



ENVIRONMENT  
AGENCY

**A Study of the use of Glycol-based de-icers  
at RAF Lyneham and their impact on local  
watercourses during the winter of 1999/2000**

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## SUMMARY

RAF Lyneham is home to the RAF's fleet of Hercules transport planes and is required to maintain operational readiness at all times.

Both the aircraft and airfield are de-iced during icy or cold conditions using glycol based de-icers. These de-icers are readily biodegradable but exert a high biochemical oxygen demand (BOD).

Following concern that the de-icers were reaching local watercourses, an investigation was undertaken to study the concentrations and impact of de-icers reaching the surface water drains.

Continuous water quality monitors were deployed on the Lilly Brook and Strings Watercourse to measure dissolved oxygen following de-icing operations at RAF Lyneham. No impact was found on D.O. concentrations.

Autosamplers were deployed on the outlet from two oil interceptors which drain to the Strings Watercourse. Some of the samples which were taken after de-icing operations had high concentrations of Propylene Glycol and high BOD's (>470 mg/l).

Further work is planned for the winter of 2000/01 to look closer at the impact on the Strings Watercourse and the Lilly brook.

Negotiations are taking place with the RAF to look at alternative disposal of contaminated water.

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## **CONTENTS**

<b>1.0</b>	<b>INTRODUCTION</b>	<b>1</b>
<b>2.0</b>	<b>METHOD</b>	<b>1</b>
<b>3.0</b>	<b>RESULTS</b>	<b>2</b>
<b>3.1</b>	<b>Continuous Monitoring</b>	<b>2</b>
<b>3.2</b>	<b>Routine Samples</b>	<b>2</b>
<b>3.3</b>	<b>Autosampler Results</b>	<b>3</b>
<b>4.0</b>	<b>CONCLUSIONS</b>	<b>3</b>
<b>5.0</b>	<b>RECOMMENDATIONS</b>	<b>4</b>
	<b>FIGURE 1 – Location Map</b>	<b>5</b>
	<b>FIGURE 2 – Graphs of results for Continuous Monitoring</b>	<b>6</b>
	<b>FIGURE 3 - Graphs of results for Autosamplers</b>	<b>7</b>
	<b>PLATE 1 – De-icing of a Hercules aircraft at RAF Lyneham</b>	<b>8</b>

## 1.0 INTRODUCTION

RAF Lyneham is the operational base for the RAF's fleet of Hercules transport planes. In addition, it is one of two airfields in the U.K. that kept permanently open 365 days a year, in case planes need to be diverted from large airports such as Heathrow.

One of the consequences of keeping the airfield open is that the runway must be kept free of ice during frosty weather. In addition, the Hercules aircraft are de-iced before use if the pilot feels it is necessary.

In the past the RAF used urea as a de-icer, as it is an effective and cheap de-icer. However it degrades in a watercourse into ammonia and as such is very polluting. Consistent pressure from the Environment Agency has led to its use being discontinued, but alternative de-icers also have a high polluting potential.

There are two different de-icer compounds currently used at RAF Lyneham, both of which are glycol based. Konsin is an ethylene glycol compound which is used to de-ice runways. For aircraft de-icing, a propylene glycol compound called Kilfrost is used. Both of these compounds are readily biodegradable, but as a consequence have very high BOD's.

A third de-icer (Clearway 3) is available but can only be used to de-ice the runway, not the aircraft. It is an acetate based compound and has a lower BOD than the glycol compounds, but it has yet to be used at RAF Lyneham.

The majority of the runway area drains to the Lilly Brook, a tributary of the Brinkworth Brook. The hardstanding where aircraft are parked and de-iced drains largely to the Strings Watercourse, a tributary of the Cowage Brook. Most of the discharges from the site pass through oil interceptors.

An investigation into the impact of these discharges was undertaken, with the analysis costs borne by the RAF.

## 2.0 METHOD

Water quality monitors were deployed in the Lilly Brook and Strings Watercourse to record dissolved oxygen (D.O.), ammonium and conductivity for a period of three weeks at the end of November '99.

During a cold spell at the end of January 2000, Epic autosamplers were deployed on two oil interceptors which discharge to the Strings watercourse and another on a discharge to the Lilly Brook. These were set to take samples every three hours. During the second half of the sampling period, as the temperature increased and de-icing was no longer being carried out, it was decided that only every other sample should be submitted for analysis.

No samples were submitted from the autosampler on the Lilly Brook discharge as the airfield had not been de-iced in the preceding few days.

