Failure of Geotextile and Armor Stone for Panel N39

PREPARED FOR: demaximis, inc.

COPY TO: Gary Foster, CH2M HILL

PREPARED BY: James Brinkman, CH2M HILL

DATE: April 21, 2014

During placement of geotextile panel N39 on the northern end of the cap area (Figure 1), the geotextile panel and armor stone placed on top of the active layer slid down the slope. The following sections outline the potential reason for this failure.

Slope Stability

As indicated in the Approved Final Design for RM 10.9, for sand or gravel type materials with relatively no cohesion properties, a 3H:1V slope is considered to be stable and with increasing cohesion (i.e, increased clay or silty clay content), the slope is expected to be stable at higher angles. Therefore, based on the available geotechnical data and boring logs for the site, the cap design was based on the placement of materials on a dredged surface with a maximum allowable slope of 3H:1V. This post dredge condition exists downriver of Station 32+00.

Existing Slope

A review of the cross-sections taken on 10 foot centers for geotextile panels N36 through N40 indicates that the average slope ranges from approximately 3.9H:1V to 4.7H:1V with the slope becoming more gradual as one proceeds down river. The average slope in the area of the failed panel N39 is approximately 4H:1V. A summary of these average slopes is provided below in Table 1 and the associated cross-sections are provided as Attachment #1.

Table 1 – Summary of Average Slope for Panels N36 to N40

Panel ID	Approximate Location	Average Slope	Date Installed
N40	31+70 to 32+00	3.9H:1V	02/26/14
N39	31+40 to 31+70	4.0H:1V	NA
N38	31+10 to 31+40	4.0H:1V	NA
N37	30+80 to 31+10	4.5H:1V	NA
N36	30+50 to 30+80	4.7H:1V	02/28/14

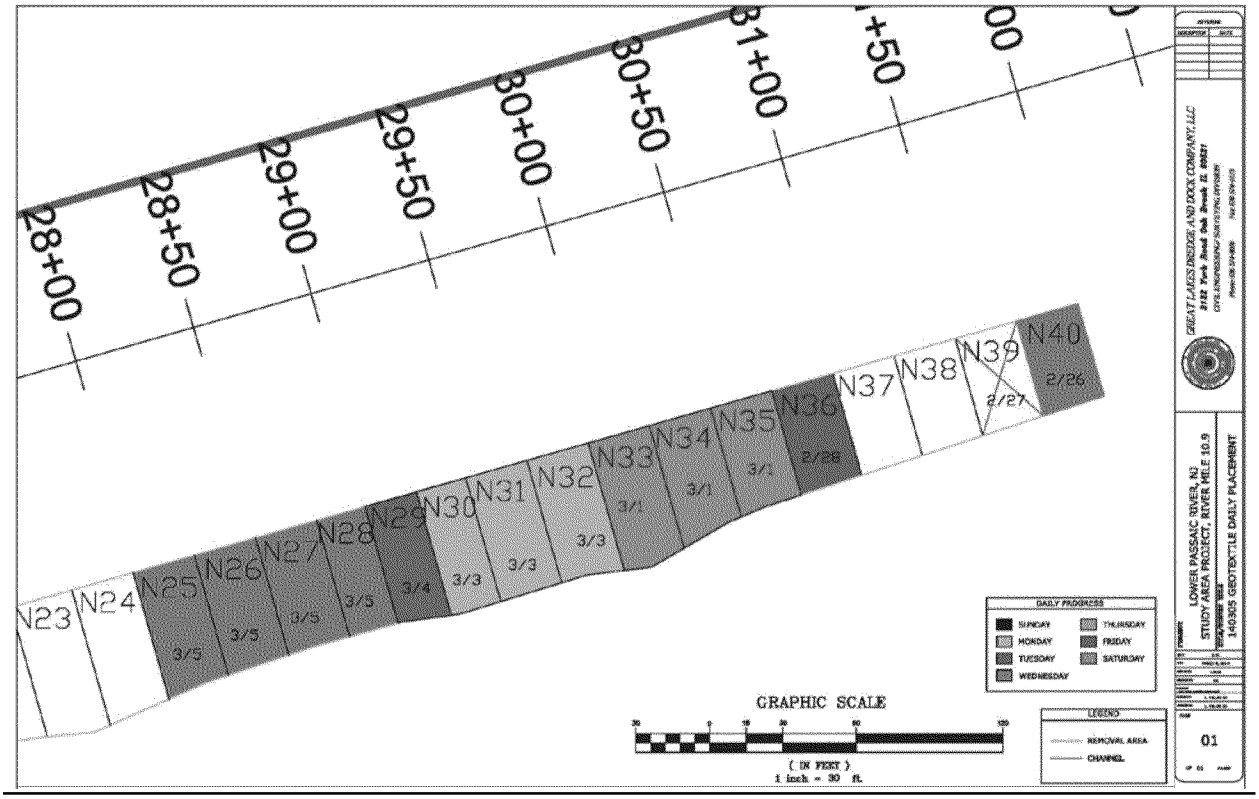

Figure 1 – Panel Installation

Conclusion

The active layer was successfully placed in early December 2013 and no failures have occurred. The average slope of the successfully placed active layer in the area of the geotextile failure (N39) has been determined to be on average a slope of approximately 4H:1V, which is less steep, and therefore considered more stable, than the acceptable design slope of 3H:1V. In addition, Panel 40 was successfully placed on a similar slope angle to Panel N39 on February 26, 2014 and no failure has occurred. The failure of Panel N39 was likely a result of the placement method rather than slope failure. Therefore, to ensure the successful placement of Panels 37, 38 and 39 the armor will be placed in a controlled manner to reduce the potential for localized failures. This approach has been outlined in the technical memorandum titled "*Repair of Panel N39 and Placement of Geotextile and Armor Stone in Panels N37, N38, and N39"* dated April 14, 2014.

