

Low Volume Roads: less expensive but still safe, efficient?

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Low volume roads: less expensive but still safe and efficient?

- ▶ what is an LVR?
- ▶ the problem
- ▶ road management philosophy
- ▶ solutions

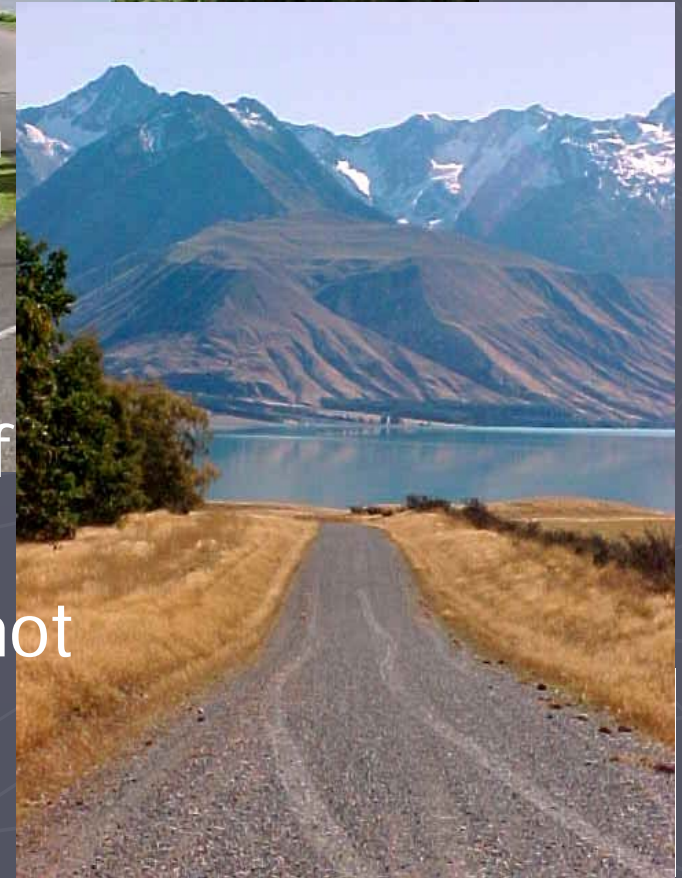


"Design environments"

