Ecologically Sustainable Development Overview Report

for Ella Bay

Prepared for

Satori Resorts Ella Bay Pty Ltd

EnSight
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1. EXECUTIVE SUMMARY

Satori Ella Bay Resorts Pty Ltd proposes to design, build and operate an ecological sustainable, master-planned resort at Ella Bay, located near Innisfail. Ella Bay is situated on the Cassowary Coast, and is surrounded by World Heritage listed rainforest. It overlooks the Great Barrier Reef. The principal aim of this Ecologically Sustainable Development (ESD) overview is to review and analysis available sustainable Solution Sets for energy and water infrastructure and overview ESD options for other development impacts such as transport, stormwater, project management, waste and building design for the Ella Bay development. Each ESD Solution Set is a combination of interconnected systems, modelled around proven technologies that are reliable and efficient.

The development of ESD Solution Sets is based on the consideration of several *sustainable design principles*, listed here:

Holistic systems "*thinking"* to capture synergies and opportunities;

Interconnectedness between supply and demand to capture cost savings;

A service-based approach to widen the choices and options;

Comprehensive economic analysis that enables whole-of-life comparisons;

End-use efficiency to secure upstream supply benefits;

Bio-mimicry to reduce waste and match solutions to the local resources;

Lowest environmental impact to maintain ecosystems and mitigate future costs;

Innovation orientation to minimse risks and increases flexibility and adaptability.

The implementation of ESD Solution Sets can deliver substantial environmental benefits, climate positive outcomes, water self-sufficiency, an environmentally benign wastewater solution and, generally, a showcase for sustainability. The project is at its conceptual design phase and this report aims to provide a design options that are consistent with ESD outcomes.

The four proposed ESD Energy Solution Sets all deliver impressive benefits: up to 90% reduction in greenhouse emissions (35,000 tonnes of CO_2 per annum), compared with Option 1, standard grid connection with buildings that meets Queensland government's building code requirements. Of the five options considered, option 1 is the business-as-usual option with five ESD options provided. Each option is technically and economically viable. Allowance has been made in the site masterplan to accommodate the six options. Many of the ESD energy options derive a significant 59% of their energy from renewable energy sources, compared to Option 1.

The proposed ESD Water Solution Set is capable of delivering impressive benefits; up to a 70% reduction in potable water use (353 megalitres per annum). The ESD Water Solution Set also significantly minimises the risk associated with a single supply connection of the water mains and could allow up to 92% effective water recycling rate in the development.

Features of the proposed Ella Bay ESD Energy and Water Solutions sets include:

- Connection to the Ergon electricity grid;
- Maximum power demand for options 2-5 of 7,900kW some 15,000kW lower than option 1;
- Individual solar PV electrical systems for dwellings and commercial buildings could provide 19% of the development's energy for options 3-5;
- Solar thermal for all water heating applications could provide 17% of the site energy needs for options 2-5;
- LPGas could supply the energy for all cooking and back-up clothes drying, reducing greenhouse emissions by 80% (compared to Option 1) and providing 12% of the development's energy requirements for options 2-5;
- Provide real time feedback to all building occupiers via resource consumption monitors for all options;
- Provide interactive control from the back-up power station of all key electrical loads in the development for options 3-5;
- Provision for future integration of advanced energy generation technologies such as fuel cells for all options;
- Dwelling and commercial building design that achieves five star cooling rating, reducing cooling needs to less than 153 MJ/m^2 per annum for Options 2-5;
- Best practice energy efficiency in all lighting, appliances, equipment and infrastructure for options 2-5;
- Disaster proofing all services to the development with undergrounding all service infrastructure; electrical, telecommunications, sewer and recycled water supplies for all options.
- Back-up power station building, if required, (also housing the communications, sewerage and water treatment plants) would be designed to withstand the highest category of cyclone for options 3-5.
- Achieve water consumption efficiency targets, 20% better than the average dwelling consumption rates.
- Re-use treated sewerage through recycling (Class A+ standard) and pipe to every dwelling/ building and re-use on the golf course.
- Achieve water savings of 321 litres of potable water per day per dwelling through recycling of Class A+ water to every dwelling, which amounts to reducing per dwelling water demand by 67%.

2. PROJECT BACKGROUND

The proposed Ella Bay development is located in the Johnstone Shire, 75 to 80 km South of Cairns and 10km North-East of Innisfail. Located approximately 3km to the South, the closest centre to Ella Bay is Flying Fish Point. Ella Bay is recognised as one of the last available significant beachfront development sites on the Queensland Coast between Harvey Bay and Port Douglas. The Ella Bay site is located in a natural amphitheatre, surrounded on three sides by World Heritage tropical rainforest and has a 2.5 km coastline frontage. The development site has an area of approximately 440 hectares.

The proposal aims to boost Ecotourism in the Innisfail and Cassowary Coast Region by using ESD principles and practices in its design, construction and operation.

The proposed Ella Bay development is designed for short and long term residential accommodation options within a resort community. The proposal includes a village precinct, resort precincts, residential precinct, education precinct, golf precinct and conservation precinct. The ESD strategies overlay these precincts in terms of the staging of development, starting at the South-East of the site (mainly village/education/resort precincts) and expanding as the development progresses. It is proposed to be fully operational in 10 to 15 years.

The expected lot yield at Ella Bay is:

Precinct	**Extent of Proposed Development**
South East	Welcome Centre/ Interpretive/ Education Centre
	Commercial Village and Golf Clubhouse
	573 units & villas
East Mid	230 units & villas
	98 lots
North East	40 resort villas
	57 lots
South West	66 lots
South West 2	78 lots
	15 units
West Mid	12 units
	80 lots
North West	161 lots
TOTAL	**1,400 DWELLINGS**

About the consultants

EnSight is an Australian award winning sustainable design consultancy, completing award winning projects in environmentally sensitive, remote and island communities. These include Couran Cove Island Resort, North Keppel Island Environmental Education Centre, Sailfish on Fraser, Lawn Hill National Park, Benwa National Park on Moreton Island and Treasure Island Resort in Fiji to name a few. Established since 1996 and working on leading sustainable projects such as the Couldiam Buck Building, the Orion Town Centre and Kelvin Grove Urban Village, EnSight brings to the Ella Bay project a range of innovative and practical sustainable energy, water and development experience.

In addition, EnSight has worked with the Queensland Environmental Protection Agency (EPA) Sustainable Industries Division to review policy initiatives and evaluation of programs. Dr John Cole, Executive Director Queensland EPA says that "IES (EnSight) have been used as advisors by the EPA's Sustainable Industries Divisions because they bring to the project the complete suite of competencies, from a strong understanding of public policy and process, to energy engineering and financial packaging.".

3. SUSTAINABLE DESIGN AREAS

Solution Sets for each of the six key sustainable design areas set out below could each be reviewed in turn.

1. Energy System
2. Transport Energy
3. Water Management Cycle
4. Stormwater Management
5. Community & Lifestyle
6. Waste & Project Management

For the purposes of this report, all energy and water modelling is based on the typical energy and water use from a standard residential high-end house, defined in this report as a “dwelling”. The Ella Bay development extent includes 540 residential lots and 860 villas and units. For the purposes of undertaking the energy and water modelling for the Ella Bay development it is assumed that the energy and water demand for villas and units are the same as residential lots. It is acknowledged that the energy and water demand for a residential lot will be higher than a villa or unit. This will result in more conservative findings. Residential lots, villas and units will be termed dwellings. A summary of the development extent is shown in Table 1. The development categorises residential development as either residential lots to represent houses and residential Units & Villas to represent resort and high density development.

ELLA BAY EXTENT OF DEVELOPMENT	
Type of Development	**Quantity of Dwellings**
Residential Lots	540
Residential Units & Villas	860
Total	**1,400**

Table 1 Ella Bay Development Extent

3.1. ENERGY SYSTEMS

3.1.1 ENERGY SUPPLY & USE OPTIONS

The supply of a reliable, cost-effective and sustainable energy system underpins the viability of the proposed Ella Bay development. This section of the report describes several optional integrated energy systems available for the Ella Bay development. Five options are considered and reported against several energy indicators. Each option is technically and economically viable. The decision to proceed with a particular option would be based on grid connection costs and its reliability, availability. Allowance has been made in the site masterplan to accommodate all five options.

ENERGY OPTIONS

Five energy strategies are proposed for the Ella Bay project, each is briefly described below:

Option 1 - Grid Connection – this is the business-as-usual option based on meeting statutory building design requirements. It involves an underground conduit run under the road from Ella Bay to Flying Fish Point, then a overhead power line to Innisfail to allow connection to the Ergon electricity network.

Option 2 - Grid Connection & energy efficiency – this option is the same as Option 1 in addition it includes implementation of energy efficiency in each dwelling, building and in all site infrastructure.

Option 3 - Grid Connection, Solar PV & energy efficiency and a back-up electrical generation system – this option is the same as Option 2 in addition it could include a three kW solar array per dwelling and it also includes a back-up electrical generation system using LPGas fuelled engines, fuel cells or gas turbines to supply essential power during times of power loss due to grid failure.

Option 4 - Grid Connection, Solar PV & energy efficiency and a synchronously operated electrical generation system – this option is the same as Option 3 except that the electrical generation system using LPGas fuelled engines, fuel cells or gas turbines would synchronously operate with the grid. This option wpuld allow the export of excess power during time of peak demand to Ergon Energy.

Option 5 – Self Generation, Solar PV & energy efficiency – this option would not connect to the electricity grid and would allow the development to operate solely on electricity generated by a LPGas fuelled power station to provide it with electrical self sufficiency. This option has the same solar PV and energy efficiency measures as proposed for Options 3 and 4.

Greenhouse conversion factors used in this report are based on the factors shown in Table 2. Data shown in the table is from the Australian Greenhouse Office reference guide published in 2001.

GREENHOUSE GAS EMISSION Fuel Factors		
Energy Supply	**Grams per Megajoule**	**Kilograms per kWhe**
Grid Electricity		1.04
Diesel Power	69.7	0.66
LPGas Power	59.4	0.56
LPGas Direct	59.4	0.21

Table 2 Greenhouse Factors

The energy use assumptions used to calculate the energy demand of Ella bay under Option 1, the business-as-usual approach is set out in column 3 in Table 3. This column sets out the estimated energy use of a "typical" high-end dwelling. As can be seen from the table the annual demand for a "typical" high-end dwelling is estimated at 25,000kWh. This compares to the estimated energy use for an "energy efficient" high-end dwelling of 13,438 kWh as shown in column 5.

TYPICAL HIGH-END DWELLING ENERGY DETAILED BY ENERGY SERVICE				
	Option 1		Options 2-6	
1#	2#	3#	4#	5#
Description	**Fuel Source**	**kWh p.a**	**Fuel Source**	**kWh p.a**
Clothes Washer Motor	Electricity	156	Electricity	82
Dishwasher Motor	Electricity	143	Electricity	100
Clothes Dryer Motor	Electricity	36	Electricity	36
Lighting	Electricity	2,884	Electricity	322
Fridge/Freezer	Electricity	1,340	Electricity	412
Microwave Oven	Electricity	152	Electricity	37
Entertainment	Electricity	584	Electricity	584
Air Conditioning	Electricity	12,500	Electricity	4,736
Ventilation	Electricity	180	Electricity	40
Pool Filter	Electricity	3,633	Electricity	1,533
Rainwater Pump	Electricity	268	Electricity	120
Low Pressure Sewer	Electricity	90	Electricity	90
Dishwasher heater	Electricity	280	Solar	280
Clothes Washer Heater	Electricity	300	Solar	300
Clothes Dryer Heater	Electricity	202	Gas	202
Water Heater Solar	Solar	2,400	Solar	2,400
Water Heater Booster	Electricity	1,200	Gas	200
Wall Oven	Electricity	432	Gas	432
Hot Plates	Electricity	732	Gas	732
Total Energy		**27,512**		**13,438**
Total Electrical Energy		**25,112**		**8,092**
Total Solar Energy	Hot Water	2,400	Hot Water	2,980
Total Gas Energy	Nil LPGas	0	LPGas	1,566
Photovoltaic (Options 3, 4 & 5)	Nil Solar	0	3kW Solar	5,475
Net Mains Supply		**25,112**		**2,617**

Table 3 Energy Use Typical High-End Dwelling; Business-as-Usual and Energy Efficient

The aims of the four integrated energy strategies (options 2-5) are to minimise the generation of greenhouse gas emissions, use less fossil-fuel and use more clean non-renewable (LPGas) and use more renewable (photovoltaic, solar hot water and passive building design) where possible. Two energy-use models are shown in Table 4; the first is based on the estimated energy demand of a "typical" high-end dwelling that complies with the Queensland Building Code (QBC) refer to column 2 and 3 of Table 3. The second energy model is based on the implementation of the proposed Ella Bay design code, which requires several energy efficiency measures over and above the QBC requirements; these are shown in column 4 and 5 of Table 5. Both approaches categorise the energy-use as electricity, solar and gas.

