Community Energy Efficiency Program

Blayney Shire Council

Final Report

“Getting the Mix Right”

*The Installation of variable speed drives at the Blayney Sewage Treatment Plant to improve efficiency and reduce power consumption.*

This activity received funding from the Australian Government.
Table of Contents

Executive Summary ....................................................................................................................... 3
Project Objectives .................................................................................................................... 3
Project Energy Efficiency Activities ............................................................................................. 5
Project Demonstration and Community Activities ....................................................................... 7
Project Outcomes and Benefits ................................................................................................... 8
Budget ........................................................................................................................................ 10
Project Operation, mechanisms and Processes .......................................................................... 11
Conclusion .................................................................................................................................. 11
Declaration ................................................................................................................................. Error! Bookmark not defined.
Executive Summary

Blayney Shire Council has installed Biological Oxygen Demand monitoring equipment and linked this to Variable Speed Drives on the motors to the mixers at its Sewage Treatment Plan using funds provided under the second round of the Community Energy Efficiency Program. Prior to commencing the project the mixers were operated by set timers however, by installing the BOD monitoring equipment then the effect of the treatment and the quality improvement of the effluent while it is mixer could be monitored and the mixer speed, timing and operation could then be changed incrementally in response.

Council sought the advice of experts in this area and had the equipment designed. The equipment used is readily available and thereafter called tenders for suitably qualified contractors, familiar with this equipment to purchase and install the equipment. About 5 contractors tendered on the project and the best offer received was chosen, and a contract awarded. While other work was included in the contract which was not funded under this Grant, the work specific to this project took about 2 months to complete with work on site totalling about 2 weeks.

The choice of an appropriate designer and the best contractor led to the success of the project. Council’s STP operators where involved with the project throughout, particular with the commissioning of the new equipment and training to them was provided by the contractor to ensure that the maximum benefits from the project was realised. The operator’s involvement and commitment to the project was another important aspect which led to the success of the Project.

At the completion of the project, and the process fine-tuning during commissioning, power consumption data was monitored to measure the impacts of the work undertaken. Although only 9 months data is available, completion of the project has led to an annual saving in electrical power costs of about $10,100 and a reduction in power to the site of about 16%. With the overall project costing just over $152,000, a payback period of about 15 years is expected. Taking into consideration the financial assistance provided by the Government, for Council, the payback period is less than 6 years.

The views expressed herein are not necessarily the views of the Commonwealth of Australia and the Commonwealth does not accept responsibility for any information or advice contained herein.

Project Objectives

The Blayney Sewage Treatment Plant (STP) is an important part of the fabric of the Blayney and Millthorpe Township’s community, as it treats the sewage effluent from both townships. The treated effluent is mainly reused by a local mining operation or is further treated in an adjacent engineered wetland and returned to the environment. Sludge is dried and dispersed on site.
The Blayney STP is owned and operated by the Blayney Shire Council. Blayney Shire Council is a small local council in regional and rural NSW and, in the context of the CEEP funding, the area is considered to be in a low-socio-economic area and to be a disadvantaged community. The STP is a community-use facility and the aim of the project was to support energy efficiency. By improving energy efficiency and thereby reduce power consumption, Council will reduce its energy usage and limit its exposure to increasing utility pricing. This places Council in a better position to properly manage the possible future impacts of carbon pricing on Council’s activities. Projects such as this are likely to raise the awareness of Council and the community of other ways of reducing power consumption and by having Council’s ‘house in order’, Council is thereafter able to provide Community leadership in this area.

The STP is located on the south eastern outskirts of town on the north side of Hobby’s Yards Rd. The STP consists of an Intermittently Decanted Extended Aeration (IDEA) activated sludge treatment plant with a design capacity of 7000EP. The original plant was constructed in 1966 with the IDEA Plant constructed in the 1970’s. The sewerage system services 3000 people in Blayney and an additional 600 people in the town of Millthorpe.

The major treatment process within the STP is the extended aeration and decants process. The most notable component is the aeration process which in simple terms aerates the influent using large mechanical/electrical mixers. The current arrangement involves the mixers starting at a nominated time in the process, and operating for a set period of time at a fixed speed. This continues until the end of the set cycle and then the aerators turn off. The aim of the mixers is to entrain oxygen into the influent and thus improve its quality by reducing the Biological Oxygen Demand (BOD), a requirement of the treatment process and a measure of an improving sewage quality.

