Technical Note

Enso Energy

June 2023

Southlands Solar Farm FRA Addendum

Project	Southlands Solar Farm FRA Updates
Project Number	P23_174
Title	Southlands Solar Farm FRA Addendum
Description	This technical note aims to address and overcome the objections to the FRA produced for this proposed solar farm development.
Prepared by	Sam Pucknell *(Senior Consultant)*
Reviewed by	Brett Park *(Principal Consultant)*
Date	23rd June 2023
Version	1.0

1 Introduction

1.1 Background

Wallingford HydroSolutions Ltd (WHS) has been commissioned by Enso Green Holdings J Ltd. ("the Applicant") to prepare an addendum to the previously prepared Flood Risk Assessment (FRA) and Outline Drainage Strategy (Document reference: WHS1973 Southlands Solar Farm FRA & Outline Drainage Strategy v2.0, 18th October 2022). The proposed site is solar farm located on land south of Runwell Road (A132), Runwell near Wickford, Essex (NGR: 576665, 194589).

This addendum aims to address and overcome the objections received from the Environment Agency (23/00285/FUL 12th May 2023).

1.2 Scope

To overcome the objection the following points will be addressed:

- Flood level data from the EA's detailed hydraulic model should be used to inform flood risk and confirm PV modules stowage height of 2m will be above modelled flood levels. Climate change uplift factors used in the hydraulic model for the key design events 1.0% and 0.1% AEPs (Annual Exceedance Probability) require updating.
- The Sequential Approach in the siting of the development should be applied. If development is in Flood Zones 2 or 3 the Exception Test must also be applied. It should be demonstrated that infrastructure can be provided above the flood level and remain operational.
- A topographic survey should be submitted.

1.3 Sources of Information

- Client supplied topographic survey[1]
- 2017 River Crouch 1D/2D hydraulic model[2]
- Client supplied Alternative Sites Assessment[3]
- Environment Agency published climate change factors[4]

[1] Topographic Survey Rayleigh Site 3 (drawing no. TX1402_RAY 3_T_01 to T_06). Texo DSI, August 2022. Available as Appendix A.
[2] River Crouch Fluvial Flood Model. Ch2m prepared for Environment Agency, May 2017.
[3] Planning Statement, Appendix 2- Alternative Sites Assessment. Enso Energy, March 2023.
[4] Peak river flow allowances available from: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

2 Detailed Hydraulic Model Flood Data

2.1 Available detailed model

A data request was submitted to the EA and a hydraulic model for the River Crouch[5] was supplied which runs along the southern boundary of the site. This model informs Flood Zones 2 and 3 associated with the river. No detailed model data was held for the tributary that runs through the site. The 2017 model applies Climate Change (CC) factors to the 1.0% and 0.1% AEP events, but these have since been updated in 2022. Therefore, the model has been revised and rerun to determine the flood depths with the latest CC uplift factors. A review of the model inputs and results provided shows that Flood Zone 3 is based on the 'Baseline' (with defences) 1.0% AEP model run and Flood Zone 2 is based on the 'Undefended' 0.1% AEP model run (the worst-case scenario run).

2.2 Latest climate change uplift factors

For essential development within Flood Zone 3 the higher central allowance should be applied to peak river flows[6]. In the Anglian River Basin District and Combined Essex Management Catchment, the 2080s higher central allowance is 38%. Therefore, this CC uplift factor needs to be applied to the 1.0% and 0.1% AEP events.

2.3 Model rerun

CC is applied within the River Crouch model by applying the uplift to the hydrograph scaling factor in all of the ReFH boundaries (excluding boundary CR13a which is fixed). With no climate change uplift this value is set to 0.50. Therefore, for a 38% uplift this value has been increase to 0.69 in the updated CC runs. The model was rerun in Flood Modeller version 6.0 and TUFLOW version 2020-10-AE for the 1.0% AEP + 38% CC and 0.1% AEP + 38% CC flood scenarios. In addition to the above modification made to the event files the following changes were made for the model simulations to run through fully:

Table 1 - Model changes

Model Run	Modification	Impact
All	File paths updated to native drive from which model was rerun.	None
Baseline (defended) 1.0% AEP + CC	A Z flag was applied to the SX link at E:568374, N:190906 to prevent an error message (lowest ZC elevation along SX link above 1D node bed) causing the model to end during setup. This was within the Laindon portion of the model approximately 10km upstream of the site.	Negligible
Undefended 0.1% AEP + CC	A Z flag was applied to the SX link at E:574279, N:191470 to prevent an error message (lowest ZC elevation along SX link above 1D node bed) causing the model to end during setup. This was within the Wickford portion of the model approximately 4km upstream of the site.	Negligible
	An error was flagged which involved a 2D connection to a 1D node that didn't exist. The 1D node in question was an out of bank downstream boundary approximately 10km upstream of the site. The boundary is present in the baseline model so was copied and added to the undefended model to resolve the error. The provided simulation files indicate a slightly newer version of the 1D model was used but this was not provided within the model package hence the update.	Negligible

The resulting maximum flood depth plots are shown below with the site layout and boundary for context.

[5] River Crouch Fluvial Flood Model. Ch2m prepared for Environment Agency, May 2017.
[6] Peak river flow allowances available from: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

To verify the modifications made to the model are negligible, the 0.1% AEP undefended scenario with no climate change was rerun. As this was used to inform Flood Zone 2 the flood extent should show a good match, see Figure 1. The flood extent overlaps with a very minimal difference in border thus demonstrating that the changes made have had a negligible impact at the location of interest.

