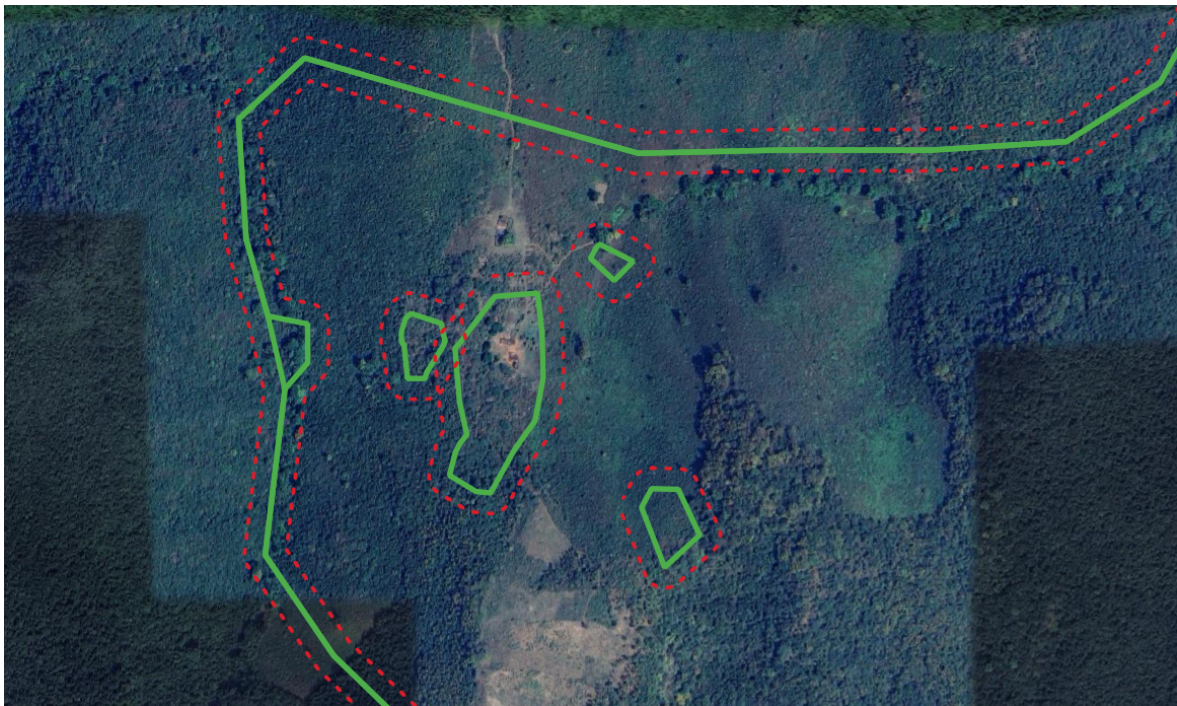


Fireline Planner

QGIS Plugin — User Manual

A multi-criteria decision-support tool for prioritizing forest blocks for firebreak (fire line) construction and generating candidate fire-line alignments.



Actual plugin output on real forest data — fire line alignments (red dashed) generated inside forest block boundaries (green).

Version 0.1

Prepared for internal forest fire management planning use

1. Introduction & Objective

Fireline Planner is a QGIS Processing plugin built to support forest fire line (firebreak) planning. It helps a field officer or planner move from raw spatial layers to a concrete, field-ready construction plan in three steps: score every forest block on fire vulnerability, allocate a fixed fire-line construction budget (in kilometres) across the highest-priority blocks, and generate the exact line alignment inside each funded block.

The tool is designed as a transparent, explainable decision-support aid — not a black-box optimizer. Every score, ranking, and allocation is visible and auditable in the attribute table, and every parameter (weights, budget, number of blocks, set-back distance) is adjustable by the user.

Who this is for

Forest officers, GIS cell staff, and planners who already work in QGIS and need a repeatable, defensible method for prioritizing where limited fire-line budget should go each season.

What the plugin does NOT do

- It does not replace field verification — always ground-truth the suggested alignment before construction.
- It does not account for land ownership disputes, legal encumbrances, or terrain obstacles (rivers, cliffs) not present in your input layers.
- It is a weighted heuristic, not a guaranteed-optimal solution.

2. Data Collection & Prerequisites

Before running the plugin, gather the following spatial layers. All layers must cover the same geographic area and, critically, must share the same projected coordinate reference system (see Section 3).

