v2-dur-13000 — run v2-dur-13000

Prepared by **Prashidha Kharel, PhD**

First rung on chilime-v2. calib-knee-10000 left the sag deposit at EL 1395.24 against the observed EL 1396.10, and off the level curve (~2,600 m3 per metre) that gap is about 2,200 m3 — so v1 was pointing at ~12,200 m3. v2 then adds somewhere between a Bingham mound at the machine-hall doorway (~1,000 m3) and hydrostatic filling of both halls to the sag crown (7,022 m3). 13,000 m3 is the low end of that bracket: if it plugs the sag, the caverns absorb little and the v1 calibration nearly stands. Peak held at the observed portal head, so the extra material comes from a longer flood rather than a deeper one.

> **This is a sensitivity experiment on an evidence-preserving reconstruction, not an operational prediction.** It explores what *could* happen under stated assumptions. Read the limitations at the end before acting on anything here.

> **The run is not finished.** This is a snapshot at t = 3435.93 s of a scenario that runs to 3473.21 s — 99% of the way through. The debris is still moving. Deposits shown here can still spread, drain or settle, so no depth, free height or blockage below is a final answer; treat them as where things stood at that moment.

Key findings

Of **30,807 m3** of meshed void, **11,116 m3** holds debris and **19,691 m3** is still air — the system is **36% full**.

section	space	shell m3	fill	debris m3 (est.)	air m3 (est.)	deposit EL	least free height
N–N′	Transformer cavern	5,986	0%	—	5,985	— dry —	7.07 m
H–H′	Powerhouse cavern	10,084	44%	4,457	5,628	1394.20	9.56 m
E–E′	Main access tunnel	8,144	55%	4,461	3,684	1397.63	0.04 m

D–D′	Horizontal penstock shaft · drawn portion	1,288	4%	48	1,240	1394.13	0.49 m
K–K′	Tailrace tunnel · drawn portion	1,378	30%	420	958	1393.14	0.00 m
I–I′	Access tunnel to powerhouse crown	775	0%	—	775	— dry —	3.45 m
A–A′	Adit to penstock	437	20%	88	349	1392.97	2.29 m
M–M′	Link to transformer cavern	391	14%	56	335	1393.11	3.78 m
G–G′	Access to powerhouse	1,881	86%	1,615	266	1395.21	0.36 m
L–L′	Second tailrace connection	312	17%	53	259	1393.14	0.00 m
B–B′	Cable duct tunnel	280	10%	28	253	1394.51	2.74 m
C–C′	Emergency exit tunnel	396	61%	240	155	1393.67	0.00 m
F–F′	Second penstock connection	186	18%	33	153	1394.13	0.49 m
J–J′	Tunnel to TRT gate	135	70%	94	41	1395.78	0.00 m

Shell volumes are the geometry package's own; the debris and air columns scale them by the mean fill of the stations along that space, so they are estimates, not cell integrals. The system totals above are cell integrals.

One air pocket, vented, carrying survivable headroom.

pocket	volume m3	class	floor EL	ceiling EL	headroom	nearest level
0	19,534	vented	1383.74	1405.07	21.33 m	Kitchen

In the **powerhouse cavern** the deposit stands at **EL 1394.20**. Recorded levels at or below it: Pump/sump pit bottom, Tailrace/base reference, MIV pit bottom, MIV centreline, Service bay, Runner and shaft centre, Printed internal level, Upper bend top, Control room. Still clear: Transformer hall floor (EL 1394.25), Kitchen (EL 1397.00), Crane beam level (EL 1397.15), Battery level (EL 1399.00), EOT crane top (EL 1399.20), and 2 more.

> no full blockage found: the highest fill is 95% and the tightest point is

> Emergency_Exit_Tunnel at chainage 0 m with 0.00 m of free height

> Tailrace_Tunnel: only 14 of 31 stations are resolved by this mesh (45%). The passage is too narrow for the cell size, so results along this route say nothing about whether it flooded — refine the mesh before drawing any conclusion from it.

What this report is

A simulation of debris and water moving through the underground void system — the tunnels, shafts and caverns — following the flood. The solver tracks two fluids at once, a dense debris mixture and air, and reports where the debris has reached, how deep it is, how much room is left above it, and which pockets of air remain.

This report covers the first **3435.93 seconds** of a run that goes to 3473.21 s. It was read from 78 reconstructed times; a mid-run look reconstructs only the newest, so that is not how many the solver has written.

What this run assumed

Every figure below is downstream of this table. These are the parameters this study varies between scenarios, in a fixed order and with fixed wording, so two reports laid side by side differ only where the scenarios do. Everything else — rheology coefficients, the full hydrograph, every boundary, the numerics, the compute — is in the appendix.

parameter	this run	what it means
Debris released (prescribed)	13,000 m³	set by the hydrograph; 42% of the modelled void, if none of it drained
Delivered by the boundary	11,089 m³ (85%)	the solver's own volume integral at the analysed time
Release window	0–1673.21 s	inflow runs for 1,673 s (28 min)
Peak discharge	11.10 m³/s	top of the hydrograph
Yield stress τ_y	744.2 Pa	the stress the mud must exceed to move at all — what decides where it stops

Debris density	1,900 kg/m³	solids fraction 0.45
Simulated duration	3,473 s (58 min)	inflow ends at 1673.21 s; the rest lets the deposit come to rest, which is what the observations record
Inlet	`portal_inlet`	flow depth 2 m at the boundary
Gates	Tailrace_Gate closed	a closed gate cuts its region out of the fluid domain
Open to the air	`emergency_exit_end`	where displaced air can escape; with none, air resists the filling
Mesh cell size	1 m	sets which passages can be measured at all

> None of these is a measurement of the real event. The volume released and the yield stress are what the sweep is solving for; the gate and vent states are recorded UNKNOWN in the observations and held fixed here. Read them as *what was asked of the model*, not as what happened.

How to read this report

The analysis cuts a thin slice across each tunnel every few metres along its centreline. Each slice is a **station**, and its position along the route is its **chainage** in metres from the route's start. Everything below is reported per station.

term	what it means
debris fill fraction	Of the open space in that slice, the share occupied by debris rather than air. 0% is a clear passage and 100% is one choked to the roof with debris. This is a physical result.
mesh coverage	Whether the mesh resolved that slice at all. This is a *data quality* statement, not a physical one — see the warning below.
free height	Vertical distance from the top of the debris to the tunnel crown: the room a person would have above the deposit.
invert / crown	The floor and the roof of the passage, as elevations.
EL	Elevation in metres above the project datum. The portal invert is at about EL 1397.7 for scale.
air pocket	A connected volume of air the debris has not displaced. *Vented* means it still connects to the outside; *isolated* means it does not — breathable but unreachable, with a finite air

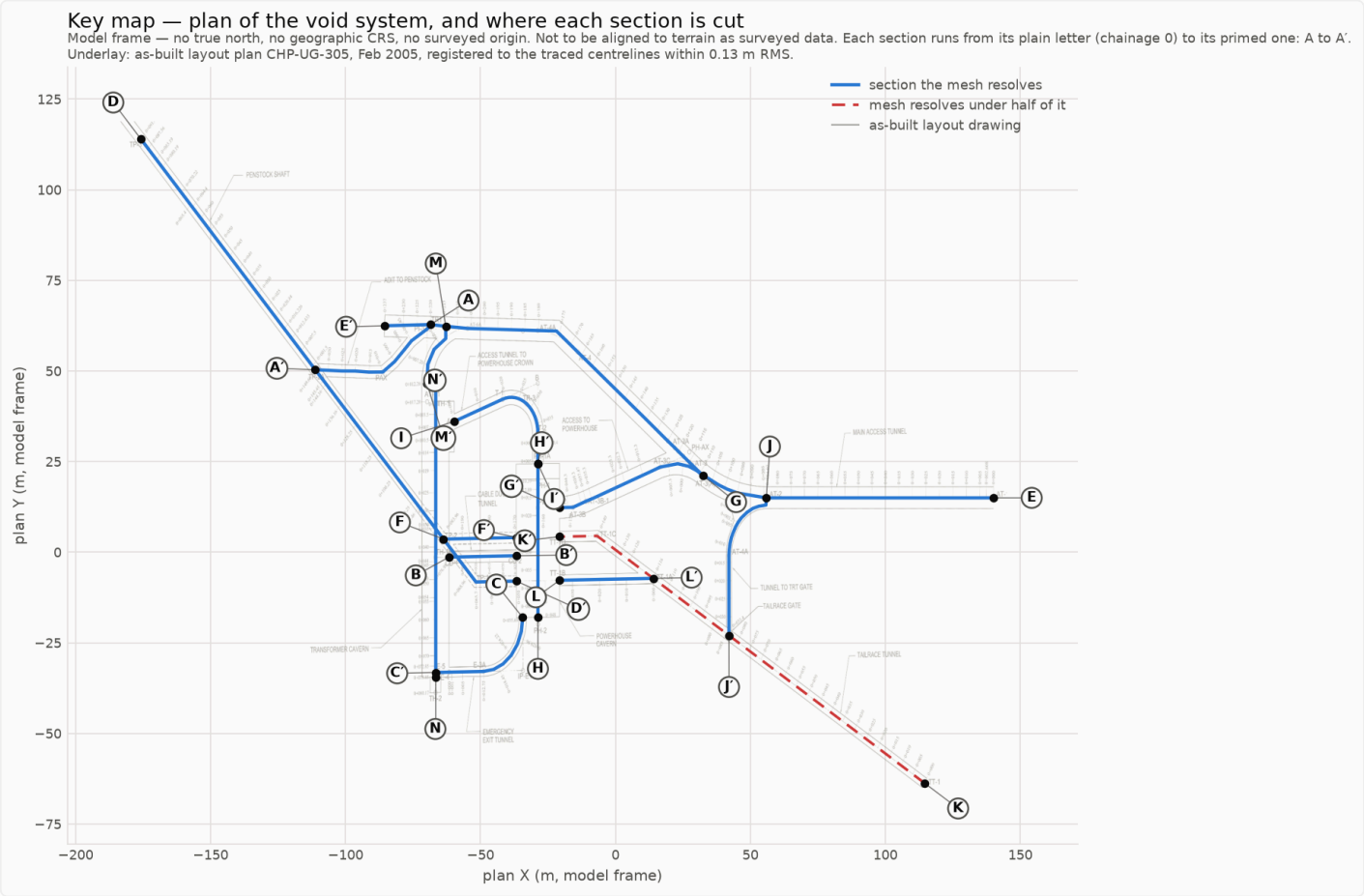
	supply.
blocked segment	A continuous run of the tunnel where fill stays above the threshold set in the scenario — a plug rather than a puddle.

> **The single most important distinction:** a station with no mesh cells is **unmeasured, not empty**. At this cell size a narrow passage may get no cells at all. Reporting that as *0% debris* would turn *we did not look* into *the flood did not reach here* — the opposite conclusion. Unmeasured stretches are hatched in every figure, never left blank.

Where things stand

At t = 3435.93 s the domain holds **11,116 m³ of debris** and 19,691 m³ of air, so the void system is **36.1% full** overall.

Key map — where everything is

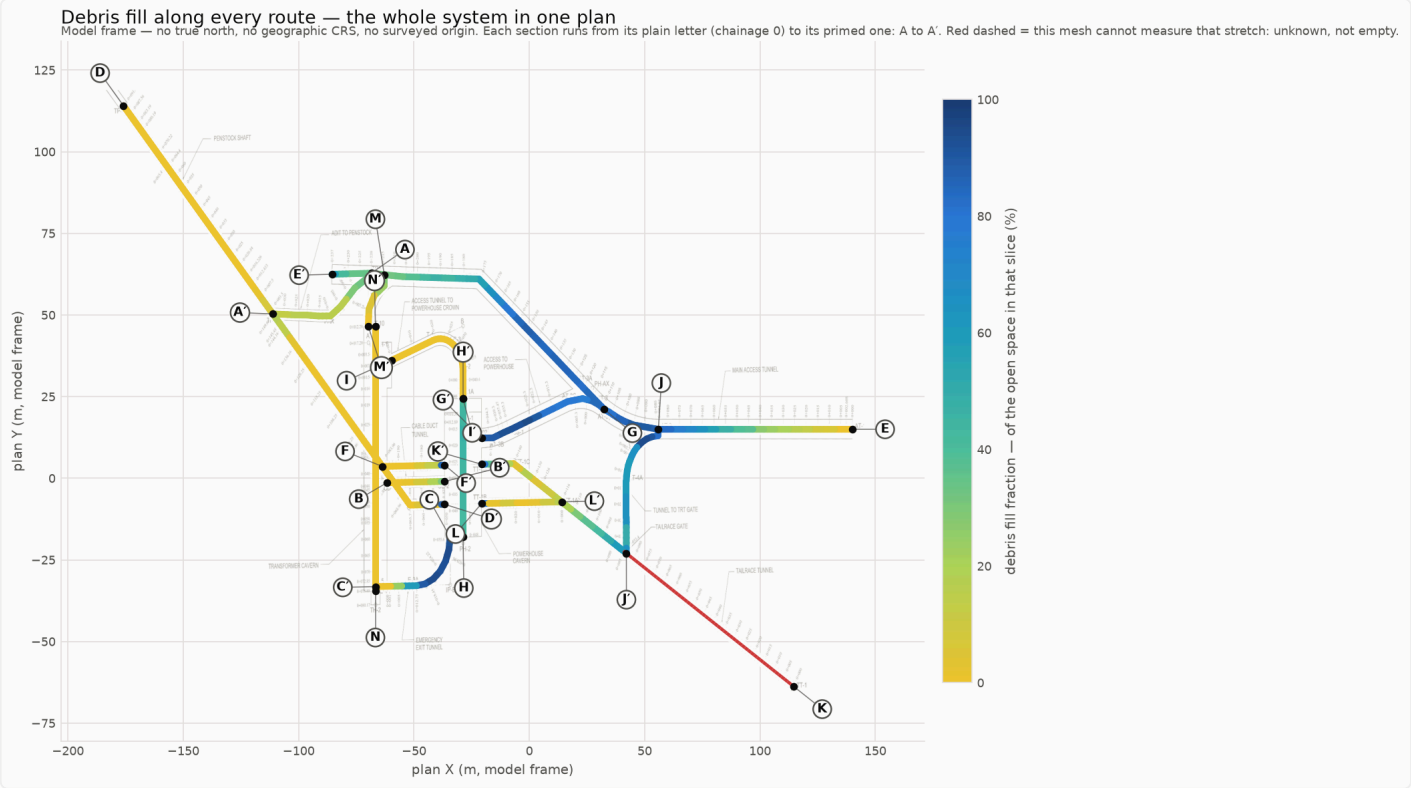


Plan of the void system. Each route runs from a plain letter at chainage 0 to a primed one at its far end, so the long-section figure titled Section A–A′ is read left to right from A to A′. Routes drawn dashed in red are ones this mesh resolves less than half of. There is no true north: these are model-frame axes.

section	route	stations	mesh resolves
A–A′	Adit_To_Penstock	10	100%
B–B′	Cable_Duct_Tunnel	6	100%
C–C′	Emergency_Exit_Tunnel	9	100%
D–D′	Horizontal_Penstock_Shaft	38	100%
E–E′	Main_Access_Tunnel	49	100%
F–F′	Penstock_Unit_Branch	6	100%
G–G′	Powerhouse_Access	12	100%
H–H′	Powerhouse_Cavern	9	100%
I–I′	Powerhouse_Crown_Access	10	100%
J–J′	TRT_Gate_Access	10	100%
K–K′	Tailrace_Tunnel	31	45%
L–L′	Tailrace_Unit_Branch	7	100%
M–M′	Transformer_Access_Link	4	100%
N–N′	Transformer_Cavern	17	100%

