Government Office for the South West

London to South West and South Wales

Multi-Modal Study

Inter-Modal Freight Plan

Final Report

May 2002

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Contents Amendment Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date	Signed
18	0	Inter-Modal Freight Plan – FINAL REPORT	Feb'02	AP
18	1	Inter-Modal Freight Plan – FINAL REPORT	May'02	DB/AP

The Preferred Strategy will go to the Regional Assemblies for the South West and South East of England, and the Welsh Assembly Government, to consider their recommendations and as an input to the revision of the Regional Transport Strategies in Regional Planning Guidance for the South West and the South East.

These bodies will consider whether they wish to support the strategy. They will then, in turn, make recommendations to Ministers. Only then will any decisions be taken on the addition of schemes to investment programmes.

The study has been taken forward in an open and consultative manner and the possible options discussed publicly. Many of the proposals are at an early stage in the planning process and if the recommendations were accepted, further work would be required to prepare and consult on detailed designs and route alignments. This will allow specific impacts to be identified.

Contents

Executive Summary

E.1 The Inter-Modal Freight Plan has considered the scope for new and improved inter-modal freight facilities within the SWARMMS area to support the Government's transport policy, as outlined in A New Deal for Transport, to encourage freight traffic to transfer from road to rail – a mode with much lower noise and greenhouse gas emissions per tonne km than road haulage - with the Ten Year Plan targeting 80% increase in tonne-km carried on rail by 2010. It is drawn up in light of the SRA's Regional Freight Strategy Template.

E.2 This has included a review of rail's strengths and weaknesses in freight transportation, together with an assessment of the infrastructure and operational requirements to enable rail to retain market share in key existing sectors such as deep-sea container distribution and international inter-modal, and to compete more strongly in the emerging domestic inter-modal sector that has been identified as a key market if rail freight is to achieve the targeted level of growth.

E.3 The review concludes that rail's strengths are carrying large volumes of goods over long distances, but that rail is constrained by high terminal costs (loading and unloading), particularly where additional road transport legs are needed to complete a trip, and a restrictive structure gauge that prevents tall or wide loads being carried by rail. With much potential traffic in containers too tall to be carried on a standard rail wagon in Britain, to maximise the potential for modal shift there will need to be:

- A network of rail lines with structure gauge sufficiently enhanced to allow industry standard containers to be carried on international standard rail wagons;
- A network of linked, strategically located inter-modal freight transfer stations; and
- A network served by frequent (at least daily, to compete with road for "Just-in-time" traffic) trains to a range of destinations.

E.4 Evaluation by SRA and Railtrack indicates that enhancement of the rail loading gauge on a strategic network of lines to 'W12' (to permit both 'high-cube' 9'6" tall marine containers and similar height but wider road-rail swap-body to be carried on standard wagons) involves the optimal trade-off of capital cost and potential market enhancement.

E.5 A comparison has also been made of the likely cost of haulage for an inter-modal load by road throughout and by rail with one or two road feeder legs. This reveals that rail has high fixed costs per train movement but that provided there is sufficient traffic to at least half fill a 900 tonne train, where no road legs or additional loading is required, rail is the cheaper mode. With one road feeder leg and a 75% load factor on a 1,200 tonne train, for deep-sea containers (2 truckloads can be carried on a single rail wagon) road:rail is cheaper than road throughout at distances above 100-150km. However, if the load is inter-modal swap bodies (which can only be loaded one per rail wagon) and two road feeder legs are needed, road:rail is only cheaper than road throughout at distances above 400km even with a fully loaded 1,200 tonne train - around 600 tonnes of goods. With a 75% load factor on a 600 tonne train (250 tonnes of goods) the 'break-even' distance is over 1,000km.

E.6 The findings from this generic market research show that if rail services are to be frequent enough to compete with road on service level and cheap enough to compete with road on cost while remaining commercially viable, there needs to be a large market with a potential for mode switching - 500 tonnes of goods per train on a daily train equals 125,000 tonnes per year.

E.7 To help formulate this Plan, matrices of road goods movements provided by DTLR were analysed to identify the main long-distance goods flows in the SWARMMS Study Area. It was found that only Somerset, the ex-Avon area and Hampshire (flow potentially crossing the area) generate significant volumes over 200km, and only Hampshire has significant volumes over 300km. The main attractors are ex-Avon and Hampshire, with Devon and Somerset also averaging around 2.5 million inbound tonnes per year. Flows travelling more than 400km to or from all the counties are relatively low. Hampshire again has the largest volume, but both Devon and Cornwall also average more than 500,000 tonnes p.a. each way. The data also shows low tonnages travelling more than 400km from counties in the north of the Study Area, which are much more centrally located.

E.8 These findings show how thin the potential market for inter-modal rail is in the South West. Rail would need to capture nearly 20% of the 400km+ traffic in Devon or Cornwall to support one inter-modal train per day, and around 30% in Somerset. To support two or more trains per day, giving a choice of departure time or destination and enhancing terminal viability, needs around 50% mode shift in the relevant markets.

E.9 The market was also analysed along three rail corridors from the South West considered to have potential for inter-modal rail services:

1. London and the EU-facing port counties of Kent, Essex and Suffolk;
2. West Midlands, North West and Scotland; and
3. East Midlands, Yorkshire and North East.

E.10 It was found that, even with 40% mode shift, Cornwall will not sustain a daily train on any corridor. For Devon the prospects are better, and arguably Devon and Cornwall combined will be able to sustain two or more daily trains if Corridor 3 traffic is carried part-way on Corridor 1 or 2 trains, although more than one inter-modal terminal in Devon and Cornwall combined would appear to be unsustainable. Further north, Somerset, the ex-Avon and Wiltshire all have significant flows in Corridors 1 and 2; Avon also has a high flow on Corridor 3. Freight movements for Gloucestershire only provide significant freight flows on Corridor 2; its most important freight flows are to / from points in the West Midlands and further north. Within the study area, flows would not seem able to support services to / from Gloucestershire.

E.11 Justification for investment in inter-modal terminals and W12 loading gauge is co-dependent - without terminals for transhipment there will be no traffic to take advantage of the enhanced clearances; without the enhanced clearances the potential market for the terminals is limited.

E.12 A number of inter-modal terminals are proposed by developers and councils in the study area. Some are already open (Cabot Park, Avonmouth), under construction (South Marston, Swindon) or essentially committed pending permissions (LIFE at Iver). W12 enhancement is in the SRA's Freight Plan for Southampton-Birmingham via Basingstoke, Reading and Oxford, and London to both Cardiff and Bristol. The first scheme is accorded high priority in the recently published SRA Strategic plan, while the second is of greater relevance to SWARMMS, giving enhanced access to the Avonmouth, Swindon and LIFE terminals.

E.13 Analysis indicates potential for two inter-modal trains per day south west of Bristol. It is unlikely at this level of demand that more than one terminal would attract sufficient traffic to justify construction, let alone expenditure on loading gauge enhancements. Sites considered were:

- *Westbury* – existing rail yard, but poor road access and no plans for enhanced rail (loading gauge) access. Limited local inter-modal demand, which could use nearby terminals at Avonmouth and Swindon anyway. Too far from M5 / trunk road network to act as a rail-head for the South West.
- *Taunton* – existing rail yard but very poor road access. Railtrack estimate negligible cost to extend W12 loading gauge from Bristol to Taunton, but limited local demand. Proximity to Avonmouth again an issue.
- *Exeter Gateway* – greenfield site between old A30 and Exeter–Salisbury rail line near Exeter Airport, too small to accept a full length train. Developer would improve highway access to A30 and M5. Negligible cost to extend W12 from Bristol to Exeter St. David's station, but very expensive to extend to the site (gradient and curvature between St. David's and Central stations would also limit size of trains). An alternative rail route via Yeovil junction is possible, but it is unlikely to be economic to improve this to W12. Strategically a good location for a Devon and Cornwall rail freight-head, but the cost/feasibility of W12 rail access and its rail operational problems may limit the range of rail-borne goods the site can handle, suggesting a role as a rail freight distribution centre for the South-west.
- *Plymouth* – existing rail yard at Tavistock Yard. Good road access (next to A38). Railtrack's preferred site for a South West multi-modal terminal, but expensive to extend W12 from Exeter to Marsh Mills, with 7 tunnels and a number of bridges to be raised, and may be too far west to capture much of the potential Devon traffic.
- *'Mid-Cornwall'* – A greenfield site at Roche, where the A30 crosses the Newquay rail line, has been promoted, but conflicts with plans to divert this line so that Newquay trains serve more stations on the main line and freight has direct access to more China Clay 'dries'. With limited freight demand for an inter-modal terminal further west than Plymouth, would be difficult to justify.

E.14 On balance, Exeter seems the best option - although there is likely to be a lower level of demand than for a site with W12 able to process a wider range of rail-borne loads.

E.15 While this suggests that there is limited potential for significant mode transfer in the Study Area, it is worth noting that:

- The market analysis identified significant volumes of potential 'conventional' rail freight, that would not require expensive infrastructure changes or terminals **-** the equivalent of one train per day of minerals leaves Cornwall by road every day for Staffordshire, while around 50% of Mendip quarry production goes by road;
- Innovations in rail freight technology such as the Freight Multiple Unit (FMU) have the potential to alter the economics of service provision. These experimental trains have the potential to encourage 'thin' flows of rail-connected freight onto rail. On the negative side, if FMUs are to carry inter-modal containers, their loading gauge requirements are the same as conventional trains, and cost per tonne/km is higher than full trainload; and
- Isolated flows of freight can also be attracted to rail in some circumstances, particularly if the parties involved are willing. An example of this is supermarket distribution of 'long-life' goods. This sort of movement already takes place to the Scottish Highlands and Truro.

E.16 Hence, on the basis of the work undertaken, SWARMMS recommends that one inter-modal freight terminal be proposed –near Exeter Airport. This would complement the facilities already constructed or under construction in Avonmouth and Swindon. The case for the gauge enhancement measures associated with a true inter-modal terminal would need to be reviewed in the light of updated cost estimates and out-turn demand at the new terminal.

E.17 Whilst the potential for a full inter-modal freight terminal in mid-Cornwall is considered limited, local decisions relating to waste disposal might predicate a rail freight transfer terminal being constructed for waste. With such a facility in place, there would subsequently be increased potential to attract business.

E.18 There is also some potential for urban freight distribution centres in Bath and Exeter and the Exeter centre could potentially be combined with an inter-modal freight terminal near Exeter Airport.

1 Introduction

1.1 ***Background***

1.1.1 Halcrow was appointed by the Government Office for the South West (GOSW) in March 2000 to undertake the London to South West and South Wales Multi-Modal Study (‘SWARMMS’ - South West Area Multi-Modal Study). The overall aim of the study is to make recommendations for a long-term strategy to address passenger and freight transport needs within the key transport corridors between London and the South West of England and South Wales (M3, M4, M5, A303, A30, A38 and the parallel rail routes).

1.1.2 This will include, as and where appropriate, plans of specific interventions to address existing and predicted strategic transport problems in the study area, looking in particular at opportunities for reducing congestion by better management and modal shift, as well as options for taking forward focused improvements.

1.1.3 The strategy developed in SWARMMS comprises a range of policies and schemes that, together, are designed to effectively address the transport problems of the SWARMMS area. A central feature of these problems is the growing imbalance between the demands made on substantial sections of the area’s transport infrastructure and services and their capacity to carry these safely and efficiently. If some of this demand can be shifted to modes or routes with spare capacity, or which are a more efficient means of transport then the requirement for additional infrastructure and services will be lessened and the generality of transport operations will be more efficient. This Plan sets out a number of proposals that are aimed at shifting the transport of freight from road to other modes, particularly rail, where this appears to be beneficial to the wider economy.

1.1.4 There are nine other Plans that form part of the strategy for the SWARMMS area and each has some elements that affect transport demand. Although this Plan is titled ‘Inter-modal Freight' and concentrates primarily on infrastructure proposals aimed at effecting a shift in goods transport from road to rail, it identifies a number of softer ‘hearts-and-minds’ measures which could lead to modal shift, or to less intrusive operations within the freight distribution industry that fall outside the strict remit of an ‘inter-modal’ plan.

1.1.5 The focus of this Plan on reducing road-based freight transport demand supports Government freight transport policy as outlined in 'A New Deal for Transport' and developed further in the daughter document 'Sustainable Distribution: A Strategy' and 'Transport 2010 - The 10 Year Plan'. This policy involves an integrated strategy for the sustainable distribution of goods and services.

1.1.6 The objectives[1] of this strategy are to:

- Improve the efficiency of distribution;
- Minimise congestion;
- Make better use of transport infrastructure;
- Minimise pollution and reduce greenhouse gas emissions;
- Manage development pressures on the landscape - both natural and man-made;
- Reduce noise and disturbance from freight movement; and
- Reduce the number of accidents, injuries and cases of ill-health associated with freight movement.

1.1.7 A key element of this strategy is to facilitate and encourage more freight transport by rail and water, modes which have much lower noise and greenhouse gas emissions per tonne km than road haulage. The 10-Year Plan sets a target for rail to increase its market share of freight transportation from 7% to 10% by 2010. Given forecasts that freight transport demand will continue to grow roughly in line with GDP, this is equivalent to an 80% increase in tonne-km carried on rail over the period.

1.1.8 The SRA has developed a template for the consolidation of regional freight strategies into a high level master plan directed at achieving the goals for rail freight set out in the 10 Year plan. This Plan has been drawn up in consultation with the SRA and as far as relevant and practicable is designed to meet the requirements of its Freight Strategy.

1.1.9 The SWARMMS Provisional Strategy identified a number of opportunities for improving the efficiency of freight transport to, from and through the Study Area. These were primarily aimed at facilitating a shift away from road haulage, largely to

1 Sustainable Distribution: A Strategy: Summary, DETR, March 1999.

rail. Other measures were focussed on reducing the impact of road freight distribution on communities.

1.2 ***Content of the Report***

1.2.1 This report begins by describing the scope of the Plan (Chapter 2) and the existing problems it seeks to address and the issues involved in developing workable solutions (Chapter 3). A quantitative and qualitative appraisal undertaken to identify the most effective transport infrastructure schemes and measures to encourage mode shift is then presented (Chapter 4). This is followed by commentary on the relationship with the provisional SWARMMS freight strategy (Chapter 5) and the likely cost of the schemes (Chapter 6). Finally, Chapter 7 indicates the deliverables and the relative priority that needs to be given to different elements of the Plan.

2 Scope of the Plan

2.1 ***Context***

2.1.1 The Government's Sustainable Distribution Strategy involves a wide range of measures aimed at increasing the efficiency of the UK distribution industry while reducing its impact on society.

2.1.2 Many of these involve 'hearts and minds' issues, also dealt with in other SWARMMS Plans that will be applied at a national level. These cover such issues as reducing the need to travel, improvements in the logistics chain, improving standards of vehicle and driver safety, and reducing the environmental impact of road goods movement via improved vehicle and fuel technology.

2.1.3 Other measures, while also having nation-wide applicability, are most effectively applied at a local - County, District or town – level. These include improved signage and weight restrictions to route through HGV traffic away from residential areas, the development of local Freight Quality Partnerships, and urban goods distribution strategies.

2.1.4 The SWARMMS Inter-modal Freight Plan is focussed at the regional and strategic level, primarily on measures to encourage multi-modal freight transport in which road is necessarily used for local collection and distribution of goods with widely spread trip ends, but more energy-efficient and less intrusive modes - water or particularly, in the current policy context, rail - is used for the trunk haul.

2.1.5 Accepting that the potential to effect modal shift of freight is much greater for longer, inter-regional movements than for short intra-regional trips, in addition to reviewing the potential efficacy of schemes and measures within the Study Area, the Plan also considers complementary actions in other regions to enable mode shift to occur. The Plan also considers local issues, including the need to locate terminals to minimise the impact of road access on local communities and the potential to combine urban (road) distribution centres with inter-modal freight terminals.

2.2 ***Road Freight***

2.2.1 As in the rest of the country most freight to, from and within the SWARMMS area goes by road with around eighty percent of goods going by van or lorry and an even higher proportion using road transport for at least a part of its journey. The average of 46 tonnes per capita being lifted and dropped in the South East and 57 tonnes per capita in the South West compares with a national average of 55 tonnes per capita. The shear bulk of freight transport, at about three thousand tonne kilometres a year is four times that of passenger transportation and the cost to the nation runs into several billions of pounds a year.

2.2.2 Road transport has a number of intrinsic advantages over other modes in greater flexibility, by having far the most extensive network, minimising the need for transhipment in transit and lower costs for most short journeys. It is for these reasons that this inter-modal freight plan focuses on longer distance journeys for those types of commodity whose shipping is less time sensitive.

2.2.3 For the most part road freight transport takes place as part of the general pattern of road traffic movements and the measures set out in the road plans for the main SWARMMS transport corridors and Principle Urban Areas will assist the movement of goods by road. This will be of particular value where the engineering standards of roads are improved, for example by providing a good standard dual carriageway where there is only a basic single carriageway today. Generally there is adequate provision of fuelling, rest and catering facilities for commercial vehicles and their drivers along the main SWARMMS corridors. Heavy goods vehicles have significantly lower power/weight ratios than light vehicles and may have to negotiate gradients in lower gears, especially when heavily laden. On those stretches of Motorway where this significantly impairs traffic flows and when economically practicable additional (crawler) lanes are proposed to accommodate HGVs.