The estimated annual energy demand of the Ella Bay development is based on the results of Table 3. The estimated annual energy demand for the entire Ella Bay development is based on 1,400 typical high-end dwellings and an allowance of 2.5GWh for energy use in the central facilities and infrastructure. Greenhouse gas emission reductions range from 67% for Option 2 to 90% for Option 5.

ELLA BAY DEVELOPMENT ESTIMATED ENERGY MEASURES BY OPTION					
ENERGY MEASURES	**Option 1** **Grid Only**	**Option 2** **Grid, LPGas & Energy Efficiency**	**Option 3** **Grid, LPGas, Solar PV & Energy Efficiency**	**Option 4** **Grid, Solar PV, LPGas, Energy Efficiency & LPGas Generator**	**Option 5** **Self Sufficiency in Power Generation, LPGas, Solar PV & Energy Efficiency**
Per Dwelling kWhe p.a. - Row 1#	25,000	8,100	8,100	8,100	8,100
Total Site Electrical Energy GWhe p.a. - Row 2#	37.7	12.1	12.1	12.1	12.1
Total Grid/Power Station Supply GWhe p.a. - Row 3#	37.7	12.1	3.4	3.4	3.4
Total Solar PV Electrical Energy GWh p.a. - Row 4#	0	0	7.7	7.7	7.7
Total LPGas Energy GWh p.a. - Row 5#	0	3	3	4	16
Total GHG Tonnes p.a. per dwelling - Row 6#	26.3	8.8	3.1	3.1	1.8
Total GHG Tonnes p.a. entire development - Row 7#	39,585	13,333	6,300	6,300	4,116

Table 4 Ella Bay Energy Options Comparisons

A summary of features in the ESD energy solution sets and the benefits of the energy efficiency measures are:-

- Maximum power demand for options 2-5 is estimated at 7,900kW some 15,000kW lower than option 1;

- Individual solar PV electrical systems for dwellings and commercial buildings could provide 19% of the development's energy for options 3-5;
- Solar thermal for all water heating applications could provide 17% of the site energy needs for options 2-5;
- LPGas could supply the energy for all cooking and back-up clothes drying, reducing greenhouse emissions by 80% (compared to Option 1) and providing 12% of the development's energy requirements for options 2-5;
- Provide real time feedback to all building occupiers via resource consumption monitors for all options;
- Provide interactive control from the power station of all key electrical loads in the development for options 3-5;
- Provision for future integration of advanced energy generation technologies such as fuel cells for all options;
- Best practice energy efficiency in all lighting, appliances, equipment and infrastructure for options 2-5;
- Disaster proofing all services to the development with undergrounding all service infrastructure; electrical, LPGas, telecommunications, sewer and recycled water supplies for all options.
- Back-up power station building, if required, (also housing the communications, sewerage and water treatment plants) would be designed to withstand the highest category of cyclone for options 3-5.

3.1.2 OPTION 1 - 4 GRID CONNECTION

Energy options 1 to 4 require the Ella Bay development site to connect to Ergon Energy's electricity grid near Innisfail, about 13 kilometers from the development site.

Under Option 1, is the business-as-usual approach to energy supply and use. Each dwelling, building and all site infrastructure will meet only the mandatory Queensland Building Code (QBC) energy efficiency measures. Specifically QBC's requirement for either a LPGas water heater or a solar water heater be installed in each dwelling. The energy model used in Table 3 and 4 is based on the assumption that the development will attract high-end buyers. The development has set an expectation amongst the market and prospective buyers that it will set high-design building standards equivalent to that of a high-end property development. Experience from high-end developments, such as the Hyatt Coolum resort, show that the peak power demand for a high-end dwelling is around 6kVA and annual energy use of around 25,000kWh.

3.1.3 ENERGY EFFICIENCY AND RENEWABLE ENERGY INITIATIVES (Options 2 -5)

The energy use per dwelling in Options 2-5 is shown in column 5 with the fuel source for the energy use in column 4. For comparative analysis a range of energy efficiency and renewable energy initiatives are included in Options 2 - 5. Through the implementation of an integrated energy efficiency strategy, the annual electricity demand of the entire development is estimated at 12.1 GWh. A reduction of 67% compared to Option 1. Solar and renewable energy sources provide 59% of the Ella Bay's energy needs for Options 2-5 compared to Option 1. LPGas provides an estimated 13% of the site's energy needs as shown in Table 4.

3.1.3 ENERGY USE DESIGN CONSIDERATIONS

To allow the developer to set energy efficiency standards for each dwelling it would necessary to adopt a set of development building design guidelines, with a proposed title of "Architectural and Sustainable Design Guidelines". Through the application of such guidelines by the body corporate the developer could require each lot purchaser to minimise energy demand in each dwelling by including minimum standards for appliances, design elements and require the adoption of a Home Energy Efficiency & Renewable Energy Solution Set (HEERESS).

The HEERESS would involve the purchaser with an investment in a grid interactive 3 kW photovoltaic solar power system, efficient lighting such as LEDs and compact fluorescents, 4 and 5 star rated appliances, smart metering, a gas boosted solar water heater and a gas clothes dryer.. The annual energy demand of a HEERESS fitted dwelling at Ella Bay is shown in Figure 1. The power and energy demand projections for Options 2 to 5 assume that the HEERESS's energy efficiency and renewable energy technologies are installed in each dwelling as well as in the central facility building, implementing as described below.

Photovoltaic Solar Power. A 3 kW solar array is an option to be considered for mandating for installation on each dwelling, unit and apartment, including central facilities. It is proposed that amorphous silicon solar panels are used for each solar array. These cells are more suitable to diffused radiation and cloudy conditions compared to polycrystalline cells. The output of the solar array could connect to the Ella Bay grid via a grid-interactive inverter system. Special precautions could be used at each dwelling and villa switchboard to ensure electrical safety, locally and in the network. Each solar array may produce an average 5,470 kWh p.a. per dwelling. This output may account for nearly 70% of each dwelling's electricity needs and 19% of Ella Bay's overall energy needs.

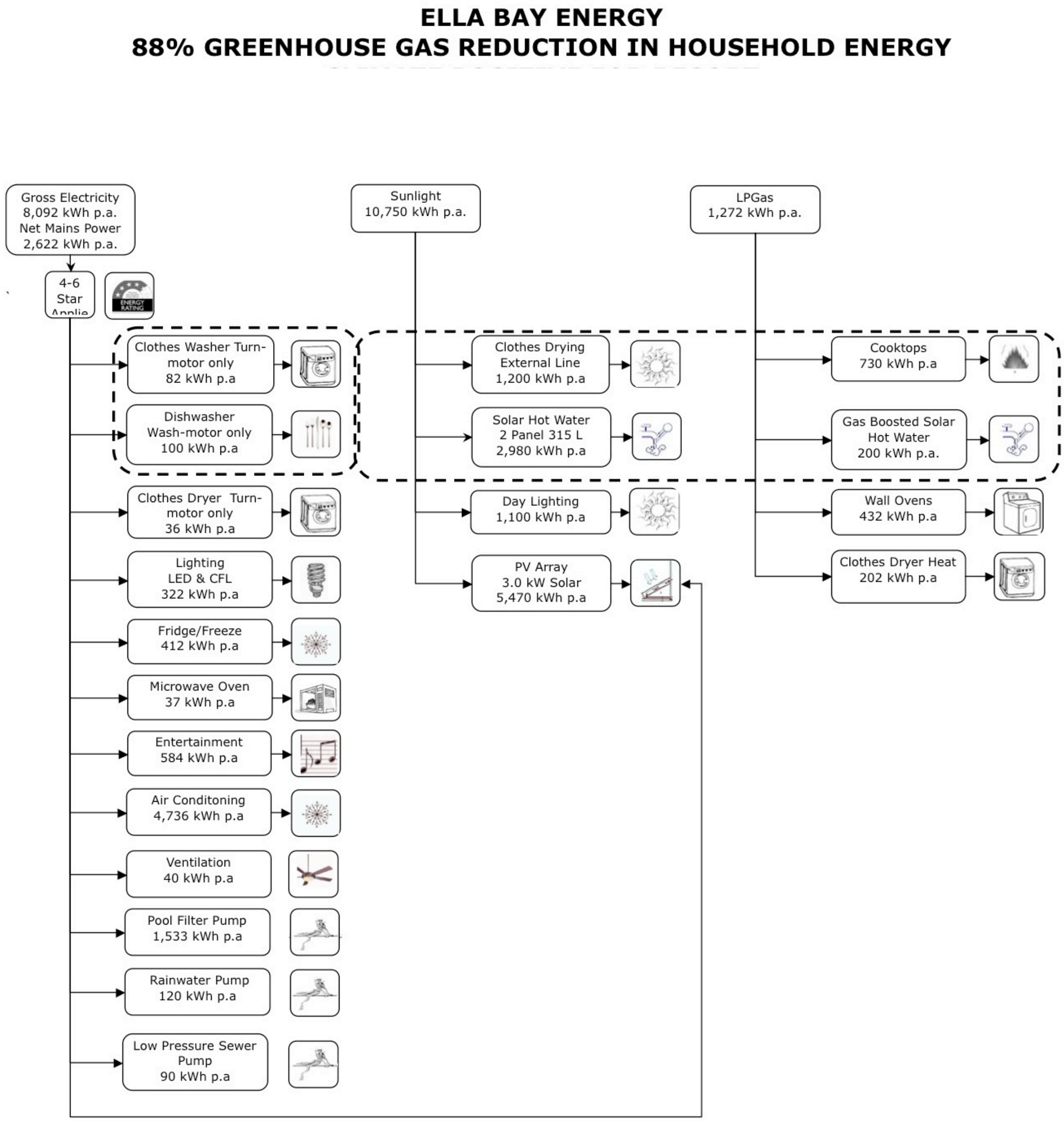

Figure 1 Typical Energy Demand by Service of an Ella Bay Dwelling

The installed cost of a 3 kW solar array will be approximately $15,000 after federal government rebates have been taken into account. During finer, milder weather, from May to October, solar power may contribute significantly to the daily peak requirements of the Ella Bay community. There is an opportunity for Options 3 and 4 to sell excess solar power back to the grid when site demand is lower than the solar power generation potential.

Efficient Building Design Consideration could be given to requiring a minimum a 5 star NathHERS rating for all buildings. This could reduce air conditioning operating energy by up to 30% compared to a 3.5 star rated property.

Energy efficiency initiatives. The proposed Ella Bay Building Design Codes could include building design criteria that required the following energy efficiency initiatives to be implemented in each dwelling:

- At least four skylights or skytubes in each dwelling to naturally light the kitchen, hallways, laundry and bathrooms;
- Ventilation controls and systems to promote natural ventilation and reduce exhaust fan run times;
- All artificial lighting is to be efficient with the use of electronic ballasts where ballasts are required;
- Energy efficient electric appliance selection;
- LPGas used for heating, cooking and drying;
- Monitoring systems for dwelling energy use.

Efficient lighting. Lighting consumes up to 10% of a household's energy use. Energy savings of up to 90% can be achieved through the use of natural lighting from skylights and the use of energy efficient artificial lighting, such as LED lighting. As a new technology LED luminaries are leading the way in energy efficiency, consuming only 15% of the power compared to conventional halogen or incandescent light fittings. The environmental benefits, through consumption of less electricity, amounts to an 85% reduction in greenhouse gas emissions. LED lighting produces very low levels of heat, which contributes to reduce heat load on air conditioners during the hotter summer months, compare a 100 watt incandescent with 6 watts of LED lighting a heat reduction of 94 watts.

