Gas Networks Ireland

GNI Grangecastle Pipelines Construction Methodology

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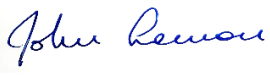
John Lennon FW Approver	Design Engineer		18/11/2024

History of Issues / Approvals

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3	15/11/24	Revised Section 2.1.1 Tie-in Point	1587-RT-0001-R3

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Introduction

The purpose of this document is to outline the construction techniques and methodology which will be implemented during construction of the proposed pipelines in the Grangecastle area which will connect the following proposed AGIs to the transmission gas network; Ballybane AGI, Milltown AGI, Kilcarbery AGI and Profile Park AGI. The purpose of this project is to provide natural gas to three new datacentres, Microsoft Operations Ireland Ltd. (Ballybane AGI), Data and Power Hub Services Ltd. (Milltown AGI) and Vantage DC (Kilcarbery AGI), in addition to a new Power Generation Plant for Greener Ideas Ltd (Profile Park AGI).

This document outlines all the pipelines required for this project. It is intended to be used as an aid to understand the methodologies to be employed during construction for the purposes of the environmental studies.

Revision 3 of this document reflects an updated hot tap location for the GNI134 Milltown pipeline. Specifically, Section 2.1.1 has been revised to reflect this change.

Please note that figures in other sections of the document may still show the previous hot tap location.

1.1 Pipeline Overview

Figure 1 gives an overview of all proposed pipelines in the Grangecastle area.

GNI134 Milltown Pipeline, will serve as a strategic main and will allow for multiple offtakes in the Grangecastle area. This pipeline shall be an offtake from the existing 900 mm NB Ballough to Brownsbarn pipeline, BGE/72. The Milltown pipeline shall be 400 mm NB as requested by GNI. The pipeline shall terminate within Milltown AGI (Gas to Bulmer) with multiple spur offtakes along the route for other projects / AGIs.

GNI135 Ballybane pipeline shall be a 200 mm NB spur off the GNI134 pipeline to feed Ballybane AGI (Gas to Microsoft). GNI136 Clonburris Pipeline will provide redundancy for Microsoft Operations Ireland Ltd. This pipeline is to be an offtake from the N.E.P. 1 Abbotstown to Brownsbarn pipeline, BGE/13. This pipeline shall be 200 mm NB and is designed to solely supply Microsoft Operations Ireland Ltd.

GNI137 Kilcarbery pipeline shall be a 200 mm NB spur off the GNI134 pipeline to feed Kilcarbery AGI (Gas to Greener Ideas Profile Park).

GNI142 Profile Park pipeline shall be a 200 mm NB spur off the GNI137 pipeline to feed Profile Park AGI (Gas to Vantage).

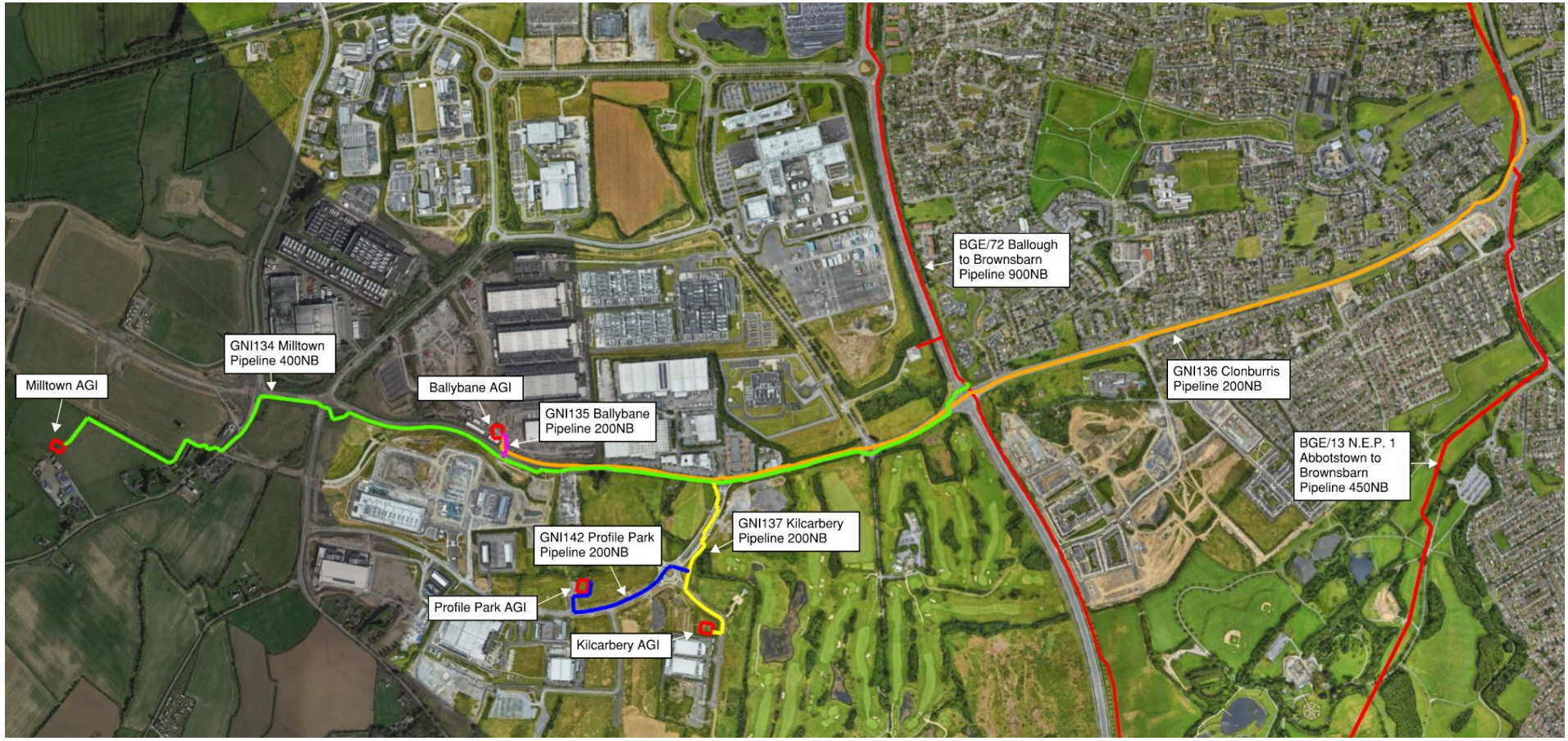

Figure 1 - Overview of the Grangecastle Pipelines

GNI134 Milltown Pipeline

Outline of GNI134 pipeline works:

- Install 3.0 km of 400 mm NB steel pipeline.
- Install 1 No. hot tap offtake valve arrangement at tie in location.
- 1 No. river crossing.

The 400 mm NB pipeline will tie in to the existing 900 mm NB Ballough to Brownsbarn pipeline at the intersection between R134, Nangor Road, and R136, the Outer Ring Road, Dublin 22. It will then route west along the New Nangor Road (R134), and south along the R120 until reaching the Old Nangor Road intersection. The pipeline then diverts west onto a South Dublin County council owned field. The pipeline runs along the perimeter of the field before crossing the site boundary and entering the Data and Power Hub Services Ltd. premises. The pipeline then follows an access roadway northwest to enter the AGI at the eastern corner.

The pipeline route includes 1 no. river crossing approximately 1.9 km west of the hot tap location. It is proposed that, with the exception of the Griffeen River crossing, the open cut method is utilised for installation of the whole pipeline route. It has been advised that due to the high level of biodiversity in the area, the Griffeen River crossing should be trenchless. For more details on the trenchless crossing and open cut method refer to Sections 7.1.1 and 7.1.3 respectively.

2.1 Proposed Pipeline Route

The location of the proposed AGI, pipeline and tie in point is shown in Figure 2. BGE/72, Ballough to Brownsbarn pipeline, is the nearest gas transmission pipeline and hence the chosen tie in point. The majority of the proposed pipeline is located within the roadway. It should be noted that there are several sections of the route in which the verge can be utilised to avoid third party services and road closures. All areas for which the verge may be utilised are shown in Figure 3, Figure 4 and Figure 5 below. Additionally, a South Dublin County Council owned field to the west of Old Nangor Road is entered for a length of 180m to avoid a high-density area of third party services along the R120. The grassy area southeast of the R134-Baldonnel Road intersection is also utilised for launch and reception pits for the trenchless Griffeen river crossing.

Figure 2 - Overview of Data & Power Hub Services Site, GNI134 Pipeline Route, AGI Location, and Location of Nearby Transmission Network

Figure 3 shows the pipeline entering the verge after crossing the R136.

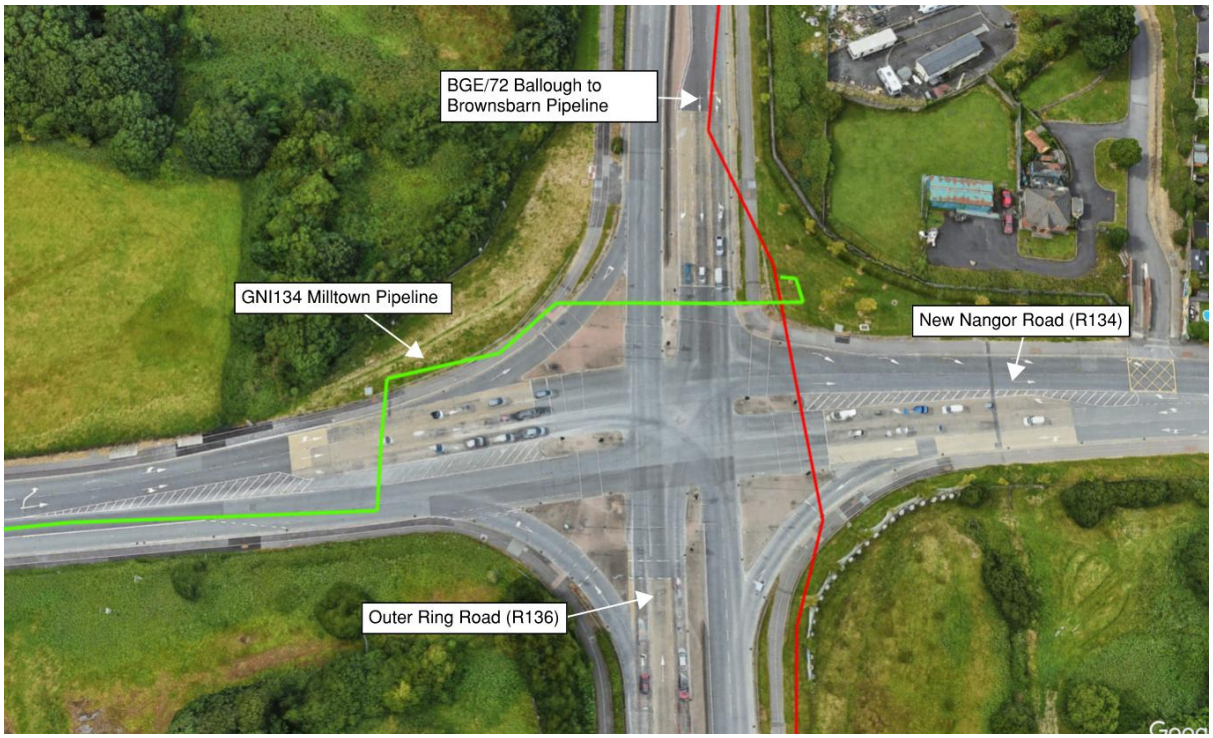

Figure 3 - Verge utilised at the west side of the R136

Figure 4 shows the pipeline route through the Grange Castle Golf Club roundabout. It is proposed to divert the into the bus lane and continue within the grass verge to avoid running in close proximity to a high voltage electrical service which is running parallel.

Figure 4 - Verge utilised at Grange Castle Golf Club roundabout

Figure 5 shows pipeline route within the grass verge and cycle path of the New Nangor Road for approximately 650 m from Boland's Car Centre to the Griffeen River. Figure 6 shows the area where the pipe enters the grass verge from the centre of the road.

