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OFFICE OF PUBLIC WORKS

# River Deel (Crossmolina) Drainage Scheme

# Cost Benefit Analysis Report

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RYAN HANLEY

# 1. Introduction and Background

## 1.1. Brief History

The River Deel and Crossmolina Town have a long history of flooding. The four most recent flood events in 1989, 2006, and 2015 (November and December) resulted in flooding of three main streets in Crossmolina Town.

At the request of Mayo County Council, the Office of Public Works (OPW) carried out a Feasibility Study in 2012, which established the potential viability of a Flood Relief Scheme for the River Deel.

## 1.2. River Deel Flood Relief Scheme

In order to further develop a Flood Relief Scheme, the OPW engaged Engineering and Environmental Teams as follows:

- Ryan Hanley in association with JBA Consulting / Hydro Environmental has been commissioned by the OPW to provide engineering services in relation to the proposed River Deel (Crossmolina) Flood Relief Scheme.
- Ryan Hanley in association with McCarthy Keville O'Sullivan has been commissioned to provide the environmental services required for the same project.

The Scheme has progressed through the following:

- Constraints Study
- Public and Statutory Consultation.
- Hydrological and Hydraulic Assessments
- Option Assessment, including environmental appraisal of alternative schemes and strategic cost benefit analysis
- Identification of a Preferred Scheme (Diversion Channel)
- Geotechnical and hydrogeological investigations
- Valuation Survey
- Preparation of AA Screening, NIS and EIAR
- Public Exhibition under the Arterial Drainage Acts 1945 and 1995
- Scheme design and development based inter alia on the comments received at Public Exhibition Stage.

The scheme is now at Confirmation Stage.

This Report presents a Cost Benefit Analysis for the scheme.

## 2. Cost Estimate

A cost-estimate has been prepared for the Scheme, which comprises of:

- A 1km long predominantly grass lined diversion channel, which will convey flood waters from the River Deel to Lough Conn. The channel base width is 28m and width at top of bank varies between 30 and 70m. When constructed, the channel depth will vary from 3m to 12m below existing ground levels.
- Creation of washlands between the end of the channel and Lough Conn.
- A new River Flow Control Structure in the River Deel and a short embankment to limit flows continuing via the River Deel through Crossmolina Town in flood conditions.
- A new 70m long intake weir with adjustable steel plate at the entrance to the diversion channel to regulate the levels in the River Deel, and flow in the diversion channel.
- Two new road bridges over the diversion channel where it crosses the R315 and L1105.
- An Energy Dissipation Structure at the downstream end of the new channel, the purpose of which will be to regulate velocities in the channel/ entering the washlands.
- 500m long diversion of the Lake Road.
- Access tracks, scour protection, short sections of embankment, regrading of land, landscaping, fencing, and other miscellaneous works.
- Maintenance of the new diversion channel and the River Deel from the channel intake weir to the Jack Garrett Bridge in Crossmolina Town.

A layout plan of the scheme is presented in Appendix A.

The cost estimate has been calculated in accordance with reliable construction rates from the following sources:

- OPW Unit Cost Database
- Transport Infrastructure Ireland (TII) Schedule of Rates
- Spon's Price Book
- Estimated costs for disposal of excess material and material transport costs considering availability of local licenced facilities
- Schedule of rates gathered by Ryan Hanley for other schemes

Construction costs associated with the scheme are estimated at €6.99M, excl. VAT. Total Contract and Non-contract Whole Life Costs (WLC), used in the calculation of the Benefit Cost Ratio (BCR) are estimated at €13.40M, excl. VAT.

Further details are presented in Appendix B.

## 3. Scheme Benefit

The flood extents for the River Deel have been mapped by JBA Consulting.

