Australian Government

NSW GOVERNMENT

Coffs Harbour Bypass

Submissions Report
Volume 3. Appendices A-E

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Appendix A

Submission ID table

Appendix A - Submission ID table

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
1		Coffs Harbour City Council	3.1
2		Coffs Harbour City Council	3.1
3		Crown Lands, Department of Planning, Industry and Environment	3.2
4		Regions, Industry, Agriculture and Resources Group, Department of Planning, Industry and Environment	3.2
5		Environment, Energy and Science Group, Department of Planning, Industry and Environment	3.4
6		NSW Environment Protection Authority	3.6
7		Heritage NSW, Department of Premier and Cabinet	3.5
8		Fire and Rescue NSW	3.7
9	Withheld	Community	4.5.5, 4.8.14, 4.8.23, 4.11.6
10	Withheld	Community	4.5.5, 4.8.14, 4.8.23, 4.11.6
11	Leonie Smith	Kororo Public School	4.7.11

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
12	Craig Murray	Coffs Bypass Action Group	4.3.4, 4.4.4, 4.4.5, 4.4.6, 4.5.2, 4.6.2, 4.6.3, 4.7.4, 4.7.5, 4.7.9, 4.8.2, 4.8.3, 4.8.4, 4.8.5, 4.8.6, 4.8.7, 4.8.8, 4.8.9, 4.8.10, 4.8.13, 4.8.14, 4.8.15, 4.8.19, 4.8.23, 4.8.26, 4.9.1, 4.9.2, 4.9.3, 4.9.4, 4.9.5, 4.9.6, 4.9.7, 4.9.9, 4.9.10, 4.9.11, 4.9.12, 4.9.13, 4.10.1, 4.10.2, 4.10.3, 4.10.4, 4.10.6, 4.13.2, 4.14.1, 4.14.2, 4.15.1, 4.15.2, 4.15.3, 4.16.1, 4.17.4
13	Wally Gately	Coffs Harbour and District Banana Growers Association	4.1.2, 4.12.2
14	Paul Sparke	North Korora Estate Residents	4.6.2, 4.13.2
15	Martin Wells	Coffs Harbour Chamber of Commerce and Industry	4.1.2, 4.19.2, 4.19.3
16	Geoff Slattery	Fapura Pty Ltd	4.8.17, 4.11.5
17	Jonathan Cassell	Coffs Harbour Greens	4.1.2, 4.5.2, 4.8.4, 4.8.13, 4.9.10
18	John Griffiths	Gas Energy Australia	4.19.1, 4.19.2, 4.19.4
19	Deborah Dootson	Garby Elders Aboriginal Corporation	4.1.2, 4.14.1, 4.14.2, 4.14.3
20	Brett Tibbett	Muurrbay Bundani Aboriginal Corporation	4.1.2, 4.14.1, 4.14.2, 4.14.3
21	Nick Zovko	Chemistry Australia	4.19.2
22	Geoff Slattery	Pacific Bay Resort Pty Ltd	4.4.6
23	Anthony Perkins	Jagun Aged and Community Care	4.1.2, 4.14.1, 4.14.2, 4.14.3

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
24	Nathan Brennan	Coffs Harbour and District Local Aboriginal Land Council	4.1.2, 4.14.1, 4.14.2, 4.14.3
25	Ben Mackay	Community	4.8.2, 4.8.6, 4.8.10, 4.11.1, 4.11.5, 4.11.6, 4.12.1, 4.13.5, 4.17.3
26	Withheld	Korora School Road Strata	4.7.6, 4.8.6, 4.8.7, 4.8.8, 4.8.11, 4.8.22
27	Mike and Gay Colreavy	Community	4.1.1, 4.5.2, 4.6.3, 4.6.6, 4.8.4, 4.8.5, 4.8.6, 4.8.13, 4.10.3, 4.19.2, 4.19.4, 4.19.6
28	Guy Perotti	Opal Cove Resort	4.10.5, 4.11.4, 4.11.6, 4.13.4, 4.15.2
29	David Spears	Dorrigo Urunga Bellingen Bicycle Users Group	4.7.9
30	Ray Smith	The Bayrange Group	4.1.2, 4.5.1
31	Stephen Dare	Boambee Palms Holiday and Accommodation Park	4.7.7, 4.8.24
32	Withheld	Community	4.1.1, 4.3.3, 4.4.3
33	Jackson Hurst	Community	4.1.2, 4.13.3
34	Withheld	Community	4.1.2, 4.8.13
35	Withheld	Community	4.7.9
36	Bruce Robertson	Community	4.1.1, 4.8.24
37	Graham Stubington	Community	4.1.1, 4.4.5, 4.5.2, 4.8.23, 4.8.25
38	Angela Furlan	Community	4.1.2, 4.5.2
39	Georgina Furlan	Community	4.1.2, 4.5.2

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
40	Roger Rudland-Wood	Community	4.19.5
41	Withheld	Community	4.1.2, 4.8.24, 4.9.6
42	Paul Murtha	Community	4.7.3, 4.11.4
43	Strider Duerinckx	Community	4.1.2
44	Peter Ramstadius	Community	4.1.1, 4.2.2, 4.4.1, 4.8.21, 4.19.4, 4.19.5
45	Colin Spring	Community	4.8.24
46	Withheld	Community	4.5.2
47	Eric Welsh	Community	4.1.1, 4.5.3
48	Leigh Harvey	Community	4.9.6, 4.9.8
49	Desmond John and Gloria Helen Eeley	Community	4.8.13, 4.8.14, 4.9.4, 4.11.6, 4.17.4
50	Len Dunne	Community	4.2.2, 4.3.2, 4.3.6, 4.7.1, 4.8.22
51	Nick Wright	Community	4.3.1, 4.3.4, 4.3.5, 4.4.3, 4.7.6, 4.7.9, 4.8.24, 4.19.2
52	Withheld	Community	4.1.1, 4.7.9
53	Withheld	Community	4.4.6, 4.7.9, 4.10.5
54	Anne and Adrian Rhodes	Community	4.3.1, 4.8.13, 4.8.15, 4.9.4, 4.11.4, 4.11.6, 4.13.3
55	Withheld	Community	4.7.3
56	Jenifer Moor	Community	4.1.2, 4.5.2

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
57	Withheld	Community	4.7.1, 4.8.13, 4.17.1
58	Brian Betts	Community	4.1.1, 4.3.5, 4.5.2
59	Withheld	Community	4.8.24
60	Jennifer Jenkins	Community	4.7.4
61	Withheld	Community	4.1.2, 4.3.1, 4.4.6, 4.5.2, 4.8.24
62	Jill Woodlock	Community	4.4.5, 4.5.2, 4.8.2, 4.8.14
63	James Woodlock	Community	4.4.5, 4.5.2, 4.8.2, 4.8.13
64	Kevin R Oxenbridge	Community	4.3.5, 4.6.1, 4.8.7, 4.9.6, 4.11.6, 4.15.3, 4.17.5
65	Dorothy Budd	Community	4.1.1, 4.3.1, 4.7.13, 4.8.24, 4.10.3, 4.10.4, 4.11.3, 4.13.3, 4.17.5
66	Withheld	Community	4.5.5, 4.7.6, 4.7.9, 4.8.24, 4.10.3
67	Withheld	Community	4.4.4, 4.4.5, 4.4.6,4.7.4, 4.8.10, 4.8.18, 4.9.4, 4.9.5, 4.11.4, 4.13.3
68	Geoffrey Maunder	Community	4.8.8
69	Peter Renshaw	Community	4.1.1, 4.3.1, 4.4.1, 4.5.4, 4.7.1
70	Wayne Evans	Community	4.17.2, 4.17.4, 4.18.1
71	Withheld	Community	4.7.4, 4.8.15, 4.11.4
72	Ryan Woodlock	Community	4.1.1, 4.4.5, 4.5.2, 4.8.2
73	Carol Betland	Community	4.1.1, 4.5.5, 4.7.13, 4.8.13, 4.10.4, 4.11.2, 4.11.3, 4.17.3

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
74	Victoria Pulman	Community	4.8.2, 4.8.4, 4.13.2
75	Ronald Woodhill	Community	4.1.2, 4.6.2, 4.6.3, 4.7.4, 4.8.5, 4.8.13, 4.13.3, 4.13.4
76	Withheld	Community	4.3.6, 4.4.6, 4.5.2, 4.6.1, 4.19.3
77	Lorraine Penn	Community	4.5.2, 4.10.3, 4.19.2, 4.19.6
78	Jan McDonald	Community	4.1.2, 4.4.5, 4.5.2, 4.6.6, 4.8.2
79	Alan Millward	Community	4.1.1, 4.4.6
80	Withheld	Community	4.1.2, 4.5.2, 4.6.2, 4.8.2, 4.8.10, 4.8.13, 4.19.2, 4.19.6
81	Withheld	Community	4.1.1, 4.5.2, 4.6.3, 4.8.2, 4.19.2, 4.19.6
82	Helen Maclean	Community	4.4.5, 4.6.2, 4.7.8, 4.8.2, 4.8.5, 4.8.23, 4.11.6, 4.13.3, 4.17.1
83	Janet McDonald	Community	4.1.2, 4.4.5, 4.5.2, 4.6.6, 4.8.2, 4.8.5
84	Cheryl Cooper	Community	4.4.4, 4.4.5, 4.4.6, 4.5.2, 4.6.6, 4.7.4, 4.8.2, 4.8.5, 4.19.2
85	Withheld	Community	4.1.1, 4.5.2, 4.8.24
86	April Randall	Community	4.8.14, 4.10.4, 4.11.4, 4.13.1, 4.13.3
87	Keith Bensley	Community	4.1.1, 4.5.2
88	Ian Foskett	Community	4.6.3, 4.8.4, 4.8.6, 4.8.13, 4.10.3, 4.19.2
89	Withheld	Community	4.8.24

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
90	Peter Walsh	Community	4.1.1, 4.5.1, 4.8.6, 4.8.24, 4.10.3
91	Withheld	Community	4.1.2, 4.6.6, 4.7.12, 4.8.6, 4.19.4
92	Withheld	Community	4.1.1, 4.7.6, 4.10.4, 4.11.4, 4.11.6
93	William Johnston	Community	4.7.8, 4.8.24
94	Cindy Hoskins	Community	4.1.2, 4.14.1, 4.14.2
95	Garrie Cooper	Community	4.5.2, 4.6.3, 4.7.4, 4.8.15, 4.19.2
96	Withheld	Community	4.7.2, 4.7.4, 4.7.8
97	Amanda Baston	Community	4.6.6, 4.7.1, 4.7.7, 4.8.24, 4.11.1, 4.11.2, 4.11.6
98	Paul Simpson	Community	4.8.24
99	Leigh Budd	Community	4.5.5, 4.7.12, 4.7.13, 4.8.14, 4.8.20, 4.8.23, 4.8.24, 4.10.3, 4.10.4, 4.11.1, 4.11.3, 4.17.5
100	Ian Scott	Community	4.1.2, 4.4.4, 4.4.5, 4.4.6, 4.5.2, 4.8.2, 4.8.3, 4.19.2
101	Liam O'Connor	Community	4.7.3, 4.8.24, 4.10.4
102	Withheld	Community	4.4.1, 4.8.13, 4.8.24
103	Maxwell Brinsmead	Community	4.1.2, 4.3.1, 4.4.5, 4.4.6, 4.5.2, 4.6.3, 4.7.9, 4.8.2, 4.8.3, 4.8.6, 4.8.7, 4.8.8, 4.8.11, 4.8.18, 4.8.22, 4.8.23, 4.11.1, 4.11.2, 4.13.3, 4.19.2, 4.19.5
104	Patricia Caves	Community	4.5.2, 4.8.21, 4.8.24, 4.19.2

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
105	Terry Price	Community	4.5.1, 4.7.3, 4.8.14, 4.8.16, 4.8.24, 4.9.10, 4.10.4, 4.11.5, 4.11.6, 4.15.3, 4.16.2, 4.17.3
106	James Woodlock	Community	4.5.2, 4.4.5, 4.8.2, 4.8.5, 4.19.2
107	Klara Steibert	Community	4.11.6, 4.13.2
108	Withheld	Community	4.11.1
109	Sarah Lamond	Community	4.8.7, 4.8.13, 4.8.17, 4.8.24, 4.10.4, 4.11.4
110	Graham Macumber	Community	4.6.1, 4.6.6, 4.8.1, 4.8.6, 4.8.15, 4.8.17, 4.13.2
111	John Courcier	Community	4.3.1, 4.8.10, 4.19.2
112	Peter Wood	Community	4.5.1, 4.8.11, 4.10.3, 4.8.17, 4.8.24
113	Withheld	Community	4.7.9
114	Withheld	Community	4.5.1, 4.8.17, 4.8.24
115	Marina Rockett	Community	4.4.5, 4.4.6, 4.5.2, 4.6.5, 4.7.4, 4.8.1, 4.8.2, 4.8.3, 4.8.5, 4.8.10, 4.8.14, 4.8.16, 4.8.19, 4.19.2
116	Craig McMahon	Community	4.6.4, 4.8.7, 4.8.14, 4.8.17, 4.8.24, 4.11.4, 4.13.2
117	Bruce Connell	Community	4.1.2, 4.4.5, 4.5.2, 4.8.2, 4.8.5, 4.8.7, 4.19.2
118	Michael Adendorff	Community	4.8.24
119	Patricia McKelvey	Community	4.8.2, 4.8.4, 4.8.6, 4.8.13, 4.19.2, 4.19.4, 4.19.6
120	Withheld	Community	4.7.6, 4.10.4, 4.11.4

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
121	Annette Perry	Community	4.1.2, 4.4.5, 4.5.2, 4.8.2, 4.8.5, 4.8.7, 4.19.2
122	Micki Rathgen	Community	4.6.3, 4.8.4, 4.8.5, 4.8.6, 4.8.7, 4.8.13, 4.10.3, 4.19.2, 4.19.6
123	Dr and Mrs Larence T Scott	Community	4.4.5, 4.5.2, 4.6.2, 4.8.2, 4.8.5, 4.8.7, 4.13.4, 4.19.2, 4.19.6
124	Kayri Shanahan	Community	4.1.2, 4.6.3, 4.8.2, 4.8.4, 4.8.6, 4.8.7, 4.8.13, 4.10.3, 4.19.2, 4.19.6
125	Lauro Spagnolo	Community	4.4.5, 4.7.4, 4.13.3
126	Leanne Spagnolo	Community	4.4.5, 4.7.4
127	Bernie Stibbard	Community	4.5.2, 4.6.3, 4.8.2, 4.8.4, 4.8.6, 4.8.13, 4.10.3, 4.19.2, 4.19.6
128	Heather Taylor	Community	4.6.3, 4.8.4, 4.8.13, 4.8.15, 4.8.17, 4.17.3
129	Faye Wiffen	Community	4.1.2, 4.5.2, 4.6.6, 4.8.23, 4.19.2
130	Brian Clarke	Community	4.1.1, 4.8.3, 4.8.8, 4.8.12
131	Lorraine Osborn	Community	4.1.1, 4.5.2, 4.19.1
132	Withheld	Community	4.1.1, 4.5.3
133	Chris Fox	Community	4.1.1, 4.4.5, 4.5.2, 4.8.2, 4.8.5, 4.8.13
134	Lesley Davison	Community	4.8.24
135	Withheld	Community	4.3.2, 4.3.1, 4.3.5, 4.3.6, 4.5.1, 4.5.2, 4.5.3, 4.6.1, 4.6.5, 4.7.6, 4.7.9, 4.8.1, 4.8.4, 4.8.5, 4.8.10, 4.8.11, 4.8.14, 4.8.16, 4.8.19, 4.9.5,

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
			4.9.7, 4.9.10, 4.11.4, 4.11.6, 4.13.1, 4.13.3, 4.14.1, 4.17.2
136	Cathie Mackay	Community	4.5.5, 4.6.5, 4.7.1, 4.8.10, 4.8.14, 4.8.20, 4.11.4, 4.13.2, 4.13.3
137	Patricia McKelvey	Community	4.1.2, 4.5.2
138	Withheld	Community	4.5.2, 4.8.15
139	Marnie Cotton	Community	4.5.2, 4.6.3, 4.8.2, 4.8.4, 4.8.6, 4.8.7, 4.8.13, 4.10.3, 4.19.2, 4.19.6
140	Cino Mattekkatt	Community	4.8.2, 4.8.4, 4.8.5, 4.8.13
141	Barry Collins	Community	4.2.2, 4.4.2, 4.4.4, 4.4.6, 4.5.2, 4.6.1, 4.6.2, 4.6.5, 4.6.6, 4.8.2, 4.8.4, 4.8.14, 4.8.17, 4.8.21, 4.8.22, 4.17.4, 4.19.2, 4.19.3, 4.19.6
142	Alpheus Williams	Community	4.9.10, 4.18.1, 4.19.1
143	John Dowsett	Community	4.4.2, 4.5.2, 4.6.1, 4.19.2
144	Brian Polack	Community	4.8.2, 4.8.6, 4.8.7
145	Trevor Harragon	Community	4.5.2
146	Jenny Beatson	Community	4.1.2, 4.4.5, 4.5.2, 4.8.2, 4.8.5, 4.8.6, 4.8.14, 4.8.15, 4.10.3, 4.19.2
147	Withheld	Community	4.3.2, 4.3.4, 4.3.6, 4.5.2, 4.6.3, 4.7.3, 4.8.14, 4.8.16, 4.11.4, 4.13.2
148	Karin Sonntag	Community	4.8.24

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
149	Peter Saxby	Community	4.7.3
150	Scott Gowers	Community	4.1.1, 4.5.1, 4.8.17, 4.8.24
151	John Outram	Community	4.2.2, 4.3.4, 4.6.3, 4.7.4, 4.8.4, 4.8.6, 4.8.7, 4.8.13, 4.10.3, 4.17.2, 4.19.2, 4.19.6
152	Withheld	Community	4.1.1, 4.3.3
153	Withheld	Community	4.1.1, 4.7.1, 4.7.11, 4.7.12
154	Withheld	Community	4.8.24
155	Withheld	Community	4.7.9, 4.8.7
156	Brad Alfred	Community	4.5.2, 4.6.5, 4.8.6, 4.10.3
157	Ian Hamey	Community	4.5.3
158	Withheld	Community	4.1.2, 4.7.7, 4.13.2
159	Michael Alexander	Community	4.1.1, 4.3.1, 4.4.2, 4.5.5, 4.7.3, 4.8.6, 4.8.8, 4.8.10, 4.8.14, 4.8.15, 4.8.16, 4.8.25, 4.13.2, 4.13.3
160	Michael McFarlane	Community	4.1.1, 4.5.5, 4.7.2, 4.7.12, 4.8.24, 4.11.4, 4.11.6
161	Ennio Bardella	Community	4.2.1, 4.3.1, 4.3.4, 4.3.6, 4.5.1, 4.5.2, 4.6.4, 4.7.8, 4.7.9, 4.9.4, 4.9.5, 4.9.11, 4.10.4, 4.11.4, 4.11.5, 4.13.2, 4.13.3, 4.13.4, 4.16.3, 4.17.1, 4.17.3
162	Elizabeth Dray	Community	4.4.5, 4.5.2, 4.6.2, 4.8.2, 4.8.5, 4.8.15, 4.19.2
163	Withheld	Community	4.3.6, 4.4.5, 4.4.6, 4.7.3

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
164	Andrew Brown	Community	4.1.2, 4.5.2, 4.6.3, 4.8.2, 4.8.4, 4.8.6, 4.8.7, 4.8.13, 4.10.3, 4.19.2
165	Withheld	Community	4.1.2, 4.3.1, 4.5.2, 4.8.14, 4.10.3, 4.13.2, 4.19.6
166	Withheld	Community	4.4.5, 4.8.22
167	Kristine Hely	Community	4.4.5, 4.6.6, 4.7.9, 4.9.1, 4.9.2, 4.9.3, 4.9.4, 4.9.5, 4.9.6, 4.9.7, 4.9.9, 4.9.10, 4.9.11, 4.9.12, 4.9.13, 4.10.1, 4.10.3, 4.16.1
168	Ann Leonard	Community	4.3.1, 4.3.6, 4.7.3, 4.10.4, 4.11.1, 4.11.4, 4.13.2, 4.13.4,
169	Sue Strodl	Community	4.3.1, 4.3.4, 4.3.6, 4.5.1, 4.5.2, 4.7.8, 4.7.9, 4.9.4, 4.9.5, 4.9.11, 4.10.4, 4.11.4, 4.11.5, 4.13.2, 4.13.3, 4.13.4, 4.16.3, 4.17.1, 4.17.3
170	Steven Dalton	Community	4.7.4, 4.8.2, 4.8.5, 4.8.13
171	David Bourke	Community	4.6.6, 4.7.10, 4.8.24, 4.10.4, 4.11.2, 4.11.6, 4.13.2
172	Gary Gardiner	Community	4.2.2, 4.3.1, 4.3.2, 4.3.6, 4.5.3, 4.7.1, 4.13.4
173	Withheld	Community	4.7.11 4.8.14, 4.8.15, 4.11.3, 4.11.4, 4.11.6, 4.13.2, 4.15.2, 4.17.1, 4.17.2
174	Kevin Montgomery	Community	4.3.2, 4.6.5, 4.8.24, 4.11.5, 4.13.2
175	M Hannaford	Community	4.1.1, 4.5.2
176	Withheld	Community	4.5.1, 4.11.2
177	Withheld	Community	4.5.1

Submission ID	Name	Organisation/stakeholder	Section where issues are addressed
178	Lara Townsend	Community	4.8.13
179	Withheld	Community	4.5.5, 4.7.2, 4.8.7, 4.8.13, 4.8.14, 4.8.23, 4.8.24, 4.11.4
180	Desnee McCosker	Community	4.2.1, 4.2.2, 4.3.1, 4.7.4, 4.9.4, 4.11.4, 4.13.2, 4.13.4, 4.15.2, 4.17.2
181	Grant Cairncross	Community	4.6.3, 4.8.4, 4.8.6, 4.8.7, 4.8.13, 4.10.3, 4.19.2, 4.19.6
182	Nicholas Ellem	Community	4.4.5, 4.5.2, 4.6.2, 4.8.2, 4.8.5, 4.8.6, 4.19.2, 4.19.6
183	Lynda Soderlund	Community	4.8.24, 4.11.4, 4.13.2
184*	Withheld	Community	4.1.2
185		School Infrastructure NSW	3.9
186		Water Group, Department of Planning, Industry and Environment	3.8

* The majority of submission ID 184 was redacted and as such could not be fully considered in this report.

Appendix B

Updated erosion and sediment management report

SEEC

Erosion and Sediment Management Report

Coffs Harbour Bypass

Prepared for:

Transport for NSW

Prepared by:

Alyssa Thomson and Andrew Macleod

25 May 2020

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.

Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this report does not contain any incomplete or misleading information.

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25 May 2020

Version Register

Version	Date	Author	Reviewer	Notes	Other
Draft A	28/09/2018	AM/AT	MP	Issued for review	
Draft B	1/05/2019	AT	AM	RMS comments addressed	
Draft C	24/02/2020	AT	AM	Updated to reflect 80% design	
Draft D	17/04/2020	AM	TfNSW	Updated to address TfNSW comments	
Rev 00	25/05/2020	AM	TfNSW	Issued as Rev00	

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1 INTRODUCTION

1.1 Proposal Identification

Transport for NSW (TfNSW) propose to construct a bypass of the Pacific Highway around Coffs Harbour (the proposal). The proposal includes a bypass of around 14 kilometres skirting west of Coffs Harbour from south of Englands Road in the south and connecting with the Pacific Highway at Sapphire in the north. The bypass seeks to improve connectivity, road transport efficiency and safety for local and interstate motorists.

This report supports the environmental assessment and concept design for the proposal.

1.2 Proposal Location and Key Features

The proposal involves constructing around 14 kilometres of new dual-carriageway, divided highway to provide a bypass around Coffs Harbour, shown in Figure 1. It includes three major interchanges at Englands Road, Coramba Road and Korora Hill, numerous watercourse crossings, a number of bridges, and three tunnels.

The Pacific Highway is the primary link between Sydney and Brisbane and, presently, all traffic must pass through the urban area of Coffs Harbour.

The proposal lies on complex terrain, including flood-prone lands and very steep hills. Such terrain can limit the potential for installing the erosion and sediment control structures that are typically used for major highway construction.

1.3 Purpose of This Report

A Preliminary Erosion and Sedimentation Assessment for the proposal identified that it is inherently high risk due to:

- High rainfall;
- Project complexity and traffic staging;
- Complex topography, including areas that are flood-prone and also very steep hills;
- Soil-related constraints such as acidic soils, highly erodible soils and acid sulfate soils;
- The need for extensive cut and fill;
- A sensitive receiving environment; and
- Site constraints that limit the amount of available land during construction.

SEEC were engaged by TfNSW to prepare this Erosion and Sedimentation Management Report (ESMR) in accordance with TfNSW QA Specification PS 311, Clause 2.3.2.

The purpose of this report is to:

- Identify proposed measures for major erosion and sediment control devices such as up-gradient stormwater diversions, cross-drainage and sediment basins.
- Assess constraints to the installation and operation of major erosion and sediment controls during construction in accordance with Volumes 1 and 2D of the NSW Blue Book (Landcom, 2004 and DECC, 2008).
- Propose methods to eliminate, substitute or manage potential erosion and sediment control hazards during construction.

1.4 Structure of This Report

This report includes the following sections:

- Section 2 provides background regarding document preparation against TfNSW procedural guidelines;
- Section 3 provides an assessment of the potential constraints and opportunities that might impact on construction-phase erosion and sediment control;
- Section 4 identifies design considerations for erosion and sediment control measures;
- Section 5 summarises a series of recommendations to manage or mitigate potential impacts relating to construction-phase erosion and sediment control.

Section 5 is accompanied by a series of Concept Erosion and Sediment Control Plans (ESCPs) which are included as Appendix 2. These ESCPs show conceptually the setup of key erosion and sediment control measures such as sediment basins.

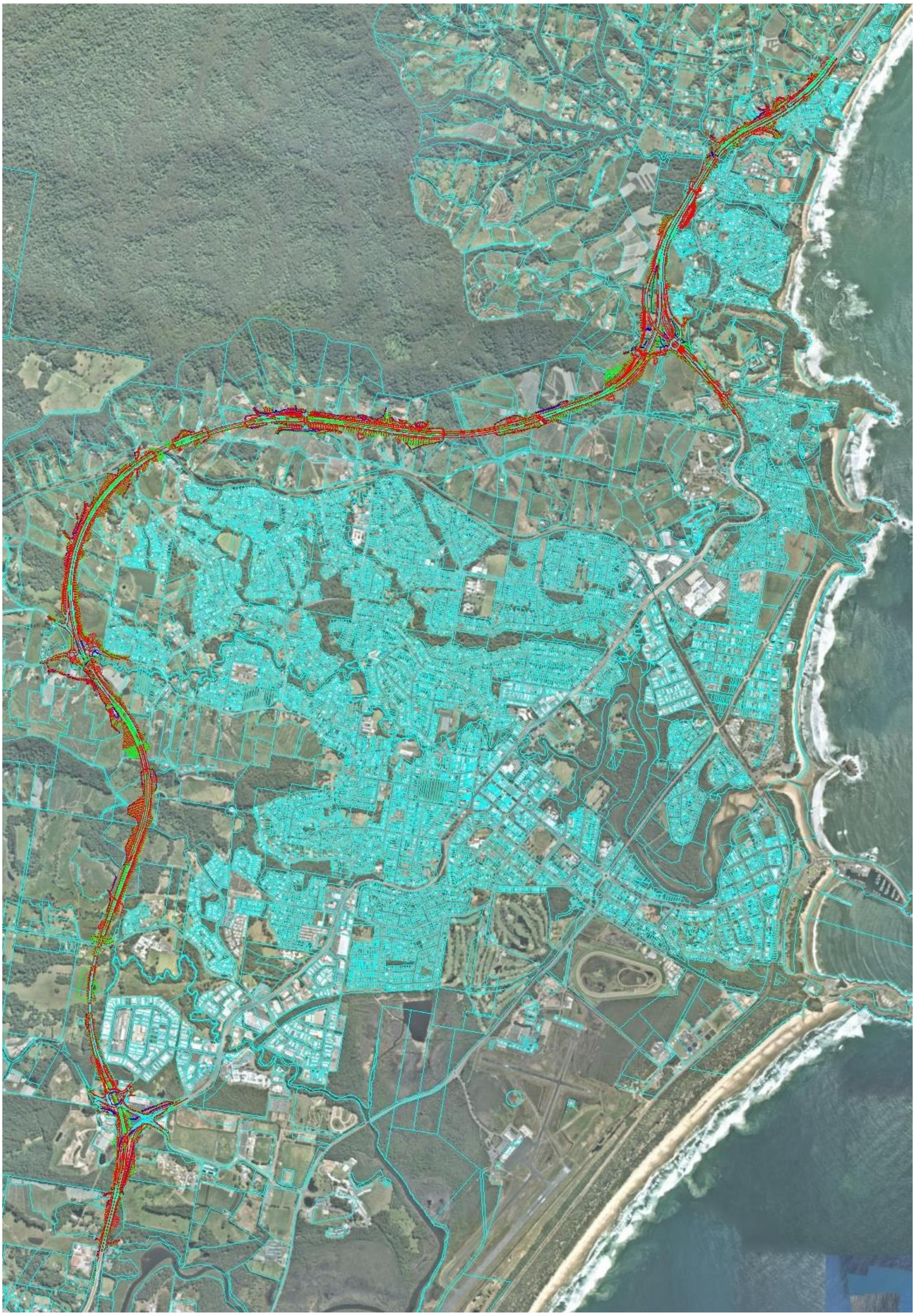


Figure 1 – Proposal area with 80% concept design model and cadastral boundaries.

2 DOCUMENTATION, REVIEW AND LIAISON

2.1 Design Documentation

A series of Concept ESCPs prepared by SEEC accompany this ESMR and are included in Appendix 2. They show the setup of key erosion and sediment control measures such as sediment basins, and have been developed iteratively as the road design was progressed.

2.2 Review of Existing Design

As part of preparing this ESMR, SEEC conducted a review of:

- The 80% concept design prepared by ARUP (2020), to determine if any inherent design issues might impact on constructability and effective implementation of erosion and sediment controls;
- Likely broad-scale traffic and construction staging, to determine how these aspects might influence the constructability of structures such as sediment basins, and the management of clean offsite water and dirty onsite water at each stage;
- The land available during construction to determine if space constraints are likely to impact on the effective implementation and establishment of erosion and sediment controls; and
- The site topography and setting, to determine if these aspects will restrict the effective implementation of erosion and sediment controls.

Constraints identified in this process have been taken into account in preparing the Concept ESCPs (Appendix 2) and comments regarding this are included in Section 5 of this ESMR.

2.3 Site Inspection

A site inspection was conducted by Alyssa Thomson from SEEC in August 2018 to identify and confirm soil and topographical conditions and how they might influence erosion and sediment control during construction.

2.4 Environmental Design and Compliance Checklist

Table 1 details the requirements for this ESMR as described in Section 2.3.2 of TfNSW PS311 Specification (Environmental Design and Compliance) and where each is addressed.

Table 1 – TfNSW Specification PS311 Compliance Checklist

Item reference	ESMR requirement	Location where this is addressed in this ESMR
2.3.2 (i)	Identify road corridor and surrounding catchments.	Section 3.5 and ESCPs (Appendix 2)
2.3.2 (ii)	Identify road construction boundary catchments and their associated erosion hazard.	ESCPs (Appendix 2)
2.3.2 (iii)	Identification of site constraints that limit the implementation of appropriate erosion and sediment control measures.	Section 3, Section 5.1 and ESCPs (Appendix 2)
2.3.2 (iv)	Identification of any sensitive receiving environments that will receive stormwater discharge from the construction project, including but not limited to: (a) lands protected under environmental planning instruments such as the Coastal Management SEPP; and (b) land reserved or protected under national parks legislation such as Marine Parks, National Park estates or State Forests.	Section 3.5 and 3.8
2.3.2 (v)	Major erosion and sediment control measures, including but not limited to: (a) Up-gradient stormwater diversion to ensure clean water does not enter the construction site; (b) Temporary cross drainage to transfer clean water through and/or around the site through all construction phases; (c) Sedimentation basins, as required, designed in accordance with the sizing criteria in Blue Book Vol 2D.	Section 3.12, Section 4, Section 5, Appendix 1, ESCPs (Appendix 2).
2.3.2 (vi)	Water flow paths and direction for the construction area and adjacent property i.e. off site and on site water flow	ESCPs (Appendix 2)
2.3.2 (vii)	Calculation of work area and soil loss for each road catchment (Refer Department of Housing's Publication Managing Urban Stormwater - Soils and Construction).	ESCPs (Appendix 2) and Section 3.12
2.3.2 (viii)	Basin calculation for each road catchment that exceeds the soil loss equation in accordance with the Department of Housing's Publication Managing Urban Stormwater - Soils and Construction	Appendix 1 and ESCPs (Appendix 2)
2.3.2 (ix)	Construction basin location and measures to direct on site runoff into the basin	ESCPs (Appendix 2)
2.3.2 (x)	A risk assessment of the effective installation, operation or maintenance of major controls, including but not limited to: (a) Timing of installation of the major controls, with reference to the construction staging of the project, including traffic and earthworks staging;	Section 5 and ESCPs (Appendix 2)

	(b) Availability of land to install major controls, with reference to any property acquisition requirements or environmental restrictions on environmentally sensitive area.	
2.3.2 (xi)	Measures to mitigate or eliminate identified risks, through design changes, construction methodology and additional land acquisition and/or leasing. Where risks cannot be eliminated, mitigation measures for managing the specific sub-catchment must be designed and documented in a summary table.	Section 5, specifically Table 6.

3 ASSESSMENT OF CONSTRAINTS AND OPPORTUNITIES

3.1 Climate

Bureau of Meteorology (BoM) rainfall statistics for Coffs Harbour are contained in Table 2. Note that BoM station 059040 closed in 2015, but has over 70 years of data available. The current BoM station (059151) has insufficient data for the generation of long-term averages.

Local knowledge suggests that rainfall on the immediate hinterland ranges around Coffs Harbour urban area can be higher than on the coastal fringe, although rainfall data is not available for a location on the ranges in the immediate vicinity of the proposal. As such, data for BoM station 059040 are reported here, but the risk of higher rainfall is taken into account in assessing the relative risk of erosion for the proposal.

Table 2 – Monthly rainfall for Coffs Harbour (BoM station 059040).

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann-ual
Rainfall (mm)	187.5	224.8	234.6	178.4	160.8	120.8	72.5	79.5	59.9	96.3	144.7	144.9	1699
Mean no of days with rain >1mm	9.4	9.7	10.8	8.5	7.7	6.3	4.5	4.5	4.5	6.7	8.2	8.4	89.2

The Bureau of Meteorology reports the 2-year, 6-hour rainfall event as 16.6mm/hr for the hinterland area that the proposal traverses. This translates to a Revised Universal Soil Loss Equation (RUSLE) R-Factor of 6390 which is very high.

The risk of high rainfall is considered to be a significant constraint for construction-phase erosion and sediment control on this proposal.

3.2 Topography

Site topography is highly variable and complex. In the southern third of the proposal, slopes are mostly very gentle (less than 5%) and include some low-lying, flood-prone lands. In the central and northern thirds of the proposal slopes are steeper, typically around 10 to 30% but with some small areas of very steep (around 65%) terrain. Steep slopes increase the risk of erosion on disturbed ground.

Topography is considered to be a significant constraint for this proposal and will impact the feasibility for constructing structures such as sediment basins.

The recommendations in Section 5 include proposed management and mitigation measures for topography-related constraints. Also refer to the accompanying ESCP (Appendix 2).

3.3 Soils - General

Soil Landscape Mapping for the Coffs Harbour 1:100,000 mapsheet shows the proposal lies on several different soil types (Milford, 1999). Figure 2 shows the soil landscapes (sourced from NSW Office of Environment and Heritage eSpade portal) with the route of the proposal. A site inspection (including soil observations) by SEEC staff confirmed the accuracy of the soil landscape mapping.

Table 3 contains a summary of soil landscape descriptions, key features and potential constraints that might influence erosion and sediment control during construction.

Table 3 – Soil landscape summary (from Milford, 1999 and Landcom, 2004).

Soil landscape name	Approximate occurrence along the proposal route	Soil landscape description	Dominant K-factor	Key landscape constraints for erosion and sediment control
Coffs Creek	20%	Level to gently undulating alluvial floodplains. Slopes are typically less than 5%. Soils are alluvial around watercourses, with greater profile development (Yellow Earths and Yellow Podzolic Soils) on terraces and higher floodplains.	0.040	Localised flood hazard Low wet bearing strength Highly organic topsoils Acidic soils Seasonally waterlogged
Megan	55%	Rolling low hills and ridgetops with slopes typically 5 to 20%. Soils are mainly deep, well-drained Red and Brown Earths.	0.040	Acidic soils High erosion hazard Low wet bearing strength
Moonee	2%	Undulating rises and footslopes, with slopes typically less than 10%. Soils are poorly-drained Humic Gleys.	0.079	Acidic soils Low wet bearing strength High run-on Subsoil sodicity (dispersion) Seasonally waterlogged
Suicide	8%	Steep hills, sideslopes and valleys, with slopes often between 33 and 56%. Soils are well-drained Yellow and Red Earths and Lithosols.	0.037	Acidic soils Mass movement hazard High erosion hazard Low wet bearing strength
Ulong	15%	Undulating low hills and ridgetops with slopes typically 5 to 20%. Soils are mainly Red and Yellow Earths, with some Podzolic Soils.	0.040	Acidic soils Low wet bearing strength High erosion hazard High run-on

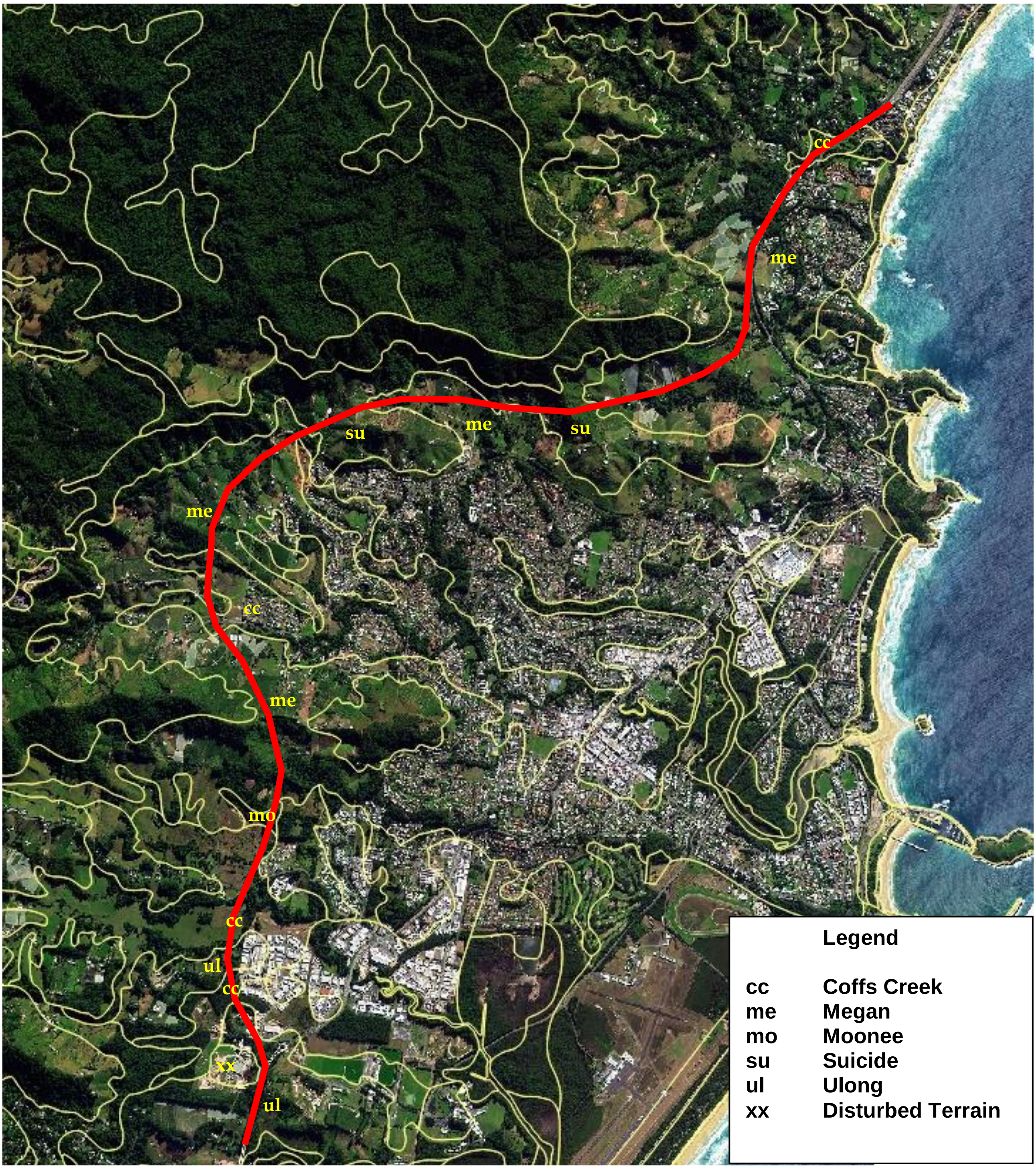


Figure 2 – Soil landscape mapping (Milford, 1999) with the proposed route of Coffs Harbour bypass.

A conservative K-factor of 0.040 is recommended for erosion hazard calculations based on typical soil data presented in Milford (1999), except for the area near Lakes Drive (The Lakes Estate), which is flagged as having a much higher soil erosivity, and higher risk of soil dispersion.

Apart from the small pocket mapped as Moonee (near Lakes Drive), soils are not noted as being dispersible.

All soils were identified as acidic, which can be a significant constraint for revegetation following construction unless properly ameliorated.

The recommendations in Section 5 include proposed management and mitigation measures for soils-related constraints.

3.4 Acid Sulfate Soils

Acid Sulfate Soil Risk Mapping (DLWC, 1997) identified several locations where the proposal crosses lands with Potential Acid Sulfate Soils (PASS) (Figure 3).

Near the southern tie-in with the existing Pacific Highway the proposal route crosses two drainage lines which have a mapped low probability of PASS occurring below 3m below ground level, buried below alluvial material. Given the grade-separated interchanges at this location there is a potential for PASS to be disturbed by piling or pre-loading in this area.

In the far north of the proposal, the route crosses an area mapped with a High Probability of PASS greater than 3m below ground level, buried below alluvial material. There is a potential for PASS to be disturbed by piling or retaining wall works in this area, or if groundwater levels are impacted by construction activities.

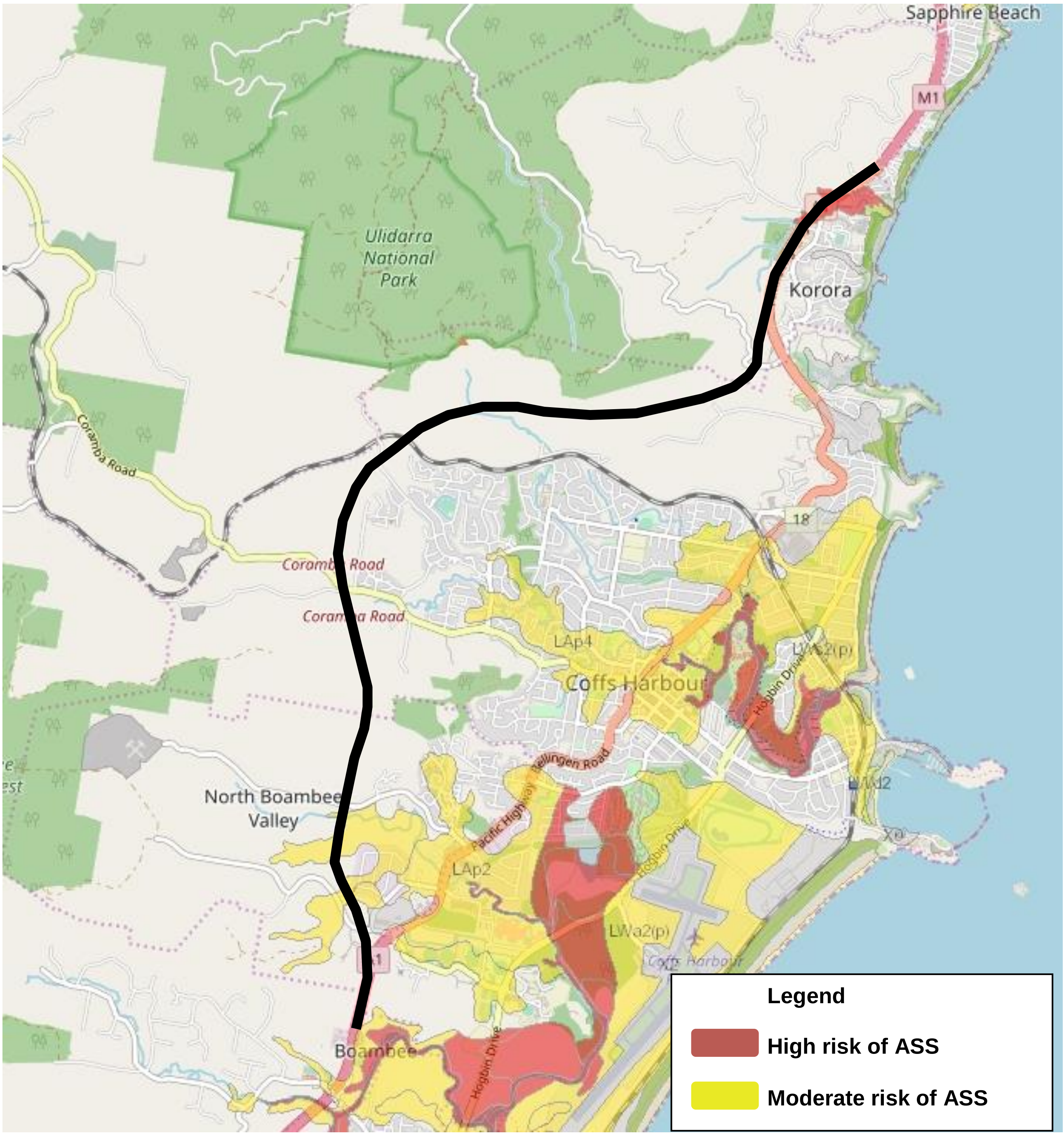


Figure 3 – Acid Sulfate Soil Risk Map (DLWC, 1997) with proposed route of Coffs Harbour bypass.

3.5 Catchments and Receiving Waters

Due to the proposal lying east of the escarpment, all drainage from the proposal route drains in a generally eastward direction into the ocean. The main waterways that cross the alignment or are in close proximity to the proposal include:

- Pine Brush Creek;

- Williams Creek;
- Jordans Creek;
- Treefern Creek;
- Coffs Creek; and
- Newports Creek.

Solitary Islands Marine Park and coastal wetlands that are subject to the Coastal Management SEPP both occur in the receiving environment downstream of the proposal.

The escarpment ranges strongly influence rainfall around Coffs Harbour, with high intensity storms and higher rainfall occurring over the coastal plain. Thus, the coastal creeks experience regular flooding due to high intensity rainfall hitting small, relatively steep catchments (Ryder *et al*., 2016).

The watercourses listed above have all been modified and impacted by agriculture and/or urbanisation. However, the proposal route tracks upstream of the urban area in all of the above-listed waterway catchments. As such, any proposal-related water quality impacts would be obvious in the downstream urban areas.

The recommendations in Section 5 include proposed management and mitigation measures for constraints relating to management of stormwater quality during construction.

3.6 Flooding

According to Ryder *et al*. (2016), because of the short, steep catchments and high intensity rainfall events in the region, the Coffs Harbour local government area experienced significant flood events in 1917, 1938, 1950, 1963, 1974, 1977, 1989, 1991 and 2009.

Intense storms in the immediate hinterland can lead to flash flooding, with relatively short concentration times and little opportunity to notify downstream landholders of an impending rise in creek flows and water levels.

During construction, the proposal has the potential to increase the runoff volumes and velocities from the affected catchments, which could have downstream impacts in terms of flood potential. Recommendations to limit the potential downstream impact are included in Section 5 of this report.

Two flood management structures (detention levees) were identified in the vicinity of the proposal's intersection with Coffs Creek. The maintenance of flood capacity in these structures must be a consideration during construction, and this is addressed in the recommendations in Section 5 of this report.

3.7 Existing and Future Drainage

During construction, there is a risk of offsite (clean) and onsite (dirty) water mixing at various locations due to the undulating and extremely steep topography which will limit the ability to install cross drainage as early works and divert offsite (clean) water catchments in some locations. Individual locations where this has been identified are detailed within Table 6.

The risk of clean and dirty water mixing is also high in tie in locations due to the proximity of the existing highway to the proposed works, and the need to maintain live traffic through the work area. This is most relevant south of the proposed Englands Road interchange and north of the proposed Korora Hill interchange.

The topography of the site and the traffic loads mean that diverting traffic off the current highway alignment during construction is not practical.

Wherever possible, permanent cross-drainage (i.e. culverts) will need to be replaced or extended as early as possible to facilitate effective separation of offsite (clean) and onsite (dirty) water. In addition, temporary cross-drainage will be required in a number of locations to facilitate effective drainage control during construction. Recommendations regarding this are included in Section 5 and on the accompanying ESCPs (Appendix 2).

3.8 Ecology

Under the TfNSW Biodiversity Guidelines (2011), avoiding or minimising ecological impacts is recommended. This has been considered in the selection and positioning of erosion and sediment control measures, especially those that typically involve disturbing land outside the earthworks footprint during construction (e.g. sediment basins).

The desire to minimise ecological impacts and clearing for this proposal presents a significant constraint for water quality management because it limits the locations for structures such as sediment basins.

The ESCPs in Appendix 2 show the conceptual positioning of construction-phase sediment basins. In locating these structures, local ecology has been considered.

3.9 Existing Services

Existing services and utilities will be a significant constraint north of the Korora Hill interchange and at the southern tie-in. The type and size of erosion and sediment control structures in that area must be considerate of existing services, and this has been taken into account in developing the ESCPs in Appendix 2, with comments included in Section 5.

Given that the majority of the remainder of the proposal route is ‘greenfield’ buried services are not expected to be a significant constraint for erosion and sediment control.

3.10 Land Availability

Land availability is a common constraint for major road projects during construction, especially for:

- Establishing stockpiles; and
- Constructing sediment basins.

As previously noted, topographical and ecological constraints limit the potential for siting sediment basins and, as a result, land availability presents a significant constraint for the construction of sediment basins.

The accompanying ESCPs (Appendix 2) identify the proposed locations for sediment basins and offsite (clean) and onsite (dirty) water drains, along with recommendations for alternative management where sediment basins cannot reasonably be constructed.

Further, Section 5 includes recommendations regarding alternative management and mitigation measures where land availability constrains the potential to install structures such as sediment basins.

3.11 Design and Construction Constraints

3.11.1 Tie-Ins and Interface

North of the Korora Hill interchange and south of the Englands Road interchange, the proposal includes modifying and widening the existing roadway footprint in immediate proximity to the existing roadway. Live traffic flow would need to be maintained during construction, although temporary short-term lane closures, traffic switches, and reduced lane widths are assumed to be necessary. Separating clean and dirty water and providing adequate sediment controls will be difficult due to the restricted working areas and progressive nature of the works. This has been taken into account when preparing the ESCPs (Appendix 2) and in the recommendations contained in Section 5 of this ESMR.

3.11.2 Piling

Piling will be required in several locations throughout the works including for bridge abutments, pylons and retaining walls. Piling rigs would be required for these works and would necessitate establishing piling platforms for the safe working of the piling rig. In locations near watercourses, these piling platforms would potentially encroach into the waterway so would risk stirring up aquatic sediments and without proper management could lead to sediment entering downstream waters.

3.11.3 Sediment Tracking onto Surrounding Roads

The proposal includes construction interactions with existing live traffic on the Pacific Highway and numerous local roads. As such, there is a risk of sediment tracking onto existing sealed live roadways from construction areas.

Refer to Section 5 for an assessment of the potential to manage sediment tracking during construction, along with recommendations for any identified constraints.

3.12 Erosion Hazard

An evaluation of the erosion hazard was made using the approach in Chapter 4 of the Blue Book (Landcom, 2004). This process involves calculating the predicted annual average soil loss using the Revised Universal Soil Loss Equation (RUSLE) as follows:

$$A = R \times K \times LS \times P \times C$$

Table 4 details the above equation and the values used in assessing erosion hazard.

Table 4 – RUSLE definitions and assumptions

Parameter	Definition	Typical values for this site		
		Gently sloped areas	Mid-range slope conditions	Steep areas
A	Total calculated soil loss (t/ha/yr)	135 t/ha/yr.	2,433 t/ha/yr.	3,462 t/ha/yr.
R	Rainfall erosivity factor (refer to Section 3.1)	6390	6390	6390
K	Soil erodibility factor (Refer to Section 3.3)	0.040	0.040	0.040
LS	Slope length and gradient factor	2% and 80m (LS of 0.41)	20% and 80m (LS of 7.32)	50% and 40m (LS of 10.42)
P	Conservation practice factor	Maximum of 1.3 assumed	Maximum of 1.3 assumed	Maximum of 1.3 assumed
C	Ground cover factor	Maximum of 1.0 assumed	Maximum of 1.0 assumed	Maximum of 1.0 assumed
Erosion hazard (from Landcom, 2004)		Very low	Very high	Extreme
Catchment size trigger for sediment basins		1.48 ha	0.25 ha	0.25 ha

The highly erodible soils of the Moonee Soil Landscape (refer to Table 3) have not been assessed in Table 4. This area occupies approximately 2% of the overall alignment length and, as such, the higher erosion hazard has been addressed in Table 6 through a higher focus on erosion control (use of temporary ground covers) and soil amelioration to address dispersion.

Included in Table 4 is an assessment of the construction catchment size that would trigger the need for constructing a sediment basin for that catchment, in compliance with Landcom (2004) and DECC (2008). This has been taken into account in positioning and sizing the sediment basins shown on the concept ESCPs in Appendix 2. Where a sediment basin is triggered but cannot reasonably be provided, alternatives will need to be proposed including enhanced erosion controls. This is discussed further in Section 5.