The whole system at a glance

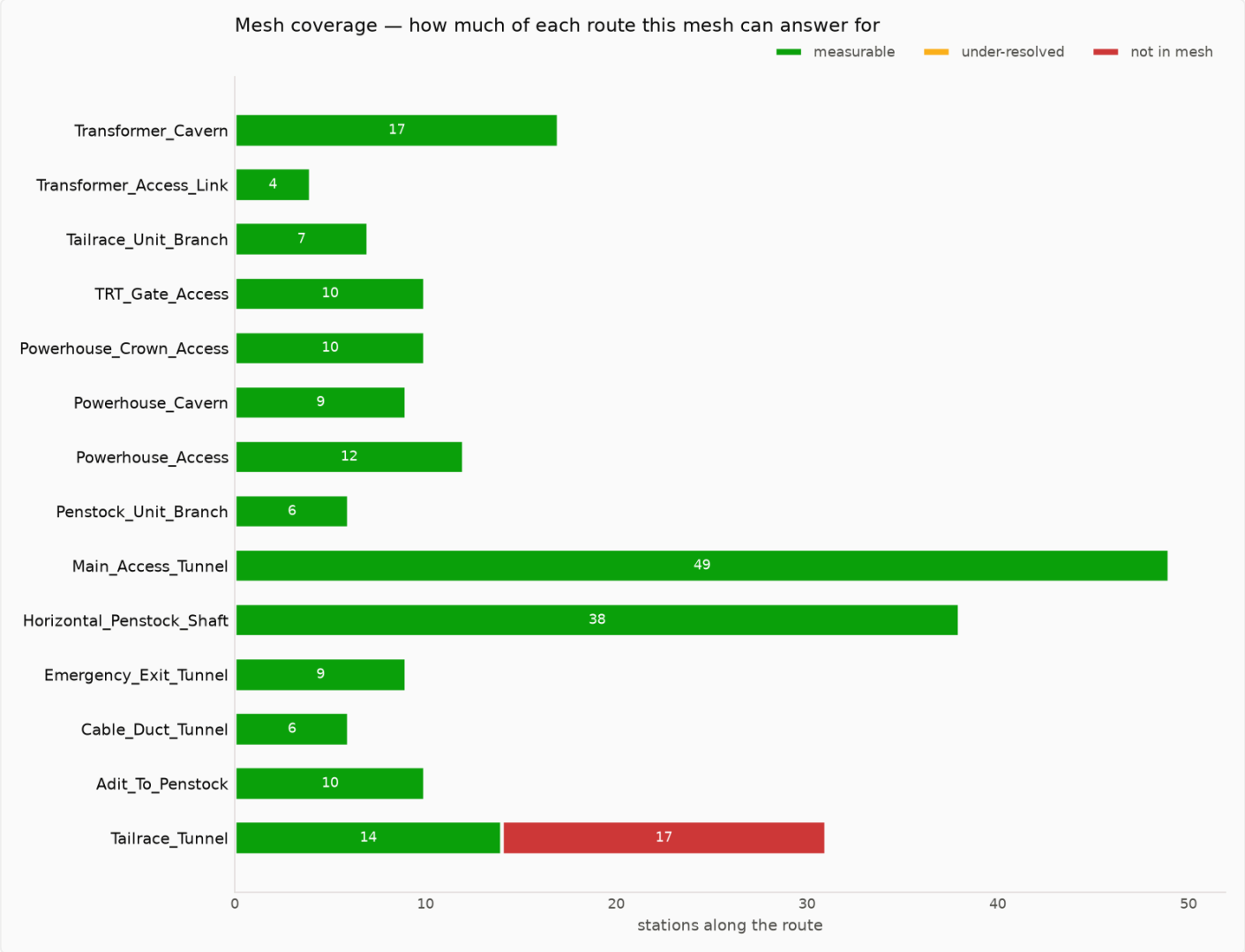
The same plan, with every route coloured by how full it is. Pale is an empty passage, deep blue is a choked one. This is the one figure that answers *where in the system is the debris* without reading twelve long sections in turn — the sections then say how deep it is and how much room is left above it.



Debris fill fraction along every route. Colour is magnitude on one hue, so darker is fuller; the scale is the same 0–100% the sections use. Stretches drawn as a red dashed line are ones this mesh cannot measure — they are given no colour, because painting an unmeasured slice as 0% would read as a passage the flood never reached.

Mesh coverage — which results you can trust

Read this before any other figure: it says which parts of the model this mesh can answer for. A station needs at least four cells to give heights; with one to three the debris fill fraction still means something but the heights do not; with none the passage was never represented.



Stations per route, split by what the mesh can measure. A route dominated by red tells you about the cell size, not about the flood.

Across the model, 201 of 218 stations are fully measurable, 0 are under-resolved, and 17 are not represented by this mesh at all.

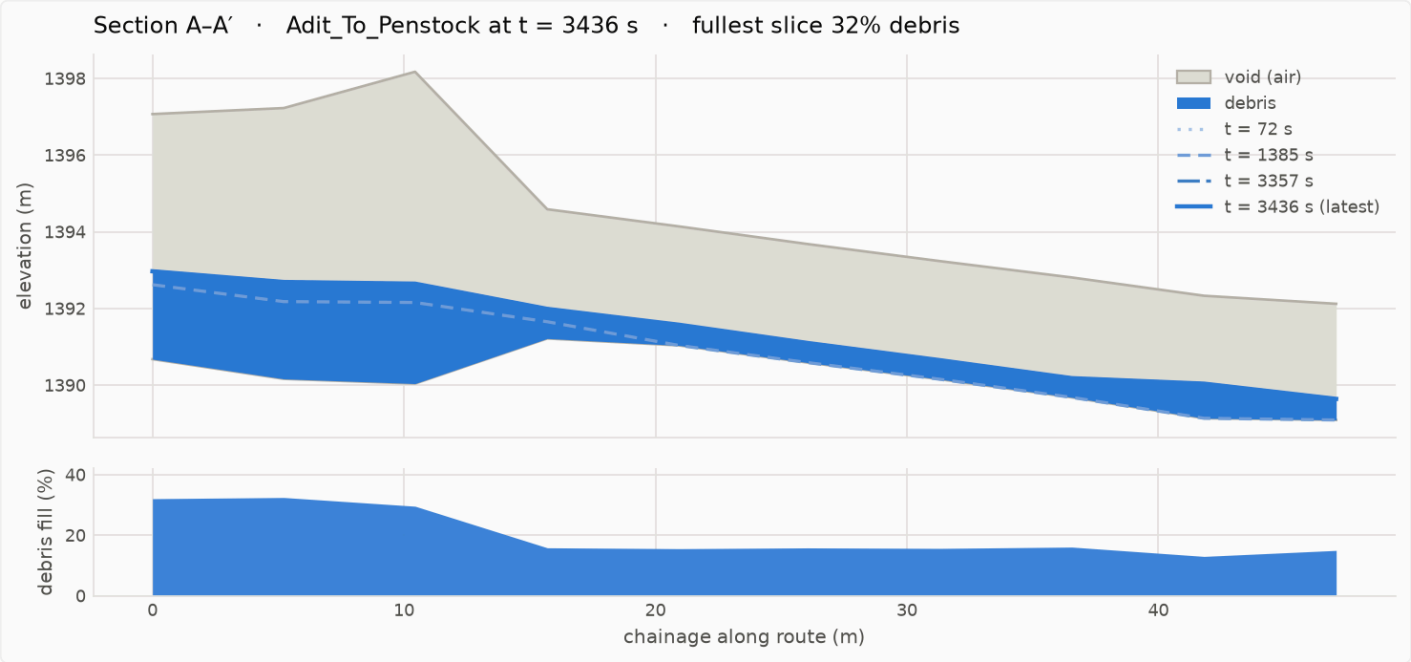
Long profiles — where the debris is, route by route

Each figure cuts along one route, left to right from the plain letter to the primed one. The grey band is the passage from floor to roof; solid blue is debris at the latest time. The panel underneath repeats the same thing as a percentage, because a slice that is a few percent full is only a few centimetres deep and vanishes at the scale the tunnel forces.

The dashed lines are the same deposit surface at three earlier times, palest first. They are what separates a deposit that has come to rest from a snapshot of one still moving: where the dashed lines sit on top of the solid one, that stretch stopped filling some time ago.

Section A–A′ · Adit_To_Penstock

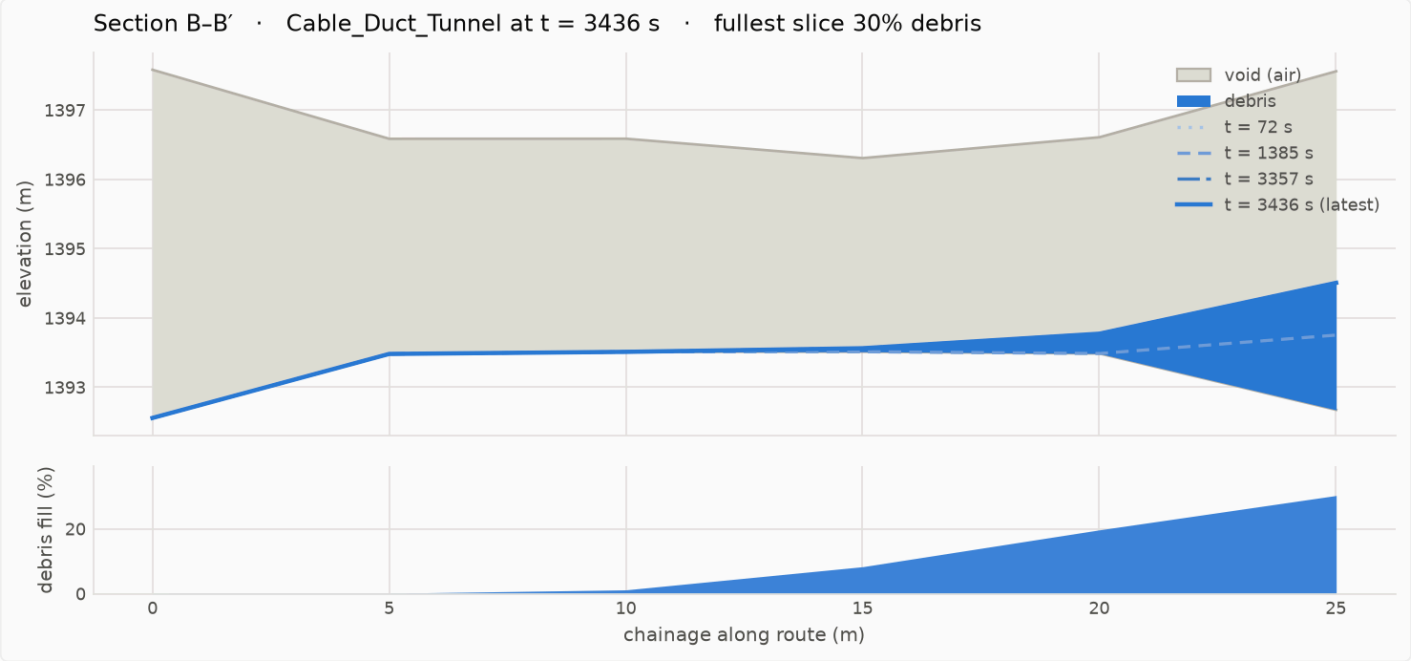
Section A–A′. The mesh resolves 10 of 10 stations along this route (100%). The fullest slice is 32% at chainage 5 m. The tightest measured point has 2.29 m of free height.



Adit_To_Penstock: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section B–B′ · Cable_Duct_Tunnel

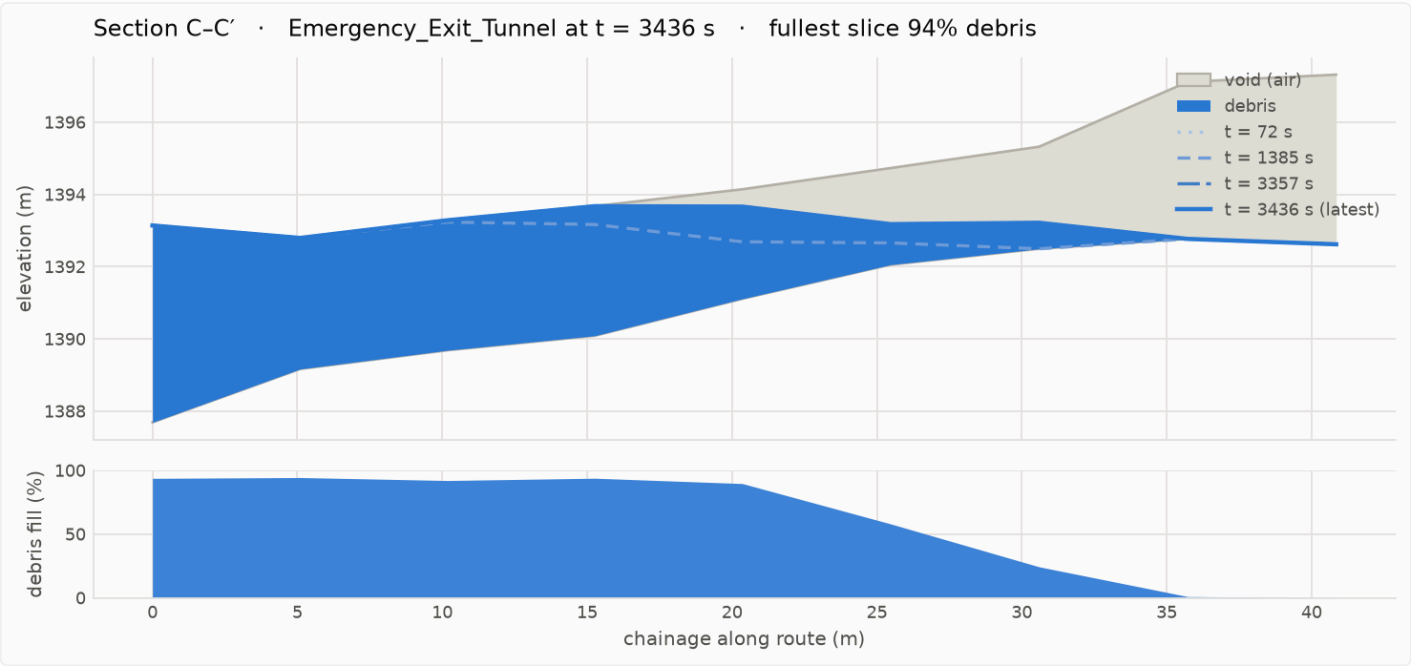
Section B–B′. The mesh resolves 6 of 6 stations along this route (100%). The fullest slice is 30% at chainage 25 m. The tightest measured point has 2.74 m of free height.



