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May 30, 2018

RE: Road Improvement Recommendation Letter – Glastonbury Homeowner's Association; Park County, MT (180481)

Members,

A site visit was conducted on May 1, 2018 by C&H Engineering and Surveying, Inc. (C&H). The visit consisted of a site tour led by Members Dennis Riley, Tim Brockett, and Claudette Dirkers. The scope of work was to visually observe existing conditions and provide general recommendations for improvements. Sub-surface exploration was not done at this time, but it may be necessary in the future to verify recommendations. This letter contains a section with general observations and recommendations followed by a section with more specific recommendations for noted problem areas. This letter should serve as a general guideline but will not take the place of engineered plan sets.

General Observations and Recommendations

Asphalt:

Shrinkage cracks aside, much of the asphalt seemed to be in reasonable shape considering its age, use, and unknown cross-section. C&H recommends replacing the significantly damaged portions of road by completely replacing that section of road. That is, removing the entire section of asphalt from edge to edge, and any questionable material below and replacing with the typical asphalt road section as shown below in figure 1. Aside from full replacement, there are no long-term fixes for any section of the road. Crack repair and chip sealing may prolong its life by keeping water infiltration to a minimum, but these are not long-term solutions. In no case will C&H recommend utilizing an asphalt overlay, due to the unknown material underneath the existing asphalt. Adequate roadside ditches existed along some of the asphalt roads, but not all. C&H recommends that these be checked thoroughly, and that ditches be added or improved as necessary.

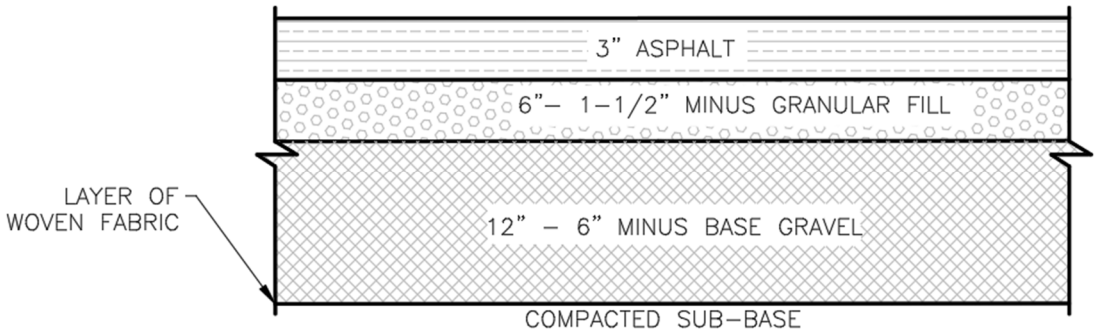

Figure 1. Typical Asphalt Road Section

Gravel:

A majority of the gravel roads are in need of simple maintenance. All gravel roads should either have a crown, or a single pitch towards one side or the other, with minimum cross-slope(s) of 3%. A clean ditch with continuous drainage connection should exist on both sides of a crowned road, or the low side of a single pitched road. Adding crowns and ditches will be the single best thing that can be done to improve the longevity of these roads. When adding crowns, additional 1-1/2" granular fill material (often called "road mix") may need to be imported to maintain correct cross section thicknesses, see figure below.

The cross section of these roads is currently unknown, no test holes were excavated during this site visit. If any soft spots are found in the gravel roads, C&H recommends fully excavating the existing cross section and replacing with the standard cross section as show in figure 2 below.

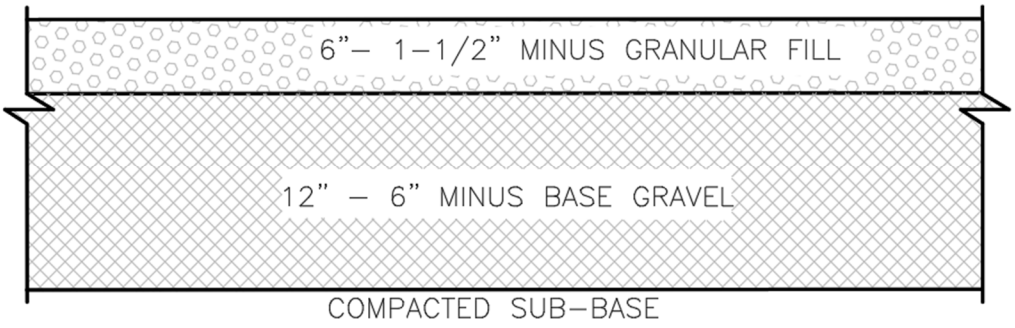

Figure 2. Typical Gravel Road Section

Once the roads are re-shaped with crowns and ditches, they should require less upkeep than before. C&H recommends maintenance of these roads on an as needed basis, with emphasis being placed on prompt attention to disappearing crowns and ditches. C&H does not recommend placing Mag-Chloride on any gravel roads unless the road has been shaped correctly. The Mag-Chloride should be installed per the supplier's recommendation.

