



Land Quality Management Ltd

For: Defra

**SP1004 International Processes for
Identification and Remediation of
Contaminated Land**

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and Remediation of Contaminated Land**

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EXECUTIVE SUMMARY

Contaminated land is recognised to be a complex challenge usually requiring considerable time, significant expertise and substantial funds to define and tackle.

International convergence in policy reflects two decades of sharing experiences at various national, European and international fora, collaborative projects through the EU and the revolution in information dissemination brought about by national bodies embracing the internet as a means of communication. However, this means neither uniformity nor stasis.

Patterns of behaviour do emerge. Countries go through an exploration stage where funding is in plentiful supply, pioneering projects establish local reputations, inventories reveal the extent of impacted land and the process of dealing with the legacy of contamination gets under way.

Risk based approaches are widely adopted, though the foundational role of the conceptual model (ASTM, 2008; Environment Agency, 2004) and the legal context are not so widely appreciated. Many regimes have a narrative definition of contaminated land. There is little evidence that inspected sites deemed not to need remediation are causing harm to health or the environment. This suggests that regulators are making sensibly precautionary decisions. Problems do arise where there is reluctance or an inability to make a decision.

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1 INTRODUCTION

- (1) Mankind has left its chemical footprint across most of the planet (Naidu 2013). While we know much about many areas affected by contamination there are also large swathes of land where information is yet to be collected
- (2) Contamination is caused by the deliberate disposal or accidental release of toxic substances to the air, water or land. Such actions have resulted in deaths (e.g. Bhopal, India), diseases (e.g. Minamata, Japan) and significant adverse impacts on the environment and property. Many countries introduced new (e.g. UK and Poland) or amended existing (e.g. Japan) contaminated land legislation at the turn of the Millennium and 2010-2012 was a period of review and revision for many, including Australia, Taiwan and the UK.
- (3) There have been several reviews of national policy and legislation but this report attempts to investigate in further detail the workings and implementation of the policy in practice and the way that policy is perceived by those implementing it and those affected by it, including by having to pay. The research was conducted in the period 2010-2012 and cross checked with in country specialist contributors during 2012-2013. Consideration of mechanisms to prevent future contamination or deal with ancillary issues such as waste management and pollution prevention was outside the scope of this project unless they directly impinge on the management of contaminated land.

2 AIMS AND OBJECTIVES

(4) The aim of this project is to provide a summary of the approaches taken by specified countries to identify and remediate contaminated land and how the regimes work in practice, including funding sources.

(5) The countries considered in detail are the UK, Australia, Belgium, Canada, Czech Republic, France, Germany, Republic of Ireland, Italy, Japan, Netherlands, Poland, Spain and the USA. A detailed summary of each of these countries policy and practice is included in the appendices to this report. The discussion on the UK refers to the policy and practice in England unless otherwise stated.

(6) The specific objectives of the project are:

- a. To determine the boundary between “contaminated” and “not contaminated” land in each country under specific legal regimes. This will include resolving the role of number-based thresholds, the basis on which such thresholds operate and the role of devolving case-by-case decision making to a regulator
- b. To estimate the effectiveness of each country’s means of deciding what land is contaminated. This will involve assessing how proportionate, targeted, consistent and transparent the means are and how the country’s modus operandi is perceived internally and by external observers
- c. To determine each country’s estimate of the scale of the task facing it. This will include estimates of the amount of potentially contaminated land and of progress in the assessment, identification and remediation of land contamination, including the means of remediation employed
- d. To determine how countries decide on who pays including the implementation of ‘polluter pays’ (including the liability of state organisations), the liability associated with owning/occupying land, strategies for ‘orphan’ sites and the role of state funding
- e. To determine the size of the contaminated land sector in each country and what drives its activity

- f. To determine how financial liability for contaminated land is attributed and a measure of the success of the approach taken
- g. To determine how successful the regime is considered by those working within it; and
- h. To identify broad positives and negatives of the approach(es) taken within each country.

3 DEFINITION OF "CONTAMINATED" AND "NOT CONTAMINATED" LAND

(7) For the purposes of this report, the phrase ‘contaminated land’ is taken to mean land that requires remediation to deal with the undesirable presence of chemical substances in the land. Most legal definitions are narrative based and many recognise the subjectivity in decision making (Table 1).

(8) The boundary is sharply and identifiably defined in some countries but not in others. Many regimes differentiate between contaminated land and land affected by contamination (e.g. USA, UK, Australia). Although many adopt a ‘suitable for use approach’ some still aspire to multi-functionality. Complexity requires subsidiarity reasonable decisions (UK, Australia).

(9) Narrative definitions are common. In Flanders (Belgium) assessment criteria “correspond to the level of contaminating substances or organisms on or in the soil, allowing the soil to fulfil all its functions without the need for imposing any restrictions”. In the UK the boundary is where the possibility of significant harm or pollution becomes significant. Canada’s provinces have widely differing definitions (Table 1).

(10) The Dutch go further than many in specifying that a case of serious contamination exists if the average measured concentration of at least one substance in a soil volume of at least 25 m³ in the case of soil contamination, or a pore-saturated soil volume of at least 100 m³ in the case of groundwater contamination, is higher than the “intervention value”.

(11) Remediation is triggered by different criteria within some countries and among different legal regimes. Some regimes are asymmetric and require remediation if a certain level is (demonstrably) exceeded or only don’t require remediation if a certain level is (demonstrably) not exceeded. Some countries specifically exclude natural substances from the definition of contaminated, while others refer to exceedances of a background concentration. Most regimes considering historic contamination are based on a source-pathway-receptor pollutant linkage paradigm (UK, Germany, Ireland, Australia). Most regimes considering new contamination adopt more stringent approaches, often requiring source removal (UK, Flanders (Belgium), USA).

- (12) Uncertainty is endemic. Australia distinguishes between potential and actual contamination. The UK between significant and other possibilities of significant harm. Germany allows land to be “not contaminated”, “under suspicion of being contaminated” or “contaminated”.
- (13) The range of definitions for contaminated land/site between and within countries is evident from Table 1 with further detail provided in the country specific appendices.
- (14) To put the country information into context, Table 2 provides an overview of each of the study countries in terms of size, population and Gross Domestic Product (GDP).
- (15) Historic and new land contamination is considered in terms of its impact on the current and intended land use (Table 3) under different legal regimes.
- (16) In some countries the regimes differ internally (Table 4). The risk evaluation test can be asymmetric with a presumption that land does not require remediation unless it is clearly shown that it does (Table 4). Some countries explicitly deal with natural and man made contamination differently either in terms of risk assessment or liability apportionment or both (Table 4). Some regimes have specific dates which define when contamination is or is not considered under a specific regime (Table 5).

Table 1 Definitions of contaminated land/ site

COUNTRY	REGION	DEFINITION	REFERENCE
Australia Appendix 1	Tasmania	A site which has been sampled in accordance with best practice, demonstrating that the hazardous substances present pose significant risks to people, and/or the likelihood of significant adverse effects on environmental receptors.	http://tinyurl.com/nb5pvg5
Belgium Appendix 2	Flanders	Soil Contamination: “the presence – as a result of human activities – of substances or organisms on or in the soil or the buildings and structures erected on it, which adversely affect or may affect the quality of the soil either directly or indirectly” Severe soil contamination: “soil contamination which constitutes or may constitute a risk of adversely affecting man or the environment”	Decree on Soil Remediation and Soil Protection 2006
Canada Appendix 3	Non Statutory	[A site] at which substances occur at concentrations (1) above background (normally occurring) levels and pose or are likely to pose an immediate or long term hazard to human health or the environment, or (2) exceeding levels specified in policies and regulations.	http://www.tbs-sct.gc.ca/fcsi-rscf/home-accueil-eng.aspx
	British Columbia	an area of land in which the soil or any groundwater lying beneath it, or the water or the underlying sediment, contains (a) a hazardous waste, or (b) another prescribed substance in quantities or concentrations exceeding prescribed risk-based or numerical criteria or standards or conditions [set out in the Contaminated Sites Regulations made under the Act]	BC Environmental Management Act 2004
	Manitoba	soil, surface water or groundwater permeated or infused with a “any product, substance or organism that is foreign to or in excess of the natural constituents of the environment at the site and that (a) has affected, is affecting or may affect the natural, physical, chemical or biological quality of the environment, or (b) is, or is likely to be, injurious or damaging to the health or safety of a person.”	Contaminated Sites Remediation Act 1997
	Newfoundland and Labrador	where the minister is of the opinion that a substance that may cause, is causing or has caused an adverse effect is present in an area of the environment	Environmental Protection Act 2002
	Nova Scotia	A Minister may designate a site as contaminated if he or she is of the opinion that a substance that may cause, is causing or has caused an adverse effect is present in an area of the environment. The Minister shall follow standards, criteria or guidelines established by the Department	Environment Act 1994
	Prince Edward Island	A Minister may designate a site as contaminated after considering any relevant evidence, standards, criteria and regulations	Environmental Protection Act 1988
	Yukon	an area of land in which the soil, including any groundwater lying beneath it, or the water including the sediment and bed below it, contains a contaminant which is in an amount, concentration or level in excess of that prescribed by regulation or allowed under a permit. The Contaminated Sites Regulations 2012 further define contaminated sites based on land use and general numerical soil standards.	Environment Act 2002

COUNTRY	REGION	DEFINITION	REFERENCE
Czech Republic Appendix 4		<u>Contaminated site</u> means any soil, land, rock formation, building constructions, surface or groundwater contamination caused by the inappropriate or illegal management of hazardous wastes and/or chemicals (e.g. petroleum products, pesticides, PCBs, chlorinated and polyaromatic hydrocarbons, heavy metals etc.).... Unauthorized landfills, abandoned industrial places, agricultural factories and facilities, unprotected storage of hazardous wastes and chemicals, former military bases or any extracting, mining and quarrying mines areas might be considered as a contaminated site.	http://iris.env.cz/AIS/web-pub2-en.nsf/cz/contaminated_sites
France Appendix 5		No specific definition	-
Germany Appendix 6		Contaminated sites (Altlasten) are: a. closed-down waste management installations, and other real properties, in/on which waste has been treated, stored or landfilled (former waste disposal sites), and b. real properties that house closed-down installations, and other real properties, on which environmentally harmful substances have been handled, ... (former industrial sites), that cause harmful soil changes or other hazards for individuals or the general public. Harmful soil changes are harmful impacts on soil functions that are able to bring about hazards, considerable disadvantages or considerable nuisances for individuals or the general public. Excludes: former mining sites and military sites and active industrial facilities.	Soil Protection Act 1998 (As quoted by Common Forum)
Ireland Appendix 7		<u>No specific definition</u>	http://www.irishstatutebook.ie/home.html

COUNTRY	REGION	DEFINITION	REFERENCE
Italy Appendix 8		No specific definition	
Japan Appendix 9		No specific definition	
Netherlands Appendix 10		Contaminated site: site where the soil is contaminated or in danger of becoming contaminated in relation to territories that on account of said contamination, the cause of the consequences thereof are connected with each other in a technical, organisational or planning sense. Seriously contaminated site: site where the soil is, or there is a danger that it will be contaminated, so that the functional properties which the soil has for man, flora and fauna have been, or are in danger of being, seriously reduced (Soil Protection Act, section 1). Potentially contaminated site: an (industrial) activity that has taken place before the year 1987 and that might have led to contamination of the soil (source approach). Further investigation of the contamination in relation to the path and receptor (land use) is needed to define the site as contaminated or not.	Soil Protection Act (As quoted by Common Forum)
Poland Appendix 11		Land is regarded as contaminated when concentration of at least one substance exceeds the soil quality standards (OSQS, 2002). Exceedances by naturally occurring substance do not trigger corrective action.	Ordinance of the Ministry of Environment on Soil Quality Standards (OSQS) issued in 2002 pursuant to Article 105 of AEPA
Spain Appendix 12		Contaminated soil: soil whose characteristics have been negatively altered by the presence of man-made chemical components of a hazardous nature in concentrations that imply an unacceptable risk for human health or the environment, and that have been declared contaminated by express decision [of the Autonomous Community in whose area the land is situated].	Royal Decree 2005
UK Appendix 13		“any land which appears to the local authority in whose area the land is situated to be in such a condition, by reason of substances in, on or under the land, that (a) significant harm is being caused or there is a significant possibility of such harm being caused; or (b) significant pollution of controlled waters is being, or is likely to be, caused” ¹	Environmental Protection Act 1990 (as amended by the Water Act 2003)
USA Appendix 14		No specific definition for contaminated land or sites. A Superfund site is defined by the USEPA as an uncontrolled or abandoned place where hazardous waste is located, possibly affecting local ecosystems or people.	Comprehensive Environmental Response, Compensation and Liability Act 1980 (CERCLA)

