



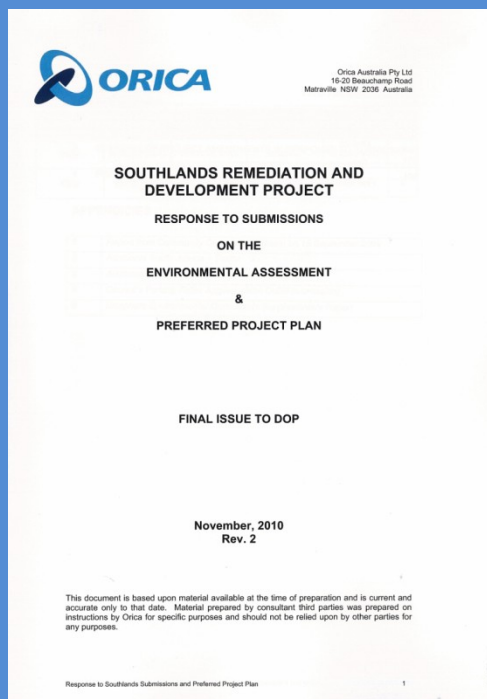
Planning &
Infrastructure

REVIEW OF ORICA SOUTHLANDS REMEDIATION and DEVELOPMENT

HYDRAULIC MODELLING REPORT and RESPONSE to EXHIBITION SUBMISSIONS/COMMENTS



DEPARTMENT OF PLANNING and INFRASTRUCTURE



AUGUST 2011



Level 2, 160 Clarence Street
Sydney, NSW, 2000

Tel: 9299 2855
Fax: 9262 6208
Email: wma@wmawater.com.au
Web: www.wmawater.com.au

REVIEW OF ORICA SOUTHLANDS REMEDIATION and DEVELOPMENT HYDRAULIC MODELLING REPORT and RESPONSE to EXHIBITION SUBMISSIONS/COMMENTS

AUGUST, 2011

Project REVIEW OF ORICA SOUTHLANDS REMEDIATION and DEVELOPMENT HYDRAULIC MODELLING REPORT and RESPONSE to EXHIBITION SUBMISSIONS/COMMENTS		Project Number 111014
Client Department of Planning and Infrastructure		Client's Representative Christine Chapman
Authors Richard Dewar		Prepared by
Date 2 August 2011		Verified by
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REVIEW OF ORICA SOUTHLANDS REMEDIATION AND DEVELOPMENT HYDRAULIC MODELLING REPORT AND RESPONSE TO EXHIBITION SUBMISSIONS/COMMENTS

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APPENDICEES

Appendix A:	WMAwater Review Report of September 2009
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1. INTRODUCTION

1.1. Review of August 2009 Submission

WMAwater (Mr R Dewar – Director) was engaged by the Department of Planning in September 2009 to provide a review of the report:

“Review of Southlands Remediation and Development Project: Environmental Assessment Project Application (MP 06_0191): Appendix G: Hydrology and Flooding” – August 2009.

The report was prepared to support a Development Application under Part 3a of the EP&A Act for an industrial estate on land that is commonly known as Southlands at Banksmeadow. The land is owned by ORICA. The land is currently (2011) open space but is used as part of the remediation works being undertaken by ORICA to remove groundwater contamination.

WMAwater prepared a review in September 2009 of the Appendix G:Hydrology and Flooding (this report was prepared by Connell Wagner and is dated 2 November 2007) as well as Chapter 8 of the main report which summarised this Appendix G. The WMAwater review report is provided as Appendix A of this present report. In summary, the WMAwater review report of September 2009 report detailed many changes and additions to the hydraulic modelling approach provided in the applicant’s August 2009 submission.

1.2. Review of November 2010 Submission

Aurecon (Connell Wagner has now been taken over and included as part of Aurecon) submitted the following two reports in November 2010 to the Department of Planning.

