

Soil Interpretations for Military Maneuvers

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Introduction

In 1998, USDA-NRCS in Arkansas began agreements with two Army National Guard Facilities.

Camp Joseph T. Robinson

Fort Chaffee Maneuver Training Center



Interpretation Needs

- Engineering Properties
- Wildlife Habitat
- Forestry Management
- Recreational Development
- Military Operations

Military Operations

Used NASIS to develop interpretations for:

- Bivouac Areas
- Helicopter Landing Zones
- Excavations for Fighting Positions
- Soil Trafficability

Bivouac Areas - virtually the same as
camping areas

Helicopter Landing Zones

- *Slope*
- *Stoniness*
- *High Water Tables*
- *Flooding*
- *Dustiness*



Excavations for Fighting Positions

- Individual
- Crew-served Weapon
- Vehicle

Individual Fighting Positions

- generally 18 inches deep
- the length of 1 or 2 M16's wide
- body length long

Crew-served Weapon Fighting Position

- Generally 4 to 5 feet deep
- varied widths
- Hand or machine dug

Vehicle Fighting Positions

- Generally up to 8 feet deep
- D-10 dozer wide
- generally done by machine

Criteria for Fighting Positions

- Depth to bedrock, cemented pan or dense layer
- Amount of cobbles and large stones and boulders
- Depth to the seasonal high water table, flooding and ponding
- Slope
- Resistance to sloughing

Soil Trafficability

Soil trafficability is the capacity of soils to support military vehicles



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Season Conditions

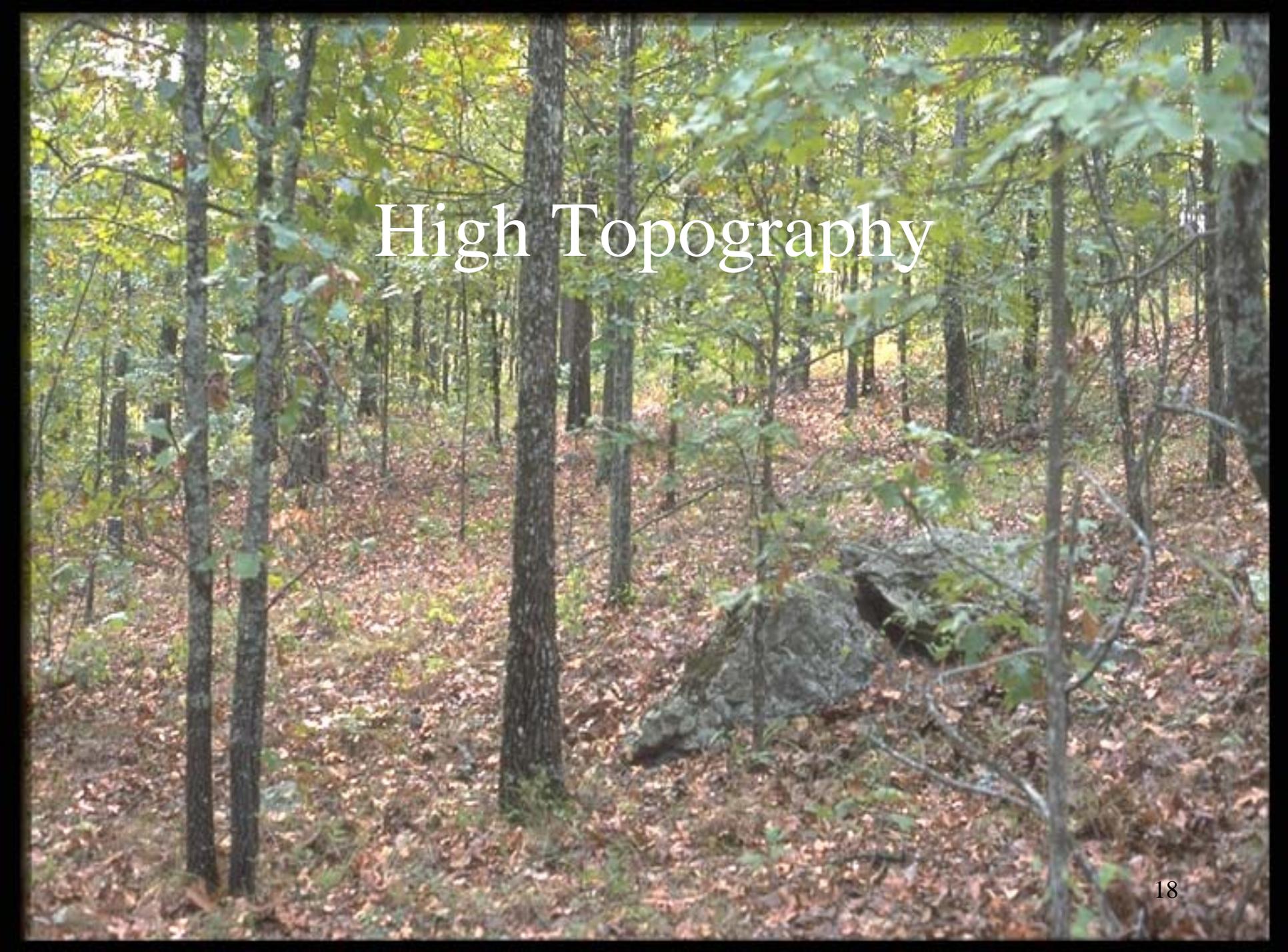
- *Wet season* A wet season is defined as a time in which weather conditions combine to produce high soil moistures. Wet seasons may occur at any time as a result of prolonged rains and floods. Adding moisture to soil affects the strength of that soil; the effect differs with soil types (Department of the Army, 1994).
- *Dry season* A dry season is defined as a time when climatic and vegetation factors combine to produce, in general, low soil moistures. A dry season may also occur at other times of the year as a result of long periods of fair weather. During the dry season, fine-grained soils usually are trafficable. Even in the dry season, trafficability is affected by a high water table that results from underground springs, low-lying and poorly drained soils, or any other cause (Department of the Army, 1994).

