GHD Advisory

Emu Swamp Dam Final Feasibility Stage 1 Report

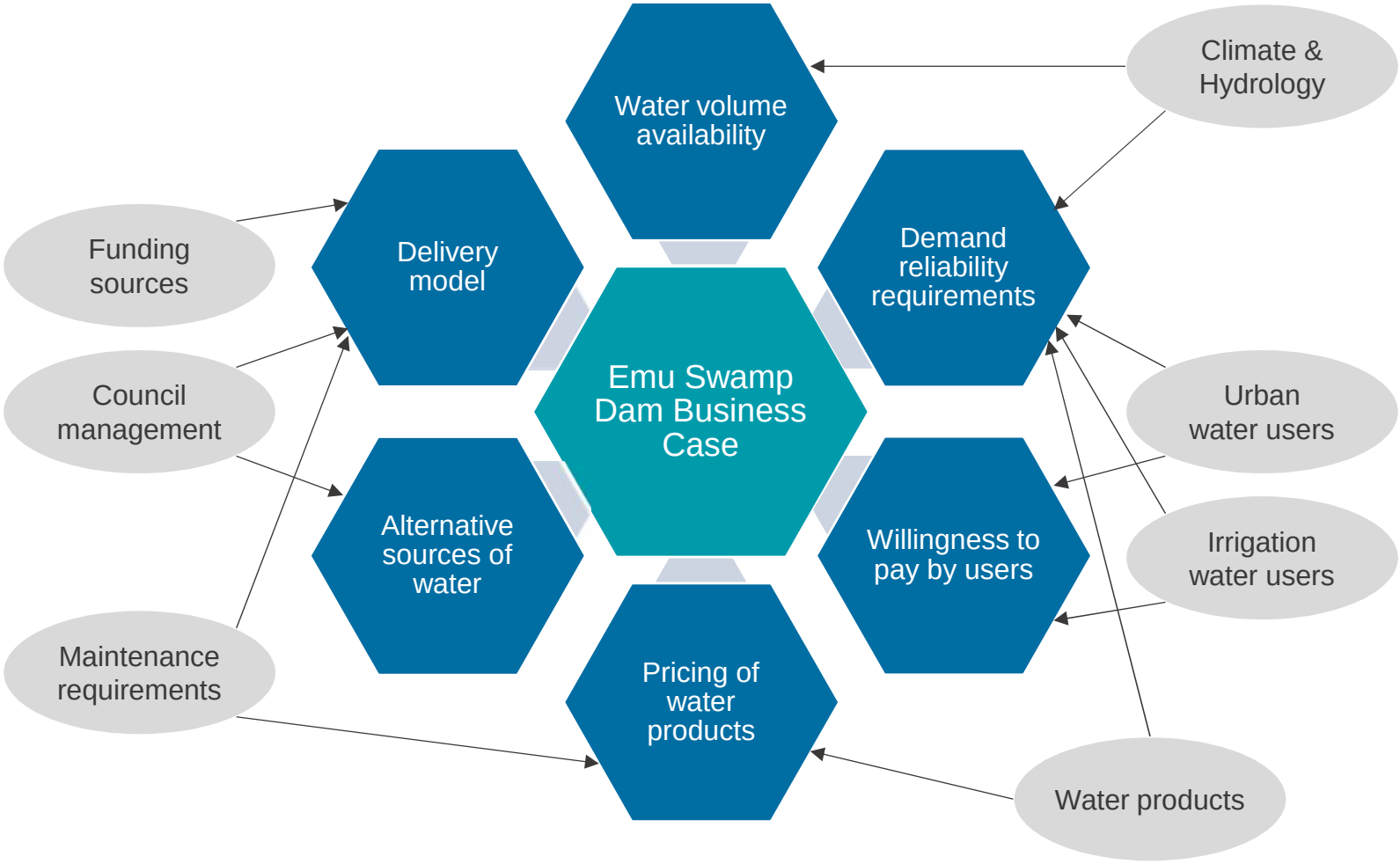
Presentation

31 July 2017

GHD Synergies

Introduction and Background

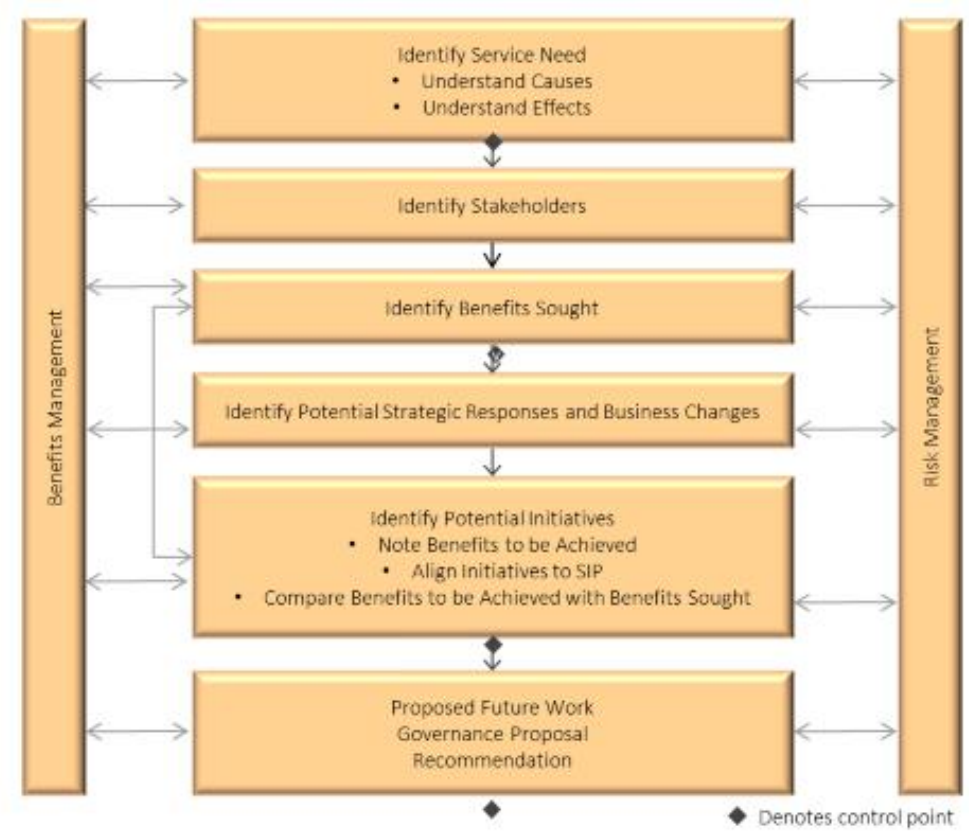
Key influences on the business case



Strategic Assessment – Identify service needs, benefits & stakeholders

Project initiation & planning | Investment logic mapping | Stakeholder engagement strategy | Document review & gap analysis | Water demand assessment | Water availability analysis | Infrastructure assessment

