Gatwick North Terminal Development Projects

Updated Flood Risk Assessment

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UPDATED FLOOD RISK ASSESSMENT

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GATWICK NORTH TERMINAL DEVELOPMENT PROJECTS

UPDATED FLOOD RISK ASSESSMENT

1. INTRODUCTION

For the Gatwick North Terminal Development Projects (NTDPs), Gatwick Airport Limited (GAL) is proposing a North Terminal Extension (NTX) and a conversion of an existing single level car park into a multi-storey car park (known as MSCP6). The project also includes the following (although these are not being applied for at this time):

- Changes to the airfield – likely to include the development of a new Pier to serve the North Terminal, reconfiguration of a number of remote and pier-served stands and redevelopment of Pier 1; and
- The development of further long-stay passenger parking facilities at the Airport (on the 'Flying Pan' and 'Summer Special' sites), both to meet increased demand arising from passenger growth and to accommodate on-airport operations arising from reductions in unauthorised off-airport parking.

The proposed aspects of the Gatwick North Terminal Development Projects are shown in Figure 1.

This document provides a summary of the FRA that has been undertaken to appraise the effects of the construction and operation stages of the North Terminal Development Projects upon fluvial flood risk and surface water run-off. The FRA largely focuses on the fluvial flood risks associated with the NTX and MSCP6.

2. POLICY BACKGROUND AND RELEVANT STUDIES

Planning Policy Statement 25 (PPS25)[1] requires a site-specific Flood Risk Assessment (FRA) for all Zone 2 and 3 developments. Black and Veatch modelling indicates that the proposed locations for the NTX and MSCP6, as well as the existing Pier 1 are situated within Flood Zone 3 (1% annual probability floodplain), discussed further in section 7. All other aspects of the proposed development are situated outside of the fluvial floodplain, and are therefore not considered in relation to fluvial flood risk; nevertheless, they are still considered in the context of risks from surface drainage flooding.

PPS25 refers to the need to comply with Planning Policy Statement 23[2](PPS23). PPS23 requires Local Planning Authorities to consider the potential for water contamination in relation to existing and proposed land uses, and the possibility of encountering contamination during development.

Relevant flood studies for local flood risk management that have informed this FRA; include the following:

- The Thames Catchment Flood Management Plan (CFMP)[3] advocates re-establishing river corridors and more effective management of run-off, including water attenuation at a local scale.
- The Southeast regional Flood Risk Appraisal[4] seeks green-field run-off rates and reduction in run-off volumes in the area through improved surface water drainage infrastructure.
- The Crawley Borough Council Strategic Flood Risk Assessment[5] states that it is essential that sustainable drainage techniques are used to fully mitigate the impact of any future

[1] Communities and Local Government (2006) Planning Policy Statement 25: development and Flood Risk
[2] Office of the Deputy Prime Minister (2004) Planning Policy Statement 23: Planning and Pollution Control
[3] Environment Agency (2007) Thames Region Catchment Flood Management Plan, summary document
[4] South East regional Assembly (2006) Regional Flood Risk Appraisal for South East Plan
[5] Crawley Borough Council (2007) Strategic Flood Risk Assessment

development within Gatwick Airport to avoid increased flood risks to properties downstream.

3. EXISTING DRAINAGE SYSTEM

The existing surface water drainage system at Gatwick Airport comprises ten drainage areas. Three of these areas drain directly into the River Mole, Gatwick Stream and Crawters Brook. The run-off from the other seven drainage areas is diverted to existing balancing ponds before discharging to a surface watercourse, with the exception of Pond D which has a water quality monitoring device which allows clean discharge to the River Mole or discharge of contaminated water to Crawley WwTW (Table 1, and Figure 2).

All of the proposed works as part of the North Terminal Development Projects fall within the discharge area that drains to Pond D (coloured green on Figure 2).

Table 1: Existing Surface Water Catchment Areas and Outfalls

Catchment Area	Outfall
Pond A	Weir to River Mole
Pond B	Weir to River Mole
Pond C	Weir to River Mole
Pond D	(Water quality monitoring device) Clean water to River Mole Contaminated water to Crawley WwTW
Pond E	Weir to Gatwick Stream
Pond F	Weir to Gatwick Stream
Pond G	Weir to Gatwick Stream
North West Zone	Direct run-off to River Mole

The closest watercourses to the North Terminal building and MSCP6 are the Gatwick Stream to the east and the River Mole to the north and west, as shown on Figure 1.

