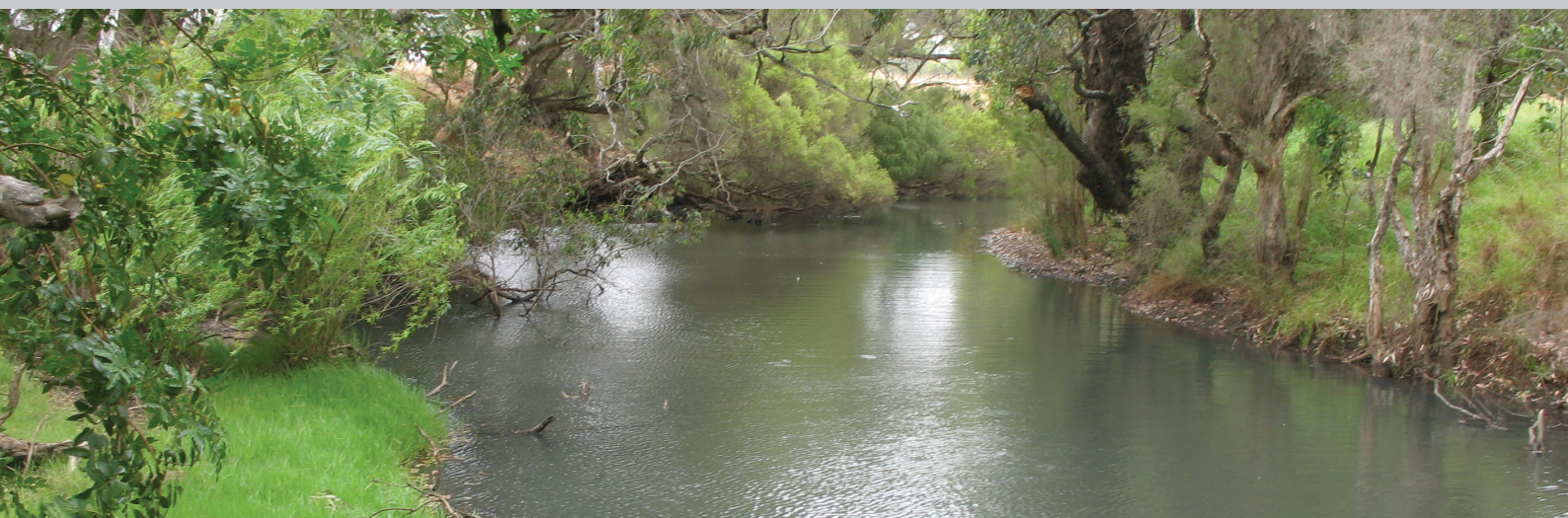




Government of **Western Australia**
Department of **Water and Environmental Regulation**



