Industrial Landfill Remediation

Badnells Pit and Sandford Farm Landfill Case Studies

University Place, Manchester

David Jacob, Technical Director, RSK Environment Ltd

Summary

- Part 1 - Introduction - Why Landfills?
- Part 2 - Case Studies.
  - Badnells Pit.
  - Sandford Farm.
- Part 3 - Perception in the Community.
- Part 4 - Lessons Learned.

Part 1

Introduction - Why Landfills?

Why Landfills?

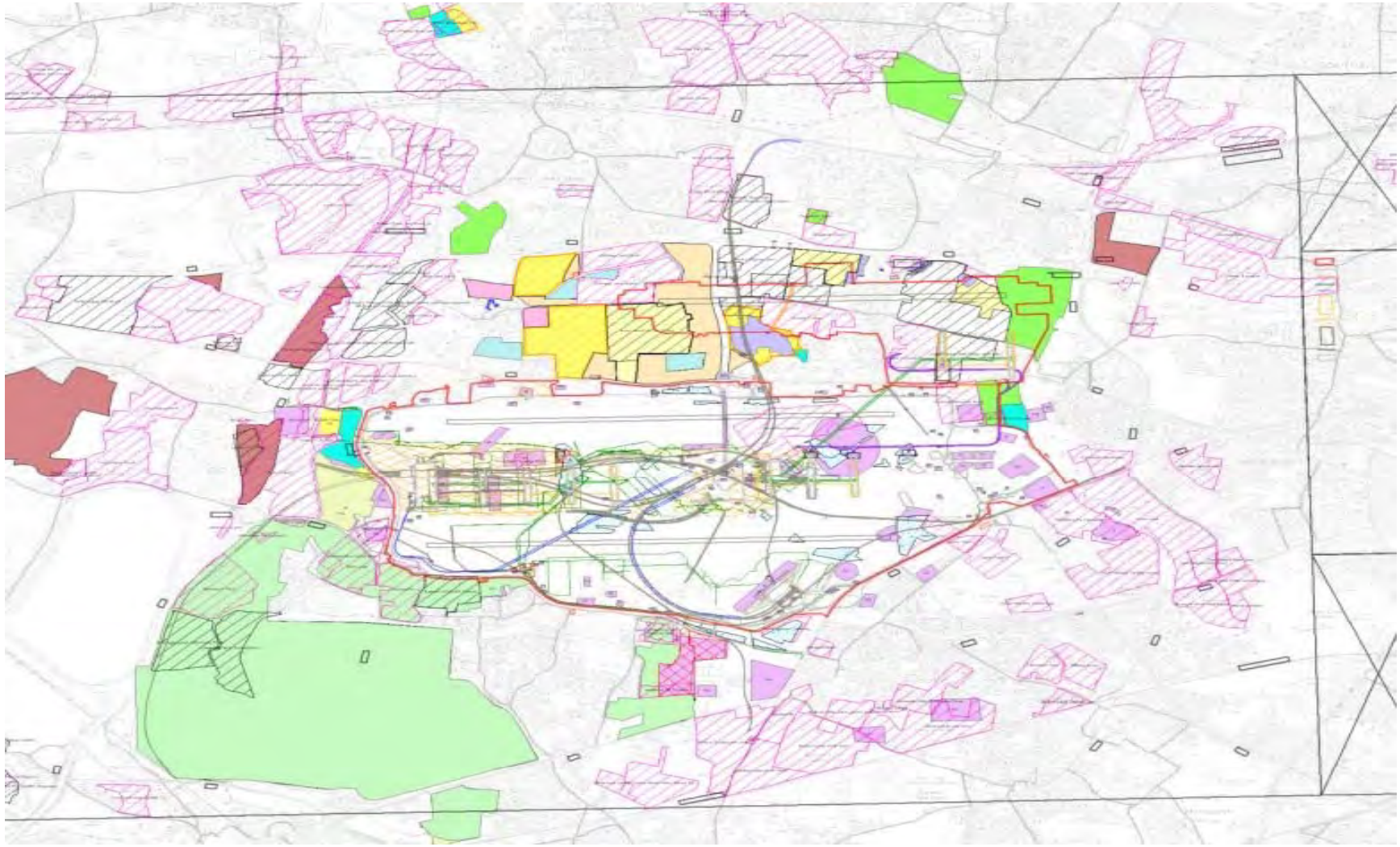
- We are running out of land and many of the less sensitive sites have been remediated forcing developers to move further into already established urban areas...

- 2017 Budget
  and 2018 Spring Statement:

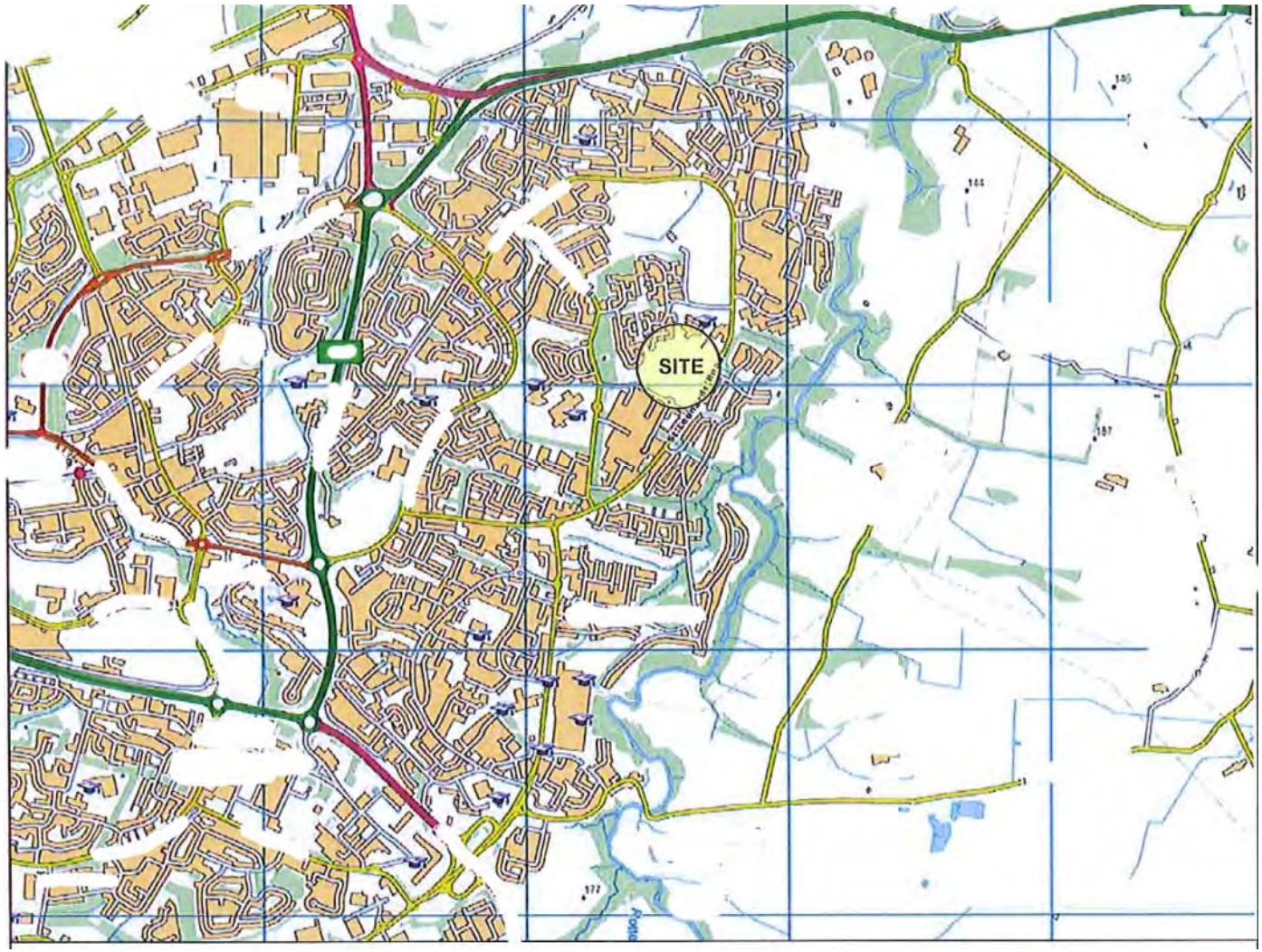
- 300,000 homes...equates to roughly 34 houses per hour!
- Taylor Wimpey - UK's biggest house builder built 14,842 units in 2017...
  - That's 0.59 houses per hour...

