HS2 Route and Service Plans

The Purpose, Background and Method

This article refers to and should be read in conjunction with my article 'Towards a High Speed Network'. That article sought to make the case for developing a network plan for all the HS routes which will eventually be needed, and, as a contribution to getting the discussion started, gave my own thoughts of what such a network could look like. Naturally, this involved describing a number of routes, in varying but superficial detail. This lays me open to the charge, something on the lines of 'That's all very easy to say, but how would you actually go about doing it?' Accordingly, a decent respect to the opinions of the interested public requires that I should go into more detail on the individual routes. The present article deals with HS2, the route from London to the West Midlands and the North West.

Unlike the other articles in this series, the route here is that planned by HS2 Ltd. (except for Euston Cross!) I have reproduced the maps, to the usual standards, but not changed them in any way. What I have changed are the service plans, and also the whole purpose and timing of phase 2 of the project.

As a piece of extreme futurology, (and for fun,) I have also considered possible additions to HS2, specifically the Coventry Variant (HS2-CV), which is an extra section of route serving Rugby and Coventry, which HS2 in its original form (HS2-orig) completely ignores and bypasses, and an extension along the west coast to Scotland. It is considered highly unlikely that Scottish traffic will ever justify a completely separate second HS route to England; HS2 will therefore join HS3 at Riccarton North Junction, and share the route to Edinburgh (and the apotheosis of the Waverley route will thus be complete).

The Maps

Naturally, the chosen route must be illustrated with maps. I briefly describe the route, giving the map reference of all significant points (invariably of tunnel end points and significant river bridges), but the accompanying maps are the real definition. Mapping software can be very expensive, but fortunately the Ordnance Survey makes available, free of charge, the OS OpenData product suite, of which I use two components, the 1:250000 Scale Colour Raster data set and the Strategi Dataset. The former comes as a set of TIFF files, each containing one of the standard National Grid 100km Reference squares. These are easily converted into Microsoft Paint files and edited. These are, in other words, pure graphics, and are the basis of the detailed maps in the 'Route' section. The maps reproduced in the text all represent an area 20km in width (unless noted otherwise) and 10 km high (if the detail I wish to show will fit within that, but otherwise as high as necessary). They do actually contain contours, but not many; the scale is too small for contours to be really informative. For the present purposes, this scale is adequate; if you need more detail, use them as an index to the corresponding 1:50000 Landranger or 1:25000 Explorer maps.

The Strategi Dataset contains GIS (Geographical Information Systems) data, which has to be processed by special software; I have used the Open Source QGIS product. This has been used to produce an overall map of HS2, including sections of other routes over which HS2's services run. These overall maps come at the end of the 'Route' description, and also show HS2's classic compatible services on classic lines (these are shown as dotted lines). Also included there are maps of the overall HS Network.

In all the maps I use the following colour scheme for the various routes:

As the various route plans have been developed, the maps have been updated, so now they show all routes, as relevant. The maps in the present article are thus not limited to HS2.

The Service Plans

The Route section of this document describes the complete lines in their final, full configuration (as far ahead as the plans consider). The service plans explain how that final state is reached: the order in which sections are opened, and the services which run on these partial configurations. The aim is always to get useful services running as soon as possible, to maximise return on the investment.

The service plans deliberately envisage maximum frequencies, to give an impression of just how much the system **could** accommodate. Initial services would certainly not be so intensive, probably no more than half of the frequencies quoted.

A standard HS station has two island platforms, thus two platformed tracks in each direction. If some of the services passing through the station are non-stop, then the main line must pass through the layout without adjacent platforms, either through the centre of the alignment, in tunnel below or on viaduct above, or the station must be on a branch loop off the main line, which thus bypasses it completely. The only relevant stations in phase 1 of HS2 are Birmingham Interchange and Calvert, and these have avoiding lines through the centre. In phase 2B, Crewe is on a loop. Everywhere else (Preston, Carlisle) has all services stopping.

Several service plans are developed, reflecting the piecemeal development of the network. As new sections open, further services come into operation. In all cases, consideration is given to maximum loadings – which section(s) are fully loaded and thus determine the maximum service frequencies. In general I take 16tph as the maximum throughput; if this is ever exceeded, the fact will be highlighted.

Two types of services are contained in the plans, those featuring High Speed trains (GC gauge and classic compatible) which travel on HS2 for at least part of their journey, and those featuring Regional Metro `(semi-fast) services on the corresponding classic route(s). Connections between the services (both HS and RM) are shown for the relevant interchange stations (the connections are usually cross-platform), together with the clock-face hourly departure plan. (Note that these plans are **representative**; the **actual** times are determined by the coordination of interchanges at multiple locations).

In the service plans I distinguish some of the GC gauge services as double deck. Originally this linked the Brighton services of HS5 with the HS Metro services of HS3, to York and Preston. It's all rather arbitrary, at present. Provided that there are no difficult technical issues in running double deck trains at 360kph, and that public reaction to them is favourable, I would like to see all GC gauge services run with double deck trains. (The Swiss like them.)

It is important always to bear in mind that the HS network is **not** a separate, stand-alone system, but an integral part of the complete railway network, hence the importance I attach to showing precisely how HS services interact with classic (RM) ones. (In this context it is worth pointing out that if, when HS lines come into service, the current ridiculous and illogical franchising system is still in operation, it will be necessary to include the corresponding classic route(s) in the same franchise as a HS route, with a strict contractual obligation on the franchisee to ensure close integration of HS and classic services. It certainly won't happen otherwise.)

Estimated Journey Times

Following the service plans, estimated journey times are produced for all GC-gauge services, and for several CC services also. The assumptions and approximations made are explained.

HS2 Route – Introduction and Assumptions

HS2's long-term classic-compatible services begin at Euston, and the GC-gauge services are all cross-London inter-regional, via Euston Cross. This is an underground station with 6 platforms, (passive provision for 8,) located on a west-east axis between Euston and St. Pancras / King's Cross stations, the precise location, horizontal position and depth, to be determined by the configuration of all the other tunnels in that area. Euston Cross and its approaches are shared by HS2 and HS4, GC-gauge services only (eventually – HS2 opens some time before HS4). It is a through station; nothing starts or terminates there. HS2's services via Euston Cross continue into Kent and East Sussex, on HS1. Appendix A gives full details of Euston Cross and its approaches. Full details of the services on HS1 are contained in the article 'HS1 Route and Service Plans'. Summary details of the inter-regional services are in the service plans of the present article.

Phase 1 of HS2 begins at Euston and extends to Birmingham and Handsacre Junction on the WCML.

Phase 2A of HS2 begins at Streethay Junction and extends to Crewe HS South Junction (as recommended in the HS2 Plus report).

Phase 2B of HS2 begins at Crewe HS South Junction and extends to Manchester and Wigan (including the first instalment of HS8, from Kenyon Junctions to Liverpool), together with, finally, the GC-gauge

section from Old Oak Common North Junction to Euston Cross and on to join HS1 (for details of which see Appendix A).

As noted above, Euston accommodates the long-term classic-compatible services of HS2, and the GC-gauge services use Euston Cross. There is a connection between classic and HS lines, diverging from the WCML at Queens Park Junction and joining HS2 at Old Oak Common North Junction (full details in Appendix A). Although HS2 is built GC-gauge from Old Oak Common North Junction, at phase 1 and phase 2A, only classic-compatible trains will be used, to give extra time for the building of Euston Cross.

HS2 Route – Junctions:

There are various junctions on the route of HS2, enabling connections with other HS and classic routes. It is convenient to list them here, together with map references and identifying remarks, since when discussing the capacity/loading of the different sections of route, the end points are usually junctions (occasionally stations). The junction names are (mostly) my suggestions. The following list is complete, but several of the junctions are relevant only to the two extra-highly-speculative extensions of HS2; those marked (*) in the list apply to the Coventry Variant, and those marked (#) to the Scottish extension. In addition, the section between Birmingham Interchange and Streethay Junction is recommended to be at least 4-track from the outset, and to share the outer tracks with HS7 (south of Marston Junction). Refer to appendix B, which contains several layout diagrams, including this one, for a full elucidation.

One feature of the following list needs clarification: certain of the junctions are given as north / south (could equally well be east / west, but in fact they're all north / south). These are all the junctions of station loops, and are where the services stopping at that station diverge from / rejoin the main line. Their location is precisely defined by the acceleration / deceleration rates of the trains. (They decelerate more rapidly than they accelerate, which is probably just as well.) The junction where a service rejoins the main line, having accelerated up to the turnout limit speed from a stop is thus further from the station than the junction where trains diverge, at the turnout limit speed, and decelerate to standing at the platform. (**Very** roughly the acceleration distance is about 50% greater than the stopping distance.) Note that this **only** applies to station loops; for a genuine route junction, where one route diverges from another, and no station is involved, junctions in both directions can be and usually are at the same location.

- Queens Park TQ229827 Allows classic-compatible services from Euston to join HS2, diverging from the WCML (despite the name) immediately to the west of Kensal Green tunnels
- Old Oak Common East TQ220821 HS4 diverges from HS2, with which it has shared tracks from Euston Cross, immediately east of Old Oak Common (Low Level). (The given location is **approximate** – it's underground!)
- Old Oak Common North TQ219821 Allows classic-compatible services from Euston to join HS2, even-more-immediately east of Old Oak Common (Low Level) station. (The given location is **approximate** –it's underground!)
- Ashendon(*) SP693133 Branch to Grendon Underwood diverges from the Princes Risborough – Banbury route.
- Grendon Underwood SP727200 SP706222 (South) HS2-CV (southbound) joins HS2-orig. (North) HS2-CV (northbound) diverges from HS2-orig.

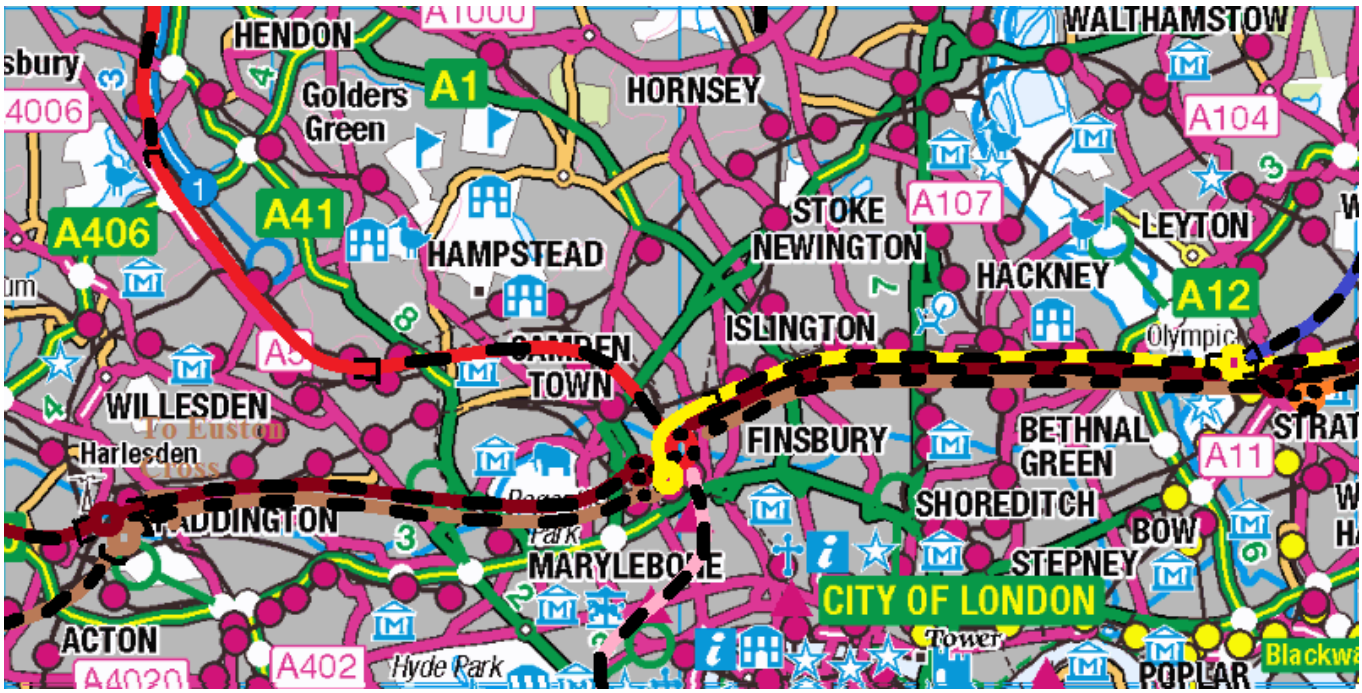
(*)		The line from Ashendon Junction joins the HS2-CV tracks – no connection with HS2-orig.
• Chetwode(*)	SP649280	(South) Southbound services (CC) stopping at Calvert diverge from HS2-orig.
	SP634301	(North) Northbound services (CC) having stopped at Calvert rejoin HS2-orig.
• Brackley(*)	SP595388	HS2-CV diverges from HS2-orig. This is a route, but not a track, junction
• Banbury(*)	SP462423	Branch to Culworth Junction diverges from the Banbury – Leamington route.
• Culworth(*)	SP555500	The line from Banbury joins the main line of HS2-CV,
• Watford Gap(*)	SP589697	The HS3 (south) interconnection diverges from HS3.
• Onley(*)	SP517723	The HS3 (south) interconnection joins the main line of HS2-CV.
• Rugby HS(*)	SP525753	The HS3 (north) interconnection diverges from the main line of HS2-CV.
• Cotesbach(*)	SP546820	The HS3 (north) interconnection joins HS3.
• Warwick Road(*)	SP325782	Westbound connection between HS2-CV and the Coventry – Birmingham classic route, just west of Coventry station.
• Mount Pleasant(*)	SP244777	(South) Southbound services having stopped at Birmingham Interchange (re-)join HS2-orig
	SP221796	(North) Northbound services stopping at Birmingham Interchange diverge from HS2-orig
• Birmingham Interchange	SP203831	HS7 (south) joins HS2-CV just south of Birmingham Interchange, and scissors crossovers are provided at both ends of the island platforms. HS7 trains normally use the outermost tracks at the station. Trains sort themselves by route, normally via the north end crossovers. (There are 6 tracks between here and Water Orton S.
• Water Orton:		
– South	SP192892	Birmingham Curzon Street south branch diverges from HS2-CV main line to Water Orton North Junction. This is a route, but not a track, junction; trains have been sorted by route from B'ham I'chg.
– West	SP172904	HS2 Birmingham Curzon Street routes north and south join.
– North	SP190913	Birmingham Curzon Street north branch joins HS2-CV main line to Streethay Junction.
• Marston	SP190943	HS7 (north) diverges from HS2-CV. This is a route, but not a track, junction.
• Streethay	SK139138	HS2-CV rejoins HS2-orig (route **and** track junction). HS2 Phase 2 route diverges from Phase 1 (which last section is now HS2-CV).
• Handsacre	SK103143	HS2-CV / HS2 Phase 1 route joins WCML
• Crewe HS South	SJ717530	Connection from HS2 to WCML south of Crewe
• Crewe HS North	SJ698586	Connection from WCML to HS2 north of Crewe

- Rostherne:
  - – South SJ718828 Manchester branch diverges from main line to Rostherne North Junction and Wigan
  - – East SJ740847 HS2 Manchester routes join
  - – North SJ721864 Manchester north branch joins main line to Wigan
- Kenyon South SJ639955 Connection to HS8 and Liverpool diverges from HS2 main line
- Kenyon West SJ628961 Connections from HS2 (south and north) join HS8 route to Liverpool
- Kenyon North SJ634968 Connection from HS8 and Liverpool joins HS2 main line to north
- Bamfurlong SD600016 HS2 main line joins WCML south of Wigan. Becomes redundant, and WCML connection removed, when HS8 opens from Bamfurlong to Gibb Farm Junction and Preston.
- Gibb Farm SD627107 Connection from HS2 joins HS8/HS9 route to Preston
- Galgate(#) SD487543 Connection from HS2 to WCML, to allow for classic-compatible services to Lancaster etc.
- Riccarton North(#) NY531988 Joins HS3 route to Edinburgh
- Ravenswood (#) NT575339 HS3/HS2 diverge from the classic Waverley route

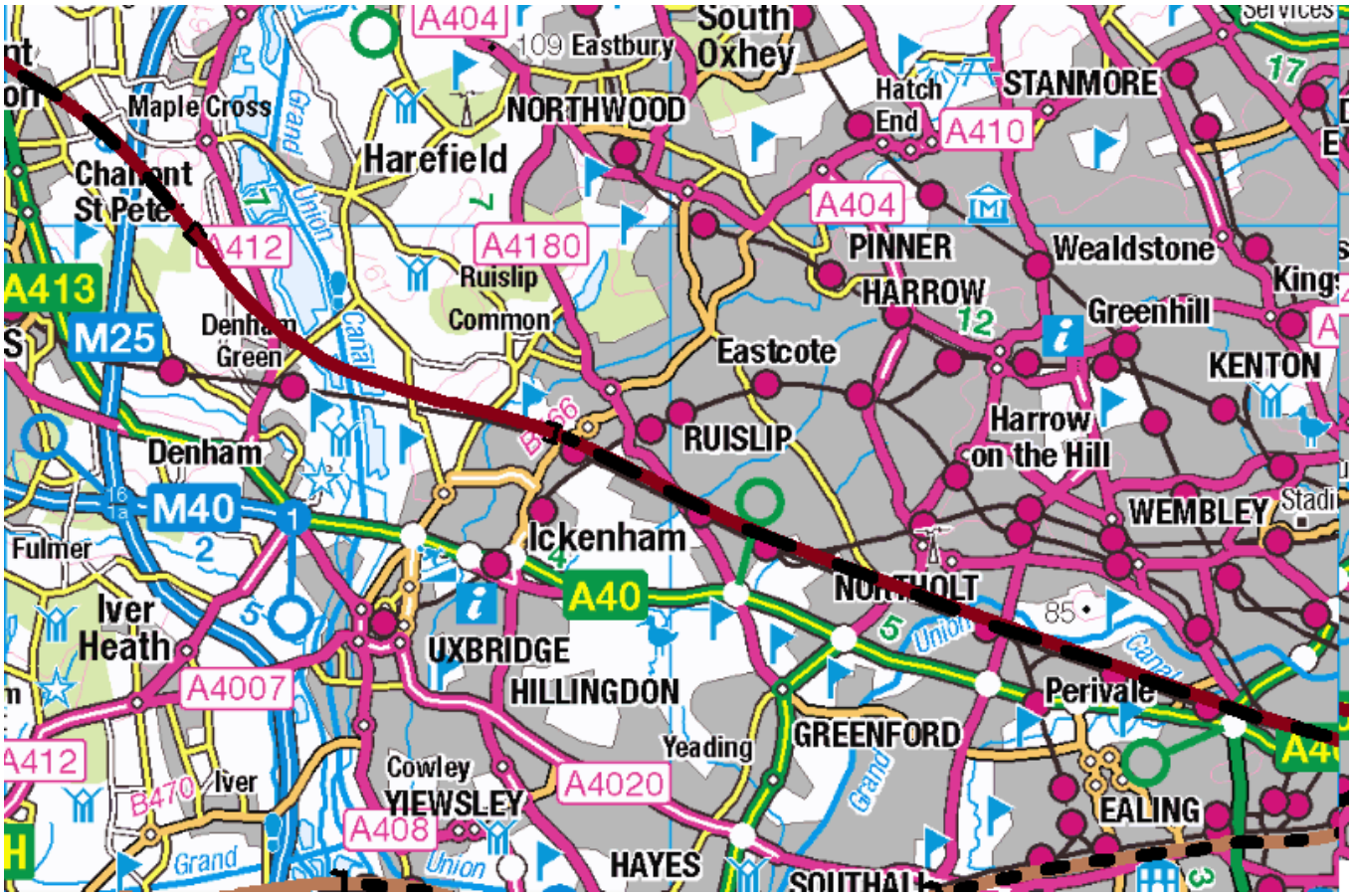
There are various other links between HS2 and classic lines, for operational purposes and not intended for regular services, so not relevant in the present context.

There now follows the definition of the actual route, in several logical sections.

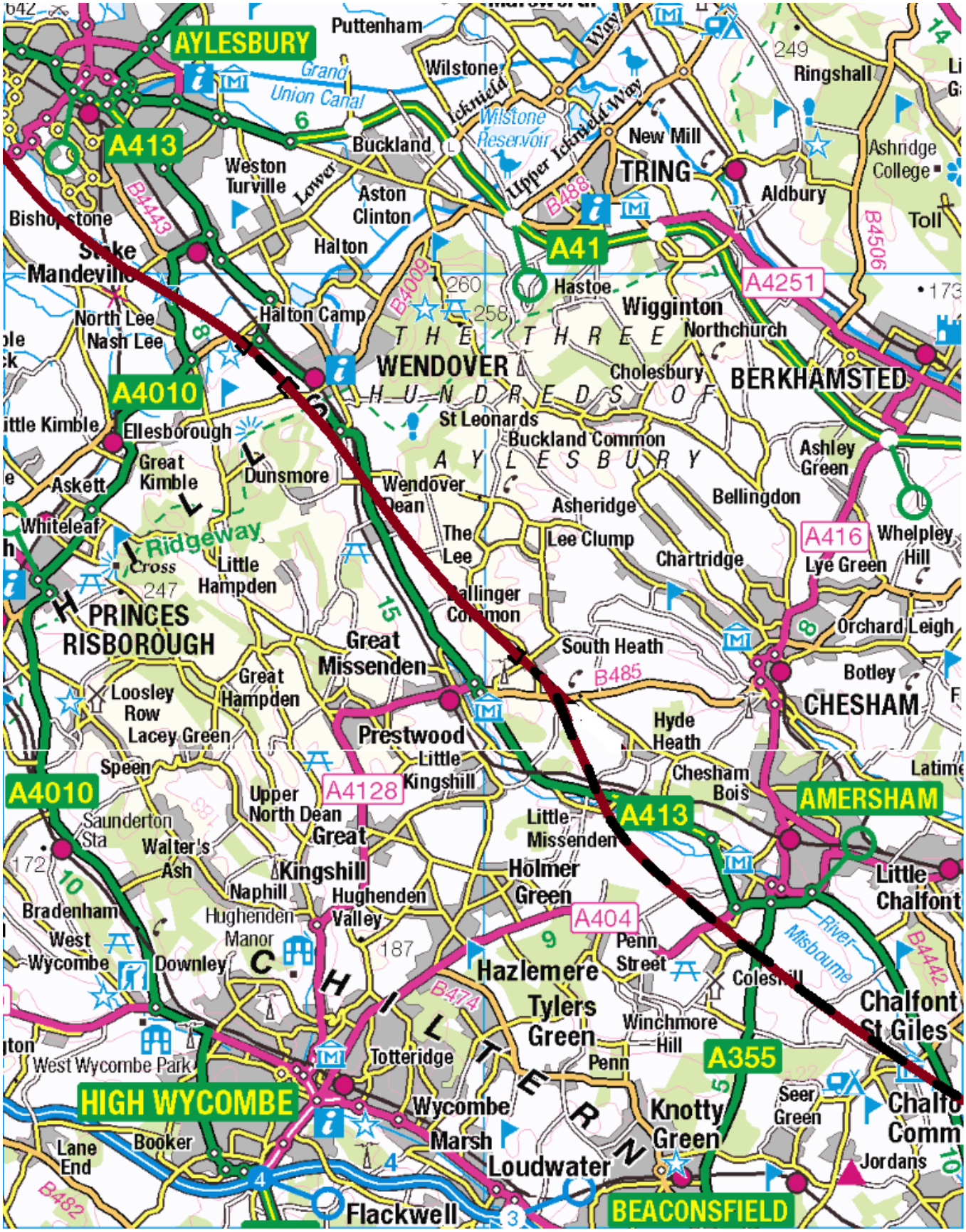
1. *HS2 Route to Manchester and Wigan – Courtesy of HS2 Ltd.:*



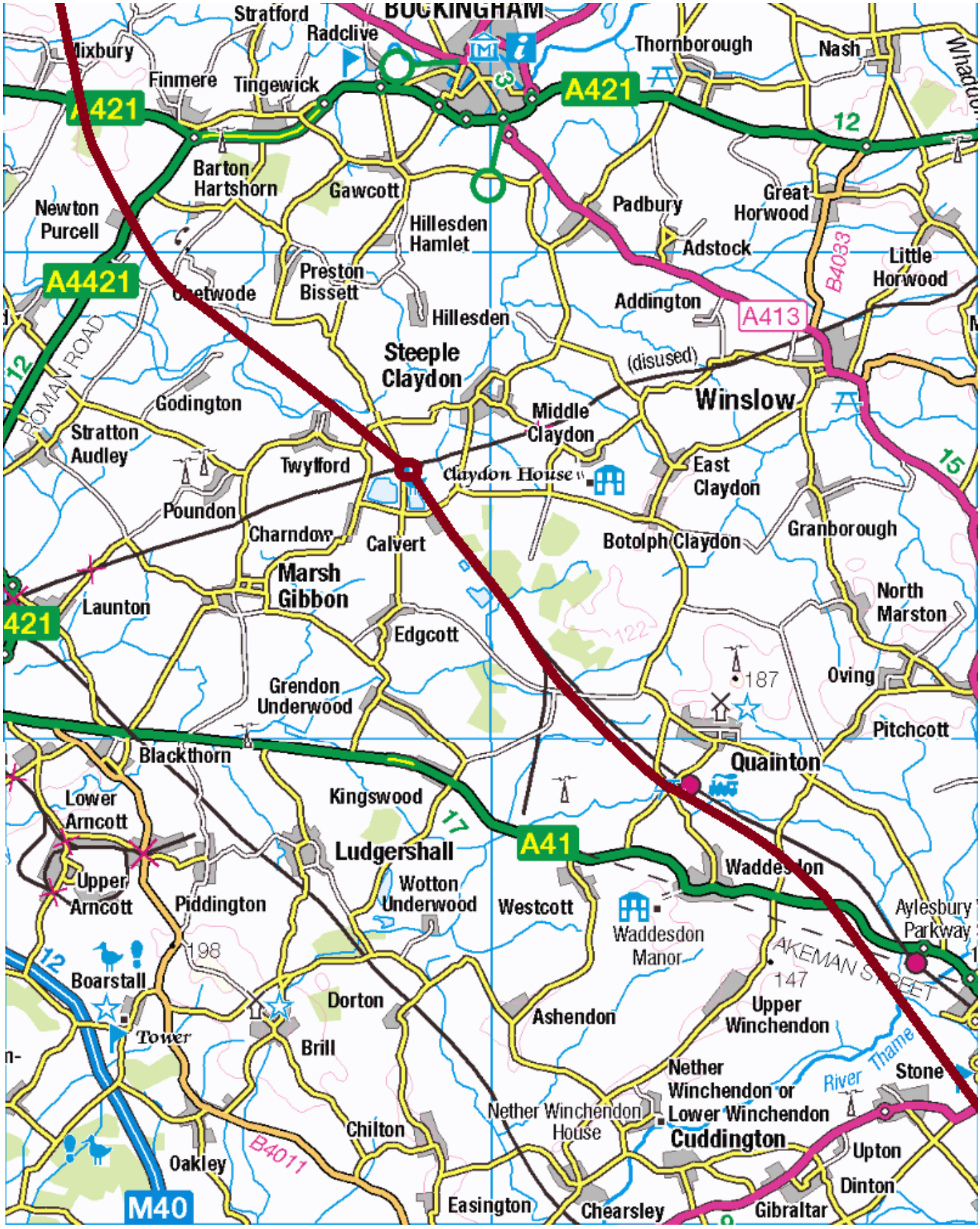
1.1 Euston – Old Oak Common Contains Ordnance Survey data © Crown copyright and database right 2013



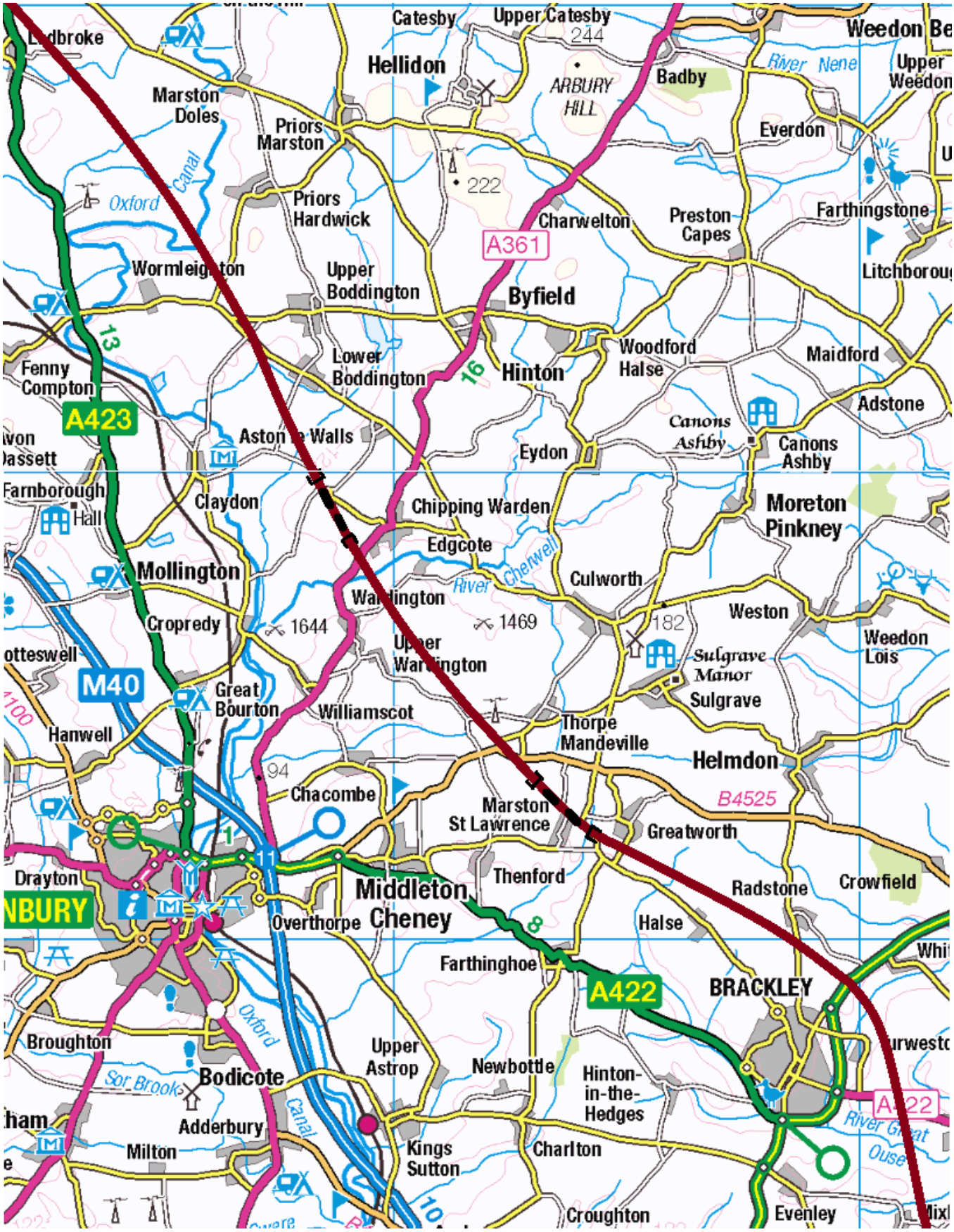
1.2 Perivale – Chalfont St. Peter Contains Ordnance Survey data © Crown copyright and database right 2013



