Follow-up to Lake Jualbup proposals

Key environmental Topics / Restoring seal / Three more myths / Wetland Statistics. Updated October 2015.

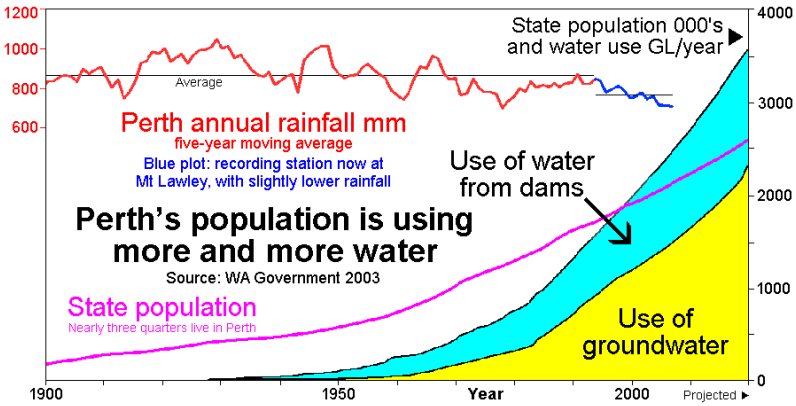
Key environmental topics

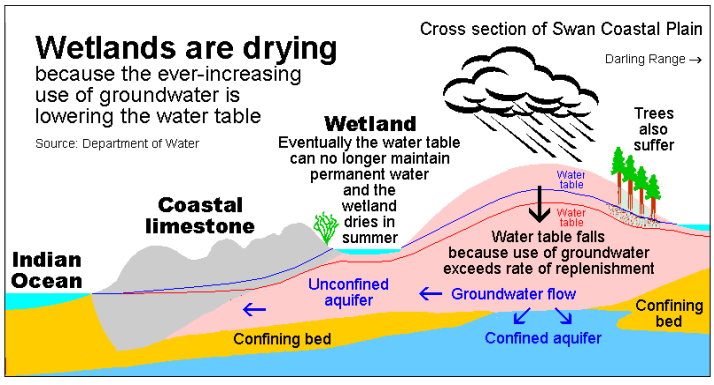
Prepared for us by Dr Geoffrey Dean from various sources including the Water and Rivers Commission, EPA, and the Department of Water, and from helpful comments by Dr Don McFarlane (CSIRO) and Dr Craig Lawrence (Fisheries)

Why wetlands are drying out

Most of the Swan Coastal Plain wetlands including Lake Jualbup are on permeable sediments and are thus hydraulically connected to the underlying groundwater. North of the river the groundwater tends to flow towards rivers and ocean from an area 20 km northeast of Wanneroo and 70 m above sea level called the Gnangara mound. If a hydraulic connection exists, the lake level will be the same as the average of the surrounding water table, which is higher in the wet season. As the water table falls, so does the lake level. If it falls far enough, the lake will dry out.

The Gnangara groundwater system supplies about 60% of Perth's drinking water. Two-thirds of that 60% is from groundwater confined under impermeable layers of rock or clay and therefore not connected to wetlands. Most of the water drawn from unconfined groundwater (which is therefore connected to wetlands) is used by horticulturists, councils, rural dwellers, and backyard bores,





Note the problem: Perth's ever-increasing population is depleting the Gnangara system faster than rain can replenish it. The depletion is more than 600 GL since 1979, and the water table is down by as much as 6 metres near the top of the mound. The situation is serious. It would need several decades of above average rainfall to replace the losses since the 1969 drought.

So wetlands such as Lake Jualbup that connect to the water table are showing more and more severe summer drying. (◄ This simplified diagram shows only how a wetland is connected to the groundwater; it does not show the actual geology.) It is the inevitable consequence of a falling water table. So how can we sensibly propose returning Lake Jualbup to permanent water?

The answer lies in the details
If Lake Jualbup was supplied only by rain and groundwater, there would be little hope of restoring permanent water. But in an average year it gets enough runoff from roads and the QEII hospital site to fill it eight times, most of which leaks backs into the groundwater (the rest evaporates or overflows to the ocean). So here is a resource that we can use to restore permanent water – to retain water we just reduce the leak. We do not need to stop all leakage, just some of it.

Left: Same view two weeks apart. Half a metre of water has leaked away.

