

# PORT PHILLIP BAY (WESTERN SHORELINE) AND BELLARINE PENINSULA SHOREBIRD SITE

## 1. Date

13 September 2000

## 2. Country:

Australia

## 3. Name of site:

Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Shorebird Site Network (SSN) Site.

The area nominated as Shorebird Site is the same area as that listed as the Western Port Ramsar site under the Convention on Wetlands (Ramsar, Iran 1971) except in the Werribee-Avalon area where parts of the Ramsar site that do not support shorebirds are excluded (see site map).

## 4. Geographical coordinates:

Laverton-Point Cook: Latitude 37<sup>0</sup> 55' S, Longitude 144<sup>0</sup> 47' E

Werribee-Avalon: Latitude 38<sup>0</sup> 02' S, Longitude 144<sup>0</sup> 33' E.

Lake Connemare System: Latitude 38<sup>0</sup> 15' S, Longitude 144<sup>0</sup> 27' E.

Swan Bay: Latitude 38<sup>0</sup> 14' S, Longitude 144<sup>0</sup> 40' E.

Mud Islands: Latitude 38<sup>0</sup> 17' S, Longitude 144<sup>0</sup> 46' E.

## 5. Altitude:

Less than 10 metres above sea level to the 2 metres below sea level.

## 6. Area:

16,540 ha

## 7. Overview:

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Shorebird Site includes a variety of wetland types including intertidal mudflat, seagrass bed, saltmarsh, shallow marine waters, seasonal freshwater swamp, saltworks and extensive sewage ponds which support a large and diverse population of migratory shorebirds, seabirds and waterfowl. The site is contained within the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site.

## 8. Justification of Shorebird Site Network Criteria

The site provides habitat for high densities of migratory shorebirds, and the largest numbers known for Victoria (Lane 1987). The Werribee-Avalon coast is renowned for its high densities of particular species, while a greater diversity of species can usually be found in the seaward parts of the Bay (Mud Islands and Swan Bay). Additional habitats are provided by the Lake Connemare system and artificial saltworks at Laverton and Avalon.

### Regularly supports > 20 000 migratory shorebirds:

- criteria met

The mean numbers of shorebirds recorded on annual summer counts from 1981-1990 and 1991-1999 were 43366 and 29502 respectively (Tables 1a and 1b). These totals include counts from some non-SSN areas that could not be separated from counts covering SSN areas. However, most of these birds would have made some use of the SSN site from time to time as an important part of their habitat. It is believed that the SSN site regularly supported more than 20000 migratory shorebirds in summer during these periods (R. Loyn pers. comm.).

### Regularly supports > 1 % of the individuals in a population of one species or subspecies of migratory shorebird:

- criteria met

Watkins (1993) noted five locations in the site that have held internationally significant numbers of individual species. Maximum numbers for each site are:

Hospital Lake (part of the Lake Connemare System) - 1654 Sharp-tailed Sandpipers (*Calidris acuminata*) and 4630

Red-necked Stints (*C. ruficollis*)- both only slightly less than internationally significant numbers (AWSG 1999)

Lake Connemare - 2570 Sharp-tailed Sandpipers (AWSG 1999) and 2820 Curlew Sandpipers (AWSG 1999);

Reedy Lake (part of the Lake Connemare System) - 4170 Sharp-tailed Sandpipers (AWSG 1999);

Swan Bay-Mud Islands - 808 Eastern Curlews (*Numenius madagascariensis*) (Barter *et al.* 1988), 570 Grey Plovers (*Pluvialis squatarola*) (Drummond 1984), 1694 Sharp-tailed Sandpipers, 7207 Red-necked Stints, 3679 Curlew Sandpipers, 293 Ruddy Turnstones (*Arenaria interpres*);

Werribee-Avalon - 5207 Sharp-tailed Sandpipers, 13417 Red-necked Stints and 13323 Curlew Sandpipers (AWSG 1999).

**Table 1a. Numbers of trans-equatorial migratory shorebirds within zones covering the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula site in summer**

year	Altona*	Werribee-Avalon*	Bellarine Peninsula*	total
1981	21682	13416	24951	60049
1982	5984	15790	18625	40399
1983	11510	18348	24210	54068
1984	8599	15421	22458	46478
1985	5544	12674	33292	51510
1986	4770	17084	23069	44923
1987	9762	10481	16964	37207
1988	4713	7569	24205	36487
1989	1628	20605	18934	41167
1990	4399	5233	11741	21373
<b>average</b>	7859	13662	21845	43366

AWSG (1999)  
from P. Driscoll

year	Laverton-Point Cook*	Werribee-Avalon*	Bellarine Ramsar	total
1991	4605	11718	7141	23464
1992	5684	15601	8395	29680
1993	10445	7637	5783	23865
1994	8641	18415	16497	43553
1995	5505	9373	15171	30049
1996	4879	14123	4062	23064
1997	3718	15507	9531	28756
1998	4102	14742	14739	33583
1999		15472		
<b>average</b>	5947	13621	10165	29502

AWSG (1999)  
from K. Harris

**Table 1b. Numbers of trans-equatorial migratory shorebirds within zones covering the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula site in winter**

year	Altona*	Werribee-Avalon*	Bellarine Peninsula*	total
1981	61	310	1066	1437
1982	350	328	849	1527
1983	270	1138	1694	3102
1984	251	450	1646	2347
1985*	718	306	1105	2129
1986	1338	1627	1842	4807
1987	125	270	851	1246
1988	38	906	2289	3233
1989	291	391	2422	3104
1990	25	16	244	285
<b>average</b>	347	574	1401	2322

AWSG (1999)  
from P. Driscoll

year	Laverton-Point Cook*	Werribee-Avalon*	Bellarine Ramsar	total
1991	375	1000	410	1785
1992*	839	1805	1748	4392
1993	10	248	359	617
1994	1302	1091	944	3337
1995	874	2867	1205	4946
1996	1928	4474	1813	8215
1997	49	774	684	1507
1998	329	1031	701	2061
<b>average</b>	713	1661	983	3358

AWSG (1999)  
from K. Harris

\* Note: *Laverton-Point Cook, Altona, Werribee-Avalon and Bellarine Peninsula* all include areas within and outside the SSN site, but most birds are expected to use the SSN site as an important part of their habitat. Counts of shorebirds in Swan Bay cover high-tide roosts that are mostly outside the SSN site (e.g. on Sand Island, used as an alternative roost to Mud Islands within the SSN site). As shorebirds forage mainly in intertidal areas within the SSN site, numbers recorded at roosts are taken as indicators of the value of the SSN site.

