



THE IRISH ACADEMY OF  
**ENGINEERING**

**Response to the**

**NTA Consultation on the**

**Development of METROLINK**

May 11<sup>th</sup>, 2018  
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## **The Irish Academy of Engineering**

The Irish Academy of Engineering is an all-Ireland body, concerned with long term issues where the engineering profession can make a unique contribution to economic, social and technological development.

Its members are Irish engineers of distinction, drawn from a wide range of disciplines, and membership currently stands at approximately 150.

Drawing on the experience and knowledge of its distinguished members, the Academy works to facilitate communication and dialogue on engineering-related matters. It regularly publishes reports and analyses, some jointly with other learned and professional bodies.

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## 1. Forward

The Irish Academy of Engineering has completed a series of reports on important topics with a significant engineering dimension. Normally these reports focus on longer term issues. But on occasions, particularly when external developments introduce near term problems or issues the Academy undertakes an analysis designed to help identify appropriate solutions. These reports follow the normal pattern of the Academy's work viz. quantifying problems, examining alternatives, proposing cost effective solutions

The Academy believes that adopting the proposals contained in this submission would

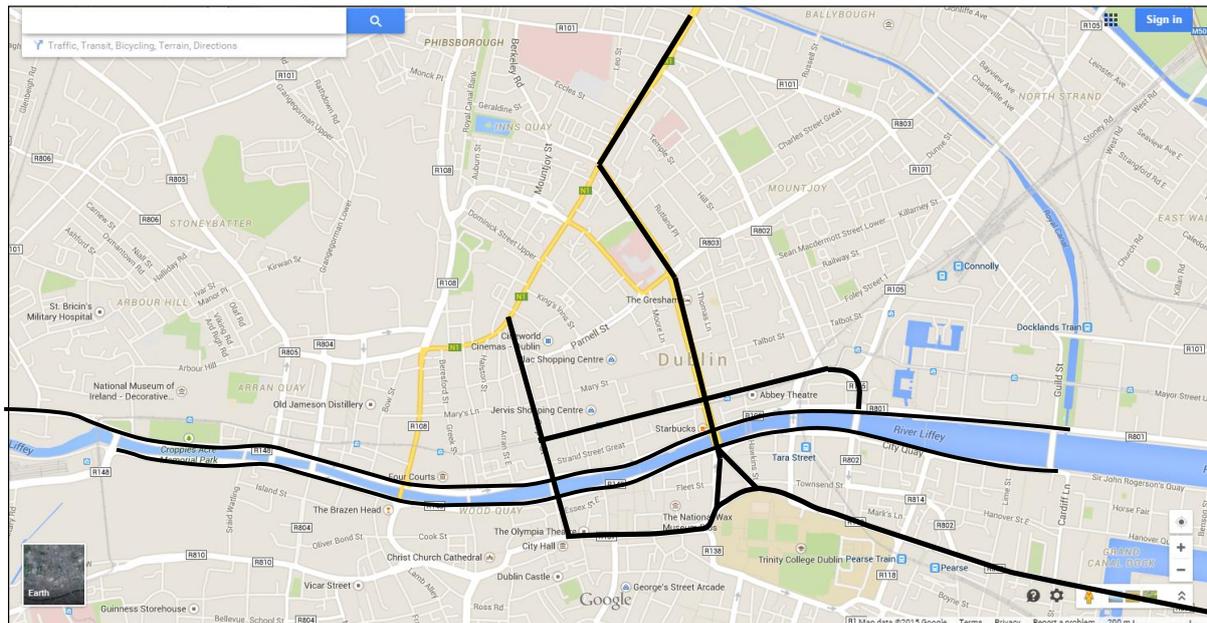
- Reduce the civil engineering costs of the Metro project by in excess of €500m
- Allow the north city transport network be developed on the fishbone model, thus increasing Metro patronage and reducing road traffic congestion
- Make a greater contribution to facilitating the development of higher density housing
- Make a comparable contribution to improving social inclusion

