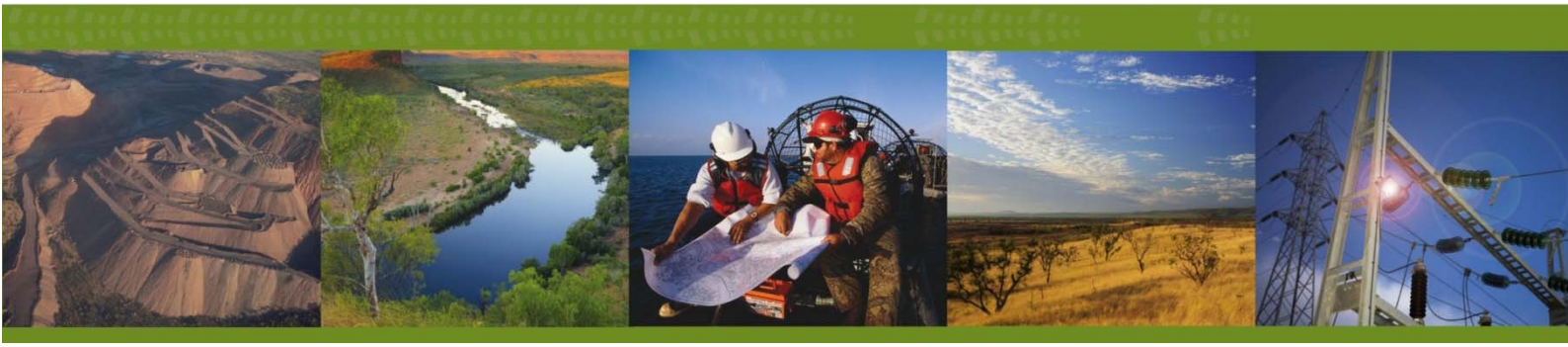

Ord Project Stormwater and Groundwater Discharge Management Plan

Stormwater and Groundwater Discharge Management Plan

Formerly LAN10119 Stormwater_Groundwater DMP Rev 10.docx

Formerly 004942.ord.pm.docx

Formerly 004945.ord.pm.docx

Originally approved by DSEWPac on 16 January 2013

[redacted]

[redacted] March 2014

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environmental consultants

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March 2014

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Strategen has not attempted to verify the accuracy or completeness of the information supplied by the Client.

Client: LandCorp

Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
Rev A	For Client review	AW/JM/CW	Electronic	4/04/2011
Rev B	For Client review	AW/CW	Electronic	12/04/2011
Rev C	For Client review	AW/MC	Electronic	19/04/2011
Rev D	For Client review	AW/MC	Electronic	02/05/2011
Rev E	For Client Review	AW/CW	Electronic	13/05/2011
Rev 1	For SEWPAC Review	AW/CW	Electronic	20/06/2011
Rev H	Client review	EJ/AW/CW	Electronic	27/10/2011
Rev I	Client review	AW/CW	Electronic	10/11/2011
Rev 2	IRG review	AW/CW	Electronic	15/11/2011
Rev J	Client review	AW/CW	Electronic	28/11/2011
Rev K	Internal review	N/A	N/A	N/A
Rev 3	IRG review	AW/MD	Electronic	1/12/2011
Rev L	Client review	AW/CW	Electronic	6/01/2012
Rev M	Client review	AW/CW	Electronic	11/01/2012
Rev4	IRG review	AW/Client	Electronic	20/01/2012
Rev N	Internal review	N/A	N/A	N/A
Rev5	For SEWPAC Review	AW/CW	Electronic	08/02/2012
Rev O	Internal review	EJ, AW/ MB, MD	Electronic	12/04/2012
Rev 6	IRG review	AW/Client	Electronic	20/04/2012
Rev P	Client Review	EJ / MB	Electronic	13/09/2012
Rev 7	For SEWPAC review	EJ / MB	Electronic	18/09/2012
Rev Q	Client Review	EJ / MB	Electronic	3/10/2012
Rev 8	SEWPAC submission	KB / MB	Hard copy	3/10/2012
Rev R	Client Review	EJ / MB	Electronic	15/11/2012
Rev 9	SEWPAC submission	KB / MB	Electronic	3/12/2012
Rev 10	SEWPAC submission	KB / MB	Electronic	12/12/2012
Rev 10	Revised status post-approval	KB / MB	Electronic	6/03/2012
Rev 11	Revision by Proponent to reflect changes to State Environmental Approval - Statement 938	Proponent (DSD)	Submitted to DotE	January 2014
Rev 12	Revised – Condition 11F variation	DSD	Submitted to DotE	March 2014

Filename: LAN10119 Stormwater_Groundwater DMP Rev 12 -

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1. Introduction

This Stormwater and Groundwater Discharge Management Plan (SGDMP) has been prepared to protect the environmental values of Border Creek and Keep River that may as a result of the Weaber Plain Development Project (the Project), be potentially affected by the discharge of stormwater and surplus groundwater (if required).

The SGDMP has also has been prepared to address the Western Australian conditions and proponent commitments of Statement 938 issued under the *Environmental Protection Act 1986* (EP Act), Condition 11 of the Environment Protection and Biodiversity Conservation (EPBC) decision statement (EPBC 2010/5491) as well as manage any potential impacts that could affect Matters of National Environmental Significance listed under the *EPBC Act 1999*.

1.1 Background

The Western Australian Minister for State Development is developing an area of land on the Weaber Plain for irrigated agriculture approximately 30 km north-northeast of Kununurra and adjoining the existing Ord River Irrigation Area, in the Kimberley region of Western Australia. Key components or environmental aspects of the Proposal relevant to discharge management include:

- application of 80 – 120 GL/yr of irrigation water which would increase recharge over the Weaber Plain and add to any rise in the watertable
- vegetation clearing of approximately 9260 ha of land for farms and infrastructure which would substantially increase groundwater recharge and result in a rise to the watertable
- installation of infrastructure (including roads, channel, power supply, drainage and flood protection infrastructure and groundwater management) which would affect the pattern of surface flows and ponding and may therefore potentially increase recharge to groundwater
- stormwater runoff to the Border Creek/Keep River system
- groundwater management system that could require periodic discharge to the Keep River system during natural high river flows depending on the extent of watertable rise and soil salinity increases in the Project Area.

1.1.1 State approval

The WA Minister for the Environment approved implementation of the Weaber Plain Development Project (as part of the M2 Proposal) February 2002 subject to a number of conditions outlined in Ministerial Statement 585. Statement 830 issued 7 May 2010, replacing Ministerial Statement 585. Ministerial Statement 830 was superseded by Ministerial Statement 938 issued 12 June 2013.

The Proposal was referred under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 14 May 2010. The Australian Government Minister determined in June 2010 that approval under the EPBC Act was required as the Proposed Action was considered to potentially have a significant impact on a number of Matters of National Environmental Significance (NES). The Proposed Action was approved, subject to a number of conditions, on 13 September 2011.

1.2 Purpose and scope

This SGDMP describes the processes for monitoring and management of discharge into the Keep River. This plan sets out the framework and foundation for monitoring and design characteristics which will be continuously refined based on future monitoring and modelling results, in consultation with the **Independent Review Group** (**IRG**).

This document has been prepared, to address requirements of WA EPA Statement 938 as well as the Commonwealth Approval for the Weaber Plain Development Project (EPBC 2010/5491).

State conditions

This document aligns with the Discharge Management Sub-plan contained within EMP 2013 (DSD 2013), addressing the commitments of the Proponent to managing stormwater and groundwater discharge in line with Ministerial Statement 938".

