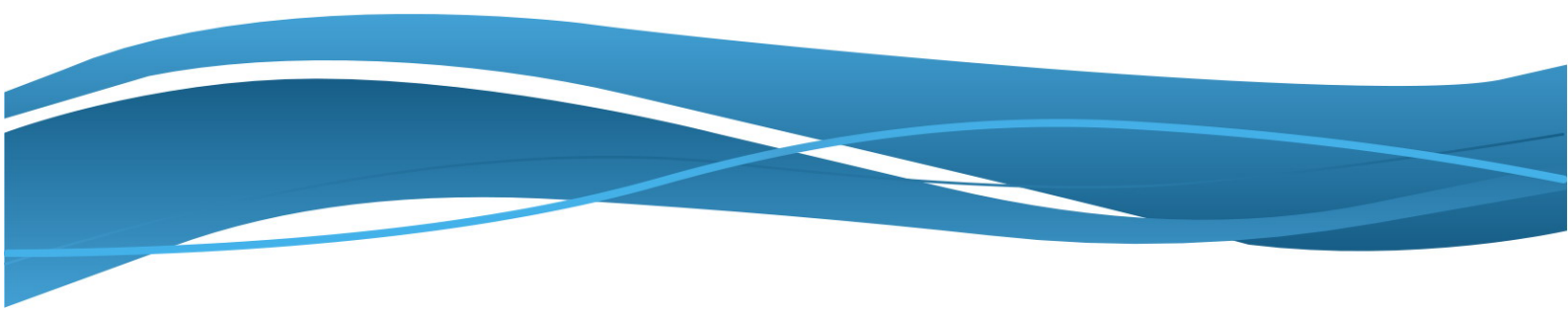




# **Fitzroy Basin Association**

Fish Barrier Prioritisation Update 2019



**Tim Marsden**

This report has been prepared by Australasian Fish Passage Services (AFPS) for Fitzroy Basin Association Incorporated (FBA).

The FBA Fish Barrier Prioritisation Update 2019 report has been prepared with due care and diligence using the best available information at the time of publication. AFPS and FBA holds no responsibility for any errors or omissions and decisions made by other parties based on this publication.

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Please cite as: Marsden, T. (2019) Fitzroy Basin Association: Fish Barrier Prioritisation Update 2019. Report to the Fitzroy Basin Association. Australasian Fish Passage Services, 60pp.

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# 1 Introduction

The free movement of fish through river systems is of great importance for the fish communities of the Fitzroy Basin Association (FBA) region. Around 49 fish species are found in freshwater streams of the FBA region. Almost half (23) of the species found in the region's streams are diadromous, requiring free access to estuarine or marine waters to successfully complete their life cycles. The remaining species complete their entire life cycle in freshwater, with a large proportion of these (23) undertaking significant migrations. Fish migration between marine and freshwater habitats and within freshwater habitats is therefore a vitally important aspect of the life cycle of freshwater fishes of the FBA region.

Barriers affect fish community condition by preventing movement of fish species which require free passage along river systems to fulfil a number of key life stage requirements. This movement is essential for:

- maintaining populations of diadromous species, which require free passage between freshwater and marine habitats for reproduction purposes i.e. barramundi, sea mullet and mangrove jack.
- maintaining genetic diversity by preventing fragmentation of fish populations, which can leave rare and threatened fish species susceptible to disease and extinction.
- the migration of adults to access habitats for feeding and reproduction purposes.
- the migration of juvenile fish species to reach up stream nursery habitats.

Barriers preventing fish passage contribute to the loss of species diversity within fish communities, severely impacting the health of the regions aquatic eco-systems and is one of the main impacts that man has had on the fish communities of the region.

This 2019 update of the Fitzroy Basin Fish Barrier Prioritisation Project (FBPP) follows on from the two previous barrier prioritisation projects undertaken in 2008 and 2015. The original 2008 project identified, assessed and prioritised all barriers to fish migration in the Fitzroy Basin Association (FBA) region, while the 2015 update reviewed the progress made since the 2008 barrier prioritisation.

The 2008 project was the first comprehensive fish barrier prioritisation project undertaken in the region (Moore and Marsden 2008) and only the second undertaken in Queensland at this scale. The primary objective of the prioritisation was to provide a list of priority instream barriers in need of fish passage remediation in the region. The project led to the installation of fishways at a number of instream barriers throughout the region. Fishways have been constructed on streams such as Amity, Moores and Waterpark creeks and have been effective at providing passage past those barriers (Ferguson et. al. 2008, Moore and Marsden 2010, Moore and Marsden 2011, Donaldson et. al. 2012 and Moore and Marsden 2013.)



The 2015 project updated the progress of installing fish passage at barriers, to provide refined guidance for future remediation works and to assess achievement against targets set in the Fitzroy Water Quality Improvement Plan (WQIP).

This latest 2019 project update follows on from these and addresses two specific elements:

1. Updating the fish passage remediation outcomes since 2015
2. Identifying and prioritising freshwater wetland barriers.

In both the 2008 and 2015 prioritisations it was recognised that freshwater wetland barriers, while outside the scope of those projects, prevented access to significant and important fish habitats. In the FBA region there are numerous freshwater wetland complexes, with the coastal plains between St Lawrence and Gladstone and the floodplain of the lower Fitzroy River containing extensive freshwater wetland areas, while the upper reaches of the catchment have a smaller array of wetlands. Most wetlands in the coastal regions have been enhanced through the construction of barriers or bunds and the raising of the full supply level of the wetland (Figure 1).



**Figure 1. Enhanced coastal freshwater wetlands along the floodplain of the Fitzroy River.**

These freshwater wetlands may be versions of an original freshwater wetland or commonly on the coastal plain, flooded salt flats and mangrove habitats. Generally, this enhancement to the capacity of the wetland or construction of a ponded pasture, is undertaken to increase the water supply and fodder for stock.

Freshwater wetland habitats are important environments for fish and are used by a wide range of fish species throughout the Fitzroy Basin. Coastal wetlands are critically important for the juveniles of many diadromous species, as they provide predator free, food rich, nursery habitats outside the estuarine environment, in which juvenile fish can live and grow (Moore et. al. 2007, Sturrock et. al. 2019). As such this report will prioritise the newly identified freshwater wetlands in a similar manner to the previous prioritisations to complete the barrier dataset for the FBA Region.

## 2 2008 Fish Barrier Prioritisation

In 2007/8 Fisheries Queensland on behalf of the FBA undertook the Fitzroy Basin Fish Barrier Prioritisation Project (FBPP). This project was the first comprehensive fish barrier prioritisation project undertaken in the FBA region. The purpose of the FBPP was to identify all potential barriers to fish passage in the FBA region and prioritise these barriers for remediation. Barriers to fish passage included any structure that impeded the movement of fish, such as culverts, pipes, road crossings, weirs and dams.

The FBPP incorporated a staged assessment process to prioritise barriers from most important through to least important based on a series of metrics that assessed biological, social and economic benefits of remediation (Figure 2).

### Barrier Assessment Procedure

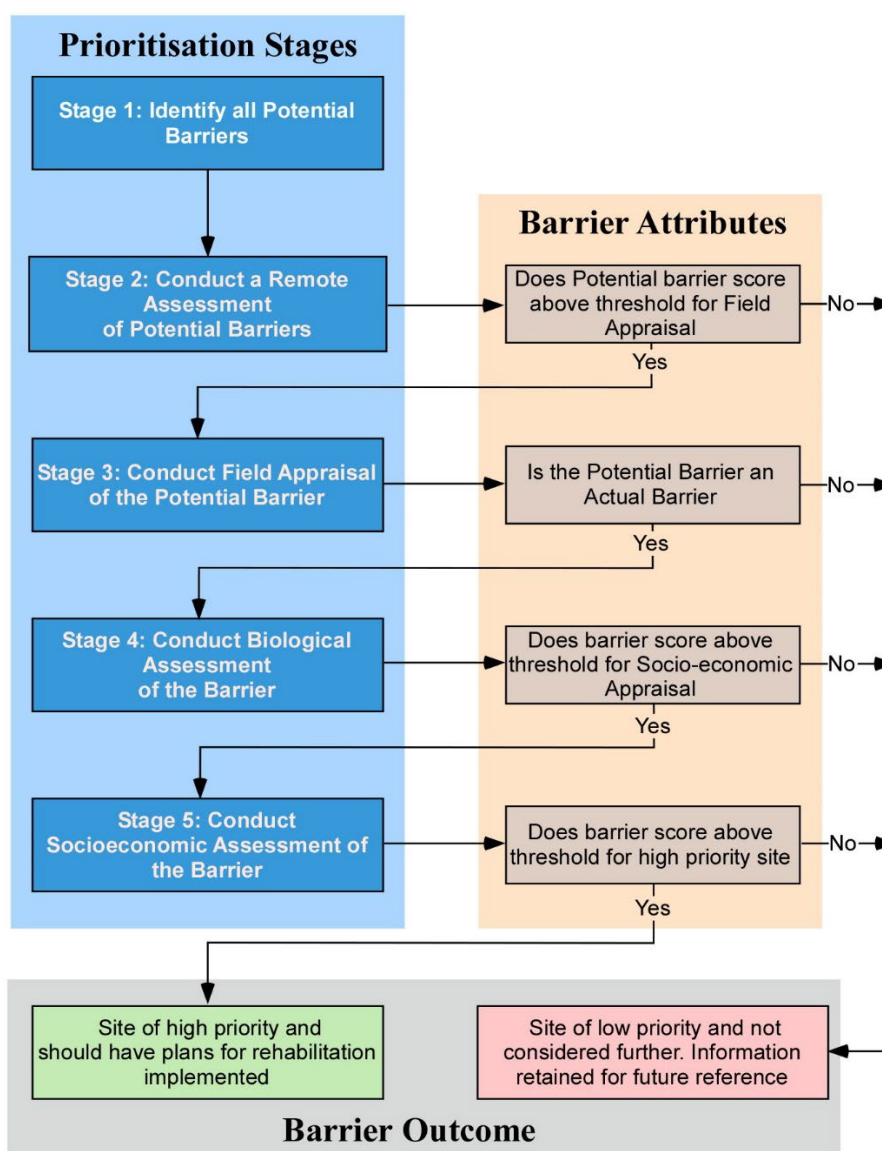
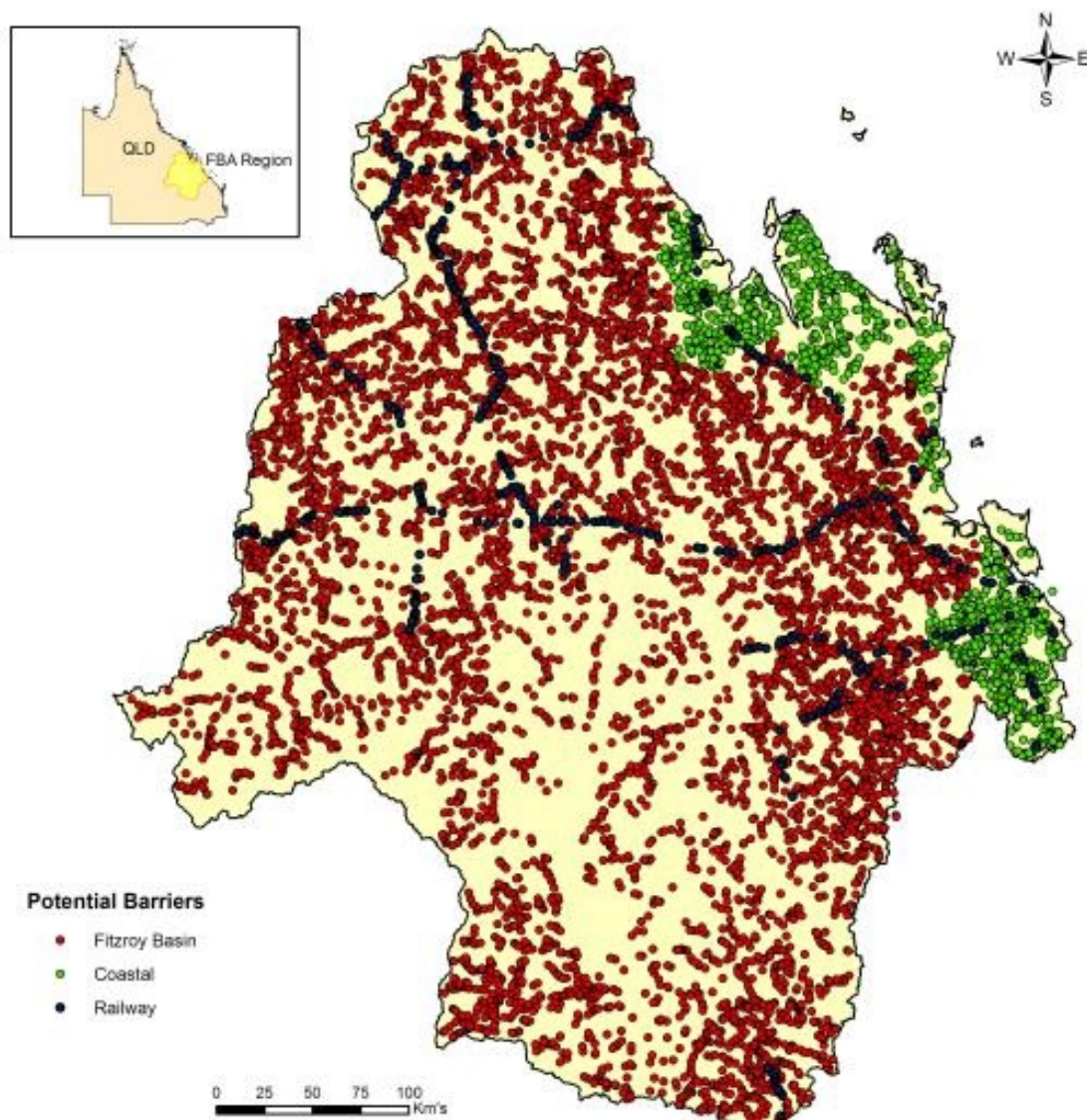


Figure 2. The 2008 Barrier Prioritisation utilised a staged assessment process methodology.

