An Introduction to Highway Maintenance

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1. Asset Management

Background

Hertfordshire’s highway maintenance programmes are based on an asset management approach, so before looking at the details of those programmes, it may be helpful to introduce the concept of ‘asset management’

Asset management involves using robust data to make good, informed decisions about how we manage and maintain the asset (in this case the highway network) as effectively as possible. Put simply, it is about looking forwards and considering the impact of the decisions we make now on the future of the service and trying to ensure that the impact is as positive as possible.

Although it has been applied to other infrastructure assets such as rail and water for many years, asset management has only been applied to roads in the UK since Hertfordshire pioneered the use of the technique in the highways sector about ten years ago.

The benefits of this approach are now widely recognised. National government, both the previous and current administrations, have stressed the importance of highway asset management in order to deliver some of the required public-sector efficiencies and nearly all local highway authorities now either have an asset management plan or are actively working on one.

“Good, informed decision making”

It is an approach which focuses on getting the best long-term value for money as opposed to a short-term approach which might prioritise immediate repairs over preventative work to preserve the asset and extend its life. In taking this approach, we look at the long-term costs and consequences of the choices that we make. In short, asset management is all about good, informed decision making.

Although asset management helps us to deliver the service more efficiently, and in spite of some significant additional investment made in Hertfordshire’s roads in recent years, there is still a great deal of work on the network that needs doing – more than we can include within our current programmes. This means that we have to make some tough choices since we cannot afford to do everything we would like to do all at once.

It is easiest to explain the concept with some examples. We’ll look at how the process is applied to roads here but the principles apply just as much to all other assets.
Asset Management in Practice

When putting together our works programmes, we have two key questions to consider:

**Which roads shall we treat?**

Because we look at the long-term impact of our decisions, we do not simply prioritise our programmes based on what appears to be most pressing at the moment but rather we look to pick the package of works, which, within the budget available, will give us the best long term result for the network.

What this means for road maintenance is that we consider over a much longer term all the roads in the county in relation to one another when working out which ones to maintain or repair first, rather than automatically fixing the roads which look worst. This enables us to make the best use of the limited resources we have but sometimes causes confusion when people see us working on roads that appear to be in better condition than some others.

**What treatment shall we use?**

Since our programmes are limited by the available budget, each pound we spend on a particular road is a pound that is not available to be spent elsewhere. It is not, therefore, simply a case of selecting the ‘best’ treatment for a particular road, we have to select the most cost-effective treatment for that road - they are sometimes the same thing, but not always. If a low-cost option will significantly delay the need for more expensive repairs, then it deserves serious consideration even if a more expensive option would deliver a wider range of benefits.

**For Example...**

When looking at some roads in a particular area, we may find one road in a really bad condition and three other roads in a slightly better condition – not yet ‘bad’ but, perhaps, vulnerable if we should have another period of severe weather.

Within the set budget available to us we have to decide whether to spend all our money on fixing the worst road (and let the other three roads continue to deteriorate into a worse condition) or whether to spend the minimum amount necessary to keep the worst road safe and invest the remaining budget in preventative maintenance works on the three vulnerable roads to protect them and stop them deteriorating into the same poor condition as the first road.

Preventative maintenance is usually cheaper, so we can often maintain three or four roads for the price of fixing one bad one. It is also generally more sustainable and less disruptive than full repair work and so it offers better value all round, but, with competing demands on the programme it means that we need to be prepared and able to take the tough decisions and do the minimum on the bad road to keep it safe while spending most of the money (in this example) on less bad roads in order to maintain and protect them – as the old saying goes ‘a stitch in time saves nine’.
“A stitch in time saves nine”

To conclude the example, if we repaired the worst road first we could find, in a year’s time, that we have one good road (the one we fixed) and three other ‘bad’ roads (the vulnerable ones that we ignored, which have subsequently deteriorated) all needing a larger amount of money spent on them. However, if we spend the budget on preventative maintenance on the three vulnerable roads, in a year’s time we would find that we have three good roads and only one bad road to spend our budget on.

In the long term, it is obvious that this is a good way for us to spend the set amount of money we have for our road network. However, in the short term, it may appear that we are ignoring those roads which appear to be in the greatest need of our attention, but this is not the case.

This is just one illustration of how asset management can be applied, there are many others too. For instance it can help us make decisions about which type of street light offers best value for money and it can help inform our improvement works to make them cheaper to maintain in the future.
2. Carriageways (or Roads)

Why do roads need maintenance?

There are a number of reasons why roads need maintenance or repair over the course of their lives.

Age and Weather

Most road surfaces are made of asphalt – a mix of stones bound together with bitumen and still colloquially called ‘tarmac’ (although tar is no longer used as a binder).

Asphalt is a flexible material able to flex and stretch a little when it is fairly new but the bitumen binder becomes brittle as it gets older. When this happens – typically between ten and twenty years into its life – cracks can open in the surface of the material.

Water can get into these cracks and freeze, widening the crack. In poor weather this ‘freeze-thaw’ effect can lead to a quick deterioration in the asphalt surface and the rapid formation of potholes. This is why potholes are so much more common in cold, wet weather.

If the deterioration goes too far, the surface may lose integrity and water can get through into the lower layers of the road, damaging them too. For this reason, keeping the surface sealed is key to getting the most life out of a road.

This type of surface failure is the most common cause of problems on Hertfordshire’s roads and, indeed, on most local authority roads in the country. The good news is that, caught early enough, the surface can often be resealed cheaply and effectively using a surface treatment to extend its life by ten or more years for a fairly modest cost.