A large component of the cost of running an STP is the cost of power. For an IDEA plant, the significant input into the consumption of power at the STP is the running of the mixers. Prior to this project being implemented, the proportion of the power consumed at the site, attributed to the mixer/aerators was estimated to be 90%. This was estimated by undertaking an audit of all the electrical equipment on the site, estimating their run-time based on available information and comparing this with the invoices received by Council for the power consumed at the site. By installing equipment which improved the efficiency of the mixers, it was estimated that a power saving of between 10% and 20% could be achieved which would lead to an 18% saving in the total power consumed at the site. This implies a cost saving of over $11,200 pa to the Blayney Community.

The policy based objectives of the Community Energy Efficiency Program are to:

- support a range of local councils and community organisations to increase the energy efficiency of different types of non-residential council and community-use buildings, facilities and lighting; particularly where this would benefit low socio-economic and
other disadvantaged communities or support energy efficiency in regional and rural councils;

This has been achieved because the Blayney STP is owned and operated the Blayney Shire Council on behalf of the Blayney and Millthorpe communities. The project has achieved energy efficiencies at the STP of around 16%, and improved the treatment efficiency of the Plant. Improvements in efficiency will extend the life of the existing plant and will therefore delay augmentation of the plant or its replacement. Couple with a decrease in operational costs as a result of lower power consumption, the need to increase rates to cover the costs associated with the operation and future upgrades will benefit the whole community, particularly the lower socio-economic and disadvantaged section of the community.

- Demonstrate and encourage the adoption of improved energy management practices within councils, organisations and the broader community.

This has also been achieved as the Council has been encouraged by its actions to look for power and efficiency saving in its operations generally. Council will be communicating these outcomes to its community and other councils with similar equipment where these advantages can likewise be realised.

**Project Energy Efficiency Activities**

The Project included the following works at the Blayney Sewage Treatment Plant (STP):

- The retrofitting of Variable Speed Drives (VSD) on the motors of the aerators.
- The retrofitting of pH and BOD probes into the aeration process to continuously measure the improving influent quality.
- The retrofitting of PLC, control equipment and telemetry to continuously adjust the operation of the aerators towards optimum to reduce power consumption and improve treatment performance.

In simple terms, the treatment of sewage initially involves the separation of the liquids and solids and in separate treatment processes; these fractions are treated using bacteria to breakdown and improve its quality for discharge / dumping or reuse. For the liquid fraction, in an IDEA plant this process requires aerobic bacteria and as such, aeration of the influent is required for this to be achieved efficiently and to improve the levels of dissolved oxygen, thus improving its quality. In most IDEA plants, aeration of the influent is achieved by aerating the liquid in large tanks for extended periods. Most aerators/mixers are large mechanical paddles, driven by an electric motor which turns at high speed mixing the liquid and encouraging air to be entrained into it.
At the time that the Blayney STP was constructed, the technology used at that time operated the mixers by timers. The influent would enter the tank, the mixers would run for a set period, sludge would be decanted and the process would recommence with fresh influent. By trial and error, taking into consideration variations in the influent quality over time, the timers were set and the plant monitored to ensure the required treatment quality. If, for example, the influent quality was better than normal, the mixers still ran at the set time. Further, if the effluent quality responded well to the process and achieved the quality outcomes required quickly, the aerators still continued to mix for the prescribed time. For these reasons, the system was considered inefficient and used significant amounts of power unnecessarily.

The project involved a mix of modern, complementary technologies and the use of equipment which wasn’t available when the plant was originally installed. These included:
- BOD and pH probes
- Variable Speed Drives (VSD) for the aerator motors.
- PLC circuitry to operate the equipment

Probes were installed in the aeration lagoons which measured the improvement in BOD as it is being aerated. These probes were then connected to control equipment which was able to read the signals. Variable speed drives (VSD) were connected to the aerator mixers which were monitored by the control equipment. The VSDs controlled the aerator motors and allowed them to start and stop slowly (soft starters), reducing the mechanical impacts of stopping and starting. As the influent comes into the lagoons, the motors start and increase speed to maximum to aerate the liquid. As the BOD decreases and the influent quality improves, the VSDs reduce the motor speed and the process continues until the required quality parameter is achieved. The VSDs either end the aeration at this point or reduce the aeration to a level to maintain this effluent quality.

By measuring the improving BOD, and reducing the aeration in response, the following can be achieved:
- power is saved,
- oxygen transfer to the influent is increased,
- Motor stops and starts are “softer” reducing the wear and tear of the aerators, also reducing mechanical stress on motors, couplings, mixers etc.
- Greater control of motor speed (aerators) to ensure they operate at optimum speed and load efficiency
- Reduced maintenance costs by reducing usage due to optimum operations.
- By increasing the treatment capacity of the Plant, the need for treatment plant upgrades is delayed.

