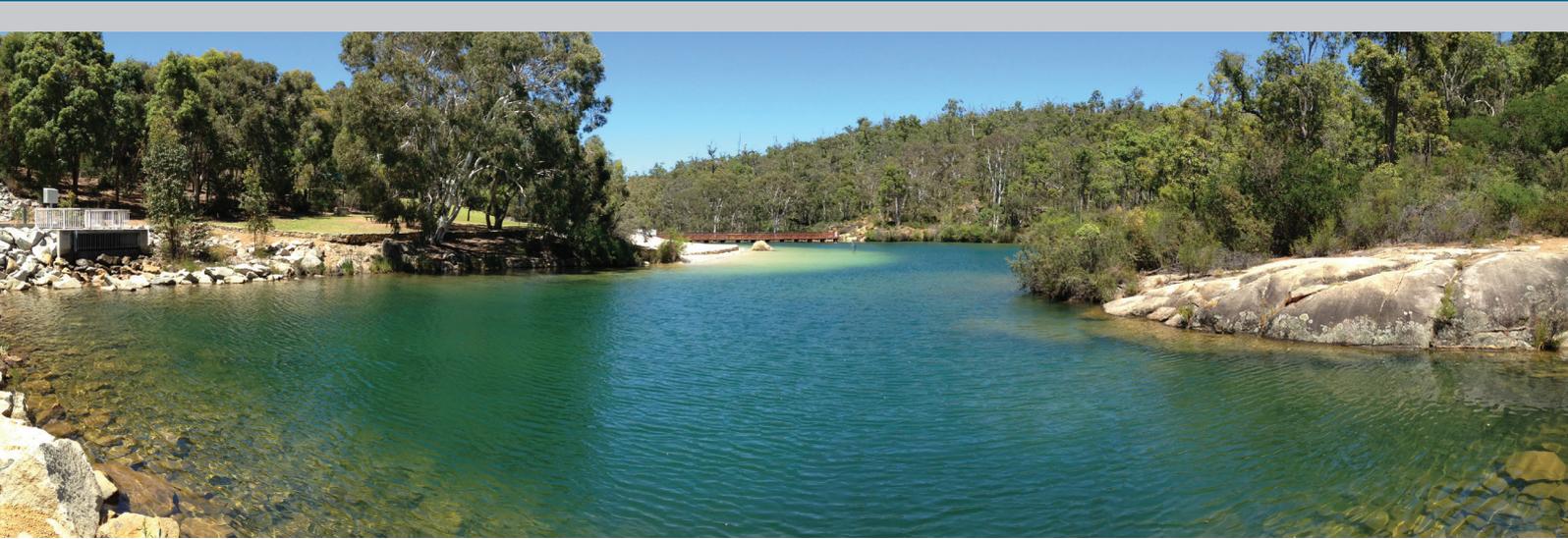




Government of **Western Australia**
Department of **Water and Environmental Regulation**



Managing releases from the North Dandalup Dam

North Dandalup allocation statement

Integrated Water Supply Scheme release review
Department of Water and Environmental Regulation
November 2017

Managing releases from the North Dandalup Dam

The North Dandalup Dam is part of Perth's Integrated Water Supply Scheme (IWSS) operated by Water Corporation. It is one of 15 dams built since the 1920s. The dams provide water not only for Perth, but also for areas of the south-west, wheatbelt and goldfields.

