21. Water quality

The proposed highway crosses a number of major creeks including:

- Corindi River.
- Halfway Creek.
- Wells Crossing Creek.
- Cassons Creek.
- Redbank Creek.

In addition to these crossings, the proposed highway crosses approximately 55 additional unnamed creek crossings.

The existing creeks have been assessed for water quality as described in Section 17.1 of this report. The proposed upgrade of the highway has the potential to impact upon the water quality of the existing creeks during construction and during operation. This section of the report sets out the potential impacts during both stages of the project and identifies the proposed methods of mitigation.

21.1 Potential impacts during construction

The most likely impact upon water quality will result from the following risk areas during construction:

- Chemical spills.
- Sedimentation, either through poorly designed sediment controls or through inadequate maintenance of sediment controls. Poor dust control can also lead to sediment being lost from site ending up in nearby creeks.
- Exposure of acid sulfate soils.
- The removal of riparian vegetation and associated habitats.
- Disturbance to the bed and bank of the waterway.

There are no known issues relating to dispersible soils within this project. For information relating to acid sulfate soils, refer to Section 12 – Earthworks.

Construction activities may also have the following potential long-term impacts:

- The creation of long-term barriers to fish movement.
- Bed and bank erosion that causes changes to the geomorphology of the creek over time.
- Continuing pollution from erosion and sedimentation, as sediment moves downstream.

21.2 Indicative mitigation measures during construction

The key mitigation measures to be adopted during the construction stages are as follows:

- A Soil and Water Management Plan to be prepared incorporating the design and installation of erosion controls in accordance with Managing Urban Stormwater, Soils and Construction Vol 1 (Department of Housing).
- As part of the Soil and Water Management Plan, a number of temporary sediment basins will be constructed to capture and retain any sediment before sediment can enter watercourses or leave

the site. A conceptual design of the temporary sediment basins has been undertaken using the procedures outlined in Managing Urban Stormwater, Soils and Construction Vol 1 (Department of Housing). Temporary sediment basins have been sized based upon the 75th percentile 5-day rainfall event (33.6 mm) using a volumetric runoff coefficient of 0.75. Those basins that are to be retained as permanent water quality treatment ponds have been designed to accommodate the 85th percentile five-day rainfall event (55.8 mm). The minimum depth of the basins will be 0.6 m, with an average depth of 1 m. The basins have been sized assuming an average cleared corridor width of 95 m. This is a conservative approach as it assumes that the area cleared is to the proposed property boundary, which in some locations is a significant distance to the edge of the works area. The proposed sediment basins are described in the following table:

Table 21-1 Preliminary sediment basin sizing

Basin No#	Chainage (m)	Side of Highway	Volume (m^3)	Comments
8	4240	East	1107	To be retained as a permanent pond
9	4820	East	737	Remove following construction
10	4860	East	491	Remove following construction
12	5540	East	670	To be retained as a permanent pond
17	7100	East	587	To be retained as a permanent pond
19	7650	East	378	Remove following construction
21	7710	East	1245	To be retained as a permanent pond
22	8140	East	454	Remove following construction
23	8220	East	904	To be retained as a permanent pond
25	8800	West	979	To be retained as a permanent pond
27	9180	East	504	Remove following construction
28	9430	East	819	Remove following construction
29	11,080	East	504	Remove following construction
30	11,400	East	564	Remove following construction
31	11,720	West (between roads)	665	Remove following construction
32	12,040	East	605	Remove following construction
33	12,400	East	706	Remove following construction
34	12500	West	529	Remove following construction
36	12,860	East	691	To be retained as a permanent pond

Basin No#	Chainage (m)	Side of Highway	Volume (m^3)	Comments
37	13,140	East	1674	To be retained as a permanent pond
38	13,520	East	363	Remove following construction
39	13,600	East	264	Remove following construction
40	13,840	East	319	Remove following construction
41	13,980	East	276	Remove following construction
42	14,360	West	700	Remove following construction
43	14,600	East	273	Remove following construction
44	14,820	West	259	Remove following construction
45	15,170	West	508	Remove following construction
46	15,380	East	427	Remove following construction
47	15,440	East	614	Remove following construction
48	15,900	East	859	Remove following construction
49	15,950	East	302	Remove following construction
50	16,110	East (between roads)	302	Remove following construction
51	16,150	East	603	Remove following construction
52	16,380	East	503	Remove following construction
53	19,560	West	942	Remove following construction
54	19,710	West	322	Remove following construction
55	20,840	East	388	Remove following construction
58	22,960	West	670	To be retained as a permanent pond
60	23,350	West	832	Remove following construction
61	24,110	West	662	Remove following construction
62	24,395	West	989	To be retained as a permanent pond
64	24,560	West	628	To be retained as a permanent pond
66	24,860	West	1004	To be retained as a permanent pond
67	25,200	West	643	Remove following construction
68	25,620	West	718	Remove following construction
69	25,920	West	567	Remove following construction

Basin No#	Chainage (m)	Side of Highway	Volume (m^3)	Comments
70	26,610	West	756	Remove following construction
71	26,740	West	756	Remove following construction

Note basins that are missing from this table are detailed in the permanent sediment control table.

