



Tugun Bypass Compensatory Habitat Package – Outstanding Offsets: Final Report

DMR Purchase Number: 2030346106

SMEC Reference Number: 3003329

Date 18th August 2009





Tugun Bypass Compensatory Habitat Package: Outstanding Offsets

For: Queensland Department of Main Roads

18TH AUGUST, 2009

TABLE OF CONTENTS

EXECUTIVE SUMMARY	7
1. INTRODUCTION	9
2. CONSULTATION	10
3. SPECIES DISTRIBUTIONS	14
4. GIS ANALYSIS	16
4.1 Initial Spatial Analysis	16
4.1.1 Spatial Data and Property Information	16
4.1.2 Selection Criteria	16
4.1.3 Assessment Process	17
4.1.4 Limitations	17
4.2 Detailed Spatial Analysis	18
4.2.1 Spatial Data and Property Information	18
4.2.2 Selection criteria	18
4.2.3 Detailed description of SAM	19
4.2.4 Limitations and SAM Adjustments	21
5. QUALITATIVE ASSESSMENT	24
6. FINDINGS	26
6.1 Results	26
6.2 Limitations	27
7. AGREED WAY FORWARD	28
8. LANDHOLDER CONSULTATION	29
9. AERIAL INSPECTION	30
10. DETAILED SURVEY OF CANDIDATE LAND PARCELS	32
11. PREFERRED CANDIDATE SITES	35
12. REFERENCES	36

APPENDIX 1: REDLAND SHIRE COUNCIL CORRESPONDENCE

APPENDIX 2: ASSESSMENT MATRICES

APPENDIX 3: MAPS

APPENDIX 4: SHORTLISTED PROPERTY DESCRIPTIONS

APPENDIX 5: MINUTE MEETINGS

APPENDIX 6: LANDHOLDER DISCUSSIONS SUMMARY TABLE

APPENDIX 7: AERIAL PHOTOGRAPHS

APPENDIX 8: TARGET SURVEYS: RUSSELL ISLAND CANDIDATURE SITE

APPENDIX 9: TARGET SURVEYS: SKINNERS SHOOT AND BROADWATER CANDIDATURE SITES

APPENDIX 10: SUITABILITY OF SITE 18 FOR COMMON PLANIGALE

APPENDIX 11: SITE 18 SUBDIVISION LAYOUT

APPENDIX 12: APPROVAL AGENCY RESPONSE

APPENDIX 13: BLOCK 18 FINAL AREA FOR PURCHASE

APPENDIX 14: BLOCK 18 SURVEY PLAN

GLOSSARY OF TERMS

Abbreviations	
DMR	Queensland Department of Main Roads
GIS	Geographical Information System
NSW	New South Wales
Qld	Queensland
RE	Regional Ecosystem
SAM	Suitability Assessment Methodology
SI	Shape Index
Sf	Final Site Suitability Score

Definitions	
Geographical Information System	Geographical information system that integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.
Regional Ecosystem	Vegetation communities in a bioregion consistently associated with a particular combination of geology, landform and soil.
Suitability Assessment Methodology	Weighted scoring method used to identify candidate sites and rank according to potential suitability as compensatory habitat.
Target species	Wallum Sedge Frog <i>Litoria olongburensis</i> , Wallum Froglet <i>Crinia tinnula</i> and Common Planigale <i>Planigale maculata</i> .
Quantitative Assessment	Geographical Information System (MapInfo) assessment of suitability of land parcels based on the following criteria: <ul style="list-style-type: none"> ▪ proximity to gazetted reserve (metres), ▪ Area of habitat within the parcel (hectares) ▪ Distance to Tugun (kilometres) ▪ Edge to Core (or Shape Index)
Qualitative Assessment	Literature and aerial imagery assessment of a range of habitat and landscape factors such as local government land use zoning, current land use, and quality of habitat present for the target species.
Compensatory Habitat	Habitat required to offset the project's overall environmental impact on a particular species or community. Generally habitat that is preserved, enhanced, restored or created at a location other than the project site.

Definitions

Candidate Sites	Sites short-listed through the selection process as having the greatest likelihood of supporting the target species and their habitats with all the requisite characteristics.
-----------------	--

EXECUTIVE SUMMARY

SMEC Australia was engaged by Queensland Department of Main Roads (DMR) to identify sites within 100 kilometres of the Tugun Bypass project that would be potentially suitable for acquisition as compensatory habitat. The investigation seeks to address the outstanding requirement for approximately 11 hectares of offset habitat for three target species, namely the Wallum Sedge Frog *Litoria olongburensis*, Wallum Froglet *Crinia tinnula* and Common Planigale *Planigale maculata*.

This report has been prepared to describe all activities undertaken under this engagement. It identifies the various contacts, data sources; analyses and outputs generated, and discusses the findings and limitations to any of the information used in the analysis. The report also identifies land parcels that are suitable as compensatory habitat to offset habitat which was lost during construction of the Tugun Bypass.

All sites within the search radius were assessed through a multi step approach using Geographical Information Systems (GIS) and qualitative assessment methods. The GIS analysis comprised an initial assessment, and a detailed spatial analysis using more accurate and comprehensive spatial data, which allowed a greater capacity for selection of individual sites.

A qualitative analysis was carried out on the final 20 candidate sites to identify Local Environment Plan (New South Wales) or Planning Scheme (Queensland) constraints, and to verify the results of the GIS analysis using aerial photography. Based on both the quantitative and qualitative assessments, candidate sites that had potential as compensatory habitat for the target species were designated as “Potentially Suitable” and all other sites were deemed “Sub-optimal”. Six (6) “Potentially Suitable” candidate sites were short listed and an aerial assessment and detailed on-ground assessment was undertaken (Table 1).

On-ground investigations revealed that all three target species inhabited Site 19 (Lot 195 DP755624). Site 18 (Lot 2 DP604378) supported both frogs and is highly likely to support Common Planigale (Lewis, 2008). Site 20 (Lot 212 DP 851963) supported both frogs, but has only a moderate likelihood of supporting Common Planigale (Lewis, 2008). Wallum Froglet and Common Planigale were found on Site 5 (X12), however Wallum Sedge Frog was not identified during the survey period (Lewis, 2008). Sites 14 and 15 did not support any of the target species during the survey period (Lewis, 2008).

Based on the outcomes of both the desktop assessment and on-ground investigations Site 18 (Lot 2 DP604378) or Site 19 (Lot 195 DP755624) would provide suitable compensatory habitat for all three target species. Contact was made with land owners, and both expressed interest in potentially selling.

The suitability of these land parcels as compensatory habitat has subsequently been agreed upon by the following Government Agencies:

- Queensland Department of Main Roads;
- Department of the Environment, Water, Heritage and the Arts;
- New South Wales Department of the Environment and Climate Change;
- New South Wales Department of Planning;
- New South Wales National Parks and Wildlife Service.

Soon after the commencement of negotiation with the owners it became apparent that Site 18 was the preferred option primarily due to reasons of eligibility for sub-division and the complexity of some long standing issues that the owner of Site 19 has with the adjacent National Park over ownership of land. At the time of this report negotiations with the owner of Site 18 are well advanced and contracts have been exchanged. The conclusion of this process should lead to a favourable result for this project.

Table 1: Summary of sites with potentially suitable features

Rank	Site	Description	General Locality
1	18	Lot 2 DP604378	Broadwater, Richmond Valley Shire, NSW
2	19	Lot 195 DP755624	Broadwater, Richmond Valley Shire, NSW
3	5	"X12" (multiple parcels)	Russell Island, Redland Shire, Qld
4	20	Lot 212 DP 851963	Broadwater, Richmond Valley Shire, NSW
5	14	Lot 220 DP 755695	Skidders Shoot, Byron Shire Council, NSW
5	15	Lot 189 DP 755695	Skidders Shoot, Byron Shire Council, NSW

1. INTRODUCTION

SMEC Australia was engaged by Queensland Department of Main Roads (DMR) to identify sites within 100 kilometres of the Tugun Bypass project that would be potentially suitable for acquisition as compensatory habitat. The investigation seeks to address the outstanding requirement for approximately 11 hectares of offset habitat for three target species being the Wallum Sedge Frog *Litoria olongburensis*, Wallum Froglet *Crinia tinnula* and Common Planigale *Planigale maculata*.

This report has been prepared to describe all activities undertaken under this engagement. It identifies the various contacts, data sources, analyses and outputs generated, and discusses the findings and limitations of the information used in the analysis. The report then identifies land parcels that are suitable as compensatory habitat to offset habitat lost during construction of the Tugun Bypass. It describes the process that was used to further evaluate selected properties to arrive at a priority list of land parcels suitable for more detailed investigation.

From this detailed assessment process, a preferred property was recommended for purchase. This report provides details of current status of negotiation.

2. CONSULTATION

The following stakeholders were consulted during the reporting period in relation to the biology and distribution of the target species, data acquisition and planning constraints of candidate sites.

