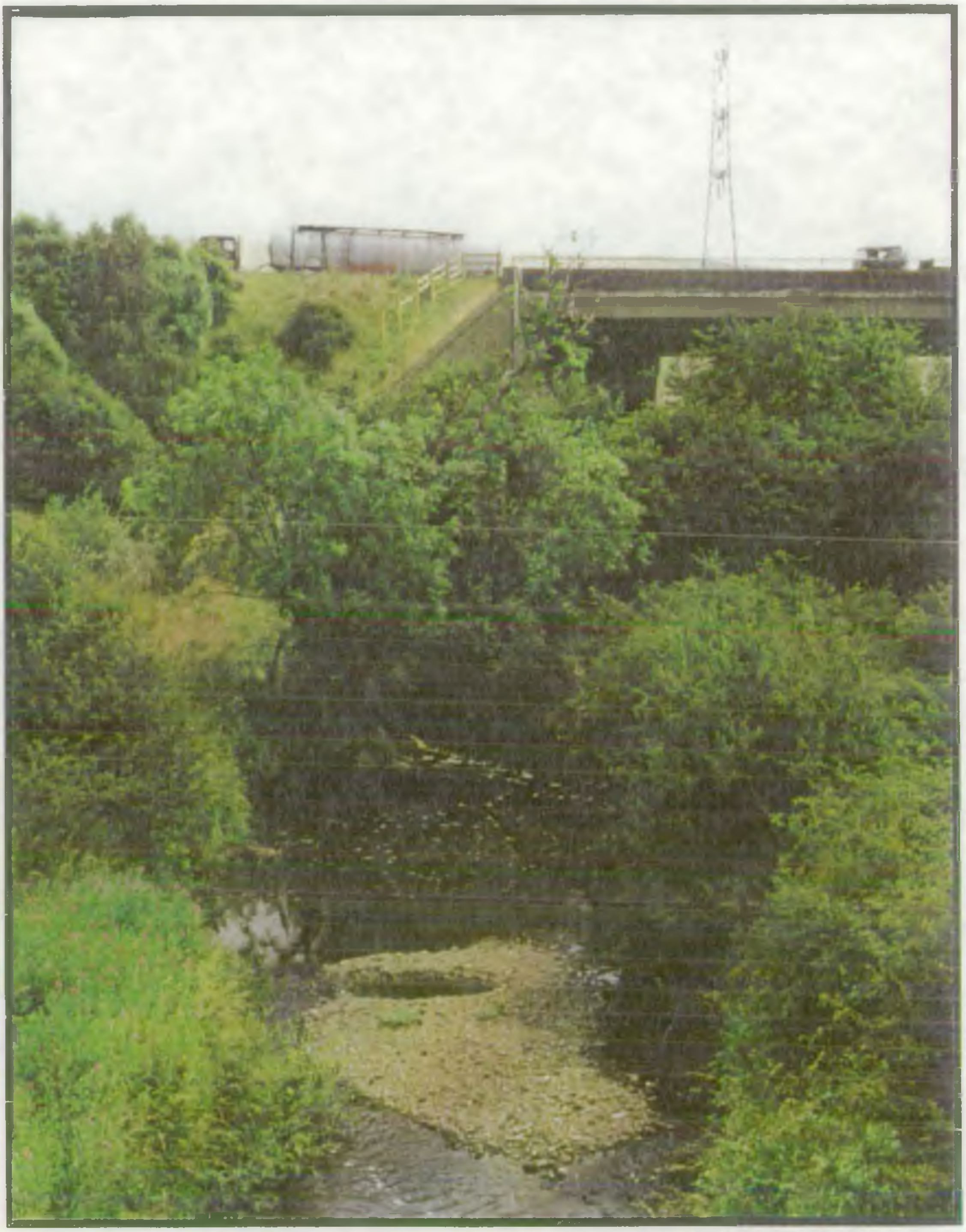
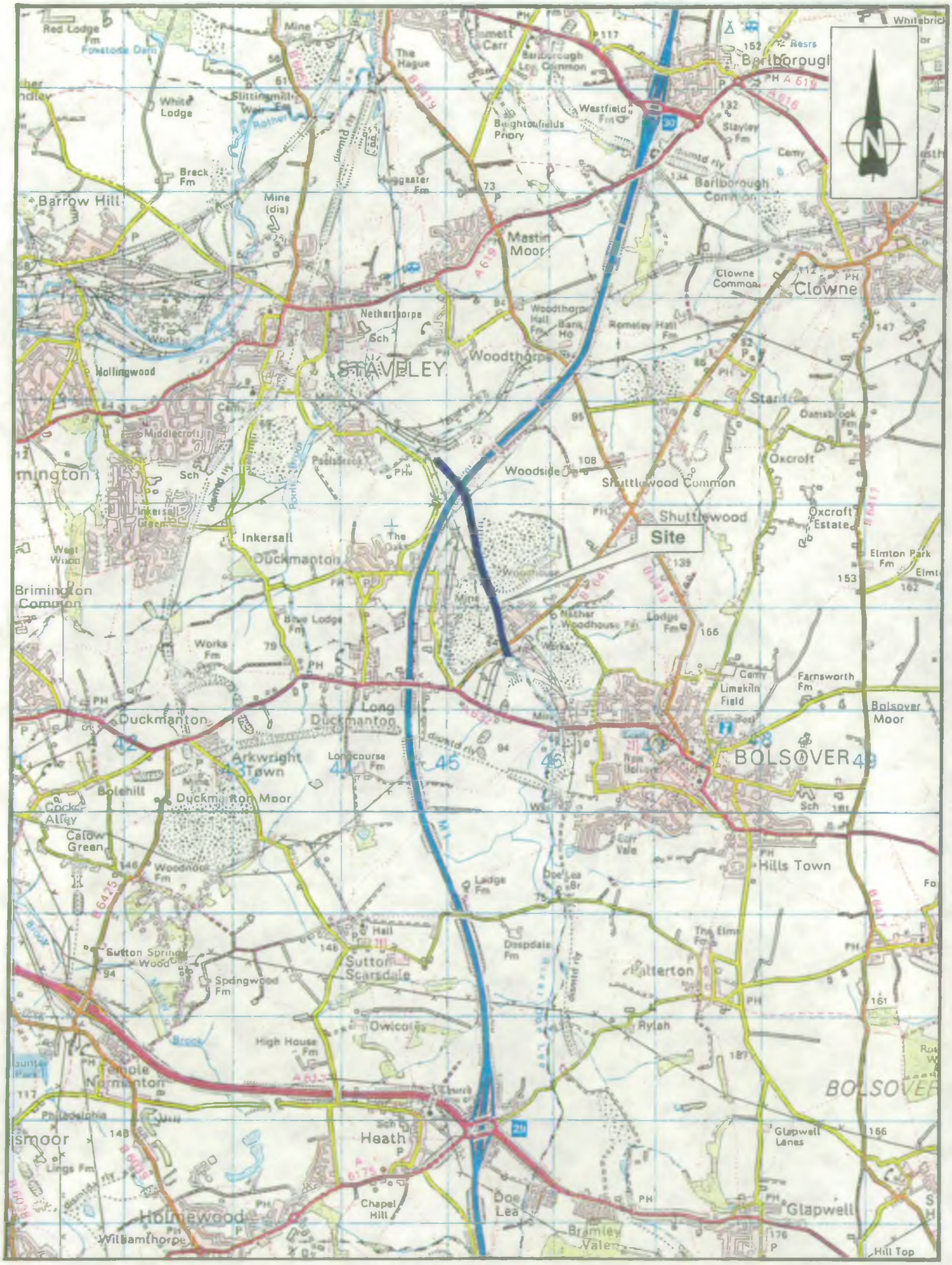
NRA Water Quality 34

