

June 25, 2013

Chip May, Executive Director  
Camp Arcadia  
3046 Oak Street, P.O. Box 229  
Arcadia, MI 49613

Re: SandGrabber Report

Dear Mr. May;

This letter is intended to serve as the final report on the SandGrabber (SG) system placed on your beach over the last two years. Placement of the SG modules was permitted by the State of Michigan as an experimental system, with its removal mandated after a three-year trial. Five surveys were performed to quantify the gains and losses that occurred during the study period. Since then, SandGrabber has changed its name to SandSaver, so any reference to SG is intended to mean either name.

Shore protection at Camp Arcadia beach goes back to at least 1978, when the existing wooden walls and groins were installed. Most of the substantial additions and maintenance took prior to 1987. The continued deterioration of these structures initiated a deliberate search for solutions to their vulnerability, being situated so close to the Lake Michigan shore. Due to the camp's previous shore protection efforts, they are not in a high risk erosion zone. However, immediately north and south of the camp, the state has measured the 60 year recession rates to be 105' and 85' respectively. This amount of beach and bluff recession at Camp Arcadia would result in the loss of their most essential buildings.

After soliciting proposals from a number of consultants and contractors, the camp's beach committee selected SandGrabber, who was willing to install a limited number of SG modules at no cost, in an effort to gain positive data to be used for future marketing. Ledy Design Group (now LSG) performed the initial topographic survey used to facilitate design, layout and permitting efforts. The State of Michigan issued a permit on 11/20/09 and the US Army Corps of Engineers issued a permit on 11/29/10. The extra 1 year to obtain the federal permit created a time crunch that forced removal of the SG modules in April, 2013 after only five surveys, instead of the 7 originally contemplated.

In retrospect, the SG system should have been left in place longer, in order to witness its response to the rising Lake Michigan water levels we are now experiencing. Instead the modules were in place during historically low water levels. This would have given all parties additional information regarding SG performance over a larger range of conditions that can be expected over a standard service life.

Attachments to this report illustrate the changes that occurred, and consist of overlapping survey profiles and a spreadsheet that quantifies these changes into square feet at each cross-section and cubic yards between each section. Additionally, I broke the beach into 4 quadrants to assist in visualizing trends based upon proximity to the SG installation.

The results of the shoreline in response to the SG system are unambiguously positive. Of the 2,567 cubic yards (cy) of beach volume gain from April 2011 to April 2013, 37% of the gain (954 cy) occurred at the SG installation, which constituted only 25% of the surveyed beach length. This equates to a gain of 6.4 cy per foot of beach front at the SG location, compared with a gain of 3.6 cy/ft over the rest of the study area.

Beach volume gains did not just occur behind the SG modules, as some had anticipated. Tangible gains in bottom elevation were witnessed as much as 50' in front of the SG system into the lake. This benefit was also visited upon the beach immediately north of the installation, which is downdrift at this location on Lake Michigan. This portion of the beach gained 6.1 cy/ft, when standard expectations were it would lose profile if the SG system was successful at "grabbing" any sand. This result appears to show that, at the very least, the SandGrabber design does not generate adjacent negative impacts associated with shore-normal and impermeable structures. The SG modules' permeability and placement in a shore-parallel orientation demonstrated no negative impacts to adjacent stretches of beach.

### Summary of Monitoring Surveys at Camp Arcadia's Lake Michigan Beach

Quadrant	Location	$\Delta$ Vol.	Average $\Delta$ Vol.
1	Sta 5+00 to 6+75	+329 cy	1.9 cy/ft
2	Sta 6+75 to 8+25	+522	3.5
3	Sta 8+25 to 9+75	+954	6.4 ← location of SandGrabber system
4	Sta 9+75 to 11+00	+761	6.1
Total	Sta 5+00 to 11+00	+2567 cy	4.3 cy/ft

It has been a distinct pleasure to work for you and your colleagues in the interest of protecting Camp Arcadia and preserving its beach. Please feel free to contact me when further discussion or action becomes warranted.

Respectfully,

*David L. Schultz, P.E.*

cc: Barry Peterman, MDEQ  
James Kohlenberg, Sand Saver

**YOUNGS CONSULTING**  
**14154 RUBY LANE**  
**BIG RAPIDS, MI. 49307**  
**TELEPHONE 231-510-4216 FAX 231-832-1947**

**Date: June 16, 2013**

To Whom It May Concern:

From: Cliff Youngs, P.E.

Subject: Survey equipment and procedures

To Whom It May Concern::

Please find listed below the information you have requested regarding the hydrographic surveying equipment used by Youngs Consulting:

- Innerspace 455 XPe 200KHZ sounder – put into service in 2006
- 208KHz 3 degree XDCR transducer – put into service in 2006
- Raven Invicta 210 GPS receiver – put into service fall of 2005
- Hypack Max Hydrographic Survey Version 2012a

Please find below the methodology and equipment used by LCM Surveying and Engineering:

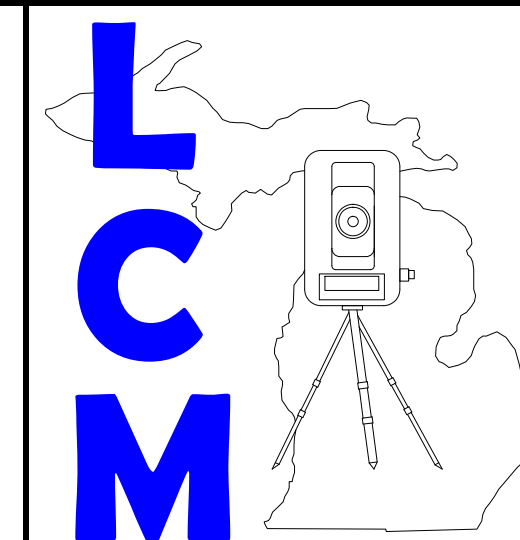
LCM Surveying & Engineering performed the upland portion of the topographic survey by utilizing Leica System 1200 GNSS GPS Receivers. We used a Base/Rover system referenced to the Michigan CORS GPS Network. We established the baseline, stationing and control for this project by using previous survey control established by LEDY Survey Group, who had previously completed a survey for the Lutheran Camp Association.

This survey control was used to establish reference lines at 25' intervals along the established baseline. Survey data was collected along said reference lines for each monitoring survey. Since data was collected along a common reference line the data could be compared with previous surveys looking for any variations.

Please contact me for any questions.

Camp Arcadia Volumetrics															
Station	Change, 4/13/11 to 9/1/11			Change, 9/1/11 to 4/17/12			Change, 4/17/12 to 9/6/12			Change, 9/6/12 to 4/12/13			4/13/11 to 4/12/13		
	c.s. area change		volume	c.s. area change		volume	c.s. area change		volume	c.s. area change		volume	Cum. volume change		
loss (sf)	gain (sf)	change (cy)	loss (sf)	gain (sf)	change (cy)	loss (sf)	gain (sf)	change (cy)	loss (sf)	gain (sf)	change (cy)	loss (sf)	gain (sf)	change (cy)	cubic yards
5+00	0.7	90.0		70.7	8.8		1.9	151.8				147.0	4.0		
5+25	0.0	98.4	86.9	39.4	10.4	-42.1	4.7	134.9	129.7	104.0	38.0	-96.8		77.7	
5+50	6.2	67.0	73.7	9.9	21.4	-8.1	3.2	119.5	114.1	159.0	12.0	-98.6		81.1	
5+75	9.1	51.2	47.6	15.7	32.8	13.2	1.8	105.6	101.9	125.0	9.0	-121.8		41.0	329.3 5+00 to 6+75
6+25	24.9	4.9	20.5	8.3	64.5	67.9	56.9	24.6	66.2	11.0	37.0	-83.3		71.2	1.88 cy/lf
6+50	42.8	17.7	-20.9	0.8	75.8	60.7	68.8	22.0	-36.6	22.0	38.0	19.4		22.7	
6+75	42.2	20.6	-21.6	2.0	67.8	65.2	56.2	24.7	-36.3	10.0	55.0	28.2		35.6	
7+00	54.9	19.2	-26.5	5.8	56.1	53.8	47.9	31.8	-22.0	18.0	57.0	38.9		44.1	
7+25	36.3	102.4	14.1	11.4	56.3	44.1	55.8	38.0	-15.7	17.0	49.0	32.9		75.3	
7+50	76.3	27.2	7.9	15.4	67.1	44.7	37.3	34.4	-9.6	8.0	64.0	40.7		83.8	522.4 6+75 to 8+25
7+75	58.6	6.2	-47.0	0.4	95.8	68.1	22.6	38.6	6.1	22.0	41.0	34.7		61.9	3.48 cy/lf
8+00	20.6	48.4	-11.4	15.6	95.1	81.0	23.5	13.6	2.8	18.0	70.0	32.9		105.3	
8+25	13.8	36.3	23.3	7.2	43.7	53.7	3.0	39.1	12.1	16.0	100.0	63.0		152.1	
8+50	23.5	28.6	12.8	15.0	30.2	23.9	52.4	9.1	-3.3	11.0	114.0	86.6		120.0	
8+75	59.7	34.4	-9.4	9.9	48.7	25.0	0.0	95.5	24.2	50.0	75.0	59.3		99.1	
9+00	32.6	57.9	0.0	20.6	46.8	30.1	8.8	78.2	76.3	19.0	113.0	55.1		161.5	
9+25	67.1	35.1	-3.1	10.6	89.2	48.5	27.3	56.0	45.4	4.0	146.0	109.3		200.1	954.0 8+25 to 9+75
9+50	51.2	28.0	-25.6	7.7	30.3	46.9	18.3	47.6	26.9	0.0	187.0	152.3		200.5	6.36 cy/lf
9+75	92.1	23.6	-42.5	12.0	52.5	29.2	18.3	51.0	28.7	1.0	154.0	157.4		172.9	
10+00	87.1	20.7	-62.5	15.4	51.9	35.6	34.4	54.1	24.3	0.0	182.0	155.1		152.5	
10+25	64.3	10.2	-55.8	1.1	51.2	40.1	38.9	37.9	8.7	5.0	186.0	168.1		161.0	
10+50	61.7	24.6	-42.2	20.2	49.8	36.9	47.1	45.1	-1.4	8.0	138.0	144.0		137.3	761.2 9+75 to 11+00
10+75	59.0	9.6	-40.0	15.3	78.7	43.1	61.5	34.5	-13.4	1.0	208.0	156.0		145.6	6.09 cy/lf
11+00	46.7	19.7	-35.4	29.3	32.7	30.9	53.2	40.7	-18.3	4.0	202.0	187.5		164.8	
			-157.0			892.4			510.7			1320.8		2566.9	

Red stations and values are at SandGrabber installation location



**Surveying & Engineering**

- Surveying
- Civil Engineering

225 EAST MAIN ST.  
MARION, MI 49665  
Phone: (231) 743-3000  
Fax: (231) 743-3001

**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY:

FTW

CHK'D BY:

CCY

DATE:

03-12-2013

FIELD BOOK/PAGE:

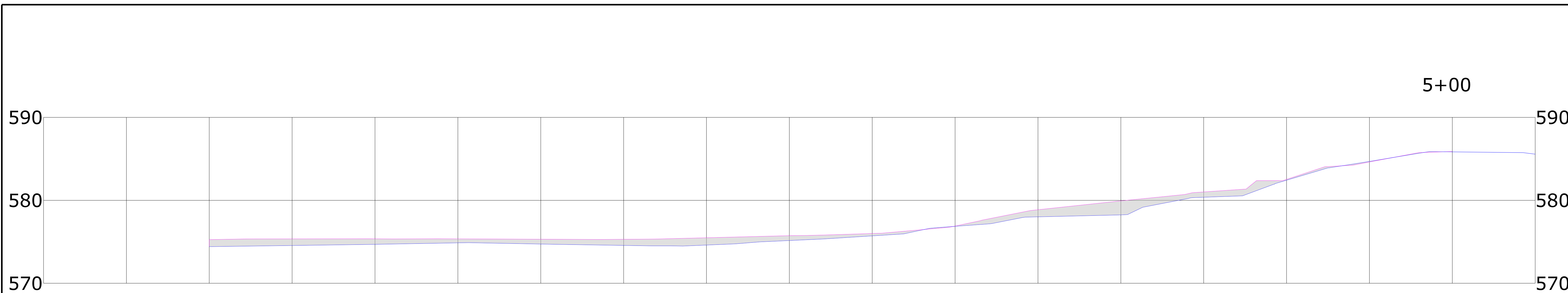
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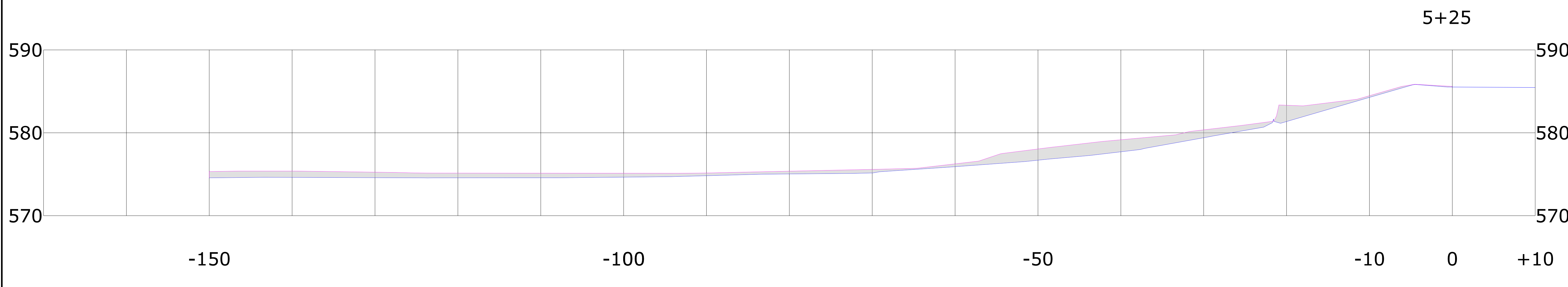
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2 OF 13



Station	Ground Elevation (ft)	Proposed Elevation (ft)
-150	574.4'	575.2'
-100	574.5'	575.3'
-50	578.0'	578.8'
-10	584.7'	584.6'
0		
+10		

Station	Description	END AREA (SQ FT)	VOLUME (CYD)
5+00.00 EX	Excavation	0.7	0
	Fill	90.0	0
5+25.00 EX	Excavation	0.0	0
	Fill	98.4	87



Station	Ground Elevation (ft)	Proposed Elevation (ft)
-150	574.6'	575.3'
-100	574.6'	575.1'
-50	576.7'	578.0'
-10	584.3'	584.5'
0		
+10		

*LAKE MICHIGAN*

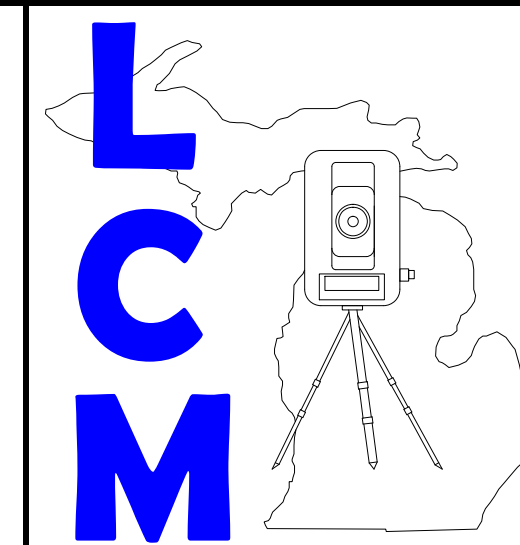
(WATER ELEV:576.9'±, APRIL 13, 2011)

04-13-2011

(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

09-01-2011

SCALE 1"=6'



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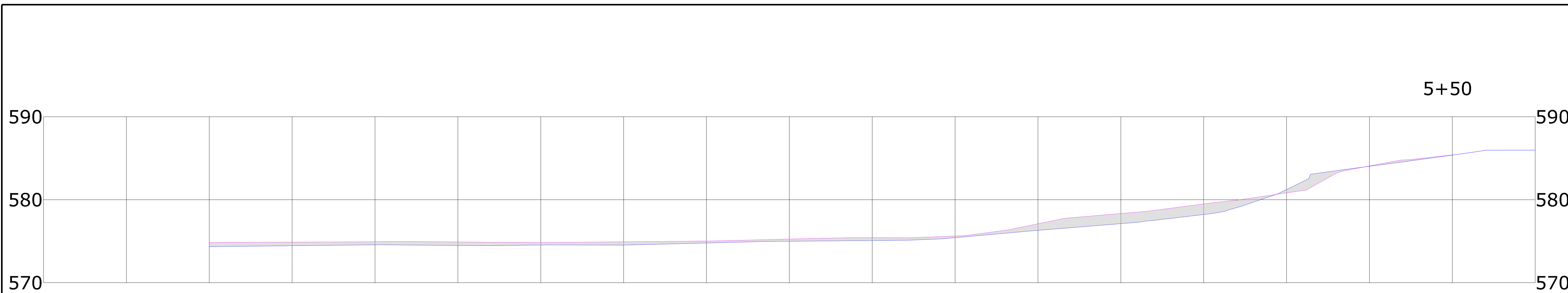
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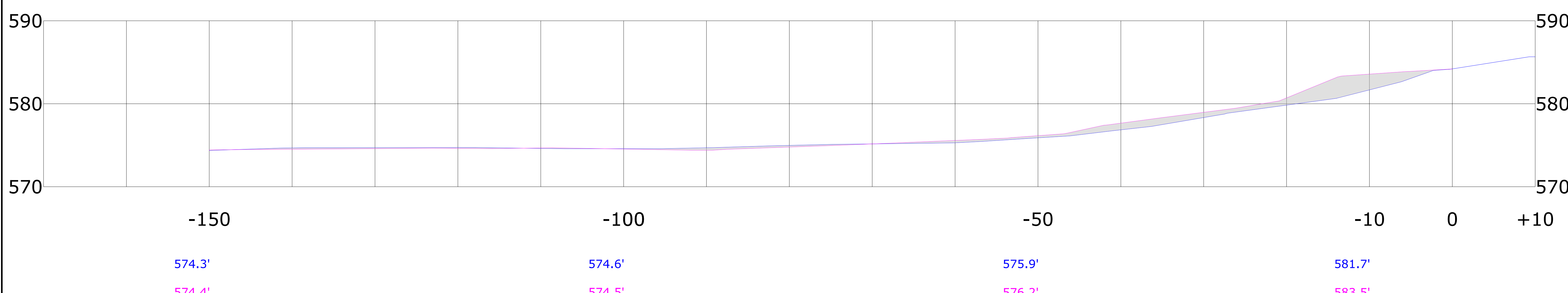
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3 OF 13



-150		-100		-50		-10	0	+10
574.4'		574.5'		576.3'		580.		
574.8'		574.9'		577.0'		580.		

		END AREA (SQ FT)	VOLUME (CYD)
5+50.00 EX	Excavation	6.2	3
	Fill	67.0	77
5+75.00 EX	Excavation	9.1	7
	Fill	51.2	55



-150		-100		-50		-10	0	+10
574.3'		574.6'		575.9'		581.7'		
574.4'		574.5'		576.2'		583.5'		

*LAKE MICHIGAN*

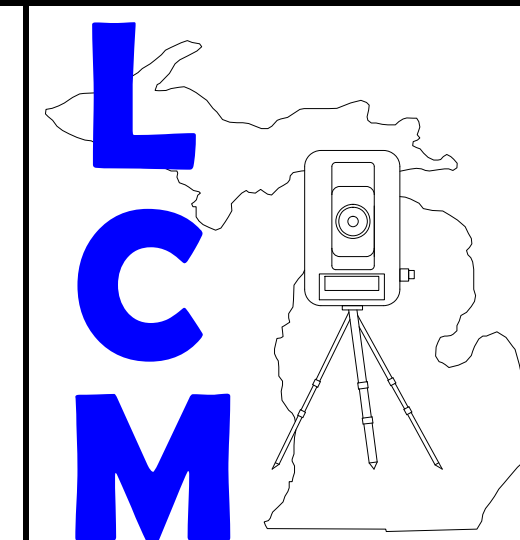
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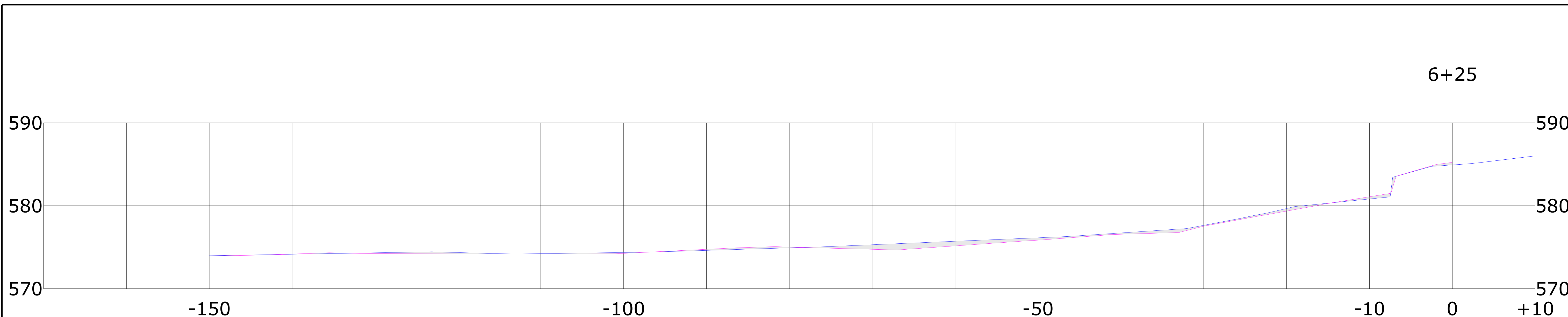
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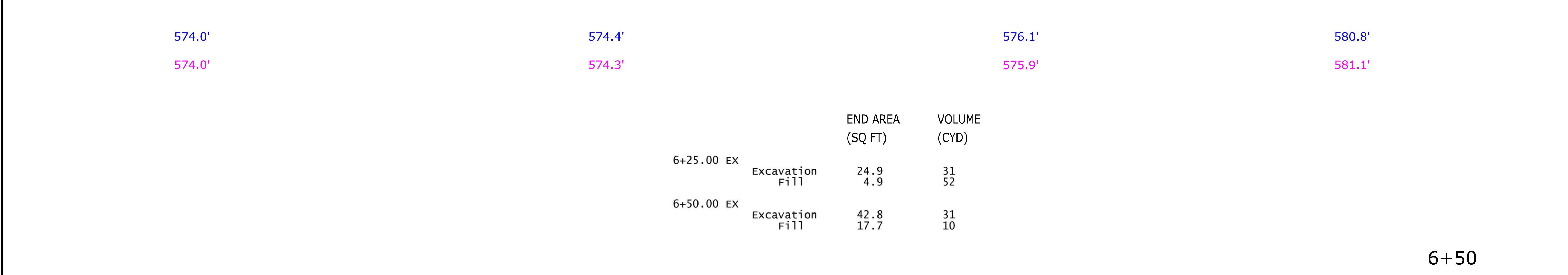
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4 OF 13



		END AREA (SQ FT)	VOLUME (CYD)
6+25.00 EX	Excavation	24.9	31
	Fill	4.9	52
6+50.00 EX	Excavation	42.8	31
	Fill	17.7	10



*LAKE MICHIGAN*

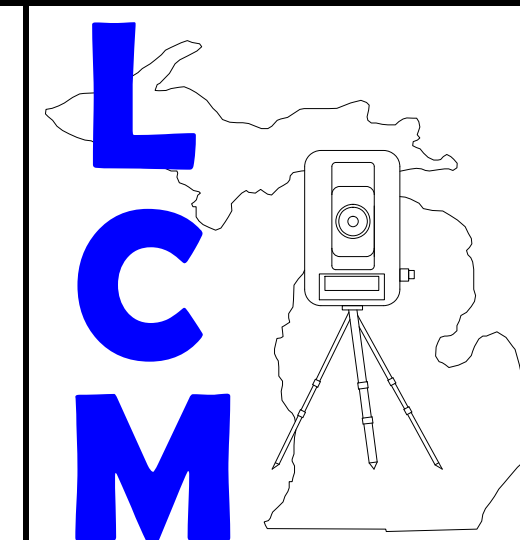
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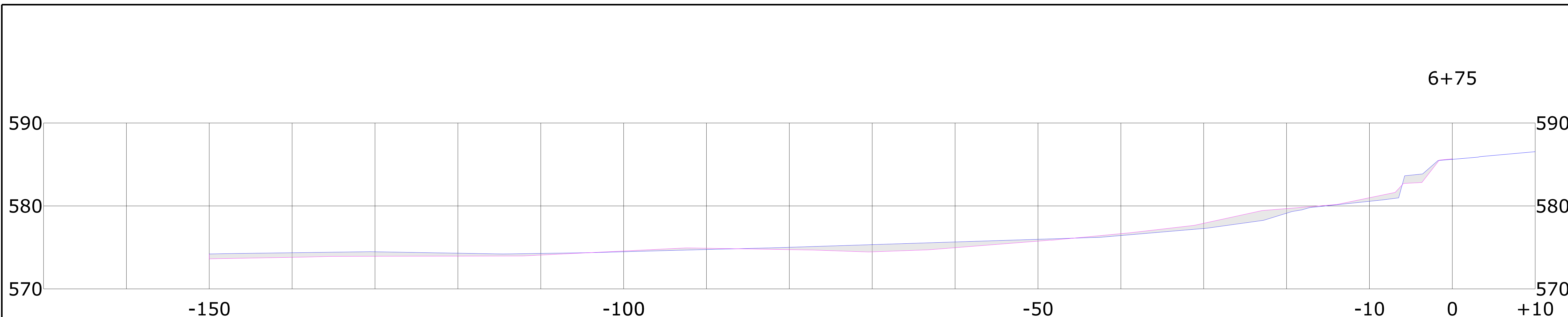
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5 OF 13



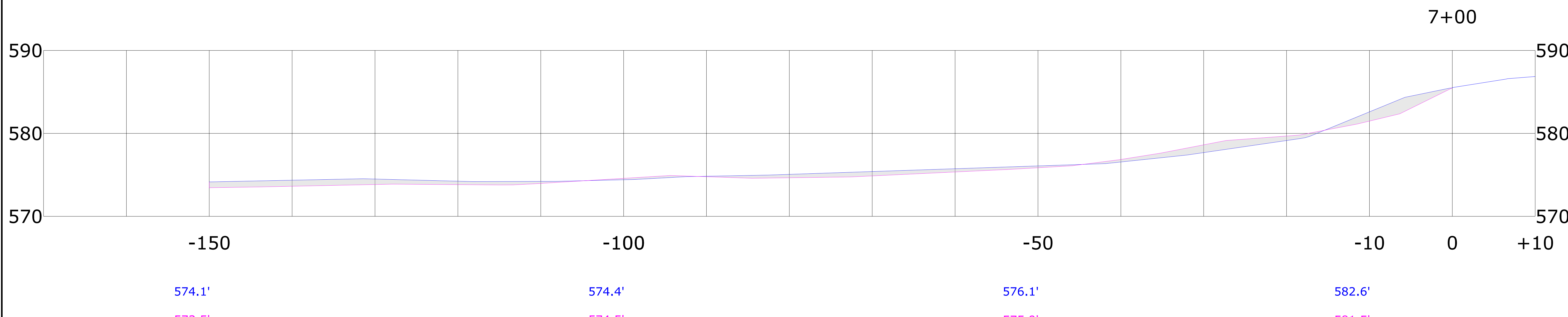
574.2'  
573.6'

574.5'  
574.5'

576.0'  
575.8'

580.6'  
581.0'

		END AREA (SQ FT)	VOLUME (CYD)
6+75.00 EX	Excavation	42.2	39
	Fill	20.6	18
7+00.00 EX	Excavation	54.9	45
	Fill	19.2	18



574.1'  
573.5'

574.4'  
574.5'

576.1'  
575.9'

582.6'  
581.5'

*LAKE MICHIGAN*

(WATER ELEV:576.9'±, APRIL 13, 2011)

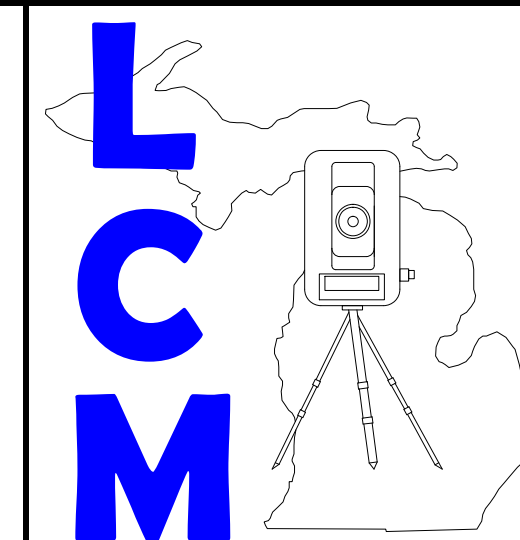
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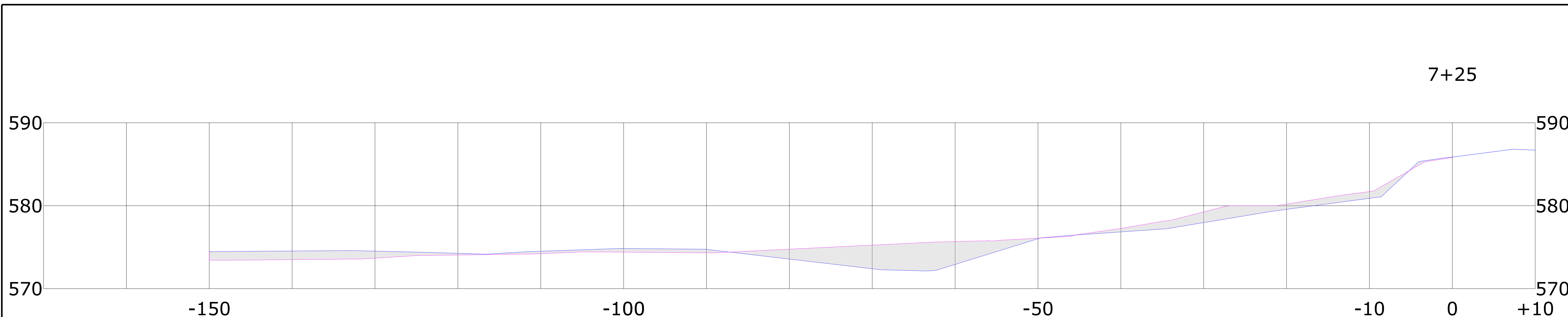
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6 OF 13



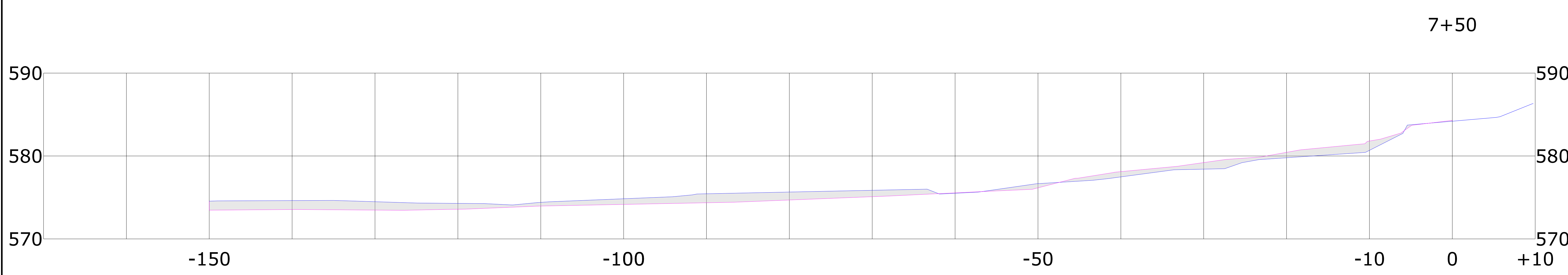
574.4'  
573.4'

574.8'  
574.4'

576.0'  
576.0'

580.9'  
581.7'

		END AREA (SQ FT)	VOLUME (CYD)
7+25.00 EX	Excavation	36.3	42
	Fill	102.4	56
7+50.00 EX	Excavation	76.3	52
	Fill	27.2	60



574.5'  
573.5'

574.8'  
574.1'

576.6'  
576.1'

580.7'  
581.8'

*LAKE MICHIGAN*

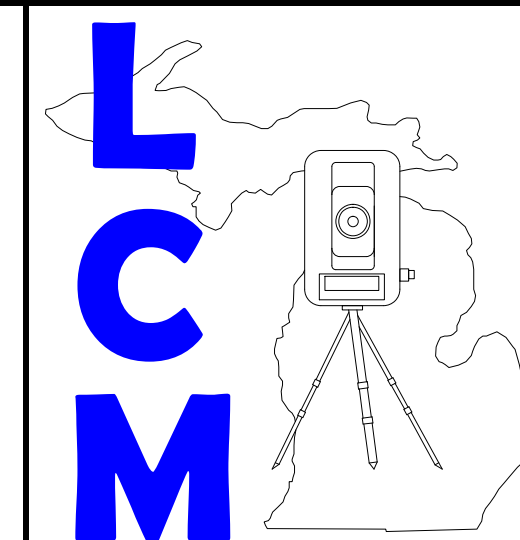
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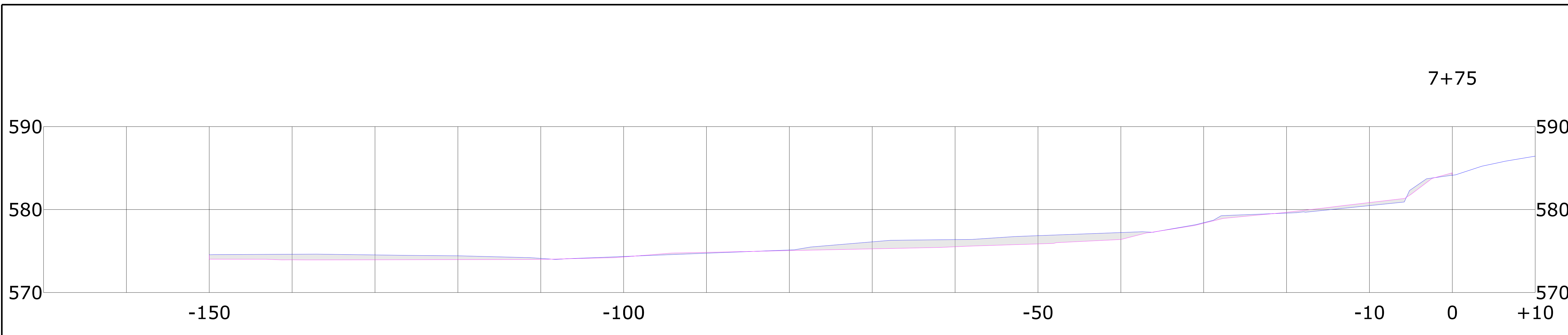
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7 OF 13