Why Landfills?

Why Landfills?
Landfills in an urban area



Why Landfills?
Landfills in an urban area



Why Landfills?

- We are running out of land and many of the easier sites have been remediated forcing developers to move further into already established urban areas...

- Landfills are comparatively cheap to buy:
  - Badnells Pit cost £1.
  - Sandford Farm cost £15M less then the Greenfield equivalent.

- This makes some landfills a very attractive prospect for developers, but they are not without their own challenges.

- Badnells Pit and Sandford Farm are examples of two very different landfill remediation schemes.

Part 2 - Case Study - Badnells Pit

Background

Badnells Pit

Badnells Pit
2010

- Location - east Maidenhead and is about 4ha in size.
- The locality - mature residential properties on three boundaries.
- Gravel quarry from 1920 until 1949 and operated as an industrial landfill between 1949 and 1970.

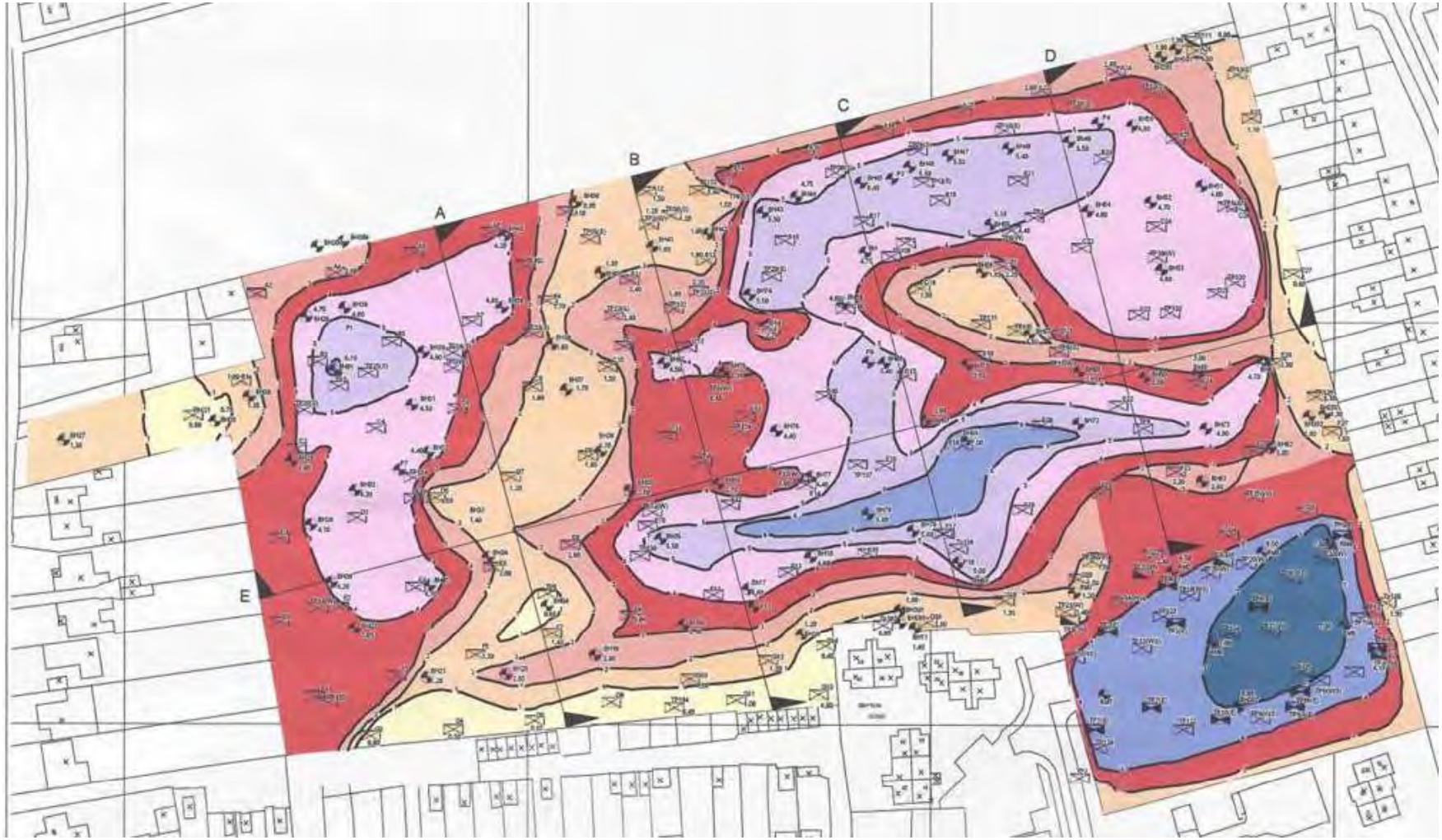
Badnells Pit
Investigation history

- The site has been under investigation since 1978.
  - Nine different phases of investigation by six different companies.
  - 350 exploratory locations.
  - 545 chemical tests: equates to one test per 280m^3 of waste.

