Further Differentiation Between Good and Bad Road Surface Characteristics From Instrumented Vehicle Testing

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Recently Gorski Consulting reported on the results of testing performed on a number of roads in Southwestern Ontario that was intended to provide objective data enabling the differentiation between "good" and "bad" road characteristics.

In a recent article ("iPhone Gyro Function Generates Detailed Data Of Road Conditions For Accident Analysis", Feb 25, 2014) we described the test procedure and discussed the results from tests conducted on three sites. In a further article ("Preliminary Comparison of City of London and South-Western Ontario Road Surface Conditions", Feb 28, 2014), we presented the results from testing on additional sites resulting in the creation of the chart shown below, combining the data from both articles.

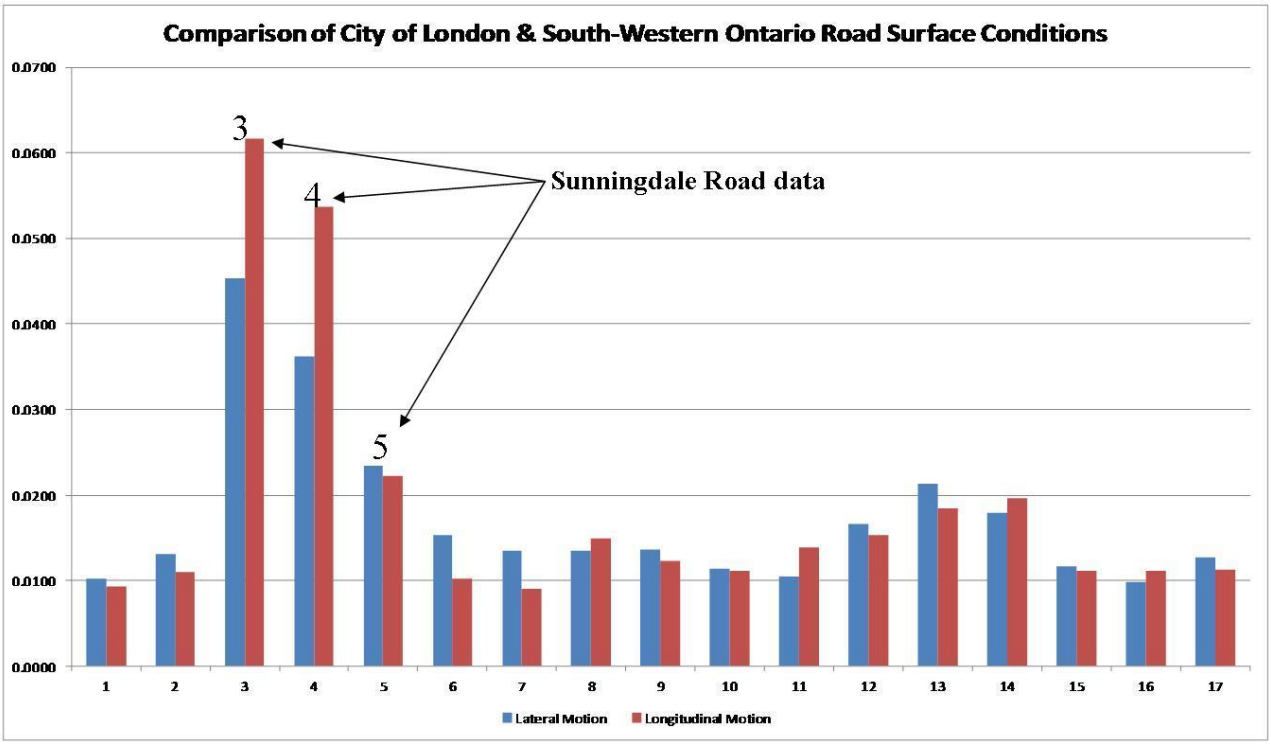

Figure 1: 17 results from testing conducted on roads in the City of London, Ontario and its vicinity.

The previous articles demonstrated that the surface of Sunningdale Road in the City of London was in extremely poor condition. Sensors mounted to our test vehicle

demonstrated there was much more lateral (blue bar) and longitudinal (red bar) motion of the vehicle when travelling on Sunningdale Road than when the same vehicle travelled on the other roadways, as shown in the above chart. In particular the high height of the red bars in the chart indicated that Sunningdale Road caused an exceptional amount of longitudinal motion of the test vehicle.

In the present article we expand the database by providing the results from 12 additional sites. These additional sites were on rural highways located to the southwest of London, in western Middlesex and eastern Lambton Counties. The orange dots on the map in Figure 2 indicate where these additional sites were located.

