Review of airport charges at Dublin Airport

Review of Capital Programme

Commission for Aviation Regulation

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1. Introduction

The Commission for Aviation Regulation (the Commission) asked IMR Solutions (IMR) and William Hynes and Associates (WHA) to carry out a high level assessment of the 10-year Capital Investment Programme (CIP) proposed by Dublin Airport Authority (DAA) and provided to the Commission in May 2005. DAA emphasised to the Commission that the CIP was not a final plan and, in the late stages of writing of this report in September 2005, DAA announced more developed plans which the Commission has not had the opportunity to examine in detail. In particular, although it has been provided with a recommendation report prepared by DAA's advisors, Pascall & Watson, the recommendation report does not include the level of detail of methodology and analysis necessary to support the size, location, specification and sequencing of major capacity-driven projects. It will be necessary to reappraise our findings in the light of detailed justification.

Notwithstanding this uncertainty in the capital expenditure planning process, the Commission has sought to draw conclusions from the detailed capacity assessment of Dublin Airport carried out by WHA, the integrated capacity and financial modelling of Dublin Airport developed by IMR and WHA together and the Review of DAA Capital Expenditure Programme undertaken by Rogerson Reddan & Associates Ltd, in conjunction with Vector Management Ltd. (RR&V) in September 2005.

This report provides an outline of the methodology and judgments that we have made in developing our assessment of the CIP to ensure that the Commission is in a position to make a final judgement for itself on the level of capital investment required during the operational period of the second determination of the maximum levels of airport charges that may be levied by DAA at Dublin Airport.

2. Overview

The CIP represents a proposal by DAA for a capital investment programme amounting to a total of €1,003 million between 2005 and 2014 (this amount excludes 'Head Office' capital expenditure). The CIP details provided to the Commission were split into some 118 projects, with descriptions and some supporting information for each project. Projects are grouped into eight classes, namely, Car Parking, Commercial Property, Key Infrastructure, Plant and Equipment, Retail, Stands and Airfield, Terminal Complexes, and All (i.e. General Provision - ART & Local & IT). Each project is assigned what DAA has termed as a "driver" for that project, with there being three types of driver: Safety/ Environmental / Compliance, Repair/ Refurbish/ Upgrade and Capacity. The Capacity driver allocation accounts for over 80% of the overall €1,003 million CIP.

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To enable detailed analyses of the CIP, and to allow for a more informed understanding of the proposed capacity deliverable, we have further allocated the capacity driven projects into our capacity modelling components: landside (L), Terminal (T) and Airside (A). The detailed components are as follows: L1 - Kerb, L2 - Car Parking, L3 - Coach Parking, L4 - Landside Enabling, T1 - Departures Concourse, T2 - Departures Check-In, T3 - Departures Check/Search, T4 - Departures Street, T5 - Departures Lounges/Gates, T6 - Departures CBP, T7 - Arrivals Through-Route, T8 - Arrivals Immigration, T9 - Arrivals Baggage Reclaim, T10 - Arrivals Customs, T11 - Arrivals Concourse, T12 - Terminal Enabling - Existing, T13 - T2 Core Build, T14 - T2 Other Enabling, T15 - Pier D, T16 - Pier E, T17 - Terminal Extension, T18 - T2 Expansion, A1 - Aircraft Parking Stands, A2 – Runways, A3 - Taxiways/Apron, A4 - Airside Enabling, A5 - T2 Airside Enabling. Also, Safety/Environmental / Compliance and Repair/Refurbish /Upgrade projects have been allocated as S1 - Safety and R1 - Repairs, respectively.

The following table summarises our overall allocation of the DAA 10-year CIP, totalling the overall proposed capital expenditure of €1,003 million (excluding head office).

DAA proposed programme *(projects categorised by WHA/IMR)*	*Total 2005-2014*	*2005*	*Total 2006-2009*
A1 - Aircraft Parking Stands	59,050,000	2,900,000	56,150,000
A2 - Runways	150,300,000	300,000	11,000,000
A4 - Airside enabling	185,000	0	185,000
Total airside	209,535,000	3,200,000	67,335,000
T13 - T2 core build	190,000,000	800,000	189,200,000
T14 - T2 other enabling	85,205,000	0	69,605,000
T15 - Pier D	88,758,271	6,725,419	82,032,852
T16 - Pier E	79,300,000	0	0
T17 - Terminal extension	31,500,000	500,000	31,000,000
T18 - T2 expansion	100,000,000	0	0
Major terminal and pier additions	574,763,271	8,025,419	371,837,852
L2 - Car Parking	12,120,000	0	3,120,000
L3 - Coach Parking	2,932,000	400,000	1,932,000
L4 - Landside Enabling	5,749,620	1,034,620	4,715,000
Total other landside	20,801,620	1,434,620	9,767,000
T4 - Departures Street	2,482,610	482,610	2,000,000
T5 - Departures Lounges/Gates	1,360,000	360,000	1,000,000
T9 - Arrivals Baggage Reclaim	2,100,000	0	2,100,000
T12 - Terminal Enabling - existing	6,880,000	4,580,000	2,300,000
Total other terminals & piers	12,822,610	5,422,610	7,400,000

DAA Proposed Programme (continued) *(projects categorised by WHA/IMR)*	*Total 2005-2014*	*2005*	*Total 2006-2009*
R1 - Repairs	64,563,765	14,338,025	35,575,740
S1 - Safety	24,404,810	5,044,810	12,710,000
O1 - Other	96,153,000	8,653,000	37,500,000
General	185,121,575	28,035,835	85,785,740
Overall total	1,003,044,076	46,118,484	542,125,592

We have been able to associate a little over 80% of the capital programme to capacity drivers, leaving a rump of costs relating to general categories such as repairs, safety and non-specific enabling works. This 80% is made up of 78% in major projects for terminals, piers, runways and aircraft parking stands and 2% in other specific capacity-related projects.

3. Methodology

We have sought to draw from the various sources of information that are available to us:

- WHA's capacity analysis and capacity models;
- DAA's capital programme and supporting information;
- RR&V's report;
- Integrated capacity and capital expenditure modelling developed by IMR and WHA;
- Drawings, surveys and other information originally acquired to support WHA's capacity analysis.