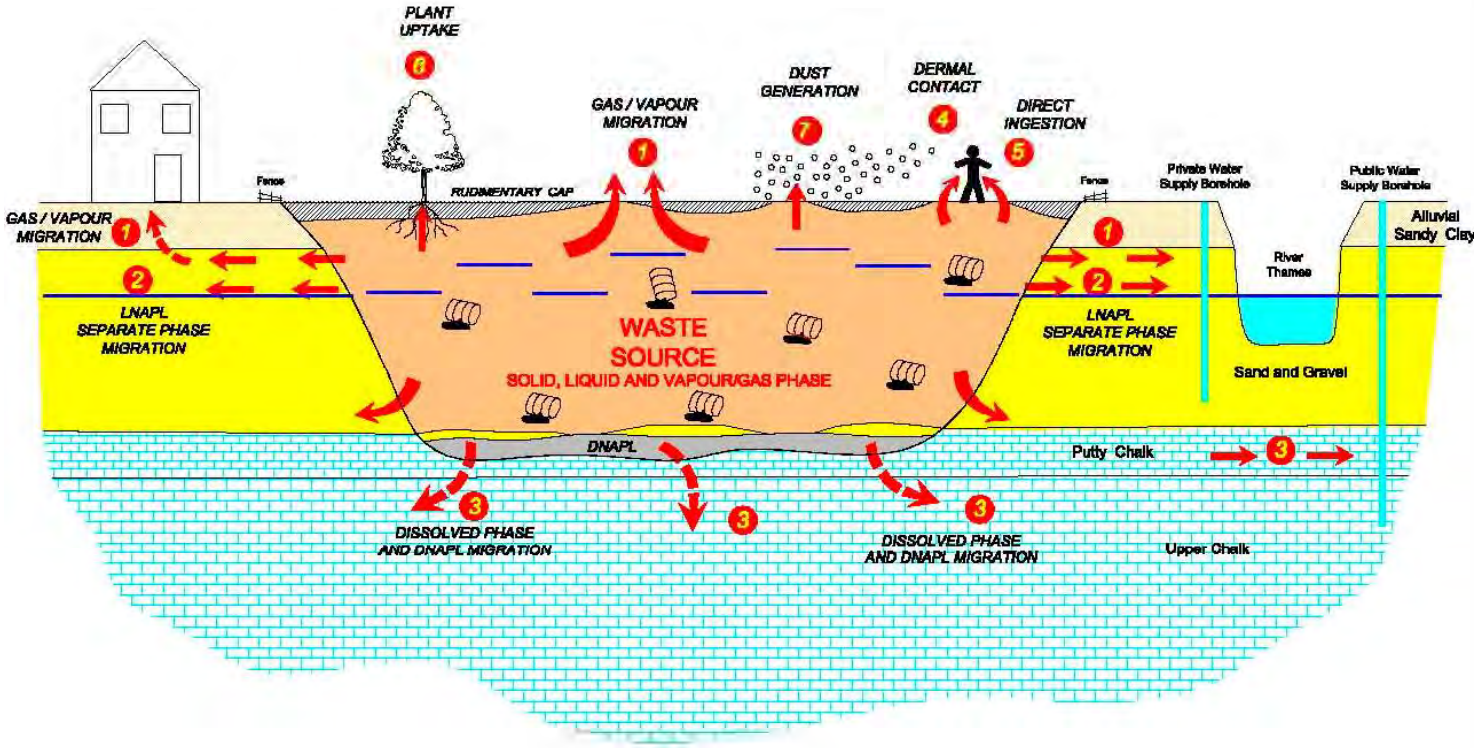
- The principal contaminants were volatile organic compounds (VOC), heavy metals and total petroleum hydrocarbons (TPH).

- Also present:
  - Asbestos in the former sheds and waste.
  - Japanese Knotweed.

Badnells Pit
Approximate waste profile



Badnells Pit
Conceptual site model prior to remediation



PATHWAYS:
1. *Gas/vapour migration,*
2. *Separate phase (LNAPL) migration,*
3. *Dissolved phase and DNAPL migration,*
4. *Dermal contact,*
5. *Direct ingestion,*
6. *Plant uptake, and,*
7. *Dust generation.*

Part 2 - Case Study - Badnells Pit

Remedial Works

Badnells Pit
Chosen remedial method

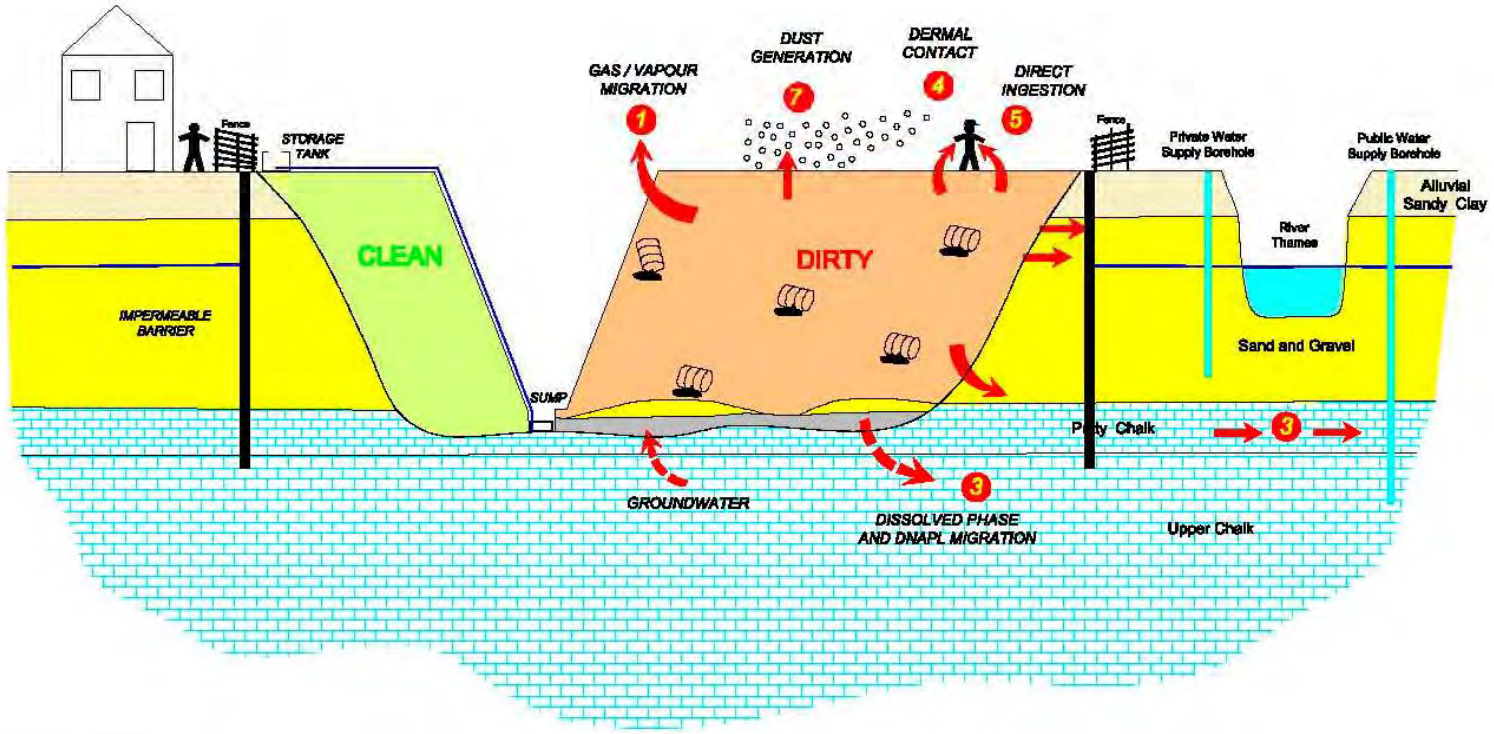
- The remedial solution was the complete removal and retro-filling with engineered fill (recycled crushed brick and concrete).

- Any form of site based treatment was discounted because of the high likelihood of an uncontrollable increase in VOC emissions to air.

- Groundwater was also at risk and a network of perimeter monitoring wells were installed to monitor the remedial works.

- An 85 week programme was required to complete the waste removal and engineering exercise.

