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Report

South Perimeter Noise Study

Report Number **17204-1 Rev B**

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Introduction

WSP (the Client) is reviewing PTH100, the outer ring road which circles Winnipeg, and looking at the design of the road path and interchanges in the southern portion highway from Highway 1 West to Highway 1 East. WSP is also looking at the connection between PTH100 and Highway 75 which goes south from Winnipeg. The Industrial Technology Centre (ITC) consults with WSP on infrastructure related environmental noise and has been contracted to review the current interchanges and perform a study on WSP designed modifications to the interchanges over the next approximately 30 years.

SoundPLAN Sound Model

Current Interchange Design (baseline) Modelling

ITC has modelled the current interchanges incorporating the current area geography, known road paths with traffic levels, and buildings. The models were built using a combination of Digital Ground Models (DGM), CAD from current road paths, and aerial photography of the buildings and ground features adjacent to the transportation routes. WSP provided traffic study data for the interchanges showing the number of passenger vehicles, medium-sized trucks, and large trucks at each intersection, as well as current traffic levels between intersections and predicted traffic levels to 2048. Figure 1 shows the interchanges in the study.

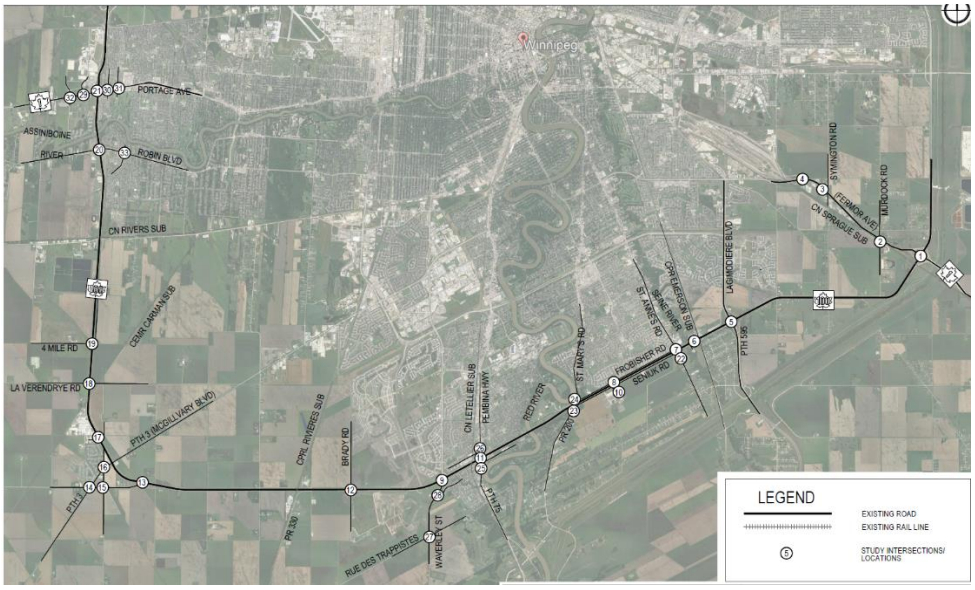

Figure 1 – Overall View of PTH100 South Interchanges (2018)

Manitoba Infrastructure performed traffic studies at various times in late 2017 and early 2018. Those studies at major intersections, typically performed over

a 2 day period, counted the number of cars, medium trucks, and large articulated trucks that passed through the intersections or turned at intersections. The studies went for up to 14 hours and also predicted the total number of vehicles in 24 hours. For each major interchange/intersection this data was used to create the hourly histogram distribution for each section/vehicle type. WSP then provided a prediction of traffic levels in Automobiles per day (AADT) and Trucks per day (AADTT) Eastbound and Westbound between each major intersection. Table 1 shows the traffic levels for 2018 and 2048.

Table 1 – Predicted Traffic Levels on PTH100 for 2018 & 2048

	AADT			
	Eastbound		Westbound	
Section between	2018	2048	2018	2048
PTH 1W & Roblin	14425	23080	14580	22455
Roblin & Wilkes	12835	20535	12335	18255
Wilkes & McGillivray	11245	16980	10815	18275
McGillvray & PR 330	9260	19815	9555	16150
PR 330 & Kenaston	8140	15955	8165	14780
Kenaston & Pembina	9650	13125	9700	12610
Pembina & St. Mary's	13615	20150	16020	23230
St. Mary's & St. Anne's	10990	18245	11860	18265
St. Anne's & HWY 59	14235	21920	13365	20985
HWY 59 & PTH 1E	7455	10360	7250	12905

	AADTT			
	Eastbound		Westbound	
Section between	2018	2048	2018	2048
PTH 1W & Roblin	1695	2715	1760	2710
Roblin & Wilkes	1945	3110	1885	2795
Wilkes & McGillivray	2220	3350	2125	3590
McGillvray & PR 330	1805	3865	1905	3220
PR 330 & Kenaston	1565	3065	1610	2910
Kenaston & Pembina	1395	1900	1420	1845
Pembina & St. Mary's	1400	2070	1535	2225
St. Mary's & St. Anne's	1425	2360	1465	2255
St. Anne's & HWY 59	1475	2275	1355	2125
HWY 59 & PTH 1E	955	1325	885	1575

The hourly histograms for each section from the traffic reports were then proportionally adjusted for each vehicle type to give the hourly distribution in each section. Those hourly histograms were loaded into the SoundPLAN histogram database. When the predictive model for the roads were created in SoundPLAN the histograms were applied to traffic lines creating noise sources.

WSP supplied DXF formatted elevation data for each intersection. This data was used by the SoundPLAN program to create the DGM. The DGM was reviewed to eliminate anomalies like holes or very small high elevation spots as they were most often excavations or mounds of dirt that were not natural ground features. Major cross roads like Highway 1, Roblin Blvd, Wilkes, McGillivray, Kenaston, Waverly, Pembina, St. Mary's, St. Anne's and Hwy 59 were added from the aerial photography. Traffic volumes for each road were supplied by WSP from traffic studies. The SoundPLAN program allows features to be placed on layers (like CAD systems) so each intersection was loaded into a layer with its appropriate properties.

Aerial photos were used to place buildings on the DGM surrounding each intersection. Houses were placed around any intersection in order to show where noise levels would affect residences. Thick forests were also placed on the model to capture where possible absorption could reduce the noise level.

The results of the noise propagation simulation for the initial model will be presented in the Results section of the report.

Future State Modeling

WSP supplied a CAD model plus documents with an aerial photo of the proposed interchanges. The previous layers for the old road paths were turned off and new layers for the new intersections were placed in new models. The traffic volumes from Table 1 for the 2048 year were assigned to the appropriate road section. The simulations for each intersection were run again with the new interchange and traffic level.

The sound level map was discussed with WSP in order to identify where noise mitigation modelling may be required (where practicable) to bring traffic related noise below the 65 dBA level.

Mitigation Modelling

Several areas in the study currently have a small berm adjacent to PTH100. The initial model would indicate whether those measures would be effective in keeping the traffic generated noise below 65 dBA. When mitigation is suggested two typical strategies are used to use mitigation for "sound shadowing". The mitigation can be placed close to the source or the mitigation can be placed close to the recreational areas attached to the residences (for example the back yard). If there was an existing berm near the

residences then the height of the berm and the addition of a sound wall on top of the berm was investigated. Where the raise in elevation occurred as an overpass over train tracks then a sound wall was also investigated adjacent to the roadway.

Results

Current State Modelling

Current sound levels, roads and key features for each section of PTH100 are given in Appendix A. Figures A1 to A10 are the 2018 levels at the intersections. Most residential areas close to PTH100 have an Ldn (average noise level over a 24 hour period; day-night average sound level) over 65 dBA at the first layer of houses close to the roadway. By the second layer of houses away from the highway, most areas have enough sound shadowing from the first row of houses that the second layer has an Ldn below 65 dBA. Areas with rail lines have included the noise of the rail lines in the simulation. Aircraft noise has not been included in the simulations. Environmental noise from wind has not been included in the simulation as it is not consistent.

The mixture of trucks to cars is important as the noise generated by each type of vehicle affects the Ldn differently. All vehicles create some noise at the tire on pavement. A second source of sound is the cooling fans and engine noise which differs in height between articulated trucks and passenger vehicles. A third source of noise is the exhaust which is just above ground level on passenger cars and at approximately 4 meters on articulated trucks (semis).

Future State Modelling

New interchanges and road paths were taken from the CAD provided by WSP and the PDF overview aerial photos. Road elevations passing through each intersection were taken from the elevation PDF for each interchange (as provided by WSP). Road path alignment was changed in several areas which brought the roadway closer to the residences in some areas and farther from the residences in other areas. This resulted in increased noise levels and decreased noise levels respectively.

Traffic levels were increased to the levels shown in Table 1. The increase in traffic level resulted in an increase in sound level in each section. The amount by which sound increased is not a linear function - that is, an increase of 15% in traffic does not equate to an increase of noise by 15%. As with the Current State model, the mixture of passenger vehicles to trucks is important in determining the type of noise and the height that the noise originates.

Mitigation Modelling

Several areas currently contain either a low berm with a wooden fence or a wall (approximately 2m). Where the noise level was higher than 65 dBA

mitigation methods were investigated with 2 primary locations and 2 types of mitigation:

- Smaller berms, 1m high or 2m high were investigated
- Sound walls were investigated from 2m high and up to 6m in one location.

While wall heights up to 8m high are known in Calgary or Toronto, most walls currently used in Winnipeg are between 2m and 3m and most new developments have a combination of a lower berm with a shorter wall on top.

The sound walls investigated were mostly reflective/refractive to medium absorption. Highly absorptive walls next to roadsides are very effective but typically cost more than simple reflective walls and clearance next to roads is necessary for snow clearing equipment in the winter.

Sound Wall Options and Effectiveness

Sound walls are rated by absorption and not material. The material of a sound wall has purchase cost, installation cost and maintenance cost implications. The simulation program is concerned with the absorption of the wall and not the material. ITC does not investigate the cost because ITC does not install the sound walls or perform the construction on berms. Berms require a certain width to height ratios so where space is tight a wall may be the only option.

The typical materials of most sound walls are:

- Refractive concrete blocks – these blocks may have different texture and color but the non-porous nature of the wall limits the absorptive properties of the wall.
- Absorptive concrete wall – the pre-cast wall sections are manufactured from concrete and other materials. The walls are porous to allow the sound waves to enter but the internal structure stops the sound. The path of the sound wave is refracted several times inside the structure and the sound is absorbed. These walls are much more effective than purely refractive walls but may cost more.
- Vinyl or plastic walls – manufactured wall sections are made with hollow sections with openings filled with mineral wool or hollow sections closed which simply reflect the sound. Some neighborhoods have concerns about the way the walls look or concerns about durability.
- Transparent Acrylic or polycarbonate sections – in several neighborhoods in Toronto and in Europe next to train routes and roadways a transparent wall panel is inserted at the eye height of the

travelling passengers. The transparent materials allow traffic and trains to view the surrounding area, improving the livability of the walls.

There is a general increase in traffic levels between 2018 and 2048 which increases the sound levels, but there are a few other aspects that affect increases in sound level.

For alignment reasons, some highway paths move closer to residences. PTH100 moves farther east between Roblin and Wilkes increasing noise levels at the closer parts. Figure A2 in appendix A shows the sound level in that area was already above 65 dBA at the first row of houses. Figure A12 shows an increase in sound level in 2048. A sound wall berm combination reduced the sound level.

Overpasses for railways also raise the elevation of the sound at Wilkes and between St. Anne's and Hwy 59. When the elevation of the road rises the height of a required sound wall needs to rise to give proper sound shadowing. An alternative is to have a sound wall close to the roadway that rises with the overpass but this may be limited in height. The addition of a sound wall at Wilkes and at the rail crossing between St. Anne's and Hwy 59 reduced the sound level over not having a sound wall close to the road but it may not reduce adjacent noise sufficiently unless the wall was over 3m tall.

A low berm exists north of PTH100 between St. Mary's and St. Anne's. The addition of a 2m sound wall on top of the berm brought sound levels back to 65 dBA levels for the 2048 year model.

South of PTH100 west of Hwy 59 several houses have large lots and are currently below 65 dBA. The rail overpass plus the increased traffic levels make several of the houses have higher sound level. Placement of a 2m wall near PTH100 brings most of the residences (minus one house close to the road) below 65 dBA but the north end of the properties are above 65 dBA. Given the amount of space in this area some planted trees may help to visually separate the properties from PTH100.