The following summarises the approach we adopted:

- Scrutinise the descriptions and supporting information for each project in DAA's programme to determine an initial allocation of projects to the main capacity drivers used - as set out in the table in section 2;
- Identify (or infer) the service capacity increments (e.g. passenger handling capacity) and physical dimensions (e.g. floor areas in m^2) associated with each project;
- Relate the intended service capacity increments and physical dimensions with reference to capacity assessment metrics, drawings, surveys and other information to identify any apparent anomalies;
- Develop a framework of standard unit costs for physical capacity informed by DAA's programme information and RR&V's report;
- Relate proposed capacity increments with projected capacity requirements;
- Thereby, identify appropriate adjustments to project timings, scale or unit costs.

DAA response to WHA's capacity assessment methodology

WHA's assessment of the current handling capacity of Dublin Airport involved extensive dialogue with DAA. DAA expressed concern over the capacity assessment methodologies in a detailed submission to the Commission and WHA has responded in detail to the criticisms and comments. We recognise that debate about different methodological approaches is never 'black and white' and that experts are liable to disagree on approaches and assumptions. We note, however, that WHA's capacity output assessments are comparable, and remarkably close in a number of cases, to those put forward by DAA. We have reviewed where the differences lie and taken a cautious approach to our capital expenditure needs assessment where the differences might be material. As well as considering DAA's views in detail, we felt it was also necessary to address them at an overall level based on the three main components of WHA's assessment of Dublin airport's capacity – airside, landside and terminals.

Although DAA disagrees with WHA on methodological points on airside capacity assessment, WHA reaches similar conclusions about when new investment is required and we do not make any adjustment to DAA's CIP. Similarly, regarding methodological issues raised by DAA on landside capacity assessments, we have made no adjustment to DAA's CIP in our capital expenditure assessment. We have made adjustments in our assessment of capital expenditure relating to terminal (& pier) capacity. Recognising that there are differences of opinion concerning methodology, we have made high-level allowances (for pier widths and for unavoidable terminal configuration inefficiency) that should accommodate the areas of concern. We conclude that, while there are differences of opinion on methodology, these are either immaterial, inconsequential (where we have made no adjustment to DAA's CIP) or reasonably accommodated in our assessment of capital expenditure needs.

Responses from other parties

The Commission has received submissions from other parties during the review, especially in response to the Commission's Draft Determination published in May 2005. We have reviewed these responses to identify matters that may be relevant to our assessment.

Many of the comments made by other parties in relation to capital expenditure were general in nature. Aer Lingus and Ryanair, two key respondents, emphasised that capital expenditure needs should be quantified and capital projects justified. We consider that our assessment is designed to address these concerns directly. We also consider that the methodology we have adopted may provide a useful framework to link capital expenditure with outputs and service levels in any future incentive proposals.

In relation to other comments, we should make it clear that our assessment does not address issues concerning methods of financing new investment, the profile of remunerating new investment over time, judgements about past inefficiencies, the cost of operating new facilities or the parties that should own or operate them.

4. Overall assessment

Overall assessment	DAA assessment		WHA/IMR assessment	
	2005-14	*2005-09*	*2005-14*	*2005-09*
	€m	*€m*	*€m*	*€m*
A1 - Aircraft Parking Stands	59.1	59.1	59.1	59.1
A2 - Runways	150.3	11.3	150.3	11.3
A4 - Airside enabling	0.2	0.2	0.2	0.2
Total Airside	209.5	70.5	209.5	70.5
T13 - T2 core build	190.0	190.0	117.2	117.2
T14 - T2 other enabling	85.2	69.6	83.6	68.0
T15 - Pier D				
Pier (excl. pre-2005)	64.0	64.0	49.0	49.0
Access links	24.7	24.7	24.7	24.7
T16 - Pier E	79.3	0.0	61.9	0.0
T17 - Terminal extension	31.5	31.5	26.5	26.5
T18 - T2 expansion	100.0	0.0	0.0	0.0
Major terminal and pier additions	574.8	379.9	363.0	285.5
L2 - Car Parking	12.1	3.1	12.1	3.1
L3 - Coach Parking	2.9	2.3	2.9	2.3
L4 - Landside Enabling	5.7	5.7	5.7	5.7
Total other landside	20.8	11.2	20.8	11.2
T4 - Departures Street	2.5	2.5	2.5	2.5
T5 - Departures Lounges/Gates	1.0	1.0	1.0	1.0
T9 - Arrivals Baggage Reclaim	2.1	2.1	2.1	2.1
T12 - Terminal Enabling - existing	7.2	7.2	7.2	7.2
Total other terminals & piers	12.8	12.8	12.8	12.8
R1 - Repairs	64.6	49.9	64.6	49.9
S1 - Safety	24.4	17.8	24.4	17.8
O1 - Other	96.2	46.2	96.2	46.2
General	185.1	113.8	185.1	113.8
Overall total	1,003.0	588.2	791.3	493.9
			79%	84%

The above analysis summarises our assessment of DAA's capital expenditure requirements based on the methodology set out in section 3.

We emphasise that it is a top-down assessment that relates the need for capital expenditure in key components of the airport's capacity to the assessment of existing physical capacity and the modelling of demand on physical capacity from passengers, aircraft movements and other airport activities. We were asked to carry out this exercise when it became apparent to the Commission that DAA's capital expenditure planning process would not be complete in good time for the statutory date for the Commission's review of airport charges. A top-down exercise, such as this, is best used in combination with bottom-up assessment techniques. Although the Commission has not been provided with a firm plan to examine, we consider the top down assessment offers a reasonable basis for a provisional assessment of capital expenditure need in the form that the Commission proposes. It should also be a useful tool to help identify the principal issues for the Commission to explore with DAA before reaching any supplementary conclusions on the capital programme after this review.

While acknowledging its limitations, the assessment highlights some key features of the capital expenditure requirement for Dublin Airport.

The largest issue by value is the proposed scale of T2. DAA have identified a terminal area of 47,000m2 for a facility designed to handle 10 million passengers annually. The proposed terminal looks too large for 10 million passengers per annum. However, our assessment does not directly identify the optimal capacity of a new terminal. It is possible that a larger capacity would be optimal, thus helping to justify the proposed scale of investment, but there would be related judgements about the maximum capacity and location of pier infrastructure that could support it.

The second issue relates to the timing of new pier investments. Our assessment broadly concurs with the proposed timing of pier investments in the May 2005 CIP, but we note that DAA's recent announcement suggests a rather accelerated programme of investment, accelerating the completion of Pier E by about four years. Our analysis does not support such an acceleration.

A third issue relates to the dimensions of the proposed piers which, at about 28m wide, appear to be wider than at some comparable airports.