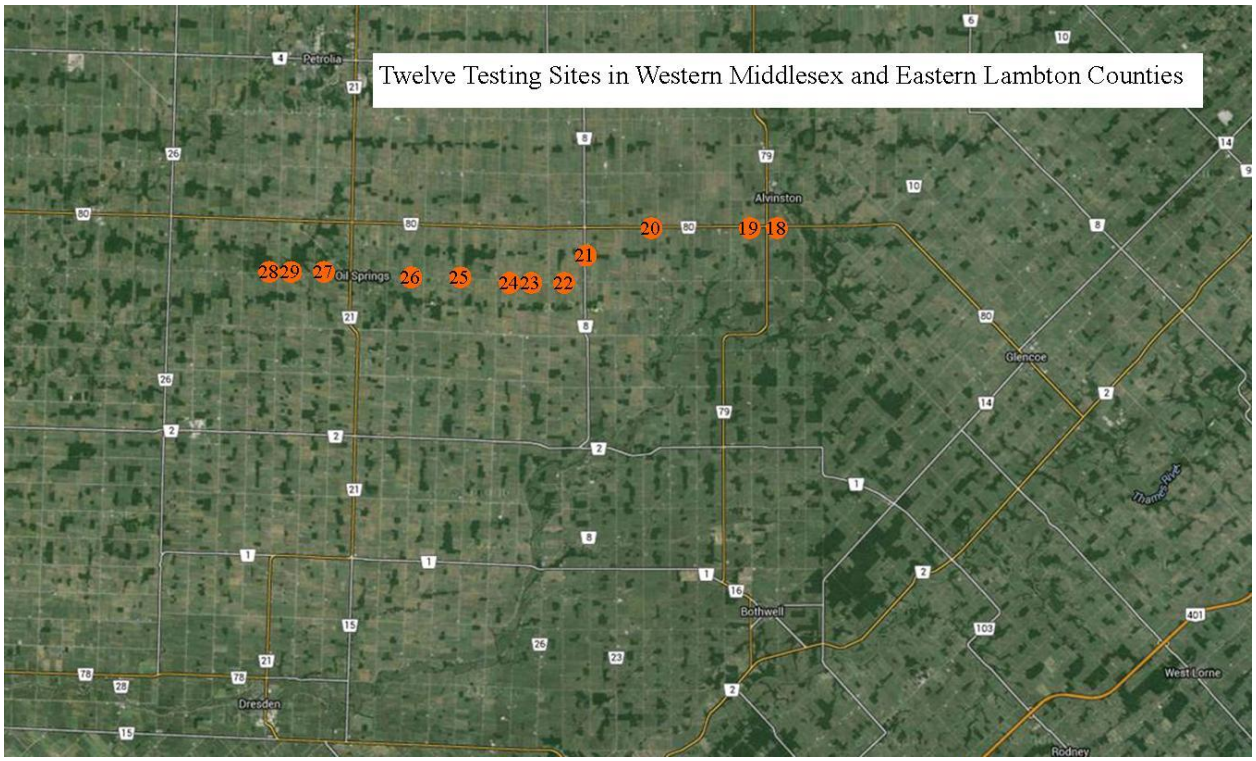

Figure 2: Map of western Middlesex and eastern Lambton Counties where testing was performed on 12 rural highways.

Figure 3 shows an updated chart showing the results of all the sites that have been tested, including those discussed in the previous two articles.

While our vehicle travelled along a road segment the rate-of-change in the lateral and longitudinal angle of the vehicle was sensed and recorded. We then obtained the standard deviation in those rates-of-change and this is the value that is shown in the chart.

The rate-of-change in the angle of the vehicle is correlated to the acceleration. So, for example, when the vehicle experiences a high acceleration this also causes a quick change in the angle of the vehicle. Optionally we could have displayed tri-axial acceleration values or the 3-dimensiional angle of the vehicle as these parameters are also available from the iPhone data.

