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CHISINAU SOLID WASTE PROJECT

HYDROGEOLOGICAL RISK ASSESSMENT

CONFIDENTIAL

DECEMBER 2016

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HYDROGEOLOGICAL RISK ASSESSMENT

European Bank for Reconstruction and Development

Version 1
Confidential

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1 EXECUTIVE SUMMARY

The European Bank for Reconstruction and Development (EBRD) has commissioned WSP I Parsons Brinckerhoff (WSP | PB) to conduct an Social (EHSS) review that includes the preparation of an Environmental and Social Impact Assessment (ESIA) of the upgrade of the Tintareni landfill for compliance with EU Landfill Directive. This hydrogeological risk assessment (HRA) is presented to assess the potential effects of Tintareni landfill upon hydrogeology and hydraulically connected downgradient groundwater and surface water resources. The aim of this HRA is to provide a further complimentary assessment alongside Section 14 of the ESIA.

The landfill is located in Tintareni (Anoii Noi District), 35 km to the southeast of Chisinau. It was operative between 1991 and 2010 and received principally municipal solid waste, classified as non-hazardous waste. The EBRD is considering extending a loan to Regia Autosalubritate, a municipal solid waste management company owned by the City of Chisinau, to upgrade the Tintareni landfill and reopen it. The qualitative assessment conducted as part of the ESIA identified the impacts and effects of the landfill on the receiving environment to be moderate. This HRA was conducted to quantitatively assess the potential impacts associated with the generation of leachate at the landfill.

The landfill is located on the Dnestr terrace plain and is included into the Sredne-Dnestr geomorphological sub region. The area is dominated by limestone sedimentary rock, which has elements of gravel, sand, silts and clays.

A geotechnical site investigation was conducted in May 2016 by the appointed consultant. The site investigation proved the presence of the Upper Sarmatian units (i.e. sand lenses of the alluvial-talus deposits). Borehole installations proved groundwater beneath the landfill at various elevations within permeable strata. Boreholes did not extend to the base of the Upper Sarmatian or into the underlying mid-Sarmatian unit (limestone aquifer) which corresponds to the productive aquifer used for water supply.

The identified groundwater on site is observed to be perched discontinuous pockets of water that have the ability to migrate via the fissures infilled with sand. The regional groundwater flow direction is estimated in a northerly direction.

Based on the surrounding environment and land uses, the potential receptors include hydraulically connected downgradient abstraction wells in Tintareni village (4km to the northwest) and River Bic, located 5km to the north of the site.

The qualitative assessment of the location of landfilled wastes over an engineered clay barrier and mixed clays and sands is that vertical migration of leachate to the underlying aquifer is likely to be significantly impeded. Groundwater quality measured under the site indicated some impact of leachate but at relatively low concentrations. Therefore, the hydraulic connectivity between the alluvial-talus deposits and the productive underlying mid-Sarmatian limestones is considered to be limited.

The quantitative assessment of the potential impacts on the identified receptors was undertaken by using software LandSim V2.5. The modelling was undertaken for the current landfill. The input parameters in relation to leachate source term, infiltration parameters, barrier information, unsaturated pathway, vertical pathway and saturated pathway were based on site-specific data, where available, and conservative assumptions.

The model simulates the migration of leachate through the liner and subsequent transport through the unsaturated zone and migration to the wider environment for a specific time scale (20,000 years). LandSim uses Monte Carlo simulation technique to select randomly from a pre-defined range of possible input values, repeating the process many times to reflect the uncertainty inherent in the input values. The risk assessment results corresponding to the 95th percentile concentration were considered, that are representative of the reasonable worst-case performance of the landfill (i.e. 95% probability that the actual value is at or below the predicted contaminant concentration). Additionally, the model is based on conservative assumptions (i.e. no losses by volatilisation or chemical transformation are considered) and input values to predict worst case concentrations at the selected compliance points.

Based on the quantitative risk assessment results, leachate generated in Tintareni landfill is not considered likely to impact on the quality of the abstracted groundwater in Tintareni village. Although modelled concentrations at the base of the landfill and its immediate vicinity exceeded the adopted water quality standards, the impact of the landfill at a distance of approximately 500m is considered to be low. The modelled concentrations 500m from the site marginally exceeded the drinking water standard for ammoniacal nitrogen in 3,000 years' time and sulphate in 400 years' time, however surface water quality standards were not exceeded. In summary, modelled concentrations breaking through the liner are not considered likely to impact on the quality of the water extracted from the regional abstraction wells or within River Bic.

The landfill is to be subject to additional engineering works and management controls which have the potential to improve the current site and reduce leakages from the current waste body, specifically these include:

- Reduction of leachate production by capping with an engineered lining system for new wastes to be deposited over (intercepting rainfall);
- Removal of leachate from the landfill for treatment and disposal; and,
- Better control of lower leachate heads at the base of the landfill by avoiding large loading events of water e.g. by melting snow or excessive leachate recirculation.

New wastes will be deposited in areas where leachate can be separately managed and kept hydraulically separated from the underlying historical waste body, lining system and/or natural strata. The addition of waste on top of the current waste cell is likely to compress the current waste mass and potentially increase the leachate head during short periods of time (i.e. until the extraction of leachate occurs), which was taken into consideration in the modelling by assuming a leachate head of up to 3m thick.

The risk of the current landfill to the identified receptors is considered to be low, although some impact was identified in the underlying groundwater and the immediate vicinity of the landfill. Theoretical discharges have been assessed and they do not represent a significant risk to receptors located more than 500m from the site. This assessment is based on the available data and it is recommended that the following is undertaken as part of the future development of the site:

- Installation of additional boreholes on the downgradient side of the site (north) which penetrate into the underlying mid-Sarmatian Limestones;
- Regular leachate and groundwater quality monitoring from existing boreholes and proposed boreholes; and
- Review of the conceptual site model and update to the quantitative risk assessment model, if required on completion of at least three monitoring events.

The above recommendations have been included in the Environmental and Social Action Plan (ESAP) that has been developed.

2 INTRODUCTION

2.1 REPORT CONTEXT

The European Bank for Reconstruction and Development (EBRD) is considering extending a loan to Regia Autosalubritate, a municipal solid waste management company owned by the City of Chisinau, Moldova. The proceeds of the loan will be used to finance priority investments in the Chisinau solid waste disposal, including Tintareni (Anoii Noi District) in Moldova.

EBRD have commissioned WSP I Parsons Brinckerhoff (WSP | PB) to conduct an Social (EHSS) review that includes the preparation of an Environmental and Social Impact Assessment (ESIA) of the upgrade of the Tintareni landfill for compliance with the Landfill Directive (EEC/1999/31/EC). This Hydrogeological Risk Assessment has been prepared to provide a further complimentary assessment alongside Section 14 of the ESIA.

2.2 OBJECTIVE

The objective of this HRA was to utilise new site investigation information to update the conceptual site model for the site and undertake quantitative risk assessment to assess the current potential effects of Tintareni landfill upon groundwater and surface water quality down hydraulic gradient of the site.

2.3 LEGISLATIVE FRAMEWORK

The national legislative framework for the protection of surface water quality is detailed below.

- → Surface Water Quality Regulation in Moldova: Policy Aspects of the Reform, Economic Co-operation and Development (OECD), 2007.

The legislative framework for the protection of drinking water quality is detailed below.

- → Guidelines for Drinking-water Quality, Fourth Edition, World Health Organisation (WHO), 2011.

The assessment has been undertaken in line with international best practice. Where appropriate when considering Water Environment, the following EU legislation has also been considered during the completion of this assessment:

- → The Landfill Directive (EEC/1999/31/EC).
- → The Water Framework Directive (2000/60/EC). These European Regulations establish a framework for protecting the water environment.
- → The new Groundwater Directive (2006/118/EC). These European Regulations are an environmental protection measure which provides enhanced protection for groundwater.

In addition UK guidance documents have been considered within this assessment on the basis that UK Water Environment guidance and UK Landfill Guidance is in line with EU Legislation.

- → Guidance on Monitoring of Landfill Leachate, Groundwater and Surface Water (LFTGN02 Landfill Directive), UK Environment Agency, February 2003.
- → Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Control and Trigger Levels (LFTGN01 Landfill Directive), UK Environment Agency, March 2003.

2.4 SITE DETAILS

The landfill is located in Tintareni (Anoii Noi District), 35 km to the southeast of Chisinau and between 2k and 5 km from Creţoaia and Tintareni, respectively. The geographical position is Latitude: 46° 51' 04 N and Longitude: 29° 10' 00 E.

Figure 2-1 Site location

Source: E. Lindberg, J. Olsson (2012)

Tintareni landfill was operative between 1991 and 2010, and the existing waste cell has a size of approximately 161,200 m^2. Based on the topographical survey conducted in December 2015, Tintareni landfill size is approximately 25 hectares. The landfill was built in a hillside by the formation of a series of benches with ground levels between 115 m above sea level (asl) (north of the site) and 196 m asl (south of the site), with an average slope of about 1/8 (Vertical/Horizontal) across the site. The waste cell has a size of approximately 19.5 ha with ground levels between 124m asl and 170m asl (Fichtner, 2016b).

The remaining capacity of the waste cell at Tintareni landfill was calculated as about 2.750.000m^3 as net waste disposal volume. In terms of lifecycle, the landfill could be operative for approximately 7 additional years (Fichtner, 2016b).

2.5 SITE SETTING

GEOLOGY

The Tintareni landfill is located on the Dnestr terrace plain and is included into the Sredne-Dnestr geomorphological sub region. The area is dominated by limestone sedimentary rock, which has elements of gravel, sand, silts and clays. This sedimentary rock reaches a depth of approximately 600m, and is underlain by Proterozoic Archean. Based on 1986 Mamontov Litho-geological map the site regional geology of the site is classified as Upper-Sarmatian (clays, sands with interbedded limy sandstone) underlain by Mid-Sarmatian stage (clays, silts, sands and limestones).

The surrounding area is primarily used for agriculture, and the main lithology comprises sedimentary soils, which are relatively young, with alluvial deposits in the river valley.

HYDROGEOLOGY

Based on Boncom Proiect (2016), aquifers in the area of investigation are confined deposits of a combination of varied stratigraphic units. The productive aquifer used for water supply corresponds to the mid-Sarmatian limestones, whereas the rest of aquifers are poorly waterlogged or contain water not suitable for drinking purposes. The capacity of the limestone strata is considered to be up to 90m (Boncom Proiect, 2016). Groundwater abstraction bores are known to be located in Creţoaia and Tintareni villages, located approximately 2km and 5km to the northwest of the landfill, respectively. Groundwater beneath the site is not considered to be hydraulically connected with Creţoaia wells, given the presence of a groundwater divide (E. Lindberg, J. Olsson, 2012).

A third of the population of the nearby villages of Creţoaia and Tintareni are dependent on groundwater for their portable water supply (Tintareni Mayor's Office, 2013). The residents of these villages have raised strong concerns regarding water quality, and the possibility that this may be linked to adverse health effects.

HYDROLOGY

Tintareni landfill is located in the Dniester River Basin. The River Bîc is the nearest permanent watercourse to the Tintareni landfill, located approximately 5km to the north of the landfill. The River Bîc is a tributary river of the River Dniester and flows through the capital Chisinau before reaching the Tintareni area, Anoii Noi district, which flows into the Black Sea. Two unnamed beams of the river Bîc and one beam from the river Calantir are located at distances of 1.2km, 1.3km and 1.7km respectively from the landfill, however they are not considered to be permanent watercourses (Boncom Proiect Ltd, 2016).

The River Bic is heavily polluted with both organic and inorganic chemical toxic substances. Many surface waters in the Republic of Moldova are contaminated with high levels of nitrites, nitrates and ammonia (WSP I Parsons Brinckerhoff, 2016a).

The State Hydrometeorological Service operates a surface water monitoring network, which includes 49 observation points on 16 largest rivers, six large water basins and one estuary. The observation points are close to urban areas. Surface water diffuse pollution monitoring is not performed in Moldova. Sampling is performed on a monthly basis for the measurement of at least 42 hydrochemical parameters and at least 6 hydrobiological parameters depending on the observation points. Since 2007, surface water quality monitoring in Moldova has focused on requirements of the Water Framework Directive and the relevant biological and chemical parameters, this included changes to optimise the location of sampling points and the frequency of observation (WSP I Parsons Brinckerhoff, 2016a).

According to the Water Pollution Index (WPI) the main rivers Dniester and Prut are moderately polluted (category III-IV) while smaller rivers like Reut and Bic are more polluted (category IV-VI), on a scale where I is the least and VI the most polluted (WSP I Parsons Brinckerhoff, 2016a).

3 SITE INVESTIGATION

3.1 SITE INVESTIGATION CONTEXT

A geotechnical site investigation comprising the advancement of six boreholes (BH1 to BH6) was conducted at the Tintareni landfill by the appointed consultant in May 2016 (Boncom Proiect, 2016). The depth of investigation varied significantly between locations given the site topography; borehole BH1 was drilled to a depth of 81 meters below ground level (mbgl), boreholes BH2 and BH3 were drilled to a depth of 33.10 mbgl and BH4, BH5 and BH6 were drilled to 14-15mbgl.

The borehole location plan (sourced from Boncom Proiect, 2016) is included in Appendix A-1.

3.2 GEOLOGY AND HYDROGEOLOGY

The site is characterised by Quaternary period Cahul formations that spread with a slight inclination towards the northwest. They present a bed of approximately 60-70m thickness, composed of alluvial-talus sediments, underlain by the upper Sarmatian sediments represented by sands within BH1 only (Boncom Proiect, 2016). These sediments are represented by clays with unclear stratification and fine sands, calcareous sandstones and carbonates. The depth of sand layers varies from a few centimetres to 10-20m. Based on the permeability test results, it was determined that the clayey layers are impermeable and poorly permeable, whilst the sandy layers are attributed to permeable and poorly permeable (Boncom Proiect, 2016).

A summary of the groundwater elevation data is presented in Table 3-1.

Table 3-1 Groundwater elevation on site

Borehole	Borehole Elevation (m ASL)	Groundwater Depth (mbgl)	Groundwater Elevation (m ASL)	Lithology
BH1	182.50	74.0	109.40	Sand with deposits of carbonate rocks granules thin substrates of sandstones
BH2	138.10	27.0	111.10	Saturated fine grained sand
BH3	138.10	29.1	109.10	Saturated medium grained sand Water was also detected at 10.9m and 14.6 m, in the embankment body (assumed to be leachate)
BH4	116.45	12.0	104.45	Clay with some sand
BH5	115.50	9.2	106.30	Saturated medium grained sand
BH6	117.40	5.0	112.40	Saturated medium grained sand Saturated zone 4m thick.

Groundwater elevation ranged between 104.45 m asl (BH5) and 112.40 m asl (BH6), with a variable saturated thickness (between 1.3m and 4m). No boreholes were extended to the limestone aquifer downgradient from the landfill, and therefore the quality of the groundwater body used for water supply and the relevant hydrogeological parameters of the extractive water body were not assessed as part of the investigation.

The Boncom Proiect (2016) site investigation detected groundwater beneath the landfill at various elevations within the more permeable strata of the upper Sarmatian units (i.e. sand lenses of the alluvial-talus deposits). The mid-Sarmatian unit (limestone aquifer) was not assessed as part of the investigation. The identified groundwater on site was considered to be perched discontinuous pockets of water that have the ability to migrate via the fissures infilled with sand and it was not considered to be in hydrogeological continuity with the downgradient abstraction wells and surface water bodies. The detected perched water was considered to be connected with the underlying mid-Sarmatian unit through infiltration processes.

Based on the above, the identified groundwater unit is considered to be in limited continuity with the productive groundwater unit used by the abstraction wells at Tintareni village. Hydraulic connectivity cannot be discarded between the alluvial-talus deposits and the productive underlying mid-Sarmatian limestones, however it is considered to be limited. The regional groundwater flow direction was estimated in a northerly direction.

The cross section of the landfill and underlying hydrogeology from south (BH1) to northwest (BH6) is included in Appendix A-2 (sourced from Boncom Proiect, 2016).

3.3 GROUNDWATER ANALYTICAL RESULTS

During the 2016 geotechnical investigation, groundwater samples were collected from the six newly installed boreholes (BH1 to BH6) between June 2016 and July 2016 (Boncom Proiect, 2016). One groundwater sample was collected from each borehole location (bottom water level) and two additional water samples were collected from BH3 at two different depths; 10.9 mbgl (127.20 m asl) and 14.6 mbgl (123.50 m asl), which was water associated with the embankment body at the northern end of the waste cell.

Previous groundwater assessments have been conducted at the landfill and abstraction wells in the near villages. Data from 2012, 2014 and 2015 were made available for assessment. The groundwater sampling conducted in 2012 included three samples from wells in Cretoaia and five samples from wells in Tintareni (E. Lindberg, J. Olsson, 2012). It is noted a groundwater divide separates the Cretoaia and Tintareni wells (E. Lindberg, J. Olsson, 2012). The location of the wells sampled in 2012 is shown in Appendix A-3. The locations assessed in 2014 and 2015 included a filtration well, a drainage well adjacent to the northern boundary of the landfill and a number of abstraction bores located at Tintareni village. The groundwater quality analysis from the wells in the Tintareni Village was dated 7 August 2014, and those from the filtration and drainage wells at the landfill were dated 4 February 2015. The location of the filtration well and drainage well is presented in Appendix A-4. The exact location of the Tintareni abstraction bores sampled in 2014 was not available.

It is noted few common contaminants were measured for the various sampling points. A summary of the reported analytical results are compared against relevant WHO or European drinking water standards (DWS) and surface water standards (SWS) is provided in Table 3-2. The detailed analytical results can be consulted in the Geological Survey for the Chisinau Landfill (Boncom Proiect report, 2016).

Table 3-2 Groundwater Quality Assessment

	GROUNDWATER CONCENTRATIONS (MG/L)				
	Nitrate (NO_3^-)	Ammoniacal nitrogen (NH_4-N)	Chloride (Cl^-)	Sulphate (SO_4^{2-})	Fluoride (F^-)
DWS	50 (1)	1.5 (2)	250 (1)	250 (3)	1.5 (1)
SWS (4)	11.3	3.1 (5)	500	500	Not identified
BH1 (6)	5.26	**3.33**	130.98	308.18	0.26
BH2 (6)	0.7	0.77	339.19	125.78	0.66
BH3 (6)	<0.1	0.40	22.84	31.11	1.17
BH4 (6)	**519.86**	0.83	**671.41**	212.03	0.43

	Groundwater concentrations (mg/L)				
BH5 (6)	3.32	0.45	230.34	116.59	0.51
BH6 (6)	**425.23**	0.62	**1,607.34**	126.01	0.20
BH3 – 10.9 (6) embankment (assumed leachate)	-	**3.84**	**6,937.00**	30.66	0.48
BH3 – 14.6 (6) embankment (assumed leachate)	-	1.42	**5,190.50**	65.41	0.23
'Landfill well 1' (7) (assumed leachate)	**30.3**	**134.7**	**6,368**	**2,317.8**	-
'Landfill well 2' (7) (assumed leachate)	**35.9**	**371.7**	**6,722**	**2,112**	-
Morari Alexandru (7)	**128**	-	120	212	0.61
59 (7)	**124**	-	149	333	0.38
Biseruca (7)	**195**	-	128	292	0.56
40 (7)	**137**	-	121	354	0.29
Gradinifa gimnaciu (7)	**27**	-	43	159	1.1
Ciminteri (7)	**24**	-	113	323	1.9
Pogreban valeriu (7)	**24**	-	163	239	2.9
6 (7)	**21**	-	85	87	2.4
Calder Maria (7)	**21**	-	135	294	1.33
2C (Cretoaia village) (8)	-	-	58	200	-
3C (Cretoaia village) (8)	-	-	145	**770**	-
4C (Tintareni village) (8)	-	-	34	85	-
4C1 (Cretoaia village) (8)	-	-	Not analysed	Not analysed	-
5C (Tintareni village) (8)	-	-	140	400	-
6C (Tintareni village) (8)	-	-	90	405	-
7C (Tintareni village) (8)	-	-	135	320	-
8C (Tintareni village) (8)	-	-	62	256	-

Shaded cells indicate exceedance of the adopted DWS. Cells in bold indicate exceedance of the adopted SWS.
(1) World Health Organisation (WHO) Drinking Water Standard (DWS)
(2) WHO threshold odour level in absence of DWS
(3) Council Directive 98/83/EC standards in absence of WHO DWS
(4) Maximum allowable concentration (MAC) for Use Class IV (OECD, 2007), unless stated otherwise
(5) The SWS for ammonium was adopted
(6) Boreholes installed during the geotechnical site investigation in June/July 2016 (Boncom Proiect, 2016)
(7) Results dated 2014 and 2015 for two landfill wells (drainage and filtration wells) and nine groundwater abstraction wells located at Tintareni village.
(8) Results dated 2012 for five wells located at Tintareni village and four wells located at Cretoaia (E. Lindberg, J. Olsson, 2012).

The groundwater analytical results summarised above reported the following.

→ Groundwater quality as analysed at the filtration and drainage wells adjacent to the landfill (named 'Landfill wells' in table above) indicate impact of landfill leachate with ammoniacal nitrogen and chloride concentrations up to 371 mg/l and 6,722 mg/l respectively.

- Groundwater quality as analysed at the newly installed boreholes BH2, BH4 and BH6 indicates impact of landfill leachate with chloride concentrations up to 1,607mg/l. Reported concentrations of ammoniacal nitrogen, sulphate and fluoride in the newly installed wells exceeded the adopted DWS in BH1 only, located hydraulically upgradient.
- Reported concentrations of chloride in water within the embankment body (BH3 at 10.9 mbgl and 14.6 mbgl) indicate impact of landfill leachate, with concentrations one order of magnitude higher than in the groundwater body. As in the groundwater body, ammoniacal nitrogen, sulphate and fluoride concentrations are considered to be generally relatively low. It is noted a number of contaminants of concern, including dichloro diphenyl trichloroethane (DDT), were only detected in these two samples.
- Nitrate concentrations in the landfill boreholes varied significantly between locations, with values ranging between below the limit of reporting (<0.1 mg/l) to 519.86 mg/l (BH4). The water samples collected from the drainage and filtration wells adjacent to the landfill returned concentrations between 30 mg/l and 36 mg/l. Reported concentrations of nitrate in the abstraction bores were up to three orders of magnitude higher than in a number of the landfill boreholes (BH2 and BH3). It is noted however nitrate concentrations were higher in BH4 and BH6 than in the abstraction bores.
- Reported concentrations of fluoride were one order of magnitude higher in the abstraction bores than in the landfill boreholes, with concentrations in three abstraction bores exceeding the adopted DWS.
- Chloride concentrations exceeded the adopted DWS in the landfill boreholes and the ‘Landfill wells’, with reported concentrations in the abstractions bores one order of magnitude lower.
- Sulphate concentrations exceeded the DWS in BH1, which is located hydraulically upgradient, the ‘Landfill wells’ and the abstraction bores only.

No clear correlation between water quality in, or adjacent to, the Tintareni landfill and that in the Tintareni village was established using the available data.

3.4 SURFACE WATER ANALYTICAL RESULTS

During the 2016 geotechnical site investigation (Boncom Proiect, 2016), a surface water sample was collected from the River Bic (sampling point location is unknown). A summary of the reported analytical results is included in Table 3-3.

Table 3-3 Surface water (River Bic) analytical results (mg/l)

	Groundwater concentrations (mg/L)				
	Nitrate (NO_3^-)	Ammoniacal nitrogen (NH_4-N)	Chloride (Cl^-)	Sulphate (SO_4^{2-})	Fluoride (F^-)
SWS	11.3	3.1	500	500	Not available
River Bic	4.69	36.94	95.88	164.45	0.14

Shaded cells indicate exceedance of the adopted SWS

The reported concentration of ammoniacal nitrogen exceeded the adopted SWS by one order of magnitude. It is noted the DWS was also exceeded for this analyte.

4 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) has been formulated utilising available information to determine the presence of plausible exposure pathways and hence the presence of significant risk to susceptible receptors. For a significant or identifiable risk to exist an exposure pathway must be present which requires each of the following to be identified:

- The presence of substances that may cause harm (source);
- The presence of a receptor which may be harmed at an exposure point (receptor); and
- The existence of means of exposing a receptor to the source (exposure pathway).

Explanatory notes on the CSM developed for the site are provided below.

4.1 SOURCES OF CONTAMINATION

The source for potential contamination is the leachate generated in the landfill. The nature and concentration of contaminants within leachate depend on the waste type. Concentrations are expected to decline overtime due to degradation of compounds, dilution by infiltrating water and losses by volatilisation.

The Tintareni landfill was and is proposed to be used to dispose of municipal solid waste (MSW) generated in Chisinau. The main sources of MSW are private households (50-60%), commerce, industry, public entities, street sweeping and landscaping activities.

When the Tintareni landfill site was operational, the daily volume of waste disposed at the landfill was approximately 3,000m^3, five days per week. The volume of waste production in Chisinau is steadily increasing. It is estimated that on average around 1,000,000m^3 MSW will be delivered yearly if the landfill is upgraded and reopened (WSP Parsons Brinckerhoff, 2016b). The estimated waste generation rate in Chisinau was 2 m^3 per person per year. The waste generation tonnage is calculated by Regia Autosalubritate based on the estimated density of 200 kg/m^3 for MSW generated by households (Fichtner, 2016a).

The waste composition studies undertaken by Regia Autosalubritate indicated the MSW was organic waste represented the largest percentage of waste, accounting for approximately 50% on average, and recyclable materials represented the second largest fraction (approximately 24%) (Fichtner, 2016a).

The storage and accumulation of waste generates leachate that, if not correctly managed, can impact on the quality of groundwater beneath the landfill and migrate to downgradient receptors in hydraulically connectivity with the site. Since 2011 the leachate is analysed regularly on the main parameters such as biological oxygen demand, chemical oxygen demand, solid suspended matter, chloride, nitrate, nitrite, ammonium and sulphate (Fichtner, 2016b). In addition, a leachate sample was collected during the 2012 water assessment conducted by E. Lindberg and J. Olsson (2012). The leachate analytical results are summarised in Table 4-1.

Table 4-1 Leachate analysis

ANALYTE	CONCENTRATION (MG/L)		
	Bottom pipe (1)	*Top pipe* (1)	*Leachate sample* (2)
BOD5	5,938.8	4,242	1,550
COD	16,968	12,120	3,606
Suspended Matter	86.4	102.6	73.9
Chloride	6,035.9	4,615.7	3,602
Detergents	10.3	6.8	3.5
Nitrate N-NO3	42.7	38.9	2.09
Nitrate N-NO2	10.4	5.2	14.56
Ammonia N/NH4	253.4	129.1	1,766
Sulphate SO4	2,317.0	1,995.0	1,648
pH	8.1	8.2	8.28

(1) Source data: Fichtner, 2016b
(2) Source data: E. Lindberg, J. Olsson (2012), Landfill closure plan – A pre-study of Tintareni landfill in the Republic of Moldova, Master Thesis, Lund University, Sweden, 6 June 2012

The upgrade of the Tintareni landfill is proposed to include a leachate collection system and leachate treatment plant to ensure the maximum allowed concentrations are achieved before water discharge.

4.2 PATHWAYS

The main feasible transport routes along which the leachate is transported through the environment are indicated below.

- Infiltration of leachate through the waste mass.
- Accumulation of leachate at the base of the landfill and leakage through the base sealing.
- Migration of leachate through the unsaturated zone and discharge to groundwater, and subsequent migration to downgradient surface waters and abstraction wells.

Contaminants will be subject to attenuation processes in the different transport media including retardation, dispersion, degradation and dilution. Retardation is also considered likely.

4.3 RECEPTORS

Based on the surrounding environment and land uses, the potential receptors include:

- The limestone aquifer beneath the site (mid-Sarmatian unit)
- Abstraction wells hydraulically connected with the aquifer beneath the site, located 4km downgradient from the site.
- River Bic, located 5km downgradient from the site.

4.4 SUMMARY

A conceptual site model for the site has been described which uses published information and site investigation data to establish the following:

- The leachate in the landfill represents a potential **SOURCE** of contamination. It has been subject to testing so the current chemical characteristics of the leachate are known;
- The site is known to have a clay barrier constructed at its base and is underlain by a natural series of clays and sands which are indicated by site investigation to be inconsistent vertically and horizontally. Groundwater intercepted in this geological horizon indicates some contamination by leachate but contaminant concentrations are well below those in the leachate source. The barrier and natural geology proven by site investigation represent a limited **PATHWAY** for downward migration of the leachate source; and,
- Published information indicates that a Limestone aquifer is present at depth beneath the site which represents a **RECEPTOR**. Additional receptors are defined as features down hydraulic gradient of the site such as drinking water abstractions in villages to the north and the River Bic. Both of these represent receptors which are impacted if the Limestone is considered as a pathway i.e. groundwater migration under a regional gradient transports contaminants.

5 HYDROGEOLOGICAL RISK ASSESSMENT

5.1 THE NATURE OF THE HYDROGEOLOGICAL RISK ASSESSMENT

The previous operation of the landfill was ceased in 2010 due to concerns from local residents regarding the potential contamination of groundwater and associated health effects. The residents of Tintareni village, located approximately 5km to the northeast, claimed the landfill could be impacting on the quality of their groundwater supply. Previous studies into this have failed to reassure the local residents.

A hydrogeological risk assessment (HRA) has been carried out to assess the potential impacts on the groundwater quality at the identified receptor populations associated to the generation of leachate at Tintareni landfill.

5.2 ASSESSMENT SCENARIO

The modelled HRA has been conducted for the current situation (landfill in its present conditions). This scenario corresponds to the potential impacts associated to the current generation of leachate, prior to the proposed upgrade of the landfill. The assessment of the potential impacts related to the generation of leachate of the upgraded landfill (future conditions) has been conducted qualitatively.

5.3 THE PRIORITY CONTAMINANTS TO BE MODELLED

The contaminants to be modelled depend on the nature of the wastes deposited and were selected and limited to a range of indicator species that will act as a realistic surrogate for the leachate as a whole. The potential contaminants of concern were selected based on the below.