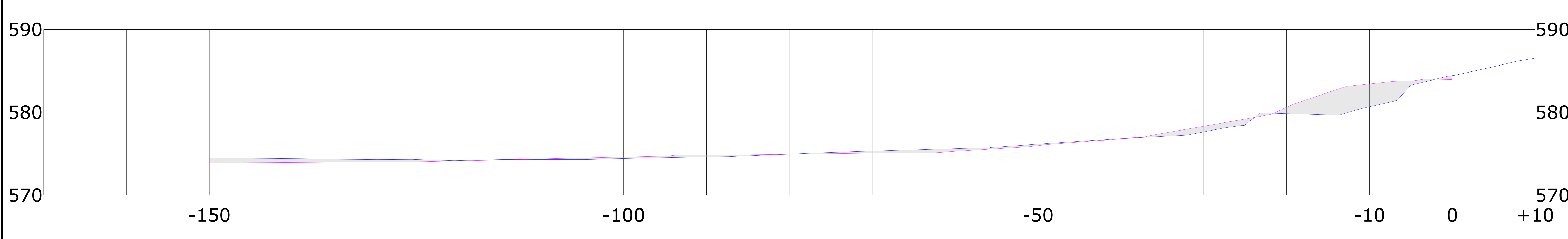
574.5'  
574.0'

574.4'  
574.3'

576.9'  
575.9'

580.5'  
580.8'

		END AREA (SQ FT)	VOLUME (CYD)
7+75.00 EX	Excavation	58.6	62
	Fill	6.2	15
8+00.00 EX	Excavation	20.6	37
	Fill	48.4	25



574.4'  
573.9'

574.4'  
574.5'

576.1'  
576.0'  
577.5'

580.6'  
583.4'  
581.9'

*LAKE MICHIGAN*

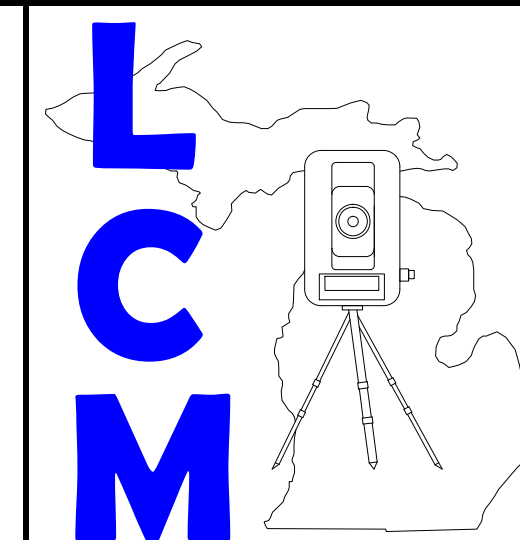
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(WATER ELEV: 577.9'±, SEPTEMBER 01, 2011)

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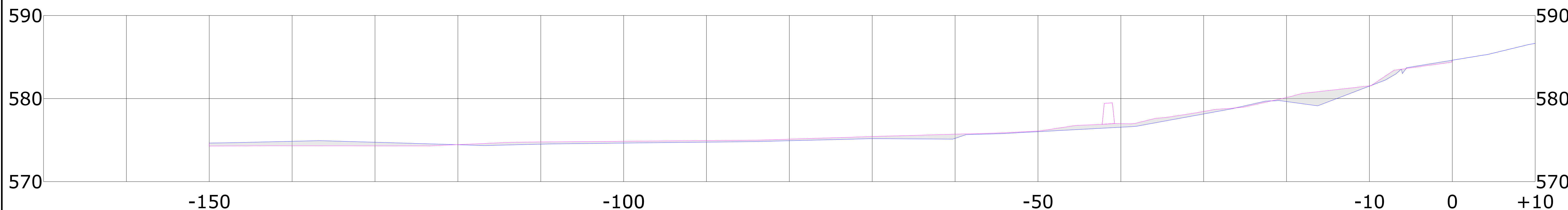
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8 OF 13



574.6'  
574.3'

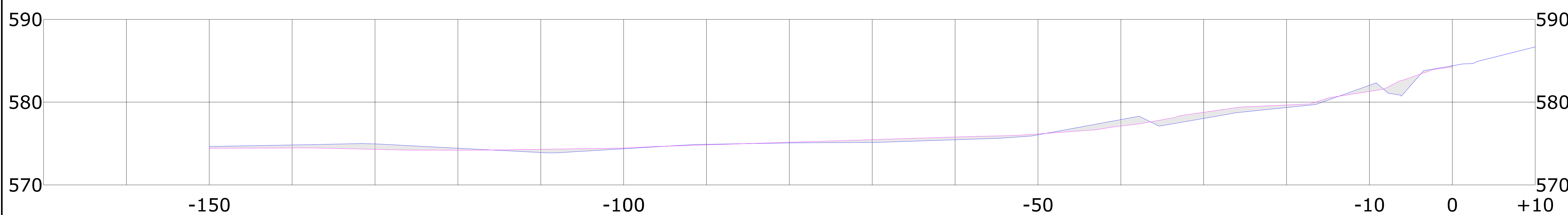
574.6'  
574.8'

576.0'  
576.1'

BASE: W. E.  
576.9' 577.0'

581.5'  
581.6'

		END AREA (SQ FT)	VOLUME (CYD)
8+25.00 EX	Excavation	13.8	16
	Fill	36.3	39
8+50.00 EX	Excavation	23.5	17
	Fill	28.6	30



574.6'  
574.4'

574.4'  
574.4'

576.0'  
576.2'

582.0'  
581.3'

*LAKE MICHIGAN*

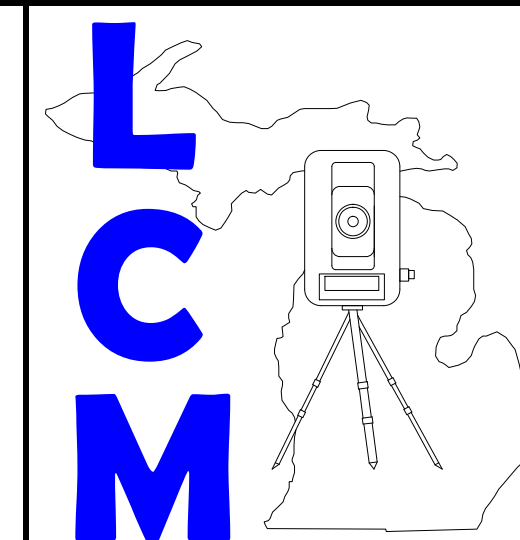
(WATER ELEV:576.9'±, APRIL 13, 2011)

04-13-2011

(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

09-01-2011

SCALE 1"=6'



**Surveying & Engineering**

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- Civil Engineering

225 EAST MAIN ST.  
MARION, MI 49665  
Phone: (231) 743-3000  
Fax: (231) 743-3001

**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY:

FTW

CHK'D BY:

CCY

DATE:

03-12-2013

FIELD BOOK/PAGE:

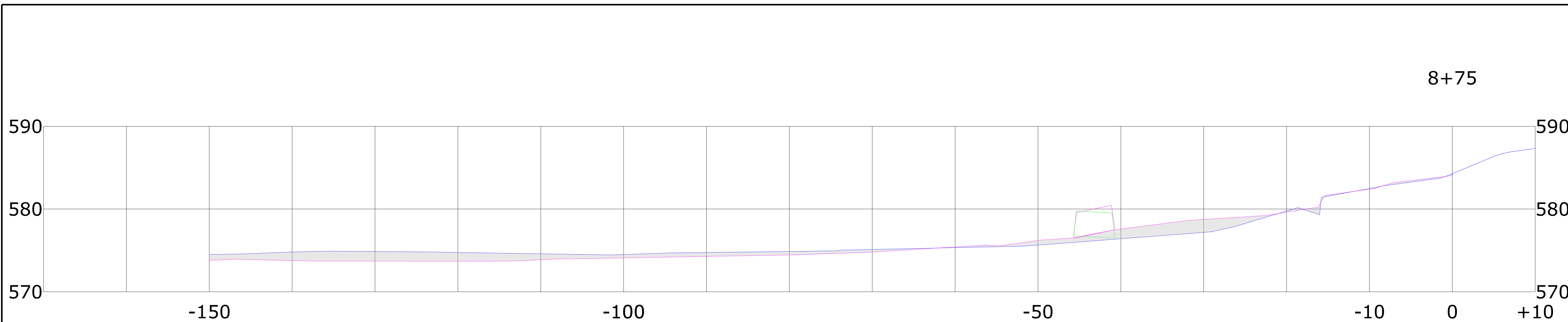
SEE FILE

JOB NO.:

10046

SHEET NO.:

9 OF 13



574.5'  
573.8'

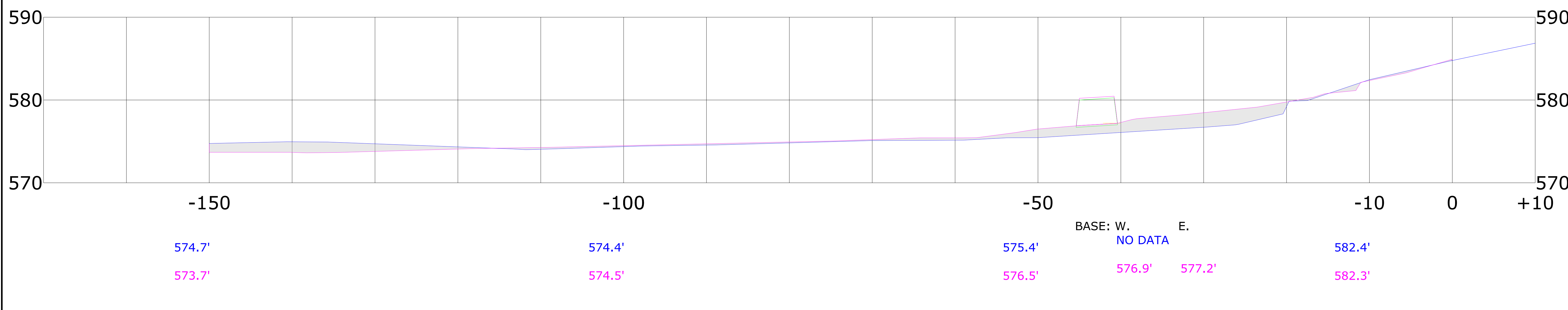
574.5'  
574.1'

575.6'  
576.2'

BASE: W. E.  
NO DATA  
576.5' 577.5'

582.5'  
582.4'

		END AREA (SQ FT)	VOLUME (CYD)
8+75.00 EX	Excavation	59.7	39
	Fill	34.4	29
9+00.00 EX	Excavation	32.6	43
	Fill	57.9	43



574.7'  
573.7'

574.4'  
574.5'

575.4'  
576.5'

BASE: W. E.  
NO DATA  
576.9' 577.2'

582.4'  
582.3'

*LAKE MICHIGAN*

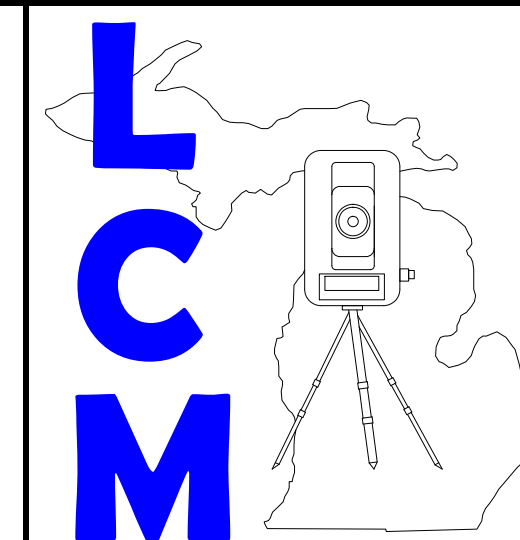
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04-13-2011

(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

09-01-2011

SCALE 1"=6'



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PROJECT:

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BIG RAPIDS, MI 49307**

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FTW

CHK'D BY:

CCY

DATE:

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FIELD BOOK/PAGE:

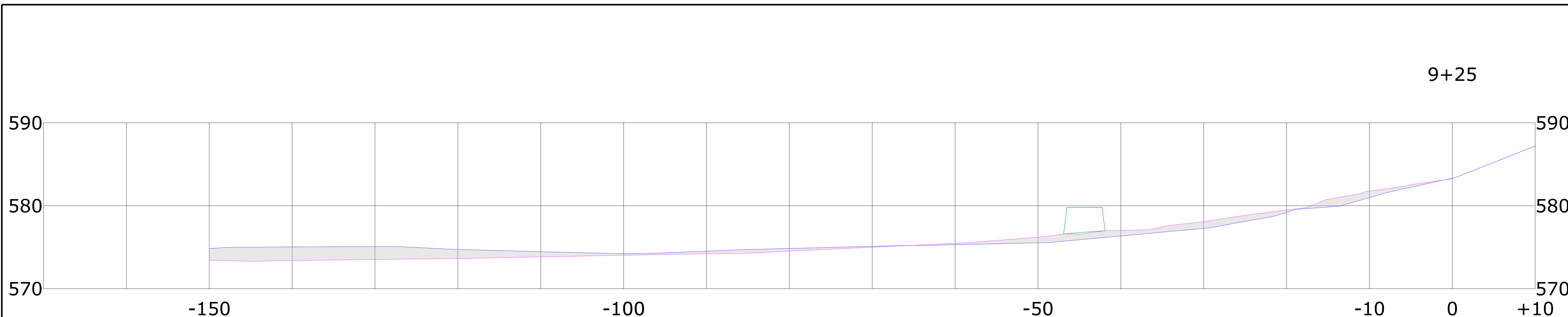
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JOB NO.:

10046

SHEET NO.:

10 OF 13



574.8'  
573.4'

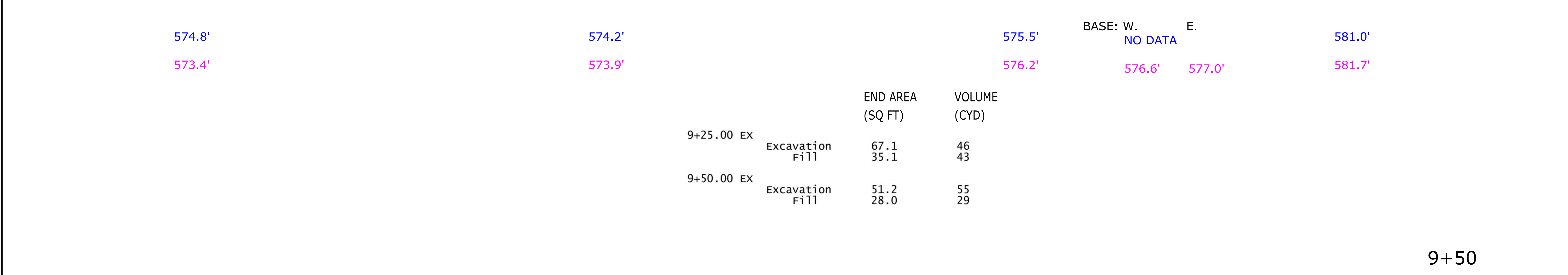
574.2'  
573.9'

575.5'  
576.2'

BASE: W. E.  
NO DATA  
576.6' 577.0'

581.0'  
581.7'

		END AREA (SQ FT)	VOLUME (CYD)
9+25.00 EX	Excavation	67.1	46
	Fill	35.1	43
9+50.00 EX	Excavation	51.2	55
	Fill	28.0	29



575.0'  
573.6'

574.4'  
574.5'

575.5'  
576.1'

BASE: W. E.  
NO DATA  
576.6' 577.3'

581.8'  
582.3'

*LAKE MICHIGAN*

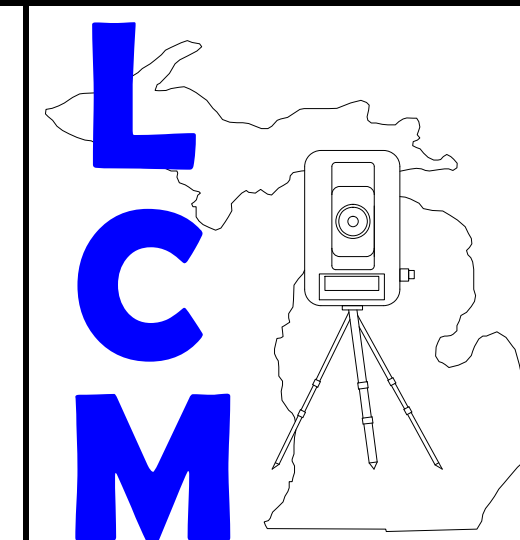
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PROJECT:

LOCATION:

**ENGINEERING FIRM:**

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BIG RAPIDS, MI 49307**

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FTW

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DATE:

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FIELD BOOK/PAGE:

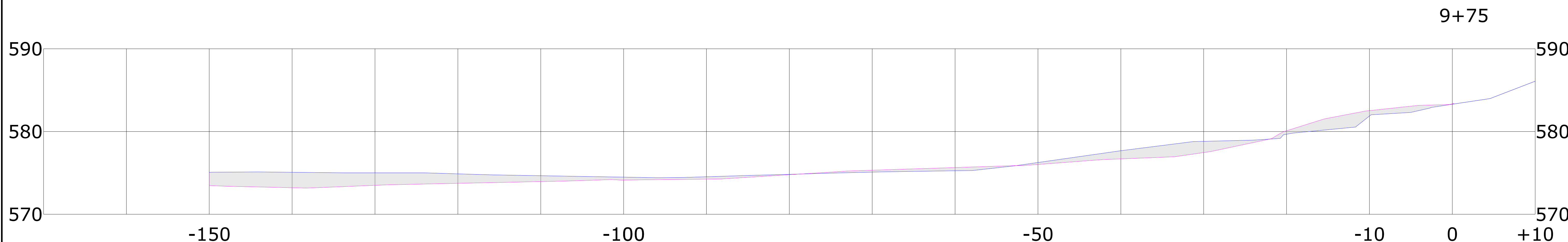
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10046

SHEET NO.:

11 OF 13



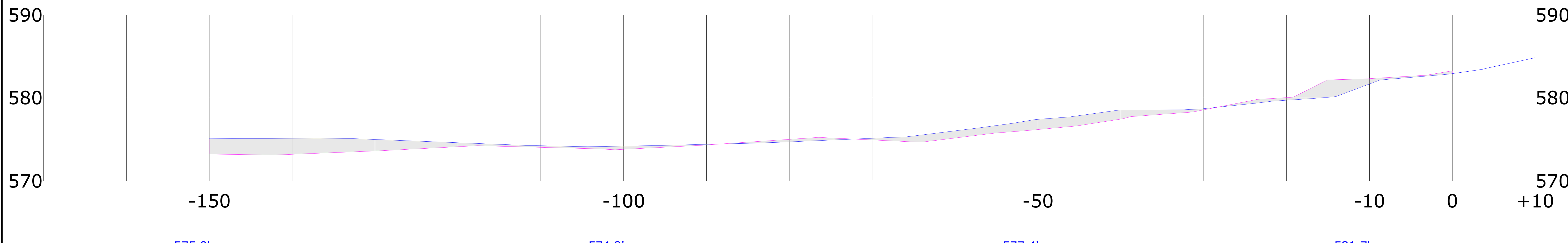
575.0'  
573.4'

574.5'  
574.1'

576.2'  
576.0'

581.9'  
582.5'

		END AREA (SQ FT)	VOLUME (CYD)
9+75.00 EX	Excavation	92.1	66
	Fill	23.6	24
10+00.00 EX	Excavation	87.1	83
	Fill	20.7	21



575.0'  
573.2'

574.2'  
573.8'

577.4'  
576.2'

581.7'  
582.3'

*LAKE MICHIGAN*

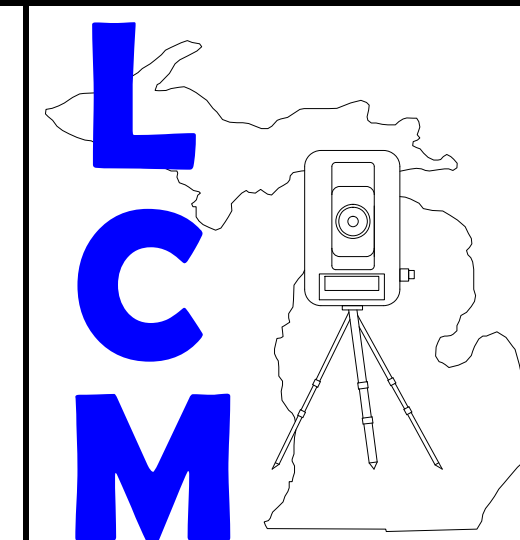
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(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

09-01-2011

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PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

PROJECT:

LOCATION:

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
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BIG RAPIDS, MI 49307**

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DATE:

03-12-2013

FIELD BOOK/PAGE:

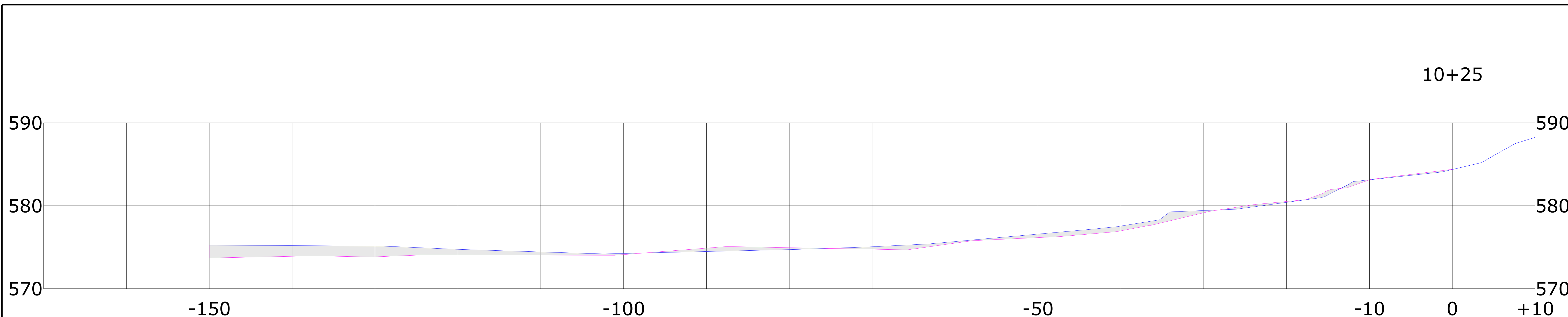
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JOB NO.:

10046

SHEET NO.:

12 OF 13



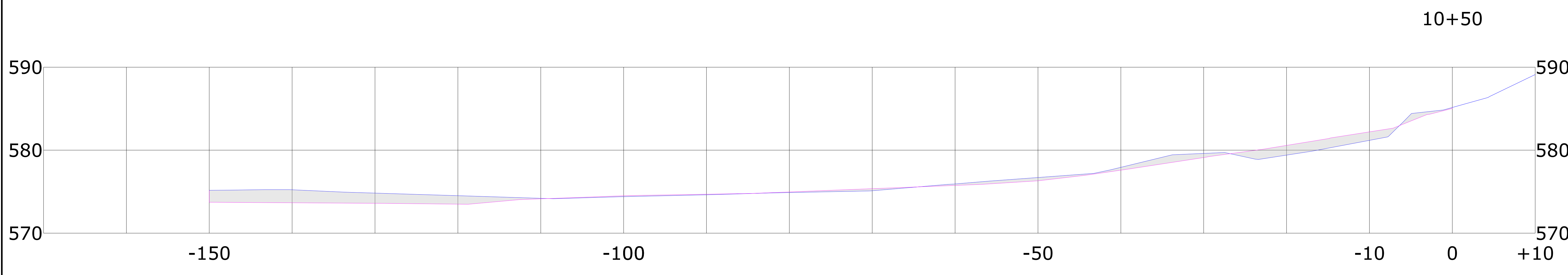
575.2  
573.7'

574.2'  
574.1'

576.6'  
576.1'

583.1'  
583.1'

		END AREA (SQ FT)	VOLUME (CYD)
10+25.00 EX	Excavation	64.3	70
	Fill	10.2	14
10+50.00 EX	Excavation	61.7	58
	Fill	24.6	16



575.1'  
573.7

574.4'  
574.4'

576.7'  
576.3'

581.2'  
582.0'

*LAKE MICHIGAN*

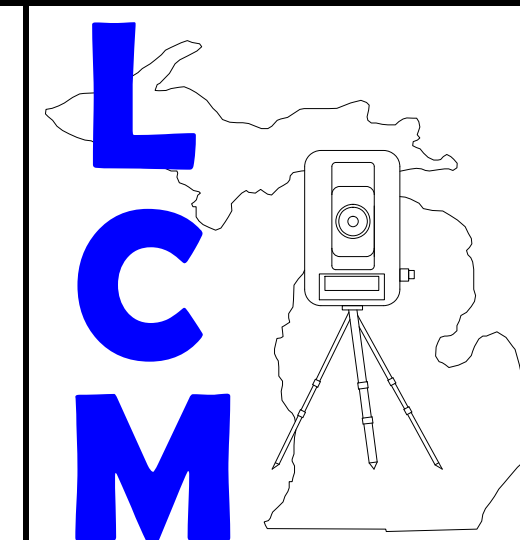
(WATER ELEV:576.9'±, APRIL 13, 2011)

04-13-2011

(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

09-01-2011

SCALE 1"=6'



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MARION, MI 49665  
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Fax: (231) 743-3001

**MONITORING BEACH TOPOGRAPHY**

PROJECT: PART OF THE  
LOCATION: SECTION 10, T24N, R16W, ARCADIA TWP.,  
MANISTEE CO., MICHIGAN.

PROJECT:

LOCATION:

**ENGINEERING FIRM:**

**YOUNGS CONSULTING**  
14154 RUBY LANE  
BIG RAPIDS, MI 49307

DRN. BY: FTW

CHK'D BY: CCY

DATE: 03-12-2013

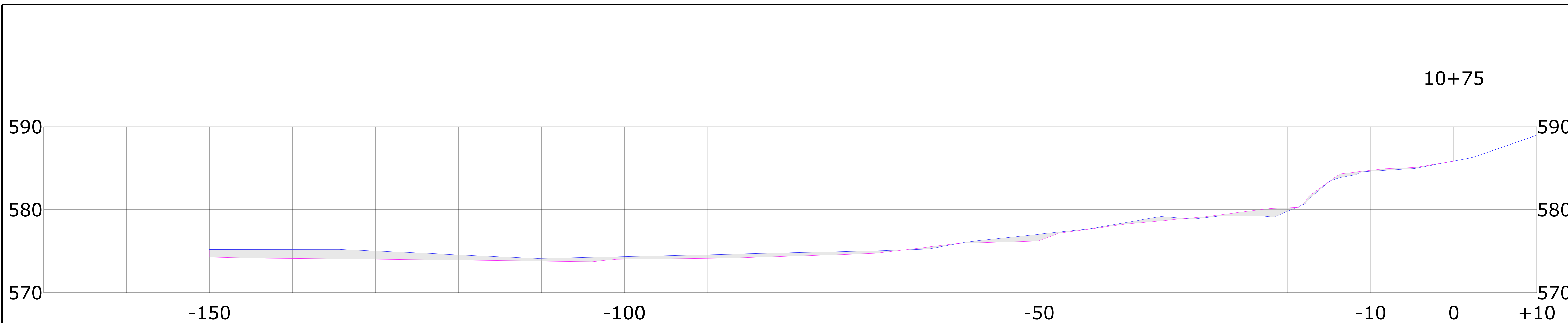
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JOB NO.:

10046

SHEET NO.:

13 OF 13



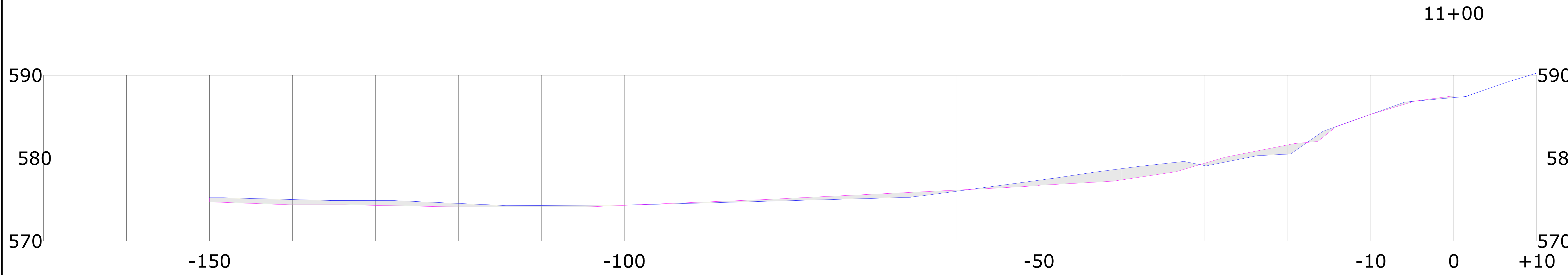
575.2'  
574.2'

574.4'  
574.0'

577.0'  
576.2'

584.6'  
584.7'

		END AREA (SQ FT)	VOLUME (CYD)
10+75.00 EX	Excavation	59.0	56
	Fill	9.6	16
11+00.00 EX	Excavation	46.7	49
	Fill	19.7	14



575.2'  
574.7'

574.3'  
574.3'

577.3'  
576.7'

585.3'  
585.3'

**GRAND SUMMARY**  
Material Name      Unadjusted  
volumes  
(cu. yd.)

EX	Excavation	947
	Fill	791

*LAKE MICHIGAN*

(WATER ELEV: 576.9'±, APRIL 13, 2011)

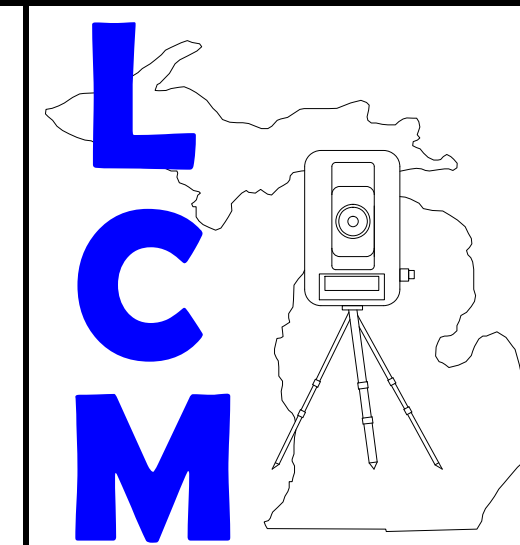
04-13-2011

(WATER ELEV: 577.9'±, SEPTEMBER 01, 2011)

09-01-2011

SCALE 1"=6'





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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

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**ENGINEERING FIRM:**

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BIG RAPIDS, MI 49307**

DRN. BY:

FTW

CHK'D BY:

CCY

DATE:

03-12-2013

FIELD BOOK/PAGE:

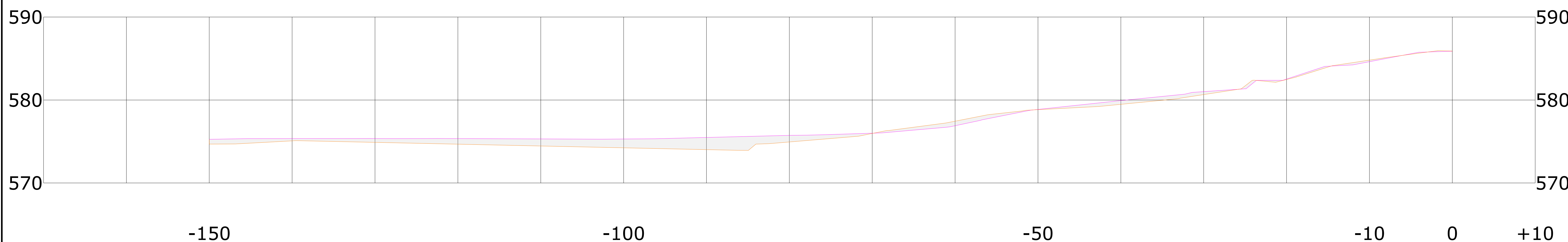
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SHEET NO.:

2 OF 13

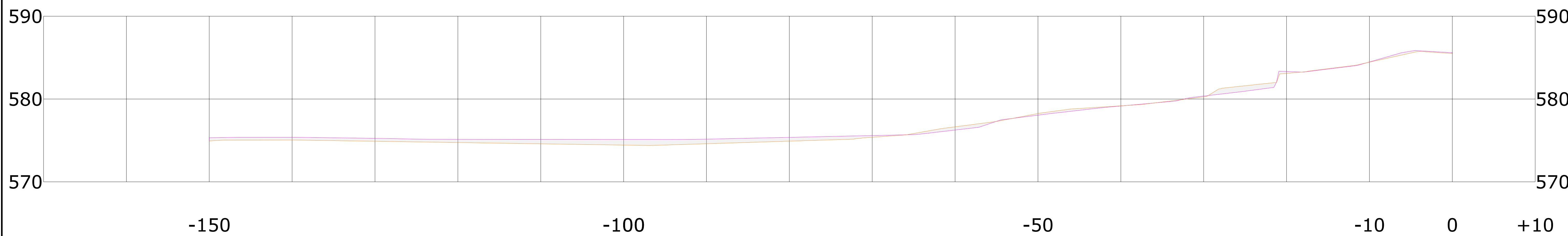


575.2'  
574.7'

575.3'  
574.3'

578.8'  
578.8'

584.6'  
584.8'



575.3'  
575.0'

575.1'  
574.4'

578.0'  
578.2'

584.5'  
584.5'

LAKE MICHIGAN

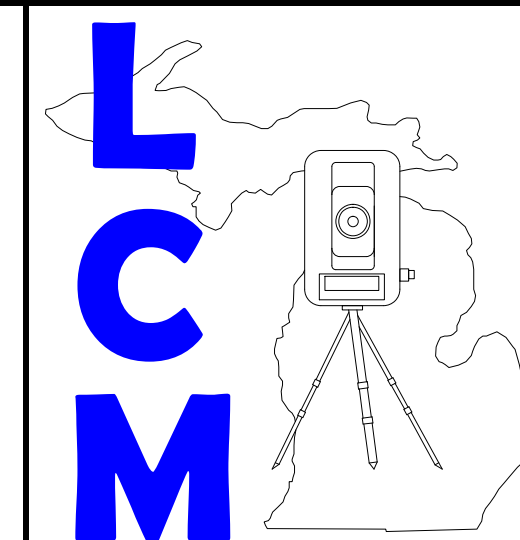
(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

(WATER ELEV:577.5'±, APRIL 17, 2012)

09-01-2011

04-17-2012

SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY:

FTW

CHK'D BY:

CCY

DATE:

03-12-2013

FIELD BOOK/PAGE:

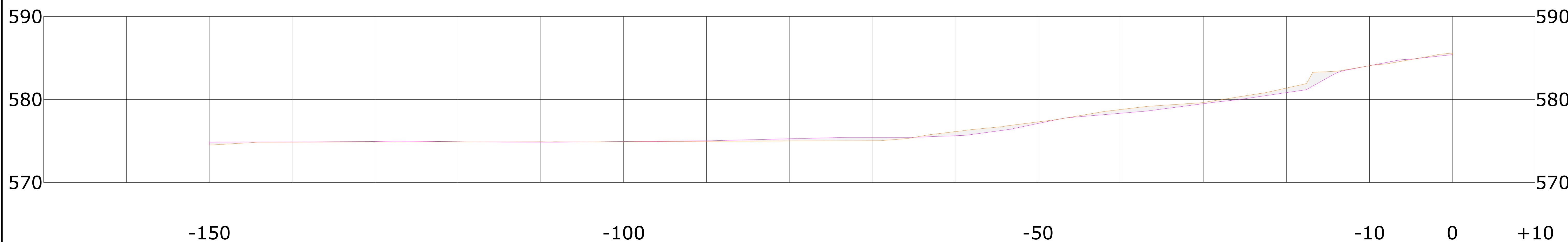
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JOB NO.:

10046

SHEET NO.:

3 OF 13



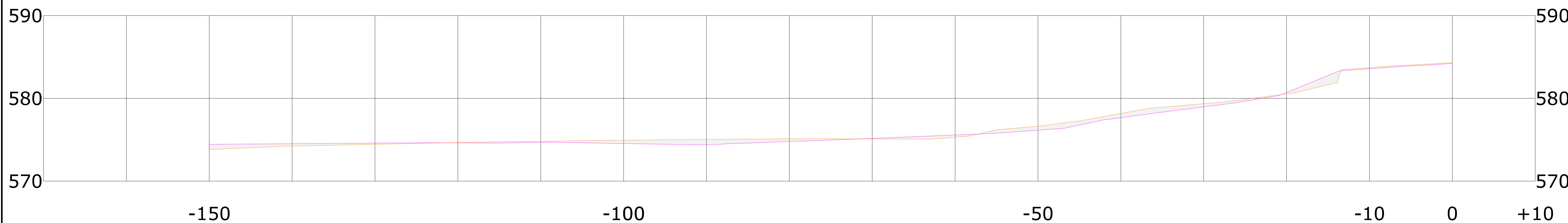
574.8'  
574.5'

574.9'  
574.9'

577.0'  
577.3'

580.  
584.0'

		END AREA (SQ FT)	VOLUME (CYD)
5+50.00 EX	Excavation	9.9	23
	Fill	21.4	15
5+75.00 EX	Excavation	15.7	12
	Fill	32.8	25



574.4'  
573.8'

574.5'  
574.9'

576.2'  
576.6'

583.5'  
583.7'

*LAKE MICHIGAN*

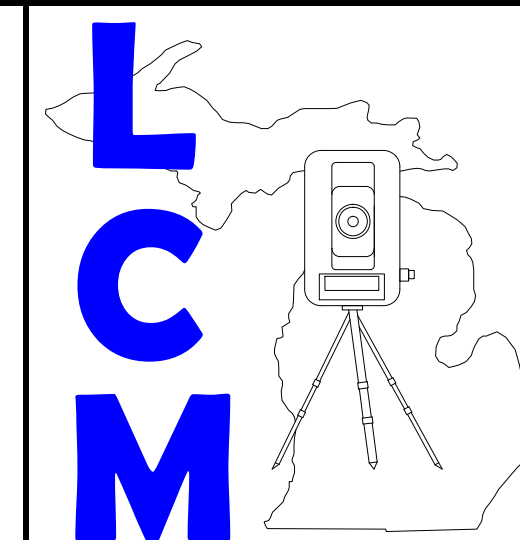
(WATER ELEV: 577.9'±, SEPTEMBER 01, 2011)

09-01-2011

(WATER ELEV: 577.5'±, APRIL 17, 2012)

04-17-2012

SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY:

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CCY

DATE:

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FIELD BOOK/PAGE:

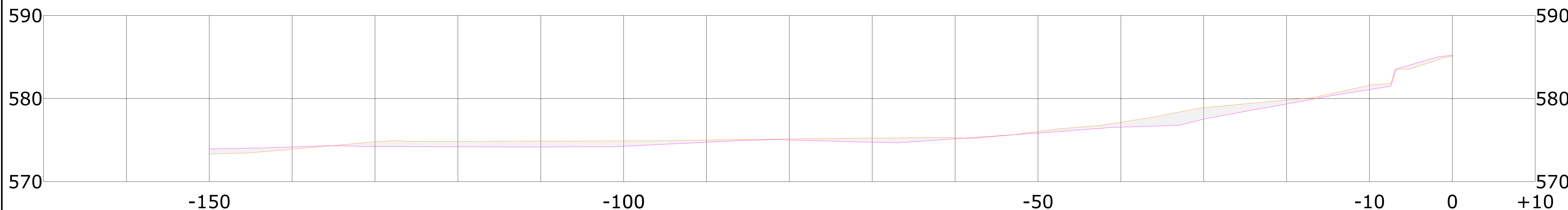
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JOB NO.:

10046

SHEET NO.:

4 OF 13



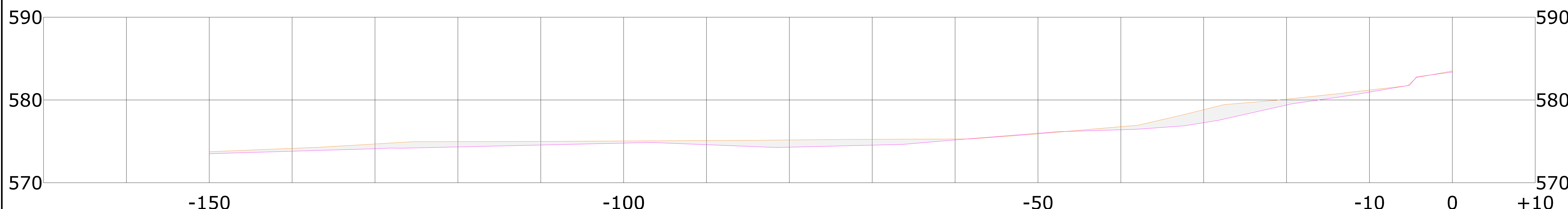
574.0'  
573.3'

574.3'  
574.9'

575.9'  
576.0'

581.1'  
581.6

		END AREA (SQ FT)	VOLUME (CYD)
6+25.00 EX	Excavation	8.3	22
	Fill	64.5	90
6+50.00 EX	Excavation	0.8	4
	Fill	75.8	65



573.5'  
573.7'

574.7'  
575.0'

576.0'  
575.9'

581.0'  
581.2

LAKE MICHIGAN

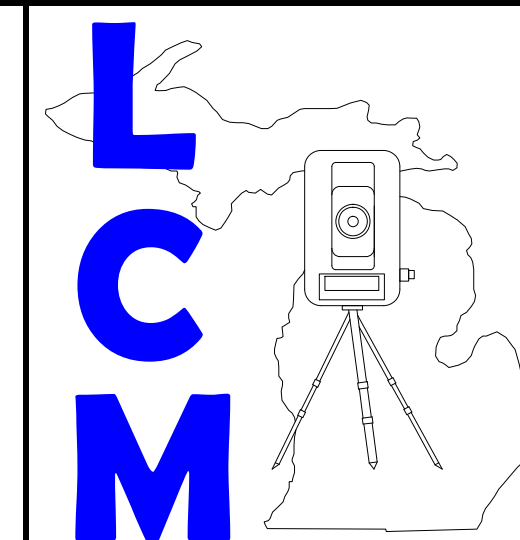
(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

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(WATER ELEV:577.5'±, APRIL 17, 2012)

04-17-2012

SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

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PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY: FTW

CHK'D BY: CCY

DATE: 03-12-2013

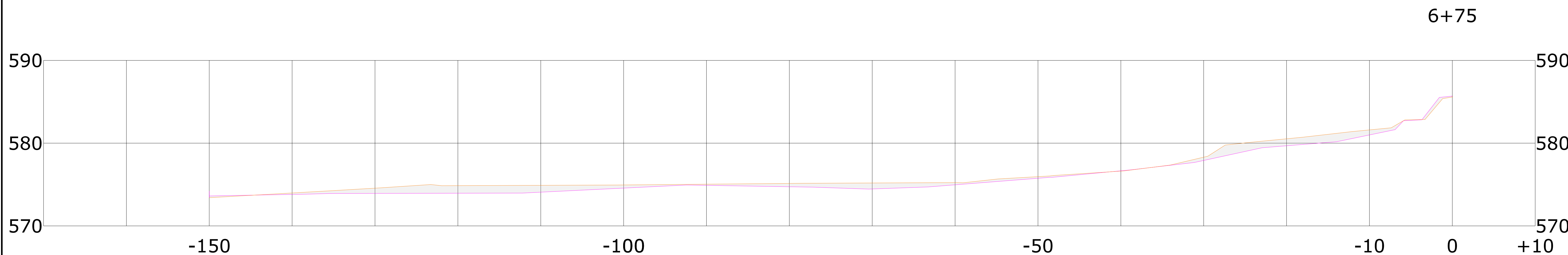
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JOB NO.:

10046

SHEET NO.:

5 OF 13



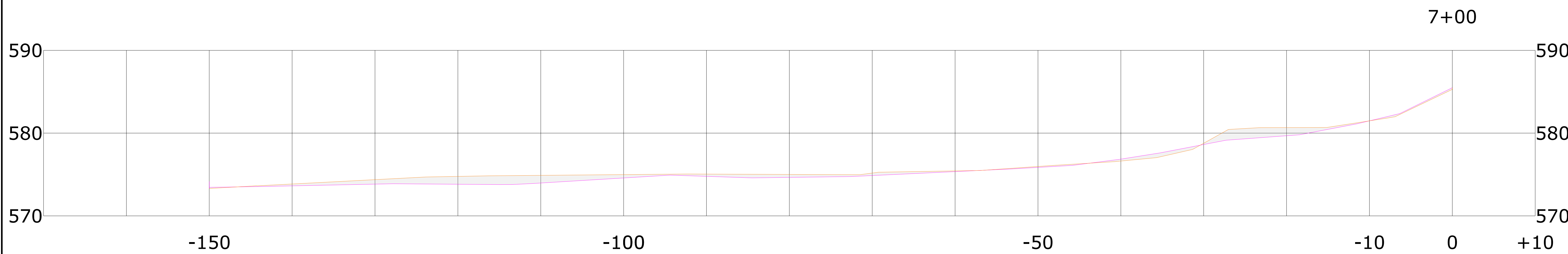
573.6'  
573.4'

574.5'  
574.9'

575.8'  
575.9'

581.0'  
581.6'

		END AREA (SQ FT)	VOLUME (CYD)
6+75.00 EX	Excavation	2.0	1
	Fill	67.8	66
7+00.00 EX	Excavation	5.8	4
	Fill	56.1	57



573.5'  
573.3'

574.5'  
575.0'

575.9'  
575.9'

581.5'  
581.5'

*LAKE MICHIGAN*

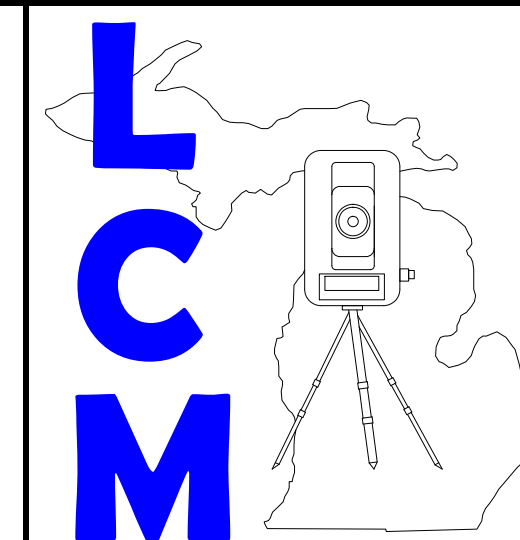
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09-01-2011

(WATER ELEV:577.5'±, APRIL 17, 2012)

04-17-2012

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DRN. BY:

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DATE:

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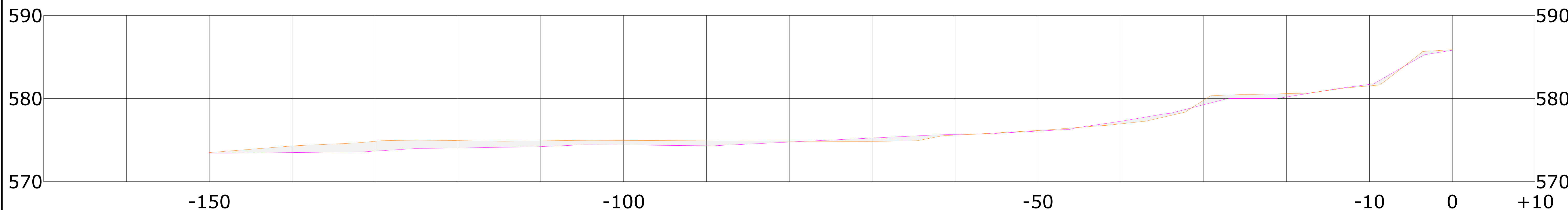
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10046

SHEET NO.:

6 OF 13



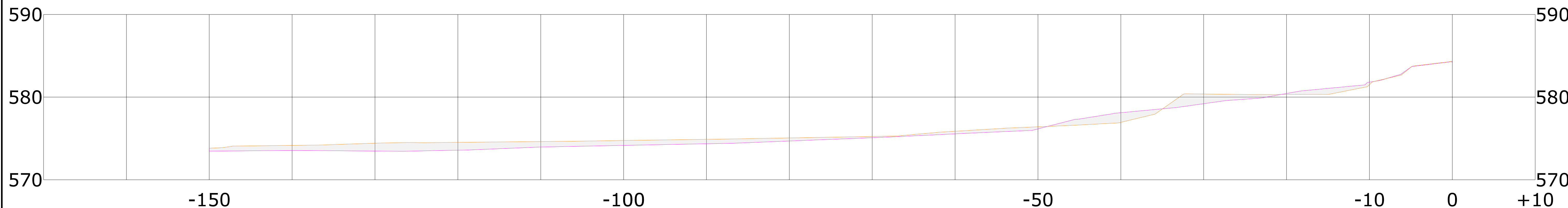
573.4'  
573.4'

574.4'  
574.9'

576.0'  
576.2'

581.7'  
581.5'

		END AREA (SQ FT)	VOLUME (CYD)
7+25.00 EX	Excavation	11.4	8
	Fill	56.3	52
7+50.00 EX	Excavation	15.4	12
	Fill	67.1	57



573.5'  
573.8'

574.1'  
574.7'

576.1'  
576.4'

581.8'  
581.5'

*LAKE MICHIGAN*

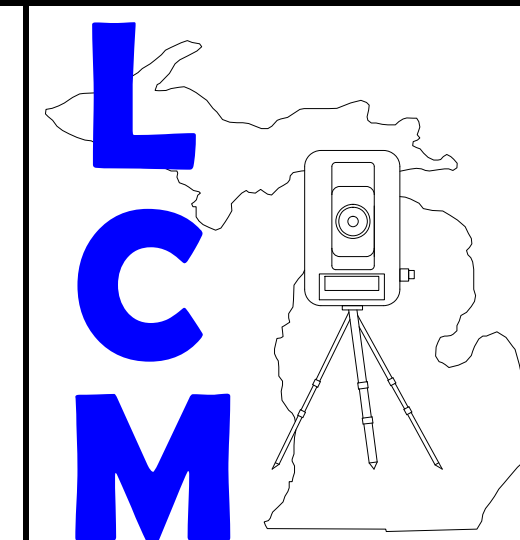
(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

09-01-2011

(WATER ELEV:577.5'±, APRIL 17, 2012)

04-17-2012

SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

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BIG RAPIDS, MI 49307**

DRN. BY:

FTW

CHK'D BY:

CCY

DATE:

03-12-2013

FIELD BOOK/PAGE:

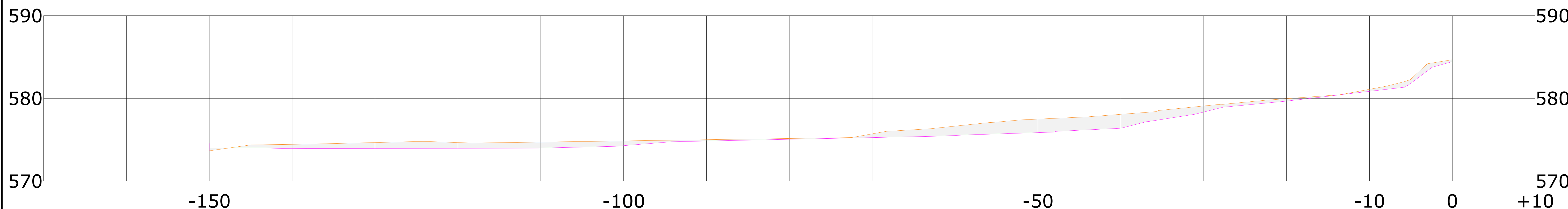
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JOB NO.:

10046

SHEET NO.:

7 OF 13



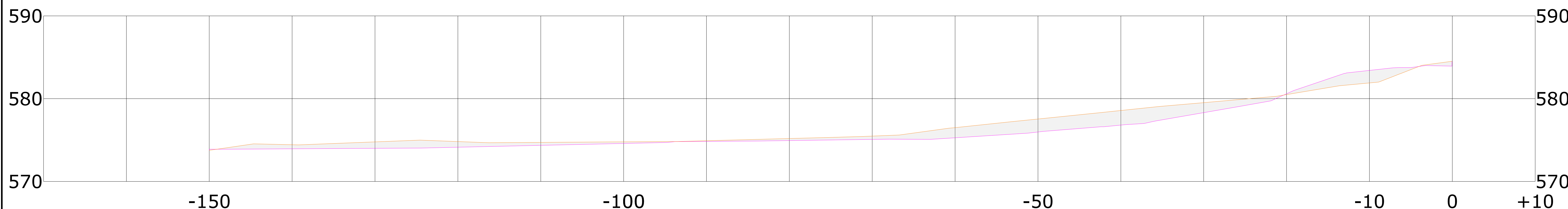
574.0'  
573.6'

574.3'  
574.8'

575.9'  
577.5'

580.8'  
581.1'

		END AREA (SQ FT)	VOLUME (CYD)
7+75.00 EX	Excavation	0.4	7
	Fill	95.8	75
8+00.00 EX	Excavation	15.6	7
	Fill	95.1	88



573.9'  
573.8'

574.5'  
574.8'

576.0'  
577.5'

583.4'  
581.9'

*LAKE MICHIGAN*

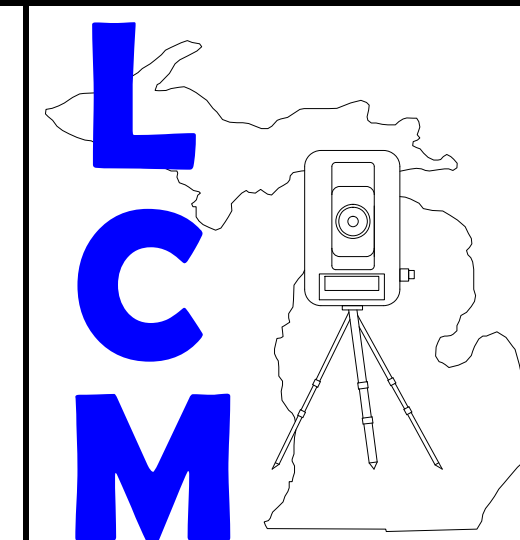
(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

(WATER ELEV:577.5'±, APRIL 17, 2012)

09-01-2011

04-17-2012

SCALE 1"=6'



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- Civil Engineering

225 EAST MAIN ST.  
MARION, MI 49665  
Phone: (231) 743-3000  
Fax: (231) 743-3001

**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY:

FTW

CHK'D BY:

CCY

DATE:

03-12-2013

FIELD BOOK/PAGE:

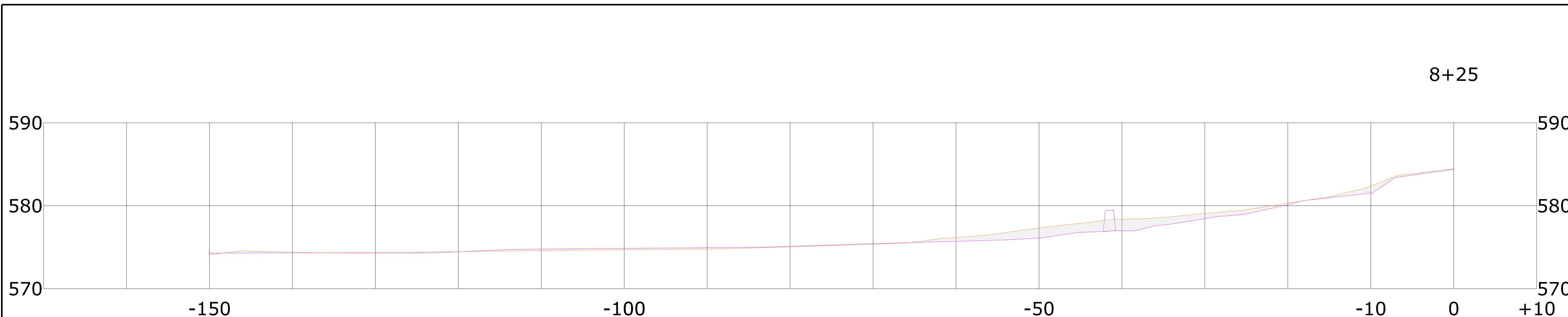
SEE FILE

JOB NO.:

10046

SHEET NO.:

8 OF 13



574.3'  
574.1'

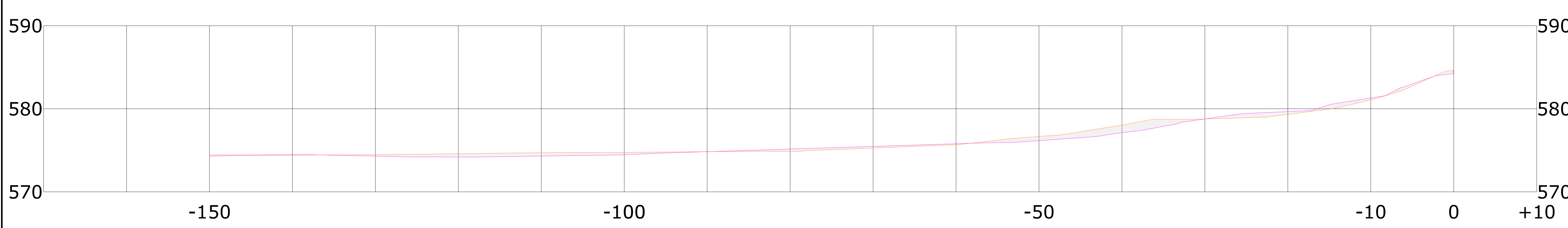
574.8'  
574.7'

576.1'  
577.3'

BASE: W. E.  
576.9' 577.0'

581.6'  
582.3'

		END AREA (SQ FT)	VOLUME (CYD)
8+25.00 EX	Excavation	7.2	11
	Fill	43.7	64
8+50.00 EX	Excavation	15.0	10
	Fill	30.2	34



574.4'  
574.3'

574.4'  
574.7'

576.2'  
576.6'

581.3'  
581.0'

LAKE MICHIGAN

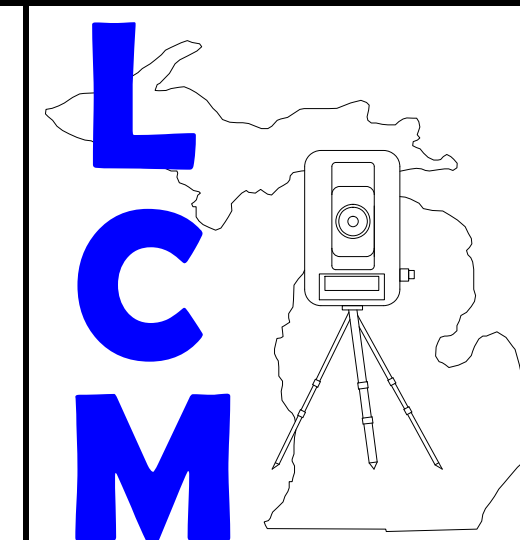
(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

09-01-2011

(WATER ELEV:577.5'±, APRIL 17, 2012)

04-17-2012

SCALE 1"=6'



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PROJECT:

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**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY: FTW

CHK'D BY: CCY

DATE: 03-12-2013

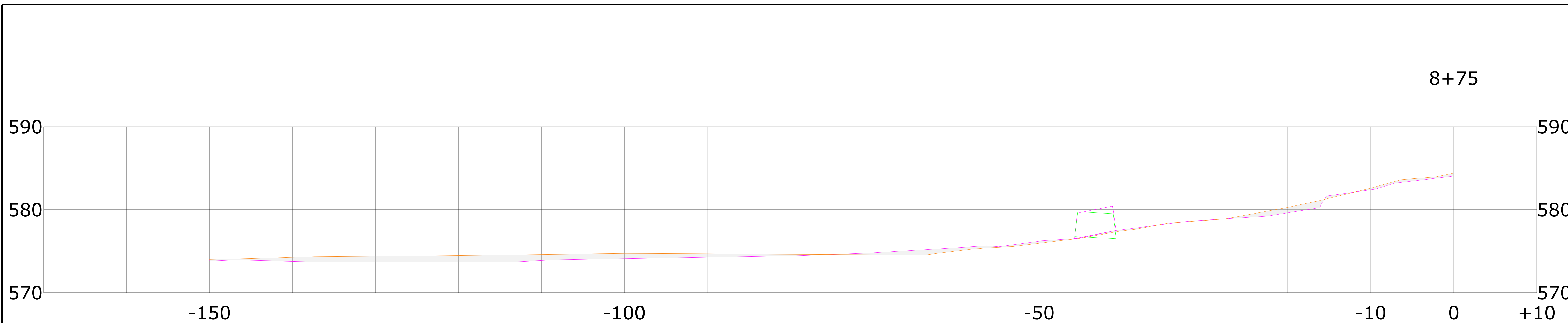
FIELD BOOK/PAGE: SEE FILE

JOB NO.:

10046

SHEET NO.:

9 OF 13



573.8'  
574.0'

574.1'  
574.7'

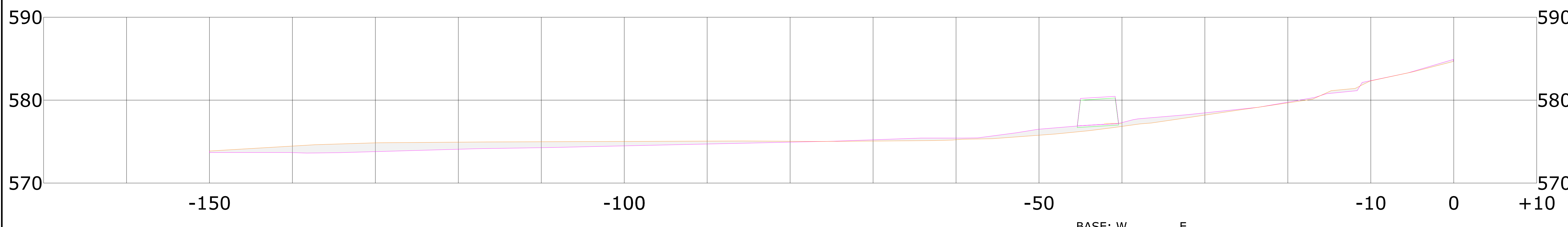
576.2'  
576.0'

576.5'  
576.5'

577.5'  
577.4'

582.4'  
582.6'

		END AREA (SQ FT)	VOLUME (CYD)
8+75.00 EX	Excavation	9.9	12
	Fill	48.7	37
9+00.00 EX	Excavation	20.6	14
	Fill	46.8	44



573.7'  
573.8'

574.5'  
575.0'

576.5'  
575.8'

576.9'  
576.6'

577.2'  
577.1'

582.3'  
582.3'

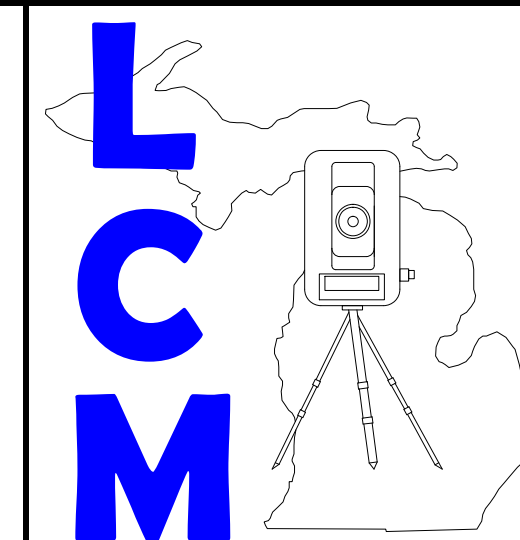
*LAKE MICHIGAN*

(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)  
(WATER ELEV:577.5'±, APRIL 17, 2012)

09-01-2011  
04-17-2012

SCALE 1"=6'





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**ENGINEERING FIRM:**

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BIG RAPIDS, MI 49307**

DRN. BY:

FTW

CHK'D BY:

CCY

DATE:

03-12-2013

FIELD BOOK/PAGE:

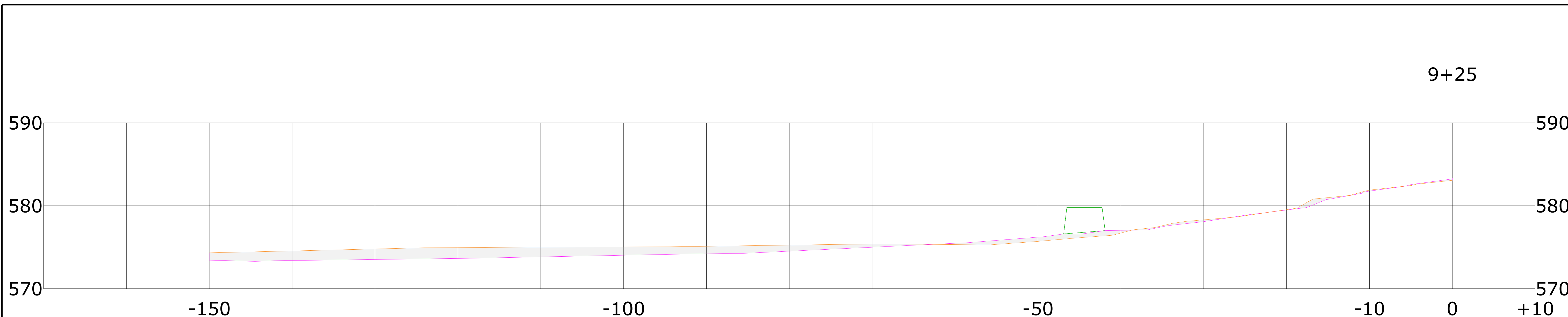
SEE FILE

JOB NO.:

10046

SHEET NO.:

10 OF 13



573.4'  
574.3'

573.9'  
575.0'

576.2'  
575.7'

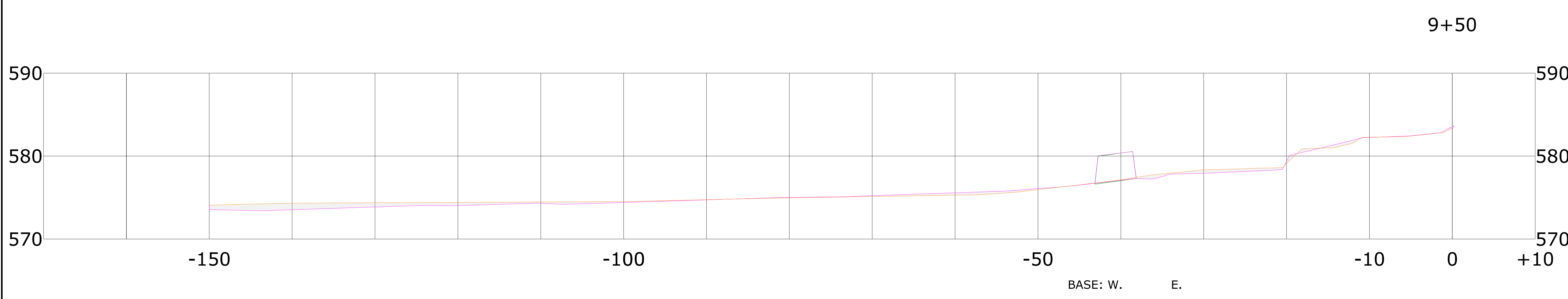
576.6'  
576.3'

577.0'  
576.7'

581.7'  
581.9'

		END AREA (SQ FT)	VOLUME (CYD)
9+25.00 EX	Excavation	10.6	14
	Fill	89.2	63
9+50.00 EX	Excavation	7.7	8
	Fill	30.3	55

BASE: W. E.



573.6'  
574.1'

574.5'  
574.5'

576.1'  
575.9'

576.6'  
576.8'

577.3'  
577.5'

582.3'  
582.3'

BASE: W. E.