Managing releases for the Serpentine River

Serpentine River allocation statement

Managing releases for the Serpentine River

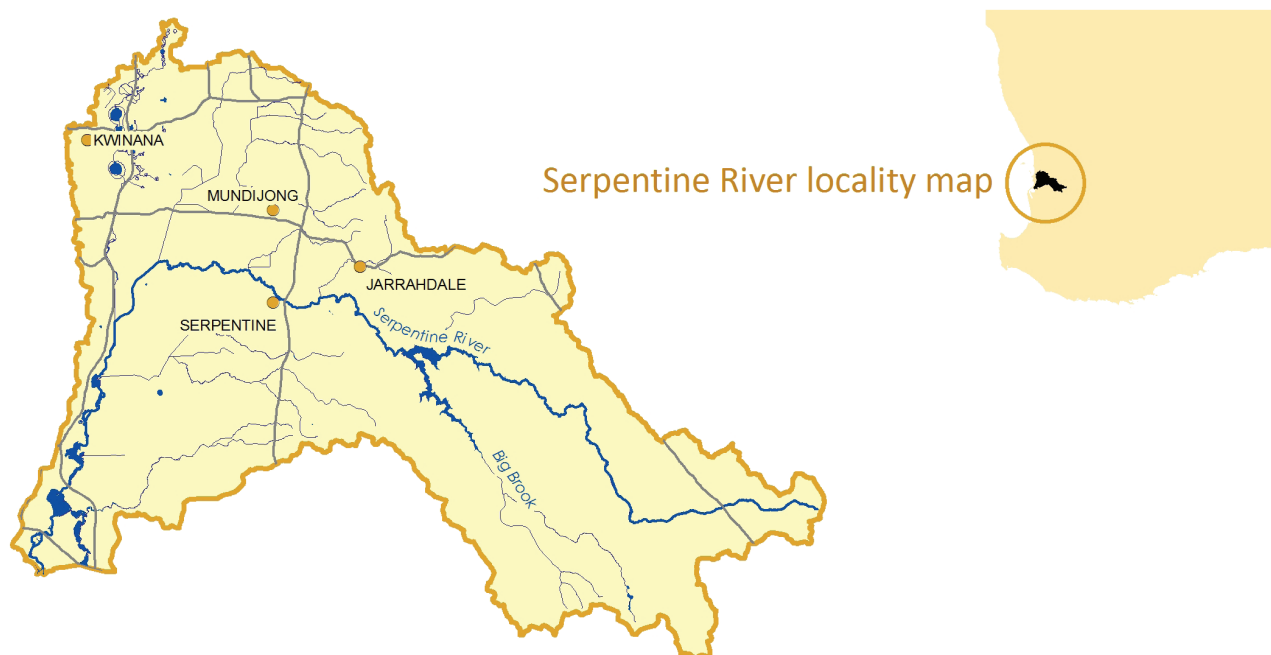
The Serpentine Main and Serpentine Pipehead dams, are part of the Integrated Water Supply Scheme (IWSS) operated by Water Corporation. They are two of 15 dams, built since the 1920s. They provide water not only for Perth, but also for areas of the south-west, wheatbelt and goldfields.

The drying climate across the south west of the state has meant that since the 1970s, the volume of water flowing into the dams annually has fallen on average by about 60 per cent. The dams now provide a smaller proportion of water for the IWSS and less is available for downstream releases between October and June.

On 1 July 2017, the Department of Water and Environmental Regulation was established which amalgamated three departments including the former Department of Water, the Department of Environment Regulation and the Office of the Environmental Protection Authority. Releases into the Serpentine River have been occurring since the dams were constructed. In 2010, in response to increasingly low dam inflows and the need to more precisely manage valuable scheme supplies, the former Department of Water began trialling reduced release volumes and implemented consistent rules across all IWSS dams. The department continued to talk with downstream users during and after changes were introduced as adjustments were made in response to feedback and river monitoring.

The Department of Water and Environmental Regulation has now revised when and how much water is released from IWSS dams. The new approach achieves a balance between continuing supply to the IWSS and protecting downstream water users and water-dependent environments.

This allocation statement outlines the new release arrangements for the Serpentine River between Serpentine Falls and Lowlands gauging station. Releases are based on current and projected future rainfall, dam inflows, river ecology, social and cultural values of the system, and an understanding of supply needs for agriculture and domestic use. A detailed methods document will be available from the department's website (Review of release outcomes and regimes for Integrated Water Supply Scheme dams in the south-west - supporting information and methods, DWER in prep).





Serpentine Falls

Serpentine Main and Serpentine Pipehead dams

The dams, both constructed in 1961, capture and store water from the Serpentine River catchment. Water is transferred into the Pipehead Dam from other IWSS dams including the Serpentine Main Dam, and from Water Corporation's southern seawater desalination plant in Binningup.

Water from the dams is used to supply scheme water to both Mandurah and Perth. Some water is released over the summer from two release points located in trunk mains below the Pipehead Dam to provide downstream flows. One release point is located above Serpentine Falls, in Serpentine National Park, and the other is located on the Swan Coastal Plain at Halls Road. Downstream of Serpentine Falls, the river runs through rural land and the Department of Biodiversity, Conservation and Attractions Lowlands Conservation Reserve. It flows through Lake Amarillo and Goegrup Lake before discharging into the Peel Harvey Estuary. The releases support the riverine environment which is important for aquatic ecology, local amenity and social reasons. Releases also provide some water for people with a licence to abstract water.

