Comptroller and Auditor General
Special Report

Department of Transport

National Roads Authority

Primary Routes Improvement Programme

April 2004

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This report was prepared on the basis of information, documentation and explanations obtained from the public bodies referred to in the report. The draft report was sent to the Department of Transport and the National Roads Authority. Where appropriate, the comments received from the Department and the Authority were incorporated in the final version of the report.

Special Report of the Comptroller and Auditor General

National Roads Authority

Primary Routes Improvement Programme

I have, in accordance with the provisions of the Comptroller and Auditor General (Amendment) Act, 1993, prepared a special report on the National Primary Routes Improvement Programme.

I hereby submit my report for presentation to Dáil Éireann pursuant to Section 11 of the said Act.

John Purcell
Comptroller and Auditor General

6 April 2004

Table of Contents

Summary of Findings

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The National Development Plan (NDP), launched in November 1999, proposed investment of €5.6 billion on national road improvement works in the period 2000 – 2006. However, the cost of measures proposed by the National Roads Authority (NRA), adjusted for accelerating the programme and qualitative changes following Government prioritisation, was €7 billion. The scale of the work envisaged in the plan represented a substantial increase on pre-2000 activity administered by the NRA. By 2002 it was being reported that the estimated cost of the measures being undertaken had risen to €15.8 billion.

Following concerns expressed in the Committee of Public Accounts I decided to review how the estimates were compiled and the impact of the procurement methods being used on outturn cost certainty. I also generally reviewed how road improvement works are managed in Ireland.

Increases in Estimated Cost

Inevitably, inflation impacts on a programme of public works. In the case of the package of road improvement measures over 40% of the total escalation in the reported cost was due to price movements. A quarter of this was due to underestimation of prices at the beginning of the programme.

A further 16% of the increase was due to a systematic failure to cost certain elements of schemes at the planning stage. This only became apparent when the NRA adopted a new standard costing approach in mid-2000.

The programme itself grew due to changes in the scope of projects and new works, accounting for around 20% of the increase. The balance of the cost escalation is due to project specific increases and increases in the cost of projects with non-standard features such as the Dublin Port Tunnel and that part of the M50 known as the South Eastern Motorway.

At the end of 2003 the estimated cost of delivering the programme was €16.4 billion in current values.

Estimation Process

It was only after the start of the programme that action was taken to address the lack of costing expertise in the NRA. The NRA set up a cost estimation function in 2000 and appointed a cost estimation manager. More realistic costs are now established for each road type and, from 2003, a more accurate method of estimation, which recognises the variable elements of a specific scheme, has been developed.

The standard costing methodology should, in future, ensure that all cost elements are recognised at the planning stage.

In regard to price effects, it remains a challenge how to adjust initial plan provisions to take account of inflation which can impact adversely on the amount of physical output that can be purchased by a given allocation. This is complicated by the fact that, in the short-term, tender price inflation can diverge from road construction cost inflation depending on competitiveness in

the market. In addition, road projects are particularly susceptible to price volatility due to the fact that a high proportion of road material prices fluctuates with oil prices.

Programme Delivery and Results

While it was acknowledged, in 2000, that the complete programme would not be delivered by 2006 it could have been expected that, at the proposed funding levels and the then estimated cost, around 80% of the proposed programme would have been delivered by that date.

Even taking account of proposed increases in funding, around half of the programme being managed by the NRA will not be delivered by the end of 2006 while just under 30% will not be delivered by the end of 2008.

While the NDP is the source of funding for the programme, there is no clear specification of the set of projects which it is planned to fund from that national programme.

It is desirable, in future programmes, that there be a greater alignment between the funding provision and planned measures so that overall programme achievement can be monitored and measured.

Procurement Methods

The challenge in procuring road construction projects is to achieve value for money and have as much certainty as possible about the outturn cost. The traditional procurement method employed by the NRA involved retention of most risks and paying for them to the extent that they occurred and were measured. This had the downside that there was little certainty when a contract was signed about the likely final outturn cost. The uplift in cost due to post-tender variations was similar to the post-contract increases experienced in Britain in the period 2000 – 2001.

This uplift is not in itself problematic providing the costs associated with risks retained are being minimised by paying only for those that accrue. However, traditional remeasurement contracts, because they give rise to claims and variations, tend towards adversarial relationships on site. Greater certainty of cost outturn has been achieved in recent design and build contracts and the final outturns are in line with standard cost projections.

While design and build contracts do not pass the risk of price increases to the contractor the NRA has recently moved to attempt to fix prices at contract inception subject to the inflation rate not exceeding 5% per annum.

In Britain, procurement has moved towards identifying a preferred prime contractor based on best value criteria, involving his team earlier in the process and remunerating him based on a fixed fee (overheads and profit) plus an agreed target cost with an agreed pain and gain sharing arrangement. The construction of the Dundalk/NI Border scheme in collaboration with the Northern Ireland Roads Service should allow the NRA to evaluate the implications of applying such an arrangement in the Irish context.

Acquisition of Land

The cost of acquiring land for road improvement is now estimated to represent 14% of programme costs. A December 2001 agreement, between the Department of the Environment, Heritage and Local Government, the NRA and the Irish Farmers' Association, covering the compulsory

acquisition of agricultural land and the escalating cost of land in urban areas have been instrumental in this proportional increase.

Management of Road Procurement

There is an acknowledged need to review the operation of regional design offices, originally set up to do work now largely done by consultants and to review the relationships between the NRA and the local authorities who are responsible for the management of road improvement projects.

The NRA commissioned a report on the future management of road improvement work. The Minister for Transport is currently reviewing the report.

The scale of the road improvement programme and the consequent rise in the NRA's purchasing power suggests that there could be scope for renegotiating fee levels for professional services.

1 Introduction

1.1 Roads are the primary mode of internal transport in Ireland accounting for 96% of passenger traffic and 93% of freight transport.

1.2 The National Development Plan (NDP), launched in November 1999, proposed investment of €5.6 billion on national road improvement works during the period 2000 – 2006[1]. The investment was included in an Economic and Social Infrastructure Operational Programme (ESIOP). The programme of work outlined in the NDP included

- the development of five major inter-urban routes (Dublin to the Border, Dublin to Galway, Dublin to Cork, Dublin to Limerick, Dublin to Waterford) to motorway or high quality dual carriageway standard
- a programme of major improvement works on many other national primary routes
- the completion of the M50 (Dublin C-Ring) and the Dublin Port Tunnel
- the improvement of national secondary routes of particular importance to economic development, and
- the continuing assignment, in the design and construction of road projects, of a high priority to the safety of all road users.

1.3 On the five major inter-urban routes the aim was to achieve a level of service equivalent to a minimum of 96 km/h average inter-urban speed from completion of construction through to 2020 (LOS C).[2] It was estimated that, by the end of 2006, this would result in total time savings of 180 minutes on end-to-end journeys on the five routes combined compared with the situation which pertained in 1999.

1.4 The remaining measures were designed to achieve a level of service equivalent to a minimum average speed of 80 km/h on single carriageway and 89 km/h on dual carriageways (LOS D) on 90% of National Primary Routes by the end of 2006.

1.5 The programme of work examined in this report comprises the works proposed by the National Roads Authority (NRA) for inclusion in the NDP together with other works prioritised by Government during the formulation of the plan[3].

Cost of Measures

1.6 While a provision of €5.6 billion (1999 prices) was included in the NDP the cost of the measures proposed by the NRA, adjusted to take account of the plan objectives, was €7 billion. Two years after the commencement of the plan the cost of completion of the specified measures, together with certain revisions to the programme, was put at €15.8 billion. Allowing for inflation

[1] The plan provision, taking account of inflators, was €6.75 billion over the period 2000 – 2006.
[2] LOS: Level of service, representing an objective average journey speed, under ideal conditions, with satisfactory conditions for overtaking and driver operation (National Roads Needs Study 1998).
[3] At the adoption of the plan no revised provision was made for the additional elements (See Chapter 2). However, subsequent adjustments have been made to the funding (See paragraph 1.7).

and project completion in the meantime this is the equivalent of €16.4 billion at 31 December 2003[4].

Funding of the Measures

1.7 Adjustments have subsequently been made to the funding of the programme notably with the introduction of financial envelopes in the 2004 budget. The revised funding provision, adjusted for inflators, for the period to 2006 is now €8.4 billion, an increase of 24% over the plan provision. Appendix A sets out how the funding provision altered with the introduction of financial envelopes.

1.8 In or around €1.3 billion was the estimated level of private sector investment included in the overall funding provision. Any private sector funding input would occur under public private partnership arrangements (PPP) where, in practice, the private partner constructs the roads and maintains them over 30 years with a State subsidy (if required). The private sector contribution is heavily influenced by the tolling revenue generated by a project. Consequently, it is difficult to estimate the net cost to the State of PPP procured projects until the contractual arrangements have been finalised in all of the 10 projects selected for PPP/tolling. Two PPP contracts have already been signed (the N4 Kilcock to Kinnegad route in March 2003 and the M1 Dundalk Western Bypass in February 2004) and the NRA has informed me that the finance raised in these cases is in line with its projections.

1.9 However, the fact that the same level of private income is being projected for a programme estimated to cost €15.8 billion in 2002 prices as was estimated for a programme costed at €7 billion based on estimates compiled three years earlier indicates that public funding demands had risen by almost €9 billion in the interim[5].

Programme Delivery Concerns

1.10 A major part of the programme will not be delivered in the period 2000 – 2006. The initial provision in the NDP was €5.6 billion which compares with a funding requirement of €7 billion to enable completion of the programme of work being prioritised following adoption of the plan. It was recognised that this initial funding shortfall of €1.4 billion would mean that certain elements of the programme would be completed after 2006. However, the extent of cost escalation up to 31 December 2002 has resulted in a situation where almost half of the cost of the programme will not, at projected levels of provision, be funded by the end of 2006[6]. In addition, attempts to accelerate delivery by allocating a greatly increased provision in the latter part of the programme might impact adversely on the capacity of the construction sector to absorb it without inflationary effects[7].

[4] This is based on road inflation of 5% for the period mid-2002 to 2003 (See Appendix E).
[5] At 31 December 2003 the estimated cost escalation was €9.4 billion.
[6] This takes account of an increased financial envelope signalled for this purpose in the 2004 budget and road construction inflation of 3% to 5% per annum in the period 2004 - 2006.
[7] The Institute of Engineers in Ireland noted in its submission on the mid-term review of the NDP that attempting to dramatically increase the rate of construction would lead to significant price inflation in the construction industry.

Examination Issues

1.11 The development and delivery of programmes to support major government strategies depend on accurate planning information, estimation capacity and effective procurement of projects.

1.12 Arising out of concerns expressed in sessions of the Committee of Public Accounts about the escalation in the reported cost of works, I decided to enquire into the procedures in place in the NRA to estimate the cost of the programme of national road improvement works and whether more effective procurement methods might be employed.

1.13 The examination, therefore, sought to

- isolate the causes of the reported escalation in the cost of the planned works from €7 billion to €15.8 billion in mid-2002
- review the estimation process which underpinned the costing of the programme
- examine the arrangements in place for the procurement of national road improvement projects
- review key aspects of the overall management of the roads improvement programme.