A total of 10,632 potential barriers to fish passage were identified in the FBA region, with 10,502 potential barriers recorded in-stream (Figure 3).



**Figure 3. Potential barriers to fish passage located on streams in the FBA region.**

Stage 1 of the prioritisation process used desktop GIS assessment to refine the large number of barriers within the Basin into a list of 150 potential barriers for field appraisal. After field inspections were completed and a biological assessment undertaken, 59 of the 150 potential barriers were determined to be actual barriers to fish migration. From this a socio-economic and technical feasibility assessment produced a list of the top 30 barriers requiring remediation in the FBA region.

## 2.1 Results

The end product of the prioritisation process was a priority list of the top 30 ranked barriers to fish passage in the FBA region (Table 1 and Figure 4)

**Table 1. Top 30 ranked barriers to fish migration in the FBA region in priority order for future remediation.**

Priority	Barrier ID	Stream Name	Barrier Name/Type	Total Adjusted Score
1	524	Fitzroy R	Redbank Crossing	159.3
2	1000	Boyne R	Mann's Weir/Tidal Barrage	157.4
3	9348	Amity Ck	Tidal Barrage/Bund wall	149.9
4	3952	Fitzroy R	Craiglee Crossing	148.8
5	523	Fitzroy R	Hanrahan's Crossing	147.4
6	3951	Fitzroy R	Glenroy Crossing	146.9
7	9393	St Lawrence Ck	St.Lawrence Weir	146.9
8	535	Amity Ck	Wumalgi Rd/Pipes	145
9	9002	Cattle Ck	Old Hwy/Pipes	144.5
10	8652	Calliope R	Blackgate Rd/Pipes	141.7
11	6474	Fitzroy R	Fitzroy Barrage	140.9
12	82	8 Mile Ck	Bajool Weir	138.2
13	85	12 Mile Ck	12 Mile Ck Rd/ Pipes	136.8
14	22	Raglan Ck	Upper Raglan/Pipes	135.4
15	8716	Amity Ck	Old HWY/Pipes	135.4
16	8945	Waterpark Ck	Waterpark Ck Weir	135
17	5	Dawson R	Neville Hewitt Weir	133.5
18	1	Fitzroy R	Eden Bann Weir	133.2
19	8618	Calliope R	Mt Alma Rd Crossing/Pipes	133.1
20	25	Raglan Ck	Langmom Rd/Pipes	127.3
21	6169	Serpentine Lagoon	Tidal Barrage	126.9
22	525	Mackenzie R	Duaringa Apis Ck Rd Crossing	126.4
23	8677	Clairview Ck	Weir	126.4
24	526	Lake Callemondah	Barrage	124.4
25	1042	Bridge Ck	Wumalgi/Pipes	123.5
26	9441	Clairview Ck	Road Crossing	122
27	3015	Mackenzie R	Tartrus Road Crossing	120.1
28	9165	Unnamed Ck	Rundle Ranges	120.1
29	2	Mackenzie R	Tartrus Weir	119.7
30	4	Mackenzie R	Bedford Weir	118.7



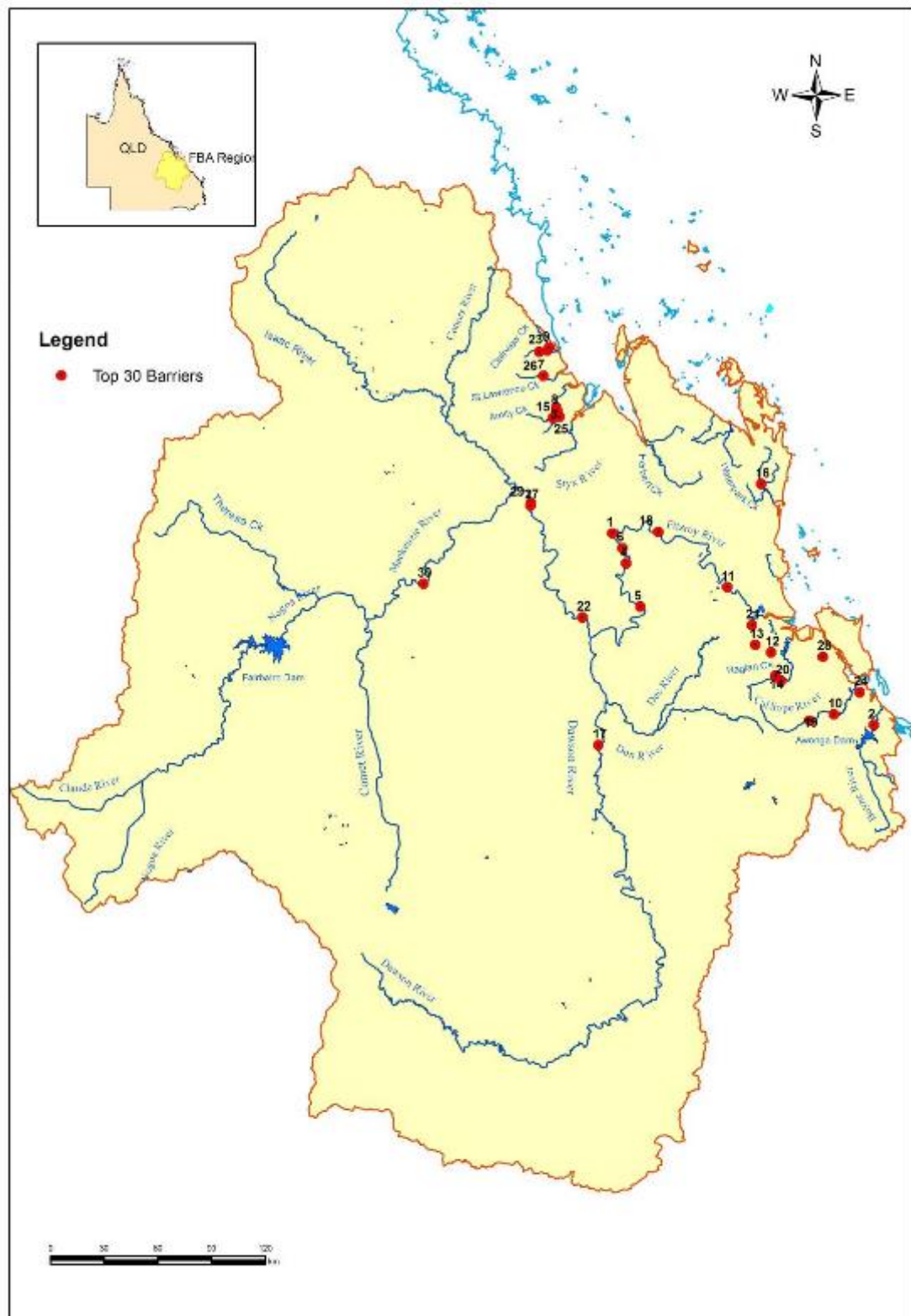


Figure 4. Location and priority rank of the top 30 barriers to fish migration in the FBA region.

### 3 2015 Re-Assessment

To update the prioritisation that was undertaken in 2008, data from that assessment was reanalysed to incorporate changes that had occurred in the intervening period. This data included an update on the transparency to fish of all barriers, has the barrier been remediated through the installation of a fishway or removal since 2008. The 2015 re-assessment also had a slight change in focus, as the assessment was identifying those barriers having the greatest impact on fish communities and did not consider the economic cost of remediation. This was required as the previous prioritisation was focussed on low cost barrier remediation for the FBA. To achieve this the re-assessment was completed on the priority 59 barriers identified at the completion of the 2008 biological assessment, rather than the final top 30 barriers where socio-economic factors also applied.

In total 13 structures were recognised as remediated and were removed from the priority list. These structures have all had fish passage provided to a greater or lesser degree (Table 2, Figure 5). While barriers such as the Fitzroy Barrage has had fish passage remediated at the barrier, thus being technically removed from the prioritisation, the large size of the structure and river and the small size of the fishways in comparison means that fish passage is still compromised at that site, although millions of fish are successfully passing through the fishways. As such, while considered remediated, if future opportunities arise to install further fish passage at the site, then this should be encouraged to improve passage further at this critical site.

**Table 2. List of barriers which have been reassessed due to remediation actions undertaken since the last prioritisation.**

Barrier ID	Stream Name	Barrier Name/Type	Remediation action	Transparency after remediation
6474	Fitzroy R	Fitzroy Barrage	Fishway	Low
1	Fitzroy R	Eden Bann Weir	Fishway	Moderate
5	Dawson R	Neville Hewitt Weir	Fishway	High
6	Dawson R	Moura Weir	Fishway	Moderate
9348	Amity Ck	Tidal interface crossing/Bund	Fishway	Very High
1042	Bridge Ck	Wumalgi/Pipes	Fishway	Very High
9002	Cattle Ck	Old Hwy/Pipes	Removal	Very High
9441	Clairview Ck	Creek Crossing	Removal	Very High
531	Moore's Ck	Botanical Gardens/Pipes	Fishway	High
527	Stony Ck	Creek Crossing-Byfield S.Forest	Fishway	Very High
529	Stony Ck	Creek Crossing/Byfield S.Forest	Fishway	Very High
8945	Waterpark Ck	Waterpark Ck Weir	Fishway	Moderate
9392	Wran Ck	Weir/Pipes	Fishway	Moderate

The remaining 46 barriers were then re-prioritised (Table 3). Scores for these barriers were adjusted to take into account the removal of the 13 barriers. The main readjustment related to the scoring of the number of barriers downstream. The 2015 re-prioritised list is shown in Table 3 and on the map in Figure 5.

Table 3. List of the 2015 top 46 reassessed barriers.

Priority	Barrier ID	Stream Name	Barrier Name/Type
1	524	Fitzroy R	Redbank Crossing
2	1000	Boyne R	Mann's Weir
3	523	Fitzroy R	Hanrahan's Crossing
4	3951	Fitzroy R	Glenroy Crossing
5	3952	Fitzroy R	Craiglee Crossing
6	535	Amity Ck	Wumalgi Rd/Pipes
7	9001	Boyne R	Awonga Dam
8	6169	Serpentine Lagoon	Tidal interface bund wall
9	9393	St.Lawrence Ck	St.Lawrence Weir
10	8652	Calliope R	Blackgate Rd/Pipes
11	8618	Calliope R	Mt Alma Rd Crossing/Pipes
12	8677	Clairview Ck	Clairview Weir
13	2	Mackenzie R	Tartrus Weir
14	525	Mackenzie R	Duaringa Apis Ck Rd
15	3	Mackenzie R	Bingegang Weir
16	8354	Boyne R	Pikes Crossing
17	8716	Amity Ck	Old HWY/Pipes
18	9718	Lake Callemondah	Barrage
19	25	Raglan Ck	Langmom Rd/Pipes
20	4	Mackenzie R	Bedford Weir
21	534	Montrose Ck	Weir/Town water supply
22	22	Raglan Ck	Upper Raglan/Pipes
23	85	8 Mile Ck	Bajool Weir
24	9165	Black Swan Ck	Flinders Rd-Rundle Ranges
25	3015	Mackenzie R	Tartrus Road Crossing
26	4152	Dawson R	Boolburra/Pipes
27	528	Stony Ck	Byfield S.Forest
28	82	12 Mile Ck	12 Mile CK Rd/ Pipes
29	8731	Stoodleigh Ck	Barretts Rd/Pipes
30	9629	Sandy Ck	Next to railline/Pipes
31	530	Stony Ck	Freeman's Crossing
32	9000	Ewen Ck	Stanage Bay Rd/Pipes
33	526	Lake Callemondah (Police CK	Creek Crossing
34	1032	Oakey Ck	Archer Station/Pipe
35	8784	Toooloombah Ck (Styx)	Rocky Crossing
36	6348	Dawson R	Nun's Crossing
37	9550	Block Ck	Stanage Bay Rd/Pipes
38	9192	Unnamed	Wydham Rd-Gladstone/Pipes
39	69	12 Mile Ck	2nd Barrier u/stream Pipes
40	9041	Coorooman Ck	Coorooman Ck Rd/Culverts
41	6144	12 Mile Ck	3rd Barrier u/stream Pipes
42	6198	Nankin Ck	Thompsons Pt Rd/ Culverts
43	8642	Unnamed	Harvey St - Gladstone/Pipes
44	532	Moore's Ck	Musgrave St weir
45	2664	Dawson R	Kianga River Rd/Pipes
46	8606	Calliope R	Pipes