The fourth issue relates to the quality of information available to us. Our top-down analysis is not sufficient by itself to provide a safe basis for a firm capital expenditure needs assessment covering a control period of four or five years. It may provide the basis for a provisional assessment provided there is an expectation it will be supplemented with a more considered bottom-up assessment after this review.

The final issue relates to the location and sequencing of projects. Our top-down assessment primarily concerns the need for and provision of capacity at an overall level, which includes the timing of investments. The location of investments, and their sequencing, requires a separate assessment.

We have directly assessed only about 68% of the capital programme, which represents about 85% of the capacity-driven programme. Our assessment includes adjustments for the major projects, which we have been able to assess, but our assessment of other projects has been limited due to their general nature, e.g. 'enabling works'. We do not believe it is appropriate to extrapolate our findings on the major projects to the remaining part of the programme – while further assessment might reduce some of the stated costs, our assessment of the investment need for car parking suggests that other costs might also be increased.

The following sections summarise our assessment for each of the main components.

5. Piers D and E

Pier project assessments	*DAA proposals*		*IMR/WHA assessment*	
	Building size		*Building size*	
	m²	*Cost*	*m²*	*Cost*
Pier D forecast		€88.8m		
less: access projects		-€24.7m		
plus incurred before 2005		€8.1m		
Pier D (including apron realignment)	14,800	€72.1m	12,513	€55.2m
Deduct spend pre-2005		-€8.1m		-€6.2m
Pier D post 2004		€64.0m		€49.0m
Pier E		€79.3m	13,585	€61.9m

DAA has specified Pier D as a two-storey pier supporting 12 narrow body aircraft contact stands with a total building area of 14,800 m^2. RR&V conclude that DAA's costings on a cost of €4,873 per m^2 including soft costs, were about 10% too high relevant to benchmarked costs of €4,412. Although a detailed cost plan has been provided, it included insufficient detail to justify the cost difference. In the absence of this detail, we consider the benchmark cost to be a more appropriate estimate. Pier E is specified at 15,951 m^2 and, from the drawings, it appears to support 13 narrow body contact stands. RR&V has assessed its costs per m^2 of building to be also about 10% lower than DAA's estimate of €4,971, with a cost of €4,559/m^2 being more reasonable.

In order to assess the requirement for piers, as opposed to the unit cost of building them, we carried out the following steps:

- Estimate the busy hour flow rates, primarily for departing passengers, that would be associated with the contact stands the piers support;
- Identify the space required for those departing passengers;
- Make an indicative allowance for non-passenger space in the departures floor and extrapolate to allow for the requirement of a two-floor segregated facility for both piers;

- Multiply the resulting building area by a suitable unit cost;
- Derive a standard unit cost per unit of passenger area to use in the capacity and capital expenditure model;
- Relate the capacity increments to capacity requirements.

Determination of Busy Hour Flow Rates

We took 'readings' from three perspectives. The first is a bottom-up assessment of the maximum passenger flows from narrow body stands. This would be expected to overstate the BHFRs as a pier would not be expected to handle maximum flight sizes for all contact stands simultaneously.

Theoretical Max. Capacity for Narrow-Body Aircraft Parking Stands		
Maximum flight size (based on aircraft type B737/800)	189	
Assumed average passenger load factor	0.9	
Implied maximum BHFR/stand	170.1	
For 12 stands, Pier D		2,041
For 13 stands, Pier E		2,211

The second perspective is a whole airport perspective, comparing the BHFRs in the airport as a whole in 2004 with the total aircraft stand requirement and extrapolating the ratio to the new piers. This would be expected to understate the BHFRs since not all stands at the airport are used actively as contact stands.

Whole Airport Assessment for Aircraft Parking Stands		
Aggregate Busy Hour Flows of Piers A, B & C	3,234	
Assessed stand requirement for 2004	68	
Implied BHFR/stand	47.6	
For 12 stands, Pier D		571
For 13 stands, Pier E		618

The third perspective is a Pier A perspective, relating the assessed BHFR capacity for Pier A with its contact stands and extrapolating to Pier D and E.

Pier A Assessment		
Assessed BHFR capacity	1,465	
Number of aircraft contact stands	14	
Implied BHFR/stand	104.6	
For 12 stands, Pier D		1,256
For 13 stands, Pier E		1,360

We considered that the Pier A perspective may provide a reasonable proxy for the relationship between narrow body contact stands and BHFRs for Pier D and

E, perhaps representing lower bounds of 1,250 and 1,350 for departures BHFRs, with the 'maximum theoretical' capacities of 2,050 and 2,200 being upper bounds. We consider a benchmark BHFR for a 12 contact stand pier (Pier D) to be 1,750 passengers per hour and for a 13 contact stand pier (Pier E) to be 1,900 passengers per hour.

Space Required by Departing Passengers

The space required by each departing passengers is a factor directly modelled in WHA's capacity assessment and it is therefore consistent to refer to the assessments for the existing piers. These lead to an estimate of 2.75 m^2 per busy hour passenger, as follows:

Assessed Space for Departing Passengers	*m2 required*	*BHFR*	*m2/BHpax*
Pier A in 2004	3,532	1,243	2.84
Total airport piers in 2004	8,777	3,234	2.71
Say, typically			2.75

Allowance for Non-Passenger Space and Arriving Passengers

Since arriving passengers do not dwell in the piers (they tend to travel through them), the pier space required is less than that for departing passengers. However, the intention to provide segregated arriving and departing areas is a factor that helps to define the building space required. Other factors include the need for storage and other non-passenger areas within the departures areas.

We have estimated the building space required on the assumption that arrivals and departures would be segregated by floor, and that excess space in the arrivals floor would be used as non-passenger areas. We have not taken any account of the possibility of using these areas for further pre-boarding lounges for departing passengers. We have made an estimate of the proportion of a departures floor that is not available to passengers. From the drawing of Pier D, around 10% of the departures floor is dedicated to toilet blocks, which are disregarded from the capacity calculations. Taking this together with an allowance for other storage areas (e.g. for commercial activities on the floor), we consider that a total allowance of 30% (i.e. 1.3m^2 for every 1m^2 of space available to passengers) would be appropriate for non-passenger related activities/areas. This results in a space requirement of 3.58 m^2 on the departures floor, making a total of 7.15 m^2 per departing BHFR for both floors (i.e. departures plus arrivals), as follows:

Building Area Requirements per Departing Passenger		*m^2/paxhr*
Estimated area per BH departing passenger		2.75
Allowance for non-pax areas on departures floor	30%	
Estimated departures floor area for BH passenger		3.58
Doubled, for two floor segregated pier		7.15

Pier width and total building areas

We have considered the building area required to handle arrivals and departing passengers in the light of these measures above. On the basis that the total length of the pier is driven by the number of contact stands it is required to handle, the variable dimension in the building is the width. We note that the proposed width of Pier D is approximately 28m. RR&V have indicated that widths of between 22m and 24m may be more usual, being broadly equivalent to the dimensions of piers at Stansted Airport. Since we have identified a range of BHFR capacities for the piers, we have been able to identify capacities that are consistent with these benchmark widths.

