

Eastern Treatment Plant Upgrade

Summary of Melbourne Water's preferred approach

Overview

Climate change, new treatment technology and a desire to reduce impacts on the natural environment are reshaping how we deal with sewage.

Traditionally, the community has seen sewage as a waste product that represents the end of a process, not as a product available to provide further benefits. Treatment methods have improved over time, but past sewage management practices have had negative impacts when effluent is discharged into the marine environment.

The Eastern Treatment Plant (ETP) represented best-practice when it was built in 1975. Considerable investment by Melbourne Water has improved its performance since then, as new technologies became available.

As part of continual improvement in line with meeting the objectives of the *State Environment Protection Policy (Waters of Victoria)*, referred to through ETP's EPA Victoria discharge licence, Melbourne Water plans a major upgrade of ETP from secondary to an advanced tertiary level of sewage treatment.

A Works Approval for an upgrade has previously been granted by EPA Victoria, but Melbourne Water is now seeking approval for a revised upgrade approach based on:

- Findings from technology trials of alternative and improved advanced tertiary treatment methods that provide significantly improved outcomes
- Success of implementation of ammonia reduction works under the existing Works Approval
- The updated strategic environment and declining flows and loads to the environment (due to reduced water consumption)
- An outlook to increase recycling of treated effluent over time to further build on the improvements for the marine environment offered by the proposed treatment upgrade.

The main features of Melbourne Water’s preferred approach as set out in this revised Works Approval Application are:

- Upgrading ETP to include an Advanced Tertiary Treatment Plant by late-2012, based on Ozone and Biological Media Filtration treatment, coupled with ultraviolet disinfection, at an estimated P50 (nominal) capital cost of \$380 million (previously estimated to be around \$330 million in equivalent dollars)¹
- In view of the reduced marine impacts from this treatment method, to not extend the existing outfall beyond Boags Rocks.

It is important to note that, while the P50 capital cost of the proposed advanced tertiary treatment upgrade is around \$50 million more (in equivalent dollars) than the tertiary treatment upgrade previously announced, the total cost of works included in the proposed new Works Approval is considerably less than originally required, because around \$400 million will be saved through not building an outfall extension.

Background

Eastern Treatment Plant Upgrade Timeline



*Note: Subject to EPA Victoria approval.

The existing EPA Victoria Works Approval for the upgrade of the Eastern Treatment Plant was issued on 28 November 2003. It provided for Melbourne Water to implement the following elements to address marine discharge impacts at the Boags Rocks outfall:

- Upgrading ETP by implementing tertiary filtration and enhanced disinfection to achieve a Class A standard effluent quality

¹ When announced in 2006, the original upgrade cost was *estimated* at \$300 million in ‘real’ 2006 dollars, with the intention that it be revised once the final treatment approach was finalised. This estimate was adjusted for inflation over time to equal approximately \$330 million in nominal dollars over the life of the project (to 2012). The comparison between the upgrade costs should therefore be between \$330 million and \$380 million (both in nominal, inflation-adjusted dollars).

- Ammonia reduction in a modified secondary treatment process
- Relocating the discharge point offshore by a minimum of 2 km.

In August 2005, the tertiary upgrade and outfall extension were deferred by agreement with EPA Victoria pending further scientific studies and investigations – including further hydrodynamic modelling and the Eastern Water Recycling Proposal feasibility study. Melbourne Water has, however, continued to proceed with the staged implementation of ammonia reduction works from the original Works Approval, specifically:

- Works enabling commencement of operation in ammonia reduction mode were completed and commissioned in 2007
- Additional secondary aeration tanks to cater for future load growth, and provide robustness of the treatment process to ensure continued compliance with licence conditions into the future, are currently under construction for completion in 2009/10.

Melbourne Water reported on the outcomes of the scientific studies to EPA Victoria in September 2006.