4 DESIGN STANDARD FOR EROSION AND SEDIMENT CONTROL

4.1 Sediment Basins

The Blue Book (Landcom, 2004 and DECC, 2008) notes that a sediment basin should be included in catchments where the erosion hazard exceeds 150 m^3/year (200 tonnes/year) of soil loss. It is standard practice that each affected catchment on a road construction project be assessed against this requirement.

Following on from the erosion hazard assessment in Section 3.12 and the calculations in Table 4, an assessment of all catchments (existing catchments and future catchments once earthworks are complete) has been undertaken. It was identified that sediment basin(s) will be required for most catchments disturbed during construction.

Although the construction period is likely to exceed three years, it is unlikely that a single sub-catchment within the construction boundary would remain exposed for longer than three years. Subsequently, it is unlikely that any single sediment basin would be in use for longer than three years. Based on these assumptions, under the conditions in Table 6.1 in Blue Book Volume 2D (DECC, 2008), sediment basins must be designed for the 80th (standard receiving environment) or 85th percentile (sensitive receiving environment) rainfall depth. However, for this project, the 85th percentile rainfall depth has been adopted for sediment basin design for all catchments, except for those areas upstream of the Solitary Islands Marine Park, where the 90th percentile rainfall depth has been adopted. This is an inherently conservative approach that exceeds the requirements of the Blue Book (Landcom, 2004 and DECC, 2008).

Sediment basins have been sized based on the following criteria (from Landcom, 2004 and DECC, 2008):

- Design rainfall depth: 74.9 mm (5-day, 90th percentile for Coffs Harbour) for all areas draining into the Solitary Islands Marine Park;
- Design rainfall depth: 55.8 mm (5-day, 85th percentile for Coffs Harbour) for all other areas;
- Basins designed for Type F/D (dispersible) sediment;
- Volumetric runoff coefficient (Cv): 0.79 (Hydrologic Group D) for all areas draining into Pine Brush Creek (i.e. upstream of the Solitary Islands Marine Park);
- Volumetric runoff coefficient (Cv): 0.74 (Hydrologic Group D) for all other areas.

The size of the basin(s) will vary depending on catchment size and conditions. Conceptual sizing of basins is included in the ESCPs in Appendix 2.

Note there are several topographical, spatial, soil and drainage constraints to constructing sediment basins, so alternative measures will be implemented instead in locations where basins are theoretically required but cannot be provided.

For all catchments where sediment basins are not feasible, undersized sediment basins, sediment sumps, mulch bunds, sediment fences or similar should be used. However, to offset the lower level of sediment control, these catchments must be subject to enhanced erosion control, mainly in the form of temporary ground cover over high-risk areas (i.e. steep (>30%) batters and concentrated flowpaths) whenever significant rainfall is imminent. This is discussed further in Section 5 (specifically in Table 6) and is noted on the concept ESCPs in Appendix 2.

4.2 Onsite and Offsite Water Separation

The permanent design includes drainage to divert upslope ('offsite' or 'clean') water away from completed cut and fill batters. As much as is practicable, these drains will be installed early to aid efficient construction and minimise the risk of erosion. This is detailed on the ESCPs (Appendix 2).

In addition, temporary drainage will be required in some locations to ensure that:

- Offsite ('clean') water is bypassed through or around work areas and away from sediment control structures; and
- Onsite ('dirty') water is diverted to sediment control structures such as sediment basins.

The locations for temporary drainage are detailed on the ESCPs (Appendix 2).

As much as possible, cross-formation culverts will be installed or extended early to assist with separating onsite (dirty) and offsite (clean) water during construction. In some locations temporary cross-drainage will be required to achieve adequate separation due to the prevailing topography and design of the road. Those locations are marked on the ESCPs (Appendix 2).

4.3 Construction-Phase De-watering

A Construction-Phase Discharge Impact Assessment has been completed for the Proposal (SEEC, 2020) to address the potential for construction-stage discharges to impact on the water quality objectives (WQOs) for the Bellinger River and Coffs Harbour region. SEEC (2020) utilizes the concept sediment basin positions and sizing from the designs in Appendixes 1 and 2.

5 PROPOSED EROSION AND SEDIMENT CONTROL MEASURES

5.1 Assessment of Applicability of Erosion and Sediment Controls

In preparing the ESCP drawings (Appendix 2), a review was conducted of the road design to determine if the inherent design would impact on effective implementation of erosion and sediment control during construction. Numerous constraints were identified that limit the establishment of features such as sediment basins in a number of locations.

Table 5 provides details of the principles of erosion and sediment control typically adopted on major road projects, along with an assessment of whether each can be effectively implemented on this project.

Where constraints to the effective implementation of typical erosion and sediment controls are identified in Table 5, details of proposed mitigation and/or management measures for each are contained in Table 6 and also on the ESCPs in Appendix 2.

Note that the ESCPs in Appendix 2 are based on the 80% Concept Design, so would be subject to further review during detailed design.

Table 5 – Assessment of Typical Erosion and Sediment Control Measures

No.	Erosion and Sediment Control Principle	Can this be fully applied on this project?	Location(s), Details or Comments
1	Assess constraints and opportunities for erosion and sediment control during the planning/design phase.	Yes – this report demonstrates this process.	N/A
2	Plan early for erosion and sediment control.	Yes – this report and the accompanying ESCPs (Appendix 2) demonstrate early planning. The requirement to keep an up-to-date register of ESCPs during construction is typically included in TfNSW QA G38 specification.	Typical G38 requirements will suffice.
3	Minimise the extent and duration of disturbance.	Yes, this has been taken into account in establishing clearing limits and will continue to be considered as the design is progressed.	A greater disturbance footprint typically occurs as a result of flattening batters (i.e. not too steep) and from the inclusion of sediment basins. This has been taken into account and balanced with the need to minimise the extent of disturbance.
4	Manage soils, including conserving topsoil for later reuse in rehabilitation.	No. The following issues were identified: • Areas of highly erodible soils occur in localised pockets. • Topsdoils are generally acidic, which could impact the success of rehabilitation. • In some areas, topsoils have been impacted by previous land use practices.	Typical G38 and Blue Book requirements for stockpiling will generally apply. However, refer to Table 7 for details regarding problem soils.

No.	Erosion and Sediment Control Principle	Can this be fully applied on this project?	Location(s), Details or Comments
5	Control water flow on, through and off the site.	No. The following issues were identified: • Temporary drainage will be necessary in numerous locations to achieve adequate separation of clean offsite and dirty onsite water, or to ensure dirty onsite water is directed to sediment basins. • Some cross-formation culverts will need to be constructed early or alternatives provided to allow for the flow of clean offsite water through the work area. • Some temporary extension of existing culverts will be required to convey clean offsite water during construction or to direct dirty onsite water across the alignment to sediment basins. • Some cross-formation culverts cannot reasonably be constructed early due to their length, steepness or positioning below natural ground level. They cannot be installed until significant earthworks have been undertaken. Alternative temporary clean water flowpaths will be required. • Upslope catchments cannot be diverted around the works in some locations due the topography and feasibility of constructing clean water drainage diversions. In these locations sediment basins will be increased in size to accommodate the upslope clean water catchment and additional temporary drainage and erosion controls across the site will be required to take the increased flows. • Large batch-dosed (typical Type D Blue Book) sediment basins might be challenging to treat and discharge within 5 days.	Refer to Table 7 and the ESCPs in Appendix 2 for locations and details.

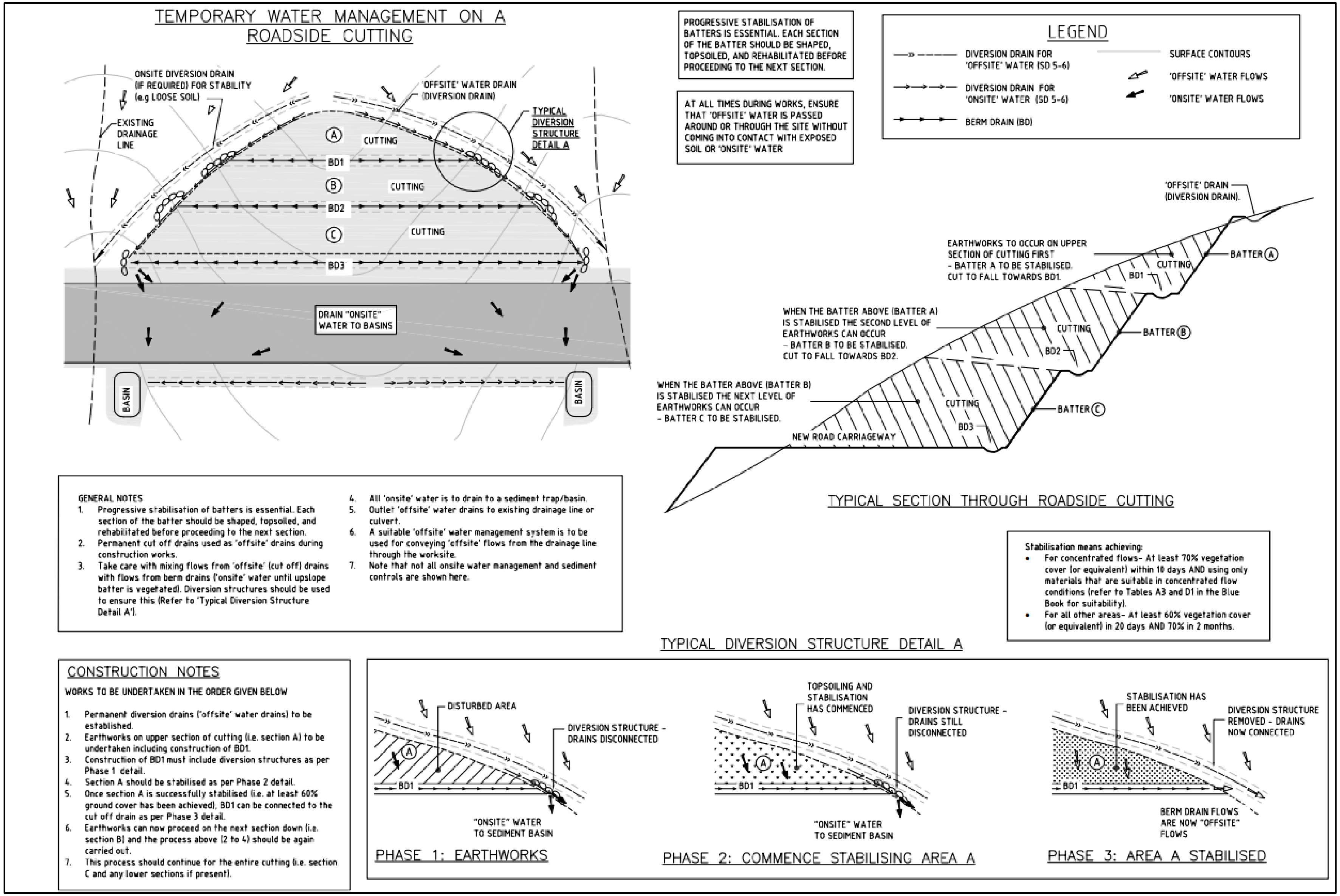
No.	Erosion and Sediment Control Principle	Can this be fully applied on this project?	Location(s), Details or Comments
6	Minimise erosion as much as possible.	No. The following issues were identified: • Rock sawing, breaking or blasting will require active dust suppression (i.e. water applied during the activity to limit dust drift). • Due to the high erosion hazard, slope breaks will be required at relatively short intervals (i.e. less than 80m as typically required by Blue Book) to minimise the risk of erosion. • Due to the high erosion hazard, temporary stabilisation of batters is required during construction to minimise the risk of erosion in those catchments where sediment basins cannot be provided.	Refer to Table 7 and the ESCPs in Appendix 2 for locations and details.
7	Maximise sediment retention onsite.	No. The following issues were identified: • There are a number of locations (individually identified within Table 6) where the erosion hazard assessment calculations indicate a sediment basin is required to comply with Blue Book, except these can't be constructed due to flooding, topographical or space constraints. • There are numerous locations where sediment basins might not fit into the proposal boundary.	Refer to Table 7 and the ESCPs in Appendix 2 for locations and details of alternatives, plus mitigation and management measures to offset constraints to basin construction.
8	Rehabilitate disturbed lands progressively, ensuring rehabilitation is effective to reduce the erosion hazard.	No. The following issues were identified: • Soils are inherently acidic. This could limit the success of revegetation unless effectively ameliorated. • Steep topography can limit the potential for effective rehabilitation. • Steep topography, live traffic or sheer distance means that it will not be realistic to spray water onto some rehabilitated areas from a water cart.	Refer to Table 7 for details.
9	Conduct regular inspections of the site to identify potential problems and allow for rectification or repair.	Yes. The requirement for documented inspections is typically included in TfNSW QA G36 and G38 specifications.	Typical G36 and G38 requirements will suffice.

No.	Erosion and Sediment Control Principle	Can this be fully applied on this project?	Location(s), Details or Comments
10	Maintain all erosion and sediment controls, including cleaning out sediment traps, until the upslope catchments are effectively rehabilitated.	Yes. The requirement to maintain and/or clean out erosion and sediment controls until the upslope catchments are rehabilitated is typically included in TfNSW QA G36 and G38 specifications.	Typical G36 and G38 requirements will suffice.

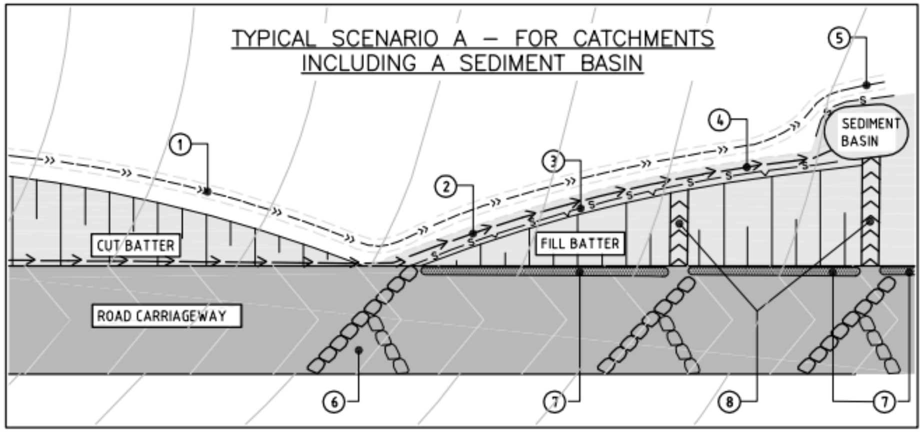
5.2 Typical Details for Erosion and Sediment Control

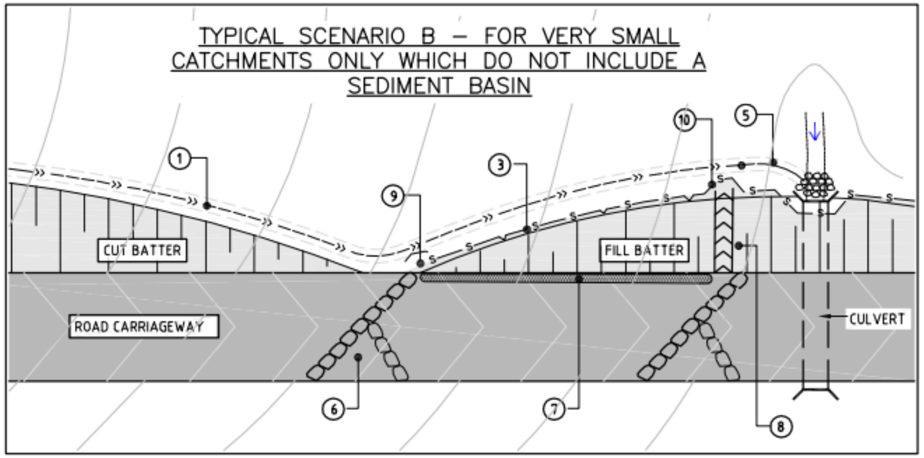
See following pages for typical details. These details show the typical setup for erosion and sediment control on major road projects such as this. The ESCPs (Appendix 2) are based on these typical details.

These typical details are contained in a TfNSW Technical Guideline 11.068 (Roads and Maritime, 2011) so will be used to help inform the preparation of Progressive ESCPs during construction.


TEMPORARY WATER MANAGEMENT ON A ROADSIDE CUTTING
ONSITE DIVERSION DRAIN (IF REQUIRED) FOR STABILITY (e.g LOOSE SOIL)
'OFFSITE' WATER DRAIN (DIVERSION DRAIN)
EXISTING DRAINAGE LINE
TYPICAL DIVERSION STRUCTURE DETAIL A
A CUTTING
BD1
B CUTTING
BD2
C CUTTING
BD3
DRAIN "ONSITE" WATER TO BASINS
BASIN
BASIN
PROGRESSIVE STABILISATION OF BATTERS IS ESSENTIAL. EACH SECTION OF THE BATTER SHOULD BE SHAPED, TOPSOILED, AND REHABILITATED BEFORE PROCEEDING TO THE NEXT SECTION.
AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER
LEGEND
DIVERSION DRAIN FOR 'OFFSITE' WATER (SD 5-6)
DIVERSION DRAIN FOR 'ONSITE' WATER (SD 5-6)
BERM DRAIN (BD)
SURFACE CONTOURS
'OFFSITE' WATER FLOWS
'ONSITE' WATER FLOWS
'OFFSITE' DRAIN (DIVERSION DRAIN).
EARTHWORKS TO OCCUR ON UPPER SECTION OF CUTTING FIRST - BATTER A TO BE STABILISED. CUT TO FALL TOWARDS BD1.
CUTTING
BATTER A
BD1
WHEN THE BATTER ABOVE (BATTER A) IS STABILISED THE SECOND LEVEL OF EARTHWORKS CAN OCCUR - BATTER B TO BE STABILISED. CUT TO FALL TOWARDS BD2.
CUTTING
BATTER B
BD2
WHEN THE BATTER ABOVE (BATTER B) IS STABILISED THE NEXT LEVEL OF EARTHWORKS CAN OCCUR - BATTER C TO BE STABILISED.
CUTTING
BATTER C
BD3
NEW ROAD CARRIAGEWAY
TYPICAL SECTION THROUGH ROADSIDE CUTTING
GENERAL NOTES
1. Progressive stabilisation of batters is essential. Each section of the batter should be shaped, topsoiled, and rehabilitated before proceeding to the next section.
2. Permanent cut off drains used as 'offsite' drains during construction works.
3. Take care with mixing flows from 'offsite' (cut off) drains with flows from berm drains ('onsite' water until upslope batter is vegetated). Diversion structures should be used to ensure this (Refer to 'Typical Diversion Structure Detail A').
4. All 'onsite' water is to drain to a sediment trap/basin.
5. Outlet 'offsite' water drains to existing drainage line or culvert.
6. A suitable 'offsite' water management system is to be used for conveying 'offsite' flows from the drainage line through the worksite.
7. Note that not all onsite water management and sediment controls are shown here.
Stabilisation means achieving:
• For concentrated flows- At least 70% vegetation cover (or equivalent) within 10 days AND using only materials that are suitable in concentrated flow conditions (refer to Tables A3 and D1 in the Blue Book for suitability).
• For all other areas- At least 60% vegetation cover (or equivalent) in 20 days AND 70% in 2 months.
TYPICAL DIVERSION STRUCTURE DETAIL A
CONSTRUCTION NOTES
WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW
1. Permanent diversion drains ('offsite' water drains) to be established.
2. Earthworks on upper section of cutting (i.e. section A) to be undertaken including construction of BD1.
3. Construction of BD1 must include diversion structures as per Phase 1 detail.
4. Section A should be stabilised as per Phase 2 detail.
5. Once section A is successfully stabilised (i.e. at least 60% ground cover has been achieved), BD1 can be connected to the cut off drain as per Phase 3 detail.
6. Earthworks can now proceed on the next section down (i.e. section B) and the process above (2 to 4) should be again carried out.
7. This process should continue for the entire cutting (i.e. section C and any lower sections if present).
DISTURBED AREA
A
BD1
DIVERSION STRUCTURE - DRAINS DISCONNECTED
"ONSITE" WATER TO SEDIMENT BASIN
PHASE 1: EARTHWORKS
TOPSOILING AND STABILISATION HAS COMMENCED
DIVERSION STRUCTURE - DRAINS STILL DISCONNECTED
A
BD1
"ONSITE" WATER TO SEDIMENT BASIN
PHASE 2: COMMENCE STABILISING AREA A
STABILISATION HAS BEEN ACHIEVED
DIVERSION STRUCTURE REMOVED - DRAINS NOW CONNECTED
A
BD1
BERM DRAIN FLOWS ARE NOW "OFFSITE" FLOWS
PHASE 3: AREA A STABILISED

CUT / FILL BATTER WATER MANAGEMENT





LEGEND

- OFFSITE WATER DIVERSION DRAIN (SD 5-6)
- ONSITE WATER DRAINS (SD 5-6)
- SURFACE CONTOURS
- ROCK STABILISED OUTLET/INLET (SD 5-8)
- CUT / FILL BATTER
- DIVERSION BERM (SD 5-5)
- CREEK / PIPE FLOW ROUTE
- SPILLWAY
- SEDIMENT FENCE (SD 6-8)

CONSTRUCTION NOTES

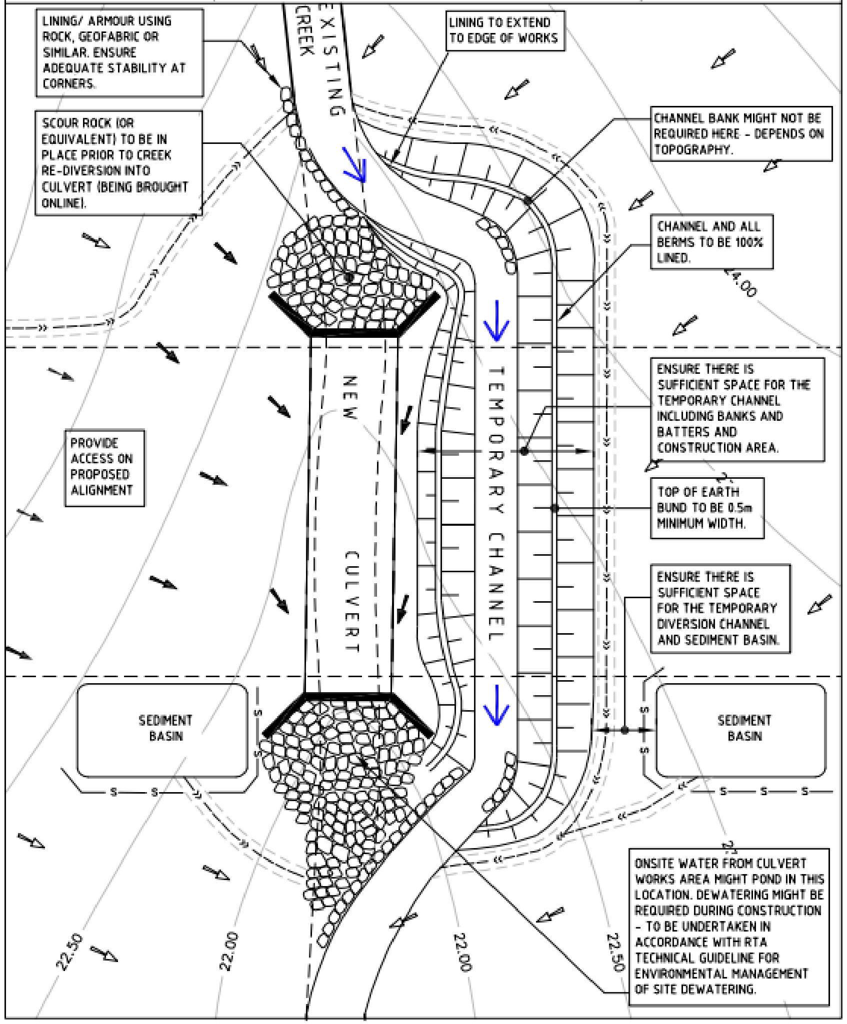
THE FOLLOWING WORKS ARE TO BE UNDERTAKEN AS SHOWN ON THE RELEVANT DIAGRAMS

1. Lined permanent diversion drains to be used as 'offsite' water drains during construction. Must convey water all the way to a watercourse or depression and onto a stabilised outlet point.
2. Provide sufficient room between toe of fill and 'offsite' water drain for management of 'onsite' water. 'Onsite' water diversion (temporary drain) - to drain to sediment basin.
3. Sediment fence at toe of batter. Include returns at 20m intervals.
4. 'Onsite' water diversion (temporary drain) - to drain to sediment basin.
5. Ensure 'offsite' water drain extends all the way to drainage line and onto a stabilised outlet point.
6. Use earth bank or sandbags to divert runoff at cut / fill line to onsite drain or sediment trap. Do not mix with 'offsite' water in cut-off drain. Use arrowhead shape if water is being shed from both sides of formation. It is only required at end of day or when rain is imminent.
7. Earth or sandbag windrow for directing water into drop-down flume. To be installed at end of day or when rain is imminent.
8. Lined drop-down chute to carry 'onsite' water to basin or trap. Only required when rain is imminent.
9. Install sediment trap at cut/fill line if runoff is not flowing to a basin.
10. Install sediment trap at base of drop-down flume if runoff is not flowing to a basin. This can simply be formed as a section of the sediment fence with returns both sides.

AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.

NEW ONLINE CULVERT (PREFERABLY AS "EARLY WORKS")



SWMP – ONLINE CULVERT CONSTRUCTION AND CREEK STABILISATION WORKS

NEW ONLINE CULVERT – CONSTRUCTION NOTES

THESE STEPS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW.

Stage 1: Temporary Channel Construction

- Establish diversion drains for offsite water.
- Construct and line the temporary channel including rock armouring at the existing creek and temporary channel junctions.
- Construct and line temporary earth bunds.
- Divert creek flows into this channel. Work downstream to upstream.

Stage 2: Culvert Construction Works

- Construct the new culvert including the stabilised culvert inlet and outlets.
- Stabilise the culvert construction works area once culvert construction works are complete.

Stage 3: Final diversion and Rehabilitation Works

- Divert creek flows into new culvert.
- Temporary channel and bunds to be decommissioned without allowing sediment downstream to creek and the disturbed area stabilised.
- Diversion drains for offsite water can be redirected to inlet of new culvert on upstream site or can be removed and rehabilitated.

OTHER NOTES

1. This design assumes that culvert construction is part of the 'early works' for the site.
2. Temporary channel to be sized and lined as per the requirements in Table 6.1 (DECC, 2008) and Table 5.2 (Landcom, 2004).
3. Ideally schedule works to periods when rainfall erosivity is low (Refer to Table 4.3 – Landcom, 2004)
4. Only undertake in-stream works (e.g. placement of rock) during periods of zero or very low flow and only when the 24 hour weather forecast suggests a significant rain event is not likely.
5. Ensure suitable temporary groundcover materials (e.g. geofabric or black plastic) are located on site for rapid stabilisation of exposed soils within in-stream locations if an unexpected rain or flow event occurs.
6. No culvert works are to occur until creek flows are successfully diverted into the stabilised temporary channel.
7. Culverts are to be completed before being allowed to convey flows. This includes all inlet and outlet protection, wingwalls etc.
8. Stabilisation, as defined by the Blue Book, means achieving:
   - For concentrated flows- At least 70% vegetation cover (or equivalent) within 10 days AND using only materials that are suitable in concentrated flow conditions (refer to Tables A3 and D1 in the Blue Book for suitability).
   - For all other areas- At least 60% vegetation cover (or equivalent) in 20 days AND 70% in 2 months.
9. A management regime should be in place to address the risk of these works creating a flooding issue due to constriction of the channel during construction.
10. If temporary access is required across the existing creek or a diversion channel, use a temporary water crossing – see standard drawing 5-1 in Blue Book Vol 1 (Landcom, 2004).
11. Minimise the time that soil is exposed to erosion.

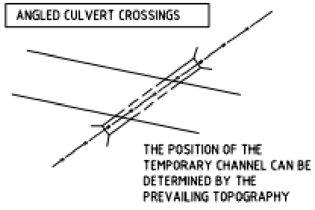
STANDARD DRAWINGS FROM VOL 1 OF THE BLUE BOOK (LANDCOM, 2004) USED HERE:

Sediment fence: SD 6-8
High flow earth bank (diversion drain): SD 5-6
Energy dissipater: SD 5-8
Temporary waterway crossing: SD 5-1

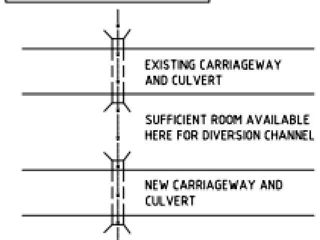
AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

THIS SCENARIO ALSO APPLIES TO:

ANGLED CULVERT CROSSINGS



DIVIDED CULVERT EXTENSION

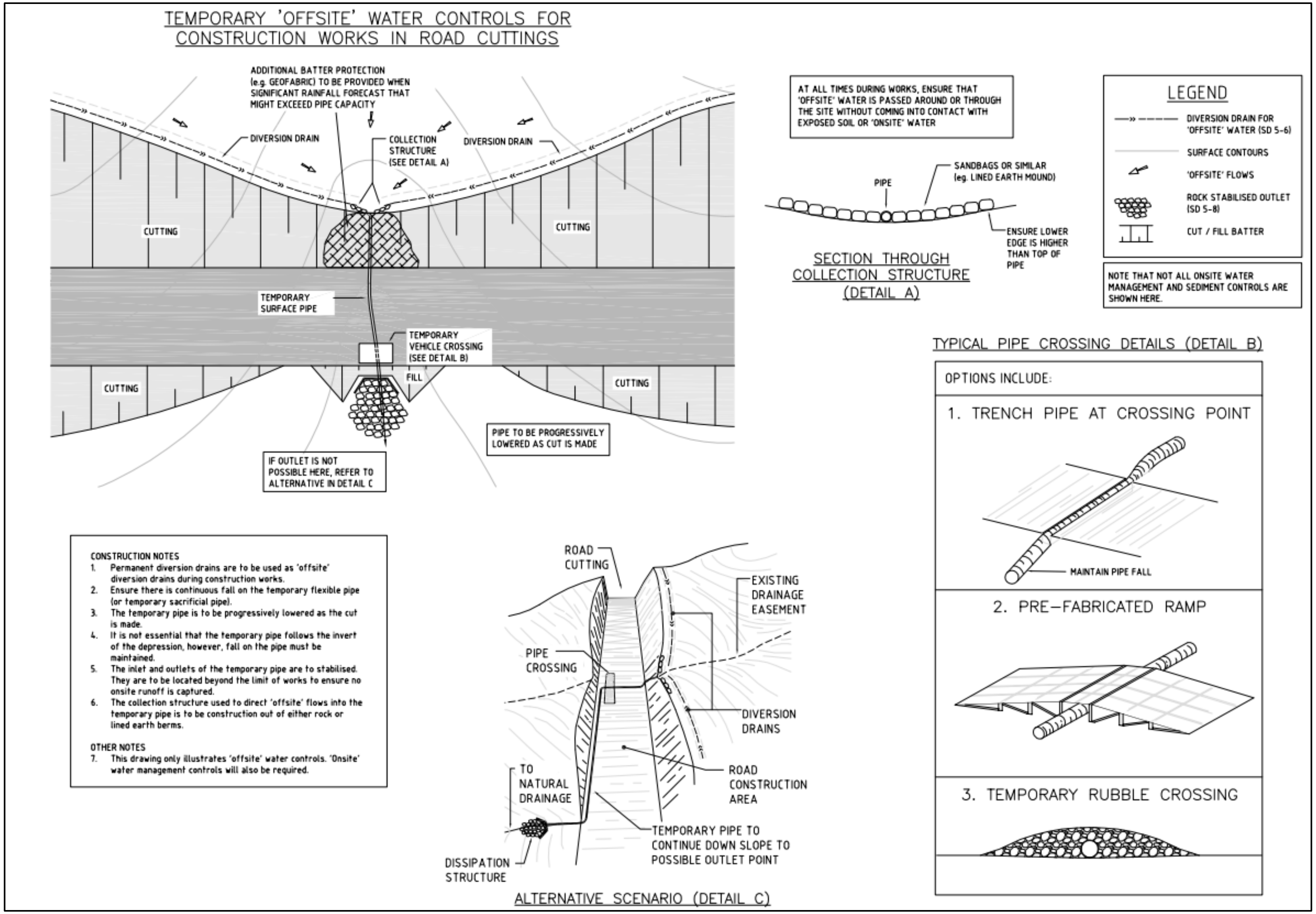


THE APPLICATION OF THIS SCENARIO TO DIVIDED CULVERT EXTENSIONS IS DEPENDENT ON WHETHER THERE IS ENOUGH AVAILABLE SPACE. IF SPACE IS LIMITED PART OF THE TEMPORARY CHANNEL CAN BE CONSTRUCTED OUT OF SHEET PILING OR SIMILAR OR ALTERNATIVELY THE SITE SHOULD BE STABILISED AS FOR A CONTINUOUS ONLINE CULVERT EXTENSION

LEGEND

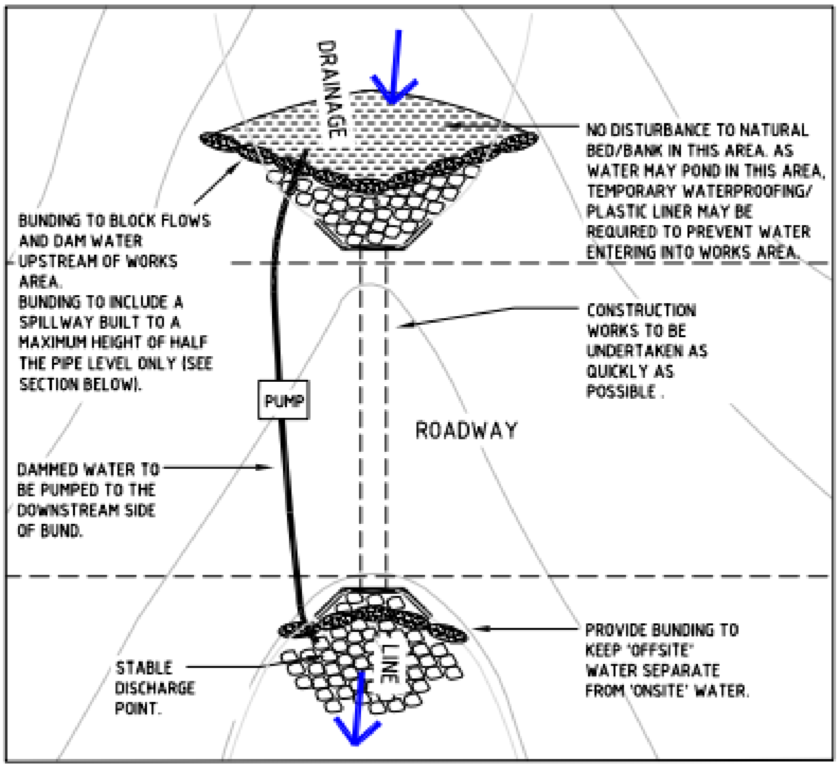
- S SEDIMENT FENCE (SD 6-8)
- DIVERSION DRAIN FOR 'OFFSITE' WATER (SD 5-6)
- SURFACE CONTOURS
- 'ONSITE' FLOWS
- 'OFFSITE' FLOWS
- CREEK/CHANNEL FLOWS
- CUT/FILL BATTER
- ROCK DISSIPATION/ STABILISATION STRUCTURES (SD 5-8)

NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.



TEMPORARY 'OFFSITE' WATER CONTROLS FOR CONSTRUCTION WORKS IN ROAD CUTTINGS
ADDITIONAL BATTER PROTECTION (e.g. GEOFABRIC) TO BE PROVIDED WHEN SIGNIFICANT RAINFALL FORECAST THAT MIGHT EXCEED PIPE CAPACITY
DIVERSION DRAIN
COLLECTION STRUCTURE (SEE DETAIL A)
DIVERSION DRAIN
CUTTING
CUTTING
TEMPORARY SURFACE PIPE
TEMPORARY VEHICLE CROSSING (SEE DETAIL B)
FILL
CUTTING
CUTTING
PIPE TO BE PROGRESSIVELY LOWERED AS CUT IS MADE
IF OUTLET IS NOT POSSIBLE HERE, REFER TO ALTERNATIVE IN DETAIL C
AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER
PIPE
SANDBAGS OR SIMILAR (eg. LINED EARTH MOUND)
ENSURE LOWER EDGE IS HIGHER THAN TOP OF PIPE
SECTION THROUGH COLLECTION STRUCTURE (DETAIL A)
LEGEND
DIVERSION DRAIN FOR 'OFFSITE' WATER (SD 5-6)
SURFACE CONTOURS
'OFFSITE' FLOWS
ROCK STABILISED OUTLET (SD 5-8)
CUT / FILL BATTER
NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.
TYPICAL PIPE CROSSING DETAILS (DETAIL B)
OPTIONS INCLUDE:
1. TRENCH PIPE AT CROSSING POINT
MAINTAIN PIPE FALL
2. PRE-FABRICATED RAMP
3. TEMPORARY RUBBLE CROSSING
CONSTRUCTION NOTES
1. Permanent diversion drains are to be used as 'offsite' diversion drains during construction works.
2. Ensure there is continuous fall on the temporary flexible pipe (or temporary sacrificial pipe).
3. The temporary pipe is to be progressively lowered as the cut is made.
4. It is not essential that the temporary pipe follows the invert of the depression, however, fall on the pipe must be maintained.
5. The inlet and outlets of the temporary pipe are to stabilised. They are to be located beyond the limit of works to ensure no onsite runoff is captured.
6. The collection structure used to direct 'offsite' flows into the temporary pipe is to be construction out of either rock or lined earth berms.
OTHER NOTES
7. This drawing only illustrates 'offsite' water controls. 'Onsite' water management controls will also be required.
ROAD CUTTING
EXISTING DRAINAGE EASEMENT
PIPE CROSSING
DIVERSION DRAINS
TO NATURAL DRAINAGE
ROAD CONSTRUCTION AREA
TEMPORARY PIPE TO CONTINUE DOWN SLOPE TO POSSIBLE OUTLET POINT
DISSIPATION STRUCTURE
ALTERNATIVE SCENARIO (DETAIL C)

ONLINE PIPE REPLACEMENT/INSTALLATION – SMALL INTERMITTENT DEPRESSIONS ONLY (PUMP OPTION)



SITE STABILISATION

THIS METHOD IS ONLY SUITABLE FOR SIMPLE DEPRESSIONS WITH INTERMITTENT FLOWS. TO BE IN PLACE FOR NO MORE THAN 3 MONTHS.

CONSTRUCTION NOTES

WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

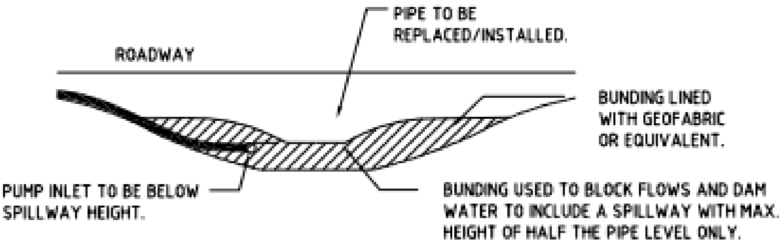
1. Ensure suitable temporary groundcover materials (e.g. geofabric, blankets) are located on site.
2. Ensure a suitable pump is available.
3. Watch the weather forecast to ensure rainfall is not forecast and monitor creek flows ensuring flows are minimal.
4. Position the bunding and line if required.
5. Undertake construction works (including inlet and outlet stabilisation) as quickly as possible. Drainage line to be blocked for no more than 3 months.

At any time during steps 4 - 5 where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.

LEGEND

—» — — — —	OFFSITE WATER DIVERSION DRAIN (SD 5-6)
—→—→—	ONSITE WATER DRAINS (SD 5-6)
———	SURFACE CONTOURS
	ROCK STABILISED OUTLET (SD 5-8)
→	CREEK/PIPE FLOW ROUTE
— s —	SEDIMENT FENCE (SD 6-8)
	BUNDS

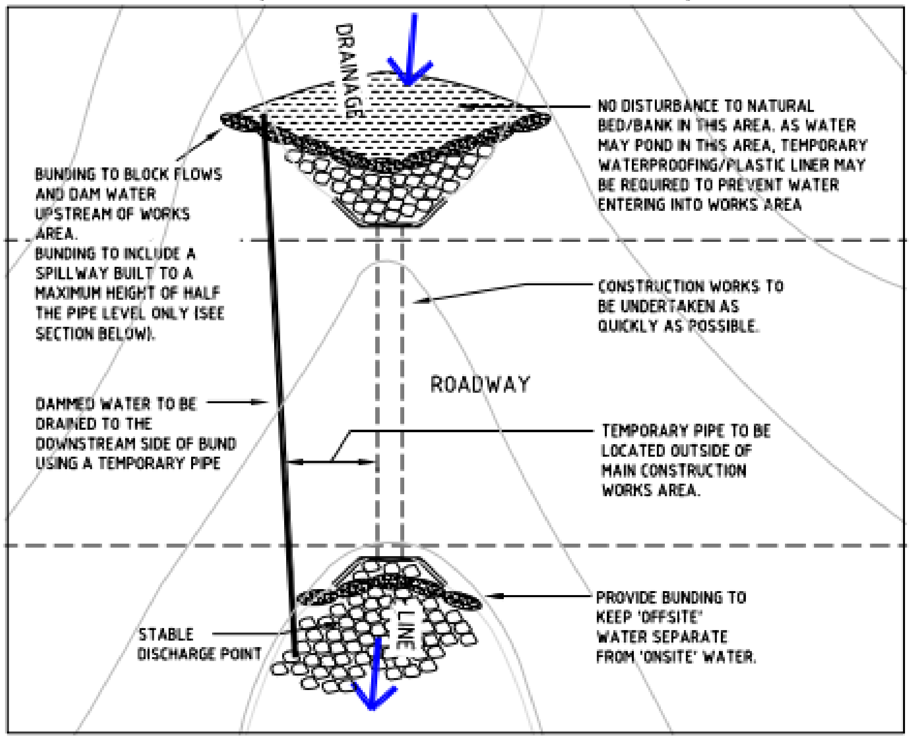
NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.



AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

SECTION THROUGH BUNDING LOCATION

ONLINE PIPE REPLACEMENT/INSTALLATION – SMALL INTERMITTENT DRAINAGE LINES (TEMPORARY PIPE OPTION)



SITE STABILISATION

THIS METHOD IS ONLY SUITABLE FOR SMALL CHANNELS WITH INTERMITTENT FLOWS.

TEMPORARY PIPE TO BE SIZED TO AT LEAST HALF THE PERMANENT PIPE.
e.g. – PERMANENT: 600ø
– TEMPORARY: MINIMUM 300ø

THIS METHOD (TEMPORARY PIPE SYSTEM) WILL NOT BE SUITABLE IN STEEP LOCATIONS WHERE TEMPORARY PIPE CANNOT BE LOCATED OUTSIDE OF WORKS AREA.

LEGEND

- OFFSITE WATER DIVERSION DRAIN (SD 5-6)
- ONSITE WATER DRAINS (SD 5-6)
- SURFACE CONTOURS
- ROCK STABILISED OUTLET (SD 5-8)
- CREEK/PIPE FLOW ROUTE
- SEDIMENT FENCE (SD 6-8)
- BUNDS

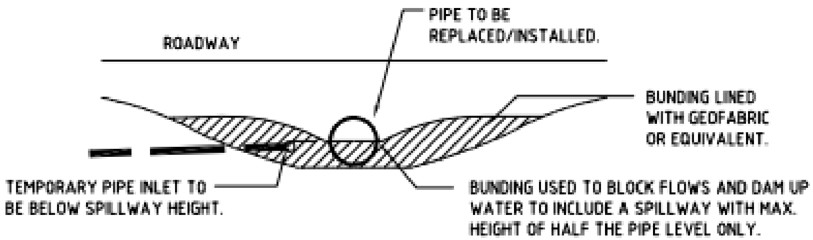
NOTE THAT NOT ALL ONSITE WATER MANAGEMENT AND SEDIMENT CONTROLS ARE SHOWN HERE.

CONSTRUCTION NOTES

WORKS TO BE UNDERTAKEN IN THE ORDER GIVEN BELOW

1. Ensure suitable temporary groundcover materials (eg. geofabric, blankets) are located on site.
2. Ensure a temporary pipe is available. Install temporary pipe to ensure flow, preferably by providing continuous fall.
3. Watch the weather forecast to ensure rainfall is not forecast and monitor creek flows ensuring flows are minimal.
4. Position the bunding within the channel to secure the site.
5. Undertake construction works (including inlet outlet stabilisation) as quickly as possible.

At any time during steps 4 – 5 where a significant rain or flow event is forecast or if the site is left unattended for prolonged periods temporary groundcover should be applied to all exposed soils in the works area.



AT ALL TIMES DURING WORKS, ENSURE THAT 'OFFSITE' WATER IS PASSED AROUND OR THROUGH THE SITE WITHOUT COMING INTO CONTACT WITH EXPOSED SOIL OR 'ONSITE' WATER

5.3 Project-Specific Recommendations

Table 6 contains a summary of those locations and aspects that are considered high-risk or that are outside of typical best-practice for a major road construction project, as identified in Table 5.

Table 6 – Summary of proposal-specific recommendations.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
1.	CH12650 to 12950	Very highly erodible soils in this section near The Lakes Estate.	4	• The following requirements are to be incorporated into the ESCPs prepared for this area: ○ Soils are to be ameliorated prior to forecast rainfall by dusting them with gypsum at 0.2 kg/m^2. ○ Prior to forecast rainfall of greater than 50% chance of more than 5mm in 24 hours, batters in this area are to be stabilised by using temporary ground covers (e.g. fabric or polymer soil binder). • It is recommended that TfNSW G38 specification be amended to include the above requirements for this specific area.
2.	Whole project	The proposed noise mounds may block onsite dirty water from entering sediment basins in some locations if they were constructed as part of the bulk earthworks.	5	• Maintain breaks within the noise mounds during construction in locations adjacent to sediment basins and/or at regular intervals to enable onsite dirty construction runoff to enter the dirty water drains and sediment basins. Alternatively temporary pipes can be provided under the noise mounds where feasible. • No amendment to TfNSW G38 specification is recommended to address this, as it is expected that site-specific ESCPs will include measures to address this if it arises.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
3.	Whole project	Cross-alignment drainage culverts are located online within existing drainage lines in some locations and considerable earthworks are required in many locations as well. This will mean that temporary diversions around the permanent culvert locations will be required during the construction works to enable the culverts to be installed.	5	• Culvert installation will need to be staged or temporary diversions (lined channels or pumps) installed to ensure upslope clean offsite water flows are maintained and diverted around the work area. • Cross-alignment drainage culverts are to be installed as early works prior to commencement of stripping or earthworks in the surrounding catchments. • Online sediment traps/sumps will be required at the lower end of each section/stage of culvert works. • No amendment to TfNSW G38 specification is recommended to address this, as it is expected that site-specific ESCPs will include measures to address this if it arises.
4.	Whole project	Large batch-dosed (typical Type D Blue Book) sediment basins might be challenging to treat and discharge within 5 days.	5	• TfNSW to investigate (or include provision in G36 or G38 specification) for irrigation to land as an option for discharging sediment basins (subject to landholder agreement and assessment of relevant environmental, flooding and heritage risks). • Detailed design phase to consider the potential for High-Efficiency Sediment Basins (HES basins) due to their ability to provide greater treatment efficiencies than traditional batch-dosed Type D sediment basins. Note that these were considered in the early design phase and significant constraints were identified including: o Potential management issues associated with the use of high-efficiency coagulants and flocculants; o Limited space due to constrained construction boundaries and/or steep topography, which limits the shape, size and inlet point(s) available for many sediment basins. Note that HES basins must have an inlet forebay and all inflows must be into that forebay.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
5.	Tie-ins, intersections and duplication works alongside the existing roadway (e.g. at the northern and southern ends of the project, Englands Road CH10500 to 10800, Coramba Road and Bennetts Road, and Bruxner Park Road CH20800 to 21200)	Many existing services are present in these areas. This might limit the placement and type of erosion and sediment controls. Various stages of works will occur meaning that the permanent stormwater and basins may not be able to be in place for all stages of works and erosion and sediment controls will need to be progressive.	5 & 7	• Divert offsite clean water flows around the works using temporary diversions until the permanent stormwater can be used. Diversions will most likely need to be modified for various stages and as the works progress. • Install temporary sediment controls (e.g. large mulch bunds or sediment traps) and supplement with enhanced erosion control measures (e.g. slope breaks at decreased intervals, temporary stabilisation of exposed soils with biodegradable soil binders, staging works to minimise the exposed area at any one time) until the proposed sediment basin/s can be installed. • Waterway diversions will be required in some locations. • No amendment to TfNSW G38 specification is recommended to address this, as it is expected that site-specific ESCPs will include measures to address this if it arises.
6.	CH9820	Limited space precludes the ability to position a sediment basin at 9820W.	7	• Construct an undersize (pocket) basin instead, and employ enhanced erosion controls during construction to offset this. Enhanced erosion controls might include (but are not limited to) providing temporary ground covers over batters immediately prior to forecast rainfall.
7.	CH10280	Koala habitat precludes the ability to position a sediment basin at 10280W.	7	• Construct an undersize (pocket) basin instead, and employ enhanced erosion controls during construction to offset this. Enhanced erosion controls might include (but are not limited to) providing temporary ground covers over batters immediately prior to forecast rainfall.
8.	ST10460W	Fairly flat topography makes a typical basin impractical, as is will be difficult to get all onsite dirty water to flow to the basin.	7	• Construct this as a linear perimeter earth bund rather than as a sediment basin. This is shown on the ESCPs in Appendix 2.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
9.	ST10800E	Fairly flat topography makes a typical basin impractical, as is will be difficult to get all onsite dirty water to flow to the basin.	7	• Construct this as a linear perimeter earth bund rather than as a sediment basin. This is shown on the ESCPs in Appendix 2.
10.	ST11200W	Fairly flat topography makes a typical basin impractical, as is will be difficult to get all onsite dirty water to flow to the basin.	7	• Construct this as a linear perimeter earth bund rather than as a sediment basin. This is shown on the ESCPs in Appendix 2.
11.	ST11850E and ST11850W	Fairly flat topography makes a typical basin impractical, as is will be difficult to get all onsite dirty water to flow to the basin.	7	• Construct this as a linear perimeter earth bund rather than as a sediment basin. This is shown on the ESCPs in Appendix 2.
12.	ST12100E and ST12100W	Fairly flat topography makes a typical basin impractical, as is will be difficult to get all onsite dirty water to flow to the basin.	7	• Construct this as a linear perimeter earth bund rather than as a sediment basin. This is shown on the ESCPs in Appendix 2.
13.	ST12300E and ST12300W	Fairly flat topography makes a typical basin impractical, as is will be difficult to get all onsite dirty water to flow to the basin.	7	• Construct this as a linear perimeter earth bund rather than as a sediment basin. This is shown on the ESCPs in Appendix 2.
14.	ST12450E and ST12450W	Fairly flat topography makes a typical basin impractical, as is will be difficult to get all onsite dirty water to flow to the basin.	7	• Construct this as a linear perimeter earth bund rather than as a sediment basin. This is shown on the ESCPs in Appendix 2.
15.	CH12800 to 21600	Risk of dust from rock sawing, breaking or blasting.	6	• During rock sawing, rock or blasting, dust suppression is to be actively undertaken to minimise dust generation and dust drift. • This must be included as a general requirement on the Progressive ESCPs. • It is recommended that TfNSW G38 specification be amended to include the above requirements for this specific area.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
16.	CH13000 to 13200	The proposed permanent clean water cross drainage pipes at the low points in this area will direct upslope clean water flows into sediment basin SB12900E unless an upslope clean water diversion drain is provided.	5	• A temporary upslope clean water diversion offset from the permanent clean water drainage is required in this location (as shown on the ESCPs in Appendix 2) to direct upslope clean water flows away from the sediment basin. • Alternatively, an additional sediment basin could be positioned around CH13100, although this might necessitate delaying the noise wall construction in this area.
17.	CH13350	The soil loss for this catchment triggers the need for a sediment basin around CH13350E. However, this sediment basin would only be effective for early works until earthworks levels change, and plus is not feasible due to the presence of Coastal Petailtail Dragonfly habitat.	7	• Given that a sediment basin is not feasible at CH13350E, online sediment traps formed within the cut must be used as an alternative, augmented with enhanced erosion controls. Enhanced erosion controls might include (but are not limited to) providing temporary ground covers over batters immediately prior to forecast rainfall. • Note that the above measures are only required during initial earthworks. Once the cut proceeds, dirty water flows from the alignment can be directed southwards towards the basins around CH12600 (E and W). Note that SB12600W has been sized to accommodate the additional catchment.
18.	CH13450	The proposed road will encroach into an existing dam here and the dam will be partially filled in.	5	• A temporary diversion will be required to take offsite clean water flows around the dam filling and culvert works. • As much as possible, works in high-risk areas should be scheduled for the lower rainfall times of year (typically late winter to late spring). • A floating silt curtain is to be deployed across the dam during the works to construct the initial earth plug, and when dam filling works occur. • A temporary extension to the proposed culvert might be required to ensure clean water flows pass beyond the curtain.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
19.	SB13500E	Limited space to fit in the sediment basin. The proposed operational basin is approximately 40m upslope of the drainage line, so is not ideally placed to act as a construction-phase sediment basin. Complex topography, limited space, and significant upslope clean water catchments make placing sediment basins and diverting offsite clean water challenging.	7	• Land might need to be leased or acquired so there is sufficient space for this sediment basin. • A complex network of temporary diversions for offsite clean water will be required, as shown on the ESCPs in Appendix 2. • Temporary diversions for offsite clean water will be required to keep such water away from the sediment basins. • Construction of diversions for offsite clean water should be prioritized as early works as much as is practicable. • The sediment basin might not be constructable to the size shown on the ESCPs in Appendix 2. If that occurs, an undersize basin must be used in conjunction with a higher focus on erosion control and temporary use of ground covers when rain is imminent. Refer to Item 42 in this table for recommendations. • Works will need to be staged as much as possible to minimise the active earthwork area to the minimum area for practical and efficient construction. All others disturbed surfaces in this zone are to be temporarily ground covered (e.g. using biodegradable soil binders) while they are inactive. • As much as possible, works in high-risk areas should be scheduled for the lower rainfall times of year (typically late winter to late spring). • Temporary slope breaks (contour banks) are to be established across exposed slopes whenever significant (i.e. >50% chance of more than 10mm in 24 hours) rain is imminent. Note this only applies to soil slopes, not rock. • Slope breaks are to be installed at maximum 40m intervals.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
20.	SB15200E and SB15250E	There is limited space and steep topography to construct SB 15250E to a large enough volume to accommodate the proposed alignment drainage runoff.	5 & 7	• Construct SB15250E as early works and use it to capture runoff from early works and the initial lifts of the fill batter. Once the culvert at CH15200 is in place, dirty onsite water from the fill should be directed past SB15250E and into SB15200E. • The permanent drainage, once in place, will flow to SB15200E which is a good outcome.
21.	SB15500E	Limited space to fit in the sediment basin.	7	• Land might need to be leased or acquired so there is sufficient space for this sediment basin.
22.	SB15900E	Limited space to fit in the sediment basin.	7	• Land might need to be leased or acquired so there is sufficient space for this sediment basin.
23.	SB16100E	Basin is positioned in a natural gully line, so potentially receives offsite clean water flows unless adequate diversions are in place.	5 and 7	• Temporary diversion of offsite clean water will be required to ensure it does not flow into this basin. This is shown on the ESCPs in Appendix 2.
24.	CH16250	The topography in this location is steep and complex and the upslope catchments are significant. Substantial earthworks will be required to establish the cut and fills and install the cross-alignment drainage culverts. Drainage from CH16250 through to the ridge at CH16410 can't drain to Basin 16100E during initial stripping and earthworks.	5, 6 & 7	• An on-alignment sediment trap will be required, and is shown as ST16250W on the ESCPs in Appendix 2. • Theoretically, ST16250W is required until the fill lifts high enough that drainage from this catchment can be directed into Basin SB16100E. However, that won't be feasible as it will impede earthworks. Rather, a high focus must be placed on erosion control and temporary use of ground covers when rain is imminent. Refer to Item 42 in this table for recommendations. • As much as possible, works in high-risk areas should be scheduled for the lower rainfall times of year (typically late winter to late spring).
25.	SB16620E	Limited space to fit in the sediment basin.	7	• Land might need to be leased or acquired so there is sufficient space for this sediment basin.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
26.	CH16800 to 17600, including basins SB16880E and 16900E	Complex topography, limited space, and significant upslope clean water catchments make placing sediment basins and diverting offsite clean water challenging.	5, 6 & 7	• A complex network of temporary diversions for offsite clean water will be required, as shown on the ESCPs in Appendix 2. • Temporary diversions for offsite clean water will be required to keep such water away from the sediment basins. • Construction of diversions for offsite clean water should be prioritized as early works as much as is practicable. • Sediment basins might not be constructable to the size shown on the ESCPs in Appendix 2. If that occurs, undersize basins must be used in conjunction with a higher focus on erosion control and temporary use of ground covers when rain is imminent. Refer to Item 42 in this table for recommendations. • Works will need to be staged as much as possible to minimise the active earthwork area to the minimum area for practical and efficient construction. All others disturbed surfaces in this zone are to be temporarily ground covered (e.g. using biodegradable soil binders) while they are inactive. • As much as possible, works in high-risk areas should be scheduled for the lower rainfall times of year (typically late winter to late spring). • Temporary slope breaks (contour banks) are to be established across exposed slopes whenever significant (i.e. >50% chance of more than 10mm in 24 hours) rain is imminent. Note this only applies to soil slopes, not rock. • Slope breaks are to be installed at maximum 40m intervals.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
27.	CH17590	The diversion of offsite clean water relies on the early installation of the cross-alignment culvert at CH17590. If this is not installed early (or an alternative temporary flowpath established for offsite clean water, there is the potential for offsite clean water to flow into the sediment basins.	5	• The permanent cross-alignment culvert and associated longitudinal drainage must be constructed early. • If this is not possible then temporary drainage diversions (pipes or lined drains) will be required.
28.	CH17700 to 18300	The roadway in this location is mainly fill constructed centrally through a valley area. Therefore, drainage is going to be a significant issue as existing waterways and runoff from upslope catchments concentrate here. Permanent cross-alignment and new longitudinal drainage will be required early.	5	• The permanent cross-alignment culvert and associated longitudinal drainage must be constructed early. • If this is not possible then temporary drainage diversions (pipes or lined drains) will be required.
29.	SB17850E	Limited space to fit in the sediment basin.	7	• Staging of earthworks will be required. • Alternatively, use a linear sediment trap along the edge of the new drainage channel instead, and offset the lack of a basin by using enhanced erosion controls. Refer to Item 42 in this table for details.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
30.	SB18780E	The soil loss for this catchment triggers the need for this sediment basin. However, space constraints limit the potential to site this basin in the most ideal location further west and closer to the culvert at CH18760. As a result, runoff from the initial stages of earthworks between the basin (as shown on the ESCPs in Appendix 2) and the culvert at CH18760 will not flow to a sediment basin. In addition, steep topography will limit the potential to install basin SB18780E to the required capacity.	7	• If this sediment basin is not feasible, online sediment traps formed within the cut could be used as an alternative until earthworks levels allow onsite dirty water to flow to SB18660E instead. At that stage, online sediment traps would no longer be required. • Note that SB18660E would need to be enlarged to accommodate the additional catchment. • Enhanced erosion controls are recommended for this catchment during construction to offset the limitations for sediment basin placement. Refer to Item 42 in this table.
31.	SB19500W	The basin lies in a natural depression, so relies on diversion of offsite clean water flows to ensure it only receives water from the construction area.	5 & 7	• Construct the new permanent diversion early.
32.	SB19900E and SB19900W	The basins lie in natural depressions, so rely on diversion of offsite clean water flows to ensure they only receive water from the construction area.	5 & 7	• Construct the new permanent diversions early.
33.	CH19950 to 20100	The final road surfaces levels camber away from the sediment basin here (SB20100E) for part of the alignment.	5, 6 & 7	• During the fill works grade the top of the working fill to fall towards SB20100E for as long as feasible. • Provide sediment traps along the western side of the alignment. • Focus on stabilising the western fill batter as quickly as possible.
34.	SB20700E	The existing dam is in the ideal location for a sediment basin but offsite clean water flows also naturally flow to this location.	5 & 7	• Use the existing dam as a sediment basin if upslope clean water flows can be diverted around the basin. If upslope flows cannot be diverted around the basin install an alternative basin to the west.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
35.	SB21450W & SB21780W	The existing dams are in the sound locations for sediment basins but offsite clean water flows also naturally flow to these locations.	7	• If alternative sediment basins (offline from offsite clean water catchment flows) can be constructed to take dirty water runoff and to the required volumes this should be undertaken as the first preference. • Alternatively the existing dams can be used as sediment basins if offsite clean water flows can be diverted around and away from the dams.
36.	SB21500E	Limited space to fit in the sediment basin.	7	• Land might need to be leased or acquired so there is sufficient space for this sediment basin.
37.	CH21800 to 22400	Basins are required for this section of works but space is very restricted (being close to the existing school, houses, existing roadway and creek) so they cannot be provided.	7	• Linear sediment traps have been shown instead on the ESCPs in Appendix 2. • This catchment should be subject to enhanced erosion controls. Refer to Item 42 in this table.
38.	CH21850 to 22100	The works adjacent to the nature reserve are very steep and space is extremely restricted, meaning that sediment controls will be very limited.	6 & 7	• Enhanced erosion control measures will be required in the form of temporary stabilisation of exposed soils with biodegradable soil binders, progressive stabilisation of batters, staging works to minimise the exposed area at any one time, scheduling works to lower rainfall periods where possible. • Provide linear sediment traps ST21960E and ST21980W as shown in the ESCPs in Appendix 2.
39.	Whole project	Steep topography, live traffic or sheer distance means that it will not be realistic to spray water onto some rehabilitated areas from a water cart.	8	• Include irrigation on those batters that water carts won’t feasibly be able to spray water following rehabilitation. • This should be noted on the ESCPs. • It is recommended that TfNSW G38 specification be amended to include the above requirement.