In the ten years to 1999, since the data used in Watkins (1993) were compiled, large populations of shorebirds continued to use locations within the SSN site:

- In the Werribee-Avalon area, annual summer counts of Sharp-tailed Sandpipers, Red-necked Stints, Curlew Sandpipers and Pacific Golden Plover exceeded the minimum internationally or nationally significant number seven, eight, and seven times, and once respectively (AWSG 1999);
- In the Lake Connemara System, annual summer counts of Sharp-tailed Sandpipers, Red-necked Stints and Curlew Sandpipers exceeded the minimum internationally or nationally significant number one to three times for each species (AWSG 1999);
- At the Laverton Saltworks (now known as the Cheetham Wetlands) annual summer counts of Red-necked Stints and Curlew Sandpipers exceeded the minimum internationally significant number twice (AWSG 1999);
- The number of Grey Plovers at Mud Islands and Swan Bay exceeded the minimum internationally significant number three times (AWSG 1999).

In addition to the internationally and nationally significant numbers of individual species and total numbers of trans-equatorial migratory shorebirds, internationally significant numbers of a trans-Tasman migrant, the Double-banded Plover (*Charadrius bicinctus*), and nationally significant numbers of non-migratory shorebirds have been recorded (Watkins 1993; AWSG 1999). Internationally significant numbers of Double-banded Plover (500) occurred regularly in pasture at Point Wilson in the 1980s, but rarely in the 1990s. This area lies just outside the Ramsar site and SSN. Significant numbers of Double-banded Plover have also been recorded in the SSN site at the Laverton Saltworks and nearby wetlands (up to 520) and Swan Bay (up to 420).

It supports appreciable numbers of an endangered or vulnerable population of migratory shorebird

- criteria not met

## **9. Wetland type:**

### Marine and Coastal Wetlands –

Laverton-Point Cook: A, B, D, E, F, G, H, I, J, K

Werribee-Avalon: A, B, D, E, F, G, H, I, J

Lake Connemara: E, F, G, H, I, J, K

Swan Bay: A, B, E, G, H, I, J

Mud Islands: A, B, E, G, H, I

- A Permanent shallow marine waters less than six metres deep at low tide; includes sea bays and straits.
- B Marine subtidal aquatic beds; includes kelp beds, sea-grass beds, tropical marine meadows.
- D Rocky marine shores; includes rocky offshore islands, sea cliffs.
- E Sand, shingle or pebble shores; includes sand bars, spits and sandy islets; includes dune systems.
- F Estuarine waters: permanent water of estuaries and estuarine systems of deltas.
- G Intertidal mud, sand or salt flats.
- H Intertidal marshes; includes salt marshes, salt meadows, saltings, raised salt marshes; includes tidal brackish and freshwater marshes.
- I Intertidal forested wetlands; includes mangrove swamps, nipah swamps and tidal freshwater swamp forests.
- J Coastal brackish/saline lagoons; brackish to saline lagoons with at least one relatively narrow connection to the sea.
- K Coastal freshwater lagoons; includes freshwater delta lagoons.

### Inland Wetlands -

Laverton-Point Cook: M, N, Ss, Ts

Werribee-Avalon: M, N, Ts, Xf

Lake Connemara: M, N, P, Ts

Swan Bay: N?

- M Permanent rivers/streams/creeks; includes waterfalls.
- N Seasonal/intermittent/irregular rivers/streams/creeks.
- P Permanent/intermittent freshwater lakes (over 8 ha); includes large oxbow lakes.
- Ss Seasonal/intermittent saline/brackish/alkaline marshes/pools.
- Ts Seasonal/intermittent freshwater marshes/pools on inorganic soil; includes sloughs, potholes, seasonally-flooded meadows, sedge marshes.
- Xf Freshwater, tree-dominated wetlands; includes freshwater swamp forest, seasonally flooded forest, wooded swamps; on inorganic soils.

### Artificial Wetlands -

Laverton-Point Cook: 2, 5, 6, 9.

Werribee-Avalon: 1, 3, 5, 7, 8, 9.

- 1 Aquaculture (e.g fish/shrimp) ponds.
- 2 Ponds; includes farm ponds, stock ponds, small tanks; (generally below 8 ha).
- 3 Irrigated land; includes irrigated channels and rice fields.
- 4 Seasonally flooded agricultural land.
- 5 Salt exploitation sites: salt pans, salines etc.
- 6 Water storage areas; reservoirs/barrages/dams/impoundments; (generally over 8 ha).
- 7 Excavations: gravel/brick/clay pits, borrow pits, mining pools.
- 8 Wastewater treatment areas: sewage farms, settling ponds, oxidation basins, etc.
- 9 Canals and drainage channels, ditches.

### **10. Outline map of site:**

See site map. The boundary of the SSN in the Werribee area of the SSN has been adjusted to include only areas important to shorebirds and does not follow the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site boundary in the Werribee-Avalon area. The adjusted boundary in the Western Treatment Plant at Werribee follows named roads, carriers, lagoon edges and fencelines. Ryans Swamp in the Western Treatment Plant is included in the site: The SSN site boundary at Ryans Swamp is represented by the Melbourne Water Corporation fenceline around the swamp.

Specific locations important to shorebirds within the SSN site and on adjacent land are listed in Appendix 2.

### **11. Jurisdiction:**

The Victorian Government Department of Natural Resources and Environment (NRE) is responsible for setting wetland policy and coordinating implementation of the Ramsar Convention in Victoria, including overseeing the management of Ramsar and SSN sites in Victoria. Ramsar strategic management plans are currently being developed for the Western Port and Port Phillip Bay and Bellarine Peninsula Ramsar sites. NRE will be responsible for coordinating the implementation of these plans.

### **12. Management Authority:**

The site is managed by a wide range of authorities (Table 2). More details of the locations and habitats of these parts of the SSN site are contained in Appendix 2.

**Table 2. Land status and management of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula SSN site**

<b>SSN component</b>	<b>Land status</b>	<b>Managing Authority</b>
Skeleton Creek-Point Cook	Crown Land Reserves	Land Victoria, NRE
	Point Cook Metropolitan Park and Cheetham Wetlands	Parks Victoria
	Point Cook Fisheries Reserve	Parks Victoria
	Port Phillip Bay nearshore area - Unreserved Crown Land	NRE (Parks Victoria manages recreation functions)
Western Treatment Plant	Freehold	Melbourne Water Corporation
Port Phillip Bay foreshore adjacent to Western Treatment Plant	Port Phillip Bay Coastal Reserve	Melbourne Water Corporation
Port Phillip Bay near Werribee and from near Point Wilson to Limeburners Bay	Unreserved Crown Land	NRE (Parks Victoria manages recreation functions)
The Spit Wildlife Reserve	Nature Conservation Reserve – Wildlife Reserve	Parks Victoria
Point Wilson-Limeburners Bay	Public purposes reserve	Land Victoria (NRE)
	Commonwealth land	Department of Defence
	Port Phillip Bay Coastal Reserve	Parks Victoria
	Wildlife Reserve	Parks Victoria
Swan Bay Marine Reserve	Fisheries Reserve	Parks Victoria
Mud Islands	Fisheries Reserve and Natural Features Reserve – Wildlife Reserve	Parks Victoria
Lake Connemara State Game Reserve	Natural Features Reserve – Wildlife Reserve	Parks Victoria

### 13. Name and address of the compiler:

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### 14. General location:

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula SSN site is located on the western shore of Port Phillip Bay between Melbourne and Geelong and on the Bellarine Peninsula south-east and east of Geelong. Melbourne (population estimated to be 3,317,920 in 2000- DPD undated) is the capital of Victoria. Geelong is a large provincial city (population of Greater Geelong local government area: estimated as 195544 in 2000- DPD 1995) 67 kilometres to the south-west of Melbourne.