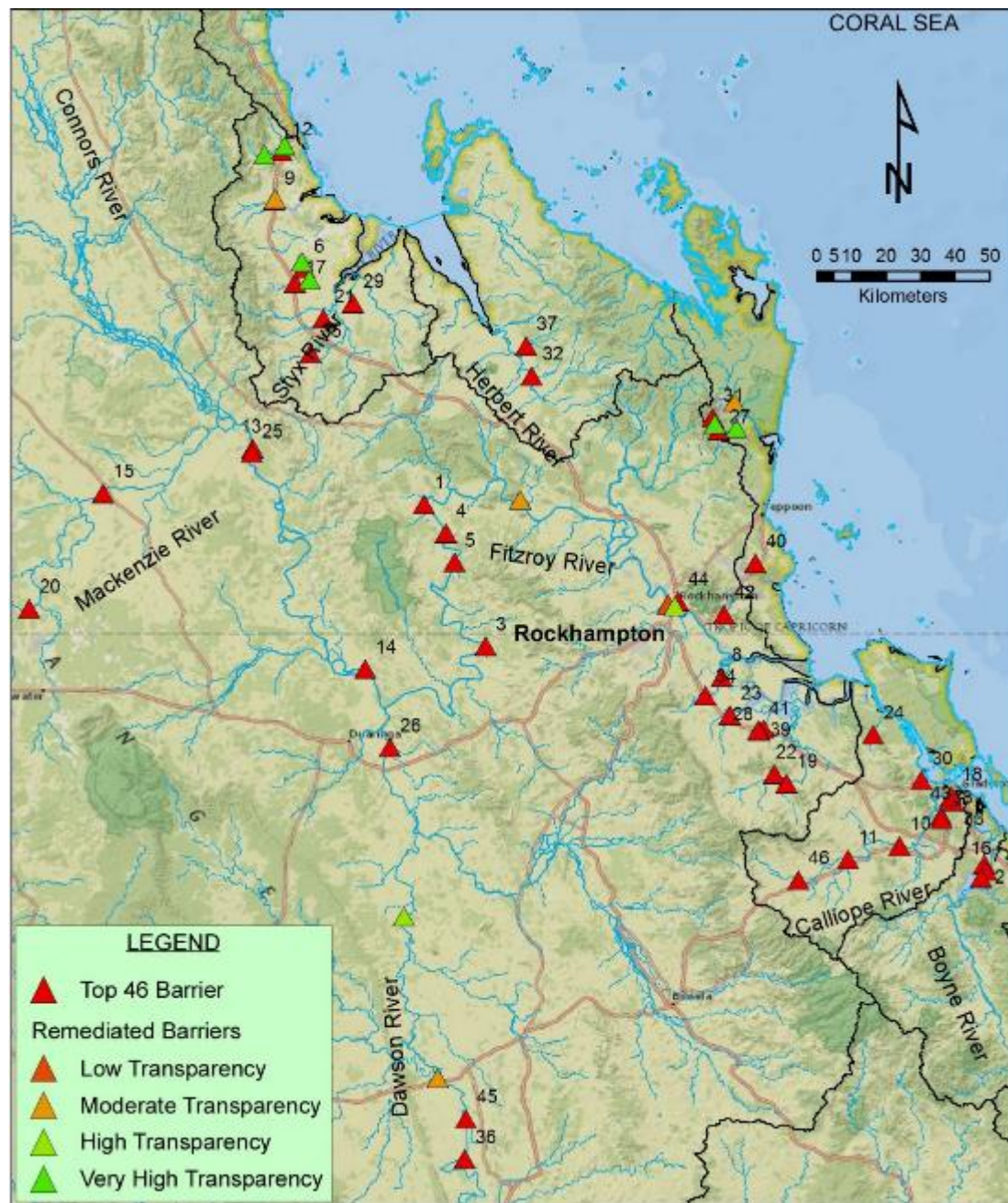


Figure 5. Location of the 2015 top 46 barriers and the 13 barriers remediated since the 2008 prioritisation.



## 4 2019 Re-Assessment

To further update the 2015 assessment, data from the 2008 and 2015 assessments were reanalysed to incorporate changes that have occurred since 2015. This data includes new information for each barrier on the current fish passage transparency of the barrier, especially if the barrier has been removed or has had a fishway installed on the barrier since 2015. The 2019 re-assessment continues to use the top 46 barriers at the completion of the 2008 biological assessment as was used in the 2015 update. This methodology enables follow-on with the 2015 update and provides a more suitable list of barriers that ignores economic considerations.

In total, four structures have changed their classification since the 2015 update, resulting in their relegation from the 2019 prioritisation. One of these structures, Redbank Crossing has fallen into disrepair and has been destroyed by repeated floods that have removed all traces of the structure. Two other structures in the top 46 have had fish passage provided through the installation of fishways, while one structure outside the top 46 has had fish passage provided through the installation baffles. The structures that have been removed from this updated prioritisation have been listed in Table 1 and are shown on the map in Figure 7

**Table 4. List of barriers which have been reassessed due to their changed status since the last prioritisation. Table indicates action type and current transparency of the barrier.**

Barrier ID	Previous Priority	Stream Name	Barrier Name/Type	Remediation action	Transparency
524	1	Fitzroy R	Redbank Crossing	Barrier Removed	Very High
9718	18	Police Ck	Lake Callemondah	Fishway installation	Moderate
6198	42	Nankin Ck	Thompson Rd Culverts	Fishway installation	High
6174	>46	Gavial Ck	Old Bruce Hwy Culverts	Fishway installation	Very High

The remaining 43 barriers have then been re-prioritised based on the previous scores they achieved within the 2008 and 2015 prioritisation. The 2019 re-prioritised list is shown in Table 6 and on the map in Figure 6 which also includes the barriers removed in the 2015 update. Scores for these barriers were adjusted to take into account the removal of the 4 barriers listed above.

Further to the removal of these barriers from the priority list, it should be noted that barrier 9348 on Amity Creek, which was removed from the list in 2015 due to the installation of a fishway, has now been washed away completely and no longer exists. It appears that a barrier may have been reinstated downstream from this structure and we have considered this barrier within the wetland prioritisation as the barrier impounds significant wetland areas upstream.

Table 5. List of the 2019 top 43 reassessed barriers.

Priority	Barrier ID	Stream Name	Barrier Name/Type
1	523	Fitzroy R	Hanrahan's Crossing
2	3951	Fitzroy R	Glenroy Crossing
3	3952	Fitzroy R	Craiglee Crossing
4	535	Amity Ck	Wumalgi Rd/Pipes
5	6169	Serpentine Lagoon	Tidal interface bund wall
6	9393	St.Lawrence Ck	St.Lawrence Weir
7	8652	Calliope R	Blackgate Rd/Pipes
8	8618	Calliope R	Mt Alma Rd Crossing/Pipes
9	8677	Clairview Ck	Clairview Weir
10	2	Mackenzie R	Tartus Weir
11	525	Mackenzie R	Duaringa Apis Ck Rd Crossing
12	3	Mackenzie R	Bingegang Weir
13	1000	Boyne R	Mann's Weir
14	8354	Boyne R	Pikes Crossing
15	9001	Boyne R	Awonga Dam
16	8716	Amity Ck	Old HWY/Pipes
17	25	Raglan Ck	Langmom Rd/Pipes
18	4	Mackenzie R	Bedford Weir
19	534	Montrose Ck	Weir/Town water supply
20	22	Raglan Ck	Upper Raglan/Pipes
21	85	8 Mile Ck	Bajool Weir
22	9165	Black Swan Ck	Flinders Rd-Rundle Ranges
23	3015	Mackenzie R	Tartus Road Crossing
24	4152	Dawson R	Boolburra/Pipes
25	528	Stony Ck	Creek Crossing-Byfield S.Forest
26	82	12 Mile Ck	12 Mile CK Rd/ Pipes
27	8731	Stoodleigh Ck	Barretts Rd/Pipes
28	9629	Sandy Ck	Next to railline/Pipes
29	530	Stony Ck	Freeman's Crossing/Byfield S.Forest
30	9000	Ewen Ck	Stanage Bay Rd/Pipes
31	526	Police CK	Creek Crossing
32	1032	Oakey Ck	Archer Station/Pipe
33	8784	Tooloombah Ck (Styx)	Rocky Crossing
34	6348	Dawson R	Nun's Crossing
35	9550	Block Ck	Stanage Bay Rd/Pipes
36	9192	Clyde Ck	Wydham Rd-Gladstone/Pipes
37	69	12 Mile Ck	2nd Barrier u/stream-Langmom Rd/Pipes
38	9041	Coorooman Ck	Coorooman Ck Rd/Culverts
39	6144	12 Mile Ck	3rd Barrier u/stream-Langmom Rd/Pipes
40	8642	Clyde Ck	Harvey St - Gladstone/Pipes
41	532	Moore's Ck	Simpson St/Pipes
42	2664	Dawson R	Kianga River Rd/Pipes
43	8606	Calliope R	Pipes

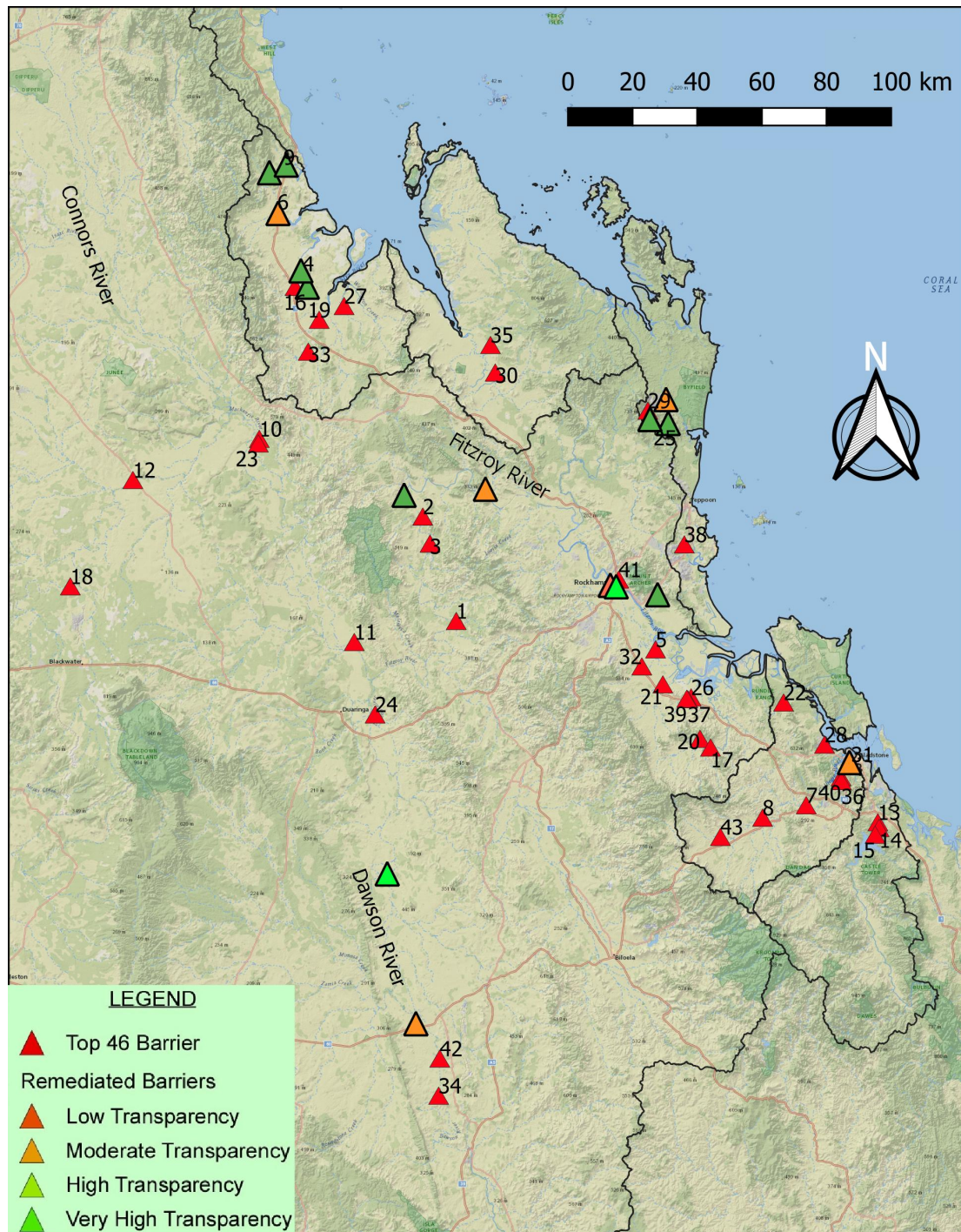


Figure 6. Location of the 2019 top 43 barriers and the 16 barriers remediated since the 2008 prioritisation.



## 5 2019 Wetland Barrier Prioritisation

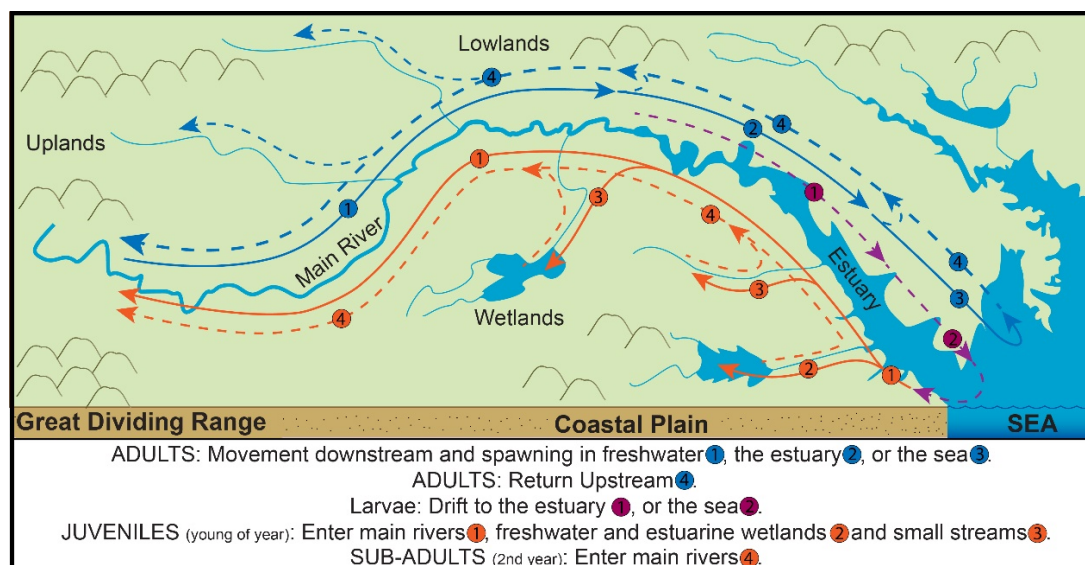
Under the 2007/8 Prioritisation Project only stream barriers were identified and prioritised due to the limitations of the GIS data layers available at that time. In that project and the subsequent 2015 update, it was known that barriers to fish migration on coastal wetlands were not identified.