In October 2006, the Victorian Government confirmed that ETP would be upgraded to treat wastewater to Class A standard by 2012, as confirmed in *Our Water, Our Future – The Next Stage of the Government's Water Plan*, June 2007.

Melbourne Water acknowledged the need to plan for the best method of implementing the upgrade while also waiting for clarification of the outlook for recycling schemes that would reduce volumes requiring disposal. In November 2006, it put forward a proposed path to making final decisions in 2009 regarding:

- The need for an outfall extension, given potential for environmental gains through better treatment and more recycling over time
- The best method of tertiary treatment, with the preferred technology to be finalised through:
 - Design and construction of a \$10M tertiary technology trial facility in 2007
 - Trials during 2008-09 on standard tertiary filtration options, and more advanced forms of tertiary treatment to better address impacts at the shoreline discharge point and produce a high quality product to facilitate increased recycling
 - A decision in 2009, based on the results of the trials, on whether or not this advanced treatment technology will form the basis for the tertiary upgrade.

Results of technology trials

In February 2009 Melbourne Water completed 12 months of technology trials. These trials included a wide range of tertiary and advanced treatment processes.

The key objective of these trials was to explore the most efficient way of achieving a treated effluent quality that addressed marine discharge impacts as required by the State Environment Protection Policy (SEPP), and produce water suitable for a broader range of recycling purposes.

The trials were extremely successful. They highlighted that significant advances have been achieved in treatment technology since the existing Works Approval was issued in 2003. In Melbourne Water's view, the results warranted a reassessment of the intended overall package of works to be undertaken as part of the upgrade.

Specifically, the trials have demonstrated that Ozone-Biological Media Filtration treatment can be implemented efficiently as part of the upgrade to better address residual aesthetic and ecological impacts of the effluent discharge at Boags Rocks.

The preferred advanced tertiary process for ETP selected on the basis of the trials consists of Ozonation and Biological Media Filtration (BMF), followed by Ultraviolet (UV) and Chlorine disinfection.

It was found that the advanced tertiary process offered greater benefits than conventional tertiary filtration approaches previously envisaged in the existing Works Approval, given ETP's unique water quality characteristics, scale and discharge point.

Advanced tertiary treatment has the ability to reduce colour (which together with suspended solids, foam and turbidity are key contributors to plume visibility), odour, and residual foam formation potential. Water clarity and plume visibility issues are addressed. The process will also further reduce the ammonia concentration and toxicity of the effluent discharged. The proposed advanced tertiary treatment process also offers all of the other benefits of a typical tertiary filtration process, including:

- The elimination of litter
- Reducing turbidity and suspended solids, oil and grease, and biological foam
- Further reducing the risk to recreational users of the marine environment via the enhanced disinfection processes.

The added benefits for the marine environment offered by the Advanced Tertiary process trains were found to be significant. The additional ammonia reduction, and barrier to potential toxicants, and improvement to the key aesthetic parameters are important features, both in terms of the receiving waters and encouraging customer acceptance and uptake in more recycled water applications.

While the initial drivers for considering this process related to the residual aesthetic impacts of a shoreline discharge, it also:

- Offers significant benefits for producing fit-for-purpose recycled water for a broader range of non-drinking applications

- Supports recycling through improving customer acceptance by removing colour and odour concerns
- Further reduces ammonia to very low levels and controls effluent toxicity peaks, with significant benefits for the marine environment
- Improves downstream process efficiency (ultra-violet and chlorine disinfection performance, or future membrane installations) hence delivering the best value for money now and into the future, as a platform for providing flexibility to further enhance recycled water treatment, as needed.

Extending the outfall

The 2003 Works Approval specified a 2 kilometre extension to the existing marine outfall at Boags Rocks.

This was based on the assumption that meeting the objectives of the SEPP around residual ecological and aesthetic impacts could only be reasonably achieved by upgrading the treatment process *and* extending the outfall.

However, results of trials show that Melbourne Water's proposed advanced tertiary treatment process can adequately address these residual marine impacts *without* the need to extend the outfall.

