The Lake Lothing (Lowestoft) Third Crossing Order 201[*]

Lake Lothing THIRD CROSSING

Document 6.3: Environmental Statement Volume 3 Appendices

Appendix 17B

HAWRAT

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Appendix 17B: HAWRAT Assessment

17.1 Introduction

17.1.1 This Technical Note summarises the findings of a quantitative assessment of potential impacts of the Scheme on the water quality of Lake Lothing. Only operational impacts have been considered in this assessment.

17.1.2 The approach that has been adopted broadly follows the approach promoted in Method A and Method D of the Design Manual for Roads and Bridges (DMRB) Volume 11, Part 10, Section 3:

- Method A of the DMRB is used to assess pollution impacts from routine run-off to surface waters; and
- Method D of the DMRB is used to assess pollution impacts from accidental spillage.

17.1.3 The assessments use the Highways Agency [now Highways England] Water Risk Assessment Tool (HAWRAT). The HAWRAT tool was designed to assess impacts to freshwater bodies and is therefore not directly applicable to the assessment of impacts to transitional waters such as Lake Lothing. The tool has therefore been adapted to assess a variety of scenarios to better understand the likelihood and magnitude of adverse effect.

17.2 Assessment Parameters

17.2.1 Lake Lothing is a transitional tidal waterbody located near Lowestoft. Review of the National River Flow Archive (NRFA)[1] indicates that Lake Lothing is fed by four small fluvial catchments that have a combined area of approximately 18km^2. The waterbody is not an impounded feature and is connected directly to the North Sea via Lowestoft Harbour that forms the eastern extents of the Lake. The west of Lake Lothing is also hydraulically linked to the River Waveney by the Oulton Broad and Oulton Dyke, separated by the Mutford Bridge lock gate.

17.2.2 Lake Lothing supports a permanent water depth, at the location of the Scheme water depths range from approximately 5.73m at Mean Low Water Spring (MLWS) to approximately 7.43m at Mean High Water Spring (MHWS). The waterbody is approximately 125m wide at the location of the Scheme.

17.2.3 The drainage design for the Scheme is summarised in Table 1 and is set out in Appendix 18B (and secured through the DCO). Figure 5.5 of the ES illustrates the drainage areas.

Table 1 Summary of drainage strategy

Ref.	Section	Area (m^2)	Discharge point and treatment
Area A	Road north of the Scheme bascule bridge and northern half of moveable bridge deck	14,000	Anglian Water sewer network via two retention ponds serving c.50% of the road area each. Penstocks and oil interceptors to be included prior to discharge. Ponds will be lined.

[1] http://nrfa.ceh.ac.uk/

Ref.	Section	Area (m^2)	Discharge point and treatment
Area B	Road south of the Scheme Bascule Bridge to Nexen building and southern half of moveable bridge deck	3,000	Anglian Water sewer network that subsequently drains directly to Lake Lothing, draining via an online storage tank. Catchpit, penstock and oil interceptor to be included prior to discharge.
Area C	Link road from Nexen building to Waveney Drive	6,000	Anglian Water sewer network via an online storage system. Oil interceptor to be included prior to discharge.
Area D	Riverside Road employment area – western catchment	3,973	Anglian Water sewer network located in Waveney Road to south, draining via online storage system. Oil interceptor to be included prior to discharge.
	Riverside Road employment area – eastern catchment	3,829	Anglian Water sewer network that drains north to same outfall as used for Area B. Penstock and oil interceptor to be included prior to discharge.
	Canning Road area	1,839	Anglian Water sewer network that drains north to same outfall as used for Area B. Oil interceptor to be included prior to discharge.
TOTAL		**32,641**	

17.2.4 In summary, surface water run-off will be discharged to the existing Anglian Water sewers that serve the connecting highway alignments. It is known that the Anglian Water sewer immediately to the south of the Scheme Bascule Bridge (which currently deals with the eastern catchment of Riverside Road and Canning Road) drains directly to Lake Lothing. Run-off from Area B and Area D (eastern catchment of Riverside Road and Canning Road) will drain to this outfall. It is currently unknown if other Anglian Water sewers, as discussed above, discharge to Lake Lothing, although this is considered likely given the topography of the area that falls towards Lake Lothing.