Table 2 Profile of study countries

COUNTRY	Area ¹ (km ²)	Population ¹	GDP (PPP)		GINI ^{1, 2}
			Total ¹ USD Billions	Per capita ¹	
Australia	7,741,220	22, 015,576	\$960.7	\$38,100	30.5
Belgium	30,528	10,438,353	\$420.6	\$38,100	28
Canada	9,984,670	34,300,083	\$1,446	\$41,500	32.1
Czech R.	78,867	10,177,300	\$286.7	\$27,200	31
France	643,801	65,630,692	\$2,253	\$35,500	32.7
Germany	357,022	81,305,956	\$3,194	\$39,100	27
Ireland	70,273	44,722,028	\$191.5	\$41,700	33.9
Italy	301,340	61,261,254	\$1,843	\$30,000	31.9
Japan	377,915	127,368,088	\$4,617	\$36,200	37.6
Netherlands	41,543	16,730,632	\$709.5	\$42,300	30.9
Poland	312,685	38,415,284	\$802	\$21,000	34.2
Spain	505,370	47,042,984	\$1,407	\$30,400	32
UK	243,610	63,047,162	\$2,323	\$36,700	34
USA	9,826,675	313,847,465	\$15,670	\$49,8--	45.0

¹ Country statistics taken from CIA online factbook (<https://www.cia.gov/library/publications/the-world-factbook/>). GDP figures are 2012 estimates

² The GINI is an index of inequality of distribution of income or wealth with 0 indicating absolute equality and 100 total inequality; Sweden has a GINI score of 23 while Namibia has a score of 70.

Table 3 Typology of legal regimes

COUNTRY	On going land use		Change of land use		Other
	Historic contamination	New contamination	Historic contamination	New contamination	New contamination
Australia	National Environment Protection Council Act 1994, Act No. 126 of 1994 as amended up to Act No. 82 of 2003				Common law
Belgium	Soil Remediation Decree		Soil Remediation Decree		Civil law
Canada					Common law (not Quebec)
Czech Republic		Environmental Liability Act 2008			Civil law
France	Industrial Law Regime 1976 Waste law (Law No. 75-633 of 15 Jul 1975)				Civil law
Germany	Federal Soil Protection Act				Civil law
Ireland	-	-	-	-	Common law
Italy	Chap Four, Legislative Decree no. 152/06 (replaced Ministerial Decree 471/99)				Civil law
Japan.	Soil Contamination Countermeasures Act 2002 & 2010	Soil Contamination Countermeasures Act 2010			

COUNTRY	On going land use		Change of land use		Other
	Historic contamination	New contamination	Historic contamination	New contamination	New contamination
Netherlands	Soil Protection Act (mended 2009) – render Pre 1987 impacts suitable for use; Soil Quality Decree	Soil Protection Act – eliminate Post 1987 contamination or impairment as much as possible; Soil Quality Decree			Civil law
	Besluit Uniforme Saneringen (BUS): Uniform Remediations Decree				
Poland	Act on Environmental Protection Law (AEPA) 2001 Ordinance of the Ministry of Environment on Soil Quality Standards (OSQS)				Civil law
Spain	Royal Decree 2005	Royal Decree 2005			Civil law
UK	Part 2A EPA 1990	Environmental Damage Regulations	Planning regime	Planning regime PPC	Common law
USA	CERCLA; RCRA;	‘Brownfields’			Common law (not Louisiana)
EU*	Mining Waste Directive; Water Framework Directive; Groundwater Daughter Directive; (proposed) Soil Framework Directive	Environmental Liability Directive		Industrial Emissions Directive	-

*The EU usually legislates through Directives that are transposed into member states national legislation

Table 4 Geographies of contaminated land

COUNTRY	SPATIAL VARIATION	REGIME VARIATION	ASYMMETRY	REGULATE NATURAL	ABOVE BACKGROUND
Australia	Commonwealth and State specific	Yes		No	Yes
Belgium	Province	Yes			
Canada	Province	Yes			Yes
Czech Republic	National	No			
France	National	No			
Germany	Lander specific	Yes	Yes		Yes
Ireland	National	No			
Italy	National	No			
Japan.	National	No			
Netherlands	National	No			Yes
Poland		No			Yes
Spain	National and Regional	Yes		No	Yes
UK	Country specific	Yes	Yes	Yes	Yes
USA	Federal and varies by state	Yes			

Table 5 Key dates

COUNTRY	DATE	EVENT
Australia	-	
Belgium	-	
Canada	1998, 1 April	Sites sold or remediated before this date do not require a full entry on the Federal Contaminated Sites Inventory (FCSI).
Czech Republic		
France	30 years	Site operators liable for remediation up to 30 years after formal notification of site closure
	30 April 2007	Earlier damage not covered by Law no. 2008-757 implementing the EU ELD
Germany	-	
Ireland	-	
Italy	-	
Japan	-	
Netherlands	-	
Poland	Contamination predates 1980, 1 September	Owners obligations limited to preclude any threat to life or health, risk of further contamination, or possibility of spreading the present contamination
	2004, 30 June	Cut off for reporting soil damage to local authorities
	2005, 1 January	Expiry of ordinance setting limit values for groundwater quality issued on 11 February 2004
Spain	-	
UK	2009, 1 March	Harm after this date is caught under the Environmental Damages Regulations 2009
USA		

3.1 Number-based thresholds

(17) Since the UK published the first set of numerical contaminant thresholds in the late 1970s many countries and jurisdictions have developed numerical generic assessment criteria to speed up and improve consistency in the process of risk evaluation. Some such values have legal authority, while others are advisory or optional. The response to an exceedance of a threshold may be more detailed investigation to refine the risk estimate or action to reduce contaminant or risk levels. In most countries such values are published or sponsored by state bodies however the UK has also seen, not without some initial controversy, sector-led initiatives in developing policy-compliant generic assessment criteria for wide use e.g. LQM/CIEH and the EIC/AGS/CLAIRE Generic Assessment Criteria (CL:AIRE *et al.*, 2010; Nathanail *et al.*, 2007; Nathanail *et al.*, 2009).

(18) A summary of the assessment criteria and their status in the study countries is provided in Table 6. All are discussed in more detail in the country specific appendices.

(19) Generic criteria usually reflect low, minimal or no appreciable levels of risk (UK, Canada and Australia). Many recognise the toxicological difference between threshold and non-threshold behaviour. Most countries consider non threshold carcinogenicity on the basis of the excess lifetime cancer risk resulting from exposure to the contaminant(s). The UK rejects such an approach in the absence of human epidemiology data.

Table 6 Assessment criteria for human health

COUNTRY	SPATIAL VARIATION	STATUTORY	SCREENING	ACTION	EXAMPLES OF ASSESSMENT CRITERIA (no. of substances)
Australia Appendix 1	No	No	Investigation level	Response level	HIL
Belgium Appendix 2	Yes	Yes	Yes	Yes	Background target levels for Soil and Groundwater Quality; Soil Remediation Targets
Canada Appendix 3	By Province	Yes (some Provinces)	Yes (some Provinces)	Yes (some Provinces)	CCME EQL
Czech Republic Appendix 4	No	-	-	-	Use Dutch values
France Appendix 5	-	-	-	-	Not relevant
Germany Appendix 6	No	Yes	Yes	Yes	Action, Trigger and Precaution levels
Ireland Appendix 7	-	-	-	-	Use UK or Dutch values
Italy Appendix 8	No	No longer	Yes	Site specific Risk Threshold Concentrations	Contaminant Threshold Concentrations
Japan Appendix 9	No	No	Yes (if no likelihood of risk to human health)	Yes (if likelihood of risk to human health)	Environmental Quality Standards for Soil Pollution; (25)
Netherlands Appendix 10	With soil type (default 10% organic matter; 25% clay)	Yes	Soil Quality Decree criteria	Intervention values	Soil Quality Decree criteria; Soil Remediation Target and Intervention Values (100+)
Poland Appendix 11	No	Yes		Yes	Soil Quality Standards (SQS)
Spain Appendix 12	No	Yes	Yes	No	Generic Values of Reference (60 - excluding metals)
	Yes		Yes	No	Metals - trigger values set by relevant Autonomous Communities
UK Appendix 13	No (Scotland reviewing its use of SGVs)	No	GAC (including SGVs)	No	Soil Guideline Values (11); LQM/CIEH Generic Assessment Criteria (82); EIC Generic Assessment Criteria (35); draft C4SL (6)
USA Appendix 14	Yes by state				US EPA Soil Screening Levels; Regions 3, 6 & 9 Regional Screening Levels.

(20) Generic values reflect various exposure scenarios and site circumstances. The CCME (Canada) values are published for both coarse and fine textured soils. The LQM/CIEH GAC

(Nathanail *et al.*, 2009) for organic contaminants are calculated for 3 soil organic matter contents (UK).

(21) Additivity is routinely considered for related substances such as petroleum hydrocarbon fractions (USA, UK and Australia) or dioxins (UK). In Italy, a maximum Excess Lifetime Cancer Risk (ELCR) of 10^{-6} for a single or 10^{-5} for multiple carcinogens is permitted. Canada takes the concept further with the Soil Quality Index (SoQI) which combines the ratio of contaminant concentration to assessment criterion for several contaminants.

(22) Having initially rejected the concept of screening values, the USA now has Federal values that inform regional and state values. Some regions publish online tools to incorporate site specific parameters (e.g. [US EPA Region 3, 6 & 9](#)).

(23) Italy's former statutory Limit Values (Appendix 8) were criticised as being too rigid. They are now treated as Contaminant Threshold Concentrations (CSCs) above which site specific risk assessment is based on Risk Threshold Concentration (CSRs) that reflect the maximum allowable soil concentration that results in an acceptable risk to human health. The basis was unclear for both Italian Limit Values and Japan's Environmental Quality Standards. British Columbia (Canada) defines numerical thresholds for specific substances. Other countries encourage site specific factors to be used to derive site specific assessment criteria where generic criteria are exceeded (UK, Canada). France, having abandoned its 'Fixed impact values' for soil, has decided that default exposure scenarios are not helpful and a case by case evaluation is being followed. France does have values for some contaminants in water that are based on exceedances of natural background.

(24) Australia's National Environment Protection Measure (NEPM) proposes land use specific investigation and response levels of contaminants for human health and the environment. However, no human health response levels have been developed.

(25) The (now withdrawn) UK ICRL thresholds (ICRL, 1987) also had two tiers and a largely unpopulated set of action values. More recent generic assessment criteria are intended to be used as screening levels whose exceedance should normally trigger a detailed quantitative risk assessment.

(26) Germany has different responses to the exceedance of three thresholds:

- Action (remediation needed; should reflect contaminant bioavailability),
- Trigger (further assessment needed to determine if site is contaminated) and
- Precaution (elevated concentration which may be important for soil protection).

(27) Flanders (Belgium) has strict numerical standards that allow “the soil to fulfil all its functions without the need for imposing any restrictions” for new, but not for historic, contamination. They represent “the level of contaminating substances or organisms found as normal background level on and in non-contaminated soils with comparable soil characteristics”. They are to be achieved ‘as much as possible’. Remediation levels represent “considerable risk of harmful effects for man or the environment, taking into account the characteristics of the soil and the functions it fulfils”. If they are exceeded, investigation and, eventually, remediation is triggered.