Wear and Tear

Hertfordshire’s roads are much busier than the national average for local authority roads – on average every mile carries 2/3 more traffic than is typical for England, which means that there are five cars on our roads for every three on an average road. This effect is even more pronounced on our A roads the busiest of which carry more than 60,000 vehicles per day – significantly more than most motorways.

All of this means more wear and tear on our roads from traffic.

Wear on the surface of the road slowly polishes the road, decreasing the amount of grip, meaning that the surface may need to be replaced or other steps taken to restore the texture. This, however, is a slow process and the surface frequently needs replacement for other reasons as well by the time grip is an issue.
More of a concern is the effect of high levels of traffic on roads that are starting to
deteriorate; if the surface has some cracks or other defects, high levels of traffic
can accelerate the rate at which the surface deteriorates further.

The final element of wear and tear is the damage done to the foundations of roads
by high numbers of heavy goods vehicles. Cars do negligible damage to road
foundations but the pounding from heavy goods vehicles will, over time, break
down the foundations of even the most stoutly-constructed road. When this
happens, major structural repairs – even complete rebuilding – may be necessary.
The good news is that this is seldom a problem on anything but the busiest of A
roads – a few lorries a day using a road will not generally cause these kinds of
structural issues – but, when and where they do happen, repairing them can be
very expensive.

Other Issues

Other problems that sometimes require maintenance treatments include utility
trenches and poor underlying ground conditions.

Any utility trench – the excavations that the gas, water companies and other similar
operators make in the road to maintain their own apparatus – introduces joints and
weaknesses into the road surface, even when reinstated properly. Like cracks, this
can allow water in and allow the road to deteriorate more quickly.

Poor underlying ground conditions can cause subsidence and other problems in
roads just as they can elsewhere. These problems can vary widely but are usually
reasonable localised and typically need a fairly limited deep repair, perhaps in
conjunction with resurfacing or another more general treatment.

The Solutions

Having looked at why maintenance is necessary, the next section looks at the
different maintenance solutions available to us and which of those solutions are
suitable for which circumstances.

Carriageway Treatments

Carriageway maintenance treatments can be grouped in to three broad categories.

- Surface Treatments
- Resurfacing
- Recycling/Reconstruction

Each has a different range of benefits and costs and some are only appropriate
under certain circumstances.
Surface Treatments

Surface treatments include surface dressing and thin surfacing such as micro asphalts. These all involve laying a thin layer over the top of the existing road to seal the surface and restore grip, extending the life of the road. They will also rectify surface defects like cracks and potholes, either as part of the treatment process or through pre-patching works done to the more significant defects in advance of the surface treatment.

Resurfacing

Resurfacing usually involves removing and replacing the existing road surface (although it is sometimes possible to lay the new surface on top of the old). Resurfacing differs from a surface treatment by using a thicker layer of material; usually at least 30mm thick and sometimes 100mm or more if several layers of the road are replaced. Resurfacing restores the road surface to a new condition, removing surface problems and most unevenness.

Rebuilding

Rebuilding works like recycling or reconstruction involve digging down to repair or replace some or all of the foundation layers of the road and then putting a new surface back on top. Limited areas of reconstruction are sometimes used to solve localised problems as part of a resurfacing scheme.

Which Treatment to Choose?

The different treatments offer a different range of benefits. Selecting the right treatment for a particular road will depend on many things including the condition and construction of the road and the amount and type of traffic it takes. The table below summarises some of the main factors to consider but each situation is unique and each road needs to be considered on its merits.

<table>
<thead>
<tr>
<th></th>
<th>Surface Treatment</th>
<th>Resurfacing</th>
<th>Rebuilding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seals the Surface?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Restores Grip?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Extends the Life of the Road?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Repairs Surface Defects?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Removes Minor Dips?</td>
<td>Sometimes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Removes Major Unevenness?</td>
<td>No</td>
<td>Sometimes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adds Strength?</td>
<td>No</td>
<td>Sometimes</td>
<td>Yes</td>
</tr>
<tr>
<td>Repairs Foundation Problems?</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Cost</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Environmental Impact</td>
<td>Low</td>
<td>Medium</td>
<td>Medium / High</td>
</tr>
<tr>
<td>Disruption</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
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## Surface Dressing

<table>
<thead>
<tr>
<th><strong>Type:</strong></th>
<th>Surface Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Also known as:</strong></td>
<td>Dressing, ‘Tar Spray and Chip’ (although we don’t use tar)</td>
</tr>
<tr>
<td><strong>Variants include:</strong></td>
<td>Double Dressing (two layers applied at the same time) ‘Fibredec’ (with glass fibre reinforcement to reduce cracking)</td>
</tr>
<tr>
<td><strong>Advantages:</strong></td>
<td>Low cost; Seals the Surface; Restores Texture and Grip Extends road life; Quick to apply meaning less disruption Low carbon footprint</td>
</tr>
<tr>
<td><strong>Disadvantages:</strong></td>
<td>Does not remove unevenness; Loose stones will remain on the road surface for some weeks after laying making it look ‘tatty’, initial public reaction can therefore be poor. Not suitable for high-stress sites (e.g. lots of turning vehicles)</td>
</tr>
</tbody>
</table>

### Typical Costs:

Surface dressing costs between £5 per m² on a quiet road and about £8 per m² on a busy road. Busy roads are more expensive both because a higher grade of treatment is usually used and because we are more likely to have to work off-peak to reduce disruption which increases the cost of the works. These costs include normal levels of patching to repair significant defects before the road is dressed but would increase further if the road was in poor condition. *Typically this might mean:*

- Quiet urban road 200m long would cost around £7,000
- Quiet country lane 1km long would cost about £25,000
- Busy A road 1km long would cost approximately £80,000