Strategic business case flow chart



Building Queensland business case development framework requires:

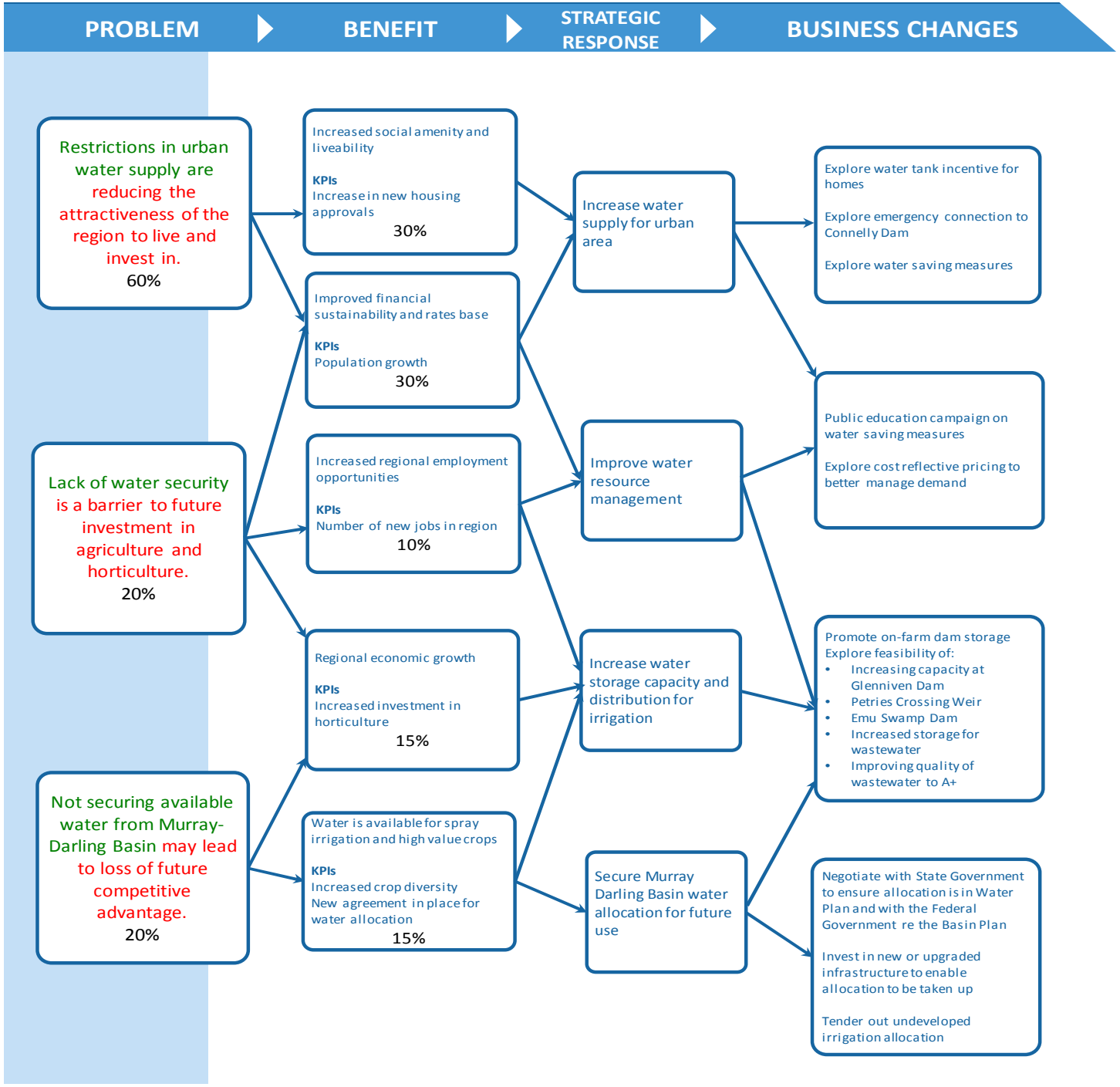
- ✓ Need assessment
- ✓ Options assessment to meet needs covering:
  - Do nothing
  - Non-major infrastructure
  - Major infrastructure

Earlier assessments reversed this:

"A solution looking for a problem"

Service need and context

- ✓Southern Downs Region is an important agricultural area, seeking economic growth in the agribusiness and tourism sectors
- ✓It has available land and good transport connections to major population centres
- ✓Earlier reports and stakeholder consultations identified water security in Granite Belt as a constraint on economic growth. As with most of South East Queensland, Stanthorpe has been subject to water restrictions: Extreme (140 L/d/p target) during the 2006-2009 drought
- ✓Slow population growth (0.4% per annum) has moderated urban demands for water
- ✓Urban consumption (under Permanent Restrictions) higher than SEQ – no water conservation measures in place
- ✓Agriculture is the main source of employment; income analysis indicates little ability to absorb increases in water service costs
- ✓Any downturn in agriculture due to extended drought likely to impact employment and wider economy in region
- ✓Identification of viable options to meet urban and irrigation needs key to regional economic sustainability.


PROBLEM
BENEFIT
STRATEGIC RESPONSE
BUSINESS CHANGES
Restrictions in urban water supply are reducing the attractiveness of the region to live and invest in.
60%
Lack of water security is a barrier to future investment in agriculture and horticulture.
20%
Not securing available water from Murray-Darling Basin may lead to loss of future competitive advantage.
20%
Increased social amenity and liveability
KPIs
Increase in new housing approvals
30%
Improved financial sustainability and rates base
KPIs
Population growth
30%
Increased regional employment opportunities
KPIs
Number of new jobs in region
10%
Regional economic growth
KPIs
Increased investment in horticulture
15%
Water is available for spray irrigation and high value crops
KPIs
Increased crop diversity
New agreement in place for water allocation
15%
Increase water supply for urban area
Improve water resource management
Increase water storage capacity and distribution for irrigation
Secure Murray Darling Basin water allocation for future use
Explore water tank incentive for homes
Explore emergency connection to Connelly Dam
Explore water saving measures
Public education campaign on water saving measures
Explore cost reflective pricing to better manage demand
Promote on-farm dam storage
Explore feasibility of:
• Increasing capacity at Glenniven Dam
• Petries Crossing Weir
• Emu Swamp Dam
• Increased storage for wastewater
• Improving quality of wastewater to A+
Negotiate with State Government to ensure allocation is in Water Plan and with the Federal Government re the Basin Plan
Invest in new or upgraded infrastructure to enable allocation to be taken up
Tender out undeveloped irrigation allocation

Review of Earlier Reports

Review of previous reports

- ✓More than 100 previous reports reviewed covering preliminarily options assessments, stakeholder consultation and demand projections
- ✓Emphasis predominantly on Emu Swamp Dam as preferred solution hence Emu Swamp Dam option extensively evaluated, most other options
- ✓Analysis undertaken at a high (pre-feasibility) level
- ✓Cost estimates for dam infrastructure (including in EIS) low, estimates for reticulation system and operating costs reasonable
- ✓Other than for Emu Swamp Dam, limited assessment of:
  - Hydrological and engineering issues
  - Risk and limitations of options
  - Comparative costs across options
- ✓Basis of assessment e.g. water yield for different options differs between (and within) reports
- ✓Difficult to undertake a robust options assessment with existing data

Stakeholder Consultation and Water Needs Assessment

Stakeholder consultation and metrics

✓Stage 1 (Strategic Business Case) informed through a structured process of engagement with irrigators, industry local businesses and broader community.