- Likely contaminants associated with the deposition of organic waste and non-hazardous materials.
  - Inorganic cations (e.g. ammonium, potassium)
  - Inorganic anions (e.g. chloride, cyanide)
  - Hydrophilic organic chemicals (e.g. phenol)
  - Hydrophobic organic chemicals (e.g. polycyclic aromatic hydrocarbons)
  - Acid herbicide (e.g. mecocrop)
  - Highly mobile metallic ions (e.g. nickel)
  - Less mobile metallic ions (e.g. mercury)
  - Organo-metallic substances (e.g. organo-tin compounds)
- List I and List II substances as defined in Groundwater Directive 80/68/EEC
- Available data from previous assessments conducted on site were used to select the relevant analytes to include in the risk assessment. Analytes detected in abstraction wells or in exceedance of the adopted quality standards were taken into account.

5.4 REVIEW OF TECHNICAL PRECAUTIONS

CURRENT SITUATION

The landfill leachate is currently collected in five storage reservoirs with a total storage capacity of 330 m^3. It is pumped from these storage reservoirs into tankers and reintroduced to the top of the landfill, as a part of a leachate recirculation strategy. This is a practice which uses leachate to saturate the waste leachate and enhance the rate of degradation of the solid waste. Excess leachate is drained by gravity flow to the base of the landfill and then into the storage reservoirs. The base of the landfill is comprised by a low permeability (assumed to be $\leq 10^{-8}$ m/s) base sealing of compacted clay (Fichtner, 2016a).

FUTURE SITUATION

The proposed upgrading of Tintareni landfill will incorporate the engineering systems required to be compliant with EU Landfill Directive. For the purpose of this report, the existing waste cell was named Waste Cell – Phase 1 and the remaining capacity of the landfill was named Waste Cell – Phase 2. The information below has been obtained from the project proposal report (Fichtner, 2016b) and is only indicative of the measures proposed to be put in place.

- The operation of Waste Cell – Phase 2 is recommended to be conducted in sub-cells, which will enable diversion of clean surface water from the unused sub-cells. In addition, only the sub-cell in operation will generate leachate and therefore leachate generation can be reduced.
- A lining system that will act as surface sealing for Waste Cell – Phase 1 and as a base sealing for Waste Cell – Phase 2 is proposed to be constructed. The cross section of the interim lining system is proposed to be as follows (from the base of Waste Cell – Phase 2 to the top of Waste Cell – Phase 1).
  - Leachate drainage system
  - Protection geotextile (min 1200g/sqm)
  - High density polyethylene (HDPE) geo membrane (2mm thick).
  - Geosynthetic clay liner (k value $\leq 10^{-11}$ m/s) and soil layer (50cm thick)
  - Geogrid
  - Levelling layer of crushed gravel material (≥ 30cm), with a permeability coefficient not less than $1x10^{-3}$ m/s.
- The proposed leachate collection system will extract leachate within Waste Cell – Phase 1 and collect leachate from Waste Cell – Phase 2. The extraction of leachate within Waste Cell – Phase 1 will reduce the impact on the quality and functionality of the base sealing and avoid instability of the dam north of the waste cell. The leachate collection for Waste Cell – Phase 2 will be comprised of drainage layer, drainage pipes, manholes and collector.
- The leachate treatment plant is proposed to consist of a combination of processes including biological and physical treatments, with an estimated capacity of approximately 150 m^3/d.
- The surface water runoff is proposed to be drained and diverted outside the landfill by the following means.
  - Collection channel alongside the perimeter embankment.
  - Collection channel at the outer side of the perimeter road.
  - Collection in waste sub-cell
- The proposed sealing is comprised of the following.
  - Gas drainage layer (30cm thick), with a permeability coefficient not less than $1x10^{-3}$ m/s.

- Impermeable layer formed by a compacted clay layer of 50cm thick with a permeability not less than $1x10^{-9}$ m/s and a separation geotextile (300 g/sqm) placed on top and underneath the clay layer.
- Drainage layer (30cm thick), with a permeability not less than $1x10^{-3}$ m/s.
- Top soil layer (100cm thick), with the upper 25cm suitable for revegetation

5.5 NUMERICAL MODELLING

JUSTIFICATION FOR MODELLING APPROACH AND SOFTWARE

The HRA was conducted in general accordance with *Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Control and Trigger Levels* (Environment Agency, 2003b). To evaluate the potential for leachate leakage and migration to groundwater, modelling was undertaken.

The quantitative probabilistic risk assessment was undertaken using software LandSim developed for the U.K Environment Agency. LandSim is a customised risk assessment tool that has been produced specifically for assessing risks to groundwater from landfills and uses Monte Carlo (stochastic) techniques.

Monte Carlo simulation technique is to select randomly from a pre-defined range of possible input values to create parameters for use in the model calculations. Repeating the process many times gives a range of output values, the distribution of which reflects the uncertainty inherent in the input values and enables the user to ascertain the likelihood of the estimated output levels being achieved.

The attenuation processes identified in the conceptual site model were considered for the modelling in the unsaturated and saturated zone. The migration of leachate through the clay liner did not include any retardation or degradation processes.

The values adopted the input parameters are detailed in the section below.

MODEL PARAMETERISATION

The input parameters in relation to leachate source term, infiltration parameters, barrier information, unsaturated pathway, vertical pathway and saturated pathway are presented in Appendix B.

The input parameters were based on site-specific data, where available. The justification of the adopted values is detailed in the relevant section within Appendix B.

SENSITIVITY ANALYSIS

Uncertainty in the selection of input parameters is addressed by the use of a probabilistic approach to the risk modelling. As the input parameters have generally been entered as ranges, the results are also returned as ranges and defined according to the probability of occurrence. The 95^{th} percentile represents a 95% confidence level that the actual value will be less than that predicted in the model. In the case of predicted contaminant concentrations the 95^{th} percentile represents a 95% probability that the predicted contaminant concentration at the compliance point will be lower than predicted. The outputs of the model are 95^{th} percentile values that are representative of the reasonable worst-case performance of the landfill. Given the LandSim model uses a probabilistic approach, it is considered that a sensitivity analysis is not required.

MODEL VALIDATION

The LandSim model was used to calculate concentrations at:

- the base of the clay barrier;
- the base of the unsaturated zone and vertical pathway;
- at the site boundary down hydraulic gradient (100m from source) for the assessment of compliance with guidance and legislation relevant to non-hazardous pollutants;
- at a distance of 500m hydraulically downgradient from the source; and
- at a distance of 4km for the assessment of the potential impacts to abstraction wells located in Tintareni village and surface water at River Bic.

ACCIDENTS AND THEIR CONSEQUENCES

Spills may occur during removal of leachate from the storage tanks which could result in the discharge of leachate to the ground. The leachate management procedures for the site are expected to include the avoidance, mitigation measures and emergency actions to be conducted following a potential spill. The potential consequences of a leachate superficial spill to the groundwater and surface water environment are considered to be minimal and therefore additional quantitative analysis is not considered to be warranted.

Storage tanks leakage may occur in the event of an overflow. The current leachate management measures include the periodic collection of leachate from the storage tanks, followed by it discharge into the surface of the landfill. No records of tanks overflows due to heavy rainfall events have been reported. The leachate management procedures for the site are expected to include the avoidance, mitigation measures and emergency actions following a potential overflow of the storage tanks. Given the storage tanks are emptied on a regular basis, the likelihood of this accident is minimal and therefore additional quantitative analysis is not considered to be warranted.

5.6 SUMMARY

The conceptual site model has been used to provide input parameters to the LandSim model. The model considers conservative assumptions, including:

- **SOURCE**. The source term concentrations used in the modelling represent a range of concentrations including values for non-hazardous waste acceptance criteria, which are for a number of contaminants higher than site specific data.
- **PATHWAY**. Attenuation is limited to the vertical pathway and excludes any benefit the engineered liner may provide. The model provides a homogenous vertical pathway which is more conducive to downward vertical migration from the observed interbedding of clays and sands may actually be.
- **RECEPTOR**. No account of external factors along the pathways has been included. The limestone is assumed to be homogenous rather than a combination of fractures of low permeability matrix materials that it is likely to be.

6 RISK ASSESSMENT RESULTS

6.1 EMISSIONS TO GROUNDWATER

The estimated concentrations (95th percentile) at the base of the vertical pathway (i.e. concentrations entering the aquifer underlying the landfill) are presented in Table 6-1. Statistical results and graphs are included in Appendix C.

Table 6-1 Peak concentrations at the base of the vertical pathway (95th percentile)

SUBSTANCE	WATER QUALITY STANDARDS		PEAK CONCENTRATION AT BASE OF THE VERTICAL PATHWAY	
	DWS (1)	SWS (2)	CONCENTRATION (MG/L)	TIME (YEARS)
Ammoniacal nitrogen (NH_4-N)	1.5 (3)	3.1 (5)	**70**	90
Chloride (Cl^-)	250	500	**2,475**	19
Sulphate (SO_4^{2-})	250 (4)	500	**1,765**	21
DDT	0.001	3.0E-05	**1.13E-04**	20,000
Lead	0.010	0.05	5.50E-09	20,000
Arsenic	0.010	0.05 (6)	1.95E-03	7,250
Nickel	0.070	0.1	3.50E-04	20,000

Shaded cells indicate concentrations exceed the DWS
Cells in bold indicate concentrations exceed the SWS
(1) World Health Organisation (WHO) Drinking Water Standard (DWS), unless stated otherwise
(2) Maximum allowable concentration (MAC) for Use Class IV (OECD, 2007), unless stated otherwise
(3) WHO threshold odour level in absence of DWS
(4) Council Directive 98/83/EC standards in absence of WHO DWS
(5) The SWS for ammonium was adopted
(6) United Kingdom SWS

The modelled concentrations entering the aquifer pathway indicated the following.

- Lead, arsenic and nickel concentrations are not predicted to exceed the DWS or SWS.
- Ammoniacal nitrogen, chloride and sulphate peak concentrations are predicted to exceed both the DWS and SWS.
- The modelled DDT peak concentration is predicted to exceed the adopted SWS.

The estimated concentrations at distances of 100m (site boundary), 500m and 4km (TIntareni village abstraction wells and River Bic) are presented in Table 6-2. The results are included in Appendix C

Table 6-2 Peak concentrations in groundwater at compliance points (mg/L)

Substance	DWS (1)	SWS (2)	100m		500m		4km	
			Peak concentration (mg/L)	Time (years)	Peak concentration (mg/L)	Time (years)	Peak concentration (mg/L)	Time (years)
Ammoniacal nitrogen (NH_4-N)	1.5 (3)	3.1 (5)	**20**	505	1.79	3,374	0.09	13,500
Chloride (Cl^-)	250	500	**1,378**	51	153	125	12	138
Sulphate (SO_4^{2-})	250 (4)	500	**2,287**	87	350	430	28	241
DDT	0.001	3.0E-05	**1.3E-04**	144	1.4E-05	220	8.9E-07	4,000
Lead	0.010	0.05	Peak concentrations entering the saturated pathway were below the adopted standards					
Arsenic	0.010	0.05 (6)						
Nickel	0.070	0.1						

The calculated groundwater concentrations indicated the following.

- The concentrations of ammoniacal nitrogen, chloride and sulphate estimated at the landfill boundary (100m from source) exceeded both the DWS and SWS.
- DDT marginally exceeded the SWS at the landfill boundary (100m) only.
- Ammoniacal nitrogen (NH_4-N) marginally exceeds the DWS at a distance of 500m at approximately 3,300 years.
- Sulphate marginally exceeds the DWS at a distance of 500m at approximately 400 years.
- All contaminants are below DWS and SWS by at least one order of magnitude at the downgradient abstraction wells and River Bic (4km).

6.2 DISCUSSION OF RESULTS

MODELLING RESULTS

Based on the results detailed in sections above, the leachate generated in Tintareni landfill is considered likely to impact on the quality of the groundwater in the immediate vicinity of the landfill. However, given the estimated concentrations decrease to levels near or below the adopted ecological and drinking water standards at a distance of approximately 500m from the source, the estimated concentrations breaking through the liner are not considered to impact on the quality of the water extracted from the regional abstraction wells and within River Bic.

A summary of the results for the analytes assessed as part of this risk assessment is provided in Table 6-3.

Table 6-3 Summary of results

RECEPTOR POINT	ANALYTES AT CONCENTRATIONS IN EXCEEDANCE OF:	
	DWS	SWS
Site boundary: 100m	Ammoniacal nitrogen Chloride Sulphate	Ammoniacal nitrogen Chloride Sulphate DDT
Tintareni village abstraction wells: 4km	None	None
Rive Bic (based on concentrations at 4km)	None	None

It is noted that the quality of the receiving environment was below the adopted quality standard, as detailed below.

- The concentration of ammoniacal nitrogen detected in the sample collected from River Bic (refer to Section 3.4) exceeded the adopted SWS.
- The majority of the abstraction wells assessed (Section 3.3) returned concentrations of sulphate in exceedance of the adopted DWS.

However, based on the assessment undertaken, it is considered that the concentrations detected in both the regional abstraction wells and River Bic are due to potential sources of contamination such as local small scale local landfilling and agricultural fertilizers, rather than the Tintareni landfill.

INVESTIGATION RESULTS

No groundwater boreholes were drilled downgradient from the landfill in the limestone aquifer and therefore the modelling results could not be validated against site specific data. However, a comparison of the groundwater results reported in the downgradient boreholes BH4, BH5 and BH6 drilled into the alluvial-talus deposits downgradient from the landfill and the estimated concentrations entering the limestone aquifer is provided below.

- Reported concentrations of ammoniacal nitrogen in downgradient boreholes BH4, BH5 and BH6 were two orders of magnitude lower than the modelled concentrations entering the limestone aquifer. Additionally, the reported concentrations in the remainder boreholes, including samples collected from the embankment, were one order of magnitude lower than that estimated by the model.
- Reported concentrations of chloride in downgradient boreholes BH4, BH5 and BH6 were up to one order of magnitude lower than the modelled concentrations entering the limestone aquifer.
- Reported concentrations of sulphate in downgradient boreholes BH4, BH5 and BH6 were one order of magnitude lower than the estimated concentrations entering the limestone aquifer. It is noted the reported concentrations in the samples collected from the embankment are two orders of magnitude lower than the modelled concentrations entering the limestone aquifer.

Based on the above, the modelling results are considered to reflect conservative assumptions within the model and potentially overestimate the actual impact of the landfill.

6.3 UPGRADE OF TINTARENI LANDFILL

The hydrogeological risk assessment detailed above was conducted for the current Tintareni landfill, which is considered to represent the worst case scenario (i.e. no surface sealing, no engineered lining system). The source term concentrations used in the model were selected based on site specific analytical results and limit values for non-hazardous waste acceptance criteria (Council Decision 2003/33/EC) and therefore are considered to be representative of leachate concentrations in the event the landfill is reopened.

The upgrade of the landfill will include measures that are expected to reduce the leachate head and ultimately reduce the concentrations of leachate entering the underlying aquifer. These measures include the following.

- Leachate collection system that will extract leachate within the current waste cell;
- Surface sealing of the current waste cell, which will act as a base sealing for the additional waste;
- Drainage of surface water runoff; and
- Surface sealing of the additional waste.

7 REQUISITE SURVEILLANCE

7.1 THE RISK BASED MONITORING SCHEME

A monitoring plan is required to be implemented in order to demonstrate the landfill is performing as designed and to identify if the operation of the landfill is impacting on the quality of the receiving water environment. Landfill sites that contain biodegradable wastes may need to be monitored for periods up to 50 years or more after completion of landfilling during the site's after care period (Environment Agency, 2003a).

The below monitoring recommendations have been included in the Environmental and Social Action Plan (ESAP) that has been developed.

7.2 LEACHATE MONITORING

In order to identify an unacceptable increase in leakage of leachate over that calculated in the HRA, the following monitoring is recommended.

LEACHATE LEVEL

The leachate level above the clay liner shall be measured on a regular basis. Leachate levels shall not exceed 1m depth of leachate above the top of the clay liner. In the event the leachate level exceeds the control level by 0.5m on three consecutive occasions, actions shall be undertaken in order to investigate the cause of the rise in leachate level, review the HRA to account for the increase of the leachate head and implement mitigation measures if deemed necessary.

LEACHATE QUALITY

The leachate quality shall be assessed on a regular basis. The selected source term concentrations were considered to be representative of leachate concentrations in non-hazardous waste landfills, however additional modelling was undertaken by doubling the source term concentrations. The transport models and other input parameters used in the main model (Section 5) were not changed. It was estimated that by doubling the source term concentrations, compliance was achieved at 750m from the waste cell. The results are included in Appendix C.

In the event the leachate concentrations exceed the levels indicated in Table 7-1 on three consecutive occasions, actions shall be undertaken in order to investigate the cause of the rise in concentrations, review the HRA and implement mitigation measures if deemed necessary.

Table 7-1 Leachate quality

SUBSTANCE	MAXIMUM CONCENTRATION (MG/L)
Ammoniacal nitrogen (NH_4-N)	4,500
Chloride (Cl^-)	17,000
Sulphate (SO_4^{2-})	14,000
DDT	$2{,}32\text{x}10^{-4}$
Lead	6

SUBSTANCE	MAXIMUM CONCENTRATION (MG/L)
Arsenic	0.6
Nickel	6

7.3 GROUNDWATER MONITORING

In order to identify any potential deterioration of the groundwater quality, groundwater monitoring shall be undertaken on a regular basis. The compliance points should be groundwater wells that target the underlying limestone aquifer located hydraulically downgradient from the site. A minimum of two groundwater monitoring wells are recommended to be installed at the downgradient landfill boundary. The compliance limits are the adopted DWS or SWS, whichever is lower, and the control levels are set as 80% of the compliance limits.

In the event the groundwater concentrations exceed the levels indicated in Table 7-2 on three consecutive occasions, actions shall be undertaken in order to investigate the cause of the rise in concentrations, review the HRA and implement mitigation measures if deemed necessary.

Table 7-2 Groundwater quality

SUBSTANCE	COMPLIANCE LIMIT (MG/L)	CONTROL LEVEL (MG/L)
Ammoniacal nitrogen (NH_4-N)	1.5	1.2
Chloride (Cl^-)	250	200
Sulphate (SO_4^{2-})	250	200
DDT	3.0E-05	2.4E-05
Lead	0.01	0.008
Arsenic	0.01	0.008
Nickel	0.07	0.056

7.4 SURFACE WATER MONITORING

Based on the distance to the nearest surface water body (River Bic, 5km), the monitoring of groundwater downgradient from the landfill is considered to be sufficient surveillance.

8 CONCLUSIONS

This hydrogeological risk assessment was conducted to assess the effects of Tintareni landfill upon hydrogeology and hydraulically connected downgradient groundwater and surface water resources. The potential receptors include hydraulically connected downgradient abstraction wells in Tintareni village (4km to the northwest) and River Bic, located 5km to the north of the site.

The qualitative assessment of the location of landfilled wastes over an engineered clay barrier and mixed clays and sands is that vertical migration of leachate to the underlying aquifer is likely to be significantly impeded. Groundwater quality measured under the site indicated some impact of leachate but at relatively low concentrations. Therefore, the hydraulic connectivity between the alluvial-talus deposits and the productive underlying mid-Sarmatian limestones is considered to be limited.

Based on the quantitative risk assessment results, leachate generated in Tintareni landfill is not considered likely to impact on the quality of the abstracted groundwater in Tintareni village. Although modelled concentrations at the base of the landfill and its immediate vicinity exceeded the adopted water quality standards, the impact of the landfill at a distance of approximately 500m is considered to be low. The modelled concentrations 500m from the site marginally exceeded the drinking water standard for ammoniacal nitrogen in 3,000 years' time and sulphate in 400 years' time, however surface water quality standards were not exceeded. In summary, modelled concentrations breaking through the liner are not considered likely to impact on the quality of the water extracted from the regional abstraction wells or within River Bic.

The landfill is to be subject to additional engineering works and management controls which have the potential to improve the current site and reduce leakages from the current waste body, specifically these include:

- Reduction of leachate production by capping with an engineered lining system for new wastes to be deposited over (intercepting rainfall);
- Removal of leachate from the landfill for treatment and disposal; and,
- Better control of lower leachate heads at the base of the landfill by avoiding large loading events of water eg by melting snow or excessive leachate recirculation.

New wastes will be deposited in areas where leachate can be separately managed and kept hydraulically separated from the underlying historical waste body, lining system and/or natural strata. The addition of waste on top of the current waste cell is likely to compress the current waste mass and potentially increase the leachate head during short periods of time (i.e. until the extraction of leachate occurs), which was taken into consideration in the modelling by assuming a leachate head of up to 3m thick.

The risk of the current landfill to the identified receptors is considered to be low, although some impact was identified in the underlying groundwater and the immediate vicinity of the landfill. Theoretical discharges have been assessed and they do not represent a significant risk to receptors located more than 500m from the site. This assessment is based on the available data and it is recommended that the following is undertaken as part of the future development of the site:

- Installation of additional boreholes on the downgradient side of the site (north) which penetrate into the underlying mid-Sarmatian Limestones;
- Regular leachate and groundwater quality monitoring from existing boreholes and proposed boreholes; and

- Review of the conceptual site model and update to the quantitative risk assessment model, if required on completion of at least three monitoring events.

The above recommendations have been included in the Environmental and Social Action Plan (ESAP) that has been developed.

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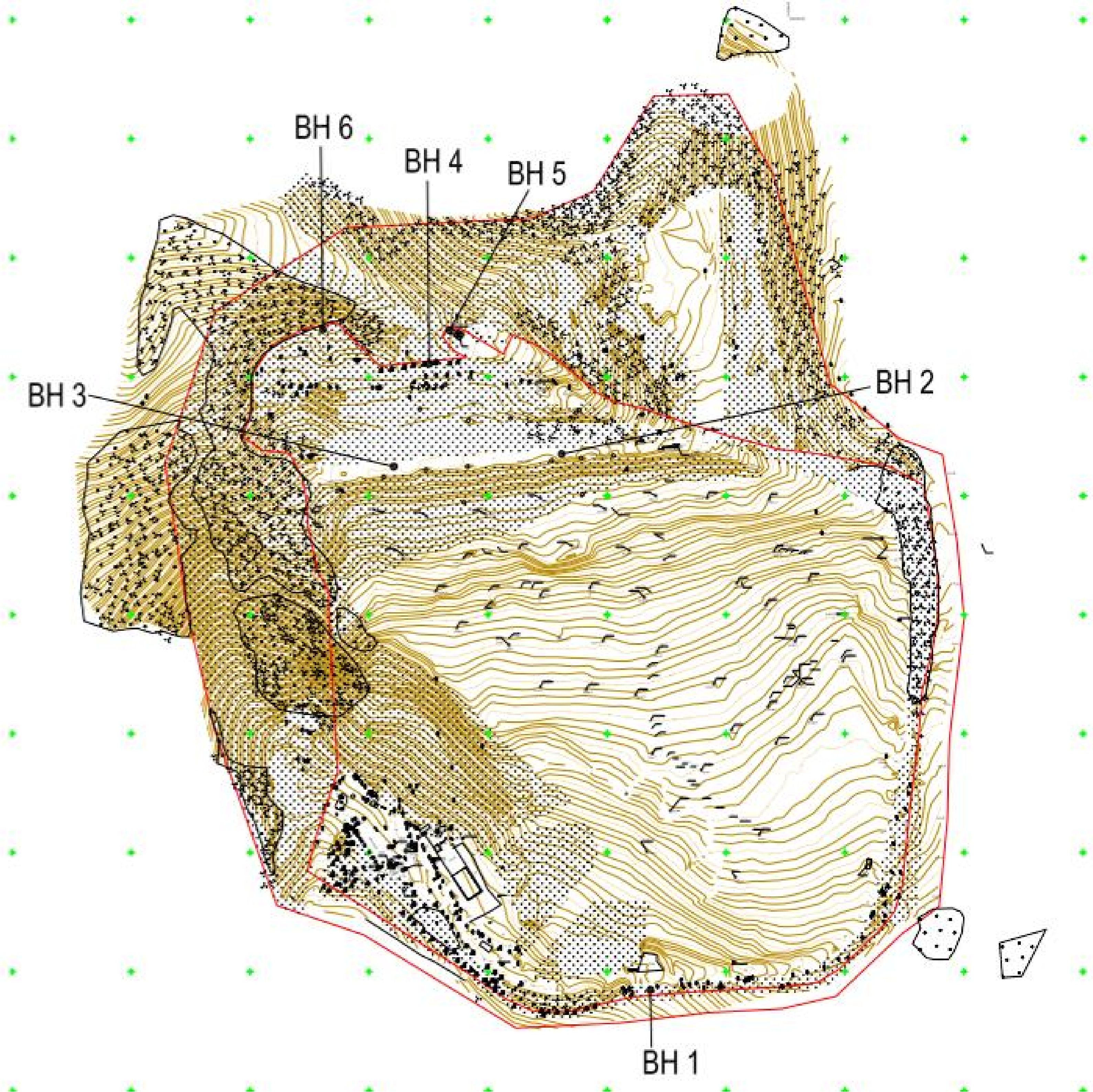
Appendix A

FIGURES

APPENDIX A-1

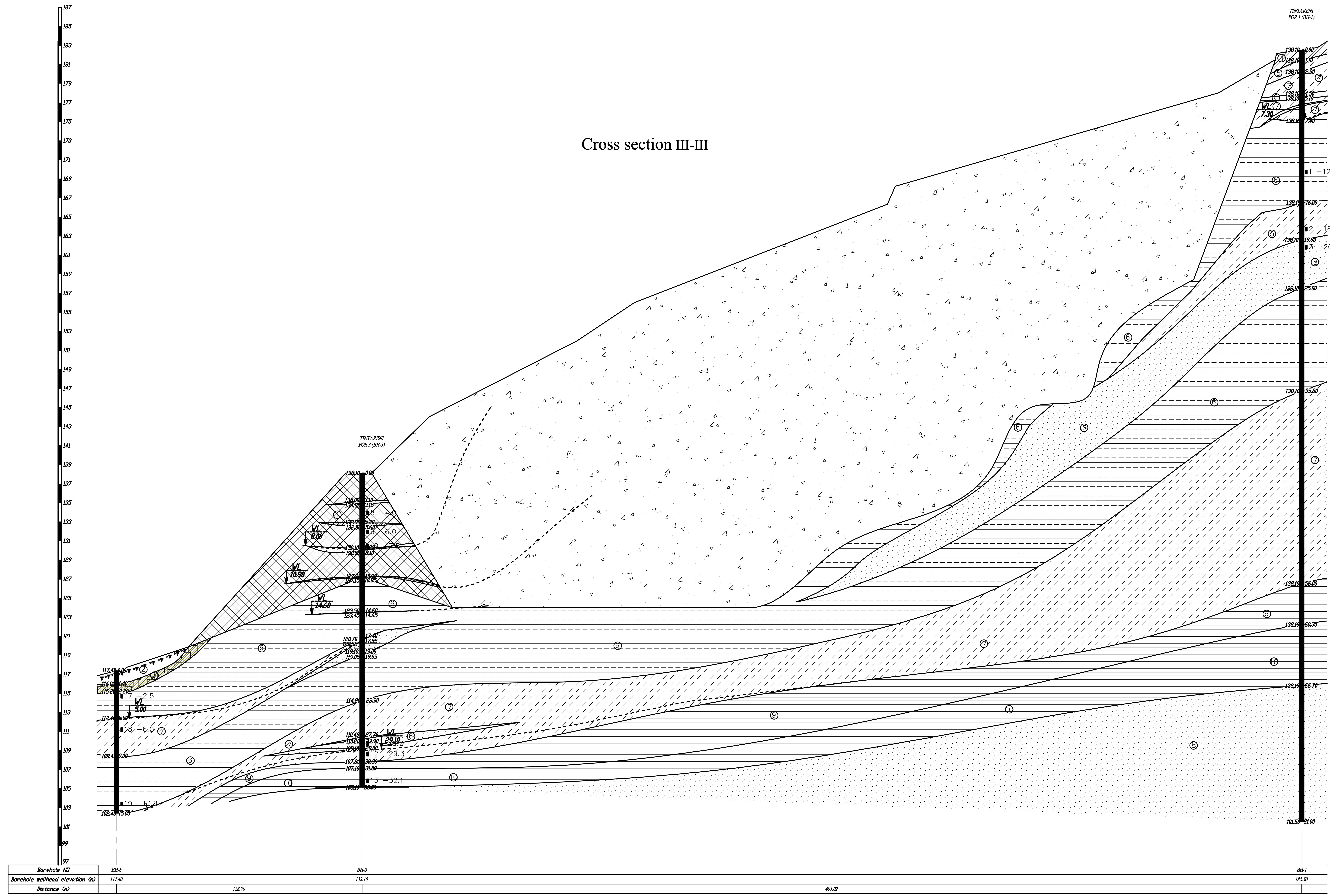
BOREHOLE LOCATION PLAN (BONCOM PROIECT, 2016)


BH 6
BH 4
BH 5
BH 3
BH 2
BH 1

APPENDIX A-2

CROSS SECTION BH1 – BH6 (BONCOM PROIECT, 2016)

Cross section III-III



1512/25

Geological Survey at the Landfill Site of Chisinau in Tintareni in the framework of the project "Moldova: Chisinau Solid Waste Project - Feasibility Study"

Mod	Nr par	Sheet	Nr. doc	Signature	Date
Pr. Manager		Colun V.			
Princ. Spec.		Bet N.			
Executed		Bet N.			

Cross section III-III

Stage	Sheet	Sheets
F S	3	

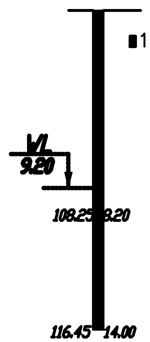
Scale: Vertical 1:200, Horizontal 1:1000

BONCOM-PROIECT Ltd.