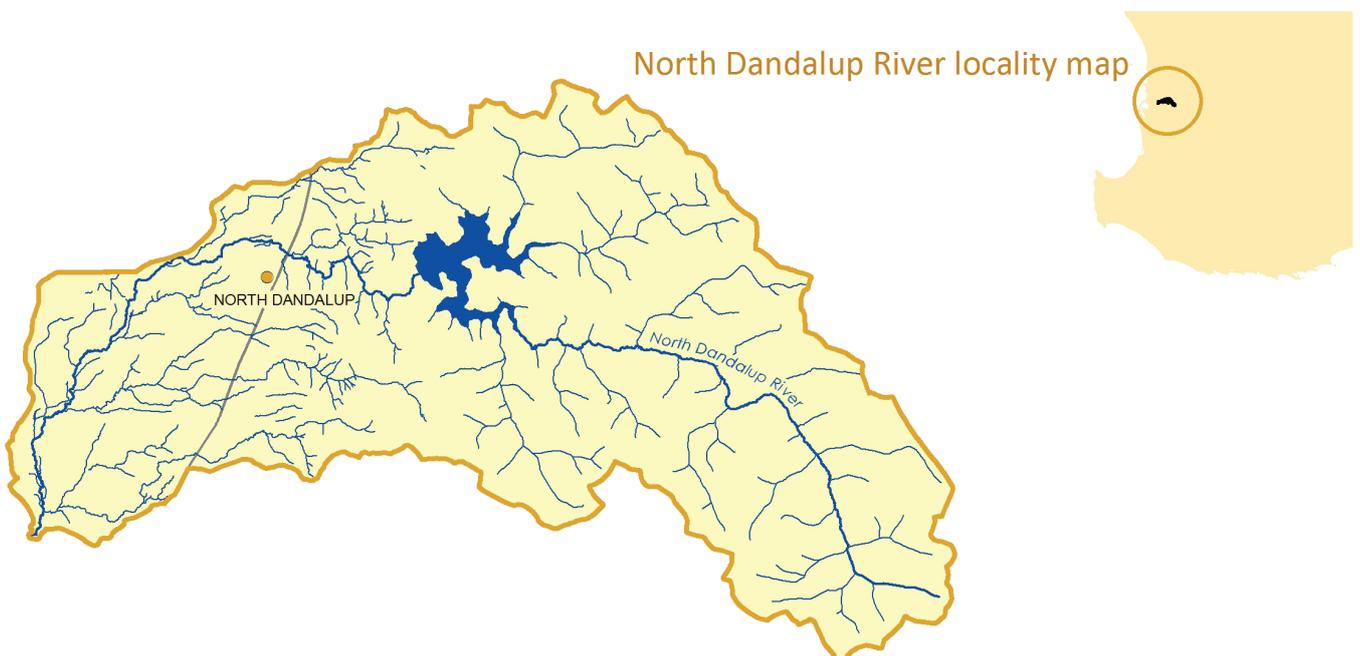
The drying climate across the south west of the state has meant that since the 1970s, the volume of water flowing into the dams annually has fallen on average by about 60 per cent. The dams now provide a smaller proportion of water for the IWSS and less is available for downstream releases between October 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 from the North Dandalup Dam have been made since its construction. In 2010, in response to increasingly low dam inflows and the need to precisely manage valuable scheme supplies, the former Department of Water began trialling reduced release volumes and implemented consistent rules across all IWSS dams. The former Department of Water continued to talk with downstream users while the changes were introduced, and through the intervening years as we made adjustments 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 North Dandalup River below the dam. 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 arrangements for Integrated Water Supply Scheme dams in the south-west - supporting information and methods, DWER in prep).