LAKE MICHIGAN

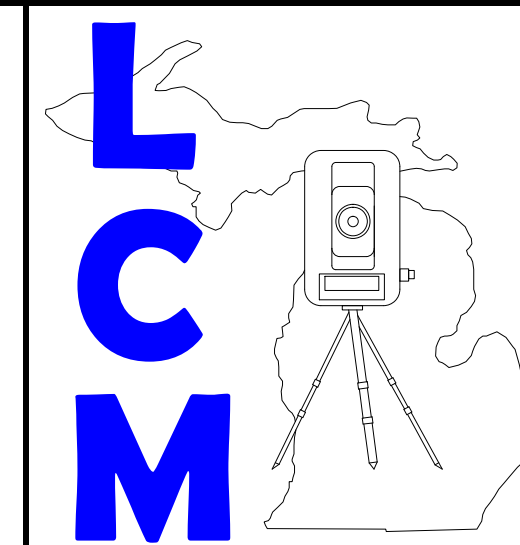
(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

09-01-2011

(WATER ELEV:577.5'±, APRIL 17, 2012)

04-17-2012

SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

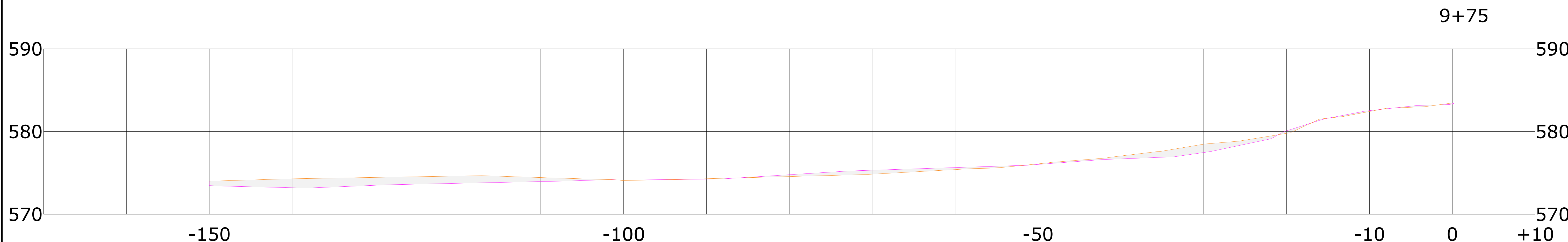
PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
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CHK'D BY:	CCY
DATE:	03-12-2013
FIELD BOOK/PAGE:	SEE FILE

JOB NO.:	10046
SHEET NO.:	11 OF 13



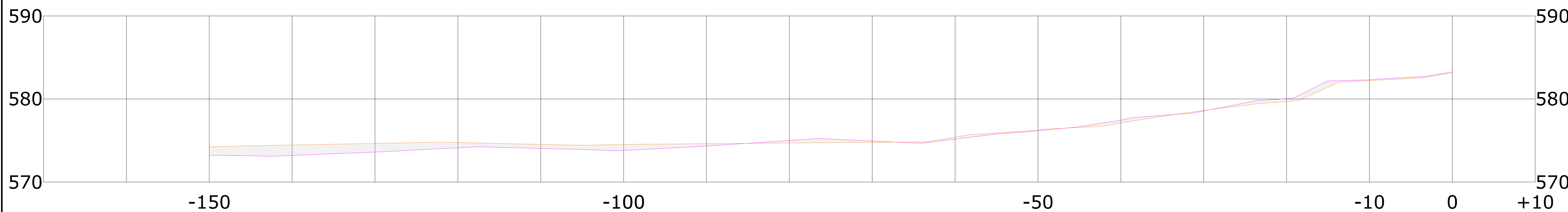
573.4'  
574.0'

574.1'  
574.1'

576.0'  
576.1'

582.5'  
582.4'

		END AREA (SQ FT)	VOLUME (CYD)
9+75.00 EX	Excavation	12.0	9
	Fill	52.5	38
10+00.00 EX	Excavation	15.4	13
	Fill	51.9	48



573.2'  
574.2'

573.8'  
574.5'

576.2'  
576.2'

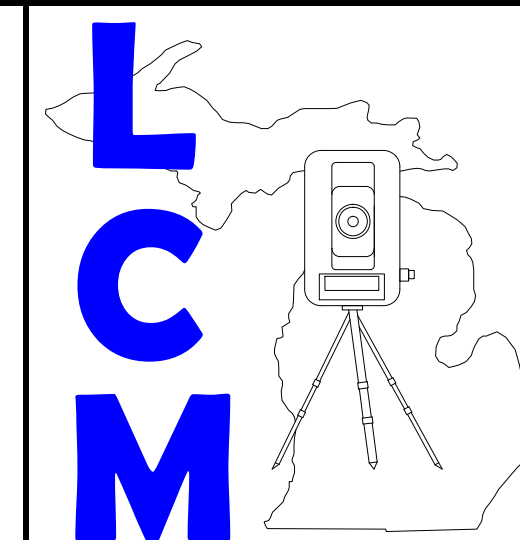
582.3'  
582.2'

*LAKE MICHIGAN*

(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)  
(WATER ELEV:577.5'±, APRIL 17, 2012)

09-01-2011  
04-17-2012

SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
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BIG RAPIDS, MI 49307**

DRN. BY:

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CCY

DATE:

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FIELD BOOK/PAGE:

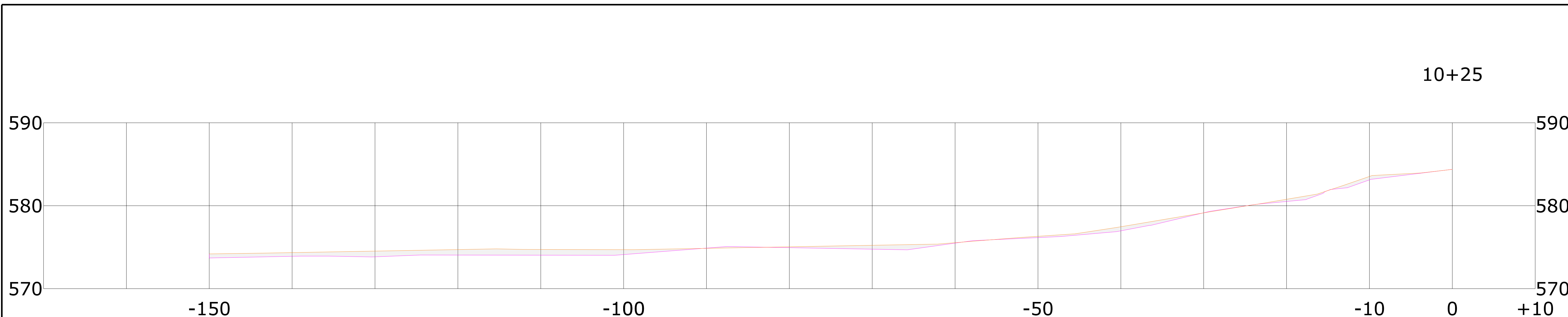
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JOB NO.:

10046

SHEET NO.:

12 OF 13



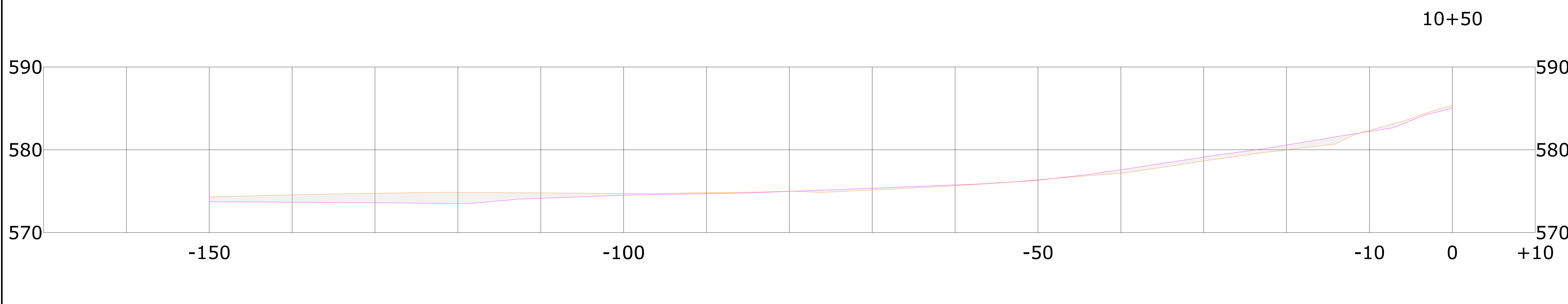
573.7'  
574.2'

574.1'  
574.7'

576.1'  
576.3'

583.1'  
583.5'

		END AREA (SQ FT)	VOLUME (CYD)
10+25.00 EX	Excavation	1.1	8
	Fill	51.2	48
10+50.00 EX	Excavation	20.2	10
	Fill	49.8	47



573.7  
574.3'

574.4'  
574.7'

576.3'  
576.4'

582.0'  
582.2'

*LAKE MICHIGAN*

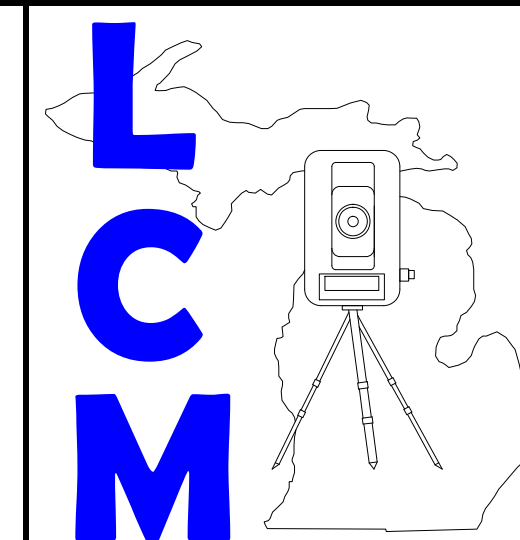
(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

09-01-2011

(WATER ELEV:577.5'±, APRIL 17, 2012)

04-17-2012

SCALE 1"=6'



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Fax: (231) 743-3001

**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY: FTW

CHK'D BY: CCY

DATE: 03-12-2013

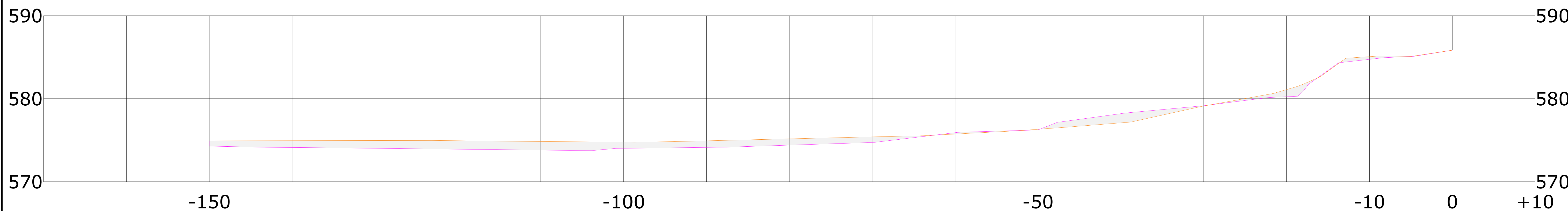
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JOB NO.:

10046

SHEET NO.:

13 OF 13



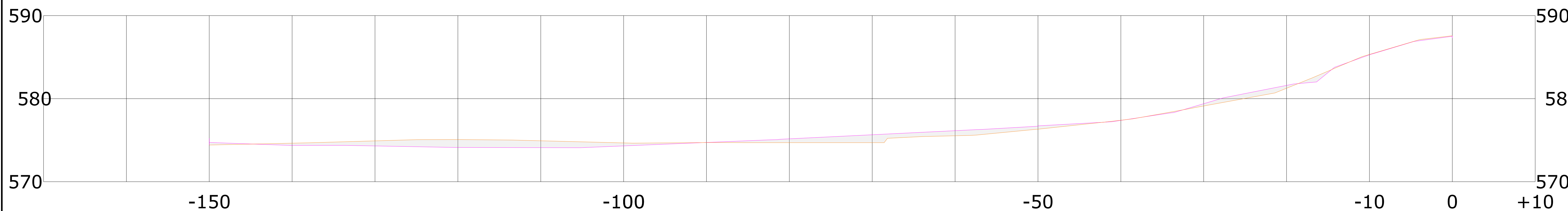
574.2'  
574.9'

574.0'  
574.8'

576.2'  
576.3'

584.7'  
585.1'

		END AREA (SQ FT)	VOLUME (CYD)
10+75.00 EX	Excavation	15.3	16
	Fill	78.7	59
11+00.00 EX	Excavation	29.3	21
	Fill	32.7	52



574.7'  
574.5'

574.3'  
574.7'

576.7'  
567.3'

585.3'  
585.3'

**GRAND SUMMARY**  
Material Name      Unadjusted  
   volumes  
   (cu. yd.)

Excavation	297
Fill	1188

(WATER ELEV:577.9'±, SEPTEMBER 01, 2011)

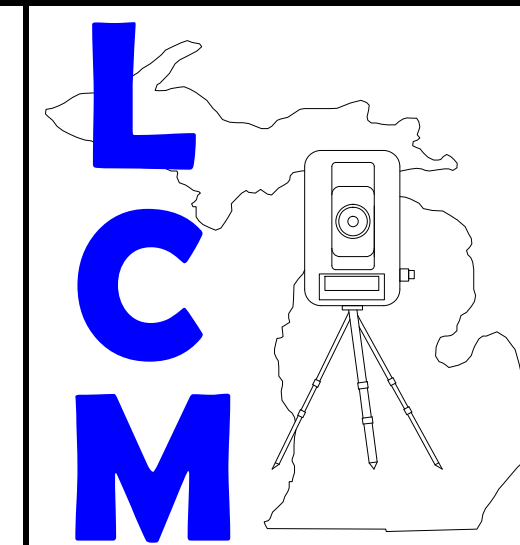
09-01-2011

(WATER ELEV:577.5'±, APRIL 17, 2012)

04-17-2012

SCALE 1"=6'

*LAKE MICHIGAN*



**Surveying & Engineering**

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Fax: (231) 743-3001

**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY:

FTW

CHK'D BY:

CCY

DATE:

03-12-2013

FIELD BOOK/PAGE:

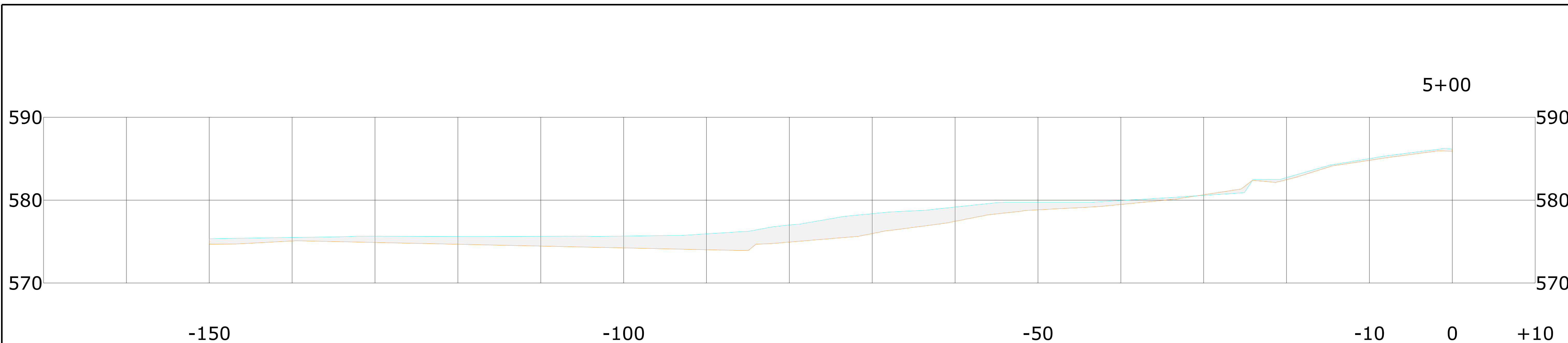
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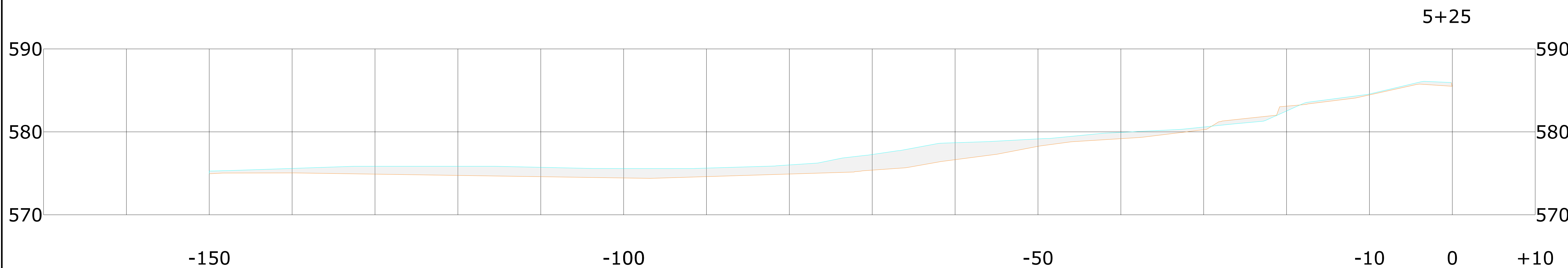
10046

SHEET NO.:

2 OF 13



		END AREA (SQ FT)	VOLUME (CYD)
5+00.00 EX	Excavation	1.9	0
	Fill	151.8	0
5+25.00 EX	Excavation	4.7	3
	Fill	134.9	133

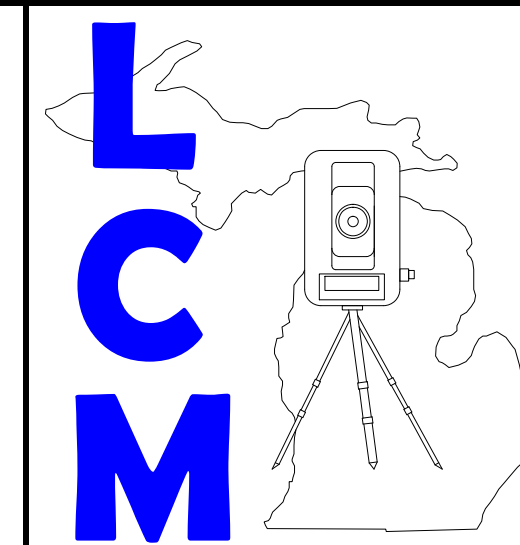


LAKE MICHIGAN

(WATER ELEV:577.5'±, APRIL 17, 2012)  
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)

04-17-2012  
09-06-2012

SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

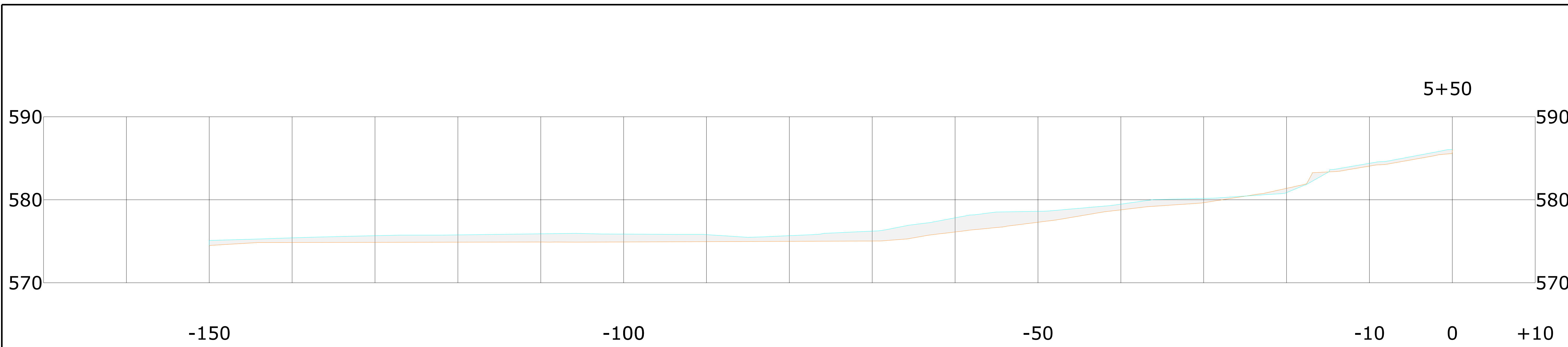
PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

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CHK'D BY:	CCY
DATE:	03-12-2013
FIELD BOOK/PAGE:	SEE FILE

JOB NO.:	10046
SHEET NO.:	3 OF 13



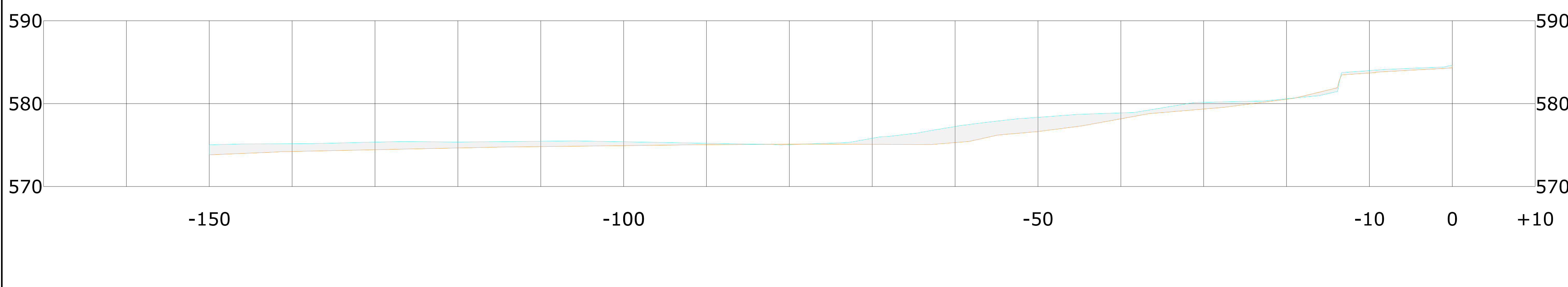
574.5'  
575.0'

574.9'  
575.8'

577.3'  
578.6'

584.0'  
584.4'

		END AREA (SQ FT)	VOLUME (CYD)
5+50.00 EX	Excavation	3.2	4
	Fill	119.5	118
5+75.00 EX	Excavation	1.8	2
	Fill	105.6	104



573.8'  
575.0'  
575.2'

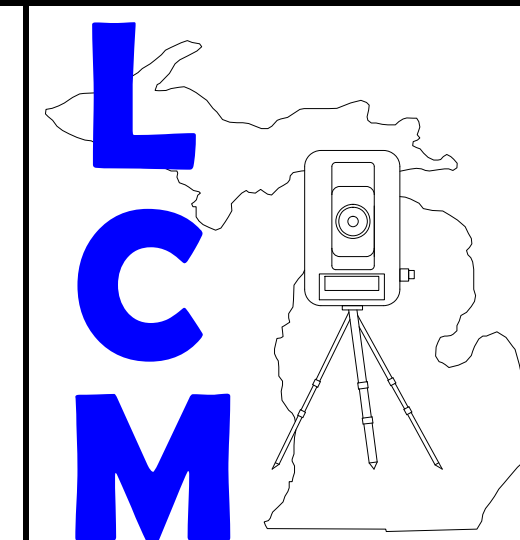
574.9'  
575.4'

576.6'  
578.3'

583.7'  
583.9'

LAKE MICHIGAN

(WATER ELEV:577.5'±, APRIL 17, 2012) 04-17-2012  
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012) 09-06-2012  
SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

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**ENGINEERING FIRM:**

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BIG RAPIDS, MI 49307**

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DATE:

03-12-2013

FIELD BOOK/PAGE:

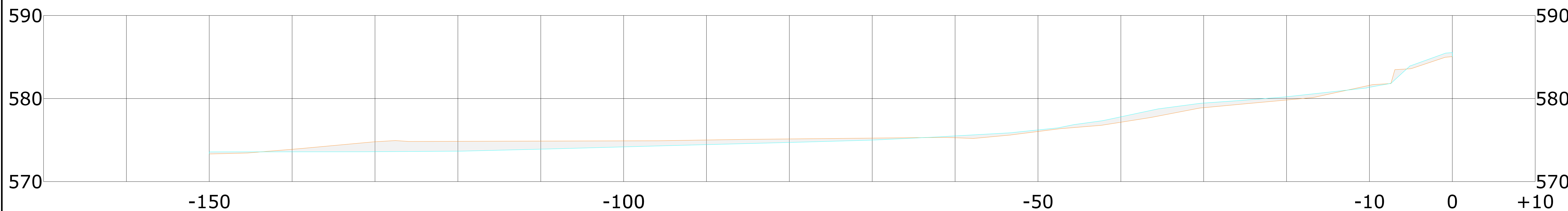
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10046

SHEET NO.:

4 OF 13



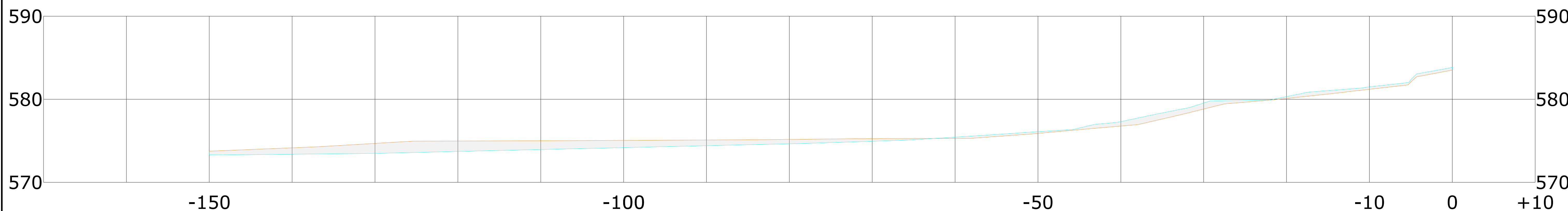
573.3'  
575.5'

574.9'  
574.1'

576.0'  
576.2'

581.6  
581.3'

		END AREA (SQ FT)	VOLUME (CYD)
6+25.00 EX	Excavation	56.9	54
	Fill	24.6	121
6+50.00 EX	Excavation	68.8	58
	Fill	22.0	22



573.7'  
573.3'  
575.2'

575.0'  
574.1'

575.9'  
576.0'

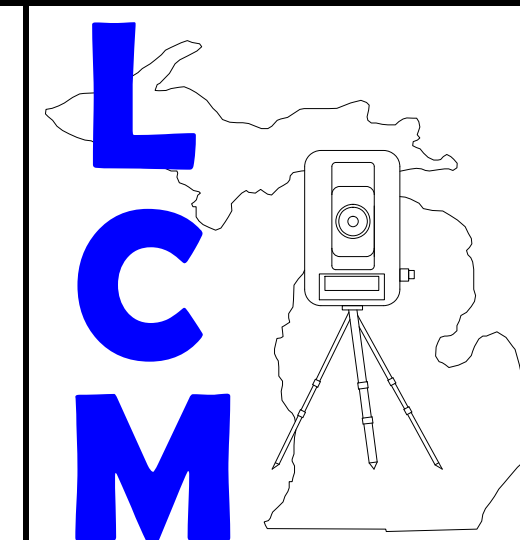
581.2  
581.5'

*LAKE MICHIGAN*

(WATER ELEV:577.5'±, APRIL 17, 2012)  
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)

04-17-2012  
09-06-2012

SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

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**ENGINEERING FIRM:**

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BIG RAPIDS, MI 49307**

DRN. BY:

FTW

CHK'D BY:

CCY

DATE:

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FIELD BOOK/PAGE:

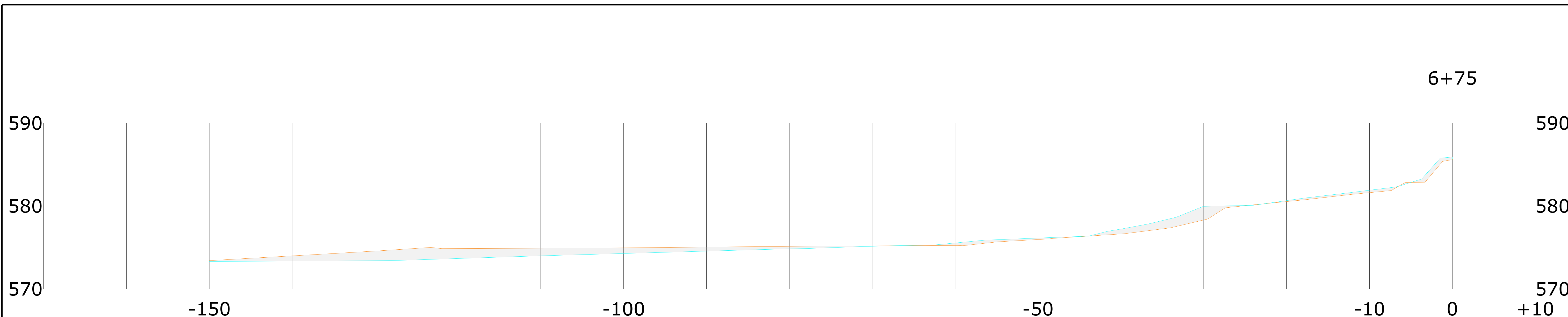
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JOB NO.:

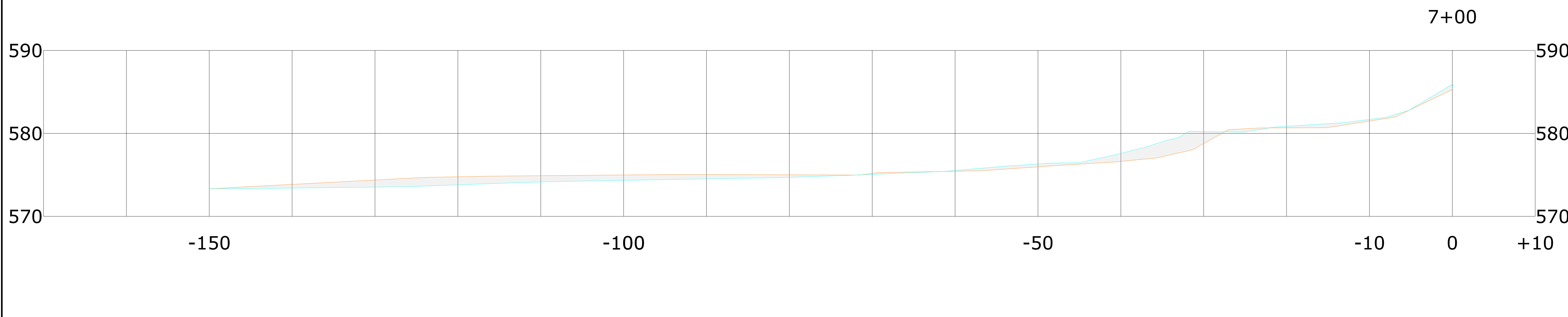
10046

SHEET NO.:

5 OF 13



		END AREA (SQ FT)	VOLUME (CYD)
6+75.00 EX	Excavation	56.2	58
	Fill	24.7	22
7+00.00 EX	Excavation	47.9	48
	Fill	31.8	26

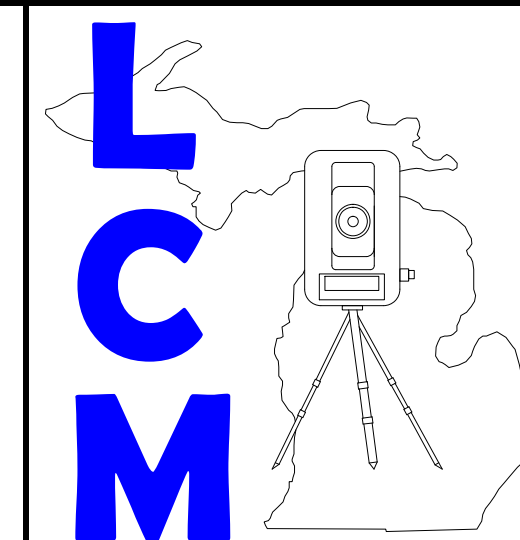


LAKE MICHIGAN

(WATER ELEV:577.5'±, APRIL 17, 2012)  
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)  
SCALE 1"=6'

04-17-2012  
09-06-2012





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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

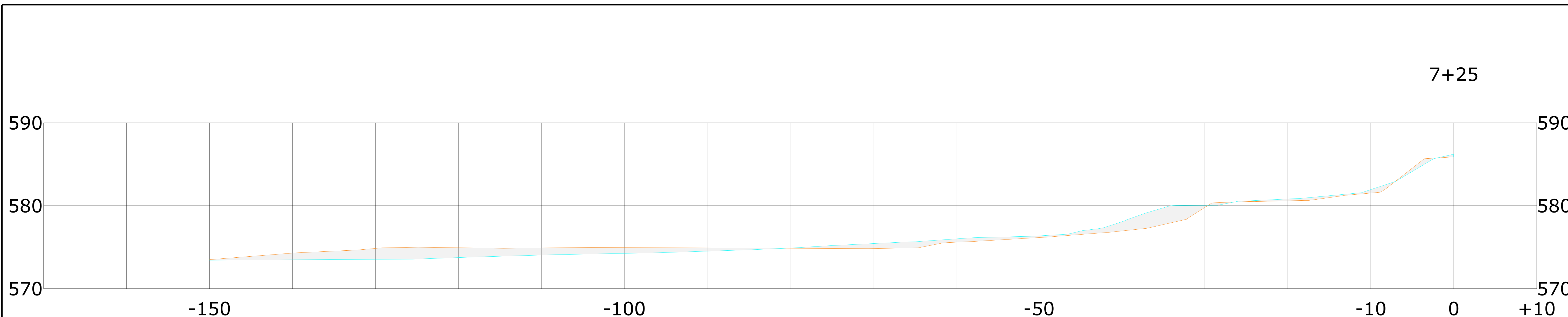
PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

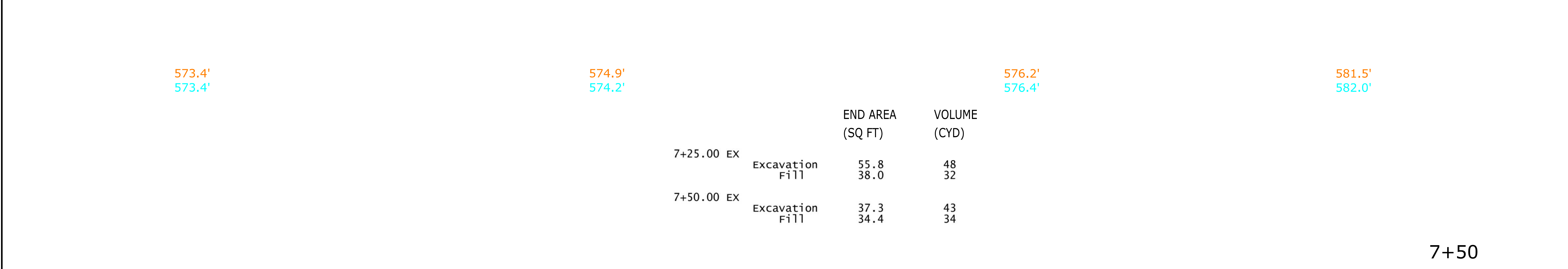
**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY:	FTW
CHK'D BY:	CCY
DATE:	03-12-2013
FIELD BOOK/PAGE:	SEE FILE

JOB NO.:	10046
SHEET NO.:	6 OF 13

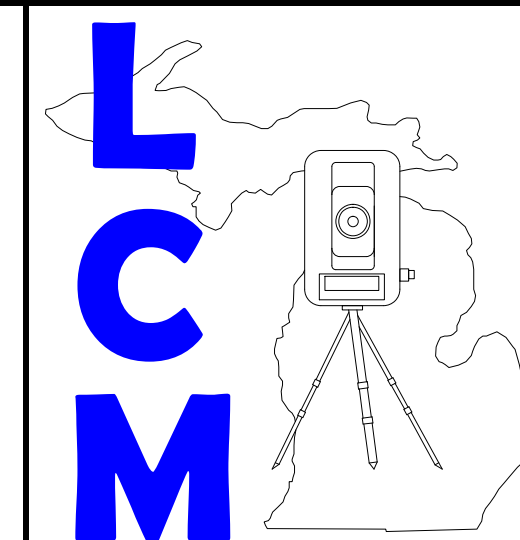


		END AREA (SQ FT)	VOLUME (CYD)
7+25.00 EX	Excavation	55.8	48
	Fill	38.0	32
7+50.00 EX	Excavation	37.3	43
	Fill	34.4	34



LAKE MICHIGAN

(WATER ELEV:577.5'±, APRIL 17, 2012) 04-17-2012  
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012) 09-06-2012  
SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

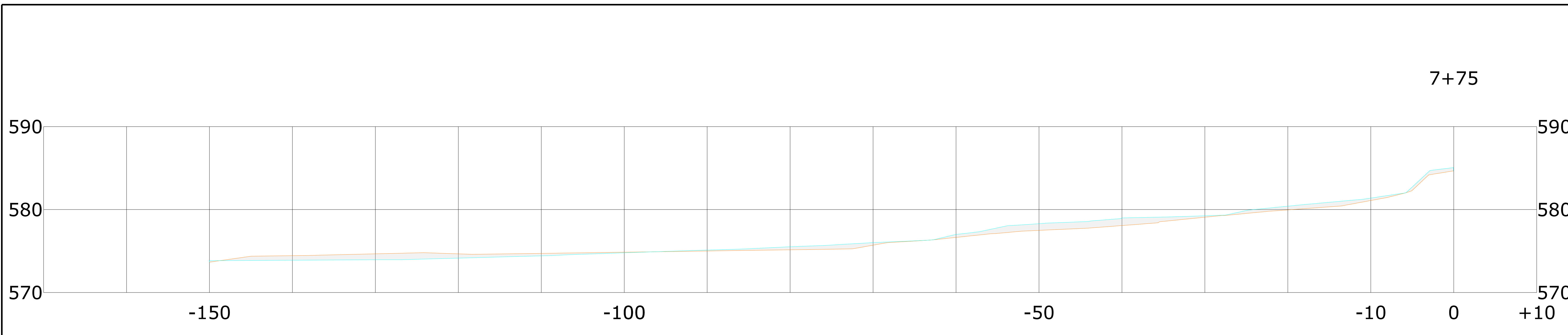
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DATE:	03-12-2013
FIELD BOOK/PAGE:	SEE FILE