Appliance Selection. Household appliances consume up to 10% of a household's energy use. It is recommended that minimum standards be set for all appliances including, fridges, freezers, washing machines and dishwashers. Suggestions are as follows:

- Dishwasher five star rated
- Freezer six star rated
- Fridge six star rated
- Washing machine four star rated

LPGas Use for Heating. Heating based appliances consume up to 10% of a household's energy use. The direct use of LPGas reduces greenhouse emissions by 80% compared to the use of electrical energy from the grid. It is recommended that LPGas be used for boosting solar hot water heaters, cooking and clothes drying. Suggested use of LPGas appliances are:

- Gas water heater with solar preheating
- Gas ovens
- Gas cook tops

- Gas clothes dryer

Central Services. The design of all central facilities should be specified to be efficient. The central facilities at each resort development could feature efficient lighting, LPGas appliances and energy efficient refrigeration and air conditioning. Exclusive use of gas for all heating appliances is preferred as the direct use of LPGas reduces greenhouse emissions by 80% compared to the use of electrical energy from the grid. LPGas could be used for cooking equipment, dishwashers, glass washers, warming trays, combo-ovens and urns. Energy efficient refrigeration and air conditioning could be used in cold and freezer rooms with efficiency measures including higher performing insulation, digital controlled Tx valves, systems sharing a common variable speed controlled compressor rack and heat rejection to a geo-exchange system.

Efficient Air Conditioning. Air conditioning could consume up to 50% of the energy at the development. Several energy efficient air conditioning options should be evaluated in the design development phase of the project. Options include ground source heat pumps, use of the recycled water line to provide heat rejection options, heat recovery from the central condenser sets, solar absorption air conditioners, variable speed and variable refrigeration volume systems.

Energy Monitoring. Centralised metering via real-time resource consumer monitor/ interface controllers could also form part of the Building Design Code. These monitors receive input pulses from electrical usage (including PV), LPGas and water usage.

3.1.4 BACK-UP POWER STATION STRATEGY - OPTION 3 and 4

Several factors need to be considered in the planning of a back-up power station.

Back-Up Power Station. If a decision is made to proceed with a back-up power station to supplement or provide back-up power to the grid the power station would likely be designed only to meet the essential load of the site. Based on power demand estimates the back-up power station would likely have a capacity of between 1,000 kW and 5,000 kW.

Back-Up Power Station Design. There are two options for the housing of the diesel/LPGas back-up generators. The first option is to house the generators in sound proofed and containerised metal cabinets. The picture below is an example of a containerised generator set. This disadvantage of this option is the difficulty of performing maintenance during wet weather, their longevity and difficulty of access. The advantages are low cost, ease of replacement and small footprint. In the second option, the electrical generators are installed in a purpose-built sound proofed building. Generators are mounted on skids. Generators are slid into place as required.

A back-up power station building could be constructed of many materials, one commonly used is besser another is hebel block. Hebel is an aerated, prefabricated concrete block that has the benefits of heat and sound attenuation. To ensure super silent operation, the generator exhaust stacks would be fitted with what are termed “super silencers”, which use resonance-cancelling technology to allow the operation of generators in residential environments. Noise levels around the power station would be set at 55dBA at 10 metres away from the noise source.

The size of a back-up power station building to house a 1,000kW would be 450m^2 and for a 5,000kW the building would have an area of 900m^2. The building would be designed to extend as each stage the development progressed and as additional generators were required to be installed.

Control, Switch Room & Transformers. A control room and switch room could be built on one end of the power station building. External to the building, there could be number of 415V/22,000V station transformers, taking the voltage from 415 volts to 22,000 volts for transmission to the entire development. The number of transformers would be confirmed after a detailed investigation of the most reliable and cost-effective high-voltage network.

Any power station built at the site would likely be fully automated to allow on & off switching of transformers in the event of the loss of the Ergon grid. The control of on & off switching of the transformer circuit breakers, combined with the ability to isolate all fridges and air conditioners, as part of the integrated energy management system, means the power station could restart automatically or be despatched by Ergon Energy.

Detailed Energy Modelling. The next stage of the back-up power generation design would be to undertake detailed energy modelling in order to estimate more accurately the minimum and maximum energy and power demands. This would be undertaken during the design development phase of the project.

Fuel Storage The estimated LPGas consumption for a 5,000 kW back-up power station (the maximum suggested size) would require a 50 tonne LPGas tank if installed with an external vaporiser. The tank would likely be designed to have physical barriers to protect them from fires from adjacent buildings. This risk assessment would be established via a formal fire risk assessment process in the design development phase of the project. LPGas tanks of this type are surrounded by fire sprinklers to ensure it remains cool in the event that a fire is present in adjoining buildings. Two fire hydrants would normally be installed near such a LPGas tank and be supplied by a site fire storage tank capable of supplying 30 litres a second for four hours. No bunding is required for the LPG gas tank. When LPGas leaks it is heavier than air and it disperses via flowing over the ground and over a short period of time reducing its concentration. In the event of a leak LPGas presents no environmental hazards compared with diesel fuel.

Transport of LPGas. The estimated volume of LPGas use for a power station during a power outage of 5 days is to be 20 tonnes. The power station would not operate at other times as the grid would be providing all the development’s electrical energy. Elgas for example, has a LPGas terminal in Townsville and trucks could deliver the gas direct from Townsville to Ella Bay. A 10 or 15 tonne truck is a fixed body truck. Under option 5 it is estimated that four 10 tonne LPGas tanker drops could be required per week when the power station was in operation.

The image in Figure 2 is of the LPGas generators at Couran Cove power station on South

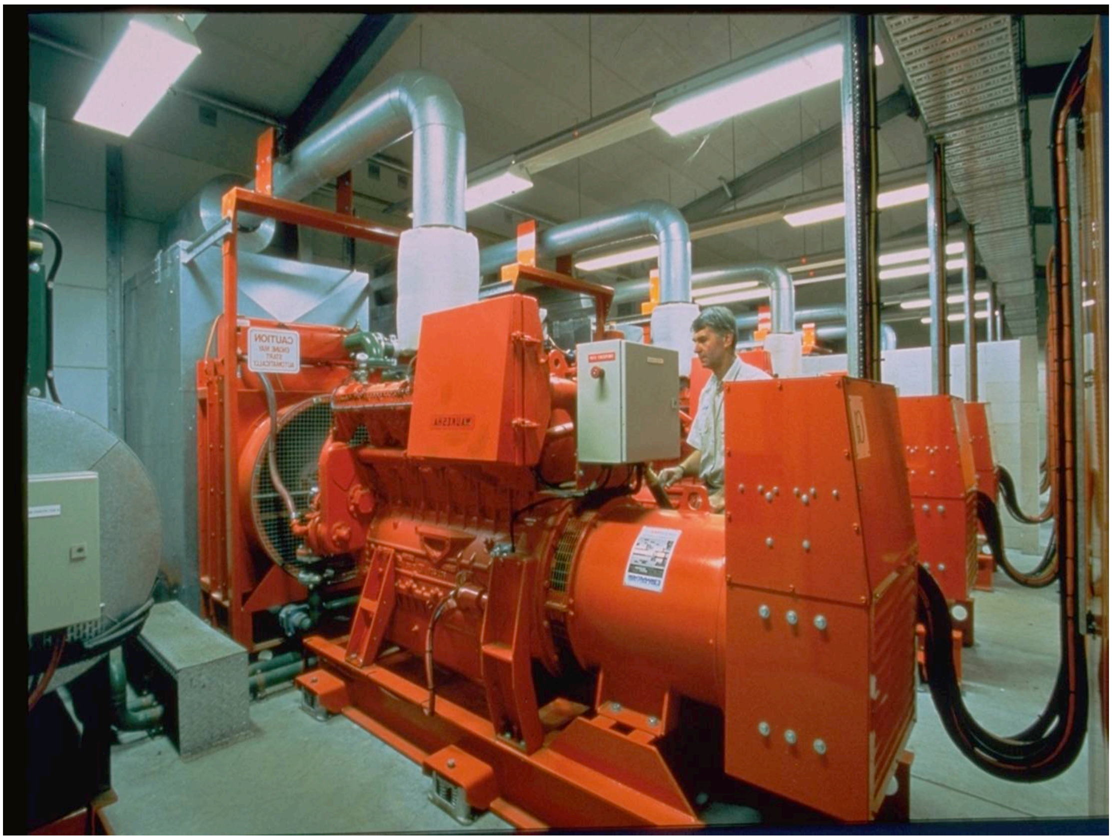

Figure 2 Couran Cove Resort Power Station

Stradbroke Island. This power station supplies 700 dwellings at a five star resort community off the Gold Coast.

Benefits of LPGas. LPGas has many benefits compared to ultra low sulphur diesel including:-

- Reduced risk of environmental damage if spilt
- 15% lower greenhouse emissions
- 90% lower oxides of nitrogen
- 99% fewer fine particles
- 80% - 95% fewer particulates

3.1.5 REGULATORY COMPLIANCE - OPTIONS 2-5

EPA Prescribed Environmentally Relevant Activity – Options 2 to 5 may require an EPA license, as the burning, or capability of burning 500kg of fuel an hour is deemed by the EPA to be a

Prescribed Environmentally Relevant Activity listed in Schedule 1 of the Environmental Protection Regulation (1998). The fully developed Ella Bay Power Station would be capable of burning 1.0 tonne per hour. Fuel consumption is listed as a Level 1 rating under Item 17 of the EPA regulations.

3.1.6 MANAGEMENT - OPTIONS 2 - 5

Ella Bay Services Company – The power station and energy systems under Options 2 to 6 could be serviced and managed by a management company for Ella Bay. The company would likely own and operate the power station under a special approval to deliver long-term services to the Ella Bay development. The service company would be responsible to manage, operate and maintain the energy systems. It is also possible that the services company could own and operate the wastewater treatment system and the Class A+ water recycling system to each building.

3.1.7 INTEGRATED COMMUNITY ENERGY MANAGEMENT AND CONTROL SYSTEM

The Integrated Community Energy Management and Control System is a possible solution for the community to share their energy and water use data. The system could provide overall environmental performance reporting for the entire property. In addition, it could provide ongoing environmental monitoring, reporting and control of all building services throughout the Ella Bay development. The scope of the system could include:

- Electrical metering and monitoring
- Energy Management and disconnection services
- LPGas metering and monitoring
- Water metering and monitoring
- Recycled water metering and monitoring
- Smoke and Fire detection and alarming
- Security detection and alarming

Ella Bay's proposed Architectural and Sustainable Design Guidelines could require that each property install this system. The basic building block would be a touch screen monitor in each building to display real-time water, LPGas and electricity use, as well as the monitoring of smoke and security alarms.

3.1.8 DISASTER MANAGEMENT - OPTIONS 1-5

Disaster Planning. The back-up power station, wastewater treatment and all services would all be designed to be disaster proof. This would be achieved by having all of the services installed underground, including high voltage and low voltage electrical cabling, telecommunications and sewer and recycled water supplies. The back-up power station building could also house the communications, sewerage and water treatment plants. The back-up power station building could be designed to withstand the highest category of cyclone and storm surge.

3.1.9 SUMMARY

Whilst Option 1 is the standard business-as-usual approach to land development in Queensland, four ESD Energy options have been suggested that demonstrate a range of greenhouse gas emission reductions from 67% to 90%. Risk to the local environment from fuels spills are minimized with the preference for the use of LPGas over diesel fuel. Under either option 3 & 4 it is estimated that two 10 tonne LPGas tanker drops could be required per week when the power station was in operation due to an Ergon grid failure. Under option 5 it is estimated that four 10 tonne LPGas tanker drops could be required per week when the power station was in operation.

3.2 TRANSPORT ENERGY

The ESD TRANSPORT STRATEGY aims to reduce greenhouse gas emissions and the use of motor vehicles in Ella Bay. A direct environmental indicator of greenhouse transport is the estimated vehicle kilometres of residents living in the development. The masterplan transport strategy limits the conventional use of motor vehicles via controlling centralised carparking. The Ella Bay transport strategy promotes the "Green" transport options to lot purchasers, including promoting cycling, pedestrian access and the use of electric golf carts. These ESD Transport initiatives aim to reduce the number residential vehicle trips. The average Australian resident undertakes 10 trips per day to attend work, entertainment, shopping and other activities. The Ella Bay ESD Transport Strategy seeks to tackle the key reasons for vehicle travel; being trips to work, entertainment, shopping and schooling.

Home Office and Local Job Creation could be encouraged with high speed global communication systems for professionals and small businesses, both servicing the Ella Bay residences and the tourism centre, and link up with cities and other business centres. Wireless cafes provide a centre for both casual and professional exchange.

