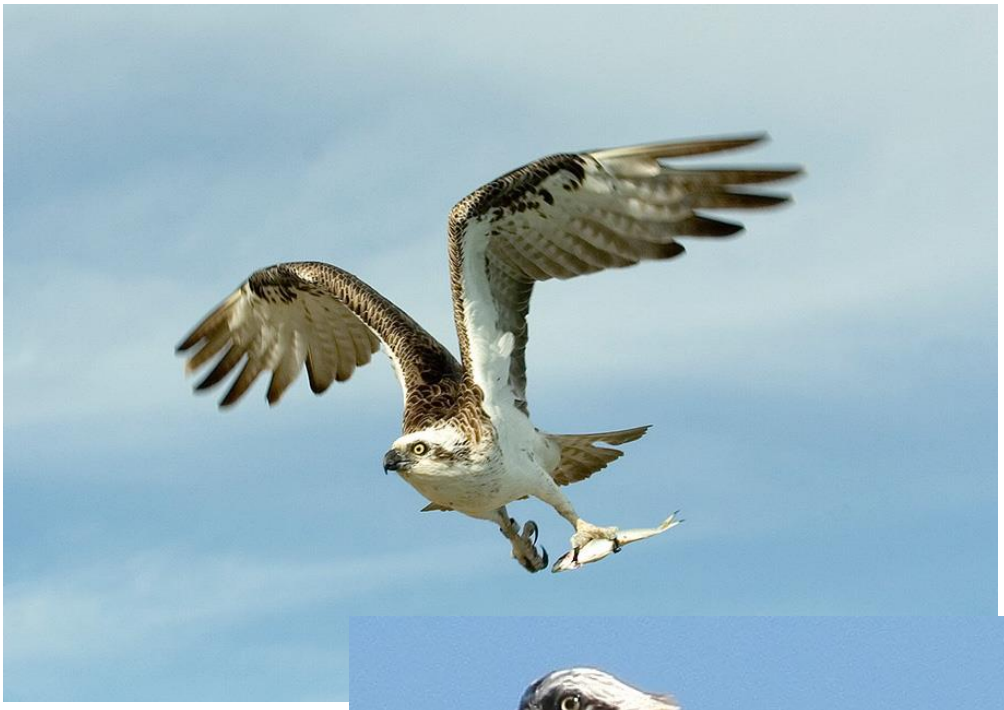
Recovery and Conservation Plan for the Osprey *(Pandion halliaetus)* on Yorke Peninsula, South Australia



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Australian Government

Recovery & Conservation Plan for the Osprey (*Pandion halliaetus*) on Yorke Peninsula, SA

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Cover photographs: Adult Osprey (male), South Australia (© Mr Nick Birks, Wildflight)

Adult Osprey (female), Yorke Peninsula, SA (Mr Kent Treloar)

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Acknowledgments

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Abbreviations

AIBS Adelaide International Bird Sanctuary	WBSE White-bellied Sea Eagle
USVG Upper St Vincent Gulf	DEW Department of Environment and Water
NRM Natural Resource Management	DELWP Department of Environment, Land, Water and Planning, Victoria
CPG Community Partnership Group	SYPLCG Southern Yorke Peninsula Landcare Group Inc
EAAF East-Asian Australasian Flyway	PA Progress Association
ARI Arthur Rylah Institute	

Summary

This Plan is intended to concentrate on the recovery and habitat management of the Osprey population across the Yorke Peninsula and adjacent Spencer Gulf and St Vincent Gulf areas (Figure 2).

The formally listed Endangered Osprey population in South Australia is considered to be disjunct from the species main distribution in Australia and appears precariously balanced ecologically at the extreme south eastern edge of its breeding range.

Comprehensive surveys across South Australia in 2008-10 recorded 58 pairs of Osprey state-wide; compared with results from a series of repeat surveys in 2015-17 when only 43 pairs were found; revealing a significant 26% decline in the breeding population to have occurred over the intervening period. All known Osprey breeding sites on the mainland of Yorke Peninsula have regularly failed or become abandoned in recent decades due mainly to human disturbance factors. Only one nest close to the main land, on an island in Pondalowie Bay remains occupied.

Few raptors, including Ospreys, will tolerate human encroachment and disturbance directly above their nest, as typically occur in South Australia's open coastal landscapes. In other states, more secure nest placement opportunities are available in tall trees in coastal forests which are absent from the SA coastline. The lack of suitable secure nesting sites maybe an important limiting factor to Osprey breeding populations in SA.

In remote locations Osprey are sensitive to human activity and will abandon a breeding attempt if disturbance is frequent or prolonged, this is in contrast to the species demonstrated adaptability and tolerance to human activity, including to establish nests on various structures in urban areas. Artificial nest platforms are a vital and proven form of threat mitigation in areas where limited natural nest sites exist and where food is plentiful, additional nest sites can substantially boost nesting densities. Conservation initiatives in Europe and North America have shown unequivocally that artificial nest structures can result in greater productivity and therefore are an important population augmentation strategy.

Heavy rain and strong winds are known to devastate some nests at exposed sites during the nesting phase and can cause heavy mortality amongst Osprey broods, while at the same time reducing the foraging success during breeding. Osprey young are also vulnerable to White-bellied Sea Eagle (*Haliaeetus leucogaster*) predation and Corvids, Pacific Gulls (*Larus pacificus*) and Silver Gulls (*Chroicocephalus novaehollandiae*) are known to predate on eggs of raptors when they are disturbed and distracted by human presence.

A temporary artificial nesting platform was constructed near Price in 2017. Two young successfully fledged from this site in the 2019 breeding season. Site characteristics and choice play an important role in the tolerance of Ospreys to human disturbance.

Much is still unknown about the South Australian Osprey population. This plan also highlights the importance of further research such as; satellite tracking to determine habitat utilisation and foraging behaviours and strategies of adult male Ospreys; colour banding of juveniles to determine dispersal and movements post fledging; development of dietary studies for Ospreys and re-assessment of the status of the Osprey population in each region to measure stability and productivity and identify trends in the available baseline data to determine mitigation strategies against any further population declines. Finally it will be important to monitor the success of artificial nesting platforms to determine breeding outcomes.

Objectives

The objectives of this plan:

1. To assess the known osprey distribution and breeding territory information for Yorke Peninsula to determine appropriate sites for artificial nest platforms
2. To re-establish and augment the Osprey population across the Yorke Peninsula and adjacent Spencer Gulf and St Vincent Gulf areas through the provision of artificial nest platforms.
3. If successful, consider the introduction of artificial nest platforms at key sites / habitats in other regions of SA
4. Promote and encourage community involvement in the fabrication and construction of artificial Osprey nest platforms and in an ongoing monitoring program.

1. General information

Conservation Status

In South Australia, the Osprey was formally up-listed to Endangered status in 2008 (*National Parks and Wildlife Act 1972*). The Osprey is listed as 'Vulnerable' in New South Wales under the *Biodiversity & Conservation Act 2016.* In Western Australia, Northern Territory and Queensland Osprey populations are considered secure.

Affected Interest Groups

Organisations that may be affected by the actions proposed in this Recovery Plan include:

Australian Government, Department of Primary Industries SA (Agriculture, Fisheries and Forestry (PIRSA), Department of Environment and Water (DEW), Department of Employment, Local Government Authorities (Yorke Peninsula Council, District Council of Barunga West), Department Planning, Transport and Infrastructure (DPTI), AMLR Natural Resource Management Board, N&Y Natural Resource Management Board, Industry Groups, National Farmers' Federation (NFF), Ag Ex Alliance, Non Government Conservation Organizations, Landcare Groups, Australian Landcare, Birdlife Australia, Birds SA, Greening Australia, Point Pearce Narungga Aboriginal Community / Aboriginal Lands Trust, Research institutions (Universities), Private landholders, Formby Bay Environmental Action Group, Community Progress Associations (PA) include Price PA, Port Clinton PA, Port Broughton PA, Corny Point PA and Foul Bay PA, Commercial Fishing Groups, Recreational Fishing Groups, Coastal Raptors Volunteer Network and SA Abalone Divers Association.

This is a list of principal stakeholders, but should not be considered exhaustive. Other interest groups may also need to be considered prior to undertaking particular tasks.

Consultation with Indigenous People

Due to the geographic range of the Osprey and hence the number of Indigenous groups with an interest in this species or the lands it occupies, limited consultation has been undertaken with Indigenous groups in relation to the development of this recovery plan to date. Key people from the Point Pearce Narungga Aboriginal Community near Port Victoria, have been involved in the planning and potential management of a nest platform for Osprey on Point Pearce Aboriginal lands.

Benefits to Other Flora & Fauna Species

Osprey occur in areas of high biodiversity, have large territories and are good indicators of the health of the environment (Pool 1989). Areas Osprey are known to frequent possess intact coastal habitat, healthy marine habitats with good fish stocks, and areas where diverse bird populations occur. Hence, the conservation of any area for Osprey will have a substantial biodiversity benefit for a wide range of coastal and marine animals and plants.

Social & Economic Benefits

The Osprey has the potential to unify interested community and volunteer groups along with government agencies to work together to provide artificial nesting platforms. These efforts are central to promoting the successful recovery of the Osprey population in SA particularly in areas where there is a shortage of natural nest sites. These cooperative partnerships are a positive way of bringing the community together and working towards improving the overall quality of the environment. If through the provision of artificial nest platforms, the Osprey becomes more common in SA, it is hoped that more people will become familiar with this spectacular bird and support its conservation.

2. Osprey Distribution & Biology

Geographic Distribution

There is only one species in the Pandionidae family (Osprey) but it inhabits most parts of the world, except the polar regions. There are four sub-species of Ospreys recognised with little variation evident apart from size. In the Australian sub-species the primary difference is a body mass 12-14% smaller for both sexes when compared with the Northern Hemisphere population. (Dennis and Clancy 2014). Marchant and Higgins (1993) refer to the Osprey *Pandion Haliaetus* subspecies *leucocephalus* which occurs in Australia, New Guinea, Indonesia, Solomon Islands and New Caladonia. In the recent past the Osprey has been referred to the Eastern Osprey however it is now widely accepted as the Osprey and the Eastern has been dropped from the name.

The Osprey in South Australia is considered a disjunct distribution: Almost continuous from Esperance in Western Australia extending north across the Northern Territory to southern NSW. A small isolated population in South Australia extends from Kangaroo Island, Yorke and Eyre Peninsula's to the western end of the Bunda Cliff (Great Australian Bight) (Detmar and Dennis 2018). To the east there is a broad gap in the species historical breeding range from Kangaroo Island to about 180 km south of Sydney (Clancy 2009). Ospreys are known only as rare vagrants in Victoria and Tasmania (Dennis and Clancy 2014).

A survey was conducted between 2003 and 2005 by Dennis (2007) which found that Ospreys were limited to coastal habitats as shown in Figure 1. More comprehensive surveys were undertaken of Osprey habitat across all coastal regions of South Australia in 2008-10 and in 2015-17.

Worldwide Ospreys have a broad distribution because they are able to live almost anywhere there are safe nesting sites and shallow water with abundant fish. In South Australia Osprey breeding habitat is limited to mostly semi-arid open coastal landscapes with low coastal heath vegetation. Nests are generally found along littoral habitats including exposed cliffs or associated broken terrain with little or no visual screening, on near-shore sea-stacks, in mangroves, estuaries and or rocky island / reef systems (Detmar and Dennis 2018). Osprey are not usually observed far from shore, in the coastal environment, ranging further out over sheltered bays and estuaries where sheltered waters provide protection from high waves and wind that interfere with their fishing (Pool 1989).

Only four occupied territories occur on Yorke Peninsula, three are on islands and the other on an artificial nest platform (previously on a navigation marker) in Gulf St Vincent. This is significant as there are no known contemporary or historical breeding records for Gulf St Vincent. Two highly disturbed nest sites on southern Yorke Peninsula have been abandoned since 2010, due to becoming highly disturbed by human activity, resulting in the entire mainland coastline of Yorke Peninsula now devoid of occupied Osprey territories. (Detmar and Dennis 2018).

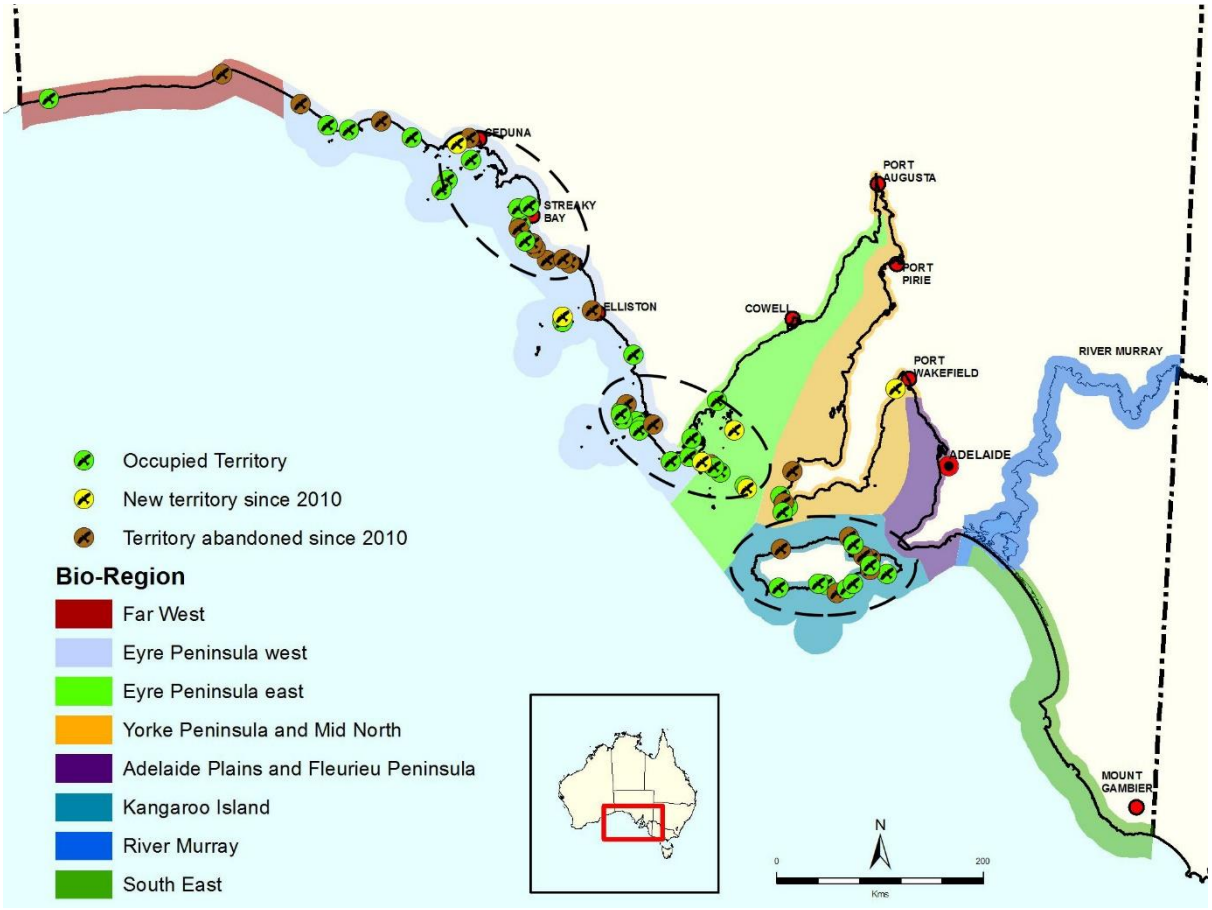


Figure 1: Map of Osprey territories (green stars) in South Australia with areas of significant habitat within the dashed circles (Detmar and Dennis 2018).