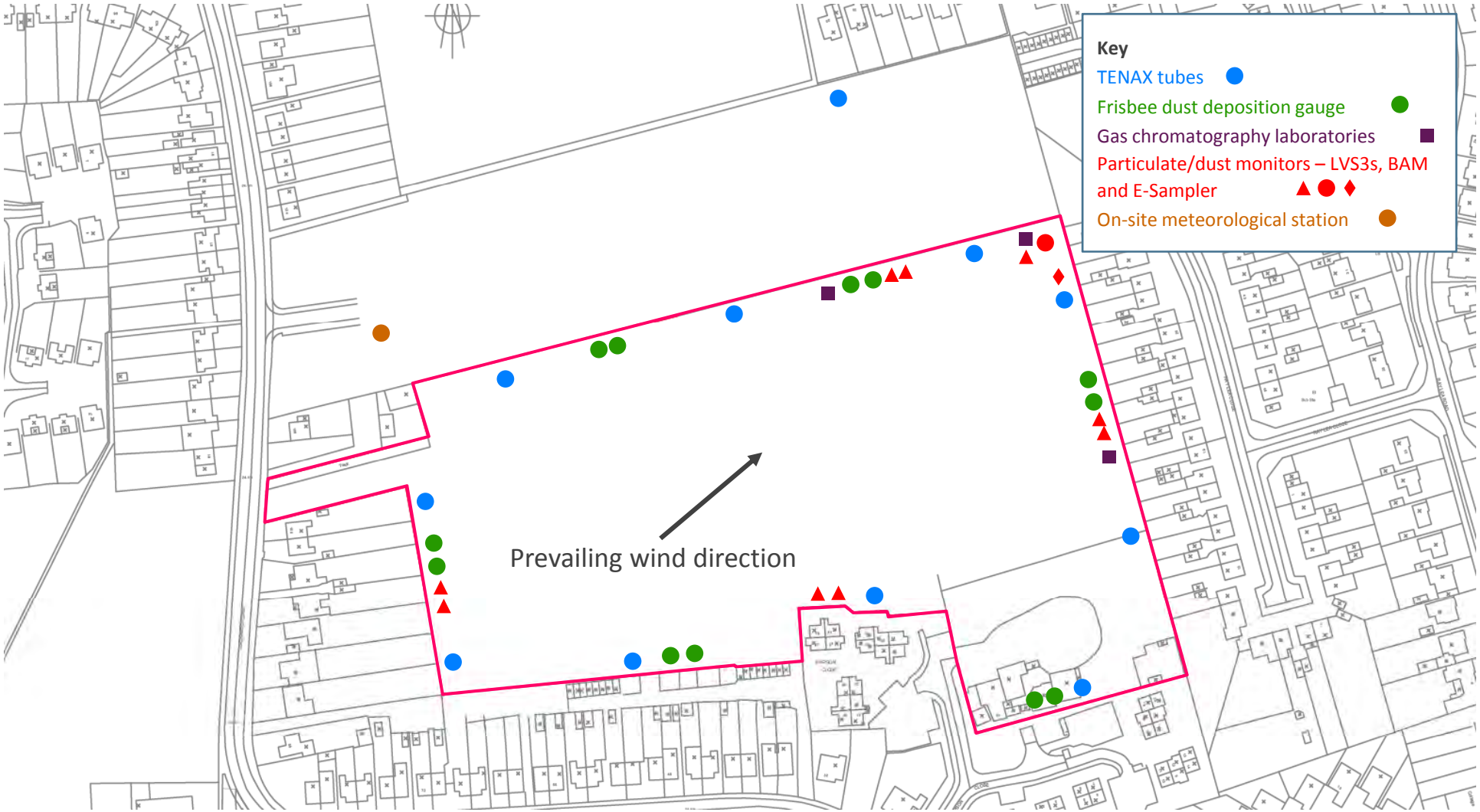
Badnells Pit
Conceptual site model during remediation



PATHWAYS:
1. Gas/vapour migration,
2. Separate phase (LNAPL) migration,
3. Dissolved phase and DNAPL migration,
4. Dermal contact,
5. Direct ingestion,
6. Plant uptake, and,
7. Dust generation.

Badnells Pit
Conceptual site model in action

Badnells Pit
Air quality monitoring network



Badnells Pit
Groundwater containment and control

- Primary method of groundwater containment was a bentonite slurry wall.
- The deepest part of the site had a sheet steel piled wall installed.
- Chalk was depressurised, but without drawn down to aid in groundwater control.
- All recovered water was treated on site prior to discharge into the foul sewer.

Badnells Pit
Groundwater containment and control

Badnells Pit
Bentonite slurry wall & sheet piled wall

Badnells Pit
Typical waste encountered

Over 100,000 litres of liquids were treated

Over 270,000t of waste removed

Over 15,000t of impacted natural removed

Over 3,500 drums removed

Part 2 - Case Study - Badnells Pit

Validation Works

Badnells Pit
Validation works

- Primary goal was the complete removal of all waste materials.
- Allowance within project for the removal of up to 20,000m^3 of impacted natural soil.
- Validation of remaining soils on the base was 1 per 100m^2 and every 10m on the side walls.
- There was to be an on-site laboratory for heavy metals and TPH.
- Clean up criteria agreed with Environment Agency and Local Authority and allowed for revisions should it be required.

So……Simple….. right?

Not so much…

So……Was it all worth it?

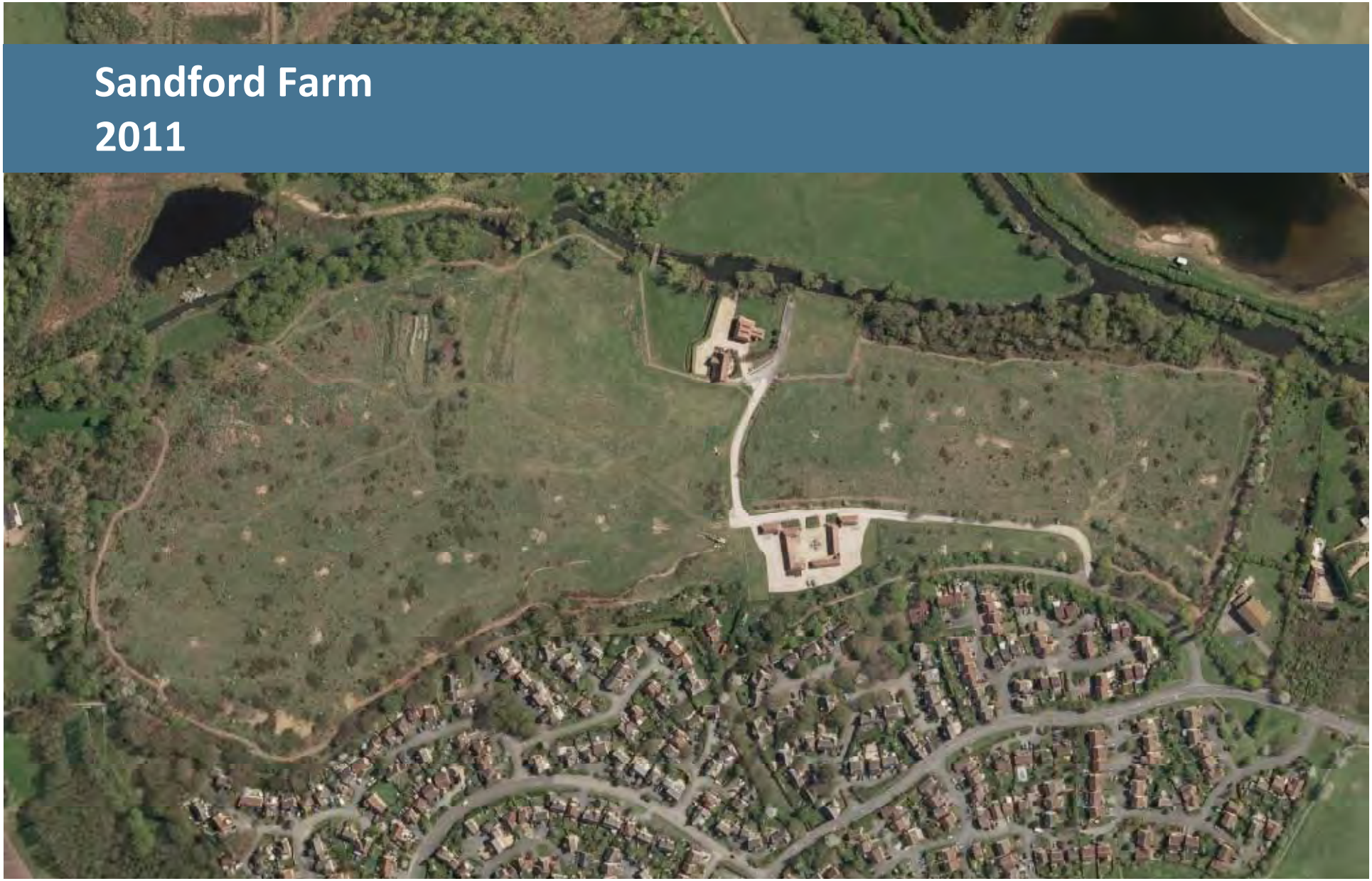
Why disturb what lies beneath?