ATTACHMENT 1

Cross-Sections for Panels N36 through N 40

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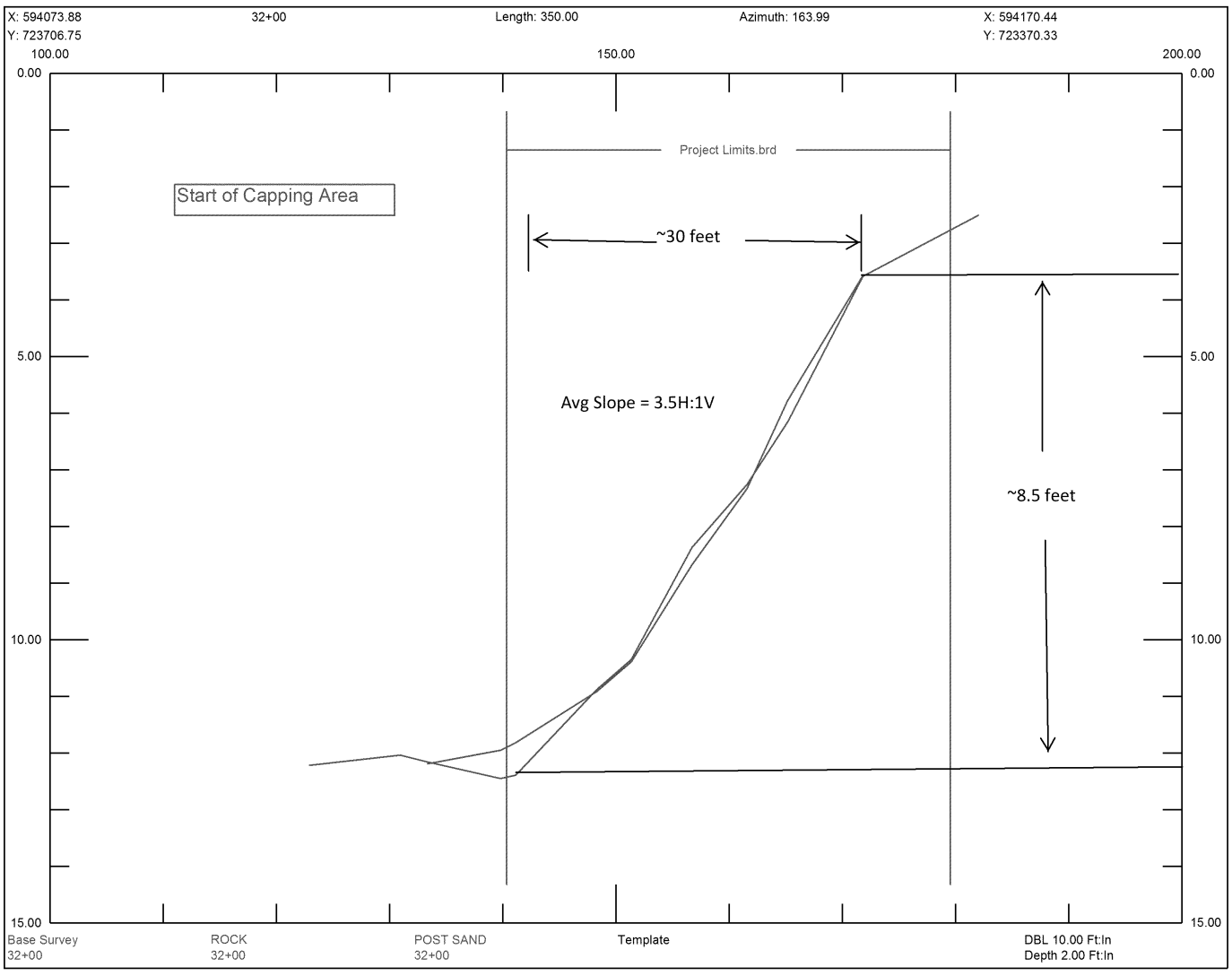
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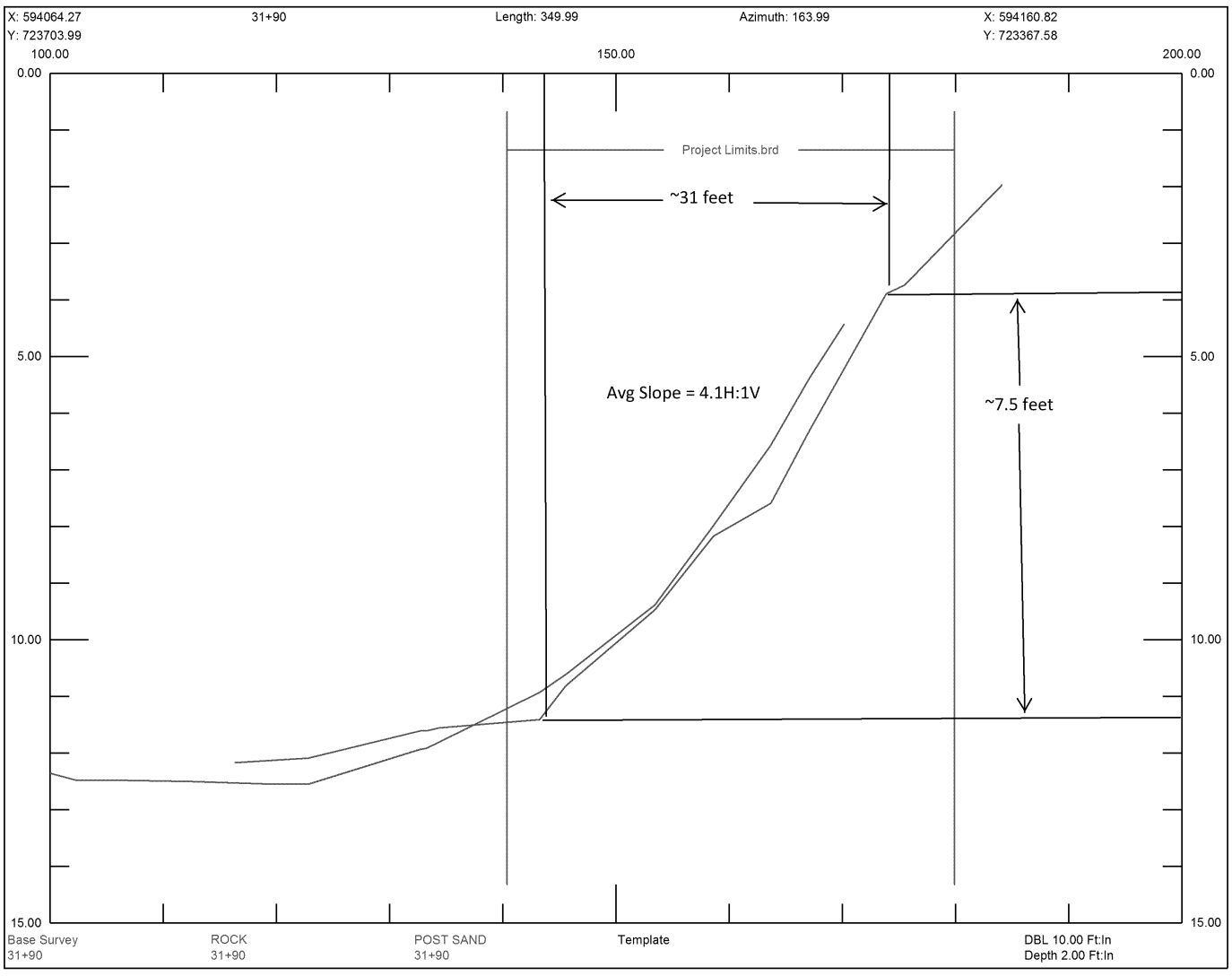
150.00
200.00
0.00
5.00
10.00
15.00
Project Limits.brd
Start of Capping Area
~30 feet
Avg Slope = 3.5H:1V
~8.5 feet
Base Survey
32+00
ROCK
32+00
POST SAND
32+00
Template
DBL 10.00 Ft:In
Depth 2.00 Ft:In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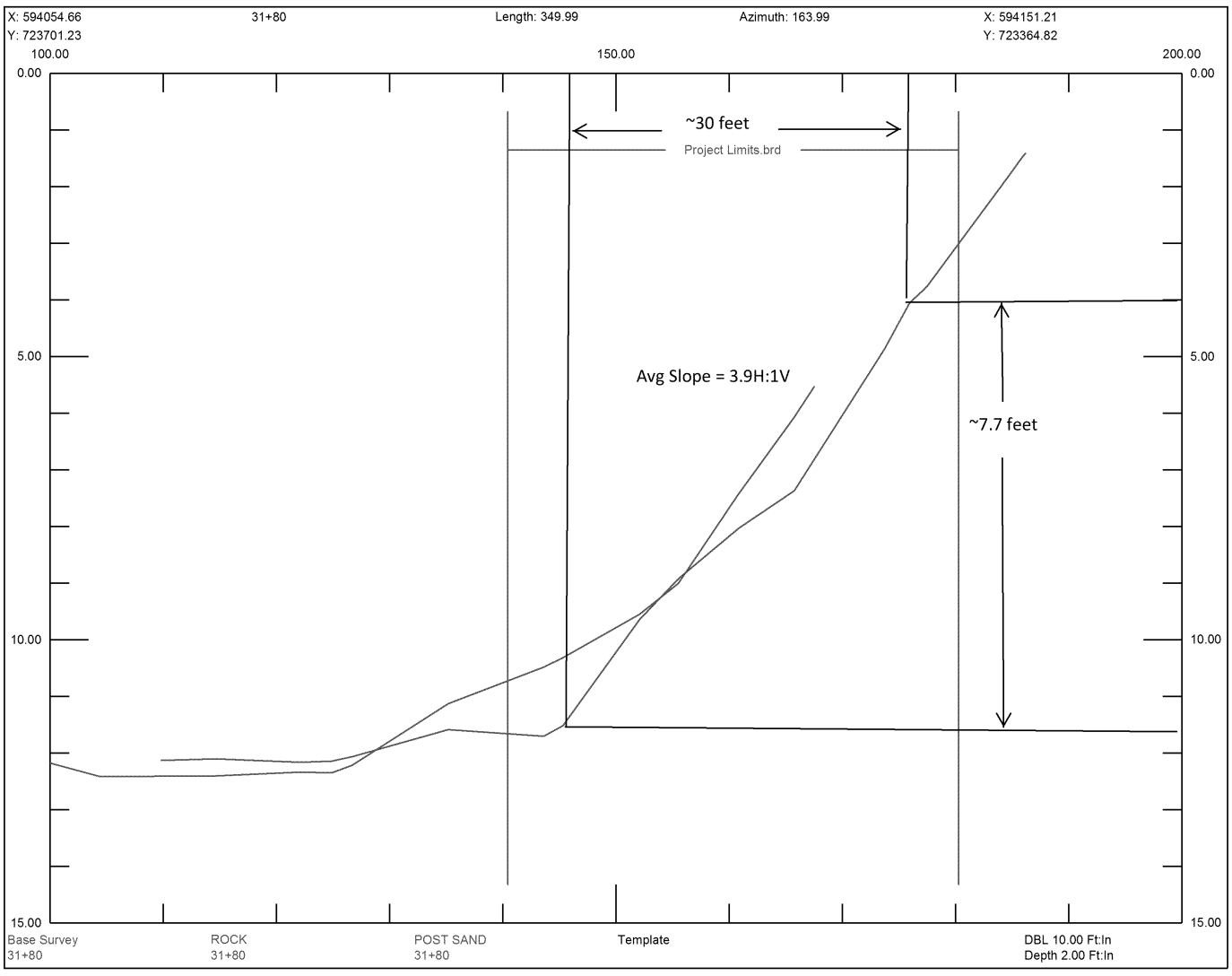
200.00
0.00
5.00
10.00
15.00
Project Limits.brd
~31 feet
Avg Slope = 4.1H:1V
~7.5 feet
Base Survey
31+90
ROCK
31+90
POST SAND
31+90
Template
DBL 10.00 Ft:In
