Stanford in the Vale Closed Landfill Site

Introduction

Stanford in the Vale closed landfill is a large site centred on NGR SU328939. It is located 2 km to the west of the village of Stanford in the Vale, and is roughly triangular in shape. The southern boundary is formed by the A417, the west boundary by the B4508 and arable farmland lies to the east.

The actual area of landfill is shown edged in red on the plan in Appendix 1. The landfilled area is north west of the land that the Parish Council are interested in (see Appendix 2). This land is immediately adjacent to the landfilled area, there are no records that suggest any waste materials were deposited on the land the Parish Council are interested in.

Landfilling commenced in the late 1960s and continued with a break in the mid-1970s until 1994. The site received domestic, industrial and commercial wastes including very low level radioactive wastes primarily from Oxford University and local hospitals. The site has been restored to a domed profile with a soil cap.

A landfill gas extraction system was installed on the site in 1996 and gas is currently collected through a network of pipework and flared on site.

Water entering landfill sites can pass through the waste to create a liquid referred to as leachate. Leachate has the potential to pollute and can contain a variety of different chemical compounds. The landfill at Stanford was built on a “dilute and disperse” basis. Essentially this means that water can pass through the site and pollutants are transported, diluted and dispersed into the surrounding environment. This was common practice at the time the site was active, however, modern sites are no longer built on this basis as it is now recognised that it is better to contain the leachate within the site and remove if for treatment.

The movement of water through the site is influenced by the amount of rainfall, gravity, the surrounding geology and level of the surrounding groundwater. The environmental risk from leachate pollution is greatest with respect to the surrounding groundwater. It should not affect activities at ground level. Surface water bodies near to the landfill site are also monitored to ensure they are not being impacted on by the site.

As the landfill site was operated under the dilute and disperse principle, monitoring is undertaken to ensure that elevated levels of landfill gas or pollution to the water courses do not breach recommended levels.

Although the site is not regulated by an Environmental Permit – it closed prior to the publication of the Waste Management Licencing Regulations (1994) – Oxfordshire County Council conducted a risk assessment in the late 1990’s to assess the potential environmental risks posed by all former landfill sites for which it has responsibility. Stanford-in-the-Vale was selected, along with 9 other sites, as having the potential to cause pollution and a scheme was developed to monitor landfill gas, leachate, groundwater and surface water around the site.

Each quarter, gas samples are taken from 40 boreholes around the outside of the site to check that landfill gas is not escaping from the site. Additional gas boreholes are sampled on a 6-monthly basis.

17 groundwater and 9 leachate samples are taken every 6 months and sent to a laboratory for chemical analysis. In addition, samples of surface water are taken from locations around the site to determine whether the landfill site is polluting local water bodies.

Potential sources of contamination

Landfill gas

Landfill gas is produced by landfills sites through the decomposition of waste in the absence of oxygen. Landfill gas consists predominantly of methane and carbon dioxide. It is flammable and potentially explosive where atmospheres contain between 5 and 15% methane combined with sufficient concentrations of oxygen.

Methane can also impact on human health as it is an asphyxiant if allowed to accumulate to sufficient concentrations in a confined space.

A landfill gas extraction system was installed on the site in 1996 and the gas is currently collected through a network of pipework and flared on site. Flaring the gas in a controlled manner converts the methane to carbon dioxide. This reduces the risk of fire/explosion and reduces the possibility of gas migrating off-site.

The Council maintains the flare through weekly site checks, monthly servicing and monthly landfill gas field balancing (ensuring the flare performance is maximised). To monitor the performance of the flare and to assess whether any landfill gas is escaping from the site, samples are taken from boreholes around the edge of the site. The boreholes are drilled deep into the ground and a mobile gas analyser is used to detect quantities of methane, carbon dioxide, carbon monoxide, hydrogen sulphide and oxygen in each borehole.

