PHOTOVOLTAIC NOISE BARRIERS: SCOPE FOR DEMONSTRATION SCHEMES ON LONDON’S MAIN ROADS

Version: Final Version

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Executive summary

The Mayor's Ambient Noise Strategy (Greater London Authority, 2004) seeks a higher profile for reducing noise in the management of transport systems, whilst promoting the concept of electricity generation by photovoltaic (PV) arrays. Specifically, Policy 9 of the Strategy states that Transport for London (TfL) “…will, and London boroughs and others should, investigate the potential benefits of noise barriers, other noise screening and acoustic modifications to highway structures, where source-related measures would not be effective.”, while the Executive Summary of the Strategy states (Paragraph 14) that “…opportunities, such as for combining barriers with generation of solar electricity using photovoltaics, will be investigated”.

As part of work towards achieving these objectives, Greater London Authority (GLA) have commissioned TRL Limited to undertake a study identifying potential sites for the demonstration of photovoltaic (PV) noise barriers on the London transport network. This study was originally focussed solely on the rail network (Morgan, 2006), but in view of the limited opportunities in the context of current constraints and cost-effectiveness, the scope was extended to include the road network.

This report provides details of an inspection survey undertaken to identify potential demonstration sites for PV noise barriers on London roads, based on locations with existing noise barriers provisionally identified by the London Energy Partnership (LEP).

Based on these inspections the following recommendations are made:

1. In general, it is considered that none of the sites are totally suited for demonstration purposed. Although the barriers all have appropriate orientation, there are other factors (e.g. risk of vandalism) which impact upon their suitability. It is recommended that alternative, more appropriate locations be sought. Although the LEP report identified all these specific sites as noise barriers, only the A40 barrier appears to have been constructed specifically for noise attenuation purposes;

2. If the various negative factors are recognised and accepted, two of the sites offer possibilities for demonstration, only one of which is located on the Transport for London Road Network (TLRN). These two sites are as follows:

   o A211, Footscray Road/Main Road, Sidcup. The noise barrier (wall) at this site could potentially be used as a demonstration scheme for PV noise barriers, providing that the risks of potential damage through vandalism and/or collision are recognised. This is considered to be the most suitable site of the seven;

   o A40, Western Avenue, Ickenham. The noise barrier at this site, which is on the TLRN, could potentially be used as a demonstration scheme for PV noise barriers, providing that appropriate distribution/use of the generated electricity can be identified and the risks of potential damage through vandalism and/or collision are recognised. In the longer term, the barrier may also be suitable for the routine application of PV arrays providing that all of the above issues are addressed.

   However, a more detailed site review and consultation should be undertaken in each case prior to any decision being taken to progress with any demonstration projects

3. The remaining five sites are considered unsuitable for demonstration purposes and in the case of the site on the A4, Cedars Road, Chiswick, the site is not suited for the installation of PV barriers at any time due to a lack of incident sunlight.
1 Introduction

The Mayor’s Ambient Noise Strategy (Greater London Authority, 2004) seeks a higher profile for reducing noise in the management of transport systems, whilst promoting the concept of electricity generation by photovoltaic (PV) arrays. Specifically, Policy 9 of the Strategy states that Transport for London (TfL) “…will, and London boroughs and others should, investigate the potential benefits of noise barriers, other noise screening and acoustic modifications to highway structures, where source-related measures would not be effective.”, while the Executive Summary of the Strategy states (Paragraph 14) that “…opportunities, such as for combining barriers with generation of solar electricity using photovoltaics, will be investigated”.

The Mayor’s Energy Strategy (Greater London Authority, 2004b) also indicated a desire to see renewables make a major contribution to London’s future economy and energy supply mix. Policy 9 of the Strategy states that “The Mayor considers that London should seek to maximise its own generation of renewable energy through developing urban renewables, and use its considerable purchasing power to support renewable energy across the rest of the UK.”

As part of work towards achieving these objectives, Greater London Authority (GLA) have commissioned TRL Limited to undertake a study identifying potential sites for the demonstration of photovoltaic (PV) noise barriers on the London transport network. This study was originally focussed solely on the rail network (Morgan, 2006), but in view of the limited opportunities in the context of current constraints and cost-effectiveness, the scope was extended to include the road network.