EPBC conditions

Condition 11 of the EPBC decision statement (EPBC 2010/5491) requires the preparation of the SGDMP in order to protect listed threatened species in the Keep River. Table 1 outlines the requirements of the EPBC approval conditions and where the requirements have been addressed in this Plan.

Table 1 Correlation between Stormwater and Groundwater Discharge Management Plan and EPBC Condition 11 and 12H

Item	EPBC Requirement	Section
Condition 11		
A	Details of a Tailwater Management System to be established on each farm to manage runoff and minimise the discharge of pollutants into the Border Creek and Keep River. The Tailwater Management System must be actively managed to minimise discharge of stormwater into the Border Creek and Keep River. The Tailwater Management Systems must be constructed and operational prior to commencement of irrigation;	This is addressed in Section 1.2.3 and Table 3, Item 2 and 3.
B	Management actions to prevent runoff transporting pollutants downstream should the agreed tailwater retention capacity be reached. This must include diversion of on-farm stormwater to irrigation channels in periods of low flow, where there is capacity, as identified by conditions 11.G and 11.H, to ensure pollutants are not transported into the Border Creek and Keep River in low flow periods;	This is addressed in Section 1.2.3.
C	A baseline monitoring program for water quality and hydrology in the Border Creek and Keep River. This must be completed prior to commencement of irrigation and prior to any release of stormwater or groundwater from farms. Sampling sites must include the Keep River estuary and the four Keep River pools (K4, K3, K2 and K1). Methodologies and sampling locations must be established in consultation with the **Independent Review Group;**	This is addressed in Table 3, Item 7.
D	Installation of water quality and flow gauging stations capable of sampling first flush discharges at: the stormwater outlet from the Development Area and installation of flow gauging stations at Border Creek and Keep River, in consultation with the **Independent Review Group.** Sampling must include analytes identified in Condition 11.I and must have the required accuracy to measure low flow rates. Gauging stations must be established prior to the commencement of irrigation. For any release of first flush water, monitoring must be conducted more than once a day and for any other stormwater flows monitoring must be conducted at least once per day. Automated sampling techniques may be utilised.	**Flow gauging:** Flow at the stormwater outlet, Border Creek and Keep River gauging stations will be monitored continuously (at hourly intervals). **Water quality monitoring:** The proposed management and monitoring strategy includes intense, flow-proportional water quality monitoring of key analytes at the stormwater outlet from the Development Area. The stormwater outlet has capacity for sub-daily monitoring intervals, as guided by the Operational Surface Water Model (OSWM). This is addressed in Section 1.2.5, Table 3 Item10 - 14, and Table 4 Item 2.

Item	EPBC Requirement	Section
E	Seasonal baseline water quality trigger values for the Keep River must be determined in accordance with ANZECC guidelines and agreed by the **Independent Review Group**. Until these trigger values are agreed by the **Independent Review Group**, ANZECC guidelines trigger values for systems with high conservation/ecological value (as defined in the ANZECC guidelines) must be used. Sample analytes must be agreed to by the **Independent Review Group** and in accordance with Condition 11.I;	This is addressed in Section 1.2.5 and Table 3, Item 8 and 10.
F	Use of best practice multivariate analyses on species level macroinvertebrate and fish assemblage data, within an adequate experimental design (as defined in the Aquatic Fauna Management Plan), using multiple indices of 'ecological condition' and a 'weight of evidence' approach, to assess any change in ecological health of Keep River pools (K1, K2 & K3) relative to baseline and upstream reference.	This is addressed in Table 3, Item 9.
G	Updating of the discharge dilution and release timing model (based on Keep River and Border Creek flow monitoring data and water quality characteristics of stormwater from the development area). This must be conducted prior to commencement of irrigation and annually during operation.	This is addressed in Section 1.2.5 and Table 3, Item 17, 19 and 20.
H	An adaptive groundwater and stormwater discharge program to provide for adaptive management of the discharge of stormwater and surplus groundwater that includes: i. discharge rules and rates and contingency actions; and ii. monitoring locations and requirements including infrastructure and setup; iii. design and location of dewatering infrastructure iv. written evidence of any Northern Territory Government permits that are required for discharge of groundwater; and v. management measures that ensure discharge of water will not impact on water quality in Border Creek and Keep River, including erosion protection measures.	This is addressed in Figure 3, Section 1.2.5, and Table 3, Item 15, 17.
I	Establishing a list of key analytes to be sampled as part of ongoing water quality monitoring in consultation with the **Independent Review Group**. The list must be updated annually based on monitoring results.	This is addressed in Section 1.2.5, Table 3 Item 10 and 12, and Table 2.
J	Discharge of groundwater to the Keep River to occur only if all other strategies have been undertaken and there is sufficient flow as determined by Condition 11.H. Discharge must be in the K1 pool or downstream in the Keep River estuary (as identified in Figure 5 of the Supplementary Environmental Impact Statement), with discharge timings and rules developed with consideration of ebb tides and in consultation with the **Independent Review Group**.	This addressed in Section 1.2.4, Figure 3 and Table 3, Item 16 .
K	Contingency actions to dispose of excess groundwater should monitoring results from Condition 10.C and 10.G indicate there are likely to be adverse impacts on listed threatened species as a result of the action.	This is addressed in Table 4 and Figure 3.
L	An Operational Surface Water Model (OSWM) (that incorporates the outcomes of Conditions 11.A, 11.G and 11.H, and the requirements of 11.J and 11.K) to minimise discharges of stormwater and groundwater into the Border Creek and Keep River and ensure that all flow rules are complied with. A framework of the OSWM must be provided prior to commencement of irrigation and a full model, which includes updated monitoring results, provided within 12 months of the commencement of irrigation. The OSWM must be updated on a seasonal basis.	This is addressed in Table 3, Items 17 and 18.

Item	EPBC Requirement	Section
M	Contingency measures should water quality and flow trigger values be exceeded or there are impacts on the health of threatened species as identified in aquatic fauna monitoring results in Condition 10.G. This must include the ceasing of discharge of stormwater and groundwater to the Border Creek and Keep River, implementation of a high intensity (at least daily) water quality sampling program, release of fresh irrigation water to flush the system and changes to farm practices such as reducing or ceasing the use of fertilisers and chemicals.	This is addressed in Figure 3, Section 1.2.3, 1.2.4, 1.2.5 and 2.4.
N	Protocols and timelines for review and reporting to the Department.	This is addressed in Section 2.5 and 3.
Condition 12		
H	Establishment of groundwater management infrastructure, including a network of groundwater abstraction bores in the Development Area and Buffer Area and discharge infrastructure at the K1 pool or downstream in the Keep River estuary designed in consultation with the **Independent Review Group.** Forecasting of trigger level exceedance must be projected 10 years into the future. Abstraction wells and groundwater discharge infrastructure must be installed and operational prior to any expected breach of trigger levels based on forecasting (incorporating the accuracy of the model into installation timings).	Groundwater management infrastructure is discussed in the Groundwater Management Plan (GMP). Discharge infrastructure is addressed in Table 3 Item 15.

This SGDMP addresses the management and monitoring of stormwater runoff and if necessary, the discharge of surplus groundwater, to protect water quality which may potentially affect EBPC listed species in the Keep River and Border Creek downstream of the Project Area.