### The Process

**Before:** Any major defects are repaired ahead of time – usually several months in advance if possible. Minor defects like cracks can usually be dressed over without additional work. **On the day:** The road is swept to clean it and remove debris then a layer of very hot bitumen binder is sprayed over the existing road surface. The binder softens the surface and seals cracks and joints, restoring life and sealing the road. While the surface is still soft, a layer of new stone chippings is spread over it and rolled. Because the surface is softened, the rolling will help the chippings start to bed in to the existing road although the bedding in process continues over the next few weeks under the normal action of traffic. **Aftercare:** There will be loose chippings on the surface of the road for several weeks after the dressing until the bedding in process is complete. This is normal, although it can look a bit unsightly, but warning signs will be present to advise drivers of the loose stones. The road will usually be swept several times during this period and the white lines will be replaced after the last sweep. This will usually be a few weeks to a month after the dressing. Once the surface has bedded in, been swept and the white lines have gone back, the newly dressed road will look like any other road surface.
Surface Dressing Gallery

**Before:**
The potholes have been patched ready for dressing but the cracks in the old road surface are still visible – the dressing will fill and seal these.

**After:**
The same road about three months after the dressing was completed.

**Texture and Grip:**
This picture shows the old surface on the right and the new surface dressing on the left about three months after the dressing was laid. The old surface is worn and polished by many years of traffic but the new surface offers much better texture and grip which can be important to road safety, especially in the wet.
Thin Surfacing

**Type:** Surface Treatment

**Also known as:** Micro surfacing, ‘Micro’, Slurry seal (similar – see below)

**Variants include:**
- Slurry Seal (a thinner version of micro asphalt)
- ‘Ralumac’ (a proprietary premium version with greater durability)

**Advantages:**
- Low cost;
- Seals the surface and extends road life;
- Restores texture and grip
- Quick to apply meaning less disruption
- Low carbon footprint
- Removes minor dips and fills potholes

**Disadvantages:**
- Does not remove major structural unevenness;
- Loose stones will remain on the road surface for some weeks after laying making it look ‘tatty’, initial public reaction can therefore be poor. Not suitable for very high-stress sites

**Typical Costs:**
Micro asphalt costs between £8 per m² on a quiet road and about £13 per m² on a busy road. Busy roads are more expensive both because a higher grade of treatment is usually used and because we are more likely to have to work off-peak to reduce disruption which increases the cost of the works. These costs include normal levels of patching to repair significant defects before the road is dressed but would increase further if the road was in poor condition. *Typically this might mean:*
- Quiet urban road 200m long would cost around £11,000
- Busier B road 500m long would cost approximately £52,000

**The Process**

**Before:** Any major defects are repaired ahead of time. Minor defects like cracks and surface potholes can usually be filled by the treatment without additional work.

**On the day:** The road is swept to clean it and remove debris and then the micro asphalt is laid over the existing road surface. It is usually laid in two coats; the first helps to fill defects and regulate out dips in the road surface, the second provides the new road surface.

The micro asphalt itself is laid as an emulsion – a mix of bitumen binder and stones of various sizes suspended in water. The emulsion is laid cold, not hot like conventional asphalt, reducing the energy used in production (and consequently the carbon footprint). The emulsion stays liquid for between 20 minutes and an hour before it ‘breaks’ (or goes off) at which point the surface can be opened to traffic. However, the material will stay relatively soft for several weeks after laying so not all roads are suitable for this treatment.

Manhole covers and drains are adjusted to suit the new road level which will be about 15mm higher than the old road due to the thickness of the micro asphalt.

**Aftercare:** There will be loose stones on the surface of the road for several weeks as stones naturally loosen from the surface of the new material. This is normal, although it can look a bit unsightly. The road will usually be swept several times during this period and the white lines will be replaced after the last sweep. This will usually be a few weeks to a month after the treatment. Once the surface has bedded in, been swept and the white lines have gone back, the new micro asphalt surface will look like any other road.
Thin Surfacing Gallery

**Before:**
A typical candidate for micro asphalt or similar thin surfacing: the surface is old and worn with numerous minor defects.

**During:**
The material is laid in a semi-liquid form by a specialist machine; this helps it level out minor dips and bumps but it looks (and is) quite a messy process.

**Immediately After:**
The new surface has a red tinge when still wet but quickly turns black. Initially it has a rather open texture and there are usually loose stones for the first few weeks.

**One Year Later:**
The new surface has fully bedded in and is indistinguishable from any other road surface.
## Resurfacing

<table>
<thead>
<tr>
<th>Type:</th>
<th>Resurfacing</th>
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<tbody>
<tr>
<td>Also known as:</td>
<td>Surfacing, ‘Plane &amp; Inlay’, Inlay, Overlay</td>
</tr>
<tr>
<td>Variants include:</td>
<td>Different types of material can be used</td>
</tr>
<tr>
<td>Advantages:</td>
<td>Replaces the surface; Restore texture and grip; Extends road life; Restores ride quality; Relatively fast operation</td>
</tr>
<tr>
<td>Disadvantages:</td>
<td>Does not fix deep problems with the foundations; Can be expensive, especially if several layers need replacing</td>
</tr>
<tr>
<td>Typical Costs:</td>
<td>Resurfacing costs between £15 per m² to replace the surface layer on a quiet road and about £50 per m² to replace several layers on a busier road. Busy roads are more expensive both because a thicker treatment is often needed and because we are more likely to have to work off-peak or at night to reduce disruption, which increases the cost of the works. These costs are typical but would increase further if the road was in poor condition. Typically this might mean: Quiet urban road 200m long would cost around £  20,000 Busier local road 500m long would cost about £150,000 Busy A road 1km long would cost approximately £450,000</td>
</tr>
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### Inlay or Overlay?

