The Study of Cooling Water Discharge into British Waterways Canal

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Aim

To develop a 3D interactive mathematical model to ensure safe and effective use of a natural resource.

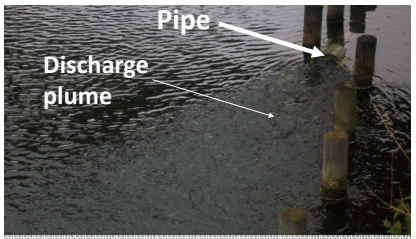
2200 miles of canals and rivers across the UK available for use

The problem

Excessive increase in ambient water temperature reduces the dissolved oxygen in the water which threatens aquatic life.


Central Services Building University of Huddersfield

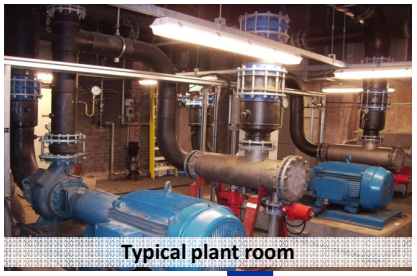
Cooling water discharge into British Waterways canal



Discharge thermal plume

What size is the plume?


Discharge heated water


Typical plant room

Cooling water discharge into British Waterways canal

Advantages of British Waterways canal water cooling system

- Using British Waterways canals for cooling systems can save **£100 million** on energy bills
- Reduce carbon emissions by **one million tonnes**.

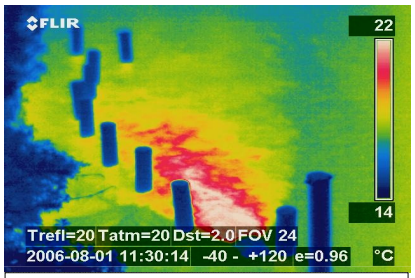

Graduated pole carried the measurements tools at canal site

On-site measurements

Laboratory Testing

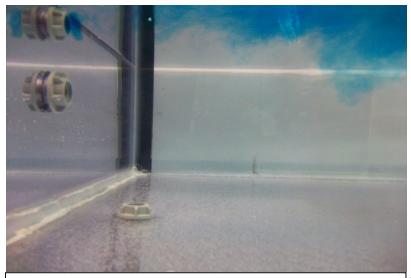

Experimental model tank setup

Thermal camera used to predict the heat distribution on the surface



Thermal plume of discharge

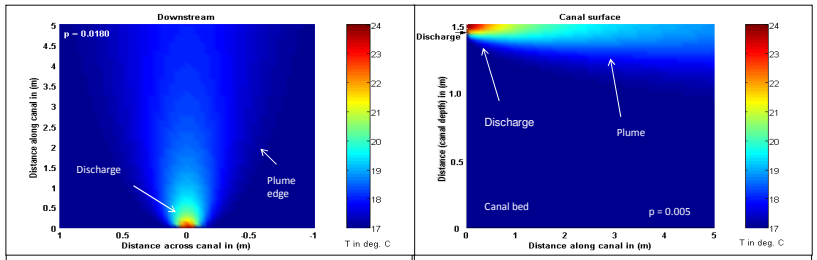
Combine


Coloured water discharged into tank

Coloured water shows the vertical extension of the plume

$$T(x,y) = \left(\frac{To - Ta}{2}\right)\left(erf\frac{b - z}{2\sqrt{p1.x}} + erf\frac{b + z}{2\sqrt{p1.x}}\right) + Ta$$

To, Ta: Discharge and Ambient Temperature, b: Nozzle Radius, z: Depth, p1:(U)velocity/(D)Turbulent Diffusivity

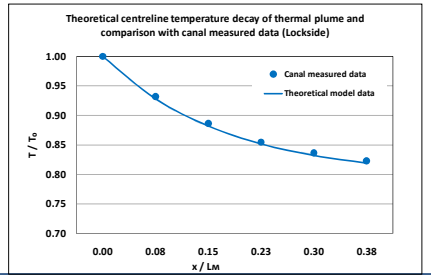


Plan view of thermal plume resulted from the mathematical model

Sectional view of thermal plume resulted from the mathematical model

Results

The final predictive model has been applied to existing canal sites where the results compare very favourably with the measured on-site results. It is now complete for national use on canal waters and lakes.



Conclusion

The work results in an interactive model that can be used to maximise use of canal water and lakes without prejudice to aquatic life. Environmental Agency approval is now being sought for it use on a national scale.