

Thearles Drain Active Floodgate Management Plan

2021-2024

Management Plan operational summary

Thearles drain is located 5 kilometres west of Woodburn in Northern NSW. The approximately 2.7-kilometre-long drain enters Swan Bay on its western bank. The system drains a low-lying area to the south of Swan Bay. Thearles drain is a constructed drainage system that shows no natural characteristics and is surrounded by agricultural land used for grazing, sugar cane and pecans. However, the drain discharges into Swan Bay, which has been identified as key fish habitat by the Department of Primary Industries.

The drain has been floodgated at its junction with Swan Bay. A large concrete headworks has been constructed through the man-made Swan Bay levee and four floodgates installed on the downstream side. One floodgate has been modified with a sluice window to allow tidal exchange. It is that modification to which this Plan applies. The term 'floodgate' within this Plan refers to the sluice window that is opened and closed to allow tidal exchange between the drain and Swan Bay.

Active floodgate management has occurred at Thearles drain since 2002. Opening the sluice window to allow tidal exchange, during non-flood periods, has improved water quality within the drain. The frequency and magnitude of acidic discharge has been reduced, as has the accumulation of Mono-sulfidic Black Ooze (MBO) within the drainage system.

Although monitoring has not occurred, based on scientific understanding and principles it is reasonable to expect that tidal exchange has improved water quality discharging from Thearles drain. Research has shown that tidal exchange can improve water quality through dilution and neutralisation of acidity. However, it is important to acknowledge that active floodgate management does not resolve all water quality issues in the system, such as deoxygenation (blackwater) events after flooding.

While acknowledging the limitations, the environmental impact of Thearles drain floodgates has been reduced through active management and it continues to be an important on-going strategy. This Plan outlines how tidal exchange will continue and suggests additional management strategies to reduce the system's impact further.

Environmental goals and strategies

The goals and strategies listed here specifically relate to Thearles drain and identify the desired outcome from actively managing the floodgates. Goals are listed in priority order.

Goals

1. Reduce the frequency and magnitude of acidic discharge from Thearles drain.
2. Reduce the accumulation of Mono-sulfidic Black Ooze within the system.
3. Reduce the impact of Thearles drain on Swan Bay.