NRA

Dioxins and the River Doe Lea



Plain English Report



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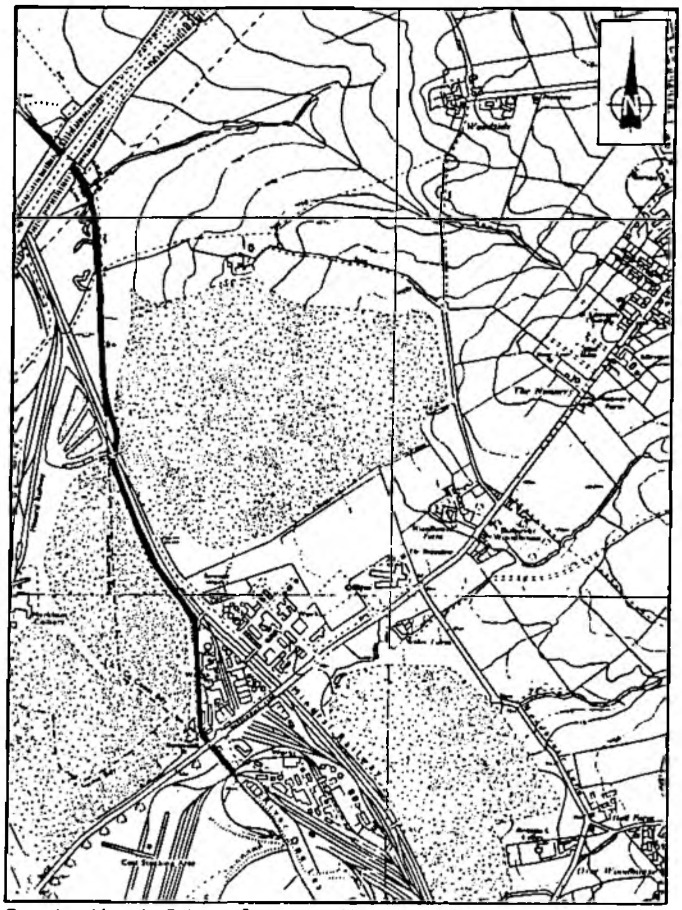
Site Location

***Front cover:** The Doe Lea as it flows under the M1*

Dioxins and the River Doe Lea

Description of the River

The River Doe Lea rises near the village of Tibshelf Wharf and then flows north through Stanley before entering the grounds of Hardwick Hall. It then continues north through the mining area, roughly parallel with the M1 motorway, passing through the village of Doe Lea and west of Bolsover. It is in this area that the Coalite Chemicals and Coalite Fuels complexes are situated. North of Coalite, the river flows by the now disused Markham Main Colliery before passing under the M1 and continuing northwards to the east of Staveley.



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Location Map

River Doe Lea Study Area

Over the length of river that has been affected by dioxins, the nature of the bed of the river varies greatly. Within a short stretch, it can change from a bare rocky bed to a marshy area with plants. Some sections have also had colliery waste and building material tipped in. The sides of the river can range from steep cuttings lined with wire boxes filled with rocks to shallow grassy slopes with bushes and flowers. From immediately upstream of the M1 to the confluence with the River Rother, the river valley widens out with fields that can flood during winter and which contain several ponds.

The river has a long history of industrial exploitation and neglect but in spite of this there is evidence of improving aquatic life in the river upstream of Buttermilk Lane. There still remains very little aquatic life between Buttermilk Bridge and the confluence with the River Rother. By contrast, the banks of the river contain many trees, bushes and other plants and the nearby ponds also contain much wildlife.

History and Industrial Background

In the middle of the 19th century the land round the river was nearly all farmland with only the Midland Railway crossing the river to terminate at Buttermilk Lane.