Lakes are more than just water

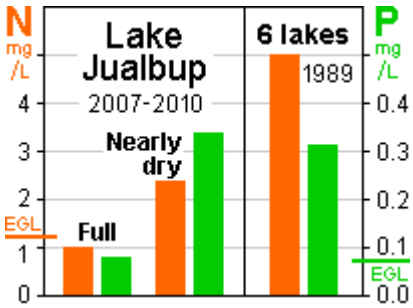
We forget that the water cycle and the life cycle are one – Jacques Cousteau

Wetland plants are important because they feed the wildlife and provide places for nesting. Plants also affect the number and diversity of wildlife and aquatic invertebrates (beetles, snails, worms, leeches, waterfleas, dragonflies, midges, in effect everything not plants, birds, reptiles or fish). As the variety of plant heights and shapes increases, so does the diversity of life that lives in and on them. The plants do not have to be native plants but they do need to provide a good range of heights and shapes, and oxygenate the lake bed.

Rushes and sedges in the shallows are **good** for all lake dwellers (wildlife, fish, aquatic invertebrates), especially if the seasonal water levels vary (as they will, see next page), which helps to keep them healthy. Only a few hardy species will survive being dry for much of the year. Many species survive flooding by passing oxygen from the air down to their roots, from where it may diffuse into the surrounding lake bed. Because the bacteria that break down organic matter in the lake bed depend on oxygen to survive, this diffusion improves water quality. Most species are one metre or more in height. Their roots reach down to one metre and stabilise the lake bed. There are many species, but some are weeds, and only a handful are top performers. In contrast, pampas grass is **bad,** too thick for birds to penetrate, non-native, and invasive.

Lakes that dry out have a greater seasonal diversity of plants, reptiles and aquatic invertebrates, and native vegetation can cope with advancing or receding water bodies. But when lakes dry out their value as a summer refuge disappears (as does the wildlife), and in urban areas they are more prone to weed infestation. Because such lakes are dry during the high-risk period for algal blooms, they tend to have fewer algal problems, but they are still vulnerable when wet. Also, when a lake dries out, exposure to air causes any iron sulphides in the lake bed to oxidise and produce sulphuric acid on rewetting, which increases acidity and leads to the formation of acid sulphate soils. For more on the pros and cons of drying out, click **Two Case Studies** on the homepage.

Heavy metals Tests at Lake Jualbup during 1988-2005 found no unacceptable levels of heavy metals in either lake water or lake bed (GHD 2006). Heavy metals are toxic metals that include As Cd Cr Co Cu Pb Hg Mo Ni V and Zn. Most of them arise from road traffic and the weathering of buildings (in groundwater an important source may be fertilisers). They arrive mainly in road runoff, which in Perth typically has a mix of metals but in amounts too small to be a problem.



Nutrients Evaporate a soup and the flavour gets stronger. The same with lake water – water quality is best in winter, worst in summer. Total nitrogen and phosphorus (the elements most responsible for plant and algae growth) in Lake Jualbup in winter do not exceed the environmental guidelines for fresh water (ANZ 2000), indicated here by EGL, but they do at the end of summer when the lake is nearly dry (HTDS 2011). Urban development and a falling water table have led to a general increase in nutrient levels across most lakes on the Swan Coastal Plain. Nutrient levels in Lake Jualbup are notably less than the average for 6 lakes on the Swan Coastal Plain (Balla and Davies 1993).

Acidity Since 2006 the lake pH has averaged between 6.5 and 7.0, close to neutral, with little seasonal variation (HTDS 2011). The environmental guidelines are 6.5 to 8.0 for acceptable quality. After the severe hailstorm of March 2010, which half-filed a previously dry lake with a record soup of road runoff and smashed vegetation, the pH was 5.8 (very weakly acidic), rising to an average of 5.9 a week later (council memo of 8 April 2010). The most acidic local lake is Lake Gnangara, whose pH levels since 1978 have decreased due to drying out causing acid sulphate soils (see picture below). The lake is now permanently acidic with a pH that has not risen above 4, the lowest being 2.9 (McHugh 2004:33). Vinegar is about 2.5.

Decayed organic matter forms a thick black natural seal that is slippery and very hard to wash off. When dry, it shrinks and forms deep cracks. The greying of the surface is due to the organic matter being oxidised in the hot sun. If the drying process reaches the underlying sand, any iron sulphides will be oxidised to iron sulphate and sulphuric acid, forming what is known as *acid sulphate soil*. The problem is the drying out, therefore permanent water prevents its formation.

Birds need varying water depths. Partially sealing the lake will not create a constant level and will not affect the variations in depth that are essential for wading birds (and native fauna and flora generally). Our proposals ensure that the lake will have shallow areas as well as the depth of one metre recommended by ENV (2007) to ensure water quality.

