Evaluation of the Material Site Access Road Alignment Alternatives

Presented below are the parameters and considerations used for assessing and calculating the least environmentally damaging practicable alternative (LEDPA).

The topographic contours were established using data collected from a LIDAR aeronautical survey that was completed over the project area. The DOT&PF used Civil 3D modeling software for calculating fill quantities and impact area for Option 2. The remaining options were calculated by using the length of the respective alignment multiplied by its width (toe-to-toe of its embankment) and by its height.

A typical haul truck used for these type operations is the Volvo articulated haul truck series A25G or A30G. Since the contract for this project has neither gone out to bid nor has it been awarded yet the DOT&PF based the calculations for the haul truck on the larger A30G series. The width of a Volvo A30G series haul truck is 9 feet 8 inches, not including mirrors, so the DOT&PF used a width of 12 feet for the haul truck. The ground pressure exerted by the A30G series when it's loaded is 26 psi (rear wheels).

Earthen Road Alternatives
Option 2 is the furthest northeast alignment proposed (Sheet 1 of 17). The ground conditions at this location are not as saturated as the areas located further toward the southwest. As such, DOT&PF's Northern Region Materials Engineer recommended that at a minimum, 4-feet of fill should be used to construct the Option 2 road alignment. Proposed road alignments southwest from Option 2 were recommended to be constructed with 6-feet of fill, at a minimum. This is because the ground conditions in these areas are softer as a result of being more saturated. Therefore, in calculating impact area the DOT&PF used a roadbed height of 4-feet for Option 2 and used a 6-feet roadbed height for Options 1, 5, and 7. Options 3, 4, and 6 were evaluated as ice roads, their parameters are discussed below. Additionally, the alignments that were evaluated as being constructed from gravel used an 18-feet wide driving surface and embankments having 2:1 slopes. Because wetland impacts from Option 2 (our preferred alternative) included 4 vehicle pullouts, the mean average of these referenced pullouts totaled 0.2 acre. As such, 0.2 acre was added to the impacts of Options 1, 5, and 7 so that we're comparing similar roadway designs.

Ice Road Alternatives
Construction of an ice road over a stream crossing requires thicker ice than it would for frozen ground. Uneven ground surfaces also require thicker ice in order to level the road surface (e.g. minimize side slopes). Because of the variability of level ground surfaces throughout the proposed ice road alignments and the fact that there are numerous stream crossings, the DOT&PF applied a uniform thickness of 6 feet as a constant for the ice road alignment options, Options 3, 5, and 7 (Sheet 1 of 17).

DOT&PF's preliminarily design for the ice road options used the parameters of 6 feet high with 2:1 embankment slopes and two 15 feet driving lanes. The volume of each ice road option was calculated by using the linear feet of its respective alignment, multiplied by 6 feet high and 54

feet wide (toe-to-toe of the embankment). The DOT&PF used the conversion factor of 1 cubic foot equals 7.5 US gallons of water for quantity calculations.

Ice roads that have grades exceeding 8% are considered too steep for vehicles to maintain safe traction. As such, the DOT&PF dismissed ice road alignments that have grades steeper than 8% as viable alternatives because of the real possibility that a haul truck could slide off the roadway or into an approaching truck from the opposite direction, causing injury or death to the driver(s) and potential petroleum releases to the environment from an overturned truck. Of lesser concern is that if the grades are too steep the applied water will run off from its intended area.

Water source withdrawal points were also given consideration in the viability of ice road construction. The mean average for the volume of water needed to construct the three ice road options (Options 3, 5, and 7) is 27,697,950 US gallons. If the ice road was constructed during the month of November (30 days) then approximately 923,265 gallons/day would be required. None of the streams that the proposed ice road alignments cross are capable of producing the required volume during the month of November. The closest stream capable of producing that volume is the Squirrel River, which is an anadromous fish stream, AWC 331-00-10490-2115. The Hydrologic Unit Code for the lower Squirrel River is 1905030407. The USGS has measured daily mean values of discharge rates from a gauge station located near Kiana, approximately 9.7 miles upstream on the Kobuk River from its confluence with the Squirrel River. For the years 1976 through 1996 the monthly mean average for November was 5,472 cubic feet per second (https://ak.water.usgs.gov/Publications/water-data/WY96/15744500.htm).

Another consideration taken into account for utilizing an ice road option is that the material needed to construct the Kiana Airport Improvements project would only be able to be transported to the project site during the winter months. Approximately 590,000 cubic yards (cy) of material will be required to complete the airport project. If construction of the ice road could be completed during the month of November, then December, January, February, and March would be the only months available for transport of the required material. The Volvo A30G series is capable of hauling 25 cy. As such, it will require 9 haul trucks working 10 hour shifts over the course of 4 months (121 days) to move 590,000 cy of material.

Additionally, a temporary stockpile area that's large enough to accommodate 590,000 cy of material will be required. Because the airport needs to remain operational, to the extent practicable during the construction of this project, phasing requirements will be emplace to ensure that at least half of the runway's width will be available for fixed winged aircraft to land and take off. As such, the airfield's obstruction free zones must be maintained at all times. Maintaining the required obstruction free zone will limit the temporary stockpile elevations and thus limit the volume of material that can stockpiled at the airfield. Given these constraints, the DOT&PF has calculated that it will take 14 years to complete the Kiana Airport Improvements project if the temporary stockpiles areas are located entirely within airport property, as opposed to 4 years using an earthen road option. Sheet 2 of 17 depicts the potential temporary stockpile areas within the airport property.

Alignment Evaluations

Option 1 (earthen road)
Option 1's alignment was selected because it follows a route of an existing winter trail. Local residents formerly rode ATVs along this trail during the summer but its use was abandoned as a summer trail because it became a quagmire. Although the ATVs attributed to the deterioration of this trail, that fact that this area is wetter (softer) ground than what exists to the northeast accelerated the trail's degradation. For this reason the DOT&PF's Northern Region Materials Engineer recommended that at a minimum, 6-feet of fill should be used to construct the Option 1 road alignment; it was also recommended that geotextile fabric should be considered in conjunction with the fill, which would substantially increase the cost of this alternative.

The dimensions of Option 1 (Sheet 3 of 17) are 12,529 linear feet (LF) by 42 feet wide by 6 feet high. The DOT&PF has calculated that 116,937 cy of material would be required to construct this alignment. Option 1's alignment would result in unavoidable permanent impacts to 12.2 acres of wetlands and 13.7 acres of temporary wetland impacts. Option 1 wetland impacts are greater than Option 2 (discussed below). Therefore, Option 1 was dismissed as being the LEDPA.

Option 2 (earthen road)
Option 2 is DOT&PF's preferred alternative. This route was selected in part because local residence knowledgeable of the terrain had already established an existing ATV trail that avoids wetter ground to the southwest. The DOT&PF's Northern Region Materials Engineer recommended that at a minimum, 4-feet of fill should be used to construct the Option 2 road alignment, as opposed to 6 feet of fill for areas southwest of Option 2.

The dimensions of Option 2 (Sheet 3 of 17) are 12,600 LF by 34 feet wide by 4 feet high. The DOT&PF has calculated, using Civil 3D modeling software, that 89,121 cy of material would be required to construct this alignment. Option 2's alignment would result in unavoidable permanent impacts to 11.7 acres of wetlands and 14.2 acres of temporary wetland impacts.

Option 3 (ice road)
Option 3's alignment was selected because it's the shortest, straightest route from the existing landfill road to the material site ((Sheet 1 of 17).

The dimensions of Option 3 (Sheet 3 of 17) are 11,819 LF by 54 feet wide (toe-to-toe of embankment) by 6 feet high. The DOT&PF has calculated that 28,720,170 gallons of water would be required to construct this alignment. No permanent or temporary impacts to wetlands would result from this ice road alignment. However, the grade exceeds the maximum allowance of an 8% grade. The steepest grade along this ice road alignment is 38% (Sheet 8 of 17), which is far too dangerous for any vehicle to travel on. As such, Option 3 was dismissed as a viable alternative.

Option 4 (ice road)
Option 4's alignment was selected because it's the shortest, straightest route from the project site (airport) to the material site. However, this alignment crosses through 2 restricted Native

allotments, AKFF 0181548 and AKFF 018858. As such, coordination with the allotment owners and BIA will be required. It's also anticipated that BIA will require a Revocable Use Permit and that each allotment owner will charge an access fee to cross their respective property.