2.2.4 Substantial volumes of heavy goods traffic can create a significant environmental nuisance where these pass through local communities. By and large the main SWARMMS road proposals are designed to direct heavy goods traffic away from small settlements.

2.2.5 The other locations where heavy goods traffic can cause a nuisance is in the more sensitive parts of the larger urban areas. Again the SWARMMS proposals for these may bring some relief but freight policies for the individual areas should address the problems of efficient distribution and environmental protection. Such policies will usually focus on lorry management schemes of one type or another. It is important that any such lorry management schemes do not impose any significant increases in heavy goods vehicle movements on hard-pressed sections of the strategic road network. Similarly if time bans are imposed on lorry access to urban areas (e.g. night time bans) they should be designed to avoid concentrating lorry movements in short periods just before the ban comes into effect or just after it is lifted especially if these coincide with general traffic peak periods.

2.2.6 There is growing interest in the transhipment of urban freight in France, Germany, Holland and, to a less extent the UK. The purpose of these is usually to consolidate loads destined for major retail areas such as city centres to reduce the number of vehicle movements, to avoid the use of large intimidating vehicles in these areas and possibly to concentrate delivery times into pre-defined periods. These types of transhipment facilities include Urban Distribution Centres (UDCs) and Freight Villages. The latter being a looser arrangement comprising a cluster of operators.

2.2.7 Not all goods are suitable for processing through a UDC or Freight Village. Non-perishable boxed items and White Goods are examples of potentially suitable goods. Perishables and high value items requiring specialist handling are examples of potentially unsuitable goods.

2.2.8 It is important to have good data on the freight movements in the area for which intervention is being considered, as the patterns of freight movement can vary widely between different types of towns and cities. A study by the University of Huddersfield has shown that in large city centres (Leeds is the example) 4,260 calls required only 732 tours. In an historic city centre (Winchester is the example) 950 calls required 810 tours. This is partly explained by the types of retailers and carriers in the two types of areas.

2.2.9 In a large city centres there will be a strong presence of national chains which use quite sophisticated distribution methods, often employing Third Party Logistic Managers (TPLMs). These national chains often have several branches and will consolidate the load at their regional distribution depot and tour the city making several drops from one fairly large vehicle. At the extreme, firms like M&S and Tescos will send a full load from their depot to a single store. In smaller city centres there will be smaller stores and fewer multiple branches. Retailers will not have the skills or the same opportunity to manage their logistics “efficiently” so there will fewer calls per tour and usually smaller consignments.

2.2.10 Transhipment facilities can be close to city centres, or sensitive zones, or at some distance away located close to the main transport arteries. The first has the advantage that goods are close to hand and a high quality and reliability of service should be possible. Also this opens up the opportunity to optimise delivery vehicle characteristics to suit the needs of the area. However land values will be higher and the opportunity to co-locate ancillary activities (warehousing, packaging, etc.) that much less.

2.2.11 Transhipment facilities at the edge of the urban area will usually be cheaper to provide and may be less environmentally sensitive. There will be more opportunity to co-locate ancillary and supporting activities and, in some cases, even multi-modal transhipment from a railhead. If well sited, they should reduce the amount of HGV movement throughout the whole urban area. However it will be more difficult to provide a reliable service and specialised vehicles.

2.2.12 Whilst there is a great deal of interest in UDCs and Freight Villages it has proven difficult to establish and maintain these as viable operations. They will usually have to be associated with a regime that restricts normal commercial delivery arrangements and may require local authority support of one kind or another. Perhaps paradoxically, it may be necessary to relax the preferred lorry control regime in order to make such facilities effective and viable. Issues that bear on this include delivery “windows” that do not create too much bunching and permitted vehicle sizes that allow multiple calls. This involves striking a balance between the number and size of delivery vehicles operating in the area.

2.2.13 This touches on the question of who operates such facilities. These could be public sector operations, private sector monopolies or a form of joint operation involving the local authority and one or more carrier(s). In the UK the existence and widespread use of TPLMs suggest that these should be a key player in any such arrangements. There is reluctance among the major players to support this kind of concept because it introduces another link in the supply change that could damage service quality, increase costs and weaken customer relationships. Any proposed arrangements must take these concerns into account.

2.2.14 A possible approach could involve the local authority in helping to develop the facility and granting licenses to deliver in the restricted area to one or more TPLMs. The licenses would specify the restricted area, the times that deliveries are permitted and the types of vehicles that can be used. The total number of vehicles licensed could be restricted so that if there were more than one operator there would be a capacity incentive to share deliveries.

2.2.15 The establishment of UDCs in the SWARMMS area could help reduce environmental impacts of goods traffic in the more sensitive urban environments but it would appear that their role is quite limited. The two urban areas where they may have value and should be investigated further are Bath and Exeter. Because of the great environmental sensitivity of Bath and the lower efficiency of retail logistics in towns of this size a UBC could bring environmental benefits without a significant loss of logistical efficiency. Potential sites for UDCs in Bath include Western Riverside for an inner location and Lower Swainswick for an outer location. Either would require careful design and access management in order to minimise traffic and environmental impacts.

2.2.16 Exeter on the other hand is a slightly larger city but still with an environmentally sensitive centre. If the proposed road/rail transhipment centre is progressed in the vicinity of the airport this would provide many of the facilities needed for an Urban Distribution Centre and the economies of scale would benefit both activities. This might also tip the balance in favour of rail for the trunk movements of some commodities to the Exeter urban area itself.

3 Key Problems and Issues

3.1 *Background*

3.1.1 Currently only 5% of goods lifted and 7.7% of freight tonne km go by rail in the UK[2]. Nationally, road transport accounts for 80.6% of goods lifted and 65.4% of freight tonne km, 16 and 8.5 times more than rail respectively. The balance of domestic freight transport is accounted for by water - mainly coastal shipping - and pipeline.

3.1.2 It follows that the average length of haul is longer for rail than for road, i.e. rail's mode share is higher for long-distance traffic, where the higher cost of loading and unloading freight trains (particularly where one or more additional transfers are needed if a different vehicle or mode is being used for local distribution and the trunk haul, known as 'double-handling') is off-set by lower line-haul costs with a large train. However, although rail is more effective as a freight haulier over longer distances, a range of products that seldom go by rail (comprising almost 40% of freight traffic) have average haul lengths in excess of 130km, with many loads travelling more than 200km.

3.1.3 In part this is because the wide dispersion of freight trip ends in a post-industrial economy, with most not located near a rail line let alone a rail freight facility, requires road haulage at one or both ends of the trip. The added cost of double-handling implicit in inter-modal freight transport increases the trip length at which rail's lower line-haul cost makes rail a cost-effective mode for the trunk haul.

3.1.4 Further factors contributing to the low use of rail for certain types of goods, regardless of trip length, include:

- the trend in modern logistics chains to carry lower stocks of goods at the point of consumption/sale, saving on stock-holding and storage cost, relying instead on just-in-time delivery from the supplier or a central distribution point;

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2 DTLR Statistics for 1999

- the impact of this trend and rail's lack of competitiveness is compounded by the relative inflexibility of rail freight departure and transit times on a predominantly passenger railway; and
- the trend to containerisation of goods for longer distance transport, either in marine (ISO) containers (where an international trunk-haul by sea is involved) or in similar sized boxes (either skeletal with curtain sides or with rigid - secure - walls and rear doors) which are semi-permanently attached to road-trailers.

3.1.5 **Just-in-Time (JiT):-** Rail freight has a poor reputation for both speed of transit and reliability, with passenger trains often having priority. JiT also involves smaller, more frequent deliveries, not suited to rail haulage, which has the capability to move large volumes of goods on a single train.

3.1.6 **Inflexible timings: -** Depending on the route, there will be certain periods when freight trains are unable to move because all capacity on key links in the network is used by passenger trains. This is the case in London, where the network is effectively closed to freight for 6 hours per day (morning and evening peaks) and freight either does not run or is held at yards (Acton, Wembley, Dollands Moor at Ashford for trains from the Channel Tunnel) until after the peaks. This either limits the realistic departure / arrival times for longer distance freight to a couple of slots per day or extends the transit time by up to 3 hours. Other "hot-spots" include Birmingham, Manchester and Reading West Junction. SRA and Railtrack are developing plans to re-open lines or chords and even build new sections to create freight bypasses that only use lines with little or no passenger traffic even in the peak.

3.1.7 **Containerisation:-** In general, the trend to containerisation of finished goods (and some raw and part-processed materials) has been positive for rail, as the loading or unloading of rail wagons can be achieved in a single crane lift rather than by several man hours of labour, reducing the handling cost disadvantage of inter-modal transport. Further, long-distance marine container flows are concentrated on the few ports with the depth of water and specialised cranes required for the container liners, which dominate international freight transport. These ports are often several hundred km from the origin or destination of the goods, giving rise to high volumes of long-distance goods traffic that is as easily loaded onto a rail vehicle as a road vehicle. However, an increasing proportion of marine containers, and almost all the road trailer mounted boxes used for domestic traffic, are too tall to be carried on standard rail wagons within the restricted structure gauge of Britain's railways.

3.1.8 In parallel with the rise in demand in these new markets there has been a decline in many of rail's traditional, heavy-haul markets (e.g. coal, oil, minerals and metals) that are typified by low time sensitivity of the goods carried and, in many instances, by the ease of loading and unloading rail by gravity food from/to hoppers or conveyor belts.. This led to a reduction in tonne-km carried (and even in mode share within sub-markets as point-to-point flows diminish to levels below which rail's economies of scale are outweighed by road haulage's greater flexibility). However, while at an aggregate level the market is perceived to have moved away from rail, rail is still dominant in its traditional markets, as well as in new markets (e.g. inland distribution of marine containers) that are suited to rail's strengths.

3.1.9 In recent years a renaissance in traditional markets (notably coal to power stations and construction materials) coupled with new, higher capacity wagons and locomotives and aggressive marketing by private sector rail freight hauliers has led to a reversal of the long term decline in railfreight activity. Table 3.1 shows a marked increase in rail's mode share of domestic goods transport between 1994 and 1999.

Table 3.1 : Domestic Freight Transport by Mode 1994 and 1999

bn tonne km

Mode	**1994**		**1999**		**Growth rate**
	Bn tonne km	Mode share	Bn tonne km	Mode share	Per annum
Road	143.7	65.1%	156.7	63.9%	1.7%
Rail	13.0	5.9%	18.2	7.4%	7.1%
Water	52.2	23.6%	58.7	23.9%	2.0%
Pipeline	12.0	5.4%	11.6	4.7%	-0.7%
Total	220.9	100%	245.2	100%	1.9%

Adapted from DTLR Transport Statistics Great Britain 2001

3.1.10 Over the same period comparison of aggregate rail freight activity data from Railtrack (in gross tonne km) and SRA/DTLR (in net tonne km) shows the ratio of goods carried to total train weight increasing from 41% to 43%, while other Railtrack data shows the average size of freight train increasing at around 1% p.a., i.e. rail freight efficiency appears to be increasing.

3.1.11 Table 3.1 also shows tonne km transported by pipeline did not increase - transport of crude and refined petroleum products, a market currently in decline, dominates domestic use of these modes - and that the volume of road freight transport continued to increase, albeit at a lower rate than before 1994. However, tables in Transport of Goods by Road in Great Britain 2000 (DETR, May 2001) show that in recent years the increase in goods tonne km by road has not led to any increase in goods vehicle km since, as with rail, the average load per vehicle has also been increasing over time.

3.2 *Modal Share*

3.2.1 The recent increase in rail's modal share suggests that the desired mode shift will be achieved merely by a continuance of current trends, but this is unlikely to happen. In addition to events subsequent to 1999 (notably the proliferation of speed restrictions following the Hatfield derailment and the current loss of international traffic due to security concerns in the Channel Tunnel) which have contributed to zero growth in rail freight demand in the last 2 years, deeper analysis indicates much of the increased demand to be attributable to three, temporary or one-off factors:

- A switch to supplying coal to power stations from (distant) ports rather than (nearby) mines. The average length of haul for coal trains increased from 77km in 1994 to 111km in 1999 - while tonne km of coal transport increased, tonnes lifted was static over this period (and declined for other modes). This switch in the sourcing of power station coal may be a one-off boost to rail traffic, rather than a long-term trend;
- A boom in the economy and thus in the construction industry, with a number of large projects suitable for delivery of materials by rail (e.g. Channel Tunnel Rail Link, West Coast Main Line, both rail infrastructure projects). A period of economic stability or even decline is now forecast, although if Government's infrastructure investment plans are fulfilled this boost to railfreight may continue; and
- Continued growth in international trade, and in the proportion of goods that are containerised. Rail's share of this market has been affected by speed restrictions, but is now reported to be recovering. Dominant rail haulier Freightliner recently reported being able to operate their full timetable for the first time since Hatfield. However, increased use of high-cube containers means rail needs to adapt in order to retain current traffic, let alone increase mode share.

3.2.2 While further demand growth in rail's existing markets is not ruled out (a number of opportunities within the SWARMMS study area are noted below), to achieve the 10-year Plan's target rail needs to become more competitive with road haulage in the growing market sectors.

3.2.3 Widely dispersed trip ends, with most some distance from a rail line, means that road will continue to be a necessary element of almost all freight transport in the UK. Rail has the potential to capture the trunk-haul part of longer distance movements, with road being used for collection / delivery at a network of road:rail transfer stations - inter-modal terminals - taking advantage of the increasing level of containerisation of goods in transit to reduce the cost and inconvenience of multiple-handling of loads (supplier⇨truck; truck⇨train; train⇨truck; truck⇨ consumer). Most existing railfreight flows in the SWARMMS area require no more handling to be carried by rail than they would by road, rail linking port, quarry, stockpile or distribution centre with port, distribution centre or end user.

3.2.4 Main flows include:

- China clay from "dries" in Cornwall to ports in Cornwall or end users throughout Europe;
- Coal from Bristol to Didcot Power Station and regional stockpiles (until recently this traffic did have to be double handled - while Bristol Port's bulk terminal is in the Royal Portbury dock, rail access was at Avonmouth, with a conveyor running under the river Avon linking the two - this traffic can now be loaded direct to rail at Portbury);
- Large quantities of aggregates from Mendip quarries to a number of distribution stockpiles - flows to London and the South East via Acton are estimated at 2.5-3 million tonnes per annum;
- Lesser flows of stone and building materials from mines and ports in the South West to distribution centres throughout the county; and
- Mail (possibly unique as a freight flow which undergoes value added processing while in transit).

3.2.5 The main bulk flows into the area are petrochemicals from Fawley refinery to distribution depots in the South West and LPG from Wytch Farm oil field (Poole) to a chemical works at Avonmouth.

3.2.6 With much potential traffic in containers too tall to be carried on a standard rail wagon in Britain, to maximise the potential for modal shift there will need to be:

- A network of rail lines with the structure gauge sufficiently enhanced to allow industry standard containers to be carried on international standard rail wagons;
- A network of strategically located inter-modal freight transfer stations; and
- A network of frequent (at least daily) railfreight services to a range of destinations, to compete with road for JiT traffic.

3.2.7 A further issue is the need, subject to the level of grant available from SRA and others, for the inter-modal transfer stations and rail freight services to be commercially viable.

3.2.8 These issues are examined in further detail below.

3.3 ***Rail Structure Gauge***

3.3.1 When Britain's rail network was being built the largest and heaviest vehicles were locomotives. Lines were built to accommodate the biggest that it was considered the new transport mode would produce. Clearance above the track was determined by the height of chimney needed to push exhaust smoke and steam clear of the driver's view and generate a good draft through the firebox. With round boilers the clearance above the track to the side of the train was less critical, ease of construction of brick arch bridges and round or ovoid tunnels was the main determinant of height clearance at the shoulders of the structure gauge.

3.3.2 As train size increased track and sub-structure was upgraded for the heavier locomotives - most main lines in Britain are now classified RA (Route Availability) 10, with a permissible axle-load of 25.4 tonnes - but easing height and width restrictions has proved more difficult. While most adopted the same track gauge (distance between the rails) as Stephenson, railway designers in other countries, benefiting from the early experience of Britain opted for greater lateral and vertical clearance. In Britain only Brunel's Great Western (originally built to a much broader track gauge, thus allowing wider trains) and parts of the Great Central (designed to connect with continental railways via a late Victorian plan for a Channel Tunnel) were built with more generous clearance. On other lines the lower cost of locating pairs of tracks closer together and minimising the size of hole that trains needed to fit through influenced design criteria and has bequeathed Britain a rail network on which trains are narrower and lower than those in most other countries.

3.3.3 While Britain's rail network was separated by the English Channel from those of continental Europe, goods carried were heavy relative to the capacity of the wagons used (i.e. freight trains would 'weigh-out' rather than 'cube-out' - see below), and freight was manhandled on / off wagons at rail yards, structure gauge was not a major issue. All the goods on offer could easily be carried on wagons designed to fit within the national standard structure gauge, classified W (wagon) 6.