Appendix A

Figure A1 – PTH100 Sound Level 2018 - South of Highway 1 West

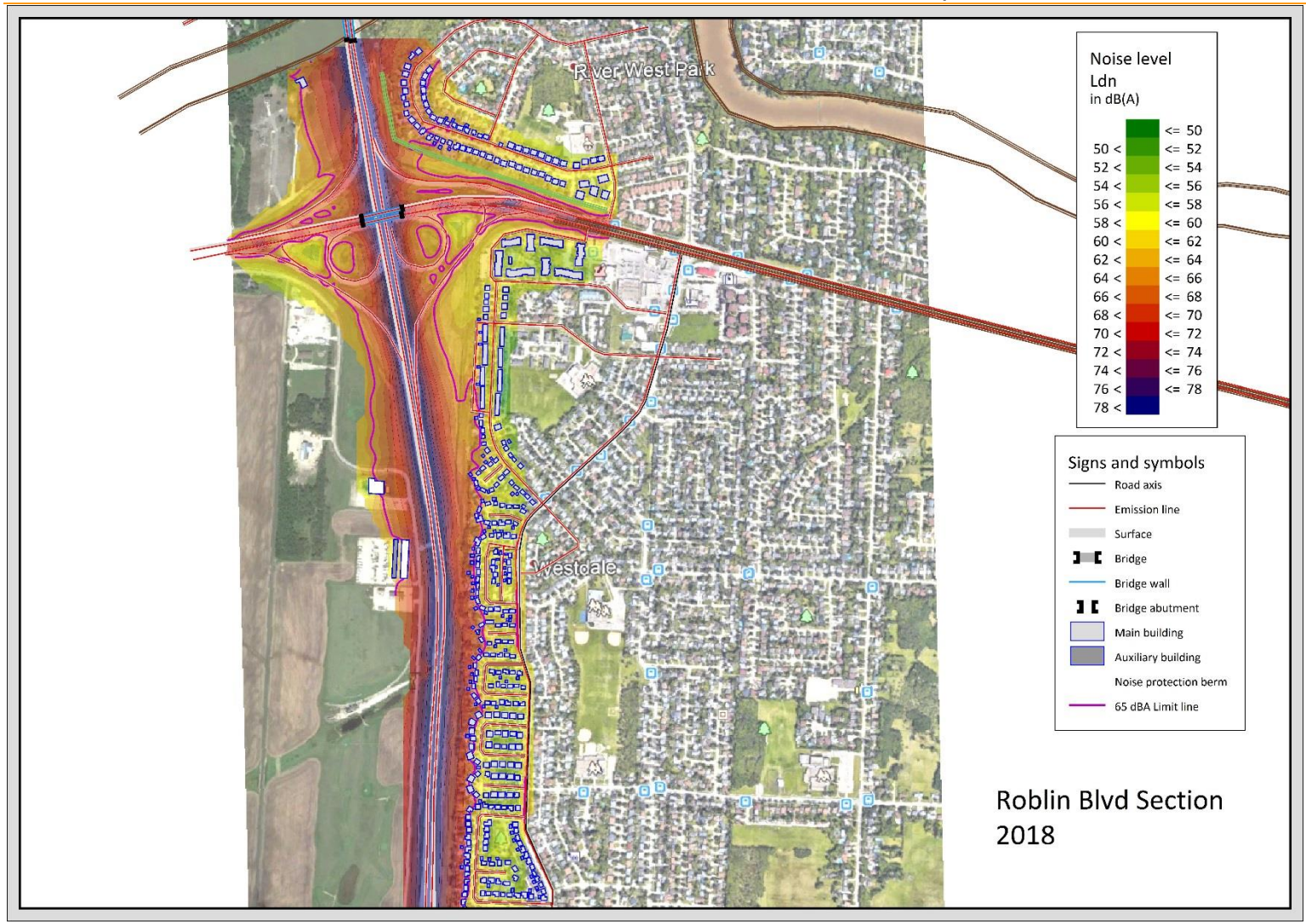

Figure A2 – PTH100 Sound Level 2018 – Roblin Blvd. Section

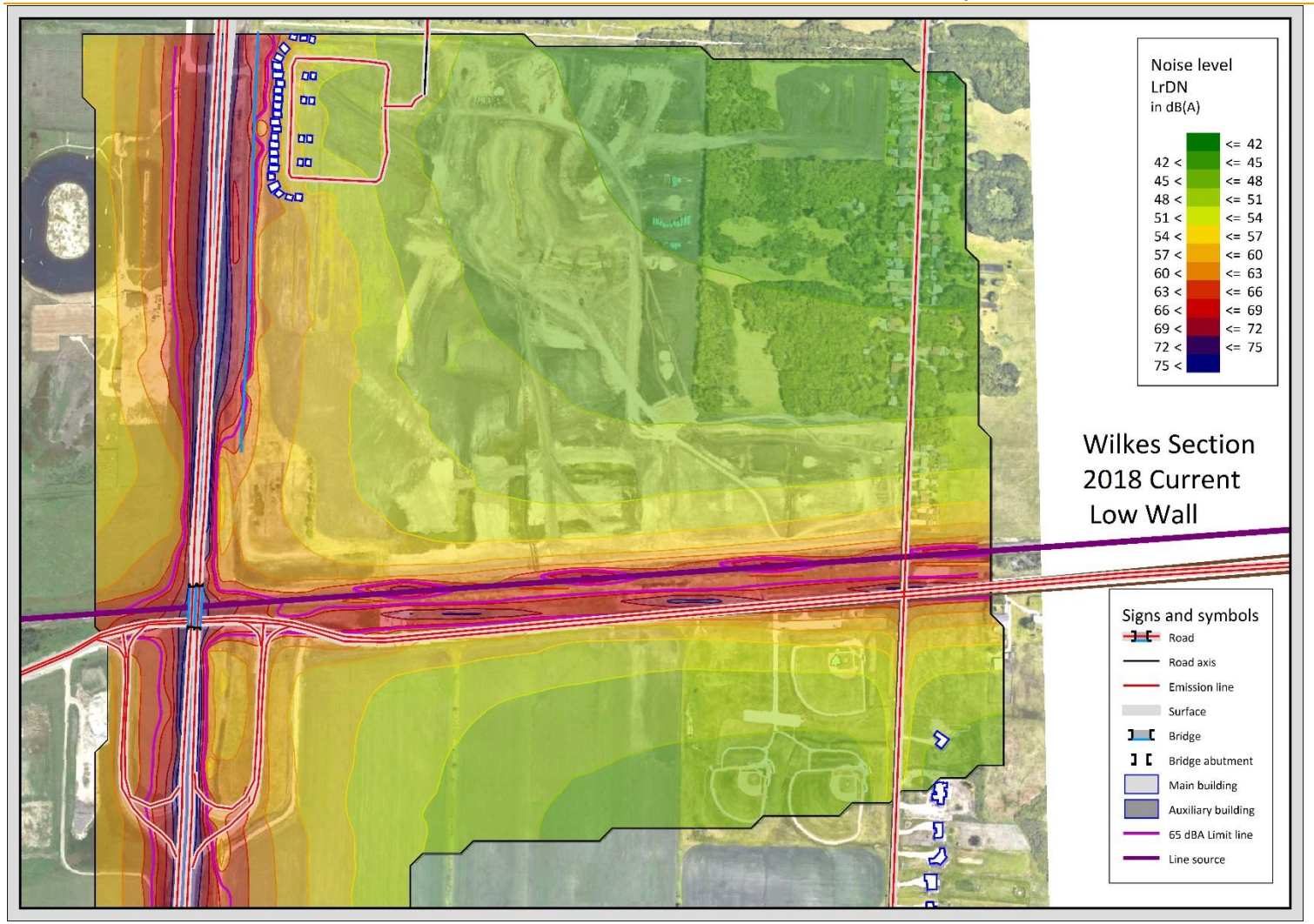

Figure A3 – PTH100 Sound Level 2018 – Wilkes Section

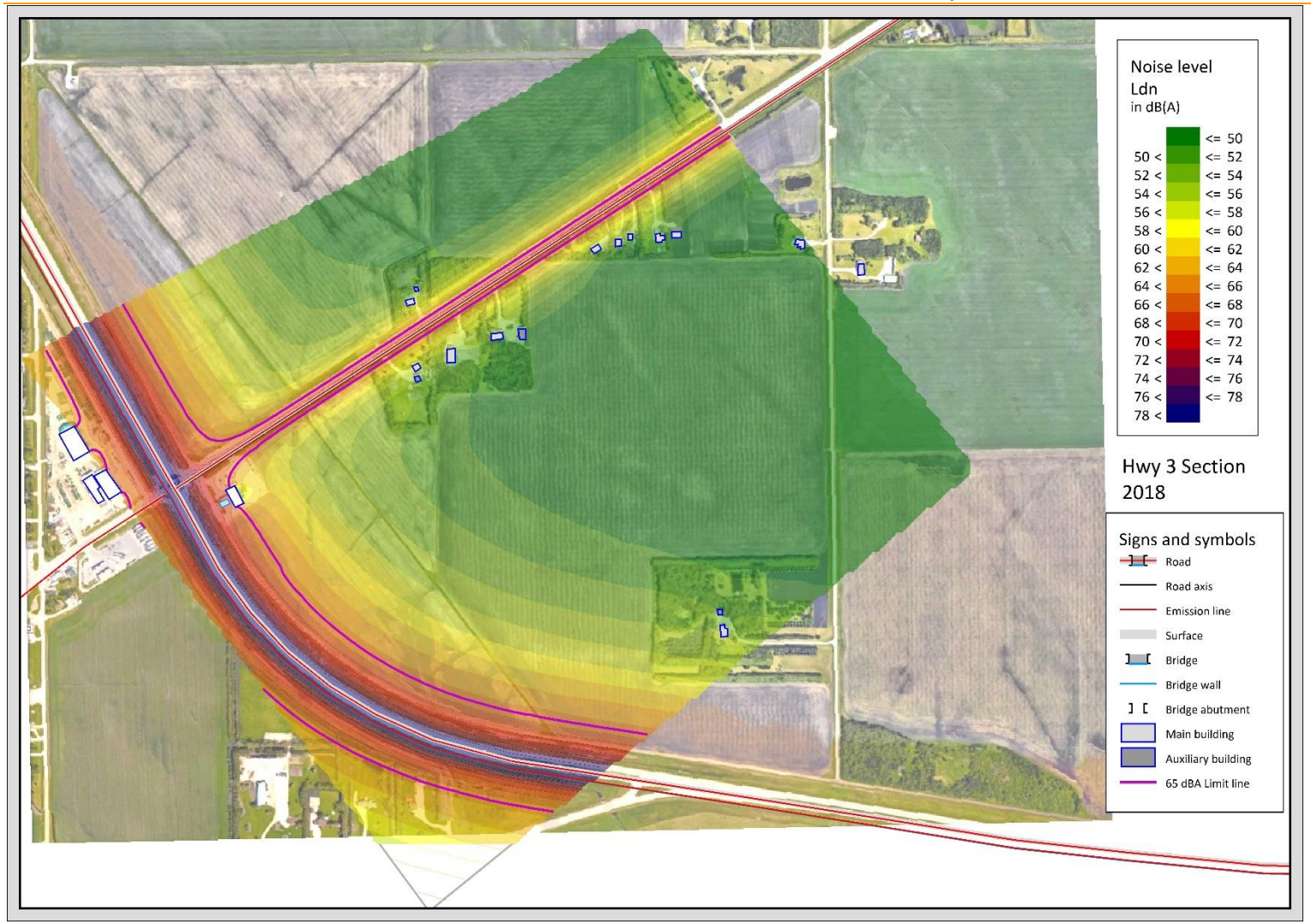

Figure A4 – PTH100 Sound Level 2018 – McGillivray (Hwy 3) Section

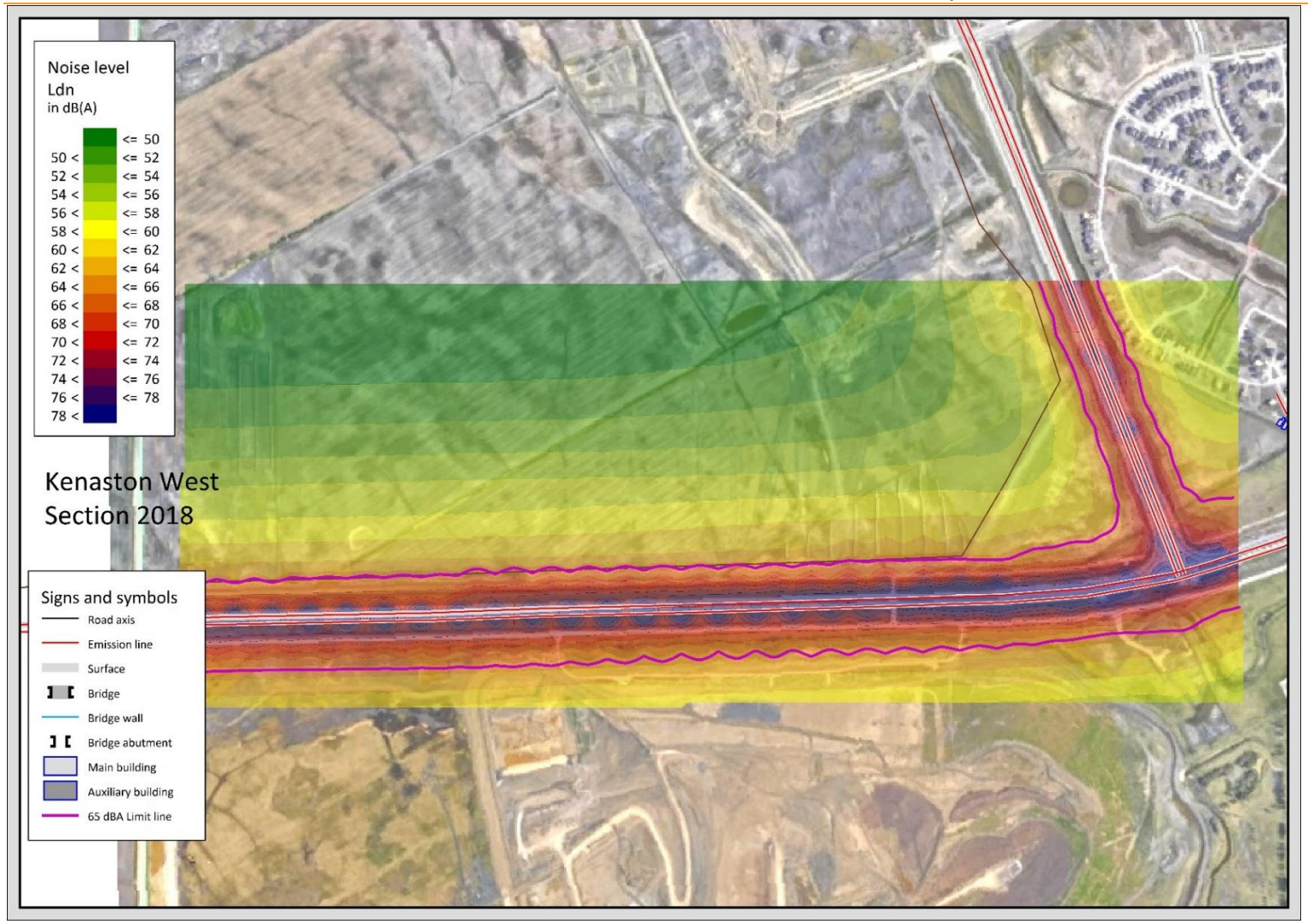

Figure A5 – PTH100 Sound Level 2018 – Kenaston West Section