The North Terminal is served by a comprehensive surface water drainage system, the layout of which is shown in Figure 3. This drainage system transfers surface water run-off to the Airport's main balancing pond, Pond D, by gravity. From Pond D, water is pumped to the River Mole via oil interceptors. During winter months, if the run-off is contaminated (for example with aircraft or pavement deicant), it is pumped from Pond D to Crawley Sewage Treatment Works, which is managed by Thames Water.

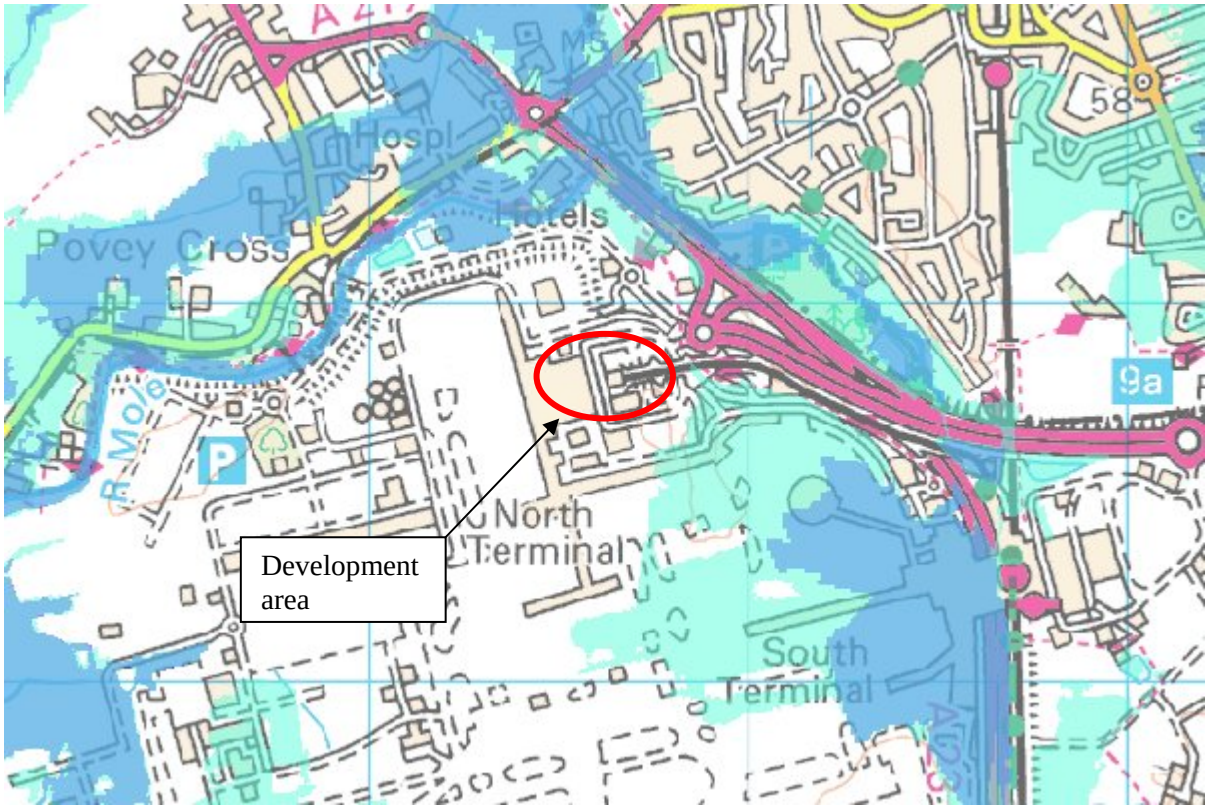
4. EXISTING FLOOD RISKS

Gatwick Airport is currently at risk of flooding from two main sources:

- Flooding from the two rivers (River Mole and Gatwick Stream) adjacent to the Airport on its north-east and west sides. This flooding generally occurs after long duration storms in the upstream areas of the catchment.