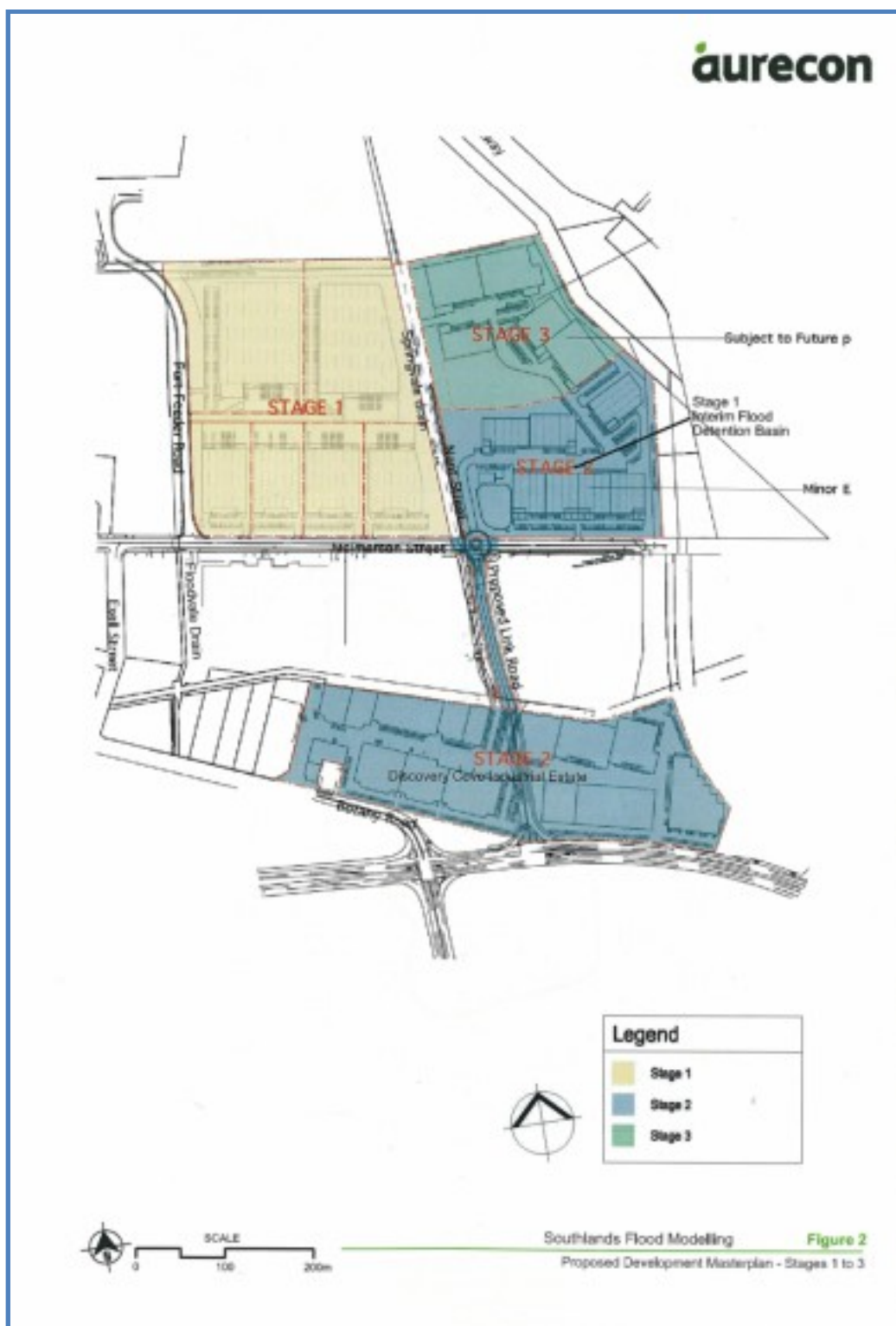
- 1. Review of Orica Southlands Remediation and Development Hydraulic Modelling Report and*
- 2. Response to Exhibition Submissions/Comments” – 29 November 2010.*

The first report (Hydraulic Modelling report) provides a re-assessment of the hydraulic modelling approach and revised results taking into account the comments made in the WMAwater review report of September 2009 report as well as comments from other parties. The second report (Response to Submissions) provides a response to all comments from the exhibition of the August 2009 submission.

WMAwater (formerly Webb, McKeown & Associates Pty Ltd) have over 25 years of experience in the field of hydrology and hydraulic modelling in NSW and are familiar with the local area and the associated flood problems. Our review includes all flood related issues contained in the two reports on behalf of Orica. From September 2009 until November 2010 Aurecon were in regular contact with WMAwater to agree upon aspects of the hydraulic modelling approach.

1.3. Extent of Proposed Development

The proposed development is to be undertaken in three stages (see diagram below) but the application (and our review of the assessment) is only for Stages 1 and 2.



Our comments have been summarised under Stage 1 and Stage 2.

2. STAGE 1 Proposal

2.1. Outline of Stage 1 Works

The Stage 1 proposal involves the following:

- Filling and development of the majority of the land between the Springvale and Floodplain Drains,
- Construction of a detention basin to the east of the Springvale Drain and immediately upstream of McPherson Street that provides additional floodplain storage to compensate for the amount lost due to the proposed filling above. At RL 4.2 mAHD the temporary floodplain storage capacity of the site is similar for the existing and Stage 1 development (i.e no loss of storage within the site),
- An easement (existing or to be created) at the northern part of the proposed development site between the Springvale and Floodplain Drains allows the exchange of floodwaters between the two drains,
- A control structure is to be formed on the Springvale Drain to control inflows to the proposed detention basin (design details to be confirmed) as well as a low flow pipe to drain the basin,
- A wall (to RL 4.5 mAHD) and fence are to be constructed around the perimeter of the proposed detention basin. The exact dimensions of the basin are to be confirmed at the detail design stage.

The report indicates that as a result of construction of the proposed works there will be no significant increase in flood levels (taken as > 0.01m) on surrounding properties or change in peak flows or velocities.

2.1.1. Flood Planning Levels

Flood Planning Levels (FPLs) are stated as the 1% AEP +0.3m freeboard for building floors in the November 2010 submission (rather than the more commonly used 0.5m freeboard). This issue was raised in our September 2009 review.

Aurecon provided further detail on this issue in their letter of 4th May 2011 which stated that “*All new building Finished Floor Levels (FFLs) for Stage 1 will be constructed a minimum of 500mm freeboard above the 100 year ARI flood level with Climate Change impacts*”. This now satisfactorily addresses this issue.

2.1.2. Water Sensitive Urban Design (WSUD)

The November 2010 submission omitted discussion on how WSUD related features compatible with best practice have been accommodated in the design (water re-use, infiltration, minimisation of hard stand etc.). This above issue was raised in our September 2009 review.

