

<b>Incident Title</b>		<b>Public Water Supply Contamination</b>	
<b>Incident Type</b>		Water Pollution	
<b>Date</b>		6 <sup>th</sup> July 1988	
<b>Country</b>		UK (England)	
<b>Location</b>		Lowermoor (Cornwall)	
<b>Fatalities</b>		<b>Injuries</b>	<b>Cost</b>
1? – Ref. 2		~ 400	Unknown
<b>Incident Description</b>		<p>The Lowermoor water treatment plant receives surface water run-off from Bodmin Moor and delivers treated water to the North Cornwall distribution network, including the nearby town of Camelford. The raw water is slightly acidic (low pH) and has a relatively intense brown colour caused by presence of suspended organic matter. Pre-treatment includes addition of aluminium sulphate (<math>Al_2(SO_4)_3</math>) flocculant to remove suspended solids and dissolved organic acids, and slaked lime (<math>Ca(OH)_2</math>) to adjust the pH. On the day of the incident, a temporary (relief) tanker driver inadvertently unloaded 20 tonnes of <math>Al_2(SO_4)_3</math> flocculant into a chlorine contact tank instead of a storage tank at the unmanned Lowermoor plant. The contact tank is just upstream of the treated water reservoir, so water with a high concentration of <math>Al_2(SO_4)_3</math> was able to enter the distribution system. Aluminium (Al) is a neurotoxin at high concentrations, but the increased acidity of the water caused by the <math>Al_2(SO_4)_3</math> stripped lead (Pb) and copper (Cu) from piping in peoples' homes, increasing its toxicity. Camelford residents complained of sore throats, vomiting, bowel problems, joint pains and short-term memory loss. The water authority who operated the plant advised the public that the water was safe to drink.</p>	
 <p>Credit: British Broadcasting Corporation</p>			
<b>Incident Analysis</b>		<p><b>Basic cause</b> was accidental contamination of the treated water system by erroneous unloading of a batch of aluminium sulphate (<math>Al_2(SO_4)_3</math>) flocculant.</p> <p><b>Critical factors</b> included: 1) The treatment plant was unmanned, 2) The relief driver was unfamiliar with the plant layout and delivery procedures, 3) The contact tank and retaining tank were not labelled, 4) A common key was used for all locks including all gates, doors and tanks at the plant, 5) No landline telephone was available at the plant (mobile phones were not in common use at the time), 6) The lime dosing pump was unreliable (masked the problem), 7) The water authority failed to notify the public health authority of the severity of the incident until nearly 16 days after the incident.</p> <p><b>Root causes</b> included: 1) Inadequate monitoring (plant operation and treated water quality), 2) Inadequate training (chemical tanker drivers), 3) Inadequate risk assessment (potential for treatment chemical overdosing), 4) Inadequate emergency planning (absence of emergency procedures for chemical overdosing and emergency callout system for treatment plant staff), 5) Inadequate communication (with public health authorities).</p>	
<b>Lessons Learned</b>		<p>1) Process hazard identification and mitigation studies should be carried out on the design and operation of water treatment plants and should include consideration of worst-case scenarios (e.g. bypassing of treatment steps leading to contamination of public water supply by treatment chemicals).</p> <p>2) Chemical receipt facility designs and procedures should prevent deliveries to the wrong tank (e.g. labels, unique locks and keys, supervised deliveries).</p>	
<b>More Information</b>		<p>1) "Water Pollution at Lowermoor, North Cornwall: 2<sup>nd</sup> Report", Lowermoor Incident Health Advisory Group, Nov 1991, Her Majesty's Stationery Office, ISBN: 978-0-11321-476-1.</p> <p>2) "Subgroup Report on the Lowermoor Water Pollution Incident", Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment, Feb 2013: <a href="https://cot.food.gov.uk/sites/default/files/cot/lwpiapp811.pdf">https://cot.food.gov.uk/sites/default/files/cot/lwpiapp811.pdf</a>.</p> <p>3) Coroner's Summing Up - Appendix 20 of the Subgroup Report (Ref. 2): <a href="https://cot.food.gov.uk/sites/default/files/cot/rwpiapp20.pdf">https://cot.food.gov.uk/sites/default/files/cot/rwpiapp20.pdf</a>.</p>	
<b>Industry Sector</b>		<b>Process Type</b>	<b>Incident Type</b>
Water		Water Treatment	Water Pollution
<b>Equipment Category</b>		<b>Equipment Class</b>	<b>Equipment Type</b>
Not equipment-related		Not applicable	Not applicable