Multi State, North to South, Water Transfer Project (Australia) updated Feb 2011

1) Overview

Australia's southern states are facing long term water shortages when world food demand is projected to double in 40 yrs from global population expansion. We are investing $14b in desalination plant for coastal cities without looking at opportunities to tap into the huge volumes of northern water going to sea and strategically move it to areas of need. CSIRO climate change modeling indicate rainfall in N/Qld will hold at current levels for 90 yrs, while 15% reductions in southern states in decades, may cut back surface irrigation water by 35%.The aim of this preview is to show the economic, social and ecological benefits of investing in N to S water transfer infrastructure that can be adapted through agriculture and technology to meet future food security issues, assist in reducing carbon emissions and introducing low to zero carbon energy technologies With a 60% population increase projected in 40 years, reliable northern water can assist in industry growth, help mitigate some flooding issues, while enabling de-centralization policies to work. Northern water will also be a more reliable and economic source of water for the environment than MDBA water- buybacks, which will return little to the environment during dry periods.

2. a) S/E Australian water transfer opportunity:

It is estimated that on average, 173,000 GL pa of river water in N/E Qld and the Gulf of Carpentaria goes to sea each year. Part of this volume, which amounts to ~100 times southern city needs, could be better utilized by moving it to areas of need. Others have suggested southern irrigated agriculture should be moved to the north where all the water is. While the lower north has agri-potential, few have made the move to the top end due to a range of issues, higher evapo-transpiration rates than rain delivers is high on list. We looked at infrastructure costs to move 4000 GL pa of water 1500-2000 km south by pipe or canal and it soon became obvious that the cost of making pipe in cities, trucking it to site by road, and laying it, at $32-40bn, was unlikely to be economic. We next looked at constructing concrete lined canal to move the same volume from a Burdekin dam source through either a Western Qld-NSW route or a central Qld-NSW route respectively going into the Murray at Wentworth or Tocumwal. From either option, a combination of rivers, subsidiary canals and pipe, could move water to major irrigation areas and city dams in Qld, NSW, Vic and SA. Canal route, length and outlets would be determined by market need and topography. Water delivery to farm/town users must be designed to minimize wastage. It will be desirable to hold seasonal supply water in existing or new Burdekin dams prior to moving it to permeable aquifers, or, to dams covered by safe mono-layer films to reduce evaporation losses. We also see long term potential to recover and treat some of the 65million GL of stored brackish and quality water in the Great Artesian Basin. Where exit water can be balanced with natural aquifer inputs, this water can be made potable by economic "modified osmosis" technology www.modernwater.co.uk and then added to canal. Power for canal pump stations will initially come from gas engines or turbines using coal seam or basin gas available in Queensland. Gas pipeline is already in place on part of proposed canal routes and where it isn't, new pipe will be installed. In the long term, we also see potential to use wind, solar, geothermal or solar hydrogen power sources on or near route, and/or utilize the wastes from grain crops or plantations near canal to produce power and bio-fuels from proven Syngas fermentation processes.

2. b) Water source statistics:

CSIRO estimates of rainfall trends indicate N/Qld will maintain or slightly increase current patterns for 90 years, while southern regions, starting in the west, continue to dry out. Capturing water from rivers such as the Mitchell & Flinders and/or the Burdekin & Herbert could supply up to 24,000GL pa of base-load water to move south. However our aim is to take no more than 1/3rd of rivers flow (4-8000GL) before it goes to sea. A good water source point for a start off major canal would be the Burdekin Falls Dam which has a current storage capacity of 2100 GL. This dam has engineering potential to hold 7600 GL and new upstream storage sites could hold up to 17,000GL The mean flow to sea (at Clare) from Burdekin (less 1300 GL to irrigation) is 8250 GL pa. There is also potential to join the Herbert to the

Burdekin (at latitude 18-25 & longitude 114-25). By so doing, combined flow over the Burdekin Falls dam could go up to ~11,700 GL pa. Tropical areas around the world are experiencing increased climatic cyclonic activity which may explain three ~28,000 GL Burdekin flows to sea in 07/08, 08/09 and 10/11. By usage of mono-layer films to reduce dam evaporation, occasional big flows could be held over in upstream dams, to even out flows to sea, reducing concerns reef ecology will be affected by loss of first flush water.

