SSWA: INTEGRATING SUSTAINABILITY IN PROJECT DESIGN AND DELIVERY

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Abstract

The Southern SeaWater Alliance (SSWA), comprising the Water Corporation, Tecnicas Reunidas, Valoriza, AJ Lucas and Worley Parsons was commissioned to design, build and operate the Southern Seawater Desalination Plant (SSDP), providing Perth with 50 GL per year potable water to address Perth's continuing decline of traditional water sources.

SSWA recognized the strategic importance of integrating sustainability into decision making processes, in order to maximize environmental and social performance, infrastructure efficiencies and cost reductions. This approach placed sustainability at the core of our bid and delivery framework. By adopting a commitment to sustainable project delivery, SSWA required the implementation of a structured and tailored management approach that would incorporate sustainability across multiple disciplines and components of the project. In response, a Sustainability Management System (SMS) and bespoke sustainable engineering model was developed encompassing the design, construction and operation phases of the SSDP.

The SMS approach in the design phase focuses on ensuring sustainability is an integral element of project delivery rather than a 'nice to have' initiative siting outside of project engineering delivery. By implementing a management system approach, sustainability elements can easily be integrated with engineering, procurement and construction management programs. A series of sustainability objectives and targets define the sustainability aims of the project, whilst sustainability procedures define the mechanisms and requirements to incorporate sustainability across the various functions of the project.

The SMS approach is designed in recognition that the greatest opportunities for sustainability benefit occur during engineering design development. For this reason, the SMS has a deliberate focus on sustainable engineering to identify, assess and deliver leading design outcomes that deliver sustainability benefits. The sustainable engineering model assesses opportunities for improvement across each area and discipline of the SSDP, culminating in a series of improvements in the design of the project when compared against the industry standard in Australia. By delivering sustainability within this structure, SSWA can articulate sustainability benefits achieved in simple metrics (i.e tonnes of greenhouse gas avoided or hectares of biodiversity preserved).

The SSWA sustainability approach established a systematic and comprehensive approach to integrating sustainability within the project delivery. This approach demonstrates leading business practice by delivering more efficient project outcomes..

I. INTRODUCTION

The SSDP offered a unique opportunity to deliver a project with an emphasis on sustainable implementation and outcomes. With the proposed site of the SSDP located in an undeveloped section of the Western Australian coastline, the project required an approach that minimised impacts, and where possible maximised benefits to the environment and community. In addition, the project was a high profile proposal in Western Australia, being only the second desalination plant in the state and one of only a few in Australia. These factors reinforced the need for the SSDP design and construction to be delivered in a manner maximising outcomes that could easily be communicated to a range of stakeholders.

The proponent, the Water Corporation, has a well established commitment to sustainability, with their strategic values and Sustainability Business Principles clearly defining a position of sustainable business and project execution. Further, Water Corporation documentation is aligned to the Western Australian State Sustainability Strategy. These mandates formed key principles for the formation of the SSWA sustainability approach. The challenge for SSWA was to develop an approach in which sustainability would be effectively integrated across the project and through the project life cycle.

For the SSWA, the delivery of sustainability focused on minimizing adverse environmental and social impacts whilst maximizing environmental benefit and positive community and socio-economic outcomes. Specifically, the over-arching principles necessitated that the approach had to demonstrate these benefits in a tangible and holistic manner.

1.1 Development of SSWA Sustainability Approach

Incorporating sustainability within the SSDP required an approach addressing both regulatory commitments and the SSWA sustainability principles. The external sustainability commitments included commitments from the Public Environmental Review (PER), the Water Corporation Planning and Approvals Stage Sustainability Review, Water Corporation Environmental Policy and Sustainability Principles.

The approach required versatility to ensure sustainability was effectively applied within multiple stages of implementation across the entire project. Each component and discipline of design, as well as every aspect and element of construction and operation, required a tailored approach to integrate sustainability.

Specific processes during the design phase were adopted to maximise project benefits. These processes embedded sustainability across the engineering phases and were critical to the success for SSWA. For every major engineering decision, sustainability processes ensured options would be assessed according to their sustainability performance, in order to determine the option presenting greatest sustainability outcome.

II. SUSTAINABILITY MANAGEMENT SYSTEM

The Southern Seawater Alliance Sustainability Management System (SMS) was developed to provide necessary structure and procedures governing the incorporation of sustainability within the SSWA. The SMS implemented a management framework approach embedding sustainability principles within the design, construction and operational phases of the Southern Seawater Desalination Plant (SSDP).