It is possible to ‘overlay’ the road - to put a new normal asphalt surface straight over the top of the existing road but the cost and difficulty of raising kerbs and footways and adjusting drains and manhole covers means this is only usually possible on rural roads where these features are not present. In most cases it is better to ‘inlay’ the road surface by removing the old surface and replacing it with a new one at the same level and that is the process described below.

### The Process

**Preparation:** The old road surface is removed by a process known as ‘planing’ where a large machine with a rotating drum covered in teeth chews off the old surface. This process is noisy and generates quite a lot of dust but it is fast and, in the case of night works, can usually be completed before midnight. Sometimes only the surface layer is removed (30-40mm) but if the damage to the surface is deeper then more of the existing road will be removed in this way. The planed surface is cleaned and sprayed with bitumen to help the new surface stick to it.

**Laying:** The new asphalt is laid at a high temperature and so is brought to site in insulated lorries. There it is fed into a paving machine which lays a controlled thickness of the chosen material, this is then rolled to compact it and give an even surface.

**Aftercare:** Once the material has cooled the road can be reopened to traffic. The white lines can be replaced before the road is reopened to traffic although, for operational reasons, they are sometimes replaced as a separate operation shortly after the resurfacing. In most cases, no other special aftercare is needed.
Before & After:
Lea Road in Waltham Cross before and after resurfacing. The old surface (left) was heavily cracked because it had become old and brittle. Because of the nature of the road and the degree of cracking, the surface needed to be replaced, not just sealed.

Resurfacing:
The paving machine in operation. The hot material is delivered in insulated lorries – one is tipping into the front hopper of the machine in the picture – and the paver lays it in an even layer out of the back of the machine. Just visible in the corner of the photograph is one of the rollers used to compact the material after it is laid.
<table>
<thead>
<tr>
<th>Recycling</th>
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<tbody>
<tr>
<td><strong>Type:</strong></td>
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<tr>
<td><strong>Also known as:</strong></td>
</tr>
<tr>
<td><strong>Variants include:</strong></td>
</tr>
<tr>
<td><strong>Advantages:</strong></td>
</tr>
<tr>
<td><strong>Disadvantages:</strong></td>
</tr>
</tbody>
</table>

**Typical Costs:**
This type of recycling costs about £35 per m² to recycle a relatively quiet road; it is not usually used on busier roads since these require a deeper construction. This includes the cost of recycling the road and putting a new surface back on the recycled layers.

Typically this might mean that a quiet urban road 200m long would cost around £50,000.

**Where would we use this?**
This option describes a process called ‘retread’ – shallow in-situ recycling. ‘Shallow’ because it only goes down perhaps 75 to 100mm and ‘in-situ’ because the material is recycled on site, not taken away for processing. This will not fix structural problems on main roads since they are thicker than this but many of Hertfordshire’s older roads have only a thin asphalt surface on them. If this surface fails it is sometimes not possible to remove it and resurface these roads normally if there is no proper structural layer underneath on which to lay the new surface. In these cases retread offers an option to renew (or create) a structural layer on which the new surface can be laid. For that reason it is usually used of quieter urban roads where no other treatment is suitable.

**The Process**

**Recycling:** The old road surface is broken up by a process known as ‘planing’ (see ‘Resurfacing’ for details). If necessary some of the old material may be removed at this stage to make space for a new surface to be laid later and the loose material can be reshaped to address ride quality or drainage problems if necessary. The loose material is then remixed with bitumen and sometimes other additives (like cement) and rolled in order to create a solid structural layer. The surface of this layer is then sealed with a surface dressing.

**Surfacing:** The new sealed surface can be left as the final road surface but it is usually best to further protect it with a surface layer. This is can be a conventional asphalt surface, micro asphalt or a further surface dressing, depending on the road. This is usually applied several weeks after the retread process meaning that the road may need to be left with the interim surface for some time.

**Aftercare:** Aftercare will depend on the type of final surface chosen for the road.
Recycling Gallery

**Before (right):**
Manland Road in Harpenden as it was before retread, the surface is heavily cracked and potholed and the lower layers are visible in places.

**After (middle right):**
Manland Road after retread with the new surface in place

**Retread Process (below):**
The picture on the left below shows the heart of the retread operation; the broken up material is remixed on site with additional binder and other additives as necessary to create a suitable base for the new surface. The lower right picture shows Manland Road as it appeared during the process.
## Reconstruction

<table>
<thead>
<tr>
<th>Type:</th>
<th>Rebuilding</th>
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<tbody>
<tr>
<td>Also known as:</td>
<td>-</td>
</tr>
<tr>
<td>Variants include:</td>
<td>Part or full Depth reconstruction</td>
</tr>
<tr>
<td>Advantages:</td>
<td>Replaces the surface;</td>
</tr>
<tr>
<td></td>
<td>Restores texture and grip;</td>
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<tr>
<td></td>
<td>Extends road life;</td>
</tr>
<tr>
<td></td>
<td>Restores ride quality;</td>
</tr>
<tr>
<td></td>
<td>Creates or restores the structural layers of the road</td>
</tr>
<tr>
<td>Disadvantages:</td>
<td>Very expensive compared to other options</td>
</tr>
<tr>
<td></td>
<td>Lengthy operation so very disruptive</td>
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</tbody>
</table>

### Typical Costs:
Reconstruction costs start at about £40 on a relatively quiet road (although such treatments are very rare). Costs go up to £100 per m² or more on A roads and can go much higher on very busy A roads since these require a deeper construction. This includes the cost of rebuilding the road and putting a new surface back on top.

Because of the substantial costs involved we do not usually reconstruct a whole road; it is more normal to reconstruct limited areas that have failed as part of resurfacing the rest of the road.

