ROUS
COUNTY COUNCIL

BULK WATER SUPPLY | WEED BIOSECURITY | FLOOD MITIGATION

Campbell's Drain
Active Floodgate Management Plan

2020-2023

Management Plan operational summary

Campbell's Drain is located 5 kilometres west of Woodburn in Northern NSW. The approximately 2-kilometre-long drain enters Swan Bay on its southern bank. The system drains a low-lying area between Swan Bay and Rocky Mouth Creek. Campbell's Drain is a constructed drainage system that shows no natural characteristics and is surrounded by agricultural land used for grazing and sugar cane. 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, with a box culvert and pipe installed through the man-made Swan Bay levee and floodgates installed on the downstream side. The largest 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 Campbell's Drain since 2005. Opening the sluice window to allow tidal exchange, during non-flood periods, can improve water quality within the drain. The frequency and magnitude of acidic discharge can be reduced, as can the accumulation of Mono-sulfidic Black Ooze (MBO) within the drainage system.

Although monitoring has not occurred, it is reasonable to expect that when tidal exchange has occurred it has improved water quality discharging from Campbell's Drain. Research has shown that tidal exchange can improve water quality through dilution and naturalisation of acidity. It is important to acknowledge that active floodgate management does not resolve all water quality issues in the system, e.g. tidal exchange does not reduce deoxygenation (blackwater) events after flooding.

While acknowledging the limitations, the environmental impact of the floodgates on Campbell's Drain 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 Campbell's 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 Campbell's Drain.
2. Reduce the accumulation of Mono-sulfidic Black Ooze within the system.
3. Reduce the impact of Campbell's Drain on Swan Bay.

Strategies

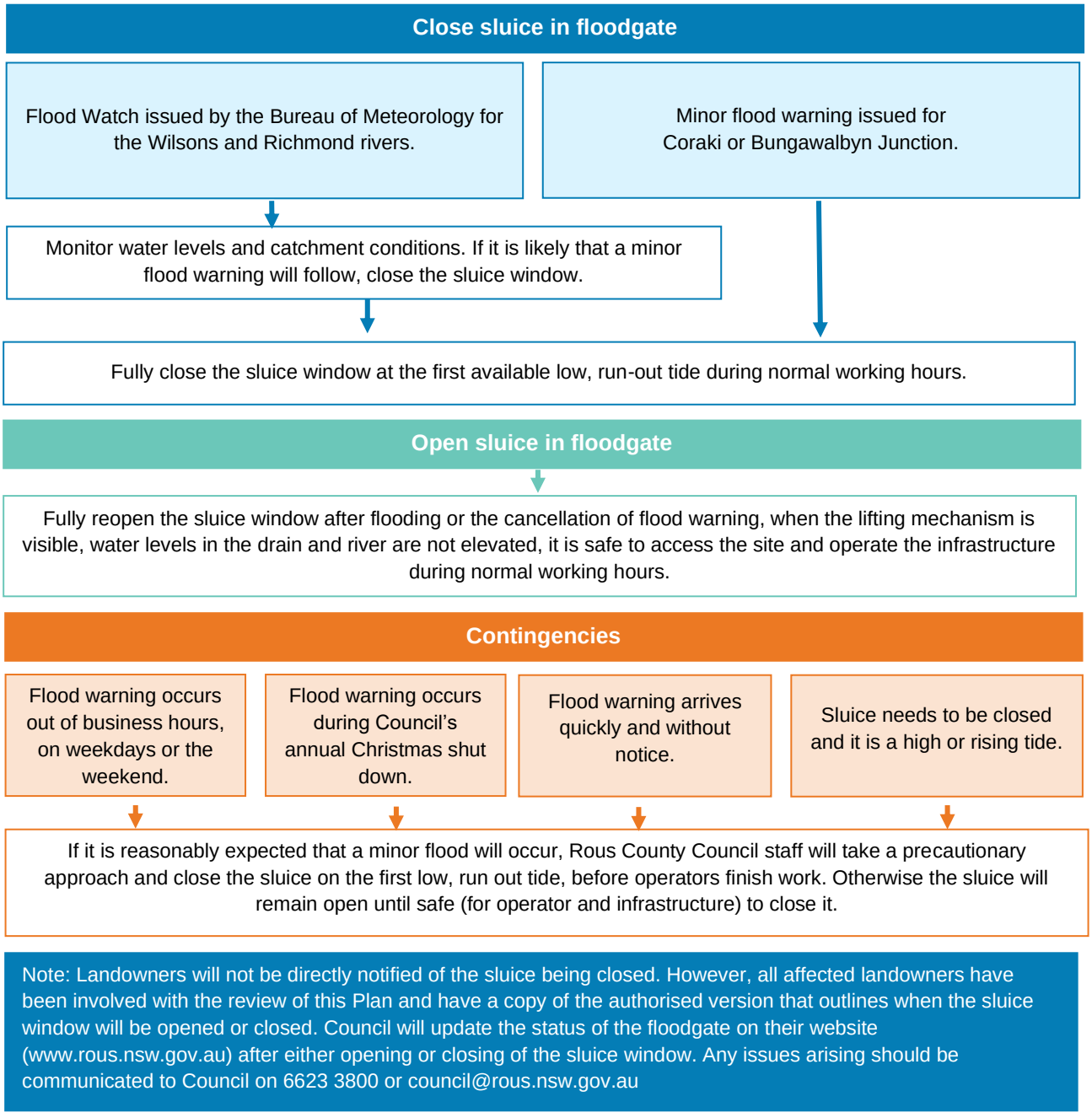
- Formalise the current opening strategy for the system's floodgate.
- Encourage best management practices and additional remediation strategies to further reduce the impact of Campbell's Drain.