Licen at AMMII Nr. 042271 from 27.06.2013

tQiv	①	Technogenic soil composed of sand and Black topsoil p.33б.
nQiv	②	Black topsoil , p.9a
aQiv	③	Sandy clay impregnated with humus and sand, p.33a,в
al,dlQiii–iv	④	Sandy yellow clay containing carbon granules, with hard and harsh consistency state, towards depth depth with yellow sand substrates, macroporous
al,dlQiii–iv	⑤	Sandy loam, dusty nests with sand and clay and sandy substrates, p.34a
N1kg al,dlQiii–iv	⑥	Compacted grey–yellowish clay with greenish–blue shades rust–mottled with small sand nests. p.8a,г.
N1kg al,dlQiii–iv	⑦	Medium and fine grained grey–yellowish sand with small grey–blue clay substratesp.27a,б
N_1S_3	⑧	Grey–yellowish sand with deposits of carbonate rocks granules, thin substrates of cochilifero–detrital rocks and sandstones p.27a,б
N1kg al,dlQiii–iv	⑨	Compacted green–yellow clay, with rusty mottles of iron oxides, with harsh consistency state with harsh consistency state and sand p.8a,г.
N1kg al,dlQiii–iv	⑩	Compacted green–yellow clay, with rusty mottles of iron oxides and sand substrates p.8a,г.
St	⑪	Technogenic soil composed of asphalt and gravel, p.24a.
		Aquifer layer level
	③	The number of geologic layer
	n.8г,g	Points after the difficulty of excavation of rocks under (СНиП IV–5–82, ed.1 tab.1)

BH



10 –7.5 Undisturbed sample taken with monolithic structure

the number of laboratory – the sampling depth

The depth of crossed water level

Bottom alltitude of the BH

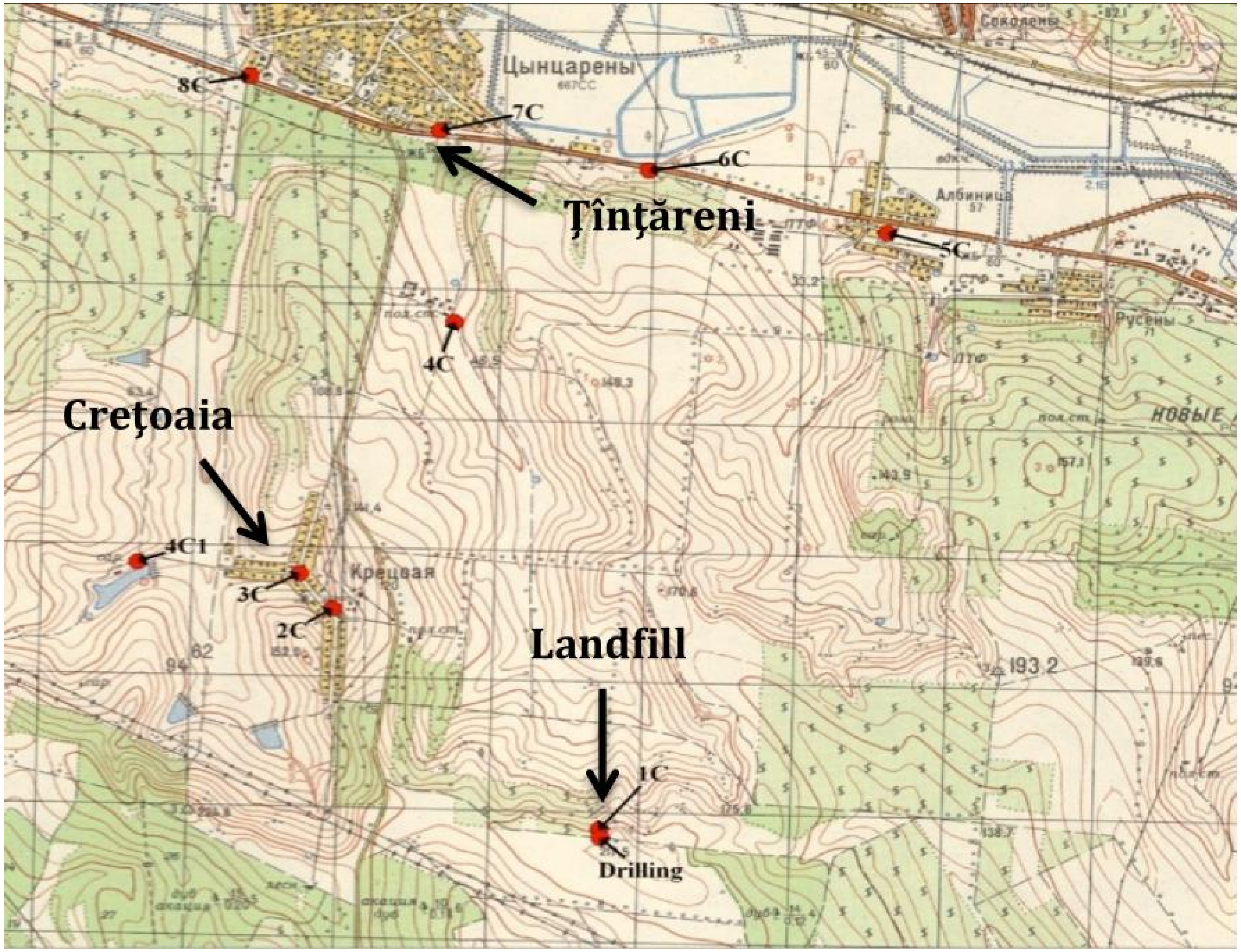
Artificial layers from the damp

tQiv	⑫	Compacted clay impregnated with humus, green clay, and substrates with sandy nests, p.33a,в
tQiv	⑬	Compacted green–yellowish clay with rusty mettles, with sand substrates of rusty color p.8a,г.
tQiv	⑭	Sand with fine and medium grittiness with particles of clay, sand with medium grain size p.27a,б

Mod	Nr.par	Sheet	Nr. doc	Signature	Date	1512/25		
						Geological Survey at the Landfill Site of Chisinau in Tintareni in the framework of the project "Moldova: Chisinau Solid Waste Project - Feasibility Study"		
Pr. Manager	Colun V.					Cross sections	Stage: F S	Sheet: 4 / Sheets:
Princ. Spec.								
Executed						Symbols	BONCOM-PROIECT l.t.d. Licen se AMMII Nr. 042271 from 27.06.2013	

APPENDIX A-3

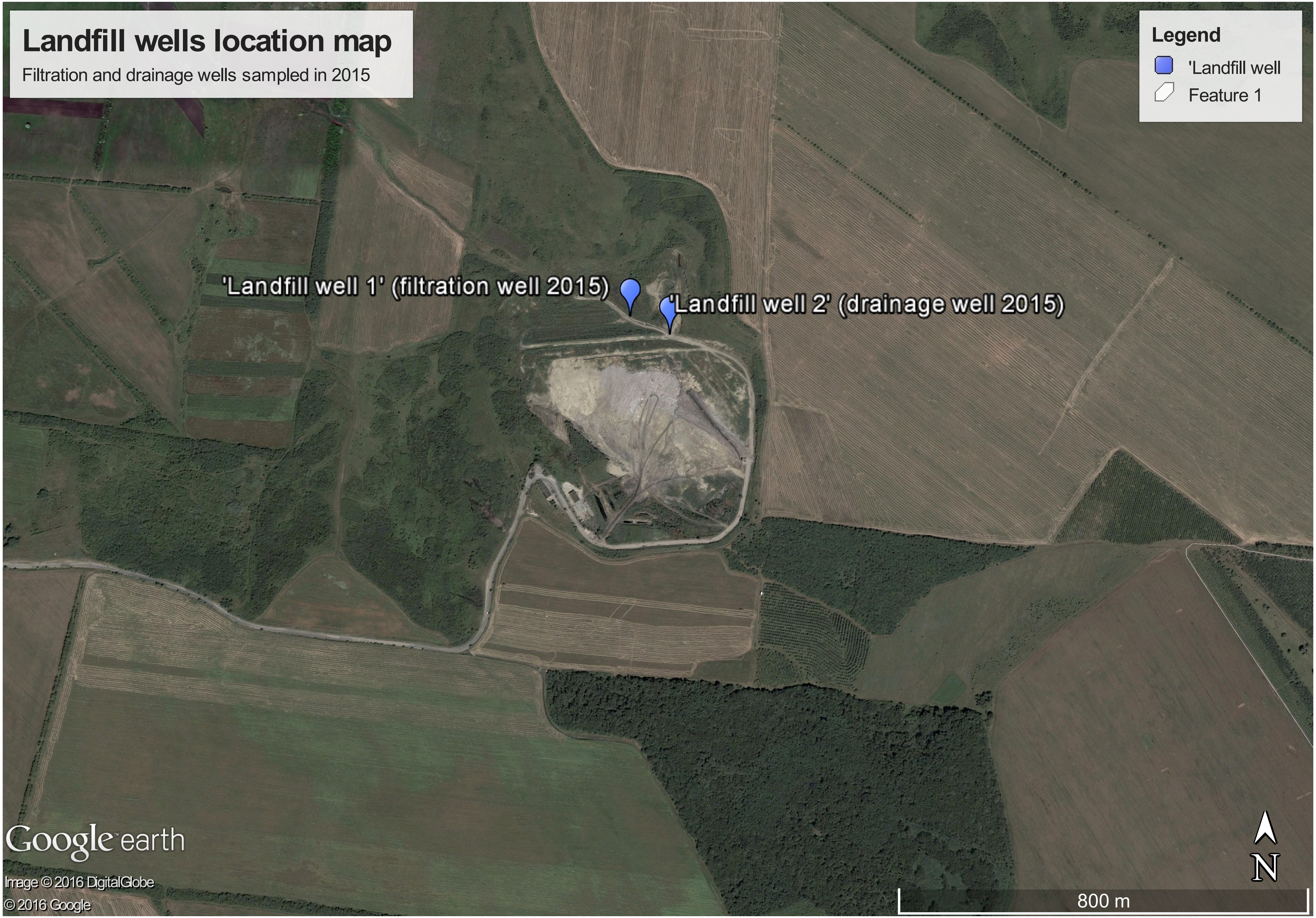
ABSTRACTION WELLS LOCATION PLAN
(E. LINDBERG, J. OLSSON, 2012)



Source: A pre-study of Tintareni landfill in the Republic of Moldova, Master Thesis, Lund University, Sweden, 6 June 2012 (E. Lindberg, J. Olsson, 2012)

APPENDIX A-4

DRAINAGE AND FILTRATION LANDFILL WELLS LOCATION PLAN (2015)


Landfill wells location map
Filtration and drainage wells sampled in 2015
Legend
'Landfill well
Feature 1
'Landfill well 1' (filtration well 2015)
'Landfill well 2' (drainage well 2015)
Google earth
Image © 2016 DigitalGlobe
© 2016 Google
N
800 m

Appendix B

MODEL PARAMETERISATION

B.1 Leachate source term

The selected analytes, justification for inclusion in the risk assessment and concentration range assigned are detailed in Table B 1.

Table B 1 Leachate source term concentrations

ANALYTE	JUSTIFICATION	CONCENTRATION [1] (MG/L)			DISTRIBUTION TYPE [2]
		MIN	MOST LIKELY	MAX	
Ammoniacal nitrogen	Indicator measurement in urban solid waste landfills. Detected above the adopted DWS and SWS in leachate and groundwater within the mid-Sarmatian unit (BH1). No exceedances detected in perched groundwater.	164.4	312.6	2,258	Triangular
Chloride	Indicator measurement in urban solid waste landfills. Detected above the adopted DWS and SWS in leachate and groundwater in perched groundwater. No exceedances detected in groundwater within the mid-Sarmatian unit (BH1 and abstraction wells).	4,903	6,036	8,500 [3]	Triangular
Sulphate	Detected above the adopted DWS and SWS in landfill leachate and embankment wells. Detected above the DWS in groundwater within the mid-Sarmatian unit (BH1 and abstraction wells). No exceedances detected in perched groundwater.	856.7	1,995	7,000 [3]	Triangular
p,p-DDT	List I priority substance. Detected above the SWS in embankment wells.	7.2×10^{-5}	-	1.16×10^{-4}	Uniform
Lead	List II priority substance. Detected above the adopted DWS and SWS in the embankment water (BH3) and in exceedance of the DWS in groundwater within the mid-Sarmatian unit (BH1)	2.39×10^{-3}	-	3 [3]	Uniform
Arsenic	List II priority substance. Detected above the adopted DWS in the embankment water (BH3) and leachate. No exceedances detected in perched groundwater or the mid-Sarmatian unit.	1.52×10^{-2}	-	0.3 [3]	Uniform
Nickel	List II priority substance. Detected above the adopted DWS and SWS in the embankment water (BH3) and leachate. No exceedances detected in perched groundwater or the mid-Sarmatian unit.	2.872×10^{-1}	-	3 [3]	Uniform

(1) *Samples considered in the calculation of concentration range include 'BH3 – 10.9', 'BH3 – 14.6', 'Landfill well 1', 'Landfill well 2', 'Bottom pipe', 'Top pipe' and 'Leachate sample' and 'Filtrat' (refer to Table 3-2, Table 4-1 and Annex B within Boncom Project (2016) report. The reported results of nitrogen ammoniacal in BH3 – 10.9', 'BH3 – 14.6' were not adopted given there were three orders of magnitude lower than in the remainder samples.*
- Ammoniacal nitrogen, chloride, sulphate: Minimum concentration refers to the 25th Percentile; Most likely concentration refers to the median value (50th percentile); Maximum concentration refers to maximum concentration detected
- DDT, lead, arsenic and nickel: unless stated otherwise, the minimum/maximum concentration refer to the minimum/maximum concentrations detected in samples collected on site. Values correspond to analytical results reported in' BH3 – 10.9', 'BH3 – 14.6' and 'Filtrat' as these compounds were not analysed in the remainder sample locations.
(2) *The distribution type describes the statistical distribution used in the model to represent the input parameters.*
(3) *The value corresponds to the limit value (C_o) for non-hazardous waste acceptance criteria (Council Decision 2003/33/EC).These values have been adopted when they have been established for the relevant compound and are higher than the maximum reported concentrations on site.*

The physicochemical parameters of the contaminants assessed are included in Table B 2 and Table B 3.

Table B 2 Kd values by species

PARAMETER	UNIT	RANGE MIN	RANGE MAX	DISTRIBUTION TYPE	JUSTIFICATION
Ammoniacal N	l/kg	0.5	2	Uniform	Landsim V2.5 default parameters, considered in the UK Default Distribution of Leachate Chemistry
Chloride	l/kg	0	0	-	No retardation
Sulphate	l/kg	0	0	-	No retardation
p,p-DDT	l/kg	0.00071		Single	Calculated based on Log Koc 5.18 (ATSDR, 2002) and fraction organic carbon 0.1% (conservative) (Kd = Koc * foc)
Lead	l/kg	27	$2.7\ 10^{5}$	Log uniform	Landsim V2.5 default parameters, considered in the UK Default Distribution of Leachate Chemistry
Arsenic	l/kg	25	250	Uniform	
Nickel	l/kg	20	800	Uniform	

Table B 3 Kappa values by species

PARAMETER	UNIT	M (slope)	C (INTERCEPT)	JUSTIFICATION
Ammoniacal N	-	0	0.59	Landsim V2.5 default parameters
Chloride	-	0.0298	0.2919	Landsim V2.5 default parameters
Sulphate	-	0.0166	0.1209	Landsim V2.5 default parameters
p,p-DDT	-	-	-	Concentrations are not considered to decline over time
Lead	-	0.0433	0.0171	Landsim V2.5 default parameters
Arsenic	-	0.0415	-0.0862	Landsim V2.5 default parameters
Nickel	-	0.0987	-0.1479	Landsim V2.5 default parameters

The adopted half-life value for p,p-DDT was 30years, based on ATSDR (2002).

B.2 Infiltration parameters

The infiltration data used in the model area described in Table B 4.

Table B 4 Infiltration parameters

PARAMETER	UNIT	VALUE	DISTRIBUTION TYPE	JUSTIFICATION
Infiltration to waste	mm/year	592	Normal with 120 standard deviation	Annual average precipitation based on a various range of references, including websites such as FAO, World Bank and World Climate and a various range of previous reports prepared for the site (E. Lindberg, J. Olsson, 2012; WSP Parsons Brinckerhoff, 2016; Fichtner, 2016a; Fichtner, 2016b; Boncom Project, 2016)
Cap design infiltration	mm/year	177	Single	Assumed to be 30% of the rainfall, for consistency with Fichtner (2016b)

B.3 Landfill parameters

The dimensions of the landfill and the waste characteristics adopted in the model are described in Table B 5.

Table B 5 Landfill geometry and waste characteristics

PARAMETER	UNIT	RANGE			DISTRIBUTION TYPE	JUSTIFICATION
		Min	Most likely	Max		
Duration of management control	Years	-	19	-	Single	Years from start of waste deposit (the landfill opened in 1991 and closed in 2010).
Cell width at base	m	-	20	-	Single	The landfill was built in a hillside by the formation of series of benches. The leachate flows by gravity to the bottom of the landfill where it is believed to accumulate. The maximum landfill width is estimated to be approximately 500m, based on Conceptual Design (Figure LF-CHS-216-Design). The width of the area where leachate accumulates is assumed to be approximately 20m

PARAMETER	UNIT	RANGE			DISTRIBUTION TYPE	JUSTIFICATION
Cell length at base	m	-	100	-	Single	The length of the area where leachate accumulates is estimated to be 100m. Based on Conceptual Design (Figure LF-CHS-216-Design)
Cell top area	Ha	-	8.5	-	Single	It has been assumed that one third of the landfill size (25ha) corresponds to the area where leachate accumulates
Cell base area	Ha	-	0.2	-	Single	Calculated
Number of cells	-	-	1	-	Single	The existing waste cell is comprised by one unique cell
Total top area	Ha	-	8.5	-	Single	Same as cell top area (one cell only)
Total base area	Ha	-	0.2	-	Single	Same as cell base area (one cell only)
Head of leachate when surface water breakout occurs	m	-	3	-	Single	Minimum thickness of waste
Fixed head	m	1	1.5	3	Triangular	Assumption. Leachate in exceedance of 3m thick will be drained to storage tanks
Final waste thickness	m	20	-	40	Uniform	Fichtner 2016a and Boncom Project 2016
Waste porosity	Fraction	0.4	-	0.6	Uniform	EPA 2000
Field capacity	Fraction	0.2	-	0.35	Uniform	EPA 2000
Waste dry density	Kg/L		0.2		Single	Fichtner (2016a)

B.4 Barrier information

The characteristics of the clay liner adopted in the model are described in Table B 6.

Table B 6 Characteristics of the barrier– Clay Liner

PARAMETER	UNIT	RANGE			DISTRIBUTION TYPE	JUSTIFICATION
		Min	Most likely	Max		
Design thickness of clay	m	5	6	7	Triangular	Based on available information
Density of clay	Kg/L	1.07	-	1.43	Uniform	Environment Agency 2009; USEPA 2004
Pathway moisture content	Fraction	-	0.20	-	Single	USEPA 2004
Hydraulic conductivity of clay	m/s	$1x10^{-11}$	$1x10^{-09}$	$1x10^{-07}$	Log triangular	The maximum corresponds to the permeability assumed for degraded clay (two orders of magnitude lower than the assumed original permeability). The most likely is the specification for clay liners. The minimum value corresponds to the top range within values provided by Domenico and Schwartz 1990.
Pathway longitudinal dispersivity	m	0.5	0.6	0.7	Single	Assumed 10% of pathway length (Environment Agency, 2006)

B.5 Unsaturated pathway

The dimensions and properties of the unsaturated zone (mid-Sarmatian clays with interbedded sands) adopted in the model are described in Table B 7.

Table B 7 Unsaturated zone characteristics – Clay (unsaturated pathway)

PARAMETER	UNIT	RANGE (1)			DISTRIBUTION TYPE	JUSTIFICATION
		Min	Most likely	Max		
Pathway length	m	-	30	-	Single	Thickness of strata, based on Boncom Proiect (2016)
Pathway moisture content	Fraction	0.16	0.21	0.23	Triangular	Site specific, Boncom Proiect (2016)
Pathway density	Kg/L	0.74	2.7	2.71	Triangular	Dry bulk density. Site specific, Boncom Proiect (2016)
Pathway hydraulic conductivity	m/s	1.15×10^{-8}	-	9.26×10^{-8}	Uniform	Site specific, Boncom Proiect (2016)
Pathway longitudinal dispersivity	m	-	3	-	Single	Assumed 10% of pathway length (Environment Agency, 2006)

(1) The range of values correspond to:
- Minimum reported analytical result for the unsaturated zone data set
- Most likely – median of the unsaturated zone data set
- Maximum reported analytical result for the unsaturated zone data set

B.6 Vertical pathway

The dimensions and properties of the underlying layer of clayey medium / fine grained sand (upper Sarmatian unit) adopted in the model are described in Table B 8.

Table B 8 Unsaturated zone characteristics – Shale (vertical pathway)

PARAMETER	UNIT	RANGE			DISTRIBUTION TYPE	JUSTIFICATION
		Min	Most likely	Max		
Pathway length (modelled as vertical pathway)	m	-	6.4	-	Single	Based on thickness of unit at BH3, Boncom Proiect (2016)
Pathway porosity	Fraction	0.01	-	0.46	Uniform	Effective porosity for fine sand
Pathway density	Kg/L		2.68		Single	Dry bulk density. Site specific, Boncom Proiect (2016)
Pathway dispersivity	m	-	0.64	-	Single	Assumed 10% of pathway length (Environment Agency, 2006)

B.7 Saturated pathway

The properties of the mid-Sarmatian unit (limestone) adopted for the modelling of the saturated pathway are described in Table B 9.

Table B 9 Saturated zone characteristics – Mid-Sarmatian unit

PARAMETER	UNIT	RANGE			DISTRIBUTION TYPE	JUSTIFICATION
		Min	Most likely	Max		
Pathway length (receptor points)	m		100 4,000		Single	Distance between the waste cell and the landfill boundary Distance to the nearest hydraulically connected groundwater extraction well
Pathway width	m		100		Single	Based on Conceptual Design (Figure LF-CHS-216-Design). Approximate width of the base of the cell perpendicular to groundwater flow direction
Mixing zone	m		Calculated		Single	Based on 90m aquifer thickness (Boncom Proiect 2016 and a vertical dispersivity of 0.1% of the pathway length (recommended range in Landsim v2.5)
Pathway regional gradient	m/m		0.02		Single	Calculated based on groundwater elevation at BH1 (Boncom Proiect, 2016) and abstraction wells (E. Lindberg, J. Olsson, 2012)
Effective porosity	cm^3/cm^3		0.14			Arithmetic mean for limestone (Mc Worter and Sunada 1977)
Hydraulic conductivity	m/s	$1x10^{-7}$		$1x10^{-3}$	Log uniform	Freeze and Cherry 1979.
Soil bulk density	g/cm^3		2.36			No site specific data available. Calculated based on total porosity (0.2 for limestone based on Heath 1983) and particle density (assumed to equal 2.65).
Pathway longitudinal dispersivity	m		10 400		Single	Assumed 10% of pathway length (Environment Agency, 2006)
Pathway transverse dispersivity	m		1 40		Single	Assumed 1% of pathway length (Environment Agency, 2006)

Appendix C

MODELLING INPUT DATA AND OUTPUT DATA

APPENDIX C-1

INPUT PARAMETERS

Calculation Settings

Number of iterations: 1001

Results calculated using sampled PDFs

Full Calculation

Clay Liner:

Unretarded values used for simulation

No Biodegradation

Unsaturated Pathway:

Retarded values used for simulation

Biodegradation

Saturated Vertical Pathway:

Retarded values used for simulation

Biodegradation

Aquifer Pathway:

Retarded values used for simulation

Biodegradation

Timeslices at: 30, 100, 300, 1000

Decline in Contaminant Concentration in Leachate

Ammoniacal_N	Non-Volatile
c (kg/l): 0.59	m (kg/l): 0
Arsenic	Non-Volatile
c (kg/l): -0.0862	m (kg/l): 0.0415
Chloride	Non-Volatile
c (kg/l): 0.2919	m (kg/l): 0.0298
Lead	Non-Volatile
c (kg/l): 0.0171	m (kg/l): 0.0443
Nickel	Non-Volatile
c (kg/l): -0.1479	m (kg/l): 0.0987
Sulphate	Non-Volatile
c (kg/l): 0.1209	m (kg/l): 0.0166
DDT	Non-Volatile
c (kg/l): 0	m (kg/l): 0

Contaminant Half-lives (years)

Unsaturated Pathway:

Ammoniacal_N	SINGLE(1e+009)
Arsenic	SINGLE(1e+009)
Chloride	SINGLE(1e+009)
Lead	SINGLE(1e+009)
Nickel	SINGLE(1e+009)
Sulphate	SINGLE(1e+009)
DDT	SINGLE(30)

Saturated Vertical Pathway:

Ammoniacal_N	SINGLE(1e+009)
Arsenic	SINGLE(1e+009)
Chloride	SINGLE(1e+009)
Lead	SINGLE(1e+009)
Nickel	SINGLE(1e+009)
Sulphate	SINGLE(1e+009)
DDT	SINGLE(30)

Aquifer Pathway:

Ammoniacal_N	SINGLE(1e+009)
Arsenic	SINGLE(1e+009)
Chloride	SINGLE(1e+009)
Lead	SINGLE(1e+009)
Nickel	SINGLE(1e+009)
Sulphate	SINGLE(1e+009)
DDT	SINGLE(30)

Background Concentrations of Contaminants

Justification for Contaminant Properties

Unjustified value

All units in milligrams per litre

Phase: Existing waste

Infiltration Information

Cap design infiltration (mm/year):	SINGLE(177)
Infiltration to waste (mm/year):	NORMAL(592,120)
End of filling (years from start of waste deposit):	19

Justification for Specified Infiltration

Annual average precipitation based on a various range of references, including websites such as FAO, World Bank and World Climate and a various range of previous reports prepared for the site (E. Lindberg, J. Olsson, 2012; WSP Parsons Brinckerhoff, 2016; Fichtner, 2016a; Fichtner, 2016b; Boncom Project, 2016)

Duration of management control (years from the start of waste disposal): 25

Cell dimensions

Cell width (m):	20
Cell length (m):	100
Cell top area (ha):	8.5
Cell base area (ha):	0.2
Number of cells:	1
Total base area (ha):	0.2
Total top area (ha):	8.5
Head of Leachate when surface water breakout occurs (m)	SINGLE(3)
Waste porosity (fraction)	UNIFORM(0.4,0.6)
Final waste thickness (m):	UNIFORM(20,40)
Field capacity (fraction):	UNIFORM(0.2,0.35)
Waste dry density (kg/l)	SINGLE(0.2)

Justification for Landfill Geometry

The landfill was built in a hillside by the formation of series of benches. The leachate flows by gravity to the bottom of the landfill where it is believed to accumulate. The maximum landfill width is estimated to be approximately 500m, based on Conceptual Design (Figure LF-CHS-216-Design). The width of the area where leachate accumulates is assumed to be approximately 20m [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED]

Source concentrations of contaminants

All units in milligrams per litre

Declining source term

Ammoniacal_N	TRIANGULAR(164.4,312.6,2258)
	Data are spot measurements of Leachate Quality
Arsenic	UNIFORM(0.0152,0.3)
	Data are spot measurements of Leachate Quality
Chloride	TRIANGULAR(4903,6036,8500)
Lead	LOGUNIFORM(0.00239,3)
Nickel	UNIFORM(0.2872,3)
Sulphate	TRIANGULAR(856.7,1995,7000)
DDT	UNIFORM(7.2e-005,0.000116)
	Substance to be treated as List 1

Justification for Species Concentration in Leachate
Unjustified value

Drainage Information

Fixed Head.
Head on EBS is given as (m): TRIANGULAR(1,1.5,3)

Justification for Specified Head
Assumption [CHANGED]

Barrier Information

There is a single clay barrier

Justification for Engineered Barrier Type
Based on information available (Fichtner 2016a)

Design thickness of clay (m):	TRIANGULAR(5,6,7)
Density of clay (kg/l):	UNDEFINED
Pathway moisture content (fraction):	SINGLE(0.2)

Justification for Clay: Liner Thickness
Fichtner 2016a [CHANGED]

Hydraulic conductivity of liner (m/s):	LOGTRIANGULAR(1e-011,1e-009,1e-007)
Pathway longitudinal dispersivity (m):	TRIANGULAR(0.5,0.6,0.7)

Justification for Clay: Hydraulics Properties
The maximum corresponds to the permeability assumed for degraded clay (two orders of magnitude lower than the assumed original permeability). The most likely is the specification for clay liners. The minimum value corresponds to the top range within values provided by Domenico and Schwartz 1990. [CHANGED]

Retardation parameters for clay liner
No retardation values used in this simulation.
Check 'Unretarded Contaminant Transport' setting under simulation preferences.

Clay pathway parameters
Modelled as unsaturated pathway

Pathway length (m):	SINGLE(30)
Flow Model:	porous medium
Pathway moisture content (fraction):	TRIANGULAR(0.16,0.21,0.23)
Pathway Density (kg/l):	TRIANGULAR(0.74,2.7,2.71)

Justification for Unsat Zone Geometry
Thickness of the strata based on Boncom Proiect (2016)

Pathway hydraulic conductivity values (m/s):	UNIFORM(1.15e-008,9.26e-008)

Justification for Unsat Zone Hydraulics Properties
Site specific, Boncom Proiect (2016)

Pathway longitudinal dispersivity (m):	SINGLE(3)

Justification for Unsat Zone Dispersion Properties
Assumed 10% of pathway length (Environment Agency, 2006)

Retardation parameters for Clay pathway

Modelled as unsaturated pathway

Uncertainty in Kd (l/kg):

Ammoniacal_N	UNIFORM(0.5,2)
Arsenic	UNIFORM(25,250)
Chloride	SINGLE(0)
Lead	LOGUNIFORM(27,270000)
Nickel	UNIFORM(20,800)
Sulphate	SINGLE(0)
DDT	SINGLE(0)

Justification for Kd Values by Species

Model default parameters [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED]

Aquifer Pathway Dimensions for Phase

Pathway length (m):	UNIFORM(100,250)
Pathway width (m):	SINGLE(100)

Shale pathway parameters

Modelled as vertical pathway.