### Where would we use this?
Reconstruction is a very expensive treatment but, fortunately, most roads will not need full reconstruction in a normal life cycle – resurfacing and surface treatment is usually enough. There are a few exceptions to this rule:
- Roads with too little structure to resurface – we tend to use retread (see recycling)
- Road with underlying ground problems – these problems are usually localised and we can use limited reconstruction along with general resurfacing
- Roads that carry very high levels of heavy traffic – this tends to be limited to former trunk roads such as the A414, A41 and A10. the sheer weight of traffic causes structural damage and means that deep structural works including general reconstruction are sometimes needed on these roads.

### The Process
The process varies considerably depending on the structure of the road and the nature of the problems but reconstruction usually involves removing the old road and replacing or repairing the structural foundation layers. This typically means removing the surface layers as if resurfacing the road and then digging out the layers below using excavators. These layers can then be replaced with new ones and new surface layers laid on top.
Before:
Subsidence on the A10 at Turnford: investigation into major undulations in the road showed that the foundations had failed – in places the concrete foundations could be crumbled by hand – full reconstruction was required.

After:
(Middle Right) The finished job – a major artery restored to full function.

During:
(Bottom Left): The old road is removed; the machine in the foreground is a ‘planer’ stripping off the old road surface.

(Bottom Right): New foundations are installed – the first layers are in place and have been rolled to compact them. The cone is sitting on the original road surface so this picture shows just how thick the structure of a main A road needs to be to take heavy traffic.
3. Drainage

Why is drainage important?

Good drainage is important for a number or reasons; a road or pavement is no use if people can’t use it because it is under water and, even more, we don’t want water flowing into someone’s home and causing damage.

Water can cause damage to roads too though. The ‘carriageways’ section discussed the effect water can have on road surfaces and water getting into the lower layers of the road can damage those too, potentially causing expensive structural problems.

Having said that, it is unrealistic to believe that we can ensure that there’s never a puddle sitting on road anywhere in the county – particularly with shifting climate patterns making more intense rainfall a more frequent occurrence. Our drainage programmes focus on ensuring what we have is functioning properly and on improving the system where necessary to solve significant problems.

What drains do we maintain?

In urban areas, most roads have kerbs whose job, in part, is to collect rainwater and channel it into the drains. These road drains (or gullies as they are often called) then usually either connect to a water company sewer or, if there is no handy sewer, a ‘soak-away’. A soak-away is a specially constructed pit designed to hold water when it rains and then let it seep into the ground gradually over time.

In rural areas, water from the road is frequently channelled into road side ditches. These ditches are sometimes part of the highway and sometimes owned by the adjacent landowner (usually a farmer).

There are many exceptions to these – some drains flow into local rivers or canals and some go into ‘SUDS’ (Sustainable Drainage Systems). SUDS are a relatively new concept although they employ many old ideas like the use of ditches. Their main aim is to slow down the rate at which water is discharged in to rivers and drainage systems to help prevent flash floods.

Recent changes in the law mean that Hertfordshire gains additional responsibilities for leading on managing drainage and flooding issues, some of which may impact on how we manage our road drains in the future.

Routine maintenance

Much of the drainage maintenance that Hertfordshire Highways does is ‘routine’ – normal cyclical maintenance and cleaning that we need to do to keep our drains functioning.
The gullies are cleaned on a regular basis with vulnerable gullies – those that fill with silt and detritus quickest or pose a greater risk of flooding – cleaned on a more frequent basis.

We also carry out cleaning of other drainage assets like some road side ditches and soak-aways where necessary.

Drainage pipes do not normally need cleaning since the flow of water down them is enough that they self-clean unless something obstructs the pipe.

**Repairs and Improvements**

Unlike a road surface (which we know will need treatment or replacement from time to time) our drains and pipes don’t generally wear out. That’s not to say that we don’t need to repair, replace or improve parts of the drainage system from time to time, but it’s usually because something has broken or something in the environment has changed. Because of this our drainage programmes are designed to respond to problems that arise, rather than trying to pre-empt them.

**Prioritisation**

We often carry out minor drainage repairs as part of the Cat 2 programmes. This can include unblocking pipes or repairing small damaged sections. Tree roots and excavations by utility companies can both cause these kinds of problems to our drains. If the problem is more extensive or it is not simply a case of repairing the existing system, then it is flagged up for consideration through the IWP drainage programme.

We prioritise these drainage problems by considering factors like how busy the effected road and footway are, whether there are know accidents, claims or property flooding, how often the problem occurs and how much it might cost to fix (so that quick wins aren’t overlooked).

These problems are then investigated and, if appropriate, a scheme is developed to solve or reduce the problem.

- **Major Repairs**

These are larger schemes to repair or replace existing drainage assets. This could be a complete length of pipe or replacing a soak away that can no longer be cleaned effectively.

- **Improvements**

Sometimes a drainage problem will develop even though the existing system is working properly. Adding more houses or hardened areas to an estate will increase the amount of water flowing to the drains quickly and this can overload the system,
especially during periods of intense rain – lots of water arriving quickly will cause more problems than the same amount spread over a longer period.

To address problems like this, it is sometimes necessary to add to the existing drainage systems to help them to cope with more extreme periods of rain.

To avoid overloading the system and simply moving the problem, we sometimes now install what are known as SUDS or Sustainable Drainage Systems. These can include elements of storage, so that water is held somewhere and discharged more slowly, or areas that allow it to soak naturally away into the ground rather than adding it to the sewer system.

These types of features can be difficult to install in the existing urban environment as they often need large areas of land but they can be an effective alternative to normal piped systems.

**Drainage Costs**

Because of the wide range of drainage problems and the equal range of available solutions, it is very hard to give typical costs for a drainage job.