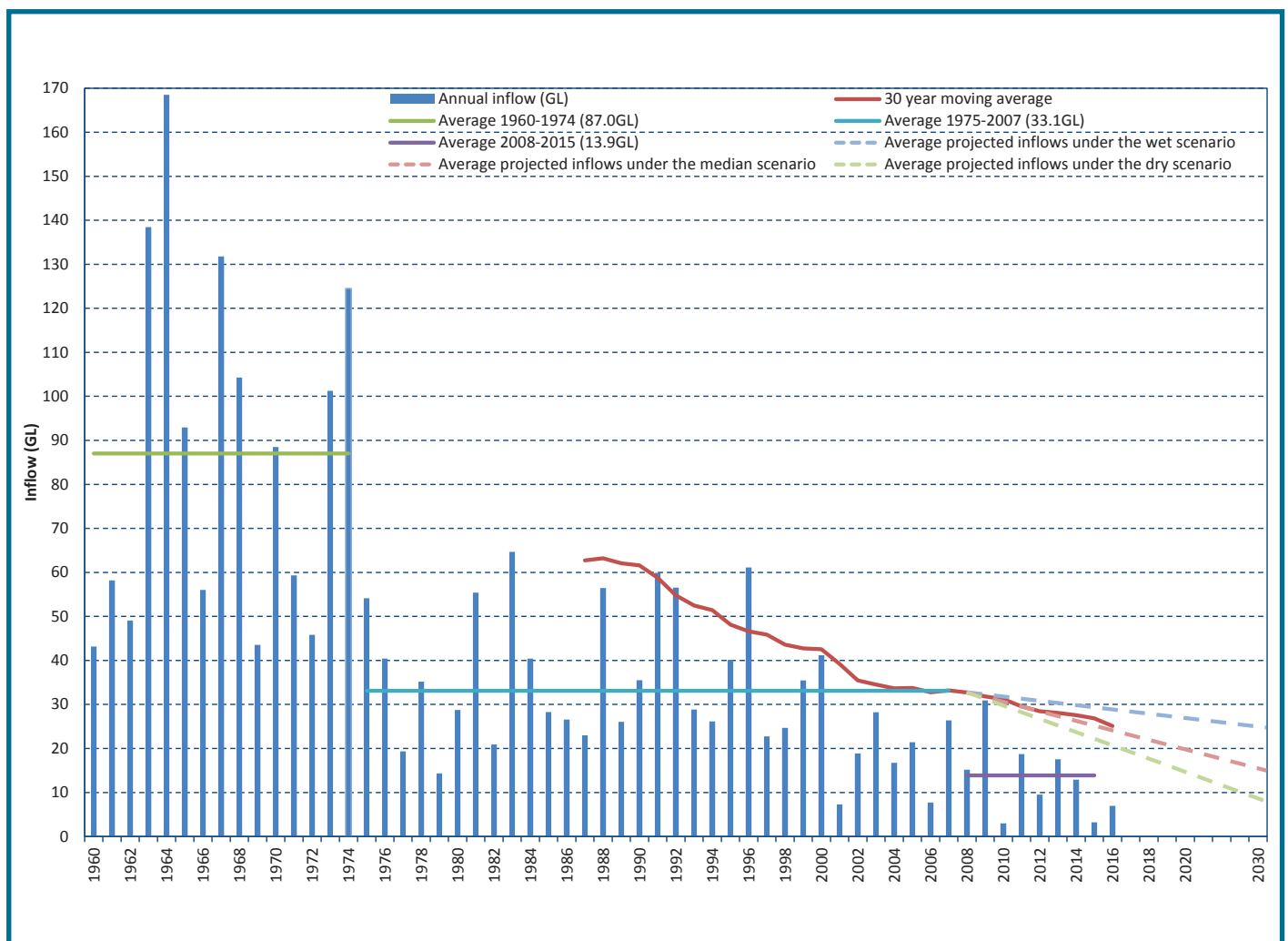
How has declining rainfall affected dam inflow and streamflow?

Average rainfall at the Bureau of Meteorology's Karnet site (1035 mm/year) for the period 2008 to 2015 has declined by 10 per cent in comparison to the 1975 to 2007 average (1144 mm/year). This has resulted in a 58 per cent reduction in inflows to the dams (figure below). For comparison, prior to the mid-70s it was common to see flows of 100 or 140 GL/year, however in the past decade combined dam inflows have rarely been above 20 GL/year.