- Project website established and social media used to encourage participation
- 2,551 people reached through Facebook information sessions with 86 engaging in update pots
- Community announcements broadcast over radio and newspaper editorials run to inform of consultation events and encourage participation
- Information sessions held in key regional centres and email updates provided. 40 attended in Stanthorpe, 10 in Warwick
- 150 businesses completed a telephone survey
- 137 irrigators approached directly by email and telephone using stakeholder lists provided by SDRC and Stanthorpe and Granite Belt Chamber of Commerce and invited to take part:
  - On-line survey – 12 responses
  - Focus group sessions – eight irrigators took part
  - One-on one meetings/telephone discussions – further eight irrigators & agri-businesses took part

Stakeholder consultation – key outtakes

- ✓Under half of businesses taking part in telephone survey indicated that water security was impacting on economic development
- ✓Main response from residential stakeholders at information sessions:
  - concerns around increasing rates and water charges
  - concerns about inundation for Emu Swamp Dam and requirement for certainty
- ✓A number of irrigators at information sessions expressed an interest in bidding for water allocation and developing on-farm storage
- ✓Irrigator on-on-one and focus group response detailed later

Water planning and availability

- ✓Water resource planning is governed under the Queensland Water Act (2000) and the Border Rivers Water Plan (2003)
- ✓The Border Rivers Water Plan identifies unallocated reserves in the Stanthorpe Water Management Area of:
  - 3,000 ML/annum for irrigation;
  - 1,500 ML/annum for town water supply.
- ✓A specific proportion of this strategic reserve for Emu Swamp Dam has been established:
  - 1,750 ML/annum for irrigation
  - 750 ML/annum for town water supply
- ✓These unallocated reserves may be reviewed in the upcoming 2019 plan
- ✓Current moratorium on additional ground water harvesting (currently estimated at 20,700 ML/annum is also likely to be reviewed in the development of the 2019 plan

Urban water demand assessment

✓Updated metrics of population growth and consumption used:

- 0.95% per annum population growth (conservative figure – actual growth has been 0.4%)
- Recent consumption figures of 324 L/c/d used
- Assessment of new dwelling construction connected to potable water reticulation system as opposed to new acreage build off the water grid
- No water conservation measures assumed

✓Forecasts compare favourably with recent DEWS forecast

- Projecting 844 ML/annum demand by 2050

✓Using updated (extended IQQM yield assessment for Storm King Dam:- 600 ML/annum at 98% monthly reliability:

- Demand exceeds supply by 2036
- Approx. 250 ML/annum shortfall by 2050

Do nothing is not an option for meeting future urban water supplies

Irrigation and Industrial Water Demand and Economic Return Assessment

Approach to assessing irrigation demand

Key objective: for those crops identified as likely sources of demand, estimate the net financial return from the use of additional irrigation water ($/ML) by modelling the financial impact of increased irrigation water use at the farm level

- Important to note that there are a range of factors' impacting on producers' willingness to pay for water – this approach provides an indication of the upper limit

- Demand is assessed separately for:
  - Application of additional water to existing crops, either to increase yield or protect against loss of yield or quality during 'dry' years
  - Use of additional water to expand the area of irrigated crop production

Key steps:

1) **Establish current water supply-demand situation**
2) **Review financial crop production information**
3) **Consultation with producers**
4) **Develop farm-level financial models**
5) **Develop demand forecasts and scenarios**

How our approach differs from past assessments

- Range of approaches to assessing irrigation water demand:
  - Assessing water market data
  - Willingness to pay surveys
  - Farm-level financial assessments

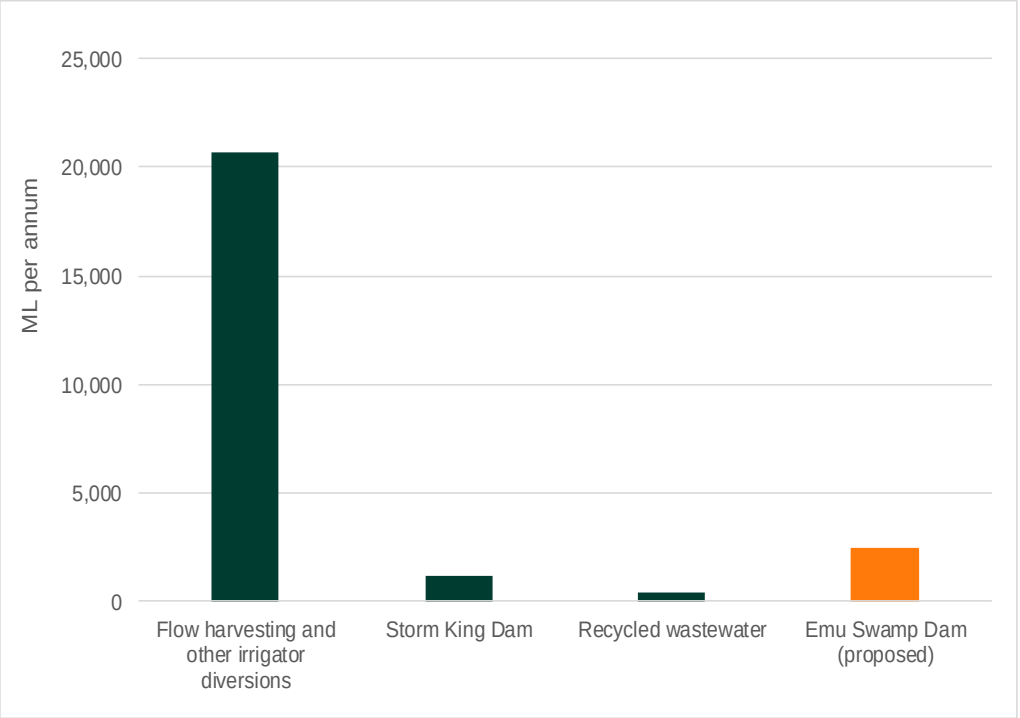
- Previous assessments have used high-level surveys to derive an overall picture of the level of demand for water and producers' willingness to pay
- Most recent assessment was an internet-based survey of 19 producers – identified total demand of 1,210 to 1,325 ML

- The pitfalls/gaps of past assessments :
  - Survey instruments have not been robust
  - Estimates based solely on anecdotal information provided by producers
  - Insufficient information on which to base an investment decision

