# SOUTHERN SEAWATER DESALINATION

**DEVELOPER : Water Corporation**
**PROJECT END VALUE : $955 Million**
**COMPLETION : October 2011**
**ARCHITECTS : Parry & Rosenthal Architects**
**SURVEYOR : BCE Surveying Pty Ltd**

## MAKING FRESH WATER FOR A VERY DRY REGION

Western Australia moves a significant step closer to almost one third of their water being from climate-independent sources with the commissioning of the Southern Seawater Desalination Plant (SSDP) between Binningup and Myalup. The design, construction and operation (for 25 years) of the desalination plant is being undertaken by the Southern SeaWater Alliance (SSWA), comprising Tecnicas Reunidas, Valoriza Agua, AJ Lucas, WorleyParsons and the Western Australian Water Corporation.

At ultimate capacity the plant will produce 100 gigalitres of drinking water annually. Water from the plant will be fed into the Integrated Water Supply Scheme near Harvey, approximately 30 kilometres inland.

To ensure effective and efficient distribution of water from this new source, a pump station is being built at Ravenswood, with the capacity to pump 125 to 265 million litres of water daily from the Stirling Trunk Main to the Tamworth Reservoir, and 30 to 130 million litres of water each day to Serpentine or North Dandalup Dam via a new, connecting pipeline.

Construction of the plant commenced in July 2009, proceeding with scrupulous care for the environment. The environmental issues identified during planning included noise, dust, protection of the marine ecosystem, endangered species, wetlands and clearing of native vegetation for the plant and associated pipelines and other infrastructure.

The Water Corporation has implemented the most intensive ocean monitoring program of any desalination plant in the world at its Kwinana desalination plant. The same thorough, stringent approach to monitoring is being taken at the SSDP, both during construction and during the operational phase.

The SSDP site is situated near open ocean which has a high energy swell. The design and locating of the discharge pipeline ensures that the concentrated seawater discharge from the plant mixes rapidly with the surrounding seawater to reach background salinity levels. Both the discharge and intake pipelines have also been located where they will have minimal impacts on seagrass beds, reef systems and other sensitive marine habitats, and minimal risk of harm to aquatic life, which includes dolphins and migrating whales, which are a protected species under Federal law. A whale expert was involved in the planning stage, and there will be ongoing monitoring of the wellbeing of cetaceans during the operational phase.

The main issues on land were associated with wetlands and the clearing of vegetation which is habitat for fauna including endangered ring tail possums and black cockatoos. These risks have been mitigated by routing pipes around wetlands and using cleared areas wherever practical for pipelines.

The state Environmental Protection Authority set the second highest level of environmental assessment for the project. This meant the Water Corporation was required to produce a Public Environmental Review (PER) document, which drew on 39 independent environmental studies. The document outlined the potential environmental issues which could arise from the proposal to build the desalination plant and mapped out strategies to minimise and mitigate these issues.

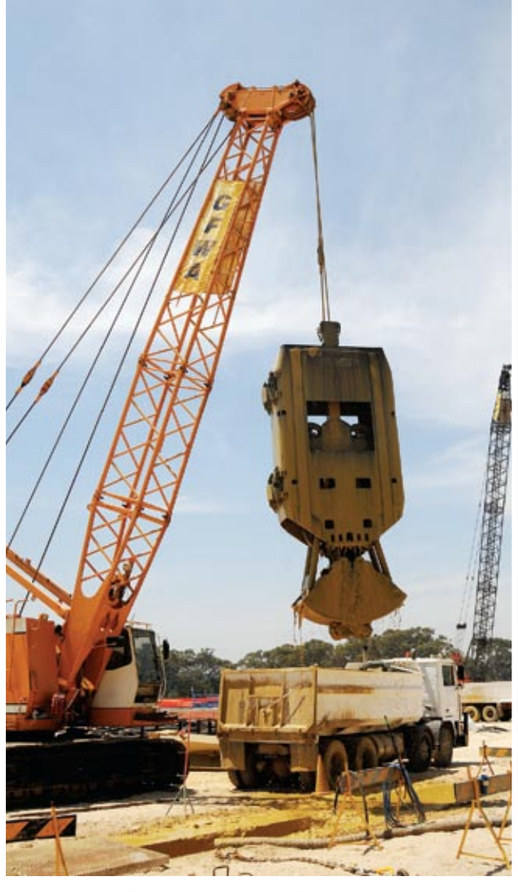
The Federal Department of Sustainability, Enviroment, Water, Population and Communities also examined the proposal and assessed the environmental impacts that relate to listed and threatened species that are protected under the Federal Environment EPBC Act.