The outfall extension requirement was also based on certain assumptions around what it would take to build. Extensive work has been undertaken by outfall construction experts in the years since, and a more thorough understanding of the required scope and costs is now in place.

In 2002, the EPA Victoria appointed an independent Panel to carry out an assessment of the then Works Approval proposal under Section 20B of the Environment Protection Act. The Panel indicated that an outfall extension should be incorporated in the overall works package. This recommendation was made in the context of cost estimates developed in the 1990s, which suggested costs of an order of magnitude lower than the more rigorously developed designs and cost plans now available.

The 1990s cost estimate was derived from a very early concept based on a 'bottom-tow' construction method comprising two pipelines which would be buried across the shoreline and to at least the 5 metre depth contour. Beyond this a trench would be excavated in the seabed. Extensive work has been undertaken by outfall construction experts in the years since, and a thorough understanding of the required scope and costs is now in place.

This work has indicated the original construction method presents significant difficulties and risks associated with constructing large pipelines through the surf zone in this high energy coastline. This method would also involve substantial disruption to

the highly sensitive environmental foreshore and dunes area. This method is not considered feasible. Consequently, the construction method was changed to tunnelling.

Following a detailed investigation into design, construction methodology and an updated costing taking into account a thorough assessment of current construction costs and risk items, a RANE P50 estimate of \$400M was established by independent experts.

The \$400M cost of extending the outfall, and the impacts associated with construction, would be incurred to facilitate more extensive recovery of a small area of potential habitat for Neptunes Necklace and Bull Kelp. This area is located immediately adjacent to the discharge point. This habitat is not unique to Boags Rocks. These species and other such inter-tidal rocky platforms are widely found along the South East Australian coastline.

Weighing up the benefit of an outfall extension against the costs associated with it, Melbourne Water believes that the environmental benefits do not justify the social and financial costs. The full triple-bottom-line analysis that has been undertaken supports this decision.

In Melbourne Water's view, the Advanced Tertiary upgrade without an outfall extension, will:

- Address the aesthetic and amenity impacts in the marine environment
- Improve the aesthetics of the treated water to improve its acceptability for recycled water customers
- Further reduce the ammonia concentration in the discharged effluent, and so protect even the most ammonia sensitive species
- Further reduce potential public health risks under peak wet weather flow conditions to recreational users of beaches around Boags Rocks
- Remove all litter, foam and suspended solids from the discharge
- Improve the marine environment outcomes to the extent that only a very small residual mixing zone is required, and
- Facilitate increased reuse development over time, which will continue the trend of declining flows and loads to the environment at Boags Rocks, and reinforcing the environmental gains.

An outfall extension, *in addition* to the Advanced Tertiary upgrade, would relocate the discharge point and increase the initial dilutions in the marine environment. Although this would have some additional benefits in terms of facilitating more extensive recovery of a small area of potential habitat for Neptune's Necklace and Bull Kelp, as outlined above, this benefit comes at the following costs:

- Capital cost of approximately \$400 million
- Significant construction impacts

- May lessen the impetus for recycling, and
- The possibility that the outfall extension may be seen as a 'stranded asset' if recycling opportunities are fully realised over time.

Therefore, it is Melbourne Water's view that construction of an outfall extension is not appropriate in this case and is demonstrably "not practicable" under the State Environment Protection Policy.

Reducing impacts on the marine environment

Melbourne Water acknowledges that the current impact of ETP on the marine environment must be improved.

The treatment method it proposes represents best practice for large-scale treatment for discharges to the open marine environment. In many respects, it will be world-leading.

Keeping the current nearshore discharge location will, in turn, require the retention of small residual freshwater and nutrient mixing zones, as allowed for in the State Environment Protection Policy.