Layer	Geometry type	Purpose	Key attributes
Administrative boundary	Polygon	Defines the overall planning area	Division / Range name
Forest blocks	Polygon	The unit of analysis and output	Block name (e.g. FB_NM), Range name, Beat name
Villages	Point or Polygon	Ignition-risk source and asset to protect	Village name (optional)
Fire points	Point	Historical fire occurrence record	Fire date (optional, for reference)
Roads	Line	Ignition-risk source (roadside fires)	Road type (optional)
Headquarters / watch points	Point	Response-time reference	HQ name (optional)
DEM (elevation)	Raster	Slope is computed internally from this	Elevation values covering full area

Typical sources: forest department GIS cell records for block/range/beat boundaries, revenue or census records for village locations, forest department fire-alert archives (e.g. departmental fire point logs) for historical fire points, Survey of India / OpenStreetMap for roads, and SRTM/ASTER/Bhuvan DEM tiles for elevation. Use whatever authoritative source your department already maintains.

3. Coordinate Reference System (CRS) Requirements

This is the single most common source of wrong results. All distance, area, and slope calculations in the plugin assume coordinates are in metres. If any input layer is in a geographic CRS (e.g. EPSG:4326,

latitude/longitude in degrees), distances will be computed in degrees and every downstream score, budget allocation, and fire-line length will be meaningless.

How to check and fix

- Right-click each layer in the Layers panel → Properties → Information → check the CRS field.
- If it shows degrees (e.g. "EPSG:4326 - WGS 84"), reproject it: Vector menu → Data Management Tools → Reproject Layer.
- Choose the correct UTM zone for your area (a projected CRS in metres) and apply the same CRS to every layer, including the DEM (Raster → Projections → Warp/Reproject).

The plugin will print a warning in the Processing log if it detects a geographic CRS on your forest blocks layer, but it cannot check every input layer automatically — please verify manually before running.

4. Installation

Fireline Planner is published on the official QGIS Plugin Repository, so installing it is the same as installing any other QGIS plugin — no manual file copying needed.

Install via Manage and Install Plugins (recommended)

- 1 In QGIS, open the **Plugins** menu → **Manage and Install Plugins...**
- 2 Go to the **All** tab and type **Fireline Planner** into the search box.
- 3 If it doesn't appear, the plugin may still be flagged experimental. Go to the **Settings** tab and tick "**Show also experimental plugins**", then search again.
- 4 Select **Fireline Planner** in the results and click **Install Plugin**.
- 5 Once installed, open **Processing** → **Toolbox**. A new group called "Fireline Planner" will appear with three tools, ready to use immediately — no restart required.

To update later: open Manage and Install Plugins → Upgradeable tab, and QGIS will show a new version whenever one is published.

Manual installation (offline / no internet access)

If your QGIS machine has no internet access to reach the plugin repository, you can still install from a zip file someone downloaded elsewhere:

- Open Manage and Install Plugins → **Install from ZIP** tab.
- Browse to the **fireline_planner.zip** file and click **Install Plugin**.
- QGIS extracts and enables it automatically — no need to locate the plugins folder yourself.

If you are updating from an older manually-installed copy, uninstall the old version first (Manage and Install Plugins → Installed → select Fireline Planner → Uninstall Plugin) before installing the new zip, to avoid stale cached files.

5. Adding Data to QGIS

- Layer menu → Add Layer → Add Vector Layer (for boundaries, blocks, villages, roads, HQ, fire points) and Add Raster Layer (for the DEM).
- Confirm every layer loads with visible geometry over the correct area (zoom to layer to check).

- Reproject any layer not already in your chosen projected CRS (see Section 3).
- Keep layer names simple and recognisable (e.g. forest_blocks, villages, roads, hq_points, fire_points, dem) — you will select each one from a dropdown in the Processing dialogs.

6. Workflow Overview

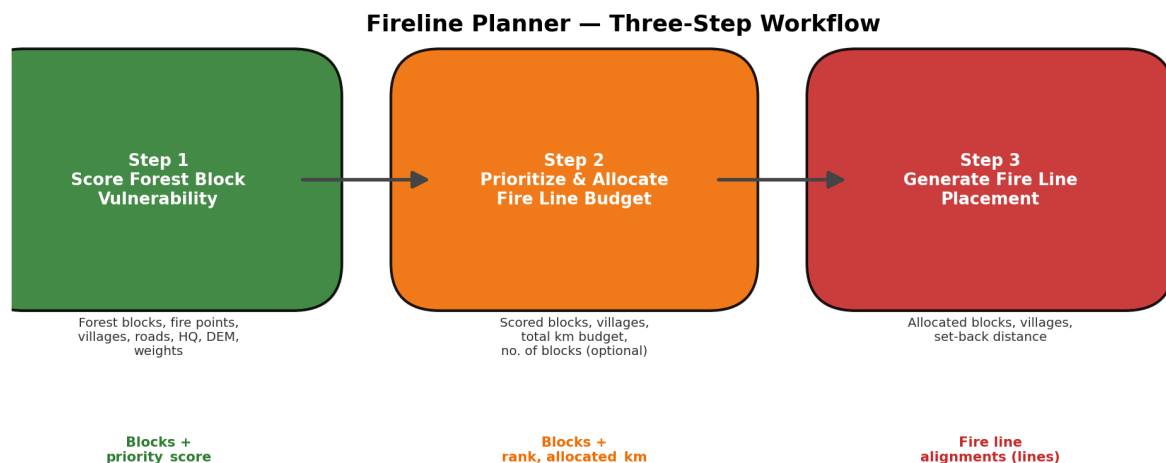


Figure 1: The three-step processing chain. Each step's output feeds directly into the next step's input.