No	Location (chainage/ structure)	Reason for adoption as a high risk area/aspect	Reference from Table 6	Recommended action(s)
40.	Whole project	Steep topography means that rehabilitation may be difficult using vegetation in some locations.	8	• Site specific rehabilitation treatments will need to be applied including heavy duty spray treatments which combine suitable binders, fertilizers and seed species appropriate for steep slopes and extreme conditions. • Alternatively engineered surface finishes may be required in some areas where rehabilitation cannot be achieved. • Landscape planning should refer to the TFNSW Batter Stabilisation Guideline (Roads and Maritime Services, 2015)
41.	Whole project	Acidic soils can limit the potential for effective revegetation.	8	• Lime-treat any topsoil that will be used for rehabilitation. The liming rate is to be determined by soil testing.
42.	CH12800 to 22000, and other high risk areas as noted elsewhere in this table	Very high to extreme erosion hazard. Also includes numerous high risk areas where sediment controls cannot practically be constructed to the specified size or in the ideal location.	5, 6 & 7	• Batters and exposed slopes greater than 20% are to be temporarily ground-covered (e.g. sprayed with biodegradable soil binder) whenever significant (i.e. >50% chance of more than 10mm in 24 hours) rain is imminent. Note this only applies to soil slopes, not to cut rock faces. • Prior to forecast rainfall, slope breaks are to be installed at the following maximum intervals: Slopes ≤ 20% - 80m intervals; and Slopes > 20% - 40m intervals. • Batters are to be progressively stabilised as levels progress (i.e. do not wait until the end of formation to commence permanent stabilisation). • It is recommended that TfNSW G38 specification be amended to include the above requirements for the chainages noted, and for other areas nominated on the ESCPs in Appendix 2

6 CONCLUSION AND RECOMMENDATIONS

TfNSW propose to construct a bypass of the Pacific Highway around Coffs Harbour (the proposal). The proposal includes a bypass of around 14 kilometres skirting west of Coffs Harbour from Englands Road in the south and connecting with the Pacific Highway at Sapphire in the north. The bypass seeks to improve connectivity, road transport efficiency and safety for local and interstate motorists.

The purpose of this report is to determine management issues for construction-phase erosion and sediment control.

- Section 3 identifies site conditions and identifies any potential constraints to construction-phase erosion and sediment control;
- Section 4 identifies design considerations for erosion and sediment control measures;
- Section 5 assesses the feasibility for constructing typical erosion and sediment control structures such as sediment basins, with a series of recommendations to manage or mitigate potential impacts relating to construction-phase erosion and sediment control.

Section 5 is accompanied by a set of concept ESCP drawings (Appendix 2) showing the setup of key erosion and sediment control measures such as sediment basins and up-gradient water diversions.

In preparing the ESCP drawings (Appendix 2), a review was conducted of the road design to determine if the inherent design would impact on effective implementation of erosion and sediment control during construction. In a number of locations the road design limits the effective implementation of erosion and sediment control, or the early installation of cross-alignment culverts. In those locations, recommendations have been included in Table 6 to address this.

Local topography presents a significant limitation for the installation of large-scale controls such as sediment basins in several locations. Table 6 contains a series of alternatives and mitigation measures to address this, and these are located on the ESCPs in Appendix 2.

Providing the recommendations in Section 5 of this report and the ESCPs (Appendix 2) are adopted during construction, the risk of pollution from erosion and subsequent sediment runoff can be managed in accordance with recognised best-practice in NSW (i.e. Landcom 2004 and DECC, 2008).

Table 6 in Section 5 details a series of erosion and sediment control recommendations for high-risk areas or where typical controls cannot be included. Note that alternative options could feasibly be developed but should be based on consultation with an expert soil conservationist.

It is recommended that TfNSW G38 specifications be modified to ensure that the recommendations in Table 6 are incorporated and thus carry through to the detailed design and construction-phase of the project.

7 REFERENCES

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8 APPENDICES

8.1 Appendix 1: Sediment Basin Calculations

Refer to the tables on ESCPs Sheets ESCP001 and ESCP002 in Appendix 2.

8.2 Appendix 2: Concept Erosion and Sediment Control Plans (ESCPs)

See overpage.

BASIN ID	SB9820W	SB9800E	SB10100E	SB10280W	ST10460W	SB10560E	SB10600E	SB10700E	SB10720E	SB10750E	ST10800E	SB11030E	SB11050W	ST11200E	ST11200W	SB11450E	SB11610E	ST11640W	ST11850E	ST11850W	ST12100E	ST12100W	ST12300E
Catchment area TOTAL (ha)	2.43	1.55	2.17	2.06	0.84	2.47	1.35	4.65	0.94	1.07	0.51	1.72	2.2	0.95	1.1	2.06	0.47	0.14	1.3	1.3	0.4	0.5	0.9
Catchment area DISTURBED (ha)	2.43	1.55	2.17	2.06	0.84	2.47	1.35	4.65	0.94	1.07	0.51	1.72	2.2	0.95	1.1	2.06	0.47	0.14	1.3	1.3	0.4	0.5	0.9
x-day, y-percentile rainfall event (mm)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
Rainfall erosivity (R-factor)	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390
Soil erodibility (K-factor)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Slope length (m)	80	80	80	80	50	80	80	20	80	20	80	80	80	15	15	15	80	15	10	10	15	15	15
Slope gradient (%)	6	6	20	20	10	20	8	50	3.5	50	3	3	3	50	50	50	20	25	50	50	50	50	50
LS-Factor	1.47	1.47	7.32	7.32	2.04	7.32	2.05	5.89	0.78	5.89	0.64	0.65	0.65	4.64	4.64	4.64	7.32	2.58	3.33	3.33	4.64	4.64	4.64
Erosion control practice (P-factor)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover (C-factor)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cv (Volumetric runoff coefficient)	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
Soil loss (t/ha/yr)	488	488	2433	2433	677	2433	682	1956	259	1956	216	216	216	1543	1543	1543	2433	856	1105	1105	1543	1543	1543
Sediment basin storage (soil) volume (m^3)	152	97	677	655	73	770	118	1166	31	268	14	78	61	188	218	408	147	15	184	184	79	99	178
Sediment basin settling (water) volume (m^3)	1003	640	896	867	347	1020	557	1920	388	442	225	710	908	392	454	851	194	58	537	537	165	206	372
Sediment basin total volume (m^3)	1155	737	1573	1522	420	1790	675	3086	419	710	239	758	969	580	672	1259	341	73	721	721	244	305	550
Catchment Soil Loss (t/yr)	1187	757	5279	5109	568	6009	920	9094	244	2093	110	372	476	1466	1697	3179	1143	120	1436	1436	617	772	1389
Is a basin required	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES

BASIN ID	ST12300W	ST12450E	ST12450W	SB12600E	SB12600W	SB13350E	SB13500E	SB13950E	SB14150W	SB14220E	SB14280E	SB14540E	ST14620E	ST14620W	SB14720E	SB15180W	SB15200E	SB15250E	SB15500E	ST15550E	SB15600W	SB15670E	SB15900E
Catchment area TOTAL (ha)	0.9	1.13	0.78	4.31	9.9	2.36	2	4.5	4.8	0.6	1.17	3.6	4	0.97	6.52	1.85	6	2.8	0.86	0.33	1.48	2	3.6
Catchment area DISTURBED (ha)	0.9	1.13	0.78	4.31	9.9	2.36	2	4.5	4.8	0.6	1.17	3.6	4	0.97	6.52	1.85	6	2.8	0.86	0.33	1.48	2	2.92
x-day, y-percentile rainfall event (mm)	55.8	55.8	55.8	55.8	55.8	55.8	55.8	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9
Rainfall erosivity (R-factor)	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390
Soil erodibility (K-factor)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Slope length (m)	15	20	7	40	7	40	40	40	80	18	80	80	50	15	80	10	20	20	20	40	40	40	40
Slope gradient (%)	50	50	50	30	50	35	35	35	20	35	20	5	20	50	20	35	50	50	50	35	35	30	35
LS-Factor	4.64	5.89	2.48	6.69	2.48	7.76	7.76	7.76	7.32	4.08	7.32	1.19	5.12	4.64	7.32	2.55	5.89	5.89	5.89	7.76	7.76	6.69	7.76
Erosion control practice (P-factor)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover (C-factor)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cv (Volumetric runoff coefficient)	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Soil loss (t/ha/yr)	1543	1956	824	2223	824	2578	2578	2578	2433	1357	2433	394	1701	1543	2433	846	1956	1956	1956	2578	2578	2223	2578
Sediment basin storage (soil) volume (m^3)	178	283	82	1228	1045	780	661	1388	1497	104	365	182	872	192	2033	201	1504	702	216	109	489	570	965
Sediment basin settling (water) volume (m^3)	372	467	322	1780	4088	974	826	2663	2840	355	692	2130	2367	574	3858	1095	3550	1657	509	195	876	1183	2130
Sediment basin total volume (m^3)	550	750	404	3008	5133	1754	1487	4051	4337	459	1057	2312	3239	766	5891	1296	5054	2359	725	304	1365	1753	3095
Catchment Soil Loss (t/yr)	1312	2210	642	9581	8154	6085	5156	828	11677	814	2846	1420	6805	1497	15861	1565	11734	5476	1682	851	3816	4446	7528
Is a basin required	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – UDATED CONSTRUCTION BOUNDARY
C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	A.J.T.	A.M.	DRAFT ISSUE – TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT – ISSUE FOR CONSULTATION

DRAWING STATUS

DESIGN BY A.J.T.
DRAWN BY A.J.T.
FINAL APPROVAL A.M.
SCALE: (on A3 Original) N/A

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PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT
CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT
CONTROL PLAN
SEDIMENT BASIN TABLE – 1 OF 2

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP001	00

BASIN ID	SB15980E	SB16100E	ST16250W	SB16620E	SB16600W	SB16880E	SB16900E	SB17660E	SB17750E	SB17800E	SB17850E	SB18180E	SB18250E	SB18350E	SB18600E	SB18660E	SB18780E	SB19500W	SB19900E	SB19900W	SB20100E	SB20300E	ST20340E
Catchment area TOTAL (ha)	1.6	5.2	2.5	2.73	1.87	1.26	1.5	2.84	0.86	2.84	1.03	4.3	6.9	1.83	3.3	3.03	1.57	2.22	3.4	1.6	1.71	4.7	2.85
Catchment area DISTURBED (ha)	1.6	5.2	2.5	2.73	1.87	1.26	1.5	2.84	0.86	2.84	1.03	4.3	6.9	1.83	3.3	3.03	1.57	2.22	3.4	1.6	1.71	4.7	2.85
x-day, y-percentile rainfall event (mm)	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9
Rainfall erosivity (R-factor)	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390
Soil erodibility (K-factor)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Slope length (m)	40	40	40	40	40	40	40	40	30	80	80	80	20	40	40	40	40	40	80	80	20	40	40
Slope gradient (%)	45	40	50	40	50	60	50	30	40	30	30	18	50	40	30	30	25	30	10	10	50	25	32
LS-Factor	9.63	8.74	10.42	8.74	10.42	11.72	10.42	6.69	6.92	11.60	11.60	6.42	5.89	8.74	6.69	6.69	5.54	6.69	2.81	2.81	5.89	5.54	7.13
Erosion control practice (P-factor)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover (C-factor)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cv (Volumetric runoff coefficient)	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Soil loss (t/ha/yr)	3198	2904	3462	2904	3462	3896	3462	2223	2299	3854	3854	2134	1956	2904	2223	2223	1841	2223	933	933	1956	1841	2369
Sediment basin storage (soil) volume (m^3)	656	1936	1109	1016	830	629	666	809	253	1403	509	1176	1703	681	941	864	371	633	407	191	429	1112	865
Sediment basin settling (water) volume (m^3)	947	3077	1479	1615	1106	746	888	1680	509	1680	609	2544	4083	1083	1953	1793	929	1314	2012	947	1012	2787	1686
Sediment basin total volume (m^3)	1603	5013	2588	2631	1936	1375	1554	2489	762	3083	1118	3720	5813	1764	2894	2657	1300	1947	2419	1138	1441	3899	2551
Catchment Soil Loss (t/yr)	5117	15100	8654	7927	6473	4909	5192	6313	1977	10945	3970	9177	13494	5314	7336	6736	2890	4935	3171	1492	3344	8670	6750
Is a basin required	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

BASIN ID	ST20630E	SB20700E	SB20720E	SB20750E	SB20850E	SB20900E	ST20920E	SB20950E	SB21060W	SB21450W	SB21500E	SB21780W	ST21960E	ST21980W	ST22320W	ST22400E	SB22480W	ST22500E	ST22800W	SB22850E	SB23550W	SB23620W	ST23620E
Catchment area TOTAL (ha)	2.7	4.45	0.77	2.15	4.3	3.31	0.18	5.15	3.2	3.1	1.2	3.12	1.6	0.58	1.43	2.54	1.4	0.98	0.9	8.9	1.2	1.1	0.95
Catchment area DISTURBED (ha)	2.7	4.45	0.77	2.15	4.3	3.31	0.18	5.15	3.2	3.1	1.2	3.12	1.6	0.58	1.43	2.54	1.4	0.98	0.9	6.2	1.2	1.1	0.95
x-day, y-percentile rainfall event (mm)	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9	74.9
Rainfall erosivity (R-factor)	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390	6390
Soil erodibility (K-factor)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Slope length (m)	40	40	20	20	80	80	80	80	80	40	40	40	40	20	80	80	80	40	80	80	80	80	80
Slope gradient (%)	30	22	50	50	5	10	10	10	20	30	30	22	22	20	6	6	10	3	5	5	3	3	3
LS-Factor	6.69	4.82	5.89	5.89	1.19	2.81	2.81	2.81	7.32	6.69	6.69	4.82	4.82	2.55	1.47	1.47	2.81	0.47	1.19	1.19	0.65	0.65	0.65
Erosion control practice (P-factor)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover (C-factor)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cv (Volumetric runoff coefficient)	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Soil loss (t/ha/yr)	2223	1600	1956	1956	394	933	933	933	2433	2223	2223	1600	1600	847	488	488	933	156	394	394	216	216	216
Sediment basin storage (soil) volume (m^3)	770	913	193	539	217	396	22	616	998	884	342	640	328	63	90	159	167	20	46	314	33	31	26
Sediment basin settling (water) volume (m^3)	1598	2633	456	1272	2544	1959	107	3047	1893	1834	710	1846	947	343	846	1503	828	80	533	5266	710	651	562
Sediment basin total volume (m^3)	2368	3546	649	1811	2761	2355	129	3663	2891	2718	1052	2486	1275	406	936	1662	995	600	579	5580	743	682	588
Catchment Soil Loss (t/yr)	6002	7120	1506	4205	1696	3086.952	168	4803	7784	6891	2668	4992	2560	491	698	1241	1306	153	355	2446	260	238	205
Is a basin required	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – UDATED CONSTRUCTION BOUNDARY
C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	A.J.T.	A.M.	DRAFT ISSUE – TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT – ISSUE FOR CONSULTATION

DRAWING STATUS
DESIGN BY A.J.T.
DRAWN BY A.J.T.
FINAL APPROVAL A.M.
SCALE: (on A3 Original) N/A

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PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
SEDIMENT BASIN TABLE – 2 OF 2

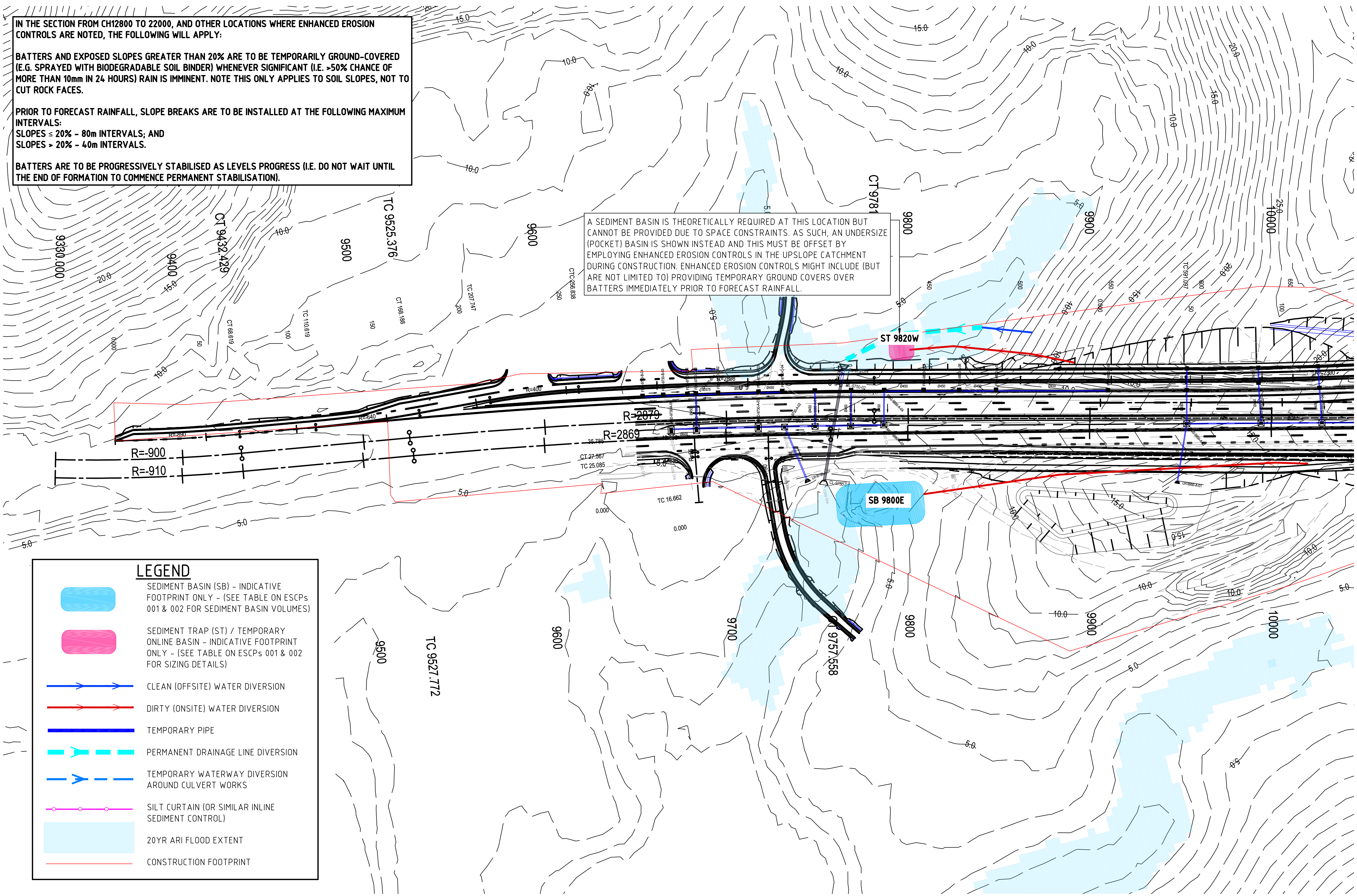
PROJECT NO. 18000288 | SUB-PR NO. P01 | DRAWING NO. ESCP002 | REV 00

IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

BATTERS AND EXPOSED SLOPES GREATER THAN 20% ARE TO BE TEMPORARILY GROUND-COVERED (E.G. SPRAYED WITH BIODEGRADABLE SOIL BINDER) WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT TO CUT ROCK FACES.

PRIOR TO FORECAST RAINFALL, SLOPE BREAKS ARE TO BE INSTALLED AT THE FOLLOWING MAXIMUM INTERVALS:
SLOPES ≤ 20% – 80m INTERVALS; AND
SLOPES > 20% – 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).



A SEDIMENT BASIN IS THEORETICALLY REQUIRED AT THIS LOCATION BUT CANNOT BE PROVIDED DUE TO SPACE CONSTRAINTS. AS SUCH, AN UNDERSIZE (POCKET) BASIN IS SHOWN INSTEAD AND THIS MUST BE OFFSET BY EMPLOYING ENHANCED EROSION CONTROLS IN THE UPSLOPE CATCHMENT DURING CONSTRUCTION. ENHANCED EROSION CONTROLS MIGHT INCLUDE (BUT ARE NOT LIMITED TO) PROVIDING TEMPORARY GROUND COVERS OVER BATTERS IMMEDIATELY PRIOR TO FORECAST RAINFALL.

LEGEND

- SEDIMENT BASIN (SB) – INDICATIVE FOOTPRINT ONLY – (SEE TABLE ON ESCPs 001 & 002 FOR SEDIMENT BASIN VOLUMES)
- SEDIMENT TRAP (ST) / TEMPORARY ONLINE BASIN – INDICATIVE FOOTPRINT ONLY – (SEE TABLE ON ESCPs 001 & 002 FOR SIZING DETAILS)
- CLEAN (OFFSITE) WATER DIVERSION
- DIRTY (ONSITE) WATER DIVERSION
- TEMPORARY PIPE
- PERMANENT DRAINAGE LINE DIVERSION
- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – UDATED CONSTRUCTION BOUNDARY
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A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT – ISSUE FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	A.J.T.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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PROJECT TITLE

COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE

EROSION AND SEDIMENT CONTROL PLAN
CH 9330 TO 10060

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP101	00

LEGEND

- SEDIMENT BASIN (SB) - INDICATIVE FOOTPRINT ONLY - (SEE TABLE ON ESCPs 001 & 002 FOR SEDIMENT BASIN VOLUMES)
- SEDIMENT TRAP (ST) / TEMPORARY ONLINE BASIN - INDICATIVE FOOTPRINT ONLY - (SEE TABLE ON ESCPs 001 & 002 FOR SIZING DETAILS)
- CLEAN (OFFSITE) WATER DIVERSION
- DIRTY (ONSITE) WATER DIVERSION
- TEMPORARY PIPE
- PERMANENT DRAINAGE LINE DIVERSION
- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

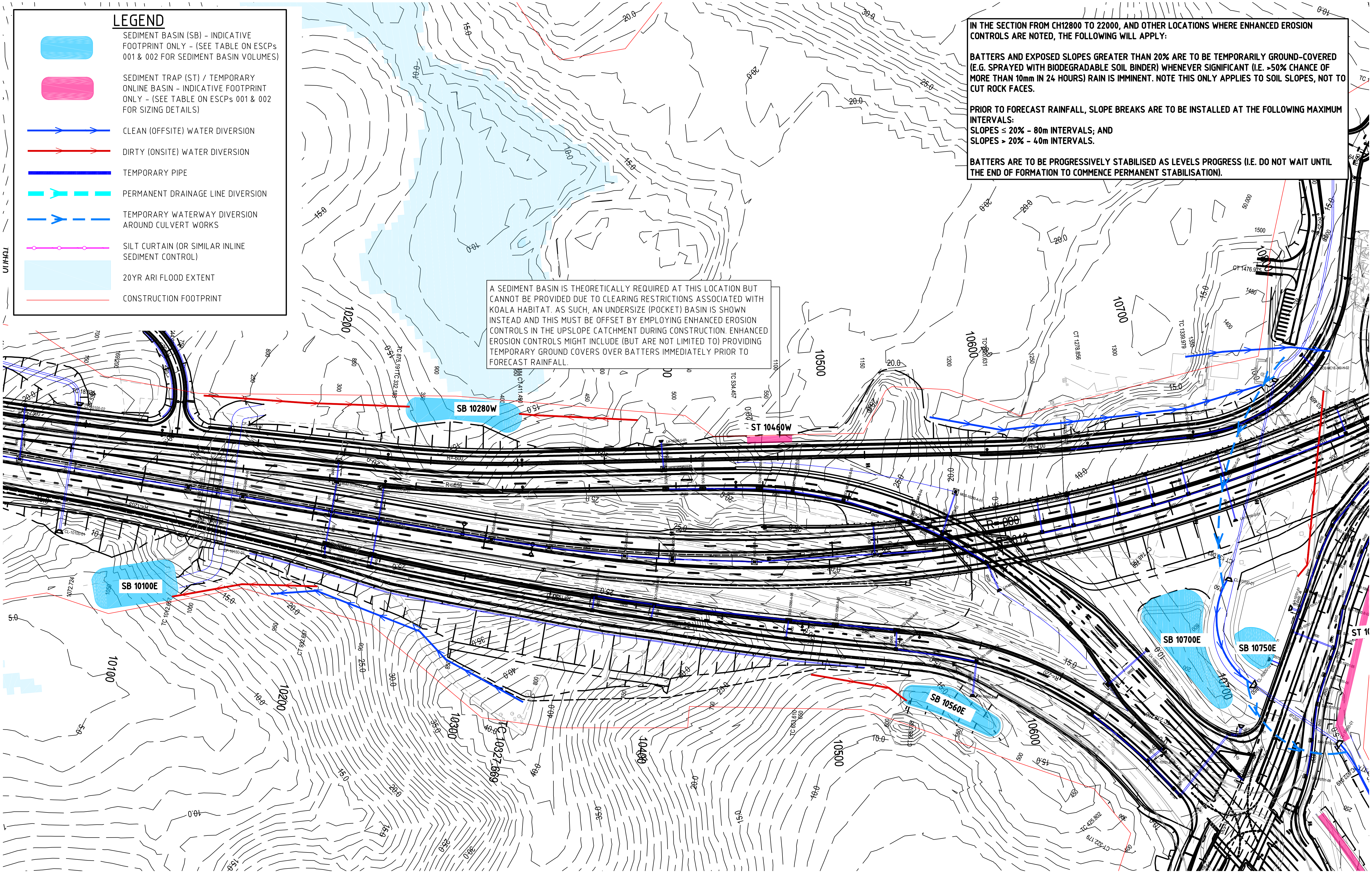
IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

BATTERS AND EXPOSED SLOPES GREATER THAN 20% ARE TO BE TEMPORARILY GROUND-COVERED (E.G. SPRAYED WITH BIODEGRADABLE SOIL BINDER) WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT TO CUT ROCK FACES.

PRIOR TO FORECAST RAINFALL, SLOPE BREAKS ARE TO BE INSTALLED AT THE FOLLOWING MAXIMUM INTERVALS:
SLOPES ≤ 20% - 80m INTERVALS; AND
SLOPES > 20% - 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).

A SEDIMENT BASIN IS THEORETICALLY REQUIRED AT THIS LOCATION BUT CANNOT BE PROVIDED DUE TO CLEARING RESTRICTIONS ASSOCIATED WITH KOALA HABITAT. AS SUCH, AN UNDERSIZE (POCKET) BASIN IS SHOWN INSTEAD AND THIS MUST BE OFFSET BY EMPLOYING ENHANCED EROSION CONTROLS IN THE UPSLOPE CATCHMENT DURING CONSTRUCTION. ENHANCED EROSION CONTROLS MIGHT INCLUDE (BUT ARE NOT LIMITED TO) PROVIDING TEMPORARY GROUND COVERS OVER BATTERS IMMEDIATELY PRIOR TO FORECAST RAINFALL.



REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
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D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE - UPDATED CONSTRUCTION BOUNDARY
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DRAWING STATUS
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DRAWN BY A.J.T.
FINAL APPROVAL A.M.
SCALE: (on A3 Original) 1:2000

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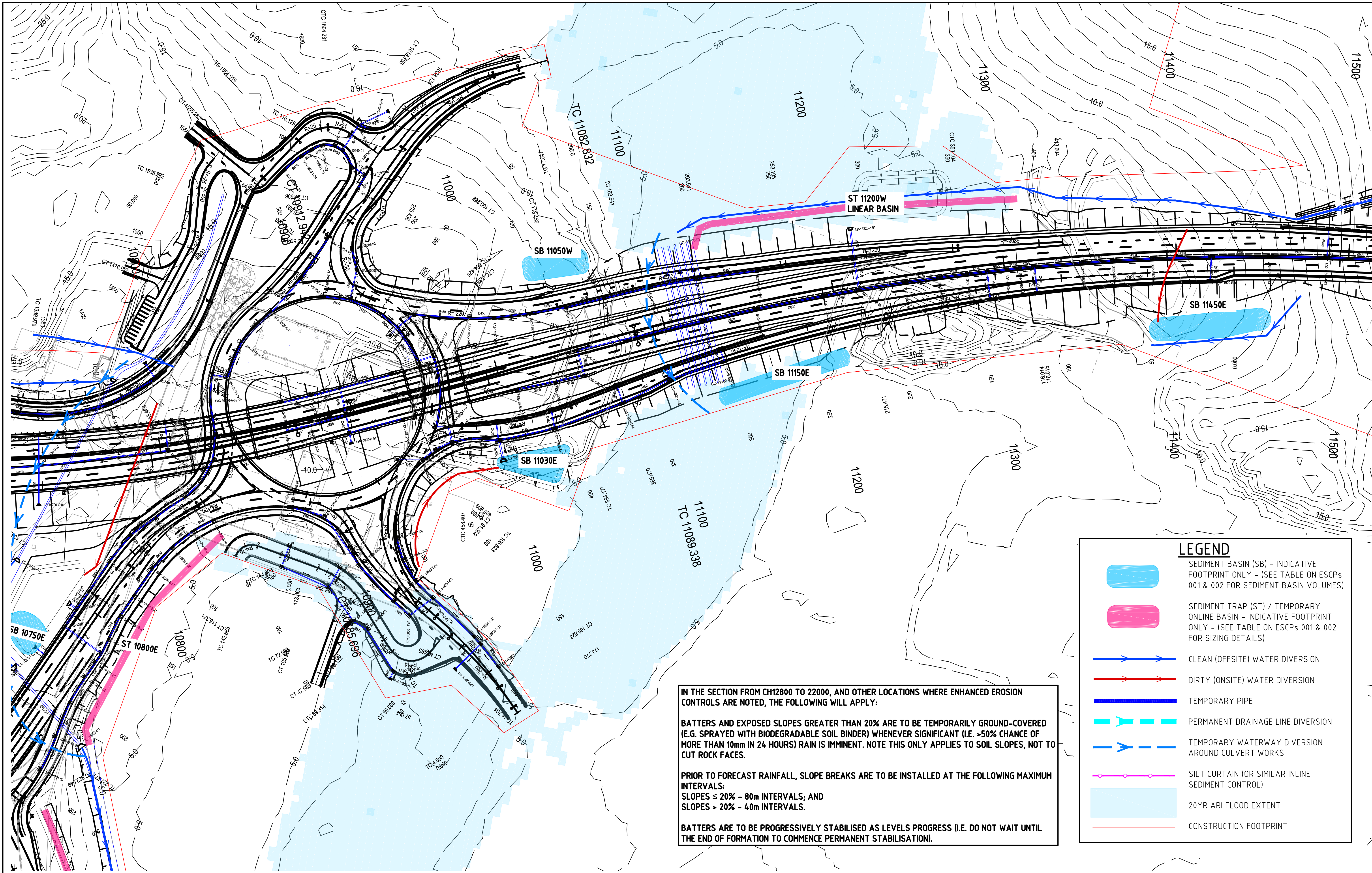
PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 10060 TO 10760

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP102	00

Plot Date: Monday, 25 May 2020 3:20:22 PM CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg



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SLOPES ≤ 20% – 80m INTERVALS; AND
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LEGEND

- SEDIMENT BASIN (SB) – INDICATIVE FOOTPRINT ONLY – (SEE TABLE ON ESCPs 001 & 002 FOR SEDIMENT BASIN VOLUMES)
- SEDIMENT TRAP (ST) / TEMPORARY ONLINE BASIN – INDICATIVE FOOTPRINT ONLY – (SEE TABLE ON ESCPs 001 & 002 FOR SIZING DETAILS)
- CLEAN (OFFSITE) WATER DIVERSION
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- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
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DRAWING STATUS

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DRAWN BY	A.J.T.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 10760 TO 11470

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP103	00

Plot Date: Monday, 25 May 2020 3:23:52 PM   CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg

IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

BATTERS AND EXPOSED SLOPES GREATER THAN 20% ARE TO BE TEMPORARILY GROUND-COVERED (E.G. SPRAYED WITH BIODEGRADABLE SOIL BINDER) WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT TO CUT ROCK FACES.

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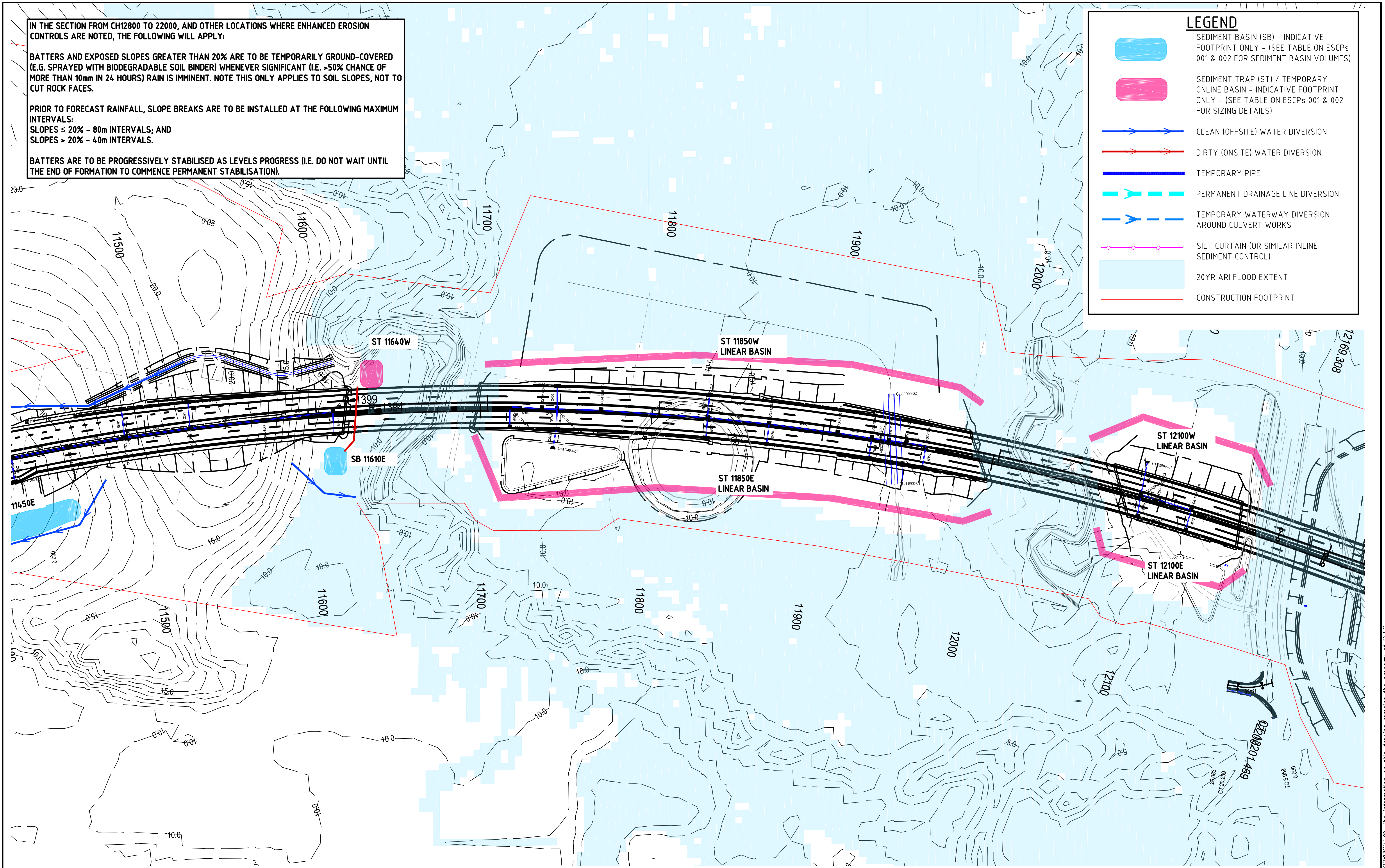

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- DIRTY (ONSITE) WATER DIVERSION
- TEMPORARY PIPE
- PERMANENT DRAINAGE LINE DIVERSION
- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – UDATED CONSTRUCTION BOUNDARY
C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	L.O.	A.M.	DRAFT ISSUE – TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT – ISSUE FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	A.J.T.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 11470 TO 12150

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP104	00

Plot Date: Monday, 25 May 2020 3:27:17 PM CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg

IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

BATTERS AND EXPOSED SLOPES GREATER THAN 20% ARE TO BE TEMPORARILY GROUND-COVERED (E.G. SPRAYED WITH BIODEGRADABLE SOIL BINDER) WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT TO CUT ROCK FACES.

PRIOR TO FORECAST RAINFALL, SLOPE BREAKS ARE TO BE INSTALLED AT THE FOLLOWING MAXIMUM INTERVALS:
SLOPES ≤ 20% – 80m INTERVALS; AND
SLOPES > 20% – 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).

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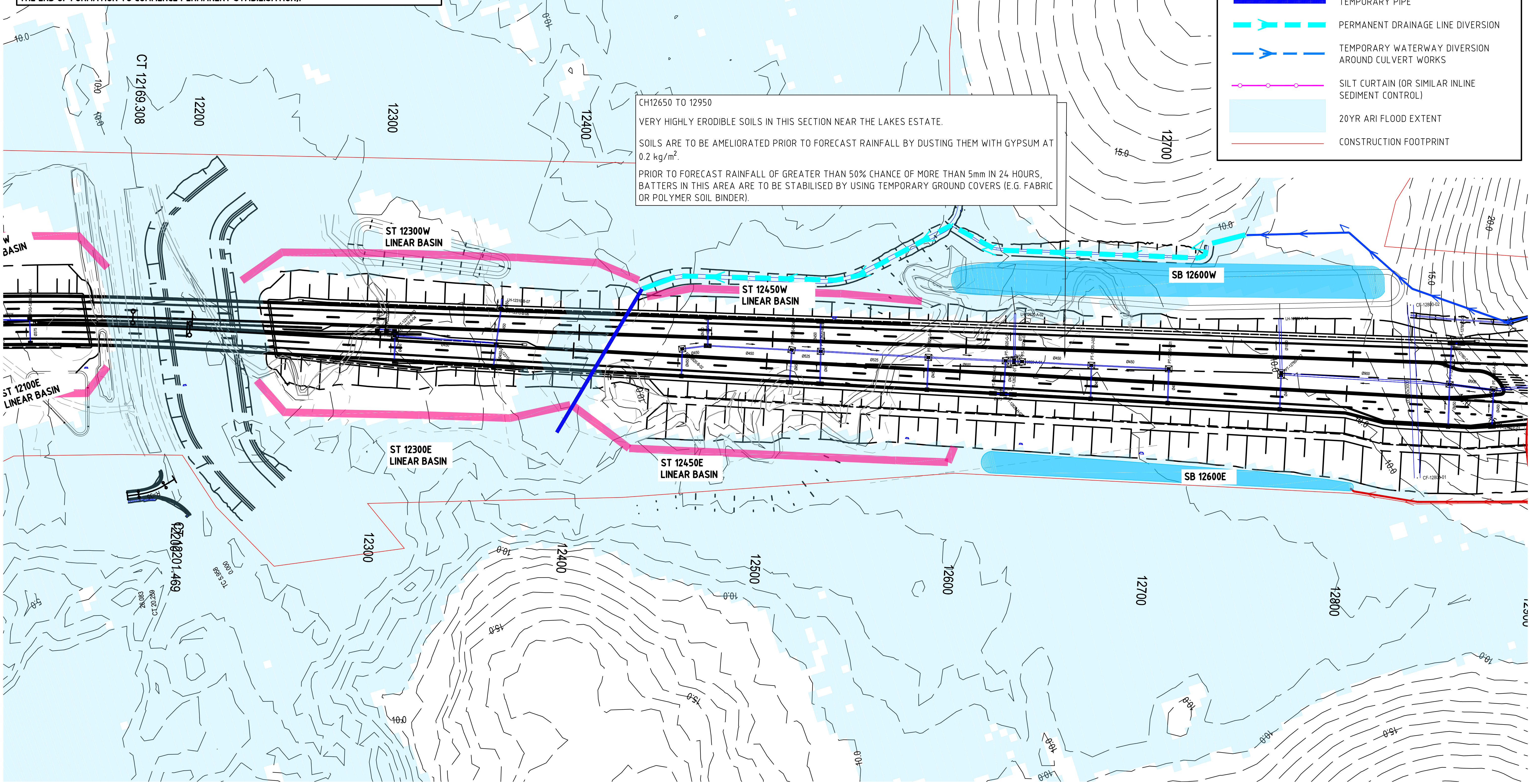
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

CH12650 TO 12950

VERY HIGHLY ERODIBLE SOILS IN THIS SECTION NEAR THE LAKES ESTATE.

SOILS ARE TO BE AMELIORATED PRIOR TO FORECAST RAINFALL BY DUSTING THEM WITH GYPSUM AT 0.2 kg/m^2.

PRIOR TO FORECAST RAINFALL OF GREATER THAN 50% CHANCE OF MORE THAN 5mm IN 24 HOURS, BATTERS IN THIS AREA ARE TO BE STABILISED BY USING TEMPORARY GROUND COVERS (E.G. FABRIC OR POLYMER SOIL BINDER).



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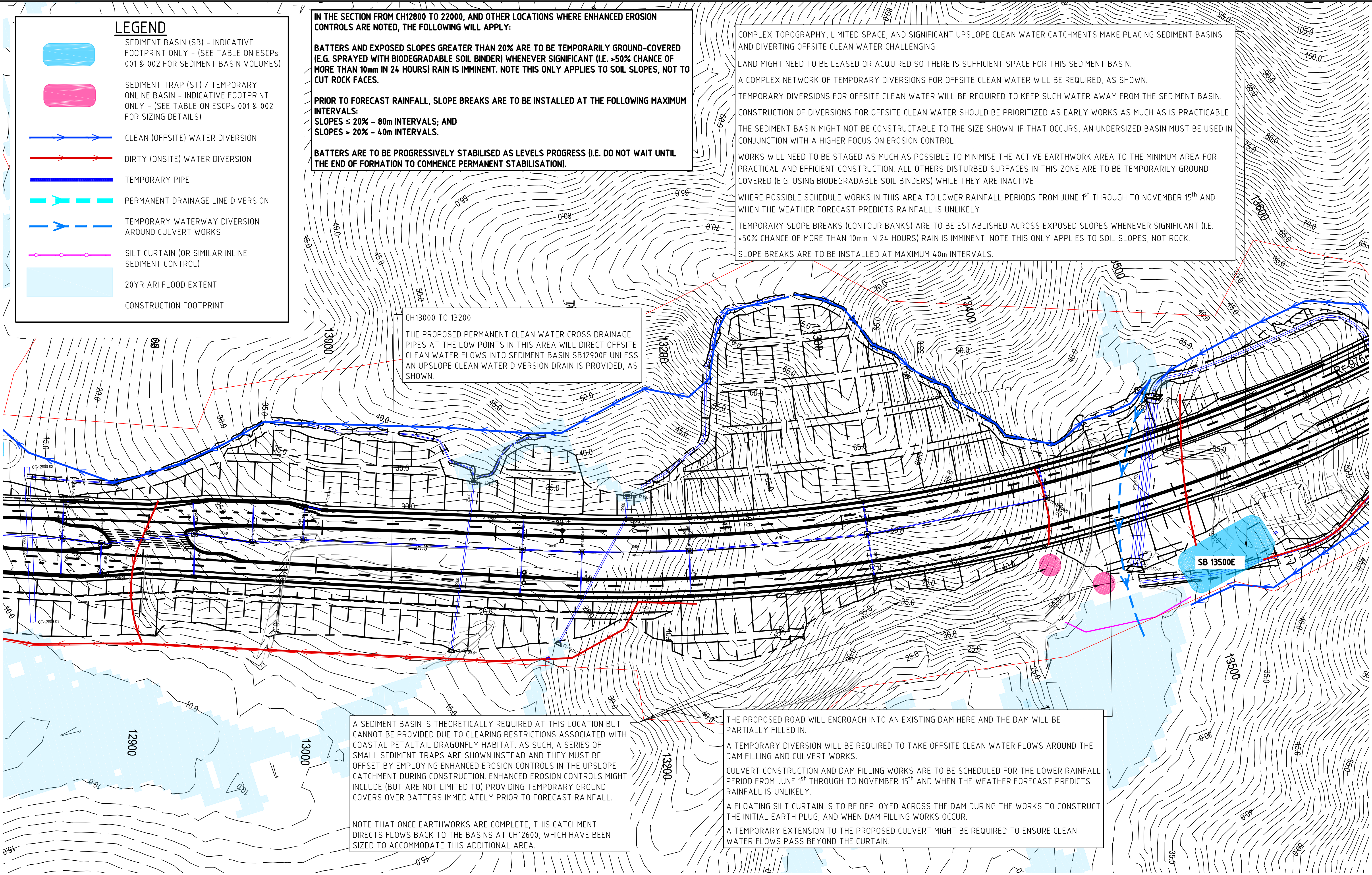
PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 12150 TO 12850

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP105	00

Plot Date: Monday, 25 May 2020 3:30:42 PM CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg



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- CONSTRUCTION FOOTPRINT

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PRIOR TO FORECAST RAINFALL, SLOPE BREAKS ARE TO BE INSTALLED AT THE FOLLOWING MAXIMUM INTERVALS:
SLOPES ≤ 20% - 80m INTERVALS; AND
SLOPES > 20% - 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).

COMPLEX TOPOGRAPHY, LIMITED SPACE, AND SIGNIFICANT UPSLOPE CLEAN WATER CATCHMENTS MAKE PLACING SEDIMENT BASINS AND DIVERTING OFFSITE CLEAN WATER CHALLENGING.

LAND MIGHT NEED TO BE LEASED OR ACQUIRED SO THERE IS SUFFICIENT SPACE FOR THIS SEDIMENT BASIN.

A COMPLEX NETWORK OF TEMPORARY DIVERSIONS FOR OFFSITE CLEAN WATER WILL BE REQUIRED, AS SHOWN.

TEMPORARY DIVERSIONS FOR OFFSITE CLEAN WATER WILL BE REQUIRED TO KEEP SUCH WATER AWAY FROM THE SEDIMENT BASIN.

CONSTRUCTION OF DIVERSIONS FOR OFFSITE CLEAN WATER SHOULD BE PRIORITIZED AS EARLY WORKS AS MUCH AS IS PRACTICABLE.

THE SEDIMENT BASIN MIGHT NOT BE CONSTRUCTABLE TO THE SIZE SHOWN. IF THAT OCCURS, AN UNDERSIZED BASIN MUST BE USED IN CONJUNCTION WITH A HIGHER FOCUS ON EROSION CONTROL.

WORKS WILL NEED TO BE STAGED AS MUCH AS POSSIBLE TO MINIMISE THE ACTIVE EARTHWORK AREA TO THE MINIMUM AREA FOR PRACTICAL AND EFFICIENT CONSTRUCTION. ALL OTHERS DISTURBED SURFACES IN THIS ZONE ARE TO BE TEMPORARILY GROUND COVERED (E.G. USING BIODEGRADABLE SOIL BINDERS) WHILE THEY ARE INACTIVE.

