Terrain Classification System

For Forestry Work in Sweden

Mikael Lundbäck, based on and with Nils Forshed's paintings from:
Berg, S (1992). Terrain classification system for forestry work. Kista: Forskningsstiftelsen Skogsarbeten.

Terrain Description

All ground based forest operations are affected by the terrain, which influences choice of method, equipment, productivity and seasonal availability.

In the Swedish system, the factors below are classified in field visits on a scale from 1 to 5, with 1 indicating very easy conditions and 5 very difficult ones.

G	Ground conditions
Y	Surface roughness
L	Slope

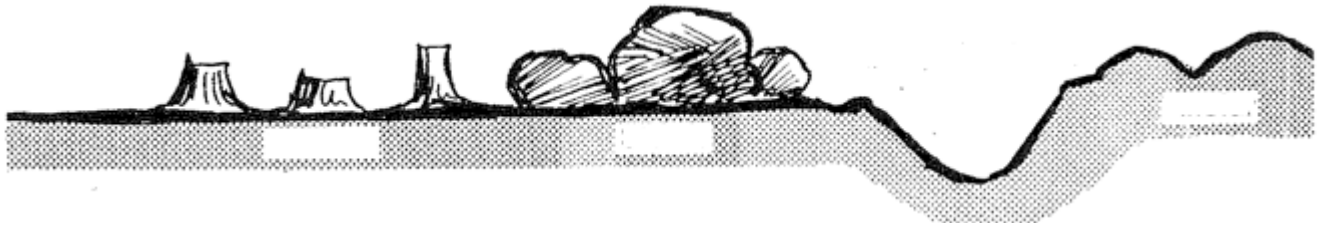
There are also indicators for regeneration operations and snow conditions, but these are not explained here.

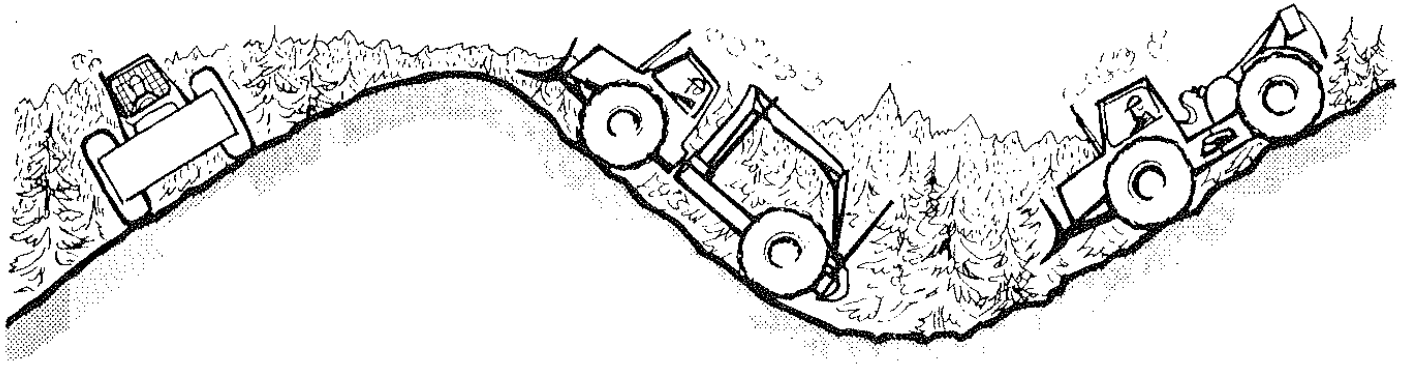
Terrain Description

Ground conditions (G) mainly give information about **when** an area is possible to drive in with heavy machines for e.g. harvesting. Wet areas need to be harvested on frozen ground, wheras dry areas can be harvested even during thaw break, and so on. If planning is not done with respect to season and current weather, consequences can be drastical and expensive.

Terrain Description

Surface roughness (Y) and slope (L) mainly determine **how** operations can be done. Y and L can set limits on what kind of machinery that can be used, and/or have impact on productivity, cost, and machine wear.