3.3.4 This is not now the case:

- The nature of freight has changed, from heavy raw materials, unprocessed foodstuffs and metal products - denser than water ($1m^3$ = 1 tonne) - to plastics, consumer goods etc. that are heavily packaged to minimise damage during transit and are much lighter (a well packaged TV set, for example, may come in a $1m^3$ box, but weigh only 50kg); and
- The nature of trade has changed, with an increasing proportion of long-distance movements undertaken in standard containers designed for international use in countries which do not suffer from the restrictive structure gauge of Britain's railways.

3.3.5 Despite their size (too large to be carried by rail on most lines in Britain), containers cannot hold very much freight. Practical limits on the weight that can be lifted by gantry cranes at ports restrict the laden weight of a container to 35 tonnes, even for the largest standard size of 45'*9'6"*8'3" with a capacity of $82m^3$. This weight limit influences the detailed design of marine containers - which may be stacked 7 or 8 high, even when loaded - and road:rail swapbodies (designed to stack 2 or 3 high), with the boxes themselves weighing around 4 tonnes (2.5 for a 20' marine container). Regulatory limits on the weight that can be safely carried on a road trailer further restrict the gross weight if road haulage is required - a 6-axle tractor-trailer unit with a permitted gross vehicle weight (GVW) of 44 tonnes will itself weigh around 11 tonnes, restricting the payload to 33 tonnes and the weight of goods to 29 tonnes (less for older vehicles with fewer axles).

3.3.6 Nevertheless, the low weight:volume ratio of packaged goods creates further problems for shippers. Despite the potential to carry 29 tonnes of goods per unit, analysis of DTLR Maritime Statistics for 1998 reveals that the average weight of goods on <u>loaded</u> vehicles using Ro-Ro ferries was 14.28 tonnes, while the average weight of goods in <u>loaded</u> maritime containers at UK ports was 15.85 tonnes (in addition, some 10% of Ro-Ro traffic and 18% of marine container movements were empty). While some units are not fully loaded because a less-than-container-load consignment has been shipped to meet JiT criteria, in general this low absolute utilisation (which is relatively high by international standards - at Hong Kong in 1992 the average weight of goods was around 10 tonnes per unit) arises because modern goods ‘cube-out’ - fill the space available - before they ‘weigh-out’ - reach the maximum permitted load for the shipment.

3.3.7 Size of container is thus important to shippers, who want to get as much as possible into a single shipment. The initial standard size, the 20' marine container (the yardstick of throughput or carrying capacity, TEU, is based on this ‘twentyfoot equivalent unit’) has an internal capacity of $33m^3$, a 40'*8'6" box is $67m^3$ and a 40'*9'6" ‘high-cube’ unit is $76m^3$, giving 13.5% more capacity for less-dense goods.

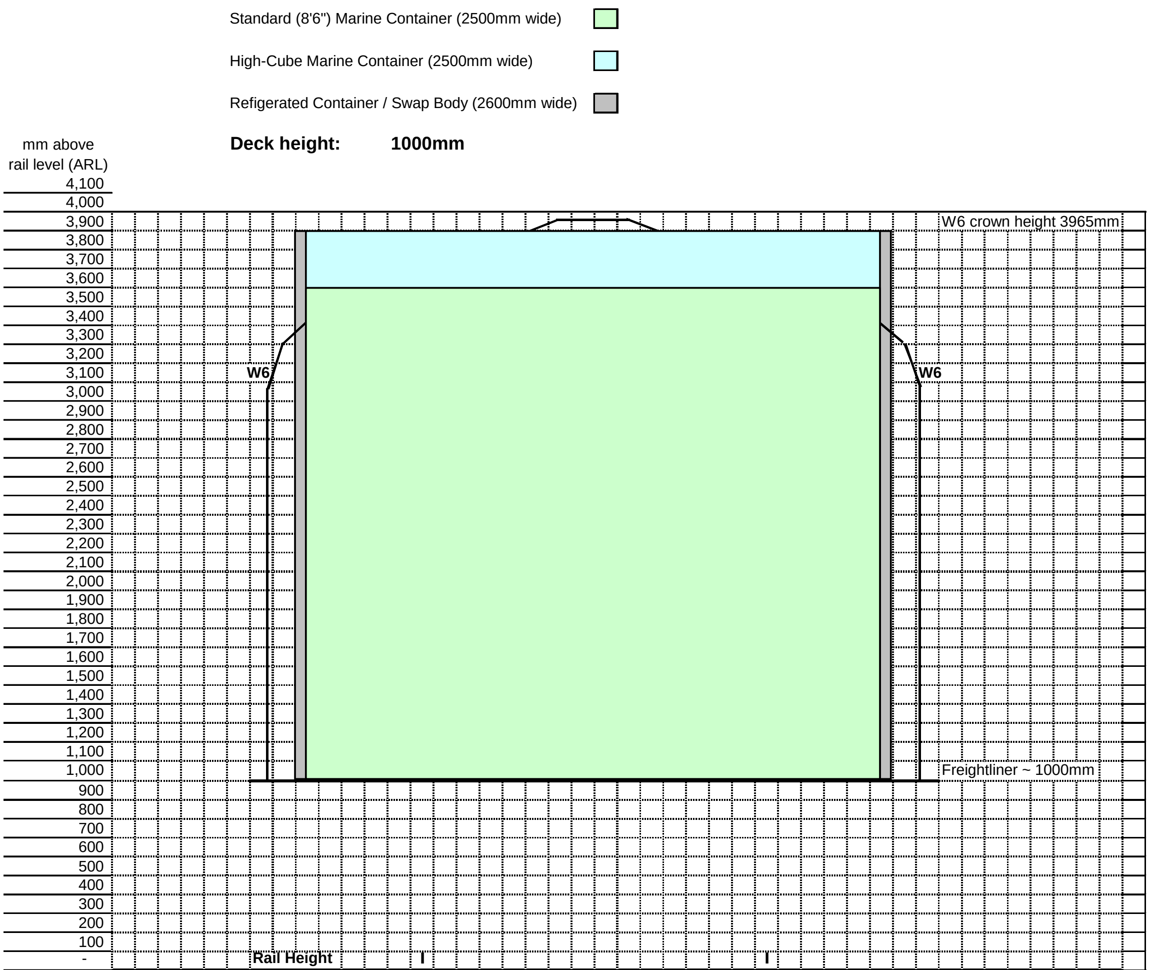
3.3.8 Figure 3.1 compares W6 loading gauge with the profile of three typical loads that rail needs to be able to accommodate in order to succeed in the inter-modal freight market - an 8'6" marine container, a high-cube marine container and a 9'6"*2,600mm wide swapbody - mounted on a typical British flat-wagon designed for container transport with a deck height 1,000mm above rail level (ARL).

3.3.9 It can be seen that, although the width of trains in Britain is less than on continental railways, this is not an issue - inter-modal loads to be carried on road vehicles have a 2,600mm maximum width, 220mm narrower than W6. It can also be seen that the crown height of W6, 3,965mm, is adequate for high-cube, but that the 8’6” container exceeds W6 at the shoulders.

3.3.10 Two approaches can be taken to resolving this conflict:

- Clearing obstructions from the shoulders to allow larger loads to be carried while retaining the W6 crown height; and
- Lowering the deck height of the wagon.

Figure 3.1 : Interaction of Structure Gauge and Wagon Height - W6 and New Freightliner Wagon



3.3.11 Some sections of line were built to more generous structure gauges. On other lines tunnel bores have been enlarged, bridges raised and arch bridges replaced by girder bridges in connection with electrification or the replacement of ageing structures. Significant lengths of the network have been found to be able to accommodate larger loads, and have been classified W7 (8' high containers on Freightliner's first generation wagons, with a deck height of 1,039mm ARL), W8 (8'6'' high containers on wagons 1,039mm ARL) and, on lines upgraded for Channel Tunnel access or in connection with the West Coast Main Line upgrade project, W9 (also known as SB1-C - this will accommodate 9' high containers on Freightliner's newer wagons, with a deck height of 980mm ARL, and a limited range of swap-bodies).

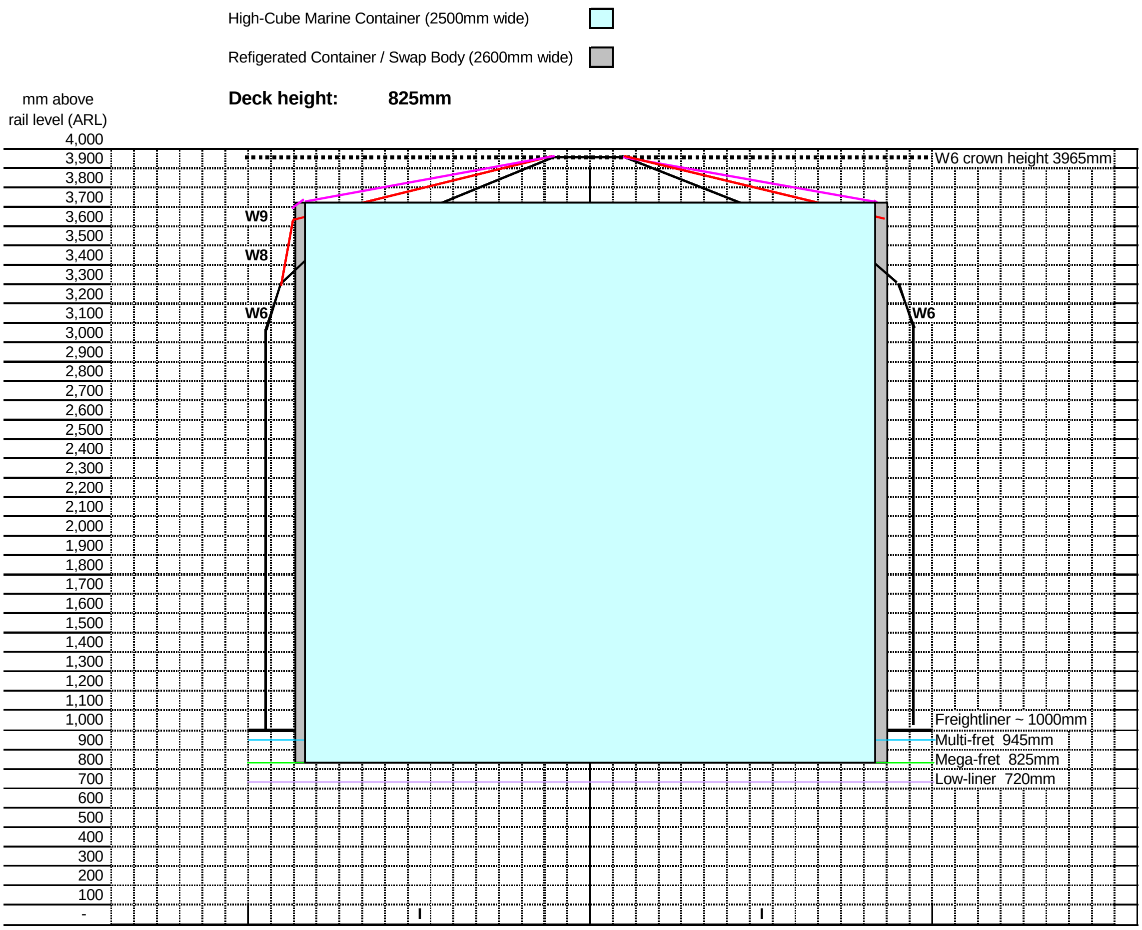
A map is available in the Freight commercial pages of Railtrack's web site (www/freightcommercial.co.uk) showing sections cleared to W8 and W9. In the SWARMMS Study Area the rail network is quite "thin", with a much more limited choice of route between points than is the case for road. This choice is even more restricted (or non-existent) if enhanced loading gauge is needed, and rail reliability suffers unduly if a key link is blocked.

3.3.12 In parallel with the progressive relaxation of loading gauge restrictions, a number of wagons have been developed, both in Britain and in Europe, which have deck heights as low as 475mm ARL. All current low-deck wagons compromise rail performance to a greater or lesser degree, reducing the length of wagon that can be used for goods (restricting the payload that can be carried in a given length or weight of train) and in many cases reducing the size of the wheels, limiting the speed at which trains can run and increasing rail wear. These issues are considered further below.

3.3.13 Figure 3.2 shows the easing of load height restrictions achieved with W8 or W9 loading gauge and the standard European low-deck wagon, the Megafret (deck height 825mm ARL). It can be seen that a high-cube container will just fit within W9, although a slightly wider swap-body of the same height will not. Figure 3.2 also shows the relative deck height of the Low-Liner wagon, specifically designed to accommodate a high-cube container within W8 loading gauge.

3.3.14 While these wagon:gauge combinations allow high cube marine containers and shorter swap-bodies to be carried on much of the network (in the SWARMMS area to Exeter Riverside Yard on the Great Western Main Line, Salisbury on Waterloo-Exeter, and Westbury on the Berks and Hants), they have limited deck length available for full height loads and cannot carry 3 TEU per wagon, unlike Freightliner's fleet. Further, given the low density of some loads, many swap-bodies are taller than 2,900mm (9'6") in order to increase the volume of goods. Railtrack and SRA have therefore evaluated the business and economic case for a limited network of lines with enhanced clearance.

Figure 3.2 : Interaction of Structure Gauge and Wagon Height - W8/9 and Megafret



3.3.15 This concluded that "the development of W12 gauge……will give the best return in terms of industry benefit compared with infrastructure costs" (Railtrack 2001 Network Management Statement, page 6/16). W12 allows high-cube on standard (3TEU) wagons, 9'6" swap-bodies on European standard multifret wagons (deck height 945mm ARL) and even higher swap-bodies on megafrets. Railtrack/ SRA are also evaluating the case for W18 piggy-back gauge (allowing loaded road tractor-trailer units to be piggy-backed on special rail wagons), but this requires a crown height of 4,130mm and would involve a significant amount of bridge raising.

3.3.16 The impact of W12 loading gauge is shown in Figure 3.3, which also illustrates the envelope of a possible piggy-back gauge. A number of routes are being considered for early enhancement to W12, of which Cardiff (Wentloog terminal)- Filton Junction (with a spur to Avonmouth Euroterminal)-Swindon-Acton-Willesden, Southampton Docks-Basingstoke-Reading West Junction, and Didcot East Junction-Oxford-Leamington-West Coast Main Line affect the SWARMMS Study Area. As well as looking at W12enhhancements to Cardiff and Bristol the SRA will be evaluating the costs of enhancements to Exeter and Plymouth.

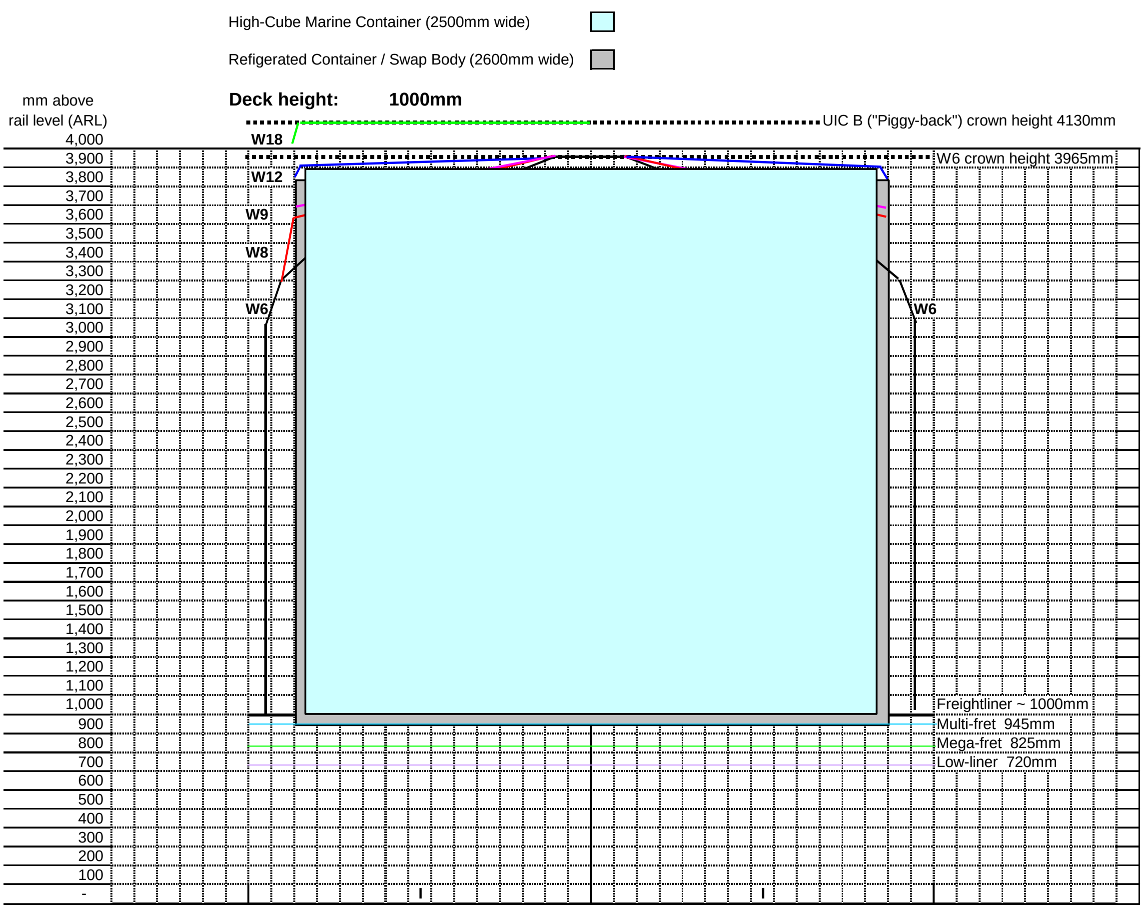
3.3.17 The proposed enhancement of loading gauge will have a limited impact on existing rail freight (most of which weighs out before it cubes out and can be carried on W6 lines), but will allow rail to retain (and possibly increase) its mode share in the marine container market as the proportion of high-cube containers increases. It would also allows rail to compete, for the first time, with long distance domestic trucking if more shippers were to invest in swap-bodies rather than the current fleet of curtain-sided and rigid containers semi-permanently attached to road trailers.