WHERE POSSIBLE SCHEDULE WORKS IN THIS AREA TO LOWER RAINFALL PERIODS FROM JUNE 1st THROUGH TO NOVEMBER 15th AND WHEN THE WEATHER FORECAST PREDICTS RAINFALL IS UNLIKELY.

TEMPORARY SLOPE BREAKS (CONTOUR BANKS) ARE TO BE ESTABLISHED ACROSS EXPOSED SLOPES WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT ROCK.

SLOPE BREAKS ARE TO BE INSTALLED AT MAXIMUM 40m INTERVALS.

CH13000 TO 13200

THE PROPOSED PERMANENT CLEAN WATER CROSS DRAINAGE PIPES AT THE LOW POINTS IN THIS AREA WILL DIRECT OFFSITE CLEAN WATER FLOWS INTO SEDIMENT BASIN SB12900E UNLESS AN UPSLOPE CLEAN WATER DIVERSION DRAIN IS PROVIDED, AS SHOWN.

A SEDIMENT BASIN IS THEORETICALLY REQUIRED AT THIS LOCATION BUT CANNOT BE PROVIDED DUE TO CLEARING RESTRICTIONS ASSOCIATED WITH COASTAL PETALTAIL DRAGONFLY HABITAT. AS SUCH, A SERIES OF SMALL SEDIMENT TRAPS ARE SHOWN INSTEAD AND THEY MUST BE OFFSET BY EMPLOYING ENHANCED EROSION CONTROLS IN THE UPSLOPE CATCHMENT DURING CONSTRUCTION. ENHANCED EROSION CONTROLS MIGHT INCLUDE (BUT ARE NOT LIMITED TO) PROVIDING TEMPORARY GROUND COVERS OVER BATTERS IMMEDIATELY PRIOR TO FORECAST RAINFALL.

NOTE THAT ONCE EARTHWORKS ARE COMPLETE, THIS CATCHMENT DIRECTS FLOWS BACK TO THE BASINS AT CH12600, WHICH HAVE BEEN SIZED TO ACCOMMODATE THIS ADDITIONAL AREA.

THE PROPOSED ROAD WILL ENCROACH INTO AN EXISTING DAM HERE AND THE DAM WILL BE PARTIALLY FILLED IN.

A TEMPORARY DIVERSION WILL BE REQUIRED TO TAKE OFFSITE CLEAN WATER FLOWS AROUND THE DAM FILLING AND CULVERT WORKS.

CULVERT CONSTRUCTION AND DAM FILLING WORKS ARE TO BE SCHEDULED FOR THE LOWER RAINFALL PERIOD FROM JUNE 1st THROUGH TO NOVEMBER 15th AND WHEN THE WEATHER FORECAST PREDICTS RAINFALL IS UNLIKELY.

A FLOATING SILT CURTAIN IS TO BE DEPLOYED ACROSS THE DAM DURING THE WORKS TO CONSTRUCT THE INITIAL EARTH PLUG, AND WHEN DAM FILLING WORKS OCCUR.

A TEMPORARY EXTENSION TO THE PROPOSED CULVERT MIGHT BE REQUIRED TO ENSURE CLEAN WATER FLOWS PASS BEYOND THE CURTAIN.

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A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT - ISSUE FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	A.J.T.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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PROJECT TITLE: COFFS HARBOUR BYPASS CONCEPT EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN CH 12850 TO 13520

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP106	00

Plot Date: Monday, 25 May 2020 3:34:07 PM CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg

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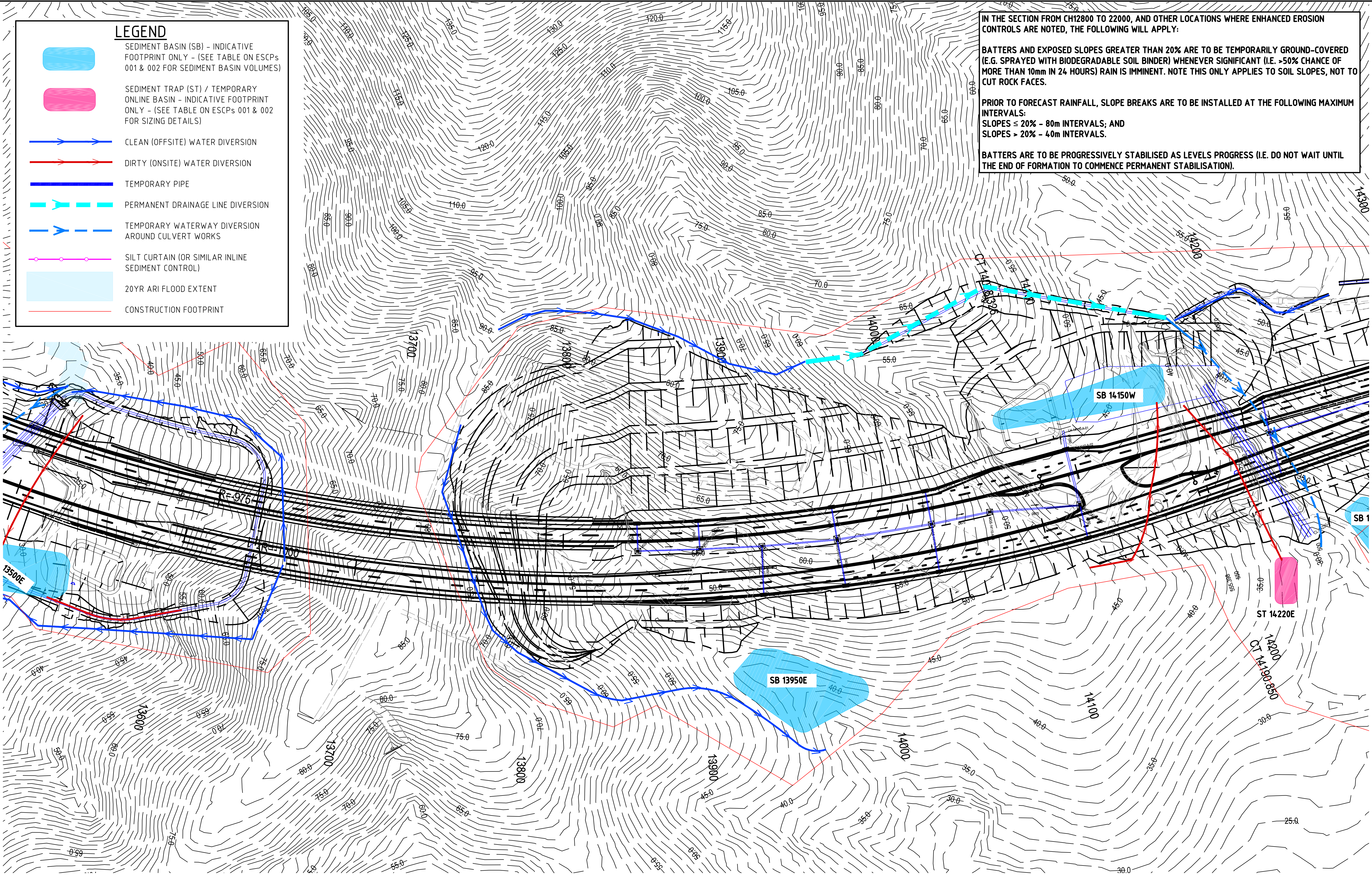

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FINAL APPROVAL A.M.
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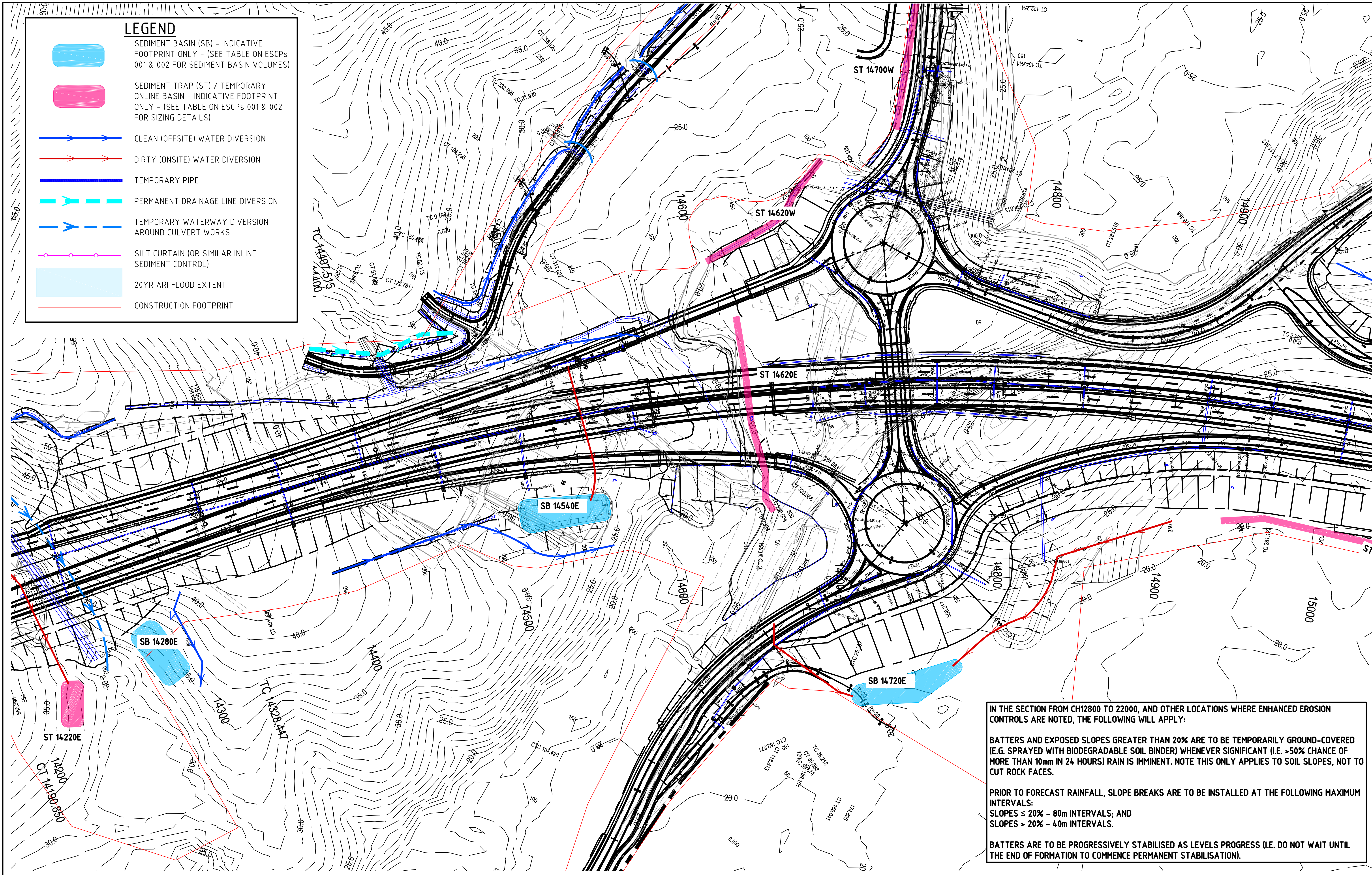
PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 13520 TO 14240

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP107	00



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FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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PROJECT TITLE

COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE

EROSION AND SEDIMENT CONTROL PLAN
CH 14240 TO 14970

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP108	00

Plot Date: Monday, 25 May 2020 3:40:54 PM CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg

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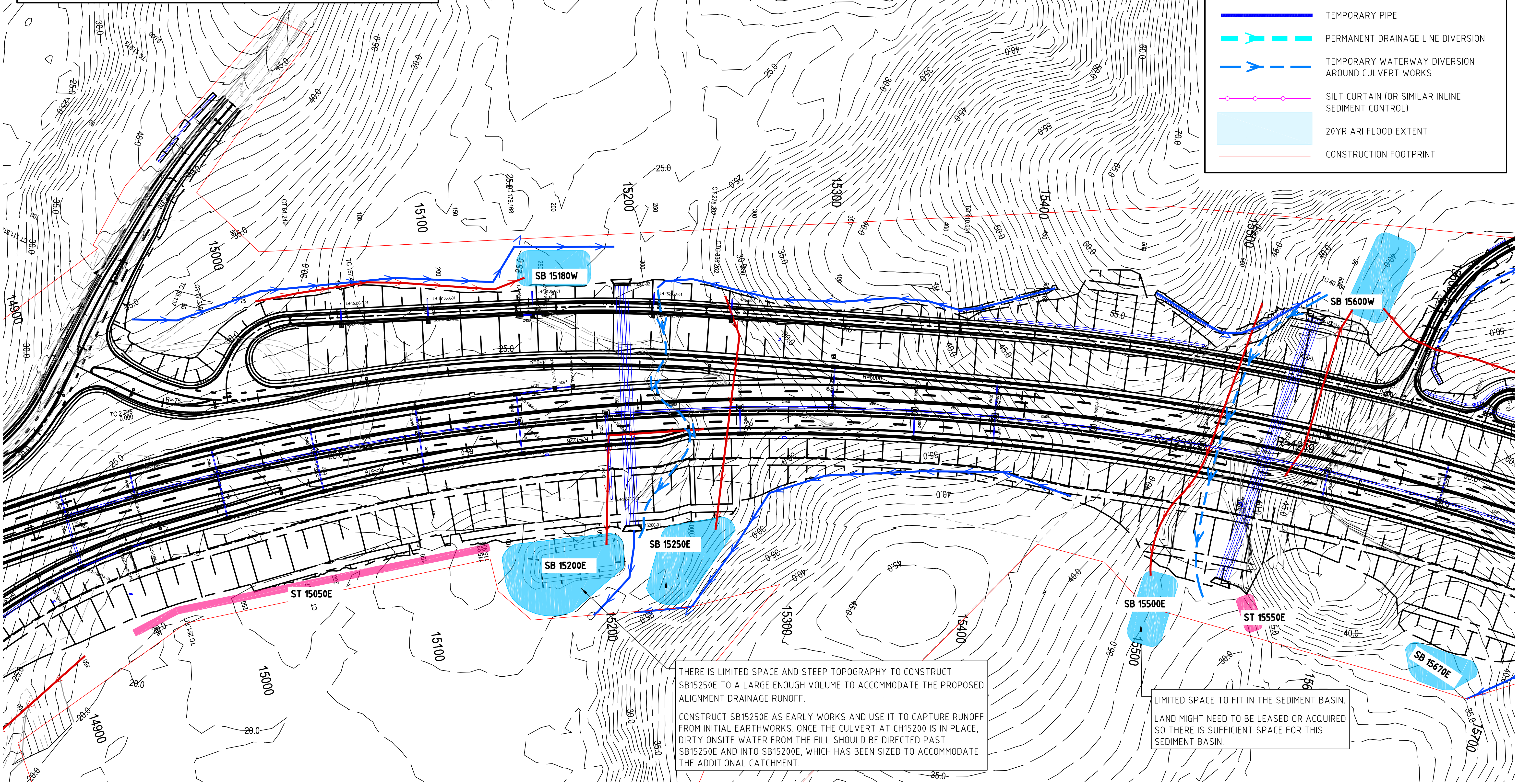

THERE IS LIMITED SPACE AND STEEP TOPOGRAPHY TO CONSTRUCT SB15250E TO A LARGE ENOUGH VOLUME TO ACCOMMODATE THE PROPOSED ALIGNMENT DRAINAGE RUNOFF.

CONSTRUCT SB15250E AS EARLY WORKS AND USE IT TO CAPTURE RUNOFF FROM INITIAL EARTHWORKS. ONCE THE CULVERT AT CH15200 IS IN PLACE, DIRTY ONSITE WATER FROM THE FILL SHOULD BE DIRECTED PAST SB15250E AND INTO SB15200E, WHICH HAS BEEN SIZED TO ACCOMMODATE THE ADDITIONAL CATCHMENT.

LIMITED SPACE TO FIT IN THE SEDIMENT BASIN.

LAND MIGHT NEED TO BE LEASED OR ACQUIRED SO THERE IS SUFFICIENT SPACE FOR THIS SEDIMENT BASIN.

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DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 14970 TO 15580

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP109	00

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THE TOPOGRAPHY IN THIS LOCATION IS STEEP AND COMPLEX, AND THE UPSLOPE CATCHMENTS ARE SIGNIFICANT.

SUBSTANTIAL EARTHWORKS WILL BE REQUIRED TO ESTABLISH THE CUT AND FILLS AND INSTALL THE CROSS-ALIGNMENT DRAINAGE CULVERTS.

DRAINAGE FROM CH16250 THROUGH TO THE RIDGE AT CH16410 CAN'T DRAIN TO BASIN 16100E DURING INITIAL STRIPPING AND EARTHWORKS.

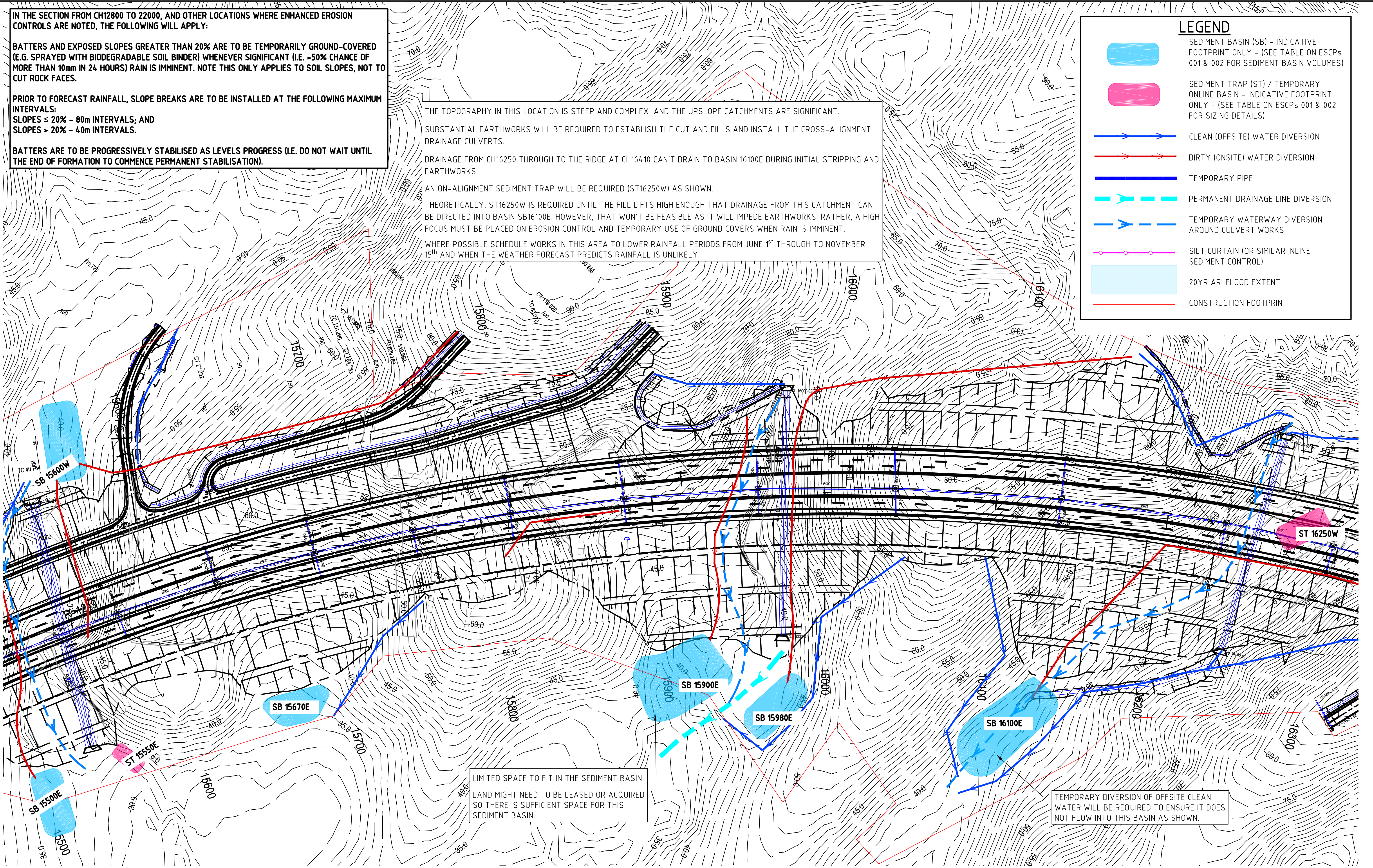
AN ON-ALIGNMENT SEDIMENT TRAP WILL BE REQUIRED (ST16250W) AS SHOWN.

THEORETICALLY, ST16250W IS REQUIRED UNTIL THE FILL LIFTS HIGH ENOUGH THAT DRAINAGE FROM THIS CATCHMENT CAN BE DIRECTED INTO BASIN SB16100E. HOWEVER, THAT WON'T BE FEASIBLE AS IT WILL IMPEDE EARTHWORKS. RATHER, A HIGH FOCUS MUST BE PLACED ON EROSION CONTROL AND TEMPORARY USE OF GROUND COVERS WHEN RAIN IS IMMINENT.

WHERE POSSIBLE SCHEDULE WORKS IN THIS AREA TO LOWER RAINFALL PERIODS FROM JUNE 1st THROUGH TO NOVEMBER 15th AND WHEN THE WEATHER FORECAST PREDICTS RAINFALL IS UNLIKELY.

LEGEND

- SEDIMENT BASIN (SB) – INDICATIVE FOOTPRINT ONLY – (SEE TABLE ON ESCPs 001 & 002 FOR SEDIMENT BASIN VOLUMES)
- SEDIMENT TRAP (ST) / TEMPORARY ONLINE BASIN – INDICATIVE FOOTPRINT ONLY – (SEE TABLE ON ESCPs 001 & 002 FOR SIZING DETAILS)
- CLEAN (OFFSITE) WATER DIVERSION
- DIRTY (ONSITE) WATER DIVERSION
- TEMPORARY PIPE
- PERMANENT DRAINAGE LINE DIVERSION
- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT



LIMITED SPACE TO FIT IN THE SEDIMENT BASIN.

LAND MIGHT NEED TO BE LEASED OR ACQUIRED SO THERE IS SUFFICIENT SPACE FOR THIS SEDIMENT BASIN.

TEMPORARY DIVERSION OF OFFSITE CLEAN WATER WILL BE REQUIRED TO ENSURE IT DOES NOT FLOW INTO THIS BASIN AS SHOWN.

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – UDATED CONSTRUCTION BOUNDARY
C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	A.J.T.	A.M.	DRAFT ISSUE – TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT – ISSUE FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	A.J.T.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT
CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT
CONTROL PLAN
CH 15580 TO 16270

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP110	00

LEGEND

- SEDIMENT BASIN (SB) – INDICATIVE FOOTPRINT ONLY – (SEE TABLE ON ESCPs 001 & 002 FOR SEDIMENT BASIN VOLUMES)
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- DIRTY (ONSITE) WATER DIVERSION
- TEMPORARY PIPE
- PERMANENT DRAINAGE LINE DIVERSION
- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

CH16800 TO 17600, INCLUDING BASINS SB16880E AND 16900E

COMPLEX TOPOGRAPHY, LIMITED SPACE, AND SIGNIFICANT UPSLOPE CLEAN WATER CATCHMENTS MAKE PLACING SEDIMENT BASINS AND DIVERTING OFFSITE CLEAN WATER CHALLENGING.

A COMPLEX NETWORK OF TEMPORARY DIVERSIONS FOR OFFSITE CLEAN WATER WILL BE REQUIRED, AS SHOWN.

TEMPORARY DIVERSIONS FOR OFFSITE CLEAN WATER WILL BE REQUIRED TO KEEP SUCH WATER AWAY FROM THE SEDIMENT BASIN.

CONSTRUCTION OF DIVERSIONS FOR OFFSITE CLEAN WATER SHOULD BE PRIORITIZED AS EARLY WORKS AS MUCH AS IS PRACTICABLE.

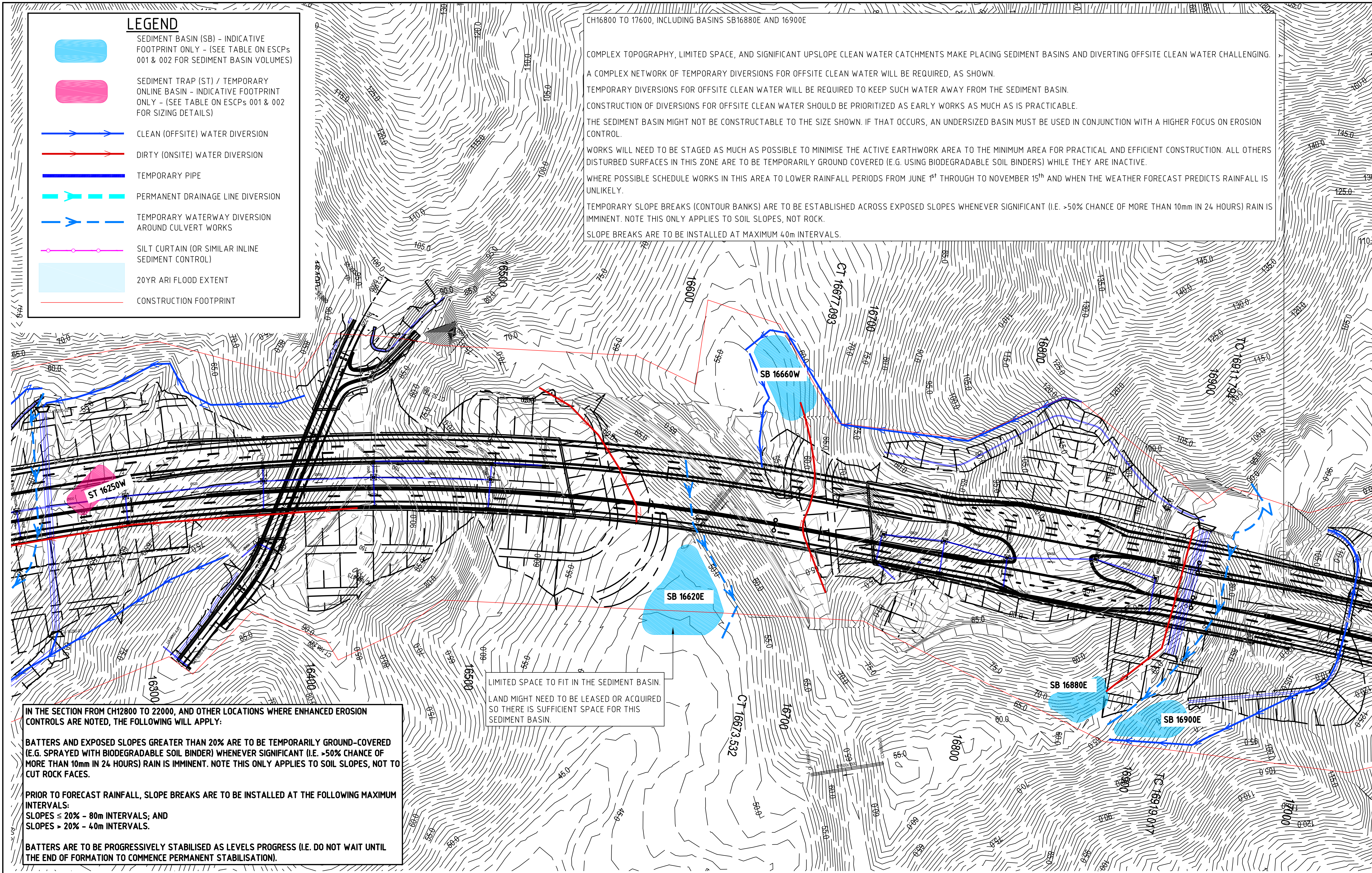
THE SEDIMENT BASIN MIGHT NOT BE CONSTRUCTABLE TO THE SIZE SHOWN. IF THAT OCCURS, AN UNDERSIZED BASIN MUST BE USED IN CONJUNCTION WITH A HIGHER FOCUS ON EROSION CONTROL.

WORKS WILL NEED TO BE STAGED AS MUCH AS POSSIBLE TO MINIMISE THE ACTIVE EARTHWORK AREA TO THE MINIMUM AREA FOR PRACTICAL AND EFFICIENT CONSTRUCTION. ALL OTHERS DISTURBED SURFACES IN THIS ZONE ARE TO BE TEMPORARILY GROUND COVERED (E.G. USING BIODEGRADABLE SOIL BINDERS) WHILE THEY ARE INACTIVE.

WHERE POSSIBLE SCHEDULE WORKS IN THIS AREA TO LOWER RAINFALL PERIODS FROM JUNE 1st THROUGH TO NOVEMBER 15th AND WHEN THE WEATHER FORECAST PREDICTS RAINFALL IS UNLIKELY.

TEMPORARY SLOPE BREAKS (CONTOUR BANKS) ARE TO BE ESTABLISHED ACROSS EXPOSED SLOPES WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT ROCK.

SLOPE BREAKS ARE TO BE INSTALLED AT MAXIMUM 40m INTERVALS.



IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

BATTERS AND EXPOSED SLOPES GREATER THAN 20% ARE TO BE TEMPORARILY GROUND-COVERED (E.G. SPRAYED WITH BIODEGRADABLE SOIL BINDER) WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT TO CUT ROCK FACES.

PRIOR TO FORECAST RAINFALL, SLOPE BREAKS ARE TO BE INSTALLED AT THE FOLLOWING MAXIMUM INTERVALS:
SLOPES ≤ 20% – 80m INTERVALS; AND
SLOPES > 20% – 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).

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A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT – ISSUE FOR CONSULTATION

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DRAWN BY A.J.T.
FINAL APPROVAL A.M.
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PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 16270 TO 17000

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP111	00

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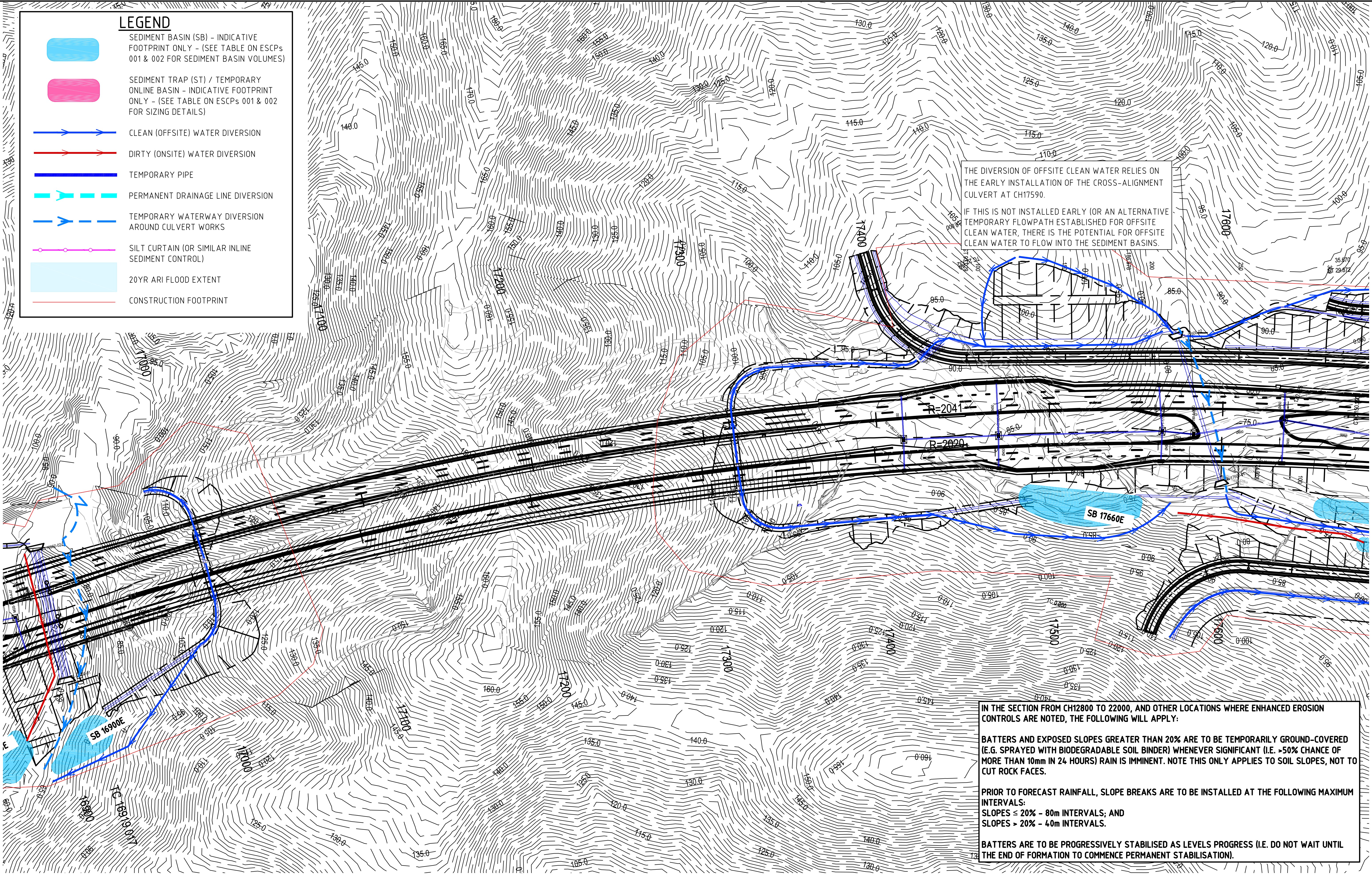

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DRAWING STATUS

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DRAWN BY	A.J.T.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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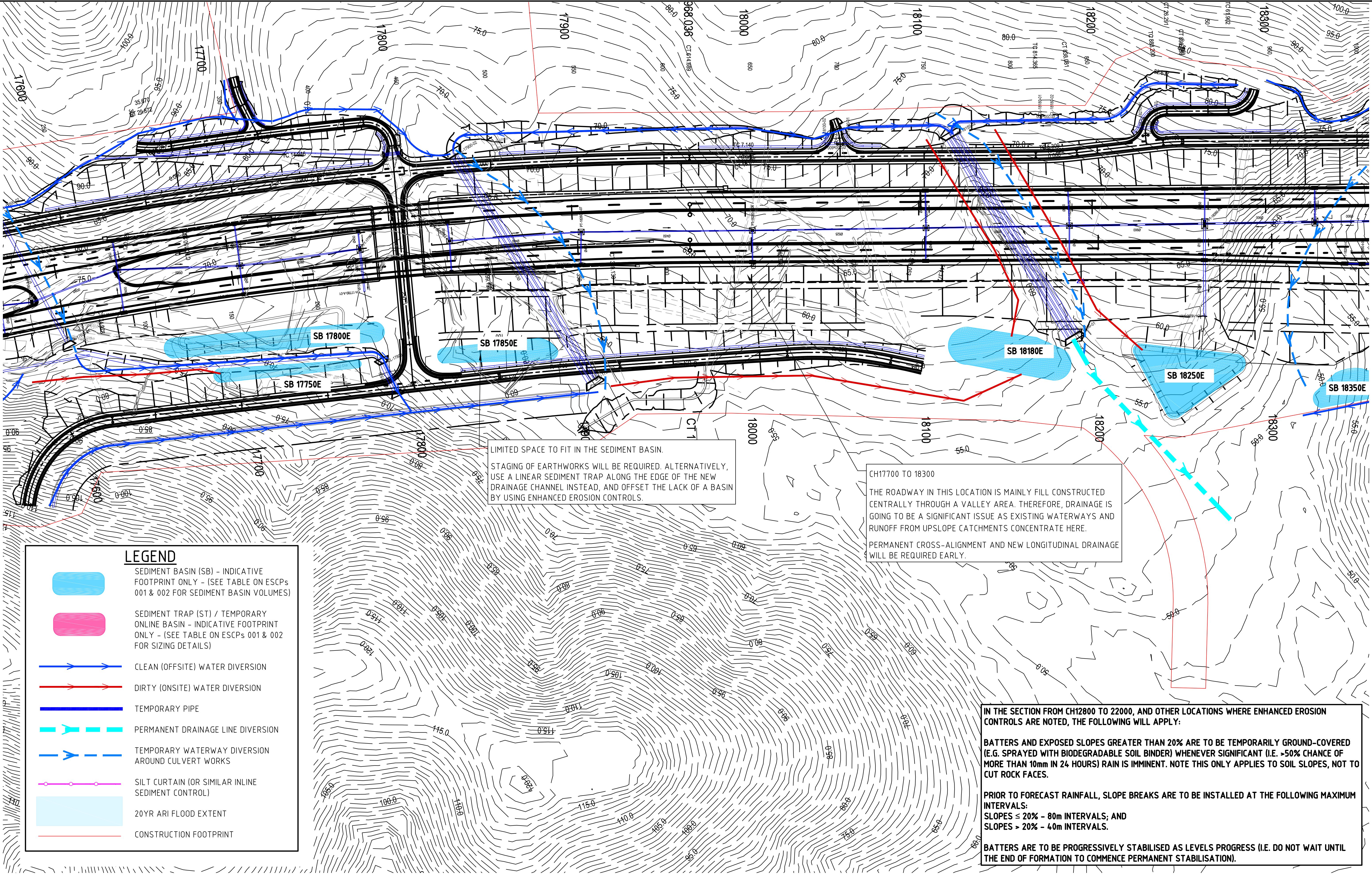
PROJECT TITLE: COFFS HARBOUR BYPASS CONCEPT EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN CH 17000 TO 17650

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP112	00

Plot Date: Monday, 25 May 2020 3:55:04 PM CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg



LIMITED SPACE TO FIT IN THE SEDIMENT BASIN.

STAGING OF EARTHWORKS WILL BE REQUIRED. ALTERNATIVELY, USE A LINEAR SEDIMENT TRAP ALONG THE EDGE OF THE NEW DRAINAGE CHANNEL INSTEAD, AND OFFSET THE LACK OF A BASIN BY USING ENHANCED EROSION CONTROLS.

CH17700 TO 18300

THE ROADWAY IN THIS LOCATION IS MAINLY FILL CONSTRUCTED CENTRALLY THROUGH A VALLEY AREA. THEREFORE, DRAINAGE IS GOING TO BE A SIGNIFICANT ISSUE AS EXISTING WATERWAYS AND RUNOFF FROM UPSLOPE CATCHMENTS CONCENTRATE HERE.

PERMANENT CROSS-ALIGNMENT AND NEW LONGITUDINAL DRAINAGE WILL BE REQUIRED EARLY.

LEGEND

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- SEDIMENT TRAP (ST) / TEMPORARY ONLINE BASIN - INDICATIVE FOOTPRINT ONLY - (SEE TABLE ON ESCPs 001 & 002 FOR SIZING DETAILS)
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- TEMPORARY PIPE
- PERMANENT DRAINAGE LINE DIVERSION
- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

BATTERS AND EXPOSED SLOPES GREATER THAN 20% ARE TO BE TEMPORARILY GROUND-COVERED (E.G. SPRAYED WITH BIODEGRADABLE SOIL BINDER) WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT TO CUT ROCK FACES.

PRIOR TO FORECAST RAINFALL, SLOPE BREAKS ARE TO BE INSTALLED AT THE FOLLOWING MAXIMUM INTERVALS:
SLOPES ≤ 20% - 80m INTERVALS; AND
SLOPES > 20% - 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).

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DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	A.J.T.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 17650 TO 18320

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP113	00

Plot Date: Monday, 25 May 2020 3:58:32 PM CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg

LEGEND

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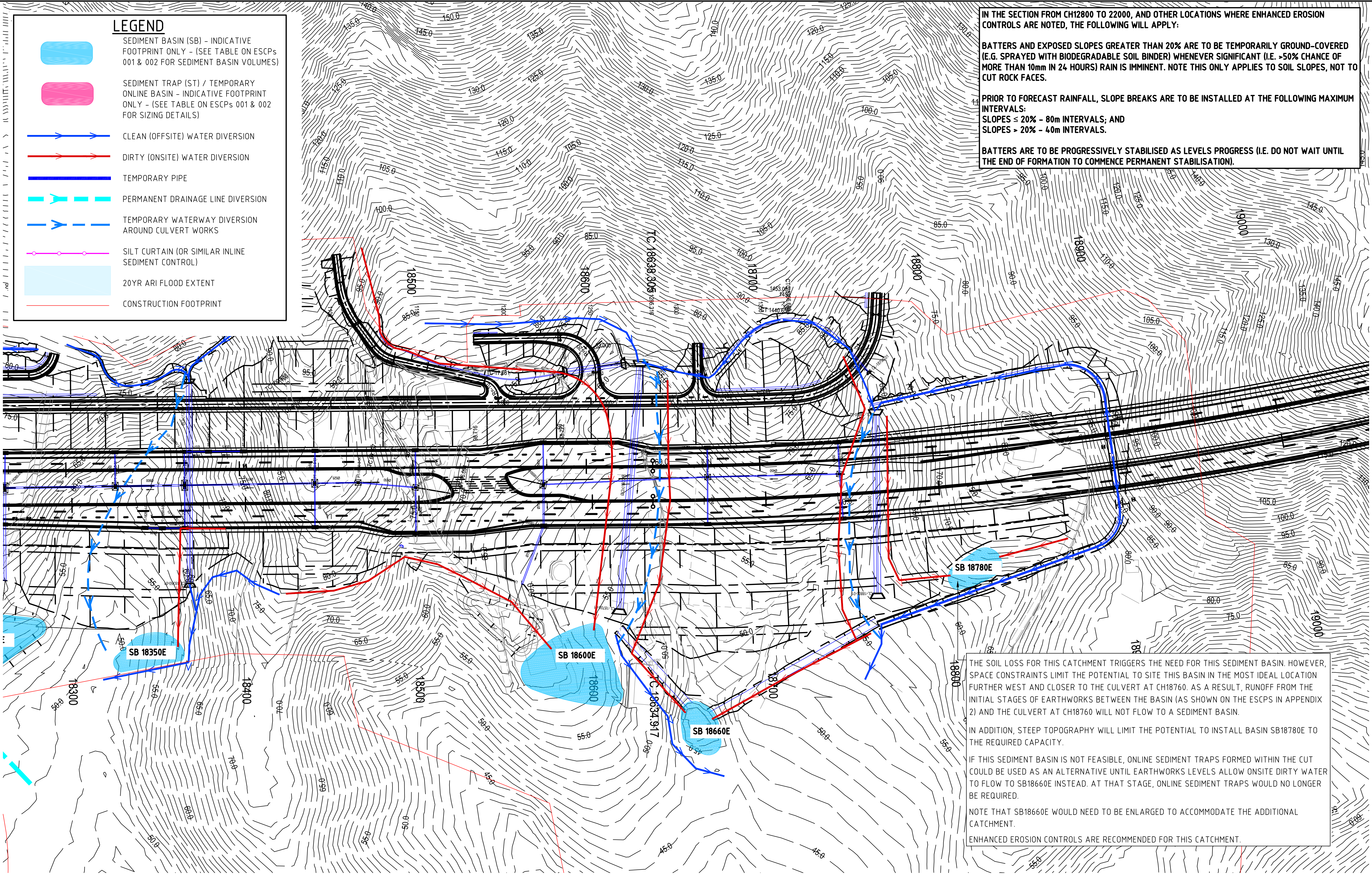
- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

BATTERS AND EXPOSED SLOPES GREATER THAN 20% ARE TO BE TEMPORARILY GROUND-COVERED (E.G. SPRAYED WITH BIODEGRADABLE SOIL BINDER) WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT TO CUT ROCK FACES.

PRIOR TO FORECAST RAINFALL, SLOPE BREAKS ARE TO BE INSTALLED AT THE FOLLOWING MAXIMUM INTERVALS:
SLOPES ≤ 20% - 80m INTERVALS; AND
SLOPES > 20% - 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).



THE SOIL LOSS FOR THIS CATCHMENT TRIGGERS THE NEED FOR THIS SEDIMENT BASIN. HOWEVER, SPACE CONSTRAINTS LIMIT THE POTENTIAL TO SITE THIS BASIN IN THE MOST IDEAL LOCATION FURTHER WEST AND CLOSER TO THE CULVERT AT CH18760. AS A RESULT, RUNOFF FROM THE INITIAL STAGES OF EARTHWORKS BETWEEN THE BASIN (AS SHOWN ON THE ESCPS IN APPENDIX 2) AND THE CULVERT AT CH18760 WILL NOT FLOW TO A SEDIMENT BASIN.

IN ADDITION, STEEP TOPOGRAPHY WILL LIMIT THE POTENTIAL TO INSTALL BASIN SB18780E TO THE REQUIRED CAPACITY.

IF THIS SEDIMENT BASIN IS NOT FEASIBLE, ONLINE SEDIMENT TRAPS FORMED WITHIN THE CUT COULD BE USED AS AN ALTERNATIVE UNTIL EARTHWORKS LEVELS ALLOW ONSITE DIRTY WATER TO FLOW TO SB18660E INSTEAD. AT THAT STAGE, ONLINE SEDIMENT TRAPS WOULD NO LONGER BE REQUIRED.

NOTE THAT SB18660E WOULD NEED TO BE ENLARGED TO ACCOMMODATE THE ADDITIONAL CATCHMENT.

ENHANCED EROSION CONTROLS ARE RECOMMENDED FOR THIS CATCHMENT.

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DRAWN BY A.J.T.
FINAL APPROVAL A.M.
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PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 18320 TO 18960

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP114	00

Plot Date: Monday, 25 May 2020 4:02:18 PM CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg

IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

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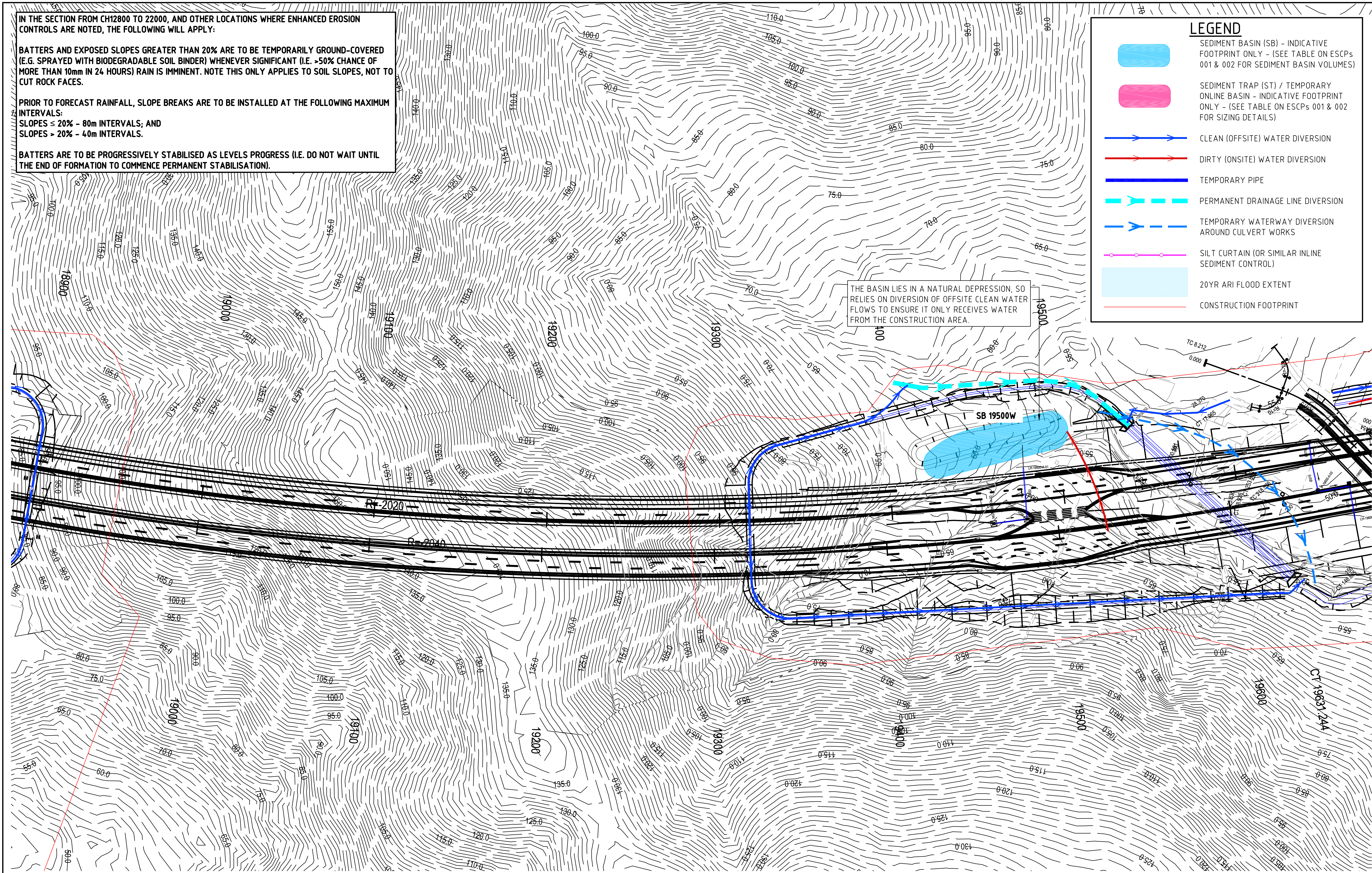
PRIOR TO FORECAST RAINFALL, SLOPE BREAKS ARE TO BE INSTALLED AT THE FOLLOWING MAXIMUM INTERVALS:
SLOPES ≤ 20% - 80m INTERVALS; AND
SLOPES > 20% - 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).



REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – UDATED CONSTRUCTION BOUNDARY
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DRAWING STATUS

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FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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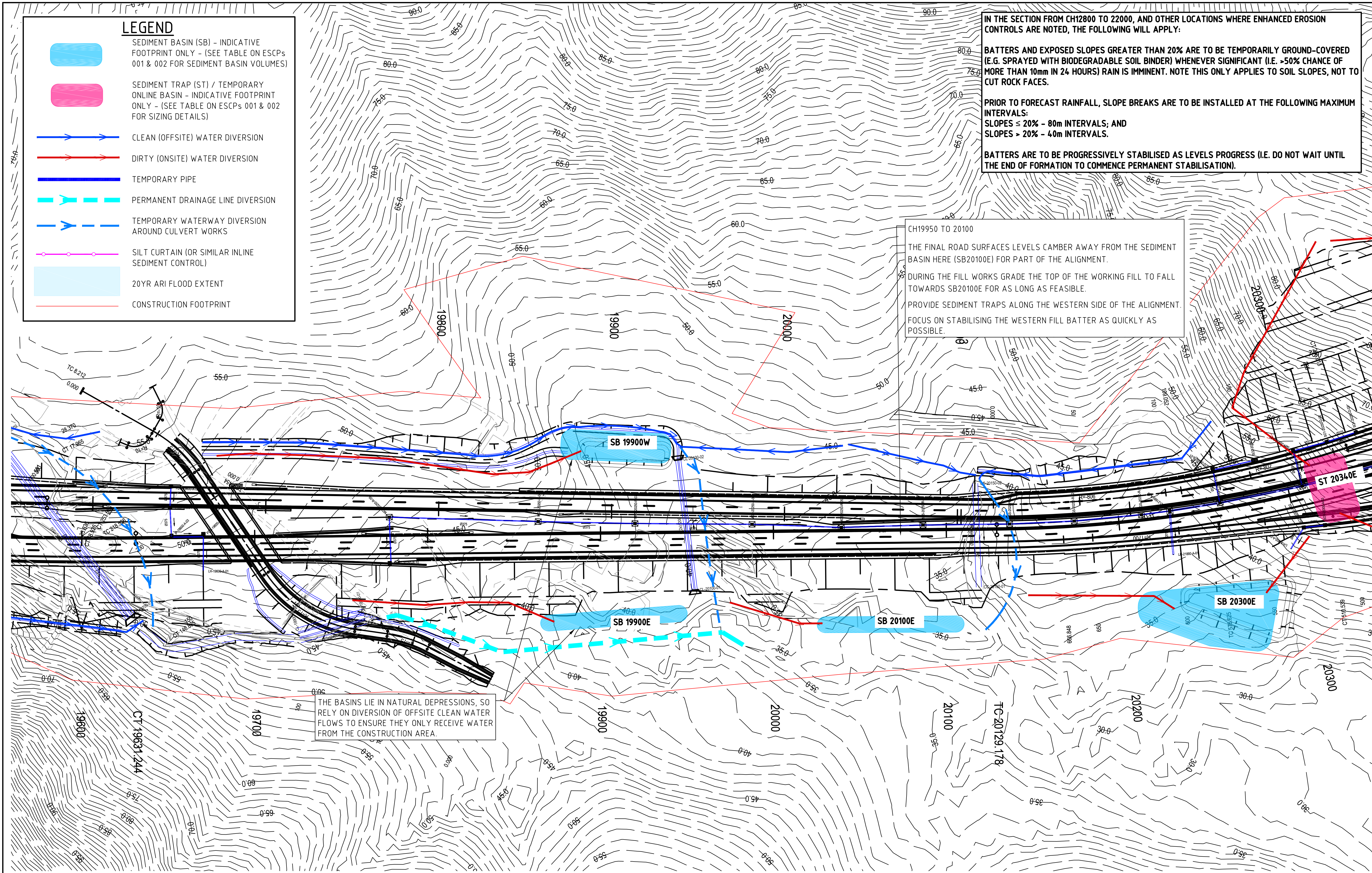
PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT
CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT
CONTROL PLAN
CH 18960 TO 19600

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP115	00

Plot Date: Monday, 25 May 2020 4:05:44 PM   CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg



LEGEND

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- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

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SLOPES > 20% - 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).

CH19950 TO 20100

THE FINAL ROAD SURFACES LEVELS CAMBER AWAY FROM THE SEDIMENT BASIN HERE (SB20100E) FOR PART OF THE ALIGNMENT.

DURING THE FILL WORKS GRADE THE TOP OF THE WORKING FILL TO FALL TOWARDS SB20100E FOR AS LONG AS FEASIBLE.

PROVIDE SEDIMENT TRAPS ALONG THE WESTERN SIDE OF THE ALIGNMENT.

FOCUS ON STABILISING THE WESTERN FILL BATTER AS QUICKLY AS POSSIBLE.

THE BASINS LIE IN NATURAL DEPRESSIONS, SO RELY ON DIVERSION OF OFFSITE CLEAN WATER FLOWS TO ENSURE THEY ONLY RECEIVE WATER FROM THE CONSTRUCTION AREA.