## 2. Introduction

The Academy considers that the consultation process now being undertaken by the National Transport Authority (NTA) in relation to METROLINK (previously called New Metro North) represents a welcome advance in the provision of an essential piece of transport infrastructure in Dublin. Indeed the Academy called for such a development in its submission to the NTA in Feb 2015 in response to the NTA's call for input in the preparation of its Transport Strategy for the GDA 2015-2035 [http://iae.ie/wp-content/uploads/2017/07/IAE\\_Submission\\_on\\_Dublin\\_Transport\\_Policy.pdf](http://iae.ie/wp-content/uploads/2017/07/IAE_Submission_on_Dublin_Transport_Policy.pdf) and in its report Sustainable Transport Infrastructure 2035 <http://iae.ie/publications/spatial-planning-infastructure-iae-sustainable-transport-2035-may-18-2016/>

The requirement for a high capacity North/South link, circa 20,000 passengers/hour/direction, stems from the fact that, though Dublin's "Wide Streets Commission" made excellent progress in providing West-East thoroughfares through the city and a high quality thoroughfare from the north city to College Green see Fig 1, it made no provision for a North-South route through the city. This was because none was required in the late 18<sup>th</sup> and early 19<sup>th</sup> century, given the pattern of development of the city at that stage. Today the lack of such a high capacity corridor is a major barrier to the proper and efficient functioning of the city and indeed the country as a whole as a significant portion of the private car traffic on the M50 is effectively cross city traffic, that would more naturally travel through the city, by other means of transport, if an efficient alternative was available. The M50 is now operating at capacity, with private car levels exceeding 5000 vehicles/hour/direction on four lane/direction sections, at peak times. Thus the provision of a high capacity cross city rail link is an essential and urgent requirement.

Fig 1 Road Widening Schemes Undertaken by the “Wide Streets Commission”



However while strongly supporting the concept put forward by the NTA; the Academy has some proposals in relation to some of the design aspects in the consultation documentation. The Academy believes the overall cost of the project could be reduced by over €500m, by choosing an alternative alignment to those considered between the M50 and the Royal Canal.

Furthermore the Academy considers that its proposal, in addition to saving a considerable sum of money, would attract more patronage, facilitate higher density residential development on key sites along its proposed route and would make a comparable contribution to social inclusion.

In addition by reducing the bored tunnelling requirement from Ballystruan (south of the airport) to Ranelagh from 11.2km, detailed in the New Metro North, Emerging Preferred Routes study for the NTA, to 5.0km in the alternative alignment proposed by the Academy, it eliminates the need for a second tunnel boring launch site.

### 3. Selection of a Lower Cost and More Beneficial Alignment

While the alternative route proposed here lies outside of the eastern Boundary for Study Area B in the New Metro North, Alignment Option Study, p4, it would, we believe, very substantially reduce the bored tunnelling requirement. The alternative, described by the Academy as Metro North/South would provide a fully segregated alignment between the airport and Ranelagh, using a mixture of at grade, cut & cover tunnel and elevated alignment between the M50 and Drumcondra, where an acceptable launch site for a tunnel boring machine is available in Clonliff College grounds.

The Academy’s proposed alignment, including the different construction elements envisaged is illustrated in Fig 2. (to follow) and detailed in eight 1:1000 maps provided to TII. The proposed METROLINK stations and Metro N/S stops, except for Drumcondra station, between the airport and the Royal Canal are contrasted in the following table. The METROLINK stations are those in the New Metro North, Emerging Preferred Route study report.

<b>METROLINK (New Metro North)</b>	<b>Metro North/South</b>	
<b>Underground Stations</b>	<b>Stops/Station</b>	<b>Elevation</b>
Dardistown	Dardistown	At Grade
Northwood West	Northwood Central	At Grade
Ballymun	Coolock Lane (Santry)	Elevated
Collins Ave. DCU	Port Tunnel Portal	At Grade
Griffith Park West (Na Fianna)	Shantalla Rd.	At Grade
Whithworth Rd.	Collins Ave. DCU	Elevated
	Griffith Ave.	In Cutting
	Richmond Rd	Elevated
	Drumcondra	Underground

Thus in the Academy's proposal six underground stations are replaced by four at grade stops, two elevated stops, one in cutting stop and one underground station. In addition, between Ballystruan (south of the airport) and the Royal Canal 6.1km of twin bored tunnel would be replaced by 2.1km at grade, 0.5km of embankment, 0.8km in cutting, 1.3km of viaduct, 1.5km of cut & cover tunnel and 0.4km of twin bored tunnel i.e. 6.6km in total.

