

Road Cut / Fill Volume Diagnostic & Validation

Independent earthworks cross-reference against an existing estimating workbook: Mean Depth Area Method, Road A

PROJECT

Housing Development, Co. Clare

DRAWING

D1169-100 / 101B

MEASUREMENT

Mean Depth Area Method

Cross-referencing an in-house earthworks model

Interrogate an existing Excel workbook calculating cut/fill for Road A, built using the Mean Depth Area Method from a longitudinal section, horizontal alignment, and a typical cross-section. Carry out an independent volume calculation to cross-check the workbook; include 1:1 batters from Ch.200 and a separate topsoil strip category, matching real tender conditions.

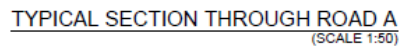
THE RISK

Earthworks is the single largest cost-risk line on a road package. A workbook built at tender stage rarely gets an independent check before it's relied upon; batter assumptions, topsoil scope, and pavement-box deductions can silently skew the number by 30%+ without any formula error.

THE SCALE

476.33m of Road A, an 11.5m formation (5.5m carriageway + 2m footpaths ×2 + 2m cycleway), with 48 chainage stations at 10m centres and a rock/BEO allowance. Cut peaks at roughly 1.0m around Ch.180; fill reaches just over 2m at Ch.300.

Typical Section Through Road A

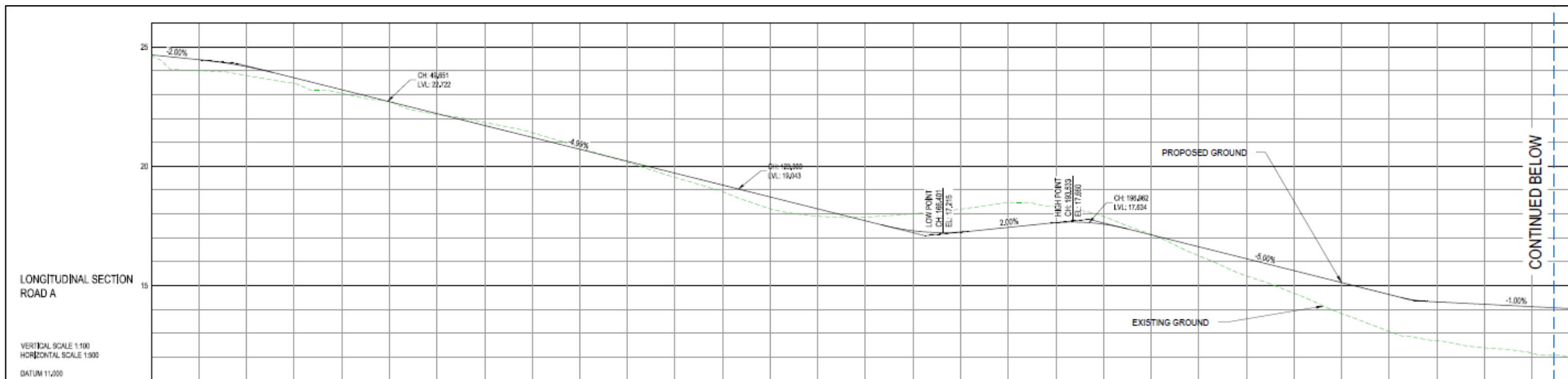


Road A — full 476.33m length

* earthworks cut to formation, excluding the road box — see p.9. † sub-base measured at about 7.1m average width, not the full 11.5m formation used above — see p.10.