The project was completed at the end of winter. The immediate improvements to the treatment process weren’t as high as originally anticipated, but it was soon realised that this was because the bacteria in the STP weren’t as active as they are expected to be when the weather is warmer. This is always the case in an STP operation and therefore the operation of the equipment had to be monitored into the warmer months to appreciate the total effect the new equipment had on the treatment process and their costs.
The equipment used in this project is readily available and a number of suppliers have this equipment for uses in a range of industrial applications. Council employed the services of an appropriately qualified designer to choose the appropriate technology for this application, and then to prepare the design drawings and specifications. Once completed, Councils called tenders for the work. Five tenders were received in this process and the best offer received was accepted by Council and a contract awarded accordingly. The chosen contractor had undertaken a number of similar projects in a range of industrial applications. The key to the success of the project generally is directly related to the choice of the design and the installation contractor.

A further key lesson learnt was the significant advantage of the involvement of Council’s treatment plant operators in the project from the start. Their knowledge of the Plant, enthusiasm for the project and their efforts ensuring the success of the project during the commissioning phase led to the project outcomes being realised and maximised.

Project Demonstration and Community Activities

The treatment of sewage by water utilities is generally only ever appreciated by the community when something goes wrong. For most members of the community, what happens after a visit to the bathroom, or completing the washing up is never contemplated, or if ever contemplated, only for a short period of time. The engagement of the community in this project was therefore difficult, notwithstanding the community benefit. Further, visitation to the STP is often problematic due to site safety, and never high on the community’s interest.

The Communication Strategy suggested that the target audience for communicating the outcomes of this project was school groups, the broader Blayney Community and other Councils with similar equipment where this same equipment could be installed.

The Blayney community were made aware of the project through press releases and press articles which followed from the launch of the Project. Notwithstanding Council’s efforts, there was little expressed interest in the project. Contact was made with the schools in the area however likewise; little interest was shown in this project and the offer of site visits was not taken up during the construction phase of the project.

Unfortunately, the key outcomes of the project are only now being realised. A greater period of time and the collection of more data is needed before a full and substantive comparison can be made of the power consumed before the new equipment was installed and the power consumed after the new equipment was installed. The timing of this Report is required ahead of when the full benefits of the project can be measured, understood and communicated confidently. This Report is based on the comparison on monthly power
consumption figures and because the power consumption is variable from month to month, a longer data set over a number of years is required. Notwithstanding, the figures collected are strongly encouraging and indicate that the project outcome of lower energy consumption was valid.

The full benefits of this Project are only just now being realised, there has been a nine month period of time allowing for the collation of data between the completion of the physical works and the production of this report. A comparison can now be made of the power saved following the project completion close to a full year, particularly when the most significant impacts were only able to be seen during the warmer summer months. Accordingly, these benefits can now be communicated to the wider Blayney community and to other councils by way of a brochure and a press release. Together with the CEEP2 funded work on the Blayney swimming Centre Point complex, these efficiencies can be communicated more widely.

**Project Outcomes and Benefits.**

The outcomes of the project were monitored over 24 months; over the 12 months before the work commenced and the 12 months following. The monitoring was done by comparing the power consumed at the site over this period by collating the power consumption data provided by the Supplier on a monthly basis. While the 12 month period following the completion of the Project has not yet been completed, the power saving is between 12% and 18% of the total site power; with an average of 16% over the 9 month period since project completion.

In addition to this excellent outcome, the installation of this equipment allows adjustments to be made to the location of the aerators within the aeration lagoons and this additional step has now also been completed. While good data is not available on the outcomes of these activities, early indications are that further savings will be realised, likely to be about 25% based on the first month’s figures. The power savings as a direct result of the Project have not taken into consideration these new adjustments.

Council’s application for funding for this project forecasted a cost saving of 18% due to reduced power savings of 43,200kWhr and an estimated saving of $13,000. This was achieved in the warmer months of the monitoring period but a lower, but still sizable reduction was achieved during the cooler months. The actual cost saving based on an annual average was 16% or 38,850kWhr which means that a total saving of about $10,100/annum was achieved over the first 12 months. This equates to a 15 year payback period, based on the total project cost of $150,600.

A review of the application for funding indicates that the estimated saving of $13,000 was based on a unit price for power of $0.30/kWhr whereas the actual cost was $0.25/kWhr.
Based on this unit price, the target savings in the Application for funding should have been more likely $10,800/annum.