The area of land the Parish Council is interested in contains a number of boreholes where samples are taken from. The location of these can be seen in Appendix 1 – the boreholes are:

- BH13
- BH20
- BH7
- BH5D
- BH5S
- NGBH31
- BH6
- BH3D (not currently sampled)
- BH3S (not currently sampled)
- BH12

- BH21
- BH22

The following boreholes are just off the plan but will still be considered here:

- BH10
- BH45 (not currently sampled)
- BH40 (not currently sampled)

To monitor the impact of the landfill, the Council monitors landfill gas concentrations at the perimeter of the site on a quarterly basis. The concentrations of methane measured in those boreholes over the last six and a half years are presented in the table below. The figures are the measured concentrations of methane by volume (%).

Date	BH10	BH12	BH13	BH20	BH21	BH5D	BH5S	BH6	BH7	NGBH31
27/01/2006		0								
19/04/2006	0	0	0	0	0	0	0	0	0	
18/10/2006	0		0	0	0	0	0	0	0	
27/04/2007			0	0	0	0.3	0	0	0	
24/07/2007		0								
25/10/2007	0	0	0	0	0	0	0	0	0	
21/01/2008		0								
10/04/2008	0	0	0	0	0	0	0	0	0	
09/07/2008		0								
07/01/2009	0	0	0.1	0	0	0	0	0	0	
09/04/2009	0	0	0.1	0	0	0	0	0	0	
30/07/2009		0								
22/10/2009	0	0	0			0	0	0	0	
15/04/2010	0	0	0	0	0	0	0	0	0	0
15/07/2010		0								0
20/10/2010		0				0	0			0
21/10/2010	0		0	0	0			0	0	
10/01/2011	0			0	0.1			0		
01/04/2011	0	0	0	0	0	0	0	0	0	0
13/07/2011	0			0	0			0		
27/10/2011	0	0	0	0	0	0	0	0	0	0
27/01/2012	0			0	0			0		
16/04/2012	0	0	0	0	0	0	0	0	0	0
16/07/2012				0.1	0.1			0.1		
09/08/2012	0									
09/10/2012	0		0	0	0	0	0	0	0	0

Methane has not detected in the vast majority of samples taken from the boreholes. There are a number of gaps in the data, for example some of the older monitoring rounds only sampled BH12 at certain times of the year. Ad-hoc data gaps are where the technician has been unable to locate a specific borehole or where there may have been a fault with a borehole.

An Environment Agency document entitled ‘Guidance on the Management of Landfill Gas’ (LFTGN03 EA, 2003) sets a recommended maximum methane concentration for the edge of a site to be 1.0% by volume. All the readings taken at Stanford are beneath this level suggesting that landfill gas is being effectively prevented from

migrating off-site and the Council believes that the readings of 0.1% may be caused by instrument error. If higher readings were to be detected, then more monitoring would be undertaken.

Landfill leachate

Leachate is liquid that can accumulate in landfill sites as the waste decomposes and may contain pollutants from the waste. Samples are taken from boreholes within the waste mass and analysed every six months. It is expected that samples taken from these boreholes will contain pollutants. A range of chemical compounds are tested for. These results provide an indication as to what contaminants to look for in the surrounding groundwater.

Groundwater quality

The leachate results indicate that the landfill site is a source of pollution. As the site is built on 'dilute and disperse' principles, it is expected that some of the pollution will be diluted and dispersed into the wider environment. To understand how pollution might leave the site, it is essential to assess the direction that groundwater flows through the site. It is understood that groundwater flows from the west to east and so it is expected that samples taken from boreholes to the west of the site would be unlikely to be impacted by the landfill whereas samples taken to east of the site may be impacted by the site.

Ammoniacal nitrogen and chloride are key determinands when looking at contamination from landfill sites. The Water Supply (Water Quality) Regulations (2000) sets standards that drinking water must adhere to. The regulations set a limit of 0.5 mg/l ammonia for drinking water. This limit converts to an equivalent standard for ammoniacal nitrogen of 0.39 mg/l. The limit for chloride is 250mg/l.