The dimensions of Option 4 (Sheet 3 of 17) are 12,145 LF by 54 feet wide (toe-to-toe of embankment) by 6 feet high. The DOT&PF has calculated that 29,512,350 gallons of water would be required to construct this alignment. No permanent or temporary impacts to wetlands would result from this ice road alignment. However, the grade exceeds the maximum allowance of an 8% grade. The steepest grade along this ice road alignment is 20% (Sheet 10 of 17). As such, Option 4 was dismissed as a viable alternative.

Option 5 (earthen road)
Option 5's alignment was selected because it's the shortest, straightest route from the project site (airport) to the material site. This alternative is parallel to Option 4's alignment, however; because the road would be constructed will gravel the grade could be lessened by adding more fill. This alternative also crosses through the same two Native allotments discussed above.

The dimensions of Option 5 (Sheet 3 of 17) are 11,913 LF by 42 feet wide by 6 feet high. The DOT&PF has calculated that 111,188 cy of material would be required to construct this alignment. Option 5's alignment would result in unavoidable permanent impacts to 11.8 acres of wetlands and 12.8 acres of temporary wetland impacts. Option 5 wetland impacts are greater than Option 2. Therefore, Option 5 was dismissed as being the LEDPA.

Option 6 (ice road)
Option 6's alignment was selected because it skirts around the Native allotments but still provides a direct access route from the project site (airport) to the material site.

The dimensions of Option 6 (Sheet 3 of 17) are 10,231 LF by 54 feet wide (toe-to-toe of embankment) by 6 feet high. The DOT&PF has calculated that 24,861,330 gallons of water would be required to construct this alignment. No permanent or temporary impacts to wetlands would result from this ice road alignment. However, the grade exceeds the maximum allowance of an 8% grade. The steepest grade along this ice road alignment is 24% (Sheet 14 of 17). As such, Option 6 was dismissed as a viable alternative.

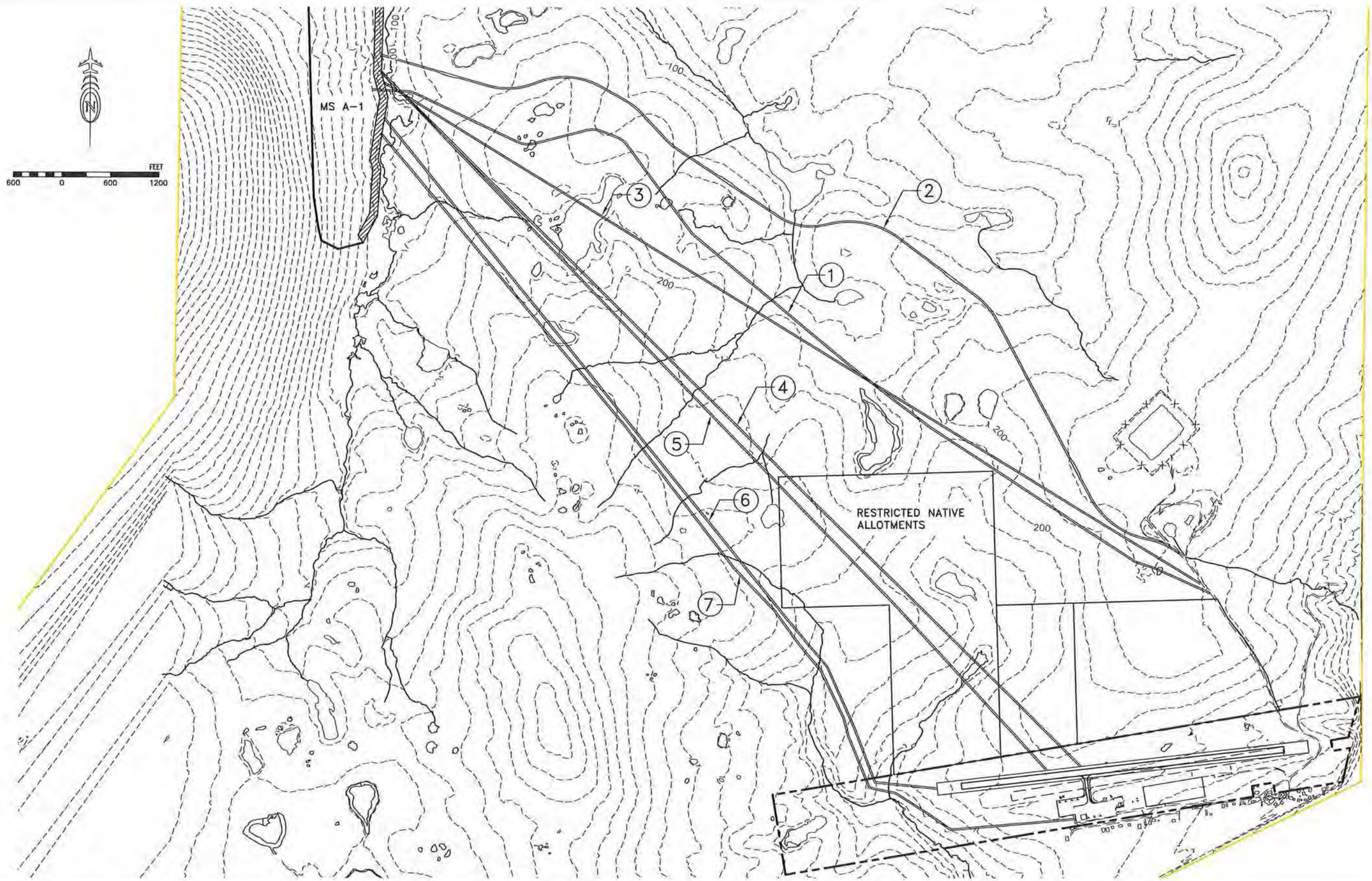
Option 7 (earthen road)
Option 7's alignment was selected because it skirts around the Native allotments but still provides a direct access route from the project site (airport) to the material site. This alternative is parallel to Option 6's alignment, however; because the road would be constructed will gravel the grade could be lessened by adding more fill.

The dimensions of Option 7 (Sheet 3 of 17) are 12,820 LF by 42 feet wide by 6 feet high. The DOT&PF has calculated that 119653 cy of material would be required to construct this alignment. Option 7's alignment would result in unavoidable permanent impacts to 12.6 acres of wetlands and 13.9 acres of temporary wetland impacts. Option 7 wetland impacts are greater than Option 2. Therefore, Option 7 was dismissed as being the LEDPA.

Summary

All three of the proposed ice road alignments (Options 3, 4, and 6) are the LEDPA because no fill would be placed in wetlands. However, each of the three ice roads evaluated greatly exceeded the maximum allowance of an 8% grade. Therefore, the ice road options were dismissed as viable alternatives.

The DOT&PF determined that of the four road alignments proposed to be constructed of gravel (Options 1, 2, 5, and 7) Option 2 is the LEDPA.



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SHEET 1 OF 17

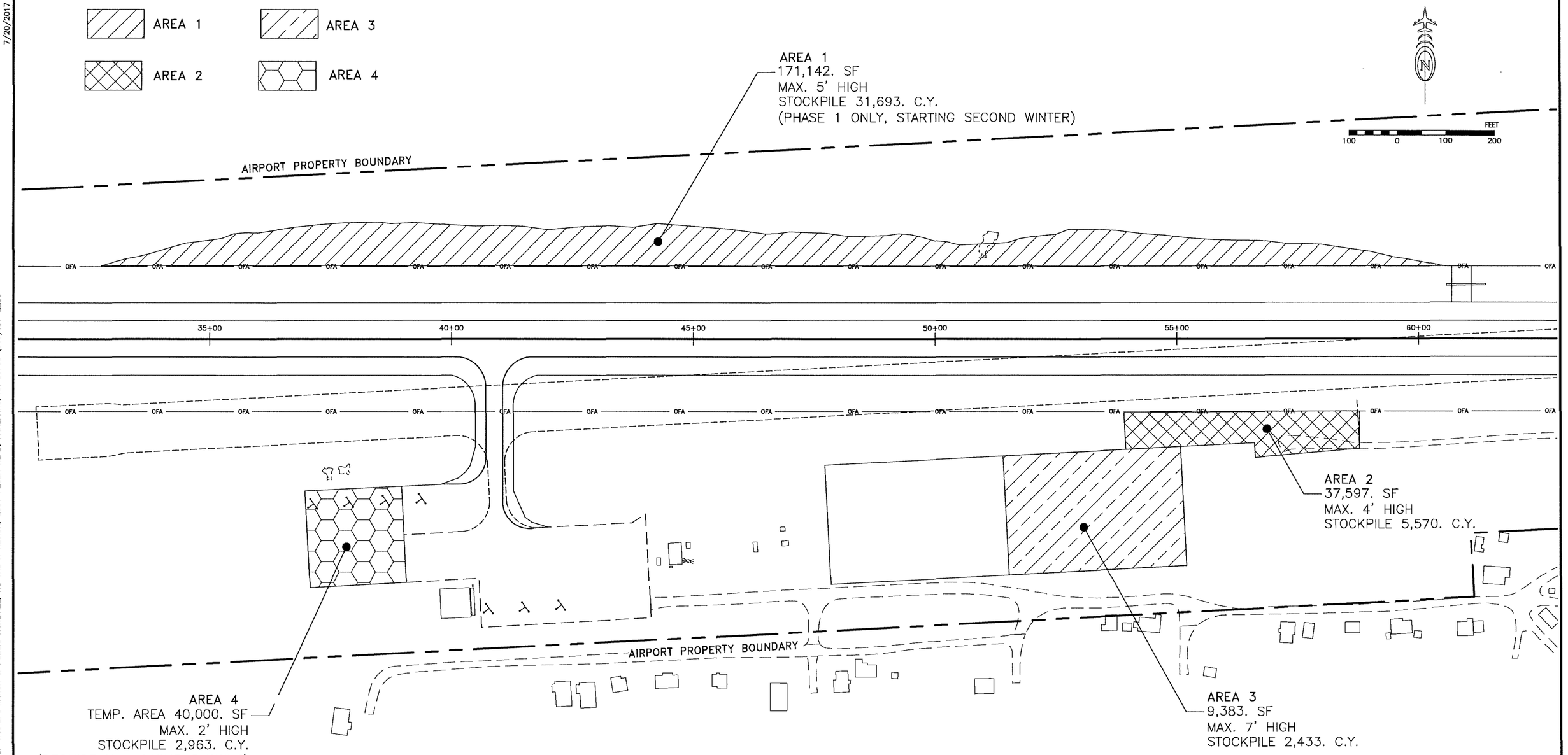
LEGEND:

AREA 1

AREA 2

AREA 3

AREA 4



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SHEET 2 OF 17

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KIANA MATERIAL SITE ROAD OPTIONS

OPTIONS	DIM.	SLOPE	MIN. FILL (HIGH)	MATERIAL QUANTITY	PERMANENT WETLANDS IMPACT	TEMPORARY WETLANDS IMPACT
OPTION 1	42' X 12529'	2:1	6'	116937 C.Y.	12.2 A.C.	13.7 A.C.
* OPTION 2	34' X 12600'	2:1	4'	89121 C.Y.	11.7 A.C.	14.2 A.C.
OPTION 5	42' X 11913'	2:1	6'	111188 C.Y.	11.8 A.C.	12.8 A.C.
OPTION 7	42' X 12820'	2:1	6'	119653 C.Y.	12.6 A.C.	13.9 A.C.

* PREFERRED ALT.

** DOES NOT FILL FOR VERTICAL CURVE CORRECTION OR TERRAIN VARIANCES.

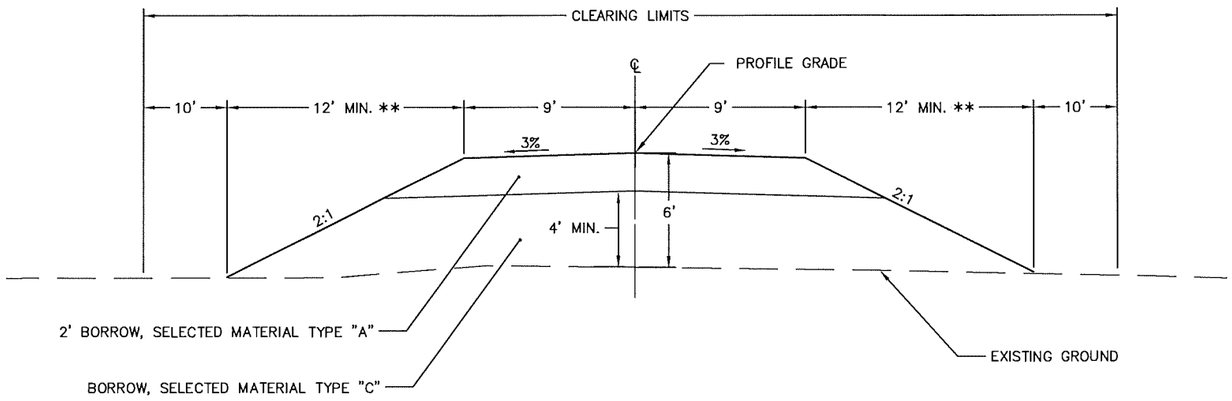
NOTES:

1. OPTION 2 CALCULATION INCLUDES 4 PULLOUTS TOTAL OF 0.2 A.C. FOR PERMANENT WETLANDS IMPACT AREA AND 1 A.C. FOR TEMPORARY WETLANDS IMPACT AREA.
2. OPTION 1, 5, AND 7 CALCULATION INCLUDES 4 PULLOUTS USING THE MEAN AVERAGE FROM OPTION 2.

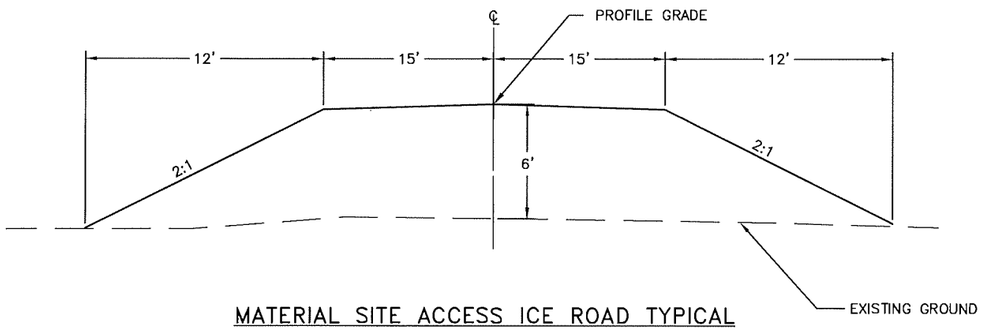
KIANA MATERIAL SITE ICE ROAD OPTIONS

OPTIONS	DIM.	SLOPE	MIN. FILL	WATER QUANTITY	PERMANENT WETLANDS IMPACT	TEMPORARY WETLANDS IMPACT
* OPTION 3	54' X 11819'	2:1	6'	28,720,170. U.S. GALLONS	NONE	NONE
* OPTION 4	54' X 12145'	2:1	6'	29,512,350. US GALLONS	NONE	NONE
* OPTION 6	54' X 10231'	2:1	6'	24,861,330. US GALLONS	NONE	NONE

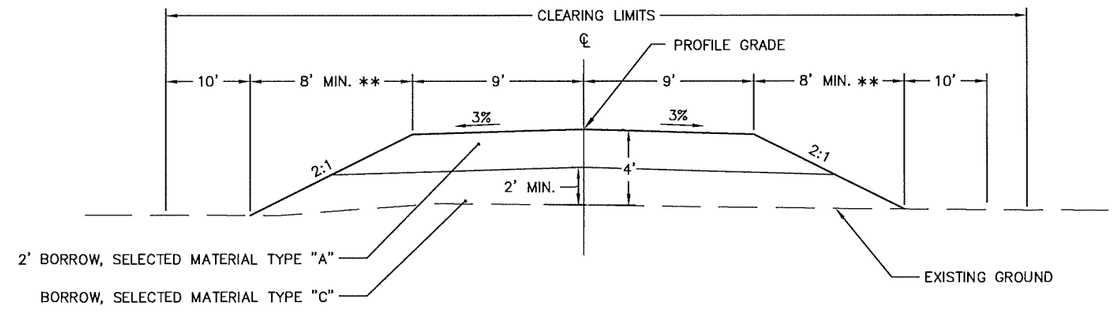
* MAX. ALLOWABLE GRADE 8% EXCEEDED.



