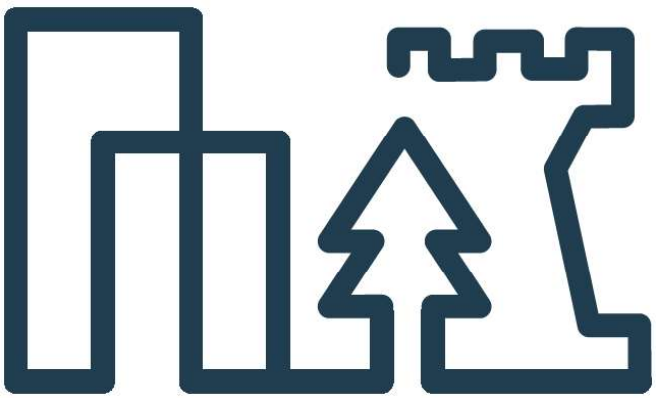
APPENDIX 5: ROAD RAISING CONCEPT DESIGN REPORT & DRAWINGS



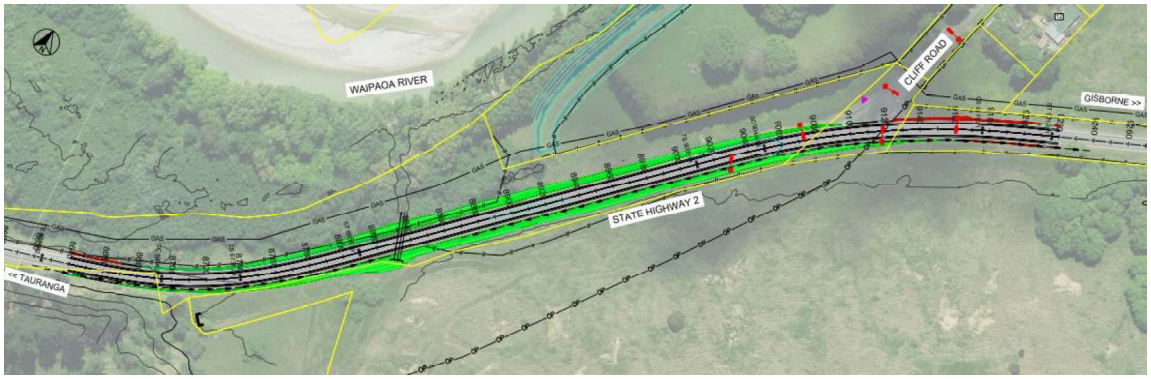
Project Number: 2-S5743.00

Te Karaka SH2 Road Raising Concept Design Report

Gisborne District Council

16 October 2025

CONFIDENTIAL



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Document Details:
Date: 31/03/2022
Status: First Issue

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Document History and Status

Revision	Date	Author	Reviewed by	Approved by	Status
1	15/10/2025	Romulo Silva	Glen Randall	Pete Sims	First Issue

Revision Details

Revision	Details
1	Initial Issue

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1 Background

WSP (the Consultant) has been engaged by Gisborne District Council (the Client) to conduct a geometric road analysis assessing the impacts on State Highway 2 (SH2) resulting from the proposed Te Karaka stopbank upgrade.

This document outlines WSP's initial concept design assumptions and identifies the key effects when considering raising SH2 at two locations to be in line with the proposed new stopbank levels.

2 Scope of Work

The following initial scope was proposed:

1. WSP to review the minimum design standards in both the Austroads Part 3: Geometric Design and Motsam guidelines to obtain maximum gradients and vertical curves so support the required vertical height changes at the following locations:
    i. Site 01 - RS406/8.900 – RS416/0.150
    ii. Site 02 - RS416/1.490 – RS416/1.66
    iii. Site 03 – Rangatira Road (excluded in this report)
2. WSP to prepare concept design plans showing the required work to achieve the new design levels. Plans to include a vertical profile together with cut/fill batter slopes which will allow for accurate quantity calculations when preparing a cost estimate. It is understood that the costing work will be undertaken by others.
3. The plans are to include the proposed extent of work to ensure the new road alignment ties in with the existing carriageway and to assess the potential impact on the Cliff Road intersection (Site 1).

At this stage, concept plans for Site 1 and Site 2 have been completed and to be reviewed by GDC before passing onto NZTA who is deemed to be the Road Controlling Authority and will be responsible for any decision making.