The main sub-plans considered relevant to this plan are:

- Groundwater Management Plan (GMP) - describes the procedures for monitoring and management of groundwater levels and quality within the Project Area (including groundwater accretion and salinity issues) and possible changes to groundwater baseflow into the K4 Pool (Strategen 2012a)
- Surface Water Management Sub-plan - addresses the management of surface water within the Project Area as well as the effects of flood protection infrastructure and stormwater management infrastructure surrounding the Project Area (Strategen 2011a)
- Chemicals Management Sub-plan to ensure that chemical storage and application is being undertaken in the appropriate manner, including maintaining a database of chemicals and nutrients used on farms (Strategen 2011a)
- Soil Management Sub-plan - describes procedures for the prevention of soil erosion and details soil monitoring and management measures including the management of sodic soil; soil conservation; repair and restoration[1]; and, soil chemical status (Strategen 2011a)
- Hydrodynamic Survey Plan - describes the objectives, methodology and findings of the KBR (2006) hydrodynamic study, which addressed Items 1 to 3 of Condition 10.1 of Statement 830 (Strategen 2011a)
- Aquatic Fauna Management Plan - outlines specific management and monitoring measures that will be implemented for the protection of the EPBC listed species. The plan includes the framework for an outcome-based risk assessment to identify the likely risk and consequences of the impacts to threatened species (Strategen 2012b).

[1] The requirement for a sub-plan for soil conservation, repair and restoration is addressed partly in the Rehabilitation Management Plan and partly in the Soil Management Plan.

Where targets in the SGDMP are exceeded, the prescribed corrective actions may, where relevant, involve verifying actions contained in the GMP, Surface Water Management Sub-plan, Chemicals Management Sub-plan, Aquatic Fauna Management Plan or the Soil Management Sub-plan.

The Weaber Plain is located within the 100 700 ha Border Creek catchment which joins the 319 000 ha Keep River catchment, downstream of Legune Road Crossing. The major watercourse downstream of the Proposal is the Keep River system. There are no incised channels across the Weaber Plain, except towards the northeast where Border Creek becomes more defined as it heads eastward towards the Keep River. The mean annual flow of the Keep River at Legune Rd crossing is approximately 428 GL and has varied between 16 and 1613 GL in response to the variation in wet season rainfall. Border Creek experiences only sporadic flows after heavy rainfall while historical flow data records indicates no flows between June and September (Bennett & George 2011). On average, Border Creek contributes approximately 10% of the Keep River flows. The Weaber Plain also contributes relatively little runoff to Border Creek except during prolonged heavy rainfall events. Catchment flow modelling indicates that peak flows from the Project Area would usually occur just prior to the peak flows in the Keep River. This delay ensures that on most occasions, Border Creek flows are flushed by delayed Keep River flows.

The main inflows onto the Weaber Plain, which occur during the wet season, originate from Sandy Creek to the north-west, Gum Creek and Yard Creek to the north, with some minor inflows originating from Pincombe Creek to the south. These flows cause localised seasonal flooding and inundation. In wetter years, inundation extends across the entire plain and velocities increase in localised areas. At present the Weaber Plain is used for rangeland cattle grazing of natural pastures, as are most of the Keep River and Border Creek catchments (Bennett & George 2011).

During the dry season there are three pools (K1, K2 and K3) in the Keep River located downstream of the confluence with Border Creek, with a fourth pool located just above the confluence (K4) (Figure 1). Pools K3, K2 and K1 are downstream of the crossing and are 2.3, 1.9 and 7.4 km in length respectively, and have been shown to be subject to regular tidal exchanges (Bennett & George 2011).

River stage height data records from the Northern Territory Department of Natural Resources, Environment, the Arts and Sport (NRETAS) gauging station G8100225 at Legune Road Crossing indicates river levels in K4 falling below the cease to flow (CTF) threshold for an extended period every dry season prior to 2000. Anecdotal evidence also supports that there was no dry season flow from this pool prior to 2000. However, water level (stage) data from the station also shows that after 2000, the minimum dry season water level in K4 rose above the height of the cease to flow level, and since 2006 water from K4 pool has continuously discharged into K3. This is due to elevated groundwater levels creating a continuous discharge into K4. The contribution of groundwater to pool K4 is anticipated to increase in the future mainly due to climate change with some additional increase as a result of the Proposal (KBR 2011). This is addressed further in the GMP (Strategen 2012a).

Several studies of the Project Area and surrounds have been undertaken primarily during the dry season to understand the water quality characteristics in the Keep River system (NCTWR 2005; KBR 2006; WRC 2003; WRM 2010a; WRM 2010b; WRM 2011; Bennett & George 2011). In the dry season, the Keep River system was characterised by moderate to high dissolved oxygen (DO) levels, pH between 6.0 and 9.2 and water temperatures between 18.0°C and 34.2°C. On occasions nutrient concentrations (Total Phosphorus [TP], Total Nitrogen [TN]) were elevated above ANZECC & ARMCANZ (2000) guideline trigger values for unmodified, high conservation/ecological value, lowland river systems in tropical Australia. Results from the 2010/2011 baseline water quality sampling program under the natural state, show large inter- and intra- seasonal variations in salinity, turbidity and nutrient concentrations. During the dry season, the K3 pool recorded EC levels ranging between 106 – 249 mS/m, while total N ranged between 0.09 mg/L to 0.64 mg/L indicating a highly variable environment which experiences impacts from tidal forcing (Bennett & George 2011). During the 2010/2011 wet season, the TN and TP concentrations reached up to 10- 100 times the ANZECC & ARMCANZ (2000) guideline values in the Keep River, while EC ranged between 5 – 31 mS/m (Bennett & George 2011). In accordance with ANZECC & ARMCANZ (2000) guidelines, it is therefore appropriate that local site-specific trigger values be developed. This

indicates that the Keep River system is likely to be well adapted to a highly variable environment thereby minimising the potential impact from discharge.

The variable environment of northern rivers has also been found to be responsible for seasonal aquatic fauna deaths (ERISS 2001). The episodic and low flows common in northern rivers can lead to fish kills by causing the depletion of oxygen, resulting in eutrophication and a rapid increase in turbidity as detailed in the Aquatic Fauna Management Plan.

[illegible]

The stormwater discharge strategy associated with runoff from the Project Area will include an irrigation tailwater management system, representing current best practice in farm water management. As part of this system, tailwater from irrigated areas will be collected, stored, conveyed, and re-used on farms as irrigation water supply (a description of the tailwater management system is provided in the EMP). The capture and reuse of tailwater is expected to cease stormwater discharge from farming areas to the drainage system in low river flow periods where rainfall events generate less than 25 mm of runoff. Dry season flows that exceed the equivalent of 25 mm of runoff have never been recorded at the Border Creek gauging station (Bennett & George 2011). As a result potential pollutants will not be transported into the Border Creek and Keep River during these periods, as required by Condition 11B.

During prolonged or intense rainfall events in the wet season that generate sufficient runoff to exceed the capacity of the tailwater retention system, the system will overflow and runoff generated will be directed to a designated point as controlled discharge. Overflow will be directed through and around the Project Area into the 107 000 ha Border Creek catchment (Figure 1).

The Ord Stage 1 D4 drain data was used as an indicator of the likely nutrient concentrations in the first flush stormwater runoff from the Project Area. This is considered a worst case scenario, as the farms within the Ord Stage 1 do not include tailwater management systems. Water quality monitoring at the developed Ord Stage 1 catchment contained no evidence of a pronounced 'initial wet season flush' of nutrients or farm chemicals Atrazine and Endosulfan. Furthermore, the nutrient concentrations in the first 'flush' upstream of the Proposal, from the Keep River and Border Creek rangelands, were elevated above the nutrient concentrations at the D4 drain and remained elevated for much of the wet season (Bennett & George 2011). Therefore, given the high flow, turbidity and nutrient concentration during much of the wet season, the water quality of the tail of the last wet season flow is likely to be of much greater ecological relevance to the pools, as this water may reside in the pools for extended periods during the dry season.