2015 saw record low inflows of 11.4 GL across all the IWSS dams with combined inflows into the two Serpentine dams of 1.7 GL. The 2016 inflows were a slight improvement on the previous few years. On top of this annual variation, as the climate dries, we can expect years of zero or close to zero inflow to the dams. Evaporation rates are also expected to increase.

Since construction of the dams, the downstream flow regime has changed significantly, mainly due to the presence of the dams. Reduced local flows from lower rainfall in the downstream catchment along with falling groundwater levels have also contributed.

During summer, some areas further downstream on the Swan Coastal Plain continued to flow due to groundwater contributions. Hydrological monitoring and onsite investigations suggest that this groundwater discharge zone is moving towards the west, so we will continue to see less contributions to flow from groundwater in the areas influenced by releases.



Inflows into Serpentine Main Dam (1960-2016) (provided by Water Corporation). Projected average future inflows under each climate scenario for the period 2008-2030 are also shown (provided by CSIRO and the Department of Water and Environmental Regulation).

What do we expect dam inflow to be in the future?

The south-west of Western Australia is one of the few areas in the world where all the global climate models predict that the climate will continue to dry into the future. Those locations at similar latitudes, on the western side of a land mass, in the southern hemisphere all show the same sort of expected future climate change patterns. To understand how dams will be affected by changes in rainfall and run-off, the department has used CSIRO projections (*South-west Western Australia sustainable yields project*, CSIRO 2009) to estimate future dam inflows. CSIRO produced three future climate scenarios ('wet', 'median' and 'dry' for the period 2008 to 2030) combining 45 international climate models to provide a range of possible future climates. The figure above shows this range of estimated future inflows.

Under a 'median' climate scenario, the CSIRO model estimates a 45 per cent reduction in future inflows from the 1975 to 2007 average. Even the 'wet' scenario is drier than the 1975 to 2007 average. If the 'dry' scenario eventuates we could see a 70 per cent reduction in inflows and more years of zero or near-zero inflow into the dams. Similar reductions in inflows are estimated for the other IWSS dams on the Darling Scarp.

With further declines in inflow projected, the department will continue to take an adaptive approach to water sharing. This means we will continue to monitor rainfall and inflows and review release arrangements if necessary. We will also continue to consult with stakeholders about their water needs and, where possible, assist with identifying alternative water sources.

The value of water in the Serpentine River

Part of trialling and refining release arrangements for the Serpentine River was identifying the values that depend on the presence of water in and released from the release points. Water stored in the dams is a valuable public water supply commodity. When it is released it also provides an important supply option for local users, maintains important aesthetic and social values for the community and ensures the protection of riverine and aquatic habitats.

Values relating to the presence of water in and below the Serpentine dams were assessed in comparison to other dammed rivers on the Darling Scarp. The detailed assessment can be found in the supporting methods document (DWER in prep.).

Public water supply

Water stored in dams, including the two dams on the Serpentine River, is a critical component of maintaining supply to around two million people through Water Corporation's IWSS. While other sources such as groundwater and desalination make up most of the supply, the dams are still very important.

Since 2010, water from inflows into the Serpentine dams alone has serviced approximately 4300 households each year. Serpentine Pipehead Dam is a key dam for the IWSS. It is used to store water from other dams and desalinated water for later use. It also provides supply to meet base load and peak demand.

Downstream water users

There are 31 licences to take 610 375 kL/yr. Water is used for dairy farms, pasture, perennial horticulture, orchards and stock and domestic purposes. Some properties also have access to alternative sources like groundwater and rainwater tanks. Scheme supply is not available in this area.

Water is also available to take during the winter months if landholders have the appropriate storage infrastructure.



Downstream ecological and social values

Releases are intended to ensure that the Serpentine River remains a functioning riverine system. An important indicator of this is the diversity and abundance of aquatic and water-dependent species. Survey work carried out in 2014 shows that the diversity of native fish and crayfish was good with six out of seven expected species being present in moderate abundances. The less common Swan River goby and cobbler are also present.

A river condition assessment found that stretches of river are in good condition. Parts of the reach run through Serpentine National Park and Lowlands Conservation Reserve, which is a conservation category wetland. In these parts, the riparian vegetation is intact with a high proportion of native species.