2. c) Preliminary Route options, Costs/ returns and environment issues

We estimate the main and subsidiary canal costs of either canal route option, delivering 3750 GL of water to crops, environment flows and city dams in Qld, NSW Vic & SA would be approx $12-13 Bn each. Another lower cost option ($3.6 Bn), that could be quickly introduced is to use the Warrego river as a conduit to replace 2/3rds of canal infrastructure along the W Qld/NSW route. To introduce we would need to build solid river embankments along sections near Bourke to contain water breakouts which now spill 95% of flood- water onto plains. When introduced, water to these wetlands would be regularly delivered by pipe from river. A major challenge would be the current Warrego water resource plan, which prefers the river to occasionally flow as now. Discussion with regulators, towns & irrigators is needed. Returns from above canal options are below

- If 3750 GL pa water sold to irrigators and environment at $125 /ML to pay back main canal and operation costs, main canal only will be paid back in 20 yrs.
- If 1500 GL sold to environment at $125/ML,1550 to farms at $250/ML & 700 GL to city dams at $1.20 KL (2/3rd desal costs) gives gross investor returns of 20% pa
- If Warrego canal/river option taken, water sold at $55/ML would pay-back canal & river ops in 20 yrs. This could be a useful first off option, for future expansion.

These preliminary costs were based on USA canal construction data of material, labor, equipment and energy usage with 50 year finance provided at 2.5% interest as in USA If finance rates rise to 7.5%, canal costs will go up by 10% and delivered water cost by 5%. Arizona canal specialists can provide design detail to Thiess or Sunwater engineers, plus Boral (for concrete) and Jemena (gas pipe). All these groups have contributed to project pre-estimates but we still need funding support to further pre-evaluate factors such as,

: Route plans are spatially/geologically surveyed to ensure best fit with land and clientele.

: Ensure canal routes can economically work around flood plains and river crossings.

: Check availability of easily accessible sand and rock for on line concrete production,
: Potential of dams & aquifers to store large volumes of water and recover economically
: Suitability of land near canals to generate future plantations, agriculture and soil carbon.
: Potential of various surface cover or mono-layer techniques to reduce dam evaporation.
: Potential of low and or zero carbon technologies to produce energy and recycle nutrients
: Potential of surface mining & new lining techniques to reduce canal construction costs.
: Potential to use Warrego as year round aqueduct, while maintaining health of wetlands

Future Returns, Australia's research organization the CSIRO, has identified key forces that will shape the world. **1)** We live in an increasingly food in-secure world, **2)** We live in an increasingly urbanized world, and **3)** We live in a future carbon constrained world. N/E Qld seasonal water can play a part in adjusting to these challenges in S/E Australia. By capturing and distributing water to a Central Qld-NSW route crossing major rivers in the MDB we can provide a more reliable source of water to top up rivers and wetlands in dry periods than water buy backs have so far demonstrated. By infiltrating water to a landscape set up for carbon farming principles we can improve water retention, fertility and create a bank of soil carbon offsets. Thus when we look at delivering 3750 GL water 20% to city dams, 40% to environment, and 40% to irrigators, 20% gross returns to a Federal PPP could come from savings, water margins, taxes from sales to irrigators, city dams, bio-fuel & power production, carbon offsets, plus reduced need for drought relief. GDP multiplier benefits of $30bn and 7% carbon reduction are also projected. (back up data available). By supplying top up water to rivers flowing west, we can protect key MDB wetlands etc. While protecting the environment is important, it has to be paid for and there are large revenue earning projects under consideration which could benefit from new water. Coal and coal seam gas projects proposed in the Qld Gallilee basin and the Darling Downs, both need water and could benefit from agricultural carbon offsets. As the country again begins to dry out, SA & Vic will be most in need of new water. If environment approvals are obtained for the "Warrego canal "option, this could quickly improve major water availability to these states as well as benefitting western Qld and NSW canal and river communities on line. Irrespective of routes chosen, all canal ops costs would include a $5/ML credit to QLD catchment authorities for water delivered.