Strategies

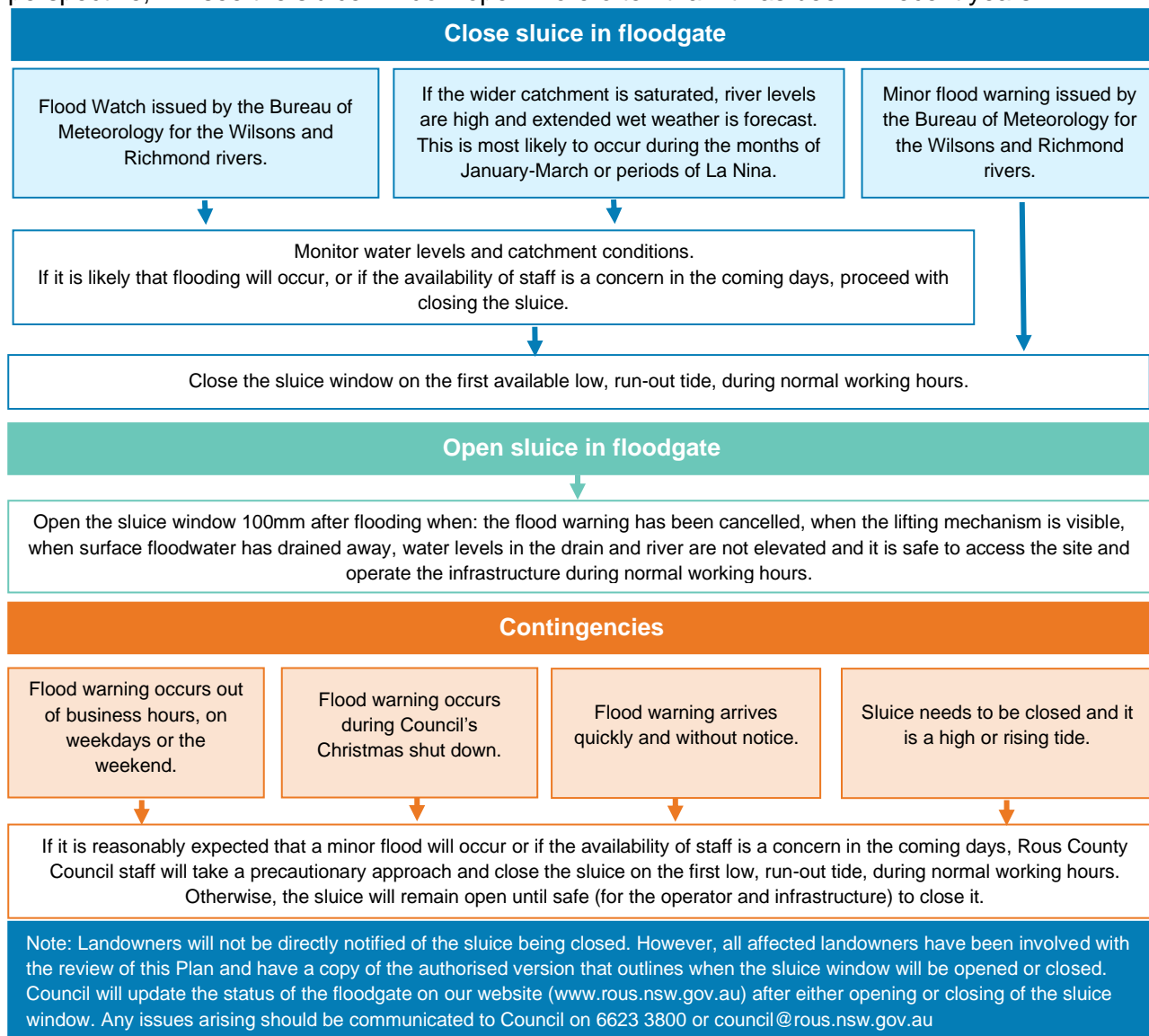
- Formalise the current opening strategy for the system's floodgate.
- Encourage best management practices and additional remediation strategies to further reduce the impact of Thearles drain.

Opening strategy for floodgate

A floodgate on Thearles drain is fitted with a sluice window, which can be winched open. Land ownership and land use has changed along the drain in recent years and the review of this management plan is an opportunity to confirm how the sluice window will be managed into the future.

The degree of tidal exchange that will occur with the outlined strategy will improve the environmental condition of the drain while having minimal impact on surrounding land use. It is recommended that this strategy be assessed when this Plan is reviewed in three years to determine its effectiveness and whether tidal flushing can be increased.

For the majority of the time, the sluice window will be opened 100mm and will be closed before floods. The sluice window will be opened and closed in accordance with the details below by Rous County Council staff. Council acknowledges there are many variables during flood events and will be guided by the details below. This Plan will not restrict Council from taking emergency actions outside of those listed, taking into consideration safe work procedures. Further, the sluice window may also be closed during periods of extended wet weather when the catchment is saturated, and a cautious approach needs to be taken to tidal flushing. This strategy will address the risk of land upstream being inundated from the sluice window being open or drain water levels being elevated from tidal flushing. This approach, although conservative from a water quality improvement perspective, will see the sluice window open more often than it has been in recent years.



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Authorisation

This Plan has been endorsed by the landowners within the immediate catchment, whose land is influenced by the management of floodgates. Those landowners have signed a letter of endorsement stating they understand the management strategy for the floodgates, including the triggers for opening and lowering into the operational position.

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Version control

Version	Description	By	Date
0.1	Draft developed before landowner consultation	Chrisy Clay	11/02/21
0.2	Final draft incorporating landowner feedback	Chrisy Clay	05/07/21
1.0	Final version – issued to landowners	Andrew Logan	19/07/21

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1. Overview

The majority of coastal floodplains in NSW have been extensively modified for flood mitigation. Networks of drains have been constructed, natural water courses altered and floodgates installed to mitigate the impacts of floods and large rainfall events.