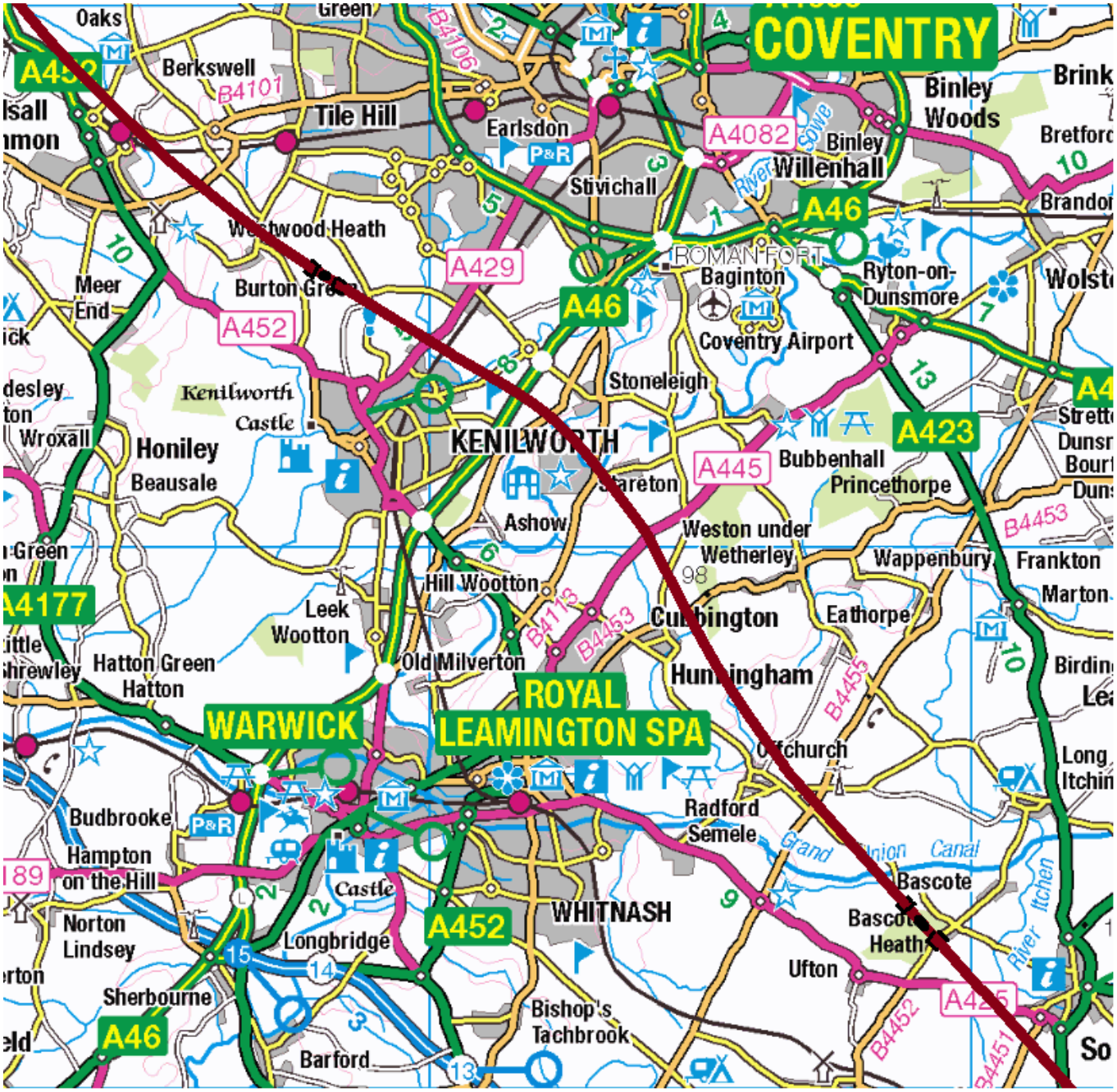
1.3 Chalfont St. Giles – Aylesbury



1.4 Aylesbury – Finmere

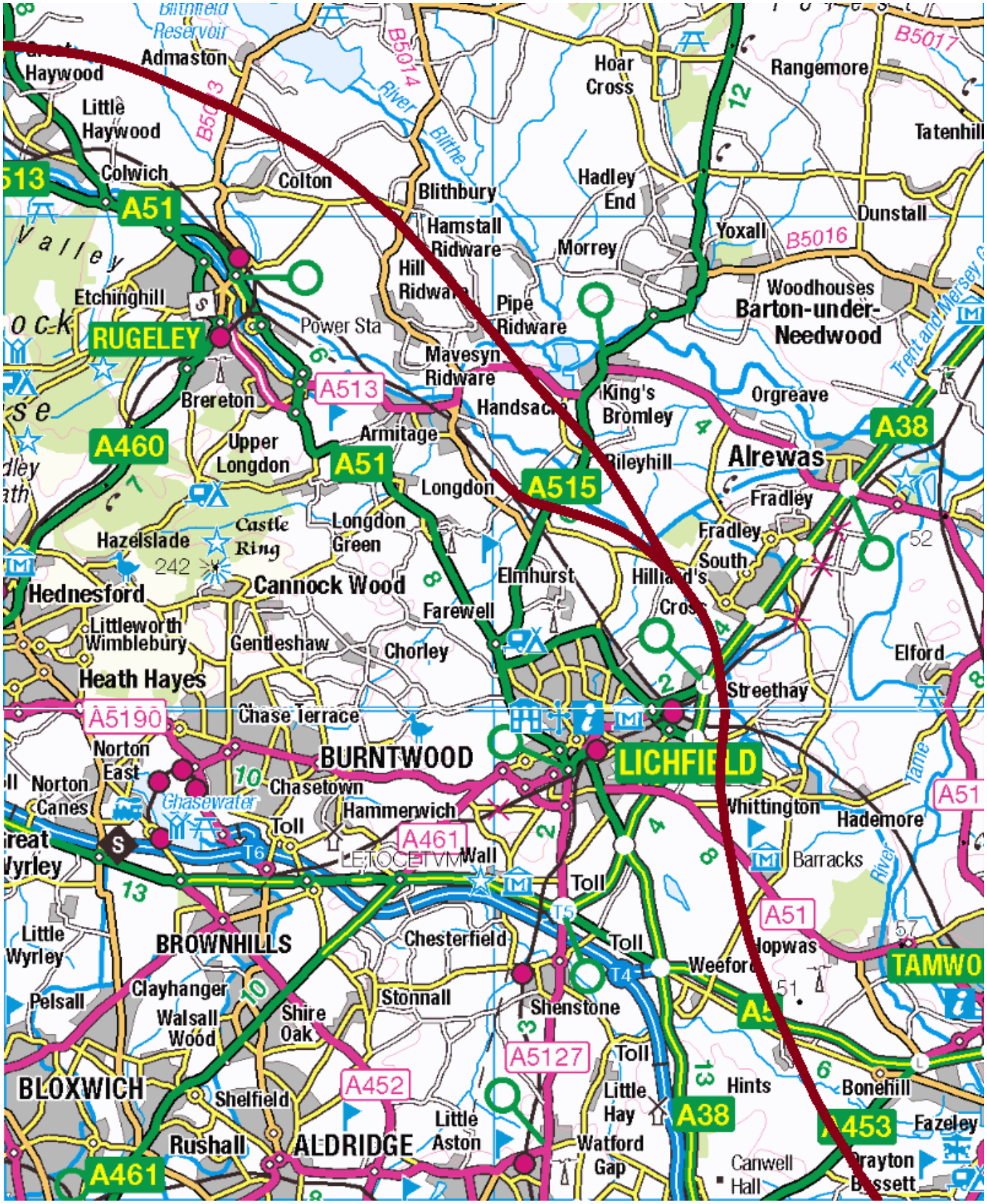


1.5 Brackley – Ladbroke

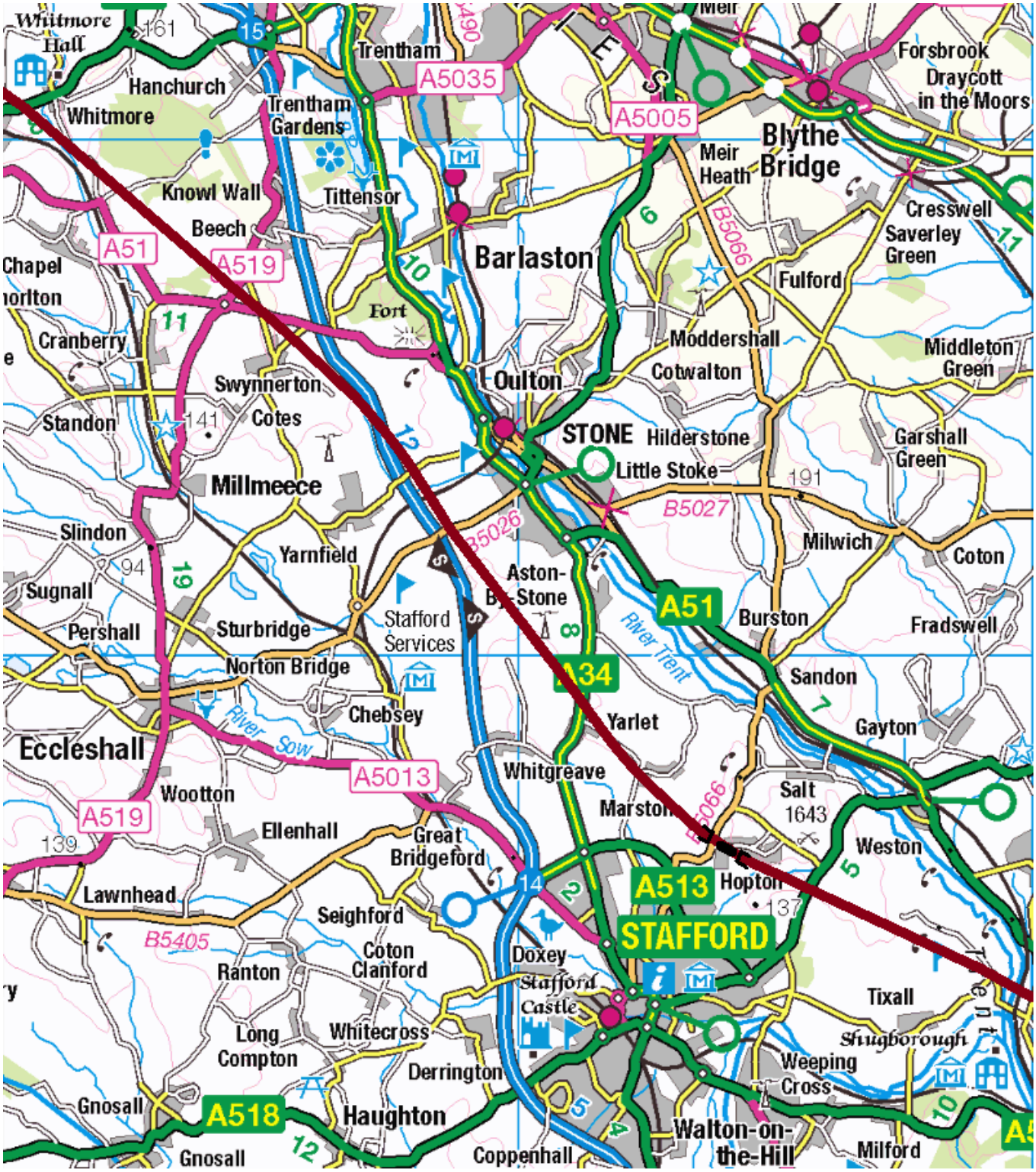


1.6 Southam – Balsall Common

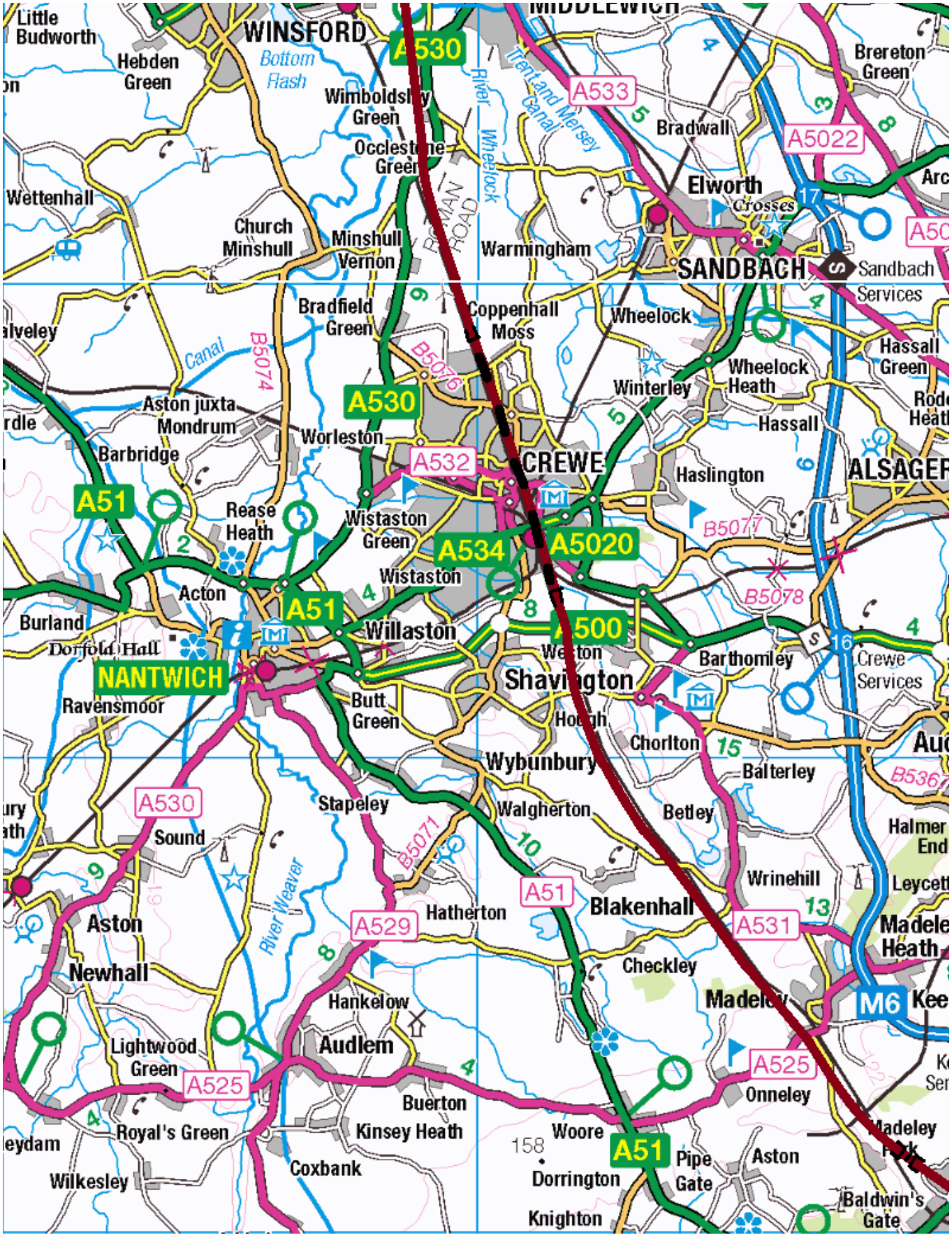
1.7 Hampton in Arden – Birmingham



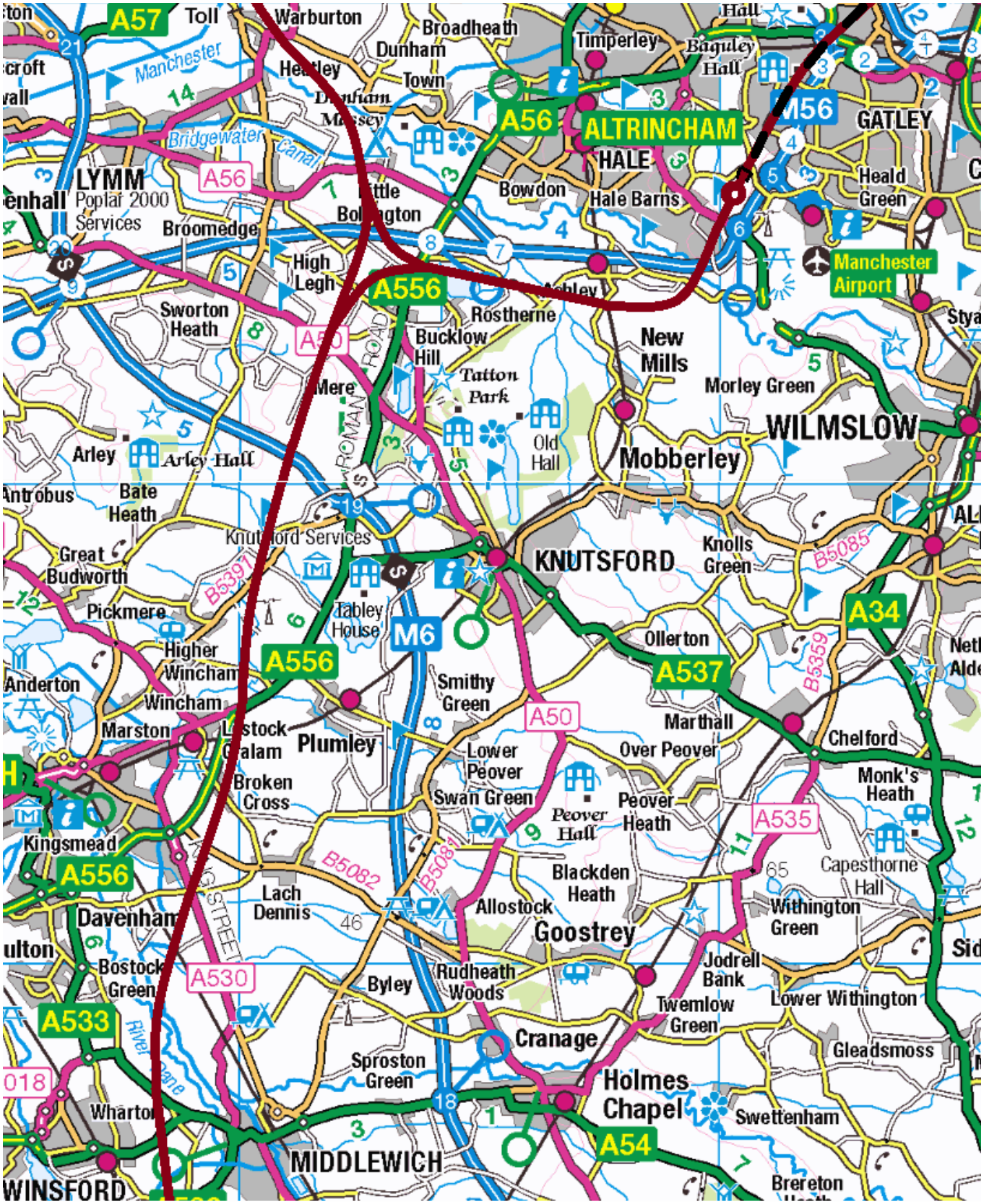
1.8 Drayton Bassett – Great Haywood



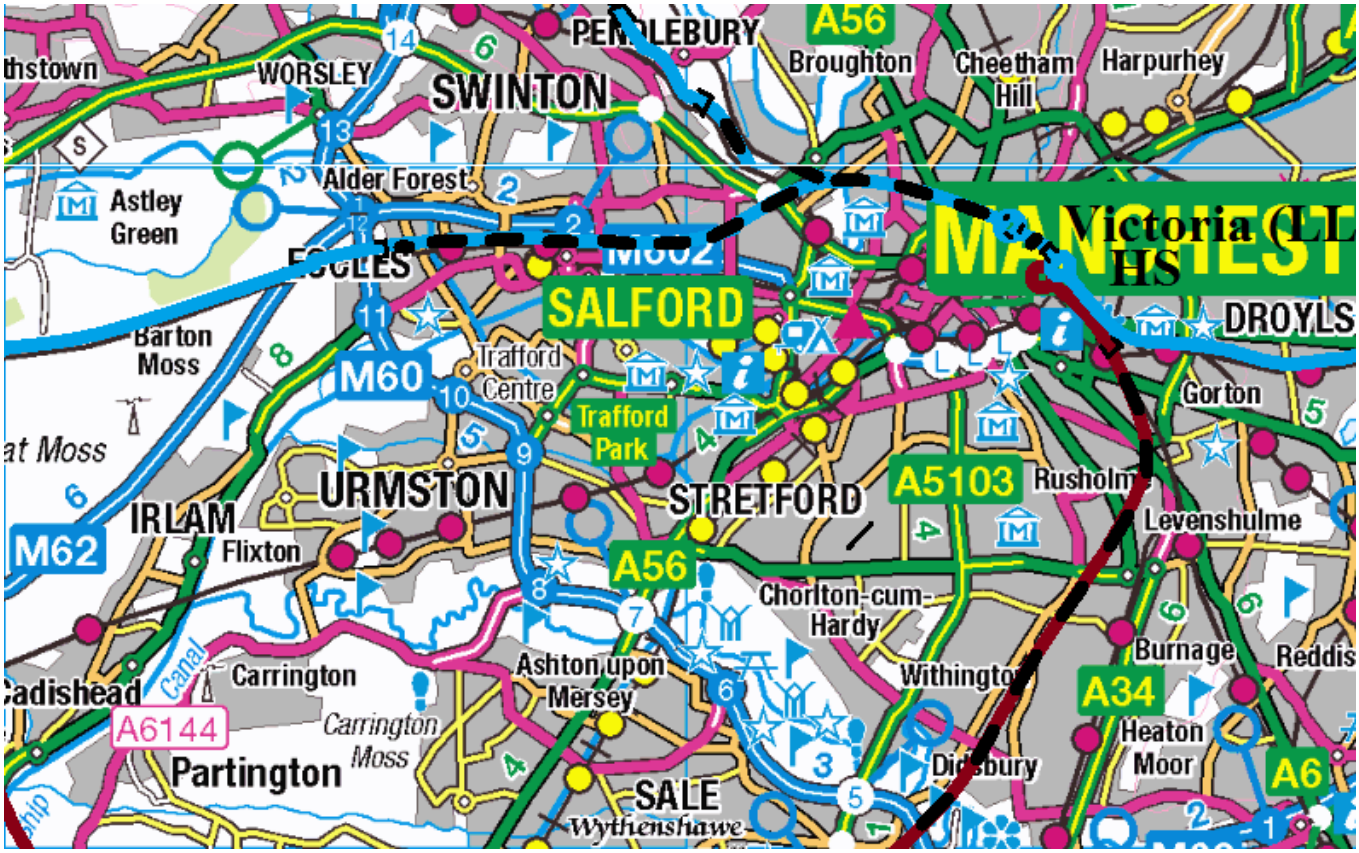
1.9 Shrugborough – Whitmore



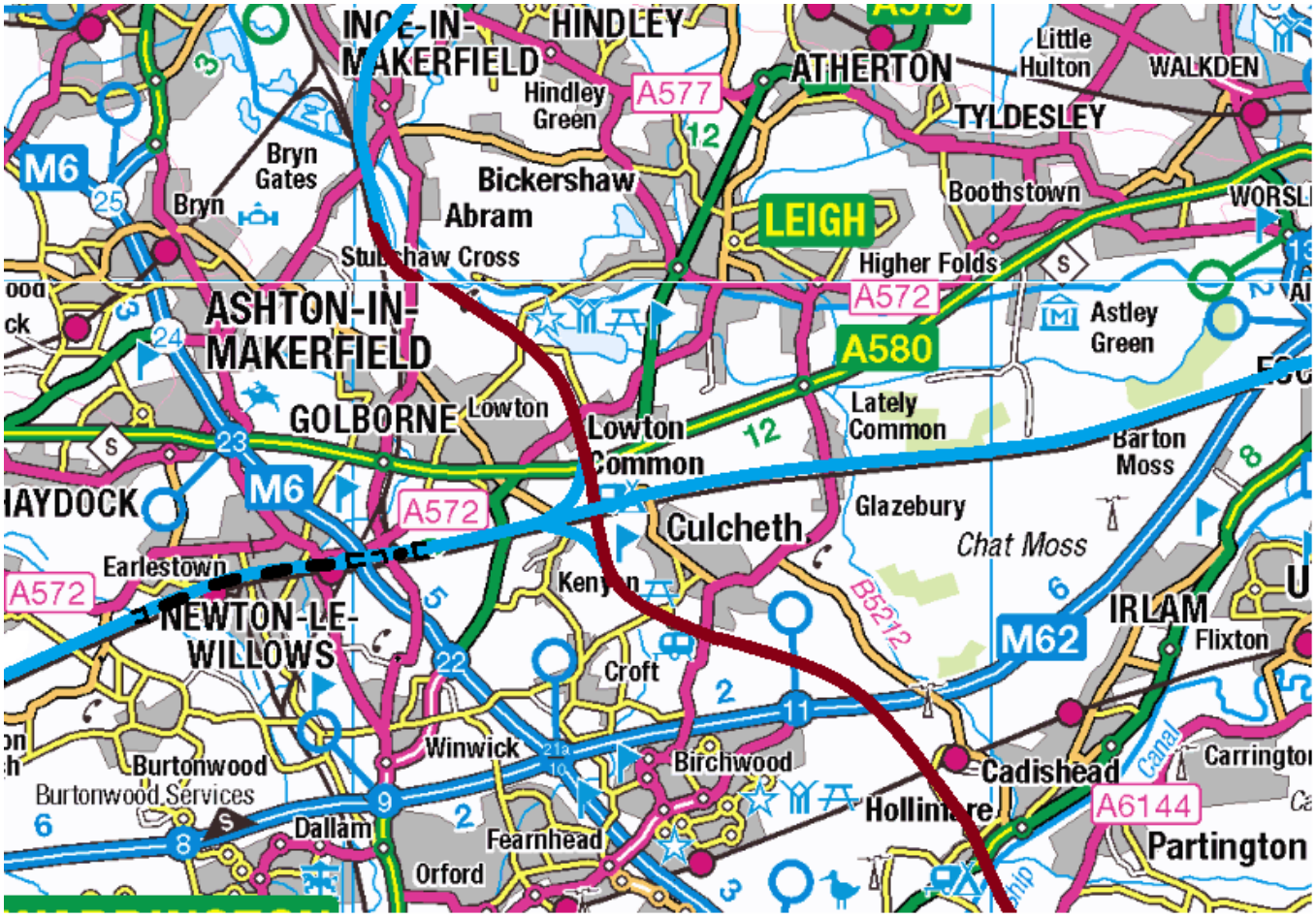
1.10 Madeley Park – Winsford



1.11 Winsford – Warburton



1.12 Didsbury – Manchester Contains Ordnance Survey data © Crown copyright and database right 2013



1.13 Partington – Abram Contains Ordnance Survey data © Crown copyright and database right 2013

2. HS2-Associated Lines in Central Lancashire:

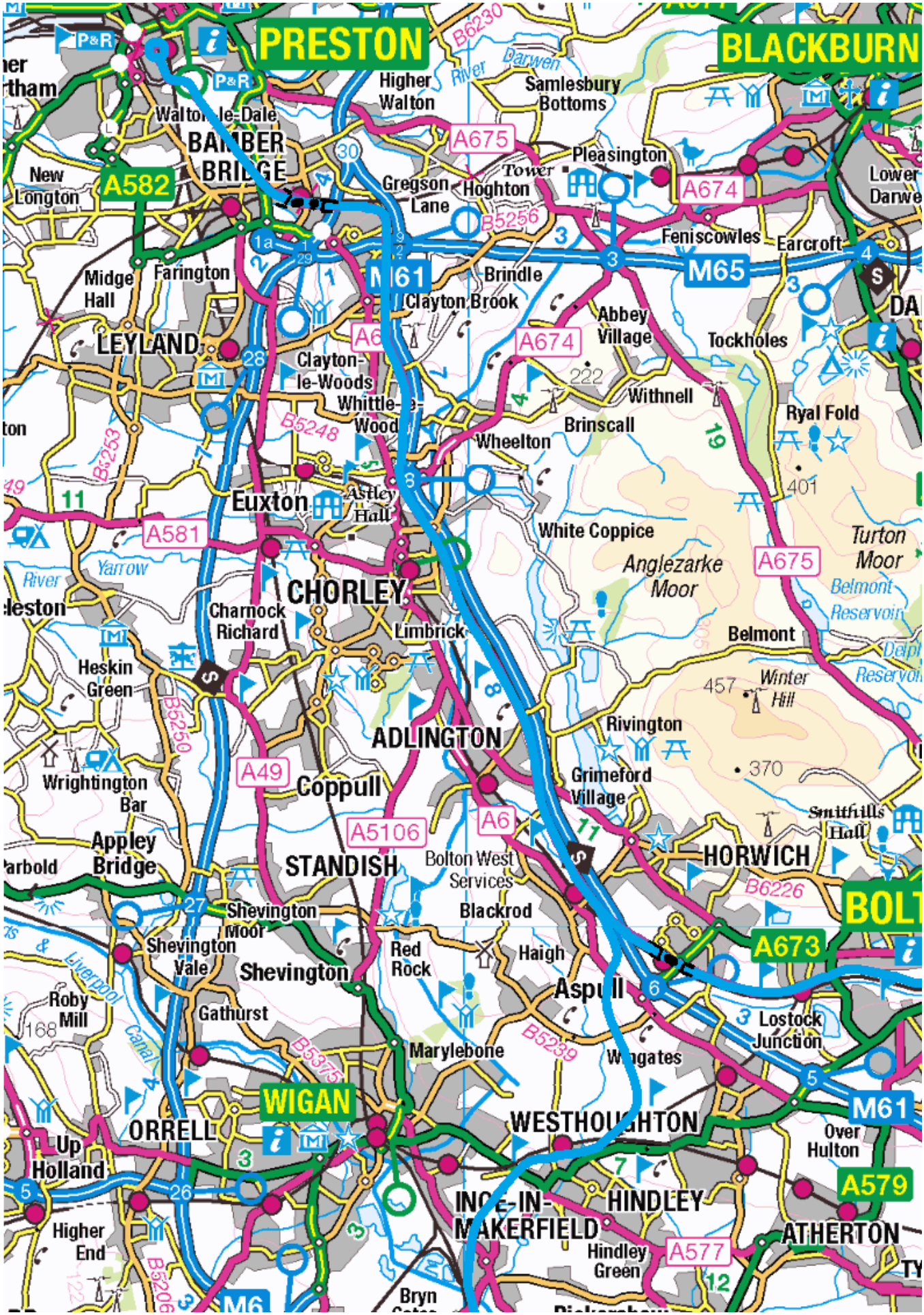
A highly desirable addition to HS2 Phase 2B is the initial section of the transpennine routes HS8/HS9, from Kenyon West Junction into Liverpool Lime Street, with connections from HS2 Kenyon South and North Junctions. These are shown in map 1.13 above, and allow GC-gauge services from Liverpool to London, and (initially) classic compatible services from Liverpool to Scotland.

Above Bamfurlong Junction, HS2 shares the route of HS8/HS9 to Gibb Farm Junction, then on to Preston. This is fully described in the HS Transpennine Routes and Service Plan article, and will not be repeated here, but the map is reproduced as 2.1. The actual junction to the WCML at Bamfurlong then becomes redundant, and is removed. The CC services from Euston (but see next paragraph), Birmingham and Liverpool to Scotland are routed via HS8 directly to Preston, and join the WCML there. (Eventually, with the Scottish extension, they join the WCML at Galgate Junction, south of Lancaster.)

The CC services from Euston to Scotland are withdrawn on the opening of HS3 to Edinburgh, with the introduction of GC-gauge services. But the services from Birmingham and Liverpool continue, as they serve quite different markets. Eventually, (with HS2's Scottish extension,) CC services from Euston to Scotland are re-introduced, with the opening of the new classic route, via Kendal.

The descriptions of the preceding sections constitute the original plan for HS2 (HS2-orig). Service Plans 1-4 describe how the various sections are implemented, and the partial services running on them.

The next sections describe two extra-highly-speculative extensions, the Coventry Variant (HS2-CV) and the West Coast HS Route to Scotland. These are, very definitely, extras; they do not replace any part of HS2-orig.



2.1 Ince – Preston

3. The Coventry Variant:

3.1 General

With the (devastating) exception of the Euston plans, and the serious but readily fixed deficiencies at Manchester HS station, also the need to serve Liverpool with GC-gauge trains from the outset, HS2 Ltd.'s plans for phase 1, phase 2A and phase 2 (western arm only), are generally good. As an intellectual exercise, I considered how I personally would have designed the route, and concluded that I could not improve on it. Considered in purely engineering terms, I do indeed accept that it is the best (and certainly the fastest) route available. However, engineering considerations are not the only, nor necessarily the most important ones. Considered in terms of business requirements, to ignore a city of such major importance as Coventry is simply crazy. (And Birmingham Interchange is **not** an acceptable station for Coventry, any more than Toton is for Nottingham and Derby, or Meadowhall for Sheffield.)