Species Description

Ospreys are spectacular and unique birds at the top of the aquatic food chain. Ospreys are large birds weighing 1.0 to 1.6kg with a wing span of about 1.4 to 1.6 metres. Ospreys exhibit reverse sexual dimorphism where males are slightly smaller than females. Unlike their relatives, Ospreys eat fish almost exclusively and catch their prey in a dramatic way diving into the water from a height of up to 40 metres. Unlike other raptors, the opposite outer toe (which can be moved to point forwards or backwards) and the sharp spines on the soles of the feet, help the Osprey to grasp the twisting fish until a safe perch is reached.

Preferred Habitat

Ospreys are adaptable birds, often tolerant of people to a certain extent and will sometimes choose to nest in close proximity to towns and passive human activities. This statement may appear contradictory given human induced disturbance may be one of the reasons for a decline in the SA population. However site characteristics and individual sensitivity to human activity play an important role in the tolerance of Ospreys to human disturbance and these and other factors are vitally important when selecting a location to establish an artificial nest platform (Pool 1989).

Generally Ospreys prefer sites that are open (peninsulas, mashes, lakes) over water or the tops of tall forest trees along shorelines (Poole 1989). In NSW and Queensland Osprey nests are mainly constructed in dead trees (Clancy 2006). However in South Australia's open coastal landscapes Ospreys have little choice for nesting sites as tall trees are basically absent from the coastline (Detmar and Dennis, 2018). Cliffs and limestone stacks, rocky headlands, off shore islands with low shrubland and mangrove forests typify the South Australian coastline. Whilst the preceding describes the lower Yorke Peninsula coastal landscape, much of the mid to upper areas are characterised by a low energy coastline of low relief with estuaries, bays, rocky island / reef systems and mangroves.

In the northern hemisphere because artificial nest structures tend to be more stable and secure, more young are fledged per nest each breeding season than from nests on naturally occurring locations such as trees (Poole 1989, Poole 1994). One of the objectives of providing artificial nesting platforms for Osprey in areas of frequent boat traffic is to encourage Osprey away from nesting on utility and navigation poles around the coast as these nests can cause safety and nuisance issues to boat navigation.

Sites near fish rich waters are also vitally important. Poles with nesting platforms in open areas need not be tall if they are well isolated amongst surrounding vegetation (mangroves) and well protected from human and pest intruders and disturbance. In all cases it is recommended to locate artificial nests at least 300 metres away from areas that people visit and access sporadically.

Ospreys can habituate to nearby human (>300 metres) activity but only when exposed on a continuous basis and the disturbance is non-threatening.

Ospreys clearly have a preference to nest sites surrounded by water. A nest platform secured to a solid pole at least 100 to 150 metres off shore makes an ideal nest site, although it must be well above waves and storm and tidal surges (6 metres minimum). An important point here is the chances of attracting a nesting pair of Osprey increases dramatically when the nesting platform is built over water or on a small off shore island. Pool (1989) highlights the importance of constructing artificial nest platform on small open islands as these situations, will attract pairs with great success.

Breeding

Osprey breed along the coast, on coastal cliffs and off shore islands in an open position for Osprey access and visibility with protection from predators via height and surrounding water (Pool 1989). Often the nest is located in a prominent position on rocky headlands, near-shore stacks, cliffs, or in low shrubs or even on the ground on offshore islands (Marchant and Higgins 1993; Dennis 2007a).

Historically Ospreys have been recorded breeding along the Murray River however it is thought that increased turbidity and poor quality water have made hunting and catching fish more difficult in recent decades, and breeding has not occurred there since 1980 (Detmar and Dennis 2018).

In South Australia a clutch of 3 eggs are laid mainly in September but ranged from mid-August to mid-October and are incubated for about 37-40 days and often only 2 eggs hatch. In a study on Kangaroo Island most hatching was found to occur from mid-October through November with some late hatching in early December, resulting in most young fledging in January (Dennis 2007b). The period between hatching and fledging was found to vary between 62 and 74 days (mean 69 days) on Kangaroo Island, which is longer than recorded elsewhere in migratory populations, but consistent with another non-migratory Osprey population in the Caribbean where nests were found to be poorly provisioned (ie where prey was scarce resulting in young taking longer to develop to maturity. (see Dennis 2007b).

Male Ospreys provide virtually all the fish for the young and the female remains at the nest. Once independent, juvenile Ospreys spend their first few years of life wandering and do not usually make their first breeding attempt until 3 to 5 years of age. In some populations it is thought that many young birds return to breed within 50 km of their natal site therefore colonisation of new areas may be relatively slow. In South Australia Dennis (2007b) found a 22% level of philopatric recruitment (the tendency of an animal to remain in or return to the area of its birth to breed) on Kangaroo Island.

Factors Affecting Population Stability

The decline of the Osprey population in South Australia is well documented (Detmar and Dennis 2018). Comprehensive surveys between 2008 and 2010 recorded 58 occupied territories (pairs at a nest); while the repeat surveys in 2015-17 only 43 were identified. Comparison of these results reveals a significant 26% decline in the breeding population over the period between the surveys (Detmar and Dennis 2018).

The main threats being loss of natural nest sites in remote areas due to encroaching coastal developments, human disturbance at nest sites, reduction in quality and quantity of prey and degradation of estuarine systems (Clancy 2006, Detmar and Dennis 2018). Other threats such as effects of pesticides, egg collecting, shooting and collision with powerlines are thought to be low in SA.

Although fairly tolerant of people and able to habituate to human activity, Ospreys do not readily accept intrusive developments near the nest during the breeding season and especially amongst pairs at remote sites (Dennis 2007b). Disturbance causing adults to leave the nest during critical periods of incubation and early brooding can be fatal to embryos and small nestlings through cooling and exposure to predation (Pool 1989). Increasing tourism activity has been directly responsible for the decline in the number of occupied nests on the sheltered northern coastline of Kangaroo Island where between 1984 and 1991 there were five nests dispersed over 68 km of coastline but which declined to two by 1993 (Dennis 2007a) and only one of these was found occupied in 2015.

A number of studies in the northern hemisphere found that Osprey pairs that nested on artificial nest platforms fledged significantly more young than pairs that used natural sites, ie 1.3 young / occupied platform nest compared with 0.5 young / occupied natural sites (Seymour and Bancroft 1983, Westall 1983).

In migratory populations in the northern hemisphere just over 50% of young Ospreys die in their first year. Also about 10 to 15% of adults die each year giving an average adult life expectancy of six to ten years with few reaching > 20 years of age (Pool 1989). In order for an Osprey population to sustain itself recruitment must balance the losses due to juvenile and adult mortality.

Biologists have calculated that a pair of Ospreys must produce on average 0.8 young per year for a population to remain stable. Pairs breeding at sites with little or no disturbance produce more young than pairs at disturbed sites (Clancy 1989).

Prey / Food Resources

Another less studied explanation for a population decrease in South Australia is a reduction in the abundance or availability of prey especially prior to and during nesting. In a study in the Florida Bay area of North America Poole (1989) found an increase in nesting mortality coincided with a reduction in food delivery to the nest (Kushlan 1983, Bird 1983, Newton 1979). In contrast in British Columbia researchers found higher breeding success of the Osprey was related to increase in the abundance and availability of fish (Fluke 1983).

An important constraint in the timing of breeding of Ospreys is the ability of the female to acquire enough energy for egg formation (Perrins 1970, Swenson 1979, Bird 1983). Where the calorific value of fish was lower, Osprey delivered more fish per hour to the nest to feed young (Bird 1983) which is energy expensive to the parents.

There have been many changes over the last century to fish populations in SA waters. Generally Ospreys feed in relatively shallow water usually in one to two metres deep. It is unclear how the changes to fish stocks have affected Osprey populations in SA.

Inshore habitats have been altered considerably due to coastal developments, pollution and nutrient discharge along the more densely populated sections of the coast resulting in loss of sea grass communities and natural habitats. These changes may have caused the loss of fish spawning habitat in some areas and both commercial and recreational fishing impacts on Osprey foraging are unknown.

Other Threats

Fox and feral cat predation of Osprey eggs and chicks is unknown in SA. On Yorke Peninsula however foxes can readily gain access to near-shore islands during periods of low tide and have been responsible for significant predation on ground nesting shorebirds. Ospreys nesting on headlands and limestone stacks that are connected to the mainland at low tide are particularly vulnerable and susceptible to fox and feral cat predation.

White-bellied Sea Eagle are usually dominant over Ospreys, forcing them out from nesting sites and occasionally stealing prey from them. Unlike Ospreys, White-bellied Sea Eagle are extremely sensitive to human disturbance near their nest especially during the incubation period and therefore are unlikely to recolonise coastal habitats with housing developments and recreational activities nearby. A number of sites proposed for the construction of artificial nest platforms for Osprey would be unsuitable for White-bellied Sea Eagle as breeding sites due to the potential level of human disturbance.

There are several different examples of predation of Osprey chicks in nests: Schokman (1991) recorded a White-bellied Sea Eagle taking an Osprey nestling: and Holmes (pers. comms. 2019) shot a feral cat in an Osprey nest on the west coast of SA. In a study on Kangaroo Island the Australian Raven and Pacific Gulls (*L. pacificus*) were identified as the likely cause of some nest failures due to predation of eggs and/or small young (Dennis 2007b).

Osprey chicks are vulnerable to White-bellied Sea Eagle and other raptor predation. Corvids, Pacific Gulls (*L. pacificus*) and Silver Gulls (*C. novaehollandiae*) have been known to predate on eggs of raptors when they are disturbed and distracted by human presence. Gulls and corvids can predate on eggs in a matter of minutes and there is little that can be done to prevent this type of predation other than keeping human disturbance to an absolute minimum to ensure the adults remain vigilant and effective in nest defence ie. seeing-off scavengers from around the nest.

Weather conditions can also have a dramatic effect on Osprey reproduction. Strong winds are known to devastate some nests at exposed sites, particularly those balanced on near-shore rock stacks with minimal support for the nest. Such conditions occurred in 2016 in SA resulting in widespread nest damage with many territories subsequently abandoned (Detmar and Dennis 2018).

In addition to nest damage, heavy rain and strong winds during the early nesting phase may cause heavy mortality amongst Osprey broods, while at the same time reducing the males foraging success. There is the potential that the increase in extreme weather events (storm surges combined with sea-level rise and extreme swell conditions) due to human induced climate change will also impact on potential natural nest sites (cliff lines and rocky stacks).

Collision With Wind Turbines

Collision of raptors with wind turbines is well documented both overseas and within Australia however the impacts on Ospreys in South Australia is unclear. Three wind farms in South Australia pose a threat to the Osprey: the Starfish Windfarm on the Fleurieu Peninsula, the Wattle Point Windfarm at Edithburgh on the southern tip of Yorke Peninsula and Whalers Way on Eyre Peninsula. Neither of these are within close proximity to active Osprey nests. However during the non-breeding season as Osprey young disperse from their breeding territories, wind turbines pose the greatest threat with the potential for blade strikes. These windfarm turbines are lower height and therefore pose the greatest risk of flying Osprey to blade strikes.

Unlike South Australia, Victorian wind farms are currently required to undertake post-construction monitoring to detect bird mortalities from wind turbine collisions. Department of Environment, Land, Water and Planning (DELWP) Arthur Rylah Institute (ARI) has collated and analyzed the mortality data from 15 Victorian wind farms, collected between 2003 and 2018. However, the mortality monitoring only detects a proportion of deaths that occur. The ARI report found that for many wind farms it was not possible to validly extrapolate from their data to provide estimates of total mortalities, because the data had not been collected rigorously enough to allow confident estimates of total collision mortalities. The report estimates a collision rate of between 0.1 to 6.2 deaths per turbine per year of operation for each species. This includes 446 bats from 13 species and 565 birds from 58 species.

The highest number of recorded mortalities for raptors were for Wedge-tailed Eagle (58), Brown Falcon (48) and Kestrels (54). Total raptors killed during this period were 187 comprising 14 species which represent 33% of the total birds killed. These figures represent only a subset of the birds that were killed, because many individuals would have been lost or scavenged in between monitoring events. Also, not all individuals would have been detected during monitoring.

The number of raptor fatalities declined substantially at a wind farm site in northern California when older and smaller low capacity turbines were replaced with the taller high capacity ones. Large turbines turn more slowly which may be partly responsible for the decline in bird collision rates. Most of the turbines proposed to be installed in South Australia in future are these taller capacity machines. Poole (2019) claims the new generation of windfarms that are much higher (270m high) and slower, pose a significantly lower risk to Ospreys and other Raptors.

Most wind turbines in South Australia are the smaller capacity turbines (92m or 124m high) which are situated in the Mid North and well inland. Whilst Ospreys in South Australia may not be seriously threatened by wind turbines at this point, caution and continued monitoring is required for Ospreys and other raptors given the location and size of turbines at the Starfish Hill Windfarm at Cape Jervis on the Fleurieu Peninsula and the Wattle Point Windfarm near Edithburgh. The Starfish Hill Windfarm comprises 23 turbines (Hub height 68m with rotor diameter of 64m) and the Wattle Point Windfarm comprises 55 turbines (hub height 68 m with rotor diameter 82m). No further expansions are proposed at these two locations at the time of writing this plan.

Human Impacts (Habituation & Sensitivity)

The Osprey is sensitive to human activities in most of its breeding range in spite of their adaptability and tolerance in some areas.

Historically Ospreys nested at a popular tourist site in Innes National Park where the nest was located near the base of a cliff on an elevated rock platform about 10 metres above the sea. Park visitors were able to view the nest from the cliff top and as the nest location became more widely known as a prime photographic opportunity, (including the illegal use of drones within a National Park), the level of disturbance became intolerable and the nest was abandoned. Despite attempts to manage the situation, Ospreys no longer nest at this territory location due to human disturbance as the primary cause. Few raptors (including Ospreys) will tolerate human encroachment and disturbance directly above their nest.

Two highly disturbed nest sites (Innes National Park and Gleesons Landing) on southern Yorke Peninsula have been abandoned since 2010. The Meehan Hill nest site has also become abandoned, however the Ospreys have relocated to a more secure nest site further along the coast due to becoming highly disturbed by human activity (Detmar and Dennis 2018).

In contrast, Osprey's successfully breed and raise young on an artificial nest platform positioned on a barge in Porter Bay at Port Lincoln, located 500 metres from the Lincoln Cove Marina entrance which houses the largest fishing fleet in the Southern Hemisphere.

Other examples in South Australia where Ospreys have successfully nested on man made structures and in close proximity to human activities include:

- Ballast Head on Kangaroo Island – decoy platform installed by CSR staff on a bulk gypsum ship loader in 1987;
- Port Lincoln – decoy platform installed by BHP staff on a bulk mineral sands ship loader in the late 1980's;
- Nepean Bay on Kangaroo Island – platform provided to encourage pair away from an unsuccessful nest on a boxthorn bush where it was vulnerable to Goanna and feral cat predation;
- Coffin Bay, where an upside down cray pot was fixed to Oyster Lease navigation pole to decoy a pair trying to nest on a moored boat just offshore from the town centre;
- Denial Bay oyster farmers erected a platform in 1991, which was immediately adopted by the resident pair;
- Shoal Bay on KI - nest platform erected on a electricity supply pole;
- Streaky Bay, Point Gibson oyster lease – nest active since 2007;
- Northbank at Streaky Bay - Haslam oyster lease constructed nest platform in 2012 but was wrecked in a storm in 2016.

More recently a temporary artificial nesting platform was constructed along Wills Creek near Price that was immediately occupied with two young successfully fledging in the 2019 breeding season.

Site characteristics and choice play an important role in the tolerance of Ospreys to human disturbance. Ospreys nesting in more remote sites are generally less tolerant of people than ones in built up sites and exposed regularly to human activity.

Individual Osprey sensitivity to human activity may be conditioned by the degree and frequency of the exposure. Pairs that demonstrate a low tolerance and are subject to increasing disturbance have a higher nest failure rate and overall lower levels of productivity (Pool 1989).

