ANNEXURE 9

7 HIGHWAY ASSESSMENT

7.1 Introduction

This section considers the impact of four traffic flow situations on the capacity of the local network, namely the:

- 2008 Existing Situation – using observed traffic count data;
- 2020 Base Situation – consisting of the observed traffic flows factored to 2020 levels and committed developments;
- 2020 Development Situation – consisting of the base flows and the traffic generated by the development;
- 2020 with Barry Island peak tourism - this flow scenario is based on the 2020 PM Peak Base situation with the addition of further traffic to and from Barry Island, in order to investigate the effect on peak traffic from tourism movements to and from Barry Island; and
- 2020 Development with Barry Island peak tourism – this flow scenario is based on the 2020 with Barry Island peak tourism with the addition of development traffic in order to assess the impact of development traffic when tourism increases the base level of traffic.

The aim of the modelling exercise is to compare traffic conditions before and after completion of the development. By doing this, it is possible to assess the impact that the development may have on the surrounding road network and to gain a better understanding of mitigation measures that would be required.

The situations have been tested for a typical weekday morning and evening peak hour period using ARCADY, PICADY, or LINSIG (software used for junction capacity modelling) as appropriate.

Junction capacity in the above software packages is measured as the Ratio of Flow to Capacity (RFC), which is a measure of the volume of traffic making a turning movement at the junction divided by the capacity of that movement; ascertained from the geometric measurements of the junction. The generally agreed operational capacity of a junction is at a ratio of 0.85, or 85% for roundabouts and priority junctions and 0.90, or 90% for traffic signals. Junctions can still operate within capacity with an RFC value of up to 1 (100%), however as practical capacity is approached delays will increase.

Interaction between the junctions has been considered as a result of the predicted queues; several of the junctions are located close to one another, as a result of which excessive queues may affect the operation of adjacent junctions. The maximum queues forecast to occur on each arm of junctions has been monitored for this reason.

A link assessment has also been completed for each scenario using the guidance provided in TA79/99.

Several of these junctions have not been fully tested having been eliminated from this requirement at the scoping stage by agreement with the Vale of Glamorgan as a result of the development having only minor effect on them. In these cases the percentage increase in traffic passing through the junction as a result of the development has been quantified. These junctions are:

- Sycamore Cross (junction 1);
- Culverhouse Cross (junction 2); and
- Barons Court (junction 24)

7.2 Existing Situation Assessment – 2008

7.2.1 Existing Highway Network

The scoping process identified a total of 24 junctions and 33 links within Barry (described in Appendix B in detail) and the surrounding area for which the development impact was to be considered. The relevant junctions and links are highlighted on Figure 7.1 and 7.2 respectively.

7.2.2 Existing Traffic Flows

In order to understand the pattern of existing traffic movements on the network, recent traffic count information was obtained from the Vale of Glamorgan for these junctions. This method was discussed and agreed with the Vale of Glamorgan during a meeting on 5 March 2008 (refer to Appendix A). In addition, a series of classified turning movement counts was carried out by Arup in order to augment existing traffic count data. Further details of the traffic data collected are contained in Appendix J.

It should also be noted that some of the older data was normalised to 2008 levels using TEMPRO adjusted NRTF 'central' growth factors where appropriate; however, all traffic data is sufficiently recent to meet guidance regarding the acceptability of counts to be used for this type of capacity analysis.

From these surveys the peak hours were identified as being 08:30-09:30 and 16:30-17:30. The resulting 2008 existing situation traffic flows for the AM and PM peak hours are shown on Figures 7.3 and 7.4 respectively.

Generally the individual traffic counts show reasonable consistency between junctions with only small discrepancies. An exception to this was the PM peak westbound flow between junctions 8 and 9 (see Figure 7.1). The original junction counts have a mismatch of 143 vehicles. To ensure a robust assessment traffic flows at junction 9 have been factored up to match those approaching from junction 8 (404 vehicles). It is these adjusted flows that are presented on Figure 7.1.

7.2.3 Capacity Analysis

Base models were built using the appropriate software for the typical weekday morning and evening peak hours. The results for all junctions are summarised in Table 7.4. In order to present this information in the most concise manner, each scenario has been given a capacity rating from 1-4, where 1 represents that the junction is within capacity, and 4 is over theoretical capacity. These levels are designated according to the largest RFC value on any one arm of the junction as illustrated in Table 7.1.

The traffic models used in the assessment of the local highway network where reviewed by Capita Symonds as part of the review of the original Transport Assessment (August 2009), in light of comments made regarding the model a number of changes have been made to the traffic models, these changes are detailed in a technical note included as Appendix Q.

Table 7.1: Junction capacity classification

	3 - Approaching Practical Capacity	[illegible]	
Priority RFC <0.75 Signals RFC <0.80	Priority RFC >0.75, <0.85 Signals RFC >0.80, <0.90	Priority RFC >0.85, <1.00 Signals RFC >0.90, <1.00	Priority RFC >1.00 Signals RFC >1.00

Queuing at junctions has been classified in a similar manner based on the length of the calculated queue as illustrated in Table 7.2:

Table 7.2: Junction capacity classification

	3 – Significant queuing	[illegible]	
<20 vehs	20-49 vehs	50-99 vehs	>100 vehs

A more complete junction summary, and full model output, is provided as Appendix K. The key points are summarised below:

- the majority (17/21) of the assessed junctions operate within practical capacity in both the AM and PM existing peak hours;
- three junctions exceed practical capacity:
  - Merrie Harrier (No. 3) – AM and PM
  - Biglis roundabout (No. 5) - PM only
  - Waycock Cross (No. 7) – AM only
- one junction exceeds theoretical capacity:
  - Palmerston Road signals (No. 14)

7.3 Base Situation Assessment – 2020

7.3.1 Base Highway Network

There are programmed improvements to the Merrie Harrier and Waycock Cross Junctions. Drawings of the programmed improvements have been received from The Vale of Glamorgan Council and are included as Appendix L.

Merrie Harrier: The proposed works to the Merrie Harrier signalised junction are aimed at providing improved facilities for buses, cyclists and pedestrians whilst increasing available capacity through the installation of new signal equipment. Initial phases of this work have already been completed.

Waycock Cross: The proposed works to the junction involve a re-siting of the roundabout to the north. The revised junction will have improved capacity on all approach arms. The improvement proposals arise from existing traffic conditions and proposals for the Defence Technical College development at RAF St Athan to the west of Barry.

7.3.2 Base Traffic Flows

It was agreed during the scoping process that 2020 would represent a suitable future year for analysis. The traffic flows were factored to 2020 levels, again using TEMPRO adjusted NRTF central growth factors to represent the future year scenario without the development in place. The 2020 base traffic flows for the AM and PM peaks are shown on Figures 7.5 and 7.6 respectively.

There are currently no major committed developments in the Barry urban area. The application of NRTF central growth and adjustments to the gravity model will account for developments in the wider area such as Penarth Heights and RAF St. Athan.

7.3.3 Capacity Analysis

The results of the analysis for each junction and link are shown in Table 7.2 and detailed in Appendix K. The key points are summarised below:

- future year traffic growth would be sufficient to have a significant effect on the operation of the existing road junctions in the study area. The level of junctions operating within practical capacity in all time periods drops to 9 out of 21 assessed junctions;
- 11 junctions are forecast to exceed practical capacity:
  - Merrie Harrier signals (No. 3) – PM only;
  - Murch Crossroads (No. 4) – PM only;
  - Biglis Roundabout (No. 5) – AM only;

- Port Road/Barry Docks Link Road roundabout (No. 6) – PM only;
- Waycock Cross (No. 7) – PM only;
- Dock View Road gyratory (No. 10) – AM only;
- Gladstone Road/Cardiff Road/Ffordd y Mileniwm roundabout (No. 13) – PM only;
- Vere Street, Hilary Rise and Gladstone Road mini roundabout (No. 15) – PM only;
- Wimbourne Road/Ffordd y Mileniwm (No. 16) – PM only;
- Cory Way/Ffordd y Mileniwm roundabout (No. 17) – PM only; and
- Broad Street/Hood Road (No. 23) – PM only.

- four junctions now exceed theoretical capacity in one or both of the peak hours:
  - Merrie Harrier signals (No. 3) – AM only;
  - Biglis Roundabout (No. 5); – PM only;
  - Dock View Road gyratory (No. 10) – PM only; and
  - Palmerston Road signals (No. 14) – AM and PM.

It is clear from the difference between the 2008 and 2020 base assessments that traffic growth in isolation has resulted in a significant number of junctions operating over capacity.

It is unlikely that these situations would be allowed to develop to such a severity; in order to mitigate these effects it is expected that the Vale of Glamorgan would look to provide a series of junction improvements in order to offset the worst of these effects to at least a nil-detriment level.

Should traffic conditions degrade to this extent it is considered that a number of journeys would switch mode (to public transport, walking or cycling) as a result of increased journey times and costs using the private car.

7.4 Development Situation Assessment - 2020

7.4.1 Development Highway Network

It is proposed that a new spine road will serve the main development of consisting of West Pond, and South Quay linking from the location of the existing four arm roundabout at the north east corner of the site to Earl Crescent at the south east edge of the application site. There are a series of junctions serving the development along this road, marked i-ix on Figure 5.1. The alignment of the spine road through the development is illustrated in Figure 7.7.

The existing roundabout at the north east corner will be replaced by a four arm signalised junction in the same position (junction i), which will provide additional capacity and control of traffic movements as well as improving pedestrian conditions by the provision of controlled crossings on all arms.

T-junctions (junction ii and iv) will serves the buildings to either side of the road including the proposed school. These junctions are expected to experience lower demand.

The main access to the West Pond residential area and the retail/petrol filling station will be from a centrally located four arm signalised junction (junction v). This junction will accommodate significant turning movements and provide controlled pedestrian crossings on all arms.

At the southern end of the site a four arm signalised junction (junction viii) provides access to the South Quay area.

Finally a priority junction (junction ix) provides vehicular access to a small residential area to the west of the spine road.

The two smaller development sites (Arno Quay and East Quay) to the east of the main development area will be served by the existing roundabouts located on Ffordd y Milleniwm.

7.4.2 Development Traffic Flows

The development traffic flows were obtained by adding the trips generated by the development site, as detailed in Chapter 6, to the 2020 base traffic flows. The development traffic flows for the AM and PM peaks are shown on Figures 7.8 and 7.9 respectively.