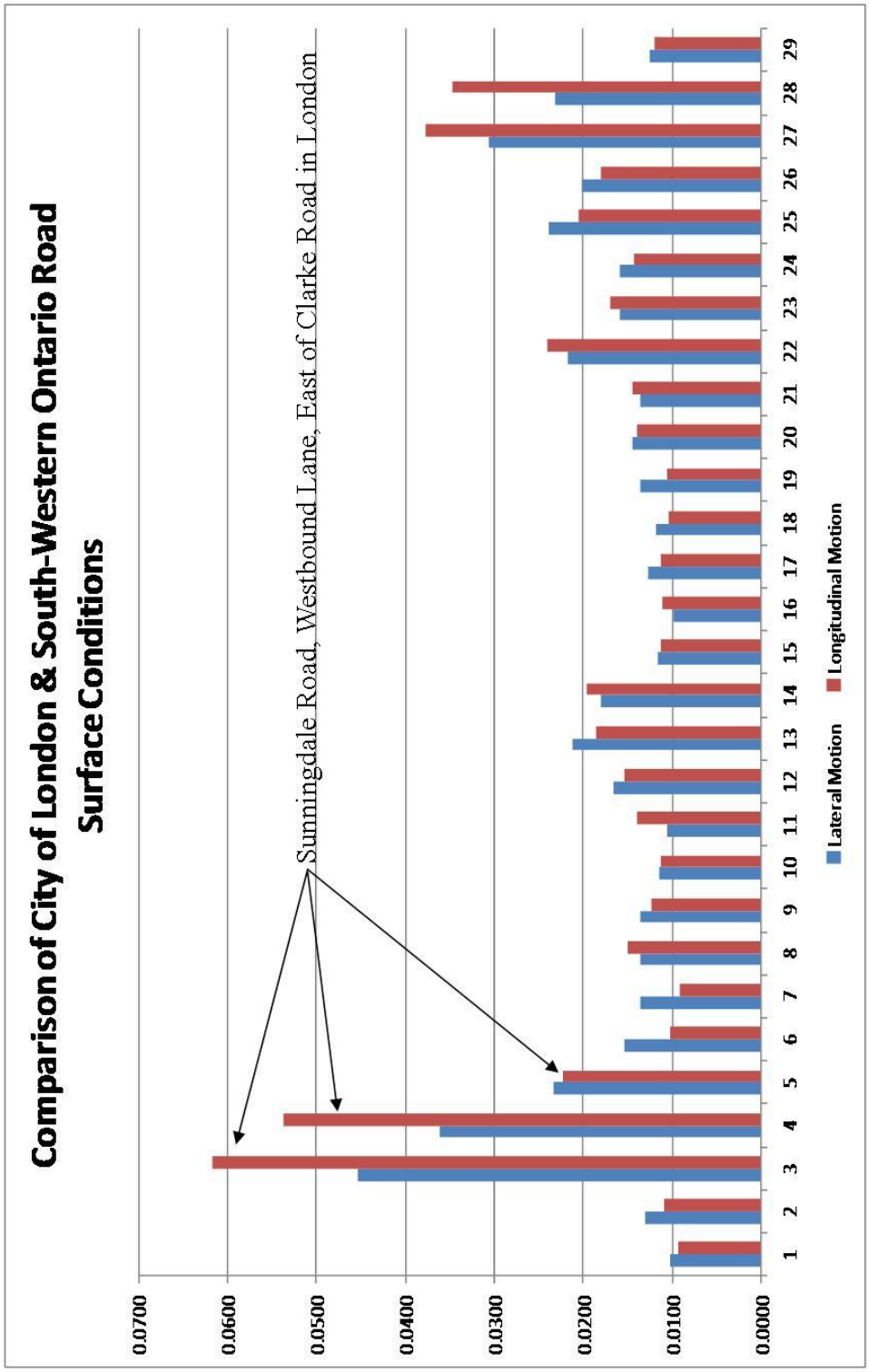
Comparison of City of London & South-Western Ontario Road Surface Conditions
Sunningdale Road, Westbound Lane, East of Clarke Road in London
0.0700
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Lateral Motion
Longitudinal Motion

Figure 3.

It can be seen in Figure 3 that Sunningdale Road still contains the most extreme surface conditions. However, near the latter portion of the chart (sites 22 through to 29) the data seems to indicate worsening conditions. In particular Sites 27 and 28 caused substantial motions of the test vehicle. Part of this difference is that packed snow was encountered on the road surface of these latter sites.

This needs further elaboration and we will do so by selecting Sites 18, 22 and 27 for more detailed discussion. The location of these sites is shown in the more-detailed map of Figure 4.

Figure 4: Location of Sites 18, 22 and 27 in eastern Lambton County, Ontario.

Better surface conditions were sensed at Site 18, which was on Highway 80. The conditions at this site are shown from the frame in Figure 5 which was exported from the video camera that was pointing forward through the windshield o the test vehicle.

As can be seen in Figure 5 the road surface is asphalt, it is bare and contains little evidence of any cracking or unevenness.

In contrast the sites with the worse conditions, Sites 22 through 29, were located further westward on Oil Springs Line, in Lambton County.