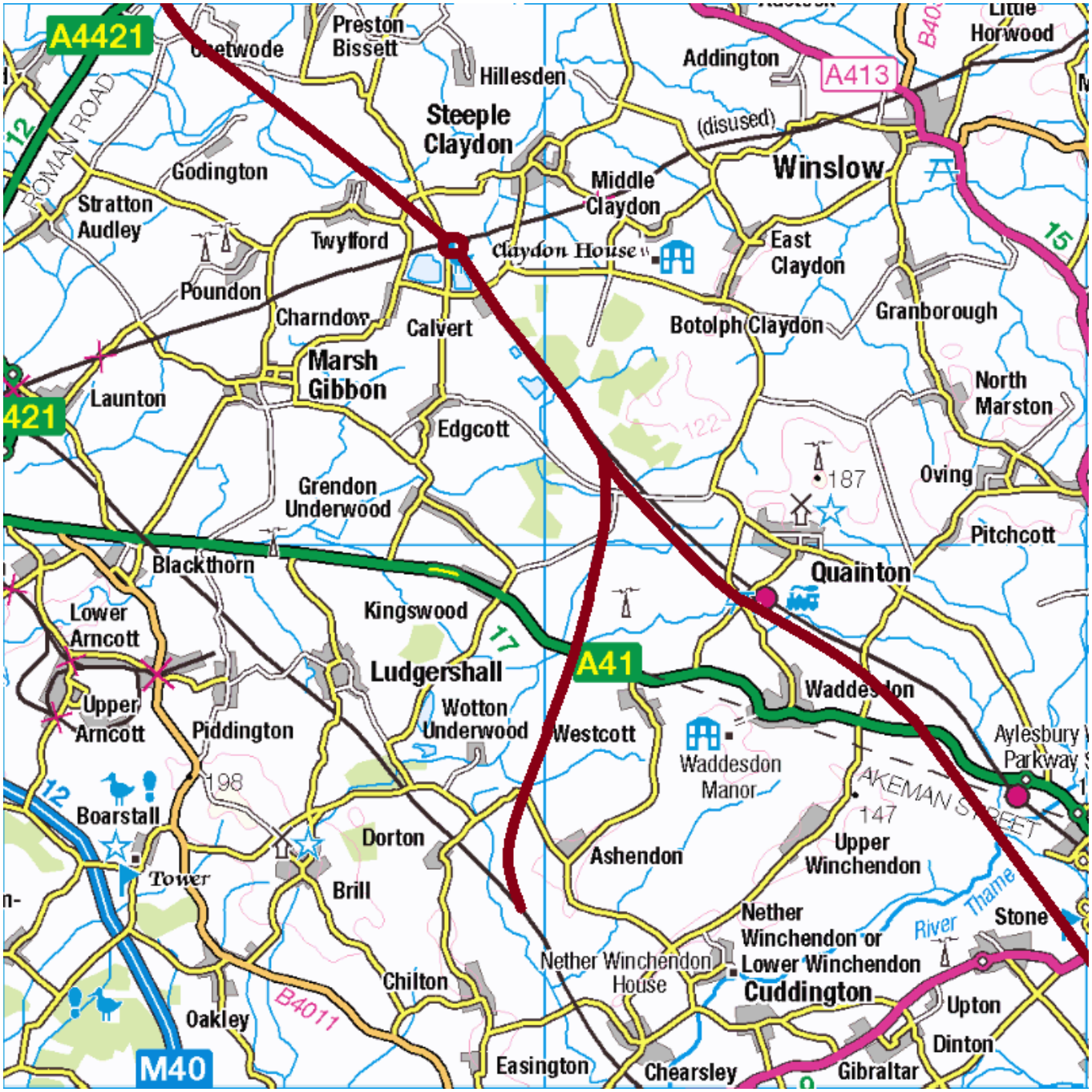
Accordingly I considered how the route could be varied to allow Coventry to be served, and this, the Coventry Variant (HS2-CV), is the subject of this section. (I originally considered whether this should in fact be a **variant** of the existing proposal, thus replacing the section of HS2-orig between Brackley and Birmingham Interchange, hence its name, but very quickly came to the conclusion that it made sense only as an addition.) It is readily possible, with amazingly little difficulty, and doing so enables certain other serendipitous benefits, in enabling each-way connections between HS2 and HS3, which wasn't an aim of the exercise, but is nonetheless very welcome. It cannot be pretended that the Coventry variant would be as fast as the original route, so the case is for building both, and using the original route (HS2-orig) for the long-distance, ultra-high-speed stuff. I certainly recommend both, since HS2-CV would carry extra traffic, which could not be accommodated with all the rest (so HS2-CV **alone** would be overloaded).

In brief, HS2-CV continues along the former route of the Great Central beyond Brackley, as far as Rugby. (Indeed a branch of HS2-CV continues all the way through and beyond Rugby to join up with HS3.) Initial thinking envisaged a station for Brackley, but this (together with Calvert) imposed such a time penalty that Coventry would see no acceleration on its current service, which rather spoils the whole idea.

The main line of HS2-CV tunnels under the centre of Rugby, with an (underground) station adjacent to the classic station, emerging from tunnel on the south side of the classic Rugby – Birmingham alignment. This it follows all the way to Berkswell, (on the north side beyond Coventry,) where it rejoins the route but not the tracks of HS2-orig. There are, amazingly, effectively no obstructions at all along the south side of the Rugby-Coventry nor on the north side of the Coventry-Berkswell alignment. In the very centre of Coventry it is necessary to enter tunnel and locate the HS station immediately beneath the classic station. There now follows a detailed description of the route, with maps.

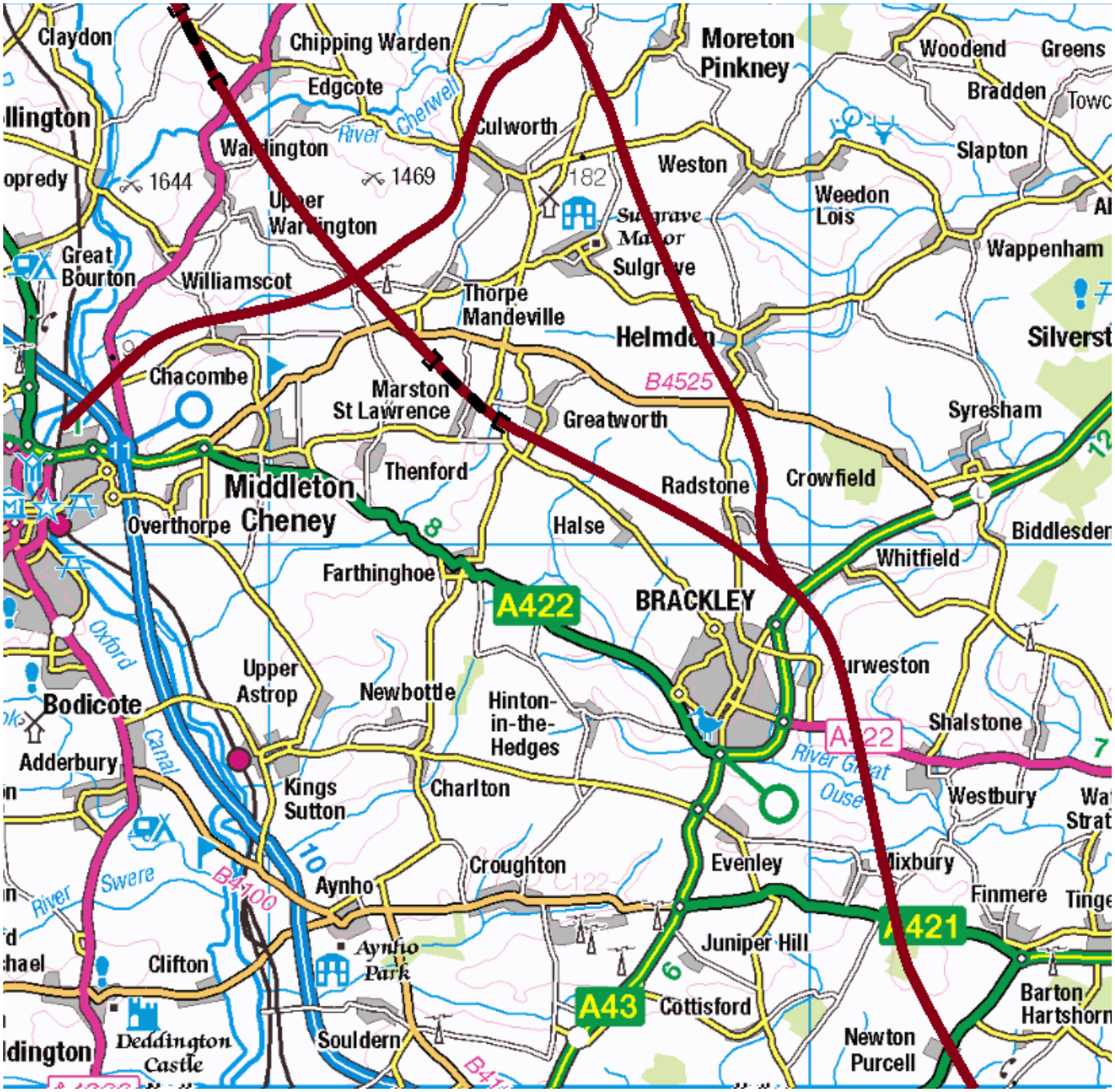
3.2 Brackley – Rugby

HS2-CV actually begins at Grendon Underwood Junction (SP706222) where the northbound line diverges from HS2-orig. The southbound line of HS2-CV joins HS2-orig at SP727200. As noted earlier, these very precise locations for the junctions, different in each direction, are determined by the configuration of station loops, and are for a turnout / turnin speed of 230kph (143.75mph). These considerations are expounded in detail in appendix B of the article 'Same Speed Railways'; only the



3.2.1 Chearsley – Chetwode

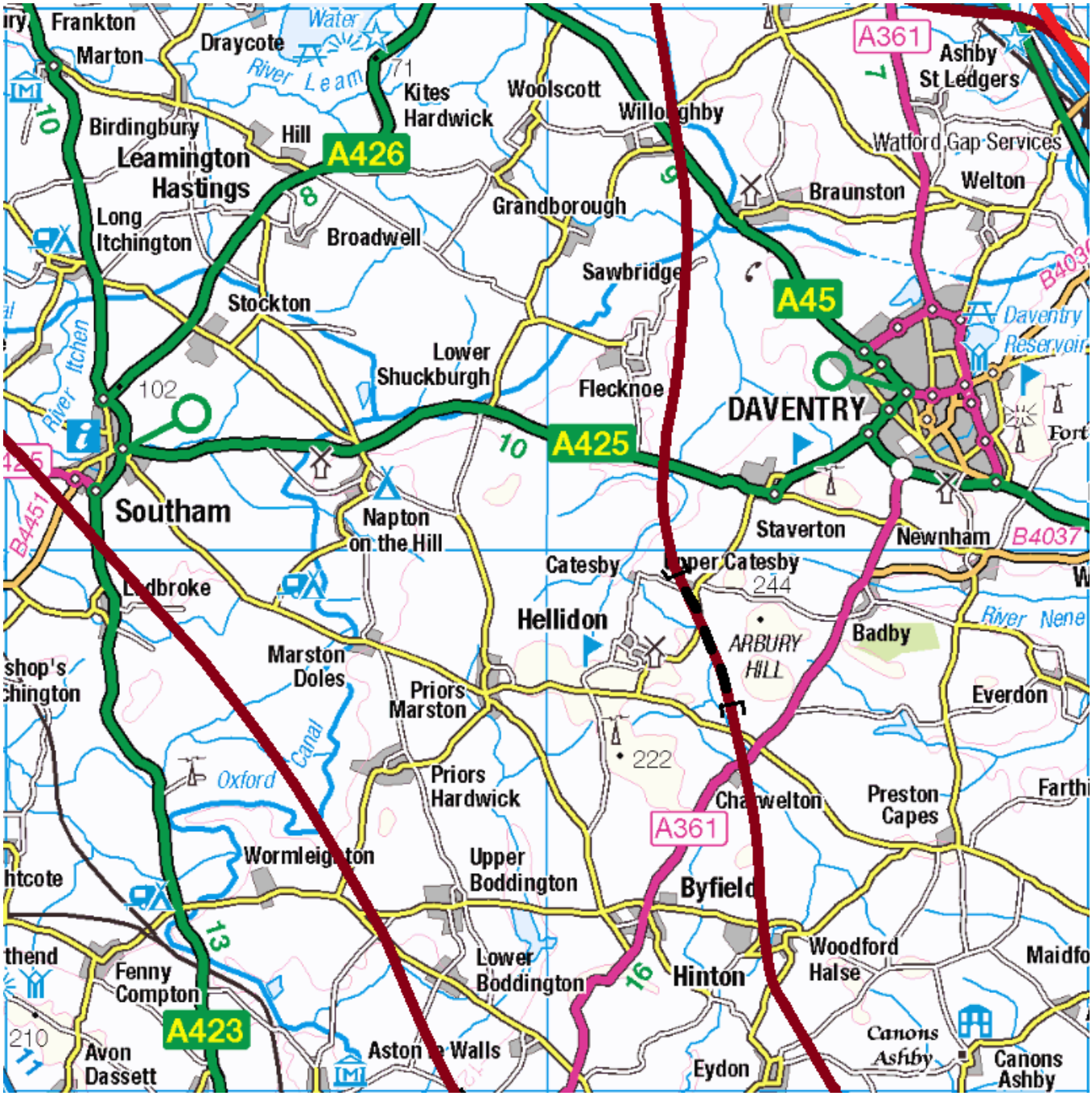
results are used here. The restored line from Ashendon Junction to Grendon Underwood Junction also joins (the HS2-CV tracks) here. There are connections back to HS2-orig at SP634301 northbound and SP649280 southbound (Chetwode North and South junctions) to allow services (specifically the CC services to Manchester via Stoke and to Preston and Blackpool / Windermere) to rejoin the main line after calling at Calvert. HS2-CV itself does not rejoin HS2-orig until (finally!) Streethay Junction. Between Grendon Underwood and Brackley Junctions, and between Mount Pleasant and Streethay Junctions, it occupies the outer two tracks of a 4 track alignment, while HS2-orig occupies the inner two tracks. HS2-CV has a line speed of 360kph as far as the outskirts of Rugby (where services are slowing in any case for the Rugby stop, and the curvature on the approaches). A line speed of 300kph or even 200kph is adequate from Rugby all the way to Streethay Junction. Appendix B of the current article contains a layout diagram illustrating this configuration.



3.2.2 Newton Purcell – Moreton Pinkney

HS2-CV diverges from the route of HS2-orig at SP595388, just after crossing the A43(T). This is Brackley Junction, a route junction although there are no links between the (HS2-CV and HS2-orig) tracks (at least for normal use). In effect the station loops extend from Grendon Underwood Junction to Brackley Junction, at which point they simply become the main line of HS2-CV. HS2-CV rejoins the GC alignment at SP590393, and follows it to Rugby. The viaduct to the west of Helmdon is still in place, and might be reusable. There has been some encroachment on the alignment at Westgate Farm (SP564484) but there's plenty of room on the west side to slew the line slightly, to avoid it. Commercial premises ('Main Line Timber') have been built directly on the alignment at Woodford Halse (SP540254); these will need to be relocated. The line from Culworth Junction, south of Woodford Halse, to Banbury Junction is also restored.

Catesby tunnel is a significant piece of infrastructure, and will very probably need a new, second bore to GC-gauge. (Although the Great Central was built to a significantly larger loading gauge than other UK lines, I don't think it's to UIC-GC gauge, but perhaps track lowering would do the trick.) Catesby viaduct



3.2.3 Eydon – Willoughby

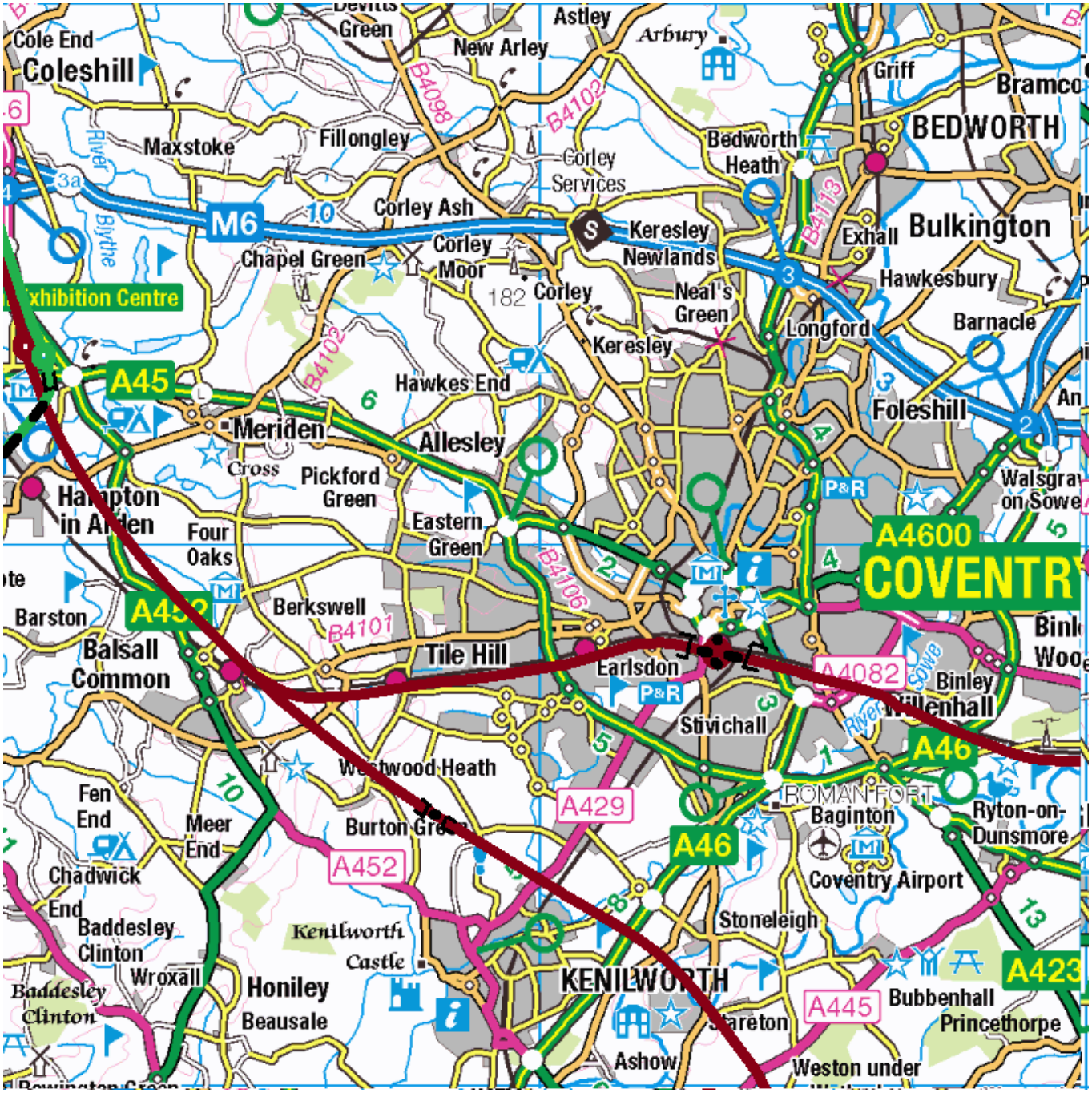
is still in place, and perhaps reusable, but the smaller Staverton viaduct, a little to the north, has disappeared, as has Willoughby viaduct.

The alignment is completely unobstructed on the approach to Rugby, certainly as far as Clifton Rd., (it's in a cutting, of course, which helps prevent encroachment). At SP525753, Rugby HS Junction, shortly after the site of the GC's Rugby station, HS2-CV diverges from the GC alignment and enters a 2-mile tunnel curving round via the underground Rugby HS station (SP 508760), adjacent to the classic station, emerging from tunnel at SP488757, just west of the A4071, on the south side of the classic Rugby – Birmingham alignment.

3.2.4/3.3.1/3.4.1 Barby – Wolston

3.3 Rugby – Berkswell

HS2-CV continues along the south side of the alignment all the way to Coventry. There are no obstructions, though noise screens will probably be desirable in a few locations. It enters a very short (less than ½ mile) tunnel at SP336781, immediately before the Quinton Rd. bridge, and the junction of the Kenilworth route. Just to the west of the A429, at SP325782, immediately following Coventry North Junction, where the Nuneaton line diverges, there is a junction with the classic route, (Warwick Road Junction,) with the connecting lines emerging from tunnel on each side of the classic lines. Immediately after that, HS2-CV itself energes, on the **north** side of the alignment. In the section following, the classic tracks will need to be slewed to the south for the next mile or so, to make room for the HS tracks. HS2-



3.3.2 Coventry – Birmingham Interchange

CV follows the north side of the alignment all the way to Berkswell, where it joins the HS-orig route (but not tracks) at SP258775, Mount Pleasant Junction.

The ideal mainline station has two island platforms, each allowing for two platform faces in the same direction, to enable cross-platform interchange. Coventry has four platforms, but only one island, in the middle, with trains either side travelling in opposite directions. This is very unsatisfactory. I recommend adding a fifth platform face, on the south side, so the southern platform is also an island, with two platform faces serving the westbound direction. The two HS island platforms would be directly underneath the classic ones, allowing for excellent interconnection between classic and HS services. Classic platform 1 would be reversibly signalled, and used by services between Nuneaton and Leamington, in both directions, passing onto the Kenilworth line ideally by a flyover, also available to southbound cross-country services on the main line. Several track diagrams, including the Coventry layouts for classic and HS2-CV, are also provided later in appendix B.

3.4 HS2-CV / HS3 Interconnections

The HS2-CV branch to HS3 continues along the GC alignment north of Rugby HS Junction. It **seems** to be unobstructed right up to the WCML. A substantial viaduct would be required here, as indeed there used to be. On the north side of the WCML the alignment has been built over by some industrial-type buildings at SP517759; these would need to be relocated. Very surprisingly, the alignment through the residential area following (SP518767 to SP521774), and indeed all the way to Cotesbach Junction with HS3 (SP546820) is completely unobstructed, but would doubtless need sound barriers in some locations. Note that services using this connection would not be able to serve Rugby HS station; perhaps a minimal station on the GC station site could be provided, for these services only.

The connection from HS3 to HS2-CV begins at Watford Gap Junction (SP589697). Originally the connection was from HS3 to the classic route, in Northampton Castle station to allow for the HS3 CC service to Birmingham, Wolverhampton and Liverpool/Chester. It now has a HS connection instead, with the line to HS2-CV, diverging from the HS3 main line at Watford Gap Junction. This crosses the M6 and joins the south side of the M45, (south side because there's housing close to the north side, at Kilsby,) at SP580702. It follows the M45 to Wood Bridge (SP525714), crosses the motorway and joins HS2-CV at SP517723, (Onley Junction,) on the approach to Rugby.

These interconnections I find irresistible, but I have to admit that they are, to some degree, a solution looking for a problem. In fact, the HS3 to HS2-CV connection would carry the HS3 CC service to Birmingham New Street, Wolverhampton (splitting/joining) and on to Liverpool and Chester. The RM service from St. Pancras to Worcester would become CC also, travelling via HS3 rather than via Bedford. (This would increase HS3's loading between West Hampstead and Crick Junctions to 18tph.) These would travel along HS2-CV as far as Warwick Road Junction, there joining the classic route on to Birmingham International and New St.

The HS2-CV to HS3 connection has less obvious uses. However, a classic-compatible service could be run from Paddington via Heathrow, the Marlow branch and the restored link between Ashendon and Grendon Underwood Junctions to Leicester (probably continuing as far as Melton Mowbray and terminating there, making a connection with the MML service to York via Corby. There is (from the GWML Service Plans article) a free slot of 2tph on the Marlow branch, between Maidenhead and High Wycombe. A further CC service could be from the Oxford area via Banbury Junction and the restored branch to Culworth Junction, and on to Leicester and Nottingham. This could perhaps be a CC replacement for the XC service between Bournemouth and York, which currently (and for many years past) travels via Birmingham New St. with a reversal, but this would in effect be a reversion to its original route via the GC between Banbury and Sheffield. This is clearly not a fully worked-up proposal, but merely an indication of the use that could be made of the HS2-CV to HS3 connection. (These two services would increase HS3's loading between Cotesbach and Watkin Road Junctions to 18tph.)

One situation in which the interconnections would undoubtedly be valuable is in each route providing the other with an alternative route to and from London in case of emergencies, or, more regularly, when the normal route is closed for engineering work. Whether this would, by itself, justify their provision is an open question. On the other hand they're not very long – 5 and 4 miles respectively.

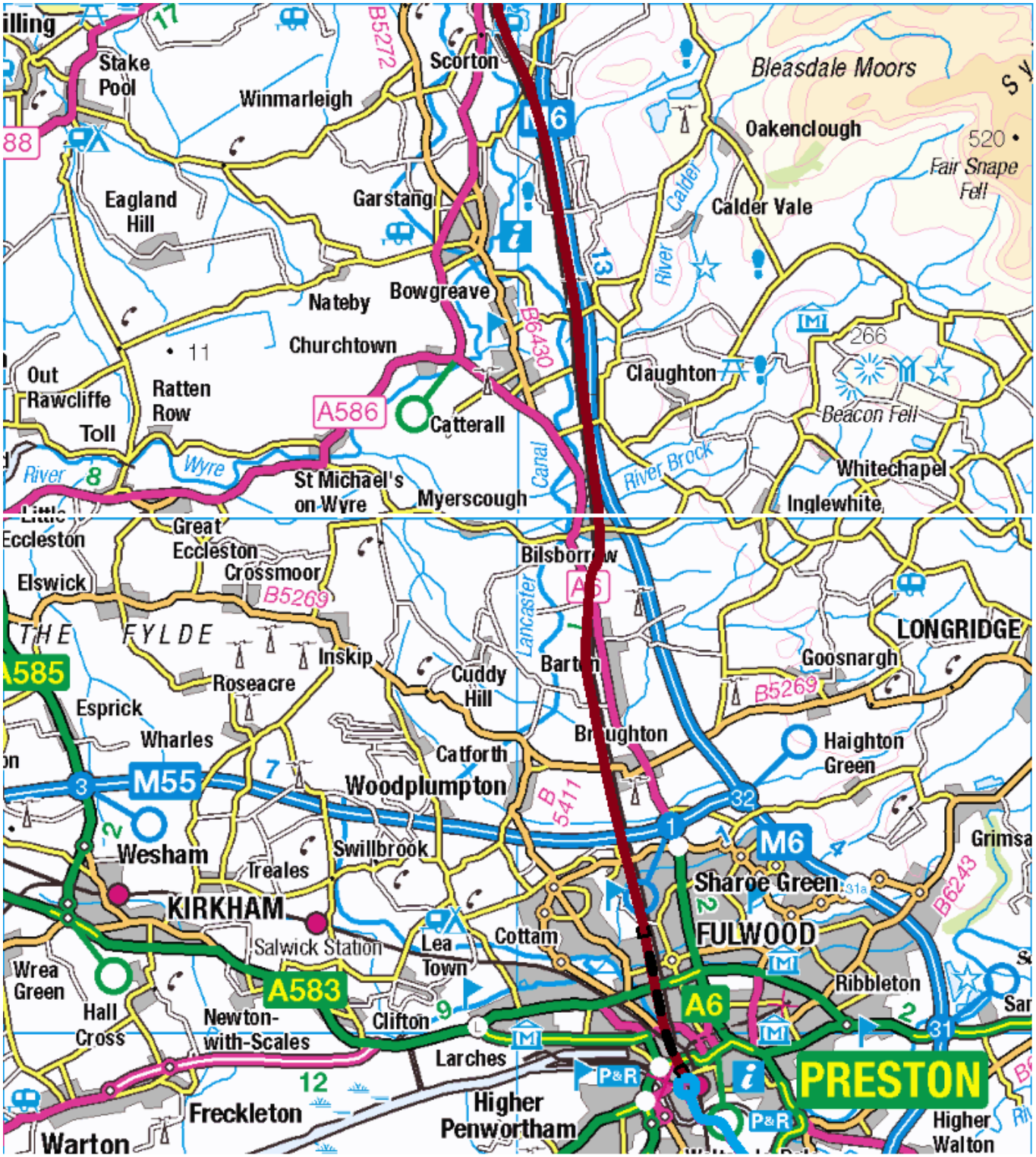
4. HS2 Route to Scotland: Preston – Carlisle:

HS2 enters a 1 mile tunnel immediately north of Preston station, at SD534296, emerging at SD525317, on the west side of the WCML alignment. This it follows for 5 miles, before switching to the east side of the alignment at SD514390. This it follows for a further 9 miles, before diverging at SD487543, Galgate Junction, (where there is a connection to the WCML, to allow classic-compatible services to join the classic route,) and joining the west side of the M6 at SD488549. It follows the motorway alignment past Lancaster and Carnforth, and not forgetting to provide adequate bridges over the Lancaster Canal at SD520752 and SD530804, rebuilding the motorway bridges at the same time (as part of the same structures). It diverges from the M6 at junction 36, and joins the south side of the A590, following this until it passes under the WCML, and rejoining the east side of the WCML alignment at SD513854. This it follows to Oxenholme, tunnelling under Oxenholme itself for 1 mile between SD526892 and SD533905. At this point it takes over the WCML alignment, from now on enlarged to GC gauge, over Shap and on to Penrith.

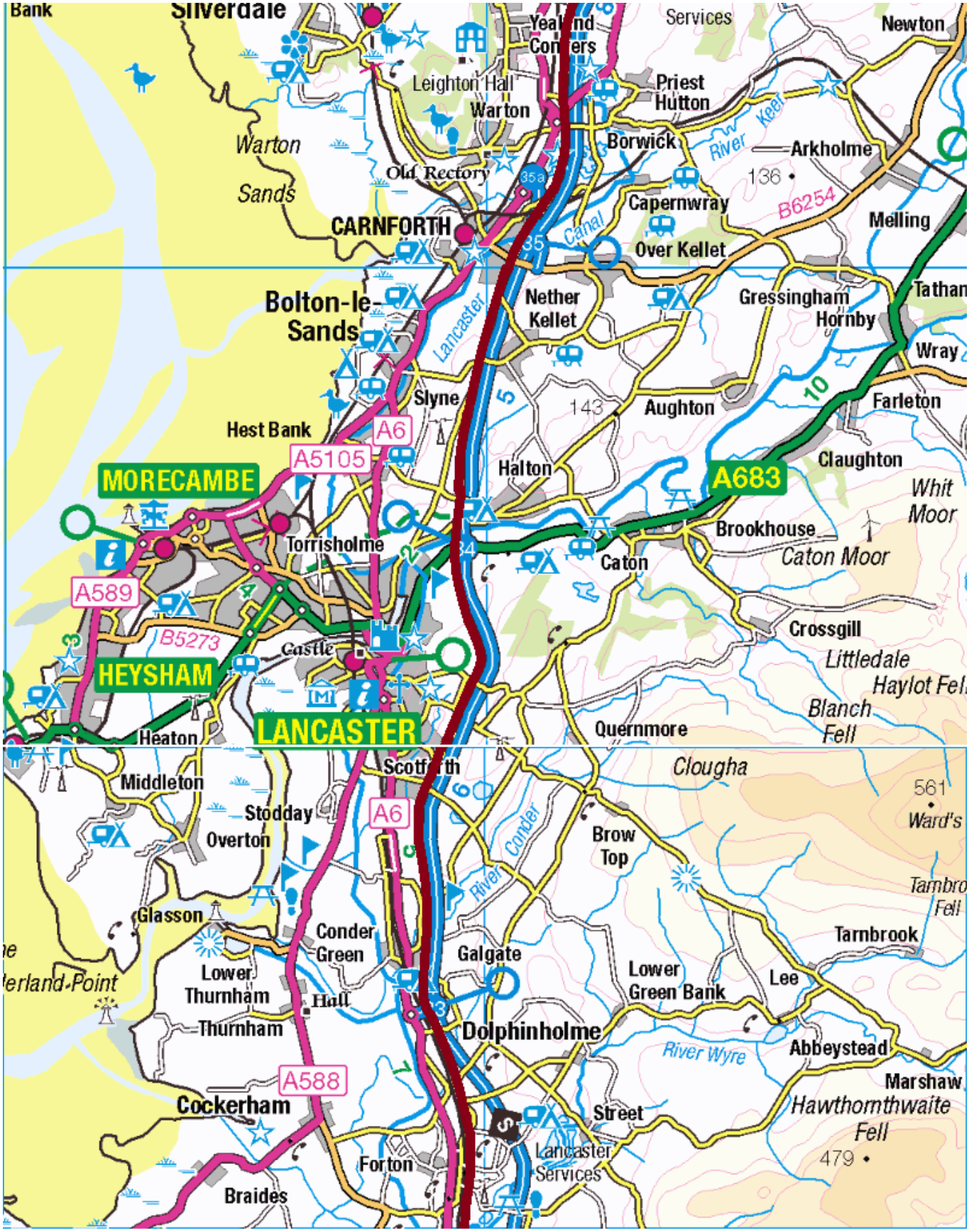
HS2 diverges from the classic route just before Penrith, at NY520272, and joins the west side of the M6 alignment at NY514286. It follow the M6 until it is recrossed by the WCML, shortly before Carlisle; it diverges at NY432502 and joins the west side of the WCML at NY432506, and follows it to Carlisle Citadel station, where there is ample room on the west side for the HS platforms. It has encountered no obstructions between Penrith and Carlisle.