7.4.3 Capacity Analysis

The results of the analysis for each junction and link are shown in Table 7.4 and detailed in Appendix K. The key points are summarised below:

- the development traffic further exacerbates the situation, however six junctions continue to operate within practical capacity in the AM and PM peak periods:
  - Ship Gyratory (No. 9)
  - Butrills Road/Barry Road staggered junction (No. 11)
  - Barry Road/Ty Newydd Road/Cemetery Road roundabout (No. 12)
  - Subway Road/Ffordd y Milleniwm (No. 18)
  - Plymouth Road/Earl Crescent Roundabout (No. 22); and
  - Hood Road signals, No. 23 (previously over capacity in the 2020 without development scenario);
- the following two exceed practical capacity:
  - Harbour Road/Station Approach/Paget Road Roundabout (No. 8) – PM only;
  - Vere Street, Hilary Rise and Gladstone Road mini roundabout (No. 15) – PM only
- several additional junctions now exceed the theoretical capacity, in total 13 junctions exceed theoretical capacity they are:
  - Merrie Harrier signals (No. 3) – AM only;
  - Murch Crossroads (No. 4) – PM only;
  - Biglis Roundabout (No. 5) – AM and PM;
  - Port Road/Barry Docks Road link Road roundabout (No. 6) – AM and PM;
  - Waycock Cross roundabout (No. 7) – PM only;
  - Dock View Road Gyratory (No. 10) – PM only;
  - Gladstone Road/Cardiff Road/Ffordd y Milleniwm roundabout (No. 13) – AM and PM;
  - Palmerston Road signals (No. 14) – AM and PM;
  - Wimbourne Road/Ffordd y Milleniwm (No. 16) – AM and PM;
  - Cory Way/Ffordd y Milleniwm roundabout (No. 17) – PM only;
  - Y Rhodfa/Ffordd y Milleniwm/Clos Tynaid Glo roundabout (No. 19) – PM only;
  - Morrisons/Ffordd y Milleniwm (No. 20) – AM and PM; and
  - Gladstone Bridge/Ffordd y Milleniwm roundabout (No. 21) – PM only

It is notable that the majority of the impacts lie close to the site where the additional traffic is focused.

For those junctions which it was agreed with the Vale of Glamorgan to exclude from detailed analysis, the percentage increase at each of these junctions as a result of the increased in traffic related to Barry Waterfront has been quantified for the AM and PM peak hours:

Barons Court: AM 3%, PM 4%

Sycamore Cross: AM 5%, PM 5%

Culverhouse Cross: AM 7%, PM 7%

7.5 Tourism Traffic Assessment 2020

The Vale of Glamorgan has previously requested that a weekend peak hour be modelled in order to account for the peak conditions which could occur on a warm summer day when the attractions of a rejuvenated Barry Island might draw significant numbers of visitors. For several reasons it is not considered appropriate to undertake such an assessment:

- the requirement for a weekend base scenario was not stated at the scoping stage of the project;
- the nature of the attractions on Barry Island means that such events are intermittent occurrences largely dependent on weather conditions. As such the gathering of reliable traffic data across the size of network considered would not be feasible;
- the consortium of the Waterfront Barry scheme is in no way responsible for the operation/management of traffic travelling to Barry Island, which is an existing problem that will be eased by the provision of a second link to Barry Island; and
- it is anticipated that the worst case in terms of development traffic is not the weekend but the PM peak hour which has already been assessed. During the weekend many elements (residential, offices, schools and some retail) will have lower trip generation and less distinct peak periods.

For these reasons it is not deemed relevant to provide a weekend peak hour. Instead a PM peak hour traffic scenario with additional tourism based traffic has been assessed. It is considered that this is the case in which traffic generation from the Waterfront development would cause the greatest influence on a scenario involving significant tourism trips.

7.5.1 Tourism Traffic Flows

It is considered that a doubling of the traffic to and from Barry Island in the PM peak period is a representative assumption for a PM peak with tourism traffic. The additional number of traffic movements is summarised in Table 7.3.

Table 7.3: Additional tourism- related trips to Barry Island in PM peak hour

Trips	IN	OUT
Existing PM Peak	409	470
Tourism to Barry Island	205	235
TOTAL	**614**	**705**

In a scenario where traffic conditions are notoriously bad and the weather is good, it would be anticipated that local visitors would travel to Barry Island by walking, cycling or rail. The construction of cycle and pedestrian facilities through the Waterfront development should help to further encourage this. For this reason it has been assumed that all trips arise from beyond the extents of the considered network and enter in equal proportions at three points:

- **Barons Court:** Traffic from Cardiff or the East
- **Culverhouse Cross:** Traffic from locations served by the M4

- **Sycamore Cross:** Traffic from the Vale of Glamorgan travelling on the A48

This traffic has been assigned onto the PM 2020 network for two scenarios:

- PM 2020 without development, without Barry Island link road, with tourism; and
- PM 2020 with development, with Barry Island link road, with tourism.

The traffic has been assigned to the network by three direct routes corresponding to the point of entry:

- From Barons Court via the A4055 and onto Ffordd y Mileniwm reaching Barry Island via the new link road through the Waterfront development.
- From Culverhouse Cross via Port Road (A4050) turning at the roundabout (Junction 6) to remain on Port Road to Waycock Cross before travelling on Pontypridd Road, St. Nicholas Avenue and Harbour Road to Barry Island.
- From Sycamore Cross through Waycock Cross and then following the same route as ii to Barry Island.

The resulting distribution of tourism trips is included as Figures 7.10 and 7.11 for the considered scenarios.

7.5.2 PM 2020 without development, without Barry Island link road, with tourism Capacity Analysis

The results of the analysis for each junction and link are shown in Table 7.4 and detailed in Appendix K. In summary as might be anticipated the additional tourism traffic causes further issues on the highway network, with six additional junctions operating over theoretical capacity in comparison to the 2020 PM 'Base' scenario:

- Merrie Harrier Signals (No. 3)
- Murch Crossroads (No. 4)
- Port Road/Barry Docks Link Road Roundabout (No. 6)
- Wimbourne Road/Ffordd Y Mileniwm Priority T-junction (No. 16)
- Cory Way/Ffordd Y Mileniwm Roundabout (No. 17)
- Broad Street / Hood Road Signals (No. 23)

Queues on all junctions affected by the tourism traffic increase, and in some cases this change is quite significant, for example at Murch Crossroads.

The effects of the tourism traffic are broadly what would be expected – congestion increases throughout the area, intensifying closer to Barry Island. The level of queuing forecast would make the operation of the network unstable with the possibility of severe issues on Ffordd y Mileniwm as queuing occurs and interacts between adjacent junctions.

7.5.3 PM 2020 with development, with Barry Island link road, with tourism Capacity Analysis

The results of the analysis for each junction and link are shown in Table 7.4 and detailed in Appendix K. Five additional junctions operate over theoretical capacity in comparison to the 2020 PM without development, without Barry Island link road, with tourism scenario:

- Waycock Cross Roundabout (No. 7)
- Harbour Road / Earl Crescent Priority (No. 8)
- Gladstone Road/Cardiff Road/Ffordd Y Mileniwm (No. 13)
- Y Rhodfa/Ffordd Y Mileniwm/Clos Tynaid Glo Roundabout (No. 19)
- Retail/Morrisons/Ffordd Y Mileniwm Roundabout (No. 20)

- Gladstone Bridge/Ffordd Y Milenlwm Roundabout (No. 21)

The presence of the Barry Island link road in the 'with development' scenario provides a second route to Barry Island which would not be constructed in the near future without the development. This route eases congestion at Gladstone Bridge Roundabout (No. 10) and provides improved potential for traffic management measures to and from the Barry Island car park areas.

Therefore whilst overall capacity in the peak hour is decreased by the presence of the Waterfront Barry development, it is considered that overall resilience of the local highway network is improved in the case of significant tourism related traffic movements.

7.5.4 Event Management Strategy

The future for tourism on Barry Island seems somewhat uncertain; however should the Council, planning policy and interested parties look to achieve a growth in tourism on Barry Island it is anticipated that an event management plan would be implemented at times of high demand. The objective of such a plan would be to ease traffic conditions for tourists, residents and workers in the area and provide clear guidance on how to travel to Barry Island. Without this it is inevitable that congestion would occur – a slow journey to the Island will in itself affect the viability of tourist attractions.

Such an event management plan is not the focus of this Transport Assessment, nor the responsibility of the Waterfront Barry development. However the Council may wish to consider the following strategies:

- the use of Variable Message Signs to implement a temporary routeing strategy, which can be used to direct visitors to the least congested routes, to available parking as well as Park and Ride sites or to existing public transport corridors;
- the promotion of public transport by the council and attraction providers as the primary means of reaching Barry Island could help achieve a notable modal shift. Barry Island benefits from a railway station which has frequent services to the local area; and
- event-specific junction operating plans may be used automatically at signalised junctions and manually at other junctions (for example the closing of minor arms at priority junctions) to create extra capacity for through traffic and avoid severe congestion.

It is considered that the implementation of such measures by the Council or attraction providers, combined with the development-related mitigation measures would help to significantly ease the situation discussed in section 7.5.2.