MATERIAL SITE ACCESS ROAD TYPICAL SECTION: OPTION 1, 5, 7



MATERIAL SITE ACCESS ICE ROAD TYPICAL SECTION: OPTION 3, 4, 6



MATERIAL SITE ACCESS ROAD TYPICAL SECTION: OPTION 2

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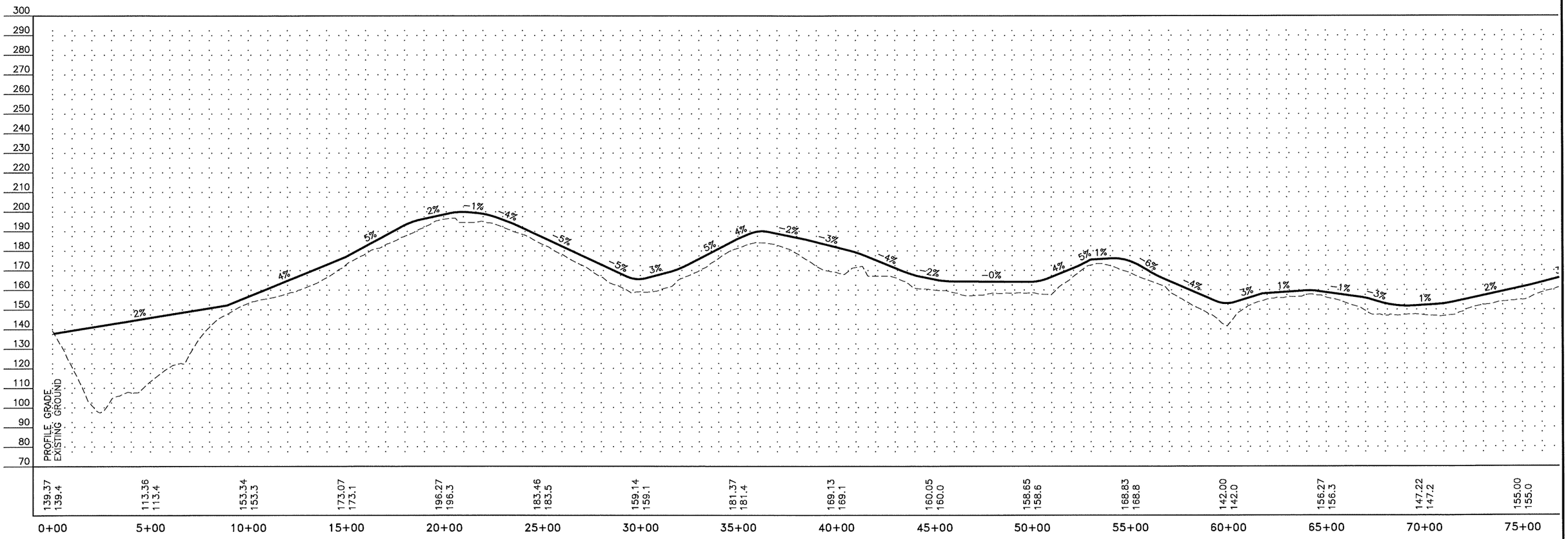
SHEET 3 OF 17

OPTION 1



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SHEET 4 OF 17

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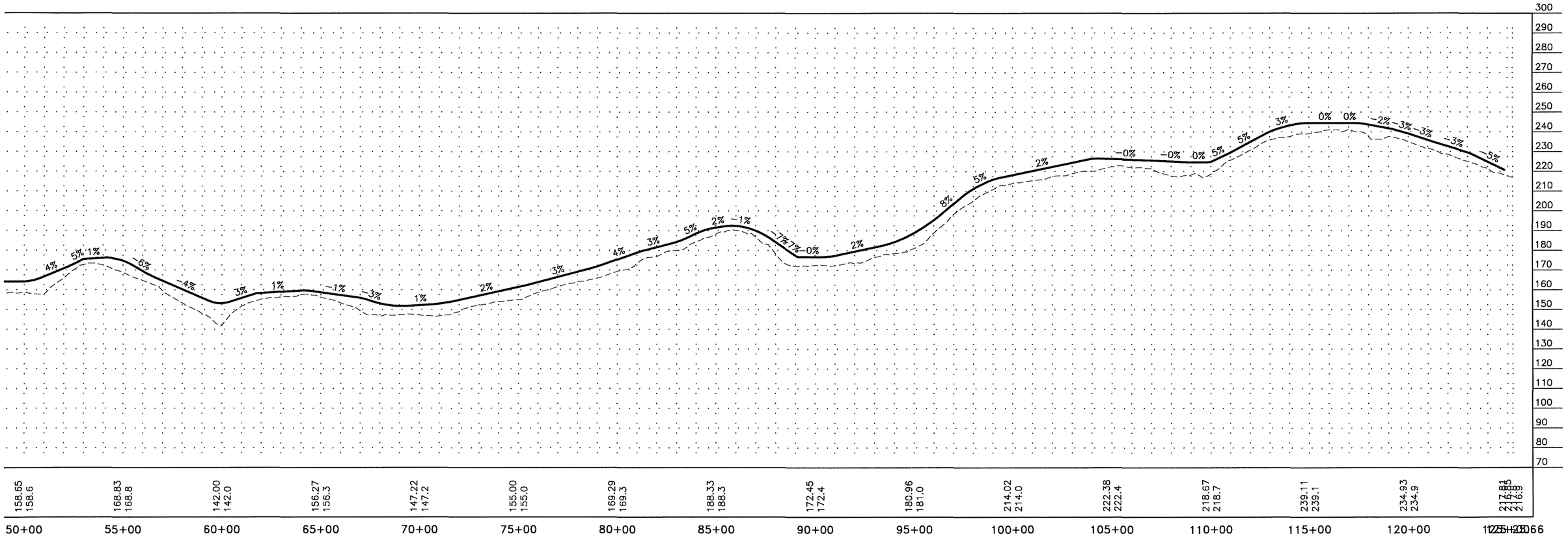
OPTION 1



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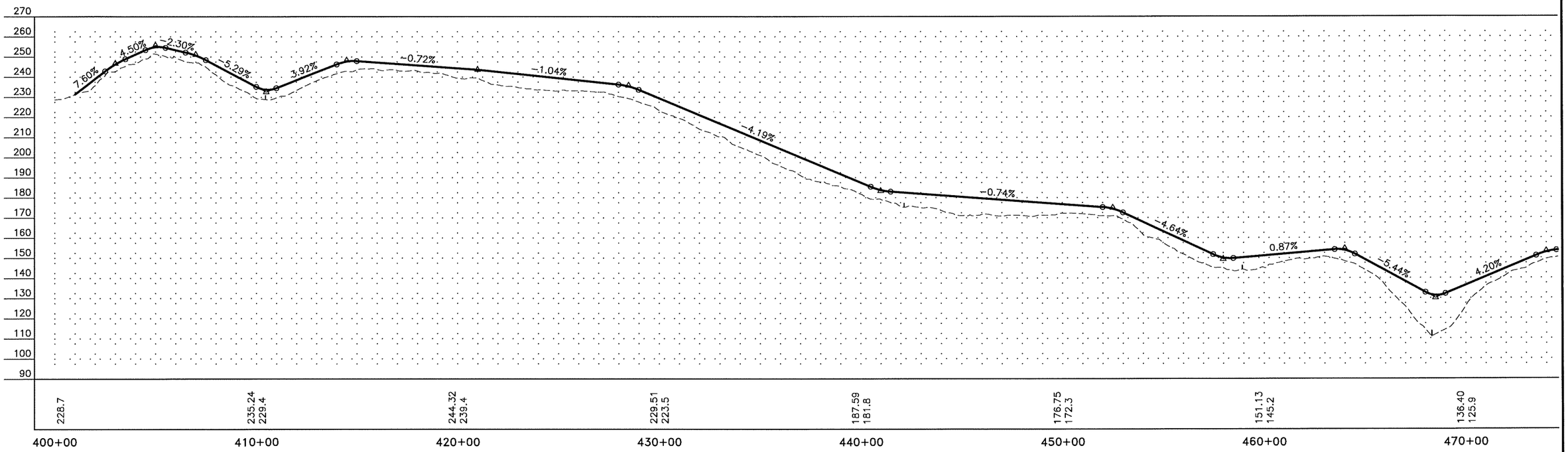
SHEET 5 OF 17