Cable_Duct_Tunnel: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section C–C′ · Emergency_Exit_Tunnel

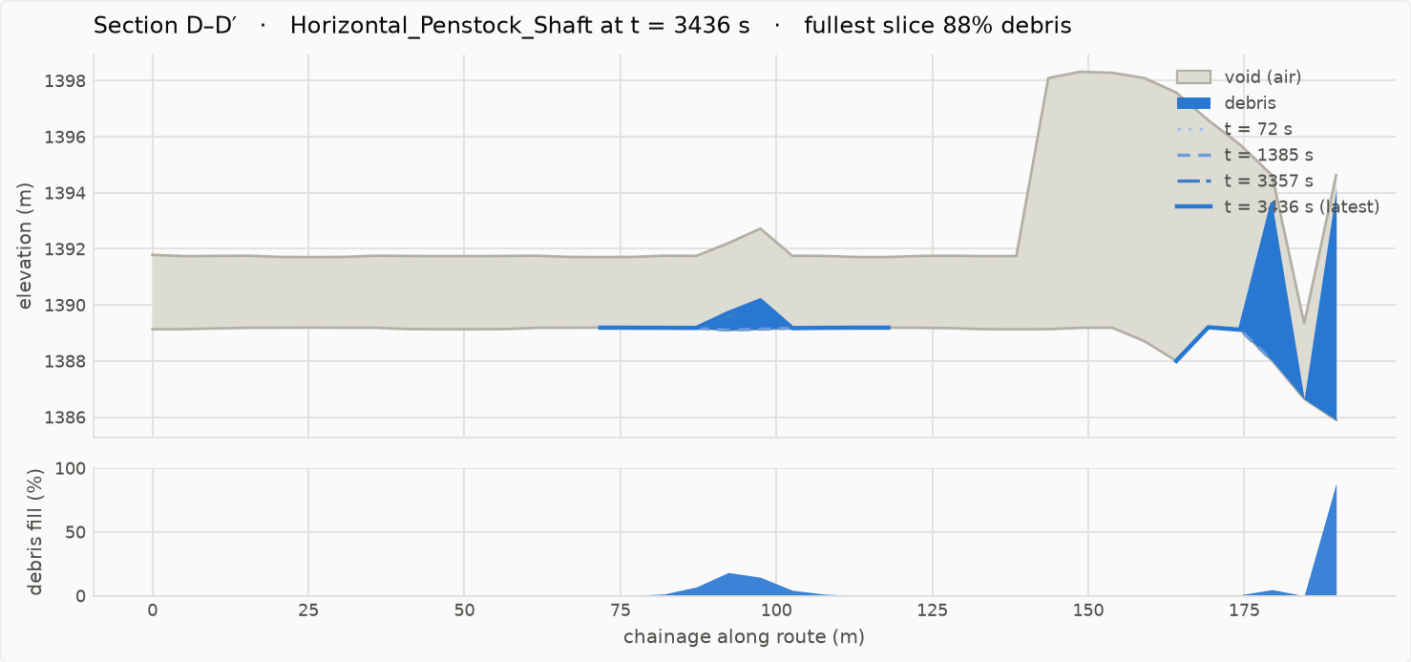
Section C–C′. The mesh resolves 9 of 9 stations along this route (100%). The fullest slice is 94% at chainage 5 m. The tightest measured point has 0.00 m of free height.



Emergency_Exit_Tunnel: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section D–D′ · Horizontal_Penstock_Shaft

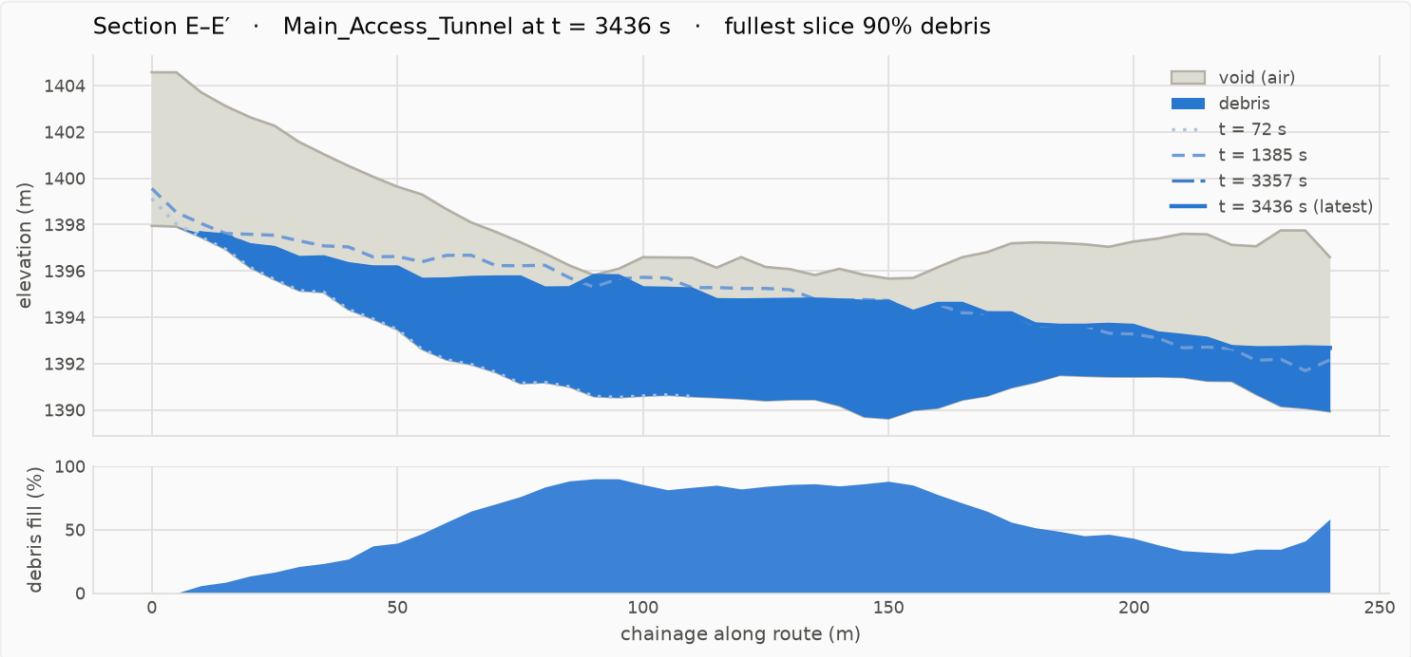
Section D–D′. The mesh resolves 38 of 38 stations along this route (100%). The fullest slice is 88% at chainage 190 m. The tightest measured point has 0.49 m of free height.



Horizontal_Penstock_Shaft: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section E–E′ · Main_Access_Tunnel

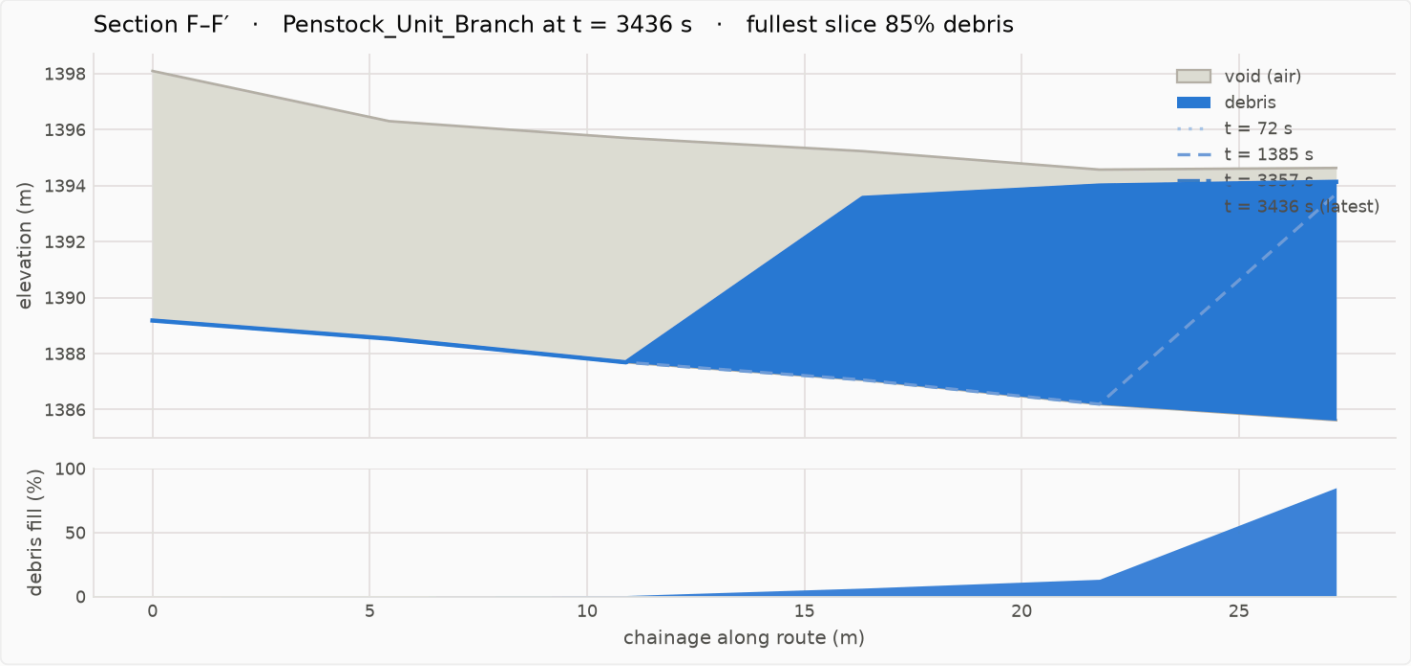
Section E–E′. The mesh resolves 49 of 49 stations along this route (100%). The fullest slice is 90% at chainage 90 m. The tightest measured point has 0.04 m of free height.



Main_Access_Tunnel: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section F–F′ · Penstock_Unit_Branch

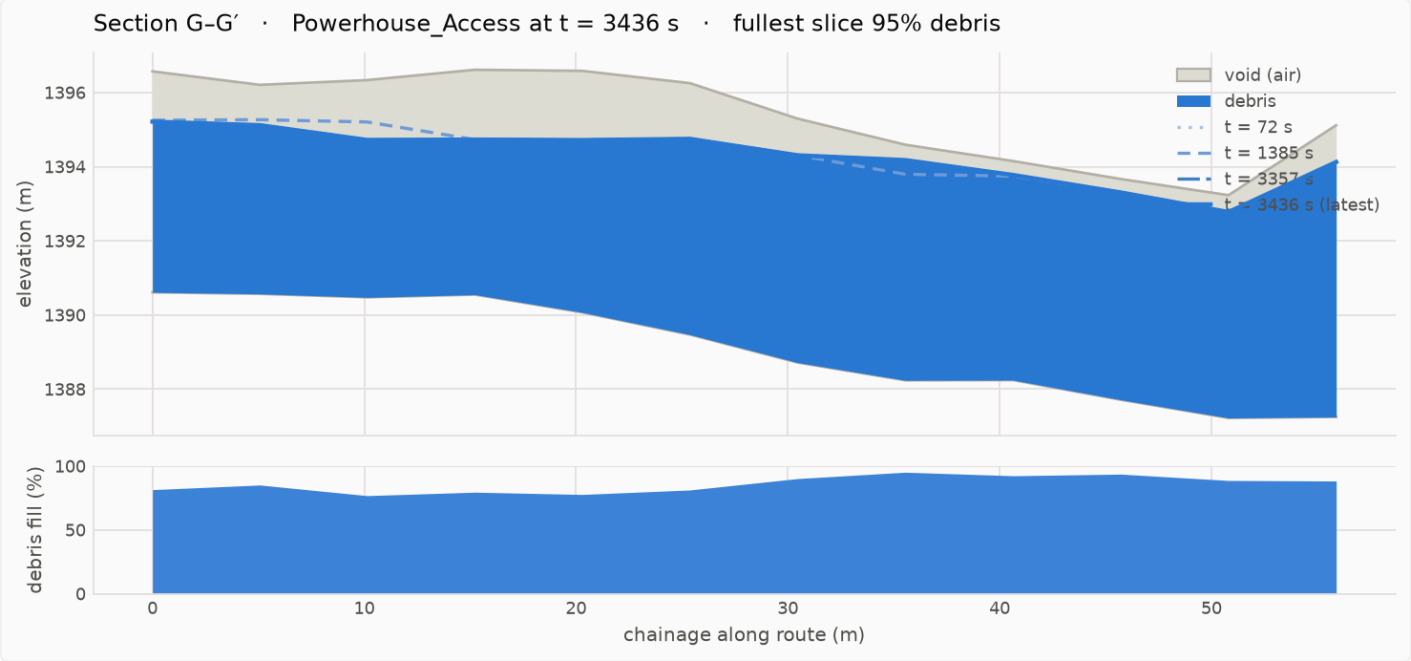
Section F–F′. The mesh resolves 6 of 6 stations along this route (100%). The fullest slice is 85% at chainage 27 m. The tightest measured point has 0.49 m of free height.



Penstock_Unit_Branch: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section G–G′ · Powerhouse_Access

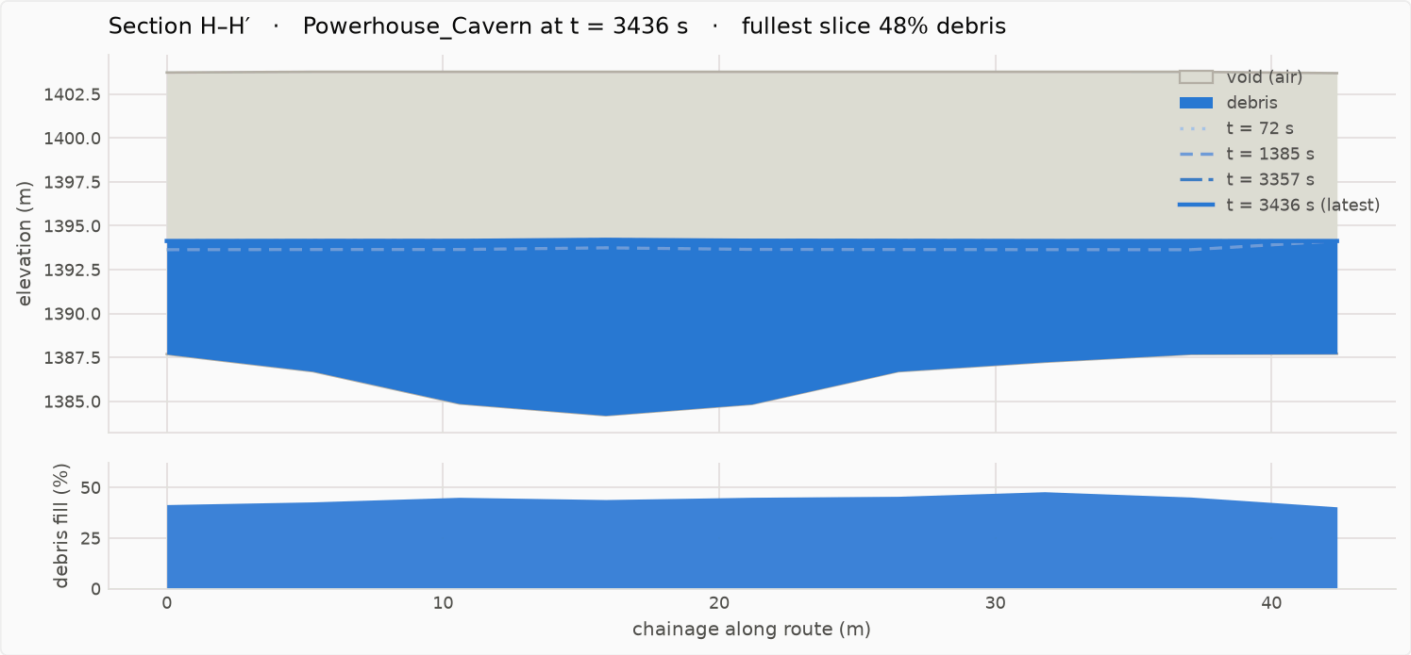
Section G–G′. The mesh resolves 12 of 12 stations along this route (100%). The fullest slice is 95% at chainage 36 m. The tightest measured point has 0.36 m of free height.