A review of European experiences with PV noise barriers can be found in the report by Morgan (2006).

A study has been previously carried out by the London Energy Partnership (2005) to investigate the use of photovoltaic arrays on road traffic noise barriers in London. Seven potential sites, located on A-roads within the London area, were identified where existing noise barriers (approximately 3.5 km in total length) have the correct orientation (south or north facing) for the potential installation of PV arrays. However, the study did not undertake any assessment of the types of barriers installed, in terms of acoustic type (i.e. reflective or absorptive) or whether the design would allow the retro-fitting of PV modules or laminates.

TRL have carried out a brief visual inspection of these barriers with a view to further establishing the suitability of the sites for demonstration purposes. This report provides full details of this inspection, together with possible PV concepts that might be adopted for these or other roadside noise barriers.
2 Details of potential sites for the installation of PV cells on existing barriers

Details of the locations and types of barriers identified by the London Energy Partnership report are summarised below. In the descriptions, the “front” face of a barrier is that facing towards the road, while the “rear” face of the barrier is the side facing away from the road.

2.1 Site #1: A41, Watford By-Pass, Edgware

There are 10 barriers sited along the A41 to the west of the junction with the A1 at Edgware. The road is a two-lane dual carriageway and the barriers provide screening for the adjacent residential properties, as follows:

- Four barriers are located on the north side of the road facing south. The total length of the four barriers is 810 m, although the length of the individual barriers is not known. Any PV modules would be installed on the front of these barriers;
- Six barriers of unknown length are located on the south side of the road. Any PV modules would be installed on the rear of these barriers.

A map showing the approximate location of the noise barriers is included in Appendix A.

2.1.1 Full description of site and barriers

The barriers located on both sides of the road were generally close-boarded timber fences which were not particularly rigid, in poor condition and frequently not vertical. Based on measurements taken on one of the barriers, it is estimated that most were approximately 1.8 m high. One section of barrier on the south-side of the road was formed from concrete panels, but again this was in poor condition. Examples of the different barriers are shown in Figure 2.1 on the following page. It is considered that several of these barriers are more likely to have been installed as garden/boundary fences rather than specifically as noise barriers, although a full inspection would confirm this.

The barriers on the north side of the road were set at varying distances from the roadside, due to variation in the width of the grass verge beyond the pavement. Trees, bushes and other vegetation was generally in very close proximity to the rear of the barriers and in many cases overhanging the barrier. Based on the poor condition of the barriers, it was concluded that a close visual inspection was not worthwhile, and as such no attempt was made to gain access to the rear of the barrier.

The barriers on the south side of the road were generally at a constant distance from the roadside, due to a consistently wide grass verge. Trees, bushes and other vegetation were generally in very close proximity to the rear of the barriers and in many cases overhanging the barrier. Based on the poor condition of the barriers, it was concluded that a close visual inspection was not worthwhile, and as such no attempt was made to gain access to the rear of the barriers, although in many cases this did not appear possible either due to the density of vegetation or the proximity of adjacent boundary fences.

2.1.2 Comments on suitability for the demonstration of PV modules

Prior to the installation of PV modules on any of the barriers at this location, it is considered that significant remedial work would be required to improve the overall condition of the barriers and to also to strengthen them to be suitable for supporting the modules. The replacement of the existing timber posts with steel ones may be required.

Installation of the PV modules would require a lane closure.
The height of the barriers is such that the PV modules would be susceptible to the risk of vandalism, particularly those facing the road on the north-side barrier. This affects the choice of available design. Further inspection of the barriers on the south side (where modules would be installed on the rear) would be necessary to investigate the proximity of buildings behind the barrier. It would be necessary to ensure that all fixings are vandal proof.