3 Existing Road Characteristics

3.1 Existing information

Legal Speed Limit	100km/h
Mean Operating Speed	92km/h
Personal Risk	Medium
Collective Risk	Medium
Infrastructure Risk Rating	Medium
ADT	1,316 vehicles per day
One Network Road Classification	Rural Connector

Table 3-1: Summary of Key Design Metrics

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3.2 Crash History

10-year crash history indicates small clusters at both site locations. Any alignment changes would need to try to ensure minor safety improvements within the design or at the minimum not resulting in new safety risks being introduced as a consequence of the project.

Figure 3-1 - Crash History

- 12 crashes, zero fatal, three serious and 2 minor injuries. Major crash type is loss of control on a bend (41%) followed by loss of control on a straight (33%). Travel speed accounts for 50% of all crashes recorded.
- 40% of drivers aged 15-19 and 40% aged 25-29. 40% of drivers operating on a restricted licence.
- No pedestrian or cyclist crashes.
- 75% of crashes occurred in Dark/Twilight conditions. 6 Crashes occurred between 6pm-9pm.
- Only 17% of crashes in wet conditions.
- All crashes were light vehicles, i.e. no trucks involved in crashes.
- 67% of crashes occurred on a weekend.

4 Survey Data

Gisborne District Council supplied approximately 500 meters of drone survey data for State Highway 2 (SH2) in the vicinity of the proposed stop bank upgrade, along with the designed stop bank surface. However, as the design extended beyond the area covered by the provided survey, it was necessary to obtain additional SH2 surface data from Land Information New Zealand (LINZ) as agreed with GDC. Furthermore, the alignment of the western stop bank on SH2 was modified during the design process. Therefore, the road raising design was carried in accordance with the client's guidance regarding both the alignment and elevation of the western stop bank.

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5 Design Guides and Assumptions

5.1 Design Guides

The following design guides have been used as a reference in undertaking the concept design:

1. Austroads Guide to Road Design Part 3 – Geometric Design, 2021
2. Motsam guidelines

5.2 Key Design Assumptions

The Austroads Guide outlines preferred parameters to achieve a conservative road design. However, site conditions may limit the feasibility of achieving all design parameters, which is not unusual.

Initially, the geometric assessment adopted the 'desirable' parameters, which resulted in increased fill volumes and additional work required to raise the State Highway 2. To balance constructability and safety, certain parameters, such as the K value for the crest vertical curve and minimum grade, were adjusted to the lower 'minimum' values permitted by the manual, without compromising safety.

5.2.1 Design Departure – K Value

Specifically, a K value of 110 was selected for the crest curve (as per Table 8.7: Minimum size crest vertical curve for sealed roads, S<L), rather than the 200–250 range suggested by the appearance criterion in Table 8.6.

5.2.2 Minimum Grade

The minimum grade of 0.3% was at the initial R.P for Site 01 to tie the new longitudinal section into the existing alignment and minimize the extent of fill. This adjustment does not impact drainage, as there are two existing culverts on the right-hand side of the road on this portion of SH2.

Further investigation and site surveys are strongly recommended to better understand local conditions; additional details are provided in Section 5 – Recommendations.

Error! Reference source not found. below shows a summary of the typical design metrics used w hen undertaking geometric design at concept stage.

Section	Description	Parameter
Section 8.5.3	Maximum Grade	4-6%
Section 8.5.4	Length of Grade	<450m
Section 8.5.6	Minimum Grade	0.3-1.0%
Section 8.6.3	Minimum K value	110
	Minimum Length of Curve	80-100%
	Minimum Grade change	0.4%
Table 8.9	Truck Stopping Sight Distance	K = 73
Figure 8.9	K Value for Sag Curve	K = 60

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Table 5-1: Summary of Key Design Metrics

6 Context and Recommendations

6.1 Site 01 - R.P. 8640 to R.P. 9220

Works on Site 01 are planned between R.P. 8640 and R.P. 9220. To achieve the required road elevation, a crest curve with a K value of 110 was incorporated, while two sag curves with K=60 were used at the ends to tie the new vertical alignment into the existing road. A -0.3% grade was selected to accommodate the first sag curve (K=60), however water flow can be effectively managed by the cross section gradient, which directs runoff either to the stream on the RHS or to the Waipoa River on LHS The proposed stop bank intersects SH2 at R.P. 8930 to match design levels.

