 0 DEGREES, 2ND HOLE @ 120 DEGREES, 3RD HOLE @ 240 DEGREES.)
9. PLACE GROUT FROM THE BOTTOM OF THE HOLE TO THE TOP OF PIPE. VIBRATE THE GROUT WITH AN IMMERSION-TYPE VIBRATING ROD SUCH AS A CONCRETE VIBRATOR OR A CASING VIBRATOR-APPROVED BY THE ENGINEER-SO THAT ALL FREE WATER IN THE HOLES DISCHARGES FROM BOTH WITHIN AND OUTSIDE THE PIPE WHILE MAINTAINING THE GROUT LEVEL AT THE TOP.


318 Vandergrift Lane
PHOTO 1
S.R. 4099


S.R. 4099

S.R. 4099

Photo of northern most remaining house along this corridor.

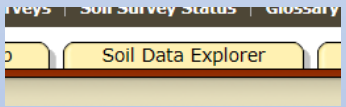
Cracks in soil occurring during construction in the front yard of the northern most remaining house.

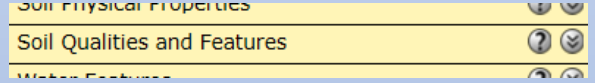
Geotechnical takeaways

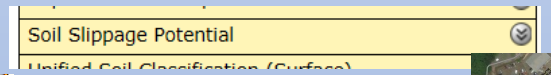
- Slide prone soils identified in Web Soil survey using the following steps indeed proved true to site conditions:
  - 1. Open Web Soil Survey (WSS): https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm
  - 2. Start WSS by pressing the green butt 

  - 3. Zoom to area of interest (AOI)
  - 4. Set AOI: 

Double click last point to set area
  - 5. Open Soil Data Explorer:
  - 6. Click Soil Qualities and Features:
  - 7. Click Soil Slippage Potential:
  - 8. Click View Rating:
  - 9. Click Printable Version:
  - 10. View, Do a screen shot if no printable version is available.







Geotechnical takeaways

- Slope movements consistent through the years occurring on top of bedrock is evident in the inclinometer readings:
  - Inclinometers show historical movement of: 0.45” and 1.025”/year
  - Inclinometers show construction activity movement at: 4.8 “/year
- Deflections will halt once tops of pipe dowels are concreted together and Design in on par with what’s needed to repair the slide:
  - Computed deflections in the piles before concreting the tops: 20”
  - Expected deflections in the piles after concreting the tops: 0.20”