Samples were analysed by the Environment Agency Laboratory at Fobney Mead, Reading for Propylene Glycol, Ethylene Glycol and Biochemical Oxygen Demand.

The Strings watercourse is routinely sampled up and downstream of Lyneham STW for RE classification purposes and the results of samples taken at these sites were reviewed as part of this investigation.

### 3.0 RESULTS

The results of the continuous monitoring are shown in Figure 1-2 and the results of the sampling are shown in Figures 3-4.

The use of de-icers during the period of monitoring and sampling is shown in Table 1 below.

**Table 1 – Use of De-icers at RAF Lyneham**

Date	16/11	21/11	04/12	05/12	13/12	14/12	15/12	19/12	20/12	21/12
Konsin/litres	3300			1200	1300	1900		8900	6740	
Kilfrost/litres		150	300			500	2100	8000	26400	650
Date	27/12	29/12	09/01	10/01	14/01	18/01	24/01	25/01	26/01	27/01
Konsin/litres	800	1300	1400							
Kilfrost/litres	250	600	400	2600	125	300	200	2000	400	6150

### 3.1 Continuous Monitoring

At both sites, no significant effect was found on the D.O. concentrations despite the use of de-icers during the monitoring period. In particular fairly large quantities of Konsin were used which might have been expected to deplete dissolved oxygen concentrations in the Lilly Brook.

It is possible that the de-icer had not made its way through the drainage system to the brook during the monitoring period or that oxygen demand of the de-icer did not impact on the brook until further downstream. It is likely that the low ambient temperature during this period would suppress the oxygen demand on the stream caused by a discharge of de-icer.

### 3.2 Routine Samples

Most of the routine samples taken during this period did not have elevated BOD concentrations. However, one sample taken on 17/12/99 from the sampling site U/S Lyneham STW had a BOD of 41.7 mg/l. The D.O. concentration on this day was not significantly lower than usual, perhaps as a result of the low temperature at this time.

The sample taken downstream of the STW had a BOD of 19 mg/l. This was significantly lower than upstream but still higher than would normally be expected. Again the D.O. concentration was not particularly affected.

The high BOD concentrations found in the samples taken on 17/12/99 were almost certainly related to the use of 2100 litres of Kilfrost two days earlier.

### **3.3 Autosampler Results**

The results of the samples taken from interceptor J/K showed very high concentrations of propylene glycol toward the latter period of sampling. The BOD concentration of the samples increased proportionally with the glycol concentration, but due to the limited number of dilutions that could be made by the lab, several of the results were over-range. The BOD concentrations were, however, very high.

The results of the samples taken from Interceptor Q showed an increase in BOD concentrations over the sampling period. Only the last five samples taken contained ethylene glycol, but in comparison with the samples taken from the other interceptor the concentrations were very low (<10 mg/l).

Large quantities of Kilfrost had been used on the morning of 27/01/00 (6150 litres), so it appears that there was a delay of about 48 hours before the Kilfrost reaches interceptor J/K.

### **4.0 CONCLUSION**

The dissolved oxygen monitoring did not show any impact from de-icing operations. However, most of the Konsin was used toward the end of the monitoring period, and so may not have come through the drainage system. Only relatively small quantities of Kilfrost were used over this period.

Routine sampling picked up one occasion of elevated BOD as a result of de-icing with Kilfrost two days previously. No significant impact on D.O. concentration was found.

The results of sampling of the interceptor J/K which drains to the Strings watercourse did show that very high concentrations of Propylene Glycol and BOD were reaching the surface water drainage system.

It is clear that de-icing operations at RAF Lyneham D.O. have an impact on the Strings watercourse which may well contribute to the failure of the RQO for this watercourse.