Width of Pier D	*Departures BHFR*	*Area m^2*	*Width m*
DAA proposed		14,800	28.0
Low case assessment (approx. Pier A)	1,250	8,938	16.9
Benchmark assessment	1,750	12,513	23.7

Unit Cost Assessment

The RR&V report provides a reference point for unit costs, including soft costs, for pier buildings. Taking these unit costs and applying them to the benchmark assessment calculated as described above gives us figures for total benchmark costs:

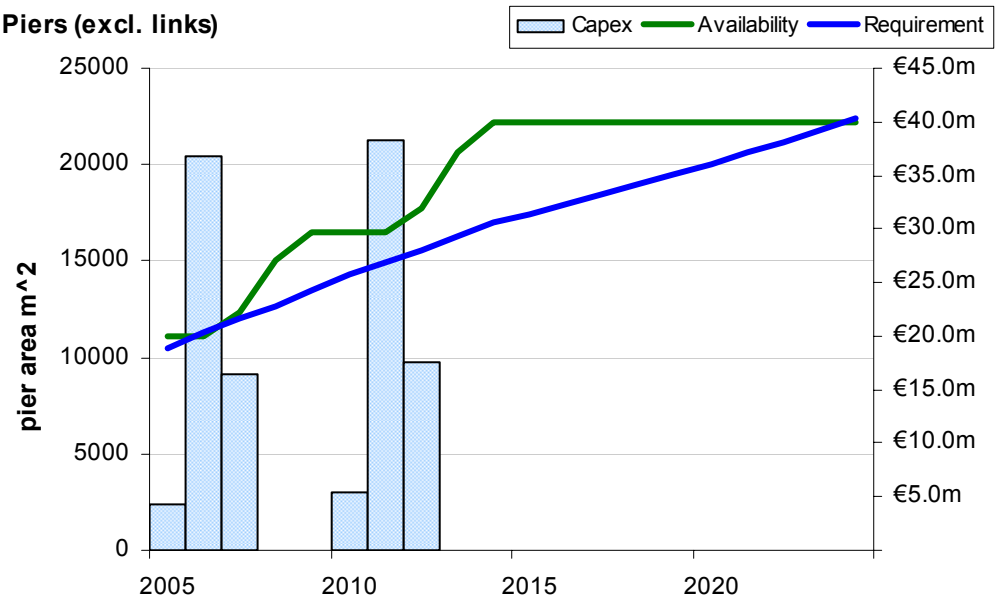
Benchmark cost calculation	*Assessed €/m^2*	*Departures BHFR*	*Area @ 7.15*	*Total cost*
Pier D	4,412	1,750	12,513	€55.2m
Pier E	4,559	1,900	13,585	€61.9m

We accept that a reduction in the width of the pier would not necessarily imply a proportional reduction in the cost of building, although we understand that RR&V's unit cost assessment is not highly sensitive to the width assumption. We recognise that the apron reconfiguration costs may also not reduce proportionately, but the effect should be relatively small and within the margins of error in other components of our assessment.

Relation to Capacity Requirements

The following graphs from the capacity and capital expenditure modelling relates the proposed capacity increments to capacity requirements, projected over the period covered and for a further 10 years. The space requirement calculations going forward include an assumption of improving standards reflected in a 1% per annum increase in the space requirement per passenger. Other possible factors such as more efficient handling of passengers within pier areas (permitting lower dwell times) have not been assumed.

The following graph shows the implied pattern of increasing pier capacity need, driven by growth in passenger flows within the airport as a whole, and the increase in pier provision caused by the CIP proposals for piers D and E:



The graph illustrates that the proposed timing of the piers (with Pier E being fully operational in 2013) appears reasonable. This suggests that DAA's scheduling of these investments in the CIP is broadly consistent with our assessment of BHFR capacities.

DAA has incurred a total of some €8.1 million prior to 2005 on Pier D, we believe primarily in relation to fees. This portion of the costs can therefore be excluded from our overall assessment.

6. Pier D Access

In assessing this project we have been unable to analyse in detail its complete specified requirement due to lack of detailed information provided by the DAA. In light of the recent proposal to locate T2 based on the southern option, i.e. adjacent to Pier C, it is our opinion that that passenger access/egress will be

required from the existing terminal to the proposed Pier D which will require a level of capital expenditure. Therefore, we have not made an adjustment to the project costs proposed by DAA. However, if T2 is going to be built to the south of T1, it might seem more efficient to construct Pier E before Pier D to ensure that terminal infrastructure is provided in a well planned and cost efficient manner.

7. Terminal 2

Assessment	*DAA proposals*		*IMR/WHA assessment*	
	Building size		*Building size*	
	m^2	*Cost*	*m^2*	*Cost*
Terminal 2	47,000	€190.0m	29,000	€117.2m

DAA, in its May 2005 CIP, specified a terminal building of some 47,000m^2 capable of handling 10 million passengers per annum (the Pascall & Watson recommendation report appears to confirm this handling capacity). The total cost of the terminal building, including planning and design fees (i.e. soft costs), is some €190 million. There are additional projects in the programme associated with the terminal directly or associated with increasing capacity of the terminals area to 30 million passengers that aggregate to €85 million. We have designated these programmes as 'T2 other enabling'.

RR&V's review broadly accepted DAA's costings on a cost per m^2 basis.

In order to assess the requirement for T2, as opposed to the unit cost of building it, we carried out the following steps:

- Estimate the busy hour flow rates that would be associated with a capacity of 10 million passengers per annum;
- Identify the assessed space requirement for those BHFRs;
- Make an indicative allowance for non-passenger space in the terminal as a whole;
- Multiply the resulting building area by a suitable unit cost;
- Relate the capacity increments to capacity requirements.

Determination of Busy Hour Flow Rates

As T2 reaches annual capacity, it would seem reasonable to assume that the relationship between annual flows and busy hour flows will start to resemble that exhibited at T1.

Our assessment is that a 10 million passenger terminal should be able to handle BHFRs of 1,600 departing passengers and 1,500 arriving passengers.