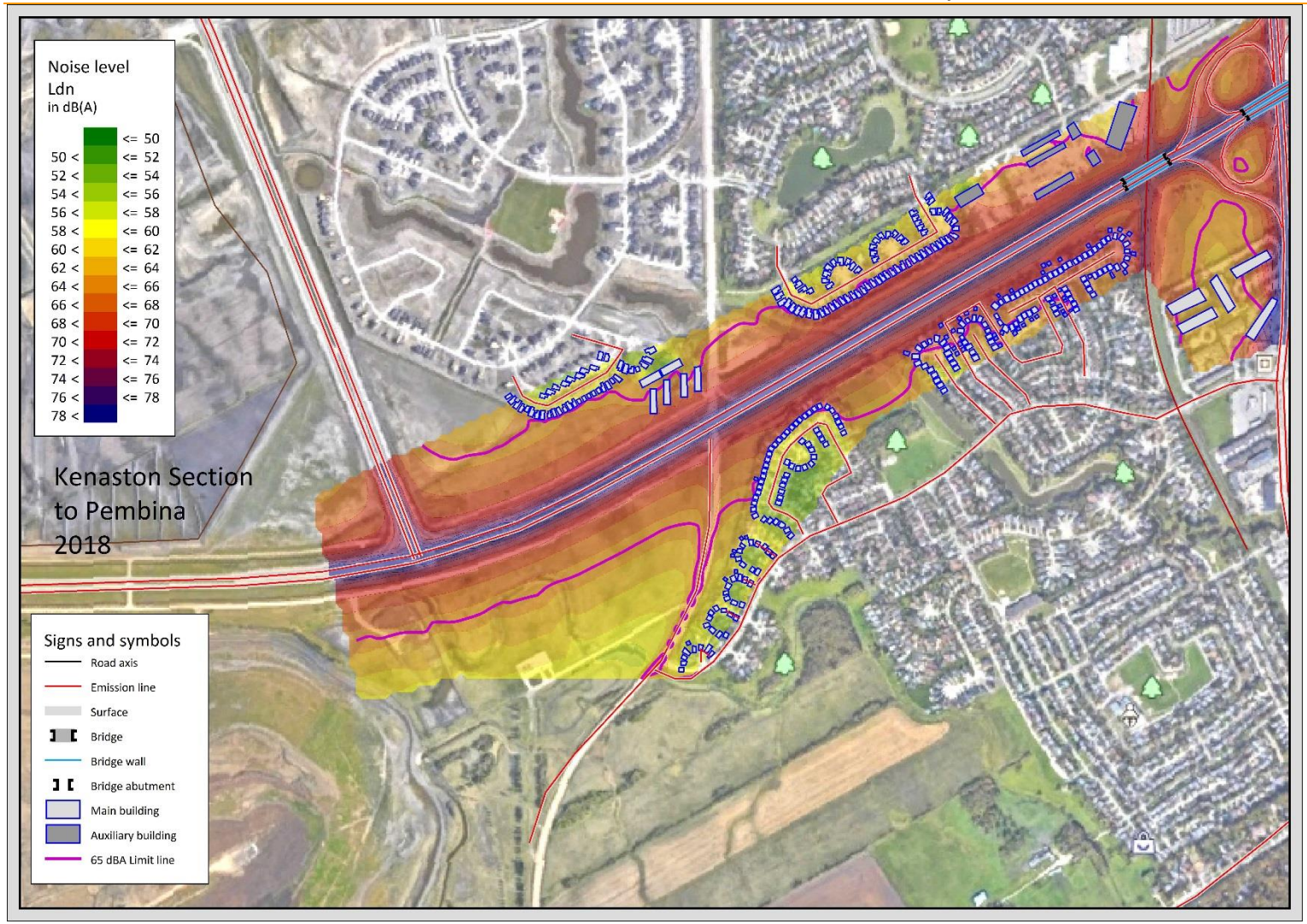

Figure A6– PTH100 Sound Level 2018 – Kenaston to Pembina Section

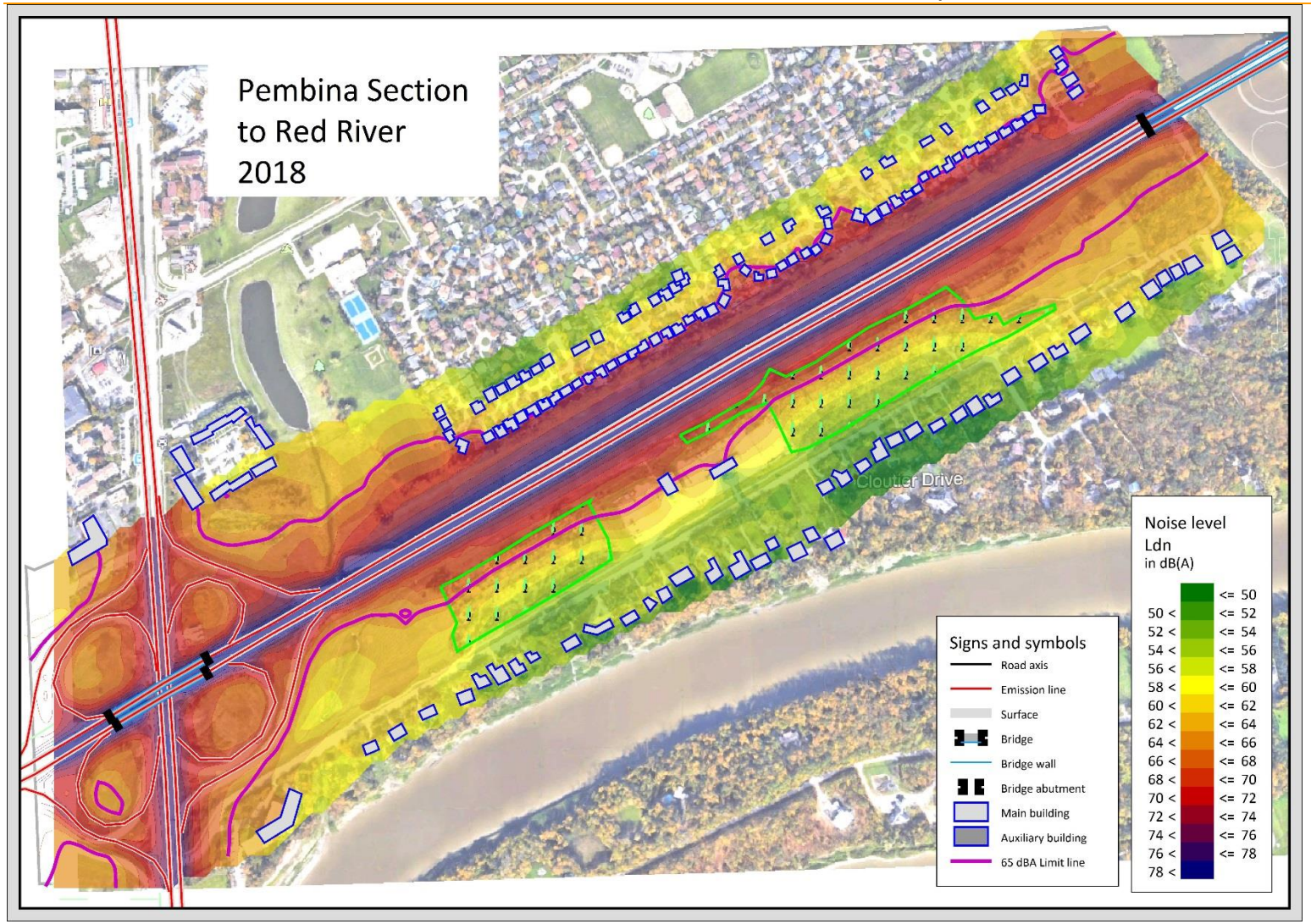

Figure A7– PTH100 Sound Level 2018 –Pembina to Red River Section

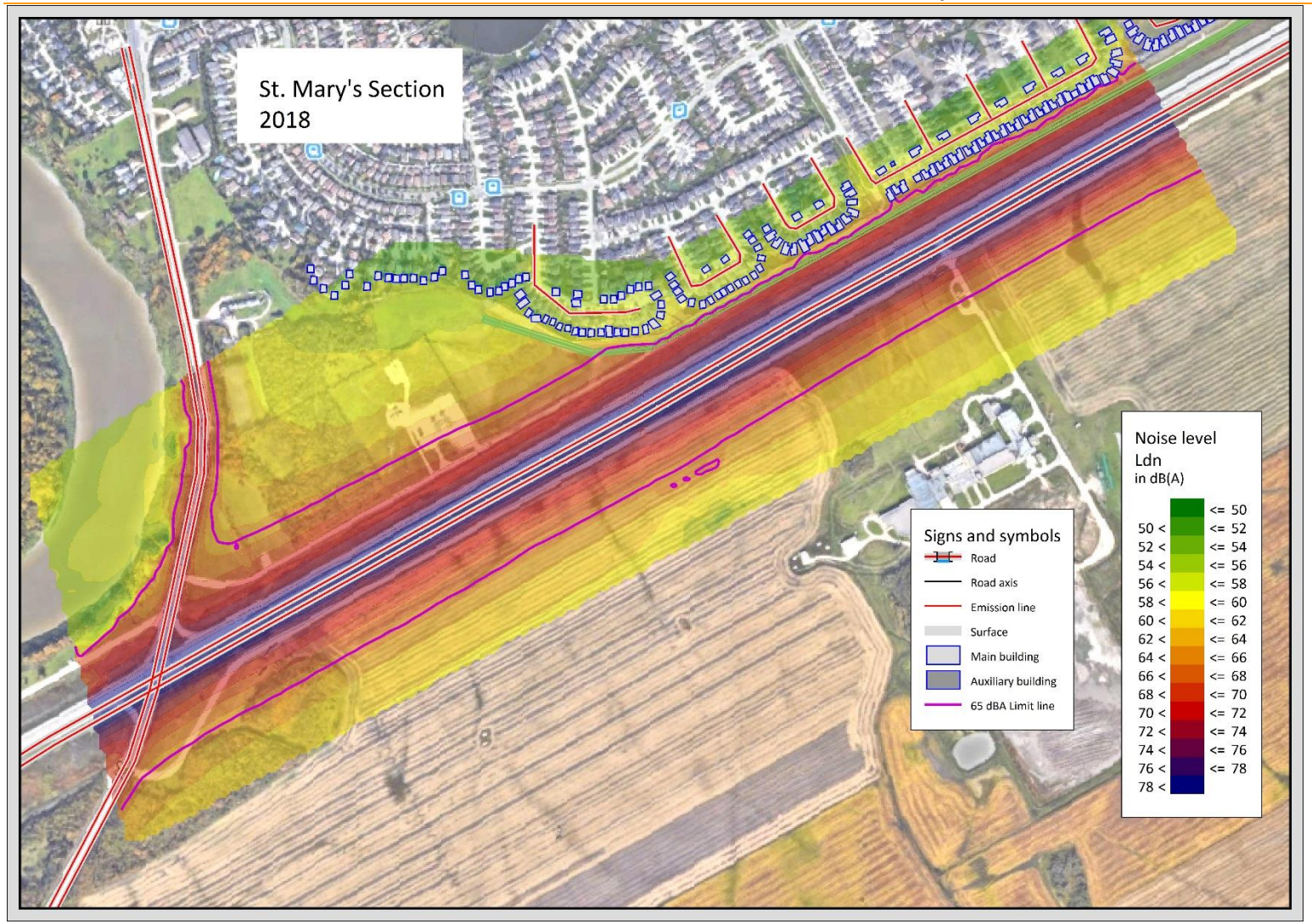

Figure A8 – PTH100 Sound Level 2018 – St. Mary's Section

Figure A9 – PTH100 Sound Level 2018 – St. Anne's Section

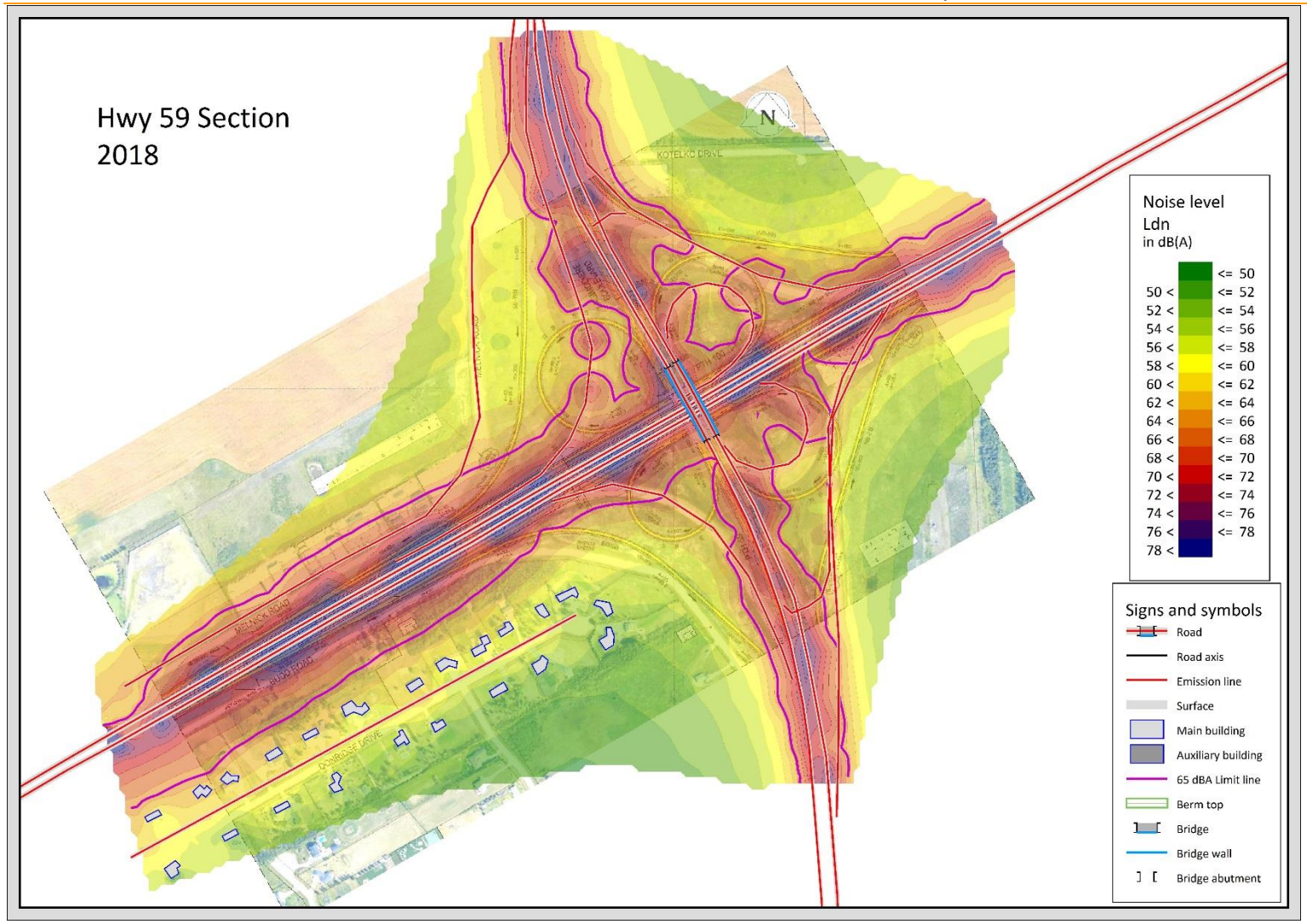