Examination Methodology

1.14 The examination involved the compilation of a database of relevant cost information relating to 149 projects included in the improvement programme and was conducted on the basis of

- reviewing the estimated costs of projects by reference to standard costs per kilometre
- information and explanations supplied by NRA personnel
- the review of files, documents and computerised information held by the NRA.

1.15 The standard costs per kilometre used in the examination have been developed by the NRA's cost estimation function. Standard costs are estimates at a point in time and do not, therefore, make any allowance for future price increases. The calculation is based on the NRA Method of Measurement for Roads Works published in 2000. This system applies standard costs to broad categories of work. Like all standard approaches it cannot be sensitive to differences arising out of specific conditions in individual projects but is useful for estimation across a range of projects included in a programme.

1.16 The results of the examination are set out in the three chapters which follow. Chapter 2 reviews the estimation process and the causes of the cost escalation. Chapter 3 examines the management of procurement risks and Chapter 4 reviews the overall management of the road improvement programme.

Supervising Department

1.17 The supervising Department[8] for the NRA, from its inception in 1993 to June 2002 was the Department of the Environment, Heritage and Local Government. Thereafter, the Department of Transport (the Department) became the supervising Department.

[8] The current title of the supervising Departments is used at all times in this report.

2 Estimating Road Improvement Costs

2.1 In June 1999 the NRA proposed a programme of work for inclusion in the NDP and presented it to the Minister for the Environment, Heritage and Local Government. At that point, it estimated that the cost of delivering the programme it proposed was €5.6 billion.

2.2 The programme that formed the original proposal by the NRA for inclusion in the NDP was based on improving the segments of the national roads network classified as 'Backlog' and 'Phase 1' in a National Roads Needs Study (NRNS) published in July 1998. These two priority categories identified the segments of the network that had already fallen, or would fall, below a satisfactory level of service (LOS D) by the end of 2004.[9] Four phases had been identified in the NRNS. Phase 1 covered the period 2000-2004. Road improvement works for the other three phases[10] were not identified in the original NDP proposal made by the NRA in 1999.

2.3 The proposed works were costed on the basis of estimates included in the NRNS, increased by 10% in an attempt to allow for inflation between 1996, when the NRNS costings were done, and January 1999. The NRNS costings were produced by consultants acting for the Authority and were derived on the basis of average costs per kilometre for each road type.

Programme Formulation

2.4 The Minister for the Environment, Heritage and Local Government requested the NRA to consider some changes to the programme proposed by the NRA and, in particular,

- the upgrading of the five major inter-urban routes to motorway or high quality dual carriageway standard, in their entirety, by 2006
- the attainment of at least LOS D on the Western Strategic Corridor by 2006.

The NRA, at his request, also examined the impact of improving sections of other national primary routes to ensure that a satisfactory level of service would be achieved on 90% of them by the end of 2006.

2.5 On 20 July 1999 the NRA wrote to the Department of the Environment, Heritage and Local Government setting out the cost implications of the additional work.

- A further €847 million would be required to accelerate progress so as to achieve the changes requested by the Minister. The NRA considered that this acceleration of the programme would be achievable provided no exceptional issues arose and that adequate cost-effective contracting was available.
- An additional €545 million would be required to attain LOS D standard on the entire network of national primary roads by the end of 2006.
- The overall effect of an acceleration of the programme would be to increase the total estimated capital expenditure on national road improvement for the period 2000 – 2006 to €7 billion.

[9] 'Backlog' constituted the segments which would fall below LOS D by end-1999 and 'Phase 1' the segments which would fall below LOS D between 2000 and end-2004.
[10] Phase 2 (2005 – 2009); Phase 3 (2010 – 2014) and Phase 4 (2015 – 2019).

2.6 At this point, no consideration had been given to any additional funding required for the upgrade of the Dublin/Waterford road connection, because the route and road type had not yet been identified.

2.7 In a separate letter to the Department of the Environment, Heritage and Local Government the NRA pointed out that the estimated cost of the programme was based on 1999 values and did not take into account any inflation over the seven-year period.

Programme Funding

2.8 The Minister for the Environment, Heritage and Local Government wrote to the Minister for Finance seeking additional funding.

2.9 The Minister for Finance replied stating that he could not agree to the inclusion in the NDP of the additional amounts requested. The Minister suggested that the NRA be asked to prioritise its programme to enable the completion of the main arteries by 2006, with lower priority projects to be completed as early as possible after 2006.

Programme Delivery

2.10 The NRA operated on the basis that the NDP as adopted entailed delivery of both the proposed programme and the amendments specified in the plan even though the funding provision was set at a level which would entail some work rolling into the post-2006 period.

2.11 The NDP included an objective of achieving a satisfactory level of service on 90% of national primary routes (other than the major inter-urban routes) by the end of 2006. The NRA informed me that it viewed this objective as a recognition that level of service is a dynamic concept and, as the volume of traffic grew, segments of the network would fall below standard within the timescale of the plan even in instances where they were categorised as routes for improvement in the second phase of the NRNS (2005 – 2009). It, therefore, viewed the direction as an instruction to follow as much as possible the aspirations of the NRNS on national primary routes excluding the five major inter-urban routes.

2.12 Figure 2.1 outlines the cost of works originally proposed, the effect of reprioritisation at NDP stage and the overall initial programme cost.

Figure 2.1 Estimated Cost of the Improvement Programme [a,b]

	NRA Proposed Programme	NDP Additional Works	Cost of all Works
	€ bn	**€ bn**	**€ bn**
National Primary Improvement Works			
Major Inter-Urban Routes[c]	2.8	0.7	3.5
Other National Primary Routes[c]	1.8	0.7	2.5
	4.6	**1.4**	**6.0**
Other Improvement Works[d]	1.0	0.0	1.0
Total Estimated Cost	**5.6**	**1.4**	**7.0**

Notes: a These estimates do not include the cost of a subsequent change in road type on the Dublin/Waterford route.
b January 1999 prices.
c Including works classified as non-standard works in Figure 2.2.
d Including improvement works on national secondary routes and safety work.

2.13 This report only examines the estimation of the cost of the national primary improvement works proposed by the NRA adjusted to take account of NDP priorities. In order to do this, a distinction is made between national primary road improvement works which were projected to absorb €6 billion of the original estimate of €7 billion and other works, on national secondary roads and safety measures, estimated to cost €1 billion. The €6 billion estimate for national primary improvement works was to cover work on 149 projects. In turn, national primary works are examined under two broad categories

- a core programme of works with largely standard features
- non-standard works.

2.14 While most improvements were standard road improvement works, certain projects had special characteristics. Because of the special cost considerations that arise in the case of the Dublin Port Tunnel and the South Eastern Motorway these are separately considered. Excluding these and other non-standard works, the initial estimated cost of the core programme was €5.1 billion. The categorisation of projects for purposes of the examination and the increase in the cost of the programme is as set out in Figure 2.2. The core programme, together with associated costs, is outlined at Appendix B.

Figure 2.2 Comparison of Road Improvement Cost Estimates 2000 – 2002

	Initial Estimated Cost[a]	2002 Estimate	Cost Increase
	€ bn	**€ bn**	**€ bn**
Core National Primary Programme			
Major Inter-Urban routes	2.75	5.82	3.07
Other National Primary Works	2.32	5.07	2.75
Additional Works	-	0.72	0.72
	5.07	**11.61**	**6.54**
Non Standard Works			
Near completed projects	0.19	0.29	0.10
Non standard improvement works	0.39	1.11	0.72
Dublin Port Tunnel	0.22	0.58	0.36
South Eastern Motorway	0.15	0.53	0.38
	0.95	**2.51**	**1.56**
All National Primary Works	**6.02**	**14.12**	**8.10**
Other Improvement Works	0.97	1.68	0.71
Overall Cost Estimates	**6.99**	**15.80**	**8.81**

Note: a January 1999 prices.

2.15 The cost of the core programme increased by 129%.

2.16 By 2002 certain additional works with an estimated cost of €0.7 billion had been added to the core programme. The principal improvement works involved are set out in Figure 2.3.

Figure 2.3 Major Additional Works

Route	Major Additional Works	Estimated Cost 2002 (€ million)
N16	Sligo-Border	159
N22	Cork Northern Ring Road	226
N25	Cork Southern Ring Road Interchanges	80
N25	Kinsale Road Interchange	45

A full list of these works is set out at Appendix C.

Original Programme Costings

2.17 At the time of the adoption of the NDP cost estimation was not well developed in the NRA. The Authority had no dedicated in-house expertise to determine or validate the cost of projects included in the programme. In mid-2000 the NRA set up a cost estimation function.

2.18 The examination reviewed the accuracy of the costing system which had been used, making use of standard costs compiled by the NRA's cost estimation function. In order to do this the individual roads selected for improvement during the course of the programme were identified and the following information extracted

- the estimated cost of each project
- the amount which had already been spent on each project at the commencement of the programme
- the cost of the remaining work at standard costs.

Standard Costs

Standard costs for each road type were compiled by the NRA from mid-2000 onwards. The standard costs, per kilometre, for the different road types in 2000 and 2002 were

Type of road	Standard Cost 2000	Standard Cost 2002
	€m	€m
Reduced Two Lane	2.09	2.58
Standard Two Lane	2.77	3.33
Wide Two Lane	3.16	3.81
High Quality Dual Carriageway/High Quality Motorway	6.73	7.80
Wide Median Dual Carriageway/Wide Median Motorway	8.28	10.32

Appendix D sets out the background to these standard cost calculations.

Cost Underestimation at Inception of Programme

2.19 The examination found that the costs used at the inception of the programme, and which in turn informed the costing of the NDP, were too low. A comparison of the estimated cost with standard cost estimates prepared by the NRA in respect of 2000 is presented in Figure 2.4.

Figure 2.4 Comparison of Initial Estimates against Standard Costs – Core National Primary Improvement Programme

	Initial Estimated Cost	Standard Cost[a] 2000	Underestimate
	€ billion	€ billion	€ billion
Major Inter-Urban Routes	2.8	3.7	0.9
Other National Primary Routes	2.3	3.5	1.2
Totals	**5.1**	**7.2**	**2.1**

Note: a Standard costs were compiled in mid-2000 and have been adjusted to January 2000 price levels.

2.20 The underestimation of €2.1 billion (41% of the original estimate) can be put down to two main factors

- The original basis of estimation used in the NRNS did not make provision for the full cost of certain elements. These would account for approximately €1.4 billion of the underestimate.
- A failure to take full account of inflation over the period 1996 - 1999, the effect of which is estimated at €0.7 billion for the improvement works included in the original core programme.

Costing Deficiencies

2.21 The need to adjust the costings for the programme had been signalled in technical reports prepared in 1998 in association with the NRNS. Particular attention was drawn to the fact that additional costs would arise in connection with

- major river or difficult crossings
- provision of roundabouts to upgrade existing junctions
- junction upgrade to grade separation.[11]

The NRA has informed me that, in the absence of developed designs and more detailed information, adjustments to the costings were not made.