Depth 2.00 Ft:In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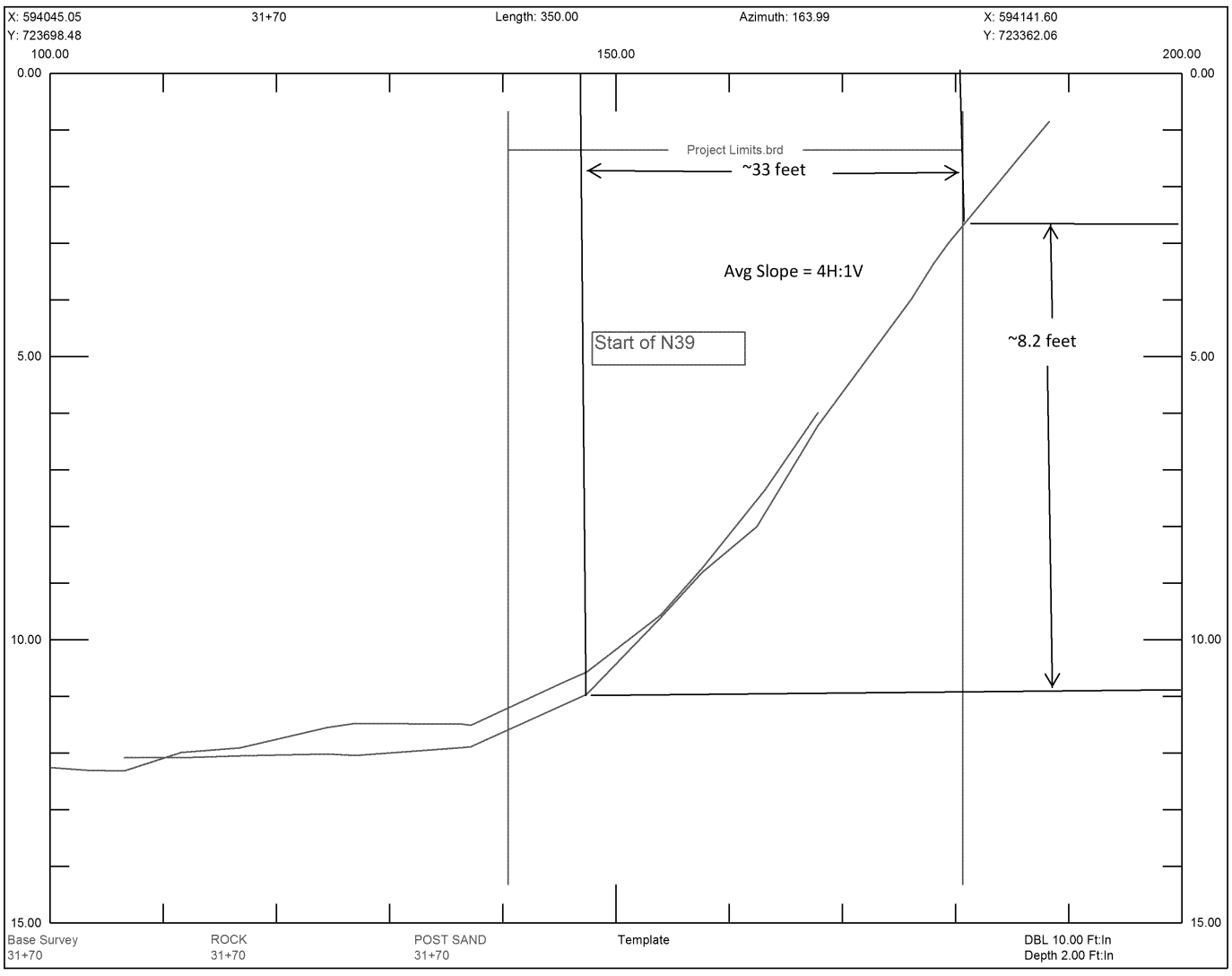
150.00
200.00
0.00
5.00
10.00
15.00
~30 feet
Project Limits.brd
Avg Slope = 3.9H:1V
~7.7 feet
Base Survey
31+80
ROCK
31+80
POST SAND
31+80
Template
DBL 10.00 Ft:In
Depth 2.00 Ft:In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Y: 723362.06
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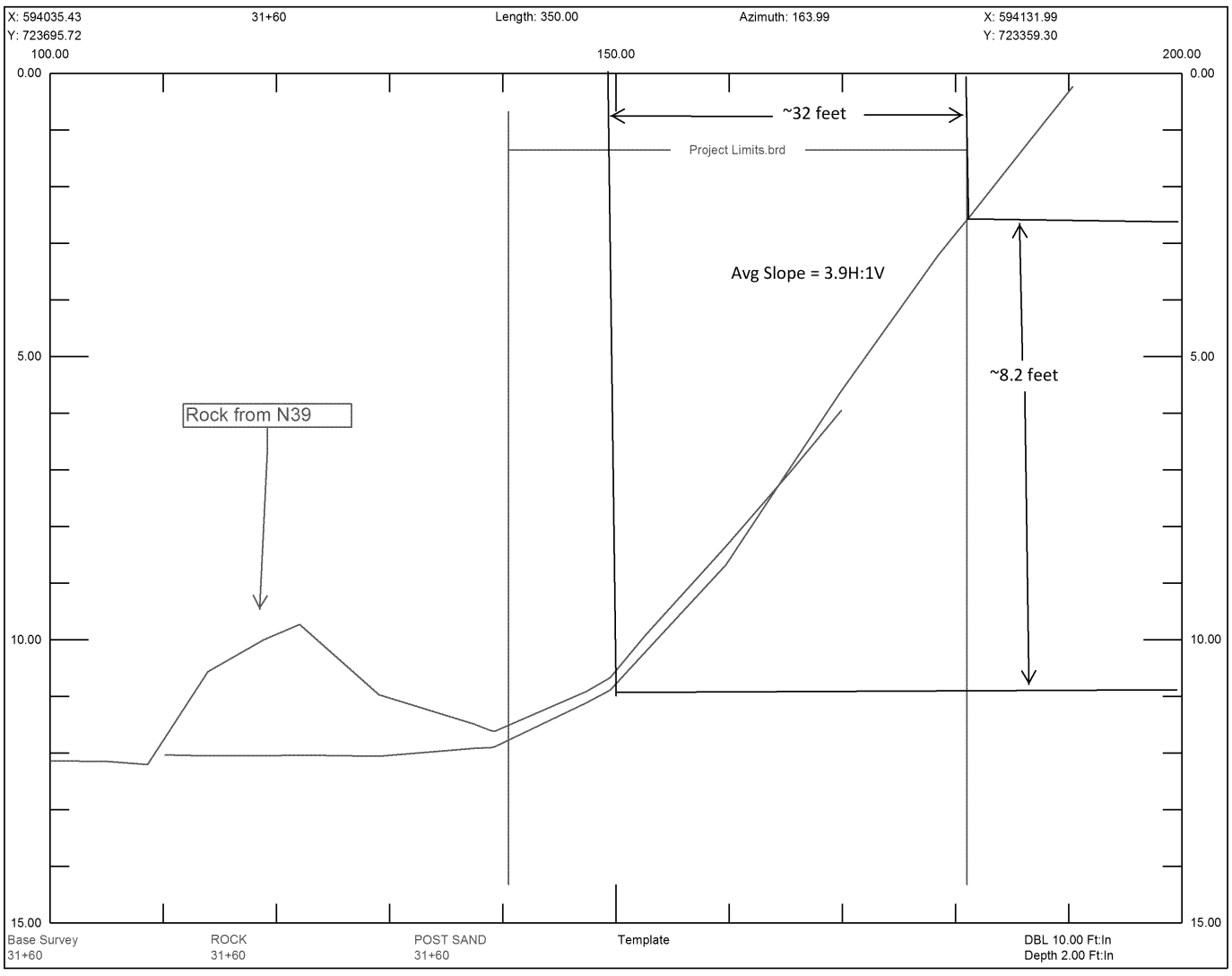
150.00
200.00
0.00
5.00
10.00
15.00
Project Limits.brd
~33 feet
Avg Slope = 4H:1V
Start of N39
~8.2 feet
Base Survey
31+70
ROCK
31+70
POST SAND
31+70
Template
DBL 10.00 Ft:In
Depth 2.00 Ft:In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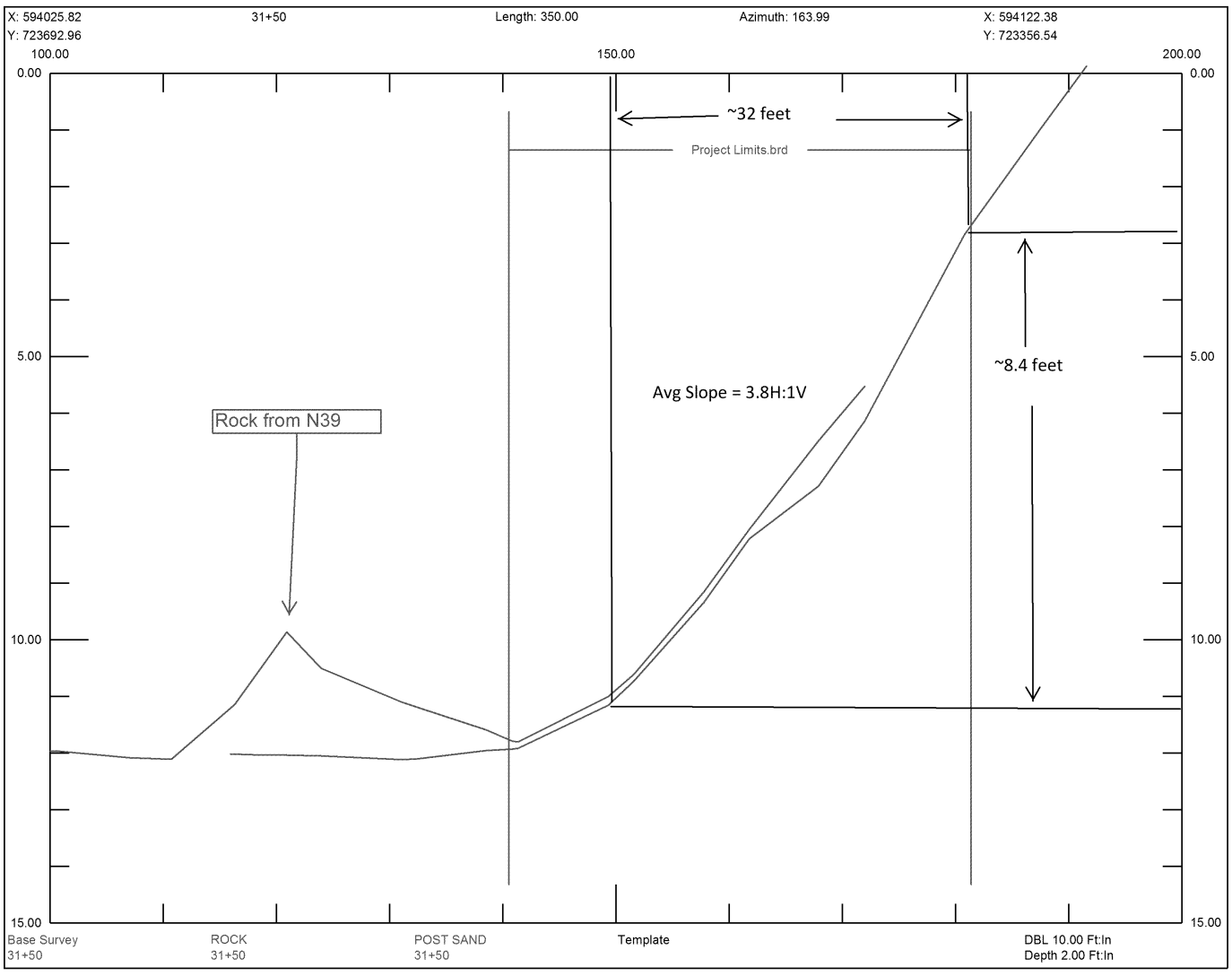
200.00
0.00
5.00
10.00
15.00
~32 feet