Powerhouse_Access: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section H–H′ · Powerhouse_Cavern

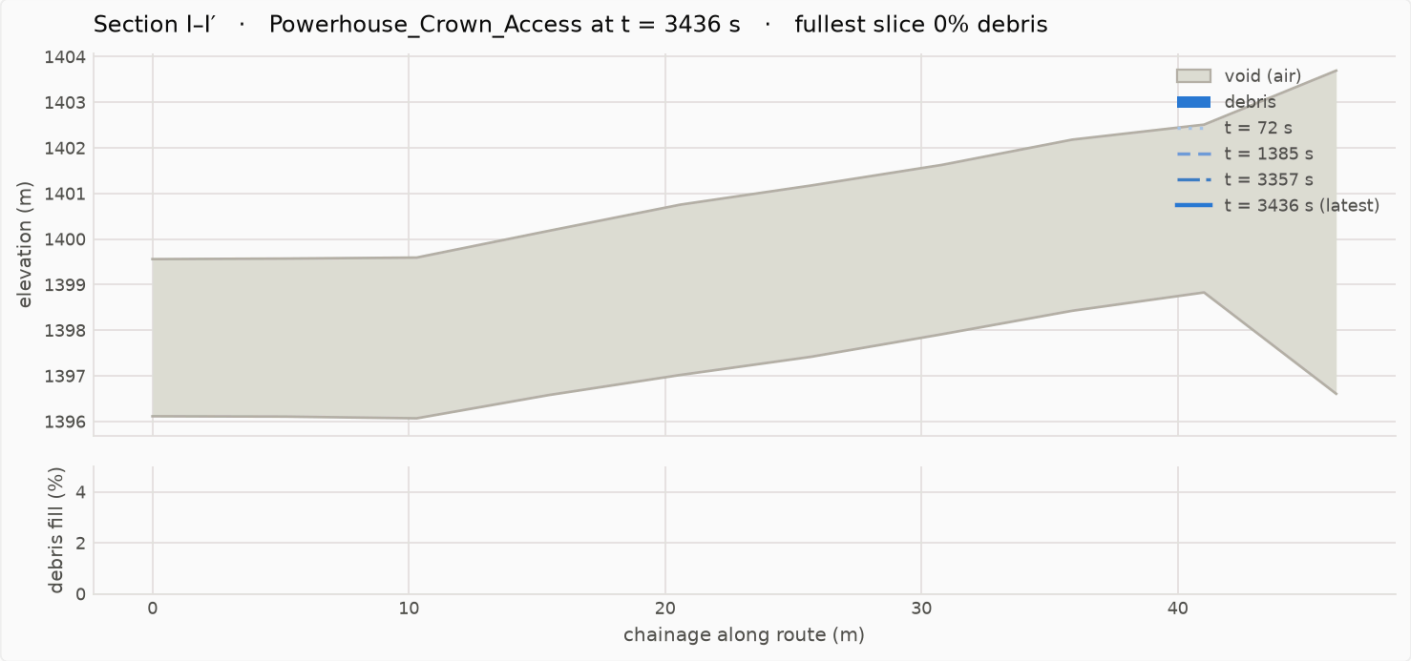
Section H–H′. The mesh resolves 9 of 9 stations along this route (100%). The fullest slice is 48% at chainage 32 m. The tightest measured point has 9.56 m of free height.



Powerhouse_Cavern: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section I–I′ · Powerhouse_Crown_Access

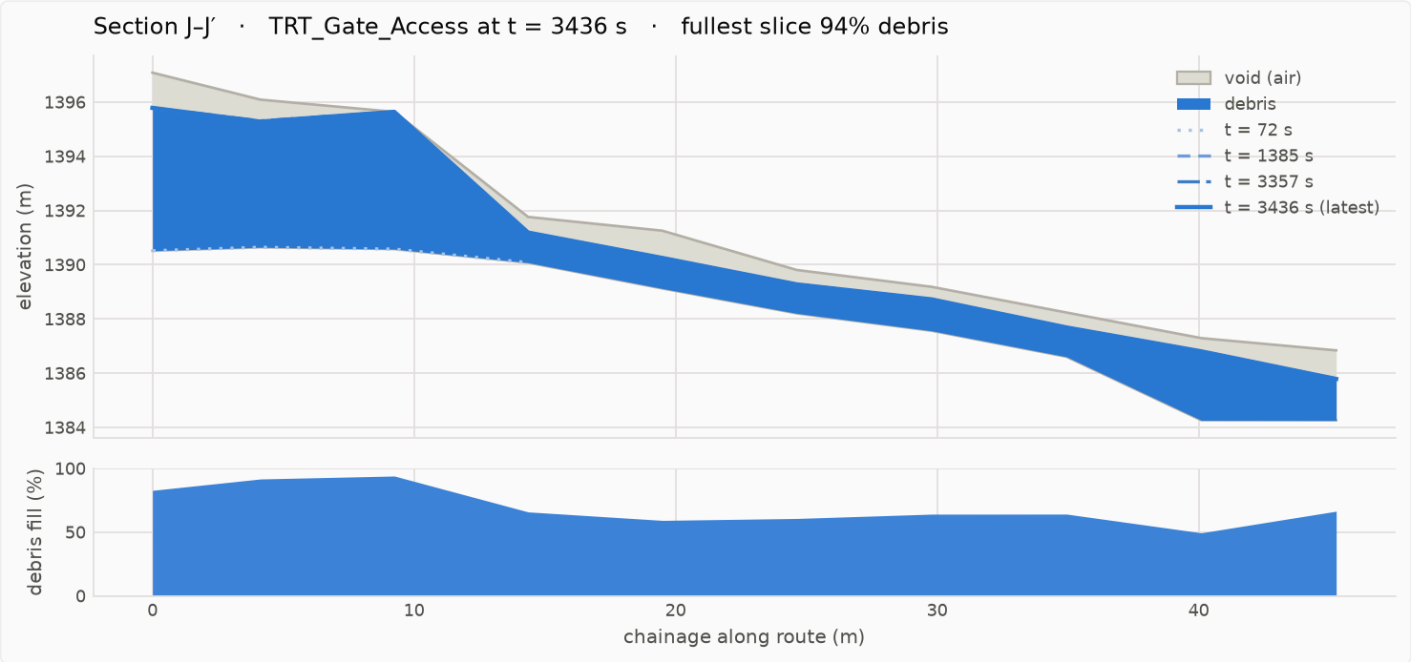
Section I–I′. The mesh resolves 10 of 10 stations along this route (100%). No debris has reached any measured slice on this route. The tightest measured point has 3.45 m of free height.



Powerhouse_Crown_Access: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section J–J′ · TRT_Gate_Access

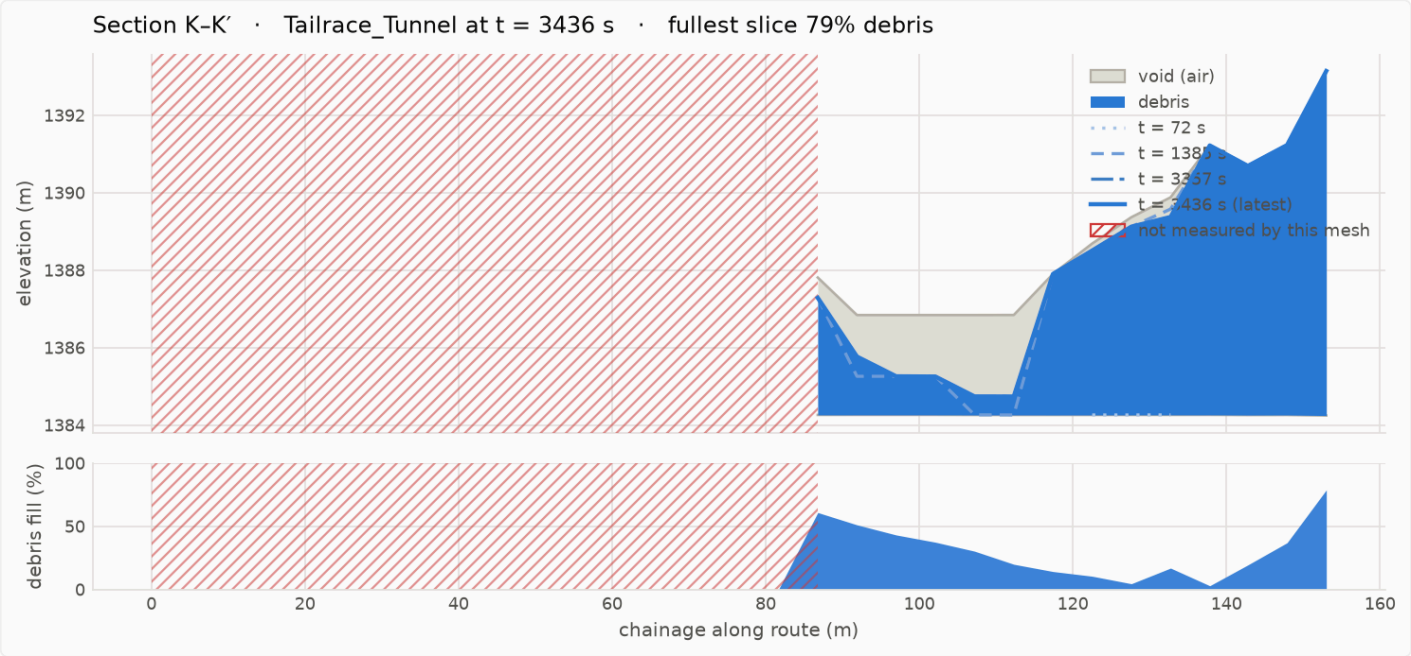
Section J–J′. The mesh resolves 10 of 10 stations along this route (100%). The fullest slice is 94% at chainage 9 m. The tightest measured point has 0.00 m of free height.



TRT_Gate_Access: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section K–K′ · Tailrace_Tunnel

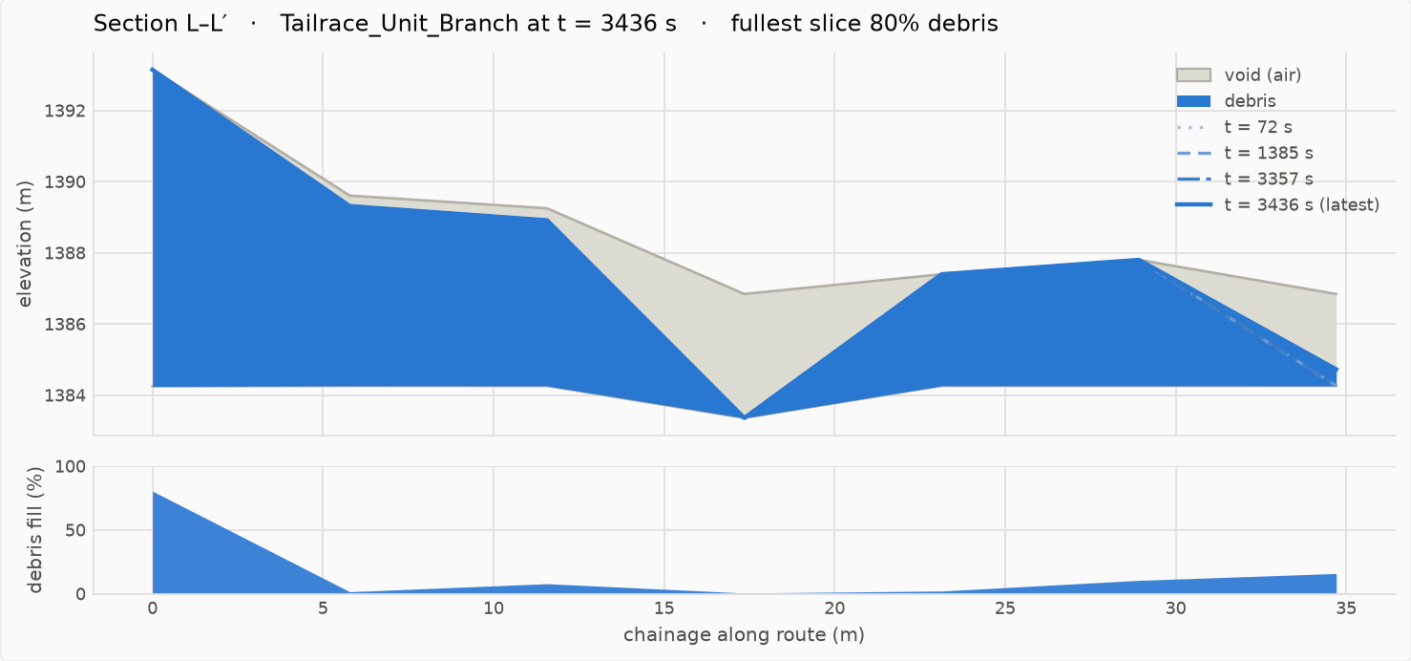
Section K–K′. The mesh resolves 14 of 31 stations along this route (45%). Under half of it is resolved, so nothing here should be read as evidence about whether this passage flooded — the hatched stretches are unmeasured, not empty. The fullest slice is 79% at chainage 153 m. The tightest measured point has 0.00 m of free height.



Tailrace_Tunnel: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section L–L′ · Tailrace_Unit_Branch

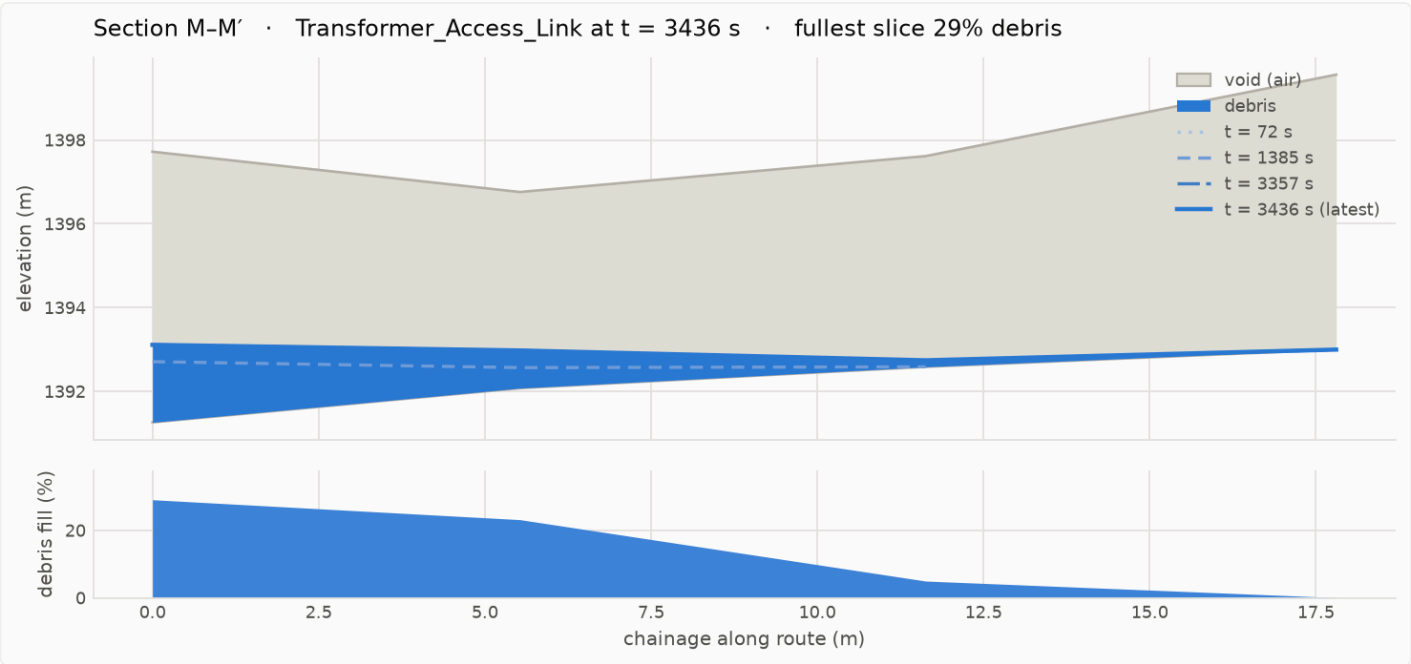
Section L–L′. The mesh resolves 7 of 7 stations along this route (100%). The fullest slice is 80% at chainage 0 m. The tightest measured point has 0.00 m of free height.