2.22 The examination concluded that there was inadequate provision for certain elements of road construction schemes in the original costings. These elements have been identified as follows:

Element	**Underprovision**
Earthworks	25%
Side Roads	75%

[11] Where a motorway or high quality dual carriageway intersects with another road, a junction, usually including a gradient and/or a bridge is required. This is known as grade separation.

Signs and Lighting	25%
Accommodation Works	50%

In addition, certain bridge construction costs were not provided for.

2.23 These omissions would have understated the unit costs per kilometre and the overall effect was an underestimation of €1.4 billion (or 27% of the original estimate) for the core programme.

Inflation

2.24 Road construction inflation is not identical to general construction inflation because of the different mix of inputs involved. In addition, road construction inflation, which reflects changes in the cost of construction materials and labour, differs from road tender price inflation which fluctuates in response to competition in the market. However, in the long run there is a broad correspondence between the two.

2.25 Initial estimates of the cost of the programme were understated. For the period 1996 to 2000 road inflation was around 21.3%. This led to the underestimation of the cost of the programme at its inception by €0.7 billion. Appendix E outlines the background to price and cost inflation in road construction in the period 1996 – 2003.

Availability of Costing Information

2.26 A smaller improvement programme was being administered by the NRA in 1999 when the estimates were being compiled. However, a certain amount of information was available at that point including

- recent tenders for conventional contracts and two pilot design and build contracts
- outturns on projects completed by 1999.

2.27 In regard to tenders, all tenders for conventional work were at levels above those included in the plan on the basis of NRNS estimates adjusted by 10%. Although the two pilot design and build tenders were at levels around the subsequently calculated standard costs, the NRA maintains that it would not have been safe to use them as a definitive basis for standard costs because of their small number and pilot nature.

2.28 The outturn on two projects completed in 1999 indicated that the NRNS estimates were too low. A low tender had been received for the Arklow Bypass in 1996, but by 1999 the project had been completed at a cost in excess of that indicated by the NRNS estimates while the Ardee/Aclint route, which had been tendered for in 1997, had also been completed at a cost in excess of that indicated by the NRNS estimates.

2.29 The NRA has explained that, while this outturn information might have impacted on estimates as it came through in 1999, the NDP provision had been determined at that point.

Accuracy of 2002 Estimates

2.30 By 2002, the cost of all road improvements was being put at €15.8 billion. The NRA based this estimate on information from consultants, local authorities and its own cost estimation.

2.31 At the time of the 2002 re-estimation the projects fell into three main categories

- completed schemes and schemes at construction for which a definite basis of estimation was achievable
- schemes which had a completed land purchase and environmental impact study stage which had detailed costings prepared by either local authorities or consultants and for which estimates were finalised using the advice of the NRA in-house estimation function
- the remaining schemes the costs of which were estimated by consultants or local authorities and benchmarked against NRA cost targets for the cost of a kilometre for each road type.

The programme had also expanded due to the addition of certain new works.

2.32 Both the standard costs and the revised 2002 estimates were independently compiled in early 2002. The NRA has informed me that, because information was at this stage beginning to crystallise in terms of scope and standards, estimates had by 2002 become more project specific and took account of construction inflation and increased land costs arising out of economic conditions and new compensation arrangements agreed with the Irish Farmers Association.

2.33 A comparison of these revised costs against standard costs compiled by the NRA indicated that by 2002 the detailed costings exceeded the standard costs by €1.0 billion as is indicated in Figure 2.5.

Figure 2.5 Comparison of 2002 estimates against standard costs – Core Improvement Programme

	2002 Estimate	Standard Cost	Difference
	€ bn	€ bn	€ bn
Major Inter-Urban Routes	5.8	5.4	0.4
Other National Primary Routes	5.1	4.7	0.4
Additional Works	0.7	0.5	0.2
Totals	**11.6**	**10.6**	**1.0**

2.34 While the initial costing appeared to underestimate the programme cost by 41%, by 2002 estimates exceeded standard costs by 9%.

2.35 While there were differences between the standard cost and the estimate on many projects, an examination of schemes showed that, across the complete programme, 65% of the variation occurred on PPP projects. The NRA informed me that this arose because these projects, which had been estimated in particular detail, contain construction features that result in costs greater than standard costs, including major bridges. In addition, the costs for each PPP scheme include provision for the installation of toll plazas.

2.36 The NRA further informed me that for all ten PPP projects, the costings had been developed by the respective local authorities and their engineering consultants. The costs of the later PPP schemes – Portlaoise to Cullahill, Galway to Ballinasloe and Nenagh to Limerick - have been based on the standard kilometric costs while the NRA has informed me that other schemes have particular cost features, including the following

- Waterford City Bypass, in addition to 23.6 km of dual carriageway, has 15.2 km of single carriageway, a 475m cable-stay bridge, a 200m river bridge, four rail crossings and a complex interchange construction
- Fermoy, in addition to 17.5km of motorway, has a 450m motorway viaduct bridge
- Dundalk, in addition to 11km of new motorway has 7km of new single carriageway, twelve over/under bridges and a major railway overbridge. The contract also includes improvements along the entire length of the existing motorway including safety barriers, environmental barriers and emergency telephones
- Limerick South Ring has a 900m long tunnel and approaches
- The Clonee to Kells scheme has a 49km motorway and 29km of additional roads including significant lengths of dual carriageway.

The use of standard costs would not fully address the cost of these features.

Estimation Capacity and Refinement

2.37 Quite apart from its impact on funding decisions, the accurate estimation of costs is an essential input to any cost benefit analysis carried out for routes and the prioritisation of schemes for development.

2.38 A Cost Estimation Manager was appointed to the staff of the NRA in July 2000. One of the principal improvements made possible by his expertise was the generation of more realistic standard or target costs per kilometre for the various types of road planned for construction. Standard costs are now established for each type of road cross section and are updated periodically.

2.39 A key role of the Cost Estimation Manager[12] is to monitor estimates produced by local authorities. Each local authority is required to prepare a comprehensive cost estimate for proposed projects in consultation with the Cost Estimation Manager. The standard costs thus become the norm or target costs against which a local authority estimate is compared.

2.40 The introduction of standard costs gave the prospect of more realistic estimation and prioritisation by the NRA. Prior to their introduction, rates included in bills of quantities for previous projects were used as a basis for the estimation of the cost of the next project. These bills of quantities could be unrealistic for project elements.

2.41 While it is acknowledged that estimation for decision making, prioritisation and programme formulation need only be accurate to a reasonable degree of precision, the fact that the estimates produced in respect of 2002 by local authorities and consultants exceeded those

[12] This has been established in the NRA Policy on Procurement Procedures published in 2001.

predicted by the standard costs by 9% indicated that there was scope for refining the costing methodology further.

2.42 The NRA has informed me that, from 2003, a new method was developed by the Cost Estimation Manager which recognises the variable elements of a specific scheme and produces a more accurate estimate, even as early as the route selection stage of a project.

2.43 The deficiencies in costing which have been outlined illustrate the need for the NRA to take steps to ensure that

- its cost estimation capacity which is currently dependent upon the expertise and knowledge of one individual is further developed in a systematic way
- future programmes, whether involving adjustments to take account of the national spatial strategy or other developments, are estimated on the basis of an anticipated scope of work, with the benefit of surveys and site investigation
- estimates cover all cost elements including land, accommodation works and, to the extent that it is feasible, archaeology.

2.44 It is important that standard costs be updated annually and at least twice a year in times of high inflation so that local authorities have current benchmarks during estimation. It is recommended that the NRA continuously monitor its standard cost methodology to ensure that it is predictive of the cost of projects.

Alterations and Cost Increases between 2000 and 2002

2.45 Quite apart from the effect of estimation deficiencies in 2000 and 2002 changes occurred in the programme due to ongoing alterations to the scope of projects. In addition, road construction inflation which was of the order of 25% between 2000 and mid-2002 increased the cost of the programme.

2.46 In addition to the underestimation that occurred at the inception of the programme, the combined effect of alterations and price increases between 2000 and 2002 would have resulted in a further uplift of €3.7 billion in the cost of the core programme as set out in Figure 2.6.

Figure 2.6. Cost adjustments to core programme 2000 - 2002

Cause of Cost Increase	Impact of increase € bn
Increase in length	0.5
Changes of scope	0.6
Price variations	1.9
New works	0.7
Total Increase	**3.7**

The alterations between 2000 and 2002 are set out in detail in Appendix G.

Causes of escalation in cost – Summary

2.47 The escalation, by 2002, of €8.8 billion in the cost of all improvement works can be attributed to the factors set out in Figure 2.7.

Figure 2.7 Overall summary of causes of cost escalation 2000 – 2002

Cause	Cost escalation € bn	Percentage of cost escalation
Core Programme		
New or uncosted elements		
Uncosted project elements at inception	1.4	16%
Scope and length changes (before price adjustment)	1.1	12%
Addition of new work	0.7	8%
	3.2	***36%***
Price effects		
Price underestimation at inception	0.7	8%
Price increases 2000 – 2002	1.9	22%
	2.6	***30%***
Project specific cost increases (net)[a]	***0.7***	***8%***
Core programme cost increase	**6.5**	**74%**
Other Work		
Increase in cost of non-standard work[b]	1.6	18%
Increase in cost of other improvement works[b]	0.7	8%
	2.3	***26%***
Total	**8.8**	**100%**

Notes: a This is the net excess of estimated cost over standard cost for originally planned work.
b If the same rate of inflation applied to non-standard and other works as to the core programme, the increase due to inflation for these works would have been of the order of €1 billion, of which just over €0.2 billion had accrued by the start of 2000. In addition, there were exceptional increases in the cost of land for the South Eastern Motorway.

Non Standard Schemes

2.48 Estimation on the basis of standard costs is problematic in the case of certain schemes.

- The South Eastern Motorway had exceptional land costs and construction delays.
- Construction of the Dublin Port Tunnel is different in character from overland works.
- Other schemes had works which also were different in character from a normal road improvement scheme.

In addition, certain routes were nearing completion in 2000 and so had a high element of historic costs.

These non-standard works increased by €1.56 billion (164%) by 2002. A full list of these works is set out at Appendix F.

South Eastern Motorway

2.49 Completion of the South Eastern Motorway (SEM), which has experienced delays and major cost escalation, is essential to achieving the full benefit of the M50 C Ring.

2.50 The options for alternative routes for the SEM were restricted to the gap between the extensive housing developments on the southern fringe of Dublin and the Dublin mountains. The original estimated cost of the SEM included in the plan was €153 million. This had risen to €530 million when estimated in 2002 and the latest estimate stands at €595 million (an increase of 288%). A major cause of the cost escalation is due to the cost of land estimated at €336 million which may ultimately represent over 50% of the overall cost. Substantial land and property claims have still to be adjudicated upon.

2.51 An injunction was granted in February 2003 which made it impossible for the local authority to grant the contractor possession of part of the motorway site at Carrickmines. The matter is still subject to litigation.

Costs on the Dublin Port Tunnel

2.52 The Dublin Port Tunnel (DPT) is intended to provide a motorway link between the M1 at Santry and Dublin Port. The overall length of the project is 5.6 km. The length is divided between a twin bored tunnel, constructed completely underground for a distance of approximately 2.6 km and the remainder constructed using open excavation which is then covered up.