Constructed drains reduce inundation after flooding and floodgates prevent flood and tidal water from inundating low areas of the floodplain. This in many cases has converted prior wetlands and low-lying floodplain areas into dryland farming areas. While these developments have enhanced rural settlement and agricultural industries, they have also caused unintended adverse impacts to downstream water users, fisheries and the ecology of estuaries.

Rous County Council ('Council') is the Flood Mitigation Authority operating across the local government areas of Ballina, Lismore and Richmond Valley. Council is responsible for the construction, replacement and routine maintenance of flood mitigation infrastructure, which includes floodgates, pipes, levees, drains and canals. Council's natural resource management function relates to the environmental consequence resulting from the operation of this infrastructure. Council is responsible for reducing the environmental impact of floodgates and other infrastructure, while retaining their benefits for flood mitigation.

The flood mitigation directive that Council operates under in the *Local Government Act 1993* is '*Prevent and mitigate menace to the safety of life or property from floods and natural resource management issues arising therefrom*'.

Purpose of a Floodgate Management Plan

Council has an Active Floodgate Management Plan ('Plan') for each of its floodgates that are actively managed. Active management is the opening of floodgates during non-flood periods when the floodgate is otherwise operating passively. Opening floodgates and allowing tidal exchange can reduce their environmental impact by improving water quality and enhancing aquatic habitat and fish passage. Opening a floodgate for tidal exchange can occur by modifying a floodgate with a sluice window or an automatic, tidally operated float system or the floodgate can be winched opened.

These plans document and communicate:

- how active management can assist in reducing the environmental impact of the floodgate,
- a strategy for how that will be monitored and achieved,
- appropriate and consistent strategy for opening the floodgate and returning it to the operational position or state and by whom,
- safe operating procedures for volunteers and Council staff,
- how adverse effects on current land use will be identified and prevented, and
- additional management strategies for the drainage system that would further reduce the environmental impact of flood mitigation.

Each Plan is tailored for the system and its floodgates, considering their location, purpose and function.

Guiding principles for management

- Rous County Council is the Flood Mitigation Authority and acts in consultation with stakeholders on the management of its infrastructure.
- The primary function of Council's infrastructure is for flood mitigation.
- The intention of active floodgate management is to reduce environmental impact without causing adverse effect on current land use.
- All landowners behind the floodgate whose property may be impacted will be invited to participate in reviewing and updating the Plan and will be sent a final version of the Plan for their records. Where property ownership changes, the new landowner will be involved at the time the Plan is reviewed unless their location and role are critical to the management strategy.
- Active floodgate management is a cooperative exercise between Council, as the Flood Mitigation Authority, and the surrounding landowners. Council appreciates landowners' continued support of this important activity.

Stakeholder involvement

This Active Floodgate Management Plan is a formal agreement between Rous County Council and landowners on how tidal exchange will occur on the identified drainage system. The Plan has been developed in consultation with landowners whose property may be impacted from the floodgate's operation.

Rous County Council seeks the input and support of other stakeholders for their Active Floodgate Management program and its delivery.

Organisation	Role
Rous County Council	Owens, develops and uses individual Active Floodgate Management Plans.
Relevant landowners	Endorses and uses individual Active Floodgate Management Plans.
Lismore City Council Ballina Shire Council Richmond Valley Council	Supports active floodgate management and provides input on general program where relevant.
NSW Department of Primary Industries	Supports active floodgate management and provides input on general program where relevant. Regulatory role under <i>Fisheries Management Act 1994</i>

Plan review frequency

The Plan will be formally reviewed every three years (from the date of adoption) and the effectiveness of the outlined strategy assessed.

Feedback on the Plan and active floodgate management matters

Feedback and comments should be referred to Council by telephone on (02) 6623 3800 or by email: council@rous.nsw.gov.au

2. Thearles drain

Asset number and description

A reference in this section to 'asset number' is to a unique reference that Council has assigned to the specified asset.

Asset number 1790 – Thearles drain

- Four floodgates, one with a sluice window operated with a winch.