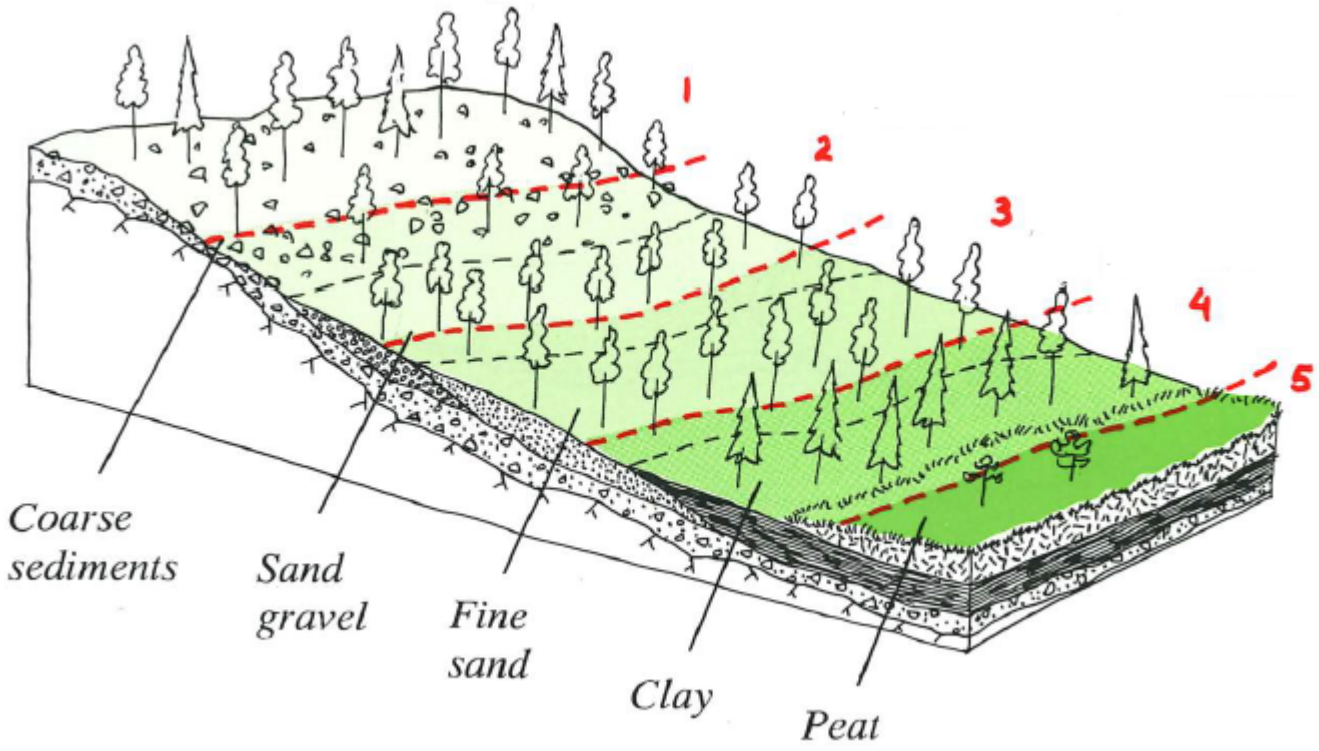
Assessment

For practical purposes, the operations planner must learn to assess terrain difficulty with the aid of supportive measurements and sound judgement.

G, Y, and L are recorded long term and stored in databases by the large forest companies, or before harvesting in the case of private forest owners.

Assessment – Ground conditions (G)

Ground conditions reflect soil type, humidity, and reinforcement. Different classes are usually found in different parts of the landscape. The five classes are defined as:



1. Very good ground conditions. Usually possible to drive on all year.
2. Intermediate class. Possible all year, but be careful at thawbreak and during copious autumn rain.
3. Average ground conditions. Be extra careful in low terrain, and if passing over the same place many times.
4. Intermediate class. The ground´s bearing capacity might not manage heavy machines unless the ground is frozen. Be careful with local marshes. Reinforcement with slash can have large influence on trafficability.
5. Very poor ground conditions. Wheeled vehicles can only be used when the ground is frozen.