By the turn of the century, Markham Colliery had started working with two small tips by the shaft-tops. A branch line had been built running parallel with the river and connecting Markham Colliery to the main railway line which was now extended to Bolsover Colliery which had also opened. Two weirs and a footbridge had been built across the river between Buttermilk Lane. In the early part of the century, the river was diverted from its original route which runs through the Markham Colliery site to its present route some 150 yards to the east. This was presumably carried out to allow the extension of the colliery headworks.

Through the early part of the 20th century the colliery and associated chemical works continued to expand. By the end of the Second World War, the northern colliery tip had extended and now was close to the river. Drainage ditches ran from both the northern and southern colliery tips into the river with a pumping engine next to the river by the northern tip. Two reservoirs had also been built to the east of the river and development work had started on what is now the Coalite works.

Through the 50s and 60s, the Coalite plants continued to develop and expand with the chemical works being to the north of Buttermilk lane and the smokeless fuel plant to the south. The colliery tips continued to increase with lagoons being dug to the north of Markham and west of the river. Markham Colliery closed in 1994 and there has been some levelling and contouring of the site.

Throughout recent times the River Doe Lea has been greatly affected by coalworking, not only because of the buildings and industrial works being carried out on its banks, but also by extensive mining subsidence. It is now being increasingly affected by open cast mining operations.

What are dioxins?

Dioxin is the name generally used to refer to a group of 210 similar chemical compounds. Within this group there are 75 polychlorinated dibenzo-p-dioxins (called dioxins) and 135 dibenzofurans (called furans). Only 17 out of the 210 are thought to pose a risk to human health because of their poisonous nature and ability to cause cancer.

They do not occur naturally but can be created whenever anything containing chlorine is burnt. They are created in natural occurrences like forest fires but the greatest sources of dioxins are industrial works. None are produced intentionally and they have no known use. Dioxins are present all over the country but at extremely low levels.

Once they have been created, they only decompose extremely slowly and they are very difficult to destroy effectively. They do not dissolve in water but instead stick to the particles of silt and sediment in the water or on the bed of the river.

How do we measure the strength of dioxins?

The strength of dioxins in a sample is given by its international toxic equivalence value (iTEQ) which is measured in nanograms per kilogram (ng/kg).

International Toxic Equivalence (iTEQ)

iTEQ is the measure of the strength of dioxins in a sample. The strength of each dioxin relative to the strength of the strongest dioxin, which has the chemical formula 2.3.7.8. - TCDD, has been calculated by research carried out throughout Europe. This ratio is called the International Toxic Equivalent Factor (iTEF).

To work out the iTEQ of any sample: the weight of each type of dioxin is multiplied by its iTEF. All these values are then added together to give the iTEQ.

Nanograms per kilogram: One nanogram per kilogram is the equivalent of one teaspoon in 16 standard swimming pools each 25 m long *or* if one nanogram was ten inches long, one kilogram would stretch 10 times round the earth.

For example, a one kilogram sample contains:

Dioxin	Weight ng/kg	iTEF	iTEQ	Description
2378-TCDD	30	1	30	Highly toxic
12378-PeCDD	20	0.5	10	Moderately toxic
123478-HxCDF	10	0.1	1	Low toxicity
		Total	41	

Therefore the total i TEQ of the sample is 41 nanograms per kilogram

What action can the National Rivers Authority take over dioxins?

Under the powers given to it by the Water Resources Act 1991, the National Rivers Authority can take action only when pollution can get into a stream or river and is likely to cause damage to the life of the river.

This means that the National Rivers Authority does not have the power to act on pollution on the river bank where this is unlikely to get into a stream or river. Dioxins, by their very nature, stick very firmly to soil particles and will only get into a river where the soil gets washed in. As only a small amount of soil normally gets washed in, the dioxin concentrations are likely to be caused by this are very low.

The National Rivers Authority looks after the river and its life. Human health concerns are looked after by the Environmental Health Departments of the local councils. The National Rivers Authority has close contacts with environmental health officers and passes on all its sample results on dioxins.

The two Councils who look after the area through which the Doe Lea passes are:-

Bolsover District Council, Sherwood Lodge, Bolsover, Chesterfield S44 6NF	and	Chesterfield Borough Council, Town Hall, Chesterfield S40 1LP
tel 01246 240 000		tel 01246 277 232

What levels are normally found in rivers?

Testing rivers for dioxins has been carried out only where there has been a problem. In England and Wales, testing has been carried out only since the beginning of the 1990s. Testing has also tended to concentrate on areas where a problem with dioxins was already known to exist with coverage elsewhere being extremely patchy or non existent.

One of the most comprehensive study of dioxins was carried out by the National Rivers Authority with the results being published in a research and development report (R&D Note 242, 1994). This report showed that the highest level recorded elsewhere in England and Wales was 120 nanograms per kilogram with industrial rivers tending to have levels between 20 and 100 nanograms per kilogram. However, even in this comprehensive survey only 36 sites were sampled and none of these was a known problem area with dioxins.

Doe Lea key events, 1991-1995

1991

In the summer of 1991, the Ministry of Agriculture, Food and Fisheries tested milk from the Bolsover area and found that it was contaminated with dioxins. The National Rivers Authority was alerted to this and, realising that the dioxins may also have been washed into watercourses, carried out a number of sediment samples on the streams and River Doe Lea in the area.

These samples showed that the small streams in the area contained only trace levels of dioxins but that the Doe Lea below Buttermilk Bridge was very highly contaminated.

Separate investigations carried out by Her Majesty's Inspectorate of Pollution found that the discharges into the air from the chimney on the toxic waste incinerator was the most probable source of a proportion of the dioxins in the milk from the neighbouring farms.