Figure A10 – PTH100 Sound Level 2018 – Highway 59 Section

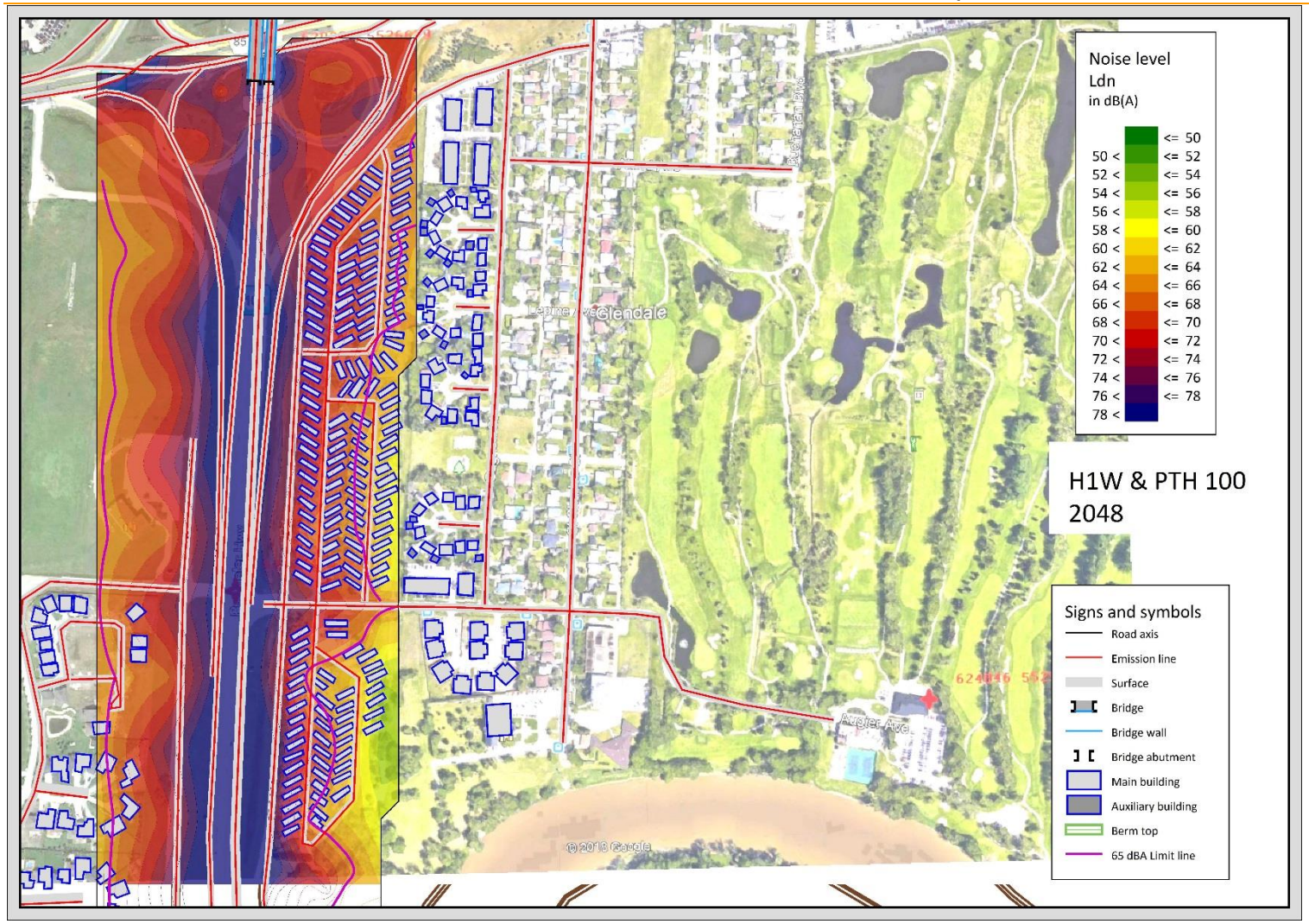

Figure A11 – PTH100 Sound Level 2048- South of Hwy 1 W to Assiniboine River

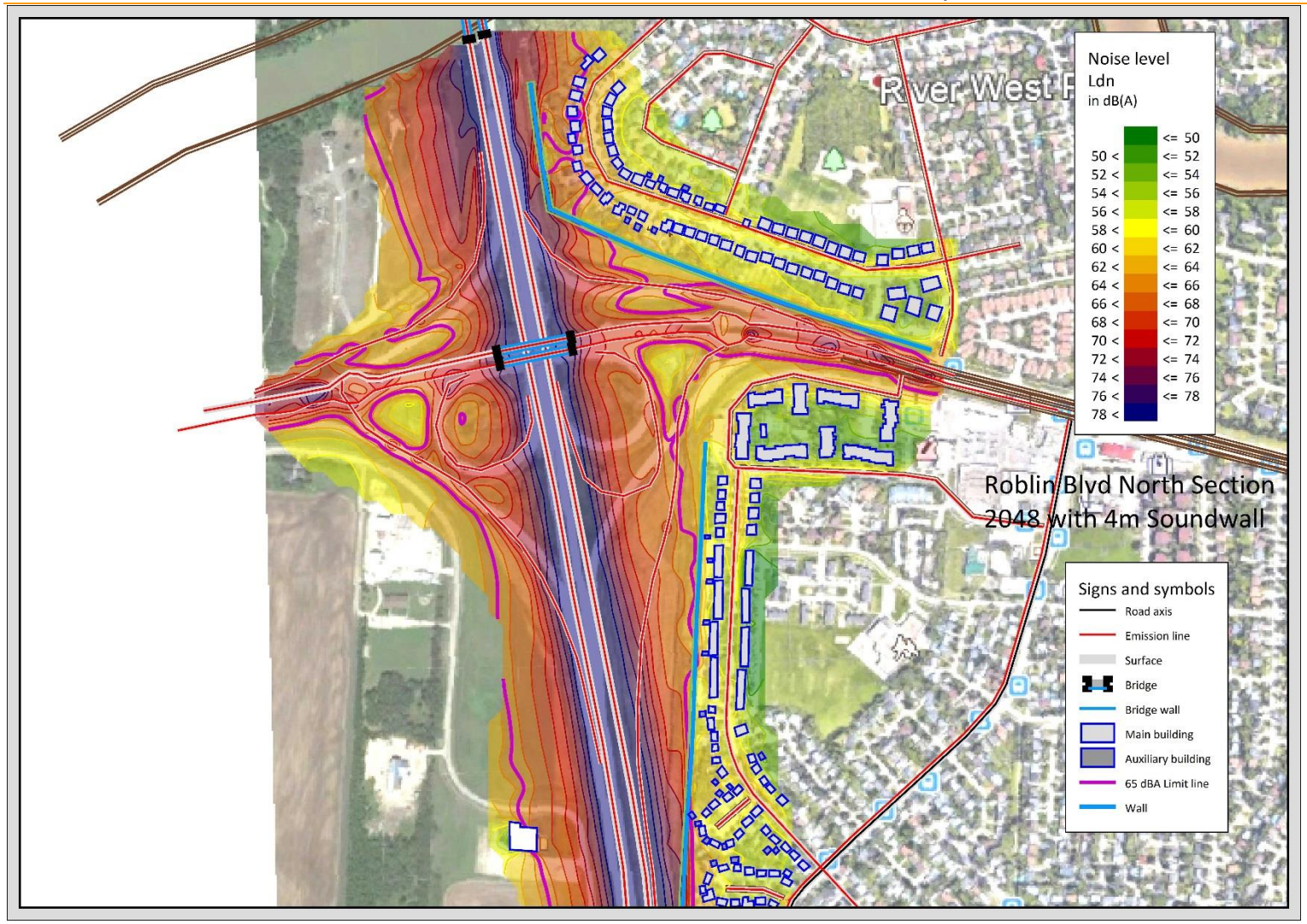

Figure A12 – PTH100 Sound Level 2048 – Roblin Blvd. Section

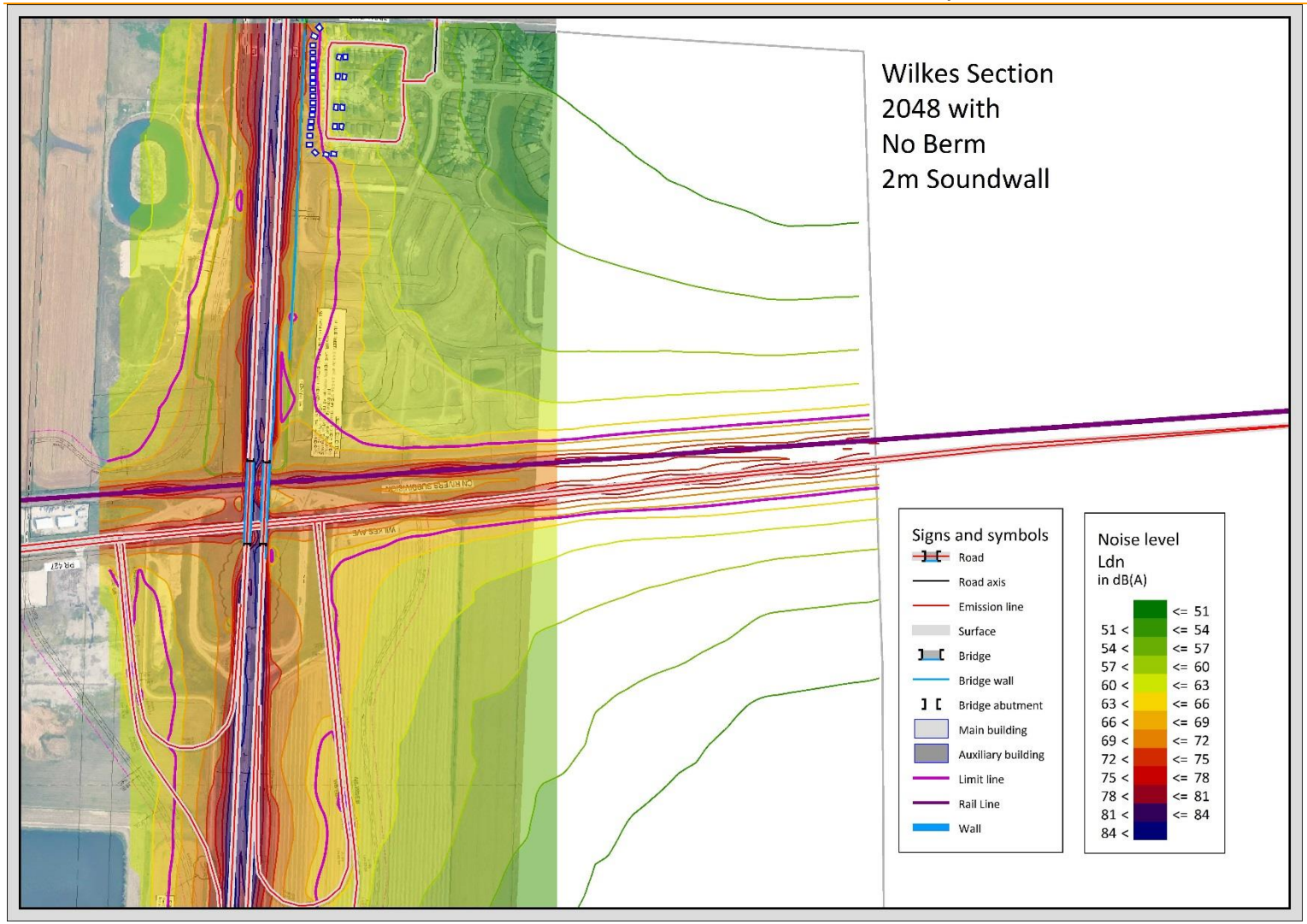

Figure A13 – PTH100 Sound Level 2048 – Wilkes Section

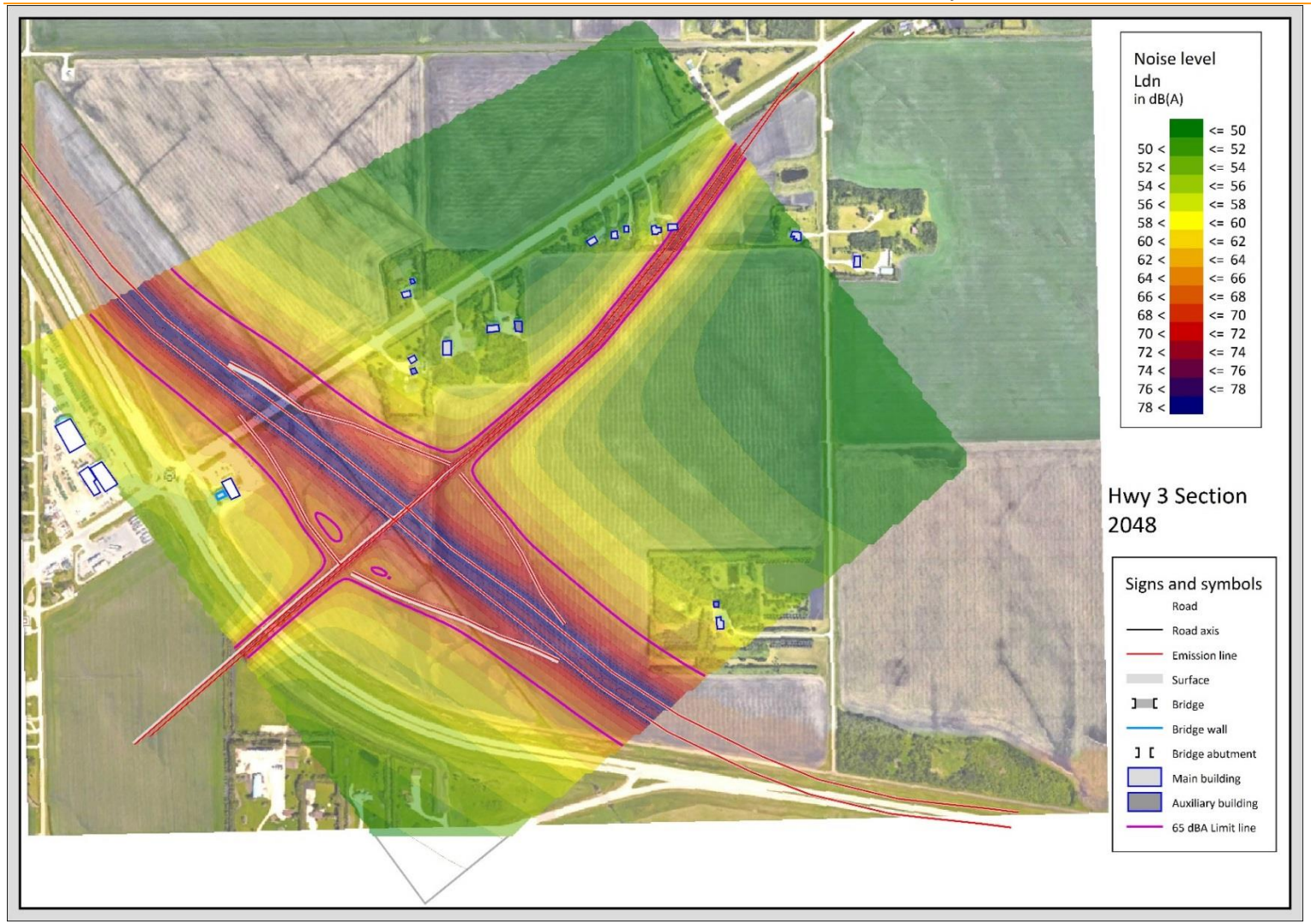

Figure A14 – PTH100 Sound Level 2048 – McGillivray (Hwy 3 Section)