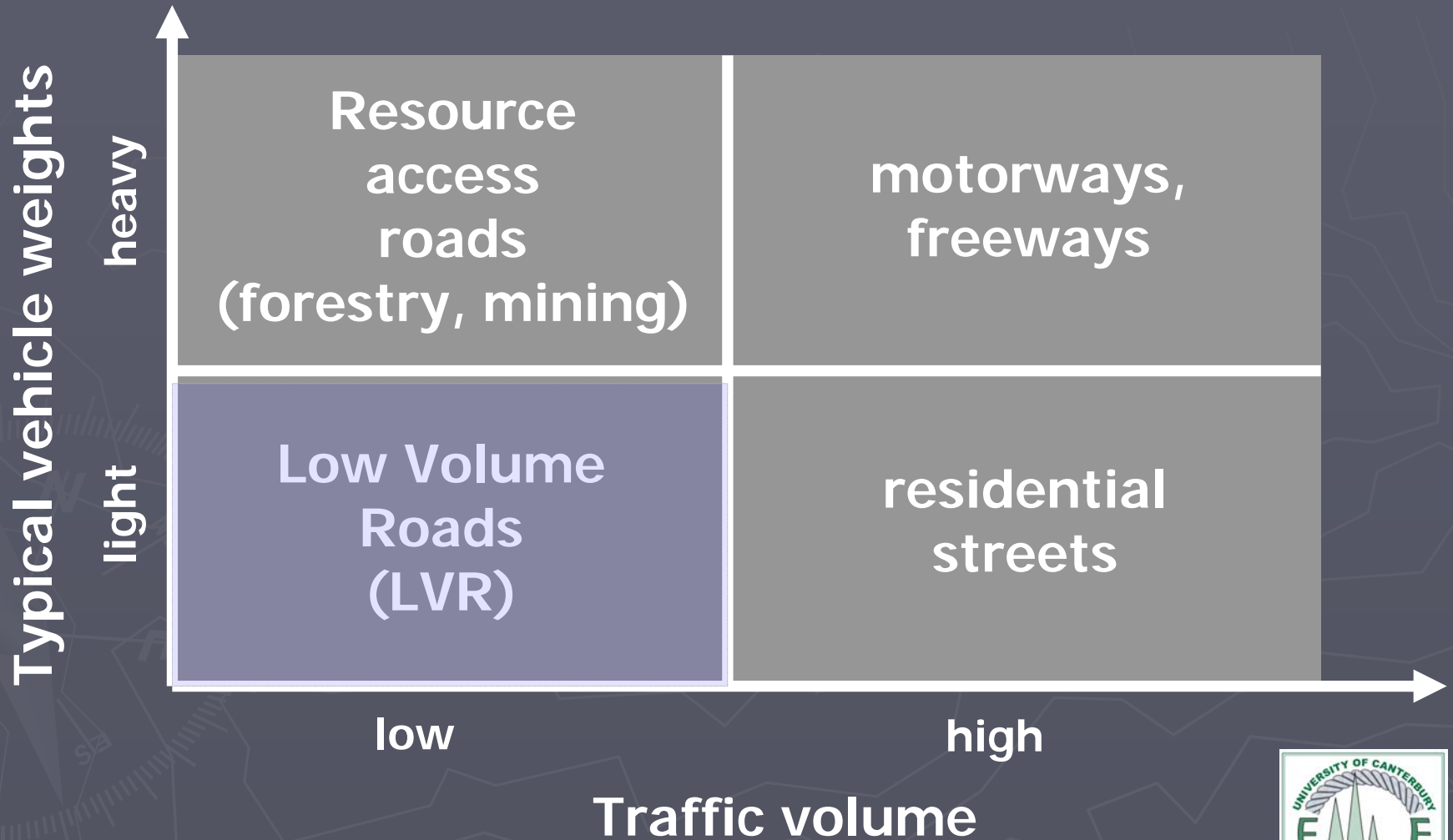


Low volume roads

- ▶ roads with low average annual daily traffic (AADT)
- ▶ in New Zealand
 - 75% of roads have fewer than 500 veh/day
 - 45% have fewer than 100 veh/day
- ▶ LVR: <200 veh/day, 60% of NZ network
- ▶ 34,000 km of NZ roads are not sealed



The problem!