(28) Water quality is usually evaluated on the basis of drinking water or water body specific environmental quality standards. Assessment criteria for ecological effects have been developed (e.g. UK and Australia) but their extremely low values have rendered them virtually useless. The effects of chloride, pH and sulphate on construction materials has long been recognised and relevant numerical thresholds are incorporated in building guidance.

4 EFFECTIVENESS OF EACH COUNTRY'S MEANS OF DECIDING WHAT LAND IS CONTAMINATED

4.1 Risk based approach

(29) There is wide but not universal consensus around a risk based approach to tackling the legacy of contaminated land (e.g. Australia, Canada, UK). However, many jurisdictions adopt different approaches to human health and water protection (e.g. Australia, Italy, UK).

(30) The phased approach of desk study/ walkover, intrusive investigation, risk assessment and remediation adopted in the UK can be seen in many other countries (Germany, Australia, Ireland, USA). The conceptual site model (ASTM, 2008; Environment Agency, 2004) is central to several national approaches (e.g. UK, USA, Australia). This has been helped by guidance from ASTM (ASTM, 2008) and bespoke conceptual modelling software (e.g. KeyCSM).

(31) Some countries (e.g. Ireland), usually as an interim measure, *de facto* adopt other national approaches in the absence of their own. Others (e.g. USA, Germany) do not seem to (obviously) borrow from abroad. Some actively seek to promote their own approach in other countries (e.g. the long standing US EPA outreach at Consoil (now AquaConsoil) and the publication in English of much technical guidance by Flanders and the Netherlands).

(32) The easy, but expensive, option of adopting screening criteria as clean up (source removal) targets is seen in Australia and has also been an issue in the UK, where the purpose of the assessment criteria was not always fully understood. Poland does not allow for site specific assessment criteria.

(33) Dutch narrative as discussed in detail in Appendix 10 indicates ‘urgent’ remediation is needed if adverse chronic or acute impacts on health may occur or if nuisances such as skin irritation or smells are occurring.

(34) Spain has extra rules to control the derivation of site specific assessment criteria. The “Reduction Principle” limits screening values for synthetic substances to 100 mg/kg soil. The “Contiguity Rule” limits the Generic Values of Reference (GVR) for urban soils to no more than ten times that for “natural areas”, and the GVR for industrial soils to no more than ten

times the GVRs for urban soils. The “Limit of Detection Rule” allows screening values to be set at the limit of detection of the analytical technique.

4.2 Budgets

(35) National budgets for publically funded remediation range from the non-existent to the substantial. Funds have come from general expenditure, regeneration budgets, EU structural funds, hypothecated (ring-fenced) taxes, hypothecating revenue from privatisations or bespoke grant schemes. Funds can usually be found for dealing with the aftermath of disasters or major incidents.

(36) The USA Superfund accumulated funds through a tax on petroleum and chemical industries to pay for remediation of orphan sites, that is sites where the potentially responsible parties cannot be identified or located or when they fail to act. The tax ended in 1995 and the funds were spent by 2003. Federal funds are allocated for work on National Priorities List sites. Suggestions that the President of the United States may restore the tax in 2011 with potential revenue of \$1B proved unfounded. The federal sequestration of funds is likely to result in a marked reduction in spending during 2013 from the 2012 level of \$1.2B USD. However in May 2013, the acting Administrator of the US EPA asked for some 1.39B USD for clean up during the financial year 2013-14.

(37) Proceeds of an environmental levy on plastic bags and on landfilling waste (some €100M 2002-2008) were paid into Ireland’s Environment Fund. The Fund was then used to pay for waste (e.g. recycling) and other environmental initiatives. Some €30M is being spent on remediation of the orphan Kerdiffstown landfill (Ireland).

(38) CzechInvest (the investment and business development agency of the Czech Republic) received the proceeds from selling off nationalised industries and now offers financing assistance to private companies interested in brownfield sites of up to 100% of demolition or remediation costs.

(39) Central government supplementary credit approval and later grants allowed English Local Authorities to inspect potentially contaminated land and to remediate orphan sites or sites for which the local authorities were responsible (either as the polluter and/or site owner/occupier).

(40) Funding limitations and the absence of specific EU legislation means some countries (e.g. Poland) do not have a national programme of tackling land contamination issues. A piecemeal approach influenced by project fund availability or opportunities for redevelopment seems to be the main driver rather than any targeted strategy.

Table 7 National expenditure

COUNTRY	DATA SOURCE	EXPENDITURE ¹
Australia		
Belgium		
Canada	FCSAP report for 2007-8	276 remediation / risk management projects, and 590 assessment projects
	FCSAP 2007	Liability £2billion for 2630 sites
	FCSAP March 31, 2008	liability of £2.22 billion for approximately 2360 contaminated sites,
	Quebec	£390million for 450 suspect sites (2006)
	Orphan mine sites 2002-08	£0.83 billion
Czech Republic	CzechInvest	
France	State funds 7% of total expenditure	
Germany		Lignite mine rehabilitation and groundwater remediation to 2007 ca. £6.8billion 2008-2012 £0.9 billion
Ireland		£26million for Kerdiffstown landfill, Co. Kildare
		Environment Fund 2011 reserves £29million; income £57million
Italy		
Japan.		
Netherlands		
Poland		
Spain		1 st National Plan £ 130million 2 nd National Plan £8.9million spent in 2004
UK	Redevelopment	£200million– £1billion/ year
	Part 2A	Defra/EA contaminated land grant £10-17million/ year 2000-2010 £4.35m 2012/13
USA	Superfund	£1.1billion collected by 1995; all monies spent by 2003 £800M in 2012
	Brownfields	
	Stimulus funds	£400million

¹ for comparison purposes all revenue converted to GB Pounds using the following conversion rates
1.00GBP = 1.5USD; 1.00GBP = 1.15Euro and 1.00GBP = 1.5CAD (Canadian Dollars)

4.3 Auditors and accreditation

(41) Australia uses accredited auditors to endorse and sign off remediation work and identify any outstanding actions that might be necessary. This is similar to the Massachusetts Licensed Site Professional (LSP) system that is licensed and regulated by the independent Board of Registration of Hazardous Waste Site Cleanup Professionals. Other US states and some Canadian Provinces also have accredited auditor schemes. The nearest UK equivalents

are those on the Specialist in Land Condition register though, at the time of writing, no legal regime requires SiLC approval. However, some public and private organisations are requiring SiLC sign off as part of their procurement process.

(42) In the USA, accreditation is on a State basis reflecting the size and heterogeneity of the country. Calls for a national accreditation scheme within Spain may be more reasonable, but politically less acceptable, than accreditation by Autonomous Regions. The Dutch ‘Kwalibo’ (Soil Quality Decree) scheme accredits companies and in 2009 two lost their accreditation.

(43) Accreditation is likely to grow with initiatives in Spain, within the Basque Country and the formation of the SiLC Register (UK). In England both national policy (CLG 2012) and national standards (BSI 2013) require site investigations to be carried out by competent professionals.

4.4 Epistemology

(44) The discussion on how to determine the toxicological basis for human health risk assessment illustrates the influence of epistemic uncertainty highlighted by Greenleaves III (Defra 2011). Issues include inter-jurisdiction policy differences, intra-jurisdiction legislative differences, scientific differences of opinion and, rarely, attempts to bias the scientific literature.

(45) The US EPA consultation on proposed changes to the classification of oral carcinogenicity of hexavalent chromium (USEPA, 2010) followed the retraction of a key peer review paper.

(46) The absence of any recognition of the impact of spatial correlation in non-governmental UK guidance on statistical assessment of contaminant concentrations raise significant issues of epistemology in this multi-disciplinary sector.

(47) Various attempts of cross-border harmonisation have been attempted with varying degrees of both impact and success across Europe and within larger countries e.g. Canada. While there is widespread agreement that ‘science’ aspects should be applicable across borders, there is a difference in opinion on how that ‘science’ should be used in risk assessment. International convergence is both desired by some, sought out by initiatives such

as HERACLES and happening by the adoption of one country's practice in another. For example, the UK adopts the US EPA's approach to vapour modelling, while Ireland is in the process of adopting the CLR 11 procedure (Environment Agency, 2004). The transition from paper to PDF publishing made national documents more widely accessible. Regularly updated online databases such as the US EPA IRIS encourage the use of current information instead of dated national guidance (such as the Environment Agency 2002-vintage TOX reports). A move away from report based publishing to a 'wiki' format may be one way of public and private sectors to provide access to up to date definitive information (Nathanail 2013).

4.5 Interaction with other regimes

(48) Interaction between contaminated land and other regimes (Figure 2) has created concerns in several countries due to either duplication of regulatory control or inconsistency among regulators or within regulators across a country.

(49) Australia, in common with many European countries, regulates excavated contaminated soil through its waste management regime. EU legislation was eventually passed to confirm that unexcavated contaminated soil was not waste. In the UK the issue was eventually resolved through an industry code of practice developed under the auspices of CL:AIRE (2011).

(50) Failure to implement regimes can cause problems. For example Ireland had to retrospectively investigate and in some cases remediate closed unlicensed landfills after failing to implement EU legislation over a period of two decades and both [Greece and France faced daily fines for landfill related pollution incidents at Chania \(Crete\) and over failing to adopt measures to effectively combat nitrates pollution in nitrate vulnerable zones.](#)

(51) Integrated land management combining remediation, reclamation, refurbishment and redevelopment has been a success in terms of regenerating former industrial sites (O₂ Arena, London; Dublin Docklands, Ireland; former Bourne Chemicals Site NJ, USA). Alberta, Canada is moving to an integrated land use planning regime. In the UK, England has coalesced almost thirty planning policy statements into a single all-encompassing document (CLG 2012). The US EPA is promoting the redevelopment potential of superfund sites.

(52) EU legislation (e.g. IPPC, Water Framework and Waste Framework Directives) has resulted in pollution prevention getting a high priority while the need for regeneration after structural changes has given redevelopment-driven remediation an impetus (e.g. in Ireland).

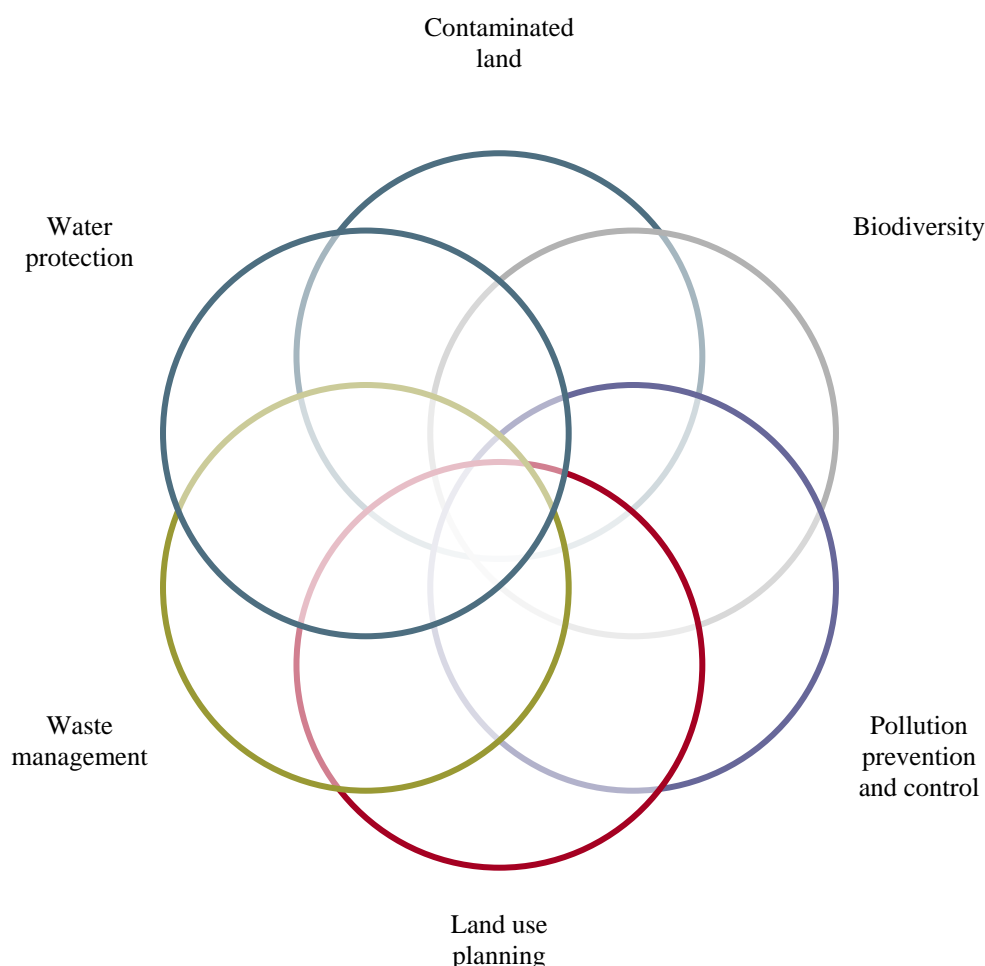


Figure 1 Interacting Legal Regimes

4.6 Proportionate

(53) The extent to which national efforts are proportionate must be seen through the lens of history and what was known, possible and acceptable at the time decisions were taken.