Tailrace_Unit_Branch: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section M–M′ · Transformer_Access_Link

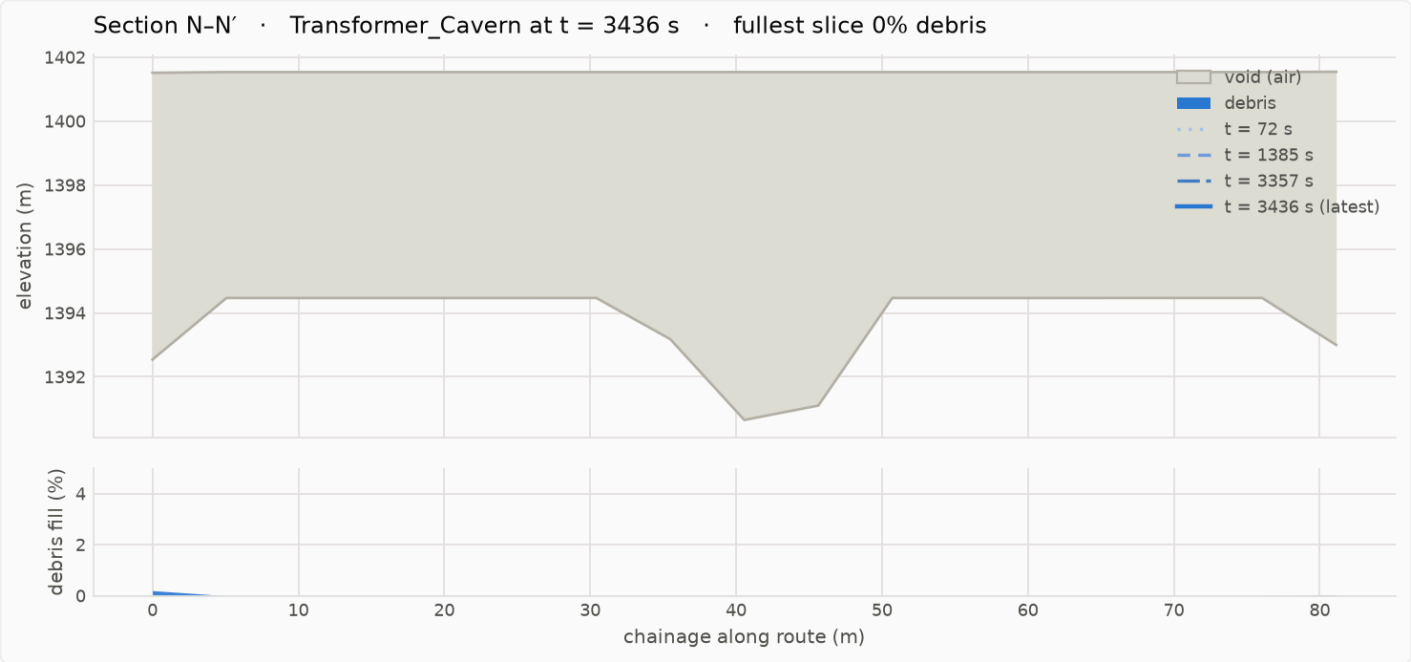
Section M–M′. The mesh resolves 4 of 4 stations along this route (100%). The fullest slice is 29% at chainage 0 m. The tightest measured point has 3.78 m of free height.



Transformer_Access_Link: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

Section N–N′ · Transformer_Cavern

Section N–N′. The mesh resolves 17 of 17 stations along this route (100%). The fullest slice is 0% at chainage 0 m. The tightest measured point has 7.07 m of free height.



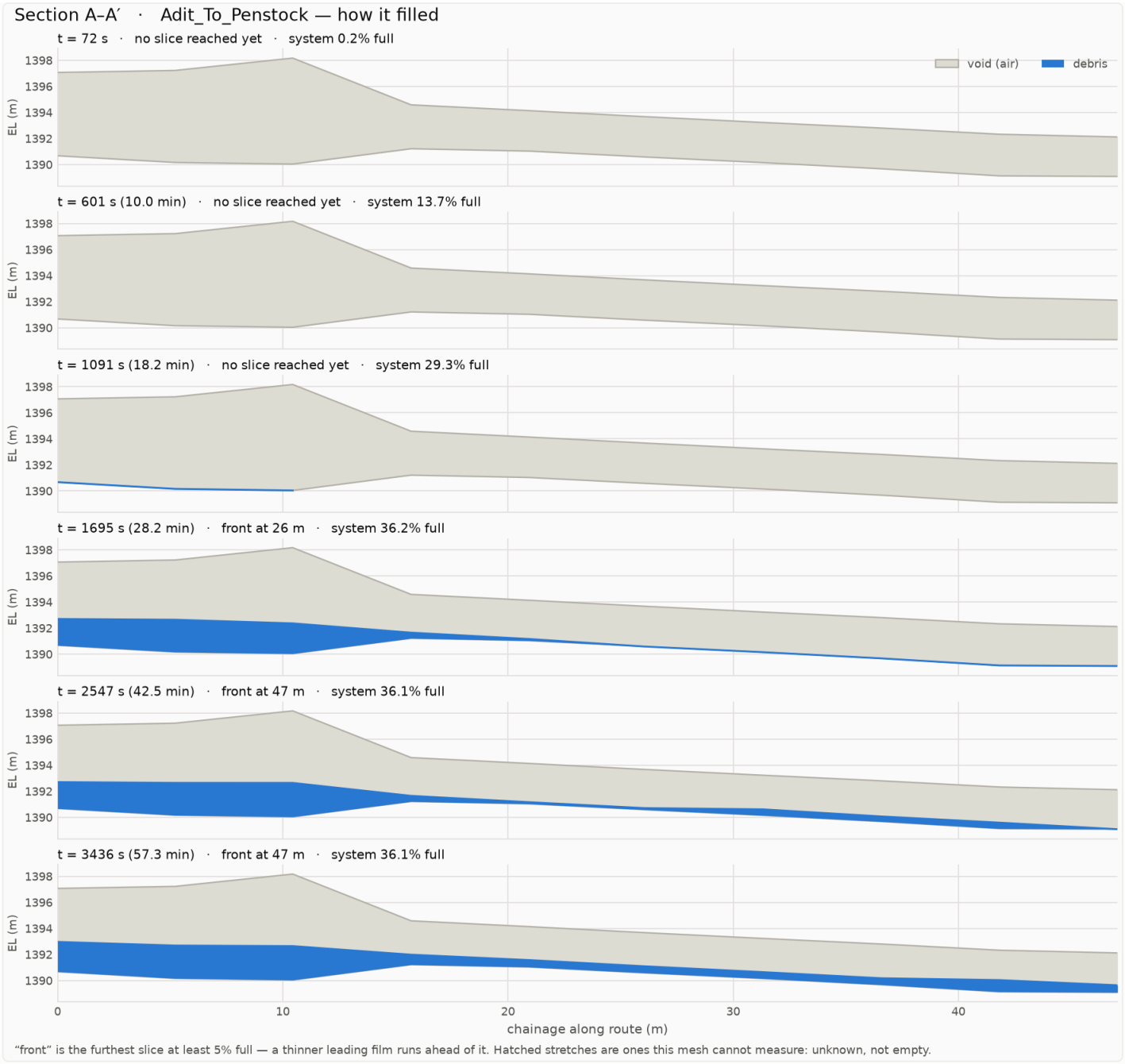
Transformer_Cavern: void envelope, debris within it, and debris fill fraction along the route. Hatched stretches are unmeasured.

How it filled — the same sections over time

The long profiles above are the end state. These are the same cuts at several times through the run, drawn on shared axes so a deposit that barely grew cannot look like one that doubled. They answer a different question from the rest of the report: not *where is the debris*, but *how did it get there, and how fast* — which is what says whether a passage filled steadily or was cut off in one surge.

The times shown are written solver times, not evenly spaced: interFoam writes on a wall-clock interval and its timestep varies, so the gaps between panels differ. The bar under each animation shows where each frame sits in the run.

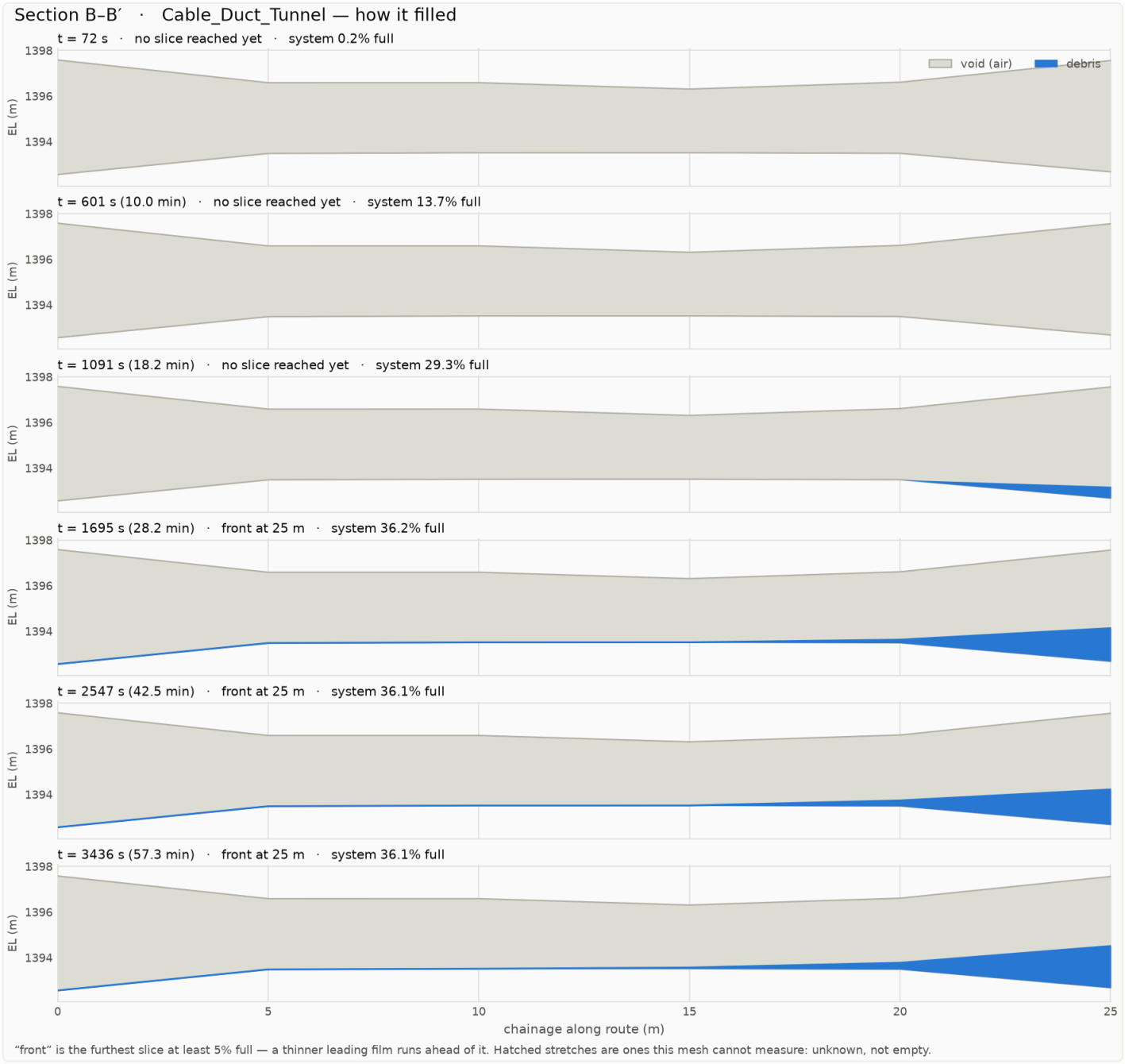
Section A–A′ · Adit_To_Penstock over time



Adit_To_Penstock: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

Adit_To_Penstock, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

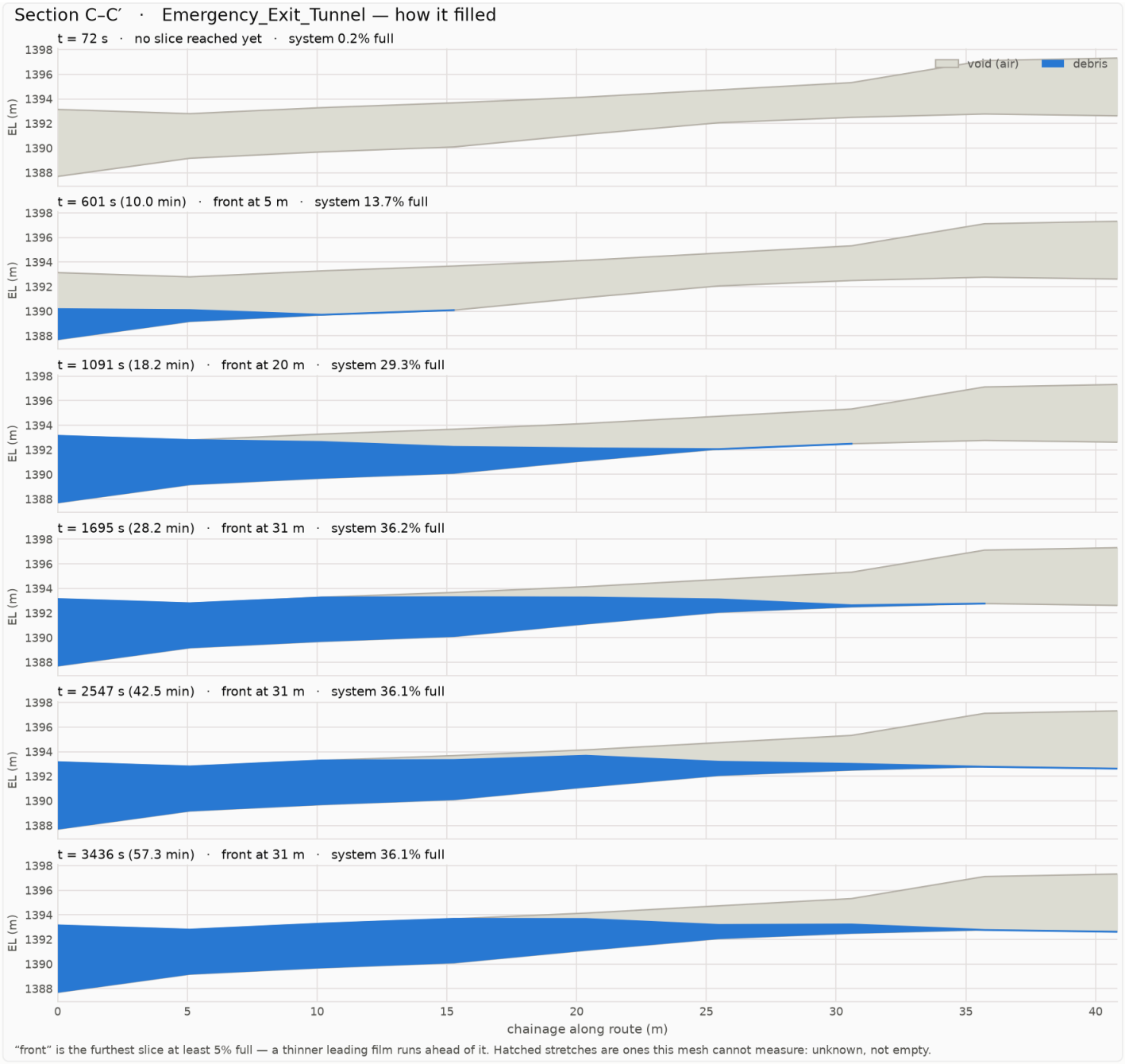
Section B–B′ · Cable_Duct_Tunnel over time