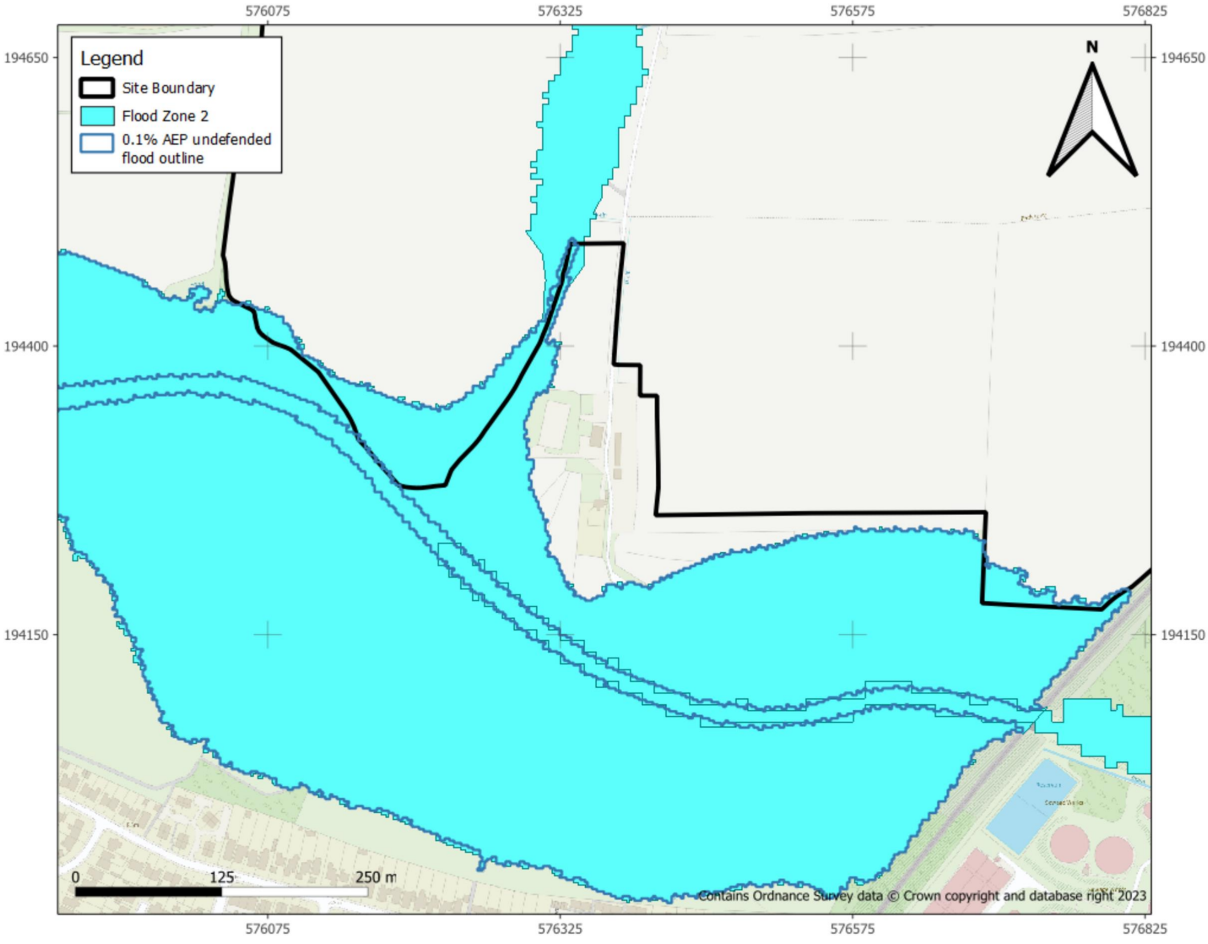


Figure 1 - 0.1% AEP rerun flood outline vs Flood Zone 2

2.4 100yr plus climate change flood depths

Figure 2 below shows the maximum flood depths associated with the 1.0% AEP flood event including a 38% climate change uplift factor.

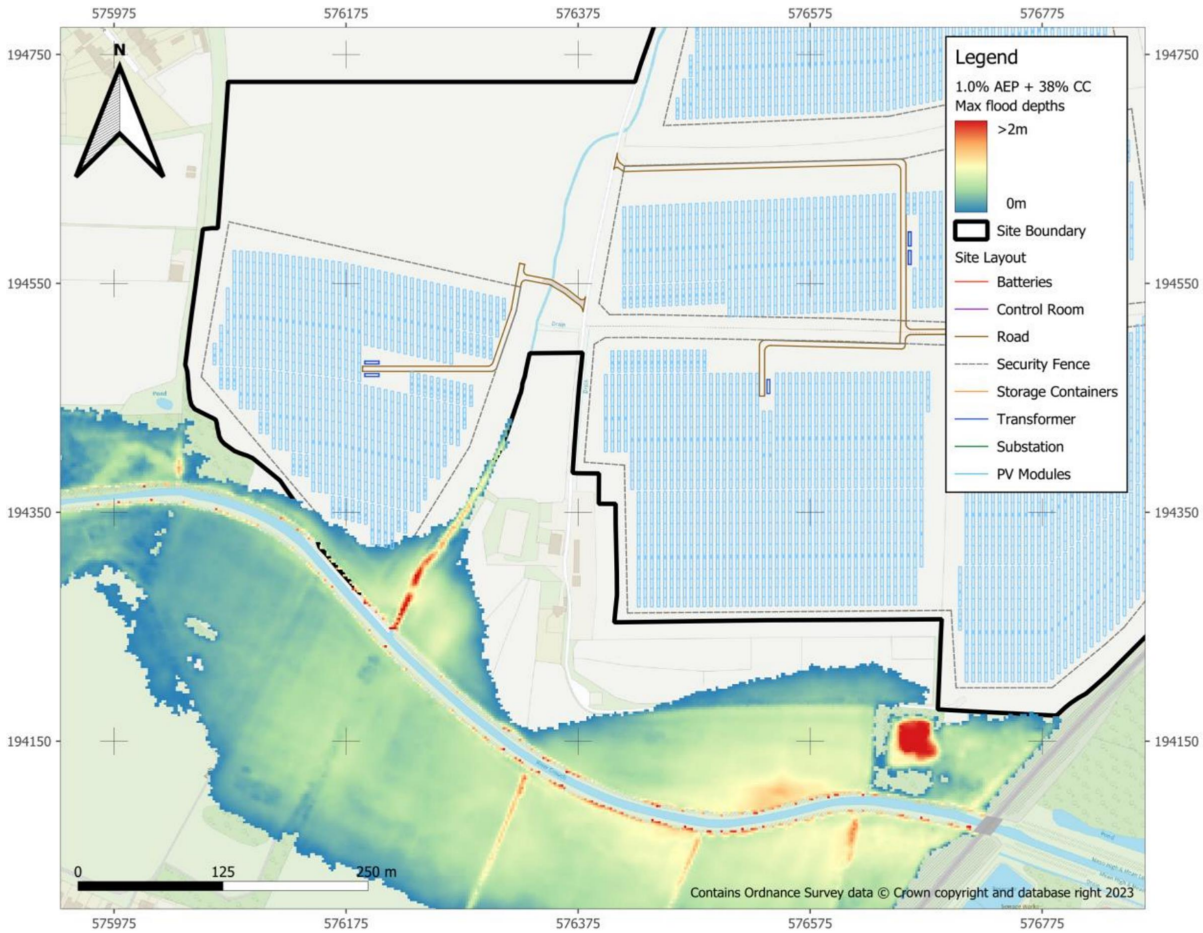


Figure 2 - 1.0% AEP + 38% climate change max flood depths (defended)

The maximum flood depth within the vicinity of the PV modules on the west side portion of the site is 0.15m. No PV modules are flooded on the east side. Therefore, for this design event the panel stowage height of 2.0m is sufficiently high enough to be above the flood level and provides a freeboard of 1.85m.

2.5 1000yr plus climate change flood depths

Figure 3 below shows the maximum flood depths associated with the 0.1% AEP flood event including a 38% climate change uplift factor.