Pathway length (m):	SINGLE(6.4)
Pathway porosity (fraction):	UNIFORM(0.362,0.44)

Justification for Vertical Path Geometry

Based on thickness of unit at BH3, Boncom Proiect (2016) [CHANGED] [CHANGED]

Pathway dispersivity (m): SINGLE(0.64)

Justification for Vertical Path Dispersion Details

Assumed 10% of pathway length (Environment Agency, 2006)

Retardation parameters for Shale pathway
Modelled as vertical pathway.

Uncertainty in Kd (l/kg):	
Ammoniacal_N	UNIFORM(0.5,2)
Retardation parameters for Shale pathway	
Arsenic	UNIFORM(25,250)
Retardation parameters for Shale pathway	
Chloride	SINGLE(0)
Retardation parameters for Shale pathway	
Lead	LOGUNIFORM(27,270000)
Retardation parameters for Shale pathway	
Nickel	UNIFORM(20,800)
Retardation parameters for Shale pathway	
Sulphate	SINGLE(0)
Retardation parameters for Shale pathway	
DDT	SINGLE(0)
Retardation parameters for Shale pathway	

Justification for Vertical Path Kd Values by Species
Landsim V2.5 default parameters [CHANGED] [CHANGED]

Pathway Density (kg/l): SINGLE(2.68)

Mid-Sarmatian unit (Limestones) pathway parameters
Modelled as aquifer pathway.

Mixing zone (m):
Calculated. Aquifer Thickness: SINGLE(90)

Justification for Aquifer Geometry
10% of strata (90m) based on Boncom Proiect 2016 [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED]

Pathway regional gradient (-):	SINGLE(0.02)
Pathway hydraulic conductivity values (m/s):	LOGUNIFORM(1e-007,0.003)
Pathway porosity (fraction):	SINGLE(0.14)

Justification for Aquifer Hydraulics Properties
Freeze and Cherry 1979 [CHANGED]

Pathway longitudinal dispersivity (m):	UNIFORM(10,25)
Pathway transverse dispersivity (m):	UNIFORM(1,2.5)

Justification for Aquifer Dispersion Details
Longitudinal: Assumed 10% of pathway length (Environment Agency, 2006)
Transversal: Assumed 1% of pathway length (Environment Agency, 2006) [CHANGED] [CHANGED]

Retardation parameters for Mid-Sarmatian unit (Limestones) pathway

Modelled as aquifer pathway.

Uncertainty in Kd (l/kg):

Ammoniacal_N	UNIFORM(0.5,2)
Arsenic	UNIFORM(25,250)
Chloride	SINGLE(0)
Lead	LOGUNIFORM(27,270000)
Nickel	UNIFORM(20,800)
Sulphate	SINGLE(0)
DDT	SINGLE(0.00071)

Justification for Aquifer Kd Values by Species

Unjustified value

Pathway Density (kg/l): SINGLE(2.36)

APPENDIX C-2

RESULTS – STATISTICAL VALUES

Concentration of Ammoniacal_N in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 5.52906E-011
99% of values less than 0.501186

Minimum 0	Maximum 35.7348	
Mean 0.0947251	Std. Dev. 1.54998	Variance 2.40244

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0.00101452
95% of values less than 0.574123
99% of values less than 20.8459

Minimum 0	Maximum 1011.23	
Mean 2.11867	Std. Dev. 33.6967	Variance 1135.47

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0.787066
95% of values less than 9.87061
99% of values less than 212.111

Minimum 0	Maximum 2048.62	
Mean 10.0301	Std. Dev. 99.8289	Variance 9965.81

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 8.47193E-006
90% of values less than 1.69671
95% of values less than 14.7431
99% of values less than 150.027

Minimum 0	Maximum 491.889	
Mean 5.08759	Std. Dev. 32.0173	Variance 1025.11

Concentration of Ammoniacal_N in groundwater [mg/l]

At infinity

01% of values less than 0

05% of values less than 6.25956E-017

10% of values less than 8.06756E-013

50% of values less than 3.76462E-009

90% of values less than 0.00101456

95% of values less than 0.00928388

99% of values less than 0.0860843

Minimum 0	Maximum 1.16179	
Mean 0.00388314	Std. Dev. 0.0398992	Variance 0.00159195

Concentration of Arsenic in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 6.06039E-017	
Mean 6.05434E-020	Std. Dev. 1.91551E-018	Variance 3.66917E-036

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 1.04616E-011

Minimum 0	Maximum 3.00124E-005	
Mean 3.13385E-008	Std. Dev. 9.49353E-007	Variance 9.01271E-013

Concentration of Arsenic in groundwater [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 9.74166E-006

95% of values less than 9.17298E-005

99% of values less than 0.00471303

Minimum 0	Maximum 0.0857895	
Mean 0.000302972	Std. Dev. 0.00352831	Variance 1.2449E-005

Concentration of Chloride in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 80.2214
95% of values less than 1192.85
99% of values less than 12318.4

Minimum 0	Maximum 77249.3	
Mean 537.657	Std. Dev. 4064.18	Variance 1.65176E+007

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.00240842
90% of values less than 233.264
95% of values less than 1116.21
99% of values less than 6317.51

Minimum 0	Maximum 19973.1	
Mean 263.035	Std. Dev. 1326.61	Variance 1.7599E+006

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.0489909
90% of values less than 31.5213
95% of values less than 123.549
99% of values less than 516.754

Minimum 0	Maximum 1962.73	
Mean 24.7617	Std. Dev. 126.209	Variance 15928.7

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 8.66525E-017
50% of values less than 1.23265E-005
90% of values less than 0.26822
95% of values less than 2.56579
99% of values less than 20.0711

Minimum 0	Maximum 142.756	
Mean 0.839539	Std. Dev. 6.04028	Variance 36.485

Concentration of Chloride in groundwater [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 1.20684E-011

90% of values less than 9.32779E-009

95% of values less than 3.95999E-008

99% of values less than 1.36072E-005

Minimum 0	Maximum 0.0103607	
Mean 1.31601E-005	Std. Dev. 0.000332446	Variance 1.1052E-007

Concentration of Lead in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 6.8663E-016	
Mean 6.86089E-019	Std. Dev. 2.17023E-017	Variance 4.70989E-034

Concentration of Lead in groundwater [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 8.39811E-007

Minimum 0 Maximum 0.00126209

Mean 1.42148E-006 Std. Dev. 3.99766E-005 Variance 1.59813E-009

Concentration of Nickel in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 6.14899E-014	
Mean 6.48591E-017	Std. Dev. 1.94642E-015	Variance 3.78855E-030

Concentration of Nickel in groundwater [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 6.44036E-010

95% of values less than 3.24414E-006

99% of values less than 0.000152389

Minimum 0	Maximum 0.00147767	
Mean 6.68099E-006	Std. Dev. 6.74966E-005	Variance 4.55579E-009

Concentration of Sulphate in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 68.6473
95% of values less than 802.435
99% of values less than 7573.2

Minimum 0	Maximum 60750	
Mean 418.142	Std. Dev. 3510.66	Variance 1.23247E+007

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.00124483
90% of values less than 446.931
95% of values less than 2107.28
99% of values less than 14263.6

Minimum 0	Maximum 39435.4	
Mean 539.943	Std. Dev. 2866.78	Variance 8.21842E+006

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.312398
90% of values less than 170.073
95% of values less than 606.637
99% of values less than 2087.22

Minimum 0	Maximum 5828.2	
Mean 110.058	Std. Dev. 476.86	Variance 227395

At 1000 years

01% of values less than 0
05% of values less than 1.73907E-012
10% of values less than 1.73041E-006
50% of values less than 0.00474307
90% of values less than 1.83959
95% of values less than 6.51089
99% of values less than 31.9043

Minimum 0	Maximum 137.564	
Mean 1.50089	Std. Dev. 7.52168	Variance 56.5757

Concentration of Sulphate in groundwater [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 4.24367E-012

90% of values less than 5.16097E-009

95% of values less than 2.13729E-008

99% of values less than 9.60087E-006

Minimum 0	Maximum 0.0251931	
Mean 2.69553E-005	Std. Dev. 0.000796843	Variance 6.3496E-007

Concentration of DDT in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 2.66227E-006
95% of values less than 2.20042E-005
99% of values less than 0.000226239

Minimum 0	Maximum 0.00169953	
Mean 1.10737E-005	Std. Dev. 8.56653E-005	Variance 7.33855E-009

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.39341E-011
90% of values less than 1.86268E-005
95% of values less than 0.000108247
99% of values less than 0.00076884

Minimum 0	Maximum 0.0025254	
Mean 3.11077E-005	Std. Dev. 0.00016465	Variance 2.71095E-008

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.12141E-008
90% of values less than 2.14468E-005
95% of values less than 0.000125011
99% of values less than 0.000775332

Minimum 0	Maximum 0.00252546	
Mean 3.21094E-005	Std. Dev. 0.000165266	Variance 2.73128E-008

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.46173E-008
90% of values less than 2.14468E-005
95% of values less than 0.000125011
99% of values less than 0.000775333

Minimum 0	Maximum 0.00252546	
Mean 3.21133E-005	Std. Dev. 0.000165265	Variance 2.73126E-008

Concentration of DDT in groundwater [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 7.00337E-018

50% of values less than 1.46173E-008

90% of values less than 2.14468E-005

95% of values less than 0.000125011

99% of values less than 0.000775333

Minimum 0	Maximum 0.00252546	
Mean 3.21133E-005	Std. Dev. 0.000165265	Variance 2.73126E-008

Approx. time to Peak Conc. Ammoniacal_N at Offsite Compliance Point [years]

01% of values less than 35
05% of values less than 141
10% of values less than 282
50% of values less than 2499
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000

Minimum 0	Maximum 20000	
Mean 5917.43	Std. Dev. 6993.68	Variance 4.89115E+007

Approx. time to Peak Conc. Arsenic at Offsite Compliance Point [years]

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000

Minimum 0	Maximum 20000	
Mean 6768.38	Std. Dev. 9151.62	Variance 8.37521E+007

Approx. time to Peak Conc. Chloride at Offsite Compliance Point [years]

01% of values less than 13
05% of values less than 23
10% of values less than 32
50% of values less than 256
90% of values less than 2499
95% of values less than 4527
99% of values less than 9999

Minimum 10	Maximum 16406	
Mean 965.059	Std. Dev. 1868.17	Variance 3.49006E+006

Approx. time to Peak Conc. Lead at Offsite Compliance Point [years]

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 20000

Minimum 0	Maximum 20000	
Mean 853.083	Std. Dev. 3914.39	Variance 1.53224E+007

Approx. time to Peak Conc. Nickel at Offsite Compliance Point [years]

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000

Minimum 0	Maximum 20000	
Mean 3726.2	Std. Dev. 7632.65	Variance 5.82574E+007

Approx. time to Peak Conc. Sulphate at Offsite Compliance Point [years]

01% of values less than 14
05% of values less than 26
10% of values less than 35
50% of values less than 282
90% of values less than 2499
95% of values less than 4527
99% of values less than 9999

Minimum 10	Maximum 16406	
Mean 978.718	Std. Dev. 1844.57	Variance 3.40245E+006

Approx. time to Peak Conc. DDT at Offsite Compliance Point [years]

01% of values less than 0
05% of values less than 0
10% of values less than 156
50% of values less than 1379
90% of values less than 12189
95% of values less than 13458
99% of values less than 18114

Minimum 0	Maximum 20000	
Mean 3147.16	Std. Dev. 4881.83	Variance 2.38322E+007

Phase: Existing waste

Source Concentration of Ammoniacal_N [mg/l]

At 30 years

01% of values less than 14.2739
05% of values less than 21.784
10% of values less than 29.0952
50% of values less than 80.9219
90% of values less than 166.474
95% of values less than 192.396
99% of values less than 250.639

Minimum 4.41791	Maximum 360.507	
Mean 91.3076	Std. Dev. 55.6975	Variance 3102.22

At 100 years

01% of values less than 0.519599
05% of values less than 0.857782
10% of values less than 1.31637
50% of values less than 7.29979
90% of values less than 22.9805
95% of values less than 26.6212
99% of values less than 37.6966

Minimum 0.149921	Maximum 55.222	
Mean 10.088	Std. Dev. 8.88903	Variance 79.0149

At 300 years

01% of values less than 2.83866E-005
05% of values less than 7.44291E-005
10% of values less than 0.000151864
50% of values less than 0.00797834
90% of values less than 0.0918141
95% of values less than 0.118251
99% of values less than 0.207911

Minimum 9.49974E-006	Maximum 0.313123	
Mean 0.0300753	Std. Dev. 0.0449461	Variance 0.00202016

At 1000 years

01% of values less than 1.92389E-020
05% of values less than 1.93864E-019
10% of values less than 1.35721E-018
50% of values less than 4.26376E-013
90% of values less than 5.08736E-010
95% of values less than 1.20061E-009
99% of values less than 2.65749E-009

Minimum 4.60722E-021	Maximum 4.42079E-009	
Mean 1.85318E-010	Std. Dev. 5.24103E-010	Variance 2.74684E-019

Phase: Existing waste

Source Concentration of Ammoniacal_N [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 0

Minimum 0 Maximum 0

Mean 0 Std. Dev. 0 Variance 0

Phase: Existing waste

Source Concentration of Arsenic [mg/l]

At 30 years

01% of values less than 0.0511805
05% of values less than 0.0622545
10% of values less than 0.0681684
50% of values less than 0.0928664
90% of values less than 0.120716
95% of values less than 0.128189
99% of values less than 0.144754

Minimum 0.0401891	Maximum 0.171157	
Mean 0.0939021	Std. Dev. 0.0202306	Variance 0.000409278

At 100 years

01% of values less than 0.0291343
05% of values less than 0.0348726
10% of values less than 0.0375622
50% of values less than 0.0567398
90% of values less than 0.0755481
95% of values less than 0.0808492
99% of values less than 0.0932016

Minimum 0.0255952	Maximum 0.103506	
Mean 0.0567492	Std. Dev. 0.0144217	Variance 0.000207986

At 300 years

01% of values less than 0.00426691
05% of values less than 0.00511076
10% of values less than 0.00604554
50% of values less than 0.0137864
90% of values less than 0.0228578
95% of values less than 0.0246157
99% of values less than 0.0279855

Minimum 0.00344996	Maximum 0.03094	
Mean 0.0142111	Std. Dev. 0.00634141	Variance 4.02135E-005

At 1000 years

01% of values less than 2.02328E-006
05% of values less than 4.53997E-006
10% of values less than 7.35229E-006
50% of values less than 0.000103462
90% of values less than 0.000459543
95% of values less than 0.000540093
99% of values less than 0.000674619

Minimum 1.35486E-006	Maximum 0.000868533	
Mean 0.000172026	Std. Dev. 0.000180161	Variance 3.24579E-008

Phase: Existing waste

Source Concentration of Arsenic [mg/l]

At infinity

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Phase: Existing waste

Source Concentration of Chloride [mg/l]

At 30 years

01% of values less than 31.2749
05% of values less than 57.5743
10% of values less than 82.3085
50% of values less than 300.01
90% of values less than 732.22
95% of values less than 852.191
99% of values less than 1145.51

Minimum 10.0886	Maximum 1830.03	
Mean 360.1	Std. Dev. 261.663	Variance 68467.4

At 100 years

01% of values less than 0.411294
05% of values less than 0.90865
10% of values less than 1.54513
50% of values less than 13.6975
90% of values less than 55.1613
95% of values less than 68.8011
99% of values less than 103.686

Minimum 0.129821	Maximum 175.644	
Mean 22.4892	Std. Dev. 23.7494	Variance 564.033

At 300 years

01% of values less than 1.34959E-006
05% of values less than 4.68916E-006
10% of values less than 1.36367E-005
50% of values less than 0.00212794
90% of values less than 0.0476124
95% of values less than 0.0687031
99% of values less than 0.120383

Minimum 4.55605E-007	Maximum 0.217049	
Mean 0.0148766	Std. Dev. 0.0264123	Variance 0.000697608

At 1000 years

01% of values less than 6.19138E-026
05% of values less than 8.70344E-025
10% of values less than 1.04008E-023
50% of values less than 1.21687E-016
90% of values less than 1.23457E-012
95% of values less than 3.6783E-012
99% of values less than 9.94932E-012

Minimum 5.18148E-027	Maximum 1.57315E-011	
Mean 5.46185E-013	Std. Dev. 1.79946E-012	Variance 3.23806E-024

Phase: Existing waste

Source Concentration of Chloride [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 0

Minimum 0 Maximum 0

Mean 0 Std. Dev. 0 Variance 0

Phase: Existing waste

Source Concentration of Lead [mg/l]

At 30 years

01% of values less than 0.00197982
05% of values less than 0.00254469
10% of values less than 0.00364871
50% of values less than 0.0361483
90% of values less than 0.366322
95% of values less than 0.491604
99% of values less than 0.904792

Minimum 0.00176736	Maximum 1.23383	
Mean 0.120734	Std. Dev. 0.183314	Variance 0.0336041

At 100 years

01% of values less than 0.00150266
05% of values less than 0.00187616
10% of values less than 0.00249684
50% of values less than 0.0138438
90% of values less than 0.0972971
95% of values less than 0.13725
99% of values less than 0.244006

Minimum 0.00128483	Maximum 0.362734	
Mean 0.0351472	Std. Dev. 0.0507231	Variance 0.00257284

At 300 years

01% of values less than 0.000106108
05% of values less than 0.00020964
10% of values less than 0.000306354
50% of values less than 0.00108156
90% of values less than 0.00413335
95% of values less than 0.00559456
99% of values less than 0.00802398

Minimum 4.33021E-005	Maximum 0.0141041	
Mean 0.0017327	Std. Dev. 0.00182481	Variance 3.32992E-006

At 1000 years

01% of values less than 5.57298E-013
05% of values less than 1.09776E-011
10% of values less than 9.90013E-011
50% of values less than 2.6112E-007
90% of values less than 3.21661E-005
95% of values less than 6.21313E-005
99% of values less than 0.000101522

Minimum 1.95538E-014	Maximum 0.000177104	
Mean 9.12606E-006	Std. Dev. 2.2342E-005	Variance 4.99165E-010

Phase: Existing waste

Source Concentration of Lead [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 1.61125E-030

Minimum 0 Maximum 2.62454E-025

Mean 5.49848E-028 Std. Dev. 1.08661E-026 Variance 1.18073E-052

Phase: Existing waste

Source Concentration of Nickel [mg/l]

At 30 years

01% of values less than 0.0244097
05% of values less than 0.037229
10% of values less than 0.0495528
50% of values less than 0.138965
90% of values less than 0.329096
95% of values less than 0.392812
99% of values less than 0.551536
Minimum 0.01228 Maximum 0.856104
Mean 0.167893 Std. Dev. 0.118243 Variance 0.0139814

At 100 years

01% of values less than 0.00098317
05% of values less than 0.00186408
10% of values less than 0.00272717
50% of values less than 0.0135876
90% of values less than 0.0421833
95% of values less than 0.0501431
99% of values less than 0.0716906
Minimum 0.000347144 Maximum 0.126081
Mean 0.018941 Std. Dev. 0.0167161 Variance 0.000279429

At 300 years

01% of values less than 4.15848E-008
05% of values less than 1.24551E-007
10% of values less than 3.41419E-007
50% of values less than 2.12018E-005
90% of values less than 0.000208934
95% of values less than 0.000321651
99% of values less than 0.000489372
Minimum 1.30524E-008 Maximum 0.000601157
Mean 7.27092E-005 Std. Dev. 0.000108676 Variance 1.18104E-008

At 1000 years

01% of values less than 5.59751E-024
05% of values less than 2.59975E-022
10% of values less than 5.13645E-021
50% of values less than 2.52316E-015
90% of values less than 5.09255E-012
95% of values less than 2.45091E-011
99% of values less than 2.65237E-010
Minimum 9.07235E-025 Maximum 7.1859E-010
Mean 8.59412E-012 Std. Dev. 4.61881E-011 Variance 2.13334E-021

Phase: Existing waste

Source Concentration of Nickel [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 0

Minimum 0 Maximum 0

Mean 0 Std. Dev. 0 Variance 0

Phase: Existing waste

Source Concentration of Sulphate [mg/l]

At 30 years

01% of values less than 165.052
05% of values less than 239.489
10% of values less than 299.313
50% of values less than 664.21
90% of values less than 1304.65
95% of values less than 1612.21
99% of values less than 2004.81

Minimum 98.6061	Maximum 2266.39	
Mean 747.907	Std. Dev. 409.405	Variance 167613

At 100 years

01% of values less than 23.781
05% of values less than 35.2338
10% of values less than 49.3536
50% of values less than 144.769
90% of values less than 358.041
95% of values less than 440.149
99% of values less than 588.554

Minimum 15.2134	Maximum 710.306	
Mean 178.95	Std. Dev. 127.314	Variance 16208.7

At 300 years

01% of values less than 0.0540335
05% of values less than 0.113337
10% of values less than 0.175394
50% of values less than 2.06741
90% of values less than 10.5776
95% of values less than 13.3088
99% of values less than 18.6934

Minimum 0.039495	Maximum 25.8086	
Mean 3.97835	Std. Dev. 4.55125	Variance 20.7139

At 1000 years

01% of values less than 2.28888E-011
05% of values less than 9.39126E-011
10% of values less than 2.68959E-010
50% of values less than 8.07555E-007
90% of values less than 7.07681E-005
95% of values less than 0.000119602
99% of values less than 0.000199442

Minimum 7.25839E-012	Maximum 0.000256615	
Mean 2.02667E-005	Std. Dev. 4.19525E-005	Variance 1.76001E-009

Phase: Existing waste

Source Concentration of Sulphate [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 0

Minimum 0 Maximum 0

Mean 0 Std. Dev. 0 Variance 0

Phase: Existing waste

Source Concentration of DDT [mg/l]

At 30 years

01% of values less than 7.30004E-005
05% of values less than 7.42828E-005
10% of values less than 7.65803E-005
50% of values less than 9.45566E-005
90% of values less than 0.000111606
95% of values less than 0.000113731
99% of values less than 0.00011549

Minimum 7.21732E-005	Maximum 0.000115949	
Mean 9.43044E-005	Std. Dev. 1.28287E-005	Variance 1.64575E-010

At 100 years

01% of values less than 7.30004E-005
05% of values less than 7.42828E-005
10% of values less than 7.65803E-005
50% of values less than 9.45566E-005
90% of values less than 0.000111606
95% of values less than 0.000113731
99% of values less than 0.00011549

Minimum 7.21732E-005	Maximum 0.000115949	
Mean 9.43044E-005	Std. Dev. 1.28287E-005	Variance 1.64575E-010

At 300 years

01% of values less than 7.30004E-005
05% of values less than 7.42828E-005
10% of values less than 7.65803E-005
50% of values less than 9.45566E-005
90% of values less than 0.000111606
95% of values less than 0.000113731
99% of values less than 0.00011549

Minimum 7.21732E-005	Maximum 0.000115949	
Mean 9.43044E-005	Std. Dev. 1.28287E-005	Variance 1.64575E-010

At 1000 years

01% of values less than 7.30004E-005
05% of values less than 7.42828E-005
10% of values less than 7.65803E-005
50% of values less than 9.45566E-005
90% of values less than 0.000111606
95% of values less than 0.000113731
99% of values less than 0.00011549

Minimum 7.21732E-005	Maximum 0.000115949	
Mean 9.43044E-005	Std. Dev. 1.28287E-005	Variance 1.64575E-010

Phase: Existing waste

Source Concentration of DDT [mg/l]

At infinity

01% of values less than 7.30004E-005

05% of values less than 7.42828E-005

10% of values less than 7.65803E-005

50% of values less than 9.45566E-005

90% of values less than 0.000111606

95% of values less than 0.000113731

99% of values less than 0.00011549

Minimum 7.21732E-005 Maximum 0.000115949

Mean 9.43044E-005 Std. Dev. 1.28287E-005 Variance 1.64575E-010

Phase: Existing waste

Concentration of Ammoniacal_N at base of Clay Liner [mg/l]

At 30 years

01% of values less than 0
05% of values less than 1.89616E-012
10% of values less than 1.37385E-009
50% of values less than 68.0707
90% of values less than 205.938
95% of values less than 255.97
99% of values less than 326.78

Minimum 0	Maximum 411.13	
Mean 86.5035	Std. Dev. 86.9399	Variance 7558.55

At 100 years

01% of values less than 2.73944E-011
05% of values less than 0.00157999
10% of values less than 0.804692
50% of values less than 16.7351
90% of values less than 71.3352
95% of values less than 88.6492
99% of values less than 125.507

Minimum 1.76842E-012	Maximum 161.499	
Mean 26.6958	Std. Dev. 29.6033	Variance 876.357

At 300 years

01% of values less than 9.58982E-005
05% of values less than 0.000360893
10% of values less than 0.00110317
50% of values less than 0.0903675
90% of values less than 10.0914
95% of values less than 15.9533
99% of values less than 31.036

Minimum 1.98443E-007	Maximum 62.7079	
Mean 2.69941	Std. Dev. 6.60288	Variance 43.598

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 1.31192E-005
95% of values less than 0.012672
99% of values less than 0.934394

Minimum 0	Maximum 10.2091	
Mean 0.0516204	Std. Dev. 0.505082	Variance 0.255107

Phase: Existing waste

Concentration of Ammoniacal_N at base of Clay Liner [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 6.4275E-014

90% of values less than 2.51272E-013

95% of values less than 3.18759E-013

99% of values less than 8.04668E-013

Minimum 0	Maximum 4.22698E-011	
Mean 2.25436E-013	Std. Dev. 2.07575E-012	Variance 4.30873E-024

Phase: Existing waste

Concentration of Arsenic at base of Clay Liner [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 2.5771E-013
50% of values less than 0.0583535
90% of values less than 0.106127
95% of values less than 0.115892
99% of values less than 0.136224

Minimum 0	Maximum 0.150824	
Mean 0.0509477	Std. Dev. 0.0444648	Variance 0.00197712

At 100 years

01% of values less than 2.09206E-014
05% of values less than 4.22415E-007
10% of values less than 0.000366296
50% of values less than 0.056831
90% of values less than 0.0833033
95% of values less than 0.0906031
99% of values less than 0.104999

Minimum 0	Maximum 0.115807	
Mean 0.0510149	Std. Dev. 0.0288297	Variance 0.000831151

At 300 years

01% of values less than 1.20414E-005
05% of values less than 0.00501321
10% of values less than 0.0071902
50% of values less than 0.0190658
90% of values less than 0.0356405
95% of values less than 0.0418749
99% of values less than 0.0507503

Minimum 4.85097E-010	Maximum 0.0569507	
Mean 0.0201799	Std. Dev. 0.0111292	Variance 0.00012386

At 1000 years

01% of values less than 3.77175E-006
05% of values less than 1.17696E-005
10% of values less than 1.93319E-005
50% of values less than 0.00025904
90% of values less than 0.00137956
95% of values less than 0.00384401
99% of values less than 0.00917586

Minimum 0	Maximum 0.0228003	
Mean 0.000787912	Std. Dev. 0.00193711	Variance 3.75241E-006

Phase: Existing waste

Concentration of Arsenic at base of Clay Liner [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 1.18999E-016

95% of values less than 2.12578E-016

99% of values less than 4.83318E-016

Minimum 0	Maximum 3.38304E-015	
Mean 3.47665E-017	Std. Dev. 1.39914E-016	Variance 1.95758E-032

Phase: Existing waste

Concentration of Chloride at base of Clay Liner [mg/l]

At 30 years

01% of values less than 0
05% of values less than 8.72121E-012
10% of values less than 8.12331E-009
50% of values less than 296.66
90% of values less than 1158.88
95% of values less than 1421.75
99% of values less than 1798.28

Minimum 0	Maximum 2766.27	
Mean 446.25	Std. Dev. 480.315	Variance 230702

At 100 years

01% of values less than 9.97535E-011
05% of values less than 0.0078128
10% of values less than 1.20886
50% of values less than 48.4725
90% of values less than 332.469
95% of values less than 445.629
99% of values less than 592.731

Minimum 4.93364E-012	Maximum 752.967	
Mean 107.756	Std. Dev. 143.892	Variance 20704.8

At 300 years

01% of values less than 7.08637E-006
05% of values less than 4.22003E-005
10% of values less than 0.000181831
50% of values less than 0.0565303
90% of values less than 52.3182
95% of values less than 80.119
99% of values less than 156.66

Minimum 2.88921E-007	Maximum 231.222	
Mean 12.5626	Std. Dev. 30.9486	Variance 957.814

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0.00490392
95% of values less than 0.342858
99% of values less than 10.3592

Minimum 0	Maximum 63.8239	
Mean 0.384061	Std. Dev. 3.065	Variance 9.39424

Phase: Existing waste

Concentration of Chloride at base of Clay Liner [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 4.53117E-013

90% of values less than 1.68494E-012

95% of values less than 2.05851E-012

99% of values less than 1.46622E-011

Minimum 0	Maximum 7.18834E-010	
Mean 2.4683E-012	Std. Dev. 2.75862E-011	Variance 7.61E-022

Phase: Existing waste

Concentration of Lead at base of Clay Liner [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 3.25989E-013
50% of values less than 0.0066953
90% of values less than 0.285281
95% of values less than 0.456362
99% of values less than 0.738513

Minimum 0	Maximum 1.30898	
Mean 0.079488	Std. Dev. 0.164777	Variance 0.0271515

At 100 years

01% of values less than 3.79262E-014
05% of values less than 1.43724E-007
10% of values less than 0.000175024
50% of values less than 0.0112586
90% of values less than 0.14243
95% of values less than 0.206447
99% of values less than 0.400849

Minimum 0	Maximum 0.730934	
Mean 0.044892	Std. Dev. 0.0805462	Variance 0.00648769