- From intense direct rainfall falling on the Airport and exceeding the capacity of the surface water drainage system. This flooding occurs during shorter, but more intense storms.

The extract below was taken from the Environment Agency website in July 2009[6], and shows that the area around the North Terminal is not within fluvial Flood Zone 2 or 3. Nevertheless, Black and Veatch has undertaken detailed modelling of the area (the methodology for which is discussed in section 6) which indicates that the proposed locations for the NTX and MSCP6, as well as the existing Pier 1 are situated within Flood Zone 3 (1% annual probability floodplain), discussed further in section 7.



Environment Agency Flood Map of North Terminal area
Source: http://www.environment-agency.gov.uk/maps, June 2009
Note: Area shaded dark blue is land with 1% annual probability of flooding. Area shaded light blue is land with 0.1% annual probability of flooding.

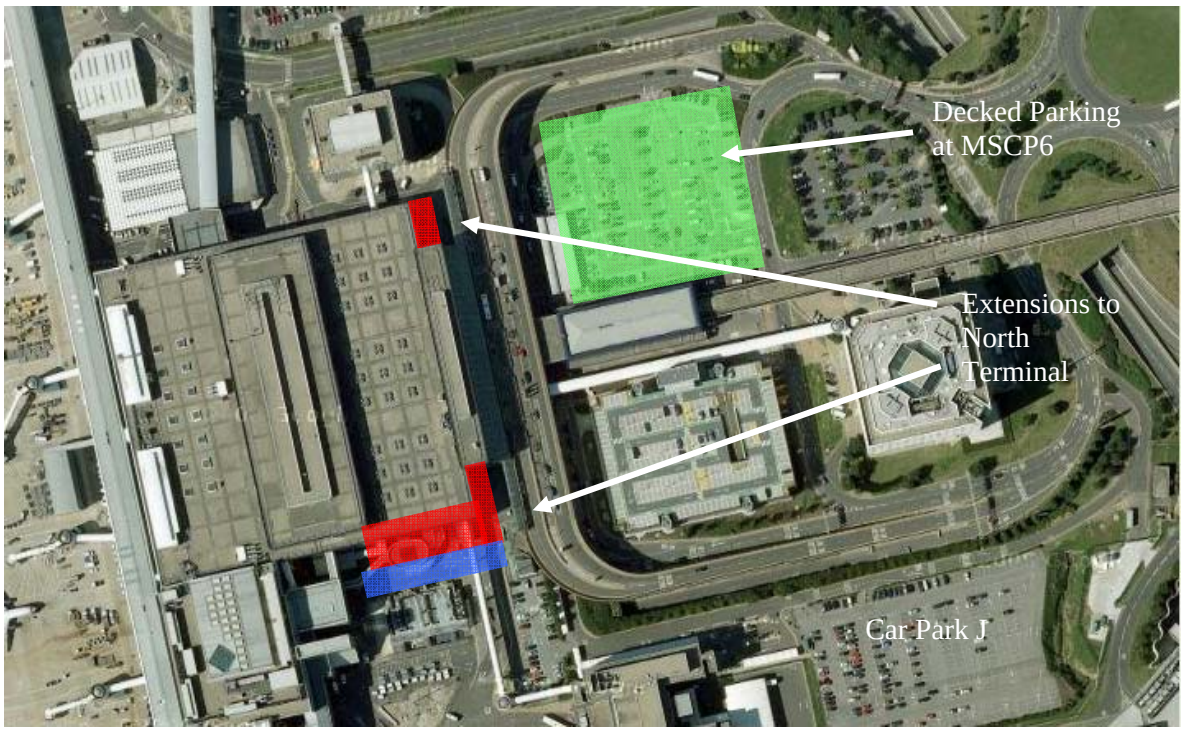
Gatwick Airport is situated on Weald Clay and is therefore considered to be at low risk of flooding from groundwater. There is no risk of flooding from tidal sources.

5. THE PROPOSED DEVELOPMENT

The NTX and MSCP6 are planned for construction between 2009 and 2011. The NTX includes two areas of extension to the North Terminal building, one in the north-east corner, and a second in the south-east corner (red shaded areas in the figure below). The south-east extension would also include an overhang over the baggage handing area (shaded blue), although this area would not be enclosed.