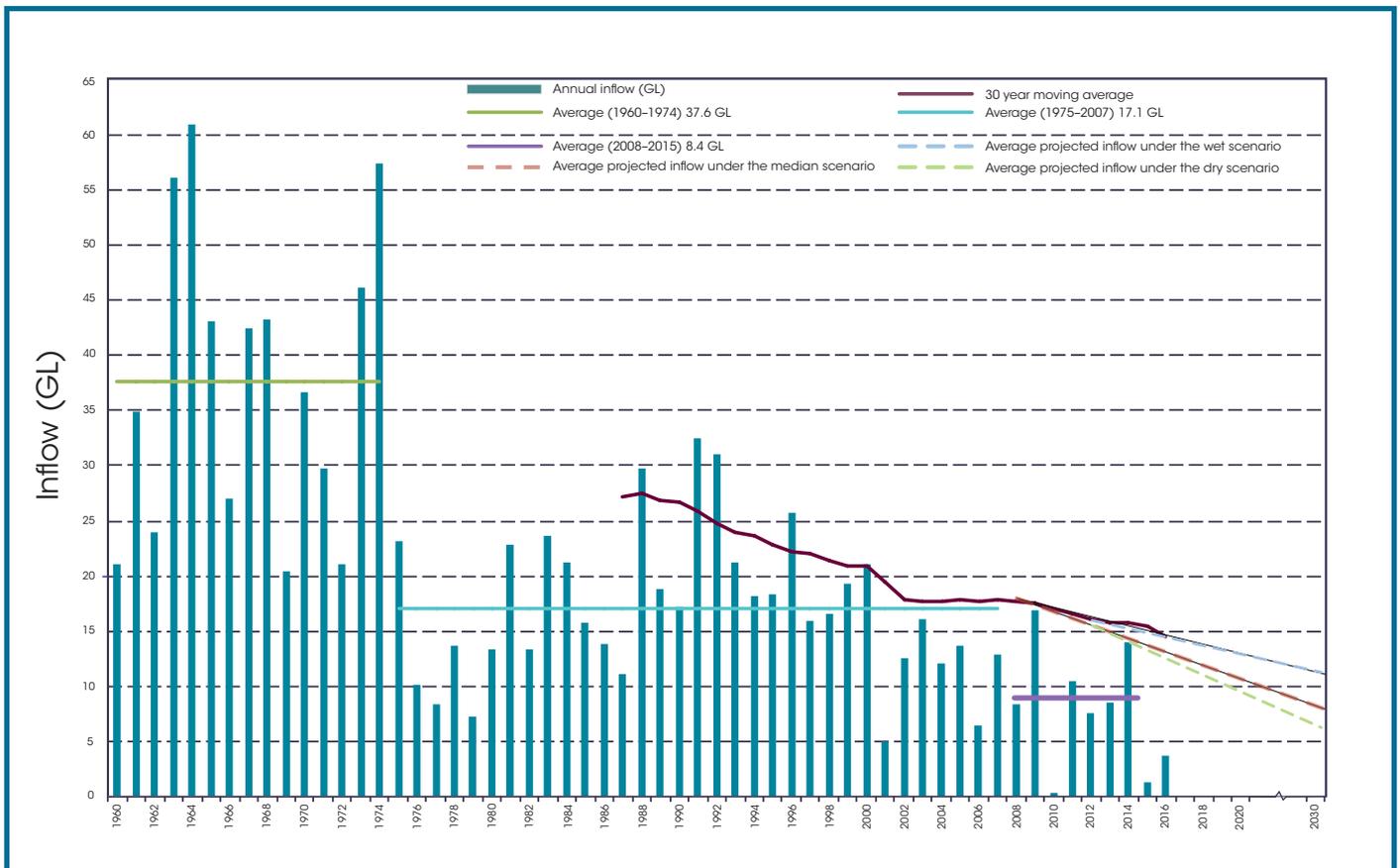
North Dandalup River locality map



North Dandalup Dam

The North Dandalup Dam, constructed in 1994, captures and stores water from the North Dandalup River catchment. The catchment is relatively small in comparison to the other IWSS dams, covering only 153 km². Water is also transferred into the dam from other IWSS dams and from Water Corporation’s southern seawater desalination plant in Binningup.

Water from the dam is used to supply scheme water to both Mandurah and Perth and some water is released over the summer to provide downstream flows. The North Dandalup River runs through rural land before joining the South Dandalup River and eventually discharging into the Peel Harvey Estuary. The releases support the riverine environment, which is important for the local community and provide water for opportunistic stock and domestic use.



Annual and average streamflow in the North Dandalup River (1960–1994) and dam inflows (1994–2016) 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).

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 51 per cent reduction in flow in the North Dandalup River and inflows into the dam. For comparison, prior to the mid-70s it was common to see flows of 50 or 60 GL/year, however in the past decade dam inflows have rarely been above 10 GL/year.