At 300 years

01% of values less than 7.65162E-006
05% of values less than 0.000296184
10% of values less than 0.00049019
50% of values less than 0.00185903
90% of values less than 0.0130853
95% of values less than 0.0265732
99% of values less than 0.0768736

Minimum 1.06345E-010	Maximum 0.324479	
Mean 0.00634634	Std. Dev. 0.0163292	Variance 0.000266642

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 4.57461E-010
50% of values less than 1.23137E-006
90% of values less than 9.28487E-005
95% of values less than 0.000197177
99% of values less than 0.00150047

Minimum 0	Maximum 0.0251088	
Mean 9.66221E-005	Std. Dev. 0.000898329	Variance 8.06994E-007

Phase: Existing waste

Concentration of Lead at base of Clay Liner [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 4.22329E-017

95% of values less than 3.27581E-016

99% of values less than 1.03495E-015

Minimum 0	Maximum 5.66277E-013	
Mean 7.9262E-016	Std. Dev. 1.84602E-014	Variance 3.40777E-028

Phase: Existing waste

Concentration of Nickel at base of Clay Liner [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 2.91229E-012
50% of values less than 0.105532
90% of values less than 0.426465
95% of values less than 0.525354
99% of values less than 0.739865

Minimum 0	Maximum 1.02544	
Mean 0.161537	Std. Dev. 0.182101	Variance 0.0331609

At 100 years

01% of values less than 3.2504E-014
05% of values less than 2.46588E-006
10% of values less than 0.0015078
50% of values less than 0.0293578
90% of values less than 0.123405
95% of values less than 0.179104
99% of values less than 0.270637

Minimum 0	Maximum 0.394522	
Mean 0.0490916	Std. Dev. 0.0594522	Variance 0.00353456

At 300 years

01% of values less than 1.23512E-007
05% of values less than 8.02093E-007
10% of values less than 2.93039E-006
50% of values less than 0.000199377
90% of values less than 0.0163826
95% of values less than 0.0290942
99% of values less than 0.0697257

Minimum 6.56037E-010	Maximum 0.0965916	
Mean 0.00484359	Std. Dev. 0.0122468	Variance 0.000149985

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 1.29904E-008
95% of values less than 1.38141E-005
99% of values less than 0.00154295

Minimum 0	Maximum 0.0167566	
Mean 9.90706E-005	Std. Dev. 0.000992777	Variance 9.85606E-007

Phase: Existing waste

Concentration of Nickel at base of Clay Liner [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 3.65745E-016

95% of values less than 5.48626E-016

99% of values less than 8.94334E-016

Minimum 0	Maximum 2.97268E-013	
Mean 7.59963E-016	Std. Dev. 1.16431E-014	Variance 1.35563E-028

Phase: Existing waste

Concentration of Sulphate at base of Clay Liner [mg/l]

At 30 years

01% of values less than 1.87455E-014
05% of values less than 8.76209E-012
10% of values less than 6.09461E-009
50% of values less than 450.432
90% of values less than 1267.14
95% of values less than 1618.9
99% of values less than 2111.16

Minimum 0	Maximum 2342.92	
Mean 537.897	Std. Dev. 542.931	Variance 294774

At 100 years

01% of values less than 1.86951E-010
05% of values less than 0.00672581
10% of values less than 4.52002
50% of values less than 209.654
90% of values less than 565.408
95% of values less than 693.514
99% of values less than 1003.01

Minimum 2.44931E-011	Maximum 1361.62	
Mean 259.707	Std. Dev. 230.764	Variance 53251.9

At 300 years

01% of values less than 0.0710446
05% of values less than 0.259728
10% of values less than 0.529182
50% of values less than 7.83894
90% of values less than 88.9206
95% of values less than 137.807
99% of values less than 242.176

Minimum 3.58032E-006	Maximum 437.459	
Mean 28.172	Std. Dev. 51.7339	Variance 2676.39

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.42988E-005
90% of values less than 0.00081514
95% of values less than 0.0305315
99% of values less than 8.08829

Minimum 0	Maximum 85.1168	
Mean 0.466461	Std. Dev. 4.82266	Variance 23.258

Phase: Existing waste

Concentration of Sulphate at base of Clay Liner [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 2.65063E-013

90% of values less than 1.54043E-012

95% of values less than 2.1105E-012

99% of values less than 2.75919E-011

Minimum 0	Maximum 3.55531E-010	
Mean 1.59585E-012	Std. Dev. 1.37035E-011	Variance 1.87786E-022

Phase: Existing waste

Concentration of DDT at base of Clay Liner [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 4.87906E-005
90% of values less than 9.80524E-005
95% of values less than 0.000103453
99% of values less than 0.000110338

Minimum 0	Maximum 0.000115609	
Mean 4.53041E-005	Std. Dev. 4.01656E-005	Variance 1.61328E-009

At 100 years

01% of values less than 0
05% of values less than 2.39776E-010
10% of values less than 3.15474E-007
50% of values less than 8.36052E-005
90% of values less than 0.000108522
95% of values less than 0.00011168
99% of values less than 0.000115208

Minimum 0	Maximum 0.000115917	
Mean 6.96821E-005	Std. Dev. 3.85339E-005	Variance 1.48486E-009

At 300 years

01% of values less than 1.57206E-008
05% of values less than 7.28139E-006
10% of values less than 4.7641E-005
50% of values less than 8.94996E-005
90% of values less than 0.000110336
95% of values less than 0.00011276
99% of values less than 0.000115323

Minimum 8.5833E-013	Maximum 0.000115949	
Mean 8.421E-005	Std. Dev. 2.75063E-005	Variance 7.56598E-010

At 1000 years

01% of values less than 2.70768E-005
05% of values less than 7.28702E-005
10% of values less than 7.46909E-005
50% of values less than 9.35978E-005
90% of values less than 0.000111266
95% of values less than 0.000113418
99% of values less than 0.000115423

Minimum 2.42979E-006	Maximum 0.000115949	
Mean 9.2096E-005	Std. Dev. 1.66424E-005	Variance 2.7697E-010

Phase: Existing waste

Concentration of DDT at base of Clay Liner [mg/l]

At infinity

01% of values less than 7.30004E-005

05% of values less than 7.42828E-005

10% of values less than 7.65803E-005

50% of values less than 9.45566E-005

90% of values less than 0.000111606

95% of values less than 0.000113731

99% of values less than 0.00011549

Minimum 7.21732E-005	Maximum 0.000115949	
Mean 9.43044E-005	Std. Dev. 1.28287E-005	Variance 1.64575E-010

Phase: Existing waste

Concentration of Ammoniacal_N at base of Unsaturated Zone [mg/l]

At 30 years
01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0.0178355
95% of values less than 7.97151
99% of values less than 264.012

Minimum 0	Maximum 399.378	
Mean 7.35076	Std. Dev. 39.8792	Variance 1590.35

At 100 years
01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 41.5974
95% of values less than 79.0678
99% of values less than 134.723

Minimum 0	Maximum 191.824	
Mean 10.0578	Std. Dev. 28.0297	Variance 785.664

At 300 years
01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.000659026
90% of values less than 26.5862
95% of values less than 39.4341
99% of values less than 61.187

Minimum 0	Maximum 92.8734	
Mean 6.7181	Std. Dev. 14.1674	Variance 200.717

At 1000 years
01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.0223062
90% of values less than 8.98743
95% of values less than 11.7351
99% of values less than 17.7005

Minimum 0	Maximum 31.1737	
Mean 2.36639	Std. Dev. 4.30954	Variance 18.5722

Phase: Existing waste

Concentration of Ammoniacal_N at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 1.40753E-013

50% of values less than 4.40926E-010

90% of values less than 0.191194

95% of values less than 0.309036

99% of values less than 0.512652

Minimum 0	Maximum 0.877169	
Mean 0.0456683	Std. Dev. 0.115593	Variance 0.0133617

Phase: Existing waste

Concentration of Arsenic at base of Unsaturated Zone [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 1.91848E-007	
Mean 1.91672E-010	Std. Dev. 6.06372E-009	Variance 3.67687E-017

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 4.84177E-009

Minimum 0	Maximum 0.00585005	
Mean 6.38552E-006	Std. Dev. 0.000185244	Variance 3.43153E-008

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 2.97524E-012
95% of values less than 2.76569E-006
99% of values less than 0.00250265

Minimum 0	Maximum 0.0253575	
Mean 0.00014439	Std. Dev. 0.00154919	Variance 2.39999E-006

Phase: Existing waste

Concentration of Arsenic at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 9.55964E-011

90% of values less than 0.000651558

95% of values less than 0.000924219

99% of values less than 0.00126794

Minimum 0 Maximum 0.00181687

Mean 0.000148218 Std. Dev. 0.000315068 Variance 9.92676E-008

Phase: Existing waste

Concentration of Chloride at base of Unsaturated Zone [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.19208E-005
90% of values less than 1293.58
95% of values less than 1737.61
99% of values less than 2408.12

Minimum 0	Maximum 2808.05	
Mean 313.9	Std. Dev. 592.576	Variance 351146

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 33.5305
90% of values less than 496.202
95% of values less than 638.151
99% of values less than 901.158

Minimum 0	Maximum 1277.82	
Mean 154.13	Std. Dev. 224.413	Variance 50361

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 3.70569E-007
50% of values less than 2.65545
90% of values less than 154.963
95% of values less than 204.417
99% of values less than 353.367

Minimum 0	Maximum 451.419	
Mean 41.2311	Std. Dev. 77.4392	Variance 5996.82

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 3.63671E-009
50% of values less than 5.87717E-005
90% of values less than 30.5896
95% of values less than 43.5475
99% of values less than 74.937

Minimum 0	Maximum 111.235	
Mean 7.15422	Std. Dev. 16.2801	Variance 265.041

Phase: Existing waste

Concentration of Chloride at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 2.55879E-011

90% of values less than 7.59798E-010

95% of values less than 2.58724E-006

99% of values less than 0.00280541

Minimum 0 Maximum 0.0802826

Mean 0.000303083 Std. Dev. 0.00384138 Variance 1.47562E-005

Phase: Existing waste

Concentration of Lead at base of Unsaturated Zone [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 1.47492E-014	
Mean 1.47345E-017	Std. Dev. 4.66179E-016	Variance 2.17323E-031

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 3.32485E-014

Minimum 0	Maximum 1.24484E-005	
Mean 1.2518E-008	Std. Dev. 3.93461E-007	Variance 1.54812E-013

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 2.2847E-005

Minimum 0	Maximum 0.00903353	
Mean 1.45261E-005	Std. Dev. 0.000306369	Variance 9.38621E-008

Phase: Existing waste

Concentration of Lead at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 3.27597E-006

95% of values less than 6.09956E-005

99% of values less than 0.000853081

Minimum 0	Maximum 0.00250889	
Mean 2.93871E-005	Std. Dev. 0.000194933	Variance 3.7999E-008

Phase: Existing waste

Concentration of Nickel at base of Unsaturated Zone [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 1.96709E-011	
Mean 2.07713E-014	Std. Dev. 6.22711E-013	Variance 3.87769E-025

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 3.78157E-013

Minimum 0	Maximum 0.000786681	
Mean 9.11013E-007	Std. Dev. 2.51564E-005	Variance 6.32844E-010

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 1.55397E-015
99% of values less than 0.000250625

Minimum 0	Maximum 0.0222463	
Mean 5.06398E-005	Std. Dev. 0.000842763	Variance 7.10249E-007

Phase: Existing waste

Concentration of Nickel at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0.000205644

95% of values less than 0.000556649

99% of values less than 0.001174

Minimum 0	Maximum 0.00270081	
Mean 7.47849E-005	Std. Dev. 0.000248364	Variance 6.16846E-008

Phase: Existing waste

Concentration of Sulphate at base of Unsaturated Zone [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 5.70817E-006
90% of values less than 1247.29
95% of values less than 1753.76
99% of values less than 2678.13

Minimum 0	Maximum 3190.92	
Mean 315.753	Std. Dev. 623.896	Variance 389246

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 93.3214
90% of values less than 757.79
95% of values less than 969.593
99% of values less than 1374.2

Minimum 0	Maximum 1664.95	
Mean 260.653	Std. Dev. 342.198	Variance 117099

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 4.09704E-007
50% of values less than 40.0428
90% of values less than 236.192
95% of values less than 367.242
99% of values less than 637.8

Minimum 0	Maximum 925.989	
Mean 91.6396	Std. Dev. 130.867	Variance 17126.1

At 1000 years

01% of values less than 6.03784E-011
05% of values less than 4.59256E-005
10% of values less than 0.000187758
50% of values less than 0.0663958
90% of values less than 39.7583
95% of values less than 71.3456
99% of values less than 122.288

Minimum 0	Maximum 190.682	
Mean 11.2298	Std. Dev. 26.4219	Variance 698.116

Phase: Existing waste

Concentration of Sulphate at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 1.46361E-011

90% of values less than 7.235E-010

95% of values less than 2.65656E-006

99% of values less than 0.00345336

Minimum 0	Maximum 0.138657	
Mean 0.000473004	Std. Dev. 0.00653845	Variance 4.27513E-005

Phase: Existing waste

Concentration of DDT at base of Unsaturated Zone [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.49388E-013
90% of values less than 7.25382E-005
95% of values less than 8.65243E-005
99% of values less than 9.56658E-005

Minimum 0	Maximum 0.000107609	
Mean 1.54374E-005	Std. Dev. 2.93015E-005	Variance 8.58578E-010

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.87478E-006
90% of values less than 7.45746E-005
95% of values less than 8.65603E-005
99% of values less than 9.56752E-005

Minimum 0	Maximum 0.000107608	
Mean 2.30051E-005	Std. Dev. 3.07632E-005	Variance 9.46376E-010

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 9.08531E-006
90% of values less than 7.45753E-005
95% of values less than 8.65607E-005
99% of values less than 9.56756E-005

Minimum 0	Maximum 0.000107609	
Mean 2.49495E-005	Std. Dev. 2.99881E-005	Variance 8.99283E-010

At 1000 years

01% of values less than 0
05% of values less than 2.13132E-014
10% of values less than 1.03554E-010
50% of values less than 9.10019E-006
90% of values less than 7.45754E-005
95% of values less than 8.65607E-005
99% of values less than 9.56756E-005

Minimum 0	Maximum 0.000107609	
Mean 2.49847E-005	Std. Dev. 2.99608E-005	Variance 8.9765E-010

Phase: Existing waste

Concentration of DDT at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 0

05% of values less than 1.52949E-013

10% of values less than 1.21332E-010

50% of values less than 9.10019E-006

90% of values less than 7.45753E-005

95% of values less than 8.65607E-005

99% of values less than 9.56756E-005

Minimum 0 Maximum 0.000107609

Mean 2.49847E-005 Std. Dev. 2.99608E-005 Variance 8.97649E-010

Phase: Existing waste

Approx. time to Peak Conc. Ammoniacal_N at Base of Unsaturated Zone [years]

01% of values less than 32
05% of values less than 70
10% of values less than 128
50% of values less than 1379
90% of values less than 16406
95% of values less than 20000
99% of values less than 20000
Minimum 19 Maximum 20000
Mean 4360.98 Std. Dev. 6110.76 Variance 3.73413E+007

Approx. time to Peak Conc. Arsenic at Base of Unsaturated Zone [years]

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 7428
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000
Minimum 0 Maximum 20000
Mean 9654.83 Std. Dev. 9239.69 Variance 8.53719E+007

Approx. time to Peak Conc. Chloride at Base of Unsaturated Zone [years]

01% of values less than 9
05% of values less than 13
10% of values less than 19
50% of values less than 156
90% of values less than 1523
95% of values less than 2759
99% of values less than 6094
Minimum 7 Maximum 9056
Mean 584.654 Std. Dev. 1113.24 Variance 1.23931E+006

Approx. time to Peak Conc. Lead at Base of Unsaturated Zone [years]

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000
Minimum 0 Maximum 20000
Mean 3605.83 Std. Dev. 7373.95 Variance 5.43751E+007

Approx. time to Peak Conc. Nickel at Base of Unsaturated Zone [years]

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000

Phase: Existing waste

Approx. time to Peak Conc. Nickel at Base of Unsaturated Zone [years]

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000

Minimum 0	Maximum 20000	
Mean 7280.43	Std. Dev. 9307.96	Variance 8.66381E+007

Approx. time to Peak Conc. Sulphate at Base of Unsaturated Zone [years]

01% of values less than 9
05% of values less than 14
10% of values less than 21
50% of values less than 172
90% of values less than 1681
95% of values less than 2759
99% of values less than 6094

Minimum 8	Maximum 9056	
Mean 597.125	Std. Dev. 1091.32	Variance 1.19098E+006

Approx. time to Peak Conc. DDT at Base of Unsaturated Zone [years]

01% of values less than 0
05% of values less than 35
10% of values less than 141
50% of values less than 1379
90% of values less than 12189
95% of values less than 13458
99% of values less than 18114

Minimum 0	Maximum 18114	
Mean 3585.56	Std. Dev. 5096	Variance 2.59692E+007

Phase: Existing waste

Concentration of Ammoniacal_N at base of Vertical Pathway [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 1.41287E-008
95% of values less than 0.0208943
99% of values less than 59.6029

Minimum 0	Maximum 413.407	
Mean 2.77708	Std. Dev. 25.443	Variance 647.344

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 13.4031
95% of values less than 68.6277
99% of values less than 145.018

Minimum 0	Maximum 222.985	
Mean 8.18163	Std. Dev. 27.8815	Variance 777.378

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 3.25419E-011
90% of values less than 22.153
95% of values less than 40.4083
99% of values less than 72.7752

Minimum 0	Maximum 107.062	
Mean 6.04811	Std. Dev. 14.9595	Variance 223.787

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.000558627
90% of values less than 8.28506
95% of values less than 14.3635
99% of values less than 22.7035

Minimum 0	Maximum 29.4641	
Mean 2.30004	Std. Dev. 4.95978	Variance 24.5995

Phase: Existing waste

Concentration of Ammoniacal_N at base of Vertical Pathway [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 9.60769E-010

90% of values less than 0.225792

95% of values less than 0.427257

99% of values less than 0.740626

Minimum 0	Maximum 1.42965	
Mean 0.0617312	Std. Dev. 0.160633	Variance 0.0258031

Phase: Existing waste

Concentration of Arsenic at base of Vertical Pathway [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 2.1893E-005	
Mean 2.1875E-008	Std. Dev. 6.9197E-007	Variance 4.78822E-013

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 2.65559E-015
99% of values less than 2.2752E-006

Minimum 0	Maximum 0.0299402	
Mean 4.68184E-005	Std. Dev. 0.00101737	Variance 1.03504E-006

Phase: Existing waste

Concentration of Arsenic at base of Vertical Pathway [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0.000503458

95% of values less than 0.00101399

99% of values less than 0.00163801

Minimum 0	Maximum 0.00195935	
Mean 0.000130644	Std. Dev. 0.000347357	Variance 1.20657E-007

Phase: Existing waste

Concentration of Chloride at base of Vertical Pathway [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 1301.37
95% of values less than 1921.64
99% of values less than 2667.88

Minimum 0	Maximum 3451.41	
Mean 285.17	Std. Dev. 648.452	Variance 420490

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 3.73085
90% of values less than 528.903
95% of values less than 726.988
99% of values less than 1014.05

Minimum 0	Maximum 1830.55	
Mean 150.113	Std. Dev. 255.875	Variance 65471.8

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 2.44734
90% of values less than 197.931
95% of values less than 281.159
99% of values less than 437.121

Minimum 0	Maximum 562.155	
Mean 50.4964	Std. Dev. 98.3465	Variance 9672.03

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.000123943
90% of values less than 36.1654
95% of values less than 62.4016
99% of values less than 96.7425

Minimum 0	Maximum 141.997	
Mean 8.89185	Std. Dev. 21.7715	Variance 473.998

Phase: Existing waste

Concentration of Chloride at base of Vertical Pathway [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 5.47218E-013

90% of values less than 2.97229E-009

95% of values less than 1.65122E-005

99% of values less than 0.0134271

Minimum 0	Maximum 0.323068	
Mean 0.00131641	Std. Dev. 0.0161911	Variance 0.000262151

Phase: Existing waste

Concentration of Lead at base of Vertical Pathway [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 1.29641E-017

Minimum 0	Maximum 4.63369E-007	
Mean 7.74147E-010	Std. Dev. 1.68137E-008	Variance 2.82702E-016

Phase: Existing waste

Concentration of Lead at base of Vertical Pathway [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 6.54978E-008

99% of values less than 0.000433948

Minimum 0	Maximum 0.00314697	
Mean 1.51333E-005	Std. Dev. 0.000153942	Variance 2.36982E-008

Phase: Existing waste

Concentration of Nickel at base of Vertical Pathway [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 7.51203E-018	
Mean 7.50452E-021	Std. Dev. 2.37432E-019	Variance 5.63742E-038

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 7.87727E-015

Minimum 0	Maximum 3.76061E-005	
Mean 3.89482E-008	Std. Dev. 1.18931E-006	Variance 1.41446E-012

Phase: Existing waste

Concentration of Nickel at base of Vertical Pathway [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 2.57376E-005

95% of values less than 0.00038182

99% of values less than 0.00145563

Minimum 0 Maximum 0.00296142

Mean 6.34657E-005 Std. Dev. 0.000271357 Variance 7.36347E-008

Phase: Existing waste

Concentration of Sulphate at base of Vertical Pathway [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 1120.64
95% of values less than 1786.94
99% of values less than 2896.03

Minimum 0	Maximum 3394.7	
Mean 267.82	Std. Dev. 631.07	Variance 398249

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 2.40057
90% of values less than 801.357
95% of values less than 1028.25
99% of values less than 1522.15

Minimum 0	Maximum 1958.03	
Mean 243.563	Std. Dev. 368.489	Variance 135784

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 40.2042
90% of values less than 312.452
95% of values less than 412.045
99% of values less than 731.968

Minimum 0	Maximum 1178.56	
Mean 107.364	Std. Dev. 159.091	Variance 25310

At 1000 years

01% of values less than 0
05% of values less than 1.02508E-007
10% of values less than 0.00027221
50% of values less than 0.139568
90% of values less than 50.6808
95% of values less than 98.0994
99% of values less than 192.492

Minimum 0	Maximum 326.399	
Mean 14.5108	Std. Dev. 37.5986	Variance 1413.65

Phase: Existing waste

Concentration of Sulphate at base of Vertical Pathway [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 9.55489E-013

90% of values less than 3.77432E-009

95% of values less than 1.60407E-005

99% of values less than 0.0165985

Minimum 0	Maximum 0.600253	
Mean 0.00203715	Std. Dev. 0.027719	Variance 0.000768341

Phase: Existing waste

Concentration of DDT at base of Vertical Pathway [mg/l]

At 30 years
01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 6.16599E-005
95% of values less than 7.88025E-005
99% of values less than 9.33733E-005
Minimum 0 | Maximum 0.000104446
Mean 1.15187E-005 | Std. Dev. 2.57803E-005 | Variance 6.64621E-010

At 100 years
01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 2.3251E-008
90% of values less than 6.71176E-005
95% of values less than 8.04612E-005
99% of values less than 9.3385E-005
Minimum 0 | Maximum 0.000104519
Mean 1.81127E-005 | Std. Dev. 2.796E-005 | Variance 7.81762E-010

At 300 years
01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 2.92095E-006
90% of values less than 6.71182E-005
95% of values less than 8.0462E-005
99% of values less than 9.33852E-005
Minimum 0 | Maximum 0.000104519
Mean 1.96767E-005 | Std. Dev. 2.749E-005 | Variance 7.55702E-010

At 1000 years
01% of values less than 0
05% of values less than 0
10% of values less than 1.78201E-014
50% of values less than 2.96897E-006
90% of values less than 6.71182E-005
95% of values less than 8.0462E-005
99% of values less than 9.33853E-005
Minimum 0 | Maximum 0.000104519
Mean 1.97001E-005 | Std. Dev. 2.74742E-005 | Variance 7.54832E-010

Phase: Existing waste

Concentration of DDT at base of Vertical Pathway [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 5.52317E-014

50% of values less than 2.96897E-006

90% of values less than 6.71182E-005

95% of values less than 8.0462E-005

99% of values less than 9.33853E-005

Minimum 0	Maximum 0.000104519	
Mean 1.97001E-005	Std. Dev. 2.74742E-005	Variance 7.54832E-010

Phase: Existing waste

Concentration of Ammoniacal_N at Phase Monitor Well [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 1.62903E-007
99% of values less than 0.439585

Minimum 0	Maximum 33.0268	
Mean 0.107031	Std. Dev. 1.65142	Variance 2.72718

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0.019603
95% of values less than 1.10114
99% of values less than 21.3726

Minimum 0	Maximum 137.804	
Mean 0.742506	Std. Dev. 5.85796	Variance 34.3156

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.58055E-017
90% of values less than 1.12277
95% of values less than 7.82437
99% of values less than 38.7357

Minimum 0	Maximum 71.755	
Mean 1.60653	Std. Dev. 7.20095	Variance 51.8537

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.09609E-005
90% of values less than 0.418593
95% of values less than 2.37044
99% of values less than 7.95174

Minimum 0	Maximum 17.7695	
Mean 0.394541	Std. Dev. 1.67161	Variance 2.79428

Phase: Existing waste

Concentration of Ammoniacal_N at Phase Monitor Well [mg/l]

At infinity

01% of values less than 0

05% of values less than 6.68306E-018

10% of values less than 3.5928E-013

50% of values less than 1.04208E-009

90% of values less than 0.000363915

95% of values less than 0.00360683

99% of values less than 0.0333676

Minimum 0	Maximum 0.16197	
Mean 0.00119764	Std. Dev. 0.00780182	Variance 6.08684E-005

Phase: Existing waste

Concentration of Arsenic at Phase Monitor Well [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 1.4371E-013	
Mean 1.83372E-016	Std. Dev. 4.71238E-015	Variance 2.22065E-029

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 3.11887E-010

Minimum 0	Maximum 0.000472453	
Mean 5.11734E-007	Std. Dev. 1.49836E-005	Variance 2.2451E-010

Phase: Existing waste

Concentration of Arsenic at Phase Monitor Well [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 1.38869E-005

95% of values less than 0.000117013

99% of values less than 0.000931613

Minimum 0	Maximum 0.00218989	
Mean 3.44687E-005	Std. Dev. 0.000168186	Variance 2.82864E-008

Phase: Existing waste

Concentration of Chloride at Phase Monitor Well [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 57.5537
95% of values less than 476.729
99% of values less than 1830.44

Minimum 0	Maximum 2551.84	
Mean 75.4353	Std. Dev. 309.689	Variance 95907.5

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.00253091
90% of values less than 71.3243
95% of values less than 180.868
99% of values less than 503.686

Minimum 0	Maximum 829.568	
Mean 27.6311	Std. Dev. 91.2774	Variance 8331.57

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.0268093
90% of values less than 6.84583
95% of values less than 20.4749
99% of values less than 89.6103

Minimum 0	Maximum 508.7	
Mean 4.48583	Std. Dev. 22.1746	Variance 491.711

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 7.12442E-016
50% of values less than 5.12579E-006
90% of values less than 0.125771
95% of values less than 1.23394
99% of values less than 4.74941

Minimum 0	Maximum 29.2995	
Mean 0.263851	Std. Dev. 1.63355	Variance 2.66849

Phase: Existing waste

Concentration of Chloride at Phase Monitor Well [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 5.95426E-012

90% of values less than 3.31387E-009

95% of values less than 1.28488E-008

99% of values less than 6.40639E-006

Minimum 0	Maximum 0.00818421	
Mean 1.00122E-005	Std. Dev. 0.000261938	Variance 6.86113E-008

Phase: Existing waste

Concentration of Lead at Phase Monitor Well [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 3.82176E-012	
Mean 6.74237E-015	Std. Dev. 1.52085E-013	Variance 2.31297E-026

Phase: Existing waste

Concentration of Lead at Phase Monitor Well [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 1.25799E-015

99% of values less than 9.46545E-007

Minimum 0	Maximum 0.000213831	
Mean 3.83755E-007	Std. Dev. 7.36178E-006	Variance 5.41958E-011

Phase: Existing waste

Concentration of Nickel at Phase Monitor Well [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 4.65833E-013	
Mean 4.89576E-016	Std. Dev. 1.47407E-014	Variance 2.17288E-028

Phase: Existing waste

Concentration of Nickel at Phase Monitor Well [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 1.47312E-008

95% of values less than 3.44786E-006

99% of values less than 0.000124637

Minimum 0	Maximum 0.000709916	
Mean 4.88766E-006	Std. Dev. 4.10166E-005	Variance 1.68236E-009

Phase: Existing waste

Concentration of Sulphate at Phase Monitor Well [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 44.8069
95% of values less than 442.419
99% of values less than 1432.16

Minimum 0	Maximum 3002.56	
Mean 61.8074	Std. Dev. 266.369	Variance 70952.5

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.00141407
90% of values less than 139.777
95% of values less than 337.76
99% of values less than 815.763

Minimum 0	Maximum 1464.28	
Mean 51.3815	Std. Dev. 161.381	Variance 26044

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.181523
90% of values less than 43.5855
95% of values less than 84.7094
99% of values less than 168.729

Minimum 0	Maximum 602.951	
Mean 13.6797	Std. Dev. 40.3872	Variance 1631.13

At 1000 years

01% of values less than 0
05% of values less than 9.64402E-013
10% of values less than 6.6071E-007
50% of values less than 0.00191168
90% of values less than 0.388625
95% of values less than 1.84682
99% of values less than 9.34004

Minimum 0	Maximum 32.7985	
Mean 0.441912	Std. Dev. 2.23309	Variance 4.98669

Phase: Existing waste

Concentration of Sulphate at Phase Monitor Well [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 2.08635E-012

90% of values less than 1.83737E-009

95% of values less than 7.34345E-009

99% of values less than 3.33836E-006

Minimum 0	Maximum 0.0199005	
Mean 2.10083E-005	Std. Dev. 0.000629358	Variance 3.96091E-007

Phase: Existing waste

Concentration of DDT at Phase Monitor Well [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 1.90482E-006
95% of values less than 1.68909E-005
99% of values less than 4.44362E-005