Vegetation in the vicinity of the barriers would need to be cut back along the length of the barrier before the panels could be installed. In the case of barriers on the north side of the road, this is solely to ensure that there are no branches etc. overhanging the barrier i.e. trimming of the vegetation; it is not being suggested that any “wholesale removal” of trees/shrubs/bushes would be necessary. The vegetation would then need to be regularly maintained to prevent any shading of the array occurring once in operation. More serious clearing of vegetation would be necessary for the barriers on the south side of the road. Biodiversity, visual and amenity issues would need to be considered for barriers on both sides of the road before any action is taken.
All of the barriers are in relatively close proximity to residential properties, so it is considered that the PV array would most likely be connected into the domestic electric utility grid, at a point which would minimise the distance between the connection and the barrier thereby reducing power loss.

In conclusion, none of the barriers at this location are considered suitable for use as demonstration schemes for PV noise barriers.

In the longer term, the barriers may be suitable for the routine application of PV arrays providing that all of the above issues are addressed. In this case, the following recommendations are made:

- For the barriers on the north side of the road it is considered that if PV modules were to be installed, then the best approach would be for these to be fitted as a cap on the existing fences so that the panels are kept as far from the ground as possible. An example of how such a barrier might look is shown in Figure 2.2a, where the overall height of the barrier has been increased to approximately 2.3 m (based on a 60º tilt); such a design uses minimal modification to the existing structure (new posts aside). Note that the increased height of the barrier would improve the noise screening of properties behind the barrier; however the wind loading on the supporting posts would increase. It would therefore be necessary to determine whether the barrier posts would still be appropriate for this changed situation, as previously noted.

  In this design, it is noted that the PV modules extend beyond the front face of the barrier (albeit by a small distance) and there is no safety barrier in front of the barrier. There may be a risk of damage to the panels and/or injury to the vehicle occupants if a vehicle impacts with the barrier. From a safety perspective it may be preferable, due to the low height of the barrier, to keep the edge of the panels level with or behind the front face (which would definitely require reinforcement of the structure or the use of smaller PV modules) and to use a safety barrier in front.

- For the barriers on the south side of the road, where the panels are on the side of the barrier facing away from the road, it is considered that if PV modules were to be installed, then whilst a similar approach would be preferred to give the panels sufficient elevation, for security it may be better for the panels to be fitted below the top of the existing barrier, as shown in Figure 2.2b. However, this would depend very much upon how visible the panels are from the adjacent properties and the ease of access to the rear of the barrier for vandals.

![Diagram](image)

(a) For barriers on the north side of the road  
(b) For barriers on the south side of the road

**Figure 2.2: Examples of possible PV module options for use on the A41**
It must be emphasised that the two concepts shown in the Figure have not been validated in terms of design or construction (stability, wind loading, etc). The mountings for the panels are similarly for illustrative purposes only. The use of more innovative designs, e.g. multiple-edge designs, etc is not considered appropriate for demonstration because of the height and location of the barriers.

2.2 Site #2: A40, Western Avenue, Ickenham

There is one barrier along the north of the eastbound carriageway of the A40 at Ickenham, beginning prior to the slip road for the A437 and extending partway up the sliproad. This barrier faces approximately south-south-west and is 260 m long. It provides noise screening to the nearby secondary school. Any PV modules would be installed on the front of the barrier.

A map showing the approximate location of the noise barrier is included in Appendix A.

2.2.1 Full description of site and barrier

The barrier itself is a substantial timber barrier, approximately 2 m high, supported by steel posts at approximately 2.5 m centres, as shown in Figure 2.3. At the time of inspection, the barrier is largely free of graffiti and is in good condition. It is clearly a purpose-built noise barrier rather than a regular timber fence used in domestic gardens.

The ground at the rear of the barrier is not level and overgrown, being part of Park Wood. Trees overhang the eastern half of the barrier, and in some places brambles are also growing between the planks of the barrier. The school located behind the barrier is some 100 m away and there are no other buildings in the vicinity of the barrier.

A steel safety-barrier is located in front of the barrier, fastened directly to the steel uprights. The barrier is set back from the road as a result of a pedestrian walkway up to the nearby footbridge.

2.2.2 Comments on suitability for the demonstration of PV modules

The barrier appears to be sufficiently sturdy enough to be fitted with PV modules without the need for reinforcement providing that the panels are not too large. Since the panels would have to be fitted facing the road and the barrier is relatively low, it is considered that any modules would have to be mounted onto the top of the barrier as additional panels (where the bottom edge of the modules are flush with front face of barrier) or as an inclined cap (where the modules overhang both sides of the barriers (although the front edge must not extend beyond the line of the safety barrier), thereby increasing the overall height.