Samples taken from boreholes BH16, NGBH26, NGBH27, NGBH28 and NGBH29 between April 2006 and October 2011 generally showed ammonical nitrogen concentrations below the Drinking Water standard. Borehole NGBH29 is closest to the waste mass and has shown concentrations in breach of the Drinking Water standard the most recent breaches were in October 2008 (1.59 mg/l) and October 2011 (0.853 mg/l).

In contrast, the monitoring data for the boreholes sampled from the area the Parish Council are summarised in the table below:

Ammoniacal Nitrogen (mg/l)	**BH5D**	**BH5S**	**BH6**	**BH7**	**BH10**	**BH12**	**BH13**	**BH20**	**BH21**	**BH22**	**NGB H31**
Apr-06	5.65	<0.04	0.91	11.1	<0.04	<0.04	19.9	45.1	<0.04	0.17	
Oct-06	0.7		0.16	0.11	<0.04		20.7	86		<0.04	
Apr-07	0.33		0.04	0.74	<0.04		29.5	27	<0.04		
Oct-07	<0.04	<0.04	<0.04	1.81			29.3	30	1.73	3.77	
Apr-08	<0.04	<0.04	<0.04	0.06	<0.04	<0.04	30.6	16.7		<0.04	
Oct-08	<0.04	<0.04	0.25	0.41	<0.04	<0.04	33.2	25.5	<0.04	<0.04	
Apr-09	0.53		<0.04	0.65	<0.04	<0.04	29.6	21.1	<0.04	<0.04	

Oct-09	2.15	0.52	<0.04	0.19	0.12	<0.04	33.8	29.8		0.17	
Apr-10	< 0.4		< 0.4	< 0.4	< 0.4	<0.04	22	3.1	< 0.4	< 0.4	
Oct-10		< 0.4	0.4	0.5	< 0.4	<0.04	50	29	< 0.4	< 0.4	< 0.4
Apr-11	<0.4		<0.4	3.54	<0.4	<0.4	54	33.5	<0.4	<0.4	<0.4
Oct-11	3.11			5.74		<0.2	59.3		<0.2	<0.2	

Results for BH13, immediately adjacent to the landfill, consistently show elevated levels of ammoniacal nitrogen. Results from BH20, and to a lesser extent BH7, are also consistently in excess of the Drinking Water standard. These boreholes are in a line to the east of the landfill suggesting that pollution from the site is migrating in the direction of groundwater flow and that the concentrations are reducing through dilution as the groundwater flows away from the site. The majority of the other samples taken since 2006 from boreholes across the area of land the Parish Council are interested have not shown notably elevated ammoniacal nitrogen concentrations.

The trend for chloride concentrations is similar in that readings are highest in samples taken from boreholes BH13 and BH20 and lower in BH7. However, few of the concentrations are above the Drinking Water standard of 250 mg/l for chloride.

Chloride (mg/l)	**BH5D**	**BH5S**	**BH6**	**BH7**	**BH10**	**BH12**	**BH13**	**BH20**	**BH21**	**BH22**	**NGB H31**
Apr-06	287	13	153	76	55	201	293	311	35	165	
Oct-06	56		138	149	53		276	304		147	
Apr-07	59		131	100	155		270	289	84		
Oct-07	11	14	160	137			282	263	135	170	
Apr-08	4	14	405	96	47	408	260	228		180	
Oct-08	5	14	234	76	63	130	228	288	26	140	
Apr-09	285		111	65	64	129	223	231	15	133	
Oct-09	278	10	119	78	75	182	198	309		145	
Apr-10	<5.0		230	150	82	140	230	320	20	140	
Oct-10		<5.0	150	130	63	130	230	280	11	150	130
Apr-11	9.7		131	148	66.7	120	209	254	30.6	196	137
Oct-11	206			168		192	174		29.1	207	

The groundwater results show that although the landfill is impacting on the quality of the groundwater directly to the east of site, this is as expected with the operation of a dilute and disperse landfill site and the concentrations decline further away from site.

Elevated concentrations of other parameters analysed for were not detected in these boreholes.