Aurecon provided further detail on this issue in their letter of 4th May 2011 which indicated that opportunities for water treatment and re-use are limited by the existence of contaminated ground

water. This reasoning is accepted and this issue has now been satisfactorily addressed.

2.1.3. Summary

The hydrologic and hydraulic modelling approaches are compatible with current standards in this field. The approach to permit the Stage 1 development is to undertake cut/fill earthworks such that the temporary floodplain storage capacity within the site is retained and peak flows are not increased. The results for Stage 1 indicate no significant impacts on adjoining land owners.

2.2. Stage 1 - Conditions of Approval

The following conditions of approval should be applied for the Stage 1 works:

1. A detention basin is to be constructed to the east of Springvale Drain and immediately upstream of McPherson Street to provide additional flood storage to compensate for the amount lost due to filling within the floodplain of Springvale and Floodvale Drains.
2. Construction of a control structure on the Springvale Drain is required to control flows into the detention basin to ensure that the detention basin will compensate for the amount lost due to filling within the floodplain of Springvale and Floodvale Drains.
3. Construction of a low flow pipe is required to allow draining of the detention basin.
4. The Proponent shall obtain written confirmation from the City of Botany Bay Council that all issues relating to public safety of the detention basin (overtopping of basin, access to basin and drowning) have been adequately accommodated in the design. The written confirmation shall be provided to the Director-General prior to the construction of the detention basin.
5. The Proponent shall obtain written confirmation from the City of Botany Bay Council that details on the dimensions and legal status of the easement on the northern part of the site between the Springvale and Floodvale Drains have been addressed to the satisfaction of Council. The written confirmation shall be provided to the Director-General prior to the construction of the easement.
6. The Proponent shall obtain written confirmation from the NSW Dams Safety Committee that the as constructed detention basin complies with current standards (refer Guidance DSC3E). The written confirmation shall be provided to the Director General within 6 weeks of completion of the construction of the detention basin.
7. The Stage 1 design relies upon a re-distribution of earthworks within the site and construction of a control structure to divert floodwaters into the detention basin. The November 2010 report (*Report Ref: 204617, 29th November 2010, Revision 3 by Aurecon*) acknowledges (page 25) that any change in the design may require re-modelling. The Proponent shall commission and pay the full cost of a Hydraulic Modelling Flood Validation Assessment Report to confirm that the as constructed Stage 1 works (filling and construction of the detention basin) have been undertaken in accordance with the principles outlined in the November 2010 report, and that the flood impact is no greater than indicated in Figures D9, D10 and D11 of that report. The assessment must:
 1. be conducted by a suitably qualified, experienced and independent expert whose appointment has been endorsed by the Director-General;

2. provide detail survey from a Registered Surveyor on all key structures;
 3. provide easy to read figures indicating any differences between the results provided on Figures D9, D10 and D11 of the November 2010 report;
 4. determine whether the as constructed Stage 1 works have been undertaken in accordance with the design principles outlined in the November 2010 report and comply with the requirements in this approval; and if necessary;
 - recommend and prioritise measures to be undertaken in the event that the assessment shows that the flood impact exceeds that shown on Figures D9, D10 and D11 of the November 2010 report and that the works as executed are not in accordance with this approval;
 5. should the Hydraulic Modelling Flood Validation Assessment report identify an exceedence or non-compliance, then the Proponent shall undertake/employ additional mitigation to the satisfaction of the Director-General within the timeframe specified by the Director-General;
 6. within 6 weeks of the completion of the Stage 1 works, the Proponent shall submit a copy of the Hydraulic Modelling Flood Validation Assessment Report to the Director-General.
8. The Proponent shall engage a Registered Surveyor to certify that all new building Finished Floor Levels for Stage 1 are constructed a minimum of 500mm freeboard above the 100 year ARI flood level with Climate Change impacts. This written confirmation shall be provided to the Director General within 6 weeks of completion of construction of the buildings.

3. STAGE 2 Proposal

3.1. Outline of Stage 2 Works

The Stage 2 proposal involves the following:

- Filling and development of approximately 95%+ of the site. The only areas not proposed to be developed are areas adjacent to the two drains and the easement to the north of the Stage 1 development proposal,
- The proposed works that are required to ensure that there is no adverse flood impact to adjoining properties are:
 - enlarging culverts along the Springvale Drain within the site,
 - additional culverts under McPherson Street,
 - enlarging the channel between McPherson Street and the SWSOOS,
 - providing additional openings under the SWSOOS,
 - providing additional culverts under the Discovery Park development,
 - providing additional culverts under Botany Road and to Botany Bay (no channel upgrading is shown through the land downstream of Botany Road or for the culverts under Penrhyn Road).
- Construction of a link road from McPherson Street, over the SWSOOS and to Botany Road

The report indicates that as a result of construction of the proposed works there will be no significant increase in flood levels (taken as $> 0.01\text{m}$) on surrounding properties or change in peak flows or velocities.

3.2. Summary

It is noted that the report acknowledges that further detailed investigations will be required prior to the issuing of the Stage 2 Construction Certificate and the Stage 2 design only demonstrates that a workable drainage solution is possible.

Construction of the Stage 2 works cannot be approved at this time as it is considered that the following issues may not be able to be satisfactorily resolved.

