Balancing Source Control and Technology for Optimal Phosphorus Removal in the Windermere Catchment

Nottingham Conference Centre - Feb 2015

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Lake Windermere

- Largest lake in England
- Attracts 14.8M visitors a year
- >1.2M visitors sail on Windermere each year
- Holds UK largest annual open water swim
- Visitors spent £994M in 2012

Water Quality of Lake Called into Question!

NORTH-WEST Evening Mail

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North West Evening Mail » **News**

TOXIC ALGAE SINKS GREAT NORTH SWIM 2010

Published at 13:06, Wednesday, 08 S

THE 2010 Great North Swim has been cancelled toxic algae in Windermere.

The Telegraph

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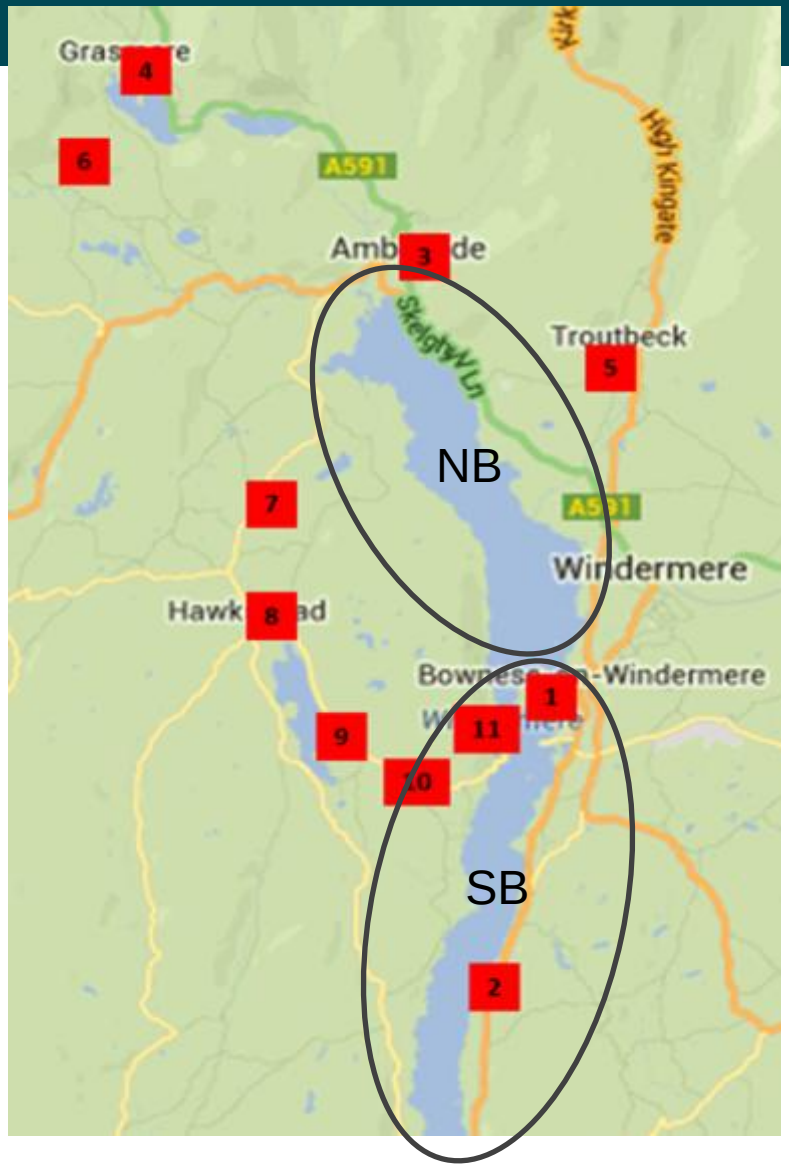
Dog dies after swallowing algae in Lake Windermere

UU invested heavily in phosphorus (P) removal in region over past 10 years

- Deemed not enough!

UU promised EA to undertake a series of studies to develop a long term holistic and sustainable strategy for investment in the wider Windermere catchment to reduce storm spills and total P load discharged to lake

The Windermere Catchment



- UU has 11 assets that discharge to lake
- 3 major WwTWs
  - Windermere
  - Ambleside
  - Grasmere
- 7 smaller WwTWs
- 1 major CSO – Glebe Road (GR) in Bowness

NB – North Basin
SB – South Basin

Definition of TP Load from UU Assets

12 month intensive sampling study

- Collection of TP data for all storm, CSO and final effluent discharges
- Included spot, composite and on-line data
- Collection of flow data
- All data added to historical information
- Data accepted by EA