Space Required for Passengers

We have modelled the spatial requirements at a terminal for BHFRs of 1,600 departing and 1,500 arriving passengers, a calculation that resulted in a figure of 9,017m^2.

The following table shows how this figure relates to the assessed capacity requirements for passenger flows through the existing terminal:

Terminal 2 Building Space	*T1 2004 assessed requirement m^2*	*T1 2004 BHFR*	*T2 capacity BHFR*	*Extrapolated m^2*
Departures concourse	4,940	2,717	1,600	2,909
Check-in	2,399	2,717	1,600	1,413
Security	545	2,717	1,600	321
Street	2,115	2,717	1,600	1,245
Arrivals baggage reclaim	3,002	2,517	1,500	1,789
Customs	300	2,517	1,500	179
Arrivals concourse	1,282	2,517	1,500	764
Overall extrapolated total	14,583			8,620
Assessed in detailed model				9,017

Allowance for Non-Passenger Space

It is necessary to make allowance for non-passenger space to determine the overall spatial requirement for the terminal building. In order to estimate this allowance, we carried out a high-level review of the existing terminal space with reference to terminal drawings. This is set out in the following:

Terminal 1 Building Space	*Building dimensions m^2*
Basement	10,100
Lower level (arrivals)	20,100
Upper level (departures)	17,200
Mezzanine	9,500
Total terminal building (excl. general office floors)	56,900

This analysis excludes the top two floors of the terminal (covering a portion of the terminal footprint) which have been converted from car park space to provide office space and other facilities. We considered it appropriate to exclude these floors from our assessment but to make a separate allowance for

some T2 space for any types of terminal-specific activities that take place on these floors in T1. We have also excluded from our assessment unused terminal areas (i.e. void areas in the basement) and areas linked to the terminal which are more properly considered with the assessment for piers and access links.

The next table summarises the total of the areas within the existing terminal that are available to passengers. These areas were measured from drawings as part of the original capacity assessment. It shows an estimated ratio of non-passenger space to passenger space is 1.79.

We recognise that it is not realistic to expect a terminal to be configured perfectly optimally. Although detailed analysis of the existing terminal shows that there are significant capacity constraints in the short term, our analysis of overall terminal space versus aggregate spatial requirements shows there to be a difference – apparent headroom (see the graph at the end of this section). Part of this apparent headroom will be a function of design inefficiencies specific to T1, a function of its history and the development culture of the company. However, part will be a natural consequence of the evolution of an airport's service profile – it may be possible to specify a terminal's configuration perfectly for a snapshot in time, but the optimality of that configuration will degrade as the service requirements of its users change. As important components of the configuration of a terminal needs to be built into a design many years ahead of capacity limits being reached, this is a significant factor.

The ratio of aggregate assessed requirement to aggregate available space that we project for the airport's terminals never falls below 1.2 (it is at its minimum before the completion of T2). We would hope that T2 would be designed for flexibility and efficient use, so we would not necessarily expect T2 to show such a large ratio when it reaches capacity, but we would expect to see some difference: an 'unavoidable terminal configuration inefficiency'. Taking the whole of this difference into account would increase our 'overhead space' ratio to about 2.15 (1.79 x 1.2). We would expect that some of such surplus space at any time would be productively redeployed in a way that could handle any 'top floor' activities (the kinds of activities carried out in the top two floors of Terminal 1 excluded from our calculations) specific to the terminal. We thus consider that an overall 'overhead space' ratio of 2.15 is supportable and an appropriate basis for our assessment.

Total Terminal 1 Space Available to Passengers	m^2
Departures concourse	5,911
Check-in	3,880
Security	576
Street	2,937
Baggage	3,491
Customs	213
Arrivals concourse	3,417
Total areas available to passengers	20,425
Overhead space for each m^2 of passenger space	1.79
Including further allowance to include related office space, say	2.15

Combining these assessments gives us a figure for the total spatial requirement for the terminal as a whole:

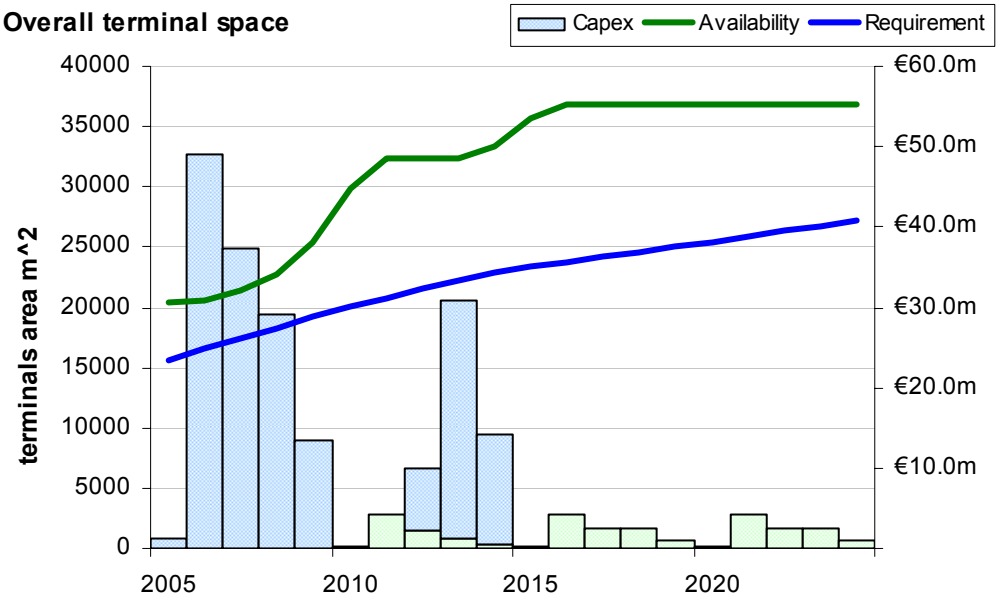
	m^2
Assessed in detailed model	9,017
Overhead space @ 2.15	19,387
Total building space required	28,404
Say,	29,000

Total Cost Assessment

Multiplying an assessed terminal area of 29,000m^2 by the unit cost of £4,043 per m^2 assessed by RR&V gives a total cost of £117.2 million. As with piers, we recognise that a reduction in the size of the building would not necessarily imply a proportional reduction in its cost but believe that a proportional calculation gives a reasonable first order estimate of the effect.

Relation to capacity requirements

The following graph relates the proposed capacity increments to projected capacity requirements. The space requirement calculations going forward include no assumptions about more efficient use of space except for an assumption of some increase in the use of self-service kiosks.