Thus the irrigation tailwater retention will be designed as a dynamic system to ensure tailwater retention capacity is available during the low flow periods that are most critical to the Keep River system. The tailwater management system, the OSWM as well as the contingency measures proposed in Section 2.4 also ensures that stormwater discharge will be managed to meet site-specific trigger values to protect the downstream river environment.

[illegible]

The proposed groundwater management system anticipates the need to abstract groundwater should groundwater trigger levels determined in the GMP be exceeded. Discharge of groundwater is unlikely to be required in the first 10 years after commencement of farming, and if required, is forecast to be progressively implemented over 50 years (KBR 2011).

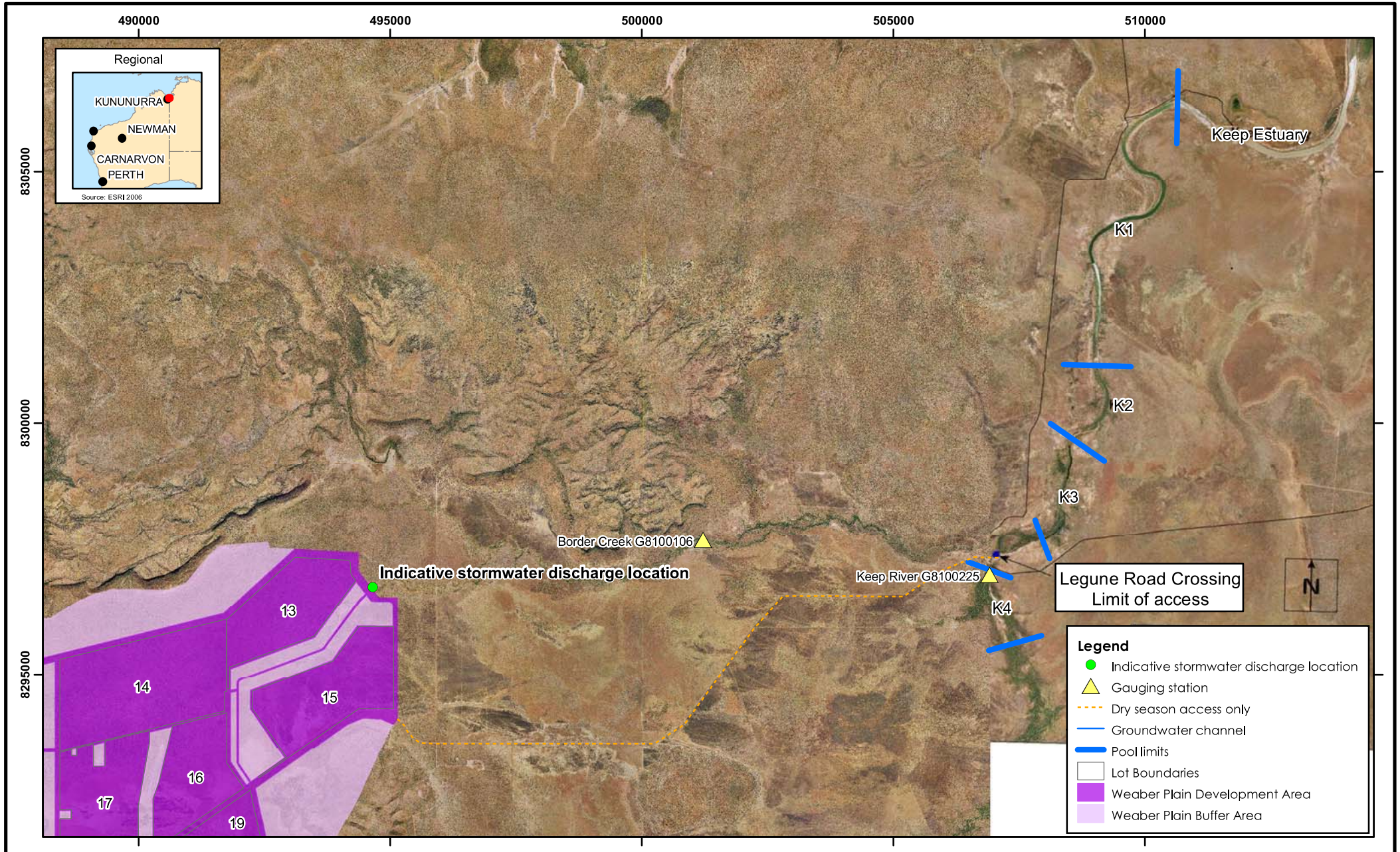
Hydrodynamic and groundwater modelling identified that if groundwater discharge was required, the preferred discharge option would include the discharge of groundwater into irrigation channels to be blended with irrigation water from the M2 channel during low Keep River flows; and discharge into the Keep River system when flows in the Keep River are sufficient to ensure flushing (see Figure 7 of the GMP). The blending of abstracted groundwater with irrigation water will be managed to ensure that irrigation supply does not exceed the 480 mg/L Total Dissolved Solids (TDS) limit for irrigation water supply. Modelling suggests that the blended irrigation water is likely to have a TDS of less than 240 mg/L (Lillicrap et al. in prep).

Hydrodynamic modelling was undertaken to determine the flushing and dilution capacity of the Keep River and to locate suitable sites for groundwater discharge (see Section 1.2.5, GHD 2011a). This plan specifies the discharge of groundwater (should it be required) in, or downstream of, the K1 Pool, as stipulated in approval condition 11J.

The discharge outlet will be designed to promote rapid mixing of groundwater releases with the river water so that the mixing zone is minimised (Figure 1). Available baseline water quality data of K3 and lower pools indicates large inter- and intra- seasonal variations in salinity and nutrient concentrations as a result of regular tidal exchange. Dry season EC ranged from 106 – 249 mS/m while total N ranged between 0.09 mg/L to 0.64 mg/L at the K3 pool. Therefore, the pools (including the K3 Pool) and the species within them already experience a highly variable environment thereby minimising the potential impact from discharge.

Potential contingency actions (pending analysis prior to groundwater discharge), could include increased groundwater discharge to Ord Stage 1 or 2 channels during the periods of low river flow, as well as discharge to the lower Keep River Estuary (see Table 4 and Figure 3). These contingency actions also assume that groundwater can be discharged at these locations as required.

The groundwater discharge management strategy will be refined in the years prior to commencement of groundwater pumping in the Project Area. The timing for the establishment of the discharge management system will be determined by the Proponent.



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Scale
0 1 2
Kilometres

N

Figure 1 Location of Keep River Pools and indicative discharge points

Coordinate System: GDA 1994 MGA Zone 52
Date: 18/09/2012
Author: jcrute

Scale: 1:100,000 at A4
Source: Geoscience Australia 2006. Weaber Plain Project Design: McMullenNolan 07/12/2011 and 03/04/2012. GHD 14/06/2011. DAFWA 05/2012

Note that positional errors may occur in some areas

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[illegible]

[illegible]

Water quality data from previous studies indicated that some ANZECC/ARMCANZ (2000) default trigger values are not appropriate for the lower Keep River system as prescribed by Condition 11E in the Commonwealth approval of the Proposal (WRM 2010c; Bennett & George 2011; GHD 2011a). In accordance with ANZECC/ARMCANZ (2000) guidelines, a baseline site-specific water quality survey commenced in 2010, which has shown large seasonal variations of nutrient concentrations. Until trigger values based on this sampling program are established, ANZECC guideline trigger values for 'high conservation/ecological value system' will be adopted.

Intense, flow-proportional water quality sampling at the stormwater outlet as well as at the groundwater discharge pipeline (when abstraction occurs) will provide data on the potential impact from the Development area. This data will be used with continuous flow data from the Border Creek and Keep River in the Operational Surface Water Model (OSWM) to guide further sampling, monitor the development, assess compliance with triggers and direct management response.