The structure of the SMS was dictated by the multi-phase nature of the SSDP and the need of developing a comprehensive and functional management system. By adopting a system approach, a greater level of direction and procedural emphasis was integrated to the project. Some of the core philosophies of the SMS approach include

- The goals and objectives for the project integrate environmental, social and economic principles ensuring that key sustainability principles are not diluted.
- The goals and objectives define specific targets and actions for the design, construction and operation of the facility to protect and enhance the sustainability.
- Design, Construction & Operation Management Plans

The SMS is structured in accordance with the standard elements of an Environmental Management System underpinned by international standard ISO 14001. The SMS approach however, is expanded to incorporate specific targets and measures for social and economic aspects and environmental improvement.

The SMS incorporates the following elements:

- Strategic Sustainability Goals establishing a set of sustainability themes that act to capture the aspects embedded within the Water Corporations sustainable policy and govern the objectives, targets and management plans.
- A ‘Sustainable Engineering Process’ to systematically identify, capture and record sustainable design project options which may have a benefit to the project.
- Sustainability Objectives relevant to the project from design to decommissioning. Sustainability management plans - Due to the nature and scale of the SSDP development, the SMS is in 3 key sections:
  - Design Sustainability Management Plan : ensures that the sustainability is considered across every aspect of project design
  - Construction Sustainability Management Plan
  - Operation Sustainability Management plan
- Social and Economic objectives included, not just Environmental
- Integration of legislative and regulatory compliance requirements (including a functional Environmental Management System)
- Sustainability assessment incorporated into traditional project decision making
- Sustainable procurement embedded to influence the sustainable performance of suppliers and project inputs
- A reporting function that captures tangible sustainability outcomes

The SSWA SMS aligns actions and commitments defined within the Public Environmental Review, the Construction Environmental Management Framework (CEMF) and the Operation Environmental Management Framework (OEMF). The requirements are captured as actions within the Construction Sustainability Management Plan and Operation Sustainability Management Plan.

2.1 Establishment of SMS

The SMS development followed a defined model of alignment, target setting, management development and implementation. This incorporated a number of key elements.

Sustainability Framing Workshop 2.1.1 – The framing workshop was held with members of SSWA management to define the process of integrating sustainability within the project and establish how the sustainability team would work with the functional project teams and disciplines. The workshop also enabled sustainability objectives and targets to be reviewed and agreed by the project team.

Sustainability Objectives and Targets 2.1.2 – Sustainability objectives and targets were established early in project development to define the direction and level of commitment from SSWA. Targets were applied through the various management phases of design, construction and operation to align the various actions and procedures to a common outcome.

Engineering and Project Alignment 2.1.3 – An important element in the SMS implementation was the alignment with other operating project plans and procedures. This ensured sustainability measures and procedures were easily overlaid on existing processes integrating sustainability rather than an "added initiative".

Phase Management Plans 2.1.4 – The design, construction and operation management plans provided management framework applying sustainability across the life of the project. The plans were high level guidance plans supported by a number of issue specific implementation plans. The Sustainable Design Management Plan was slightly different in being tailored to the implementation of the Sustainable Engineering Process.

Sustainable Design Process 2.1.5 – The Sustainable Design Process facilitates the identification, assessment and implementation of sustainable engineering options within the overall engineering delivery of the project.

Sustainable Procurement 2.1.6 –Sustainable Procurement is an integral element in the SMS approach to ensure benefits identified in engineering development are implemented throughout the procurement and project implementation. Sustainable engineering benefits can often be lost without control and influence over the procurement process as the cheapest selection can often dominate. As part of the technical review, sustainability was a key element of consideration in undertaking the procurement process.

The following diagram provides a schematic of the SMS structure.