- How our approach differs:
  - Incorporates information from producers into financial modelling to provide robustness in terms of the on-farm return to irrigation water use
  - This provides valuable information in terms of the value of water to producers which informs an assessment of their capacity to pay

Current irrigation water supply and use

- Producers reliant upon on-farm storages and harvesting of overland flows and near-surface groundwater
- Emu Swamp Dam would result in relatively marginal increase (estimated at <10%) in total irrigation water use
- Additional water would be used to top up existing storages to cover dry periods and/or for incremental expansion by existing producers
- Significant variability in irrigation application rates across crops produced in the region (3 to 12 ML per hectare)
- Access to suitable land is unlikely to represent a constraint on the expansion of production



***KEY POINT*: Marginal increase in total water use by producers and land available to established producers means additional volumes will be taken up by established producers as opposed to greenfield producers.**

Consultation with producers

- Consultation with producers was undertaken through three streams:
  1) Focus groups with producers to discuss implications of increased water availability
  2) Internet-based survey to obtain information on demand for additional water, crop production, yield estimates, irrigation application rates, and impact of increased water availability
  3) One-on-one telephone interviews with producers over the duration of the consultation period

- Key findings from the consultation process:
  - Water availability a significant constraint on the expansion of crop production, particularly for tomatoes, strawberries and strawberry runners
  - Market factors are the other key constraint, particularly for apples, other three fruits, wine grapes and a range of vegetable crops
  - Consistent with the results of the 2013 Agricultural Land Audit, producers have access to additional land for the expansion of crop production
  - Additional irrigation water would be used to supplement existing irrigation water supply sources (i.e. on-farm storages) rather than to underpin greenfield developments
  - Strong demand for additional irrigation water for a wide range of crops (apples, tomatoes, strawberries, wine grapes, strawberry runners, green vegetables and specialty crops)
  - Water shortages resulting in reduced application of irrigation water negatively impacts on crop yields, particularly for apples and wine grapes

‘Annual’ vs ‘permanent’ crops

- Models were developed for selected crops based on:
  - Review of available information on crop production and water use
  - Outcomes of consultation with producers

- Crops included in the analysis can be separated into two categories – ‘annual’ crops and ‘permanent’ crops

Category	Examples	Key considerations
Annual crops	Tomatoes, capsicums, green vegetables	• Producers are able to vary levels of production over the short term • Production decisions are made periodically taking into consideration a range of factors including market circumstances and water availability
Permanent crops	Apples, wine grapes	• Require significant up-front capital investments with minimal scope to vary production levels over time – capital costs must be recovered over the lifetime of the crop • Access to high reliability over the long term is very important – producers must have access to a minimum volume of water to maintain permanent plantings

Crops modelled

Crop	Use of additional irrigation water
Apples	Predominantly for increased water security for existing crops in addition to small scale incremental expansion of cropping area
Tomatoes and capsicums	For the expansion of crop production, predominantly for tomatoes
Strawberries	For the expansion of crop production
Wine grapes	Predominantly for application to existing crops, but also to facilitate small scale expansion of crop production
Strawberry runners	For the expansion of crop production

Note: It is acknowledged that producers of other crops may purchase additional volumes of irrigation water were they to be made available, however based on the review of documentation and consultation with producers, producers of these crops are likely to account for the vast majority of demand for additional irrigation water

Example crop model: apples

Parameter	Measure	Estimate
Yield	Tonnes/ha	55
Irrigation application rate	ML/ha	5.5
Farm revenue		
Price	$/tonne	$1,800
Operating revenue	$/ha	$99,000
Farm operating costs		
Pre-harvest costs	$/ha	$30,000
Irrigation costs	$/ha	$2,750
Harvesting and post-harvest costs	$/ha	$33,000
Total variable growing costs	**$/ha**	**$65,750**
Gross margin per hectare	**$/ha**	**$33,250**
Gross margin per ML	**$/ML**	**$6,045**

Benefits of use on existing crops

Crop	Likelihood of use for existing crops	Rationale
Apples	High	• Significant reductions in yield and quality as a result of water shortages • Producers expressed strong interest in securing additional water for use in dry years • Limited flexibility to alter year-on-year production due to need to protect permanent plantings
Tomatoes and capsicums	Low	• Producers scale production based on water availability due to significant planting costs, ability to alter production levels and importance of maintaining crop quality and yield • Rather than reduced yields, lower water availability manifests as reduction in area of crop production
Strawberries	Low	• Production is high cost and water-intensive – important that water security is maintained • Additional water would be sought primarily to expand area of production
Wine grapes	High	• Significant variation in irrigation application rates across producers – some producers would seek additional volumes to increase yields or to protect vines in dry years
Strawberry runners	Low	• Producers scale production based on water availability due to the need to meet yield and quality requirements – producers would therefore seek to expand area of production
Green vegetables	Medium	• Water could be used both to avoid yield losses for existing crops and to expand crop area

Potential for expansion of cropping area

- Important to note that water is only one of several factors that can constrain the expansion of crop production. Other key factors:
  - Availability of suitable land
  - High up-front costs
  - Market factors, in particular insufficient demand or inability to access markets

Crop	Likelihood of expansion	Rationale
Apples	Low	• Market factors are the primary constraint on apple production
Tomatoes and capsicums	High	• Water availability is the key constraint on the expansion of tomato production – producers estimated that production could increase by 20-30% without a reduction in price
Strawberries	Medium	• Whilst water is a constraint, market factors are also now a constraint on production – expansion anticipated to be incremental
Wine grapes	Low	• Market factors are the key constraint on wine grape production, noting some producers may look at incremental expansion, particularly for new varietals
Strawberry runners	High	• Water is the primary constraint on production. Subject to it being addressed, producers advised that production could expand by 20-30%
Green vegetables	Low	• Based on anecdotal information from other crop producers, any expansion in production of these crops will be limited to incremental expansion by some producers for specific crops

Modelling of returns from use on established crops

- For some crops, producers would use additional irrigation water to maintain yield and product quality during ‘dry’ years
  - Mostly for ‘permanent’ crops where producers have limited control over their scale of production over the short term (i.e. apples and wine grapes)

- Steps to modelling return to irrigation water from this use:
  - Through consultation with producers, determine the impact of a shortfall in water application rates during a ‘dry’ year on crop yield/quality (e.g. for apples, determined through consultation that average loss of revenue due to lower yield or quality in ‘dry’ years was ~15%)
  - Apply to crop models to determine the impact of a ‘dry’ year on gross margin per ha, taking into account loss of revenue and changes to growing costs
  - Based on this estimate, determine the loss of revenue that can be avoided in a ‘dry’ year by having access to additional ML of irrigation water
  - Apply the incidence rate for ‘dry’ years to determine the average annual value of each additional ML of water
  - Apply a discount rate to determine the total return from the additional ML of water