Riparian vegetation provides habitat for aquatic and land biota and provides river shading. Where riparian zones are fenced and stock access is controlled, reaches are in better condition than where the reach runs through agricultural land, which generally had only a narrow strip of riparian vegetation separating the cleared land from the river. There was also a high proportion of exotic species present in the understorey. The condition of the riparian fringe reflects the impacts of surrounding land use on the river. There was a lot of erosion along the river and bank stability was poor.

The survey also found there were a few deeper pools along the river with good instream habitat, although silt accumulation in some pools was high. The pools provide essential refuge for fish and crayfish over summer. Releases are important in maintaining water quality, water level and habitat area in these pools.

The Serpentine River also supports local recreational, education and aesthetic values. Serpentine Falls is used for recreation activities by the local community and visitors from other areas. The river also runs past the properties of many local people to whom it has lifestyle and aesthetic values and provides a sense of place.

Improving the health of the Peel Harvey Estuary is a focus of the department led Regional Estuaries Initiative www.rei.dwer.wa.gov.au. River releases are not expected to reach the Peel-Harvey Estuary, so would not be a means to improve its water quality.

Comparison with other systems

A qualitative comparison suggests the Serpentine River is comparatively higher in the values assessed than most of other river systems on the scarp. Systems assessed as higher value are in better condition, have a greater diversity and abundance of native fish and crayfish species, have significant social values such as tourist precincts or waterfalls, or provide water for licensed productive use. Releases are made to protect the values that exist in the river. Critical to this is maintaining river pools over summer to provide refuge for aquatic fauna and support a functioning and aesthetically pleasing riverine system.

How water will be released into the Serpentine River

The new release arrangements balance water for public water supply with the downstream values and their associated water requirements.

To account for the drying climate and to ensure we are making the most of every drop of water stored in the dams, inflows are categorised and releases adjusted so less water is released when the inflows are low. The amount of water released over summer will depend on whether inflows represent a 'standard' or a 'low-inflow' year. We use the total inflow into all IWSS dams as the trigger for determining the release category because the dams are a connected system and water is often moved from dam to dam. The pattern of releases is flexible and can vary from year to year dependent on flow and temperature. The table on the next page provides the detailed release arrangements.

Our objectives for the new release arrangements are to:

- Provide for an average volume of water in the dams to 2020 from inflow only of between 8600 ML/year and 24 800 ML/year depending on future climate.
- Provide an average release volume to 2020 of 860 ML/year in 'standard' years and 800 ML/year in 'low-inflow' years.
- Meet licensed downstream user requirements frequently in a 'standard' year and most of the time in a 'low-inflow' year. There are also limited properties with a riparian right (due to the presence of river reserves). Users may have access to groundwater as an alternative source.
- Provide refuge for native aquatic species over the summer months by maintaining connectivity and water quality in pools down to and including the Lowlands Conservation Reserve, frequently in a 'standard' year and most of the time in a 'low-inflow' year.
- Meet social requirements most of the time in all years.

Release arrangements for the Serpentine River below Serpentine Falls in 'standard' and 'low-inflow' years