Stunning new development

Part 2 - Case Study - Sandford Farm

Background

Sandford Farm
2011

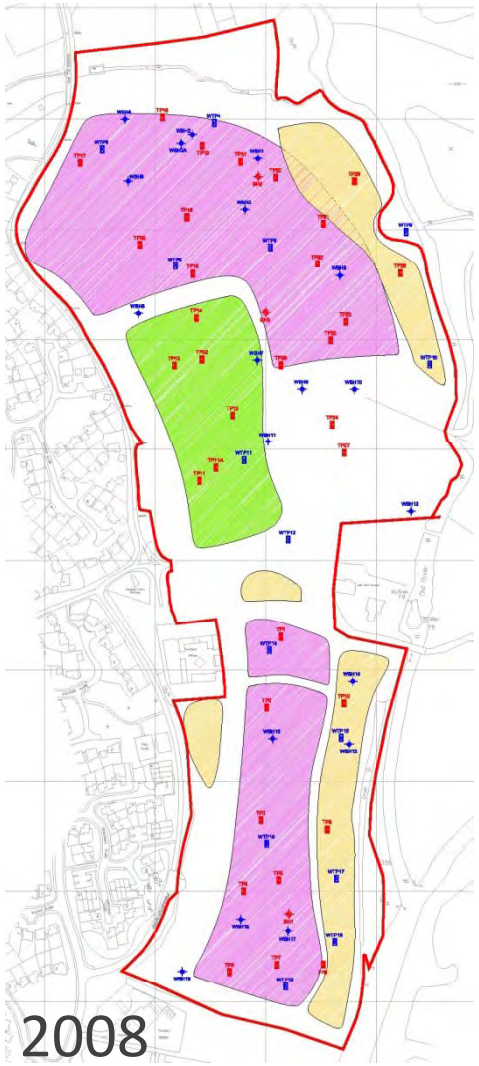


- Location - Reading and is about 20ha in size.
- The locality - mature residential properties on one boundary.
- Former sand and gravel quarry. Operated as a licensed industrial landfill between 1981 and 1991.

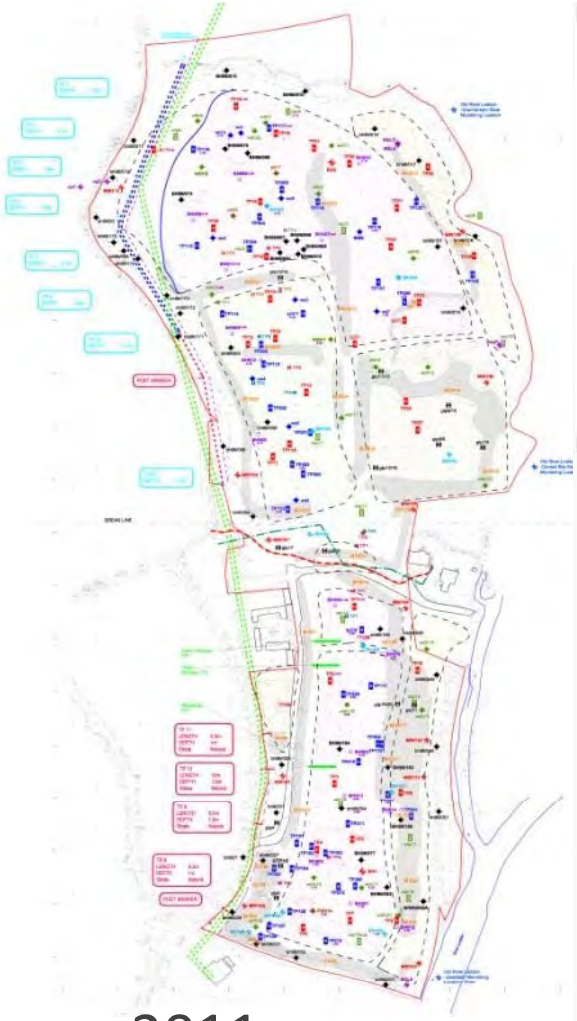
Sandford Farm
Investigation history

- The site has been under investigation since 1995.
  - 8 different phases of investigation by 4 different companies.
  - 8 distinct landfill cells (4 inert and 4 industrial/commercial).
  - 267 exploratory locations.
- The principal reason that the site was remediated prior to development was the risk from ground gases - CO_2 and CH_4 and to a lesser extent:
  - H_2S.
  - Geotechnical instability.
  - Limited pockets of TPH and heavy metals.
- RSK also completed a detailed assessment of the waste volumes which included a significant amount of geophysics.
- VertaseFLI completed a detailed Remedial Method Statement based on the RSK trials.