In the FBA Region there are numerous freshwater wetland complexes that provide a range of habitats for fish, with most wetlands in the coastal regions having been enhanced through the construction of barriers or bunds, raising the normal water level of the wetland. Freshwater wetland habitats are important environments for fish and are used by a wide range of fish species throughout the Fitzroy Basin. Coastal wetlands in particular are critically important for the juveniles of many diadromous species (Table 6), as they provide predator free, food rich, nursery habitats outside the estuarine environment, in which these juvenile fish can live and grow.

In the Fitzroy, juvenile fish (10-100 mm long) undertake migrations into these lowland wetland habitats as part of their complex life-long migration strategies that see many species utilising estuarine, freshwater wetland, small freshwater stream and large freshwater stream habitats at various stages of their life cycle (Figure 7). It is essential for these juvenile fish to access safe nursery habitats in order to maximise the recruitment of sub-adults and adults to the other habitats within the system. Whole year classes of some species can be wiped out at barriers that impede migration, which impacts the receiving stream and has a flow on effect to other adjacent systems (Stuart and Berghuis 2002).

**Table 6. list of species and life stages of those species likely to be accessing wetland habitats within the FBA region.**

Species Name	Juvenile	Sub-Adult	Adult
barramundi	✓	✓	x
tarpon	✓	✓	x
empire gudgeon	✓	✓	✓
purple spotted gudgeon	✓	✓	✓
agassiz's glassfish	✓	✓	✓
mangrove jack	✓	✓	x
Eastern rainbowfish	✓	✓	✓
fly-specked hardyhead	✓	✓	✓
spangled perch	✓	✓	✓
carp gudgeon	✓	✓	✓
rendahl's catfish	✓	✓	✓
long-finned eel	✓	✓	✓
bony bream	✓	✓	✓
sea mullet	✓	✓	✓
hyrtl's tandan	✓	✓	✓
snub-nosed gar	✓	✓	✓



**Figure 7. Life cycle migrations typical for fish found in the Fitzroy Basin (From: Marsden and Stuart 2019).**

AFPS has undertaken a prioritisation of the Fitzroy Basin wetland barriers in order to close this data gap and enable the focussed rehabilitation of barriers on priority wetlands. The wetland barrier prioritisation incorporated a three staged assessment process similar to that used in the original 2007/8 project. This process prioritises wetland barriers from most important through to least important based on the biological, social and economic benefits and the difficulty and cost of remediation. We undertook the full prioritisation process to maintain consistency with the original prioritisation. As the biological assessment is incorporated into this assessment, the prioritisation may also be linked with the 2015 and 2019 stream barrier prioritisations as well. We have also ignored the presence of existing fishways on any wetland barrier as there is limited information on the success of these structures, some are in disrepair and some are reaching the end of their useful life. This allows all structures to be assessed equally without biasing those that may have fishways, be they functioning or not.

## 5.1 Methods

Due to the extremely large project area and high number of barriers encountered during the study it was vitally important to prioritise potential wetland barriers so that funding and time constraints could be utilised in the most efficient manner. To achieve this, a stage score and rank process was used to prioritise the large number of potential barriers in the FBA region. The stages evaluated the biological, social and economic benefits of providing fish passage past the wetland barrier. These stages consisted of:

1. Remote Assessment – remote identification of all wetland barriers in the region and scoring and ranking against 5 metrics that could be determined using desktop materials

2. Field Assessment – visit high priority sites and record physical characteristics of the site and if found to be a barrier score a further nine metrics.
3. Biological - rank the priority barriers for the five metrics scored in the field assessment.
4. Social and Economic Assessment – rank the priority barriers for the four metrics scored in the field assessment.

The final result of the prioritisation process after taking these considerations into account is a list of the top 41 wetland barriers to fish migration at wetlands in the FBA region.

### 5.1.1 Stage 1- remote assessment

The remote assessment was undertaken to initially identify potential fish passage barriers on all Fitzroy Basin wetlands as identified in the freshwater wetlands layer on Queensland wetlands info (<https://wetlandinfo.des.qld.gov.au/wetlands/>) and using GIS software (QGIS Desktop 3.8.1). This software was employed to identify and create waypoints for barriers using Google satellite imagery. The satellite imagery was used to locate potential barriers such as farm road crossings, small farm weirs and bund walls on ponded pastures, all of which are types of structures that have been identified as restricting fish passage into wetland areas in previous studies (Hyland 2002). These waypoints were created as point shape files in QGIS so subsequent GIS analysis could be performed. To maintain quality assurance, each potential barrier was assigned its own unique identification number. The lack of quantitative spatial data representing wetlands in the region and the different habitat characteristics associated with lentic habitats compared with lotic habitats, meant wetland (off-stream) barrier point shape files were created separately to the previously identified in-stream barrier points.

Once all potential wetland barriers had been identified using the satellite imagery, and assigned a shape file point, they were scored and ranked against five metrics within the QGIS program. These five metrics could be determined remotely and generally assessed physical aspects of the wetland system associated with the barrier. QGIS allowed the rapid scoring of a large number of potential instream barriers identified during the study through assignment of scores from the background data and through layer calculations. The five metrics used in the remote assessment and associated scoring system within the QGIS program are as follows:

#### **R01          Area of Wetland**

The first GIS question set out to determine the overall area of the wetlands that the barriers created. Larger areas of wetland scored higher than smaller wetlands, which scored lower.

- |   |            |
|---|------------|
| a) Total area of wetland greater than 10ha    | (5 points) |
| b) Total area of wetland between 4 to 10ha    | (4 points) |
| c) Total area of wetland between 1.5 to 4ha   | (3 points) |
| d) Total area of wetland between 0.5 to 1.5ha | (2 points) |
| e) Total area of wetland less than 0.5ha      | (1 point)  |

### **R02 Catchment Condition**

The native vegetation area of the wetland was calculated to determine overall natural vegetation coverage surrounding the wetland barrier. This was expressed as a percentage, with wetlands that were more vegetated scoring higher than those with little to no vegetation, which scored less.

- a) Wetland catchment was between 50% to 100% forested (5 points)
- b) Wetland catchment was between 30% to 49% forested (4 points)
- c) Wetland catchment was between 20% to 29.9% forested (3 points)
- d) Wetland catchment was between 10% to 19.9% forested (2 points)
- e) Wetland catchment was between 0% to 9.9% forested (1 point)

### **R03 Barriers downstream from barrier**

The number of barriers between the wetland barrier and the estuary were determined as diadromous fish species are greatly affected by migration barriers, with potential extirpation from upstream habitats if no fish passage can be achieved at a barrier. Those with no to low numbers of barriers scored highest.

- a) No barriers encountered downstream from wetland barrier (5 points)
- b) 1 barrier encountered downstream from wetland barrier (4 points)
- c) 2 or 3 barriers encountered downstream from wetland barrier (3 points)
- d) 4 to 8 barriers encountered downstream from wetland barrier (2 points)
- e) More than 8 barriers encountered downstream from wetland barrier (1 point)

### **R04 Total area upstream to next barrier**

The upstream area of the wetland and catchment were calculated as far as the next upstream barrier. Larger upstream areas scored higher than those with lower areas.

- a) Upstream area was found to be greater than 30ha (5 points)
- b) Upstream area was found to be between 10 to 30ha (4 points)
- c) Upstream area was found to be between 5 to 10ha (3 points)
- d) Upstream area was found to be between 2 to 5ha (2 points)
- e) Upstream area was found to be less than 2ha (1 point)

### **R05 Wetland Permanence**

The duration of water retention in the wetlands were determined using historical imagery from drought years in the region. Wetlands that maintained water levels all year round scored higher than those that regularly dried out, which scored lower. The early 2000's presented a period of significant drought which gave confidence in the assessment of the permanence of wetlands.

- a) Wetland always maintains large areas of water (5 points)
- b) Always retains refuge pools (4 points)

- c) Rarely dries out (only in large droughts) (3 points)
- d) Occasionally dries out (3 years in 10) (2 points)
- e) Frequently dries out (1 point)
- f) Dries every year (No points)

After this first round of assessment, a list of priority wetland barriers for stage 2, field assessments, was generated.

### 5.1.2 Stage 2 – Field assessment

Five further metrics were incorporated into the GIS program after each high priority site had been visited. For sites that could not be visited due to access issues within the project timeframe, the metrics were scored based on previous site visits or information from local landholders. Enough information was available from these sources to confidently assess the metrics. For each metric a score was assigned (i.e. 1-5) relating to how well the barrier fulfilled the metric criteria as follows:

#### **B01. Barrier Type**

The transparency of a barrier to fish passage reflects what proportion of the fish community is able to pass the barrier when migrating upstream. The transparency of a barrier is determined by the size of the barrier.

- a) Dam or Weir  $\geq 4$  m high (5 points)
- b) Dam or Weir or Wetland Regulator 2 - 4 m (4 points)
- c) Dam or Weir or Wetland Regulator 1 - 2 m (3 points)
- d) Weir or Causeway  $\leq 1.0$ m or Culvert or Pipes  $\leq 50\%$  of stream width (2 points)
- e) Causeway or Ford  $\leq 0.3$ m or Culvert or Pipes  $> 50\%$  of stream width (1 point)
- f) No Barrier – DO NOT SCORE REMAINING CRITERIA

#### **B02. Wetland Condition**

This metric assesses the condition of the wetland upstream from the barrier, with natural wetlands supporting open water and native vegetation scoring the highest.

- a) Wetland uncleared and fully natural/native vegetation (5 points)
- b) Wetland partially cleared and mostly natural/native vegetation (4 points)
- c) Wetland over 50% cleared with some natural/native vegetation (3 points)
- d) Wetland mostly cleared with little natural/native vegetation (2 points)
- e) Wetland has little vegetation or is weed infested (1 point)



**B03. Stream Flow**

This metric determines the flow through the wetland, where wetlands with permanent outflow score the highest.

- a) Natural permanent flow (5 points)
- b) Mostly permanent or augmented permanent flow (4 points)
- c) Stream occasionally dries up with refuge pools (3 points)
- d) Stream dries seasonally with refuge pools (2 points)
- e) Stream dries seasonally with no refuge pools (1 point)

**B04. Wetland Fish Habitat**

An assessment of the quantity and quality of fish habitat within the wetland upstream considered the condition of important aspects of the wetland such as the presence of natural vegetation, the absence of weeds, adequate shaded areas, shallow and deep areas; open water, emergent macrophytes, instream cover. Wetlands with large areas of high-quality habitat score the highest.

- a) Large quantities of habitat suitable for all migratory fish (5 points)
- b) Moderate quantities of habitat suitable for all migratory fish (4 points)
- c) Little habitat suitable for all migratory fish (3 points)
- d) Fish only survive in very wet years (2 points)
- e) Fish unable to survive in this wetland due to poor habitat (1 point)

**5.1.3 Stage 3 – Socio-economic assessment**

The final scoring was done with four socio-economic metrics and these were also incorporated into the QGIS program. Barriers were then prioritised based on their total score, with the top scoring barrier becoming the highest priority barrier during each stage of the prioritisation process.

**S01. Fisheries Importance**

The impact of a barrier on the local fish community is intrinsically linked to the number of fish that are being negatively affected by the barrier during their migrations. Barriers that have been observed as having large numbers of fish present below them were more likely to negatively impact fish communities and score highest.

- a) High fish numbers and many migratory species (5 points)
- b) Moderate fish numbers and some migratory species (4 points)
- c) Moderate fish numbers and few migratory species (3 points)
- d) Few fish and few migratory species (2 points)
- e) Few fish and no migratory species (1 point)

**S02. Restoration Cost**

As funds for fishway construction are generally limited, it is important to ensure that the best value is achieved with each fishway. To ensure this, fishways that are lower in cost score higher points than those that are expensive to build. 'Technical' fishways such as vertical-slot, lock and lift types require significantly more engineering and maintenance than 'nature-like' fishways such as bypass, cone and rock ramps.

- a) Low cost small/low nature-like fishway (<1.0m) or culvert baffles (5 points)
- b) Moderate cost nature-like fishway (1.0-3.0m) or low technical fishway (<1.0m) (4 points)
- c) Low-medium height technical fishway (1.0-3.0m) (3 points)
- d) Medium-high height technical-fishway (3.0-6.0m) (2 points)
- e) High height or large technical-fishway (>6.0m) Fish Lock or Lift (1 point)

**S03. Constructability**

This metric determines the best fish passage option for the site and the ease of installing a fishway on the site. Sites with simple designs, minimal engineering and easy access score the highest.

- a) Simple installation, current design, easy access, limited engineering (5 points)
- b) Simple installation, current design, difficult access or engineering (4 points)
- c) Modest installation, current design, easy access, limited engineering (3 points)
- d) Modest installation, current design, difficult access or engineering (2 points)
- a) Complex installation, detailed engineering, or new design (1 point)

**S04. Restoration effectiveness**

For a remediation to be effective most fish should be capable of passing through the fish passage device. However, on many structures it is not possible to pass all fish through due to compromises required due to the structures such as the large size of the fish populations and the small size of the potential fish passage. This metric assesses the potential to install an effective fishway.