This SSN consists of a number of disjunct parts: Laverton-Point Cook, several locations within the Werribee area, Point Wilson-Avalon, the Lake Connemara System, Swan Bay and Mud Islands. For the purposes of this SSN listing, the Werribee and Point Wilson-Avalon parts are considered together as they are close to each other and shorebirds regularly move between them.

### 15. Physical features:

Port Phillip Bay lies in a sunkland formed by faulting and movement of the earth's surface during past geological eras. This low-lying area is a natural discharge point for the rivers draining southern central Victoria. A shallow lake formed even when sea levels were lower, and the Yarra River previously entered Bass Strait near Queenscliff. As the sea level rose, the sunkland was flooded, and wetlands formed at the deltas of a number of rivers and creeks. The Barwon River may have flowed into the ancestral Yarra River but more recently it has discharged directly to Bass Strait at Barwon Heads.

The hydrology of the SSN site is varied as there are widely differing catchments, seawater influence and geomorphology involved for each part. Details of the site's hydrology are:

Laverton-Point Cook: Skeleton Creek flows through the former Laverton Saltworks to the coast and it forms an estuary up to a ford near Altona Meadows. The position of the creek in this area has changed through being artificially channelled and the mouth regularly opened after being closed by spit growth at the beach. Seawater is pumped from the creek into former saltworks ponds where the water circulates by gravity feed and pumping to super-saturate it with salt. The saltworks ponds were formerly sections of tidally influenced spit lagoons that formed as the coastline prograded during the Quaternary (Appleby 1989).

Werribee-Avalon: *Werribee* – Most of this area has been greatly modified as the major sewage treatment complex for Melbourne (Western Treatment Plant). Sewage water is pumped into a vast network of artificial ponds and irrigated paddocks. This water then circulates through the ponds by gravity and pumping. Some of the shallower ponds and borrow pits are deliberately provided with low water flows to maintain habitat for waterbirds. The Little River flows through the area to the sea and is joined by the outflow of Ryan's Swamp, an ephemeral swamp fed by local runoff, infiltration and streamflow. Several major drains channel treated sewage and minor streams flow to the sea. A natural spit lagoon in the south-west of this area is sheltered from the sea by mobile barriers of shellgrit known as The Sand Hummocks or more popularly The North and South Spits. This area and much adjacent saltmarsh are included in the Murtcaim Wildlife Reserve. The hydrology of The Spits is described in Kinhill (1982). [The SSN includes all major habitats for shorebirds, including the near-coastal parts of the Western Treatment Plant. These are considered among the richest feeding areas for shorebirds in Australia. The SSN also includes part of the deep sewage lagoons 11E, 55E and 25W because the banks of these lagoons next to important shorebird feeding areas in the adjacent conservation lagoons are used for roosting by shorebirds. The deep sewage lagoons themselves are not used by shorebirds. Inland parts of the Western Treatment Plant have been excluded because they mainly consist of irrigated pasture and some deep lagoons rarely used by shorebirds.](#)

*Avalon* – This area has been greatly modified for extraction of salt. Seawater is channelled into a former spit lagoon between Point Lillias and Avalon and then circulated through a pond network of the Avalon Saltworks. Limeburners Bay is a partly enclosed intertidal lagoon, fed by Hovells Creek.

Lake Connemara: The Barwon River flows into Lake Connemara and then reforms to flow to the sea at Barwon Heads. A weir upstream of Lake Connemara allows water to be diverted to Reedy Lake and Hospital Lake that were both naturally flooded by the Barwon. Flows to both these locations are currently artificially controlled. Lake Connemara is affected by tidal flows that do not penetrate the system upstream of the weir.

Swan Bay: Swan Bay is strongly tidal and very large expanses of mudflats are exposed at low tide. Some small streams and drains flow into the Bay. The Bay is partly sheltered by Edwards Point in the north and Swan Island in the south. Sand Island (on the south side of Swan Island) lies outside the SSN site, and has been greatly modified by addition of sand from dredging operations.

**Mud Islands:** The Islands form a constantly changing tidal lagoon system that usually has two main entrances. The lagoon occupies about 35 ha and is surrounded by an irregular mobile ring of sand ridges occupying about 51 ha and rising to 4m in elevation (LCC 1993).

The area contains six sites of State geomorphological significance (Bird 1977; Rosengren 1987).

The Bellarine Peninsula parts of the SSN site, on average receive more rainfall than those north of Geelong, as the Geelong to Laverton area is part of a rainshadow influenced by a combination of the Otway and Brisbane Ranges and the You Yangs. As shown in the summary of rainfall below, there is also considerable variation in rainfall patterns (Table 3).

**Table 3. Rainfall of selected locations in or near the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula SSN site.**

	Median annual rainfall	Average annual rain days	Highest median monthly rainfall	Lowest median monthly rainfall
Laverton (Point Cook-Cheetham Wetlands)	547 mm	146 days	57 mm (October)	31 mm (March)
Werribee (Western Treatment Plant)	521 mm	152 days	55 mm (October)	29 mm (March)
Lara Saltings (Point Wilson-Avalon)	498 mm	95 days	52 mm (May)	25 mm (February)
Barwon Heads (Lake Connewarre)	613 mm	105 days	65 mm (August)	28 mm (February)
Queenscliff (Swan Bay and Mud Island)	600 mm	137 days	58 mm (May)	29 mm (January)

Source: BoM (1995a).

The mean daily maximum and minimum temperatures at (1) Laverton, (2) Geelong and (3) Point Lonsdale are 19.6°C and 9.2°C, 19.8°C and 9.4°C, and 18.2°C and 10.6°C respectively (BoM 1998). The maximum average daily, minimum average daily and average annual evaporation at Laverton and Werribee are 7.5 mm (January), 1.6 mm (June) and c. 1596 mm, and 6.9 mm (January), 1.3 mm (June) and 1418 mm respectively (BoM 1995b).

Tidal variations for the different parts of the SSN site (VCA 1999), expressed as the difference between mean higher high water and mean lower low water, are:

Laverton-Point Cook: 0.8 m at Point Cook

Werribee-Avalon: 0.8 m at the Werribee River mouth and Point Wilson; 0.9 m at Corio (Geelong)

Lake Connewarre: 1.8 m at Barwon Heads bridge; likely to be approximately 1 m at Lake Connewarre (G. Appleby pers. obs.)