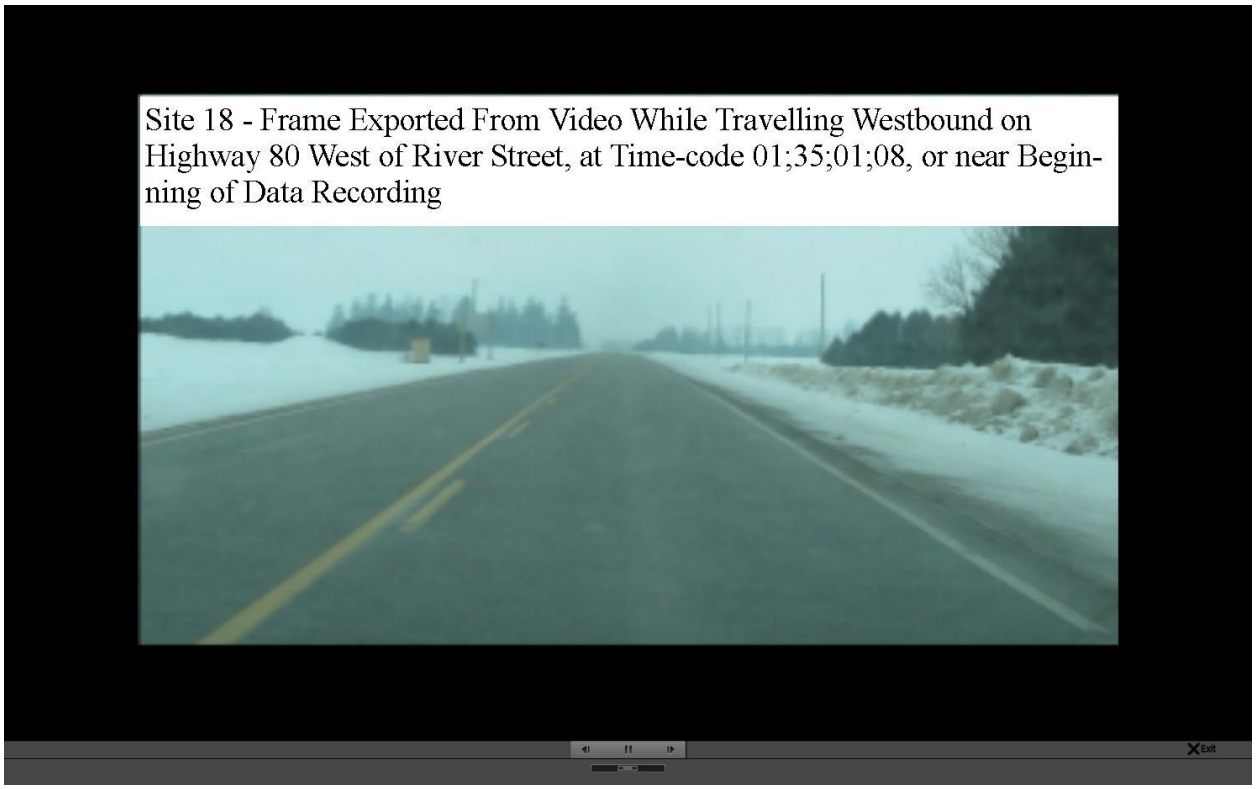

Figure 5.

For example, we started recording for Site 22 just after we entered onto Oil Springs Line, just west of Inwood Road. While travelling along Oil Springs Line the test vehicle encountered hard packed snow/ice on the right half of the westbound lane while the left half was bare and wet. This was a potentially unsafe condition because of the difference in tire force that could be experienced by the two sides of the vehicle.

Figure 6 shows the road conditions on Oil Springs Line near the beginning of the recording for Site 22. Figure 7 shows the conditions about halfway through the recording and Figure 8 shows the conditions near the end of the recording. In all three of these figures we can see how hardened snow and ice were compacted onto the right half of the westbound lane. If one were to drive properly within the westbound lane then the right side wheels of the vehicle would have to travel near the edge of that hardened snow and ice. Note how the edge of the hardened snow and ice is irregular so the right side wheels of the vehicle would be continually travelling onto that snow/ice and travelling off it, back and forth. This is the type of condition that caused excessive motion of the test vehicle.

Note however, that the snow and ice were not the only problem. The surface of the road was also uneven and this can be seen in the irregular pooling of water on the surface from time to time in those areas where there were depressions and the water could not drain away.