Project Limits.brd
Avg Slope = 3.9H:1V
~8.2 feet
Rock from N39
Base Survey
31+60
ROCK
31+60
POST SAND
31+60
Template
DBL 10.00 Ft:In
Depth 2.00 Ft:In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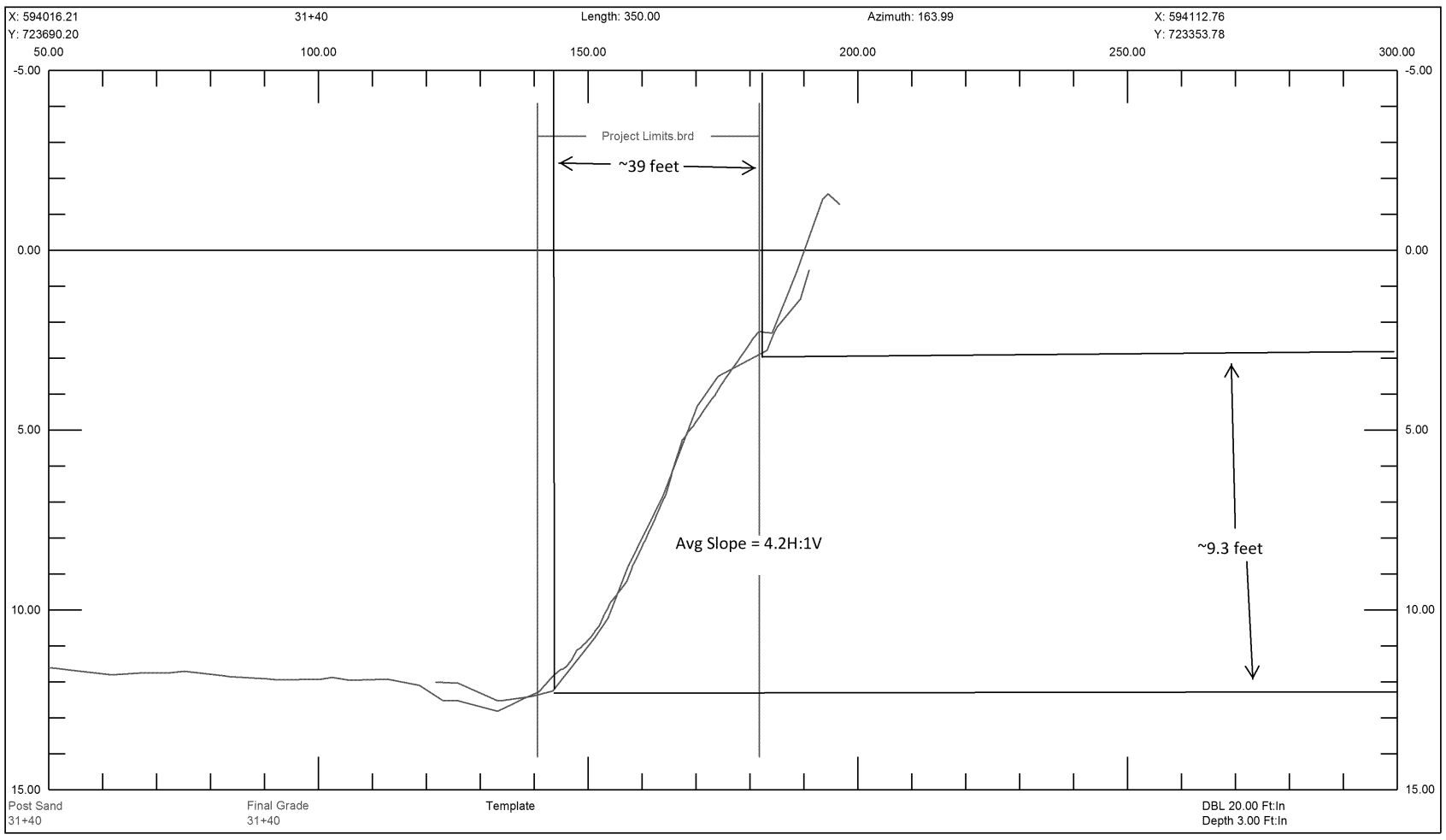
200.00
0.00
5.00
10.00
15.00
~32 feet
Project Limits.brd
~8.4 feet
Avg Slope = 3.8H:1V
Rock from N39
Base Survey
31+50
ROCK
31+50
POST SAND
31+50
Template
DBL 10.00 Ft:In
Depth 2.00 Ft:In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150.00
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300.00
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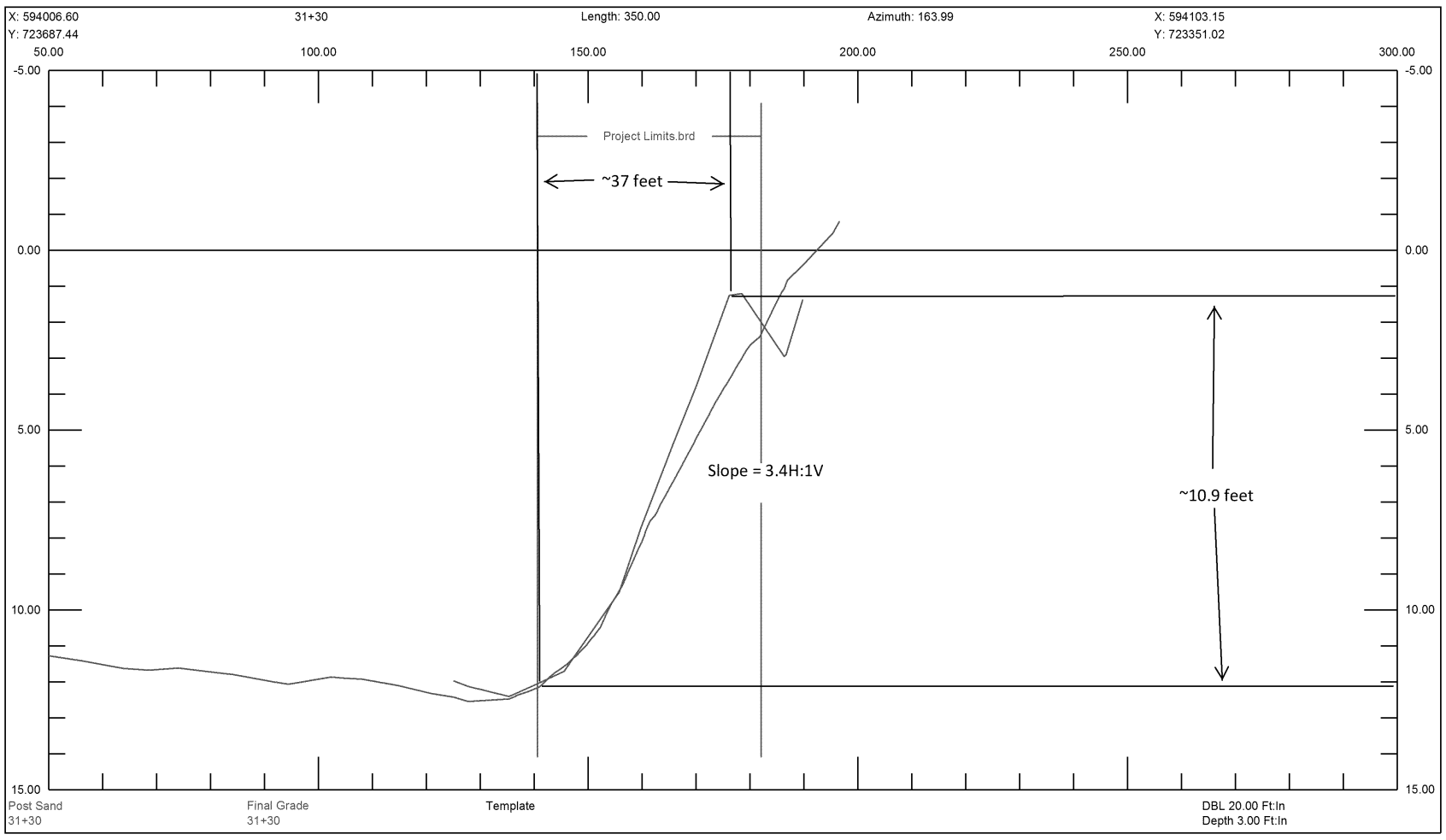
0.00
5.00
10.00
15.00
Project Limits.brd
~39 feet
Avg Slope = 4.2H:1V
~9.3 feet
Post Sand
31+40