It highlights the following key features:

- Total terminal space available to passengers, at about 20,400m^2 represents significant apparent headroom over the aggregate assessed requirement for passenger space of some 14,600m^2 – this apparent headroom is projected to be inadequate at around the time that T2 is intended to be completed;
- Meanwhile, DAA proposes to complete a significant de-bottlenecking extension by 2008 to the north of the existing terminal of more than 5,000m^2, of which we assess some 2,200m^2 should be available for passengers (see further discussion on this project below) – on the face of it, this would appear to defer the need for further terminal capacity to about 2015;
- However, viewing headroom in aggregate overlooks the fact that there is very little assessed headroom in some of the components of terminal capacity – it is clear that some terminal areas will become critically overcrowded in the short term;
- The need for an additional extension to T2, projected to be completed by 2015, is not apparent from the graph.

8. De-bottlenecking Extension North

Assessment	DAA proposals		IMR/WHA assessment	
	Building size m^2	Cost	Building size m^2	Cost
De-bottlenecking extension	5,114	€31.5m	5,114	€26.5m

DAA has specified an extension to the existing terminal to the North of a little over 5,000m2. The total cost of the extension in the plan is some €26.5 million (€31.5 million in the plan, but adjusted by RR&V). The rate of €5,114 per m^2, including soft costs, put forward by DAA is acceptable to RR&V and, therefore, we have used this rate in our assessment.

In order to assess the impact of the extension on terminal capacity, we have reviewed the stated dimensions of the extension, reviewed the costs and estimated a proportion of the space available to passengers that we can rationalise with reference to the ratio of passenger to non-passenger space in the rest of the terminal, the (rather small scale) drawings available to us and the unit costs per m2 of available space we have inferred for the T2 project.

The following table identifies the high-level dimensions of the proposed extension.

Dimensions of the De-bottlenecking Extension					m^2
Total costed space per RR&V					5,114
Departures floor dimensions	12m	x 3 bays	x 85m	=	3,060
Implied number of floors					1.67

Although the supporting explanation for the project refers to the "optional provision of an additional net 1,140m^2 of commercial floor space on the mezzanine level", it would appear that there is not enough room within the costed space of 5,114m^2 for such space to be included. The following table shows that a departures floor area of 3,060m^2 identified in the previous table is substantially accounted for and the remaining space of 0.67 of a floor appears to be consistent with the drawings of the baggage hall level which show a floor space smaller than the floor above it.

The table calculates passenger areas for the departures floor. The proportion we have used is a proportion that provides some comparability in both the overhead space ratio and the unit cost of available space. We accept that we have a poor quality of information on which to base this judgement, but

consider that the result provides a reasonable first-order indication of the impact of the extension on terminal capacity.

The table below also includes a notional area that we have attributed to passengers, representing an increase that is pro-rata to the addition of a single incoming baggage conveyor.

Estimated Space for Passengers	*m²*	*% for pax*	*m²*
Retail space per CIP 7.2	1,485	65%	965
Operational space per CIP 7.2	1,476	65%	959
Total departures floor	2,961		1,925
Single carousel, notional space			275
Total			2,200
Implied overhead space			1.32

The next table identifies the unit costs on a whole building basis and on an available space basis:

Unit costs	*Cost*	*m²*	*€/m²*
RR&V assessment	26,500,000	5,114	5,182
Cost per available space	26,500,000	2,200	12,047

9. T2 Enabling Works

In addition to the core build project for T2, we have identified 10 projects which relate directly to T2 or to the increase in terminal area capacity brought about by T2. We characterise these projects as 'T2 enabling works'. The aggregate projected cost amounts to some €85 million, another 50% on the cost of building T2 itself and significantly more than 50% of the cost of T2 assessed by us.

The nature of these projects is such that we cannot directly link the projects to components of airport service capacity. The project specifications are substantially site-specific.

However, RR&V have reviewed the majority of the costs and reached an assessment of the costings, based mainly on unit rates (e.g. the costs per lane length of roads).

The result of the RR&V assessment can be summarised in the following table, which shows the composition of 'T2 enabling works', RR&V's assessments and RR&V's indications of the level of information available to support their assessment (none to provisional to functional to outline to plan).

The table shows an adjustment to one project only. We have calculated an overall assessment taking this adjustment into account without any extrapolation across projects not assessed by RR&V.

T2 Enabling Works		*Total project*	*2005-09 costs*	*Amount assessed*	*RR&V assessment*	*Design detail*	*Cost detail*
		€	€	€	€		
CIP 1.7	Passenger Links (Atrium, T2)	2,470,000	670,000				
CIP 1.10	Staff Carpark Relocations	1,210,000	1,210,000				
CIP 3.1	T2 Masterplan Enabling Works	26,000,000	26,000,000	26,000,000	26,000,000	Functional	Functional
CIP 3.2	T2 Site Preparation (Environmental D	1,250,000	1,250,000				
CIP 3.9	Internal Campus Roads	15,000,000	5,000,000	15,000,000	15,000,000	Outline	Outline
CIP 3.11	New Build Kerbs & Access Ramps	5,775,000	5,775,000	5,775,000	5,775,000	Outline	Outline
CIP 3.16	Reservoir Expansion	6,000,000	6,000,000	6,000,000	4,400,000	Functional	Functional
CIP 3.19	Sew erage Upgrade	4,000,000	4,000,000				
CIP 3.27	Utilities Provision and Diversion	7,500,000	4,700,000	7,500,000	7,500,000	None	Provisional
CIP 6.34	T2 North Apron Works (5)	16,000,000	15,000,000	16,000,000	16,000,000	Outline	Outline
	Total	85,205,000	69,605,000	76,275,000	74,675,000		
				89.5%	*97.9%*		
	Overall assessment	83,605,000	68,005,000				