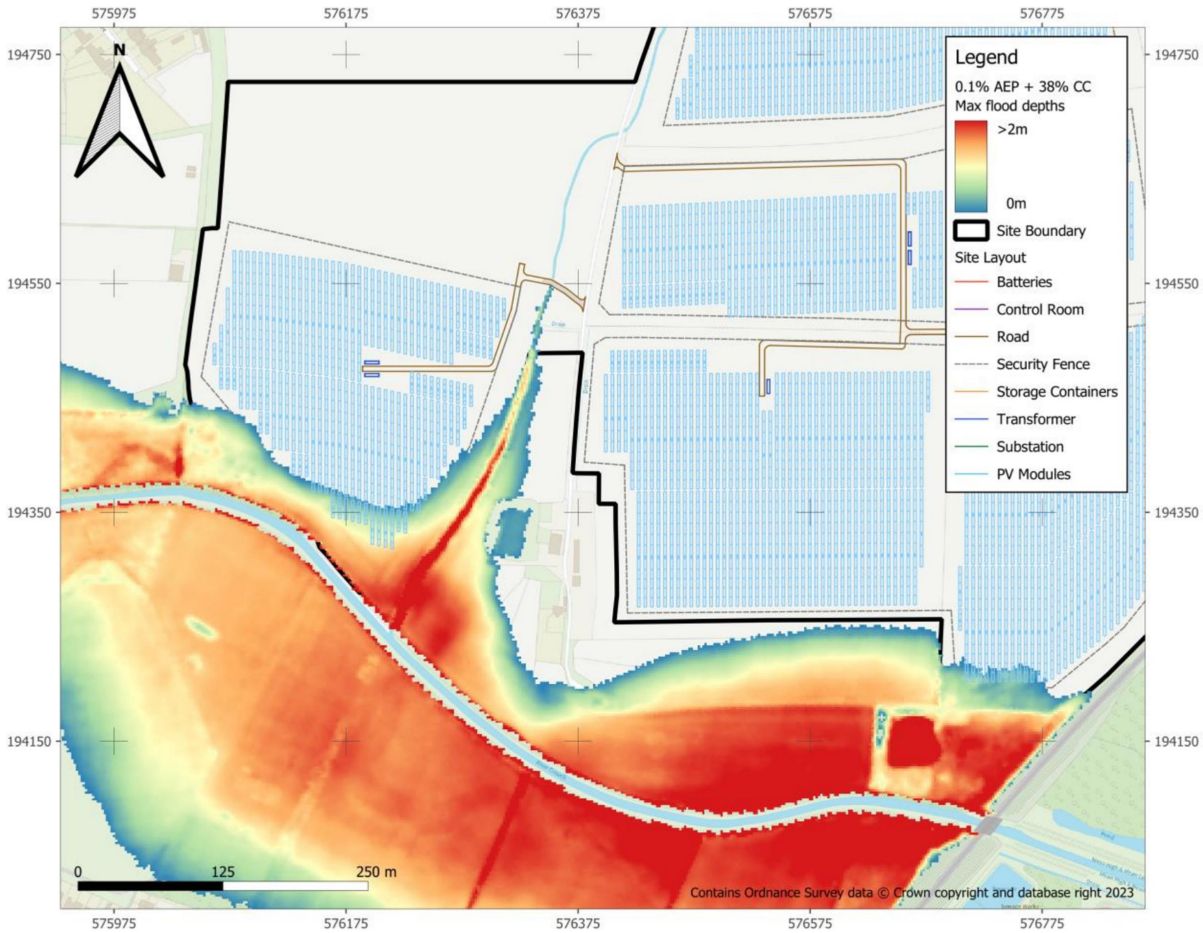


Figure 3 - 0.1% AEP + 38% climate change max flood depths (defended)

The maximum flood depth within the vicinity of the PV modules on the west portion of the site is 1.35m. In the east portion of the site the maximum flood depth within the vicinity of the PV modules is 0.60m. Therefore, for this design event the panel stowage height of 2.0m is sufficiently high enough to be above the flood level and provides a freeboard of at least 0.65m.

A 0.1% AEP +38% CC undefended scenario was also run as a sensitivity test to understand the impact of removing the upstream defences on the flood levels here. In this scenario the maximum flood depth in the vicinity of the PV modules was 1.50m. This is still below the stowage height but reduces the freeboard slightly to 0.50m.

In either scenario (100yr+cc or 1000yr+cc), the solar farm would remain safe and operational, and not lead to any negative impact outwith the site.

3 PV Panel Elevations

The proposed PV panels will have the ability to rotate around their centre to maximise their efficiency throughout the day. This has the advantage of being able to be stored horizontally as required, providing 2m of clearance above local ground levels, Figure 4.

During extreme flood events the PV panels will be stored horizontally, thus providing the freeboard identified in Section 2.4 and 2.5.

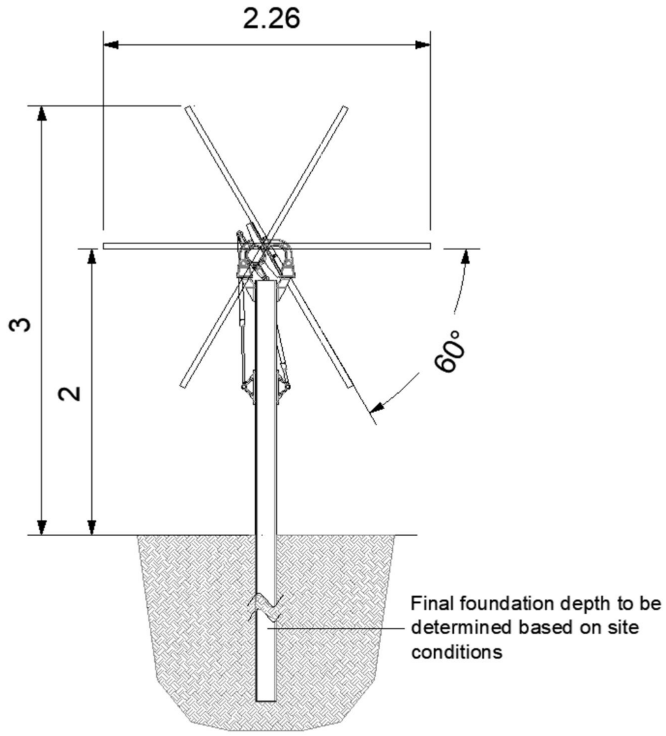


Figure 4 – Elevation View of proposed PV Panels

4 Sequential and Exception Tests

4.1 Sequential Test

The site is located in Flood Zone 2 and 3 and therefore the sequential test needs to be carried out which justifies its location. An Alternative Sites Assessment[7] (Appendix 2 of the Planning Statement) was prepared by the client which reviewed multiple other sites based on a number of parameters on a scoring system. This included factors such as land availability, size, topography, ecology and flood risk. Ultimately the assessment concluded there was not a suitable available alternative site.

Upon development of the site layout within the boundary the Flood Zones were considered and the layout sequentially developed accordingly. All critical infrastructure at ground level including batteries, the control room, storage containers, transformers and the substation were located in Flood Zone 1 only. Due to the large number of PV modules and the space requirements some were located in Flood Zone 3. The panels can return to a stowage height of 2m; this is above the very worst case flood level and the equipment will not be damaged. Sufficient protection will also be provided to the connecting cables, which are waterproof.

The sequential approach has therefore been taken on a site scale as well as the development layout.

4.2 Exception Test

As the site is 'essential infrastructure' located in Flood Zone 3 the exception test must be completed. This test must demonstrate the following:

- The sustainability benefits of the development to the community outweigh the flood risk.
- The development will be safe for its lifetime taking into account the vulnerability of its users and that it won't increase flood risk elsewhere.

The proposed solar farm will provide an additional, urgently required, source of renewable energy and storage capacity to support the UK's goal to decarbonise all sectors and meet the net zero target by 2050. Flood risk to the solar farm is relatively small due to the sequential placement of equipment and the design height of solar panels on the site meaning the solar farm is sufficiently protected. The sustainability benefits therefore significantly outweigh the minor flood risk, which has been mitigated throguh design.

Key infrastructure has been placed outside of the Flood Zones with the exclusions of a small number of PV modules and an access track. The PV modules will return to a stowage height of 2m which is above the 0.1% AEP scenario flood level including the latest climate change uplift factor, as demonstrated in section 2. The panels will therefore not negatively impact flood mechanisms here by taking flood water storage space. The metal framework upon which the panels are placed will not impeed the flow of water. The access track will be permeable and at grade and therefore will not impede or impact flooding here. During an extreme flood event, users of the site (which will be infrequent) will not access the southwestern portion of the site and will evacuate to the east side of the site. The placement of the infrastructure and panel raising will therefore ensure there is no increase in flood risk elsewhere.

[7] Planning Statement, Appendix 2- Alternative Sites Assessment. Enso Energy, March 2023.

5 Topographic Survey

A topographic survey[8] was commissioned by the client as part of the planning application, this is available as Appendix A of this technical note. This has been compared with the 1m LiDAR data used to review topography in the FRA to confirm a good match. LiDAR typically has an accuracy of ±150mm. Several spot checks were conducted across the site with particular focus on the southwestern corner in the flood zones, see Figure 5. All comparisons were favourable, see Table 2, and showed a difference no greater than ±100mm. Therefore, the topographic survey and LiDAR are considered to be suitably accurate for use.