Samples taken in 1991	Location	iTEQ ng/kg
1 July '95	Bolsover	13
2 July '95	M1	32435
3 October '95	Bolsover	13
4 October '95	Upstream of Buttermilk Lane	10
5 October '95	Buttermilk Lane	64000
6 October '95	M1	54000
7 November '95	Netherthorpe	26000
8 November '95	Upstream of Stavely	13000

1992

In January and April 1992, further samples were taken in the Doe Lea which confirmed that the Doe Lea was highly contaminated from Buttermilk Bridge downstream to below Staveley. The National Rivers Authority was of the opinion that the most likely source of the dioxins was Coalite Chemicals and sought expert legal advice on prosecuting them.

This legal advice made two major points:-

- The samples of sediment taken so far were not legally admissible because they had not been split into three with one portion going to the possible polluter. This is known as "tripartiting" the sample. As a result of a court case heard elsewhere in the country after the 1991 and 1992 Doe Lea samples were taken, it had been ruled that unless samples had been "tripartited," they were not legally admissible as evidence. This was a change in established practice. This meant that the National Rivers Authority was unable to submit or argue that it should be allowed to bring before a court its evidence against Coalite Chemicals of dioxin pollution.
- All companies that discharge waste into any rivers require a "consent" from the National Rivers Authority to do so. Under its consent, Coalite Chemicals was allowed to discharge chemical refinery waste and dioxins were not specifically excluded from this. A strict legal interpretation of this situation was that Coalite Chemicals was allowed to discharge dioxins and could not be prosecuted for doing so.

For these reasons, the expert legal advice was that "a prosecution is unlikely to succeed." The NRA then decided to investigate options for removing the dioxin pollution and recover the costs from Coalite Chemicals through a civil court action.

Samples taken in 1992	Location	iTEQ ng/kg
1 January '92	Upstream of Buttermilk Lane	0
2 January '92	Buttermilk Lane	7700
3 January '92	M1	32000
4 April '92	Upstream of Buttermilk Lane	3
5 April '92	Buttermilk Lane	5850
6 April '92	M1	17000

1993

In March 1993 the National Rivers Authority carried out a much fuller set of sampling covering the Doe Lea in greater detail and also extending the area studied by taking some samples lower down the Rother and Don. Other incoming watercourses were also checked to make sure that they were not the source of the dioxins. Several of these samples were "tripartite" with a third of the sample being given to Coalite Chemicals as the company believed to be responsible should any pollution be found. This "tripartiting" meant the results from the samples could be used as evidence in any court case.

The samples showed that the Doe Lea between Buttermilk Bridge and Staveley was still heavily contaminated.

WRc, water experts, were appointed to advise on the effects of dioxins, ways of dealing with them and to establish whether there was a level at which no environmental effects could be detected. This is known as an Environmental Quality Standard.

Samples taken in 1993	Location	iTEQ ng/kg
1 March '93	Upstream of Glapwell	7
2 March '93	Downstream of Glapwell	6
3 March '93	Upstream of Buttermilk Lane	9
4 March '93	Buttermilk Lane	45310
5 March '93	M1	7407
6 March '93	Netherthorpe	12303
7 March '93	Downstream of Staveley Sewage Works	5145

1994

The work carried out by WRc indicated that the levels of dioxins being found in the Doe Lea could have a harmful effect on aquatic life and prevent it returning to the Doe Lea.

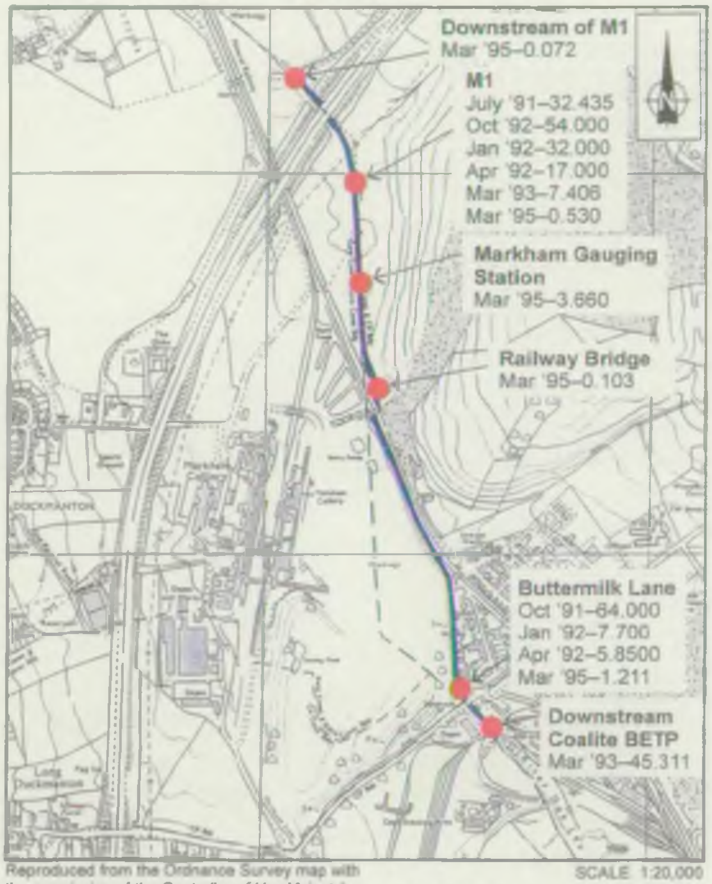
The National Rivers Authority set up a project to investigate ways of making the Doe Lea safe from the harmful effects of dioxin and, if possible, to clean up a short length of the Doe Lea. The project was also to investigate the possibilities of a civil action to recover the costs of any clean up carried out. This project was called the Doe Lea Restoration Study and the National Rivers Authority made sure that £500,000 was available to spend on it.

The Doe Lea restoration study: 1994–95

There were three main areas to the project and experts were appointed by the National Rivers Authority to advise and carry out work on each.

- The analysis of sample results and deciding where the dioxins came from.
- Eastablishing what effect the levels of dioxins have on aquatic life.
- Investigation of methods of cleaning up the river and possible risks involved.