- a) All species – all migration flows (5 points)
- b) All species – most flows, Many species – all flows (4 points)
- c) All species – some flows, Some species – all flows (3 points)
- d) Some species – some flows, few species – all flows (2 points)
- e) Some species – narrow range of flows (1 point)

### S05. Productivity Benefits

This metric measures which fish species are likely to benefit from the remediation and whether this will benefit commercial/recreational fisheries and/or increase local business revenue. Sites that were closer to large population centres had a greater number of potential beneficiaries and scored higher.

- a) Producing high numbers of fish for many fishermen (5 points)
- b) Producing moderate numbers of fish for many fishermen (4 points)
- c) Producing high numbers of fish for some fishermen (3 points)
- d) Producing moderate numbers of fish for some fishermen (2 points)
- e) Producing any numbers of fish for few fishermen (1 point)

## 5.2 Results

The first stage of the prioritisation process used remote GIS assessment to refine the large number of wetland barriers into a list of 50 potential barriers for field appraisal. After field inspections were completed and a further assessment undertaken, 46 of the 50 potential barriers were determined to be actual barriers to fish migration.

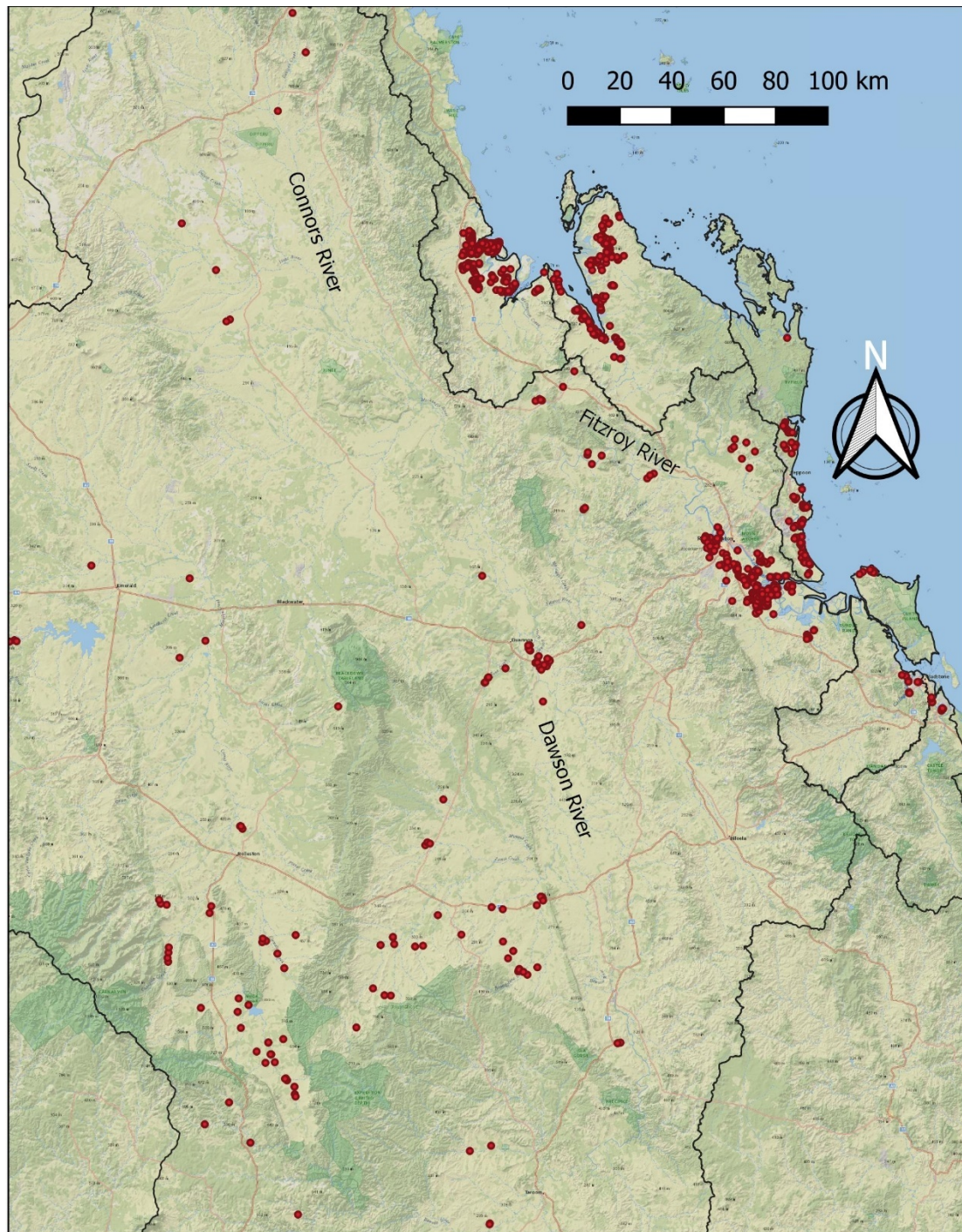
### 5.2.1 Remote Assessment

A total of 956 potential wetland barriers were analysed through GIS during the first stage of the prioritisation process (Figure 8). The highest score for this wetland and location assessment was 25 out of a possible 25 points which was attained by barriers on Solitude Creek wetland in the Shoalwater Bay Training Area and an unnamed wetland near St Lawrence (Table 7 and Table 8). A further 62 barriers scored between 20 and 24 points, while the remaining 892 potential barriers scored less than 20 points (Table 7). Most barriers within the top seventeen barriers after the remote assessment were located on the coastal plain between St Lawrence and Gladstone (Table 8).

**Table 7. The number of potential barriers identified at each score from the highest score to the lowest score**

Score	Number Potential barriers	Score	Number Potential barriers
25	2	18	32
24	5	17	63
23	5	16	92
22	5	15	115
21	26	14	126
20	21	13	96
19	59	12 or less	309





**Figure 8. Potential wetland barriers to fish passage located on wetlands in the FBA region.**

**Table 8. The list of the top 15 barriers identified after remote assessment of barriers.**

Priority	Barrier ID	Stream Name	Barrier Name	Score
1	FBAW0366	Solitude Ck	Freshwater Bay Rd	25
1	FBAW1242	Unnamed ck	St Lawrence Bund 1	25
2	FBAW0099	Unnamed ck	St Lawrence Bund 3	24
2	FBAW0372	Station Ck	Iwasaki Bund 1	24
2	FBAW0373	Station Ck	Iwasaki Bund 2	24
2	FBAW0375	Station Ck	Iwasaki Bund 4	24
2	FBAW1349	Station Ck	Iwasaki Bund 7	24
8	FBAW0376	Station Ck Anabranh	Iwasaki Bund 5	23
8	FBAW0379	Fishing Ck Anabranh	Iwasaki Dam	23
8	FBAW1350	Station Ck Anabranh	Iwasaki Bund 8	23
8	FBAW1351	Station Ck Anabranh	Iwasaki Bund 9	23
8	FBAW1352	Station Ck Anabranh	Iwasaki Bund 10	23
15	FBAW0207	Amity Ck	Wumalgi Rock Weir	22
15	FBAW0377	Station Ck Anabranh	Iwasaki Bund 6	22
15	FBAW0466	Gavial Ck	Yeppen Lagoon Outlet	22
15	FBAW0470	Gavial Ck	Port Curtis Rd	22
15	FBAW1391	Barramundi Ck	Tidal Bund	22

### 5.2.2 Field Appraisal and Biological Assessment

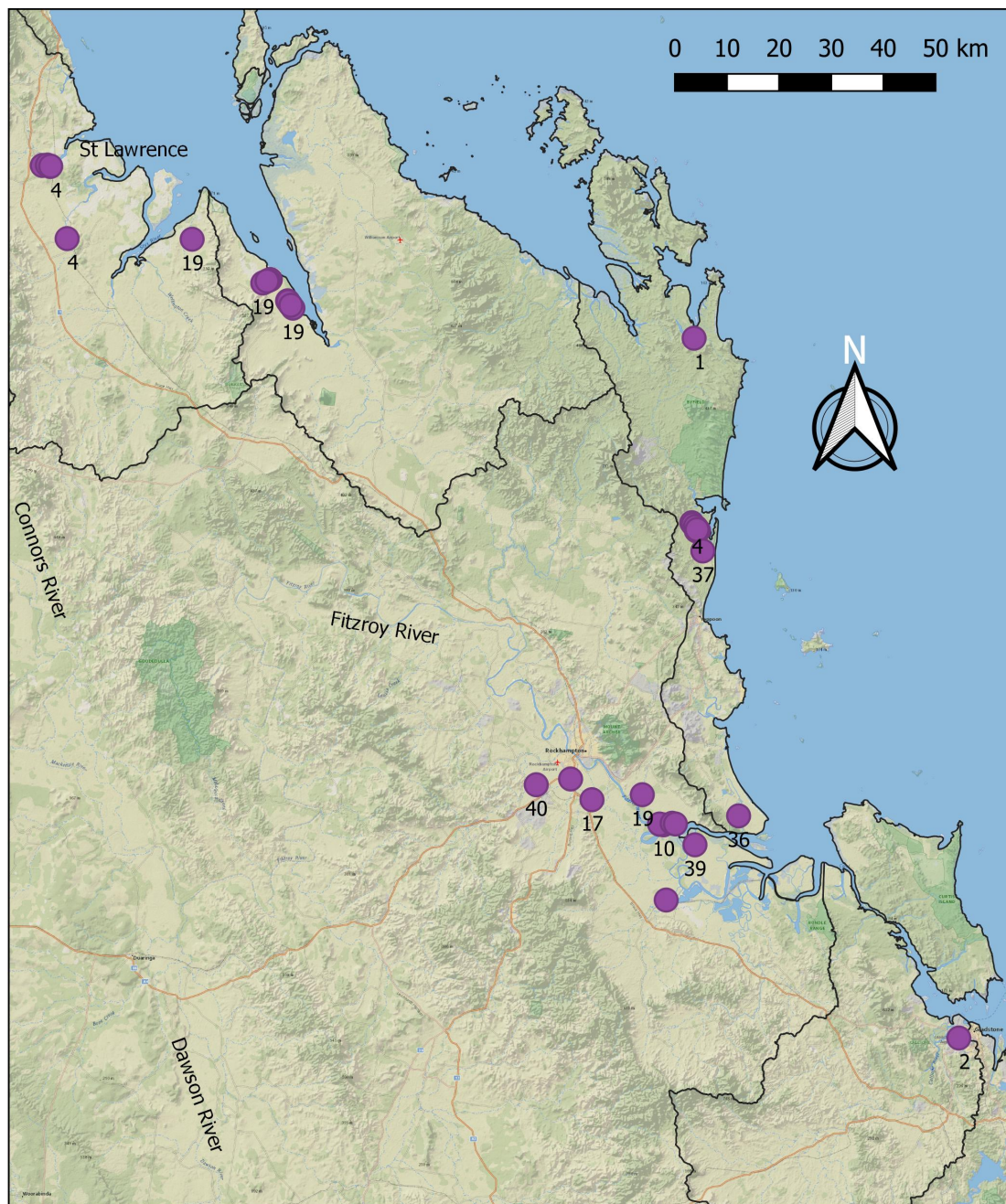
A total of 46 potential wetland barriers were validated in the field during the field appraisal section of the prioritisation process. This was the maximum number that could be assessed within the time and funding constraints of the project. Of these, 41 were found to be barriers to fish migration and scored against the five biological assessment metrics. The barriers were priority ranked (Table 9 and Figure 9) in accordance with the five additional biological criteria set out for the biological assessment. As diadromous fish species are greatly affected by inhibited access to coastal wetlands, many of the highest priority barriers in the biological assessment were found close to the coast, reflecting the importance to juvenile diadromous species of these sites. The list in Table 9 provides a record of the highest priority barriers affecting the biological function of diadromous fish species in the FBA region regardless of the cost, difficulty or productivity benefit of restoring fish passage.