Figure 5 - Grass verge and cycling path utilised along New Nangor Road

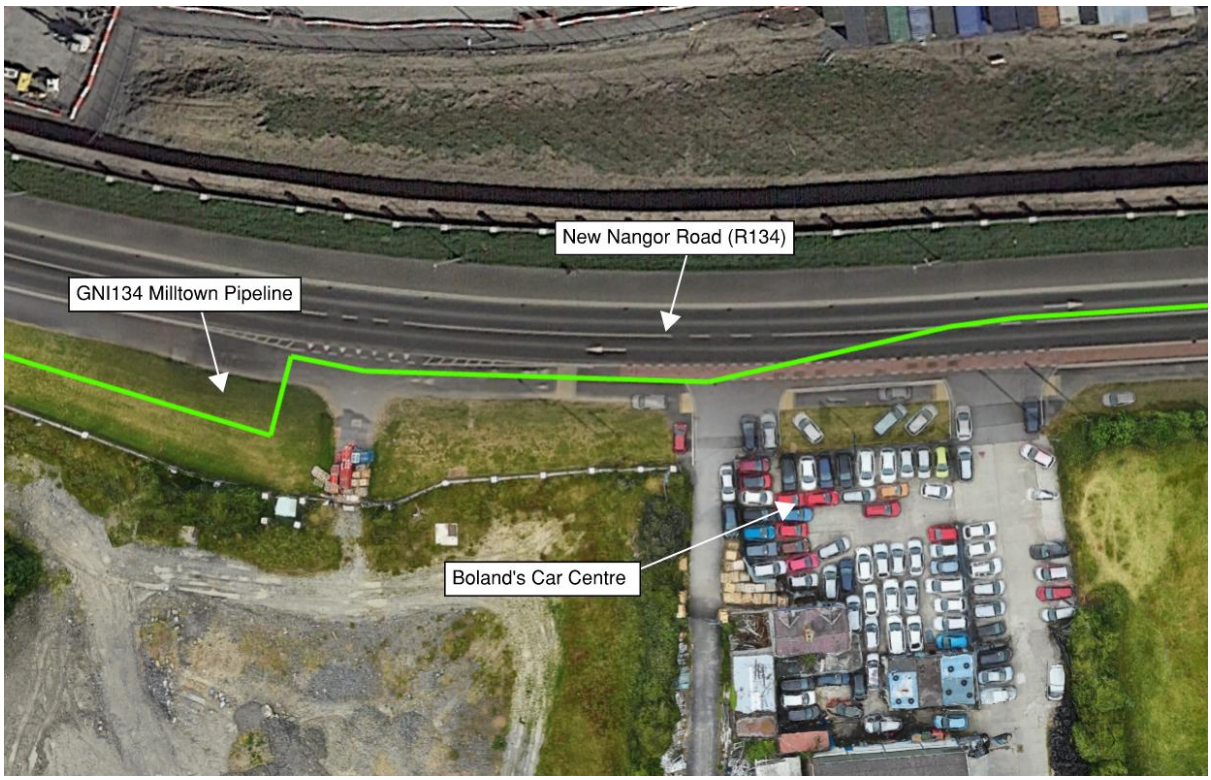

Figure 6 - Pipeline route turns onto cycling path then grass verge at Boland's car centre

Figure 7 depicts the pipeline route along the R120 and into Data & Power Hub Services site. The pipeline follows the R120 along the eastern side of the road, the route then diverts west upon reaching the Old Nangor Road intersection into a South Dublin County Council owned field. The pipeline follows along the perimeter of the field before entering the Data & Power

Hub Services premises through the north-eastern corner. The pipeline is routed through the berm onto a site access roadway which it follows westward, to enter the AGI on the north-eastern corner.

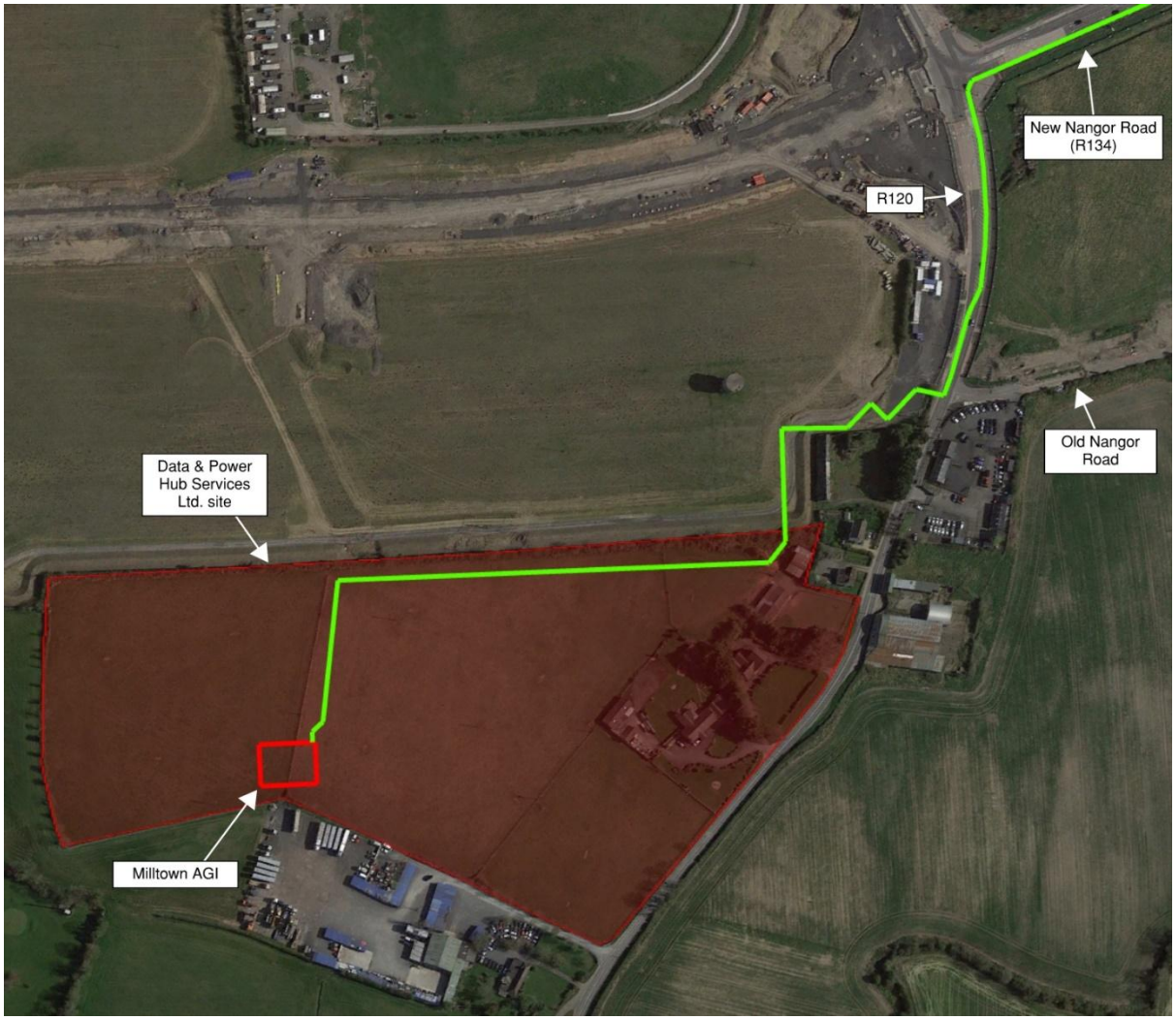

Figure 7 - Pipeline Route into Data & Power Hub Services site

2.1.1 Tie-in Point

The tie in point will be at the south-east verge of the intersection between R134, Nangor Road, and R136, the Outer Ring Road, as shown in Figure 8, Figure 9 and Figure 10. An approximate 4.6 m deep excavation is required to perform the hot tap works, based on the depth of cover to the existing BGE/72 Ballough to Brownsbarn pipeline. An excavated length of 12.5 m from the hot tap is required to facilitate the drilling equipment. The proposed hot tap valve arrangement is shown in Figure 11. Note, the whole verge and section of the SDCC detention basin will be utilised as a temporary works area during the hot tapping

process, refer to Figure 8 which shows the proposed temporary working area required at this location to perform the works.