Table 2: Liaison and consultation undertaken to date

Government Agency / Company	Name of contact, position	Month (2008)	Nature of Discussion	Outcomes / Actions
Lewis Consulting	Ben Lewis, Director	June	<ul style="list-style-type: none"> ▪ Properties/locations that may contain the target species; ▪ Alternative methods to obtain an initial list of properties that contain the target species; and ▪ Possible assistance during the investigation. 	Lewis Consulting prepared a formal proposal and was engaged to provide specialist technical advice and undertake detailed surveys of identified blocks.
Department of Environment, Water, Heritage and the Arts (DEWHA)	Chris Murphy, Environment Assessment Branch	July	<ul style="list-style-type: none"> ▪ Properties/locations that may contain the target species. 	Federal Government uses State Government Agency data, therefore use State data. No further action required.
Queensland Environmental Protection Agency (EPA)	Tim Ellis, Director Tenure Action Group	July	<ul style="list-style-type: none"> ▪ Conservation acquisitions program. 	Department strategy is to acquire regional ecosystems (RE) that are not adequately represented in reserves and the RE associated with the target species do not fall under this category.
	Wade Ostreich, Threatened Species Partnerships Unit	July	<ul style="list-style-type: none"> ▪ Properties/locations that may contain the target species. 	Contact Wayne Martin from EPA to obtain point location data of target species.
	Wayne Martin, Wildlife Online Database Manager	July	<ul style="list-style-type: none"> ▪ Request Wildlife Online data base records for target species. 	Species data base records obtained.
	Dot Lim	July	<ul style="list-style-type: none"> ▪ Digital Data. 	Relevant digital data sets obtained.

Government Agency / Company	Name of contact, position	Month (2008)	Nature of Discussion	Outcomes / Actions
NSW Department of Environment and Climate Change (DECC)	Shelly Braithwaite	July	<ul style="list-style-type: none"> Contacted in regards to any information available on the department's priority acquisitions for the target species. 	<p>Unavailable to respond until the 28th July. 2008</p> <p>No response received. Project past stage where information may have been useful.</p>
	Damien Hofmeyer / John Martindale, Senior Threatened Species Officer	July	<ul style="list-style-type: none"> Potential candidate properties. 	Investigate Pacific Highway south of Brunswick Heads to the southern boundary of the search zone.
	Nathan Oliver, Tweed Area Manager Northern Rivers Region	July	<ul style="list-style-type: none"> Potential candidate properties. 	List of land parcels provided.
Moreton Bay Regional Council	Erin Porter, Environmental Officer	July	<ul style="list-style-type: none"> Council's conservation acquisition program; and Known occurrences of species within Shire. 	List of potential land parcels obtained.
Ballina Shire Council	Environmental Officer	July	<ul style="list-style-type: none"> Council's conservation acquisition program; and Known occurrences of species within Shire. 	Ballina Shire Council does not have a conservation acquisition strategy for the target species and could not provide any information on local distributions.
	Duty Planner	August	<ul style="list-style-type: none"> Property zoning; and Subdivision potential of potential candidate sites. 	Information obtained. No further action required.
Richmond Valley Shire Council	Environmental Officer	July	<ul style="list-style-type: none"> Council's conservation acquisition program; and Known occurrences of species within Shire. 	Richmond Valley Shire Council does not have any acquisition strategy for the target species and could

Government Agency / Company	Name of contact, position	Month (2008)	Nature of Discussion	Outcomes / Actions
				not provide any information on local distributions
	Duty Planner	August	<ul style="list-style-type: none"> ▪ Property zoning; and ▪ Subdivision potential of potential candidate sites. 	Information obtained. No further action required.
Byron Shire Council	Environmental Officer	July	<ul style="list-style-type: none"> ▪ Council's conservation acquisition program; and ▪ Known occurrences of species within Shire. 	Byron Shire Council does not have a conservation acquisition strategy for the target species and could not provide any information on local distributions.
	Duty Planner	August	<ul style="list-style-type: none"> ▪ Property zoning; and ▪ Subdivision potential of potential candidate sites. 	Information obtained. No further action required.
Tweed Shire Council	Environmental Officer	July	<ul style="list-style-type: none"> ▪ Council's conservation acquisition program; and ▪ Known occurrences of species within Shire. 	Tweed Shire Council does not have a conservation acquisition strategy for the target species and could not provide any further information on local distributions.
Redland Shire Council	Dan Carter, Senior Advisor Natural Environment	July	<ul style="list-style-type: none"> ▪ Council's conservation acquisition program; and ▪ Known occurrences of species within Shire. 	List of potential land parcels obtained, which will be included in assessment.
		August	<ul style="list-style-type: none"> ▪ Property zoning; and ▪ Council's willingness to manage land parcels. 	Council would be willing to take on responsibility of land and manage as part of council's assets.
		September	<ul style="list-style-type: none"> ▪ Current and proposed land management practices; and ▪ Time frame for removing 	See Appendix 1 for full email correspondence.

Government Agency / Company	Name of contact, position	Month (2008)	Nature of Discussion	Outcomes / Actions
			road reserves and re-configuring land parcels to form conservation reserve.	
CRL mining	Paul Smith, Environmental Manager	July	<ul style="list-style-type: none"> ▪ Willingness to participate in compensatory habitat program. 	Existing tenure of the CRL land is leasehold. Compensatory habitat must be on freehold land, therefore this property is unsuitable. No further action required.
Qld DMR Property Services	Greg Marning and Paul Murphy	July	<ul style="list-style-type: none"> ▪ Property valuations. 	Greg to undertake preliminary valuations on all 20 candidate properties.

3. SPECIES DISTRIBUTIONS

A review of online literature through the NSW Threatened Species website (Table 3) and EPA website (Table 4) identified a variety of vegetation associations that are known to support the target species. The vegetation communities listed are based on searches of associations with the Wallum Sedge Frog and Wallum Froglet. The more general habitat requirements of Common Planigales occur throughout the listed communities and in a wide range of other vegetation types.

Table 3: Vegetation / Species Associations (NSW)

Vegetation Types	Wallum Sedge Frog	Wallum Froglet	Common Planigale
Coastal Floodplain sedgelands, rushlands, and forblands	✓	✓	✓
Coastal Floodplain Swamp Oak (143)	-	✓	✓
Coastal Swamp Paperbark Swamp Sclerophyll Forest	✓	✓	✓
Coastal Swamp Mahogany (142) Forest	-	✓	✓
Coastal Freshwater meadows/forblands	✓	✓	✓
Coastal Wet Heathland & Shrublands	✓	✓	✓
Wallum Sedgeland, and Rushlands	✓	✓	✓
Coastal Headland Heaths	-	✓	✓
<i>Themeda australis</i> sod tussock grassland (FE96 Natural Grassland)	-	✓	✓
Banksia Dry Sclerophyll Shrubland (FE5 Banksia)	✓	✓	✓
Graminoid Clay Heaths	✓	✓	✓

Table 4: Vegetation / Species Associations (QLD)

RE	Description
12.2.5a	Swales dominated by <i>Livistona</i> spp., and <i>Melaleuca quinquenervia</i>
12.2.7	<i>Melaleuca quinquenervia</i> or <i>M. viridiflora</i> open forest to woodland on sand plains
12.2.12	Closed or wet heath ± stunted emergent shrubs/ low trees on poorly drained Quaternary coastal dunes and sand plains
12.2.15	Coastal sedgeland with <i>Baumea</i> spp., <i>Juncus</i> spp. <i>Lepironia articulata</i> , <i>Gahnia</i> spp. and <i>Eleocharis</i> spp. and associated water bodies
12.3.4	<i>Melaleuca quinquenervia</i> , <i>Eucalyptus robusta</i> open forest on or near coastal alluvial plains
12.3.5	<i>Melaleuca quinquenervia</i> tall open forest on coastal alluvial plains

RE	Description
12.3.6	<i>Melaleuca quinquenervia</i> , <i>Eucalyptus tereticornis</i> , <i>Lophostemon suaveolens</i> woodland on coastal alluvial plains
12.3.13	Closed or wet heathland
12.5.9	Closed sedgeland to heathland
12.9-10.22	Closed sedgeland to heathland with emergent trees on Cainozoic to Proterozoic sediments

Online data searches suggested that all three target species have previously been recorded in five (5) of the 13 Local Government areas considered in this analysis (Table 5). The findings of these searches provided the basis for initial contact with Local Government officers in seeking information on properties known to them with the features as listed in Tables 3 and 4.