During construction The Water Corporation had human monitors at sea to raise the alert if whales or dolphins were spotted in the exclusion zone. Construction ceased when this occurred. In addition, an ocean watch vessel was deployed before blasting or pile driving activities to look for cetaceans. The community were also encouraged to report whale or dolphin sightings to the Water Corporation.

Along with the 45 gigalitre Kwinana plant, which has been successfully operating since 2006, the Water Corporation operates a number of reverse osmosis plants in country WA. It also owns and operates the Kwinana Water Reclamation Plant – the biggest water recycling plant of its kind in WA. The reclamation plant reduces industry demand for scheme water by up to six gigalitres a year, which is equivalent to about two per cent of Perth's total scheme water use.

This year, the decision was made to commence work on doubling the capacity of the plant from the currently constructed 50 gigalitre capacity to 100 gigalitres annual capacity, with work commencing in August. This will enable the SSDP to meet the water needs of communities from Perth to the Goldfields, whether it rains or not.

The first stage of the SSPD commenced supplying water in September 2011, which was ahead of the original construction and commissioning schedule. The project cost to this point has been $955 million, and the additional expanded capacity is estimated to add another $450 million to the total cost of the SSDP. The additional capacity is due to come on line into the Water Corporation's Integrated Water Supply System by the end of 2012.



# GEOTECHNICAL KNOW-HOW DELIVERS OUTSTANDING SOLUTIONS

As experts in geotechnical engineering for Western Australian conditions, GFWA had the skills and ingenuity to resolve numerous complex challenges for the Southern Seawater Desalination Plant (SSDP) project. GFWA were involved in constructing the diaphragm walls for the intake pump station (IPS), which is the subterranean structure receiving sea water from bored tunnels for on-pumping to the processing sections of the plant. GFWA also undertook the SSDP piling works. Work commenced September 2009 and was completed in April 2010, ensuring an on schedule launch for the TBM (Tunnel Boring Machine).

This was a challenging assignment. GFWA had to design and implement a practical methodology for the constructability of the structural design; design of the assembly and lifting programme of the very heavy diaphragm wall cages; and placement of specially designed soft spots that would not disturb the cage's integrity during lift, but which would allow facilitated drilling during tunnelling phase. GFWA logged over 20,000 man hours on the project.

"To accelerate the construction programme and eliminate requirement for ground anchors and tiebacks, top down construction methods were selected to form each of the shafts. Following roof slab construction, panels were designed to span approximately 10 m during bulk excavation to base slab level," explains GFWA project manager, Gary Webley.

"Preliminary geotechnical investigations indicated that voids in the underlying Tamala Limestone presented risks associated with piping failure and base slab heave following decommissioning of dewatering. To counter these risks panels were extended to depths of 25 m, achieving a socket into the underlying Leederville formation. Further challenges for Diaphragm Wall reinforcement design were posed by the IPS' 100 year design life in an aggressive salt water environment and stringent crack control requirements; complex loading scenarios given the staged excavation and flooding process; and reaction loading during pipe jacked tunnel construction."

6,250 $m^2$ of 1.0m Diaphragm Wall comprising thirty eight 1.0m thick heavily reinforced diaphragm wall panels were installed to depths of 25 m in variable ground conditions. Fifteen 2.8 x 1. m Barrettes were also constructed to facilitate support of ancillary structures.