Topographic Classes

Based on water table status.

Absolute elevation has no significance.

- High Topography - > 48 inches (120 cm)
- Low Topography - 20 to 48 inches (50 to 120 cm)
- Low Topography, High Moisture - < 20 inches (50 cm), ponded or frequently flooded for long or very long duration.

A photograph of a forest with a steep slope covered in fallen leaves and a large rock. The trees are mostly thin and have green leaves, though some are starting to turn brown. The ground is covered in a thick layer of brown and orange leaves. A large, dark rock is visible in the lower right foreground. The text "High Topography" is overlaid in the center of the image.

High Topography



Low Topography





Low Topography, High Moisture



A photograph of a tank in a wooded area. Two soldiers are visible on top of the tank, one appearing to be operating a machine gun. The tank is moving through a field of dark, loose soil or sand, which is being kicked up by its tracks. The background consists of tall pine trees under a clear blue sky.

Soil Group

- Fine-grained soils and remoldable sands
 - all unified classes except SP

Factors Impacting Soil Trafficability

- Soil Strength
- Slipperiness
- Stickiness
- Slope
- Stoniness

Estimates for Trafficability

- Seven vehicle classes
- Vehicle Cone indices (VCI)
- Critical layers

Critical Layer: The layer that supports the weight of the vehicle in question. Within the critical layer depth, the **UNIFIED** soil group is used to make the estimation.

Military Vehicle Types



Vehicle Type	Range		Vehicle Examples	Critical Layer (inches)
	VCI ₁	VCI ₅₀		
1	12 or less	29 or less	M116	3 to 9
2	12-21	30-49	MLRS, HMMWV	3 to 9

Military Vehicle Types



	Range			Critical Layer
Vehicle Type	VCI ₁	VCI ₅₀	Vehicle Examples	(inches)
3	21-26	50-59	M60	6 to 12
4	26-30	60-69	M1A1	6 to 12