Table 5: Distribution of Target Species by Local Government Area

Local Government Area	Wallum Sedge Frog	Wallum Froglet	Common Planigale
New South Wales (BioNet)			
Richmond Valley Shire	✓	✓	✓
Ballina Shire	✓	✓	✓
Lismore City	-	-	✓
Byron Shire	✓	✓	✓
Tweed Shire	✓	✓	✓
Kyogle	-	-	✓
Queensland (EPA Wildlife online)			
Brisbane City	-	✓	✓
Moreton Bay Regional Council	-	✓	✓
Gold Coast City	✓	✓	✓
Redland Shire	✓	✓	✓
Scenic Rim Regional Council	-	-	✓
Ipswich City	-	-	✓
Logan City	-	-	✓

4. GIS ANALYSIS

4.1 INITIAL SPATIAL ANALYSIS

The initial spatial analysis was undertaken to assess the potential distribution of candidate sites and the extent of potential habitat throughout the study area.

4.1.1 SPATIAL DATA AND PROPERTY INFORMATION

The following data was obtained from Government agencies or through online query tools:

New South Wales

- NSW Wildlife Atlas flora and fauna records;
- NSW Cadastre;
- NSW Vegetation mapping. Eastern Bushlands Database (2006); and
- NSW National Parks and Wildlife Service Estate.

Queensland

- Qld Cadastre;
- Qld Regional Ecosystem vegetation; and
- Qld Museum records of target species.

General

- Shuttle Radar Topography Mission, 3 arc-second DEM; and
- MapInfo Data, Australia and general features.

4.1.2 SELECTION CRITERIA

Selection criteria used in the initial spatial analysis was developed with consideration of the limitations inherent in the GIS data available. Limitations to the GIS data are described in subsequent sections. The initial spatial analysis was a broad scale assessment relying on general mapping data and hence employed selection criteria appropriate to the accuracy of the data. The initial spatial analysis used the following general criteria to select potential candidate sites:

- Known habitat for all target species with order of priority being:
 - i. Wallum Sedge Frog;
 - ii. Wallum Froglet; and
 - iii. Common Planigale.
- Suitable vegetation community / potential habitat for all target species;
- Minimum 11 hectares;
- Within 100km from Tugun;
- Freehold land;
- Adjacent to gazetted state conservation reserve or within one kilometre; and
- Within 12 kilometres of coastline (general limit of frog species distributions).

4.1.3 ASSESSMENT PROCESS

Using MapInfo Professional and the plug-in program Vertical Mapper, spatial data sourced for the project was assessed following the procedure as outlined in Figure 1. Fauna records and locations of potentially suitable land parcels were also exported to a Google Earth format for viewing over imagery provided by that application.

A further validation of the results was possible using Google Earth to cross-check results against the extent of urban development evident on satellite imagery. At the time of investigation, imagery was noted by the Google Earth application as being dated circa 2008 across the entire area of investigation. However it is noted by Google literature that this date is only an approximate.

The initial spatial analysis resulted in a total of 32 land parcels being identified in Qld and 64 in NSW. These parcels contained the known records of one or more of the target species and/or the habitat associated with the target species as determined by the methodology described above. Sites were not eliminated at this stage due to a lack of database records given the known limitations (section 4.2.4) for these datasets.

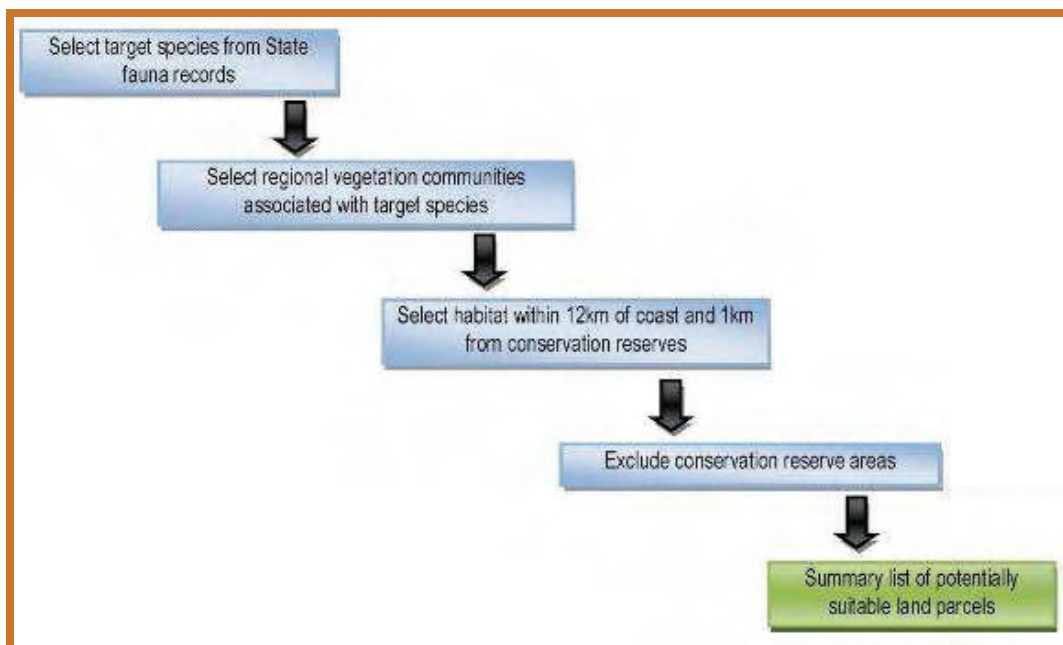


Figure 1: Initial Site Selection Process

4.1.4 LIMITATIONS

The generality of the data used in the initial GIS analysis limited the accuracy of the outputs. More detailed data was ordered and used in the preparation of the detailed candidate list to further refine the search results.

Fauna records provided by the Queensland Museum, EPA and DECC were accompanied by disclaimers on the accuracy and coverage of the information. The use of these records in the analysis has been to:

- Correlate vegetation communities with the species potential occurrence;
- Corroborate verbal advice from different sources; and
- Indicate potential distribution regionally and locally.

Aerial photography and satellite imagery available through Google Earth is of variable date and it was likely that certain areas indicated as being vegetated may have been cleared or more substantially disturbed than apparent since capturing of the image. This was likely to have resulted in more sites being selected than were actually suitable.

4.2 DETAILED SPATIAL ANALYSIS

The detailed spatial analysis was undertaken using more accurate and comprehensive spatial data which allowed a greater capacity for selection of individual sites. As a broad scale assessment, while being capable of detecting areas with potential suitability, the findings were still subject to the limitations of scale. The detailed spatial analysis resulted in a number of sites being identified through a weighted scoring system termed SAM (Suitability Assessment Methodology).

4.2.1 SPATIAL DATA AND PROPERTY INFORMATION

The following digital data was obtained from Government agencies to conduct the detailed spatial analysis.

New South Wales

- Cadastre;
- Known locations of target species;
- Vegetation associations; and
- Voluntary Conservation Agreement areas.

Queensland

- Cadastre;
- Wildlife online point location data; and
- Regional ecosystem.

General

- Australian Museum records for Wallum Sedge Frog.

4.2.2 SELECTION CRITERIA

Following the receipt of more detailed spatial data additional to that used during the initial spatial analysis, the assessment for Potential Candidate Sites was re-run using the approach described in Section 4.1. This approach was built into the detailed SAM for identification of the final Candidate List.

The SAM weighted scoring method, developed specifically for the purpose of identifying potential candidate sites, was used to identify and rank cadastral parcels according to suitability. It was applied to the updated preliminary candidate lists following a period of testing its efficacy. The SAM approach used a scoring method weighted to favour sites as follows:

- Proximity to a record of Wallum Sedge Frog *Litoria olongburensis* – weighted to favour sites containing actual records;
- Proximity to a conservation reserve – weighted to favour closer sites;
- Area of the habitat within the site – weighted to favour habitat closest to 11ha;

- Proximity to Tugun – weighted to favour closer sites;
- Low edge: core ratio – weighted to favour square habitat patches (or better);
- Low levels of disturbance – weighted to favour sites with least disturbance as evident on aerial photography; and
- High level of connectivity – weighted to favour habitat patches connected to other like habitat as evident on aerial photography.