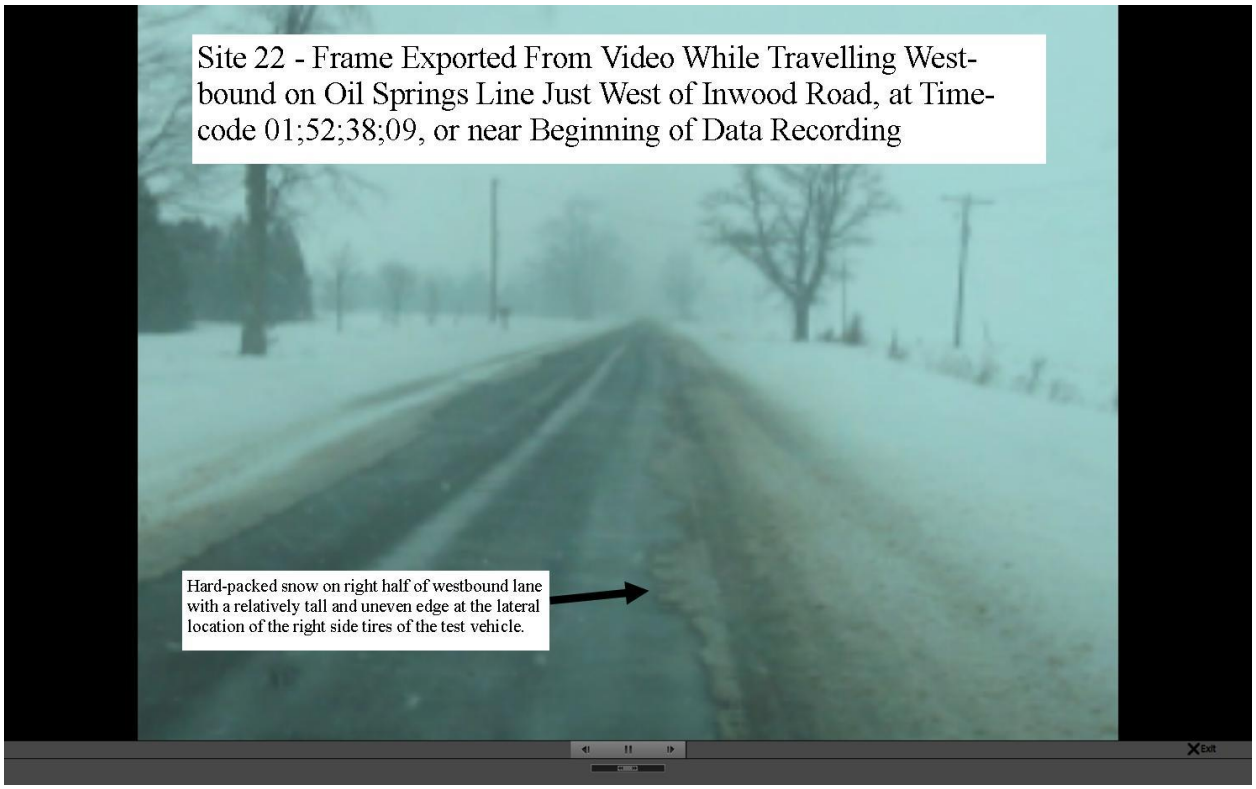

Figure 6.

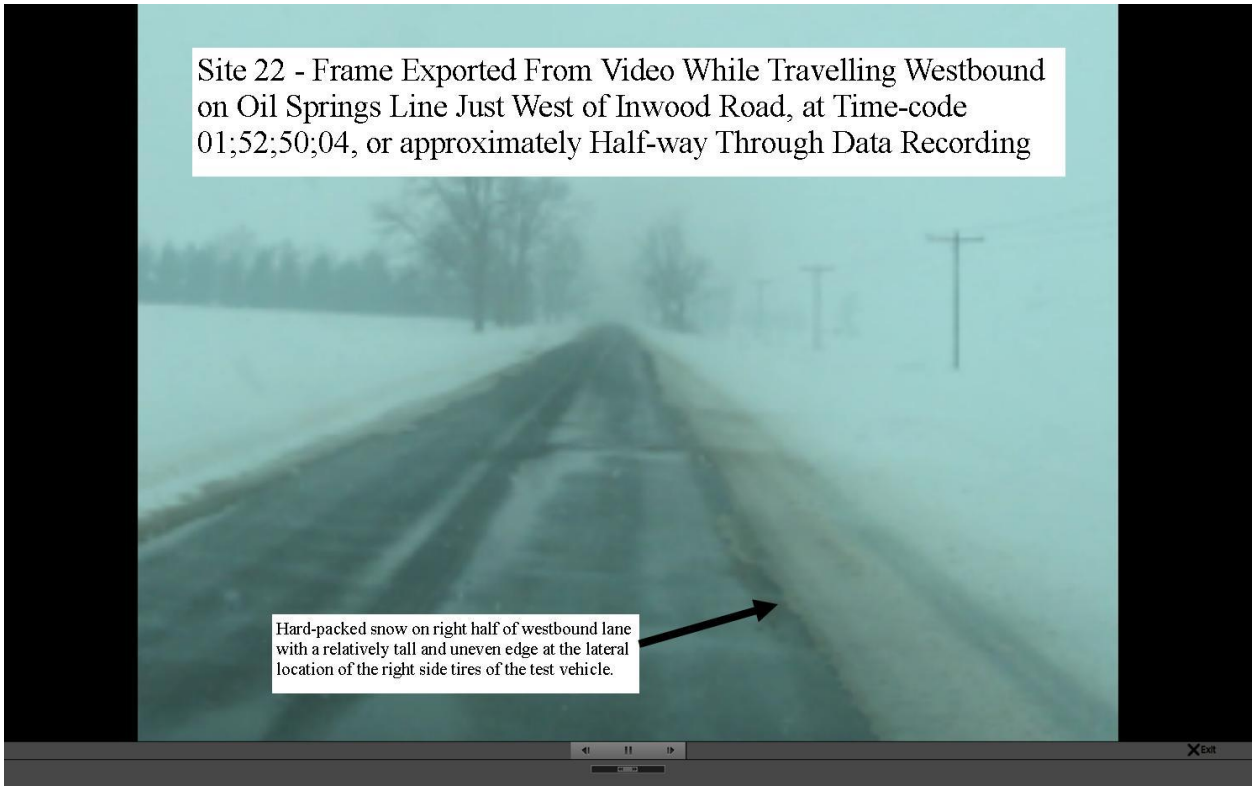

Figure 7.