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE - UDATED CONSTRUCTION BOUNDARY
C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE - AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	A.J.T.	A.M.	DRAFT ISSUE - TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT - ISSUE FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	A.J.T.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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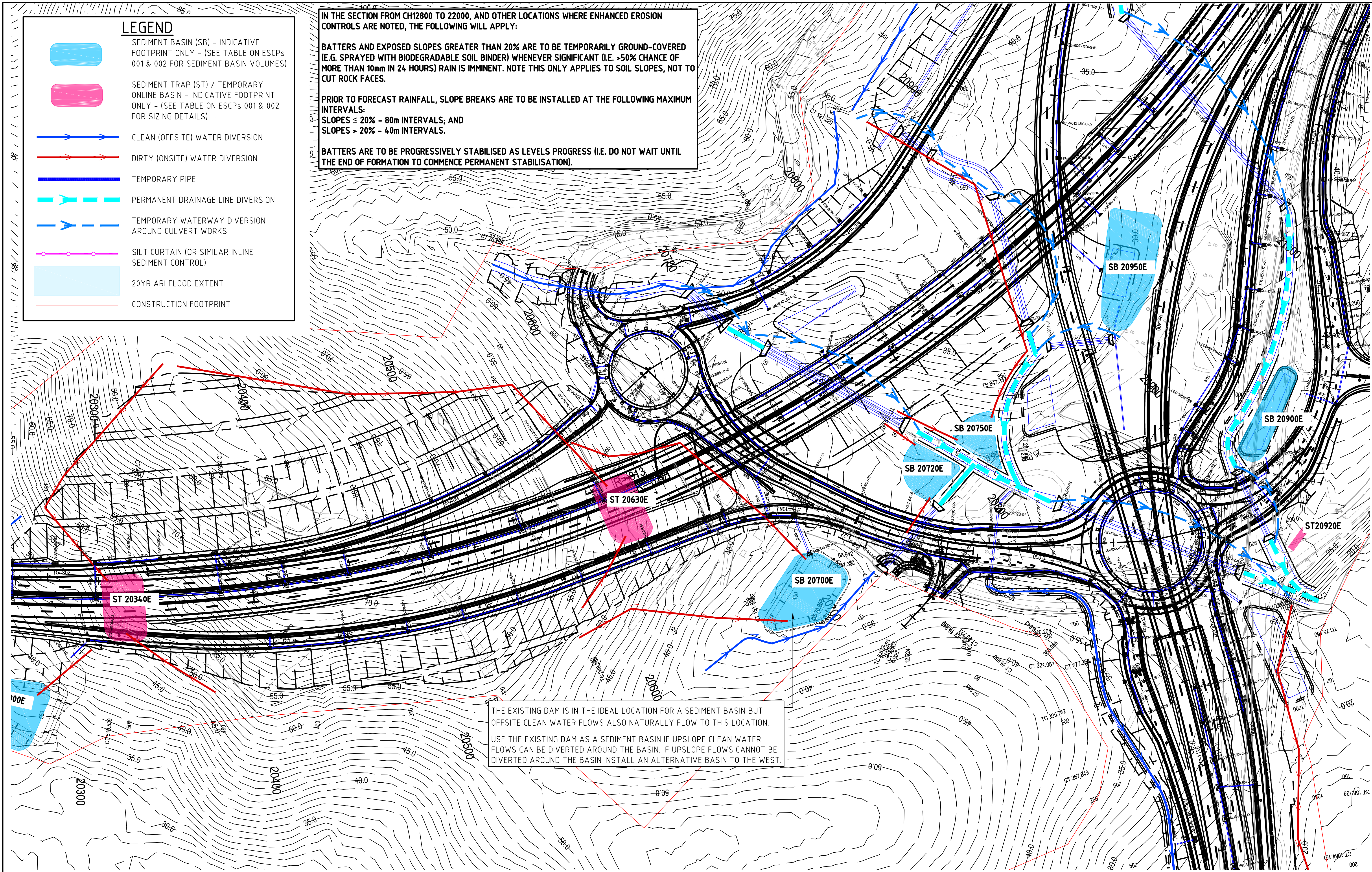
PROJECT TITLE: COFFS HARBOUR BYPASS CONCEPT EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN CH 19600 TO 20300

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP116	00

Plot Date: Monday, 25 May 2020 4:09:12 PM CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg



LEGEND

- SEDIMENT BASIN (SB) - INDICATIVE FOOTPRINT ONLY - (SEE TABLE ON ESCPs 001 & 002 FOR SEDIMENT BASIN VOLUMES)
- SEDIMENT TRAP (ST) / TEMPORARY ONLINE BASIN - INDICATIVE FOOTPRINT ONLY - (SEE TABLE ON ESCPs 001 & 002 FOR SIZING DETAILS)
- CLEAN (OFFSITE) WATER DIVERSION
- DIRTY (ONSITE) WATER DIVERSION
- TEMPORARY PIPE
- PERMANENT DRAINAGE LINE DIVERSION
- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

BATTERS AND EXPOSED SLOPES GREATER THAN 20% ARE TO BE TEMPORARILY GROUND-COVERED (E.G. SPRAYED WITH BIODEGRADABLE SOIL BINDER) WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT TO CUT ROCK FACES.

PRIOR TO FORECAST RAINFALL, SLOPE BREAKS ARE TO BE INSTALLED AT THE FOLLOWING MAXIMUM INTERVALS:
SLOPES ≤ 20% - 80m INTERVALS; AND
SLOPES > 20% - 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE - UDATED CONSTRUCTION BOUNDARY
C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE - AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	A.J.T.	A.M.	DRAFT ISSUE - TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT - ISSUE FOR CONSULTATION

DRAWING STATUS
DESIGN BY A.J.T.
DRAWN BY A.J.T.
FINAL APPROVAL A.M.
SCALE: (on A3 Original) 1:2000
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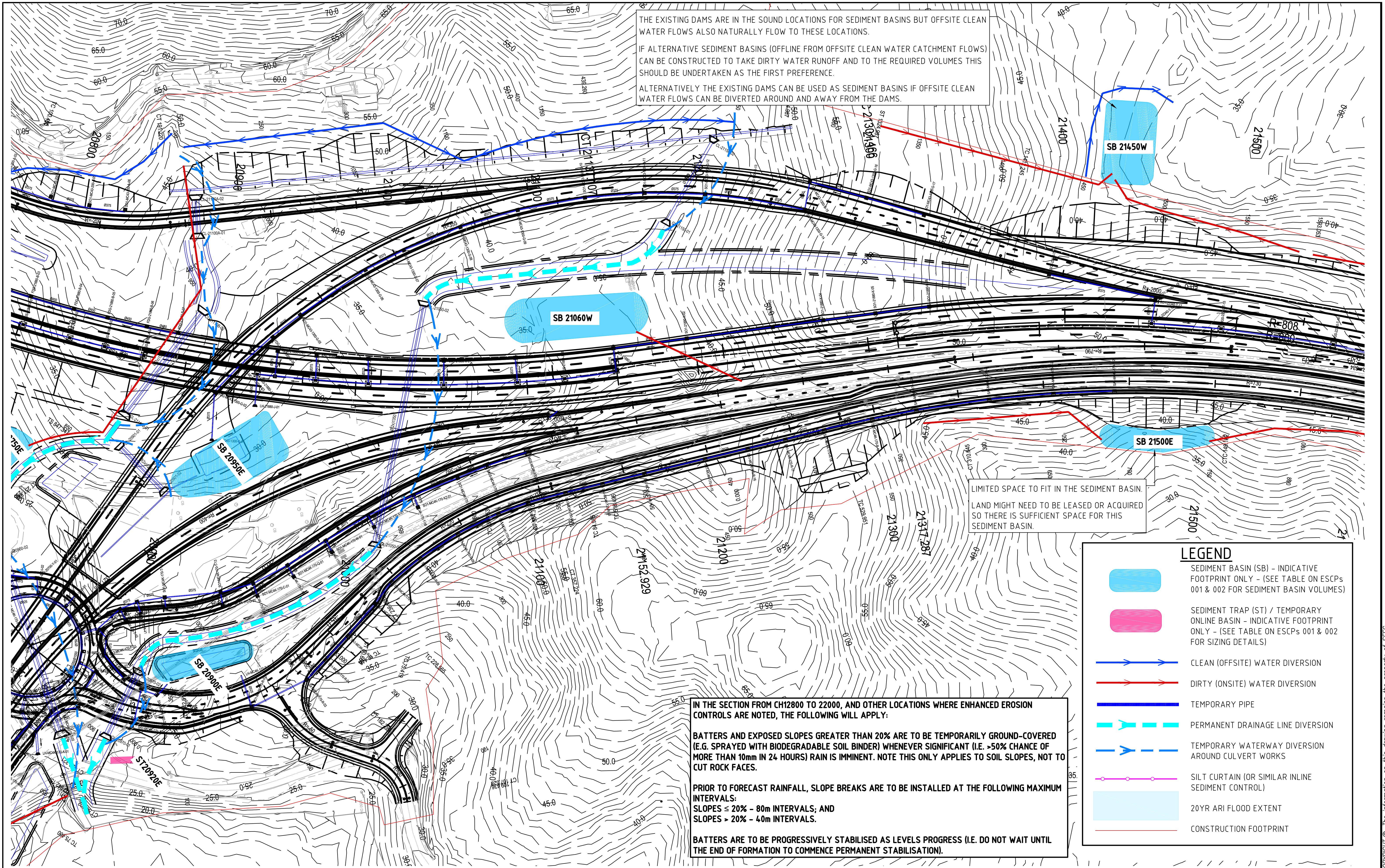
PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 20300 TO 21000

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP117	00

Plot Date: Monday, 25 May 2020 4:12:49 PM   CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg



THE EXISTING DAMS ARE IN THE SOUND LOCATIONS FOR SEDIMENT BASINS BUT OFFSITE CLEAN WATER FLOWS ALSO NATURALLY FLOW TO THESE LOCATIONS.

IF ALTERNATIVE SEDIMENT BASINS (OFFLINE FROM OFFSITE CLEAN WATER CATCHMENT FLOWS) CAN BE CONSTRUCTED TO TAKE DIRTY WATER RUNOFF AND TO THE REQUIRED VOLUMES THIS SHOULD BE UNDERTAKEN AS THE FIRST PREFERENCE.

ALTERNATIVELY THE EXISTING DAMS CAN BE USED AS SEDIMENT BASINS IF OFFSITE CLEAN WATER FLOWS CAN BE DIVERTED AROUND AND AWAY FROM THE DAMS.

LIMITED SPACE TO FIT IN THE SEDIMENT BASIN.

LAND MIGHT NEED TO BE LEASED OR ACQUIRED SO THERE IS SUFFICIENT SPACE FOR THIS SEDIMENT BASIN.

IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

BATTERS AND EXPOSED SLOPES GREATER THAN 20% ARE TO BE TEMPORARILY GROUND-COVERED (E.G. SPRAYED WITH BIODEGRADABLE SOIL BINDER) WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT TO CUT ROCK FACES.

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SLOPES ≤ 20% – 80m INTERVALS; AND
SLOPES > 20% – 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).

LEGEND

- SEDIMENT BASIN (SB) – INDICATIVE FOOTPRINT ONLY – (SEE TABLE ON ESCPs 001 & 002 FOR SEDIMENT BASIN VOLUMES)
- SEDIMENT TRAP (ST) / TEMPORARY ONLINE BASIN – INDICATIVE FOOTPRINT ONLY – (SEE TABLE ON ESCPs 001 & 002 FOR SIZING DETAILS)
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- DIRTY (ONSITE) WATER DIVERSION
- TEMPORARY PIPE
- PERMANENT DRAINAGE LINE DIVERSION
- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – UDATED CONSTRUCTION BOUNDARY
C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	A.J.T.	A.M.	DRAFT ISSUE – TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT – ISSUE FOR CONSULTATION

DRAWING STATUS

DESIGN BY	A.J.T.
DRAWN BY	A.J.T.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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PROJECT TITLE

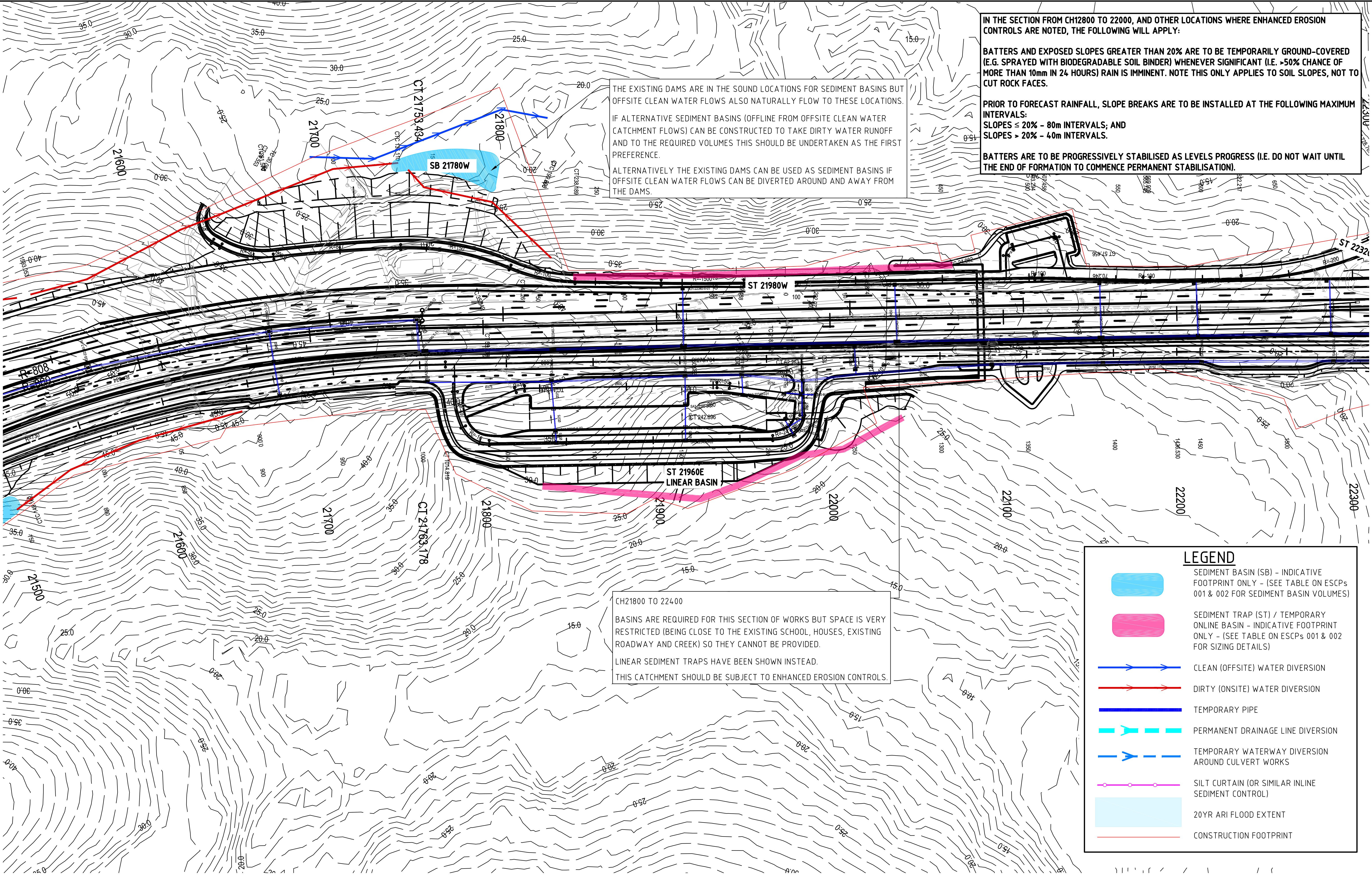
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE

EROSION AND SEDIMENT CONTROL PLAN
CH 21000 TO 21560

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP118	00

Plot Date: Monday, 25 May 2020 4:16:23 PM   CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg



IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

BATTERS AND EXPOSED SLOPES GREATER THAN 20% ARE TO BE TEMPORARILY GROUND-COVERED (E.G. SPRAYED WITH BIODEGRADABLE SOIL BINDER) WHENEVER SIGNIFICANT (I.E. >50% CHANCE OF MORE THAN 10mm IN 24 HOURS) RAIN IS IMMINENT. NOTE THIS ONLY APPLIES TO SOIL SLOPES, NOT TO CUT ROCK FACES.

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ALTERNATIVELY THE EXISTING DAMS CAN BE USED AS SEDIMENT BASINS IF OFFSITE CLEAN WATER FLOWS CAN BE DIVERTED AROUND AND AWAY FROM THE DAMS.

CH21800 TO 22400

BASINS ARE REQUIRED FOR THIS SECTION OF WORKS BUT SPACE IS VERY RESTRICTED (BEING CLOSE TO THE EXISTING SCHOOL, HOUSES, EXISTING ROADWAY AND CREEK) SO THEY CANNOT BE PROVIDED.

LINEAR SEDIMENT TRAPS HAVE BEEN SHOWN INSTEAD.

THIS CATCHMENT SHOULD BE SUBJECT TO ENHANCED EROSION CONTROLS.

LEGEND

- SEDIMENT BASIN (SB) - INDICATIVE FOOTPRINT ONLY - (SEE TABLE ON ESCPs 001 & 002 FOR SEDIMENT BASIN VOLUMES)
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- TEMPORARY PIPE
- PERMANENT DRAINAGE LINE DIVERSION
- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE - UDATED CONSTRUCTION BOUNDARY
C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE - AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	A.J.T.	A.M.	DRAFT ISSUE - TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT - ISSUE FOR CONSULTATION

DRAWING STATUS
DESIGN BY A.J.T.
DRAWN BY A.J.T.
FINAL APPROVAL A.M.
SCALE: (on A3 Original) 1:2000

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PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 21560 TO 22280

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP119	00

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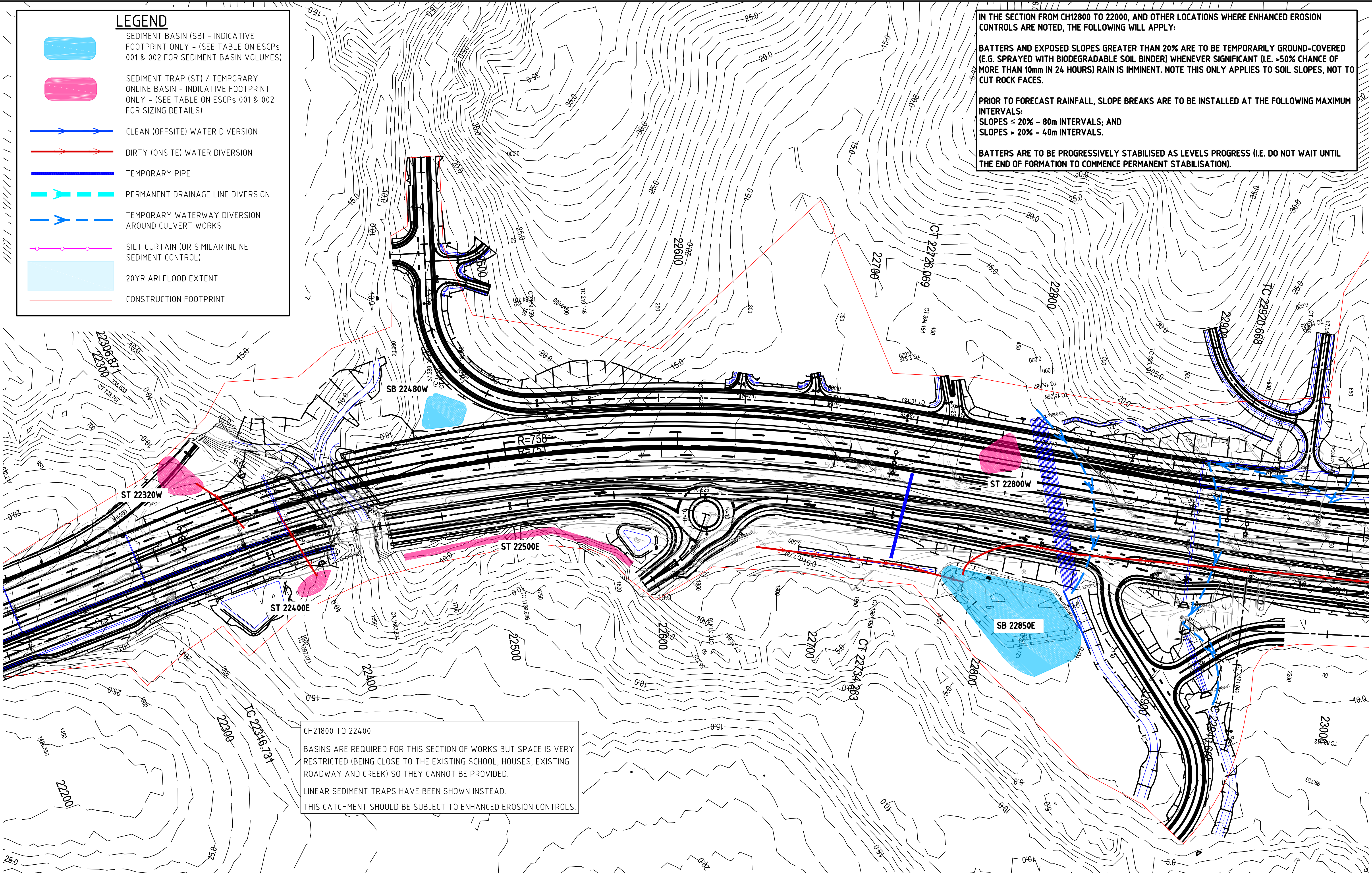

LEGEND

- SEDIMENT BASIN (SB) - INDICATIVE FOOTPRINT ONLY - (SEE TABLE ON ESCPs 001 & 002 FOR SEDIMENT BASIN VOLUMES)
- SEDIMENT TRAP (ST) / TEMPORARY ONLINE BASIN - INDICATIVE FOOTPRINT ONLY - (SEE TABLE ON ESCPs 001 & 002 FOR SIZING DETAILS)
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- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

IN THE SECTION FROM CH12800 TO 22000, AND OTHER LOCATIONS WHERE ENHANCED EROSION CONTROLS ARE NOTED, THE FOLLOWING WILL APPLY:

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SLOPES > 20% - 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).

CH21800 TO 22400

BASINS ARE REQUIRED FOR THIS SECTION OF WORKS BUT SPACE IS VERY RESTRICTED (BEING CLOSE TO THE EXISTING SCHOOL, HOUSES, EXISTING ROADWAY AND CREEK) SO THEY CANNOT BE PROVIDED.

LINEAR SEDIMENT TRAPS HAVE BEEN SHOWN INSTEAD.

THIS CATCHMENT SHOULD BE SUBJECT TO ENHANCED EROSION CONTROLS.

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE - UPDATED CONSTRUCTION BOUNDARY
C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE - AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	A.J.T.	A.M.	DRAFT ISSUE - TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT - ISSUE FOR CONSULTATION

DRAWING STATUS
DESIGN BY A.J.T.
DRAWN BY A.J.T.
FINAL APPROVAL A.M.
SCALE: (on A3 Original) 1:2000

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PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 22280 TO 23000

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP120	00

Plot Date: Monday, 25 May 2020 4:23:21 PM   CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg

LEGEND

- SEDIMENT BASIN (SB) – INDICATIVE FOOTPRINT ONLY – (SEE TABLE ON ESCPs 001 & 002 FOR SEDIMENT BASIN VOLUMES)
- SEDIMENT TRAP (ST) / TEMPORARY ONLINE BASIN – INDICATIVE FOOTPRINT ONLY – (SEE TABLE ON ESCPs 001 & 002 FOR SIZING DETAILS)
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- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

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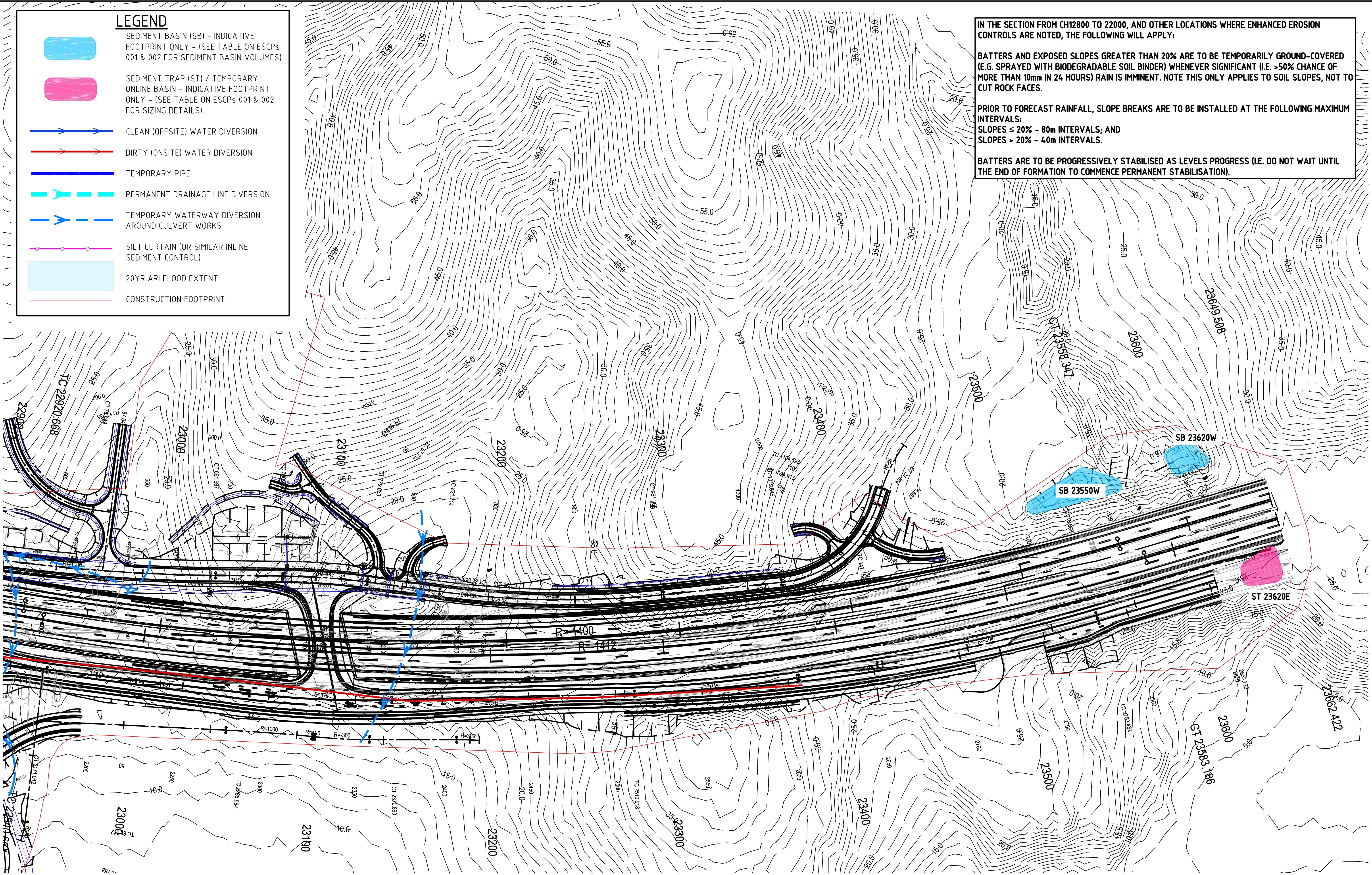

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – UDATED CONSTRUCTION BOUNDARY
C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	A.J.T.	A.M.	DRAFT ISSUE – TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT – ISSUE FOR CONSULTATION

DRAWING STATUS
DESIGN BY A.J.T.
DRAWN BY A.J.T.
FINAL APPROVAL A.M.
SCALE: (on A3 Original) 1:2000
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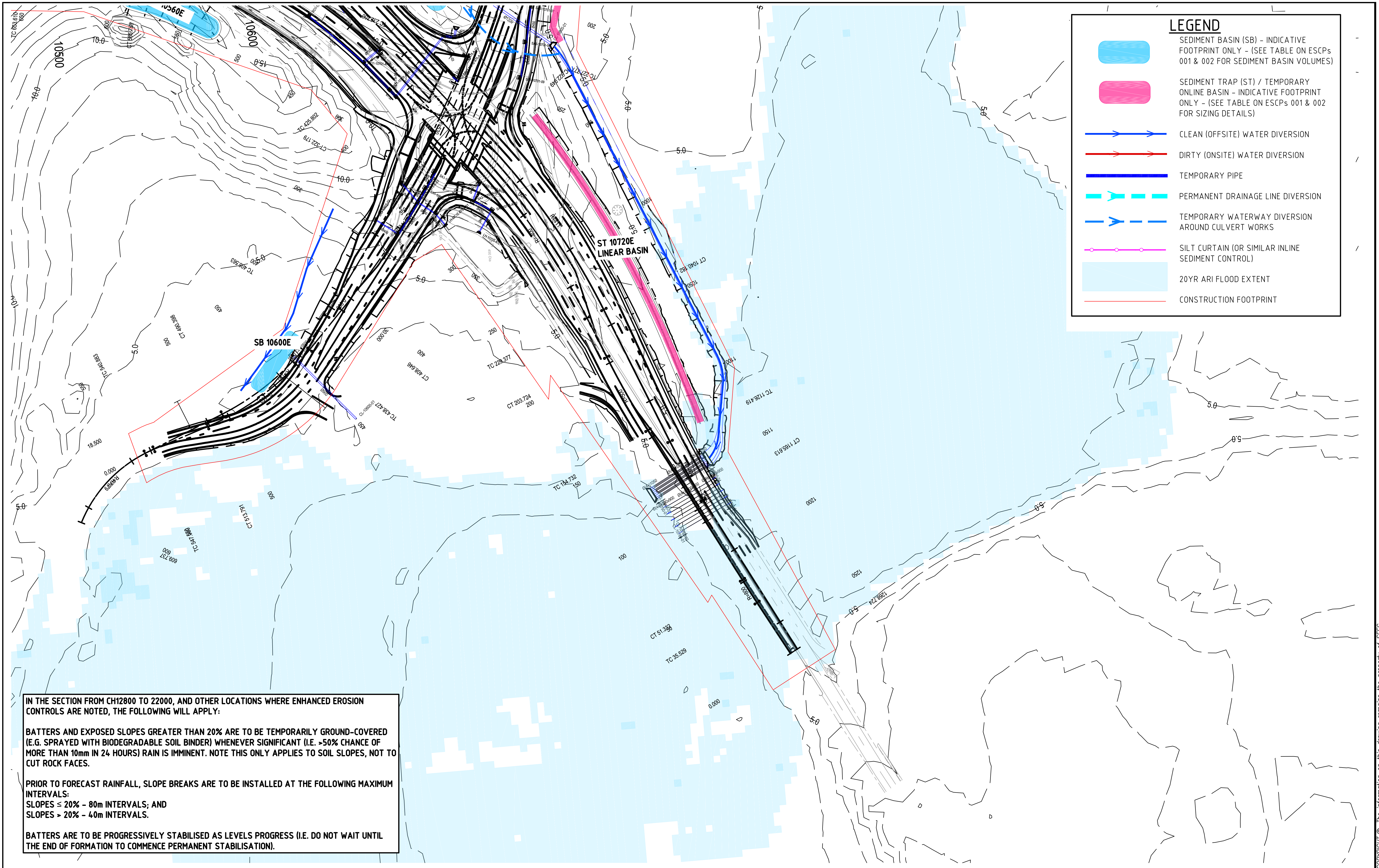
PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
CH 23000 TO 23682.172

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP121	00

Plot Date: Monday, 25 May 2020 4:26:48 PM CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg



LEGEND

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- CONSTRUCTION FOOTPRINT

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REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
00	25/05/20	A.J.T.	L.O.	A.M.	ISSUED FOR USE
D	20/04/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – UDATED CONSTRUCTION BOUNDARY
C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE – AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	A.J.T.	A.M.	DRAFT ISSUE – TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT – ISSUE FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	A.J.T.
DRAWN BY	A.J.T.
FINAL APPROVAL	A.M.
SCALE: (on A3 Original)	1:2000

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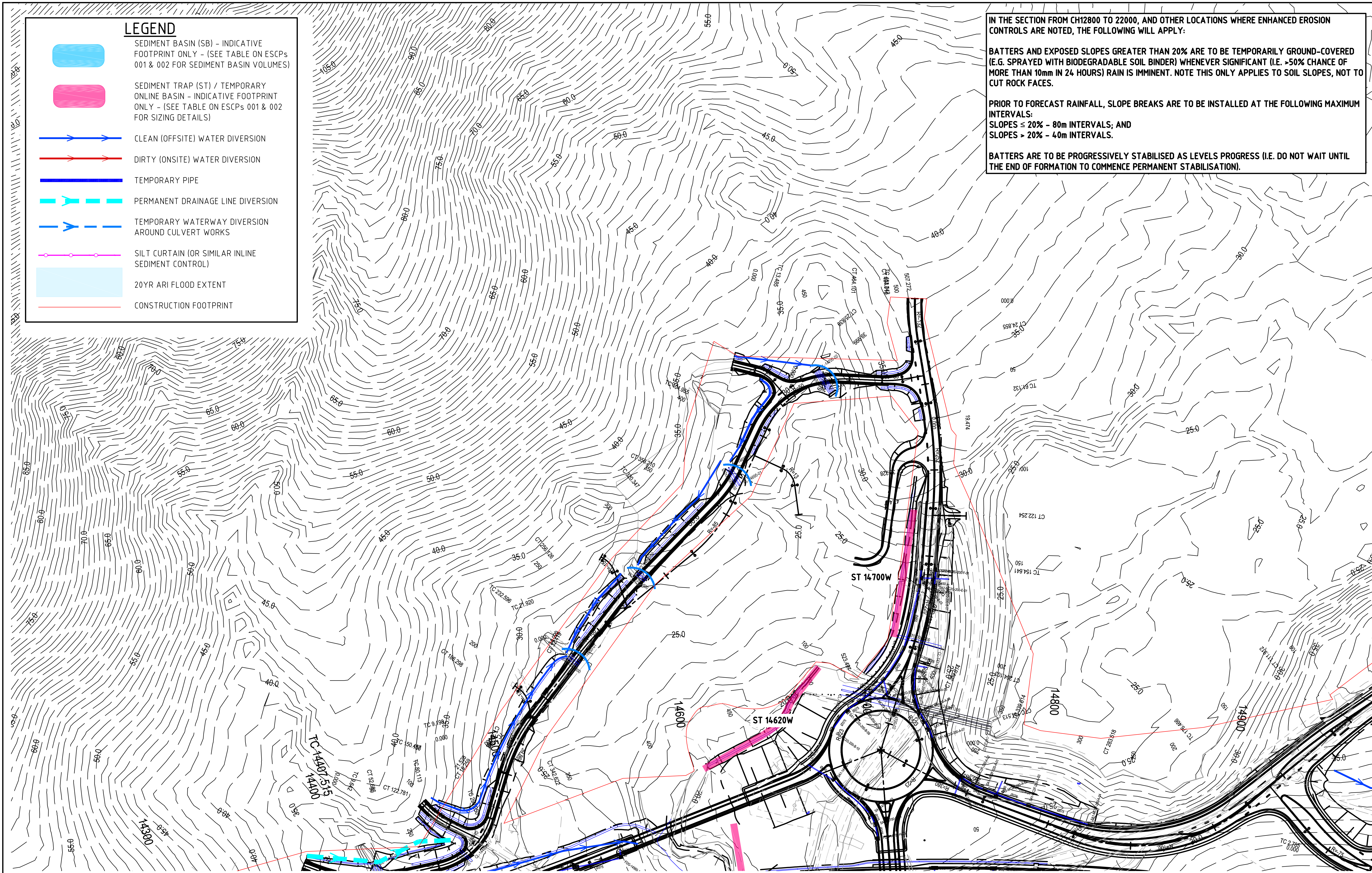
PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT
CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT
CONTROL PLAN
PACIFIC HWY AT ENGLANDS RD

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
18000288	P01	ESCP122	00

Plot Date: Monday, 25 May 2020 4:30:15 PM   CAD File Name: U:\18000288 Coffs Harbour Bypass\Drawings\18000288_P01_ESCP100_REV 00.dwg



LEGEND

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- PERMANENT DRAINAGE LINE DIVERSION
- TEMPORARY WATERWAY DIVERSION AROUND CULVERT WORKS
- SILT CURTAIN (OR SIMILAR INLINE SEDIMENT CONTROL)
- 20YR ARI FLOOD EXTENT
- CONSTRUCTION FOOTPRINT

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PRIOR TO FORECAST RAINFALL, SLOPE BREAKS ARE TO BE INSTALLED AT THE FOLLOWING MAXIMUM INTERVALS:
SLOPES ≤ 20% - 80m INTERVALS; AND
SLOPES > 20% - 40m INTERVALS.

BATTERS ARE TO BE PROGRESSIVELY STABILISED AS LEVELS PROGRESS (I.E. DO NOT WAIT UNTIL THE END OF FORMATION TO COMMENCE PERMANENT STABILISATION).

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C	07/02/20	A.J.T.	L.O.	A.M.	DRAFT ISSUE - AMENDED TO REFLECT REVISED ROAD DESIGN
B	01/05/19	A.J.T.	A.J.T.	A.M.	DRAFT ISSUE - TO REFLECT REVISED ROAD DESIGN
A	28/09/18	A.J.T.	A.J.T.	M.P.	FIRST DRAFT - ISSUE FOR CONSULTATION

DRAWING STATUS

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DRAWN BY	A.J.T.
FINAL APPROVAL	A.M.
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PROJECT TITLE: COFFS HARBOUR BYPASS CONCEPT EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN BENNETTS ROAD

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
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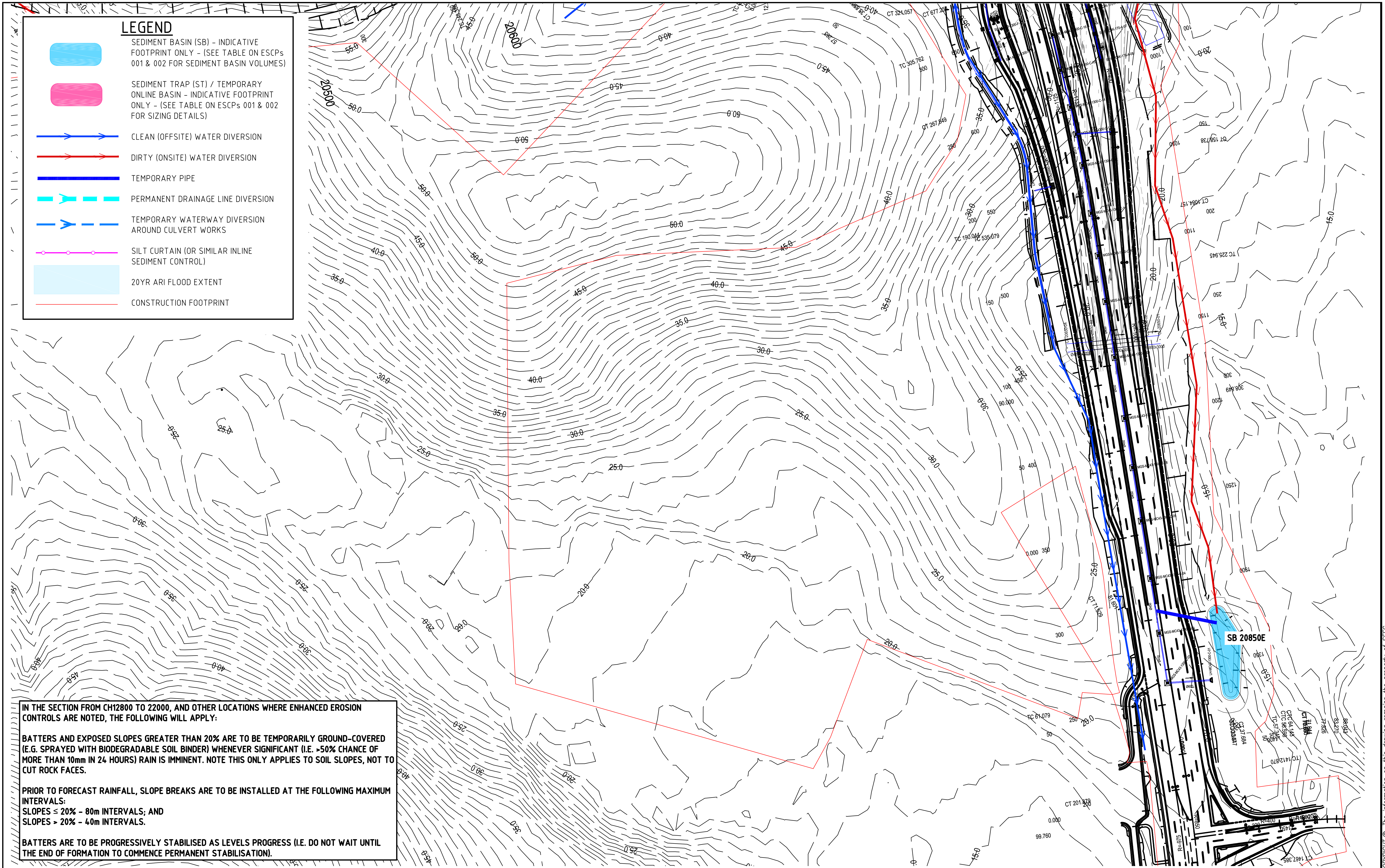

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PROJECT TITLE
COFFS HARBOUR BYPASS
CONCEPT
EROSION AND SEDIMENT CONTROL PLAN

DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN
PACIFIC HWY AT BRUXNER PARK RD

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
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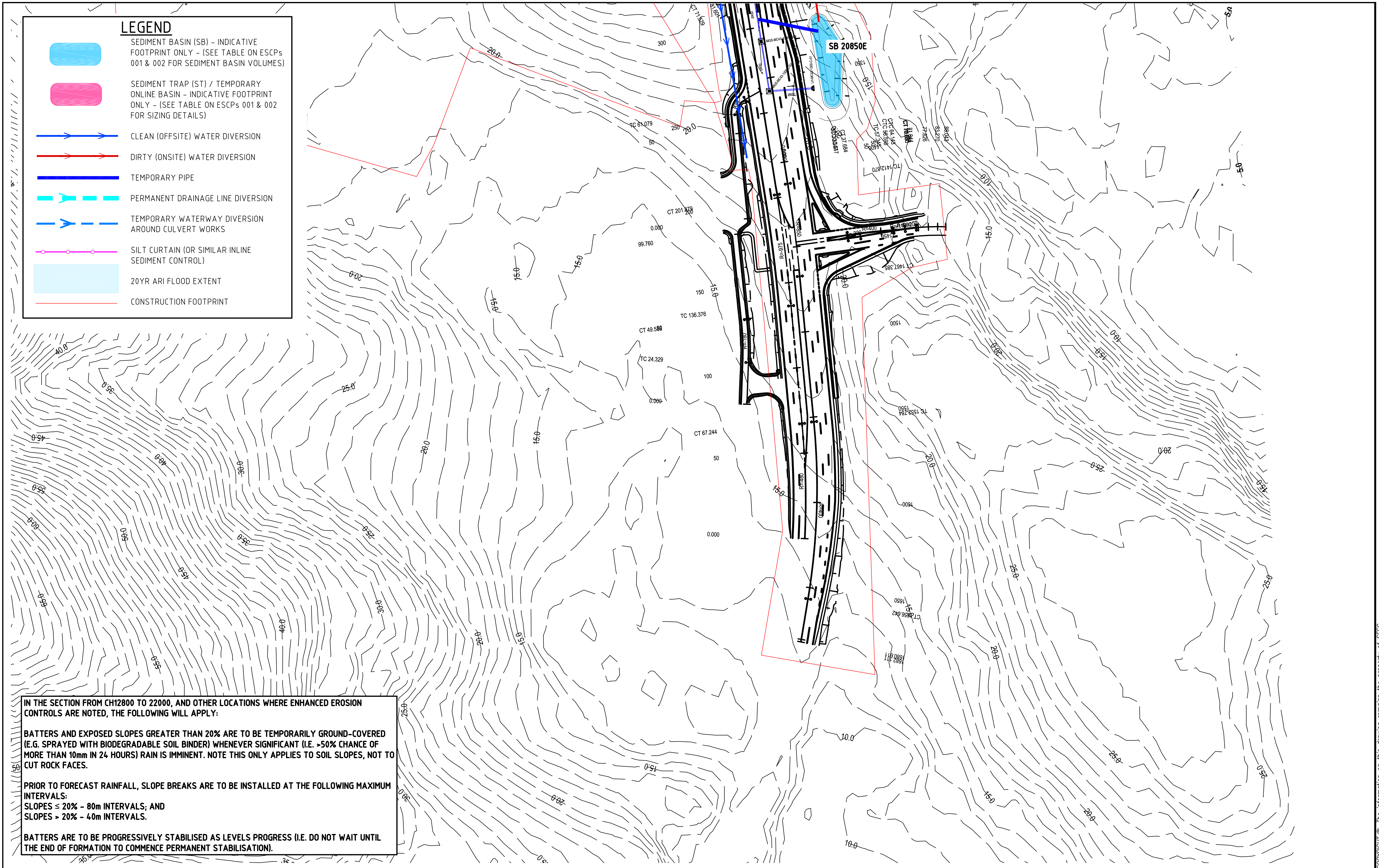

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EROSION AND SEDIMENT CONTROL PLAN
PACIFIC HWY AT BRUXNER PARK RD

PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
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Appendix C

Construction sediment basin discharge assessment report

SEEC

NSW WATER QUALITY OBJECTIVES:

ASSESSMENT OF IMPACTS OF PROPOSED CONSTRUCTION-PHASE SEDIMENT BASINS ON CONSTRUCTION WATER QUALITY

Coffs Harbour Bypass

Prepared for:

Transport for NSW

Prepared by:

Bill Johnson

25 May 2020

Strategic Environmental & Engineering Consulting

Strategic Environmental and Engineering Consulting

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.

Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this report does not contain any incomplete or misleading information.

Bill Johnson B.Eng M, Eng.Sc (Hons) CPESC RPEQ
Senior Engineer
SEEC

25 May 2020

Version Register

Version	Date	Author	Reviewer	Notes	Other
A	25/2/2019	BJ	AM	Issued to RMS	For initial review
B	4/7/2019	BJ	AM	Issued to RMS	For review
C	27/4/2020	BJ	AM	Issued to TfNSW	For review
00	25/5/2020	BJ	AM	Issued to TfNSW	Issued as Rev00

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1 INTRODUCTION

1.1 Proposal Identification

Transport for NSW (TfNSW) propose to construct a bypass of the Pacific Highway around Coffs Harbour (the proposal). The bypass will be around 14 kilometres long, skirting west of Coffs Harbour from south of Englands Road in the south and connecting with the Pacific Highway at Sapphire in the north. The bypass seeks to improve connectivity, road transport efficiency and safety for local and interstate motorists.

This report supports the amended concept design and environmental assessment for the proposal and specifically assesses water quality issues associated with discharge from sediment control structures to be constructed as part of the main construction works. Note that this report does not assess water quality issues associated with the operational stage of the proposal.

1.2 Proposal Location and Setting

The proposal involves constructing around 14 kilometres of new dual-carriageway, divided highway to provide a bypass around Coffs Harbour, as shown in Figure 1. It includes three major interchanges at Englands Road, Coramba Road and Korora Hill, numerous watercourse crossings, a number of bridges, and three tunnels.

The Pacific Highway is the primary link between Sydney and Brisbane and, presently, all traffic must pass through the urban area of Coffs Harbour.

The proposal lies on complex terrain, including flood-prone lands and very steep hills. Such terrain can limit the potential for installing the erosion and sediment control structures that are typically used for major highway construction.

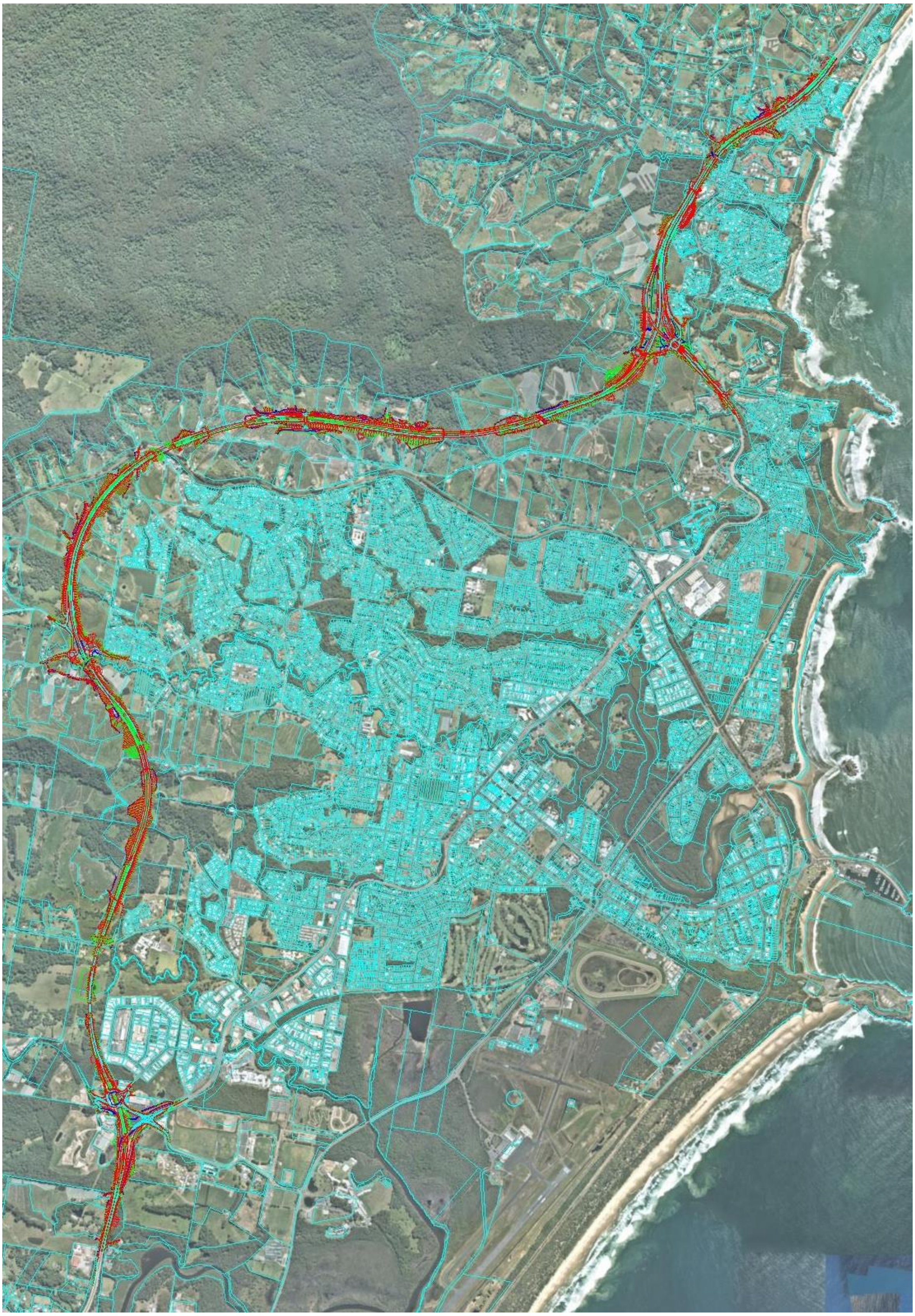

Figure 1 – Proposal area with 80% concept design model and cadastral boundaries (supplied by TfNSW).

1.3 Purpose of This Report

The purpose of this report is to assess the impacts of proposed construction-phase sediment basin discharge limits against the NSW Water Quality Objectives (WQOs) at this location. A separate report provides an assessment of water quality issues associated with the operational stage of the proposal.

This report should be read in conjunction with the following reports and Erosion and Sediment Control Plans (ESCPs) developed for the proposal:

- SEEC (2020). *Erosion and Sediment Management Report: Coffs Harbour Bypass*. Strategic Environmental and Engineering Consulting (SEEC) Pty Ltd.
- ARUP (2019). *Environmental Impact Statement: Coffs Harbour Bypass.*
- ARUP (2020). *Amendment Report: Coffs Harbour Bypass*.

1.3.1 Secretary's Environmental Assessment Requirements

The proposal has Secretary's Environmental Assessment Requirements (SEARs) to meet as part of its environmental requirements. Table 1 provides where the SEARs are addressed within this report.

Table 1 – SEARs Checklist

Ref	Key Issue SEARs	Where addressed in this report
10. Water – Quality		
1.	The project is designed, constructed and operated to protect the NSW Water Quality Objectives where they are currently being achieved, and contribute towards achievement of the Water Quality Objectives over time where they are currently not being achieved, including downstream of the project to the extent of the project impact including estuarine and marine waters (if applicable).	Section 4
	a) State the ambient NSW Water Quality Objectives (NSW WQO) and environmental values for the receiving waters relevant to the project, including the indicators and associated trigger values or criteria for the identified environmental values;	Section 4
	b) Identify and estimate the quality and quantity of all pollutants that may be introduced into the water cycle by source and discharge point and describe the nature and degree of impact that any discharge(s) may have on the receiving environment, including consideration of all pollutants that pose a risk of non-trivial harm to human health and the environment;	Section 9.5
	c) Identify the rainfall event that the water quality protection measures will be designed to cope with; d) Assess the significance of any identified impacts including consideration of the relevant ambient water quality outcomes;	Section 8 Section 10
	e) Demonstrate how construction and operation of the project will, to the extent that the project can influence, ensure that: – Where the NSW WQOs for receiving waters are currently being met they will continue to be protected; and – Where the NSW WQOs are not currently being met, activities will work toward their achievement over time;	Section 10
	f) Justify, if required, why the WQOs cannot be maintained or	N/A

Ref	Key Issue SEARs	Where addressed in this report
10. Water – Quality		
	achieved over time;	
	g) Demonstrate that all practical measures to avoid or minimise water pollution and protect human health and the environment from harm are investigated and implemented;	Section 7
	h) Identify sensitive receiving environments (which may include estuarine and marine waters downstream such as the Solitary Islands Marine Park) and develop a strategy to avoid or minimise impacts on these environments; and	Section 3.2 Section 10.1
	i) Identify proposed monitoring locations, monitoring frequency and indicators of surface and groundwater quality.	N/A

1.4 Assumptions Used In This Report

Figure 2 shows the three sub-catchments the proposal passes through. For the purpose of the assessment of Water Quality Objectives in this report, the catchments of KorORO Basin, Coffs Creek and Boambee Creek have been modelled separately considering the entire catchment upstream and downstream of the proposal.

The sizing and positioning of construction-phase sediment basins, as well as the proposed discharge limits for de-watering of construction-phase sediment basins, are based on ESCPs and the ESMR prepared by SEEC (2020). Basin sizing and discharge criteria have been prepared in accordance with the NSW Blue Book (Landcom, 2004 and DECC, 2008) to protect the desired water quality objectives described in Section 2.