(54) The USA Superfund allowed, and perhaps even encouraged, seemingly disproportionately expensive remediation in the first two decades of its operation – some of which is still on going. More recently Potentially Responsible Parties (PRPs) and others have sought to improve efficiency with projects to optimise monitoring programmes and avoid the

need for up front construction of fall back remediation schemes. Since the early 1990s Superfund sites have been increasingly seen as opportunities for redevelopment rather than liabilities and remediation efforts have shifted to brownfield sites where practices are similar to those adopted in the UK. This journey reflects the USA's global history of leading in technology and policy development. Breaking new ground is wisely done cautiously and others following on can learn and improve.

(55) Early Dutch and German policies of remediation to multi-functional reuse standards were eventually found to be unaffordable and the more pragmatic suitable for use approach implemented in the UK since the 1970s has since been implemented, at least in principle, in many other countries.

(56) The Dutch regularly update their policy. Key transitions have been from multi-functionality to suitable for use in the mid-1990s and most recently to a holistic land management approach. Their small country on the edge of the Rhine delta features shallow groundwater, unconsolidated soils and a legacy influx of pollution from its upstream neighbour, Germany. Reuse of soil and protection of water resources are essential for Dutch viability and benefit from a pragmatic and flexible decision making culture involving both private and public sector. The national approach to achieving the 2015 target of dealing with 'urgent sites' was endorsed by a national cost-benefit analysis while recognising it would leave many other 'unacceptable risk' sites unremediated for some time (see Appendix 10).

(57) Spain's decontamination narrative has echoes of multi-functionality as it requires a guarantee that any remaining contamination translates into acceptable risk levels in relation to current land use and anticipated future uses.

(58) The one size fits all approach adopted in Japan in 2002 was welcome for its simplicity but recognised to result in unnecessary remediation and diversion of funds from other environmental conservation issues. The April 2010 amendments to the Soil Contamination Countermeasures Act (see Appendix 9) failed however to adequately define what constitutes acceptable or unacceptable levels of risk so the situation has not been resolved. While some countries have attempted numerical definitions of acceptable risk (e.g. Netherlands) others have rejected them and adopted a narrative approach (e.g. UK and at least in theory the USA).

(59) In some cases the No Further Action (NFA) letters are issued by regulators or certified professionals. For example under Ohio's USA Voluntary Action Program (VAP) a certified

professional issues a NFA letter that: describes the environmental problems found at a property, how those environmental problems were investigated and how the property was cleaned up (sic). As the Ohio EPA points out, the NFA “letter” is actually a thick document full of very detailed information about the property. Illinois issues No Further Remediation letters that acknowledge a site owner or operator has satisfied the relevant legal requirements.

(60) Developer reluctance to allow for very low or even perceived residual liability associated with remaining low levels of contaminants has resulted in excavation and offsite disposal being adopted in place of process based treatment technologies. Overcoming the reluctance of regulators to give what the US EPA refer to as ‘no further action’ letters in many domains, including the UK, would encourage process based, human resource intensive remediation and save landfill void space and carbon footprint. Such a formal statement that regulatory concerns have been addressed to the point of satisfaction would increase developer confidence.

4.7 Targeted

(61) Attention to historic contamination has been more variable. Some regimes are targeted at specific historic land uses (e.g. Germany’s Soil Protection Act) or only seek to protect a specific range of receptors (e.g. UK Part 2A). Others rely on public health statutes (e.g. Ireland) and still others argue for the provision of the proposed Soil Framework Directive.

(62) The Dutch focus on urgent sites requiring their remediation to begin within 4 years of determination (Appendix 10).

4.8 Consistency

(63) Consistency, or rather a lack of it, in practice and regulation is a concern in many countries. However Flanders (Belgium) considers ‘flexibility’ a strength of its regime. The central role of a single regulator – OVAM – is seen as contributing to the success of the Flemish regime.

(64) Defra recognises that reasonable but diametrically opposite decisions can be taken on the same site circumstances (Defra, 2012). However, Defra has maintained both the plurality of regulators and the centrality of the local authority in investigating and determining

contaminated land despite increasing recognition of the multi-disciplinary complexities involved.

(65) The Dutch national regime is implemented by local regulators at provincial level. This means that it may not always be implemented in the same way. Local non-enforcement of remediation criteria has led to suspicions of ‘soil remediation crimes’.

(66) The Czech Republic recognised socially acceptable levels of residual environmental and health risks and that attaining “zero risk” through total elimination of contamination would likely incur remediation costs disproportionate to the environmental and health benefits. At the Karolina site (Ostrava) remediation criteria were set at an Incremental Lifetime Cancer Risk (ILCR) 1 in 10,000 or a Hazard Quotient (HQ) of 1. Despite cost-benefit analysis showing costs for remediation to below 1:1,000,000 would be disproportionately high, remediation involved source removal by excavation and offsite disposal.

(67) Ireland’s reliance on Dutch and UK assessment criteria has led to inconsistency in the values adopted on different sites and even the proposal of values withdrawn in the originating countries (such as the UK ICRCL values or the Dutch ABC values). This was also the case in the UK in the absence of Environment Agency SGVs for the common contaminants and was only resolved, with the exception of lead, by the publication of the LQM/ CIEH GAC in 2006 and 2009 (Nathanail *et al.*, 2007; Nathanail *et al.*, 2009).

(68) Larger countries demonstrate greater variation in practice across their regions (e.g. Spain, Canada). In Spain, differences include how generic soil quality values are used and generated with only a few of the autonomous regions having developed generic values for metals, and how site specific risk assessment is carried out, including for example the consideration of background concentrations of contaminants. This in turn may lead to higher or lower remediation costs for similar sites across the regions. The Canadian provinces have different definitions of what constitutes contaminated land. Although the Canadian Council of Ministers of the Environment (CCME) have developed nationally consistent environmental guidelines and standards these are not always implemented in full across the provinces (Appendix 3). Within the UK, following the publication of new statutory guidance in England and in Wales, Scotland now has a different definition of what constitutes a significant

possibility of significant harm to human health to that in England and Wales while Northern Ireland has yet to implement its contaminated land regime.

(69) Across all the countries studied, soil excavation and offsite (pre)treatment/ disposal was the most significant form of remediation by volume.

4.9 Transparency

(70) Transparency in guidance has increased dramatically with the virtually ubiquitous release of official documents on the internet. However changes in the internal structure of a website and indeed the wholesale change of institutional domain names do mean that links to key documents quickly go out of date.

(71) The cost of accessing even simple information such as the UK DoE Industry Profiles, which provide a summary of the processes, materials and wastes associated with individual industries is effectively zero compared to £10 for each of the 47 profiles when they were published in 1995 ([Environment Agency - DoE Industry Profiles](#)). While generic search engines have increased retrieval of guidance documents, the sector specific EUGRIS stands out as an effective but currently volunteer-supported and therefore variably updated resource for the entire European community, while the US EPA uses several, well resourced, web sites to achieve similar ends for its community including [Superfund](#), [Integrated Risk Information System \(IRIS\)](#) and [Remediation Technologies](#).

(72) In Australia, the widely lauded use of independent auditors is seen to have helped transparency as well as transferring costs to the private sector. Flanders experience of only allowing accredited consultants to design and verify remediation is also seen as helpful.

(73) The publication in 2008 of the Czech SEKM (Contaminated Sites Database System) publically accessible online GIS-linked database of contaminated site information dispelled any perceptions of secrecy in the immediate post-socialist period.

(74) The joint German-Dutch organised Consoil conferences have fostered a greater willingness to publish case studies. EU funded initiatives, notably EuroDEMO, have also helped share often publically funded experiences across a wider audience. In England, access to Defra/EA funded site specific risk assessments and remediation validation reports is possible. Environment Agency staff also provide summaries from time to time at conferences

and workshops. The EA produces an annual outcomes report with some case studies (e.g. Environment Agency 2012). The Expert Panel on Contaminated Land set up by Defra in late 2012 to provide advice to local authorities in England and Wales will publish case studies of sites it has considered.

(75) Countries where site specific documents are not automatically put into the public sphere (as they are in the USA and Germany) suffer from a lack of transparency of how decisions were reached, particularly in cases where local issues have necessitated deviation from national standards. The proposed requirement for lay summaries of decisions under Part 2A in England and Wales is a step in the direction of full disclosure of all local authority information collected under Part 2A.

(76) ‘Duty of care’ and ‘consignment notes’ are routine for waste in the UK. Quebec also requires the regulator be informed of the destination of soil.

4.10 Disclosure vs. notification

(77) Proactive regimes require a nominated organisation to actively seek out sites that fall within a legal definition. Reactive regimes require the discovery of contamination to be reported and the regulator to consider the response to that disclosure.

(78) New contamination is reportable under many regimes (e.g. Canada; Dutch for ‘serious contamination’).

(79) The UK’s Part 2A regime is proactive and since 2000 local authorities have inspected ca. 1000 sites with central government funding through either supplementary credit approval or grants. However many more sites are considered under the land use planning system as developers provide local planning authorities with evidence that sites are – or have been remediated to be – safe and suitable for their intended use. Dutch public sector spending is estimated at some £160M to £200M (200M to 250M euros) to their competent authorities (Appendix 10) compared to ca. £10M (2011) falling to £2M (2013) available through the Environment Agency contaminated land grant scheme for local authorities in England (Scotland and Wales have ended their schemes). Closure of manufacturing facilities triggers regulatory attention in Japan. This was recently widened to include land use changes.

(80) Australia's New South Wales, Capital Territory, Victoria and Queensland require disclosure. Some states have modified the caveat emptor principle to require disclosure to potential buyers. In comparison the UK considers seller permission to investigate to constitute having access to the findings of such investigation. Flanders (Belgium) uses transfer of ownership where potentially contaminative processes were likely to have occurred as the trigger to consider land contamination despite the recognition that this can be a slow process and delay land sales. To mitigate this, buyer-seller agreements to transfer responsibility for remediation have been introduced. Transfer of ownership has also been proposed as the trigger under the proposed EU Soil Framework Directive.

(81) Where sale or transfer of land is involved two opposing approaches have been adopted throughout the study countries. In the UK the onus is on the buyer to establish the condition of the land (*caveat emptor*), whereas in the Netherlands the seller has to deliver land fit for the intended use or agree on transfers of liability. Polish landowners had a duty to report soil damage to Local Authorities by 30 June 2004. The 2001 Act on Environmental Protection Law (AEPA) also imposed a duty for counties to maintain a register of contaminated land to be updated on an annual basis, however no guidance was produced on how this was to be done hence the implementation has not been consistent (Appendix 11).