17.2.5 The Method A and Method D assessments consider the 24 hour two-way Annual Average Daily Traffic (AADT) flow for the Scheme – this is the total volume of two-way vehicle traffic of a highway or road for a year divided by 365 days passing a specific point in a 24-hour period. The 24 hour AADT for the 2022 and 2037 scenarios is estimated as 29,223 and 33,406 respectively. Approximately 2% of this will comprise HGVs for both the 2022 and 2037 scenarios; see Figure 19.4.

17.3 Assessment approach: Method A

Scope of the assessment

17.3.1 Method A assesses the risks of water pollution within the receiving watercourse associated with the discharge from the Scheme.

17.3.2 Given the size and transitional nature of Lake Lothing, its current use for commercial and recreational navigation, and the regular dredging activities to remove accumulated sediment

it is considered highly unlikely that the Scheme would pose a notable risk to existing water quality levels. However, in order to quantify and therefore better understand the scale of potential impact, the HAWRAT assessment process has been applied. As discussed in paragraph 17.1.3 the tool was designed to assess impacts to freshwater bodies rather than transitional waters such as Lake Lothing. However, the tool will still enable consideration of likely pollutant concentrations and dilution requirements to better understand likely effects.

17.3.3 Two separate HAWRAT assessments were undertaken:

- Scenario 1: Completed for Areas B and D (eastern catchment of Riverside Road and Canning Road) that are the only sections of Scheme that are known to discharge directly into Lake Lothing, which have a combined impermeable area of 8,668m^2; and
- Scenario 2: Completed for the entire impermeable area of the Scheme, including the bridge, roundabouts and associated roads, equating to a total of 32,641m^2. This assumes a worst case scenario that all run-off discharged to the Anglian Water network will be discharged to Lake Lothing.

17.3.4 Two types of assessment are undertaken within the HAWRAT tool:

- Short-term acute and chronic impacts on aquatic ecology related to the intermittent nature of road run-off. It assesses the acute and chronic pollution impacts on aquatic ecology associated with soluble and sediment bound pollutants, respectively. For an individual outfall to pass the HAWRAT assessment it must pass both the soluble pollutant and sediment pollutant impacts.
- Long-term impacts based on annual average concentration of certain hazardous pollutants, as defined under the Water Framework Directive (WFD). The long-term risks over the period of one year are assessed through comparison of the annual average concentration of pollutants discharged from the Scheme with the published Environmental Quality Standards (EQS) for those pollutants.

17.3.5 The assessment of soluble pollutants (short term acute and annual average concentration) gives consideration to dissolved copper and zinc, whereas the assessment of sediment bound pollutants gives consideration to a wider range of pollutants including copper, zinc, cadmium, pyrene, fluoranthene, anthracene, phenanthrene and total PAH (Polycyclic Aromatic Hydrocarbons).

17.3.6 HAWRAT is a tiered consequential system which involves up to three assessment stages, outlined as ‘steps’. These are detailed as follows:

- Step 1 uses statistical models to determine pollutant concentrations in raw road run-off prior to any treatment or dilution in the receiving watercourse;
- Step 2 assesses in-river pollutant concentrations after dilution and dispersion in the receiving watercourse, but without active mitigation; and
- Step 3 considers the in-river pollutant concentrations with active mitigation.

Assessment parameters

17.3.7 In additional to the drained areas listed above, the following additional information has been used to complete the HAWRAT assessment:

- Permeable area drained to outfall is assumed to be 0m^2.

- Standard Average Annual Rainfall (SAAR) of 600mm based on rain gauges from nearby stations and as contained within the HAWRAT guidance for different climatic regions;
- Base Flow Index (BFI) of 0.43 for nearby river catchments taken from NRFA;
- A low value for water hardness of < 50mg $CaCO_3$/L was selected as a worst case scenario as this information is uncertain;
- Typical dimensions of Lake Lothing at the bridge crossing of 125m; and
- Two way AADT.

Determining the annual 95% river flow

17.3.8 The HAWRAT tool requires an estimation of the 95 percentile (%) river flow rate to represent likely low flow conditions (and therefore potential for greatest impact). As Lake Lothing is a transitional water body the usual methods for calculating the 95% flow are not applicable. This is because the waterbody is tidal and does not have flows in a single direction as a river would have. Two scenarios were therefore considered as described below.