As work on the project got under way, further samples were taken concentrating on the stretch of river between Buttermilk Bridge and the M1. The results showed a great reduction from previous levels and were as follows:-



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Note: All results in i-TEQ All samples in March '95 < 2mm particle size

Sampling Points with Dioxin Results

Samples taken in 1995	Location ng/kg	iTEQ ng/kg
1 March '95	Stainsby Mill	3
2 March '95	Glapwell	11
3 March '95	Upstream of Buttermilk Lane	18
4 March '95	Buttermilk Lane	1211
5 March '95	Railway Bridge	103
6 March '95	Markham Weir	3660
7 March '95	Upstream of M1	529
8 March '95	Downstream of M1	72
9 March '95	Mastin Moor	467

Analysis of samples—Professor Hanspaul HagenMaier, University of Tubingen, Germany

Professor Hagenmaier is one of the two foremost experts in Europe for the sources of dioxins and analysis for dioxins. He has extensive experience of the problems of dioxins and is also giving expert advice to Her Majesty's Inspectorate of Pollution in their case against Coalite Chemicals over their operation of the plant.

Professor Hagenmaier carried out all the analyses of the 1995 samples and reviewed all previous dioxin sample results. He also analysed the samples to determine how much carbon they contained as this affects how the dioxins can pass into the water life.

After the 1995 sample analyses were known, Professor Hagenmaier investigated the congener profiles or "fingerprints" of the dioxins in the river and he concluded that the dioxin pollution found in the river "must be due to Coalite Chemicals."

Dioxin "fingerprints"—the congener profile

Each industrial process or accident produces different types of dioxins and in different proportions. This is called the congener profile or "fingerprint." If two samples have the same congener profile, it is highly likely that they will have come from the same source.

For example, if four samples contained the following proportions of different types of dioxins.

	Dioxin Type 1	Dioxin Type 2	Dioxin Type 3	Dioxin Type 4	Dioxin Type 5
Sample 1	10	30	30	20	10
Sample 2	20	30	15	20	15
Sample 3	10	30	30	20	10
Sample 4	15	5	25	25	30

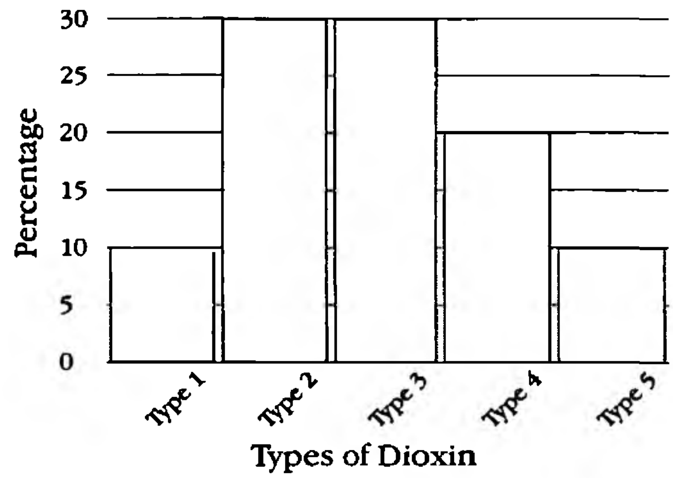
Showing these figures as bar charts demonstrates which are from the same source and which are not.

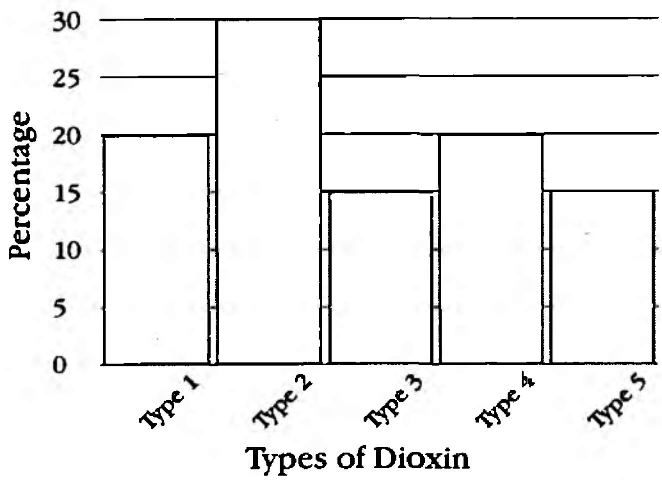
The bar charts for these examples (which are not from real life) are on the next page.

Samples 1 and 3 have the same congener profile and will come from the same source.

Other samples have similar proportions of individual dioxins but do not match completely (eg Samples 1 & 2 for dioxin types 2 & 4). They will not come from the same source.