Swan Bay: 0.8 m at Swan Island Dock; 0.9 m at Queenscliff Pier (just outside Swan Bay)

Mud Islands: 0.7-0.9 m at various navigation structures in the South and West Channels, Port Phillip Bay.

Swan Bay is generally less than two metres in depth, resulting in a large area of mudflats being exposed at low tide.

## 16. Hydrological values:

Major river discharges are shown in Table 4.

**Table 4. River discharge through the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula SSN site**

	Max. monthly discharge (ML)	Min. monthly discharge (ML)	Max. annual discharge (ML)	Min. annual discharge (ML)	Mean annual discharge (ML)	Mean pH	Mean conductivity (Ec)
Barwon River (Pollocksford)	230000	64	663000	17100	236000	8.0	2270
Moorabool River (Batesford)	95600	0	217000	1590	69600	-	-
Little River (Little River)	22100	17	46800	664	10300	-	-

Source: RWC (1990a-d).

The Barwon River drains a large basin including the headwaters in the Otway Ranges and receives fresh to saline flows from diversion channels from the Lake Colac-Lough Calvert and Woody Yallock drainage schemes near Colac. The Moorabool River drains a smaller basin with its headwaters in the Midlands.

## 17. Ecological features:

Component of SSN site	Ecological features
Laverton-Point Cook	The former saltworks ponds of the Cheetham Wetlands, the adjacent intertidal zone and wetlands in the Point Cook Metropolitan Park provide important habitat for waders, particularly sandpipers, avocets and stilts, and other waterbirds. Habitats in this area contain valuable remnants of native vegetation.
Werribee-Avalon	The wetlands have a very high diversity of habitat types ranging from hypersaline to fresh, permanent to ephemeral and they cover a large area. They are of very high value for birds including trans-equatorial migratory shorebirds. Feeding densities of shorebirds may be higher than anywhere else in Australia (C.Minton, pers. comm.). Over 240 bird species have been recorded on the Western Treatment Plant that overlaps this area.
Lake Connewarre System	This system consists of a series of interconnected fresh to saline habitats on the lower Barwon River. The wetlands support a large and diverse waterbird population and contain a significant area of natural vegetation for this part of the state.
Swan Bay	Swan Bay is very productive for marine invertebrates, birds, molluscs and fish. The saltmarsh and intertidal seagrass meadows are regionally significant. The avifauna is particularly diverse, with 190 bird species recorded (Barter <i>et al.</i> 1988).
Mud Islands	The islands support large numbers of migratory wading birds and breeding seabirds. A diverse population of shorebirds moves regularly between Mud Islands and Swan Bay.

Source: ANCA (1997).

## 18. Noteworthy flora:

Point Cook Metropolitan Park is a site of State botanical significance. This is the only Reserve in the western region of Melbourne that contains examples of four vegetation types in proximity (dune vegetation, salt marsh, swamp and grassland). McDougall (1987) rated the Point Cook Metropolitan Park as a site of State botanical significance. Thirteen plant species that are considered rare or restricted within the Melbourne Study Area occur in the area (Beaughole 1983).

The saltmarsh and adjacent vegetation near The Spits at Werribee-Avalon has international significance as an extensive example of a wide range of saltmarsh and coastal plant communities, including several rare species (Carr *et al.* 1979). The area supports the best coastal stands of Grey Glasswort (*Halosarcia halocnemoides*) which more commonly occurs in north-western Victoria (Yugovic 1984). This plant also grows at other sites in the SSN, and Farrell (1973) and Barson & Calder (1976) described the Grey Glasswort community at Limeburners Bay as structurally unusual for Victoria. It is an example of a dry saltmarsh, without the typical broad zone of Beaded Glasswort *Sarcocornia quinqueflora* (previously *Salicornia quinqueflora*). Also at this location, where spit deposits raise the level of the marsh in the upper part of Limeburners Bay, an assemblage of halophytes forms a low sward or type of saltmarsh meadow not as yet noted elsewhere in Victoria.

A total of 137 native and 78 exotic vascular plants are recorded from the Lake Connewarre State Game Reserve, indicating a very high species richness for wetland vegetation. The Reserve is the largest area of native vegetation remaining on the Bellarine Peninsula. Reedy Lake is the largest natural freshwater lake in central Victoria and has outstanding significance due to its large size, floristic richness and structural diversity (Yugovic 1985). The lower two-thirds of the Barwon estuary is essentially unmodified (Yugovic 1985). Salt Swamp supports an extensive (65 ha) Silky Wiltonia *Wilsonia humilis* herbland, which is the largest expanse of this unusual association in Victoria. The southernmost occurrences in Australia of Grey Glasswort and Tangled Lignum *Muehlenbeckia cunninghamii* and the westernmost occurrence in Victoria of the White Mangrove *Avicennia marina* are found at Lake Connewarre. Forty-five (85%) of the 53 salt marsh species recorded for Victoria occur at Lake Connewarre. The vegetation of this area is described further by LCC (1993). Swan Bay is an unusual shallow embayment with 700-1000 ha of mudflats exposed at low tide. It has a mixture of seagrass species that is relatively undisturbed and in good ecological condition. A new population of mangroves was discovered in 1999. The vegetation of Mud Islands has changed substantially in recent decades (LCC 1993), and includes some rare species such as Australian Hollyhock *Lavatera plebeia*.

Threatened plant species (e = endangered, v = vulnerable and r = rare at the state level) that have been recorded and are found in or close to wetland habitats of the SSN site (DCE 1991; see also Walsh & Entwisle 1994, 1996) are: Creeping Rush *Juncus revolutus* (r), Tiny Arrow Grass *Triglochin minutissimum* (r), Sea Water-mat *Lepilaena marina* (v) and Devious Sea-wrack *Halophila decipiens* (r). The alga *Acetabularia peniculus*, which has a restricted distribution (mainly in the tropics and subtropics) occurs in Swan Bay, which is its major site in south-eastern Australia (Womersley 1984).

## 19. Noteworthy fauna:

The range of habitats within the SSN site leads to a very diverse avifauna, with more than 150 waterbird species being recorded (Pescott 1983; Emison *et al.* 1987; Robinson 1982, 1983, 1984; Drummond 1985, 1986; Peake 1991; NRE 1999a).

**Waterbirds:** Surveys of shorebirds have been undertaken at all parts of the SSN site since 1981 (AWSG 1999). More specific studies of shorebirds and Orange-bellied Parrots have been completed as part of development proposals by: ORICA (formerly ICI) for the Point Wilson area (Loyn & Chandler 1978; Barkla *et al.* 1980; Chandler *et al.* 1981; Loyn *et al.* 1986), the Victorian Government at Point Lillias (PLPU 1996) and the Commonwealth Government at Point Wilson (Hill 1995). Other specific bird studies have been undertaken by Barter *et al.* (1988).