3.4 *Inter-modal Freight Transfer Stations*

3.4.1 Rail's entry to these new markets also requires inter-modal transfer facilities to switch loads between road and rail. A number of terminals have been constructed in key locations in connection with international inter-modal traffic using the Channel Tunnel. Common features are: long sidings for trains up to the maximum length allowed through the Channel Tunnel, 775m (750m of train plus locomotive – the 'tunnelmax' freight train also sets the standard for new or upgraded freight passing loops); good road and rail access (typically on or close to a main line to London and the Channel Tunnel and adjacent to a motorway junction or trunk road); sophisticated freight handling equipment such as gantry cranes; and a high throughput (3 or more services per day each way). In appraising potential sites in the SWARMMS Study Area, incorporating some of these features will be more important than others.

3.4.2 The ability to accept 775m long trains will be important to handle the full range of inter-modal traffic. Given the low average weight of swap-bodies (under 20 tonnes) highlighted above and the limited carrying capacity of current inter-modal wagons (1 swapbody per 18.5m wagon) a fully loaded 775m train would comprise 40 wagons and weigh 1,600 tonnes, well within the hauling capacity of the General Motors Type 66 locomotives being used by the main rail freight hauliers in Britain (EWS, Freightliner and GBRail).

Figure 3.3 : Interaction of Structure Gauge & Wagon Height - W12 and New Freightliner Wagon



3.4.3 For such trains to access the site, it needs to be on or close to a main line, with no steep grades or sharp curves, which limit the weight of train that could be hauled by a single locomotive at a competitive speed (the Type 66 has a design speed of 120km/hr for inter-modal traffic). The site also needs to be on the Inter-modal network, with more than 2 tracks or 775m+ passing loops so that freight trains can be overtaken by express passenger trains (design speed 200km/hr+) and, for the widest range of inter-modal traffic, W12 loading gauge.

3.4.4 Good road access is also critical - while a successful site will remove a significant volume of truck traffic from roads nationally, it will increase HGV activity in the vicinity of the terminal. In general, vehicle miles removed will be on motorway and rural trunk roads, but the local vehicle miles added may be on local, urban roads.

This is a balance that must be recognised in the design and location of transhipment sites and consideration should be traffic management measures that reduce local environmental impacts of HGV and other vehicle movements

3.4.5 Given the low commercial viability of inter-modal rail freight operations (see next sub-section), terminals and rail services to them will need to attract as much grant payment as possible. Grants are currently administered by SRA and are based on ‘sensitive lorry miles’ (SLM), with payments based on the net change in lorry miles on different types of road with the rail freight facility or service. While the level and method of calculation is under review, the current rates, intended to reflect the relative road damage, accident, congestion, and environmental disbenefits of HGV traffic on different types of road are:

- £1.50 per lorry mile removed from urban single carriageway and at-grade dual carriageway roads;
- £1.00 per lorry mile removed from rural single carriageway roads; and
- £0.20 per lorry mile removed from motorways, rural dual-carriageway and urban grade separated dual carriageway roads.

3.4.6 For long-distance inter-modal traffic, most miles removed will qualify for grant at the lowest rate, whereas miles added (in diverting a truck from a trunk road to a rail-head) may be charged at the highest rate. To minimise the loss of potential grant, sites thus need to be easily accessible from a motorway or rural dual-carriageway road, as 1 additional mile on an urban road offsets the benefit from nearly 8 miles removed from a motorway.

3.4.7 Most inter-modal sites are large and sophisticated, with on-site warehousing for breaking or consolidating loads. Site operators argue that the fees the market will bear for transferring boxes between modes will not justify the construction and operation of the facility (even with part of the cost off-set by grant) and that both a high throughput and the ability to charge for value added from warehousing and distribution activities are needed to make such sites commercially viable (the financial model for the proposed London International Freight Exchange near Slough is based on 7 trainloads per day each way plus on-site warehousing and distribution).

3.4.8 Arguably, the expensive gantry cranes installed at most sites are not necessary; modal transfer could as easily be effected on an area of hard-standing by fork-lift trucks or reach-stackers (swap-bodies can be stacked up to 3 high while awaiting collection). The reduced construction and operating costs should enable the site to be viable on a lower level of throughput or without the need for additional non core on-site activities.

3.4.9 On the other hand, the urban fringe location that would be suitable for a road:rail transfer station (e.g. where rail line crosses ring-road) would also be ideal for break-bulk activities and road:road transfer activities in connection with a local freight quality partnership. Further, as drawn out below, high turnover may be required to ensure the viability of rail services that are frequent enough (and serve a range of destinations) to compete with JiT road services so that rail freight hauliers will be prepared to serve the site. Outside the main industrial areas, which generate high volumes of potential traffic it may therefore be necessary to have a few large sites with a regional focus, rather than a number of small local sites serving a large town or rural county, in order to achieve viability for both terminal and rail services.

3.5 ***Rail Freight Commercial Viability***

3.5.1 Achieving commercial viability for new rail freight services is an iterative process. On the one hand, to attract sufficient business from road to cover long run operating costs rail must offer a level of service that, taking a range of attributes (including cost, journey time, flexibility of departure and destination, reliability and security) into account is at least as good as road. This implies frequent (at least daily) services to a range of destinations. On the other hand, rail has high fixed costs and if the market is too thin rail will not be able to cover its costs no matter how good the offer. While a number of innovative measures are being trailed which aim to lower fixed and terminal costs, rail remains a high-cost, high-volume mode of transport, whether for passengers or freight.

3.5.2 Mode choice criteria vary from shipment to shipment, and only the broadest comparisons can be made within the context of this Study. An assessment has been made of the likely door to door costs of transport by road and (inter-modal) rail for a variety of types of load under a range of train size and load factor assumptions to determine the distance above which, other criteria being equal, rail should be the preferred mode for the trunk haul. At present other criteria are not equal, rail having a record of poor reliability and low flexibility on collection or delivery times. While rail will be the preferred mode for some traffic, in general rail will need to be cheaper than road in order to break into new markets.

3.5.3 As with mode choice criteria, the cost elements incurred will depend on the goods to be carried and the location of the trip ends. The cost comparisons presented here are intended to represent a typical goods movement, but can be broken down into individual elements (line haul, waiting time, empty running, lift fees etc.).

3.5.4 The following bottom-up assumptions, on a 1999 price base, have been made in estimating costs for road haulage:

- Tractor-trailer unit**,** GVW 33tonnes +;
- Cost per hour (return on capital, crew, fixed maintenance) £15;
- Running cost per km (fuel, variable maintenance) £0.27;
- Average speed when running 65km/hr;
- 2 standing hours to load or unload; and
- average 100km re-positioning trip (empty running) for next load.

3.5.5 Combining hourly cost, average speed and running cost, on average road haulage has a total cost per km of £0.50 plus a fixed cost of £110 per trip (4 hours to load/unload, 100km re-positioning).

3.5.6 As a check, a top-down regression analysis was undertaken using a database of road haulage costs quoted to Containerisation International magazine in the spring of 2001 in a survey to compare road throughout with inter-modal (rail trunk haul) and inter-modal (sea trunk haul) for a trip between Newcastle and Naples. This revealed costs of £85 fixed and £0.67 per km over the whole data set (including Channel crossing charges) and £136 fixed and £0.56 per km for UK feeder haulage only. With no allowance for overheads included in the bottom-up value, the actual costs confirm that the bottom-up estimate produces realistic values.

3.5.7 For ease of comparison, rail cost has been calculated per truckload. Bottom-up assumptions (1999 price base) are:

- Locomotive fixed cost per annum £442,000 (£1.5m capital cost, 10% rate of return over 30 years, £140,000 crew costs, £100,000 overheads, £50,000 fixed maintenance);
- Locomotive annual utilisation 150,000km (12 hours per day, 250 days per year, average 50km/hr);
- Locomotive running costs (fuel, variable maintenance) £1 per train km;
- Wagon fixed cost per annum £7,250 (£50,000 capital cost, 10% rate of return over 20 years, £1,650 fixed maintenance);

- Wagon annual utilisation 110,000km;
- Wagon running costs - negligible;
- Track access costs – as recently proposed by ORR, for diesel hauled inter-modal traffic these will be in the region of £1.75 per 1,000 gross tonne km, but it is likely that these will be covered by track access grant (or its successor) for all inter-modal traffic;
- Mobilisation cost £300 per train;
- Administration cost £10 per load;
- Load lift-on or lift-off £20; and
- Road feeder services £80 per leg (average 50km, with lower waiting time and re-positioning distance than for trunk-haul road).

These assumptions give a cost of £3.95 per locomotive km plus £0.07 per wagon km, i.e. an inter-modal train needs to comprise at least 10 loaded wagons (truck loads) for rail's line haul cost per km net of track access charges (£4.65) to be lower than road's (£5.00).

3.5.8 It has not been possible to directly compare synthesised and actual costs for rail - recent data from EWS and Freightliner confirms the capital cost and utilisation estimates are reasonable. If the 10-Year Plan growth target is met and planned infrastructure improvements benefiting freight operations are implemented, however, there will be scope for greater productivity in rail freight operations and cost per locomotive km should fall.

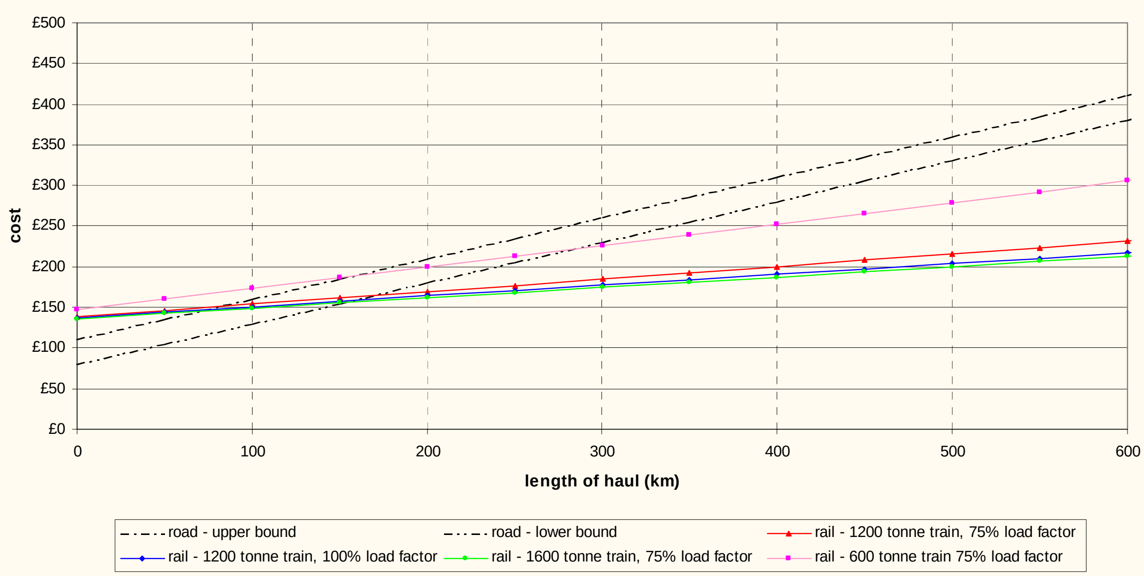
3.5.9 With running cost dominated by locomotive cost the effective cost per truckload will depend on the number of loaded wagons per train and whether none, one or two road legs are required to complete the trip. Although Type 66 locomotives can haul much heavier trains, base cost comparisons are based on the 1,200 tonne trains commonly used at present to minimise conflict between freight and passenger trains on a congested network. With the future increases in capacity (longer passing loops, more widespread use of Type 66 locomotives etc.) 1,600 tonne trains may become the norm.

3.5.10 Mineral, coal or oil flows are not usually carried as inter-modal traffic, rail running direct from port, mine or quarry to power station or distribution centre. There are unlikely to be backloads available for either mode. A 1,200 tonne train can comprise 12*100 tonne wagons with a payload around 900 tonnes, equivalent to at least 35 truckloads and a cost per truckload km around half that of road (track access grant is unlikely to be payable for this traffic given rail's cost advantage over road). With similar loading/unloading cost for each mode, rail is cheaper provided there are rail connections at both origin and destination and the flow is sufficient to generate trainload traffic.

3.5.11 For deep-sea container traffic the inter-modal transfer is sea: rail or road at the port (with similar loading costs for both modes) and rail will only need road haulage at the inland end of the trip. With W12 clearance throughout the route rail can load 3 TEU (1*40' and 1*20' box) per wagon. A 1,200 tonne train would comprise 20 wagons and be equivalent to 40 truckloads. However, a 50:50 mix of 20' and 40' boxes on each train cannot be guaranteed, while to meet shippers' reliability expectations, rail will need to offer scheduled services, a 100% load factor is therefore unrealistic.

3.5.12 Figure 3.4 compares cost per truckload for trips up to 600km by road and rail allowing for a road feeder trip at one end of the rail haul. In the base case a 75% load factor is assumed for rail – a 24 wagon train would carry 36 containers (= 36 truckloads), be 450m long and weigh around 1,300 tonnes including locomotive. Figure 3.4 also shows cost per truckload by rail with 100% load factor on a 1,200 tonne train (20 wagons, 40 truckloads), 75% load factor on a 1,600 tonne train (32 wagons, 48 truckloads), 75% load factor on a 600 tonne train (18 truckloads), and a lower cost bound for road assuming lower downtime for loading and unloading.

Figure 3.4 Road vs Rail - Marine container distribution



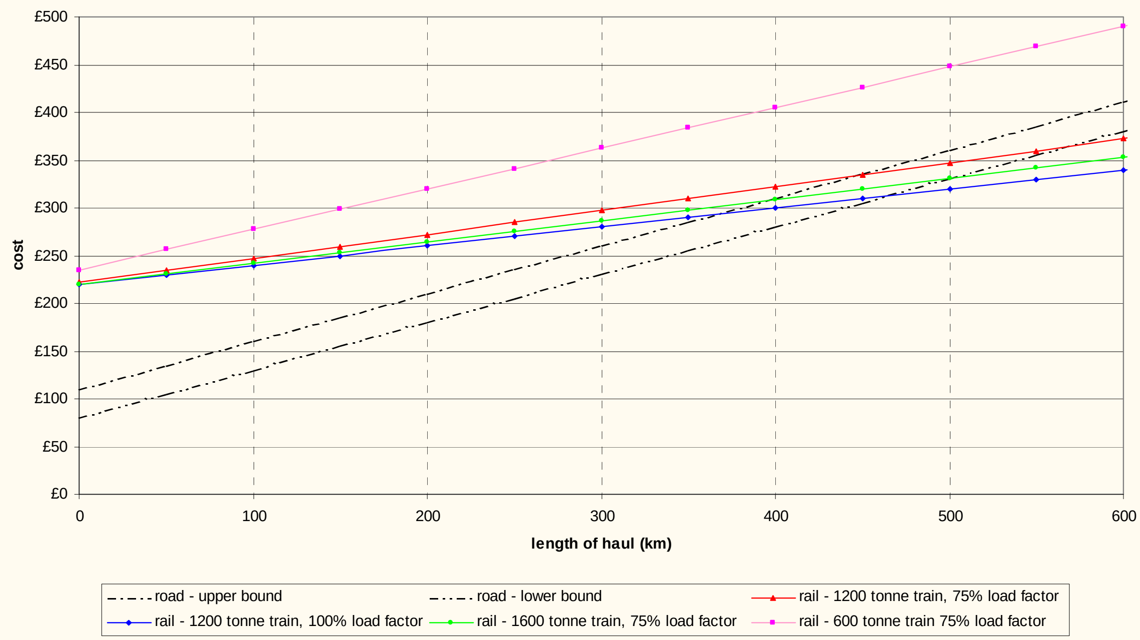
3.5.13 It can be seen that there is little difference in rail cost per truckload-km for the larger trains, with rail plus road feeder cheaper than road throughout for trips longer than 100-150km. If the market is thin, however, rail's high fixed (locomotive and mobilisation) costs push the break-even distance to 200-300km. These findings are reflected in practice, with most current Freightliner marine container hauls at least 300km (e.g. Southampton or Felixstowe to Birmingham), but some shorter hauls (e.g. Southampton – Barking, less than 150km) where these can be accommodated in schedules.

3.5.14 Where W12 loading gauge is not available, low deck wagons will be needed for high-cube loads. With a shorter usable deck length on these wagons they only carry 1 40' box (or 2 20' boxes) per wagon, reducing truck equivalence and thus, with rail costs relatively fixed, increasing cost per load.