Assessment – Ground conditions (G)

	North Sweden				South Sweden	
	Forest Type				Humidity 200-400 mm	Humidity 400 mm +
	Dwarf Shrub Type	Dryopleris Dwarf Shrub Type	Herb Dwarf Shrub Type	Herb Type	Soil Humidity	Soil Humidity
	Very Dry / Dry / Mesic / Moist / Wet	Dry / Mesic / Moist / Wet	Dry / Mesic / Moist / Wet	Mesic / Moist / Wet	Very Dry / Dry / Mesic / Mesic-Moist / Some Water Soaked / Very Water Soaked	Very Dry / Dry / Mesic / Mesic-Moist / Some Water Soaked / Very Water Soaked
Soil Type	Ground Condition Class				Ground Condition Class	
Moraines						
Gravel	1 1 1 2 2	1 1 2 2	1 1 2 3	1 2 3	1 1 1 1 2 2	1 1 1 2 2 3
Sandy	1 1 2 3 3	1 2 3 3	1 2 3 3	2 3 4	1 1 2 2 3 3	1 1 2 3 3 4
Sandy-Fine Sand	1 1 2 3 4	2 3 3 4	2 3 4 4	3 4 5	1 1 2 3 4 4	1 2 3 4 4 5
Fine Sand, Silt	1 2 3 4 5	2 3 4 5	3 3 4 5	4 5 5	1 2 3 4 4 5	2 3 4 4 5 5
Clay						
Sediments						
Gravel	1 1 1 1 2	1 1 1 2	1 1 1 2	1 1 2	1 1 1 1 1 2	1 1 1 1 2 2
Coarse Sand	2 2 1 2 3	2 1 2 3	2 2 2 3	2 3 3	2 2 1 1 2 3	2 1 1 2 3 3
Intermediate Sand	2 2 2 3 4	2 2 3 4	2 2 3 4	2 3 4	2 2 2 2 3 4	2 2 2 3 4 4
Fine Sand	2 2 2 4 5	2 2 3 4	2 3 4 5	3 4 5	2 2 2 3 4 5	2 2 3 4 5 5
Fine, Fine Sand, Silt, Clay	2 2 3 4 5	2 3 4 5	3 4 5 5	4 5 5	2 2 3 4 4 5	2 3 4 4 5 5
Peat	5				5	

Soil type is assessed with a soil probe, hands, and local knowledge. The soil probe is also good for quick assessment of the penetration resistence of the soil, which can lead to conclusions about trafficability also without use of this table.

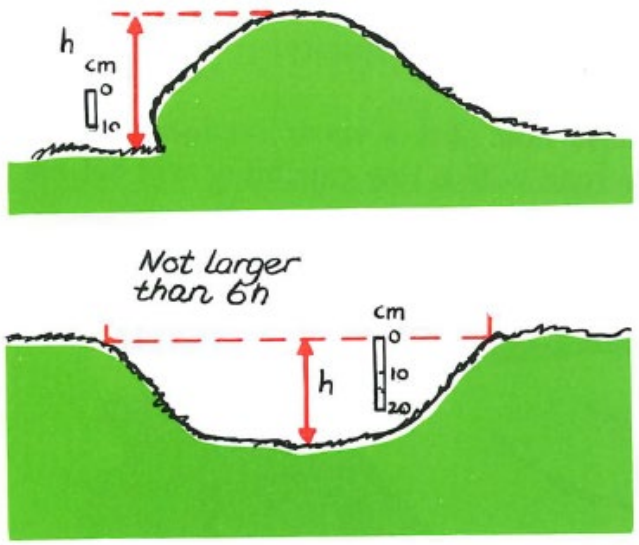
Tips:

- Many passages with machinery can ’wear out’ the bearing capacity.
- A small section close to the timber truck road with low bearing capacity can set the limit for the whole area (becomes a bottle neck).

Assessment – Surface roughness (Y)

Obstacles in the terrain are measured and counted according to the classes below. Rocks, boulders, soil mounds, and cavaties are included, while stumps are not.

In practice, experienced foresters normally eye-ball surface roughness, but based on these rules.