Minimum 0	Maximum 8.11173E-005	
Mean 2.10886E-006	Std. Dev. 8.39039E-006	Variance 7.03986E-011

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.39202E-011
90% of values less than 8.00163E-006
95% of values less than 2.85308E-005
99% of values less than 5.64634E-005

Minimum 0	Maximum 8.33843E-005	
Mean 3.61288E-006	Std. Dev. 1.10779E-005	Variance 1.2272E-010

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 6.64621E-009
90% of values less than 9.52066E-006
95% of values less than 2.88378E-005
99% of values less than 5.64659E-005

Minimum 0	Maximum 8.33851E-005	
Mean 3.78777E-006	Std. Dev. 1.11169E-005	Variance 1.23585E-010

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 1.00703E-018
50% of values less than 8.02349E-009
90% of values less than 9.52069E-006
95% of values less than 2.88378E-005
99% of values less than 5.6466E-005

Minimum 0	Maximum 8.33851E-005	
Mean 3.78919E-006	Std. Dev. 1.11164E-005	Variance 1.23575E-010

Phase: Existing waste

Concentration of DDT at Phase Monitor Well [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 8.12681E-018

50% of values less than 8.02349E-009

90% of values less than 9.52069E-006

95% of values less than 2.88378E-005

99% of values less than 5.6466E-005

Minimum 0	Maximum 8.33851E-005	
Mean 3.78919E-006	Std. Dev. 1.11164E-005	Variance 1.23575E-010

Phase: Existing waste

Approx. time to Peak Conc. Ammoniacal_N at Phase Monitor Well [years]

01% of values less than 35
05% of values less than 128
10% of values less than 232
50% of values less than 2263
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000
Minimum 0 Maximum 20000
Mean 5746.43 Std. Dev. 6998.69 Variance 4.89817E+007

Approx. time to Peak Conc. Arsenic at Phase Monitor Well [years]

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000
Minimum 0 Maximum 20000
Mean 7355.31 Std. Dev. 9258.52 Variance 8.57201E+007

Approx. time to Peak Conc. Chloride at Phase Monitor Well [years]

01% of values less than 13
05% of values less than 21
10% of values less than 30
50% of values less than 256
90% of values less than 2499
95% of values less than 4527
99% of values less than 9999
Minimum 10 Maximum 16406
Mean 953.871 Std. Dev. 1868.53 Variance 3.49141E+006

Approx. time to Peak Conc. Lead at Phase Monitor Well [years]

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 9999
99% of values less than 20000
Minimum 0 Maximum 20000
Mean 1032.83 Std. Dev. 4312.32 Variance 1.85961E+007

Phase: Existing waste

Approx. time to Peak Conc. Nickel at Phase Monitor Well [years]

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000

Minimum 0	Maximum 20000	
Mean 4398.55	Std. Dev. 8118.56	Variance 6.5911E+007

Approx. time to Peak Conc. Sulphate at Phase Monitor Well [years]

01% of values less than 13
05% of values less than 23
10% of values less than 32
50% of values less than 282
90% of values less than 2499
95% of values less than 4527
99% of values less than 9999

Minimum 10	Maximum 16406	
Mean 965.97	Std. Dev. 1843.51	Variance 3.39854E+006

Approx. time to Peak Conc. DDT at Phase Monitor Well [years]

01% of values less than 0
05% of values less than 0
10% of values less than 156
50% of values less than 1379
90% of values less than 12189
95% of values less than 13458
99% of values less than 18114

Minimum 0	Maximum 20000	
Mean 3133.67	Std. Dev. 4864.42	Variance 2.36626E+007

Phase: Existing waste

Flow to Leachate Treatment Plant [l/day]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Phase: Existing waste

Flow to Leachate Treatment Plant [l/day]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Phase: Existing waste

Head on EBS [m]

At 1000 years

01% of values less than 3
05% of values less than 3
10% of values less than 3
50% of values less than 3
90% of values less than 3
95% of values less than 3
99% of values less than 3

Minimum 3	Maximum 3	
Mean 3	Std. Dev. 8.62736E-008	Variance -7.44314E-015

At infinity

01% of values less than 3
05% of values less than 3
10% of values less than 3
50% of values less than 3
90% of values less than 3
95% of values less than 3
99% of values less than 3

Minimum 3	Maximum 3	
Mean 3	Std. Dev. 8.62736E-008	Variance -7.44314E-015

Phase: Existing waste

Surface Breakout [l/day]

At 300 years

01% of values less than 28945.5
05% of values less than 34833.2
10% of values less than 37754.3
50% of values less than 40920.3
90% of values less than 41168
95% of values less than 41178.1
99% of values less than 41185.7

Minimum 20426.3	Maximum 41188	
Mean 39944.5	Std. Dev. 2591.22	Variance 6.71443E+006

At 1000 years

01% of values less than 28945.5
05% of values less than 34833.2
10% of values less than 37754.3
50% of values less than 40920.3
90% of values less than 41168
95% of values less than 41178.1
99% of values less than 41185.7

Minimum 20426.3	Maximum 41188	
Mean 39944.5	Std. Dev. 2591.22	Variance 6.71443E+006

At infinity

01% of values less than 28945.5
05% of values less than 34833.2
10% of values less than 37754.3
50% of values less than 40920.3
90% of values less than 41168
95% of values less than 41178.1
99% of values less than 41185.7

Minimum 20426.3	Maximum 41188	
Mean 39944.5	Std. Dev. 2591.22	Variance 6.71443E+006

Phase: Existing waste

Leakage through EBS [l/day]

At 100 years

01% of values less than 5.31448
05% of values less than 12.901
10% of values less than 22.9229
50% of values less than 270.621
90% of values less than 3436.71
95% of values less than 6357.81
99% of values less than 12245.5

Minimum 2.95514	Maximum 20764.7	
Mean 1246.43	Std. Dev. 2591.22	Variance 6.71443E+006

At 300 years

01% of values less than 5.31448
05% of values less than 12.901
10% of values less than 22.9229
50% of values less than 270.621
90% of values less than 3436.71
95% of values less than 6357.81
99% of values less than 12245.5

Minimum 2.95514	Maximum 20764.7	
Mean 1246.43	Std. Dev. 2591.22	Variance 6.71443E+006

At 1000 years

01% of values less than 5.31448
05% of values less than 12.901
10% of values less than 22.9229
50% of values less than 270.621
90% of values less than 3436.71
95% of values less than 6357.81
99% of values less than 12245.5

Minimum 2.95514	Maximum 20764.7	
Mean 1246.43	Std. Dev. 2591.22	Variance 6.71443E+006

At infinity

01% of values less than 5.31448
05% of values less than 12.901
10% of values less than 22.9229
50% of values less than 270.621
90% of values less than 3436.71
95% of values less than 6357.81
99% of values less than 12245.5

Minimum 2.95514	Maximum 20764.7	
Mean 1246.43	Std. Dev. 2591.22	Variance 6.71443E+006

Phase: Existing waste

Aquifer Flow [m³/year]

At 30 years

01% of values less than 142.394
05% of values less than 294.424
10% of values less than 503.574
50% of values less than 23409.2
90% of values less than 1.06655E+006
95% of values less than 1.82342E+006
99% of values less than 2.89386E+006

Minimum 0	Maximum 3.94536E+006	
Mean 300165	Std. Dev. 618813	Variance 3.8293E+011

At 100 years

01% of values less than 142.394
05% of values less than 294.424
10% of values less than 503.574
50% of values less than 23409.2
90% of values less than 1.06655E+006
95% of values less than 1.82342E+006
99% of values less than 2.89386E+006

Minimum 0	Maximum 3.94536E+006	
Mean 300165	Std. Dev. 618813	Variance 3.8293E+011

At 300 years

01% of values less than 142.394
05% of values less than 294.424
10% of values less than 503.574
50% of values less than 23409.2
90% of values less than 1.06655E+006
95% of values less than 1.82342E+006
99% of values less than 2.89386E+006

Minimum 0	Maximum 3.94536E+006	
Mean 300165	Std. Dev. 618813	Variance 3.8293E+011

At 1000 years

01% of values less than 142.394
05% of values less than 294.424
10% of values less than 503.574
50% of values less than 23409.2
90% of values less than 1.06655E+006
95% of values less than 1.82342E+006
99% of values less than 2.89386E+006

Minimum 0	Maximum 3.94536E+006	
Mean 300165	Std. Dev. 618813	Variance 3.8293E+011

Phase: Existing waste

Aquifer Flow [m³/year]

At infinity

01% of values less than 142.394

05% of values less than 294.424

10% of values less than 503.574

50% of values less than 23409.2

90% of values less than 1.06655E+006

95% of values less than 1.82342E+006

99% of values less than 2.89386E+006

Minimum 0 Maximum 3.94536E+006

Mean 300165 Std. Dev. 618813 Variance 3.8293E+011

APPENDIX C-3

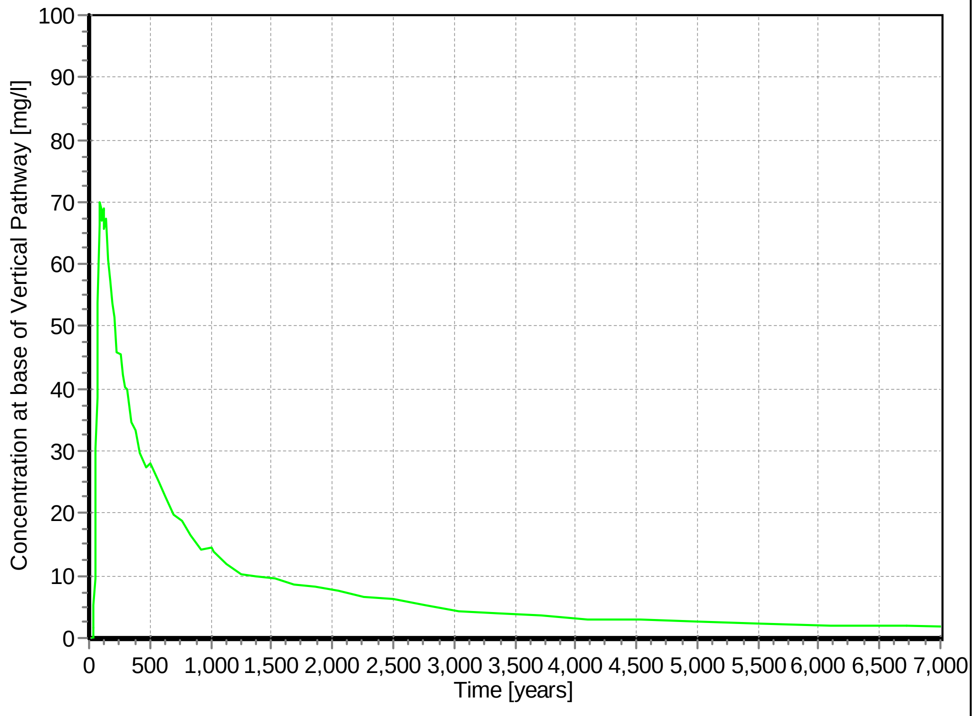
RESULTS – GRAPHS VERTICAL PATHWAY

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Existing waste, Ammoniacal_N Concentration at base of Vertical Pathway [mg/l]



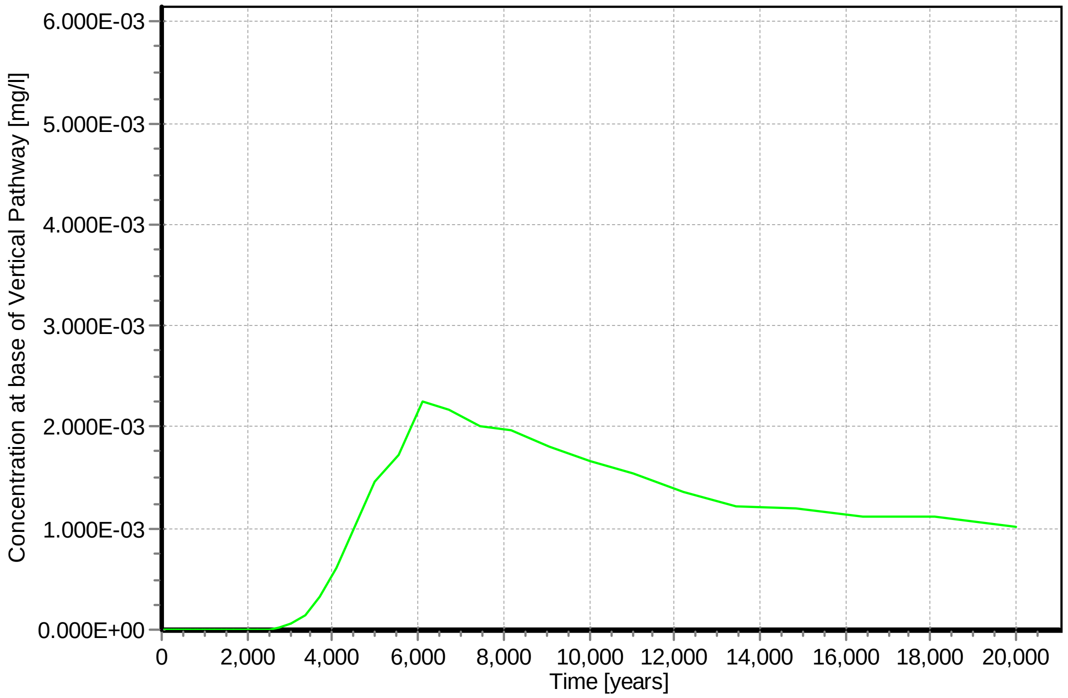
\Moldova_current situation_Dec source & biodegr_all COC-0.109/12/2016 14:27:43

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Existing waste, Arsenic Concentration at base of Vertical Pathway [mg/l]



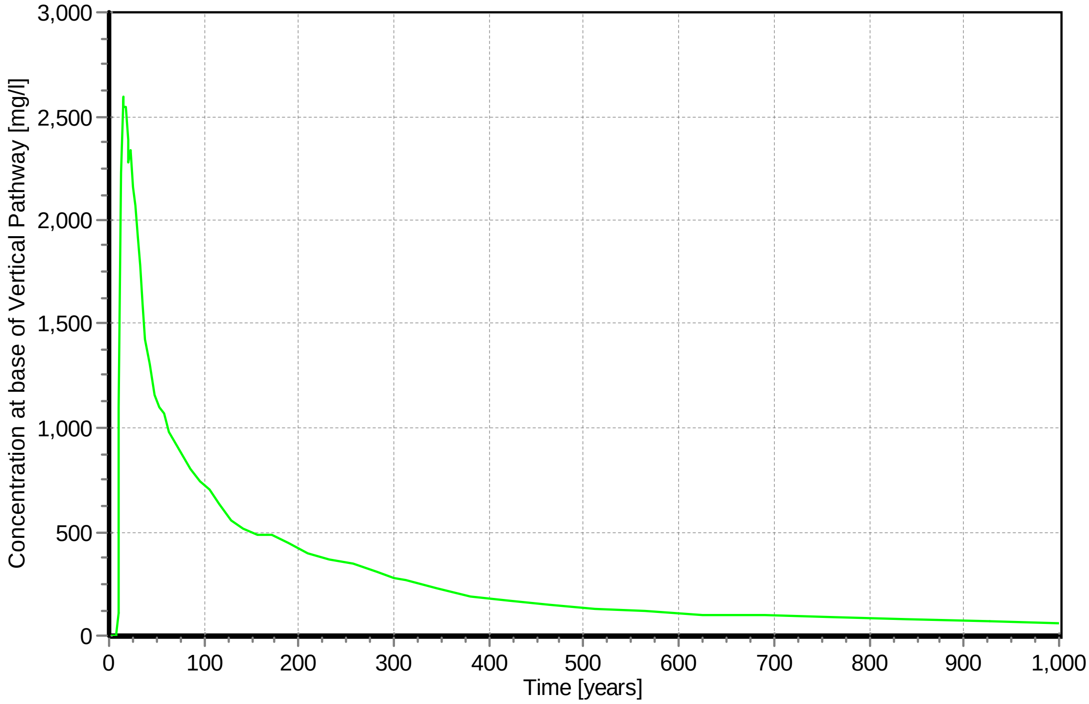
\Moldova_current situation_Dec source & biodegr_all COC-0.14.sim 09/12/2016 14:27:43

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Existing waste, Chloride Concentration at base of Vertical Pathway [mg/l]



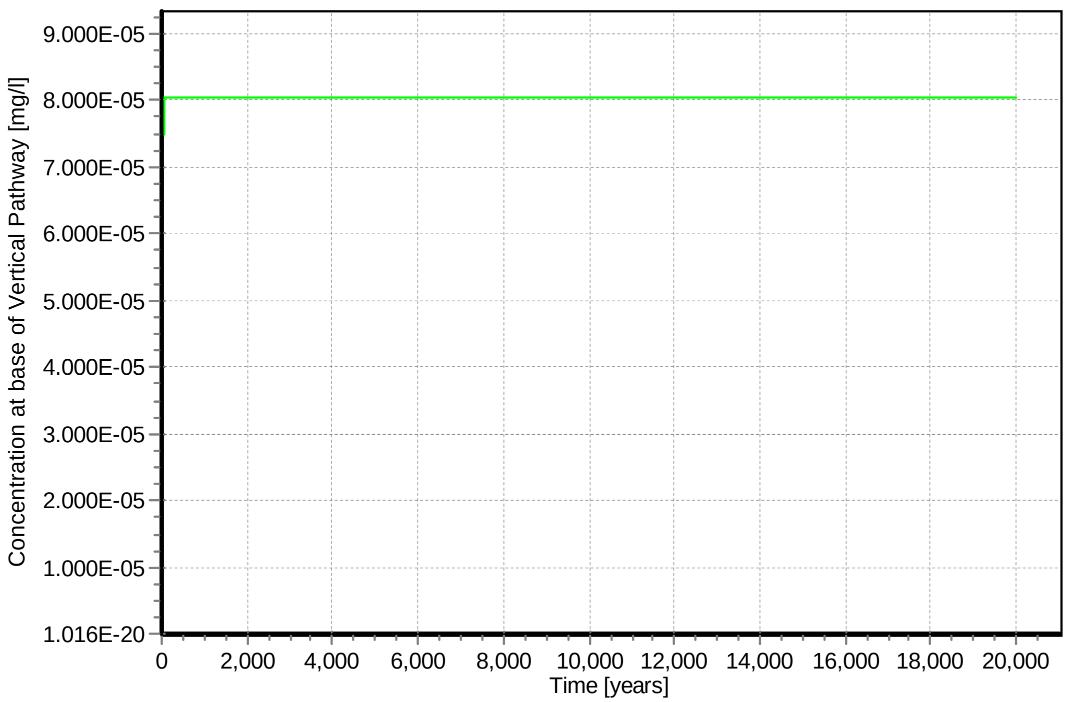
\Moldova_current situation_Dec source & biodegr_all COC-0.14.sim 09/12/2016 14:27:43

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Existing waste, DDT Concentration at base of Vertical Pathway [mg/l]



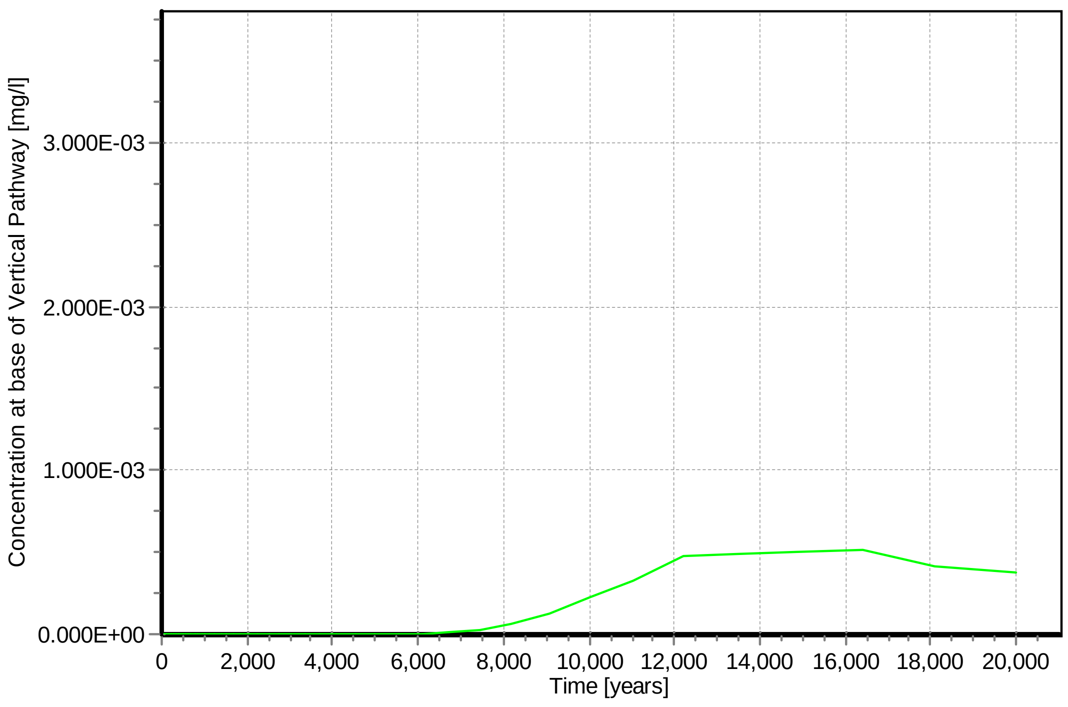
\Moldova_current situation_Dec source & biodegr_all COC-0.14.sim 09/12/2016 14:27:43

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Existing waste, Nickel Concentration at base of Vertical Pathway [mg/l]



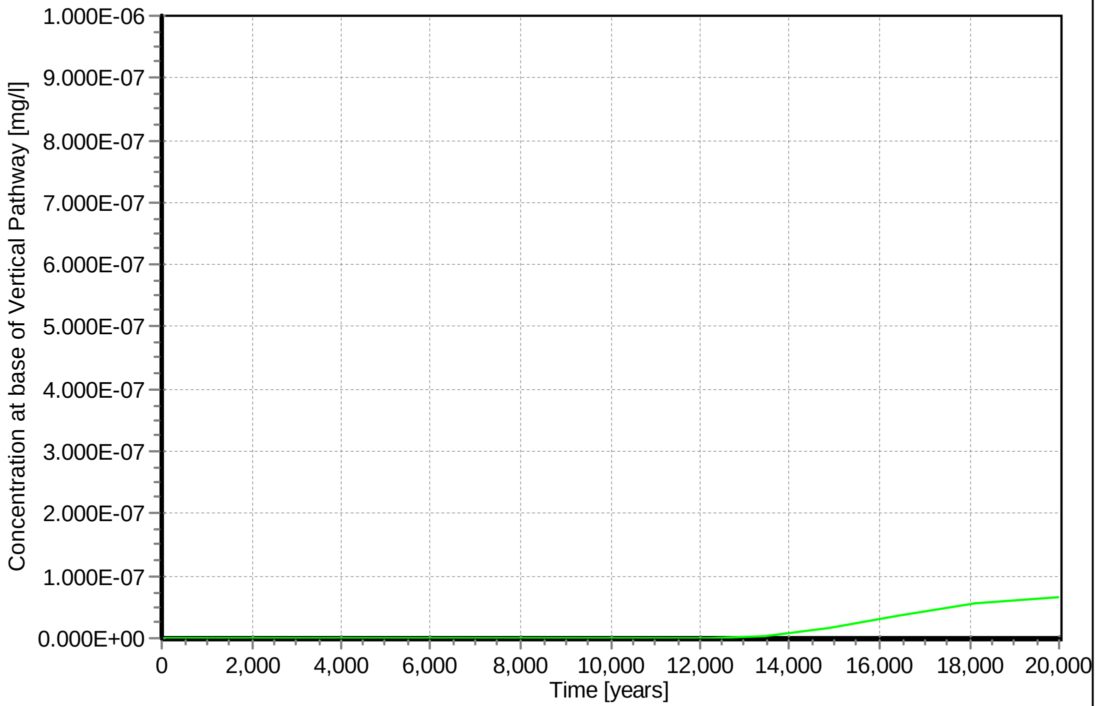
\Moldova_current situation_Dec source & biodegr_all COC-0.14.sim 09/12/2016 14:27:43

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Existing waste, Lead Concentration at base of Vertical Pathway [mg/l]



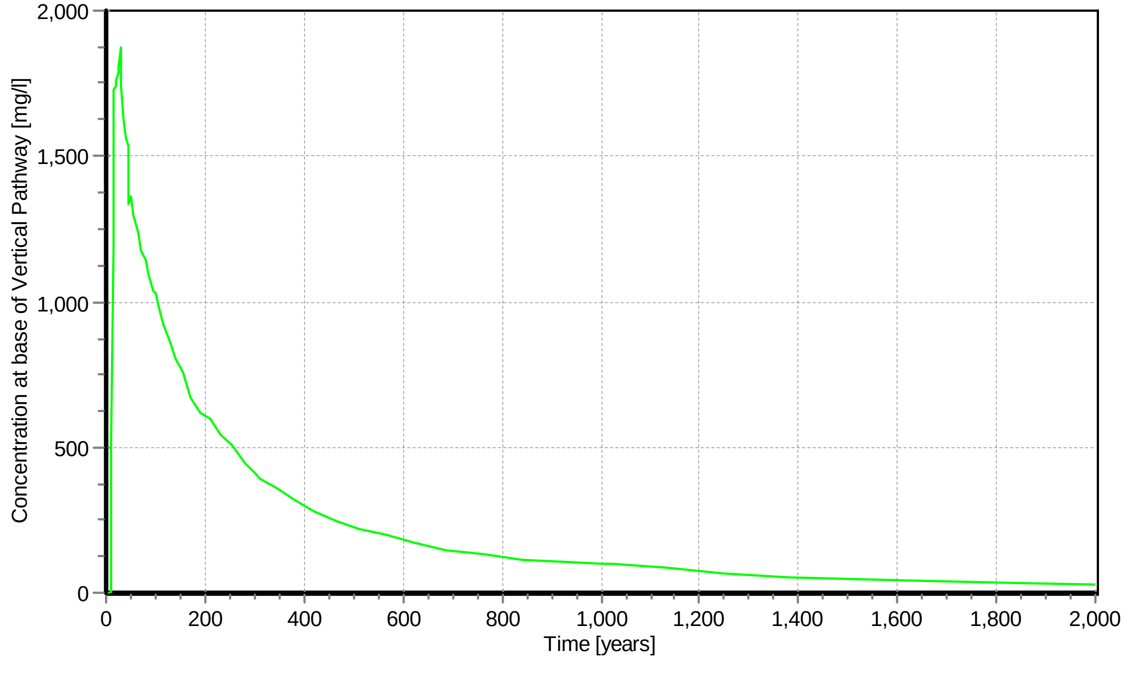
\Moldova_current situation_Dec source & biodegr_all COC-0.14.sim 09/12/2016 14:27:43

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Existing waste, Sulphate Concentration at base of Vertical Pathway [mg/l]



APPENDIX C-4

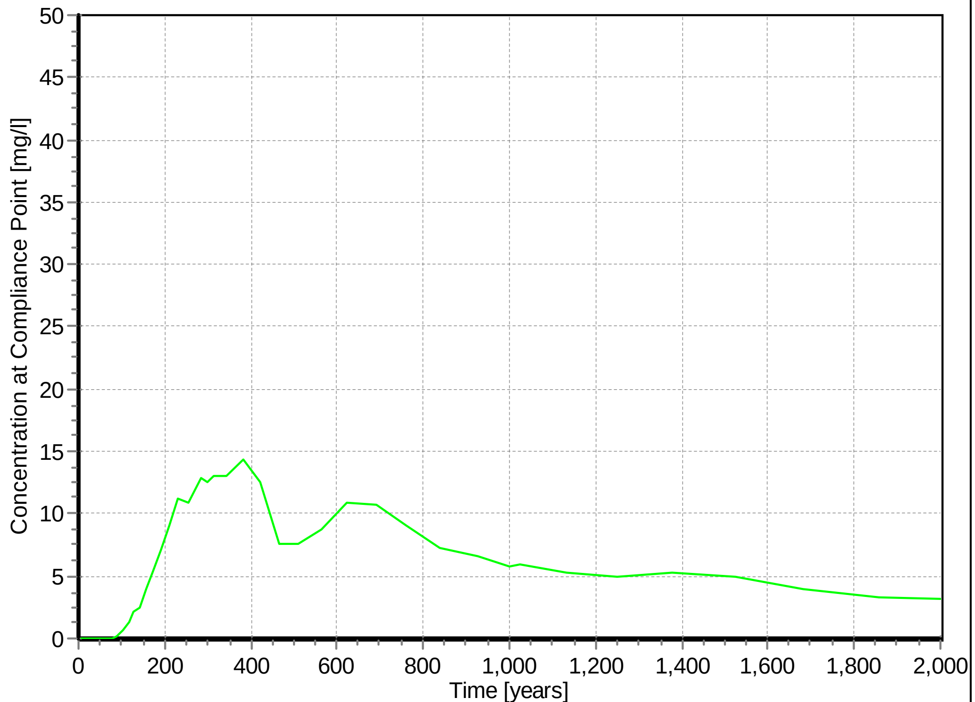
RESULTS – GRAPHS 100M

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Ammoniacal_N Concentration at Compliance Point [mg/l]