It is considered that any modules should be inclined at 60 degrees to the horizontal. This would increase the height of the barrier to approximately 2.7 and 2.5 m respectively. The fitting of the modules in such a manner would increase the acoustic performance of the barrier.

Depending on how any PV modules are mounted onto the noise barrier and the low overall height, there is the potential for the modules to be damaged if a vehicle were to collide with the barrier, even though the modules would not extend beyond the safety fence: safety fences deform on impact and high-sided vehicles might roll towards the protruding edge. There is also the potential risk to the safety of the vehicle occupants in such cases via intrusion into the passenger compartment.

The orientation of the panels (facing towards the road), the height of the barrier, its proximity to the pavement and the ease of access to the rear of the barrier all combine to make the
site prone to the risk of vandalism. It would be necessary to insure that all fixings and mountings are vandal proof.

(a) Barrier panel viewed from the front (south side)  
(b) Barrier viewed from the front (south side) looking west  
(c) Barrier viewed from the rear (north side)  
(d) Barrier viewed from the front (south side) from the adjacent footbridge

Figure 2.3: Noise barrier alongside the A40, Western Avenue, Hillingdon

Vegetation in the vicinity of the barrier would need to be cut back along the length of the barrier before the panels could be installed. However, it should be noted that this is solely to ensure that there are no branches etc. overhanging the barrier, i.e. trimming of the vegetation; it is not being suggested that any “wholesale removal” of trees/shrubs/bushes would be necessary. The vegetation would then need to be regularly maintained to prevent any shading of the array occurring once in operation. Biodiversity, visual and amenity issues would need to be considered before any action is taken.

The nearest buildings to the barrier are those of the nearby secondary school, which are estimated to be at least 100 m away. Connection to the electric utility grid at the school would require significant effort since the majority of the ground between the barrier and the school is woodland. Other means of distributing the power from the array would need to be identified.

In conclusion, it is considered that the noise barrier at this site could potentially be used as a demonstration scheme for PV noise barriers, providing that appropriate distribution/use of the generated electricity can be identified and the risks of potential damage through vandalism and/or collision are recognised.
In the longer term, the barrier may also be suitable for the routine application of PV arrays providing that all of the above issues are addressed. In this case, Figure 2.4 shows possible concepts for how the PV arrays might be mounted. The angle of tilt is assumed to be 60º on both designs. From a safety perspective, design (b) is preferable.

It should be noted that the concepts shown in the Figure have not been validated in terms of design or construction (wind loading, stability, etc). The mountings for the panels are similarly for illustrative purposes only. The use of more innovative designs, e.g. multiple-edge designs, etc is not considered appropriate for demonstration because of the height and location of the barriers.

![Figure 2.4: Examples of possible PV barrier concepts that could be used on the A40](image)

Based on a total length of 260 m length and using framed modules similar to those used in the PV noise barrier trial on the M27 (Carder and Barker, 2006), it is estimated that approximately 200 panels would be required, at a cost of approximately £70,000, generating 12.8 kWp peak power. Were the system south-facing, this could generate in the order of 9600 kWh of electricity per annum (the cost of which would be £864 assuming £0.09 per kWh), however since the barrier actually faces south-south-west, this figure will be slightly reduced. The time period required to recover the costs of the installation is therefore excessive and much longer than the lifetime guarantee available for most types of PV module.

Using instead the PV laminates as trialled on the M27 (Carder and Barker, 2006), the cost of the system is reduced by approximately 75%, although both the potential energy generation per annum and the cost recovery period are only reduced by 50%.

No information on mountings, installation costs, or any of the other components required as part of the PV system have been compiled at this time.