Two culvert structures were identified from the site contours, the first, at R.P. 8710, is likely an access bridge, while the second, at R.P. 8830, is a standard culvert. The latter may be impacted by the proposed fill at its inlet, and its outlet could not be confirmed from aerial imagery. Accurate assessment of the impacts on the culvert inlet and outlet is currently limited, as the drone survey data lacks precision in areas obscured by vegetation. To fully understand the effects of raising the road and placing fill over the culvert, it is essential to obtain detailed information on the culvert's dimensions, inlet structure, invert and overt levels, type, and resistance class. This data is critical for evaluating how the proposed works may affect drainage and the long-term performance of the culvert.

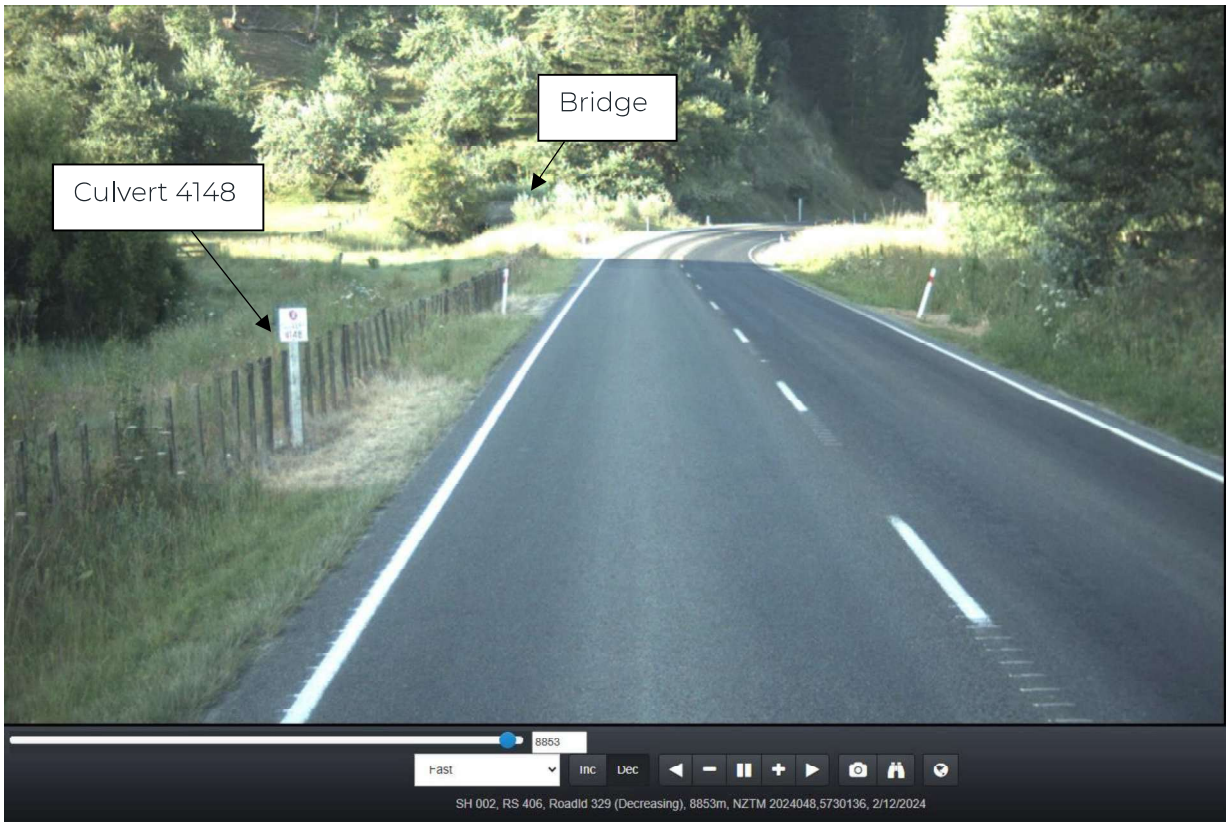

Figure 6-1 - Road Runner decreasing direction R.P.8853

Raising the SH2 at the proposed location will require filling over the drainage structure and may cause the batter to encroach on existing fences or LINZ property boundaries, potentially limiting space for side drains. Batters were designed with 4V:1V slope extending 1.85 meters beyond the shoulder, to ensure the slope is recoverable and enhances roadside safety. Changes in the gradient

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of existing side channels could also affect micro-drainage. Additionally, elevating the road may introduce risks associated with increased height, such as potential safety hazards for vehicles leaving the carriageway, which should be carefully considered during the design process. WSP recommend that a both stormwater assessment a side barrier assessment be carried out during preliminary design to ensure water flow paths and risk associated with increased road height are thoroughly understood and properly addressed in the design.