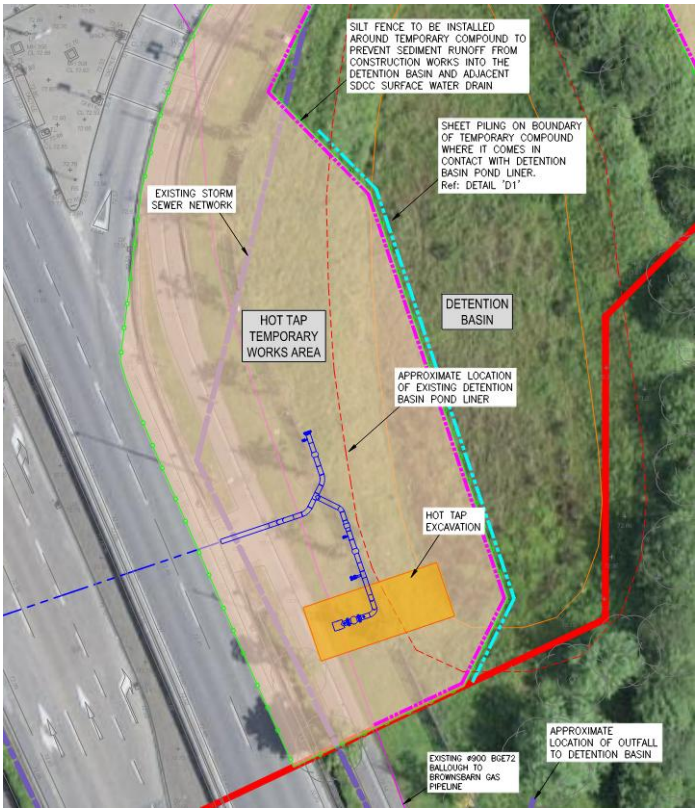

Figure 8 - Tie-in Location Plan View

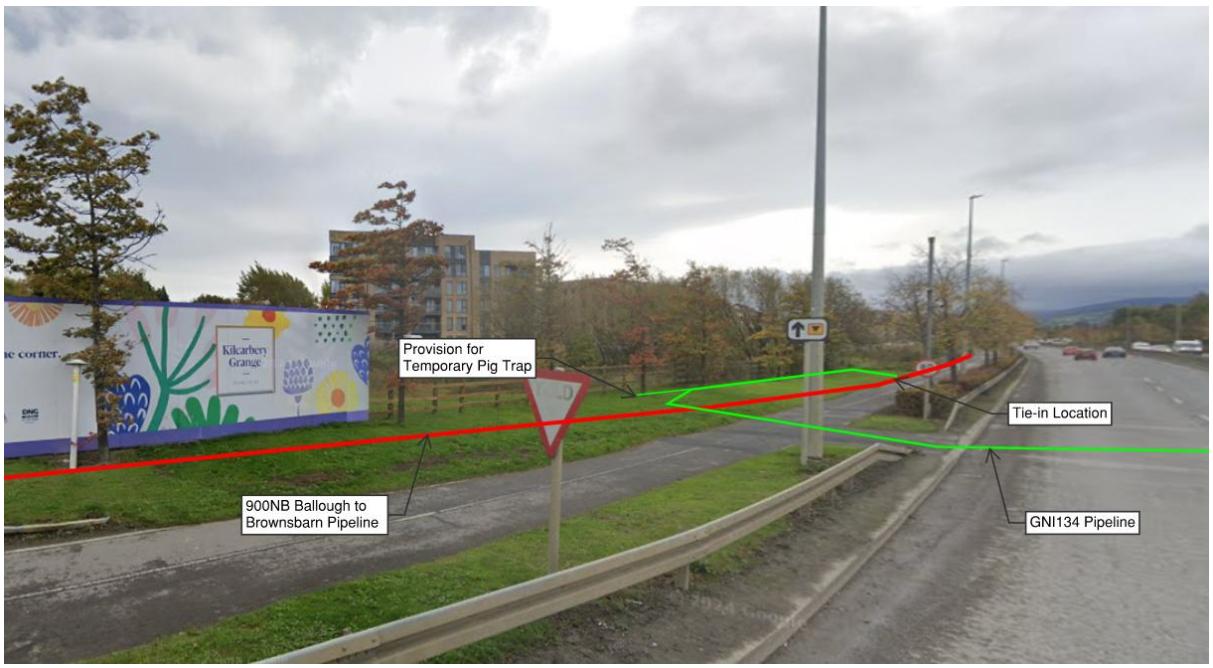

Figure 9 - Tie-in Location Street View

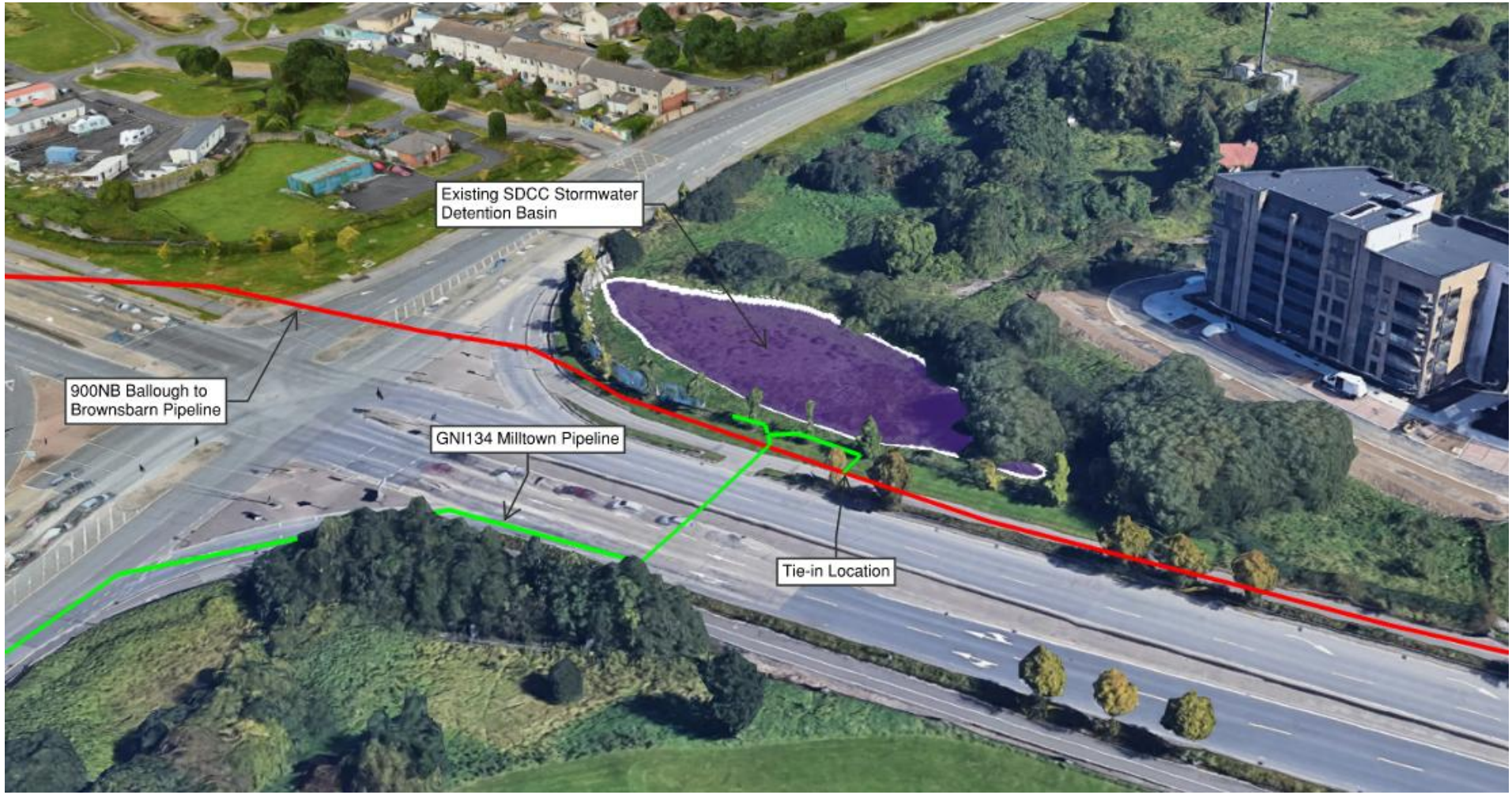

Figure 10 - Tie-in location 3D view

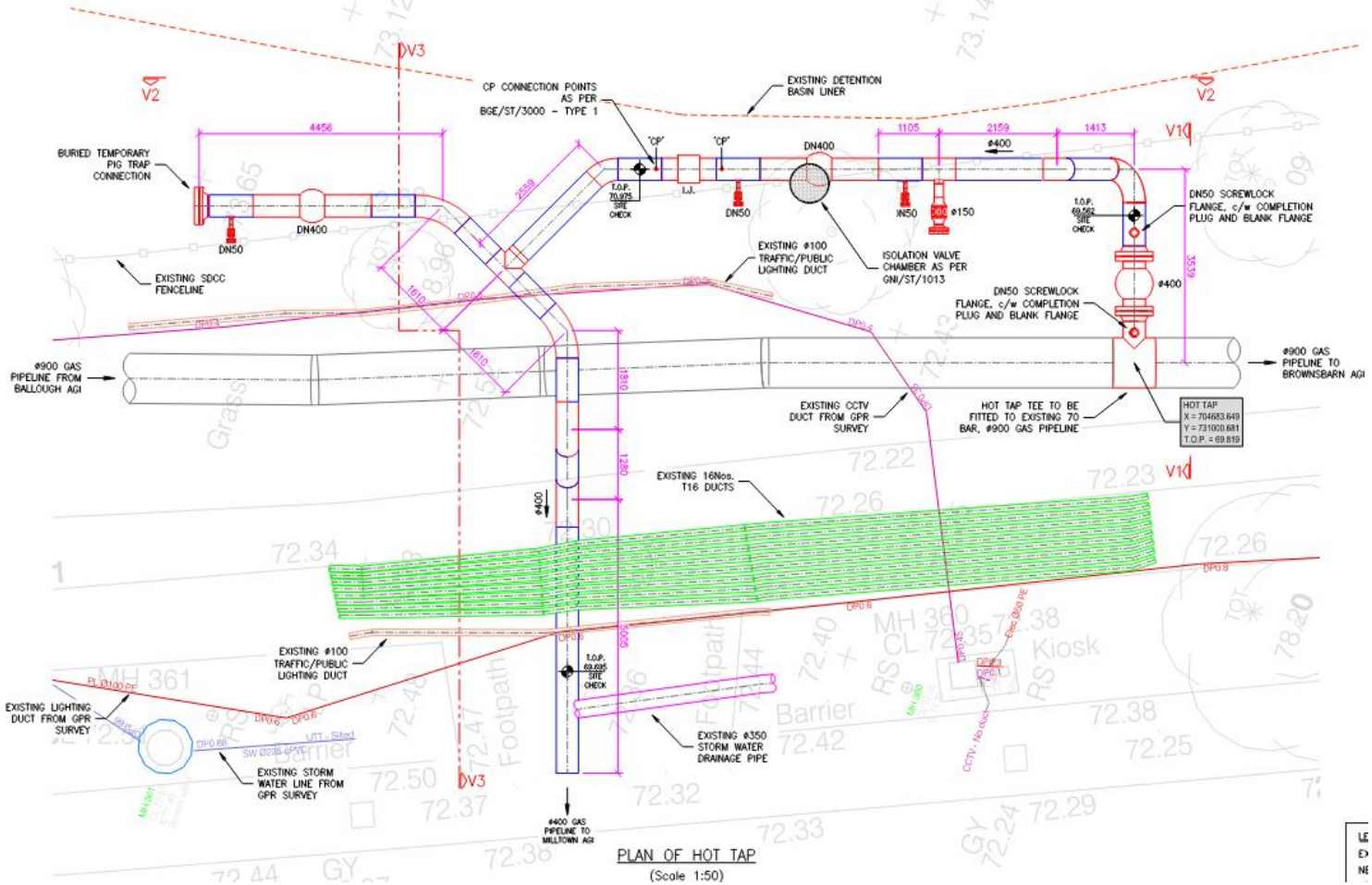

Figure 11 – Valve Arrangement at Tie-In

2.1.2 Main Pipeline Route in Roadway

The pipeline route crosses one major traffic junction, the R134-R136 intersection at the hot tap location. This junction is shown in Figure 3. The pipeline crosses perpendicular to R136, which at this location comprises of two footpaths/cycling lanes and six traffic lanes. It is expected that pipeline construction in this area will involve single lane isolation, where the pipe is laid and the road reinstated one lane at a time, thereby minimising the works effect on traffic flow in the area. It may also be prudent to restrict works to non-peak times such as weekends or evenings for this area. The contractor shall produce a traffic management plan for the entirety of the works, and this shall be agreed with the local authority.

A number of minor junctions are also crossed, including two roundabouts and the R134-Baldonnel Rd. intersection.

Figure 12 – Profile Park Roundabout

The R134-Baldonnel Rd. intersection involves crossing three lanes of the Baldonnel road, while routing the pipeline along a west bound lane in R134. As with the R134-R136 intersection it may be prudent to restrict works to non-peak times such as weekends or evenings for this area. The R134-Baldonnel Rd. intersection is shown in Figure 13 below.

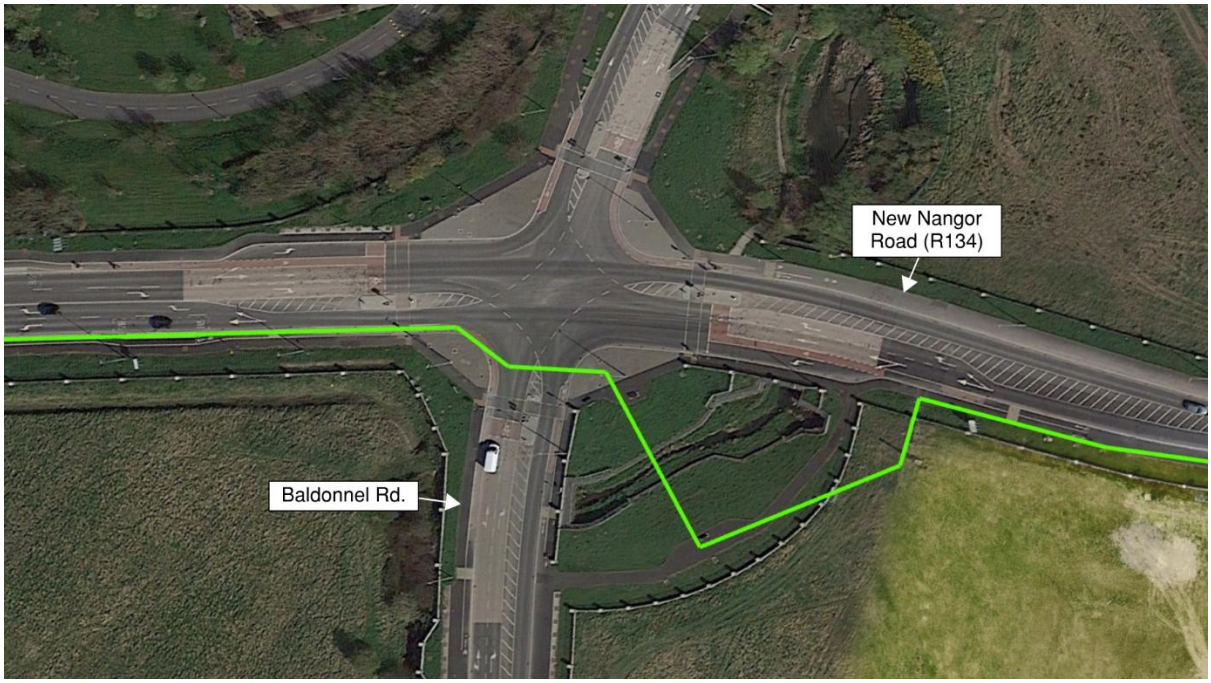

Figure 13 – R134–Baldonnel Rd. Intersection

The location of each road / intersection crossing can be found in Figure 14 below.