3.2.1. Financial Viability of Stage 2

Stage 2 involves significant costs to construct:

- Additional culverts under McPherson Street,
- Enlarging the channel between McPherson Street and the SWSOOS,
- Providing additional openings under the SWSOOS,
- Providing additional culverts under the Discovery Park development,
- Providing additional culverts under Botany Road and to Botany Bay,
- Construction of a link road from McPherson Street, over the SWSOOS and to Botany Road.

No costings are provided for these works though it is suggested that they could be paid for out of a Section 94 contribution Plan. The applicant should provide the following additional details:

- An indicative itemised cost to construct the required drainage works for Stage 2,
- The viability of a Section 94 contribution Plan when it would appear from the results (Figure D18) that the only beneficiary of the Stage 2 drainage works, apart from ORICA, is 9-13 McPherson Street. The owners of 9-13 McPherson Street should be contacted to determine if they consider the reduction in flood levels as a result of the Stage 2 works of value. It is suggested that their flood levels could be reduced by a similar amount to those shown on Figure D18 by introducing the same blockage minimisation measures proposed in the Stage 2 works for the existing openings under the SWSOOS. These measures would cost a fraction of the cost of the Stage 2 drainage works and provide a similar benefit to 9-13 McPherson Street.

If it cannot be demonstrated that a Section 94 contribution Plan is viable then ORICA need to confirm that their development is still viable if they contribute the entire costs for the Stage 2 works.

3.2.2. Loss of Pervious Area and Temporary Floodplain Storage

Stage 2 involves the loss of a significant amount of pervious area and replacement with impervious cover as well as the loss of a significant amount of temporary floodplain storage. This approach is contrary to generally accepted WSUD and floodplain management practice and comments are required to justify why this approach should be approved.

3.2.3. Approval from Sydney Water for SWSOOS Waterway Crossing

The SWSOOS presents a significant obstacle to flood flows and for Stage 2 it is assumed that additional siphons (to take 3* the existing capacity) or other structures to increase flow capacity are required on the Springvale Drain crossing of the SWSOOS. In addition there is construction of the link road over the top of the SWSOOS.

The SWSOOS is a major asset of Sydney Water and written confirmation needs to be obtained from Sydney Water that they will agree in principle to these works and the conditions on the proponent they may impose. ORICA needs to confirm that it will accept in principle the Sydney Water conditions of approval and include any costs in the above project costings.

3.2.4. Increase in Peak Flow

Table 5.2 indicates that for the Stage 2 development the 1% AEP peak flow in the Springvale Drain will increase from approximately 8m³/s to 21m³/s (160% increase). Page 24 also indicates that *“flows will be redistributed from Floodvale Drain to Springvale Drain”*. It is unclear if this redistribution is occurring as Table 5.2 indicates that there is minimal change in the peak flow in the Floodvale Drain under Stage 2 conditions.

In general there should be minimal increase in peak flow as a result of any development on the

floodplain. The magnitude of this flow increase is extreme and insufficient information is provided to ensure that the possible increases in flood damages, the risk to life and environmental impacts to downstream floodplain users are adequately addressed.

3.2.5. Flow under the SWSOOS

The Stage 2 proposal relies upon enlarging the siphons under the SWSOOS to cater for a 160% increase in peak flow. Hydraulic modelling of the existing siphons using a computer model relies upon a number of assumptions that are not well understood (hydraulic losses as the floodwaters enter the structure). For the Stage 1 proposal this is not critical as there is no proposed change to the structure. However under Stage 2 conditions the design relies on the success of enlarging the siphons and a more critical investigation, possibly using a physical model or sensitivity of the model parameters, is required to confirm this approach.

3.2.6. Percentage of Land Flood Free in 1% AEP event

Stage 2 results in approximately 95%+ of the Orica site becoming flood free in the 1% AEP event and thus development on it will not be burdened by flooding. In theory it is possible to construct works that will largely make the majority of flood affected sites in urban areas flood free, however the magnitude and cost of such works as well as the environmental consequences makes this impractical. It is noted that all the surrounding properties (except 15 McPherson Street which has been filled) are flood affected and the Stage 2 works results in an inequitable distribution of land that will not be burdened by flooding amongst the adjoining property owners. This approach is not in accordance with accepted and equitable floodplain management practice.

4. REVIEW of SUBMISSIONS

4.1. Summary

The DoP provided copies of the November 2010 submission by Orica to various private and public authorities for further comment. The following provides a summary of the comments received in regard to flooding and are in no particular order.

4.2. Sydney Water

Sydney Water advised that it would need detailed design plans before it could provide a specific comment. However the response indicated that a major works deed would need to be entered into and Sydney Water would need to be satisfied that the structural integrity of the SWSOOS was not compromised.

Comment by WMAwater: This issue has been included in the Stage 2 Proposal (Section 3).

4.3. NSW Transport

No comment were made on flooding matters.

4.4. Sydney Ports

Sydney Ports indicates that the Stage 2 proposal lacks detail and the potential for significant impacts means that approval for Stage 2 would be premature. Also Sydney Ports is concerned about the change in velocity of the discharge into Penrhyn Bay and the proposed mitigation measures (feasibility, who pays and whether they are possible).

Comment by WMAwater: This issue is only of relevance if approval for Stage 2 is given.

4.5. Randwick City Council

Council notes that the report refers to the DECC 2007 Guideline on Climate Change impacts but this has now been superseded by the August 2010 Guideline and use of the latter may change results.