3.5.15 Similar rail loading restrictions apply with road:rail inter-modal traffic. The standard swap-body is 45' long, with very few short units. Rail can only carry one load per wagon. A further restriction on rail competitiveness is that, on most trips, road haulage will be needed at both ends of the rail haul.

3.5.16 Figure 3.5 compares cost per truckload for trips up to 600km, allowing for a road feeder trip at both ends of the rail haul. In the base case a 75% load factor is assumed for rail – a 34 wagon train would carry 25 containers (= 25 truckloads), be 630m long and weigh around 1,300 tonnes including locomotive. Figure 3.5 also shows rail cost per truckload with 100% load factor on a 1,200 tonne train (30 wagons, 30 truckloads), 75% load factor on a '1,600 tonne' train – at 75% load factor rail cubes out, a 775m, train weighs less than 1,600 tonnes (40 wagons, 30 truckloads), 75% load factor on a 600 tonne train (12 truckloads), and a lower cost bound for road assuming lower downtime for loading and unloading. It can be seen that rail plus 2 road feeder services is only cheaper than road throughout for trips of more than 400km. If the market is thin, high fixed locomotive cost pushes the running cost per truckload close to road's - the break-even distance is around 1,000km.

Figure 3.5 Road vs Rail costs - Domestic swapbody trunk-haul



3.5.17 Most current road:rail inter-modal services in Britain are international trains running through the Channel Tunnel, length of rail haul comfortably exceeds the break-even distance. Other examples are niche markets such as 'binliner' trains to land-fill sites where road haulage is only needed at one end of the trip, a dedicated truck fleet is used, and 100% load factor is achievable.

3.5.18 It can be seen from the above that to achieve commercial viability for road: rail inter-modal services, high flows of long-distance traffic are needed. A daily (Monday-Friday) service of 25-30 truckloads (combining flexibility of timing of departure with low charges) equates to a flow of around 100,000 tonnes of goods each way. To sustain daily services to a range of destinations, either needs much higher flows (in excess of 250,00 tonnes per annum each way), or for trains to re-marshalled at strategically located hubs (most international inter-modal services are re-marshalled at Wembley), but this extends journey time and adds to rail's cost.

3.5.19 Any increase in the cost per km for road haulage (e.g. motorway tolling) would make the slope of the road cost curves in Figures 3.4 and 3.5 steeper, i.e. would make the distance above which rail was cost-competitive shorter. It can be seen from these Figures that any lowering of rail's line-haul costs would have to be significant to have the same impact - rather, as comparison of Figures 3.4 and 3.5 shows, it is a reduction in rail's access and loading costs that has the greater impact on rail's break-even distance.

4 Appraisal of Proposed Measures

4.1 ***Introduction***

4.1.1 There are proposals for road:rail inter-modal terminals in a number of locations throughout the SWARMMS study area, together with upgrading of the rail lines via which they would be served to W12 gauge. These upgradings include long passing loops and, in places, multiple tracking to avoid conflict between freight trains serving these sites and the enhanced rail passenger services that are part of the SWARMMS Corridor and Area Plans. Further proposals involve improved access to ports for enhanced road:water and rail:water interchange.

4.1.2 Inter-modal terminals and rail loading gauge enhancement are largely inter-dependent. Without W12, terminals will be constrained in the loads they can accept. Without modern terminals there will be no inter-modal traffic to take advantage of the gauge enhancement. The viability of both investments is dependent on there being a sufficient volume of traffic to make operation of the terminals and trains to them a commercial proposition. Evaluation of proposed schemes for inclusion in the Inter-modal Freight Plan is thus based on an assessment of the potential for mode shift to rail, coupled with a review of the operational feasibility of each site and the cost of rail infrastructure improvements needed for W12 access.

4.2 ***Potential Market***

4.2.1 Estimation of the potential market for inter-modal services is based on analysis of a county-county matrix of tonnes carried by road derived from the Continuing Survey of Road Goods Transport (CSRGT). This is undertaken by DETR/DTLR and underlies the road goods statistics published annually in Transport of Goods by Road in Great Britain (TGRGB) and Transport Statistics Great Britain. The survey samples the activity and use of ‘heavy’ goods vehicles - over 3.5 tonnes GVW. While this excludes light goods vehicles, HGVs perform the overwhelming bulk of road goods haulage in Britain. Tables in TGRGB 2000 show that, while the average road goods length of haul is 94km (below the level at which rail could be competitive for most traffic), for (smaller) rigid vehicles average length of haul is only 49km but for the largest articulated vehicles (GVW over 33 tonnes), with which inter-modal rail would be in competition, average haul is 135km with a significant number of trips over 300km. These large vehicles also dominate road goods activity, carrying 67% of road tonne km.

4.2.2 Matrices of aggregate tonnes were made available to the Study team for all years from 1993 to 2000, while matrices disaggregated into 19 commodity groups were supplied for 1998, 1999 and 2000. For continuity, these data continue to give values for the Metropolitan Counties (e.g. the ex-Avon area).

4.2.3 The various Local Transport Plans of the SWARMMS counties report a considerable tonnage of road freight in the Study Area counties of Cornwall, Devon, Somerset, the ex-Avon area Wiltshire and Gloucestershire - nearly 130 million tonnes lifted and dropped each year on average in the period 1998-2000. Although small, the ex-Avon area, containing Bristol Port, has the highest level of activity - 35 million tonnes lifted and 33 million tonnes dropped; Cornwall has the lowest level of activity. Rail would need to capture only a small percentage of this traffic in total to ensure viable services and terminals. However the required percentages of those types and routings of traffic that could reasonably be transferred to rail would be rather higher.

4.2.4 However, average length of haul is short. Of the total tonnes lifted in the Study Area, 76 million tonnes (nearly 60%) were dropped in the same county. Nationally, only 50% of freight movement is intra-county, suggesting that the average length of freight haul is shorter in the far South West (Cornwall, Devon, Somerset) than in other areas. At the periphery this trend is even more marked - 79% of freight in Cornwall is intra-county (minerals movements from mine to port or rail-head may contribute to this figure) and a further 9% only travels as far as Devon. Similarly, in Devon 71% of freight lifted only moves within the county, and only 18% of tonnes lifted travel further than the next county. Even in the ex-Avon area only 45% of freight lifted crosses the old county boundary. Such figures suggest a more limited market for inter-modal services.

4.2.5 As a filter to identify the volumes with the greatest potential to transfer to rail, flows were stratified by distance travelled (approximated as County Town - County Town). Average annual flows over the period 1993-2000 are shown in Figures 4.1 (flows from counties) and 4.2 (flows to counties) for the SWARMMS counties and also for the south coast port counties of Dorset (Poole, Weymouth) and Hampshire (Southampton, Portsmouth) for which much traffic needs to cross the SWARMMS Study Area.

Figure 4.1 Goods by Road
annual average (1993-2000) from County, by distance band

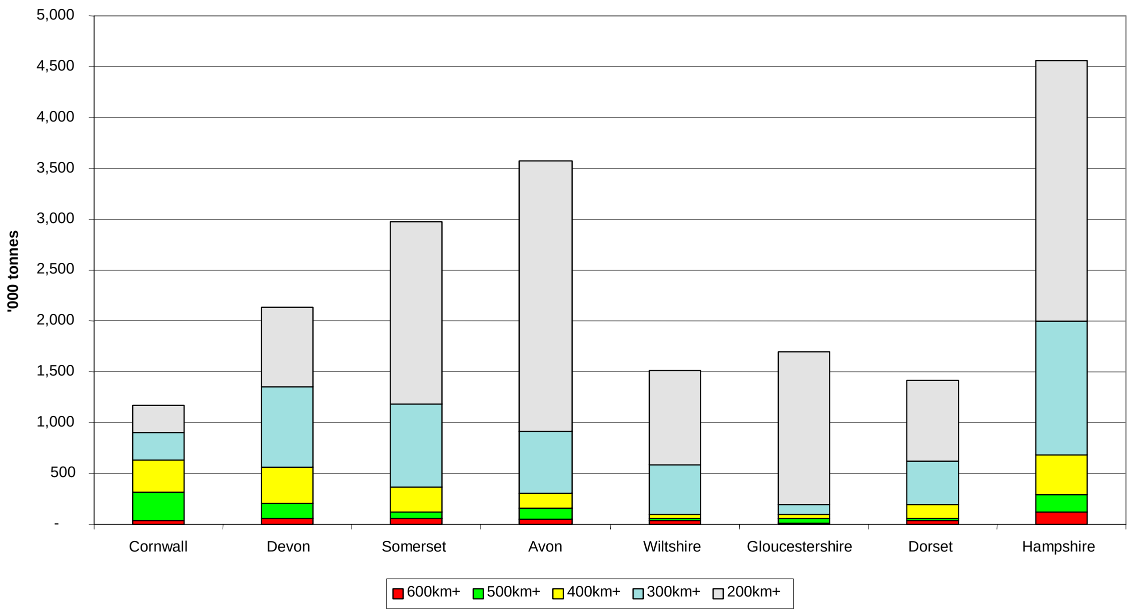
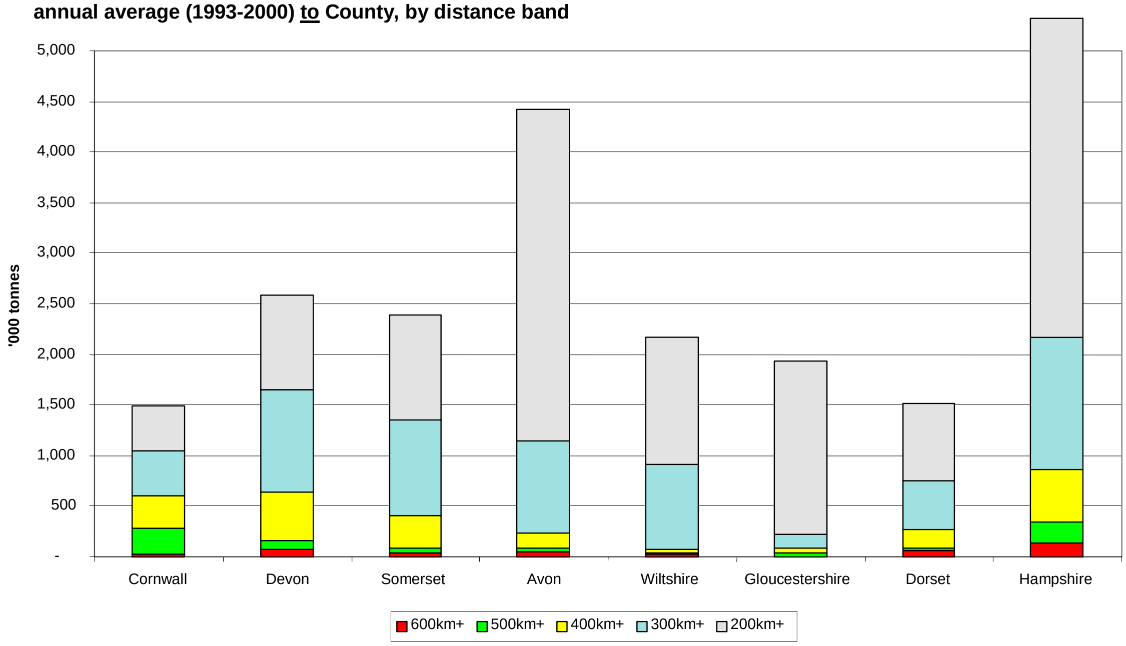


Figure 4.2 Goods by Road
annual average (1993-2000) to County, by distance band



4.2.6 It can be seen that only Somerset, the ex-Avon area and Hampshire generate significant volumes over 200km, and only Hampshire has significant volumes over 300km. The main generation sites are the Mendip Quarries, Avonmouth Docks/Portbury and Southampton Port. The main attractors are Avon and Hampshire, with Devon and Somerset also averaging around 2.5 million inbound tonnes per year. Hampshire and Devon attract the largest volumes travelling over 300km. Flows travelling more than 400km (the distance above which rail becomes competitive for inter-modal trunk haul traffic) to or from all the counties analysed are relatively low. Hampshire again has the largest volume, but both Devon and Cornwall also average more than 500,000 tonnes p.a. each way. Indeed, while only a small volume of goods travel more than 200km from Cornwall, the county's preipherality means that it has the second highest tonnage of goods (after Hampshire, a major port county) travelling more than 500km. The Figures also show low tonnages travelling more than 400km from counties in the north of the Study Area, which are much more centrally located, and that freight traffic through Dorset's ports appears to have largely local trip ends.

4.2.7 Tables in TGRGB 2000 show both tonnes lifted and average length of haul for road freight to be increasing over time - freight lifted increased by 9% between 1992 and 2000, while average length of haul increased by 14%. To check for such trends in the South West, the aggregate datasets were analysed by county and distance band. The results are presented in Appendix A, Figures A1-5 (flows from the SWARMMS counties) and A6-10 flows to the SWARMMS counties.

4.2.8 While there is evidence in these Figures of an increase over time in long distance freight movements to and from the far South West, this seems to be at a lower level than nationally - indeed, over the last 3 years SWARMMS area long-distance freight tonnages have declined. At longer distances there is considerable variance in tonnage from year to year at the county level, and even at the aggregate level - this may reflect reality, but is more likely to be due to the low sample rate and the resulting grossing-up factors.

4.2.9 However, the Figures also draw out how thin the potential market for inter-modal rail is in the far South West. Rail would need to capture nearly 20% of the potential (400km+) traffic in Devon or Cornwall to support one inter-modal train per day, and around 30% in Somerset. To support two or more trains per day, giving a choice of departure time or destination and enhancing terminal viability, needs around 50% mode shift in the relevant markets.

4.2.10 If, with the proposed infrastructure improvements, rail were able to make a good enough offer, such modal shift might be possible if all trips were to/from areas where there are adequate rail freight facilities (inter-modal terminals have already been established in the Midland, Northern and Scottish industrial areas in connection with international traffic, and are planned for London). However, some flows will be to regions with a local market as thin as the far South West's and adequate railfreight facilities will be equally hard to justify, limiting the potential for modal transfer.

4.2.11 The final analysis undertaken for the market overview was to identify flows along three rail corridors from the far South West considered to have potential:

1. London and the EU-facing port counties of Kent, Essex and Suffolk;
2. West Midlands, North West and Scotland; and
3. East Midlands, Yorkshire and North East.

4.2.12 This analysis was also undertaken at commodity group level. DTLR statisticians advised that values in the commodity group matrices are much less robust than those in the aggregate matrices; a value in the matrix may result from the grossing-up of a single truckload picked up by the survey. To improve the reliability of the data, values for 1998, 1999 and 2000 were averaged. Findings are presented in Table 4.1 below.

Table 4.1 : Average Annual Flow on Potential Inter-modal Rail Corridors

('000 tonnes)

County	**Corridor 1**		**Corridor 2**		**Corridor 3**	
	From	to	From	to	From	To
Cornwall	135	121	220	192	96	184
Devon	538	510	893	947	333	486
Somerset	972	665	625	644	237	442
Avon	1,064	1,619	2,063	2,258	879	1,533
Wiltshire	836	962	1,070	1,009	387	735
Gloucestershire	640	540	1,219	1,290	464	607

4.2.13 Even with 40% mode shift, Cornwall will not sustain a daily train on any corridor. For Devon the prospects are better, although on Corridor 2 50% of the flow identified is to/from the West Midlands, less than 300km and probably too short a distance for inter-modal rail to be truly competitive. Arguably, Devon and Cornwall combined will be able to sustain two or more daily trains if Corridor 3 traffic is carried on Corridor 1 or 2 trains and re-marshalled on-route and a suitable site can be found which both captures sufficient Devon demand (with widely dispersed trip-ends within the county) and can act as a rail-head for Cornwall.

4.2.14 More than one inter-modal terminal in Devon and Cornwall combined would appear to be unsustainable, both in terms of terminal viability (throughput) and in being able to attract rail services to multiple sites.

4.2.15 Further north, Somerset, the ex-Avon area and Wiltshire all have significant flows in Corridors 1 and 2; the ex-Avon area also has a high flow on Corridor 3. It should be noted, however, that distances are much shorter from these counties - some 50% of the ex-Avon and Wiltshire traffic on Corridor 2 is West Midlands based, only 150km. Conversely, much Corridor 1 traffic is Mainland European, via the Channel Ports, with potentially a very long rail haul. Most trip ends in Somerset may well be close enough to the ex-Avon area to rail-head through a terminal there, adding to the viability of both the terminal and the trains serving it.

4.2.16 Freight movements for Gloucestershire only provide significant freight flows on SWARMMS Corridor 2; its most important freight flows are to/from points in the West Midlands and further north. Within the study area, flows would not seem able to support services to/from Gloucestershire.

4.2.17 A final caveat to these findings is that, while there are significant potential rail flows on Corridors 2 and 3, there are no proposals for W12 enhancement of rail lines on a north-east - south-west axis. Consequently inter-modal trains would need to route via London unless plans are modified, increasing rail cost and time. Conventional rail freight between Bristol and Birmingham is constrained by a severe gradient, although W6 diversionary routes are less circuitous than those for loads requiring W12 clearance.