Height Class	Obstacle Height (h)
H 20	10 - 30 cm
H 40	30 - 50 cm
H 60	50 - 70 cm
H 80	70 - 90 cm

Average Distance		Number of Obstacles per ha
Abundant	less than 1.6 m	More than 4,000
Moderate	1.6 - 5.0 m	4,000 - 400
Sparse	5.0 - 16.0 m	400 - 40
Very few	16.0 - 50.0 m	40 - 4

Assessment – Surface roughness (Y)

When the size and number of obstacles are known for a forest stand, or more commonly for a sample plot, the table to the right can be used to find the right surface roughness class.

Start at the H20 column and find the current amount of obstacles, then continue to the right for next obstacle size class and if needed go down. Never go up or left in the table.

Example 1

Example 2

High Class				Surface Structure Class
H20	H40	H60	H80	
Sparse	Occasional			1. Very even ground surface
Mode-rate	None			
	Sparse	Occasional		2. Intermediate class
Abun-dant	Occasional			
	Moderate	Sparse	Occa-sional	3. Somewhat uneven ground surface
			Sparse	4. Intermediate class
All ground more difficult than Class 4				5. Very uneven ground surface

Example 1. The assessed unit has the following amounts of obstacles. H20 sparse, H40 sparse, H60 and H80 together very few. Follow the arrow for example 1 in the table.
The estimate gives surface structure class 2 (Stereo photo 2).

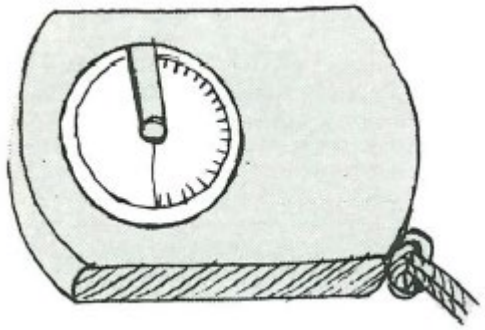
Example 2. The assessed unit has the following amount of obstacles. H20 Moderate, H40 sparse, H60 sparse and H80 very few. Follow the arrow for example 2, in the table. The estimate gives surface structure class 3. (Stereo photo 4).

Assessment – Slope (L)

Slope is described in percentage or degrees. It should be measured between two points, 25 meters apart horizontally, and at representative places within the assessed area.

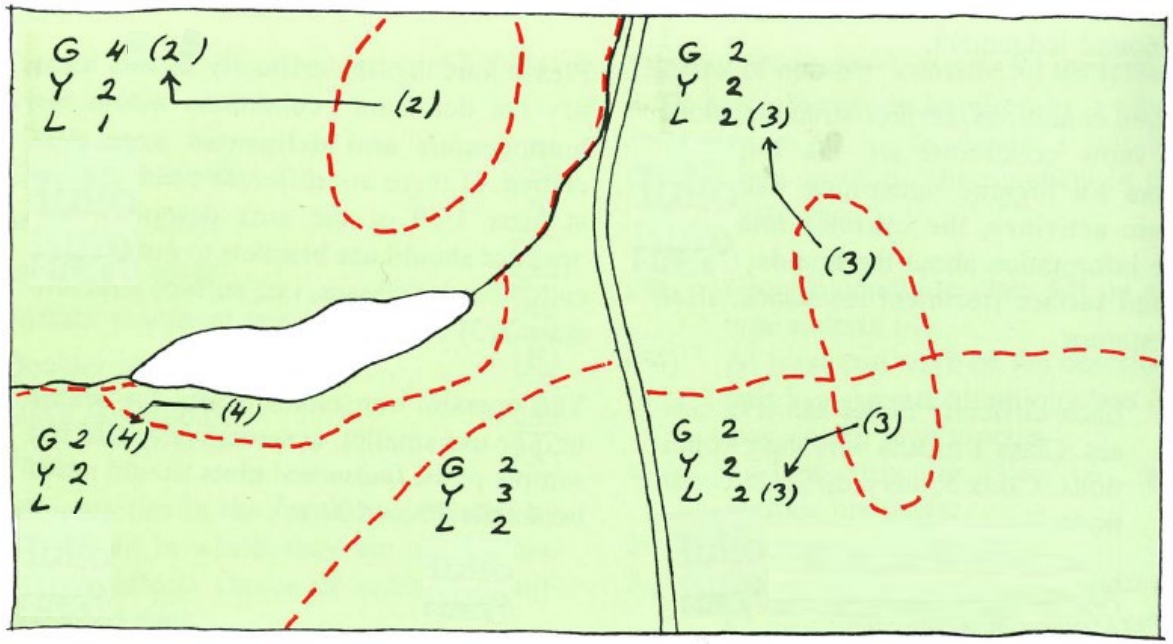
Slope can be estimated using an inclination-meter or a height-meter.