Landuses and areas for the catchment were obtained from aerial photos and Council's on-line mapping showing land zoning. A summary of the adopted land use areas for each sub-catchment are provided in Table 2.

Table 2 – Catchment Landuses

Landuse	Korora Basin (ha)	Coffs Creek (ha)	Boambee Creek (ha)
Forest	440.20	748.45	1,839.09
Rural	783.05	725.86	1,513.78
Urban	255.71	1,176.21	1,017.33
TOTAL AREA	**1,478.96**	**2,650.52**	**4,370.20**

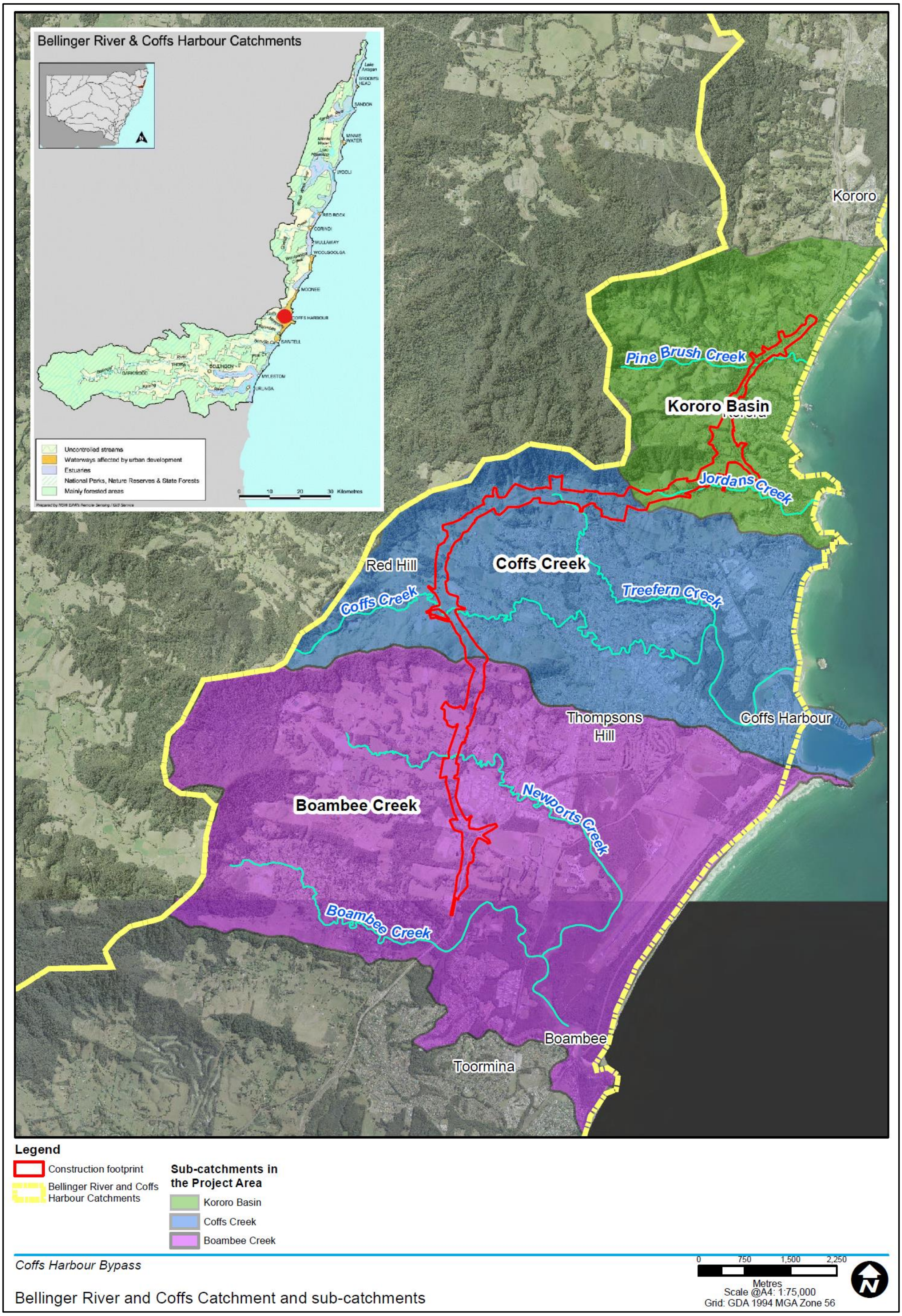

Figure 2 – Catchment boundaries for Kororo Basin, Coffs Creek and Boambee Creek (supplied by TfNSW).

2 NATIONAL WATER QUALITY FRAMEWORK

The National Water Quality Management Strategy (NWQMS) has been developed to assist protect the nation's water resources by maintaining and improving water quality, while supporting dependent aquatic and terrestrial ecosystems, agricultural and urban communities, and industry. It includes a Water Quality Management Framework (10 step process) of key requirements for long-term management strategies that provide:

- good understanding of links between human activity and water/sediment quality.
- clearly defined community values or uses, including the setting of unambiguous management goals.
- clearly identified and appropriate water/sediment quality objectives.
- adoption of cost-effective strategies to achieve water/sediment quality objectives.

This study has used the 10 steps to implement the Water Quality Management Framework as shown in Figure 3.

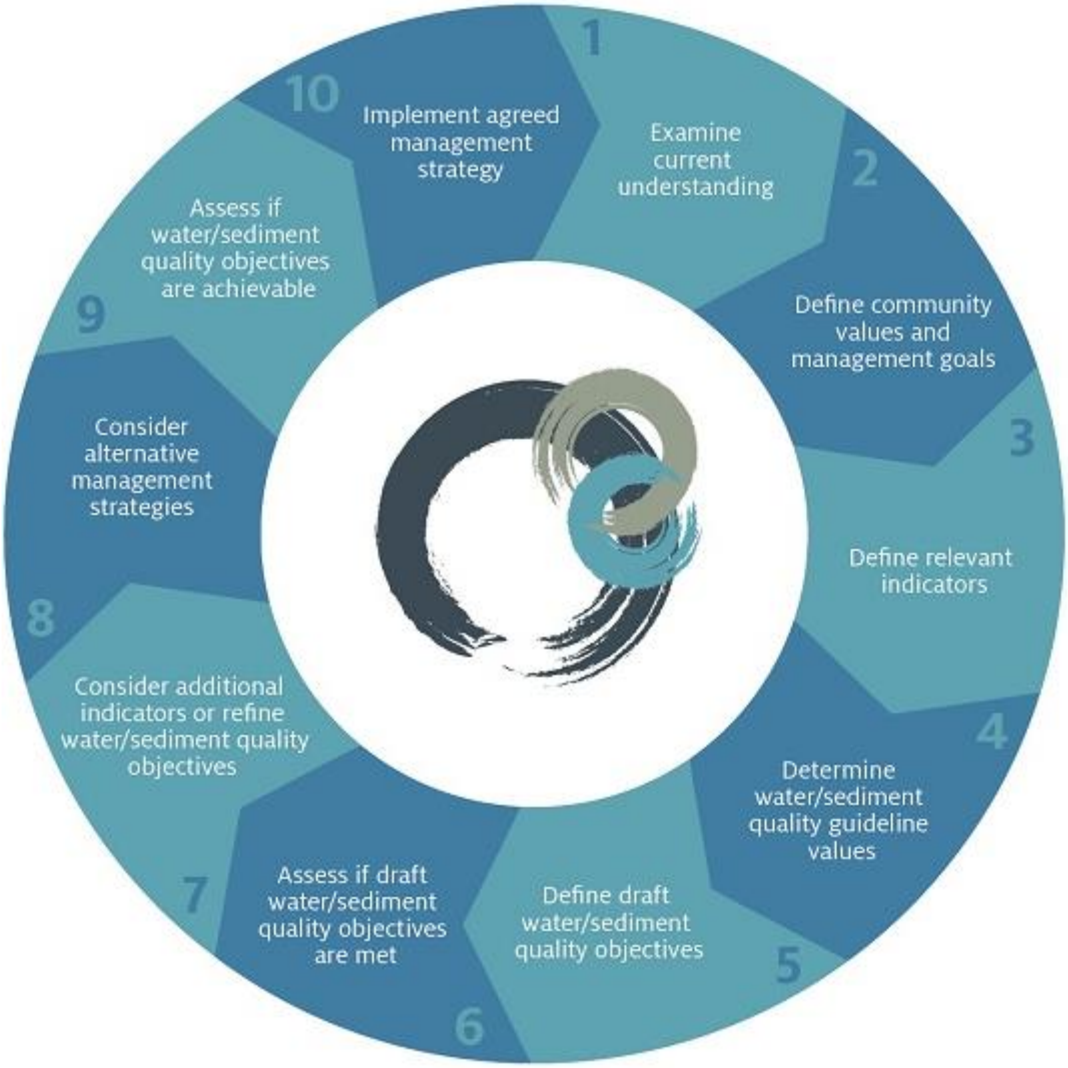

Figure 3 – Water Quality Management Framework (Source: https://www.waterquality.gov.au/anz-guidelines/framework).

Each step will be discussed in more detail throughout this report.

3 CURRENT UNDERSTANDING (Step 1)

3.1 Site Conditions for Impact Assessment

In conducting this assessment of potential impacts against the WQOs, site, soil and catchment conditions have been taken into account. Climate, topography, soils (including acid sulfate soils) and catchment conditions are described in detail in the ESMR (SEEC, 2020) so are not repeated here.

3.2 Catchment Characteristics

All runoff from the proposal site flows into Newports Creek, Treefern Creek, Coffs Creek, Jordans Creek and Pine Brush Creek.

Pine Brush Creek, Jordans Creek (Kororo Basin catchment) and Treefern Creek and Coffs Creek (Coffs Creek catchment) flow into the Solitary Islands Marine Park. The Solitary Islands Marine Park extends north from Coffs Harbour about 75 km to Sandon River and covers a total area of 71,000 ha. The Commonwealth Solitary Islands Marine Park is directly adjacent to the seaward boundary of the NSW Solitary Islands Marine Park and extends three nautical miles seaward for an area of 152 km^2. This section of the Commonwealth Marine Park is considered a matter of national environmental significance (MNES) under the EPBC Act. There are wetlands associated with Pine Brush Creek which are mapped about 800 m downstream from the proposal and are also within the Solitary Islands Marine Park. (ARUP, 2019). The sensitive receiving waters are shown in Figure 4.

The Coffs Creek Estuary Coastal Zone Management Plan – Estuary Condition Study (Geolink, 2016) describes Coffs Creek estuary as a key recreational resource for the Coffs Harbour city and contains significant ecosystems of forest, wetlands, saltmarsh, mangroves, and areas of koala habitat. There are wetlands located over five kilometres downstream from the proposal following Coffs Creek or about 3.7 km downstream from the proposal following Treefern Creek (the main tributary of Coffs Creek). Coffs Creek wetlands consist of small sections of tidal wetlands and are within and adjacent to sections of the Solitary Islands Marine Park (ARUP, 2019). Coffs Creek is a wave-dominated estuary with a predominantly open entrance, however it can close under low creek flow conditions and during periods of beach accretion or after large ocean storm events. The lower estuary is dominated by marine-derived sediment.

The Coastal Zone Management Plan for Boambee/Newports Estuary (GHD, 2012) describes the Boambee/Newports estuary as a roughly rectangular shape catchment with an area of approximately 49 km^2. It extends about 8 km from the coast with a coastal floodplain that is approximately 3 km wide. It consists of three main tributaries, including Newports Creek, Boambee Creek and Cordwells Creek. The estuary is permanently open to the ocean and has no artificial entrance training works, as it is naturally trained by Boambee Headland on the southern side. It is classified as a Wave Dominated Delta (WDD) – a creek that is directly connected to the ocean by a channel that is typically flanked by floodplain vegetation and swamps and has a moderately high wave influence (compared to tidal influence) at the mouth. There is a small section of the mapped Boambee wetlands within 100 m of the southern end of the proposal. However, no works will occur within the wetland, or the 50 m wetland buffer (ARUP, 2019).

The catchment area is dominated by historic clearing for the timber industry and agricultural which is predominantly a range of fruit production including bananas and blueberries. Steep areas of the catchment remain vegetated and urban development within Coffs Harbour is expanding from the coastal plain to the foothills (ARUP, 2019).

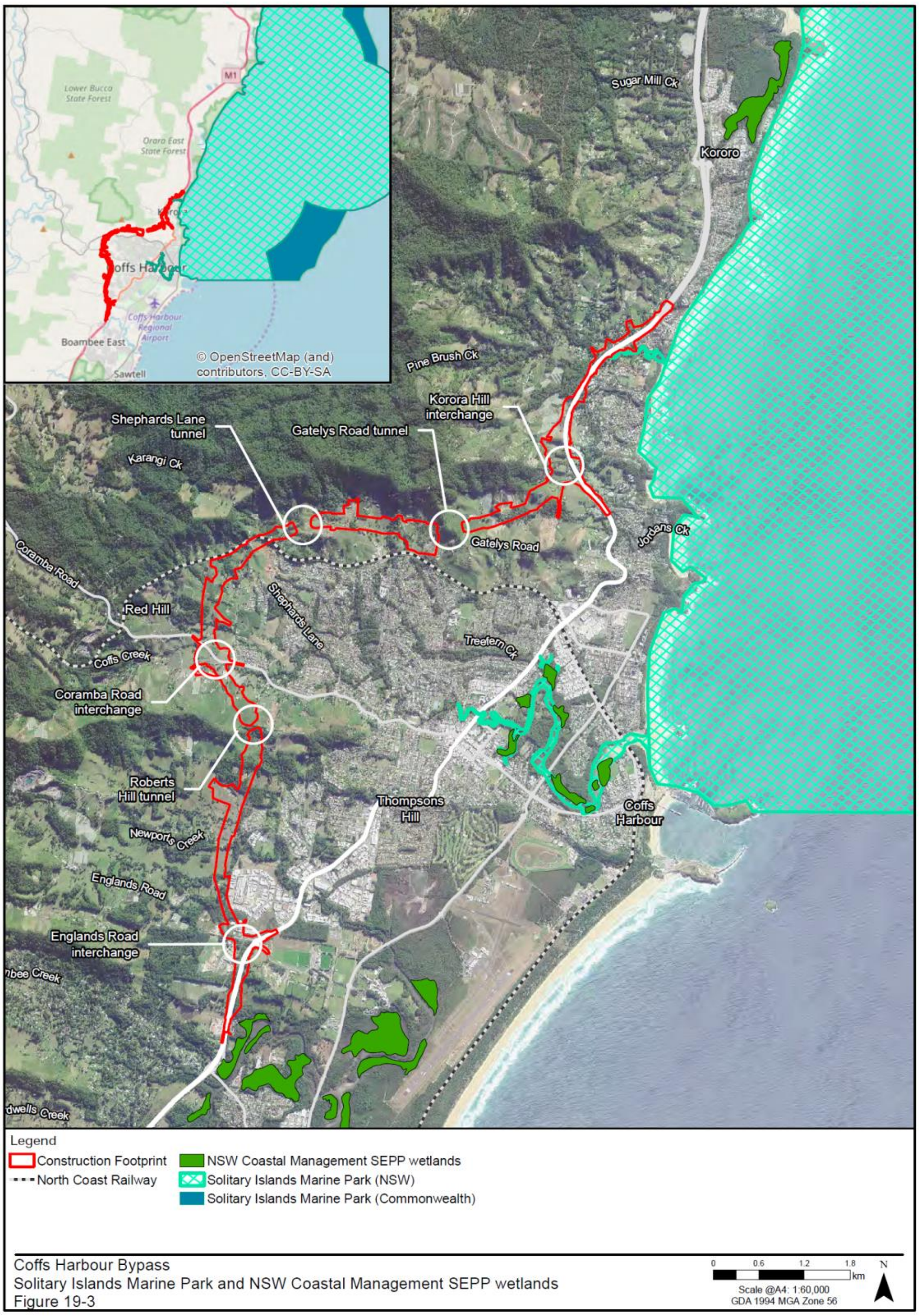

Figure 4 – Sensitive Receiving Waters (supplied by TfNSW).

4 ENVIRONMENTAL VALUES (Step 2)

4.1 Introduction

Environmental values are those values or uses of water that are desired by the community to be protected. These include, but are not limited to, protection of aquatic ecosystems, drinking water, primary and secondary recreation, visual amenity, and agricultural water for irrigation, livestock and growing aquatic foods.

The National Water Quality Management Strategy (NWQMS) provides guidance on water quality planning and management. It highlights the need to adopt locally established community values where provided by the relevant authorities. In NSW, interim water quality objectives have been established in consultation with the community. They help decision makers consider water quality in both big picture strategic planning such as State Strategic Plans and Regional Strategies and at the local level when assessing impacts of development.

Environmental values for each catchment in NSW are provided by the NSW government. The proposal is within the Bellinger River and Coffs Harbour catchment. The majority of the catchment upstream of the proposal site is mainly forested or is considered an uncontrolled stream. However, at the location of the proposal the waterways are classified as "waterways affected by urban development" or "uncontrolled streams" (Figure 5).

Refer to https://www.environment.nsw.gov.au/ieo/Bellinger/report-02.htm for details.

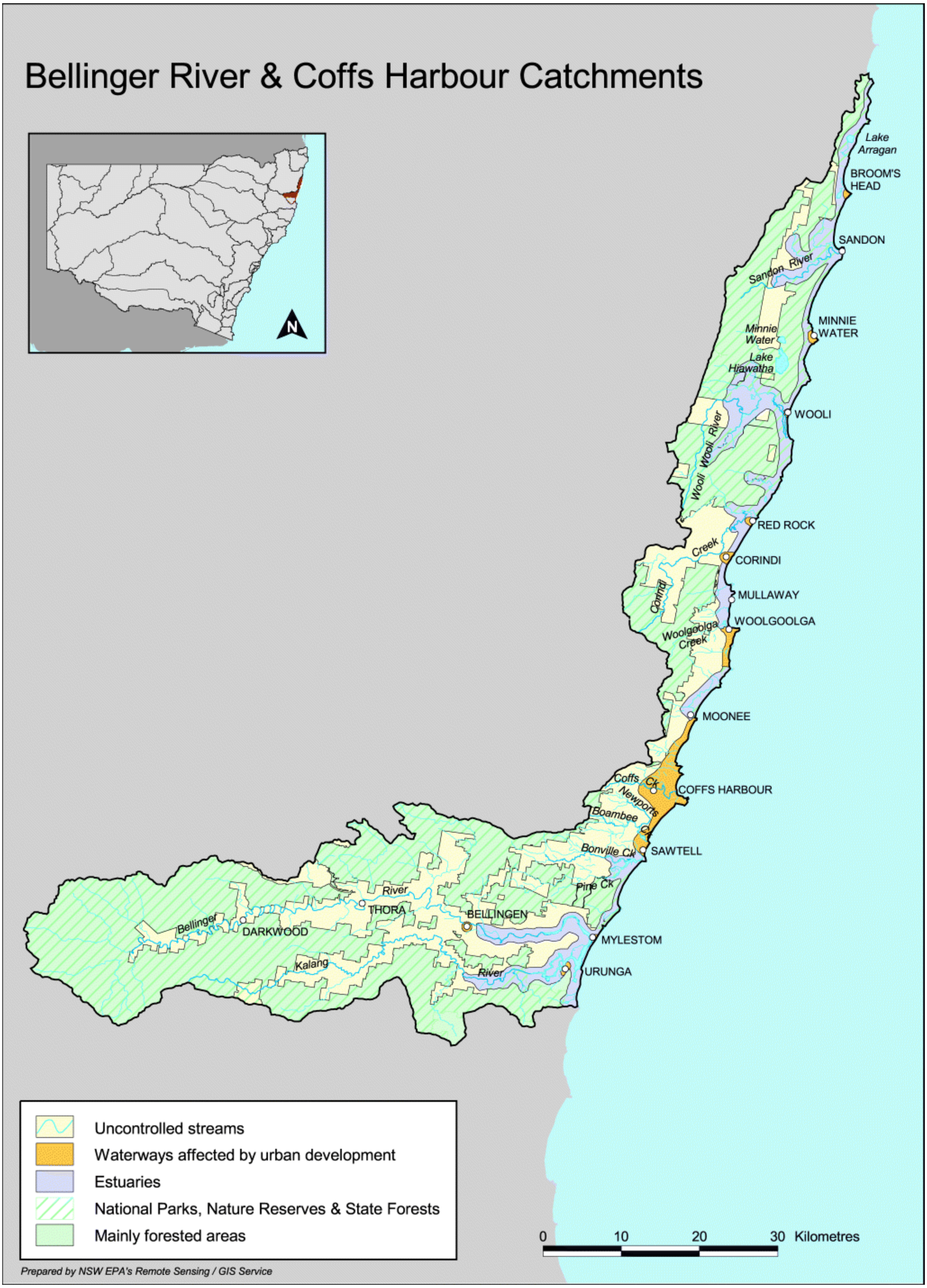

Figure 5 - Bellinger River and Coffs Harbour Catchment Map, including classification of environmental values (from www.environment.nsw.gov.au).).

The water quality objectives for uncontrolled streams and waterways affected by urban development for the Bellinger River and Coffs Harbour:

- Aquatic ecosystems
- Visual amenity
- Secondary contact recreation (short term objective, within 5 years)
- Primary contact recreation (assess opportunities for a longer term objective 10 years or more)
- Livestock water supply
- Irrigation water supply
- Homestead water supply
- Drinking water at point of supply – disinfection only
- Drinking water at point of supply – clarification and disinfection
- Drinking water at point of supply – groundwater
- Aquatic foods (cooked). Note that ANZECC (2000) Guidelines list this environmental value as "Aquaculture and human consumption of aquatic foods." Therefore, it covers shellfish such as oysters.

4.2 Indicators (Step 3)

The indicators of water quality are selected for the relevant pressures identified for the waterway system, their associated stressors and anticipated ecosystem receptors. This is consistent with using multiple lines of evidence in a weight-of-evidence process for assessing and managing water/sediment quality. The NSW Department of Planning, Industry and Environment has selected indicators for the environmental values identified in Section 4.2 and these have been adopted. Typical physical and chemical indicators include turbidity, total phosphorus, total nitrogen that can compromise waterway health.

4.3 Water Quality Guideline Values (Step 4)

The water quality guideline values are a measureable quantity/threshold or condition of an indicator that, if exceeded (or in some cases, not reached) are expected to have a low risk of unacceptable effects occurring. The guideline values are expected to provide the desired level of protection (if applicable) for the management goals of relevant waterways.

The NWQMS framework advises to use locally relevant (e.g. site-specific, catchment) guideline values where available. The NSW Department of Planning, Industry and Environment has selected guideline values associated with the indicators identified in Section 4.2 and these have been adopted.

The NSW Water Quality Objectives, indicators and guideline values are the environmental values and long-term goals for consideration when assessing and managing the likely impact of activities on waterways. As noted in DECC (2006) they are not intended to be applied directly as regulatory criteria, limits or conditions but are one factor to be considered by industry, the community, planning authorities or regulators when making decisions affecting the future of a waterway.

4.4 Define draft water/sediment quality objectives (Step 5)

Water quality objectives are the guideline value or narrative statement for each selected indicator that should ensure the protection of all identified community values. They guide management decisions to protect community values and specific management goals by adopting the most stringent guideline value or narrative statement for each indicator to ensure that all community values are protected. The objectives set by the NSW Department of Planning, Industry and Environment have been adopted for this study.

5 WATER QUALITY DATA (Step 6)

There is limited historical water quality data for the three catchments. ARUP (2019) includes some baseline sampling conducted over two events (17 and 18 April 2018 – end of wet season, and 24 and 25 of July 2018 to capture the early dry season). The results of the sampling indicated that overall the water quality was generally within the existing regional Water Quality Objectives (WQOs) and ANZECC guidelines.

Compared to the guideline values, most sites recorded higher levels of total nitrogen, and most sites had a low percentage saturation of Dissolved Oxygen (DO) however the authors believed that, based on the consistency of conditions within the study area, it can be presumed that the region has high pre-existing concentrations of total nitrogen and total phosphorus with low DO throughout. A summary of the results is provided in Table 3.

Table 3 – Water quality survey results (ARUP, 2019)

Parameter	Results		
	Minimum	Maximum	Average
pH (units)	6.6	8	7.0
Electrical conductivity (µS/cm)	127	1055	242.9
Turbidity (NTU)	0.3	18.1	3.3
Dissolved oxygen (% sat)	7.9	108.5	59.7
Total nitrogen (mg/L)	0.055	8.44	0.944
Total phosphorus (mg/L)	0.005 (below LOR)	0.25	0.025
Zinc (µg/L)	0.25 (below LOR)	28	2.4

The University of New England (UNE) and the NSW Environment Energy and Science Group (EESG) (previously known as the Office of Environment and Heritage (OEH)) conducted sampling and testing in 2015 as part of the Coffs Harbour Region Ecohealth Project. Three sites were monitored in Coffs Creek and Boambee Creek. The site COFFS1 was the most downstream site and was located in the lower estuary of Coffs Creek in the marine zone. Site COFFS3 was located in the mid estuary, and COFFS4 was located in the freshwater zone of Coffs Creek.

Similarly the site BOAM1 was located in the lower estuary downstream of the confluence of Boambee and Newports Creeks and is considered to be in the marine zone. BOAM3 was located at the tidal limit of Boambee Creek, and the most upstream site, BOAM4 was located within the freshwater reach of Boambee Creek.

The results of the UNE and EESG sampling program are provided in Table 4 and Table 5.

Table 4 – Summary of water quality data from Coffs Creek (Ryder *et al.,* 2016).

	COFFS1			COFFS3			COFFS4		
Variable	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Temperature	17.9	24.8	20.9	13.5	27.6	20.3	11.5	23.1	18.5
pH	6.8	7.6	7.1	6.1	7.7	7.0	6.2	9.0	8.1
Electrical Conductivity	34.9	52.2	43.7	3.0	13.4	8.3	0.1	0.2	0.2
Salinity (PPT)	23.0	37.5	30.8	1.7	7.5	4.3	0.1	0.1	0.1
Dissolved Oxygen (mg/L)	7.5	12.1	11.1	7.2	23.4	11.0	4.8	13.4	9.8
Dissolved Oxygen (%)	102.9	162.0	149.0	82.1	119.0	99.3	54.1	138.2	103.1
Turbidity (NTU)	1.2	3.6	2.0	1.8	28.9	14.4	1.9	10.1	4.8
Max Depth (m)	0.5	1.1	0.8	0.5	0.8	0.6	02	0.3	0.2
Chlorophyll a (µg/L)	2.0	4.0	3.3	2.0	970	21.1	2.0	15.0	5.8
Total Suspended Solids (mg/L)	5.0	27.0	13.0	4.0	24.0	12.8	2.0	14.0	5.5
Total Nitrogen (mg/L)	0.2	0.6	0.3	0.3	1.5	0.7	0.3	0.9	0.5
Total Phosphorous (mg/L)	<0.03	0.08	<0.03	<0.03	0.15	0.07	<0.03	0.06	0.04
Coliforms (cells/100mL)	21	>1000	127	-	-	-	-	-	-

Table 5 – Summary of water quality data from Boambee Creek (Ryder *et al.* ,2016).

	BOAM1			BOAM3			BOAM4		
Variable	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Temperature	18.8	24.7	20.3	17.4	27.0	22.2	15.3	24.1	19.2
pH	6.5	7.6	7.0	6.6	7.5	7.0	6.6	7.9	7.0
Electrical Conductivity	19.1	55.7	45.7	0.0	48.6	27.1	0.1	5.9	1.0

	BOAM1			BOAM3			BOAM4		
Variable	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Salinity (PPT)	30.4	43.1	36.9	6.8	38.4	26.1	0.1	0.1	0.1
Dissolved Oxygen (mg/L)	7.6	15.2	10.7	4.4	18.1	8.1	5.4	14.3	9.5
Dissolved Oxygen (%)	104.8	170.0	132.1	58.3	136.0	83.5	58.0	142.9	102.9
Turbidity (NTU)	0.3	7.0	2.3	2.0	18.0	7.0	0.4	6.8	2.6
Max Depth (m)	1.0	2.0	1.5	1.1	1.8	1.3	0.2	0.3	0.3
Chlorophyll a (µg/L)	2.0	3.0	2.5	2.0	15.0	7.0	2.0	2.0	2.0
Total Suspended Solids (mg/L)	2.0	25.0	12.0	3.0	22.0	8.9	2.0	6.0	4.2
Total Nitrogen (mg/L)	0.2	0.3	0.2	0.3	0.6	0.4	0.2	0.7	0.5
Total Phosphorous (mg/L)	<0.03	<0.03	<0.03	<0.03	0.03	<0.03	<0.03	0.05	<0.03
Coliforms (cells/100mL)	4	40	18	-	-	-	-	-	-

The UNE and EESG (Ryder *et al*., 2016) study graded Coffs Creek, concluding it ranged from an F to a C- based on the recorded water quality. Most recorded parameters exceeded the maximum estuarine trigger thresholds a number of times. Recorded turbidity was reasonable in the freshwater and lower estuary however the mid estuary region had three samples that exceeded the water quality thresholds.

The Boambee Creek grading varied from a D to a B with pH and DO being the main parameters that exceeded the estuarine trigger thresholds on a number of occasions. Turbidity remained below the guideline threshold in the lower estuary and the freshwater site however the tidal limit exceeded the estuarine trigger threshold once.

6 ADDITIONAL INDICATORS (Step 7)

Water quality impacts associated with road construction activities are predominantly associated with the mobilisation of sediment as a result of rainfall run-off over soils exposed during construction activities.

Nutrients and other pollutants potentially generated from rainfall runoff over exposed soils (such as phosphorus, heavy metals and organic chemicals) often utilise sediment as the medium for transportation in runoff. The deposition of sediment can result in the release of these nutrients or pollutants at a later time when the ambient conditions related to the redox potential of the sediment and water column becomes favourable for their release. This mechanism provides the opportunity for pollutant re-mobilisation in later flow events enhancing the risk of further environmental degradation of downstream aquatic ecosystems (Wong *et al*., 2000).

Given the typical pollutants from a road, the water quality objective, indicator and guideline values are appropriate for consideration by this study.

7 ALTERNATIVE MANAGEMENT STRATEGIES (Step 8)

The flow chart in Figure 6 shows how surface water management occurs on the proposal. This demonstrates how the project aims to avoid discharge if at all possible through:

- Beneficial re-use of detained surface water from sediment basins, sumps and excavations; or
- Land application of detained surface water onto vegetated or rehabilitation areas.

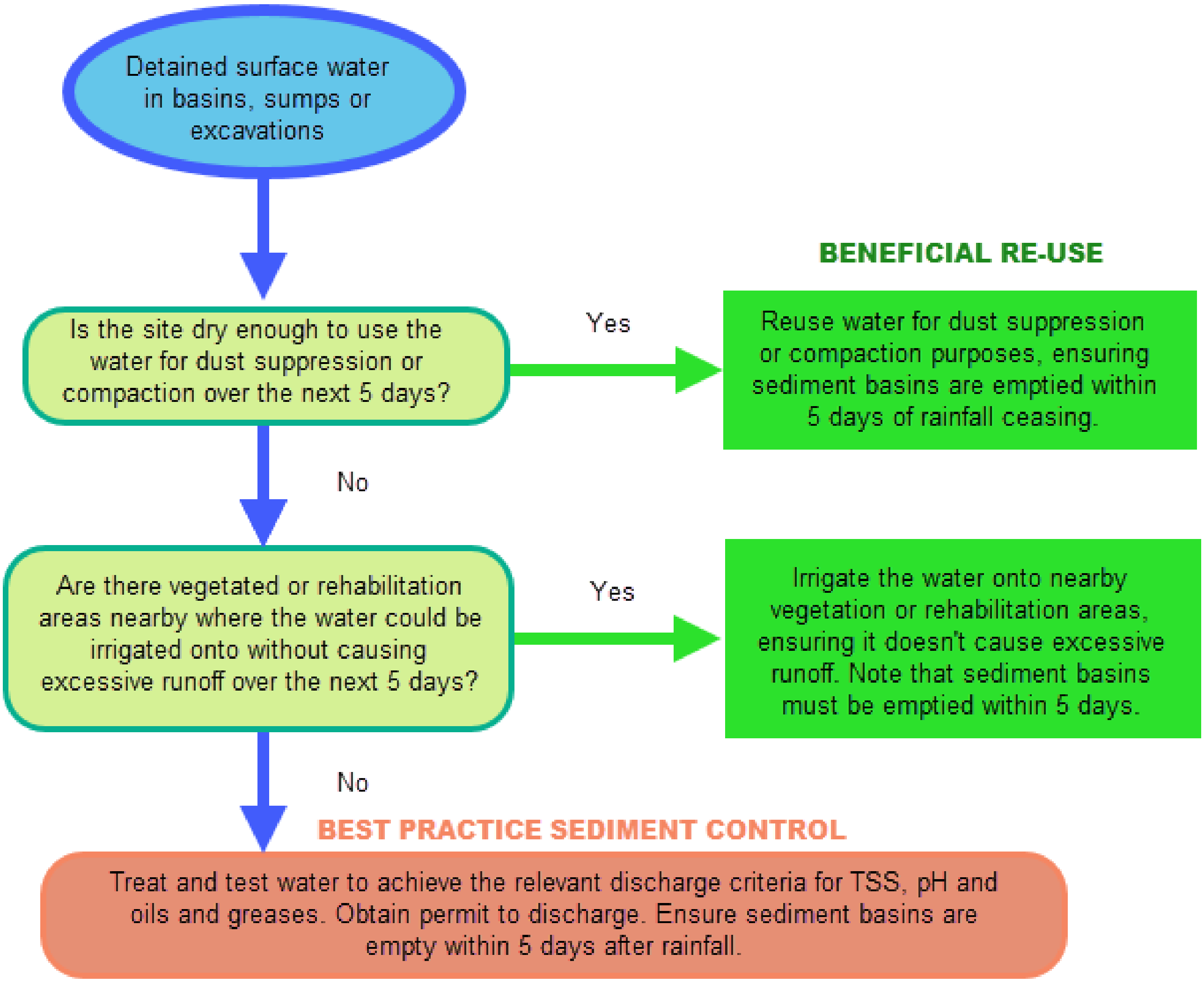

Figure 6 - Flow chart for management of surface water on the proposal.

A discharge from the project will only occur when the above options are exhausted. This typically occurs when:

- Heavy rainfall has made the site too wet for beneficial onsite re-use such as dust suppression; and/or
- The volume of detained surface water in sediment basins exceeds what can be feasibly re-used onsite within the 5-day period for basin maintenance; and/or
- Heavy rainfall has made land application onto nearby vegetated or revegetation areas impossible; and/or
- There are no suitable onsite re-use options available in reasonable proximity to the detained body of surface water.

Consequently, the capture and retention of sediment on site using the best practice management principles outlined in the Blue Book (Landcom, 2004 and DECC, 2008) decreases the potential for a range of other pollutants degrading the receiving environment. Other best practice approaches include contractual mechanisms such as the use of Quality Assurance specifications such as the TfNSW G38 Soil and Water specification.

Predictive modelling of the proposed discharge impacts are provided in Section 9.

8 WATER QUALITY MANAGEMENT DURING ROAD CONSTRUCTION

A series of recommendations and commitments for erosion and sediment control are included in the ESMR, along with conceptual construction-phase Erosion and Sediment Control Plans (ESCPs) (SEEC, 2020). The ESCPs have been prepared to accord with the guidelines and recommendations in Volumes 1 and 2D of the Blue Book (Landcom, 2004 and DECC, 2008 respectively). The plan also accords with typical TfNSW specifications for soil and water management (*G38 – Soil and Water Management)*.

The ESMR and ESCP for the main construction phase of the proposal include a range of recommendations to avoid or minimise erosion and maximise the retention of sediment on the site. These include:

- Avoiding discharge through the beneficial re-use of detained surface water from sediment basins, sumps and excavations and the land application of detained surface water onto vegetated or rehabilitation areas (Refer to Section 7).
- A Soil and Water Management Plan (SWMP) and ESCP should be prepared in accordance with Volumes 1 (Landcom, 2004) and 2D (DECC, 2008) of the Blue Book and the conditions of any Environment Protection Licence (EPL).
- A certified soil conservationist should be engaged for the duration of the project. The soil conservationist undertakes regular inspections (e.g. fortnightly during the initial earthworks establishment period and then monthly) and provides advice on erosion and sediment control design, installation, and maintenance in accordance with Volumes 1 and 2D of *Managing Urban Stormwater* (Landcom, 2004 and DECC, 2008)
- Works should be programmed to minimise the extent and duration of disturbance to vegetation/groundcover.
- Sediment barriers should be installed downslope of all disturbed areas.
- Clean water diversions should be installed to minimise clean water from entering site from upslope.
- Temporary construction water quality basins should be designed and installed in accordance with the Blue Book (Landcom, 2004 and DECC, 2008). Basins should typically incorporate:
  - Inlet flow control structures (i.e. baffles, forebays) to control the velocity of water entering the basin and to allow settling of some material at the inlet,
  - Internal baffles if the length-to-width ratio of the basin is less than 3:1,
  - Liquid flocculants that comply with the requirements of TfNSW Specification G38 (consider all risks associated with flocculants including ecotoxicity requirements as required for approval by TfNSW),
  - Floating siphon devices that decant by siphoning water from the top of the water column,
  - An overflow outlet or spillway,
  - Outlet protection to reduce erosion downstream, and

  - Compacted earth embankments or a rock filled wire basked wall with geofabric lining.
- Sediment basins and associated drainage should be installed and commissioned prior to the commencement of earthworks in that catchment, and must remain active until their contributing catchments are adequately stabilised or rehabilitated.
- In areas where it is not possible to direct dirty water to sediment basins, other sediment controls should be implemented in accordance with Blue Book e.g. check dams, sediment sumps, earth/mulch bunds, sediment fence, rock dissipaters etc. and should be augmented by an increased focus on erosion control.
- Clean and dirty water runoff should be adequately separated to avoid mixing through the use of diversions, clean water drains, and batter chutes.
- The velocity of water flow over the construction site should be minimised by implementation/construction of slope breaks, level spreaders, check dams, bank and channel linings.
- Land should be shaped to minimise slope lengths and gradients and to improve drainage.
- Long term stockpiles, fill under settlement, access tracks, and disturbed areas should be stabilised by:
  - Seeding with cover crops, or
  - Placement of hardstand material, or
  - Application of soil binder, or
  - Covering with geotextile fabric.
- Cut and fill batters should be created at a maximum of 2:1 (H:V) slope unless otherwise agreed during detailed design stage.
- Active work areas should be temporarily stabilised prior to forecast inclement weather by applying ground covers, grading, smooth drum rolling, installing slope breaks or similar.
- Hardstand material, rumble grids or similar should be provided at exit points to minimise mud tracking.
- Scour protection should be installed at drainage outlets where water velocities indicate scour protection is required.
- Drainage works should be stabilised against erosion by appropriate selection of channel dimensions, slope and lining, and the inclusion of drop structures and energy dissipaters.
- Disturbed areas should be progressively stabilised during the construction phase e.g. with a cover crop, hydromulch, hydroseeding, topsoil and/or mulch.
- Rainfall forecasts should be monitored daily.
- Erosion and sediment controls should be inspected at least weekly (with maintenance and/or modifications made as necessary).

Note that the ESMR and accompanying ESCP are conceptual only, and are subject to change as the design and construction methodology is refined. However, these documents together demonstrate the feasibility to employ best-practice environmental controls during construction.

For most major road construction projects, the installation and operation of construction sediment basins in key catchments provides the most effective control of sediment from the site. Operation of the basins typically involves capture of sediment laden water up to the basin design rainfall event (as determined by Landcom, 2004), treatment (i.e. flocculation) following the cessation of the rainfall event to remove sediment in suspension, and discharge of the treated water from licensed discharge points.

The Blue Book (Landcom, 2004) suggests that special erosion and sediment control measures should apply to any works below the 2-year average recurrence interval (ARI) flood level. This includes:

- Sediment controls should be placed above the 2-year ARI flood level (e.g. basins, sediment fences etc.) wherever possible.
- Requirements to stabilise lands using temporary ground cover whenever rain is falling or imminent.
- Scheduling high risk works for lower-risk times of year (where possible), based on historical rainfall figures.

The ESMR and the accompanying ESCP (SEEC, 2020) take these requirements into account.

8.1 Blue Book Discharge Limits

Landcom (2004) proposes recommended water quality standards for site de-watering and discharges from sediment basins. These are noted in Table 6. The purpose of this assessment is to determine whether the recommended standards in Table 6 are appropriate for this site or if need to be amended to account for the WQOs in the receiving environment and the potential for impacts on watercourses as a result of sediment basin discharges.

Table 6 – Water quality standard for site dewatering as recommended in Landcom (2004)

Parameter	Recommended standard during construction
Total suspended solids (TSS)	50mg/L
pH	6.5 to 8.5
Oils and greases	None visible

Generally, the proposed construction sediment basin discharges consist of water generated by rainfall run-off over soil exposed during road construction activities, and typically they are treated to meet the nominated discharge criteria.

Where water detained in a construction sediment basin exceeds the nominated TSS limit to enable it to be discharged, the basin is treated with a flocculent or coagulant to reduce the amount of suspended solids in the basin supernatant. TfNSW specifies the use of gypsum for the flocculation of basins however it does allow alternative flocculants subject to approval from TfNSW via a risk-based assessment using their standard template.

The use of any coagulants and/or flocculants must consider their by-products which in some circumstances become toxic to aquatic life. This is typically due to a high or low water pH which is often the trigger for the release of these materials in a toxic form. Specific chemical ecotoxity information should be sought from the chemical supplier in accordance with the TfNSW risk-based assessment.

The Blue Book (Landcom, 2004) suggests that water discharged from construction sites should not contain more than 50 mg/L of suspended sediment and notes that "the actual discharge load should be considerate of the loads normally carried in the receiving waters, including those during and following storm events." This is generally considered acceptable for most locations because:

- The construction period is relatively short-term so long-term impacts are unlikely;
- A more stringent water quality requirement can add significantly to the cost of site dewatering, and most likely couldn't be achieved within a reasonable timeframe using safe flocculants.

IECA (2008) notes that 50mg/L equates to 50 kg, or approximately three and half domestic buckets of soil, evenly distributed in an Olympic swimming pool (1,000m^3). It also notes that setting a design target TSS concentration of 50mg/L would, in most regions of Australia, limit soil loss rates from construction sites to less than the commonly-adopted natural soil loss rate of 0.5 to 1.0 t/ha/yr (the "geological erosion rate").

The purpose of this assessment is to consider the potential impacts of discharging water from sediment basins against the NSW WQOs and environmental values of the receiving environment.

9 STORMWATER MODELLING

9.1 Predictive Modelling of Management Strategies

Predictive modelling has been adopted to evaluate the effectiveness of proposed sediment basin discharges to assist address identified water quality issues and assess if water quality guidelines can be met. The NWQMS framework describes a number of modelling approaches from conceptual to complex hydrodynamic models simulating the behavior of flows and in-stream water quality processes.

A detailed catchment wide model to derive flows from rainfall and estimate associated pollutant loads has been adopted for this assessment of the potential impact from detention basin discharges. It is anticipated that more detailed modelling may be undertaken for the sensitive receiving environments during future design stages if required.

9.2 Introduction

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC) was used to assess the impacts of proposed construction sediment basin discharge limits on the receiving environment of the Coffs Harbour Bypass proposal. MUSIC is a water quality decision support tool for stormwater managers. It aids the planning and design (to a conceptual level) of appropriate stormwater management systems from an individual development to a catchment level. The MUSIC modelling software was developed by researchers and practitioners of the former Cooperative Research Centre (CRC) for Catchment Hydrology and the current eWater CRC, and represents an accumulation of the best available knowledge and research into urban and rural stormwater management in Australia.

MUSIC estimates stormwater pollutant generation and simulates the performance of stormwater treatment devices individually and as part of a treatment train (individual devices connected in series to improve overall treatment performance). By simulating the performance of stormwater quality improvement measures, MUSIC provides information on whether a proposed stormwater management system conceptually would achieve water quality targets.

Utilisation of the model has involved a three step process:

1. Development of a MUSIC model of the existing catchment;
2. Calibration of the developed MUSIC model against observed water quality data;
3. Modelling of the impact of proposed discharge limits on the receiving environment.

Each of these stages is outlined in more detail below. In conducting this modelling, we have focused on the three pollutants of concern for the construction-phase of the project (TSS, TP and TN). Other pollutants and key indicators such as pH, conductivity, visual clarity and colour etc are discussed further in Table 11.

9.3 Model Development

In order to consider the stormwater discharge characteristics of the existing catchments, the forest, rural, residential and urban areas within these catchments were identified (see Figure 7 and Table 2). The runoff parameters and pollutant generation parameters were applied to these areas as per the Coffs Harbour City Council Water Sensitive Urban Design (WSUD) Design Manual which references the South-East Queensland (SEQ) MUSIC Modelling Guide (WBD, 2010) and the draft CMA MUSIC guidelines (CMA, 2010).

Following identification of land use, run-off and pollutant generation parameters, the MUSIC model was run to generate water quality pollutant loads for the relevant catchments. The model was developed to include all rainfall events from a representative climatic timeframe for Coffs Harbour (in this case, from January, 1999 to December, 2003) as recommended by the CMA MUSIC guidelines.

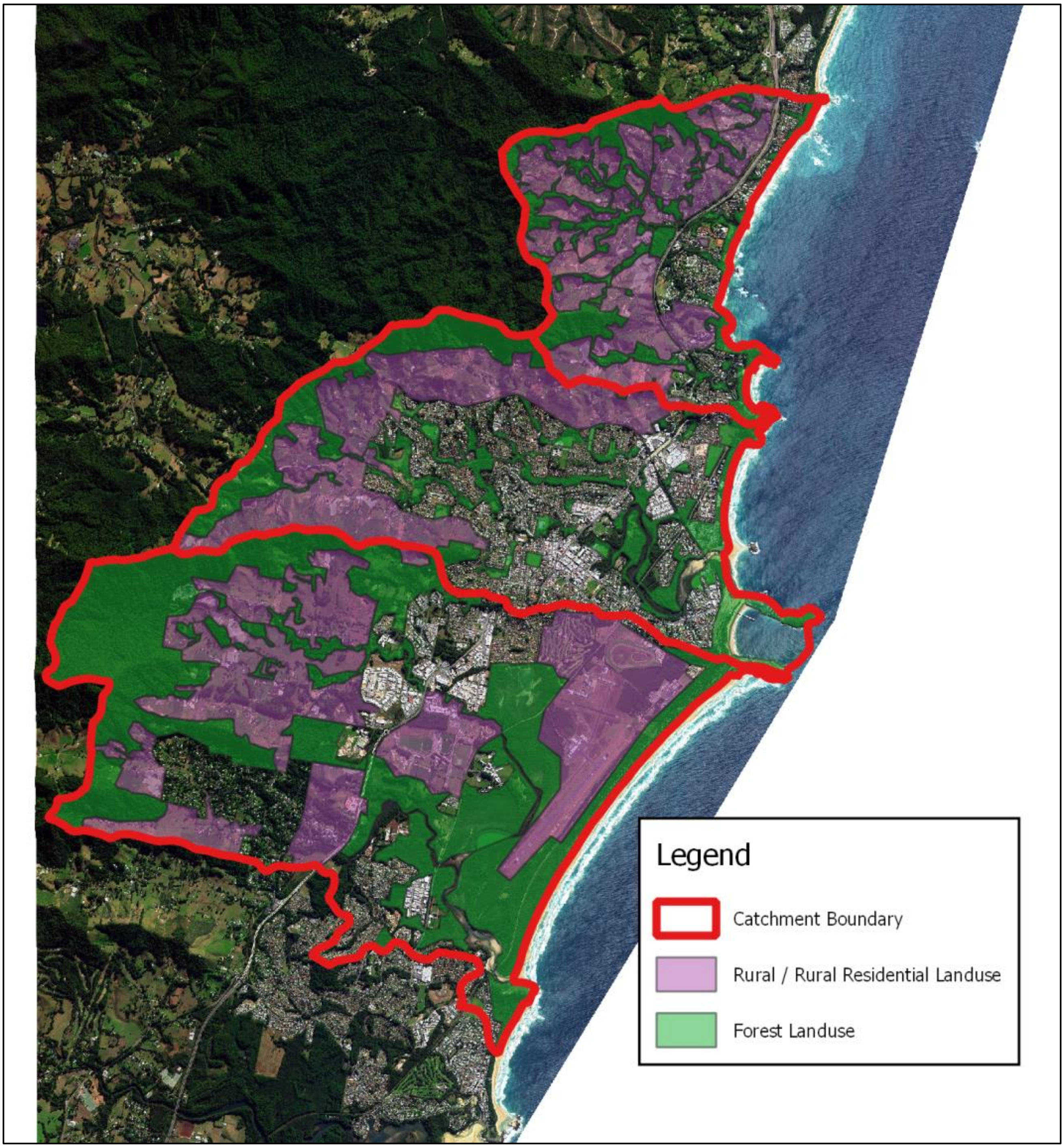

Figure 7 – Catchment Boundaries and Landuse.

9.4 Model Calibration

Calibration of the MUSIC model involved the following steps:

9.4.1 Collection of Historical Water Quality Monitoring

There is limited historical water quality monitoring data available with only average and maximum values of various parameters (i.e. no daily results are available). The UNE and DEH study undertaken in 2015 provides the longest source of data and these results will be compared against the predicted MUSIC results for the year 2015.

9.4.2 Correlation of Total Suspended Solids and Turbidity

The water quality objectives include turbidity rather than TSS. As the MUSIC model does not provide a turbidity output, an estimate of the TSS to turbidity correlation is required. Previous projects have adopted the TSS to turbidity correlation based on the Environment Protection Licence (EPL) for the recent Foxground and Berry Bypass (FBB) project north of Nowra which converted historical turbidity values to TSS. This correlation was based on over 400 samples taken during the construction of the FBB project. The adopted TSS:Turbidity ratio is 1:2. The recent Berry to Bomaderry Upgrade project adopted the same correlation for water quality assessments. The correlation was adopted for locations with similar soil landscapes and is expected to be a conservative correlation.

The UNE and DEH study measured both TSS and turbidity however only minimum, maximum and mean values were recorded over the 12 month testing period. The results indicate that the ratio at this location is more like 1:0.7; i.e. turbidity is generally lower than TSS. This is unusual and may be inaccurate as the comparison is based on mean results over a year rather than results on individual days. Therefore a conservative correlation of TSS:Turbidity ratio of 1:2 was adopted.

A more detailed description of the soils at the Coffs Harbour Bypass site is contained in the ESMR (SEEC, 2020).

To allow for a comparison of MUSIC model outputs against NSW Water Quality Objectives, the relevant turbidity objectives (0.5-10 NTU for estuaries) have been converted to TSS using the above correlation to give a TSS objective of 0.25-5mg/L for estuaries.

9.4.3 Comparison of Historical Water Quality Monitoring with the Model

As noted in Section 9.4.1, there is limited historical water quality monitoring records around the proposal location. However, the available statistics in downstream sections of the two creeks were compared against the MUSIC model outputs to verify the patterns of water quality modelling during the sampling periods.

The following table indicates the MUSIC model generally over-estimates TSS concentrations when compared to historical water quality data. Estimated TP and TN levels are similar to the historical mean values as shown in Table 7.

Table 7 – Historical Mean TSS and Predicted MUSIC Results (Ryder, et al 2016)

Parameter	Kororo Basin	Coffs Creek	Boambee Creek
TSS (mg/L) - Mean recorded value	-	5.5	2.6
TSS (mg/L) - MUSIC prediction	5.3	5.9	5.2
TP (mg/L) - Mean recorded value	-	0.04	< 0.03
TP (mg/L) - MUSIC prediction	0.027	0.037	0.030
TN (mg/L) - Mean recorded value	-	0.5	0.5
TN (mg/L) - MUSIC prediction	0.38	0.52	0.42

Although individual days cannot be compared, mean values over a year provide some confidence that the MUSIC results are reasonable and can be used to assess potential changes in water quality. This approach is considered to be appropriate as the relative change in the MUSIC model results has been reviewed as well as the predicted loads and concentrations.

Figure 8 compares the predicted TSS concentrations for the three catchments for the calibration period (2015). Note that maximum values that exceed the scale of the chart have been provided as text values.

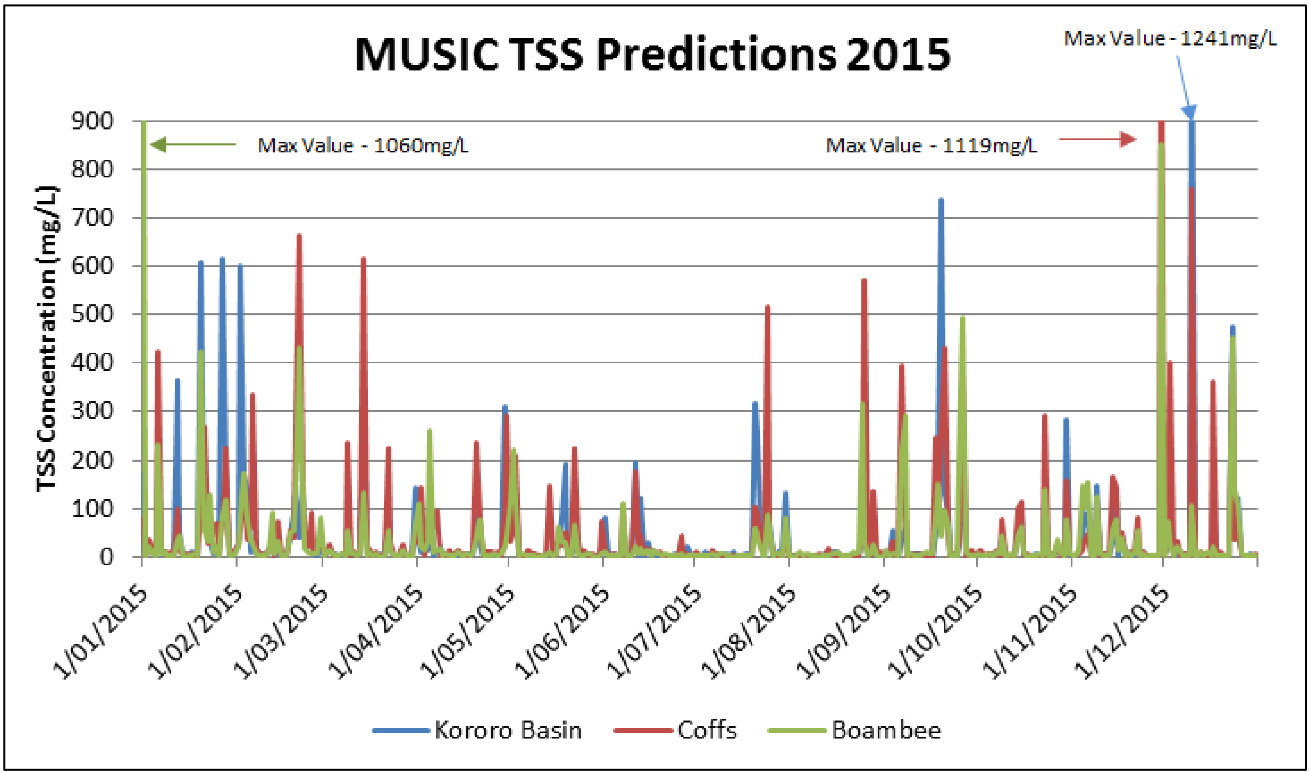

Figure 8 – TSS values predicted by MUSIC (2015).