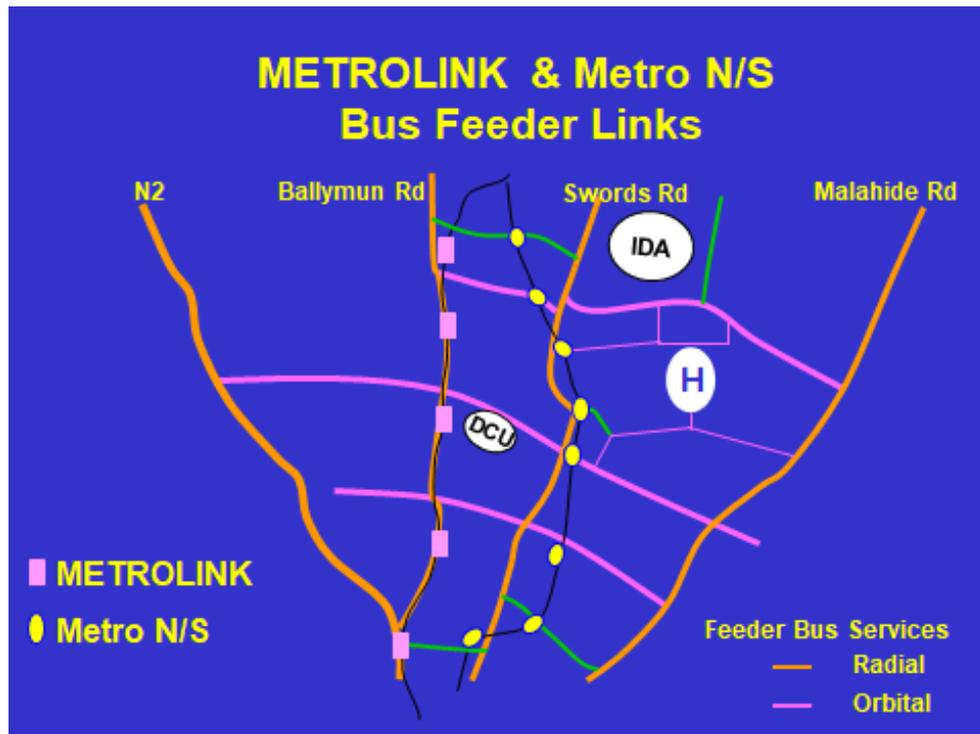
The Academy's comparison of the civil engineering costs of the different routes, for the section where the alignments differ, is given in Appendix 1. The costs for the METROLINK element are derived from the alignment and cost estimates for twin bored tunnelling and underground stations given in the Tunnel Configuration Study prepared for the NTA. The costs for the at grade, elevated and cut & cover elements of the Metro N/S alignment are based on estimates made by Roughan O'Donovan, in an earlier study for the Metro North East Route Alliance. The bored tunnelling and underground cost estimates are the same as used for METROLINK.

The conclusion of the cost estimate comparison is that adopting the alignment proposed by the Academy would result in a civil engineering cost saving in excess of €500m, i.e. over 60% of the estimated civil engineering costs of the section where the Academy's alignment differs from that in the consultation documentation. In addition there would be significant mechanical and electrical capital cost savings on the provision of escalators and ventilation equipment and ongoing operating cost savings by having five fewer underground stations. The costs of developing the Whithworth Rd or Drumcondra sections to Ranelagh will be the same for both options but will be higher than estimates made to date, for the reasons identified in Section 7.

#### **4. Public Transport Patronage**

International experience shows that where a high capacity radial rail line serves urban areas with relatively low population densities, as is the norm in suburban Dublin, the highest patronage levels are achieved if the local transport network can be organised on a fishbone basis. That is where the rail line acts as the spine and the local bus network, operating on orbital roads, acts as a feeder system for the rail route. This arrangement has the potential to extend the rail catchment area from 1km either side of the rail line to 5km either side as indicated for Metro N/S in Fig 3.