Military Vehicle Types



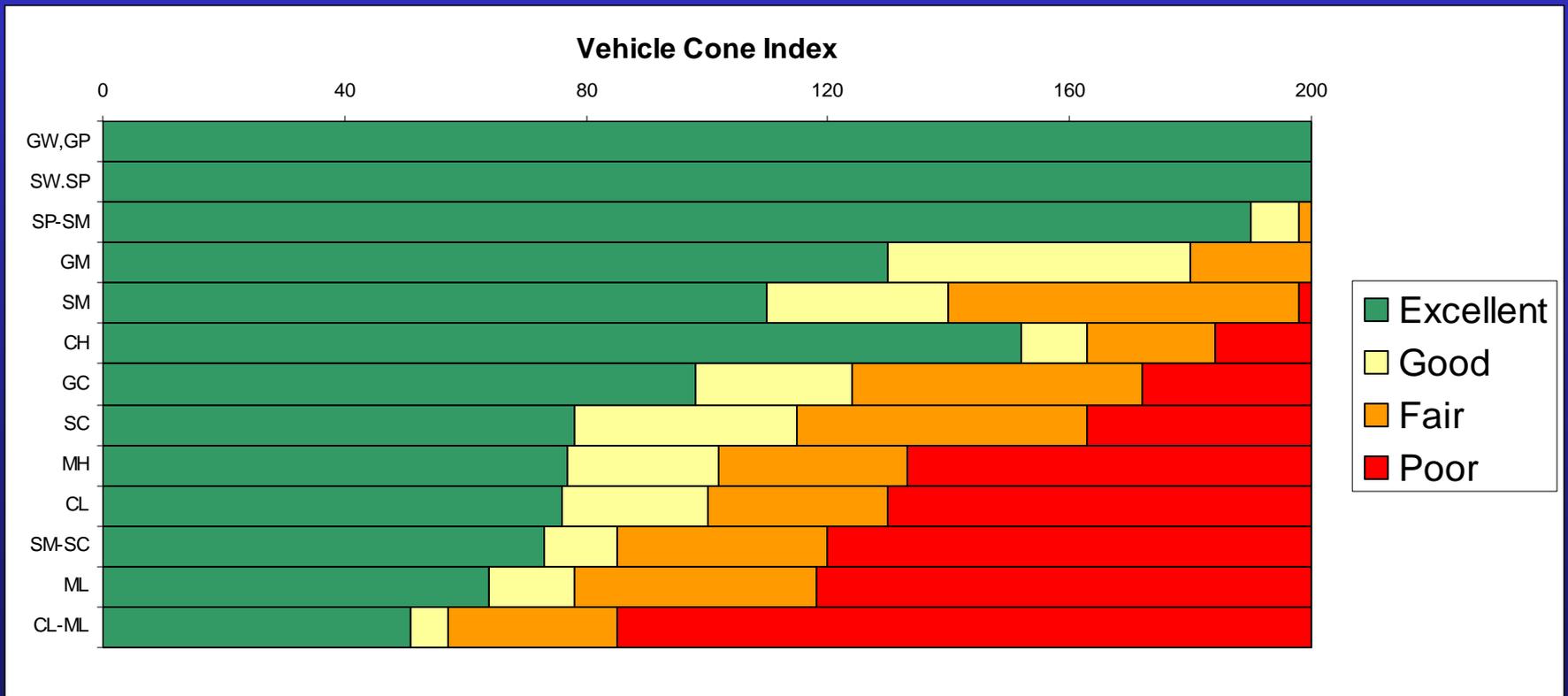
Vehicle Type	Range		Vehicle Examples	Critical Layer (inches)
	VCI ₁	VCI ₅₀		
5	31-35	70-79	M34	9 to 15
6	35-44	80-99	M125	9 to 15
7	45 or greater	100 or greater	Cranes	9 to 15