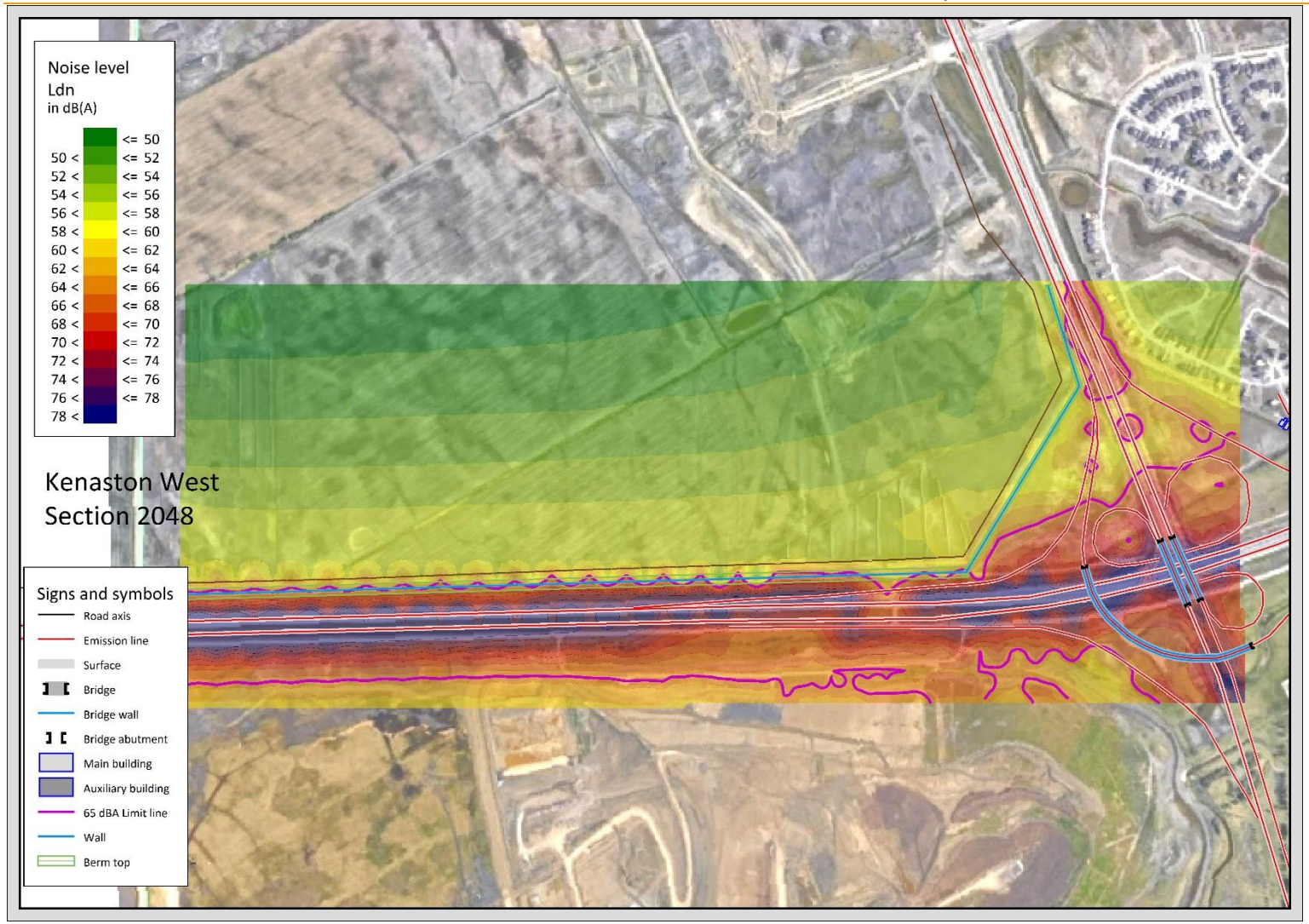

Figure A15 – PTH100 Sound Level 2048 – Kenaston West Section

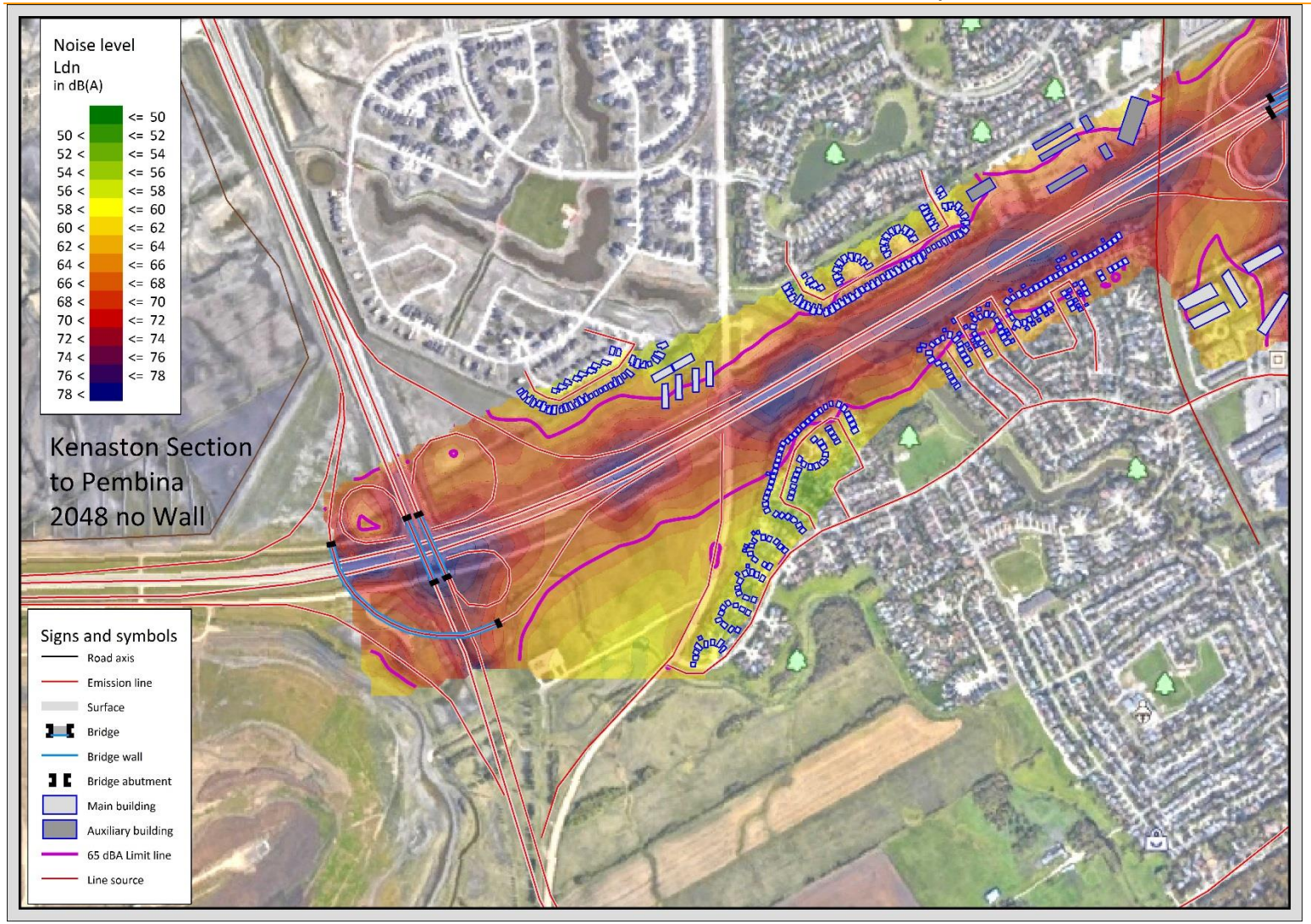

Figure A16 – PTH100 Sound Level 2048 – Waverly to Pembina Section

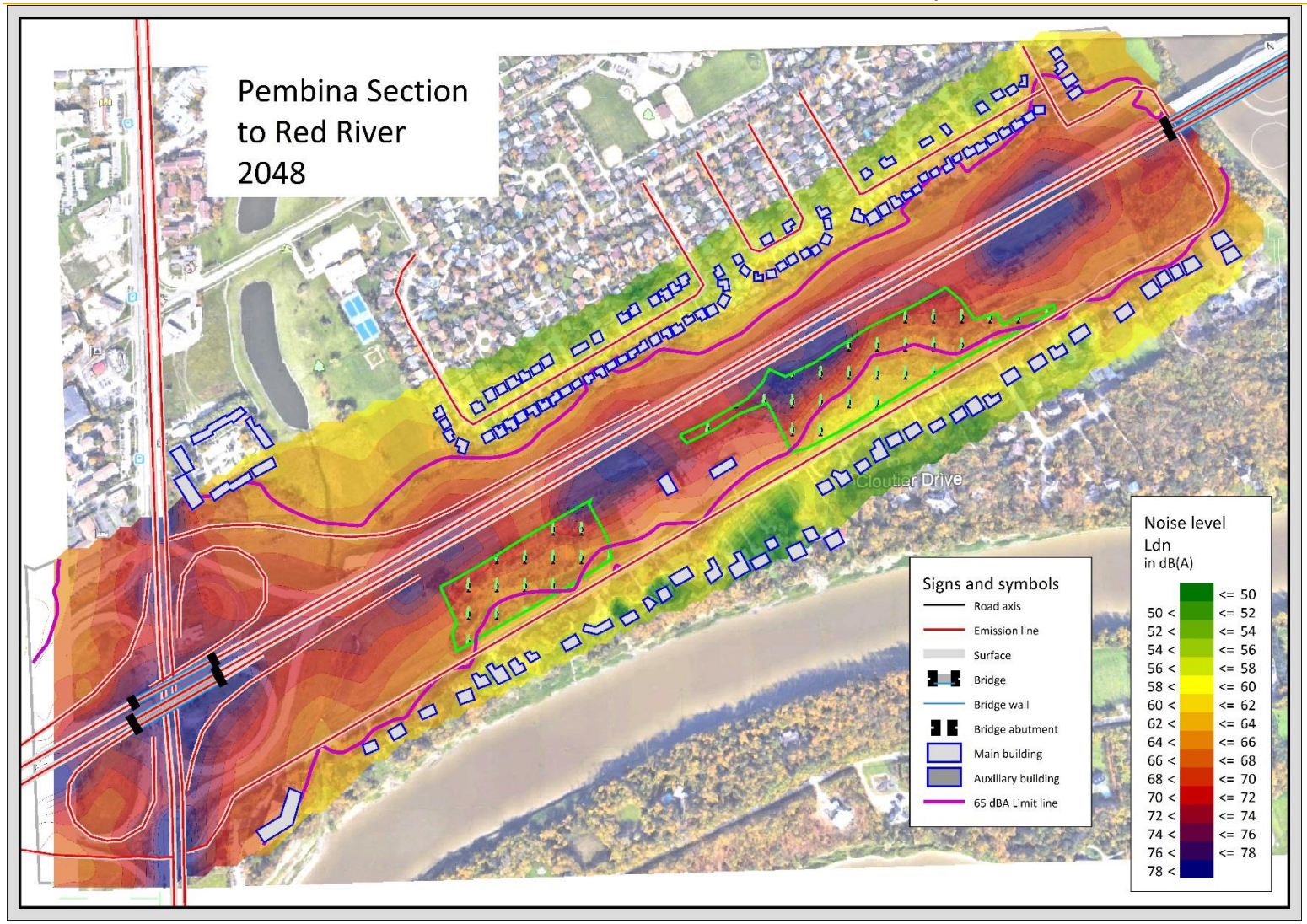

Figure A17 – PTH100 Sound Level 2048 – Pembina to Red River Section

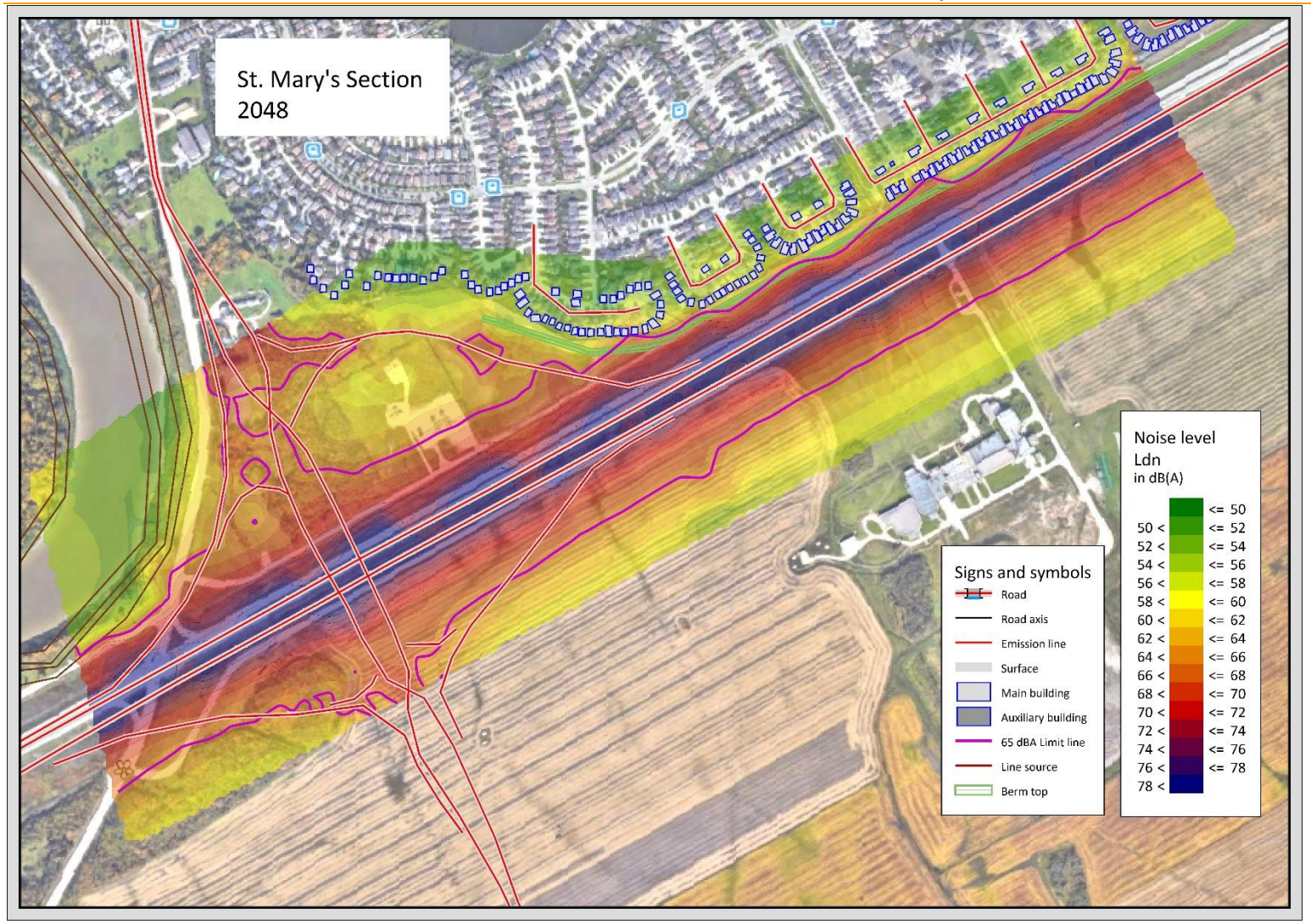

Figure A18 – PTH100 Sound Level 2048 – St. Mary's Section