Some solutions

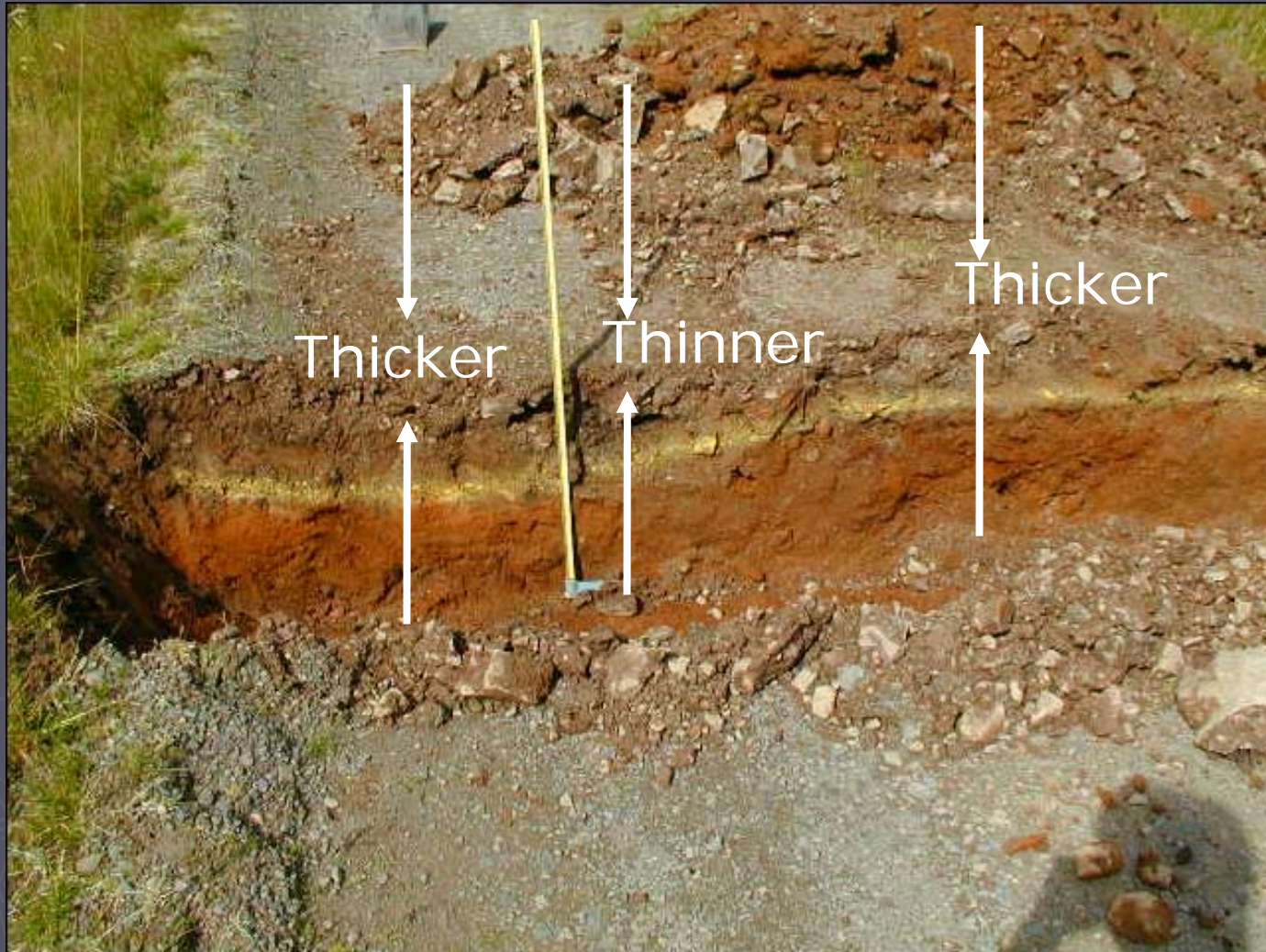
- ▶ transfer the techniques used for forestry haul roads to public LVRs
 - keep to *unsealed* roads wherever possible (even strip off seals?)
 - accept lower reliability
 - leads to more failures, but more easily repaired (“heal” the road from the surface, top down)