		Percent	Degrees
Class 1	Even ground or slight slope	0 - 10	0 - 6
Class 2	In between class	10 - 20	6 - 11
Class 3	Moderate slope	20 - 33	11 - 18
Class 4	In between class	33 - 50	18 - 27
Class 5	Strong slope	50 -	27 -



Assessment – estimation for entire forest stands

The final estimate of GYL should reflect the dominating conditions within a homogeneous area. If there are certain parts of the terrain with other characteristics, constituting more than 10% of the area described, those parts can be described with an extra number in paranthesis.



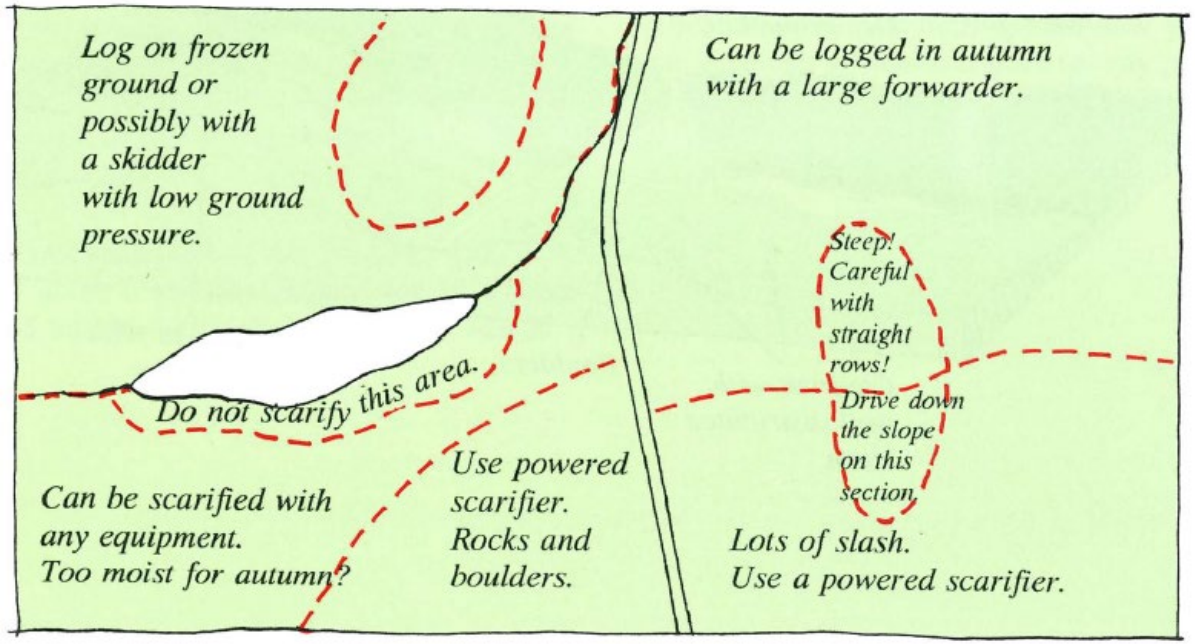
Example of a harvest area that is divided into seperate homogeneous units.

Assessment – estimation for entire forest stands

A supervisor or operator can make a practical translation of the classification with respect to time of year, used equipment, etc.

Tips:

It is important to visit the whole area before setting the code, even if measurements are not made everywhere. Otherwise there is a risk of misrepresentation leading to a less useful assessment.



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