Birds need permanent fresh water. Fresh water has become very scarce on the Swan Coastal Plain. During the past fifty years almost all of its lakes have become saline or dry. So lakes that still have permanent fresh water are becoming more and more important for birds that need a summer refuge for breeding. Ducks and swans cannot use places along the river in summer because even estuarine birds need fresh water to drink, and many species need fresh water to breed.

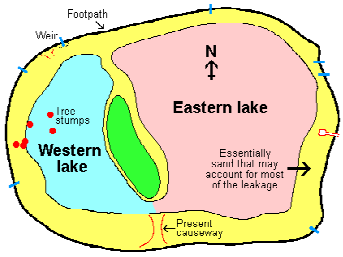
Lucky Lake Jualbup. Because Lake Jualbup receives huge amounts of road runoff even in dry years, most of which leaks away, the simplest way to retain water is to reduce leakage – which is easy and not expensive. It makes no sense to prefer a dry lake when it is just as easy to have a wet one, and when birds need fresh water in summer. Because it receives so much water each year, the lake is efficiently flushed, thus preventing the build-up over the years of anything harmful.

A number of lakes on the Swan Coastal Plain (eg Lake Forrestdale west of Armadale, area 220 ha) have largely impervious clay bottoms and minimal annual flushing, yet they remain healthy.

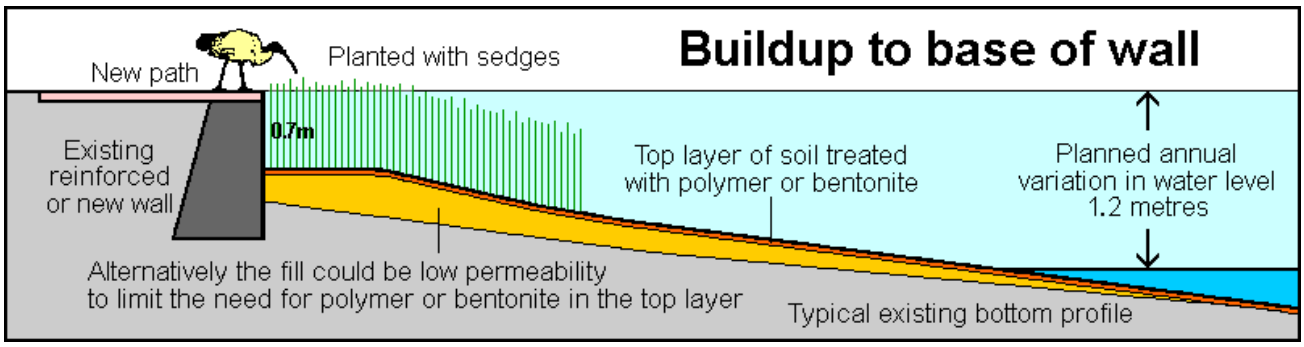
Children invade an almost-dry Lake Jualbup, March 2011. But is the soft sludgy bottom safe for them?

Restoring Lake Jualbup's natural seal

The key to reducing lake leakage and delaying drying out



Here the aim is to restore the natural seal lost by dredging in the 1980s. Naturally occurring clays such as bentonite and kaolinite have long been used to seal farm dams in sandy soils with no adverse effects. Synthetic polymers can be cheaper and were originally considered. But the lake was found to leak mostly around its sandy edges as shown on left in yellow, and hardly at all in the middle areas covered by sludge, for details see *Summary of Events*. Sandy edges are precisely where natural clays can be easily applied as part of the planned buildup to the base of wall to improve safety, an application to which polymer is less suited.



Lake Jualbup has a fast leak (typically 2 cm a day in summer, 6 cm or more in winter) which will require something like a 75% reduction overall to maintain permanent water in summer. The aim is not to obtain a perfect seal (which in principle would be difficult anyway due to the difficulty of application in existing reed areas) so the lake will still leak, thus avoiding a buildup of dissolved solids. Much will depend on field tests. For the latest news click on *Events since 2008* on home page.

Three myths about community support

for the Lake Jualbup management plan adopted in July 2000

Myth A: The 2000 management plan was developed by the City and the community.
Wrong. The plan released in July 2000 by the City administration stated: "This management plan has been developed by the City of Subiaco and the community". The steering committee did have community representatives on it. But the City's plan bore so little resemblance to the committee's plan that in November 2004 one of the original community reps sent a fax to the CEO and councillors asking them to "Stop calling the development plan 'the plan devised by a committee including community reps' … Please go back to the original plan". But to no avail. Six years later, the briefing document for the Lake Jualbup community consultation still referred to the plan as

having been developed "with community input". And the same rep was still complaining about the plan being "emasculated" (council minutes 23 Feb 2010). Click *Aboriginal Heritage* on the home page for details of the associated agreement between the City of Subiaco and Nyungah Elders.