Final Grade
31+40
Template
DBL 20.00 Ft:In
Depth 3.00 Ft:In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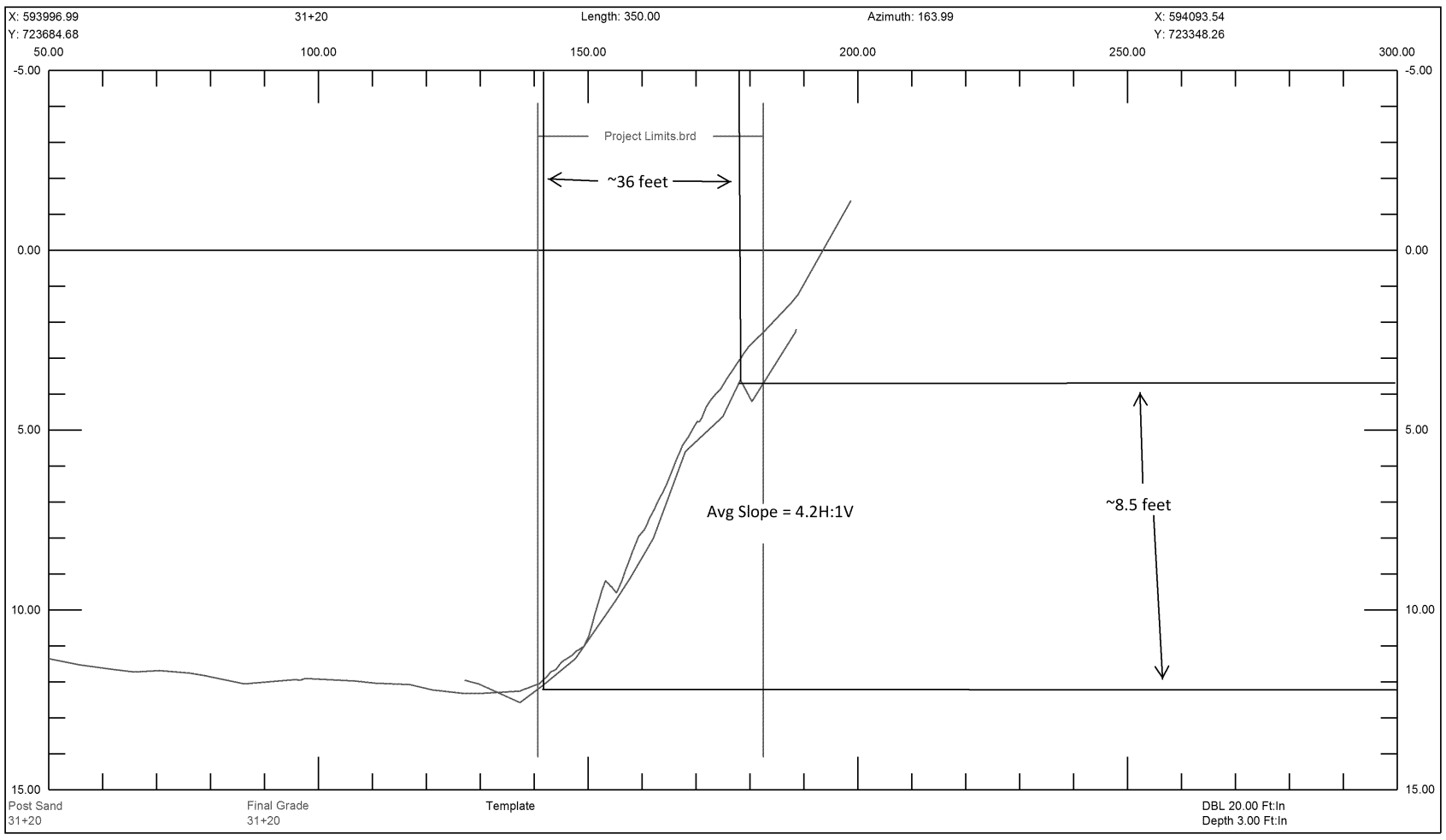
150.00
200.00
250.00
300.00
-5.00
0.00
5.00
10.00
15.00
Project Limits.brd
~37 feet
Slope = 3.4H:1V
~10.9 feet
Post Sand
31+30
Final Grade
31+30
Template
DBL 20.00 Ft:In
Depth 3.00 Ft:In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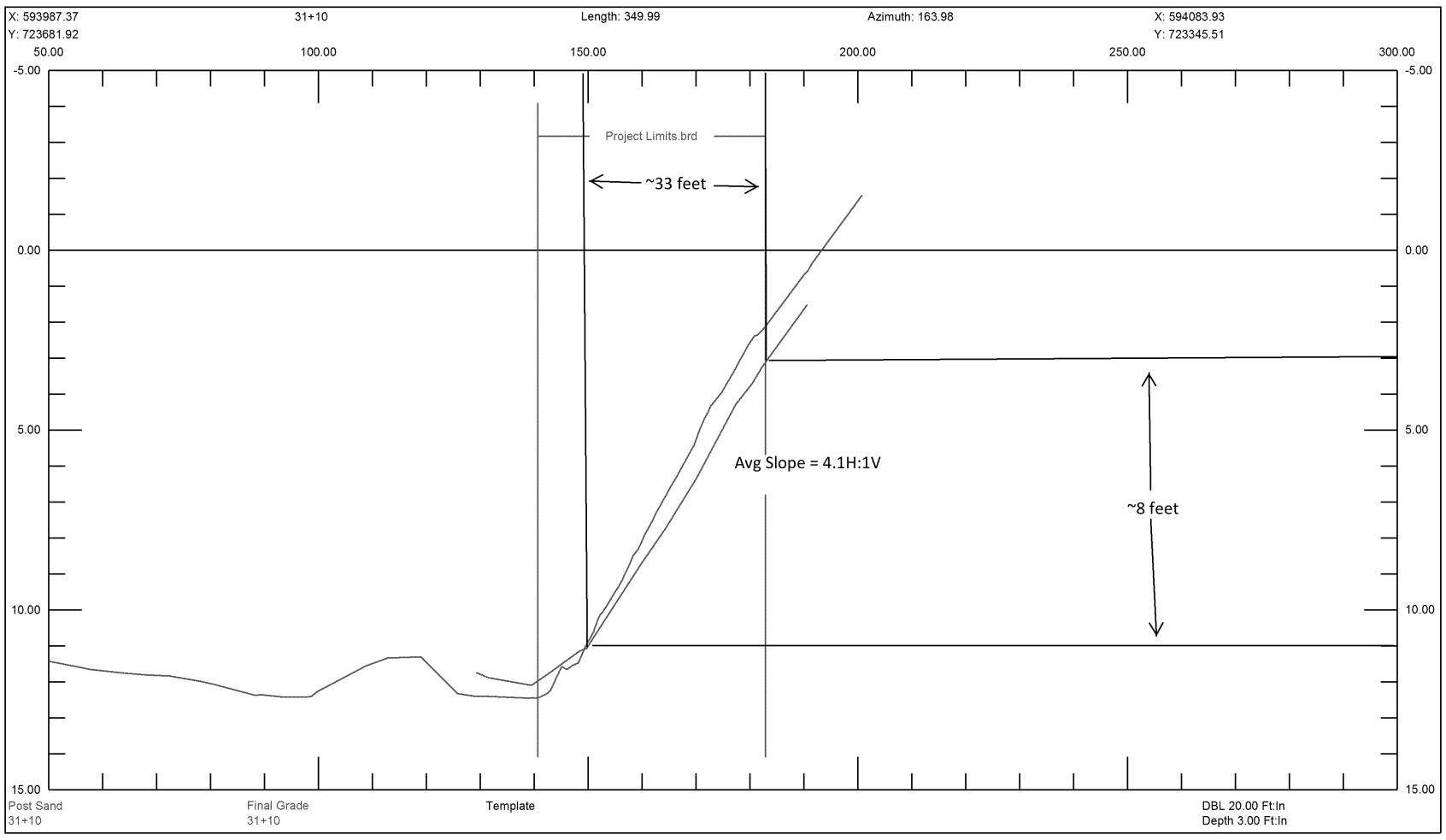
200.00
250.00
300.00
-5.00
0.00
5.00
10.00
15.00
Project Limits.brd
~36 feet
Avg Slope = 4.2H:1V
~8.5 feet
Post Sand
31+20
Final Grade
31+20
Template
DBL 20.00 Ft:In
Depth 3.00 Ft:In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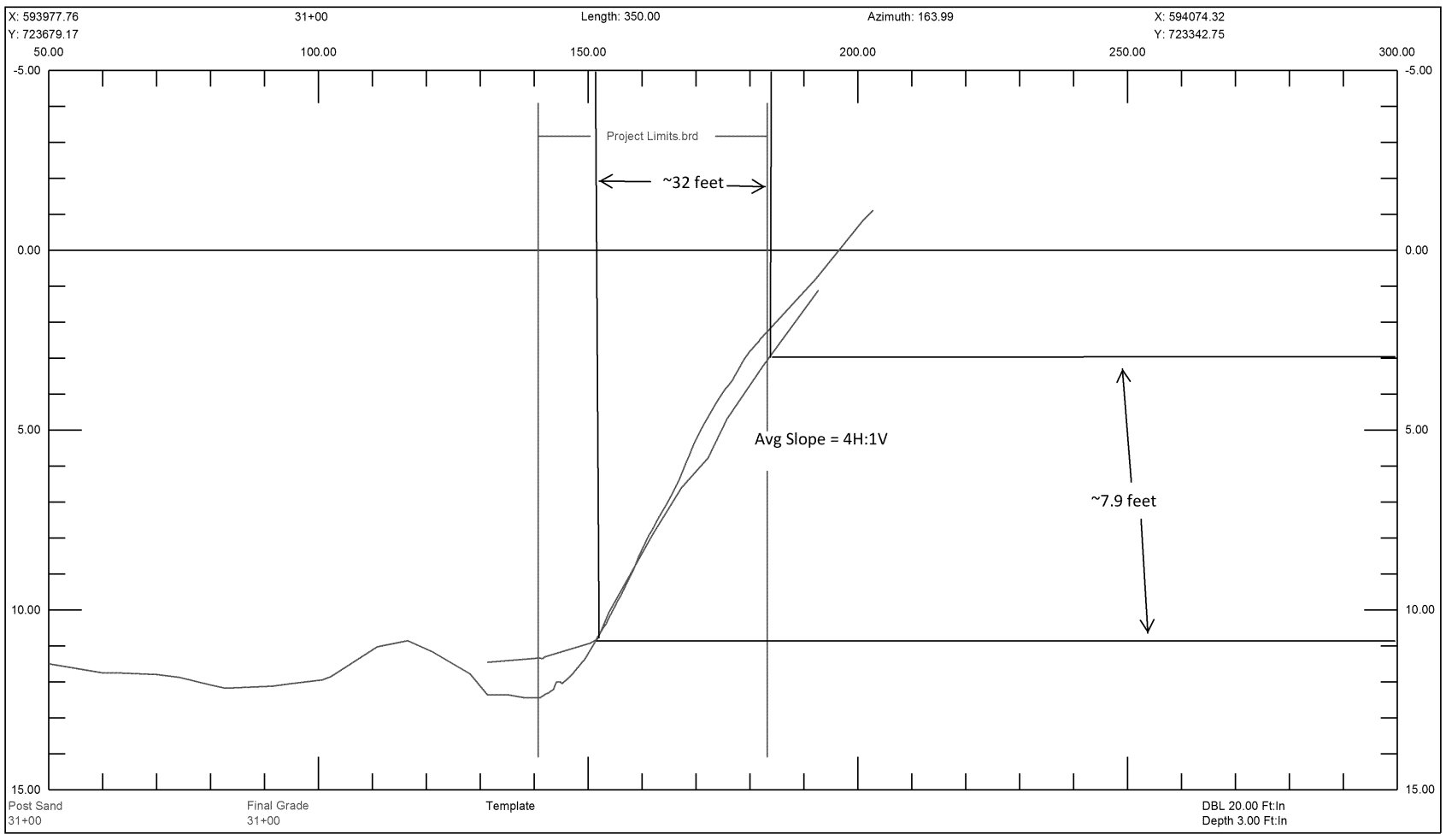
150.00
200.00
250.00
300.00