4.2.3 DETAILED DESCRIPTION OF SAM

The SAM was designed at the outset to target the most appropriate sites for selection and further detailed investigation. It included seven (7) criteria comprising five (5) quantitative and two (2) qualitative components. The various components and the values assigned to each were as follows:

Table 6: SAM Assessment Categories (highlighted top scores)

Category	Criteria	Score	Rationale
C1. Presence of Wallum Sedge Frog (<i>Litoria olongburensis</i>)	Present on site	10	Both Common Planigale and Wallum Froglet are known to occur in association with Wallum Sedge Frog; however the opposite is not true. Sites with Wallum Sedge Frog are therefore preferential given potential for both other species.
	Within 600m	5	
	Suitable habitat only	2	
	Absent / no habitat	0	
C2. Proximity to gazetted reserve (metres)	Shared boundary	10	It is preferential that sites which can be easily incorporated into existing reserves are selected to maximise benefits to conservation and investment in management.
	< 100	5	
	< 1000	2	
	> 1000	1	
C3. Area of habitat within the parcel (hectares)	< 1	0	The conservation offset target for this assessment is 11 hectares. However sites less than 11 hectares were also considered especially where they occurred as adjoining parcels. In the instance that adjoining parcels with less than the target were identified, the combined area up to the target of 11 hectares was considered in preference to the single title as defined by the cadastral boundaries.
	1 - 2	1	
	2 - 5	2	
	5 - 11	5	
	11	10	
	11 - 23	5	
	23 - 50	2	
	> 50	1	
C4. Distance to Tugun (kilometres)	< 10	10	It is preferential to implement offset and other conservation measures closer to the area affected by the
	10 - 30	5	

Category	Criteria	Score	Rationale
	30 - 100	2	impact.
C5. Edge to Core (or Shape Index)	< 1.19	10	The equation (1) used to calculate SI (Shape Index) (adapted from Schumaker 1996) was: $SI = \left(\frac{C}{2\sqrt{A}} \right) \div 100 \dots\dots 1.$ Where: C = habitat circumference (m) & A = habitat area (ha)
	1.19 - 1.23	5	
	1.23 - 1.3	2	
	1.3 - 1.4	1	
	> 1.4	0	
C6. Extent of visible disturbance	None evident	10	Determined from assessment of aerial imagery assessing the extent of disturbance to the area of habitat. The basis upon which each criterion was applied was based on experience in the subject matter and aerial photograph interpretation.
	Minor	5	
	Moderate	2	
	High	1	
	Cleared	0	
C7. Connectivity to other habitat (cardinal compass points)	4 sides	10	Due to the irregularity of many habitat patches this assessment needed to be undertaken manually. The purpose was to score sites more highly where there was less chance of edge effects negatively affecting habitat values from adjacent human activities.
	3 sides	5	
	2 sides	2	
	1 side	1	
	Isolated	0	

The final Site Suitability Score (Sf) for any given site was given by the equation (2):

$$Sf = \left(\sum_{C2 \rightarrow C7} S \right) \times S_{C1} \dots\dots\dots 2.$$

Where: S = the score assigned to each category (C)

Cn = categories as identified in Table 6

The resulting Site Suitability Score could have a maximum possible value of 600. Such a score would represent a cadastral parcel:

- with a known record of Wallum Sedge Frog;
- directly adjoining a national park, nature reserve or other gazetted state conservation area;
- containing an area of appropriate habitat equalling 11 hectares;
- within 10 kilometres of the Tugun bypass;

- with the target habitat having a shape equivalent to a square (or better);
- with no disturbance evident within the area of target habitat; and
- with native vegetation adjoining the target habitat on all sides.

Other biophysical criteria that could have been included in the SAM were considered during the initial stages of methodology development however were not included despite availability of the data. Table 7 identifies the environmental criteria that were not included and justifications for their exclusion.

Table 7: Bio / Geo-physical Variables not considered

Criteria	Reason for Omission
Elevation	Data available was the SRTM 3 Arc-second DEM giving a resolution of about 90 metre grid cells. Vegetation community mapping and the presence of target species would result in elevation being a redundant inclusion.
Slope & Aspect	These would have been derived from the SRTM DEM and similarly to the issue described for elevation, vegetation mapping would reflect in most instances the effect of slope and aspect on the distribution of target habitat.
Geology & Soils	Vegetation mapping, particularly for Qld is based heavily on soil variation. The inclusion therefore of geology and soils as another variable would have been redundant given the association of the target habitats with a very specific soil type.

During application of the SAM to the data, it became apparent that various inherent inadequacies in the data and general limitations were skewing the results obtained in calculation of the final score (Sf). Consequently, the site scoring equation was tested for sensitivity against the various categories prior to the final calculation for site suitability being made. Adjustments to the final score equation are described in the following section.

4.2.4 LIMITATIONS AND SAM ADJUSTMENTS

The SAM approach was designed specifically to identify areas with the characteristics both required by the project brief and also recommended by best practice and policy in conservation planning and offset identification. Limitations in the data affected the full implementation of the methodology, given scale and accuracy effects, in addition to the significant number of parcels included in the final analysis.

Vegetation Mapping

The scale of vegetation mapping varied across the study area however was generally no better than 1:250,000 in NSW but slightly better in Qld at about 1:100,000. For the purpose of the current assessment both datasets were adequate for the initial regional queries. However the resulting accuracy necessary for the finer scale site-by-site assessments introduced errors such as:

- Non-identification of habitat on sites that actually supported habitat as determined from aerial photographs;
- Averaged and inconsistent vegetation patch definition resulting in different calculations for the Shape Index (see C5 in Table 6); and

- Identification of target vegetation in areas where it did not exist either as a result of recent clearing or due to the scale of the original mapping.

Following this it was also evident that limitations in the data also included the age of the mapping where the effects of land clearing during the intervening year between publishing of the data and the current assessment.

Fauna Records

Fauna database records obtained from NSW and Qld authorities exist at different accuracies dependent on the age of the record and quality of the original data upon which the records are based. This introduced a bias that was most pronounced in the scoring of sites under the C1 category (see Table 6). As a consequence of this general limitation the scoring values were adjusted such that the first two criteria were combined. The result was that any cadastral parcel within 600 metres of a known record received a score of 10 and the presence of habitat only scored 5 as opposed to the original scoring method as described by Table 6.

Cadastral

Cadastral parcel size was found to influence the site selection, particularly when sites of less than 11 hectares were included in the scoring and analysis. The effect was most pronounced for small sites of less than one (1) hectare. It was found to be in part due to the general scale limitations of the vegetation mapping which also affected the Shape Index (C5) category. Smaller sites were found to be scoring better on the site index as a result of the roughly rectangular shape of cadastral parcels which excised correspondingly shaped portions of habitat from the vegetation mapping layers. Many of these sites scored a 10 in the site index category skewing the results in favour of these smaller and generally unsuitable sites. Following this the SAM was applied generally to all sites and then again separately to all sites using the criteria under category C3 (see Table 6) only for sites containing habitat of 11 hectares or greater.

The initial analyses were based on limited cadastral information that resulted in approximately 120 cadastral parcels being identified in the preliminary potential candidate list. Following incorporation of the new GIS data the number of parcels matching these initial search criteria was increased to over 8,000. As a consequence the two subjective components of the SAM became unviable with this number of sites and accordingly these were not undertaken across the entire range of potential candidate sites. The methodology was at this stage amended to identify twenty (20) short listed sites for which the qualitative analyses were then undertaken.

SAM Adjustments

Steps taken as a consequence of this amended method, while still following the concept defined by the SAM, divided the approach into two main stages. This can be summarised as follows:

1. Undertake quantitative assessments on all potential candidate sites to identify the top 20 (short-listed) sites;
 - a. Following completion of this, a cursory review of the entire study area using aerial photography was also undertaken to confirm the findings of the first stage and adjust the top twenty accordingly where the data was obviously incorrect, i.e. mapped vegetation did not faithfully represent extant vegetation coverage.

- b. Assess the distribution of small sites supporting suitable habitat to identify groups that could be reconsidered as a single virtual parcel. The primary example of this is on Russell Island.
 - c. Re-run the quantitative assessment incorporating the updated information.
2. Undertake a full quantitative and qualitative assessment on the short listed sites.

By including this iterative process in the initial stage it was possible to identify a number of sites that would have originally been omitted due to limitations in the data. The final five candidate sites therefore represent the results of a well defined and repeatable methodology.

SAM – Final Methods

Due to the limitations identified in section 4.2.4, the final Site Suitability Score was given by the following equation (3):

$$Sf = \sum_{C2 \rightarrow C5} S \dots\dots\dots 3.$$

Where: S = the score assigned to each category (C)

Cn = categories as identified in Table 6

The resulting Site Suitability Score could have a maximum possible value of 40.

5. QUALITATIVE ASSESSMENT

A qualitative assessment was conducted for each of the 20 candidate land parcels identified through the detailed GIS analysis. Sites were assessed against habitat and landscape factors, based on a preliminary assessment of the potential limitations posed by the NSW Local Environment Plan and Qld Planning Schemes where relevant.

Additionally, features observed from aerial photography were also considered as a verification of the general habitat features and vegetation community structure as described by vegetation map layers used in the quantitative assessment. Google Earth imagery was used for aerial imagery given recent updates that have been incorporated into that system. Notwithstanding the inherent limitations of Google Earth, this provided a clearer understanding of context and likely habitat potential based on structural appearance and topographic location.

The following factors were considered:

Habitat Factors

- Quality – extent of visible disturbance, eg. a site with no obvious disturbance is scored highly.
- Connectivity – linkages to other habitat areas, eg. a site connected directly to other areas of native vegetation is scored highly.
- Quantity – area of habitat apparent in aerial imagery in comparison to GIS analysis, e.g. a site with less habitat apparent on aerial imagery than indicated by the GIS analysis is scored low while sites with the equivalent area of habitat are scored highly. This is a validation of the vegetation mapping with respect to area.
- Common Planigale – assessment of visual appearance of vegetation characteristics to determine potential suitability for species, suitability determined from published descriptions of habitat preferences.
- Wallum Froglet – assessment of visual appearance of vegetation characteristics to determine potential suitability for species, suitability determined from published descriptions of habitat preferences.
- Wallum Sedge Frog – assessment of visual appearance of vegetation characteristics to determine potential suitability for species, suitability determined from published descriptions of habitat preferences.