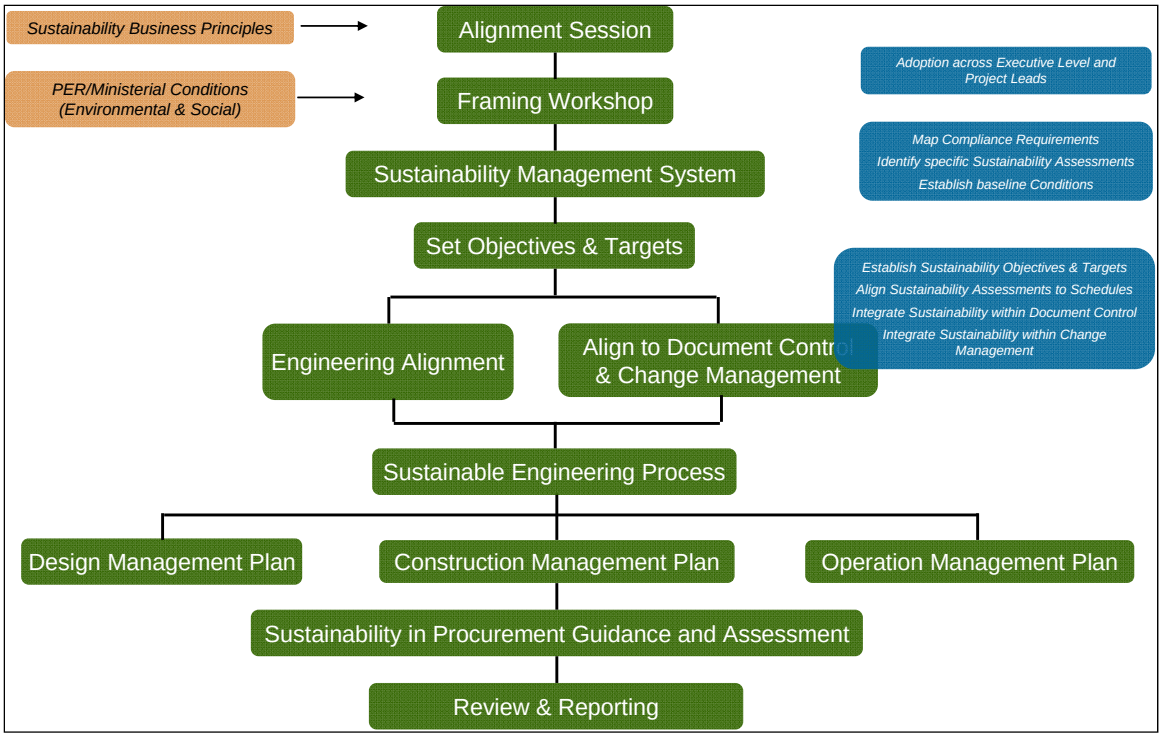

Figure 2.1: SSWA SMS Structure Flow Chart

2.2 Sustainable Design

The SMS focuses on the project design phase in order to maximise project sustainability benefits. Although the construction and operation project phases can achieve a high level of sustainability benefit through efficient resource use and reuse strategies, the design phase of the project has the capacity to facilitates fundamental project changes improving the overall sustainability of the project. By adopting optimal engineering solutions providing benefits over the life of the project, the implications to the environment and community can be significant.

The Design Sustainability Management Plan (DSMP) defines how sustainability and legislative compliance commitments were considered during the design phase. The key component of the DSMP was the structured approach applying sustainability design across all project disciplines. This was achieved by providing sustainable guidance and facilitation to the design teams. This support included the use of sustainable design assessments integrated with a programme of design workshops and review gateways. The programme was encapsulated within the Sustainable Engineering Process as a core element of the project delivery model. The Sustainable Engineering Process was implemented across the engineering disciplines to maximise the opportunities for sustainable engineering.

Sustainable Engineering Discipline Workshops 2.2.1 – Discipline workshops provided an opportunity to identify possible alternative design options on the project. Held at the initiation of the design phase, the workshops comprised of members from the engineering discipline and sustainability teams to evaluate all components of the project and identify potential design alternatives relevant to that discipline.

The options identified were captured in the SSWA Sustainable Engineering Opportunities Database. Discipline Guidance Sheets were distributed to provide an overview and record for engineering teams. For each opportunity identified, the potential benefits to the project and information required from engineering was defined for the next phase assessment process.

Sustainable Engineering Assessments 2.2.2 – A number of assessment methodologies were implemented across the Preliminary Design and Detailed Design phases of the project. The assessments evaluated the alternative design options against the engineering "business as usual" benchmark in order to determine which engineering solutions was the most optimal.

Implementation 2.2.3 – Once the optimal design had been selected the implementation phase focused on incorporating the alternative design across other aspects of the design development. In some cases incompatibilities meant that the preferred and more optimal design could not proceed. However, where there were no technical constraints, the sustainable engineering solutions were recorded and incorporated within the design report. This was used as a basis for the procurement process and ensured contractor submissions were elevated against the preferred design.