Electric golf carts and LPGas vehicles. Ella Bay resort could exclusively use LPGas vehicles and electric golf carts to provide the necessary servicing of the resort. This could eliminate the need to store petrol on site and reduce greenhouse gas emissions.

Integrated education & retail shopping precinct. The development of Stage 1 of Ella Bay could see the construction of a retail centre and educational research facility. This could mean that residents could be able to access retail, education and research services within the development.

Integrated pedestrian and cycle ways that interconnect and provide residents with easy walking access from home, the village centre or education precinct. The diverse facilities and mix of residential, golf, eco-tourism, retail and education precinct could create a safe, convenient and attractive village.

Electric golf carts, residents would be encouraged to only use electric golf carts for movements within the development. Residents could be encouraged to purchase and use electric golf carts to reduce use of motor vehicles.

LPGas and Hybrid Electric Vehicles (HEV) could be used at Ella Bay. It is proposed that Ella Bay consider the use of LPGas and HEV in the local Ella Bay buses. LPGas and HEV buses could provide the regular services around Ella Bay, improving mobility to Flying Fish Point and Innisfail, reducing traffic movements and improving air quality. The public transport system at Ella Bay could be planned to reduce vehicle trips and to facilitate residents in being less dependent on cars. The bus interchange in the village centre could be designed to be accessed by golf buggy, walking or cycling.

HEV buses combine a conventional propulsion system with an on-board rechargeable energy storage system to achieve better fuel economy than a conventional vehicle, without being hampered by range. HEV busses are considered environmentally sound and economically viable. They are efficient and have reduced greenhouse gas emissions, with up to 45 percent better fuel economy than diesel buses.

3.3 WATER AND WASTEWATER

3.3.1 ESD WATER STRATEGY

The supply of reliable, cost-effective sustainable potable water and wastewater treatment underpins the feasibility of the proposed Ella Bay development. This section of the report describes a proposed integrated water system for the Ella Bay development, including water supply and an environmentally friendly wastewater treatment system. Two water solution sets are:-

Option 1. Potable water and wastewater connection to Innisfail and business-as-usual water use,

Option 2. Local wastewater treatment and reuse initiatives and local potable water supply with water efficient technologies.

The ESD water option could:-

- Achieve water consumption efficiency targets, 20% better than the average dwelling consumption rates;
- Re-use treated sewerage through re-cycling (Class A+ standard) and pipe to every dwelling/ building and re-use on the golf course reducing potable water demand by 56%;
- Provide real time feedback on energy and water use to all building occupiers via resource consumption monitors.

3.3.2 EFFICIENT WATER CONSUMPTION

The water internal demand (excluding landscaping and pool top up) of a standard Queensland home average 703 litres per day. Through the adoption of water efficient appliances and fixtures this figure can be reduced to 586 litres per day. A breakdown of the water demand of a water efficient residential dwelling is provided in Table 5. Daily internal water use totals 586 litres and external water use totals 223 litres. Efficient water demand for a typical dwelling totals 809 litres per day as shown in Table 5.

EFFICIENT WATER USE Daily Household Demand By Service		
Description	**Percent Usage by Service Total**	**Litres per day by Service**
Toilet	23%	186
Hand basin	3%	28
Bath/shower	24%	193
Kitchen	5%	44
Laundry	17%	135
Total Internal Use only		586
Total External Use only	28%	223
Total Dwelling Use	100%	809

Table 5 Efficient Daily Water Demand per Dwelling

The use of water efficient fixture and fittings reduces the standard water demand from 703 litres per day to 586 litres per day. This standard for water efficiency could be required by the Ella Bay Architectural and Sustainable Design Guidelines including:

- Water efficient shower roses, minimum 3 star WELS rating
- Water efficient taps, minimum 6 star WELS rating
- Water efficient dishwashers, minimum 4 star WELS rating
- Water efficient washing machines, minimum 4 star WELS rating
- Water efficient toilets, minimum 4 star WELS rating
- Water efficient landscaping, designed for the tropical North Queensland climate
- Hot water recirculation systems

3.3.3 WATER RECYCLING

The water efficiency strategy involves providing water that is suitable to the application for which it is used. Several studies by Australian water authorities have concluded that Class A+ recycled water is suitable for toilet flushing, clothes washing and subsurface landscape watering. It is proposed to reuse treated wastewater, under Option 2, to reduce demand for potable water. The use of recycled water will require the wastewater treatment plant operate to hold a water-recycling license from the Queensland EPA.

Table 6 shows the typical dwelling daily water demand for potable water of 265 litres per day, recycled water use of 544 litres per day and flow to sewer rates of 586 litres per day.

SERVICE VOLUMES FOR CLASS A+ WATER REUSE Daily Household Demand By Service			
Description	**Potable Water Use Litres per day by Service**	**Recycled Water Use Litres per day by Service**	**Flow to Sewer Litres per day by Service**
Toilet	0	186	186
Hand basin	28	0	28
Bath/shower	193	0	193
Kitchen	44	0	44
Laundry	0	135	135
Total Internal Use	**265**	**321**	**586**
Total External Use		223	
Total Dwelling Use		**544**	

Table 6 Recycled Water Volumes Per Dwellings

For the purposes of this study Option 1 will assume a daily water demand of 586 litres per dwelling. Option 2 will assume a daily potable water demand of 265 litres per dwelling and recycled water demand of 544 litres per day and total daily flow to sewer rate of 586 litres.

In addition to this demand the golf course has been estimated to require an estimated 1ML per day during dryer weather periods.

3.3.4 MAINS WATER AND SEWER CONNECTION – OPTION 1

Option 1 describes the business-as-usual approach; a mains water and sewer connection to Innisfail. Although Flying Fish Point water and sewer connections and systems are at capacity, these services could be upgraded from Innisfail if the developer was prepared to negotiate with council and fund the upgrade costs. This would be the case in a typical development scenario. The business-as-usual, Option 1, involves the following design elements:-

- 225 mains connections to Innisfail
- Water treatment plant upgrade
- Sewer rising main to Innisfail
- Sewer plant upgrade

3.3.5 EFFICIENT WATER CYCLE – OPTION 2

A brief description of Option 2 is be set out below.

Option 2 - In this option, the efficient water cycle include the following:

Residential Lots

- Installation of rainwater harvesting tanks at each dwelling
- Household rainwater treatment to potable standard

Villas, Units & Central Facilities

- Central rainwater harvesting and collection
- Central rainwater treatment to potable standard
- Reticulated potable water to all units and villas

Common System

- Distribution of pressurised treated Class A+ wastewater to each dwelling, villa, unit and central facility from a holding tank
- A combination of gravity sewer system with rising main and sewer pump stations and low pressure sewerage collection systems to transfer all sewage on site to the sewer treatment plant.
- MBR sewer treatment systems to treat all wastewater to Class A standard
- Wet weather storage to hold excess Class A water during the wet season
- Use of low phosphorus, sodium detergents and cleaners
- Use of low nitrate fertilizers, herbicides and pesticides in resort and lot landscaping
- Stormwater collection for reuse in swimming pools

3.3.6 RAINWATER HARVESTING – OPTION 2

Residential Lots

The dwellings at Ella Bay have an estimated daily demand of potable water of 265 litres. Ella Bay has the advantage that it is proposing to implement a comprehensive water use monitoring system. This system would provide useful feedback on the water use and water usage patterns of apartments, villas and residences, after 12 months of operational records from Stage 1 have been analysed. Design parameters for future stages at Ella Bay could be revised, if the operational data from either Little Cove or Stage 1 of Ella Bay demonstrate and prove more efficient and sustainable water reductions could be factored into future stages.

A real-time rainwater model was run for a typical dwelling using the daily water estimate of 265 litres. The model demonstrated that a 30,000 litre rainwater tank would meet the potable water demand, even in the driest 1 decile rainfall event year. The model shows that at the end of the 1 decile year (a 1 decile rainfall in the lowest 10% of per month rainfall), the proposed 30,000-litre rainwater tank is at 25% capacity. The driest 1 decile year has 70% lower rainfall than the lowest annual recorded rainfall in Innisfail. The rainfall data used are shown in the diagram below. For apartments and commercial facilities, a centralised rainwater facility could operate to supply potable water demand within similar storage considerations as individual dwellings.

Rainfall Data Innisfail (mm)

Mean rainfall (mm)	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
Mean rainfall (mm)	505.1	595.5	661.5	463.5	300.7	190.4	133.8	119.3	85.1	83.0	153.5	263.7	3560.
Median rainfall (mm)	453.4	497.9	623.2	409.4	262.4	173.0	113.3	96.8	63.6	61.2	105.1	186.6	3512.4
Decile 1 rainfall (mm)	139.6	256.8	223.5	155.0	93.5	42.1	37.3	20.9	3.0	6.0	20.0	39.5	2545.2

Villas, Units & Central Facilities

Under Option 2 it is proposed to harvest rainwater from the roofs of all villas and units. This stored rainwater will supply all potable water demand for the Villas, Units and Central Facilities. Due to the medium to high density of these developments it is recommended that the rainwater be stored in a central tank farm. The potable water will be reticulated to each of these facilities and be treated to potable water standards at a central water treatment facility. The tank farm could be incorporated under the main carparks and roadways. These central water treatment systems would be managed by the Ella Bay Services Company.

Maintaining Rainwater Quality. The design guidelines would include a specification for rainwater quality and rainwater pre-treatment measures that would be required to be included at each house, to ensure that the water entering the tank is safe. These include:-

- First flush diverters
- Inlet screening for mosquitoes
- Leaf guards

All stored rainwater, whether used for the residential Lots or Villas and units, be treated to the Australian potable water standard. One such package includes a 10-micron carbon filter and a 1-micron cartridge filter with UV filter. It is suggested that all water treatment systems be maintained under contract by the proposed Ella Bay Services Company.

3.3.7 WATER RECYCLING & CLEANING PRODUCTS – OPTION 2

The code of environmental practice for the Ella Bay resorts and residences would nominate the use of low phosphorus and sodium detergents and cleaners. This could reduce the load of phosphorus and sodium to be eliminated by the wastewater treatment plant, and consequently its re-use and disposal. It is proposed to have a selection of suitable cleaners and detergents for sale at the resort supermarket. New residents could be given a sampler kit on their induction.

3.3.8 WATER RECYCLING – OPTION 2

Reuse use of wastewater involves sewerage undergoing treatment to minimum Class A+ standard. Class A+ water would be used in washing machines, toilets and landscape watering. Figure 3 shows the total water demand from various water services. The figure shows a single line diagram, with the various water sources and the implementation of water efficiency and water re-use measures of a typical dwelling. This could save a total of 544 litres per day of potable water providing water savings from both internal and external water use. Internal water use savings are estimated at 321 litres of potable water per day per dwelling. External water use savings are estimated at 223 litres per day for landscaping and wash down.

3.3.9 ESD WASTEWATER STRATEGY

There are several wastewater treatment solutions suitable for the Ella Bay development. The wastewater solution set includes the collection of the sewage, treatment of the sewage and reuse and recycling of the treated wastewater. Under Option 1, sewage is centrally collected and pumped for treatment to Innisfail. Below are two functional design descriptions of the ESD systems for Option 2, respectively. Both systems would include sophisticated operational monitoring to ensure minimal impact on the environment.

3.3.10 WASTEWATER COLLECTION & TREATMENT – OPTION 1

The collection of site sewage would be normally undertaken with a gravity sewerage system. This system conveys the sewage to Innisfail to a wastewater treatment plant via large gravity fed pipes. Due to the distances and topography involved, the system would likely use sewer pump stations to collect sewage in lower parts of the site and pump it to the Johnstone Shire's sewer treatment plant in Innisfail, or another sewer pump station, depending on the location. This is the system used by most Queensland councils. The key disadvantages of this system for low-lying land, is its high capital and operating costs and high storm water infiltration rates.