Alternatively, shifting the stop bank closer to Cliff Road would necessitate more extensive intersection works, which is likely to result in a sizable increase in construction costs. For this reason, WSP attempted to reduce the impact on the intersection as the finished road level is only 1100mm above the existing road level. Notwithstanding the reduced impact, the design does require some changes to existing streetlight poles, survey marks and overhead power cable crossing SH2 to Te Karaka.

Summary of Key Risks and their impact

	Low	Medium	High
Land Acquisition		X	
Changes to existing culverts	X		
Redesign of Cliff Road intersection	X		
Impact on Overhead Powerline	X		
Impact on Survey Marks	X		
Impact on Existing Buildings		X	
Side Barrier Requirement		X	

Table 6-1: Summary of Key Risks and their impact

6.2 Site 02 - R.P. 10360 to R.P. 10990

Works on Site 02 are planned between R.P. 10360 and R.P. 10990. To achieve the required road elevation, a crest curve with a K value of 150 was incorporated, while two sag curves with K=60 were used at the ends to tie the new vertical alignment into the existing road. The proposed stop bank intersects SH2 at R.P. 10680, and 3(three) accesses are present along the LHS of the section and 1 (one) on the RHS.

Additionally, four survey marks may be affected by the fill batters, and the overhead power cable at the stop bank section may need to be raised.

Raising the SH2 at the proposed location will require filling over the side drain on LHS and may cause the new batter slopes to encroach on existing fences or LINZ property boundaries, potentially limiting space for the reconstructing the side drain. Changes in the gradient of existing side drain could also affect micro-drainage.

The provided stop bank is currently passing through existing buildings and raising around 1.88m the most affected access, which will required discussion with landowner about the potential changes.

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6.3 Recommendations

Based on the initial investigations WSP are confident that uplifting the SH at these locations is possible without compromising existing geometry to the point that it would negatively impact on road safety. The project would result in reduced flooding of the road and this would significantly benefit the local community.

The designs have shown to be achievable, despite some local design issues which could be overcome as the designs progress. It is hoped that the plans are sufficiently detailed to allow for an accurate estimate to be undertaken in order to secure funding.

The concept design has identified several key risks associated with the proposed works. These risks can be effectively mitigated through the following actions:

- Engage proactively with NZTA to clarify their requirements and expectations for the affected road section.
- Consult with landowners to explore and negotiate alternative solutions different from land acquisition, aiming to minimize disruption and foster collaborative outcomes.
- Conduct detailed survey to accurately assess the potential impacts of the works on existing assets.
- Define and plan all associated works, including but not limited to intersection redesign, pavement design, and culvert improvements.

7 Schedule of Quantities

Table 7-1: Schedule of Quantities – Site 01

Item	Quantity	Unit
Fill Volume	9,345	m^3
Cut Volume	420	m^3
Pavement Surface 50mm Thick (TBC)	250	m^3
Basecourse 165mm Thick (TBC)	900	m^3
Subbase 200mm Thick (TBC)	1,280	m^3

Table 7-2: Schedule of Quantities – Site 02

Item	Quantity	Unit
Fill Volume	9,290	m^3
Cut Volume	490	m^3
Pavement Surface 50mm Thick (TBC)	285	m^3
Basecourse 165mm Thick (TBC)	1,040	m^3
Subbase 200mm Thick (TBC)	1,455	m^3

