

## **Appendix C**

Hydrology & Drainage Report



# **R407 SALLINS BYPASS**

## **HYDROLOGY AND DRAINAGE ROUTE SELECTION REPORT**

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## HYDROLOGY AND DRAINAGE ROUTE SELECTION REPORT

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**Abstract:** Fehily Timoney Gifford (FTG) has been retained by Kildare County Council to carry out the constraints study, route selection and environmental impact assessment for the R407 Sallins Bypass. This report describes and assesses the impacts on the various route corridor options being considered from a hydrology and drainage point of view.

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## 1. INTRODUCTION

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In this section of the Route Selection Report for the Sallins Bypass Scheme, the hydrological impact, cross drainage structure requirements and the feasibility of draining/outfall for each route corridor are examined briefly.

The proposed Sallins Bypass will be located near Sallins town, just to the north of Naas town in County Kildare. The principle hydrological features of the study area are the River Liffey, which flows through the western part of the study area and the Grand Canal, which passes through the middle of the study area. The other water courses in the area are the Nass & Corbally branch of the Grand Canal (which branch offs from the main Grand Canal within the project area), the Morell River, the Hartwell River, a few branch canals and some unnamed tributaries of the Liffey and the Morell.

Altogether eleven routes options are been considered for Sallins Bypass which include the Green, the Cyan, the Red, Cyan/Red, the Blue, the Yellow, the Purple and the Orange routes. Some of the alternative routes also include various options. The routes options located to the west and to the east of Sallins finish at various junctions on the M7 whereas the routes located to the middle of the study area end at the R407 at the south of Sallins., all seven alternative routes commence at Point A on the R407 just north of Sallins (Route Corridor Options Drawing in Appendix A).

As the Cork - Dublin Railway Line and the Grand Canal pass approximately through the middle of the study area all route options cross them. Two route options (namely, the Red Option A and Cyan/Red Option A) also crosses the Naas & Corbally branch of the Grand Canal. Four route options to the west of Sallins cross the River Liffey twice and the Red route passes very close to the Liffey, but does not actually cross it. The Purple and Orange route options to the east of Sallins cross the Morell River.

FTG have carried out a preliminary flood risk assessment of the River Liffey at the Sallins area and the report is presented in Appendix D. Using the annual maximum flood data at Celbridge and Straffan gauging stations made available by the ESBI and the EPA, the study estimated 100-year peak flow values in the River Liffey at Sallins as approximately 160m<sup>3</sup>/s (present case) and 192m<sup>3</sup>/s (including the effect of the future climate change in Ireland). The corresponding 100-year water levels in the River Liffey were estimated as approximately 72.0m OD and 72.3m OD respectively.

During the route selection and constraints study stage the various local and national bodies related to the watercourses in the study area were contacted, these included the Office of Public Works (OPW), the Eastern Regional Fisheries Board (ERFB) and Waterways Ireland. The OPW responded by suggesting that subject to satisfactory provision being made for hydrology via Section 50 Applications, and maintaining a 15m clear width on each river bank for maintenance access, they have no fundamental objection to either crossing or constructing a road along the River Liffey.

The hydrological constraints and feasibility of drainage for each of the route corridors are presented in the following sections.

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## **2. HYDROLOGY AND DRAINAGE OF EACH ROUTE CORRIDOR**

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### **2.1. The Green Route**

The Green Route travels from the proposed millennium junction at M7 and progresses in a northeast direction. After crossing a local stream it crosses the Osberstown Road (L-2006) road and takes a right turn. This route then crosses the River Liffey and the Cork-Dublin Railway line, both in almost perpendicular direction. As it advances further north it crosses two local ditches (both of which need culverting) and takes a right turn to cross the Grand Canal at a skewed angle. The route then takes a gentle left turn to meet the Cyan route. The Green route again crosses the River Liffey almost perpendicularly, and than taking a gentle right turn the combined route reaches the R407 to the north of Sallins.