Consideration of clearing areas has been taken into account in determining the size and location of sediment basins.

- Silt fences and diversion drains would be utilised in those areas of the project where the sediment basins are not appropriate ie in extremely flat areas.
- The Soil and Water Management Plan would prescribe a detailed inspection and maintenance program to ensure that the erosion controls are maintained and improved if required.
- Vehicles would have designated refuelling locations that will include bunding so that any spillage is contained and does not enter any waterway.
- The bridges have been designed so that piers are not located within creeks where possible. The contractor will be required to minimise the work adjacent to the creeks.
- Generally, where a woody snag is in the site of a proposed waterway crossing, lopping should be considered as the first priority for the management of the snag. Where lopping will not solve the problem, realignment should be considered as the next possible management option, followed by relocation. Removal of a snag is the least desirable alternative and should only be adopted as a last resort. NSW Fisheries is required to be notified of any such proposed works that involve the lopping, realignment, relocation or removal of snags.
- Where piling is required within a waterway, a silt barrier such as a boom, bund or curtain should be installed either downstream of the work site or around the piles themselves prior to the commencement of works.
- To minimise sedimentation, fill or excavated material will not be stockpiled in flood prone areas. Particular care should be taken in sitting stockpiles and dumps. Soil stockpile sites will be situated either above mean high water mark in tidal areas, or be secure from a one in 10 year flood level and have effective sediment control works to contain any runoff including cut-off drains, vegetation and silt fences.
- To facilitate any excavation work and to minimise the local impact of sediment immobilisation, the waterway flow may be temporarily diverted around the works, by either pumping or channelling the flow. If this is not an option then all works will be undertaken during periods of minimal flow. The timing of such works will minimise the interference with the possible migration of fish within the waterway.
- It is recommended that a sediment core be taken and analysed prior to excavation work within each waterway to determine concentration levels of potential acid sulphate soil.

Care should also be taken to minimise the potential impacts of construction to protect the hydrology and habitat values of any dry waterways within the preferred route corridor. Actions to achieve this include:

- The prevention of in stream barriers that impede future flows or obstruct fish passage in times of flow.
- The immediate notification of appropriate authorities should any pollution incident occur.

21.3 Potential impacts during operation

The potential impacts during the operation of the highway can be divided into two main areas as follows:

- Road runoff.
- Cross drainage and impacts upon surface water flows.

Storm water runoff coming off highways can be a mix of trash, oil, antifreeze, rubber, hydraulic fluid, exhaust particles, brake dust and microscopic bits of metal. It includes solvents, pesticides, fertilizers and human and animal waste. If left unchecked, this material will find its way into the adjacent waterways and may contaminate the environmentally sensitive areas that are down.

In addition poorly designed cross drainage may provide a barrier to fish movement and may lead to bed and bank erosion of creeks, that can change the geomorphology of the creek over time resulting in water quality deterioration.

21.4 Indicative mitigation measures during operation

Mitigation measures are required to address the two main impact areas. These mitigation measures are described in the following sections.

21.4.1 Road runoff

In discussions with representatives of the RTA and DECC, a general strategy was discussed and agreed for the treatment of road runoff. The strategy is based upon the following philosophy.

- The area that the road drains through is divided into areas that are:
  - Highly sensitive.
  - Medium sensitive.
  - Low sensitivity.