- The first considered a typical 95% flow for a catchment located close to Lake Lothing (namely the Wittle at Quidenham – 33045). The catchment considered has an area of 28.3km^2 which is greater than the 18km^2 catchment which is estimated to drain directly into Lake Lothing, if inflows from the North Sea and upstream Oulton Broad are not taken into consideration. The NRFA estimates the 95% flow for the Wittle catchment to be 0.017m^3/s, so a conservative (low) estimate of the 95% flow for the selected catchment draining into Lake Lothing was estimated to be approximately 0.008m^3/s (interpolating from a catchment of 28.3km^2 to a catchment of 18km^2 and reducing by a further 25% for robustness and managing uncertainty).
- The second gave consideration to the flow velocities modelled within the sediment analysis that is being undertaken to inform the assessment of scour and sediment deposition impacts. The modelling indicates a lowest flow velocity of 0.006m/s. This suggests a lowest flow rate during the MLWS tide in the region of 2.0m^3/s assuming a varied bed profile.

17.3.9 The estimated freshwater flow of 0.008m^3/s was therefore used as the 95% flow to inform the HAWRAT assessment to provide a worst case scenario.

Summary of assessment

17.3.10 The Scheme failed Step 1 of the HAWRAT assessment for both of the assessed scenarios of differing impermeable areas – noting that Step 1 is the assessment of pollutant concentrations in raw road run-off prior to any treatment or dilution in the receiving watercourse.

17.3.11 The Scheme passed the HAWRAT assessment at Step 2 for both of the assessed scenarios - noting that Step 2 is the assessment of pollutant concentrations after dilution and dispersion in the receiving watercourse, but without active, embedded mitigation. This follows HAWRAT standard methodology which excludes embedded mitigation at Step 2. Table 2 summarises

the findings of Step 2 of the HAWRAT assessment, with a review of this assessment provided below.

Table 2 Summary of HAWRAT assessment of pollution risks to Lake Lothing for different impermeable areas

Input data			Short term pollutant impacts		Long term pollutant impacts		
Q95 (m^3/s)	Impermeable road area drained (ha)		Acute impact assessment of copper	Acute impact assessment of zinc	Sediment-bound chronic impact	Annual average concentration of copper (µg/l) due to road run-off	Annual average concentration of zinc (µg/l) due to road run-off
0.008	Area B & D:	0.8668	PASS	PASS	PASS	0.07	0.21
0.008	Total:	3.2641	PASS	PASS	PASS	0.24	0.62

17.3.12 The HAWRAT tool indicates the acute concentration of pollutants generated by the Scheme would be below the acceptable threshold values set by the DMRB methodology. Considering that the dilution potential within Lake Lothing will be significantly greater than the watercourse used within this assessment, the HAWRAT assessment indicates that the Scheme will not pose unacceptable short term pollution risk to the waterbody.

17.3.13 The HAWRAT tool indicates that that there could be settlement of sediments in Lake Lothing as a result of the low flow velocity, but suggests that this is not extensive given the estimated width of Lake Lothing and Deposition Index as calculated within the HAWRAT tool. The potential increase in pollutant risk from sediment associated with the Scheme is therefore not considered to pose notable impact.

17.3.14 As discussed above, the assessment of long term pollution impacts to the receiving water environment considers the annual average pollutant concentrations associated with the Scheme against the EQS that inform the WFD. As Lake Lothing is a transitional water body, the usual EQS values for dissolved copper and dissolved zinc are not strictly applicable. Consultation with the Environment Agency recommended appropriate annual average concentrations of copper and zinc in a transitional waterbody of 5 µg/l and 40µg/l respectively in all hardnesses of water. The results of the HAWRAT assessment indicate annual average concentrations of copper and zinc well below these threshold values.

17.3.15 Step 3 of the HAWRAT assessment was not completed as the Scheme passes the HAWRAT assessment at Step 2.

Cumulative assessment

17.3.16 The DMRB Volume 11, Part 10, Section 3 states that a cumulative assessment of outfalls that discharge to the same reach of watercourse should be undertaken.

17.3.17 Scenario 2 of the assessment presented in this report (i.e. completed for the entire impermeable area of the Scheme) is effectively a cumulative assessment of all the drainage from the Scheme.