VERTICAL ALIGNMENT

Longitudinal Section — Drawing & Extracted Data



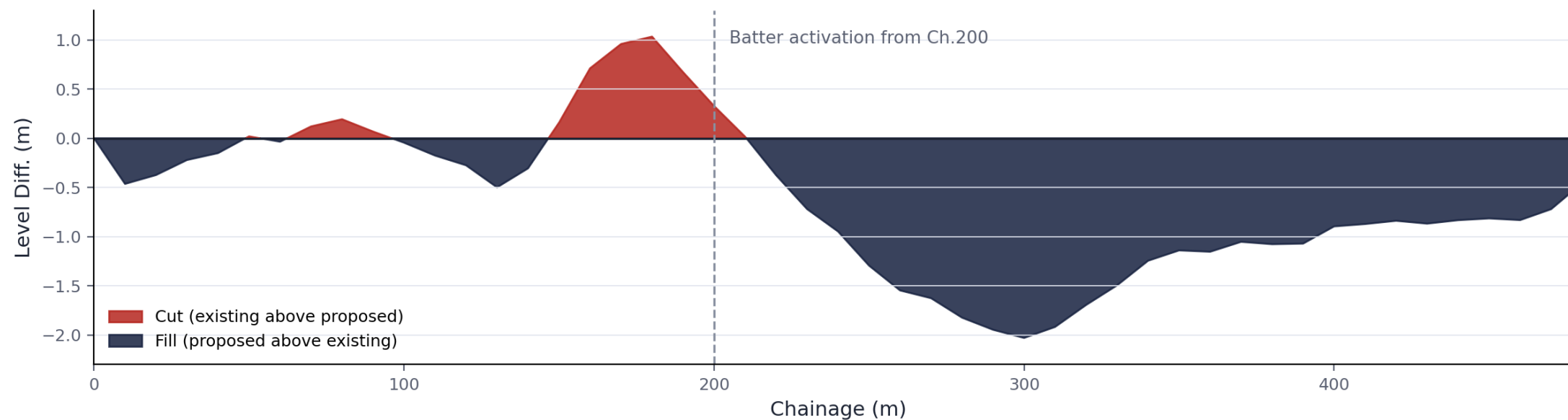
Drawing D1169-101B — Road Longitudinal Sections (Sheet 1 of 2, Ch.0–300 shown)

Levels extracted at 10m centres, Ch.0 to Ch.476.33 — the source data behind every cut/fill calculation in this case study

Chainage (m)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Existing (m)	24.66	24.00	23.80	23.48	23.05	22.73	22.17	21.83	21.40	20.78	20.16	19.53	18.93	18.21	17.90	17.87	18.01	18.20	18.47	18.31	17.90	17.14	16.25	15.40	14.67	13.83	13.08	12.69	12.39	12.16	11.98
Proposed (m)	24.66	24.46	24.17	23.70	23.20	22.70	22.20	21.71	21.21	20.71	20.21	19.71	19.21	18.71	18.21	17.71	17.29	17.24	17.43	17.63	17.57	17.12	16.62	16.12	15.62	15.12	14.62	14.31	14.21	14.11	14.01
Diff. (m)	+0.00	-0.46	-0.37	-0.22	-0.15	+0.02	-0.04	+0.12	+0.20	+0.07	-0.04	-0.18	-0.28	-0.50	-0.30	+0.16	+0.71	+0.96	+1.03	+0.67	+0.33	+0.02	-0.38	-0.72	-0.95	-1.29	-1.55	-1.63	-1.82	-1.95	-2.03

Chainage (m)	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	476.3
Existing (m)	11.98	11.88	11.89	11.89	12.08	12.14	12.07	12.12	12.05	12.01	12.08	12.06	12.04	11.96	11.95	11.92	11.85	11.91	12.05
Proposed (m)	14.01	13.80	13.59	13.38	13.33	13.28	13.23	13.18	13.13	13.08	13.03	12.98	12.93	12.88	12.83	12.78	12.73	12.68	12.60
Diff. (m)	-2.03	-1.92	-1.70	-1.50	-1.25	-1.14	-1.15	-1.05	-1.08	-1.07	-0.95	-0.92	-0.89	-0.92	-0.88	-0.86	-0.88	-0.77	-0.55

Mean Depth Area Method — Cut/Fill Profile

**01**

Average End Area

Level difference (existing – proposed) taken at each 10m station; interpolated to zero at sign changes.

02

Batter Geometry

1:1 batters applied from Ch.200 both sides; volume = (formation width × h) + h² per interval.

03

Topsoil Strip

200mm depth stripped separately across the full battered formation width; not bundled with earthworks.

