December 14, 2018 Project No. 1791724

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EVALUATION OF PAVEMENT SURFACE AND AGGREGATES
RED HILL VALLEY PARKWAY, CITY OF HAMILTON

Dear Sir,

Golder Associates Ltd. (Golder) is pleased to present this letter report to the City of Hamilton (City) with the results of the investigation of the condition of the existing pavement surface on the Red Hill Valley Parkway (RHVP), located in the City of Hamilton. Our work for this assignment was completed in accordance with Golder's Proposal No. P1791724 to the City, dated November 23, 2017.

Field Investigation

Golder's work for this assignment commenced with carrying out a limited field investigation program which comprised the following:

- Testing of the surface frictional properties using the British Pendulum Tester in accordance with Test Method ASTM E303;
- Pavement texture measurements at the surface friction test locations, using a volumetric technique (Sand Patch) in accordance with Test Method ASTM E965; and
- Coring of the surface course asphalt layers.

All the field investigations for this assignment were carried out at nights on December 6 and 7~~7~~, 2017. Golder retained a qualified subcontractor to provide the required traffic control for the field investigations program. The friction and texture measurements were made at 15 locations in each direction of the RHVP, with both tests (i.e. friction and surface texture) being carried out at each location. A total of 30 of each test were performed. The testing was performed by a member of Golder's engineering staff.

At each location that was tested for surface friction and texture, Golder also obtained a core of the surface course asphalt layer. A 150 mm diameter core barrel was used to obtain the asphalt core by a Golder representative. After the core was extracted at each location, the core hole was patched with Hot Mix Asphalt (HMA).

Laboratory Testing

The asphalt cores were brought to Golder's CCIL certified laboratory to Whitby, Ontario. The cores were broken down and the aggregates from the surface course asphalt layers were extracted from each core. The extracted aggregates were sent to James Fisher Testing Services in Ireland for testing of Polished Stone Value (PSV) in accordance with European Test Method EN 1097-8: 2009. The laboratory performing the test was accredited for this test by the United Kingdom Accreditation Service (UKAS). The PSV is not a standard test in Canada and thus the sample was sent to Europe for testing. The PSV~~olished Stone Value~~ of aggregate is intended to give a measure of resistance to the polishing action of vehicle tires under conditions similar to those occurring on the surface of a road.

Analysis and Interpretation

The detailed results of the field investigations and laboratory testing are attached to this letter report. A summary of the test results was presented to the City in a meeting on March 9, 2018.

The corrected PSV of the tested aggregates was 45. This value is considered to be average/medium [1]. As discussed during the meeting, there is a concern that an aggregate with a PSV of 45 will not provide sufficient long-term frictional characteristics if the surface course asphalt mix is subjected to hot-in place (HIR) recycling. At the time, HIR was one of the rehabilitation strategies being considered by the City for the RHVP. One of the solutions to this particular concern with HIR could be the addition of a high percentage of a beneficiating mix during the HIR process. The beneficiating mix in this case would have to incorporate aggregate(s) with high PSV values to improve the average characteristics of the blend. The desired target PSV value for the blend would be 50. Golder is currently evaluating the feasibility of carrying out HIR of the SMA surface course HMA mix on the RHVP.

The average texture depth was 1.25 mm and it ranged from 0.57 mm to 1.98 mm. Overall, the texture of the surface is generally considered to be good. A pavement with good macro-texture should have a texture depth of about 1.0 mm [2].

The British pendulum tester is a dynamic pendulum impact-type tester used to measure the energy loss when a rubber slider edge is propelled over a test surface. The values measured, BPN = British pendulum (tester) number for flat surfaces, represents the frictional properties obtained with the apparatus at the time of the test. The higher the BPN, the better the frictional properties of the test surface.

The average PBN value was 39 and the results ranged from 21 to 62. While the average can be considered as good, the test results were ~~very~~ variable. The values below 30 would be considered as low. Six of the readings were below 30, i.e. 20% of the locations tested. However, as stated during the meeting with the City, the BPN testing was carried out while the temperature was below 0°C and there was a light snow fall; therefore, the BPN numbers would not be considered to be reliable. A detailed, reliable friction testing survey was carried out on the RHVP by Tradewind Scientific using a GripTester on November 20, 2013 [3]. The Grip Number (GN) values were variable and ranged from 27 to 54, and the average GN value in the eastbound direction was 34.5 and in the westbound direction 37.5. To our knowledge, the actual designation of pavement surface friction standards (such as minimum Skid Number, SN) is not commonly practiced by any provincial/states or local agencies in Canada and the United States [~~4~~3]. An example of criteria for identifying low friction pavement surfaces given by the Transportation Association of Canada in [34] is shown in Table 1 below. The same criteria are also included in [2]. In Table 1, Skid Number SN40 is used as the basis for establishing surface friction conditioncriterion. SN40 means

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that the testing was carried out at a speed of 40 miles/hour. We are not aware of any establishedclear correlation between SN, GN and BPN values.