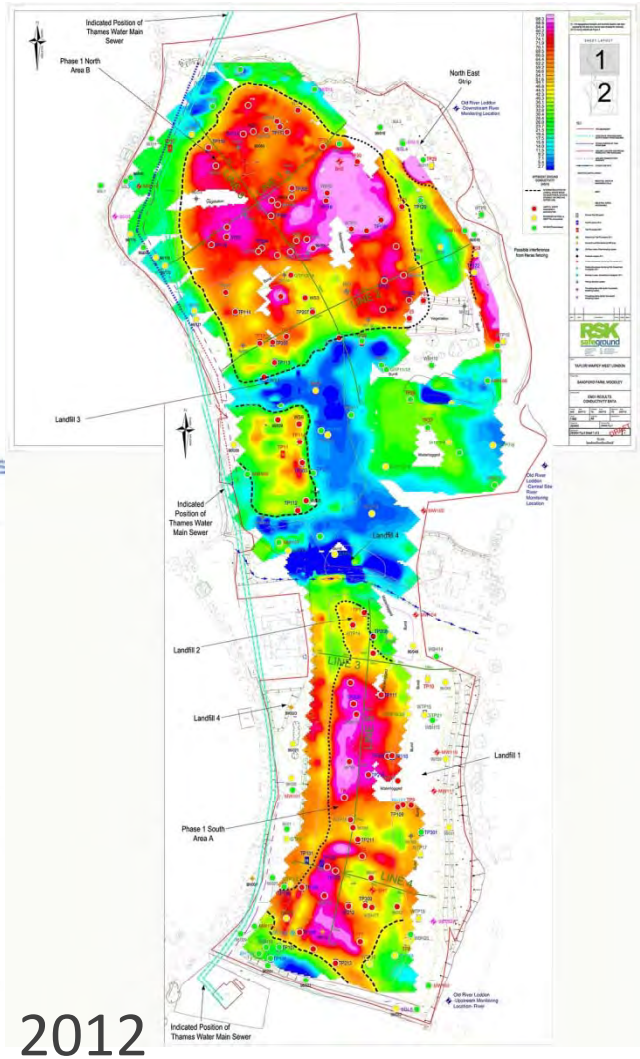
Sandford Farm
Investigation history



2008

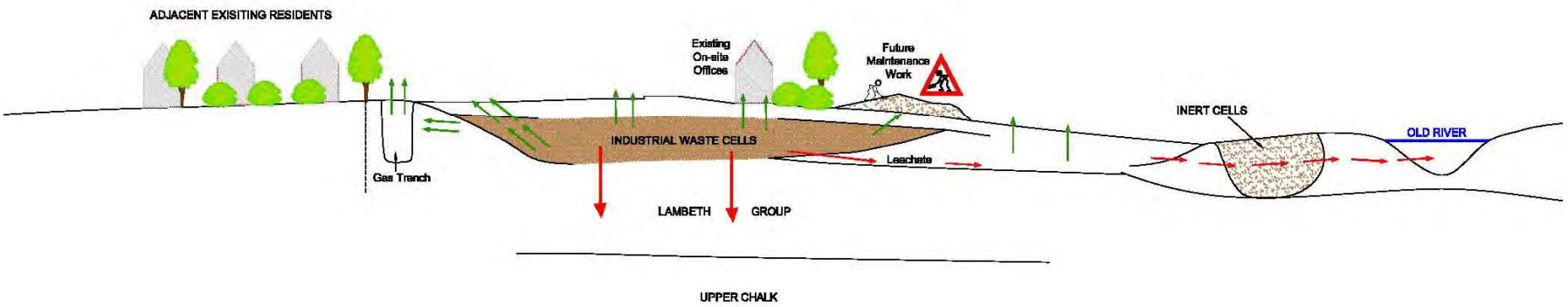


2011



2012

Sandford Farm
Conceptual site model



POTTENTIALLY COMPLETE LINKAGES

- MIGRATION OF LANDFILL GASES INTO HOUSES, OFFICES AND MAINTENANCE CHAMBERS, RESULTING IN ASPHYXIATION OR EXPLOSIVE ATMOSPHERE.
- MIGRATION OF LEACHATE WITHIN SHALLOW AQUIFER INTO 'OLD RIVER'.
- DOWNWARDS LEACHATE MIGRATION INTO MINOR AQUIFER (LAMBETH GROUP) AND FURTHER INTO CHALK MAJOR AQUIFER.
- DIRECT CONTACT WITH SOIL BY SITE CONSTRUCTION WORKERS AND RESIDENTS
- MEMBERS OF THE PUBLIC MAY COME INTO DIRECT CONTACT WITH MADE GROUND SOILS UNDERLYING THE SITE

POTENTIAL CONTAMINANT SOURCES

- WASTE MATERIAL CONTAINING ELEVATED CONCENTRATIONS OF POTENTIAL CONTAMINANTS.
- LANDFILL LEACHATE

LANDFILL GAS

POTENTIAL PATHWAYS

- MIGRATION OF GROUND GAS ALONG BACKFILL AROUND SERVICE PIPES AND THROUGH STRATA
- LATERAL LEACHATE MIGRATION VIA SHALLOW GROUNDWATER
- DIRECT CONTACT WITH WORK MATERIAL.

POTENTIAL RECEPTORS

- CONTROLLED WATERS INCLUDING THE SHALLOW WATER TABLE WITHIN THE REMNANT VALLY GRAVEL MINOR AQUIFER AND THE OLD RIVER
- ADJACENT RESIDENTS
- FUTURE MAINTENANCE WORKERS
- ONSITE OFFICES + USERS.
- GENERAL MEMBERS OF THE PUBLIC WHO ACCESS THE SITE.