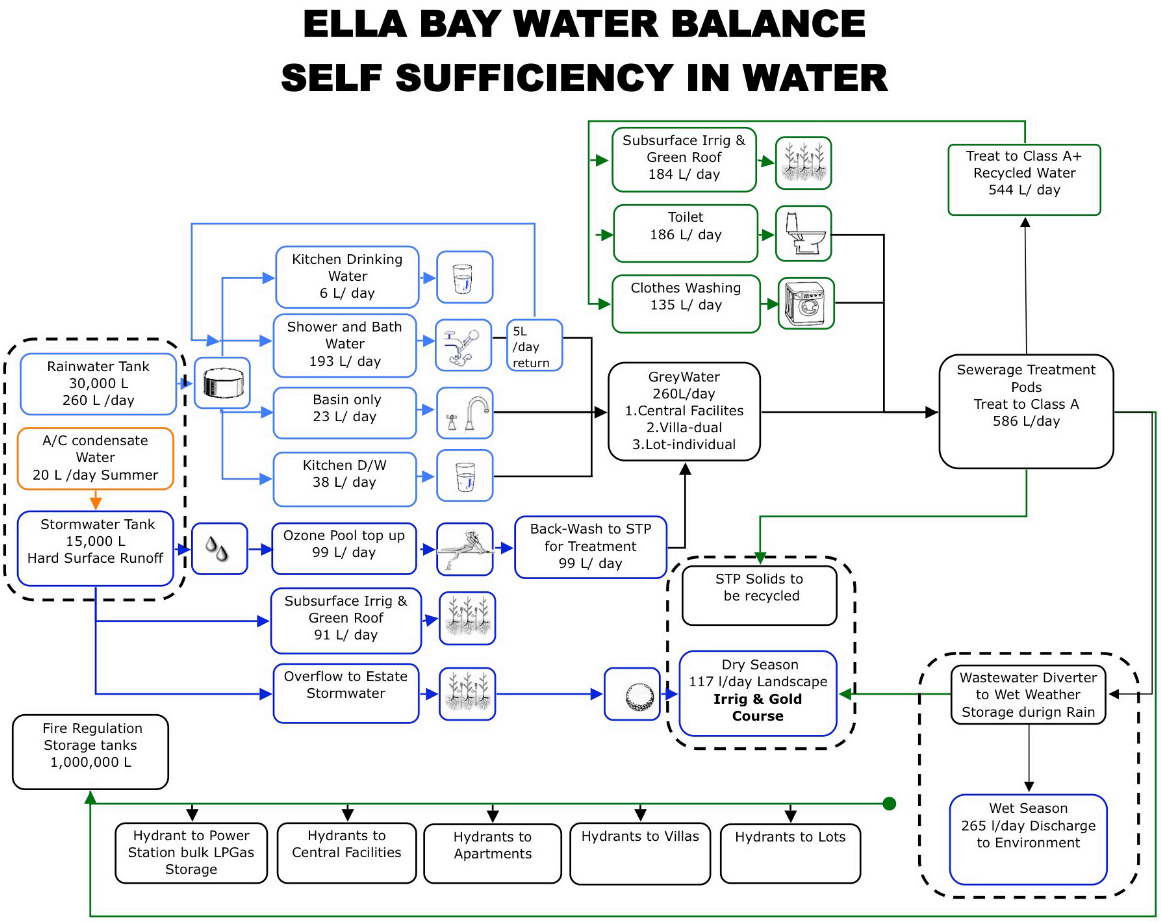

Figure 3 Water Balance Schematic Overview Diagram

3.3.11 WASTEWATER COLLECTION & TREATMENT – OPTION 2

Option 2, wastewater collection and treatment, features a combination of gravity sewer and low-pressure sewage collection and an MBR type sewerage treatment plant.

Combined Gravity & Low Pressure Sewer. The collection of the sewage would likely be via a combination gravity sewer and low-pressure sewage collection system. Lower pressure sewer systems start as a gravity fed system from the dwelling to an underground pump station, on or near the property boundary. From the underground pump station the sewage is ground and pumped to a transfer line that is operating at low pressure. This is achieved via small-bore pipes between 40mm – 160mm diameter. These pipes can be laid level and therefore buried in shallow trenches as they do not rely on gravity to make the sewage flow. This shallow trenching significantly reduces disturbance of ground water, tree roots and soil. These transfer lines pump the raw sewage to the sewer treatment plant. The biggest advantage of low pressure sewer systems in that they eliminate stormwater infiltration during rainfall events. This has several benefits to the development. It reduces environmental impacts because stormwater cannot enter the sewer system and be contaminated. In gravity sewer systems, the sewer treatment system must be sized to treat all of the infiltrated stormwater (typically equivalent to the actual daily flow of sewage). This has both a high capital and operating cost impact. Low pressure systems have flow-on benefits to the physical size of the sewerage plant and its operating performance. The key disadvantage of low pressure sewer systems are their high capital costs. It is likely that when the lower capital cost associated with a smaller wastewater treatment plant is taken into account, this will likely support an investment in a combined gravity and low pressure sewer infrastructure.

Membrane Bio Reactor (MBR) sewer treatment plant. Under Option 2 it is proposed to treat all wastewater to Class A standard. The sewerage plant/s will be located either as a central plant or distributed plant. It is recommended that sewage treatment plant be a MBR type system. It combines activated sludge treatment with a membrane separation process that eliminates the need for a secondary clarifier. A low-pressure membrane, such as a micro filter (MF), performs the solids separation. The MBR process therefore contains the elements of secondary, tertiary and advanced wastewater treatment in a single unit operation.

The MBR system involves establishing a suspended growth process with an activated sludge system that utilizes micro porous membranes for solid-liquid separation (operating at concentrations 20 times higher than in a standard activated sludge sewer treatment plant). The system configuration includes a submerged membrane in the aerated portion of the bioreactor, an anoxic zone and internal mixed liquor recycler. MBR has become the sewerage plant of choice for sensitive environments.

The first commercial scale MBR in Australia was commissioned at Picnic Bay on Magnetic Island in Queensland in late 2002. The decision to consider a MBR for water treatment was made necessary by the stringent tertiary treatment standards, imposed to protect the Great Barrier Reef. The plant has consistently produced very high quality water (at 540 m^3/day) for recycling and discharge to the sensitive waters of the Great Barrier Reef Marine Park. This is a similar sized system to the one proposed for Ella Bay. The reduced flow of wastewater, through the use of a combined gravity and low-pressure sewer transport system, means these systems can remain decentralized and still be very cost-effective. The main advantages of MBR include:-

- Secondary and tertiary filtration processes are eliminated, reducing plant footprint.
- The quality of solids separation is not dependent on the mixed liquor suspended solids concentration, so the aeration basin volume can be reduced, further reducing plant footprint.
- It can be designed with long sludge age, hence low sludge production.
- Indicative output quality of MF systems include SS < 1mg/L, turbidity <0.2 NTU and up to 4 log removal of virus and provide a barrier to certain chlorine resistant pathogens.
- The resultant small footprint aids visual amenity and lowers noise and odor. The entire MBR Sewage Treatment Plant can be housed in a building designed to blend in with its surrounding landscape.

3.3.12 COMMON MANAGEMENT ISSUES - OPTION 2

Common management issues related to Option 2 are discussed in this section. They include:-

- Centralized/Decentralized sewage treatment plants
- Wet weather storage and discharges
- Real-Time monitoring
- Management Options
- Emergency water supply

3.3.13 CENTRALISED/DECENTRALISED SEWAGE TREATMENT PLANTS

Two options exist to locate the MBR sewer treatment plant/s. The first option is to centralise the sewer treatment plant at location 1 refer to Figure 4. Location 1 is also the proposed location of the back-up power station, LPGas tank, telecommunications, possible workshop, worm farm and laundry. The second option is to decentralise the sewer plants in the locations numbered 1 – 7 as shown in Figure 4 . Each of the plants would treat and recycle all wastewater in their associated development pods. There are several advantages and disadvantages to centralisation and decentralised of the sewer treatment plants.

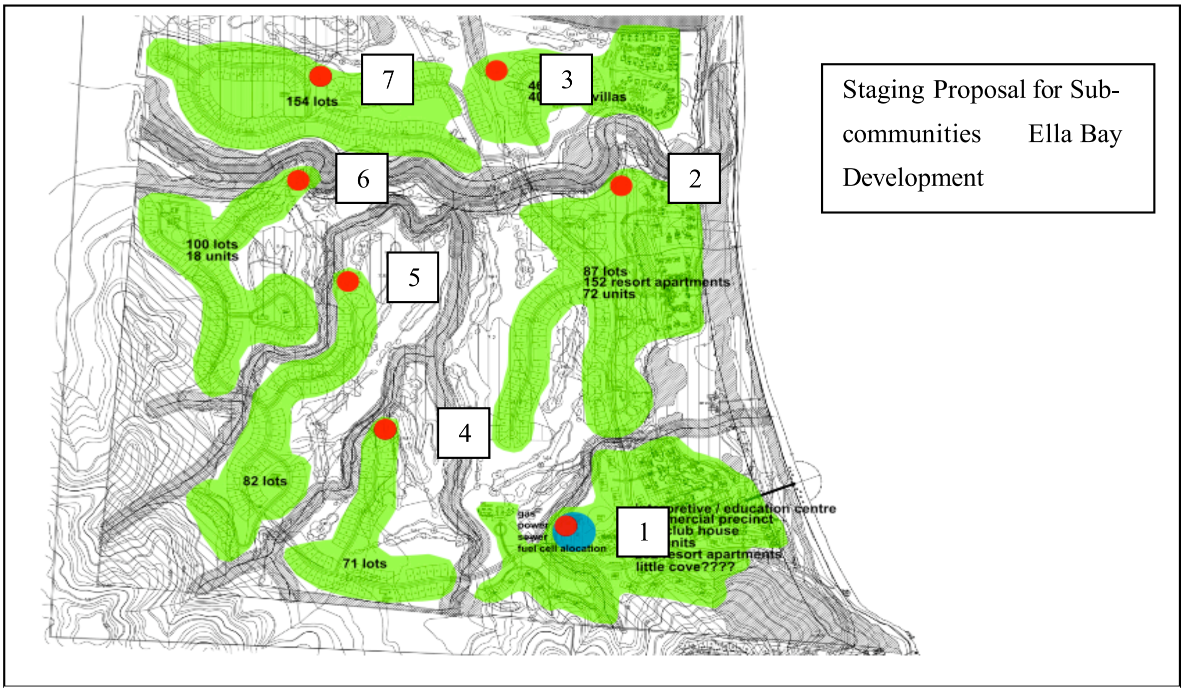

Figure 4 Ella Bay Site Plan

The key disadvantage of a decentralised solution is the maintenance challenges associated with 7 plants versus concentrating efforts at 1 plant location. The key advantage of the decentralised solution is that the plants are designed for the needs of its associated development pod. This could significantly reduce water and sewer pumping energy (estimated at 650,000 kWh per annum), greenhouse gas emissions (660 tonnes) and operating costs (in excess of $250,000 per annum). Consideration of the energy penalties of distributing water around a dispersed site provides a key reason to support the decentralised sewer treatment solution.

Possible locations for the decentralised sewer treatment plants are shown in the locations on the plan on the previous page, marked from numbers 1 to 7. These locations were principally chosen for their ability to access the golf course for disposal of excess treated wastewater.

3.3.14 WET WEATHER STORAGE & DISCHARGE – OPTION 2

A study by Simmons and Bristow on sewer treatment plant options for Ella Bay has suggested that a 3,000 kilolitre wet weather storage tank along with environmental discharge of Class A water would meet the environmental requirements of the EPA for this project. The proponent has committed to detailed modelling and liaison with the Queensland EPA to develop a wet weather storage solution and requisite wastewater treatment standard to protect the environment.

3.3.15 REAL-TIME MONITORING – OPTION 2

Option 2 could feature a Real Time Resource monitoring and water use data collection and metering system via the Integrated Community Energy Management and Control System. Resource data would be displayed on a flat screen would typically be located in the kitchen. The screen would display resource usage data for each, villa, unit or lot. Residents and guests would have access to real-time water resource data, individual rainwater tank levels etc., all provided in a consumer friendly manner. It would receive input consumption data on rainwater, stormwater, Class A+ water re- use. The installation of this system could be required by the , as part of the Ella Bay Architectural and Sustainable Design Guidelines.

3.3.16 MANAGEMENT - OPTION 2

The proposed Ella Bay Services Company **could be responsible for management of** the rainwater treatment systems, fire fighting system and sewer treatment and water reuse systems require ownership, maintenance and operation to provide long-term reliable services to the Ella Bay development. The development would also be required to hold a water supply, sewer treatment plant and wastewaste reuse licenses from the Queensland EPA. The Ella Bay services company could own and operate the water systems including central rainwater collection and treatment in the villas and units (excluding household rainwater tanks).