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PLAN VIEW

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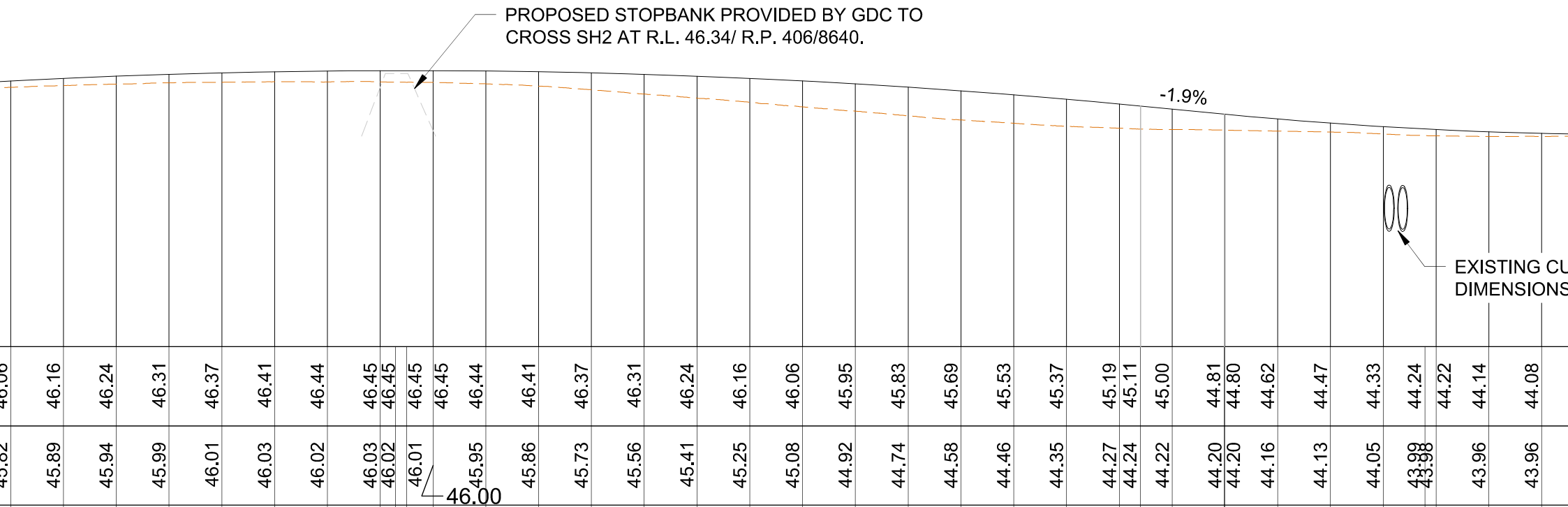