3. Management Techniques

Management of Nesting Habitat

While habitat protection alone is an important threat mitigation strategy, it can be combined with habitat enhancement and management to actively increase Osprey productivity. Enhancement and management of prime habitat can be used to alleviate problems caused by natural or human related impacts that are limiting a population or make otherwise suitable areas more attractive to Ospreys by providing vital habitat components. Creating artificial nest platforms is a vital and proven form of threat mitigation and population augmentation in areas where limited natural nest sites exist and/or are threatened by developments or other factors.

Lack of suitable nesting sites may limit Osprey breeding populations. Where food is plentiful additional nest sites can substantially boost nesting densities. Conservation initiatives in Europe and North America have shown unequivocally that artificial nest structures can result in greater productivity by reducing brood mortality (Postupalsky and Stackpole 1974, Schmutz et. al. 1984).

Along the northern coastline of New South Wales (NSW) the population has increased significantly in recent decades from an estimated 25 birds in 1980 to more than 250 in 2006, with a corresponding southward expansion of more than 800km beyond their historical breeding range (Dennis and Clancy 2014, Clancy 2009). There is some evidence that this population expansion is linked, at least in part, to changing climatic conditions associated with the strengthening of the tropical Eastern Australian Current. A similar phenomena exist in the marine environment around Kangaroo Island and the west region which is influenced by the warm water Leeuwin Current which originates in the tropical western Indian Ocean.

However, the success of a nest site augmentation program will depend on its form, placement, exposure, prominence and proximity to potential foraging habitat (Pool 2019, Dennis 2016).

Increased prey availability through habitat manipulation could also be an important management strategy. The dry creek salt fields demonstrate this point and although these areas were created for the production of salt, they do provide an important roosting and foraging area for resident and migratory shorebird populations where water levels are maintained. These shallow ponds are largely land-locked and through regular pumping of water from the sea, small fish are pumped through the pumps and into the ponds. As these fish grow to maturity quickly in these ponds, they could potentially be managed to provide extended foraging opportunities for Osprey as well as other birds such as cormorants, pelicans, etc and would be relatively safe from recreational and commercial fishing pressure.

Community Education and Involvement

Experience world-wide has shown that community support and involvement is integral to the success of conservation projects, resulting in heightened levels of voluntary involvement in wildlife conservation projects including ongoing monitoring activities. Community support and involvement can vary from assisting in construction through to assisting in monitoring via web cams (i.e. citizen science related projects).

To date the local community have been involved to varying degrees in Osprey monitoring and meaningful involvement in this project will be integral to the future success of the Osprey recovery project on Yorke Peninsula and the upper St Vincent Gulf region**.**

A Community Partnership Group (CPG) has recently been established for the Adelaide International Bird Sanctuary (AIBS) and Upper St Vincent Gulf (USVG). The group will focus

on a land/seascape approach to conservation and management of the AIBS and Upper St Vincent Gulf which is part of the East Asian Australasian Flyway (EAAF), one of the most significant shorebird sites in South Australia and one of the most important migratory bird flyways globally. Within the USVG, key partners comprise the Adelaide Mount Lofty Ranges Landscape Board, AIBS, Department of Defence, DEW (including management of Clinton and Wills Creek Conservation Parks) and Northern and Yorke NRM Board.

Opportunities exist to seek support from the CPG with resources and community involvement from the AIBS and USVG area for the Osprey Recovery Project. In other areas such as Port Broughton and southern Yorke Peninsula the introduction of the Osprey project provides an opportunity to involve local Schools including Yorketown and Maitland. The strategy to include schools facilitates the opportunity to educate local children and could be extended into community involvement including identifying specific activities and projects. Notwithstanding the points above, government and DEW commitment to support and fund community involvement will be critical to success. The Conservation Action Planning process is also be a vital element in helping to identify specific community groups (and or individuals) and the role they can play in the delivery of the Osprey recovery project.

Artificial Nest Site Guidelines

Important considerations during the planning phase for placement of artificial Osprey platforms include development applications from local councils (planning approvals may differ from region to region). Structures installed in the marine environment may require DPTI approval. In addition, landowner approval is required prior to the installation and placement of any structure (including private land, public land, conservation park, marine park, council land, etc). In some cases, Scientific Permits and Animal Ethics approvals maybe required for monitoring and conducting scientific research at active nest sites.

The provision of artificial nest platforms not only increases breeding success and productivity, but also potentially results in range expansion. Dennis (2016) explains that it is most effective in extending the edges of suitable breeding habitat areas by creating intermediate nesting locations between established territories. In the Northern Hemisphere artificial nest platforms over water have been found to produce the highest rate of success

When moving an unoccupied nest, it should be kept largely intact and relocate within 200m of the original nest location if possible. However the Wills Creek nest was moved over 800m from the existing nest on the Navigation Pole and was successfully adopted. Metal zip ties or copper wire are best used to attach nest material to the new support structure. After moving the nest, the original nest site should be removed / modified to discourage the osprey from rebuilding. Osprey should quickly spot and take up the new nest structure.

Placement of nest structures for ospreys affects the chances they'll be used. As a general rule, the closer to water, the better. Information recorded on migrating Ospreys indicates colonization of new sites is related to how close ospreys presently nest to the new site, since young birds returning to breed usually take up nesting within one to several kilometres of their natal area (Pool 1989). Further research is required to determine if this is the case for non-migratory Ospreys such as those within South Australia.

Nearby perching opportunities are an important component to attract Ospreys to a nest platform as, after delivering prey to the nest the male prefers to perch nearby. A simple perch consists of a 50mm x 100mm hardwood piece of timber that rises 100cm higher on the side of the nest platform with a wood branch (50mm or more in diameter) mounted horizontally, with another similarly mounted below the nest is ideal.

Ospreys generally commence nest building and repair in June to August with most egg-laying between September and October, young hatching late October and fledging mid November through to February (Dennis 2007). Nest structures should be in place by late

May at the latest for that season's use. Ospreys are most sensitive to disturbance during July through to September, when they are laying eggs and are most likely to abandon the nest if disturbance is too great. They become more defensive of the nest area in August to September and particularly from October onwards when they have developing young. It is important that human disturbance is minimized during this time.

Ospreys are adaptable and exhibit tolerance of certain types of disturbance, such as passing boat traffic. A safe distance from which to observe ospreys will vary depending on the area, but observers must stay beyond the distance at which the adults react, not simply when they lift off the nest or sentry perch in defense.

Its also important when choosing a suitable platform location to consider what other wildlife maybe negatively impacted in the area.

Artificial Nest Platform Specifications

There are no strict design requirements for Osprey nesting platforms. Historically Ospreys have successfully nested on timber pallets affixed to a pole, upside down cray pots fixed to the top of a navigation pole, etc. The height of the platform will vary from site to site but essentially should be greater than any surrounding or nearby trees and structures (eg Mangroves). It is recommended that artificial nest platforms be a minimum of 6 metres above ground (or water) and surrounding ground to afford reasonable protection from disturbance and provide the birds with security and confidence during breeding. Most trees and shrubs near selected Osprey sites would be well below the 6 meter height range (Mangrove and Mallee).

Pole depth is dependent on soil type and specifications required is a minimum of one metre plus 10% for each metre of length. Additional support for a pole and nest platform may be required in deep sand or mud substrates but will also depend on design and structural characteristics. When applying the preceding specifications to an artificial nest platform and 6 metre pole above ground, the length required below ground is 1.6m (+ extra subject to the soil or substrate type).

General guidelines have been provided in Appendix 3 for poles and platforms however one of the central questions is whether the poles and platforms should be fabricated in hardwood timber, composite fibre and recycled plastic or hot dipped galvanised steel. All materials have their benefits and disadvantages and an analysis of the key attributes and characteristics of each is outlined in Table 3 (Appendix 4).

It is recommended that Composite Fibre materials be used for the construction of artificial nest platforms and poles where possible (based on ease of construction, durability & longevity in harsh environments, strength and cost effectiveness). However there is no one design that fits all situations and some sites will require a combination of steel, hardwood timber and composite fibre materials to be used.

Detailed diagrams, plans and guidelines for pole, nest platforms and costing are provided in Appendix 1 and 3. In addition, a mobile nesting platform has also been included which can be transported to preferred locations in kit form and assembled on site and anchored with support cables.

Note; The author strongly recommends a structural engineer be consulted and or engaged to provide advice on the strength of the poles and platform structures to ensure they are fit for purpose.

4. Site Assessments

Criteria for establishing artificial nest platforms at key locations is based on;

- historical Osprey breeding habitat,
- human disturbance or other factors that have caused Osprey's to abandon a site;
- regularity of Ospreys observed in the area;
- good food resources, and
- community support.

4.1 Wills Creek Conservation Park.

In 2017 Ospreys built a nest on the Navigation Pole at the entrance to Wills Creek (Photo 1). This pole is situated on the eastern side of the navigation channel and about 200 metres north of the mangroves. The Ospreys built their nest on a steel mesh platform which is surrounded by safety railing for technicians undertaking maintenance on the light. It is difficult to ascertain the level of human disturbance at this site however it has been reported that recreational fishing boats regularly tie up to this pole during periods of calm weather. The nest is approximately 6.0 metres above the water. Given the height of the nest and its exposure to disturbance, Ospreys incubating eggs would almost certainly be flushed from the nest by boats tying up to the pole. Osprey egg laying would certainly coincide with the peak crabbing period e.g. (Sept–April). Ospreys produced one young which fledged at this site in November 2018.

For this Osprey nest platform project, this site was visited on the 3rd November 2019 and a pair of Pacific Gulls (*L. pacificus*) were observed perched on the safety railing (photo 1). No adult Ospreys were present and inspection of the nest revealed no evidence of egg shell fragments and nest lining was not recent. A number of local fishermen had observed adult Ospreys on the nest about 4 weeks prior however it is uncertain whether eggs were laid. Based on the condition of the nest, it is not possible young were produced at this site in 2019. Whilst there is no direct evidence of human disturbance, evidence from locals suggest human disturbance may be the cause of the initial breeding failure at this site.

An inspection of an artificial nest platform constructed in 2017 about 880 metres south of the present navigation pole (S 34 16 43.22, E 138 01 0.21) was undertaken on the 4th December (Photo 3). An agitated and vocal female Osprey flew from the nest and circled the area and the male arrived a few minutes later.

A telescopic pole with GoPro camera* was used to inspect nest contents and 2 young were confirmed (photo 5). Only a few minutes were spent at the nest due to the agitated behaviour of the adult female. The female Osprey landed on the perch above nest during the visit and the platform swayed from side to side. The nest platform (plastic crate) is perched precariously on top of a mangrove tree and supported by a number of timber struts (Photo 4). (* Note a Scientific Permit and Animal Ethics Committee Approval under the National Parks and Wildlife Act, 1972 is required when inspecting nests of protected species including Ospreys).

On the 3rd December 2019 a male Osprey was photographed near Clinton carrying a fish (possibly a Flounder) and heading in a southerly direction (pers. comms. Brooks). The current nest is about 5.6 km from where the male Osprey was seen and most likely was carrying the prey back to the nest.

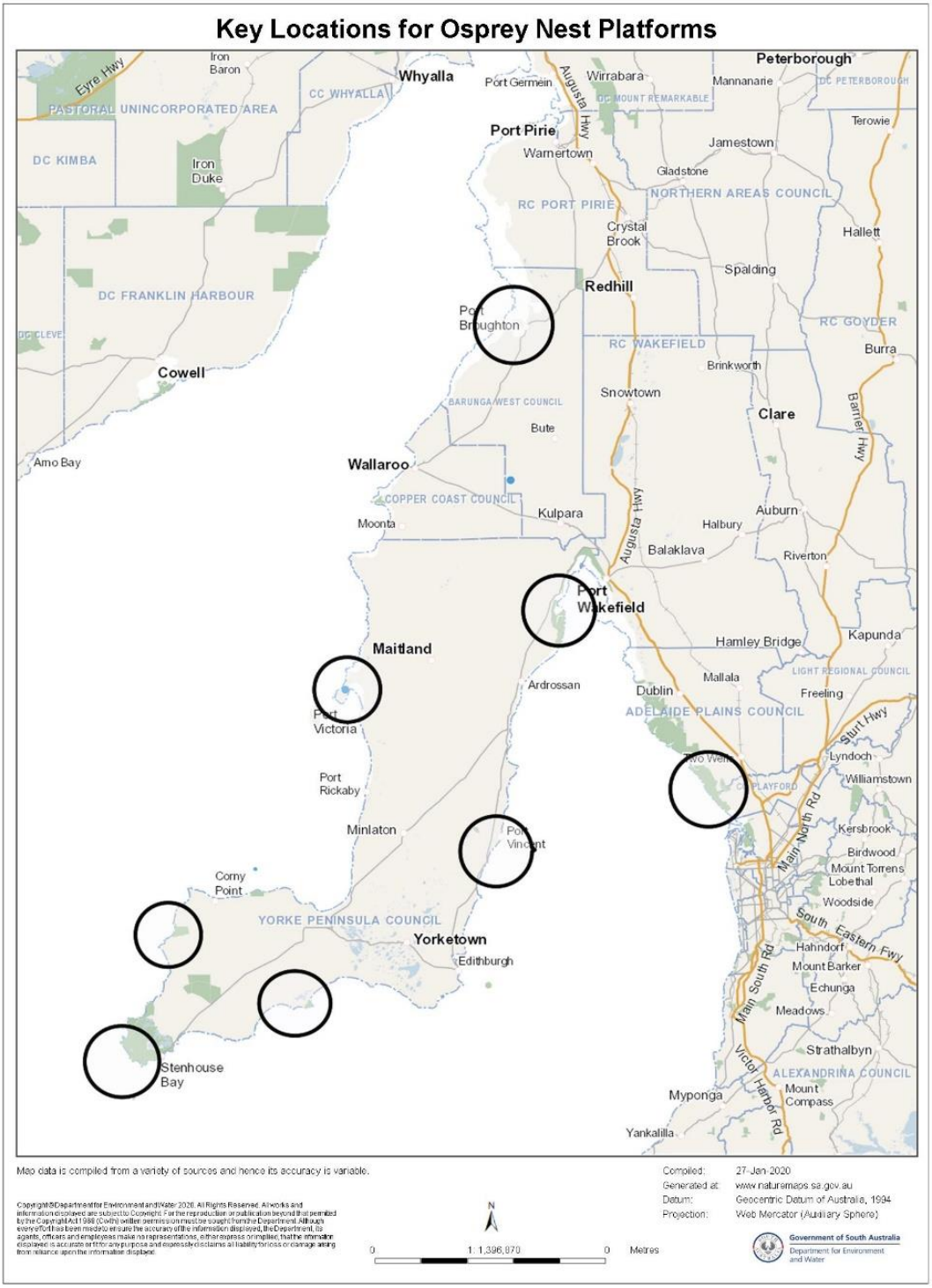


Figure 2 Key locations for the establishment of Artificial Nest Platforms on Yorke Peninsula and the Upper St Vincent Gulf East Asian Australasian Flyway and Adelaide International Bird Sanctuary

Photo 1 (above & left). Navigation pole at the entrance to Wills Creek. Note the Osprey nest on the platform. Ospreys were observed on the nest earlier in the 2019 breeding season. The two birds perched on the safety railing are Pacific Gulls (*L. pacificus*).

Photo 2 (above & right). Same navigation pole with a recreational fishing boat anchored adjacent (photo courtesy of Kent Treloar).

Photo 3 (left). Mangrove canopy from the nest looking west towards Wills Creek.

Photo 4 (right). The temporary Osprey nest platform constructed in 2017 in the top of a Mangrove tree near Wills Creek. Note the Osprey makes full use of the functional perch and support strut configuration.

Given the build-up of the existing artificial nest platform, it is unlikely to support increasing weight of sticks into the future and would be at risk of collapse during periods of high winds and storms. This location certainly affords greater protection from boat traffic, fisherman and the mooring of boats. The new nest platform configuration should have a perch mounted about 1.5 metres above and to the side of the nest. The existing nest platform demonstrates that Ospreys do not necessarily need a sophisticated and elaborate nest platform to produce young.