Landscape Factors

- Planning limits – preliminary assessment of limitations in NSW Local Environment Plan or Qld Planning Scheme where relevant. This considers subdivision limitations such as minimum lot size provisions a site with no apparent limitations is scored highly.
- Lot size – area of cadastral parcel irrespective of planning limitations in consideration of the offset target e.g. a parcel closer to 11 hectares is scored highly.
- Adjacent land uses – type of adjacent land uses such as residential, agricultural or industrial, e.g. a site adjacent to less intensive activities is scored highly.
- Existing land uses – activities currently conducted on the site, e.g. a site with low intensity activity within or adjacent to the habitat is scored highly.
- Proximate Records – distance to known locations of target species and numbers of records of target species, e.g. a site close to known records of all target species is scored highly.

Sites were scored using a similar system to that used in the GIS analysis. Where a site scored zero (0) in any factor, the site did not continue through to the next stage of assessment in the matrix. The results of the qualitative analysis were used to grade land parcels “Potentially Suitable”, “Sub-optimal” or “Not Suitable”.

Appendix 2 contains the qualitative assessment matrix and all scores as determined for the potential candidate sites. The assessment factors and criteria described above are also replicated in the matrix. The assessment was conducted in a progressive manner whereby if a site failed in the habitat factor stage, the assessment did not progress to the landscape factors.

Potential candidate sites were ranked in order of relative suitability on the basis of the assessments as described (see table 8).

6. FINDINGS

6.1 RESULTS

The 20 short listed sites determined by the SAM approach were subjected to a qualitative assessment as described in Section 5. All sites considered “Potentially Suitable” were those most representative of the selection criteria and therefore most likely to represent offset habitat.

Table 8 lists the 20 candidate sites. From the analysis of these sites it was concluded that six sites were potentially suitable, 13 sites sub-optimal and one site (Site 4) not suitable as the land is currently owned by Redland Shire Council. Of the potentially suitable land parcels, one site (Site X12) is located in Qld and the remaining sites are located in NSW.

Table 8: Summary of Final Qualitative Assessment

Site	Description	Conclusion	Reason
1	Lot 264 S312597	Sub-optimal	Apparent lack of preferred habitat
2	Lot 230 SL12221	Sub-optimal	Apparent lack of preferred habitat
3	Lot 3 RP139023	Sub-optimal	Apparent lack of preferred habitat
4	Lot 424 S312233	Not Suitable	Land owned by Council
5	“X12”	Potentially Suitable	Site generally meets selection criteria (ranked 3rd)
6	Lot 272 DP755701	Sub-optimal	Recent vegetation clearing
7	Lot 21 DP1058759	Sub-optimal	Planning limitations, Wallum Sedge Frog not present on adjacent site
8	Lot 4 DP601993	Not Suitable	Previously assessed parcel, Wallum Sedge Frogs not present
9	Lot 162 DP755692	Sub-optimal	Planning limitations
10	Lot 104 DP1023126	Sub-optimal	Planning limitations
11	Lot 7 DP573269	Sub-optimal	Planning limitations
12	Lot 27 DP858323	Sub-optimal	Planning limitations
13	Lot 449 DP812102	Sub-optimal	Planning limitations
14	Lot 220 DP755695	Potentially Suitable	Site generally meets selection criteria (ranked equal 5th)
15	Lot 189	Potentially Suitable	Site generally meets selection criteria

Site	Description	Conclusion	Reason
	DP755695		(ranked equal 5th)
16	Lot 251 DP755691	Not Suitable	Distance to conservation reserve, apparent lack of preferred habitat
17	Lot 4 DP253906	Not Suitable	Recent extensive disturbance
18	Lot 2 DP604378	Potentially Suitable	Site generally meets selection criteria (ranked 1st)
19	Lot 195 DP755624	Potentially Suitable	Site generally meets selection criteria (ranked 2nd)
20	Lot 212 DP851963	Potentially Suitable	Site generally meets selection criteria (ranked 4th)

Maps presented in Appendix 3 indicate the distribution and general context of each site in relation to the Tugun Bypass project site and other biophysical features and infrastructure. These can also be viewed in conjunction with the detailed site assessment sheets (Appendix 4) and assessment matrices (Appendix 2), which give a more detailed view of each site.

While many of the sites were found to be clearly lacking the necessary site characteristics, several supported habitat features potentially conducive to the occurrence of the target species. In addition to this, there were also a number of other sites disregarded in the earlier quantitative SAM analysis due to the area of habitat being significantly larger than the required 11 hectares. Should the final sites identified in the table above be found to be unsuitable as a result of planning limitations, ecological factors or economic reasons, there are a number of alternatives that could be considered.

It also needs to be recognised that the analysis was undertaken using the specific criteria as described in the methodology sections. These criteria were identified in order to quickly identify the most optimal sites representing most, if not all, of the most desirable features. Given the repeatable and transparent approach that has been used, further iterations can be undertaken by broadening the selection criteria in order to identify additional sites.

Regardless, the findings of these analyses are based entirely upon desktop methods and would be subject to verification by field survey.

6.2 LIMITATIONS

Limitations are discussed in section 4.2.4 in relation to the methodology and several elements of the data used for the analysis. The main limitation beyond these was the lack of actual detailed site information for the majority of sites considered. To alleviate this limitation it was decided that a quick assessment of a larger number of sites using a fixed wing light aircraft be undertaken. This allowed for the collection of current and targeted information on the condition and general nature of potential habitat for the sites selected. This limitation was further alleviated by undertaking the assessment with the assistance of an ecologist sufficiently experienced in the life-cycle requirements of the target species.

7. AGREED WAY FORWARD

On September 15, 2008 a meeting was held with relevant State and Federal Government Departments to present the results of the desktop assessment and agree on actions to be undertaken to finalise the compensatory habitat package. Representatives attended from the following Government Departments: QLD DMR, NSW Department of Planning (DoP), DEWHA, DECC and NSW Roads and Traffic Authority (RTA). As per the meeting minutes (Appendix 5), an agreed way forward was determined as follows:

1. A. Detailed study of the Russell Island site.
 B. Flyover of all six shortlisted, potentially suitable sites.
 C. Consult with landowners and councils of all six shortlisted sites.
2. Ground assessment/brief walkover of blocks 14, 15, 18-20 based on outcome of item 1C (above).
3. If item 1A was found not to be optimal then undertake detailed study of sites 18, 19 and 20, subject to outcome of items 1C and 2.
4. If the outcome of items 1, 2 and 3 above are not optimal then look at remaining sites out of item 2 (sites 14 and 15).
5. If all sites are not found to be optimal, the group will meet again to discuss the balance of the top 20 sites.

Items 3-5 above were identified during this meeting in order to allow for contingency and review of the analysis in the event that the shortlisted sites identified to date were all unsuitable. The progression of the project from this point is discussed in detail in the following sections and identifies the outcome of this agreed way forward.

8. LANDHOLDER CONSULTATION

Landholder contact details were not available from DMR property databases, which caused delays in making initial contact with landholders. As a consequence additional liaison was required with the relevant councils in order to extract landholder name/s and postal addresses. On receipt of this information, letters were sent on 10th September 2008 to landholders of the six properties determined as being “Potentially Suitable” as a result of the assessments described in the preceding sections. Letters sent to the landholders provided information on the Tugun Bypass Compensatory Habitat Package, the process by which the property was identified and the area of the land parcel that may be suitable as compensatory habitat.

Property owners of all “Potentially Suitable” land parcels expressed interest in participating in the Compensatory Habitat Program, and gave approval to conduct detailed on-ground surveys for the target species. During September, advice was received from the RTA that the Department was in negotiation with land holders of Site 18 and 19 in relation to hardship acquisition proposals for the Pacific Highway upgrade. DMR worked closely with the RTA on exploring the potential implications of these issues on future negotiations between DMR and the land owners.

A detailed description of consultation undertaken with landholders can be found in Appendix 6.

9. AERIAL INSPECTION

An aerial inspection of potentially suitable land parcels was conducted, on Monday 29th September 2008, to verify the results of the desktop analysis and gain a better appreciation of current site conditions and landscape context. The inspection targeted the six shortlisted potentially suitable land parcels identified from the desktop analysis, namely sites 5, 14, 15, 18, 19 and 20. The specific objectives of the inspection were to confirm the type and extent of habitat present and its suitability as compensatory habitat for the target species while also providing a reconnaissance of the sites ahead of any detailed site survey. A summary of the findings are detailed below.