III. PRELIMINARY DESIGN

The Preliminary Design Phase of the project presented a number of opportunities to improve the sustainability performance of the project. A series of strategic decisions were presented during this phase resulting in a number of assessments being undertaken within the Sustainable Engineering Assessment.

Due to the nature of the SSDP project, the preliminary design phase was a competitive process. Engineering Designs were high level and strategic in nature. Each opportunity proposed for major engineering required an evaluation against a set of sustainability indicators, in order to determine which opportunity presented the lowest sustainability impact. An interdisciplinary decision was taken for all the major decisions throughout the project using cost, technical and sustainability drivers as the key differentiators.

3.1 Sustainability Scorecard

A sustainability scorecard ranked and assessed design alternatives during the project Preliminary Design phase to determine the relative value and impact across a number of environmental and social performance categories. The scoring involved members from the sustainability engineering and commercial teams of the project. The relative scores were calculated as a means of guiding the decision making process and selection of preferred design to be put forward to the Water Corporation as part of the competitive bidding process.

The scorecard was undertaken on a number of key components of the project.

Pretreatment 3.1.1 – A number of media and micro filtration options were evaluated with micro filtration selected due to the energy, waste and materials consumption performance over the life of the project.

Marine Pipelines Construction 3.1.2 – Micro-tunneling, Directional Drilling and trenching were evaluated to determine their environmental, social and financial impacts. The scoring process clearly defined micro-tunneling, the higher financially impacting option, as the most sustainable option for the project due to the minimised impact on both the marine environment and community coastal access.

Location of Pump Station and Layout 3.1.3 – The overall layout of the plant was evaluated through the scoring process to determine the optimal configuration with respect to the community amenity and environmental impacts. The layout was also evaluated through the Multi Criteria Analysis process.

3.1 Multi Criteria Analysis Mapping

In addition to the sustainability scorecard, a Multi Criteria Analysis mapping process was undertaken to evaluate and guide the final layout of the SSDP. This approach overlaid environmental, social and financial values to determine areas of least constraint. By adopting this process, the layout design of the SSDP could be orientated to ensure the least impacting outcome and ensure a higher level of compliance to regulatory and community concerns.