2 d): Environment issues

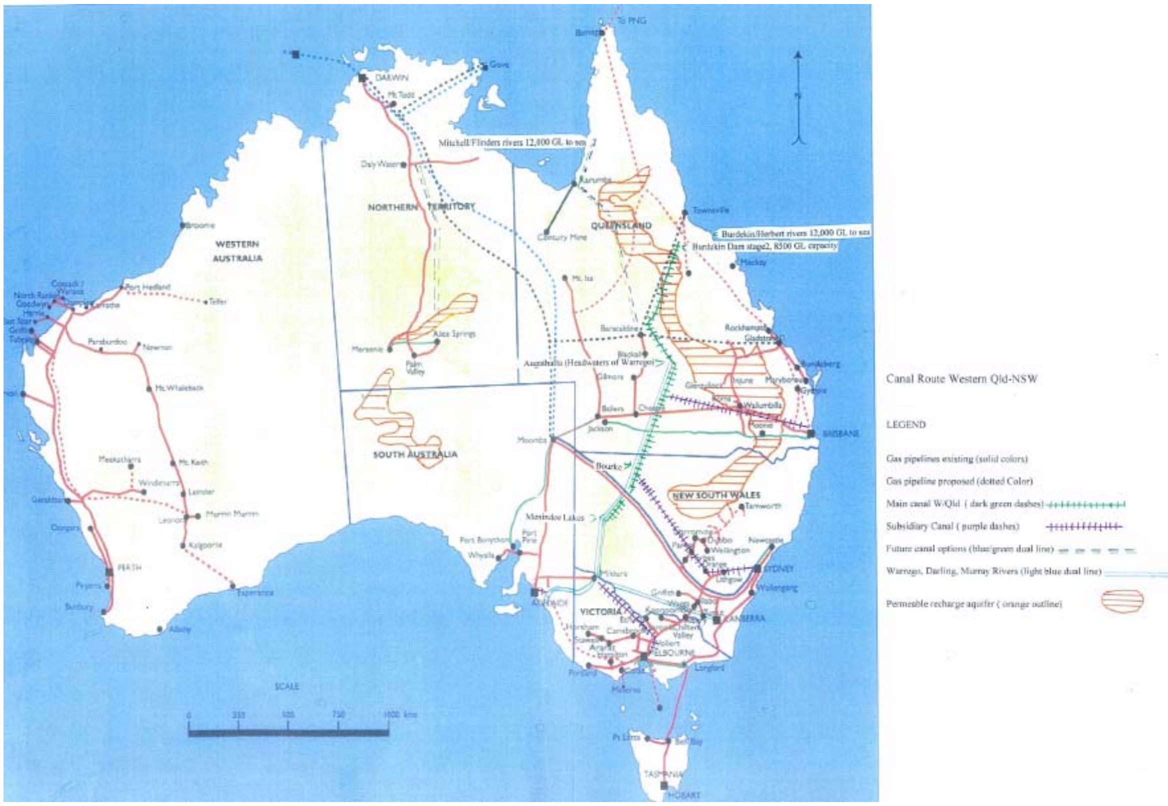
Water Services Australia projections of future need for 1.5 trillion litres (1500 GL) of desalinated urban water and Wentworth group projections of 4200 GL of water to sustain the Murray Darling Basin are so high, that a N to S transfer of northern water now going to sea must be considered an option, provided, the ecological impact of doing so is minor. All the source N/E QLD rivers under consideration carry agricultural silt which infiltrate tributaries of the Barrier Reef Lagoon. Diverting 4000 of the 29,000 GL pa mean flow of all rivers to sea over the reef, should part reverse this impact, with little effect on ecology.