The WCML itself is rerouted between Oxenholme and Penrith, via Kendal, diverging from the Windermere line just after Kendal station, at SD517933 and following the west side of Long Sleddale to NY480071, where it enters a 2¼ mile tunnel to Hawes Water, emerging at NY468105. Average gradient from Kendal to the tunnel is 1 in 80. It crosses the top of Hawes Water, the follows the western bank, (level for 4 miles, of course,) then along the side of Bampton common, passing west of Bampton, Helton and Askham, roughly following the 750’ contour all the way, so essentially level all the way from the tunnel to Askham (NY509246), then rejoining the original course of the WCML at Eamont Bridge, NY510275, at 500’, thus descending 250’ in 2 miles, at 1 in 42 (which could very easily be made less steep by starting the descent sooner – but what’s the point?). It is shown on the maps as a narrow orange line.

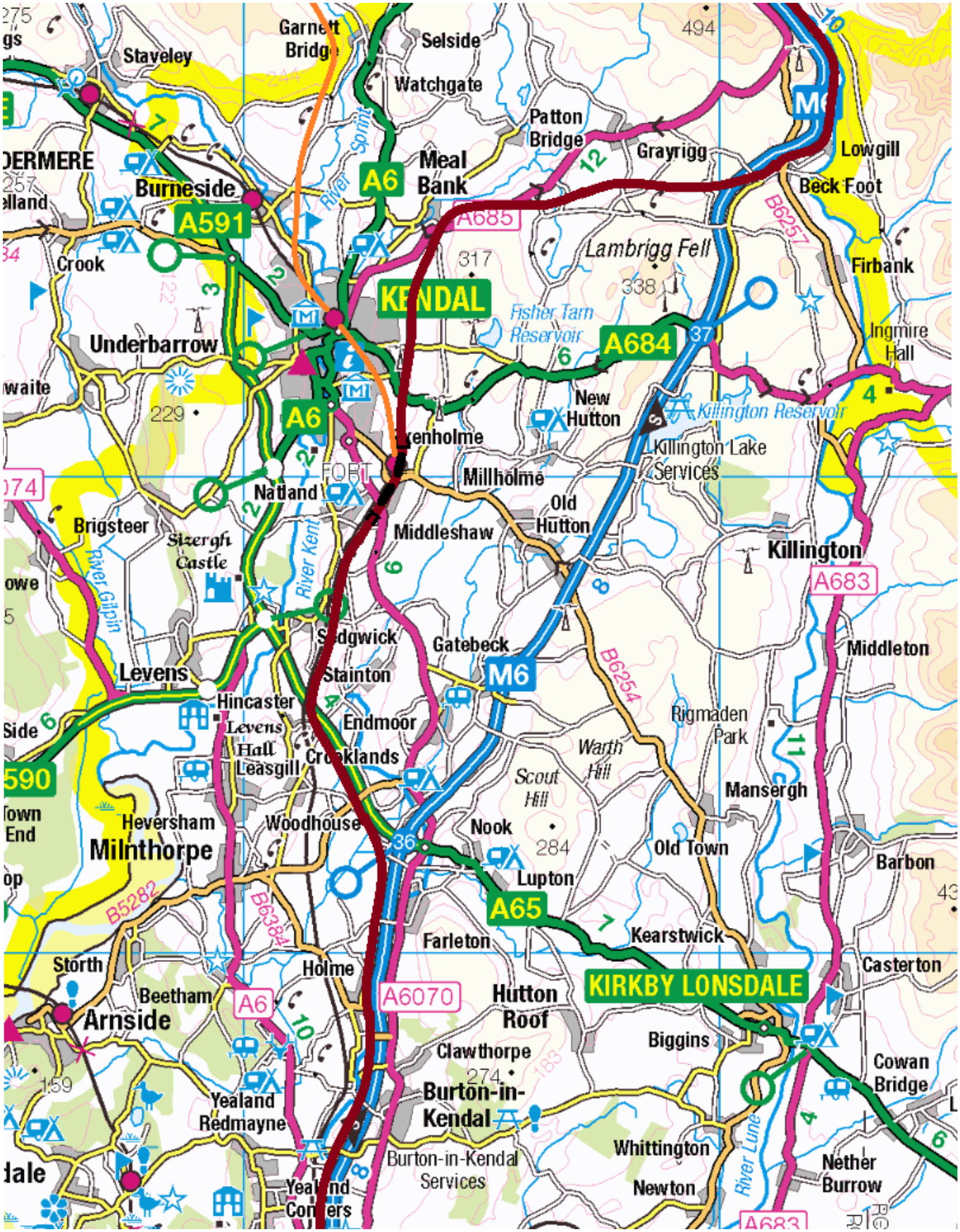
I had always thought that this route was George Stephenson’s design for the Lancaster and Carlisle Railway. It seems I was mistaken. There was indeed such a proposal, but it was produced by a local, Kendal surveyor, to the instruction of various civic notables who were much miffed by Joseph Locke’s proposal to bypass Kendal – as indeed actually happened. I have always thought the Kendal route much preferable to Shap, so it pleases me greatly to propose it as the correction of an historical mistake, albeit 170 years late. George Stephenson did indeed produce a design – it crossed Morecambe Bay and went along the coast all the way, never more that 40ft above sea level. That would certainly have been fun, but hardly suitable for a main line railway.



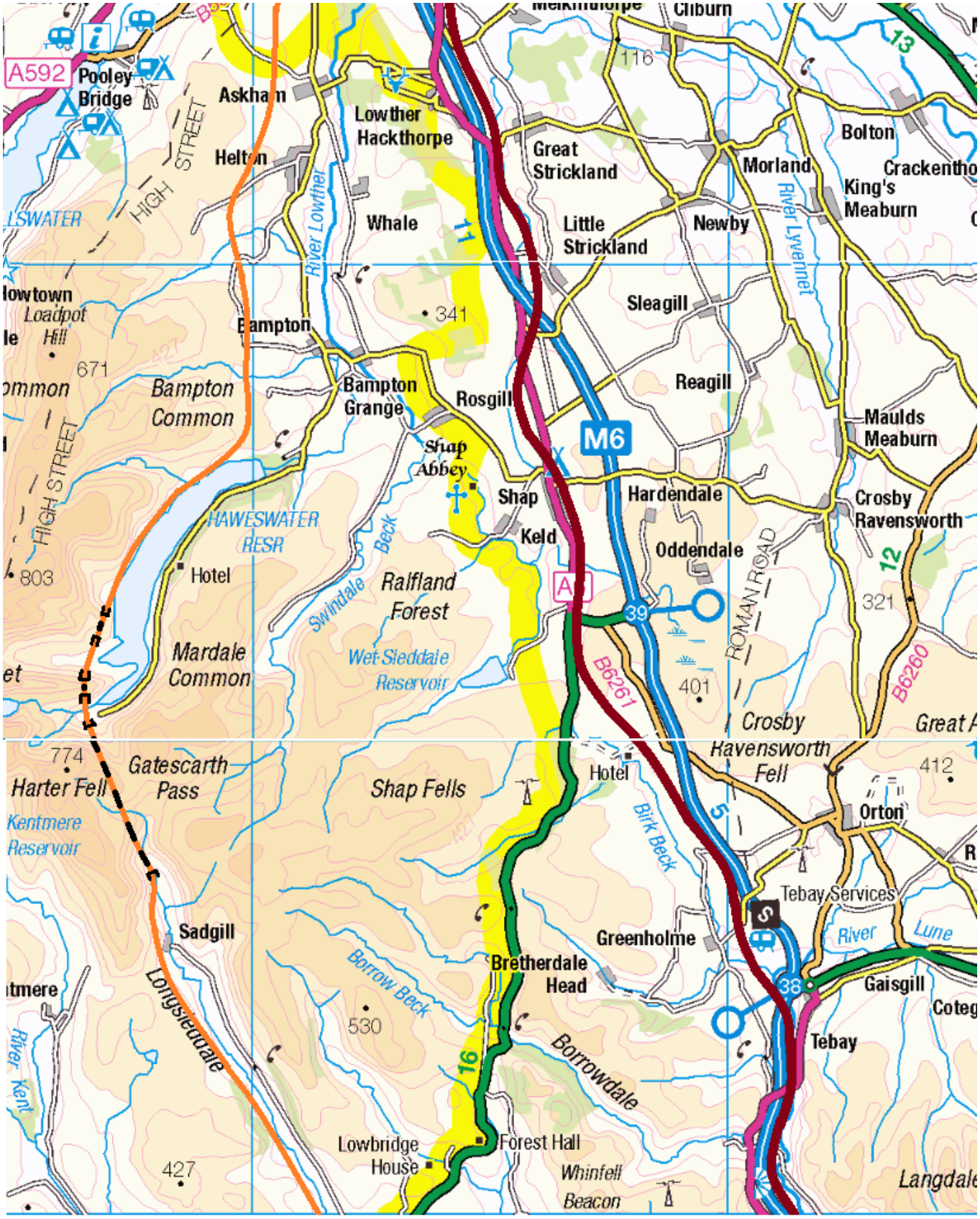
4.1 Preston – Scorton



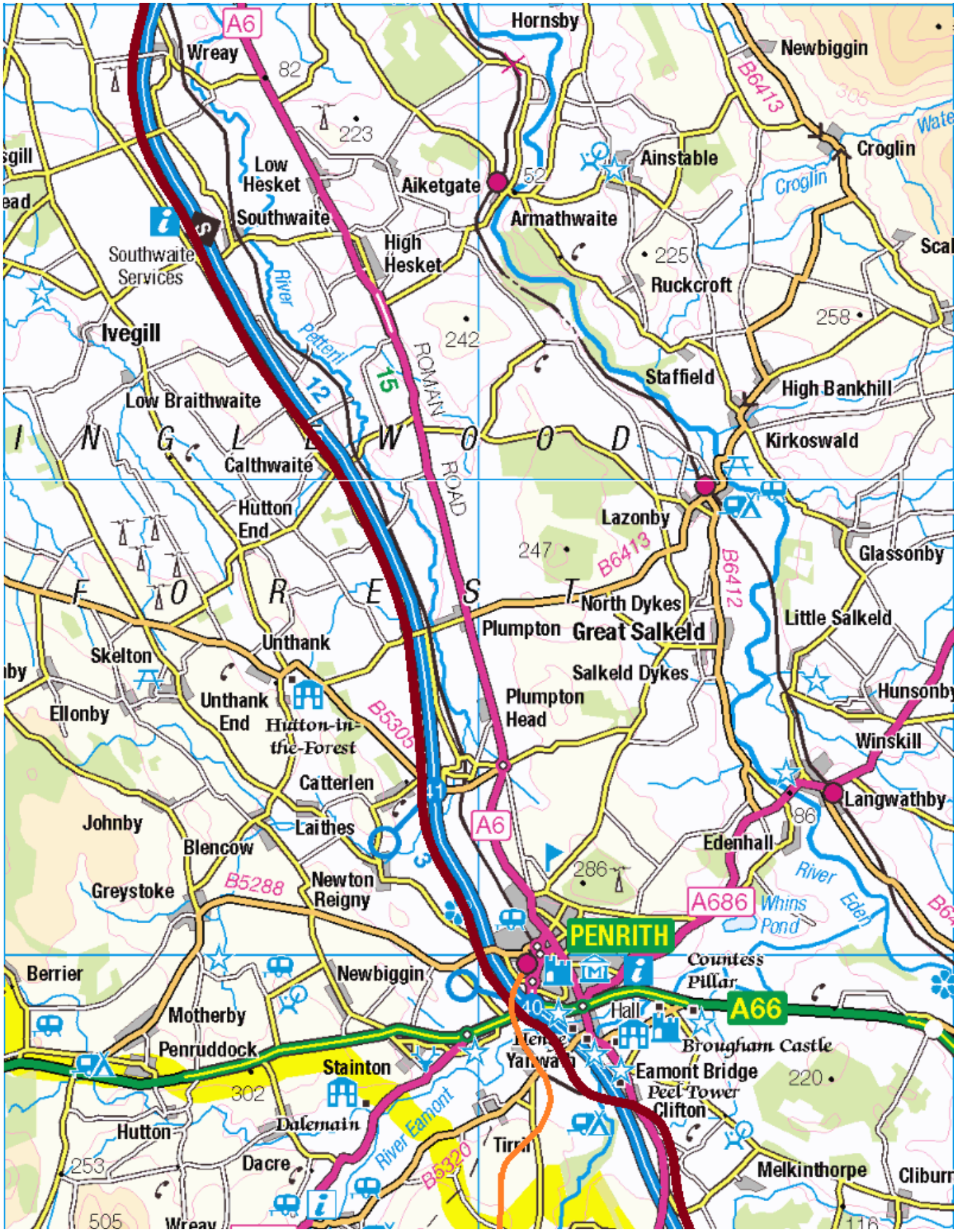
4.2 Forton – Warton



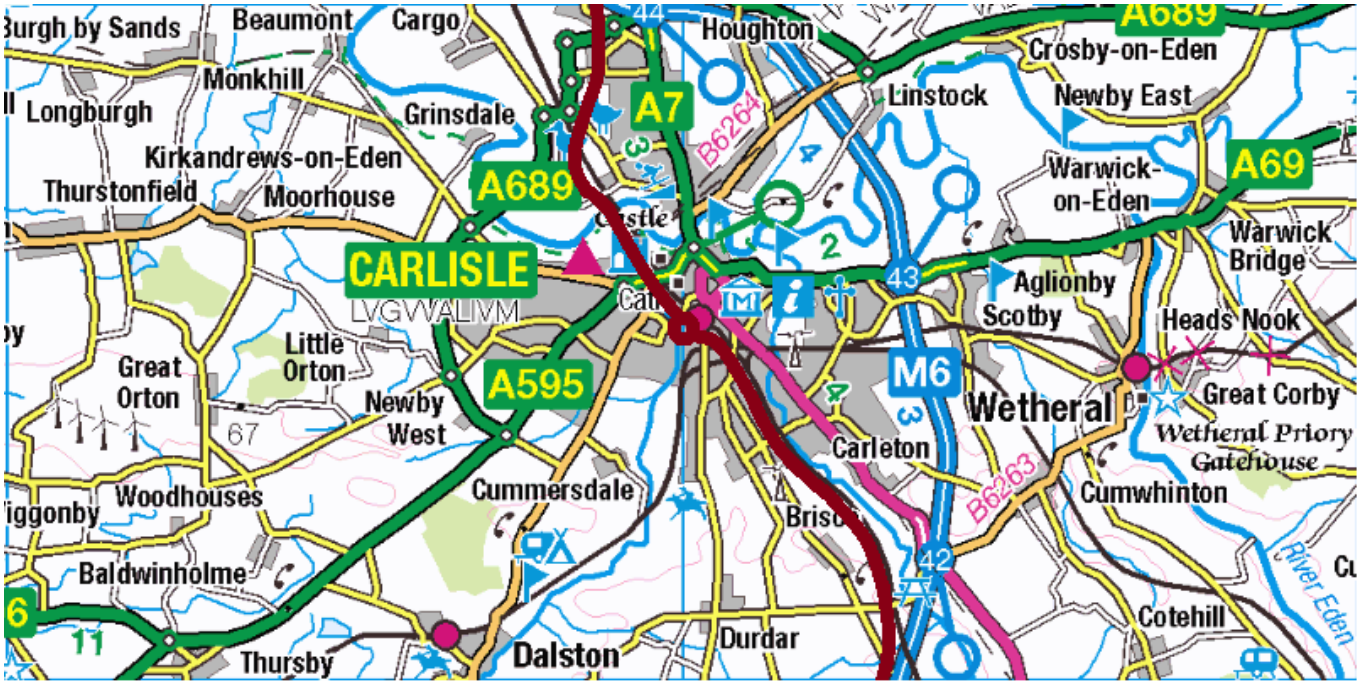
4.3 Yealand Conyers – Low Gill



4.4 Tebay – Great Strickland



4.5 Clifton – Wreay



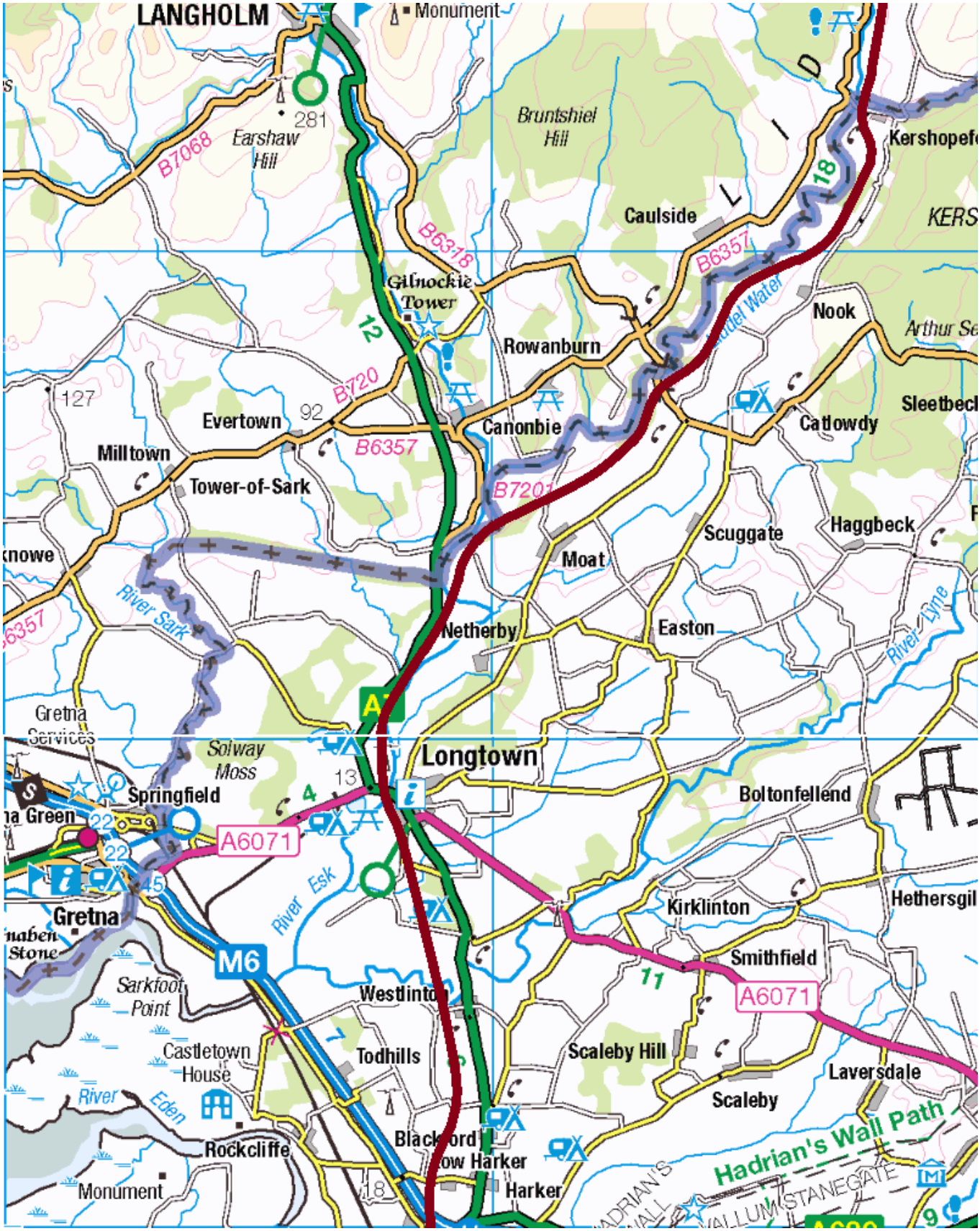
4.6 Brisco – Carlisle

5. *HS2 Route to Scotland: Carlisle – Riccarton North Junction:*

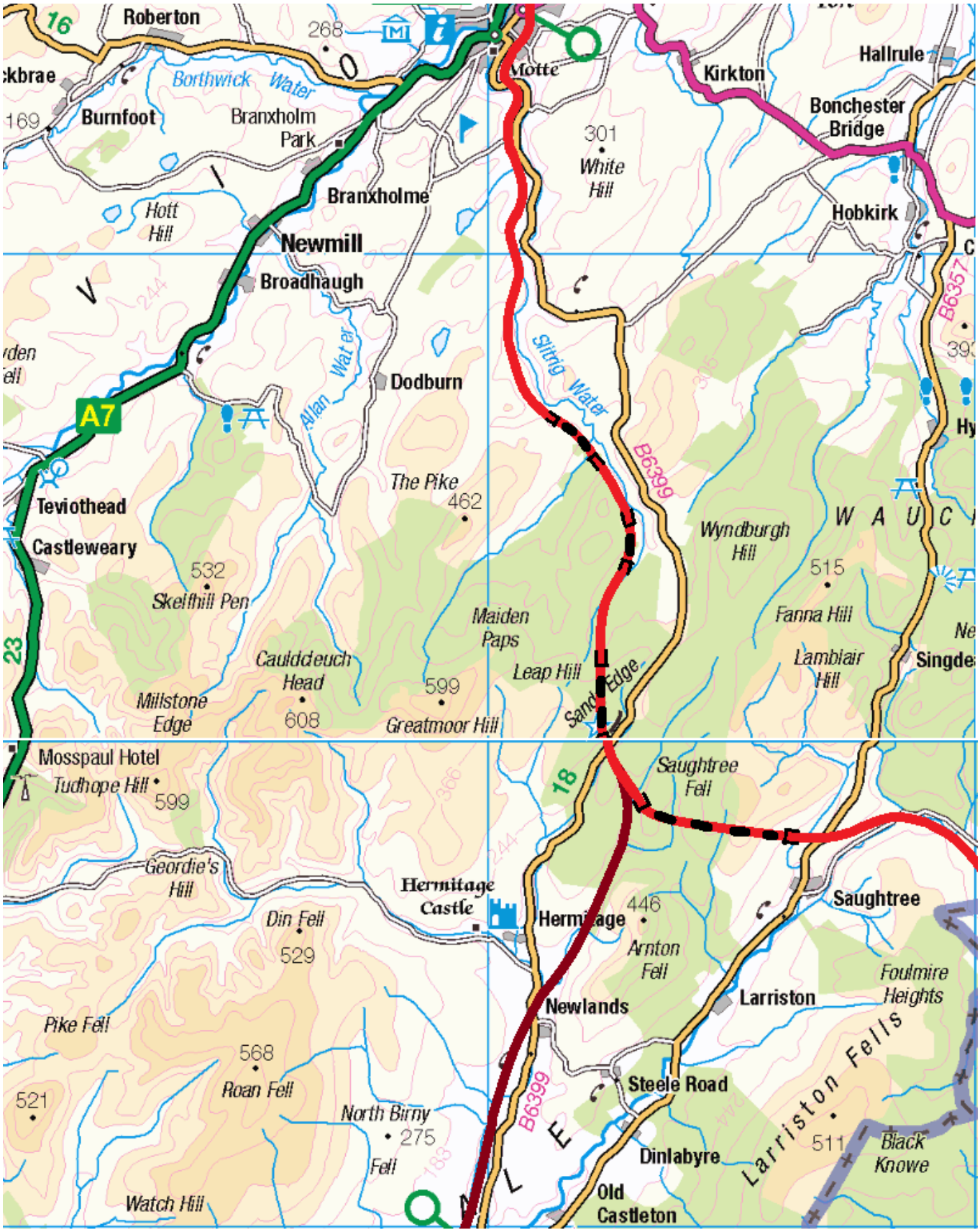
North from Carlisle, HS2 follows the west side of the WCML alignment for a short distance. It diverges at NY388572, just after crossing the Esk, passing to the west of Etterby Depot to join the Waverley route at NY383577. HS2 follows the alignment, and takes over the trackbed of the Waverley route, and follows this to NY490893, just north of Newcastleton. A few warehouses will need to be relocated in the Viaduct Estate in north Carlisle.

The section of the Waverley route at the Carlisle end already has excellent alignments and, with a bit of strategic straightening, could readily be brought up to HS standards. It's the bit in the middle, around the original Riccarton Junction, that's badly aligned. Accordingly, a 6 mile diversion is proposed, from NY490893, north of Newcastlton, straight up the valley of the Hermitage Water, then the Roughly Burn, to join HS3, which has already absorbed the northern part of the route, at NY531988, Riccarton North Junction, and then share the route to Edinburgh. This part is described in the HS3 Route and Service Plans article and will not be repeated here, though the maps will be, for completeness. This section does of course feature in the service plans.

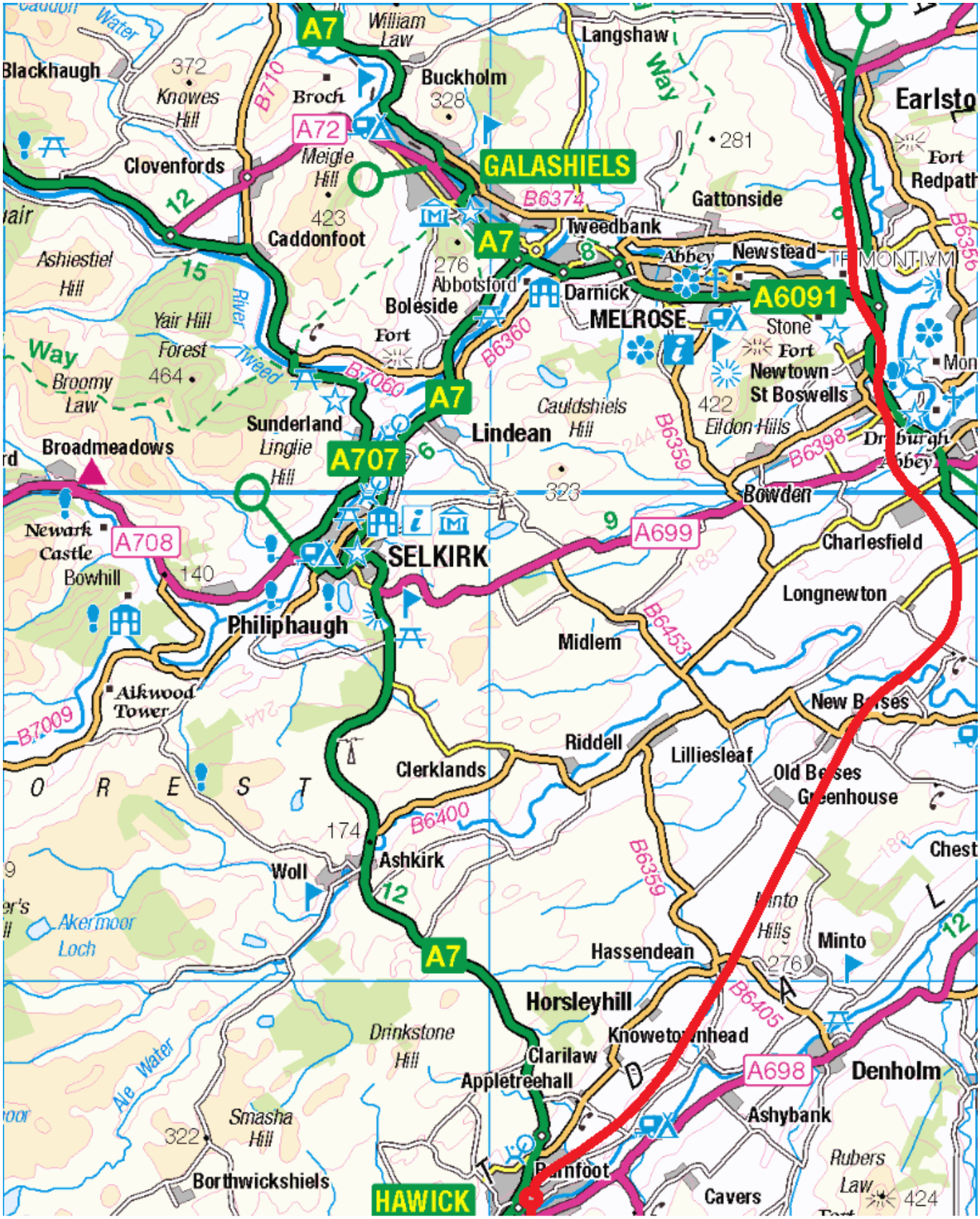
It is necessary to demonstrate the feasibility of the diversion between Newcastleton and Riccarton North Junction. The point of diversion is at an altitude of 400ft, and Riccarton North Junction is at 900ft, in a distance of 6 miles, so 500ft in 6 miles – 1 in 63. But things are rarely so convenient, and indeed here the altitude at NY514952 on the Roughly Burn, just 2 miles from Riccarton North Junction is only 500ft, leaving a climb of 400ft in 2 miles – 1 in 26. As I understand it, this is actually (just!) within the capacity of a HS train, but I don't like it; I try never to recommend a gradient in excess of 1 in 40. The valleys of the Hermitage Water and Roughly Burn are, however, cooperative – no side valleys making major viaducts unavoidable. So we can climb up the valley side to keep the gradients down. By passing through the following locations (with heights) the gradient is kept within 100ft/mile – 1 in 53: NY508927 (500ft), NY514953 (600ft), NY519957 (700ft) and NY525972 (800ft).