Triggers	Standard year	Low-inflow year
Has it been a standard year or a low-inflow year The summer release arrangements are based on the proceeding winter inflow into all IWSS dams.	Inflow into dams: between 1 May and 31 October is ≥ 30 GL.	Inflow into dams: between 1 May and 31 October is < 30 GL.
When and how are releases turned on Releases are turned on/up from 1 October based on: - flows measured by the department at Lowlands gauging station (AWRC ref. 614114) - departmental field visits to Halls Road (AWRC ref. 614117), Rapids Road (AWRC ref. 614116) and Lowlands East (AWRC ref. 6141797).	Releases will be turned: - on at 1.5 ML/day when flow at Lowlands gauging station falls below 2 ML/day and/or flows at Halls Rd fall below 2 ML/day - up by increments of 0.25 ML/day at each release point if flows at Halls Rd are, < 0.5 ML/day and/or Lowlands East are < 0.75 ML/day, up to a maximum of 5 ML/day - up to 5 ML/day on 20 December, unless done so earlier.	Releases will be turned: - on at 1 ML/day when flow at Lowlands gauging station falls below 1 ML/day and/or flows at Halls Rd fall below 1 ML/day - up by increments of 0.25 ML/day at each release point if flows at Halls Rd are, < 0.25 ML/day and/or Lowlands East are < 0.5 ML/day, up to a maximum of 4 ML/day - up to 4 ML/day on 20 December, unless done so earlier.
What will happen if a number of days of hot weather are forecast Between 1 December and 31 March releases can be turned up for up to seven days if hot weather is forecast at Mandurah Bureau of Meteorology (BoM) station (no. 9977). No more than two hot weather release events per month.	If BoM forecasts five consecutive days of temperatures $> 30^{\circ}\text{C}$ releases can be turned up to a maximum of 5.5 ML/day.	If BoM forecasts five consecutive days of temperatures $> 30^{\circ}\text{C}$ releases can be turned up to a maximum of 4.5 ML/day.
How and when are releases turned down and off Releases are turned off for winter/spring. Between 1 October and 1 May flows may be turned down dependent on flows measured at Halls Road and Lowlands East staff gauges. From 1 April, releases are turned down and then off based on rainfall recorded at Karnet BoM station (no. 9111).	Releases are turned: - down if flows at Halls Road are > 0.5 ML/day and/or Lowlands East are > 1.5 ML/day - down to 3 ML/day when 60 mm of cumulative rainfall is received after 1 April if 60 mm of cumulative rainfall is not received in April, releases will be reduced to 3 ML/day on 1 May - off when 60 mm of cumulative rainfall is received after 1 May. If 60 mm of cumulative rainfall is not received in May, releases will be turned off on 31 May.	Releases are turned: - down if flows at Halls Road are > 0.5 ML/day and/or Lowlands East are > 1 ML/day - down to 2 ML/day when 60 mm of cumulative rainfall is received after 1 April if 60 mm cumulative rainfall is not received in April, releases will be reduced to 2 ML/day on 1 May - off when 60 mm of cumulative rainfall is received after 1 May. If 60 mm of cumulative rainfall is not received in May, releases will be turned off on 31 May.

Triggers	Standard year	Low-inflow year
When and how pulse releases are made for the environment following a dry start to winter - up to June 30?. At any point between the time releases are turned off and 30 June we can make a release for a short period to top up pools. This is based on rainfall recorded at Karnet BoM station and streamflow at Halls Road, Rapids Road and Lowlands East.	If there are no events of daily rainfall ≥ 30 mm at Karnet for 14 days, and/or a field visit confirms that flows at Halls Road, Rapids Road and Lowlands East are low, releases up to 4 ML/day can be made for a period of up to seven days dependent on BoM's weekly rainfall forecast for Mandurah.	

NB The release volume breakdown between Serpentine Falls and Halls Road is dependent on flows measured at Halls Road and Lowlands East.