The construction of the MSCP6 would involve the conversion of the existing surface car park to the east of the terminal to a multi-storey car park, the location of which is indicated by the green shaded area in the figure below. The multi-storey car park will be open sided.

[6] http://www.environment-agency.gov.uk/homeandleisure/floods/default.aspx



Proposed works in vicinity of North Terminal

The reconfigured Pier 1 is programmed for construction between 2010 and 2011. The design of the new Pier configuration has not been finalised, however it is very likely that it would entail a smaller Pier footprint, and hence reduced flood levels in the South Terminal area. As this aspect of the project would not increase flood risks it is not considered further in this FRA.

6. METHODOLOGY

6.1 Proposed FRA Methodology for Fluvial and Surface Run-off Flooding

The proposed methodology for the FRA was discussed and agreed with the Environment Agency at meetings on the 11th March and 3rd April 2009. The minutes of these meetings are included as appendices to the North Terminal Development Projects ES (Appendix L).

The methodology in relation to fluvial flooding is detailed below:

- Model a range of flood return periods, including a 20% increase in flows to allow for climate change. Modelled return periods to include 1:50 and 1:100.
- Incorporate overland flow paths into the model.
- Assess flood depths in the vicinity of the North Terminal.
- Based on the footprint of the development (north and south extensions of the North Terminal), identify the volume of compensatory storage required.
- Using GIS contour modelling and associated site visits, identify potential areas for compensation, including assessment of the following:
    - likely flood storage capacity of each option;
    - constructability;
    - potential for environmental enhancement; and
    - associated costs.
- Discuss and agree preferred compensation option(s) with the Environment Agency.
- Consider the potential effects of the Upper Mole Flood Alleviation Scheme upon fluvial flood risks.

The proposed methodology in relation to flooding from surface drainage is detailed below:

- Identify extent of proposed new areas of hardstanding, and the likely effects of these upon surface run-off flooding.
- Identify suitable mitigation to alleviate the effect of surface run-off flooding.
- Discuss and agree preferred compensation option(s) with the Environment Agency.

6.2 PPS25 Requirements and the Exception Test

In line with PPS25 requirements under Annex D, this FRA has assessed the flood risk vulnerability and Flood Zone compatibility of the NTX and MSCP6.

According to Black & Veatch Modelling, the proposed locations of the NTX and MSCP6 lie within Flood Zone 3a, which is defined as land vulnerable to 1% or greater annual probability of river flooding.

The proposed locations of the NTX and MSCP6 are considered to be 'less vulnerable' to flooding as defined by Table D.2, Annex D of PPS25, as they comprise commercial buildings. Accordingly, in line with Table D.3, Annex D of PPS25, the 'Exception Test' detailed in PPS25 is not required for this scheme. Nevertheless in line with best practice, this FRA has ensured compliance with the rules of the Exception Test. For the Exception Test to be passed:

1) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared.
2) The development should be on developable, previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and
3) A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall[7].

6.3 Modelling

The effects of the scheme have been assessed using an ISIS river model and, in line with Defra guidance, include a 20% increase in fluvial flows to account for potential climate changes. The model incorporated a 2D overland flow module, TUFLOW, which used recently purchased LiDAR level data. The combined model was therefore able to model river flooding and subsequent flow paths across the airport.

The ISIS model was based on the MIKE 11 Horley Flood Study model, purchased from the Environment Agency on 7th January 2007. The following amendments to the Horley Flood Study model were made:

- It was found that the model overestimated the capacity of the Gatwick Stream by making it too easy for water to bypass the culvert under the South Terminal. This was amended, resulting in more spillage to the airport
- The cross-sections for the latest River Mole diversion, circa 1999, were added
- The diameter of the River Mole siphon under the runway was corrected

[7] Communities and Local Government (2006) Planning Policy Statement 25: development and Flood Risk

7. FLOOD RISK ASSESSMENT

7.1 Fluvial Flooding

(a) Modelled Flood Extents – Existing Situation

The results of the river model indicate that the Airport is not predicted to flood from the River Mole in a 1% annual probability flood event plus a 20% allowance for climate change. Instead, the Airport is mainly at risk of flooding from the Gatwick Stream due to a lack of capacity in the culvert under the South Terminal.