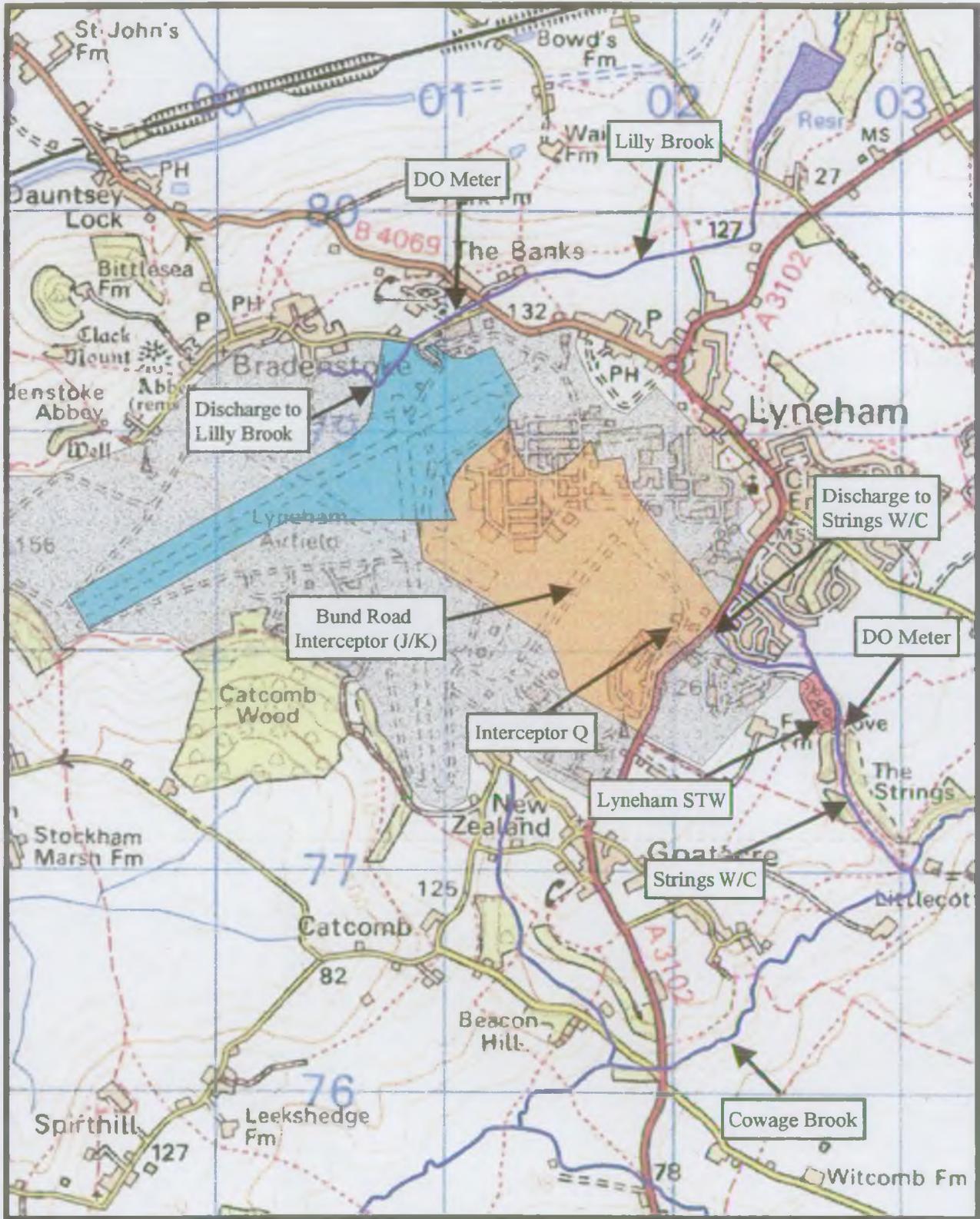
## 5.0 RECOMMENDATIONS

Further continuous monitoring of the Strings watercourse and Lilly Brook is planned for winter 2000. If sufficient equipment is available monitors may be placed further downstream than in 1999 to see if the BOD in the streams exerts a D.O. sag in the lower reaches.

Autosamplers will be deployed on both watercourses and set to take samples for BOD analysis during periods when it is known that de-icing operations have taken place at RAF Lyneham.

Negotiations are underway with RAF Lyneham to look into the feasibility of blocking drains when de-icing is taking place and using tankers to remove the contaminated water for more appropriate disposal. The use of Clearway as a replacement for Konsin has still not had full approval due to concerns over corrosion on some types of aircraft.