4.2.18 This analysis also revealed some 2 million tonnes each way on Corridor 2 and around 1 million tonnes on Corridor 3 for Hampshire, suggesting significant potential for diversion to rail of north-south cross-Study Area traffic.

4.3 ***Appraisal of Schemes***

4.3.1 Within the Study Area a number of proposals have been made for inter-modal freight facilities and other rail capacity enhancements, supported, in varying degrees, by Developers, County Councils, Railtrack, SRA and the South West Regional Development Agency. These include:

- W12 loading gauge from London to Filton Junction along the Great Western Main Line, thence to Cardiff (Wentloog terminal), Avonmouth and 'mid-Cornwall';
- W12 loading gauge from Southampton Docks to the West Coast Main Line W12 network in the West Midlands, via Basingstoke, Reading West Junction, Oxford and Leamington Spa;
- Upgrade of the Great Western main line between Reading and Wootton Bassett, with grade separated junctions at Reading West, Didcot East and Wootton Bassett and four tracks between Didcot and Swindon;
- Inter-modal terminals at South Marston (Swindon), Avonmouth, Westbury, Taunton, Exeter Airport, Marsh Mills (Plymouth) and 'mid-Cornwall'.
- Improved rail access to ports within the Study Area at Bristol (Royal Portbury Dock), Falmouth and Fowey; and
- Improved rail access to ports outside the Study Area at Portsmouth and Poole.

4.3.2 During the course of this Study, plans for a number of these schemes have become sufficiently advanced for them to be regarded as committed, and part of the future do-minimum network against which other schemes will be evaluated. These are:

- W12 loading gauge from London to Filton Junction, Cardiff (Wentloog terminal), and Avonmouth (prioritised in SRA's Freight Strategy, May 2001);
- W12 loading gauge from Southampton Docks to the West Coast Main Line W12 network in the West Midlands, via Basingstoke, Reading, Oxford and Leamington Spa (prioritised in SRA's Freight Strategy);
- Avonmouth 'Euroterminal' is already in operation; at former rail sidings between Avonmouth docks and the Cabot Park business park;
- At South Marston a rail connection has been laid between the Great Western and the site of the proposed modal terminal;
- The line to Royal Portbury Dock opened in December 2001, using the former Portishead branch between Parson Street and Pill with connections to the coal and general cargo terminals; and
- An inter-modal terminal is to be constructed close to Portsmouth ferry terminal.

4.3.3 For the remaining terminal sites, the market analysis above indicates the potential for a small number of inter-modal trains per day south west of Bristol, but only perhaps 2 per day further west than Taunton. These findings are similar to those obtained by a more detailed analysis of the potential inter-modal market in the South West as assessed for the Railtrack/EU Study to 'Assess the Feasibility of Reducing the Peripherality of the Western Extremities of the UK Rail Network' as part of the Trans European Network (TEN) framework (1998). This identified a potential 50 truckloads per day (each way) south west of Bristol that might transfer to rail with W9, but only 10 per week as far west as Cornwall. These levels of demand would make rail freight services and ONE terminal (in the whole South West) viable.

4.3.4 While the market potential of the W12 loading gauge now being considered will be greater, the TENs study also evaluated W18 (piggy-back gauge) and found only another 30 potential truckloads per day. The cost of clearing the route to W12 will also exceed that estimated in 1998 for W9.

4.3.5 The five non-committed sites are reviewed below with regard to the operational feasibility of the site as an inter-modal terminal, road access, rail access, and potential demand for road:rail transfer, summarised in an overall assessment.

Westbury

Site	Brownfield – existing rail yard adjacent to station and town centre. Existing sidings not long enough for 775m train, but could be re-configured within site.
Road Access	Poor - via town centre or industrial estate. When site proposed it was expected that the A358 Westbury bypass would follow the inner western alignment, taking it through the rail yard. An eastern alignment which does not serve the site is now being promoted.
Rail Access	Moderate - on main line to London (W8), South West, regional line to Bristol / Southampton (all W7) but no plans for enhanced loading gauge.
Potential Demand	Poor - limited local inter-modal demand, which could use the nearby terminals at Avonmouth and Swindon. Too far from M5 / trunk road network to be considered as a railhead for South West freight.
Overall	No potential as an inter-modal site, but a key marshalling

Westbury

Assessment	location for (W6) Mendip minerals traffic (see below).

Taunton

Site	Existing – Fairwater yard, virtually disused at present. Total site over 850m long, but may need to be re-configured to handle more than one train at a time.
Road Access	Currently very poor – narrow track from single carriageway A3065, access to A38 and M5 is via urban roads. Plans to improve access also involve a bus-based park-and-ride site which could take part of the yard.
Rail Access	Excellent - on Great Western and Railtrack estimate negligible cost to extend W12 loading gauge from Filton Junction to Taunton.
Potential Demand	Local demand could easily use Avonmouth as a railhead. Close to M5, so could serve as railhead for South West, but proximity to Avonmouth again an issue - 1-200km rail-heading road trip from South West reduces advantage of switch to rail.
Overall Assessment	Not a main terminal, but potential for longer distance services to drop-off / pick up wagons, with fork-lift, reach stacker etc. transfer to road vehicles.

Exeter "Gateway"

Site	Greenfield site, , on farmland between old A30 and the Exeter-Salisbury rail line to the north of Exeter airport. The site is constrained - the planned layout cannot accommodate trains >600m long even with relatively tight (radius <200m) approach curves from the rail line. An archaeologically sensitive site (a manageable constraint).
Road Access	Potentially good – highway access would be improved as part of the scheme, with direct access to the new A30 (south of the airport) and thence to M5 at Junction 29.
Rail Access	Somewhat problematic –Railtrack estimate negligible cost to extend W12 loading gauge from Filton Junction to

Exeter "Gateway"

	Exeter Riverside, but it will be difficult and expensive to extend over the last 4 miles to the site – potential need to re-build Exeter Central station in order to lower track-bed through St Davids tunnel and to open up the cut-and-cover Blackboy tunnel, demolishing the buildings above. Further, the combination of grade and curve on the line from Riverside will limit trains to 750 tonnes (less than the limit imposed by siding length). An alternative approach is from the east via Yeovil Junction. While there are plans for loading gauge enhancement of this W7 gauge line between Worting Junction (Basingstoke) and Laverstock junction (Salisbury) as a diversionary route for container trains should the Dibden Bay development go ahead, no detailed investigation has been undertaken of the cost / feasibility of extending enhanced loading gauge to the airport. The difficulty/expense of increasing the structure gauge on either approach to the site will limit it to general freight (e.g. Enterprise) and low-height swap-bodies unless a new generation of low-loader wagons can be developed to maximise the potential of this site (and others).
Potential Demand	Limited local demand, but strategically a good location for a Devon and Cornwall railhead, with a short dual carriageway / trunk road access to M5.
Overall Assessment	A good location, but cost / feasibility of W12 rail access, coupled with the limited size of train that could be accommodated (and thus the viability of rail services to the site) limit the types of traffic that could be handled. Unlikely to be capable of development as a true inter-modal site. Greater potential as a general cargo terminal (e.g. "Enterprise" services than as a true inter-modal transfer station, suggesting that on site warehousing and value-added services are essential to the viability of this site.

Plymouth

Site	Brownfield site on existing rail yard at Tavistock Junction (Marsh Mills). Existing sidings are long enough to handle the largest trains that could get there (see below), although junction with Great Western would need to be revised (the yard is configured for minerals from the west rather than inter-modal from the east).
Road Access	Good – next to grade separated junction on the A38 Plymouth bypass, regional traffic would not need to use urban roads.
Rail Access	Poor – on the main line, but the cost of extending W12 from Exeter to Marsh Mills, with 7 tunnels (principally those on the sea front at Dawlish) and a number of bridges to be raised is likely to exceed £10m. Further, there are a number of hills on the route from Exeter. The most severe of these is Hemmerdon Bank, between Plympton and Sparkwell, 3.5 miles averaging 1:50 uphill away from Plymouth, which would limit single-headed trains to 1000 tonnes. Railtrack advise that EWS and Freightliner do not see this as a major problem – EWS have light locomotive running in this area in connection with china clay traffic that could be used to double head as far as Exeter, while Freightliner would combine with South Wales services, splitting a 2000 tonne train at Bristol.
Potential Demand	Moderate – an excellent railhead for Cornwall, but may be too far west to capture potential Devon traffic. However, Railtrack advise most of the traffic identified for the TEN study was from West Devon.
Overall Assessment	Moderate – limited demand and rail access poor, but good highway access and a brownfield site, which should not give rise to any environmental concerns. Like Exeter, may be better suited to wagon-load Enterprise traffic than true container/swap-body intermodal activities.

Mid-Cornwall

Site	Not determined - a potential site has been identified at Roche, where the A30 crosses the Newquay rail line, but Cornwall CC and Railtrack are working on plans to divert the railway away from this site so that Newquay branch trains serve more stations on the main line and freight has direct access to more China Clay 'dries'. (The TEN Study considered existing rail yards near Par.)
Road Access	Moderate - the A30 is not currently dual carriageway on this section, but it is not an urban area.
Rail Access	Poor – branch line, single track sections on main line, severe grades and considerable cost to extend W12 from Exeter.
Potential Demand	Very limited – negligible inter-modal demand this far west
Overall Assessment	No potential for an inter-modal site anywhere in Cornwall. Some potential for increased mineral and waste traffic, which would need improved consolidation facilities.

4.3.6 Thus none of the sites are without their problems. In general, the further west a site, the lower the potential demand and the higher the cost of extending W12 to it. This argues for a site to the north-east of the area under consideration, but there are rail and road access issues at Westbury and Taunton is too close to Avonmouth. With a site in Cornwall too far west, Devon would appear to be the only option, but the cost of extending W12 to either of the potential sites will be relatively high and there are limits on the size (and thus viability) of train that could access either site.

4.3.7 To avoid the rail access problems of these sites, alternative locations alongside the Great Western Main Line were considered. However, while W12 rail access to an inter-modal terminal at the existing Exeter Riverside yard would be simple (and low cost) the site has very poor access from strategic roads, and was not considered further.

4.3.8 Any site to the north, between Exeter and Bristol, would also have disadvantages. It would be greenfield (involving a protracted and possibly contentious planning application), and further from the urban areas of south Devon most likely to give rise to inter-modal freight demand. To minimise distance driven on non-trunk roads, a site would need to be near a motorway junction and long enough to accommodate 775m trains. The Great Western runs parallel to the M5 between junctions 28 (Cullompton) and 27 (Tiverton), and land between the rail line and the road would be ideal (already being severed from adjacent farmland by the two transport routes).

4.3.9 No suitable sites appear to exist near to junction 28, where additional HGV traffic would be a nuisance on local roads and land alongside the railway is low-lying and already in urban / recreational use. A suitable area could be found to the west of the line near Willand, but is less than 700m long and has poor road access (including, crucially, the lack of an adjacent Motorway junction).

4.3.10 At junction 27 there are potential sites over 800m long on the east side of the rail line both north and south of the junction. That to the south could share road access with the adjacent Tiverton Parkway station, while that to the north would require a new access road from the dual-carriage way A361. No detailed analysis of current land uses or of the rail freight potential of the sites has been undertaken - it is understood that there are no current development proposals for these sites.

4.3.11 A Tiverton Parkway intermodal terminal would be some distance from any urban area, limiting any parallel function as an urban distributiion centre, and would be over 20km north of the proposed site at Exeter. The road vs inter-modal cost comparison presented in Figure 3.5 is based on an average road feeder leg of 50km and assumes efficient road haulage. Any increase in the road haul reduces the prospects of this, involving the truck in more empty running to find a backload or in a possibly protracted wait for a return load from the railhead. Distances in the south west are such that these assumptions are not strictly applicable in considering the competitiveness of inter-modal rail from South Devon - Exeter is 70km from Plymouth and 120km from "mid Cornwall". With a further increase in the road haul necessary to access the rail head, the "fixed" cost of road haulage will rise and the three rail cost lines will move up the chart, pushing the break-even distance further to the right.

4.3.12 An inter-modal terminal at Tiverton Parkway would thus have negligible local demand and, like Taunton, limited potential to serve as a railhead owing to its distance from the areas to be served, and this option has not been pursued further.

4.3.13 It thus seems likely that, given the potential level of demand, the cost of developing a true inter-modal terminal, handling the full range of international containers and swap-bodies, would not be justified, either as a commercial venture or in terms of environmental benefits, at any location to the south-west of Bristol. On balance, given the limitations of the two sites with potential to be developed as rail freight distribution centres, Exeter seems the better option. It is well located to attract significant traffic and is the subject of a current planning application. Road access does not present any particular problems but securing W12 gauge rail access presents problems - the SRA is considering either gauge enhancements to W12 standard via Yeovil Junction (at Basingstoke this could join the planned W12 line running north from Southampton to the West Midlands) or the potential for low loader wagons..

4.3.14 The site covers an area of about 85 hectares and will require three parallel tracks with overhead gantries, mobile lifting and stacking equipment, hard standing as well as office accommodation and vehicle parking for both HGVs and cars.

4.4 ***Other Options, Opportunities and Proposals***

4.4.1 While outside the main (road:rail) scope of this Inter-modal Freight Plan, further improvements to rail access to ports is recommended at Par and Fowey. These are already included in Railtrack's Network management statement and Cornwall's Local Transport Plan. This will both encourage mode shift from road for clay traffic to the ports and make the local clay industry more competitive internationally by lowering transport cost. (Include reference to the RDA Gateway Study). Improved rail facilities at Falmouth should also be considered in connection with proposals for development of the port.

4.4.2 Enhancement of rail access at Poole would not appear to be worthwhile as existing facilities are quite adequate for present and future traffic. The port is already rail connected, but most traffic is on Ro-Ro ferries and has fairly local trip ends - market analysis did not reveal high tonnages of road freight crossing the study area that could usefully (or economically) be diverted to rail. The port consider the existing rail facilities to be underused, many potential conventional rail cargoes (e.g. steel) going by road because of lack of capacity elsewhere on the network which may be relaxed following the completion of the West Coast Main Line upgrade, i.e. there is a potential for increased rail freight use at Poole which is unrelated to the facilities at the port.

4.4.3 There would appear to be limited opportunities for modal transfer to inland waterways or pipeline. The inland waterway network in this part of the country is very sparse and the products suited to this type of transport are typically carried by rail rather than road. While some local, niche opportunities for inland waterways may exist in the SWARMMS Study Area, their strategic impact is restricted by low carrying capacity of narrow canal barges (3-4 barges are needed to carry as much as one 30 tonne truck), slow and unreliable transit times given the number of locks, high levels of leisure traffic in the summer, and periods of closure for maintenance or adverse weather in the winter.

4.4.4 Pipelines are even more specialised in what they can transport and are usually dedicated to one kind of product (e.g. gas, oil or petroleum products). Most traffic suitable for pipeline transport is already using this mode.

4.4.5 Similarly, there seems to be little further opportunity for coastal shipping, with low levels of demand to other coastal areas on the roads As with rail, road:sea transfers involve costly double-handling unless the truck itself is carried on a Ro-Ro ferry. For scheduled Ro-Ro services capable of loading at all states of tide sophisticated loading ramps are needed which, as with rail terminals, require a minimum volume of traffic for viability. In Cornwall, the county with the greatest potential for these facilities, the market is too thin for an additional port to compete effectively with Plymouth.

4.4.6 However, it is worth noting that there are a number of opportunities for rail freight in the SWARMMS area:

- There are potentially significant prospects for 'conventional' freight to use rail in the study area which would not require expensive infrastructure changes or terminals. The market analysis revealed the equivalent of around one trainload per day of 'sand, gravel and clay' going by road between Cornwall and Staffordshire (there is already one train per day on this route);
- Similarly, around 50% of Mendip quarry production goes by road - to attract this traffic to rail requires more traditional approaches of marketing, service delivery and rail freight grant funding to re-open or create lines to quarries;
- Innovations in rail freight technology such as the Freight Multiple Unit (FMU) have the potential to alter the economics of service provision. This experimental train, based on a German concept, is being trialled between Hereford and London. It does not need specialist loading equipment or extensive terminal facilities and has a much smaller capacity than a full trainload. The FMU has the potential to encourage 'thin' flows of rail-

connected freight onto rail. On the negative side however, if it is to carry inter-modal containers or boxes, the loading gauge requirements are no different from large inter-modal trains, while cost per tonne/km will be higher than a full trainload. The potential for this type of train is for traffic to and from rail connected sites north of Exeter rather than sites to the west where light traffic densities and loading gauge problems limit opportunites, and;

- Isolated flows of freight can also be attracted to rail in some circumstances, particularly if the parties involved are willing. An example of this is supermarket distribution of 'long-life' goods. This sort of movement already takes place to the Scottish Highlands and Truro and also does not need loading gauge enhancement if the shipper is committed enough to invest in swap-bodies low enough to be carried on W8 lines - palletised baked beans, for example, will weigh-out well within the volumetric capacity of an 8' tall swap-body.

4.4.7 There is thus a case for retaining existing traditional rail freight yards and developing both breakbulk/wagonload (Enterprise) and trainload flows that do not require daily services (i.e. a lower level of traffic would be viable for rail) or loading gauge enhancement.

4.4.8 There are also opportunities to combine urban distribution centres, at which road-borne goods are exchanged between small vehicles for local collection / delivery and tractor-trailer units for trunk-haul transport as part of an urban area freight quality partnership scheme, with the road:rail transfer facilities described above.