Once water leaves the Gatwick Stream at the South Terminal (ground level approximately 58.500mAOD) it flows downhill towards the North Terminal. The North Terminal is the lowest point at the airport, with a minimum ground level of approximately 55.000mAOD, and effectively sits in a 'bowl'. Figure 4 shows the ground levels in the South Terminal and North Terminal, along with an indicative flow path (generated by Arc GIS software using the LiDAR level data). Water generally ponds in the North Terminal until it can be drained to the River Mole via the surface water drainage system and screw pumps at Pond D.

Figures 5, 6 and 7 illustrate the model output for a 2% annual probability event, a 1% annual probability event and a 1% annual probability event with a 20% allowance for climate change. They show maximum flood depths (the flooding does not all happen at the same time) and support the flow path indicated by Figure 4. As well as overtopping of the banks of the Gatwick Stream at the South Terminal, there is some flooding from the confluence of the River Mole and Gatwick Stream. The flooding at the confluence of the rivers is restricted to the A23, however, and does not extend to the airport. The reason for this can be seen on Figure 8, which shows the 'ditch' adjacent to the A23 at approximately 54.500mAOD and the nearby bund which has a low point of approximately 57.000mAOD. The flood maps show that, for the larger events, flood water extends to this area from the North Terminal. However, due to the same bund, interaction is limited. Any floodwater from the North terminal that breaches this bund will either flow into the River Mole or cross the A23 and into the Gatwick Stream.

At present the area around the North Terminal is currently protected from flooding from the Gatwick Stream up to a 5% annual probability flood event. During a 1% annual probability event with a 20% allowance for climate change, the modelled maximum flood level in the vicinity of the North Terminal is 57.514mAOD. The total predicted volume of floodwater in the North Terminal is 264,953m^3. Based upon the maximum flow rate of the screw pumps at Pond D (of 1616 l/s) it would take approximately 45 hours to pump this volume to the River Mole.

(b) Results – Effect of the North Terminal Development Projects

The extensions to the North Terminal, assuming that they were water tight, would remove 233m^2 (northern extension) plus 3000m^2 (south eastern extension, excluding baggage handling overhang) of area from the floodplain. Existing ground levels at the sites of the proposed extensions vary between 56.400mAOD and 57.000mAOD. Table 2 below summarises the volume of floodwater displaced for a range of flood depths, up to the 57.514mAOD maximum (generated by Arc GIS software):

Table 2: Floodwater Displaced by Terminal Extensions

Ground Level (mAOD)	NTX Displacement (m3)	
	100mm sections	Cumulative
56.3	0.000	0.000
56.4	0.005	0.005
56.5	4.303	4.308
56.6	31.054	35.362
56.7	72.626	107.988
56.8	122.919	230.907
56.9	208.451	439.359
57	245.211	684.569
57.1	262.314	946.884
57.2	288.476	1,235.359
57.3	306.269	1,541.628
57.4	307.600	1,849.228
57.5	307.600	2,156.828
57.514	43.064	2,199.892

It can be seen that, for a 1% annual probability flood event plus a 20% allowance for climate change, approximately 2,200m^3 of floodwater is displaced by the proposed terminal extensions. The MSCP6 is not anticipated to exacerbate flooding as this would be an open sided building.

(c) PPS25 Requirements and the Exception Test

Although not required for this scheme, in accordance with best practice, adherence to the three aspects of the exception test is considered below:

a) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk.

The need and benefits of the proposed NTX and MSCP6 developments are set out in full in the Planning Statement. These show that substantial economic benefits would be derived from the project as well as benefits in terms of service levels and journey experience to Gatwick Airport's passengers and airlines.

b) The development should be on developable, previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land.