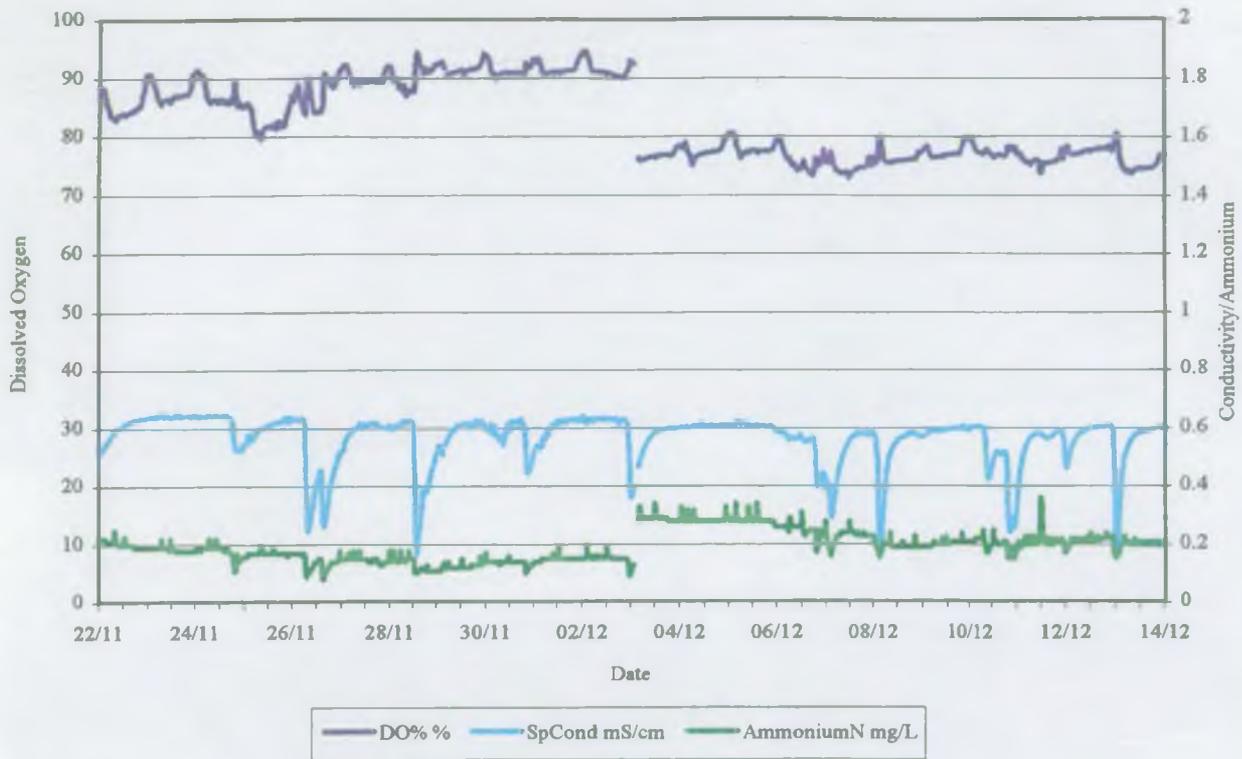
Figure 1 - Map of RAF Lyneham and local watercourses