Comment by WMAwater: At the time of undertaking the study the DECC 2007 Guideline was the most current version and the August 2010 Guideline does not provide any advice regarding the possible climate change increase in rainfall intensity (the only climate change issue that was considered in the assessment) only sea level rise.

Council raises the issues that on going pipe clearance and beach nourishment may alter the results.

Comment by WMAwater: These two matters will have no significant impact on the relative impacts of the pre versus post works assessment.

4.6. Roads and Traffic Authority

No comment on flooding matters.

4.7. Hynlong Pty Ltd Owners of 9-13 McPherson Street

Hynlong indicate that insufficient detail is provided to assess/certify the design, namely:

- lack of detail in text and on drawings of the proposed levee and flood control structure,
- no detailed design is provided,
- existing surface contours are unreadable in Figure 3,
- indistinguishable flood extents contours provided in report,
- earthworks drawings indicate that final levels may change by +/- 300mm and finalised levels should be provided,
- insufficient detail on application plans and civil works drawings.

However if approval is granted Hynlong request:

- works as executed (WAE) drawings to be re-modelled and confirmation by the certifier prior to the issue of any construction certificates that there is no adverse flood impact,
- provision of adequate floodplain storage during the construction phase,
- the floodplain storage should not be adversely affected by any other remediation or associated works.

Comment by WMAwater: The Orica report is based on a Stage 1 concept design and it is acknowledged that this will be modified as detailed design is undertaken. The issue of WAE compliance has been included in the Stage 1 Proposal (Section 2). The issues of adequate floodplain storage during construction will need to be addressed by Orica as part of their detailed design. The issue of affectation by any other works on the site would need to be addressed by Orica if and when that occurs.

4.8. Gazal Corporation

Gazal indicated that they are concerned about flooding but provided no specific details.

4.9. Department of Environment, Climate Change and Water (DECCW)

DECCW indicated that a long term monitoring program to assess the impacts of increased flows in the Penrhyn Bay estuary should be undertaken for Stage 2.

Comment by WMAwater: This issue is only of relevance if approval for Stage 2 is given.

4.10. City of Botany Bay Council

The following comments were made in Council's letter of 18th February 2011:

- i. the relocation of the flood storage area will prolong the duration of flooding across Nant Street and increase the hazard during floods. Comment by WMAwater: This issue has been addressed in Aurecon's letter of 4th May 2011,
- ii. there is concern about the loss of flood storage between Stage 1 and the subsequent

- stages. Comment by WMAwater: This issue is only of relevance if approval for Stage 2 is given.
- iii. additional details are required for the flow path easement between the two drains. Comment by WMAwater: The hydraulic modelling has demonstrated the capacity of the flow path and the requirement for an “official easement” has been included in Section 2.2.3 – Conditions of Approval,
- iv. there are safety concerns with the proposed basin. Comment by WMAwater: This issue has been included in Section 2.2.3 – Conditions of Approval,
- v. there are no details of whether the flood control structure in the Springvale Drain proposed for Stage 1 will be retained for Stage 2 and whether a higher blockage factor is required. Comment by WMAwater: This issue is only of relevance if approval for Stage 2 is given,
- vi. no velocity-depth products have been provided in the flood flow paths, especially along Nant Street and the new link road. Comment by WMAwater: This issue along Nant Street (not the new link road) has been addressed in Aurecon’s letter of 4th May 2011.

The following comments were made in Council’s letter of 30th June 2011 following review of Aurecon’s letter of 4th May 2011:

- no details are provided of the flow path north of the Southland site (point iii above). Comment by WMAwater: whilst there is no exact dimensions of these works the hydraulic modelling undertaken by Aurecon has included these Stage 1 works and concluded that there is no significant adverse impact to other floodplain users. At the detailed design stage, drawings will be provided indicating the exact details and the outcomes of Section 2.2.3 – Conditions of Approval (hydraulic modelling of works as executed) will demonstrate that what is built has been included in the hydraulic modelling and will produce increases in flood level no greater than those indicated in the November 2010 report,
- a repeat of point iv above. Comment by WMAwater: This issue has been included in Section 2.2.3 – Conditions of Approval,
- a repeat of point v above. Comment by WMAwater: This issue is only of relevance if approval for Stage 2 is given,
- no velocity-depth products have been provided for the new link road. Comment by WMAwater: This is an issue for the designers of the new link road regarding whether the road can be constructed in accordance with acceptable flood inundation standards.





REVIEW OF SOUTHLANDS REMEDiation AND DEVELOPMENT PROJECT APPLICATION MP 06_0191

Appendix G: Hydrology and Flooding



DEPARTMENT OF PLANNING



Southlands Remediation and Development Project
Environmental Assessment
Project Application (MP 06_0191)

Appendix G: Hydrology and Flooding



August 2009

URS

SEPTEMBER 2009



Level 2, 160 Clarence Street
Sydney, NSW, 2000

Tel: 9299 2855
Fax: 9262 6208
Email: wma@wmawater.com.au
Web: www.wmawater.com.au

**REVIEW OF SOUTHLANDS REMEDIATION AND DEVELOPMENT PROJECT:
ENVIRONMENTAL ASSESSMENT PROJECT APPLICATION (MP 06_0191):
APPENDIX G: HYDROLOGY AND FLOODING**