Asset No.	Description	Number
1790-031-01	900mm floodgate	1
1790-031-02	Aluminium floodgate (2100mm square)	2
1790-031-03		
1790-031-04	Aluminium floodgate (2100mm square) with sluice window	1
1790-060	Lifting gear	2
1790-610	Handrail	2
1790-120	3 cell box culvert with headwall	1
1790-263	Canal	1
1790-290	Outlet	1
6570-410	Swan Bay levee	1
5950-100	Pipe	1
1800-100	Pipe	3

Aerial photograph of asset location and images of asset



1: Thearle's drain locality map.



2: Thearles drain floodgates.



3: Aerial shot of Thearles drain, looking upstream from floodgates after minor flooding in February 2020.

Drainage system characteristics

Location in estuary.	Mid-estuary.
Location in landscape.	Riverine natural levee and floodplain.
Land elevation.	0.8m – 1.8m AHD.
Land use.	Agriculture: grazing, sugar cane and pecans.
Vegetation.	Grasses and pastures.
Salinity levels and estuary dilution capacity.	Low.
Tidal range.	Low.
Land elevation adjacent to drains.	High, graduating from natural levee along Richmond River.
Soil type.	Likely to be alluvial sediment overlaying estuarine clay.
Acid sulfate soils.	High risk, areas of sulfuric sediments (actual sulfate soils). Present in low-lying areas. MBOs present in drain.
Hydraulic conductivity.	Unknown. Based on chronic acid conditions observed in drain, likely to be medium-high in places.
Acid export.	System is known to export acid after heavy rain and for acidic conditions to persist for some time afterwards.
Water quality issues.	Prolonged acidification after rain. Chronic acidic discharge with low dilution capacity within Swan Bay. Can discharge deoxygenated water (blackwater) after flooding.

Water quality

Chronic acidic conditions are often observed within the drainage system. Council has previously had some spot water samples laboratory analysed during acidic conditions and very high levels of iron (54mg/L) and aluminium (12.4mg/L) were recorded. Historic spot water quality readings and observations indicate the drain can be acidified for a prolonged period after rainfall.

In 2018, Council had drain sediment samples collected from along the bottom of the nearby Reardons drain and analysed for the presence of acid sulfate soil material. Analysis showed extremely elevated levels of acidity within the sludge in the bottom of the drain. This indicates that Reardons drain is located through areas of high-risk acid sulfate soils and MBOs can be present in the drain. It is highly likely that Thearles drain is similar.

After major summer floods, the system does discharge deoxygenated water (blackwater). Low-lying areas within the drainage system can be inundated for lengthy periods, until water levels in Swan Bay and the Richmond River drop, allowing water to drain away.

Aquatic habitat values

Thearles drain is a constructed drainage system that shows no natural characteristics. The drainage system provides little aquatic habitat, however it discharges into Swan Bay. Swan Bay has been identified as key fish habitat by the Department of Primary Industries. Active floodgate management at Thearles drain aims to reduce the system's impact upon Swan Bay and downstream aquatic habitat.

Apart from acidic runoff and deoxygenated blackwater, Thearles drain may also contribute to the prolific growth of aquatic weeds in Swan Bay. Swan Bay frequently experiences large and prolonged infestations of aquatic weeds like the high-priority weed, Alligator Weed (*Alternanthera*

philoxeroides) and environmental weeds like Water hyacinth (*Eichhornia crassipes*) and Salvinia (*Salvinia molesta*). Swan Bay is a sheltered waterway, with little flow, and any nutrients discharged into it from surrounding land are likely to accumulate and provide an ideal environment for aquatic weeds to grow. Thearles drain is one of four main systems that drain nearby land into Swan Bay.

Whole of system management

The following table outlines what management changes have already been made within Thearles drainage system and what could be explored in the future. A cooperative approach that balances the needs of current land use and environmental benefits is promoted by Council. Thearles drain has benefitted from the willingness of previous landowners to trial and adopt different management strategies to its environmental condition and Council acknowledges their efforts.

Council provides this information for landowners and other organisations that are responsible for promoting and facilitating natural resource management on private freehold land. This information identifies a range of relevant strategies for improving water quality based on the characteristics of the system and are consistent with current best management practice.