Photo 5. Two Osprey chicks in the artificial nest constructed in 2017. The young are about 4 to 5 weeks of age and fledged in the first week of January 2020.

4.2 Gleeson's Landing

A site assessment in November 2019 revealed no Ospreys present at the nest located on the low stack on the reef system. Pacific Gulls (*L. pacificus*) had taken over the nest with one young. This site has a long history of nesting failures due largely to human disturbance and in part due to the nests low elevation and exposure to the elements and sea conditions. The nest is about 1.8 metres above the surrounding reef and during high tidal surges and storms the adults and or young would be exposed to considerable risk. In addition, the nest (photo 6 & 7) is vulnerable to human interference, disturbance from fisherman (photo 10) and predation from foxes, cats and corvids.

The coastal strip between Daly Head and Gleeson's Landing Campground is the Blue Bay Reserve managed by Yorke Peninsula Council. Thidna Conservation Park (CP) adjoins Gleesons Landing campground and the Osprey nest is located about 1.3 km to the south west of Thidna CP. This section of coast receives considerable visitation from campers, surfers and fishermen and is highly impacted by campers, day visitors, vehicles and bush walkers as evidence by the network of tracks, camping nodes and associated erosion.

At Daly Head the local community have been building a section of walking trail as part of the "Walk the Yorke" initiative. It has been suggested that an Osprey perch/pole be placed on the Daly Head cliff top to assist Ospreys with detecting prey from the vantage point. This location would be about 2.8 km from the current abandoned Osprey nest site.

The local community were also of the view that an artificial nest platform could be placed inland a short distance from Gleeson's Landing or near the cliff top adjacent to the current nest. Whilst these sites have merit, human disturbance is currently a significant problem and visitor management strategies and other site protection measures would need to be put in place as a matter of priority if this option was to be considered in future.

Photo 6 (above & left). Osprey nest perched on a limestone platform about 1.8 metres above the reef. This nest has been abandoned due to human disturbance.

Photo 7 (above & right). The same nest in 2010 was active and used by Osprey (photo courtesy of Kent Treloar).

An inland or cliff top artificial nest platform should be discouraged and is considered unsuitable for this site at the present time for the reasons outline above. Discussion should be initiated with representatives of FBAG, local surfers representatives, local fisherman representatives and Yorke Peninsula Council about some track rationalisation and identifying a section of cliff top land immediately in front of the reef to be classified as habitat protection zone. The proposed area should afford reasonable protection from disturbance from camping, vehicles and fishing activities.

No Ospreys were seen during the two visits to Gleesons Landing in November and December 2019 and the site was abandoned. However a pair of Ospreys were seen perched on a marker pole a few kilometres west of Point Turton in November and another sighting of an Osprey foraging along the Point Turton foreshore in October. A search of the coast between Daly Head and Point Turton revealed no Osprey breeding however Ospreys have been observed using a TV antennae on a property near Corny Point (Seaview housing estate area east of the lighthouse) and fishing and flying around the Corny point coast area. Whilst there are a number of likely sites along the section of coast between Gleesons Landing and Point Turton where Ospreys could potentially breed, all are significantly impacted by people and therefore unsuitable as a secure Osprey breeding site.

Photo 8 (above & left). The partly submerged rocky reef on a rising tide

Photo 9. (above & right). The flat section of granite rock that would be suitable to fix the steel base plate into position to support a pole and nest platform. Location of the granite rock - 35^0 00'.477 S and 136^0 56'.868 E.

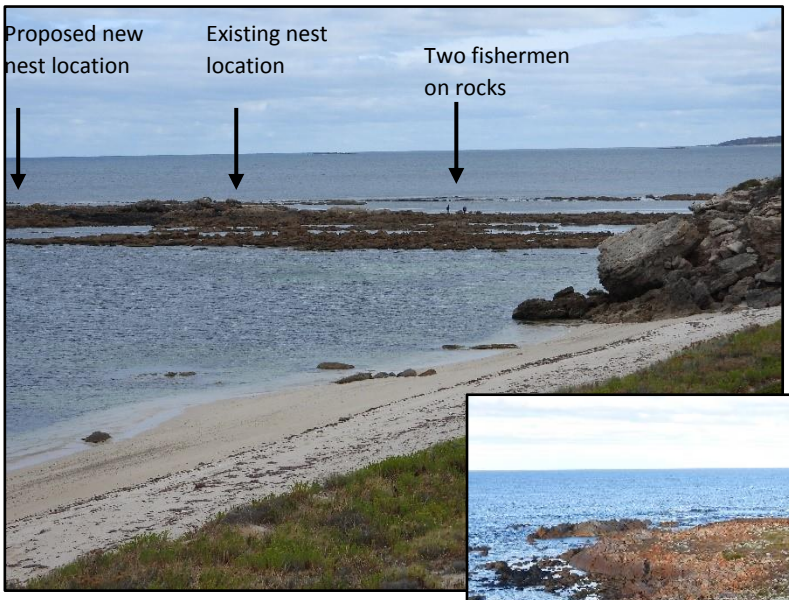


Photo 10 (left). Reef section with location of existing and proposed nest sites. Two fishermen on the rocks near the existing nest location. This type of disturbance would potentially cause breeding failure particularly during the egg laying and incubation phase.

Photo 11 (right). Rocky headland further south. Note the well used walking trail heading to the end of the headland and reef.

Given the presence of a pair of Ospreys in the Point Turton area and the local observations in the Corny Point area combined with a history of breeding at Gleesons Landing, the construction of an artificial nest platform at a more secure location (further seaward) than the existing nest should be a priority. The sightings of the Ospreys at Point Turton were approximately 45km from Gleesons Landing site (following the coastline).

The estimated cost of installing the steel pole is about $6,000 if the contractor can do the work on the way to another job. If requested to travel to the site specifically to undertake this job only, the cost would be substantially more.

4.3 Port Broughton

A site assessment was undertaken in November 2019 along the section of coast (Munderoo Bay) between the Port Broughton caravan park and Fishermans Bay boat ramp. No Ospreys were sighted, however a visit to the Fishermans Bay boat ramp later in the morning revealed a White-bellied Sea Eagle hunting along the beach near a group of shacks on the northern shore. Two local fisherman indicated that White-bellied Sea Eagle nest in a patch of remnant mallee to the north of the shacks, however T. Dennis suspect Shag Island and surrounding areas including Fishermans Bay is attractive to transient and sub-adult Sea-Eagles due to abundant prey (seabird rookeries).

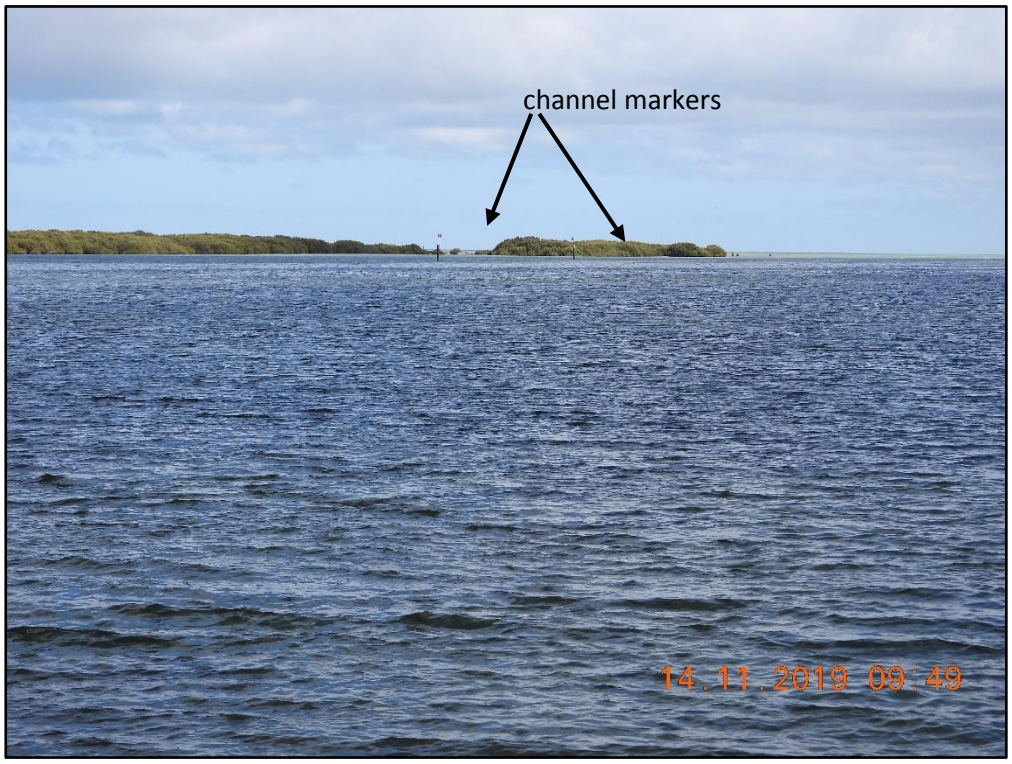


Photo 12. Possible location for an artificial Osprey nest platform near the mangroves and opposite the Port Broughton boat ramp. A nest platforms would need to be a reasonable distance from the navigation channel (note the channel markers in foreground) which has frequent boat traffic.

A further site assessment was conducted of the southern section of Munderoo Bay Port Broughton on the morning of the 14th November 2019. No Ospreys were sighted. Garry Barnes a professional fisherman at Port Broughton has observed Osprey's regularly perched on marker posts near the boat ramp and TV antennas around the town (pers. comms. Barnes). Garry is of the view that the birds may breed if a nest platform was provided. However it is unclear whether the Osprey sighted is a lone bird, an adult or one of a pair that may be in the vicinity.

This area would also be of sufficient distance from a possible White-bellied Sea Eagle nesting territory north of Fishermans Bay. This would provide a minimum of 5 km distance between a White-bellied Sea Eagle nest and an artificial Osprey nesting platform. Whilst there is the possibility of intra specific conflict between the two species, the distance highlighted should be within reasonable tolerance's of both species.

4.4 Point Pearce Peninsula

A site assessment was undertaken in November 2019 and the entire Point Pearce Peninsula was checked for suitable nest sites. No Ospreys were seen during the assessment. Two sites have been identified as preferred locations for nest platforms. The Island Point (locally known as 'Rocky Island') at the south west shore of Point Pearce is the preferred site. This small rocky island is off shore a few hundred metres and would afford good protection from human disturbance. The shallow reef system around the island would also be a deterrent to small fishing boats approaching the island. The nest platform would be positioned on the highest point on the island. The soils on the island are presumed to be shallow over sheet limestone.

The shore line to the north (8 kilometres) is relatively shallow and the Port Victoria bay to the east is a short distance away. Both areas would afford good fishing and foraging opportunities for Osprey.

The second location and less preferred site is Reef Point at the north end of Point Pearce. A reef extends out from the shoreline and to the east is a low lying area of samphire. This area comprises a sheltered bay with shallow water for fishing and foraging. The coastline to the south also provides good fishing and foraging areas for the Osprey and Port Victoria Bay is located about 3.5 km to the south east.

The Point Pearce Peninsula is managed by the Aboriginal community with the cropping land being leased to a farmer who crops the land most years. This section of coast receives few visitors and camping by the general public is prohibited. However there was some evidence of tracks and some camping along sections of the coast by members of the Aboriginal community. The local aboriginal community are very supportive of the proposal to erect an artificial nest platform at these sites.

White-bellied Sea Eagle reportedly nest near the southern end of the nearby Wardang Island about 10km from the Rocky Island. Goose Island CP is located about 4.6km south west of the Rocky Island. It would be highly unlikely White-bellied Sea Eagle would be nesting in the Point Pearce Peninsula area for reasons of sensitivity to human disturbance.

Photo 13 Rocky Island at Point Pearce Peninsula. This island would be ideal for an artificial nest platform. These islands are typically are covered in low shrubs with no trees

A large stick nest in a Sheaoak tree near the southern end of the island has been historically used by White-bellied Sea Eagle, however some reports suggest that Wedge-tailed Eagle may have taken over this site in recent years. The proposed Osprey nest platform on the Point Pearce Peninsula is of sufficient distance from the White-bellied Sea Eagle nest site (10km) to provide little inter specific competition and conflict.

4.5. Point Davenport

A site assessment was undertaken in November 2019 over two days in the Foul Bay / Point Davenport area and included John Halfords property and Point Davenport Conservation Park. No Ospreys were seen during these visits however discussion with John Halford revealed a good insight into Osprey movements and use of his property and the adjoin beach area. The nearest Osprey nest is located at Foul Hill approximately 15km to the west. John owns about 1km wide by 2 km long section of coast with good quality native coastal vegetation.

Photo 14 (above & left). Rocky headland at Foul Bay with fisherman on Rocks. This location is only a short distance from an active Osprey nest.

Photo 15 (above & right). Rocky headland at Foul Bay.

John also explained that the Ospreys regularly perch on his TV antenna causing nuisance with droppings. At times John observes Ospreys on a daily basis hunting and foraging along his section of coast. The sheltered bay and spit to the west clearly would provide ideal foraging opportunities for the Osprey. GPS waypoints 35^0 10'.154 S, 137^0 17'.942 E. and 35^0 10'.120 S, 137^0 17'.930 E. would be suitable sites for a platform.

This area is of low relief characterised by dunes systems. No cliffs exist in the area and the nearest cliffs are located at Foul Hill about 20 km west. In addition to Osprey's John Halford has also provided records of his observations of White-bellied Sea Eagle (mainly immature sea-eagles) also regularly flying east or west in the vicinity (over period 2014-2017) while NY regional staff (including L. Heard) have observed 2 immature sea-eagles in the vicinity of the wetland and shallow bay area at Point Davenport Conservation Park (CP) over period November – December 2016 (pers. comms L. Heard, NY Regional Ecologist 2013-2017). These observations are now available through the Biological Database of SA. These records combined with John Halford's observations indicate regular use of the Point Davenport CP area, including the wetland and bay area, by at least immature sea-eagles possibly as a prime feeding area (pers. comms L. Heard).

An inspection was undertake of Point Davenport in December 2019. The entire beach to the Point was checked followed by the wetland entrance and southern shore of the lake and wetland area. No Ospreys or White-bellied Sea Eagle were seen at Point Davenport during that visit. Evidence of a 4WD quad motor bike was seen on the beach and through samphire habitat adjacent to the wetland area. Large numbers of water birds (Grey Teal, Chestnut Teal, Pacific Black Duck, Cormorants and Pelicans) were perched on the extensive seaweed

wracks at the entrance to the wetland. Little evidence of vehicle access and motor bikes was seen (apart from the one quad bike).

In addition there was little evidence of people access beyond the vehicle tracks at the entrance to the Conservation Park. No evidence of nesting material was seen on the navigation pole at the southern end of the reef and sandy point.

There appears to be some low level camping in the park however little rubbish was seen and minimal off tracks damage by vehicles was observed. The lack of signage was also obvious about the Conservation Park and camping and access requirements. However a number of Walk the Yorke signs were present along vehicle tracks in the park.

Photo 16 (above & left). Wetland at Point Davenport Conservation Park which would provide an ideal and secluded location for an artificial nesting platform.

Whilst the sandy point has some merit for an Osprey nesting platform, public access would be difficult to manage and regulate at this remote and isolated location. The wetland area however offers a more suitable and secure location over shallow water. The wetland is also in close proximity to shallow bays beaches and reef systems for hunting and foraging.

While both the coast adjacent John Halford's property and Point Davenport offer very good potential Osprey nest platform locations, the presence of White-bellied Sea Eagles in the Point Davenport CP wetland and bay area does indicate the potential for intra-specific conflict and sea-eagles to prey on nestling Ospreys if a platform was put in the wetland area. To reduce the potential for this the best initial location for the nest platform would be on the coastline at John Halford's property approximately 4 kilometres to the west of Point

Davenport wetland and bay area. This could also allow more opportunity for observations of coastal raptors and interactions to be undertaken around the greater Point Davenport area over time. Dependent on the success of Osprey breeding on the platform at John Halford's and better understanding of the use of the area by both coastal raptor species a semi-portable platform could be shifted if needed (if the wetland is considered a better option later).