Catchment	Total (kg TP/annum)	% of total
Windermere WwTW	1,919.6	32%
Glebe Road Storm PS	1,327.4	22%
Glebe Road Gravity Overflow	1.2	0%
Grasmere WwTW	434.8	7%
Grasmere Storm Overflow	717.0	12%
Ambleside WwTW	713.2	12%
Ambleside Storm Overflow	128.4	2%
Hawkshead WwTW	173.5	3%
Hawkshead Storm Overflow	40.9	1%
Langdale WwTW	214.9	4%
Troutbeck WwTW	129.2	2%
Near Sawrey WwTW	74.5	1%
Far Sawrey WwTW	48.9	1%
Outgate WwTW	30.0	1%
Total	**5,953.5**	**100%**

Source Apportionment

- Initial assessment completed by Atkins
  - SAGIS and SIMCAT models used
  - 90% accuracy for prediction of flows
  - Predicted phosphorus concentrations – not as good

- UU supplemented Atkins data
  - Used phosphorus load data from sampling study
  - Refined septic tank input
    - Identification of properties not on main sewers
    - Identification of residential and non residential properties
    - Identification of proximity to a water body
    - Assumptions on TP removal rates from septic tanks and soakaways

ATKINS

Source Apportionment

Without UU investment water quality objective for lake will not be met!

25%

55%

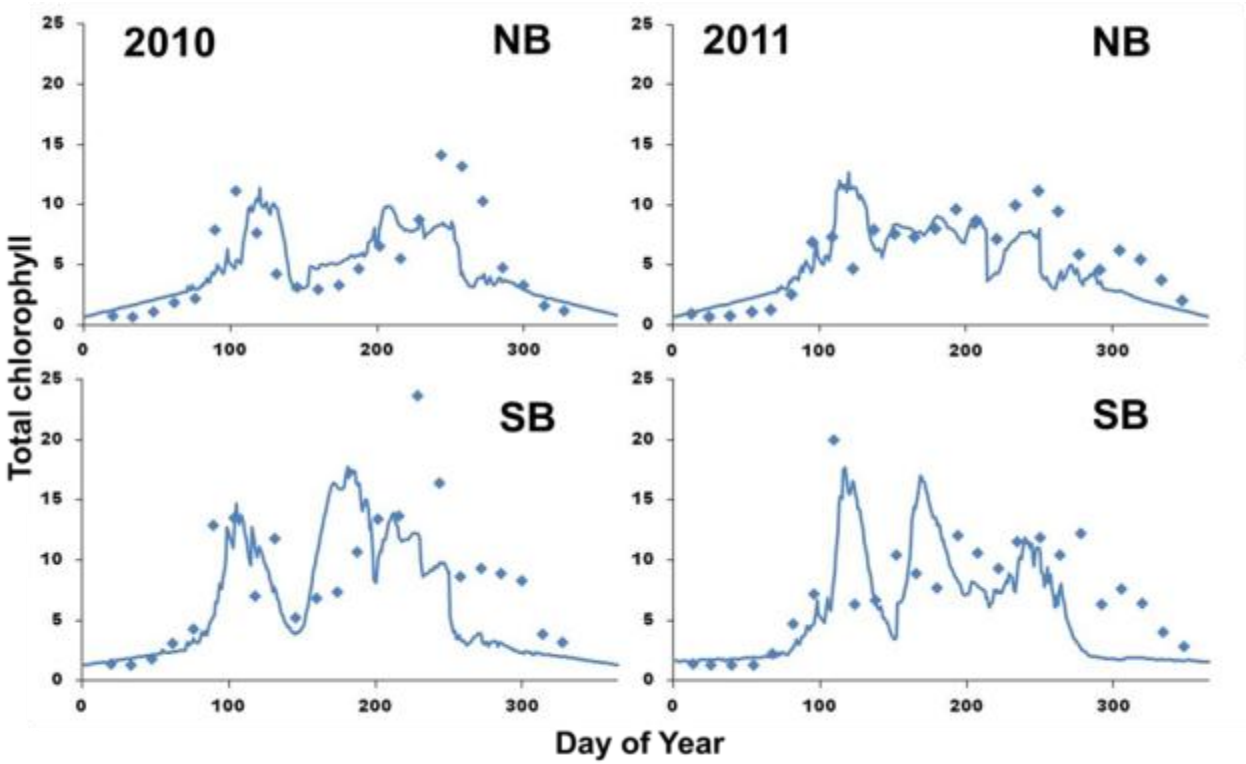
United Utilities

20%

	TP load (kg/yr)
Livestock	2644
Spetic tanks	2085
UU assets	5954
Total	10683

Lake Modelling – Development of Model

- Existing model baselined for 2010 and 2011
- 365 data points for each year – flow (m^3/s) and SRP (µg/l)
- EA provided all riverine inputs, UU all WwTW & CSO inputs