Opening strategy for floodgate

A floodgate on Campbell's Drain is fitted with a sluice window, which can be winched open. Land ownership has changed 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 sluice window will remain fully open all year and will only be lowered before flood events. This is the optimal strategy for the existing floodgate structure and no improvement is suggested at this time for its future management. This degree of tidal exchange improves the environmental condition of the drain while having minimal impact on surrounding land use.

The sluice window will be opened and closed, in accordance with the details below by Rous County Council staff. Council acknowledge 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.



Note: Landowners will not be directly notified of the sluice being closed. However, all affected landowners have been involved with the review of this Plan and have a copy of the authorised version that outlines when the sluice window will be opened or closed. Council will update the status of the floodgate on their website (www.rous.nsw.gov.au) after either opening or closing of the sluice window. Any issues arising should be communicated to Council on 6623 3800 or council@rous.nsw.gov.au

Rous County Council contact details

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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 closing the sluice window.

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Version control

Version	Description	By	Date
0.1	Draft developed before landowner consultation	Chrisy Clay	29/05/20
0.2	Final draft incorporating landowner feedback	Chrisy Clay	09/06/20
1.0	Final version – issued to landowners	Brenda Ford	09/07/20

Rous County Council File 2547.1

Contents

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 what were historically 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, including floodgates and some pipes, levees, rural 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 these 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 ('the 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	Owns, 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 *Fisheries Management Act 1994*

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. Campbell's drainage system

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 1780 – Campbell's Drain

- A square 3,000 x 2,700mm floodgate with a sluice window operated with a winch.
- A round 600mm floodgate

Asset No.	Description
1780-031-01	Aluminium floodgate (3000mm x 2700m round) with sluice (600mm x 500mm)
1780-031-02	Aluminium floodgate (600mm round)
1780-060	Lifting gear
1780-261	Canal (first 800m only)
1780-290	Outlet
6570-410	Swan Bay levee

Aerial photograph of asset location and images of asset

1: Campbell's Drain locality map.

2: Campbell's Drain floodgates, showing sluice window.

3: Aerial shot of Campbell's 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.	0.86m – 2.17m AHD
Land use.	Agriculture: grazing and sugar cane.
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 can be present in drain.
Hydraulic conductivity.	Unknown.
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. Can discharge deoxygenated water (blackwater) after flooding.

Water quality

Historic spot water quality readings and observations indicate the drain can be acidified after rainfall. Both low pH readings (3.7) and elevated dissolved aluminium levels (2.2 - 6.2 mg/L) have been recorded in the drain and indicate the presence of acid sulfate soils.

Richmond River County Council had drain sediment samples collected from the bottom of the drain and analysed for the presence of acid sulfate soil material. Analysis showed extremely elevated levels of acidity within the sediment and sludge in the bottom of the drain. This also indicates the system is located through areas of high-risk acid sulfate soils and Mono-sulfidic Black Ooze (MBOs) can be present in the drain.

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

Campbell's 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 Campbell's drain aims to reduce the system's impact upon Swan Bay and downstream aquatic habitat.