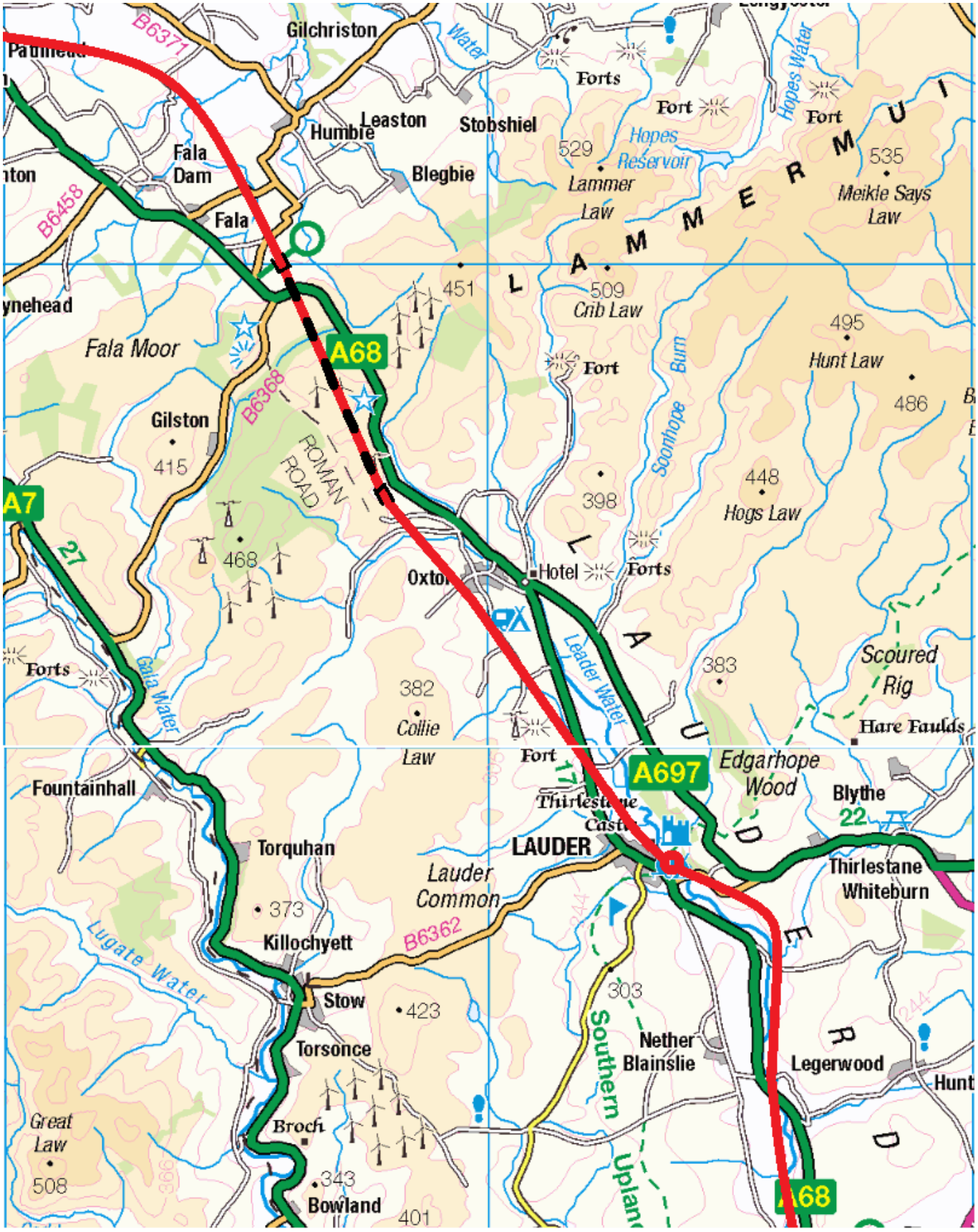
5.1 Harker – Kershopefoot



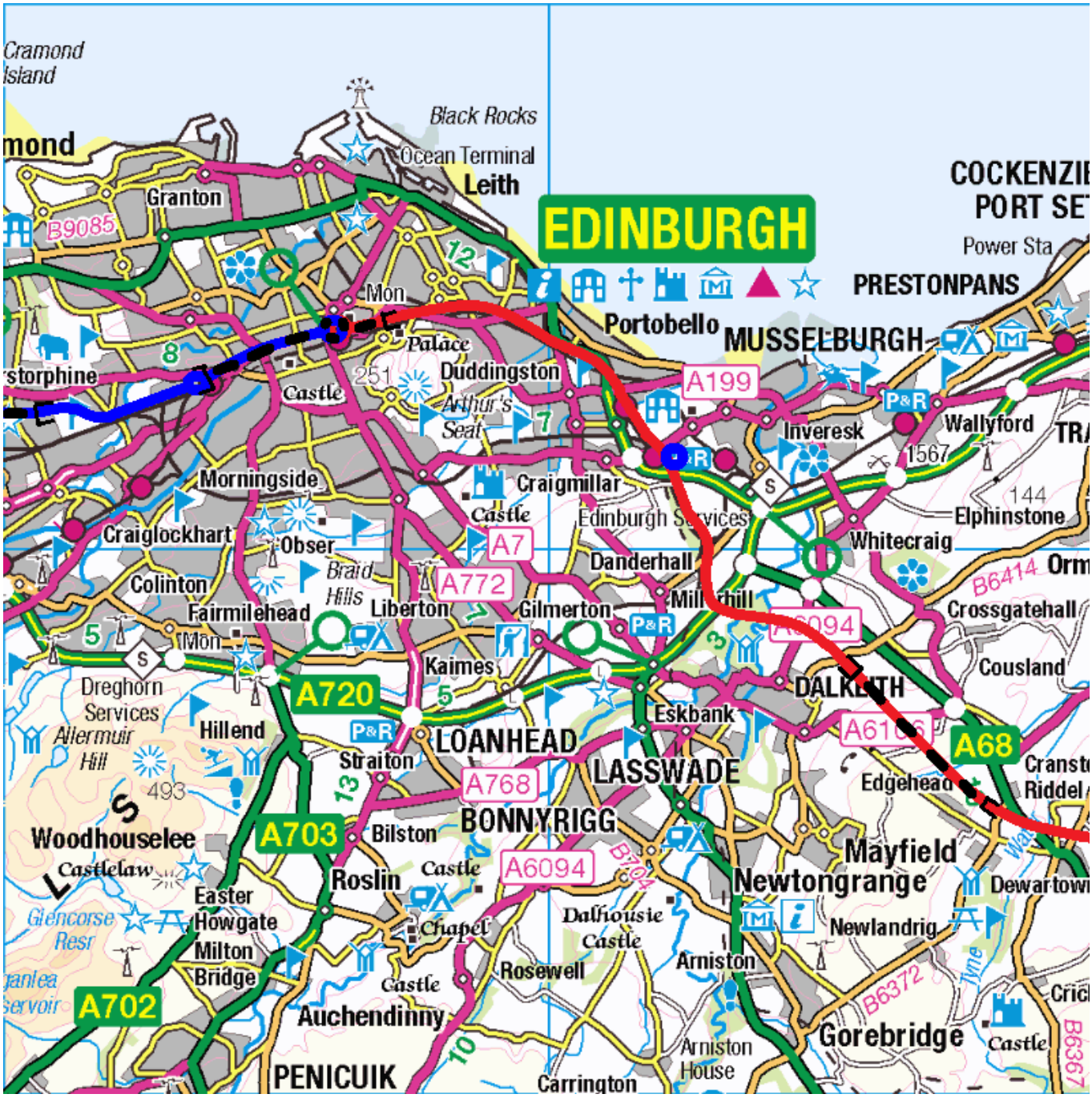
5.2 Old Castleton – Hawick



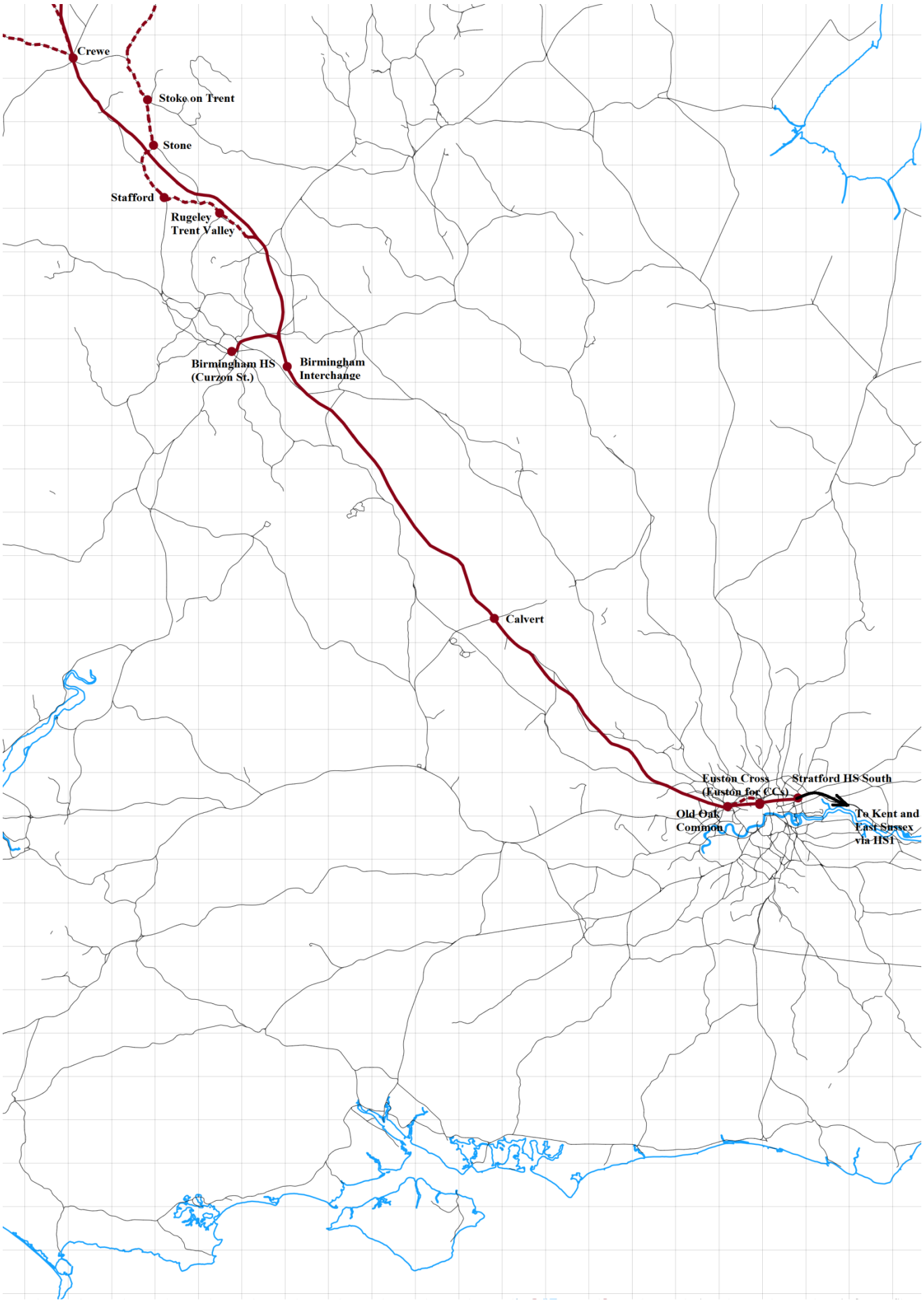
5.3 Hawick – Earlston

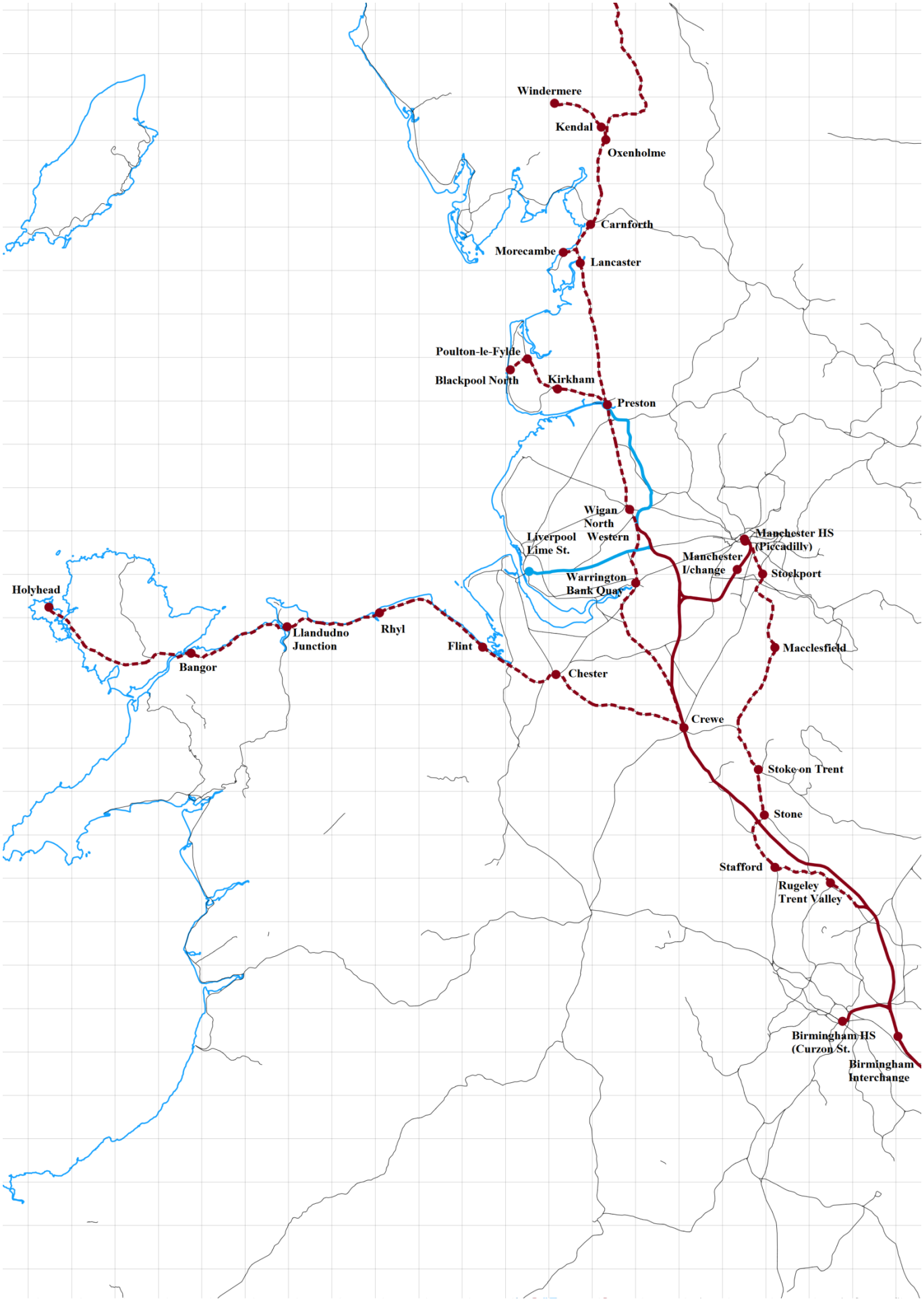


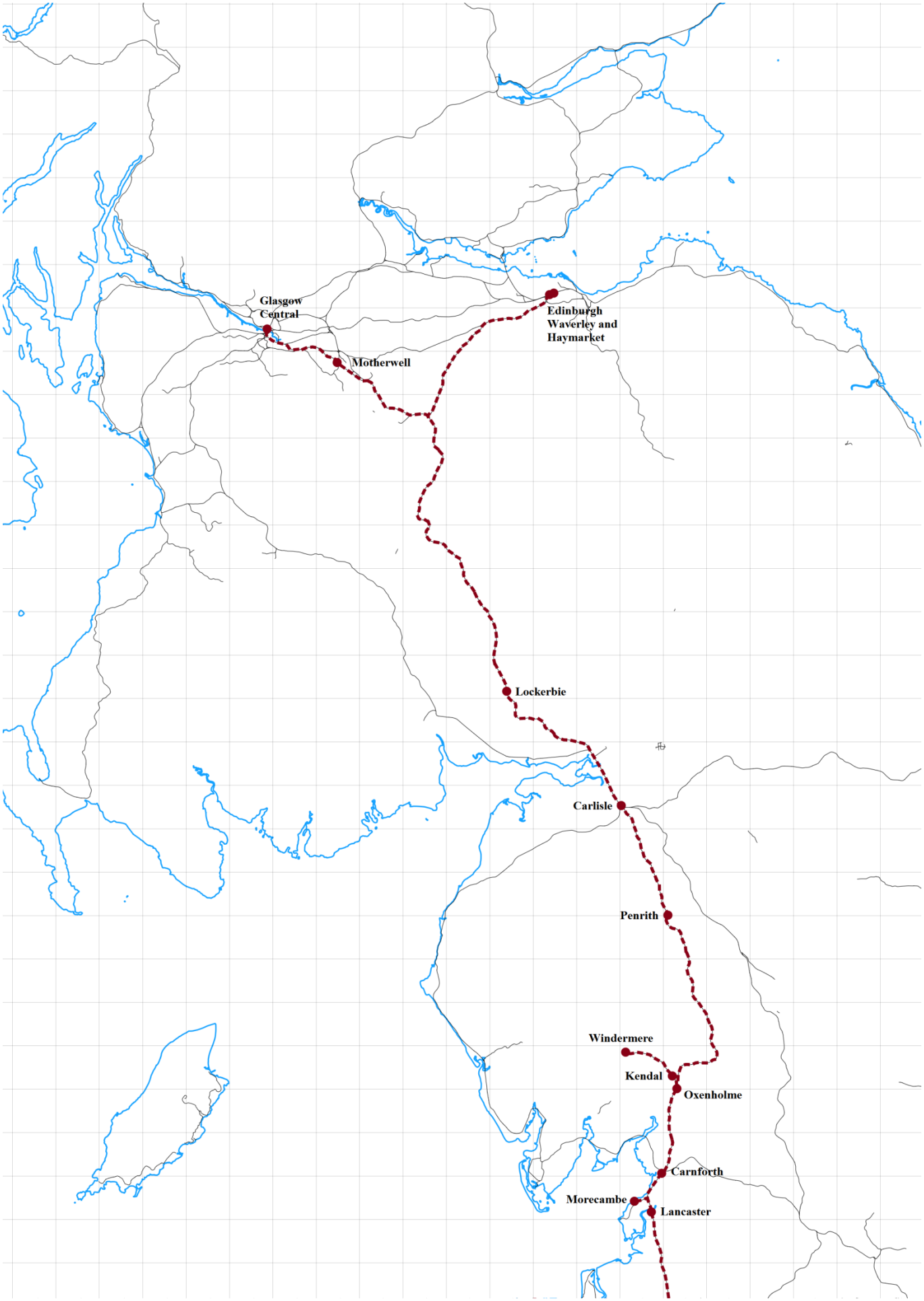
5.4 Legerwood – Pathhead

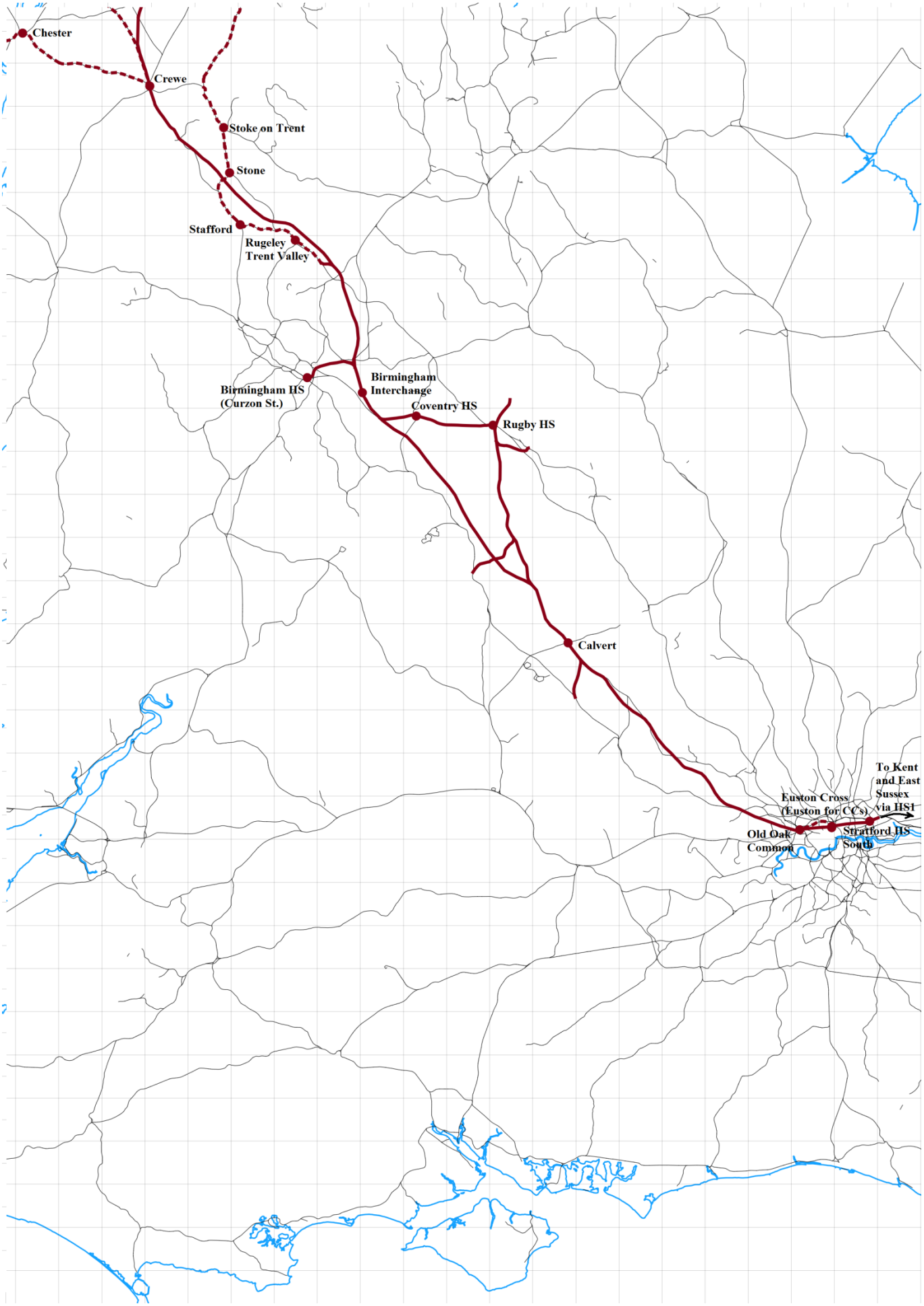


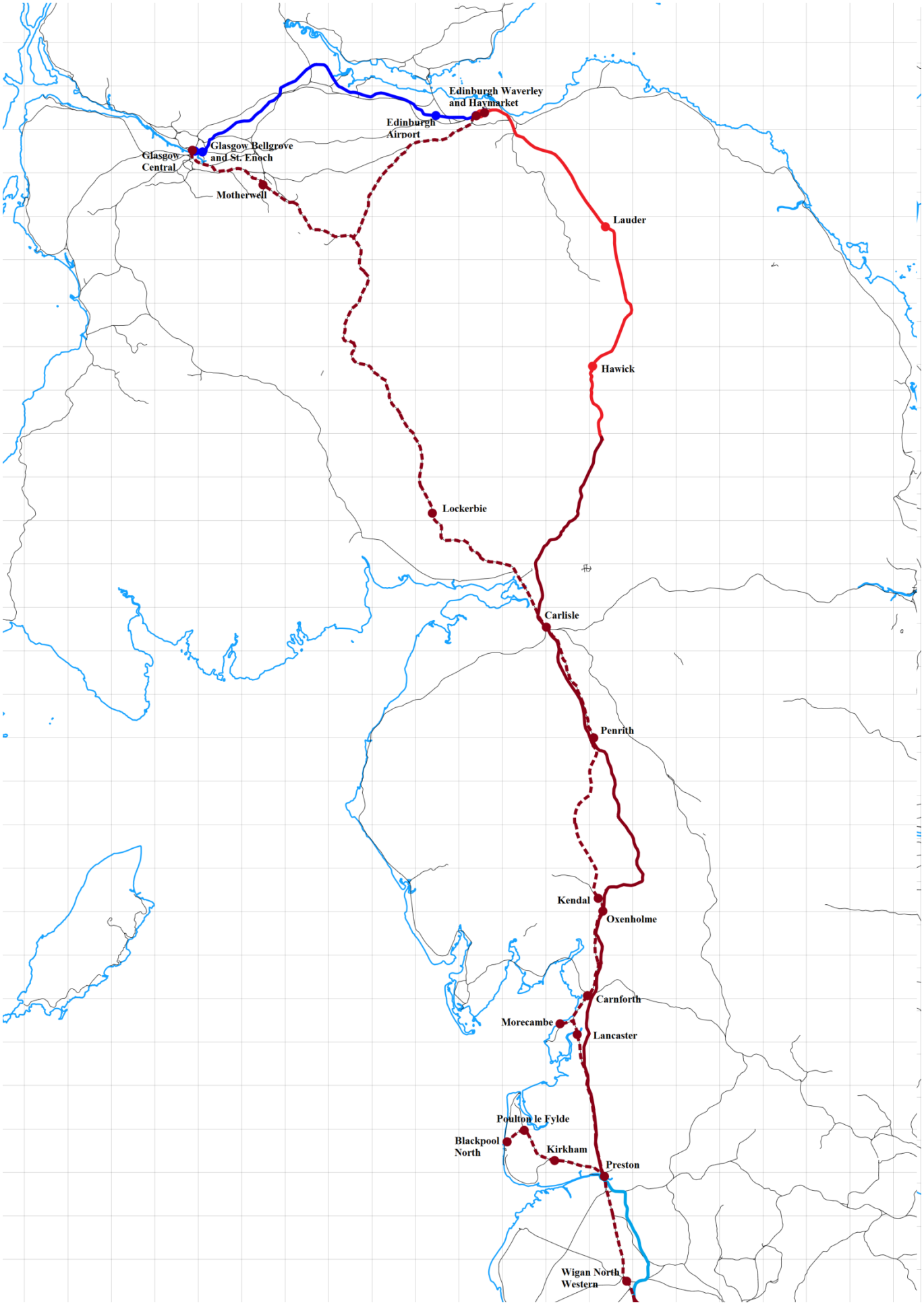
5.5 Dewar Town – Edinburgh

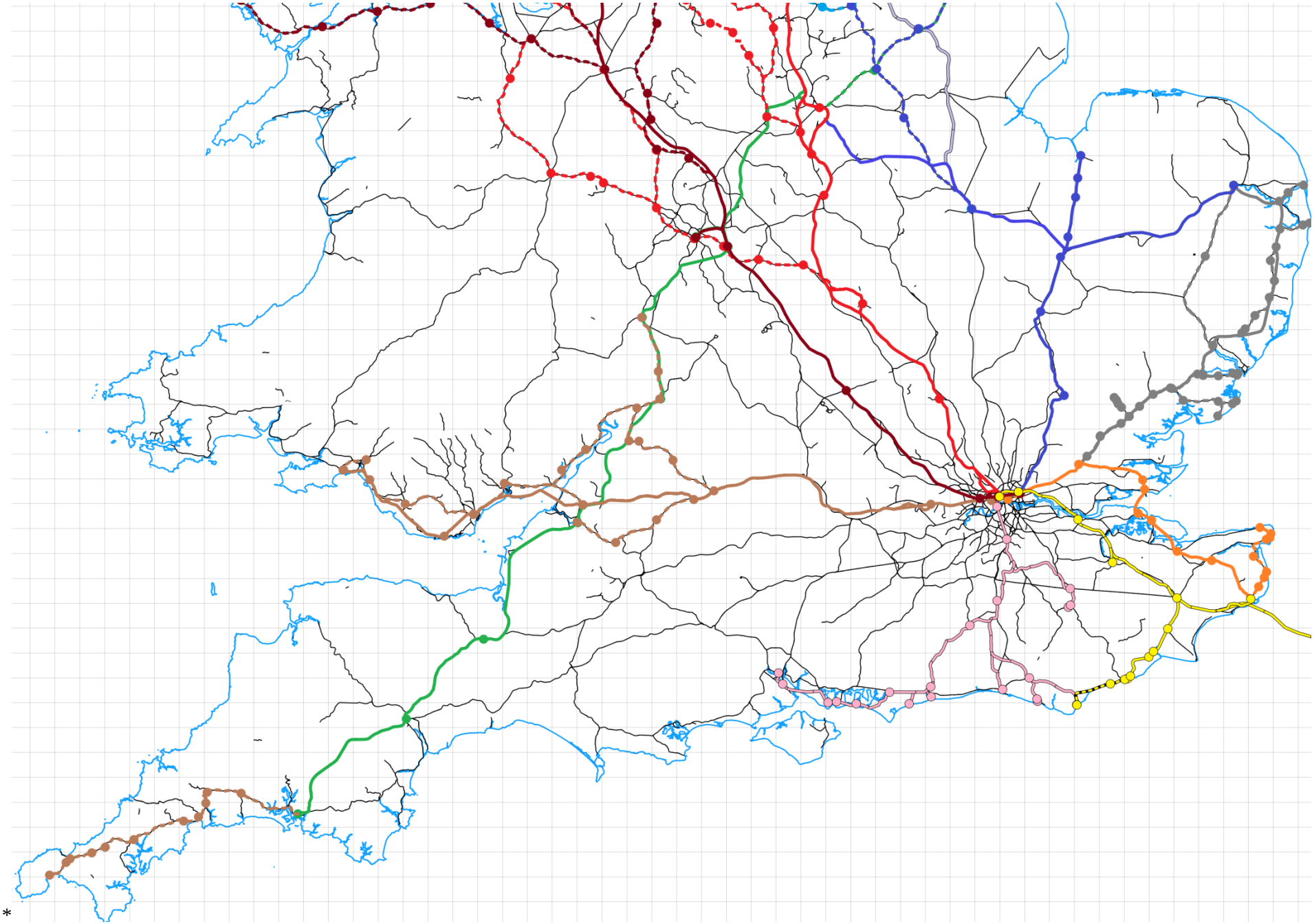












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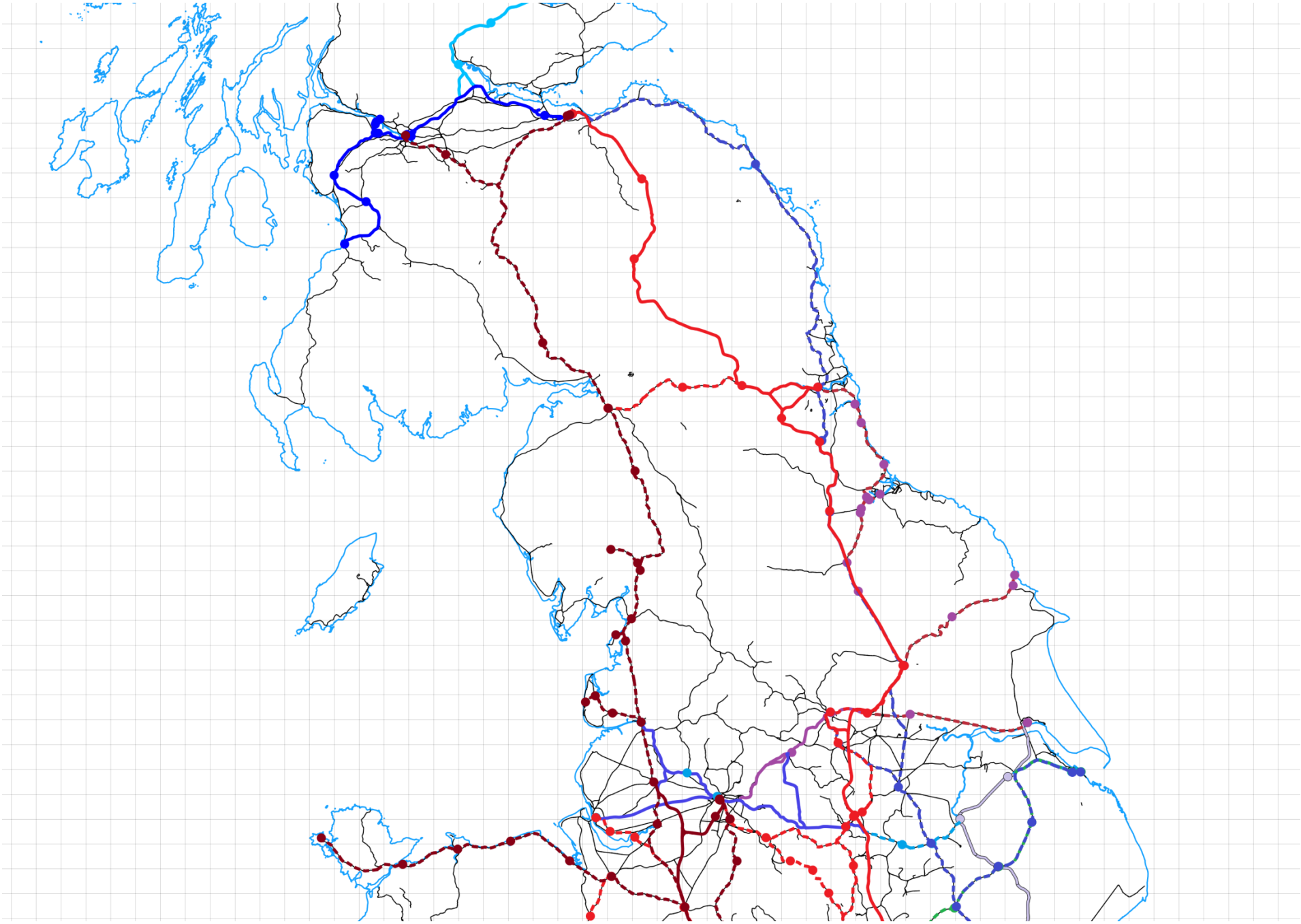
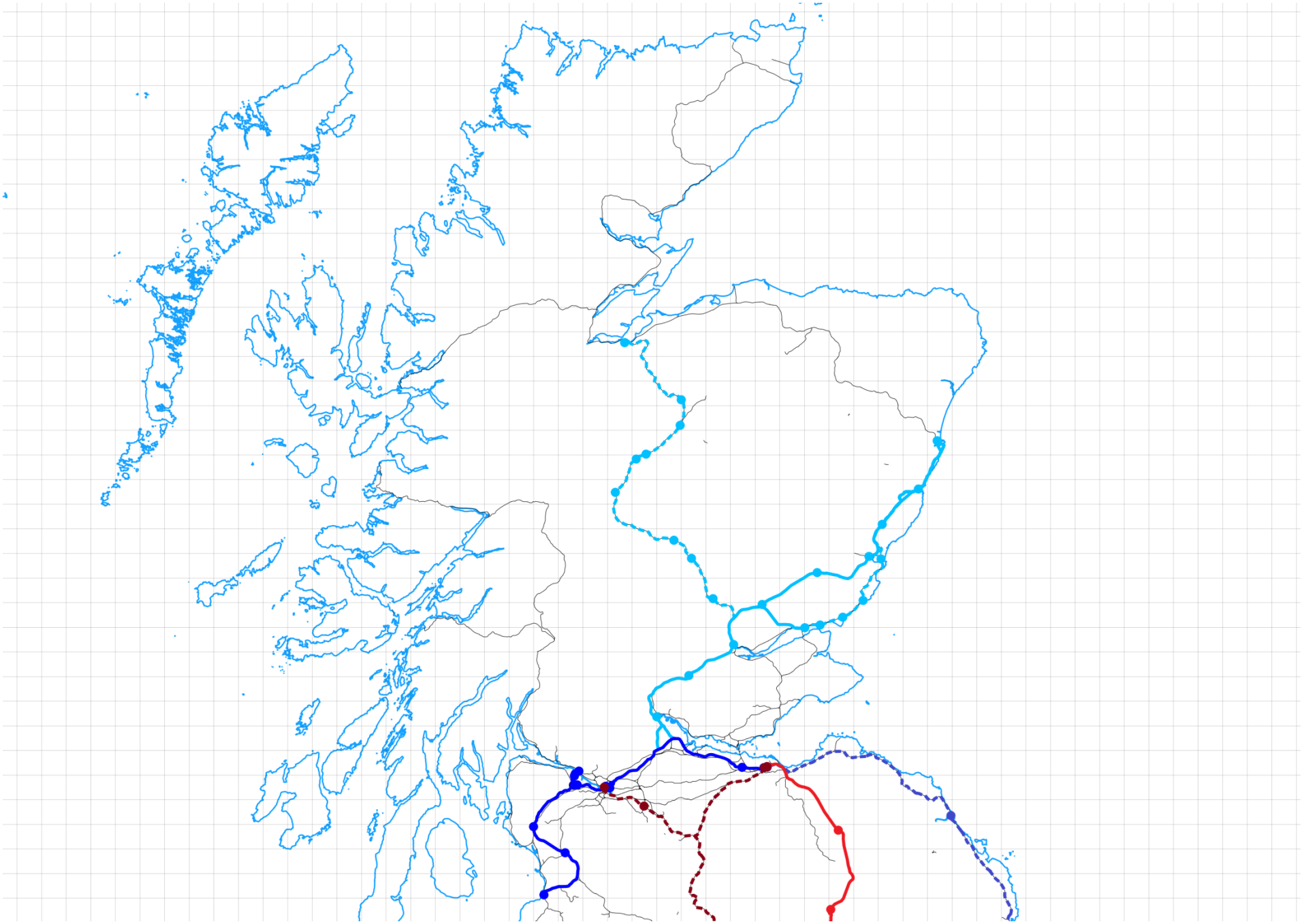
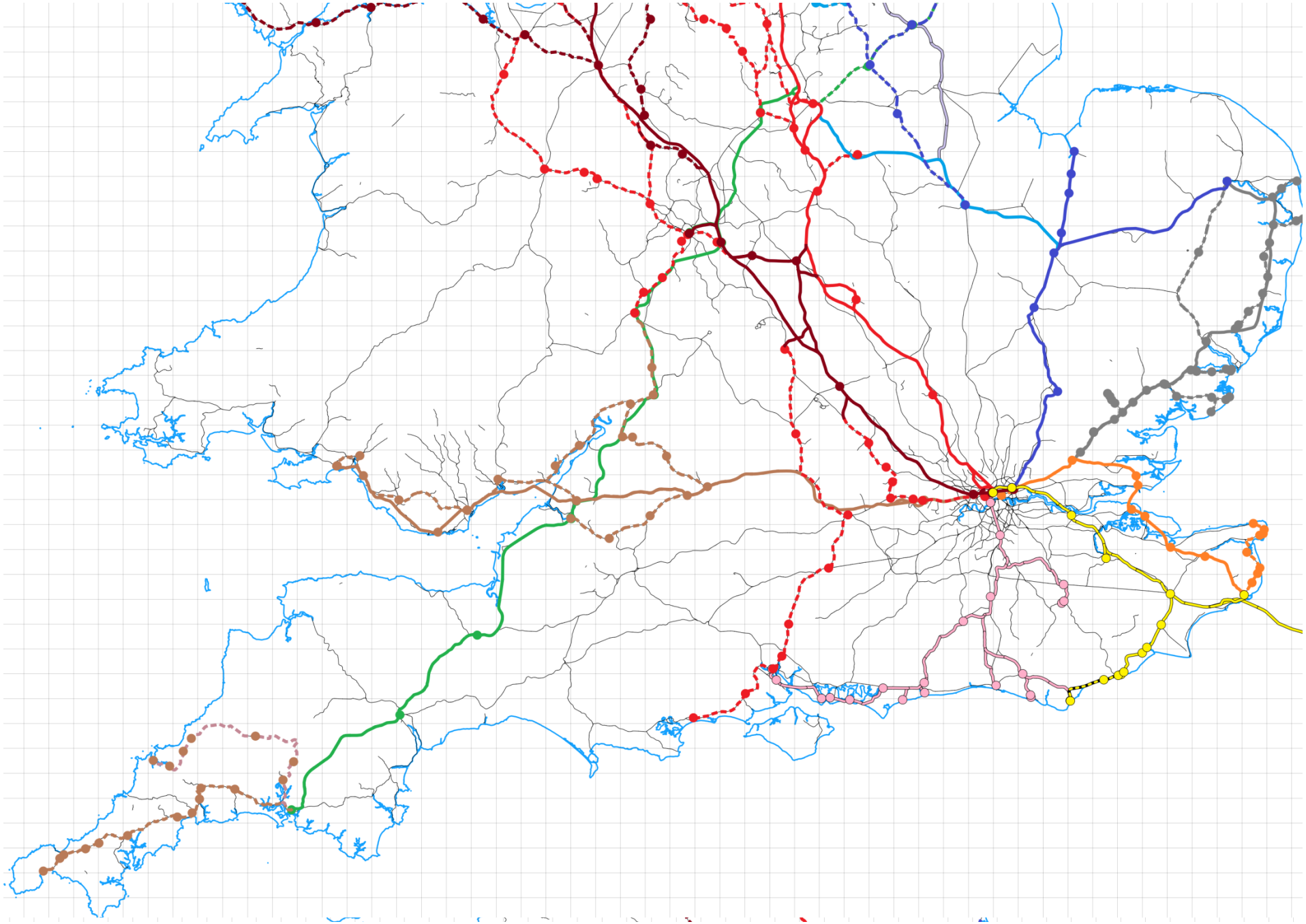
Complete HS Network, South Sheet



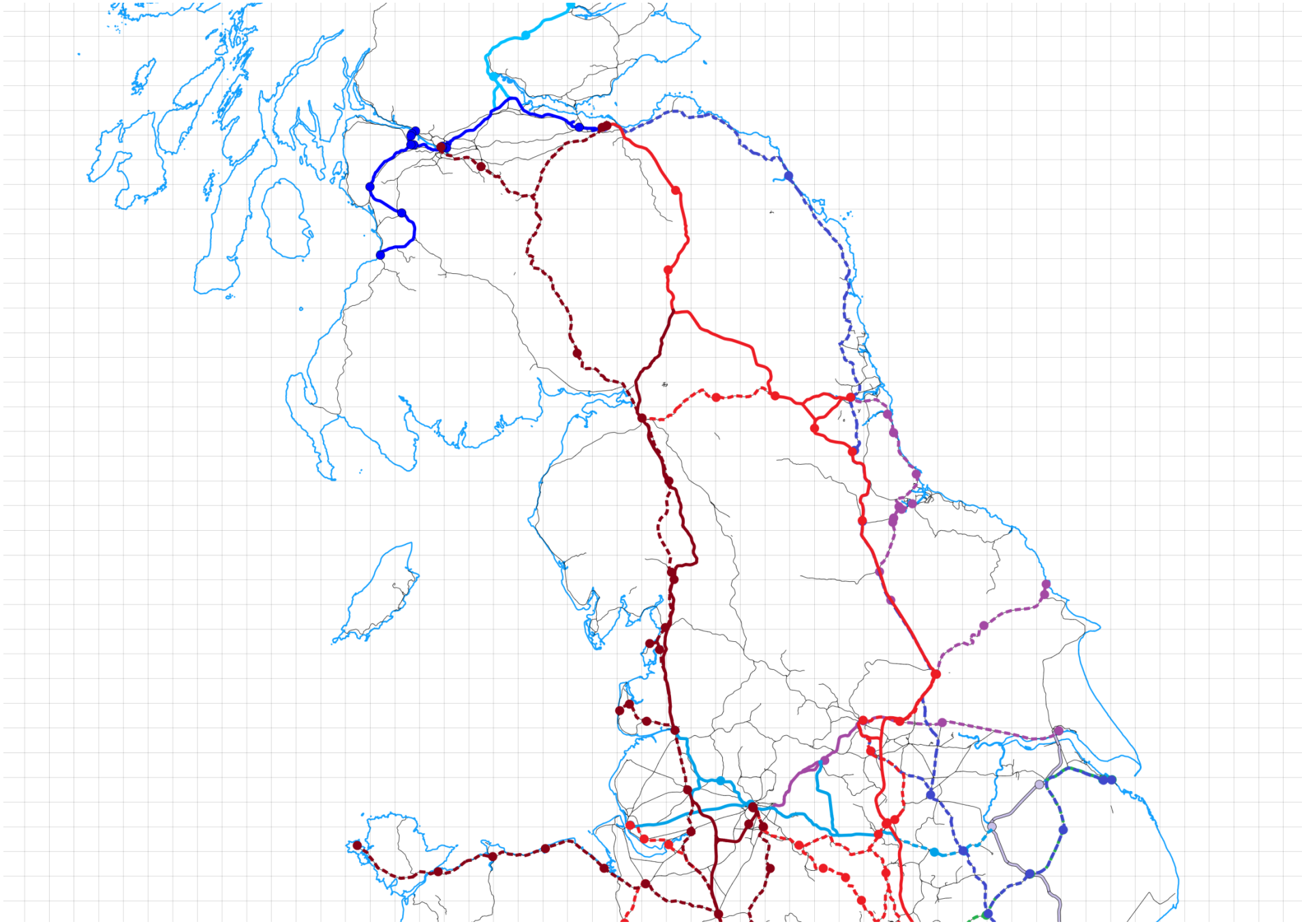
Complete HS Network, Central Sheet



Complete HS Network, North Sheet



Extended HS Network, South Sheet



Extended HS Network, Central Sheet

The Service Plans

A new service plan comes into effect when some significant change takes place which causes a change to the service loadings of one or more sections of HS3 itself. This most commonly occurs when a new section of HS3 opens, but it may also be a consequence of a change on some other HS route.

The service plans use the following notation:

- tph trains per hour
- G GC gauge train
- GG GC gauge, double deck train
- C classic-compatible train
- R Regional Metro train, semi-fast service
- RS Regional Metro train, stopping service (all stations)

Occasionally other notations are used; these will be defined when used.

As was mentioned earlier, the service plans deliberately envisage maximum frequencies. The results may thus seem, at least initially, somewhat optimistic.

Service Plan 1

The first service plan comes into effect as soon as HS2 Phase 1, the core route between Euston and Birmingham / Handsacre Junction, opens. The GC-gauge service to Birmingham starts, initially, from Old Oak Common. The other services are all classic-compatible, from Euston.

- 3tphG Old Oak Common – Birmingham Interchange – Birmingham HS
- 2tphC Euston – Old Oak Common – Stockport – Manchester Piccadilly
- 1tphC Euston – Old Oak Common – Crewe – Wilmslow – Stockport – Manchester Piccadilly
- 2tphC Euston – Old Oak Common – Calvert – Birmingham Interchange – Rugeley Trent Valley – Stafford – Stone – Stoke on Trent – Macclesfield – Stockport – Manchester Piccadilly
- 2tphC Euston – Old Oak Common – Stafford – Crewe – Runcorn – Liverpool Lime Street
- 1tphC Euston – Old Oak Common – Stafford – Crewe – Chester
- 1tphC Euston – Old Oak Common – Warrington Bank Quay – Wigan North Western – Preston – Lancaster – Oxenholme – Carlisle – Glasgow Central
- 1tphC Euston – Old Oak Common – Warrington Bank Quay – Wigan North Western– Preston – Lancaster – Penrith – Carlisle – Edinburgh Waverley
- 2tphC Birmingham HS – Rugeley Trent Valley – Stafford – Stone – Stoke on Trent – Macclesfield – Stockport – Manchester Piccadilly
- 1tphC Birmingham HS – Crewe – Warrington Bank Quay – Wigan North Western – Preston (splits/joins) – :
  – Oxenholme – Carlisle – Lockerbie – Haymarket – Edinburgh Waverley
  – Lancaster – Penrith – Carlisle – Lockerbie – Glasgow Central

As compared with current services on the WCML, this frees up 6 slots/hour south of Lichfield WCML Junction.

There are no interchanges at this service plan.

The following loadings are imposed on HS2:

- Euston Cross – Old Oak Common East Junction 0tph
- Old Oak Common East Junction – Old Oak Common station 0tph
- [Euston –] Queens Park Junction – Old Oak Common station 10tph
- Old Oak Common station – Water Orton South Junction 13tph
- Water Orton South Junction – Water Orton West Junction 3tph
- Water Orton West Junction – Birmingham HS 6tph
- Water Orton West Junction – Water Orton North Junction 3tph
- Water Orton South Junction – Water Orton North Junction 10tph
- Water Orton North Junction – Streethay Junction 13tph
- Streethay Junction – Handsacre Junction 13tph
- Streethay Junction – Crewe HS South Junction 0tph
- Crewe HS South Junction – Crewe HS North Junction 0tph
- Crewe HS South Junction – Crewe station 0tph
- Crewe station – Crewe HS North Junction 0tph
- Crewe HS North Junction – Rostherne South Junction 0tph
- Rostherne South Junction – Rostherne East Junction 0tph
- Rostherne East Junction – Manchester HS 0tph
- Rostherne East Junction – Rostherne North Junction 0tph
- Rostherne South Junction – Rostherne North Junction 0tph
- Rostherne North Junction – Kenyon South Junction 0tph
- Kenyon South Junction – Kenyon West Junction 0tph
- Kenyon West Junction – Liverpool Lime St. station 0tph
- Kenyon West Junction – Kenyon North Junction 0tph
- Kenyon South Junction – Kenyon North Junction 0tph
- Kenyon North Junction – Bamfurlong Junction 0tph
- Bamfurlong Junction – Gibb Farm Junction 0tph
- Gibb Farm Junction – Preston station 0tph
- Preston station – Galgate Junction 0tph
- Galgate Junction – Carlisle station 0tph
- Carlisle station – Riccarton North Junction 0tph
- Riccarton North Junction – Ravenswood Junction 0tph
- Ravenswood Junction – Edinburgh Waverley station 0tph

Service Plan 1A

This service plan comes into effect as soon as HS2 Phase 2A, the extension from Streethay Junction to Crewe HS South Junction, opens. Those services north of Lichfield **not** stopping at Stafford, viz:

- 2tphC Euston – Old Oak Common – Crewe – Stockport – Manchester Piccadilly
- 1tphC Euston – Old Oak Common – Crewe – Wilmslow – Stockport – Manchester Piccadilly

- 1tphC Euston – Old Oak Common – Warrington Bank Quay – Wigan North Western – Preston – Lancaster – Oxenholme – Carlisle – Glasgow Central
- 1tphC Euston – Old Oak Common – Warrington Bank Quay – Wigan North Western – Preston – Lancaster – Penrith – Carlisle – Edinburgh Waverley
- 1tphC Birmingham HS – Crewe – Warrington Bank Quay – Wigan North Western– Preston (splits/joins) – :
  – Oxenholme – Carlisle – Lockerbie – Haymarket – Edinburgh Waverley
  – Lancaster – Penrith – Carlisle – Lockerbie – Glasgow Central

now proceed directly from Streethay Junction to Crewe. The only changes in the route loadings are thus:

- [Water Orton North Junction – Streethay Junction 13tph]
- Streethay Junction – Handsacre Junction 7tph
- Streethay Junction – Crewe HS South Junction 6tph
- [Crewe South Junction – Crewe HS North Junction 0tph]

Service Plan 2

This service plan comes into effect as soon as the first section of HS3, south of Northampton, opens. A classic-compatible service begins between St. Pancras and Wolverhampton, splitting/joining there, and proceeding on to Liverpool and Chester:

- 2tphC St. Pancras – Luton Airport Parkway – Northampton – Rugby – Coventry – Birmingham New St. – Wolverhampton (splits/joins) – :
  – Stafford – Crewe – Runcorn – Liverpool S. Parkway – Liverpool Lime St.
  – Telford – Wellington – Shrewsbury – Wrexham – Chester

This supplants the 2tph Euston – Liverpool and 1tph Euston – Chester of service plan 1. These are replaced by:

- 2tphC Euston – Old Oak Common – Birmingham Interchange – Crewe – Warrington Bank Quay – Wigan North Western – Preston (splits/joins) –:
  – Kirkham – Poulton le Fylde – Blackpool
  – Lancaster – Oxenholme – Kendal – Windermere
- 1tphC Euston – Old Oak Common – Crewe – Chester – Flint – Rhyl – Llandudno Junction – Bangor – Holyhead

The only changes in the route loadings are thus:

- [Water Orton North Junction – Streethay Junction 13tph]
- Streethay Junction – Handsacre Junction 4tph
- Streethay Junction – Crewe HS South Junction 9tph
- [Crewe South Junction – Crewe HS North Junction 0tph]

The service to St. Pancras replaces the classic service from Birmingham to London, and thus frees up 3 further slots/hour on the WCML south of Rugby.

Service Plan 3

This service plan comes into effect when:

- HS2 phase 2B opens from Crewe HS South Junction to Manchester and Wigan
- HS8 opens to Liverpool Lime St. from Kenyon South and North Junctions
- HS2 opens from Euston Cross to Old Oak Common North Junction
- HS2 opens from Euston Cross to Woodgrange Road Junction, where it merges with HS1.

The 3tph Euston – Manchester via Crewe become GC-gauge, add a fourth, and switch to the new route, also from Euston to Euston Cross. The existing 3tph GC-gauge to Birmingham similarly add a fourth, and are extended to Euston Cross. The 2tph from Birmingham to Manchester likewise become GC-gauge and switch to the new route. New services of 1tphC from Birmingham to Holyhead, and 1tph Liverpool – Scotland (same stopping pattern as Birmingham – Scotland), are added. The full service on HS2 is thus (including the HS1 origins of the GC-gauge inter-regional services):

- 4tphGG [HS1 Maidstone –>] Euston Cross – Old Oak Common – Birmingham Interchange – Birmingham HS
- 4tphGG [HS1 Dover –>] Euston Cross – Old Oak Common – Manchester Interchange – Manchester HS
- 2tphGG [HS1 Hastings –>] Euston Cross – Old Oak Common – Crewe – Liverpool Lime St.
- 2tphC Euston – Old Oak Common – Calvert – Birmingham Interchange – Rugeley Trent Valley – Stafford – Stone – Stoke on Trent – Macclesfield – Stockport –Manchester Piccadilly
- 2tphC Euston – Old Oak Common – Calvert – Birmingham Interchange – Crewe – Warrington Bank Quay – Wigan North Western – Preston (splits/joins) –:
  – Kirkham – Poulton le Fylde – Blackpool
  – Lancaster – Oxenholme – Kendal – Windermere
- 1tphC Euston – Old Oak Common – Crewe – Chester – Flint – Rhyl – Llandudno Junction – Bangor – Holyhead
- 1tphC Euston – Old Oak Common – Warrington Bank Quay – Wigan North Western – Preston – Lancaster – Oxenholme – Carlisle – Glasgow Central
- 1tphC Euston – Old Oak Common – Warrington Bank Quay – Wigan North Western– Preston – Lancaster – Penrith – Carlisle – Edinburgh Waverley
- 2tphGG Birmingham HS – Crewe – Manchester Interchange – Manchester HS
- 1tphC Birmingham HS – Crewe – Chester – Flint – Rhyl – Llandudno Junction – Bangor – Holyhead
- 1tphC Birmingham HS – Crewe –Wigan North Western – Preston (splits/joins) – :
  – Oxenholme – Carlisle – Lockerbie – Haymarket – Edinburgh Waverley
  – Lancaster – Penrith – Carlisle – Lockerbie – Glasgow Central
- 1tphC Liverpool Lime St. –Wigan North Western – Preston (splits/joins) – :
  – Oxenholme – Carlisle – Lockerbie – Haymarket – Edinburgh Waverley
  – Lancaster – Penrith – Carlisle – Lockerbie – Glasgow Central

Representative Hourly Cross-Platform Interchange Pattern at Birmingham HS:

00GG Euston Cross – Birmingham HS
GG Birmingham HS – Manchester HS

15GG Euston Cross – Birmingham HS