The coastal site has a naturally high water table, and it was vital to ensure a watertight IPS structure to facilitate effective dewatering prior to excavation. To produce panel joins that satisfied the project specification of less than 2 ml/min of water ingress at any one location, GFWA implemented the use of the patented CWS joint system. This system utilises a shaped steel form or stop end, and incorporates a PVC water-stop over the full depth of the panel. Both elements are cast into primary panels during concreting. The stopend is then extracted sideways during excavation of the adjacent panel forming a keyed joint, with the water-stop remaining cast into the previous panel's concrete.

Panel excavation was carried out by two 65T heavy duty crawler cranes, each equipped with rope operated or mechanical grabs and star, cross and box shaped chisels, digging under a bentonite support fluid. Excavation rates exceeded 10 $m^2$/hr in the upper 12 m. The lower 13 m, with the sandstone in particular, proving more challenging. Maximum penetration into the sandstone of 2.5 m was initially required. Total excavation time for this panel including socket totalled 750hrs (an average of 71 mm/shift). Maximum rock socket requirements were revised to 0.5 m thereafter. GFWA had to use innovative thinking for the structural design of panel reinforcing cages. As constructed cage weights exceeded 360 kg/$m^3$, with a total of 10 layers of reinforcing bar required to account for the complex bending and crack control requirements. To maintain programme a fabrication crew of 35 personnel was required. Cages were constructed flat on ground, and lifted to vertical for installation into the open excavation by a 150 T crawler crane. The heaviest of the completed cages weighed in at a massive 72 T, and 1,900 T of steel in total was fixed, welded, lifted and installed.

To safely lift and position the cages, GFWA conducted detailed lift assessments. The assessments found that any cage less than 3.1m in width could be lifted as a single unit 25 m long, with a maximum cage weight of 33 T. Any cage wider than 3.1 m would require building in two separate sections that would then be installed separately and spliced over the excavation. Maximum cage weights lifted from horizontal in this case was 42 T, with a maximum spliced lift of 72 T.

In total, 6,250 $m^3$ Concrete was placed for the IPS wall panels, supplied from an on-site batch plant. Given the heavy, closely spaced reinforcing a high flow Self Compacting Concrete (SCC) was specified. To further ensure concrete encasement of bars, maximum aggregate size was limited to 10 mm. Given the aggressive environment, hydrophobic admixtures were included in the mix design, which fill pores within the concrete to reduce permeability. The tested and approved SCC mix with high silica fume, caltite/3CC & glenium content utilised achieved permeability results of less than $3x10^{-12}$m/s.

GFWA was established in 1973, and since then has been involved in the construction of most Western Australian projects that require geotechnical contracting.

"Early involvement of GFWA in a project can yield better results for our clients. We will be able to advise them of methods and technologies that can assist them in accelerating their construction programmes with the most affordable costs. Our involvement can either be in the capacity of a design and construct specialist or contracting only," said GFWA Managing Director, Rob Simpson. "Soletanche Freyssinet Group is the world's leading geotechnical contracting group with offices in about 100 countries in all continents. The group has numerous inventions and hundreds of innovations that form today's construction methods worldwide. Being a member of the Group, GFWA has unlimited access to the source of the thoughts and technologies that have performed the most challenging projects that have ever been done. At the same time more than 40 years of Western Australian experience has enabled us to optimise the latest technologies to suit the local market's requirements.

"GFWA has been a strong supporter and promoter of geotechnical engineering. This year we will have the 19th GFWA prize that will be held at Engineers Australia by Australian Geomechanics Society in Perth. We won the Master Builders Award Subcontractor of the Year Award in 2000 for the Lakeside Joondalup Cinemas and Tunnel Project. Head contractors of some of our other projects, such as One40William, State Theatre of Western Australia, Ennex 100 and St. Mary's Cathedral have been winners of the MBA's of 2010 and 2011. We (our sister company, Menard Bachy, in the east coast) are also Engineers Australia's Environmental Engineering Excellence Award 2007 winner for the deep barrier wall that was constructed at the former Steelworks Site in Newcastle."