Canal Design factors to protect environment

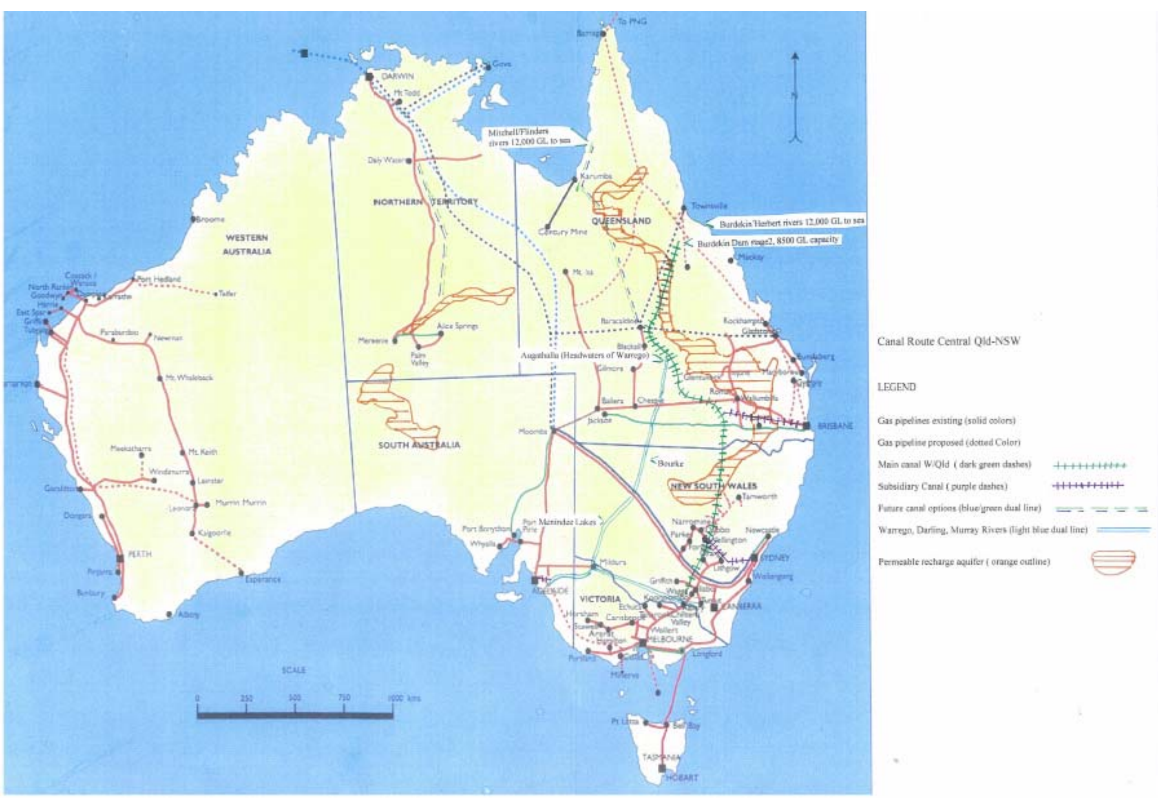
Arizona canal groups in the USA who we suggest could oversee our project have been working to tight USBR environment controls on multiple installations. Energy to move water a long distance is a major cost and emissions factor and we have selected a route to minimize lifting, while still providing ease of water distribution to online users. Where practical, stock routes will be used to reduce easement costs, while still providing user benefits. Unsealed roads will be on canal embankments and fences built on either side. Needed cross-roads and animal crossings will be built into the design. Radial gate flow structures on canal will control water levels and when needed, isolate canal sections to allow drainage and repairs. Cross stream flow will be directed by levees & contouring into canal cross- drainage structures. Inverted siphons and/or bridges will be used to cross large rivers and streams. Out-turns will direct water to subsidiary canals, pipe, rivers etc.

Integration of water with multi-basin carbon reduction innovations

Over the years there has been much criticism of the role of indiscriminate water usage on the past deterioration of the MDB. We have learnt many lessons from this and see large potential to integrate water transfer and usage with carbon farming techniques that will improve water retention, rehabilitate landscape and control salinity. Cane toads & Tilapia fish can be removed by filtration, and dry/hot southern climates will stop toad movement. Items 4- 8 describe how new water, integrated with agriculture can improve land fertility that lead to carbon offsets that could cut total Australian carbon emissions by up to 7%pa.



Canal route western Qld-NSW



Canal route central Qld-NSW

3.) Solar and renewable power

Studies of future PV opportunities indicate arrays over or beside a canal could generate power needs. Day solar power can be stored by holding water in elevated dams and metering it out at night, or, by running water through solar electrolysers and converting it to hydrogen. The use of PV solar arrays over the entire canal could potentially generate 2.0 Gw of base load power. When combined with potential for up to 0.9Gw of hydro power from stored Burdekin dam water, future power from crop biomass and reduction of power needs for desalination on the coast, a proposed N to S water project could also become a major generator of renewable power and carbon offsets