C Birmingham HS – Edinburgh / Glasgow

30GG Euston Cross – Birmingham HS
GG Birmingham HS – Manchester HS

45GG Euston Cross – Birmingham HS
C Birmingham HS – Holyhead

Representative Hourly Cross-Platform Interchange Pattern at Crewe:

00C Euston – Preston – Blackpool / Windermere
C Euston – Holyhead

30C Euston – Preston – Blackpool / Windermere
C Birmingham HS – Holyhead

The following loadings are imposed on HS2:

- Euston Cross – Old Oak Common East Junction 10tph
- Old Oak Common East Junction – Old Oak Common North Junction 10tph
- [Euston –] Queens Park Junction – Old Oak Common North Junction 7tph
- Old Oak Common North Junction – Water Orton South Junction 17tph
- Water Orton South Junction – Water Orton West Junction 4tph
- Water Orton West Junction – Birmingham HS 8tph
- Water Orton West Junction – Water Orton North Junction 4tph
- Water Orton South Junction – Water Orton North Junction 13tph
- Water Orton North Junction – Streethay Junction 17tph
- Streethay Junction – Handsacre Junction 2tph
- Streethay Junction – Crewe HS South Junction 15tph
- Crewe HS South Junction – Crewe HS North Junction 4tph
- Crewe HS South Junction – Crewe station 9tph
- Crewe station – Crewe HS North Junction 5tph
- Crewe HS North Junction – Rostherne South Junction 9tph
- Rostherne South Junction – Rostherne East Junction 6tph
- Rostherne East Junction – Manchester HS 6tph
- Rostherne East Junction – Rostherne North Junction 0tph
- Rostherne South Junction – Rostherne North Junction 3tph
- Rostherne North Junction – Kenyon South Junction 3tph
- Kenyon South Junction – Kenyon West Junction 2tph
- Kenyon West Junction – Liverpool Lime St. station 3tph
- Kenyon West Junction – Kenyon North Junction 1tph
- Kenyon South Junction – Kenyon North Junction 1tph
- Kenyon North Junction – Bamfurlong Junction 2tph
- Bamfurlong Junction – Gibb Farm Junction 0tph
- Gibb Farm Junction – Preston station 0tph
- Preston station – Galgate Junction 0tph

- Galgate Junction – Carlisle station 0tph
- Carlisle station – Riccarton North Junction 0tph
- Riccarton North Junction – Ravenswood Junction 0tph
- Ravenswood Junction – Edinburgh Waverley station 0tph

(The two users of the north end of the main line are the Birmingham /Liverpool – Scotland services. The solitary user of Lichfield WCML Junction is the 2tph Euston – Manchester Piccadilly via Stoke service.)

Service Plan 4

This service plan comes into effect only when the Transpennine routes HS8 and HS9 open fully between Manchester HS and Liverpool / Bolton and Preston. The connections between HS2 and HS8 at Kenyon Junctions were made in service plan 3. Now a connection is likewise made between HS2 at Bamfurlong Junction and HS8 at Gibb Farm Junction making available a GC-gauge route between London and Preston.

- 2tphGG [HS1 Hastings –>] Euston Cross – Old Oak Common – Crewe – Preston

This increases the route loadings by 2tph between Euston Cross and Bamfurlong.

HS4 has opened between Old Oak Common East and West Junctions, and is now sharing Euston Cross. This affects only the section loading between Euston Cross and Old Oak Common East Junction.

When HS7 opens, it has no effect on HS2's service plan, but does give rise to interchange arrangements at Birmingham Interchange; HS7 occupies the outer and HS2 the inner platforms, giving cross-platform interchange. HS7's own services have cross-platform interchange at Birmingham HS, and also non-cross-platform interchange with HS2.

Representative Hourly Cross-Platform Interchange Pattern at Birmingham Interchange:

00C Euston – Manchester Piccadilly
G HS7 Bristol Temple Meads HS (later from Plymouth) – York (later to Newcastle)

15C Euston – Preston – Blackpool / Windermere
G HS4/HS7 Cardiff HS (later from Swansea) – Nottingham (later to Norwich)

– repeating at 30 and 45 minutes past.

Representative Hourly Cross-Platform Interchange Pattern at Birmingham HS (paired by HS2 and HS7):

00GG Euston Cross – Birmingham HS
GG Birmingham HS – Manchester HS
G HS7 Bristol Temple Meads BT – Birmingham HS
G HS7 Birmingham HS – York

15GG Euston Cross – Birmingham HS
C Birmingham HS – Edinburgh / Glasgow OR Birmingham HS – Holyhead (at 45 minutes past)
G HS4/HS7 Cardiff HS – Birmingham HS
G HS7 Birmingham HS – Cleethorpes

– repeating at 30 and 45 minutes past.

The following loadings are imposed on HS2:

- Euston Cross – Old Oak Common East Junction 18tph
- Old Oak Common East Junction – Old Oak Common North Junction 12tph
- [Euston –] Queens Park Junction – Old Oak Common North Junction 7tph
- Old Oak Common North Junction – Water Orton South Junction 19tph
- Water Orton South Junction – Water Orton West Junction 4tph
- Water Orton West Junction – Birmingham HS 8tph
- Water Orton West Junction – Water Orton North Junction 4tph
- Water Orton South Junction – Water Orton North Junction 15tph
- Water Orton North Junction – Streethay Junction 19tph
- Streethay Junction – Handsacre Junction 2tph
- Streethay Junction – Crewe HS South Junction 17tph
- Crewe HS South Junction – Crewe HS North Junction 4tph
- Crewe HS South Junction – Crewe station 11tph
- Crewe station – Crewe HS North Junction 7tph
- Crewe HS North Junction – Rostherne South Junction 11tph
- Rostherne South Junction – Rostherne East Junction 6tph
- Rostherne East Junction – Manchester HS 6tph
- Rostherne East Junction – Rostherne North Junction 0tph
- Rostherne South Junction – Rostherne North Junction 5tph
- Rostherne North Junction – Kenyon South Junction 5tph
- Kenyon South Junction – Kenyon West Junction 2tph
- Kenyon West Junction – Liverpool Lime St. station 13tph
- Kenyon West Junction – Kenyon North Junction 1tph
- Kenyon South Junction – Kenyon North Junction 3tph
- Kenyon North Junction – Bamfurlong Junction 2tph
- Bamfurlong Junction – Gibb Farm Junction 2tph
- Gibb Farm Junction – Preston station 10tph
- Preston station – Galgate Junction 0tph
- Galgate Junction – Carlisle station 0tph
- Carlisle station – Riccarton North Junction 0tph
- Riccarton North Junction – Ravenswood Junction 0tph
- Ravenswood Junction – Edinburgh Waverley station 0tph

(Note that the loadings between Kenyon West Junction and Liverpool Lime St. station, and between Gibb Farm Junction and Preston station include the **full** HS8/HS9 service.)

Note that the loadings between Old Oak Common North Junction and Water Orton South Junction, and between Water Orton North Junction and Streethay Junction are, at 19tph, somewhat over the desired maximum.

Service Plan 4A

This service plan comes into effect when HS3 opens to Scotland. The two HS2 services from London to Scotland switch to HS3, but the Birmingham / Liverpool to Scotland services remain, as they usefully serve intermediate locations. The route loadings between Euston and Crewe HS South Junction are thus reduced by 2tph (all other loadings are unchanged,):

- Euston Cross – Old Oak Common East Junction 18tph
- Old Oak Common East Junction – Old Oak Common North Junction 12tph
- [Euston –] Queens Park Junction – Old Oak Common North Junction 5tph
- Old Oak Common North Junction – Water Orton South Junction 17tph
- Water Orton South Junction – Water Orton West Junction 4tph
- Water Orton West Junction – Birmingham HS 8tph
- Water Orton West Junction – Water Orton North Junction 4tph
- Water Orton South Junction – Water Orton North Junction 13tph
- Water Orton North Junction – Streethay Junction 17tph
- Streethay Junction – Handsacre Junction 2tph
- Streethay Junction – Crewe HS South Junction 15tph

Service Plan 4 Summary

It's worth summarising the full set of services at service plan 4, as this represents the final, complete state of these plans, in the absence of / prior to the Scottish extension (this will certainly be the service plan over a prolongued period) and the services have so far been introduced piecemeal, at the various stages.

- 4tphGG [HS1 Maidstone –>] Euston Cross – Old Oak Common – Birmingham Interchange – Birmingham HS
- 4tphGG [HS1 Dover –>] Euston Cross – Old Oak Common – Manchester Interchange – Manchester HS
- 2tphGG [HS1 Hastings –>] Euston Cross – Old Oak Common – Crewe – Liverpool Lime St.
- 2tphGG [HS1 Hastings –>] Euston Cross – Old Oak Common – Crewe – Preston
- 2tphC Euston – Old Oak Common – Calvert – Birmingham Interchange – Rugeley Trent Valley – Stafford – Stone – Stoke on Trent – Macclesfield – Stockport –Manchester Piccadilly
- 2tphC Euston – Old Oak Common – Calvert – Birmingham Interchange – Crewe – Warrington Bank Quay – Wigan North Western – Preston (splits/joins) –:
  – Kirkham – Poulton le Fylde – Blackpool
  – Lancaster – Oxenholme – Kendal – Windermere
- 1tphC Euston – Old Oak Common – Crewe – Chester – Flint – Rhyl – Llandudno Junction – Bangor – Holyhead
- 2tphGG Birmingham HS – Crewe – Manchester Interchange – Manchester HS
- 1tphC Birmingham HS – Crewe – Chester – Flint – Rhyl – Llandudno Junction – Bangor – Holyhead
- 1tphC Birmingham HS – Crewe – Preston (splits/joins) – :
  – Oxenholme – Carlisle – Lockerbie – Haymarket – Edinburgh Waverley
  – Lancaster – Penrith – Carlisle – Lockerbie – Glasgow Central

- 1tphC Liverpool Lime St. – Preston (splits/joins) – :
  – Oxenholme – Carlisle – Lockerbie – Haymarket – Edinburgh Waverley
  – Lancaster – Penrith – Carlisle – Lockerbie – Glasgow Central

Representative Hourly Cross-Platform Interchange Pattern at Birmingham Interchange:

00C Euston – Manchester Piccadilly
G HS7 Bristol Temple Meads HS (later from Plymouth) – York (later to Newcastle)

15C Euston – Preston – Blackpool / Windermere
G HS4/HS7 Cardiff HS (later from Swansea) – Nottingham (later to Norwich)

– repeating at 30 and 45 minutes past.

Representative Hourly Cross-Platform Interchange Pattern at Birmingham HS (paired by HS2 and HS7):

00GG Euston Cross – Birmingham HS
GG Birmingham HS – Manchester HS
G HS7 Bristol Temple Meads BT – Birmingham HS
G HS7 Birmingham HS – York

15GG Euston Cross – Birmingham HS
C Birmingham HS – Edinburgh / Glasgow OR Birmingham HS – Holyhead (at 45 minutes past)
G HS4/HS7 Cardiff HS – Birmingham HS
C HS7 Birmingham HS – Cleethorpes

– repeating at 30 and 45 minutes past.

Representative Hourly Cross-Platform Interchange Pattern at Crewe:

00C Euston – Preston – Blackpool / Windermere
C Euston – Holyhead

30C Euston – Preston – Blackpool / Windermere
C Birmingham HS – Holyhead

Service Plan 5

This service plan comes into effect probably quite a long time after service plan 4, when HS2-CV opens.

