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June 28, 2017

Genie McNaughton
Land Stewardship Committee
Advisory to the Bolinas Community PUD
geniemcnaughton@gmail.com

RE: Preliminary Erosion Assessment and Conceptual Treatments for Bolinas PUD Trail

Dear Ms. McNaughton,

You have asked us to investigate causes and potential treatments for erosion and drainage problems along the Bolinas PUD trail between Mesa Road and Olema-Bolinas Road. Below, we offer our assessment of trail conditions and propose recommendations for possible improvements.

Overall Impressions

On 6/15/2017 I visited and walked the trail with Genie McNaughton and Janine Aroyan, and met with Jennifer Blackman and Bill Pierce. I also reviewed a problem assessment provided by Don Smith. I commend the Bolinas PUD and community advisors for the effort that has gone into developing and maintaining the trail. Considering the trail is 10 years old and has just weathered one of the wettest winters on record (2016-2017), I found the trail to be in relatively good condition, having survived the winter better than many other trails in California. During our site visit we saw several people walking and cycling on the trail.

Overall Recommendations

- Avoid concentrating runoff on trails: Surface drainage occurs along the trail in several locations, and our primary recommendation is to prevent runoff from concentrating and running along the trail by constructing standard drainage-control features for trails; in this case we suggest "rolling dips" and "drain ditches". Rolling dips and ditches can be installed relatively quickly and cheaply, with hand tools and hand labor, to minimize future erosion and gullying on trails. Rolling dips should be spaced closely enough to minimize how much water runs along the trail tread, ideally spaced every 30 or 40 feet where the trail parallels the hillslope. Details and design specifications can be found at: https://www.fs.fed.us/t-d/atv_trails_site/build/keeping-water-off-the-trail/rolling-dips.html. Care should be taken that runoff from a drain ditch is not directed toward a lower trail section or other sensitive areas.

- Encourage drainage across trails: In sections where the trail is perpendicular to the hillslope grade, additional drainage may be required to prevent ponding and wet soils on the trail. For example, if the trail continues to be wet between Sites 4-6, additional drainage lenses would be

appropriate. In addition, best practices suggest outsloping trails to allow drainage (https://www.fs.fed.us/t-d/pubs/htmlpubs/htm07232806/page09.htm). Finally, wood chips can be added to wet spots to introduce organic matter to soil over time, improve traction, and elevate the trail surface above the water table.

- Fill gullies in trail: In conjunction with diverting water off trails and improving drainage, we recommend filling gullies with (compacted) local soils to prevent worsening erosion. Moisture may need to be added to the soil mixture to achieve optimal compaction.

- Address erosion promptly: a quick response to gullying in the channel (through the methods described above) will prevent the problem from expanding and becoming harder to treat. Additional future erosion might suggest a need for an additional rolling dip at that location, or more closely spaced rolling dips, in general.

- Increase mowing frequency: vegetation encroachment onto the trails directs traffic towards the center of the trails and then wear on the trail is then concentrated along the center where footsteps and tires keep the plants out, but also preferentially compact and erode the soils. Increased mowing frequency can help to more evenly distribute wear across the width of the trail, and foot/bike/horse traffic can then further keep vegetation off the trails. Another option is to invite goat grazing on the trails from the neighboring goat farm.

- Leave roots in place: Although there are exposed roots in several places, we recommend leaving those in places unless they present a specific hazard. The roots appear to be effectively preventing erosion in many parts of the trail, and we suggest leaving them in place as much as possible, except when they pose a safety threat to foot, bike, or horse traffic. In some cases, there are protruding root sections that could probably be removed without harming the trees (consult with an arborist if needed) and without destabilizing the trail. Alternately, soil could be compacted over the top of the roots to provide a smoother trail surface.

- Leaf litter on the trails: Leaf litter and eucalyptus gumnuts may increase the slipping hazard to walkers and destabilize bikes, but organic cover also protects the trail by limiting rain-splash erosion and wear. In general, for an unpaved trail, we feel that leaves are an expected hazard. We do not have specific recommendations for managing leaf litter, and instead suggest your group work to find an acceptable management strategy.

Several resources are available for outlining strategies and techniques for trail maintenance. We have included several relevant references below that are the basis for our recommendations. They provide additional details and technical specifications for the recommended treatments.

Site-Specific Recommendations
Locations are marked on the attached map.