3.3.17 EMERGENCY WATER SUPPLY - OPTION 2

The development requires an emergency potable water supply make-up strategy. Several options exist for this supply. It is proposed that a low volume potable water line interconnect all resort and central facilities. Two emergency of the possible water sources are discussed here; first a trickle feed system from Flying Fish Point could be established. This system would provide 10 litres a second during offpeak hours so that it did not burden the existing infrastructure. The second option is to use deep ground water. Golders, in their ground water report (2006), identified two main groundwater supplies that are to yet to be tested for water quality. The deepwater aquifers could be tested for their sustainable delivery capacity for use as an emergency back-up. The requirement for an emergency water supply has been estimated at six litres per second. According to Golders this is within the sustainable ability of the deep aquifer. However, as it is only a back-up, this aquifer would only be accessed for short times during extended dry periods. The driest of the driest years, taking the driest month of every year recorded since 1902, annual rainfall was recorded at 1.77 meters. Even in this period, the water- use models show that with a 30,000 litre tank there is sufficient rainfall to meet water needs. So the access to the aquifer, if required, is likely to be only a 1/100 year type event. A similar results applies to the central rainwater collection solutions for the villas and units.

3.3.18 ESD WATER STRATEGY SUMMARY

The proposed ESD Water Solution Set, option 2, is capable of delivering impressive benefits; up to 70% reduction in potable water use (353 megalitres per annum). This Solution Set would also significantly minimise the risk associated with a single source water supply. Combining this with the proposed combined gravity and low pressure sewer collection system would likely eliminate peak infiltration of stormwater into the sewer system, providing a 50% reduction in sewer plant treatment peak volumes, reducing wet weather end flows to the environment by over 1,000 kilolitres per day. Treated wastewater modelling undertaken by specialist wastewater consultants Simmons and Bristow has developed a comprehensive wet weather strategy. The proponent has committed to develop a wastewater strategy that will allow the Queensland EPA to grant it a sewerage treatment plant license for the project.

3.4 STORMWATER

ESD STORMWATER STRATEGY. The Ella Bay stormwater solution is based on the implementation of the Water Sensitive Urban Design (WSUD). The WSUD ESD Strategy would specifically address Satori Resort's aim to achieve sustainable and integrated urban water cycle management in all its developments. It is the interactions between the urban built form (including urban landscapes) and the urban water cycle, as defined by the three urban water streams of potable water, wastewater, and stormwater. The guiding principles of WSUD are centered on achieving integrated water cycle management solutions aimed at:

a) Reducing potable water demand through water efficient appliances, rainwater and treated wastewater re-use.
b) Minimizing wastewater generation and treatment of wastewater to a standard, suitable for effluent re-use opportunities and/or release to receiving waters.
c) Treating urban stormwater to meet water quality objectives for re-use and/or discharge to receiving waters.
d) Using stormwater in the urban landscape to maximize the visual and recreational amenity, following the development principles of:-
    (i) sustainable quality of life;
    (ii) resource conservation;
    (iii) pollution minimization; and
    (iv) biodiversity conservation.

Sustainable indicators of the WSUD include the following:-

Pollution Control Indicators

a) 45% reduction in the mean annual load of Total Nitrogen (TN).
b) 45% reduction in the mean annual load of Total Phosphorus (TP).
c) 80% reduction in the mean annual load of Total Suspended Solids (TSS).
d) Retention of litter greater than 50 mm, for flows up to 50% of the one-year Average Recurrence Interval (ARI) peak flow.
e) Retention of sediment coarser than 0.125 mm for flows up to 50% of the one-year ARI peak flow.
f) In areas with concentrated hydrocarbon deposition, no visible oils for flows up to 50% of the one-year ARI peak flow.

Water Conservation Indicators

Combination of water efficiency and reuse options achieves a 40% reduction on Option 1 the base case.

Flow Management Indicators. Post-development storm discharges could equal pre-development storm discharges for one and a half year ARI event. The purpose of this is to minimize the impact of frequent events on the natural waterways and to minimize bed and bank erosion.

WSUD Measures. WSUD involves a number of source controls and measures such as:-

a) rainwater tanks, porous pavements
b) rain gardens
c) swales and buffer strips
d) bio-retention swales
e) bio-retention basins
f) sand filters
g) on-site infiltration measures
h) sediments basins
i) constructed wetlands
j) other elements such as litter baskets, trash racks, gross pollutant traps (oil/ grease)
k) separators and green roofs
l) constructed wetlands

The application of these measures is shown in the diagram below.

Figure 5 Possible WSUD Initiatives

ESD STORMWATER STRATEGY A description of the strategic WSUD solution proposed for Ella Bay is described below.

Flow Management This objective relates to the management of the hydrologic impact of catchment urbanization on the ecosystem health of urban waterways. Research has now directly linked the increase in the magnitude of frequent storm flows to degradation of habitat values in urban waterways. The target for this objective is to maintain the post-development storm discharges to the natural catchment's storm discharge levels for one and a half year ARI event.

Strategies for Water Conservation. In relation to wastewater management refer to the ESD Water Strategy portion of this report for details of the water conservation measures.

Pollution Control as it relates to the reduction in urban stormwater pollutants discharged from an area following development. Rainwater permeable surfacing could be a design consideration at the proposed Ella Bay development. Reduced sealing and maximized permeability of the built landscape could reduce hard surface run-off and maintain soil moisture regimes. The Building Design Code could require each lot to install a stormwater tank under their permeable driveway to reduce runoff to the streets.

The code of environmental practice for the Ella Bay resort and residences could specify the use of low nitrate fertilizers, no herbicides or pesticides in landscaping. This could reduce the nitrate, herbicide and pesticide load in the stormwater system and consequently in the riparian zone. The Design Guide could include recommendations on the sustainable landscaping initiatives. Refer to the ESD Landscaping Strategy for details.

The impact and benefits of the integrated stormwater management system could be modeled as part of the next phase of the design process. Refer to ESD Water and Landscaping Strategies for pollutant reduction from resort operation and residential occupation.

A description of the WSUD measures likely to included at the Ella Bay development.

WSUD Measures	Descriptions
Swales and Buffer Strips	A swale is a shallow trapezoidal channel lined with vegetation. A buffer strip is a vegetated slope. Stormwater flows along a swale, but across a buffer strip. Treatment is provided by infiltration to the soil and by filtration of shallow flow through the vegetation.
Bio-retention Swales	Bio-retention swales include a vegetated infiltration trench within the invert of a swale. Incorporating the infiltration trench enhances removal of both particles and nutrients.
Sedimentation Basins	A sedimentation basin is a small pond, about 1 m deep, designed to capture coarse to medium sediment from urban catchments. Treatment is provided primarily through settling of suspended particles.
Bio-retention Basins	A bio-retention basin is a vegetated bed of filter material, such as sand and gravel. The basin is designed to capture stormwater-runoff which then drains through the filter media. Pollutants are removed by filtration and by biological uptake of nutrients.
Constructed Wetlands	Constructed wetland systems are shallow, vegetated water bodies that use enhanced sedimentation, fine filtration and biological uptake processes to remove pollutants from stormwater.

WSUD Measures	Descriptions
Infiltration Measures	Infiltration measures typically consist of a holding pond or tank designed to promote infiltration of appropriately treated to surrounding soils. The primary function of these devices is runoff volume control rather than pollutant removal.
Sand Filters	A sand filter is a sand layer designed to filter fine particulates from stormwater before discharging to a downstream drainage system.
Aquifer Storage and Recovery	Aquifer storage and recovery involves enhancing water recharge to underground aquifers through pumping or gravity feed of treated stormwater.

Table 7 WSUD Measures & Descriptions

3.6 COMMUNITY AND INDOOR ENVIRONMENT

ESD COMMUNITY STRATEGY aims to create Ella Bay as a place where people want to live and work, now and in the future. Ella Bay could meet the diverse needs of residents, be sensitive to their environment and contribute to a high quality of life. Ella Bay could be safe and inclusive, well planned, built and run, and offer equality of opportunity and good services for all. Elements that contribute towards sustainable community include:

- Creation of walk-able neighborhoods that reduce automobile dependence.
- Facilitate equitable access to goods, services, employment and educational opportunities.
- Creation of a strong community identity.
- Creation of SAFE (Safe, Attractive, Friendly, Efficient) street networks where buildings face the streets, increasing the level of activity and personal security.
- Creation of neighborhoods that are supportive of diverse transport systems.
- Creation of diverse opportunities within the community, supporting mixed-use developments to occur in line with community expectations.

Sustainable community based initiatives to support the development of a sustainable community at Ella Bay is set out below:-

Walk-able neighborhoods are the foundation of the design of the Ella Bay masterplan. Through the integration of bikeways, pathways and local electric hybrid buses, it is anticipated that daily vehicle usage could be reduced by up to 70%.

Equitable access to goods, services, employment and educational opportunities could be provided and promoted to residents of the Ella Bay community. This could include environmental programs, local shopping, schooling and university studies and employment within the community, including tourism ventures, golfing, and retail and resort based businesses.

Strong community identity. Ella Bay could have a strong community identity related to its several unique features; community title living, sustainable and environmentally sensitive living, connection with the world heritage rainforest and great barrier reef and its resort lifestyle. An element of the the Environmental Sustainability Policy requirements are that all owners, contractors, staff and visitors are inducted into the unique elements of the developments, including the sensitive environment, sustainable living initiatives, sustainable transport options and community engagement activities. Satori embraces the principle of sustainable development that meets the needs of the present generation without compromising the ability of future generations to meet their needs. These principles are fundamental to sustainable development.

Safe, Attractive, Friendly and Efficient (SAFE) street networks, where buildings face the streets, increasing the level of activity and personal security.

Neighborhoods are designed to be supportive of diverse transport systems as set in the ESD Transport Strategy.

Diverse opportunities could be created in the Ella Bay community. A key strategy is the provision of high speed internet access to support work from home professionals. The establishment of resort support services, environmental guiding, golfing, education and research on sustainability and retail opportunities are all supporting a range of businesses and employment opportunities.

ESD INDOOR ENVIRONMENT STRATEGY (ESD IE Strategy) is the incorporation of design elements and products that show an understanding that good building design is inherently codependent with human beings. ESD IE recognizes the influence of the built environment upon our health and comfort. Mounting evidence about the inter-relationship of occupant health to a building's IE is significant. The goal of ESD IE is to effectively use design solutions that both encourage higher performance of the building and enhance the occupants' health and productivity — which ultimately also ends up translating into numerous benefits for building occupiers. IE improvements can increase the resale value of buildings.

ESD IE Strategies, as it relates to residential housing and apartments, include the quality of indoor air such as moisture management and control of contaminants. Specifying materials that release fewer and less harmful contaminants such as paint, glue, carpet and floor covering selection can have significant impact on air quality.

Moisture management Moisture ranks as a leading cause of structural damage and excess moisture in a building has been associated with a variety of health problems in children and adults. The Ella Bay design guidelines could support building designs that are sited, constructed, operated, and maintained to minimize moisture build up. Excess water or moisture in a building can lead to structural failures and health-related problems when materials stay wet long enough for microbial growth, physical deterioration, or chemical reactions to occur. Under certain conditions, water vapor can condense within the building envelope. When this occurs the materials that make up the wall can become wet, lessening their performance and contributing to their deterioration. To prevent this, special attention should be given by the design and builder to the vapor barrier, the vapor tight sheet of plastic or metal foil, to be as close to the warm side of the wall construction as possible. For example, in areas with meaningful heating loads, the vapor barrier should go near the inside of the wall assembly. This placement can lessen or eliminate the problem of water-vapor condensation. During the humid wetter months humidity control by air conditioning system could be promoted.

Volatile Organic Compounds (VOCs) are highly evaporative, carbon-based chemical substances, which produces noxious fumes, found in many paints, caulks, stains, and adhesives. Ella Bay design guidelines could promote the use of low VOC paints, caulks, stains, glue and floor coverings.

Design Control Code, is the vehicle that Ella Bay could use to guide and control landowner choices about aspects of the built form that impact on the overall sustainability of the community. Built form designs could be encouraged that allow for adequate natural heating, cooling, ventilation and light could be necessary to meet requirements under the Code, like:

a. Identify and promote the use of safe, non-toxic and sustainable manufactured materials, products and technologies;

b. Promote enhanced indoor environmental quality, especially air quality;

c. Identify and promote the use of safe, sustainable and non-toxic materials products and technologies;

d. Re-use of materials in the dwelling and estate infrastructure, including bulk buying suitable supply to minimize transport, cut unit costs and support supply;

e. Use of durable materials that are suited to tropical conditions to minimize replacement or disruption, once the infrastructure is in place.