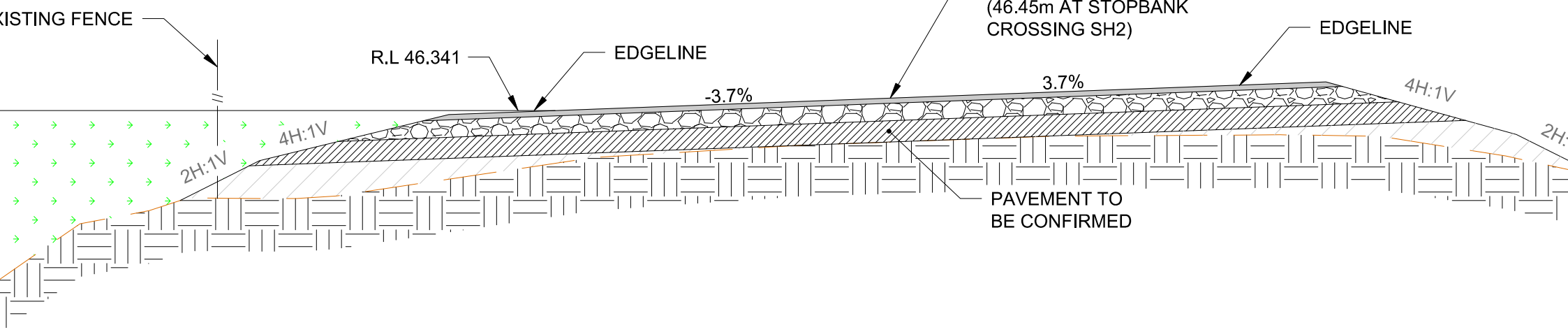

TYPICAL CROSS SECTION 01

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PLAN VIEW