Step 1 — Score Forest Block Vulnerability

Open Processing Toolbox → Fireline Planner → "1. Score Forest Block Vulnerability". This scores every forest block on a 0–1 vulnerability scale using five factors, each with its own adjustable weight:

Factor	Direction of risk
Fire history (nearby fire points)	More fires nearby = more vulnerable
Slope (from DEM)	Steeper = more vulnerable (fire spreads faster uphill)
Proximity to villages	Closer = more vulnerable (ignition source + assets at risk)
Proximity to roads	Closer = more vulnerable (roadside/human-caused ignition)
Distance from HQ	Farther = more vulnerable (slower emergency response)

Weights do not need to add up to 1 — enter any relative numbers (e.g. village=3, road=2, others=1 if village proximity matters most to you) and the tool normalizes them internally. You only need to supply the raw DEM; slope is calculated automatically inside the tool.

1. Score Forest Block Vulnerability

Forest blocks	<i>your_forest_blocks.gpkg</i>
Fire points	<i>fire_points.gpkg</i>
Villages	<i>villages.gpkg</i>
Roads	<i>roads.gpkg</i>
Headquarters / watch points	<i>hq_points.gpkg</i>
DEM	<i>dem.tif</i>
Weight: fire history	1.0
Weight: slope	1.0
Weight: proximity to villages	3.0
Weight: proximity to roads (ignition risk)	2.0
Weight: distance from HQ (inaccessibility)	1.0
Scored forest blocks	<i>[Save to file...]</i> Run

Illustrative layout — actual field order/wording may vary slightly by QGIS version

Figure 2: Illustrative layout of the Step 1 dialog (not a live screenshot — your actual QGIS window may differ slightly by version).

Output: your forest blocks layer with added columns including `priority_score` (0–1), plus the raw and normalized value of each factor for auditing.

Step 2 — Prioritize Blocks & Allocate Fire Line Budget

This step ranks blocks by `priority_score` and allocates your total fire-line budget (in km) across them. It computes each block's "forest–village interface" — the portion of its boundary within a set distance of a village — since that determines the maximum fire line length a block can physically hold.

Key parameter: Spread budget across top N blocks

- **Set to 0** — greedy mode: fills the highest-priority block first, then the next, until the budget runs out. This can concentrate the entire budget in just a few blocks if they have long village-facing boundaries.
- **Set to a number (e.g. 15)** — spreads the budget proportionally (by priority score) across exactly the top 15 blocks, capping each at what it can physically hold, and redistributing any surplus among the rest of that group.

Output: blocks with a rank field (1 = highest priority), `interface_len_m`, `allocated_len_m`, and `allocated_km`. Check the Processing log after each run — it reports how much of the budget was actually used and flags any blocks that were skipped.

Step 3 — Generate Fire Line Placement

For every block with an allocated length greater than zero, this step finds the boundary segment facing villages, offsets it inward into the forest by your chosen set-back distance (so the line isn't literally sitting on the property boundary), and trims it to the allocated length.

Also select the forest block name, range name, and beat name fields from your data here (all optional but recommended) — the tool copies these into guaranteed output columns (`forest_block_name`, `range_name`, `beat_name`) so the output is easy to read without joining anything back manually. If your layer already has a column with a clashing name, the tool automatically renames the new column and tells you in the log (e.g. "range_name" becomes "range_name_2").

Output: a line layer — the exact, field-ready fire line alignment for every funded block, carrying all original block attributes plus `built_len_m` (actual length drawn, which can be slightly less than the allocation if the available boundary was shorter).