Fig 3



This mode of operation is not feasible on the Luas Green Line as it has neither the capacity, at peak times at present, nor the required orbital road network. But the north city has a significant number of major orbital roads as well as a number of minor orbital roads. Thus, where possible, the Metro line should be designed to facilitate fishbone operation, to maximise patronage. The Northside METROLINK design may be improved we believe, as only one of the proposed underground stations, between the M50 and the Royal Canal, Whithworth, directly serves a minor orbital road. The DCU station is 150m from Collins Ave. and the Northwood West station is 250m from Northwood Ave. In contrast the proposed Metro N/S alignment has stops directly adjacent to the three major orbital roads in the north city viz. Oscar Taylor Rd/Coolock Lane, Collins Ave. and Griffith Ave. In addition it has stops directly adjoining Northwood Ave. Shantalla Rd. and Richmond Rd. thus enabling the development of a fishbone transport network, capable of serving the 120,000 people living between the Malahide Rd. and the N2, south of the M50/R139 and north of the Royal Canal.

In addition the proposed stop east of the Port Tunnel Portal could serve Beaumont Hospital, its rear entrance being 1.5km away. A shuttle bus service should be provided connecting the hospital campus to the Metro. Surveys have indicated that approximately 20,000 persons/day pass through the doors of the hospital on weekdays between 08.00 and 17.00 and there is additionally substantial traffic outside these hours, throughout the year. Road access to the hospital is poor and car parking, for staff, day patients and visitors is limited.

Therefore based on the above analysis it is believed that the proposed Metro N/S is capable of attracting a significantly higher level of patronage, than METROLINK, provided the required bus services are put in place and could consequently would make a greater contribution to reducing traffic levels on the already congested radial roads, thus benefiting all travellers

## 5. Contribution to Social Inclusion

The original Metro North proposal and the current METROLINK proposal place significant emphasis on the contribution it would make to social inclusion in Ballymun. However though Ballymun is nationally known, because of its original high rise, though low density, development, it has no monopoly on social deprivation in the north city. Indeed the 1986 Census, taken prior to the redevelopment of Ballymun, revealed that there were four distinct areas in the north city where a number of contiguous District Electoral Divisions had unemployment rates in excess of 30% and indeed in some cases 50%. Thus METROLINK would help to address social deprivation in just one of those areas. In contrast Metro N/S, if it is developed on the fishbone model, as proposed, could make a contribution to addressing social deprivation in a number of areas

## 6. Facilitation of Higher Density Residential Development

The METROLINK Northwood West station would facilitate higher density residential development in the undeveloped areas south of Junction 4 on the M50 and north of Ballymun, though development of these lands would be almost equally well served by the Northwood Central stop, on the proposed Metro N/S. But the latter would facilitate higher density residential development on over 45ha of additional land, much of it in Local Authority ownership, as indicated in the following table.

<b>Housing Development Potential on Metro N/S Route</b>		
<b>Location</b>	<b>Area ha</b>	<b>Served by Metro N/S stop</b>
Coolock Lane	22.0	Port Tunnel Portal
Collins Ave	6.5	Collins Ave./DCU
Carmelite Convent	1.8	Griffith Ave.
Tolka Park	1.5	Richmond Rd.
Holy Cross College, Clonliff	14.0	Richmond Rd.
<b>Total</b>	<b>45.8</b>	

## 7. Academy's Observations in Relation to Design Aspects of NTA's Proposed Solution

The Academy has a number of detailed comments in relation to some of the engineering aspects put forward in the detailed documentation made available for consultation purposes.