Proposed key physico-chemical and biological indicators to be developed in consultation with the **IRG** are listed in Table 2, separated into high and low river flow periods. They will be reviewed as a result of ongoing monitoring of on-farm practices in consultation with the **IRG**. A register of all chemicals applied on farms in the Development area will be maintained as described in the Chemicals Management Sub-plan. They will also be used to determine site-specific trigger values, once baseline surveys are complete, in consultation with the **IRG**.

[illegible]

Data collected during 2010/2011 (Bennett & George 2011) and modelling (GHD 2011a) currently indicates that the simulated proportion of stormwater or discharged groundwater from the Project Area at the onset of the dry season is typically less than 1% of the volume of the pools and upper estuary. This is due to dilution and flushing by final wet season flow events and tidal activity, and that groundwater discharge will cease while there remains sufficient flushing and dilution capacity in the Keep River pool system (GHD 2011a). As a result, the water quality at the onset of the dry season (following stormwater or groundwater discharge from the development) is predicted to be equal to or less than the low river flow trigger values and is therefore unlikely to affect Matters of National Environmental Significance.

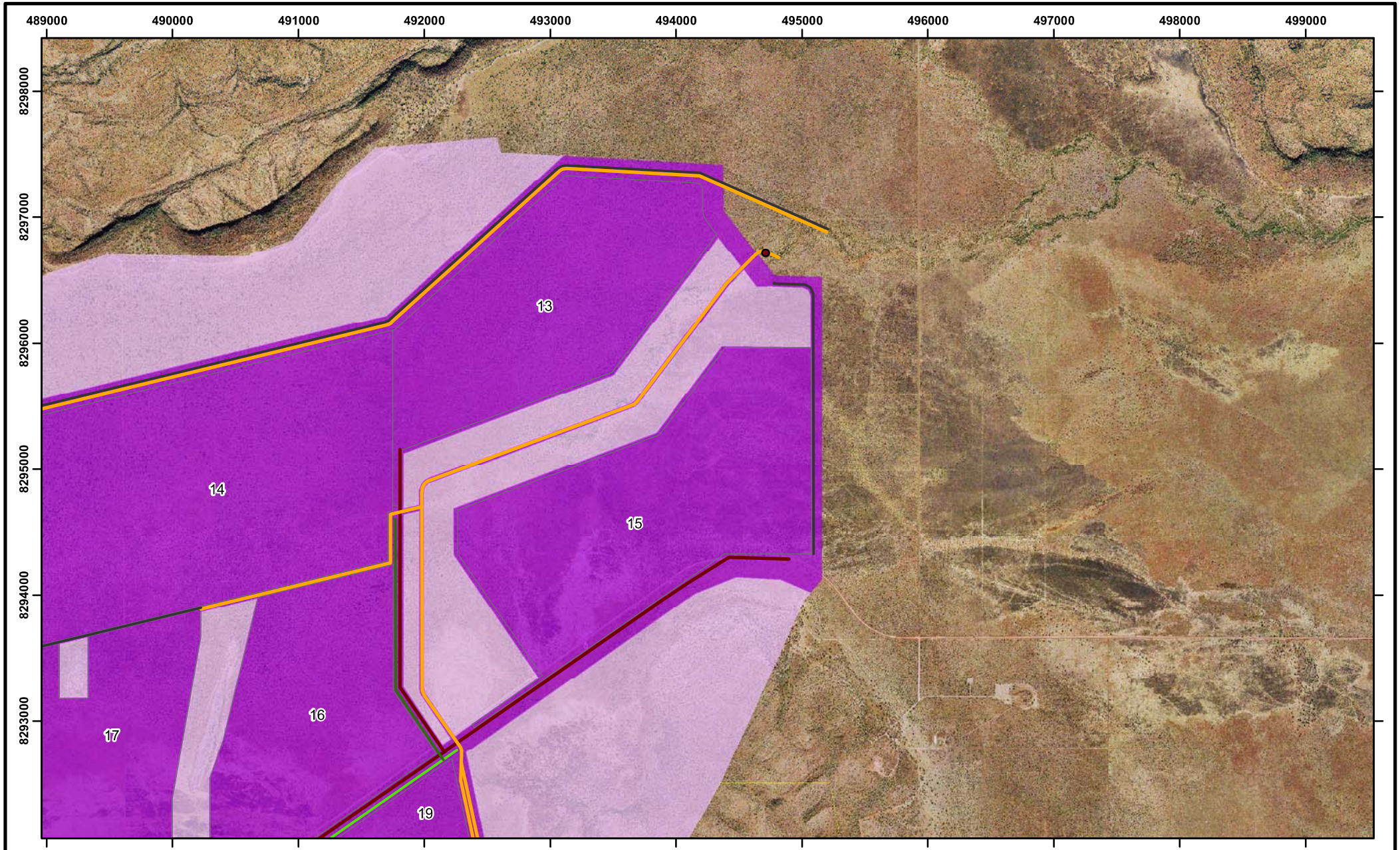
Current modelling indicates that a flow volume of approximately 3 GL will be required to completely flush the Keep River pool system. The flushing volume will be used to determine when groundwater discharge can occur and to manage stormwater discharge through the release of M2 channel supply water into the Keep River, if required. The flushing volume will be reviewed following results from ongoing monitoring, baseline water quality monitoring of the Border Creek and Keep River system as well as the ongoing water quality monitoring at the stormwater outlet and groundwater discharge pipeline to ensure that low flow site-specific trigger values are able to be met (GHD 2011a).

Stormwater discharge from the Project Area is anticipated to cease before the Keep River flow falls below that required to adequately flush the pools (GHD 2011a). However, if flow rates are not sufficient to flush remaining stormwater runoff from the Project Area, an intensive water quality sampling program will commence immediately downstream of the stormwater discharge to determine whether nutrient concentrations within pools K1 – K3 and the Keep Estuary are above natural upstream conditions. In the event that the sampling program indicates concentrations are above baseline conditions, corrective actions listed in Table 4 will be implemented, such as releasing good quality irrigation water from the Project Area to flush the system. The tailwater retention and re-use system may also be used to manage runoff from irrigation areas at the end of the wet season while sufficient storage capacity remains in the system.

This information together with flow monitoring data from the stormwater outlet, Border Creek and Keep River will be used in conjunction with the OSWM to continuously forecast the water quality in the Keep River and inform groundwater discharge management, and the requirement for any contingency measures. Flood protection levees have also been designed to limit flooding at the stormwater outlet gauging station to provide accurate flow and water quality data, which is a modification of the original design (Figure 2).

The OSWM will be developed as the primary operational tool to inform and manage water quality monitoring of discharge; retention and release of stormwater retained on farms; surplus groundwater release; and, the implementation of mitigation measures and contingency actions. The OSWM will use historic and real time data, forecasts and operational rules to predict water quality downstream of the Project Area and will be updated on a seasonal basis. A decision flow chart to manage discharges is presented in Figure 3.

Management and monitoring of potential impacts to the K4 pool as a result of increased baseflow due to the development are discussed in the GMP and Aquatic Fauna Management Plan.



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Scale
0 250 500
Meters

N

Figure 2 Indicative stormwater gauging station, flood protection levee and drain

Coordinate System: GDA 1994 MGA Zone 52
Date: 12/04/2012
Author: jcrute

Scale: 1:40,000 at A4
Source: Geoscience Australia 2006. Weaber Plain Project Design: McMullenNolan 07/12/2011 and 03/04/2012. GHD 14/06/2011.