Rating Values for Soil Strength

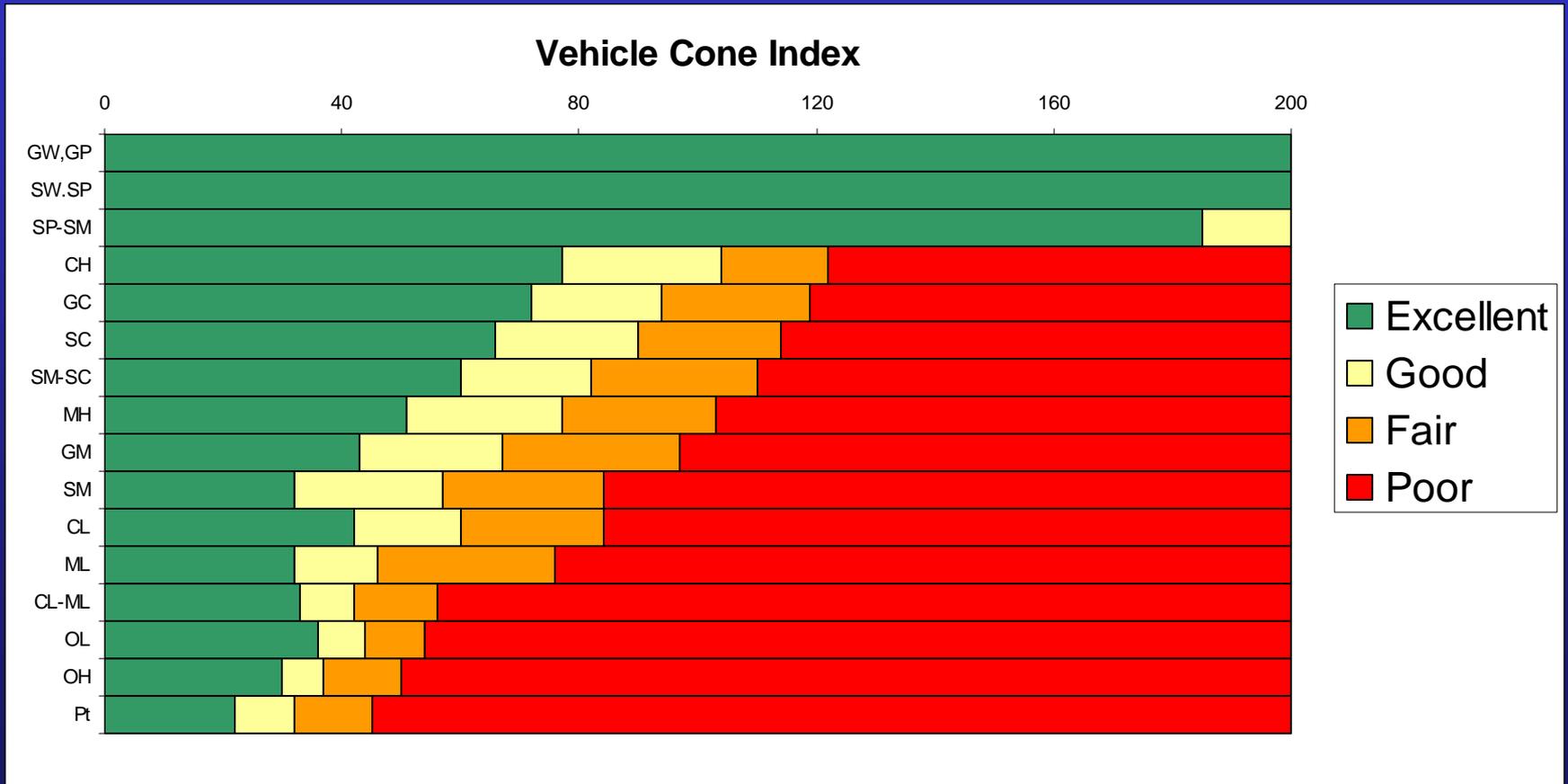
(Probability of making a pass)