The SSN site is home to a vast number of birds dependent on its coastal wetlands and sheltered waters. The area is of international significance due to the presence of large numbers of migratory wading birds, seabirds and because of its importance to waterfowl and the endangered Orange-bellied Parrot. It is the sixth most important area in Australia for migratory shorebirds and the most important in Victoria. It is also of national significance due to the large number of different bird species (many of them relatively rare) and the large concentration of cormorants, Pied Oystercatchers, Banded Stilts and Red-necked Avocets. The presence of large numbers of terns, crakes, rails, coots, Great Crested Grebes, Straw-necked Ibis and Royal Spoonbills also give the site State significance.

**Seabirds:** A large proportion of the Victorian population of the White-faced Storm-Petrel (*Pelagodroma marina*), breed on Mud Islands and nearby South Channel Fort Island (there is only one other breeding site in the state). Lake Borrie has been the site of the largest breeding colony of Pied Cormorants (*Phalacrocorax varius*) in the state (after PV 1998b) but this colony has recently moved to another site across the Little River (R. Loyn pers. comm.).

**Terns:** One of the largest breeding colonies of Crested Terns (*Sterna bergii*) in Victoria (and the only Port Phillip Bay colony) is situated on Mud Islands. Smaller numbers of Caspian Terns (*S. caspia*) also nest there. Fairy Terns (*S. nereis*) breed irregularly at Mud Island, the Spits and Swan Bay. A pair of the threatened Little Tern (*S. albifrons*) bred recently at Sand Island on the edge of Swan Bay.

**Gulls:** Silver Gulls have regularly bred at Mud Islands in recent decades, with 40 000-50 000 pairs in 1986 (Menkhorst *et al.* 1988), representing over 5% of the Victorian breeding population.

**Ibis, Herons, Spoonbills and Egrets:** Tens of thousands of Sacred Ibis (*Threskiornis aethiopica*) and Straw-necked Ibis (*T. spinicollis*) roost at Lake Borrie or in other stands of inundated trees on the Western Treatment Plant. Yellow-billed Spoonbills (*Platalea flavipes*) and Royal Spoonbills (*P. regia*) occur regularly, particularly at the Spit, Avalon Saltworks and Swan Bay. Straw-necked Ibis and Australian White Ibis have regularly nested at Reedy Lake and more recently on Mud Islands, along with small numbers of Royal Spoonbills. Glossy Ibis *Plegadis falcinellus* and Royal Spoonbills nest infrequently at Reedy Lake. Great Egrets and Little Egrets occur regularly in various coastal parts of the SSN, and a small breeding colony of Little Egrets (in planted trees outside the SSN near Limeburners Lagoon) may now be the only nesting colony of that species in the state.

**Shorebirds (waders):** Most species spend the spring, summer and early autumn in Port Phillip Bay, and banding has shown that many individuals generally return to the same part of the bay every spring. The bay and the Bellarine Peninsula, including the SSN site, is the sixth most important location for shorebirds in Australia (Lane 1987).

**Waterfowl (ducks and swans):** Waterfowl are another numerous group with Laverton-Point Cook, Swan Bay, the Lake Connearre System and particularly the Werribee-Avalon area supporting tens of thousands of birds.

**Other birds:** Australian Pelicans *Pelecanus conspicillatus* now breed on Mud Islands and this is one of only six or seven colonies in Victoria. Pied Cormorants *Phalacrocorax varius* also bred there in 1987 (Menkhorst *et al.* 1988) but not in other years. Waterbirds such as grebes, coots, crakes and rails, and passerines inhabiting coastal scrubs and saltmarshes, also occur in significant numbers in the SSN site. A large proportion of the population of the critically endangered Orange-bellied Parrot overwinters on the saltmarshes of Swan Bay, the Werribee-Avalon area and Lake Connearre (Loyn *et al.* 1986, Starks *et al.* 1992). This species has also occurred historically on Mud Islands.



Fish: Swan Bay and Limeburners Bay are valuable fish breeding grounds for many of the commercial fish species caught in Port Phillip Bay.

A list of threatened wetland fauna that have been recorded in the Port Phillip Bay and Bellarine Peninsula SSN site is contained in Appendix 1.

## **20. Social and cultural values:**

Estimated human populations in the year 2000 are shown below for areas immediately adjacent to the different parts of the SSN site (listed for former local government areas- DPD 1995, except for the current area of Greater Geelong- DPD undated):

Laverton-Point Cook: 3,317,920 (Melbourne statistical division)

Werribee-Avalon: 195544 (Greater Geelong); estimate unavailable for Werribee Shire

Lake Connewarre: 102234 (City of South Barwon and Borough of Queenscliffe)

Swan Bay: 56018 (Bellarine Rural City and Borough of Queenscliffe)

Mud Islands: 56018 (Bellarine Rural City and Borough of Queenscliffe); estimate unavailable for Flinders Shire.

All parts of the SSN site are in close proximity to the very large populations of Victoria's two largest cities, Melbourne and Geelong.

Activities that occur in the different parts of the SSN site are:

Laverton-Point Cook: walking, sightseeing, nature observation (mainly birdwatching), limited bait collection, recreational fishing, recreational boating, park-based "Friends" group. Vines & Lane (1991) identified cultural and natural features of the former Laverton Saltworks.

Werribee-Avalon: sewerage treatment, agriculture, nature conservation, salt production, boating (including launching facilities), recreational fishing, nature observation (mainly birdwatching), explosives storage (including buffer area), walking, swimming, sightseeing,

Lake Connewarre System: recreational boating (various types), duck hunting, nature observation (mainly birdwatching), nature conservation, recreational fishing, commercial eel fishing, swimming, VFGA waterfowl nesting boxes and wetland management

Swan Bay: boating, nature observation (mainly birdwatching), nature conservation, recreational fishing, dredge spoil dumping (Sand Island)

Mud Islands: boating, nature observation (mainly birdwatching), nature conservation, recreational fishing, boat charters/ecotourism, biological research (ongoing).

The Point Cook Estate, Point Cook Homestead and the Stables are within the SSN site and are all listed on the Register of the National Estate, classified by the National Trust and are listed on the Register of the Historic Building Council (NTA 1985). Swan Island has historical value and is also listed on the Register of the National Estate for its fort complex and other historical buildings.

Aboriginal shell middens occur at Point Cook (C. Appleby pers. comm.). A large oyster midden exists on Campbell Point at Lake Connewarre (Gill & Lane 1985).

## **21. Land tenure/ownership:**

See 12. Management Authority:

## **22. Current land use:**

(a) the site: recreation; nature conservation; sewage treatment; aquaculture (trials); fishing; eel fishing in Reedy Lake and Hospital Swamps.

(b) the surroundings/catchment: grazing; industry including oil refining; quarrying; salt production; port facilities; urban development.

## **23. Adverse factors affecting the ecological character of the site:**

General threats across the whole SSN site include predation by foxes and adverse impacts associated with growing residential development and increasing recreational use, particularly use of personal water craft. Coastal implications of the Greenhouse Effect (eg. sea level rises) were examined by PMA (1992). Substantial modification is likely to the flat low coastline within the SSN site.