Apart from acidic runoff and deoxygenated blackwater, Campbell's 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 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. Campbell's 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 Campbell's 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. Campbell's 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, RCC 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 Thearle's and Campbell's drainage systems were reshaped and shallowed to reduce impact of acid runoff on Swan Bay,	Could apply to both private drains entering Campbell's Drain and the main canal itself.	Review previous works with landowners. Explore possibility with relevant landowners to do further shallowing.	Private landowners. Local Government: • Rous County Council • Richmond Valley Council. State Government: • North Coast Local Land Services. • Department of Primary Industries. • Department of Planning, Industry and Environment (previously Office of Environment and Heritage) • 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 on cane farms as this is a widespread industry practice.	Land growing sugar cane.	Explore with landowners whether further laser levelling and reduction of field drains can occur.	Private landowners. Local Government: • Richmond Valley Council. State Government: • North Coast Local Land Services. • Department of Primary Industries. • Department of Planning, Industry and Environment (previously Office of Environment and Heritage) • Marine Estate Management Authority.
Tidal flushing for dilution and buffering of acidification.	Actively manage floodgates.	Yes, by RRCC in 2005.	Sluice window installed on main floodgate.	Continue with current management strategy.	Private landowners 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.	Entire drainage system.	Explore possibility with landowners. Assess cost versus benefit.	Private landowners. Local Government: • Rous County Council • Richmond Valley Council. State Government: • North Coast Local Land Services. • Department of Primary Industries. • Department of Planning, Industry and Environment (previously Office of Environment and Heritage) • Marine Estate Management Authority.
	Explore further management strategies for lowest lying areas.	No.	Entire drainage system.	Explore possibility with relevant landowners.	
Reduce nutrients discharged into Swan Bay.	Industry best management practices for using nutrients.	On-going.	Surrounding sugar cane farms.	Support industry extension programs.	Private landowners. Industry • NSW Sugar Cane Industry. Local Government: • Rous County Council • Richmond Valley Council. State Government: • North Coast Local Land Services. • Department of Primary Industries. • Department of Planning, Industry and Environment (previously Office of Environment and Heritage) • Marine Estate Management Authority.
	Installation of vegetative filter strips alongside drain.	No.	Along the drain through sugar cane farms.	Explore possibility with relevant landowners.	
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: • Rous County Council.

RRCC = Richmond River County Council, former Flood Mitigation Authority on the Richmond.
DPI = Department of Primary Industries
NR CMA = 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 bowing.
- 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.

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 or of lateral salt seepage into the banks.

4. Monitoring, evaluation and reporting

Council will explore whether water quality monitoring can occur at Campbell's 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

It is unclear when Campbell's Drain was constructed as the names of some drains at Swan Bay have changed through time and the exact location of those aren't clear.

The Northern Star reported in 1922 that a banquet was held by the Swan Bay Drainage Trust to celebrate the opening of what could be Campbell's Drain. The article reads:

> "The Chairman proposed a toast to 'The Swan Bay Drainage Trust.' Firstly, he thanked the Trust for the honor it had conferred on him, and he also had to congratulate them on having completed such an important work on the drain. Some years ago, the Lower Richmond was largely uncultivated ti-tree swamps. Successful drainage had since converted that land into most fertile cane farms, returning large profits. The C.S.R. Co. were to be chiefly thanked for this. In this instance the Trust would achieve the same result, for the low-lying land in this district, if properly drained, was as fertile as any in the State. It would grow anything, and some day no doubt this locality would be one of the most successful maize and potato growing centers in the district. The men who undertook the financial responsibility of this scheme had big hearts. They were to be complimented on their energy and enterprise, and he trusted that their efforts would be rewarded with success. The drain referred to above is 120 chains (1.5 miles) in length, commences in Mr. Geo. Newman's property; passes thence through Messrs. T. Newman's, Fava Bros '., and Thompson Bros ', and enters Swan Bay near the boundary of the latter's 'farm and

> Campbell 's property. A large area of valuable land is served by the drain, the contract price of which was in the vicinity of £1,000."

Reardon's Drain (which is located nearby) was also constructed in the early part of the 1900's, reported to already exist by the local Richmond River Herald newspaper in 1928. The article reported on the installation of floodgates on four major drains entering Swan Bay. It's likely that Campbell's Drain was one of them.

There were major works undertaken by Richmond River County Council in the 1960's in the Swan Bay area and by 1972 Campbell's Drain and floodgate were in existence and being referred to as such.

During the 1980's the Campbell's Drain area was covered by the Swan Bay Drainage Union. It is unclear when the Union commenced or ceased to function and what role Richmond River County Council had in maintaining the floodgate mitigation infrastructure on Campbell's Drain.

Like all of the drainage systems at Swan Bay, Campbell's was constructed to alleviate inundation of low-lying land that would have taken a very long time to drain. Campbell's Drain reduces inundation of land between Swan Bay and Rocky Mouth Creek which is also drained by Thearle's Drain and Wagner's Drain. Without these drainage systems the low-lying area would be almost permanently wet for many months of the year.

History of active floodgate management

Active floodgate management commenced at Campbell's Drain in 2005. Initially the sluice window was operated by both landowners and Richmond River County Council.

Land ownership has changed 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 sluice window will remain fully open all year, and only lowered before flood events to protect upstream areas from riverine inundation. The sluice window will be operated by Rous County Council Operators in accordance with this Plan.

Appendix: Campbell's drainage system