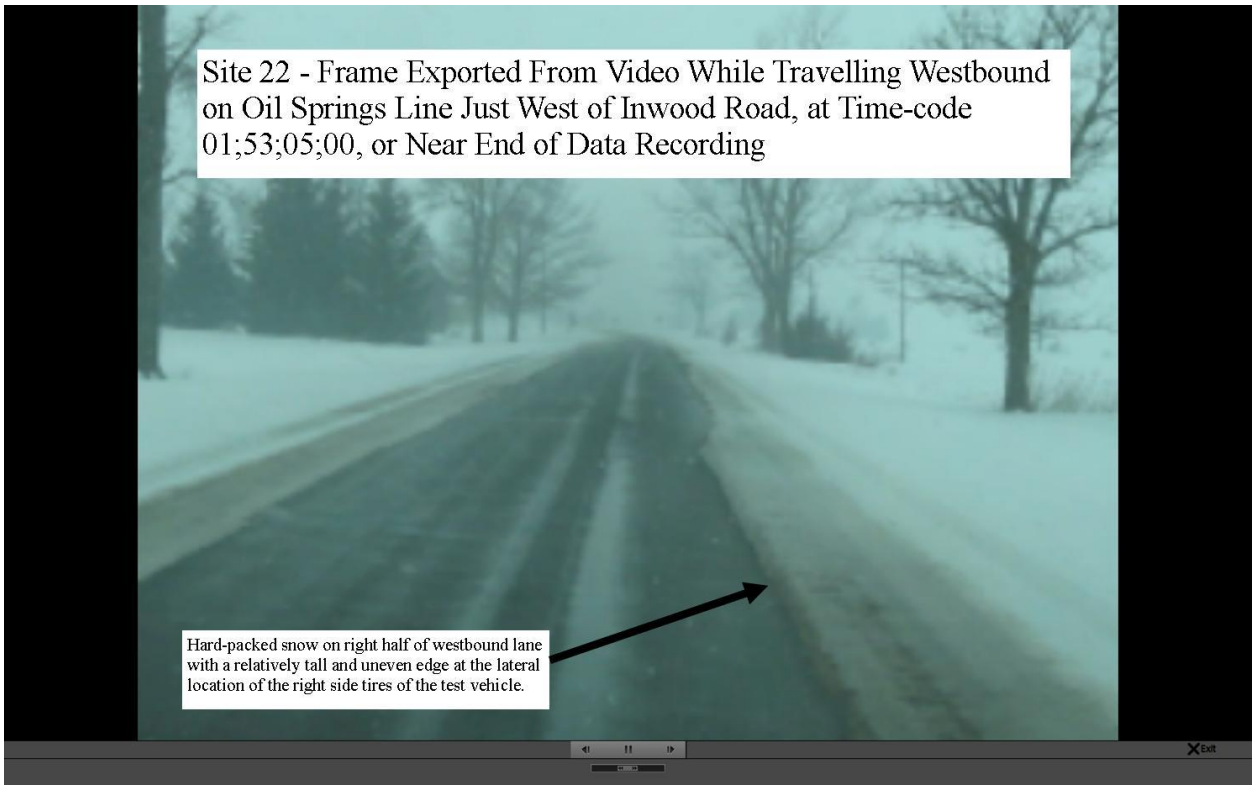

Figure 8.

The third site that we will look at in detail, Site 27, has particular importance because of a serious collision that reportedly occurred in the vicinity of the site less than 24 hours before we performed our testing.

Various news media reported that a serious collision occurred on Oil Springs Line on February 13, 2014. As an example, the excerpt below is taken from CTV News in London, Ontario.

"Lambton County OPP has laid charges following a serious roll-over crash on Oil Springs Line.

Police say a Chevrolet pickup truck with four occupants was involved in a roll-over around 8:30 p.m. Thursday on Oil Springs Line west of Oil Heritage Road.

OPP say 21-year-old Danny Gibbons of Petrolia, Ont. remains in a London hospital with life threatening injuries.

Police have charged the driver of the pickup, 22-year-old Ben Waite of Petrolia with impaired driving causing bodily harm and driving over the legal limit."

Sites 27, 28 and 29 were all located on Oil Springs Line west of Oil Heritage Road. The recordings for Sites 27 and 28 were obtained while travelling westbound while the

recording for Site 29 was obtained while travelling eastbound. The news media did not mention the specific location of the rollover collision and it was not possible to locate it during our testing due to the snow cover. However the results of our testing in the vicinity should be relevant to most portions of the road.

Figure 9 shows the condition of the road at the beginning of the recording of Site 27, Figure 10 shows the conditions mid-way through the recording and Figure 11 shows the conditions near the end of the recording.