Laverton-Point Cook: Shoreline recession and progradation along the Point Cook-Altona coast, particularly at the Cheetham Wetlands, has altered the coast substantially (Appleby 1989). Consequently, several ponds within the former saltworks have been lost while new spit lagoons have been formed, and new spit growth and barriers formed at channel or creek mouths have provided new roost sites for waterbirds. Massive sand movements have smothered seagrass beds

and the Point Cook reef (G. Appleby pers. obs.; C Appleby pers. comm.). Illegal trail-bike riding is a detrimental use and residential development has the potential to increase disturbance to wildlife.

Werribee-Avalon: The Victorian EPA has issued changes to licence conditions in 2005 relating to the discharge of wastewater from the Western Treatment Plant into Port Phillip Bay. The lower nutrient levels required under the new licence will benefit water quality in the Bay but, at a more localised level, may affect shorebird and waterbird usage and abundance in the vicinity of Lake Borrie.

Due to EPA requirements to reduce the amount of nitrogen entering Port Phillip Bay, sewage treatment processes at the WTP will be augmented. This will mean that raw or partially treated sedimented sewage will not be applied directly to land as has occurred in the past. Instead all sewage will be processed using an enhanced lagoon process, primarily in modern lagoons. Land irrigation using effluent will continue for agricultural or horticultural purposes but the nature and extent of this has not been determined. These changes may impact on waterbirds that utilise this habitat type. Changes proposed by Melbourne Water to meet EPA licence requirements are outlined in an environment improvement plan (Melbourne Water Corporation 1999).

Weston *et al.* (1995) found significant effects of aircraft disturbance on birds, as measured at the annual Avalon Airshow.

An aquaculture development at Avalon Saltworks is proposed adjacent to the SSN site, on 17 ha of leasehold land (held by Cheetham Salt until 2009) and possibly on at least 30 ha of adjacent grassland and brackish-saline herbfield that are held under annual grazing lease (ECC 1998).

Introduced grazing and predatory mammals (rabbits, hares, foxes and feral cats) are abundant.

Other uses with the potential to be detrimental if not carefully managed are agriculture (affects part of area), any new industrial and residential development, livestock grazing and visitor impacts.

Lake Connewarre: Erosion of clay banks in the saltmarsh is occurring. Disturbance to feeding and roosting shorebirds may arise from duck hunting.

Swan Bay: Changes to the dynamics of sediment movement in Swan Bay may affect all aspects of the ecosystem. Boating may cause localised disturbance around dock and mooring facilities.

Mud Islands: The expanding Silver Gull colony is threatening tern breeding areas. Associated vegetation changes may have unknown impacts on island dynamics and habitat for shorebirds and other species. The population of the introduced Common Shore Crab *Carcinus maenas* in the lagoon at Mud Islands may become a problem. Boating, walking and wading may disturb feeding and roosting shorebirds. An aquaculture development is proposed for Pinnacle Channel in the waters of Port Phillip Bay near Mud Islands (ECC 1998). Marine ecosystems may be vulnerable to unseen changes such as establishment of exotic organisms.

Coastal implications of the Greenhouse Effect (eg. sea level rises) were examined by PMA (1992). Substantial modification is likely to the flat low coastline within the SSN site.

## **24. Conservation measures taken:**

Management plans or strategy plans have been prepared for the Lake Connewarre State Game Reserve (CNR 1993a), Swan Bay Marine and Wildlife Reserves (DCE 1991), Point Cook Metropolitan Park and Cheetham Wetlands (MPW 1995a, 1995b, 1996) and the Western Treatment Plant and The Spit Nature Conservation Reserve (Melbourne Water Corporation 2000). A water management plan for Reedy Lake is being prepared.

Melbourne Water Corporation commissioned a study to investigate the likely impact of the changed licence conditions for discharge of wastewater from the sewage treatment process to the Bay on the habitat of shorebirds and waterbirds in the Lake Borrie treatment system and along the adjacent shoreline in the Werribee-Avalon area (Melbourne Water Sewerage Group 2000a). Melbourne Water Corporation has designed a waterfowl and migratory wader monitoring program (Melbourne Water Sewerage Group 2000b).

An EPA works approval for changes in operation to lagoon 55E at WTP, following an assessment of the potential impact on waterfowl, has been granted.

Catchment management strategies (NRE 1997a,b) and a regional landcare plan (CNR 1993b) affecting all parts of the SSN site have been prepared. The South West water strategy (Drew 1987) and a water resources management strategy for the Corangamite Basin drainage schemes (RWC 1988) cover the Barwon River.

Environmental impact statements for the proposed drainage scheme at the Cheetham Saltworks (CSF *et al.* 1992), the relocation of the East Coast Armaments Complex to Point Wilson (Blakers 1996) and the relocation of the Coode Island bulk liquid chemical storage facility to Point Lillias (PLPU 1994; Dunt 1996; PLPU 1996) have been completed. It was decided not to proceed with the latter project.

Management information for four threatened fauna taxa (White-bellied Sea-eagle, Little Tern, Orange-bellied Parrot and Altona Skipper Butterfly) that are listed on the Flora and Fauna Guarantee (NRE 1999c) is provided by Clunie (1994), Reside (1994), Edgar & Menkhorst (1993) and Crosby (1990) respectively. General management recommendations for waterbird species listed as nationally threatened (ie. species listed in Appendix 1 as well as Fairy Tern *S. nereis*, Freckled Duck *Stictonetta naevosa* and Painted Snipe *Rostratula benghalensis*) are given in Garnett (1992) and Garnett *et al.* (1993). Several flora and fauna species found in the SSN area are listed as threatened in Victoria (NRE 1999e).

The exotic cord grass, *Spartina anglica*, has recently been found in the Barwon estuary, close to a popular boat launching ramp (Walsh & Entwisle 1994; G. Appleby pers. obs.). The ecology and control of *Spartina* spp. (including Townsend's Cord-grass *Spartina X townsendii* that is found in some other Victorian estuaries (Walsh & Entwisle 1994) are covered in Rash *et al.* (1996).

Some wetlands in the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula SSN site have been placed on an environmental significance overlay in the City of Greater Geelong local planning scheme by virtue of their Ramsar site status.

## **25. Conservation measures proposed but not yet implemented:**

Melbourne Water Corporation has undertaken an assessment of the potential impact on waterfowl of the changes in the operation of the 55E lagoon. The impacts of the proposed changes could not be predicted with any precision and monitoring of bird populations before and after the implementation of the 55E lagoon upgrade has been recommended. Melbourne Water is in the process of implementing this recommendation.

Melbourne Water Corporation will initiate a waterfowl and migratory wader monitoring program in October 2000. This and other actions are outlined in the Western Treatment Plant and The Spit Nature Conservation Reserve Conservation Management Action Plan (Melbourne Water Corporation 2000).