2.53 Unit costs for road construction overland cannot be used to estimate the cost of construction of tunnel projects. The original provision included in the plan was set at €220 million. The current completion estimate is €715 million, which is over three times the original estimate. However, the NRA informs me that an updated cost/benefit analysis of the project demonstrates that it is justified on economic grounds with an internal rate of return of 11%.

2.54 The contract, however, has certain features which give rise to additional up-front costs

- It transfers risks in relation to unforeseen ground conditions to the contractor.
- It makes the contractor responsible for ‘fitness for purpose’.

2.55 A separate maintenance and service contract will also be in place for 15 years after completion.

Other Non-Standard Work

2.56 Ten non-standard schemes estimated to cost €387 million were included in the plan. These were estimated by 2002 to cost €1.1 billion. The major works involved, and the associated costs in 2002 prices, are

- the Ballyvourney/Macroom/Ballincollig route (€225m)
- the Naas Road widening schemes (€196m)
- M50 improvement works (€562m).

The escalation in the costs for these three amounted to €659 million largely due to the cost of interchanges and structures not originally provided for. A full list of the works is set out at Appendix F.

Height and Ventilation Concerns – Dublin Port Tunnel

The haulage industry has raised the question of whether steps should be taken to increase the height of the tunnel to cater for 'supercube' trailers. The NRA has informed me that it is satisfied that the tunnel height meets best international standards, that it will cater for the vast majority of vehicles which use the road network and that the costs of any increase in height would be excessive and disproportionate. Nonetheless, the Department of Transport commissioned a consultancy study into the cost of increasing the tunnel height from the current 4.65 metres. The report has been submitted to the Minister. Following a request from the Department of Transport to the NRA, the contractor has been asked to provide the all-inclusive cost of providing operational clearance of 4.9 metres.

Concerns have been raised about the ventilation arrangements in the tunnel. The NRA has informed me that the tunnel is constructed as two separate tubes each accommodating two lanes of traffic. In each tunnel tube, traffic will travel in one direction only. Forced ventilation is provided in each tunnel tube by means of jet fans mounted in the ceiling. This system performs two main functions – dilution of pollution from traffic and dispersal of smoke in the event of fire.

In simple terms, the air is moved along the tunnel in the direction of the traffic flow and is expelled at each exit portal. In normal circumstances, the movement of traffic within the tunnel acts as a piston and forces the air ahead. The quality of the air in the tunnels will be constantly monitored and where preset limits are approached the fans automatically switch on.

In the event of fire, fans are automatically switched to control the smoke and move it in the direction of the traffic flow. The speed of the airflow is designed to prevent the smoke being blown back into and along the tunnel over traffic.

Prior to completion of the tunnel Dublin City Council will be establishing a permanent air quality monitoring unit at the Whitehall exit to the northbound tunnel. Information from these tests will be available to the public.

Near Completed Routes 2000

2.57 21 near-completed projects estimated to cost €186 million were included in the plan. €161 million, calculated at 2000 standard prices, had been incurred on these projects at the inception of

the programme. Comparison on the basis of standard costs would not be appropriate in these cases and they are not material in the context of the overall programme.

Programme Completion

2.58 In 2000 it might have been expected that if estimation was accurate, at the proposed levels of funding, 80% of the programme would have been delivered by 2006.

2.59 By 2002, the estimated cost of the revised programme had risen to €15.8 billion. Taking account of road construction inflation which averaged around 6.5% per annum for the period 1996 – 2003 and assuming that road inflation will be around 3 - 5% per annum over the period 2004 - 2006, and, also, that the programme remains substantially unaltered then just over half of the programme will have been delivered by 31 December 2006.

2.60 In addition, if the rate of road inflation is in the range of 3 - 5% per annum for 2007 and 2008 and assuming future funding levels announced in the 2004 budget, then around 70% of the programme should be delivered by the end of 2008.

2.61 The NRA has informed me that significant elements of the major inter-urban routes have already been, or will be, completed by 2006 - 2007. These include

- Cloghran – Lissenhall – Balbriggan
- Drogheda Bypass
- Dundalk Bypass
- Dundalk/NI Border
- Kilcock – Kinnegad
- Loughrea Bypass
- Naas Road widening and upgrade
- Kildare Bypass
- Monasterevin Bypass
- Limerick Southern Ring Road Phase 1
- Watergrasshill
- Fermoy – Watergrasshill including the Fermoy Bypass
- Mitchelstown Bypass
- Cashel Bypass

The NRA has also informed me that, when account is taken of the higher traffic volumes on these sections, the journey time saving attributable to their completion will be significant when compared to the anticipated time savings, for end-to-end journeys, upon completion of the entire routes.

Impact on the Monitoring of the NDP

2.62 While physical progress achieved is reported and outcome in terms of transit time savings and levels of service are recorded for the segments completed, and these are reviewed by the

ESIOP Monitoring Committee, there is no overall evaluation of achievement for the programme as a whole.

2.63 In order to properly monitor and manage the application of the €5.6 billion allocated in the original plan it would have been desirable to have a transparent alignment between the provision and the projects encompassed in the plan. It is not possible to determine whether and to what extent value for money is being achieved unless there are physical targets or desired outputs associated with an allocation which, in turn, is based on accurate costings. In the event, there were deficiencies both in costing the components of the plan and a failure to specify the physical outputs which the allocation was designed to fund.

2.64 The Department has informed me that in considering the national roads programme and its development and management in the past four to five years it is important to bear in mind the major expansion in the programme which occurred over the period since 2000. The level of activity has been ramped up very significantly in this period in response to the high priority accorded generally to the upgrading of transport infrastructure as an essential prerequisite for continuing growth and development. Initial costing of the programme of work identified as necessary to bring the national road network up to a reasonable standard proved difficult due to the limited information available from the smaller preceding programme and the preliminary scheme outlines available as a basis for costing. This was compounded by the strong inflation in construction and land costs over the period 1999 - 2001.

2.65 The Department also pointed out that significant efforts have been made to strengthen programming and project management systems and cost estimation and control and, in addition, a number of independent evaluation reports have acknowledged that the national roads investment programme is, in general, well managed. As part of the continuing effort to improve management of the programme a major consultancy assignment on arrangements for the implementation of the programme (including cost estimation and control) has recently been completed and its recommendations are currently being considered.

Information Available to Government

2.66 In the ongoing management of the programme information was being supplied to the supervising Departments. In general, this information failed to distinguish the impact of underestimation from the effect of price increases due to inflation. Nonetheless, taking account of the fact that estimation systems and management information were not well developed the information supplied during the course of the programme was reasonably accurate and sufficient for programme monitoring and decision making purposes.

Conclusion

2.67 74% of the €8.8 billion escalation in cost arose on the core programme. The remaining 26% arose on schemes which had non-standard features including the Dublin Port Tunnel and the South Eastern Motorway.

2.68 The original estimate was understated by over 40% due to a systematic failure to fully cost certain project elements and a failure to take full account of construction inflation.

2.69 After 2000, as the programme developed, variations and new works added €1.8 billion to the cost of the core programme.

2.70 Inflation between 2000 and 2002 would, in any event, have increased the cost. The impact of inflation between 2000 and 2002 has been estimated at €1.9 billion for the core programme and a further €1 billion for non-standard works.

2.71 It is apparent, that while the introduction of standard costs brought a greater rigour to the estimation process they needed to be further refined so as to distinguish the fixed and variable elements associated with schemes. The NRA has made this type of modification in 2003.

2.72 In future national development programmes for roads it is desirable that there be a closer alignment between programme allocation and desired output so that the delivery of the programme can be monitored and value for money demonstrated.

3 Managing Procurement Risks

3.1 Traditional contracts have given rise to major cost movements between tender and completion. This has made estimation and budgeting difficult both for the NRA and supervising Departments. Any move to address these deficiencies would call for revised practices which ideally would simultaneously provide the prospect of

- outturn cost certainty for estimation purposes
- best value for the money invested.

3.2 This chapter considers the risks and financial exposures that attach to the different methods of procurement. Each method brings its own particular risks which call, in turn, for practices designed to mitigate and monitor the State's exposure. The chapter examines risks arising in the case of

- traditional remeasurement contracts
- design and build contracts
- fixed price contracts.

In addition, it also examines land procurement and route selection risks.

Risks associated with Procurement

3.3 Risks make accurate estimation of cost difficult. Ultimately, they impact on cost to the extent that they materialise where the risk is retained by the State or are included in the contract price in cases where the State attempts to transfer the risk. The thinking, until recently, has been that over a large number of projects the State is better off paying for what happens on each individual job rather than having tenderers price for all risks and eventualities on all jobs.

Traditional Remeasurement Contracts

3.4 The major risks inherent in a remeasurement contract include increased costs arising from

- unforeseen ground conditions
- exceptional weather conditions
- additional work arising in the course of construction
- design changes
- risks associated with Statutory Undertakers[13] and Archaeology
- changes in legislation
- price fluctuation.

3.5 The examination reviewed the extent of post-tender increases in prices in standard remeasurement contracts. All such contracts completed in the period 2000 to 2003 (up to July

[13] Statutory undertakers are the ESB, Telecom services, local authorities for water services and An Bord Gáis.

2003) were examined. Where actual final outturns had not yet been agreed the NRA's best estimate for any final payment elements was used.

3.6 The review indicated that the uplift included in the final outturn on conventional contracts represented 42% of the agreed tender price.

3.7 There was a wide range of uplift under all headings. The range of uplifts on individual contracts and average cost increases were

	Range	Average
Scope Changes/Variations	2 - 56%	21%
Price Variation	4 - 22%	14%
Claims	0 - 65%	7%

3.8 Similar cost escalation exposure led the UK, following publication of the Latham[14] and Egan[15] reports, to introduce radical reform. The key element of the UK reform was to move towards 'building together' and partnership with the objective of eliminating the adversarial and litigious industry ethos which had arisen under traditional procurement.

3.9 In Ireland, the Minister for the Environment, Heritage and Local Government established a Strategic Review Committee (SRC) to formulate and develop a strategy for the Construction Industry and in 1997 established the Forum for the Construction Industry to implement the SRC's recommendations. The implementation of packages of recommendations applied to all public funded contracts for which tenders were sought on or after 31 March 2001.

3.10 The fact that traditional contracts involve remeasurement has been put forward as a key reason for variation in outturn. However, remeasurement only applies in practice on a limited number of project elements. The examination noted that there was little information captured by the NRA on remeasurement. This is due to its inclusion with variations authorised in the course of construction and the effect of this phenomenon is included in general variations. It would be preferable if the two were clearly distinguished since variations are authorised and carried out as a result of adjustments to the works while remeasurement is an unavoidable effect of carrying out the core work envisaged. Better information on this aspect of contract cost would inform the NRA on how it might manage

- the risks associated with underestimation of quantities for these elements
- the risk of strategic pricing, of individual remeasureable elements within a contract, designed to yield windfall gains on their remeasurement.

Design and Build Contracts

3.11 Up to this point, the traditional remeasurement contract has been the general method used to procure public construction works in Ireland. However, there has been a shift in recent times to design and build contracts in the roads sector.