Table 7.4: Junction Capacity Summary

	Junction	2008 Existing		2020 Base		2020 with Dev't		2020 PM Tourism	
		AM	PM	AM	PM	AM	PM	Without Dev't	With Dev
3	Merrie Harrier Signals Junction		2						
4	Murch Crossroads			2					
5	Biglis Roundabout								
6	Port Road/Barry Docks Link Road Roundabout		2	2					
7	Waycock Cross Roundabout		2			2		3	
8	Harbour Road/Station Approach/Paget Road Roundabout								
	Harbour Road / Earl Crescent Priority								
9	Harbour Road/Nicholas Road (Ship gyratory) Priority								
	Harbour Road/Broad Street (Ship gyratory) Priority								
	The Parade / Harbour Road Mini Roundabout								2
10	Gladstone Bridge Roundabout				2	2	2		2
	Dock View Road Gyratory		2						2
11	Buttrills Road/Barry Road Staggered Junction			2		2			
12	Barry Road/Ty Newydd Road/Cemetery Road Roundabout								
13	Gladstone Road/Cardiff Road/Ffordd Y Milenlwm		2	2					
14	Palmerston Road/Cardiff Road Signals Junction		2						
15	Vere Street/Cardiff Road/Gladstone Road - Mini Roundabout								
	Cardiff Road/Holton Road/Gladstone Rise - Priority T-junction								
16	Wimbourne Road/Ffordd Y Mileniwm Priority T-junction								
17	Cory Way/Ffordd Y Mileniwm Roundabout		2			2			
18	Subway Road/Ffordd Y Mileniwm Priority left in / left out								
19	Y Rhodfa/Ffordd Y Mileniwm/Clos Tynaid Glo Roundabout				2	2			
20	Retail/Morrisons/Ffordd Y Mileniwm Roundabout			2				2	
21	Gladstone Bridge/Ffordd Y Mileniwm Roundabout				2	2		3	
22	Plymouth Road/Earl Crescent Roundabout								
23	Broad Street / Hood Road Signals		2				2		

	2 - Approaching Practical Capacity	[illegible]	
Priority RFC <0.75	Priority RFC >0.75, <0.85	Priority RFC >0.85, <1.00	Priority RFC >1.00
Signals RFC <0.80	Signals RFC >0.80, <0.90	Signals RFC >0.90, <1.00	Signals RFC >1.00

Table 7.5: Maximum modeled queue lengths on a single arm (veh rounded up)

	Junction	2008 Existing		2020 Base		2020 with Dev't		2020 PM Tourism	
		AM	PM	AM	PM	AM	PM	Without Dev't	With Dev
3	Merrie Harrier Signals Junction	2	2	3	2		2	3	3
4	Murch Crossroads	2	2	2	2	2	3	3	
5	Biglis Roundabout				3	2			
6	Port Road/Barry Docks Link Road Roundabout				2	2		2	
7	Waycock Cross Roundabout						2		3
8	Harbour Road/Station Approach/Paget Road Roundabout								2
	Harbour Road / Earl Crescent Priority								
9	Harbour Road/Nicholas Road (Ship gyratory) Priority								
	Harbour Road/Broad Street (Ship gyratory) Priority								
	The Parade / Harbour Road Mini Roundabout								
10	Gladstone Bridge Roundabout					2			
	Dock View Road Gyratory				2		2	2	2
11	Buttrills Road/Barry Road Staggered Junction								
12	Barry Road/Ty Newydd Road/Cemetery Road Roundabout								
13	Gladstone Road/Cardiff Road/Ffordd Y Mileniwm					2		2	
14	Palmerston Road/Cardiff Road Signals Junction	2	2	3	2			3	
15	Vere Street/Cardiff Road/Gladstone Road - Mini Roundabout								
	Cardiff Road/Holton Road/Gladstone Rise - Priority T-junction								
16	Wimbourne Road/Ffordd Y Mileniwm Priority T-junction						3		
17	Cory Way/Ffordd Y Mileniwm Roundabout							2	
18	Subway Road/Ffordd Y Mileniwm Priority left in / left out								
19	Y Rhodfa/Ffordd Y Mileniwm/Clos Tynaid Glo Roundabout						3		
20	Retail/Morrisons/Ffordd Y Mileniwm Roundabout					2	2		3
21	Gladstone Bridge/Ffordd Y Mileniwm Roundabout								
22	Plymouth Road/Earl Crescent Roundabout								
23	Broad Street / Hood Road Signals				2			3	3

	2 – Significant queuing	[illegible]	
<20 vehs	20-49 vehs	50-99 vehs	>100 vehs

7.6 Mitigation Measures

7.6.1 Introduction

The analysis has shown that the forecast growth in background traffic and the additional traffic generated by the development will exacerbate capacity problems, resulting in a number of junctions exceeding their practical and/or theoretical capacity. This will result in significant queues and delays to all road users, which is clearly undesirable to the local authority, consortium as well as future residents and visitors to Barry Waterfront. The local highway network is a key asset and is therefore important to the success of the proposed development. In order to minimise the impact on the highway network a number of junction improvement schemes have been identified and assessed.

For those junctions where improvements are proposed the aim is to achieve a "nil detriment" effect on the highway network in comparison to the 2020 'Base' conditions within the extents of current highway land. The funding of the proposed improvements are subject to ongoing Section 106 of the Highways Act negotiations with the Vale of Glamorgan Council.

Where nil detriment cannot be achieved and only minor improvements with marginal capacity benefits are possible the Vale of Glamorgan has suggested that resources would be better allocated to improvements which encourage sustainable transport to the development such as those measures detailed in section 11.4. Whilst the Consortium understand and are committed to the need for sustainable travel (evidenced by the commitment to a range of improvements schemes outlined in sections 9-11), they remain of the opinion that a more comprehensive range of improvements to tackle both existing and future congestion should be undertaken to maintain the best possible operation of the highway network. Therefore the level of mitigation works presented here follows the requests of the Vale of Glamorgan Council, with a final comparison with that previously presented in an earlier version of the TA which assumed a greater number of mitigation schemes.

The consortium's preferred approach would be for the Council to undertake works to offset the significant effects of traffic growth between 2008 and 2020 in order to achieve nil-detriment in comparison with existing conditions. The consortium would then undertake works, where possible within highway land, to achieve a nil-detriment situation in comparison with a 'without development' scenario.

Table 7.6 below, summarises the operation of the existing junctions, with green boxes representing junctions that operate within practical capacity, and red boxes representing junctions that operate over practical capacity.

Table 7.6: Summary of junctions operating over practical capacity in 2020 with and without Waterfront Barry

No.	Junction	2020 without Waterfront Barry	2020 with Waterfront Barry
3	Merrie Harrier Signals Junction		
4	Murch Crossroads		
5	Biglis Roundabout		
6	Port Road/Barry Docks Link Road Roundabout		
7	Waycock Cross Roundabout		
8	Harbour Road/Station Approach/Paget Road Roundabout		
	Harbour Road/Earl Crescent Priority		
9	Harbour Road/Nicholas Road (Ship gyratory) Priority		
	Harbour Road/Broad Street (Ship gyratory) Priority		
	The Parade/Harbour Road Mini Roundabout		
10	Gladstone Bridge Roundabout		
	Dock View Road Gyratory		
11	Buttrills Road/Barry Road Staggered Junction		
12	Barry Road/Ty Newydd Road/Cemetery Road roundabout		
13	Gladstone Road/Cardiff Road/Ffordd Y Milemiwm		
14	Palmerston Road/Cardiff Road Signals Junction		
15	Vere Street/Cardiff Road/Gladstone Road - Mini Roundabout		
	Cardiff Road/Holton Road/Gladstone Rise - Priority T-junction		
16	Wimbourne Road/Ffordd Y Mileniwm Priority T-junction		
17	Cory Way/Ffordd Y Mileniwm Roundabout		
18	Subway Road/Ffordd Y Mileniwm Priority left in/left out		
19	Y Rhodfa/Ffordd Y Mileniwm/Clos Tynald Glo Roundabout		
20	Retail/Morrisons/Ffordd Y Mileniwm Roundabout		
21	Gladstone Bridge/Ffordd Y Mileniwm Roundabout		
22	Plymouth Road/Earl Crescent roundabout		
23	Broad Street / Hood Road Signals		

Details of possible mitigation measures are assessed in Appendix K and discussed below.

7.6.2 Port Road/Barry Docks Link Road Roundabout

In order to improve capacity at the Port Road/Barry Docks Link Road roundabout consideration could be given to remodelling the existing roundabout to increase capacity by the provision of dedicated left turn lanes to all three arms of the roundabout. The proposed design is contained wholly within existing highway land.

An outline design for these improvements is shown on Figure 7.12. Tables 7.7 and 7.8 illustrate that the operational efficiency of the Port Road/Barry Docks junction is improved to a nil detriment level as a result of the proposed changes, and consequently the queue lengths are reduced.

Table 7.7: Impact of junction improvements on operational efficiency

2020 without Development		2020 with Development			
[illegible]		[illegible]		[illegible]	
AM	PM	AM	PM	AM	PM
2	[illegible]				2

Table 7.8: Impact of junction improvements on queue lengths

2020 without Development		020 with Development			
Without Improvement		Without Improvement		With Improvement	
AM	PM	AM	PM	AM	PM
	2	2			

7.6.3 Harbour Road/Station Approach Road/Paget Road & Plymouth Road/Earl Crescent

In order to improve capacity at the junctions consideration could be given to replacing the existing priority and roundabout complex of junctions with two linked signal controlled junctions. These arrangements will improve the capacity of the junctions whilst introducing controlled pedestrian crossings over two of the arms, and improving the level of traffic control afforded to the highway authority. The proposed design is contained wholly within existing highway land.

An outline design for these improvements is shown on Figure 7.13. Tables 7.9 and 7.10 illustrate that the operational efficiency of the Harbour Road/Station Approach Road/Paget and Plymouth Road/Earl Crescent junctions are improved to a level approaching nil detriment as a result of the proposed changes.

Table 7.9: Impact of junction improvements on operational efficiency

2020 without Development		2020 with Development			
Without Improvement		Without Improvement		With Improvement	
AM	PM	AM	PM	AM	PM
					2

Table 7.10: Impact of junction improvements on queue lengths

2020 without Development		2020 with Development			
Without Improvement		Without Improvement		With Improvement	
AM	PM	AM	PM	AM	PM

7.6.4 Wimbourne Road/Ffordd y Milenium

Consideration could be given to replacing the existing priority junction with a roundabout to improve the capacity for vehicles exiting Wimbourne Road, and those turning right from Ffordd y Milenium into Wimbourne Road. The proposed design is contained wholly within existing highway land.

An outline design for these improvements is shown on Figure 7.14. Tables 7.11 and 7.12 illustrate that the operational efficiency of the Wimbourne Road/Ffordd y Milenium junction is improved to a nil detriment level as a result of the proposed changes, and consequently the queue lengths are reduced.

Table 7.11: Impact of junction improvements on operational efficiency

2020 without Development		2020 with Development			
Without Improvement		Without Improvement		With Improvement	
AM	PM	AM	PM	AM	PM
					2

Table 7.12: Impact of junction improvements on queue lengths

2020 without Development		2020 with Development			
Without Improvement		Without Improvement		With Improvement	
AM	PM	AM	PM	AM	PM
			2		

7.6.5 Gladstone Bridge/Ffordd y Mileniwm

In order to improve capacity at the junction consideration could be given to remodelling the existing roundabout to increase capacity, with all arms slightly realigned and an increased circulatory diameter. The proposed design is contained wholly within existing Highway land.

An outline design for these improvements is shown on Figure 7.15. Tables 7.13 and 7.14 illustrate that the operational efficiency and queue lengths at the Gladstone Bridge/Ffordd y Mileniwm junction are improved as a result of the proposed changes. Whilst the improvements do not achieve nil detriment they do represent a significant improvement and enable the junction to operate within theoretical capacity in the with-development scenario.