Figure 14 - Road crossings for pipeline GNI134

2.1.3 River Crossing

The pipeline route crosses the Griffeen River approximately 1.9 km east of the hot tap location. The location of the river crossing is shown in Figure 15 and Figure 16 (approx. coordinates 53°19'13.8"N 6°27'22.0"W). Initially it was thought an open cut method would be

suitable for the river crossing. However, review with the project ecologist found the area to have high local biodiversity value (SDCC area). The presence of otter is well known by SDCC biodiversity officers, and NPWS would be highly concerned about any potential impacts on water quality. There are also White claw Crayfish and Trout that are stocked in the river by Anglers Association/Inland Fisheries Ireland. Overall, there would be a high risk to the project with a trenched crossing solution. As a result, specialist advice was sought to determine the feasibility of a trenchless crossing.

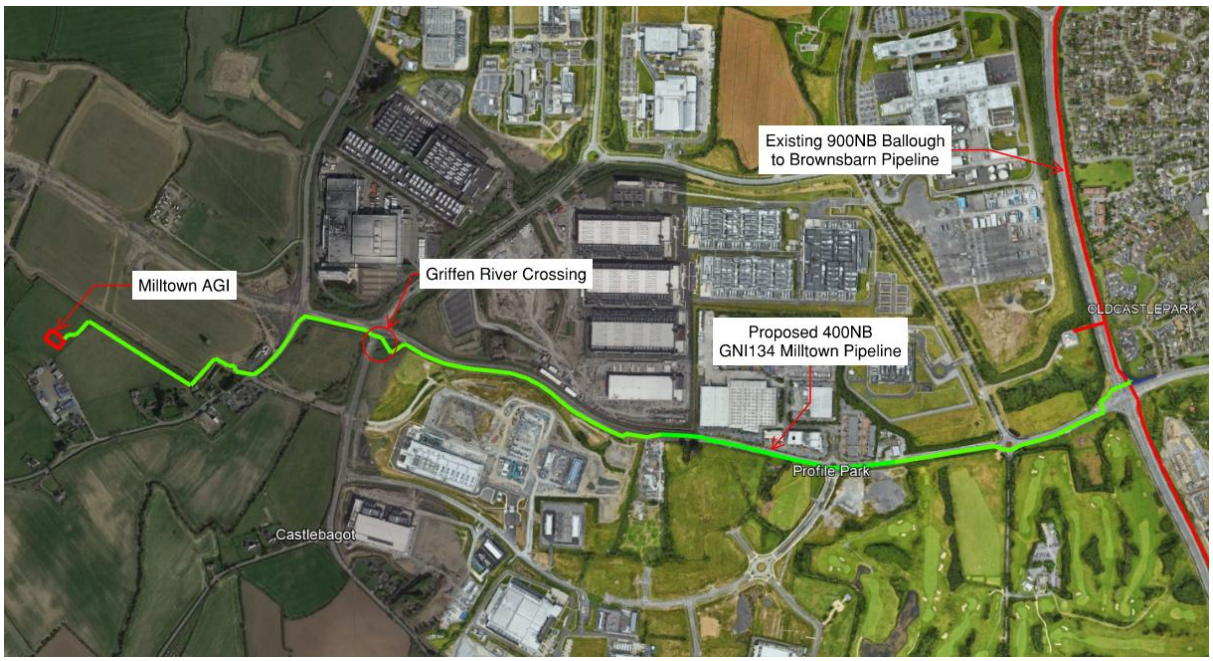

Figure 15 - Overview of the Proposed GNI134 Pipeline Route with River Crossing Location

1587-RT-0004-R0 Griffeen River Trenchless Crossing Feasibility Report was produced to assess the feasibility of a trenchless crossing and, if feasible, which construction technique would be most appropriate for this crossing. The report found that trenchless crossing would be feasible, and an unguided auger bore would be the most suitable technique given the short nature of the pipeline crossing.

The trenchless crossing method is described in more detail in section 7.1.1. A plan and section view of the river crossing can be seen in Appendix D.

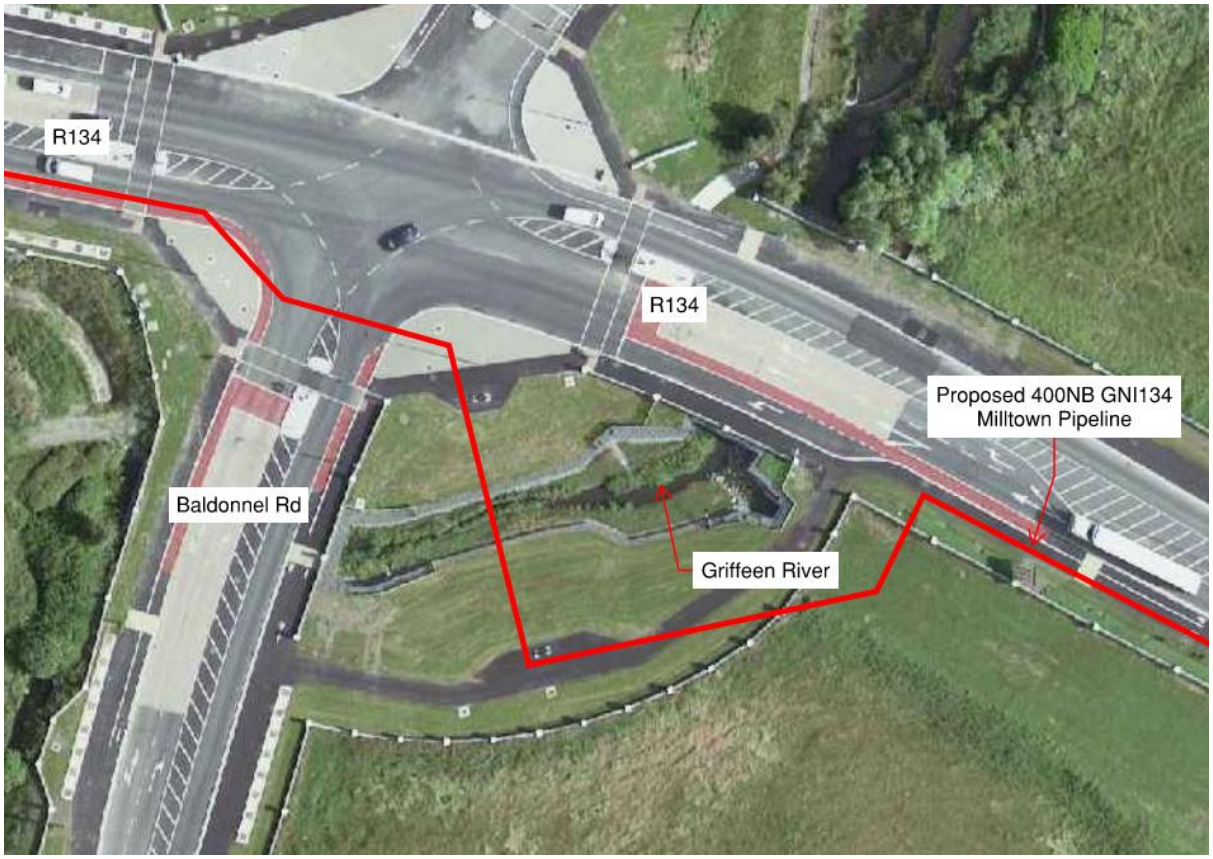

Figure 16 - Plan View of Griffeen River Crossing Location

GNI135 Ballybane Pipeline

Outline of GNI135 pipeline works:

- Install 0.08 km of 200 mm NB steel pipeline.
- Install offtake from GNI134 pipeline.

The 200 mm NB pipeline will tie in to the proposed 400 mm NB GNI134 pipeline in the New Nangor Road, south of the proposed Ballybane AGI. It will cross the Nangor Road and then route north through Microsoft Operations Ireland Ltd.'s site before entering Ballybane AGI. There are no significant crossings along the proposed route, hence the open cut method is proposed for the entire pipeline length. For more detail, please refer to section 7.1.3.

3.1 Proposed Pipeline Route

Figure 17 depicts the location of the proposed AGI, pipeline, and tie in point. The GNI135 pipeline will tie-in with the new GNI134 pipeline within R134 grass verge / footpath. A 400 mm x 200 mm barred tee and a buried valve arrangement shall be installed to facilitate a tie-in with GNI135. The construction of GN135 will start once the tee has been installed. The GNI135 pipeline shall cross the New Nangor Road, R134, and enter Microsoft Operations Ireland Ltd.'s new proposed site, routing north before turning 90 degrees to enter Ballybane AGI.

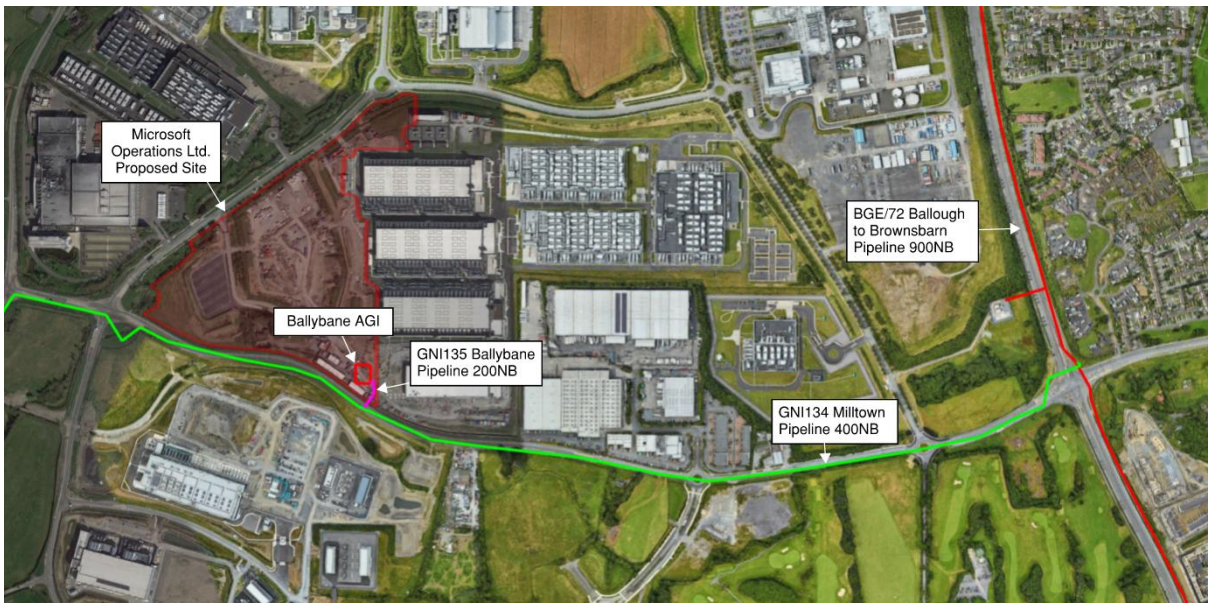

Figure 17 - Overview of Microsoft Operations Ireland Ltd. premises, AGI Location and GNI135 Pipeline Route

GNI136 Clonburris Pipeline

Outline of GNI136 pipeline works:

- Install 3.35 km of 200 mm NB steel pipeline.
- Install 1 No. hot tap offtake valve arrangement at tie in location.

The 200 mm NB pipeline will tie in to the existing 450 mm NB N.E.P. 1 Abbotstown to Brownsbarn pipeline at the southern section of the R113, Dublin 22. It will then route southwest crossing two major roundabouts and continues west along the New Nangor Road (R134), before turning north to enter Microsoft Operations Ireland Ltd.'s premises.

The pipeline route includes no river crossings. It is proposed that the open cut method is utilised for installation of the whole pipeline route. For more details on the open cut method, please refer to section 7.1.3.

4.1 Proposed Pipeline Route

The location of the proposed AGI, pipeline, and tie in point is shown in Figure 18. Microsoft Operations Ireland Ltd. has made a request for an additional pipeline to ensure redundancy for their AGI system. They have specified that the two pipelines should be linked to separate transmission lines in order to eliminate the risk of gas flow disruption in case one of the lines experiences a catastrophic failure. The new 400 mm NB GNI134 pipeline will tie into the nearest transmission pipeline; BGE/72, Ballough to Brownsbarn. BGE/13 N.E.P. 1 Abbotstown to Brownsbarn is the next nearest transmission pipeline. There is an adjacent GNI project in close proximity that intends to utilize this pipeline as a hot tap tie-in point to connect their AGI supply pipeline. This hot tap will serve as a connection for both projects.