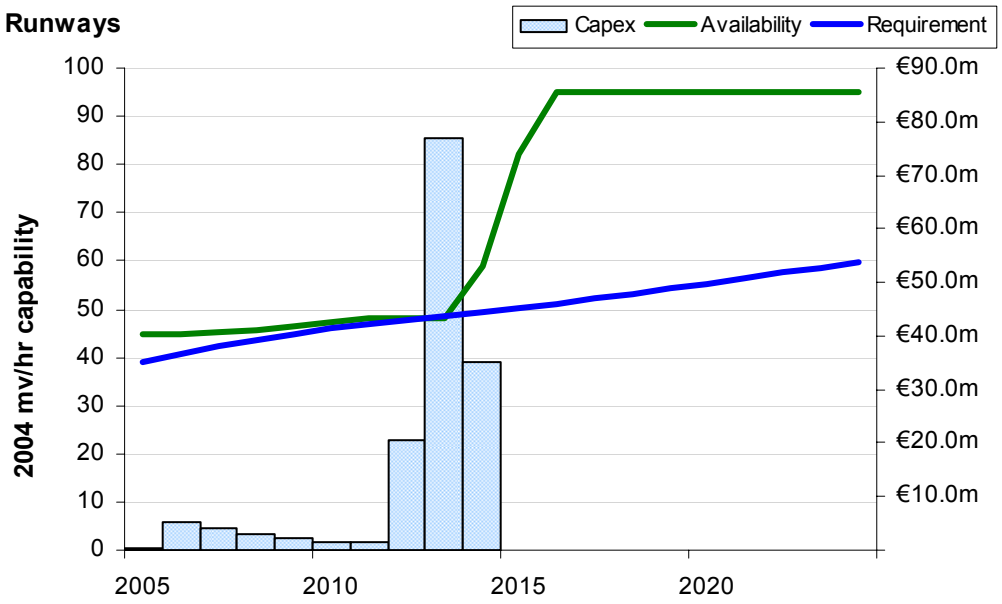
The scope of RR&V's assessment is limited to the question of costings. RR&V have not undertaken a systematic review of the specification of these projects with respect to need. We accept therefore that these project costings may represent a significant overstatement or understatement of need. We consider it is unsafe to extrapolate the scale of under or overstatement from our assessment of other projects – we have found indications of overstatement in some high profile projects, but we have also found indications of understatement in less high profile areas of capacity, car parks in particular, which would be consistent with the plan not being a fully comprehensive list of necessary enabling works.

10. Runways and Aircraft Parking

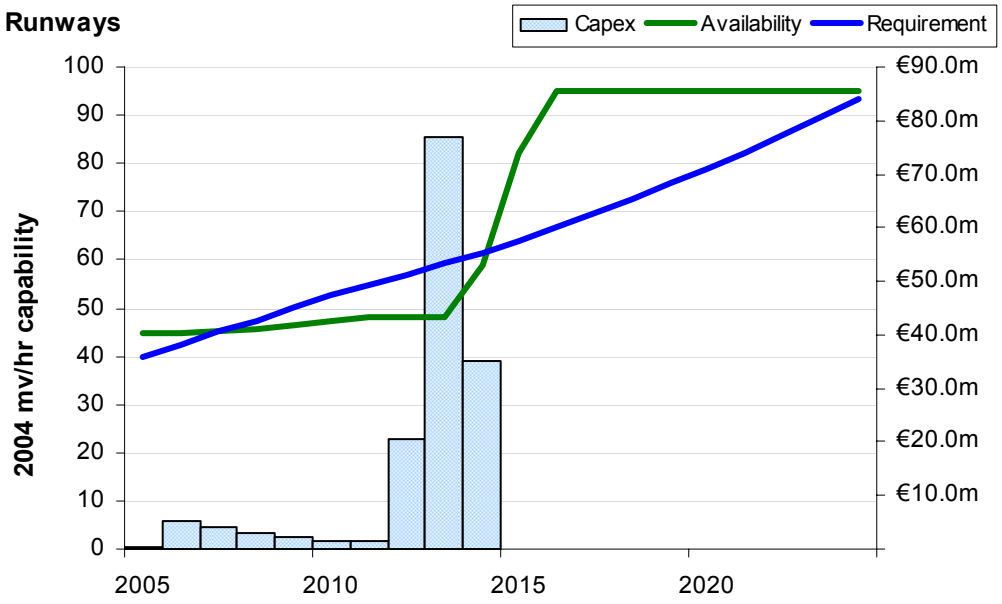
DAA proposes a runway project of some €132 million for completion in 2014 and a further €18.3 million on runway enhancements such as rapid exit taxiways. RR&V do not dispute DAA's costings.

DAA assesses that, with the proposed enhancements, the existing runway should be able to handle approximately 49 movements per hour by the time the second runway is completed. The following graph shows our projection, based

on an illustrative assumption concerning the new runway's capacity, which supports DAA's contention that a new runway will be needed by around 2014:

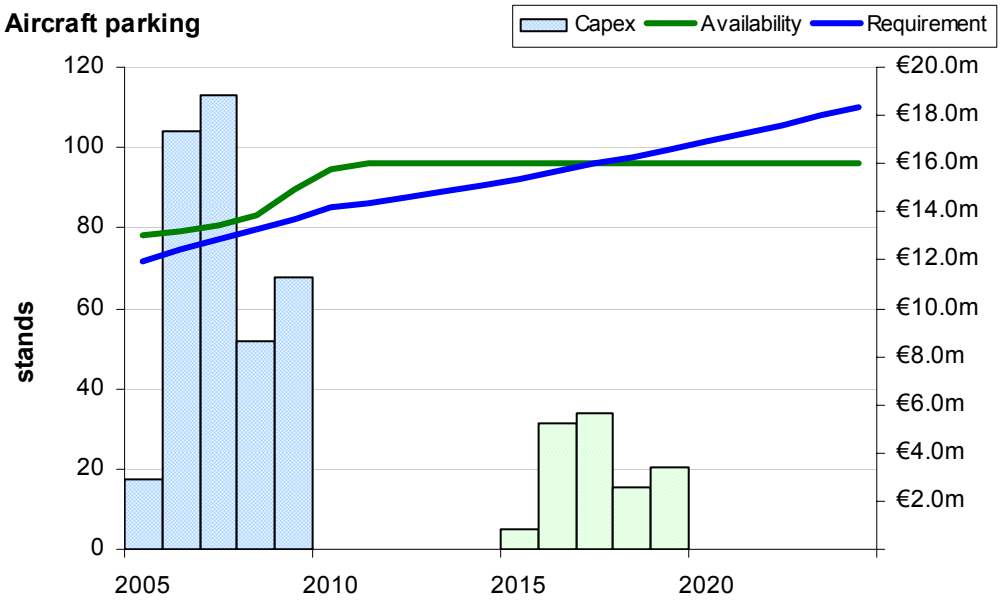


However, it is revealing to see what lies behind this analysis. A critical assumption is the relationship between passenger numbers and aircraft movements. Implicit in DAA's aircraft movements projections is an underlying increase in the number of passengers per movement of some 2.25% per annum. This may not seem a large number by itself, but the following graph shows what the impact would be if the relationship remained stable:



This example helps to highlight how sensitive capacity projections can be to relatively low level changes in utilisation, whether due to technology, more efficient management, intelligent facility design, changing usage patterns or any other factor. Changes in utilisation could potentially affect all components of capacity, and this insight may have an important bearing on the focus of an incentive regime intended to encourage efficient development of the airport – it is not necessarily just about efficient expenditure.