4. USA canal experience:

For over 100 years the United States Bureau of Reclamation have been building concrete lined trapezoidal canals to recover seasonal river water from melting snow and moving it thru suitable land to make it profitable for agriculture and industry. Most USA canals have been financed by the Feds at 2.5% interest rates on condition that “user-pay” water charges are to recoup capex and operating costs over 50 yrs. By opening this land, canals have led to the development of W/USA cities such as Los Angeles, Tuscon, and Phoenix, plus associated industries, to which they still supply water. Canal construction costs are less than pipe for equivalent volumes and transmission loss from evaporation & seepage when run thru 600km of the Arizona desert at 100Km/day, are repeatedly found to be rated at approx 4% per 1000 km of transit. Canals are easier to maintain than pipe which can have air supply problems during inspections, also, unlike pipe, they can be upgraded in volume flow as demand develops. As demand for water in Western states of USA has begun to exceed supply, authorities have begun saving seasonal water, excess to needs, by storing same in aquifers along canal routes. Water charges to growers along canals are currently around $60/ML but can be as low as $30/ML when subsidized by hydro-power or higher city water charges (when applicable). Use of centre pivots etc, to minimize farm water usage, can add ~$50/ML to growers from Capital/ Power/ R&M costs. Problems of algal development in canals have been solved by usage of sterile fish to eat algae and weed. Benefits from new canal infrastructure in eg Arizona USA has seen a doubling of the population to 7 million over 25 yrs from agriculture, industry and economic growth. This illustrates importance of water, when proposing regional development in Australia.

5. Market Opportunities:

With large demands coming out of N/Asia for agri-commodities, bio-fuels and mine resources both agriculture and mining should continue to be industries of major focus. Below is an overview of economic and environmental benefits that can be made possible from making new water available.

6. a) The Murray Darling River's needs for 1500 GL of environmental flows: Based on historical sales high security water would cost ~$2800 /ML or $280 on a 10% return basis. If Government financed canals as suggested, the delivery charges for environment water @ $128 /ML would be approx 50% less and could save $230 mill pa. This is a cost effective option to buying out water rights whose volume may reduce as climatic drying takes hold. Water right buyouts can lead to loss of towns, no longer supported by farms.

6. b) Sell water from coastal dams at prices below costs of desalination. ie $1.20/KL Estimates indicate water delivered by canal/ pipe to city dams, could average ~$0.30/KL

6. c) $100bn pa grain and fuel sales from new water, to supply world markets:

The GRDC are projecting by 2020, grain output of 100 million TPA could come from value added areas of demand such as ethanol, starch, feed concentrate, meat substitutes etc. The main requirement to grow a quarter of this volume, is a temperate climate and reliable rainfall and/or irrigation water. If a North to South 7500 GL pa canal system as described above, was set up to irrigate 3.2 million ha of land with new irrigated wheat varieties yielding 9T/ha (6T in north -12T in south) it could produce 26 mill T of wheat. (ref- S Kearns GRDC). With variable growing costs of $2000/ha (inc'l $750 for water) and a grain price of $350/T, the crop could generate $9.1bn pa revenue and $3.0bn pa of grower margins. It is possible to concurrently recover 12T/ha of straw from above crop while retaining stubble. This could be converted to 12bn litre of ethanol & generate 7.5 million Mwh of base load power. Ethanol sold at 70c/L would generate $8.4bn revenue, (60% of our fuel demand) giving a $3.4bn margin. To meet larger demand, more canals sourcing water across the top end from Qld toWA would be required. While these plans are ambitious, as Asia urbanizes grains and bio-fuels will become higher value export items. Taxes at 30c/Dollar and GDP multiplier effects will create large economy benefits. By rotationally growing other grains, legumes or camelina (an oil seed for bio-diesel crop which double crops with wheat) we can potentially develop up to 150 million TPA of CO_2 carbon offsets coming from soil carbon, energy and bio-fuels. These offsets could be useful in protecting coal mining and other large CO_2 emitters from carbon charges. If plantings could be expanded using water further west, they could offset all our emissions.