Cable_Duct_Tunnel: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

Cable_Duct_Tunnel, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

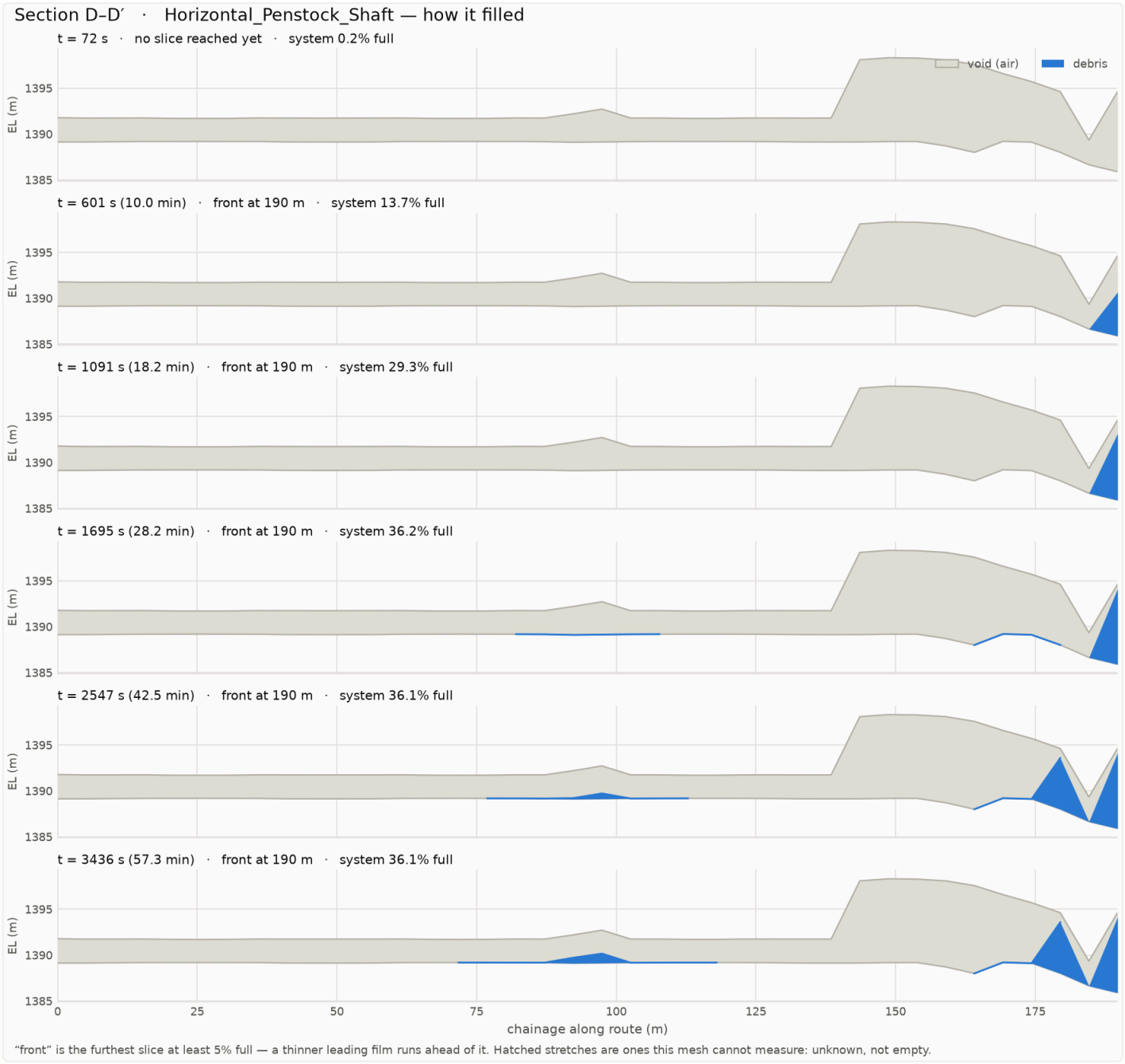
Section C–C′ · Emergency_Exit_Tunnel over time



Emergency_Exit_Tunnel: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

Emergency_Exit_Tunnel, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

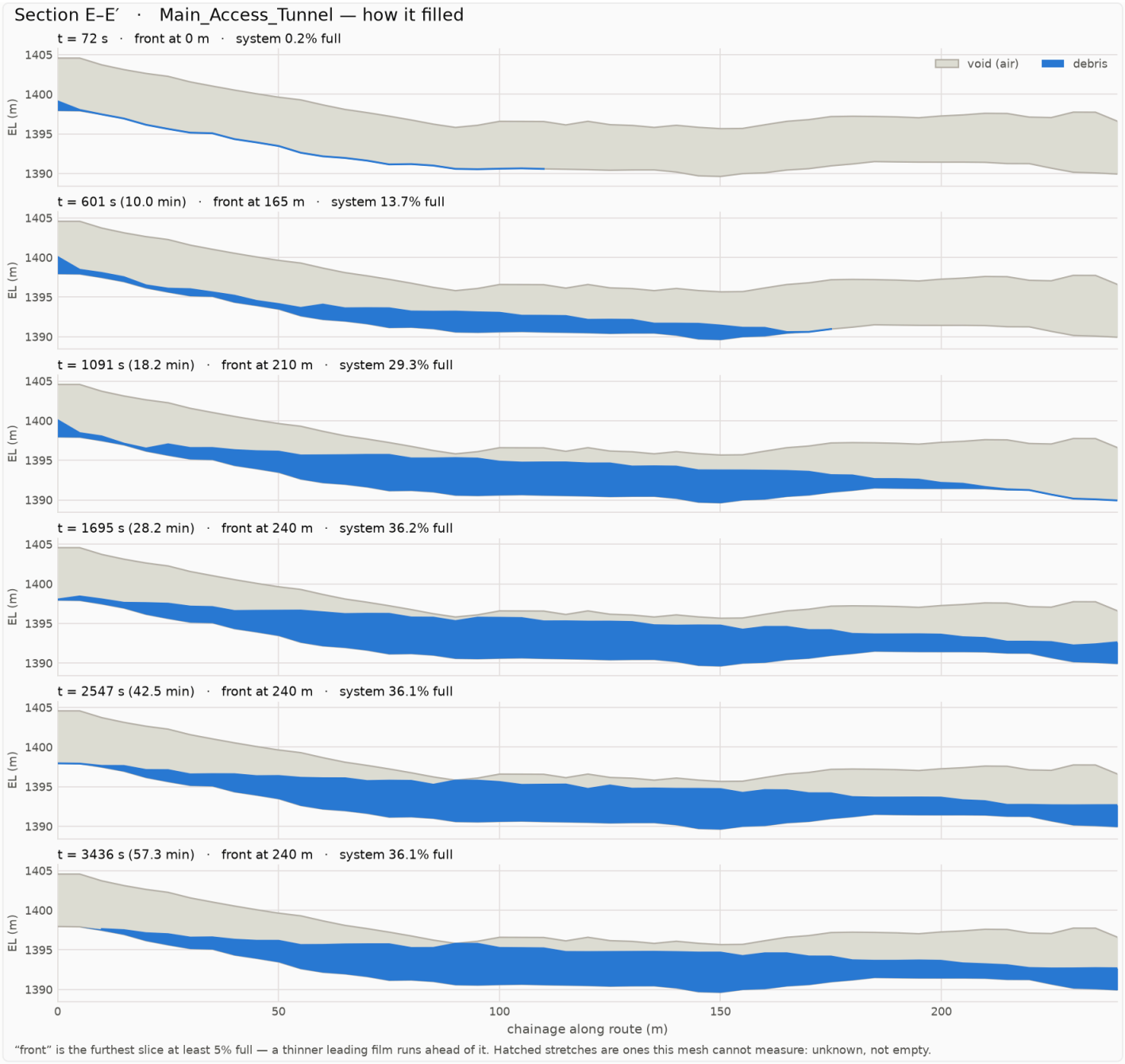
Section D–D′ · Horizontal_Penstock_Shaft over time



Horizontal_Penstock_Shaft: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

Horizontal_Penstock_Shaft, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

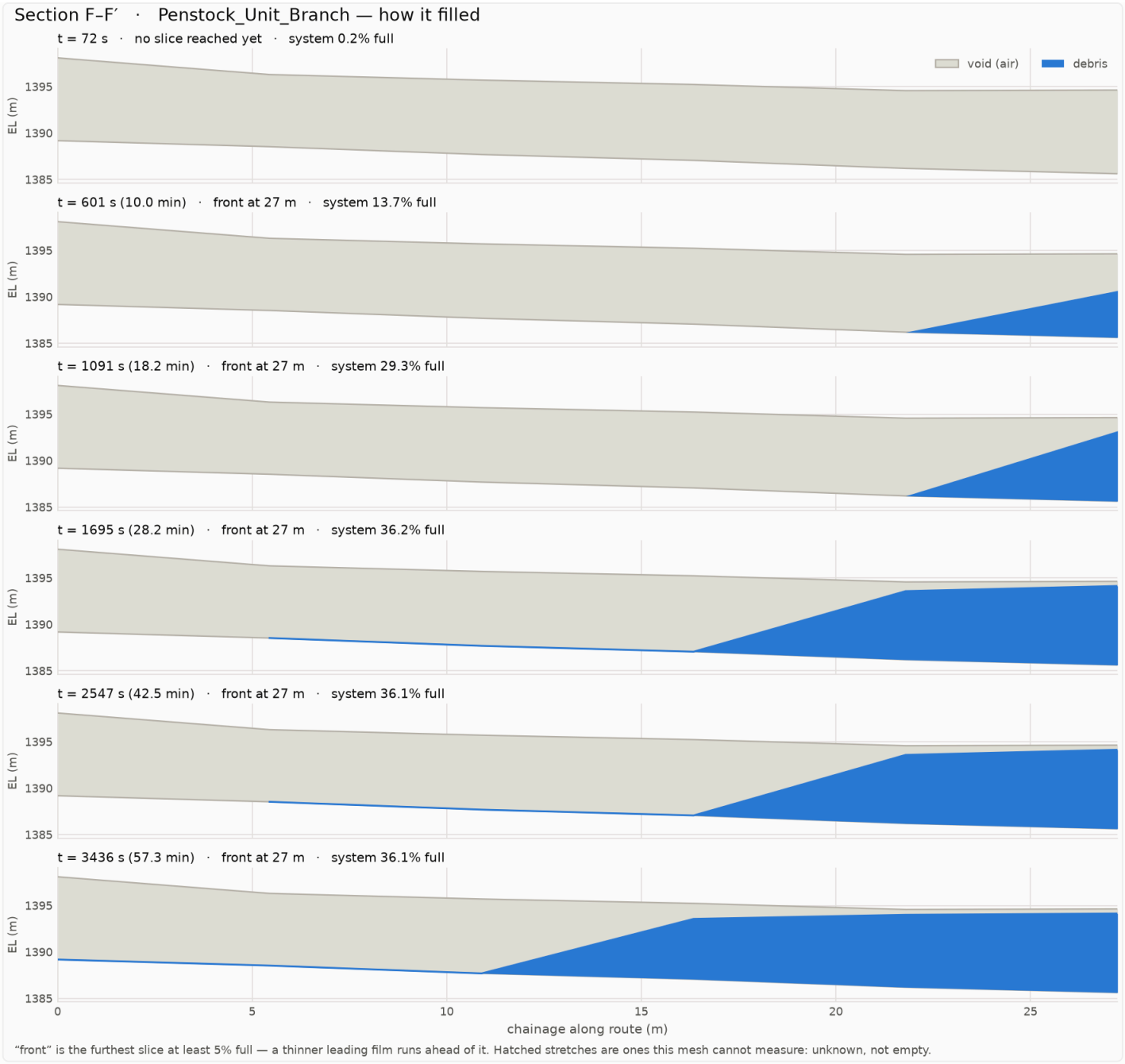
Section E–E′ · Main_Access_Tunnel over time