Table 2 - Topography Sample Points

ID	Easting	Northing	Topo Survey (m AOD)	LiDAR (m AOD)	Difference (m)
1	576170	194320	5.04	5.11	0.07
2	576210	194290	4.78	4.86	0.08
3	576240	194330	5.32	5.32	0.00
4	576240	194610	11.78	11.76	-0.02
5	576560	194880	17.97	18.07	0.10
6	576920	194990	22.68	22.69	0.01
7	576730	194670	21.42	21.47	0.05
8	577090	194620	14.45	14.4	-0.05
9	576780	194420	13.00	13.04	0.04
10	576570	194280	7.97	8.04	0.07

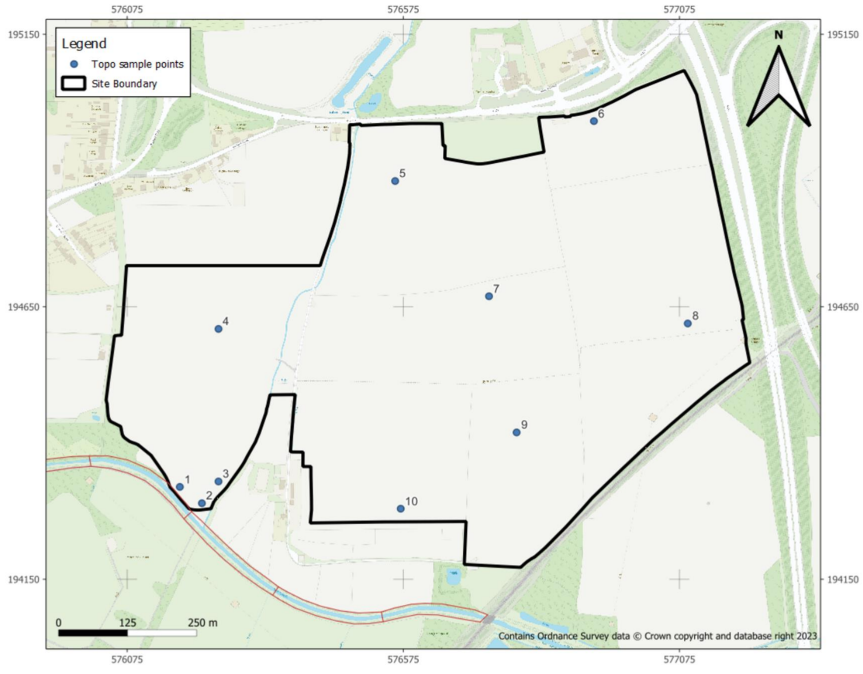
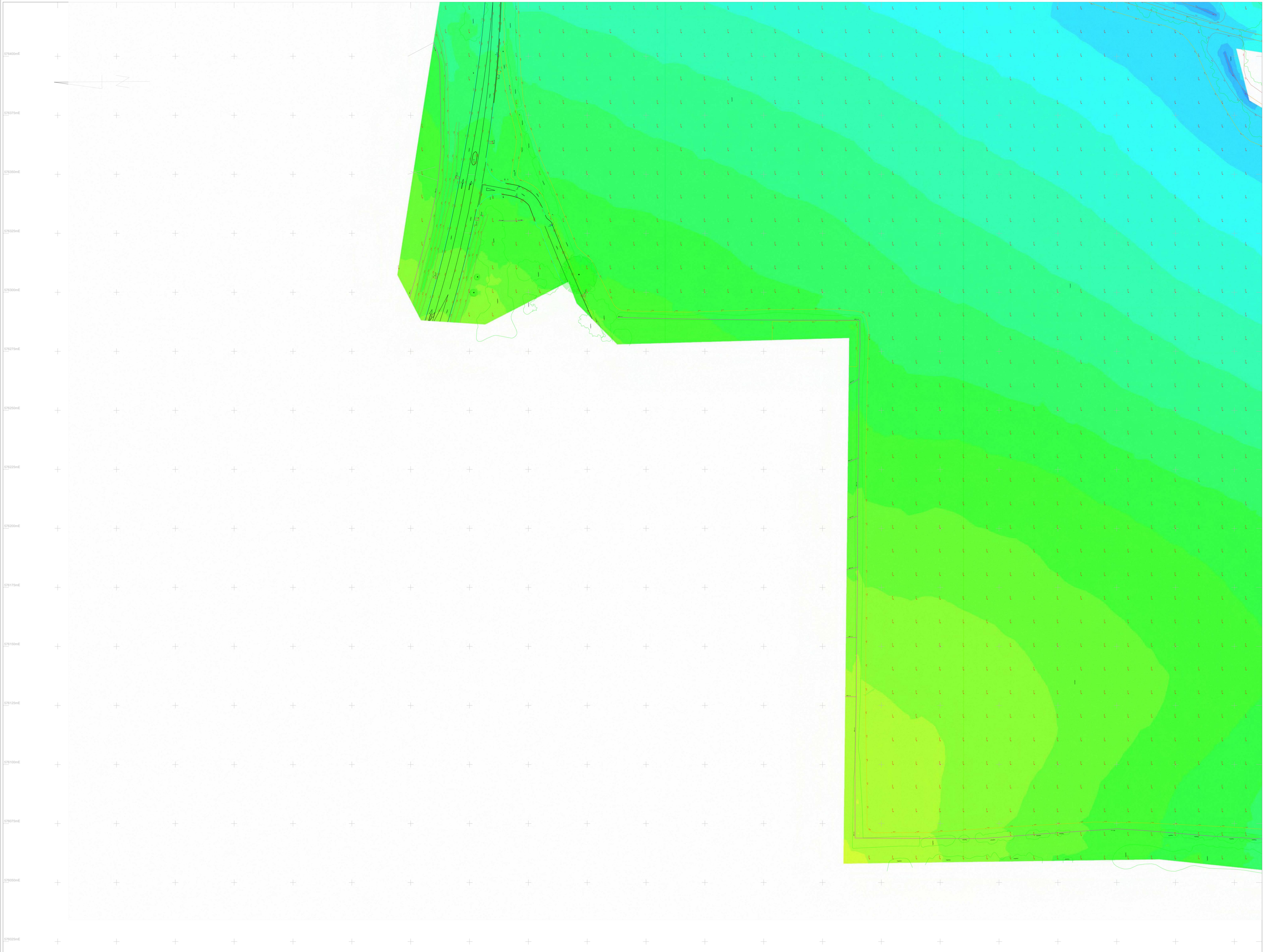


Figure 5 - Sample Point Locations

[8] Topographic Survey Rayleigh Site 3 (drawing no. TX1402_RAY 3_T_01 to T_06). Texo DSI, August 2022.