6. d) Ethanol , Bio-diesel, Hydrogen

Projections are by 2015, $30 bn of Australia's trade deficit will be due to oil imports. We plan to introduce a proven ethanol from cellulosics technology via www.brienergy.com. This syngas fermentation technology can produce ethanol and power from carbonaceous feed-stocks such as waste plastics, straws and MSW. It also can recycle essential P and K crop nutrients in a ash form, (a solution to peak phosphorous concerns). NSW has already mandated introduction of ethanol into fuels and by 2012, it will reduce costs to motorists by allowing purchase of a lower cost E10 fuel with lower carbon charges. Cars can be fitted in NSW with a $350 fuel conversion kit to use regular fuel or purchase E85 fuel at approx 2/3rds the current cost of regular fuel. (yesterday's cost, who knows tomorrow?)

Oil from tree seeds is possible in northern regions. www.pacificrenewableenergy.com.au Pongamia Pinnata oil can be processed into diesel, growth will generate carbon offsets.

Opportunities are developing to produce oil from algae grown in covered ponds, channels or clear pipes. A USA group www.phycobiosciences.com have Arizona demo projects growing high protein algae in channels for stock feed &/or bio-fuels, using grow systems designed to fit in with regular farm equipment & expertise. System now going into China.

Solar hydrogen from water is a developing technology. Low carbon power over or beside proposed canals could generate up to 2.0 Gw of future zero or low carbon power or fuels

6. e) Meat: $revenue traditionally triples the value of grain used to lot feed animals. As populations in Asia urbanize a 80% increase in world meat demand by 2030 is expected. The methane ex cattle/sheep is responsible for 18% of our GHG. We should reduce meat usage, but its amino acids are important to health. More intensive cattle feed-lot shedding and effluent plant can be designed to capture methane and use it for dairy power. Cereal based meat substitutes, poultry, pork and even kangaroos, do not produce methane output

6.f) Dairy Farmers in recent dry periods have found it less expensive to feed cows grain than on pasture grown using expensive irrigation water. Dairy farms could triple feed /Ha while halving water usage /litre of milk by using intensive farming systems to grow grain for feed**. (see7.0),** US grain fed cattle tend to yield 2 times more milk per cow than ours. Demand for dairy products and stock is already high and expanding in China particularly.

6. g)Wine& Fruit: Low water allocations in NSW, Vic & SA grape districts put $3bn pa of wine exports at risk. Many in this industry are now looking at how to tap into huge markets in Asia. Many vignerons desperate from prolonged drought are selling water rights at low prices.

6. h) Mallee Eucalypts to control salinity, sequester carbon & produce industry products: Mallees are a fast growing local tree that survives in dry conditions of 125mm rainfall or can yield 10 dry T/ha/yr in 550mm regions. Growth will taper off, when not harvested at 4 YO maturity. They are grown to sequester carbon & mallee alleys are used to lower salinity in WA wheat cropping areas. By harvesting coppiced tree tops 1 in 4 yrs on plantations, irrigated with 7500 GL water, we could produce biomass for 20% of Australian base power needs or 55% of our liquid fuel needs (via ethanol). By growing without harvesting they could sequester 10% of Australian carbon emissions. Other uses of harvested wood are for panel board products, or to extract lignin via a solvent paper pulping process to

be used as a binder for production of carbon fiber suitable for light weight car panels, competitive with steel. Fiber can reduce car weight by up to half and Nissan and Honda are planning to go this way within 8 yrs. Pyrolysis systems can convert mallee biomass into bio-char and bio-fuel. The fuel can be used to generate turbine power and the char can be usefully added to soils to improve long term fertility. Bluescope steel say Bio-char can also be used now as a 33% substitute to coke when converting iron ore to steel, (Brazilians are already doing so). 100% coke substitution is possible from stronger chars adapted to suit blast furnaces. In the long term char could also be used to convert high temperature CO2 emissions from industries such as cement and shale oil into carbon monoxide and then to ethanol. Wood char may be a substitute for CO2 geo-sequestration from coal if it fails to gain acceptance in Asian economies . It is worth noting that power plants in central NSW are now growing mallees to test coal replacement in power plant.

7:) New Mining sites

Qld,-uranium, shale oil, zinc, copper, rare earths, gas, coal **SA –** uranium, gold, copper **NT-** uranium, gold, phosphates, rare earths. **NSW**: coal. All require water for viability and all can benefit from future carbon offsets derived from agricultural soil carbon etc.