Record low inflows were seen in 2015 of 11.4 GL across all the IWSS dams with inflow into North Dandalup Dam of 1.3 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 North Dandalup Dam, the downstream flow regime has changed significantly, mainly due to the presence of the dam. Reduced local flows from lower rainfall in the downstream catchment along with falling groundwater levels have also contributed.

Before the dam was constructed, the river ceased to flow at the base of the Darling Scarp 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.

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 on the previous page shows this range of estimated future average inflows.

Under the 'median' climate scenario, the CSIRO model estimates a 36 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 58 per cent reduction in inflows and more years of zero or near-zero inflow into the dam. 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 North Dandalup River

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

Values relating to the presence of water in and below North Dandalup Dam 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 North Dandalup Dam, 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 North Dandalup Dam alone has serviced approximately 2800 households each year. North Dandalup Dam is also used for storing desalinated water for later use. It is particularly effective for this as it is narrow and deep and therefore has the lowest reservoir surface area and evaporation rate.

Downstream water users

The former Department of Water carried out a water use survey in early 2016. The survey showed that most users downstream of the dam only take small volumes of water from the river and have access to alternative sources like groundwater, rainwater tanks, and in some cases, scheme supply. Volumes used are estimated at between 15 000 and 20 000 kL/year which represents less than five per cent of the total released from the dam. Unlike most other IWSS dams there is no licensed use from the river below the dam. This is because North Dandalup was the last IWSS dam built and the effects of drying climate on water security were already being understood when it was constructed.

Water is not released from the dam over winter, and natural flows are available for take during the winter months if landholders have authorised access and appropriate storage infrastructure.



North Dandalup downstream of Lakes Road

Downstream ecological and social values

Releases from the dam are intended to ensure the North Dandalup River remains a functioning riverine system. An important indicator of this is the diversity and abundance of aquatic and other water-dependent species. Survey work carried out in 2012 showed that the diversity of native fish and crayfish was good with four out of the five expected species being present, although abundance for all species was generally low.

Riparian vegetation provides shading for important instream habitat such as river pools. A river condition assessment found that stretches of river where riparian zones are fenced and stock access is controlled are in better condition. Most riparian vegetation along the North Dandalup River was generally in poor condition. There was a high proportion of exotic species and only a narrow strip of vegetation separating cleared agricultural land from the river. The condition of the riparian fringe reflects the impacts of surrounding land use on the river with large amounts of erosion along the river and poor bank stability.

The survey also found there were a few deeper pools along the river. These pools provide essential refuge for fish and crayfish over summer. Releases are important in maintaining water quality, water level and habitat area in the pools.

The North Dandalup River also supports local recreational, educational and aesthetic values. The recreational pool directly below the North Dandalup Dam is used by the local community and visitors. Local schools use the river for teaching science and investigating water quality, and the river 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. Releases from the dam are not expected to reach the Peel-Harvey Estuary, so would not be a means to improve its water quality. Even the maximum release that could be made from the dam infrastructure would only increase the amount of water reaching the estuary by 0.15 per cent - assuming no losses to evaporation, pumping or seepage.

Comparison with other systems

A qualitative comparison suggests the North Dandalup River is not as high in the values assessed as most other river systems on the scarp. However, water is still required to protect the values that do 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.



Looking upstream at South Western Highway gauging station

How water will be released from the North Dandalup Dam

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 dam, 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 '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 an average volume of water in the dam to 2020 (from inflow only) of between 5100 ML/year and 11 000 ML/year depending on future climate.
- Provide an average release volume to 2020 of 510 ML/year in 'standard' years and 460 ML/year in 'low-inflow' years.
- Meet authorised downstream user requirements most of the time in a 'standard' year and part of the time in a 'low-inflow' year.
- Provide refuge for native aquatic species over the summer months by maintaining connectivity and water quality in pools to Lakes Road, most of the time in a 'standard' year and part of the time in a 'low-inflow' year.
- Meet social requirements most of the time in all years.