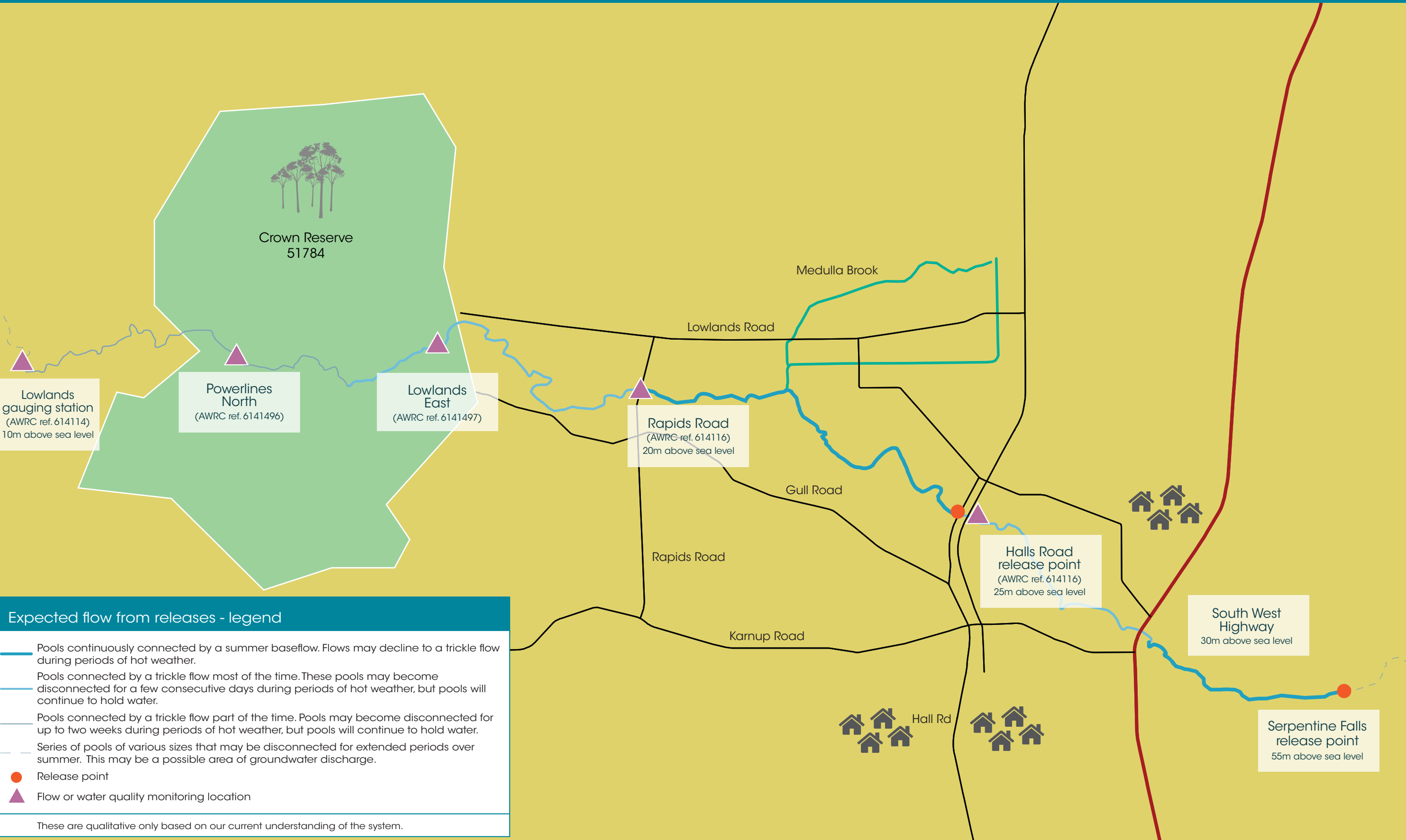
How will releases be adjusted?

Release requirements are set out in the Water Resource Management Operating Strategy associated with the Water Corporation's licence for the Serpentine dams. The Department of Water and Environmental Regulation monitors streamflow, temperature and rainfall regularly. To make changes to the releases we use an established process of contacting Water Corporation and requesting that releases be adjusted in accordance with the specified release arrangements for each situation.