Regarding aircraft parking stands, DAA propose investments amounting to some €59 million creating around 19 new stands, mainly the Phase 6 projects west of Runway 16/34. Again, RR&V do not dispute the costings. The following graph shows that WHA's capacity analysis broadly supports the need.



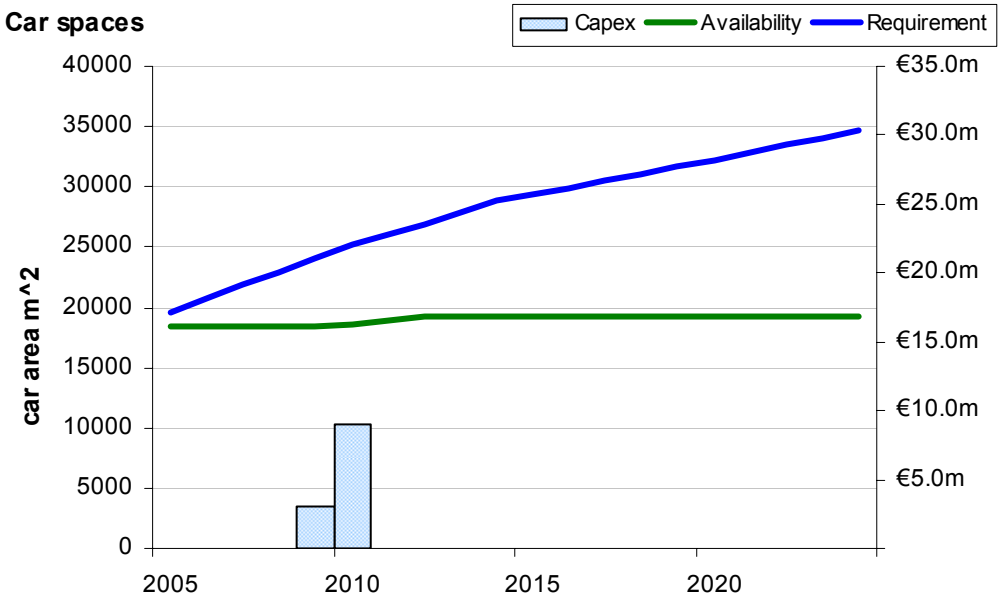
The graph, which projects a continuing passenger growth rate of 4.0% per annum after 2014 and continuing pattern of increasing aircraft sizes, suggests that further stands may not need to be added until after DAA's planning horizon. Importantly, this perspective overlooks the fact that increasing passengers per aircraft may also be reflected in increasing aircraft sizes which will have an impact on the effective capacity of the stand areas (and on the optimal specification of the runway).

11. Car parks

Apart from the major projects, we have considered the investment need for car parking.

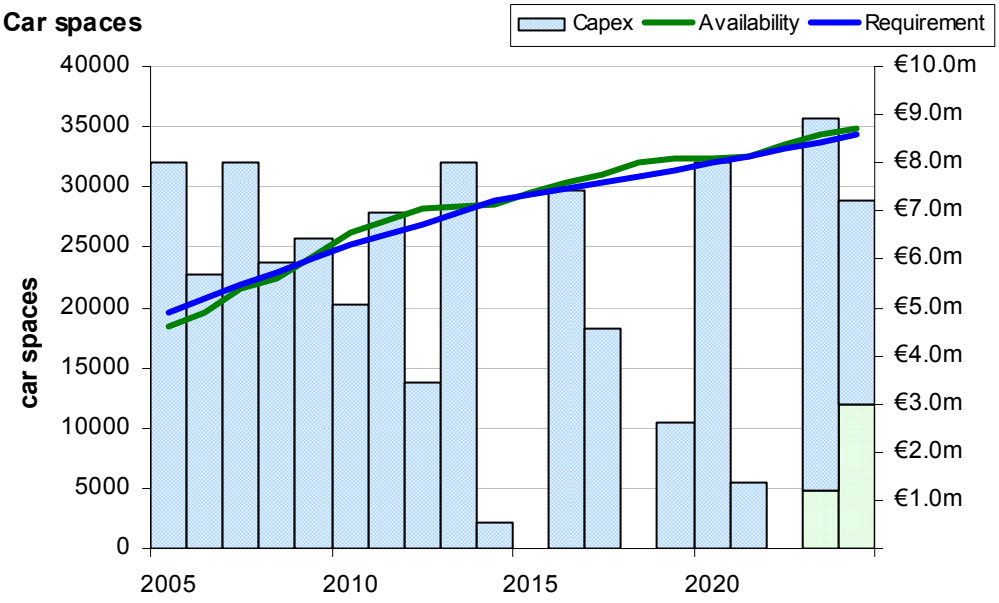
WHA's assessment of passenger/public car park requirements identifies a small capacity deficit in 2004. This is made up of surplus short-term capacity and a deficit in long-term. DAA's proposed capital programme identifies one

car park project, CIP 1.6, which creates 800 spaces for completion in 2010. In a context of rapidly growing passenger numbers, there seems to be a disjoint. The following graph shows the projected relationship between availability and need for car park spaces assuming that the proportion of passengers using DAA's car parks remains stable:



If that assumption is appropriate, it suggests a significant hole in DAA's capital programme.

From RR&V's assessment of CIP 1.6, we might suppose a standard unit cost of some €15,000 per space for short-term (multi-storey) car parking. Recognising that surface car parks are cheaper to build, we have carried out projections of the cost of building car parks using an indicative average cost of €5,500 per space based on the assessed percentage split requirement for short-term (multi-storey) and long-term (surface) car parking (at approximately €4,000 per space for surface car parking), to generate the following graph:



These projections suggest a significant level of required spend, amounting to about €53 million to DAA's planning horizon of 2014.

The actual requirement for investment might be significantly lower than this for a number of reasons, including:

- Increased provision of third-party provision of car parking facilities (although this might have other impacts on the roads and kerb arrangements):
- Reduction in the proportion of passengers using car parks:
- Any overstatement in our estimated weighted average cost per space.

While we make no adjustment to our assessment in respect of car parking, our findings suggest that further analysis of the non-major projects would be appropriate during the Commission's review of DAA's more detailed plans.

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