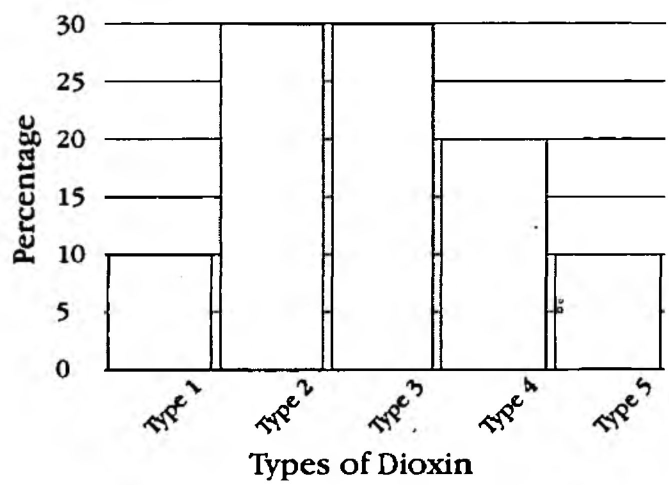
Sample One

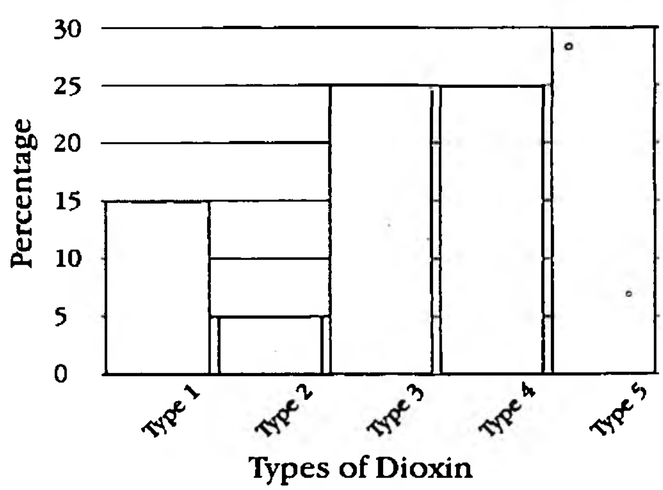




Sample Two

Sample Three





Sample Four

In reality, with over two hundred different types of dioxins and furans to consider matters are very complex. Also as dioxins from other sources enter the river, these will combine and alter the congener profile. This is rather like smudging a fingerprint by putting another fingerprint on top.

Effects of dioxins—WRc

WRc were formerly known as the Water Research Centre and are the country's leading technical experts on all matters involving water contamination. They have been in the lead of research in this field for over 30 years and have a worldwide reputation.

WRc carried out the following work on dioxins in the Doe Lea:

- Laboratory tests on sediments and how these were passed to fish
- Investigation on how the dioxins stuck to the sediments
- A detailed review of all existing knowledge of the effects of dioxin on fish.
- Investigation of how the dioxins on the sediments could pass to aquatic life and what levels could be picked up by fish in the river.
- Investigation of how different carbon levels in the sediment affected the passage of dioxins from the sediments of the Doe Lea to the aquatic life.
- The assessment of how harmful the levels of dioxins found in 1993 would be to aquatic life.
- The assessment of how harmful the levels of dioxins found in 1995 would be to aquatic life.
- An initial report on the feasibility of removing the dioxin contamination from the Doe Lea.
- Draft guideline values for safe levels of dioxins in rivers. It must be emphasised the safe values are generally ten to one hundred times lower than the levels at which harmful effects can be expected.

WRc also gave much help on dioxins and their possible sources.

WRc's work was made very much more difficult by the fact that there was little or no aquatic life in the stretch of the Doe Lea affected by the dioxin contamination. There was no aquatic life in the Doe Lea that could be tested to see what dioxin levels were in their bodies and if there had been any harmful effects. Everything that WRc did had to be built up from laboratory experiments and assessing information from elsewhere.

There are two ways in which the dioxins in the sediments can pass into the aquatic life:

- via the water
- on sediment attached to the food particles that the aquatic life eats.

As dioxins are accumulative in their effect (in other words, they accumulate in the body tissues over a lifetime) the water route was looked at in great detail as the aquatic life is exposed to dioxins via this route 24 hours a day, 365 days a year. Minute amount of dioxins pass from the sediments into the water and from there into the fish.

WRc produced four main reports :-

1. A report on the environmental hazard associated with dioxins in the Doe Lea.

   This report showed that:

   a. dioxins did not dissolve at all easily in water

   b. dioxins in rivers would tend to stick quite firmly to the sediments

   c. different types of dioxins dissolve at different rates into water.

   The main way in which the dioxins got from the sediments into the aquatic life is by dissolving in the water and being taken up via the skin and gills. However, the carbon content of the sediment is important as the dioxins stick very firmly to it. This means that high levels of carbon will attract dioxins. This leaves less dioxin in the water to be taken up by fish. The more carbon that there is, the firmer the dioxins will stick. As the Doe Lea passes through a coal mining area, it has a relatively high amount of carbon (between 1 and 5%). All available data was reviewed and a method of assessing the impact of different levels of dioxins was developed.

2. A report on guideline safe values for dioxins in river sediments

   This work led directly on from the previous report. Guideline safe values for the 17 most harmful dioxins were calculated using both the methods from WRc's first report and previously established methods which predict how much dioxin will be taken up by the aquatic life eating it. This work can be applied to all rivers not just the Doe Lea.

3. Laboratory studies on the effects of the Doe Lea Sediments.

   Sediments were collected from the Doe Lea both upstream and downstream of Buttermilk Bridge where the dioxin contamination starts. These were put into fish tanks, covered with water and fish and water insect larvae put in. After three months there was no significant effect on the fish but the insect larvae showed noticeable differences in growth and mortality from what would normally be expected.

4. Report on the options for dealing with the dioxin contamination in the Doe Lea

   This was a feasibility study to investigate whether it was possible to remove the dioxin contamination from the Doe Lea. Several methods were looked at in outline and the report concluded that methods could be developed to remove or make safe the dioxins but that much more work was needed on the safety, effectiveness and practicality of any project. This work was continued by Ove Arup (see below).

The main conclusions of WRc were:-

In 1993, in all of the Doe Lea below Buttermilk Bridge, levels of dioxins were above those where harmful effects on aquatic life would be expected. Several places were well above.

In 1995, in some places the levels of dioxins in the Doe Lea were above the levels where effects on aquatic life would be expected but other sample sites gave results below the level where an effect would be seen.

It should be noted though that when "safe levels" are set, these are between 10–100 times less than the level at which effects on aquatic life might be expected.

The best way to clean up the river—Ove Arup

Ove Arup are an international firm of consulting engineers with extensive experience in dealing with contaminated land, rivers and designing and drawing up contracts.