OPTION 2



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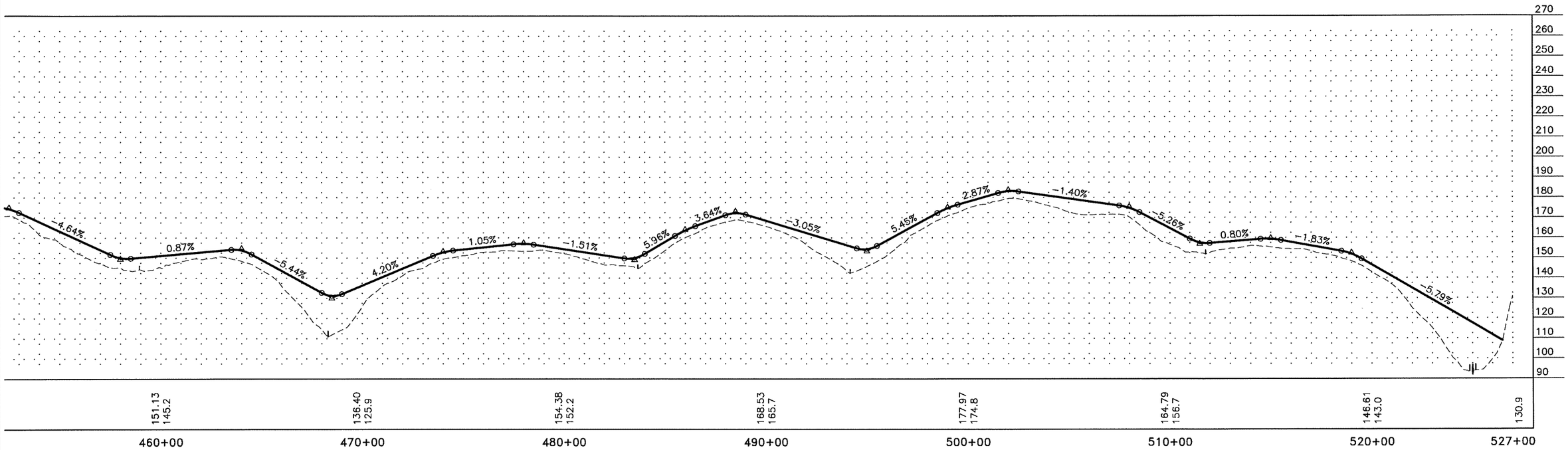
SHEET 6 OF 17

OPTION 2



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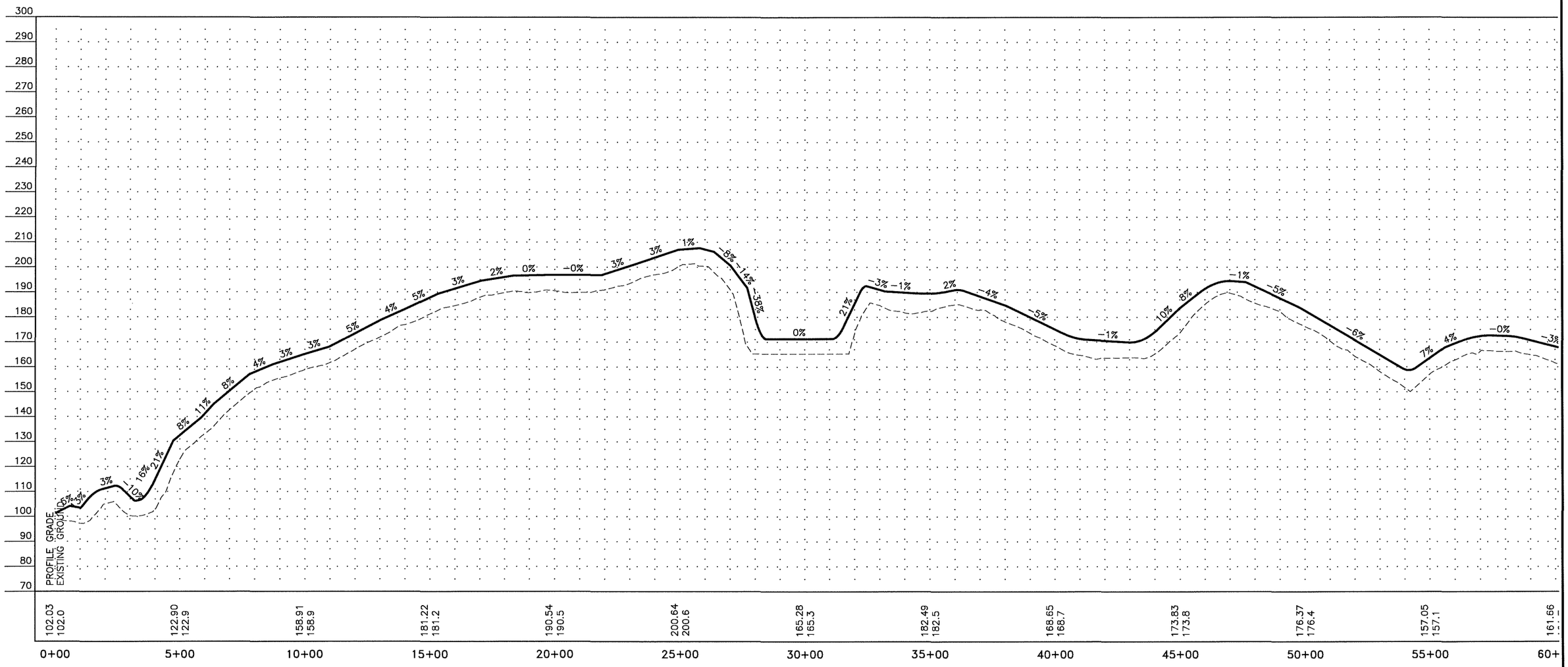
SHEET 7 OF 17

OPTION 3 ICE ROAD



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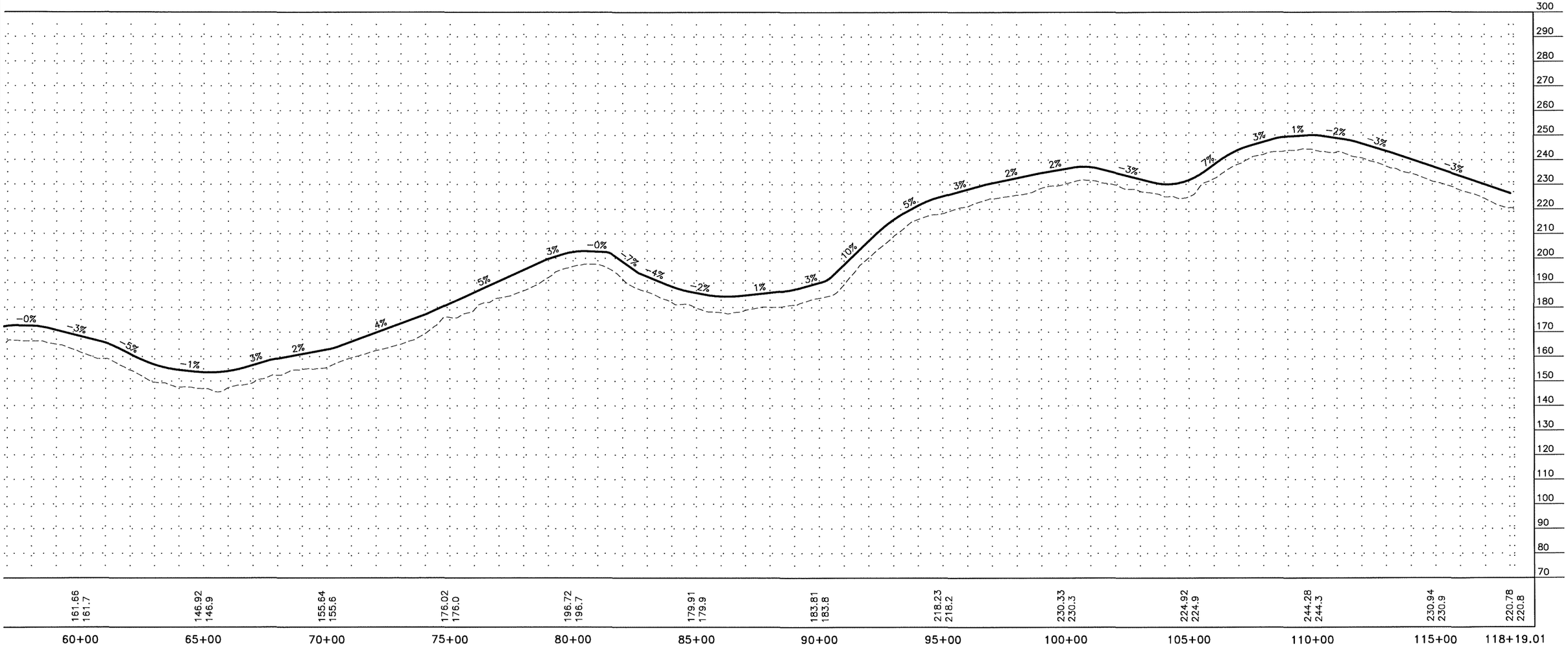
SHEET 8 OF 17