-5.00
0.00
5.00
10.00
15.00
Project Limits.brd
~33 feet
Avg Slope = 4.1H:1V
~8 feet
Post Sand
31+10
Final Grade
31+10
Template
DBL 20.00 Ft:In
Depth 3.00 Ft:In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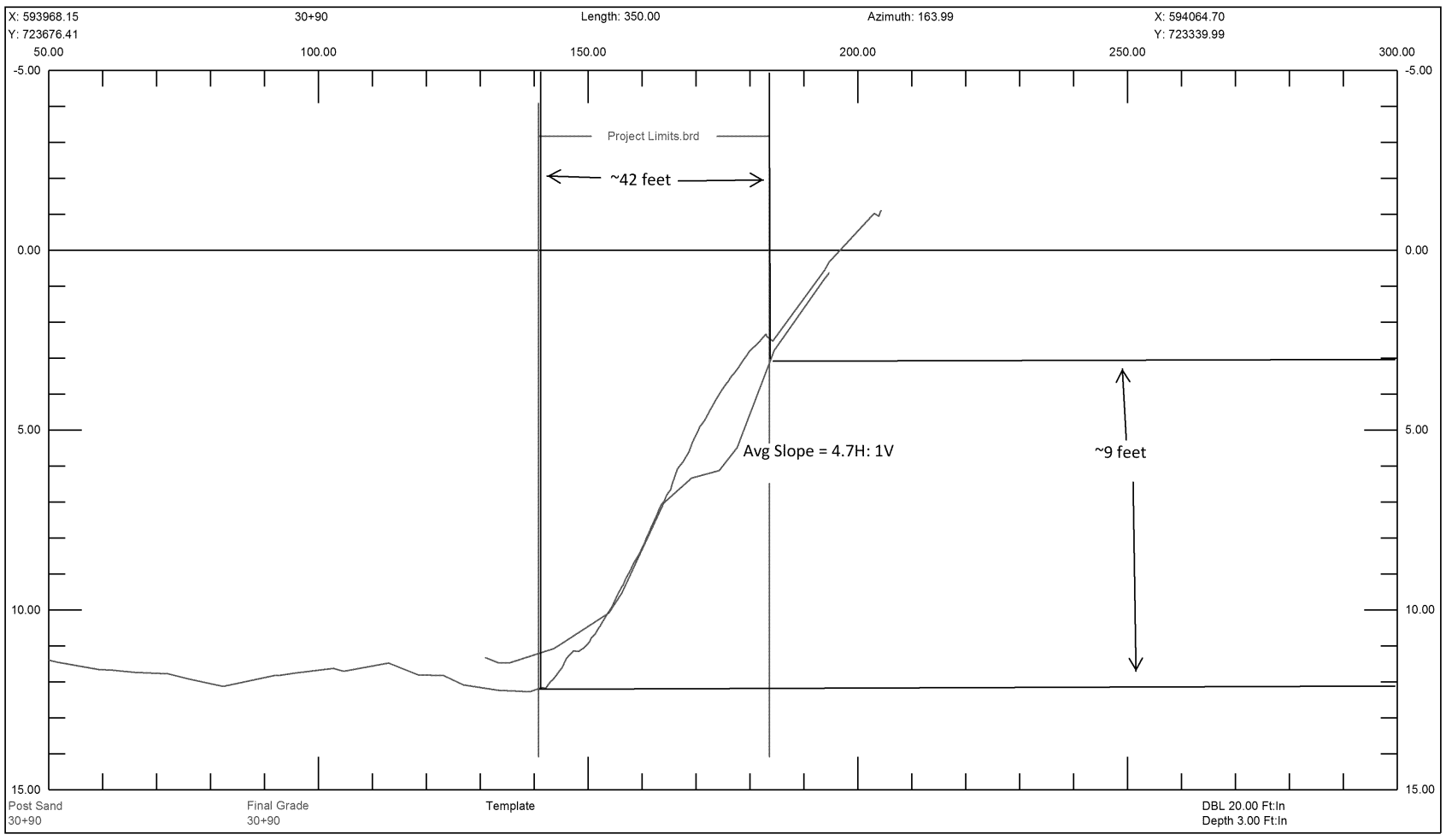
200.00
250.00
300.00
-5.00
0.00
5.00
10.00
15.00
Project Limits.brd
~32 feet
Avg Slope = 4H:1V
~7.9 feet
Post Sand
31+00
Final Grade
31+00
Template
DBL 20.00 Ft:In
Depth 3.00 Ft:In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300.00
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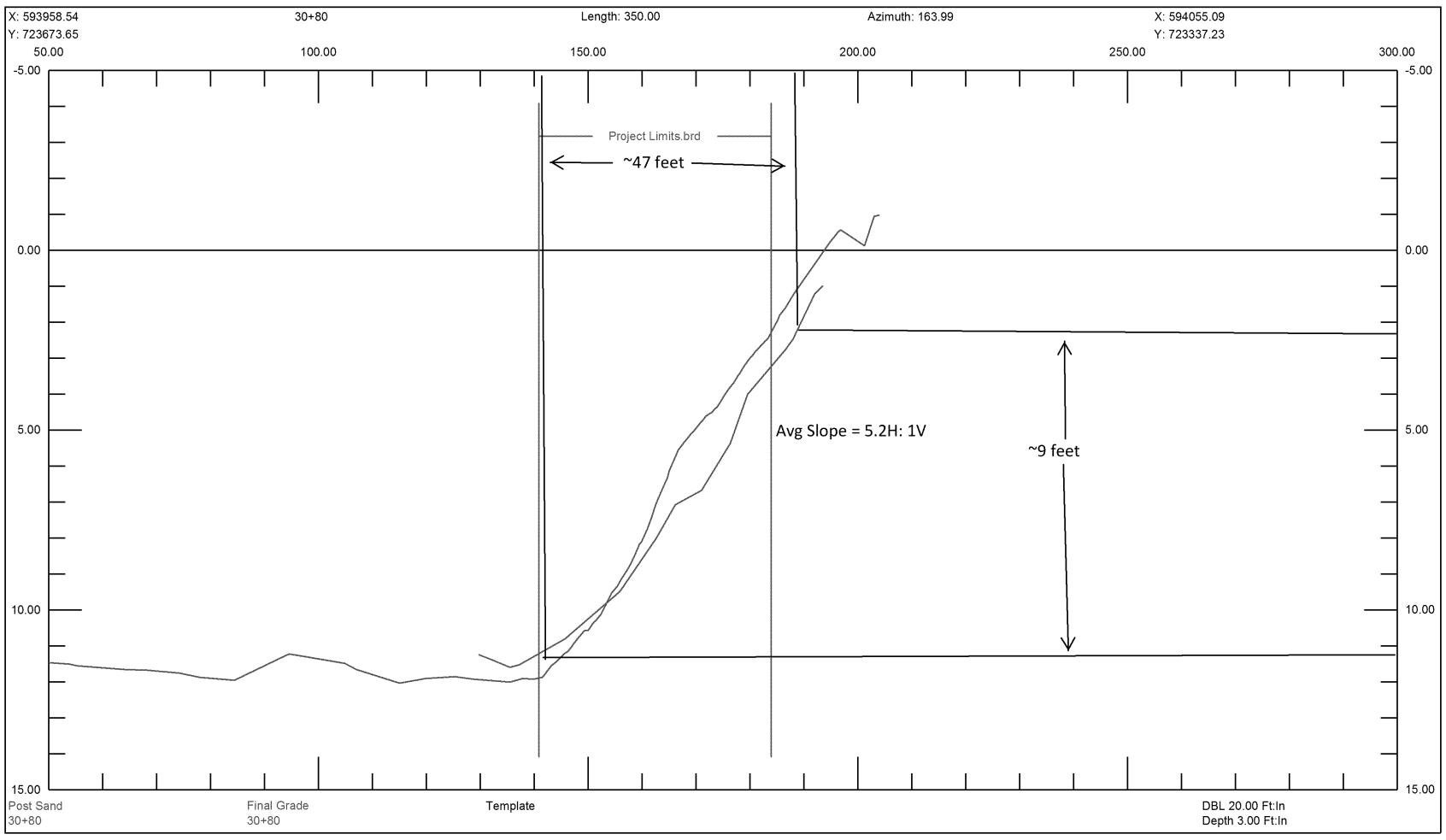
0.00
5.00
10.00
15.00
Project Limits.brd
~42 feet
Avg Slope = 4.7H: 1V
~9 feet
Post Sand
30+90
Final Grade
30+90
Template
DBL 20.00 Ft:In