Additional areas suitable for Ospreys were checked at Foul Hill and Meehan Hill. The Osprey nest on the rocky cliff at Meehan Hill is abandoned and is hardly recognisable now as it is nearly completely overgrown by Nitre Bush. However a pair of Peregrine Falcons were seen on the cliff about 50 metres from the old Osprey nest. The Peregrine Falcons were vocal and aggressive and given their behaviour, had most likely nested on this cliff recently. I also noticed a "Walk the Yorke" walking trail sign on the cliff top near the nesting falcons and Osprey nest. Whilst the original car park had been shifted a short distance further west, a fisherman had been fishing the beaches to the west and east of the car park, thus walking the cliff top past the Peregrine Falcon nest and old Osprey nest. Surfers also use a surf break near the Meehan Hill site and walk the cliff area above the old nest site to get a vantage point to check the surf break.

During a visit to Foul Hill car park I observed an active Osprey nest on a rocky stack to the east GPS waypoint 34^0 14'.21 S, 137^0 10'.42 E. I observed the pair of Ospreys at this nest for approx. 45 minutes through a spotting scope. It is unclear whether the birds had young, however the female was feeding for about 30 minutes during this time. The male was perched on the edge of the nest during this time. An immature White-bellied Sea Eagle flew low over the car park area heading in a north east direction.

The distance between the Foul Hill Osprey nest and the abandoned Meehan Hill nest is approximately 9.15 km (direct line of sight). The distance between the Foul Hill Osprey nest and Point Davenport spit is 13.7km (direct line of sight) or 21km around the coast. The distance between the John Halfords spit and the Point Davenport Spit is 4.7 km or 4km to the wetland sites (direct line of sight).

A number of fisherman also arrived at this car park during my presence and quickly made their way to the rocky island out from the car park for fishing (refer to photos 14 & 15). At low tide many of these off shore islands are connected to mainland by exposed reef systems that make access by fishermen possible. Clearly public access to these rocky reef systems near Osprey nests pose a serious threat particularly during the incubation period.

4.6 Adelaide International Bird Sanctuary (AIBS)

Osprey are regularly seen hunting and foraging in sections of the AIBS. White-bellied Sea Eagle historically once nested in the Buckland Park area. The area was recently earmarked for a large housing development however this plan is now on hold. Human disturbance and expanding developments were clearly not compatible with the sensitive breeding requirements of the White-bellied Sea Eagle and they have now abandoned this area as a nesting location. However the site would now be more suitable for Osprey breeding.

Increased prey availability through habitat manipulation is a key issue for long term management and this is relevant to the Dry Creek salt fields. Although these salt field areas were created for the production of salt, they also provide an important area for roosting and foraging for both resident and migratory shorebirds. This area has not been considered as raptor habitat in the past, however as these shallow ponds, which are largely land locked, have sea-water regularly pumped through and as a result, small fish are pumped in (through the pumps) thus providing a reliable food resource. As the fish grow to maturity quickly in

these ponds, they would be relatively safe from recreational and commercial fishing pressure and provide a reliable food source for Osprey.

This area would also be of sufficient distance from any possible White-bellied Sea Eagle territory to the south around Torrens Island. This would provide a minimum of 6.5 km distance between regular sightings of White-bellied Sea Eagle and an artificial Osprey nesting platform. Whilst there is the possibility of intra specific conflict between the two species, the distance highlighted should be within reasonable tolerances of both species. Both nest platforms would be similar in construction.

4.7 Port Vincent

A site assessment was undertaken in December 2019 and January 2020 along the section of coast south of Port Vincent township and north to Sheaoak Flat and North Spit. No Ospreys were sighted during these visits.

Ospreys have been observed at Port Vincent in 2008 and periodically since. A large stick nest was reported on the 3 mile beacon a few years ago however there has been no confirmation of Ospreys breeding at this site.

There have also been unconfirmed reports of a large stick nest on the cliffs north of the township, however no Osprey breeding attempt has been observed in this area. About 10 years ago an Osprey was found dead under one of the street light towers on the Marina. The death appeared suspicious however the cause was never determined.

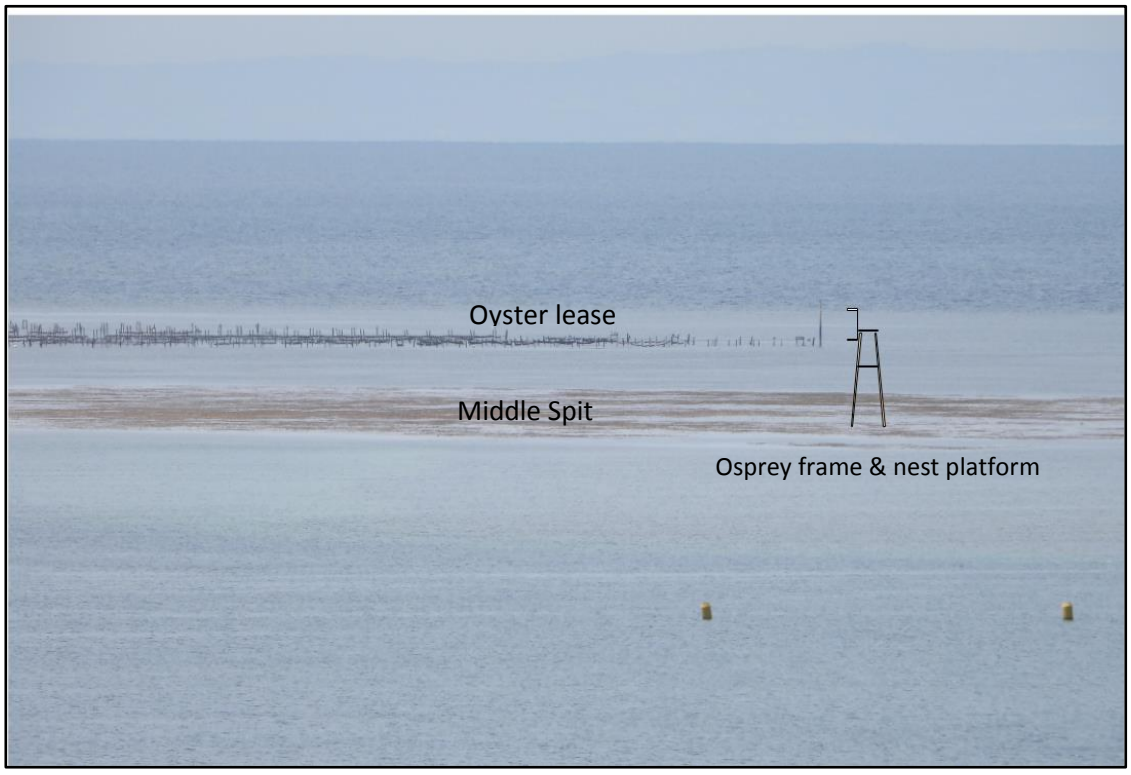


Photo 17 Proximity of Osprey frame and nest platform on Middle Spit near the Port Vincent Oyster Lease.

Given the sightings of Osprey along the coast it is considered reasonable to locate an artificial nest platform in this area. The proposal is to erect a 125mm Composite Fibre nest platform at the outer section of the Spit and a short distance south west of the Oyster farm/lease. The nesting platform would be 6 metre high with Composite fibre or hardwood timber slat nest platform and perch configuration attached to the top. The Composite Fibre poles would be water jetted into the sand substrate. Whilst the nest platform would be close to Port Vincent township and the Caravan Park, it would be located in the shallow and relatively protected waters on the west side of the spit. The access requirements for a boat and equipment to install the structure, nest platform and perches would need to be considered and costed appropriately.

5 Other Requirements

5.1 Research / Knowledge Gaps

Future research should focus on what we do not know about the population. Whilst much is known about Ospreys in the Northern Hemisphere, little is known about the dynamics of the non-migratory and disjunct Osprey population in South Australia. There are likely to be different constraints on a non-migratory population than the northern hemisphere populations.

Australian Ospreys have been neglected by comparison to Northern Hemisphere populations. We know a lot about Ospreys and what they eat in their diet in parts of the globe, but we know much less about how and where they catch their food. A detailed study on foraging strategies is required.

Satellite tagging of male Ospreys during the breeding season would be extremely valuable in SA however Pool 2019 highlights that some Ospreys fitted with satellite trackers in the northern Hemisphere maybe compromised. The reasons for the higher mortality in some Osprey tracking projects are unclear. Therefore some caution and careful consideration will be required when developing any tracking program for Ospreys in SA.

Consideration be given to the collection of serum chemistry profiles to achieve greater diagnostic specificity in Ospreys and their prey. Common serum chemistries include total protein levels, cholesterol, glucose, uric acid etc. These profiles may help provide a qualitative and quantitative analysis of the Osprey dietary. The taking of blood samples is simple and a less intrusive method of finding out much about the Ospreys biology.

5.2 Webcam Monitoring

In the Northern Hemisphere many Osprey pairs reproductive lives have been recorded season after season at nests with webcam. A wealth of information exists that may help to provide useful knowledge of Osprey behaviour such as the rates of fish delivery in relation to weather conditions and times of the day/night, food sharing at the nest and how the diet changes during the breeding season. Use of web cams also allows for incorporating ‘citizen science’ to contribute off-site monitoring, local community engagement and an environmental education tool for local school children, local community and tourists.

Each year webcam captures a pair of Osprey’s successfully raising young on an artificial nest platform on a barge in Porter Bay, Port Lincoln. Mrs Janet Forster has been a great advocate for the local Ospreys and her webcam recordings have been viewed in many countries across the world. This site has a high profile as it is located a short distance from the Lincoln Cove Marina entrance which houses the largest fishing fleet in the Southern Hemisphere.

The justification for establishing a webcam on another artificial Osprey nest platform in SA requires further discussion. Any commitment should be based on the collection of useful information that helps build our knowledge about Osprey behavior, dietary requirements and threating processes on Yorke Peninsula or across South Australia. If more web cams are considered then it is important to consider what aspects would help provide that information. One example, could be looking at the influence of the different coastal environment / habitats on Ospreys with several web cams on Yorke Peninsula e.g. one located in each of the two different Gulfs (Spencers Gulf and Gulf St Vincent) and another where the coast is exposed to the Southern Ocean (e.g. toe area of Yorke Peninsula). These sites may have different types of threatening process also.

5.3 Community Engagement, Public Relations & Managing Expectations

Aside from take up of the nest platforms by Ospreys, the success of nest platforms also relies on the acceptance and support of the local community, community groups and local industries (commercial fishing, boat charters & tourist operators, etc). This also includes holiday-makers and tourist recreation groups such as surfers and recreational fishers. It is important the local input is sought in relation to recommended sites, site management and signage so that no site is set-up for failure.

For example, surfers and fishers use certain vantage points to view sea conditions and it would be important to engage and discuss with them any changes before implementing these measures to avoid failure. Using tools such as local media (newspapers, radio, social media and education through schools) would also be important to promote the importance of coastal raptors to the environment and importance of the artificial nest platform project and other conservation management activities.

There is the potential that there may be delayed take-up of some nest platforms and / or that some may not get taken up at all for a variety of unknown reasons. It would be helpful to communicate these possibilities to the local and tourist community so that they are not disappointed or blaming if that occurs.

Communication, public relations and education programs with local, schools, holiday makers / tourists could also be used to seek interest in establishing a potential ‘citizen science‘ project to monitor the use of nest platforms. This may progress to developing monitoring teams particularly if web cams are established at some sites. Web cams and monitoring teams could then allow for discoveries about the local Osprey ecology to be communicated via local media (newspapers, radio, social media) which may also increase local pride, care and ownership in the presence of Ospreys and White-bellied Sea-Eagles around the Yorke Peninsula coastline, AIBS, USVG and increase general environmental awareness and appreciation of the natural world.

6 Recommendations

Wills Creek Conservation Park / Price

1. Replace existing artificial nest platform in the mangroves with a more secure and substantial platform as a priority. Refer to Diagram 4 for an example of a nest platform that may be suited to this site. Any work carried out at this site must be scheduled for March and April 2020.
2. Ensure that the Ospreys are unable to nest on the existing Navigation Pole in future. (This will require fixing rods to the base of the platform to discourage nest building).
3. Provision of appropriate interpretation signage at the boat ramp, jetty area and caravan park. Signage to focus on protecting Osprey breeding habitat, minimising disturbance to Ospreys and the importance of mangrove habitats. Also include information on White-bellied sea-eagles in any signage as they have been observed in the area as well.

Gleesons Landing

4. Erect a 120mm x 120mm square steel pole at a suitable rocky platform further seaward of the proposed location on the reef. Davey Hydraulics have advised that they could drill a 2 metre deep hole x 270mm diameter into the rock base and pile drive a square pole into the hole. The 6 metre high pole (8 metre total length) to have a nest platform and perch configuration bolted to the top (refer to Diagram 1A or 1B). The work would need to be undertaken on a high tide as the barge and drilling equipment requires at least 800mm depth of water to operate. This means the pole would be further seaward than the proposed site and well beyond any human disturbance.
5. In the event that 4 above does not progress, an alternative is to erect 4 x bonded 125mm Composite Fibre Pole and nest platform over the reef. The nesting platform would be 6 meter high with Composite fibre or hardwood timber slat platform and perch configuration attached to the top. The Composite Fibre poles to be anchored to the rock using stainless steel bolts epoxied into the rock. The pole to be fixed to a base plate which is secured to a flat slab of granite rock by Stainless Steel bolts drilled into the rock and epoxied into place. The nest pole to be supported in place by galvanised (double hot dipped) steel bracing, bolted to the pole using SS bolts (316 marine grade) and fixed to the steel plate bolted to the rock (refer to Diagram 3).
6. Interpretive signage to be appropriately placed at vantage points in the car park adjacent to the reef system and at walking trails that lead down the cliff face. Additional signage to be affixed on the “Walk the Yorke” walking trail nearby. Signage to include information on both Ospreys and White-bellied Sea-eagles as both species are seen in the area.
7. An inland nest or cliff top nest platform should be discouraged and is considered unsuitable for this site.
8. Initiate discussion with Yorke Peninsula Council, Formby Bay Environmental Action Group, local surfers and fishing representatives about track rationalisation and interpretative coastal raptor signage about track rationalisation for this site.

Port Broughton Site

9. Erect a 125mm Composite Fibre Technologies nest platform over the southern section of Hamilton Lagoon wetland. The nesting platform would be 6 meter high with Composite fibre or hardwood timber slat nest platform and perch configuration attached to the top. The Composite Fibre poles to be water jetted into the mud / sand (to confirm) substrate. Whilst the nest platform would be close to Port Broughton township and the Caravan Park, it would be located in the shallow and protected waters of the lagoon.

However the project would need to consider access requirements and costs for a boat and equipment to install the Pole and nest platform and perches (Diagram 6A and 6B or Diagram 4).

10. A second favoured location would be within the Mangrove stand in the southern section of Munderoo Bay. (Diagram 4) The small stand of Mangroves extends out from the old Prawn Farm near Ward Hill. This area is generally shallow water near a sand bar with sufficient distance from the boat channel to afford reasonable protection from disturbance from fishing boats and other human disturbance. For these reasons, this is the preferred location of Mr Garry Barnes (local commercial fisherman and local coastal raptor observer). The nest platform configuration would be similar to above with a perch mounted about 1.5 metres above and to the side of the nest. In addition a timber hardwood perch should be mounted about 0.5 metre below the nest and to the side of the platform.

11. Provision of appropriate signage. Signage at key user, visitor and / or coastal viewing spots (Port Broughton boat ramp and beach area). Signage to focus on protecting Osprey breeding habitat, minimising disturbance to Ospreys and the importance of mangrove habitats.