It is usually possible to install a new road gully and connect it up for around £2,000, depending on the location and circumstances, but there is no guarantee this will solve the problem. In many cases the drain itself is blocked or under capacity and adding another gully will make no difference to the problem.

If you would like more information on drainage costs and solutions, we would be happy to discuss it further, but we can't give a menu of prices in the way that we can for some other works.
**SUDS in Action:**
In response to long-standing drainage problems at Burns Road in Royston where all the water from surrounding roads is concentrated at a low point, causing problems.

In the event of flooding the water will follow a predetermined route to attenuation (holding) ponds and soakaways to avoid flooding properties and limit the impact to other road users. We also opted to use a cellular drainage system (being installed right) to provide extra underground storage capacity in this densely populated area where open space for other options was limited.

**Drainage Problems (below):**
Drainage problems come in many forms and can be unpredictable and hard to trace – a problem that appears once may not appear the next time it rains – some only occur under a particular set of circumstances.
4. Footways (or Pavements)

Footways, footpaths and pavements – what’s in a name?

There are some technical and legal differences between these different terms but, in general terms, a footway is next to a road (even if there’s a verge between the two) and a footpath is a right of way – often out in the countryside – that is not next to a road. In technical parlance, the term ‘pavement’ means any area with a bound surface – including things like roads, car parks and airport runways!

For simplicity, we’ve stuck to the term ‘footway’ in this guide, since that’s mostly what we’re discussing, but the same principles and considerations apply to similar assets like cycle tracks and other paved areas not normally intended to carry motor vehicles.

Why do footways need maintenance?

There are a number of reasons why footways need maintenance or repair over the course of their lives. Some are similar to those factors effecting roads, others are specific to footways.

Age and Weather

About 80% of our footway surfaces are made of asphalt and these are susceptible to the same kinds of weather and age damage as asphalt roads (refer to the roads section for more details on this).

As with roads, the surface of an asphalt footway can be sealed and protected relatively cheaply to extend its life.

The rest of the footway network is surfaced with a range of different materials including paving slabs of various sizes and different styles of block paving. These can be grouped under the general term of ‘modular paving’ because the surface is assembled from pre-formed ‘modules’. These modules could be slabs or blocks and might be made of concrete or (less often) natural stone. There are a few other materials as well – for instance there are a few footways made of in-situ concrete – but the vast majority of the footway network has either an asphalt surface or a modular surface.

Modular paving does not usually deteriorate due to age or weather, most of the need to maintain or repair these surfaces is driven by wear and tear, damage and other factors.
Wear and Tear, Damage and Other Factors

Normal pedestrian traffic does not cause structural damage to footways. Unfortunately there are a number of other factors that damage them and mean that maintenance or repairs are needed from time to time.

- **Vehicle Damage**

Vehicles – especially heavy vehicles – mounting or parking on the footway is one of the main causes of damage to footways and this damage can happen very rapidly and create hazards to pedestrians.

Modular paving is particularly vulnerable to vehicle damage, especially the traditional large slabs. A delivery lorry or van pulling up on a footway to unload or cutting a tight corner and running across the footway can easily crack or break slabs and even lighter vehicles parking on the footway can cause damage.

Asphalt surfaces, being slightly flexible, are much more resistant to vehicle damage although they can still be subject to damage in some circumstances.

Repairing this type of damage can be costly, especially in vulnerable locations where the damage can be repeated regularly and measures such as bollards or fencing may be needed to protect the footway and reduce repeated repairs (although these measures can have their own drawbacks).

- **Tree Roots**

Street trees are a valuable part of the street scene but their roots can cause significant damage footways by pushing upwards as they grow.

As a general rule, the roots of a tree spread as far underground as the branches do in the air, so the root structure of even a small tree is usually quite extensive. Some roots reach downwards but others radiate out from the tree close to the surface, searching for water and nutrients. As these roots grow, they can push up the surface of the footway causing localised bumps which can, eventually, pose a significant trip hazard if not dealt with.

In asphalt footways, the slight elasticity in the asphalt means that these bumps usually start off as a gradual rise in the surface and, when the problem becomes more pronounced, the surface can be patched or re-laid to flow over the root in a gentle curve; the surface is not totally flat but it does not pose a trip hazard.

With modular paving, there is no ‘give’ in the surface so the root pushing upwards will create a sharp trip where the edge of a block or slab is pushed up. There is little that can be done to restore the surface without removing the tree so, if the trees are to be retained, it is often necessary to put an asphalt patch around the tree to form the footway, even where the rest of the footway surface is modular.
Slabs or Asphalt?

Because of the issues we’ve already mentioned, modular surfaces can be very durable where there are no adverse factors to damage them. However, where those factors do occur, they are likely to happen again and again, often at very frequent intervals. Whether it is tree roots or vehicle damage or some other cause, if a modular footway has been damaged once, that damage will probably occur again meaning we will need to keep spending money repairing or replacing modular paving at that particular location.

While asphalt footways are not immune to damage, their inherent flexibility makes them much more resistant to it and, with asphalt, we have a wider range of options open to us to repair or maintain them.

For this reason, as a matter of policy, Hertfordshire replaces modular footways in need of significant repair or replacement with asphalt footways in almost all cases. This helps to save money on future repairs and also helps the footway to remain safe and trip-free for longer. There are some specific exceptions to this rule – mostly around enhanced town centres or conservation areas – but this is the general approach we take. It’s worth noting that we do not replace modular footways if they are in generally good condition, we only replace them when they are damaged or worn out and need repair or replacement anyway.

The Solutions

Having looked at why maintenance is necessary, the next section looks at the different maintenance solutions available to us and which of those solutions are suitable for which circumstances.