Appendix 1 - Topographic Survey



TX1402_RAY 3_T_01

STANDARD ABBREVIATIONS

A/C	Air Conditioner	LB	Litter Bin
ATM	Automated Telling Machine	LP	Lamp Post
B	Bollard	Max	Maximum
BB	Belisha Beacon	Mb	Multibole
Bh	Borehole	MH	Manhole
Br	Brick	Min	Minimum
BrS	Brick Setts	Mkr	Marker
BRW	Brick Retaining Wall	NB	Notice Board
BS	Bus Stop	NP	Name Plate
BT	British Telecom	OBF	Open Boarded Fence
BW	Brick Wall	O/H	Overhead
BWF	Barbed Wire Fence	OSBM	Ordnance Survey Bench Mark
CBF	Close Boarded Fence	P	Post
CCTV	Closed Circuit Television	PB	Pillar Box
CIF	Corrugated Iron Fence	PGM	Permanent Ground Marker
CL	Cover Level	PLt	Pavement Light
CLF	Chain Link Fence	PM	Parking Meter
Col	Column	PRF	Post and Rail Fence
Conc	Concrete	PS	Paving Stones
CoW	Cable on Wall	PWF	Post and Wire Fence
CPS	Concrete Paving Slabs	RE	Rodding Eye
CTV	Cable Television IC	RG	Road Gully
d	depth	RS	Road Sign
DC	Duct Cover	RSJ	Rolled Steel Joist
DH	Duct Height	RWP	Rain Water Pipe
DP	Down Pipe	s	spread
DrC	Drainage Channel	SB	Sign Board
EIC	Electrical Inspection Cover	SBM	Site Bench Mark
EJB	Electrical Junction Box	SC	Stop Cock
EP	Electricity Pole	SF	Security Fence
ER	Earthing Rod	ShB	Shrub Bed
ESG	Electrical Switchgear	SL	Sump Level
FB	Flower Bed	SO	Smoke Outlet
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HR	Handrail	TLCB	Traffic Light Control Box
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IL	Invert Level	Typ	Typical
IRF	Iron Railing Fence	V	Vent
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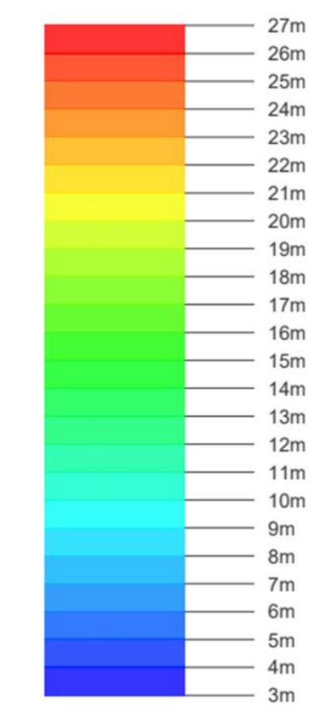
HEIGHT SHADED KEY



STATIONS

STATION	TYPE	EASTING	NORTHING	LEVEL
RA1	NAIL	576880.366	195011.627	25.019
RA2	NAIL	576710.308	194997.501	22.614
RA3	GM	576831.024	194930.041	23.410

NOTES

Yellow Ground Marker (GM) used for PGM

All levels are in metres and are above Ordnance Survey Newlyn Datum derived by multiple network RTK GPS observations

The survey grid shown on this drawing is positioned on Ordnance Survey (OS) National Grid, obtained by multiple network RTK GPS observations

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SHEET KEY

01	02	03
04	05	06

ISSUES & REVISIONS

Issue	Details	By	Date
P1	Drawing incomplete and unchecked	JM	12/08/22
R1	Original Issue	NA	15/08/22

Enso Energy

Top Floor, The Priory, Dursley,
Gloucestershire, GL11 4HR

Topographic Survey
Rayleigh Site 3

Runwell,
Essex, SS11 8NL

TEXO DSI
SURVEY AND INSPECTION

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Web: www.texodsi.co.uk

SCALE 1:500 @ A0

DATE OF SURVEY 15 August 2022

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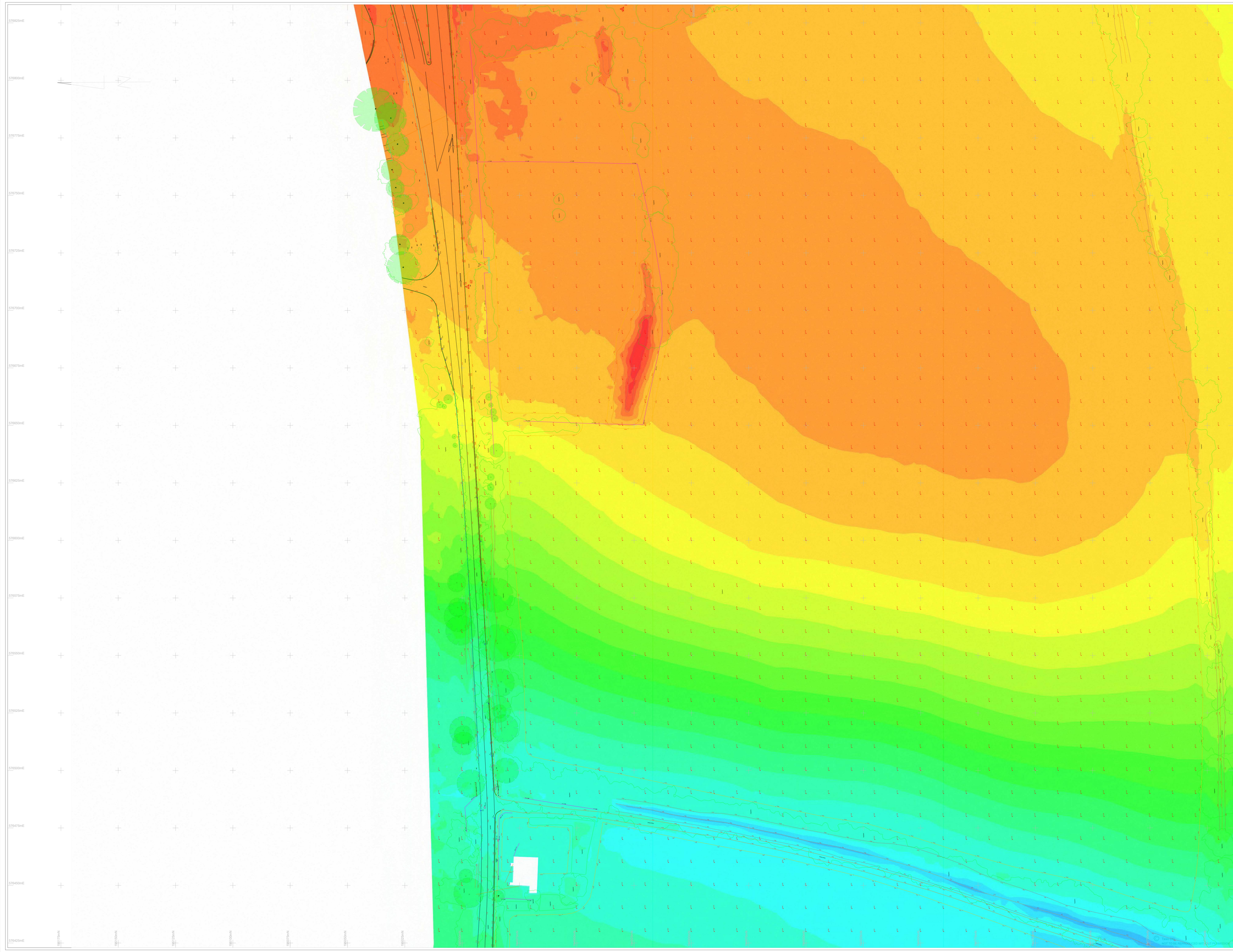

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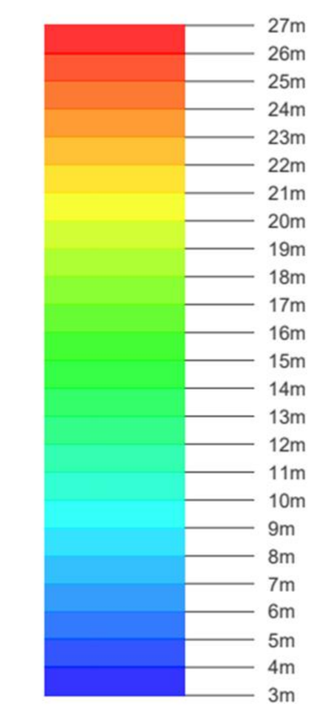