Site 5: X12, Russell Island

The potential suitability of Site 5 is generally consistent with the findings of the qualitative assessment. The low lying region in the centre of the site may provide suitable habitat for both Wallum Sedge Frog and Wallum Froglet, and Common Planigale may inhabit the surrounding, slightly elevated woodland areas. A natural drainage line was evident on the southern most portion of the Island and a small man-made drainage line transects through the site. There is evidence of die back of *Melaleuca* species in the centre of the site, which could be due to extreme dry periods or extended periods of inundation. At the time of the aerial survey the site appeared relatively dry however water was apparent in several locations as indicated by reflections through the sedgeland vegetation. This site remains ranked 3rd. Aerial photographs of the site are found in Appendix 7, Figures 11.1 and 11.2.

Site 14: Lot 220 DP 755695, Skinners Shoot

The aerial survey showed that this site appears less favourable than previously concluded from the desktop assessment. The site is very densely vegetated by woodland species and does not show obvious signs of periodic inundation. This limits the likelihood that the site provides breeding habitat for Wallum Sedge Frog and Wallum Froglet. Although this site may still provide migratory habitat for the frog species, it is unlikely to support permanent populations and other sites, outside the list of six potentially suitable land parcels, should be considered prior to conducting an on-ground investigation of this site. The site remains potentially suitable for Common Planigale. An Aerial photograph of the site is found in Appendix 7, Figure 11.3.

Site 15: Lot 189 DP 755695, Skinners Shoot

This site is within close proximity of Site 14 and appears to share similar ecological characteristics. Upon evaluation of the aerial photography, this site also appears less favourable than previously concluded from the desktop assessment and other sites, outside the list of six potentially suitable land parcels, should be considered prior to conducting an on-ground investigation of this site. An Aerial photograph of the site is found in Appendix 7, Figure 11.4.

Site 18: Lot 2 DP604378, Broadwater

The aerial survey showed that this site is potentially suitable for all target species, which is consistent with the findings of the desktop assessment. Vegetation in the eastern corner of the area proposed for subdivision appears highly suitable to Wallum Sedge Frog and Wallum Froglet due to the visible extent of sedges and apparent signs of periodic inundation of the drainage line. Moreover, the western area of the site is slightly elevated and is more densely vegetated by woodland species. This area of the site is likely to provide foraging habitat for Wallum Froglet and support Common Planigale. The general extent and type of habitat evident on Google Imagery was found to be consistent with observations from the aerial survey. This site is most likely to support the target species.

The proposed subdivision layout includes an access track to the dam, however at the time of conducting the aerial survey, this track appeared inaccessible due to a local depression that was filled with water and extended the width of the track. This may affect the intentions of the proposed subdivision, which was to maintain access to the dam that lies in the south western corner of the property. Regardless, consultation with the landholder would be required and at this point a review of the subdivision layout could be considered. Aerial photographs of the site are found in Appendix 7, Figure 11.5 and 11.6

Site 19: Lot 195 DP755624, Broadwater

The general extent and type of habitat present on this site during the aerial survey is consistent with Google imagery used in the desktop assessment. Portions of the site appear to be periodically inundated and sedges are evident in these areas, which are likely to provide habitat for both Wallum Sedge Frog and Wallum Froglet. The slightly more elevated areas of the site are vegetated by woodland species which may support common Planigale. The results of the aerial survey confirm desktop analysis, which concluded that this site contains potentially suitable habitat for all target species. An Aerial photograph of the site is found in Appendix 7, Figure 11.7.

Site 20: Lot 212 DP 851963, Broadwater

During the aerial survey of Site 20 the apparent disturbance of habitat present was greater than initially identified during the desktop assessment. A senescent stand of what appeared to be Monterey / Slash Pine (*Pinus radiata*) exists towards the eastern portion of the site and is likely to be the remains of a once larger plantation. There is also evidence of pine trees having been cleared and due to their senescent crowns, small stature and dispersed coverage of pines suggest the establishment of this plantation was not successful. The proposed subdivision includes only a small portion of the remaining stand of pine trees; however the layout may be amended to predominately avoid areas that still retain the senescent pine trees. A low lying area towards the south-western corner of the proposed subdivision area may provide breeding habitat for Wallum Sedge Frog and Wallum Froglet, and Common Planigale may opportunistically forage throughout the site. Aerial photographs of the site are found in Appendix 7, Figure 11.8, 11.9 and 11.10.

10. DETAILED SURVEY OF CANDIDATE LAND PARCELS

Once permission had been received from the owners to enter their land Lewis Ecological Surveys undertook a detailed survey of the candidate land parcels. Below is a summary of the methods and findings of the detailed survey of candidate land parcels undertaken by Lewis Ecological Surveys.

Site 5: X12, Russell Island

Field investigations of Site 5 (X12) were undertaken between the 6th and 12th October, 2008. Survey methods employed include pitfall trapping for Common Planigale at four locations for four days and audible and observational surveys for Wallum frogs over a consecutive seven day period.

Lewis (2008) identified three fauna habitats within the survey area including "Swamp Sclerophyll Forest dominated by Swamp Mahogany (2.2 ha), Wet Heath dominated by Hakea and Leptospermum (6.6 ha) and Broad-leaved Paperbark wetland (2.1 ha) growing in low pH waters (5.20-36)". In comparing Site 5 with the habitat removed during construction of Tugun Bypass both sites contain a Swamp Sclerophyll Forest dominated by a Swamp Mahogany and/or Broad-leaved Paperbark with dense shrub and ground covers (Lewis, 2008).

Common Planigale was recorded at two locations within the site, but is expected to inhabit the entire site with its distribution likely to only be influenced by the extent of surface water present (Lewis, 2008). Wallum Froglet was found at numerous locations both within and adjacent to the site (Lewis, 2008). According to Lewis (2008) approximately 3-4 ha of suitable breeding habitat for this species occurs in the southern precinct of the site. The Wallum Sedge Frog was not recorded during the survey period and is unlikely to inhabit the candidature site despite the presence of suitable habitat. Based on surveys undertaken at the site and comparative surveys at multiple reference sites elsewhere on the island, Lewis (2008) concluded that the Wallum Sedge Frog may not inhabit the Island in comparison to any obvious decline or rapid disappearance of the species.

The acquisition of this site would result in a net gain of habitat for both Common Planigale and Wallum Froglet, however no net gain would be provided for Wallum Sedge Frog (Lewis, 2008). Appendix 8 contains the complete report produced by Lewis Ecological Surveys for Site 5.

Site 14: Lot 220 DP 755695 and Site 15: Lot 189 DP 755695, Skinners Shoot

Site 14 and 15 were surveyed together and share similar ecological attributes, therefore the results of these sites are presented together. Field surveys of these sites were undertaken between 24th November and 1 December, 2008. Targeted searches were undertaken in a two part process: audible and observational surveys for Wallum frogs were conducted over an eight day period and, once their presence was confirmed, surveys were to be undertaken for Common planigale. A reference site was established near Lennox Head (2 km north of the township) to demonstrate that conditions were suitable for detecting Wallum frogs.

Both sites contain Broad-leaved Paperbark and Swamp Oak wetland growing in relatively neutral waters (6.8-7.05). The sites provide little habitat to wallum frogs and the species were not found during the field survey (Lewis, 2008). Pitfall trapping for Common planigale was not undertaken; however the flooded nature of the sites suggests that the species is likely to be seasonally restricted to adjacent areas of higher topography rather than the potential candidature sites (Lewis, 2008). According to Lewis (2008) Site 14 and 15 are

considered inadequate for the purpose of addressing the outstanding offsets for the Tugun Bypass project. Appendix 9 contains the complete report produced by Lewis Ecological Surveys for Site 14 and 15.

Site 18: Lot 2 DP604378, Broadwater

Field surveys of Site 18 were undertaken between 24th November and 1 December, 2008. Survey methods employed include pitfall trapping for Common Planigale at three locations for four days and audible and observational surveys for Wallum frogs over a consecutive eight day period.

According to Lewis (2008) the site contains a diversity of habitat including: dry heath, wet heath, sedge swamp, swamp forest and coastal woodland. Wet heath is found in the central and eastern portions of the site, and Sedge swamp is found along the southern and central northern boundaries of the site (Lewis, 2008). These vegetation types are of particular importance to Wallum frogs. Dry heath is distributed over the central and western section of the site (Lewis, 2008). The western part of the site contains Swamp forest and Coastal woodland is restricted to the south eastern portion of the site (Lewis, 2008).

Wallum Froglet was found at Site 18 with individuals heard and captured on multiple occasions during the study period (Lewis, 2008). The frequency and intensity of frog calls increased with the onset of rain during 26-30th November when hundreds of individual were heard (Lewis, 2008). The primary foraging and breeding habitat for this species is the littoral margins of wet heath and sedge swamp associations within the Swamp forest (Lewis, 2008). Wallum Sedge Frog is broadly distributed in a north south direction across the site, encompassing areas of sedge swamp and wet heath (Lewis, 2008). Transect counts of Wallum Sedge Frogs recorded at this site tallied 16 adults and one sub adult (Lewis, 2008). Although Common Planigales were not encountered during the survey period there is a high likelihood that they occur given that the habitat present is consistent with other capture locations (Lewis, 2008).