Figure A19 – PTH100 Sound Level 2048 – St. Anne's Section

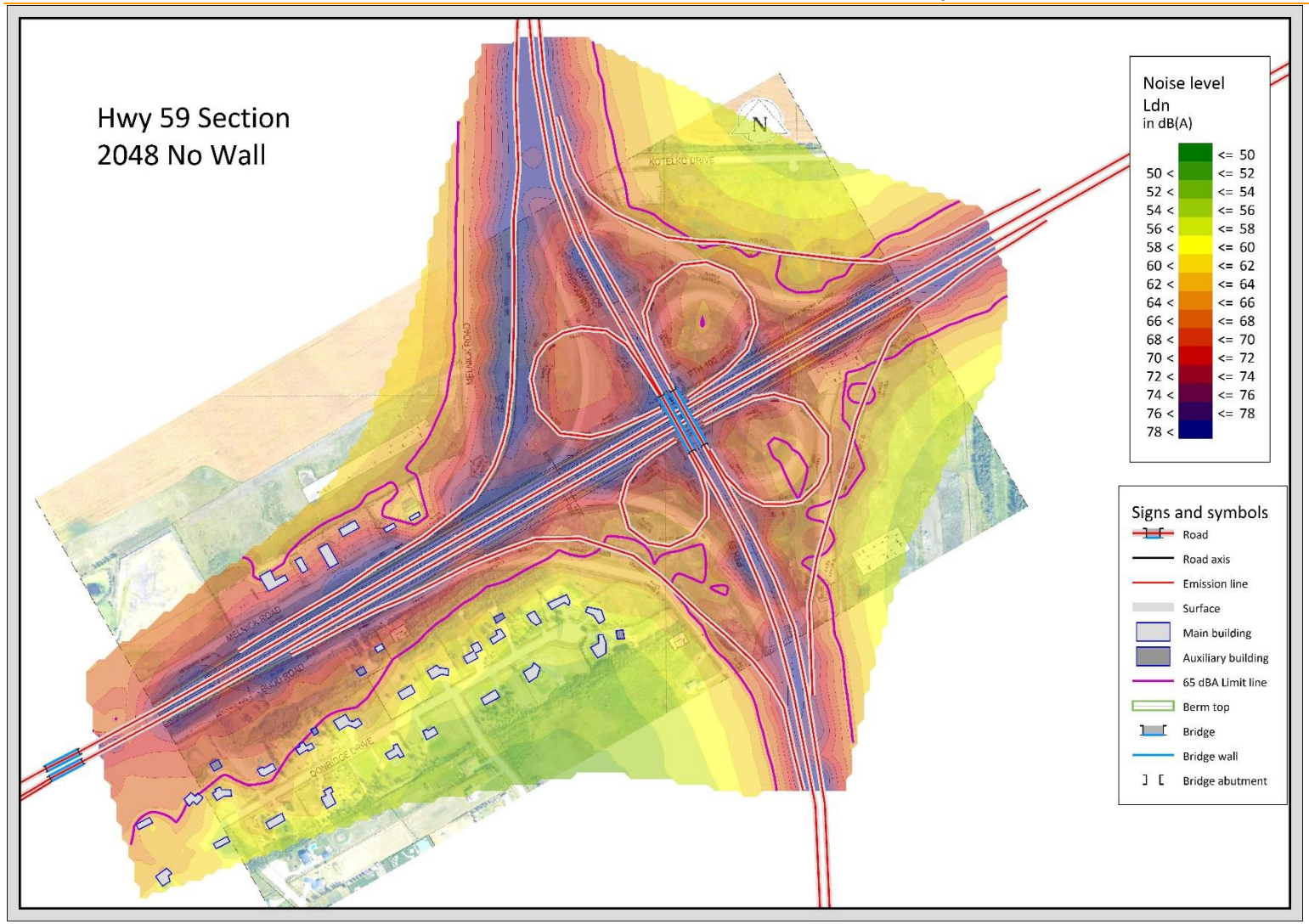

Figure A20 – PTH100 Sound Level 2048 – Hwy 59 Section

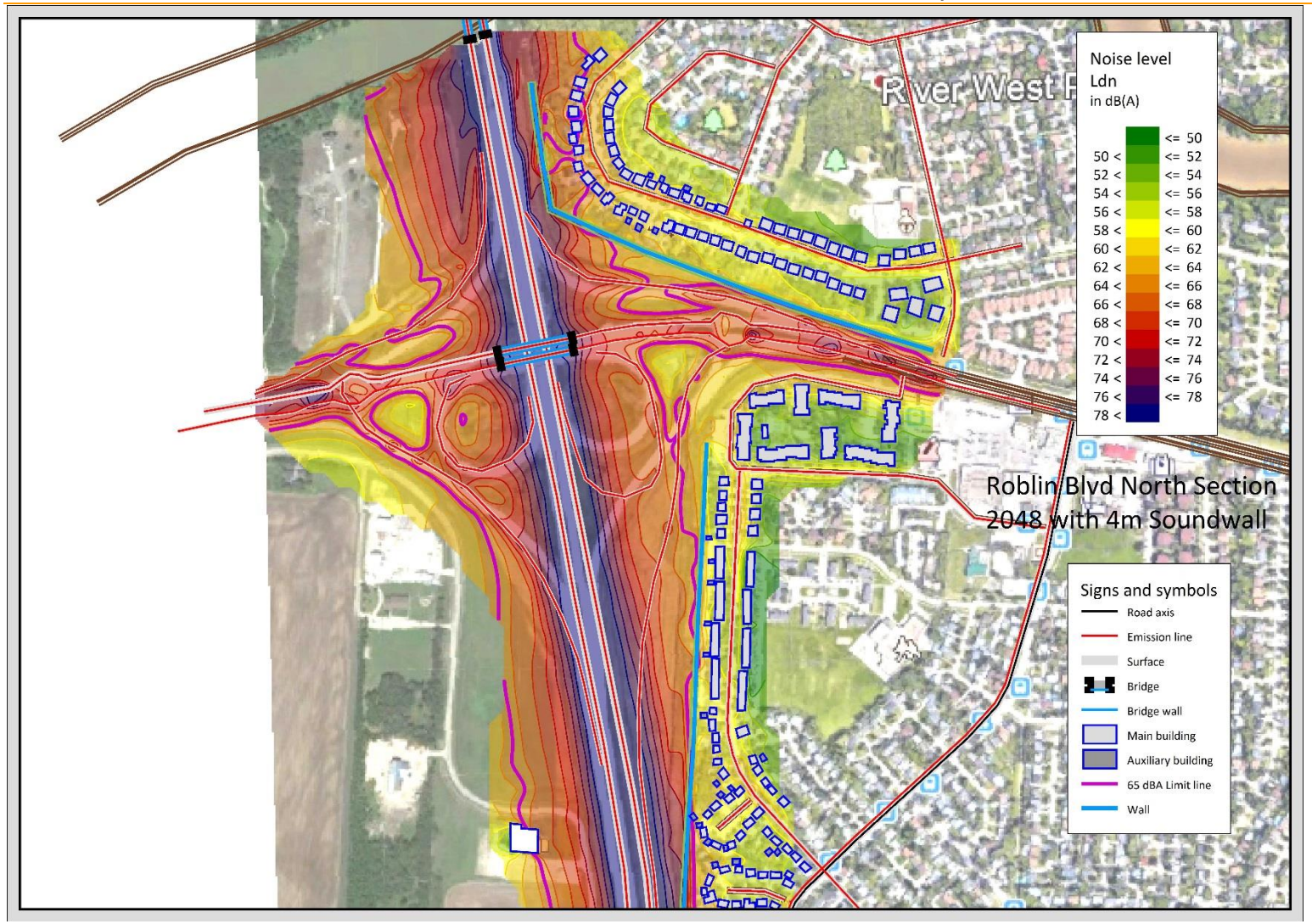

Figure A21 – PTH100 Sound Level 2048 – Roblin Section with Berm and Sound wall – North Section

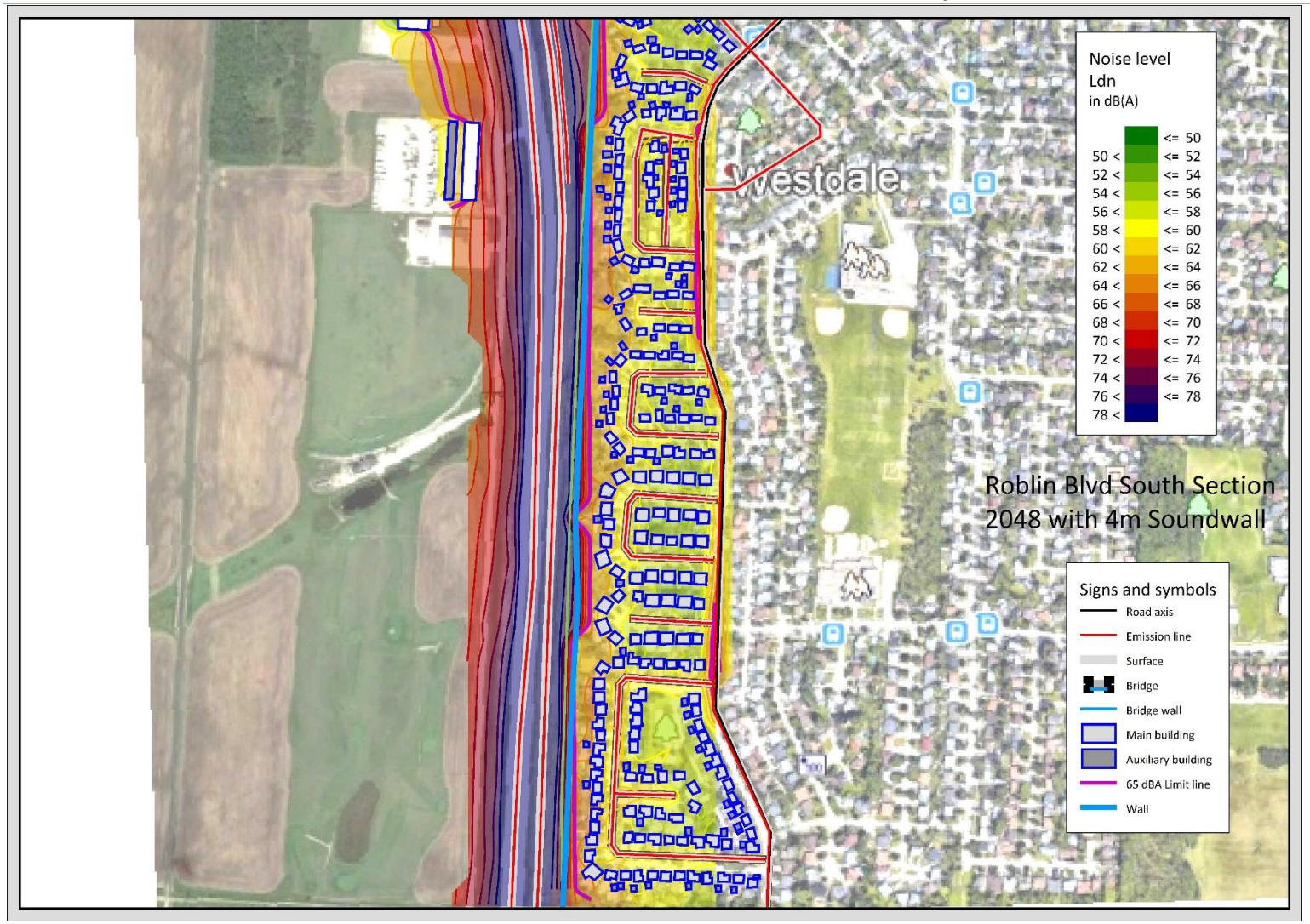