The majority of the pipeline is located within the roadway. However, it should be noted that there are several sections of the route in which the verge and cycling paths are utilised to ensure a sufficient separation distance between both third-party services and the proposed GNI134 pipeline. Figure 19 depicts the run of pipeline for which the verge and cycling paths are entered.

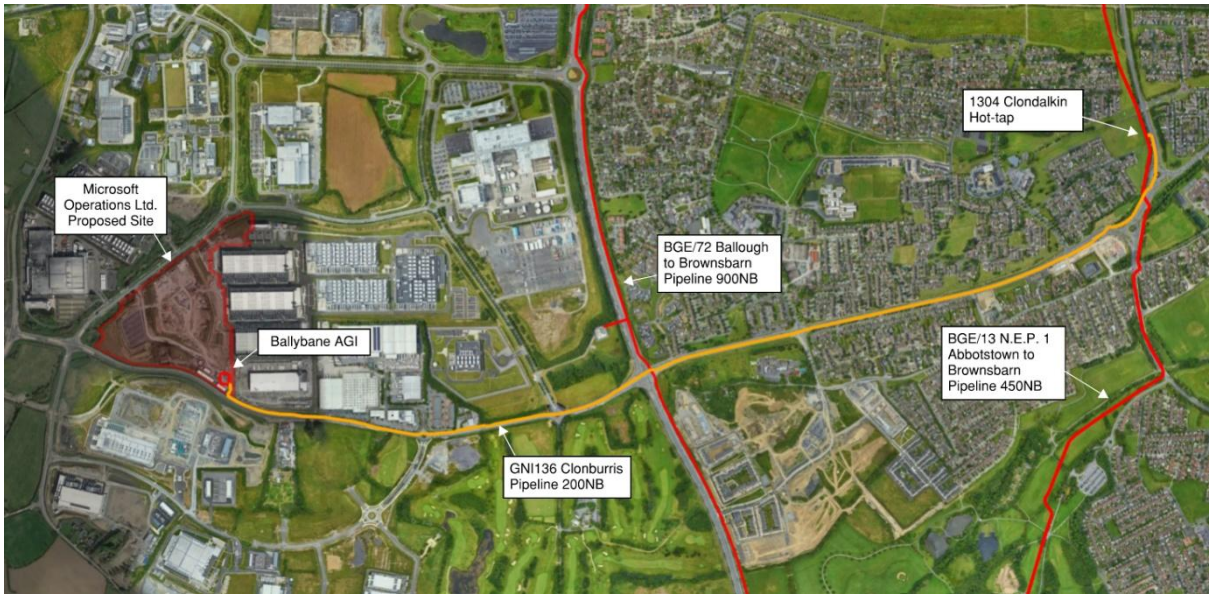

Figure 18 - Overview of Microsoft Operations Ireland Ltd., GNI136 Pipeline Route, AGI Location, and Location of Nearby Transmission Network

Pipeline GNI136 enters the cycling lane/footpath after the Grange Castle Golf Club roundabout to provide adequate separation distance between it and GNI134 pipeline. The pipeline exits the verge to cross the Profile Park roundabout and continues in the roadway for 150m before again entering the cycling lane/footpath due to proximity to GNI134, see Figure 20.

Figure 19 – Verge utilised along the north side of the New Nangor Road from the Grange Castle Gold Club Roundabout until the GNI136 pipeline enters Microsoft Operations Ireland Ltd.'s site

Figure 20 – GNI136 Pipeline re-enters the roadway for a run of 150m after Profile Park roundabout

Figure 21 – GNI134 and GN136 pipelines separate as two high voltage cables enter and run parallel along the R134 roadway

4.1.1 Tie-in Point

The tie in point will be a grass verge area east of the R113, as shown in Figure 22 and Figure 23. An approximate 3.0 m deep excavation is required to perform the hot tap works

based on current as-laid depth of cover information for the existing BGE/13 N.E.P. 1 Abbotstown to Brownsbarn pipeline. An excavated length of 10 m from the hot tap is required to facilitate the drilling equipment. The proposed hot tap valve arrangement is shown in Figure 24. Note that there are serval trees within the excavation area and proposed new pipeline route that may obstruct hot tap activities. These trees will have to be removed before the hot tap works can commence. For an indicative temporary works compound, see Appendix G.

Figure 22 - Tie-in Location Street View

Figure 23 - Tie-in location 3D view

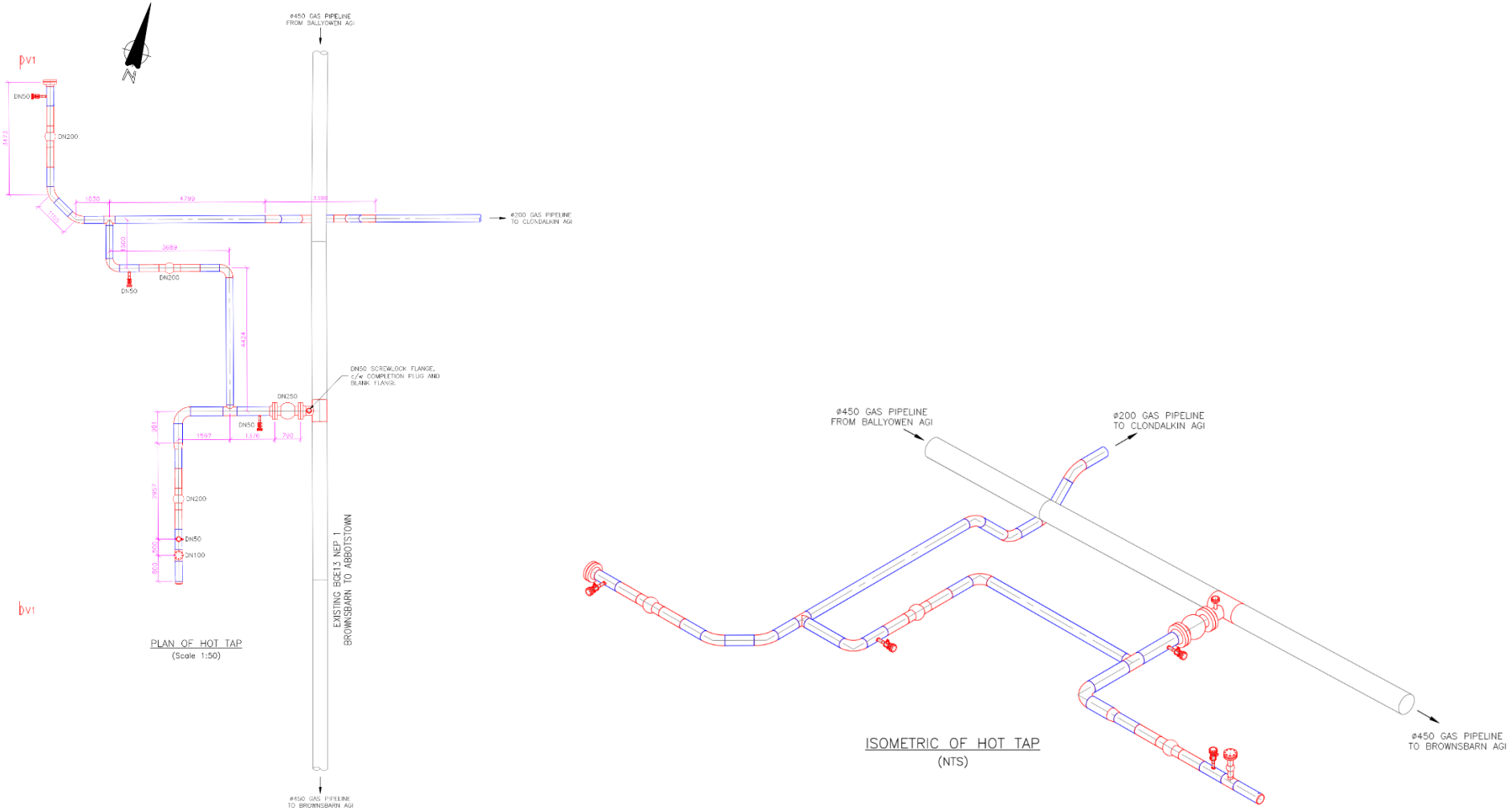

Figure 24 – Valve Arrangement at Tie-In

4.1.2 Main Pipeline Route in Roadway

The 3.35 km pipeline will be constructed using open cut method. The pipeline route crosses several major traffic junctions, including two major roundabouts near the hot tap location as well as two busy traffic intersections:

1. From the tie in location the pipeline routes south towards the first major roundabout. To avoid services running parallel on either side, GNI136 routes through the left-hand lane of R113, then straight through the roundabout as shown in Figure 25

Figure 25 - First major roundabout (R113-R134), south of Clondalkin Hot Tap

2. The second major roundabout is positioned 170m southwest of the first. The services previously running parallel in close proximity to the pipeline move to the verge, allowing the route to utilise the bus lane. This minimises the effect on traffic flow and negates the requirement to disturb the existing roundabout structure, see Figure 26. Upon exiting the roundabout, the pipeline crosses the R134, moving to the south side of the road.

Figure 26 - Second major roundabout (R113-R134)

3. The pipeline routes towards the middle of the road to avoid services on either side and remains here until the first major intersection. At the Old Nangor Road- R134 intersection, the pipeline angles south to continue on the south side of R134, see Figure 27.

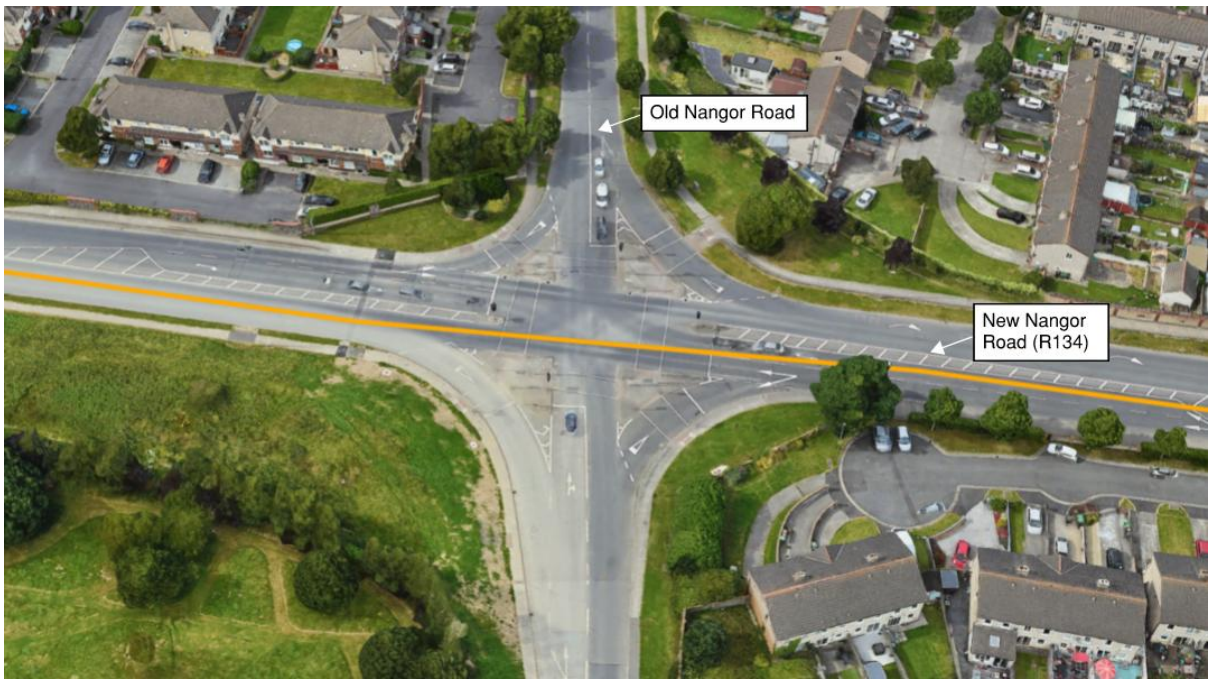

Figure 27 - 1st Major intersection (R134-Old Nangor Road)

4. The pipeline continues in the southern side of the road until reaching the R134-R136 intersection where the Deansrath Hot Tap is located. GNI136 repositions to the north side of the road before crossing the junction to ensure a sufficient separation distance is maintained between it and the proposed GNI134 pipeline.