Excellent	0.90 to 1.00
Good	0.75 to 0.89
Fair	0.50 to 0.74
Poor	0.00 to 0.49

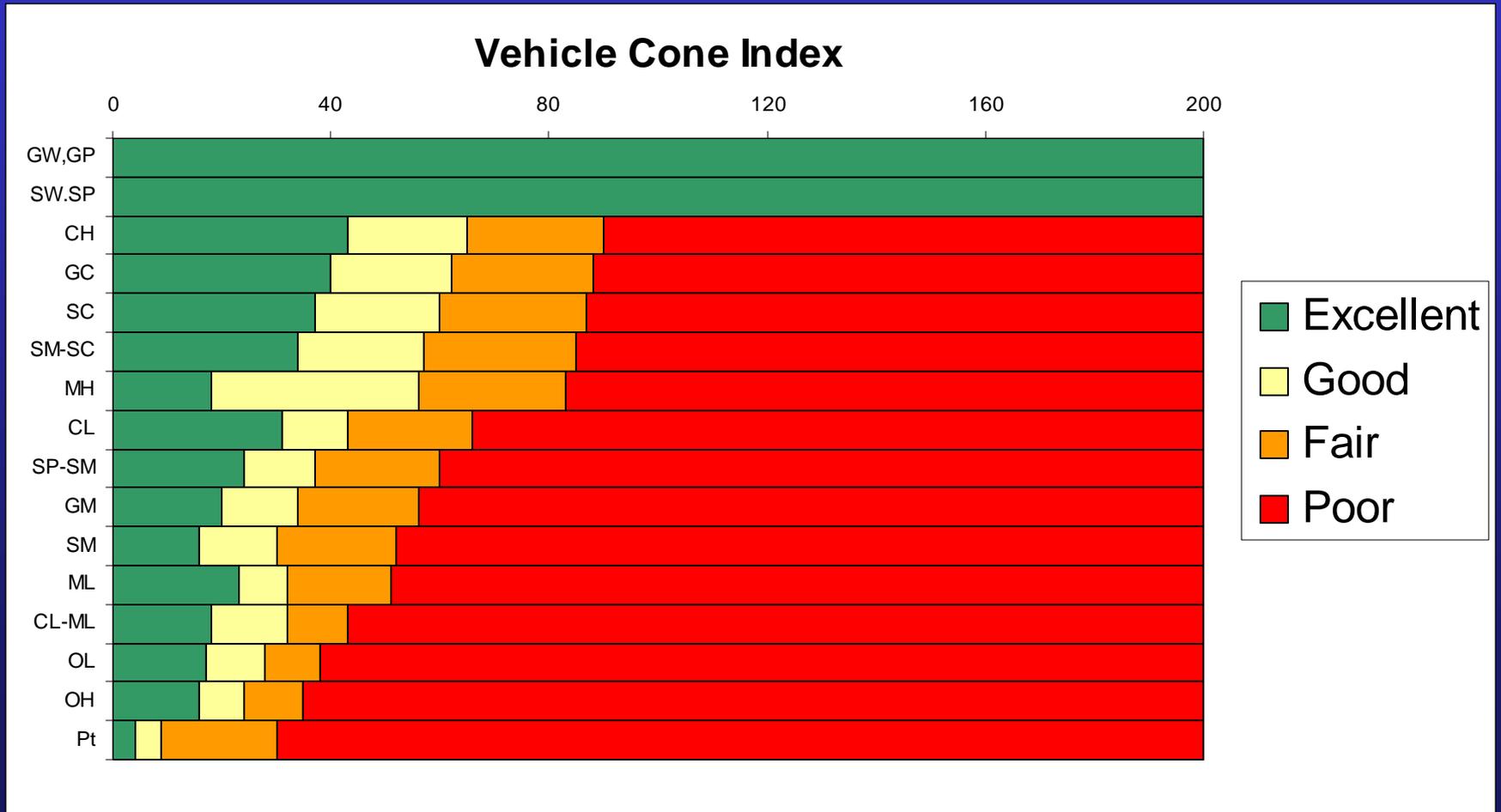
Soil Strength - High Topography



Soil Strength - Low Topography



Soil Strength - Low Topography, High Moisture



Rating Values for Slipperiness and Stickiness