Footway Treatments

Footway maintenance treatments can be grouped in to three broad categories.

- Surface Treatments
- Resurfacing
- Recycling/Reconstruction

Each has a different range of benefits and costs and some are only appropriate under certain circumstances.

Surface Treatments

Surface treatments include slurry seals and micro asphalts. Both involve laying a thin layer over the top of the existing footway to seal the surface and extend its life. They will also rectify surface defects like cracks and potholes, either as part of the treatment process or through pre-patching works done to the more significant defects in advance of the surface treatment. Micro asphalt is a thicker two-coat process and can regulate out some dips in the footway.
**Resurfacing**

Resurfacing involves removing the existing footway surface, whether it is asphalt or modular, and replacing it with a new surface. On an asphalt footway, resurfacing usually involves replacing all the asphalt – usually 75mm to 100mm thick. In modular footways, it involves removing the modular paving and either relaying it and replacing broken units (if it is being retained) or replacing it with a suitable thickness of asphalt. Lifting and relaying modular paving is very labour-intensive and so it is as expensive as the other resurfacing options even where most of the paving can be reused.

Resurfacing restores the footway surface to a new condition, removing surface problems and most unevenness.

**Rebuilding**

Rebuilding works like recycling or reconstruction involve digging down to repair or replace the foundation layers of the footway and then putting a new surface back on top. Limited areas of reconstruction are sometimes used to solve localised problems as part of a resurfacing scheme.

**Which Treatment to Choose?**

For asphalt footways that are reasonably even but deteriorating due to age, the surface can usually be restored and sealed with a surface treatment. In places where there is more significant damage, resurfacing or reconstruction may be needed.

Modular footways are not suitable for surface treatment, so our only options are to replace the surface or reconstruct. The choice between the two options will usually be down to the causes of the damage and how sound the foundations of the footway are.
**Footway Micro Asphalt**

<table>
<thead>
<tr>
<th><strong>Type:</strong></th>
<th>Surface Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Also known as:</strong></td>
<td>Micro surfacing, ‘Micro’, Slurry seal (similar – see below)</td>
</tr>
<tr>
<td><strong>Variants include:</strong></td>
<td>Slurry Seal (a thinner version of micro asphalt)</td>
</tr>
<tr>
<td><strong>Advantages:</strong></td>
<td>Low cost; Seals and waterproofs the surface and extends footway life; Quick to apply meaning less disruption; Low carbon footprint; Removes minor dips and fills potholes</td>
</tr>
<tr>
<td><strong>Disadvantages:</strong></td>
<td>Does not remove major unevenness; Loose stones will remain on the surface for some weeks after laying making it look ‘tatty’, initial public reaction can therefore be poor.</td>
</tr>
</tbody>
</table>

**Typical Costs:**
Micro asphalt costs between £15 per m² and about £25 per m² depending on how much preparation work is needed and how busy the footway and adjacent road are. Busy roads are more expensive because we are more likely to have to work off-peak to reduce disruption which increases the cost of the works. These costs include normal levels of patching to repair significant defects before the footway is surfaced but would increase further if the footway was in poor condition. *Typically this might mean:*
- Quiet urban road 200m long (both sides) would cost around £ 11,000
- Busier road 500 long (both sides) would cost approximately £45,000

**The Process**

**Before:** Any major defects are repaired ahead of time. Minor defects like cracks and surface potholes can usually be filled by the treatment without additional work.

**On the day:** The footway is swept or sometimes jet washed to clean it and remove debris and then the micro asphalt is laid over the existing surface. It is usually laid in two coats; the first helps to fill defects and regulate out dips in the surface, the second provides the new surface. Alternatively a slurry seal can be used; this is a single coat and so is consequently cheaper but it is typically less durable and does not regulate out dips.

The micro asphalt itself is laid as an emulsion – a mix of bitumen binder and stones of various sizes suspended in water. The emulsion is laid cold, not hot like conventional asphalt, reducing the energy used in production (and consequently the carbon footprint).

The emulsion stays liquid for between 20 minutes and an hour before it ‘breaks’ (or goes off) at which point the surface can be opened to pedestrians.

In some cases inspection covers in the footway will need to be adjusted to suit the new level but in many cases the surface can be laid level with the cover.

**Aftercare:** There will be loose stones on the surface for several weeks as stones naturally loosen from the surface of the new material. This is normal, although it can look a bit unsightly. Once the surface has bedded in the new micro asphalt surface will look like any other footway. Indeed, many of our footways have had this treatment over the years and the public will usually see no difference once the treatment is complete.
Before (right):
A micro site before application (right): the footway has been cleaned but the micro asphalt will fill and seal the cracks and cover the joints left by the utility trench.

During and After (below):
The micro asphalt material is hand laid - the process looks rather messy but the end results are good. The material looks brown when still liquid (bottom left) but turns black when set and rapidly fades to a normal dark grey over time (below right).
Footway Resurfacing and Reconstruction

<table>
<thead>
<tr>
<th>Type:</th>
<th>Resurfacing/Reconstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Also known as:</td>
<td>Surfacing, recon, retread, recycling (depending on process)</td>
</tr>
</tbody>
</table>
| Variants include: | Retread (in situ recycling)  
Different approaches for modular or asphalt footways |
| Advantages: | Replaces the surface;  
Extends footway life;  
Make the surface even  
Will deal with deeper problems if reconstruction is chosen |
| Disadvantages: | Can be expensive, especially if several layers need replacing  
Relatively slow process since much of the work is done by hand, a typical scheme will last for around a month |

**Typical Costs:**

Resurfacing costs from £20 per m² and reconstruction costs about £42 per m² depending on how much deep work is required. The cost will also depend on how busy the footway and adjacent road are. Busy roads are more expensive because we are more likely to have to work off-peak to reduce disruption which increases the cost of the works.