OPTION 3 ICE ROAD



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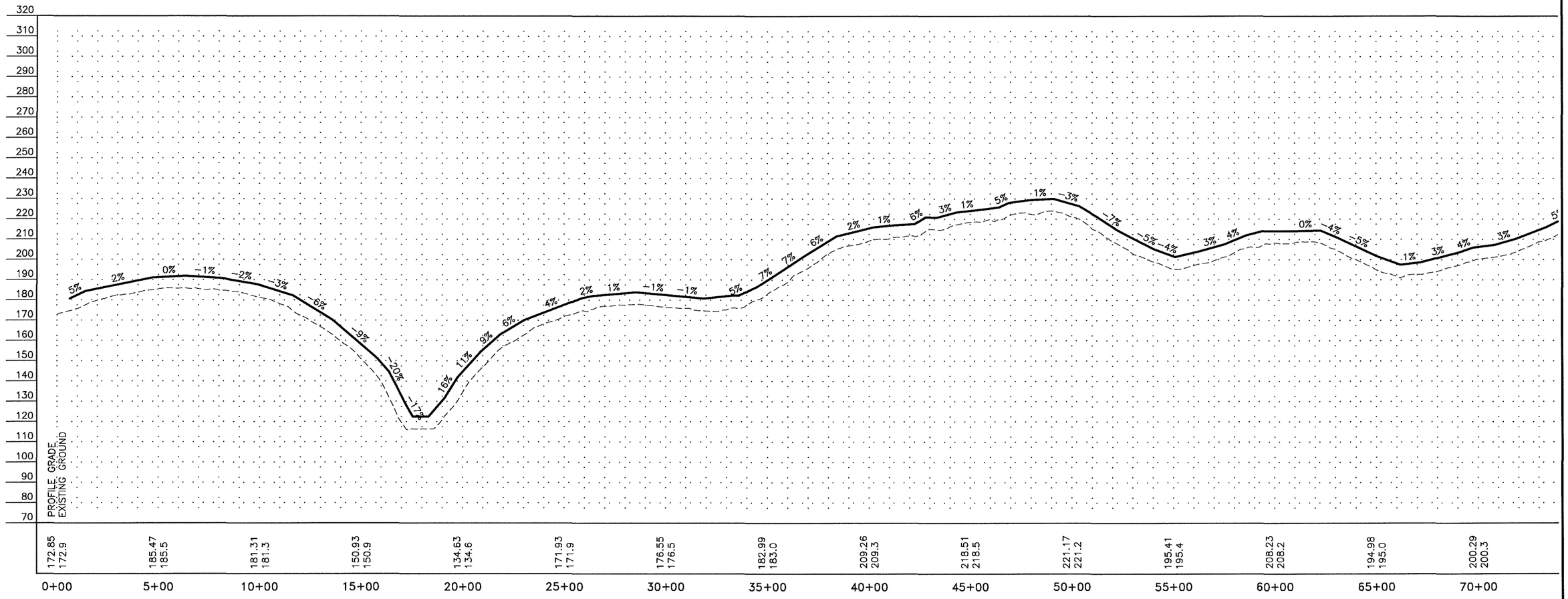
SHEET 9 OF 17

OPTION 4 ICE ROAD



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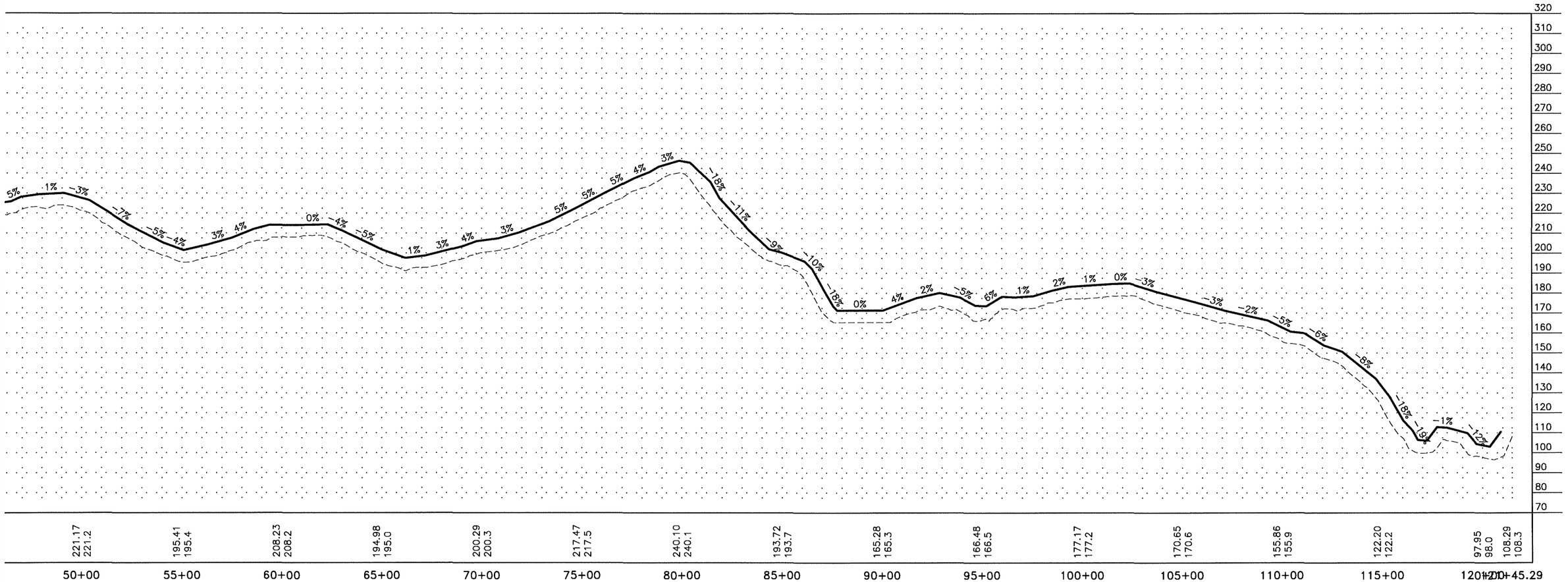
SHEET 10 OF 17

OPTION 4 ICE ROAD



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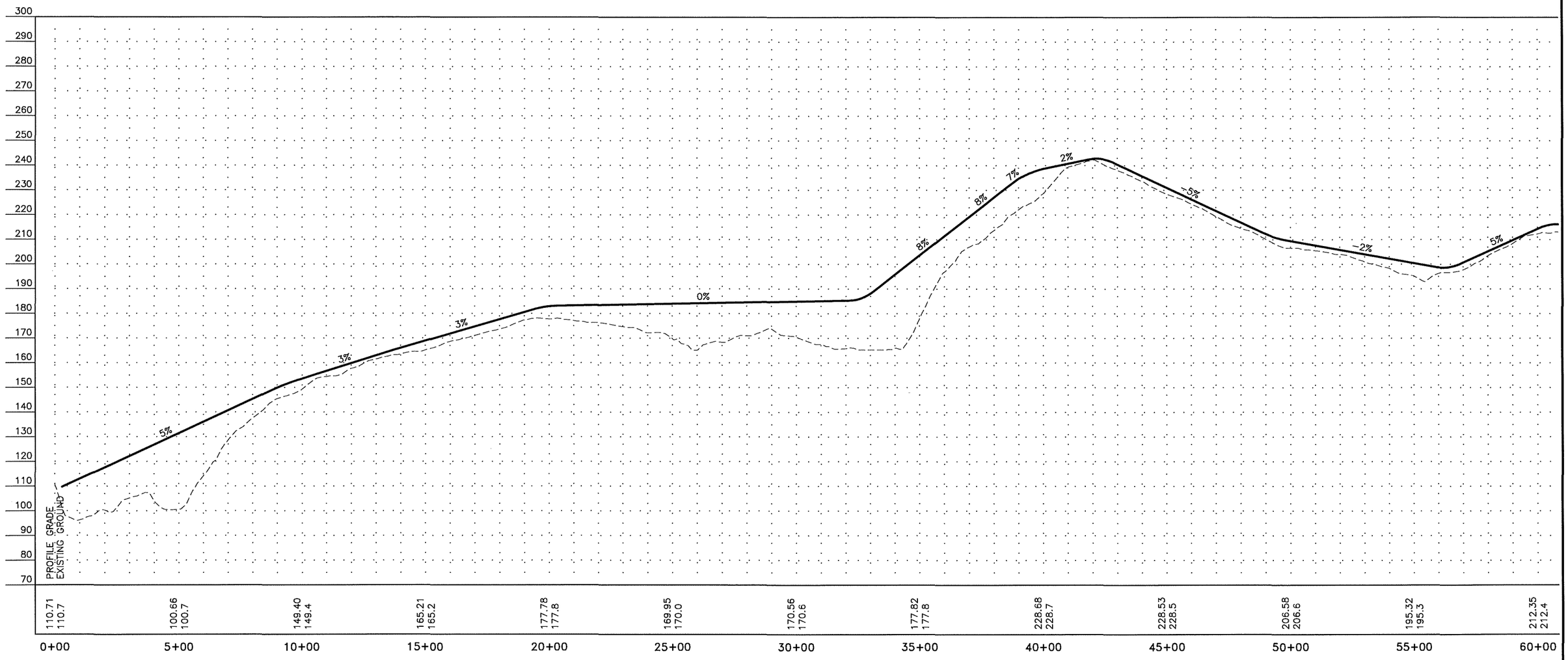
OPTION 5