04

Mass Haul Balance

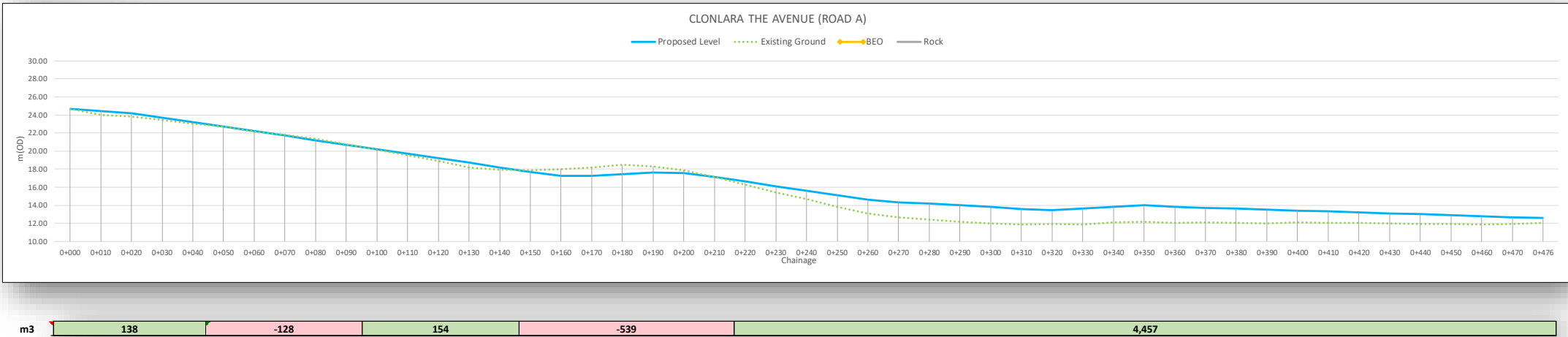
Cut, fill, capping and pavement volumes reconciled into a net import/export figure.

Cross Section Measure: Road A (Excel Graph)

Mean Depth Area worksheet: Drawing D1169-100 Rev.B, full cross-section including widenings, footpaths & cycleways

Project
Drawing No.
Revision
Date
Description

Clonlara
D1169 - 100
B
07/10/2023
Mean Depth Area Method



WHY THIS MATTERS

This is the actual worksheet behind every "Sheet" figure quoted in this case study; the Proposed Level, Existing Ground, BEO and Rock profile plotted directly from the level data. The full row-by-row Cut/Fill/Batter/Topsoil/Pavement breakdown behind this chart is reproduced on p.7. It's the same calculation independently cross-checked throughout this deck.

Full Calculation Grid — Road A (Excel)

[illegible]

Full Mean Depth Area worksheet, provided at native resolution for reference (zoom to read individual cells)

Workbook vs Independent Calculation

Item	Sheet (m³)	Independent Check (m³)	Variance
Topsoil Strip	1,230	1,220	-0.8%
Excavation / Cut	689	482	-30.1%
Fill (gross)	4,435	4,247	-4.2%
Capping / Subbase	1,019	1,643	+61.3%

READING THE VARIANCE

Every gap traces to a scope choice, not a formula error. Cut is reconciled on p.9.

Length (m)	Traverse Depth (m)	Description	Unit	Measured Qty	Asp Width (m)	Calculated Qty	Qty Checked
ROAD A	0.2	Topsoil Strip	m³	895	7.28	100%	895
		Excavation	m³	621	100%	621	
		Formwork	m²	3,667	7.28	100%	3,667
		PIS	m³	2,282	95%	2,168	
ROAD B	0.2	Capping / Subbase	m³	895	6.25	85%	759
		Topsoil Strip	m³	537	12.91	100%	537
		Excavation	m³	69	100%	69	
		Formwork	m²	2,684	12.91	100%	2,684
ROAD C	0.2	PIS	m³	2,282	95%	2,168	
		Capping / Subbase	m³	126	7.13	85%	107
		Topsoil Strip	m³	537	12.91	100%	537
		Excavation	m³	69	100%	69	
TOTALS							
No Variance							1,230
Topsoil B							895
Subbase							4,315
Excavation							4,775
PIS							1,019
Deduct batter on one side							