There are very few changes from service plan 4, and these are now listed and explained:

The 4tph Birmingham GC gauge service is now an HS Metro service, travelling via Coventry. However 2tph UHS to Birmingham are retained (since it is believed that the citizens of Birmingham would be much aggrieved to lose them all, and not consoled by a (still fast, but slower) service via Coventry. Space is made for these by cancelling 2tph UHS to Manchester, since there is now (from HS3 service plan 3) a UHS service of 2tph to Manchester, and on to Liverpool, via Sheffield, which are actually very slightly faster than the ones via Birmingham. So Manchester still has its 4tph from London, but now 2tph from Euston Cross and 2tph from Pancras Cross. The full service at SP5 is thus:

- 4tphGG [HS1 Maidstone –>] Euston Cross – Old Oak Common – Rugby HS – Coventry HS – Birmingham Interchange –Birmingham HS
- 2tphGG [HS1 Dover –>] Euston Cross – Old Oak Common – Birmingham Interchange – Birmingham HS
- 2tphGG [HS1 Dover –>] Euston Cross – Old Oak Common – Manchester Interchange – Manchester HS
- (also 2tphGG [HS5 Tunbridge Wells –>] HS3/HS8 Pancras Cross – Sheffield HS –Manchester HS – Manchester Victoria (LL) – Liverpool Lime St.)
- 2tphGG [HS1 Hastings –>] Euston Cross – Old Oak Common – Crewe – Liverpool Lime St.
- 2tphGG [HS1 Hastings –>] Euston Cross – Old Oak Common – Crewe – Preston
- 2tphC Euston – Old Oak Common – Calvert – Birmingham Interchange – Rugeley Trent Valley – Stafford –Stone – Stoke on Trent – Macclesfield – Stockport –Manchester Piccadilly
- 2tphC Euston – Old Oak Common – Calvert – Birmingham Interchange – Crewe – Warrington Bank Quay –Wigan North Western – Preston (splits/joins) –:
  – Kirkham – Poulton le Fylde – Blackpool
  – Lancaster – Oxenholme – Kendal – Windermere
- 1tphC Euston – Old Oak Common – Crewe – Chester – Flint – Rhyl – Llandudno Junction – Bangor – Holyhead
- 2tphGG Birmingham HS – Crewe – Manchester Interchange – Manchester HS
- 1tphC Birmingham HS – Crewe – Chester – Flint – Rhyl – Llandudno Junction – Bangor – Holyhead
- 1tphC Birmingham HS – Crewe – Preston (splits/joins) – :
  – Oxenholme – Carlisle – Lockerbie – Haymarket – Edinburgh Waverley
  – Lancaster – Penrith – Carlisle – Lockerbie – Glasgow Central
- 1tphC Liverpool Lime St. – Preston (splits/joins) – :
  – Oxenholme – Carlisle – Lockerbie – Haymarket – Edinburgh Waverley
  – Lancaster – Penrith – Carlisle – Lockerbie – Glasgow Central
- 2tphC Pancras Cross – Luton Airport Parkway – Northampton – Rugby HS – Coventry HS – Birmingham International – Birmingham New Street – Wolverhampton (splits/joins) – :
  1) – Stafford – Crewe – Runcorn – Liverpool South Parkway – Liverpool Lime Street
  2) – Telford – Wellington – Shrewsbury – Wrexham – Chester

- 2tphC Pancras Cross – Luton Airport Parkway – Northampton – Rugby HS – Coventry HS – Birmingham International – Birmingham New Street – University – Bromsgrove – Droitwich Spa – Worcester Shrub Hill.
- 2tphC Paddington – Old Oak Common – LHR Terminals 1,2,3 – LHR Terminal 5 – LHR Interchange – LHR Interchange – Slough – Maidenhead – Bourne End (connections to and from Marlow) – High Wycombe – Princes Risborough – Calvert – Rugby (GC?) – Leicester – Melton Mowbray
- 2tphC (XC) Bournemouth – Brockenhurst – Southampton – Southampton Aitport Parkway - Winchester – Basingstoke – Reading (reverse) – Oxford – Banbury – Rugby (GC ?) – Leicester – Nottingham – Chesterfield – Sheffield – South Yorkshire (Meadowhall) – Rotherham – Wakefield Westgate – Leeds City – Micklefield – York

Representative Hourly Cross-Platform Interchange Pattern at Birmingham Interchange:

00C Euston – Manchester Piccadilly
G HS7 Plymouth – Newcastle

15C Euston – Preston – Blackpool / Windermere
G HS4/HS7 Swansea –Norwich

– repeating at 30 and 45 minutes past.

Representative Hourly Cross-Platform Interchange Pattern at Birmingham HS (paired by HS2 and HS7):

00GG Euston Cross – Birmingham HS (HS Metro)
C Birmingham HS – Edinburgh / Glasgow OR Birmingham HS – Holyhead (at 30 minutes past)
G HS7 Bristol Temple Meads BT – Birmingham HS
G HS7 Birmingham HS – York

15GG Euston Cross – Birmingham HS (HS Metro)
GG Birmingham HS – Manchester HS
G HS4/HS7 Cardiff HS – Birmingham HS
C HS7 Birmingham HS – Cleethorpes

– repeating at 30 and 45 minutes past.

Representative Hourly Cross-Platform Interchange Pattern at Crewe:

00C Euston – Preston – Blackpool / Windermere
C Euston – Holyhead

30C Euston – Preston – Blackpool / Windermere
C Birmingham HS – Holyhead

Route loadings are given separately for the main lines (Euston Cross / Euston to Ashenden Junction, and above Streethay Junction, and the HS2-orig tracks between those locations) and for the relief lines (HS2-CV between Ashenden Junction and Streethay / Handsacre Junctions via Rugby, also for the HS7 tracks, where separate, around Birmingham). Understanding these loadings will certainly require reference to the track diagrams for the sections between Grandon Underwood and Brackley junctions and between Mount Pleasant and Streethay junctions, and around Coventry station; these are contained in appendix B.

The following loadings are imposed on the main lines of HS2:

- Euston Cross – Old Oak Common North Junction 12tph
- [Euston –] Queens Park Junction – Old Oak Common North Junction 5tph
- Old Oak Common North Junction – Grendon Underwood Junctions 17tph
- Grendon Underwood Junctions – Chetwode Junctions 9tph
- Chetwode Junctions – Mount Pleasant Junctions 13tph
- Mount Pleasant Junctions – Streethay Junction 7tph
- Streethay Junction – Crewe HS South Junction 13tph
- Crewe HS South Junction – Crewe HS North Junction 2tph
- Crewe HS South Junction – Crewe station 11tph
- Crewe station – Crewe HS North Junction 7tph
- Crewe HS North Junction – Rostherne South Junction 9tph
- Rostherne South Junction – Rostherne East Junction 4tph
- Rostherne East Junction – Manchester HS 4tph
- Rostherne East Junction – Rostherne North Junction 0tph
- Rostherne North Junction – Kenyon South Junction 5tph
- Kenyon South Junction – Kenyon West Junction [– Livpl] 2tph
- [Livpl –] Kenyon West Junction – Kenyon North Junction 1tph
- Kenyon South Junction – Kenyon North Junction 3tph
- Kenyon North Junction – Gibb Farm Junction [– Preston] 4tph

The following loadings are imposed on the relief lines of HS2, and the distinct tracks of HS7:

- Ashendon Junction – Grendon Underwood Junctions 2tph
- Grendon Underwood Junctions – Chetwode Junctions direct 6tph
- Grendon Underwood Junctions – Chetwode Junctions via Calvert 4tph
- Chetwode Junctions – Culworth Junction 6tph
- Banbury Junction – Culworth Junction 2tph
- Culworth Junction – Onley Junction 8tph
- Watford Gap Junction (HS3) – Onley Junction 4tph
- Onley Junction – Rugby HS Junction 12tph
- Rugby HS Junction – Cotesbach Junction (HS3) 4tph
- Rugby HS Junction – Warwick Road Junction 8tph
- Warwick Road Junction – Mount Pleasant Junctions 4tph
- Mount Pleasant Junctions – Birmingham Interchange station 10tph
- Birmingham Interchange station – Water Orton South Junction (inner) 8tph
- Birmingham Interchange station – Water Orton South Junction (outer) 10tph
- Water Orton South Junction (outer) – Water Orton West Junction (HS2) 6tph
- Water Orton South Junction (outer) – Water Orton West Junction (HS7) 4tph
- Birmingham HS – Water Orton West Junction (HS2) 10tph
- Birmingham HS – Water Orton West Junction (HS7) 8tph
- Water Orton West Junction (HS7) – Marston Junction (HS7) 4tph
- Water Orton South Junction (inner) – Marston Junction (HS7) 4tph
- Marston Junction (HS7) – Derby 8tph
- Water Orton West Junction (HS2) – Streethay Junction (relief lines) 8tph
- Streethay Junction (relief lines) – Handsacre Junction 2tph
- Streethay Junction (relief lines) – Streethay Junction (main lines) 6tph

Service Plan 6

This service plan comes into effect probably a long time after service plan 5, and **certainly** a long time after service plan 4, when HS2 to Scotland opens. The section between Carlisle and Edinburgh opened much earlier – the section from Riccarton North Junction to Ravenswood Junction opened as part of HS3, and the connections from Tweedbank to Ravenwood Junction, and from Riccarton North Junction to Carlisle opened shortly after, as completion of the restored Waverley route. From Carlisle to Ravenswood Junction, (and on to Edinburgh via Lauder,) it is built as a HS line, but is not restricted to HS traffic.

HS2 was already fully loaded, effectively between Old Oak Common North Junction and Streethay Junction, at service plan 4, and the section between Streethay Junction and Crewe South Junction hadn't much capacity left. But the situation eased at service plan 5, with the opening of HS2-CV, and the effective diversion of 2tph Euston Cross – Manchester HS to travel on HS3 from Pancras Cross, via Sheffield, instead. Also the 4-tracking between Birmingham Interchange and Streethay Junction, sharing the outer tracks between HS2-CV and HS7 (as far north as Marsworth Junction) has significantly eased capacity restraints in a key area. So I shall simply add the desired additional services, and note the resultant loadings.

The connection from Kenyon West Junction on HS8 to Kenyon North Junction (SJ634968) on HS2 allows a GC-gauge service from Liverpool to Scotland (replacing the classic-compatible service, with double the frequency). No similar service is provided from Manchester as it already has 8tph to Scotland, via a cross-platform interchange at Preston.

The connection at Bamfurlong to the WCML is removed as redundant; all HS2 services north of Bamfurlong continue to Preston via Gibb Farm Junction. Bamfurlong is removed from the loadings table, being no longer relevant. The classic-compatible service from Birmingham to Scotland is replaced by a GC-gauge service with double the frequency.

The Euston Cross – Preston service omits the Crewe stop, and is extended to Scotland.

The Euston – Blackpool / Windermere service is switched to Blackpool / Morecambe, since Kendal (and on to Carlisle) now has its own classic compatible service from Euston

The following services are introduced/amended (note the Regional Metro services):

- 2tphG [HS1 Hastings –>] Euston Cross – Old Oak Common – Preston – Carlisle – Hawick – Edinburgh Waverley HS – Haymarket – Edinburgh Airport – Bellgrove – Glasgow St. Enoch
- 2tphG Birmingham HS – Crewe – Preston – Carlisle – Hawick – Edinburgh Waverley HS – Haymarket – Edinburgh Airport – Bellgrove – Glasgow St. Enoch
- 2tphG Liverpool Lime St. – Preston – Carlisle – Hawick – Edinburgh Waverley HS – Haymarket – Edinburgh Airport – Bellgrove – Glasgow St. Enoch
- 2tphC Euston – Old Oak Common – Preston – Lancaster – Carnforth – Oxenholme – Kendal – Penrith – Carlisle (split/join) –:
  – Motherwell – Glasgow Central
  – Lockerbie – Haymarket – Edinburgh Waverley
- 2tphC Birmingham HS – Crewe – Preston – Lancaster – Carnforth – Oxenholme – Kendal – Penrith – Carlisle (split/join) –:

– Haymarket – Edinburgh Waverley
– Lockerbie – Motherwell – Glasgow Central

- 2tphC Euston – Old Oak Common – Birmingham Interchange – Crewe – Warrington Bank Quay – Wigan North Western – Preston (splits/joins) –:
  – Kirkham – Poulton le Fylde – Blackpool
  – Lancaster – Morecambe
- 2tphR Euston – Watford Junction – Bletchley – Milton Keynes – Wolverton – Northampton – Long Buckby – Rugby – Nuneaton – Atherstone – Polesworth – Tamworth (LL) – Lichfield Trent Valley (LL) – Rugeley Trent Valley – Stafford – Crewe
- 2tphR Manchester Airport – Manchester Piccadilly – Manchester Oxford Rd. – Bolton – Horwich Parkway – Chorley – Preston – Lancaster – Carnforth – Silverdale – Arnside – Grange-over-Sands – Cark and Cartmel – Ulverston – Dalton – Roose – Barrow in Furness
- 2tphR Leeds City – Bradford Central – Shipley – Keighley – Skipton – Gargrave – Hellifield – Long Preston – Giggleswick – Clapham – Bentham – Wennington – Carnforth (reverse) – Silverdale – Arnside – Grange-over-Sands – Cark and Cartmel – Ulverston – Dalton – Roose – Barrow in Furness

The **complete** service plan is thus:

- 4tphGG [HS1 Maidstone –>] Euston Cross – Old Oak Common – Rugby HS – Coventry HS – Birmingham Interchange – Birmingham HS
- 2tphGG [HS1 Dover –>] Euston Cross – Old Oak Common – Birmingham Interchange – Birmingham HS
- 2tphGG [HS1 Dover –>] Euston Cross – Old Oak Common – Manchester Interchange – Manchester HS
- 2tphGG [HS1 Hastings –>] Euston Cross – Old Oak Common – Crewe – Liverpool Lime St.
- 2tphG [HS1 Hastings –>] Euston Cross – Old Oak Common – Preston – Carlisle – Hawick – Edinburgh Waverley HS – Haymarket – Edinburgh Airport – Bellgrove – Glasgow St. Enoch
- 2tphGG Birmingham HS – Crewe – Manchester Interchange – Manchester HS
- 2tphG Birmingham HS – Crewe – Preston – Carlisle – Hawick – Edinburgh Waverley HS – Haymarket – Edinburgh Airport – Bellgrove – Glasgow St. Enoch
- 2tphG Liverpool Lime St. – Preston – Carlisle – Hawick – Edinburgh Waverley HS – Haymarket – Edinburgh Airport – Bellgrove – Glasgow St. Enoch
- 2tphC Euston – Old Oak Common – Preston – Lancaster – Carnforth – Oxenholme –Kendal – Penrith – Carlisle (split/join) –:
  – Motherwell – Glasgow Central
  – Lockerbie – Haymarket – Edinburgh Waverley
- 2tphC Birmingham HS – Crewe –Preston – Lancaster – Carnforth – Oxenholme – Kendal – Penrith – Carlisle (split/join) –:
  – Haymarket – Edinburgh Waverley
  – Lockerbie – Motherwell – Glasgow Central
- 2tphC Euston – Old Oak Common – Calvert – Birmingham Interchange – Rugeley Trent Valley – Stafford – Stone – Stoke on Trent – Macclesfield – Stockport –Manchester Piccadilly
- 2tphC Euston – Old Oak Common – Calvert – Birmingham Interchange – Crewe – Warrington Bank Quay – Wigan North Western – Preston (split/join)

– Kirkham – Poulton le Fylde – Blackpool
– Lancaster – Morecambe

- 1tphC Euston – Old Oak Common – Crewe – Chester – Flint – Rhyl – Llandudno Junction – Bangor – Holyhead
- 1tphC Birmingham HS – Crewe – Chester – Flint – Rhyl – Llandudno Junction – Bangor – Holyhead
- 2tphR Euston – Watford Junction – Bletchley – Milton Keynes – Wolverton –Northampton – Long Buckby – Rugby – Nuneaton – Atherstone – Polesworth– Tamworth (LL) – Lichfield Trent Valley (LL) – Rugeley Trent Valley –Stafford – Crewe
- 2tphR Manchester Airport – Manchester Piccadilly – Manchester Oxford Rd. –Bolton – Horwich Parkway – Chorley – Preston – Lancaster – Carnforth –Silverdale – Arnside – Grange-over-Sands – Cark and Cartmel – Ulverston –Dalton – Roose – Barrow in Furness
- 2tphR Leeds City – Bradford Central – Shipley – Keighley – Skipton – Gargrave –Hellifield – Long Preston – Giggleswick – Clapham – Bentham – Wennington– Carnforth (reverse) – Silverdale – Arnside – Grange-over-Sands – Cark and Cartmel – Ulverston – Dalton – Roose – Barrow in Furness

Representative Hourly Cross-Platform Interchange Pattern at Birmingham Interchange:

00C Euston – Manchester Piccadilly
G HS7 Plymouth – Newcastle

15C Euston – Preston – Blackpool / Windermere
G HS4/HS7 Swansea –Norwich

– repeating at 30 and 45 minutes past.

Representative Hourly Cross-Platform Interchange Pattern at Birmingham HS (paired by HS2 and HS7):

00GG Euston Cross – Birmingham HS
GG Birmingham HS – Manchester HS
G HS7 Bristol Temple Meads BT – Birmingham HS
G HS7 Birmingham HS – York

15GG Euston Cross – Birmingham HS
G Birmingham HS – Edinburgh – Glasgow
G HS4/HS7 Cardiff HS – Birmingham HS
C HS7 Birmingham HS – Cleethorpes

– repeating at 30 and 45 minutes past.

Representative Hourly Cross-Platform Interchange Pattern at Crewe:

00C Euston – Preston – Blackpool / Morecambe
C Euston – Holyhead

15C Birmingham HS – Carlisle – Edinburgh / Glasgow
R Euston – Crewe via Trent Valley

30C Euston – Preston – Blackpool / Morecambe
C Birmingham HS – Holyhead

45C Birmingham HS – Carlisle – Edinburgh / Glasgow
R Euston – Crewe via Trent Valley

Representative Hourly Cross-Platform Interchange Pattern at Preston:

00G Euston Cross – Edinburgh
GG HS8 Norwich – Preston

07C Euston – Glasgow / Edinburgh
C HS9 Hull – Preston

15G Birmingham HS – Edinburgh
GG HS3/HS8 Pancras Cross – Preston

23C Birmingham HS – Edinburgh / Glasgow
C HS9 Scarborough – Preston

– repeating at 30, 37, 45 and 53 minutes past.

Representative Hourly Non-Cross-Platform Interchange Pattern at Carnforth:

00C Euston – Carlisle – Glasgow / Edinburgh
R Manchester Airport – Barrow in Furness

15C Birmingham HS – Carlisle – Edinburgh / Glasgow
R Leeds City – Barrow in Furness

– repeating at 30 and 45 minutes past.

The loadings imposed on the relief lines below Birmingham (specifically below Water Orton West Junction (HS2 lines), likewise on the specifically HS7 lines, are unchanged from SP5, so are not repeated here. The section Between Birmingham HS (HS2 lines) and Streethay (main lines) Junction does have new services, so this section is included in the table below.

The following loadings are imposed on HS2:

- Euston Cross – Old Oak Common North Junction 12tph
- [Euston –] Queens Park Junction – Old Oak Common North Junction 7ph
- Old Oak Common North Junction – Grendon Underwood Junction 19tph
- Grendon Underwood Junction – Chetwode Junction 11tph
- Chetwode Junction – Mount Pleasant South Junction 15tph
- Mount Pleasant Junction – Streethay (main lines) Junction 9tph
- Birmingham HS – Water Orton West Junction (HS2) 13tph
- Water Orton West Junction (HS2) – Water Orton North Junction 7tph
- Water Orton North Junction – Streethay (relief lines) Junction 11tph
- Streethay (relief lines) Junction – Handsacre Junction 2tph
- Streethay (relief lines) Junction – Streethay (main lines) Junction 9tph
- Streethay (main lines) Junction – Crewe HS South Junction 18tph
- Crewe HS South Junction – Crewe HS North Junction 4tph
- Crewe HS South Junction – Crewe station 14tph
- Crewe station – Crewe HS North Junction 10tph
- Crewe HS North Junction – Rostherne South Junction 14tph
- Rostherne South Junction – Manchester HS 4tph
- Rostherne East Junction – Rostherne North Junction 0tph
- Rostherne South Junction – Kenyon South Junction 10tph
- Kenyon South Junction – Kenyon West Junction (– Livpl) 2tph
- (Livpl –) Kenyon West Junction – Kenyon North Junction 2tph
- Kenyon South Junction – Kenyon North Junction 8tph
- Kenyon North Junction – Gibb Farm Junction 10tph
- Gibb Farm Junction – Preston station 22tph
- Preston station – Galgate Junction 10tph
- Galgate Junction – Riccarton North Junction 6tph
- Riccarton North Junction – Hawick 10tph
- Hawick – Edinburgh Waverley station 12tph

Estimated Journey Times

The conditions governing acceleration, deceleration, behaviour at junctions and line capacity of high speed lines are dealt with exhaustively in appendix B of the article 'Same Speed Railways'. Technically-minded readers, who want all the hard details, should look there. Only the required results are quoted here.

The following calculations are only approximate. I have no official figures for distances in HS2 Ltd.'s plans, and have been obliged to derive them, to the nearest km, from my own maps.

The crudest approximation, usually, is the assumption that, once line speed has been reached, that speed (360kph) is maintained until it becomes necessary to decelerate for the next station stop. In fact, given the notably excellent alignments of this particular route, and its peculiar suitability for really high speed, I am considerably more confident of this assumption than on certain other routes (Trans-Pennine, in particular).

The results are, in any case, valuable in giving a **feel** for the journey times possible.

My estimated distances (between stations) are:

- Euston Cross – Old Oak Common 8km
- Old Oak Common – Calvert 73km
- Calvert – Birmingham Interchange 78km
- Old Oak Common – Birmingham Interchange (non-stop) 151km
- Birmingham Interchange – Birmingham Curzon St, 20km
- Birmingham Interchange – Handsacre Junction (WCML) 33km
- Birmingham Interchange – Rugeley Trent Valley 41km
- Birmingham Interchange – Crewe 90km
- Birmingham Curzon St. – Crewe 95km
- Crewe – Manchester Interchange 45km
- Old Oak Common – Manchester Interchange (non-stop) 286km
- Birmingham Curzon St. – M/C Interchange (non-stop) 140km
- Manchester Interchange – Manchester HS 8km
- Old Oak Common – Crewe (non-stop) 241km
- Crewe – Bamfurlong Junction 50km
- Bamfurlong Junction – Preston 33km
- Crewe – Preston non-stop 83km
- Crewe – Liverpool Lime St. 73km

The above are all distances on HS2 itself or on the associated sections of HS8. In addition the following distances on the classic route are included in the tables (there's no uncertainty about these!)

- Handsacre Junction – Rugeley Trent Valley 8km
- Rugeley Trent Valley – Stafford 14km
- Stafford – Stone 13km
- Stone – Stoke-on-Trent 11km
- Stoke-on-Trent – Macclesfield 20km
- Macclesfield – Stockport 18km

- Stockport – Manchester Piccadilly 9km
- Bamfurlong Junction – Wigan North Western 5km
- Old Oak Common – Wigan North Western (non-stop) 296km
- Crewe – Warrington Bank Quay 38km
- Warrington Bank Quay – Wigan North Western 19km
- Wigan North Western - Preston 24km
- Crewe – Runcorn 36km
- Runcorn – Liverpool Lime St. 21km
- Preston – Edinburgh Waverley 272km
- Preston – Glasgow Central 273km

Further data, for the HS2-CV addition:

- Euston Cross – Old Oak Common 8km
- Old Oak Common – Rugby HS 130km
- Rugby HS – Coventry HS 18km
- Coventry HS – Birmingham Interchange 17km
- Birmingham Interchange – Birmingham Curzon St. 20km

The further distances pertaining to the possible Scottish extension are included for interest and completeness. Note that this has a 360kph line speed throughout, including the GC-gauge-converted Waverley route (where HS2 is assumed to be the main line, thus attracting no junction time penalty at Riccarton North Junction.

- Bamfurlong Junction – Preston 33km
- Crewe – Preston (non-stop) 83km
- Old Oak Common – Preston (non-stop) 324km
- Preston – Oxenholme 60km
- Oxenholme - Carlisle 78km
- Preston – Carlisle (non-stop) 138km
- Carlisle – Hawick 67km
- Hawick – Edinburgh (non-stop) 82km

Acceleration/deceleration distances and times (taken from ‘Same Speed Railways’ appendix B) are:

- Acceleration from stationary to 360kph takes 16.67km and 333 seconds
- Acceleration from stationary to 300kph takes 11.57km and 278 seconds
- Deceleration from 360kph to stationary takes 10.00km and 200 seconds
- Deceleration from 300kph to stationary takes 6.945km and 167 seconds
- Time to travel from Euston Cross to Old Oak Common (start to stop) is 292 seconds
- Time to travel from Rugby HS to Coventry HS (start to stop) is 438 seconds
- Time to travel from Coventry HS to Birmingham Interchange (start to stop) is 426 seconds
- Time to travel from Manchester Interchange to Manchester HS (start to stop) is 292 seconds

The final fouro times need elucidation. When the distance between stations is less than 18.5km, and the line speed is 300kph, (which applies in all the above cases,) a train accelerating from the first station is not able to reach line speed, before it has to begin decelerating for the next station. ‘Same Speed

Railways' contains a table of times taken to travel between adjacent stations, for inter-station distances of up to 18.5km, and the above times are taken from this.

Certain sections of the route incur time penalties because of junctions. (Refer to the 'Same Speed Railways' article, specifically the sections 'The Effect of Junctions' and 'Adjacent Junctions'. These penalties apply only at junctions which are taken at high speed, and not those on the approach to stations. Specifically:

- Old Oak Common – Rugby HS incurs a time penalty of 26 seconds at Grendon Underwood Junction, where HS2-CV diverges from HS2-orig. (HS2-CV services do not stop at Calvert, so this is actually 'a junction taken at high speed', rather than 'on the approach to a station'.)
- Crewe – Liverpool incurs a double-junction penalty of 32 seconds at Kenyon South and West junctions, where the connecting spur for Liverpool diverges from the main line of HS2 and joins the main line of HS8.

The procedure in calculating journey times between station stops is to take the two values of acceleration / deceleration distance, and the two times, as given in the first 4 lines of the above list, and sum them, thus acceleration / deceleration takes 16.67 + 10.00 = 36.67km, and 333 + 200 = 533 seconds, at line speed 360kph, and 11.57 + 6.95 = 18.52km and 278 + 167 = 445 seconds at line speed 300kph. The appropriate distance value is subtracted from the inter-station distance, and the remaining length is assumed to be travelled at line speed, taking time = distance / speed. This time is then added to the acceleration / deceleration time to obtain the actual journey time between the stations. This is all very laborious (error-prone, too!) to perform manually, so I have developed spreadsheets to do the work and present the results. For those sections less than 18.5km in length, the time-calculating formula in the spreadsheet cell is replaced by the actual value, as given in the above list. For any junction penalties, the explicit vale of the penalty is included in the formula, for that particular cell. The various section times are accumulated to obtain the overall journey times. One further refinement: a standard wait time of 3 minutes is assumed at stations, and this is added into the accumulated time at each stop.

For those sections of classic route included in CC schedules, the section journey times are taken from current timetables. These are all arrival times, so the station wait time is already included. There is thus no need to add 3 minutes per station stop on these sections. With that summary, we now proceed to the results.

1. HS Euston Cross – Birmingham / Manchester / Liverpool / Preston (2 stops in all cases) also Birmingham – Manchester (1 or 2 stops):

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London, inc. Station Wait Times
Euston Cross - Old Oak Common	8	8	4.9	4.9	4.9
Old Oak Common - Birmingham Interchange	151	159	29.6	34.5	37.5
Birmingham Interchange - Birmingham Curzon St.	20	179	7.8	42.3	48.3
Old Oak Common - Manchester Interchange (non-stop)	286	294	52.1	57.0	60.0
Manchester Interchange - Manchester HS	8	302	4.9	61.9	67.9
Birmingham Curzon St. - Crewe	95	95	20.3	20.3	20.3
Crewe - Manchester Interchange	45	140	11.9	32.2	35.2
Manchester Interchange - Manchester HS	8	148	4.9	37.1	43.1
Birmingham Curzon St. - Manchester Interchange	140	140	27.8	27.8	27.8
Manchester Interchange - Manchester HS	8	148	4.9	32.7	35.7
Old Oak Common - Crewe	241	249	44.6	49.5	52.5
Crewe - Liverpool Lime St.	73	322	17.1	66.6	72.6
Crewe - Preston	83	332	18.3	67.8	73.8

Current fastest time (minutes) from London/Birmingham (with HS2 Ltd.'s estimates) [and the above values] to:

- London – Birmingham New Street (Curzon) 81 (49) [49]
- London – Stockport (M/C I/ch/Airport) 115 (59) [60]
- London – Manchester 127 (68) [68]
- London – Liverpool 128 (96) [73]
- London – Preston 128 [74].
- Birmingham – Manchester 88 (41) [36/43 – non-stop/ Crewe-stop]

I declare that the distances in the above spreadsheet are exactly as originally measured, and that no shading or refinement has been performed subsequently. The fact that I get exactly the same estimates as HS2 Ltd. is either an extraordinary coincidence, or HS2 Ltd.'s estimating methods are as crude as mine!

The significance of the above table of HS times is that these are all GC-gauge services, thus assuming the availability of sections of HS8 to Liverpool and Preston. These are in my plans, but not in HS2 Ltd.'s. HS2 Ltd.'s estimate for Liverpool is via the WCML above Crewe.

2. HS Elapsed Times Summary:

Section	Euston Cross - Birmingham HS	Euston Cross - Manchester HS	Euston Cross - Liverpool HS	Euston Cross - Preston HS	Birmingham - Manchester HS
Euston Cross - Old Oak Common	4.9	4.9	4.9	4.9	
Old Oak Common - Birmingham Interchange	37.5	|	|	|	
Birmingham Interchange - Birmingham Curzon St.	48.3	|	|	|	
Old Oak Common - Manchester Interchange (non-stop)		60.0	|	|	
Manchester Interchange - Manchester HS		67.9	|	|	
Birmingham Curzon St. - Crewe			|	|	20.3
Crewe - Manchester Interchange			|	|	35.2
Manchester Interchange - Manchester HS			|	|	43.1
Birmingham Curzon St. - Manchester Interchange			|	|	27.8
Manchester Interchange - Manchester HS			|	|	35.7
Old Oak Common - Crewe			52.5	52.5	
Crewe - Liverpool Lime St.			72.6	|	
Crewe - Preston				73.8	

3. CC Euston – Liverpool / Manchester (3/9 stops):

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London, inc. Station Wait Times
Euston - Old Oak Common	8	8	4.9	4.9	4.9
Old Oak Common - Crewe	241	249	44.6	49.5	52.5
Crewe - Runcorn	36	285	27.0	76.5	79.5
Runcorn - Liverpool Lime St.	21	306	21.0	97.5	100.5
Old Oak Common - Calvert	73	81	16.6	21.5	24.5
Calvert - Birmingham Interchange	78	159	17.4	38.9	44.9
Birmingham Interchange - Rugeley Trent Valley	41	200	11.3	50.2	59.2
Rugeley Trent Valley - Stafford	14	214	10	60.2	69.2
Stafford - Stone	13	227	11	71.2	80.2
Stone - Stoke-on-Trent	11	238	11	82.2	91.2
Stoke-on-Trent - Macclesfield	20	258	16	98.2	107.2
Macclesfield - Stockport	18	276	13	111.2	120.2
Stockport - Manchester Piccadilly	9	285	10	121.2	130.2

Current fastest time (minutes) from London [and the above values] to:

- Crewe 90 [53]
- Runcorn 113 [80]
- Liverpool 128 [101]
- Rugeley TV 98 [60]
- Stafford 65 [70]
- Stone 103 (1 change) [81]
- Stoke-on-Trent 84 [93]
- Macclesfield 101 [108]
- Stockport 115 [121]
- Manchester 127 [131]

The time for the CC service between Birmingham Interchange and Rugeley Trent Valley, via HS2 and Handsacre Junction, is calculated as normally for a HS section (taking the section length as 33 + 8 km). Only the short distance of 8km is run on the classic route, and it is assumed that the speed will have reduced sufficiently by Handsacre Junction for there to be no problem here.

The times to Stoke-on-Trent and Macclesfield are, frankly, disappointing. However, the times from Rugeley to Stafford, Stafford to Stone and Stone to Stoke-on-Trent are derived from current timetables, involving local, relatively slow services, with average speeds of 52mph, 44mph and 38mph respectively. We may reasonably expect a better performance from a CC train. The extra stops are essential to help fill the trains, as there's likely to be little if any traffic from London to Manchester (which is the bulk of the patronage of the current service). The CC service to Manchester is explicitly designed to ensure that Stoke-on-Trent and Macclesfield do not lose out when HS2 opens, as on HS2 Ltd.'s published plans they most disgracefully do. (There have been promises that they will continue to enjoy services at least as good as at present, but, as yet, no delivery on that.) It also serves a very important interconnection role, making connections at Calvert with the East-West line and with Crossrail 4, and at Birmingham Interchange with the HS7 service from Plymouth to Newcastle.