Main_Access_Tunnel: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

Main_Access_Tunnel, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

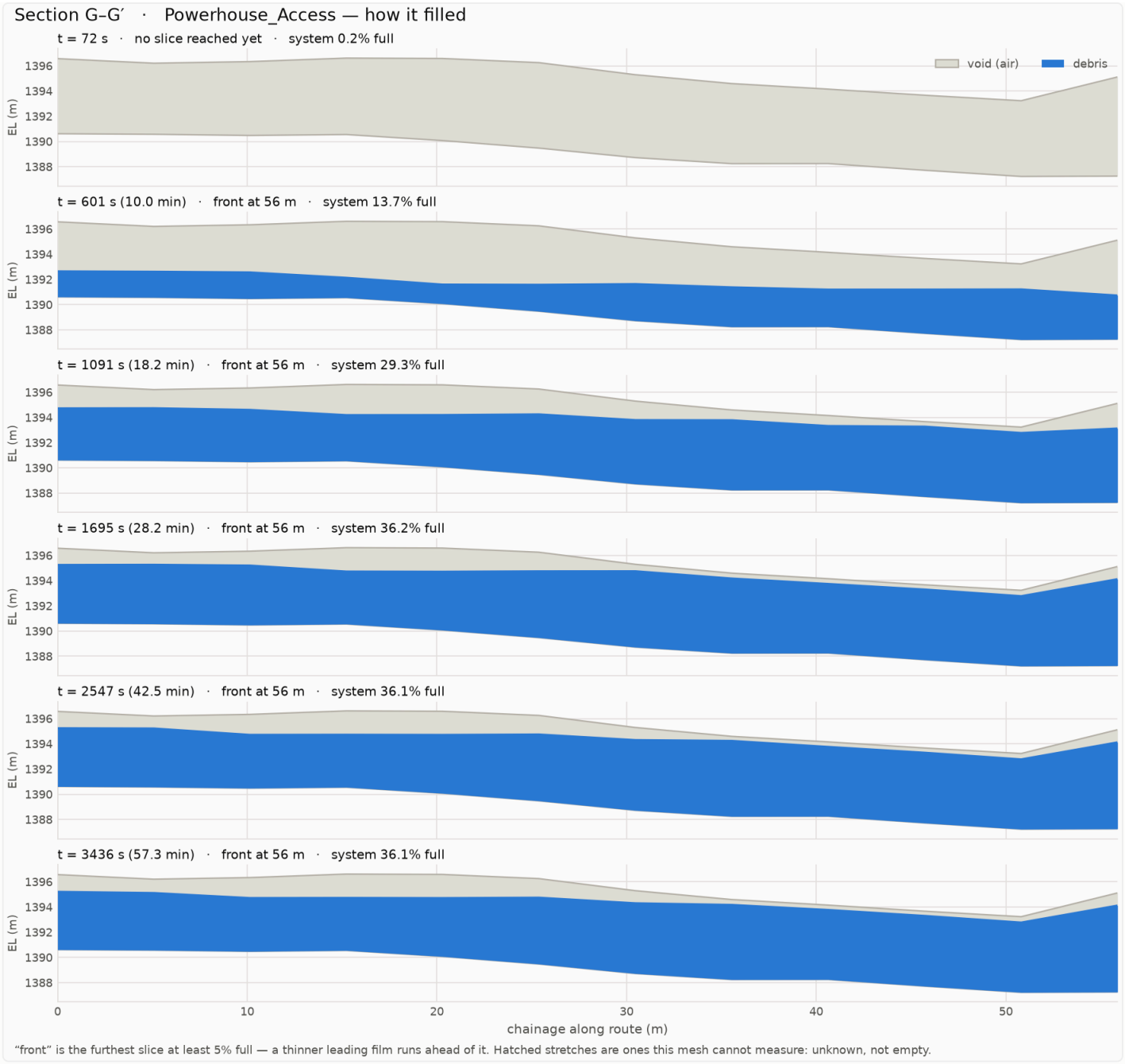
Section F–F′ · Penstock_Unit_Branch over time



Penstock_Unit_Branch: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

Penstock_Unit_Branch, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

Section G–G′ · Powerhouse_Access over time



Powerhouse_Access: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

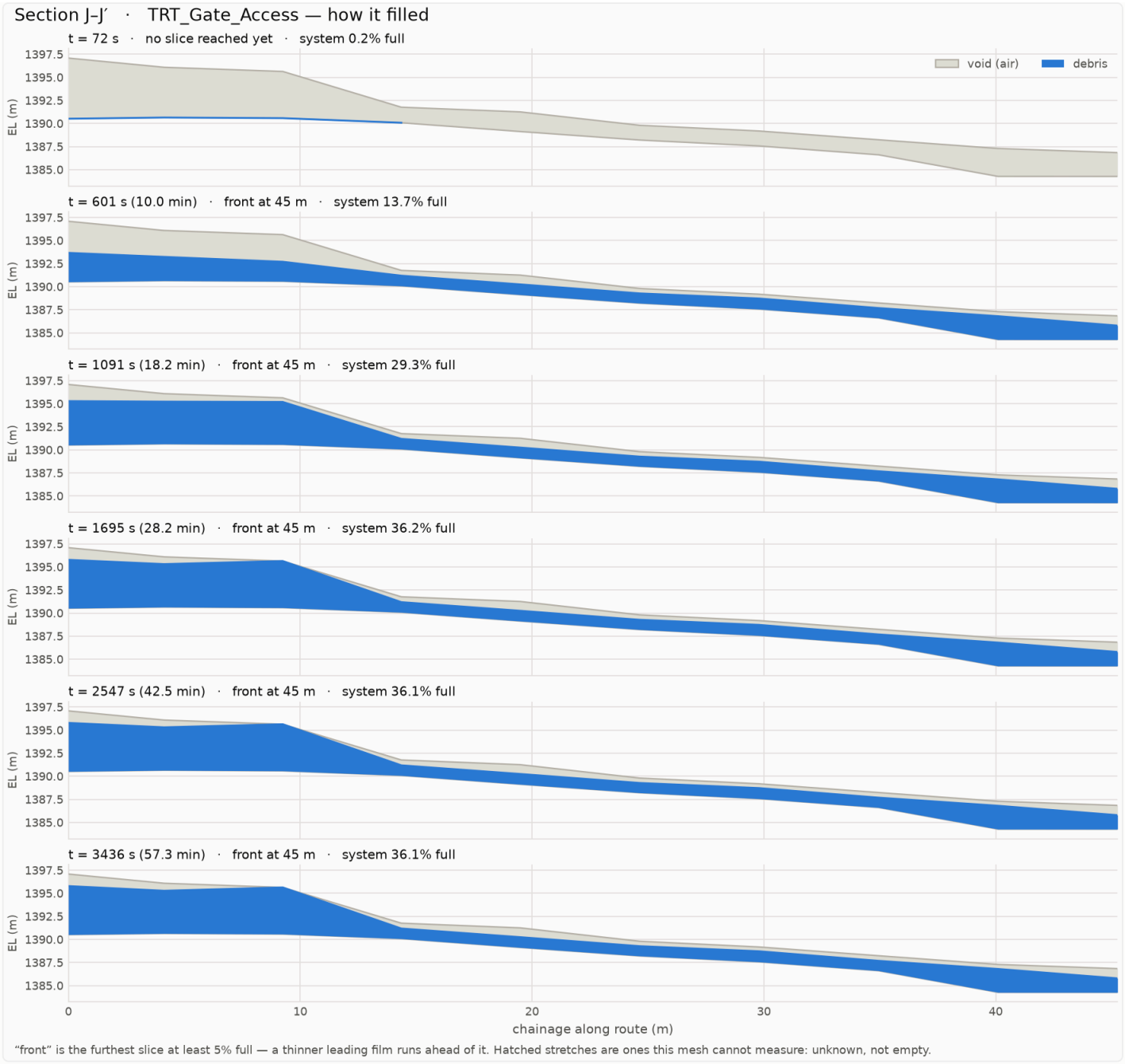
Powerhouse_Access, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

Section H–H′ · Powerhouse_Cavern over time

Powerhouse_Cavern: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

Powerhouse_Cavern, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

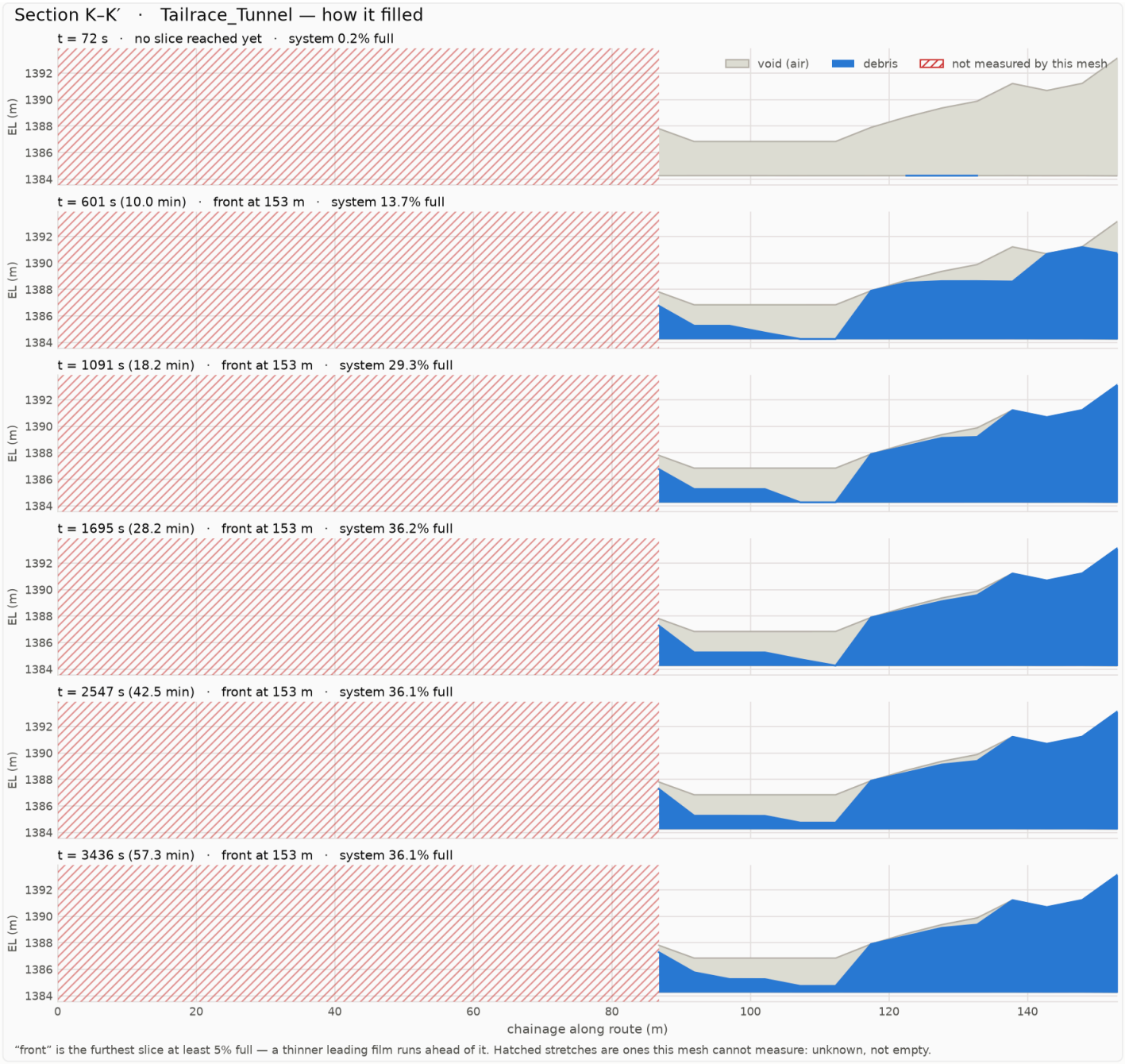
Section J–J′ · TRT_Gate_Access over time



TRT_Gate_Access: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

TRT_Gate_Access, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

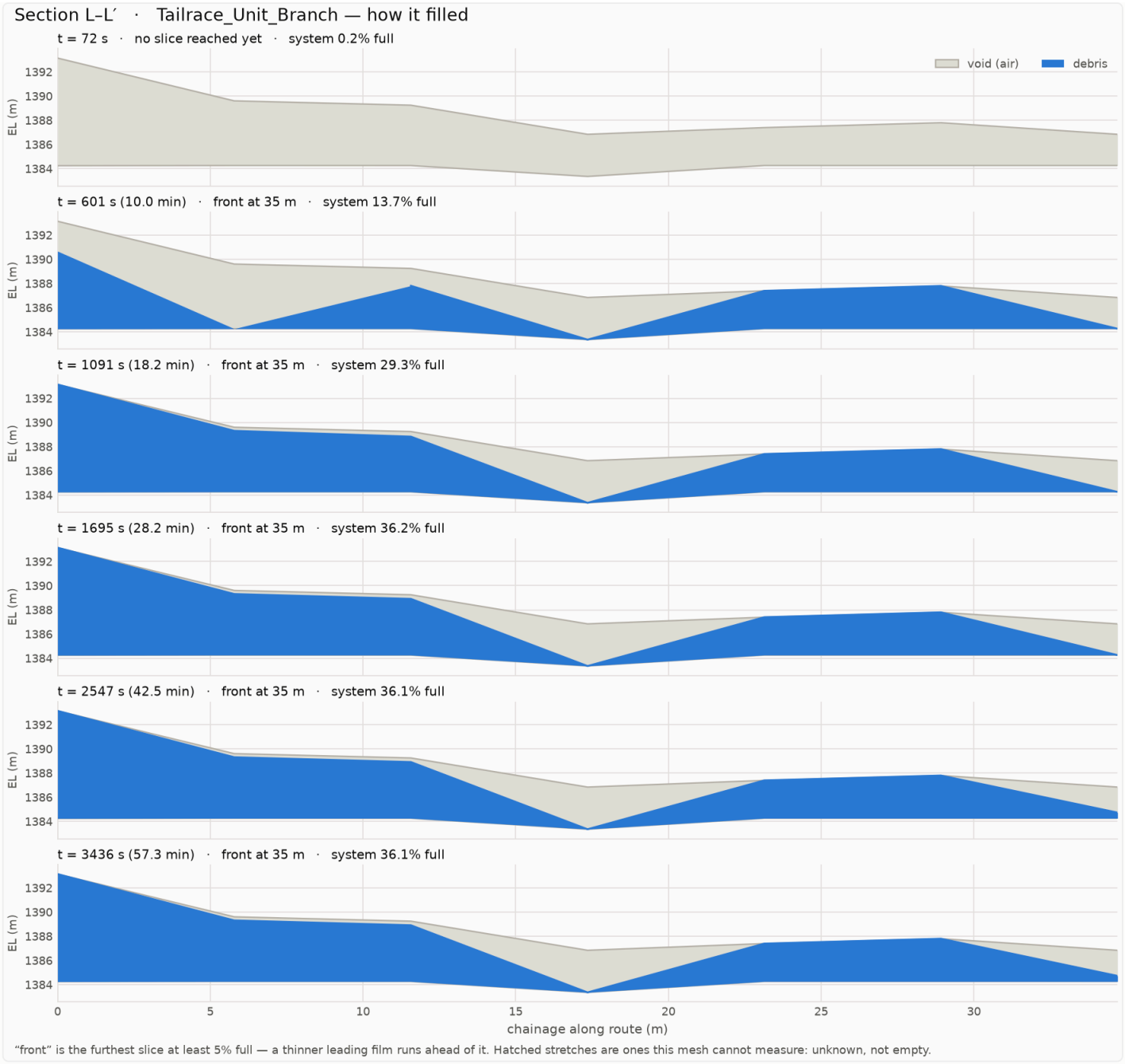
Section K–K′ · Tailrace_Tunnel over time