JOB NO.:

10046

SHEET NO.:

7 OF 13



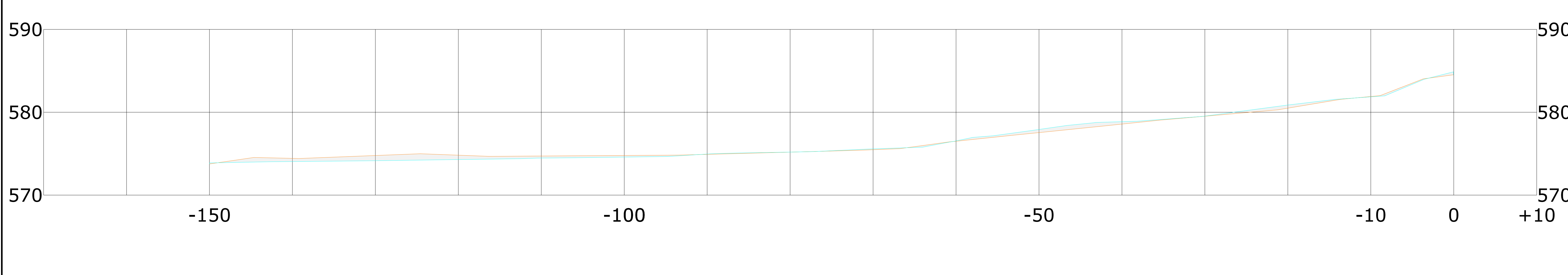
573.6'  
573.6'

574.8'  
574.5'

577.5'  
578.0'

581.1'  
581.1'

		END AREA (SQ FT)	VOLUME (CYD)
7+75.00 EX	Excavation	22.6	28
	Fill	38.6	34
8+00.00 EX	Excavation	23.5	21
	Fill	13.6	24



573.8'  
573.9'  
575.2'

574.8'  
574.6'

577.5'  
577.9'

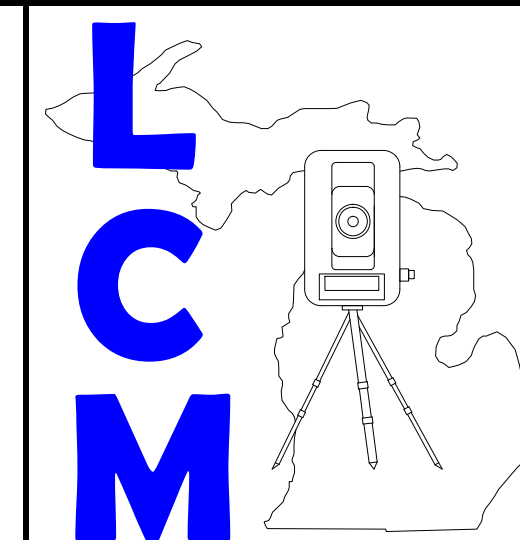
581.9'

LAKE MICHIGAN

(WATER ELEV:577.5'±, APRIL 17, 2012)  
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)

04-17-2012  
09-06-2012

SCALE 1"=6'



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PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

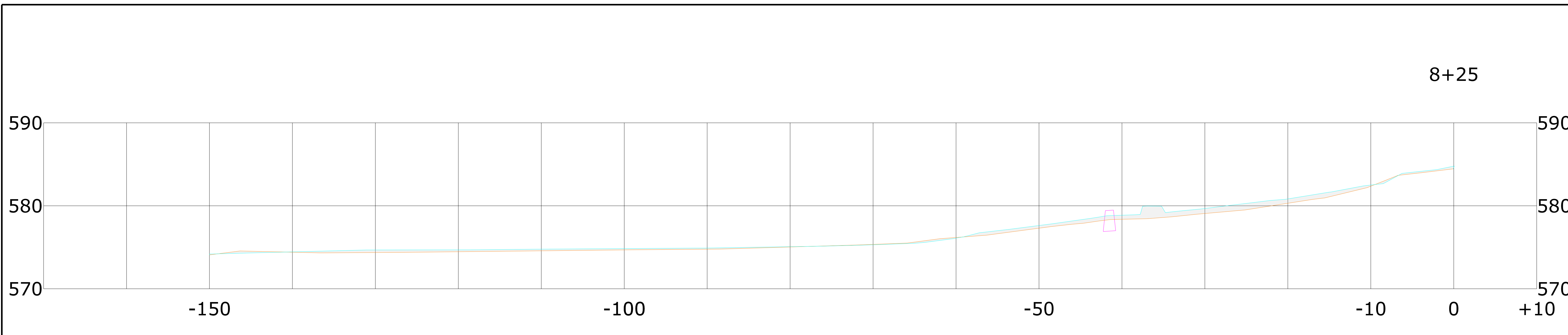
**ENGINEERING FIRM:**

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BIG RAPIDS, MI 49307**

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DATE:	03-12-2013
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JOB NO.: 10046

SHEET NO.: 8 OF 13



574.1'  
574.2'

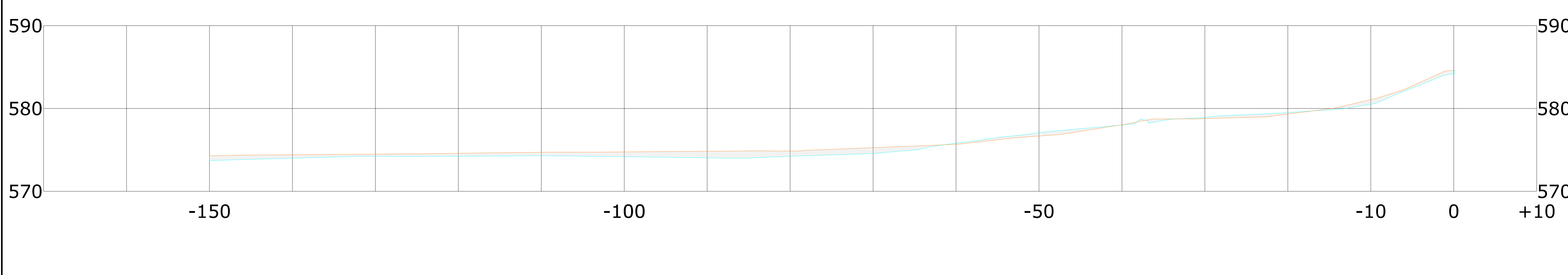
574.7'  
574.8'

577.3'

582.3'  
582.5'

BASE: W. E.

		END AREA (SQ FT)	VOLUME (CYD)
8+25.00 EX	Excavation	3.0	12
	Fill	39.1	24
8+50.00 EX	Excavation	52.4	26
	Fill	9.1	22



574.3'  
574.4'  
575.2'

574.7'  
574.8'

576.6'  
577.9'

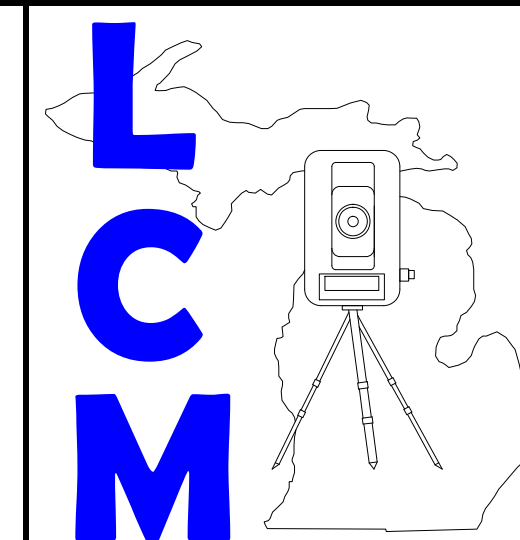
581.0'  
581.2'

LAKE MICHIGAN

(WATER ELEV:577.5'±, APRIL 17, 2012)  
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)

04-17-2012  
09-06-2012

SCALE 1"=6'



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DRN. BY: FTW

CHK'D BY: CCY

DATE: 03-12-2013

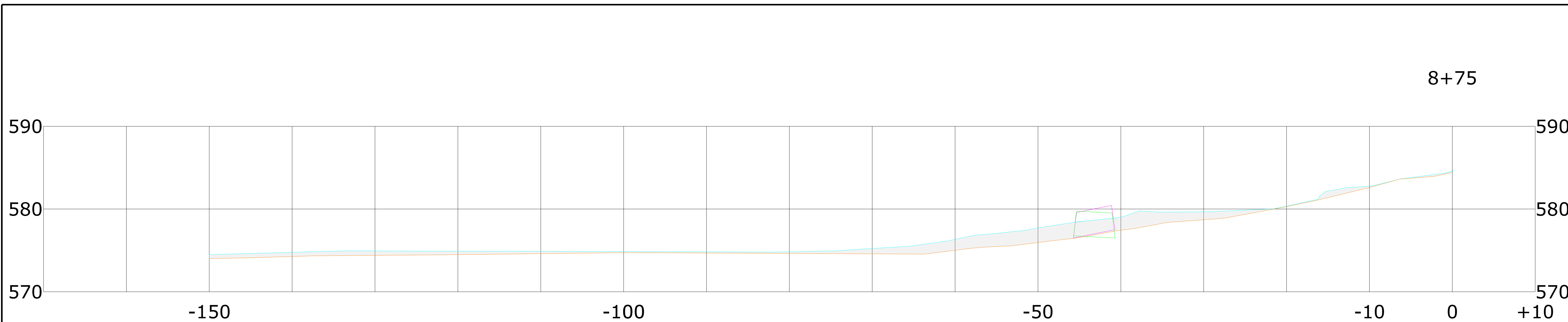
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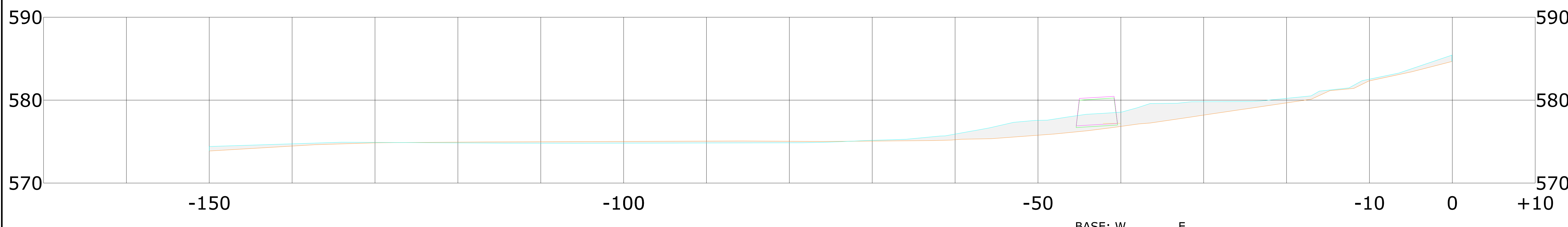
SHEET NO.:

9 OF 13



BASE: W. E.

		END AREA (SQ FT)	VOLUME (CYD)
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	Fill	95.5	48
9+00.00 EX	Excavation	8.8	4
	Fill	78.2	80



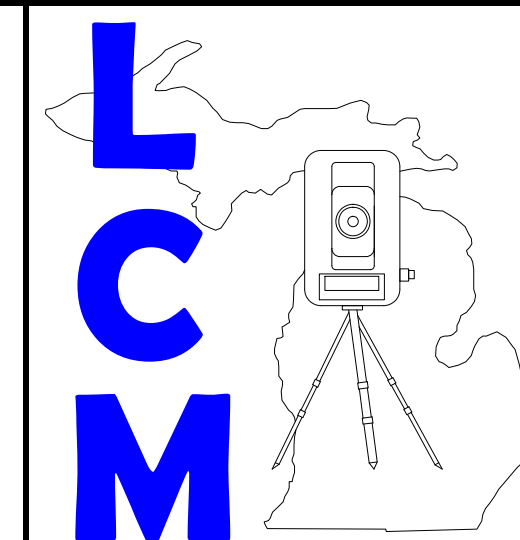
BASE: W. E.

LAKE MICHIGAN

(WATER ELEV: 577.5'±, APRIL 17, 2012)  
(WATER ELEV: 577.0'±, SEPTEMBER 6, 2012)

04-17-2012  
09-06-2012

SCALE 1"=6'



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**ENGINEERING FIRM:**

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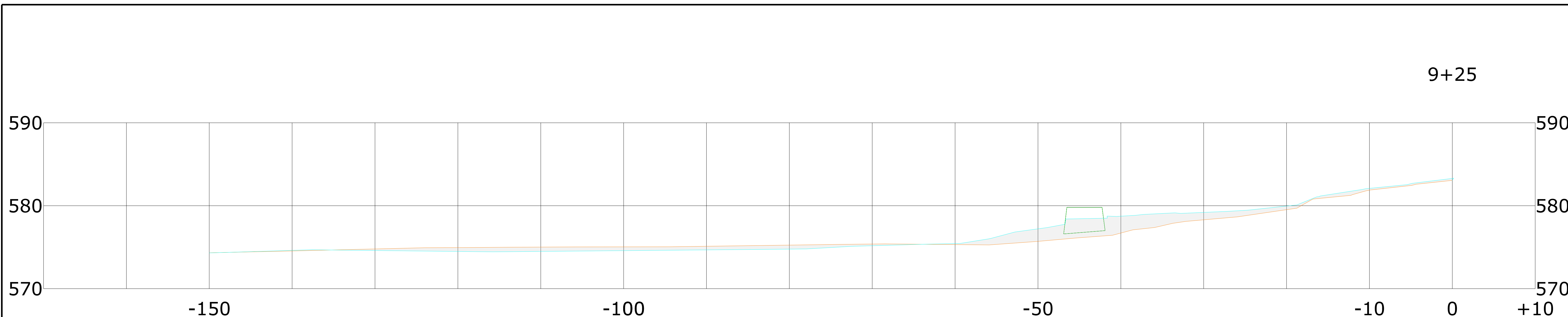
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JOB NO.:

10046

SHEET NO.:

10 OF 13



BASE: W. E.

574.3'  
574.3'

575.0'  
574.6'

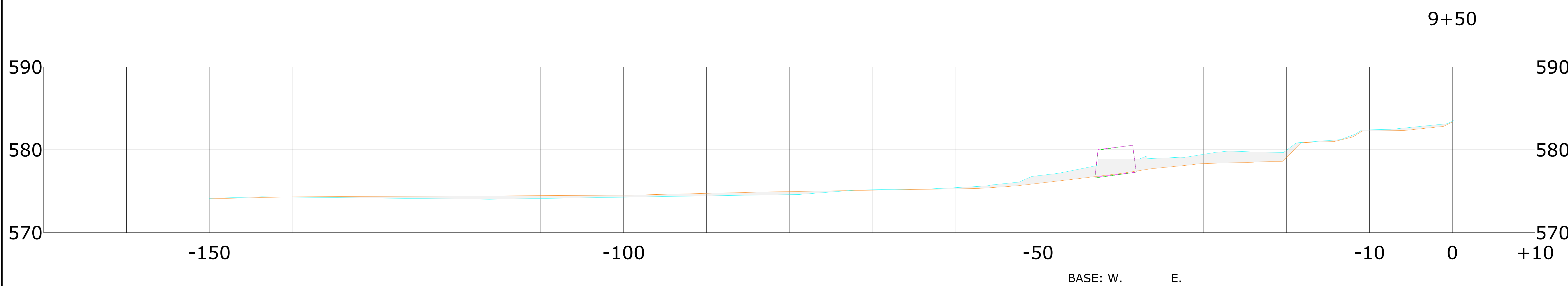
575.7'  
577.2'

576.3'

576.7'

581.9'  
582.1'

		END AREA (SQ FT)	VOLUME (CYD)
9+25.00 EX	Excavation	27.3	17
	Fill	56.0	62
9+50.00 EX	Excavation	18.3	21
	Fill	47.6	48



BASE: W. E.

574.1'  
574.1'  
575.2'

574.5'  
574.3'

575.9'  
576.9'

576.8'

577.5'

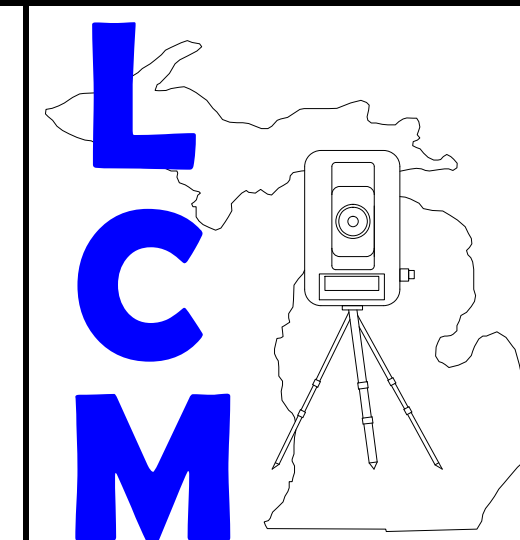
582.3'  
582.4'

LAKE MICHIGAN

(WATER ELEV:577.5'±, APRIL 17, 2012)  
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)

04-17-2012  
09-06-2012

SCALE 1"=6'



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PROJECT:

LOCATION:

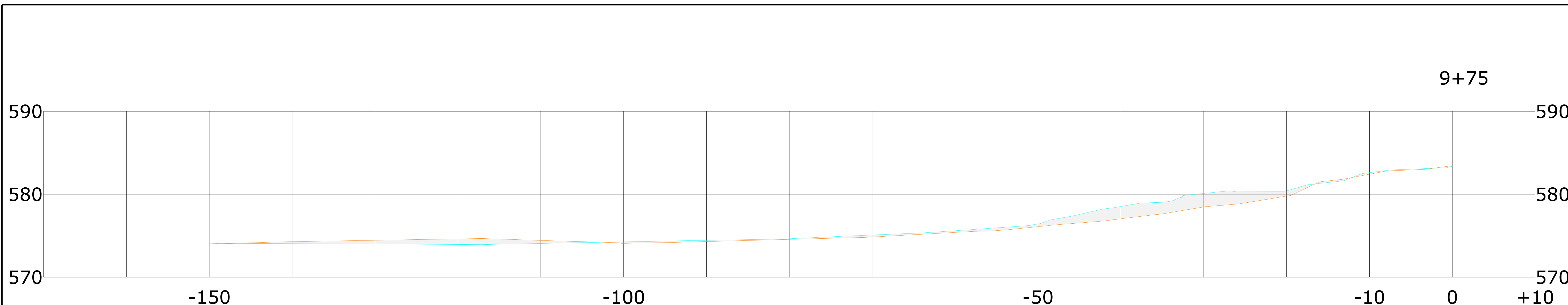
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JOB NO.:	10046
SHEET NO.:	11 OF 13



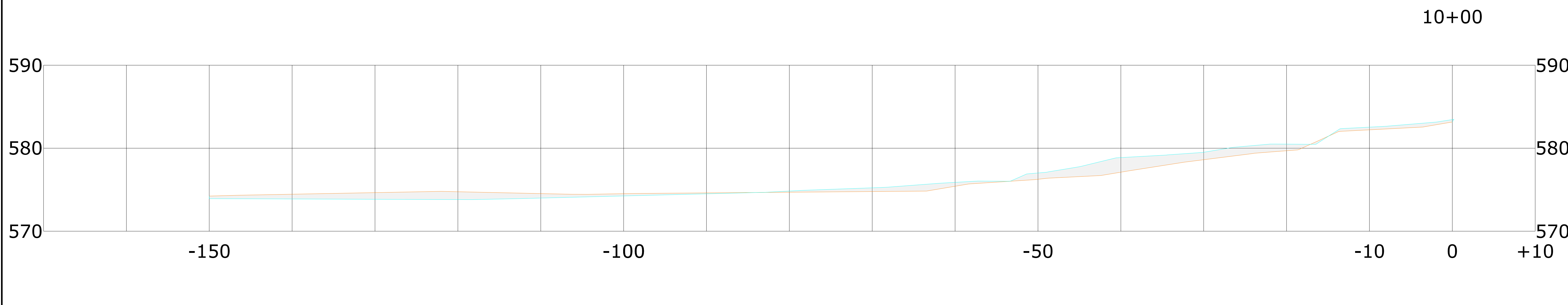
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574.0'

574.1'  
574.2'

576.1'  
576.4'

582.4'  
582.6'

		END AREA (SQ FT)	VOLUME (CYD)
9+75.00 EX	Excavation	18.3	17
	Fill	51.0	46
10+00.00 EX	Excavation	34.4	24
	Fill	54.1	49



574.2'  
573.9'  
575.2'

574.5'  
574.2'

576.2'  
577.0'

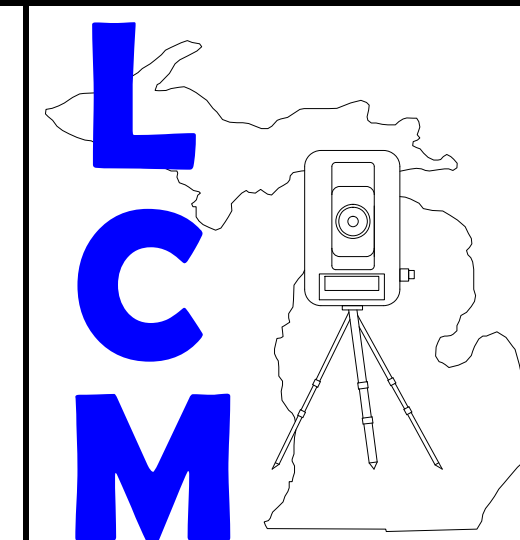
582.2'  
582.5'

LAKE MICHIGAN

(WATER ELEV:577.5'±, APRIL 17, 2012)  
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)

04-17-2012  
09-06-2012

SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

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PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

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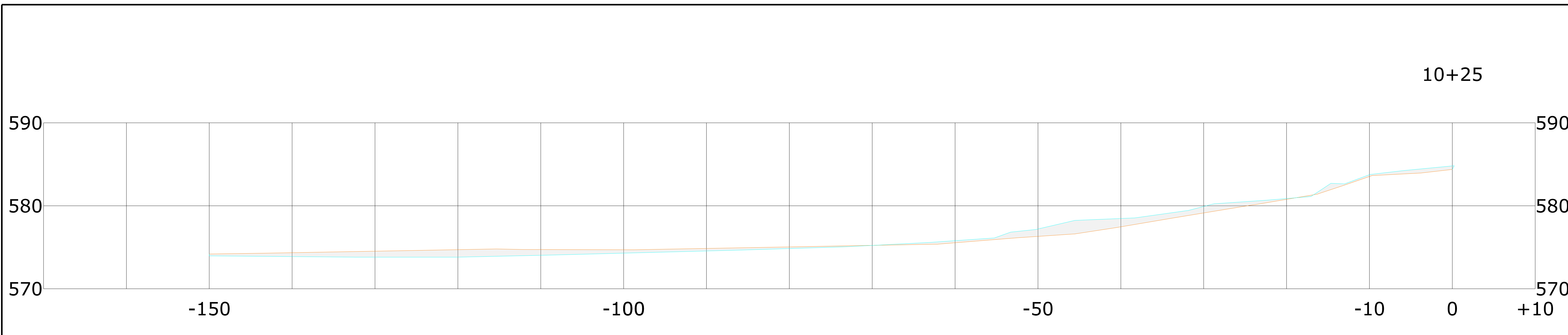
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10046

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12 OF 13



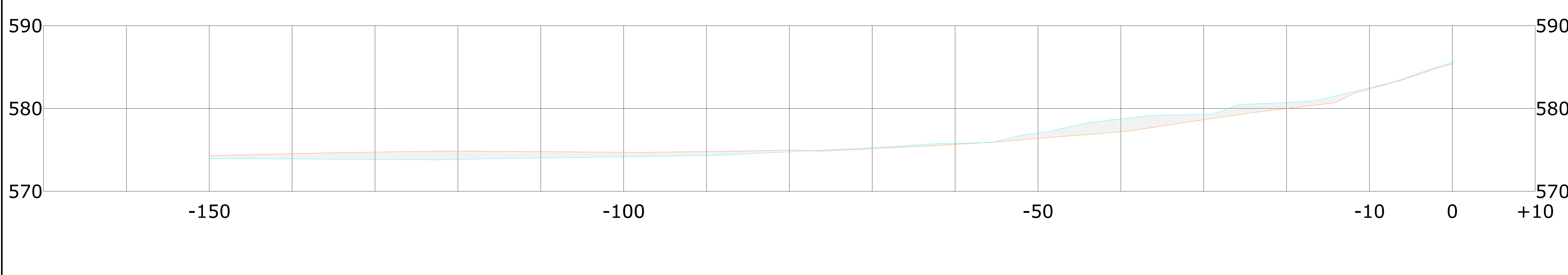
574.2'  
574.1'

574.7'  
574.3'

576.3'  
577.2'

583.5'  
583.7'

		END AREA (SQ FT)	VOLUME (CYD)
10+25.00 EX	Excavation	38.9	34
	Fill	37.9	43
10+50.00 EX	Excavation	47.1	40
	Fill	45.1	38



574.3'  
573.9'  
575.2'

574.7'  
574.1'

576.4'  
577.0'

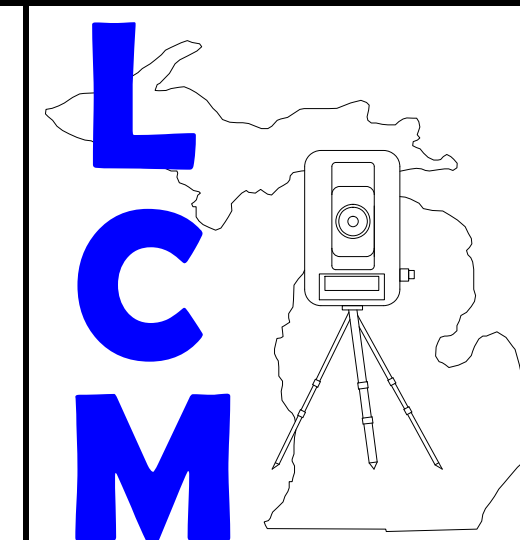
582.2'  
582.5'

LAKE MICHIGAN

(WATER ELEV:577.5'±, APRIL 17, 2012)  
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)

04-17-2012  
09-06-2012

SCALE 1"=6'



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**MONITORING BEACH TOPOGRAPHY**

PROJECT:

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**YOUNGS CONSULTING  
14154 RUBY LANE  
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DATE: 03-12-2013

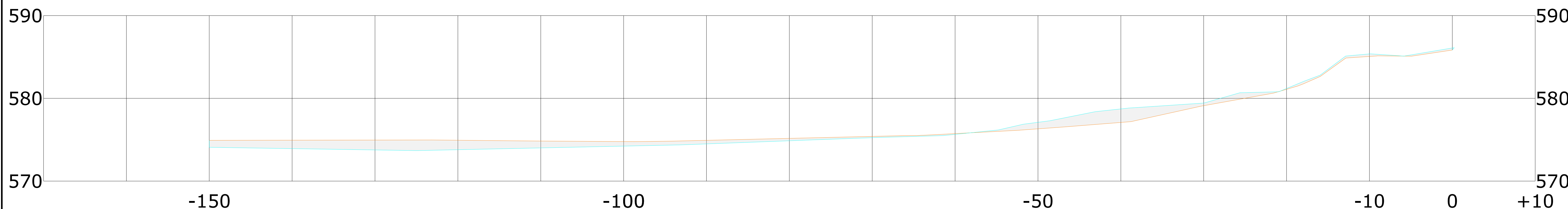
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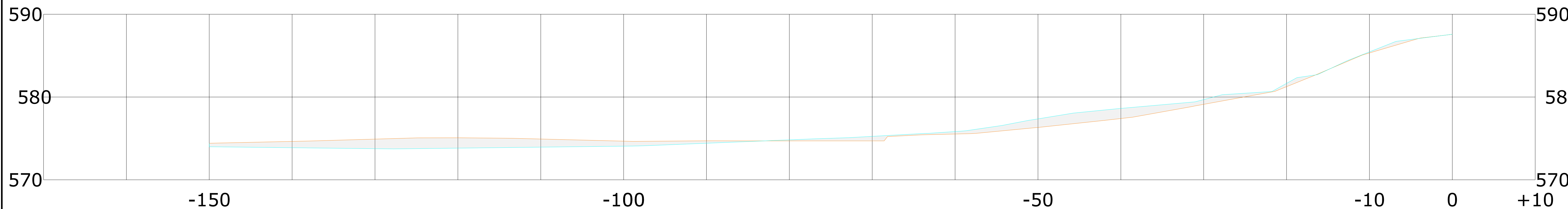
10046

SHEET NO.:

13 OF 13



		END AREA (SQ FT)	VOLUME (CYD)
10+75.00 EX	Excavation	61.5	50
	Fill	34.5	37
11+00.00 EX	Excavation	53.2	53
	Fill	40.7	35



**GRAND SUMMARY**  
Material Name      Unadjusted volumes (cu. yd.)

Excavation	689
Fill	1202

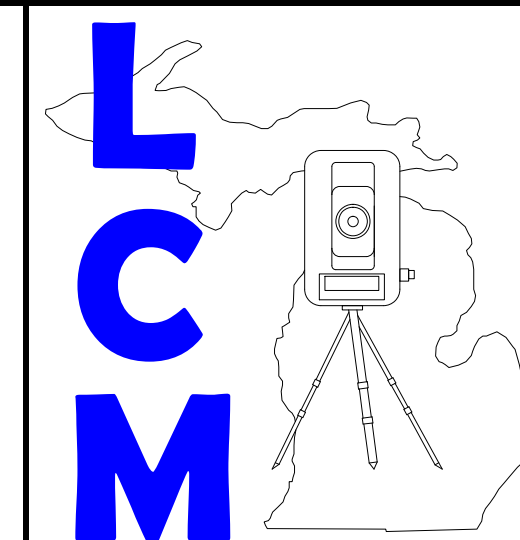
(WATER ELEV:577.5'±, APRIL 17, 2012)  
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)

04-17-2012  
09-06-2012

SCALE 1"=6'

*LAKE MICHIGAN*





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**ENGINEERING FIRM:**

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14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY: FTW

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DATE: 06-14-2013

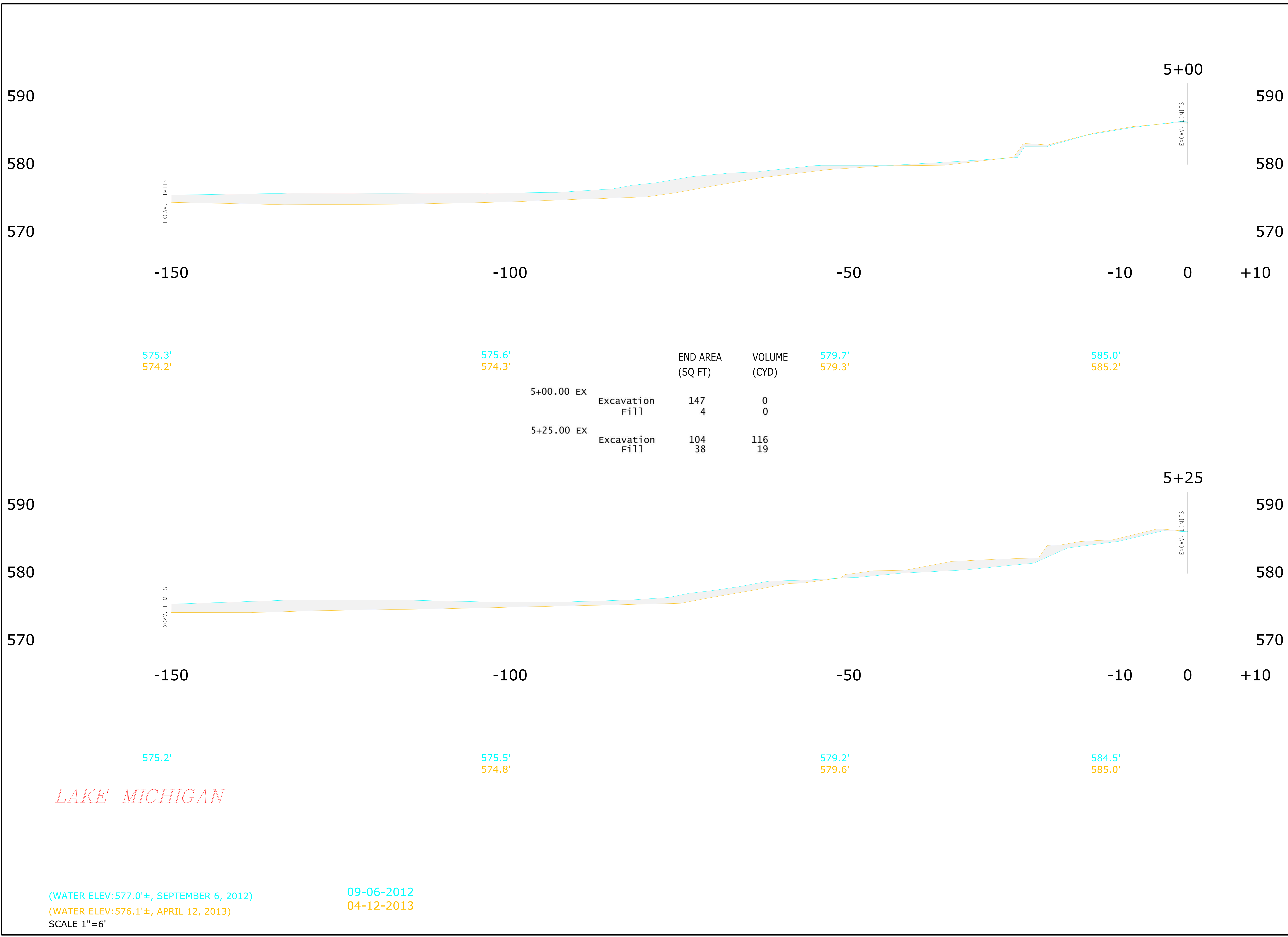
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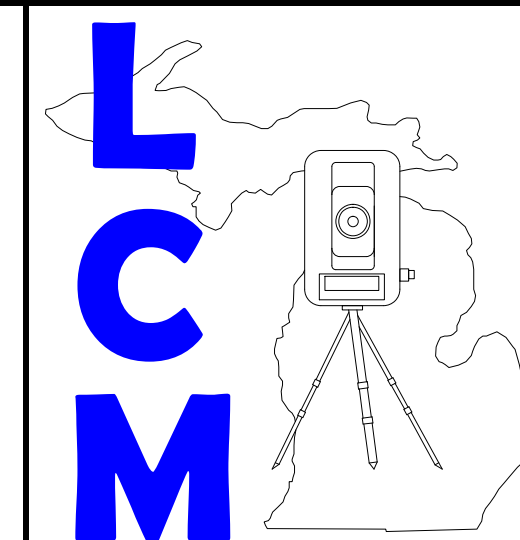
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2 OF 13



LAKE MICHIGAN

(WATER ELEV:577.0'±, SEPTEMBER 6, 2012) 09-06-2012  
 (WATER ELEV:576.1'±, APRIL 12, 2013) 04-12-2013  
 SCALE 1"=6'



