Aten
28 July 2010
Slope Variability Concerns

I am responding to Monique's request today to elaborate on my feedback that variation E does not allow enough variability.

There are several reasons for slope variability, and different scales. Most of these are described in the LRP Concept, Part One.

(1) Accepting rainfall. Variability at scales ranging from cradle/knoll topography, moisture-catching depressions, contour furrows, and roughness of surface (please note, I'm not minimizing the importance of seeding techniques that make good seed-soil contact) are all important (in addition to soil structure for roots, of course) to minimizing runoff and enabling appropriate ecosystem rainfall behavior. It is important to counteract the sometimes expressed preference for smooth slopes, surface sheet flow, and managed drainage. "Best" stormwater practices do often emphasize sheet flow -- as opposed to the alternative of sending water quickly to concentrated routes (pipes, ditches) -- but this oversimplification is meant to prevent a worse problem, rather than explaining the complexities of a better situation. Sheetflow is better than pipes and ditches. But smooth slopes discount the function that nature can provide. Topographic variability that is within the ranges where native vegetation is sustainable and functional is better than smooth slopes everywhere. Pockets of water collection are, in our ecosystems, good. It can be admittedly complex to model rainfall effects on this restored landscape with slope variability. It requires understanding of the natural systems to operate perhaps near their margins of functional operating conditions (e.g. steeper slopes, more flow if stormwater sources or early in restoration). Slope variability also doesn't lend itself to large equipment answers.

(2) Supporting vegetation/roots establishment by buffering rainfall. Quite similar to (1) but with a different emphasis that is likely to be specific to plant community type, where a particular technique for trapping moisture will include some form of slope variability. Details will not be known until later in the LRP; but some slope allowance for such techniques is desired.

(3) Reducing erosion by using microtopography to connect rainfall to root establishment. Again, another way of looking at (1) or (2). I agree with CDF's comment that variation E can support erosion control, but we're going for great, not minimum.

(4) Supporting plant community zones. Substantial cradle-knoll topography is important for tree establishment in forest community types on slopes like these.

(5) Supporting variable zones within a plant community. In a natural system over a long time, the interaction of vegetation, soil, climate, aspect, trampling, hydrology, etc., all tend to lead to variation in local conditions: a local depression in a prairie where different species establish, etc. Since we are working to restore to a future quality 'wildness' / naturalness, jump-starting conditions like these is important. Allowance for slope variability now will allow details to mutually develop with the LRP. (I believe this is also what CDF meant when they commented that the proposed variability will not allow variability for species within habitat).

(6) Telling the glacial story. Slope variability in particularly drumlins and eskers; see Wisconsin topo maps for scale.

(7) Supporting human stewardship. Traversing and working on slopes for both teaching and for stewardship by humans is challenged by uniform slopes. It is physically demanding and tiring. Periodic leveling-off points irregularly on large slopes are important. This is not talking about trails; it is supporting access to any point in the landscape (in a leave-no-trail-trace practice).

I am inclined toward variation D in the attached as a reasonable compromise between tight fill accommodation and the above considerations, for those (significant) portions of the plan with long steep slopes. (Of course, in variation D, I show the ACM core slope at 3.4:1, but if we don't have that much ACM, it can certainly be 3:1 with simply more clean cap on the lower slope :)).

I believe that variation E will, in later trying to meet the above considerations, result in the majority of those slopes being 2.5:1 with brief slight breaks every 12' that are insufficient to support the kind of variability desired.

In addition, all of the other variability "to be determined later", must also fit within the conditions established now. To make a contour furrow means balancing it with a steeper portion. To make a depression means balancing it with a steeper portion. To make a cradle/knoll means balancing it with a steeper portion. I have tried to illustrate the latter in the final diagram. It seems more important to allow more variability on likely forested plant community slopes.

Please note that these diagrams represent just one possible section in a slope. I am not intending to suggest this is a uniform section (i.e. uniform contours), just representative in a variable overall slope.

Of course, tradeoffs are part of this: steeper slopes might allow more cut and more desirable wet habitats -- but I don't think there is enough detail in the progress plans to assess this yet. My preference would be to work from conditions of average 3.3 or 3.4 :1 in max slope conditions especially on forested slopes.

Thank you for the opportunity to comment.