While slightly lower savings were achieved ($700/annum) than that forecast, Councils belief is that the cost-saving targets have been met. This is further justified because:

a. The work done has opened up opportunities to make further adjustment to the aerators which have already shown further power savings are likely; up to 25% of the pre-project power consumption.

b. The installation of VSDs allows softer motor starting reducing the mechanical impacts and loadings on the aerators and their motors. This will reduce future maintenance on this equipment by reducing wear and tear.

c. The improved efficiency of the STP will ensure that the need to upgrade the STP to accommodate future population growth can be delayed by a number of years, deferring the need for Council to invest capital funds at this site. This, in addition to the immediate saving in operational costs will allow Council to defer rate increase. While this has a positive impact on the whole community, this is of particular importance to the lower socio-economic and disadvantaged sections of the Blayney community.

A significant issue uncovered during the project was the initial estimates made of the power savings that were achieved once the project was completed. The project was completed during winter and the power savings measured during the commissioning of the equipment indicated a lower than estimated power saving, which initially was disappointing. A review of the system, and taking head of the advice of the STP operators indicated that that this was because the effectiveness of the bacterial digestion of the effluent was temperature related and, while savings were being made, it was at that time predicted that these savings would increase following the arrival of the warmer weather. This in fact was the case, and better than predicted power savings were achieved during the warmer period of the year.

In addition to the above, the improved efficiency and effectiveness of the treatment process is likely to improve the effluent quality produced at the STP. Although not measured, this improvement is also likely to have positive environmental benefits either in the wetlands adjacent to the site or in the reuse of the effluent at the local mine site. This improvement is also likely to reduce odours from the plant however this has also not been quantified as it is difficult to do so, and there are a number of other factors which impact on odour and final effluent quality.
Budget

Below is the budget which was included in the funding application; now showing the actual expenditure for the project. This table shows that the project was delivered on budget.

The contract price accepted by Council was for an amount of $121,500 for the installation of the equipment to operate the two existing mixers at the site. During construction of the project, 2 variations were approved because of onsite conditions which weren’t anticipated when the work was being designed which totalled an amount just over $14,000. The total project costs were therefore about $135,000 or about 3.5% over the anticipated costs.

Council originally estimated a budget of $3,000 for communications and public engagement. Could had 2 simultaneously funded projects under the CEEP program and while the communications for both project were undertaken concurrently and More of Council’ funds were expended in this over all component, only the budget amount was committed to this project.

Because of the technical nature of the project for Council, additional project management costs were incurred. Because of the nature of the project and the complexities of the site, Council had allowed a contingency in the original budget taking this into consideration. These additional costs were covered by the contingency included and were justified given the positive outcomes from the project. Also, the reporting requirements of the project were include in this amount.

In conclusion, the project was completed for just under the original budget amount as detailed below.

<table>
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<tr>
<th>Project Items</th>
<th>Original Budget</th>
<th>Expenditure</th>
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</thead>
<tbody>
<tr>
<td>Communications and public engagement</td>
<td>$3,000</td>
<td>$3,000</td>
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<tr>
<td>Equipment design, procurement installation and commissioning Contract</td>
<td>$130,970</td>
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<tr>
<td>Project Management</td>
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<td>Contingencies</td>
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<td><strong>TOTAL</strong></td>
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<td><strong>$150,570</strong></td>
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<td>Departmental Funding</td>
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<td><strong>TOTAL</strong></td>
<td><strong>$153,520</strong></td>
<td><strong>$150,570</strong></td>
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</tbody>
</table>
Project Operation, mechanisms and Processes

The project was managed by Council using contractors for the following project components:

- Project management including the preparation of the funding application
- Design, installation and documentation

The project was awarded through an open-tender in accordance with the NSW Local Government Act (1993) and the contractor chosen for the work was a Victorian company. Council took the opportunity to include additional work in the tender which was not covered by the CEEP2 funding.

Council’s staffing levels at the time that the CEEP2 grants were announced would not have been able to apply for funding, or to undertake the project management component of the project because they were already stretched. By adopting this means to manage the project meant it could be completed. Council has changed its staff resource levels since this time and, depending on the size of the project, may be now able to undertake future similar projects internally.

It is Council’s view that the use of external project managers for specific projects is a good use of resources as day-to-day operations tend to make use of all the internal resources council has. An external project manager may bring additional skills and, once the project is completed they are no longer a cost to Council. For projects of suitable size, particularly when particular skills are required, Council is likely to continue with this method of project management.