3.7 CIVIL, LANDSCAPE, PROJECT AND WASTE MANAGEMENT

ESD CIVIL STRATEGY aims to sustainable design, specify and construct bulk earth works and pavement to minimize environmental impacts by:-

- Minimizing importation and removal of soil from site
- Roads and pavements designed to support the performance outcomes of the proposed ESD transport, water sensitive urban design and landscape
- Roadways, walkways and bikeways' use of cool pavements
- Minimize use of asphalt use and maximize use of concrete
- Use recycled materials for road base

Cut & Fill Balance on the major earthworks to minimize the removal and importation of soil from site. This could reduce transport requirements and save greenhouse emissions. All topsoil removed could be stored on site for reuse in landscaping and the golf course.

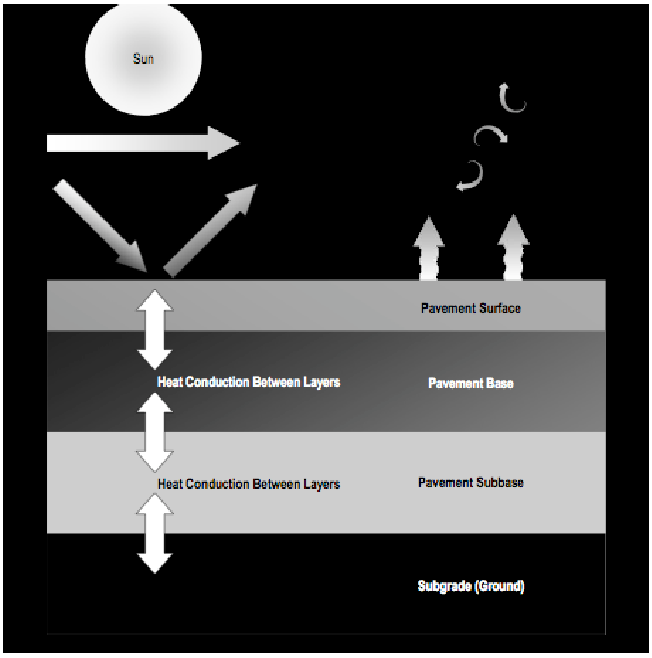

Figure 6 Image of Urban Heat Island Effect

Cool pavements. Dark materials absorb more heat from the sun. Black surfaces in the sun can become up to 40°C hotter than the most reflective white surfaces. Roads and parking lots are frequently paved with black asphalt concrete (commonly called "asphalt") and other dark materials that absorb most of the sunlight. The energy of the sunlight is converted into thermal energy and pavements get hot, heating the air around them and contributing greatly to the heat island effect. Cool pavements can be achieved with existing paving technologies and do not require new materials. Possible mechanisms for creating a cool pavement that have been studied to date are:

a) Increased surface reflectance, which reduces the solar radiation absorbed by the pavement;

b) Increased permeability, which cools the pavement through evaporation of water; and

c) A composite structure for noise reduction, which also has been found to emit lower levels of heat at night.

Several conventional paving technologies now exist that can apply these mechanisms. As part of a heat island reduction strategy, cool pavements contribute to the general benefits of heat island mitigation, including increased comfort, decreased energy use, and likely improved air quality. Cool pavements also can be one component of a larger sustainable pavements program, or a “green” transportation infrastructure.

Minimize Asphalt The strategy involves minimizing the use of asphalt in favor of concrete to reduce the heat island effect. The use of asphalt involves the consumption of fossil fuel in the form of oil, to bind the blue metal.

Use recycled materials for road base via sourcing regionally where possible the supply of recycled materials, primarily crushed concrete, brick and reclaimed asphalt blends for the following uses:

- Road base for urban roads with light to medium traffic
- Select fill for use on sub-grades to enhance strength or for raising site levels, particularly in roadways and beneath buildings
- Bedding material for paving blocks to be used in pedestrian areas, car parks
- Drainage medium for drainage lines and drainage structures.

Permeable Paving could be incorporated into paved areas such as roads, pathways and bikeways.

ESD LANDSCAPE STRATEGY aims to achieve an attractive environment that is in balance with the local climate and requires minimal resource inputs, such as fertilizer, pesticides and water. Sustainable landscaping begins with an appropriate design that includes functional, cost efficient, visually pleasing, environmentally friendly and maintainable areas. The proposed landscaping measures include the following:-

- Best adapted to local conditions / thrive with least care
- Great variety of species for all conditions
- Won't harm natural areas
- High habitat value
- Provide "sense of place"
- Use greatest diversity of plants
- Less noticeable damage from pests and disease
- More wildlife habitat
- Plant sites more densely, in layers

Practice Integrated Pest Management:-

- Monitor and assess
- Cultural controls first
- Least toxic chemicals

- Follow label directions carefully
- Spot treat rather than broadcast

Careful Nutrient Application Careful Nutrient Application

- Test soil to determine appropriate fertilizer
- Use organics and slow-release
- Apply sparingly and at correct time, according to directions
- Little to none needed for natives

ESD PROJECT MANAGEMENT aims to deliver sustainability in the management of the detailed design and construction phases of the development so that all of the sustainable performance outcomes and promise are delivered. The areas that allow for the monitoring and reporting of sustainable outcome are:-

- Development of a broad Environmental Management Plan;
- A plan for systems and building tuning to ensure the integrity of the Integrated Community Energy Management and Control System.

The head contractor could be responsible for the development, implementation and monitoring of the Ella Bay Environmental Management Plan. The EMP during construction phase of the project could include a section dealing with the following matters:

- Proposed methods of works
- Assessment of environmental impacts
- Proposed timing/duration of works
- Incident register and rectification process
- Licences and approvals required
- Understanding of the Commonwealth and state regulatory framework
- Responsibilities and qualifications of key staff
- Site induction and staff training schedule
- Contractor's Environment Policy
- Reporting structure (eg kick-off and regular site meetings) and Construction EMP audit schedule

Assessment of environmental impacts This section of the EMP is to outline the environmental impacts and subsequent management strategies to negate impacts associated with the development works including possible impacts as listed in the table below.

Possible Environmental Impact	Items to be considered in an EMP
Sediment and Erosion Control	This section should consider information relating to the locations of stormwater discharge points off the site, sediment fences, gravel beds, grids, stockpile locations, treatments along haulage routes on adjacent roads etc. Presenting the above information on a site plan is usually the most effective method of documenting this information.
Air Quality	Outline how and when dust control measures are to be implemented in addition to odor controls, noise and/or vibration controls if applicable.
Waste Management	Document the management of various waste streams including concrete wastes, general wastes, hazardous or regulated waste removal etc
Flora and Fauna	Identify vegetation disturbance, weed management, vegetation recovery and landscaping works, locations of protected flora/fauna species.
Soils	An Acid Sulphate Soils Management Plan should be referred to if applicable.
Water Quality	This section should contain information relating to water quality monitoring
Cultural Heritage	Outline the process of managing any cultural heritage values should the issue arise during the construction phase
Chemical Storage	Outline the process for the storage of chemicals, refueling activities, spill response procedures and other emergency response protocols.

Table 8 Possible EMP Environmental Impacts

Requirements for environmental sign-off and site handover The contractor could prepare summary reports (including monitoring data summary) and final inspection certification to sign off compliance and report any deviation from the plan. The reports could include as-constructed drawings a stormwater management plan showing flow directions and pollution control devices.

Review process for draft Construction EMP. The head construction contractor bears the responsibility for developing and submitting the EMP for Satori Resorts Australia review and forms part of the conditions of contract approval.

Systems and building tuning aims to ensure that the energy and water savings targeted in the design phase is achieved in the operational phase of the project. This is achieved through a witnessing of all fixed appliances, monitoring of the building's actual energy and performance during full commissioning (this could include each dwelling, apartment and resort buildings). This entails two parts:

- Actual energy and water use under full test at time of commissioning
- The builder is required to set up a commissioning test in accordance with the Design Guide
- Satori Resorts could have a third party witness and verify the commissioning tests
- Equipment and appliances checked for compliance to the Design Guide
- Non compliance could mean disconnection of water and energy until rectification of non-compliance
- Energy and water metering equipment could be tested to confirm that it operates and displays on the local monitor and remotely at the central monitoring system
- Smoke and security systems could be tested to confirm it operates and displays on the local monitor and remotely at the central monitoring system
- Water quality testing could be performed on potable and non potable supplies
- Local energy management systems could be tested for functionality and performance
- Energy management load shedding systems from central location to confirm operation
- Remote water and energy disconnect services could be tested for operation and then sealed to ensure it remains tamper proof.

This information is used as input into the writing of several 'performance reports'. Improved energy efficiency and visitor comfort within the building in all seasons due to adequate commissioning of the climate control systems. A 12-month commissioning building tuning period after handover, this includes quarterly reviews and a final recommissioning after 12 months of operation.

The purpose of the commissioning process is to ensure that all systems included under the commissioning scope of work operate in accordance with the project; stated design intent of the building, and meet operational needs in the most reliable and economical manner obtainable. Improved energy efficiency benefits from the appointment of an independent commissioning agent from design through to handover.

ESD WASTE MANAGEMENT STRATEGY consists of a Waste Construction Management plan and an Operational Waste Management Plan. These plans seek to maximise the materials that are recycled and minimise the disposal to landfill. Satori Resorts Ella Bay Pty Ltd's core intention for waste management at Ella Bay's is to reduce waste movement off site and establish a high standard of waste reuse/recycle record. The waste management strategies proposed for the project consider waste management from the concept and planning stages through design, construction and operation. Waste planning for the project allows for considerable flexibility in the management of all wastes. Adequate separation of components of the waste stream at the point of generation could be practiced by the Project, for example the segregation of steel, glass, paper and aluminum cans. Maintaining segregation of different types of waste during generation, storage or transportation makes recovery achievable. The appropriate management and storage of wastes could prevent on-site and off-site pollution and enhance opportunities for reuse. Waste could be sent for disposal to landfill if other options have been ruled out. Waste streams could be assessed for potential reuse, prior to transport to an appropriately licensed disposal facility.

Opportunities to reuse and recycle site-generated waste could be investigated and regularly reviewed. Continual improvement practices such as life cycle analysis, cleaner production, pollution prevention and waste minimisation could be important components of the waste management strategy for the project. There are likely to be opportunities to recycle aluminum cans, some containers such as glass bottles, paper, cardboard and scrap steel during both the construction and operation phases of the project.

Waste Monitoring and auditing could be undertaken once the construction phase of the project is operational. The purpose of monitoring waste management activities and outcomes on-site include:

- assessing actual waste generation and comparing with predicted impacts and mitigation measures;
- monitoring of potential environmental impacts; and
- providing baseline data to enable continuous improvement of waste avoidance, reduction and
- management measures throughout the project.

Waste Characteristics The major sources of waste generation from construction and operation of the Project are:

- excavated material (spoil);
- concrete;
- steel and pipe off-cuts;
- general construction waste (timber, concrete blocks/bricks);
- regulated waste (hydrocarbon liquids and contaminated materials (i.e. rags, paper towel),
- detergents, solvents/degreasers, paints, etc.); and
- general waste (food scraps, paper, cardboard, cans and glass);

The Waste Management Plan could develop a plan to manage each of these waste streams as part of the project construction EMP taking into account local and regional opportunities and risks.
Operational Waste Management The proposed land uses associated with the development comprise resort, residential housing and apartments, retail, administration offices, maintenance facility, chemical storage, filtration/primary wastewater treatment and the RO plant. Hazardous materials could be stored at one location to localize emissions to air, the administration offices

would produce general office/domestic wastes only. The proposed management of each waste stream are given in Table below. It is expected that the proposed development could produce the following waste products:

- General maintenance wastes such as paints, solvents, solid materials; and
- General office waste
- Hazardous waste
- Organic waste

Waste Type	Source(s)	Management Method/s
General wastes including putrescible & organic (food waste), some plastics and paper not suitable for recycling	Offices and workshop	Collection on-site and stored in segregated area. Transportation off-site to Innisfail Council landfill.
Recyclables – including paper and cardboard, plastics, and glass.	Resorts, Offices and workshop Segregation and collection on-site.	Transportation by a waste contractor for off-site recycling.
Hazardous waste – chemicals, paints, resins and solvents.	Workshop / maintenance	The minimal amount expected to be produced, could be collected on-site and stored in the chemical storage area. All wastes could be transported off-site by a licensed regulated waste transporter, to a licensed regulated waste receiver, for recycling or treatment and disposal.
Organic waste.	Resorts, dwellings and villas.	Composting and worm farming for reuse on the golf course as natural fertilzer.