The instructions given by the National Rivers Authority to Ove Arup when they were appointed were:

- Prepare a study of all possible options for dealing with the dioxins in the Doe Lea.
- Recommend the works and operations which would be the best option available bearing in mind effectiveness and possible risks to the public.
- If the recommended option is shown to be safe to the public, to design and supervise the contract for the removal of dioxins from a stretch of river starting at Buttermilk Bridge. It was thought that this stretch would be 500 metres to 1000 metres long.

Ove Arup carried out a detailed investigation into the current state of the river which included:

- A site survey
- A history of how the river and surrounding land had been developed
- Investigation of sediment movement
- Investigation of river flows and how they varied
- Geology of the river and its surrounds
- Discharges to the river
- Details of water, electricity, gas and other services in the area

After the March 1995 results it was decided to concentrate on the two areas where dioxin levels were highest and which contained the most sediment. Ove Arup then went on to investigate the various practicable options for making the dioxins safe. These options divided into four main categories:

- Allowing the river to clean itself naturally
- Sealing the dioxins into the bed of the river
- Treating the dioxins whilst still in the river
- Removing the dioxins and disposing of them elsewhere.

When removal of the dioxins was considered, the options divided into a further four of concern:

- Removing the dioxins from the river
- Separating out the water and the dioxin contaminated sediment
- Transport from site
- Ultimate disposal

Where appropriate, options were considered with and without diverting the river during installation. The options considered were:

1. Allowing the river to clean itself naturally

A comparison of the 1993 and 1995 figures showed a 95% reduction in dioxin levels proving that the river was already cleaning itself. Most of this is likely to take have taken place during times of high river flow or floods when the sediments start to move. The most important elements of this option are the prevention of further dioxins entering the river and long term monitoring to make sure that levels of dioxins are decreasing.

2. Sealing the dioxins in the bed of the river

There are two main ways of doing this. Either by placing an artificial liner, such as concrete or plastic, on top of the contaminated sediments or by placing sand or clay over them. Both would be difficult to install, may well disturb the sediments and may be damaged during floods allowing the release of the dioxins. Unless the river was widened or floodbanks raised, the reduced size of the river would result in more frequent flooding.

3. Treating the dioxins whilst still in the river

In this option there were three main categories.

Bioremediation Dioxins are believed to be able to be broken down by some bacteria and fungi

Fungal Treatment This is a more recent development of bioremediation where a fungi called white rot is used to break down the dioxins

Detoxification The addition of chemicals to break down or neutralise the dioxins

All these techniques were largely unknown for use on a river and had only been used on small scale treatment of sediment that had been removed from rivers. Any such effects were not well documented and all treatments were at risk of being washed away during floods. It would also take a long time for the dioxins to be broken down.

4. **Removing the dioxins**

The dioxins can be removed from the river using:

- Dragline excavators
- Mechanical excavators
- Amphibious dredgers
- Vacuum dredging
- Jet washing

All of these techniques can be carried out by several different types of machinery all of which could work. The limitations, secondary impacts, efficiency, availability and suitability of a range of machines were considered.

Once the sediments are removed from the river, it is necessary to reduce their wetness for the following reasons:

- Ease of handling/less spillages likely
- Reduces transport costs and lorry numbers
- Makes final disposal easier

The methods compared were settlement tanks, filters, centrifuges, air drying and adding dry material.

For transport of the material from the river to where it would be disposed of, several routes and possibilities were assessed. All involved significant traffic through a number of villages or towns.

The main methods of final disposal were land fill and incineration. Land farming, rotovated treatment beds and deep treatment beds were also investigated.

All options were then compared using the following measures:

1. Definition of the works including information required, planning and management
2. Design reliability and limitations, whether it had been applied in similar circumstances to the Doe Lea
3. Novelty of method—was it tried and trusted, readily available and scientifically credible
4. Had it worked before and would it last, was it effective, did it require continued monitor and management after completion
5. Size of construction plan, how it would work operationally and the potential environmental impacts
6. Number of site staff and the health and safety aspects for workers

7. Potential for airborne release including health and safety and potential environmental impacts
8. Potential for waterborne release including health and safety and potential environmental impacts
9. Haulage length to disposal site including health and safety, potential environmental impacts
10. Costs
11. Site access, whether other permissions were needed including planning and management of the project.

When this comparison was complete Ove Arup recommended that the best and safest option was to allow the river to clean itself naturally.

Why allowing the river to clean itself naturally is the best option

- It involves the lowest overall risk to the general public.
- It involves the lowest risk to the people carrying it out.
- The river has already reduced the levels of dioxins by over 95% in four years.
- In most of the areas sampled, dioxin levels are already below levels which could be expected to harm aquatic life.

However, before the natural clean up can be certain of continuing, it is essential to ensure that future discharges of dioxins are kept well below acceptable limits. It is impossible to stop them altogether as dioxins are being formed in minute amounts all the time. The National Rivers Authority has satisfied itself that any major potential sources of dioxins now well under control.

A great deal of public concern has been expressed to the National Rivers Authority over possible discharges from Coalite Chemicals. Since 1991, the following improvements have been made to the treatment of discharges at Coalite Chemicals.

- All discharges from the factory area are taken to the on-site Biological Effluent Treatment Plant for treating before the effluent is put in the river. A storm water lagoon has been constructed which will operate during times of very heavy rain. It will prevent the Biological Effluent Treatment Plant from being overwhelmed by high flows of water. Excess water will be stored in the storm water lagoon until it can be treated after the rain has stopped.
- The Coalite Chemicals' plant has been made the subject of an Integrated Pollution Control Authorisation administered by Her Majesty's Inspectorate of Pollution in consultation with the National Rivers Authority. Under this Authorisation the plant is fully controlled and the effluent monitored on a regular basis.
- This monitoring will be reinforced by the National Rivers Authority's future monitoring of the river sediments.

One other result of the decision to allow the river to clean itself up naturally is that the National Rivers Authority will not incur any expense in cleaning the river up. There is therefore no need to take a legal case under Section 161 of the Water Resources Act for the recovery of costs.