In the current scenario (i.e. ignoring the effects of climate change on river flows), a flood in Crossmolina Town would result in the following to flood damages.

| | Total Count | Commercial | Residential | Both |
|---|---|---|---|---|
| Q2 | 3 | 2 | 1 | 0 |
| Q5 | 4 | 2 | 1 | 1 |
| Q10 | 34 | 10 | 20 | 4 |
| Q20 | 72 | 21 | 39 | 12 |
| Q50 | 111 | 29 | 70 | 12 |
| Q100 | 116 | 31 | 73 | 12 |
| Q200 | 120 | 32 | 76 | 12 |
| Q1000 | 128 | 36 | 79 | 13 |

Not only would a diversion channel would eliminate flooding up to the 1% AEP (Annual Exceedance Probability) design standard for the scheme, but it would also address flooding in more extreme events due to the introduction of a flow split between the River Deel and the new diversion channel, with the majority of excess flows diverted away from the town.

The economic benefit of the scheme has been calculated at €16,963,737. Further detail is presented in the JBA Report at Appendix C.

## 4. Cost Benefit Analysis Summary

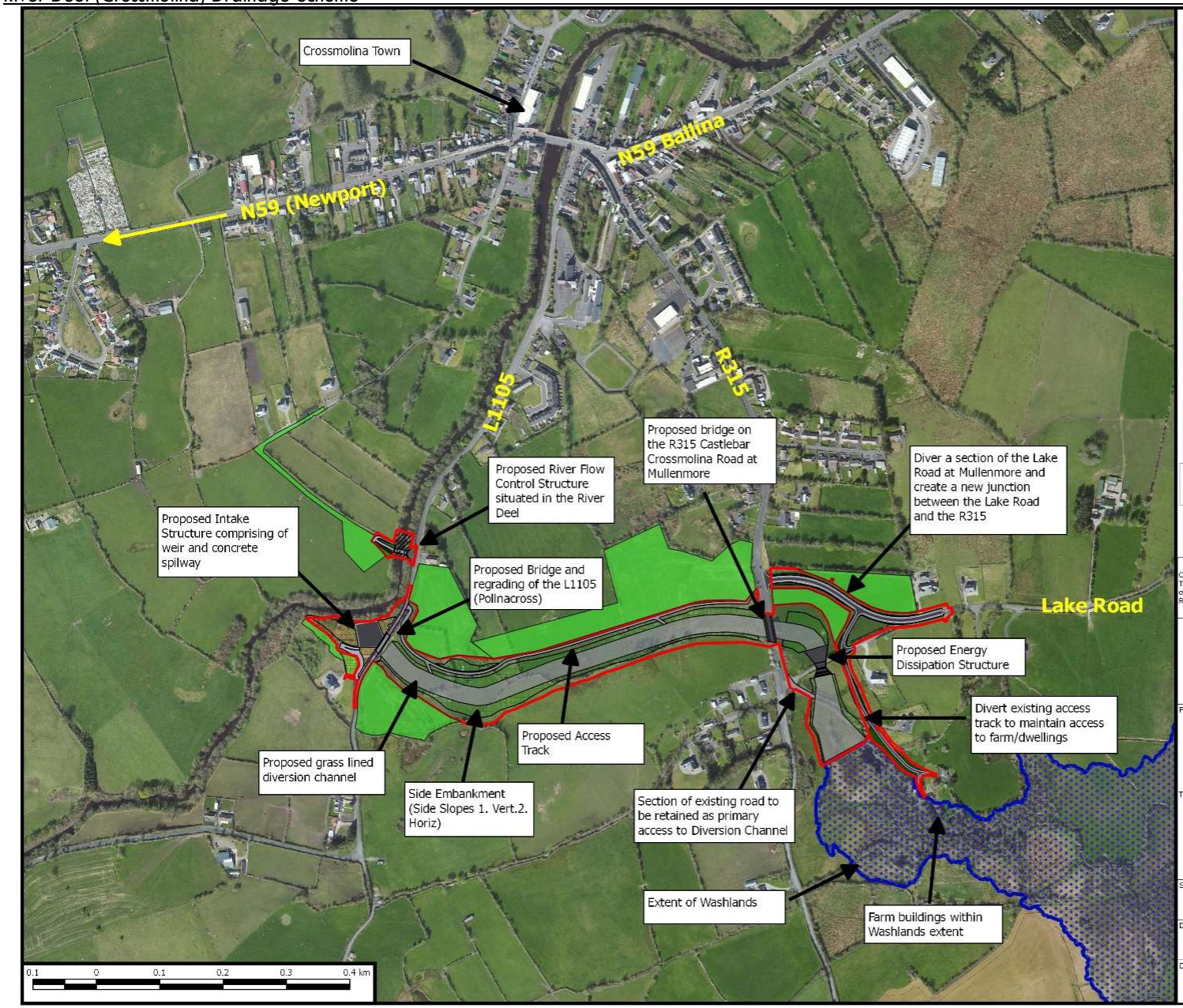
The Benefit to Cost Ratio (BCR) and the Net Present Value of the Benefits (NPVB) for the scheme is presented below.