4.4.9 These proposals and opportunities will lead to increased numbers of freight trains on the main passenger routes. Rail service and infrastructure enhancements being considered in the Corridor and Area Plans will need to allow increased capacity for freight if these opportunities are to be taken: at least one freight train per hour south of Bristol as far as Plymouth and two or three between Filton and Didcot/Reading/London. On the main north-south railfreight corridor there may be an average of two trains per hour between Eastleigh (junction for Portsmouth and Southampton) and Oxford via Reading and Didcot (up to four per hour if the proposed container terminal at Dibden Bay goes ahead and rail is to maintain or increase its mode share).

4.4.10 Plans to re-double the single track section between Swindon and Kemble to accommodate additional passenger services and serve as a rail freight route from

South Wales could make it more costly to add this route to the W12network if it is not possible to accommodate double track and W12 clearance in Kemble tunnel.It may be more practical to double track to W6 gauge, which would allow conventional freight operations but inter-modal trains would continue to use the Severn Tunnel route.

4.4.11 The three main study area railfreight flows (South West-London, Mendips-London and Hampshire-Midlands) meet at Reading. Railtrack proposals for grade separation of Reading West Junction, allowing freight to avoid the Great Western fast line when transferring between the Great Western relief line and the Berks and Hants line (to Basingstoke or Wesbury) are crucial to maintaining freight capacity through this area while also allowing for more frequent and faster passenger services.

4.4.12 One further rail infrastructure improvement will be needed for railfreight to fulfil its potential. While the market analysis has identified the potential for inter-modal services between the ex-Avon area or the South West and West Midlands and the North, there are no plans for enhanced loading gauge on the direct lines between Bristol and Birmingham. The shortest route will be via Didcot, where the committed W12 lines from London to Bristol and Southampton to Birmingham meet. Trains could reverse here (reducing the capacity of the relief line platforms at Didcot station for passenger services) or at Reading West sidings (adding 32 miles to the rail journey and unnecessarily increasing traffic on the relief lines between Didcot and Reading).

4.4.13 Alternatively, trains could run direct between the two W12 lines via the West Curve, adjacent to the power station. Upgrading this short section to W12 will be simple - there is only one overbridge - but the Curve is too short (650m) to accommodate a full-length inter-modal train waiting clearance to proceed to Swindon or Oxford and would need to be lengthened to give this route maximum potential.

4.4.14 While this scheme is added to the Inter-modal Freight Plan, detailed design and costing will thus be dependent on rail infrastructure improvement in the area in connection with enhanced passenger services. Lengthening could either be achieved at the southern end in connection with the four-tracking of Didcot-Swindon or, more conveniently, by extending the West Curve parallel to the Didcot-Oxford passenger line as far as Didcot North Junction, where it merges with the Reading-Oxford 'Avoiding ' (freight) line - this would extend the length of the Curve to 1050m.

5 Relationship with Preferred Strategy

5.1 *Synergy with Other Measures*

5.1.1 The Inter-modal Freight Plan adds 'on the ground' detail to several component policy themes of the Preferred Strategy, notably "More opportunity for freight to use rail", "Expand air and sea networks" and "New road and rail infrastructure". The schemes in the Plan and their expected impact on travel patterns also relate to the "Reducing the need to travel", "Traffic restraint within main urban areas", "Local road safety and other measures" and "Smarter use of existing roads" themes.

5.1.2 The main focus is on allowing "More opportunity for freight to use rail". The Plan includes schemes which will not only enable existing rail freight flows to continue to use rail as the market develops (e.g. W12 loading gauge to Southampton consolidates rail's position in deep-sea container distribution) but also to increase the capacity of the rail network for larger (W12, 775m) and more frequent freight services to a number of new terminals and mode interchange points. The latter will increase rail's attractiveness to shippers, enabling it to enter new domestic and international inter-modal markets.

5.1.3 Many of these schemes also impact on expansion of (air and) sea networks by improving the accessibility of the Region's main ports, allowing them to attract a wider range of traffic and increase throughput of existing cargoes. Following the recent addition of direct rail access to the Royal Portbury Dock at Bristol, the single greatest impact of the schemes in the Plan on port accessibility may, however, be at Southampton and Portsmouth, outside the immediate Study Area.

5.1.4 While the elements of this Plan cannot be argued to reduce the need to travel per se (indeed, by reducing the cost of inter-regional and international freight transport they can be seen as increasing demand), locating the new inter-modal terminals at the intersection of existing rail lines and trunk roads at the edge of the principal urban areas will minimise the distance to be travelled by road vehicles using the sites. Coupled with the proposal to co-locate urban freight distribution centres with road:rail interchange facilities (see section 2.2), the Plan will also be compatible with projects and policies to restrain traffic within the main urban areas.

5.1.5 The proposals would involve at least 4 more freight trains per day (e.g 1 mineral train from Cornwall, 2 inter-modal from Devon and an additional inter-modal from Avonmouth). This would remove a significant volume of HGV traffic (conservatively estimated as at least 20 million vkm) from road to safer modes, so making a contribution to improved road safety. This traffic reduction will also enhance the effectiveness of schemes and policies to achieve smarter use of existing roads.

5.1.6 Finally, the schemes in the Plan both contribute to the "New road and rail infrastructure" theme and are partially dependent on schemes to be included in other Plans. Common use of most rail infrastructure by passenger and freight means that enhancements elsewhere in the Preferred Strategy to "Provide more opportunities to travel by (passenger) rail" will also benefit rail freight, e.g. Swindon-Didcot quadruple-tracking will, inter-alia, provide capacity for express passenger services to overtake freight without the latter being brought to a stand in a passing loop.

6 Costing

6.1 ***Cost Benefits***

6.1.1 Construction costs have been estimated for the schemes in the Inter-Modal Freight Plan by updating earlier cost estimates derived by Railtrack for the EU TEN study on reducing the peripherality of the South West and for annual Network Management Statements. These have been adjusted to take account of the different specification of the works originally costed and those in the Plan.

6.1.2 No cost estimates are made for the inter-modal terminals themselves. Out-turn cost of these sites will be determined by the facilities the developer chooses to provide in order to achieve commercial viability - where a simple terminal with road:rail transfer facilities may cost less than £10m, the construction of a substantial area of warehousing on the same site could push the cost to over £25m.

6.1.3 While these costs are considered here to be developer - dependant, the SRA anticipates a need for support to ensure that the necessary terminals are built. The SRA Freight Strategy (May 2001) notes that the SRA is seeking to develop, within EU competition and subsidy rules, a mechanism that would recognise the risks involved and the long-term nature of terminal developments while not constraining the market's ability to identify opportunities and develop them. Support may come in the form of loans, an equity stake or grants to be recovered as traffic passes through the site rather than an outright (Freight Facilities) Grant as at present.

6.1.4 Alternatively, with the SRA now poised to take responsibility for all rail infrastructure investment, support may come in the form of providing the rail infrastructure works (connection to the network, loading gauge enhancement etc.) that are needed to maximise the potential of the terminal. Cost estimates have been produced for various degrees of structure gauge relaxation on key sections of the network in and across the Study Area. These are reviewed in Table 6.1 below.

Table 6.1 : Previous Cost Estimates for Loading Gauge Improvement

Section	Target gauge	Year	Cost (£m)	Key Structures	Notes
Southampton-Midlands	W10	1999	27	4	Cost largely for works outside the Study Area
		2000	27	4	
	W12	2001*	*	*	
London-Cardiff	W10	1999	25	3	Breakdown of costs for Filton to Cardiff (outside Study Area) not known
		2000	30	3	
	W12	2001*	*	*	
Bristol-Exeter	W8	1998	0.8	3**	
	W9	1998	1.5	16**	
	W18	1998	20.7	56**	
Exeter-Plymouth	W8	1998	4.7	21**	
	W9	1998	5.9	24**	
	W18	1998	19.9	51**	

1998 cost and structure estimates based on EU TEN Study

1999-2001 cost and structure estimates from Railtrack Network Management Statements

* No estimates included in the 2001 Network Management Statement while W12 is being evaluated

** All structures. Consultants estimate key structures for W12 as 0 Bristol-Exeter, 7 Exeter-Plymouth

6.1.5 The W10 loading gauge costed by Railtrack in 1999 and 2000 is not shown on Figures 3.2 and 3.3, but is broadly similar to W12, differing only in the width of 2,900mm high swap-body that can be carried on a wagon with 1,000mm deck height. It is therefore anticipated that the number of structures needing to be moved to clear a path for W12 will be similar to that already assessed for W10.

6.1.6 Although much of the expenditure needed to clear lines to W12 on the Southampton-Midlands and London-Cardiff routes will be incurred outside the Study Area, it is considered that this is necessary in order to get the full benefits. That is, the extension of W12 from Filton to Cardiff will reduce the volume of South Wales HGVs on the M4. Also, almost no vehicles would be removed from the Study Area roads unless the Southampton-Midlands scheme extends all the way from the Hampshire ports to inter-modal terminals in the West Midlands and to the enhanced loading gauge network currently being implemented on the West Coast Main Line.

6.1.7 Many infrastructure improvement cost estimates contained in earlier Network Management Statements have recently been revised sharply upwards. These increases relate largely to the cost of re-signalling and of disruption to the working railway while the works are carried out. These considerations are not expected to affect gauge enhancement works to the same extent as track layout or signalling changes, however, it is likely that out-turn costs for gauge enhancement works will be higher than has previously been estimated. On the other hand, some of the works required will already have been carried out - Railtrack advises that where attention to or replacement of structures is needed on lines shortlisted for loading gauge enhancement the new works are to W14 standard (i.e. slightly more generous than the target W12).

6.1.8 Subject to these caveats, estimates are made of £30m for both the Southampton-Midlands scheme and the London-Cardiff scheme.

6.1.9 No cost estimate is given in recent Network Management Statements for the extension of W12 from Filton Junction to Plymouth; the values in Table 6.1 are from the TEN study of 1998, which considered upgrading to W8, W9 or W18 (piggy-back). Figure 3.3 indicates the area that needs to be cleared to increase the W9 swept path costed in 1998 to W12, and also shows the W18 gauge costed in 1998.

6.1.10 While W12 will clearly cost more to achieve than W9, much of the cost of W18 involves raising the crown height of almost all overbridges and tunnels. Further, Railtrack has already rebuilt a number of structures in connection with other work - Bristol-Exeter is now shown on network maps as being a W8 line, with the rebuilt structures adequate for W12 rather than W8. Allowing for the increased scope of works, revised standards, increased unit rates and work already done, the 1998 estimates are revised for the SWARMMS schemes to: Bristol-Exeter £2m; Exeter-Plymouth £10m.

6.1.11 No estimates of the requirements to extend W12 (or similar enhanced loading gauge) to Exeter Gateway via Yeovil Junction have been made - the distance involved is similar to London - Bristol. While the lineside is less developed, unlike the Great Western Main Line these routes were not originally constructed as broad gauge lines and may have more structures per km to be altered. An indicative estimate of £20m would not be justified for likely traffic of 2 trains per day and low loader wagons may be a more cost-effective method of increasing the range of loads that can be handled at the site.

6.1.12 Other works supporting this Plan primarily focussed on improved passenger services, and cost estimates are included elsewhere in the documentation.

However, an additional cost of £0.5m should be allowed for W12 enhancement and curve extension works at Didcot West to allow inter-modal trains to run direct between Avon / South West and West Midlands.

7 Plan Deliverability and Priorities

7.1 ***Issues***

7.1.1 No significant deliverability issues are foreseen for any of the schemes comprising the Inter-modal Freight Plan.

7.1.2 All projects involve operational rail lines and should be able to be contained within the existing railway boundary. No land take is therefore required, with the possible exception of work sites where bridges or tunnels need to be raised for loading gauge enhancement, and given local authority support for the terminals, planning consents should not be withheld.

7.1.3 There are two areas where a note of caution is needed, namely:

- As highlighted in the recently published SRA Strategic Plan, the British railway industry is experiencing skills shortages in a number of key areas, including signalling engineers and project management. Measures to resolve these shortages have been put in place, but the Strategic Plan recognises the shortages with a shift in timescale for all but the highest priority schemes (of the schemes affecting the SWARMMS Study Area, Southampton-West Midlands gauge enhancement is given the highest priority). Accordingly, it needs to be recognised that there may not be the resources to implement all of the schemes within this Plan by 2010, the limit of SRA's current planning horizon; and
- The engineering feasibility of adapting a number of tunnels to W12 loading gauge while retaining the existing track layout has not yet been fully examined - Southampton, in particular, may be problematic.

7.1.4 A further requirement for the successful implementation of the Plan is, of course, that there are developers willing to invest in the terminals and rail hauliers ready to provide services of sufficient quality to attract the desired level of modal transfer.

7.2 ***Priorities***

7.2.1 The nature of the physical works incorporated in the Inter-modal Freight Plan requires some schemes to be implemented early in order that others can be fully effective.

7.2.2 The highest priority element of the Plan is for W12 loading gauge between Southampton and the West Midlands. This work is not primarily needed to allow rail to enter new markets (although, with an inter-modal terminal to be constructed near to the Portsmouth Ro-Ro ferry terminal, it will have this effect). Rather, it is needed to allow rail to remain competitive within an existing market, deep-sea container distribution at Southampton.

7.2.3 The volume of deep-sea container movement through UK ports is forecast to grow at 4-5% p.a. over the next 10-15 years, and the existing container terminal at Southampton is expected to increase its capacity by 50% in the next 6 years regardless of whether the nearby Dibden Bay project goes ahead, requiring an increase in rail freight capacity on this key route. Further, as described in Chapter 3, there is an increasing trend to the use of high-cube (9'6") units in this trade, requiring W12 loading gauge if rail is to carry these loads efficiently.

7.2.4 It is also sensible that the London-Bristol-Cardiff route, serving the existing inter-modal terminals at Avonmouth and Wentloog as well as those planned at South Marston (planning permission granted) and Colnbrook (planning permission awaited) is cleared to W12 loading gauge before those elements of the Plan that would extend W12 further into the South West are implemented.

7.2.5 For the full benefit to be obtained from these W12 projects capacity for freight through Reading needs to be enhanced, with grade separation of Reading West Junction essential if the frequency and speed of rail passenger services is to be increased in the London-Bristol corridor.

7.2.6 Notwithstanding this clear prioritisation of the W12 schemes, there is scope for new rail freight terminals to be developed without any early prospect of enhanced loading gauge (just as Avonmouth Euroterminal has opened several years in advance of W12 loading gauge reaching it). Carriage of a wide range of actual and potential rail freight does not need the enhanced gauge. Rather, there is no case for extending the W12 network to serve new terminals without the parallel or earlier development of the terminals. The case for loading gauge improvement can then be reviewed given updated cost estimates and a clearer indication of the demand that could be forthcoming with enhanced access.

7.2.7 Other elements of the Plan have lower priority, particularly Didcot West Curve, which would not be justified until both lines at Didcot have been upgraded and

West Country-West Midland inter-modal trains, reversing on route, were already in operation.