FM-430	NASIS Fuzzy Value
None	1.00
Slight	0.85
Moderate	0.65
Severe	0.45

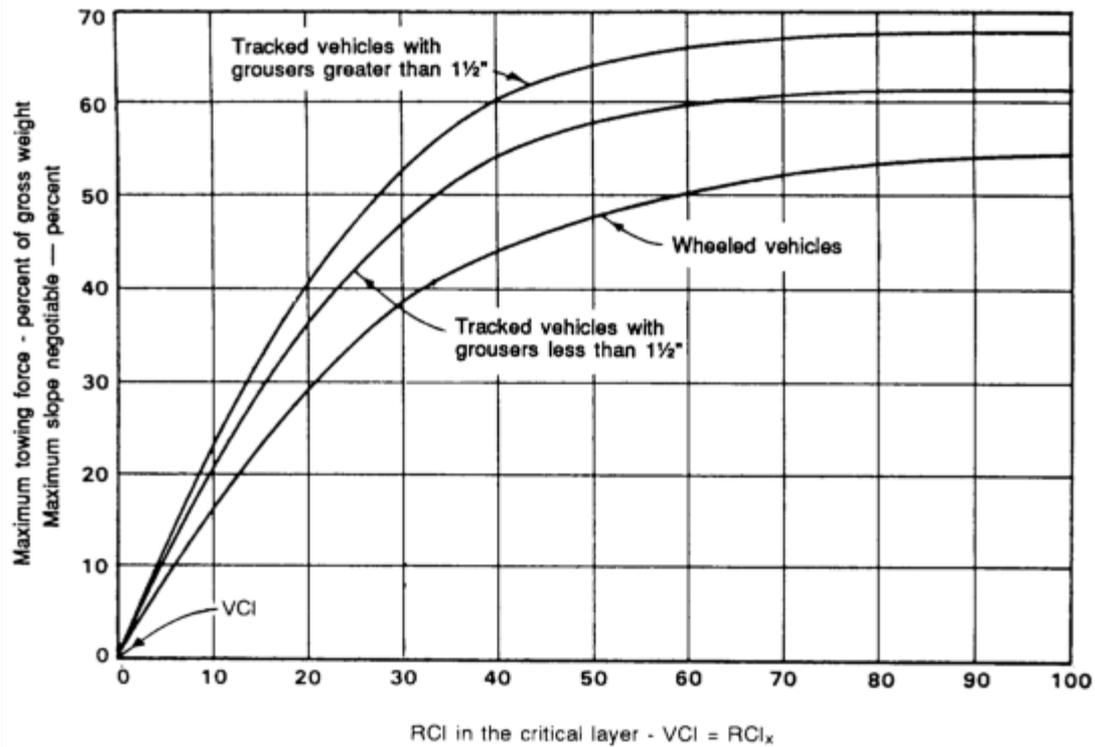


Figure 7-7. Fifty-pass performance curves for self-propelled vehicles operating in fine-grained soils or remoldable sands