SEPTEMBER, 2009

Project REVIEW OF SOUTHLANDS REMEDIATION AND DEVELOPMENT PROJECT: ENVIRONMENTAL ASSESSMENT PROJECT APPLICATION (MP 06_0191): APPENDIX G: HYDROLOGY AND FLOODING		Project Number 29055	
Client Department of Planning		Client's Representative Anne Maree Carruthers	
Authors Richard Dewar		Prepared by	
Date 17 September 2009		Verified by	
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**REVIEW OF SOUTHLANDS REMEDIATION AND DEVELOPMENT
PROJECT: ENVIRONMENTAL ASSESSMENT PROJECT APPLICATION
(MP 06_0191): APPENDIX G: HYDROLOGY AND FLOODING**

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1. INTRODUCTION

WMAwater (Mr R Dewar – Director) was engaged by the Department of Planning in September 2009 to provide a review of the report:

“Review of Southlands Remediation and Development Project: Environmental Assessment Project Application (MP 06_0191): Appendix G: Hydrology and Flooding”.

The report was prepared to support a Development Application under Part 3a of the EP&A Act for an industrial estate.

WMAwater (formerly Webb, McKeown & Associates Pty Ltd) have over 25 years of experience in the field of hydrology and hydraulic modelling in NSW and are familiar with the local area and the associated flood problems. Our review is primarily of Appendix G:Hydrology and Flooding as well as Chapter 8 of the main report which summarises this appendix.

Section 2 of this report provides a summary of the key floodplain management issues that need to be resolved regarding this Development Application.

No site inspection of the site has been undertaken.

2. KEY ISSUES

The proposed development is to be undertaken in three stages (see diagram below) but the application (and our review of the assessment) is only for Stages 1 and 2.



Our comments have been summarised under these two stages and are within no particular order within each section.

2.1. Comments on Stage 1 Proposal

2.1.1. Climate Change

Climate change has the potential to raise flood levels due to sea level rise and rainfall increase. These two phenomenon need to be addressed in the context of the level of flood immunity of the proposed development throughout its lifespan. The Department of Environment and Climate Change has recently (November 2007) issued guidelines regarding the possible impacts of climate change on flood levels and these should be evaluated for the 1% AEP event.

Climate change does NOT need to be taken into consideration as part of the existing v design flood assessment but needs to be considered in the setting of Flood Planning Levels.

2.1.2. Blockage

The report states *"it is assumed that the existing drains and other structures are clean and function as they were originally designed"* (Page 10). This assumption is clearly not valid as the following photographs (taken from the report) illustrate that the existing drainage system is already partially blocked (the report also states that both drains are *"heavily blocked with silt and debris"* and *"the culverts are currently severely blocked"*) and includes structures (small openings, vegetative debris, pipes and railings crossing the channel) conducive to a high level of blockage during a flood.

Existing conditions MUST relate to what is there at present (i.e considerable blockage) and for design it cannot be assumed that this blockage will be removed unless some form of blockage minimisation device or maintenance is included. These devices will only be accepted if it can be demonstrated that they will work as designed and be properly maintained for the life of the project. It cannot be assumed that Council or any other authority will undertake this task.

An assessment of blockage of ALL culverts and waterway openings therefore needs to be considered in the existing v design flood assessment as well as for the setting of Flood Planning Levels.



Photo 1: Floodwater drain at SWOOS crossing looking south.



Photo 2: Floodwater drain at McPherson Street culvert looking south.



Photo 14: Springvale drain SWOOS crossing looking south.



Photo 3c: Springvale drain at McPherson Street culvert V north well looking south.

A suggestion is to assign a % blockage to each structure based on a review of the structure as they exist today and use this same value for all subsequent hydraulic analysis (identical values for existing and design). The SWOOS and McPherson Street crossings are likely to have >70% blockage.

2.1.3. Flood Planning Levels

Flood Planning Levels (FPLs) are stated as the 1% AEP +0.3m freeboard for building floors. It must be demonstrated why a 0.3m freeboard is considered appropriate rather than the more commonly used 0.5m freeboard (particularly as the report states that the absolute accuracy of the design flood levels is likely to be only +/- 0.5m).

FPLs are also required for all structures in the floodplain such as:

- Car parking,
- Services ducts and equipment,
- Access roads during a flood.

2.1.4. On-Site Stormwater Detention (OSD)

OSD is proposed for Stage 1 (Figure 6) as underground tanks. These tanks are costly to build, are underground and possibly may affect the groundwater table, are likely to require pumps to discharge the collected runoff and must be maintained to be effective. Justification is required as to why OSD is proposed rather than accommodating the additional storage volume required in the proposed Stage 1 basin. In Stage 2 the channel dimensions can be marginally increased to accommodate any slight increase in peak flow due to the lack of OSD on the site.

2.1.5. Water Sensitive Urban Design (WSUD)

The report needs to include a discussion on how WSUD related features have been accommodated in the design.