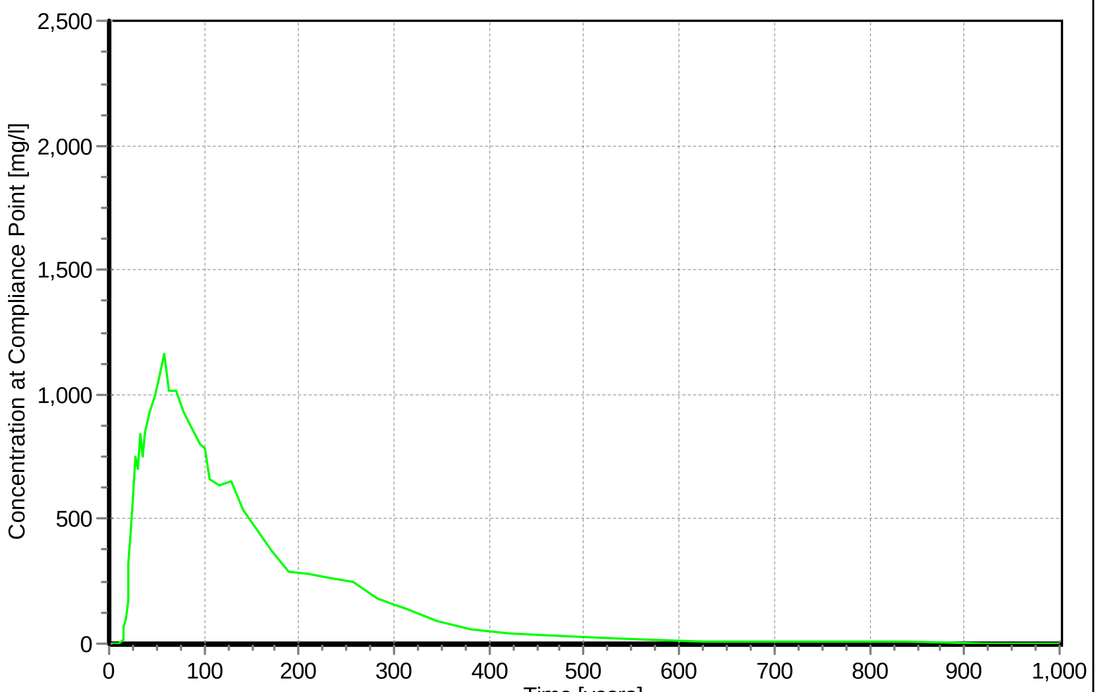
\Moldova_current situation_Dec source & biodegr_all COC fin: 09/12/2016 14:53:47

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Chloride Concentration at Compliance Point [mg/l]



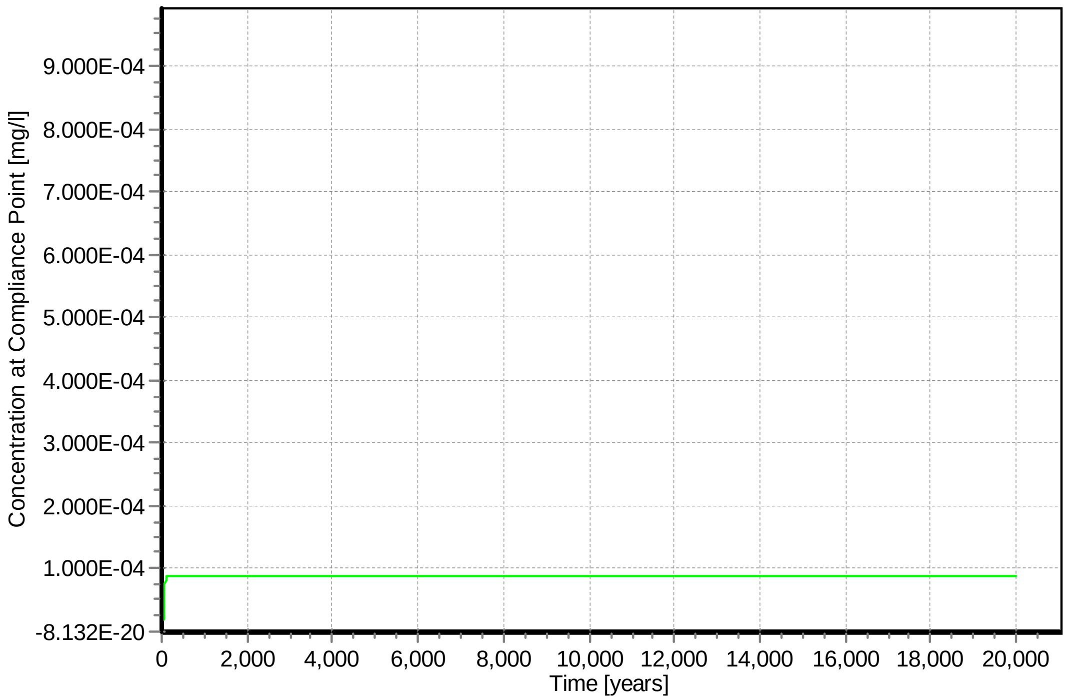
\Moldova_current situation_Dec source & biodegr_all COC final.sim 09/12/2016 14:53:47

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: DDT Concentration at Compliance Point [mg/l]



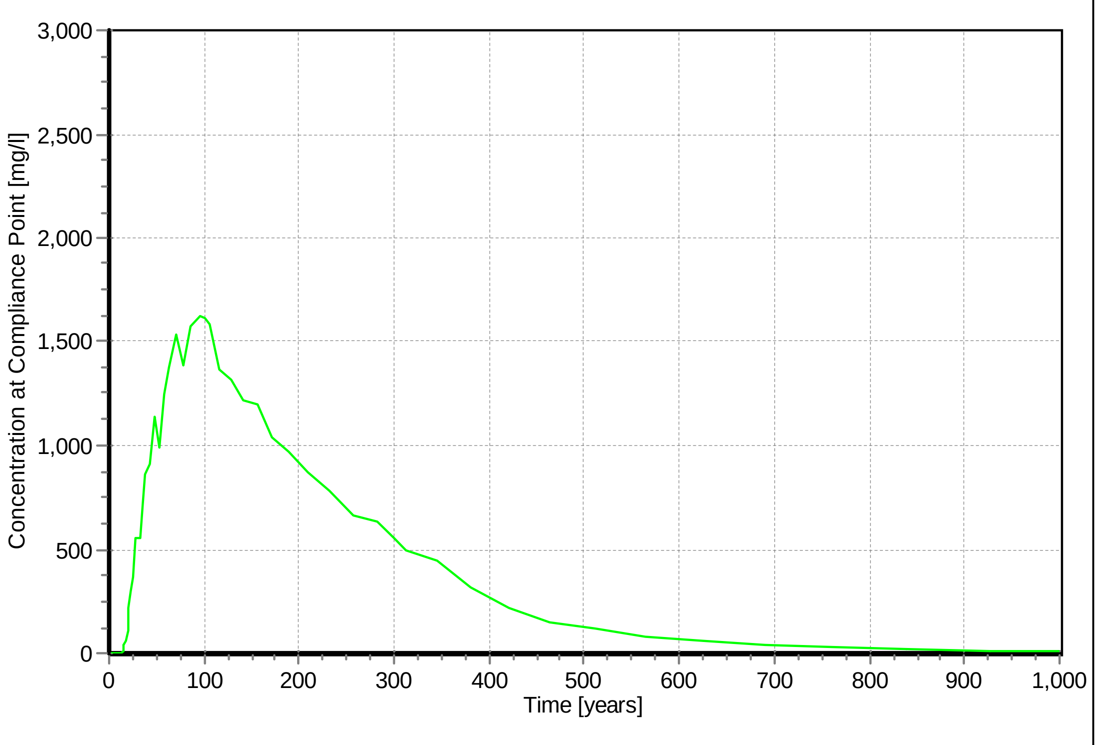
\Moldova_current situation_Dec source & biodegr_all COC final.sim 09/12/2016 14:53:47

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Sulphate Concentration at Compliance Point [mg/l]



\Moldova_current situation_Dec source & biodegr_all COC final.sim 09/12/2016 14:53:47

APPENDIX C-5

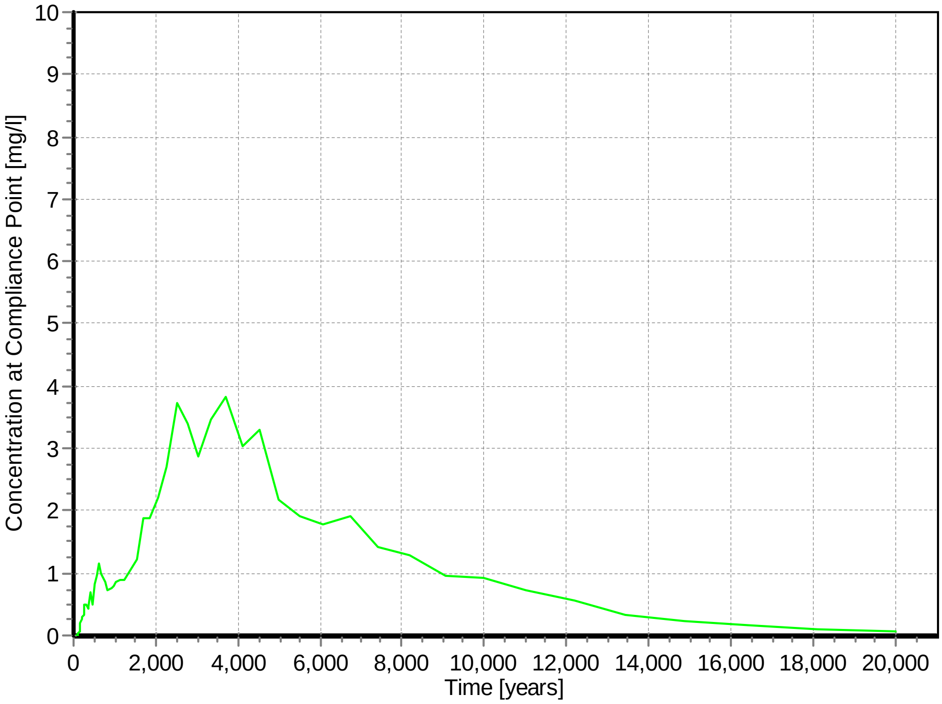
RESULTS – GRAPHS 500M

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Ammoniacal_N Concentration at Compliance Point [mg/l]



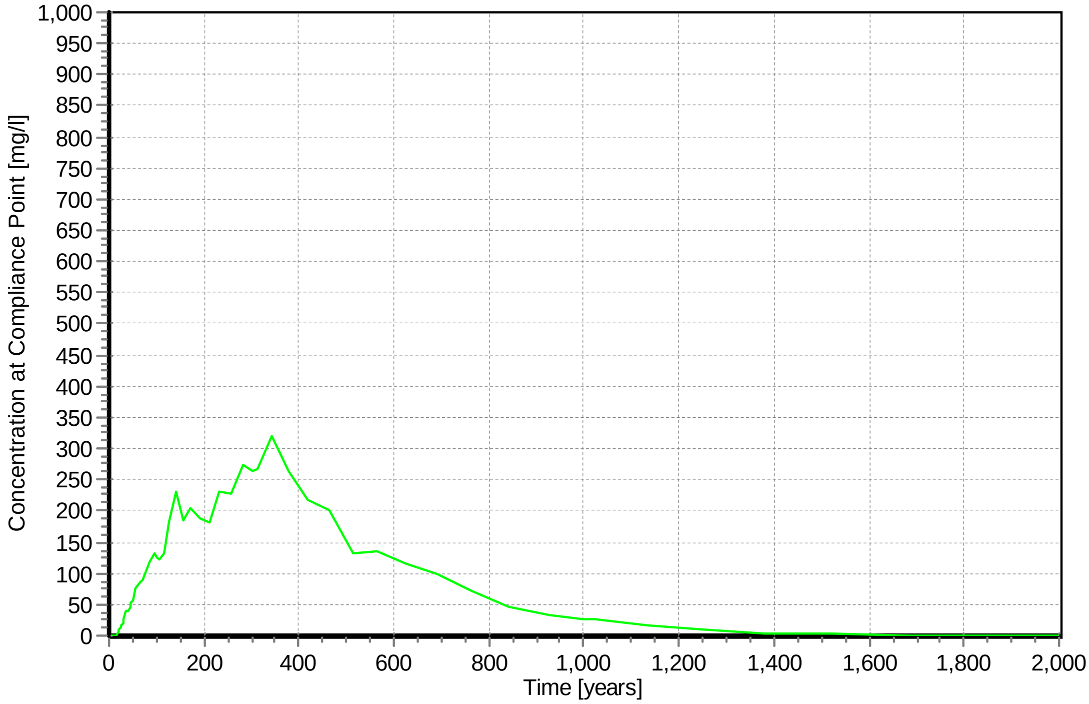
\Moldova_current situation_Dec source & biodegr_all COC plu09/12/2016 12:19:27

LandSim Version 2.5

Project Name: Tintareni

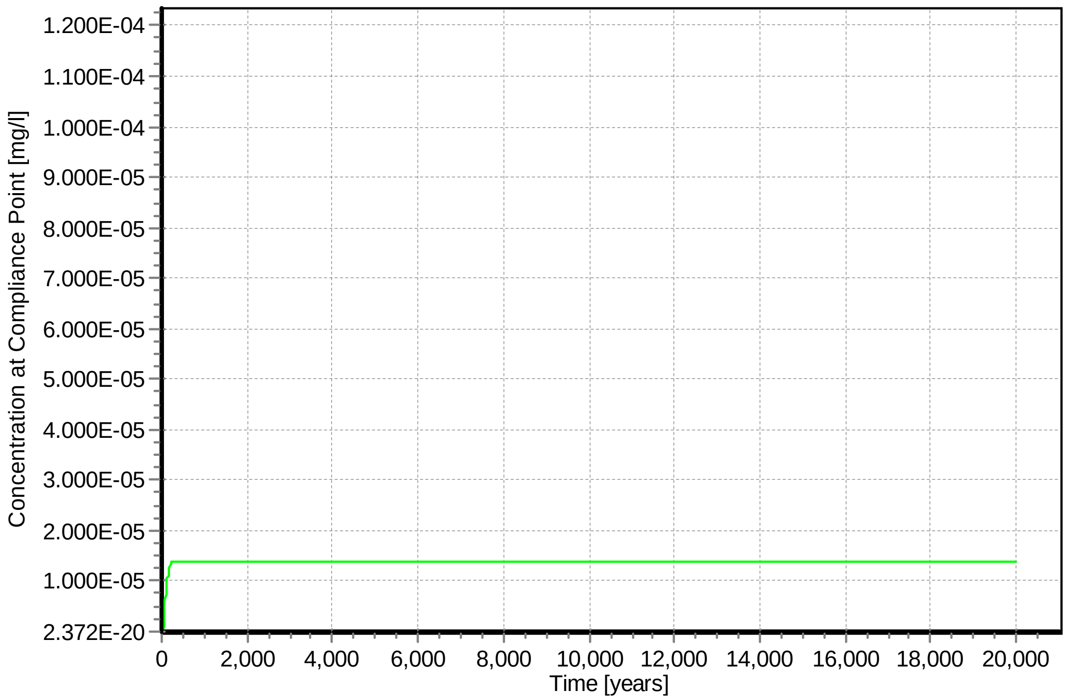
Customer:EBRD

Results: Chloride Concentration at Compliance Point [mg/l]



\Moldova_current situation_Dec source & biodegr_all COC plus 500m.sim09/12/2016 12:19:27

LandSim Version 2.5
Project Name: Tintareni Customer:EBRD
Results: DDT Concentration at Compliance Point [mg/l]



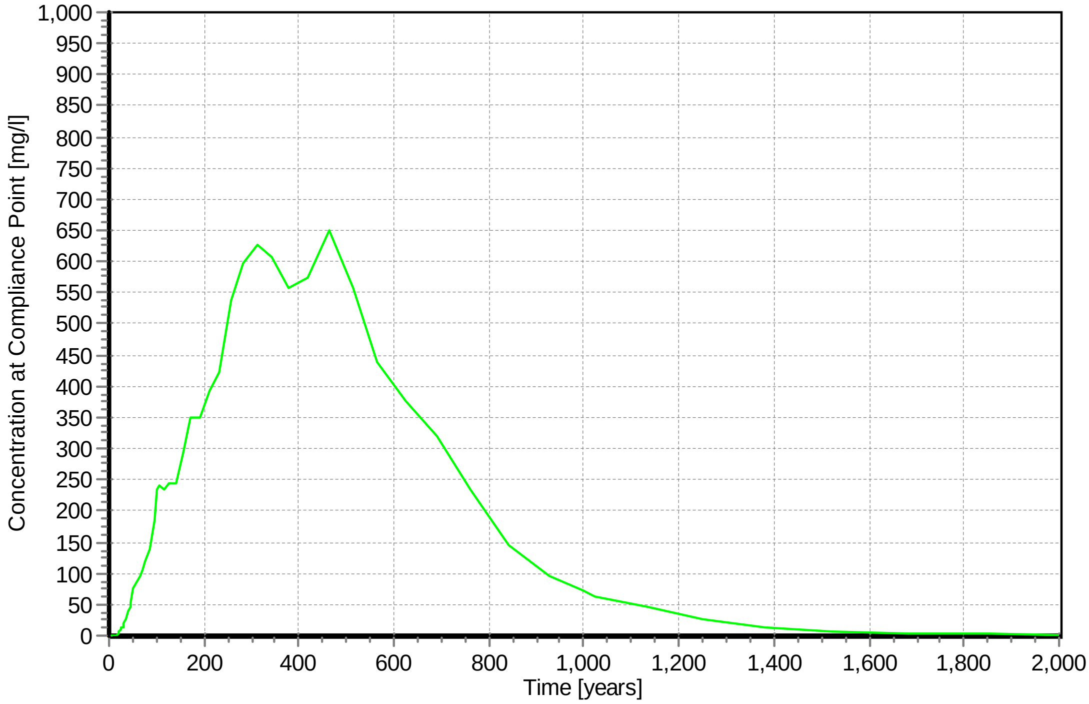
\Moldova_current situation_Dec source & biodegr_all COC plus 500m.sim09/12/2016 12:19:27

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

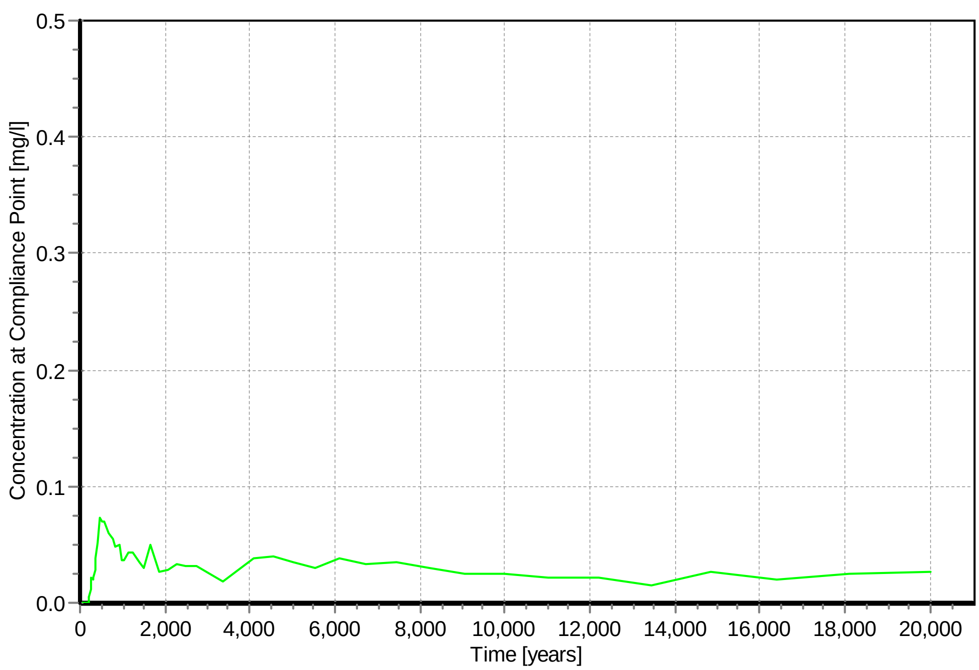
Results: Sulphate Concentration at Compliance Point [mg/l]



\Moldova_current situation_Dec source & biodegr_all COC plus 500m.sim09/12/2016 12:19:27

APPENDIX C-6

RESULTS – GRAPHS 4KM

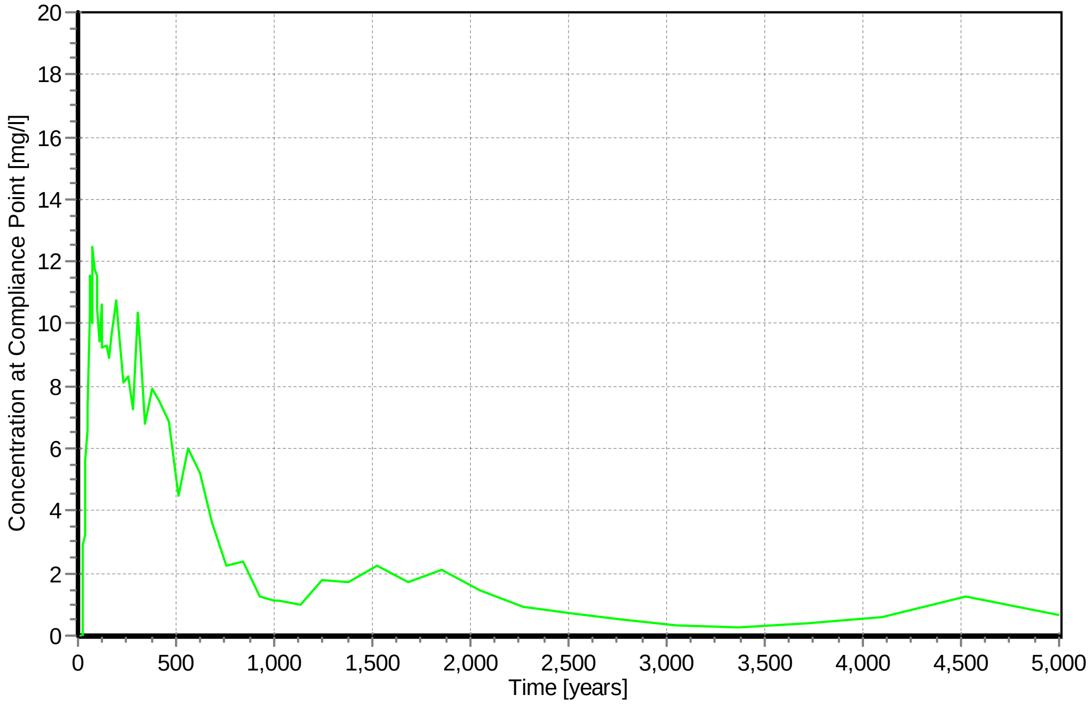
LandSim Version 2.5
Project Name: Tintareni Customer:EBRD
Results: Ammoniacal_N Concentration at Compliance Point [mg/l]

\Moldova_current situation_Dec source & biodegr_all COC plus 4 12/12/2016 13:29:53

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Chloride Concentration at Compliance Point [mg/l]



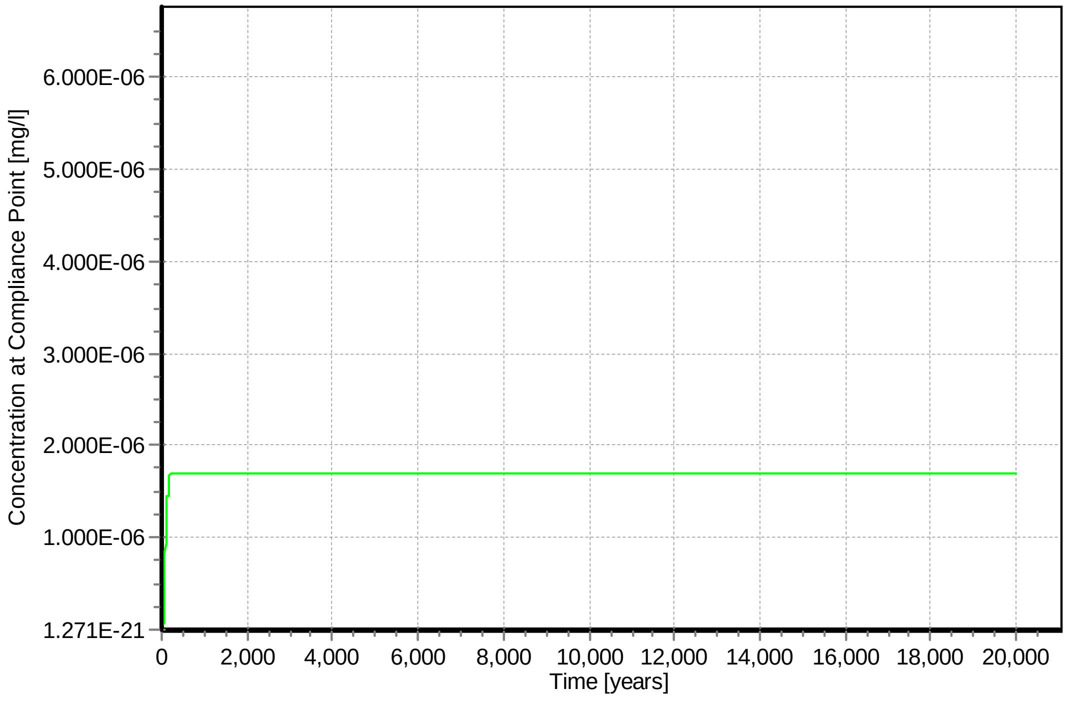
\Moldova_current situation_Dec source & biodegr_all COC plus 4km.sim 12/12/2016 13:29:53

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: DDT Concentration at Compliance Point [mg/l]



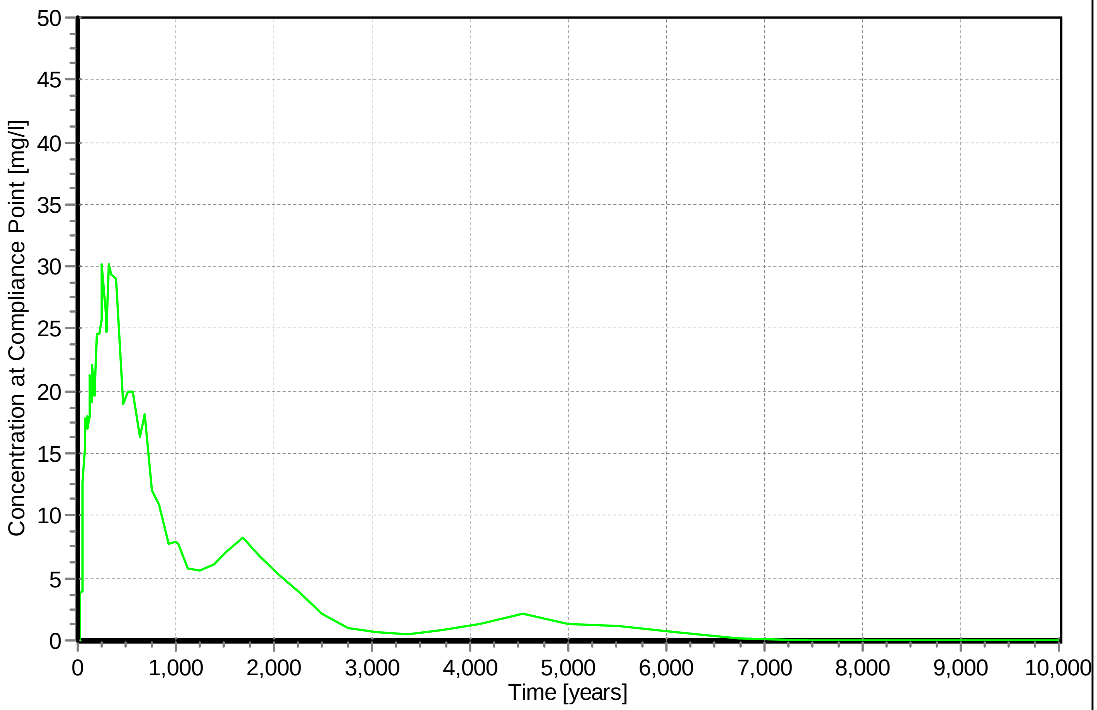
\Moldova_current situation_Dec source & biodegr_all COC plus 4km.sim 12/12/2016 13:29:53

LandSim Version 2.5

Project Name: Tintareni

Customer:EBRD

Results: Sulphate Concentration at Compliance Point [mg/l]



\Moldova_current situation_Dec source & biodegr_all COC plus 4km.sim 12/12/2016 13:29:53

APPENDIX C-7

RESULTS – REQUISITE SURVEILLANCE 750M

Calculation Settings

Number of iterations: 1001

Results calculated using sampled PDFs

Full Calculation

Clay Liner:

Unretarded values used for simulation

No Biodegradation

Unsaturated Pathway:

Retarded values used for simulation

Biodegradation

Saturated Vertical Pathway:

Retarded values used for simulation

Biodegradation

Aquifer Pathway:

Retarded values used for simulation

Biodegradation

Timeslices at: 30, 100, 300, 1000

Decline in Contaminant Concentration in Leachate

Ammoniacal_N	Non-Volatile
c (kg/l): 0.59	m (kg/l): 0
Chloride	Non-Volatile
c (kg/l): 0.2919	m (kg/l): 0.0298

Contaminant Half-lives (years)

Saturated Vertical Pathway:

Chloride	SINGLE(1e+009)

Aquifer Pathway:

Chloride	SINGLE(1e+009)

Background Concentrations of Contaminants

Justification for Contaminant Properties

Unjustified value

All units in milligrams per litre

Phase: Existing waste

Infiltration Information

Cap design infiltration (mm/year):	SINGLE(177)
Infiltration to waste (mm/year):	NORMAL(592,120)
End of filling (years from start of waste deposit):	19

Justification for Specified Infiltration

Annual average precipitation based on a various range of references, including websites such as FAO, World Bank and World Climate and a various range of previous reports prepared for the site (E. Lindberg, J. Olsson, 2012; WSP Parsons Brinckerhoff, 2016; Fichtner, 2016a; Fichtner, 2016b; Boncom Project, 2016)

Duration of management control (years from the start of waste disposal): 25

Cell dimensions

Cell width (m):	20
Cell length (m):	100
Cell top area (ha):	8.5
Cell base area (ha):	0.2
Number of cells:	1
Total base area (ha):	0.2
Total top area (ha):	8.5
Head of Leachate when surface water breakout occurs (m)	SINGLE(3)
Waste porosity (fraction)	UNIFORM(0.4,0.6)
Final waste thickness (m):	UNIFORM(20,40)
Field capacity (fraction):	UNIFORM(0.2,0.35)
Waste dry density (kg/l)	SINGLE(0.2)

Justification for Landfill Geometry

The landfill was built in a hillside by the formation of series of benches. The leachate flows by gravity to the bottom of the landfill where it is believed to accumulate. The maximum landfill width is estimated to be approximately 500m, based on Conceptual Design (Figure LF-CHS-216-Design). The width of the area where leachate accumulates is assumed to be approximately 20m [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED]

Source concentrations of contaminants

All units in milligrams per litre

Declining source term

Ammoniacal_N	TRIANGULAR(164.4,625.2,4516) *Data are spot measurements of Leachate Quality*
Chloride	TRIANGULAR(4903,6036,8500)

Justification for Species Concentration in Leachate
Unjustified value

Drainage Information

Fixed Head.
Head on EBS is given as (m): TRIANGULAR(1,1.5,3)

Justification for Specified Head
Assumption [CHANGED]

Barrier Information

There is a single clay barrier

Justification for Engineered Barrier Type
Based on information available (Fichtner 2016a)

Design thickness of clay (m):	TRIANGULAR(5,6,7)
Density of clay (kg/l):	UNDEFINED
Pathway moisture content (fraction):	SINGLE(0.2)

Justification for Clay: Liner Thickness
Fichtner 2016a [CHANGED]

Hydraulic conductivity of liner (m/s):	LOGTRIANGULAR(1e-011,1e-009,1e-007)
Pathway longitudinal dispersivity (m):	TRIANGULAR(0.5,0.6,0.7)

Justification for Clay: Hydraulics Properties
The maximum corresponds to the permeability assumed for degraded clay (two orders of magnitude lower than the assumed original permeability). The most likely is the specification for clay liners. The minimum value corresponds to the top range within values provided by Domenico and Schwartz 1990. [CHANGED]

Retardation parameters for clay liner
No retardation values used in this simulation.
Check 'Unretarded Contaminant Transport' setting under simulation preferences.