Myth B: The 2000 management plan has widespread community support.
Wrong**.** In November 2001 the City implemented the plan's first stage by removing the eastern wall and eight mature trees, The community reacted with objections at the Annual General Meeting of ratepayers in December 2001, and a petition of 470 signatures calling for a halt to further work. In 2004 the City tried to force through the plan's second stage, which led to a petition of 504 signatures and many individual objections. In 2008 a feasibility study supporting the plan generated two more petitions totalling 362 signatures and 42 responses from concerned ratepayers. A further petition in 2011 received 1697 signatures (see below) in favour of restoring the lake. From the start, **community opposition** was apparent in letters to the POST. One of them ("Subi has got it wrong over changes to lake" 24 Nov 2001 p.14) was accompanied by the following black-and-white photo, which shows better than any words what the community was objecting to:

Left: Eastern end of the lake after the plan's first stage. Eight mature trees are gone. Sand embankments have replaced the original wall. 2nd stage would be more of the same. **Colour insert:** same area today in winter. In summer the eastern end is as shown in the photo below.

Opposition to the 2000 plan is easy to understand – visitors want to engage with the lake, not be shut off by a wall of reeds and scrub. The lake used to be a magnet for tourist buses, but not since it began drying out. Contrary to claims about widespread community stalemate over the plan, no such stalemate is apparent in recent letters to the POST or among lake visitors. Instead there is a clear majority opposition to the plan, as can be seen by clicking *Letters* on our home page.

Myth C: Ratepayers who live around the lake are interested only in property values.
Wrong**.** Like any ratepayers, they chose the area because it was where they wanted to live. They see the lake as a valuable community asset that has deteriorated in recent years due to neglect and lack of permanent water. They seek only to have the asset restored. In any case, property values are a **legitimate council concern**. According to the EPA's method of wetland evaluation given in *EPA Bulletin 374: A guide to wetland management in Perth*, released in 1990, a wetland that adds more than 10% to nearby real estate values (which is true of any fresh water north of the river) has a significant effect. In which case "The enhancement of real estate values is a legitimate reason for increased expenditure on the active management of a wetland" (from Appendix B).

When you think of Lake Jualbup, think also of Cottesloe. The amenity of Lake Jualbup is one reason why people want to live in Shenton Park. The closer they can get to water the more they are willing to pay. Would the value of Cottesloe as a suburb be diminished if the beach suddenly became unfit for use? Of course it would. The same applies to Shenton Park when Lake Jualbup dries up. A recent study found that, for an average property within 1.5 km of an urban wetland on the Gnangara groundwater system (mostly lakes much larger than Lake Jualbup), the increase in **land value** on moving just 100 m closer to the wetland averages $83,000 (Tapsuwan et al 2007). And remember that the lake today is not quite where it used to be, see next.

So where was the lake in the old days?

When considering the lake we must also consider the adjoining recreation ground. Ken Spillman's *Diehards: The Story of the Subiaco Football Club 1896-1945* describes the Shenton Park recreation ground (aka football oval) as being impressive for "apparent suitability" (p.11). In 1898 it was "the municipality's major public sporting facility … a popular location for picnics, a venue for footracing and novelty events, and – most significantly – home to both the Subiaco Football Club and Subiaco Cricket Club, which merged with the Shenton Park Cricket Club in September, 1898" (p.11). It was also "picturesque" (p.19). Nevertheless it was "a small and heavy ground" that was "half hill and the rest mud and water" (p.24), where "spectators perched on a sand bank amid the trees" (p.25). But to discover its exact location (not given by Spillman or any local oral history) we have to consult the newspapers. Thus in 1905, Subiaco Council's plan for improving the oval was reported in the *West Australian* for 30 March 1905, from which the following excerpts are taken:

SUBIACO RECREATION GROUND.

IMPROVING SHENTON PARK.

PROGRESSIVE POLICY ADOPTED.