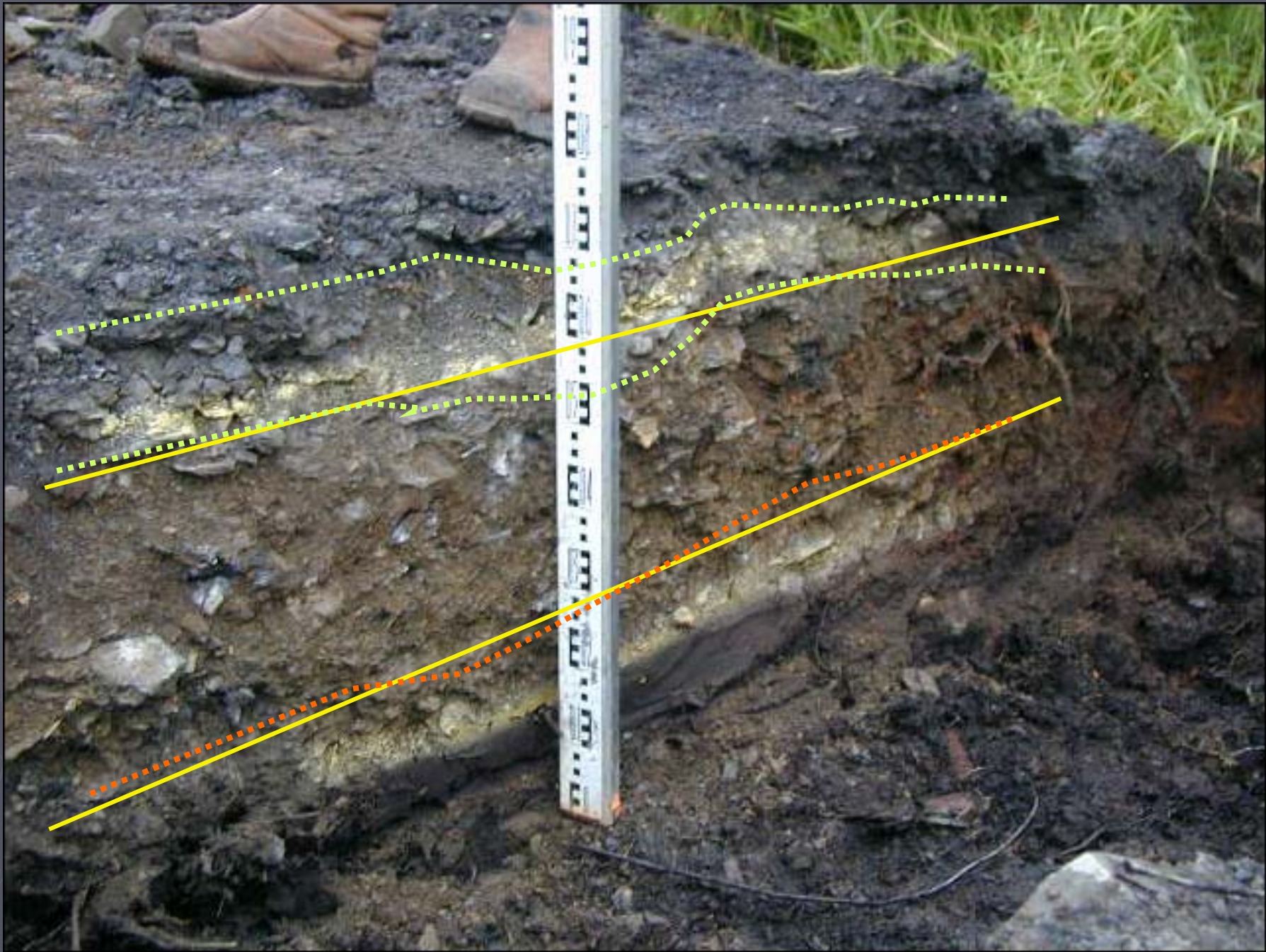


- ▶ approach requires thorough knowledge of unsealed road design
 - materials, design methods
- ▶ think about transferring some of the principles to thin sealed roads



The road base is key







Tricks of the trade

- ▶ road thickness design
- ▶ road geometry
- ▶ materials specifications
- ▶ construction methods
- ▶ stabilisation, foamed bitumen
- ▶ compaction
- ▶ geosynthetics (geotextiles)
- ▶ graded granular filters
- ▶ culvert installations
- ▶ road maintenance management systems



Pavement thickness design

- ▶ use a *rational* method
 - simple: ARRB graph
 - moderate: USFS program *STP*
 - sophisticated: *CIRCLY*
- ▶ gain experience, then fine tune design results based on experience



Base is vitally important

- ▶ seem to be seeing more failures in base than in subgrade
 - evidence in photos presented earlier, typical of many failed unsealed roads
- ▶ relies on selection of proper materials
- ▶ compaction vitally important
 - must be done deliberately, truck traffic not a good compactor of granular materials
 - need to fully understand the five requirements for successful compaction (pressure, moisture content, confinement, appropriate equipment, grain size distribution)



Pavement design reliability

- ▶ should be considerably less than for highway designs
 - *expect failures, plan for failures*
 - consequences of failure are not dire (low traffic volume, few affected!)
- ▶ wait for failures to develop, then make repairs where needed quickly
- ▶ especially easy to do with unsealed roads



Weak, flexible, rutted roads

- ▶ interaction between road condition and vehicle operating costs
- ▶ the worse the road gets, the higher the rolling resistance, and therefore vehicle operating costs
- ▶ this is a hidden, insidious cost often not considered, yet can be significant



Road geometry

- ▶ ... particularly width:
- ▶ worst thing is a 1½ lane road, or 2½ lane road
- ▶ the extra ½ lane adds nothing to function, yet magnifies construction and maintenance costs
- ▶ unsealed roads have a habit of growing in width over time, this is to be avoided!