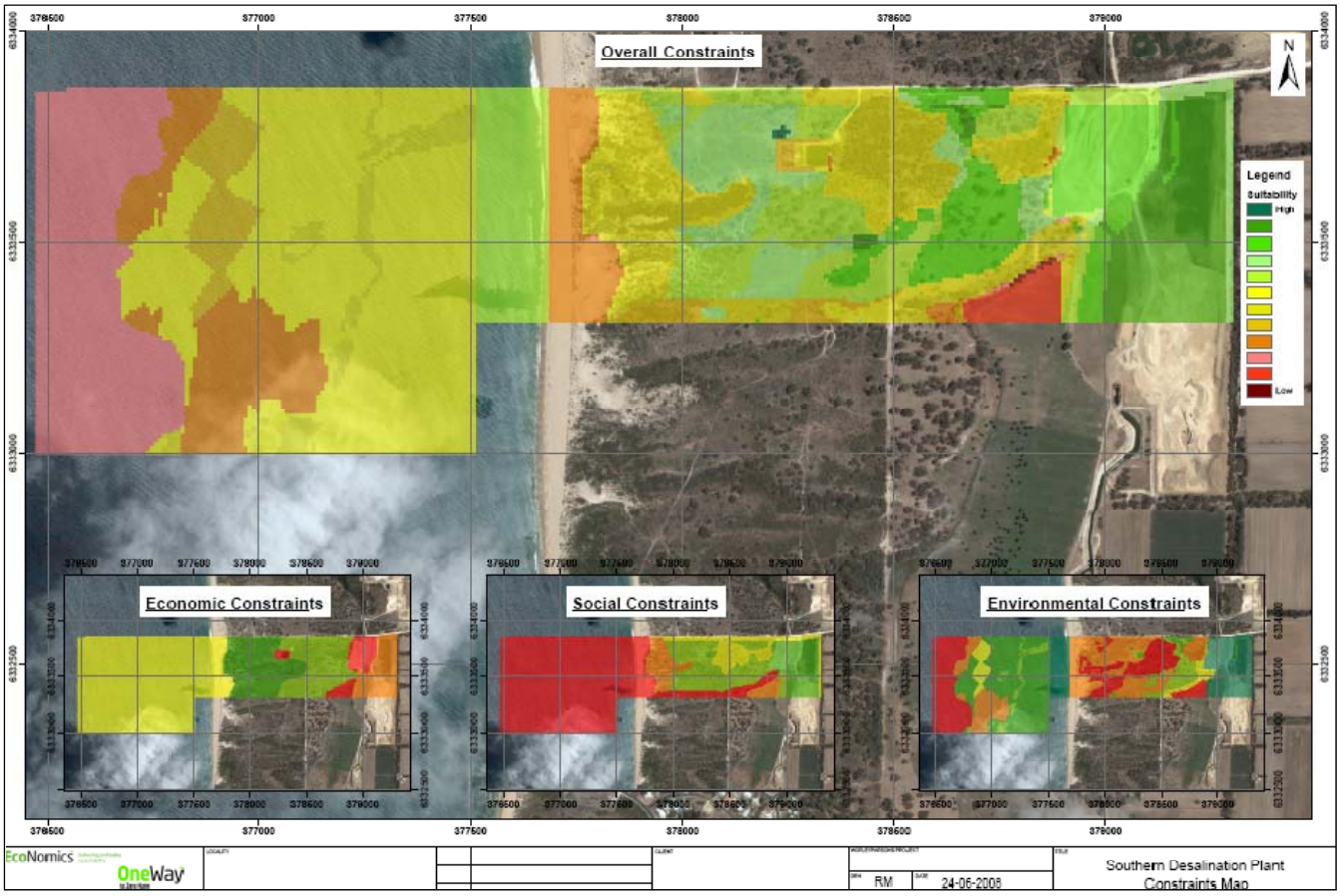

Figure 3.1: SSWA Sustainability Multi Criteria Analysis to determine preferred SSDP Layout

IV. DETAILED DESIGN

The Detailed Design Phase of the project required a more detailed execution of the Sustainable Engineering Process and assessment of project alternatives. In particular, the implementation of Discipline Workshops was critical to the Detailed Design phase to evaluate each component of the plant and identify all potential sustainable design alternatives. However, to undertake the assessment of these alternatives it was apparent that a baseline or "business as usual" model was required to assess the alternative design against

4.1 Desalination Plan Life Cycle Assessment Comparison

SSWA engaged Curtin University to undertake a Life Cycle Assessment (LCA) in order to establish a base line position for design assessments during the Detailed Design Phase. The LCA was structured to compare the Preliminary Design of the SSDP with the existing Kwinana Perth Desalination Plant. The analysis established that 1GL of produced water from the SSDP resulted in 3890 tonnes of CO2-e compared to the 4,750 tonnes of CO2-e emitted in the production of 1GL of water from the Perth Desalination Plant.

The LCA was important in determining the relative performance of the Preliminary Design of the SSDP and providing a reference point for the Sustainable Engineering assessments during the Detailed Design