Clay pathway parameters

Modelled as unsaturated pathway

Pathway length (m):	SINGLE(30)
Flow Model:	porous medium
Pathway moisture content (fraction):	TRIANGULAR(0.16,0.21,0.23)
Pathway Density (kg/l):	TRIANGULAR(0.74,2.7,2.71)

Justification for Unsat Zone Geometry

Thickness of the strata based on Boncom Proiect (2016)

Pathway hydraulic conductivity values (m/s):	UNIFORM(1.15e-008,9.26e-008)

Justification for Unsat Zone Hydraulics Properties

Site specific, Boncom Proiect (2016)

Pathway longitudinal dispersivity (m):	SINGLE(3)

Justification for Unsat Zone Dispersion Properties

Assumed 10% of pathway length (Environment Agency, 2006)

Retardation parameters for Clay pathway

Modelled as unsaturated pathway

Uncertainty in Kd (l/kg):

Ammoniacal_N	UNIFORM(0.5,2)
Chloride	SINGLE(0)

Justification for Kd Values by Species

Model default parameters [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED]

Aquifer Pathway Dimensions for Phase

Pathway length (m):	UNIFORM(750,900)
Pathway width (m):	SINGLE(100)

Shale pathway parameters

Modelled as vertical pathway.	
Pathway length (m):	SINGLE(6.4)
Pathway porosity (fraction):	UNIFORM(0.362,0.44)

Justification for Vertical Path Geometry
Based on thickness of unit at BH3, Boncom Proiect (2016) [CHANGED] [CHANGED]

Pathway dispersivity (m):	SINGLE(0.64)

Justification for Vertical Path Dispersion Details
Assumed 10% of pathway length (Environment Agency, 2006)

Retardation parameters for Shale pathway
Modelled as vertical pathway.

Uncertainty in Kd (l/kg):	
Ammoniacal_N	UNIFORM(0.5,2)
Retardation parameters for Shale pathway	
Chloride	SINGLE(0)
Retardation parameters for Shale pathway	

Justification for Vertical Path Kd Values by Species
Landsim V2.5 default parameters [CHANGED] [CHANGED]

Pathway Density (kg/l):	SINGLE(2.68)

Mid-Sarmatian unit (Limestones) pathway parameters

Modelled as aquifer pathway.

Mixing zone (m):

Calculated. Aquifer Thickness:	SINGLE(90)

Justification for Aquifer Geometry

10% of strata (90m) based on Boncom Proiect 2016 [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED] [CHANGED]

Pathway regional gradient (-):	SINGLE(0.02)
Pathway hydraulic conductivity values (m/s):	LOGUNIFORM(1e-007,0.003)
Pathway porosity (fraction):	SINGLE(0.14)

Justification for Aquifer Hydraulics Properties

Freeze and Cherry 1979 [CHANGED]

Pathway longitudinal dispersivity (m):	UNIFORM(10,25)
Pathway transverse dispersivity (m):	UNIFORM(1,2.5)

Justification for Aquifer Dispersion Details

Longitudinal: Assumed 10% of pathway length (Environment Agency, 2006)

Transversal: Assumed 1% of pathway length (Environment Agency, 2006) [CHANGED] [CHANGED]

Retardation parameters for Mid-Sarmatian unit (Limestones) pathway

Modelled as aquifer pathway.

Uncertainty in Kd (l/kg):

Ammoniacal_N	UNIFORM(0.5,2)
Chloride	SINGLE(0)

Justification for Aquifer Kd Values by Species

Unjustified value

Pathway Density (kg/l):	SINGLE(2.36)

Concentration of Ammoniacal_N in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 6.29077E-018
99% of values less than 0.000706526

Minimum 0	Maximum 4.93946	
Mean 0.00722123	Std. Dev. 0.159995	Variance 0.0255983

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 3.07747E-010
95% of values less than 0.00168918
99% of values less than 3.76222

Minimum 0	Maximum 79.0497	
Mean 0.356492	Std. Dev. 4.28434	Variance 18.3555

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0.0626238
95% of values less than 0.522061
99% of values less than 9.44263

Minimum 0	Maximum 201.452	
Mean 0.924903	Std. Dev. 9.86037	Variance 97.2269

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 3.75645E-011
90% of values less than 0.132312
95% of values less than 0.704658
99% of values less than 18.0277

Minimum 0	Maximum 234.232	
Mean 1.16854	Std. Dev. 11.5183	Variance 132.671

Concentration of Ammoniacal_N in groundwater [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 6.62251E-013

50% of values less than 1.09154E-008

90% of values less than 0.0217558

95% of values less than 0.279191

99% of values less than 3.11854

Minimum 0	Maximum 12.8046	
Mean 0.120683	Std. Dev. 0.781138	Variance 0.610176

Concentration of Chloride in groundwater [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 1.04775
95% of values less than 19.5095
99% of values less than 514.763

Minimum 0	Maximum 3564.59	
Mean 20.9946	Std. Dev. 177.103	Variance 31365.6

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.50648E-009
90% of values less than 16.1234
95% of values less than 139.932
99% of values less than 1125.97

Minimum 0	Maximum 27963.7	
Mean 93.1274	Std. Dev. 1086.48	Variance 1.18044E+006

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.0112261
90% of values less than 11.6538
95% of values less than 72.6317
99% of values less than 975.894

Minimum 0	Maximum 8984.04	
Mean 48.014	Std. Dev. 448.454	Variance 201111

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 4.70137E-005
90% of values less than 2.81903
95% of values less than 27.051
99% of values less than 228.115

Minimum 0	Maximum 792.595	
Mean 8.25082	Std. Dev. 49.3395	Variance 2434.38

Concentration of Chloride in groundwater [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 1.83197E-011

90% of values less than 1.40575E-008

95% of values less than 5.92012E-008

99% of values less than 2.46018E-005

Minimum 0	Maximum 0.00217165	
Mean 3.97103E-006	Std. Dev. 7.18728E-005	Variance 5.1657E-009

Approx. time to Peak Conc. Ammoniacal_N at Offsite Compliance Point [years]

01% of values less than 39
05% of values less than 232
10% of values less than 420
50% of values less than 4527
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000

Minimum 0	Maximum 20000	
Mean 7583.04	Std. Dev. 7333.68	Variance 5.37829E+007

Approx. time to Peak Conc. Chloride at Offsite Compliance Point [years]

01% of values less than 14
05% of values less than 30
10% of values less than 47
50% of values less than 380
90% of values less than 2759
95% of values less than 4999
99% of values less than 12189

Minimum 11	Maximum 14859	
Mean 1141.63	Std. Dev. 2110.75	Variance 4.45527E+006

Phase: Existing waste

Source Concentration of Ammoniacal_N [mg/l]

At 30 years

01% of values less than 19.4455
05% of values less than 43.3091
10% of values less than 59.4006
50% of values less than 157.118
90% of values less than 333.288
95% of values less than 389.513
99% of values less than 522.828

Minimum 8.72207	Maximum 815.964	
Mean 181.026	Std. Dev. 111.572	Variance 12448.3

At 100 years

01% of values less than 0.726093
05% of values less than 1.62112
10% of values less than 2.35087
50% of values less than 15.5391
90% of values less than 44.1087
95% of values less than 55.8899
99% of values less than 76.8436

Minimum 0.260277	Maximum 119.488	
Mean 20.4258	Std. Dev. 18.1488	Variance 329.38

At 300 years

01% of values less than 4.10295E-005
05% of values less than 9.76937E-005
10% of values less than 0.000219723
50% of values less than 0.0205351
90% of values less than 0.191677
95% of values less than 0.258943
99% of values less than 0.380999

Minimum 1.14227E-005	Maximum 0.693367	
Mean 0.0639443	Std. Dev. 0.0932229	Variance 0.0086905

At 1000 years

01% of values less than 3.02974E-020
05% of values less than 1.36072E-019
10% of values less than 1.50804E-018
50% of values less than 1.66645E-012
90% of values less than 1.36762E-009
95% of values less than 2.48407E-009
99% of values less than 4.98438E-009

Minimum 6.08694E-021	Maximum 1.20672E-008	
Mean 4.16275E-010	Std. Dev. 1.12608E-009	Variance 1.26806E-018

Phase: Existing waste

Source Concentration of Ammoniacal_N [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Phase: Existing waste

Source Concentration of Chloride [mg/l]

At 30 years

01% of values less than 24.3697
05% of values less than 54.1447
10% of values less than 87.7404
50% of values less than 306.85
90% of values less than 708.572
95% of values less than 840.705
99% of values less than 1166.17
Minimum 8.893 Maximum 2241.87
Mean 363.593 Std. Dev. 261.293 Variance 68274.2

At 100 years

01% of values less than 0.319053
05% of values less than 0.783945
10% of values less than 1.45393
50% of values less than 14.804
90% of values less than 56.1292
95% of values less than 71.8312
99% of values less than 100.199
Minimum 0.0948616 Maximum 186.493
Mean 23.2728 Std. Dev. 23.9626 Variance 574.205

At 300 years

01% of values less than 1.0102E-006
05% of values less than 3.38465E-006
10% of values less than 8.00113E-006
50% of values less than 0.00311577
90% of values less than 0.052886
95% of values less than 0.0754273
99% of values less than 0.111504
Minimum 2.20255E-007 Maximum 0.175688
Mean 0.0159794 Std. Dev. 0.0261907 Variance 0.000685955

At 1000 years

01% of values less than 2.88997E-026
05% of values less than 2.33297E-025
10% of values less than 4.56872E-024
50% of values less than 3.00173E-016
90% of values less than 1.62757E-012
95% of values less than 3.73053E-012
99% of values less than 8.63643E-012
Minimum 3.51156E-027 Maximum 2.27258E-011
Mean 6.03749E-013 Std. Dev. 1.86553E-012 Variance 3.48021E-024

Phase: Existing waste

Source Concentration of Chloride [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Phase: Existing waste

Concentration of Ammoniacal_N at base of Clay Liner [mg/l]

At 30 years

01% of values less than 0
05% of values less than 2.10771E-012
10% of values less than 2.44894E-009
50% of values less than 147.12
90% of values less than 414.105
95% of values less than 501.182
99% of values less than 638.675

Minimum 0	Maximum 893.775	
Mean 170.715	Std. Dev. 171.298	Variance 29343

At 100 years

01% of values less than 2.60779E-011
05% of values less than 0.000590689
10% of values less than 1.01088
50% of values less than 35.16
90% of values less than 130.756
95% of values less than 170.245
99% of values less than 273.626

Minimum 3.34613E-012	Maximum 440.432	
Mean 54.611	Std. Dev. 60.7569	Variance 3691.4

At 300 years

01% of values less than 0.000127514
05% of values less than 0.000678645
10% of values less than 0.00186893
50% of values less than 0.176389
90% of values less than 18.9592
95% of values less than 34.8134
99% of values less than 59.0854

Minimum 1.27847E-006	Maximum 112.163	
Mean 5.08696	Std. Dev. 12.6326	Variance 159.583

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 6.22116E-006
95% of values less than 0.0123574
99% of values less than 2.46319

Minimum 0	Maximum 14.2103	
Mean 0.102045	Std. Dev. 0.873718	Variance 0.763384

Phase: Existing waste

Concentration of Ammoniacal_N at base of Clay Liner [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 1.17003E-013

90% of values less than 5.13258E-013

95% of values less than 7.06156E-013

99% of values less than 3.01792E-012

Minimum 0	Maximum 1.25178E-010	
Mean 4.44052E-013	Std. Dev. 4.30179E-012	Variance 1.85054E-023

Phase: Existing waste

Concentration of Chloride at base of Clay Liner [mg/l]

At 30 years

01% of values less than 0
05% of values less than 6.2244E-012
10% of values less than 8.92327E-009
50% of values less than 322.939
90% of values less than 1153.62
95% of values less than 1385.25
99% of values less than 1937.95

Minimum 0	Maximum 2925.77	
Mean 452.513	Std. Dev. 484.974	Variance 235200

At 100 years

01% of values less than 4.9238E-011
05% of values less than 0.00229302
10% of values less than 1.12417
50% of values less than 48.7484
90% of values less than 321.687
95% of values less than 414.097
99% of values less than 653.051

Minimum 4.37077E-012	Maximum 1022.43	
Mean 112.673	Std. Dev. 147.321	Variance 21703.6

At 300 years

01% of values less than 5.29316E-006
05% of values less than 3.49801E-005
10% of values less than 0.000167057
50% of values less than 0.0633512
90% of values less than 45.7838
95% of values less than 82.9605
99% of values less than 138.8

Minimum 0	Maximum 217.952	
Mean 11.6209	Std. Dev. 29.5922	Variance 875.699

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0.000912428
95% of values less than 0.433684
99% of values less than 11.4273

Minimum 0	Maximum 37.2542	
Mean 0.382755	Std. Dev. 2.49043	Variance 6.20224

Phase: Existing waste

Concentration of Chloride at base of Clay Liner [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 4.50273E-013

90% of values less than 1.52042E-012

95% of values less than 1.98341E-012

99% of values less than 4.55256E-012

Minimum 0	Maximum 2.4527E-009	
Mean 3.62635E-012	Std. Dev. 7.80592E-011	Variance 6.09324E-021

Phase: Existing waste

Concentration of Ammoniacal_N at base of Unsaturated Zone [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0.0250056
95% of values less than 25.3032
99% of values less than 544.316

Minimum 0	Maximum 982.833	
Mean 14.8148	Std. Dev. 83.4048	Variance 6956.36

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 78.442
95% of values less than 142.25
99% of values less than 287.784

Minimum 0	Maximum 493.059	
Mean 20.0827	Std. Dev. 58.266	Variance 3394.93

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.00024716
90% of values less than 46.1134
95% of values less than 71.9951
99% of values less than 123.661

Minimum 0	Maximum 189.965	
Mean 12.047	Std. Dev. 27.2113	Variance 740.456

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.0567741
90% of values less than 15.9616
95% of values less than 22.4923
99% of values less than 37.5612

Minimum 0	Maximum 68.58	
Mean 4.65075	Std. Dev. 8.36265	Variance 69.9339

Phase: Existing waste

Concentration of Ammoniacal_N at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 1.226E-009

90% of values less than 0.264288

95% of values less than 0.577881

99% of values less than 1.06262

Minimum 0	Maximum 1.64377	
Mean 0.0790191	Std. Dev. 0.218638	Variance 0.0478026

Phase: Existing waste

Concentration of Chloride at base of Unsaturated Zone [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 7.44567E-007
90% of values less than 1295.78
95% of values less than 1700.13
99% of values less than 2425.27

Minimum 0	Maximum 4555.2	
Mean 304.713	Std. Dev. 614.076	Variance 377089

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 33.4944
90% of values less than 465.676
95% of values less than 638.825
99% of values less than 907.475

Minimum 0	Maximum 1588.82	
Mean 151.41	Std. Dev. 220.652	Variance 48687.4

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 1.6271E-008
50% of values less than 3.19406
90% of values less than 159.586
95% of values less than 224.143
99% of values less than 305.034

Minimum 0	Maximum 418.175	
Mean 44.1366	Std. Dev. 76.4233	Variance 5840.51

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 4.70243E-009
50% of values less than 0.000125516
90% of values less than 29.1666
95% of values less than 43.0879
99% of values less than 77.2924

Minimum 0	Maximum 137.56	
Mean 6.90767	Std. Dev. 16.3028	Variance 265.78

Phase: Existing waste

Concentration of Chloride at base of Unsaturated Zone [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 2.49575E-011

90% of values less than 2.03811E-009

95% of values less than 1.80581E-005

99% of values less than 0.00362333

Minimum 0	Maximum 0.394398	
Mean 0.00060674	Std. Dev. 0.012694	Variance 0.000161139

Phase: Existing waste

Approx. time to Peak Conc. Ammoniacal_N at Base of Unsaturated Zone [years]

01% of values less than 28
05% of values less than 70
10% of values less than 128
50% of values less than 1523
90% of values less than 16406
95% of values less than 20000
99% of values less than 20000

Minimum 0	Maximum 20000	
Mean 4323.91	Std. Dev. 6099.44	Variance 3.72032E+007

Approx. time to Peak Conc. Chloride at Base of Unsaturated Zone [years]

01% of values less than 8
05% of values less than 13
10% of values less than 19
50% of values less than 172
90% of values less than 1681
95% of values less than 3046
99% of values less than 6728

Minimum 7	Maximum 9056	
Mean 623.458	Std. Dev. 1258.15	Variance 1.58294E+006

Phase: Existing waste

Concentration of Ammoniacal_N at base of Vertical Pathway [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 6.52876E-009
95% of values less than 0.116536
99% of values less than 310.957

Minimum 0	Maximum 859.613	
Mean 7.26881	Std. Dev. 58.3265	Variance 3401.99

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 23.4575
95% of values less than 145.161
99% of values less than 305.145

Minimum 0	Maximum 517.143	
Mean 16.9927	Std. Dev. 60.2637	Variance 3631.71

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.26621E-012
90% of values less than 42.5606
95% of values less than 81.8271
99% of values less than 137.622

Minimum 0	Maximum 259.246	
Mean 11.3849	Std. Dev. 30.6965	Variance 942.273

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.00148671
90% of values less than 16.7699
95% of values less than 24.6684
99% of values less than 39.9996

Minimum 0	Maximum 83.0896	
Mean 4.38692	Std. Dev. 9.55196	Variance 91.24

Phase: Existing waste

Concentration of Ammoniacal_N at base of Vertical Pathway [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 3.95021E-009

90% of values less than 0.441069

95% of values less than 0.703685

99% of values less than 1.43942

Minimum 0	Maximum 2.19392	
Mean 0.107815	Std. Dev. 0.289703	Variance 0.0839279

Phase: Existing waste

Concentration of Chloride at base of Vertical Pathway [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 1100.43
95% of values less than 1850.01
99% of values less than 2651.97

Minimum 0	Maximum 4713.11	
Mean 259.097	Std. Dev. 627.648	Variance 393942

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 1.01348
90% of values less than 515.97
95% of values less than 690.579
99% of values less than 940.232

Minimum 0	Maximum 1309.53	
Mean 146.681	Std. Dev. 239.404	Variance 57314.1

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 3.56072
90% of values less than 208.922
95% of values less than 292.004
99% of values less than 418.64

Minimum 0	Maximum 631.235	
Mean 53.9517	Std. Dev. 102.681	Variance 10543.3

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.000167625
90% of values less than 43.9252
95% of values less than 65.8036
99% of values less than 96.3369

Minimum 0	Maximum 140.299	
Mean 9.78739	Std. Dev. 22.8395	Variance 521.645

Phase: Existing waste

Concentration of Chloride at base of Vertical Pathway [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 7.70462E-013

90% of values less than 3.9767E-009

95% of values less than 8.03216E-005

99% of values less than 0.0166743

Minimum 0	Maximum 1.57283	
Mean 0.00237641	Std. Dev. 0.0504596	Variance 0.00254617

Phase: Existing waste

Concentration of Ammoniacal_N at Phase Monitor Well [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 1.02081E-019
95% of values less than 2.0858E-008
99% of values less than 0.0731811

Minimum 0	Maximum 16.6833	
Mean 0.0249058	Std. Dev. 0.546261	Variance 0.298401

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0.00322741
95% of values less than 0.365601
99% of values less than 19.9332

Minimum 0	Maximum 70.1329	
Mean 0.634943	Std. Dev. 4.56404	Variance 20.8304

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0.27529
95% of values less than 2.40755
99% of values less than 19.4976

Minimum 0	Maximum 121.766	
Mean 0.793443	Std. Dev. 5.43832	Variance 29.5753

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 2.18764E-006
90% of values less than 0.19102
95% of values less than 1.27418
99% of values less than 9.66645

Minimum 0	Maximum 47.5472	
Mean 0.37281	Std. Dev. 2.25655	Variance 5.09202

Phase: Existing waste

Concentration of Ammoniacal_N at Phase Monitor Well [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 7.70156E-014

50% of values less than 7.71406E-010

90% of values less than 0.000262828

95% of values less than 0.00126869

99% of values less than 0.011342

Minimum 0 Maximum 0.0645728

Mean 0.000522745 Std. Dev. 0.00360003 Variance 1.29602E-005

Phase: Existing waste

Concentration of Chloride at Phase Monitor Well [mg/l]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 5.67766
95% of values less than 92.9432
99% of values less than 592.965

Minimum 0	Maximum 2271.81	
Mean 22.3132	Std. Dev. 130.856	Variance 17123.2

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.00016036
90% of values less than 16.9537
95% of values less than 49.6056
99% of values less than 261.405

Minimum 0	Maximum 1209.69	
Mean 12.1419	Std. Dev. 59.0583	Variance 3487.88

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0.00450185
90% of values less than 2.93433
95% of values less than 10.2225
99% of values less than 40.7425

Minimum 0	Maximum 91.1093	
Mean 1.9271	Std. Dev. 7.77281	Variance 60.4166

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 1.53129E-014
50% of values less than 2.49002E-006
90% of values less than 0.0616585
95% of values less than 0.273988
99% of values less than 2.09254

Minimum 0	Maximum 4.83767	
Mean 0.073654	Std. Dev. 0.395972	Variance 0.156794

Phase: Existing waste

Concentration of Chloride at Phase Monitor Well [mg/l]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 1.70093E-012

90% of values less than 1.47595E-009

95% of values less than 5.54286E-009

99% of values less than 2.45948E-006

Minimum 0	Maximum 0.000214099	
Mean 3.9817E-007	Std. Dev. 7.10435E-006	Variance 5.04718E-011

Phase: Existing waste

Approx. time to Peak Conc. Ammoniacal_N at Phase Monitor Well [years]

01% of values less than 43
05% of values less than 128
10% of values less than 232
50% of values less than 2499
90% of values less than 20000
95% of values less than 20000
99% of values less than 20000

Minimum 0	Maximum 20000	
Mean 5695.48	Std. Dev. 6684.96	Variance 4.46887E+007

Approx. time to Peak Conc. Chloride at Phase Monitor Well [years]

01% of values less than 11
05% of values less than 19
10% of values less than 32
50% of values less than 282
90% of values less than 2759
95% of values less than 4999
99% of values less than 12189

Minimum 10	Maximum 14859	
Mean 1018.93	Std. Dev. 2110.85	Variance 4.45568E+006

Phase: Existing waste

Flow to Leachate Treatment Plant [l/day]

At 30 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 100 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 300 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

At 1000 years

01% of values less than 0
05% of values less than 0
10% of values less than 0
50% of values less than 0
90% of values less than 0
95% of values less than 0
99% of values less than 0

Minimum 0	Maximum 0	
Mean 0	Std. Dev. 0	Variance 0

Phase: Existing waste

Flow to Leachate Treatment Plant [l/day]

At infinity

01% of values less than 0

05% of values less than 0

10% of values less than 0

50% of values less than 0

90% of values less than 0

95% of values less than 0

99% of values less than 0

Minimum 0 Maximum 0

Mean 0 Std. Dev. 0 Variance 0

Phase: Existing waste

Head on EBS [m]

At 1000 years

01% of values less than 3

05% of values less than 3

10% of values less than 3

50% of values less than 3

90% of values less than 3

95% of values less than 3

99% of values less than 3

Minimum 3	Maximum 3	
Mean 3	Std. Dev. 8.62736E-008	Variance -7.44314E-015

At infinity

01% of values less than 3

05% of values less than 3

10% of values less than 3

50% of values less than 3

90% of values less than 3

95% of values less than 3

99% of values less than 3

Minimum 3	Maximum 3	
Mean 3	Std. Dev. 8.62736E-008	Variance -7.44314E-015

Phase: Existing waste

Surface Breakout [l/day]

At 300 years

01% of values less than 25106.1
05% of values less than 34163
10% of values less than 37677.2
50% of values less than 40951.1
90% of values less than 41168
95% of values less than 41180
99% of values less than 41186.6

Minimum 20291.7	Maximum 41187.5	
Mean 39907.6	Std. Dev. 2828.67	Variance 8.00138E+006

At 1000 years

01% of values less than 25106.1
05% of values less than 34163
10% of values less than 37677.2
50% of values less than 40951.1
90% of values less than 41168
95% of values less than 41180
99% of values less than 41186.6

Minimum 20291.7	Maximum 41187.5	
Mean 39907.6	Std. Dev. 2828.67	Variance 8.00138E+006

At infinity

01% of values less than 25106.1
05% of values less than 34163
10% of values less than 37677.2
50% of values less than 40951.1
90% of values less than 41168
95% of values less than 41180
99% of values less than 41186.6

Minimum 20291.7	Maximum 41187.5	
Mean 39907.6	Std. Dev. 2828.67	Variance 8.00138E+006

Phase: Existing waste

Leakage through EBS [l/day]

At 100 years

01% of values less than 4.31614
05% of values less than 11.006
10% of values less than 22.9395
50% of values less than 239.856
90% of values less than 3513.72
95% of values less than 7027.98
99% of values less than 16084.9

Minimum 3.45703	Maximum 20899.3	
Mean 1283.33	Std. Dev. 2828.67	Variance 8.00138E+006

At 300 years

01% of values less than 4.31614
05% of values less than 11.006
10% of values less than 22.9395
50% of values less than 239.856
90% of values less than 3513.72
95% of values less than 7027.98
99% of values less than 16084.9

Minimum 3.45703	Maximum 20899.3	
Mean 1283.33	Std. Dev. 2828.67	Variance 8.00138E+006

At 1000 years

01% of values less than 4.31614
05% of values less than 11.006
10% of values less than 22.9395
50% of values less than 239.856
90% of values less than 3513.72
95% of values less than 7027.98
99% of values less than 16084.9

Minimum 3.45703	Maximum 20899.3	
Mean 1283.33	Std. Dev. 2828.67	Variance 8.00138E+006

At infinity

01% of values less than 4.31614
05% of values less than 11.006
10% of values less than 22.9395
50% of values less than 239.856
90% of values less than 3513.72
95% of values less than 7027.98
99% of values less than 16084.9

Minimum 3.45703	Maximum 20899.3	
Mean 1283.33	Std. Dev. 2828.67	Variance 8.00138E+006

Phase: Existing waste

Aquifer Flow [m³/year]

At 30 years

01% of values less than 592.961
05% of values less than 948.56
10% of values less than 1709.84
50% of values less than 89372.1
90% of values less than 5.2073E+006
95% of values less than 8.2004E+006
99% of values less than 1.26045E+007

Minimum 0	Maximum 1.47679E+007	
Mean 1.43593E+006	Std. Dev. 2.85678E+006	Variance 8.1612E+012

At 100 years

01% of values less than 592.961
05% of values less than 948.56
10% of values less than 1709.84
50% of values less than 89372.1
90% of values less than 5.2073E+006
95% of values less than 8.2004E+006
99% of values less than 1.26045E+007

Minimum 0	Maximum 1.47679E+007	
Mean 1.43593E+006	Std. Dev. 2.85678E+006	Variance 8.1612E+012

At 300 years

01% of values less than 592.961
05% of values less than 948.56
10% of values less than 1709.84
50% of values less than 89372.1
90% of values less than 5.2073E+006
95% of values less than 8.2004E+006
99% of values less than 1.26045E+007

Minimum 0	Maximum 1.47679E+007	
Mean 1.43593E+006	Std. Dev. 2.85678E+006	Variance 8.1612E+012

At 1000 years

01% of values less than 592.961
05% of values less than 948.56
10% of values less than 1709.84
50% of values less than 89372.1
90% of values less than 5.2073E+006
95% of values less than 8.2004E+006
99% of values less than 1.26045E+007

Minimum 0	Maximum 1.47679E+007	
Mean 1.43593E+006	Std. Dev. 2.85678E+006	Variance 8.1612E+012

Phase: Existing waste

Aquifer Flow [m³/year]

At infinity

01% of values less than 592.961

05% of values less than 948.56

10% of values less than 1709.84

50% of values less than 89372.1

90% of values less than 5.2073E+006

95% of values less than 8.2004E+006

99% of values less than 1.26045E+007

Minimum 0	Maximum 1.47679E+007	
Mean 1.43593E+006	Std. Dev. 2.85678E+006	Variance 8.1612E+012