Area drains to Lilly Brook
  Area drains to Strings W/C
  RAF Lyneham

Figure 2 - Continuous Monitor Results

Lilly Brook 1/2 kilometre D/S RAF Lyneham

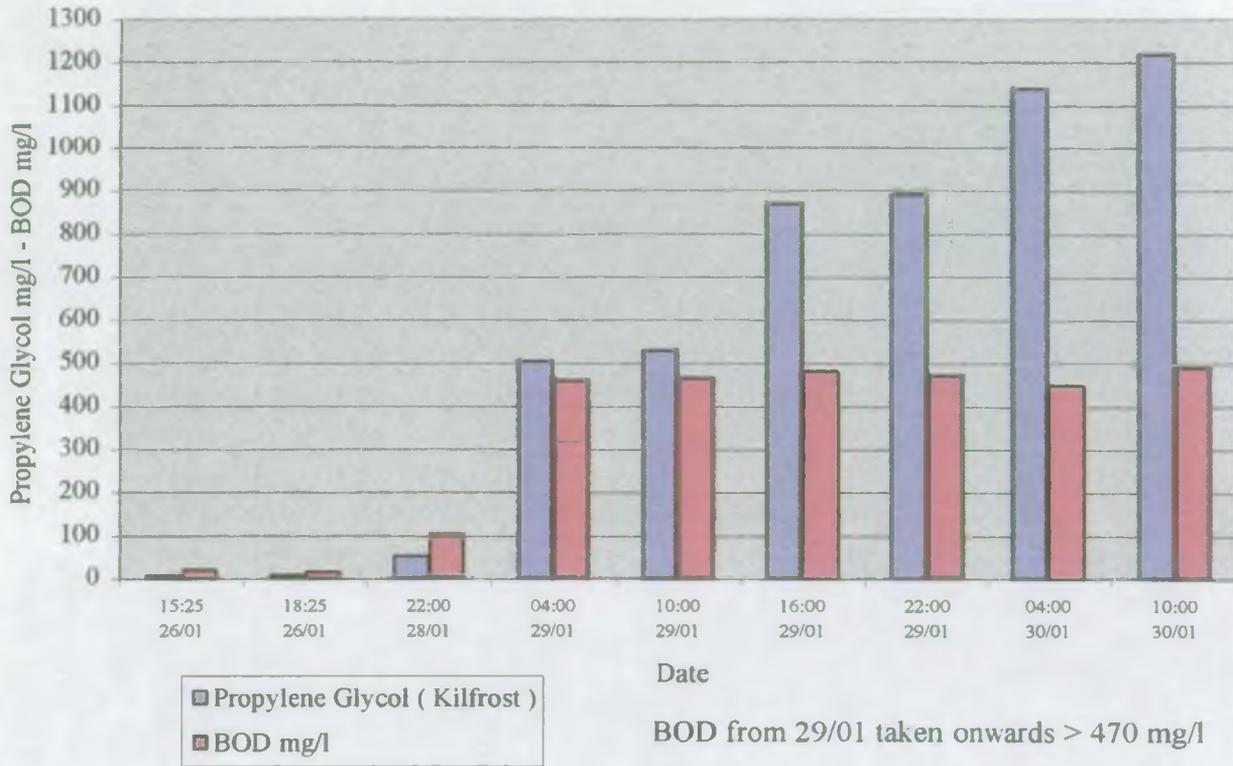


Strings Watercourse 1/2 Kilometre D/S RAF Lyneham



Figure 3 - Sample Results

RAF Lyneham - Bund Road Interceptor



RAF Lyneham - Interceptor Q

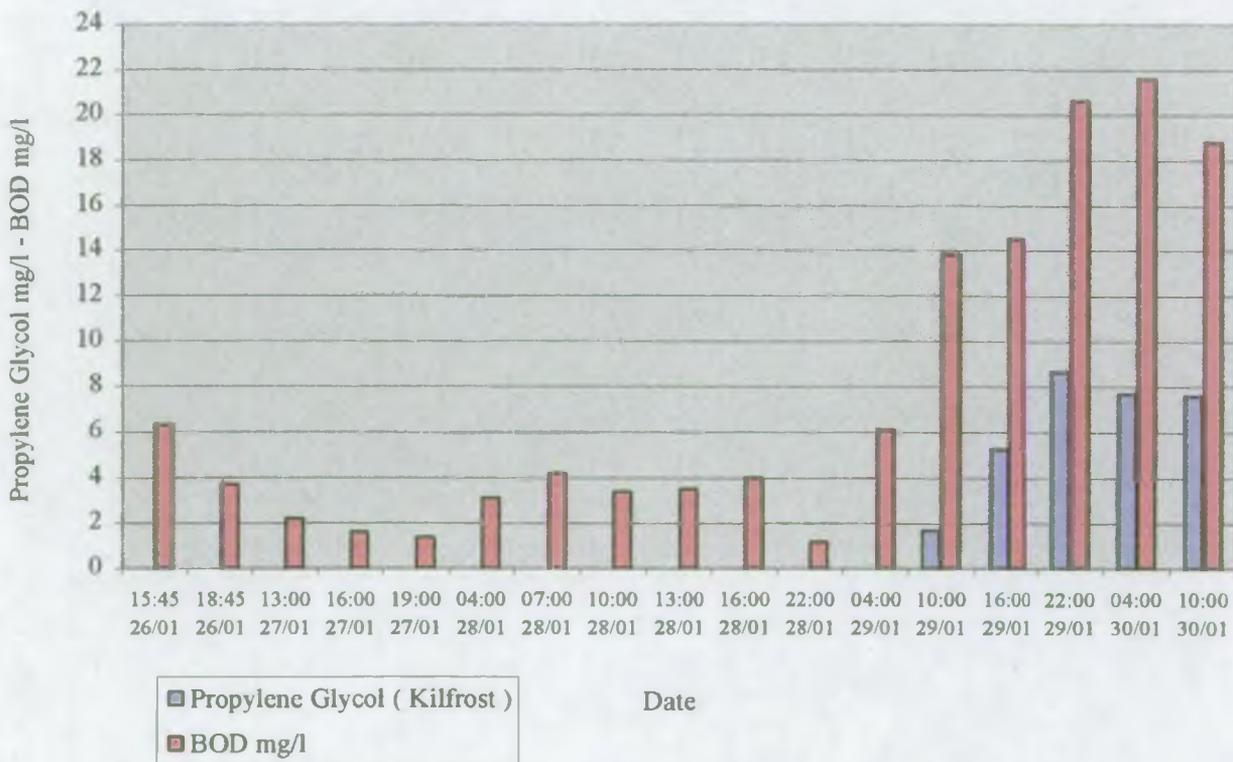


PLATE 1 – De-icing a Hercules Aircraft with Kilfrost at RAF Lyneham