Management strategy	Works	Undertaken	Location	Recommendation	Responsibility
Acidic groundwater containment.	Reducing drainage density – removing drains or reshaping so shallow and wide to only drain surface water.	Yes. RRCC and DPI Fisheries with funding from the NRCMA and ET, in private drains that connect to the main channel. 5.1km of private drains across both Thearles and Campbells drainage systems were reshaped and shallowed to reduce impact of acid runoff on Swan Bay.	Could apply to both private drains entering Thearles drain and the main canal itself.	Explore possibility with relevant landowners.	Private landowners. Local government: <ul style="list-style-type: none"> • Rous County Council. • Richmond Valley Council. State government: <ul style="list-style-type: none"> • North Coast Local Land Services. • Department of Primary Industries. • Department of Planning, Industry and Environment. • Marine Estate Management Authority.
	Laser levelling of paddocks to enhance drainage of surface water and remove the need for field drains that can drain groundwater.	Likely to have been completed on cane farms as this is a widespread industry practice.	Land growing sugar cane and tea tree.	Explore with landowners whether laser levelling and reduction of field drains can occur.	Private landowners. Local government: <ul style="list-style-type: none"> • Richmond Valley Council. State government: <ul style="list-style-type: none"> • North Coast Local Land Services. • Department of Primary Industries. • Department of Planning, Industry and Environment. • Marine Estate Management Authority.
Tidal flushing for dilution and buffering of acidification.	Actively manage floodgates.	Yes, by RRCC in 2002. Partly funded by NSW Fisheries via ET funding.	Sluice window installed on main floodgate.	Continue with current management strategy.	Private landowners. Local government: Rous County Council.

Management strategy	Works	Undertaken	Location	Recommendation	Responsibility
Reduce impact of deoxygenation events.	Reducing drainage density – removing drains or reshaping so shallow and wide to only drain surface water.	No.	All drains in grazing land.	Explore possibility with landowners. Assess cost versus benefit.	Private landowners. Local government: <ul style="list-style-type: none"> • Rous County Council. • Richmond Valley Council.
	Explore further management strategies for lowest lying areas.	No.	All drains in grazing land.	Explore possibility with relevant landowners.	State government: <ul style="list-style-type: none"> • North Coast Local Land Services. • Department of Primary Industries. • Department of Planning, Industry and Environment. • Marine Estate Management Authority.
Reduce nutrients discharged into Swan Bay.	Industry best management practices for using nutrients.	On-going.	Surrounding agricultural land.	Support industry extension programs.	Private landowners. Industry <ul style="list-style-type: none"> • NSW Sugar Cane Industry. Local government: <ul style="list-style-type: none"> • Rous County Council. • Richmond Valley Council. State government: <ul style="list-style-type: none"> • North Coast Local Land Services. • Department of Primary Industries. • Department of Planning, Industry and Environment. • Marine Estate Management Authority.
	Installation of vegetative filter strips alongside drain.	No.	Along the drain through sugar cane farms.	Explore possibility with relevant landowners.	State government: <ul style="list-style-type: none"> • North Coast Local Land Services. • Department of Primary Industries. • Department of Planning, Industry and Environment. • Marine Estate Management Authority.
Further information to understand the drainage system.	Drain invert survey.	No	Entire drainage system.	The drain invert survey would assist in identifying opportunity and challenges for further tidal flushing. The invert survey may also guide options such as drain reshaping.	Local government: <ul style="list-style-type: none"> • Rous County Council.
Water quality monitoring.	Monitoring program to identify any water quality issues and confirm benefits of managing floodgate.	No, only spot samples and observations.	Main floodgates.	That a program be developed to determine success of Active Floodgate Management Plan. Identify resources required and assess cost versus benefit.	Local government: <ul style="list-style-type: none"> • Rous County Council.

RRCC = Richmond River County Council, former Flood Mitigation Authority on the Richmond.

DPI = Department of Primary Industries.

NRCMA = Northern Rivers Catchment Management Authority.

ET = Environmental Trust.

3. Risks of actively managing floodgates

Work Health and Safety

- The sluice window is fitted with a winch and large forces can be involved in winch systems.
- The sluice window should only be opened on a low or falling tide. This will reduce the risk of the wire rope breaking and the floodgate deforming.
- The sluice window is opened and closed by Council operators, who must consult and follow the approved Safe Work Procedure relevant for the activity.
- Operating the sluice window during and after heavy rain or flooding can require working in wet and slippery conditions. Safe access to the site should be assessed after events.