Culverts and Ditches:

Most of the culverts observed during the site visit appeared to be in good working order. Some additional culverts are recommended in specific locations in the next section of this letter; there me be need for additional culverts not mentioned here. Roadside ditches were often nonexistent. It is important that a clear, continuous path for runoff exists for all roads. It was reported that some areas backup with water during the spring thaw due to snow loading in the ditches. Consider increasing the size of the ditches in these areas.

It is recommended that all culverts and ditches be visually inspected twice each year for obstructions/blockages and dealt with accordingly. These inspections should take place just after spring run-off, and just before the onset of winter. Any blockages reported during the interim should be dealt with expediently. If any culverts or ditches are reported to flow at more than half full a majority of the time, considering replacing with the next larger size.

Site Specific Observations and Recommendations

Site 1 – Hercules at Dry Creek

1. Add centerline crown, add/improve ditch on the outside of the curve where Hercules meets Dry Creek
2. Add outfall for ditch on the inside of the curve, seek permission from landowner
3. Add culvert crossing under Dry creek starting at outside of curve and heading south. Seek permission from ditch owner.
4. Add sump for inlet side of culvert, instruct snow plow contractor to pile snow above sump.

Site 2 – Hercules at Polaris and Scorpio

1. Existing culverts under Scorpio and Hercules are nearly at capacity, consider upsizing.
2. Add a culvert to collect ditch water from near fire fill site. This culvert could cross either Hercules or Polaris. Ensure sump does not interfere with fire fill site, instruct snow plow contractor to pile snow above sump.
3. Add/improve ditch on East side of Hercules heading north from fire fill site.
4. Regrade ditches on both sides of Hercules heading north from this intersection. Deep low spots exist currently that are holding water. Consistent and positive drainage in the bottom of the ditches towards culvert inlets is desired.

Site 3 – Hercules at Goldmeyer Creek

1. Add a driveway or short berm that heads West across Ramp property from Hercules, paralleling Goldmeyer. This is intended to keep the meandering overflow of Goldmeyer headed towards the Goldmeyer culvert, instead of overloading the culverts at site 2.
2. Consider adding a high spot or grade break in between here and site 2, splitting the drainage load between the 2 culverts.
3. Note 4 from site 2 also applies here.

Site 4 – "First Meadow" on Hercules

1. The meandering overflow of Goldmeyer is overloading the ditch that is intended for road drainage. Add a short berm on the backside of the existing ditch (between the ditch and the meadow) to keep the waters separated.

Site 5 – Various spot Hercules that are being eroded by Goldmeyer creek

1. The addition of rip-rap for bank stability will stabilize the more minor areas of erosion.
2. On more damaged areas, consider a minor re-routing of the stream, further from the edge of the road.
3. Permitting is likely required for both solutions above

Site 6 – Capricorn, West of Aries, Near Gravel pit

1. Recommend that damaged section be saw-cut and fully replaced from edge to edge with standard cross-sections as mentioned in Summary
2. A culvert appears to cross under this section. The outfall of the culvert was not found. This should be investigated and repaired during the repair of the asphalt.

Site 7 – Capricorn, near the McCowan and Sandoval Properties

1. Add a culvert that cross Capricorn, east of driveways.
2. Seek permission from McCowan and/or Buford for a ditch and/or retention area to handle runoff from this portion of Capricorn.

Site 8 – Capricorn at Venus

1. Add/improve ditch on west side of Venus and connect it to the culvert that crosses Capricorn.
2. Seek Permission from Bush's to add a ditch the re-routes storm water to west of property to mitigate Corral flooding. Also see recommendations for site 9.

Site 9 – Venus at Mercury

1. Add/improve ditch connection from outfall of existing culvert to large ditch that parallels Venus.
2. Add centerline crown to both roads
3. Consider adding culvert that crosses Venus, just south of Mercury, that conveys runoff from the west side of Venus to the east side. This may reduce the Corral flooding at the Bush property during large storm events. The ditch on the east side of Venus will likely need be enlarged to handle the additional flow.

Site 10 – The end of Platted Venus, near the dome home

1. From Site 10 to site 9, add centerline crown and ditches on either side that connect to culvert system at Venus and Mercury.
2. Culverts or shallow, drive-over ditches should be added at the various driveway and road intersections here.

Site 11 – Gemini Between Orion and Starlight

1. Add centerline crown, add/improve ditches on both sides.
2. A private road heads east from Gemini in middle. A culvert or drive-over ditch should be added to maintain drainage connection for Gemini ditch. This private drive has a culvert that conveys a ditch. This culvert should be cleaned.

Site 12 – Gemini, just north of Capricorn

1. Add centerline crown, improve ditch on west side of Gemini.
2. Improve ditch connection from west side of Gemini to culvert sump
3. Expose, clean, and repair the inlet of this culvert.
4. Install erosion control measures up-stream to help with silt-in of sump.

Site 13 – Capricorn, Near Nye and Ali Properties

1. A ditch should be added on the south side of Capricorn that starts at the existing culvert that crosses Capricorn at the Nye property, and heads East past the Ali property
2. A culvert will likely be needed for the Ali driveway to cross the proposed ditch.
3. Connect existing culvert under Nye driveway to proposed ditch.
4. The ditch on the north side of Capricorn in this area may need to be enlarged for additional snow storage capacity. This is reportedly an area that backs up during spring thaw.