1 Assuming £350 per panel (taken from Table 2.1 in Morgan (2001)) and no bulk discount
2 It is estimated that the usable power output from a south-facing installation in the UK is approximately 750 kWh per annum per kWp output from the array, assuming typical weather conditions, etc.
2.3 Site #3: A312, The Parkway, Yeading

There are two barriers on the A312 near Yeading, between the roundabout with the A4180 and B455 and the roundabout with Willow Tree Lane, as follows:

- One barrier, 12 m long, is located to the west of the A312 near Viking Primary School on Radcliffe Way and faces north-east. Any PV arrays would be mounted on the rear of the barrier, however the orientation of this face is at the limit of what is best for PV orientation and the barrier is only 12 m long. As such, it has not been visited as part of this current study and it is considered unlikely that this site would be of use for demonstration purposes;

- The second barrier is on the east of the road near Wayfarer Road. Half of the barrier faces due west and is therefore not suitable for the use of PV arrays. The remaining 10 m of the barrier faces south-west, and whilst this could potentially be suitable for use with PV arrays, it is not considered appropriate for a demonstration project due to the short length and has not been visited as part of the current study.

In view of the extremely short lengths of barrier at this site, it was not visited during the inspections.

A map showing the approximate location of the noise barriers is included in Appendix A.

In conclusion, neither of the barriers at this location are considered suitable for use as demonstration schemes for PV noise barriers due to their short length. If length was not an issue, an inspection of the site would be necessary to further assess suitability.

A full inspection of the site would be required before any recommendations can be made as to whether the barriers are suitable for the routine application of PV arrays.

2.4 Site #4: A4, Cedars Road, Chiswick

There is a barrier on the south side of the A4 Cedars Road, east of the junction with the A406, A205 and A314 in Chiswick, which is 96m long, and screening adjacent residential properties. Any PV arrays would be installed on the rear of the barrier.

A map showing the approximate location of the noise barrier is included in Appendix A.

2.4.1 Details of site and barrier

The barrier is a close boarded timber fence, 1.8 m high on steel posts at 3 m centres, as shown in Figure 2.5. The barrier is vertical and, apart from graffiti on one section, in good condition.

2.4.2 Comments on suitability for the demonstration of PV modules

Since any PV modules would require to be mounted on the rear face of the barrier, it is considered that they are likely to be in the shadow of the adjacent buildings for large parts of the day, thereby significantly reducing the efficiency of the modules. The presence of the trees on the verge may also results in the modules being screened from incident sunlight, particularly when the trees are fully in leaf. Further evaluation of the site was therefore considered unnecessary.

In conclusion, the barrier at this location is not considered suitable either for use as a demonstration scheme for PV noise barriers or for the routine installation of PV arrays, due to a lack of incident sunlight.
2.5 Site #5: A2, Rochester Way, Eltham

There are two possible barriers on the A2 Rochester Way near Eltham between the junctions with the A2213 and the A205, as follows:

- There is approximately 310 m of south-west facing barrier on the north side of the road (and some further irregular sections of barrier which might also be suitable). Any PV arrays would be installed on the front of the barrier;
- There is a 375 m long barrier on the south of the road, which is adjacent to the railway. Any PV arrays would be installed on the rear of the barrier facing the railway.

A map showing the approximate location of the noise barriers is included in Appendix A.

2.5.1 Details of sites and barriers

The first barrier on the north side of the road is be constructed from concrete panels as shown in Figure 2.6. In terms of its position relative to the road, the barrier was constructed at the edge of the carriageway, separated only by a steel safety barrier, and it was not possible to make a closer inspection from the traffic side. Only a cursory inspection was feasible from the rear of the barrier, which indicated that a significant amount of vegetation would require to be cut back prior to any installation and that the barrier is seriously prone to vandalism.

The barrier on the south side of the road, shown in Figure 2.7, is of unknown height and appears to be similarly constructed from concrete panels. In terms of its position relative to the road, the barrier was constructed at the edge of the carriageway, separated only by a steel safety barrier, and it was not possible to make a closer inspection from the traffic-facing side. The south side of the barrier is adjacent to a railway line and as such, it was not possible to gain access for any inspection.
Figure 2.6: Noise barrier alongside the north side of the A2, Rochester Way, Eltham

(a) View of rear of barrier (south side) looking across railway

(b) View of front of barrier (north side) from the A2

(c) View of the front of barrier (north side) from the A2

Figure 2.7: Noise barrier alongside the south side of the A2, Rochester Way, Eltham
2.5.2 Comments on suitability for the demonstration of PV modules

The nature of the surrounding area suggests that the site might be prone to vandalism were PV arrays to be installed. It would therefore be necessary to insure that all fixings and mountings are vandal proof. Any construction work may well require a lane closure on the A2, even though the panels would be fitted facing away from the road.