**Table 9. Top 41 ranked barriers to fish migration after biological assessment of wetland barriers.**

Priority	Barrier ID	Stream Name	Barrier Name	Score
1	FBAW0366	Solitude Ck	Freshwater Bay Rd	43
2	FBAW1242	Unnamed ck	St Lawrence Bund 1	42
2	FBAW1564	Auckland Ck	Lake Callemonda	42
4	FBAW0099	Unnamed ck	St Lawrence Bund 3	41
4	FBAW0207	Amity Ck	Wumalgi Rock Weir	41

Priority	Barrier ID	Stream Name	Barrier Name	Score
4	FBAW0372	Station Ck	Iwasaki Bund 1	41
4	FBAW0373	Station Ck	Iwasaki Bund 2	41
4	FBAW0375	Station Ck	Iwasaki Bund 4	41
4	FBAW1349	Station Ck	Iwasaki Bund 7	41
10	FBAW0376	Station Ck Anabranh	Iwasaki Bund 5	40
10	FBAW1350	Station Ck Anabranh	Iwasaki Bund 8	40
10	FBAW1423	Nankin Ck Anabranh	Fitzroy Vale Bund 1	40
10	FBAW1424	Nankin Ck Anabranh	Fitzroy Vale Bund 2	40
10	FBAW1425	Nankin Ck Anabranh	Fitzroy Vale Bund 3	40
10	FBAW1426	Nankin Ck Anabranh	Fitzroy Vale Bund 4	40
10	FBAW1427	Nankin Ck Anabranh	Fitzroy Vale Bund 5	40
17	FBAW0377	Station Ck Anabranh	Iwasaki Bund 6	39
17	FBAW0470	Gavial Ck	Port Curtis Rd	39
19	FBAW0253	Unnamed ck	Stoodleigh Rd Bund	38
19	FBAW0260	Bald Hills Ck	Ball Hills Rd Bund 1	38
19	FBAW0261	Bald Hills Ck	Ball Hills Rd Bund 2	38
19	FBAW0262	Bald Hills Ck	Ball Hills Rd Bund 3	38
19	FBAW0263	Bald Hills Ck	Ball Hills Rd Bund 4	38
19	FBAW0269	Back Gully Ck	Glenprairie Bund 1	38
19	FBAW0270	Back Gully Ck	Glenprairie Bund 2	38
19	FBAW0271	Back Gully Ck	Glenprairie Bund 3	38
19	FBAW0374	Station Ck	Iwasaki Bund 3	38
19	FBAW0434	Nankin Ck	Fitzroy Vale Track	38
19	FBAW0466	Gavial Ck	Yeppen Lagoon Outlet	38
19	FBAW1244	Unnamed ck	St Lawrence Bund 2	38
19	FBAW1328	Bald Hills Ck	Ball Hills Rd Bund 5	38
19	FBAW1333	Back Gully Ck	Glenprairie Bund 4	38
19	FBAW1334	Back Gully Ck	Glenprairie Bund 5	38
19	FBAW1520	Back Gully Ck	Glenprairie Bund 6	38
19	FBAW1521	Back Gully Ck	Glenprairie Bund 7	38
36	FBAW1391	Barramundi Ck	Tidal Bund	37
37	FBAW0106	Unnamed ck	St Lawrence Bund 4	36
37	FBAW1549	Fishing Ck Swamp	Fishing Ck Rd	36
39	FBAW0513	Unnamed ck	Alligator Passage Bund	34
40	FBAW1079	Gracemere Ck	Orphanage Swamp Outlet	33
41	FBAW1447	Inkerman Ck Anabranh	Tidal Bund	32





**Figure 9. Location of the top 41 wetland barriers to fish migration from stage two of the prioritisation process.**

### 5.2.3 Socio-Economic Assessment

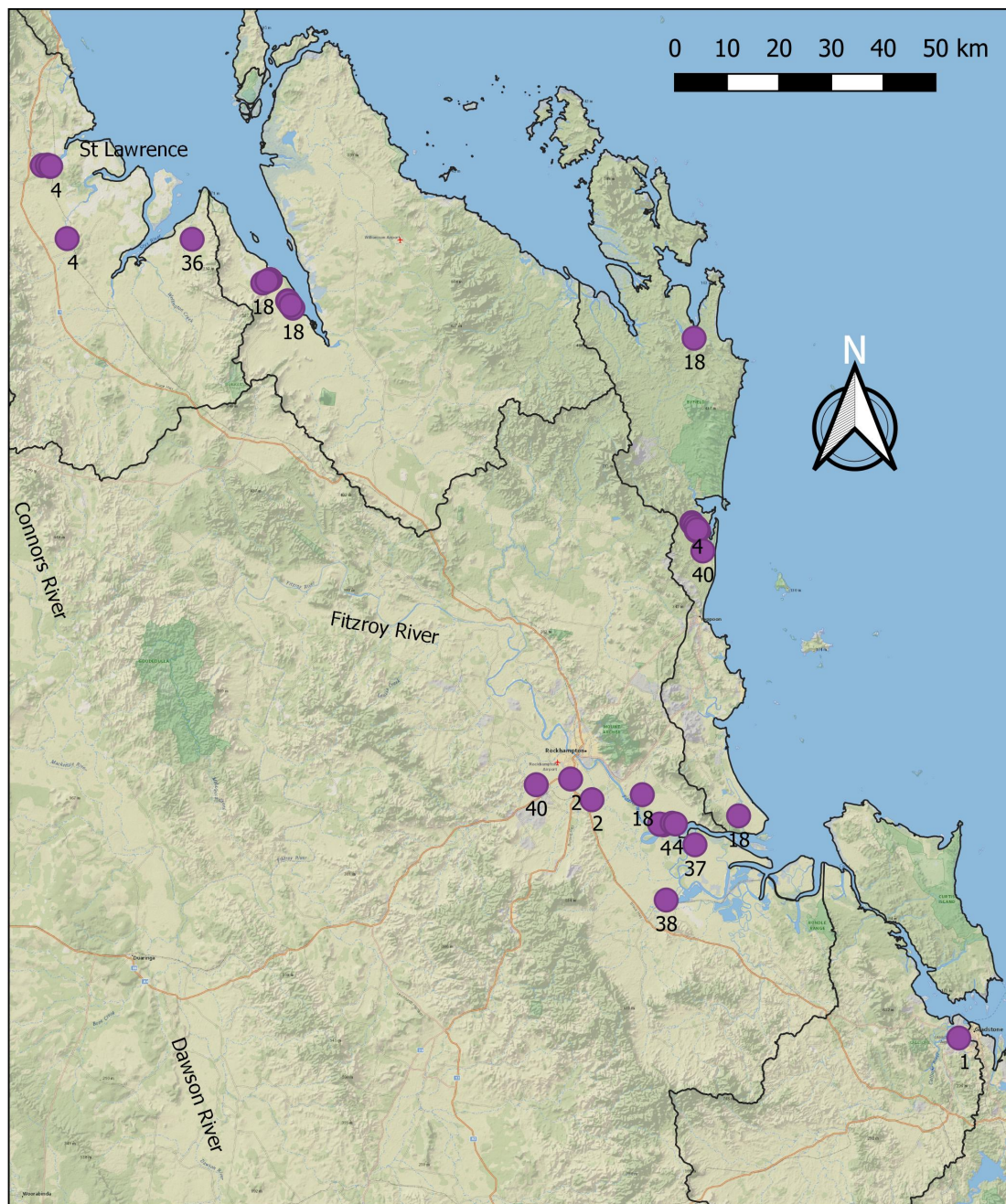
The socio-economic assessment stage involved analysing the top 41 barriers after the field appraisal and biological assessment stage of the process with four economic, social and technical metrics. The end product of this score and ranking system is a priority list of the top 41 ranked wetland barriers requiring future remediation in the FBA region (Table 10 and Figure 10). Due to the similarity between many of the structures, the final rankings have a number of barriers with equal scores, as such the list of the top 41 barriers is grouped around these equal scores, hence the ranking can miss individual ranks, with several barriers with the same score sharing the same rank.

This is different to the stream prioritisation where there was a greater spread of scores within the prioritisation.

**Table 10. Top 41 ranked barriers to fish migration after stage 3 socio-economic assessment of wetland barriers.**

Priority	Barrier ID	Stream Name	Barrier Name	Score
1	FBAW1564	Auckland Ck	Lake Callemonda	59
2	FBAW0470	Gavial Ck	Port Curtis Rd	58
2	FBAW0466	Gavial Ck	Yeppen Lagoon Outlet	58
3	FBAW1242	Unnamed ck	St Lawrence Bund 1	57
3	FBAW0207	Amity Ck	Wumalgi Rock Weir	57
4	FBAW1423	Nankin Ck Anabranh	Fitzroy Vale Bund 1	56
4	FBAW1424	Nankin Ck Anabranh	Fitzroy Vale Bund 2	56
4	FBAW1425	Nankin Ck Anabranh	Fitzroy Vale Bund 3	56
4	FBAW1426	Nankin Ck Anabranh	Fitzroy Vale Bund 4	56
4	FBAW1427	Nankin Ck Anabranh	Fitzroy Vale Bund 5	56
4	FBAW0372	Station Ck	Iwasaki Bund 1	56
4	FBAW0373	Station Ck	Iwasaki Bund 2	56
4	FBAW0375	Station Ck	Iwasaki Bund 4	56
4	FBAW1349	Station Ck	Iwasaki Bund 7	56
4	FBAW0099	Unnamed ck	St Lawrence Bund 3	56
16	FBAW0376	Station Ck Anabranh	Iwasaki Bund 5	55
16	FBAW1350	Station Ck Anabranh	Iwasaki Bund 8	55
18	FBAW0260	Bald Hills Ck	Ball Hills Rd Bund 1	54
18	FBAW0261	Bald Hills Ck	Ball Hills Rd Bund 2	54
18	FBAW0262	Bald Hills Ck	Ball Hills Rd Bund 3	54
18	FBAW0263	Bald Hills Ck	Ball Hills Rd Bund 4	54
18	FBAW1328	Bald Hills Ck	Ball Hills Rd Bund 5	54
18	FBAW0434	Nankin Ck	Fitzroy Vale Track	54
18	FBAW0366	Solitude Ck	Freshwater Bay Rd	54
18	FBAW0269	Back Gully Ck	Glenprairie Bund 1	54
18	FBAW0270	Back Gully Ck	Glenprairie Bund 2	54
18	FBAW0271	Back Gully Ck	Glenprairie Bund 3	54
18	FBAW1333	Back Gully Ck	Glenprairie Bund 4	54
18	FBAW1334	Back Gully Ck	Glenprairie Bund 5	54
18	FBAW1520	Back Gully Ck	Glenprairie Bund 6	54
18	FBAW1521	Back Gully Ck	Glenprairie Bund 7	54
18	FBAW0377	Station Ck Anabranh	Iwasaki Bund 6	54
18	FBAW1391	Barramundi Ck	Tidal Bund	54
34	FBAW0374	Station Ck	Iwasaki Bund 3	53
34	FBAW1244	Unnamed ck	St Lawrence Bund 2	53
36	FBAW0253	Unnamed ck	Stoodleigh Rd Bund	52
37	FBAW0513	Unnamed ck	Alligator Passage Bund	51
38	FBAW0106	Unnamed ck	St Lawrence Bund 4	47
38	FBAW1447	Inkerman Ck Trib	Tidal Bund	47
40	FBAW1549	Fishing Ck Swamp	Fishing Ck Rd	46
40	FBAW1079	Gracemere Ck	Orphanage Swamp	46





**Figure 10. Location of the top 41 wetland barriers to fish migration from stage three of the prioritisation process.**

## 6 Discussion

The re-assessment of barriers identified in the 2008 prioritisation and updated in the 2015 prioritisation processes has produced a re-organised list of stream barriers that still impact fish communities within the FBA region. Remediation through the construction, upgrade or recommissioning of fishways or the destruction of the barrier has remediated seventeen barriers since the original prioritisation. However, there is still considerable work to be undertaken to remove high priority barriers.

### 6.1 2015 - 2019 Stream Barrier Update

Between 2015 and 2019 there were four barriers removed from the prioritisation, in comparison to the thirteen barriers removed between 2008 and 2015. Of these only three were deliberately rehabilitated, with fishways installed on Police, Nankin and Gavial creeks. Redbank Crossing, the highest priority site in 2015, has been washed away in repeated large flow events and no longer exists as a barrier. The other remediated barriers were at lower priority sites, with Police Creek being the highest priority at rank 18, while Gavial Creek was outside the top 46 barriers in the 2015 assessment.

This has resulted in a similar outcome between the 2015 and 2019 studies (Table 11), with the highest priority barriers found in major waterways of the region such as the Fitzroy, Calliope, and Mackenzie rivers, as well as some smaller barriers on St Lawrence, Amity and Clairview creeks. Each of the priority barriers is having a continual impact on the fish communities of these river systems, particularly the diadromous species.

**Table 11. List of high priority barrier in 2019 and 2015.**

2109 Priority	2015 Priority	Barrier ID	Stream Name	Barrier Name/Type
1	3	523	Fitzroy R	Hanrahan's Crossing
2	4	3951	Fitzroy R	Glenroy Crossing
3	5	3952	Fitzroy R	Craiglee Crossing
4	6	535	Amity Ck	Wumalgi Rd/Pipes
5	8	6169	Serpentine Lagoon	Tidal interface bund wall
6	9	9393	St.Lawrence Ck	St.Lawrence Weir
7	10	8652	Calliope R	Blackgate Rd/Pipes
8	11	8618	Calliope R	Mt Alma Rd Crossing/Pipes
9	12	8677	Clairview Ck	Clairview Weir
10	13	2	Mackenzie R	Tartus Weir
11	14	525	Mackenzie R	Duaringa Apis Ck Rd Crossing
12	15	3	Mackenzie R	Bingegang Weir
13	2	1000	Boyne R	Mann's Weir
14	16	8354	Boyne R	Pikes Crossing
15	7	9001	Boyne R	Awonga Dam
16	17	8716	Amity Ck	Old HWY/Pipes
17	19	25	Raglan Ck	Langmom Rd/Pipes
18	20	4	Mackenzie R	Bedford Weir

19	21	534	Montrose Ck	Weir/Town water supply
20	22	22	Raglan Ck	Upper Raglan/Pipes
21	23	85	8 Mile Ck	Bajool Weir
22	24	9165	Black Swan Ck	Flinders Rd-Rundle Ranges
23	25	3015	Mackenzie R	Tartrus Road Crossing
24	26	4152	Dawson R	Boolburra/Pipes
25	27	528	Stony Ck	Creek Crossing-Byfield S.Forest
26	28	82	12 Mile Ck	12 Mile CK Rd/ Pipes
27	29	8731	Stoodleigh Ck	Barretts Rd/Pipes
28	30	9629	Sandy Ck	Next to railline/Pipes
29	31	530	Stony Ck	Freeman's Crossing/Byfield S.Forest
30	32	9000	Ewen Ck	Stanage Bay Rd/Pipes
31	33	526	Police CK	Creek Crossing
32	34	1032	Oakey Ck	Archer Station/Pipe
33	35	8784	Tooloombah Ck (Styx)	Rocky Crossing
34	36	6348	Dawson R	Nun's Crossing
35	37	9550	Block Ck	Stanage Bay Rd/Pipes
36	38	9192	Clyde Ck	Wydham Rd-Gladstone/Pipes
37	39	69	12 Mile Ck	2nd Barrier u/stream-Langmom Rd/Pipes
38	40	9041	Coorooman Ck	Coorooman Ck Rd/Culverts
39	41	6144	12 Mile Ck	3rd Barrier u/stream-Langmom Rd/Pipes
40	43	8642	Clyde Ck	Harvey St - Gladstone/Pipes
41	44	532	Moore's Ck	Simpson St/Pipes
42	45	2664	Dawson R	Kianga River Rd/Pipes
43	46	8606	Calliope R	Pipes

The top three structures identified in the 2019 update are all road crossings on the lower Fitzroy River that may be upgraded in the near future as part of the Rookwood Weir project. Several of the top priority barriers are large structures owned and operated by Sunwater, such as Tartrus Weir, it is unlikely that any of these structures will be upgraded unless significant funding becomes available or the structures themselves are upgraded. Many of the remaining barriers are small structures that would be relatively easy to remediate. The remediation of these smaller barriers should be given a high priority within the Systems Repair Programme, to reduce their impact and increase the productivity of the rivers systems of the Fitzroy Basin.