Figure A22 - PTH100 Sound Level 2048 – Roblin Section with Berm and Sound wall – South Section

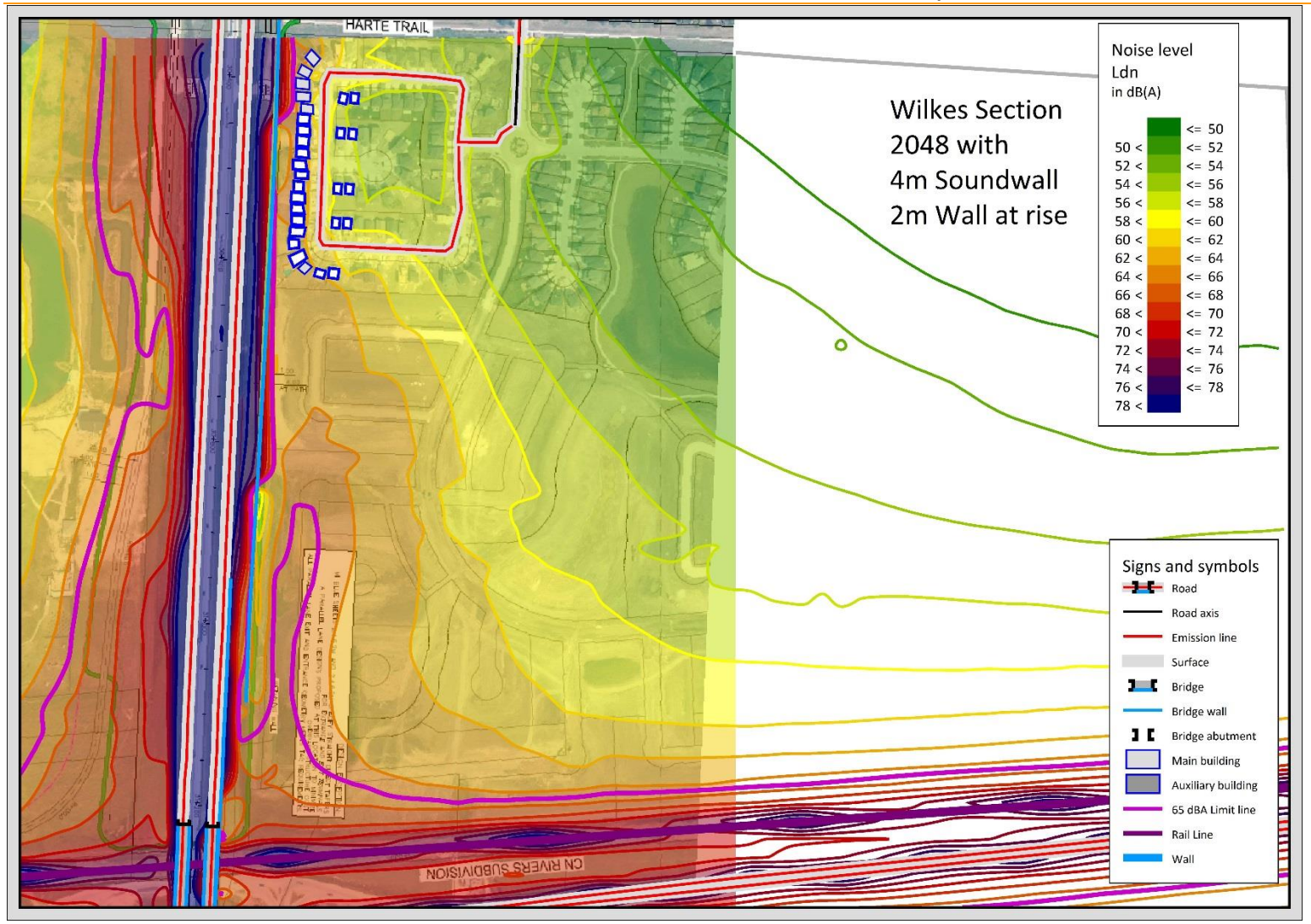

Figure A23 – PTH100 Sound Level 2048 – Wilkes Section with Berm and Sound wall

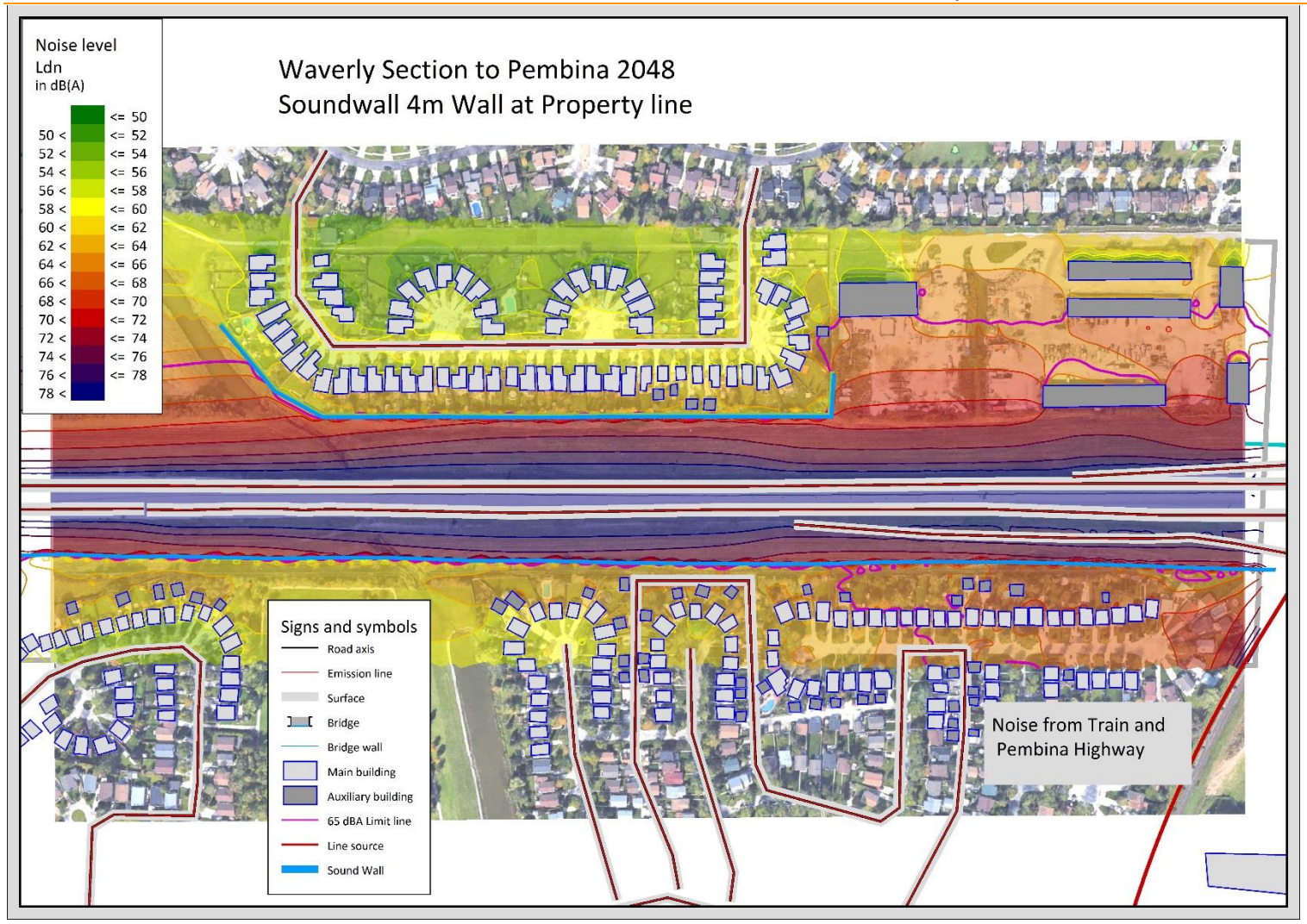

Figure A24 – PTH100 Sound Level 2048 – Waverly Section with Berm and Sound wall
Note: East part of St. Norbert noise level affected by rail line and noise from Pembina Highway