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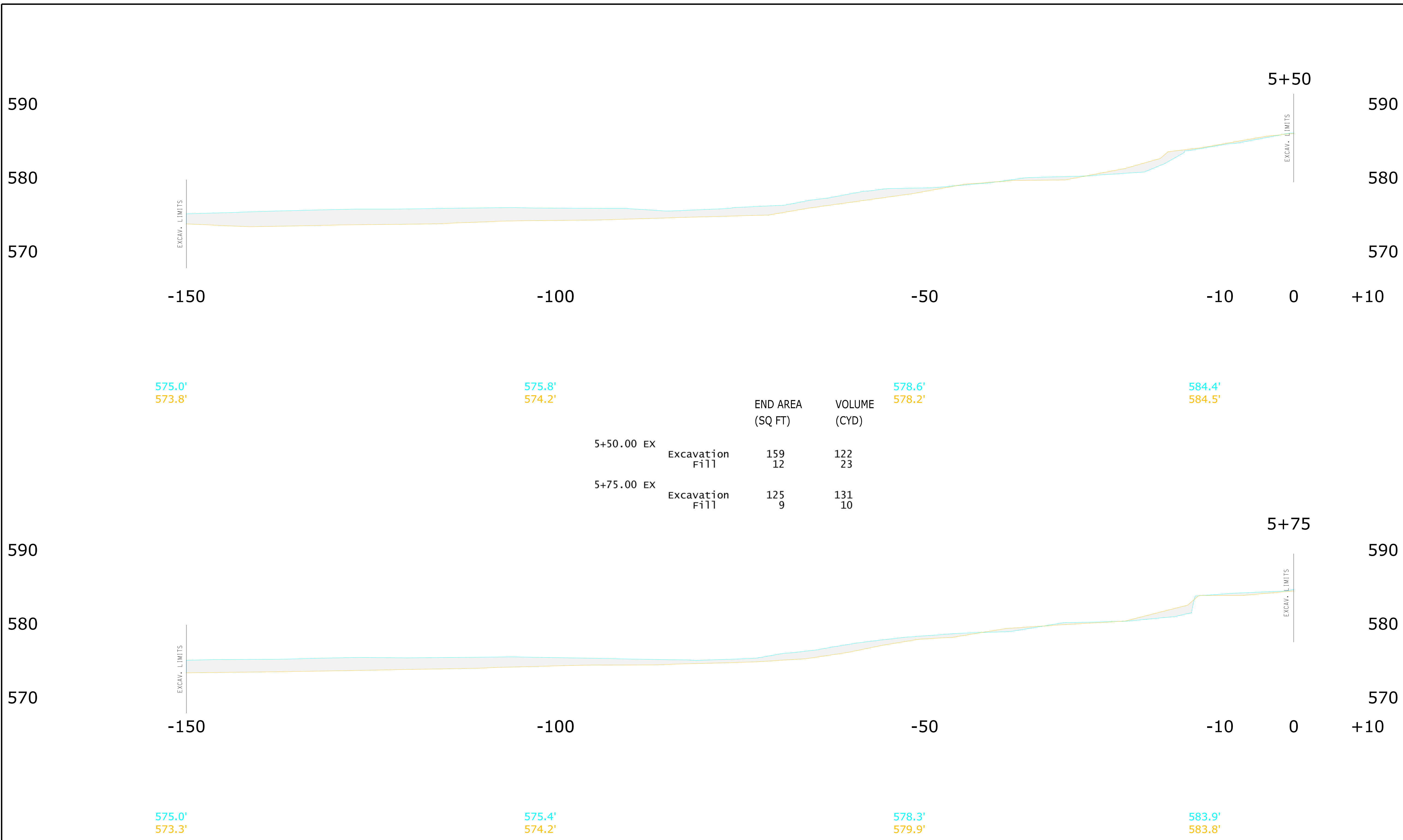
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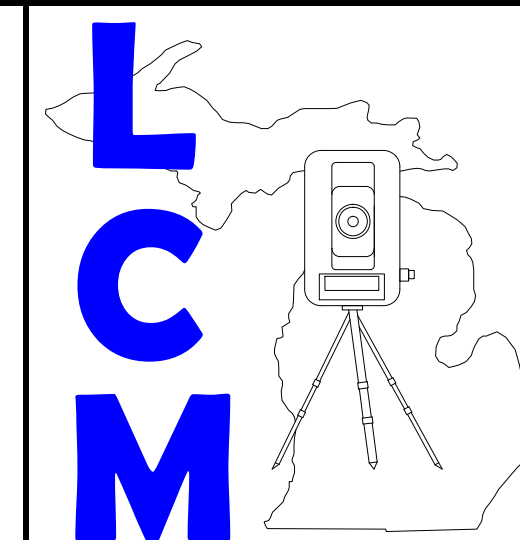
SHEET NO.:

3 OF 13



LAKE MICHIGAN

(WATER ELEV:577.0'±, SEPTEMBER 6, 2012) 09-06-2012  
(WATER ELEV:576.1'±, APRIL 12, 2013) 04-12-2013  
SCALE 1"=6'



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DRN. BY: FTW

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DATE: 06-14-2013

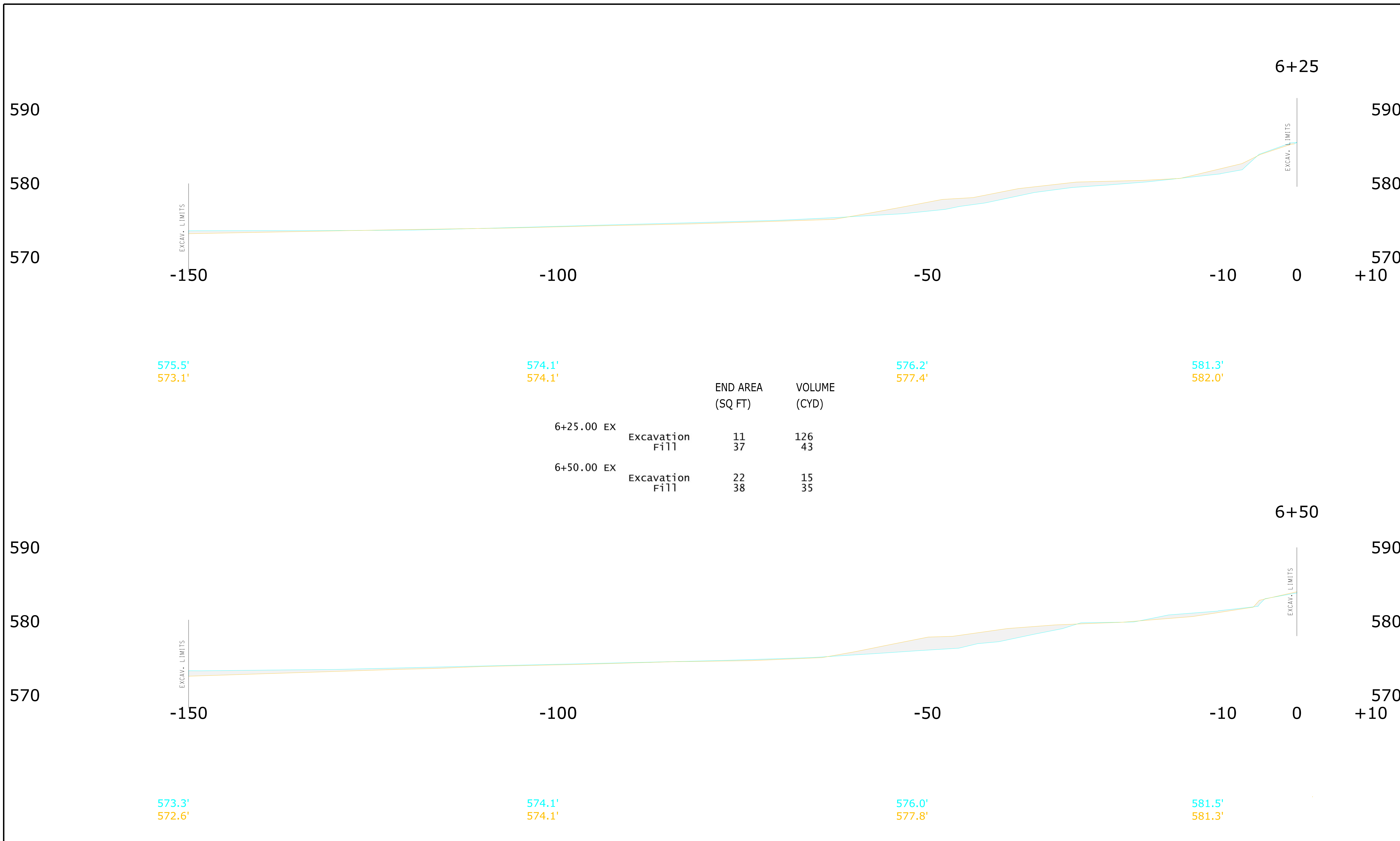
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10046

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4 OF 13



LAKE MICHIGAN

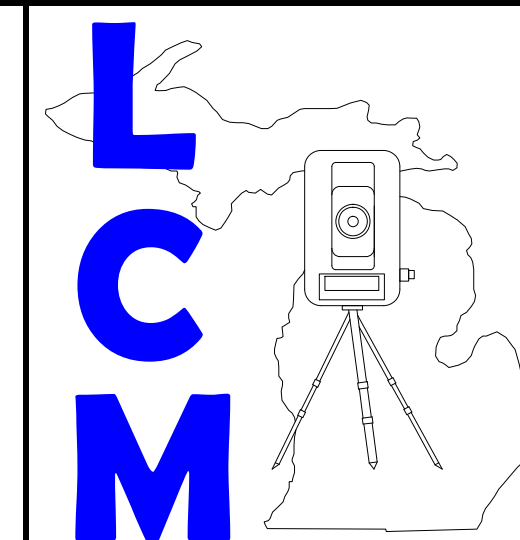
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)

09-06-2012

(WATER ELEV:576.1'±, APRIL 12, 2013)

04-12-2013

SCALE 1"=6'



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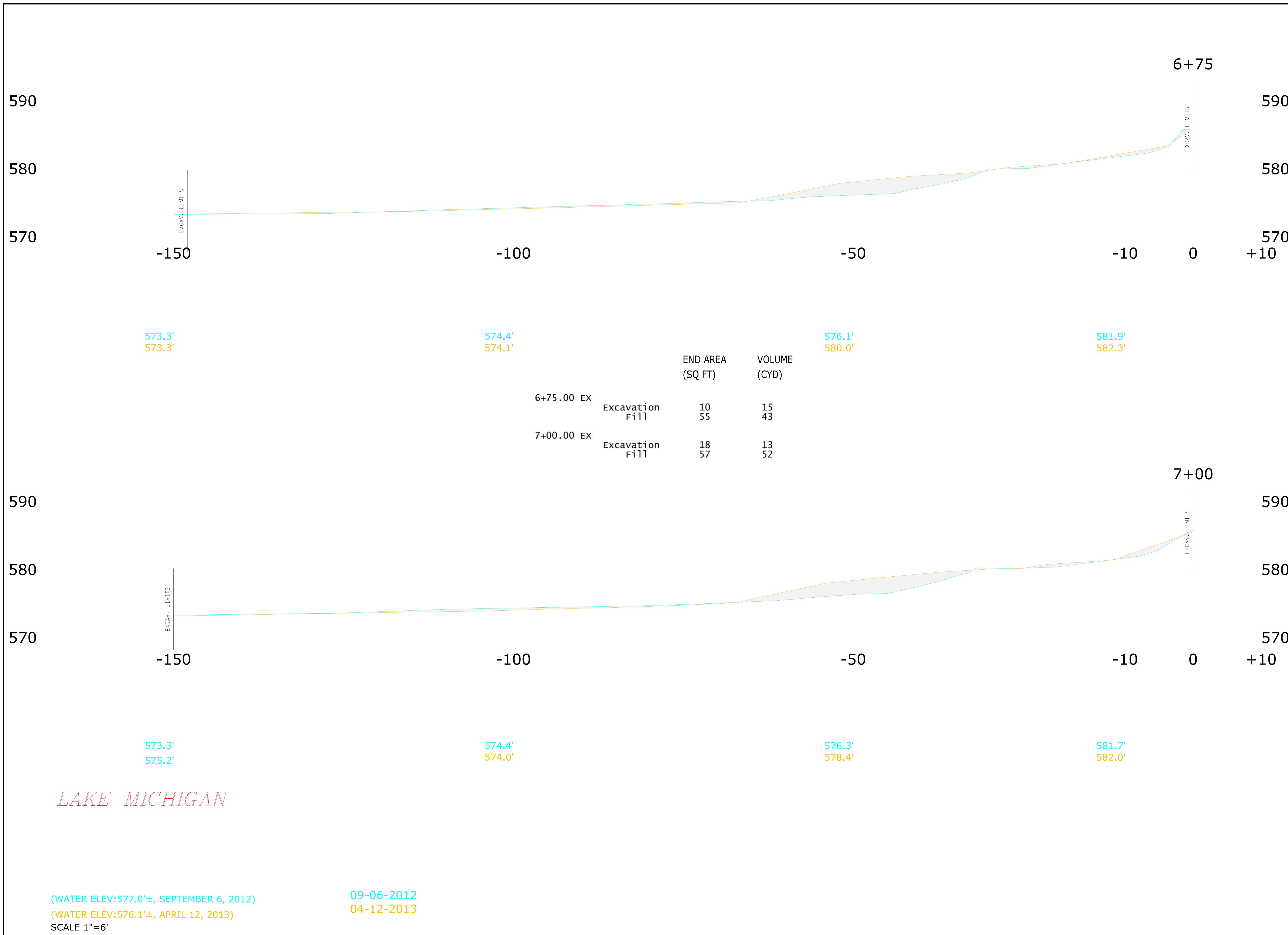
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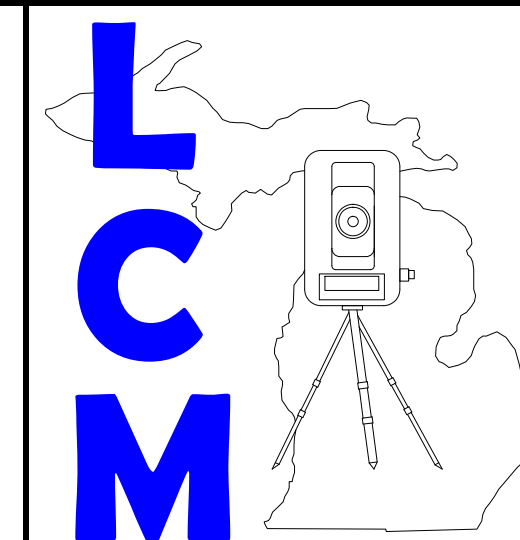
SHEET NO.:

5 OF 13



LAKE MICHIGAN

(WATER ELEV:577.0'±, SEPTEMBER 6, 2012) 09-06-2012  
 (WATER ELEV:576.1'±, APRIL 12, 2013) 04-12-2013  
 SCALE 1"=6'



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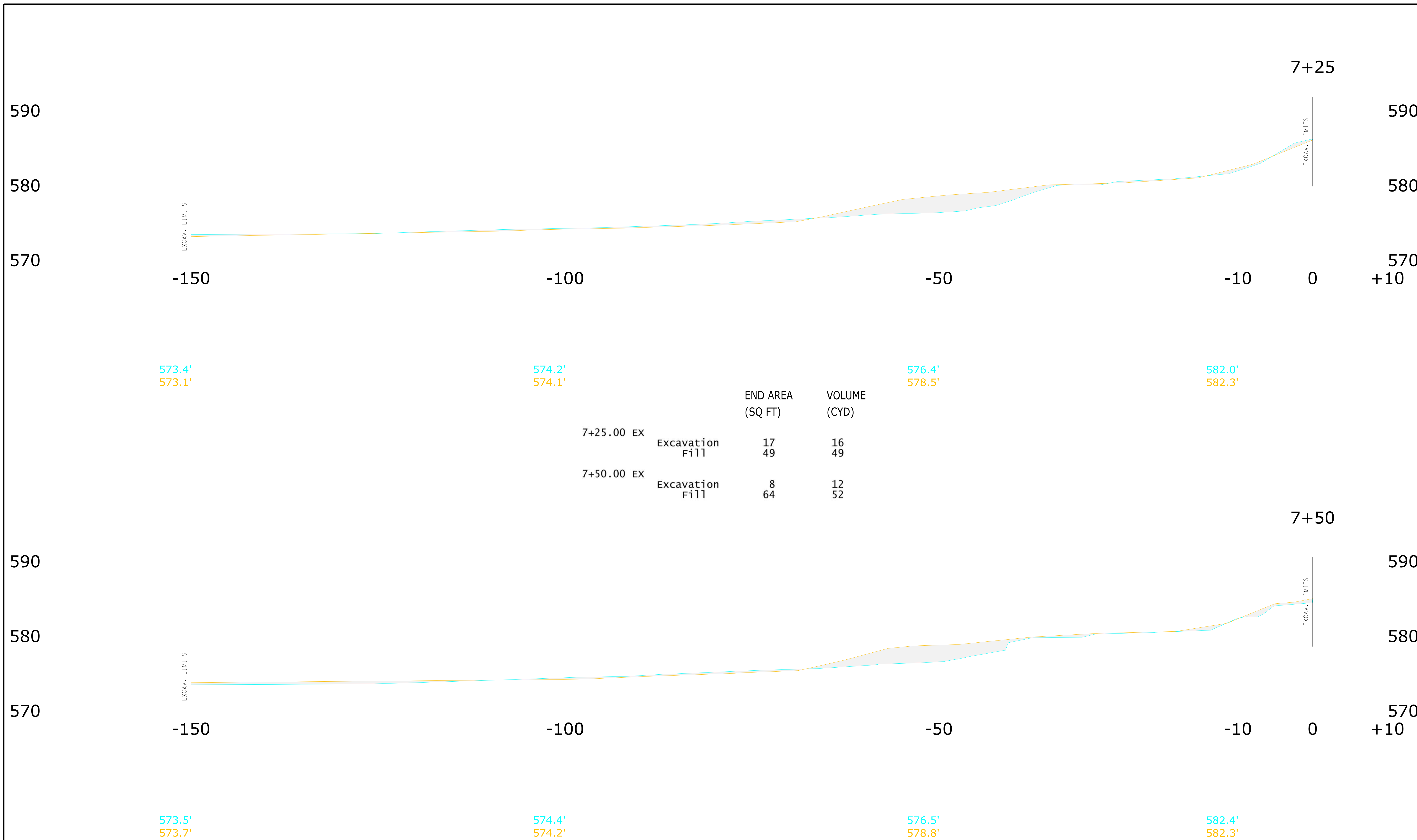
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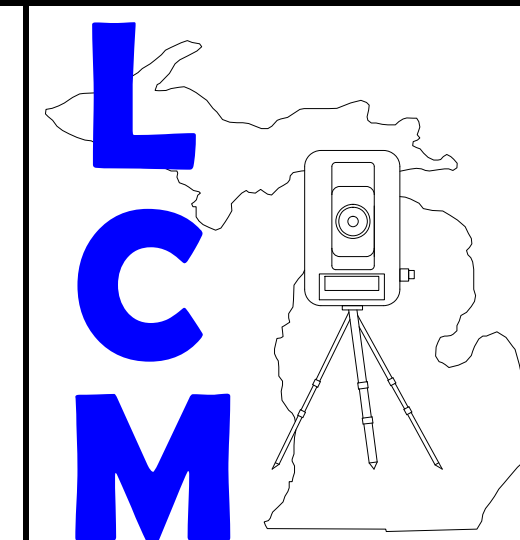
6 OF 13



LAKE MICHIGAN

(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)  
(WATER ELEV:576.1'±, APRIL 12, 2013)  
SCALE 1"=6'

09-06-2012  
04-12-2013



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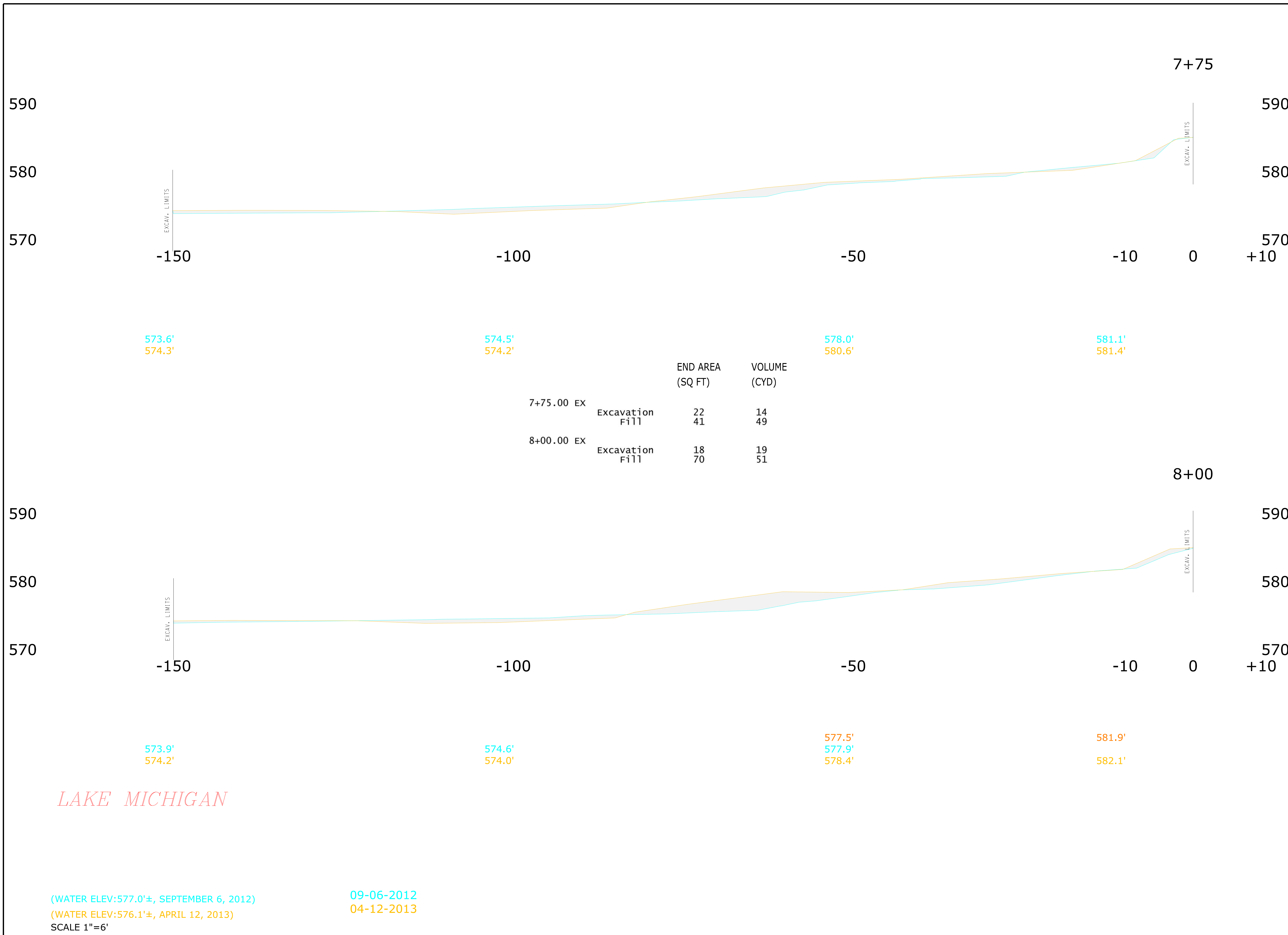
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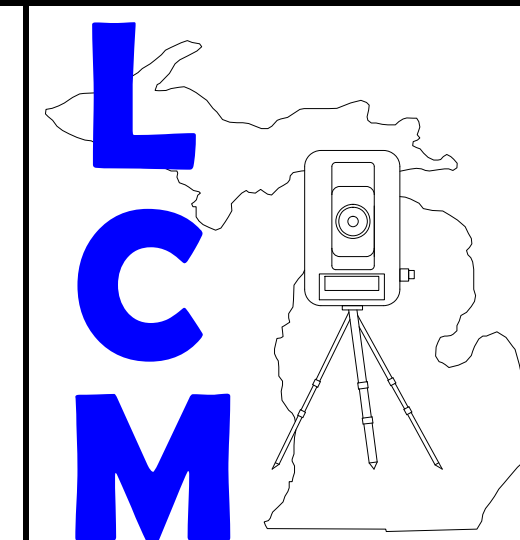
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7 OF 13





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Fax: (231) 743-3001

**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY: FTW

CHK'D BY: CCY

DATE: 06-14-2013

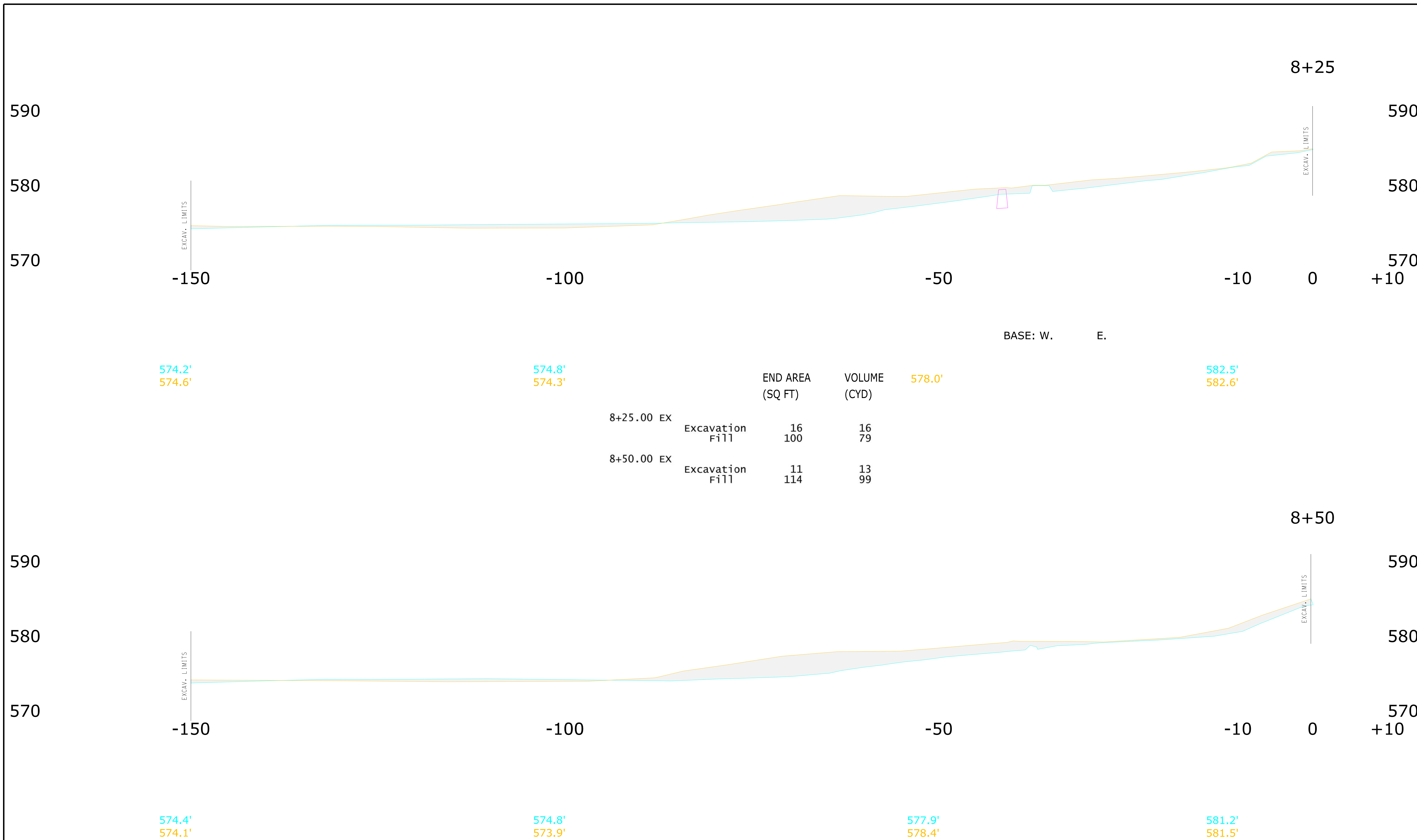
FIELD BOOK/PAGE: SEE FILE

JOB NO.:

10046

SHEET NO.:

8 OF 13



574.2'  
574.6'

574.8'  
574.3'

578.0'

582.5'  
582.6'

		END AREA (SQ FT)	VOLUME (CYD)
8+25.00 EX	Excavation	16	16
	Fill	100	79
8+50.00 EX	Excavation	11	13
	Fill	114	99

BASE: W. E.

574.4'  
574.1'

574.8'  
573.9'

577.9'  
578.4'

581.2'  
581.5'

LAKE MICHIGAN

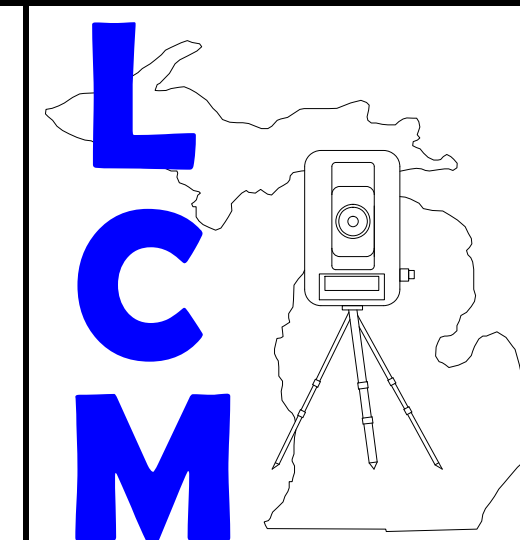
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)

09-06-2012

(WATER ELEV:576.1'±, APRIL 12, 2013)

04-12-2013

SCALE 1"=6'



**Surveying & Engineering**

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225 EAST MAIN ST.  
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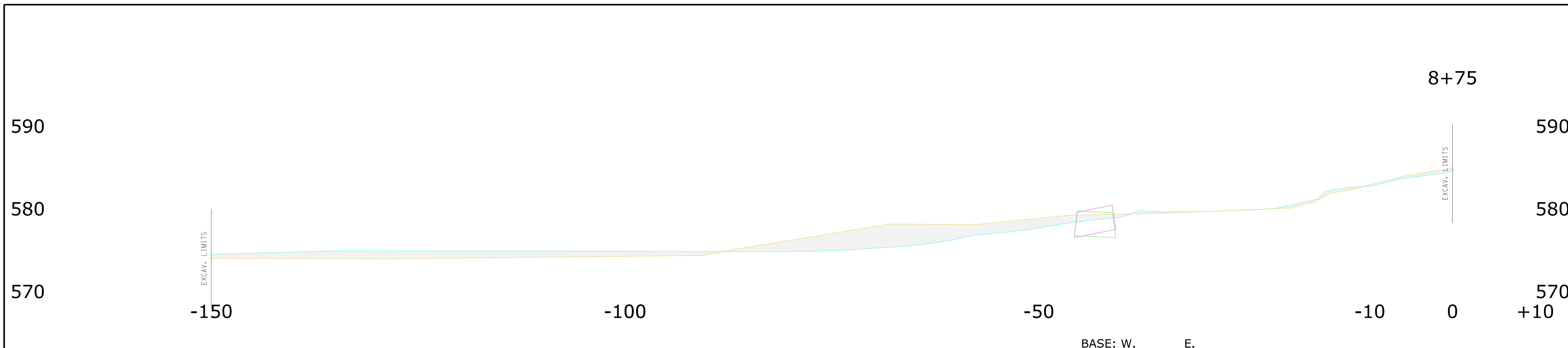
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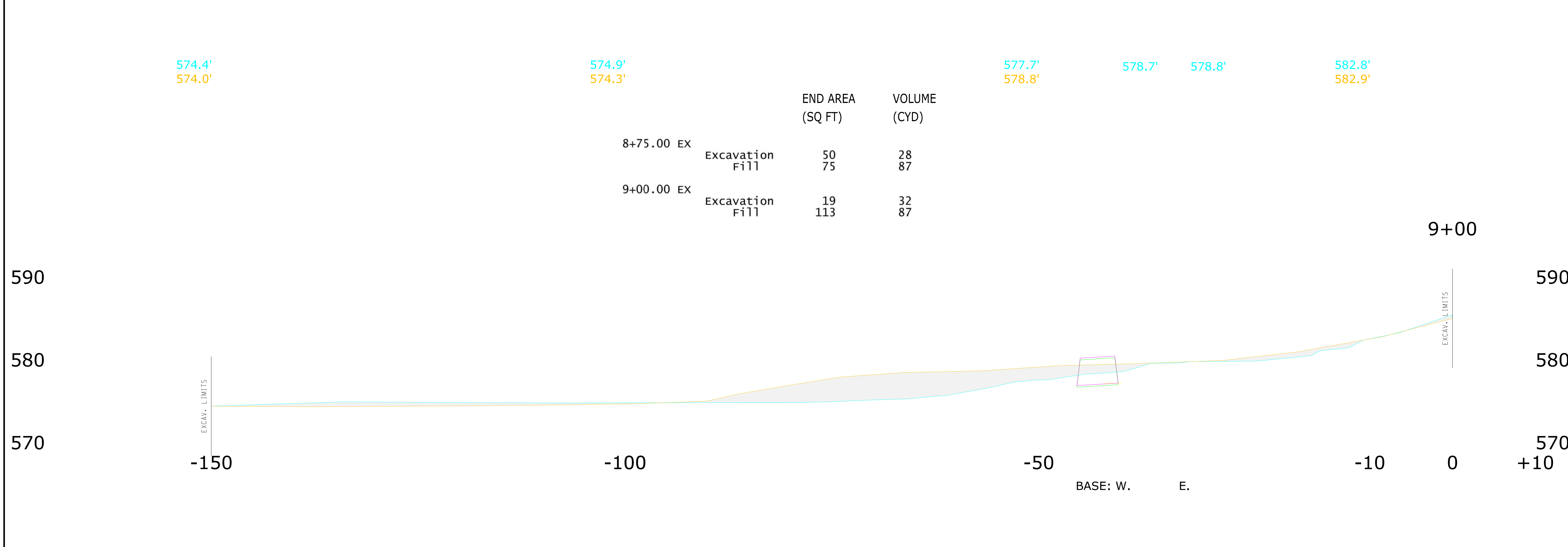
10046

SHEET NO.:

9 OF 13



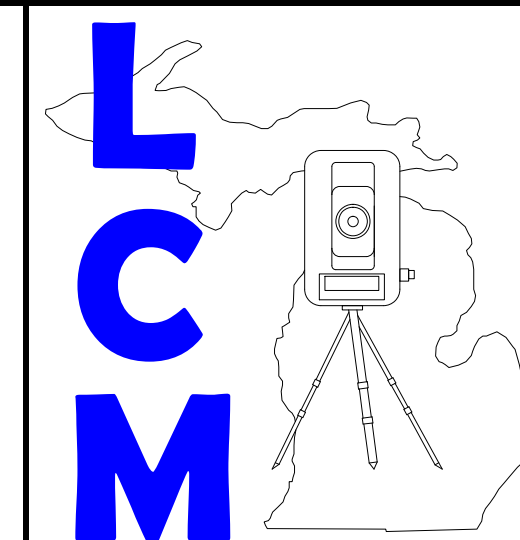
		END AREA (SQ FT)	VOLUME (CYD)
8+75.00 EX	Excavation	50	28
	Fill	75	87
9+00.00 EX	Excavation	19	32
	Fill	113	87



LAKE MICHIGAN

(WATER ELEV:577.0'±, SEPTEMBER 6, 2012) 09-06-2012  
(WATER ELEV:576.1'±, APRIL 12, 2013) 04-12-2013  
SCALE 1"=6'





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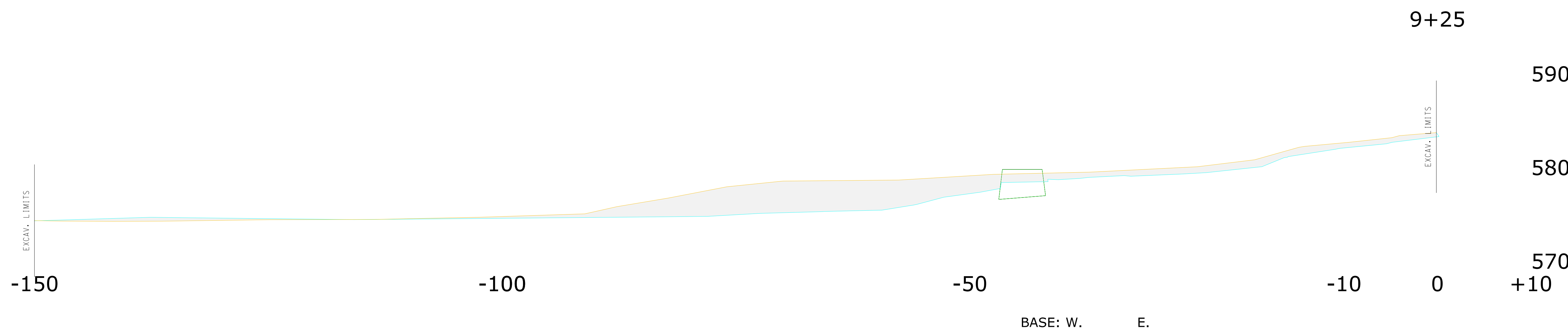
FIELD BOOK/PAGE: SEE FILE

JOB NO.:

10046

SHEET NO.:

10 OF 13



574.3'  
574.3'

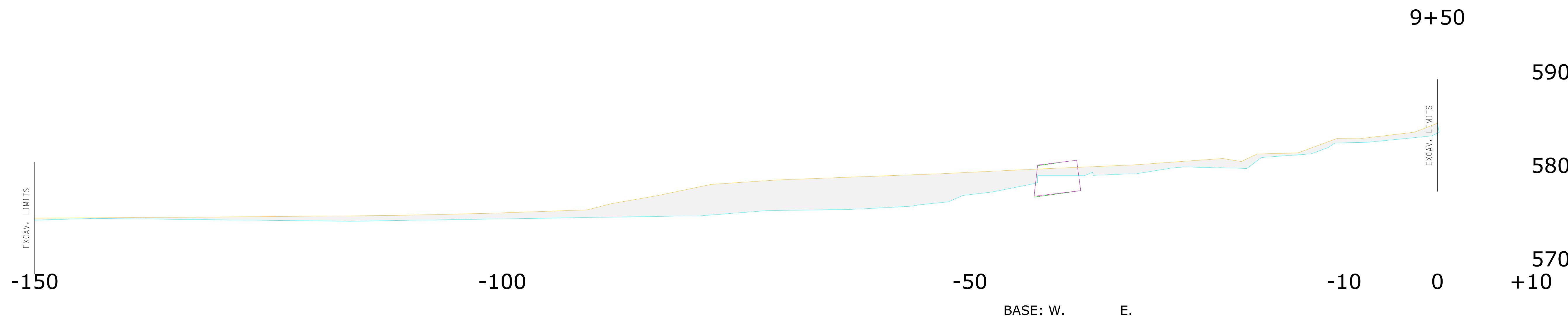
574.6'  
574.7'

577.2'  
579.1'

582.1'  
582.6'

	END AREA (SQ FT)	VOLUME (CYD)
Excavation	7	12
Fill	146	120
9+50.00 EX	0	3
Excavation	187	154
Fill		

BASE: W. E.