Appendix A

Freight Trends in the South West

Figure A1 Goods by Road **travelling more than 200km from the SWARMMS Counties**

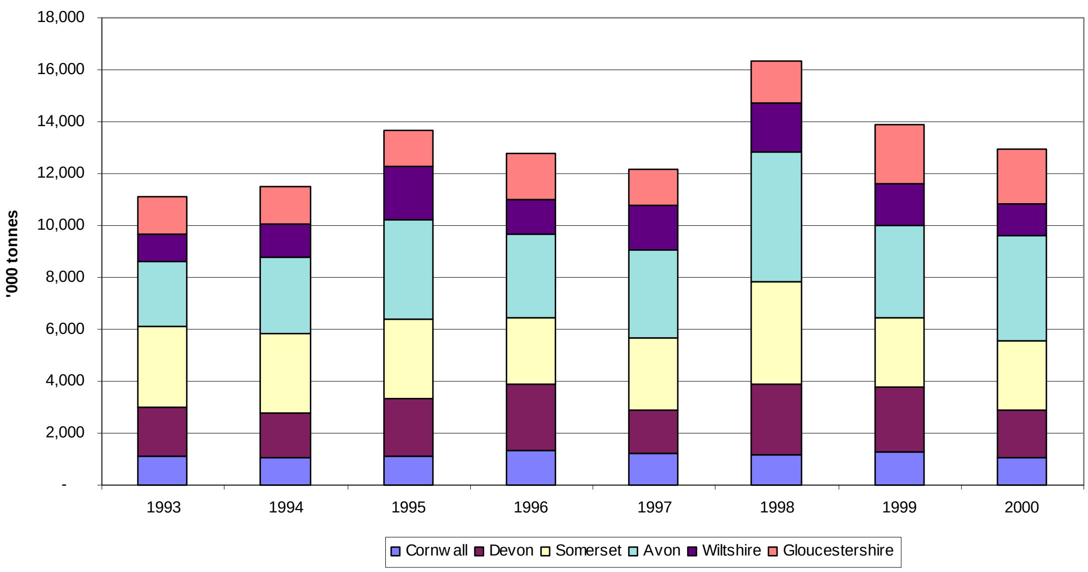


Figure A2 Goods by Road **travelling more than 300km from the SWARMMS Counties**

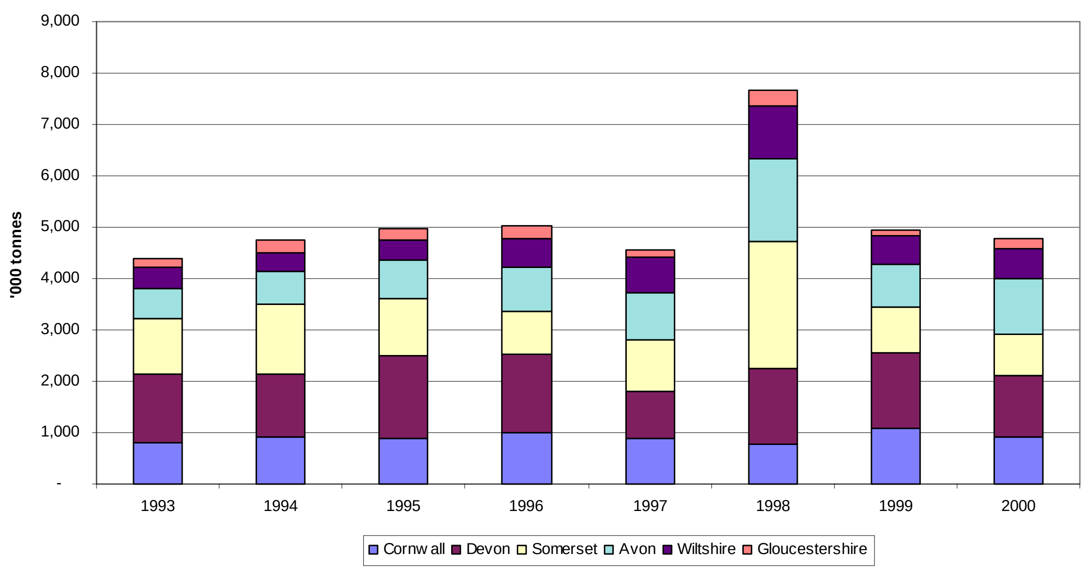


Figure A3 Goods by Road travelling more than 400km from the SWARMMS Counties

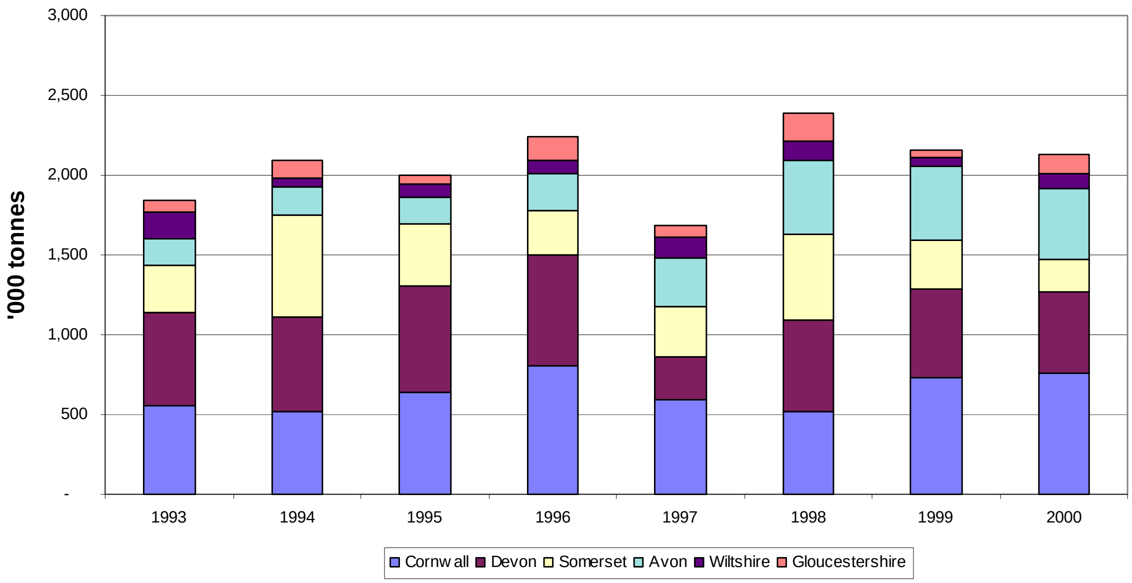


Figure A4 Goods by Road travelling more than 500km from the SWARMMS Counties

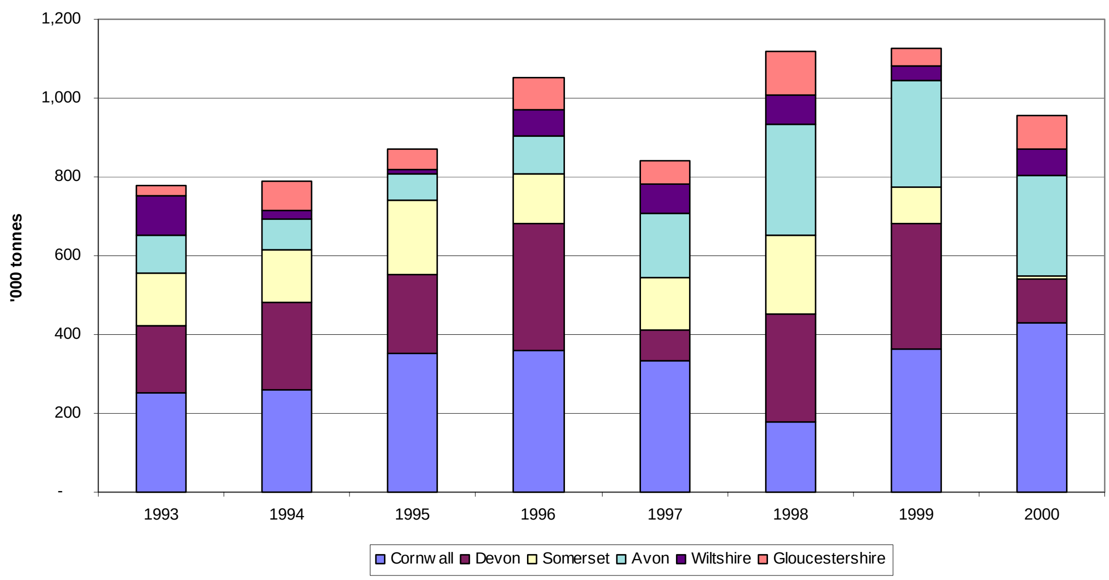


Figure A5 Goods by Road travelling more than 600km from the SWARMMS Counties

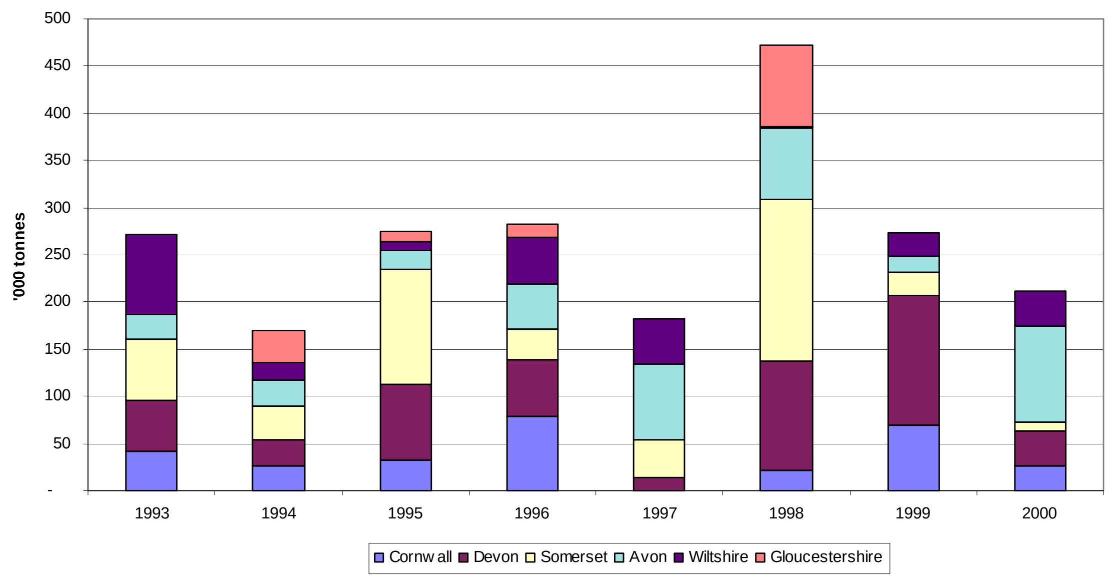


Figure A6 Goods by Road travelling more than 200km to the SWARMMS Counties

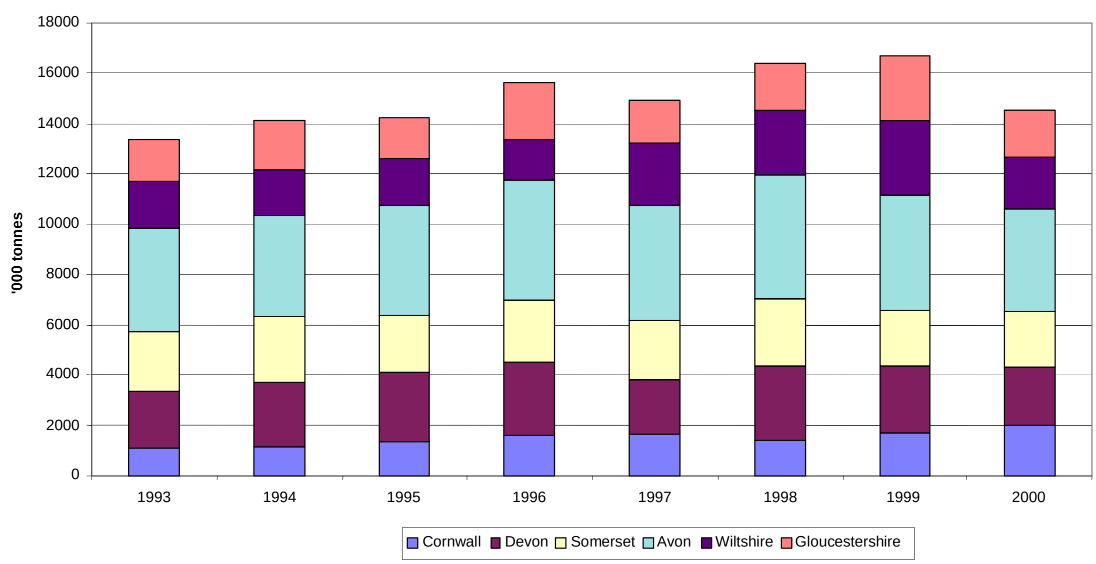


Figure A7 Goods by Road travelling more than 300km to the SWARMMS Counties

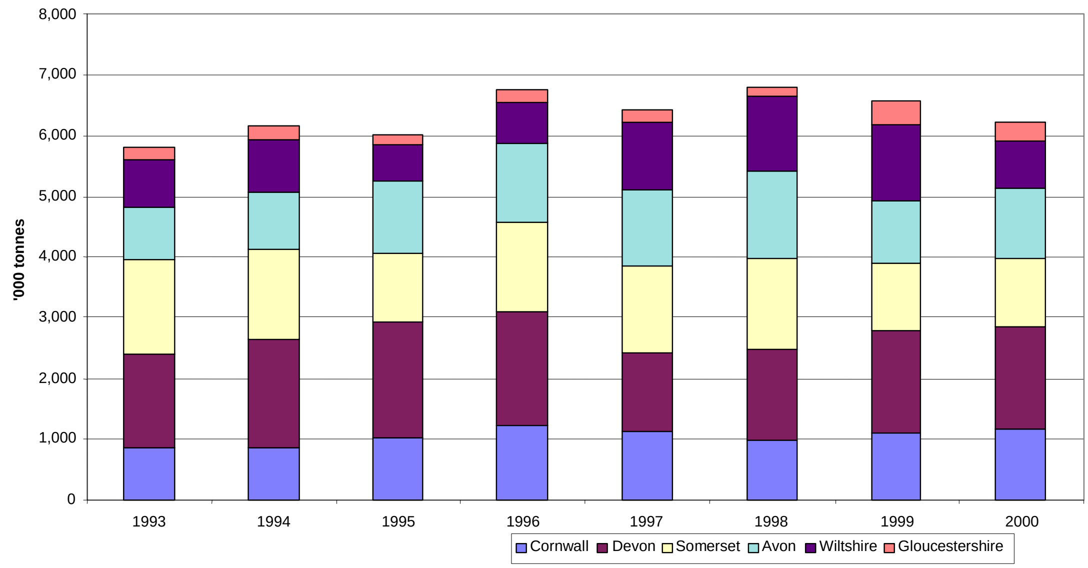


Figure A8 Goods by Road travelling more than 400km to the SWARMMS Counties

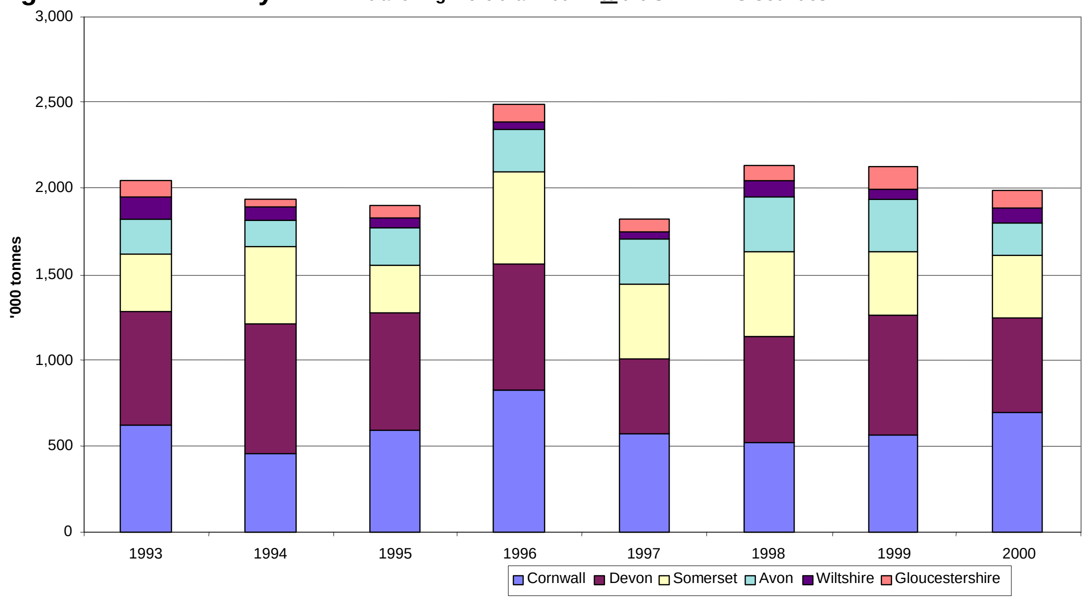


Figure A9 Goods by Road travelling more than 500km to the SWARMMS Counties

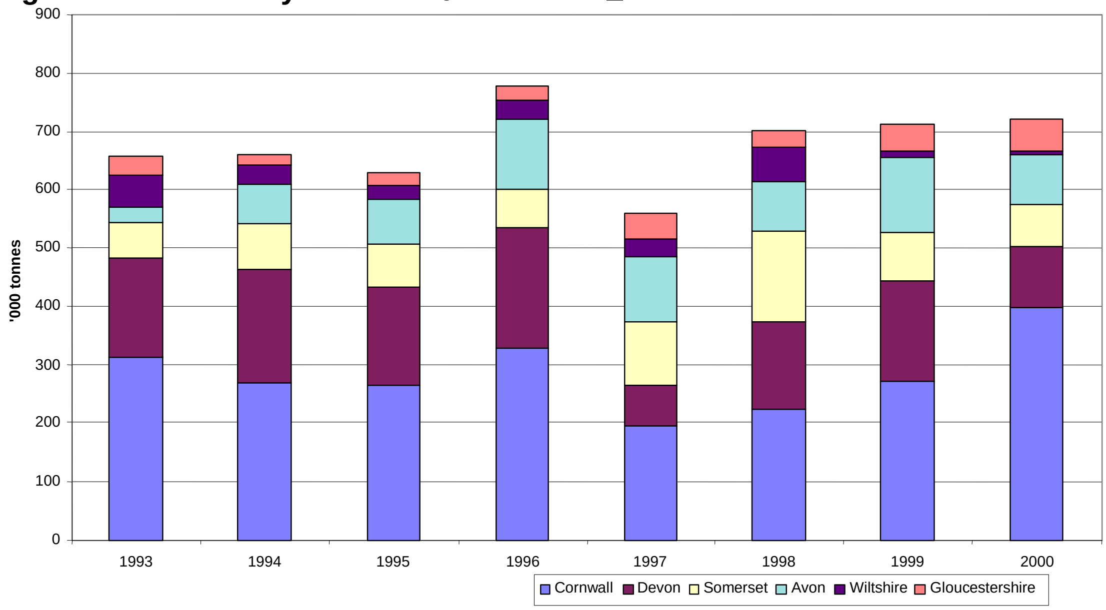


Figure A10 Goods by Road travelling more than 600km to the SWARMMS Counties