Release arrangements for the North Dandalup River in 'standard' and 'low-inflow' years

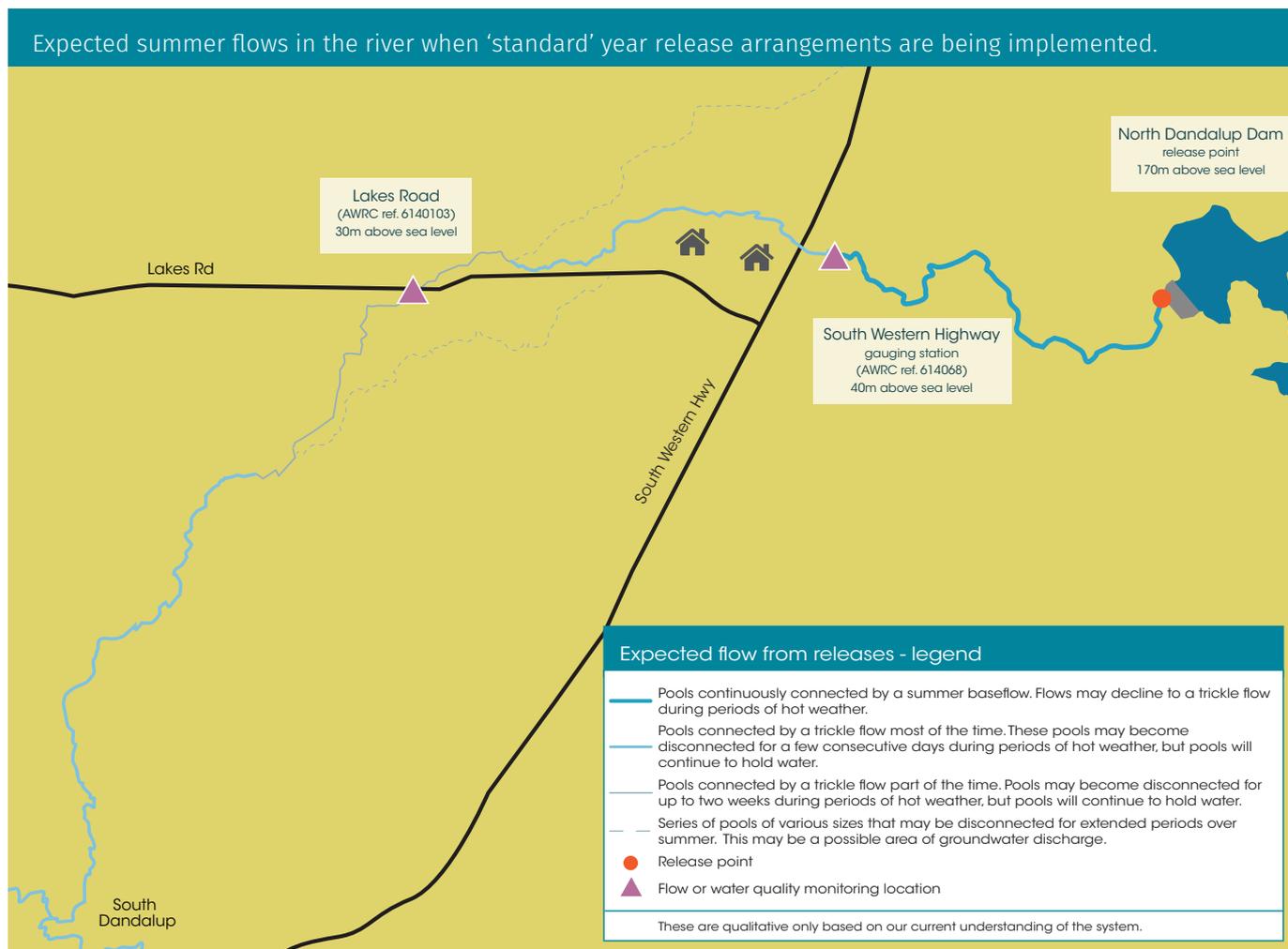
Triggers	Standard year	Low-inflow year
<p>Has it been a standard year or a low-inflow year</p> <p>The summer release arrangements are based on the proceeding winter inflow into all IWSS dams.</p>	<p>Inflow into dams:</p> <ul style="list-style-type: none"> between 1 May and 31 October is ≥ 30 GL. 	<p>Inflow into dams:</p> <ul style="list-style-type: none"> between 1 May and 31 October is < 30 GL.
<p>When and how are releases turned on and up</p> <p>Releases are turned on based on flows measured by the department at Lakes Road from 1 October onwards.</p> <p>Releases are turned up depending on flow at Lakes Rd or on 20 December if not already done so.</p>	<p>Releases will be turned:</p> <ul style="list-style-type: none"> on at 1 ML/day when flow is < 0.75 ML/day at Lakes Road up in increments of 0.5 ML/day to a maximum of 2.5 ML/day if flow at Lakes Road falls below 0.5 ML/day up to 2.5 ML/day on 20 December unless done so earlier. 	<p>Releases will be turned:</p> <ul style="list-style-type: none"> on at 1 ML/day when flow is < 0.75 ML/day at Lakes Road up in increments of 0.5 ML/day to a maximum of 2 ML/day if flow at Lakes Road falls below 0.5 ML/day up to 2 ML/day on 20 December unless done so earlier.
<p>What will happen if a number of days of hot weather are forecast</p> <p>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.</p>	<p>If BoM forecasts five consecutive days of temperatures $> 30^{\circ}\text{C}$ releases can be turned up to a maximum of 3 ML/day. If flow at Lakes Road is > 1.5 ML/day releases will not be turned up.