If PV modules were fitted to the barrier on the north side of the road, where they would be on the traffic facing side of the barrier, there is the risk of the modules being directly damaged or injury to vehicle occupants via intrusion into the passenger compartment if a vehicle (particularly a high-sided vehicle) collided with the safety barrier. In the case of the barrier on the south side of the road, because the PV modules would be on the side of the barrier facing the railway, there is less risk of damage.

Based on the limited information available, it is not considered that either of the barriers are suitable for use as a demonstration scheme for PV noise barriers. However, further inspection of the barrier on the south side of the road may be worthwhile.

A full inspection of the site would be required before any recommendations can be made as to whether the barrier on the south side of the road is suitable for the routine application of PV arrays.

2.6 Site #6: A2, East Rochester Way, Bexley

There are two sections of barrier on the A2 further east in Bexley, both on the north side of the road facing south, providing screening to adjacent residential properties.

- The first section is straight and 123 m long. Any PV arrays would be installed on the front of the barrier;
- The second section is on the slip road off the eastbound carriageway onto the A223 and is curved (57 m long). However the curve is such that it would not preclude the use of rigid panels. Any PV arrays would be installed on the front of the barrier.

A map showing the approximate location of the noise barriers is included in Appendix A.

2.6.1 Details of sites and barriers

The main barrier is an open-slatted timber fence, approximately 2m high supported by half-height timber posts at approximately 3 m centres, as shown in Figure 2.8. The barrier is in relatively good condition, but is not upright over the full length and, due to the use of short timber posts, was not particularly sturdy. It is mounted on top of a brick retaining wall and runs uphill for its full length. Due to the type of construction, (the gaps between the boards appear to be intentional rather than a result of any shrinkage of the timber) it is considered that the barrier has been constructed more for visual screening than any particular acoustic benefit.

A steel safety barrier separates the barrier from the adjacent carriageway of the A2.

The second (curved) barrier was a close-boarded timber fence as shown in Figure 2.9, which appears to be more of boundary/garden fence than a purpose-built noise barrier. Mounted on the top of a brick wall, this barrier is immediately adjacent to the pavement, with shrubs and trees directly up against the barrier in the adjacent private garden. Graffiti was present on all panels of the barrier.

2.6.2 Comments on suitability for the demonstration of PV modules

With regards to the main barrier at this site the following observations are noted:
The barrier would most likely need to be reinforced before any PV arrays could be fitted. This would especially be the case if the arrays were fitted in a way which would increase the height of the barrier. Since any PV modules would still most likely have to hang over the front face of the barrier, although they would be unlikely to extend beyond the safety fence, were a passing vehicle to impact with the safety fence (particularly a high-sided vehicle) then there is a potential risk of severe damage to the PV array. Unlike the site on the A40, there is no pavement between the safety barrier and the carriageway.

The barrier is not obscured by any vegetation and is not in the shadow of any adjacent buildings, thereby allowing unobstructed exposure to sunlight.

Figure 2.8: Noise barrier alongside the A2, East Rochester Way, Bexley
(Barrier appears to be a purpose-built open structure, i.e. the gaps between the timbers are not caused by shrinkage)
Figure 2.9: Curved noise barrier alongside the A2, East Rochester Way, Bexley

Although the barrier is mounted on top of a wall, making access to the top of the barrier awkward for pedestrians, the barrier can be readily accessed from the traffic side of the barrier by standing on the inside of the safety fence. As such, there is a potential risk of vandalism to any PV arrays. It would be necessary to insure that all fixings and mountings are vandal proof.

The barrier is in close proximity to residential properties, so it is considered that the PV array could be connected into the domestic electric utility grid, at a point which would minimise the distance between the connection and the barrier. Alternatively, a traffic camera is in the immediate vicinity of the barrier, which may offer an alternate use for any power generated by the PV array.