Summary of the Doe Lea Restoration Study

The major findings of the Doe Lea Restoration Study are:-

- Allowing the river to clean itself naturally is the best and safest option.
- Up to date sample results giving a comprehensive picture of dioxins in the Doe Lea.
- Contribution to science and general knowledge of the effects of dioxins on aquatic life.
- Much better understanding of the effects and actions of contamination which sticks to sediments.
- The National Rivers Authority and its successor, the Environment Agency, is in a stronger position to deal with any future similar situation rapidly and effectively

Current state of the Doe Lea

Dioxin levels in the Doe Lea have fallen quite rapidly over the past four years but are still well above the levels normally associated with this type of river.

The overall health of the river depends on more than just the levels of dioxins. The National Rivers Authority is pleased that, because of its efforts to encourage and enforce improvements to other discharges to the Doe Lea, the health of the river is showing distinct signs of improvement. Recent successes have been:-

- Staveley Sewage Treatment Works has been rebuilt with a new, much tighter discharge consent agreed by the National Rivers Authority and Yorkshire Water. Levels and volumes of pollution have been greatly reduced.
- The operation of Coalite Biological Effluent Treatment Plant has been significantly improved with a reduction in the discharges of organic chemicals, ammonia and solids.
- The stopping of the discharge of minewaters from Markham and Bolsover pits which had previously discharged lots of saltwater into the Doe Lea.
- Several unconsented discharges from Holmewood Industrial Estate have been identified, tested and cleaned up.
- There has been an improvement in the discharge of water draining out of Glapwell Tip, particularly a reduction in the ammonia being discharged.

The Doe Lea flows into the River Rother near Renishaw. The quality of the Rother is now recovering rapidly. Fish were introduced into what had been a fishless river for many decades in 1994. A survey in 1995 showed that these fish were doing very well and had grown significantly in size. Equally encouraging was the evidence that roach and gudgeon were already breeding.

Future monitoring and public reporting

The National Rivers Authority has drawn up a Catchment Management Action Plan for all the rivers in the Don, Rother and Dearne. This includes the river Doe Lea. The Management Plan was drawn up and agreed after detailed consultation with local authorities, amenity and environmental groups and the general public. It will form the basis for improvement to the water environment by outlining areas of work and investment by the National Rivers Authority and others. The Plan outlines the next five years and will be reviewed and reported on every year. It will be improved and amended wherever possible.

The action identified in the Plan for the Doe Lea are:

- Review the consent for Bolsover Sewage Treatment Works
- Update the sewage overflows discharging into the Doe Lea
- Monitor Glapwell tip and ensure conditions are complied with
- Work with Derbyshire Waste Limited to reduce potential pollution threat from Glapwell Tip
- Improve quality of minewater discharged from Cresswell
- Work at Coalite Chemical and Coalite Fuels to improve quality of discharges.

Those actions which involve Yorkshire Water have been incorporated into their future works programme.

Future Monitoring

The National Rivers Authority has made a firm commitment to monitor they levels of dioxins in the Doe Lea until they reduce down to levels which would normally be expected in this type of river.

Although levels of dioxins have reduced by over 95% in the past four years, it is not possible to predict when normal levels will be achieved. This is because the dispersion of sediments by any river is extremely complex as well as depending greatly on the number and frequency of minor floods.

The type and frequency of the monitoring will need to be adjusted as more becomes known about the dioxins and how they are dispersing. The National Rivers Authority will inform the general public of the results of the monitoring by two methods:

- Placing all results on the National Register. This is a register maintained and updated by the National Rivers Authority and contains the results of all tests taken by the National Rivers Authority on the rivers. There is free access to information but a charge may be made if copies are required of any results. To view this data, contact the local office of the National Rivers Authority. For information on the Doe Lea and other rivers in the Don and Rother catchments, please contact:

  National Rivers Authority,
  Northumbria & Yorkshire Region,
  Olympia House,
  Gelderd Lane,
  Gelderd Road, Tel:- 0113 244 0191
  Leeds LS12 6DD Fax:- 0113 231 2116

- Passing the results of all monitoring to the local authorities as soon as the results are known and verified. The local authorities are:

  - District of Bolsover
  - Chesterfield Borough Council
  - Derbyshire County Council
  - North East Derbyshire District Council
  - Old Bolsover Town Council
  - Staveley Town Council

In addition, the results will also be sent direct to the local Environmental Health Departments who look after human health.

In looking at the overall state of the Doe Lea and ensuring that the improvements seen over the past four years are maintained and continued, the National Rivers Authority is well aware that the issue of dioxins is only part of the overall picture. Other pollutants need to be reduced and the National Rivers Authority is working with companies, local authorities, community and local interest groups to ensure that this reduction takes place as soon as practicable.

However, accidental pollution can still occur at any time and the quicker it is reported to the National Rivers Authority, the quicker it can be dealt with and the less damage is likely to occur.

To report any problems or worries about possible pollution, please use the National Rivers Authority Free Emergency Hotline on: 0800 80 70 60.

Summary of all sediment sample results taken to date

Numbers are the iTEQ in nanograms per kilogram.

Location	July 1991	Oct/Nov 1991	Jan 1992	April 1992	March 1993	March 1995
Upstream of Glapwell (Stainsby Mill)				7	3	
Downstream of Glapwell					6	11
Bolsover	13	13				
Upstream of Buttermilk Lane	10	0	3	9	18	
Downstream of Buttermilk Lane		64000	7700	5850	45310	1211
Railway Bridge						3660
Upstream of the M1	32435	54000	32000	17000	7407	529
Downstream of the M1						72
Netherthorpe		26000			12303	
Mastin Moor (downstream of Staveley)		13000				467
Downstream of Staveley Sewage works				5145		

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