Road Summary

-0.8%

Topsoil

Effectively matching

-30.1%

Cut

Reconciles to 1.9%: see next page

-4.2%

Fill

Batter activation range + topsoil carried in batter height

+61.3%

Subbase

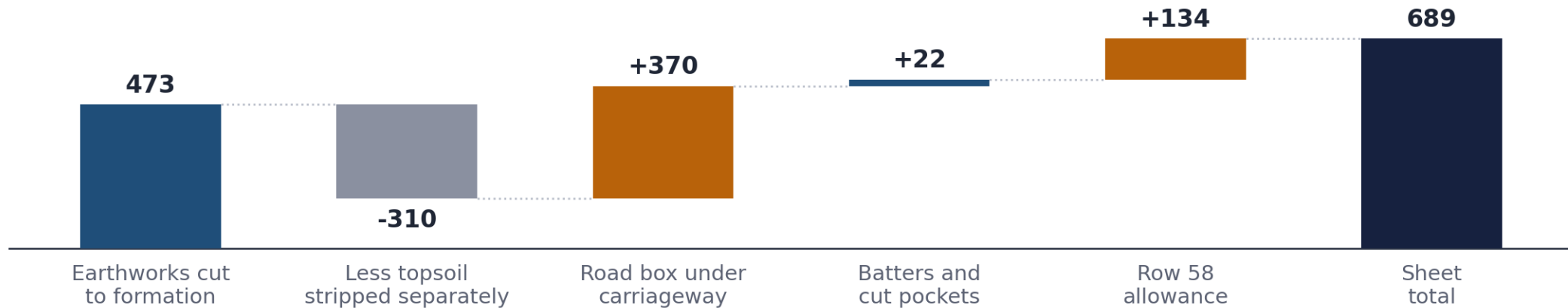
Scope difference: carriageway vs full formation

RECONCILIATION

Excavation: 689m³ reported, 473m³ earthworks

Traced line by line against the workbook's live formulas. Road A (2) is the reporting worksheet and already measures the full 11.5m formation, so the 30.1% headline gap is construction below formation plus a separately measured topsoil strip — not an earthworks disagreement.

Compared at 473 m³ against the independent check's 482 m³ — 1.9%. Both existing ground to formation, full 11.5m width.



WHAT'S IN THE LINE

Construction below formation dominates: 370m³ of road box under the carriageway and 134m³ from row 58's flat 0.96m³ per metre allowance. The 310m³ deduction removes the 200mm topsoil, which is measured separately as 1,230m³.

THE COMPARISON

473m³ of earthworks cut, existing ground to formation across the full 11.5m formation, against the independent check's 482m³ — a 1.9% variance. Like for like, with no scaling and no adjustment on either side.

Reconciled Quantities — Final Comparison

Item	Sheet (Reported)	Reconciled Basis	Independent Check	Final Variance
Topsoil Strip	1,230	1,230	1,220	-0.8%
Excavation / Cut	689	473	482	+1.9%
Fill (gross)	4,435	4,435	4,247	-4.2%
Capping / Subbase	1,019	not comparable	1,643	n/a

WHAT CHANGED

Excavation moves from a 689m³ reported figure to a 473m³ earthworks basis once the road box, the row 58 allowance and the separately measured topsoil are taken out. No width scaling is involved; the reporting worksheet already measures the full 11.5m formation. Against the independent check's 482m³, that's a 1.9% variance, down from 30.1%.

WHAT'S STILL OPEN

Capping/Subbase remains a genuine scope difference, not a reconcilable variance; the sheet measures sub-base at about 7.1m average width, while the wider figure covers the full 11.5m formation including footpaths and cycleway. Confirm which basis matches the intended pricing scope. Fill is explained but not adjusted; the residual 4.2% sits in the batter activation range and the topsoil carried in the batter height.

Method confirmed sound for tender purposes

- ✓ Mean Depth Area Method produces net volumes consistent with measurement rules, and on a grade of this profile differs from the prismoidal formula by only 1–3%; immaterial against CBR and ground-condition risk.
- ✓ The volume chain is clean: levels → depths → areas → volumes → batters traced cell by cell on both worksheets, with no arithmetic error carried into any reported quantity.
- ✓ Every variance traces to a scope choice, not a mistake; cut reconciles to within 1.9% once the road box, the row 58 allowance and the separately measured topsoil are taken out of the excavation line; fill and topsoil were already within 5%.
- ✓ The row-by-row layout is a genuine QA tool; an incorrect level or transposition error shows up immediately as a spike in the depth row or the profile chart, before it ever reaches a BoQ.

VERDICT

For tender purposes, this workbook produces defensible, auditable quantities.

One action remaining: row 58 adds a flat 0.96m³ per metre of cut, 134m³ in total, tied to no width or depth on the section. The 370m³ road box is legitimate excavation but confirm the sub-base and pavement rates are supply-and-lay only so it isn't paid for twice.

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