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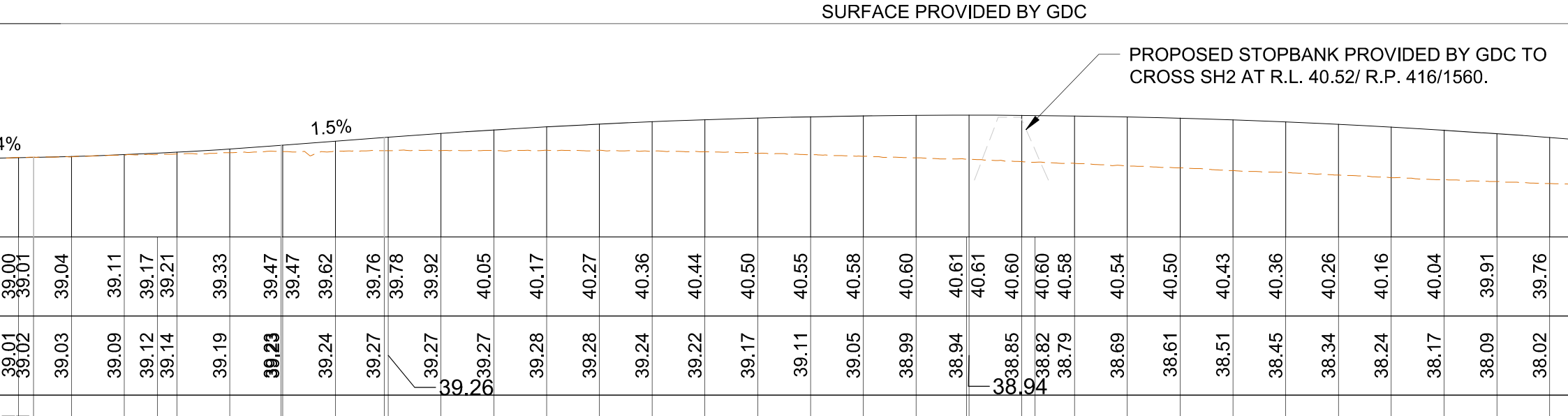
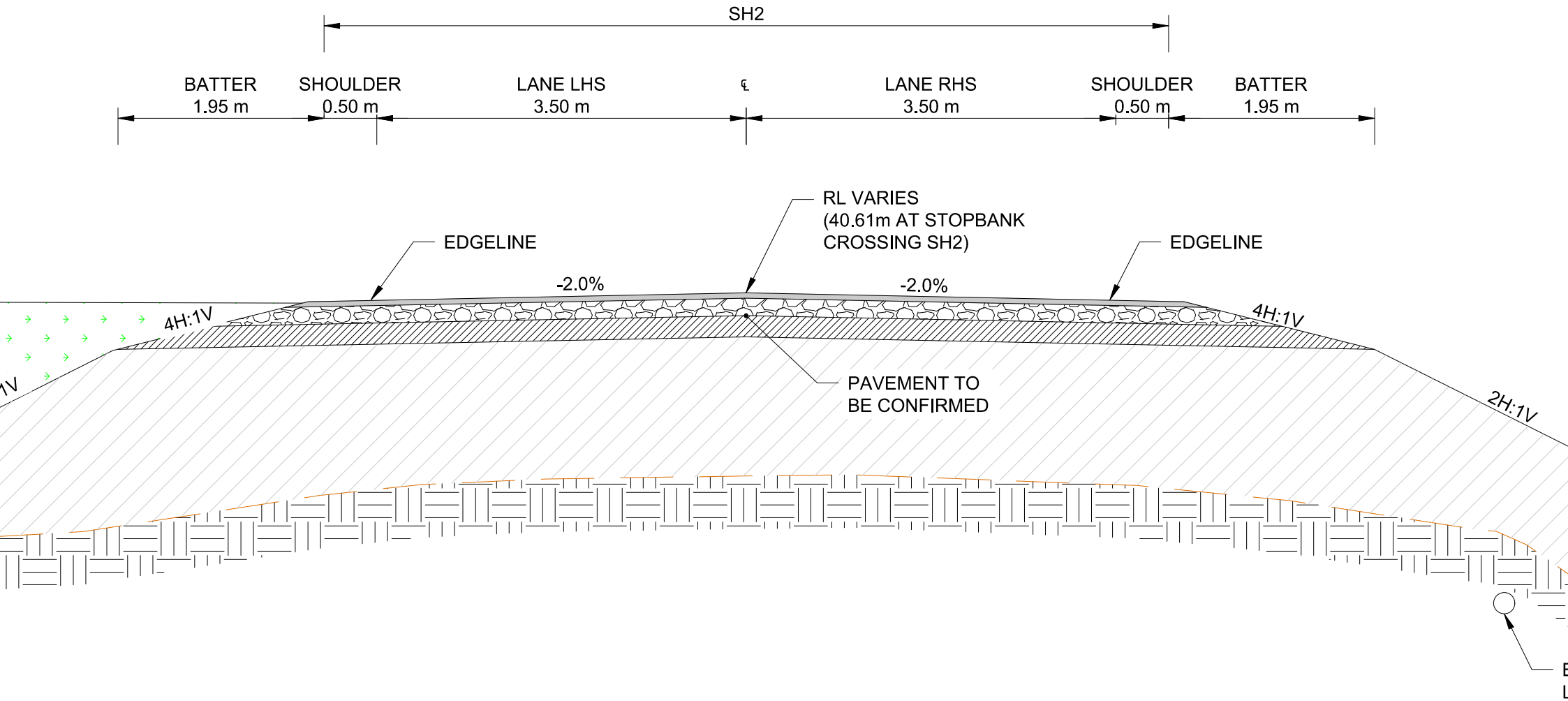
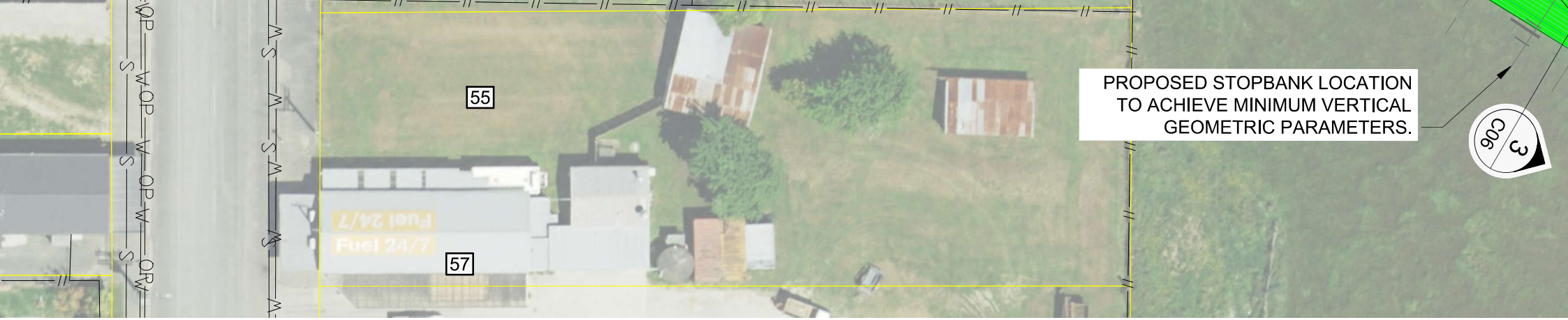