[14] 'Constructing the Team',1994. An independent review of construction written by Sir Michael Latham.
[15] 'Rethinking Construction', 1998. A report produced by the Construction Task Force, headed by Sir John Egan.

3.12 Increased use of design and build contracts may give greater certainty from the viewpoint of budgeting and cost control. International firms, in the experience of the NRA, tend to prefer this method of procurement even though it passes the responsibility for managing key risks to the contractor. In summary, design and build contracts have the potential to

- improve efficiency because the contractor can influence buildability [16]
- provide greater certainty of outturn by passing more risk to the contractor in cases where he is better positioned to manage it
- create a less adversarial approach with more emphasis on partnering and co-operation in construction
- eliminate the opportunity for a contractor to use a strategic pricing strategy.

3.13 The NRA reports that experience on design and build contracts to date has been positive and that it is considering the expansion of this form of procurement. The process has, to date, delivered very competitive prices.

3.14 In contracts completed to date the uplift in design and build contracts was 14%, almost all of which was due to price increases. A comparison of the tenders for design and build contracts awarded in 1999 indicated that the quoted prices corresponded closely with standard costs in 2000. This appears to indicate that design and build contracts may hold out the prospect of price certainty at or around the estimated cost of a conventional remeasurement procurement adjusted for normal uplifts.

3.15 Any extended use of design and build contracts would call for revised approaches to the management of risks and costs.

- Unless speculative low cost tenders are rejected there is a likelihood that they could still lead to adversarial site conditions and militate against partnership.
- In practical operation, the emphasis may need to switch from supervision focused on the measurement of quantities to quality assurance.
- Design solutions are accepted based on meeting the specified requirement. Thereafter, award is largely based on price. This may still rule out getting a more economic solution from bidders whose initial proposal did not fully meet the requirements or who proposed a more expensive solution with significant advantages.
- Design by contractors gives rise to costs which ultimately get passed to the State. The design by a number of firms adds to industry costs.

Fixed Price Contracts

3.16 While design and build contracts tend to freeze the cost to the State of variations other than price an additional option is to freeze the contract price thus passing the risk of price increases to the contractor.

3.17 A ‘fixed price’ contract means that the individual rates in the Bill of Quantities become fixed at the tendered rate and no increases are given for inflation. Contractors will build an

[16] Improving design to avoid difficulties in building; finding the optimum building solution.

allowance for them into their bids. Currently, the use of these contracts is not recommended by the SRC for contract periods exceeding eleven months.

3.18 Other than under the PPP arrangements and an attempt to remove price variation clauses from certain design and build contracts there has been little recourse to fixed price arrangements by the NRA.

3.19 A design and build contract without a price variation clause was tendered for improvement works on the N25 at Kilmacthomas. The contract was for a period of 18 months from mid-1999. Following an increase in oil prices, labour costs and inflation in 1999 and through 2000 the contractor requested a price variation in July 2000. In August 2000, the NRA agreed to offer, on an ex-gratia basis, a price variation but it subsequently withdrew this offer 2 months later. The contractor then lodged a claim for €2.24m, exclusive of VAT. The claim was referred to arbitration. It was agreed between both parties at conciliation that a payment of €1.28m, inclusive of VAT, be accepted.

3.20 The Conciliator concluded that the contract between the parties had an implied term that exceptional unforeseen price increases are payable to the contractor. A price variation clause was subsequently reinserted into design and build contracts following the decision.

3.21 The capacity of the NRA to move to fixed price contracts is limited since current arrangements with the industry do not permit the fixing of prices for terms exceeding eleven months. Due to the fact that the construction phase of typical road contracts takes on average three years and that around 15% of their cost is in bituminous material, which fluctuates in line with oil prices, there is a likelihood that even if the price could be fixed at tender stage, the risk might well be priced into the contract at a level which insured the contractor against large increases. This practice in every case would have implications for the value for money achievable by the Exchequer across the whole programme.

3.22 As a response to this and partly arising out of learning from the Kilmacthomas case, the NRA is moving towards a form of contract where price is fixed up to a certain inflation level. The proposal is to seek a fixed price which will only be subject to review when inflation exceeds a predefined percentage (currently 5%) over a defined period (currently one year). In such cases only the excess inflation would be considered as part of the review. Price increases are measured with reference to the Central Statistics Office materials and wages index.

Alternative Procurement Approaches

3.23 In Britain, road construction projects completed around 1999 and 2000 had an average outturn cost of 40% above the tender price and the Highways Agency was also concerned that it had an adversarial relationship with suppliers.[17] The Agency decided to develop alternative forms of procurement which would provide better predictability of delivery to time and to budget and a reduction in the number of disputes on contracts.

3.24 This revised approach was part of a general revision of procurement in Britain under which capital projects would be acquired under one of three main methods

[17] Modernising Construction. Report by the Comptroller and Auditor General (UK), January 2001.

- partnership arrangements involving private entities in the design, build, financing and operation of the assets
- conventional design and build arrangements
- using a prime contracting approach under which a contractor is selected as soon as possible after identification of the preferred route and well before the stages which normally involve a public enquiry.

3.25 In the UK model, the contractor selection process is largely based on best value criteria, with the Agency seeking to identify, through a risk-based assessment, a supplier that has all the right skills and who is considered most capable of working in partnership, to identify the optimal solution and to deliver it as efficiently and safely as possible.

3.26 Benefits are expected to accrue in the areas of improved design through working together to minimise the need for costly design changes, identification of ways to drive out inefficiencies in the construction process and minimising the risk of costly disputes.

3.27 This system includes an option of Target Cost Contracts under which contractors are asked to bid at an earlier stage (before the detailed design) on the basis of best information. The incentive for the contractor is to co-operate with the client in finding the cheapest/quickest solution with bonuses on a 'management fee' for earlier, cheaper delivery but penalties for late delivery or overruns.

3.28 These target cost arrangements are an attempt to meet the challenge of designing arrangements to guarantee that both the State and the contractor achieve a win/win situation. Traditional lowest bid contracts, where cost was greater than the tender, tended to lead to adversarial relationships. On the other hand arrangements guaranteeing a particular return on top of cost would lead to a situation where higher costs would lead to higher returns to a contractor. This has led to the notion of designing contractual arrangements where overheads and profits are ring-fenced. The prospect is that both parties would be incentivised to reduce cost since lower costs would result in a higher percentage return to the contractor while at the same time reducing the State's outlay.

3.29 The objective of this approach is to ensure that all participants focus on delivering a quality job on time, while eliminating certain wasted costs which would be borne by both parties under traditional procurement. It has been claimed that the adoption of this form of procurement may produce better value for money through

- integration of the design and construction process
- the promotion of innovative solutions
- transfer of the risk of design failure
- greater price certainty
- the setting of continuous improvement targets
- the elimination of waste through the use of value engineering[18] and risk management techniques

[18] The assessment of the contribution, or value, of each part of a process and consideration of how improvements can be made to eliminate waste and inefficiency.

- incentives for both parties to reduce costs below the target through the resultant increase in economy and efficiency.

The new arrangements in Britain are still in their early stage of development and it will be some time before an evaluation of their impact can be definitively made.

3.30 In Ireland, the first recourse to such arrangements will be on the Dundalk/NI Border scheme which is a scheme being jointly administered with the Roads Service in Northern Ireland. The Roads Service of Northern Ireland will be the lead procurement agency on the project. However, its involvement should position the NRA to evaluate the wider applicability of this form of procurement.

Implications of Altering Procurement Arrangements

3.31 Issues which may require careful consideration in relation to possible procurement methods include

- the requirement for an open, competitive selection process with clearly defined and documented selection criteria conforming to EU procurement rules
- the importance of setting clear output measures and then measuring performance to determine if improved value for money is being achieved, in particular as innovative procedures are adopted
- the importance of the availability of accurate, relevant and timely information
- the risk that a cosy relationship would develop with contractors
- the need to develop an open book accounting policy so that State agencies can have reasonable access to contractors' financial records and cost information to have confidence in reported improvements in efficiency and performance
- ensuring that projects are delivered to a sufficiently high standard.

Managing Land Procurement

3.32 In order to expedite the planning and construction of projects the timely access to land and its cost-effective acquisition are important.

3.33 In recent times, the cost of land has been increasing driven by two main factors

- an agreement with farmers (the IFA agreement)
- increased costs in urban areas.

3.34 Traditionally, land represented about 11% of road costs. However, this element of cost has increased in recent years and the NRA estimates that it now constitutes about 14% of costs. An agreement concluded with the Irish Farmers Association altered the valuation approach and provided for a payment of €5,000 per acre to facilitate co-operation with local authorities. Land costs in urban areas are also increasing.

3.35 In a survey of land acquisitions in three regions made in 2002, the average cost per acre ranged from €27,235 in the Southern Region to €30,250 in the Mid-West. A further survey in

2003 found that average land costs ranged from €31,400 per acre in the South-East to €61,700 in the North-West. The average percentage of compensation in each region attributable to the different compensation categories showed a wide variation as set out in figure 3.1.

Figure 3.1. Compensation elements in land acquisition costs 2002-2003

Compensation Element	Proportion of Compensation (Range)
Basic land cost	37% to 84%
Goodwill payment	5% to 16%
Injurious affection[a]	4% to 32%
Severance[b]	0% to 19%
Disturbance[c]	1% to 14%

*Notes: a **Injurious affection** is where the road construction causes damage to the retained land e.g. view obstructed by embankment.*
*b **Severance** is where loss of part of a property reduces the value of the retained portion.*
*c **Disturbance** can be permanent where there is a loss sustained or expenses incurred as a result of the compulsory purchase of land or, temporary which includes such disturbances as dust, noise, disruption of services, etc.*

3.36 In addition, where a settlement is not reached, interest is payable from the date of entry onto lands, following the notice to enter, up to the settlement date. At present, the rate of interest is higher than that of the commercial banks for deposits. This has contributed to delays in agreeing or concluding settlement terms. This was further exacerbated, until recently, by the fact that a panel of qualified arbitrators had not yet been set up, under Section 11 of the IFA agreement, and a number of cases are awaiting settlement.

3.37 The NRA now proposes, under the Land Closures Act, 1845, to lodge the amount due for land with the courts in cases where closure is being delayed. This will have the effect of preventing interest accruing.

3.38 The cost of land acquisition is much higher in urban areas. This is underscored by the following

- the average cost of property acquisition for the SEM was around €0.75 million per acre. The highest price paid on this scheme was about €2 million per acre.
- in other urban projects, the cost was also quite high. For instance, the all-in cost per acre for the Sligo Inner Relief Road was, in some instances, as high as €300,000.

Agreement with the IFA

3.39 Local authorities have extensive statutory powers under the Roads Act, 1993 allowing entry onto land for road planning purposes. However, during 2000 and 2001 the IFA refused access and sought to negotiate higher compensation for land.