Acquisition of Site 18 would be suitable in offsetting 11 ha of wallum habitat for the Tugun Bypass project (Lewis, 2008). Appendix 9 contains the complete report produced by Lewis Ecological Surveys for Site 18. In addition, Appendix 10 contains additional supporting evidence from Lewis Ecological Surveys in relation to the likelihood of Common Planigale inhabiting Site 18.

Site 19: Lot 195 DP755624, Broadwater

Field surveys of Site 19 were undertaken between 24th November and 1 December, 2008. Survey methods employed include pitfall trapping for Common Planigale at three locations for four days and audible and observational surveys for Wallum frogs over a consecutive eight day period.

Habitat types identified include: dry heath, wet heath and sedge swamp (Lewis, 2008). Dry heath is distributed over the central and north western parts of the site, while wet heath is confined to the south western precinct and parts along the central eastern boundary (Lewis, 2008). Sedge swamp is found on the southern and eastern extremities of the site (Lewis, 2008).

During the survey period, all three target species were found to inhabit Site 19 (Lewis, 2008). Wallum Froglet was heard and captured at Site 19, with the frequency and intensity of frog calls increasing with the onset of rain during 26-30th November when hundreds of individual were heard (Lewis, 2008). Wallum Sedge Frog was recorded along the eastern boundary of the site and extending north to an artificial dam (Lewis, 2008). One adult male

planigale was captured in the ecotonal area between wet and dry heath located in the north eastern portion of the site (Lewis, 2008).

Acquisition of Site 19 would be suitable in offsetting 11 ha of wallum habitat for the Tugun Bypass project (Lewis, 2008). Appendix 9 contains the complete report produced by Lewis Ecological Surveys for Site 19.

Site 20: Lot 212 DP 851963, Broadwater

Field surveys of Site 20 were undertaken between 24th November and 1 December, 2008. Survey methods employed include pitfall trapping for Common Planigale at three locations for four days and audible and observational surveys for Wallum frogs over a consecutive eight day period.

Three habitat types were identified during the site survey, these include: dry heath, wet heath-wallum shrubland, sedge swamp, swamp forest and exotic pine plantation (Lewis, 2008). Dry heath is restricted to the northern precinct of the site while Wet heath – wallum shrubland is restricted to the south eastern part of the site (Lewis, 2008). Sedge swamp occurs along the sites southern and eastern boundaries, and Swamp forest is restricted to the south western part of the site (Lewis, 2008). Exotic pine plantation occurs over much of the site (Lewis, 2008).

Wallum Froglet was heard and captured at Site 20, with the frequency and intensity of frog calls increasing with the onset of rain during 26-30th November when hundreds of individual were heard (Lewis, 2008). Wallum Sedge Frog was recorded in the far northern and south eastern part of the site (Lewis, 2008). These areas were vegetated by regenerating wet heath, which was inundated by up to 0.4 m of water at the time of survey (Lewis, 2008). Common Planigale was not recorded during the survey period and has a moderate likelihood of occurrence at the site (Lewis, 2008).

As Site 20 has been historically used as a pine plantation, the suitability of the site for compensatory habitat is reduced (Lewis, 2008). Appendix 9 contains the complete report produced by Lewis Ecological Surveys for Site 20.

11. PREFERRED CANDIDATE SITES

Based on the outcomes of both the desktop assessment and on-ground investigations, Site 18 (Lot 2 DP604378) or Site 19 (Lot 195 DP755624) would provide suitable compensatory habitat for all three target species. During the on-ground investigations all three species inhabited Site 19 (Lot 195 DP755624), and Site 18 supported both Wallum frogs and has a high likelihood of supporting Common Planigale (Lewis, 2008).

Site 18 is zoned No. 1(d) Rural (Urban Investigation) Zone under the Richmond River Shire Council LEP 1992. Clause 11(2)(e), Part 3 Special Provisions, Division 2 – Rural Development relating to subdivision, identifies the minimum lot size of not less than 10 hectares. Subdivision of this land parcel could achieve the minimum lot size provision. Potential subdivision options for this land parcel are shown in Appendix 11. The conceptual subdivision layouts have been designed such that the current land owner retains access to and ownership of the existing dam.

Site 19 is in Zone No. 1(a) Rural (Prime Agricultural Land) Zone under the Richmond River Shire Council LEP 1992. Clause 11(2)(a), Part 3 Special Provisions, Division 2 – Rural Development relating to subdivision, identifies the minimum lot size of not less than 40 hectares. Given this minimum lot size, it would be necessary to acquire the whole parcel which equates to approximately 24.1 hectares.

Contact was made with land owners of sites 18 and 19, and both expressed interest in potentially selling.

The suitability of these land parcels as compensatory habitat has been agreed upon by the following Government Agencies:

- Queensland Department of Main Roads;
- Department of the Environment, Water, Heritage and the Arts;
- New South Wales Department of the Environment and Climate Change;
- New South Wales Department of Planning; and
- New South Wales National Parks and Wildlife Service.

Written responses from these agencies are presented in Appendix 12.

Soon after the commencement of negotiations with the owners it became apparent that Site 18 was the preferred option. At the time of this report negotiations with the owner of Site 18 are well advanced and contracts have been exchanged.

Forming part of the conditions of contract is the requirement for the block to be fenced and for additional firebreaks to be constructed. These works are still to be organised and carried out.

The figure in Appendix 13 provides an indication of the final area of Block 18 that is in the process of being purchased. The survey plan of the subdivision is presented in Appendix 14.

12. REFERENCES

- Ballina shire Council 2008, Ballina Local Environmental Plan 1987,
http://www.ballina.nsw.gov.au/content/uploads/LEP__7_Nov_2008.pdf
- Barry, S 2005, *Wetland Management Profile: Coastal Wet Heath / Sedgeland Wetlands*, Queensland Parks and Wildlife Service, Brisbane.
- Byron Shire Council 2008, Byron Local Environmental Plan 1988,
<http://www.byron.nsw.gov.au/local-environmental-plan/>
- Environmental Protection Agency, 04 April 2008,
http://www.epa.qld.gov.au/nature_conservation/biodiversity/regional_ecosystems/introduction_and_status/regional_ecosystem_maps/
- Forman, RTT & Godron, M 1986, *Landscape ecology*. John Wiley & Sons, New York, New York, USA.
- Google Earth, 04 April 2008, <http://earth.google.com/intl/en/userguide/v4/>
- Information Queensland, Queensland Government, 04 April 2008
<http://www.information.qld.gov.au/>
- Joyce, K 2006, *Wetland Management Profile: Coastal Melaleuca Swamp Wetlands*, Queensland Parks and Wildlife Service, Brisbane.
- Lewis, BD 2008, Target surveys for Wallum Frogs (*Litoria olongburensis*, *Crinia tinnula*) and Coastal Planigale (*Planigale maculata*) as part of the Tugun Bypass Compensatory Habitat Project – Russell Island Candidature Site. Report to Department of Main Roads, Nerang.
- Lewis, BD 2008, Target surveys for Wallum Frogs (*Litoria olongburensis*, *Crinia tinnula*) and Coastal Planigale (*Planigale maculata*) as part of the Tugun Bypass Compensatory Habitat Project – Skinners Shoot and Broadwater Candidature Sites. Report to Department of Main Roads, Nerang.
- Logan City Council 2008, Logan Planning Scheme,
<http://pdonline.logan.qld.gov.au/cityplan/enquirer/publishR.aspx?page=eplan>
- Meyer, E, Hero, J-M & Lewis, B 2006, *National recovery plan for the wallum sedgefrog and other wallum-dependent frog species*. Report to the Department of the Environment and Water Resources, Canberra.
- NASA, 04 April 2008, <http://www2.jpl.nasa.gov/srtm/>
- NSW threatened species website,
<http://www.threatenedspecies.environment.nsw.gov.au/>
- Patton, DR 1975, 'A diversity index for quantifying habitat "edge"'. *Wildlife Society Bulletin*, Vol 3, pp.171-173.
- Redland Shire Council 2008, Redland's Planning Scheme 2006,
<http://rpsdocs.redland.qld.gov.au/>

Richmond Valley Shire Council 2006, Richmond River Local Environmental Plan 1992 (as amended),
<http://www.richmondvalley.nsw.gov.au/index.php?action=view&view=27021>

Schumaker, NH 1996, 'Using landscape indices to predict habitat connectivity', Ecology. FindArticles.com. 06 Aug. 2008.
http://findarticles.com/p/articles/mi_m2120/is_n4_v77/ai_18475483

Spatial Information Exchange, Department of Lands, 04 April 2008
<http://www.maps.nsw.gov.au/>

Tweed Shire Council 2008, Tweed Local Environmental Plan 2000,
<http://www.tweed.nsw.gov.au/planningdocs/pdfs/planningdocs/TLEP%202000.pdf>

APPENDIX 1: REDLAND SHIRE COUNCIL CORRESPONDENCE

Hi Melissa

Thanks for the chat; I hope I have covered everything. Please see Richard's e-mail address included if you need some further information next week.