574.1'  
574.3'

574.3'  
574.9'

576.9'  
579.2'

582.4'  
582.8'

BASE: W. E.

LAKE MICHIGAN

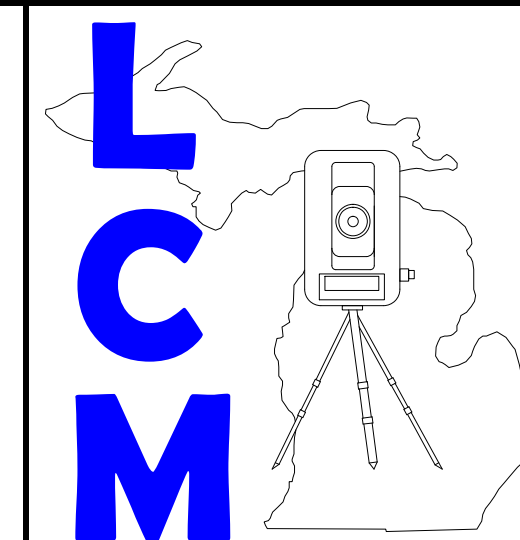
(WATER ELEV:577.0'±, SEPTEMBER 6, 2012)

09-06-2012

(WATER ELEV:576.1'±, APRIL 12, 2013)

04-12-2013

SCALE 1"=6'



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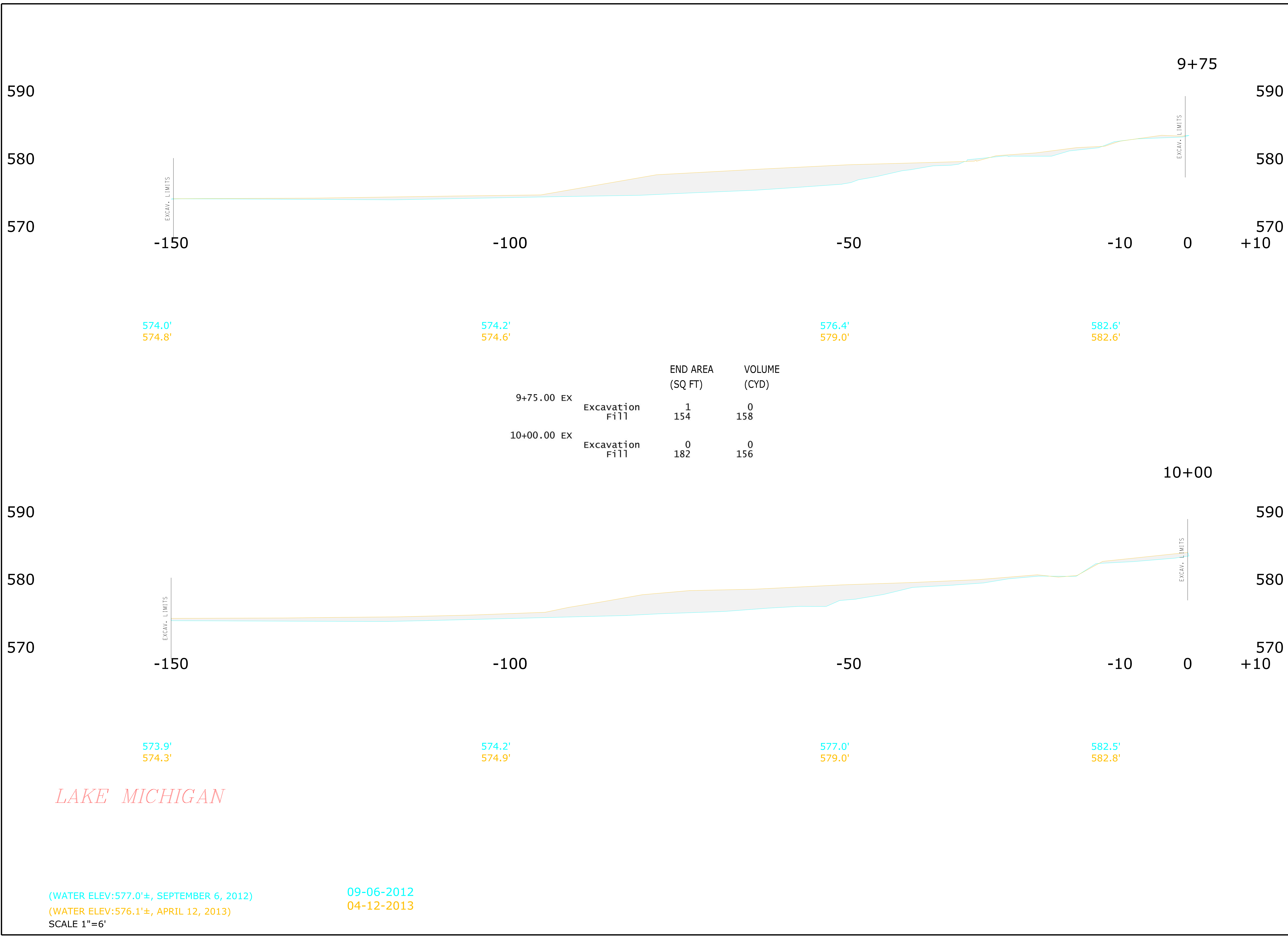
FIELD BOOK/PAGE: SEE FILE

JOB NO.:

10046

SHEET NO.:

11 OF 13



574.0'  
574.8'

574.2'  
574.6'

576.4'  
579.0'

582.6'  
582.6'

		END AREA (SQ FT)	VOLUME (CYD)
9+75.00 EX	Excavation	1	0
	Fill	154	158
10+00.00 EX	Excavation	0	0
	Fill	182	156

573.9'  
574.3'

574.2'  
574.9'

577.0'  
579.0'

582.5'  
582.8'

LAKE MICHIGAN

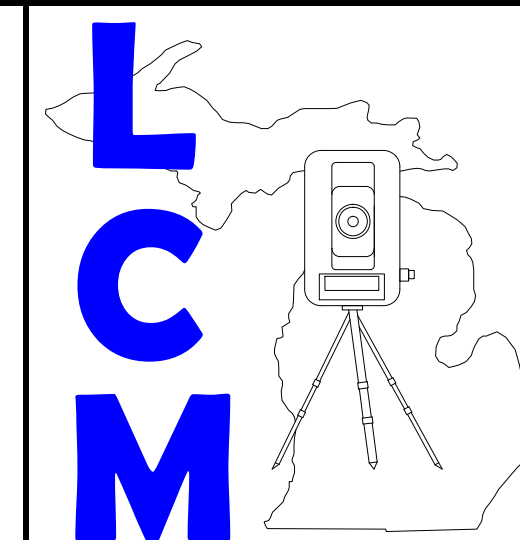
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(WATER ELEV:576.1'±, APRIL 12, 2013)

04-12-2013

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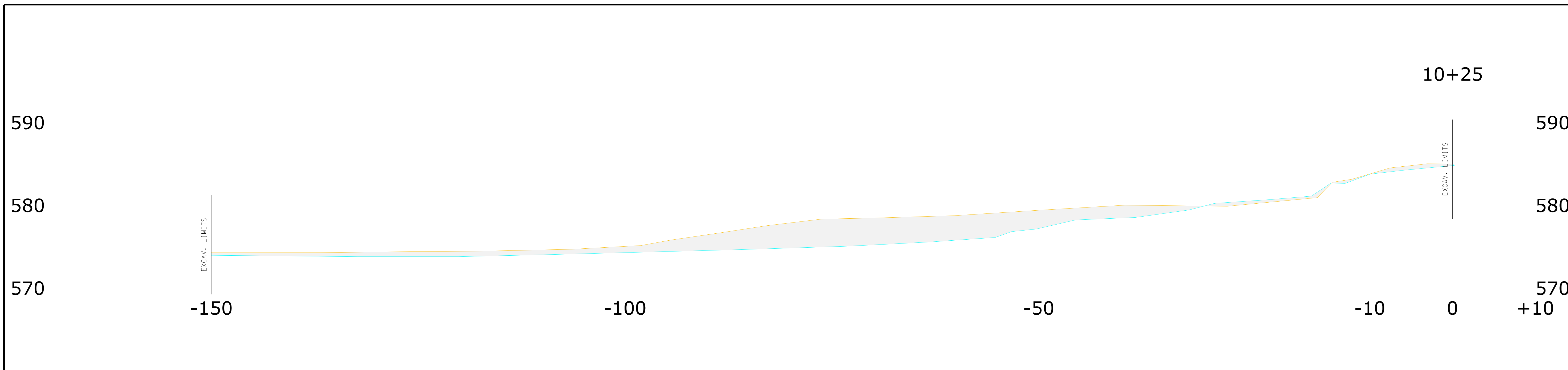
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JOB NO.:

10046

SHEET NO.:

12 OF 13



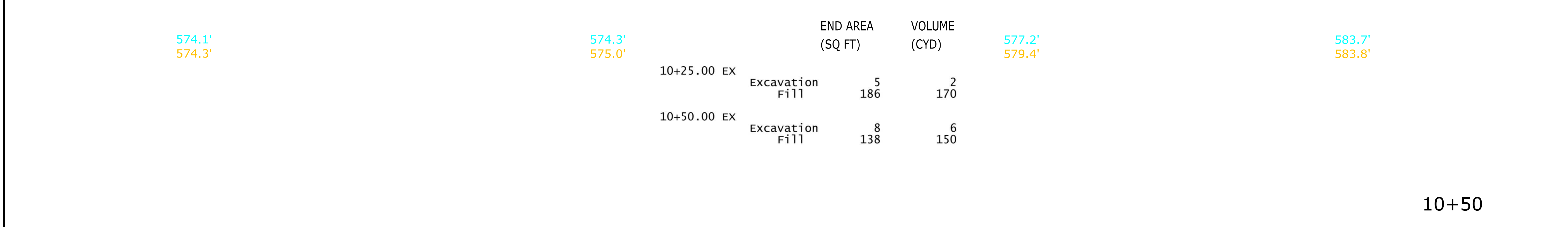
574.1'  
574.3'

574.3'  
575.0'

577.2'  
579.4'

583.7'  
583.8'

		END AREA (SQ FT)	VOLUME (CYD)
10+25.00 EX	Excavation	5	2
	Fill	186	170
10+50.00 EX	Excavation	8	6
	Fill	138	150



573.9'  
573.6'

574.1'  
574.4'

577.0'  
578.8'

582.5'  
582.6'

LAKE MICHIGAN

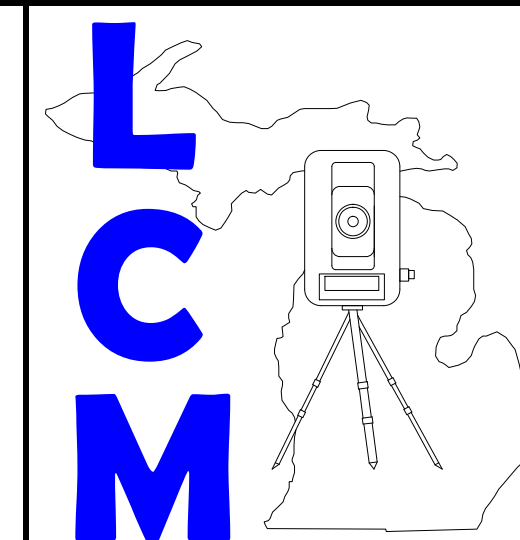
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09-06-2012

(WATER ELEV:576.1'±, APRIL 12, 2013)

04-12-2013

SCALE 1"=6'



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DRN. BY: FTW

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DATE: 06-14-2013

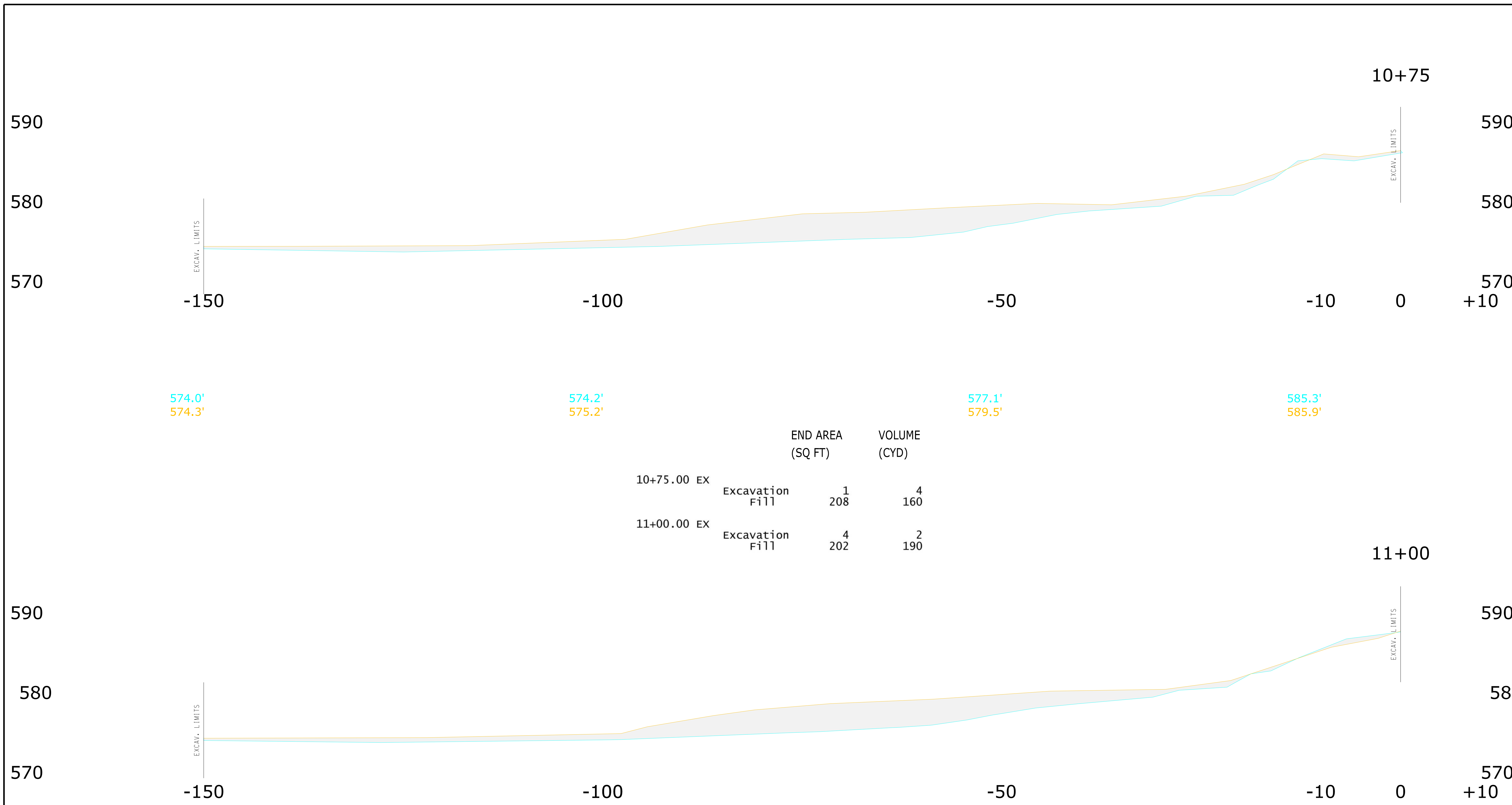
FIELD BOOK/PAGE: SEE FILE

JOB NO.:

10046

SHEET NO.:

13 OF 13



574.0'  
574.3'

574.2'  
575.2'

577.1'  
579.5'

585.3'  
585.9'

END AREA  
(SQ FT)      VOLUME  
(CYD)

10+75.00 EX	Excavation	1	4
	Fill	208	160
11+00.00 EX	Excavation	4	2
	Fill	202	190

574.0'  
574.2'

574.0'  
574.8'

567.4'  
579.7'

585.4'  
585.2'

LAKE MICHIGAN

GRAND SUMMARY		TOTALS		
Material Name	Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult	Factor
EX				
Excavation	717	717	1.00	
Fill	2036	2036	1.00	

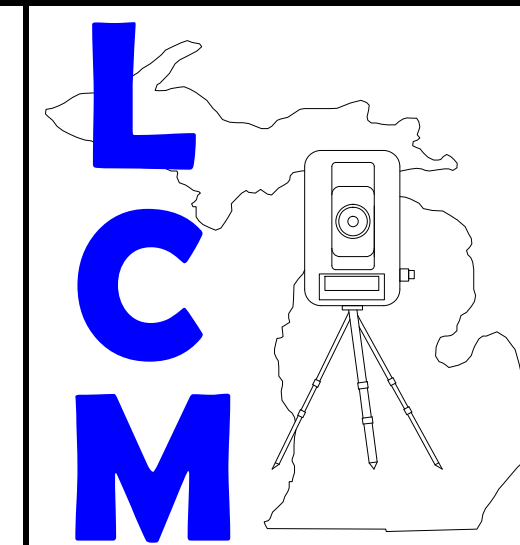
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09-06-2012

(WATER ELEV:576.1'±, APRIL 12, 2013)

04-12-2013

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**YOUNGS CONSULTING  
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BIG RAPIDS, MI 49307**

DRN. BY:

FTW

CHK'D BY:

CCY

DATE:

03-12-2013

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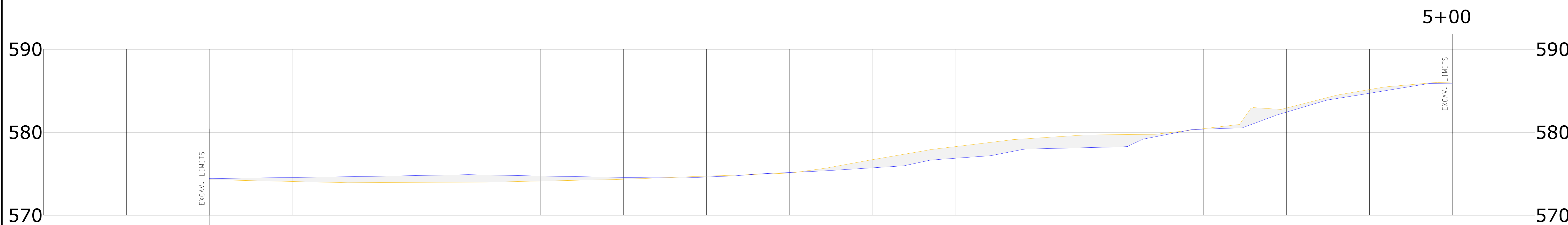
SEE FILE

JOB NO.:

10046

SHEET NO.:

2 OF 13



-150

574.4'

574.2'

-100

574.5'

574.3'

-50

578.0'

579.3'

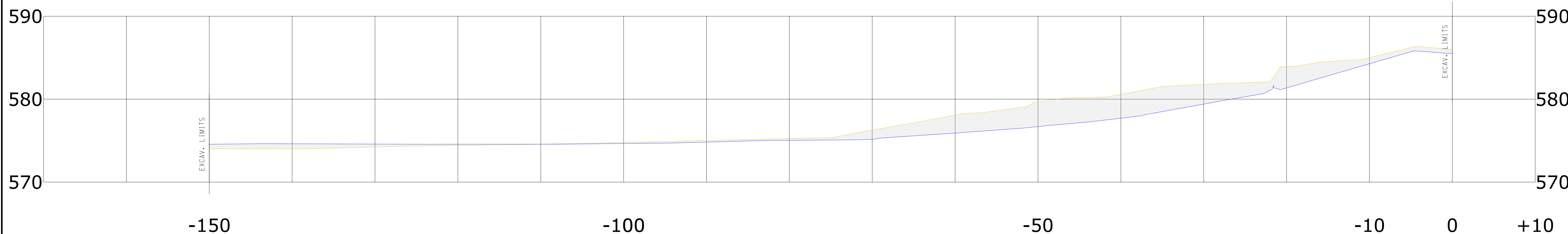
-10

584.7'

585.2'

5+00

5+25



-150

574.6'

-100

574.6'

574.8'

-50

576.7'

579.6'

-10

584.3'

585.0'

5+25

*LAKE MICHIGAN*

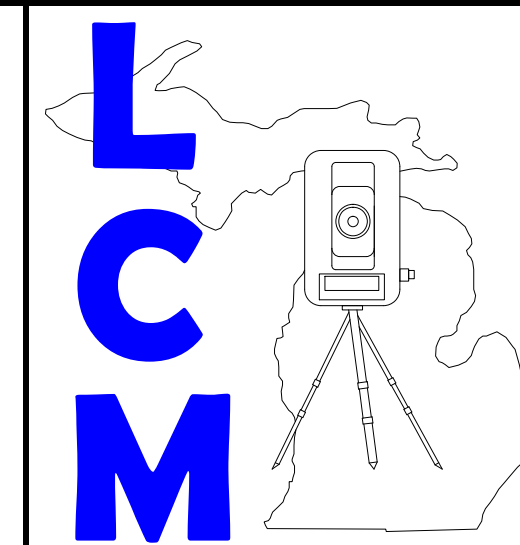
(WATER ELEV:576.9'±, APRIL 13, 2011)

04-13-2011

(WATER ELEV:576.1'±, APRIL 12, 2013)

04-12-2013

SCALE 1"=6'



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BIG RAPIDS, MI 49307**

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CCY

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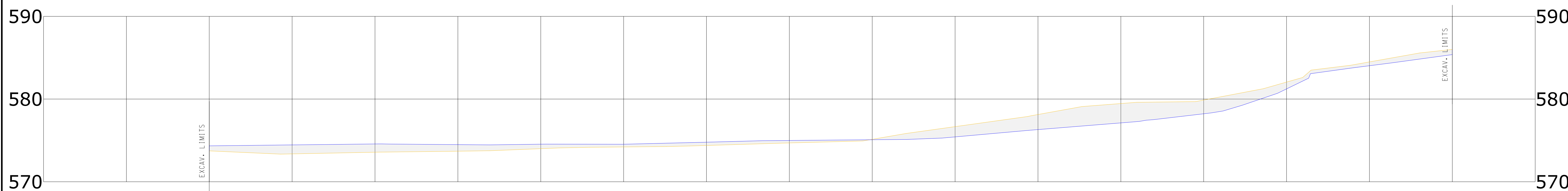
SEE FILE

JOB NO.:

10046

SHEET NO.:

3 OF 13



-150

-100

-50

-10

0

+10

574.4'

574.5'

576.3'

580.

573.8'

574.2'

578.2'

584.5'

END AREA  
(SQ FT)

VOLUME  
(CYD)

5+50.00 EX

Excavation  
Fill

48

29

92

111

5+75.00 EX

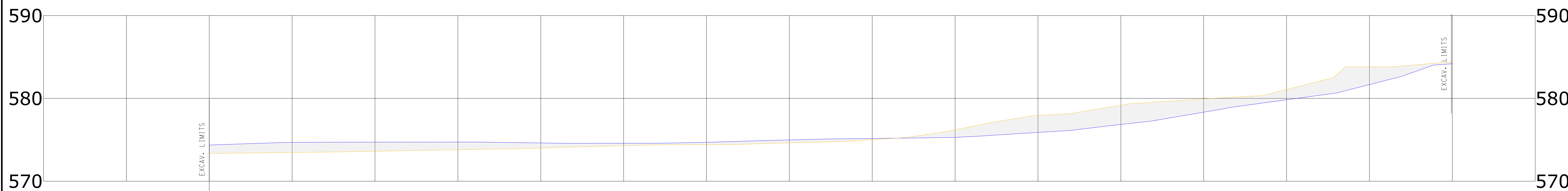
Excavation  
Fill

55

48

102

90



-150

-100

-50

-10

0

+10

574.3'

574.6'

575.9'

581.7'

573.3'

574.2'

579.9'

583.8'

*LAKE MICHIGAN*

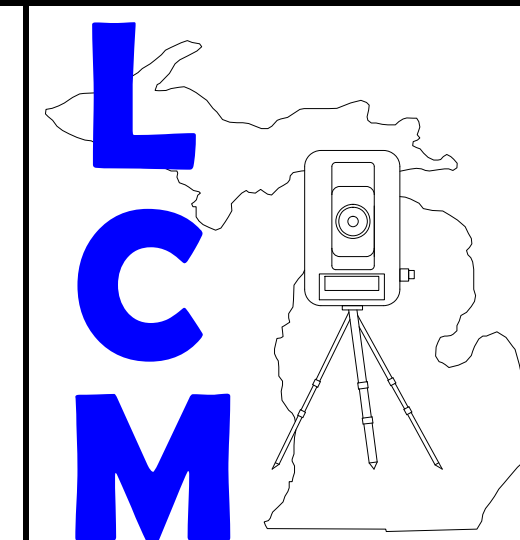
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(WATER ELEV:576.1'±, APRIL 12, 2013)

04-12-2013

SCALE 1"=6'



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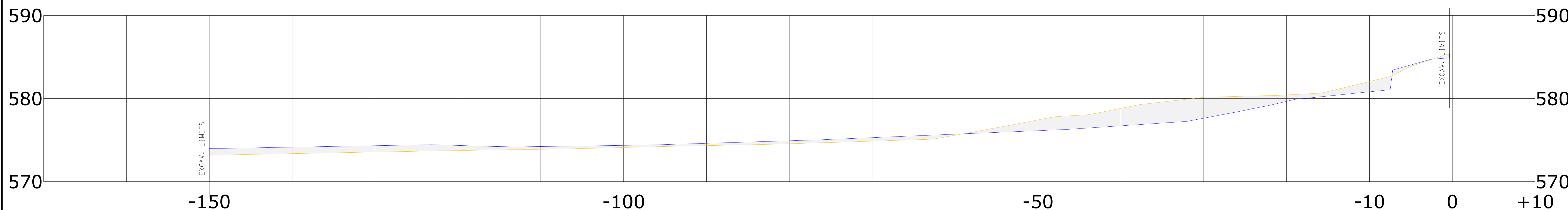
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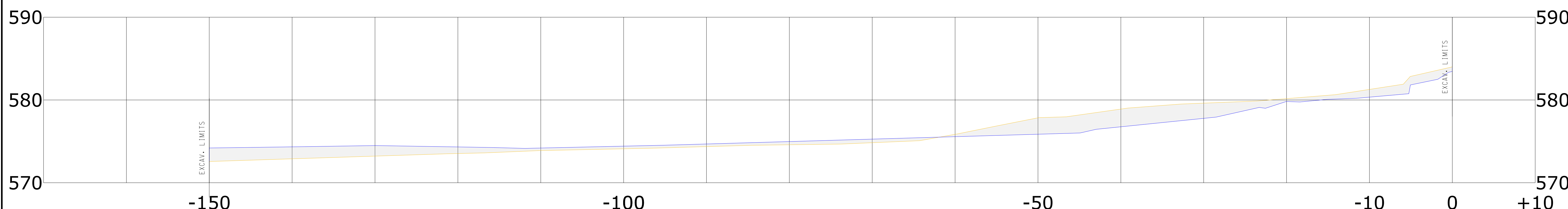
10046

SHEET NO.:

4 OF 13



		END AREA (SQ FT)	VOLUME (CYD)
6+25.00 EX	Excavation	46	94
	Fill	75	164
6+50.00 EX	Excavation	62	50
	Fill	81	72



LAKE MICHIGAN

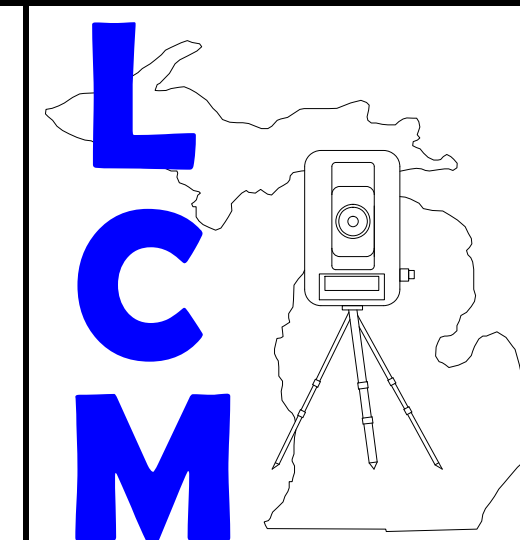
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04-13-2011

(WATER ELEV:576.1'±, APRIL 12, 2013)

04-12-2013

SCALE 1"=6'



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CCY

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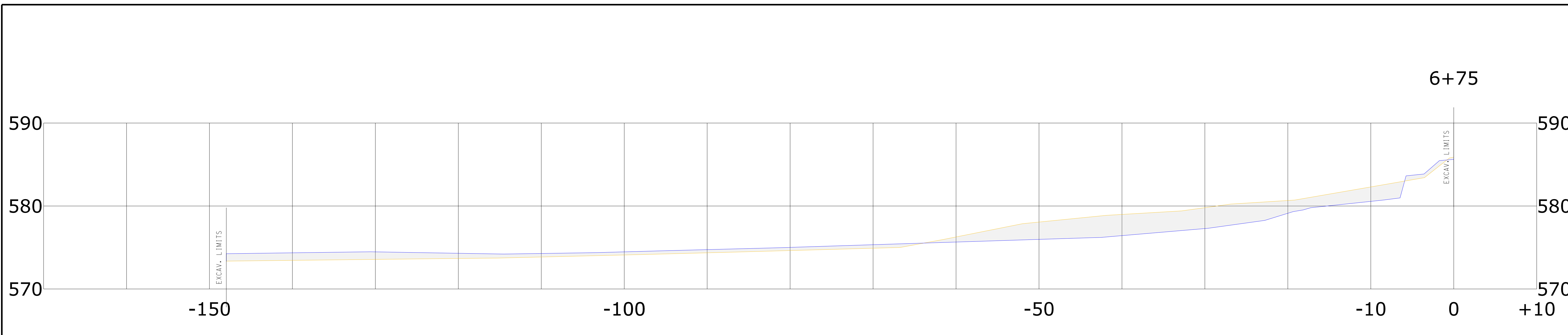
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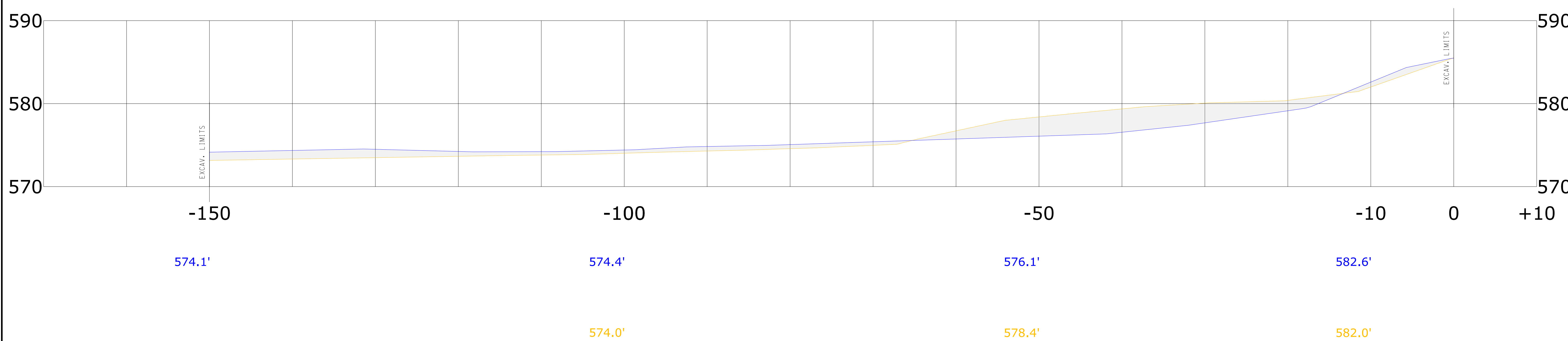
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SHEET NO.:

5 OF 13



		END AREA (SQ FT)	VOLUME (CYD)
6+75.00 EX	Excavation	49	51
	Fill	109	88
7+00.00 EX	Excavation	60	50
	Fill	97	95



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(WATER ELEV:576.9'±, APRIL 13, 2011)

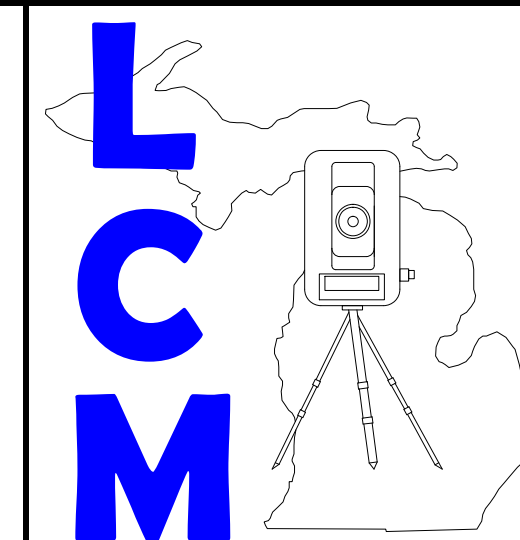
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(WATER ELEV:576.1'±, APRIL 12, 2013)

04-12-2013

SCALE 1"=6'





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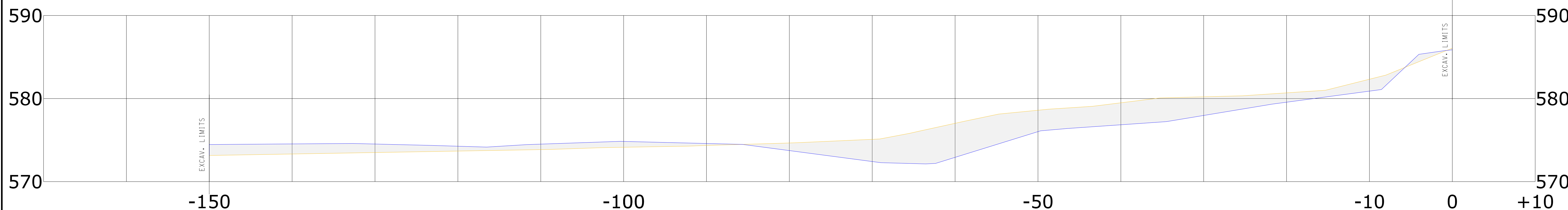
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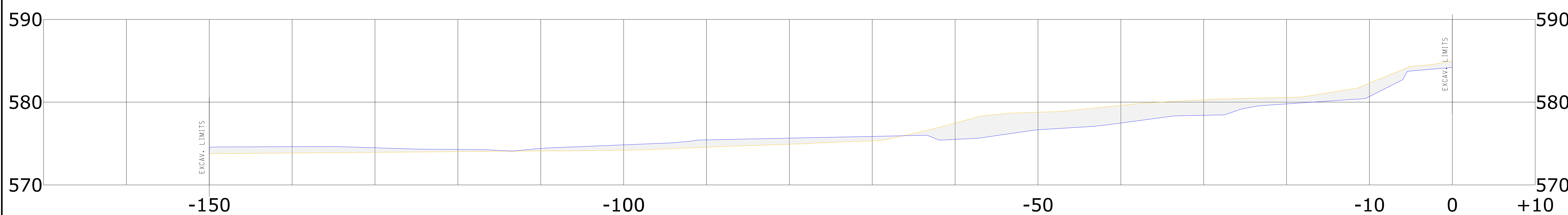
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SHEET NO.:

6 OF 13



		END AREA (SQ FT)	VOLUME (CYD)
7+25.00 EX	Excavation	52	52
	Fill	175	126
7+50.00 EX	Excavation	49	47
	Fill	104	129



*LAKE MICHIGAN*

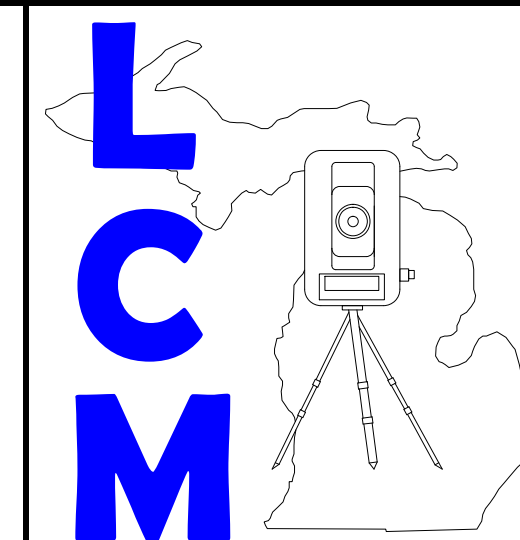
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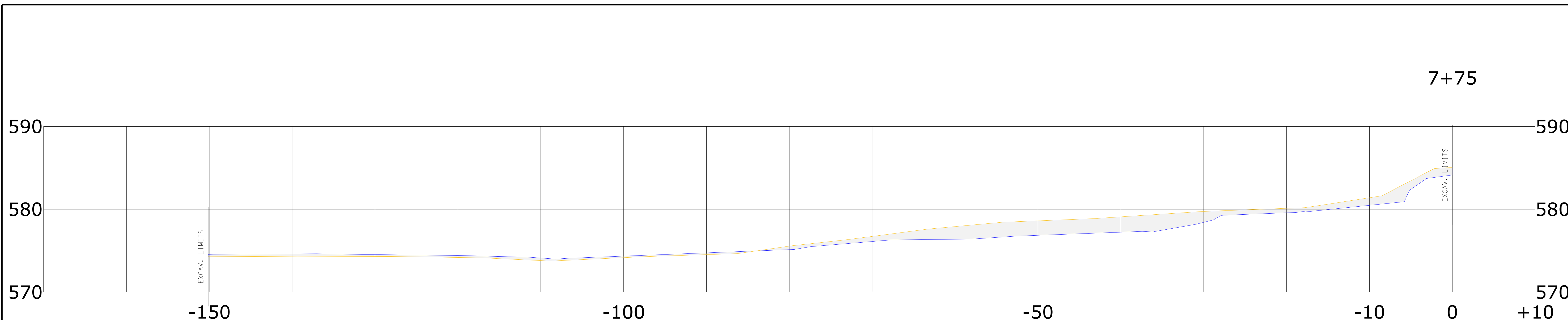
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JOB NO.:

10046

SHEET NO.:

7 OF 13



574.5'

574.4'

576.9'

580.5'

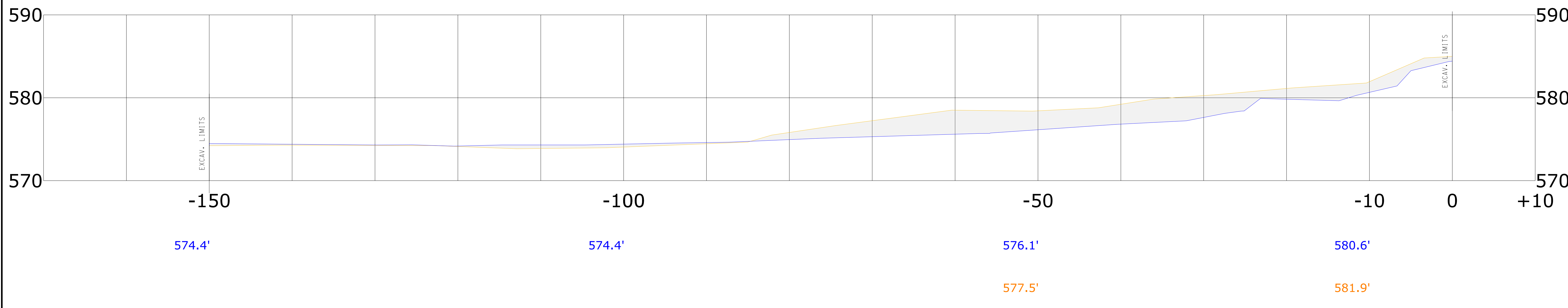
574.3'

574.2'

580.6'

581.4'

		END AREA (SQ FT)	VOLUME (CYD)
7+75.00 EX	Excavation	16	30
	Fill	94	92
8+00.00 EX	Excavation	13	13
	Fill	163	119



574.4'

574.4'

576.1'

580.6'

574.2'

574.0'

577.5'

581.9'

578.4'

582.1'

*LAKE MICHIGAN*

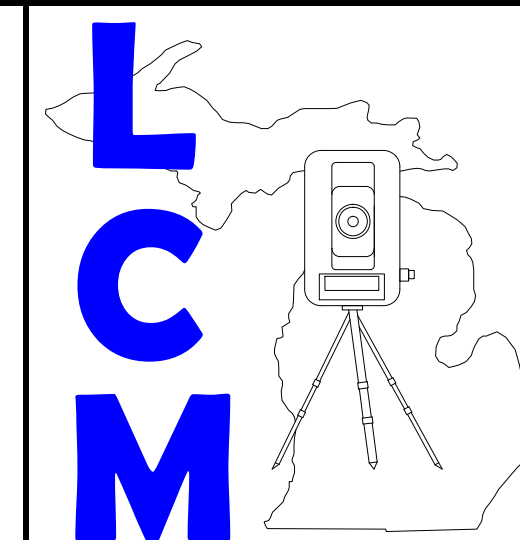
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04-13-2011

(WATER ELEV:576.1'±, APRIL 12, 2013)

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Fax: (231) 743-3001

**MONITORING BEACH TOPOGRAPHY**

PROJECT:

LOCATION:

PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

**ENGINEERING FIRM:**

**YOUNGS CONSULTING  
14154 RUBY LANE  
BIG RAPIDS, MI 49307**

DRN. BY:

FTW

CHK'D BY:

CCY

DATE:

06-14-2013

FIELD BOOK/PAGE:

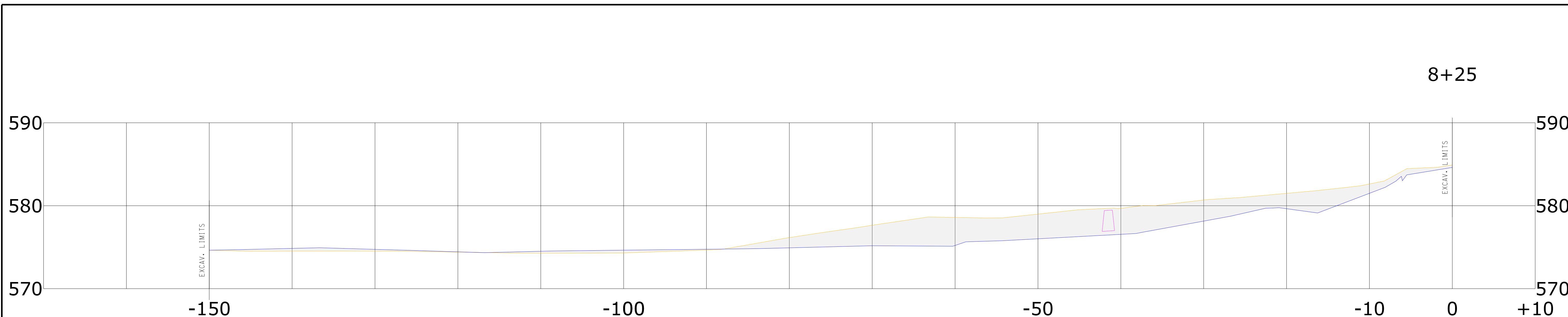
SEE FILE

JOB NO.:

10046

SHEET NO.:

8 OF 13



574.6'

574.6'

576.0'

581.5'

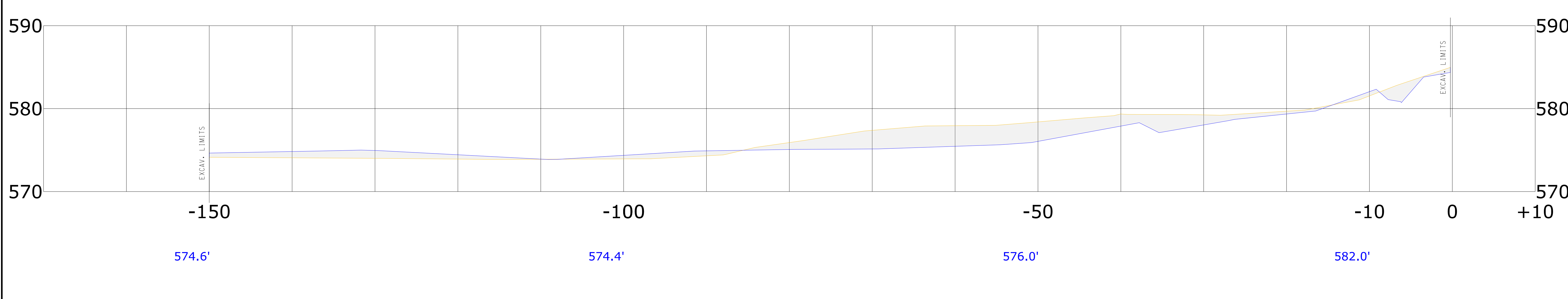
574.6'

574.3'

578.0'

582.6'

		END AREA (SQ FT)	VOLUME (CYD)
8+25.00 EX	Excavation	12	12
	Fill	191	164
8+50.00 EX	Excavation	37	23
	Fill	117	143



574.6'

574.4'

576.0'

582.0'

574.1'

573.9'

578.4'

581.5'

*LAKE MICHIGAN*

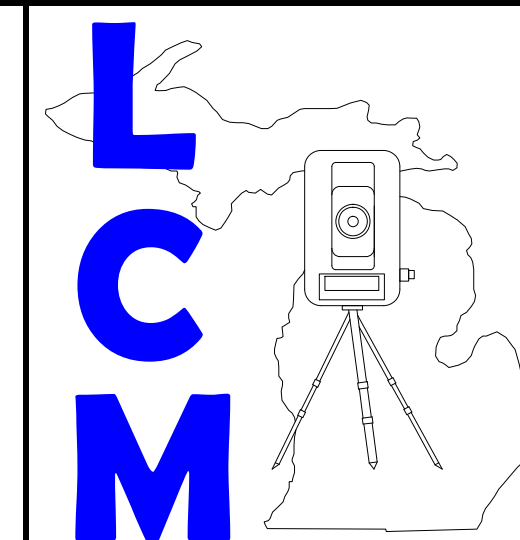
(WATER ELEV:576.9'±, APRIL 13, 2011)

04-13-2011

(WATER ELEV:576.1'±, APRIL 12, 2013)

04-12-2013

SCALE 1"=6'



**Surveying & Engineering**

- Surveying
- Civil Engineering

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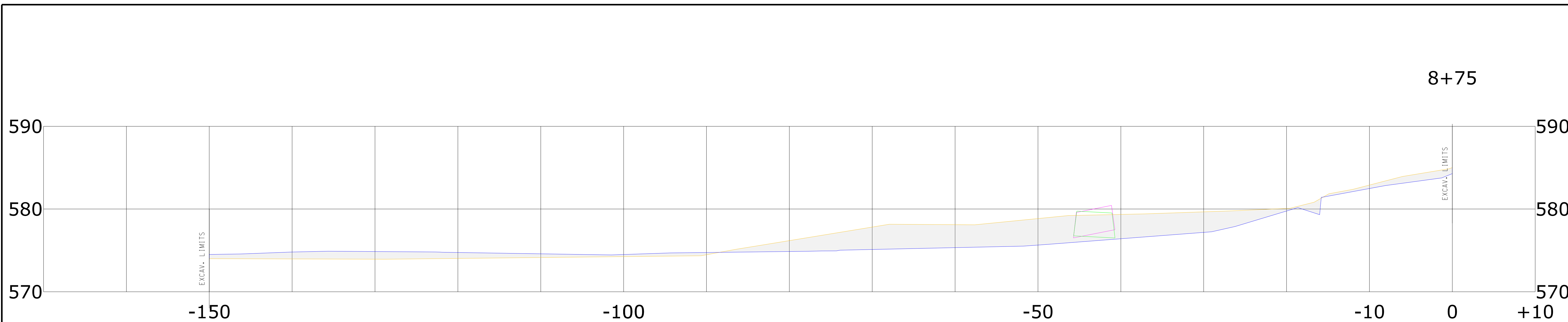
SEE FILE

JOB NO.:

10046

SHEET NO.:

9 OF 13



574.5'

574.5'

575.6'

582.5'

574.0'

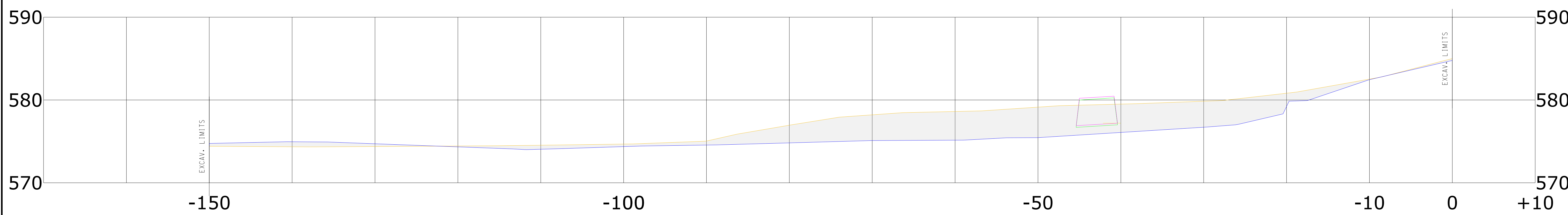
574.3'

578.8'

582.9'

END AREA (SQ FT)    VOLUME (CYD)

8+75.00 EX	Excavation	37	34
	Fill	170	133
9+00.00 EX	Excavation	11	22
	Fill	227	184



574.7'

574.4'

575.4'

582.4'

574.4'

574.7'

579.1'

582.5'

*LAKE MICHIGAN*

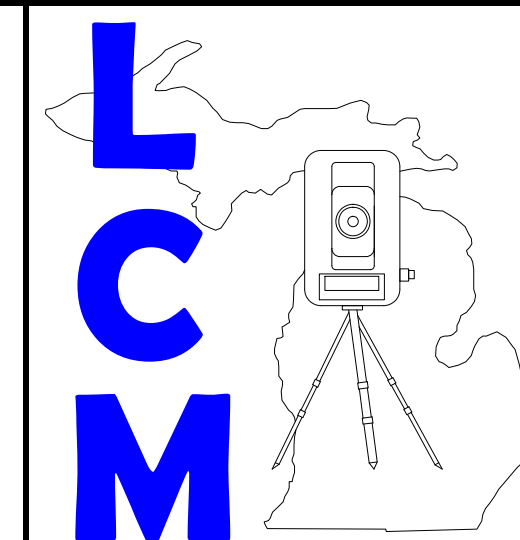
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04-13-2011

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04-12-2013

SCALE 1"=6'



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PROJECT:

LOCATION:

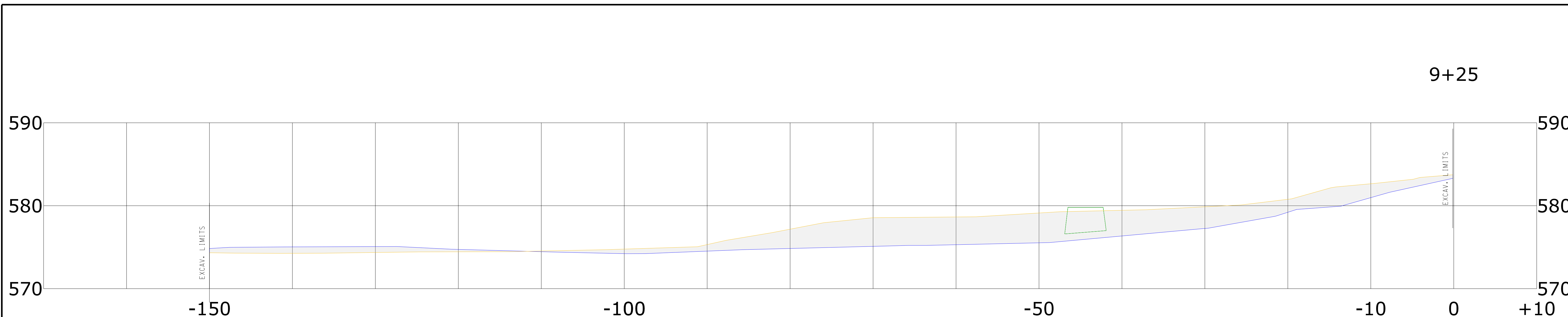
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**ENGINEERING FIRM:**

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BIG RAPIDS, MI 49307**

DRN. BY:	FTW
CHK'D BY:	CCY
DATE:	06-14-2013
FIELD BOOK/PAGE:	SEE FILE

JOB NO.:	10046
SHEET NO.:	10 OF 13



574.8'

574.2'

575.5'

BASE: W. E.  
NO DATA

581.0'

574.3'

574.7'

579.1'

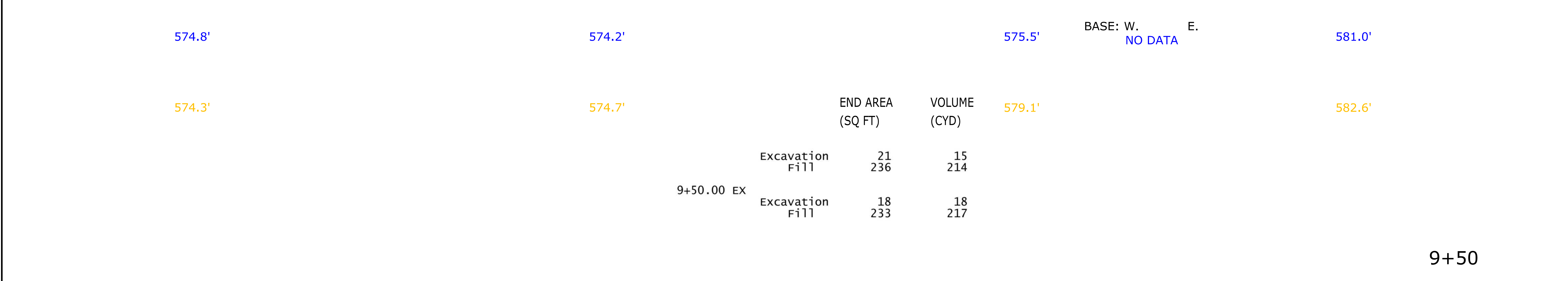
582.6'

END AREA  
(SQ FT)

VOLUME  
(CYD)

Excavation	21	15
Fill	236	214
Excavation	18	18
Fill	233	217

9+50.00 EX



575.0'

574.4'

575.5'

BASE: W. E.  
NO DATA

581.8'

574.3'

574.9'

579.2'

582.8'

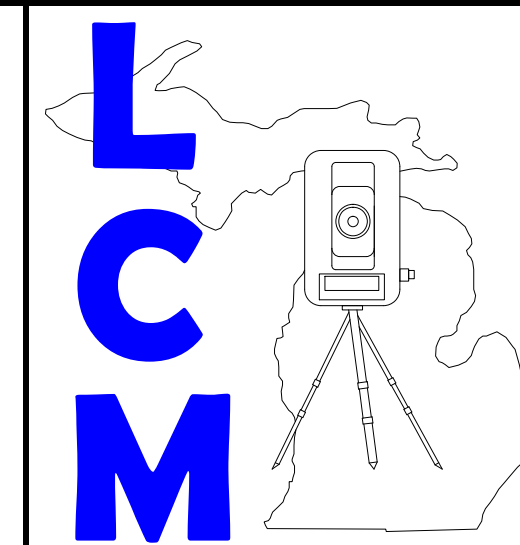
*LAKE MICHIGAN*

(WATER ELEV:576.9'±, APRIL 13, 2011)

04-13-2011

(WATER ELEV:576.1'±, APRIL 12, 2013)  
SCALE 1"=6'

04-12-2013



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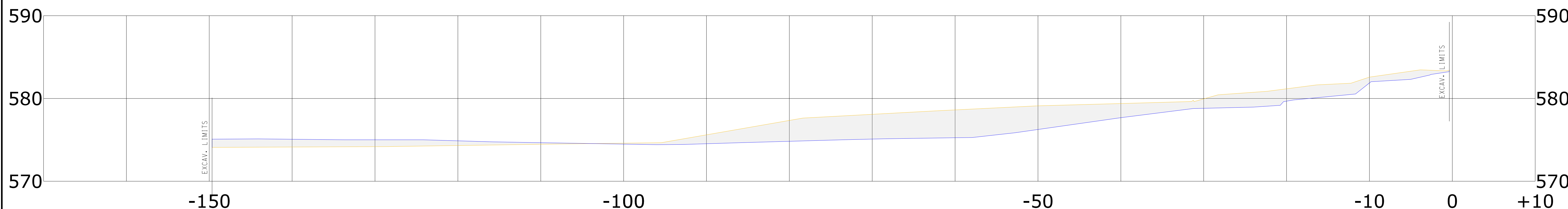
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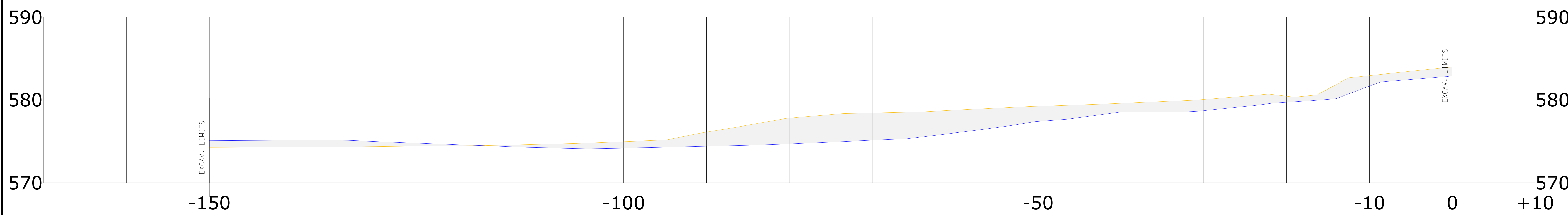
10046

SHEET NO.:

11 OF 13



		END AREA (SQ FT)	VOLUME (CYD)
9+75.00 EX	Excavation	30	22
	Fill	188	195
10+00.00 EX	Excavation	20	23
	Fill	191	175



*LAKE MICHIGAN*

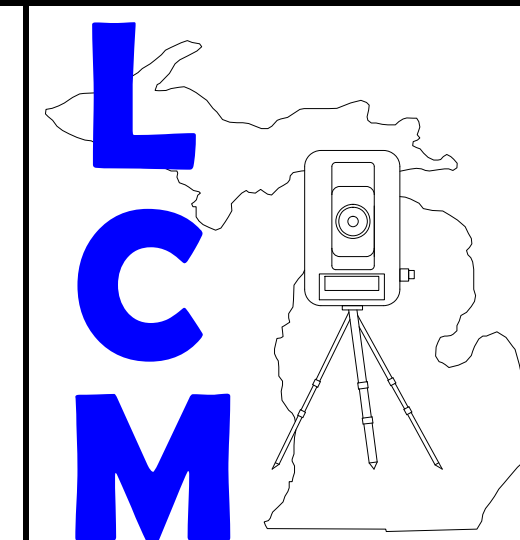
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04-13-2011

(WATER ELEV:576.1'±, APRIL 12, 2013)

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SCALE 1"=6'



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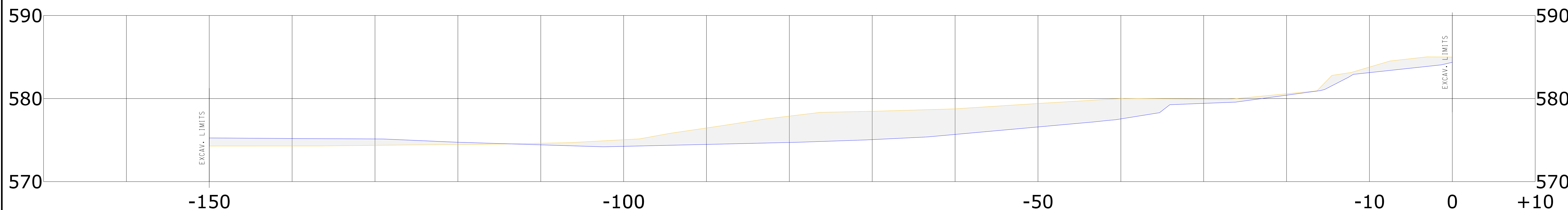
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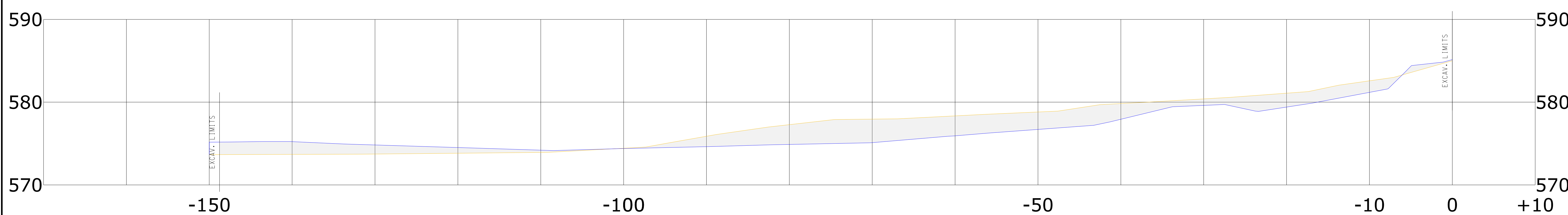
10046

SHEET NO.:

12 OF 13



		END AREA (SQ FT)	VOLUME (CYD)
10+25.00 EX	Excavation	24	20
	Fill	200	181
10+50.00 EX	Excavation	44	31
	Fill	166	169



*LAKE MICHIGAN*

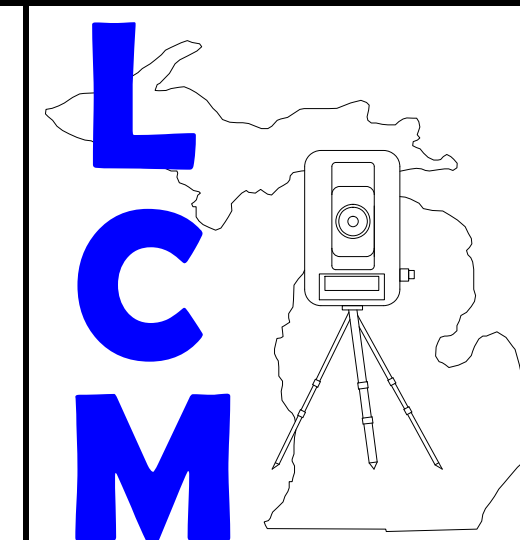
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(WATER ELEV: 576.1'±, APRIL 12, 2013)

04-12-2013

SCALE 1"=6'



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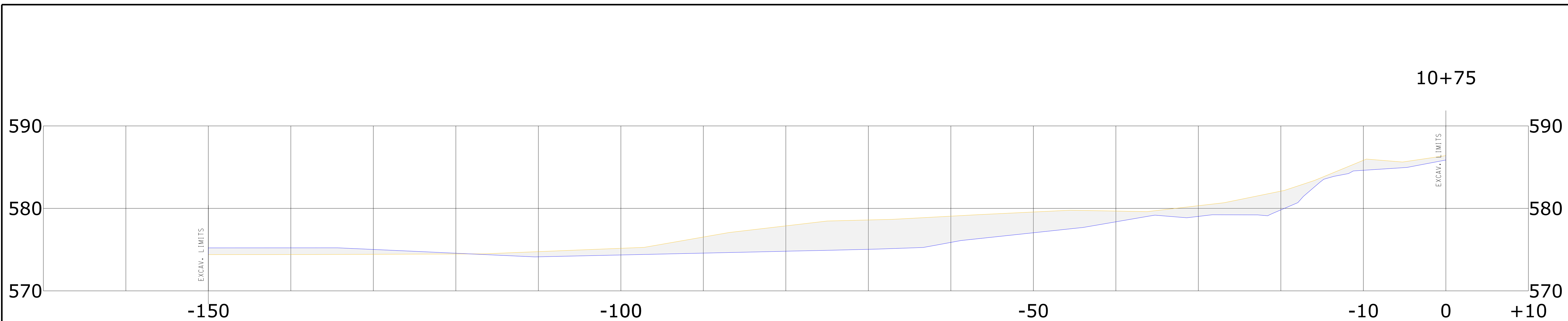
PROJECT: PART OF THE SECTION 10, T24N, R16W, ARCADIA TWP., MANISTEE CO., MICHIGAN.

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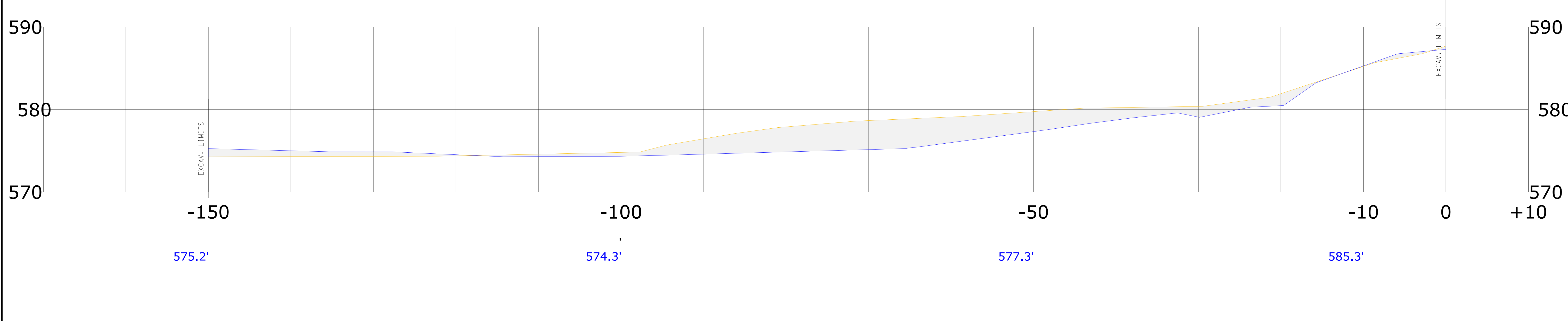
JOB NO.:	10046
SHEET NO.:	13 OF 13



575.2' 574.4' 577.0' 584.6'

574.3' 575.2' 579.5' 585.9'

		END AREA (SQ FT)	VOLUME (CYD)
10+75.00 EX	Excavation	19	29
	Fill	214	176
11+00.00 EX	Excavation	21	19
	Fill	182	183



575.2' 574.3' 577.3' 585.3'

574.2' 574.8' 579.7' 585.2'

EX	GRAND Material Name	SUMMARY		TOTALS	
		Unadjusted Volumes (cu. yd.)	Adjusted Volumes (cu. yd.)	Mult Factor	
	Excavation	753	753	1.00	
	Fill	3319	3319	1.00	

LAKE MICHIGAN

(WATER ELEV:576.9'±, APRIL 13, 2011) 04-13-2011

(WATER ELEV:576.1'±, APRIL 12, 2013) 04-12-2013  
SCALE 1"=6'