SH2
BATTER
1.95 m
SHOULDER
0.50 m
LANE LHS
3.50 m
℄
LANE RHS
3.50 m
SHOULDER
0.50 m
BATTER
1.95 m
RL VARIES
(40.61m AT STOPBANK
CROSSING SH2)
EDGELINE
EDGELINE
-2.0%
-2.0%
4H:1V
4H:1V
2H:1V
PAVEMENT TO
BE CONFIRMED



PLAN VIEW

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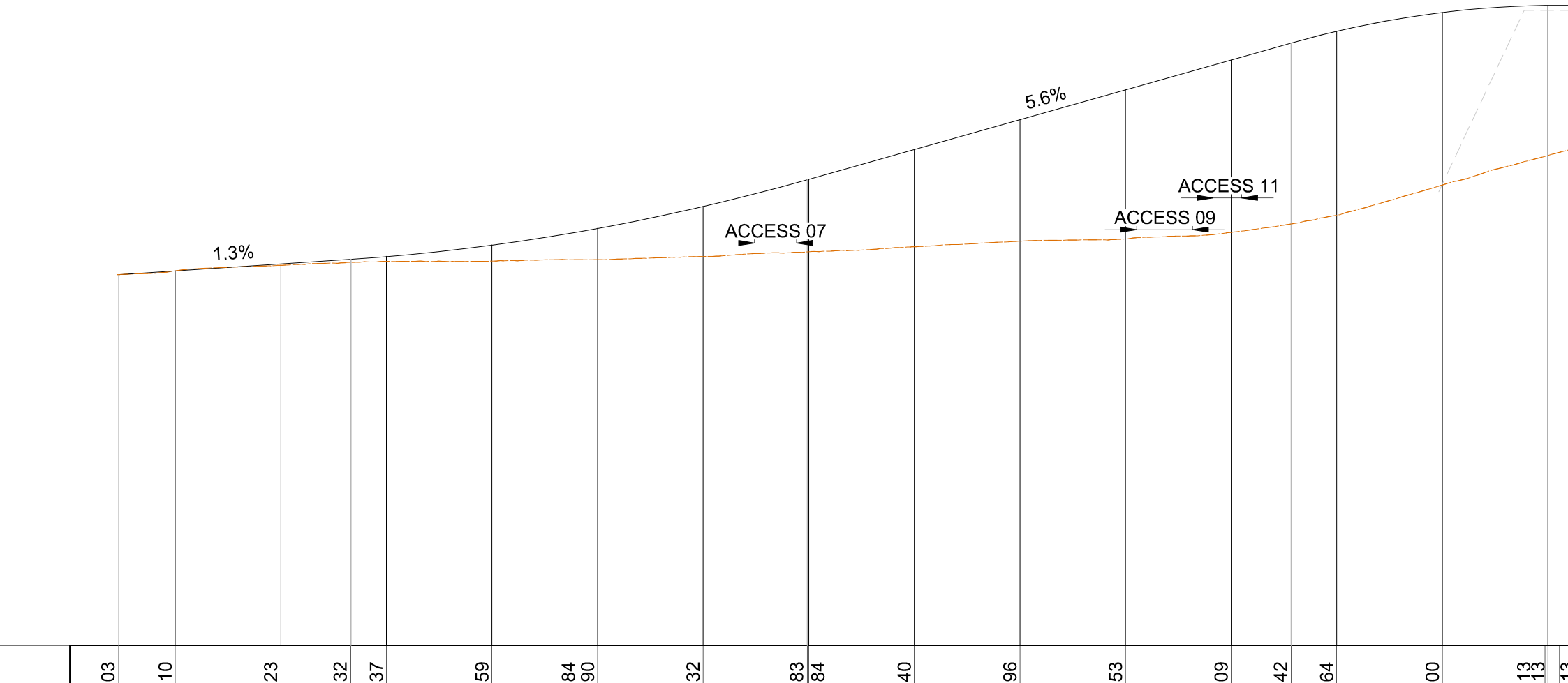

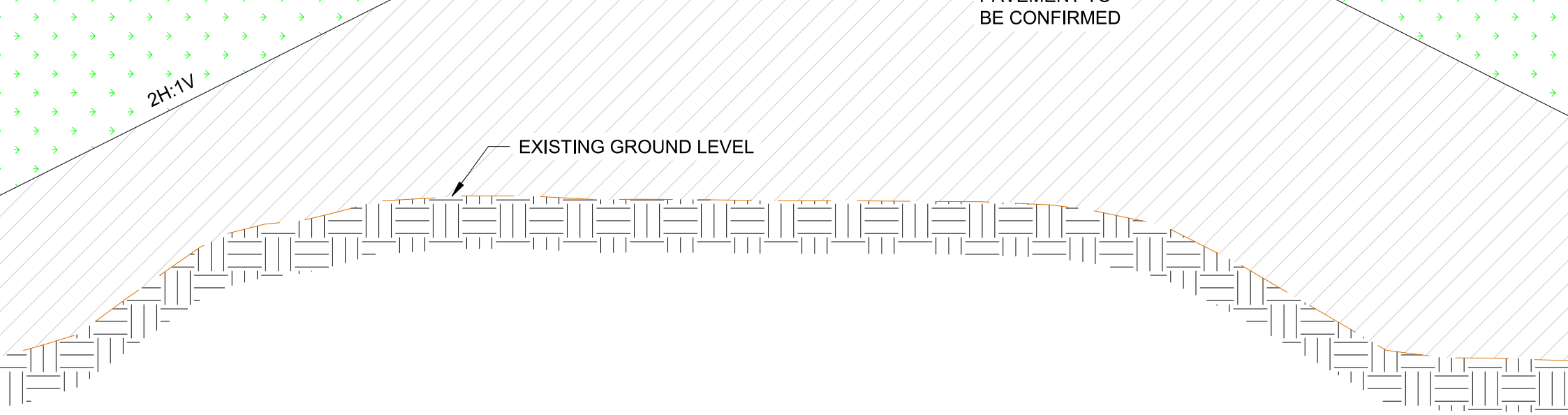

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