</p>	<p>If BoM forecasts five consecutive days of temperatures $> 30^{\circ}\text{C}$ releases can be turned up to a maximum of 2.5 ML/day. If flow at Lakes Road is > 1.5 ML/day releases will not be turned up.</p>
<p>How and when are releases turned down and off</p> <p>Releases are turned off for winter/spring. Between 1 October and 1 May flows may be turned down dependent on flows measured at Lakes Road staff gauge.</p> <p>From 1 April, releases are turned down and then off based on rainfall recorded at Karnet BoM station (no. 9111).</p>	<p>Releases are turned:</p> <ul style="list-style-type: none"> down at intervals of 0.5 ML/day if mean daily flow measured at Lakes Road staff gauge is > 1.5 ML/day down to 2 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 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. 	<p>Releases are turned:</p> <ul style="list-style-type: none"> down at intervals of 0.5 ML/day if mean daily flow measured at Lakes Road staff gauge is > 1.5 ML/day down to 1.5 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 1.5 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.
<p>When and how pulse releases are made for the environment following a dry start to winter - up to June 30</p> <p>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 Lakes Road.</p>	<p>If there are no events of daily rainfall ≥ 30 mm at Karnet for 14 days, and flows at Lakes Road are < 0.5 ML/day, releases of 2 ML/day can be made for a period of up to seven days dependent on BoM's weekly rainfall forecast for Mandurah.</p>	