4.11 Skills and guidance

(82) Canada reported skills shortages among both regulators and service providers. Similar concerns were expressed in the UK, however the economic downturn and an upsurge in training seem to have resolved the quantity, if not the quality, issue.

(83) Implementation of Italy's recently replaced regime was hindered by regulatory bodies who felt they lacked appropriate skills and guidance. However until the Agency for Environmental Protection (APAT) provided guidance the risk based approach was also resisted due to its perceived 'difficulty'. Spain's Basque region reported the scale of the problem was more than regulator staff could deal with.

(84) Flanders requires investigation and remediation to be carried out by licensed experts. In an OVAM survey Flanders' Licensed Experts system is deemed 'optimal' by 30% and bad by 20% of problem holders. In the UK, there is no such centrally mandated system. Membership of the SiLC Register (www.silc.org.uk), set up by the core professional bodies, is, however, used by some organisations as an indicator of competency.

(85) Sometimes guidance can fail to keep up with legislation (e.g. Spain) or simply be out of date (e.g. UK definitive guidance on toxicology is not updated frequently enough to keep up to date with scientific advances). Occasionally guidance can be misleadingly silent on key issues (e.g. the CL:AIRE/CIEH statistics guidance does not cover spatial correlation). By being too generic, for example by not reflecting relevant soil conditions, it can fail to prevent unnecessary detailed risk assessment (e.g. UK, Spain).

5 PRACTICE

(86) Many countries have learnt from specific incidents (Table 8). The following text discusses national practices in specific activities or former contaminative uses. Gasworks, mines, landfill, military land and megasites form a useful means of comparing practice on similar issues in different countries. Many countries have created inventories of land affected by contamination and adopted monitored natural attenuation – thereby allowing the implementation to be compared. Vapour intrusion into buildings is widely recognised but approached differently in different countries. Finally brownfield sites are both defined and managed differently.

Table 8 Legal consequence of contaminated land incidents

COUNTRY	Incident	What happened	LEGISLATIVE IMPACT
Australia			
Belgium	Van der Walle	Fuel contaminated in situ soil deemed to be waste	EU Directive modified
Canada			
Czech Republic			
France			
Germany			
Ireland			Retrospective legislation
Italy	Seveso	industrial accident (1976)	Seveso II (Council Directive 96/82/EC); UK Control of Major Accident Hazards Regulations (COMAH)
Japan	Minamata	Mercury poisoning	Minamata Convention 2013
Netherlands	Lekkerkerk	Village built on former hazardous waste landfill	Triggered Interim Soil Remediation Act 1981
Poland			
Spain	Aznalcóllar mine, 1998	Failure of tailings dam	
UK	Loscoe	Explosion of landfill gas in residence	
	Abbeystead	Explosion of natural methane in underground valve house; 16 fatalities	
	Bontddu North Wales	Rapid combustion of hydrocarbon vapours during site investigation of a house	Prosecution of consultants by HSE
USA	Love Canal	Housing and school above hazardous waste landfill	Triggered Comprehensive Environmental Response, Compensation, and Liability Act 1980 (CERCLA) (aka SuperFund)

5.1 Inventories

(87) Inventories of contaminated land or sites are expensive to compile and difficult to ensure their accuracy without clear definitions and consistent methodology.

(88) The UK repealed s143 of the EPA 1990 as the proposed register of potentially contaminated land was deemed, largely by property industry stakeholders, likely to cause undue and unfairly widespread blight. The proposed EU Soil Framework Directive contains

provisions for a register of potentially contaminated sites, with various criteria for inclusion having been proposed at different times. Elsewhere however such inventories have been developed.

(89) The Dutch inventory cost £87M (€100M) and suggested there were an order of magnitude fewer ‘urgent’ or ‘serious’ sites than two other studies. A cautious estimate of £10,000 by each of 380 British Local Authorities suggests some £3.8M was spent prioritising sites for Part 2A. Inadequate guidance meant LAs adopted different approaches. This type of inconsistent approach as a result of inadequate guidance was also encountered by Polish Counties.

(90) Tasmania’s register (Australia, Appendix 1) includes those sites where one of 53 land uses on the Hazardous Activities and Industries List (HAIL) has taken place; access is free. The location of most Dutch (potentially) contaminated sites is freely available online (www.bodemloket.nl).

(91) In 2009, Italy’s National Priority List contained only 57 sites but these collectively covered more than 3% of Italian territory (including 330,000 ha of marine environment).

(92) CzechInvest maintains a database of some 10,000 brownfields to attract foreign investment and encourage growth in the Czech private sector. Ostensibly more akin to the UK National Land Use Database (NLUD) of previously developed land yet in practice most CzechInvest sites have a potentially contaminating history, which is not the case for sites on NLUD.

(93) Spain’s 2005 Royal Decree is also selective in which activities it includes: for example excluding waste disposal, and both coal and metal mining. Going one step further, Spain records soil assessments within the Land Registry, something akin to the UK’s Urban Task Force suggestions of a land condition ‘passport’ (Urban Task Force, 2005). Spain had two rounds of inventory in 1990 and again in 1994-5. Its recent submissions to the EEA EIONET system showed an increase between 2001 and 2004 of suspect, investigated and remediated sites. Flanders’ Soil Certificates, essential when land is changing hands, serve a similar purpose.

(94) Other countries (e.g. Poland) are awaiting EU legislation before compiling an inventory.

5.2 Gasworks

(95) Gasworks were a feature of major cities, towns, villages and even many stately homes across the UK and in many other parts of the world. While reputedly one of the most contaminative of industrial uses, hundreds have been returned to beneficial use (e.g. as residential developments) showing that where there is a market there is a way to remediate.

(96) The price of being ‘first’ is illustrated by the former West Melbourne Gasworks (Victoria, AUS) which was redeveloped between 1999 and 2005. An independent auditor ensured compliance with clean-up criteria to protect workers and residents, ecology in the adjacent river and the Victoria Harbour. Remediation involved excavation, screening arisings and treating fines. Waste disposed to landfill greatly exceeded the estimated amount. Non Aqueous Phase Liquids (NAPLs) were recovered in a treatment plant. Treated water was discharged under permit to foul sewer. The contract price was AUD€44.35 million. A number of management difficulties occurred over the project, in particular in conjunction with dust and odour control. The site was one of the first to be regulated by a new state groundwater policy.

(97) The remediation of two gasworks in Hamburg by excavation and offsite disposal was hampered by WWII unexploded bombs. Gasworks have also been useful research facilities. In the UK the SEREBAR project explored a sequential reactive barrier to treat gasworks polluted groundwater in Exeter (CL:AIRE 2008). The RUBIN project (for use of treatment walls for site remediation) involved a 1.2km long Funnel and [four] GateTM permeable reactive barrier (PRB) to remediate Quaternary and Tertiary aquifers contaminated by dense nonaqueous phase liquids (DNAPLs) beneath a former gasworks in Munich (Germany). The PRB replaced a pump-and-treat system running since 1992 (annual energy consumption of 600 MWh).

(98) Their location and size has meant gas works often host iconic redevelopment projects. The former Millennium Dome (now O₂ Arena) in London was built on Europe’s largest gas works. The Dublin Docklands Development Authority undertook the redevelopment of the Sir Rogerson’s Quay Gas Works. Though not without its challenges, Belfast Gasworks was the cornerstone from which the entire Waterfront regeneration flowed.

(99) Changes to a risk-based regime have made it easier to redevelop gasworks for residential use in Italy. Flanders had to adopt “a phased approach” to gasworks remediation

that would initially seem strange to UK readers. However the former Basford gasworks is well known both for being the first use of soil washing in the UK and for then remaining undeveloped for many years.

5.3 Mining

(100) The 1966 Aberfan disaster (Wales, UK), which saw the catastrophic collapse of a colliery spoil tip resulting in the death of 116 children and 28 adults, prompted a paradigm shift in how industrial and derelict land was dealt with in the UK that led to new legislation, much research and technical guidance.

(101) The breach of a tailings dam at the Aznalcóllar mine (Southern Spain) in 1998 resulted in the release of an estimated 4 million m³ of acid mine water and 2 million m³ of mining sludge into the Agro river. Rehabilitation involved the pragmatic skimming of impacted soil and the provision of vegetative cover in other affected areas to create what was welcome as a 'green corridor'. Andalucian, State and EU funding, as well as some from the mining company, was provided. Large sums have been allocated to the rehabilitation of former lignite mines in eastern Germany.

(102) The Mines Waste Directive has provided an impetus for many EU Member States to develop national strategies. Ireland's Inventory of Mine Wastes Sites resulted in only 31 sites being identified. Slovakia has an estimated 17,000 and Hungary some 5-6000 sites. The UK has been inspecting mine sites under Part 2A (e.g. Greenside Mine, Cumbria).

5.4 Megasites

(103) There are an estimated 20,000 large and complex contaminated so called megasites in Europe. EUGRIS defined mega-sites as large scale contaminated sites, which pose a large potential or an actual risk of deterioration to groundwater, sediment, soil and surface-water quality. Although the term is not in common use in the UK, sites such as the former Corby steelworks, the Avenue Coking Works and the Greenwich Gasworks would be recognisable megasites. The US EPA generally sub-divides megasites into self-contained operable units (OUs) for the purpose of delivering remedial action.

(104) Special sessions at Consoil and the EU funded Welcome project (Integrated Management Strategy for Prevention and Reduction of Pollution of Waterbodies at

Contaminated Industrial Megasites) have pushed eastern Germany's Bitterfeld megasite (regional contamination of soil, surface water and groundwater as a result of a long and varied history of chemical production) into the European consciousness. A century of industrial production of up to 5000 chemicals in an area of some 1,300ha resulted in fifteen landfills in former opencast lignite mines and polluted some 100 million m³ of groundwater in two aquifers. Remediation is estimated to cost £1.05B (1.2B euros) and needs to cope with rising groundwater levels. Derogations from the WFD have been sought as remediation is deemed neither technically nor economically feasible. Another Welcome project site, the 3000ha Tarnowskie Góry (Silesia, POL) illustrated the limitations imposed by inadequate characterisation and remediation caused by limited funding.

5.5 Waste including former landfills

(105) Landfills have been implicated in many of the most serious contaminated land incidents. In the UK, Landfill gas caused the explosion at 51 Clarke Avenue, Loscoe (UK) and leachate has been implicated in the determination of many sites under the Part 2A regime. The underground fire at the Kerdiffstown landfill in Sallins, Co. Kildare (Ireland) is currently drawing funds from the Irish Environment Fund.

(106) Waste has a longer history of regulation than contamination. The Van de Walle case (C-1/03 Van de Walle [2004] ECR I-7613: as to whether hydrocarbons which were spilled unintentionally and cause soil and groundwater contamination may be considered to be waste) brought the interaction of waste and contamination to the fore and required the explicit exclusion of undisturbed but contaminated soil from the definition of waste in the Waste Framework Directive. Quebec expressly prohibits even contaminated soil from becoming waste.

(107) Redevelopment on closed landfills is permitted in the UK but virtually never for residential purposes. Restoration to open space is common (e.g. the Ilperveld landfill, NL or the Bramote landfill, UK). Restoration to public open space is common across the USA (e.g. Boston's Spectacle Island, New York's Freshkills Park, San Francisco's Presidio Park). The solution to the Love Canal landfill was secure entombment of waste and fencing to prevent unauthorised access to the site.

5.6 Vapour intrusion

(108) The explosion on 24 March 1986 at 51 Clarke Avenue, Loscoe (Derbyshire, UK) was instrumental in alerting the contaminated land sector of the hazard of landfill gas. The fireball at Bontddu, North Wales (UK) (Hansard [HC Deb 19 November 1997 vol 301 cc292-8](#) & [7 January 2003 Column 53WH](#)) was a reminder that significant concentrations of petroleum vapours can accumulate inside a house. However the Environment Agency followed the lead of CIRIA in incorporating a 10-fold correction factor to compensate for over conservatism in the vapour intrusion model within CLEA 1.06.