Both the NTX and MSCP6 would be located on previously developed land in the built up area around the North Terminal. The proposed new structures have been sited in this location because of the existing concentration of airport passenger facilities in these areas.

c) A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

In discussions with the Environment Agency and in accordance with the PPS25 exception test GAL has considered a number of compensation storage options to avoid increased flood risks as a result of the project. The built-up characteristics of the North Terminal area, however, mean that finding undeveloped land suitable for holding compensatory storage for the displaced volume of flood water on the 'level for level' basis sought by the Environment Agency has proved difficult.

In these circumstances the Environment Agency's preferred option is to reduce the overall ground level of staff North Terminal Car Park J. According to both the EA flood maps and Black and Veatch modelling, the bulk of the car park is currently above the 1% annual probability flood event level, sitting up to 2m above the ground level of the proposed North Terminal extensions. This means that in order to release a relatively small 'level for level' flood compensation volume a very large quantity of waste material has to be excavated and, because it is Made Ground, disposed to landfill. This quantity has been estimated as amounting to approximately 1,500 additional lorry movements. The cost of this excavation has been calculated to be in excess of £2m. Whilst this option results in no increased flood levels in the North Terminal 'bowl', it would increase flood risk in this operational car park, which is not currently at risk of flooding.

An alternative option considered by GAL is to create compensation storage below the proposed MSCP6. At present, ground levels of the existing car park vary between approximately 56.000mAOD and 56.700mAOD, as can be seen on Figures 9 and 10. It is proposed to locate the ground floor of the MSCP6 at level 56.715mAOD, substantially reducing flood risk for users. This solution also enables the ground to be excavated beneath the car park to create compensation storage, as summarised in Figures 11 and 12. The storage area beneath the ground floor measures approximately 82m by 41m. Based on this area and the existing ground levels, Table 3 summarises the flood compensation storage provided for a range of excavation depths (generated by Arc GIS software):

Table 3: Flood Compensation Volumes beneath MSCP6

Ground Level (mAOD)	Compensation Volume (m3)	
	100mm sections	Cumulative
55.6	325.000	2259.463
55.7	325.000	1934.463
55.8	325.000	1609.463
55.9	324.960	1313.735
56	295.783	988.776
56.1	244.189	692.993
56.2	205.982	448.803
56.3	142.779	242.822
56.4	74.587	100.043
56.5	24.970	25.456
56.6	0.486	0.486
56.7	0	0

It can be seen that, by excavating to a level of 55.600mAOD, sufficient compensation storage will be provided to mitigate the displacement by the terminal extensions.

Floodwater will enter the compensation storage volume via 2000mm x 300mm grated inlets at pavement level along the east and west sides. Pavement levels and inlet locations are shown on Figure 11. Flow will exit the compensation storage volume by gravity via a 450mm diameter outlet pipe to the existing surface water drainage system (invert level approx. 54.000mAOD) and, ultimately, to the River Mole via Pond D. The suspended ground floor slab will be supported by columns. Access points will be provided to enable the space to be inspected and maintained. Standard remote sewer techniques can be employed to limit the need for confined space entry.

(d) Additional Flood Risk Management Measures

GAL has an existing contingency plan for external drainage contamination and flooding for the Airport, which includes a response to flood risk. This has been reviewed in light of the North Terminal Development Projects. Since there are no additional hardstanding areas resulting from the NTX or MSCP6 Projects, and the displaced water from NTX would be absorbed by MSCP6,

GAL does not feel that the approach to a flood event would substantially change following implementation of the project.

(e) Upper Mole Flood Alleviation Scheme

As a result of the existing flood risks to Gatwick Airport (particularly in the North Terminal area) GAL has agreed to make a significant financial contribution to support the bringing forward of the Environment Agency's planned flood attenuation scheme for the River Mole (known as the Upper River Mole Flood Alleviation Scheme (UMFAS). When introduced, the UMFAS will significantly reduce the risk of flooding in the North Terminal area and other parts of the Airport.

In the context of GAL's contribution to the UMFAS, the effect of which will be to significantly reduce risk of flooding at North Terminal environs from 5% annual probability to 2% annual probability, it can also be noted that the extent of fluvial flooding at the North Terminal with the implementation of the UMFAS and the NTX and MSCP6 would be less in the future than occurs today (the reduction in flood level for a 1% annual probability event is of the order of 300mm).