Environmental / Agricultural

Flooding

There is a risk of flooding to land upstream of the floodgate and surrounding areas, if the sluice window is not closed before a flood arrives and floodwater from Swan Bay enters the drainage system.

There is also concern of increased flooding from elevated drain water levels caused by tidal exchange. To reduce this risk, the sluice window will be opened only 100mm to maintain storage capacity (air space) in the drainage system for heavy rain events.

Increased salt levels in drainage system

Salinity levels are low in this part of the Richmond River estuary, even during droughts and periods of low flows. There is no risk posed by tidal water overtopping banks in low-lying areas because of the height of the banks and tidal range in this part of the estuary. There is no risk posed by lateral salt seepage into the banks because of the salinity experienced in this part of the estuary.

4. Monitoring, evaluation and reporting

Council will explore whether programmed and longer term water quality monitoring can occur at Thearles drain. However, if resources are not available for monitoring, scientific principles and visual observations support the assumption that implementing the outlined management strategy will improve water quality.

An evaluation of the success of the Plan will be made at the 3-yearly review, and a report provided by Council to landowners and relevant stakeholders.

5. Historical context

History of when and why asset was installed

Thearles drain reduces inundation in an area well known for flooding. The system drains a low-lying area that sits between Bungawalbyn Creek and Rocky Mouth Creek. This area has been historically problematic as drainage is reliant on the level of the Richmond River and the area is denied drainage for long periods until the river level drops after floods. Without these drainage systems the low-lying area would be wet for many months of the year.

Complaints about flooding in the area appear in historical newspapers in the early 1920s, and again in the 1950s when broken floodgates and a damaged levee along Bungawalbyn Creek caused floodwater from Bungawalbyn to flow across the flats towards Swan Bay. The article reported that floodwaters at Swan Bay were still rising, although upstream Coraki had started to recede.

It is not known when Thearles drain was constructed, but an article in the Richmond River Herald newspaper stated that in December 1928, it and other drains in the Swan Bay area already existed. The article reported on the installation of floodgates on Williams, Robinsons, Thompsons and Thearles drains. The article praised the construction of the floodgates and associated structures: *'These are massive works for ordinary drains and are built to stand for all time, while the big 6ft pipes should deal easily with the immense quantity of water that will pour through after the torrential rains.'*

Historic aerial photography confirms that construction of Thearles drain in its current location and size, was completed before 1957.



4: Aerial photograph of Thearles drain and Swan Bay taken in 1957.

Thearles drain has generated concerns and complaints from landowners on how well it functions. In 1934, a report in the Northern Star newspaper says landowners along Thearles drain asked the then Woodburn Shire Council to rate their land to provide funds to maintain the drain, specifically to clean it once every two years. Woodburn Shire Council agreed and requested that a Drainage Trust be formed and the land be rated accordingly. In 1991, landowners along Thearles unsuccessfully petitioned to have a Drainage Union created, as it was felt Richmond River County Council had done little work in the area and the creation of a landowner run Drainage Union would result in more maintenance of the system.

Landowners have also had long-held concerns that the box culvert under Coraki-Woodburn Road restricts flow and drainage. Rous County Council records and historic newspaper articles show that in the past, landowners have pumped water into Swan Bay from the water body between the floodgates and the road to relieve the inundation upstream. They would pump that section dry and let it refill from upstream through the road culvert. In 2006, landowners lobbied Richmond River