Note that positional errors may occur in some areas

Legend

- Gauging station
- Drain
- Flood protection levee
- Weaber Plain Development Area
- Weaber Plain Buffer Area

Path: Q:\GIS\Consult\2010\LAN\LAN10119\Discharge_MP\ArcMap Documents\RevO\LAN10119_Stormwater_Groundwater_DMP_RevO_F002.mxd

Table 2 Physico-chemical and biological indicators for stormwater and groundwater discharge

Indicator[1]	Physico-chemical and biological indicators							
	Border Creek (high rainfall)	Border Creek (Low rainfall)	Keep River (High rainfall)	K4 (Low rainfall)	K3 (Low rainfall)	K2 (Low rainfall)	K1 (Low rainfall)	Keep Estuary (Low rainfall)
Flow/level	M2 discharge rules TBA	M2 discharge rules TBA	M2 discharge rules TBA	M2 discharge rules TBA	M2 discharge rules TBA	M2 discharge rules TBA	M2 discharge rules TBA	M2 discharge rules TBA
Salinity (TDS/EC)^	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	N/A
pH	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile
Temp*	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile
TN (mg/L)^[2]	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile
NH_3 or NH_4	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile
NO_3	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile
NO_2	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile
TP (mg/L)^[2]	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile
FRP (SRP)	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile	80th percentile
SPM (TSS)	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile
TURBIDITY*	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile
DO*	20th percentile	20th percentile	20th percentile	20th percentile	20th percentile	20th percentile	20th percentile	20th percentile
DOC*	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile	20/80th percentile
Metals*	99% ANZECC	99% ANZECC	99% ANZECC	99% ANZECC	99% ANZECC	99% ANZECC	99% ANZECC	99% ANZECC
Atrazine*[2]	99% ANZECC	99% ANZECC	99% ANZECC	99% ANZECC	99% ANZECC	99% ANZECC	99% ANZECC	99% ANZECC
Sediment analysis*	Revised ANZECC	Revised ANZECC	Revised ANZECC	Revised ANZECC	Revised ANZECC	Revised ANZECC	Revised ANZECC	Revised ANZECC
Early detection indicator#	99% ANZECC or 20/80 percentile	99% ANZECC or 20/80 percentile	99% ANZECC or 20/80 percentile	99% ANZECC or 20/80 percentile	99% ANZECC or 20/80 percentile	99% ANZECC or 20/80 percentile	99% ANZECC or 20/80 percentile	99% ANZECC or 20/80 percentile
Biodiversity indicators[Ψ]	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA
RBA indicator [Ψ]	TBA	TBA	TBA	TBA	TBA	TBA	TBA	TBA

Source: Bennett & George 2011

* <2 years duration of monthly data will be available.

appropriate physico-chemical indicator may be determined after data analysis at end of data collection period.

[Ψ] indicators to be defined at conclusion of three year baseline monitoring period.

[1] list was based on available water quality data and will be updated annually based on ongoing monitoring and on-farm practices.

[2] In the 12 years of monitoring the D4 drain, the only chemicals and nutrients recorded above the detection limits were total nitrogen (TN), total phosphorous (TP), endosulfan and atrazine. Of these chemicals, endosulfan has now been banned and will not be utilised in the Project Area, and the median and 80[th] percentile concentrations of atrazine were significantly below the ANZECC & ARMCANZ (2000) 99% species protection level.

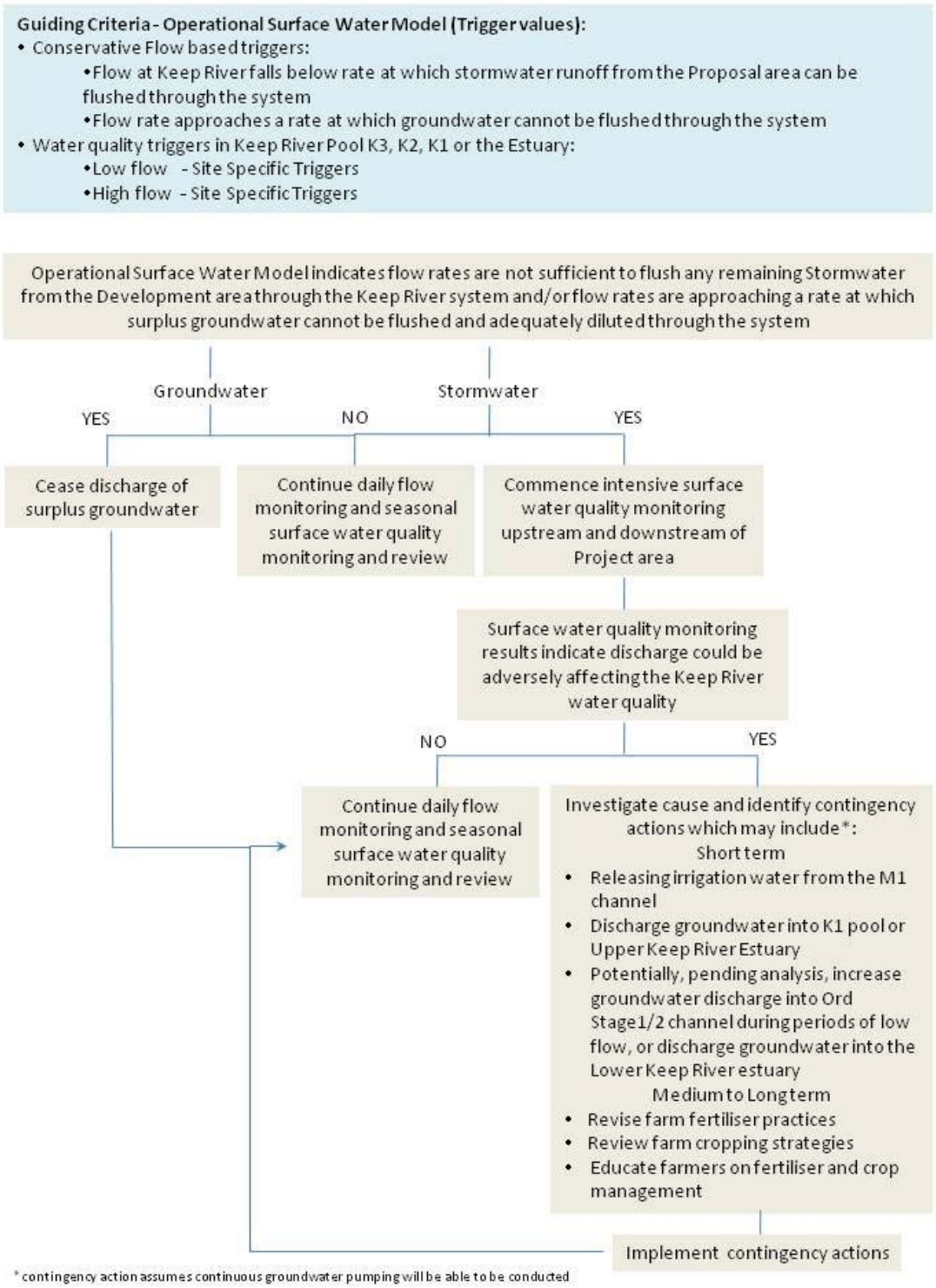

Figure 3 Decision flow chart for the management of stormwater and surplus groundwater discharge

2. Management

[illegible] Environmental aspects to be managed

The following broad environmental aspects of the development could potentially affect Border Creek and Keep River water quality:

- **discharge of stormwater** from Project Area to Border Creek
- **discharge of surplus groundwater** from Project Area to the Keep River.