A strategic management plan is being prepared for the Port Phillip Bay and Bellarine Peninsula Ramsar Site in which this SSN site is included.

The Environment Conservation Council made interim recommendations that Mud Islands and Swan Bay be included in a 'Great Sands Sanctuary Zone' within the proposed Port Phillip Heads Marine Park (ECC 1998). These recommendations have yet to be considered by Government.

An environmental management plan is being prepared for Port Phillip Bay.

## **26. Current scientific research and facilities:**

The Marine and Freshwater Research Institute (Queenscliff campus) of the Department of Natural Resources and Environment is based near Swan Bay at Queenscliff. The type of work undertaken includes recreational fisheries assessment, fisheries biology research and assessment, aquatic ecology, marine and estuarine dynamics, research into aquaculture, ecotoxicology and aquatic chemistry, and Geographic Information Systems (GIS) applications.

There is a large body of current and previous research for the SSN site as outlined below.

Summaries have been completed for shorebirds, bird populations or fauna generally at the former Laverton Saltworks (Vines & Lane 1991), Point Cook Metropolitan Park (Meredith *et al.* 1989), Western Treatment Plant (Lane & Peake 1990), the Werribee-Avalon area (RAOU 1995 a,b; Appleby 1997), Geelong and the Bellarine Peninsula (Pescott 1983), the western side of Port Phillip Bay (Schulz *et al.* 1991), Port Phillip Bay (Lane *et al.* 1984), southern Victoria (Dann 1993) and national shorebird sites (Watkins 1993). Several of these reports assign ratings at international, national, state, regional and local scales, to areas of various sizes that cover parts of the SSN area. Other work includes a study of the environmental values of Queenscliff Harbour (Ball & O'Callaghan undated).

The SSN site has been covered by detailed historical bird survey data for Orange-bellied Parrots, shorebirds, waterbirds and seabirds (Loyn *et al.* 1986; Starks *et al.* 1992; J. Starks pers. comm.; AWSG 1999; R. Swindley pers. comm). The Victorian Wader Study Group regularly uses several areas for trapping and banding of shorebirds. Bird banding has been carried out on Mud Islands since 1914. Between 1979 and 1987, 11 300 Silver Gull chicks were banded of which 2% have been recovered (Menkhorst *et al.* 1988).

The type specimens of two isopods *Haliophasma cycneum* and *Paranthura boronia* held at the Museum of Victoria were collected in Swan Bay (R. Wilson pers. comm.).

Vegetation surveys of Lake Connemare and Mud Islands are detailed by Yugovic (1985) and Yugovic (unpublished). Saltmarsh sheep grazing and its effects on Orange-bellied Parrot habitat values were examined in Carr *et al.* (1979).

A series of reports including those examining: microphytobenthos (Beardell & Light 1997), biomarkers for sewage, primary producers and bacteria (O'Leary *et al.* 1994), the role of suspension feeding and deposit feeding benthic macroinvertebrates in nutrient cycling (Wilson *et al.* 1993) were produced for the Port Phillip Bay Environmental Study undertaken by CSIRO (Harris *et al.* 1996).

Coastal erosion and spit formation was investigated in Appleby (1989).

Studies of hydrology have been conducted for the lower Barwon River (Sherwood 1988), Swan Bay (Kenley 1974) and The Spit (Kinhill 1982). Water quality in the Barwon River was examined by CEE (1986). Inter-relationships between waterbirds and changes in effluent flows at the Western Treatment Plant were studied by Steele (1996).

## **27. Current conservation education:**

Education kits covering estuarine wetlands (O'Callaghan 1992) and the Swan Bay catchment (Longmore & O'Callaghan) and a report examining potential wetland education and research (Lane & Wood 1988) have been prepared. The Marine and Freshwater Discovery Centre (part of the Marine and Freshwater Research Institute of the Department of Natural Resources and Environment) is based at Queenscliff.

The City of Greater Geelong has been undertaking a wetland community awareness program since 1998.

The SSN site is close to universities and a large number of schools in the Melbourne and Geelong area. Lake Connemare and parts of the Western Treatment Plant has been used extensively for teaching purposes. Mud Islands is used for excursions by Frankston TAFE and the Victorian Institute of Marine Sciences, which also run summer holiday activities for the general public.

## **28. Current recreation and tourism:**

The Point Cook Metropolitan Park receives large numbers of visitors and provides recreational and picnic facilities. New interpretation features including an observation tower, board walks and walking tracks have been recently developed in the Cheetham Wetlands section.

The Western Treatment Plant has very high values for birdwatching. Although access is restricted it is within easy reach of Melbourne. It is regarded as the best place in Victoria for waterbirds and is internationally renowned.

Parts of the Laverton and Werribee-Avalon coastline are heavily used for recreational fishing.

Lake Connemare State Game Reserve has been used for duck hunting and is a good fishing area for Jewfish *Sciaena antarctica*, which has a limited distribution. Windsurfing and boating are popular activities on the river, especially in the estuary.

Mud Islands is only accessible by boat but still receives a number of visitors.

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### 30. List of appendices:

- 1: Threatened fauna recorded from the Port Phillip Bay and Bellarine Peninsula SSN site.
- 2: Important shorebird sites inside and adjacent to the Port Phillip Bay and Bellarine Peninsula SSN site



## Appendix 1: Rare or threatened fauna recorded from the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula SSN site

ce = critically endangered, e = endangered, v = vulnerable, lr = lower risk- near threatened, dd = data deficient; upper case and lower case indicate national and state ratings respectively

### Shorebirds

Hooded Plover ( <i>Charadrius rubricolis</i> ) – e	vagrant; pairs resident on ocean beaches and nearby wetlands near Point Lonsdale (outside SSN)
Painted Snipe ( <i>Rostratula benghalensis</i> ) – e	rare vagrant to shallow wetlands
Eastern Curlew ( <i>Numenius madagascariensis</i> ) – lr	regular in small numbers on coasts, e.g. Spit Lagoon; larger flocks (hundreds) Swan Bay and Mud Islands
Pectoral Sandpiper ( <i>Charadrius melanotos</i> ) – d	regular in small numbers vegetated sewage lagoons and shallow wetlands
Long-toed Stint ( <i>Charadrius subminuta</i> ) - d	Small numbers occasional on vegetated sewage lagoons and shallow wetlands