In conclusion, it is considered that the main barrier is not overly suited for use as a demonstration scheme for PV noise barriers, due to the potential risk of vandalism and the proximity of any PV arrays to passing traffic.

It is not considered that the second (curved) barrier is suitable either for use as a demonstration scheme for PV noise barriers or for the routine installation of PV arrays.

2.7 Site #7: A211, Footscray Road/Main Road, Sidcup

There is a single barrier, 50 m long, on the A211 in Sidcup, between the A211 and the A20 where the two roads converge, providing screening for the adjacent residential properties on the A211. Any PV arrays would be installed on the rear of the barrier, where it faces the A20.

A map showing the approximate location of the noise barrier is included in Appendix A.

2.7.1 Details of the site and barrier

The barrier is a brick and concrete wall, approximately 2 m wide and 0.5 m wide, as shown in Figure 2.10. On the south-facing side, the foot of the barrier is at the edge of the carriageway on the A20. On the opposite side, there is a grass verge between the A211 and the wall, with a steel safety barrier also installed. The wall is curved at each end, following the route of the A211 at the western end and the A20 at the eastern end. It is considered that the 50 m section referred to in the LEP report is the straight section in the middle of the barrier.
2.7.2 Comments on suitability for the demonstration of PV modules

The concrete cap on the wall offers suitable mounting space for bolting PV modules to the top of the wall. The width of the cap also potentially allows modules to be securely installed whilst keeping them within the footprint of the top of the wall. No reinforcement of the structure would be required before installation of the modules.

The structure is sufficiently rigid that if vehicles were to impact with the wall, there would be most likely be relatively little damage to the PV modules.

The barrier is not obscured by any vegetation and is not in the shadow of any adjacent buildings, thereby allowing unobstructed exposure to sunlight.

The low height of the wall, the ease of access to both sides of the barrier all combine to make the site prone to the risk of vandalism. It would be necessary to insure that all fixings and mountings are vandal proof.
The barrier is in close proximity to residential properties, so it is considered that the PV array could be connected into the domestic electric utility grid, at a point which would minimise the distance between the connection and the barrier.

In conclusion, it is considered that the noise barrier (wall) at this site could potentially be used as a demonstration scheme for PV noise barriers, providing that the risks of potential damage through vandalism and/or collision are recognised.

A sample concept of how the PV modules might be arranged on the wall is shown in Figure 2.11. The angle of tilt is assumed to be 60º. It should be noted that the concept has not been validated in terms of design or construction. The mounting for the panels is similarly for illustrative purposes only. The use of more innovative designs, e.g. multiple-edge designs, etc is not considered appropriate for demonstration because of the height and location of the barriers.

![Diagram of PV barrier concept]

**Figure 2.11: Example of a possible PV barrier concept that could be used on the A211**

Based on a total length of 50 m length and using framed modules similar to those used in the PV noise barrier trial on the M27 (Carder and Barker, 2006), it is estimated that approximately 39 panels would be required, at a cost of approximately £13,650³, generating 2.5 kWp peak power. Were the system south-facing, this would generate in the order of 1875 kWh of electricity per annum⁴ (the cost of which would be £169 assuming £0.09 per kWh), however since the barrier is not directly on this alignment, this figure will be slight reduced. As with the other designs suggested in this report, the time period required to recover the cost of the PV system is considerable and much longer than the lifetime guarantee available for the panels. No information on mountings, installation costs, or any of the other components required as part of the PV system have been compiled at this time.

³ Assuming £350 per panel (taken from Table 2.1 in Morgan (2001)) and no bulk discount
⁴ It is estimated that the usable power output from a south-facing installation in the UK is approximately 750 kWh per annum per kWp output from the array, assuming typical weather conditions, etc.
3 Summary and conclusions

The Mayor’s Ambient Noise Strategy (Greater London Authority, 2004) seeks a higher profile for reducing noise in the management of transport systems, whilst promoting the concept of electricity generation by photovoltaic (PV) arrays. Specifically, Policy 9 of the Strategy states that Transport for London (TfL) “…will, and London boroughs and others should, investigate the potential benefits of noise barriers, other noise screening and acoustic modifications to highway structures, where source-related measures would not be effective.”, while the Executive Summary of the Strategy states (Paragraph 14) that “…opportunities, such as for combining barriers with generation of solar electricity using photovoltaics, will be investigated”.