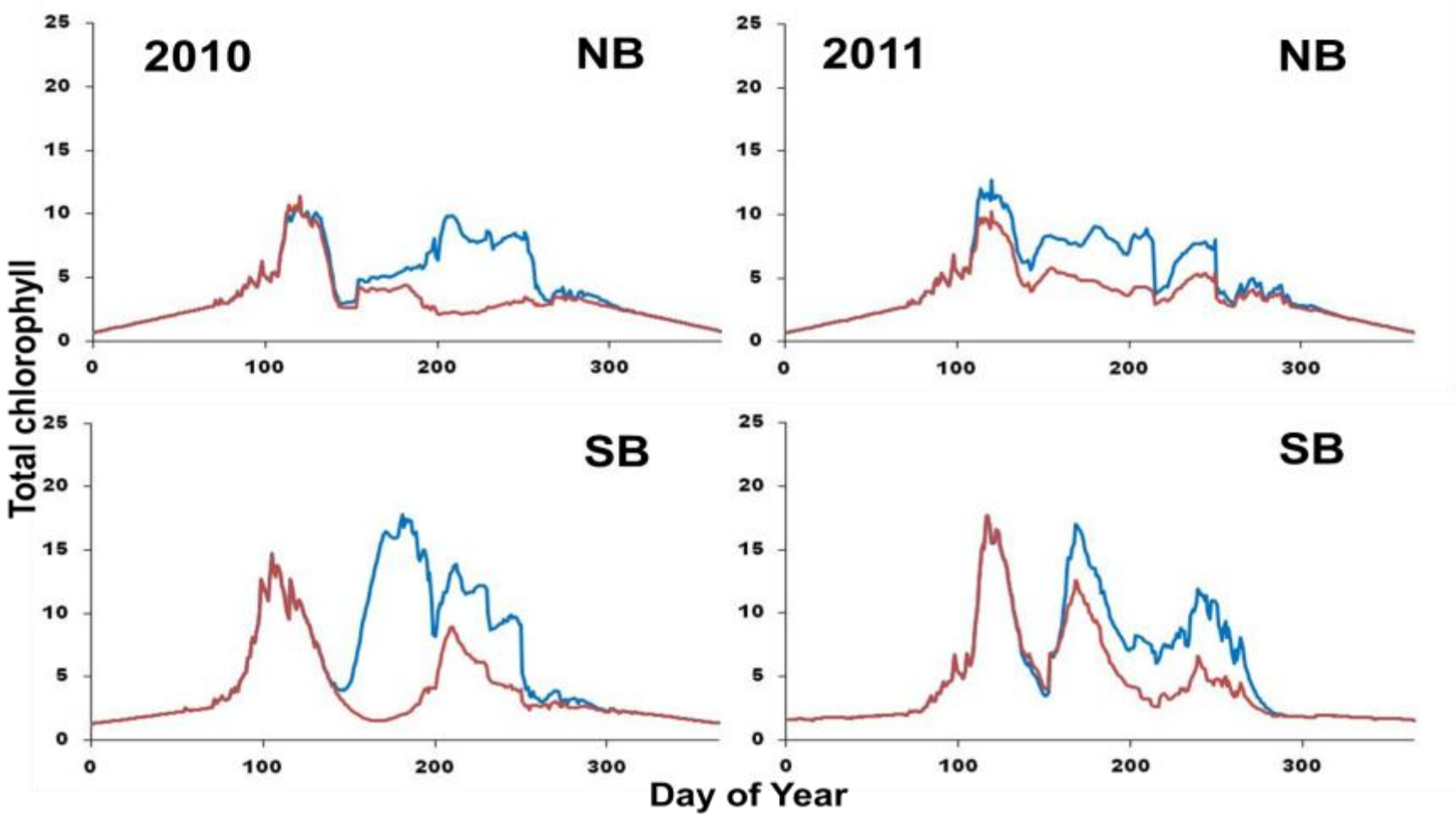
Predicted values

Observed values

NB – North Basin
SB – South Basin

Lake Modelling – Defining the Solution

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL



Conclusions from Lake Modelling & Requirements to meet WFD 'good' Status in Lake

UU requirements:

- Pass forward a minimum of formula A flows from GR to WM WwTW
  - FTFT at WM must increase from 17Ml/d - >30Ml/d
- Reduce annual TP load to North Basin by >22%
- Reduce annual TP load to South Basin by >65%