### Waterbirds

Orange-bellied Parrot ( <i>Neophema chrysogaster</i> ) - Ece	flocks winter in saltmarsh and weedy paddocks or roadsides
Little Tern ( <i>Sterna albifrons</i> ) – Ev	shallow sea and saline lagoons; has bred Sand Island
Intermediate Egret ( <i>Ardea intermedia</i> ) – ce	vagrant, freshwater swamps
Little Egret ( <i>Egretta garzetta</i> ) – ce	saline lagoons; breeds near Limeburners Lagoon
Magpie Goose ( <i>Anseranus semipalmata</i> ) – e	vagrant, swamps and lagoons
Great Egret ( <i>Ardea alba</i> ) – e	mainly tidal lagoons, and river shores
Little Bittern ( <i>Ixobrychus minutus</i> ) – e	vagrant, densely vegetated freshwater swamps
Freckled Duck ( <i>Stictonetta naevosa</i> ) – e	small to large flocks irregularly on swamps and sewage lagoons, e.g. Lake Borrie
White-bellied Sea-Eagle ( <i>Haliaeetus leucogaster</i> ) – e	vagrant, hunting over sea and wetlands
Australasian Bittern ( <i>Botaurus poiciloptilus</i> ) – e	erratic visitor in small numbers to densely vegetated lagoons, ditches and rank grasslands
Lewin's Rail ( <i>Rallus pectoralis</i> ) – e	resident or regular visitor to saltmarsh, e.g. beside Little River
Fairy Tern ( <i>Sterna nereis</i> ) – v	shallow sea, has bred Spits, Mud Is and Sand Is
Cape Barren Goose ( <i>Cereopsis novaehollandiae</i> )	occasional visitor, wetlands and pasture
Blue-billed Duck ( <i>Oxyura australis</i> ) v	varying numbers up to hundreds on sewage lagoons
Brolga ( <i>Grus rubicundus</i> ) – v	small numbers occasional, saltmarsh and wet pasture
Ground Parrot ( <i>Pezoporus wallicus</i> ) – v	at least one vagrant in saltmarsh, Lake Connewarre
Baillon's Crake ( <i>Porzana pusilla</i> ) – v	occasional visitor, mainly freshwater swamps
Caspian Tern ( <i>Hydroprogne caspia</i> ) – v	shallow sea; breeds Mud Islands
Glossy Ibis ( <i>Plegadis falcinellus</i> ) – v	small flocks occasional in shallow wetlands
Royal Spoonbill ( <i>Platalea regia</i> ) – v	small flocks regular in tidal lagoons, and nearby wetlands; may breed Mud Islands and Reedy Lake
Australasian Shoveler ( <i>Anas rhynchos</i> ) – v	varying numbers up to thousands on sewage lagoons; fewer on nearby tidal waters
Hardhead ( <i>Athya australis</i> ) – v	varying numbers up to thousands on sewage lagoons or other open water
Musk Duck ( <i>Bizyura lobatus</i> ) – v	varying numbers up to over a thousand on sewage lagoons; fewer on other open water including shallow sea
Nankeen Night Heron ( <i>Nycticorax caledonicus</i> ) – v	occasional visitor in small numbers, treed wetlands
Pied Cormorant ( <i>Phalacrocorax varius</i> ) – lr	feeds in shallow sea; nests and roosts among dead trees Western Treatment Plant
Whiskered Tern ( <i>Chlidonias hybrida</i> ) – lr	many hundreds regular in summer over open water and rank grasslands nearby
Pacific Gull ( <i>Larus pacificus</i> ) – lr	regular in small flocks along tidal shores and adjacent lagoons
Crested Tern ( <i>Sterna bergii</i> ) – lr	open sea, roosting on rocks or sandy spits; breeds Mud Islands

<b>Fish</b>	
Australian Grayling ( <i>Prototroctes maraena</i> ) – v	rivers (e.g. Barwon), migrating to sea
Yarra Pigmy Perch ( <i>Edelia obscura</i> ) – lr	rivers and wetlands (Barwon)
Tasmanian Mudfish ( <i>Galaxias cleaveri</i> ) - v	recently discovered in lower Barwon River

<b>Reptiles</b>	
Swamp Skink ( <i>Egernia coventryi</i> ) – v	saltmarsh

## **Appendix 2: Important shorebird sites inside and adjacent to the Port Phillip Bay and Bellarine Peninsula SSN site**

### Laverton-Point Cook:

*SSN site:* the eastern half of the former Cheetham Saltworks south of a former course of the Skeleton Creek to Point Cook; the Point Cook area; the coastline fringing this area to marine waters two metres deep at low tide

*Adjacent to or contiguous with SSN site:* the former Cheetham Saltworks north of a previous course of the Skeleton Creek to Laverton Creek (freehold and leasehold recently proposed to be transferred to DNRE/PV); a north-south section between the Skeleton Creek lake and No. 1 pump (freehold recently transferred to DNRE/PV); the coastline fringing the remainder of the saltworks coast; Spectacle Lakes including lignum-fringed pond and tributary, and Red Gum swamp; RAAF Lake and surrounding saltmarsh and saltmarsh/pasture transition (part Commonwealth land proposed to be transferred to DNRE/PV); freshwater meadows and marshes along Point Cook Metropolitan Park access road.

### Western Treatment Plant:

*SSN site:* shallow ponds (ie. Austin Road Lagoons and T-Section Lagoons Paradise Road Lagoons, parts of Lake Borrie complex, Walsh Lagoons, Borrow Pits/Conservation Ponds adjacent to 145W Drain, other borrow pits in deep sewage pond areas); part of some deep ponds (ie. used by shorebirds for roosting); some drain easements; embankments/bunds and adjacent roads in deep sewage pond areas; Ryan's Swamp (all Melbourne Water-owned); saltmarsh, dunes and reefs fringing the coast, Little River estuary including saltmarsh; The Spit lagoon; inter-tidal zone to marine waters two metres deep at low tide or 100 metres offshore; swamps in swales between beach barrier lagoons.

*Adjacent to or contiguous with SSN site:* inland part of Murtcaim dry saltmarsh, inland parts of some sewage treatment lagoons (25W, 55E, 115E, 85WC and 145WA).

### Avalon-Point Wilson:

*SSN site:* all of current Ramsar site listing

*Adjacent to or contiguous with SSN site:* Avalon Saltworks (freehold and leasehold); Point Lillias coastline; saltmarsh-pasture transition, including rocky areas, fringing Avalon Saltworks and west Point Wilson saltmarsh (private and Commonwealth); east Point Wilson low saltmarsh and meadow/shallow marshes (Commonwealth); east Point Wilson coastline; lower Hovells Creek saltmarsh (private or local council) .

### Lake Connewarre System:

*SSN site:* all of current Ramsar site listing

*Adjacent to or contiguous with SSN site:* southern and western fringes of Hospital Lakes including artificial wetland; saltmarsh north of Belchers Lane; saltmarsh east of Lake Murtnaghurt; south-west part of Salt Swamp (all private).

### Swan Bay:

*SSN site:* Swan Bay including bay on the north side of Swan Island

*Adjacent to or contiguous with SSN site:* between Queencliff and the south-west end of Swan Island including Sand Island (unreserved Crown land) and the yacht club basin (Commonwealth, leasehold); the fringe of Swan Island facing into Swan Bay; saltmarsh fringing the western side of Swan Bay and Edwards Point (Wildlife Reserve and private).

### Mud Islands:

*SSN site:* Mud Islands and adjacent marine waters within Marine Reserve.

*Adjacent to or contiguous with SSN site:* none relevant.