Site 1: Bike path next to Mesa Road, west in road bend. Runoff is concentrating along trail and should be diverted off trail to minimize future gullying. Trail is now in good shape. Poison oak is encroaching the trail near the Mesa Road bend and should be removed from the edge of the trail to prevent people going off-trail to avoid contact.

Site 2: Eucalyptus roots are exposed, but also helping to stabilize soil and the trail. We recommend leaving the roots in place as much as possible. Diverting runoff from the trail may help prevent future erosion from concentrating runoff. Root areas could also be covered with soil.

Site 3: The trail is in good condition now. Diverting runoff from the trail may help prevent future erosion.

Site 4: The trail is in good condition now, thanks in part to extensive grass cover and drainage lenses. Trail is reported to be wet in winter. Adding additional drainage lenses or outsloping the trail will assist drainage across the trail. Adding wood chips can help make the wet sections passable. More frequent mowing (or grazing) will encourage foot and bike traffic to stay on the trail even if it wet.

Site 5: The bend in the trail collects runoff and has eroded in the center of the trail, presumably because of this concentrated runoff and preferential wear from walking and biking in the center. We recommend rolling dips and ditches to divert water off the trail towards the outside of the bend. In addition, we recommend filling the eroded path and regrading the trail so that it slopes downhill.

Site 6: An informal (shortcut) footpath appears to have been created on a steep slope below the trail along the hillslope grade. We recommend creating a slightly longer path (connecting to the trail just north of the current alignment) and fencing off and planting the existing trail. The existing trail will continue to be bare and susceptible to erosion unless treated. If realignment of the trail is not feasible, we recommend rolling dips to divert runoff, and mulching, planting, and fencing off the edges of the trail to minimize the extent of bare soil.

Site 7: The horse trail is over steepened and eroded at the junction with the bike trail. We recommend planting and placing jute erosion control matting to discourage shortcutting. We also recommend building wood/log-framed steps or realigning the trail to reduce the slope. We recommend consulting a horse-trail specialist to receive advice about best practices for horses (such as step material, height, and spacing). Above the junction, the trail is concentrating runoff. We recommend rolling dips and ditches to divert water off the trail.

Site 8: The bend near Mesa Road is collecting drainage and accumulating leaf litter. We recommend diverting water off the trail as much as possible (e.g. down the decommissioned trail above the pictured bend). Existing gullies can be filled and compacted to minimize flow collecting in the trail. Below this curve the trail would be improved by installing rolling dips to divert water off the trail.

Closing

We appreciate the opportunity to contribute to the maintenance of this worthwhile trail and look forward to assisting in the future if needed.

References

International Mountain Bicycling Association. "Building Better Trails: Designing, Constructing and Maintaining Outstanding Trails." *International Mountain Bike Association, Boulder, CO, 64pp* (2001).

International Mountain Bicycling Association. "Trail Solutions: IMBA's guide to building sweet singletrack." *International Mountain Bike Association, Boulder, CO, 272pp* (2004).

Parker, Troy Scott. *Natural surface trails by design: physical and human design essentials of sustainable, enjoyable trails*. Natureshape, 2004.

https://www.fs.fed.us/eng/pubs/pdf/BAERCAT/lo_res/Chap_4.pdf

https://www.fs.fed.us/t-d/pubs/htmlpubs/htm07232806/page09.htm

https://www.fs.fed.us/t-d/atv_trails_site/build/keeping-water-off-the-trail/rolling-dips.html

Sincerely,

BALANCE HYDROLOGICS, Inc.

DRAFT

Zan Rubin, Ph.D.
Hydrologist/Geomorphologist

DRAFT

Jonathan Owens
Principal

Bolinas Bicycle/Pedestrian Path System

Don Smith 5/13/08 rev.

- route designed for minimum grade; meets ADA recreational-trail guidelines of max. 200' unrelieved length at 1/20 to 1/12 grade and 30' for 1/12 to 1/10.
- "rolling-grade" dips to be used as needed to prevent erosion.

BCPUD Class I path proposal, 4700' total, all within BCPUD land AP# 193-030-38 except as noted

- existing paved path
- - - existing footpath to be upgraded
- ▪▪▪▪▪ new route cut through eucalyptus grove and meadow (70 cu. yds excavation not incl. North Entry cut)
- ooooo County Class I path in DPW engineering

500'

True North

crosswalk

gravel topping as needed in chronically wet areas (typ.) (path-mix gravel, 1/2" to fines)