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TEXO DSI
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Email: info@texodsi.co.uk
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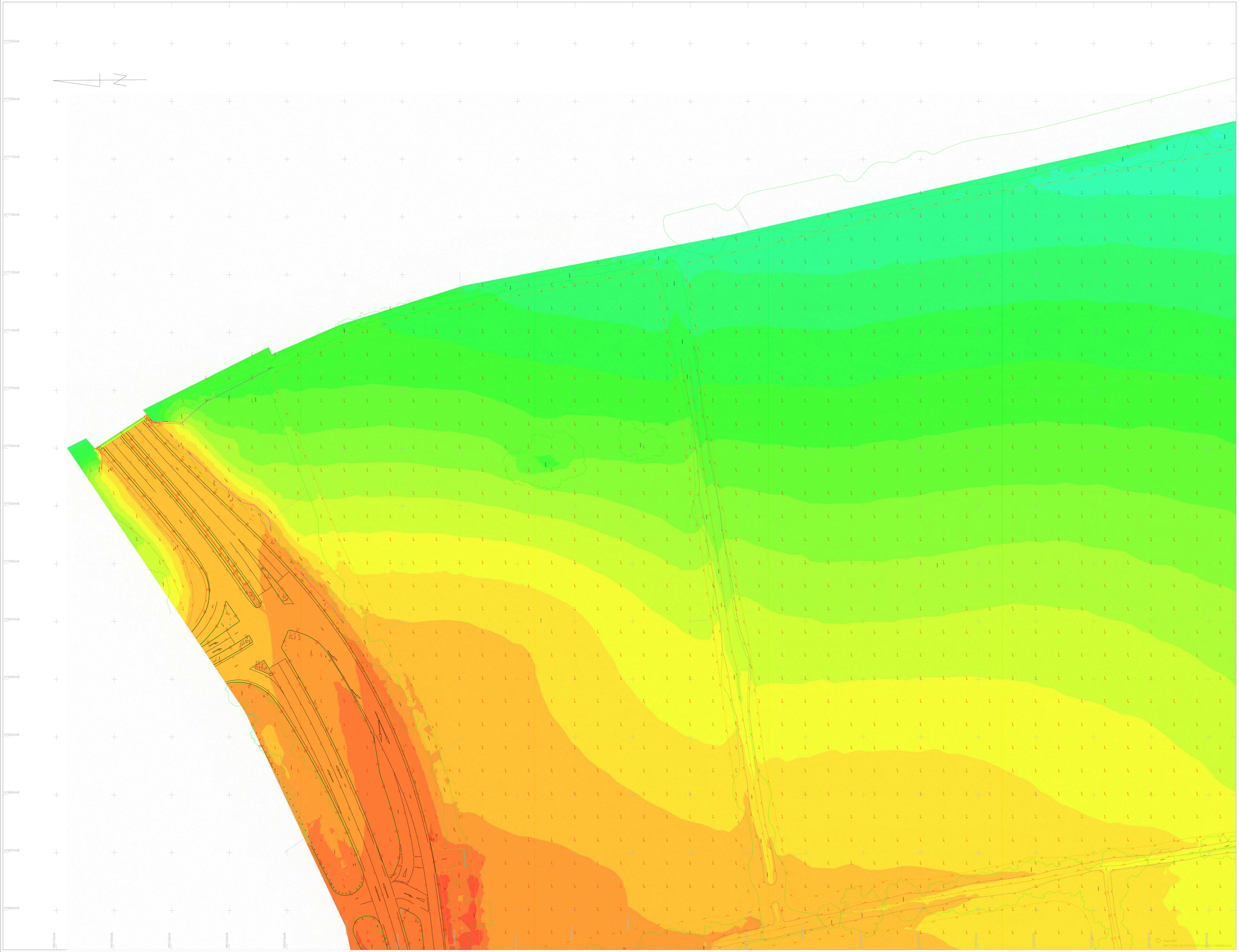

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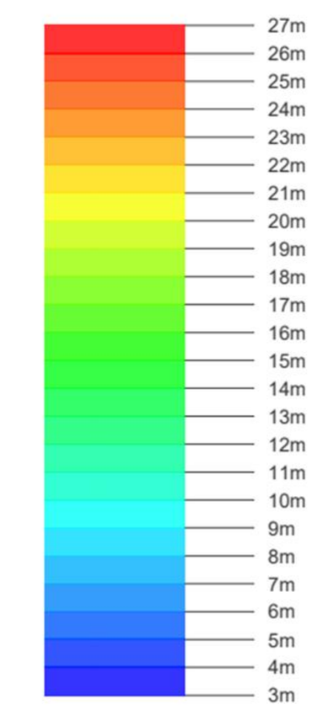

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P1	Drawing incomplete and unchecked	JM	12/08/22
R1	Original Issue	NA	15/08/22

Enso Energy

Top Floor, The Priory, Dursley,
Gloucestershire, GL11 4HR

Rayleigh Site 3

Runwell,
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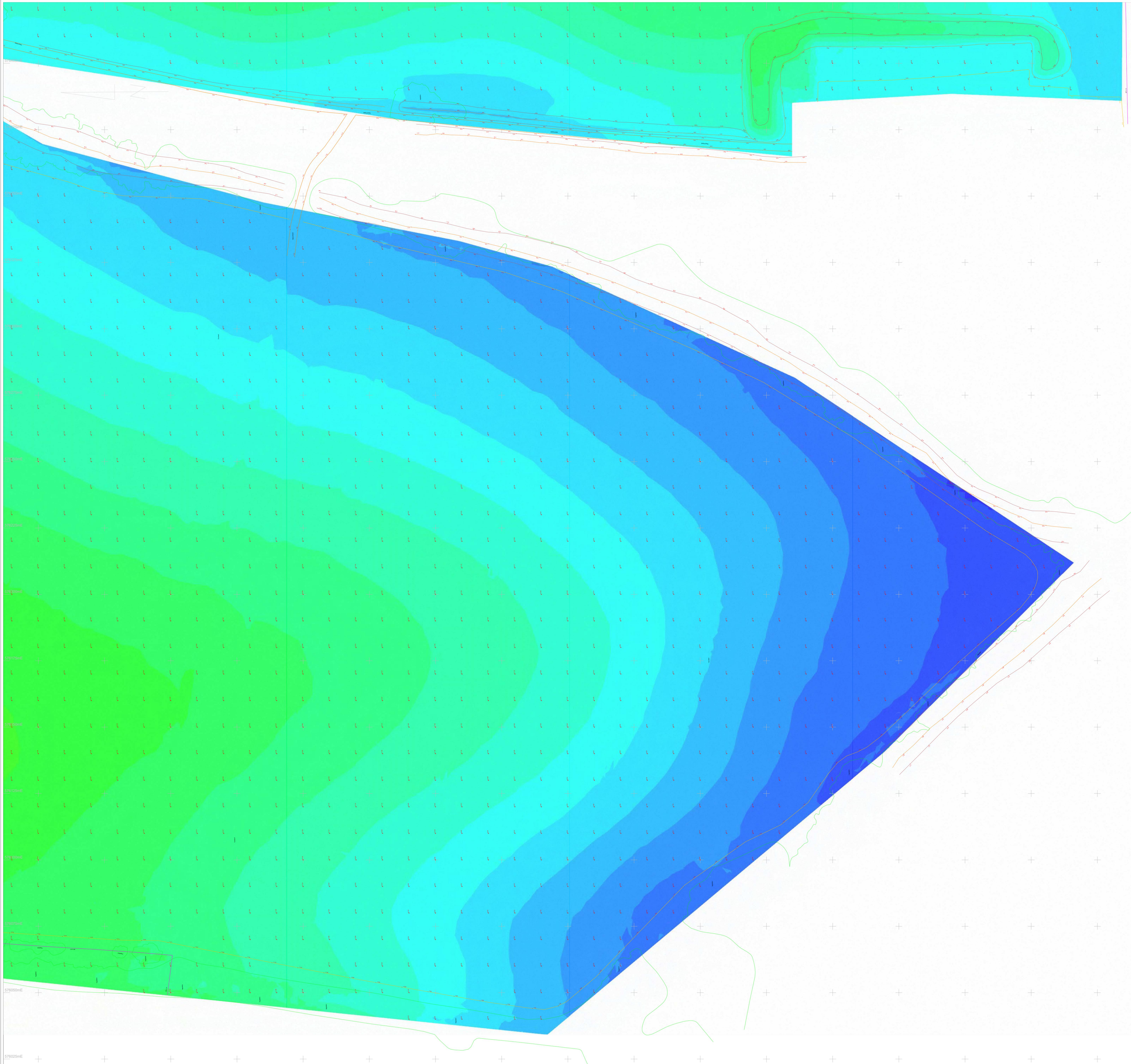
SCALE 1:500 @ A0