### 7.1 Selection of the Metro/Luas Cross City interchange location

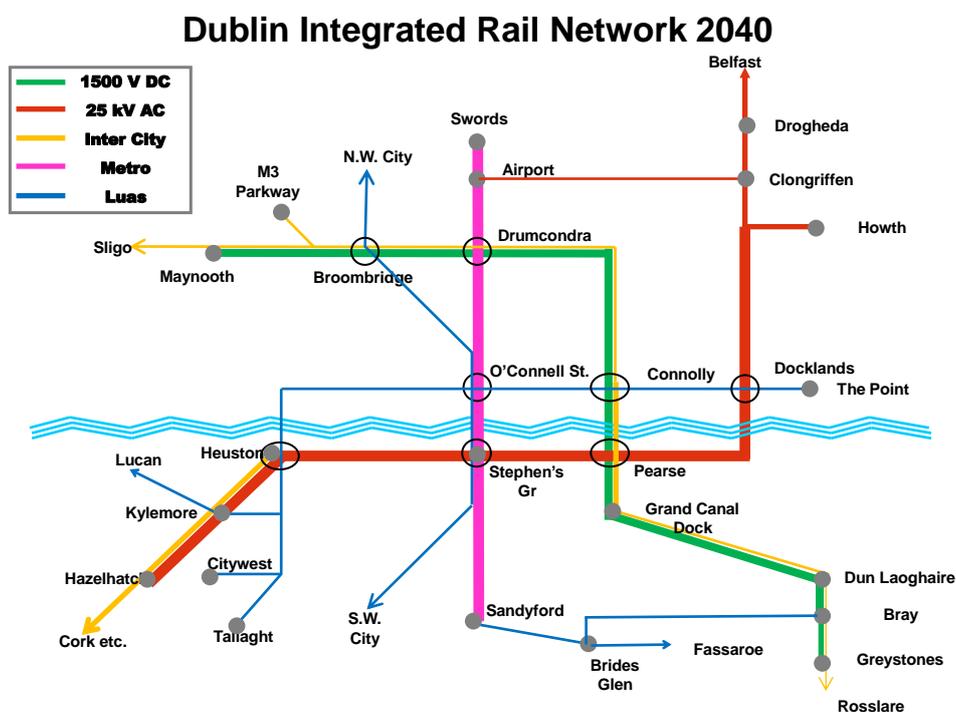
The Academy considers that the construction of a Metro station at Adelaide Rd. as opposed to the one proposed at Charlemont is both feasible and represents a more satisfactory longer term solution. This is because while it would require a 180m walk to connect to Luas Cross City at Harcourt St. it would then allow for the extension of Luas Cross City from Harcourt to the south west city, an area with particularly slow bus and car travel times at present. The Academy recognises that a previous study on the extension of the Luas to the south west city failed to identify a satisfactory alignment. But future developments, including the suggestion that Cathal Brugha Barracks be redeveloped for housing may make a Luas extension feasible. Therefore this option should be kept open, rather than closed out, as would be the case if the Metro to Luas connection was at Charlemont. Furthermore a station at Adelaide Rd. rather than at Charlemont would result in more even distances between stations.

## 7.2 Need to allow for integration with proposed DART Interconnector

The Academy recognises that relocating the Metro station site from the western to the eastern side of St. Stephens Green makes the construction of the station easier, by avoiding conflicts between construction traffic and the Luas system. But the Academy also considers it essential that the design of the St. Stephens Green station be fully engineered, to allow for future integration with the proposed DART Interconnector, notwithstanding the present proposed connection to the existing DART and Commuter networks at Tara St.

This would enable full connection between a reconfigured and extended DART and Commuter networks at some future date and permit the development of a coherent rail network, serving the whole of the city, as envisaged by the Academy in its previously referenced submission to the NTA and as illustrated in Fig 4. This development is considered essential if commuters are to have acceptable travel times and access to affordable housing and if Ireland is to meet its emission reduction obligations.

Fig 4



## 7.3 Proposal to construct city centre station boxes by top-down means

The Alignment Option Study p174 proposes that the station boxes at Tara St. and O'Connell St. Upper be constructed by top down means. This would require excavations which would be over 18m wide, 25m deep and 80m long at each location. This could result in effectively closing O'Connell St. to through vehicular traffic for the duration of the station box construction and require the demolition of 70 relative new apartments and a recreation centre near Tara St. station. Given the importance of O'Connell St. for bus and Luas Cross City traffic and the lack of by-pass options, coupled with the chronic shortage of housing in the city at present the Academy considers this proposal is likely to prove unacceptable. The alternative is that the platform areas of these stations are developed by mining methods, from the bored tunnels. This would confine the excavation to

that required for passenger access and for mechanical and electrical services, thus limiting traffic disruption and housing controversy.