Dan Carter
Senior Advisor Natural Environment
3829 8640

From: Zulpo, Mellissa [mailto:Mellissa.Zulpo@smec.com.au]
Sent: Thursday, 18 September 2008 4:06 PM
To: Daniel Carter
Cc: Cowper, Peter
Subject: Tugun Bypass Compensatory Habitat: Outstanding Offsets - Russell Island

Hi Dan,

We met with the Tugun Bypass Compensatory Habitat approval agencies (DECC, DEWAH, DMR, RTA, DoP) on Monday 15th September to agree on land parcels to conduct on-ground investigations. The agencies are happy to proceed with an on-ground investigation of Russell Island, but would like some further information on how the land parcels will be managed by Redland Shire Council's following approval as compensatory habitat.

Specifically, the agencies would like to know:

How does Redland Shire Council currently manage Council owned on Russell Island?

We have specific conservation team that manage all existing council owned land, this are is managed as a wetland which has high significance for council considering the species that exist in this area. Currently we would be dealing with any declared weed issues on the lot, in this case mostly groundsel. Council has land in freehold or in trustee arrangements. In the case of trustee arrangement our management of those lands are controlled by the Land Act or the Nature conservation Act.

Under the Land Act we have management for conservation or an environmental purpose which means management of the land must meet the criteria, so we could not build a playground or something without approval of the state. Under Nature Conservation Act there are a number of criteria available which again established the management intent of the block or parcels of land.

It would be part of negation what level of work is required from the surrender of the land, (i.e. removal of declared and environmental weeds, fencing, installation of signage etc). In this case given my recollection of the land very little management would be required as it is rather intact native vegetation, with issues only on the road edge.

With council acquisition we normally set aside a further 10% of acquisition price for the initial management of the property, this ensure existing maintenance management funds is not consumed getting the property up to scratch. So in other cases this has required fencing, removing rubbish, closing illegal track etc).

What is the expected timeframe for amalgamating Council owned land parcels, and removing road reserves from the southern tip of Russell Island to form a Conservation Reserve?

Council has a resolution to commence amalgamation and road closure currently. At this stage no set time or project has been established to do this. It is dependent on having blocks of land in council ownership or management to allow this to occur.

How does council currently manage Conservation Reserves within the shire? Do you have a management plan that could be provided as an example?

We do develop management plans for individual areas as the need arises, we are also developing a draft management intents documents which would provide overarching management objectives for council conservation estate. It could be negotiated that council will develop a management plan requiring authorisation by respected parties for the management of the property.

Any other information that could be provided would be beneficial.

We have spoken to the land owner of Russell Island, and they are happy to proceed with an on-ground assessment. We will be doing an aerial survey of the sites tomorrow, and on-ground investigation of Russell Island will commence in early October.

Could you please respond by Monday 22nd September.

Regards,

Melissa Zulpo | Environmental Scientist

SMEC Australia Pty Ltd

Level 2, 60 Leichhardt Street, Spring Hill, QLD 4000

p +61 7 3230 3600 | f +61 7 3230 3650 |

e Melissa.Zulpo@smec.com.au | www.smec.com.au

SMEC SNOWY MOUNTAINS ENGINEERING CORPORATION

High Quality Consulting and Development Solutions

Disclaimer: The information contained in this e-mail and any attached files is confidential. It is intended solely for the addressee, and may not be used, reproduced, disclosed or distributed without SMEC's permission. The message and attachments should be scanned to detect and remove viruses. SMEC accepts no liability for loss or damage (whether caused by negligence or not) resulting from the use of any attached files. If you are not the addressee or you received this e-mail in error, please notify us immediately and promptly delete this e-mail from your system and server. You may not disclose or use the information in the email or the files.

APPENDIX 2: ASSESSMENT MATRICES

QUANTITATIVE

Property Description	Site Number	C1		C2		C3		C4		Total (sf)
		Reserve (A)	Habitat Area (B)	Habitat Area (B)	Distance to Tugun (C)	Edge (m): Core (ha)	Edge (m): Core (ha) (D)			
Lot 264 S 312597	1	10	5	5	2	0		17		
Lot 230 SL 12221	2	10	5	5	2	0		17		
Lot 3 RP 139023	3	10	10	10	2	0		22		
Lot 424 S 312233	4	10	10	10	2	0		22		
"X12" Multiple Parcels	5	1	10	10	2	10		23		
Lot 272 DP 755701	6	10	10	10	5	0		25		
Lot 21 DP 1058759	7	10	10	10	5	0		25		
Lot 4 DP 601993	8	10	5	5	5	10		30		
Lot 162 DP 755692	9	10	5	5	2	0		17		
Lot 104 DP 1023126	10	10	5	5	2	0		17		
Lot 27 DP 858323	11	10	5	5	2	1		18		
Lot 7 DP 573269	12	10	10	10	2	2		24		
Lot 449 DP 812102	13	10	10	10	2	0		22		
Lot 220 DP 755695	14	10	5	5	2	2		19		
Lot 189 DP 755695	15	10	5	5	2	5		22		
Lot 251 DP 755691	16	1	10	10	2	10		23		
Lot 4 DP 253906	17	10	5	5	2	0		17		
Lot 2 DP 604378	18	10	2	2	2	0		14		
Lot 195 DP 755624	19	10	10	10	2	0		22		
Lot 212 DP 851963	20	10	5	5	2	2		19		

A. RESERVE

- 10 0m, shared boundary
- 5 <100m to boundary
- 2 <1000m to boundary
- 1 >1000m

C. DISTANCE TO TUGUN

- 10 <10km
- 5 <30km
- 2 <100km

B. HABITAT AREA

- 1 >1Ha
- 2 >2Ha
- 5 >5Ha
- 10 9-13Ha
- 5 <23Ha
- 2 <50Ha
- 1 >50Ha

D. EDGE(m):CORE(Ha)

- perfect = 1*
- 10 <1.19
 - 5 <1.23
 - 2 <1.30
 - 1 <1.40

QUALITATIVE

Property Description	Site Number	FINAL SCORE	Habitat factors					Landscape factors					SCOR E		
			quality	connectivity	quantity	Planigale	Crinia	Litoria	SCOR E	planning limits	lot size	adjacent land uses		existing land uses	proximate spp records
Lot 264 S 312597	1	0	10	10	2	10	5	0	0.0						0.0
Lot 230 SL 12221	2	0	5	10	2	10	5	0	0.0						0.0
Lot 3 RP 139023	3	0	2	2	2	10	10	0	0.0						0.0
Lot 424 S 312233	4	0	10	10	2	10	10	0	0.0						0.0
"X12" Multiple Parcels	5	10	10	10	10	5	10	5	24.7	10	10	10	2	10	14.1
Lot 272 DP 755701	6	0	5	2	1	10	10	5	12.7	10	1	2	10		0.0
Lot 21 DP 1058759	7	0	10	10	1	10	10	0	0.0						0.0
Lot 4 DP 601993	8	0	10	10	5	10	10	0	0.0						0.0
Lot 162 DP 755692	9	0	5	5	5	10	10	5	17.7	2	0	10	10	10	0.0
Lot 104 DP 1023126	10	0	2	10	5	10	10	5	19.1	0	0	10	10	10	0.0
Lot 7 DP 573269	11	0	10	5	5	10	10	10	30.0	0	5	5	10	10	0.0
Lot 27 DP 858323	12	0	10	5	5	10	10	10	30.0	0	1	5	5	10	0.0
Lot 7 + Lot 27	12.1	0	10	5	10	10	10	10	35.0	0	5	5	5	10	0.0
Lot 449 DP 812102	13	0	10	10	10	10	10	5	28.3	0	0	5	5	10	0.0
Lot 220 DP 755695	14	5	10	10	5	10	5	2	11.1	10	10	10	2	10.0	10.0
Lot 189 DP 755695	15	5	10	10	5	10	5	2	11.1	10	10	10	2	10.0	10.0
Lot 251 DP 755691	16	0	10	10	10	10	5	0	0.0						0.0
Lot 4 DP 253906	17	0	1	5	1	1	1	0	0.0						0.0
Lot 2 DP 604378	18	15	10	10	10	10	10	10	40.0	10	5	5	10	10	15.8
Lot 195 DP 755624	19	11	10	10	10	5	10	10	35.0	5	5	5	10	10	7.9
Lot 212 DP 851963	20	8	5	10	10	5	5	5	15.0	10	5	5	5	10	15.8