17.3.18 Regarding the wider highways drainage network beyond the Order limits, information is not known (specifically drainage areas, outfall locations and traffic flow) and as such, a cumulative HAWRAT assessment of the wider area has not been completed. However, review of the

information provided above and considering that the dilution potential within Lake Lothing will be significantly greater than the watercourse used within this assessment, the impact of the Scheme on a wider cumulative assessment is likely to be small.

17.4 Assessment approach: Method D

Scope of the assessment

17.4.1 Method D of the DMRB assesses the risk of pollution from spillages in the operational phase – i.e. if an accident were to occur. The assessment considers likely spillage rates based on the nature of the road (i.e. presence of slip roads, roundabouts, junctions etc. that can increase risk) and the percentage of the AADT that comprises HGVs.

17.4.2 The assessment takes the form of a risk assessment, where the risk is expressed as the annual probability of a serious pollution incident occurring. This risk is the product of two probabilities:

- The probability that an accident will occur, resulting in a serious spillage of a polluting substance on the carriageway; and
- The probability that, if such a spillage did occur, the polluting substance would reach the receiving watercourse and cause a serious pollution incident.

17.4.3 Factors which influence the overall probability within a road drainage network are: the type of road (i.e. motorway or trunk road), the road components (i.e. slip road, roundabout, side road), the length of each road component within the road drainage network, traffic flow, the percentage of traffic flow that comprises HGV's, and the response time of the emergency services.

17.4.4 The assessment is designed to consider spillage risks to motorways and A roads and, as such, is not particularly applicable to this Scheme given the slower speeds of vehicles using these roads. The assessment will, however, give an indication of potential risks should an accident occur. It has been decided to only include the main carriageway in this assessment – i.e. Areas A, B and C, and exclude Area D that forms the Riverside Road employment area as the speed and volume vehicle movements within this area will be much less.

17.4.5 The length of the main carriageway considered in this assessment (excluding the Riverside Road employment area) measures approximately 850m between Waveney Drive and Denmark Road. For simplicity and to consider a worst case scenario, it has been assumed that all sections of the road will drain to the same outfall and that this will be directly into Lake Lothing.

Assessment parameters

17.4.6 The following information has been used to complete the HAWRAT Method D assessment:

- Outfall will drain to a surface watercourse;
- The road type was selected as an A-road in an urban area;
- Response time taken as <20 minutes as the site is urban;
- Two way AADT; and
- 2% HGV traffic.

17.4.7 The DMRB provides spillage rates for different types of junctions and for lengths of road within 100m of these junctions.

Summary of assessment

17.4.8 A summary of this information is provided in Table 3, noting that only new junctions have been considered and that the assessment has been completed before the inclusion of mitigation.

Table 3: Summary of HAWRAT assessment of pollution impacts from spillages

Ref.	Location and type of junction	Length of carriageway within 100m of junction(s)	Spillage rates (Table D1.1 DMRB)	Annual probability of a serious pollution incident
Area A	Roundabout adjacent to Denmark Road	300m	5.35	0.00017 (0.02%)
Area C	Cross roads x 2 serving Riverside Road employment area	265m	1.46	0.00004 (0.0%)
Area C	Roundabout to Waveney Drive	300m	5.35	0.00017 (0.02%)
All areas	Remaining carriageway not within 100m of junctions	250m	0.31	0.00001 (0.0%)
			Total	**0.0004 (0.04%)**

17.4.9 The DMRB recommends that an annual probability of a serious pollution incident occurring of less than 1% would be acceptable, where no sensitive freshwater receptors are located within 1km. The results of the HAWRAT assessment indicate an annual probability of 0.04% which is well below this threshold. As discussed, this assessment has been undertaken prior to the inclusion of mitigation.

17.4.10 It is proposed in the Drainage Strategy that all run-off draining from the Scheme is passed through an oil interceptor prior to discharge to the Anglian Water sewer network. It is also proposed that penstocks are used where discharge from the Anglian Water network may be in close proximity to Lake Lothing – particularly for the known outfall immediately to the south of the Scheme Bascule Bridge that drains Area B and Area D (eastern catchment of Riverside Road and Canning Road), and potentially the outfall that will serve Area A. Discharge from Area A will also be passed through a retention pond prior to discharge.

17.4.11 With mitigation is taken into account and reduces the risk of spillage by 50% in accordance with Table 8.1 of DMRB Volume 11, Part 10, Section 3, the annual probability of a serious pollution incident reduces to 0.02%.