Table 7.13: Impact of junction improvements on operational efficiency

2020 without Development		2020 with Development			
Without Improvement		Without Improvement		With Improvement	
AM	PM	AM	PM	AM	PM
2		2		2	

Table 7.14: Impact of junction improvements on queue lengths

2020 without Development		2020 with Development			
Without Improvement		Without Improvement		With Improvement	
AM	PM	AM	PM	AM	PM

7.7 Summary of External Highway Junctions

The improvements and their impacts have been outlined above, and to provide a comparable overview to the before mitigation results in Table 7.2, the results are summarised in Table 7.15 overleaf, which displays the operational efficiency of the junctions in the 2020 with development scenario with and without the outline mitigation works. Table 7.16 presents a comparison to Table 7.6, giving a simplified summary of junctions that operate within practical capacity, and junctions that operate above practical capacity with and without mitigation measures.

It is apparent from the table that the mitigation measures outlined in this section could provide improvement to the operation of the considered highway network. At the request of the Vale of Glamorgan Council only significant measures capable of achieving a notable improvement, ideally to the level of nil detriment in comparison to the 2020 without development scenario, have been considered. In addition these measures would improve the control of traffic and in several cases an improved opportunity for pedestrians to cross roads

Table 7.15: Junction operational efficiency with and without mitigation measures

		Without mitigation						With mitigation	
		2008 Existing		2020 Base		2020 with Dev't		2020 with Dev't	
		AM	PM	AM	PM	AM	PM	AM	PM
3	Merrie Harrier Signals Junction		2						
4	Murch Crossroads			2					
5	Biglis Roundabout								
6	**Port Road/Barry Docks Link Road Roundabout**		2	2					2
7	Waycock Cross Roundabout		2			2			
8	**Harbour Road/Station Approach/Paget Road Roundabout**								2
	Harbour Road/Earl Crescent Priority								
9	Harbour Road/Nicholas Road (Ship gyratory) Priority								
	Harbour Road/Broad Street (Ship gyratory) Priority								
	The Parade/Harbour Road Mini Roundabout								
10	Gladstone Bridge Roundabout				2	2	2		
	Dock View Road Gyratory		2						
11	Buttrills Road/Barry Road Staggered Junction			2		2			
12	Barry Road/Ty Newydd Road/Cemetery Road Roundabout								
13	Gladstone Road/Cardiff Road/Ffordd Y Milemiwm		2	2					
14	Palmerston Road/Cardiff Road Signals Junction		2						
15	Vere Street/Cardiff Road/Gladstone Road - Mini Roundabout								
	Cardiff Road/Holton Road/Gladstone Rise - Priority T-junction								
16	**Wimbourne Road/Ffordd Y Milenium Priority T-junction**								2
17	Cory Way/Ffordd Y Mileniwm Roundabout		2			2			
18	Subway Road/Ffordd Y Mileniwm Priority left in/left out								
19	Y Rhodfa/Ffordd Y Mileniwm/Clos Tynaid Glo Roundabout				2	2			
20	Retail/Morrisons/Ffordd Y Mileniwm Roundabout			2					
21	**Gladstone Bridge/Ffordd Y Milenium Roundabout**				2	2		2	
22	Plymouth Road/Earl Crescent Roundabout								
23	Broad Street / Hood Road Signals		2				2		

Junctions with Mitigation measures

	2 - Approaching Practical Capacity		
Priority RFC <0.75	Priority RFC >0.75, <0.85	Priority RFC >0.85, <1.00	Priority RFC >1.00
Signals RFC <0.80	Signals RFC >0.80, <0.90	Signals RFC >0.90, <1.00	Signals RFC >1.00

Table 7.16: Summary of Junction operation with and without mitigation measures

	Junction	2020 without Waterfront Barry	2020 with Waterfront Barry without Mitigation	2020 with Waterfront Barry and Mitigation
3	Merrie Harrier Signals Junction			
4	Murch Crossroads			
5	Biglis Roundabout			
6	Port Road/Barry Docks Link Road Roundabout			
7	Waycock Cross Roundabout			
8	Harbour Road/Station Approach/Paget Road Roundabout			
	Harbour Road/Earl Crescent Priority			
9	Harbour Road/Nicholas Road (Ship gyratory) Priority			
	Harbour Road/Broad Street (Ship gyratory) Priority			
	The Parade/Harbour Road Mini Roundabout			
10	Gladstone Bridge Roundabout			
	Dock View Road Gyratory			
11	Buttrills Road/Barry Road Staggered Junction			
12	Barry Road/Ty Newydd Road/Cemetery Road roundabout			
13	Gladstone Road/Cardiff Road/Ffordd Y Milenium			
14	Palmerston Road/Cardiff Road Signals Junction			
15	Vere Street/Cardiff Road/Gladstone Road - Mini Roundabout			
	Cardiff Road/Holton Road/Gladstone Rise - Priority T-junction			
16	Winkzonia Road/Ffordd Y Milenium Priority T-junction			
17	Cory Way/Ffordd Y Milenium Roundabout			
18	Subway Road/Ffordd Y Milenium Priority left in/left out			
19	Y Rhodfa/Ffordd Y Milenium/Clos Tynaid Glo Roundabout			
20	Retail/Morrisons/Ffordd Y Milenium Roundabout			
21	Gladstone Bridge/Ffordd Y Milenium Roundabout			
22	Plymouth Road/Earl Crescent roundabout			
23	Broad Street / Hood Road Signals			

7.8 Comparison to effects of previous nil-detriment approach

Table 7.17 is presented in order to compare the effect of this strategy with that adopted in the initial version of the Transport Assessment (August 2009), in which a more comprehensive package of junction mitigation measures was proposed. The table compares the junction capacity results for the 2020 'with development' scenario. It is acknowledged that traffic generation related to the site has increased marginally as a result of this revised Transport Assessment and traffic model parameters have been revised in some cases; however, it is considered that the previous results remain comparable and indicate the improved junction capacity that a more comprehensive package of mitigation works could achieve.

With a greater level of mitigating works as previously proposed junctions are forecast to operate over theoretical capacity 11 scenarios, a reduced set of mitigating works increases the number of scenarios where junctions operate over capacity to 14. The number of junctions operating over practical capacity also reduces marginally. These differences in junction capacity represent potentially increased congestion, delays and queuing. The consortium are therefore of the opinion that where possible improvements should be made to the modelled junctions in order to achieve the best available operation of the local highway network.

Table 7.17: Comparison of junction mitigation strategies for 2020 with development scenario

		2020 with Dev't Vale of Glamorgan requested mitigation As Table 7.15		2020 with Dev't Comprehensive mitigation as August 2009 TA (previous traffic flow results)	
		AM	PM	AM	PM
3	Merrie Harrier Signals Junction		3		
4	Murch Crossroads	2			
5	Biglis Roundabout				
6	Port Road/Barry Docks Link Road Roundabout		2		
7	Waycock Cross Roundabout	2			
8	Harbour Road/Station Approach/Paget Road Roundabout				
	Harbour Road/Earl Crescent Priority				
9	Harbour Road/Nicholas Road (Ship gyratory) Priority				
	Harbour Road/Broad Street (Ship gyratory) Priority				
	The Parade/Harbour Road Mini Roundabout				
10	Gladstone Bridge Roundabout	2	2		
	Dock View Road Gyratory	3			
11	Buttrills Road/Barry Road Staggered Junction	2		2	2
12	Barry Road/Ty Newydd Road/Cemetery Road Roundabout				
13	Gladstone Road/Cardiff Road/Ffordd Y Mileniwm			2	
14	Palmerston Road/Cardiff Road Signals Junction				
15	Vere Street/Cardiff Road/Gladstone Road - Mini Roundabout				
	Cardiff Road/Holton Road/Gladstone Rise - Priority T-junction				
16	Wimbourne Road/Ffordd Y Mileniwm Priority T-junction		2		2
17	Cory Way/Ffordd Y Mileniwm Roundabout	2		2	2
18	Subway Road/Ffordd Y Mileniwm Priority left in/left out				
19	Y Rhodfa/Ffordd Y Mileniwm/Clos Tyndal Glo Roundabout	2		2	2
20	Retail/Mountjoy/Ffordd Y Mileniwm Roundabout				
21	Gladstone Bridge/Ffordd Y Mileniwm Roundabout	2			2
22	Plymouth Road/Earl Crescent Roundabout				
23	Broad Street / Hood Road Signals		2		2

* These junctions have been modelled with committed improvement schemes since the initial version of the TA resulting in improved capacity without development related mitigation.

Junction with proposed mitigation works Transport Assessment Rev A and August 2009 TA

Additional junctions with proposed mitigation works August 2009 TA

7.9 Internal Junctions

The junctions illustrated in the Masterplan, Figure 5.1, have been assessed to ensure efficient operation of the internal network. The junctions have been modelled using the flows on the internal network illustrated previously in Figures 6.2 and 6.3. For the purpose of establishing a local Heavy Goods Vehicle (HGV) proportion, the existing HGV proportions using Harbour Road have been assumed throughout the internal junctions, except for the supermarket service access where a higher proportion has been used. Table 7.18 summarises the results, with the model outputs being provided in Appendix K.

These results represent an initial test of internal junctions for information, and are not strictly the subject of the outline application, but are provided here for information subject to further detailed design. In the case of signalised junctions [i], [v] and [viii] there are differences in the assumed

operation of the pedestrian crossings from that indicated on Figure 7.7. The detailed design and operation of these junctions will be the subject of a separate planning application.

Table 7.18: Internal junction assessment summary

Junction	AM		PM	
	Operational efficiency	Queue	Operational efficiency	Queue
Junction [i] - 100s cycle AM, 120s cycle PM			[redacted]	[redacted]
Junction [ii]				
Junction [iv]				
Junction [v] - 120s cycle		[redacted]	[redacted]	[redacted]
Junction [viii] - 120s cycle			[redacted]	[redacted]
Junction [ix]				

	[redacted]	[redacted]	
Priority RFC <0.75 Signals RFC <0.80	Priority RFC >0.75, <0.85 Signals RFC >0.80, <0.90	Priority RFC >0.85, <1.00 Signals RFC >0.90, <1.00	Priority RFC >1.00 Signals RFC >1.00

	[redacted]	[redacted]	
<20 vehs	20-49 vehs	50-99 vehs	>100 vehs

7.10 Link Assessment

The link assessment is based on Design Manual for Roads and Bridges (DMRB) Advice Note TA 79/99, and has been carried out on the main routes in Barry detailed within this report.

The table included as Appendix M displays the results of the link capacity assessment. The table indicates that the main corridor running through the southern areas of Barry and the waterfront are approaching and/or exceeding the design capacity.