3.40 An agreement was concluded with the IFA in December 2001, by the Department of the Environment, Heritage and Local Government, and covered all agricultural land compulsorily acquired after that time up to the end of 2006. Up to that point, detailed design and land

investigation had been carried out only after the confirmation of the Compulsory Purchase Order (CPO). The agreement now facilitates the completion of both steps in parallel. The main effects of the agreement are

- to facilitate access to lands prior to a CPO for investigation purposes following 14 days notice to enter the lands
- to provide for payment of compensation for damage or disturbance during site investigation works, whether the plot is acquired or not
- in the case of buildings or other fixtures, to define the reinstatement cost as the cost of provision of new facilities instead of equivalent facilities
- to make provision for a goodwill payment of €5,000 per acre in return for co-operation with the local authority, in addition to compensation, to land owners in cases where their land is ultimately purchased under a CPO.

3.41 The value of agricultural land is assessed under open market conditions having regard to the actual size, location and quality of the land being acquired. Previously, agricultural land was purchased as a percentage of the total value of the farm.

Route Selection Risk

3.42 All routes are subject to archaeological investigation. There are three stages in this process

- a desk review together with walk-overs and geophysical surveys to inform route selection, the CPO and the preparation for the Environmental Impact Study (EIS)
- a preliminary examination to determine the presence and extent of any relevant features designed to inform the preparation of a formal physical investigation or clearance contract
- formal investigations under archaeological contracts.

3.43 The potential impact of archaeological issues is illustrated by the experience at Carrickmines on the SEM.

3.44 The EIS on the preferred route for the SEM had identified Carrickmines Castle as an important archaeological feature and recommended the investigation of the castle environs. The recommended approach was the preservation, in-situ, of the remaining upstanding element of Carrickmines Castle and investigation of the castle environs to identify any further archaeological features by excavation and recording. It envisaged preserving some sites and excavating and recording others and was endorsed by Dúchas, the Heritage Service.

3.45 Delays occurred in completing the SEM mainly due to disputes and legal action relating to archaeology. Dun Laoghaire/Rathdown County Council arranged the archaeological excavations at Carrickmines Castle, which commenced in August 2000 and were due to last until May 2001. The period allocated was extended by a further 12 months to ensure full excavation of the site and this period was again extended by a further 3 months to August 2002.

Archaeological costs have escalated as follows

	Original Contract	Projected Outturn
	€m	€m
Carrickmines Castle	0.7	6.5
Remainder of route	0.1	4.0

The increased expenditure on archaeology was retrospectively approved by the NRA in January 2003.

Conclusion

3.46 In managing road procurement the challenge is to ensure that each risk is borne by the party best positioned to manage it. For most risks, up to recently, the thinking was that it was better for the State to bear the risk and so pay only on the basis of measured outcome whether for price increases or variations to the contract. In light of experience with remeasured contracts, where the increase between tender and final contract cost has, in recent times, been of the order of 40%, a fundamental rethink on their use is justified.

3.47 A recent move to design and build arrangements results in the original tenders including a price for the risks being assumed by the contractors. The contract outturns to date have been at or around the standard costs which include an adjustment for variation. Consequently, they are, so far, providing greater outturn certainty although they continue to be susceptible to price increases. In this respect, the NRA has recently sought to fix prices which may only lead to compensation for variations when they increase by over 5% per annum.

3.48 In Britain there has been a move to earlier contractor involvement and remuneration based on a fixed fee plus agreed target costs with a provision that savings, or the cost of overruns be shared between the contractor and the Highways Agency. These new contract models will need to operate for some time before a definitive evaluation of their impact can be made.

3.49 The cost of acquiring land has increased disproportionately in recent years.

4 Managing the Road Improvement Programme

4.1 This chapter examines the management of the design and construction of road improvement projects and the mechanisms used by the NRA to manage and monitor performance in this regard.

Management of Road Projects

4.2 The Board of the NRA approves annual road grant allocations to local authorities. In managing the roads programme the NRA's main leverage derives from its control of the funds since in practice, the full cost of the programme is met from public funds. Moneys are disbursed locally and included in the accounts of local authorities (who are the statutory road authorities) and audited by the Local Government Audit Service.

4.3 In the case of PPP schemes the NRA has a more direct role, albeit achieved through a process of licensing by the local authorities to the NRA. The NRA initiates the procurement process, conducts the tender negotiations directly and is the contracting party for a PPP contract.

The effective management of the programme requires that

- programme commitments and outturns be reviewed regularly and any appropriate remedial action taken
- projects are designed and managed effectively
- projects are subject to monitoring and control.

Commitment Approval

4.4 The roles and powers of the Board derive from the Roads Act, 1993 and are set out in a Code of Practice for the Governance of the NRA.

4.5 In practice, the Board notes proposals to accept a tender by a local authority in advance of its approval by the Chief Executive and it has a sub-committee (the monitoring committee) to which certain large tenders must be brought prior to acceptance. These cover commitments for works on all major inter-urban routes, construction work costing over €40 million and service contracts over €4 million.

4.6 The monitoring committee, in turn, reports to the Board on construction contracts over €130 million and service contracts greater than €13 million.

4.7 The NRA is obliged to have regard to forward commitments when awarding contracts. The general parameters are that the sum of commitments in future years cannot exceed a certain percentage of the current year's budget. A maximum of 75% of the current year's budget may be committed for the following year, 65% for the subsequent year, 50% for the third year and 35% for the fourth year.

4.8 In practical terms, this involves a comparison of a proposed project's expenditure profile with the likely funding profile to ensure compatibility with the commitment framework. In 2003, the forward commitments were running at levels of 57%, 25%, 7% and 1%, of that year's budget, for the next four years.

Design of Roads

4.9 A network of eleven regional design offices (RDO) with 226 staff has been established. The cost of these services is met by the NRA and the staff operate under the control and supervision of an agreed lead local authority. The cost of this service in 2002 was €13.6 million.

4.10 The original purpose of the service was to plan and design projects and advance them through the statutory processes including CPOs and EISs. This role has been altered and the primary function of these offices is project management with design now mainly carried out by consultants.

4.11 The NRA has recently asked management consultants to review

- the role of the regional design offices
- the scope for a rationalised regional design network and its future structure
- the scope to improve procedures and practices within the current or revised framework.

Design and Management Costs

4.12 Concerns have been raised over the value for money aspects of fee determination on the basis of a percentage of the outturn value of a project and it has been suggested in this context that consultants lack incentives to control costs.

4.13 The fee arrangements are a modified version of those contained in Circular BC 5/87, issued by the Department of the Environment, Heritage and Local Government in 1987, which splits fee payments into three stages.

4.14 The scale of fees for contracts in excess of €25.4 million is €162,000[19] plus 4% of the cost of the works. Payments are broken down as follows

- At preliminary report stage – 35% of 4% of an estimate of the cost of the work agreed between the consultant and the local authority.
- At design and preparation of contract document stage – 35% of 4% of the actual tender sum plus a further allowance where reinforced concrete is used.
- At supervision of construction stage – 30% of 4% of the final cost of the construction works.

4.15 The NRA has developed a 'multi-framework contract'. This type of agreement allows a number of local authorities to come together and establish a list of schemes requiring consulting engineering services. The advertising, shortlisting, evaluation and interview processes follow and a panel of consultant engineers is then established. The agreement defines the services to be provided and the remuneration to be paid.

4.16 In the case of design and build contracts, the fee is reduced to 86% of 4% of the total outturn reflecting the reduced design and supervision requirements. Payments are made at 35%, 25% and 26% of the relevant sums at the three stages.

[19] This sum is paid in stages over the contract in association with the percentage based payments.

4.17 The NRA has assured me that it is satisfied that the basis of payment is reasonable because standards of design and workmanship are established in the ***NRA Design Manual for Roads and Bridges and Specification for Road Works*** and that its own and local authority staff ensure that consultants adhere to those standards and that design and specification decisions reflect value for money. There is, therefore, no opportunity for over-elaborate design.

4.18 In regard to the practice of basing the final 30% of the fee for supervision on outturn costs, the NRA points out that in most contracts, overruns are made up of three components which also impact on the costs of the consultants

- price variation — consultants' costs rise broadly in line with price variation and an increased fee based on this element is reasonable
- variations/additional works — the additional fee is justified because of the administration and supervision costs involved
- successful contractor claims — on traditional remeasurement contracts and design and build contracts, the management and administration of contractor claims is demanding of time and resources and is carried out under the close scrutiny of the local authority and the NRA and significant work is involved in assessing and contesting claims. The additional fee associated with this work is, therefore, in the view of the NRA, also justified.

Notwithstanding this, given the purchasing power of the State there may be scope to negotiate fee levels so as to reduce the cost of these professional services.

Design Initiative

4.19 The NRA has recently taken two major initiatives designed to achieve economies

- reducing the width of roads
- standardising bridge design

Reduced Cross Section

4.20 The NRA has adopted smaller cross section designs by reducing the overall width of dual carriageways and motorways by 10 metres. The grass median in the centre has been reduced to three metres (from nine metres) and the remaining savings were achieved by reducing the lane size, hard shoulders and grass verges. The savings are expected to accrue from

- Reduced land acquisition
- Reduced bridge costs
- Reduced pavement and earth works
- Less risk of environmental impacts

Standard Bridge Design

4.21 Bridges constitute a significant proportion of the overall cost of major road schemes. In the case of fully grade separated dual carriageways and motorways[20], bridge costs can typically constitute up to 20% of the overall construction costs.

4.22 Historically, bridge design for a major road scheme involved the appointment of a number of firms of consulting engineers. This resulted from the fact that indigenous Irish engineering practices were generally small and did not have the resources to deliver large numbers of bridge designs and contract documents within the requisite time scales. However, as a consequence of having to adopt this approach, there were inefficiencies and diseconomies resulting from, for example, duplication of effort and inconsistencies in the documentation provided by the consultants.

4.23 The introduction of consultancy services from abroad and the accumulation of bridge design expertise within Irish consultancies has eliminated the need to employ multiple bridge consultants on each scheme. A standard bridge type is developed for each major scheme, thereby avoiding diseconomies.

4.24 In order to further standardise bridge design practice, the NRA's inspectorate has compiled a standard set of requirements for road authorities which it is hoped will lead to further standardisation of design practice and rationalisation of bridge forms and take cognisance of the greater need for precasting or prefabrication in order to avoid resource constraints in elements such as in-situ concrete construction.

Management Reporting

4.25 Ten NRA Inspectors report to their Senior Project Managers, of which there are eight, on the monthly progress of their projects. The information is collated by one of the Senior Project Managers. The manager, in turn, compiles a report for the Head of Project Management and Engineering who presents the report to the Monitoring Committee and subsequently to the Board.

4.26 The report contains progress reports of all projects under construction, projects started in the current year and schemes being tendered for.

4.27 Outturns reported include variations and claims to date and an allowance for expected costs under these headings during the remainder of the project. It also includes the impact of inflation to date. It does not, however, include any allowance for future inflation.

Project Control – NRA

4.28 Once a project is approved by the NRA, the local authority enters into a contract with the successful tenderer.

[20] Traffic movements on or off a main road catered for by interchanges, while overbridges and underpasses cater for traffic on local roads.

4.29 Each project has a Technical Steering Committee which meets monthly, on site. The members are the NRA, the local authority, the team in the RDO who monitor the day-to-day activities on-site and the Consultant Engineer, if there is one.