*Typically this might mean:*

- Resurfacing on a quiet urban road 200m long (both sides) would cost around £15,000
- Reconstruction on a busier road 500 long (both sides) would cost approximately £75,000

**The Process**

**Differences:** The difference between resurfacing and reconstruction is mostly around how deep the works go. Resurfacing is limited to the top layers – the asphalt or slabs themselves whereas reconstruction also deals with the foundations underneath.

**The Works:** The footway surface is removed either by hand or using small machinery like a mini-digger. If the footway is to be reconstructed then the foundation layers are also removed in the same way although the foundations of a footway are shallower than those of a road – perhaps 150mm thick. Asphalt footways can also be recycled in situ in a process similar to carriageway retread.

Once the foundations have been repaired or replaced if necessary, the new surface is laid. If it is a modular surface, a layer of sand is laid first and the blocks or slabs are laid on top of this and bedded down. If it is an asphalt surface, the new surface is laid in two layers and rolled while hot to give a neat, even finish.

In some cases inspection covers in the footway will need to be adjusted to suit the new level, especially if the profile of the footway has been changed to remove dips or bumps, but in many cases the surface can be laid level with the cover.

**Aftercare:** Usually no particular aftercare is needed following footway resurfacing or reconstruction, normally the finished surface is ready for use straight away.
Before (right):
The majority of the sites we resurface each year are slab footways in a poor condition. In this example an asphalt verge had been laid previously to protect the most vulnerable part of the footway but the slabs in the main footway have still been damaged by tree roots and vehicles as the close-up shows.
5. Structures (Bridges etc)

Bridges – A Vital Asset

Bridges form key links for the road network and are often the point where the road network interacts with other networks like railways and canals. Bridges have a wide variety of structural forms from large multi-span viaducts carrying major roads to small pedestrian footbridges. Bridges are often landmark structures and can create focal points for local communities. Bridges can also provide a window to our historic past. Some bridges in Hertfordshire are more than 200 years old.

In total, there are approximately 2,500 bridges and highways structures in Hertfordshire, of which approximately 1,700 are owned and maintained by Hertfordshire County Council. The following table breaks down the stock by Borough. As well as bridges, the highways structures stock includes things like culverts, retaining walls and subways.

Bridge Inspections

Each structure owned and maintained by HCC is inspected every two years. The inspection data is recorded in the bridge database, from where it is interrogated to determine future maintenance needs. The inspection data is also collated to produce a ‘bridge condition indicator score (BCI)’ The current BCI for the County’s bridge stock is 84 out of 100 where a high score is a good score.

Bridges have many forms of construction for example arches, subways or large viaducts. Each form of construction can be further broken down into bridge elements for example deck beams, abutment walls and foundations. Some elements have a potentially infinite life for example foundations. Whereas some elements wear out and have finite lives (shorter than the expected life of the bridge) for example concrete waterproofing systems.

Identified maintenance is then programmed in the bridges forward work programme.

Bridges – Forward Work Programming

In addition to maintenance identified by the inspection process the FWP also includes upgrade and strengthening works. Many of Hertfordshire’s bridges are old, and were built before modern design codes and modern traffic levels were created. Increased traffic, over time, can accelerate the deterioration of a structure, for example lorry vibrations over brick arches. Strengthening and upgrading can greatly increase the lifespan of a bridge. Hertfordshire Highways also carries out upgrades for safety purposes where historic structures are not compliant with modern safety standards. For example parapet upgrading to prevent cars driving from roads onto railways.
Typically the bridge programme delivers between 5 and 10 capital schemes each year with an allocated annual budget of approximately £2m.

**Bridges – Other Activities**

In additional to structural maintenance Hertfordshire Highways manages graffiti removal from subways and structures, either directly or in partnership with the district or borough council, and we are working with the districts and boroughs where possible to further improve anti-graffiti works.

There are a number of options for cosmetic enhancements to bridges and structures although our programmes naturally focus on critical maintenance and safety related works.

Steel bridges usually need painting periodically to protect and maintain them although local communities sometimes want them painted sooner in order to enhance them.

Similarly pedestrian subways can often be quite unwelcoming places and may dissuade pedestrians from using them, especially after dark. Subways are most often found in, around and on routes to town centre areas and so the look and feel of them can influence the impression the town creates on a visitor.

Enhancements to such structures can be hard to deliver within maintenance budgets that already cover so much critical work. However, there are quite often relatively low-cost, high-impact solutions that could be enhance the appearance of a local bridge or subway and could potentially be funded within a Locality Budget if desired. Since all structures are different, it is easiest to consider these issues on a case-by-case basis but the Structures team would be happy to assist with options and estimates as required.
<table>
<thead>
<tr>
<th>Bridges Gallery</th>
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<tbody>
<tr>
<td><strong>Major Structures:</strong></td>
</tr>
<tr>
<td>Hertfordshire’s network includes some major structures like the Baldock tunnel (right) and the A10 Kingsmead viaduct (below right).</td>
</tr>
<tr>
<td><strong>Bottom:</strong></td>
</tr>
<tr>
<td>Besides bridges, the structures inventory also includes things like overhead gantries (bottom left) and retaining walls (bottom right).</td>
</tr>
</tbody>
</table>
### Smaller Structures:
The structures portfolio also includes many smaller structures like this subway giving farm access under a main road (right) and the culvert (below right) carrying surface water under the road.

### Old and New:
Some of our bridges are unusual or historic, like the bridge over the canal at Hunton Bridge (below left) others are very modern like this foot bridge over the Baldock bypass.