One significant lesson learnt during the project was the need for the treatment process at the STP to be fully understood, functionally. A function, operating statement was not available and the costs to prepare such a Statement seemed unwarranted at the time. Such a Statement would detail how the plant operates; ‘effluent enters the lagoon until full, mixers mix for 10 minutes, decant commences…..’ for example. A detailed understanding of the electrical programming of the plant was therefore prepared during the project by analysing the existing control equipment logic and working backwards to prepare the Operating Statement. This was a tedious process and would have been more easily prepared by engaging a sewage treatment specialist to prepare this document as part of the design process.

**Conclusion**

Council concludes that this has been a successful project. By applying modern technology to an older piece of plant at their STP, Council has achieved annual power savings of about $10,000 per year, reduced wear and tear on this equipment and improved the overall
efficiency of treating sewage for the community of Blayney. This is an annual average saving of about 16% of the power consumed before implementation of the project.

In addition to the reduction in power consumption, efficiency of the treatment process has also been improved. This has wider environmental benefits for the reuse of the treated effluent and the likelihood of odour issues at the plant for example.

The project has delayed the need for further augmentations of the STP and, coupled with the reduced operating costs, can defer part of any rate increases. This has a benefit to the whole community, particularly the disadvantaged component.

As part of this project Council has attempted to engage the community with the opportunities available to reduce power consumption generally by the community.

Council implemented the project by using an external, project manager, external designers and external contractors. This form of project delivery worked well for this project because of its specialist nature.

Council was able to deliver the project under budget. Project management costs were higher than originally budgeted however within the included contingencies. The project management costs however also included the Grant preparation and reporting requirements of CEEP. The actual management costs of the project were in accordance with the prepared budget. The project benefits were only just under those predicted. Because of the issues highlighted during the process, further adjustments to the plant is now being considered which is likely to further improve the power savings and environmental benefits.

Council may not have undertaken this project except for the funding made available under the CEEP2 program so it appreciates the Government’s commitment to this issue and the success of this project.
Declaration

The Authorised Officer of the organisation makes the following declarations:

☐ I declare that I am authorised to submit this Final Report (including any attachments) on behalf of BLAYNEY SHIRE COUNCIL.

☐ I declare that the information provided in this Final Report is true and accurate.

☐ I understand, and acknowledge that giving false or misleading information in this Final Report is an offence under the Criminal Code Act 1995.

☐ I understand that final payment will only be made in accordance with the Funding Agreement including on satisfactory completion of Milestones.

Authorised Officer Signature:     Date: 16/04/2015

Name: Grant Baker
Position: Director Infrastructure Services   Organisation: Blayney Shire Council

Witness Signature:     Date: 16/04/2015

Name: David Swan
Position: Project Manager   Organisation: Swan Environmental Project Management

The use and disclosure of information provided in this Final Report is regulated by the relevant provisions and penalties of the Public Service Act 1999, the Privacy Act 1988, the Freedom of Information Act 1982, the Crimes Act 1914 and the general laws of the Commonwealth of Australia.

Information contained in the Final Report may be disclosed by the Department for purposes such as promoting the program and reporting on its operation and policy development. This information may also be used in answering questions in Parliament and its committees. In addition, the selected project information will be made publicly available. Public announcements may include the name of the grant recipient and of any project partners; title and description of the project and its outcomes; and amount of funding awarded.
<table>
<thead>
<tr>
<th>Building, Facility or Site 1</th>
<th>Blayney Council Sewage Treatment Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Building, Facility or Site 1</td>
<td>Blayney Shire Council</td>
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<tr>
<td>Location (address)</td>
<td>Hobbys Yards Rd, BLAYNEY.</td>
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<tr>
<td>Type of building, facility or site</td>
<td>Sewage Treatment Plant</td>
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<tr>
<td>Activity Type and Measure</td>
<td>Installation of variable speed drives to the mixers</td>
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<tr>
<td>Energy Efficiency Estimate Method</td>
<td>Power consumed at the overall site was measured based on power accounts. The estimation of the power consumed by the mixers was estimated to be 90% of the total site consumption.</td>
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<tr>
<td>Baseline Energy Usage</td>
<td>216,050 kWh per annum (240,054kWhr x 90%)</td>
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<td>Baseline Energy Efficiency</td>
<td>216,050 kWh x 3.6 = 777,780 MJ per annum</td>
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<td>Energy Efficiency Improvement</td>
<td>Annual power savings reduced to 201,200 kWh per annum</td>
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<td>Reporting Data (Measuring Energy Efficiency and Additional Data)</td>
<td>Reporting data based on power consumption provided by the supplier by their monthly accounts.</td>
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<td>Cost of Activity</td>
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<td>Estimated Cost Savings</td>
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