Groundwater levels

The following table shows the level of the water beneath the surface of the site at each borehole.

Water level (m below surface)	**BH5D**	**BH5S**	**BH6**	**BH7**	**BH10**	**BH12**	**BH13**	**BH20**	**BH21**	**BH22**	**NGB H31**

Apr-06	5.83		5.42	5.84	6.45	2.70	6.82	6.76	3.21	5.18	
Oct-06	6.98	6.60	6.31	6.62	6.92		7.27	7.59	4.03	6.88	
Apr-07	6.89	5.98	5.12	5.54			6.24	6.48	2.86	4.77	
Oct-07	6.82	6.59	4.68	5.69		1.98	5.87	6.46	2.98		
Apr-08	5.52	4.56	4.22	5.18	5.44	1.41	5.49	6.03	4.27	4.35	
Oct-08	5.89	6.11	4.87	5.61	5.97	2.27	5.70	6.31	3.14	4.91	
Apr-09	5.36	5.44	3.97	5.07	5.18	1.34	5.08	5.74	2.38	5.46	
Oct-09	5.73	6.09	5.20	6.01	6.44	2.59	6.01	6.61	3.43	5.39	
Apr-10	5.98	6.10	5.68	4.70	6.17	2.60	6.35	6.64	3.18	5.18	8.65
Oct-10	6.63		6.42	6.35	6.72	3.60	6.77	7.18	3.80	6.70	5.18
Apr-11	6.55		6.42	6.24	6.64	3.10	7.11	7.28	3.61	5.64	9.14
Oct-11	7.3		6.89	6.90	7.35	3.95	7.70	7.85	4.65	6.30	

The groundwater level data shows that the groundwater has been typically 5 metres below ground level when monitored over the last 6 years. There is some variation between boreholes with the obvious exceptions being BH12 where readings in April 2008 and 2009 found the groundwater to be 1.41 metres and 1.34 metres respectively.

As the groundwater is some depth below the ground, it is unlikely that it will have transported any pollution from the landfill to the surface of the site.

Surface water

As well as monitoring the groundwater and leachate below the site, samples are taken from a number of surrounding surface water bodies and analysed. The locations of the surface water sampling points are shown in Appendix 3.

Ammoniacal Nitrogen (mg/l)	SW1	SW3	SW4 (quarry)	SW5	SW6
Oct-06			<0.3	<0.3	<0.3
Apr-07			0.8	<0.3	<0.3
Oct-07			<0.3	<0.3	<0.3
Apr-08			<0.3	<0.3	<0.3
Apr-09			<0.3	<0.3	<0.3
Oct-09			<0.3	<0.3	<0.3
Apr-10	<0.4	<0.4			
Oct-10	<0.4	<0.4	<0.4	0.48	<0.4
Apr-11	<0.4	<0.4	<0.4	<0.4	<0.4

Only 2 of the samples were slightly greater than the drinking water standard of 0.39mh/l. The breach in 2007 was from surface water collected from the adjacent quarry and a further minor breach in 2010 was some distance from the site which may not be related to the landfill site.

There is therefore no consistent evidence from the surface water data that the landfill is polluting surrounding water bodies

Contaminated soil

The land the Parish Council is interested in is not known to be directly in contact with the waste mass. It is therefore unlikely that soils will be contaminated. However, the Council has not conducted any soil testing to confirm this.

Summary

- The landfill site generates both landfill gas and leachate which could have the potential to pollute.

- The monitoring data for landfill gas indicates that the landfill gas extraction system is working effectively and preventing landfill gas from migrating into the area of land the Parish Council are interested in.

- There is evidence from analysis of water samples that the groundwater contains elevated levels of key indicators which could be coming from the landfill site, this is as expected with a dilute and disperse site, but as the water is well beneath the surface of the ground, there is little chance that the pollution will be present at the surface of the site.

- The surface water samples indicate that the water courses are not contaminated.

- The land is not known to be directly in contact with the waste mass. It is therefore unlikely that soils will be contaminated.