The benefits of the high level of treatment are reflected in the very small size of residual mixing zones - an important benefit when considered in the context of managing 40% of Melbourne's treated wastewater. Even within the residual mixing zone, significant environmental benefits accrue from the proposed changes including resolution of aesthetic issues, reduction of the suspended solids food source for opportunistic species (which have colonised the platform area within 150m of the discharge point), major improvements to water clarity, and the toxicity impacts on the key ammonia sensitive indicator (Neptunes Necklace) are addressed.

The increased use of recycling into the future (made more feasible by the higher level of treatment) would build on these gains for the marine environment as freshwater volumes and nutrient loads decline further through diversion to recycling applications. This will facilitate continuous improvement and the opportunity to shrink the mixing zones even further over time.

In designing its preferred approach, Melbourne Water has taken note of issues of amenity raised by recreational users in the vicinity of the discharge point. The advanced tertiary treatment process ensures better conditions for swimmers and surfers by comprehensively addressing the microbiological concerns and aesthetic issues associated with the current discharge.

As mentioned earlier, the Panel assessing the original Works Approval Application in 2002 indicated that an outfall extension should be incorporated in the upgrade.

Melbourne Water believes material, evidence-based changes on a number of fronts require this to be reassessed.

Below is a summary of how Melbourne Water's preferred approach to the upgrade would address the key marine impacts that were to originally be managed with an outfall extension.

The risk of foams/solids causing impacts at the point of discharge - The Ozone-BMF process will reduce any residual foam forming potential to a level comparable to tap water. Biological foam formers are removed by the proposed treatment. Oil and grease levels are further reduced. Solids and surfactant effects are comprehensively removed by the treatment. This will build upon the improvements that have been observed from treatment improvements in recent years.

Allowing for ecosystem recovery and compliance with SEPP mixing zones requirements - The Ozone-BMF process will reduce the toxicity of the discharge at Boags Rocks through a combination of further reduced ammonia levels and a broad spectrum barrier to other potential minor toxicants. The most sensitive species for ammonia toxicity is consistently protected by the advanced tertiary process, leaving only residual freshwater effects which are addressed by a safe dilution of 20:1 for the most salinity sensitive test (scallop larval development). Hydrodynamic modelling indicates the 20:1 safe dilution is achieved within a radius of 250m from the discharge point.

The small residual mixing zone is provided for in the SEPP, and even within the residual mixing zone, significant environmental benefits accrue from the proposed changes including reduction of the suspended solids food source for undesirable opportunistic species (in particular the spionid worm *Boccardia*), major improvements to water clarity, and from addressing the toxicity impacts on the key macroalga indicator *H. Banksii* (Neptune's Necklace).

Effects within a defined mixing zone can be expected to further decline over time as the trend towards diversions of freshwater and nutrient loads to recycling continues.

Ensuring the recreational amenity of swimmers and surfers - The advanced tertiary treatment process ensures the recreational amenity of swimmers and surfers by comprehensively addressing the microbiological concerns and the aesthetic issues associated with the current discharge.

Management of freshwater impacts - Complete reuse of the effluent stream will not be possible to achieve in the medium term, therefore some form of ocean discharge will remain. However, the science on freshwater impacts has been clarified by the extensive ecotoxicity testing program. The residual freshwater effects are

addressed by a safe dilution of 20: 1 for the most salinity sensitive test (scallop larval development), and this is achieved within a radius of 250m from the discharge point.

The treated effluent flows outlook has changed significantly in the intervening years. The overall picture is now one of declining flows and loads to the environment. Successful adaptation to the uncertainties of climate change, and the drivers for increased utilisation of fit-for-purpose water resources where practicable, will continue this trend.

Current plant inflows are actually around 20% lower than the outlook considered by the Panel in 2002 and this translates to lower flows to the outfall. Furthermore, the local recycling developments (see following section) have the potential to significantly enhance this.

The role of water recycling

One of the major benefits of Melbourne Water's preferred treatment approach is increased scope for more water recycling for non-drinking purposes.