**GFWA**
113 Radium Street
Welshpool WA 6106
t. 08 9350 5394
f. 08 9358 3095
www.gfwa.com.au

GFWA

# A ‘CAN DO’ APPROACH TO CLIENT NEEDS

Going to great lengths to deliver quality work is what JT Contracting (JTC) has built their business on. On the Southern Seawater Desalination Plant they not only supplied and installed the roof and wall cladding, they also assisted in keeping the wider works program on track, by mobilising a carpenter, riggers and boilermaker to help keep the rigging and other day to day construction activities on schedule.

JTC’s scope of works was the wall and cladding package, and the company had up to 15 staff on site for eight months completing their program. JTC also supplied all the project flashings from their workshop, and supplied and installed the 750mm throat acoustic ridge ventilator on the MF building.

“The QA on this job was extremely high and the construction schedule was extremely tight,” said JTC Director, James Ainger.

Even working at a cracking pace, JTC’s crew maintained the highest quality of workmanship and highest standards of safety.

JTC has been involved in many other major projects across the industrial, mining, civil and commercial construction sectors, including Pluto, Gorgon, Cape Preston, Brockman 4, Boddington Gold, Yandi HI Expansion Project and Worsley Rapid Growth Project. They are currently working on a 40,000m² facility for Coca Cola. The company capabilities include both design and construct, and the workforce includes roof plumbers, riggers, boilermakers, scaffolders and carpenters. The JTC workshop is equipped with a 65ft boom lift and a 45ft boom lift, enabling the company to handle massive fabrication tasks.

The newly upgraded workshop includes a flashing department with a 6.5m slitter folder, a new 6m 250T Press Brake and 6m x 6mm Guillotine, with a range of tooling that allows JTC to cut and bend 6m long material with thickness varying from .55 rainwater goods to 6mm mild steel.

“This new machinery is now in full operation and gives us the edge over our competitors with shorter lead times, and we have our own 6.5m tray truck with a hiab to deliver materials on time,” said James.

JTC are a family owned company who strive to build strong ongoing relationships with clients, delivering the highest standard of work across both metroplitain and regional areas of Western Australia.

The company’s range includes metal roof decking; metal wall cladding; all profiles of roof and wall sheeting; roof vents including flues, ridges, whirlybirds; skylights (polycarbonate / fibreglass); gutters, downpipes and flashings; Temporary Edge Protection (engineered to comply with Australian Standards); roof and wall insulation (anticon / aircell); and wall vents (Louvres).

JT Contracting WA Pty Ltd
Commercial & Industrial Roofing

**JT CONTRACTING (WA) Pty Ltd**
t. 08 9493 4500
f. 08 9493 4600
e. Jamie@jtcontractingwa.com.au
www.jtcontractingwa.com.au



# INNOVATORS ON A MASSIVE SCALE

Enthusiasm, engineering ability and quality work make Permacast the market leader in supplying major projects throughout Western Australia with custom-designed precast components. Their skills in both fabrication and installation were invaluable for the Southern Seawater Desalination Plant (SSDP) project.

The Permacast factory is set up for large scale, high volume projects, with over 200,000m² of storage capacity. For the SSDP, they produced over 1050 precast wall and roof panels, totalling over 15,600m² of product, storing up to 600 at a time to enable easy access and rapid loading onto trucks on request from installation crews. Permacast also supplied 72 large electrical box culverts and covers weighing over 15T each, again storing these at their site until required.

Detailed precast requirements are a company speciality, such as the 630 panels for the Micro Filtration and Reverse Osmosis buildings Permacast was contracted to deliver, install, seal and grout at the SSDP. The panels for this project were far from standard: S50 LH (low heat) concrete was used for this project, and over 12 panels a day were produced with this slow-curing mix, with many unique piping and access penetrations. The panels also had small crack tolerances and highly detailed shapes, reinforcement design and cast in items. Overall, Permacast’s engineering staff produced over 450 shop drawings for this project, and the production side poured up to 45m³ of concrete a day, and trowelled off up to 200m² a day of precast panels to a high quality finish.