Part 2 - Case Study - Sandford Farm

Remedial Works

Sandford Farm
Typical waste encountered

Sandford Farm
Processing the waste

Sandford Farm
Processed material

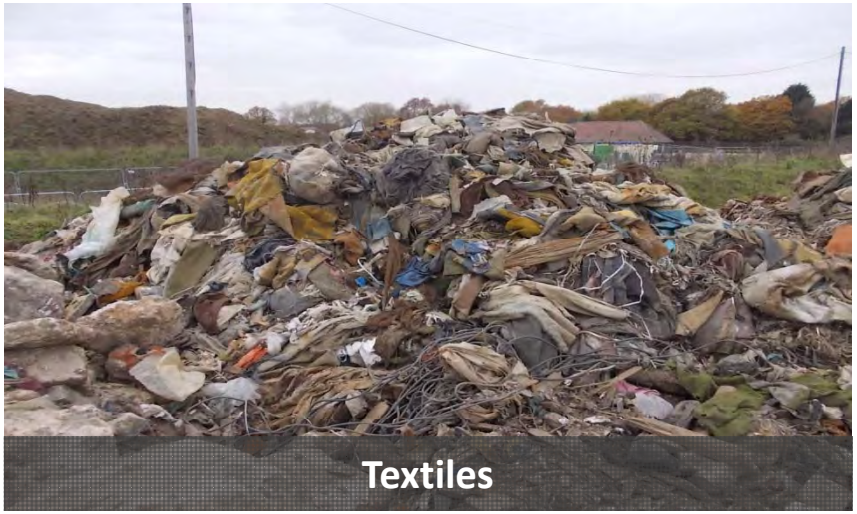
0 to 40mm

40 to 100/125mm

Oversized

Scrap Metal

Sandford Farm
Processed material



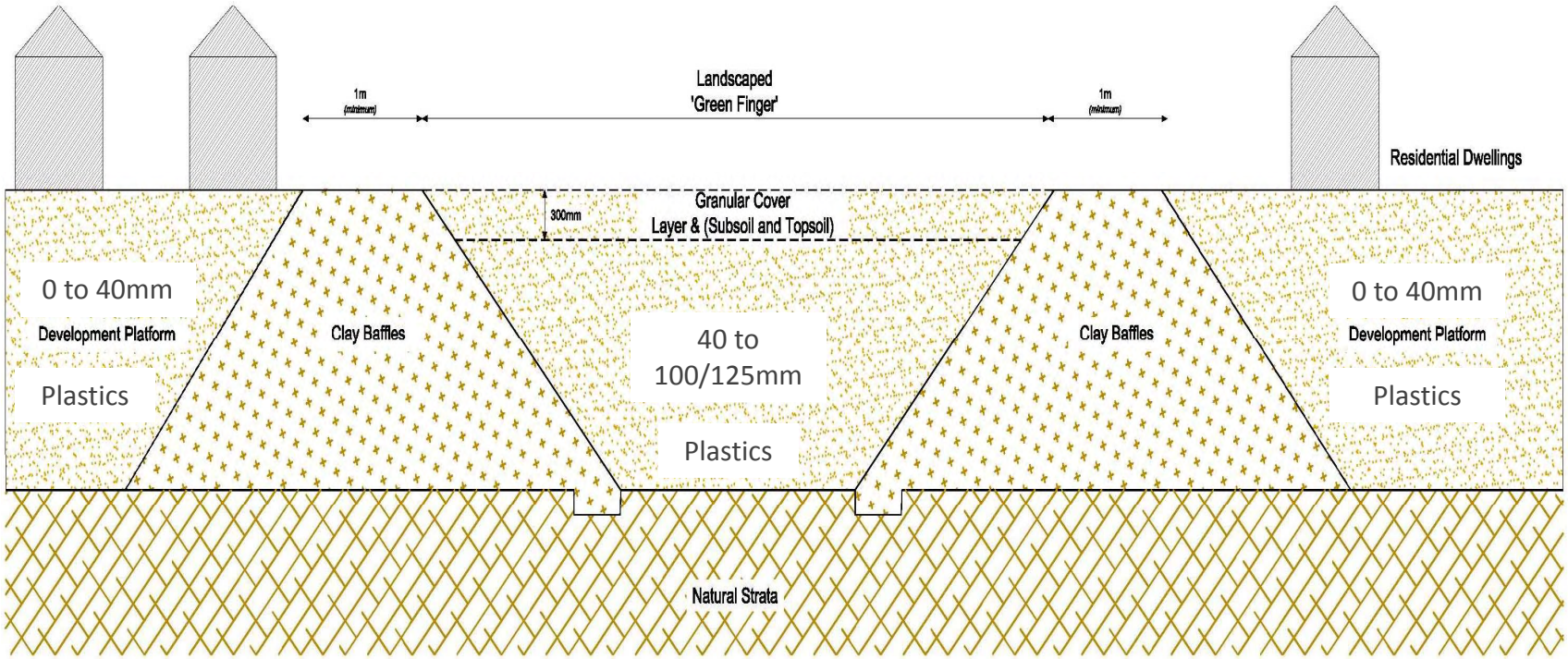
Textiles

Plastics

Concrete

Filter Cake

Sandford Farm
Placement of processed soils



Sandford Farm
Placement of processed soils

Sandford Farm
Placing the processed soils

Another stunning new development

Another stunning new development

Part 2 - Case Study - Sandford Farm

Validation Works

Sandford Farm
Validation works

- Primary goal was the complete removal and processing of all waste materials to remove the degradable fraction. VertaseFLI completed:
  - Ground gas measured in drum tests from processed waste.
  - Forensic assessment of TOC content - RB17.
  - Monitoring of ground gas wells for a minimum of 6 months.
  - FID/TLD surface survey.
  - Flux box tests.
  - Sub floor monitoring under some unoccupied units .
- Placement of processed material to provide a suitable development platform for a residential development.
  - Suite of geotechnical testing in situ as processed materials are placed.
  - Laboratory data to support on site testing.
  - Final loading tests at finished levels.

Sandford Farm
Actual waste excavated...How'd we do?

- RSK calculated volume of waste: 229,076m^3

- Actual removed volume of waste: 229,609m^3

Part 3 - Perception in the Community

Remediation
Perception in the community

THE MAIN PLAYERS: (From left) William Franklin and David Jacob from RSK, John Leach from Countdown Property Developments, Royal Borough planning officer Graham Stallwood and Cllr Alison Knight, cabinet member for planning. Ref:108465-2

Lorries lumber from toxic site

Riverside: Remediation at Badnells Pit finally begins

Speed Read

REMEDIATION work at Badnells Pit will begin on Monday, November 29, the council announced yesterday. Those involved in ensuring the works goes smoothly and safety say they are happy with all the measures in place.

AS WORK finally looks set to begin at the toxic Badnells Pit site, the teams involved with the project have said it was more important to do things 'right rather than fast'.

By John Baslon
johnb@baylismedia.co.uk

It comes following the announcement that mud-laden lorries should start rolling out of the Blackamoor Lane site on Monday, November 29 – almost a year after remediation was due to begin.

The council and developer Countdown Property Developments (part of Shanly Homes) – which has said it has not been frustrated by the delays – believes it has been worthwhile.

"The time frames are less important than getting it right," said Royal Borough planning officer Graham Stallwood yesterday.

Some lorries will leave the site this week as Japanese knotweed and other materials from an earlier screening process are removed.

Once full work begins to clear toxic mud and replace it with clean soil, vehicle movements will be limited to 300 a day, of which no more than 200 can be HGVs.

McArdle Group, which is clearing the former dumping ground ahead of development, will also hand a member of staff a speed gun to crackdown on lorries which speed above 25mph between the site and A4.

Meanwhile, Royal Borough planning and enforcement protection officers will continue to monitor the site for the effects of dust, noise and vibration.

William Franklin, senior environmental consultant at RSK Group, which is also based on site, described Badnells Pit as 'the most monitored field in the country'.

Cllr Alison Knight, cabinet member for planning, said she was reassured that there were 'so many experts' and assured residents that all work would be monitored 'very closely'.

She also encouraged residents to register any concerns with the contractor by calling the McArdle Group's 24-hour freephone helpline on 0845 2584164.

'We're breathing in toxic pit dust'

Riverside: Mum fears for health of nine-month-old baby

Speed Read

A WORRIED mother-of-two held up a bag of black dust to council officers, saying the dirt had come into her home from the toxic Badnells Pit. Fearful for the health of her two sons, she wants more done to protect residents while the contaminated site in Blackamoor Lane is cleaned up.

A MOTHER is terrified for the health of her nine-month-old baby after finding deposits of dust in her garden she believes have come from the toxic Badnells Pit site.

By John Balson
johnb@baylismedia.co.uk

Nabeela Baig, 35, whose Ray Lea Close home backs on to the former dumping ground, says dust has been blowing in since April.

The mother-of-two said 'unusual' particles were collecting on the trampoline where her young son Ibraheem and his 10-year-old brother Adam play together.

"It's a contaminated pit and we are breathing that stuff in," she said.

"My nine-month-old could be putting that stuff in his mouth. I'm very concerned and I can't just sit here and wait – I need to know."

She added: "He's already had two ear infections, and I'm not saying it is connected, but I can't rule it out."

The 15-acre site is laced with oils, solvents and asbestos and soil analysis suggests that 40 per cent of the ground is hazardous and has carcinogenic properties.

Nabeela has made complaints but says McArdle Group – which has been contracted by Shanly Homes to excavate the site – has been slow to respond.

She took bags of metal shavings and dust to show members of the Badnells Pit Residents' Monitoring Group on Tuesday.

Saul Disbury, from McArdle Group, who was at the meeting, said the firm was now using Dustbuster – 'a compound mixed with water which keeps dirt wetter for longer.

He said this was helping to stop dust-spread but also agreed to have plans for 'additional measures' ready by tomorrow (Friday).

Cllr Pam Procter (Lib Dem, Riverside) said the whole situation was making her nervous as it seemed McArdle was playing 'catch-up' even before the 'critical phase' had begun.

Nathan Craker, development manager for Shanly Homes – which eventually wants to develop the site into houses – responded to the worries.

He said: "Can I assure everyone that I will put the necessary pressure on them [McArdle] to make sure the issue is addressed before it happens."