9.5 Results of Modelling

To demonstrate the effect of the proposed discharge limits, and assess these against the relevant NSW WQOs, refinement of the MUSIC model focused on the time periods where controlled discharges from construction-phase sediment basins are likely to occur. The construction-phase sediment basins are assumed to be discharged within five days of the cessation of a rainfall event when the receiving water quality is at (or below) the proposed discharge limit of 50mg/L. The construction-phase basin discharge has been assumed to be completed using a nominal pump rate over a 24-48 hour period.

Results are provided for flows from the upstream catchment on discharge days (i.e. basin de-watering after treatment, not overflows from rainfall in excess of the basin design event). As a comparison, results are also provided for all days modelled (i.e. all events including discharge days and basin overflows during heavy rain events).

The NSW WQOs are provided as turbidity (NTU) and have been converted to total suspended solids using the assumed conversion ratio of 1:2 for TSS:Turbidity (i.e. 10NTU has been converted to 5mg/L).

9.5.1 Kororo Basin Catchment

A summary of the model results for the Kororo Basin catchment flows entering the marine environment are provided in Table 8. The table includes results considering the entire construction period (all days) and results that have been refined to include just the days of discharge (discharge days) to demonstrate the short-term effect of the proposal on the indicators on the days of discharge.

Table 8 – Summary of average water quality data for the Kororo Basin catchment.

Variable	Existing Scenario	Construction Phase Sediment Basins	% Increase
Ave TSS Conc - All Data/Days (mg/L)	40.90	44.92	9.8%
Median TSS Conc - All Data/Days (mg/L)	4.78	5.24	9.6%
Ave TSS Conc - Basin Discharge Data/Days (mg/L)	4.19	4.88	16.4%
Median TSS Conc - Basin Discharge Data/Days (mg/L)	3.49	3.11	-10.7%
Ave TP Conc - All Data (µg/L)	63.49	57.33	-9.7%
Ave TN Conc - All Data (µg/L)	514.71	483.90	-6.0%
Ave TP Concentrations - Basin discharge Data (µg/L)	21.41	21.35	-0.3%
Ave TN Concentrations - Basin discharge Data (µg/L)	320.24	299.54	-6.5%

As expected, the concentration of pollutants in the receiving environments is much lower on discharge days which occur two to five days of after a rain event (due to the effect of dilution). When all days are considered (including during the rain events), the existing TSS concentrations in the receiving waters are expected to increase from 4.19mg/L up to 40.9mg/L.

The MUSIC model predicts the average TSS concentration in the receiving waters varies from 4.19mg/L for the existing case to 4.88mg/L during periods of discharge from the construction-phase sediment basins. This is an increase of 16.4%. It should be noted, however, that the median values decreased by 10.7%. As discussed previously, the MUSIC model over-estimates TSS levels, but it can be assumed that the relative percentage impacts predicted by the model are representative. The median turbidity level of the historical data varies from 2.0-2.3 NTU for the most downstream reaches of Coffs Creek and Boambee Creek. Assuming that the Kororo Basin catchment would have similar water quality, increasing the mean historical turbidity levels of both waterways by the expected percentage of 16.4%, as estimated by MUSIC, would result in a median turbidity level of 2.68 NTU, which is well under the NSW WQO trigger value of 10 NTU.

MUSIC predicts that TP concentrations are expected to decrease by 9.7% based on results from the entire data set. When considering just the days when the construction-phase sediment basins discharge, TP concentrations are expected to decrease by 0.3%. The average TP concentration in the waterways is expected to be around 21µg/L during days when the construction-phase sediment basins discharge.

The model predicts that TN concentrations are expected to decrease by 6.5% when considering all the data. The concentrations decrease by 6.0% when considering just the days the construction-phase sediment basins discharge. The average TN concentration is expected to be around 300µg/L.

Figure 9 highlights the various TSS concentrations predicted by the model for the basin discharge conditions described above.

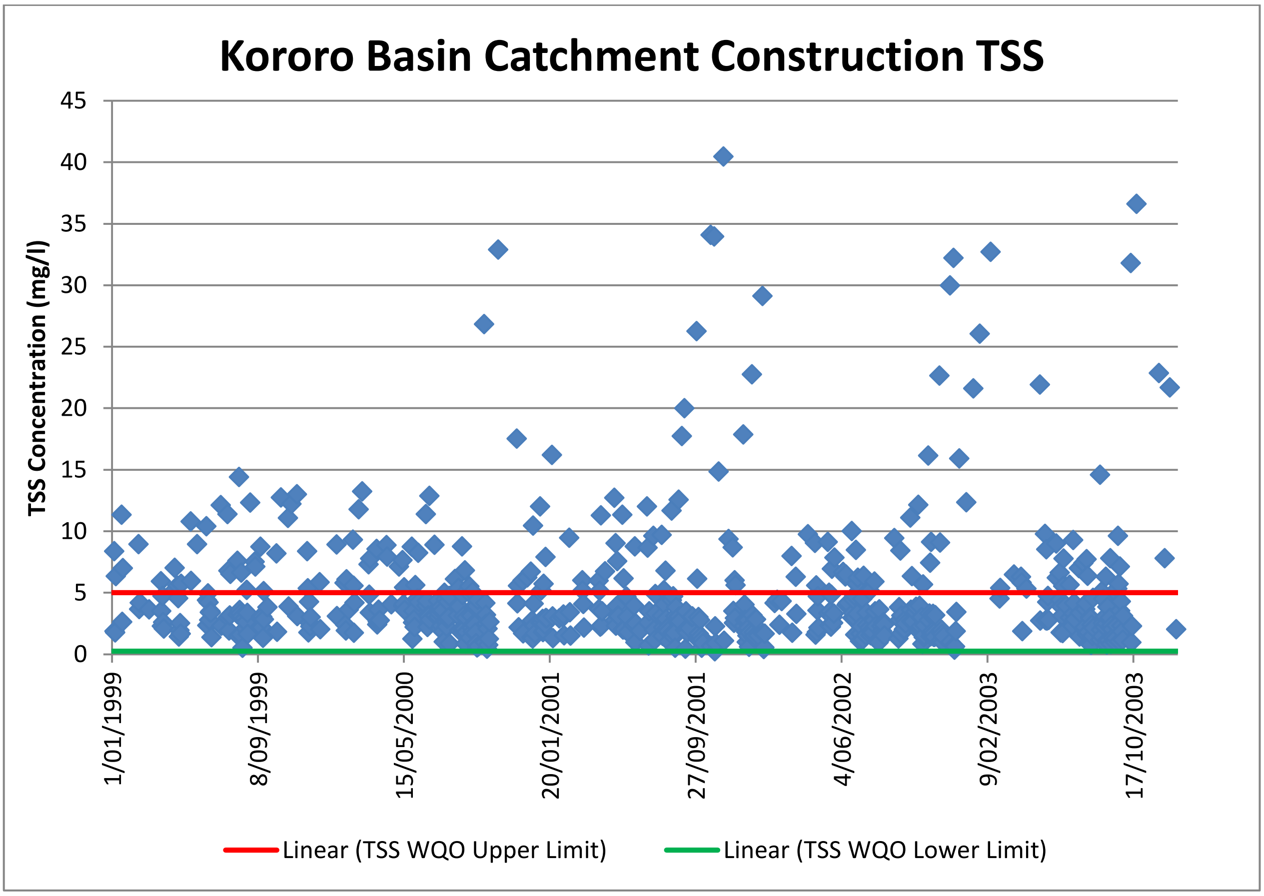

Figure 9 – MUSIC TSS modelling of the short-term (24 hour) effect of construction-phase sediment basin discharges from the Kororo Basin catchment immediately downstream of the proposal.

Figure 10 plots the modelled TSS results from the Kororo Basin catchment on days when the construction-phase sediment basin discharges against the modelled catchment flow conditions. It highlights no real correlation of modelled peak estimates of TSS with catchment flow and is not dissimilar from the existing scenario as shown in Figure 11. As expected, the construction plot does include several high TSS concentrations for low flows associated with basin discharge during low flow periods. Figure 11 shows the same information for the existing scenario for the same days the construction basins would discharge.

Both plots are expected to be conservative, with the MUSIC model over-estimating TSS concentrations. However the plots highlight that the relatively short term proposed sediment basin discharges should not significantly impact the average TSS concentration levels in the waterways.

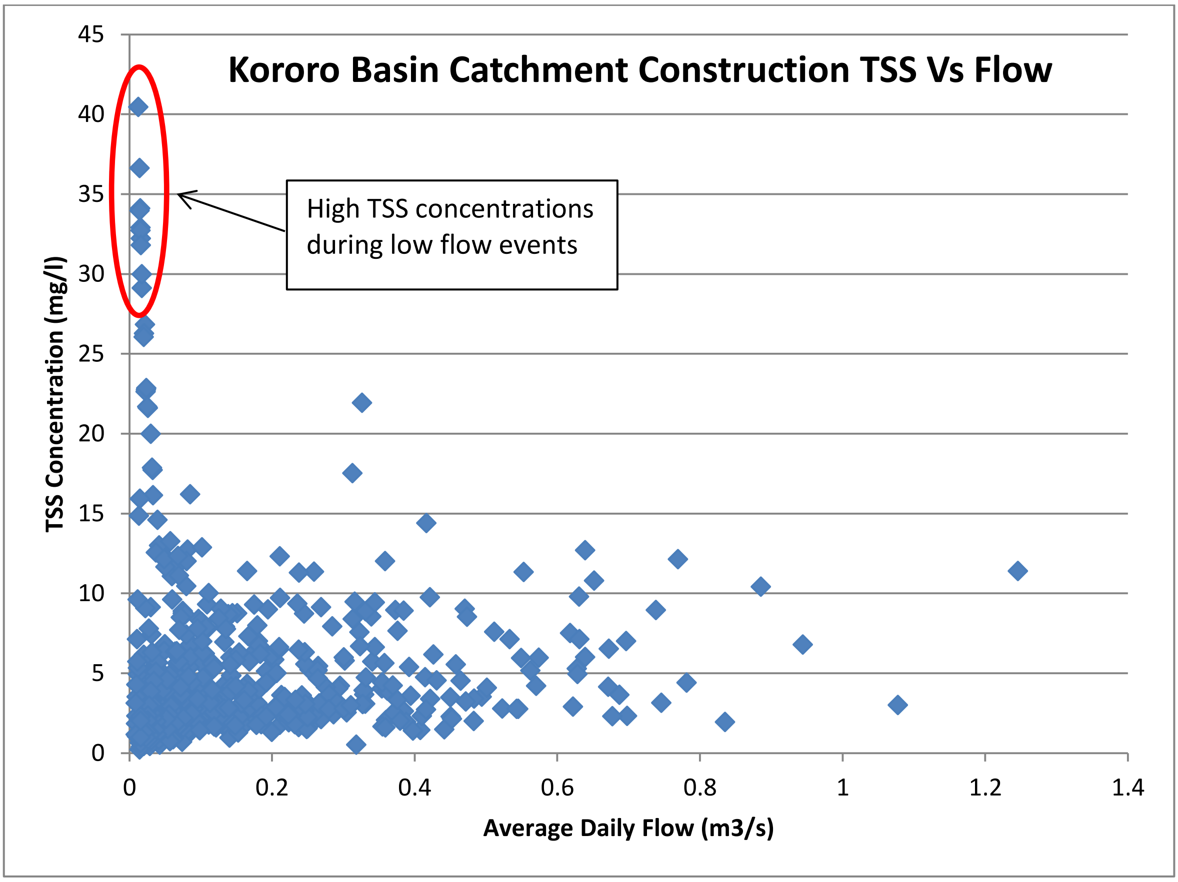

Figure 10 –TSS concentrations against catchment flow from Kororo Basin catchment immediately downstream of the proposal alignment following discharge of construction-phase sediment basins.

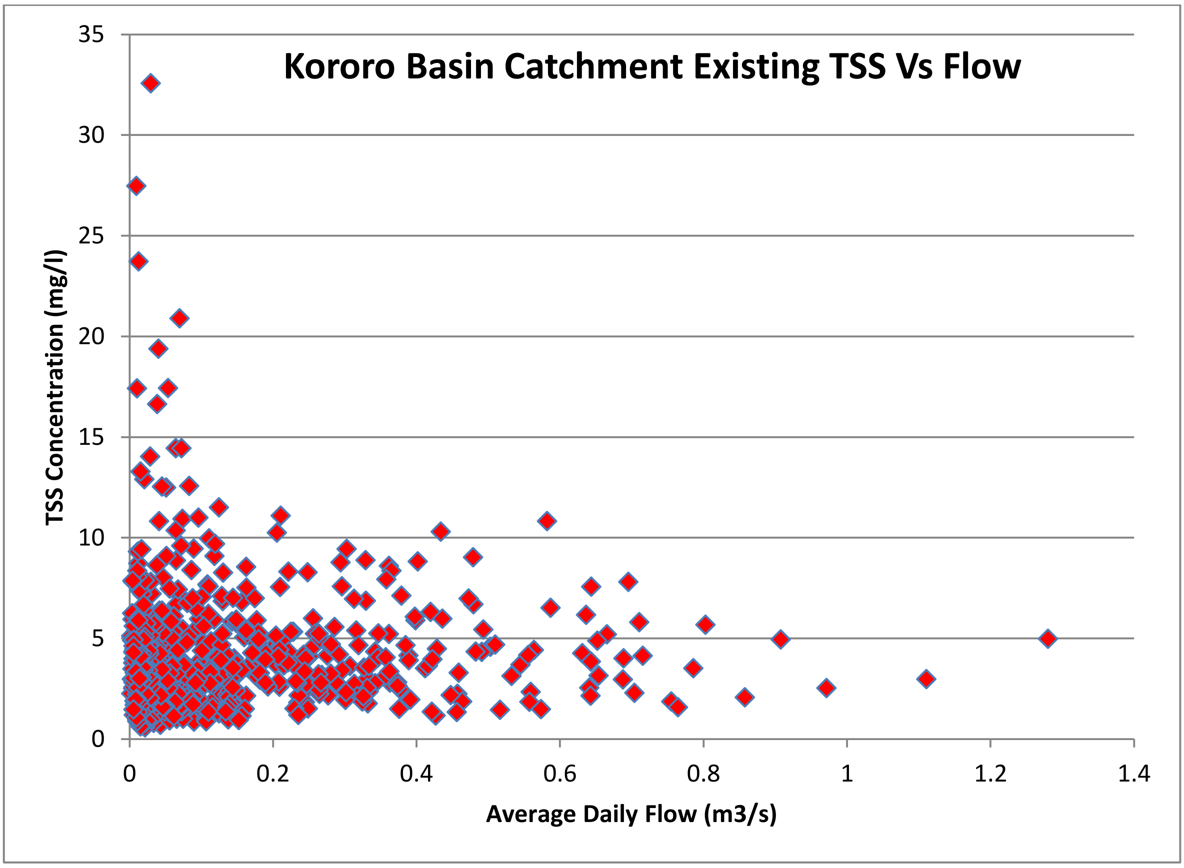

Figure 11 –TSS concentrations against catchment flow from Kororo Basin catchment immediately downstream of the project alignment on the same days construction-phase sediment basins discharge.

9.5.2 Coffs Creek

A summary of the model results for the Coffs Creek catchment flows entering the marine environment are provided in Table 9. The table includes results considering the entire construction period (all days) and results that have been refined to include just the days of discharge (discharge days) to demonstrate the short-term effect of the proposal on the indicators on the days of discharge.

Table 9 – Summary of average water quality data for the Coffs Creek catchment.

Variable	Existing Scenario	Construction Phase Sediment Basins	% Increase
Ave TSS Conc - All Data/Days (mg/L)	45.93	45.72	-0.4%
Median TSS Conc - All Data/Days (mg/L)	5.489	6.067	10.5%
Ave TSS Conc - Basin Discharge Data/Days (mg/L)	4.54	5.12	12.6%
Median TSS Conc - Basin Discharge Data/Days (mg/L)	3.91	3.76	-3.8%
Ave TP Conc - All Data (µg/L)	97.14	93.26	-4.0%

Variable	Existing Scenario	Construction Phase Sediment Basins	% Increase
Ave TN Conc - All Data (µg/L)	680.81	684.34	0.5%
Ave TP Concentrations - Basin discharge Data (µg/L)	27.97	26.57	-5.0%
Ave TN Concentrations - Basin discharge Data (µg/L)	373.69	369.41	-1.1%

The MUSIC model predicts the average TSS concentration in the receiving waters varies from 4.54mg/L for the existing case to 5.12mg/L during periods of discharge from the construction-phase sediment basins. This is an increase of 12.6%. It should be noted, however, that the median values decreased by 3.8%. The median turbidity level of the historical data is 2.0 NTU for the most downstream reaches of Coffs Creek. Increasing the mean historical turbidity levels by the expected percentage of 12.6%, as estimated by MUSIC, would result in a median turbidity level of 2.25 NTU, which is well under the NSW WQO trigger value of 10 NTU.

MUSIC predicts that TP concentrations are expected to decrease by 4.0% based on results from the entire data set. When considering just the days when the construction-phase sediment basins discharge, TP concentrations are expected to decrease by 5.0%. The average TP concentration in the waterway is expected to be around 27µg/L during days when the construction-phase sediment basins discharge.

The model predicts that TN concentrations are expected to increase by 0.5% when reviewing all the data. TN concentrations are expected to decrease by 1.1% for the days when the construction-phase sediment basins discharge. The average TN concentration is expected to be around 369µg/L.

Figure 12 highlights the various TSS concentrations predicted by the model for the discharge conditions described above.

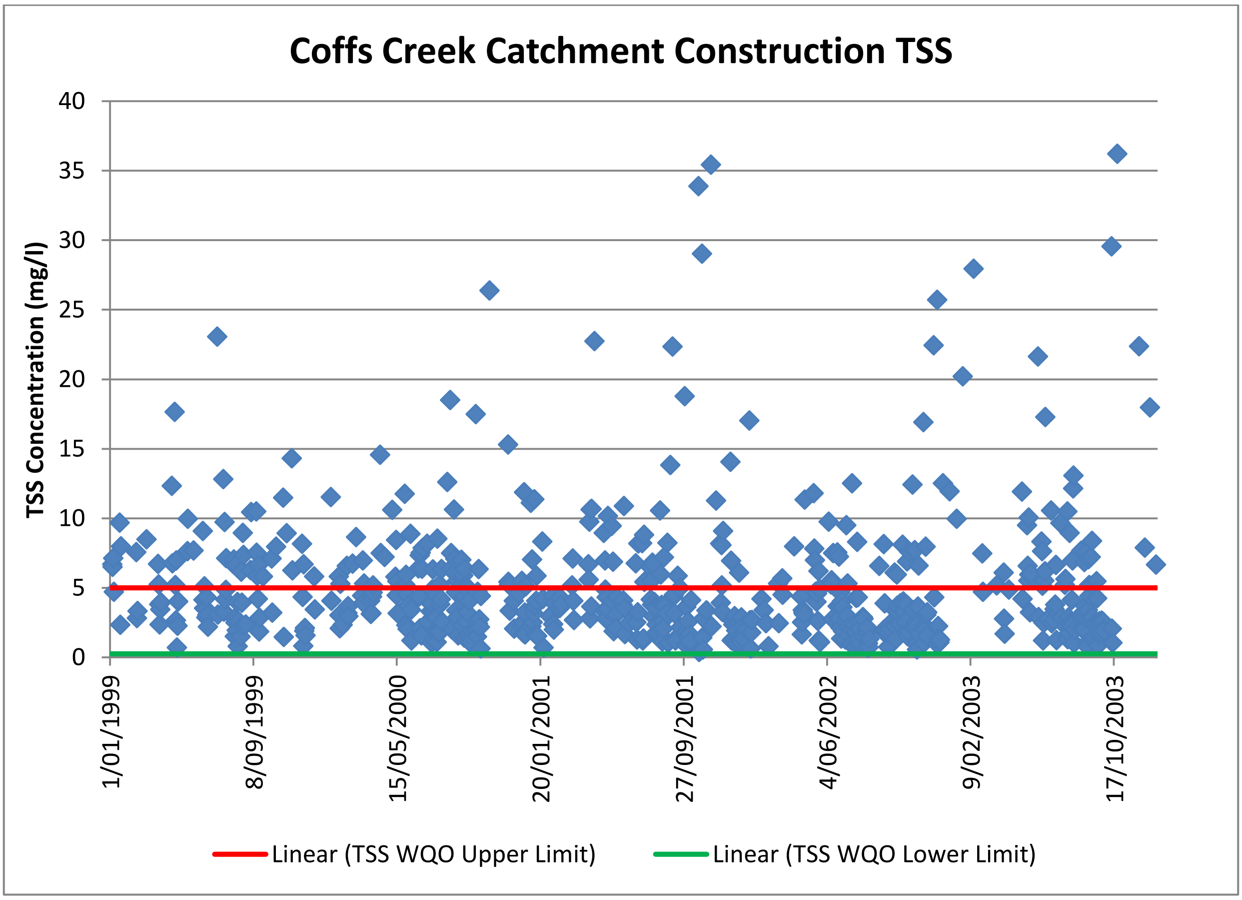

Figure 12 – MUSIC TSS modelling of the short-term (24 hour) effect of construction-phase sediment basin discharges from the Coffs Creek catchment immediately downstream of the proposal alignment.

Figure 13 plots the modelled TSS results from the Coffs Creek catchment on days where the construction-phase sediment basin discharges against the modelled catchment flow conditions. It highlights no real correlation of modelled peak estimates of TSS with catchment flow and is not dissimilar from the existing scenario as shown in Figure 14. As expected, the construction plot does include several high TSS concentrations for low flows associated with basin discharge during low flow periods. Figure 14 shows the same information for the existing scenario for the same days the construction basins would discharge.

Both plots are expected to be conservative, with the MUSIC model over-estimating TSS concentrations. However the plots highlight that the relatively short term proposed sediment basin discharges should not significantly impact the average TSS concentration levels in the waterways.

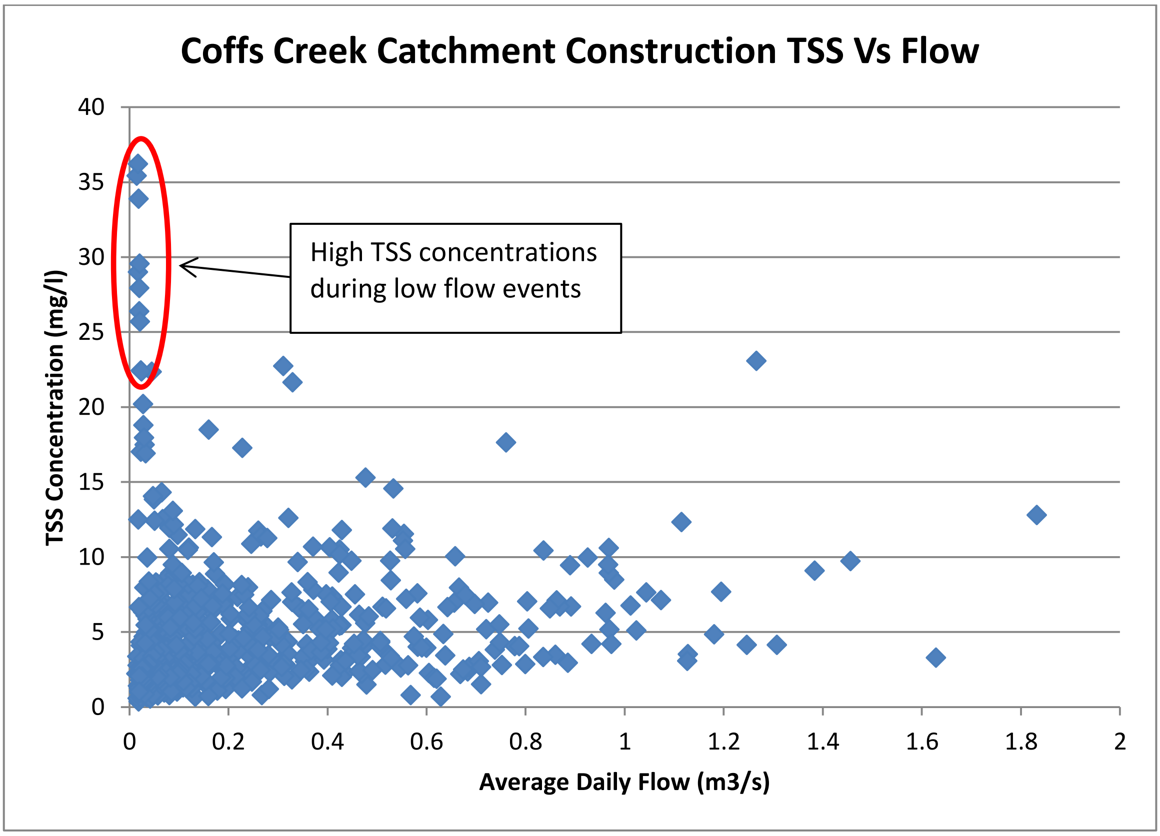

Figure 13 –TSS concentrations against catchment flow from the Coffs Creek catchment immediately downstream of the project alignment following discharge of construction-phase sediment basins.

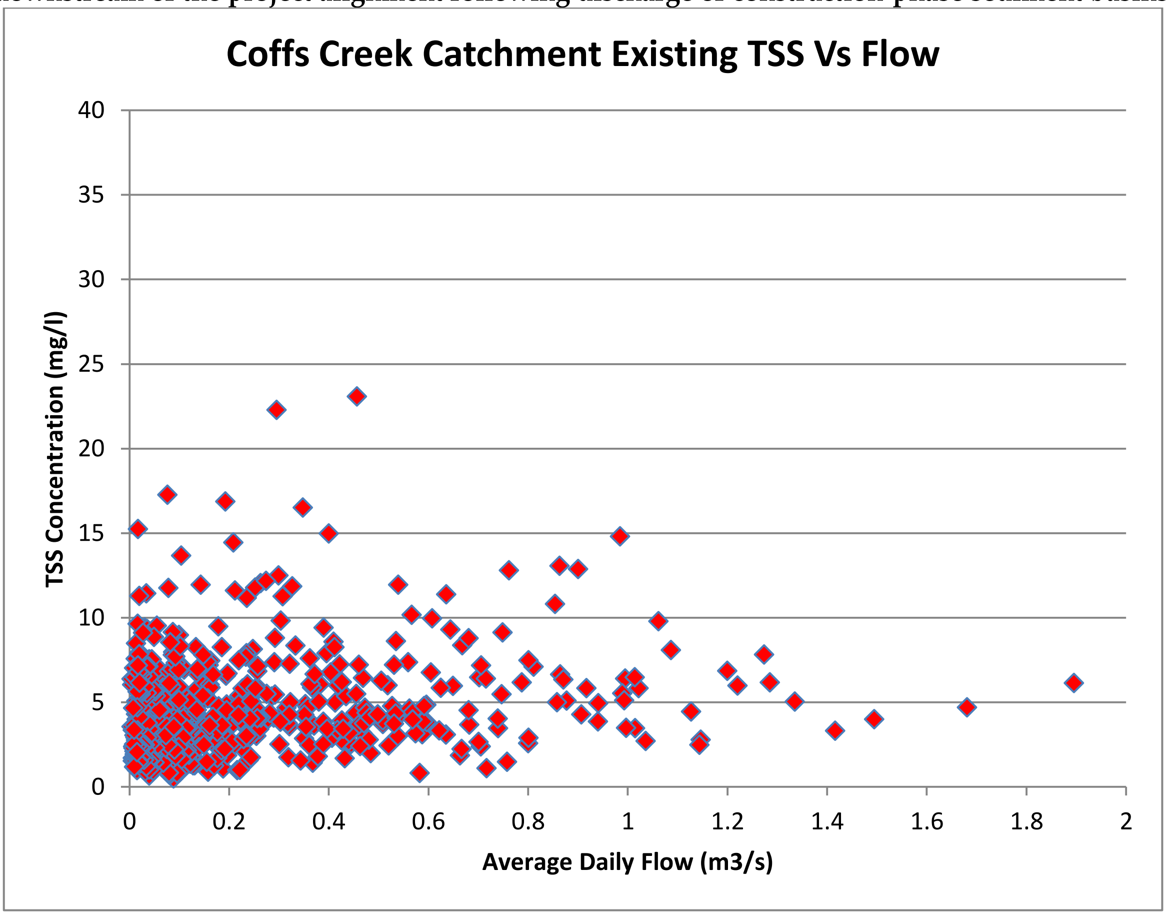

Figure 14 –TSS concentrations against catchment flow from the Coffs Creek catchment immediately downstream of the proposal alignment on the same days construction-phase sediment basins discharge.

9.5.3 Boambee Creek

A summary of the model results for the Boambee Creek catchment flows entering the marine environment are provided in Table 10. The table includes results considering the entire construction period (all days) and results that have been refined to include just the days of discharge (discharge days) to demonstrate the short-term effect of the project on the indicators on the days of discharge.

Table 10 – Summary of average water quality data for the Boambee Creek catchment.

Variable	Existing Scenario	Construction Phase Sediment Basins	% Increase
Ave TSS Conc - All Data/Days (mg/L)	39.55	39.49	-0.2%
Median TSS Conc - All Data/Days (mg/L)	4.90	5.41	10.5%
Ave TSS Conc - Basin Discharge Data/Days (mg/L)	4.32	4.72	9.3%
Median TSS Conc - Basin Discharge Data/Days (mg/L)	3.64	3.74	2.9%
Ave TP Conc - All Data (µg/L)	71.40	70.11	-1.8%
Ave TN Conc - All Data (µg/L)	552.57	552.84	0.0%
Ave TP Concentrations - Basin discharge Data (µg/L)	21.96	23.10	5.2%
Ave TN Concentrations - Basin discharge Data (µg/L)	322.50	336.53	4.3%

The MUSIC model predicts the average TSS concentration in the receiving waters varies from 4.32mg/L for the existing case to 4.72mg/L during periods of discharge from the construction-phase sediment basins. This is an increase of 9.3%. It should be noted, however, that the median values increased by 2.9%. The median turbidity level of the historical data is 2.3 NTU for the most downstream reaches of Boambee Creek. Increasing the mean historical turbidity levels by the expected percentage of 9.3%, as estimated by MUSIC, would result in a median turbidity level of 2.51 NTU, which is well under the NSW WQO trigger value of 10 NTU.

MUSIC predicts that TP concentrations are expected to decrease by 1.8% based on results from the entire data set. When considering just the days when the construction-phase sediment basins discharge, TP concentrations are expected to increase by 5.2%. The average TP concentration in the waterway is expected to be around 22µg/L during days when the construction-phase sediment basins discharge.

The model predicts that TN concentrations are expected to remain unchanged when reviewing all the data. TN concentrations are expected to increase by 4.3% for the days when the construction-phase sediment basins discharge. The average TN concentration is expected to be around 337µg/L.

Figure 15 highlights the various TSS concentrations predicted by the model for the discharge conditions described above.

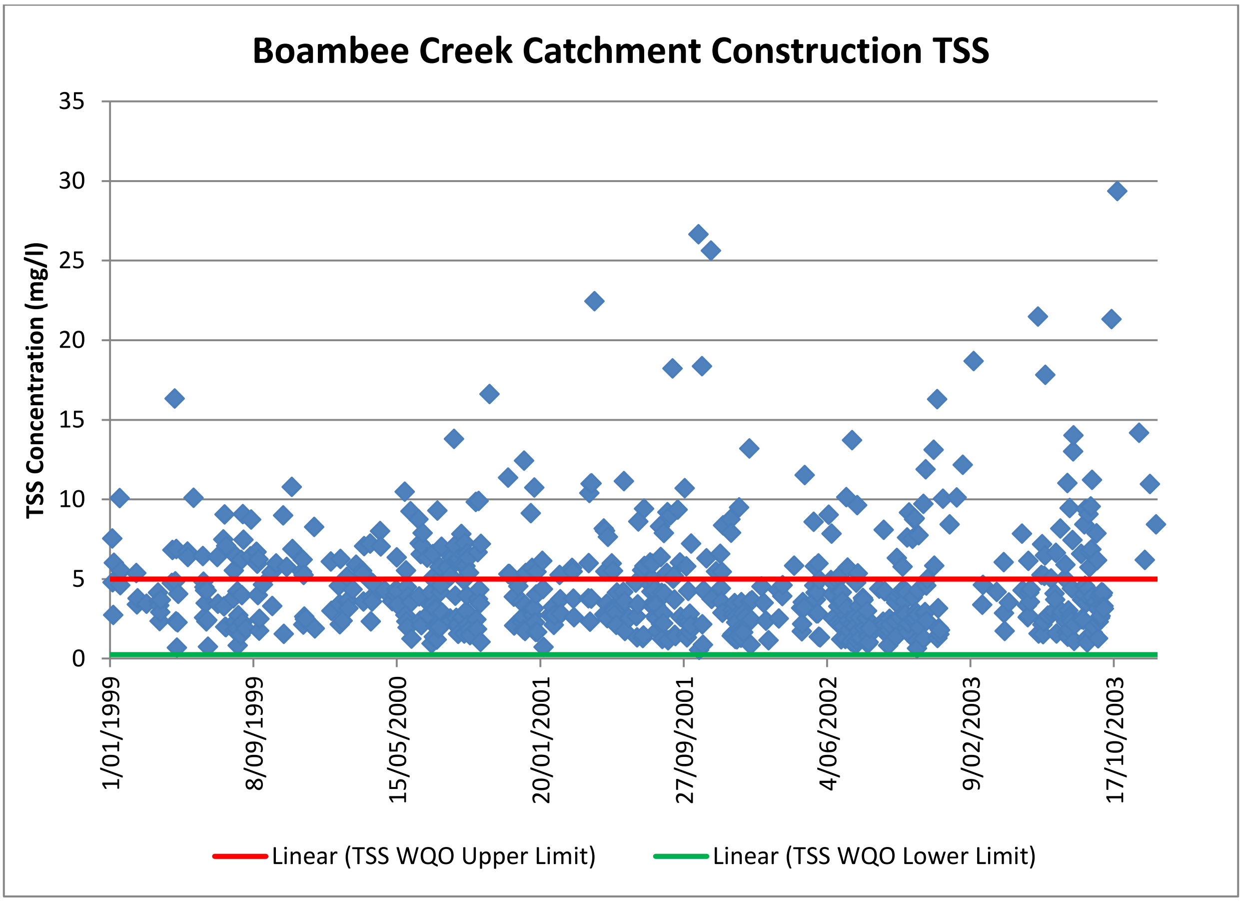

Figure 15 – MUSIC TSS modelling of the short-term (24 hour) effect of construction-phase sediment basin discharges on Boambee Creek catchment immediately downstream of the proposal.

Figure 16 plots the modelled TSS results from the Boambee Creek catchment on days where the construction-phase sediment basin discharges against the modelled catchment flow conditions. It highlights no real correlation of modelled peak estimates of TSS with catchment flow and is not dissimilar from the existing scenario as shown in Figure 17. As expected, the construction plot does include several high TSS concentrations for low flows associated with basin discharge during low flow periods. Figure 17 shows the same information for the existing scenario for the same days the construction basins would discharge.

Both plots are expected to be conservative, with the MUSIC model over-estimating TSS concentrations. However the plots highlight that the relatively short term proposed sediment basin discharges should not significantly impact the average TSS concentration levels in the waterways.

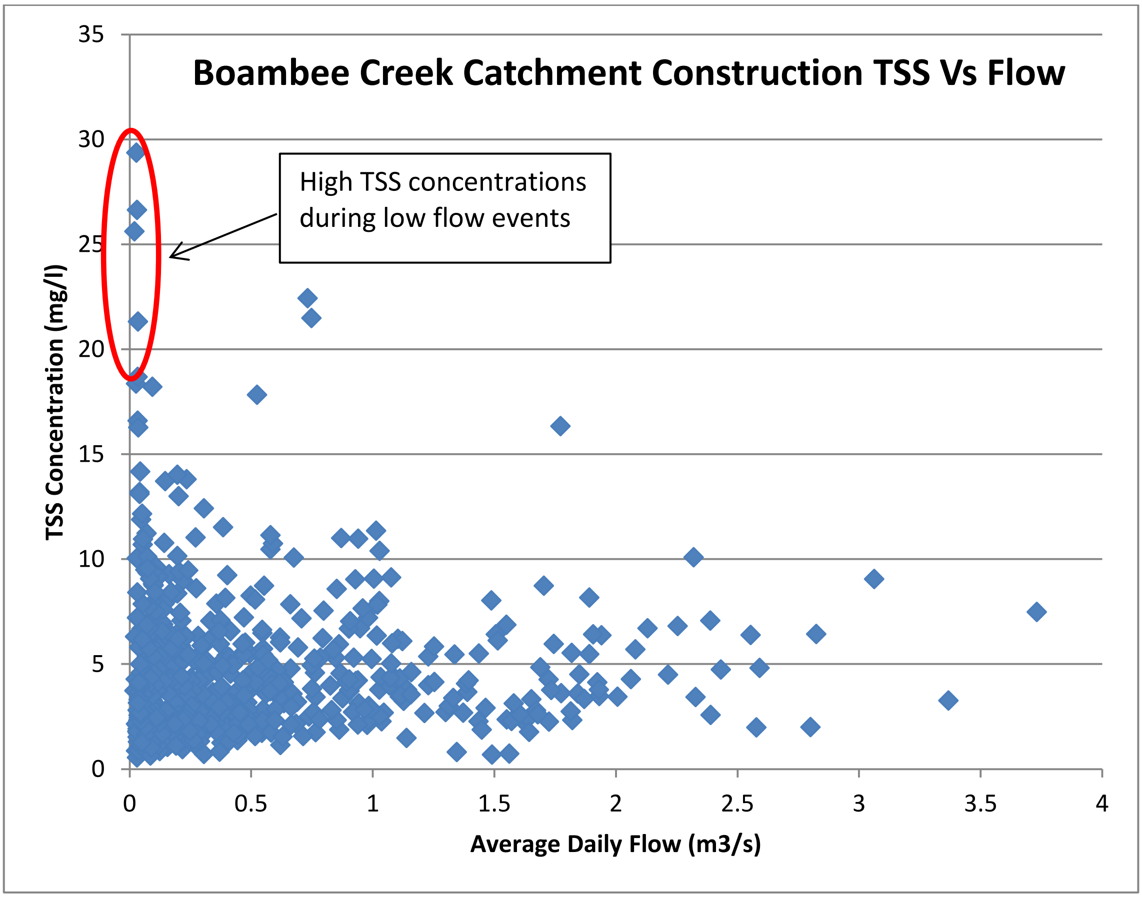

Figure 16 –TSS concentrations against catchment flow from the Boambee Creek catchment immediately downstream of the proposal following discharge of construction-phase sediment basins.

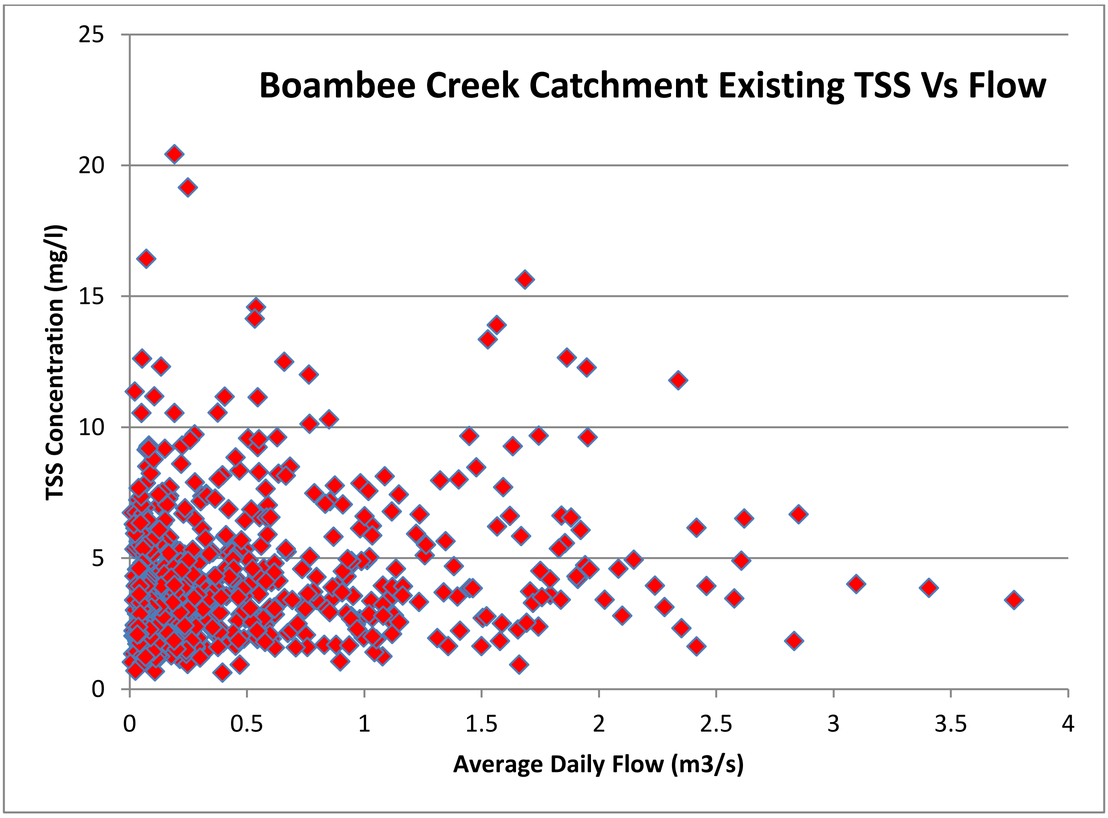

Figure 17 –TSS concentrations against catchment flow from the Boambee Creek catchment immediately downstream of the proposal on the same days construction-phase sediment basins discharge.

10 ASSESSMENT OF POTENTIAL IMPACTS (Step 9)

Table 11 provides a list of the key indicators and water quality objectives for each relevant environmental value for the receiving environment. Table 11 includes a description of the potential impact associated with the proposed construction-phase sediment basin discharge limits and a discussion on the expected likelihood of the impact. In undertaking the assessment in Table 11, site and soil conditions have been considered, as summarised in the ESMR (SEEC, 2020).

As noted in Section 4, for the purposes of this assessment, the environmental values been based on protecting the water quality objectives for waterways affected by urban development and uncontrolled streams. These include:

- Aquatic ecosystem protection
- Visual amenity
- Secondary contact recreation (short term objective, within 5 years)
- Primary contact recreation (assess opportunities for a longer term objective 10 years or more)
- Aquatic foods (cooked). Note that ANZECC (2000) Guidelines list this environmental value as "Aquaculture and human consumption of aquatic foods." Therefore, it covers shellfish such as oysters.

The adopted indicator or trigger values have been adopted for estuaries rather than lowland rivers (< 150m altitude) as the water quality is being assessed for the entire upstream catchment just prior to release into the marine environment.

Table 11 – Assessment of the impacts of the Coffs Harbour Bypass proposal on environmental values and associated indicators of WQOs.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential proposal impact from proposed discharge limits
Total Phosphorus	Estuaries: 30 µg/L (for aquatic ecosystem protection).	Excessive phosphorus could lead to stimulation of the growth of nuisance plants which could dominate and change the dynamics of the aquatic ecosystem (e.g.eutrophication, algae and macrophytes). Eutrophication occurs when excessive plant growth deprives the water column of oxygen thereby killing other forms of aquatic biota. The growth of algae is also stimulated by excessive nutrients and may result in a build-up of toxins in the water column. The availability of inorganic phosphorus from soil is strongly controlled by pH. Maximum phosphate availability occurs in the pH range of 6.0-7.0. The soils are expected to have a pH range of around 5.0-6.5.	MUSIC modelling indicated an average existing TP concentration of approximately 23.8 µg/L for the existing catchment on the days of discharge. The model predicts TP concentrations around 77 µg/L when all days (including large storm events) are reviewed. The majority of TP organic material is expected to be present in topsoil. Road construction programming typically involves the clearing of vegetation and stripping of topsoil as one of the first activities, with the subsoils only exposed for the majority of the construction period. Local controls are provided for topsoil stockpiles (e.g. cover crops, bunds) and excess run-off from disturbed topsoil areas would be captured by construction sediment basins with expected reductions in TP associated with retention, settlement and removal of deposited sediment. TP is further reduced by the flocculation of remaining colloidal material prior to discharge. MUSIC modelling has predicted the main construction works would result in a slightly lower mean TP concentration of 74 µg/L within the receiving waterways during the entire construction period. More specifically for the construction-phase sediment basin discharges, modelling has predicted the proposed discharge limit would result in a mean TP concentration of 23.7 µg/L within the receiving waterways, This is generally a slight decrease of less than 0.5% from existing conditions on the days of the discharge. Modelling also provides TP loads from the construction-phase sediment basin discharges to the receiving environment. The proposed discharge limit would result in a small increase of annual TP loads of up to 0.2%, for the period when the construction basins discharge. While there are modelled exceedances of the trigger value for this indicator, these exceedances are characteristic of the prevailing catchment conditions rather than the impacts of the proposed construction-phase sediment basin discharge limits. As such, the proposed discharge limits would have minimal impacts on this indicator. The proposed detention basin discharge limits are therefore expected to continue to maintain the current water quality which bas been estimated to meet the water quality objectives.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential proposal impact from proposed discharge limits
Total Nitrogen	Estuaries: 300 µg/L (for aquatic ecosystem protection).	Excessive nitrogen could lead to stimulation of the growth of nuisance plants which could dominate and change the dynamics of the aquatic ecosystem. (e.g. algae and macrophytes). Most nitrogen in surface soils is immobilised, bound as organic nitrogen associated with humus. A small proportion is steadily turned into inorganic (mineralised) forms such as nitrate compounds through nitrification that can be released to groundwater or soil water. Direct addition of fertiliser can increase the levels of nitrate in a soil.	Limited historical water quality monitoring in this location indicates that TN is variable with TN levels recorded between 200 and 500 µg/L. MUSIC modelling indicates an average existing TN concentration of approximately 583 µg/L for the existing catchment. The majority of TN at the Proposal is expected to be present in topsoil. Road construction programming typically involves the clearing of vegetation and stripping of topsoil as one of the first activities, with the subsoils only exposed for the majority of the construction period. Local controls are provided for topsoil stockpiles (e.g. cover crops, bunds) and excess run-off from disturbed topsoil areas would be captured by construction sediment basins with expected reductions in TN associated with retention, settlement and removal of deposited sediment. TN is further reduced by the flocculation of remaining colloidal material prior to discharge. Modelling predicts that the proposal would result in a mean TN concentration of approximately 574 µg/L within the receiving waterway, generally a decrease of 1.6% below existing levels. More specifically for the construction-phase sediment basin discharges, modelling has predicted that the proposed discharge limit would result in a mean TN concentration of 339 µg/L within the receiving waterways, generally a decrease of around 1.1% on the days of the discharge. Modelling also provides TN loads from the construction-phase sediment basin discharges to the receiving environment. The proposed discharge limit would result in a small change to the TN loads of approximately 3.8%. While there are modelled exceedances of the trigger value for this indicator, these exceedances are characteristic of the prevailing catchment conditions rather than the impacts of the proposed construction sediment basin discharge limits. As such, the proposed discharge limits would have minimal impacts on this indicator. The proposed detention basin discharge limits are therefore expected to slightly improve or at least maintain current average total nitrogen concentrations. The existing water quality has been estimated to exceed the water quality objectives.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential proposal impact from proposed discharge limits
Chlorophyll-a	Estuaries: 4 µg/L (for aquatic ecosystem protection).	Chlorophyll a (chl a) concentration is often used as a general indicator of plant biomass as nutrients alone cannot indicate whether a waterbody actually has a nuisance plant problem. Increased chl a in the water indicates that plants, algae or cyanobacteria are actually growing. Chl a is usually measured in a waterbody so is not a typical stormwater pollutant.	None expected, as Chlorophyll-a is not expected to be present in construction-phase sediment basin discharges. The proposed detention basin discharge limits are therefore expected maintain current water quality.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential proposal impact from proposed discharge limits
Turbidity	Estuaries: 0.5-10 NTU (for aquatic ecosystem protection). A 200 mm diameter black disc should be able to be sighted horizontally from a distance of more than 1.6 m (approximately 6 NTU) (for primary contact recreation). 5 NTU; <1 NTU desirable for effective disinfection; >1 NTU may shield some micro-organisms from disinfection. (homestead water supply) Suspended solids: less than 40 micrograms per litre (freshwater) (for aquatic foods, cooked).	Turbidity is the presence of suspended particulate and colloidal matter consisting of suspended clay, silt, phytoplankton and detritus measured by a technique called nephelometry, which measures the fraction of light scattered at right angles to the light path of water. Increased turbidity can reduce light penetration through the water column and therefore reduce the level of photosynthetic activity. Turbidity increases with sediment load.	Turbidity and Total Suspended Solids (TSS) are the principle pollutant of concern associated with road construction projects. Detailed modelling has been completed to assess the turbidity impacts of the proposed discharge limits on the receiving environment. The MUSIC modelling only calculates TSS and the results generally indicate that the trigger value is exceeded in the waterways when using the adopted TSS:Turbidity correlation factor. The model results are expected to be conservative as the model cannot account for the impact of naturally saline water that would result in a lower turbidity level as observed in the historical water quality data. The mean TSS level as observed with the historical sampling is 4.2-12mg/L across the three waterways compared with the MUSIC modelled mean concentration of 33.1 to 46.6mg/L for the same period. The MUSIC model predicts a slight increase of 3.0% in the average TSS concentrations for the entire period modelled. TSS concentrations are expected to increase on the days of basin discharge by around 12.8% with the average TSS levels increasing from 4.35mg/L to 4.90mg/L. The largest increase was in the Kororo Basin catchment with 16.4% However the median concentration was estimated to decease 10.7% from 3.49mg/L to 3.11mg/L. Assuming that the MUSIC concentrations are conservative (refer to Section 9.4.3 for discussion regarding MUSIC over-estimation of TSS levels in tidal waters) and that the increase of the concentration is relative, the observed mean turbidity would be expected to increase up to 16.4% from 2.3 NTU to 2.68 NTU which is lower than the NSW WQO trigger value. There is predicted to be minimal impact on this indicator as any impacts above trigger values are short-term in nature, are similar to the existing turbidity levels, and only experienced for the duration of construction. A number of mitigation measures typically implemented for road construction projects would also be implemented, such as those detailed in the ESMR and the ESCP (SEEC, 2020).

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential proposal impact from proposed discharge limits
Dissolved Oxygen	Estuaries: 80-110% (for aquatic ecosystem protection). > 6.5 mg/L (> 80% saturation) (for drinking water groundwater)	The dissolved oxygen concentration in a waterbody is highly dependent on temperature, salinity, biological activity (microbial, primary production) and rate of transfer from the atmosphere.	No significant change is expected as a result of the proposed construction-phase sediment basin discharge limits providing sediment is adequately managed to limit changes to salinity and nutrients (microbial activity). It is anticipated that the construction-phase sediment basin discharges could improve dissolved oxygen levels in some circumstances through increased catchment flow.
pH	Estuaries: 7.0-8.5 (for aquatic ecosystem protection). 5.0-9.0 (for primary contact recreation). 6.5-8.5 (for homestead water supply, drinking water -groundwater)	pH is a measure of the acidity or alkalinity of water and has a scale from 0 (extremely acidic) to 7 (neutral), through to 14 (extremely alkaline).	The proposed construction sediment basin discharge limits are expected to be consistent with the trigger values for this indicator for all WQOs except for estuaries (6.5 vs 7.0). However, the proposed discharges are consistent with the pH of natural stormwater runoff of fresh water into the waterways and, given the small quantities relative to the river flows, are not expected to impact on this objective.
Temperature	Iterative (for aquatic ecosystem protection). 15 – 35^{o}C (for primary contact recreation). Less than 2 degrees Celsius change over one hour (for aquatic foods, cooked).	Aquatic ecosystem functioning is very closely regulated by temperature. Temperature changes can occur naturally as part of normal diurnal (daily) and seasonal cycles, or as a consequence of human activities (anthropogenic).	The water temperature in the construction-phase sediment basins is not expected to be significantly different from local waterways as the depth is relatively shallow – less than 2m. Cold water pollution isn't expected in dams less than 15m deep. No impacts are expected.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential proposal impact from proposed discharge limits
Chemical contaminants	Iterative (for aquatic ecosystem protection and primary contact recreation). Waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreation (for primary and secondary contact recreation). Refer to Table 4.3.2 (ANZECC 2000 Guidelines) for heavy metals and metalloids in livestock drinking water (for livestock water supply) See Guidelines for Inorganic Chemicals in the Australian Drinking Water Guidelines (NHMRC & NRMMC 2004) (for homestead water supply). See ANZECC 2000 guidelines, section 6.2.2.) (for drinking water - groundwater)	Chemical contaminants are likely to be sourced either from spills that may occur during construction or from naturally contaminants or toxicants made soluble when run-off occurs over disturbed soils.	Chemical contamination from spills is likely to be restricted to oil spills from plant and machinery or from uncontrolled concrete washout activities. Both spill occurrences are readily cleaned up as part of routine construction activities and addressed by the proposed construction-phase sediment basin discharge limits (pH criteria and visible oils and grease). While there is potential for some mobilisation of chemical contaminants from run-off over naturally occurring soils, these contaminants are largely removed from discharges following treatment to remove sediment within the supernatant. There is not considered to be a potential impact from the proposed construction-phase sediment basin discharge limits that would result in an exceedance of these trigger values.
Biological assessment indicators	Iterative (for aquatic ecosystem protection)	Refer to comments on blue-green algae, faecal coliforms, enterococci, protozoans and nuisance organisms.	Refer to comments on blue-green algae, faecal coliforms, enterococci, protozoans and nuisance organisms.
Visual clarity and colour	Natural visual clarity should not be reduced by more than 20% (for visual amenity and primary and secondary contact recreation). Natural hue of the water should not be changed by more than 10 points on the Munsell Scale (for visual amenity and primary and secondary contact recreation). The natural reflectance of the water should not be changed by more than 50% (for visual amenity and primary and secondary contact recreation).	Clarity is a measure of how clear or transparent water is. It indicates how much light is available for photosynthesis at different depths.	This indicator is largely assessed above in relation to turbidity and TSS. There is limited baseline information on the natural visual clarity, hue and reflectance of the receiving environments to determine whether there is likely to be a predicted change in the nominated indicator. However, given the minor change in TSS concentrations and loads, it is unlikely that construction-phase sediment basin discharge would adversely impact on this environmental value.