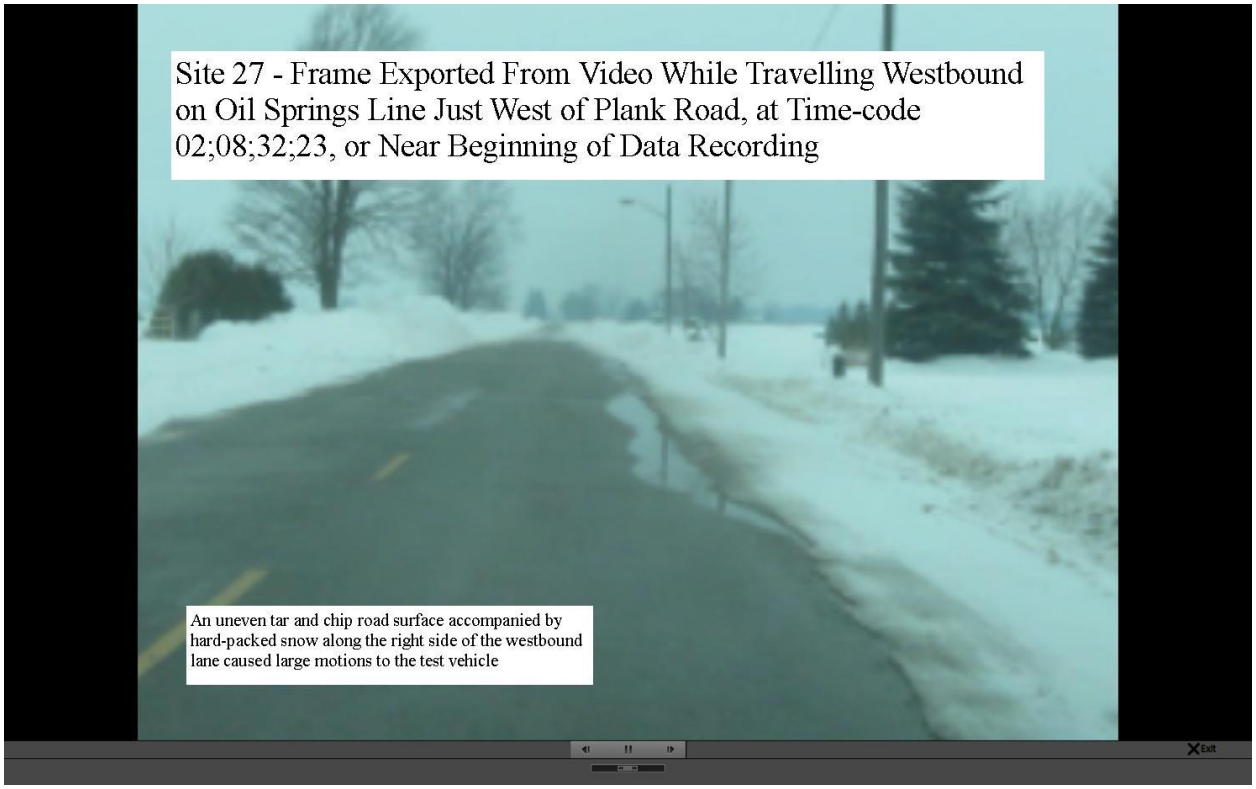

Figure 9.

Similar to the conditions at Site 22, the uneven tar and chip road surface was intermittently covered in snow and ice.

Historically it has been known that a vehicle like a pick-up truck is more susceptible to loss-of-control than a typical passenger car. We found it interesting that according to news media, one of the passengers of the pick-up truck made the following comment:

"...the vehicle was travelling too fast when it hit black ice..."

While being impaired by alcohol and driving too fast are obvious factors that lead to many serious and fatal collisions, the presence of road deficiencies is rarely discussed or identified even when those deficiencies exist. Given the road conditions shown in these figures and the motion data that was recorded by our test vehicle, the poor road conditions at the site of the loss-of-control rollover collision were likely a factor that could have contributed to the event.