The tourism scenario also shows that some links are exceeding the design capacity. It is argued that this is to be expected, and is likely to happen with or without the Waterfront development. It is considered that the tourism scenario is unlikely to be a regular occurrence, and it would be undesirable to design the highway network for such rare occasions.

7.11 Impact of development on accidents in the local highway network

It is anticipated that as a consequence of the increased traffic volumes on the highway network there will be an associated minor increase in the predicted rate of accidents across the highway network. This is typical of all scenarios in which traffic increases, as historical evidence indicates a link between traffic volumes and accidents.

However in the majority of cases the observed accident record across the network has been below the COBA predicted rates and this is likely to continue to be the case.

The proposed mitigation measures have been designed in accordance with relevant standards and as such safety considerations have been central to the design of the works. A Road Safety Audit Stage 1 (included as Appendix N, with the related designers response included as Appendix O) has been undertaken for the mitigation measures and the points raised in this report

will be considered in detailed design work. In several cases the proposed works are comprehensive and will provide the opportunity to greatly improve the safety record, particularly for vulnerable users, at key junctions across the considered area

7.12 Summary

The analysis demonstrates the impacts of the development proposals on the road network and, where necessary and feasible within current highway land boundaries, suggestions for junction mitigation works have been proposed to mitigate the effects of traffic associated with the proposed development. It should be noted that the Waterfront Barry consortium have no responsibility for the growth in base traffic but acknowledge the impacts of the development which may require a contribution; this will be the subject of negotiation based on the results and analysis presented in this Transport Assessment.

The approach to mitigation works presented in this revised version of the Transport Assessment is at the request of the Vale of Glamorgan Council. The Consortium understand the reasons for this approach but considers that, where possible, a wider programme of mitigation works to offset the impacts of traffic growth and that of the development remains valid and would improve the operation of the local highway network for all users.

Further to this it should be noted that whilst proposals for the construction of higher capacity road links to Cardiff Airport are no longer being progressed by the Welsh Assembly Government, the recently published National Transport Plan does include reference to improvements on Five Mile Lane A4226 as a named scheme:

"*...and take forward safety improvements on the A4226 Five Mile Lane*"

The National transport Plan also states an objective to:

"*Introduce a high-quality, frequent bus service between Cardiff and Cardiff Airport*"

It is likely that both of these improvements would have significant benefits for Waterfront Barry both in improving access to the A48 and M4 via Five Mile Lane and also offering an improved bus service which should result in modal shift and therefore improvement in local highway conditions.

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Project title	Waterfront Barry	Job number	122374-00
cc	Richard Keogh Jonathan Kinghorn John Smith	File reference	4-70
Prepared by	Roddy Beynon (Cardiff)	Date	5 October 2010
Subject	Response to Audit of Transport Assessment Rev A		

1. INTRODUCTION

This technical note provides a response to the points requiring clarification or comment in the Capita Symonds audit of the Transport Assessment Rev A issued by Arup in relation to the outline planning application.

The audit report produced by Capita Symonds includes a commentary and description of the Transport Assessment, only those points requiring clarification or comment are considered and are organised on a by chapter basis.

Additionally there are a number of points which required the Vale of Glamorgan Council to confirm applicable standards in relation to the development.

2. RESPONSE TO AUDIT POINTS

2.1 Chapter 1: Introduction

No audit comments raised requiring response. Chapter agreed.

2.2 Chapter 2: Existing Site

Audit Ref. 2.2.3: Tables 2.1 and 2.3 refer to the proposed signalisation of Biglis Junction. This signalisation has been dropped as a proposal in Chapter 7.

Arup Response: Typographical error there is currently no proposed improvement at Biglis junction.

2.3 Chapter 3: Development History

No audit comments raised requiring response. Chapter agreed.

2.4 Chapter 4: Policy Context

Audit Ref. 2.4.4: The South East Wales Transport Alliance Regional Transport Plan dated March 2010 should replace the 2008 draft plan in section 4.2.1.

Arup Response: Accepted, this document has been approved since the original Transport Assessment was submitted. There have been no changes to the finalised document that affect its input to the TA.

2.5 Chapter 5: The Masterplan and The Transport Strategy

No audit comments raised requiring response. Chapter agreed.

2.6 Chapter 6: Trip Making

No audit comments raised requiring response. Chapter agreed.

2.7 Chapter 7: Highway Assessment

Audit Ref 2.7.2: The trip making section estimates that Morrisons is trading at 158% and with the introduction of the new food store, this figure will reduce to 117%. This reduction has not been taken into account in the capacity analysis.

Arup Response: Agreed, therefore the analysis represents a worst case in terms of traffic generation from Morrisons.

Audit Ref 2.7.3: 6 – Port Road /Barry Dock Link Road

Appropriate dedicated left turn facilities are required. These are not adequately provided for in current proposals. The dedicated left turn lane exist are give way. No capacity analysis on the exits from has been undertaken.

Port Road westbound merge is 50m. Minimum of 100m preferred.

The left from Barry Dock Link Road does not meet the minimum flow requirements for a dedicated left turn. The RFC for this approach is just under 0.85 with or without dedicated left.

The required minimum entry angle of 20 degrees on the give way is not achieved.

Arup Response: Detailed design issues. Exits could be eased with additional third party land, the proposals represent an improvement in roundabout geometry in comparison to the standards of the existing roundabout. Dedicated L from Barry Docks Link Rd can be removed however it is considered that the dedicated L turn does make a contribution to capacity.

Audit Ref 2.7.3: 8 – Harbour Road / Station Approach/Paget Road: Traffic signals. Comments on this junction and modelling of all other traffic signal junctions are contained within appendix A.

Arup Response: The comments raised in this Appendix have been fully considered and responded to in section 2.8.

Audit Ref 2.7.3: 16 – Wimbourne Road/Ffordd y Miteniwm:

The proposed junction is 170m from the existing roundabout Cardiff Road/Weston Square Roundabout. The modelling work indicates that with development traffic is expected to queue back (43 vehicles/247m) through the new junction, from the adjacent junction.

Arup Response: The queue indicated in the modelling work is 4.3 PCU, it would appear that a typographical error has been made elsewhere. A queue of 4.3 PCU can be accommodated on the link.

Audit Ref 2.7.3: 21 – Gladstone Bridge / Ffordd y Mileniwm: Improvement to existing roundabout.

The proposed improvement design to the roundabout has remained unchanged. However, the ARCADY analysis has revised parameters and the queues on Ffordd y Mileniwm are resolved with the geometry included in the ARCADY (entry width increased from 7.03 to 8.66 and roundabout diameter increased from 37 to 45). The revised design is required.

Sensitivity testing of unequal lane use has been stated in Appendix Q (section 8.36) to have been undertaken but the results are not included and are required.

Arup Response: Figure 7.15 included in TA Rev A has measurements which are consistent with entry width of 8.66 and ICD of 45m. Table 1 presents the results of sensitivity testing on the Cardiff Rd E arm of the junction comparing the proposed improvement to the roundabout and the results for a single lane with the heaviest turning volume in the PM 2020 development scenario. The results indicate that the capacity of the roundabout is more balanced through the use of increased entry widths with improved capacity on the Gladstone Bridge arm.

Table 1: Sensitivity testing of entry width variation at Ffordd Y Mileniwm/Gladstone Bridge

	RFC		Queue (veh)	
	Proposed	Single lane	Proposed	Single lane
Ffordd Y Mileniwm E	0.864	0.804	4.0	6.1
Ffordd Y Mileniwm W	0.563	0.512	1.0	1.3
Gladstone Bridge	0.777	0.942	10.9	3.4

Audit Ref 2.7.4: The Highway Authority will have concerns at locations where nil detriment cannot be achieved. The previous proposals for Biglis Roundabout had a 'modest impact on the operational efficiency' (Section 7.6.3 of the August 2009 TA). There is however, a large area defined as 'Highway land' which is outside the adopted highway area. Options should be considered to improve this junction within the land available.

Also, at Palmerston Road/Cardiff Road Signals, there is a large area to the north of Cardiff Road in the Council's control and a large area to the south in private ownership. What improvements could be considered at this location should the land to the south be acquired?

Arup Response: It was at the councils request that a wider range of junction improvements wase not proposed in the TA Rev A and thus proposals for Biglis roundabout were removed from revision A of the TA.

At the Palmerston Road junction the consortium are unable to commit to providing solutions requiring third party land. The previously available information on land ownership was restricted to areas of highway land, solutions using land to the north of Cardiff Road in council control could be considered but it is suggested that use of land to the south would result in a superior solution.

Audit Ref 2.7.6: Table C highlights that in 2020, the year in which the development is completed, three proposed internal junctions (i / v / viii) have RFCs in excess of the practical capacity.

Arup Response: The internal junctions will all remain within theoretical capacity and are only forecast to have RFC in excess of practical capacity during the PM peak hour. The analysis has not included consideration of signal technologies such as vehicle actuation or MOVA. Elsewhere such technologies have been proven to improve the operation of signalised junctions. It is considered that designing these junctions to provide plentiful capacity in a future year for limited

peak periods would require additional lanes at the junctions and compromise the urban nature and discourage sustainable transport around the development.

2.8 Audit Appendix A – Signalised junctions

Appendix A of the Revision A audit raised a number of technical points in relation to the modelling of signalised junctions. This section responds to the points raised which are referenced at the start of each section, the bold text relates to the queried areas of the model. Where appropriate minor alterations have been made to the junction models. Results for these revised models are included as appendices A-E.

2.8.1.1 Audit Ref App A, 8.11: Merrie Harrier

Arup has revisited the site following implementation of the Merrie Harrier junction improvements and altered the Linsig model accordingly to more closely replicate the conditions. The two sections of the junction now run on a split stream controller to allow better coordination, phasing/staging has been changed accordingly. The revised model output is included as Appendix A.

Pedestrian crossing on Barry Road east, site observations show there is little activity at the pedestrian crossing during the peak periods. It is thus considered that its omission would have minimal effect on capacity.

Phase D left turn into Penlan Road, this has now been modelled with a signal as on site, but there is an effective green throughout the cycle with a left turn filter. Left turning traffic advances to a junction at which it gives way to the right turners from Barry Road. In combination this arrangement effectively runs as a give way.

Phase L right into Redlands Road, altered to run as a give way with a demand dependant stage for the indicative right arrow, the indicative right only runs approximately every fourth cycle so has been omitted from the model.

Andrews Road, is a bus only arm off Merrie Harrier junction. The stage is demand dependant and only called when a bus is present. As a result of the relatively low number of bus movements this link been omitted from the model.