| | |
|---|---|
| **Scheme Benefit** | **€16.96** |
| **Whole Life Costs** | **€13.40** |
| **Benefit Cost Ratio (BCR)** | **1.27** |
| **Net Present Value of the Benefits** | **€3,563,370.21** |

Based on the above assessment it is concluded that the scheme is cost beneficial.

# Appendix A

Scheme Layout Plan






RYAN HANLEY

PROJECT
**River Deel (Crossmolina) Drainage Scheme**

TITLE
**Outline Discription of Diversion Channel**

| SCALE @ A3 | DATE |
|---|---|
| 1:5,500 | 24 JUN 2020 |

| DRAWN | CHECKED | APPROVED |
|---|---|---|
| RS | KC | JR |

| DRAWING No. | REV. |
|---|---|
| Figure 3.1 | A |

# Appendix B

Summary Cost Estimate

**ENGINEERING DRAINAGE / FLOOD RELIEF SCHEME**
**CALCULATION OF PROJECT BUDGET**

| | | | |
|---|---|---|---|
| **For River Deel (Crossmolina) Drainage Scheme** | | € | |
| **(1)** Project: Basic Construction Cost | | €6,986,863.91 | |
| **(2)** Regional Adjustment | | €0.00 | |
| **Sub-total** | | €6,986,863.91 | |
| **(3a)** Additional Contingencies | **15%** | €1,048,029.59 | |
| **(3b)** Preliminaries | **10%** | incl in (1) | |
| **(4)** Construction Cost (Excl Vat) | | €8,034,893.49 | |
| **(5)** Design Team Fees and Expenses | **15%** | €1,205,234.02 | |
| Incl Site Supervision, and Environmental fees | **8%** | €642,791.48 | |
| **CONSTRUCTION AND FEES:** | | | €9,882,918.99 |
| **(6)** Other Items (including VAT where applicable) | | | |
| **(a) (i)** Allowance for archaeology | **5%** | €401,744.67 | |
| **(a) (ii)** Allowance Environmental Risk and Mitigation Measures | **6%** | €482,093.61 | |
| **(b)** Allowance for compensation and land acquisition | **15%** | €1,205,234.02 | |
| **(c)** Site investigations (Certified) | | €323,077.52 | |
| **(d)** Art Allowance | | €50,000.00 | |
| **(e)** NPV Maintenance | | €1,055,297.98 | |
| **OTHER ITEMS:** | | | €3,517,447.81 |
| **TOTAL COSTS (Excl. VAT):** *(Figure to be used for CBA purposes)* | | | **€13,400,366.80** |
| **(8) Elements which are not used in comparison against Benefits Calculations** | | | |
| **(a**) ValueAdded Tax (VAT) on (4) € @ 13.5% | | €1,084,710.62 | |
| **(b)** VAT on (5) Fees, etc (% above**)** € @ 23% | | €147,842.04 | |
| | | | **€1,232,552.66** |
| **BUDGET FOR WHOLE PROJECT :** | | | **€14,632,919.46** |

# Appendix C

Damages Report

# 1 Overview

The scope of this assessment is to derive flood damages for the proposed Crossmolina Flood Relief Scheme.

# 2 Property Categorisation Assumptions

Prior to the analysis, property areas were geographically linked to the An Post data. Where multiple An Post points existed within the same building polygon it was assumed the building footprint was divided equally between points. Where An Post data did not coincide with a building polygon a footprint area of zero was applied and hence no damages will be calculated for these points.

The Properties' threshold levels were set using the mean LiDAR level over the buildings' footprint polygon.