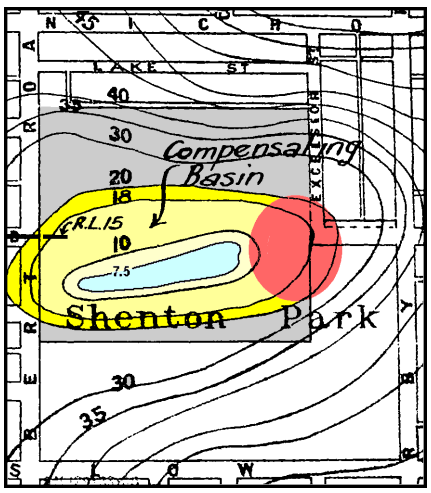
DETAILS OF THE SCHEME.

Mr. Hargrave, who was the surveyor approached by the Council, supplied the following details of a scheme for improving the Park:—"I take it that the Council wishes a scheme prepared that will admit of portions of the work involved being carried out from time to time as funds permit. Levels to permit of a complete scheme being prepared are be provided. The most important question to be dealt with is drainage. According to the Government contour plan, the natural surface level of the lowest part of the reserve is about 10ft. only above the low-water mark at Fremantle, and I understand that Dyson's Swamp, by which name the reserve was originally known, has always been considered as a permanent water basin. It

"The ground, at present used for cricket, is obviously too limited an area for general sports, including football, cycling, etc. … A pavilion is shown on the plan, and should in any case face the south or south-east".

The oval was to be enlarged to make the perimeter one third of a mile [536 m], which required filling in two chains [40 metres] of the eastern end of the lake "which has always been considered as a permanent water basin" (see above right column at end). Most important was:

"raising the centre of the oval at least 2 ft above the highest known water level of the swamp, and provide for the carrying off of the water which falls during the heavy rains … and discharging at the western side into such portion of the original swamp as it is desirable to retain as an ornamental pond. … the present turf should be cut into sods and stacked. The filling would be best of sand topped with the black soil obtained from the excavations necessary for the ornamental pond, over which the sods could be replaced. … the estimate will be £1,013 18s. 4d [then the equivalent of about ten average annual wages] … a plain and workable plan, which would make Shenton Park an up-to-date and beautiful reserve."



But already the rising water table was starting to flood the oval in winter, and the workable improvements never started.

The report refers to a plan showing a pavilion but does not reproduce it, so we have no clear idea of where the recreation ground actually was – other than presumably somewhere east of the lake. Fortunately we have this **contour map** (mentioned in the report) surveyed in 1895 which allows us to work out the exact location of the recreation ground..

◄ The map shows contours in feet above Fremantle low water. It was surveyed in the days before the rising water table flooded the lake basin to beyond the 20-ft contour in the early 1920s. The spacing between contours allows the ground slope to be calculated, and the flattest area (shown in red) is consistent with the above report and is therefore the oval's most likely location. The red area is 120 m x 90 m, has slopes between 1 in 20 to 1 in 42 (average 1 in 29, only slightly less steep than the steepest part of Derby Road next to Rosalie Park), all consistent with the comments cited by Spillman and with the observation that on one occasion the oval was half

covered with water a foot deep. The blue area is the estimated water body before it flooded. It is about 170m long and averages 25 m wide, a significant body of water, but its area of 0.43 ha is notably smaller than the 2.5 ha of the existing Lake Jualbup water area including the island.

In 1906 construction began on a hotel at the corner of Nicholson and Derby Roads,

a location chosen and approved almost solely on the assumption that the recreation area at the Shenton Park Lake would remain the home of the Subiaco Football Club, and would develop as the municipality's major sporting facility. Rising waters at the lake and the Council's acquisition of the site between Mueller and Subiaco Roads, however, robbed the Shenton Park Hotel of the benefits of this development only shortly after it was opened for business in 1907, transferring them instead to the delighted proprietors of 'The Vic' [Subiaco's 2nd hotel built around 1900 on Hay Street near the new oval] (*Identity Prized* p.189).

Wetland statistics: Seeing Lake Jualbup in context

From Hill et al (1996). Database held by DEC. Updates are made if nearby land is released (wetland status affects land values) or boundaries change, but neither apply to Jualbup. Drying out does not count (vegetation takes precedence).