The same advanced treatment process that reduces impacts on the marine environment will simultaneously broaden the potential uses of recycled water. It is also expected to increase customer acceptance of recycled water for non-drinking purposes through addressing key areas of potential customer concern (odour, foaming, colour).

Recycled water is already used in operating the Eastern Treatment Plant instead of potable water that would otherwise be required. Off-site recycled water use from ETP totalled 7.9 billion litres for 2007/08, and was supplied to the Eastern Irrigation Scheme and to South East Water customers who take Class C recycled water from various points along the South Eastern Outfall reducing discharges at Boags Rocks.

In June 2009, the Minister for Water announced that investigations into two major recycling projects to use the Class A water produced at ETP (post-upgrade) had found that the cost-benefit balance made these reuse options unfeasible. Instead, the focus will be on local, cost-effective recycled water projects.

In addition to the 7.9 billion litres per year of current offsite recycling, South East Water schemes that have existing approval, or approval in-principle are expected to deliver up to a projected additional 9.1 billion litres per year² of recycling diversions, further reducing the nutrient and freshwater loads to the receiving environment.

² This includes approximately 2 billion litres from South East Water treatment plants, which currently discharge via the outfall.

Additional work undertaken for South East Water has identified a range of potential projects over the next 20 years that could take the total offsite recycling up to 40 billion litres per year. These projects will continue to be investigated as work on the ETP upgrade continues.

The discharge to Bass Strait will therefore need to continue for the foreseeable future, albeit with volumes reduced from the mid-1990s levels by some 25-40%. However, the significant advance in treatment technology proposed will ensure that the ongoing marine discharge impacts will be reduced to acceptable levels following its completion.

The advanced tertiary upgrade provides a 'future-proof' process train that allows for later addition of ultrafiltration and reverse osmosis membranes, to further enhance recycled water treatment in the future as needed.

Conclusion

The proposal put forward in the Works Approval Application is consistent with achieving continual improvement in the discharge from ETP, in-line with meeting the objectives of the State Environment Protection Policy referred to through ETP's EPA Victoria discharge licence. The SEPP requires the practicability of the proposed actions to be taken into account to ensure that the environmental benefits justify the social and financial costs. This requires consideration of the following issues:

- the severity of the environmental risk in question and the environmental benefits of removing or mitigating that risk;
- the state of knowledge of the environmental risk and options for removing or mitigating that risk;
- the availability, efficiency and suitability of options to remove or mitigate that risk; and
- the financial and social costs and benefits of removing or mitigating that risk.

The Advanced Tertiary and ammonia reduction upgrades, in conjunction with ongoing recycling development, will have a significant environmental benefit. An outfall extension, in addition to the Advanced Tertiary upgrade, would also address the residual localised impacts caused by freshwater and nutrients by relocating the discharge and increasing the initial dilutions in the marine environment. However, Melbourne Water is of the view that this environmental benefit does not outweigh the financial and social costs of an outfall extension.

One of the major benefits of Melbourne Water's preferred treatment approach is scope for more water recycling.

The triple bottom line (TBL) assessment has considered the options available. It shows that scenarios which include Advanced Tertiary, but no outfall extension, have a significantly better outcome than a scenario which includes both Advanced Tertiary *and* an outfall extension.

The TBL assessment clearly supports Melbourne Water's conclusion that an outfall extension is not practicable in the circumstances.

In consideration of international best practice, it is necessary to assess the combination of treatment and disposal methods together. Long outfalls were generally built prior to implementation of treatment to either primary or secondary treatment. The advanced tertiary treatment process proposed for ETP is at the forefront of international best practice for a wastewater plant, and clearly represents best practice for discharges to the open marine environment. The treatment outcomes achieved allow for retention of a near shore discharge.

In summary, significant environmental improvements will be achieved at the discharge point from implementation of advanced tertiary treatment, plus the current ammonia reduction works, plus the progressive development of recycling diversions over time.