Point Pearce Peninsula

12. Erect a 125mm Composite Fibre Pole and nest platform on Rocky Island. The nesting platform would be 6 meter high with Composite fibre platform or hardwood timber slats and perch configuration attached to the top. The Composite Fibre pole to be concreted into a hole drilled / excavated into the limestone rock. (refer to Diagram 1) and / or

13. Erect a 125mm Composite Fibre Pole and nest platform at the marshland at the northern end of the peninsula. The nesting platform should be 6 meter high with Composite fibre platform or hardwood timber slats and perch configuration attached to the top. The Composite Fibre pole to be concreted into a hole drilled / excavated into the substrate. (refer to Diagram 1A or 1B).

Point Davenport / Foul Bay

14. Erect a 125mm Composite Fibre Technologies nest platform over the wetland within Point Davenport Conservation Park (Diagram 4). The elevated structure and nesting platform should be 6 metres high with Composite fibre nest platform or hardwood timber slats and perch configuration attached to the top. The Composite Fibre poles to be water jetted into the mud substrate. Refer to maps 7 & 8, Appendix 2 for location of the nest structure. A portable mobile nest platform option at John Halfords reef area could also be provided as a second site.

15. Provision to be made to discourage visitors from the site. Interpretive signage to be placed at an appropriate location. Signage to highlight the importance of protecting the Osprey breeding habitat and respect the breeding conservation zone around the nest and also include information on sea-eagles as well. Also establish signage at Point Davenport CP informal camping area and termination of the vehicle tracks providing information on both Ospreys and sea-eagles

16. Additional signage about both coastal raptor species to be affixed adjacent to “Walk the Yorke” signage on the walking trail.

Adelaide International Bird Sanctuary (AIBS)

17. Construct a nest platform south of the Gawler River Estuary on the edge of the mangroves. This site is largely protected from public access for crabbing due to the deep mud and limited access. Whilst fishermen occasionally access the Gawler River by boat, the location is of sufficient distance to afford minimal disturbance. The nest is in close proximity to a series of artificial ponds north and south of this location which contain good prey for fishing and foraging (refer to Diagram 6A and 6B or Diagram 4) and / or.
18. Construct a nest platform in the Dry Creek salt evaporation pond immediately south of Buckland Lake (refer map 6). This area is protected from public access and disturbance and the series of ponds contain good fish stocks for foraging and hunting. Water levels are maintained through pumping from the Chambers Creek pumping outlet. (refer to Diagram 6A and 6B or Diagram 4)
19. Provision of appropriate signage. Signage to focus on protecting Osprey breeding habitat, minimising disturbance to Ospreys, the importance of mangrove habitats and include information on sea-eagles.

Port Vincent Site

20. Erect a 125mm Composite Fibre Technologies nest platform at the outer section of the Spit and a short distance south west of the Oyster farm (Diagram 4). The nesting platform would be 6 meter high with Composite fibre or hardwood timber slat nest platform and perch configuration attached to the top. The Composite Fibre poles to be water jetted into the sand substrate. Whilst the nest platform would be close to Port Vincent township and the Caravan Park, it would be located in the shallow and relatively protected waters on the west side of the spit. Would need to consider access requirements for a boat and equipment to install the structure and nest platform and perches.
21. Provision of appropriate signage at the Port Vincent boat ramp and Port Vincent foreshore area and caravan park. Signage to focus on protecting Osprey breeding habitat, minimising disturbance to Ospreys provide information on sea-eagles and the marine environment.

Portable (temporary) Nest Structures and Platforms

22. Installation of three portable and temporary nest platforms at key locations to assess the likelihood of Ospreys adopting artificial nest platforms in different habitats including
    - The Adelaide International Bird Sanctuary - dry creek salt ponds (Recommendation 17)
    - Port Broughton at the southern end of Hamilton Lagoon wetland (Recommendation 9) with
    - one at John Halford's property (4km west of Point Davenport).

Research and Monitoring

23. Develop targeted research projects that focus on Satellite Tracking to determine habitat utilisation and foraging behaviours and strategies of adult male Ospreys and colour banding of juveniles to determine dispersal and movements post fledging. (Note: caution and justification is required for the development of satellite tracking of Ospreys).

24. The development of dietary studies with consideration be given to the collection of serum chemistry profiles to achieve greater diagnostic specificity in Ospreys and their prey. Common serum chemistries include total protein levels, cholesterol, glucose, uric acid, etc. These profiles may help provide a qualitative and quantitative analysis of the Osprey diet and other nutritional/health insights.
25. Re-assess the status of the Osprey population in each coastal region of SA to measure population stability and productivity and identify trends against the available baseline data from previous surveys (in line with Detmar and Dennis 2018 methodology).
26. Undertake regular monitor at all natural breeding territories and artificial nesting platforms in SA (with a focus on the Yorke Peninsula and St Vincent and Spencer Gulf areas) to determine breeding activity and productivity outcomes (number of young) at each site.
27. If this project is successful, consider the introduction of artificial nest platforms at key sites / habitats in other regions of SA to help argument the Osprey population.

Web cam

28. Investigate establishing 1-3 webcams to monitor Osprey nests across the range of coastal habitats and different platform situations (e.g. the two Gulfs and the coast exposed to the Southern Ocean (southern toe of Yorke Peninsula) to investigate diet, seasonal storm (climate change) affects, breeding timing and breeding behavior /fledging differences) and potential threatening processes. Site could be at Innes Natural Resource Centre for Environmental education (Peters Island (natural site) or platform at John Halford's site if appropriate), Spencer's Gulf (Port Broughton or Point Pearce area) and Gulf St Vincent (at Price or Port Vincent).

Community Involvement

29. A strong emphasis on local community groups such as Progress Associations, Local Action Groups, Friends Groups and Lions Clubs, etc to fabricate, construct and where possible install Osprey structures and nest platforms on site. Installation at some sites however may need specialist contractor involvement, not withstanding support and assistance from DEW and other organisations.
30. Encourage community involvement (Citizen Science) in monitoring Osprey nest platforms. DEW to assist with training volunteers in monitoring techniques, data collection procedures, Osprey biology and ethical considerations.

Local Community Engagement, Public Relations and Managing Expectations

31. Seek local input from local council officers, local recreational user groups (surfers, recreational fishers, boat charter operators), commercial fishers, oyster lease holders and local community representatives to check and finalise sites, site management and signage.
32. Provide information to local councils, community groups, newspapers and media to engage with and inform the local community about Osprey and White-bellied Sea-Eagle ecology, proposed or established Osprey platform areas /sites, appropriate human behaviour around coastal raptors and possible uptake or not of nest platforms. This should focus on generating local interest and engagement with the project and education to manage expectations about

success of the project (i.e. there may be some platforms that don't get taken-up initially or at all). This will require the input of the NY Region and specialist community engagement staff.

33. Develop / encourage a strong emphasis on local community groups such as Progress Associations, Local Action Groups (e.g. Formby Bay Environmental Action Group), Friends Groups and Lions Clubs, etc fabricating, constructing and where possible installing Osprey structures and nest platforms on site and appropriate signage nearby. Installation at some sites however may need specialist contractor involvement, support and assistance from DEW and other organisations.
34. Encourage community involvement (Citizen Science) in monitoring Osprey nest platforms. Investigate how establishing citizen science monitoring team for each platform (or each webcam platform) could be supported by NY region, DEW and Birds SA. This is required to assist with training volunteers in monitoring techniques, data collection procedures, Osprey biology and ethical considerations. This could require a part-time volunteer support officer,for volunteer and data entry coordination, and funding. Data to be go into appropriate DEW or Birdlife Australia Birdata or Birds SA database. It would also allow for regular monitoring of the platform structure and human behaviour in the vicinity.

Conclusion

A species at the top of the food chain can tell us a great deal about the quality of the coastal habitats in which it lives. It may serve as a useful indication of the undesirable effects certain activities are having on the natural environment. The Osprey is a good indicator species in this sense because unlike some other top order predators such as White-Bellied Sea-Eagle, it is relatively tolerant of humans and will often nest near towns and in areas close to recreational pressures. Generally Ospreys are highly regarded by the general public as a symbol of a healthy and productive environment.

The Osprey has the potential to be a catalyst for the community, volunteer groups along with government agencies to work together in a positive way to provide artificial nesting platforms to help augment the Osprey population on Yorke Peninsula and Gulf St Vincent and Spencer Gulf areas. These efforts will be central to promoting the successful recovery of the Osprey population in SA particularly in areas where there appears to be a shortage of natural nest sites.