2.2 Objectives

The environmental objective of this plan and the implementation of other related plans is to ensure changes to the water quantity and quality regime within the Border Creek – Keep River system does not adversely affect the downstream environment, which supports EPBC listed species, specifically:

- the critically endangered speartooth shark (G*lyphis glyphis*)
- the endangered northern river shark (*Glyphis garricki)*
- the vulnerable dwarf sawfish (*Pristis clavata*)
- the vulnerable freshwater sawfish (*Pristis microdon).*

Specific monitoring and mitigation measures have been developed to ensure the achievement of this management objective (see Section 2.3).

2.3 Management actions

The following management actions (required by conditions of approval) have commenced and/or have already been completed, contributing to the current knowledge of the Keep River and potential management of discharge:

- development of a refined groundwater model for the Weaber Plain and utilisation of the model to run a number of development and management scenarios determined with guidance and feedback from a Technical Review Group (TRG) (KBR 2011)
- detailed water quality and aquatic fauna sampling of the downstream receiving environment (Border Creek and Keep River) (Bennett & George 2011; WRM 2011)
- Keep River Catchment: River and Hydrodynamic modelling (GHD 2011a)
- hydrological regime of the Border Creek and Keep River System (GHD 2011b)
- Ord Stage 2 M2 Area Hydrodynamic Studies (KBR 2006).

Additional and ongoing groundwater management actions that will be implemented are outlined in Table 3.

The Proponent and farmers are responsible for implementation of particular elements of the proposal relevant to Statement 830 and all the elements of the conditions attached to the approval under the EPBC Act. The Proponent has the responsibility for ensuring selected elements of the construction stage and all elements of the operational stage of the proposal (once proponency for these elements are transferred to it) are implemented in accordance with the environmental obligations under Statement 830 and Commonwealth Approval EPBC 2010/5491.

Table 3 Stormwater and groundwater discharge management actions

Item	Action	Purpose	Timing	Responsibility
Groundwater Management Plan				
1.	Implement the Groundwater Management Plan.	To manage groundwater to minimise impact to receiving environment.	Ongoing	Proponent
Farm tailwater management				
2.	Construct a tailwater retention area on each farm lot sufficient to retain stormwater runoff during the periods most critical (low flow periods) to the Keep River system.	Capacity to manage runoff to avoid transporting chemicals downstream.	Prior to commencement of irrigation of each farm lot	Farm owners/ managers, Proponent
3.	Include tailwater diversion infrastructure in farm tailwater system to transfer on-farm stormwater to on-farm irrigation channels.	Capacity to manage runoff to avoid transporting chemicals downstream.	Prior to commencement of planting of crops	Farm owners/ managers
4.	No usage of chemicals and fertilisers when the tailwater retention capacity is unavailable.	To prevent the transporting of nutrients and chemicals downstream.	During operation of the action	Farm owners/ managers
Education and erosion protection measures (as per Surface Water Management Sub-plan and Soil Management Sub-plan				
5.	Provide an Information Package to prospective landowners, which: • outlines the susceptibility of soil to erosion from high intensity rainfall during the wet season • encourages maintenance of crop cover during the wet season to reduce soil erosion • outlines optimal irrigation strategies to reduce potential impacts of sodicity and salinity • includes information regarding identification of salinity and sodicity and mechanisms to report this to the Proponent.	To minimise the potential for agricultural practices to result in erosion by ensuring prospective landowners are aware of the risks and appropriate management measures.	At sale of land	Proponent
6.	Install erosion protection measures along Border Creek downstream of the drainage discharge points.	To prevent increased sedimentation in Border Creek.	Prior to the commencement of construction	Proponent
Water quality and hydrodynamics				
7.	Implement a baseline monitoring water quality and hydrology in Border Creek, the Keep River estuary and the four Keep River pools (K4, K3, K2 and K1) in accordance with ANZECC guidelines in consultation with the IRG.	To establish baseline conditions and determine site-specific trigger values.	Prior to commencement of irrigation and prior to the release of stormwater from operational farms	Proponent
8.	Adopt ANZECC guidelines trigger values for a 'high conservation/ecological value system' until site-specific trigger values for the Keep River pools and estuary are determined, in accordance with ANZECC guidelines and requirements of the IRG.	To manage the discharge of stormwater and surplus groundwater to protect the downstream environment and EPBC listed species.	Prior to commencement of irrigation	Proponent
9.	Determine best practice multivariate analyses on species level macroinvertebrate and fish assemblage data, in consultation with the IRG.	As above	As above	Proponent

Item	Action	Purpose	Timing	Responsibility
10.	Establish and update annually, a list of key analytes (chemicals and nutrients) to be sampled, based on-farm practices as part of ongoing water quality monitoring in consultation with DAFWA, DoW and the IRG.	To ensure key chemicals and nutrients are included in water quality monitoring.	Prior to commencement of planting of crops, then ongoing annually	Proponent
11.	Install a water quality and flow gauging station capable of sampling, on a flow proportional basis (at least sub-daily when required) at the stormwater outlet from the Development Area.	To determine flow rate from the Project Area to inform management.	Prior to commencement of planting of crops	Proponent
12.	Monitor water quality (as listed in Table 3, Item 10) at the stormwater outlet from the Development Area, in consultation with DAFWA, DoW and DEC.	To determine salinity and nutrient contribution from the Project Area to inform management.	On a flow proportional basis (with the ability to sample sub-daily as required)	Proponent
13.	Ensure the flow gauging stations at Border Creek and the Keep River have the required accuracy to measure low flow rates in consultation with the Northern Territory NRETAS and IRG.	To provide flow data to manage the discharge of stormwater and surplus groundwater.	Prior to commencement of planting of crops	Proponent
14.	Monitor water flow at the stormwater outlet from the Development Area, Border Creek and the Keep River, determined in consultation with IRG, DAFWA, DoW and DEC.	To preserve and protect the water quality of the Keep river and EPBC listed species, prevent erosion of the banks of the Keep River and provide maximum mixing potential.	During operation of the action	Proponent
Discharge infrastructure and program				
15.	Develop and implement an adaptive groundwater and stormwater discharge program that addresses: • design and location of dewatering infrastructure • design and location of discharge infrastructure • discharge rates, rules and contingency actions • monitoring locations and requirements including infrastructure and setup • written evidence of any Northern Territory Government permits that are required for discharge of groundwater • management measures that ensure discharge of water will not impact on water quality in Border Creek/Keep River; this includes erosion protection measures.	To provide information for adaptive management of the discharge of stormwater and surplus groundwater.	During operation of the action and prior to the commencement of stormwater and groundwater discharge from operational farms	Proponent
16.	Locate discharge point for surplus groundwater in the K1 Pool or downstream of the Keep River estuary where discharge will not cause erosion, and with consideration of ebb tides, and in consultation with the IRG.	To preserve and protect the water quality of the Keep River, prevent erosion of the banks of the Keep River as a result of the Proposal and provide maximum mixing potential.	Prior to any requirement to discharge to the Keep River system	Proponent
17.	Provide a framework of an Operational Surface Water Model to DoTE.	To prevent the exceedance of site-specific trigger values for water quality in the Border Creek and Keep River.	Prior to commencement of irrigation	Proponent

Item	Action	Purpose	Timing	Responsibility
18.	Provide to DoTE a full Operational Surface Water Model that incorporates the outcomes of Table 3, Item 2, 9, 15 and 21, and the requirements of Table 4.	To prevent the exceedance of site specific trigger values for water quality in the Border Creek and Keep River.	Within the first 12 months of the commencement of irrigation and updated seasonally thereafter	Proponent
19.	Refine the discharge dilution model/relationship based on river flow monitoring data and water quality history from the Ord Stage 1 D4 drain and available water quality data from the Keep River system.	To determine when flow rates at Border Creek and the Keep River fall below a minimum flow rate to enable flushing.	Prior to commencement of irrigation	Proponent
20.	Refine the discharge dilution model/relationship based on flow monitoring data from the Development Area and the Keep River system and water quality characteristics of stormwater from the Development Area.	To determine when flow rates at the Keep River fall below a minimum flow rate to enable flushing.	During operation of the action on a seasonal basis, commencing 12 months after commencement of irrigation	Proponent
21.	Refine flow trigger values for the Keep River and Border Creek gauging station based on the refined discharge dilution model and Operational Surface Water Model.	To determine when flow rates at Border Creek and the Keep River fall below a minimum flow rate to enable flushing.	During operation	Proponent

2.4 Monitoring regime, targets and corrective actions

The proposed monitoring regime includes activities to be performed throughout the life of the project; should water quality triggers be exceeded at the pools or estuary, corrective action/s will be undertaken (Table 4). The monitoring regime will be further refined in the years prior to commencement of farming operations to ensure discharge from the Proposal does not adversely affect native flora and native fauna habitat (particularly EPBC listed species).