7.2 Surface Drainage Flooding

Due to the existing extent of hardstanding within the Airport, the FRA has determined that all North Terminal Development Project sites would be vulnerable to flooding from surface run-off. The following potential effects and mitigation for increases in surface run-off have been identified for the North Terminal Development Projects:

- **NTX and MSCP6**: there are no additional hardstanding areas and therefore no increase in surface water runoff. Nevertheless, improvements to the existing drainage system have been built into the design by way of local attenuation in the form of oversized drainage pipes with downstream flow restriction to endeavour to reduce run-off to greenfield run-off rates. Figures 11 and 12 show the proposed attenuation tank sewer.
- **Airside**: There would be approximately 0.2ha of additional hardstanding in aircraft transit areas. When these proposals are brought forward changes in drainage would be addressed through local attenuation (most likely through oversized drainage pipes with downstream restriction), such that peak flows would not be increased.
- **Decked Car Parks**: It is not anticipated that the decked car parking would affect existing drainage patterns. It is proposed to deal with run-off drainage through local attenuation (either through discharge to adjacent drainage channels or through drainage pipes with downstream restrictor) such that peak flows would not be increased.

8. WATER QUALITY

Any changes in surface water quality as a result of the North Terminal Development Projects would be negligible; discussed further in section 17 of the Environmental Statement. This assessment has taken into account the pollution control measures designed into the existing drainage system and the actions outlined in Gatwick Airport's Water Quality Management Action Plan (2009-2011)[8]. Measures which would be undertaken to further reduce water quality effects on the water environment are listed below:

- All levels of MSCP6 will be drained to the surface water drainage system, via an oil interceptor, in order to prevent rainfall entering the separate foul drainage system. Sufficient surface water drainage will be installed on the lower decks to capture wind-blown rainfall. A connection point into the foul water system on each level will be installed for potential future car washing facilities.

[8] Gatwick Airport Limited (2009) London Gatwick Airport Water Quality Management Action Plan 2009-2011

- ongoing improvements to the surface water drainage systems would refine pollution prevention and control mechanisms, eg design of interceptors;
- river water quality would be regularly monitored adjacent to discharge points; and
- the use and type of herbicides and pesticides would be managed, so that run-off containing these substances is minimised.

9. CONCLUSION

For the Gatwick North Terminal Development Projects, GAL is proposing a North Terminal extension and the conversion of an existing surface level car park into a multi-storey car park (known as MSCP6), as well as upgrades to car parks and piers. The key issues for this FRA in relation to fluvial flood risks are as follows:

- According to Black & Veatch modelling for this FRA, the NTX and MSCP6, as well as the existing Pier 1 are situated within Flood Zone 3 (1% annual probability floodplain). All other aspects of the proposed development are situated outside of the fluvial floodplain.
- The design for the reconfiguration of Pier 1 has not yet been finalised, however it is very likely that the reconfiguration would result in a smaller Pier footprint, and hence reduce flood levels in the South Terminal area.
- The extensions to the North Terminal would cause the displacement of 2,200m^3 of flood water in a 1% annual probability flood event plus a 20% allowance for climate change.
- Compensation storage will be provided below the ground floor of MSCP6 to ensure no increase in flood risks.
- GAL is contributing to the UMFAS, the effect of which will be to significantly reduce risk of flooding at North Terminal environs from 5% annual probability to 2% annual probability. Therefore it can also be noted that the extent of fluvial flooding at the North Terminal with the implementation of the UMFAS and the NTX and MSCP6 would be less in the future than occurs today.

The key issues for this FRA in relation to surface drainage flood risks are as follows:

- Due to the existing extent of hardstanding within the Airport, the FRA has determined that all North Terminal Development Project sites would be vulnerable to flooding from surface run-off.
- There are no additional hardstanding areas resulting from the NTX or MSCP6 and therefore no increase in surface water runoff. However, attenuation will be provided so that, as far as possible, flow from the proposed developments will be restricted to greenfield run-off rates.
- It is proposed to deal with any changes in drainage as a result of the decked car parking and the limited increase in airside hardstanding through local attenuation (either through discharge to adjacent drainage channels or through drainage pipes with downstream restrictor) such that peak flows would not be increased.