### 6.1.1 Existing Fishways

Within the FBA region, eighteen fishways have been constructed by Sunwater and FBA. Fishways are a compromise solution to fish passage and even the best fishway on a structure will be limited in its ability to pass all fish upstream. The low full-width rock ramp fishways such as those on Stoney Creek in Byfield State Forest are likely to have very high transparency to migrating fish, however most partial-width fishways will be compromised in their ability to pass the whole fish community. In addition, some

fishways have been in place for over 10 years and have had limited maintenance during that time that has potentially reduced their operating effectiveness. These factors make it likely that many of the eighteen structures removed from the barrier list due to the installation of fish passage may in fact still be inhibiting fish movement.

During field inspections it was indeed observed that some of the smaller fish passage structures are in need of repair, however it was not possible to determine the operational status of many of the larger structures. The operation and maintenance of fishways has always been a problematic area within Queensland, with many existing fishways currently non-operational due to a lack of upkeep. This may be due to the low priority such structures generally rate within the gamut of structures that organisations such as councils and water utilities own. A full review of the operation and maintenance of all fishways in the region should be undertaken to ensure that the progress made since the 2008 assessment continues to service improved fish communities.

### 6.1.2 Fishway Functionality

In addition to a review of operation and maintenance of the remediated structures, the functionality of existing fishways on these structures should be reviewed. This will establish the increase in transparency the fishways are providing to the barrier. The transparency of barriers is determined by the size of the barrier in relation to the size of the channel of the stream on which they are built, the flows that occur within that stream and the location and design of any fishway constructed on them. A 1m high barrier will have a much greater impact on fish movement in a small stream than in a large river as the barrier blocks a much smaller percentage of the stream channel area and flows that are required to drown out the structure occur more frequently in the larger stream. The smaller the structure, the greater the ability to construct a highly transparent fishway on the structure. Larger structures may only ever be partially ameliorated through the construction of a fishway.

While this review has attributed a level of transparency to each of the barriers, this is a generalised assessment that needs to be refined. A targeted assessment of remediated structures would better define their performance. It is recommended that a detailed assessment of the functionality of each of the fishways attached to remediated structures be undertaken to highlight any deficiencies and recommend further refinements to improve performance.

### 6.1.3 Upland Rivers

The barrier prioritisation process has again been undertaken with a distinct coastal emphasis. Diadromous fish must return to the sea at some point in their life cycles and as such barriers that prevent return migrations from the sea can have a significant impact on the diadromous species upstream, sometimes leading to localised extinctions (McDowall 1988). Potadromous species are not considered as severely affected as they can theoretically maintain populations either side of a barrier. The 2008 prioritisation deliberately focused on barriers that affected these diadromous migrations the most and as such there are many smaller barriers in the coastal zone that are given a high priority. This has however resulted in few high priority barriers in



more inland systems such as the Dawson and Mackenzie rivers. To address this problem, consideration should be given to undertaking separate prioritisation processes for each of the larger sub-catchments in the upper river systems, to provide a better balance between the coastal and upland catchments and to encourage remediation in these upper catchments where free movement of potadromous species is very important.

## 6.2 Wetland Barriers

Wetlands in the FBA region are considered to be very important fish habitats (Power and Marsden 2007), hence barriers on these lentic habitats may have a great impact on fisheries production and wetland function. Wetland barriers to fish migration were not considered as part of the 2008 project objectives and as such wetland barriers in the region were not prioritised. In a more recent prioritisation in the Mekong (Marsden *et. al.* 2014), the author assessed wetlands barriers along with stream barriers, providing a mixed prioritisation. This was achievable through new data assessments such as equalizing stream area and wetland area that made the comparison of wetland barriers to stream barriers achievable. These data assessments were not available at the time of the Fitzroy Basin 2008 prioritisation.



**Figure 11. Left. Tidal interface ponded pasture (Nankin) at the mouth of the Fitzroy River. Right. Barrier to fish migration (pipe), on a tidal interface ponded pasture at the mouth of Waterpark Creek (wetland priority 4).**

The identification and prioritisation of wetland barriers in this report has provided significant information that will enable appropriate remediation options to be considered and implemented. The highest priority sites are clustered around the coastal systems where barriers have been constructed to prevent saltwater ingress into the freshwater wetlands and hence also prevent diadromous species entering freshwater habitats.

These coastal wetlands are recognized as significant habitats (WetlandInfo 2019), particularly as juvenile nurseries for commercial and recreational diadromous fish species such as barramundi. Remediation of these barriers through the provision of fish passage would open these wetlands to greater numbers of juvenile fish and have a positive impact on the fisheries productivity of the wetlands and adjacent systems.

A number of the wetland barriers prioritized in this project have already had fishways installed on them as part of previous fish habitat rehabilitation projects (Ferguson et. al.). The sites have still been included within this prioritisation to highlight their importance and put forward their candidacy for improving the fishways already on the structures. Structures such as the St Lawrence wetland rock ramp fishway (Figure 12) were constructed with very limited budgets as part of previous FBA/DPI collaborative fishway projects. While these structures are known to pass fish, they are compromised with excessive drops between pools and are now several years old and have had no maintenance on them. As such consideration to their ongoing status should be considered in any future fish passage program.



**Figure 12. Rock ramp fishway constructed on the St Lawrence wetland.**

## 7 Recommendations

- Development of an investment strategy for a fish migration barrier remediation program targeting barriers in the top 43 stream barriers and to 41 wetland barriers to fish passage identified in this report. This program would include:
  - Preparation of an investment strategy for the highest priority sites based on information in this report
  - Negotiation with structure owners to permit rehabilitation of highest priority sites
  - Detailed survey of the sites and production of design documents for suitable fishways
  - Construction of agreed fishway designs
  - Establishment of ongoing maintenance agreements with local structure owners
  - Monitoring of the rehabilitated sites to ensure proper operation of the fishway
  - Pre and post barrier remediation fish community sampling to determine the effectiveness of providing fish passage past the barrier.
- Undertake catchment-specific re-assessments of upland catchments to ensure that they are adequately represented in the regional context.
- Assess current operation and maintenance plans for each of the remediated structures in the region and where relevant, develop new operation and maintenance plans in conjunction with structure owners.
- Assess the functionality of each of the existing fishways in the region and identify improvements in functionality (as opposed to operation & maintenance) that could improve the transparency achieved by the fishway.

## 8 References

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## 8.1 Glossary of Terms


Diadromous - Diadromous fishes are truly migratory species whose distinctive characteristics include that they (i) migrate between freshwaters and the sea; (ii) the movement is usually obligatory; and (iii) migration takes place at fixed seasons or life stages. There are three distinctions within the diadromous category, catadromous, amphidromous and anadromous.


- Catadromous - Diadromous fishes which spend most of their lives in fresh water and migrate to sea to breed.
- Amphidromous - Diadromous fishes in which migration between freshwater and the sea is not for the purpose of breeding but occurs at some other stage of the life cycle.
- Anadromous - Diadromous fishes which spend most of their lives at sea and migrate to freshwater to breed.


Potamodromous - fish species whose migrations occur wholly within freshwater for breeding and other purposes.


## 9 Top 43 Stream Barriers


Overall Priority	1	
Barrier ID	523	
Stream Name	Fitzroy River	
Barrier Name	Hanrahan's Crossing	
Barrier Type	Causeway	
Comments	Low causeway that creates 0.5m jump. Formalisation of D/S ramp required	
Remediation Solution	Rock Ramp Fishway	


Overall Priority	2	
Barrier ID	3951	
Stream Name	Fitzroy River	
Barrier Name	Glenroy Crossing	
Barrier Type	Causeway/culverts	
Comments	Permanent crossing that is barrier at low flows. Fish passage can be provided through culverts at low flows	
Remediation Solution	Baffles/Rock Ramp Fishway	


Overall Priority	3	
Barrier ID	3952	
Stream Name	Fitzroy River	
Barrier Name	Craiglee Crossing	
Barrier Type	Causeway	
Comments	Low causeway that creates a 0.5m drop at low flows. Formalisation of downstream ramp require to prevent drops	
Remediation Solution	Rock Ramp Fishway	


Overall Priority	4	
Barrier ID	535	
Stream Name	Amity Creek	
Barrier Name	Wamalgi Rd	
Barrier Type	Pipes	
Comments	Pipe create high velocities not passable by fish. No way to use existing structure must be replaced	
Remediation Solution	Baffled culverts	

Overall Priority	5	
Barrier ID	6169	
Stream Name	Serpentine Lagoon	
Barrier Name		
Barrier Type	Bund	
Comments	Small tidal bund required to create ponded pasture. A fixed water level fishway required	
Remediation Solution	Rock Ramp Fishway	


Overall Priority	6	
Barrier ID	9393	
Stream Name	St Lawrence Creek	
Barrier Name	St Lawrence Weir	
Barrier Type	Weir	
Comments	4m high weir located at tidal interface. Difficult site but well worth consideration	
Remediation Solution	Cone Fishway	


Overall Priority	7	
Barrier ID	8652	
Stream Name	Calliope River	
Barrier Name	Blackgate Rd	
Barrier Type	Causeway/Pipe	
Comments	Low causeway with pipe, stabilisation of D/S channel to create a wet crossing	
Remediation Solution	Rock Ramp Fishway	


Overall Priority	8	
Barrier ID	8618	
Stream Name	Calliope River	
Barrier Name	Mt Alma Rd	
Barrier Type	Culverts	
Comments	Culverts barrier at high flows, installing devices to provide low flow zone at high flow required	
Remediation Solution	Baffled culverts	


Overall Priority	9	
Barrier ID	8677	
Stream Name	Clairview Creek	
Barrier Name	Clairview Weir	
Barrier Type	Causeway	
Comments	Low weir with pipes at tidal interface. Site requires set headwater level as local water supply	
Remediation Solution	Rock Ramp Fishway/Culverts	





Overall Priority	10	
Barrier ID	2	
Stream Name	Mackenzie River	
Barrier Name	Tartus Weir	
Barrier Type	Weir	
Comments	Large weir owned by Sunwater. Design for fishway partially undertaken but likely to cost around \$4M	
Remediation Solution	Vertical Slot Fishway	


Overall Priority	11	
Barrier ID	525	
Stream Name	Mackenzie River	
Barrier Name	Duaringa - Apis Rd	
Barrier Type	Pipes	
Comments	Many barrelled culvert requires baffles installed in at least two culvert barrels	
Remediation Solution	Baffles	

Overall Priority	12	
Barrier ID	3	
Stream Name	Mackenzie River	
Barrier Name	Bingegang Weir	
Barrier Type	Weir	
Comments	High weir that has facility for fish lock already incorporated into design. Structure owned by Sunwater	
Remediation Solution	Fish Lock	


Overall Priority	13	
Barrier ID	1000	
Stream Name	Boyne River	
Barrier Name	Mann's Weir	
Barrier Type	Earthen weir	
Comments	Weir is a 3m high semi-permanent barrier. Has been more permanent in recent times	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	14	
Barrier ID	8354	
Stream Name	Boyne River	
Barrier Name	Pikes Crossing	
Barrier Type	Pipes	
Comments	Pipe culvert requires baffles installed in the two outer culvert barrels. Structure generally has water through the structure	
Remediation Solution	Baffles	


Overall Priority	15	
Barrier ID	9001	
Stream Name	Boyne River	
Barrier Name	Awonga Dam	
Barrier Type	Dam	
Comments	Large dam that would require extensive modification to provide passage	
Remediation Solution	Fish Lift	


Overall Priority	16	
Barrier ID	8716	
Stream Name	Amity Creek	
Barrier Name	Old Hwy	
Barrier Type	Pipes	
Comments	Old pipe culvert structure that would need to be replaced with new box culverts with baffles on the outside two culvert barrel walls	
Remediation Solution	Baffled culverts	


Overall Priority	17	
Barrier ID	25	
Stream Name	Raglan Creek	
Barrier Name	Langmom Rd	
Barrier Type	Culverts	
Comments	Many barrelled culvert requires baffles installed in at least two culvert barrels	
Remediation Solution	Baffles	

Overall Priority	18	
Barrier ID	4	
Stream Name	Mackenzie River	
Barrier Name	Bedford Weir	
Barrier Type	Weir	
Comments	High weir that has facility for fish lock already incorporated into design. Structure owned by Sunwater	
Remediation Solution	Fish Lock	