  These areas have been defined by ecological investigations. Highly sensitive sites are generally SEPP 14 Wetlands, National Parks, floodplains and areas of high biological diversity. Areas of low sensitivity are generally cleared areas of land used for farming or residential use.
- In highly sensitive areas, all water will be captured and directed to water quality basins (otherwise known as permanent sediment basins). These basins are designed to capture the 85th Percentile 5-day rainfall in accordance with the process defined in Chapter 6 of Managing Urban Stormwater, Soils and Construction, Vol 1, 2004. The design rainfall is 55.8 mm.
- These basins have also been sized to capture a chemical spillage volume of 30,000L.
- All runoff from bridges over creeks and floodplains will be captured using scupper drains and will be directed to water quality basins.
- In areas of low and medium sensitivity, basins will not be constructed however water will be directed through open drains beside the road which will be designed to allow spillage control prior to discharge to creeks. In most locations water will drain directly off the roads into these drains. The drains will be grass lined which provides significant filtration and water quality benefit and as a result road runoff is expected to be substantially polished prior to discharge to local creeks.

Table 21-2 contains a list of water quality basin locations and size. Where possible construction stage sediment basins are located and sized so that they can be retained as water quality basins during the operational phase of the project.

Table 21-2 Indicative water quality basin size and location

Basin No[#]	Chainage (m)	Side of Highway	Volume (m^3)	Comments
1	3380	East	147	
2	3380	West	147	
3	3640	East	221	
4	3640	West	221	
5	3860	East	193	
6	3860	West	193	
7	4300	West	203	
8	4240	East	1107	Sediment Basin to be converted to water quality pond
11	5520	West	64	
12	5540	East	670	Sediment Basin to be converted to water quality pond
13	5860	East	212	
14	5870	West	212	
15	6700	West	120	
16	6700	East	120	
17	7100	East	587	Sediment Basin to be converted to water quality pond
18	7100	West	184	
20	7700	West	184	
21	7710	East	1245	Sediment Basin to be converted to water quality pond
23	8220	East	904	Sediment Basin to be converted to water quality pond
24	8220	West	92	
25	8800	West	979	Sediment Basin to be converted to water

Basin No#	Chainage (m)	Side of Highway	Volume (m^3)	Comments
				quality pond
26	8820	East	110	
35	12,800	West	120	
36	12,860	East	691	Sediment Basin to be converted to water quality pond
37	13,140	East	1674	Sediment Basin to be converted to water quality pond
56	22,600	East	230	
57	22,630	West	230	
58	22,960	West	670	Sediment Basin to be converted to water quality pond
59	22,960	East	166	
62	24,395	West	989	Sediment Basin to be converted to water quality pond
63	24,340	East	285	
64	24,560	West	628	Sediment Basin to be converted to water quality pond
65	24,580	East	230	
66	24,860	West	1004	Sediment Basin to be converted to water quality pond

Missing basin numbers relate to construction stage sediment basins that are not required following construction.

21.4.2 Cross drainage and surface flow

Drainage parallel to the road

Swale drains have been designed to intercept clean water that is flowing towards the road and divert this water to cross drainage structures where it can be directed past the road, without mixing with road runoff. The drains are generally sized for the five-year average recurrence interval and are generally 1.5 m wide by 0.5 m deep. The drains are trapezoidal in shape and are lined with grass. In some areas where the grades are steeper, concrete lining or erosion protection using jute mesh or geomeshes may be required.

Cross drainage

The cross drainage structures are identified in Section 10.4 of this report.

Where possible bridge or culvert structures are designed to:

- Minimise changes to the channel's natural flow, width, roughness and base-flow water depth through the culvert's wet cells. Wet cells should have a minimum water depth of 0.2-0.5 m to encourage fish passage (Fairfull and Witheridge 2003).
- Facilitate flow equal to the natural or existing flow area of the channel below the deck/crest level of the structure (Fairfull and Witheridge 2003).
- The structure is designed to maximise the geometric similarities of the natural channel profile from the bed of the culvert up to a flow depth of 0.5 m (Fairfull and Witheridge 2003).
- Where bridges are provided, where possible the piers are located on the flatter section of the floodplain outside any permanent water bodies.
- Where appropriate, pools will be constructed at both the inlet and outlet of the structure to assist in the dissipation of flow energy and to act as resting areas for migrating fish (Fairfull and Witheridge 2003). In some cases due to levels and flow geometry this is not possible.
- To avoid the formation of a perched structure and damage to the stream's bed and banks, erosion at the outlet will be controlled with the use of rock protection. Where velocities exceed 4m/s, stabilised energy dissipation pools will be formed (Fairfull and Witheridge 2003).
- Maximise light penetration as far as possible within the wet cells by maximising the height or diameter of the structure, and possibly by introducing a skylight (Fairfull and Witheridge 2003). In addition culvert lengths have been minimised where possible by minor redirection of the creek so that the culvert is at a more perpendicular angle to the road.
- Minimise the loss of riparian vegetation, and associated habitat for fauna particularly aquatic species.