Variation A

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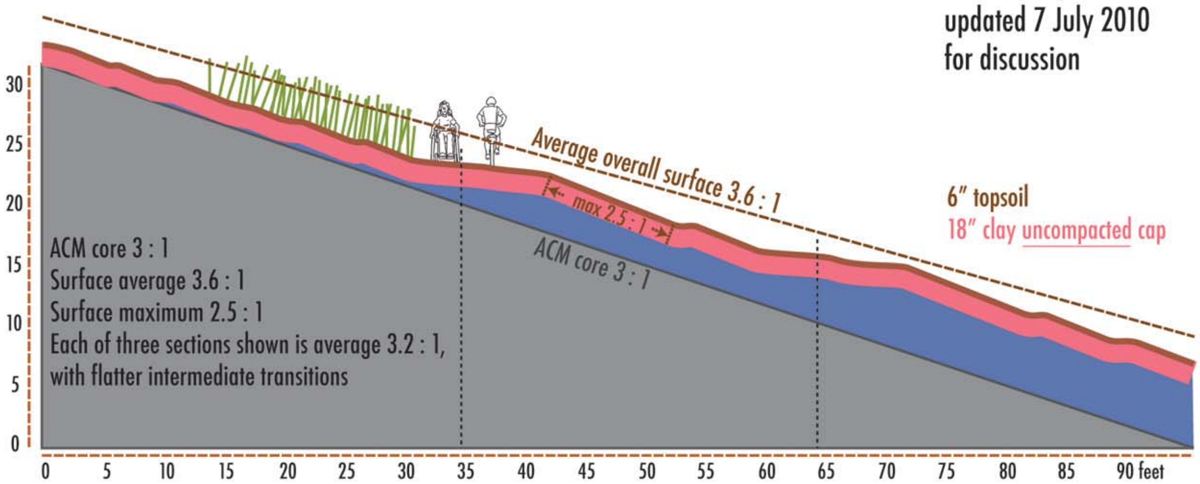
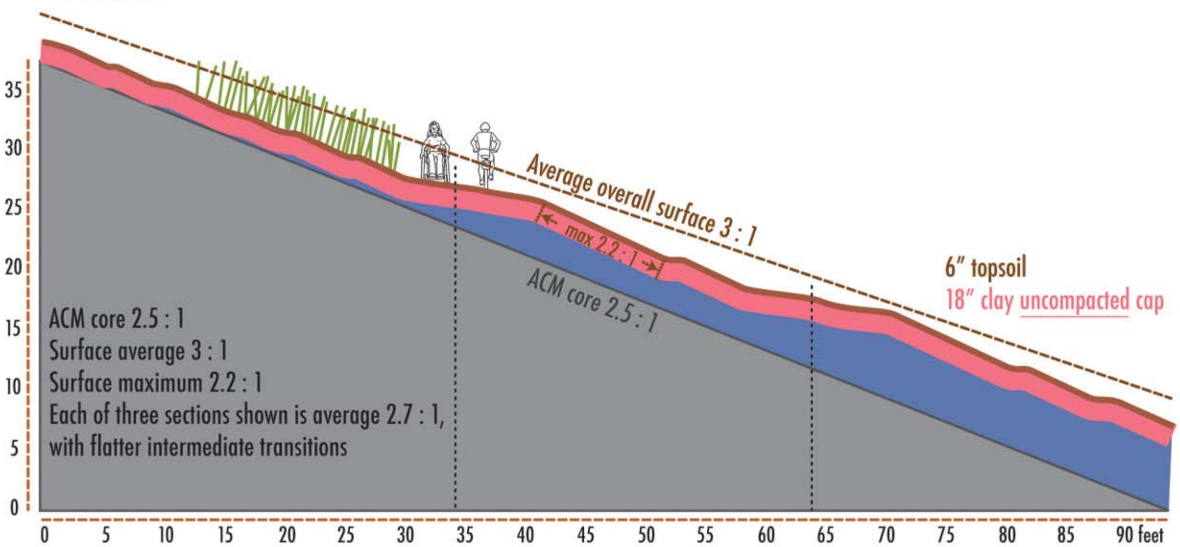
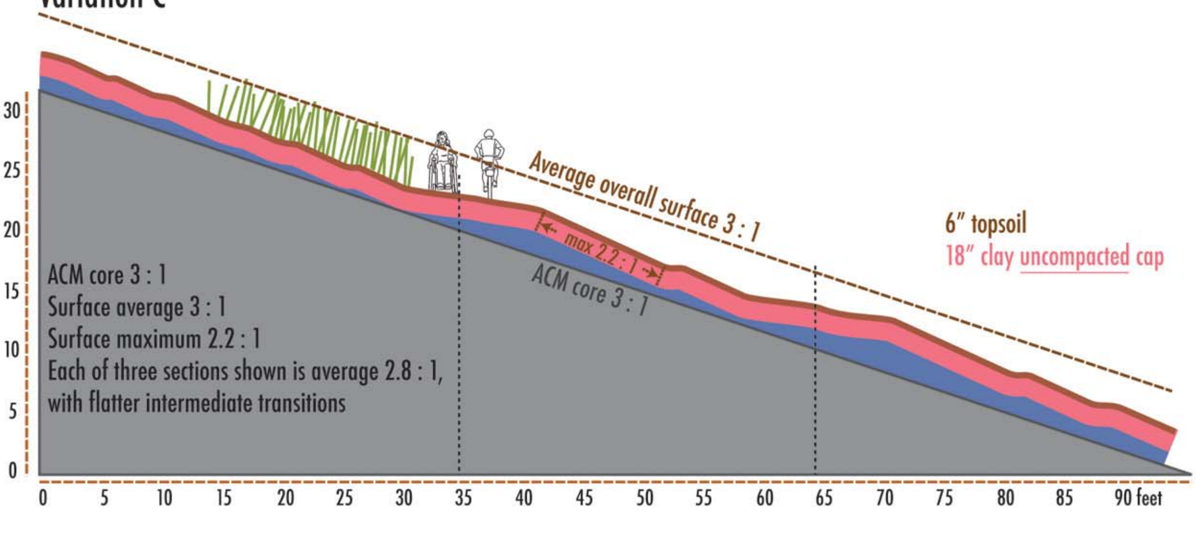
updated 7 July 2010
for discussion