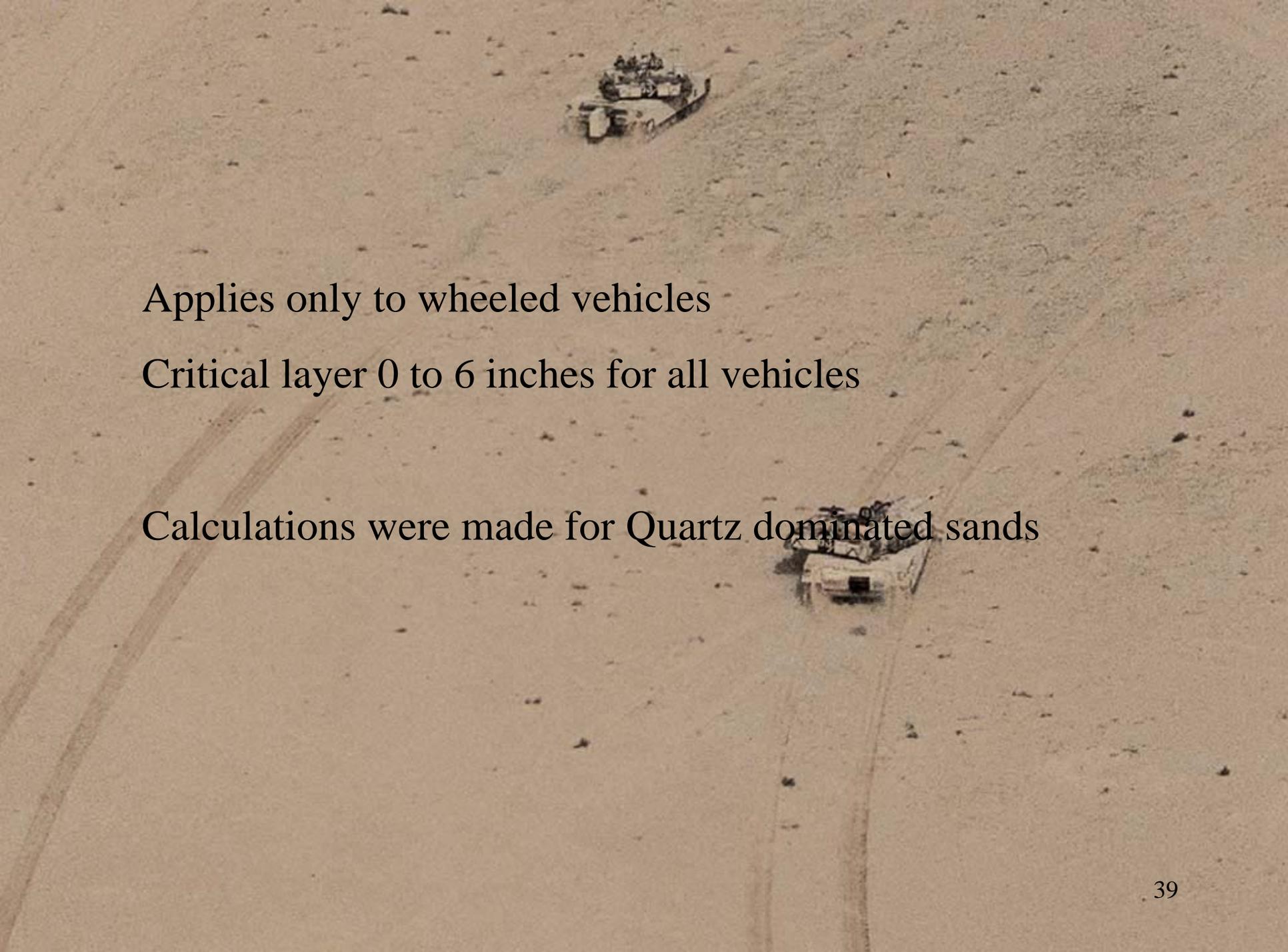
Values for Slope for Fine-grained Soils

Vehicle Type	Excellent	Good	Fair	Poor
1 & 2	0-20%	20-35%	35-50%	>50%
3, 4 & 5	0-15%	15-25%	25-40%	>40%
6	0-8%	8-12%	12-18%	>18%
7	0-5%	5-8%	8-12%	>12%