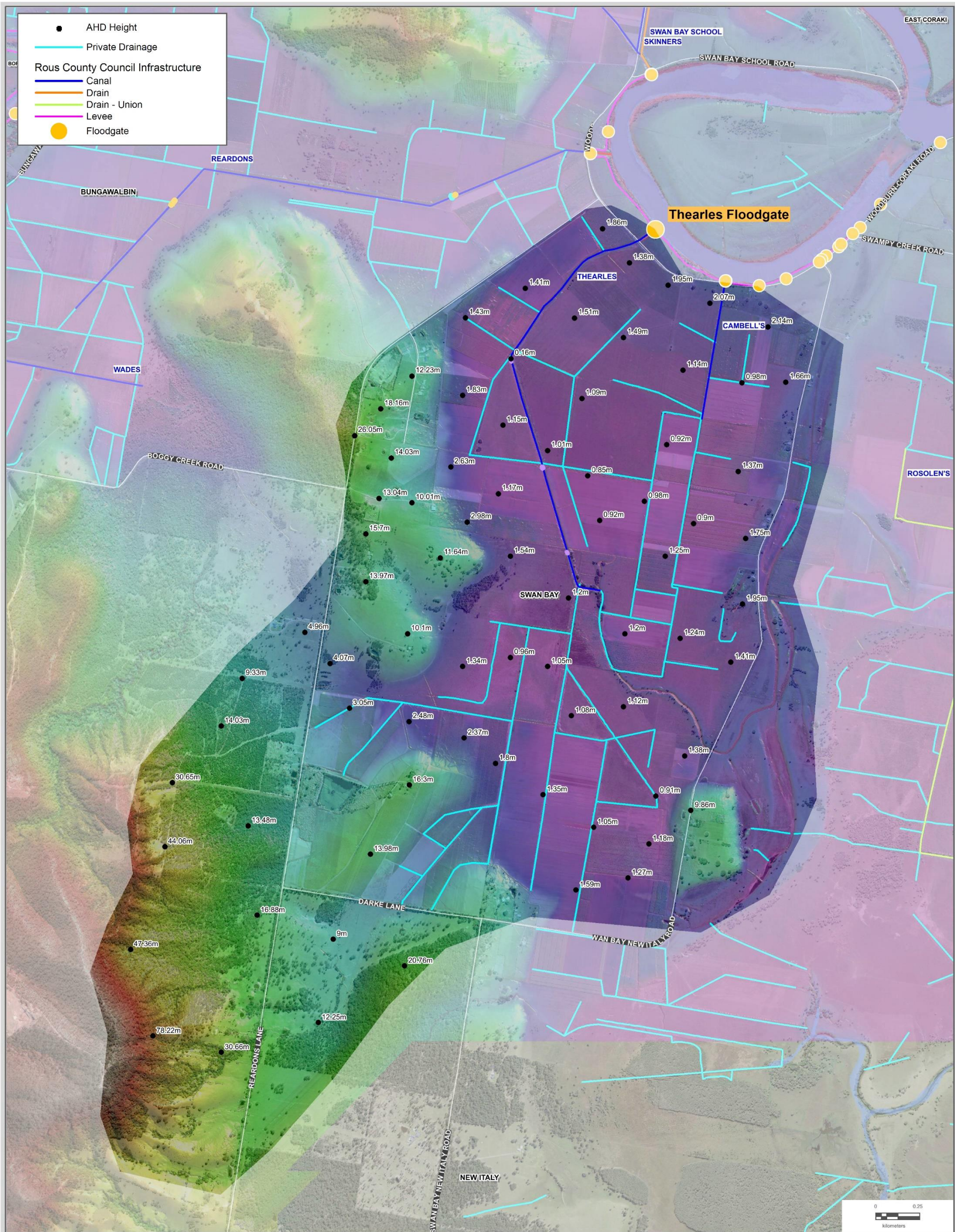
County Council to upgrade the structure, and designs were developed but late objections shelved the project. Responsibility for the box culvert under the Coraki-Woodburn Road lies with Richmond Valley Council.

History of active floodgate management

Thearles floodgates have been opened by landowners for many years, long before active floodgate management formally commenced. In 2002, Richmond River County Council removed the winch used to open the floodgates to stop unauthorised people operating Council assets. Following this, landowners along the system requested in writing that a sluice be installed that they could safely operate.

Active floodgate management commenced at Thearles drain in 2002. The fabrication of the sluice window was partly funded by NSW Fisheries through an Environmental Trust grant.

Land ownership and land use has changed in recent years, and the review of this Plan is an opportunity to confirm how the sluice window will be managed into the future.



Thearles Canal Catchment

THE INFORMATION ON THIS MAP MAY NOT BE ACCURATE.

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