Phase H left turn into Redlands Road, the movement is not modelled to experience congestion, the phase has been revised to operate as a left turn filter in an additional stage. This change has a nominal effect.

Tourism Scenario, has been modelled with and without development in the PM peak.

Link 5/2, left turn into Redlands road (Link 5/1) is a flare with a 6 PCU capacity fed by link 5/2. With development in 2020 link 5/2 queues and block vehicles from entering the left turn flare but releases at the start of the green stage allowing full saturation of both Link 5/1 and 5/2.

Internal Links, during some scenarios the internal links have a mean max queue (MMQ) above the physical storage but have an end of red queue within storage capacity. As a test queue limiters were applied to the internal links this test forced the mean max queues down and increased the RFC of the feeding arms. In reality when the internal link starts to empty the feeding arm adds to the back of the queue generating a rolling queue that fully depletes before the stage closes down as shown in Figure 1.

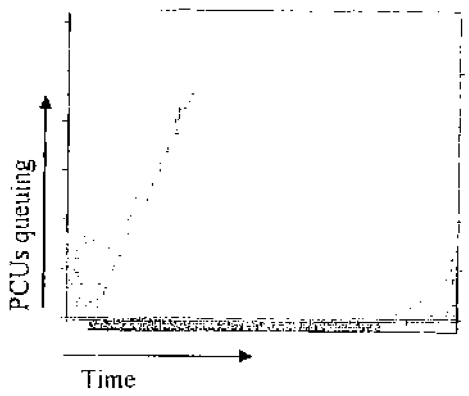


Figure 1: Queue depletion pattern on Merrie Harrier junction link

Figure 1 shows the back of queue building while the front of the queue is released. The queue becomes fully depleted before the next red stage commences.

2.8.1.2 Audit Ref App A, 8.12: Murch Crossroads

Revisions to the model have been made in light of audit comments. Appendix B includes the revised results set.

Geometry, left turn into Murch Road south (Link 1/1) has been set to 8m radius and left turn into Cardiff Road east has been set to a 10m radius.

Cycle Times, during site observations complex staging with demand dependant stages and large fluctuation in cycle times. It is therefore considered reasonable to allow Linsig to optimise the cycle time as a flat profile.

Queue Lengths, the queue on Cardiff Road eastbound/westbound is a rolling queue that fully releases within their green phase.

Over Capacity, the junction operates over capacity in the base situation and as outlined in section 7.6 of the TA no remedial measures are proposed in relation to the Waterfront Barry scenario.

2.8.2 Audit Ref App A, 8.16: Palmerston Road/Cardiff Road

Revisions to the model have been made in light of audit comments, Appendix C includes the revised results set.

Saturation flows, the saturations flows have been based on a report issued by TRL 'The prediction of saturation flows for road junctions controlled by traffic signals' report (RR67) which has been adopted as a recognised method to determine saturation flows at signalised junctions. The note was produced in 1986 and it could be argued that as a result of increased driver familiarity with traffic signals an increase in saturation flows above that laid out in RR67 could be justified. RR67 is based on road geometry and is supported directly in the Linsig modelling software as well as other standard transport guidance and modelling software.

While it is important not to overestimate the capacity of a junction underestimating the capacity could result in an over engineered design for a one hour peak that is inappropriate for the level of demand and its location.

Proposed junction, as discussed in section 7.6 of the TA Rev A the junction operates over capacity in the existing situation. Due to the available Highway land it has not been possible to propose an improved solution.

Indicative right into Palmerston Road, has now been modelled as an indicative right. This indicative right is a demand actuated stage that is double cycled in the AM peak. This has only a nominal improvement effect to the junction capacity results.

Over capacity, the junction does currently have capacity issues but as outlined in section 7.6 of the TA no improvements are proposed in the TA Rev A for the with development scenario.

2.8.3 Audit Ref App A, 8.18: Hood Road/Broad Street

Revisions to the model have been made in light of audit comments; Appendix D includes the revised results set.

Opposed right turns, The right turn from Island Road north and Hood Road south have now been modelled with give way parameters. Because of the low demand and opposing flow this has a negligible effect.

Combined link 4/1 and 4/2, Broad Street west is a one lane approach (link 4/1) with right hand flare (link 4/2), in order to accurately model the right hand flare in Linsig the option 'short lane with lane on left' needs to be selected. This allows Linsig to determine the usage of the flare which could be limited by the blocking back of the vehicles in the long lane. It is not possible to separate the queues for analysis purposes between the flare and the straight ahead queue.

Queue blocking back, there may be some cases in which traffic blocks vehicles entering adjacent flares or adjacent lanes however these effects are considered by the modelling software when calculating overall queue lengths.

2.8.4 Audit Ref App A, 8.29: Harbour Road/Station Approach Road

Revisions to the model have been made in light of audit comments, Appendix E includes the revised results set.

Pedestrian Phases, the pedestrian crossings at Station Road and Paget Road have been staggered and therefore can be run during the other stages without affecting green times. For this reason they have been omitted from the Linsig analysis.

Right turn coefficient, the right turn coefficient into Plymouth Road has now been updated.

Right turn stacking, the right turn storage into Plymouth Road has been reduced to one blocking PCU.

Tourism Scenario, it is accepted that the junction will be over capacity during the peak of tourism.

Internal Queue Length, the internal storage between junctions fills and dissipates within each cycle. If demand fluctuates from this level there is still capacity within the junctions to balance the queues.

Only covers 2020 with development and development plus tourism, the junction improvements are part of development and are therefore not assessed in the 2008 base year.

Saturation flows, as 8.16.

2.8.5 Audit Ref App A, 8.38: South Quay Junction (junction viii)

Saturation flows, as 8.16.

Only covers 2020 with development, the junction is part of the development and is therefore only assessed not assessed for the 2008 base year.

Combined link 1/1 and 1/2, the southbound through road from the supermarket is a one lane approach (link 1/1) with right hand flare (link 4/2) in order to accurately model the right hand flare in Linsig the option 'short lane with lane on left' needs to be selected. This allows Linsig to

determine the usage of the flare caused by the blocking back of the vehicles in the long lane. The queues between the flare and the straight ahead queue cannot be separated.

On the limit of capacity 2020 PM, agreed, in order to add further significant capacity a step change would be required to the design, this would result in an over-engineered design for a one hour peak that is inappropriate for the level of demand and its location for the rest of the day.

Right turning movements, this is one of the key junctions along the spine road, approaching the junction the carriageway flares to three lanes on the northern arm the right turners have been set to run during their own stage which allows the legs of the pedestrian staggers to run and therefore keeping the stages to minimum.

Whilst it is agreed that the opposed right turn stage is a departure from standards there are a number of junctions using such phasing in the surrounding area. This solution offers benefits in terms of space required for the junction, capacity and vehicular delay. The acceptability of implementing such phasing lies with the Vale of Glamorgan.

2.8.6 Audit Ref App A, 8.39: Central West Pond Junction (junction v)

Pedestrian Intergreens, this is a compact junction with short staggered pedestrian crossings which only require short intergreens.

Saturation flows, as 8.16.

Only covers 2020 with development, the junction is part of the development and is therefore only assessed for 2020 base plus development traffic.

Combined links 1/2 & 1/3, 2/1 & 2/2 and 3/1 & 3/2, as previously stated it is not possible to separate the queue lengths on links.

2.8.7 Audit Ref App A, 8.40: Internal Northern Junction (junction i)

Pedestrian Intergreens, this is a compact junction with short staggered pedestrian crossing which only require short intergreens.

Right turning movements, As 8.38. As modelled the dedicated right turn movements run at the same as a pedestrian phase. In order to run the right turn as an indicative phase an additional stage would required or an all red pedestrian stage that would push the junction over capacity.

Saturation flows, as 8.16.

Only covers 2020 with development, the junction is part of the development and is therefore only assessed for 2020 base plus development traffic.

2.8.8 Summary of effects of revisions to signalised junctions

Tables 2 and 3 provide a comparison of the capacity results between those models presented in the Transport Assessment Rev A (Arup, June 2010) and revised models following the changes made according to audit comments (Capita Symonds, August 2010).

The changes have had the effect of minor improvements to capacity at Merrie Harrier and at the Palmerston Road junction in the 2008 AM period. At other junctions the alterations have had no significant effect on capacity; it is therefore considered that the previously presented results are representative and that the comments raised in the most recent audit are minor in nature.

Table 2: Signalised junction Capacity results presented in Transport Assessment Rev A, June 2010.

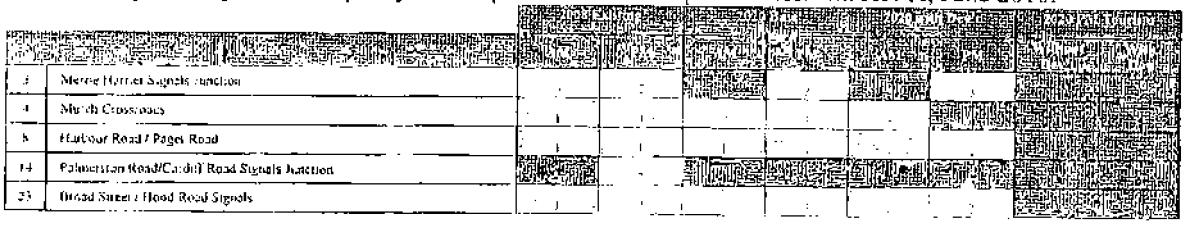
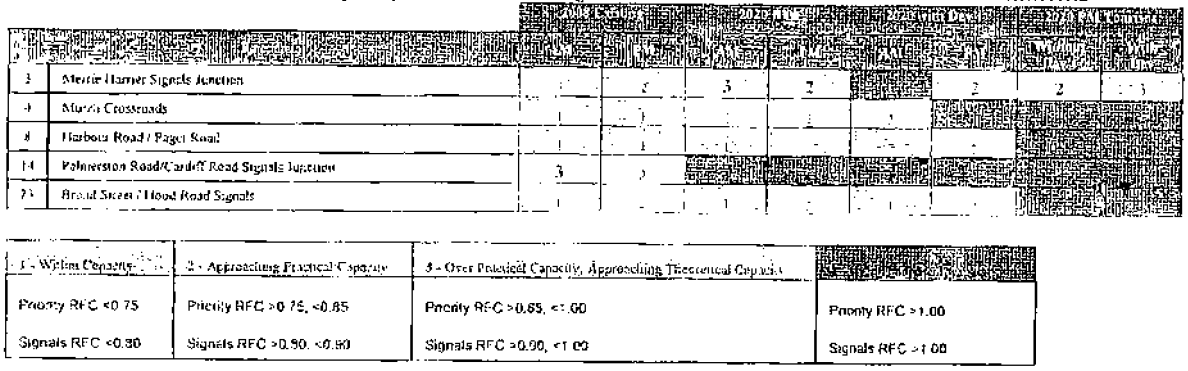


Table 3: Signalised junction capacity results following model alterations in relation to audit comments



1 - Within Capacity	2 - Approaching Practical Capacity	3 - Over Practical Capacity, Approaching Theoretical Capacity	
Priority RFC <0.75	Priority RFC >0.75, <0.85	Priority RFC >0.85, <1.00	Priority RFC >1.00
Signals RFC <0.80	Signals RFC >0.90, <0.90	Signals RFC >0.90, <1.00	Signals RFC >1.00

2.9 Chapter 8: Parking Assessment

Audit Ref 2.8.4: The lack of an agreed parking provision for cyclists is of concern. With the predicted vehicular congestion on the adjacent road network highlight, the sustainability of the site is key. With significant differences between the standards, an agreed provision should be part of the planning process.