Depth 3.00 Ft:In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150.00
200.00
250.00
300.00
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0.00
5.00
10.00
15.00
Project Limits.brd
~47 feet
Avg Slope = 5.2H: 1V
~9 feet
Post Sand
30+80
Final Grade
30+80
Template
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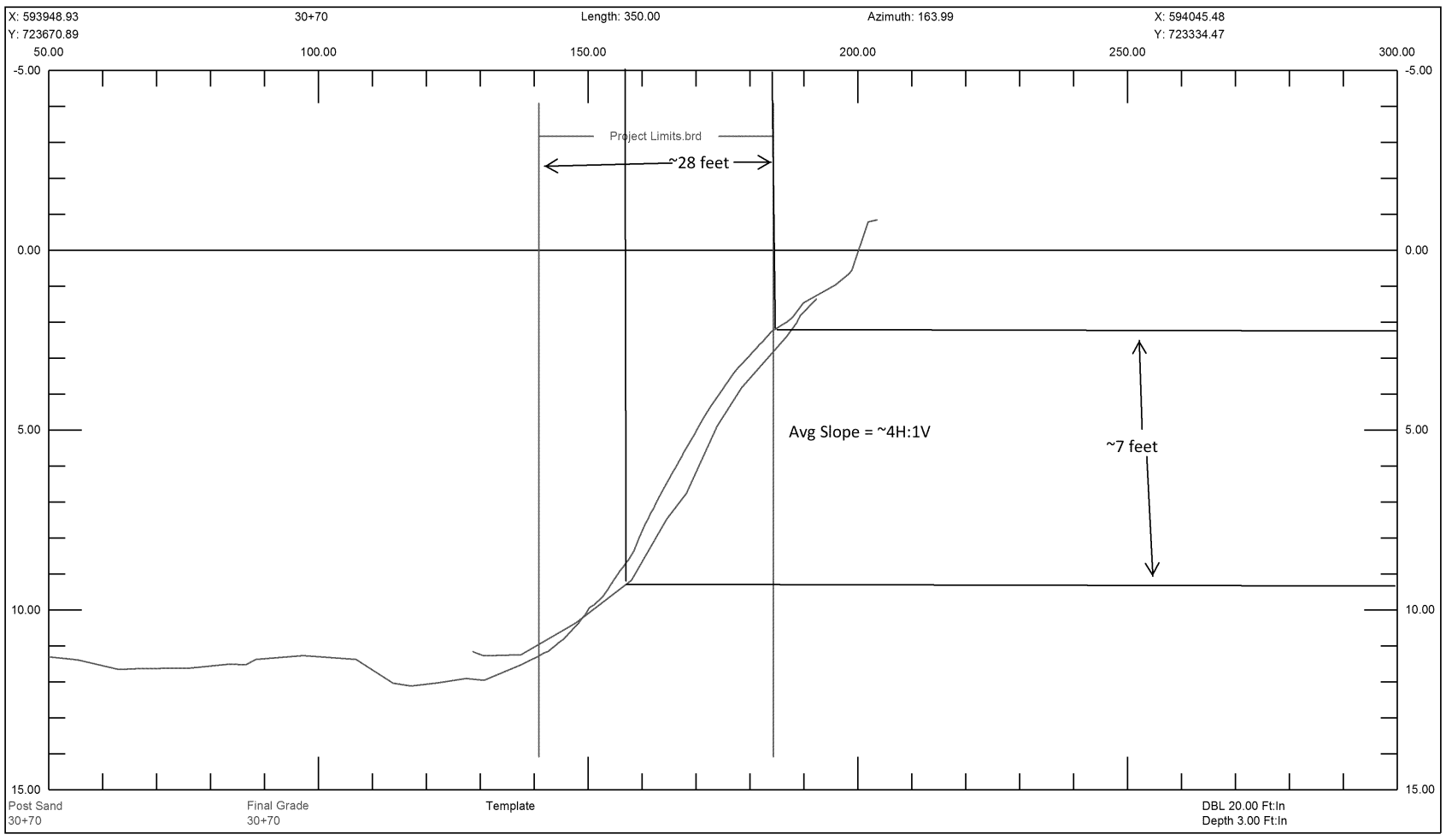
Depth 3.00 Ft:In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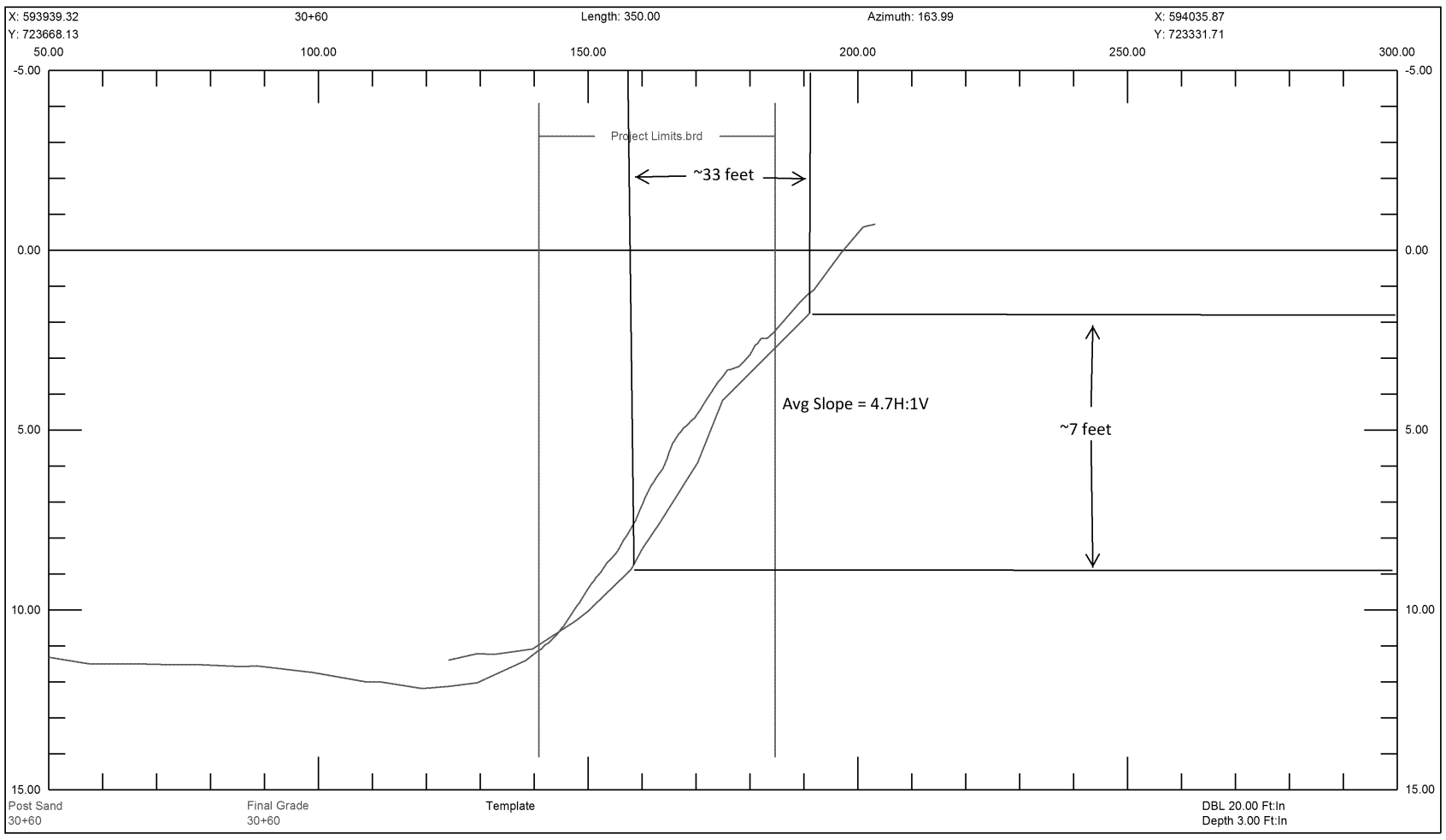
150.00
200.00
250.00
300.00
-5.00
0.00
5.00
10.00
15.00
Project Limits.brd
~28 feet
Avg Slope = ~4H:1V
~7 feet
Post Sand
30+70
Final Grade
30+70
Template
DBL 20.00 Ft:In
Depth 3.00 Ft:In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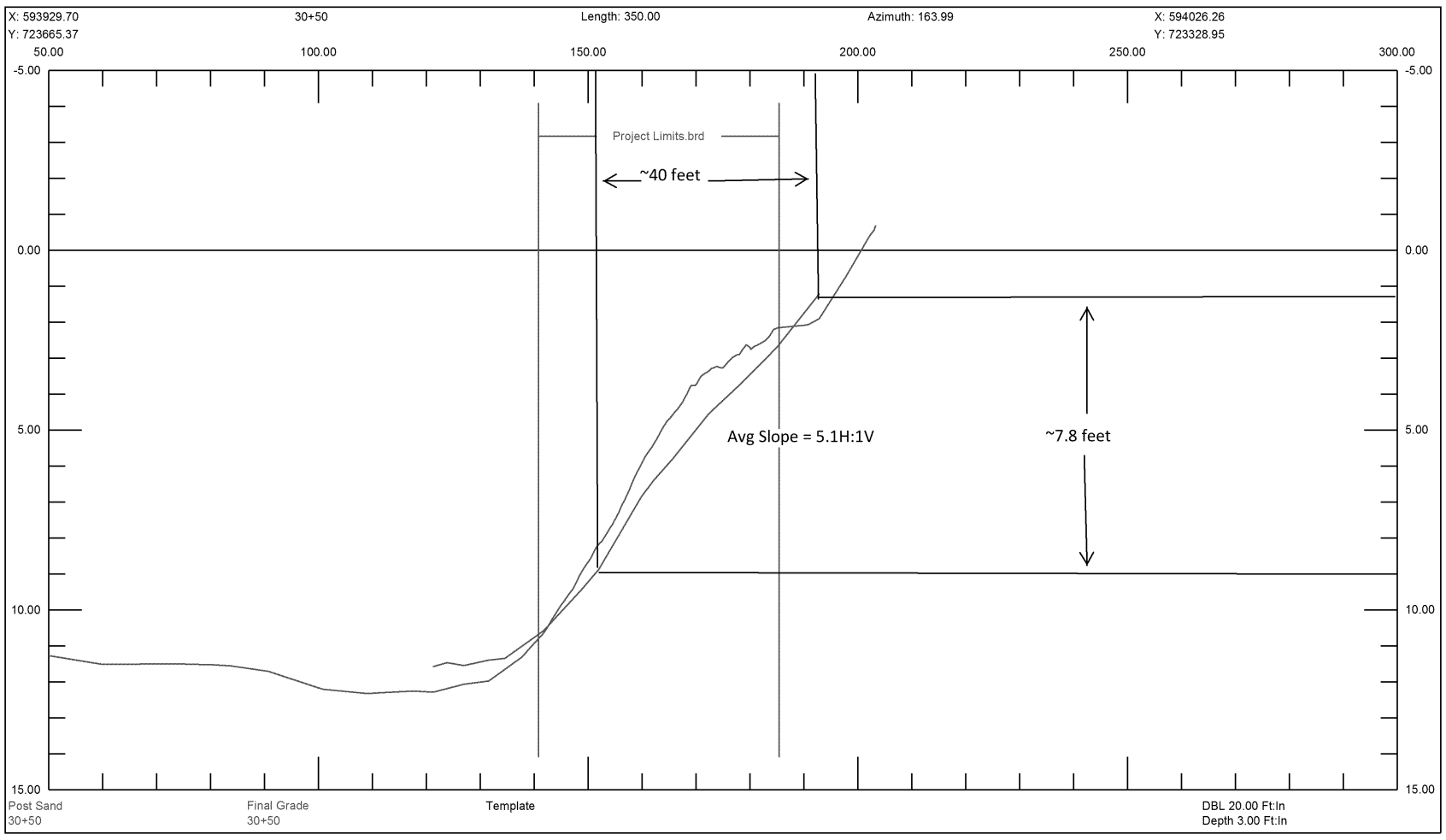