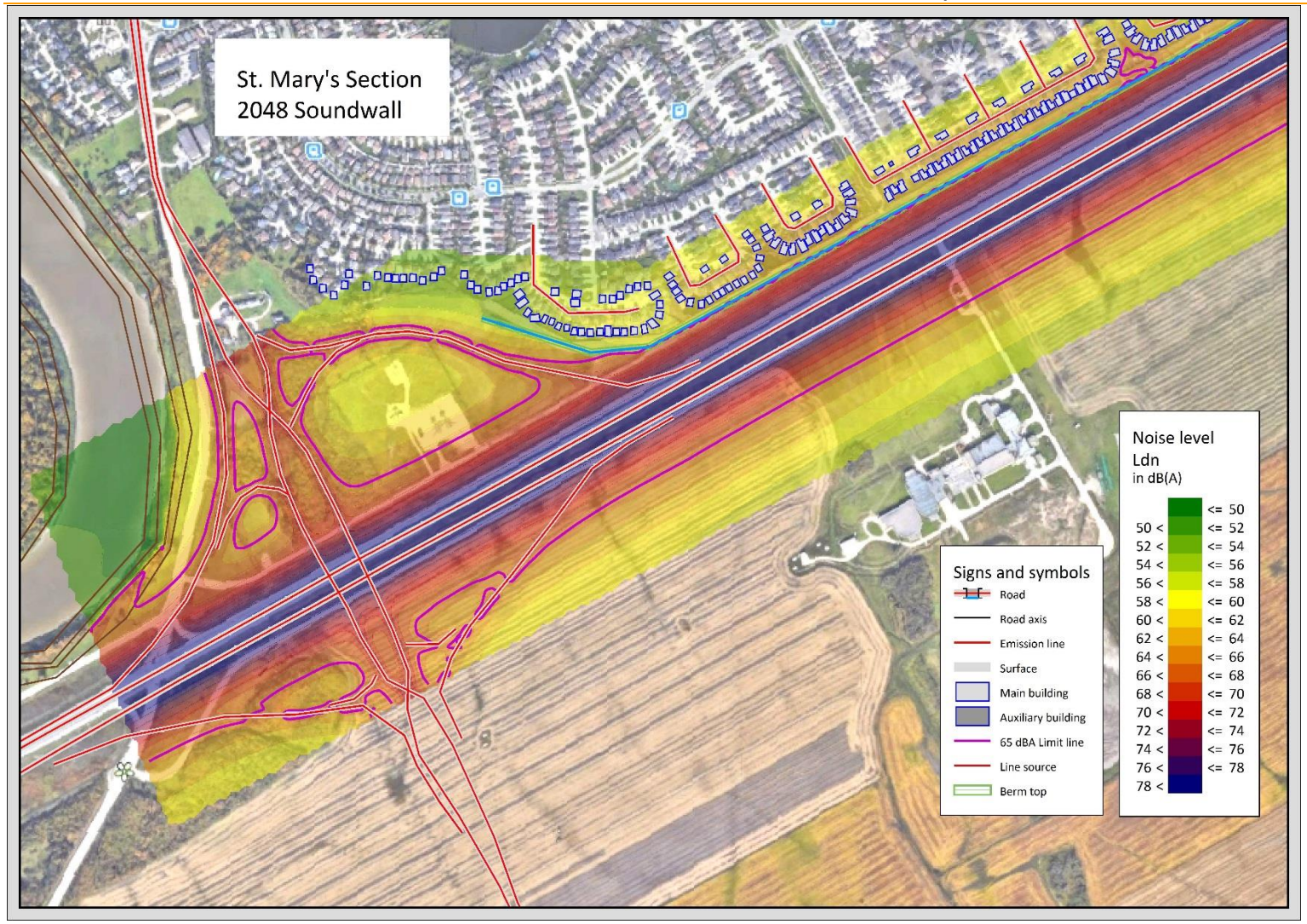

Figure A25 – PTH100 Sound Level 2048 – St. Mary's Section with Berm and Sound wall

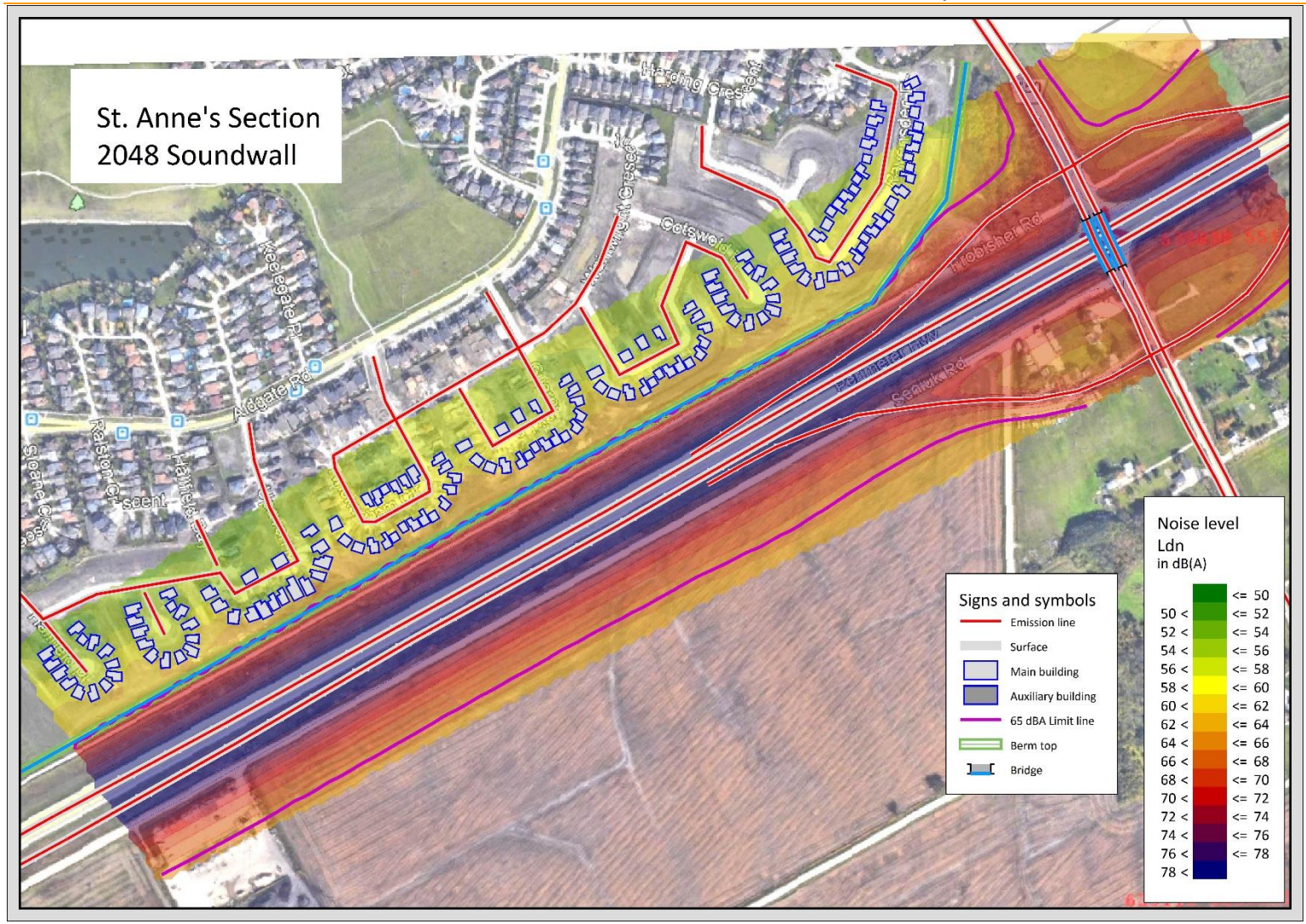

Figure A26 – PTH100 Sound Level 2048 – St. Anne's Section with Berm and Sound wall

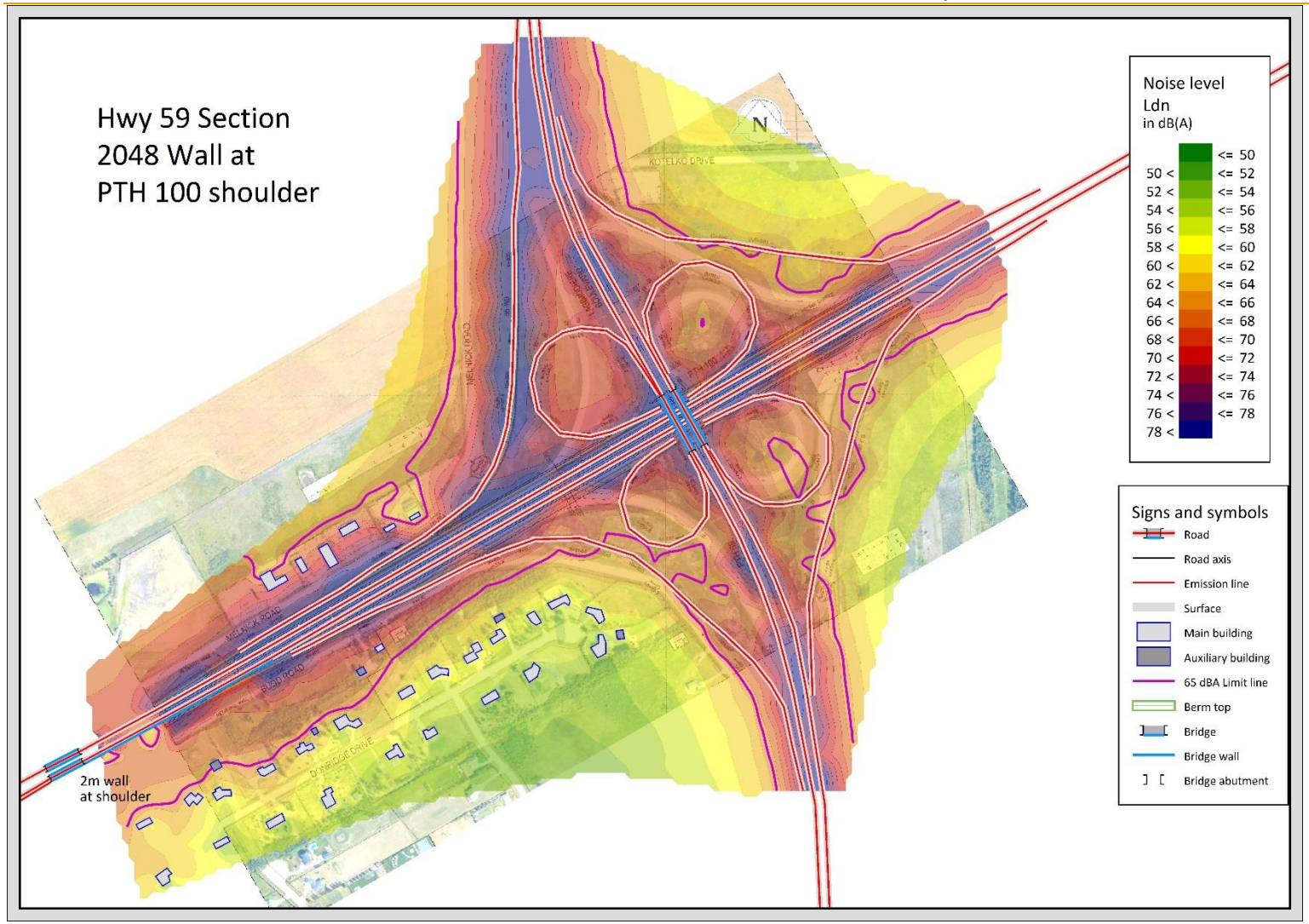

Figure A27 – PTH100 Sound Level 2048 – Hwy 59 Section with Berm and Sound wall