Modelling of returns from expansion of crop production

- Producers would also seek access to additional irrigation water to expand crop production
  - This use applies to both permanent and annual crops

- Steps to modelling return to irrigation water from this use:
  - Identify, through review of past studies, available documentation and consultation with producers, the extent to which additional irrigation water would facilitate the expansion of crop production within the dam footprint
    - Apples (5%)
    - Tomatoes (60%)
    - Strawberries (15%)
    - Wine grapes (5%)
    - Strawberry runners (25%)
  - Using crop models, estimate the gross margin attributable to each ML for new cropping area
  - Apply estimates for the cost of establishing new crops (e.g. $100,000 per ha for apples) and the average lifetime of new crops and other capital equipment (e.g. irrigation pumps)
  - Derive an estimate for the net annual return from newly established crops, both on a per hectare and per ML basis
  - Apply a discount rate to determine the total return from additional ML of water used to establish new crops

Modelling results – per ML returns

Crop	Approx. area in dam footprint (ha)	Total return for existing crops (PV per ML)	Total return for new crops (PV per ML)
Apples (low water security)	1,202	$44,000	$34,000
Apples (high water security)		$26,000	
Tomatoes and capsicums	65		$38,000
Strawberries	160		$55,000
Wine grapes	170	$21,000	$25,000
Strawberry runners	170		$13,000
Green vegetables	500	$26,000	$31,000

- Areas of production are approximations only based on updated work completed by Orchard Services
- For apple producers – 'low water security' refers to those producers that currently have lower levels of water security and are therefore more susceptible to water shortages ('high water security' producers are less susceptible)
- Returns for green vegetable production were modelled based on an average of various crops for which gross margin estimates were available

Modelling results – total demand

Crop	Additional demand for existing crop production		Additional demand for new crop production		
	Per ha	Total demand	Additional production	ML/ha	Total demand
Apples (low water security)	0.55 ML	330.5 ML	60 ha (5%)	6.05	363.5 ML
Apples (high water security)	0.55 ML	330.5 ML			
Tomatoes and capsicums			39 ha (60%)	6.05	236 ML
Strawberries			24 ha (15%)	8.80	211 ML
Wine grapes	0.53 ML	45 ML	8.5 ha (5%)	1.93	16.5 ML
Strawberry runners			42.5 ha (25%)	11.00	467.5 ML
Green vegetables	0.5 ML	125 ML	25 ha (5%)	5.50	137.5 ML

- For wine grapes and green vegetables, assumed that only 50% of producers will demand access to additional irrigation water for existing crops
- Above estimates indicate following total demand for irrigation water:
  - 2,000.5 ML for all crops without green vegetables
  - 2,263 ML for all crops including green vegetables

Merit order of demand for Emu Swamp Dam

Use	ML used	Cumulative ML supplied	Total returns (Present Value)	Cumulative returns (Present Value)
Strawberries – new crops	211.2	211.2	$11.71 m	$11.71 m
Apples – existing crops (lower security)	330.6	541.8	$14.46 m	$26.17 m
Tomatoes – new crops	236.0	777.7	$9.07 m	$35.24 m
Apples – new crops	363.6	1,141.3	$12.32 m	$47.56 m
Apples – existing crops (higher security)	330.6	1,471.9	$8.67 m	$56.24 m
Wine grapes – new crops	16.4	1,488.2	$0.41 m	$56.65 m
Wine grapes – existing crops	44.6	1,532.8	$0.93 m	$57.58 m
Strawberry runners – new crops	167.2	1,700	$2.11 m	$59.69 m

- Merit order of demand based on supply of 1,700 ML of high priority water for irrigation use from the proposed Emu Swamp Dam
  - Acknowledged that in practice different producers of the same crop with derive different returns, subject to a range of factors – merit order provides an indication of take-up and total returns from use of the water
- Yield of 1,700 ML results in supply to strawberry runners being curtailed as on a per ML basis it has the lowest return per ML
  - Were water to be supplied for green vegetable production, no water would be available for strawberry runner production

Implications for the Strategic Assessment

- Important to note that the estimates are for total return, not taking into account
  1) Ongoing annual water infrastructure and supply charges (i.e. cost of delivering water, operating and maintaining dam and pipeline infrastructure and water pricing structures)
     - Estimate of $500 per ML per annum adopted for Strategic Assessment
  2) Up-front costs to producers of accessing irrigation water delivered to the farm gate
     - Will vary across producers based on circumstances, (i.e. need for augmentation of water supply infrastructure, volume of water to be supplied, pipe infrastructure required)
     - Indicative estimate of $2,500 per ML (one-off cost) assumed for Strategic Assessment
- Based on a discount rate of 10%, this results in $7,500 being ‘netted off’ the total return estimates
- This lowers the average per ML return (based on a yield of 1,700 ML) from $35,100 per ML to $27,600 per ML
  - It is this value that should be compared to the cost of supply augmentations

Sensitivity analysis

- Sensitivity analysis is important for assessing the impact of changes to key parameter estimates on the modelling results

- Key findings:
  - Changes to all three parameters results in significant changes to average return per ML
  - Impact of a reduction in crop prices is significant – 10% reduction in prices results in a reduction to average return per ML of over 40%
  - Demonstrates the impact of crop price fluctuations on both profitability and the return to irrigation water use

- Multiple parameters can vary under the same scenario
  - Example: 10% reduction in both crop prices and incidence of ‘dry’ years results in average return per ML falling from $35,100 per ML to $19,200 per ML

Key observation: These results have important implications for what producers may actually be willing to pay for additional irrigation water

Industrial demand assessment

- Previous assessments have reached significantly different conclusions regarding future industrial water demand in the Stanthorpe region
  - Estimates developed for EIS forecast that industrial demand would outstrip residential demand by 2020
  - Recent assessment by DEWS assumed that industrial water demand would grow in proportion to population growth

- Key principle underpinning our approach was similar to assessment of irrigation water demand:

To what extent is access to a reliable water supply constraining industrial activity in the Stanthorpe region?

- Outcomes from consultation with Granite Belt Chamber of Commerce:
  - Identified Emu Swamp as its number one priority for promoting industrial development in Stanthorpe
  - Considered access to high reliability water a significant constraint on industrial output
  - Identified agrifood processing operations as the primary source of growth

Industrial demand assessment conclusions

- Few producers consulted with for irrigation demand assessment raised any interest in shifting into agrifood processing – focus was on maximising returns from fresh produce
- Volume of water from proposed Emu Swamp Dam are relatively small and unlikely to underpin increase in crop production sufficient to underpin a local food processing hub
- Producers currently have the option of transporting produce to Warwick for processing prior to supplying to market – better access to labour and infrastructure and no water constraint – little evidence of this occurring

Overall conclusion:

While non-residential water demand is expected to increase over time, it is Synergies' view that there is insufficient evidence to support a forecast that would have industrial demand outstripping residential demand in the foreseeable future or exhibiting a 'step change' in economic development if a new bulk water supply was developed.