In addition to a major cross drainage structure on the Grand Canal, this route requires two major bridges on the River Liffey. At the location of the first crossing by the Green route, the River Liffey has a shallow right bank which could require a longer than 100m span bridge. Furthermore, the first bridge on the Liffey is also very close to the railway crossing bridge. The second crossing on the River Liffey by a 3-span bridge of approximately 90m total span (25m + 40m + 25m) seems sufficient to fulfil the criteria set by the OPW (no encroachment of the main river channel section and provision of a strip of 15 m width on both sides of the river bank). This route also needs one major culvert on a local stream just before the Osberstown Road crossing and two culverts between the railway and the Grand Canal crossing

Should the Green route be chosen, the vertical alignment will require a high point at the most southern bridge on Liffey. The lowest point between the commencement of the Green Route at M7 and the first high point at the Liffey first bridge is also the crossing point of a local stream. As this stream has some urbanized catchment area, the size (height) of the culvert could also affect the vertical alignment of the road. This has to be investigated from the invert level of the stream survey section and preliminary sizing of the culvert. The southern section of the road can be drained/outfall to this stream.

It is considered that surface water attenuation facility is not required for this route because the ditches/streams to which the surface runoff outfalls, meet the River Liffey at a very short distance from the outfall. However, adequate pollution control measure (such as Class A bypass separator) will need to be provided before the outfall.

### **2.2. The Red & Red Option A routes**

The Red route travels from the proposed Millennium Junction at M7 and progresses in a northeast direction, takes a left turn and crosses the railway line almost perpendicularly. After then, this route takes a gentle right turn and progresses in a northerly direction along

the right bank of the Liffey to meet the R407. Unlike the Green and Cyan Routes, this route never crosses the River Liffey, although approximately 400m stretch of this route is located very close to Liffey. The Red Option A route connects to the R407 just south of Sallins and travels along the Osberstown local road (L-2006). It then crosses the Naas & Corbally branch of the Grand Canal and takes a right turn to meet the Red route.

As mentioned in the Chapter 1, FTG have carried out a preliminary flood risk assessment of the River Liffey at the Sallins area the report is presented in Appendix D. The results of the preliminary flood assessment estimated the 100-year water level in the River Liffey as approximately 72.0m OD in the present case and approximately 72.3m OD including the effect of the future climate change. The study also found that out of the 400m stretch of the Red route located close to the eastern bank of the River Liffey, approximately 200m pass through the 100-year flood plain. As the average depth of water on this flood plain would be approximately 1.0m at the 100-year flood condition, the reduction of 100-year flood plain storage volume by the 200m length of road would be very small in comparison to the entire floodplain storage capacity of the River in the area.

The Red route requires only one major cross drainage structure on the Grand Canal. In addition, two culverts, namely, one on a stream near the proposed Millennium junction and the second on a stream coming out of Sallins, are necessary. The Red Option A route requires crossing on the Naas and Corbally branch of the Grand Canal and culverting of the stream(s) adjacent to this canal. Although this route would not require any crossings on the River Liffey, some retaining structure could be required for approximately 200m stretch of the route along the Liffey so as to minimise the reduction of the 100-year flood plain storage volume by the road embankment.

The southern section of the route up to the railway crossing will be fairly drainable. However, draining/outfall the stretch of road between the railway crossing and the main Grand Canal crossing will be difficult. Should the Red route be chosen it would be necessary to drain/outfall directly into the Liffey River through a drainage pipe along the local road adjacent to the Grand Canal. Draining/outfall for the remaining of the route seems reasonably feasible.

No surface water attenuation seems necessary for this route, as the surface runoff is either directly outfall to the River Liffey or to the ditches/streams which join the River Liffey at a very short distance from the outfall. However, adequate pollution control measure (such as Class A bypass separator) will need to be provided before the outfall.

### **2.3. The Cyan Route**

The Cyan route follows the same corridor as that of the Red route from the railway crossing to the proposed Millennium Junction. Similarly, it follows the same corridor as the Green route from the R407 north of Sallins to just before the crossing of the River Liffey. From the railway line the Cyan route progresses in a northerly direction for a short distance and then takes a gentle right turn to cross the Grand Canal almost perpendicularly. This route then progresses northward, crosses the River Liffey almost

perpendicularly and progresses further northward to meet the Green route. The combined Green/Cyan route then takes a gentle right turn and again crosses the River Liffey to meet the R407, north of Sallins.