Coarse Textured Soils

SP unified class



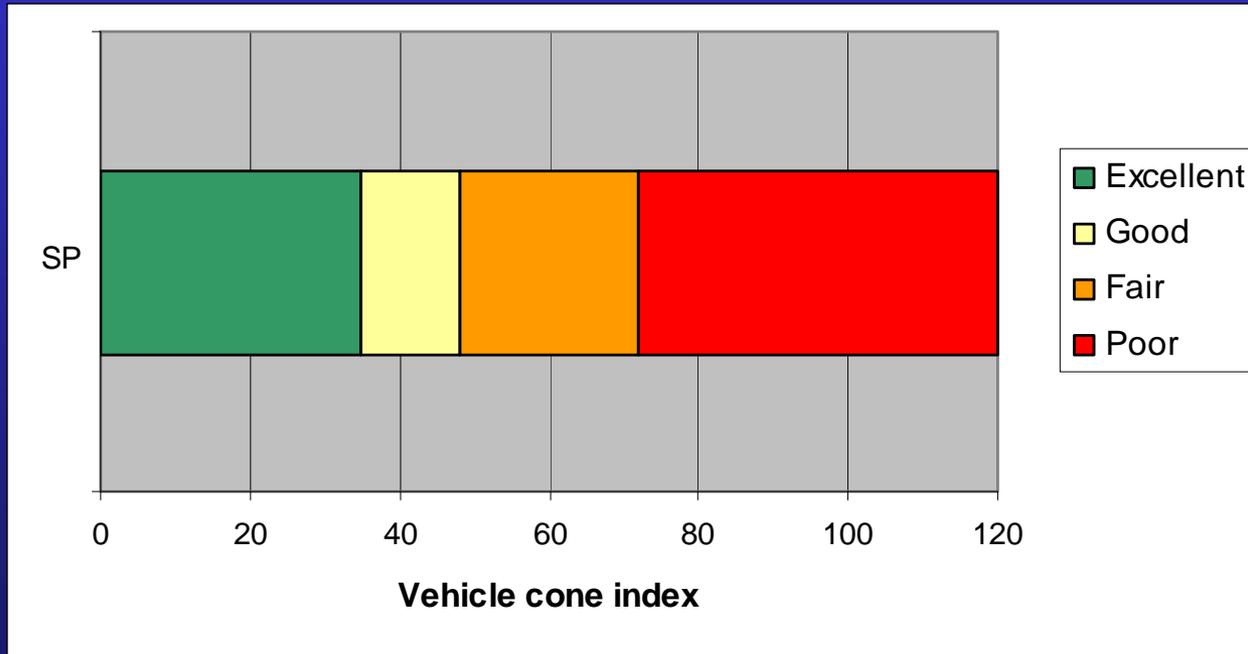


Applies only to wheeled vehicles

Critical layer 0 to 6 inches for all vehicles

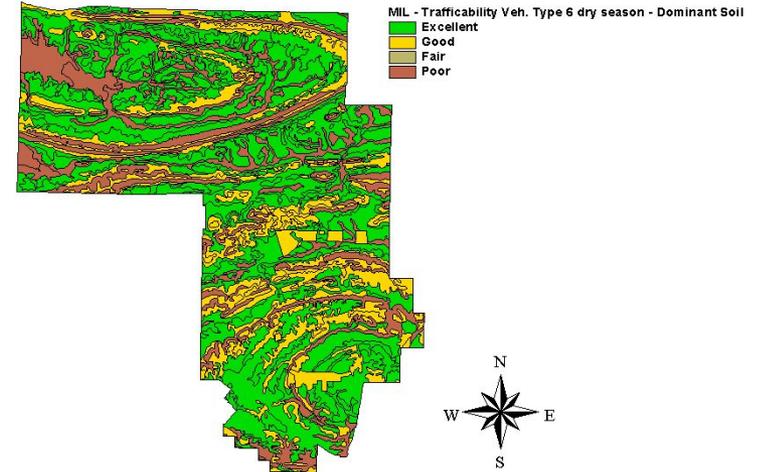
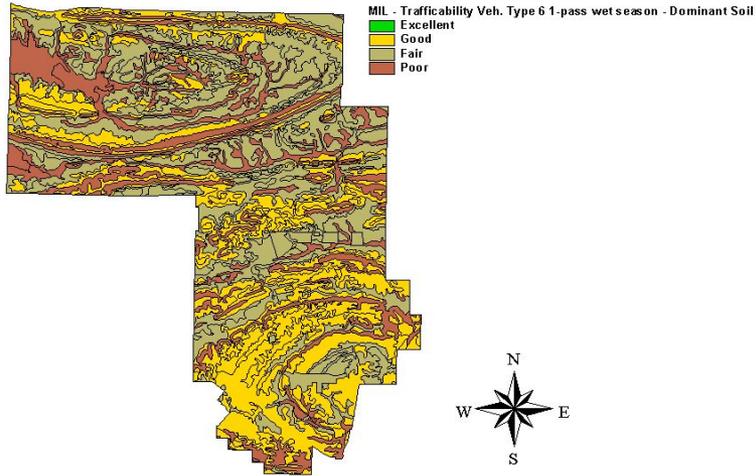
Calculations were made for Quartz dominated sands

Soil Strength-Coarse-grained Soils



Values for Slope for Coarse-grained Soils

Vehicle Type	Excellent	Good	Fair	Poor
1 & 2	0-15%	15-25%	25-35%	>35%
3, 4 & 5	0-8%	8-15%	15-25%	>25%
6	0-5%	5-8%	8-12%	>12%
7	0-2%	2-4%	4-6%	>6%



Soil trafficability maps
 produced using Soil Data
 Viewer Extension in
 ArcView®

Summary



The soil interpretation models for military maneuvers were developed from known concepts from Army engineering field manuals or from the adaptation of existing NASIS soil interpretations.