Variations

4.30 Variations require NRA approval. Approval to proceed, with a variation, is given by the Senior Engineer on site. Approval is normally given in writing, to the contractor, in advance of the work being carried out.

4.31 There is a general understanding that necessary variations may go ahead and these are reported at the monthly meeting (by the on-site team). The NRA has assured me that, in practice, the constant on-site presence means that variations are usually flagged in advance.

Claims

4.32 The Engineer[21] has power under the contract to award claims and the local authority must pay them. In order to secure payment the local authority must demonstrate that adequate levels of prior approval were obtained. Claims are discussed at monthly site meetings and the practice is for the Engineer to award claims only where the NRA has indicated that it will pay for these. When a project is completed there may be claims outstanding. These can take some time to resolve as, quite often, arbitration or conciliation is necessary.

Price Variation

4.33 Most price variation is paid on an ongoing basis as costs are submitted by the contractor. However, in some cases an agreement is reached between the contractor and the local authority under which the local authority buys out the price variation clause. This requires NRA approval.

Audit by NRA

4.34 An audit section in the NRA carries out checks to ensure that local authorities can account for the moneys which they have spent. The audit section has a standard programme of work for the review of a project.

Future Management of National Roads

4.35 The NRA has overall responsibility for the planning and supervision of works for the construction and maintenance of national roads. While the NRA is vested with specific functions in this regard, it is required under the Roads Act, 1993 to operate, as far as possible, through the relevant local authority in relation to these functions. For most national road schemes, the local authority undertakes planning and design and is the contracting authority in relation to construction and maintenance works.

4.36 The NRA has recognised certain concerns and criticisms of the present approach to the implementation of the national roads programme and, in particular

[21] Each contract provides for the designation of an Engineer for the purposes of the contract. The Engineer's functions are set out in the contract and works must be completed to the Engineer's satisfaction.

- the length of time involved from project initiation to commencement of construction
- delays, objections and challenges associated with the planning process and the statutory approval procedures applying to national road schemes
- sub-optimal cost estimation and the escalating cost of the overall roads programme resulting in a gap between the cost of delivery and the level of funding currently expected to be available, and
- perceived sub-optimal project management – the apparent inability to secure value for money or bring in projects within budget and, to a lesser extent, on time.

4.37 The NRA also recognises that the current NRA/local authority relationship and the management arrangements at project and programme level are seen by some as vesting responsibility with the NRA and control with the local authorities. This division of roles was seen by some as a central cause of below optimum programme management achievement and a major cause of problems in project cost controls. According to this analysis, improved performance in both areas would be achieved if control were vested to a much greater degree, or even exclusively, in the NRA.

4.38 The NRA has informed me that it has appointed consultants to assist it in preparing a submission to the Minister for Transport setting out the position of the NRA in relation to what it considers to be the most appropriate arrangements for securing the efficient delivery of the national roads programme having regard to the need to secure value for money.

4.39 The role of the consultants is to review the operations and structure of the NRA as well as its internal and external relationships particularly with local authorities, with a view to making recommendations on their optimisation to secure further efficiencies in the delivery of the national roads programme and ensure value for money.

Conclusion

4.40 The role of the regional design offices has shifted from designing works to project management. Their role is currently under review.

4.41 There may be scope for renegotiating professional fee levels to better reflect the purchasing power of the State.

4.42 Future management of the road improvement programme should be informed by the consultants' report which is currently being considered by the Minister for Transport.

Appendices

Appendix A Programme Funding

The foregoing report has reviewed the cost of all projects at two points in time – costs at the inception of the plan and at 2002 levels.

Availability of Funding

Funding at inception before taking account of inflators was €5.6 billion.

The inflation in the cost of projects is dealt with in Appendix E. In an attempt to take account of likely cost inflation, the programme provision was expressed after the application of inflators. Accordingly, at the inception of the programme, the proposed funding was €5.6 billion or €6.75 billion adjusted for inflators.

By the end of 2003, proposed funding, after taking account of increased capital envelopes proposed in the 2004 budget, had increased by 24% to €8.4 billion as set out in Figure A.1, with the bulk of the increase being provided by the Exchequer.

Figure A.1. Funding of National Roads Programme 2000 – 2006

Year	ESIOP – Proposed Funding (adjusted for inflators) € m			Revised Funding Proposals[a] € m			Increase in Exchequer funding	Overall increase in funding
	Exchequer	PPP	Total	Exchequer	PPP	Total		
2000 – 2003	2,929	443	3,372	3,782[b]	52[c]	3,834	29%	14%
2004	701	362	1,063	1,227	150	1,377	75%	30%
2005	749	385	1,134	1,320	250	1,570	76%	38%
2006	786	393	1,179	1,335	250	1,585	70%	34%
Total	**5,165**	**1,583**	**6,748**	**7,664**	**702**	**8,366**	**48%**	**24%**

Notes: *a* *2004 – 2006: Budget 2004.*
b *Actual funding.*
c *Approximate outturn.*

In addition, the 2004 budget proposed funding of €1.7 billion in 2007 and €1.8 billion in 2008, both inclusive of €250m per annum funding under PPP arrangements.

Private Funding

The NDP envisaged that a minimum of €1.3 billion (€1.6 billion including inflators) of the original funding provision would be sourced though the PPP mechanism.

By 2002 the projects to be included in the PPP programme had been selected and are targeted to provide €1.2 billion by way of private funding. The overall PPP programme envisages the completion of construction work, funded by public and private moneys, valued at €3.2 billion in 2002 prices. Some of this work will be completed after 2006.

The full €1.2 billion will not be sourced by the end of 2006. The likely level of private investment before 2007 is around €700 million. The reason for this is that certain schemes selected for partnership funding will not start early enough to draw down the private funding.

The level of private investment in projects is determined ultimately by the view taken by the private investors of the traffic levels expected on the roads. This is the major variable factor in determining their turnover since toll charges on the routes are being set by the NRA. Consequently, the levels of private funding which may materialise are scheme specific.

Tolling

The NRA policy is to

- devise tolls at an affordable level consistent with its objective of deriving revenue for the construction and operation of the road
- ensure significant usage of the proposed road by avoiding serious traffic diversion
- deliver each scheme's transportation and environmental benefits.

Consequently, for a number of the PPP schemes, the setting of tolls at affordable levels will entail a substantial public sector subsidy as it is not envisaged that the toll rates proposed could provide sufficient revenues to a concessionaire to cover the full construction outlay and the long-term operational and maintenance costs. The extent of the subsidy required will emerge from the competitive tender process used.

Tolling currently exists on the Westlink and Eastlink bridges and on a section of the M1 route. A six-month contract was entered into with a private operator in June 2003 to collect tolls from users of the Drogheda section of the M1. These tolls will be treated as assigned revenue and used as part of the PPP financing deal for the Dundalk Western bypass, which was delayed due to a legal challenge which has now been disposed of. The net proceeds in the first half-year of operation, June to December 2003, amounted to €4.72 million.

Funding Gap

By the end of 2006, assuming construction inflation of around 3 - 5% per annum for the period 2004 – 2006, approximately 51 - 52% of the programme will have been delivered.

The funding shortfall cannot be bridged within existing established priorities for public capital investment. The options appear to be limited to allowing the period for delivery of the programme to be extended into the post-2006 period or generating new sources of funds or a combination of both.

Other funding options might include options such as

- tolling existing facilities
- making a State contribution over the period of a PPP scheme instead of up front
- generating income from roadside concessions
- raising separate revenue by securitisation of income flows from tolling or concessions.

Appendix B Core Improvement Programme Estimates

The programme being pursued by the NRA envisaged carrying out works costed at €7 billion. €6 billion of these works related to the national primary routes including the five major inter-urban routes. Excluding non-standard works a core national primary programme costed at €5.1 billion at inception was being prioritised. This appendix sets out a summary of the development in the estimated cost of the projects by route between the inception of the programme and 2002. The 2002 figures took account of scope changes in the meantime.

	2000		***2002***	
	NRA Initial Estimate	***Standard Cost***	***NRA Estimate***	***Standard Cost***
	€ m	***€ m***	***€ m***	***€ m***
Major Inter-Urban Routes				
N1	327	455	665	565
N4/N6	849	1,112	1,590	1,591
N7	691	800	1,353	1,008
N8	719	1,081	1,350	1,402
N9	162	277	862	858
	2,748	***3,725***	***5,820***	***5,424***
Other National Primary Routes				
N2	138	236	307	255
N3	250	397	755	709
N4	71	133	140	142
N5	94	119	182	194
N11	291	390	535	522
N13	27	37	61	60
N15	100	126	159	135
N17	231	341	372	407
N18	289	400	638	686
N20	206	375	338	381

N21	116	160	151	208
N22	97	101	250	233
N24	142	210	332	310
N25	178	283	591	323
N26	33	42	52	53
N28	13	26	75	38
N30	26	67	64	66
M50[a]	15	7	69	9
	2,317	***3,450***	***5,071***	***4,731***
Additional Works[b]			***723***	***484***
Total Estimated Cost	**5,065**	**7,175**	**11,614**	**10,639**

Notes:

a *These works included structures which were not capable of accurate estimation using the then standard costing methodology.*

b *Additional works are road improvements initiated after 2000. They are detailed in Appendix C.*

Appendix C Additional Works

Certain works not originally included in the programme were subsequently prioritised. These have been estimated to cost €0.72 billion at 2002 price levels. The standard costs of these works was €0.5 billion. For most projects the cost as estimated by engineers coincides with the standard costs. However, the ring roads and interchanges in Cork were urban projects which had features that increase the cost above the levels predicted by a standard cost approach.

		2002 Estimate
		€ m
N2	Slane Bypass	29
N4	Enfield Relief Road	12
N4	Carrick-on-Shannon Bypass	25
N4	Cloonmahon/Castlebaldwin	34
N5	Longford Bypass	14
N5	Strokestown Bypass	30
N7	Naas Road (Kingswood Interchange)	5
N16	Sligo/NI Border	159
N22	Gortalea/Farranfore (Inchinveema)	12
N22	Cork Northern Ring Road[a]	226
N25	Cork Southern Ring Road Interchanges	80
N25	Kinsale Road Interchange	45
M50	Second Westlink Bridge	23
	Miscellaneous	29
Total additional works		**723**

Note: a Includes both road works and interchanges.

Appendix D Standard Costs

The format of the target costing methodology used by the NRA is based on its *Method of Measurement for Roads Works*. The individual elements correspond with typical headings in a Bill of Quantities for a roads project.

In compiling the standard costs from time to time, the cost of labour and materials current at the time of compilation are used and quotations are obtained from major sub-contractors for specialist works.

Included in the standard cost per kilometre is an allowance of 20% of the value of all planned work to allow for such items as site accommodation, site vehicles, insurance, bonds, etc. A further allowance of 20% is included for claims and variations allowable under the terms of the contract.

The relevant standard costs for each road type comprised in the programme are set out in Figure D.1. The detailed scheme for their derivation is illustrated in Figure D.2 (for standard dual carriageway/motorway in 2002).