Requirements of others:

- Reduce TP load from Millbeck
- Better control of septic tanks
- Catchment sensitive farming
- Low phosphorus initiatives
  - Low/no P detergents
  - Low/no P food additives
  - Low/no P fertilisers

National Trust

Forestry Commission

Environment Agency

Lake District National Park

South Lakeland District Council

Natural England

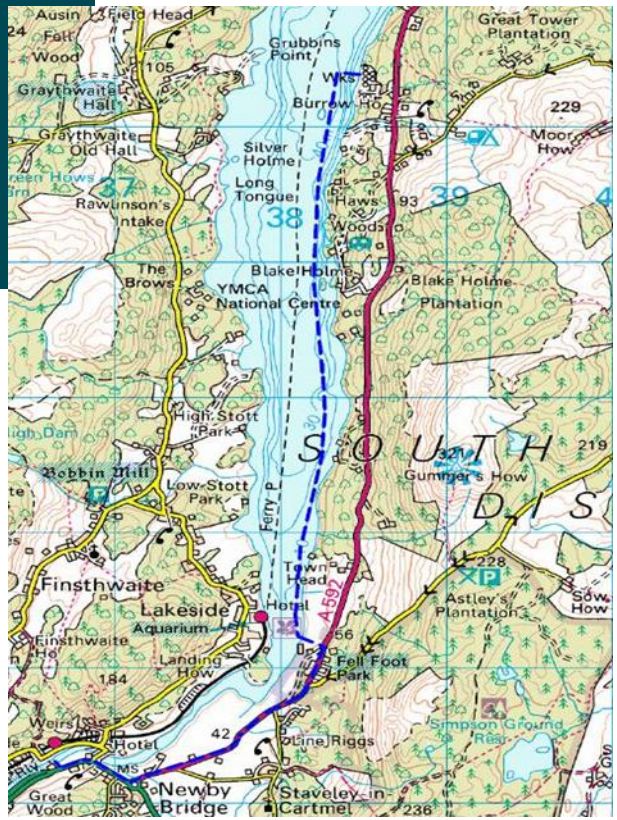
Windermere Reflections

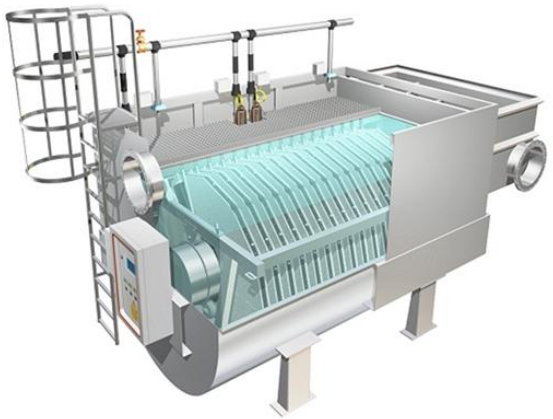
Solutions Considered: 1

- Consent negotiation
  - on-going
- P removal at all 10 UU works
  - Not the optimal solution
- Lake management
  - Treating symptoms not eliminating problem
- Network management
  - Included
- Catchment management, source control and raising public awareness
  - Included – led by 3rd party organisations