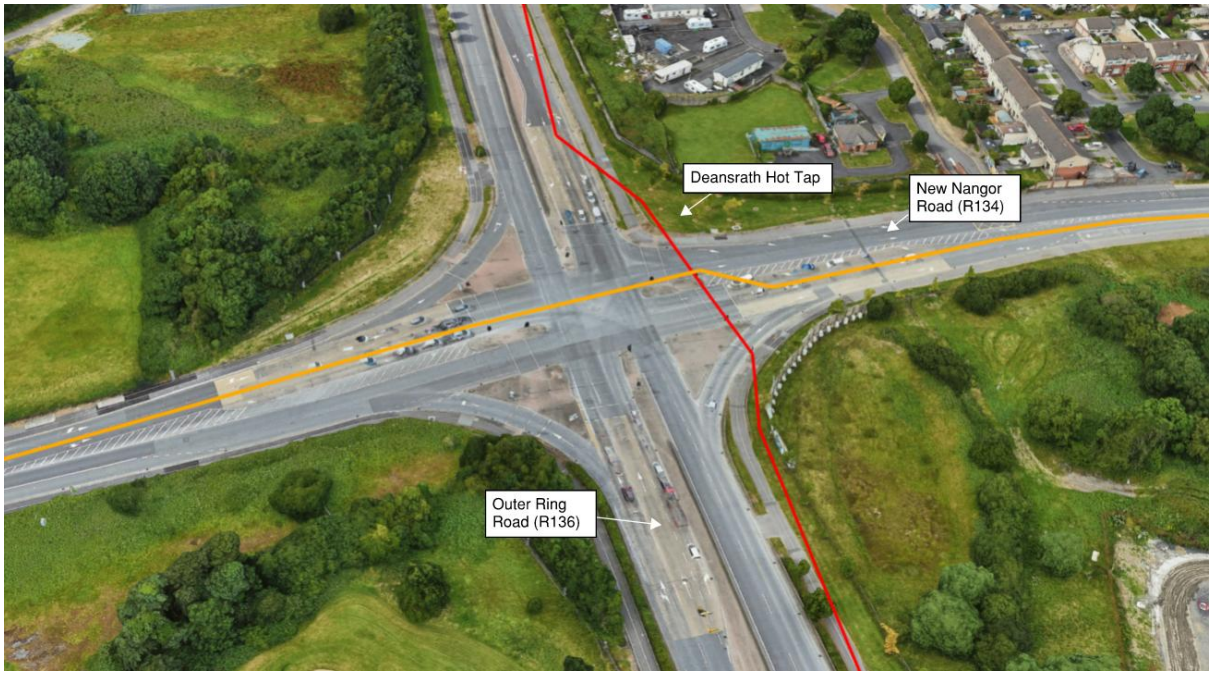

Figure 28 -2nd Major intersection (R134-R136)

A number of minor junctions are also crossed including two roundabouts; Grange Castle Golf Club roundabout and Profile Park roundabout which are also crossed by GN134 and shown in Section 2.1.2.

GNI137 Kilcarbery Pipeline

Outline of GNI137 pipeline works:

- Install 0.55 km of 200 mm NB steel pipeline.
- Install offtake from GNI134 pipeline.
- 2 no. open steam crossings

The 200 mm NB pipeline will tie into the proposed 400 mm NB GNI134 pipeline in the New Nangor Road. It will route south along the Profile Park road and turn south east at the first roundabout in Profile Park. The pipeline will continue southeast approx. 200 m at which point it will turn 90 degrees and enter the Greener Ideas site.

The pipeline route includes 2 no. open stream crossings. It is proposed that the open cut method is utilised for installation of the whole pipeline route. For more details on the open cut methods, please refer to sections 7.1.2 and 7.1.3.

5.1 Proposed Pipeline Route

The location of the proposed AGI, pipeline and tie in point is shown in Figure 29. GNI have advised that the strategic main Milltown pipeline (GNI134) is to serve as the feeder main for Kilcarbery AGI. A 400 mm x 200 mm barred tee and buried valve arrangement shall be installed to facilitate this tie -in. An offtake named Profile Park Offtake will be provided along the GNI137 pipeline as part of the works to facilitate a connection for the GNI142 pipeline to Profile Park AGI.

The majority of the pipeline is located within Profile Park Road. However, it should be noted that there are several sections of the route in which the verge is utilized to ensure a sufficient separation distance between third party services.

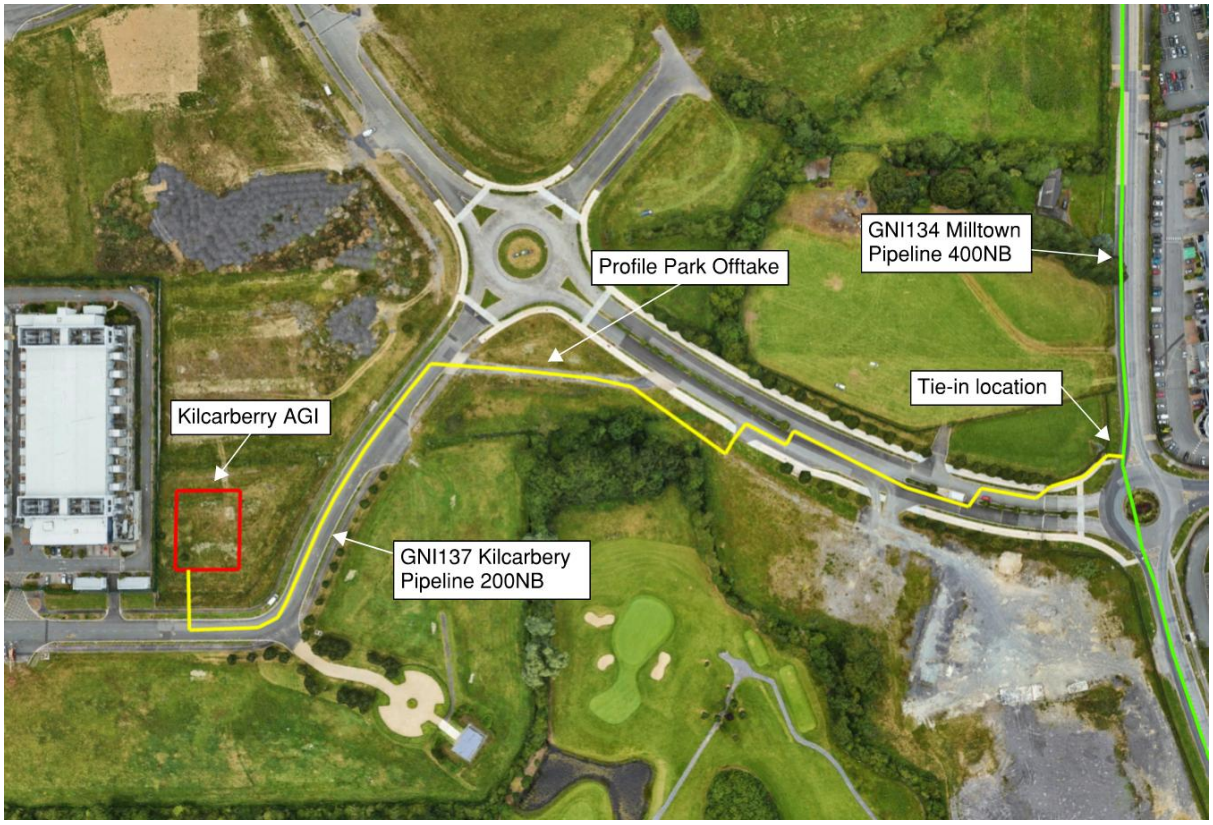

Figure 29 - Overview of GNI137 Pipeline Route and AGI location

5.1.1 Tie-in Point

The tie in pint will be located in the verge south west of New Nangor Road roundabout shown in Figure 30. GNI137 pipeline will tie-in into the proposed GNI134 pipeline near the grass verge as shown. A 400 mm x 200 mm barred tee and a buried valve arrangement shall be installed to facilitate the tie-in with GNI134. The valve arrangement shall be installed within the grass verge.

Figure 30 - Tie-in Location Street View

5.1.2 Main Pipeline Route in Roadway

The 550 m pipeline will be constructed using open cut method. The pipeline will be routing within a private road, Profile Park Road, after the offtake from the GNI134 pipeline. There are 2 no. open stream crossings. These are shown in Figure 35.

1. From the tie-in in location in the verge of the Nangor Rd the pipeline routes south-east. To avoid services the pipeline routes into the left-hand lane of Profile Park Rd.

2. The pipeline routes south along the west lane of the Profile Park road, before switching side into the eastern lane and continuing parallel to the high voltage electrical cables located within the roadway. See Figure 31.

Figure 31 - Pipeline routing from the Nangor Road roundabout in the Profile Park Road

3. The pipeline will cross the high voltage cable and continues southwards before turning into the grass verge / field east of the Profile Park Road to facilitate the crossing of the first open stream along the route. See Figure 32.

Figure 32 - Pipeline routing into grass area adjacent to the Profile Park Road

4. The pipeline routes within the grass verge crossing the open stream and then continues along the pathway as shown in Figure 33. The offtake for GNI142 pipeline will be left in this section.

Figure 33 - Pipeline routing through the pathway adjacent to the first roundabout on the Profile Park road

5. The pipeline routes southeast along the profile park road before turning 90 degrees and crossing the open stream again and entering into the Kilcarbery AGI site as shown in Figure 34.

Figure 34 - Pipeline routing along the Profile Park Roadway and into Kilcarbery AGI

5.1.3 Baldonnel Stream Crossing

The pipeline route crosses a stream/culvert at three locations south of the tie in location. The locations of the stream crossings are shown in Figure 35. Crossing 1 and 3 shown in Figure 35 are open streams while Crossing 2 is a concrete culvert in the road. Open cut method is proposed for these stream / culvert crossings.

Figure 35 - Location of stream/culvert crossings

5.1.4 Contaminated Land

The customers GIL (Greener Idea) has informed us that the mound/banking at entrance to the site is made up of contaminated land. More information is being sought about the nature of this contamination.

GNI142 Profile Park Pipeline

Outline of GNI142 pipeline works:

- Install 0.45 km of 200 mm NB steel pipeline.
- Install offtake from GNI137 pipeline.

The 200 mm NB pipeline will tie in to the proposed 200 mm NB GNI137 Kilcarbery pipeline in Profile Park. It will then route through a roundabout and before turning north to enter Vantage DC Ltd.'s premises. The pipeline will then route through the Vantage DC's site access road before entering the AGI.

It is proposed that the open cut method is utilised for installation of the whole pipeline route. For more details on the open cut method, please refer to section 7.1.3.

6.1 Proposed Pipeline Route

Figure 37 and Figure 37 below depicts the location of the proposed AGI, pipeline, and tie in point. The GNI142 pipeline will tie-in with the new GNI137 pipeline within the Profile Park Road grass verge. A 200 mm x 200 mm barred tee and a buried valve arrangement shall be installed to facilitate a tie-in with GNI137. The construction of GN142 will start once the tee has been installed. The GNI142 pipeline shall cross the profile park road, route west, through a roundabout and then route through profile park before turning north to enter the Vantage site, routing through Vantage's site access road and entering the proposed Profile Park AGI.