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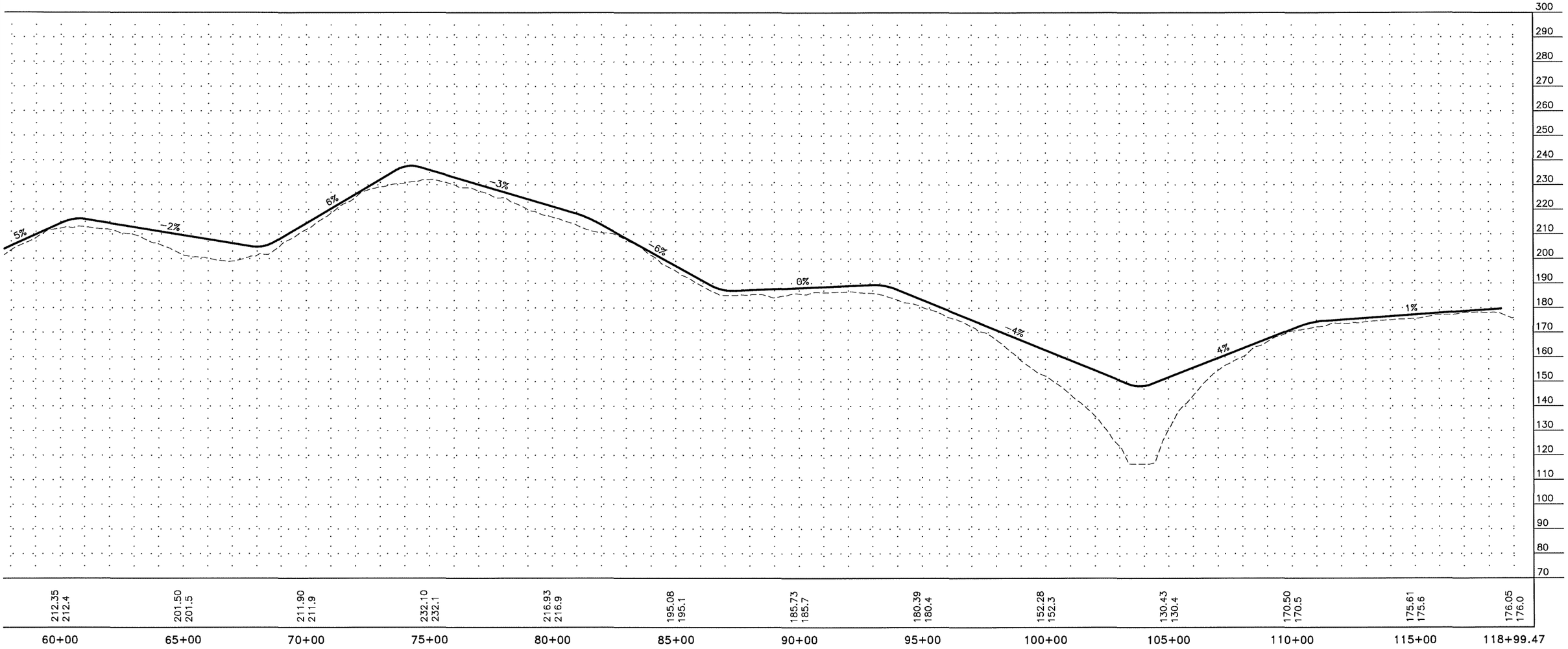
SHEET 12 OF 17

OPTION 5



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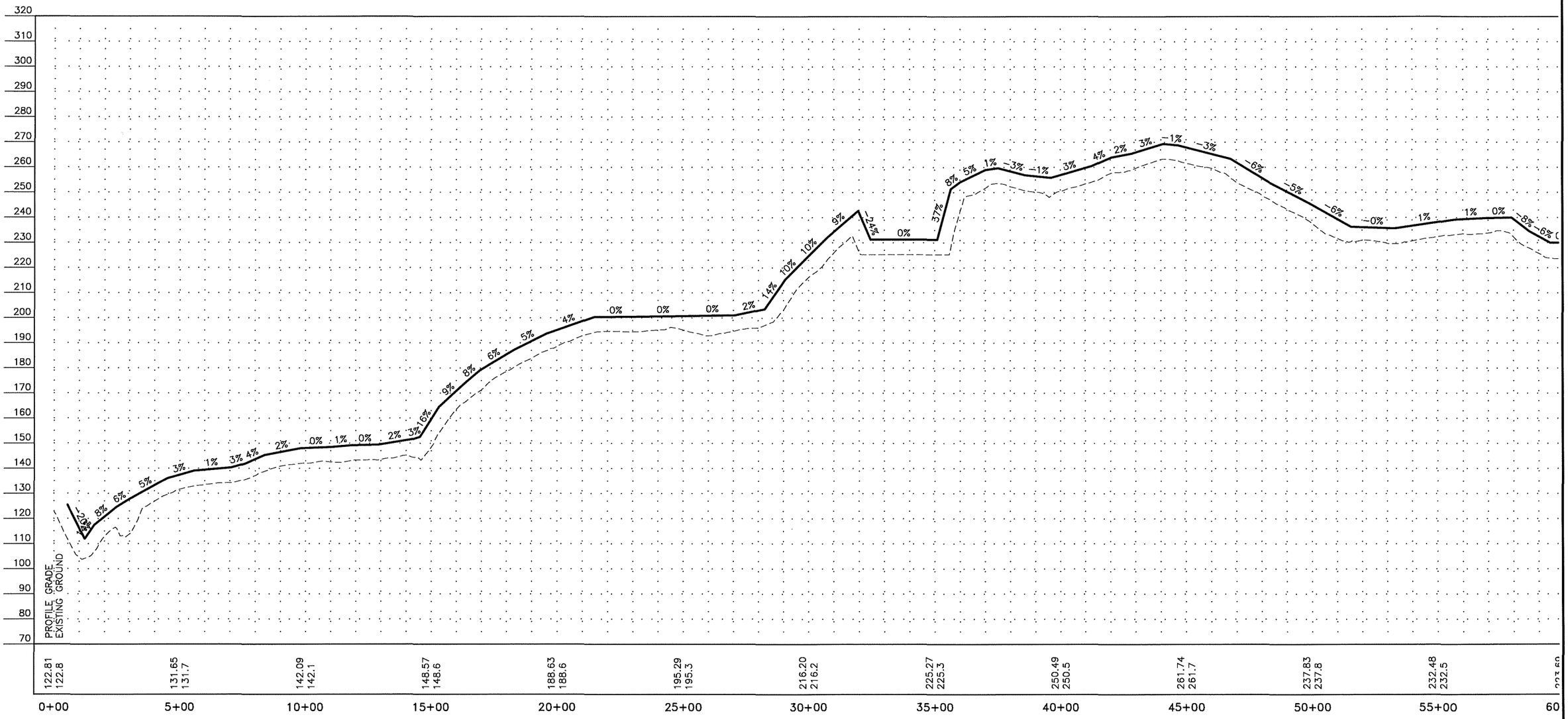
SHEET 13 OF 17