## **8 Conclusions**

The development of a cross city Metro is now essential and the Academy believes that this commentary will add to the efficacy of this important infrastructure project which is in line with the recommendations in the Academy Reports mentioned earlier . Furthermore we believe that the changes, which are suggested here are worth examining, to add to the public value of the project, and the selection of such an alternative alignment between the M50 and the Royal Canal could

- Reduce civil engineering costs by in excess of €500m
- Allow the north city transport network be developed on the fishbone model, thus increasing Metro patronage and reducing road traffic congestion
- Make a greater contribution to facilitating the development of higher density housing
- Make a comparable contribution to improving social inclusion

The Academy is happy to discuss these suggestions in further detail if required.

## **Appendix 1**

**METROLINK Ballystruan - Whithworth Rd 80m Trams**

**Civil Engineering Cost Estimates**

<b>Profile</b>	<b>At Grade</b>	<b>Embankment</b>	<b>Cutting</b>	<b>Viaduct</b>	<b>Cut &amp; Cover Tunnel</b>	<b>Twin Bored Tunnel</b>	<b>Total</b>
	m	m	m	m	m	m	m
Ballystruan-Whithworth Rd.						6065	6065
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>6065</b>	<b>6065</b>
<b>Prime Cost Estimates</b>							
Linear Works €/km	4	10	5	20	35	47.3	
Estimated Cost €m	0.0	0.0	0.0	0.0	0.0	286.9	<b>287</b>
<b>Stops 90m Platform</b>							
		<b>Cut &amp; Cover</b>			<b>Mined</b>		<b>Total</b>
		Ultra Shallow	Shallow	Deep			0
<b>Number</b>		2	3	0	1		
<b>Prime Cost Estimates €/Unit</b>		24	36	33.5	50		
Estimated Cost €m		48	108	0	50		<b>206</b>
<b>Total Prime Cost €m</b>							<b>493</b>
Engineering, Inflation, Risk							
Project Management VAT							
80 % of Prime Cost							<b>394</b>
<b>Total Civil Construction Cost €m</b>							<b>887</b>

**Metro North/South Ballystruan - Drumcondra 80m Trams**  
**Civil Engineering Cost Estimates**

<b>Profile</b>	<b>At Grade</b>	<b>Embankment</b>	<b>Cutting</b>	<b>Viaduct</b>	<b>Cut &amp; Cover Tunnel</b>	<b>Twin Bored Tunnel</b>	<b>Total</b>
	m	m	m	m	m	m	m
Ballystruan-M50 Overbridge	100	465	300				865
M50 Overbridge-Northwood Central Stop				100	640		740
Northwood Central Stop-Coolock Lane Stop	380			170			550
Coolock Lane Stop-Port Tunnel Portal				485			485
Port Tunnel Portal-Shantalla Rd.	810						810
Shantalla Rd.-Collins Ave	400		150	250			800
Collins Ave.-Griffith Ave.	385				365		750
Griffith Ave.-Richmond Rd.			360	145	400		905
Richmond Rd.-Drumcondra		<u>60</u>		<u>170</u>	<u>60</u>	<u>350</u>	<u>640</u>
<b>Total</b>	<b>2075</b>	<b>525</b>	<b>810</b>	<b>1320</b>	<b>1465</b>	<b>350</b>	<b>6545</b>
<b>Prime Cost Estimates</b>							
Linear Works €/km	4	10	5	20	35	47.3	
Estimated Cost €m	8.3	5.3	4.1	26.4	51.3	16.6	<b>112</b>
<b>Number of Stops</b>							
	<b>At Grade</b>	<b>In Cutting</b>	<b>Elevated</b>		<b>Cut &amp; Cover</b>	<b>Mined</b>	
	4	1	3			1	
<b>Prime Cost Estimates €/Unit</b>	2	5	6			50	
Estimated Cost €m	8	5	18		0	50	<b>81</b>
<b>Total Prime Cost €m</b>							<b>193</b>
Engineering, Inflation, Risk							
Project Management VAT							
80 % of Prime Cost							<b>154</b>
<b>Total Civil Construction Cost €m</b>							<b>347</b>