	Naturalness score	% undisturbed vegetation		
	Wetland area ha		Wetland category	Wetland type
Herdsman Lake, Osborne Pk	359.1	30	66	O	Lake
Lake Joondalup, Joondalup	269.2	41	86	H	Lake
Lake Monger, Wembley	67.9	26	90	O	Lake
Lake Claremont, Claremont	16.3	29	na	O	Sumpland
Perry Lakes, Floreat	12.1	31	95	O	Lake
Jackadder Lake, Woodlands	7.7	19	80	M	Lake
Star Swamp, North Beach	3.1	37	98	C	Sumpland
Cliff Sadlier, Daglish	3.0	na	0	na	Sumpland
Hyde Park Lakes, Perth	2.6	na	0	na	Artificial lake
Lake Jualbup, Shenton Park	2.5	18	0	R	Sumpland
Mabel Talbot, Jolimont	0.8	na	0	na	Artificial Lake
Aberdare Road, Nedlands	0.4	na	33	na	Artificial Lake

na = not assessed

Wetland area is the wetted area, which for Lake Jualbup is the same as the water area when full.
Naturalness score (the higher the better) is obtained by applying the criteria in EPA Bulletin 374. The more the vegetation is original and in good condition, and the less the human development, the higher the score.
% undisturbed vegetation is determined from aerial photographs. 100% means cover is 100% undisturbed.
Wetland type is what it says. **Lake** is a permanent lake. **Sumpland** is a seasonal lake. These descriptions may have changed since 1996 because many wetlands are now drying out.

Wetland categories are from EPA Bulletin 374 (1990) and are based on a mix of **naturalness** and **human use** (eg walking, bird watching, playgrounds, picnics). No category is more important than another, and in each case the aim of management is to "maintain and enhance". But that was in 1990. Today land prices (a proxy for how people value wetlands), and access to stormwater (as at Lake Jualbup) or access to treated wastewater (as at Perry Lakes), might be additional factors to take into account when evaluating wetlands.

	Category	Naturalness	Human Use
H	High Conservation	Maximum	Med to High
C	Conservation	High	High
O	Conserv & Recreation	Medium	Medium
R	Resource Enhancement	Low	Medium
M	Multiple Use	Low	Low

Wetland categories were updated by the EPA in 2004 as part of a provisional new policy called the *Revised Draft Environmental Protection (Swan Coastal Plain Wetland) Policy 2004*. The new policy was about classifying wetlands and registering new ones. But the Minister rejected the new policy because (1) it overlapped existing legislation, leaving it unclear what the responsible authorities (who had no right of appeal) were supposed to do, and (2) it had been devised without adequate consultation. So current wetland categories remain as set out in EPA Bulletin 374. Subiaco administration was evidently unaware of this and incorrectly classified Lake Jualbup as "a wetland of high conservation and ecological value" (council minutes 22 February 2011), which is hardly compatible with it having 0% original vegetation and a rating of low in naturalness.

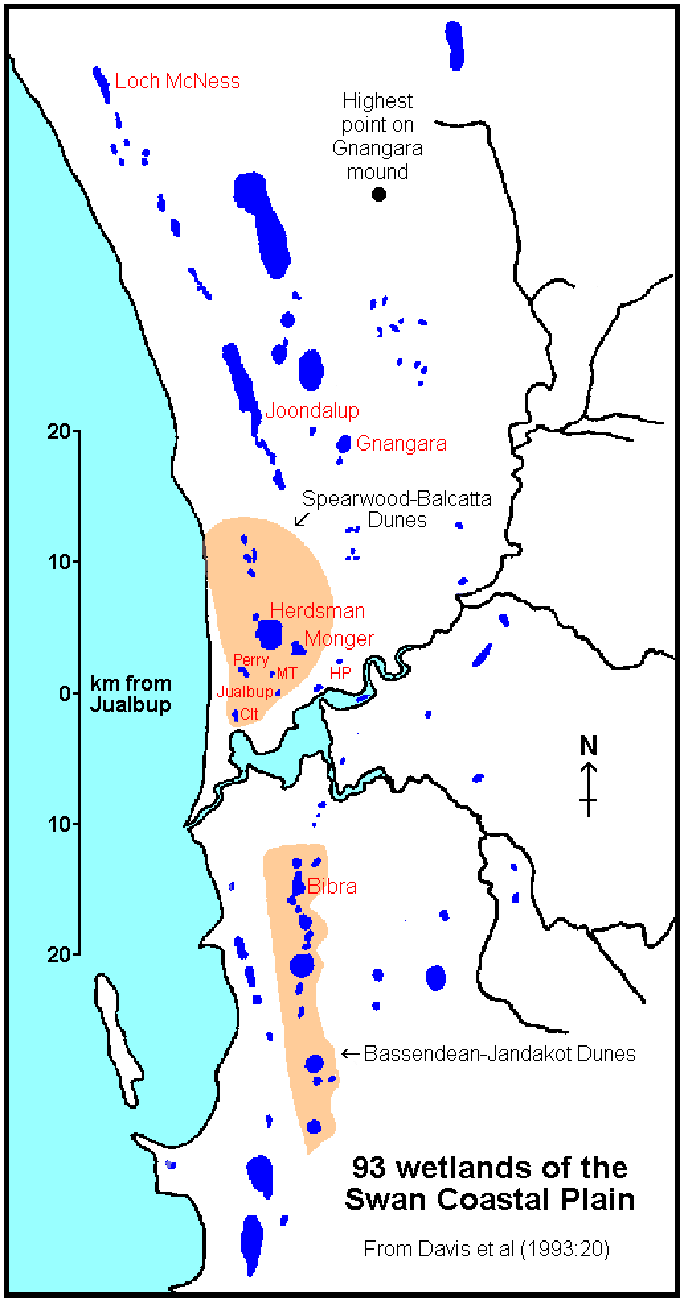
Status of wetlands on the Swan Coastal Plain