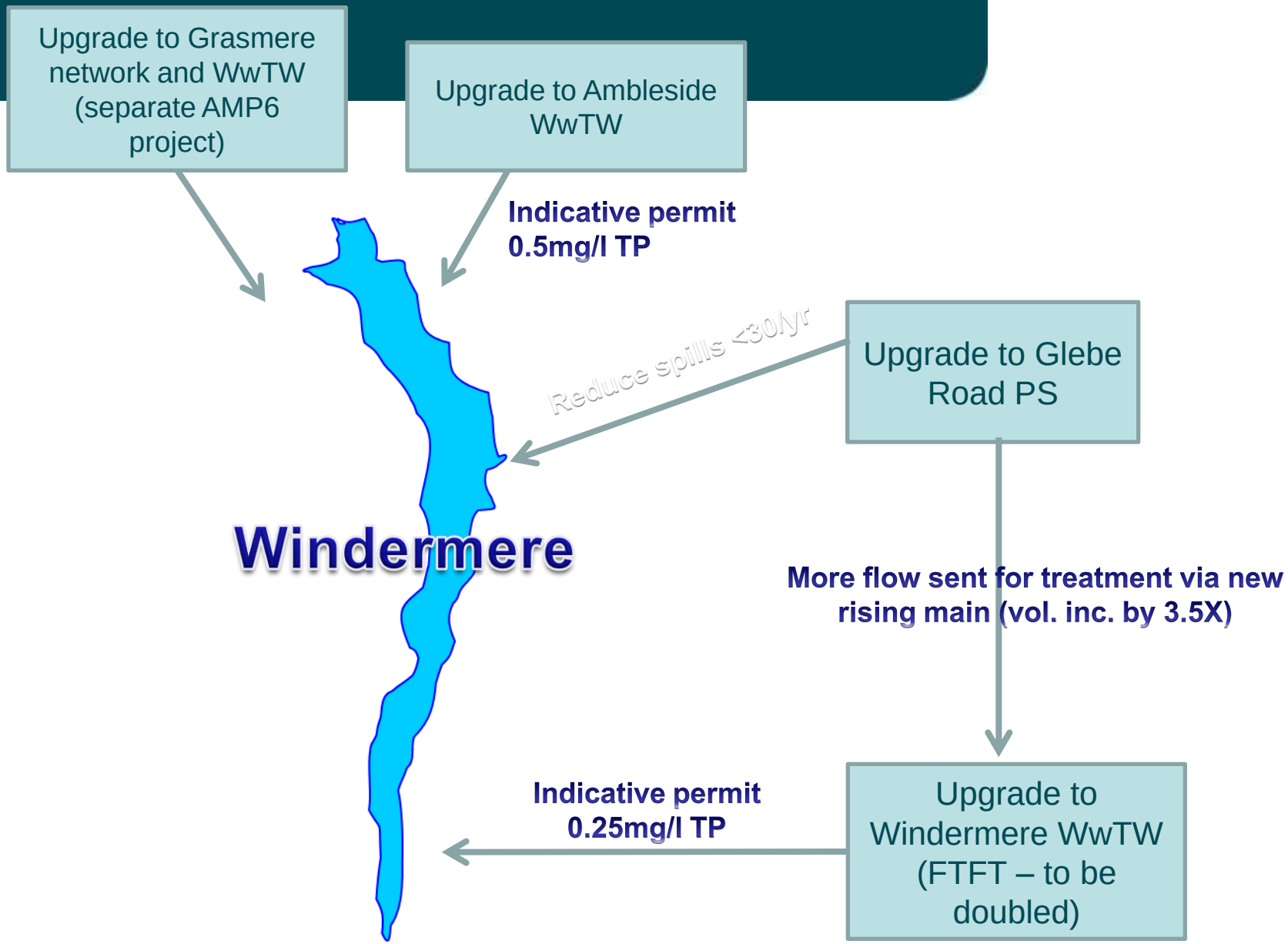
Solutions Considered:2

- Transfer of UU effluents to alternative waterbody
- Advanced P removal at WwTW
  - Successful trials of 2 technologies - included
- Treatment of storm water
  - Not accepted by EA
  - reduction in spills - included
- Optimise current UU operations
  - Included
- Construct a ‘super works’





Indicative UU Solution for Catchment -to be Delivered by 2020



EA Confirmation that Reference Solution for Catchment Suitable

NORTH BASIN	Total Phosphorus	Chlorophyll		EA Conclusion
	Annual Ave ug/l	Annual Ave ug/l	Summer Ave ug/l	
Baseline	10.5 to 11.6	4.4 to 5.7	6.6 to 8.5	Just at Good WFD Status. Blooms occur.
Future scenario	10.1 to 11.0	3.6 to 5.1	3.8 to 5.8	Will secure Good WFD Status and reduce risk of blooms.

SOUTH BASIN	Total Phosphorus	Chlorophyll		EA Conclusion
	Annual Ave ug/l	Annual Ave ug/l	Summer Ave ug/l	
Baseline	14.8 to 17.0	5.5 to 8.6	9.3 to 13.2	Moderate Status. Blooms occur.
Future scenario	11.4 to 12.2	4.1 to 5.8	5.3 to 6.2	Will secure Good WFD Status and reduce risk of blooms.

WFD Classes	**High**	**Good**	**Moderate**
Mean Chlorophyll A ug/l	3.96	6.00	11.65
Total Phosphorus ug/l	8.26	12.79	25.57

Conclusions

- Catchment study facilitated development of a holistic solution allowing targeting of investment to give greatest environmental benefit
- In this instance investment in UU assets best solution
- Looking holistically allows investment at 3 strategic assets instead of all 11
- Solution can be accommodated on UU operational land negating need for a new WwTW in a national park
- Identification of an advanced P removal process negates the need for a high energy transfer solution
- Community work will ensure continued restoration of lake
- Design of the scheme has commenced and will be delivered by 2020

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