(109) In the US, concerns are often raised about the risks to human health from volatilisation of dissolved phase chlorinated solvents. In the early 1990s *A Civil Action* (c.f. the eponymous book by journalist Jonathan Harr) was brought by residents affected by a chlorinated solvent (PCE) contamination of Wells G & H in Woburn MA (USA). Some have recently been asked by the US EPA for permission to drill in their basements after finding minor exceedances of the drinking water standard for PCE to test for potentially hazardous vapours. The work is being paid for by WR Grace (the chemical company found liable in the earlier civil action case) and Unifirst (the laundry company who settled out of court in the earlier case).

5.7 Military land

(110) One legacy of the end of the cold war was large swathes of former military land across Eastern Europe. The legacy of Soviet bases in Poland, eastern Germany and the Czech Republic has provided local practitioners with funds and inward knowledge transfer but with variable results and long term impact. The Kluczewo airfield was the subject of the STRESOIL project into accelerated remediation by integrating existing technologies. Hydrocarbon recovery was completed and barriers installed to protect nearby freshwater resources. Although little genuinely novel was developed, the project enabled remediation that would otherwise not have taken place and brought about technology transfer in both hydraulic fracture and bioaugmentation from the USA. Poland has a more *ad hoc* approach to its legacy of Soviet bases. Pesticide disposal in former military bunkers and fortifications across Poland is being tackled by excavation and disposal of impacted soils. Arisings have however been reported to be used to build local roads.

(111) In Canada, the remediation of small but remote early warning facilities was made more difficult by their inaccessibility.

5.8 Brownfields

(112) The term brownfield means different things in different parts of the UK, the USA and Europe. Brownfields can be understood as sites that: “have been affected by the former uses of the sites and surrounding lands; are derelict and underused; may have real or perceived contamination problems; are mainly in developed urban area; and require intervention to bring them back to beneficial use” (World Bank, 2010; CABERNET 2006).

(113) Spain has a rich reputation for regeneration not least because of the successful Barcelona Olympics and Bilbao’s iconic Guggenheim. In Bilbao, public-private partnerships were a prerequisite to the large scale but conventional remediation that helped transform the city. Indeed remediation is relatively dynamic in urbanised areas seeking to recover from structural change (e.g. Basque Country, Barcelona and Madrid).

(114) In Hamilton, Ontario the local authority overcame public financing restrictions on supporting private redevelopment and used municipal funds to stimulate brownfield regeneration in partnership with the private sector. Each CAN\$1 million of local authority investment is thought to have leveraged CAN\$15 million of private investment.

(115) Brownfields require a strategic approach to bringing about their regeneration. Poland’s Framework of the Governmental Programme for Post-industrial Areas (REWITARE) is intended to protect greenfields and reuse brownfields. England had a sequential test which ensured Previously Developed Land (PDL) (aka brownfield) was redeveloped first. The extent to which England’s National Planning Policy Framework (CLG 2012) will deliver on one of its aims to “encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value” remains to be seen.

6 REMEDIATION

(116) Across Europe initiatives such as Eurodemo have eased the take up of process based remediation by giving regulators and decision makers easier access to the results of experiences in other countries. While most remediation is still either off or on site encapsulation or containment; chemical, physical and biological treatment of source zones or plumes are common. Monitored natural attenuation is also widely accepted.

(117) Australia has not been able to benefit from such cross border knowledge exchange and consequently on site remediation techniques, whether *ex* or *in situ*, have not achieved great market penetration.

6.1 Monitored natural attenuation (MNA)

(118) MNA is recognised as valid remediation by the Environment Agency (England) and is invoked in many countries. Australia adopts a similar approach to the UK including a ‘lines of evidence approach’ and a 30 year time frame. Queensland (QLD) requires sources removal whereas New South Wales (NSW) has no such prerequisite requirement.

(119) Different plumes of the same contaminant can mix making it difficult to attribute responsibility. The Dutch are developing legislation whereby the source will be remediated by the owner and the plumes will be remediated on a regional scale.

(120) MNA is not widely used in Germany. However a public sector financed research and demonstration project in Baden-Württemberg successfully, though somewhat tautologously, argued in favour of MNA over pump and treat on proportionality grounds because evidence indicated steady state plume conditions had been achieved. Ireland’s EPA permitted MNA as part of the remediation strategy for four of Dublin’s major regeneration projects of the last decade.

7 COUNTRY ESTIMATES OF THE SCALE OF THE TASK

(121) Waste disposal, resource extraction and industrial accidents continue to be headline grabbing issues across the globe, all of which result in contaminated land. For example there are an estimated 2750 polluted sites in the [Arctic](#). There have been various national and regional estimates of the extent of contaminated land and the number of contaminated sites within individual countries or regions (Table 9). Estimates of the number of potentially, actually and significantly contaminated sites for various countries and regions (Table 9) reveal the importance of the differences in the definitions (Table 1). Nevertheless whatever the true number of sites that ought to be remediated might be, the number actually registered as needing remediation – let alone having been remediated – is relatively small for most countries.

(122) No country is close to claiming it has identified and remediated all contaminated sites. In many countries sites continue to be discovered or added to national inventories. On going structural change is creating new brownfields even as others are being redeveloped. Indeed in France the brownfield stock was constant between 1993 and 2003 despite considerable reclamation efforts. England's stock of previously developed land (PDL) (aka brownfield) did not change much during the 2000s. The Netherlands investigates 1400-1600 sites and remediates 1200-1500 sites covering some 200-300Ha annually. In 2005-9 some 28,000 sites were investigated and found not seriously contaminated while 8000 were remediated. Only 2-3% of identified suspect sites have been investigated in Spain.

(123) A 'lines of evidence' and cross-checking involving data redundancy is useful in the fraught area of estimating the extent of contaminated land and the budgets involved. National and supra-national figures on the extent of and cost to remediate contaminated land (Table 9) may be compared against more recent Eurostat figures (detailed statistics collated by the EU) for the entire environmental sector.

(124) Based on 3,800 remediated sites, the Dutch estimate £10.4 billion (€12 billion) by 2030 are needed to deal with the putative 56,000 remaining seriously contaminated sites. The serious and urgent sites, assuming a number of 11,000, are expected to cost £2.6 billion (€3 billion) by 2015.

Table 9 Scale of contaminated land

COUNTRY	REGION	Contaminated land		Costs
		Area	Sites	
Australia	-		80,000 (2001) 'thousands' certified by auditors in 20 years	
	WA		1,500 estimated (1995) 1358 formally reported (2008) 1,029 potentially contaminated (2009) 232 listed (2009)	
	SA		Unknown (2003)	
	NSW		60,000 of which 7,000 likely to require remediation (1997 estimate) 272 regulated contaminated sites 37 reported annually but only half found to be significantly contaminated 35 site remediated between 2006 and 2009	
	WA		1358 contaminated sites (2007) 48 site audit reports (2008-9)	
Belgium	Flanders		75,000 potentially contaminated (1995) By 2005, 29,000+ investigated; 8500 need further investigation; remediation underway at 3000; 700 completed	
Canada			30,000 nationwide 18,000 on Federal Contaminated Sites Inventory	
	Indian & Northern Affairs		63 known contaminated sites (Contaminated Sites Program)	CAN \$754 million liability
Czech R.			10,000 brownfields 60 of 73 former Soviet Army sites significantly contaminated; 5 remediated by 2003	
			1991 – 2003: 269 Environmental Liability Agreements concluded; 61 terminated	
			2007: 281 Environmental Liability Agreements concluded; 98 terminated	
France			4,000	1B euro/ year growing at 10% Entire environment sector: 1B (2007)
			200,000 former industrial and service sites about 200 former mines	
		20,000Ha brownfield		
		1980s Nord Pas de Calais: 10,000Ha industrial brownfields; ca. 50% of French total. 1989-2006 4752Ha land remediated.		

COUNTRY	REGION	Contaminated land		Costs
		Area	Sites	
Germany	Länder		363,000 (2000 estimate) Ca. 300,000 suspected to be contaminated (2008-9 estimates)	1.6B Euros/ year (2004) Entire environment sector: 4.6B (2007)
		3,500 km ² military areas	2005 figures: 367 sites assumed contaminated; 1,367 under investigation; 111 being remediated	
Ireland			<2500 (2006) 27 historic mines	30-40M/ year (Consultancy)
Italy				
Japan ⁴		113,000 ha likely to be affected	700 out of 1100 investigations found elevated contamination (2005)	
Netherlands			760,000 suspect sites 420,000 possibly need remediation (20,000 waste; 100,000 oil tanks; 100,000 filled ditches; 200,000 industrial sites comprising 380 gasworks, 2,000 dry cleaners and 50,000 petrol stations) 1500-2500 serious or urgent sites 56,000 seriously contaminated 11,000 urgent sites	320M (2009); est 12B by 2030
Poland		8,000 km ² (2.7%) moderately or heavily degraded 120-140km ² industrial or waste sites	Mainly in Upper Silesia 3,000 sites	113M USD (1999) 63M USD (2004) 10B Euro/year needed to meet 2025 target Entire environment sector: 2.9B (2007)
Spain			2004 figures: 33,595 potentially and actually suspect 15,126 sites. 349 of these sites investigated, with measures completed at 288 (including 139 remediated sites).	207M Euro (2004)
	Basque	7,898Ha (16.5 %) potentially of which 3,100Ha heavily contaminated	8,587 potentially contaminated sites 22% around the Bilbao Estuary	
	Catalonia		5000 sites with potentially polluting activities (2001)	
UK				
USA				
EU			300,000 – 1,500,000	59-109 B Euros
	25			5.2B/ Euros year (2004)
	27			4.6B Euros (2000)

8 DECIDING ON WHO PAYS

(125) In the UK the person who caused or knowingly permitted the contamination is liable or in their absence the present owner or occupier is liable for most remediation under Part 2A Environmental Protection Act 1990 (Appendix 13). However in practice the polluter usually does not pay since most remediation is paid for by developers. Cases in the English courts suggest identifying the polluter is complex. National Grid successfully argued, on the basis of the Sid-creating *Gas Act* 1986, that they were not liable for the remediation at the former Bawtry gasworks. Redland Minerals Ltd and developers Crest Nicholson Ltd were found by the courts and Secretary of State to be jointly liable for groundwater pollution at St Leonards Court – the UK’s largest point source contaminant plume.

(126) In Australia the fairness of retrospective liability for then legal actions is reportedly a common concern.

(127) However, the Czech Republic accepts that in most cases either the State or former Soviet forces were the polluter, so state funded remediation was the norm while proceeds from privatisation lasted. Soviet authorities negotiated that the value of buildings and infrastructure left behind by the Soviet army was equal to the value of the environmental contaminated caused. Revenue from the post-socialism privatisation of state industries provided the Czech Republic with funds for state funded remediation and a mechanism for releasing private inward investors of historic land contamination related liabilities. The polluter pays principle has not been adopted for former Soviet bases in the Czech Republic.

(128) Spain has also used public sector funding for most remediation, often as part of local efforts to stimulate brownfield redevelopment. The lack of implementation of the polluter pays principle was criticised in the aftermath of the Aznalcóllar dam breach (Spain, Appendix 12).

(129) Italy’s implementation of ‘polluter pays’ has been less controversial as large, often multi-national, companies have been able to absorb the relevant costs.

(130) In Germany, post-reunification privatisation of former East German state-owned enterprises in the form of [Volkseigener Betrieb](#) (VEBs), was carried out by the Federal Treuhandanstalt (Trust Agency) while residual liabilities rested with the Federal Government.

The legacy of the Agency is disputed since its closure in 1994 with debts of some 260M DM and the assassination of one of its chairmen.