Table 4 Discharge monitoring regime and corrective actions

Item	Activity and location	Frequency	Target	Corrective action	Responsibility
1.	Telemetered flow monitoring at development gauge, existing gauging stations along Border Creek and the Keep River and in groundwater discharge pipe.	Continuous (hourly) flow monitoring when stormwater or groundwater discharge occurs.	No discharge of surplus groundwater to the Keep River unless there is sufficient threshold natural flow. No significant impact on the health of aquatic ecosystems from stormwater and surplus groundwater.	1. Investigate cause. This could include examining management practices and identifying instances where water may have been unnecessarily discharged during low flow periods. 2. Conduct an intensive water quality sampling program (of analytes determined in Table 2, Item 10) upstream and downstream of the discharge point. 3. Immediately initiate processes to identify whether remedial action is required, in consultation with the IRG. Remedial actions could include: • releasing irrigation water from the M2 channel into Border Creek • increasing groundwater pumping into the Ord Stage 1 or 2 supply channel during periods of low river flow • installing additional erosion protection • educating farm owners/managers • revision of management practices (including groundwater discharge rules). 4. Implement remedial action/s. 5. Monitor success of remedial action/s quarterly for a period of 12 months 6. Report on any findings as a result of monitoring in accordance with Section 2.5.	Proponent

Item	Activity and location	Frequency	Target	Corrective action	Responsibility
2.	Conduct water quality monitoring (as listed in Table 2, Item 10, 12, 14) at the stormwater outlet and groundwater pipeline from the Development Area.	Automated flow proportional sampling (with sub-daily capability) at stormwater outlet in the Development area. Monthly at the groundwater discharge pipeline (when discharge occurs) and during dry season in Keep River.	Levels in discharge are unlikely to cause exceedance of water quality triggers in Keep River pools or estuary.	As guided by outputs from the OSWM: 1. Initiate intensive water quality sampling program upstream and downstream of discharge point (of analytes determined in Table 2, Item 10) 2. Immediately investigate cause by reviewing management practices and determining whether water quality has deteriorated as a result of discharge from the Development area. 3. Identify remedial action required in consultation with the IRG. Remedial actions could include: • releasing irrigation water from the M2 channel into Border Creek • increasing groundwater pumping into the Ord Stage 1 or 2 supply channel during periods of low river flow • installing additional erosion protection • educating farm owners/managers • revision of management practices (including groundwater discharge rules). 4. Implement remedial action/s. 5. Monitor success of remedial action/s quarterly for 12 months. 6. Report on any findings in Annual Environmental Report (AER) as a result of monitoring in accordance with Section 2.5.	Proponent – Superintendent (once established)
3.	Aquatic ecology monitoring (including aquatic invertebrates and fish) in the Keep River pools (K1, K2, K3 and K4) and threatened aquatic ecology monitoring (this includes the Speartooth shark [Glyphis glyphis], Northern river shark [Glyphis garricki], Dwarf Sawfish *Pristis clavata* and *Pristis Microdon*) at three sites in the Keep River estuary (EST1, EST2, EST3). Monitoring to be supported by concurrent sampling at five control / reference locations to differentiate natural changes from those potentially resulting from the action (as listed in Table 7 of the Aquatic Fauna Management Plan).	Annually in the late dry season from the commencement of the action. Initially for three years to establish a baseline, and then for a further three years post-development. If there is no detectable effect on any of the species included in the aquatic monitoring program, then frequency is reduced to three-yearly, or in response to known events that may result in exceedances of site-specific trigger values for water quality Keep River.	No detrimental change in the macroinvertebrate or fish assemblage composition that is caused by the action. This can be resulting from stormwater, surplus groundwater and groundwater seepage increases, as compared against reference sites that reflect natural variability in ecosystem health.	1. Immediately investigate cause over a period of at least12 months through reviewing management practices and determining whether ecological health of aquatic fauna has deteriorated. 2. Identify remedial action required. Remedial actions could include: • releasing irrigation water from the M2 channel in Border Creek • increasing the pumping rates of the eastern bores to reduce groundwater seepage • increasing groundwater pumping into the Ord Stage 1 or 2 supply channel during periods of low river flow • potentially, pending analysis, discharging groundwater into the lower Keep River estuary • installing additional erosion protection • educating farm owners/managers • revision of management practices (including groundwater discharge rules) • review flow monitoring data. 3. Implement remedial action/s, as required, immediately or at a time determined with the IRG to be appropriate. 4. Monitor success of remedial action/s at least quarterly for 12months. 5. Report on any findings in Annual Environmental Report (AER) as a result of monitoring in accordance with Section 2.5.	Proponent

[illegible] Performance reporting

Performance reporting of this Stormwater and Groundwater Discharge Management Plan will be implemented consistent with the reporting requirements set out in the Ord River Irrigation Area – Weaber Plain Development Project Environmental Management Plan (DSD 2013).Audit

Consistent with Condition 19 of the EPBC approval, an independent audit of compliance with conditions will be conducted and the resultant report will be submitted to the Australian Government Minister.

Where there is an exceedance in trigger levels or any non conformances this will be reported to the Australian Government Department of the Environment (DotE) and the **IRG** in the first instance, from where further action and reporting will commence.

3. Review and revision

Consistent with the Ord EMP, the Stormwater and Groundwater Discharge Management Plan will be revised as required based on assessment of monitoring results and assessment of performance, which may include updating the dilution and flushing characteristics, sampling frequency and water quality parameters sampled.

Construction personnel will be notified of revisions to the plan at a site briefing or using other suitable methods as required. In addition, the Proponent will ensure that adaptive improvement of the plan occurs in response to environmental incident resolutions, audit findings, monitoring results, and changes in regulatory requirements.

The Department of Agriculture and Food (DAFWA), Department of Environment Regulation (DER), Department of Water (DoW) and the **IRG** will be advised of any changes to the management actions and will be provided with the revised Stormwater and Groundwater Discharge Management Plan as required. Major changes as determined by the Proponent or the **IRG** will be undertaken only in consultation with DAFWA, DER, DoW; **IRG** and submitted to DotE for approval based on the advice of these agencies.

In accordance with Condition 15 of the approval (EPBC 2010/5491) if the proponent wishes to carry out any activity not in accordance with any of the management plans as specified in the conditions, the person taking the action must submit to the Department for the Minister's written approval a revised version of that management plan. The varied activity shall not commence until the Minster has approved the varied management plan in writing.

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Strategen 2011c, *Ord River Irrigation Area – Weaber Plain Development Project: Gouldian Finch Management Plan*, unpublished report prepared for LandCorp, November 2011.

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