Overall Priority	19	
Barrier ID	534	
Stream Name	Montrose Creek	
Barrier Name	Town weir	
Barrier Type	Weir	
Comments	Small weir structure with bedrock base, a channel and cone fishway could be constructed across rock bar	
Remediation Solution	Cone Fishway	


Overall Priority	20	
Barrier ID	22	
Stream Name	Raglan Creek	
Barrier Name	Upper Raglan	
Barrier Type	Causeway/Pipes	
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	21	
Barrier ID	85	
Stream Name	8 Mile Creek	
Barrier Name	Bajool Weir	
Barrier Type	Weir	
Comments	Large weir/road, Main road makes construction difficult	
Remediation Solution	Cone Fishway	



Overall Priority	22	
Barrier ID	9165	
Stream Name	Black Swan Creek	
Barrier Name	Flinders Rd	
Barrier Type	Pipes	
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	23	
Barrier ID	3015	
Stream Name	Mackenzie River	
Barrier Name	Tartus Rd	
Barrier Type	Causeway	
Comments	Low causeway that creates a 0.5m drop at low flows. Formalisation of downstream ramp require to prevent drops	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	24	
Barrier ID	4152	
Stream Name	Dawson River	
Barrier Name	Boolburra Rd	
Barrier Type	Causeway/Pipe	
Comments	Moderate sized pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	25
Barrier ID	528
Stream Name	Stoney Creek
Barrier Name	Daddys Crossing
Barrier Type	Causeway/Pipes
Comments	Moderate sized pipe culvert crossing that should be replaced with baffled box culverts
Remediation Solution	Baffled culverts




Overall Priority	26
Barrier ID	82
Stream Name	12 Mile Creek
Barrier Name	12 mile Rd
Barrier Type	Pipes
Comments	Moderate sized pipe culvert crossing that should be replaced with baffled box culverts
Remediation Solution	Baffled culverts





Overall Priority	27
Barrier ID	8731
Stream Name	Stoodleigh Creek
Barrier Name	Barretts Rd
Barrier Type	Pipes
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts
Remediation Solution	Baffled culverts








Overall Priority	28	
Barrier ID	9629	
Stream Name	Sandy Creek	
Barrier Name	Railway Line Rd	
Barrier Type	Pipes	
Comments	Moderate sized pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	29	
Barrier ID	530	
Stream Name	Stoney Creek	
Barrier Name	Freemans Crossing	
Barrier Type	Causeway	
Comments	Low causeway that creates a small drop at low flows. Formalisation of downstream ramp require to prevent drops	
Remediation Solution	Rock Ramp Fishway	


Overall Priority	30	
Barrier ID	9000	
Stream Name	Ewan Creek	
Barrier Name	Stanage Bay Rd	
Barrier Type	Pipes	
Comments	Moderate sized pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	


Overall Priority	31	
Barrier ID	526	
Stream Name	Police Creek	
Barrier Name		
Barrier Type	Causeway	
Comments	Low causeway that creates a small drop at low flows. Formalisation of downstream ramp require to prevent drops	
Remediation Solution	Rock Ramp Fishway	


Overall Priority	32	
Barrier ID	1032	
Stream Name	Oakey Creek	
Barrier Name	Archer Station Rd	
Barrier Type	Pipe	
Comments	Small pipe culvert crossing that should be replaced with low ford crossing	
Remediation Solution	Ford	

Overall Priority	33	
Barrier ID	8784	
Stream Name	Tooolombah Creek	
Barrier Name	Rocky Crossing	
Barrier Type	Causeway/Pipes	
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	



Overall Priority	34	
Barrier ID	6348	
Stream Name	Dawson Rver	
Barrier Name	Nun's Crossing	
Barrier Type	Causeway/Pipes	
Comments	Moderate sized pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	36	
Barrier ID	9550	
Stream Name	Block Creek	
Barrier Name	Stanage Bay Rd	
Barrier Type	Causeway/Pipes	
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	36	
Barrier ID	9192	
Stream Name	Clyde Creek	
Barrier Name	Wydham Rd	
Barrier Type	Pipes	
Comments	The crossing has been replaced by a new bridge and is no longer required. Should be removed unless there is local usage of the structure	
Remediation Solution	Remove	

<b>Overall Priority</b>	37
<b>Barrier ID</b>	69
<b>Stream Name</b>	12 Mile Creek
<b>Barrier Name</b>	Langmom Rd
<b>Barrier Type</b>	Causeway/Pipes
<b>Comments</b>	Small pipe culvert crossing that should be replaced with baffled box culverts
<b>Remediation Solution</b>	Baffled culverts



<b>Overall Priority</b>	38
<b>Barrier ID</b>	9041
<b>Stream Name</b>	Cooraman Creek
<b>Barrier Name</b>	Cooraman Ck Rd
<b>Barrier Type</b>	Culverts
<b>Comments</b>	Many barrelled culvert requires baffles installed in at least two culvert barrels. Marine inundation requires that baffles are stainless steel
<b>Remediation Solution</b>	Baffles



<b>Overall Priority</b>	39
<b>Barrier ID</b>	6144
<b>Stream Name</b>	12 Mile Creek
<b>Barrier Name</b>	San Jose Rd
<b>Barrier Type</b>	Causeway/Pipes
<b>Comments</b>	Small pipe culvert crossing that should be replaced with baffled box culverts
<b>Remediation Solution</b>	Baffled culverts





Overall Priority	40
Barrier ID	8642
Stream Name	Clyde Creek
Barrier Name	Harvey St
Barrier Type	Culverts
Comments	Large box culverts that require baffles on the two outer barrels
Remediation Solution	Baffles




Overall Priority	41
Barrier ID	532
Stream Name	Moore's Creek
Barrier Name	Musgrave St
Barrier Type	Weir
Comments	Small weir with significant erosion downstream under main roads bridge. Last barrier now blocking Moore's Ck
Remediation Solution	Cone Fishway




Overall Priority	42
Barrier ID	2664
Stream Name	Dawson River
Barrier Name	Kianga River Rd
Barrier Type	Culverts
Comments	Large box culvert that have a drop on the downstream side, will require rock ramp to allow fish to enter culverts
Remediation Solution	Rock Ramp Fishway/Baffles




<b>Overall Priority</b>	43	
<b>Barrier ID</b>	8606	
<b>Stream Name</b>	Calliope River	
<b>Barrier Name</b>	Duck Holes Rd	
<b>Barrier Type</b>	Pipes	
<b>Comments</b>	Small pipe culvert crossing that should be replaced with baffled box culverts	
<b>Remediation Solution</b>	Baffled culverts	





## 10 Top 41 Wetland Barriers


Overall Priority	1	
Barrier ID	FBAW1564	
Stream Name	Auckland Ck	
Barrier Name	Lake Callemonda	
Barrier Type	Causeway	
Comments	Current fishway leaking, preventing fish passage	
Remediation Solution	Repair current fishway	

Overall Priority	Equal 2nd	
Barrier ID	FBAW0470	
Stream Name	Gavial Ck	
Barrier Name	Port Curtis Rd	
Barrier Type	Culverts	
Comments	New culverts replaced a bridge at the site.	
Remediation Solution	Culvert Baffles	


Overall Priority	Equal 2nd	
Barrier ID	FBAW0466	
Stream Name	Gavial Ck	
Barrier Name	Yeppen Lagoon	
Barrier Type	Earth Bund	
Comments	Left over works from bridge building	
Remediation Solution	Flatten bund	


Overall Priority	Equal 3rd	
Barrier ID	FBAW1242	
Stream Name	Unnamed Ck	
Barrier Name	St Lawrence Bund 1	
Barrier Type	Earth Bund/Road	
Comments	Existing fishway adequate but could be better	
Remediation Solution	Rebuild existing fishway to decrease slope	


Overall Priority	Equal 3rd	
Barrier ID	FBAW0207	
Stream Name	Amity Ck	
Barrier Name	Wumalgi Rock Weir	
Barrier Type	Rock Weir	
Comments	Small tidal weir to hold freshwater for stock. A fixed water level fishway required	
Remediation Solution	Rock Ramp Fishway	


Overall Priority	Equal 4th	
Barrier ID	FBAW1423, 1424, 1425, 1426, 1427	
Stream Name	Nankin Ck Anabranh	
Barrier Name	Fitzroyvale Bund 1, 2, 3, 4 and 5	
Barrier Type	Earth Bund/Road	
Comments	Low bund with two pipe outlets	
Remediation Solution	2 x Rock Ramp Fishways at most appropriate outlets	





Overall Priority	Equal 4th	
Barrier ID	FBAW0372, 0373, 0375 and 1349	
Stream Name	Station Creek	
Barrier Name	Iwasaki Bund 1, 2, 4 and 7	
Barrier Type	Earth Bund/Road	
Comments	Low bund located at tidal interface. Large wetland upstream	
Remediation Solution	2 x Rock Ramp Fishways at most appropriate outlets	

Overall Priority	Equal 4th	
Barrier ID	FBAW0099	
Stream Name	Unnamed Creek	
Barrier Name	St Lawrence Bund 3	
Barrier Type	Earth Bund/Road	
Comments	Earth bund upstream of fishway would increase access to the lagoon	
Remediation Solution	Baffled culverts	


Overall Priority	Equal 16th	
Barrier ID	FBAW0376 and 1350	
Stream Name	Station Creek	
Barrier Name	Iwasaki Bund 5 and 8	
Barrier Type	Earth Bund/Road	
Comments	Low bund located at tidal interface. Large wetland upstream	
Remediation Solution	2 x Rock Ramp Fishways at most appropriate outlets	

Overall Priority	Equal 18th	
Barrier ID	FBAW0260, 0261, 0262, 0263 & 1328	
Stream Name	Bald Hills Ck	
Barrier Name	Bald Hill Rd Bund 1, 2, 3, 4 and 5	
Barrier Type	Earth Bund/Road	
Comments	Low bund located at tidal interface. Large wetland upstream	
Remediation Solution	2 x Rock Ramp Fishways at most appropriate outlets	


Overall Priority	Equal 18th	
Barrier ID	FBAW0434	
Stream Name	Nankin Ck	
Barrier Name	Fitzroy Vale Track	
Barrier Type	Ford	
Comments	Low ford small drop across structure	
Remediation Solution	Rock Ramp	


Overall Priority	Equal 18th	
Barrier ID	FBAW0366	
Stream Name	Solitude Ck	
Barrier Name	Freshwater Bay Road	
Barrier Type	Pipes	
Comments	Main access road within the SWBTA	
Remediation Solution	Replace with culverts	





Overall Priority	Equal 18th	
Barrier ID	FBAW0269, 0270, 0271, 1333, 1334, 1520 and 1521	
Stream Name	Back Gully Ck	
Barrier Name	Glanprairie Bund 1, 2, 3, 4, 5, 6 and 7	
Barrier Type	Earth Bund/Road	
Comments	Low bund located at tidal interface. Large wetland upstream	
Remediation Solution	2 x Rock Ramp Fishways at most	


Overall Priority	Equal 18th	
Barrier ID	FBAW0377	
Stream Name	Station Ck Trib	
Barrier Name	Iwasaki Bund 6	
Barrier Type	Earth Bund/Road	
Comments	Low bund located at tidal interface. Large wetland upstream	
Remediation Solution	Rock Ramp Fishway	


Overall Priority	Equal 18th	
Barrier ID	FBAW1391	
Stream Name	Barramundi Ck	
Barrier Name	Tidal Bund	
Barrier Type	Earth Bund	
Comments	Low bund located at tidal interface.	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	Equal 34th	
Barrier ID	FBAW0374	
Stream Name	Station Ck	
Barrier Name	Iwasaki Bund 3	
Barrier Type	Earth Bund/Road	
Comments	Low bund, large wetland upstream	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	Equal 34th	
Barrier ID	FBAW1244	
Stream Name	Unnamed Creek	
Barrier Name	St Lawrence Bund 2	
Barrier Type	Earth Bund/Road	
Comments	Existing fishway adequate but could be better	
Remediation Solution	Rebuild existing fishway to decrease slope	


Overall Priority	36	
Barrier ID	FBAW0253	
Stream Name	Unnamed Ck	
Barrier Name	Stoodleigh Rd Bund	
Barrier Type	Earth Bund	
Comments	Low bund, large wetland upstream	
Remediation Solution	Rock Ramp Fishway	


Overall Priority	37	
Barrier ID	FBAW0513	
Stream Name	Unnamed Creek	
Barrier Name	Alligator Passage Bund	
Barrier Type	Earth Bund/Road and pipe	
Comments	Low bund, large wetland upstream	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	Equal 38th	
Barrier ID	FBAW0106	
Stream Name	Unnamed Creek	
Barrier Name	St Lawrence Bund 4	
Barrier Type	Earth Bund	
Comments	Upstream from exiting fishways	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	Equal 38th	
Barrier ID	FBAW1447	
Stream Name	Inkerman Ck Trib	
Barrier Name	Tidal Bund	
Barrier Type	Earth Bund/Road	
Comments	Low bund, large wetland upstream	
Remediation Solution	Rock Ramp Fishway	



Overall Priority	Equal 40th	
Barrier ID	FBAW1549	
Stream Name	Fishing Ck Swamp	
Barrier Name	Fishing Ck Rd	
Barrier Type	Road	
Comments	Isolates freshwater swamp from tidal areas	
Remediation Solution	Baffled culverts	

Overall Priority	Equal 40th	
Barrier ID	FBAW1079	
Stream Name	Gracemere Creek	
Barrier Name	Orphanage Swamp	
Barrier Type	ford	
Comments	Low ford that creates a 0.5m drop at low flows.	
Remediation Solution	Rock Ramp Fishway	