(131) Poland's National Investment Fund (NIF) combined managing more than 450 former state entities with a citizen share ownership. Effectively "every adult Polish citizen involuntarily paid an amount of money for restoration work" funded by discounting the market value of NIF assets. Poland also requires current owners to remediate historic contamination. However they are not liable for contamination caused by others since the owner took over a site.

(132) Flanders rejected the polluter pays principle and instead requires the present owner or occupier to pay prior to selling land and thereby required very little public funding. Flexibility within the Soil Remediation Decree allows "tailor-made legal solutions" to be developed where remediation costs would be unaffordably high.

(133) Until recently France had no specific soil or contaminated land regime and dealt with issues through industrial or waste management regulatory functions. Case law established liability for industrial installations lay with the operator, rather than the owner, and passed from one operator to the next. Revenue from a levy on industrial waste was used to remediate orphan sites.

(134) Legislation raises awareness and major incidents create awareness. In Japan contamination surveys increased after 2003 legislation suggesting the lessons from incidents such as Minamata (where the unregulated release of methyl mercury in industrial waste waters from a chemical factory over a period of about 35 years into Minamata Bay, Japan and subsequent bioaccumulation in shellfish and fish caused a neurological syndrome which in many cases has led to severe paralysis and death; see National Institute For Minamata Disease) may be short lived unless enshrined in legislation. The Minamata Convention on Mercury, signed by over 140 countries in January 2013, provides controls and reductions across a range of products, processes and industries where mercury is used, released or emitted.

8.1 Financial liability attribution

(135) Attributing responsibility and financial liability is often seen as the most complicated and contentious aspect of dealing with land contamination. UK court cases would back this

up. For example in *Bawtry (National Grid Gas plc (formerly Transco plc) v. Environment Agency 2007)* it was deemed on appeal that National Grid could not be held liable for contamination caused by its predecessors. In *Sevenoaks (Circular Facilities Ltd v Sevenoaks District Council 2004)* it was upheld that a developer could be held liable even when they did not introduce the contaminants to a site. The developer was given leave to appeal however the case was settled out of court. In *Sandridge, Crest Nicholson* (the developer who was deemed to have undertaken inadequate remediation) and *Redland Minerals Limited* (the company who acquired the former chemical works) unsuccessfully appealed remediation notices served under the Part 2A regime. Many regimes allow contractual transfer of responsibility but leave it up to the parties involved rather than the regulator to establish that contractual chain.

(136) Japan allocates liability based on the proportion of contamination caused. However, under the Civil Code compensation is claimed as a joint tortfeasor, effectively joint and several liability.

(137) Germany's Federal Soil Protection Act is based on strict liability and allows only the defence of innocent historical (but not present) ownership. The liability of innocent owners is capped at the market value of the land but there is no limit to the liability of polluters beyond a general constitutional provision (s. 548 Civil Code) whose arbiter is the Federal Supreme Court.

(138) In Canada, many, but not all, of the provinces adopt a joint and several approach to assigning liability. Canada's orphan mining sites are being handled through the Federal National Orphaned/Abandoned Mines Initiative (NOAMI). The Federal government owns some 40% of Canada's land mass and has the Federal Contaminated Sites Action Plan to reduce human and environmental risks as well as federal liabilities.

8.2 Orphan sites

(139) Most countries recognise that orphan sites are either dealt with by the public purse or will not be dealt with at all.

(140) Spain's First and Second National Plans of Remediation included provisions for orphan sites. Polish Starosta (effectively County Chief Executives) have a duty to reclaim land where polluters do not own the affected land or contamination was caused by natural processes. This is seen as weak authorisation for public authorities to deal with orphan sites.

Australia has no provision for orphan sites apart from WA and some schemes (e.g. NSW) for derelict mines.

(141) Under the Part 2A regime in place in the UK regions (excluding Northern Ireland) costs for remediation of orphan linkages (i.e. contaminant linkages for which no liable person can be found) falls to the local authority.

(142) In the US the EPA cleans up orphan sites when potentially responsible persons (PRP) cannot be located.

(143) Canada has a federal programme for managing orphan mining sites, the National Orphaned/Abandoned Mines Initiative (NOAMI). However, there does not appear to be any other federal or provincial orphan site programmes.

(144) In order to assist with the financial liability associated with the cleanup of orphan sites in France, the Law of 2 February 1995 (Barnier Law) levies a tax on Special Industrial Waste which was intended to finance their remediation.

9 NATIONAL CONTAMINATED LAND SECTORS

(145) National legislation, where it exists, is the main driver for dealing with land contamination (e.g. Canada, Australia). Elsewhere it is redevelopment and the opportunity to attract external funds that triggers remediation (e.g. Poland). In Flanders and in the Netherlands changes in ownership trigger investigations and on occasion remediation. However, brownfield redevelopment accounts for the majority of remediation even in those countries with specific contaminated land legislation (e.g. Canada and UK). In a way Czech remediation efforts in a desire to privatise state industry and attract inward investment could be seen as an attempt to prevent brownfield creation.

(146) Australia's contaminated land sector is largely driven by redevelopment and accounted for £117M (\$175M) of its £12B (\$18B) environmental market (2007). The 2008 global financial crisis resulted in some scaling back but more recently the sector has recovered and is increasingly recruiting professionals from overseas to meet demand.

(147) Canada reported a £2.1B (\$3.2B) (2008) combined Waste Management and Remediation Services Sector with only 146 of 2800 employers having more than 50 staff.

(148) German reunification both created large swathes of abandoned contaminated military sites and a pollution legacy from closed factories in former East Germany. The need to integrate and unify meant significant expenditure on regeneration, including remediation, by the Federal government. Efforts to reduce the daily consumption of greenfield land from 180 to 60 football pitches have driven German developers onto brownfield land.

(149) Ireland's National Development Plan (2007-13) was another strategic driver. Limited landfill capacity meant that on site solutions needed to be found for keystone projects such as Sir John Rogerson's Quay gasworks that formed part of the regeneration of the 520 hectare Dublin Docklands area.

9.1 Availability of remediation technologies

(150) Ten years ago remediation technology availability within Europe was largely limited to within country. However, EU tendering rules have facilitated the ease with which equipment and expertise from one country can be deployed in another. Initiatives such as CLARINET and EuroDemo have allowed experience in one country to be recognised in

another. The UK's flagship Avenue remediation contract for the former coking works site (<http://www.theavenueproject.co.uk>) was awarded to a non-UK consortium.

(151) The USA has the most extensive and most mature remediation market and indeed developed and first applied most of today's remediation technologies. Neighbouring Canada also has a wide range of technologies available and is an international leader in ex situ bioremediation thanks to its network of soil treatment centres in Quebec.

(152) A wide range of remediation technologies are available and have been used in Australia as shown in a series of case studies from the late 1990s in the NATO/CCMS Pilot Study Reports (USEPA, 2003).

10 PERCEIVED SUCCESS

(153) One indicator of how effectively a regime is working is the (inverse of the) extent to which recourse to the courts is made to sort out differences. In Australia the auditor system is credited for ‘almost no litigation’. In the UK several court cases have upheld the regulators’ decisions (e.g. Sevenoaks vs. Circular Facilities; Sandridge) and the notable exception (Bawtry) required the Law Lords to interpret liability transfer provisions in the Gas industry privatisation act.

(154) Another indicator is the scale of knowledge transfer activities associated with the sector such as conferences, workshops, bulletins and electronic fora. The UK has a long history of sector specific conferences hosted for example by commercial organisations and professional bodies or NGOs. The SGV Taskforce, set up to enable stakeholder involvement in the consideration of the (mis)application of the Soil Guideline Values, was a sign that all was not well in the sector a few years ago however more recent fora hosted by Defra and the HPA have been seen as evidence of vigour and innovation.

(155) The USA has a long history of making Federal information both publically available and free of copyright ensuring it is widely disseminated. The US EPA biennial Brownfields conference is free to attend for its several thousand delegates and is seen as an outreach event for community initiatives.

(156) Several countries have recognised the need for a strategic focus for knowledge creation and technology development. The UK had its FIRSTFaraday partnership (a knowledge transfer network which existed from 2001-2006). Australia recently extended funding to CRC CARE (a science-based partnership involved in assessing, preventing and remediating contamination of soil, water and air, set up in 2005) until 2020 (<http://www.crccare.com>). A Czech end user-research institute network focused on biotic and abiotic PRB technologies.

(157) Canada’s regime suffers from needing consultation with a plethora of bodies and from the plethora of initiatives and policy.

(158) Polish observers bemoan the lack of transparency in setting national criteria – which given their rarity in including maximum permissible levels is regrettable.

(159) Many regimes were introduced in the decade after 1995 and were reviewed in the five years from 2005. Most revisions have involved improvements and refinements rather than repeal or wholesale reinvention.

(160) Recent changes in Italy's regime to a more risk-based approach stem from perceived limitations of the previous mechanism that tended to result in costly and slow remediation. Embedding technical detail in Italian legislation was realised to be a mistake as it hindered taking on board more recent advances in science and technology.

(161) Japan's inflexible EQS values have also been criticised. Japan dealt with perceived stigma by creating a sub-category of contaminated site that does not require remediation until it is developed.

(162) In Belgium a 2006 OVAM survey showed strong support for the 1995 Decree while highlighting problems with how large sites are handled and how remediation is interlinked with subsequent redevelopment. Flanders (Belgium) codified its Soil Remediation Decree (SRD) to improve efficiency and reduce costs. For example, remediation lasting less than 180 days could benefit from fast-track authorisation. Concerns about the present owner shouldering liability were not so addressed.

(163) The UK took a similar approach through informal soundings through both the SGV Taskforce process and by bilateral discussions between Defra and stakeholders in the run up to issuing proposals for revisions to the Part 2A statutory guidance that came into force in 2012. Both the Flemish Decree and Part 2A have raised awareness of contamination issues.

(164) Over prescriptive evaluation criteria have been criticised by contaminated land practitioners in both Germany and Italy while their absence has been criticised by some in the UK. German brownfields suffer from a lack of private sector involvement whereas most remediation in the UK has been funded by developers.

(165) Funding is a ubiquitous issue. German state funding after reunification and Czech investment post the velvet revolution against the one party Communist government and the subsequent introduction of a parliamentary republic were driven by larger political agendas. The UK's reuse of PDL was driven by a buoyant property market over almost 2 decades. Elsewhere state funds have been available for disasters (e.g. Spain, Romania) or strategic investment areas (Ireland).

(166) Collateral impacts of the Flemish Decree included heightened awareness of the need to prevent pollution and an improvement in the quality of investigation and remediation.

11 EXTERNAL PERCEPTIONS

(167) It is difficult to be specific on how national regimes are perceived by others. Although the adoption of some countries' approaches by others could be seen as endorsement, it could also be motivated by funding issues, influential elites, (absence of) copyright, language and serendipity. Of necessity therefore this section draws on subjective impressions and soft lines of evidence.

(168) Europe's leaders in assessing and managing land contamination would comprise the industrial heartland nations (Netherlands, UK, Germany and Flanders) while France, Finland and Denmark have also made noteworthy contributions to international practice. Indeed France's impact would be greater if it published more information bilingually, while the Flemish and Dutch policy of almost simultaneous publication in Flemish and English has led to their thinking having a disproportionately large influence on European thinking. The UK community benefits from others' translation efforts yet suffers from its poor penetration of publications in other languages, particularly German and to an increasing extent Mandarin, which is becoming an increasingly important player in the field.

(169) National practices can change as a result of external influences. The Dutch and Germans all but abandoned multi-functionality because of concerns over its economic viability and its impact of reducing the re-use of contaminated land compared with contemporary UK experiences being shared at events such as Consoil and meetings of the Ad Hoc Working Group. Many countries (e.g. France, Ireland) followed the UK into a risk-based approach. Most process based technologies were both developed and extensively implemented in the USA. The Flemish approach has been largely adopted by the European Commission in its proposed Soil Framework Directive. A combination of public and private sector *investment* has been achieved in the USA, UK and Netherlands. Elsewhere, including Canada and Spain, an *expenditure* philosophy has worked while funds are plenty and struggled once they dry up.