Appendix 1 – Diagrams and Plans of Osprey Nest Platforms

Diagram 1A - Osprey Nesting Platform at Sites with Mud, Silt or Sand Substrates

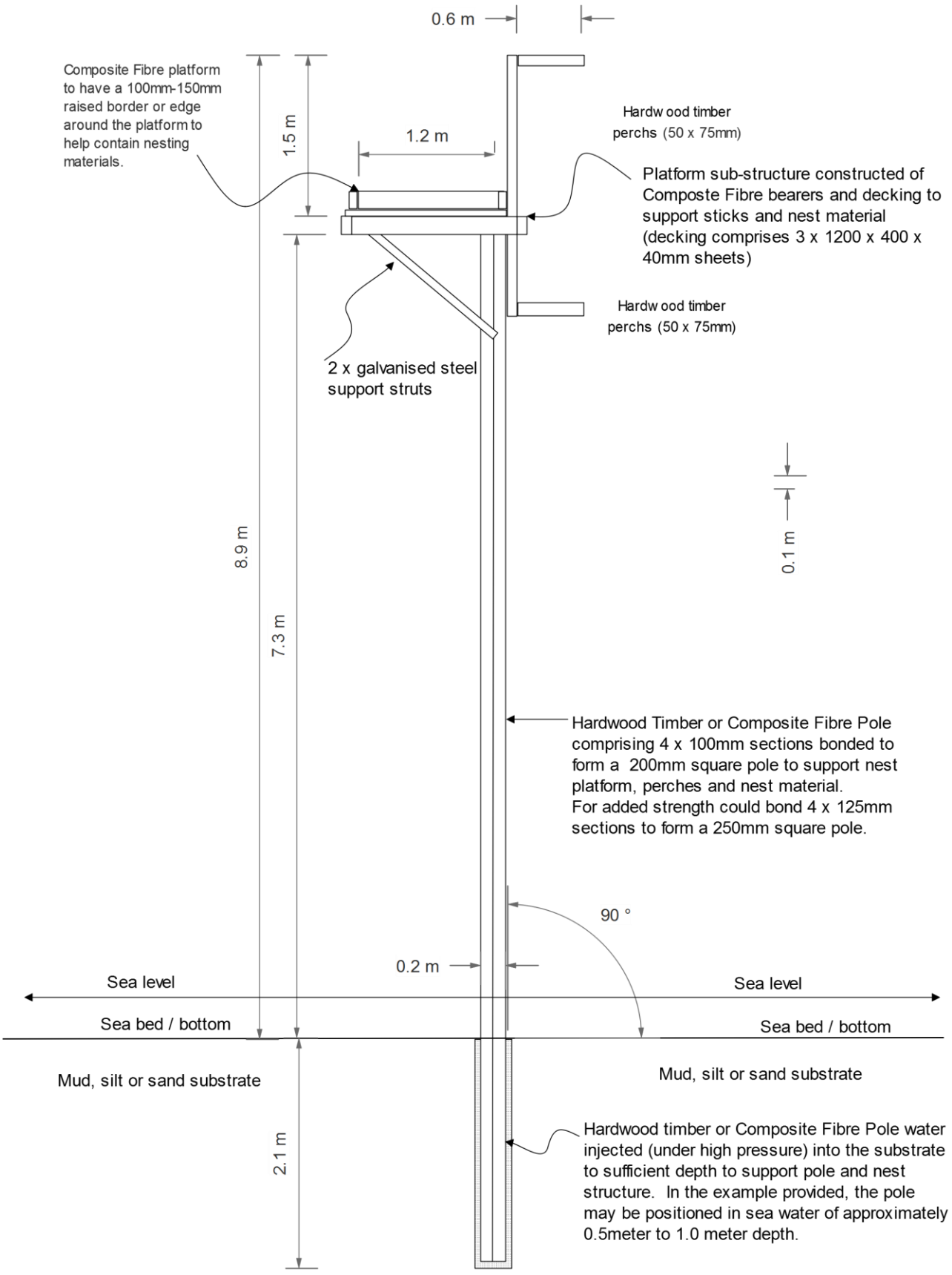


Diagram 1B - Osprey Nesting Platform at Sites with Mud, Silt or Sand Substrates

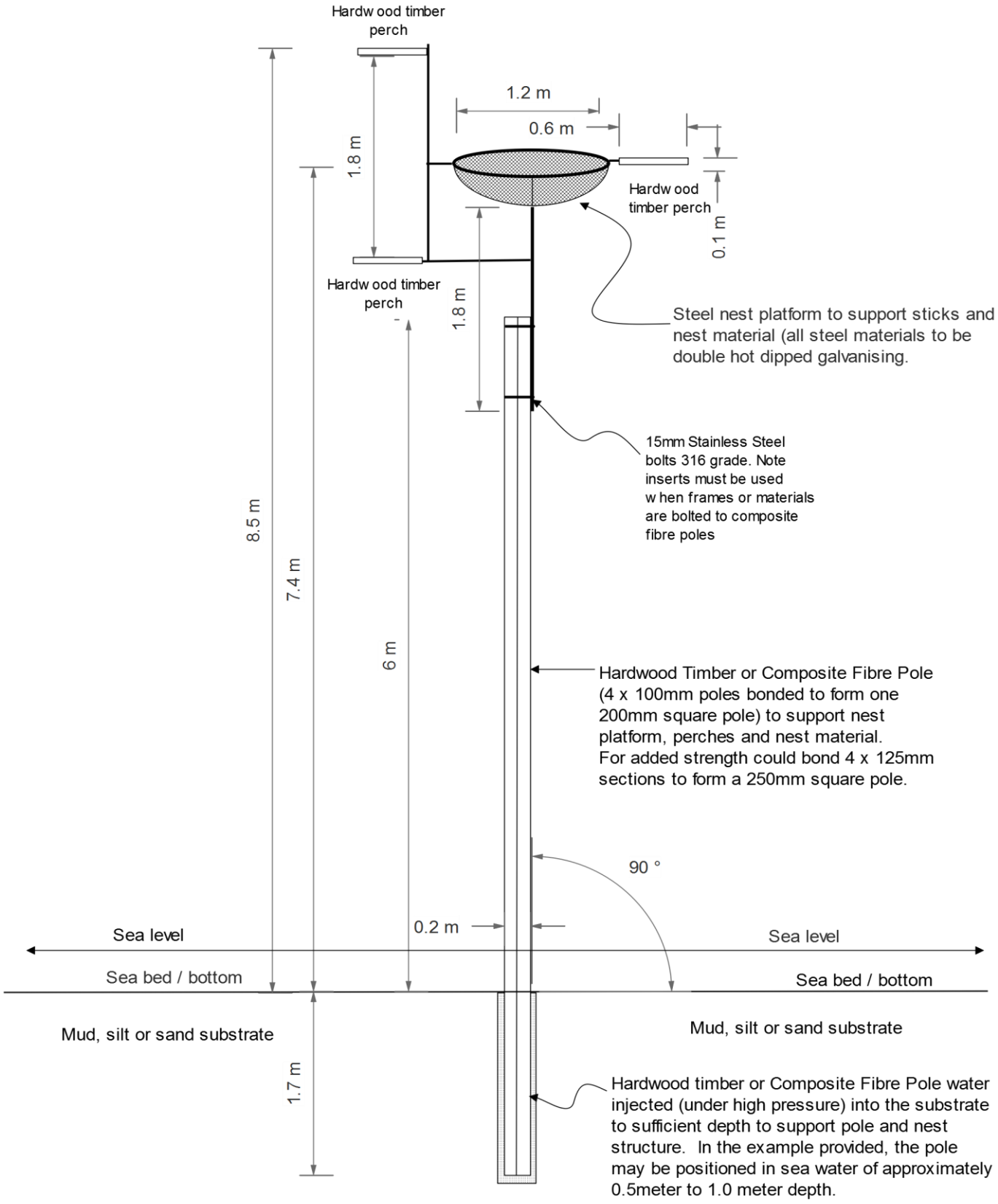
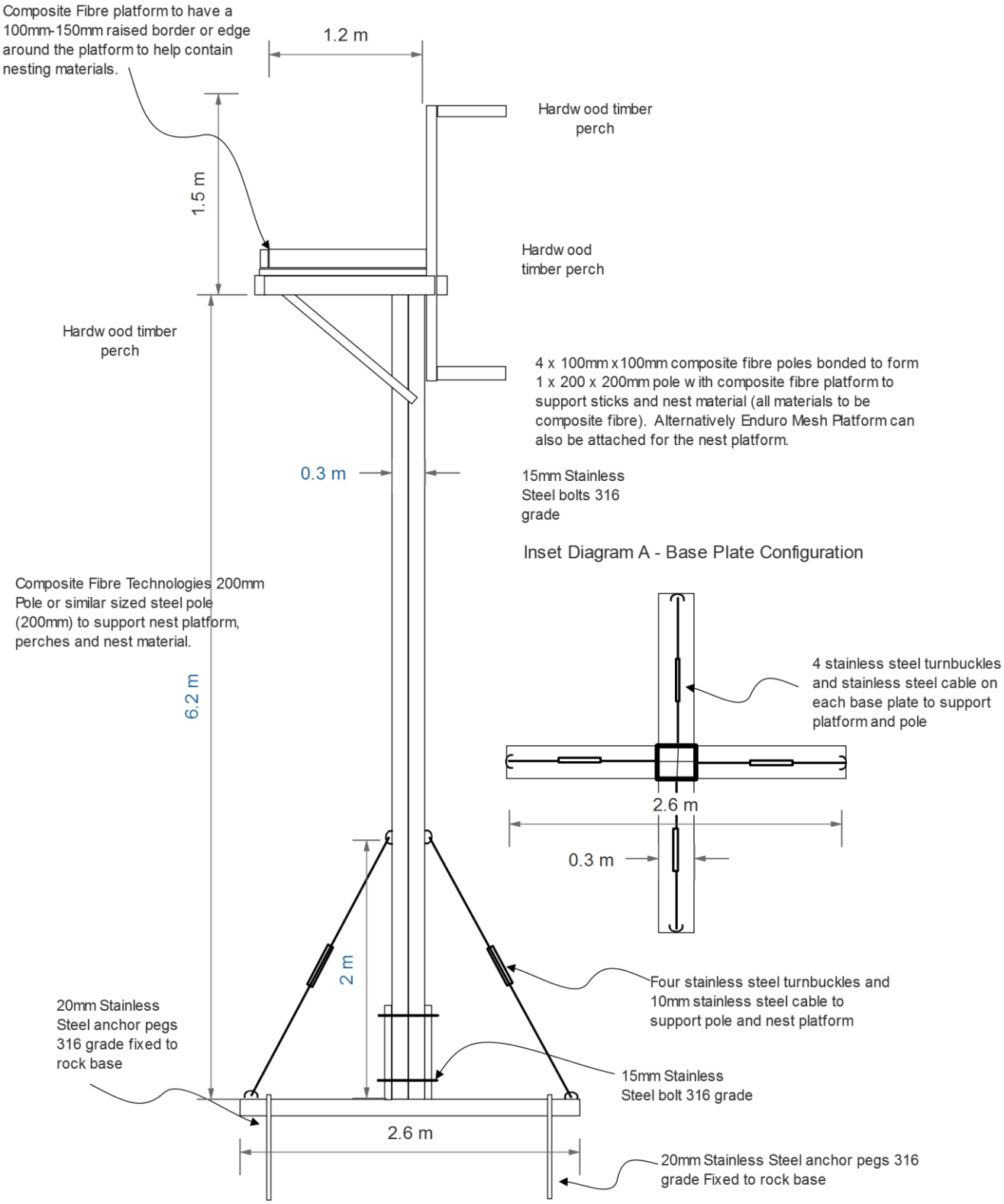


Diagram 3 - Osprey Nesting Platform & Pole for Rock & Reef Sites



4 stainless steel turnbuckles and 10mm stainless steel cables on each base plate and fixed to pole for support and stablity. Subject to rock type and location of platform, additional support from gussets may be required (eg areas of high wave action and tidal surge). The length of the SS anchor pegs would be dependant on rock type. All bolts and fixings to be 316 grade stainless steel. In the example provided, the pole would be bolted to the base plate configuration (see Inset Diagram A) and securely fixed upright by the 4 turnbuckles and guy wires (cables) as required.

Diagram 4 - Nest Platform for Shallow Estuarine Sites

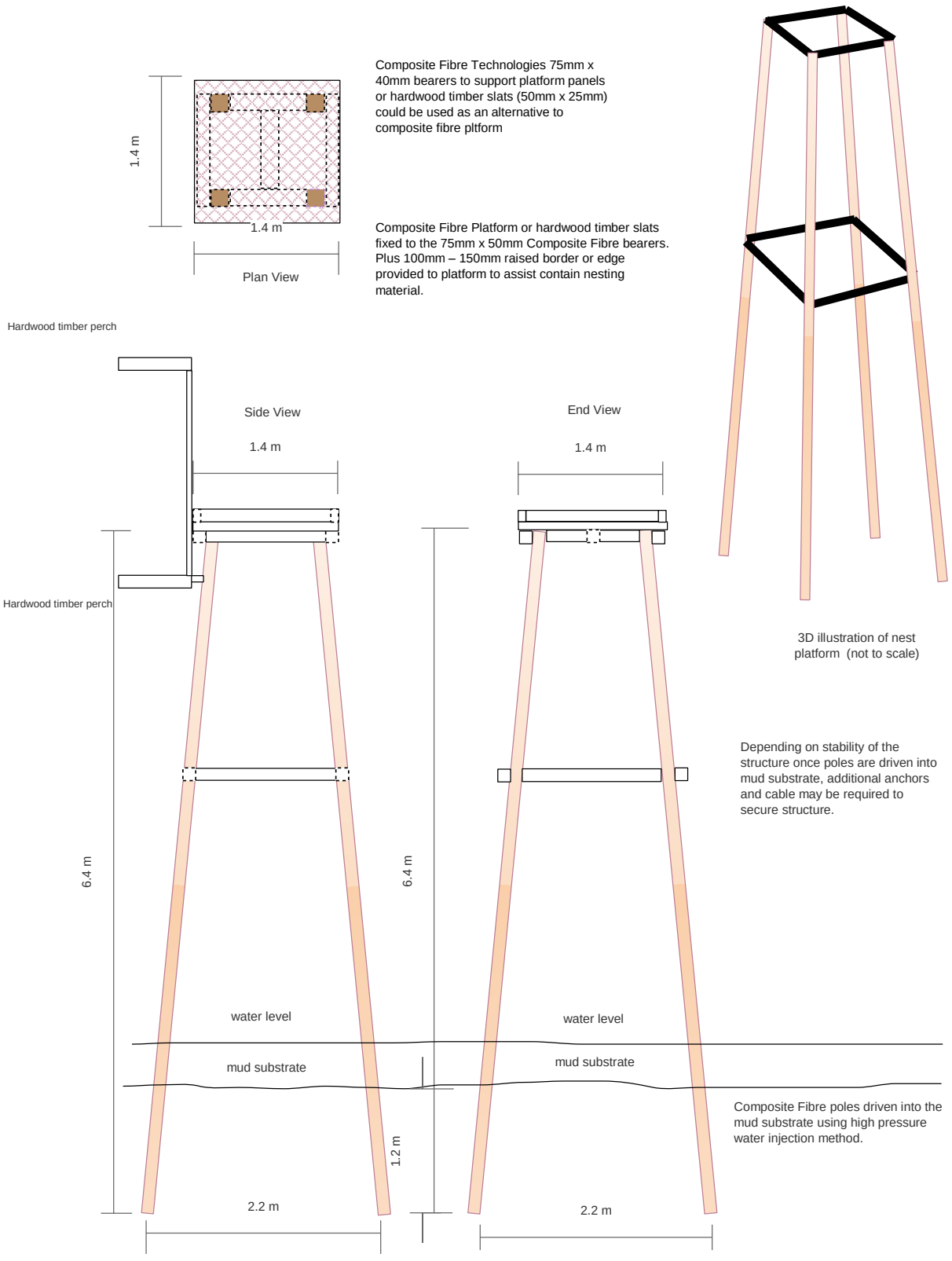


Diagram 5 - Osprey Nest Platform and Composite Fibre Pole Mount

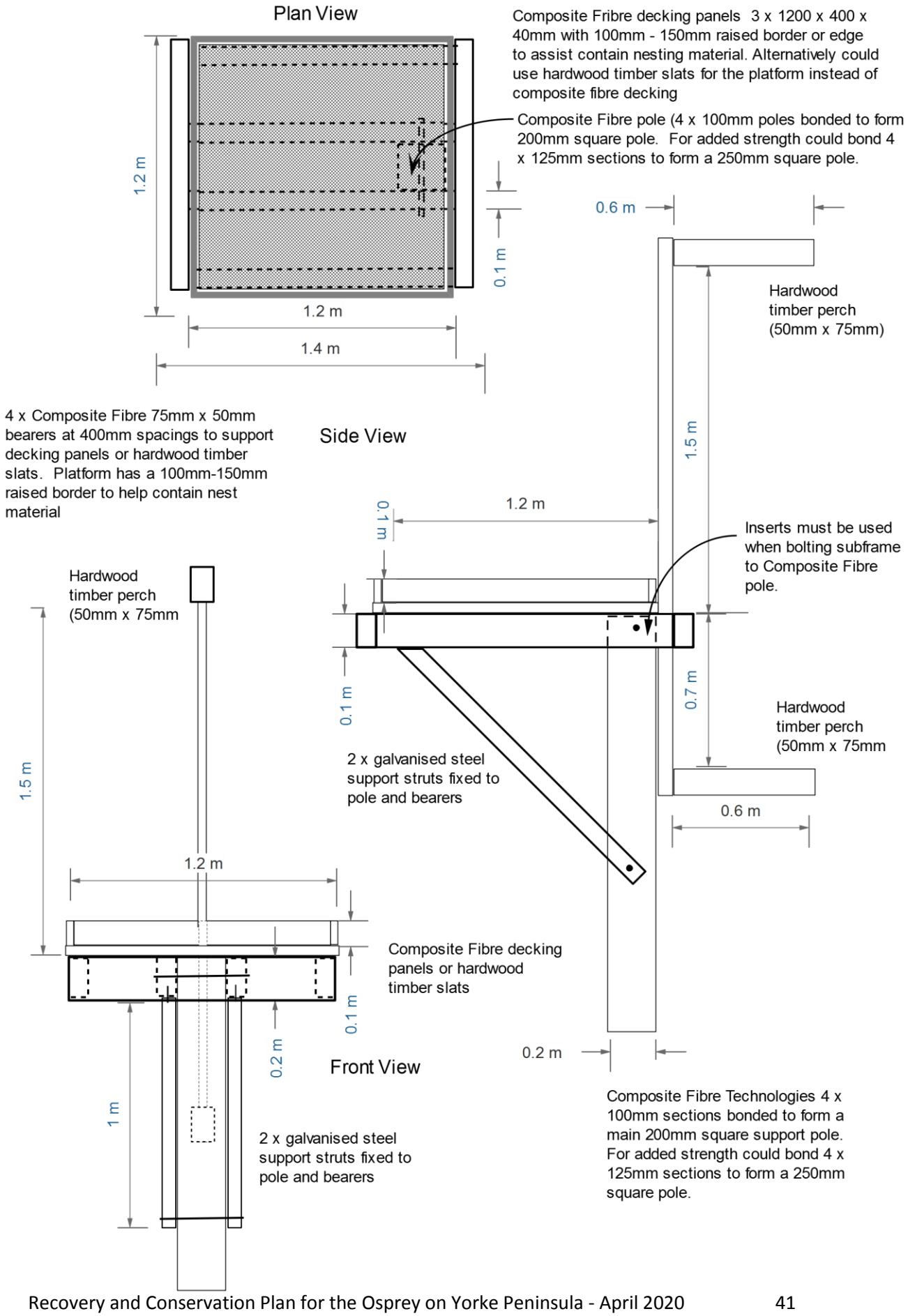
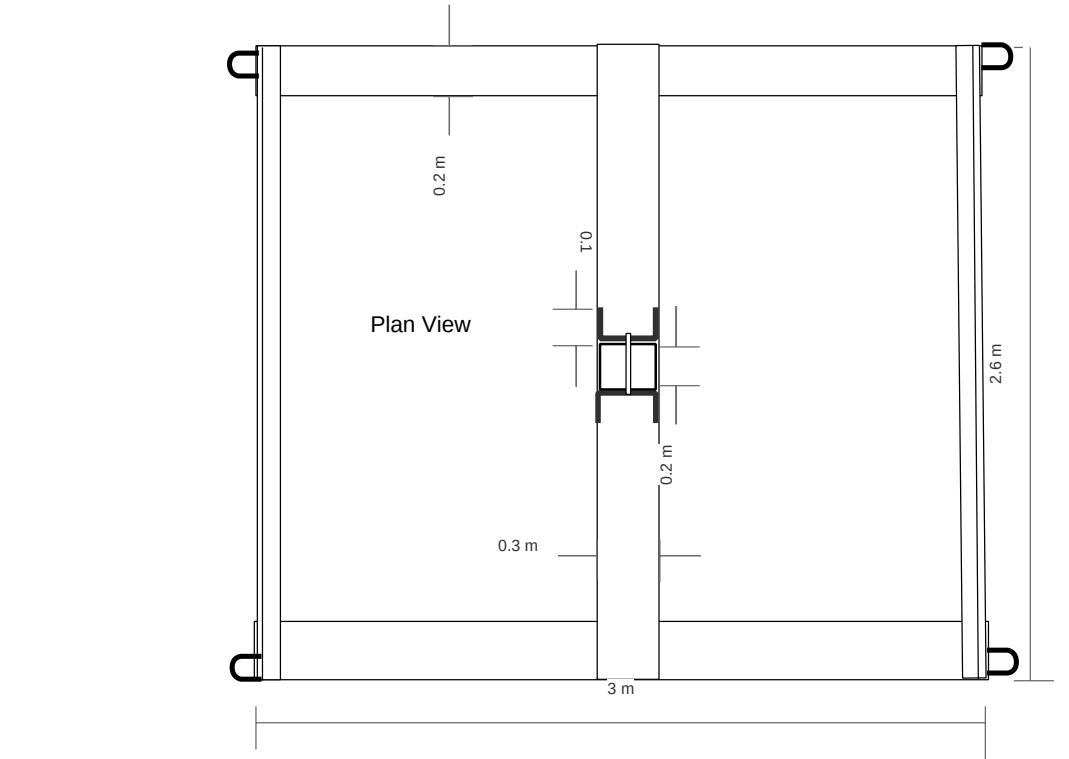
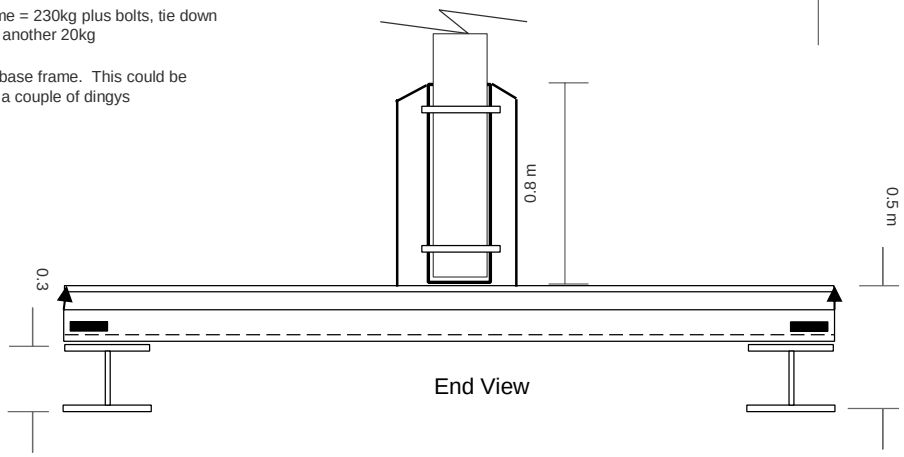