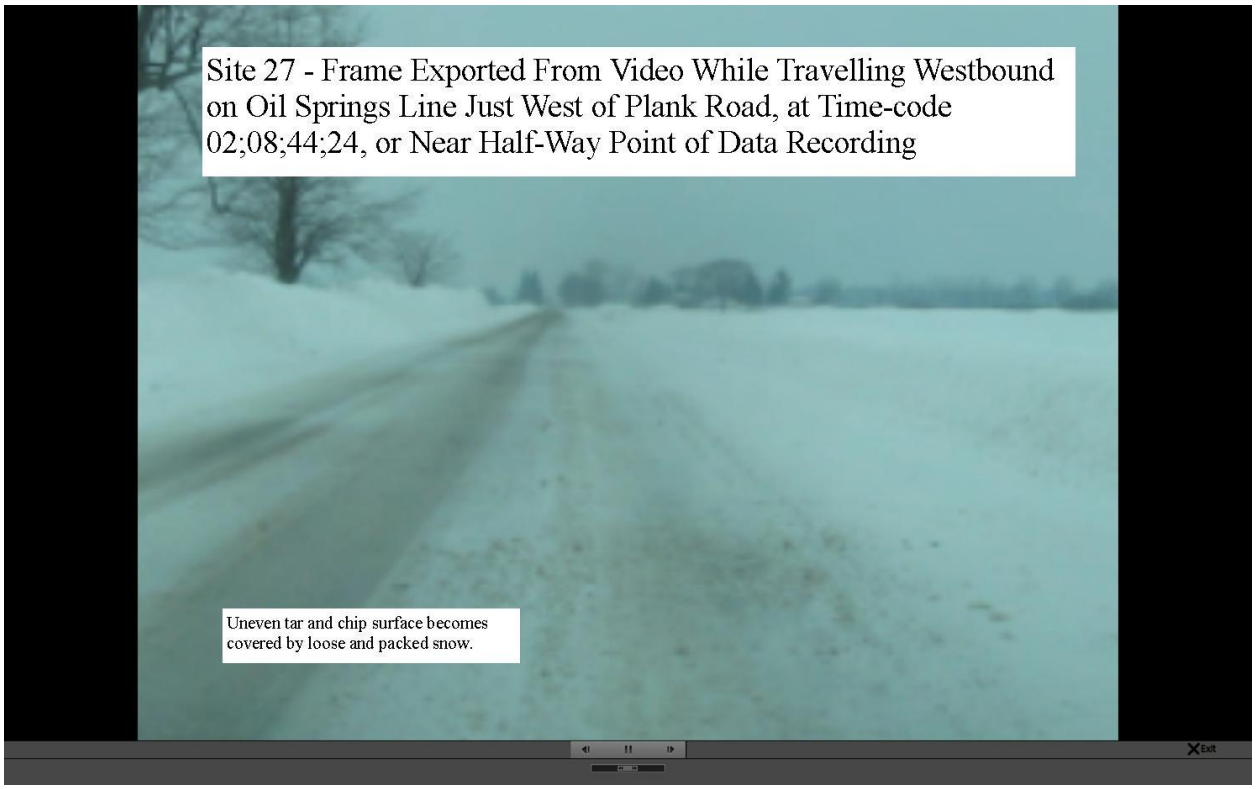

Figure 10.

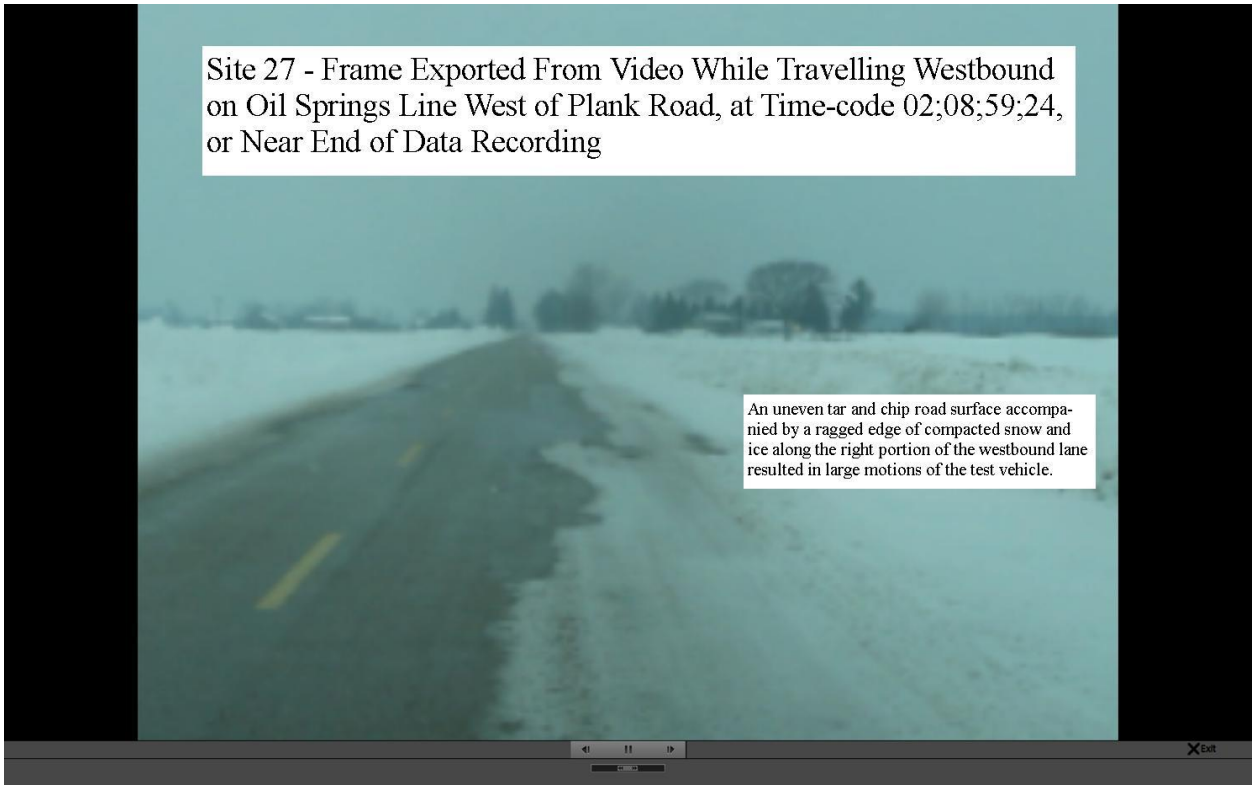

Figure 11.

Using the analogy of a pathologist performing an autopsy, imagine that a deceased's body contained traces of two poisons, strychnine and arsenic. If the pathologist reported the existence of the strychnine, and did not note the existence of the arsenic, we would find him or her to be incompetent or untruthful, and we would immediately investigate further. Yet, when a death occurs on our highways, the "arsenic" of road condition is continually being unreported and we feel no obligation to ask why.

At Gorski Consulting we will continue our research and testing of road conditions. As we do so we expect to obtain data on a larger number of roadways in the City of London, Ontario and in south-western Ontario and this data will be reported as it becomes available.

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