Options Selection and Analysis

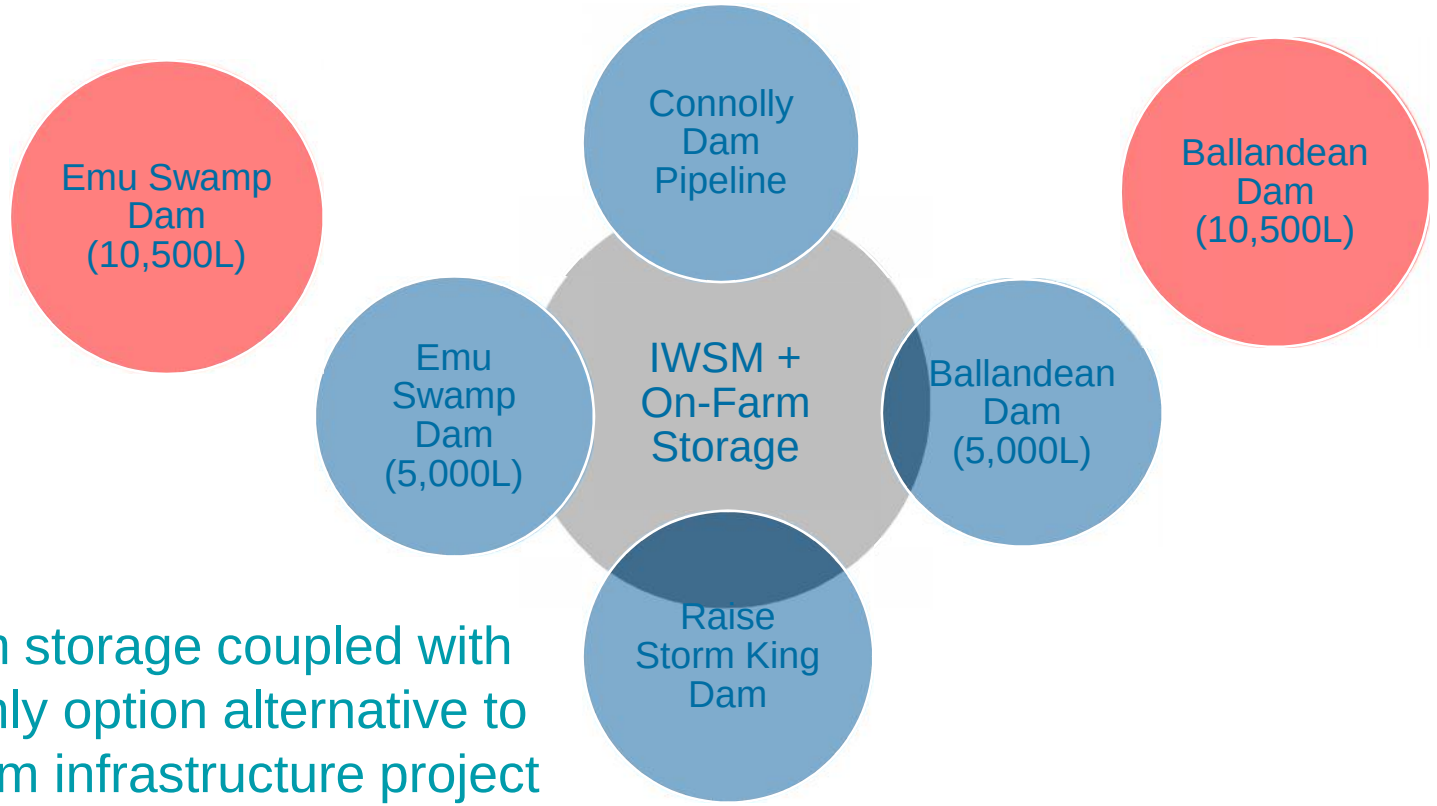
Approach to Options Selection and Analysis

- ✓Long list of options identified both existing and new options
- ✓Information synthesised from report reviews, water yield and demand assessment used to filter options using criteria such as yield as a hard ‘pass/fail’ to produce a short list for further analysis.
- ✓Further analysis of options included:
  - ✓developing distribution infrastructure layouts,
  - ✓updating dam capital cost through escalation and comparison with benchmark
  - ✓developing P50 costs for reticulation infrastructure
- ✓Economic models developed to generate levelised costs of water, PV of total costs/annual yield cost/ML etc. to allow comparison between options
- ✓Levelised cost of water and PV of total costs/annual yield were compared to irrigator net return per $ML_{p.a.}$ and net total return to assess economic viability irrigation supply options
- ✓Financial modelling was used to determine required level of government funding for integrated urban and irrigation supply options
- ✓Multi-criteria analysis was undertaken to produce a ranking of options

Long list options filter

- ✓13 Options previously assessed evaluated on a basis of sufficient water yield (urban and irrigation supply)
- ✓4 Additional options assessed, again evaluated on a basis of sufficient water yield (urban and irrigation supply)
- ✓The following options were discarded as not being capable of meeting demand:
  - Base case - do nothing (continued use of Storm King Dam for urban supplies, continued use of surface water harvesting (on-farm storage)
  - Off-stream storage at Diamondvale Road (down stream of Storm King Dam)
  - Lane Weir off-stream storage
  - Leslie Dam pipeline to Mount Marley Water Treatment Plant
  - Petries Crossing Weir and off-stream storage
  - Quart Pot Creek Dam
  - Kia Ora Dam
  - Bookookoorara Dam (NSW/QLD border dam pipeline connection initiative
  - The Broadwater
  - Severn River off-stream storage
  - Recycled water scheme – better use through on-farm storages

Option combinations



On-farm storage coupled with urban only option alternative to Major dam infrastructure project

Key:

Grey – market response and DSM

Blue – urban only infrastructure

Red – urban and irrigation infrastructure

Short list options evaluated further

Response type	Option
Reform	Integrated Water Supply Management (urban) Auction of water reserve and additional on-farm storage
Improve existing	Raising Storm King Dam plus on-farm storage
Improve existing	Connolly Dam and pipeline plus on-farm storage
New build	Emu Swamp Dam: a) "Small 5,000 ML" urban only dam plus on-farm storage b) "Large 10,500 ML" urban and irrigation supply dam with an irrigation distribution system
New build	Ballandean Dam: a) "Small (5,000 ML" urban only dam plus on-farm storage b) "Large (10,500 ML)" urban and irrigation supply dam with an irrigation distribution system

Further analysis of short list options

- ✓Assessed yield (e.g. at 98% monthly reliability) for each option
- ✓Assessed available technical data as to constructability
- ✓Assessed environmental approval requirements
- ✓Escalated dam infrastructure costs and compared with recent GHD comparable dam cost estimates to develop updated dam costs
- ✓Developed:
  - urban and irrigation reticulation system routing, concept design and P50 costs for infrastructure
  - operating costs including pumping costs