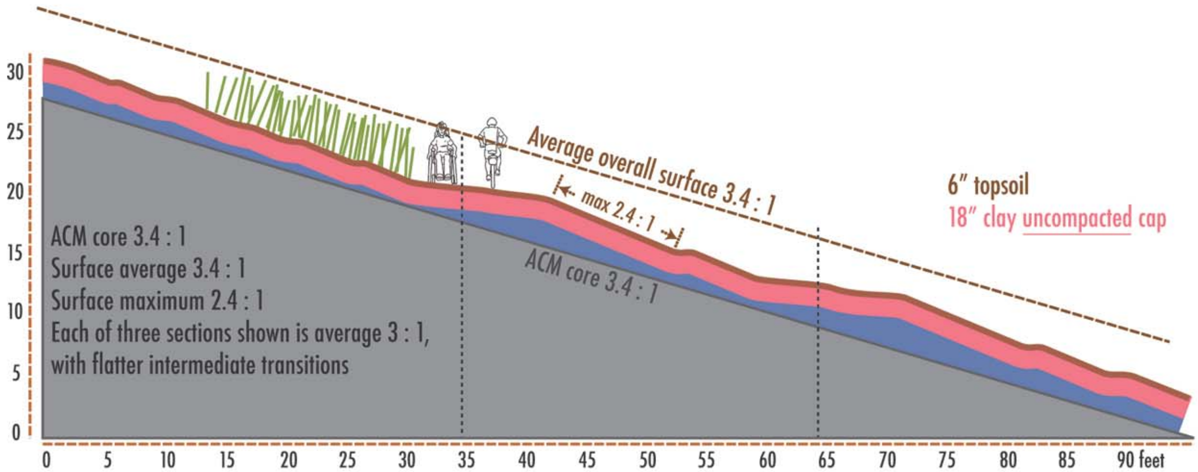
Variation B



Variation C



Variation D


Average overall surface 3.4 : 1
max 2.4 : 1
ACM core 3.4 : 1
6″ topsoil
18″ clay uncompacted cap
ACM core 3.4 : 1
Surface average 3.4 : 1
Surface maximum 2.4 : 1
Each of three sections shown is average 3 : 1,
with flatter intermediate transitions
30
25
20
15
10
5
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 feet

Details on the proposed "E", 3:1 surface average, 3:1 ACM, and allowing 2.5:1 for 12′ horizontal to provide variability. Maximizing the use of the allowed 12′ steeper portions – to "balance" that section, for example, you can do 9.6 feet at 4:1, or 3.4 feet at 10:1, or have a 2 inch deep furrow/swale that is 1.8′ long.