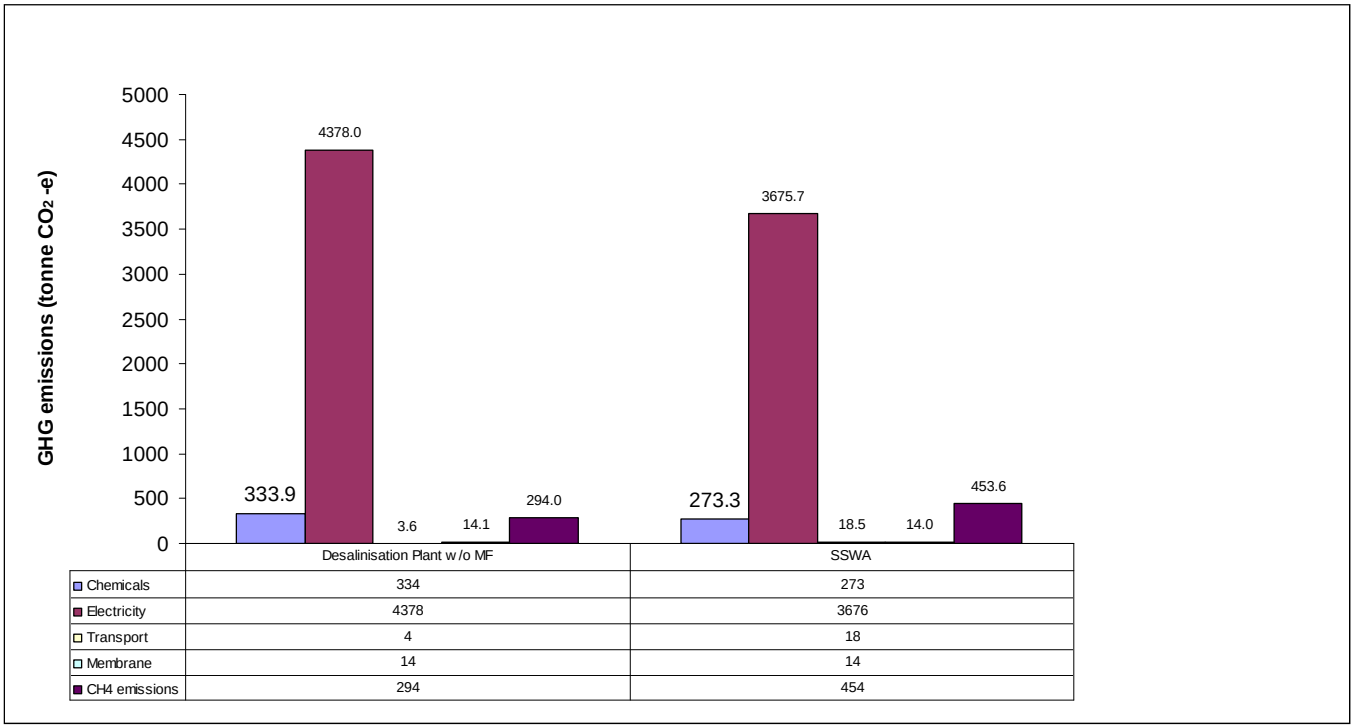

Figure 4.1: SSWA Life Cycle Assessment comparison of the SSDP and Perth Desalination Plant

4.2 Discipline Workshops

All engineering and construction disciplines participated in a series of Sustainability Discipline Workshops at the initiation of the Detailed Design phase. The workshops were structured to identify and record all potential alternative designs across the SSDP project.

Outcomes from the discipline workshops were recorded on a Sustainability Opportunities Database, incorporating information on the base case and alternative design options and the costs and benefits to the project in sustainability measures such as capital cost, operating cost, biodiversity, localized employment/contracting, noise and greenhouse gas emissions. In addition, the database incorporated a data collation process to define the quantum of benefit across the various sustainability measures. For biodiversity for example, the measure was the total hectares of biodiversity preserved. Continual follow-up meetings with engineering disciplines were utilised to maintain the database and define the data required to be acquired through the engineering teams.

Over 110 engineering and construction options were identified through the Discipline Workshops with over 30% implemented on the project during the detailed design phase.

4.3 Detailed Studies

The Discipline Workshops informed a series of detailed assessments undertaken of design alternatives to determine the most sustainable solution for the project. A number of the design alternatives identified during the initial workshop review were dismissed due to technical or other constraints. However a number of design alternatives required detailed analysis in order to determine the overall financial, environmental and social optimal solution when compared against a base case design.

To enable the evaluation, the design from the Preliminary Design phase and outcomes from the LCA were used to establish design base cases.

Case Study 4.3.1 An example of a sustainability innovation relating to technical specification variations is the incorporation of higher voltage switchboards and VSD's in place of 3.5MVA transformers. A sustainability assessment determined that the use of the technical innovation resulted in a reduction of 7.5tones of steel and a capital expenditure saving of over $1.2M, these savings also resulted in the saving of 258 tonnes of CO2, 74000L of water and 2160L in fuel for transportation in down stream benefits.

V. OUTCOMES AND BENEFITS

The SSWA sustainability approach was based on the integration of sustainability principles throughout project delivery. This has been achieved by aligning the whole project team with sustainability policy and objectives, starting with the Alliance Leadership Team.

The SSWA is demonstrating significant savings and benefits including reductions in capital and operational expenditure, water, waste, energy and carbon savings, as well as investment in local

industry. Capturing and recoding these outcomes is critical to ensure that the SSDP is recognized as a leading example in sustainable project delivery.

To date, the project team has delivered the following project outcomes, with further detailed figures still to be calculated:

- 104 design innovations captured and assessed
- 60% design innovations implemented
- $6.24M Capex saving
- $2.16M Opex saving over 25 years
- 240,630 tonnes of virgin material avoidance
- 313,000 kilowatts of energy saved
- 2,442 tonnes of CO2 saved
- 88,163 litres of potable water saved
- 100% of suppliers taken through the Sustainable Procurement process