Financial assessment of shortlist options

✓GHD used the following financial metrics to compare the shortlisted options (all costs in 2017 dollars):

- Levelised cost of water – equivalent to amount needed to charge $/ML
- Total capex / 20 year yield - $/ML
- Total capex / annual yield - $/MLp.a.
- Total capex / storage capacity – $/ML
- PV of total costs / annual yield - $/MLp.a. – equivalent to one-off up front payment to cover costs per ML
- Total bulk supply capex ($) – i.e. dam construction costs
- Urban distribution capex ($)
- Irrigation distribution capex ($)
- Total distribution capex ($)
- Urban distribution opex ($)
- Irrigation distribution opex ($)
- Total opex ($)

Urban only supply economic assessment

URBAN ONLY					
Supply Option	**Raising SKD**	**ESD TWS**	**BD TWS**	**CD Pipeline TWS**	**IWSM**
LCOW (Regular Demand)	$4,300	$9,700	$7,000	$2,600	$400
LCOW (Dry Demand)	$3,700	$8,400	$6,000	$2,200	$300
Total Capex/Yield ($ '17/ML)	$5,300	$4,000	$2,900	$2,700	$500
Total Capex/Yield p.a. ($ '17/ML p.a.)	$160,000	$120,000	$86,000	$81,000	$14,000
Total Capex/Capacity ($ '17/ML)	$7,800	$18,000	$12,900		
PV Total Costs/ML ($ '17/ML)	$161,500	$121,000	$86,700	$96,400	
Supply Capex $2017	$41,900,000	$92,600,000	$61,700,000	$300,000	$7,100,000
Urban Dist Capex $(2017)	$5,000,000	$13,500,000	$14,100,000	$23,600,000	
Total Capex $(2017)	$46,900,000	$106,100,000	$75,800,000	$23,800,000	$7,100,000
Urban Dist Opex $(2017)	$33,000	$39,000	$40,000	$227,000	
Total Opex $(2017)	$33,000	$39,000	$40,000	$227,000	

Key: Red – upper cost range, Amber – mid cost range, Green – lower cost range

Urban only supply ranking based on economic assessment

1. Integrated water supply management
2. Connolly Dam Pipeline
3. Raising Storm King Dam
4. Ballandean Dam
   (small 5,000 ML – town water supply)
5. Emu Swamp Dam
   (small 5,000 ML – town water supply

Irrigation only supply option

URBAN ONLY	IRRIGATION ONLY
Supply Option	**OFS ONLY**
LCOW (Regular Demand)	$300
LCOW (Dry Demand)	$300
Total Capex/Yield ($ '17/ML)	$3
Total Capex/Yield p.a. ($ '17/ML p.a.)	$100
Supply Capex $2017	$6,000,000
Total Capex $(2017)	$6,000,000

OFS - Market led: Water allocation auction, increased surface water harvesting and on-farm storage. This option may be combined with any of the urban only supply options taken forwards.

Combined urban and irrigation options

URBAN AND IRRIGATION							
Supply Option	**Raising SKD + OFS**	**ESD Urban and Irrigation**	**ESD TWS + OFS**	**BD Urban and Irrigation**	**BD TWS + OFS**	**CD pipeline + OFS**	**Combined IWSM & OFS**
LCOW (Regular Demand)	$1,300	$4,500	$3,300	$3,600	$2,400	$1,000	$300
LCOW (Dry Demand)	$1,100	$3,900	$2,900	$3,100	$2,100	$900	$300
Total Capex/Yield ($ '17/ML)	$600	$2,200	$1,300	$1,700	$900	$400	$100
Total Capex/Yield p.a. ($ '17/ML p.a.)	$18,000	$65,000	$38,000	$52,000	$52,000	$13,000	$4,000
Total Capex/Capacity ($ '17/ML)	$7,200	$15,400	$19,000	$6,400	$13,900		
PV Total Costs/ML ($ '17/ML)	$18,700	$58,700	$38,300	$46,700	$28,000	$14,600	$4,300
PV Irrigation Costs/Discounted Irrigation ML ($ '17/ML)		$56,500		$46,600			
Supply Capex $2017	$38,600,000	$101,600,000	$98,600,000	$67,500,000	$67,700,000	$6,200,000	$13,100,000
Urban Dist Capex $(2017)	$5,000,000	$13,500,000	$13,500,000	$14,100,000	$14,100,000	$23,600,000	
Irrigation Dis Capex $(2017)		$47,000,000		$47,400,000			
Total Capex $(2017)	$43,500,000	$162,100,000	$112,100,000	$129,000,000	$81,800,000	$29,800,000	$13,100,000
Urban Dist Opex $(2017)	$33,000	$39,000	$39,000	$40,000	$39,000	$227,000	
Irrigation Dis Opex $(2017)		$497,000		$554,000			
Total Opex $(2017)	$33,000	$536,000	$39,000	$594,000			

Irrigation only supply infrastructure metrics

Comparison of Irrigation Water Only Supply Metrics from Irrigation Supply Options			
Supply Option	**ESD Urban and Irrigation**	**BD Urban and Irrigation**	**OFS ONLY**
LCOW (Regular Demand)	$4,500	$3,600	$300
LCOW (Dry Demand)	$3,900	$3,100	$300
Total Capex/Yield p.a. ($ '17/ML p.a.)	$65,000	$52,000	$100
Total Capex/Capacity ($ '17/ML)	$15,400	$6,400	$3,429
PV Irrigation Costs/Discounted Irrigation ML ($ '17/ML)	$56,500	$46,600	$4,300
Total Irrigation Supply Component of Capex	$118,120,000	$94,650,000	$6,000,000
Irrigation Distribution Opex	$497,000	$554,000	$0

Comparison between irrigation component of combined urban and irrigation dam option and on-farm storage. On farm storage is and order of magnitude less expensive All costs excludes payment for water allocation.