Tailrace_Tunnel: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

Tailrace_Tunnel, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

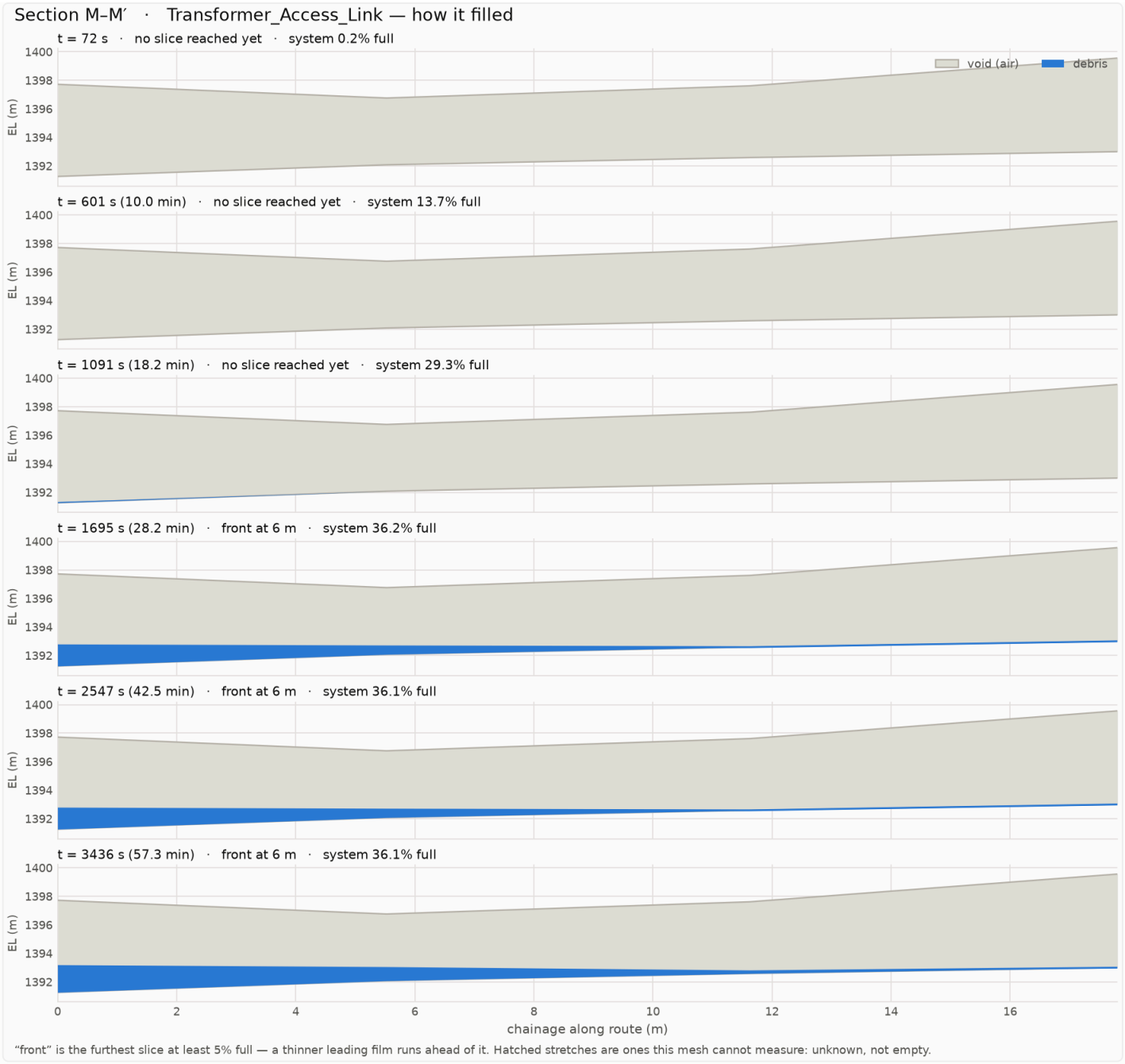
Section L–L′ · Tailrace_Unit_Branch over time



Tailrace_Unit_Branch: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

Tailrace_Unit_Branch, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

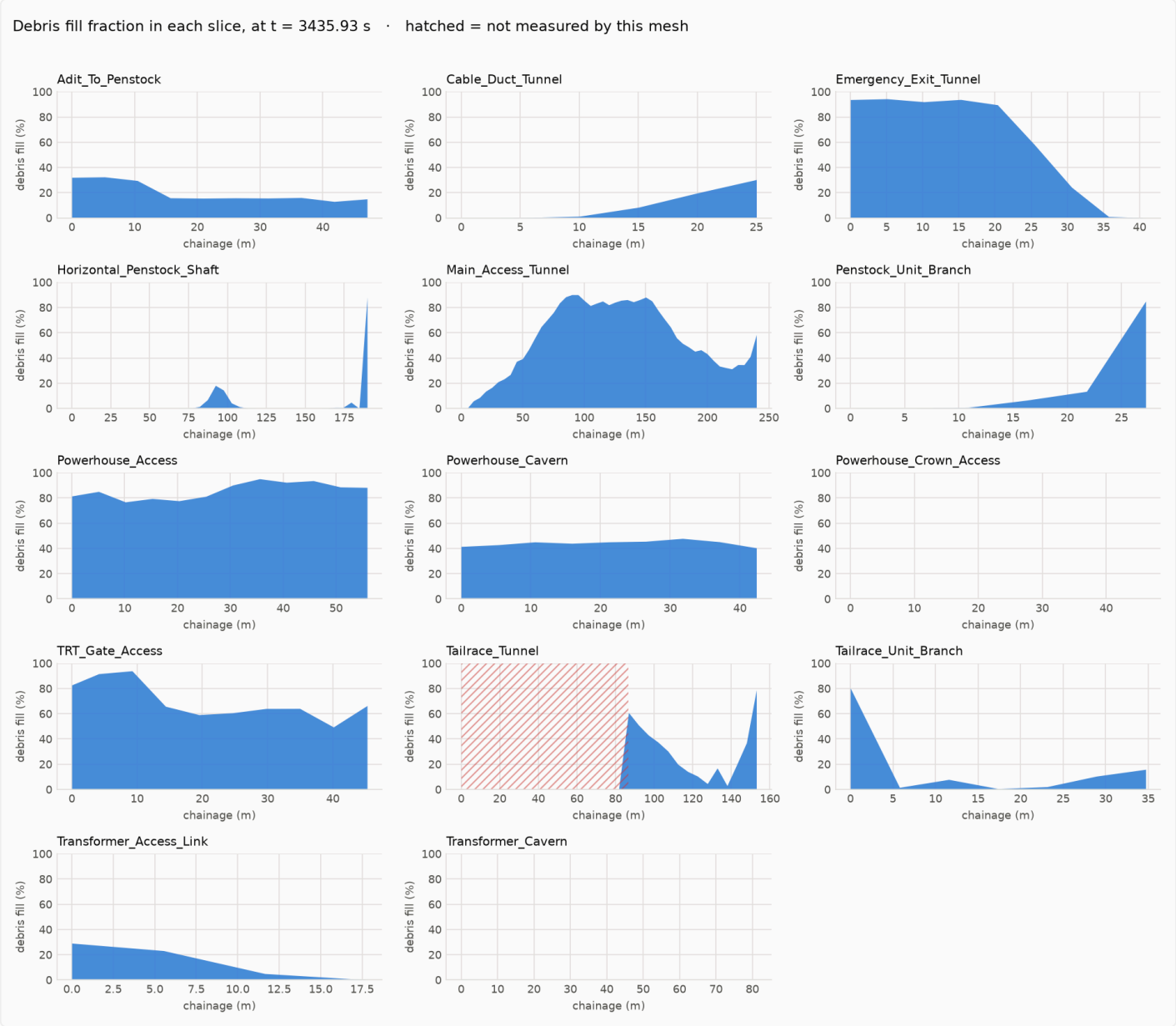
Section M–M′ · Transformer_Access_Link over time



Transformer_Access_Link: the void envelope and the debris in it, at several times through the run. All panels share one pair of axes.

Transformer_Access_Link, every written time. The bar underneath marks where the frame sits in the run and where the solver wrote.

Debris fill at a glance



Every route on the same 0–100% debris scale, for comparison at a glance.

Blocked segments

Continuous runs where the passage is full enough to count as blocked, using the threshold set in this scenario.

none

Air pockets

Connected volumes of air the debris has not displaced, largest first. An **isolated** pocket is breathable space that nothing has reached — but it is also unreachable, and its air is finite.

#	volume (m³)	class	floor EL	ceiling EL	headroom (m)	survivable
0	19,534	vented	1,383.74	1,405.07	21.33	yes

Fullest stations

route	chainage (m)	fill	free height (m)	arrival (s)
Powerhouse_Access	36	95%	0.41	262
Emergency_Exit_Tunnel	5	94%	0.00	563
TRT_Gate_Access	9	94%	0.00	116
Emergency_Exit_Tunnel	15	94%	0.00	721
Emergency_Exit_Tunnel	0	94%	0.00	449
Powerhouse_Access	46	94%	0.36	262
Powerhouse_Access	41	92%	0.38	262
Emergency_Exit_Tunnel	10	92%	0.00	647
TRT_Gate_Access	4	92%	0.81	116
Powerhouse_Access	30	90%	0.99	262
Main_Access_Tunnel	90	90%	0.04	116
Main_Access_Tunnel	95	90%	0.32	116
Emergency_Exit_Tunnel	20	90%	0.48	926
Powerhouse_Access	51	89%	0.45	232
Main_Access_Tunnel	85	88%	0.98	116

Volumes and mass balance

quantity	value

domain_m3	30,807
debris_m3	11,116
air_m3	19,691
filled_fraction	0.36
air_in_pockets_m3	19,534

The solver's own volume integral went from 169 m³ to 11,089 m³, a gain of 10,920 m³. Compare that against the inflow prescribed in the scenario to confirm the boundary delivered what it should.

Warnings from this run

- no full blockage found: the highest fill is 95% and the tightest point is Emergency_Exit_Tunnel at chainage 0 m with 0.00 m of free height
- Tailrace_Tunnel: only 14 of 31 stations are resolved by this mesh (45%). The passage is too narrow for the cell size, so results along this route say nothing about whether it flooded — refine the mesh before drawing any conclusion from it.

Provenance

The geometry is an evidence-preserving reconstruction: every component carries a classification recording how well it is known, from a measured field book through to an outright assumption.

Evidence classifications used: `CONFIRMED_FROM_DRAWING`, `HANDWRITTEN_ANNOTATION`, `GEOMETRIC_INFERENCE`, `ASSUMPTION_FOR_VISUALIZATION`, `UNKNOWN`, `OWNER_SPECIFICATION`, `MEASURED_FIELD_BOOK`, `CROSS_DOCUMENT_CORROBORATION`

Incident chronology and public reporting: chilimerescue.org (Swoorup Joshi). That site and this study draw on the same canonical reconstruction, but its map is published as illustrative and explicitly not for engineering decisions, so it is cited here and not reproduced.

Appendix — the full parameter set

Everything needed to reproduce this run, and nothing needed to read the result. Values are the run's own `scenario.json` and `run-manifest.json`, so an archived run reports what it was actually run with rather than whatever the scenario file says today.

A1 · Rheology and phases

The debris is modelled as a single non-Newtonian fluid, not as grains in water. It plugs by yield stress alone — floating timber, which the portal photograph shows, is not represented, so a calibrated yield stress may be standing in for a mechanical jam. (n = 1, so this is a Bingham fluid)

property	debris	air
rheology model	`herschel_bulkley`	Newtonian
density (kg/m³)	1,900	1.2
kinematic viscosity (m²/s)	from the rheology	0.00001500
yield stress τ_y (Pa)	744.2	—
consistency k (Pa·sⁿ)	5	—
flow index n	1	—
viscosity cap ν_max (m²/s)	100	—
solids volume fraction	0.45	—

A2 · Inflow hydrograph

Discharge prescribed at the inlet patch, linearly interpolated between these points and held at the last value afterwards. The volume under it is the sweep's swept parameter.

time (s)	discharge (m³/s)	volume delivered by then (m³)
0	0	0
334.641	11.099	1,857
1003.92	11.099	9,285
1673.21	0	13,000

A3 · Boundary conditions

Only the open boundaries are listed individually — they are what decide whether air can leave and so whether the system can fill. The remaining 11 patch(es) are no-slip walls: `adit_to_penstock_end`, `horizontal_penstock_shaft_end`, `main_access_dead_end`, `penstock_unit_branch_end`, `penstock_upstream_end`, `tailrace_river_end`, `tailrace_tunnel_end`, `tailrace_unit_branch_end`, `tailrace_unit_branch_start`, `trt_gate_access_end`, `walls`.

patch	type	slip
`emergency_exit_end`	atmosphere	no_slip

A4 · Mesh

The cell size is the limit on what the analysis can answer for: a passage narrower than a few cells is reported as unmeasured, not as empty.

setting	value
base cell size (m)	1
surface refinement level	1
refinement regions	near junctions, r = 8 m, level 1
minimum cells across a passage	4
boundary layers	0
quality preset	`default`
cells produced	198,678
faces produced	626,665
max non-orthogonality (°)	58.9
max skewness	4.57

A5 · Numerics and time stepping

The timestep is set by the Courant limit rather than by the write interval, so written times are not evenly spaced.

setting	value

solver	`interfoam`
turbulence	`laminar`
scheme preset	`robust`
momentum predictor	False
α sub-cycles	2
interface compression c_α	1
end time (s)	3,473
write interval (s)	116
max Courant	0.50
max α Courant	0.50
max timestep (s)	0.50
adjustable timestep	True
checkpoint interval (wall s)	900

A6 · Analysis thresholds

These decide what the report calls blocked, what counts as an air pocket, and which pockets are reported as survivable. Changing them changes the wording of the findings, not the physics.

setting	value
station spacing (m)	5
blocked above debris fill fraction	0.95
blocked minimum length (m)	2
air pocket minimum volume (m³)	2
survivable minimum headroom (m)	1
vent patches	`portal_inlet`, `emergency_exit_end`

A7 · Compute and provenance

The image digest is what makes a result reproducible: the same digest on any machine runs the same solver build.

item	value
geometry package	`geometry/chilime-v2`
extra voids included	`Pump_Sump_Pit`, `MIV_Pit_Connection_A`, `MIV_Pit_Connection_B`, `Machine_Hall_Trenches`
backend	`ssh`
container image	`opencfd/openfoam-default:2412`
image digest	`opencfd/openfoam-default@sha256:1ba02114b1c025c370f2e269a07677c16c9bea8d990fcd75ac8378aff9d41b50`
MPI ranks	14
memory limit (GB)	48
host	Linux aarch64
host cores / memory	16 / 63 GB
wall time · build	0 s
wall time · mesh	73 s
wall time · solve	44,447 s
wall time · analyze	102 s
wall time · export	1 s
wall time ·	180 s

timelapse	
wall time · report	8 s
wall time · archive	20 s

A8 · Dimensionless numbers at build time

Computed from the scenario before the run, to check the regime is the one intended. They describe the inflow, not the result.

quantity	value
peak discharge m3s	11.10
fill time s	2,777.20
fill time min	46.30
tau y pa	744.20
arrest thickness m	0.65
reynolds	895
bingham	2,274.99
hedstrom	2,036,131.20
froude	0.05
velocity m s	0.39
estimated cells	169,732
estimated memory gb	0.25

Limitations

Embedded verbatim and unconditionally: the handoff asks that these travel with any derived product, and a report is the most likely thing to be forwarded on its own.

- Not a survey-certified CFD/DEM domain.
- Separate component shells are not Boolean-unioned at junctions.

- Open boundaries and overlapping shells require solver-specific preprocessing.
- No verified CRS, true-north bearing, geographic origin, or common site benchmark tie.
- No rheology, roughness, inflow, blockage, or incident boundary conditions are encoded.
- Cavern connectivity is corrected, not surveyed: six passage ends were swept along their own axes into the cavern boxes they point at, by 0.75-2.77 m each. The openings are the tunnels' own cross-sections at their own inverts; no doorway dimension, sill or lintel is evidenced.
- The caverns are still box volumes with flat crowns, no internal floors and no equipment. Powerhouse internals (control room, switchgear gallery, generator and crane envelopes, stair core, catwalk) exist in the package as solids and are off unless a scenario names them.
- The connections below the powerhouse floor are NOT made: the two penstock/MIV ends (EL 1386.910) and the two tailrace/draft-tube ends (EL 1385.560) remain sealed, as in chilime-v1. They pass through valves and gates whose state is a scenario question, and the draft-tube geometry is not in the handoff.