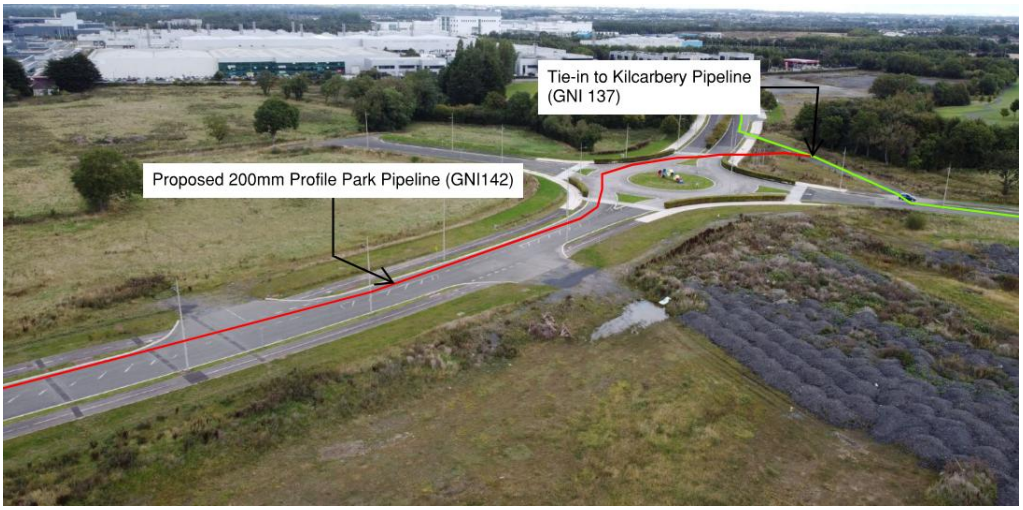

Figure 36 - GNI 142 Pipeline Route, AGI location and Tie in Point

Figure 37 - GNI142 Pipeline Route, AGI location and Tie in Point

6.1.1 Tie-in Point

The tie in point will be located in the grassy area south east of the roundabout as shown in Figure 37. GNI142 pipeline will tie-in with the new GNI137 pipeline within a grass verge on Profile Park Road. A 200 mm x 200 mm barred tee and a buried valve arrangement shall be installed to facilitate a tie-in with GNI137.

6.1.2 Main Pipeline Route in Roadway

The pipeline route for GNI142 will be on the Vantage DC side of Profile Park Road west of the roundabout. The pipeline will cross a minor roundabout about after the offtake from the Kilcarbery Pipeline but will have no significant crossings further along the route. GNI142 will be 0.5 km and does not include any river crossings. This can be seen in Figure 37. It is proposed that the open cut method is utilised for installation of the pipeline route. For more details on the open cut method, please refer to section 7.1.3.

7.1.1 Auger Bore Methodology – Griffeen River Crossing

An auger bore will be used for the trenchless crossing of the Griffeen River, as determined by 1587-RT-0004-R0 Griffeen River Trenchless Crossing Feasibility Report.

Traditional auger-boring is a method where basic, horizontal bores can be “drilled” through the ground on a generally straight alignment using equipment that consists of an external, rail mounted auger-boring rig positioned in an excavation. Where the excavation depth exceeds a few metres, the auger can be installed utilising a launch and reception cofferdam structure installed either side of the crossing as shown in Figure 38.

The mechanical power component is located outside of the bore and is uninfluenced and unrestricted in terms of power by the confines of the bore diameter. The auger rig drives steel sleeves that contain an Archimedes screw (continuous flight augers), and a cutting head is attached to the lead auger. Sectional lengths are installed by pushing the sleeve into the ground using hydraulic jacks on the auger-boring rig, whilst simultaneously rotating the augers and cutting head via a hexagonal coupling. Excavated material (in its natural untreated state) is transported back to the pit by the screw and is discharged in the pit for removal to the surface using conventional muck skips or an excavator.

Figure 38 - Typical Auger-boring Set Up for Deep Crossing

Once complete, the cutting head is removed and the augers withdrawn, leaving the installed pipe in situ in the ground. The cutting head has a nominal over-cut facility that enables the sleeve to be installed without picking up excessive friction from the surrounding soil. The

sleeve is then left in place, and the nominal annular space between the outside of the sleeve and the excavated ground is not grouted. Sacrificial sleeves (if used) are usually steel and can be up to 12m long. They are welded together in sufficient lengths to achieve the total crossing length. Alternative methods exist for shorter pipe lengths, including facilities to use clay pipes, and whilst traditional methods are usually non-steerable, modern equipment can now include for a degree of steering, with other variations also including “guided auger-boring” using a pre-driven pilot bore and reverse auger boring method.

Soft rock is theoretically possible by utilising a conventional hard cutter head, but in reality conventional auger heads are fairly low-tech and are generally limited to being able to deal with highly weathered rocks n/e 25MPa Unconfined Compressive Strength (UCS). For harder rocks, a special hard rock cutter head (SBU) is used - this is similar to an MTBM rock cutter head, but is still driven by the auger-boring unit identified as shown in Figure 39.

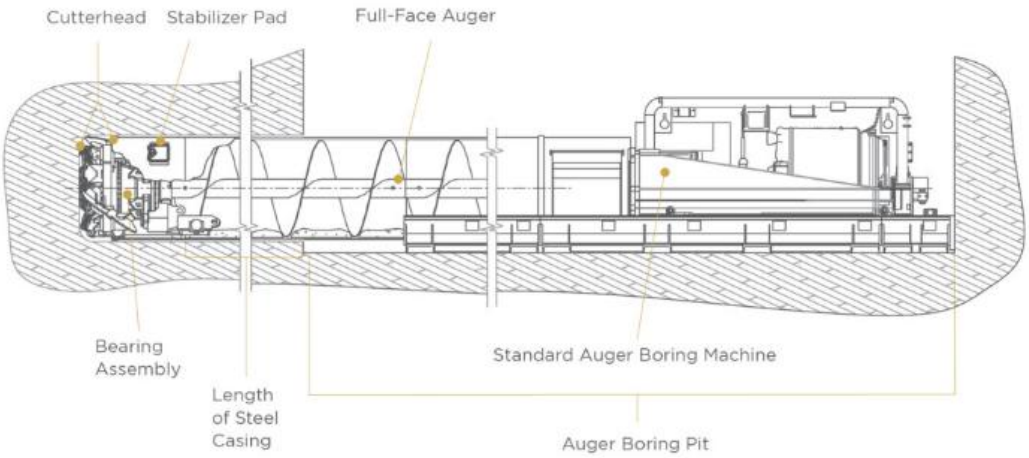

Figure 39 - Auger boring with a Rock Head

7.1.1.1 Griffeen River Crossing

The auger bore is routed so that it crosses the river at 90° as seen in Appendix D. This option results in a crossing length of approximately 30m. The detailed route and preliminary alignment are outlined in drawing GNI134/04/001, attached in the appendices.

The boring depth will be determined by both the depth of the rock head and riverbed depth. A minimum clearance of 1.6m from the bottom of the riverbed to the top of pipe is required as per IS 328:2021 and GNI standard drawing BGE/ST/2002. The auger bore method will require a reception and launch pit on either side of the river. The pits/shafts and tunnel are essentially Temporary Works and detailed design of these pits/shafts will be carried out by

the main works contractor. Refer to section 7.1.1.2 for typical detail on construction of the shafts.

It is expected that the Griffeen river crossing will need to be undertaken in rock, but this will be confirmed upon receipt of SI. The minimum size of the rock cutter head is ~600mm. It will be required to circulate out the sacrificial steel sleeve with concrete pipes prior to installing the final gas pipe to prevent interference with cathodic protection measures. For installation of a 400mm NB pipe, it is likely that sacrificial sleeves of 1100mm OD will be used.

Concrete jacking pipes of an equivalent outside diameter are used, and the steel sacrificial pipe is cut off in sections in the reception pit as the string is pushed forward by the jacking pipes, which effectively replaces the sacrificial steel auger-bored sleeve in entirety. The HP Gas Pipeline can then be threaded inside the concrete sleeve in the same way it would be done for a micro-tunnel crossing.

All excavated material (in its natural untreated state) is transported back to the pit by the Archimedes screw (continuous flight augers) and is discharged in the pit for removal to the surface using conventional muck skips or an excavator.

The basic design parameters for proposed auger-bore crossing of the Griffeen River are outlined in Table 1.

Table 1 - Basic Design Parameters for Proposed Auger-bore Crossing Technique

Parameter	Specification
Total Bored Tunnel Length	Approximately 30m
Vertical Alignment	Straight - depth TBC post SI and bathy survey.
Horizontal Alignment	Straight.
Launch Shaft	*TBC (typically 15m x 3.5m, but can be shorter, 8m x 3.5m, if half pipes are used), see section 7.1.1.2
Reception Shaft	*TBC (typically 3.5m x 3.5m, subject to depth), see section 7.1.1.2
Sacrificial Steel Sleeve OD	1100mm
Auger Machine Type	American Auger / Robbins ABM 36-630
Cutter Head	Robbins SBU-A42 (bore diameter 1120 mm to match sacrificial)
Concrete Jacking Pipe	FP McCann DN900 (1100mm OD to match sacrificial)
Jacking Pipe Type	RC jacking pipes to BS EN 1916 and BS 5911-1, steel banded
Pipe Length	2.5m
Packer Type	68mm MDF / self-lubricating joint gasket

7.1.1.2 Launch and Reception Shaft Construction

Prior to any boring, the thrust and reception pits (temporary works) will need to be carefully planned, designed, set-out and fully excavated. The design of the shafts is temporary works and is to be undertaken by the contractor. The detail presented here is typical of auger bore shaft construction for the size and depth of the proposed crossing.

Thrust and reception shafts will incorporate adequate tolerances to allow the auger-boring process to be executed safely and will consider any other relevant considerations regarding the final product pipe installation method including pipe length and overall pipe-string length and the requirement to carry out hot works below ground.

Shafts for auger-boring can be constructed in relatively small open sheet-piled excavations extending to very large piled cofferdams. It is envisaged the that shafts will be constructed for this crossing using a steel sheet piled cofferdam structure.

Steel sheet piled cofferdams are a specific form of deep open-trench construction for pipelines that is essentially a ‘temporary works’ solution. The main purpose of a cofferdam is to enable safe and efficient excavation (and hold back soil pressure and/or water) to form a safely supported trench excavation where pipeline construction/installation can take place.

Cofferdams are formed using steel sheet piles acting either in cantilever or being supported by internal steelwork bracing frames or external anchorages. The exact design solution will be dependent on a number of factors including final depth of excavation, external design forces, surcharge from heavy equipment, pipeline construction methodology and pipe-string lengths, and installation/welding and tie-in methodology. An example of a steel sheet piled cofferdam is shown in Figure 40.

As part of the detailed design, the typical size and the general geometry of the Piled Cofferdam will be developed. However, the Sheet Piled Cofferdam will remain Temporary Works and its design will be the responsibility of the Contractor appointed to carry out the gas pipeline diversion. Only the gas pipeline (and its associated geometry) will comprise the Permanent Works.

Once the pipe concrete sleeve and gas pipe has been installed, the Cofferdam will be backfilled in a structured sequence that allows security of the bottom frame before its removal. When suitably compacted, the bottom frame is then removed carefully in strict accordance with the sequence specified in the Contractors temporary works design. This typically requires the pressure on the bottom frame to be released carefully and the frame

lowered onto the base of the pit where it is usually dismantled and lifted out in sections, taken cognisance of the installed pipe locations.

Once the bottom frame (and subsequent frames) are removed, compacted backfilling can be carried out in accordance with any specified requirements to inhibit surface settlement due to compaction. When all shoring has been removed and the shaft is fully backfilled and compacted the steel sheet piles can be removed, typically using a dedicated pile extractor.

Suitable compaction density testing (i.e. Clegg or similar) should be carried out on each compacted layer to ensure the specified limits are achieved.

Figure 40 - Example of a Sheet Piled Excavation

GNI-134-04-001, attached in the appendices, shows the proposed pipeline route and pit locations for the trenchless crossing of the Griffeen River. The ground level at both sides of the river is steep, with an approximate 2 m change in elevation from the road / footpath level (approx. 68 m A.O.D.) to the riverbank level (approx. 66 m A.O.D.). The depth of the launch and reception shafts required for the Griffeen is to be confirmed following receipt of SI (borehole information) but they are estimated to be in the region of 6-8m deep. A typical launch pit requires an area of c. 15m x 3.5m (L x W) if full 12m long pipe spools are to be used. However, due to spacing constraints, it was determined half-pipes will be used, allowing a reduced pit size of 8m x 3.5m (L x W).

A temporary site compound will be set up at the launch shaft side (south of the river) and at the smaller reception shaft (north of the river). Both of these compounds will be arranged to minimise disruption to roadway and footpath users. The temporary compound layout drawing, GNI-0101-DG-006-R0, will be provided south of the Griffeen river and will be kept at a minimum distance of 20m from the river bank.