The 100-year water level in the River Liffey was estimated as approximately 72.3m OD (including the effect of the future climate change). Considering a freeboard of approximately 0.5m, the required minimum finished road level would be 72.8m OD. The finished road level within an approximately 200m stretch of the Cyan corridor will need to be at least 72.8m OD.

In addition to the major cross drainage structure on the Grand Canal, the Cyan route requires two bridges on the River Liffey. Both of these bridges will need to be 3-span bridges of total length 90m (25m + 40m + 25m). As the average top width of the river at the crossing location is approximately 25 to 30 m, such three span bridges could fulfil the criteria set by the OPW (i.e. no encroachment of the main river channel section and provision of a strip of 15 m width on both sides of the river bank). For the Cyan Route, at least one culvert is required to culvert a local stream near the proposed M7 millennium junction (similar to that for the Red route option). However, if the Cyan/Red Option A is selected, an additional bridge over the Naas and Corbally branch of the Grand Canal and culverting of a local stream adjacent to this canal would be necessary.

The draining of the southern section of this Cyan route is similar to that of the Red route. Drainage outfall for the section of road between the railway and the Grand Canal crossing will be difficult, similar to that in the case of Red route. The sections of the road north of the Grand Canal crossing can be drained/outfall directly to the River Liffey, near to the two crossings. Adequate pollution control measure (such as Class A bypass separator) will need to be provided before the outfalls.

## **2.4. The Blue Route**

The Blue Route travels from R407, south of Sallins (just south of the railway line) and traverses in a northwest direction. It first crosses the Cork-Dublin railway line and then the Grand Canal, both at a skewed angle. After then, it takes a right turn and progresses in a northerly direction to meet the R407, just north of Sallins. This is the shortest of the routes been considered, and passes through the undeveloped corridor in currently reserved for the development of the Sallins bypass..

The major cross drainage structures required for the Blue route is a bridge on the Grand Canal. In addition, a culvert is required on a local stream coming out of Sallins town to join the Liffey.

Regarding the draining of this route, the first high point occurs at the railway bridge crossing and the second high point occurs immediately after the Grand Canal Crossing. Drainage of this stretch of the road (between the first two high points) will be difficult due to the present of a low point in between but having no local ditch/stream as a suitable outfall. The remaining section of the route is fairly drainable and can be discharged to a local



stream. Although surface water attenuation system is considered not required for this route, adequate pollution control measure (such as Class A bypass separator) will need to be provided before the outfall.

## **2.5. The Purple Route & its 'Option A'**

The Purple route travels from Johnstown Bridge on the M7 and traverses generally in a northwest direction all the way until it reaches the R407 north of Sallins. Along its route, it crosses the Cork-Dublin Railway line almost perpendicularly, and the Grand Canal at a skewed angle, two local road crossings, one just before the railway crossing and the other just after the Grand Canal crossing. All these four crossings are almost at the middle of this route and located very close to each other. The Purple Option A route travels from Maudlins Junction on M7 and traverses in a northerly direction to meet the main Purple Route. The Purple route corridor also touches the boundaries of a civil amenity, a local sand quarry and the Naas Golf Course.

The major cross drainage structure on the Purple Route is the crossing on the Grand Canal. In addition, up to two culverts are necessary for two local streams/canal supplies. For the Purple Option A of the Purple route, two additional culverts will be required to cross local branch canals.

The Purple route corridor passes almost through boundary of the catchment areas of the Morell River. If the surface runoff of any section of road is discharged to the tributaries/ditches of the Morell River, then provision of surface water attenuation would be necessary, as the Morell River has a propensity of flooding. However, most part of the road drainage would outfall to the local streams/ditches joining the River Liffey at a short distance and hence surface water attenuation may not be required for them. Adequate pollution control measure (such as Class A bypass separator) will need to be provided before the outfalls.