Table 9 Waste Management Options

Organic Waste Processing - It is proposed to establish an Ella Bay community compost and worm farm managed by the Service Company. The processing of organics can deliver important environmental benefits, including the recovery and conservation of resources and a reduction in the quantity of organics going to landfills. These benefits come from turning organics into useful and safe products, without causing harm to the environment. It is proposed to use worm castings as a natural fertiliser for the golf course.

Modern worm farming and composting operations can process considerable quantities of organics. Consequently, the management systems need the ability to monitor, control and report on the generation of unwanted by-products, particularly odours and water-soluble chemical compounds, can become greater than the capacity of natural processes to cope with them adequately. Even relatively simple tasks in composting and related organics processing – such as mulching, grinding and chopping – can have negative environmental impacts if not managed appropriately.

The manager of the worm farm could be responsible for selecting and applying the best mix of techniques for site development and management for their particular location to meet the required environmental objectives. The managers could collect the organic waste from dwellings and the resorts and run education programs so that the organic waste has minimal contamination. The Ella Bay compost and worm farm managers could follow the voluntary Australian standard for composts, soil conditioners and mulches, AS4454-2003 Composts, soil conditioners and mulches. This standard adopts contamination thresholds from products derived from organic wastes, compostable organic materials and biosolids that are current federally or in individual states. The standard was developed for assessing the quality of compost produced from segregated green waste and for unrestricted use, such as domestic and residential uses.

Spill Containment and Management, during operation of the resort development, a chemical storage facility could be used to store all hazardous materials and chemicals. The main hazardous material stored at Ella Bay could be oil, chlorine and industrial detergents. Standard procedures for the storage, handling, disposal and spill response for potentially hazardous waste materials could be adopted. A chemical storage facility could be located on-site a location 1 and could be provided with secondary containment bunding in the event of a spill from the primary containment vessel. This bunding could be designed to contain, at a minimum, 110 percent of the largest container in addition to the containment of the volume of fire water produced over a 20 minute period. Spill clean up kits could be provided at the storage facility. Systems could be implemented to minimise and contain spillage of hazardous materials on-site or workshop compound to conform to the appropriate Australian Dangerous Goods Codes of Practice. Any chemical spill could be contained and collected with appropriate absorbent materials and disposed of through a licensed regulated waste transporter. Recyclable wastes could be collected and transported off-site by a licensed regulated waste contractor.

3.8 INNOVATION AND FUTURE-PROOFING

It is recommended that the Ella Bay design code support the application of future technologies that could provide substantial benefits to the development as they emerge. For example, land could be set aside for fuel cell technology near the back-up power station with pre-laid electrical and communications conduits for later connection to the development electrical infrastructure.

Innovation in Energy

Innovation in Energy Supply and Use is the showcase innovation at Ella Bay:

- **Ground source heat pump** air conditioning;
- **Future use** allocation for improved fuel cells technologies;
- **PV solar** integrated on buildings to account of 90% of load;
- **Real Time Resource and Community Monitors** for feedback and energy management.

Innovation in Water Use

Water use could set a new standard for wastewater disposal in Australian resorts. Planned measures include: includes the Membrane bioreactors with the Class A+ wastewater circulated in a combined recycled water and the fire hydrant system. This infrastructure provides individual dwellings and all buildings with water for recycling and for a possible domestic fire sprinkler system in each building. The combined recycled water and fire hydrant system supplies water to nominated external to fire hydrants. This utilizes water wisely, cuts infrastructure and is an extra fire prevention measure in the Ella Bay development land, which is surrounded by World Heritage Rainforest.

Future Proofing & Design Flexibility

To provide ongoing flexibility and to allow for future changes in technology it is proposed that Ella Bay install conduits in the road alignment that meets Australian Standards and utility requirements for the following:

- Potable water top-up system
- Telecommunications
- High Voltage Electrical Connection

Innovation in Transport

Innovations in Transport include the integrated village based transport solution proposed to utilize electric/gas vehicles with central parking and central charging ports for vehicle recharge. Landowners and visitors would be encouraged to calculate the cost of their personal GHG emission (including air-travel) and offset via companies such as Greenfleet, who specialize in sequestration.

4 CONCLUSION

This ESD Overview Report on Satori Ella Bay Resorts Pty Ltd's proposed Ella Bay resort community has demonstrated that the principals of ecological sustainable development can be adhered to in the design planning, proposed construction and operational management of the development. It is recommended that the proponent further investigate many of the key ESD principles of environmental, economic and social initiatives listed in this report in the design development phase of this project.

The range of ESD energy and water systems provide innovative, holistic and cost effective infrastructure could deliver:-

- water self-sufficiency and its wastewater solution is environmentally benign.
- a combination of interconnected systems, modelled around proven technologies that are reliable and efficient.

The proposed ESD Energy Solution Sets can deliver impressive benefits: up to an 90% reduction in greenhouse emissions (35,000 tonnes of CO_2 per annum), compared with a standard grid connected solution that meets government building code requirements. Five options are considered, option 1 is the business-as-usual option with four ESD options provided. Each option is technically and economically viable. Allowance has been made in the site masterplan to accommodate the five options. Many of the energy options derives a significant 59% of their energy from renewable energy sources.

The proposed ESD Water Solution Set is capable of delivering impressive benefits; an estimated 70% reduction in potable water use (353 megalitres per annum. This Solution Set also significantly minimises risk associated with a single source supply connection to the water mains.

The ESD strategy also reports on several key environmental areas; Stormwater Management, Community & Lifestyle, Waste & Project Management. Innovation & Futureproofing is the other key area that is addressed in the Ella Bay ESD Overview Report as they link sustainable design principles to support the ESD Water and Energy Solution Set.

The other ESD strategies including Civil, Waste, Project Management, Landscape, Transport and Community highlight opportunities and a vision to create a truly sustainable community during design, construction and operational phases.

APPENDICES

APPENDIX 1 ESD STRATEGY

TABLE1	PRINCIPAL AIMS
1. ENERGY • Construction Power • LPGas Power Plant • Photovoltaic Cells • LPGas reticulation • Ground source heat pump Energy **TRANSPORT ENERGY** • Efficient transport	Efficiency in design of a remote power station in Tropical Queensland requires a combination of innovation, planning, technology and monitoring systems: • Construction electricity supplied for an estimated 6 months with bio-diesel fuelled diesel generators (prior to the commissioning of the LPGas Power Plant) via double-skinned diesel tanks and trailer mounted generators; • Reduce greenhouse emissions by 60%, and supplemented by individual solar PV; • LPGas could be used where direct heating is required; • LPGas; gas boosted solar water heaters 3kW PV solar panels (unless the dwelling solar access < 3 peak sun hours per day); • All Estates infrastructure energy 60% lower than standard practice. All infrastructure meets Building Design Codes to incorporate sustainable design; • Monitor and measure energy via real-time resource consumer monitor / interface controllers receives input from electrical (including PV) and LPGas, as an integral part of the Building Design Code; • Set up for application of future technologies with minimal infrastructure / landscape disturbance (e.g. fuel cell technology); Increase and enhance public transport and efficient transport options to improve mobility and build community and tourism support. • Electric golf Buggy transport options with electric recharge at Central Facilities; • Encourage a village style development; • Encourage home office and walking to work or school; • Establish a Tourist Bus services and promote walking site visits; • Sequestration to provide equivalent 30% of the generated greenhouse gas emissions. A) During construction GHG offsets could be purchased (e.g. Green Fleet) for all energy used by all contractors and consultants B) Sequestration strategies could be established for ongoing carbon based energy use;
2. WATER AND WASEWATER • Rainwater Capture & Reuse • Water efficiency • Wastewater collection • Wastewater treatment • Wastewater-reuse	• Self-sufficient Estates with project-specific Water Sensitive Urban Design strategy that minimizes use and discharge of water to the environment. • Hydrological connectivity of the site with adjacent wetlands. Public domain irrigation shall be from Class A+ recycled water and reed bed naturalized source and incorporate local native landscaping. • Class A+ water treatment of all wastewater • Low-pressure sewer treatment system could eliminate infiltration during rainfall events reducing environmental impacts. • Monitor water via real-time resource consumer monitor /

TABLE1	PRINCIPAL AIMS
	interface controllers receives input from rainwater, A+ water re- use consumption on infrastructure services, units, villa and lot services.
3. STORMWATER • Stormwater • Wet Season Water Management	• Reduce hard surface runoff by using permeable paving and sub-surface water retention such as Atlantis Cells in common areas; • Maintain soil-moisture regime. Allow infiltration to reduce runoff and erosion; • Low-pressure sewer system could eliminate infiltration during rainfall events reducing environmental impacts or Wet Season Water management. • Monitor water via real-time resource consumer monitor / interface controllers receives input from stormwater.
4.COMMUNITY • Community Title • Building Design Codes • Regional Growth • Heritage • Education • Employment	The Community Title on the land to ensures the land is developed and buildings design and constructed consistent with the sustainable goals. The Building Design Control Code and Environmental Covenant are to cover all aspects of building requirements. • Design that allow for adequate natural heating, cooling, ventilation and light could be necessary to meet the Code. • Identify and promote the use of safe, sustainable and non-toxic materials products and technologies; • Re-use of materials in the dwelling and estate infrastructure, including bulk buying suitable supply to minimise transport, cut costs and ensure supply; • Use of durable materials that are suited to tropical conditions to minimise replacement or disruption. Contribute towards the sustainable social and community growth of the Cassowary Coast and Queensland Eco-Tourism industry. • Identify and conserve Indigenous / European heritage to promote conservation, interpretation and community engagement; • Individuals could be empowered to contribute to the highest of their ability build a strong community. Focus on Education/Conservation/Innovation; • Promote employment based on tourism ventures and professional services consistent with Cassowary Coast development.
5. CIVIL AND LANDSCAPE • Construction • Soils / Vegetation • Greenhouse gas reduction	All civil and landscape could be designed for low impact in construction and design to enhance the natural environment. • Aims to reduce the building construction waste going to landfill by 90%. • No import or export of soils and landscape propagation using native seed; • Re-use and recycling of all building timber, steel and concrete waste. • Reduced GHG emissions in project set-up and running; • Low impact subterranean pipe work built for access and minimise upgrade.

TABLE1	PRINCIPAL AIMS
	• Compost all organic waste to produce fertilizer for landscape and golf course.
6. INNOVATION • Development • Efficiency	Reduce environmental impact, capital expenditure, ongoing running cost and resource use by innovative, efficient design combining simplicity with technology that supports a sustainable community. • Support further research into sustainable design in tropical areas. • Reduce capital expenditure with efficient technologies; • Reduce ongoing running cost and resource use by innovative design; • Increase lifestyle options conducive with a sustainable living.

APPENDIX 2. COURAN COVE RESORT

Savings Through Synergy

Award-Winning, Sustainable Energy Solutions for Five-Star Resort

INTEGRATED DESIGN SOLUTIONS

A state-of-the-art energy management system, with gas fired power generation and super-efficient building services design make this Queensland five-star island resort an environmental world leader.

CASE STUDY

Couran Cove Resort
South Stradbroke Island
Australia

OVERVIEW

Integrated Energy Services (IES) award-winning energy systems design at Couran Cove Resort demonstrates that energy costs and environmental impacts can be significantly reduced through an integrated, whole-systems design approach.

Ron Clarke, CEO Interpacific Resorts and, former world-champion runner and strong advocate of sustainable development asked IES to "examine every piece of equipment and each item requiring power to ensure they used the lowest possible energy output without compromising any efficiency of purpose".

ENERGY EFFICIENCY SOLUTIONS

Features of the energy-efficient design include:

- Power is provided for the resort's 567 rooms by a 750kW gas-fired power station.
- Super-efficient building services in the hotel, villas, lodges and service areas.
- An Energy Management Control System (EMCS) controls and monitors over 4,000 devices and also allows guests to view their individual energy usage on the in-room TV.

OUTCOMES

- Capital cost savings of $2.5 million.
- Reduced annual operating costs by $1 million.
- Reduced Greenhouse Gas emissions by 75 percent.
- Awarded National Engineering Excellence Awards for:
  - Sustainable Engineering
  - Energy Smart Design
  - Environmental Management
- Demonstration of environmental best practice in five star resort.

Savings through Synergy
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FOOTNOTES