Arup Response: The consortium are awaiting clarification of which standard is required from the Vale of Glamorgan Council. The Transport Assessment provides comparison of proposed parking levels to a range of standards, it is considered that the location and sustainable objectives of the site make the CSS standards appropriate. It is also considered that in line with Manual for Streets principles on-street spaces will form a key part of the parking strategy for Waterfront Barry.

Actions: Vale of Glamorgan Council to clarify parking standards (car and cycle) to be applied to the site and acceptability of currently proposed parking schedules, Tables 8.1. 8.2 and 8.3 of the Transport Assessment Rev A.

2.10 Chapter 9: Rail Assessment

Audit Ref 2.9.1: The previous audit noted that the proposed Defence Technical College and Aerospace Business Park at St Athan had not been taken into account. This is now mentioned in Section 9.1.5, but not analysed in detail.

Arup Response: Demand generated by the Defence Technical College and Aerospace Business Park at St Athan is remote from the Barry train stations which lie several kilometres to the south. It is considered that the express bus to Cardiff, due to be implemented by the Welsh Assembly Government will offer a preferable transport service to Cardiff. Local transport needs are likely to be shared between existing local bus services and the rail service. It is considered that more detailed analysis is not therefore required.

Audit Ref 2.9.2: Figure 9.3 highlights capacity on the 07:56 train from Barry. Maximum capacity ranges from 280-300 with occupancy recorded at 245 approx. Table 6.11 identified a predicted121 residents departing by public transport in the AM peak. Based on the public

transport times comparison in section 10.1.1, most commuters to Cardiff will use the train. Although here are alternative trains in the AM peak, the one service highlighted had spare capacity of only 35 to 56.

Arup Response: It is agreed that the most attractive form of public transport to Cardiff is likely to be by the train services with a service frequency of 15 minutes throughout the day. The agreed gravity model (Table 6.12) suggests that around 29% of trips are to Cardiff in the AM peak period, therefore if 100% of public transport users to Cardiff used rail this would result in 29% of 121 public transport trips which is 35 trips. This number of trips could be accommodated on the single peak train service. In reality use is likely to be more evenly spread over the alternative services distributed across the peak hour with some destinations better served by bus. Improvements in service are also likely should the level of demand increase to a commercially viable level.

2.11 Chapter 10: Bus Assessment

Audit Ref 2.10.3: Cardiff Bus has taken the view that adequate capacity and frequency would remain at these stops. At minimum, the services remaining will be one every 30 minutes.

Arup response: Many stops are served by more than one service and therefore many of the stops will retain a service frequency greater than 30 minutes.

Audit Ref 2.10.4: A patronage survey of route 95 has been undertaken to determine spare capacity. It indicates that there is adequate spare seated capacity to enable a diversion of the route through the development site. The 95 service operating every 20 minutes, with provision for 30 seating and 15 standing, is likely to be sufficient to accommodate the predicted peak of 97 departures in the AM. However, is this frequency sufficient to encourage the sustainability the site requires with the predicted congestion on the adjacent highway network?

Arup Response: The performance and patronage of the service will be monitored as part of the Travel Plan monitoring by both the consortium and the Vale of Glamorgan Council.

2.12 Chapter 11: Walking and Cycling Assessment

Audit Ref 2.11.3: Access to Barry Railway Station is key to the development, as the railway provides a quick, frequent and sustainable commuting route to Cardiff for the potential residents of the development. The failure to have a direct link from the proposed residential area to the railway station is a major concern especially as the sustainability of the site is crucial. Have all alternatives been assessed e.g. provision of a pedestrian crossing over the steam railway been reviewed with operation only in the non tourist season?

Arup Response: All options for improving this link have been considered by the consortium. The Vale of Glamorgan Council is not willing to fully support level crossing. Arup were commissioned to investigate options for crossing the steam railway lines and noted implementation of level crossings in similar situations elsewhere. During a site visit with the Vale of Glamorgan and Cambrian railways objections were raised to a level crossing. Cambrian transport stated they would object to such a proposal. It is considered that a crossing would be of significant benefit to a significant number of daily users but that a stepped alternative would be costly and lack the directness and benefits of a level crossing. If a level crossing cannot be achieved consideration will be given to altering the masterplan at the detailed design stage to improve the route to Barry railway station.

Audit Ref 2.11.4: The quality/extent of the proposed improvements is of concern e.g. cosmetic improvements to underpasses.

Arup Response: The proposals for five sustainable links are comprehensive and improve connectivity between the site and a variety of key destinations. The majority of the routes are pre-

existing and essential infrastructure is in place. Recent inspection of underpasses indicated that lighting and drainage were in good order. It is considered that cosmetic improvements are important for making routes attractive to a range of users for whom personal security is a major consideration. Improvements to surfacing will also be key for the elderly or mobility impaired.

2.13 Chapter 12: Other Travel Considerations

No audit comments raised requiring response. Chapter agreed.

2.14 Chapter 13: Outline Travel Plan

Audit Ref 2.13.1: The previous audit noted quantitative modal split targets had not been identified in the outline travel plan. Quantified modal split targets of 65% car, 35% walking, 8% bus and 3% cycle are now specified. These targets, however, sum to 111%

Arup Response: Typographical error. Correct split is 65/27/6/2 which is directly related to the resultant trip generation split presented in section 6.2.7 of the TA Rev A.

2.15 Chapter 14: Recommendations and Summary

No audit comments raised requiring response. Chapter agreed.

3. SUMMARY

The audit indicates that with the exception of minor typographical errors chapters 1-6, 12 and 13 of the Waterfront Barry Transport Assessment Revision A are now agreed. This technical note provides a response to points raised in relation to chapters 7-11 of the Transport Assessment.

It is notable that a large number of points have been raised in relation to the capacity modelling work undertaken but that revision of the models in line with a number of these points have led to only a very marginal change in results at two junctions where available capacity has improved.

The consortium requires clarification from the Vale of Glamorgan Council on the parking standards to be applied to the site and the acceptability of implementing of suggested signal phasing.

It is therefore considered that the overall findings and conclusions of the Waterfront Barry Transport Assessment Rev A remain valid.

Our ref 122374/RB
File ref 5.45

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Yvonne Prichard
Planning and Transportation
Vale of Glamorgan Council
Dock Offices
Barry Docks
Barry
CF63 4RT

19 May 2011

Dear Yvonne,

Barry Waterfront
Response to Vale of Glamorgan Council Highways Comments

We have reviewed the recent comments from the Vale of Glamorgan Council Highways department and consider it to be unfortunate that this response has taken so long to be forthcoming and that a number of the points put forward contradict statements previously made on the trip rates in the original Transport Assessment (dated August 2009) which considered a more sustainable mode share for travel to and from the site.

With regard to the points raised for refusal the following comments are raised:

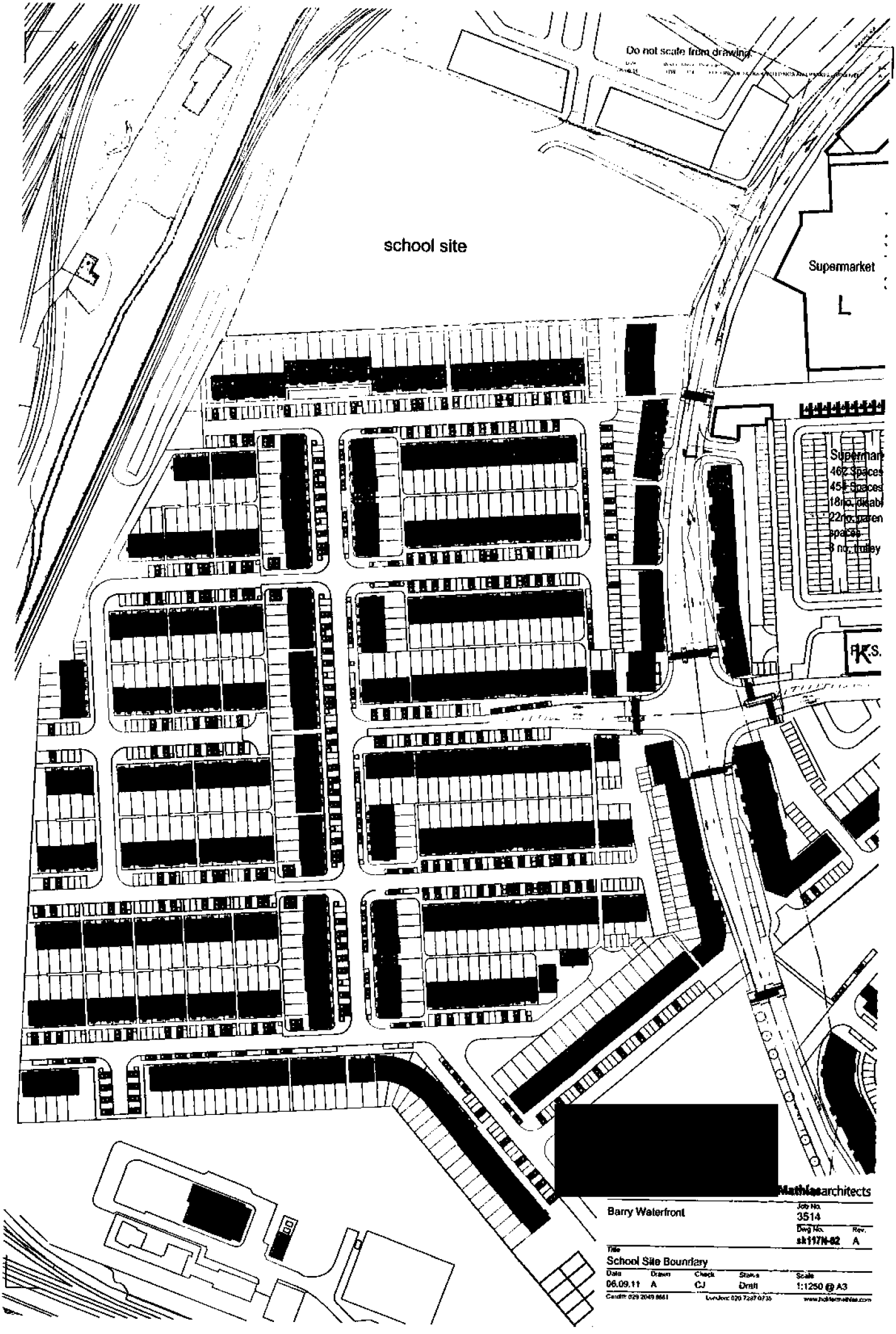
1. ***The proposed development will create traffic hazards and congestion to the detriment of highway safety***

Whilst it is accepted that if the Council take no action to mitigate current and background growth related traffic issues the development would add to congestion these current and background growth situations are not the responsibility of the consortium. The consortium has put forward a significant s106 offer for mitigation works related to development traffic. The council has put forward no evidence to substantiate any 'detriment to highway safety'. In the case of increased congestion it is likely traffic will move more slowly but any claim that this will lead to safety issues should be justified.