100.00
150.00
200.00
250.00
300.00
-5.00
0.00
5.00
10.00
15.00
Project Limits.brd
~33 feet
Avg Slope = 4.7H:1V
~7 feet
Post Sand
30+60
Final Grade
30+60
Template
DBL 20.00 Ft:In
Depth 3.00 Ft:In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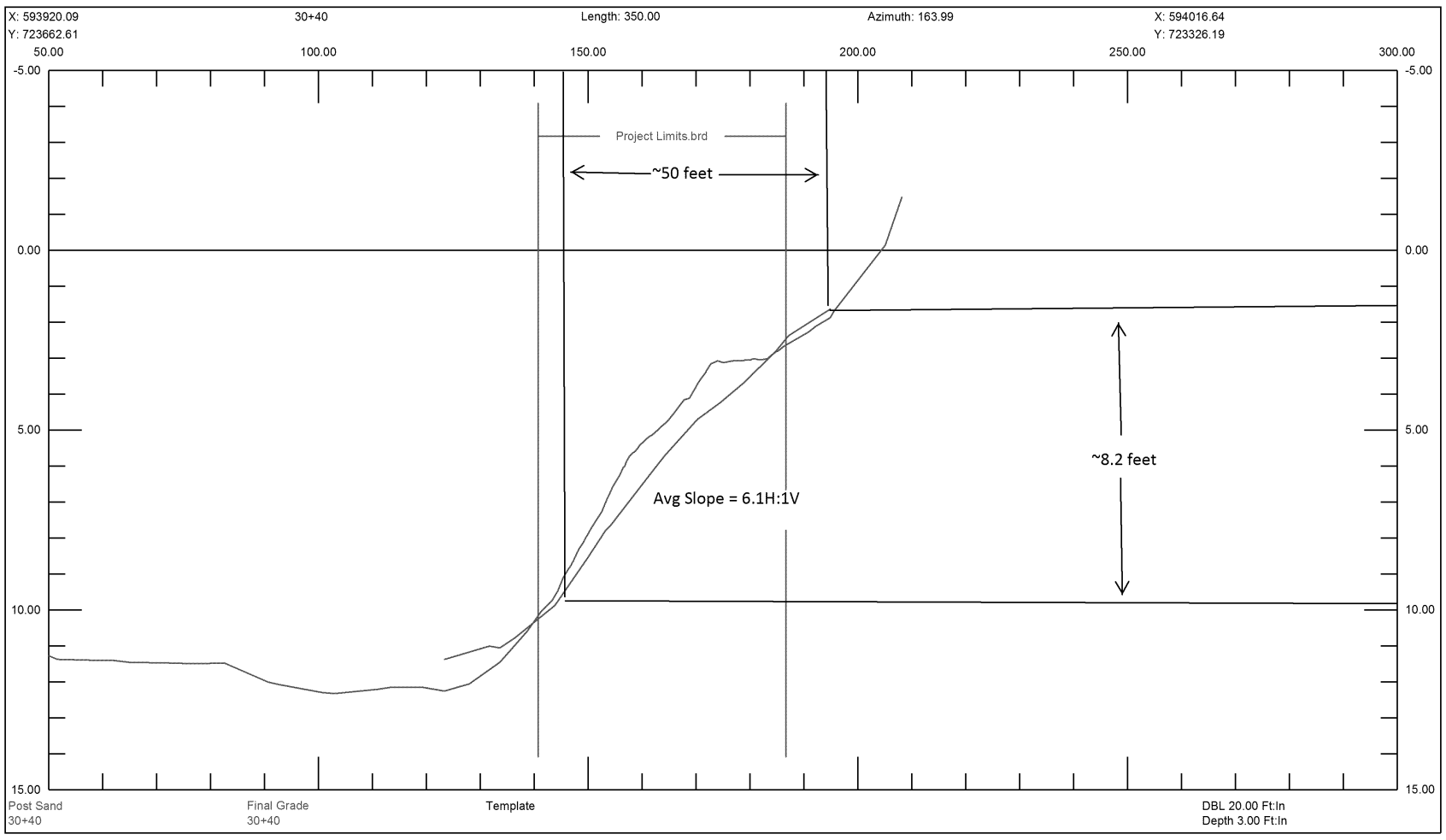
100.00
150.00
200.00
250.00
300.00
-5.00
0.00
5.00
10.00
15.00
Project Limits.brd
~40 feet
Avg Slope = 5.1H:1V
~7.8 feet
Post Sand
30+50
Final Grade
30+50
Template
DBL 20.00 Ft:In
Depth 3.00 Ft:In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100.00
150.00
200.00
250.00
300.00
-5.00
0.00
5.00
10.00
15.00
Project Limits.brd
~50 feet
~8.2 feet
Avg Slope = 6.1H:1V
Post Sand
30+40
Final Grade
30+40
Template
DBL 20.00 Ft:In
Depth 3.00 Ft:In