## **2.6. The Yellow Route**

The Yellow Route travels from R407 south of Sallins and traverses in an easterly direction. It crosses two small branch canals and then takes a left turn to meet the Purple route just before its crossings with the two local roads, the railway line and the Grand Canal.

As in the case of Purple route, the Yellow route requires a major bridge on the crossing on the Grand Canal and up to three culverts, two on the local canals and one on a local stream/ditch.

The drainage requirements for the Yellow route are similar to those of the Purple route for the section of the route where these two routes are combined. However, drainage of the an approximately 1km long section of the Yellow route seems difficult, as this section has to be drained towards the south where no suitable stream/ditch are available to outfall.

As most part of the road drainage would outfall to the streams/ditches joining the River Liffey at a short distance, surface water attenuation may not be required for this route, except for the 1km mentioned. Adequate pollution control measure (such as Class A bypass separator) will need to be provided before the outfalls.

## **2.7. The Orange Route**

The Orange route travels from the Johnstown Junction on M7 and progresses due north for a short distance after which it takes a gentle left turn and progresses in a northwest direction. Taking a gentle left turn, this route first crosses the Morell River and then the Grand Canal, both at some skewed angle. The Orange route then takes a gentle right turn to cross the Cork-Dublin railway line almost perpendicularly, after which it takes a gentle left turn, crosses the Straffan Road (L-6011) and progresses in a westerly direction to meet Point A on R407 north of Sallins. This route passes through the corner of a golf course and also passes very close to one of the several ponds in the area. The Orange route is the longest route been considered for Sallins bypass.

Apart from a major cross drainage structure on the Grand Canal, this route also requires a bridge on the Morell River and up to four culverts on the local streams/ditches. Vertical alignment of road just before and after the Straffan Road (L-6011) crossing could be raised so as to accommodate two culverts at these locations.

Almost the entire Orange route passes through the Morell River catchment which has a propensity of flooding at the downstream reach (north to the study area). As the surface runoff from this route is drained/outfall to the tributaries of the Morell River, attenuation systems is considered necessary for this route so as to limit the runoff at the Greenfield discharge rates. In addition, adequate pollution control measure (such as Class A bypass separator) will need to be provided before the outfalls.

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### 3. CONCLUSION

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All of the route options been considered for Sallins bypass are fairly drainable although the drainage requirements of some sections, in particular, the stretch between the railway and Grand Canal crossings for all routes will impact on the vertical alignment.

The vertical alignment road level in approximately a 200m section of the Cyan route will need to be above 72.8 m OD (i.e., 500mm above the 100-year flood level in the River Liffey). Similarly, the vertical alignment of a small section of the Orange route will also need to accommodate culverts on local ditches/stream.

Provision of surface water attenuation may be necessary for the Orange route as it passes through the Morell River catchment which has propensity of flooding the adjoining area further downstream of the project area. It is generally considered that such attenuation system is not required for other routes as the ditches/streams into which the surface water outfall meet the River Liffey at fairly short distance from the location of outfall. Suitable pollution control measure such as bypass separators are considered necessary for all routes.

All route options require a major cross drainage structure on the Grand Canal. In addition, the Green and the Cyan routes need to cross the River Liffey twice, whereas the Orange route requires a crossing on the Morell River. The Red Option A requires a crossing of the Naas & Corbally branch of the Grand Canal and the Purple Option A requires a crossing of a small branch canal. It is estimated that 2 to 4 culverts are required for all routes, with the Cyan route requiring the minimum number of culverts and the Orange route requiring the maximum number of culverts.

In case of the River Liffey, a three span bridge of approximately 90m (25m + 40m + 25m) would be nessecary to fulfil the OPW requirements. However, the first crossing of the River Liffey by the Green route could require little longer than 90m span bridge due to the local condition of the river, this will require further investigations.

Although the Red route does not cross the River Liffey, approximately a 400m section of the route passes very close to the River. A preliminary flood study carried out by FTG showed that, out of the 400m section of the Red route, approximately 200 metres pass through the 100-year flood plain. To reduce the extent of 100 flood plain storage by the road embankment, some retaining structure at the river side of the road may be required for approximately 200m section of the Red route.