DATE OF SURVEY 15 August 2022

TEXO REF: TX1402 CHECKED JM

DRAWING No. TX1402_RAY 3_T_03

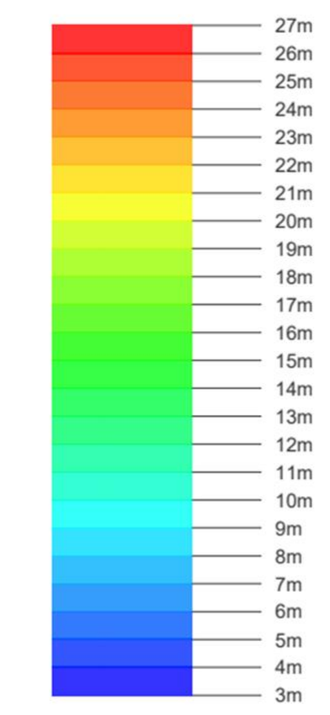


TX1402_RAY 3_T_04

STANDARD ABBREVIATIONS

A/C	Air Conditioner	LB	Litter Bin
ATM	Automated Telling Machine	LP	Lamp Post
B	Bollard	Max	Maximum
BB	Belisha Beacon	Mb	Multibole
Bh	Borehole	MH	Manhole
Br	Brick	Min	Minimum
BrS	Brick Setts	Mkr	Marker
BRW	Brick Retaining Wall	NB	Notice Board
BS	Bus Stop	NP	Name Plate
BT	British Telecom	OBF	Open Boarded Fence
BW	Brick Wall	O/H	Overhead
BWF	Barbed Wire Fence	OSBM	Ordnance Survey Bench Mark
CBF	Close Boarded Fence	P	Post
CCTV	Closed Circuit Television	PB	Pillar Box
CIF	Corrugated Iron Fence	PGM	Permanent Ground Marker
CL	Cover Level	PLt	Pavement Light
CLF	Chain Link Fence	PM	Parking Meter
Col	Column	PRF	Post and Rail Fence
Conc	Concrete	PS	Paving Stones
CoW	Cable on Wall	PWF	Post and Wire Fence
CPS	Concrete Paving Slabs	RE	Rodding Eye
CTV	Cable Television IC	RG	Road Gully
d	depth	RS	Road Sign
DC	Duct Cover	RSJ	Rolled Steel Joist
DH	Duct Height	RWP	Rain Water Pipe
DP	Down Pipe	s	spread
DrC	Drainage Channel	SB	Sign Board
EIC	Electrical Inspection Cover	SBM	Site Bench Mark
EJB	Electrical Junction Box	SC	Stop Cock
EP	Electricity Pole	SF	Security Fence
ER	Earthing Rod	ShB	Shrub Bed
ESG	Electrical Switchgear	SL	Sump Level
FB	Flower Bed	SO	Smoke Outlet
FH	Fire Hydrant	SP	Sign Post
FL	Floor Level	SV	Stop Valve
Flt	Floodlight	T	Telephone
g	girth	Tac	Tactile Paving
G	Gully	TBM	Temporary Bench Mark
GC	Gas Cock	TCB	Telephone Call Box
GM	Gas Meter	TCP	Traffic Control Post
GP	Gate Post	TIC	Telephone Inspection Cover
GV	Gas Valve	TJB	Telephone Junction Box
h	height	TL	Traffic Light
HR	Handrail	TLCB	Traffic Light Control Box
IB	Illuminated Bollard	TLIC	Traffic Light Inspection Cover
IC	Inspection Cover	TP	Telephone Pole
IL	Invert Level	Typ	Typical
IRF	Iron Railing Fence	V	Vent
IRS	Illuminated Road Sign	VP	Vent Pipe
JB	Junction Box	W	Window
KO	Kerb Outlet	WM	Water Meter
L	Light	WV	Water Valve

HEIGHT SHADED KEY



STATIONS

STATION	TYPE	EASTING	NORTHING	LEVEL
RA1	NAIL	576880.366	195011.627	25.019
RA2	NAIL	576710.308	194997.501	22.614
RA3	GM	576831.024	194930.041	23.410

NOTES

Yellow Ground Marker (GM) used for PGM

All levels are in metres and are above Ordnance Survey Newlyn Datum derived by multiple network RTK GPS observations

The survey grid shown on this drawing is positioned on Ordnance Survey (OS) National Grid, obtained by multiple network RTK GPS observations

All quoted dimensions are in metres

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SHEET KEY

01	02	03
04	05	06

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DATE OF SURVEY 15 August 2022

TEXO REF: TX1402 CHECKED JM

DRAWING No. TX1402_RAY 3_T_04

TX1402_RAY 3_T_05

STANDARD ABBREVIATIONS

A/C	Air Conditioner	LB	Litter Bin
ATM	Automated Telling Machine	LP	Lamp Post
B	Bollard	Max	Maximum
BB	Belisha Beacon	Mb	Multibole
Bh	Borehole	MH	Manhole
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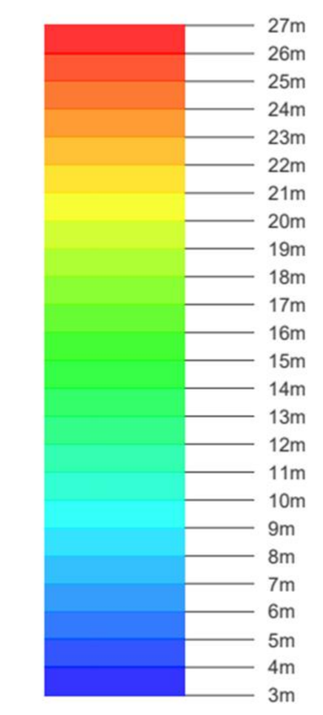