How will releases be adjusted?

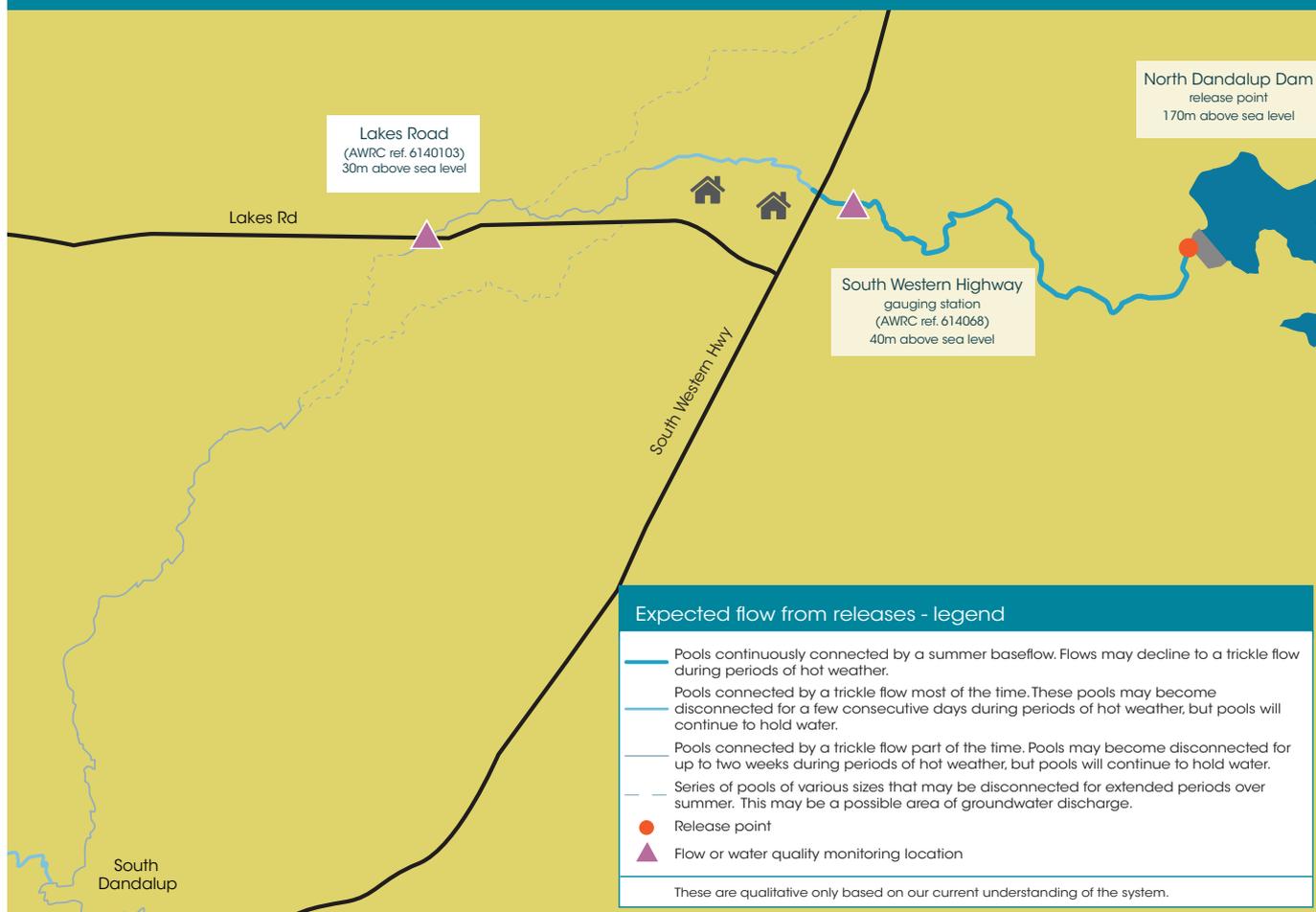
Release requirements are set out in the Water Resource Management Operating Strategy associated with the Water Corporation's licence for North Dandalup Dam. The Department of Water and Environmental Regulation monitors streamflow, temperature and rainfall regularly. To make changes to the releases we use an established process of contacting the 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 '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 dam maintenance by Water Corporation. This means the releases do not guarantee 100 per cent reliability of supply over the summer months. From time to time Water Corporation may also make releases of higher volumes to freshen the recreational pool below the dam.



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



Monitoring

The Lakes Road flow monitoring site is used to measure flow in the river. In late 2015, a telemetered gauging station was installed where the river crosses South Western Highway. Over the next couple of years the department will use this site to remotely monitor flow and manage releases.

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 and water quality in the river to determine if species richness and abundance are being maintained.

The future

Release arrangements will apply from the present until they are reviewed again in 2020. Up until this time, the Department of Water and Environmental Regulation will annually evaluate the flow regime at Lakes Road and the South Western Highway 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 landowners 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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