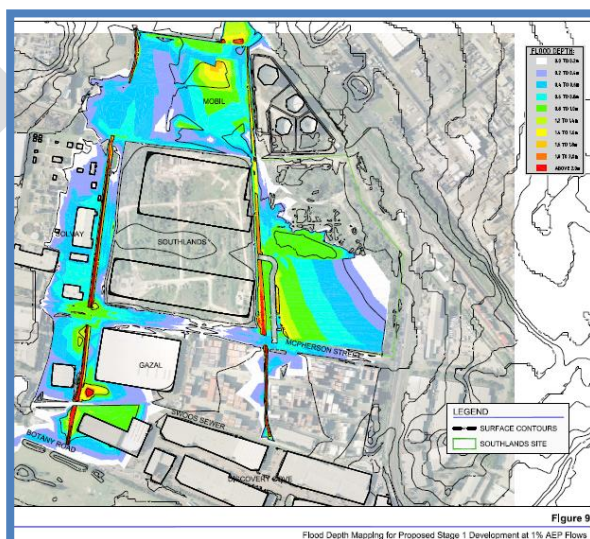
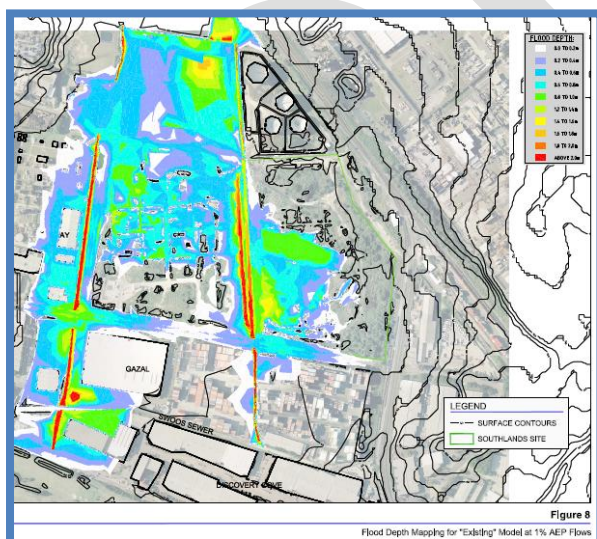
2.1.6. Compensatory Stage 1 Detention Basin

The approach adopted of providing compensatory storage to mitigate the filling of flood liable lands is acceptable in principle. However the following further details are required:

- How has safety to life (overtopping of basin, access to basin and drowning) been addressed in the design?
- A RL(mAHD)/floodplain storage graph should be prepared for both the existing and design scenarios to demonstrate that there is no significant change in temporary floodplain storage capacity within the Southlands site.

2.1.7. Hydraulic Modelling

Under existing conditions the overland flow from the Floodvale and Springvale tributaries merge upstream of Southlands within the Mobil site and enter the site over a 200m wide boundary (see figure below). Under design the combined flow becomes concentrated into two narrow channels on either side (see figure below). The hydraulic modelling needs to conclusively demonstrate that for design the filling of the site will not increase the peak flow in the Floodvale Drain or increase flood levels in the Mobil site. The “connections” shown on Figure 5 do not appear to relate to the topographic conditions.



Mike-11 is a “branched” 1 Dimensional model and it would appear that in order to satisfactorily model the “split” in the flows between the two tributaries within the Mobil lands and elsewhere a 2 Dimensional approach is required. These models (Tuflow, Sobek, Mike-21) are widely used for hydraulic modelling of these systems and would be the preferred approach to address this problem. For example Figure 8 indicates that the flows from the two drains join at McPherson

Street. How has this been adequately simulated in a 1D model?

The report acknowledges the “*complex interaction of catchment runoff coupled with flat terrain*” and the use of a 2 D model will also assist in explaining why there is a relatively steep flood gradient in the Springvale Drain with the Mobil land and upstream but a relatively flat gradient within the Floodvale Drain, this needs to be clarified.

Figure 11 (and for other events) indicates that for the proposed Stage 1 design there is an increase in flood level (up to 0.25m) within the Mobil land. This appears contrary to the many statements in the report which indicate no increase in flood levels upstream or downstream of the site. The report states that at this location the increase would have negligible impact as “*it is contained within the banks of Springvale Drain*” (Page 13). This statement does not appear consistent with the flood extents shown on Figure 9 and requires clarification. An increase in flood level is unacceptable as it will increase the flood damages and risk to life on land beyond that owned by Southlands. No such increase can occur.

The report should provide a tabulation of peak levels and peak flows at key locations for the range of design events for both the existing and design scenarios.

Of interest is the water level upstream of the SWOOS and in what event the SWOOS becomes overtopped. It appears that overtopping in the Floodvale Drain first occurs in a 5% AEP event. In the Springvale Drain the SWOOS is not overtopped in the 1% AEP event (crest at 3.8 m AHD). This result is surprising as the area beneath the SWOOS is only 6m² and the peak flow is of the order of 39m³/s (i.e 6.5m/s). The effect of the SWOOS on flood levels in both drains and including the potential for blockage needs to be clarified. Some clarification is also required to justify why the flood flows from the two drains do not converge immediately upstream of the SWOOS.

The hydraulic analysis for existing and design must be undertaken for an event larger than the 1% AEP (say 0.5% AEP) as well as the Probable Maximum Flood.

2.1.8. Cross Sections

Figure 5 and 7 show different chainages for the Floodvale Drain. A review of the cross sections would seem to indicate that the chainages shown on Figure 5 do not always match with the cross section chainages shown in Appendices E and F. Figure 5 must show exactly the same section chainages as those shown in Appendices E and F (chainages beyond 820 are listed in the Appendices but not shown on Figure 5 and some sections e.g Figure E27 section 510.21 are not shown on Figure 5 and there are others).