OPTION 6 ICE ROAD



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BY	DATE	REVISIONS

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KIANA AIRPORT IMPROVEMENTS
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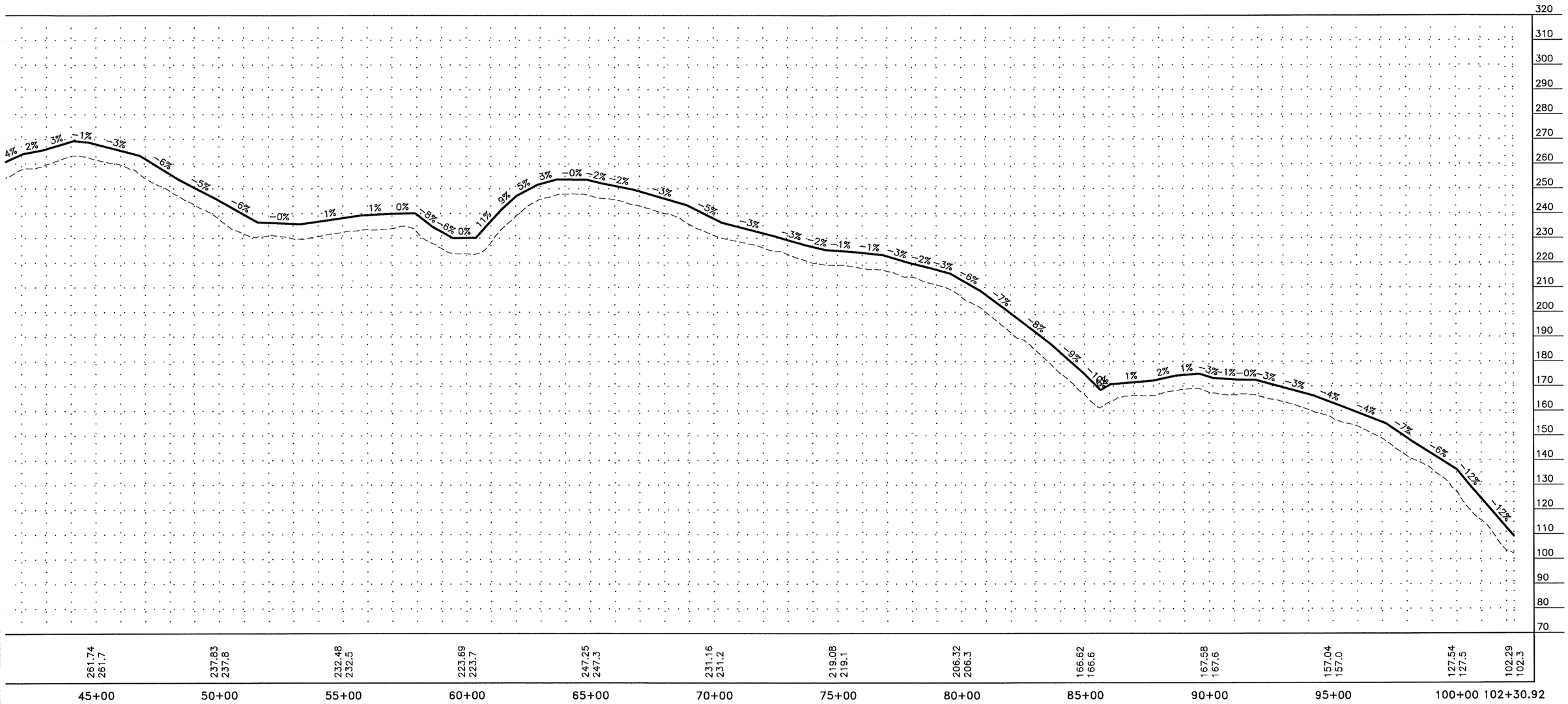
SHEET 14 OF 17

OPTION 6 ICE ROAD



DESIGN DAP
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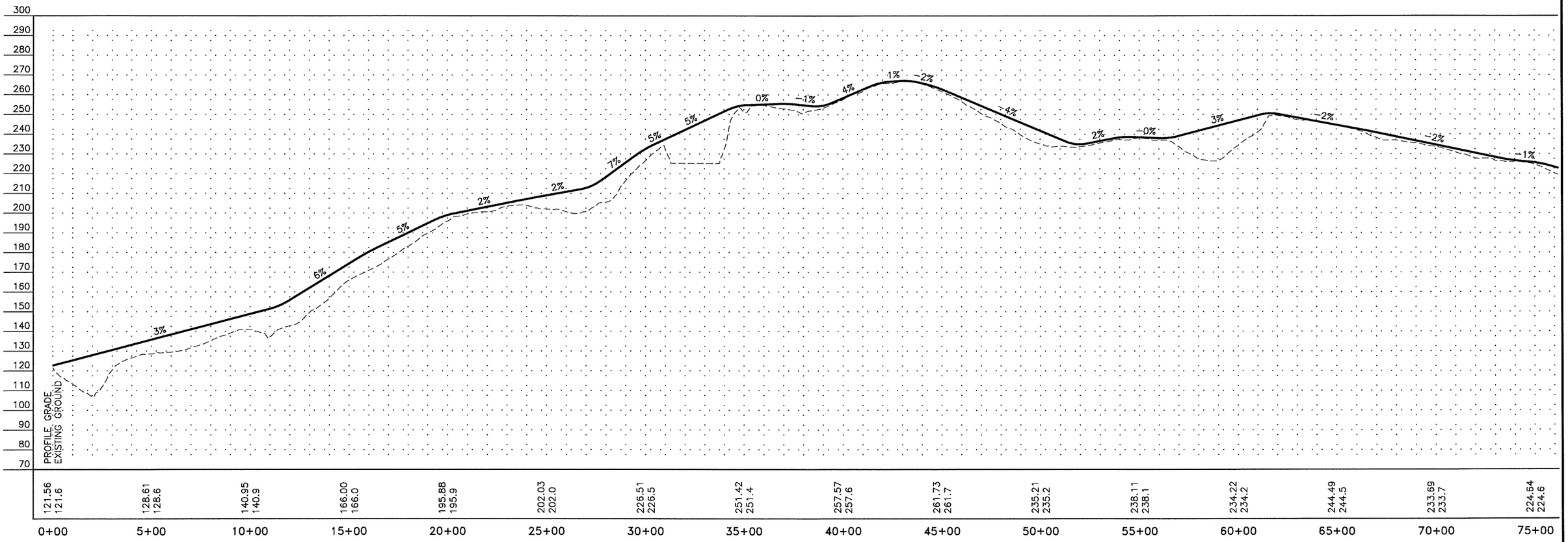
SHEET 15 OF 17

OPTION 7



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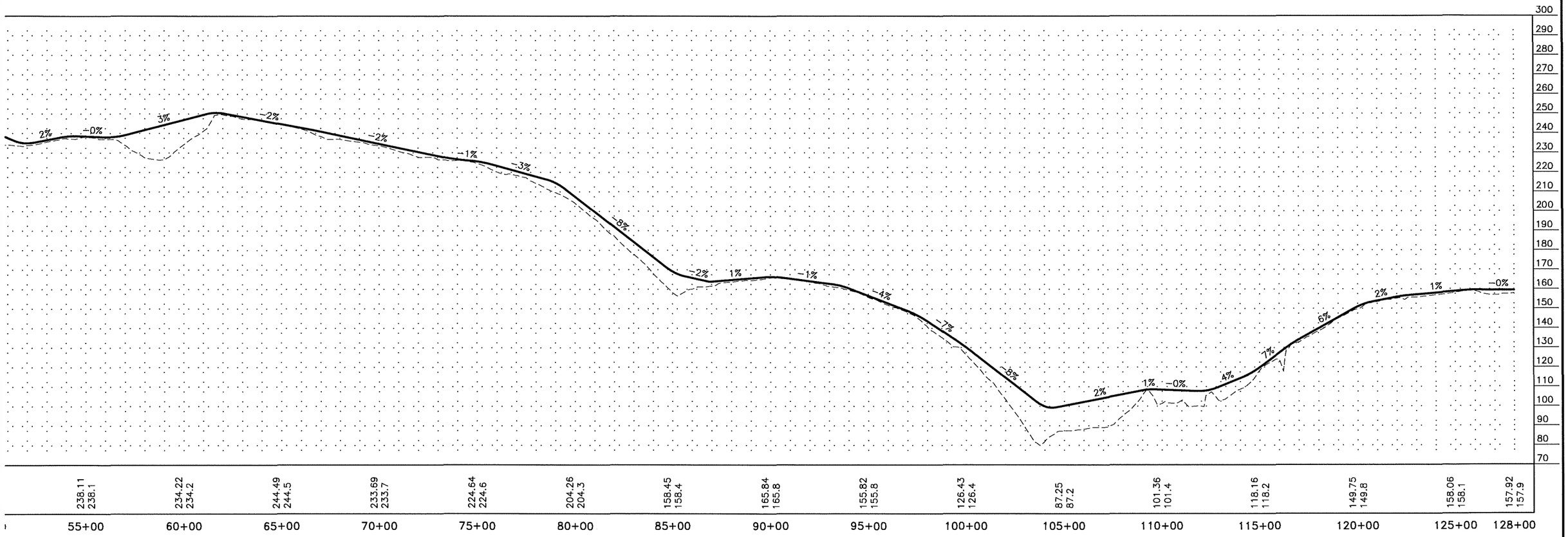
SHEET 16 OF 17

OPTION 7



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SHEET 17 OF 17