Flood depths were extracted based on the building footprint polygon. The mean flood depth within each building polygon was used

The An Post directory assigns one of four codes to each of the property points to indicate the property type. These are R – residential, C – commercial, B – both and U – Unknown.

Residential properties are further categorised into detached, semi-detached, terraced, duplex and bungalow.

Commercial properties have an NACE code assigned, a European equivalent to the MCM codes but not directly comparable.

To link these data to the property descriptions and hence damage curves outlined in the Multi-coloured Manual the following assumptions were made:

- Residential damages would be based on the sector average for each type of property with the sector average applied where no category was available. No age data was included in the assessment.
- Commercial property damages have been based on an conversion of the An Post data to MCM codes where this data was available, where this was not available this information has been extracted from Google Street View. A secondary review of those properties with the greatest damages against Google Street View has also been completed to confirm an appropriate MCM code has been applied.
- Where residential and commercial property types are within the same building, these have been reviewed and are generally commercial on the ground floor. Residential properties in these instances have been removed.
- Unknown properties were found to include a description of the property type (detached, semi-detached etc) so were assumed to be residential.

# 3 Property Capping Assumptions

Average residential property values were obtained from using estate agent data for current prices and recently sold price which produced a value of €118,000.

Average commercial property values have proved to be difficult to pinpoint. The high level approach outlined within the MCM is to estimate values as a factor of 10 greater than the rateable value, broadly defined as the annual rental value of the property[1]. Similarly to the residential property value, commercial rateable values were calculated for all commercial properties within Crossmolina. This approach produced a factor of 10 times greater than rental values of €134 per $m^2$/yr.

[1] http://www.voa.gov.uk/corporate/Publications/businessRatesAnIntro.html

# 4 Damage Assessment Assumptions

Damages have been calculated assuming an event duration in of <12 hours and applying depth damage curves assuming no basement is present. The adjustment to the MCM 2010 damage curves is based on the CPI and has been set to 5.1%. This is derived from inflation rates based on the CPI in Ireland for the period 2010-2013.

A PPP multiplication factor of 1.279 has been applied to convert MCM damages into Euros. This is derived from the relative OECD Purchasing Price Parity values for the UK and for Ireland for 2010.

Average annual damages have been discounted at a rate of 4% over an appraisal period of 50 years. This equates to a multiplier of 21.48 for the 4% and discounts rates.

Flood damages were assumed to begin at flood depths of -0.3m relative to floor level for residential property and at flood depths of 0m for non-residential property.

No consideration of climate change was included in this assessment.

For residential properties, the intangible and indirect damages are equal to the total property damages. For non-residential intangible and indirect damages are only apply to small, individually or family-owned businesses where the intangible impact would be personal and similar in nature to that which might be experienced were the property residential. This has been justified on a property-by-property basis.

# 5 Damage Assessment Results

Using JBA's custom software package FRISM three scenarios were assessed. The first scenario is Existing Risk Scenario which models the current scenario in Crossmolina. The second is a Defended Scenario which models the town with Q100 flood walls in place. The third scenario was for the inclusion of a diversion channel with a capacity to defend flooding in the town to Q100 event.

## 5.1 Existing Risk Scenario

| Existing Risk Scenario | | | |
|---|---|---|---|
| | ***Annual Average Damages*** | | |
| ADD Min | | £269,656 | €344,890 |
| ADD Mean | | £311,664 | €398,618 |
| ADD Max | | £357,905 | €457,761 |
| | ***Principal Direct Damages*** | | |
| | *Uncapped* | *Capped* | *Conversion* |
| PDD Min | £5,792,209 | £5,257,567 | €6,724,428 |
| PDD Mean | £6,694,543 | £6,094,304 | €7,794,614 |
| PDD Max | £7,687,800 | £6,909,556 | €8,837,322 |
| | ***Other Damages*** | | |
| Infrastructural Utility Assets | | 20% | €1,558,923 |
| Emergency Services | | 8.1% | €631,364 |
| | | | €2,190,287 |
| | **Intangible and Indirect Damages** | | |
| | *Uncapped* | *Capped* | *Conversion* |
| | £5,757,362 | £5,757,362 | €7,363,666 |
| | **Total Damages** | | |
| Present Value of Damages | | | €7,794,614 |
| Other Damages | | | €2,190,287 |
| Intangible and Indirect Damages | | | €7,363,666 |
| | | | €17,348,567 |