4. CC Euston – Preston (6/3 stops) and Scotland:

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London, inc. Station Wait Times
Euston - Old Oak Common	8	8	4.9	4.9	4.9
Old Oak Common - Calvert	73	81	16.6	21.5	24.5
Calvert - Birmingham Interchange	78	159	17.4	38.9	44.9
Birmingham Interchange - Crewe	90	249	19.4	58.4	67.4
Crewe - Warrington Bank Quay	38	287	18.0	76.4	88.4
Warrington Bank Quay - Wigan North Western	19	306	11.0	87.4	99.4
Wigan North Western - Preston	24	330	13.0	100.4	112.4
Old Oak Common - Crewe	241	249	44.6	49.5	52.5
Crewe - Wigan North Western (HS2 direct via Bamfurlong)	55	304	13.6	63.1	69.1
Wigan North Western - Preston	24	328	13.0	76.1	82.1
Old Oak Common - Wigan North Western	296	304	53.8	58.7	61.7
Wigan North Western - Preston	24	328	13.0	71.7	77.7
Preston - Edinburgh	272	600	148.0	219.7	225.7
Preston - Glasgow	273	601	140.0	211.7	217.7

Current fastest time (minutes) from London [and the above values] to:

- Crewe 90 [68]
- Warrington 104 [89]
- Wigan 115 [100]
- Preston 128 [113]

The times in the above table reflect HS2 Ltd.'s plans, where HS2 terminates at Bamfurlong Junction, and there is no GC-gauge route beyond that.

The CC service to Preston serves a very important interconnection role, making connections at Calvert with the East-West line and with Crossrail 4, and at Birmingham Interchange with the HS7 service from Swansea to Norwich. It splits / joins at Preston, the portions continuing to/from Blackpool North and Windermere.

The time for the faster, direct route between Crewe and Wigan, via HS2 and Bamfurlong Junction, is calculated as normally for a HS section (taking the section length as 50 + 5 km). Only the short distance of 5km is run on the classic route, and it is assumed that the speed will have reduced sufficiently by Bamfurlong Junction for there to be no problem here.

The main interest is in the times to Scotland. The times quoted between Preston and Edinburgh/Glasgow are the fastest in the current timetable, but include 3 stops – Lancaster, Oxenholme or Penrith, and Carlisle. (The Edinburgh service also assumes a stop at Haymarket, but **every** service approaching Waverley from the west assumes a stop at Haymarket.) HS2 Ltd. has promised a headline time to Edinburgh and Glasgow of within 3 hours. It must therefore find time savings of 35 – 45 minutes on the above schedule to make good that promise. Four stops can be dropped – the only purpose of including a stop at Wigan North Western in the above table is to allow my spreadsheet to calculate automatically the time from Old Oak Common – or 5, if Preston is dropped also. That saves possibly 20 minutes, but there will have to be an additional stop at (presumably) Carstairs to split / join the Glasgow and Edinburgh portions. (HS2's published service plans allow for two London – Scotland CC services per hour, so if both Edinburgh and Glasgow are to get two London trains per hour, there must be separate portions.) So there needs to be an actual acceleration of 15 – 25 minutes north of Preston. I don't say that this **can't** be done, (at least, without some serious infrastructure investment,) but I shall certainly be very interested to see **how** it is proposed to be done.

5. CC Elapsed Times Summary:

Section	Euston - Manchester CC	Euston - Liverpool CC	Euston - Preston (direct HS2 via Bamfurlong CC	Euston - Preston CC	Euston - Scotland CC
Euston - Old Oak Common	4.9	4.9	4.9	4.9	4.9
Old Oak Comm - Calvert	24.5	|	|	24.5	|
Calvert - Birmingham Interchange	44.9	|	|	44.9	|
Birmingham Interchange - Rugeley Trent Valley	59.2	| |	| |	| |	| |
Rugeley Trent Valley - Stafford	69.2	|	|	|	|
Stafford - Stone	80.2	|	|	|	|
Stone - Stoke-oon-Trent	91.2	|	|	|	|
Stoke-on-Trent - Macclesfirld	107.2	|	|	|	|
Macclesfirld - Stockport	120.2	|	|	|	|
Stochport - Manchester Piccadilly	130.2	|	|	|	|
Old Oak Common - Crewe		52.5	52.5	|	|
Crewe - Runcorn		79.5	|	|	|
Runcorn - Liverpool Lime St.		100.5	|	|	|
Crewe - Wigan North Western (HS2 direct via Bamfurlong)			69.1	| |	| |
Wigan North Western - Preston			82.1	|	|
Birmingham Interchange - Crewe				67.4	
Crewe - Warrington Bank Quay				88.4	|
Warrington Bank Quay - Wigan North Western				99.4	| |
Wigan North Western - Preston				112.4	|
Old Oak Common - Wigan North Western					61.7
Wigan North Western - Preston					77.7
Preston - Edinburgh					225.7
Preston - Glasgow					217.7

The foregoing estimated timings all refer to service plan 4. The final sections refers to service plans 5 and 6, dealing with the extra-speculative Coventry Variant and Scottish extension.

6. Euston Cross – Birmingham via HS2-CV, 4 stops:

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London, inc. Station Wait Times
Euston Cross - Old Oak Common	8	8	4.9	4.9	4.9
Old Oak Common - Rugby HS	130	138	26.5	31.4	34.4
Rugny HS - Coventry HS	18	156	7.3	38.7	44.7
Coventry HS - Birmingham Interchange	17	173	7.1	45.8	54.8
Birmingham Interchange - Birmingham Curzon St.	20	193	11.5	57.3	69.3

Comparative timings (minutes), London to:

	Current Fastest	Via HS2-CV	Via HS2-orig
• Rugby HS	48	35	-
• Coventry HS	59	45	-
• Birmingham Intnl / Intchg	70	55	38
• Birmingham New St. / Curzon St.	82	70	49

These are very respectable times for HS2-CV, though obviously overshadowed by HS2-orig's Birmingham times.

7. Euston Cross – Edinburgh (4stops):

Section	Distance (km)	Cumulative Distance (km)	Start - Stop Time (minutes)	Cumulative Journey Time (minutes)	Elapsed Time from London, inc. Station Wait Times
Euston - Old Oak Common	8	8	4.9	4.9	4.9
Old Oak Common - Preston	324	332	58.4	63.3	66.3
Preston - Carlisle	138.0	470	27.4	90.8	96.8
Carlisle - Hawick	67.0	537	15.6	106.4	115.4
Hawick - Edinburgh	82.0	619	18.1	124.5	136.5

Current fastest time (minutes) from London [and the above values] to:

- Preston 128 [67]
- Carlisle 195 [97]
- Edinburgh 260 [137]

Some comments on the Scottish services of HS2, vis-a-vis those of HS3, are in order.

HS2 is faster: 136.5 minutes London – Edinburgh as against 157.2. The service has 2 fewer stops (4 against 6) but even subtracting 15 minutes from the HS3 time, to give an equivalent for 4 stops, still (**very** slightly) faster. What is slightly more surprising is that the distance is shorter – 619km as against 635, thus 2.5% less – whereas the London – Edinburgh distance by the WCML is longer than by the ECML – 640km as against 629, thus 2% more.

I'm not happy about these results. The difference should be larger in HS2's favour. HS3 has a line speed of 300kph between Darlington and Hawick (123km). 123km at 300kph takes 24.6 minutes as against 20.5 at 360, so 4.1 minutes more. If HS3 were 360kph throughout, then, with 4 stops should take c.4 minutes less than HS2, although 2.5% longer!!!

In fact the problem is purely perceptual. To confirm that the values are indeed pukka, cancel the effects of the intermediate stops. We know that a station stop imposes a time penalty of c.7.5 minutes at 360kph and c.7 minutes at 300kph. So subtract 30 minutes (4 * 7.5) from HS2's overall time and 43.5 minutes (3 * 7.5 + 3 * 7) from HS3's. HS3 travels at 300kph between Darlington and Hawick, 123km, which takes 24.6 minutes at 300kph and 20.5 minutes at 360kph. So subtract a further 4.1 minutes from HS3's time to bring it u[to 360kph throughout. The virtual journeys are now:

- HS2: 619km in 106.5mins giving an average speed of 349kph or 218mph.
- HS3: 625km in 109.6mins giving an average speed of 348kph or 217mph.

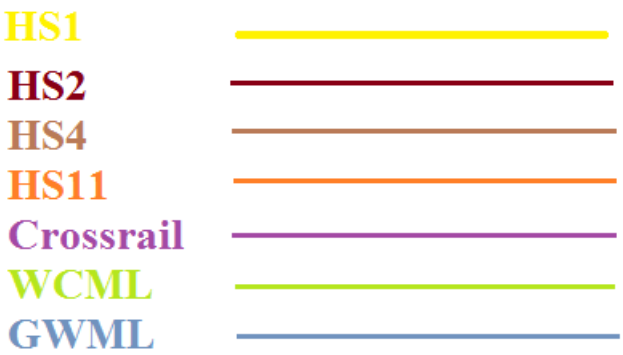
These calculations are very approximate, of course, so one wouldn't expect exact agreement after the equalisation, but the agreement is in fact gratifyingly good. I don't know why the original results looked so suspect, but they worried me sufficiently to document the fact, and its refutation, in case anyone else should feel the same.

Appendix A – Euston Cross and the Inter-Regional Connections

General

By routing the classic-compatible services of HS2 and HS4 into Euston and Paddington, respectively, and all the GC-gauge services of both routes through Euston Cross, and on to HS1 and HS11/HS12, superlative cross-London inter-regional HS services are enabled, between the West Midlands / North West and Kent / East Sussex, and between South Wales / West Country and North Kent / East Anglia. The classic compatible services of HS1 (there's only one) and HS11/HS12 are likewise routed into St. Pancras East (the 'Javelin' platforms) and Liverpool Street respectively. The GC-gauge services of HS1 (not the international ones) and HS11/HS12 balance exactly those of HS2 and HS4. There is thus no need for any rebuilding work at the four terminal stations to accommodate GC-gauge trains. (Euston certainly needs rebuilding because it's such a disgusting mess, but it need not expand significantly beyond its current footprint, Paddington needs nothing more than a good clean and a fresh coat of paint, St. Pancras and Liverpool Street probably need nothing at all.) Given the GC-gauge loadings of the London end of HS2 and HS1 (12tph) and of HS4 and HS11/HS12 (6tph) – these are at the final service plans of each route – a single tunnel in each direction, with a minimum of 6 platforms, (passive provision for 8,) at Euston Cross, would suffice. That a single Euston Cross station, with a single pair of approach tunnels, would serve two HS inter-regional routes should seriously enhance its business case. I would like to see **passive** provision for 8 platforms, as is indicated in the diagrams.

The following sections illustrate the significant locations on the Euston Cross cross-London, inter-regional route. The track diagrams all use the colour scheme:



Old Oak Common

Old Oak Common station is on two levels, (3 actually, including London Overground, but that, although important, is not relevant in the current context):

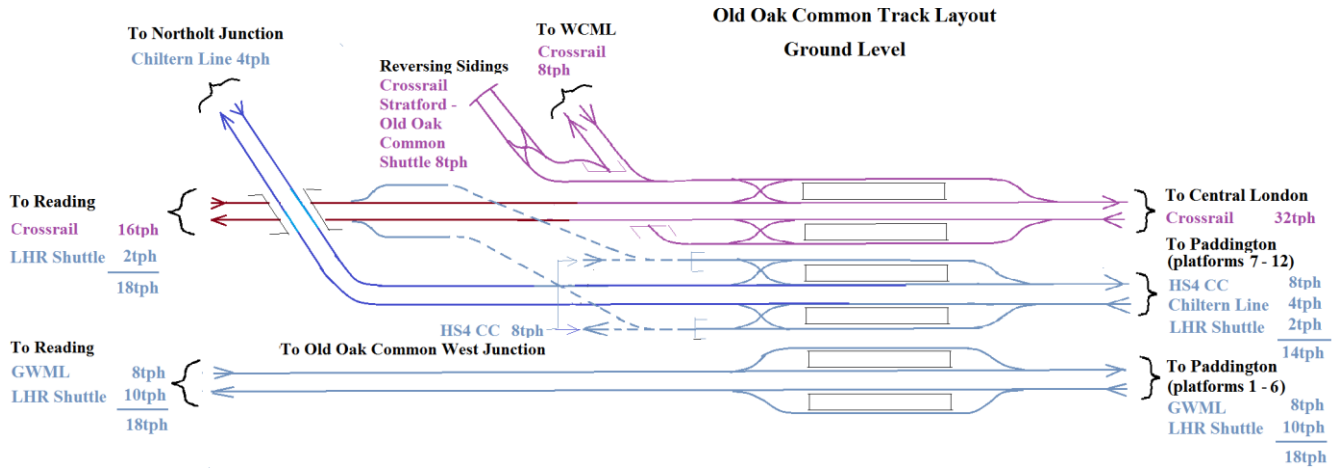
Ground Level, consisting of three sets of four platforms, serving the routes:

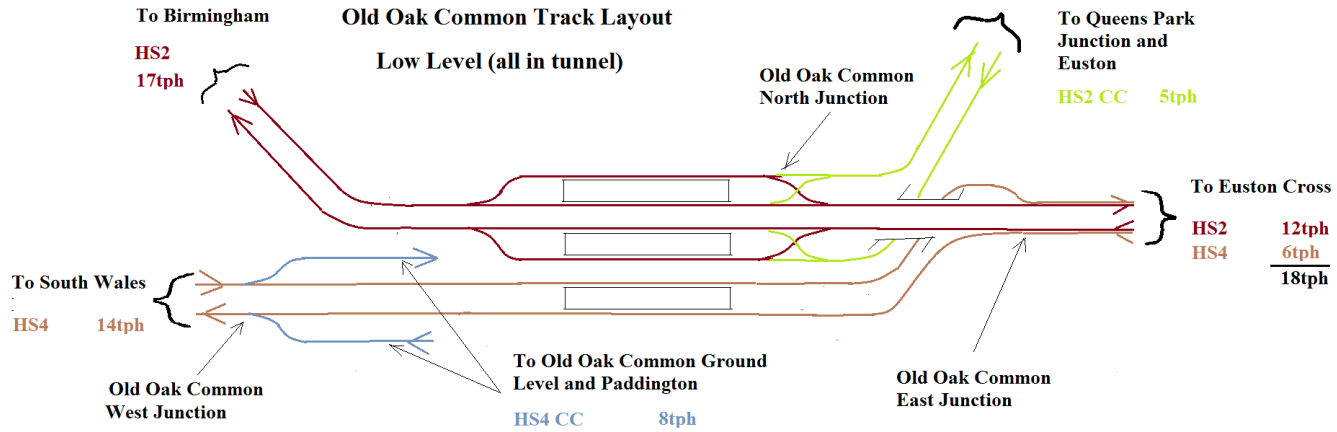
- GWML (Classic, long distance, and Heathrow Shuttle services,) on the fast lines
- HS4 Classic Compatibles and Chiltern Line services on the relief lines, both of which diverge immediately west of the platforms, the CCs to join HS4 at Old Oak Common West Junction, at the low level and the Chiltern Line services to Northolt Junction

- Crossrail, of which the arm to the WCML and the Stratford Shuttle reversing sidings diverges immediately west of the platforms, and the GWML arm takes over the relief lines

Low Level, consisting of HS2 (all services, so variable platforms will be required) and HS4 (GC-gauge services).

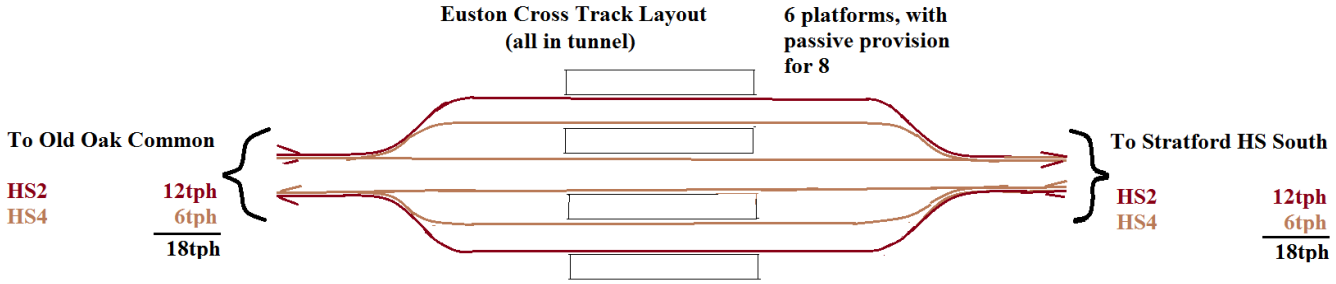
Ideally, these should be one above the other, with the passenger entrances and circulating area between them, with lifts, escalators and stairs directly to all platforms. In order for HS2 and HS4 GC-gauge services to share the same pair of tracks, the classic-compatible services must first diverge, those of HS4 **before** the LL station (heading east), at Old Oak Common West Junction (then using the GWML platforms at ground level), and those of HS2 immediately after the LL station, at Old Oak Common North Junction. HS2 and HS4 merge shortly after that, at Old Oak Common East Junction. HS2's London-bound classic-compatible trains join the WCML at Queens Park Junction. In the original Euston Cross plans, this was seen as actually at Queens Park (since there was then no need to get them off HS2 as soon as possible after Old Oak Common). In fact Queens Park Junction (I'll keep the name as it's already in the literature) would best be located immediately west of the Kensal Green tunnels – there's plenty of room for it there, and it's only about ½ mile from Old Oak Common North Junction.





Euston Cross

This is trivial, a two track route widening to serve 6 platforms. The middle two platform faces would ordinarily be served by HS4 trains, and the two outer pairs by HS2.



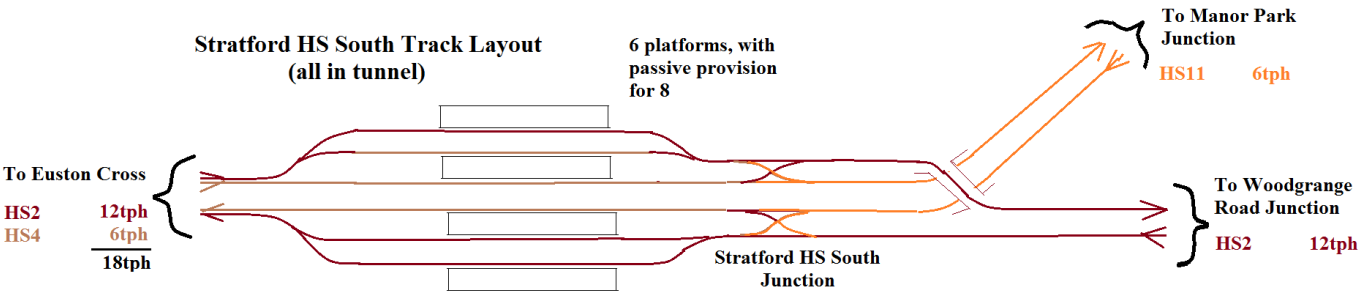
Stratford HS South

HS2/HS4 follow, in tunnel, the alignment of HS1, but a little to the south of it, from north of St. Pancras to Stratford. Thus whereas HS1/HS6 arrive at Stratford HS North station (the former Stratford International, which it never was,) HS2/HS4 arrive at Stratford HS South station, underneath Stratford (Regional) station. This is similar to Euston Cross – the route widens to serve 6 platforms, with HS4 occupying the middle two – but afterwards the HS4 tracks diverge from the HS2 tracks at Stratford HS South Junction, and HS4 metamorphoses into route HS11. The scissors crossovers are provided for operational flexibility but should not normally be used.

HS11 emerges from tunnel on the north side of the GEML and is joined by a connection from the classic route, at Manor Park Junction.

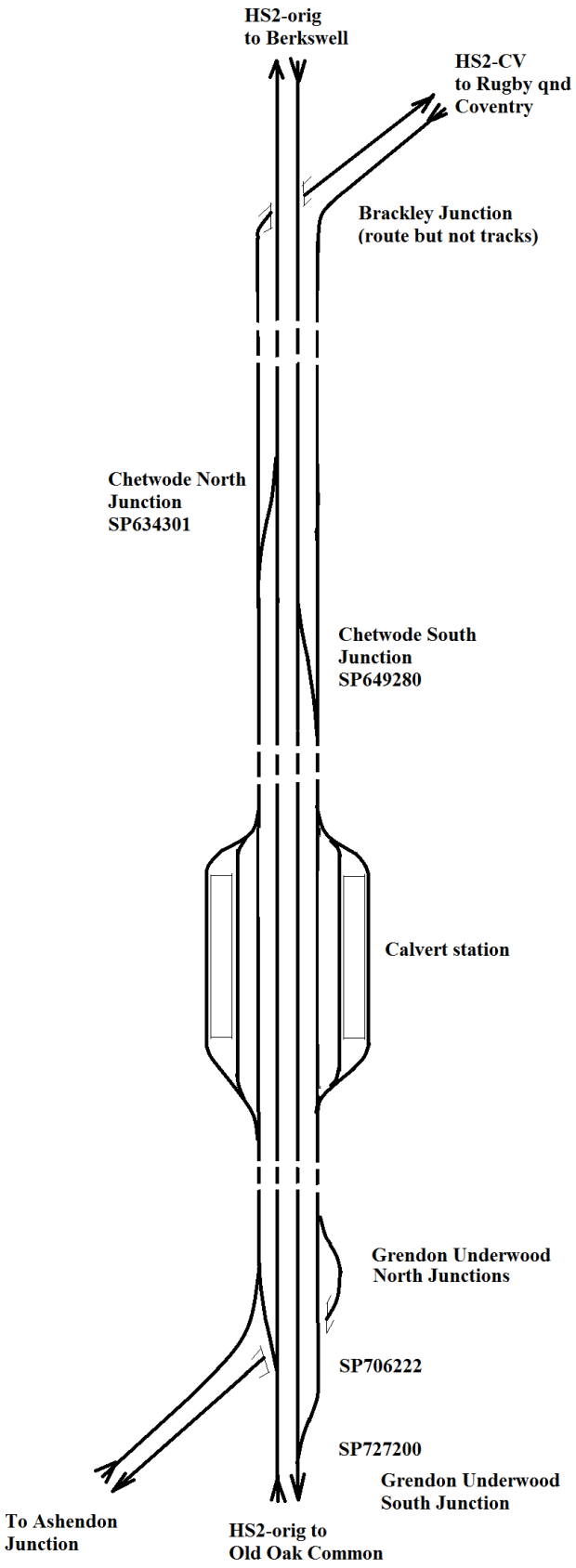
HS2 continues to Woodgrange Road Junction in Forest Gate, where it merges with HS1.

Stratford HS South corresponds in many respects to Old Oak Common. Both are served by all the GC-gauge inter-regional services, and afford convenient interchange with Crossrail. The Crossrail tracks are likewise in the high level station, having taken over the former slow lines, thus providing cross-platform interchange with the LT Central Line. Stratford HS South is on the Shenfield branch of Crossrail, and thus has a 12tph service, but additionally is served by the 8tph shuttle between Stratford and Old Oak Common.



Appendix B – Track Diagrams

Track Diagrams 1: Grendon Underwood Junction – Brackley Junction



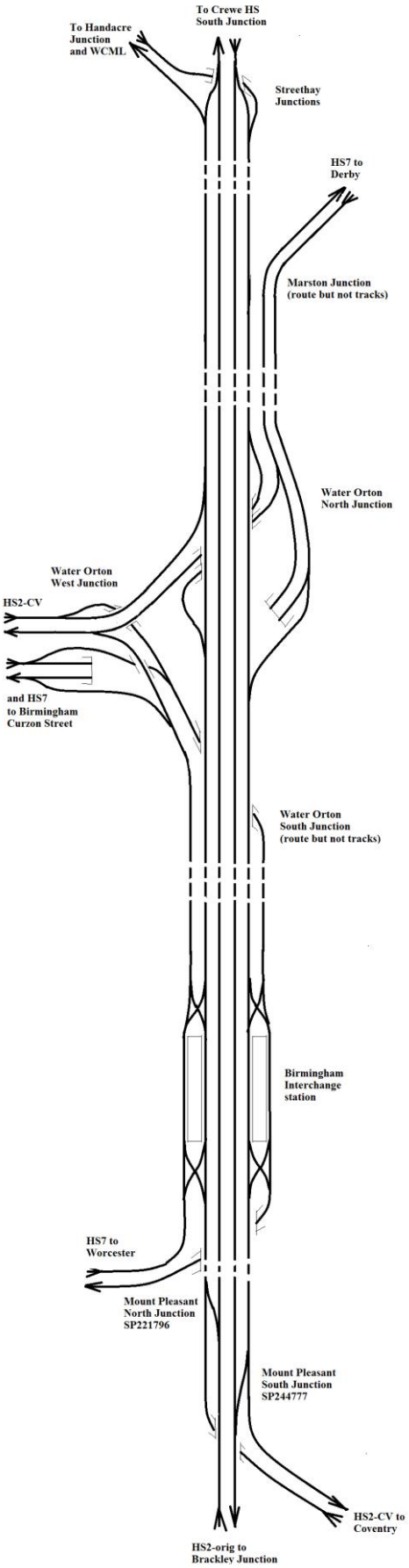
The article Same Speed Railways, Appendix B, gives extensive information on HS Junctions, layout of stations, acceleration and deceleration distances and times. The following track diagrams, whilc purely topological, follow the above conventions exactly.

HS2-CV begins at Grendon Underwood, where there are several track junctions. The northbound track of HS2-CV diverges from HS2-orig at map reference SP706222, and the southbound track joins HS2-orig further south at SP727200. These locations are prescribed by the requirement to come to a standstill in Calvert station, northbound, and to accelerate from standstill at Calvert station, southbound, diverging from / joining the main line at the turnoff limit speed of 230kph. (Deceleration actually begins / line speed is reached, some way further south, yet. These details are all in the above reference.) Chetwode junctions, north of Calvert, allow stopping services to regain / diverge from HS2-orig.

Calvert station and Brackley Junction are less than 18.5km, 11.6miles, apart (c.10miles, actually) so the station loops are continued between them, as recommended in the above reference; after Brackley Junction they become the lines of HS2-CV. There are 4 tracks through the middle of Calvert station, avoiding the platforms, since the HS2-CV services, while also using Grendon Underwood Junction, do not stop at Calvert, but pass through at high speed. I consider it very bad practice to allow a non-stop HS train to pass through a platform line.

Directly after Brackley station, the HS2-CV and HS2-orig routes diverge. Brackley Junction is a route junction but not a track junction, since there are no connections between the tracks. Indeed, after the connections at Grendon Underwood and Chetwode, the tracks do not have a further connection until Birmingham Interchange, for HS2-orig to HS2-CV, or, finally, Streethay Junction, for HS2-CV to HS2-orig.

Track Diagrams 2: Mount Pleasant – Streethay Junctions



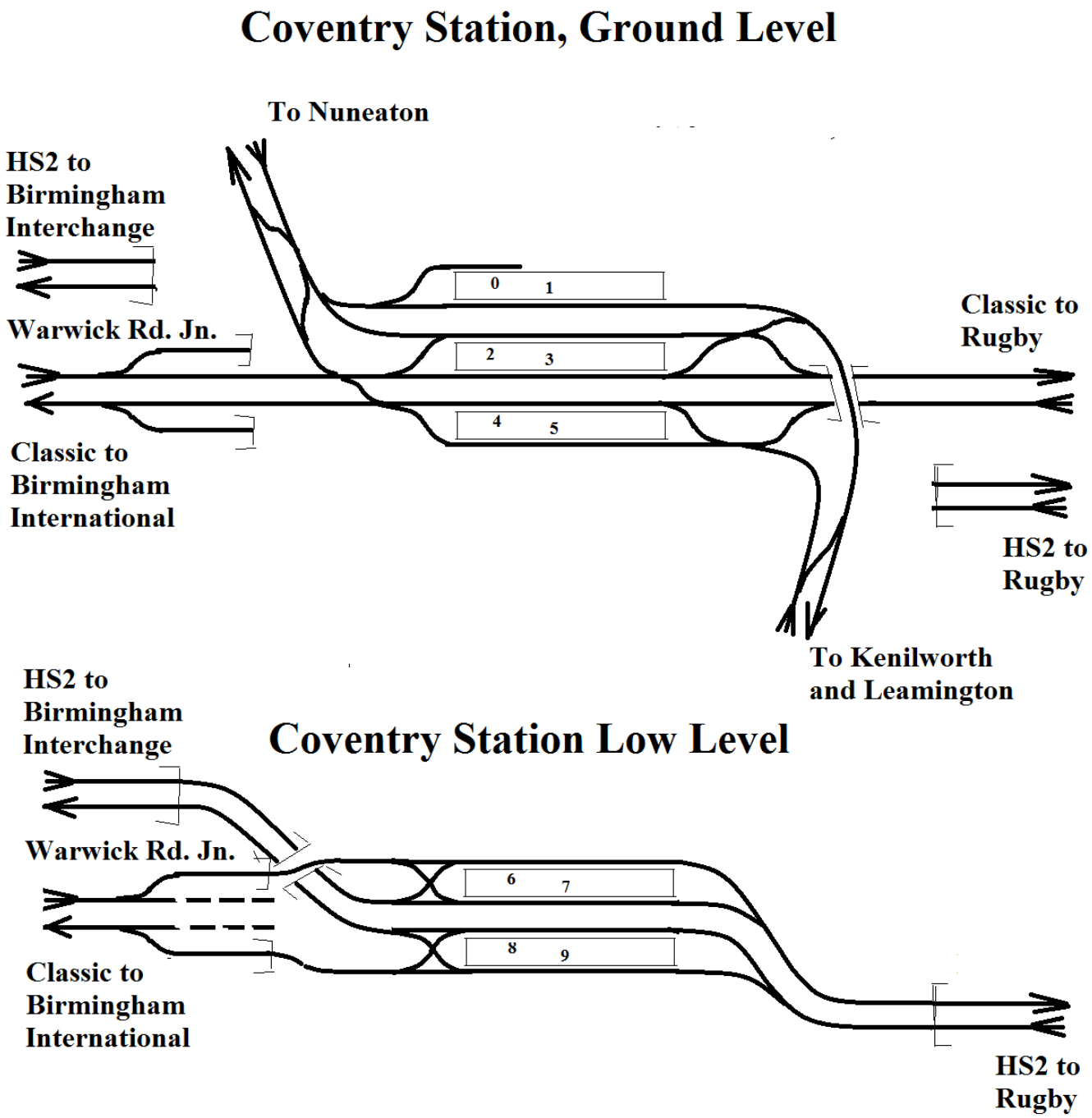
HS2-CV rejoins the route, but not the tracks, of HS2-orig at Mount Pleasant Junction, near Berkswell. Services on HS2-orig which stop at Birmingham Interchange, are, however able to switch to HS2-CV at Mount Pleasant North Junction, or join HS2-orig from HS2-CV at Mount Pleasant South Junction. By great good fortune, Mount Pleasant South Junction is just before the routes diverge (going south). HS2-CV occupies the outer two tracks of a 4-track, parallel arrangement. The 4-track section continues all the way to Streethay Junction, but over much of this section, where HS7 is also involved, there are effectively six tracks.

HS7 and HS2-CV have separate tracks, but with several connections between them. HS7 joins the route immediately south of Birmingham Interchange station. There are six tracks thence to Water Orton South Junction. There are scissors crossovers immediately south and north of Birmingham Interchange. Those to the south are for operational convenience, and not used in normal service, services switching between the outer pairs of tracks north of the station. The convention is that HS7 services use the two outermost platform faces, and HS2-CV the inner two. Services switch between tracks immediately north of the station, the arrangement being that services to and from Birmingham Curzon Street use the outermost of the six tracks, and those to and from Water Orton North Junction the inner tracks of the outer pairs.

There are four tracks between Water Orton West Junction and Curzon Street, arranged as alternating pairs, the north pair for HS2 services and the south pair for HS7. Northbound HS7 services from Curzon Street do not make connection with HS2, but pass beneath the HS2 tracks and diverge from the alignment at Marston Junction (a route but not a track junction). There are connections at Water Orton North Junction from the HS2 to the HS7 tracks, to enable the HS7 services not calling at Curzon Street to regain the HS7 route.

There are several track junctions at Streethay. The HS2-CV tracks finally merge with those of HS2-orig, for services to the North West via Crewe. But, immediately before that, there is a connection between the HS2-CV tracks and the WCML at Handsacre Junction. This is used only by the CC service from Euston to Manchester via Stoke. Note that there is no connection from the HS-orig tracks to Handsacre Junction.

Track Diagrams 3: Coventry Station



The above diagrams are intended to be largely self-explanatory.

The HS station is directly below the classic station, platforms 6,7 directly below 2,3 and 8,9 below 4.5, allowing stair, lift and escalator connections between them.

Platform 0 is for local services to Numeaton. Platform 1 is reversible, and intended for services, in both directions, between Nuneaton and Leamington, perhaps to more distant destinations. It is possible for Nuneaton services to access the main lines, but this is not foreseen as normal.

It is expected that CC services will use platforms 6,9 to ensure no conflict with GC-gauge services using 7,8. The scissors crossovers at the west ends of these platforms are for operational convenience, but not used in normal service.