<table>
<tr><th>Key Indicator</th><th>Numerical criteria (trigger values)</th><th>Discussion</th><th>Potential proposal impact from proposed discharge limits</th></tr>
<tr><td>Toxicants (as applied to aquaculture activities)</td><td>For aquatic foods (cooked) the following applies:
Metals:
• Copper: less than 5 µgm/L.
• Mercury: less than 1 µgm/L.
• Zinc: less than 5 µgm/L.
Organochlorines:
• Chlordane: less than 0.004 µgm/L (saltwater production)
• PCB's: less than 2 µgm/L.</td><td>Heavy metals and organochlorines can accumulate in aquatic foods to toxic levels.</td><td>None expected, as construction-phase sediment basin discharges are not predicted to be outside the triggers values nominated for this indicator.</td></tr>
</table>

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential proposal impact from proposed discharge limits
Faecal coliforms	Median bacterial content in fresh and marine waters of < 1000 faecal coliforms per 100 mL, with 4 out of 5 samples < 4000/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month) (for secondary contact recreation). For primary contact recreation, Beachwatch considers waters are unsuitable for swimming if: • the median faecal coliform density exceeds 150 colony forming units per 100 millilitres (cfu/100mL) for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 600 cfu/100mL (faecal coliforms) for five samples taken at regular intervals not exceeding one month. For primary contact recreation, ANZECC 2000 recommends: • Median over bathing season of < 150 faecal coliforms per 100 mL, with 4 out of 5 samples < 600/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month). For livestock water supply less than 100 thermotolerant coliforms per 100 mL (median value). For irrigation water supply trigger values for thermotolerant coliforms in irrigation water used for food and non-food crops are provided in table 4.2.2 of the ANZECC Guidelines. For homestead water and drinking water (groundwater) supply 0 faecal coliforms per 100 mL (0/100 mL). If micro-organisms are detected in water, advice should be sought from the relevant health authority. For aquatic foods, guideline in water for shellfish: • The median faecal coliform concentration should not exceed 14 MPN/100mL; with no more than 10% of the samples exceeding 43 MPN/100 mL. For aquatic foods (cooked), standard in edible tissue: • Fish destined for human consumption should not exceed a limit of 2.3 MPN E Coli /g of flesh with a standard plate count of 100,000 organisms /g.	Coliforms are bacteria present in the digestive tracts of animals including humans and are found in their wastes and are used as an indicator of faecal contamination.	None expected from the release of construction-phase sediment basin discharges.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential proposal impact from proposed discharge limits
Enterococci	Median bacterial content in fresh and marine waters of < 230 enterococci per 100 mL (maximum number in any one sample: 450-700 organisms/100 mL) (for secondary contact recreation). For primary contact recreation, Beachwatch considers waters are unsuitable for swimming if: • the median enterococci density exceeds 35 cfu/100mL for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 100 cfu/100mL (enterococci) for five samples taken at regular intervals not exceeding one month. For primary contact recreation, ANZECC 2000 Guidelines recommend: • Median over bathing season of < 35 enterococci per 100 mL (maximum number in any one sample: 60-100 organisms/100 mL).	Intestinal enterococci are a functional group of organisms from the *Enterococcus* and *Streptococcus* genera that are excreted in human and animal waste and are used as an indicator of faecal contamination.	None expected from the release of construction-phase sediment basin discharge.
Protozoans	Pathogenic free-living protozoans should be absent from bodies of fresh water. (Note, it is not necessary to analyse water for these pathogens unless temperature is greater than 24 degrees Celsius) (for primary contact recreation)	Protozoans are waterborne pathogens that indicate water contaminated with human or animal waste.	None expected from the release of construction-phase sediment basin discharge.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential proposal impact from proposed discharge limits
Algae and Blue-green algae	< 15 000 cells/mL (for primary contact recreation). An increasing risk to livestock health is likely when cell counts of microcystins exceed 11 500 cells/mL and/or concentrations of microcystins exceed 2.3 µg/L expressed as microcystin-LR toxicity equivalents. (for livestock water supply). Should not be visible. No more than low algal levels are desired to protect irrigation equipment. (for irrigation water supply). For Homestead water supply recommend twice weekly inspections during danger period for storages with history of algal blooms. No guideline values are set for cyanobacteria in drinking water. In water storages, counts of < 1000 algal cells/mL are of no concern. >500 algal cells/mL - increase monitoring. >2000 algal cells/mL - immediate action indicated; seek expert advice. >6500 algal cells/mL - seek advice from health authority For Drinking water – groundwater as for Homestead water supply with additional triggers below. < 2000 algal cells/mL - water may be used for potable supply >15 000 algal cells/mL - may not be used for potable supply except with full water treatment, which incorporates filtration and activated carbon. No guideline is directly applicable for aquatic foods (cooked), but toxins present in blue-green algae may accumulate in other aquatic organisms.	Blue-green algae are a type of bacteria known as Cyanobacteria. They photosynthesise using sunlight to produce oxygen. Low levels of blue-green algae are present in freshwater all the time. However a series of favourable environmental factors including warm water temperatures, sunny days and nutrients can lead to a blue-green algae bloom. Blooms lead to environmental and visual impacts.	Refer to comments on temperature, Total Phosphorus and Total Nitrogen.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential proposal impact from proposed discharge limits
Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, sewage fungus and leeches should not be present in unsightly amounts (for visual amenity and primary contact recreation).	The presence of macrophytes, algal mats etc will be impacted by the amount of nutrients / organic matter in the waterway. Refer to discussion on Total Phosphorus, Total Nitrogen and Chlorophyll a.	None expected from the release of construction-phase sediment basin discharge.
Surface films and debris	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour (for visual amenity and primary and secondary contact recreation). Waters should be free from floating debris and litter (for visual amenity and primary and secondary contact recreation).	Refer to discussion on chemical contaminants.	Refer to discussion on chemical contaminants.
Salinity	Recommended concentrations of total dissolved solids in drinking water for livestock are given in table 4.3.1 (ANZECC 2000 Guidelines). (for livestock water supply). To assess the salinity and sodicity of water for irrigation use, a number of interactive factors must be considered including irrigation water quality, soil properties, plant salt tolerance, climate, landscape and water and soil management. For more information, refer to Chapter 4.2.4 of ANZECC 2000 Guidelines. (for Irrigation water supply).	Salinity or electrical conductivity (EC) are measures of the total concentration of inorganic ions (salts) in the water. Increases in salinity may result in animals being reluctant to drink water. Further increases may result in a loss of production and a decline in animal condition and health.	No significant change is expected as a result of the proposed construction-phase sediment basin discharge limits providing sediment is adequately managed to limit changes to salinity.

Key Indicator	Numerical criteria (trigger values)	Discussion	Potential proposal impact from proposed discharge limits
Heavy Metals and Metalloids	Long term trigger values (LTV) and short-term trigger values (STV) for heavy metals and metalloids in irrigation water are presented in table 4.2.10 of the ANZECC 2000 Guidelines. (for irrigation water supply).	Heavy metals and metalloids have the potential to impact soil biota (ecotoxicity), farm infrastructure (e.g. bio-clogging of irrigation lines due to iron or manganese), plant phytotoxicity or be washed/transported off site.	Refer to toxicants (as applied to aquaculture activities)
Total Dissolved Solids	For Homestead water supply < 500 mg/L is regarded as good quality drinking water based on taste. 500-1000 mg/L is acceptable based on taste. >1000 mg/L may be associated with excessive scaling, corrosion and unsatisfactory taste	Total dissolved solids (TDS) is a measure of the inorganic salts (and organic compounds) dissolved in water. TDS can come from a number of natural sources such as the rocks or soil in the catchment, or from man-made sources such as industrial wastes or sewage. For convenience, TDS is often estimated from electrical conductivity (EC).	Refer to discussion on salinity.

10.1 Local Impacts

The previous assessment has been undertaken on a catchment wide basis that indicates that the impacts are minor and are not expected to increase pollutant concentrations above the guideline trigger values. The only exception was Total Nitrogen where the existing water quality already exceeds the trigger values.

Detailed modelling of mixing zones can be undertaken to define the extent around a discharge where the water quality objectives are not met. A simplified assessment has been undertaken for Pine Brush Creek which is one of the more sensitive catchments to determine the extent of the potential mixing zone.

Pine Brush Creek has 14 sediment basins discharging into it (Refer to ESMR (SEEC, 2020) for details on the basins between CH21327 to CH23261). The total volume of the basins is 16,659m^3. Adopting a typical pump out rate of 100 litres per second from each dam results in 0.14m^3/s of water being discharged into the creek with a TSS concentration of 50mg/L. This equates to a load of 0.007kg/s of TSS per second. Assuming a constant pump rate, the dams would be emptied in around 33 hours.

Sampling indicates that the historical average concentration of TSS in Coffs Creek is 5.5mg/L and this has been assumed as an average water quality in Pine Brush Creek. Assuming that the plume from a sediment basin discharge pipe expanded at a rate of 1:6 as it moved down Pine Brush Creek (i.e. 1m across the width of the creek for every 6m it travelled down the creek), it would take a creek length of around 24 metres to reach a plume width of 4m.

Assuming that the depth of the plume varied from 0.1m to a maximum creek depth of 0.8m with an expansion rate of 1:10, the plume volume after 24 metres of creek length would be approximately 39.0m^3. The time to reach a distance of 24 metres at a flow rate of 1.5m/s is 16 seconds and a total load of 0.112kg of TSS would have been discharged into the creek.

If the creek velocity was 0.2m/s, an additional volume of 0.66m^3 has been estimated to mix with the sediment plume with a concentration of 5.5mg/L. This is estimated to result in a total TSS load in the creek of 0.33kg within a water volume of 39.73m^3, resulting in a TSS concentration of approximately 8.3mg/L.

The WQO for lowland rivers is 6 – 50 NTU which can be approximately converted to 3 – 25 mg/L. This coarse analysis highlights that the expected sediment plume with a concentration of 50 mg/L from numerous sediment basins can be mixed within a relatively short distance of less than 25m to meet the NSW WQO for turbidity.

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

The results can be summarised as follows:

i. The MUSIC model is conservative in predicting TSS concentrations in tidal environments. However, it is assumed the predicted increase in loads and concentrations from the proposed construction phase works is relative and can be proportionally applied.
ii. Following construction-phase sediment basin discharge events, average TSS levels are predicted to increase on average by around 12.8% however median values will increase around 10.2%. The maximum increase observed in the modelling was 16.4%. Historical monitoring results indicate that the average mean turbidity is 2.3 NTU. Increasing the historical mean turbidity value by the maximum predicted increase in MUSIC of 16.4% results in a turbidity level of 2.68 NTU which is still well below the trigger value of 10 NTU.
iii. The predicted average TN concentrations are expected to decrease by around 1.1% on days of basin discharge to approximately 335 µg/L. This exceeds the trigger value for estuaries of 300 µg/L, however the model estimates that the average water quality within the existing receiving environment is 339 µg/L.
iv. The predicted TP concentrations are expected to decrease by around 0.5% on days of basin discharge to approximately 23.7 µg/L. This is below the trigger value of 30 µg/L.
v. TSS, TP and TN concentrations are predicted to be close to, or above, the trigger values for these indicators, but do not increase significantly over the background catchment conditions. Given the small loads associated with proposed construction-phase basin discharge limits, it is considered these exceedances are representative of the prevailing catchment conditions rather than any impacts associated with the main construction phase of this proposal.
vi. Coarse analysis of the potential local impact at Pine Brush Creek indicates that the plume would be mixed sufficiently within 25m to meet the required WQOs. Detailed mixing modelling can be undertaken during further detailed design stages to refine this assessment.

11.2 Recommendations for This Proposal (Step 10)

Notwithstanding the above conclusions, for this proposal a range of management measures are recommended to reduce the potential environmental impacts associated with construction-phase sediment basin discharges. These are outlined in Section 1 and are detailed in the EIS (ARUP, 2019), and in the ESMR (SEEC, 2020).

In addition, the following management measures are recommended for the construction-phase works component of this proposal:

- Apply a risk based approach regarding the re-use of water in construction-phase sediment basins in preference to discharge. This will include process for reusing surface detained on the site as discussed in Section 7. Road construction is an activity that requires considerable water volumes for earthworks compaction and dust control. During drier periods (minimal or no rainfall predicted), construction sediment basin water would typically be utilised for this purpose rather than discharged.
- Irrigation of sediment basin water to approved land where feasible and the water quality meets the required irrigation standards.
- All construction-phase sediment basin outlets would be rock armoured to meet Blue Book design requirements. Where nominated discharge points are located away from waterways, the rock armouring provides an opportunity for infiltration of discharged water into the underlying soil prior to discharge into the receiving environment.
- Basin dewatering activities are required to be undertaken in accordance with TfNSW's document titled *Environmental Management of Construction Site Dewatering*, which requires the following:
    - Preparation of site specific environmental work method statement for dewatering activities,
    - Dewatering methods that will minimise potential environmental impacts,
    - Reuse opportunities and any limitations,
    - Discharge locations and adequate energy dissipation,
    - Water quality criteria for discharge and/or reuse,
    - Treatment techniques required to meet the water quality criteria,
    - Water sampling and testing requirements.
- Use of floating siphon devices where possible to minimise resuspension of sediment during dewatering operations. Floating siphon devices remove water from the top of the water column where the supernatant is likely to be the best quality.
- Review the need to undertake more detailed modelling for the sensitive receiving waters. This analysis highlights that the proposed discharge limits have minor impacts to water quality when assessed on a catchment basis. Turbidity and TN are predicted to be below adopted trigger values and TP concentrations are reduced. However there may be a small zone directly downstream of the discharge point where concentrations are higher than estimated, although it is anticipated that discharges will be quickly mixed with the receiving waters.

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Appendix D

Supplementary non-Aboriginal cultural heritage assessment

Date: 18 May 2020

To: Arup

From: Biosis

Heritage Impact Statement of North Coast Railway Culvert in proximity to Lot 20 DP 811472

Our Ref: Matter #31434

This addendum Heritage Impact Statement (HIS) report has been prepared by Biosis Pty Ltd (Biosis) on behalf of Arup for Transport for New South Wales (TfNSW). It relates to the works for the Coffs Harbour Bypass, which will impact on a previously unidentified culvert, headwall and dry argillite retaining wall associated with the North Coast Railway. This culvert, headwall and dry argillite retaining wall is located partly in Lot 20 DP 811472 within the central section of the bypass, Coffs Harbour, NSW (Figure 1).

This HIS was written by Maggie Butcher (Consultant Archaeologist) and reviewed for quality by Samantha Keats (Consultant Archaeologist) and Taryn Gooley (Team Leader – Heritage).

Purpose of this document

The purpose of this document is to assess the heritage significance of a previously unidentified culvert, headwall and dry stone retaining wall associated with the North Coast Railway. The *Coffs Harbour Bypass Non-Aboriginal Heritage Assessment* (Biosis 2019) was prepared for the Coffs Harbour Bypass Environmental Impact Statement (EIS) and initially identified several heritage items and assessed the impacts the Coffs Harbour Bypass would have on them. Since the 2019 report was finalised, the culvert, headwall and dry stone retaining wall was identified. This report, in the form of a HIS, will analyse the heritage values of the culvert, headwall and dry argillite retaining wall and will evaluate the impacts the Coffs Harbour Bypass will have on these items. This HIS includes:

- A brief summary of the conclusions of the *Coffs Harbour Bypass Non-Aboriginal Heritage Assessment* to provide context for this report.
- A review of statutory instruments and heritage listings relevant to the study area.
- A brief history of the North Coast Railway and associated works.
- The results of the field investigation, including a comparative analysis of other culverts in the area under the North Coast Railway.
- An assessment of significance of the items.
- An assessment of impacts to the items.

Previous heritage assessment

The *Coffs Harbour Bypass Non-Aboriginal Heritage Assessment* (Biosis 2019) identified several items both in the study area and in the vicinity of the study area (shown as the construction footprint in Figure 1 in Appendix 1), which were assessed as having local cultural significance in regards to the development of the local Coffs

Harbour economy and that of the wider north coast region. The area of inspection for this HIS is shown as the 'area of field investigation' in the figures, whereas the construction footprint for the Coffs Harbour Bypass is shown as the 'study area' for consistency across the two reports. The heritage items identified in *Coffs Harbour Bypass Non-Aboriginal Heritage Assessment* (Biosis 2019) will not be reassessed in this report as the scope has not changed and the impacts are consistent with the impacts identified in the EIS. These heritage items included:

- The Coffs Harbour Banana Plantation Landscape.
- The former Coffs Heights Post Office, now located at 343D Coramba Road.
- The North Coast Railway.
- Old Coast Road Bridge No. 1, Korora.
- Old Coast Road Bridge No. 2, Korora.
- Marked tree stumps.

The *Coffs Harbour Bypass Non-Aboriginal Heritage Assessment* (Biosis 2019) concluded that the proposed works would have direct and indirect levels of impact to the heritage items located in the study area. Direct impacts would occur to the Banana Plantation heritage landscape and the Coffs Heights Post Office; indirect impacts would occur to the North Coast Railway and the timber beam bridges. The assessment (Biosis 2019) determined that any archaeological remains potentially found in the study area are unlikely to provide any additional knowledge that cannot be obtained from other sources.

Statutory requirements

Approval is being sought under Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) as Critical State Significant Infrastructure (CSSI). As the project is a CSSI, it must be completed in accordance with the Secretary's Environmental Assessment Requirements (SEARS). The SEARS for this project regarding historical heritage, and relevant sections which respond to these requirements are outlined in Table 1.

Table 1 SEARS requirements

SEARs requirements	Where addressed
1. The Proponent must identify and assess any direct and/or indirect impacts (including cumulative impacts) to the heritage significance of	
c) environmental heritage, as defined under the Heritage Act 1977; and	• Coffs Harbour Bypass Non-Aboriginal Heritage Assessment (Biosis 2019). • This HIS.
d) items listed on the National and World Heritage lists, Environmental Protection and Biodiversity Conservation Act 1999	• Coffs Harbour Bypass Non-Aboriginal Heritage Assessment (Biosis 2019).
2. Where impacts to State or locally significant heritage items are identified, the assessment must:	

SEARs requirements	Where addressed
a) include a significance assessment and statement of heritage impact for all heritage items (including any unlisted places that are assessed as having heritage value);	• Coffs Harbour Bypass Non-Aboriginal Heritage Assessment (Biosis 2019). • HIS sections: – Assessment of significance – Statement of heritage impact
b) provide a discussion of alternative locations and design options that have been considered to reduce heritage impacts;	• Coffs Harbour Bypass Non-Aboriginal Heritage Assessment (Biosis 2019). • HIS section: – Statement of heritage impact
c) in areas identified as having potential archaeological significance, undertake a comprehensive archaeological assessment in line with Heritage Council guidelines which includes a methodology and research design to assess the impact of the works on the potential archaeological resource and to guide physical archaeological test excavations and include the results of these excavations;	N/A – no areas of archaeological potential were identified in the Coffs Harbour Bypass Non-Aboriginal Heritage Assessment (Biosis 2019) or this HIS.
d) consider impacts to the item of significance caused by, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, increased traffic, visual amenity, landscape and vistas, curtilage, subsidence and architectural noise treatment (as relevant);	• Coffs Harbour Bypass Non-Aboriginal Heritage Assessment (Biosis 2019). • HIS section: – Statement of heritage impact
e) outline measures to avoid and minimise those impacts in accordance with the current guidelines; and	• Coffs Harbour Bypass Non-Aboriginal Heritage Assessment (Biosis 2019). • HIS section: – Statement of heritage impact
f) be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director Criteria).	Report authors are outlined on page 1. No archaeological excavations were required and therefore compliance with the NSW Heritage Council's Excavation Director criteria was not required.

Analysis of documentary sources

Early settlement of Coffs Harbour

Following Captain John Korff's visit to the area in 1847, 960 acres of land were reserved by government gazette on 24 December 1861 under the misspelling of "Coff's Harbour." Almost a century earlier, both

Captain James Cook (1770) and Captain Mathew Flinders (1779) had sailed past and noted the rocky islands off the Coffs Harbour Coast but did not dock closer to shore.

Coffs Harbour was one of the last regions settled on the north coast of NSW. True European settlement of the region did not take place until 1880 (Yeates, N 1990, p.24). Hermann Rieck arrived shortly after in 1881, settling on four blocks to the north of Pine Brush Creek and Small's land where he soon became known for introducing bananas to the district. In the following years the population of Coffs Harbour and the surrounding area gradually grew, with the main settlement concentrated around the harbour itself.

Industry and transport

Two main methods were utilised for transporting goods from the Coffs Harbour region; roads and maritime transport. Roads were cut inland and along the coast from Coffs Harbour throughout the 1880s, linking Coffs Harbour to Moonee Moonee, Grafton and Bellingen. These roads generally seem to have been in a poor state, and bridges were gradually constructed over the many creek lines in the area throughout the late 19th century, bringing new workers and machinery into the area ('Coff's Harbour [From Our Correspondent]' 1883').

By 1880, cedar getters in the Upper Orara were crossing Red Hill to transport their logs by sea from Coffs Harbour. Red Hill was notoriously treacherous and had been the subject of road improvements since the 1880s. By 1889 a small grant was given by the government to put a small cutting through the hill and ease the transport of logs to the coast (Yeates 1990a, p.20; The Coffs Harbour Regional Museum n.d., p.3).

During its construction, the railway employed up to 1400 men, peaking during the construction of the Number 5 Red Hill tunnel shown in Plate 1. Workers camps were set up to house the workers during these extended periods of construction, creating mushroom towns such as Coffs Heights at Red Hill (Coffs Harbour Historical Society n.d.).

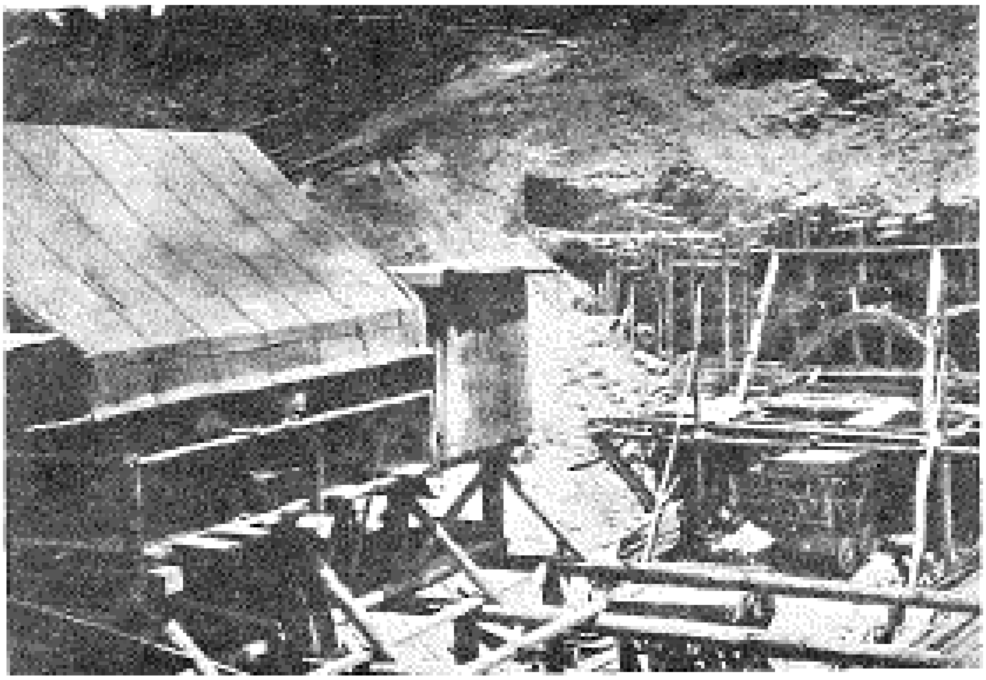

Plate 1 Construction of the railway tunnel at Red Hill (Yeates 1990a, p. 84)

As populations grew along the east coast, the government recognised the need for a railway along the coast linking Maitland to South Grafton. In 1903, a Parliamentary Standing Committee Enquiry was made into a North Coast Railway, although no decision was made on the route of the train line for another seven years (Yeates 1990, p.58). This interest was enhanced by the growth of the sugarcane, dairying and timber industries which had to contend with unreliable coastal shipping routes (Coffs Harbour City Council 2015, p.22). The route was ultimately designed to connect with Coffs Harbour itself, as the harbor and its jetties had become an important centre for commerce and would enable the easy transport of logs (Coffs Harbour Historical Society n.d.). During 1905, the advent of large-scale timber procurement resulted in an enormous boost to the growth of Coffs Harbour. By 1906, the jetty received eight ships a week, four times that which visited in 1903 (Coffs Harbour City Council 2015, p.21).

In 1913, a narrow gauge railway was constructed linking the Coffs Harbour Timber Company Mill at Bonville with the then partially complete North Coast Railway. A second line connecting the Boambee Mill is noted as being under construction at that time ('THE COFFS HARBOUR TIMBER COMPANY' 1913). The North Coast Railway was constructed in stages, with the first section of the railway completed from the harbour south to Repton in 1915. Construction began on the northern portion of the railway, which runs through the northern half of the study area, in the same year, finally connecting Coffs Harbour with Glenreagh in the north in 1922.

Traditionally, the supporting structure of the railway sleepers were made of wood. For the North Coast Railway, this large supply of hardwood was procured from local logging businesses when construction began in 1911. According to Yeates, at the beginning of 1916 Great Northern Timber had stockpiled 3500 sleepers in preparation for the railway's construction (Coffs Harbour City Council 2015, p.29). The need for such a large volume of construction materials significantly improved the local timber industry in the area (Coffs Harbour City Council 2015, p.29).

The NSW section of the North Coast Railway provided many design challenges for its designers and builders. This section of the railway was to span over large, mountainous regions and a variety of drainage lines and creeks. These drainage lines presented significant engineering problems. Roberts, in his paper addressing the issue suggested the construction of steel truss bridges for traversal over large water bodies (J.W Roberts 1910). Any smaller creeks were provided for by either concrete culverts or wood openings. Across the whole line, these ranged in size from 2 to 20 feet for concrete, and 4 to 24 feet for timber (J.W Roberts 1910, p.76).

Little information is available today regarding the construction of the North Coast Railway Tunnel Number 2 located adjacent to the culvert, but they were likely subject to similar conditions as at Red Hill (NSW Land Registry Services Crown Plan 172-3065). In total, five railway tunnels were constructed all of which were built during the 1920s (Coffs Harbour City Council 2015, p.122).

By 1921 the culverts along with the bridges and a large portion of the tunnel along the Coffs Harbour to Glenreagh section had been completed ('NORTH COAST RAILWAY' 1921). Construction of the railway was completed in 1923, with the first "through" train reaching Coffs Harbour from Sydney in December (Coffs Harbour Advocate 1923). However, it appears that the wooden culverts were unsuitable for the conditions experienced on the Coffs Harbour section of the line. In 1933 old wooden culverts were replaced on sections of the Pacific Highway ('NEW CULVERTS' 1933). It is likely these changes also took place to any wooden culverts situated on the North Coast Railway.

Field investigation

The field investigation to inform this HIS was undertaken by Maggie Butcher (Consultant Archaeologist) on 30 January 2020. The principal aims of the field investigation were to identify heritage values associated with the culvert, headwall and dry stone retaining wall and to undertake a comparative analysis of several other culverts located underneath the North Coast Railway.

The culvert (concrete pipe), northern headwall and dry argillite retaining wall located to the north of the North Coast Railway and access road was inspected during the field investigation (Plate 2). The headwall of the culvert (shown as 'culvert/headwall' in Figure 1 and Figure 3) was constructed largely of small irregular argillite blocks and timber planks holding the argillite in place (Plate 3, Plate 4). The other headwall located to the south of the rail line was not examined due to access issues. Notwithstanding, this end of the culvert will not be impacted by the works. The end of the concrete pipe sits flush with the argillite and timber (Plate 4) and has been extended with a new concrete pipe. The interior of the pipe can be seen to be worn on the invert of the culvert from water flow (Plate 5). The argillite has no bonding material. The condition of the timber and irregularity and size of the argillite blocks suggest the headwall has at some point been disturbed and repaired.

To the north of the concrete pipe, the argillite wall continues as a retaining wall (Plate 6). It continues for approximately 20 metres with a slight deviation in its direction in the centre. The retaining wall is also made of rough cut argillite blocks, larger than those in the headwall. They have a more uniform shape than the argillite blocks in the headwall. There was no bonding material such as mortar present indicating this is what is known as a "dry stone wall'. Argillite is typically crushed and used for railway ballast, it is very uncommon for argillite to be used for substantial infrastructure in larger blocks (see significance assessment in Table 2 for further detail). It is probable that the material for the culvert headwall and dry argillite wall comes from the rock that was blasted out of the adjacent North Coast Railway Tunnel Number 2.

Seven other culverts located along the North Coast Railway to the east were visited during the field investigation. Five of the culverts could be seen from the road but access was limited to two (Plate 7, Plate 8). Figure 2 shows the location of these comparison culverts to the one being assessed in this HIS. These comparison culverts consisted of a similar concrete pipe, however the headwalls were drastically different. Their headwalls are precast concrete with a kilometre marker.

Plate 2 **Railway line (on the crest on the left) and access road. Culvert is located to the north of this position. Photo facing west.**

Plate 3 **Headwall with timber and argillite rubble/blocks, note the new modern pipe has been extended to be flush with the headwall. Photo facing south east.**

Plate 4 **Close up of timber planks and irregular argillite rubble, note the new modern pipe has been extended to be flush with the headwall. Photo facing south east.**

Plate 5 **Interior of the concrete pipe, worn from water. Photo facing south east.**

Plate 6 **Dry argillite retaining wall adjacent to culvert. Photo facing north west.**

Plate 7 **Comparison culvert #2 to east of argillite and wood culvert. Photo facing west.**

Plate 8 **Comparison culvert #3 to east of argillite and wood culvert. Photo facing west.**

Assessment of significance – culvert and retaining wall

The significance of the item has been assessed in accordance with the guidelines for *Assessing Heritage Significance* (NSW Heritage Office 2001) and *the Burra Charter* (Australia ICOMOS 2013) These guidelines are based upon the premise that items, places, buildings, works, relics, movable objects or precincts can be of either local or State heritage significance, or have both local and State heritage significance. Places can have different values to different people or groups and as such the guidelines outline seven criteria to characterise the nature of significance. The level of significance can be defined as follows:

- **Local heritage** items are those of significance to the local government area. In other words, they contribute to the individuality and streetscape, townscape, landscape or natural character of an area and are important parts of its environmental heritage. They may have greater value to members of the local community, who regularly engage with these places and/or consider them to be an important part of their day-to-day life and their identity. Collectively, such items reflect the socio-economic and natural history of a local area. Items of local heritage significance form an integral part of the State's environmental heritage.
- **State heritage** items, places, buildings, works, relics, movable objects or precincts of State heritage significance include those items of special interest in the State context. They form an irreplaceable part of the environmental heritage of New South Wales and must have some connection or association with the State in its widest sense.

The following evaluation attempts to identify the cultural significance of the disturbed headwall, culvert and dry argillite retaining wall, and their contribution to the overall significance of the North Coast Railway. The statement of significance for the North Coast Railway is unchanged and can be viewed in the *Coffs Harbour Bypass Non-Aboriginal Heritage Assessment* (Biosis 2019). Each criteria is addressed in Table 2.

Table 2 Heritage significance criteria

Criterion	Assessment
Criterion A: An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area)	The headwall and culvert were built as part of the North Coast Railway which is a major piece of transport infrastructure and represents an important stage in the economic development of Coffs Harbour, linking the town with Sydney as well as Grafton and Northern NSW. The original headwall and culvert would have held some significance in association with the North Coast Railway, however as the headwall and culvert are no longer in their original form due to repair works they are not considered to have significance under this criterion. The dry argillite retaining wall adjacent to the headwall and culvert looks to be contemporary with the North Coast Railway. It would have acted as part of the drainage system from the North Coast Railway. The retaining wall has significance as it contributes to the significance of the North Coast Railway. The headwall and culvert do not meet this criterion. The dry argillite retaining wall does meet this criterion.
Criterion B: An Item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area)	There is no clear evidence linking the disturbed headwall and culvert, or dry argillite retaining wall to any individual or group of people of importance in NSW's cultural history, or that of the Coffs Harbour area. The items do not meet this criterion.
Criterion C: An item is important in demonstrating the aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area)	The headwall and culvert have been highly disturbed and do not demonstrate aesthetic characteristics and/or high degree of creative or technical achievement in NSW, or the Coffs Harbour area. The dry argillite retaining wall is in good condition and does not look to have been disturbed or repaired since it was built. It has aesthetic significance as part of the North Coast Railway. The headwall and culvert do not meet this criterion. The dry argillite retaining wall does meet this criterion.
Criterion D: An item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons	There is no clear evidence linking the head wall and culvert, or dry argillite retaining wall to any community or cultural group of importance in NSW's cultural history, or that of the Coffs Harbour area. The items do not meet this criterion.

Criterion	Assessment
Criterion E: An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area)	Whilst the North Coast Railway as a whole contains fabric associated with the construction and operation of the rail line, the fabric of the headwall and culvert, and dry argillite retaining wall do not have the potential to yield information that cannot otherwise be answered through documentary sources and as such do not meet this criterion. The items do not meet this criterion.
Criterion F: An item possess uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area)	There are multiple examples of better preserved headwalls and culverts along the railway, however these are all concrete not argillite. The impacted and repaired condition of the headwall and culvert limits their significance under this criterion. While the headwall and culvert is disturbed and does not fulfil this criterion, the dry argillite retaining wall appears contemporary with the construction of the North Coast Railway. While crushed argillite is used as ballast for tracks, the size of the blocks and the construction of the wall is not typical for the infrastructure of the North Coast Railway. As demonstrated from the site visit, the majority of the built infrastructure associated with the railway is made of concrete. While TfNSW has noted that other projects have encountered different types of dry stone walls (e.g. the Banora Point project), further research has not identified other dry stone walls in the vicinity that are associated with the railway. If there are any present, they have not been recorded. The only retaining wall that has listed heritage significance in the Coffs Harbour area is associated with the remains of a wooden bridge crossing the Corindi River (Item I88 on the Coffs Harbour LEP). The headwall and culvert does not meet this criterion. The dry argillite retaining wall does meet this criterion.
Criterion G: An item is important in demonstrating the principal characteristics of a class of NSW's Cultural or natural places; or Cultural or natural environments (or a class of the local area's Cultural or natural places; or Cultural or natural environments)	There is no evidence that the headwall and culvert or dry argillite retaining wall demonstrate principal characteristics of NSW's cultural or natural places or environments. The items do not meet this criterion.
Statement of significance	The headwall and culvert were built as part of the North Coast Railway, which is a major piece of transport infrastructure and represents an important stage in the economic development of Coffs Harbour. While the headwall and culvert are associated with the railway which holds heritage significance, they have been disturbed. They do not hold any associative, aesthetic, technical,

Criterion	Assessment
	research potential, rarity or representativeness significance. The headwall and culvert is not of local or state significance. The dry argillite retaining wall appears to be contemporary with North Coast Railway. It has not been disturbed like the culvert and headwall and is in relatively good condition. It would have acted as part of the drainage system from the North Coast Railway. The retaining wall has significance as it contributes to the significance of the North Coast Railway. Using large argillite blocks for infrastructure is unusual in the Coffs Harbour area, concrete is the typical material that is used. While TfNSW has noted that other projects have encountered other types of dry stone walls (e.g. the Banora Point project), further research has not identified other dry stone walls in the vicinity that are associated with the railway. If there are any present, they have not been recorded. The only retaining wall that has listed heritage significance in the Coffs Harbour area is associated with the remains of a wooden bridge crossing the Corindi River. The dry argillite retaining wall is of local significance.

Proposed works and heritage impacts

The proposed works that will impact the headwall, culvert and dry argillite retaining wall include the construction of bridge piers and superstructure. There will also be drainage works in the area. Please refer to Figure 3 for the location of the culvert, headwall and dry argillite wall in relation to the construction footprint. In relation to the items being assessed in this HIS, impacts include:

- Demolition of the existing culvert, headwall (northern end). This will most likely damage or partially demolish the dry argillite retaining wall.
- Reconstruction of the culvert, headwall (northern end).

The culvert and headwall will be directly impacted as a result of the works identified above, however as they have been assessed as not holding heritage significance, a statement of heritage impact is not required for these items.

The current design and placement of the bridge pier and superstructure will directly impact the dry argillite retaining wall. This would classify as minor partial demolition. The argillite retaining wall has been assessed as holding local heritage significance. *Statements of Heritage Impact* (Heritage Office & DUAP 1996) outlines several questions that must be answered for items that hold heritage significance. This is outlined in Table 3.

Table 3 Statement of heritage impact questions for the argillite retaining wall

Some questions that must be answered in a Statement of Heritage Impact	Argillite retaining wall response
Is the demolition essential for the heritage item to function?	No, demolition is not essential for the heritage item to function. The partial demolition of the item could impact its structural integrity and cause more damage.
Are important features of the item affected by the demolition (e.g. fireplaces in buildings)?	Yes, important features of the item would be affected by the demolition.
Is the resolution to partially demolish sympathetic to the heritage significance of the item?	No, demolition would not be sympathetic to the heritage significance of the item. Demolition would damage the heritage significance of this item.
If the partial demolition is a result of the condition of the fabric, is it certain that the fabric cannot be repaired?	N/A

Statement of heritage impact

The dry argillite retaining wall has been assessed as having local heritage significance for its rarity, aesthetic significance and association with the North Coast Railway. It is located adjacent to the headwall of a culvert that is to be demolished. The dry argillite retaining wall will also be impacted by the drainage works and construction of the bridge pier.

It is understood that due to the structure of the bypass, the piers cannot be moved. As a result, direct impacts to the dry argillite retaining wall cannot be avoided through redesign. There is also potential for indirect impacts such as vibration and visual impacts to the dry argillite retaining wall during construction works due to its proximity to the project.

Heritage structures should be considered on a case by case basis, and detailed inspections of heritage structures should be undertaken prior to the commencement of works. The direct impacts to the structural integrity of the dry argillite retaining wall should be minimised by attempting to stabilise the sections of the wall that will not be impacted during works. This could include reinforcing the front of the dry argillite retaining wall during construction. If this is followed, this will also potentially mitigate any indirect vibration impacts from construction.

The structural integrity of the dry argillite retaining wall should be confirmed at the detailed design stage by a suitably qualified structural engineer. The results of the inspection should be used to confirm the stabilisation works required, and to verify the applicable vibration criteria and associated impacts. The results of the inspection should also be used to confirm potentially feasible and reasonable mitigation options to be implemented. If the dry argillite retaining wall is considered to be sensitive to damage from vibration following inspection, it is recommended to reduce the vibration criteria. These mitigation measures may include selecting plant and equipment that minimise vibration generation, monitoring to determine safe working distances.

The visual impacts can be partially mitigated through the preparation of an archival recording. This was a recommendation of the *Coffs Harbour Bypass Non-Aboriginal Heritage Assessment* (Biosis 2019) and should be updated (if already undertaken) to include the dry argillite retaining wall.

Discussion and recommendations

These recommendations have been formulated to respond to client requirements and the significance of the site. They are guided by the ICOMOS *Burra Charter* with the aim of doing as much as necessary to care for the place and make it useable whilst retaining its cultural significance (Australia ICOMOS 2013).

This HIS has assessed the disturbed culvert and headwall as not holding heritage significance. The dry argillite retaining wall holds local heritage significance and will be directly impacted by the proposed works, being the construction of the bridge piers, substructure and drainage. These impacts can be partially mitigated by the following recommendations. All recommendations in the *Coffs Harbour Bypass Non-Aboriginal Heritage Assessment* (Biosis 2019) must still be followed.

Recommendation 1 Recommendations from Coffs Harbour Bypass Non-Aboriginal Heritage Assessment (Biosis 2019) are still applicable

This HIS assesses the headwall and culvert, and dry argillite retaining wall associated with the North Coast Railway and the impacts to these items as a result of the bridge piers, substructure and drainage only. As such, all recommendations outlined in *Coffs Harbour Bypass Non-Aboriginal Heritage Assessment* (Biosis 2019) are still applicable and should be implemented when appropriate.

Recommendation 2 Inclusion of impact area in archival recording report

The dry argillite retaining wall should be included in the archival recording report (Recommendation 2 in Biosis' *Coffs Harbour Bypass Non-Aboriginal Heritage Assessment* (Biosis 2019)). The archival recording report should document the items both prior to impacts, and at the completion of the project.

Recommendation 3 Argillite retaining wall stabilisation

The direct impacts to the structural integrity of the dry argillite retaining wall should be minimised by stabilising the wall during works. This could include reinforcing the front of the wall during construction. If stabilisation works are undertaken, this will also potentially mitigate any indirect vibration impacts from construction.

Recommendation 4 Assessment of the structural integrity of the dry argillite wall

The structural integrity of the heritage structures should be confirmed at the detailed design stage by a suitably qualified structural engineer. The results from the inspection should be used to confirm the stabilisation works required, and to verify the applicable vibration criteria and associated impacts. The inspection should also confirm feasible and reasonable mitigation options to be implemented.

References

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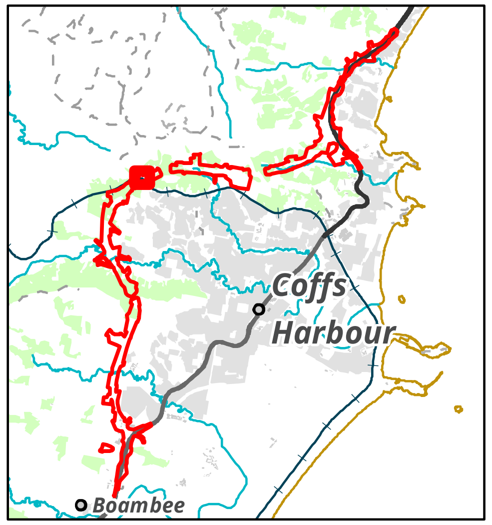
Appendix 1 Figures



Legend

- Construction footprint
- Area of field investigation
- Culvert/headwall
- Dry argillite retaining wall
- Dry argillite retaining wall curtilage
- Lot

Figure 1 Study area detail

0 10 20 30 40 50

Metres

Scale: 1:1,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

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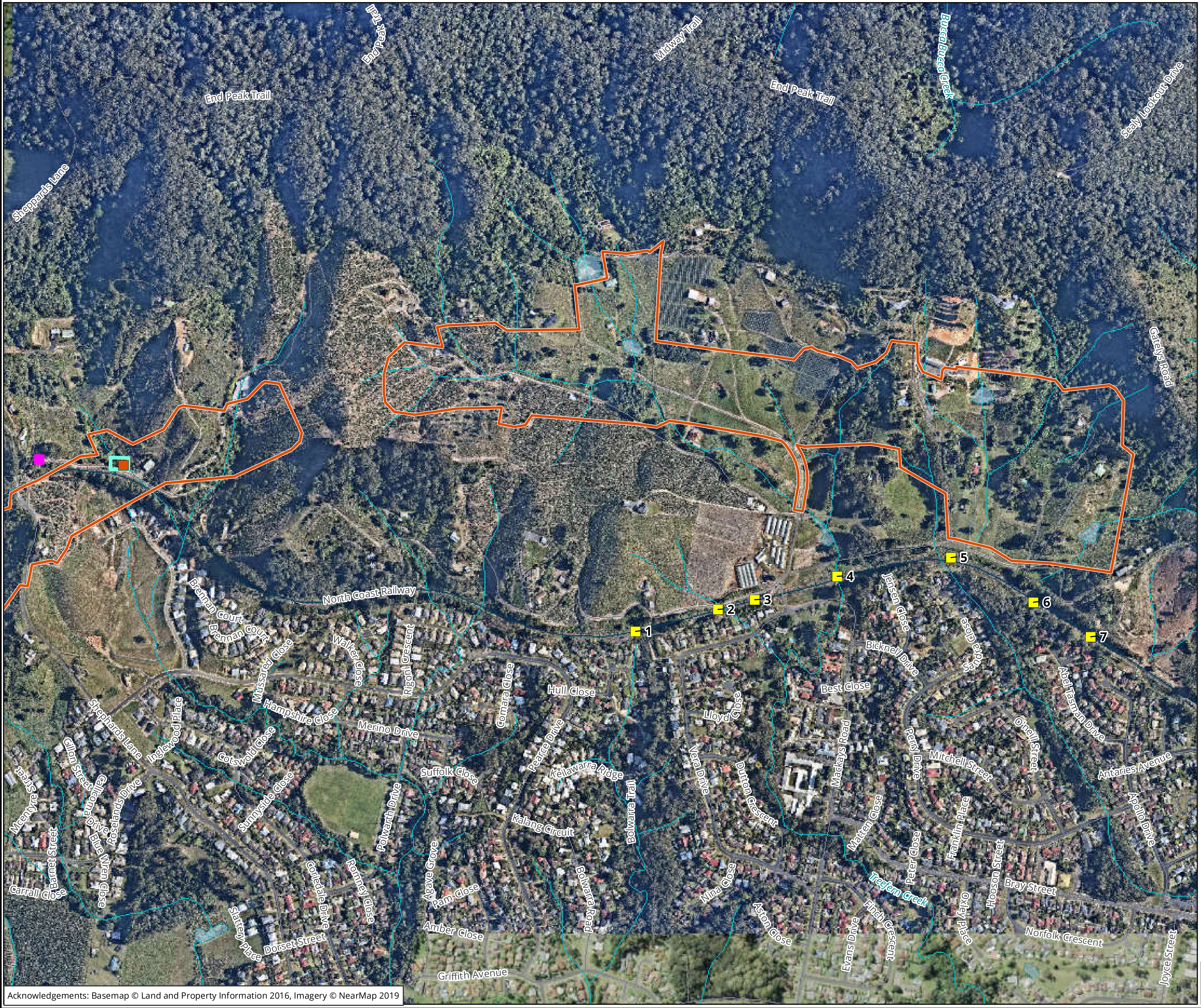
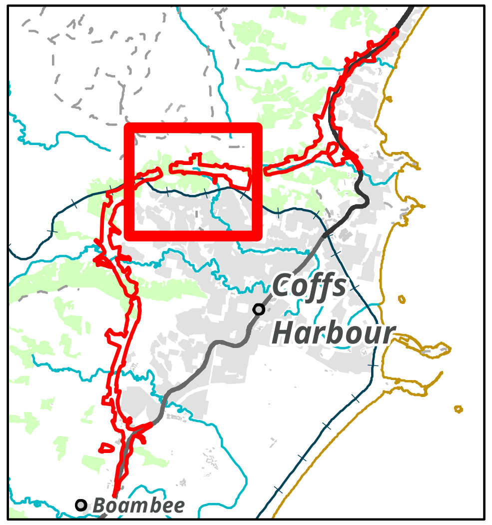
Matter: 31434
Date: 30 April 2020,
Checked by: MIB, Drawn by: AEDM, Last edited by: lharley
Location:P:\31400s\31434\Mapping\31434_F2_CulvertLocation



Acknowledgements: Basemap © Land and Property Information 2016, Imagery © NearMap 2019



Legend

- Construction footprint
- Area of field investigation
- Culvert/headwall
- Comparison culvert
- Railway tunnel no.2

Figure 2 Location of comparison culverts

0 100 200 300 400

Metres

Scale: 1:8,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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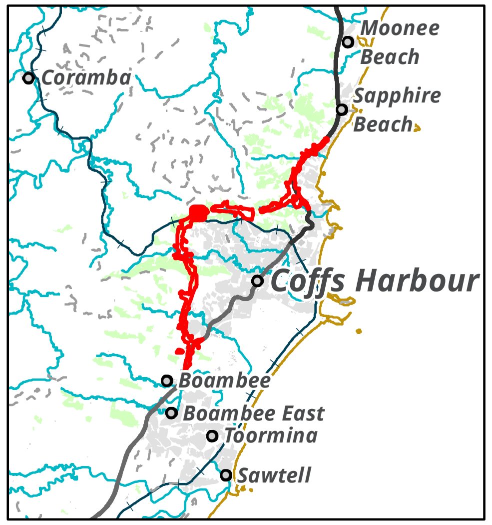
Matter: 31434
Date: 30 April 2020,
Checked by: MIB, Drawn by: AEDM, Last edited by: lharley
Location:P:\31400s\31434\Mapping
31434_F3_ComparisonCulverts



Legend

- Construction footprint
- Area of field investigation
- Culvert/headwall
- Dry argillite retaining wall
- Dry argillite retaining wall curtilage
- Lot

Proposed works

- Bridge
- Alignment
- Pavement
- Permanent basin

Locally listed items

- North Coast Railway

Figure 3 Proposed works and heritage items

0 10 20 30 40 50
Metres
Scale: 1:1,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Matter: 31434
Date: 30 April 2020,
Checked by: MIB, Drawn by: AEDM, Last edited by: lharley
Location:P:\31400s\31434\Mapping\31434_F4_ProposedWorks_Heritage

Appendix E

TfNSW environmental record

Appendix E, Environmental record

Proposed development / title of the action – Pacific Highway Upgrade - Coffs Harbour Bypass

EPBC Referral Number - EPBC 2017/8005

EP&A Act Assessment Number - SSI 7666

Designated proponent - Transport for NSW (TfNSW)

ACN / ABN - 18 804 239 602

Postal address - PO Box 973, Parramatta, 2124

TfNSW (including the former Roads and Maritime Services) is a major infrastructure agency with responsibility for the delivery of a substantial transport infrastructure construction and maintenance program. Given the scale and complexity of works undertaken, TfNSW has a very good environmental record and puts significant resources into environment and conservation measures on its construction and maintenance projects. TfNSW is committed to reducing its impact on the environment through continual environmental performance improvement. Within this context TfNSW has a good environmental record, with few infringements over the last decade. This is due largely to the commitment of TfNSW and its staff to environmental outcomes and the systems it has put in place.

There have, however, been occasions where successful proceedings have been brought against TfNSW and where penalty infringement notices have been issued. In such instances, TfNSW has instituted measures to ensure that appropriate lessons are communicated to its staff and/or contractors and that any necessary changes are made to management systems and operating procedures. Further detail is provided below.

Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against: (a) the person proposing to take the action; and (b) for an action for which a person has applied for a permit—the person making the application	
2 February 1998	The NSW Land and Environment Court found that RTA grit blasting operations on the Wallaby Rock Bridge over the Turon River near Bathurst resulted in material containing paint, limestone and copper slag grit entering the river.
3 June 1998	Penalty Notice (P8669550) for inadequate sediment controls at an RTA site on the corner of Stoney Creek Road and King Georges, Beverly Hills.
21 February 2000	Penalty Notice (Z0578326) for the inappropriate cleaning of a bitumen sprayer at a roadside stockpile site near Bowenfels. The infringement was for cleaning the sprayer at a location which created the potential to pollute an onsite drain and possibly other waters.
18 January 2002	Penalty Notice (N7899706) for contravention of a condition of environment protection licence number 10008 for the Pacific Highway Upgrade at

Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against: (a) the person proposing to take the action; and (b) for an action for which a person has applied for a permit—the person making the application	
	Mullumbimby. Sub-contractor employed an incorrect sediment basin pump out procedure.
28 October 2002	Penalty Notice (B5102543) issued to the Mona Vale Road upgrade project for pollution of waters. Sediment laden water escaped the site into stormwater drains during the works.
7 August 2006	Penalty Notices (7616962760 & 7616962751) for failing to supply Dangerous Goods Shipping documents to two drivers of asphalt trucks near Nyngan, western NSW.
8 November 2007	Penalty Notice (7616957069) for unauthorised discharge of water from a construction site to an adjacent water course at Pambula.
11 December 2008	Penalty Notice (7616963164) for clearing of native vegetation (Myall Woodland) adjacent to Mitchell Highway west of Trangie.
29 April 2008	Penalty Notice (7633250250) for pollution of waters as a result of inadequate sediment control measures, Great Western Highway, Marangaroo.
29 June 2009	Penalty notice (3014073848) issued to TIDC for a breach of its environment protection licence in relation to works undertaken out-of-hours without the necessary approvals in place on the Cronulla Line Duplication project.
28 September 2010	Penalty Notice (7601508934) for a breach of environment protection licence 13204 for failure to maintain pollution control equipment leading to the discharge of material from the Oxley Highway Upgrade construction works at Port Macquarie.
22 October 2010	Penalty Notice (7601508961) for pollution of waters arising from discharges from the Central Coast Highway Upgrade project.
31 March 2011	3 Penalty Notices (3013382406, 3013382415 & 3013382424) for breaches of Dangerous Goods transport legislation for RFS vehicle on New England Highway.
17 November 2011	Penalty Notice (3068038537) for pollution of waters of Byarong and America Creeks, Wollongong for failure to fully implement the sediment and erosion control measures outlined in the REF for the project.
15 June 2012	Penalty Notice (3085764202) for a breach of environment protection licence 13135 for failure to operate pollution control equipment to prevent the discharge of material from the Central Coast Highway upgrade construction works at Erina Heights.
17 January 2017	Penalty Notice for breaches of Dangerous Goods transport legislation for a Roads and Maritime vehicle on Cormorant Road at Kooragang.

If the person proposing to take the action is a corporation, details of the corporation's environmental policy and planning framework

TfNSW has set the environmental direction for the organisation in its Corporate Framework which seeks to minimise impacts on the natural, cultural and built environment from road use and TfNSW activities.

TfNSW's commitment to meeting this priority is demonstrated in its environmental policy and the environmental considerations incorporated into its activities. TfNSW has detailed procedures and guidelines for carrying out environmental assessment of its activities, including specific requirements for biodiversity assessment, mapping biodiversity impacts during construction and offsetting unavoidable impacts.