According to Balla and Davis (1993), some 70% of the original wetlands on the Swan Coastal Plain has been lost due to white settlement. Ultimately the number of wetlands determines the number and diversity of plants and wildlife. If we prefer nature to concrete, further loss has to be avoided. The authors note that conservation of wetlands may eventually require limits to population growth.

Status of Lake Jualbup among wetlands on the Swan Coastal Plain

According to Davis et al (1993), the coastal plain from Wedge Island to Dunsborough has 200 permanent lakes covering a total of 14100 ha, average 70 ha per lake, and 4879 seasonal lakes covering a total of 34339 ha, average 7.0 ha per lake. So Lake Jualbup is just one of 5078 lakes, and its area (2.5 ha) is 2.5 / 43438 or 0.006% of the total.

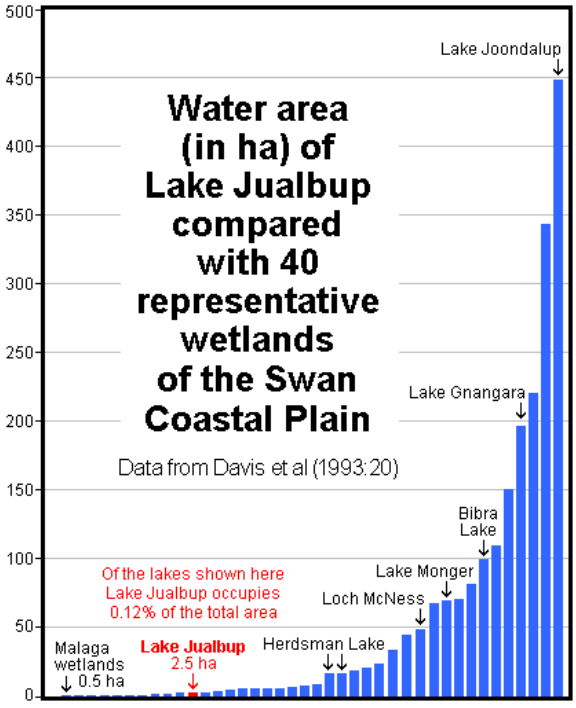
In Coffey (1990), a total of 28 educators and wetland researchers identified 42 wetlands in the Perth-Bunbury area as having **educational value**. Top-rated were Herdsman Lake (because of its staffed education centre) and Lake Joondalup (large size, undisturbed vegetation on western side, and well-signed heritage trails). Eighteen others were seen as significant. Lake Jualbup was one of the 42 but was not seen as significant. Today it might be seen as significant, if only because it gets enough stormwater to allow it to potentially provide open water when other lakes are drying out. The map below shows Lake Jualbup's location among other wetlands on the Swan Coastal Plain.



Left: Wetlands from Yanchep to Warnbro. Wetlands can be grouped according to their underlying geology, and the shaded areas show two examples. Lake Jualbup is in the upper shaded area along with Mabel Talbot and lakes Herdsman, Monger, Perry N & S, Claremont, and several others. Bibra Lake is in the lower shaded area with 14 others.

The Swan Coastal Plain consists of sediments that form four main dune systems that run parallel to the coast, which is why the wetlands form long chains that also run parallel to the coast. Each system has its own distinctive geology, drainage, soils, and plants.

Below: Ranking of representative wetlands on the Swan Coastal Plain according to water area when full. Lake Jualbup (in red) is at the low end, ranking 12th out of 41.