The site installation works presented their own set of challenges. At the peak, up to 30 panels a day were delivered on pocket road trains making a 240km round trip to the site. Two Permacast crane installation crews installed up to 30 panels a day, with a strong focus on safety and efficiency for setups and installations, given multiple other contractors in close proximity.

Permacast work closely with clients to meet specific project requirements, and all their work is produced to ISO 9001 Quality Standard. They service projects across the mining, industrial, marine, building and civil sectors. Their wide range of precast and prestressed engineered components includes box culverts, drainage components, retaining walls, precast beams, precast panels, columns, bridge and jetty structures. Other current major projects include supplying foundations, pits and manholes, cyclone corridor tunnels and large box culverts to the Gorgon Gas project; precast products for Woodside Pluto LNG; and Rio Tinto Cape Lambert Jetty.

Permacast is a member of the National Precast Concrete Association Australia and Concrete Institute Australia.

PERMAcast
*“Efficiency in Construction”*

394 Robertson Road
Cardup WA 6122
t. 08 9525 1380
f. 08 9525 1872
e. info@permacast.com.au
www.permacast.com.au

Construction starts on the Reverse Osmosis Building at The Southern Seawater Desalination plant, WA




# PROBEDRILL PTY LTD
## GEOTECHNICAL SURVEY

# EXPERTS AT GEOTECHNICAL INVESTIGATION

For a project like the Southern Seawater Desalination Plant (SSDP), knowing the characteristics of the ground is essential. Probedrill provided the geotechnical data which project engineers and the construction team required, undertaking Cone Penetration Testing (CPT) with Pore Pressure measurements and dissipation tests; installation of Vibrating Wire Piezometer (VWP's) and Dilatometer testing (DMT).

Probedrill are leaders in the field in geotechnical site investigation and assessment. They provided services at three key project stages. Firstly, a six day Greenfields site investigation for GHD, using a 12 tonne track mounted CPT rig. Then, five days of additional site investigation for Southern Seawater JV using a 22 tonne truck mounted CPT rig, followed by three days testing ground compaction for Watpac during the construction phase, using a 22 tonne truck mounted CPT Rig. Final CPT plots for each stage were delivered to the clients.

The Greenfields stage proved the most challenging, with the site conditions requiring use of a tracked rig to obtain access to a variety of terrain including heavily vegetated areas, dunes, beaches, steep access and boggy conditions.

Probedrill have been testing Western Australian sites since 1995, and their combination of experience and best available technology allows them to provide a highly cost-effective and efficient service. On the SSDP project, the installation of Vibrating Wire Piezometer (VWP's) was done rapidly, saving the project team money and delivering results quickly.

Probedrill have a variety of trucks, tracked rigs and portable equipment available for all conditions, and are constantly expanding their Geotechnical capabilities, including new 10 and 20 tonne tracked rigs; new 13 tonne Marshbuggy (amphibious) tracked rig; new rig operated Vane Shear tester; new Seismic DMT; and a variety of CPT equipment for near shore work on Jack up barges.

The company's experienced team of CPT operators provide specialist services including electric friction cone penetration testing; piezocone testing; seismic testing; dilatometer testing; soil sampling; standpipe installation; water sampling and vibrating wire installation. Other recent major projects include conducting on-shore and near-shore CPT testing over three phases, with a variety of CPT rigs, for the Chevrons Wheatstone Project (Onslow). Probedrill also provided geotechnical investigation services for the Southern Gateway Alliance, new Perth to Bunbury Highway project.

Public infrastructure projects, building and construction projects, the marine industry and academic research needs accurate geotechnical testing and results - and Probedrill will always strive to discover and deliver the data which meets the customer's needs.

**PROBEDRILL Pty Ltd**
t. 08 9314 6611
f. 08 9314 6699
e. office@probedrill.com.au
www.probedrill.com.au