NEW DEVELOPMENTS

8:) Bush-fires need to be put out while still small. NASA in conjunction with USA forest services has devised systems to use unmanned air vehicles (UAV's) or high flying drones fitted with cameras to transmit fire images to base and quickly direct water bombers to pick up water in dams located on roads in fire prone regions. Water needed for these dams can be moved from canals by tankers off season. Bushfires are known to markedly reduce water output from burnt catchments, while increasing output of carbon emissions. The CFA in Vic are reviewing UAV's, concerns are coming from the aviation industry.

9.) Soil fertility& soil carbon offsets (CSIRO Research projects now underway to validate)

Many broad acre farms in the <u>southern half</u> of Australia are swinging over to "no-till/liquid fert" pasture farming techniques to grow crops and feed livestock on same land. Wheat when planted in cooler months out-strips growth of below foliage, shading it as a competitor. In a few seasons grain yields return to normal as a result of improved soil carbon, water retention and fertility. Vic growers are improving yield on duplex soils by using an initial cultivation technique that does not disturb top soil, when adding gypsum and nutrients into the clay base. They then stabilize soil with a perennial rye grass. Irrigators using this technique are dramatically increasing crop yields while sequestering soil carbon at rate of 30 T CO2e/ha/pa. Providing the land is not compacted this technique has potential to rehabilitate land, improve yields and generate large carbon offsets. With a future need to consider recycling of crop nutrients such as phosphate fertilizers, intensive carbon farming techniques, in conjunction with adequate irrigation and recycling of crop wastes, offer potential to re-vegetate land, improve crop yields, recycle nutrients, while reducing GHG.

10.) National Broadband Network and Other Services Canal infrastructure, controlled by fiber, could provide low cost communications in regions within vicinity of canal. We estimate 40 towns (population 270,000) could be joined with optical fiber broadband to improve medical, educational and business services, with wireless provided to town folk. Services such as communications, water, power and transport will ne needed to develop regional industries that attract people away from working in over populated coastal cities.

11.0: Zero carbon energy is being looked at around the world mainly based on using solar power to split H2 and O2 from water. New electrolyzing catalysts are being used to increase conversion efficiency to enable economic hydrogen to be stored for power generation or usage as a fuel for fuel cell driven vehicles. The early introduction of this technology is expected to be home PV powered systems. Large scale introduction is possible where high solar input and water is available, and power easily distributed. Our proposed water transfer project is ideally located to produce up to 2 Gw power for canal power and grid. Economic usage of H2 in fuel cell driven vehicles or power outlets will expand when alternates to expensive platinum electrodes become available. Some USA groups are well advanced in hydrogen power and fuel plant, eg - www.suncatalytix.com

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12.0 Vortex power. A local group www.kourispower.com and others in Austria have been successfully testing the potential to use the rotational kinetic energy of the earth, ie Coriolis force, to generate hydroelectric power. (a simple application of this can be seen in water turning as it goes down plug hole) What interests us with this technology is the predicted potential to produce about 27Mw of power from a 30m wide vortex chamber which we see as fitting in well with our canal design parameters to power canal pump stations. The predicted power with low fall applications could also be useful for a wide range of energy applications such as an alternate to a hydro plant on the Burdekin river

13.0 : Supermarket to Asia. We have 300 million potential consumers on our northern door step. If we can set up to produce quality food, fuels, power they need, at an affordable delivered cost this could be a sustainable future market. To make it happen, retailers need to evaluate the potential market and cost to set up effective supply chains. The main difficulty growers and food processors have now in setting up export markets is related to variable annual outputs from variable rainfall. Providing adequate water is available and power, transport and communications adequate, potential to supply dairy, meat, fruit and vegetables is possible. A 1-2 day delivery service to S/E Asia could come from fast moving refrigerated catamarans leaving from the Karumba port on the Qld Gulf

14.0: Project advancement

T Bowring and Associates wish to use our international experience and contacts in agri-food development, crop planning, manufacturing and engineering to establish the cost benefits of a N to S water transfer project to expand our economy. We see introduction via a federal government funded PPP as the most likely way forward and will be seeking further expressions of interest from a range of government and current industry bodies to evaluate in more detail issues that still need resolution (see item 2c & new developments)

T Bowring (Director)

T Bowring and Associates Pty Ltd,