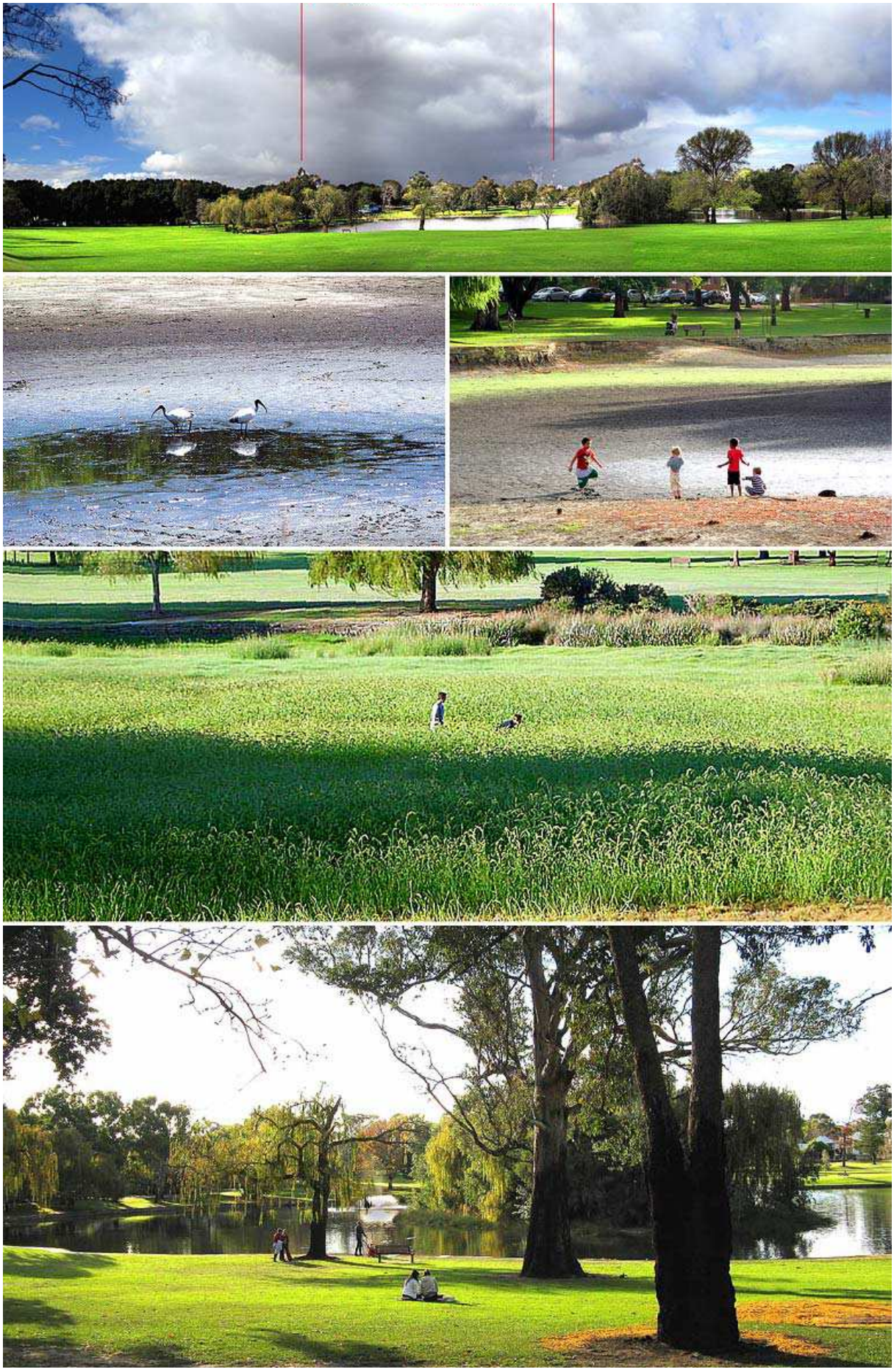
One final thought

Lake Jualbup is not a large water body, nor does it rate highly in terms of naturalness (see above). But it is one of the few wetlands that can be easily saved from the trend towards dryness, in which case it would be remiss not to do so. If successful it would be a real triumph for the local council, and might well receive accolades from biodiversity and conservation groups. It would also provide a model to other councils to show how their own wetlands on the Swan Coastal Plain might be

saved. In short, it is not enough to consider only **our** use of Lake Jualbup. We must also consider it as a **sanctuary for wildlife**, for whom a wet lake is clearly more beneficial than a dry one:

From top: Sunset @ Subi free concert. Spoonbills. Playground. No water, no wildlife. Death by spraying.

And some pictorial afterthoughts



From top: The finite size of storm clouds makes the measurement of catchment rainfall uncertain. Ibises and young boys love glorious mud. Weeds love a dry lake bed. Visitors and wildlife love water. Just slow the leakage!

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