2. ***The Barry Waterfront Site is in a prime location close to good existing public transport facilities and public attractions. The development as proposed fails to demonstrate that it will deliver adequate sustainable travel opportunities and facilities for all modes of transport as outlined in the Approved Barry Waterfront Principles Document (July 2009)***

The Transport Assessment covers all modes of transport to the site in significant detail and proposes a commercially viable diversion to an existing frequent bus service. Connections and associated improvements to a number of key destinations (including all three nearby railway stations) are proposed. The prime location of the site, its mixed use nature, the connections to the transport facilities, committed improvements to the railway service and

ANNEXURE 10



Mathiasarchitects

Barry Waterfront

Job No. 3514

Dwg No. sk1117M-02 Rev. A

Title
School Site Boundary

Date	Drawn	Check	Status	Scale
06.09.11	A	CJ	Draft	1:1250 @ A3

Cardiff: 029 2049 8661 Llandudno: 020 7287 0735 www.hollemathias.com

ANNEXURE 11

TIMESCALE & ASSUMPTIONS

Timescale (Duration in months)

Project commences
Phase 1

Stage Name	Duration	Start Date	End Date	Anchored To	Aligned	Offset
Phase Start						
Phase End						
Phase Length						

Project Length

Assumptions

Expenditure

Professional Fees are based on Construction
Purchaser's Costs are based on Gross Capitalisation
Purchaser's Costs Deducted from Sale (Not added to Cost)
Sales Fees are based on Net Capitalisation
Sales Fees Added to Cost (Not deducted from Sale)

Receipts

Show tenant's true income stream
Offset income against development costs
Rent payment cycle
Apply rent payment cycle to all tenants
Renewal Void and Rent Free apply to first renewal only
Growth starts from lease start date
Deduct Ground Rent from Stepped Rent.

Initial Yield Valuation Method
Default Capitalisation Yield
Apply Default Capitalisation to All Tenants
Default stage for Sale Date
Align end of income stream to Sale Date
Apply align end of income stream to all tenants
When the Capital Value is modified in the cash flow
Valuation Tables are
Deduct Post-Sale TI Costs & Lease Comm. from Cap. Value
Rent Free method

Finance

Financing Method
Interest Compounding Period
Interest Charging Period
Nominal rates of interest used
Calculate interest on Payments/Receipts in final period
Include interest and Finance Fees in IRR Calculations
Automatic Inter-account transfers
Manual Finance Rate for Profit Erosion

Calculation

Site Payments
Other Payments
Negative Land
Receipts

Initial IRR Guess Rate
Minimum IRR
Maximum IRR

[redacted]

TIMESCALE & ASSUMPTIONS

Assumptions

Manual Discount Rate
IRR Tolerance

Letting and Rent Review Fees are calculated on
Development Yield and Rent Cover are calculated on
Include Tenants with no Capital Value
Include Turnover Rent
Net of Non-Recoverable costs
Net of Ground Rent deductions
Net of Rent Additions/Costs
Leasing Commissions are calculated

Value Added Tax

Global VAT Rate
Global Recovery Rate
Recovery Cycle every
1st Recovery Month
VAT Calculations in Cash Flow

Residual

Land Cost Mode

Distribution

Construction Payments are paid on
Sales Receipts are paid on
Sales Deposits are paid on

Interest Sets

Interest Set 1

Debit Rate	Credit Rate	Months	Start Date

Loan Set 1

Debit Rate	Credit Rate	Months	Start Date

Inflation and Growth

Growth Sets

Growth Set 1
Inflation/Growth for this set is calculated in arrears
This set is not stepped

Rate	Months	Start Date

TIMESCALE & ASSUMPTIONS

Assumptions

Inflation Sets

Inflation Set 1
Inflation/Growth for this set is calculated in arrears
This set is not stepped

Rate	Months	Start Date

APPRAISAL SUMMARY

Summary Appraisal for Phase 1

REVENUE

OUTLAY

TOTAL COSTS

PROFIT

Performance Measures

Profit on Cost%
Profit on GDV%
Profit on NDV%

IRR

Profit Erosion (finance rate)

RENT & SALES SCHEDULE

REVENUE & COST SUMMARY

Revenue and Cost Summary

Phase 1

Heading	%	Total £	At Date	To Date	Distribution

DETAILED CASH FLOW

Detailed Cash flow Phase 1

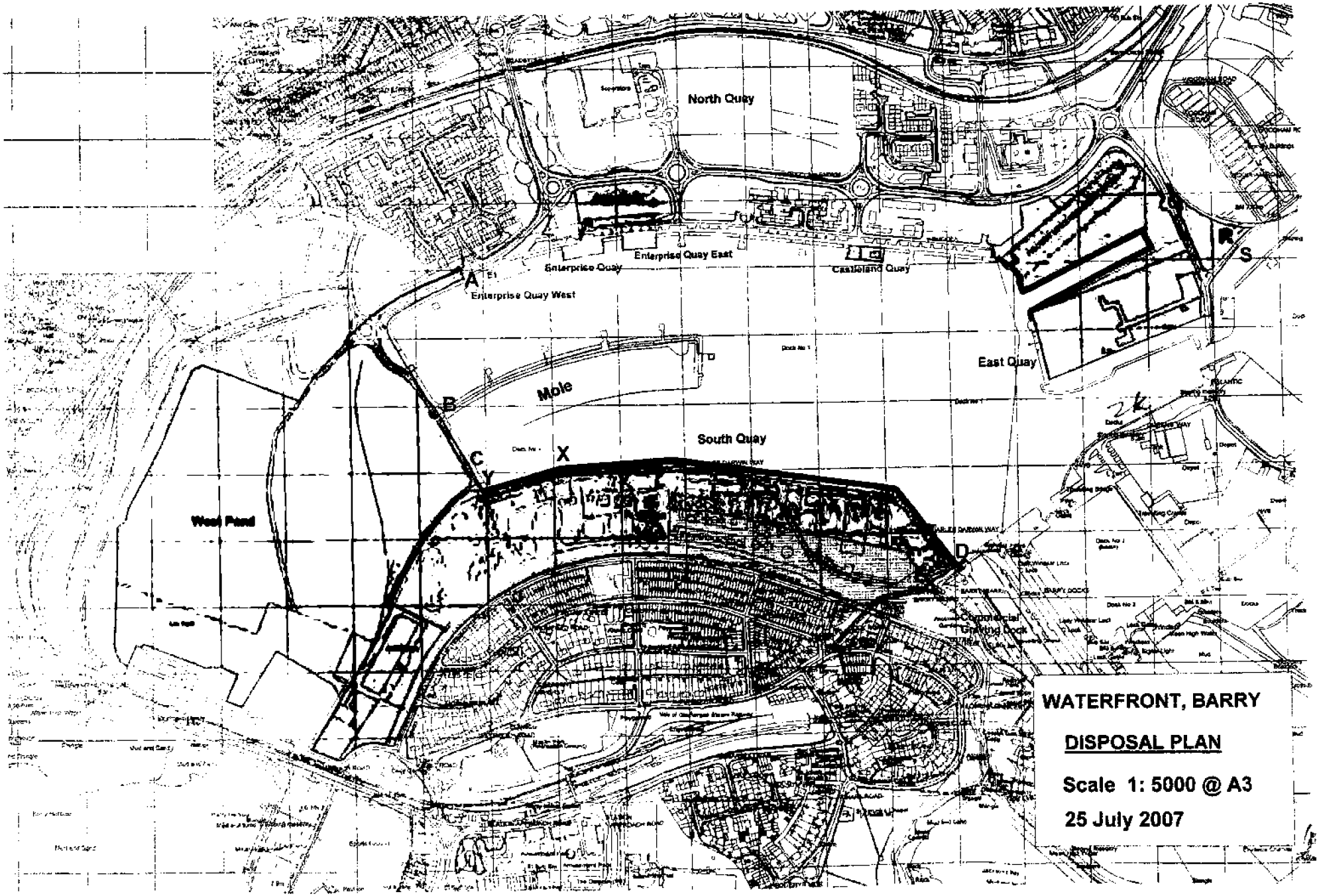
	001:	002:	003:	004:	005:	
MonthlyB/F	0	0	0	0	0	
Unit Information						
Period Total Before Finance	0	0	0	0	0	
Debit Rate	0.000	0.000	0.000	0.000	0.000	
Credit Rate	0.000	0.000	0.000	0.000	0.000	
Finance Costs (All Sets)	0	0	0	0	0	
Period Total After Finance	0	0	0	0	0	
Cumulative Total C/f Monthly	0	0	0	0	0	

DETAILED CASH FLOW

Detailed Cash flow Phase 1

006:	007:	008:	009:	010:	011	012:	
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

ANNEXURE 12


North Quay
Enterprise Quay East
Enterprise Quay
Castleland Quay
Enterprise Quay West
A
B
C
D
X
Y
R
S
East Quay
Mole
South Quay
West Pond
WATERFRONT, BARRY
DISPOSAL PLAN
Scale 1: 5000 @ A3
25 July 2007