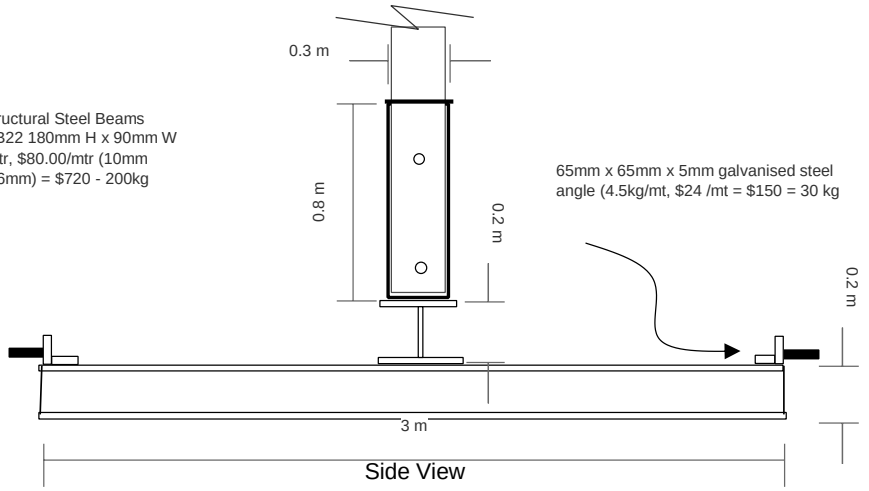
Diagram 6A - Osprey Nest Pole Base for Sites with Mud Substrates



Weight of the base frame = 230kg plus bolts, tie down eyes, and pole bracket another 20kg

Total weight 250kg for base frame. This could be floated into position on a couple of dingys





RSJ Structural Steel Beams
(180 UB22 180mm H x 90mm W
22kg/mtr, $80.00/mtr (10mm
thick x 6mm) = $720 - 200kg

65mm x 65mm x 5mm galvanised steel
angle (4.5kg/mt, $24 /mt = $150 = 30 kg

Diagram 6B - Osprey Nest Pole & Platform for Sites with Mud Substrates

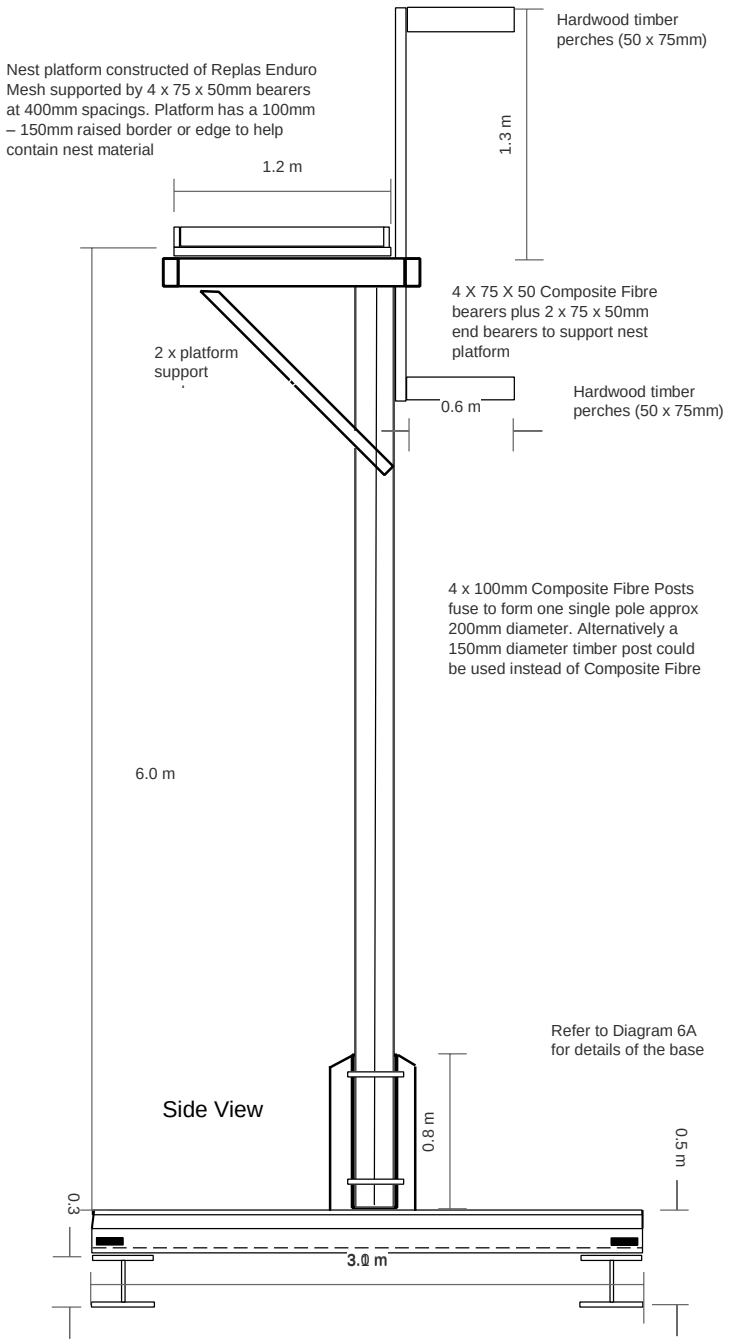
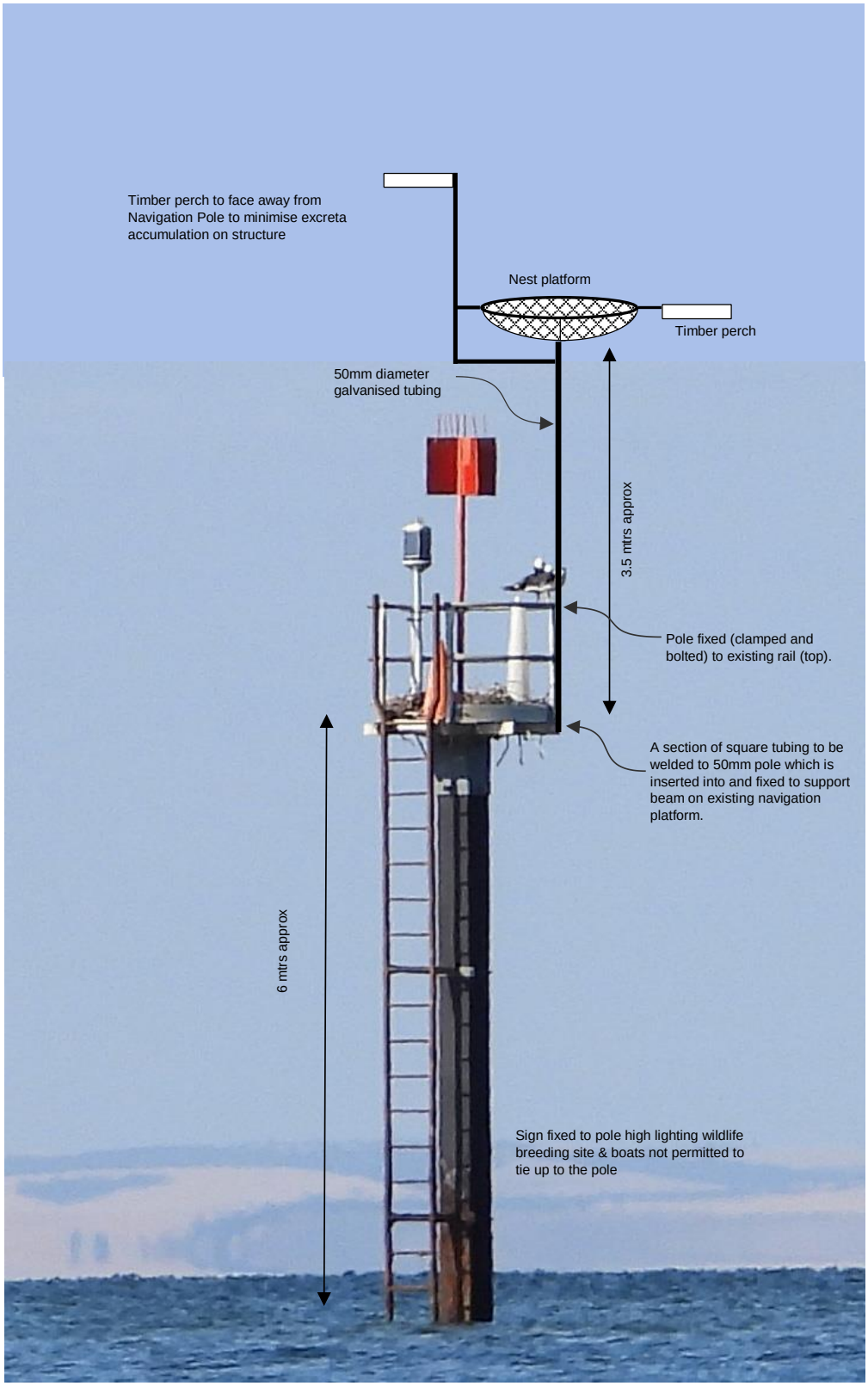


Diagram 7 - Wills Creek Navigation Pole with Artificial Platform Mounted Above



Appendix 3 – Guidelines & Costings for Construction & Fabrication of Nest Platform

Osprey Artificial Nest Platform fabrication & construction should be undertaken by community groups (eg Mens Sheds, Progress Associations, etc) in the areas the platforms are proposed to be erected.

Installation of nest platforms and structures at sites where Ospreys are present will need to be undertaken during the non-breeding season (March to May) to ensure adverse impacts on potential breeding activity for the following breeding season is minimal.

1. Size of platform: approximately 1.2 m x 1.2m with 100mm-150mm raised border.
2. Support poles should be solid posts of either hardwood timber (Ironbark) at least 150mm in diameter or steel (12mm wall thickness) or Composite Fibre (4 x bonded 125mm or 100mm square sections)
3. Minimum pole size in accordance with AS/NZS 3000:2007, 150mm for full length hardwood poles, with durability of class 1 and strength grade of S3 or better.
4. A minimum of two stays for the base to be a minimum of 75mm x 38mm, 3,000mm long and secured to the pole and pegs using a minimum of two galvanized coach screws of adequate size at each fixing point.
5. Pegs for the base to be a minimum of 600mm and driven to a depth of 450mm.
6. The nest platform should be able to support the weight of at least 150kg.
7. Depth of pole in ground to be 1 metre plus 10% for each meter of height.
8. If poles are longer than the figures shown, then additional depth will be required proportional to the additional length above the ground and soil type.
9. Pole caps are required on all hardwood timber poles (to prevent moisture ingress).

Hardwood Timber Poles. (6 m out of ground). Pole diameter 200mm at the but end and 130 mm at the head. (Costs approx. $970 each).

Excavated hole = recommended 10% of the length of pole plus 1 metre = 1.6mtrs depth for 6 metre pole.

If Poles are concreted into the ground, require 28 bags of pre-mix (easymix) (10kg bags)

Mobile nesting platform which can be transported to preferred locations in kit form and assembled on site and anchored with pegs and support cables.

8 metre x 200mm (4 x 100mm) Composite Fibre reinforced box sections

8 metre x 125mm Composite Fibre Pole (Costs approx. $50.00 / linear metre = $450.00 for a 8 metre pole)

Table 1 – Selection of Artificial Nest Platform Materials

2 ea	1.2mt x 100mm x 50mm timber	Hardwood timber or CCA / H6
2 ea	1.2mt x 100mm x 50mm timber	Hardwood timber or CCA / H6
1 ea	100cm x 120cm x 2.5cm sheet	REPLAS sheet forms the nest platform
4 ea	1.2 mtr x 75mm x 25mm timber	REPLAS batten forms a border around nest platform
3 ea	600mm x 50mm x 75mm (Perch)	Hardwood timber or CCA / H6
2 ea	600mm x 50mm x 75mm (Perch)	Hardwood timber or CCA / H6
20ea	75mm x 8mm tech screws	
6 ea	150mm x 10mm hex head bolts	Stainless Steel (316 grade)

Note; The author strongly recommends a structural engineer be consulted and or engaged to provide advice on the strength of the poles and platform structures to ensure they are fit for purpose.

Table 2 - Project Costs (nest platforms, poles & signage)

No	Tasks / Item		Costs
	Certify poles & platforms by licenced engineer to ensure fit for purpose & mitigate any liabilities	engineering consultant	$5,000
4	Bonded 100mm Composite Fibre Poles & platforms with anti crush inserts & fixings		$8,000
5	16 x Composite Fibre poles for frames & inserts, bracing and fixings		$9,600
3	Portable steel base frames for nest platforms FP6A comprising double hot dipped galvanised steel @ $3,500 ea		$10,500
9	Composite Fibre Nest Platforms with mesh base	$150 ea	$1,200
3	Bonded composite fibre poles (for FP6B & FP2)		$12,000
1	Davey Hydraulics Contractor for rock drilling and pile driving steel poles		$6,000
28	Rapid set premix concrete 32 bags @ $9 / bag		$290
	Hire of water injection equipment ($352 x 2 wk)	$352	$704
	Hire H65 Jack Hammer for pole excavation (3wk)	$231	$693
	Hire hand held Core Drill (25mm) $693 / wk		$693
	Stainless Steel fixings, bolts, turnbuckles, etc		$1,250
	Stainless Steel 10mm cables 316 ssw026-305		$3,464
	36 Stainless Steel anchor/rods 20mm for rock installation ($55 / m x 10)		$550
24	Hardwood timber perches $10.50 L/M x 24m		$252
6	Ramset Epoxy anchor chemset 801plus ($75 x 6)		$450
3	Hire of 8Kva power generator ($370 / wk)		$1,110
	Transport of fabricated platforms to sites		$1,200
8	Interpretive education signage at each location including powder coated frames & sign panels	$1,500 ea	$12,000
	Total		**$75,000**

Appendix 4 – Analysis of different material types used for nest platforms

Table 3 - The benefits and disadvantages of 3 different material types used to construct artificial nest platforms, poles and frames.

Materials	Advantages	Disadvantages
• **Steel Nest Platform & Pole**	1. Durable and longevity particularly if double hot dipped galvanised	1. Metal fabricator required to construct platform
	2. Once fabricated only requires installation work in the field	2. More expensive to build and construct including the double dipped galvanising
		3. Heavier and therefore more difficult to erect on a pole (if manual installation on offshore islands is required)
		4. More difficult to make modifications (post platform fabrication)
• **Hardwood Timber Nest Platform & Pole**	1. Less expensive to build and construct than steel	1. Durability and longevity less than galvanised steel
	2. Easier to fabricate platform by tradesman / handyman / volunteers.	
	3. Hardwood timber relatively durable	
	4. Easier to make design modifications to suit the location / situation in the field	
	5. Lighter and therefore easier to erect on a pole in the field	
• **Fabricated Composite Fibre Pole & Nest Platform**	1. Costs comparable to other materials to build and construct	6. Slightly more expensive than steel poles *
	2. Relatively easy to construct and fabricate platform & pole configurations by volunteers and tradesman	**7.** Ethical considerations of using plastic materials and products in a marine environment
	3. Composite fibre considered long lasting & very durable material & stable	
	4. Composite Fibre long lasting, strong, light, durable and non corrosive	
	5. Easier to make design modifications to suit the location / situation	
	6. Comp Fibre Pole & platform lighter and therefore easier to erect/install.	

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