Royal Borough planning officer Graham Stallwood asked him if Shanly would terminate the contract if problems persisted.

The question was met with silence.

Yesterday (Thursday) Mr Stallwood said: "Following resident concerns at the monitoring group, we served a statutory notice requiring the developer and contractor to remove the dust nuisance."

He said if they failed to comply, the council would be able to prosecute the two firms.

The Shanly group predicts HGVs will start removing the contaminated soil in October.

TOXIC DUST FEARS: (From left) Adam Rouf, 10, Farhan Baig, Ibraheem Baig, nine-months, and Nabeela Baig in their garden. Ref:107610-30

Remediation
Perception in the community

MAIDENHEAD NEWS email news@

'Pit stink is making us ill'

Riverside: Badnells neighbours demand action over fumes

SICKENING smells escaping from the clear-up operation at a toxic pit need to be stopped immediately for the sake of residents' health, homeowners have said.

By John Balson
johnb@baylismedia.co.uk

People living in Ray Lea Close say fumes released during the massive dig at Badnells Pit are giving them sore throats and headaches.

They have asked developers to erect tents to trap the nauseating gases and called on the council to use its powers to halt work if their demands are not met.

At a residents' monitoring group meeting on Thursday, resident Pam [illegible]aid she felt sick exposure to [illegible]d was con- miserable having to leave her house all the time.

But independent monitor RSK said target levels of chemicals were not being exceeded and that 'tenting' might not help the situation.

Former councillor Alison Napier, who lives nearby, replied: "I appreciate target levels are low but it is how residents are feeling which is the major issue at this point.

"We all knew there would be odours but it is the acknowledgement that Pam and other residents are suffering because of the stress of the situation."

Resident Ray Hague said immediate action was needed as the issue had been flagged up months ago.

"Otherwise it will go on and on and then you will say 'OK, we're finished'," he said.

Others complained about dust, breathing difficulties and that chunks of soil were falling from lorries into Blackamoor Lane and beyond.

McArdle Group, which is due to finish the remediation in September ahead of houses being built at the site, is already using an odour suppressant and a dust suppressant.

Company representatives told the Badnells Pit Residents' Monitoring Group they would look into other ways to reduce the smell.

Royal Borough planning officer Graham Stallwood said McArdle was already 'going beyond' what was legally required but, with the council, would continue to investigate the latest technologies.

Speed Read

DISTRESSED homeowners living near Badnells Pit have demanded developers find a new way to halt the release of nauseating fumes during the operation to clean it up. Way of reducing the smell, which they say is giving them sore throats and headaches, were discussed at Badnells Pit Residents' Monitoring Group on Thursday.

FUMING: Residents are upset at smells being released during digging at toxic Badnells Pit in Blackamoor Lane.
Ref:108609-20

Remediation
Perception in the community

MAIDENHEAD NEWS

email news@

FROM THE PIT: The overturned Badnells Pit lorry. Ref:109765-3

TOXIC WASTE? A site chemist analyses material from the toxic Badnell's Pit. Ref:109765-42

A4 chaos after 'toxic' spill

Maidenhead: Gridlock as Badnells Pit waste lorry over turns

Speed Read

TRAFFIC came to a standstill in Maidenhead this week when a Badnells Pit lorry overturned in the Bath Road. Site chemists were called to the scene and found the waste was not harmful.

SITE chemists rushed to the Bath Road on Monday after a lorry ferrying soil from the toxic Badnells Pit overturned and spilled its load.

Fire service, Royal Borough and Environment Agency officers were also called to the scene, with fears the waste dug up from the contaminated former landfill site was harmful.

By Sonia Kapur
soniak@baylismedia.co.uk

But all agencies were quick to report the material was non-hazardous.

The accident at the roundabout next to Maidenhead Police Station brought traffic to a standstill.

A section of the road was closed and traffic diverted off the A4 into Oldfield Road.

Mike Coleman, general manager at The McArdle Group which has been contracted by Shanly Homes to remove the waste, said: "We have had about 20,000 vehicle movements already without any incidents.

"Everything was checked before the vehicle left the site and we are giving the drivers a talk this week about safety."

He said the material was made up of soil and stones and he did not know how the vehicle had overturned.

The driver was taken to Wexham Park Hospital by emergency services and treated for minor injuries.

He has been reported to Thames Valley Police for careless driving and McArdle will be carrying out a full investigation.

Firefighters from Maidenhead and Reading and Berkshire Fire and Rescue Service hazardous materials officers were also called to the scene, near the Forlease Road junction, at about 12.15pm.

A spokesman from the borough said the material was returned to Badnells Pit and the road was cleared with a water bowser.

There are about seven to eight thousand lorry loads still needed to clear the toxic waste and the contractors are on schedule to finish the clearance work by August.

Controversial plans by Shanly Homes to build 448 homes on the toxic pit were approved by the Secretary of State for Communities and Local Government in 2009.

WATCH: A video report from the scene at: www.maidenhead-advertiser.co.uk

Remediation
Perception in the community

Badnells clear-up's not so bad after all

Riverside: Residents impressed as toxic pit excavation gets underway

By John Balson
johnb@baylismedia.co.uk

Speed Read

LORRIES finally started taking away waste from toxic Badnells Pit, off Blackamoor Lane, on Monday – almost a year later than planned.

MUD-LADEN lorries started rolling out from the toxic Badnells Pit this week but homeowners say the impact is not as bad as they feared.

The first heavy goods vehicle to be loaded with excavated mud left the Blackamoor Lane site on Monday morning.

DIGGING IN: Lorna Bacon from RSK Group testing for heavy metals. Ref:108609-10

The vehicle's exit marked the start of an estimated 12 months of work to clear the former unlicensed dumping ground.

Residents living opposite the exit said they were pleased with how work had started but would be keeping a watching brief.

"We were all worried about what they were going to dig up but so far they have been quite good," said Enza Cuva, 59.

"They are cleaning vans, they drive very, very carefully and the road is constantly being cleaned, so actually, it has been okay."

Her neighbours mother-of-two Siobhan Whittaker, and Tasneem Iqbal, 18, said the road had been blocked a few times, especially during the school run, and that noise from HGVs sometimes made their window frames rattle.

However, they too said it was better than they had feared.

Mike Coleman, general manager for McArdle Group, which is carrying out the remediation, said he was pleased with the 'progress and performance' so far.

"In conjunction with the council we have resolved the slight congestion that occurred in the first couple of days and everything is going as anticipated," he said.

CLEAN MACHINE: A HGV taking mud from Badnells Pit has its wheels washed before leaving the site. Ref:108609-39

Royal Borough planning officer Graham Stallwood said they had not had any complaints about the work but instead about residents driving irresponsibly.

Restrictions have been in place in Blackamoor Lane after some motorists drove on the pavement to avoid the lorries, he said.

Up to 70-80 HGVs a day have left the site so far. Vehicle movements in and out of the site are limited to 300 a day, of which no more than 200 can be HGVs.

The work is being done for Shanly Homes, which wants to build houses on the site.

Part 4

Lessons learned

Lessons learned

- The science of remediation is often not the only aspect that will need to be considered.
- Social effects of remedial works need to be considered.
- An openness to demonstrate the working remedial processes to the stakeholders and residents alike is critical.
- Innovation in remediation and monitoring techniques can be the key to unlocking historical sites.

Thank you

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