Urban and irrigation supply option ranking based on economic assessment

1. IWSM plus on-farm storage
2. Connolly Dam Pipeline plus on-farm storage
3. Raising Storm King Dam plus on-farm storage
4. Ballandean Dam (5,000 ML TWS) plus on-farm storage
5. Emu Swamp Dam (5,000 ML TWS) plus on-farm storage
6. Ballandean Dam (10,500 ML) integrated urban and irrigation supply
7. Emu Swamp Dam (10,500 ML) integrated urban and irrigation supply

Comparison of calculated cost of water with net economic benefit

Option		Emu Swamp Dam - Irrigation	Ballandean Dam - Irrigation	On-Farm Storage
LCOW - Irrigation ($ '17/ML)		$ 4,500	$ 3,600	$ 300
Net Annual Benefit ($ '17/ML p.a.)	Apples (existing - low water security producers)	$ 4,150	$ 4,150	$ 4,150
	Apples (existing - high water security producers)	$ 2,350	$ 2,350	$ 2,350
	Apples (new crops)	$ 3,150	$ 3,150	$ 3,150
	Tomatoes (new crops)	$ 3,550	$ 3,550	$ 3,550
	Strawberries (new crops)	$ 5,250	$ 5,250	$ 5,250
	Wine Grapes (existing)	$ 1,850	$ 1,850	$ 1,850
	Wine Grapes (new crops)	$ 2,250	$ 2,250	$ 2,250
	Strawberry Runners (new crops)	$ 1,050	$ 1,050	$ 1,050
	Green Vegetables (existing)	$ 2,350	$ 2,350	$ 2,350
	Green Vegetables (new)	$ 2,850	$ 2,850	$ 2,850
	Average Weighted by volume by crop	$ 3,300	$ 3,300	$ 3,300

Option		Emu Swamp Dam - Irrigation	Ballandean Dam - Irrigation	On-Farm Storage
PV Irrigation Costs/Irrigation Yield ($ '17/ML)		$ 56,500	$ 46,600	$ 2,900
Total On-Farm Return ($ '17/ML)	Apples (existing - low water security producers)	$ 41,500	$ 41,500	$ 41,500
	Apples (existing - high water security producers)	$ 23,500	$ 23,500	$ 23,500
	Apples (new crops)	$ 31,500	$ 31,500	$ 31,500
	Tomatoes (new crops)	$ 35,500	$ 35,500	$ 35,500
	Strawberries (new crops)	$ 52,500	$ 52,500	$ 52,500
	Wine Grapes (existing)	$ 18,500	$ 18,500	$ 18,500
	Wine Grapes (new crops)	$ 22,500	$ 22,500	$ 22,500
	Strawberry Runners (new crops)	$ 10,500	$ 10,500	$ 10,500
	Green Vegetables (existing)	$ 23,500	$ 23,500	$ 23,500
	Green Vegetables (new)	$ 28,500	$ 28,500	$ 28,500
	Average Weighted by volume by crop	$ 32,600	$ 32,600	$ 32,600

Comparison of estimated cost of water with irrigator willingness to pay

Option		Emu Swamp Dam - Irrigation	Ballandean Dam - Irrigation	On-Farm Storage
LCOW - Irrigation ($ '17/ML)		$ 4,500	$ 3,600	$ 300
Net Annual Benefit ($ '17/ML p.a.)	Apples (existing - low water security producers)	$ 2,075	$ 2,075	$ 2,075
	Apples (existing - high water security producers)	$ 1,175	$ 1,175	$ 1,175
	Apples (new crops)	$ 1,575	$ 1,575	$ 1,575
	Tomatoes (new crops)	$ 1,775	$ 1,775	$ 1,775
	Strawberries (new crops)	$ 2,625	$ 2,625	$ 2,625
	Wine Grapes (existing)	$ 925	$ 925	$ 925
	Wine Grapes (new crops)	$ 1,125	$ 1,125	$ 1,125
	Strawberry Runners (new crops)	$ 525	$ 525	$ 525
	Green Vegetables (existing)	$ 1,175	$ 1,175	$ 1,175
	Green Vegetables (new)	$ 1,425	$ 1,425	$ 1,425
	Average Weighted by volume by crop	$ 1,650	$ 1,650	$ 1,650

Option		Emu Swamp Dam - Irrigation	Ballandean Dam - Irrigation	On-Farm Storage
PV Irrigation Costs/Irrigation Yield ($ '17/ML)		$ 56,500	$ 46,600	$ 2,900
Total On-Farm Return ($ '17/ML)	Apples (existing - low water security producers)	$ 20,750	$ 20,750	$ 20,750
	Apples (existing - high water security producers)	$ 11,750	$ 11,750	$ 11,750
	Apples (new crops)	$ 15,750	$ 15,750	$ 15,750
	Tomatoes (new crops)	$ 17,750	$ 17,750	$ 17,750
	Strawberries (new crops)	$ 26,250	$ 26,250	$ 26,250
	Wine Grapes (existing)	$ 9,250	$ 9,250	$ 9,250
	Wine Grapes (new crops)	$ 11,250	$ 11,250	$ 11,250
	Strawberry Runners (new crops)	$ 5,250	$ 5,250	$ 5,250
	Green Vegetables (existing)	$ 11,750	$ 11,750	$ 11,750
	Green Vegetables (new)	$ 14,250	$ 14,250	$ 14,250
	Average Weighted by volume by crop	$ 16,300	$ 16,300	$ 16,300

On-farm storage only viable option without significant government funding

Results of multi-criteria assessment

Rank	Urban Only	Weighted Score	Urban and Irrigation^	Weighted Score
1	IWSM	3.42	Connolly Dam Pipeline + On-farm Storage	3.39
2	Connolly Dam Pipeline	3.35	Ballandean Dam TWS + On-farm Storage	3.06
3	Raise Storm King Dam	2.90	Raise Storm King Dam + On-farm Storage	3.02
4	Ballandean Dam (small)	2.88	Ballandean Dam Urban + Irrigation Supply	2.89
5	Emu Swamp Dam (small)	2.78	Emu Swamp Dam Urban + Irrigation Supply	2.87

Conclusions and Recommendations

Conclusions

- ✓Urban water consumption 50 L/c/d higher than SEQ
- ✓Urban demand will outstrip supply from Storm King Dam by 2036 with a 250 ML shortfall by 2050
- ✓Significant additional irrigation demand exists including requirement for high reliability water to draw on during times of drought
- ✓Do nothing (base case) is not a viable option to meet urban demand
- ✓IWSM should be investigated and implemented and restrictions enforced to defer requirement for capital expenditure to meet urban demand
- ✓Release of water reserve for auction for irrigation supply coupled with on-farm storage lowest cost option to meet irrigation demand (to supplement existing 20,700 ML of surface water harvesting) but may not meet fully requirement for high reliability water during time of drought
- ✓Capital infrastructure is required to meet urban demand
- ✓Significant government funding (up to $120 million) required for Ballandean Dam or Emu Swamp Dam urban and irrigation options to be economically viable
- ✓Irrigator commitment to make necessary up-front contributions required to facilitate obtaining government funding (per recent experience in Tasmania)

Recommendations

- ✓Shortlisted options be taken forward for further evaluation.
- ✓Urban solution only options coupled with market led irrigation option (water allocation auction and on-farm storage) should be evaluated first in order of MCA ranking, progressing to less favourable options only if an option is not viable.
- ✓Only proceed with further investigation of the integrated urban and irrigation capital options if the market led irrigation option is found not to be viable.
- ✓If an integrated urban and irrigation capital option is to proceed beyond investigation, commitment should be sought from irrigators e.g. in the form of a “Heads of Agreement” to make one-off up-front capital contributions.
- ✓Indication of government willingness to contribute required funding should also be sought before evaluating integrated urban and irrigation capital infrastructure options (BD or ESD).

Questions?

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