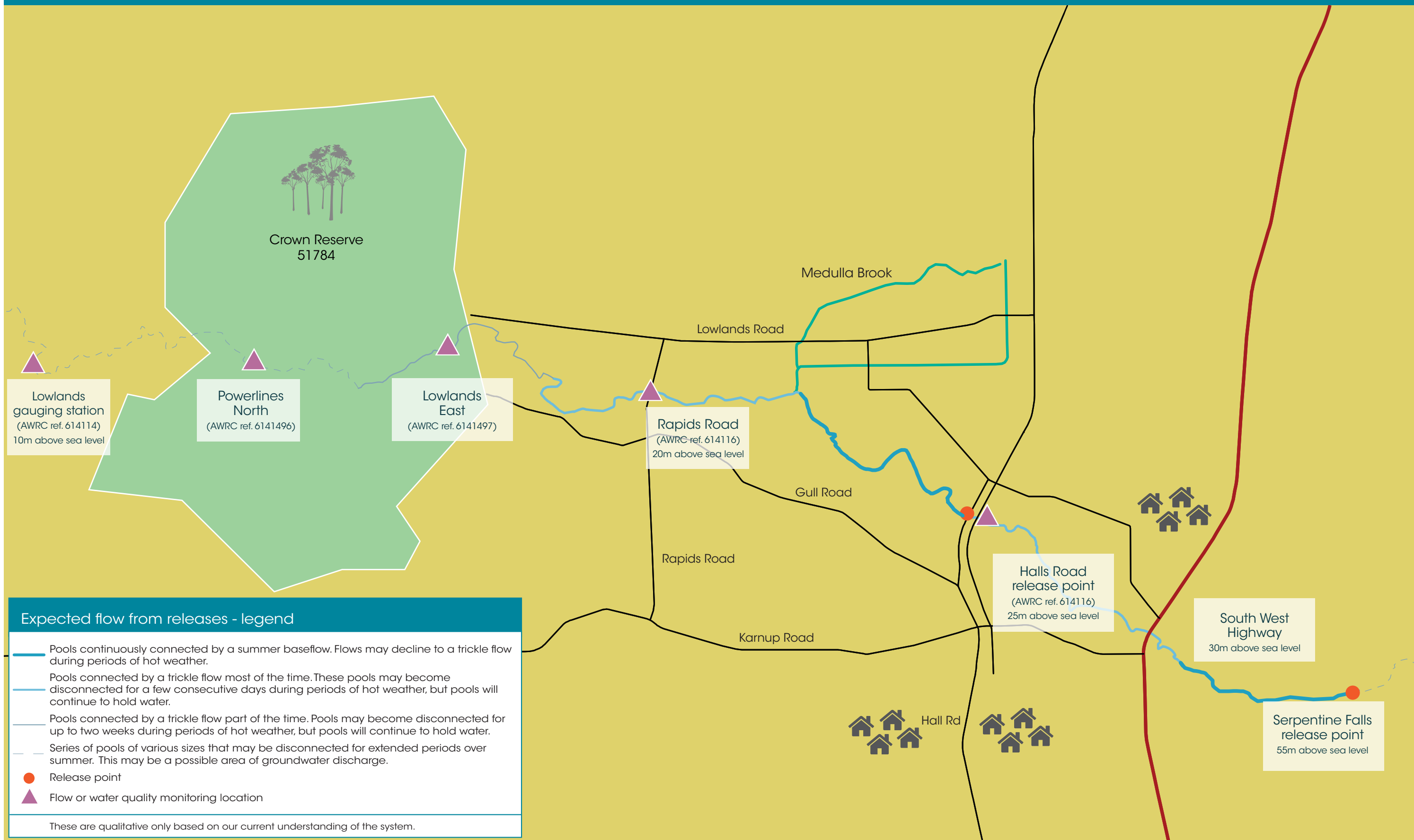
What the flow regime means for the river

Using hydrological data we can estimate the extent of flows in the river when the new release arrangements are implemented for both 'standard' and the 'low-inflow' years. The expected flows are indicative and based on our current hydrological understanding of the system. The actual flows may vary from year to year because flows can be affected significantly by periods of high temperature, declining groundwater levels, abstraction from the river or groundwater and Water Corporation undertaking maintenance on the dams or the trunkmains containing the release points. This means the releases do not guarantee 100 per cent reliability of supply over the summer months.

Expected summer flows in the river when 'standard' year release arrangements are being implemented



Expected summer flows in the river when 'low-inflow' year release arrangements are being implemented





Serpentine River

Monitoring

Monitoring sites at Halls Road, Rapids Road and Lowlands East are used to measure flow in the river. Releases are adjusted accordingly, where applicable. The department also regularly monitors water quality, including dissolved oxygen, pH, temperature and salinity to assess the health of river pools during summer. Every three years, as required through the operating strategy associated with its water licence, Water Corporation samples fish, crayfish species and water quality in the river to determine if species richness and abundance are being maintained. The department is also working with the Department of Biodiversity, Conservation and Attractions in the Lowlands Conservation Reserve to map pools and monitor water quality.

The future

Release arrangements will apply from the present until they are reviewed again in 2020. During this time, the Department of Water and Environmental Regulation will annually evaluate the flow regime at Halls Road, Rapids Road and Lowlands East and communicate with stakeholders.

With seasonal variation and the likelihood of more and more dry years into the future, the new release arrangements may not always achieve 100 per cent reliability of supply over the summer months. Over time landholders will need to consider further developing reliable alternative water sources to meet their water needs.

Further information

Please contact our Kwinana Peel office for further information on 08 9550 4222 or through our website www.dwer.wa.gov.au.

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ISBN online 978-1-925524-44-4