The following issues should be addressed in any revision:

- What does TWL relate to?
- It would make it easier to read if the vertical scale was say only to 5m AHD on all figures. Also it would assist if the horizontal extent was limited to show only land up to say 5m

AHD (or even less at the downstream end),

- What Manning's "n" values have been adopted and where do they apply?
- It is presumed that the sections are drawn left to right looking downstream and I note a "spike" at chainage 70 in the Floodvale Drain sections 864.47 to 868.0 (Figure E13). What is this spike and how can water enter the land beyond chainage 70 as the "spike" acts as a barrier?
- In many sections the extremities of the section are not limited by high ground (e.g Floodvale Drain section 866.37 on Figure E14 but there are many others). This requires further explanation as to what decisions have been taken to define the extent of each of these sections.
- Sections 134.06 to 466.88 on the Springvale Drain show that beyond chainage 100+ the flood extent is not limited by high ground. Presumably this is because the floodwaters join up with the Floodvale Drain. It would appear that there is some not documented "split" between the flood extents for the two drains. This requires further explanation and suggests that it may be more appropriate to use a 2D model rather than a 1D model. This is a key issue as it has implications for the distribution of flows between the two drains and the potential impacts of development,
- Floodvale Drain section 866.37 on Figure E14 shows the flood waters extending 400m in width with presumably the same water level (there are other sections showing similar extents as well). Are the flood waters all flowing with some velocity across this width or should some more appropriately be modelled as floodplain storage with nil velocity? This requires further explanation as it may affect the design flood levels,
- In Appendix F could the existing and design sections for each river chainage be provided on the same graph? This would make it easier to see what changes to the section have been made. There is no need to plot sections in Appendix F that have not been altered for design,
- What is the relevance of showing the Detention basin chainages on Figure 7? How do these sections relate to the sections used in the Mike-11 model?
- Comment needs to be made on how the many culverts and other waterway structures have been included in Mike-11 and in particular the siphons beneath the SWOOS. What additional losses etc have been assumed?
- What approach has been taken to include buildings and containers in the sections? For example section 108.2 on the Springvale Drain (Figure E22) does not appear to show the oil storage tank indicated on Figure 5. Also there appears to be a "spike" at chainage negative 10m on Figures E21 to E24, what is this? If this defines a bund around the storage tanks how do flood waters enter the bunded area as shown on the sections? All sections must be checked to make sure that they accurately reflect how floodwaters can flow through the Mobile site (and elsewhere). This task would be much simpler if a 2D hydraulic model was used,
- Further detail is required to explain how the floodwaters are contained to such a small waterway area at Section 711.04 (and 785.31) on Figure E30,
- It is noted that there is a high mound on the downstream side of McPherson Street on the east side of the Springvale Drain. Has this been included in the hydraulic model?

2.2. Comments on Stage 2 Proposal

It is noted that the report acknowledges that further detailed investigations will be required prior to the issuing of the Stage 2 Construction Certificate and the Stage 2 design only demonstrates that a workable drainage solution is possible.

2.2.1. Loss of Temporary Floodplain Storage

Stage 2 involves the loss of a significant amount of temporary floodplain storage. This approach is contrary to generally accepted practice and comments are required to justify this approach.

2.2.2. Loss of Pervious Area

Stage 2 involves the loss of a significant amount of pervious area and replacement with impervious cover. This approach is contrary to generally accepted practice and comments are required to justify this approach.

2.2.3. SWOOS Waterway Crossing

The SWOOS prevents a significant obstacle to flood flows and for Stage 2 it is assumed that an additional siphon or other structure to increase flow capacity is required on the Springvale Drain. As the existing “siphons” do not appear (needs to be clarified for the Stage 1 assessment) to be able to cater for large flows (refer photographs previously and acknowledgement that one sump is blocked - refer Figure B2) further details are required in order to demonstrate that a viable solution can be found at this location.

2.2.4. Interaction between Floodvale and Springvale Drains

Page 14 states that “*this assessment assumes no interaction between the flow in Floodvale Drain and an enhanced Springvale Drain*”. The validity of this assumption has been questioned above at several locations (Mobil site, McPherson Street and upstream of SWOOS) and will only be accepted if verified by hydraulic modelling. It is suggested that a 2D modelling approach is required which would eliminate the need for any assumptions.

2.2.5. Hydraulic Modelling

It would appear that no hydraulic modelling (other than an assumed 40m³/s steady flow) for Stage 2 (as given on Figure 12) has been reported. A Stage 2 concept design must be analysed using the hydraulic model for the full range of design events with reporting of results, profiles, flood extents etc.

For approval of Stage 2 the same level of hydraulic detail (blockage, climate change) as provided for Stage 1 must be included.

3. RECOMMENDATIONS

Whilst in principle the Stage 1 construction of an industrial complex and a compensatory floodplain storage basin land is acceptable from a flooding perspective there are a number of design issues which still require resolution. These are summarised below:

- Climate Change,
- Blockage,
- Flood Planning Levels,
- On Site Stormwater Detention,
- Water Sensitive Urban Design,
- Compensatory Stage 1 Detention Basin,
- Hydraulic Modelling,
- Cross Sections.

Significant drainage works are required outside of the Southlands site area for Stage 2 of the development. The report does not provide sufficient detail on the following issues to ascertain whether it will be in accordance with best practice in floodplain management:

- Loss of temporary floodplain storage,
- Loss of pervious area,
- SWOOS waterway crossing,
- Interaction between Floodvale and Springvale Drains,
- Hydraulic Modelling.