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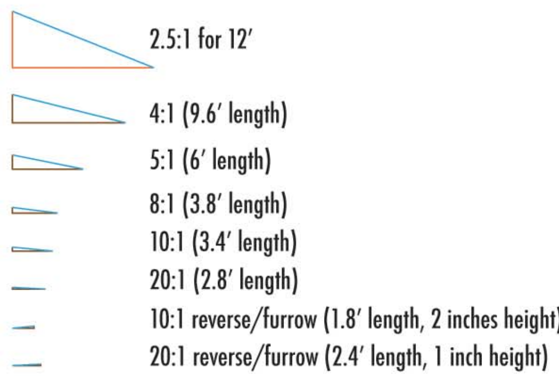
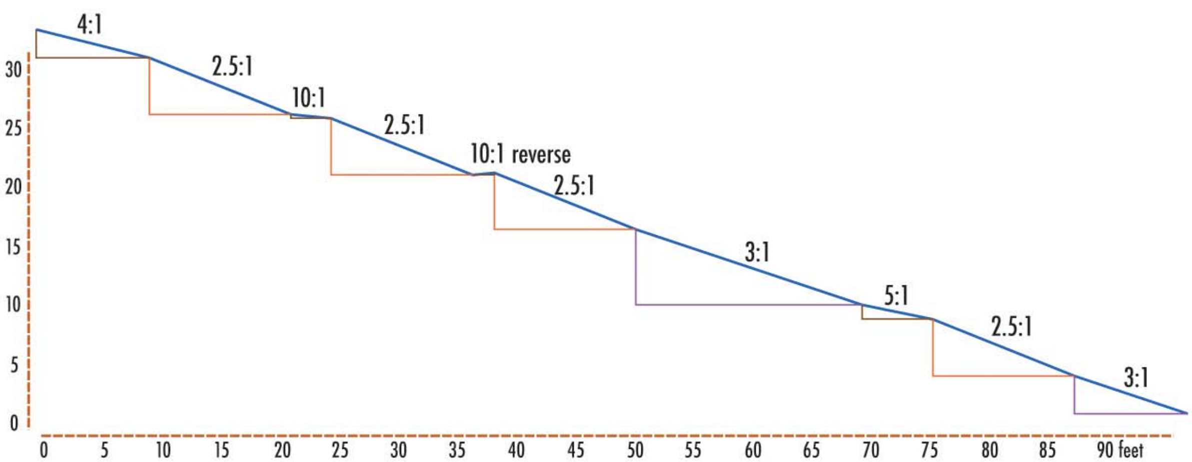
Basic geometry: if "s" is the more gradual slope of the form s:1, like 4:1, then the vertical element of the more gradual section is v = 2.4 / (s - 3). I.e., a 4:1 section can drop (moving downhill) 2.4 / (1) or 2.4 feet, with a horizontal length of 4 * 2.4 or 9.6 feet.

For a reverse grade section (a furrow/swale) that balances the 2.5:1 section,
v = 2.4 / (s + 3). I.e., a 10:1 reverse slope can rise (moving downhill) 2.4 / 13 or 0.18 feet, or 2 inches, with a horizontal length of 10 * 0.18 or 1.8 feet.

Understanding sections that "balance" 2.5:1 for 12 feet so that 3:1 average is maintained:

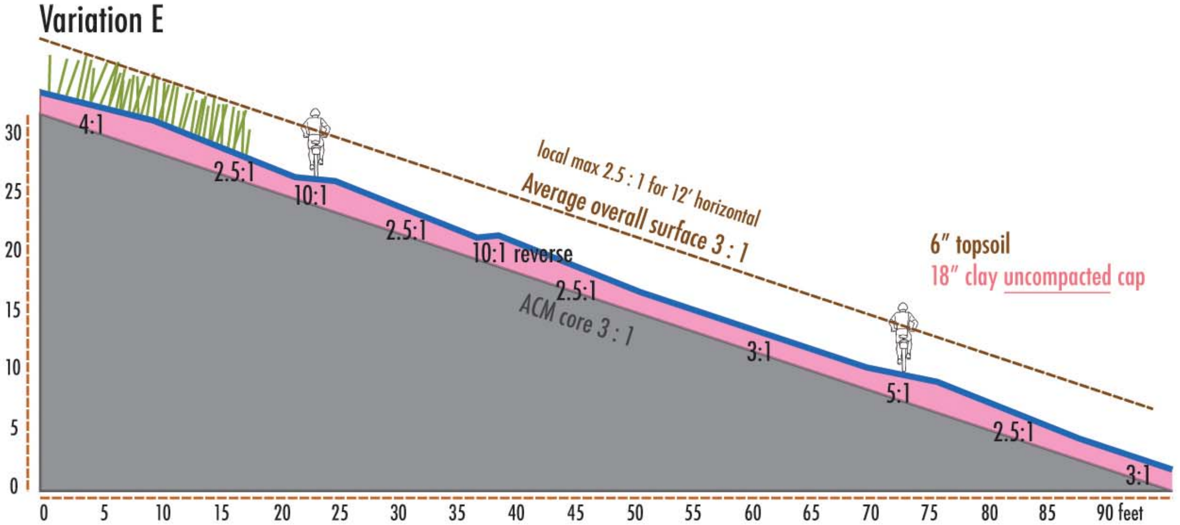


Assembling a longer slope comprised of as quite a few, but not quite the maximum, 2.5:1 12-foot lengths, one scenario might look like this:

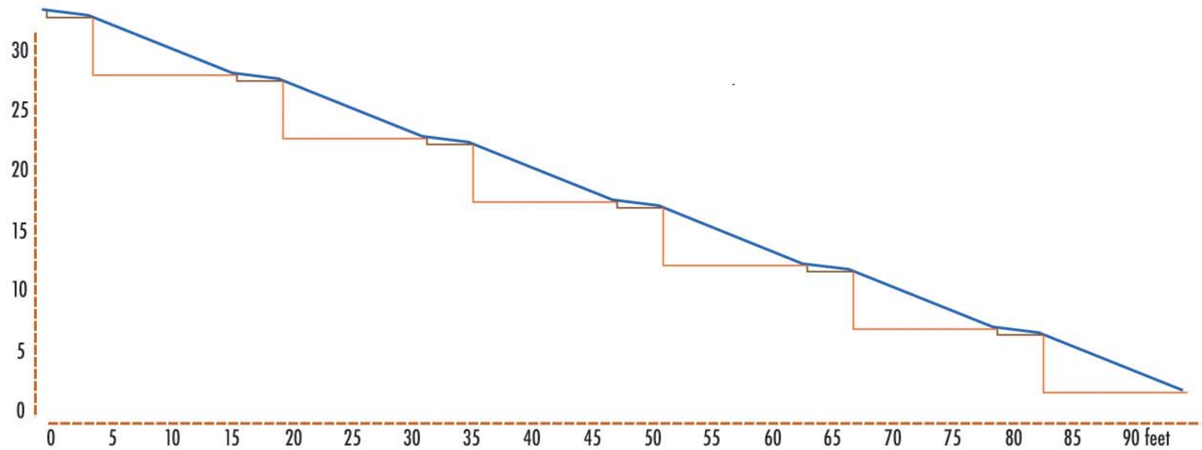


And that same composite, viewed in context:

Variation E

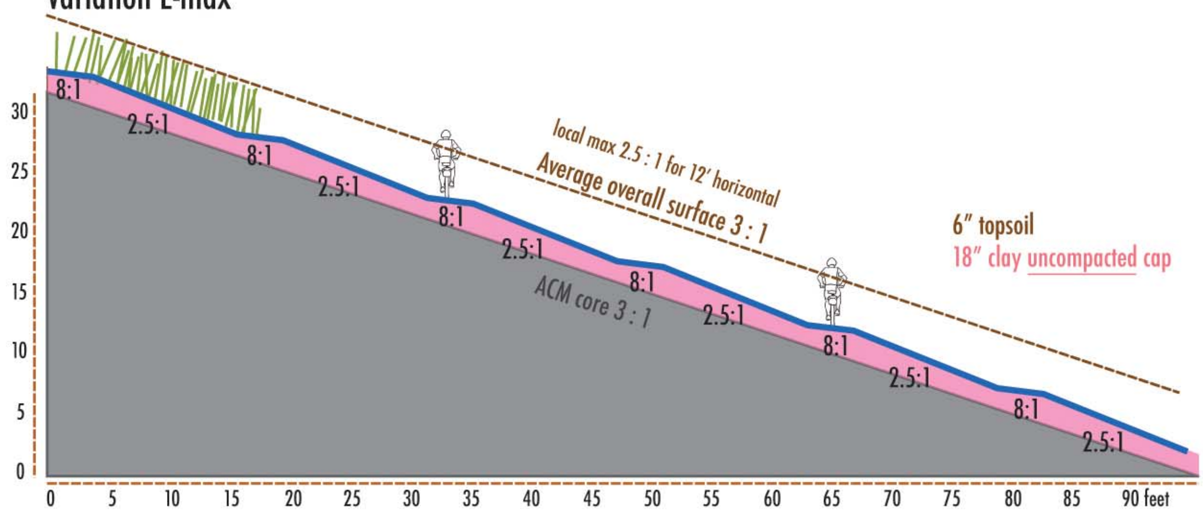


A longer slope comprised of maximum, 2.5:1 12-foot lengths (e.g. enabling most possible variation), separated by 8:1 (<4′ wide) breaks would look like this. Note that 75% of this slope is at 2.5:1.



And that same composite, viewed in context:

Variation E-max



A bit of an elevation giving an indication of potential desired topography to support forested community...
includes small sections of steeper topography. Overall slope is 3.35:1.