Materials

- ▶ appropriate material specifications!
 - for bases under seals, TNZ M/4 is great, BUT it is totally inappropriate for surfacing layer of unsealed (i.e. no chip seal) roads
- ▶ see unsealed road surface material specs in Ferry's Unsealed Roads Manual (NZ RRU TR8, 1986)
 - material actually seals the road (with granular material), and provides an excellent, *safe* running surface
- ▶ by the same token, material recommended by Ferry for unsealed road surfacing must never then be covered with chip seal, as *this* material is totally inappropriate as a base for chip seal – doesn't provided needed internal drainage



- ▶ material to surface “unsealed” roads is higher in fines than bases for seals
- ▶ “rotten rock” can be excellent
 - weathered rock off the top of the quarry
- ▶ fines are needed to shed water, keep it from getting into lower layers (hence an “unsealed” (meaning no chip seal) road is actually sealed by this surfacing layer of high-fines gravel)



Construction methods

- ▶ make appropriate use of stabilisation where needed
 - clean sands (cementitious materials, bitumen)
 - clayey materials (lime, salts)
 - the type and dosage of stabiliser is highly material-specific, so tests must be made first
- ▶ foamed bitumen showing great promise
 - can be used to strengthen roads in a very rapid, top-down operation



Geosynthetics

- ▶ generic name for the array of geotextiles, filter cloths, grids, composites etc. now available
- ▶ hugely useful in certain applications
- ▶ touted as “reinforcement” but that can be debated
- ▶ seems more likely that the major function served is *separation* of granular base layer and fine grained subgrade
 - therefore design for separation, not reinforcement (except for grids), different criterion, this different fabric selection
 - construction “servivability” is an issue, but there are servivability criteria (see Canadian Foundation Engineering Manual)



Graded granular filters

- ▶ a very old trick
- ▶ use layer of appropriate grain size between a coarse layer (i.e. gravel base) and lower, fine-grained layer (i.e. a silty subgrade)
- ▶ must make careful selection of grain size distribution, based on numerical criteria
- ▶ properly designed, in certain circumstances, can be a very inexpensive alternative to geotextile



Culverts

- ▶ failures can be a source of irritation
- ▶ more often than not, the failure is actually due to installation inadequacies, *not* hydraulic inadequacies (i.e. undersized for storm flow)
 - UNB study: of 29 failed culverts (only failed culverts surveyed), max time to failure 8 years, mean time to failure 23 months, half didn't last a year, 4 didn't last a month! *these are not hydraulic failures, collapse happening much sooner than return period of design storm, pretty much failing with first storm*
- ▶ fortunately, there are easy steps to take to ensure installation is properly done
 - see manual by American Iron and Steel Institute (Canadian edition is metric)



Road maintenance management systems

- ▶ just do the routine maintenance when needed
- ▶ for unsealed roads, this mainly amounts to grading
- ▶ therefore grade only when needed
- ▶ road roughness can be the criterion
- ▶ commercial systems now exist for this, e.g. "Optigrade"



Optigrade

- ▶ commercial system of hardware and software produced by the Forest Engineering Research Institute of Canada (FERIC) – see www.feric.ca
- ▶ hardware installed on haul truck or supervisor's ute to measure road roughness routinely
- ▶ software provided to analyse road roughness data, roughness threshold set to trigger call for grading
- ▶ result can be reduced grading costs



Other road maintenance issues

- ▶ careful grading technique
- ▶ don't waste valuable rock
- ▶ don't damage surface layer by grading too deeply, into base layer (which has a different grain size distribution from surface material)
- ▶ skip "light grading", it's generally not effective
- ▶ pay attention to road cross sectional geometry, don't remove it with grading operations (safe road can become dangerous, or freely draining road can cease to be, leading to failures)



Final comments

- ▶ everybody “knows” roads, common in daily experience: unfortunately most think they know more about roads than they actually do, there are plenty of misconceptions
- ▶ this is even more so the case with low volume roads
- ▶ however, there are great savings to be had, if proper engineering judgment is applied
- ▶ for low volume roads compared to other types of roads, because the budgets are smaller, and the extent larger, the roads are more remote, the importance to the operations they serve greater, but in many ways they aren't as sophisticated, *more* engineering judgment is required, *not less* for low volume roads



Thanks!

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