Figure D.1 Target or Standard Road Costs by Road Type Compared with adjusted NRNS costs

	Road Width (metres)	**Costs per Kilometre €m**		
		Adjusted NRNS Cost[a] 1999	Standard Cost 2000	Standard Cost 2002
Reduced Two Lane	13	1.54	2.09	2.58
Standard Two Lane	18.3	1.96	2.77	3.33
Wide Two Lane	21	2.37	3.16	3.81
High Quality Dual Carriageway/High Quality Motorway[b]	28.5	4.89	6.73	7.80
Wide Median Dual Carriageway/Wide Median Motorway[c]	36	6.29	8.28	10.32

Notes:
a The NRNS cost was adjusted by 10% to allow for inflation.
b Includes roads previously designated as Reduced Dual Carriageway.
c Includes roads designated as Standard Motorway and Standard Dual Carriageway.

Figure D.2 Standard Cost for Standard Dual Carriageway/Motorway 2002

Activity	Cost per kilometre €m
Site clearance	0.026
Fences	0.155
Barrier	0.042
Drainage	0.607
Earthworks	1.300
Pavement	0.788
Kerbs	0.023
Roads and Interchanges	0.598
Statutory Undertakers	0.047
Structures	0.074
Standardised bridges	1.076
Total for Construction Work	**4.736**
Preliminaries	0.947
Variations	1.137
Construction Cost per Kilometre	**6.820**
VAT	0.921
Construction Costs excluding Land	**7.741**
Increase for Other Costs, including Land	2.580
Total Construction Cost per Kilometre	**10.321**

Road width is based on the measurement from the outside edge of the grass verge to the corresponding edge on the other side. This cross section width is a key determinant of the cost of the roadway. The use of the term “Motorway” or “Dual Carriageway” is determined by the type of access permitted rather than cross-section width.

Appendix E Road Construction Inflation

Sources of information

The Department of the Environment, Heritage and Local Government (DoEHLG) publishes the annual Construction Industry Review and Outlook (the Review), which includes an index for road construction inflation.

In compiling the index the DoEHLG uses information supplied by the NRA, the Department of Transport and other sources. The index is set out in Figure E.1.

Figure E.1 Road Construction Inflation 1996 to 2002[a]

Year	%
1996	2[b]
1997	3[b]
1998	5
1999	10
2000	12
2001	9
2002	5

Source: *Department of the Environment, Heritage and Local Government. Index for New Infrastructure – Roads, Review and Outlook for the Construction Industry, 2003.*

Notes:
a *For the purposes of comparison with the inflation rates reported by the DoEHLG a composite index was compiled using cost categories identified by the Central Statistics Office in its wholesale price and building earnings indices, adjusted by weightings relevant to the road sector. This was designed to isolate cost inflation movements in the sector. The result was an inflation index which was reasonably close to the DoEHLG road inflation index.*

b *Inflation for the period 1995 to 1998 was 11.4%. It has been assumed that inflation was 1% in 1995, 2% in 1996 and 3% in 1997.*

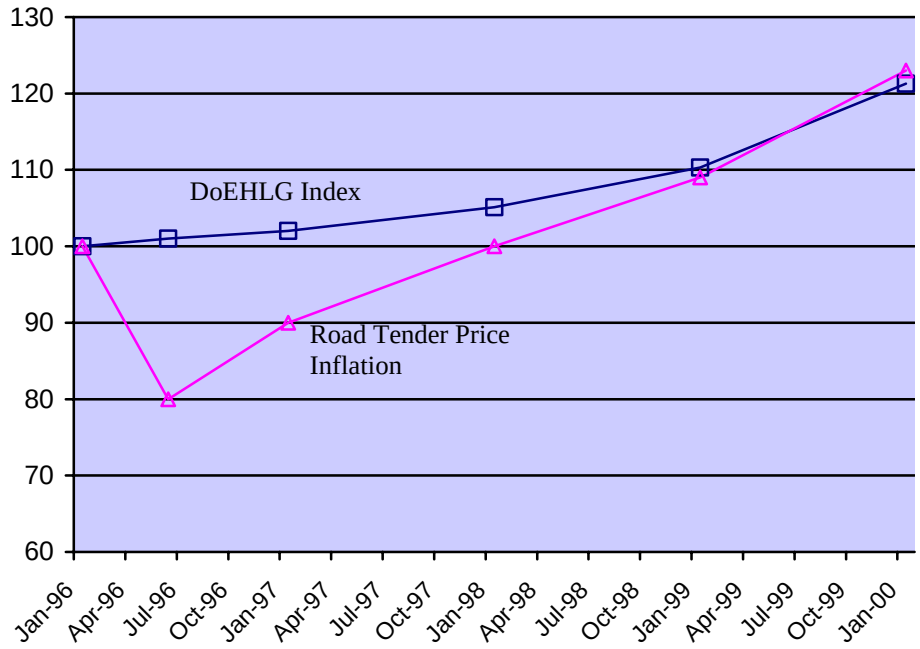
The overall increase in inflation between 1996 and the end of 2002 is estimated at 55.5%.

For purposes of this report, it has been assumed that, overall, the rate of construction inflation can be applied equally to all projects including to their land acquisition costs. In addition, it has been assumed that, while there may be differences in individual years between cost and tender price indices, over time the rate of increase will be similar for both types of index.

The NRA commissioned a study of inflationary trends in 2000. The study, by Stavely and Partners, Consulting Engineers and Quantity Surveyors compared tender price inflation with the DoEHLG index for the period from late 1995, when both indices were based on a value of 100, to early 2000. The study noted that there was a rapid fall in the inflation trend for road tenders in 1996[22] and a steady rise in the trend for the years 1997 to 2000. By March 2000, the study indicates that the two indices were at the same level. Trends in road inflation from January 1996 to January 2000 are set out in Figure E.2.

[22] The tender for the Arklow Bypass, in April 1996, was at around 80% of the expected tender at NRNS price levels. The actual construction outturn was 65.5% greater than the tender price when the project was completed in January 1999.

Figure E.2. Trends in road inflation Jan 1996 – Jan 2000



Source: *DoEHLG Index. Review and Outlook for the Construction Industry, September 2003*
Road Tender Price Inflation. Study of Inflationary Trends in Tenders/Costs of Current and Recent Road Projects, October 2000. Stavely and Partners, Consulting Engineers and Quantity Surveyors.

The figure indicates that, by mid-1996, tender prices had fallen by around 20% from the early 1996 levels while costs in the industry rose steadily. However, in the period from mid-1996 to 1999 tender prices rose more rapidly than costs and by the end of 1999 tender prices and costs exceeded levels of late 1995 by just over 20%.

Calculation of price effects in report

The original estimates prepared by the NRA were stated in early 1999 prices, while the standard costs compiled by the NRA were stated at 2000 and 2002 price levels. Inflationary effects, for the programme, were calculated as follows

Core Programme	
1996 to 1998	Approximately 80% of the original 1999 estimates were based on the 1996 NRNS estimates. The NRA had increased the NRNS based estimates by 10% in order to calculate the 1999 prices. No adjustment is required for this period.
1999	Inflation for 1999 was 10%. The 2000 standard costs, at the inception of the NDP, included €0.7 billion inflation for 1999.
2000 to mid-2002	The price increase for this period, €1.9 billion, was calculated by comparing the standard costs in 2000 and 2002, on a route-by-route basis.
Non-Standard and Other Works	
1999 to mid-2002	The price increase, around €1billion, was calculated on a route-by-route basis for the major non-standard works and on a programme basis for the remaining non-standard and other improvement works. This assumes that inflation for these projects was in line with general road inflation. In addition, there were

exceptional increases in the cost of land for the South Eastern Motorway.

Overall programme	
2003	Road construction cost inflation was around 5% from mid-2002 to December 2003. Allowing for funding already applied between 2000 and 2003, the adjustment required to bring the cost of the uncompleted work to 2003 price levels is of the order of €0.6 billion.

Appendix F Non-Standard Works

	2000 estimate	2002 estimate
	€ m	€ m
Dublin Port Tunnel	***220***	***580***
South Eastern Motorway	***153***	***530***
Non-Standard Improvement Works		
Naas Road widening	56	196
Edgeworthstown Bypass	12	46
Ballyvourney/MacroomBypass/Ballincollig	78	225
Ballinteer/Wyckham	7	17
Celbridge Interchange	7	14
Enniskerry Junction	3	4
Leixlip/M50 Junction	21	41
Cork Southern Ring Road Resurfacing	13	6
M50 Improvements	190	562
	387	***1,111***
Total Non-Standard Works	**760**	**2,221**

Appendix G Alterations within the Programme

The movement between the cost of the programme estimated at different dates using a standard cost methodology gives an indication of the impact of the price increases and internal scope changes which had occurred in the interim. In order to gauge the extent of the movement that would have been expected at standard costs over the two years, a comparison was made which revealed that the core programme cost would have increased from €7.2 billion to €10.2 billion, calculated at standard costs, while new works added a further €0.7 billion at 2002 prices. The effect of these changes is shown in Figure G.1.

Figure G.1 Cost Effect of Variations in Core Programme

	Length Changes	Scope Changes	Price Variations	Total Variations
	€ m	€ m	€ m	€ m
Major Inter-Urban Routes	275	482	942	1,699
Other National Primary Routes	222	145	914	1,281
Variations in Original Projects	497	627	1,856	2,980
New Works at 2002 Prices				723
Cost of all variations 2000 – 2002				**3,703**

Scope changes involve the alteration of road types. Decisions made to change the road type of projects added €0.6 billion to the cost of the programme. The scope changes had knock-on effects for the length of roads and this again added a further €0.5 billion to the cost. The most significant scope change was the decision to upgrade the Dublin/Waterford route (N9) to motorway or high quality dual carriageway standard from a wide two lane route, which together with length variations added €455 million to the cost of improvements on this route.

The variations to the core programme of works expressed in 2000 standard prices added €1.1 billion to overall cost. New works added a further €0.7 billion to the cost of the programme at 2002 costs. This indicates that even if no price increase occurred, changes in the programme would have added 15% to its cost and the cost of the programme increased by a further 6% due to the addition of new works.[23] Price increases between 2000 and 2002 added another €1.9 billion.

While it is accepted that the length of routes cannot be accurately determined until after route selection stage the estimation method used resulted in cost underestimates. This arises due to the fact that estimation was based on lengths measured from town to town along old routes, while after selection the new routes, in most cases, were longer.

The net cost of scope and length changes mask changes arising from both increases and decreases depending on the route involved. These are summarised for the major inter-urban routes and national primaries in Figure G.2.

[23] Variations to core programme expressed as a percentage of 2000 standard cost. New works expressed as a percentage of 2002 estimate for core programme, excluding new works.

Figure G.2 Effect of increases and decreases in scope and length

	Scope changes	Length changes
	€ m	**€ m**
Increases in cost	809	921
Decreases in cost	(182)	(424)
Net change	**627**	**497**

The NRA has informed me that the route selection process is a compromise between finding the path of least physical resistance and minimising cost by avoiding physical, environmental and archaeological features which could subsequently stop or delay the scheme. In the case of bypasses, it is inevitable that the route around an urban area will be longer than the old route particularly if the old route is relatively straight.