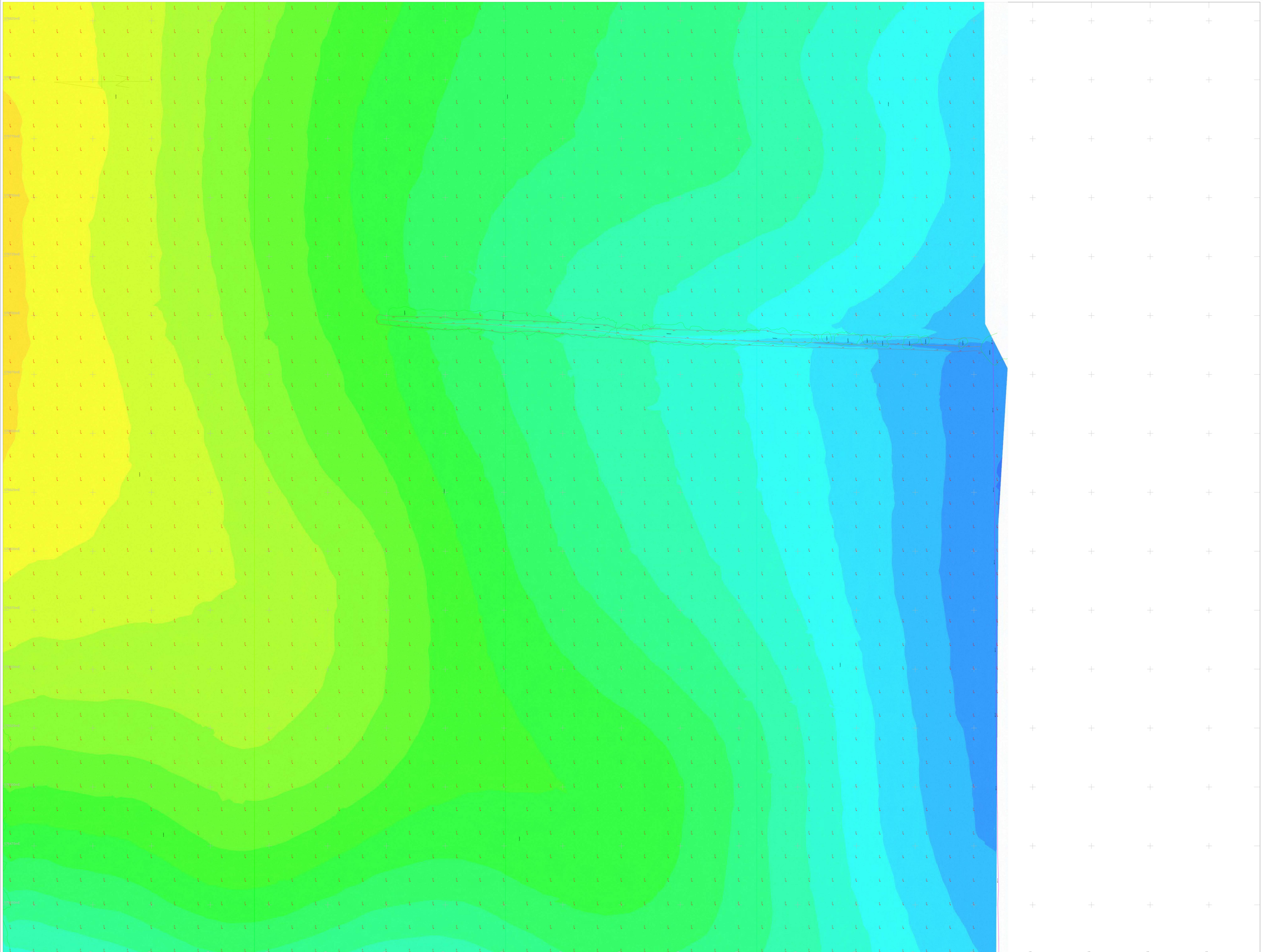

STATIONS

STATION	TYPE	EASTING	NORTHING	LEVEL
RA1	NAIL	576880.366	195011.627	25.019
RA2	NAIL	576710.308	194997.501	22.614
RA3	GM	576831.024	194930.041	23.410

NOTES

Yellow Ground Marker (GM) used for PGM

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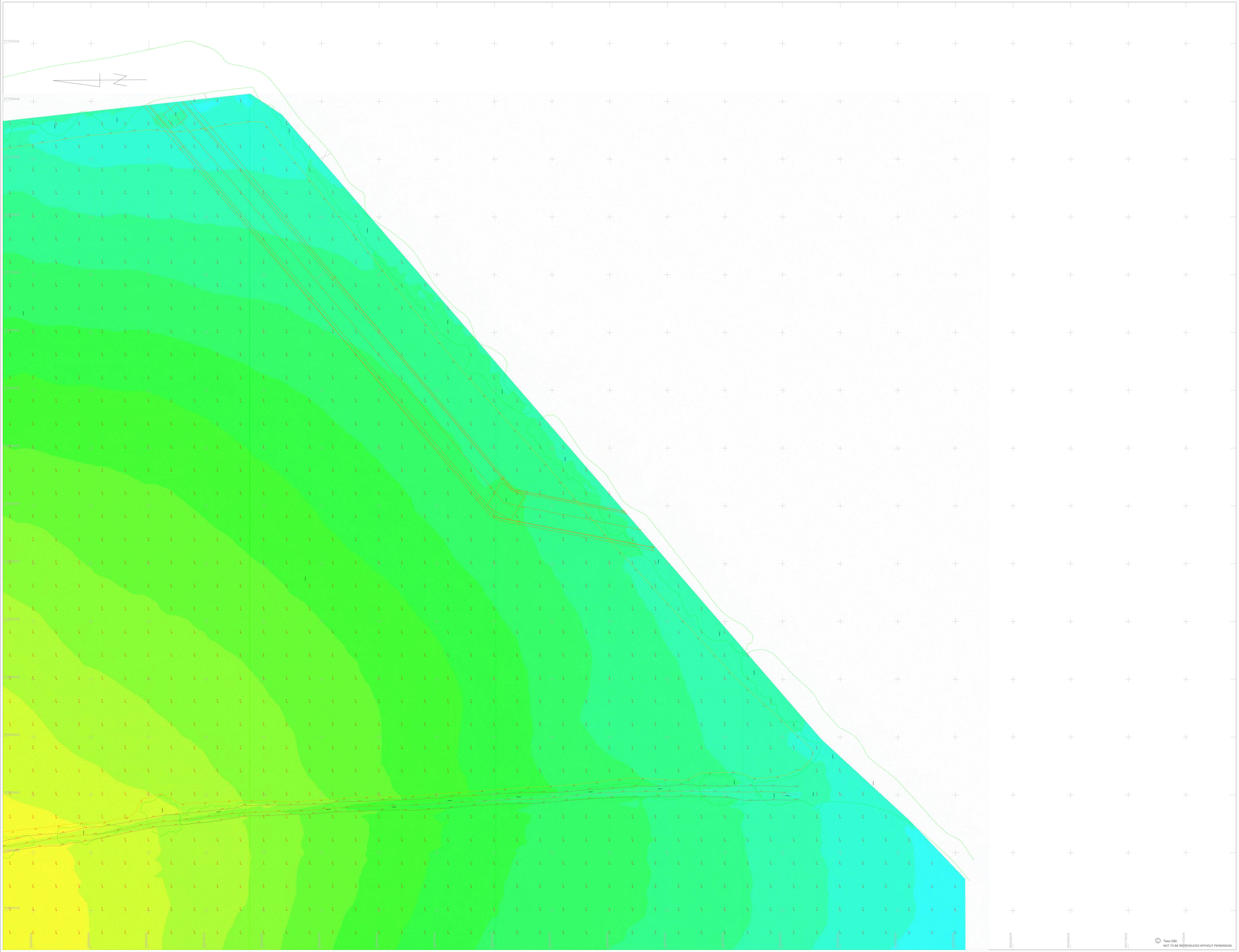
DATE OF SURVEY 15 August 2022

TEXO REF: TX1402 CHECKED JM

DRAWING No. TX1402_RAY 3_T_05



TX1402_RAY 3_T_06

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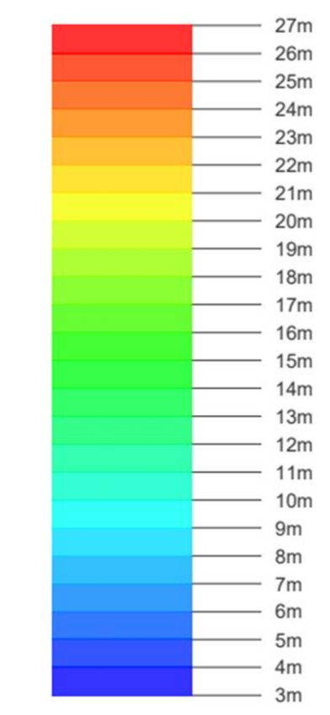

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