As part of work towards achieving these objectives, Greater London Authority (GLA) have commissioned TRL Limited to undertake a study identifying potential sites for the demonstration of photovoltaic (PV) noise barriers on the London transport network. A study carried out by the London Energy Partnership (LEP) (2005) to investigate the use of photovoltaic arrays on road traffic noise barriers in London identified seven potential sites (all with existing noise barriers), located on A-roads within the London area. TRL have carried out a brief visual inspection of these barriers with a view to further establishing the suitability of the sites for demonstration purposes. Based on these inspections the following recommendations are made:

1. In general, it is considered that none of the sites are totally suited for demonstration purposes. Although the barriers all have appropriate orientation, there are other factors (e.g. risk of vandalism) which impact upon their suitability. It is recommended that alternative, more appropriate locations be sought. Although the LEP report identified all these specific sites as noise barriers, only the A40 barrier appears to have been constructed specifically for noise attenuation purposes;

2. If the various negative factors are recognised and accepted, two of the sites offer possibilities for demonstration, only one of which is on the TLRN. These two sites are as follows:
   - Site #7: A211, Footscray Road/Main Road, Sidcup. The noise barrier (wall) at this site could potentially be used as a demonstration scheme for PV noise barriers, providing that the risks of potential damage through vandalism and/or collision are recognised. This is considered to be the most suitable site of the seven;
   - Site #2: A40, Western Avenue, Ickenham. The noise barrier at this site, which is on the TLRN, could potentially be used as a demonstration scheme for PV noise barriers, providing that appropriate distribution/use of the generated electricity can be identified and the risks of potential damage through vandalism and/or collision are recognised. In the longer term, the barrier may also be suitable for the routine application of PV arrays providing that all of the above issues are addressed.

   However, a more detailed site review and consultation should be undertaken in each case prior to any decision being taken to progress with any demonstration projects.

3. With regard to the other five sites identified by the London Energy Partnership survey, the following can be concluded:
   - Site #1: A41, Watford By-Pass, Edgware. All ten barriers at this site are considered to be unsuitable for use as demonstration schemes for PV noise barriers. A wide range of factors would require to be addressed/considered for the barriers to be routinely fitted with PV arrays in the longer term;
   - Site #3: A312, The Parkway, Yeading. Both barriers at this site are considered unsuitable for use as demonstration schemes due to their short length. If length was not an issue, an inspection of the site would be necessary to further assess suitability;
- **Site #4: A4, Cedars Road, Chiswick.** This site is not suited for the installation of PV barriers at any time due to a lack of incident sunlight;

- **Site #5: A2, Rochester Way, Eltham.** Both barriers at this site are considered unsuitable for demonstration schemes, but it is noted that no detailed inspection of the barrier on the south side of the road was possible;

- **Site #6: East Rochester Way, Bexley.** Both barriers at this site are considered unsuitable for use as demonstration schemes due to the risk of vandalism and, in the case of the main barrier, the proximity of any PV arrays to passing traffic.
References


Appendix A. Location maps showing approximate noise barrier locations

The approximate locations of the noise barriers reviewed in this study are indicated by thick blue lines on the maps included in this Appendix. It should be noted that these sites have only been considered in terms of their potential for the demonstration of PV noise barriers and that none of the sites are proposed as definitive future test sites.

Figure A.1: Site #1 - A41, Watford By-Pass, Edgware
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Figure A.2: Site #2 - A40, Western Avenue, Ickenham
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Figure A.3: Site #3 – A312, The Parkway, Yeading
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Figure A.4: Site #4 – A4, Cedars Road, Chiswick
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Figure A.5: Site #5 – A2, Rochester Way, Eltham
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Figure A.6: Site #6 – A2, East Rochester Way, Bexley
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Figure A.7: Site #7 – A211, Footscray Road/Main Road, Sidcup
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