An outline construction method for each compound would be expected to consist of a reduced dig to lower the ground level and establish a safe plant operating area. Once in place a sheet pile installation will be undertaken. Before any excavation is undertaken a sufficient ground and surface water mitigation system will need to be in place.

7.1.2 Open Cut Trench Methodology – Baldonnel Stream Crossing

It is proposed that entire length of this pipeline will be constructed using the open cut trench method. The following step by step methodology will apply for this technique for the 2 no. open Baldonnel stream crossings:

1. During the initial stages of construction, trees or hedges lining the banks of water crossings are cleared, along with neighbouring topsoil.

2. The stream is left undisturbed until a few days (approx. 2-3) prior to the scheduled pipeline installation. The banks are then graded back to bed level. Topsoil shall be stored separately to the subsoil.

3. Flume pipes, designed to accommodate the volume of floodwater, are inserted into the watercourse. The contractor will ensure they extend past the area of the proposed trench and running track. The flume pipes are surrounded with sandbags to create a seal. Straw bales are placed downstream to capture sediments as required. Refer to Figure 41. It should be noted that depending on the time of year, the Baldonnel stream at these 2 no. locations is dry.

4. The pipe trench is excavated below the flume pipe. This excavated material is stored separately to the topsoil and subsoil, only this excavated material will be used to backfill the watercourse trench. If dewatering is required, particular care will be taken to ensure appropriate sediment control is taken.

5. The pipeline is installed in the trench. For stream crossings a distance of 1600mm will be maintained from the top of the pipeline to the bottom of the true cleaned stream. A precast marker slab will be laid 300mm above the pipeline.

6. The trench is backfilled such that it is level with the rest of the watercourse bed. The watercourse banks are then reformed to their original profile.

7. The dams and flume are removed, and the watercourse is allowed to flow normally for the remainder of construction.

8. Where appropriate the stream banks are reinstated with native plants as agreed with the landowner.

Open cut water crossings are carried out as quickly as possible (typically 3-4 days) to minimise the potential environmental impact. Please see Appendix F for the Baldonnel Stream Crossing drawings.

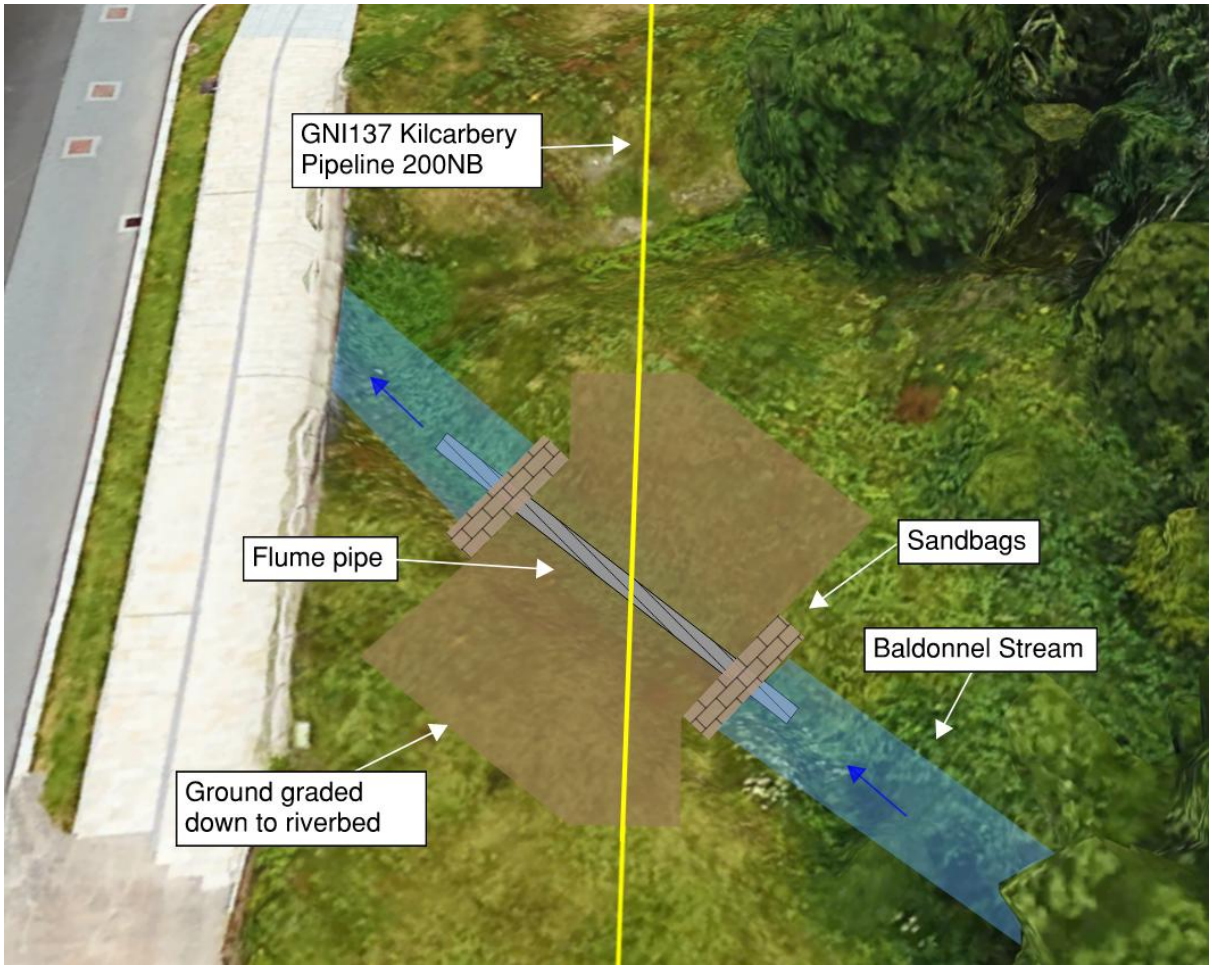

Figure 41 - Sketch of Flumed Crossing of Baldonnel Stream

7.1.3 Open Cut Trench Methodology – Roadway and Verge

The following is a step-by-step methodology for the open cut trench technique:

1. For GNI134, the 400mm NB pipe will require excavation to a **minimum** depth of 1750 mm (to base of trench) and minimum width of [1]700 mm (at base of trench) and 700 mm width (at ground level). For GNI135, GNI136, GNI137 and GNI142, the 200mm NB pipe will require excavation to a **minimum** depth of 1600 mm (to base

[1] To be confirmed by contractor

of trench) and [2]500 mm width (at base of trench) and 500 mm width (at ground level). These excavations will extend locally every 12 – 24 m at bell hole locations to facilitate welding activities. Note that trench depths will be determined based on existing service crossings etc. along the pipeline route. The minimum depths are given above to achieve minimum depths of cover required on the pipeline as per I.S. 328: 2021. Please refer to Figure 42 for example of streetworks excavation.

2. Place bedding layer of CL.503 material in accordance with IS 328:2021, GNI/AO/SP/007, Guidelines for Managing Openings in Public Roads 2017 (The Purple Book) and compact.

3. Lay the pipeline as detailed on the design drawings.

4. Carefully surround and cover pipe with CL.503 material in accordance with the design drawings, IS 328:2021, GNI/AO/SP/007, Guidelines for Managing Openings in Public Roads 2017 (The Purple Book) and Appendix B.

5. Place gas pipeline marker tape on compacted CL.503 and subsoil, 500 mm from the top of the pipe and 250 mm from the surface.

6. For concrete and asphalt/bitmac road sections, carry out immediate temporary reinstatement in accordance with the design drawings and *IS 328:2021, GNI/AO/SP/007, Guidelines for Managing Openings in Public Roads 2017 (The Purple Book*) and to the approval of the local authority and/or private landowners, unless otherwise agreed with local authorities. The roads will then be permanently reinstated at a later date as agreed with the local authority / landowners, with either full or half road width reinstatement.

7. For unsurfaced/grass sections, backfill with suitable excavated material to ground level leaving at least 200 mm topsoil or match existing level at the top to allow for seeding or replace turves as per the specification of the local authority or landowner.

8. Clean and test the pipework in accordance with the IS328:2021, GNI/AO/SP/007, Guidelines for Managing Openings in Public Roads 2017 (The Purple Book)

9. For each construction crew, the length of working area at any one time is expected to be 100 m. Note it is expected that there will be 2 – 3 working sections of 100 m

[2] To be confirmed by contractor

along all the routes during construction. These working sections will be separated by a distance as agreed with the local authorities / business parks so that traffic disruption is minimised.

10. The advance rate is expected to be 18 – 24 m per day.

The approximate quantity of material expected to be excavated and taken off site is detailed below in Table 2.

Table 2 - Approximate Quantity of Material to be Excavated

Works Area	Quantity (m^3)	Description
7208 Deansrath Hot Tap	740	3.7 m deep excavation over an area of 200 m^2
1304 Clondalkin Hot Tap	1581	3.0 m deep excavation over an area of 527 m^2
Pipeline GNI134	3675	Based on 1.75 m deep x 0.7 m wide excavation
Pipeline GNI135	64	Based on 1.6 m deep x 0.5 m wide excavation
Pipeline GNI136	2680	Based on 1.6 m deep x 0.5 m wide excavation
Pipeline GNI137	440	Based on 1.6 m deep x 0.5 m wide excavation
Pipeline GNI142	400	Based on 1.6 m deep x 0.5 m wide excavation

Figure 42: Example of Open Cut Streetworks Excavation for Gas Pipeline

Storage of Plant and Machinery

All plant, machinery and equipment will be stored on site within the works area or within the temporary construction compound to be defined during detailed design/tendering of the project. Oils and fuels will not be stored on site and will be stored in an appropriately bunded area within the temporary storage compound.

Expected Site Personnel and Construction Duration

It is anticipated that the construction of the pipeline will be completed during normal construction hours i.e. 7am to 7pm Monday to Friday, and 8am to 2 pm on Saturdays. However, it is possible that the contractor may wish to carry out certain operations outside these hours i.e. Sunday or evening hours during long summer days etc. Such occurrences will be kept to a minimum and take place over a short timeframe and as such are unlikely to cause excessive disturbance.

It is estimated that there will initially be 40-60 personnel on site on a typical day, however during peak construction periods this is expected to fluctuate up to a maximum of 80 site personnel and contractors on site per day. Site personnel will include management, engineers, construction crews, supervisors, environment health and safety personal, and pipeline specialist contractors.

Estimates for the duration of the construction works are included in Table 3 below. The overall start-to-finish duration is estimated to be 12 months. Construction is anticipated to commence in Q1 2024 and be completed by Q1 2025.

Table 3 - Estimated Construction Duration

Works Area	Estimated Construction Duration (Months)
Pipelines (GNI134, GNI135, GNI136, GNI137, GNI142)	10
Deansrath Hot Tap	3
Clonburris Hot Tap	3

Traffic Management

Traffic management and road signage for site access will be in accordance with the Department of Transport: Traffic Signs Manual - Chapter 8: Temporary Traffic Measures and Signs for Road Works and in agreement with South Dublin Co. Co. The contractor will prepare detailed traffic management plans for the project.

For the proposed street works, it is envisaged that each crew's working area will be restricted to 100m to allow a stop-go system be put in place using a single lane. It is anticipated that there could be 2 – 3 crews working on the pipeline routes at any one time, therefore 2 – 3 100m working sections along the entirety of the routes. A separation distance between these working sections will be maintained as agreed with the local authorities and business parks (1 km for example) so that traffic disruption is minimised and the areas do not cumulatively impact traffic.

APPENDIX A: Pipeline Routes and Footprint for EIA (Redline Boundary)

APPENDIX B: Typical Trench Reinstatement Details

APPENDIX C: 1587-RT-0004-R0 Griffeen River Trenchless Crossing Feasibility Report

APPENDIX D: GNI-134-06-001 Griffeen River Crossing Plan and Longitudinal Section

APPENDIX E: GNI-0101-DG-006-R0 Indicative Pipeline Temporary Construction Compound Layout

APPENDIX F: Badonnel Stream Crossing Plans and Longitudinal Sections