7. Interpreting Results

Conceptual Output: Ranked Blocks + Fire Line Placement

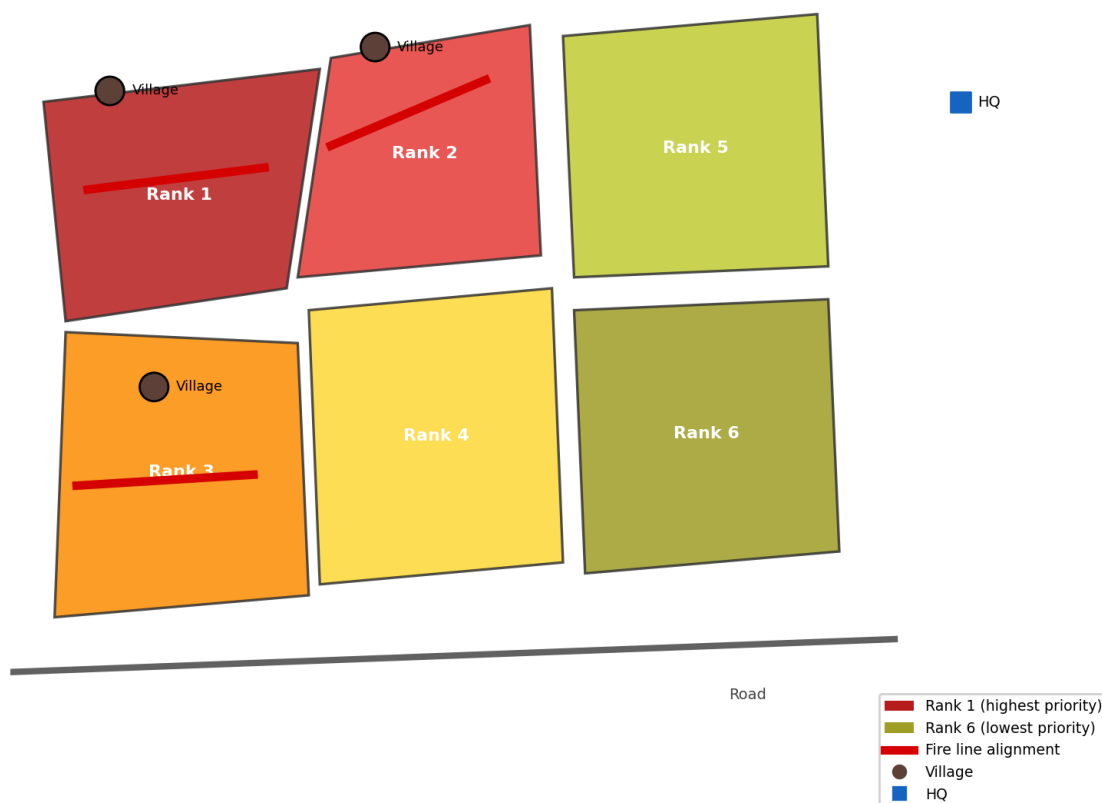


Figure 3: Conceptual illustration — forest blocks colored by rank, with fire line alignments (red) placed inside the forest near villages.

Suggested symbology

- Style the Step 2 output by **graduated color on the "rank" or "priority_score" field** (Layer Properties → Symbology → Graduated) to see the priority pattern spatially.
- Style the Step 3 fire-line output as a **thick, bright line** (e.g. red, 1.2mm width) so it stands out against forest and village basemaps.
- Label features using forest_block_name (or your original block name field) for quick identification in the field.

Key output fields reference

Field	Produced by	Meaning
priority_score	Step 1	Composite vulnerability score, 0 (low) to 1 (high)
rank	Step 2	Priority order, 1 = highest priority block
interface_len_m	Step 2	Length of the block's village-facing boundary (metres)
allocated_len_m / allocated_km	Step 2	Fire line length assigned to this block
built_len_m	Step 3	Actual length of line drawn (may be less than allocated if boundary was short)
forest_block_name / range_name / beat_name	Step 3	Copied from your chosen identification fields, for easy reading

8. Troubleshooting

Symptom	Likely cause	Fix
"Input layer uses a geographic CRS" warning	A layer is in degrees, not metres	Reproject to a projected UTM CRS (Section 3)
Budget mostly used in just a few blocks	Greedy mode (N=0) filled top blocks completely	Set "Spread budget across top N blocks" to a number in Step 2
"Cannot create field X — already exists" error	Your data already has a same-named column	Fixed automatically in the current version — the tool renames and logs it. Re-run from Step 1 if you see old errors
A block you expected to be funded has no fire line	No forest-village interface within the interface distance	Increase "Village interface distance (m)" in Steps 2 and 3
slope_mean column looks like all zeros	DEM doesn't cover the block extent, or CRS mismatch between DEM and blocks	Check DEM extent and reproject DEM to match your other layers
Budget left over after Step 2	Not enough interface length across selected blocks to absorb it	Increase interface distance, add more blocks (raise N), or reduce total budget

9. Important Notes

This tool provides a transparent, adjustable first-pass prioritization and alignment — it is a decision-support aid, not a substitute for field verification, engineering judgement, or statutory approval processes. Always ground-truth suggested alignments before construction, and review the underlying scores if a result looks operationally implausible.

— End of Manual —