## 5.2 Defended Scenario

| Defended Scenario | | | |
|---|---|---|---|
| | ***Annual Average Damages*** | | |
| ADD Min | | £41,449 | €53,014 |
| ADD Mean | | £44,980 | €57,529 |
| ADD Max | | £51,744 | €66,181 |
| | ***Principal Direct Damages*** | | |
| | *Uncapped* | *Capped* | *Conversion* |
| PDD Min | £890,333 | £890,333 | €1,138,736 |
| PDD Mean | £966,170 | £966,170 | €1,235,732 |
| PDD Max | £1,111,467 | £1,111,467 | €1,421,566 |
| | ***Other Damages*** | | |
| Infrastructural Utility Assets | | 20% | €247,146 |
| Emergency Services | | 8.1% | €100,094 |
| | | | €347,241 |
| | **Intangible and Indirect Damages** | | |
| | *Uncapped* | *Capped* | *Conversion* |
| | £821,901 | £821,901 | €1,051,212 |
| | **Total Damages** | | |
| Principal Direct Damages | | | €1,235,732 |
| Other Damages | | | €347,241 |
| Intangible and Indirect Damages | | | €1,051,212 |
| | | | €2,634,184 |

## 5.3 Diversion Channel Scenario

| Diversion Channel Scenario | | | |
|---|---|---|---|
| | ***Annual Average Damages*** | | |
| ADD Min | | £5,396 | €6,901 |
| ADD Mean | | £6,375 | €8,154 |
| ADD Max | | £7,227 | €9,243 |
| | ***Principal Direct Damages*** | | |
| | *Uncapped* | *Capped* | *Conversion* |
| PDD Min | £115,906 | £115,906 | €148,244 |
| PDD Mean | £136,944 | £136,944 | €175,151 |
| PDD Max | £155,235 | £155,235 | €198,546 |
| | ***Other Damages*** | | |
| Infrastructural Utility Assets | | 20% | €35,030 |
| Emergency Services | | 8.1% | €14,187 |
| | | | €49,217 |
| | **Intangible and Indirect Damages** | | |
| | *Uncapped* | *Capped* | *Conversion* |
| | £125,459 | £125,459 | €160,462 |
| | **Total Damages** | | |
| Principal Direct Damages | | | €175,151 |
| Other Damages | | | €49,217 |
| Intangible and Indirect Damages | | | €160,462 |
| | | | €384,830 |

## 5.4 Results Summary

| Results Summary | |
|---|---|
| Existing Risk Scenario | €17,348,567 |
| Defended Scenario | €2,634,184 |
| Benefit | €14,714,384 |

| Results Summary | |
|---|---|
| Existing Risk Scenario | €17,348,567 |
| Diversion Channel Scenario | €384,830 |
| Benefit | €16,963,737 |

## 5.5 Sensitivity Test

To facilitate the determination of the cost-benefit of the scheme using higher or lower discount rates, a sensitivity test was conducted using discount rates of 5% and 3% respectively.

### 5.5.1 Higher Discount Rate

A 5% discount rate produced a discount factor of 18.26 for a 50 year project horizon.

| Results Summary | |
|---|---|
| Existing Risk Scenario | €14,963,838 |
| Defended Scenario | €2,167,040 |
| Benefit | €12,796,798 |

| Results Summary | |
|---|---|
| Existing Risk Scenario | €14,963,838 |
| Diversion Channel Scenario | €327,141 |
| Benefit | €14,636,697 |

### 5.5.2 Lower Discount Rate

A 3% discount rate produced a discount factor of 25.73 for a 50 year project horizon.

| Results Summary | |
|---|---|
| Existing Risk Scenario | €20,433,113 |
| Defended Scenario | €3,053,557 |
| Benefit | €17,379,556 |

| Results Summary | |
|---|---|
| Existing Risk Scenario | €20,433,113 |
| Diversion Channel Scenario | €460,972 |
| Benefit | €19,972,141 |