Table 1: Criteria for Identifying Low Friction Pavement Surface [4]

Category	Skid Number (SN_{40})	Accident Problem	Action by Engineering District
A	< 31	Yes	Improvements or general maintenance programs considered for betterment
B	31 – 34	Yes	Maintain surveillance and take corrective action as required
C	34 or less	No	Maintain surveillance and take corrective action as required
D	35 – 40	-	Maintain surveillance and take corrective action as required
E	> 40		No further action is required

As ~~discussed with~~was brought to the City's attention a number of times previously, ~~if there is~~ an immediate, effective treatmentsolution to address a concern with frictional characteristics of the SMA surface course on the RHVP~~, an immediate, effective solution~~ would be to carry out shot blasting/skid abrading of areas of concern on the existing pavement surface. This treatment is quick and relatively low cost. It improvesrestores the skid resistance immediately. However, it does not address pavement cracking or bumps and dips in the pavement and is not a structural rehabilitation treatment. We are not aware of any Ontario or other Canadian standards for shot blasting of pavement surfaces and do not have immediate references available for using shot blasting to improve pavement frictional characteristics on highways in Ontario. However, we have included two brochures withto this report: one on using a Skidabrader [5]; and another one on using Blastrac [6]. Shot blasting is considered technically ~~and financially~~ feasible to efficiently improve~~restore~~ skid resistance of a pavement surface [7 and 8]. Other treatments ~~solutions~~ could be the application of microsurfacing; however, although this improves frictional characteristics, seals ~~the~~ cracks and can correct minor dips in a pavement, it is significantly more expensive than shot blasting. It also requires good weather conditions for successful application ~~and would have a relatively short life expectancy given the traffic volumes on the RHVP~~. (I don't want to include this considering that we have recommended this treatment for RHVP in the past).

Closure

We trust that this report meets your present requirements. If you have any questions about this report or require further clarification, please do not hesitate to contact the undersigned.

References:

Commented [MM1]: Is this the exact duplication of a table in Ref 4? I don't understand why Category C is 34 or less and it's no problem and Category B is 31 to 34 and is a problem?

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Commented [MM2]: We should avoid the word 'restores' as it implies that we have concluded that the friction is inadequate. We have previously stated that there are no strict guidelines.

Commented [MM3]: I don't think we should comment on what is financially feasible for the City.

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1. B.S. Heaton, J.J. Emery and N.A. Kamel, "Prediction of Pavement Skid Performance", Paper Sponsored by Ontario Ministry of Transportation and Communication, 1978.
2. Allauddin, Mohammad Ahmed, Susan L. Tighe, "Incorporation of Surface Texture, Skid Resistance and Noise into PMS", 7th International Conference on Managing Pavement Assets, 2008.
3. Tradewind Scientific, Friction Testing Survey Summary Report, Lincoln Alexander & Red Hill Valley Parkways (Hamilton), November 20th, 2013.
4. Transportation Association of Canada (TAC), Pavement Design and Management Guide, 1997.
5. Skidabrader, Pavement Texturing for Skid Resistance, Bi-Directional Shotblasting Process for Safety,
6. Blastrac, Shot Blasting Systems, 2013
7. Douglas D. Gransberg, "Life-Cycle Cost Analysis of Surface Retexturing with Shotblasting as an Asphalt Pavement Preservation Tool", Transportation Research Record, 2009.
8. Bruce Rymer, Paul Donavan, Ervin Kohler, "Tire/Pavement Noise Levels Related to Road Friction Improvements", Transportation Research Board Annual Meeting, 2010.

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Yours truly,

Golder Associates Ltd.

~~**DRAFT**~~

Ludomir Uzarowski, Ph.D., P.Eng.
Principal, Senior Pavement and Materials Engineer

LU/MLJM/TL/rr

Attachments: Table 1 – Measured Texture Depth on RVHP
Table 2 – Average BPN Values
Laboratory Test Report for Determination of Polished Stone Value

Commented [MM4]: Need to add the two brochures mentioned above.

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