(170) Conservatism is essential if Type I errors (the incorrect rejection of a true [null hypothesis](#)) are to be avoided. Yet over conservatism has been a criticism by developers and site owners among others of many regimes (UK, USA, Italy).

12 TRENDING ISSUES

12.1 Sustainable remediation

(171) Contaminated land management has been seen as a component of sustainable development (Flanders; UK). The UK has a long history of regulatory interest in sustainable remediation and the recent changes to the Part 2A regime will effectively introduce a pre-determination sustainability appraisal of potential remediation strategies.

(172) The Sustainable Remediation Forum (SuRF) has achieved a cross-stakeholder consensus that sustainable remediation is both desirable and achievable and is in the midst of contributing to metrics and methodologies. Elsewhere SuRF UK's Framework contains an elegant and succinct definition. Some regimes (e.g. Maine, USA) allow for remediation to be deemed 'not technically feasible'. However if 'do nothing' is deemed more sustainable than intervention, sites could be labelled contaminated and then left unremediated due to financial, social or environmental considerations.

(173) Structural changes create derelict and abandoned, sometimes contaminated, land that requires intervention to be returned to beneficial use. Contaminated land management usually takes place at the nexus of several regulatory regimes. Problems can occur where a narrow perspective is allowed to develop. On any given site sustainable remediation must not be pursued at the expense of broader sustainable redevelopment of the site.

12.2 Total solutions

(174) Clients, including land owners, in many countries want complete transfer of contamination related liabilities and are being offered packages combining technical remediation wrapped by environmental impairment liability insurance. Elsewhere remediation costs can be fixed using a cost cap policy that is effective in capping the costs associated with a known remediation. Both approaches involve additional costs but deliver the desired corporate security and allow for contamination to cease to be considered a contingent liability – a requirement of most of the world's major stock exchanges (e.g. FRS 12 in London and the US Sarbanes-Oxley Act 2002 in New York).

(175) Fixed price remediation is also used to encourage take up of specific products. One Belgian vendor fixes the price if they have carried out bench hand pilot tests (<http://www.e-r-t.net>).

12.3 Holistic site management

(176) There is increasing interest in the Netherlands in integrating groundwater pump-and-treat with ground heat exchange to maximise the benefit obtained from the ‘cost’ of relocating groundwater. At Eindhoven (a former manufacturing area where chlorinated solvents are present in the saturated zone from 30 to 60m below ground level – see Appendix 10) the concept of a large scale ‘bio washing’ machine has been engineered to allow for large volumes of water for heat exchange while also avoiding relocating contaminants.

(177) Zoning to locate less sensitive land uses on more impacted areas is a valid form of institutional control that has been successfully adopted at a former sewage farm in Tillberg (NL) and at the former Avenue Coking Works (UK).

12.4 Harmonisation, convergence and standardisation

(178) Many countries have made significant investments in fundamental and applied research and now have decades of experience. The usual processes of knowledge transfer have seen convergence or at least conscious rather than unintended discrepancies in approach. Examples of proactive collaboration include those between Australia-New Zealand and between Canada’s Atlantic Provinces. Networks have been encouraged in Europe (Common Forum (<http://www.commonforum.eu>), CARACAS, NICOLE (<http://www.nicole.org>)). Some have developed approaches that have gone on to be more widely applied (e.g. BARGE ([the Bioaccessibility Research Group of Europe](http://www.bioaccessibilityresearchgroupofeurope.org)), CABERNET (<http://www.cabernet.org.uk>) and CARACAS). Others have tried to bring about a degree of convergence but with only limited success to date (HERACLES (<http://www.rivm.nl/bibliotheek/rapporten/711701091.pdf>) and EuroDemo (<http://www.eurodemo.info>)).

12.5 Climate change and soil health

(179) As our understanding of likely climate changes improve, changes will need to be made to default exposure scenarios and food security considerations that will result in changes to the default parameterisation and possibly the pathways considered in default exposure

scenarios that underpin generic quantitative risk assessments and the development of generic assessment criteria (GAC). Failure to do so could result in a long tail of liability for risk assessors who choose not to consider the effects of climate change over the lifespan of a development when deciding on the relevance to their site of GAC.

13 BROAD LESSONS LEARNT

(180) The following lessons have been drawn from the above summary of the country reviews.

13.1 Positives

- Independent auditing and strong central policy control of site management facilitates operations and regulatory compliance.
- A wide range of available treatment based remediation technologies, and advisors familiar with the operating windows of the range, are needed to divert more waste from landfill.
- Dissemination of authoritative knowledge is vital in ensuring consistent practice. Many lessons are learnt on publically funded projects and all should benefit from these. For example Flanders publishes biennial lessons learnt bulletins while the EPA runs free-to-attend conferences.
- There is a policy difference between historic and new contamination.
- The widely adopted tiered approach is seen to reduce costs. This must begin with a clear conceptual model and appreciation of the relevant legal context.
- State support for competent authorities combines finance and technical expertise in many countries (NL, USA, France). This must recognise the skills base for “easy” and complex or megasites sites are quite different.
- Japan dealt with the perceived stigma and the issue of perceived disproportionate remediation costs by creating a sub-category of contaminated site that does not require remediation until it is developed (Appendix 9).

13.2 Negatives

(181) There is a widespread low level of policy interest in contaminated land management and in brownfield renewal but a high level in urban and economic regeneration. The structural change caused by the 2008 global financial crisis has created new brownfields and reduced

the availability of public funds in many countries. There is a general reliance on ephemeral funding from EU, special funds, special taxes and one off sources.

(182) Contaminated land management is slower and more expensive where it is fragmented over several jurisdictions or legal regimes. While recognising the inherent complexities of contaminated land management, overly complicated procedures and a combative approach can result in inefficiency and create skills shortages in regulators and service providers. Intra-state subsidiarity results in different approaches and results in inefficiency and inconsistent decisions.

(183) There is widespread acceptance that many approaches are overly conservative but a reluctance to tackle this. After remediation the polluter/ owner remains responsible for residual risk. That means that companies do not see many benefits for remediation.

(184) The continued lack of penetration of on site or in situ remediation technologies in many countries means landfill disposal, on site encapsulation or delayed remediation are common. Embedding technical detail in legislation e.g. the setting of maximum Limit Values in the Ministerial Decree 471/99 in Italy in 1999 was seen by practitioners and regulators as a mistake as it hindered exploiting advances in science and technology. In Italy in 2006 MD 471/99 was replaced by Chapter Four of Legislative Decree 152/06 which introduced a focus on risk assessment and site-specific Limit Values

14 OVERALL IMPLICATIONS FOR THE ASSESSMENT OF CONTAMINATED LAND

(185) We suggest that Defra consider:

1. increasing the degree of transparency in publically funded projects by requiring Local Authorities to publish all reports commissioned with public funds under Part 2A Environmental Protection Act 1990;
2. ensuring relevant succinct and up-to-date guidance is readily available in an actively Government managed database;
3. avoiding issuing non statutory guidance or make the status of such guidance clearer than hitherto;
4. encouraging the use of suitably regulated licensed professionals to demonstrate regulatory compliance;
5. ensuring public sector procurement mechanisms result in the right technical competencies being brought to bear on projects;
6. mechanisms of overcoming the reluctance of regulators to give ‘no further action’ letters to encourage process based, human resource intensive remediation and save landfill void space and carbon footprint;
7. continuing to engage in international fora to share UK practice.

15 LIMITATIONS

(186) This report was prepared by LQM for our client. Any third party using this report does so entirely at their own risk. LQM makes no warranty or representation whatsoever, express or implied, with respect to the use by a third party of any information contained in this report or its suitability for any purpose. LQM assumes no responsibility for any costs, claims, damages or expenses (including any consequential damages) resulting from use of this report or any information contained within this report by a third party.

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APPENDIX 1 AUSTRALIA

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1 AUSTRALIA

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Australia has a federal structure¹. There are six States in Australia: New South Wales (NSW), Queensland (Qld), South Australia (SA), Tasmania (Tas), Victoria (Vic) and Western Australia (WA). Each State has its own State Constitution, and at the national level is the "Commonwealth Constitution". In addition, there are ten Australian Territories outside the borders of the States. Seven Territories are governed only by Commonwealth law, usually through an Administrator: Ashmore and Cartier Islands, Australian Antarctic Territory, Christmas Island, Cocos (Keeling) Islands, Coral Sea Islands, Jervis Bay Territory, Territory of Heard Island and McDonald Islands. There are two mainland Territories: the Australian Capital Territory (ACT) and The Northern Territory (NT) which have limited self-government. One offshore Territory, Norfolk Island, has also been granted limited self-government.

Contaminated land in Australia is mainly regulated by the States, except for sites that are either owned by or are the responsibility of the Commonwealth. This annex provides an overview at national level and across the States and Territories, with particular reference to New South Wales which was one of the pioneer jurisdictions in Australia.

The Australian and New Zealand Environment and Conservation Council (ANZECC) was set up by the Australian and New Zealand Governments to provide a forum for consultation and coordination between the State, Territory and Commonwealth Governments Australia and the Government of New Zealand. It has released non-binding guidelines and position papers over the period 1992 to 1999 (CRC CARE 2009), including:

- Guidelines for the assessment of on-site containment of soils (ANZECC, 1999)
- Financial liability for contaminated site remediation (ANZECC, 1994)
- Guidelines for the assessment and management of contaminated sites (ANZECC, 1992)

These guidelines established a risk-based approach to the management of contaminated land in Australia, and are now largely superseded by Commonwealth of Australia and State policy and legislation.

¹ <http://australia.gov.au>

In 1994 the National Environment Protection Council Act (NEPC) was enacted² by the Commonwealth. This Act set out to bring a degree of uniformity in waste and pollution legislation across the Australian Sites and Territories. It includes provision to bring a consistent approach to contaminated site assessment across the Commonwealth. It led to the National Environment Protection (Assessment of Site Contamination) Measure (Site Assessment NEPM). The goal of the Site Assessment NEPM is to “provide adequate protection of human health and the environment where site contamination has occurred through the development of an efficient and effective national approach to the assessment of contamination”. The scope of the NEPM is confined to assessment of contamination, and it does not extend to providing guidance on the remediation and management of contamination. It has been enacted in each State and Territory of Australia (CRC CARE 2009), and has now replaced the 1992 ANZECC guidelines referred to above. The Site Contamination NEPM is currently undergoing a comprehensive revision, and a consultation draft has been issued. The final document was issued in April 2013, taking effect from 13 May 2013. State and Territory regulators have agreed a 12 month transition period (COAG Standing Council on Environment and Water 2013).

Australian States and Territories have individually enacted legislation related to investigation and remediation; responsibilities and liabilities; and regulatory and planning processes, as set out in Table 1 (CRC CARE 2009), some of which predates the NEPC.

In Australia there are separate environmental protection and development planning regimes. All jurisdictions have a mechanism to require site assessment or remediation under environmental protection legislation (CRC CARE 2009). In all jurisdictions an accredited auditor³ is engaged to review the work that has been carried out, and advises on whether the condition of the land and groundwater is suitable for particular land and groundwater uses, and any conditions that might apply. In some jurisdictions it is the auditor’s statement that is the final decision on this matter, and in other States the auditor advises the regulatory agency who reaches a final conclusion based on the auditor’s advice. In some jurisdictions (e.g. NSW) a distinction is made between significantly contaminated land which is dealt with by the environmental regulator and the regulation of contaminated land that does not pose a risk of harm, where future use is regulated under the planning process.

Requirements for site assessment as part of the planning process are complex. There are no legislative requirements for the Site Assessment NEPM to be applied to the

² National Environment Protection Council Act 1994, Act No. 126 of 1994 as amended up to Act No. 82 of 2003

³ Auditors are Private Sector professionals; in Queensland they are referred to as “Third Party Reviewers”. The Territories do not have a formal accreditation process, and draw on accredited auditors from other jurisdictions.

redevelopment of contaminated sites under land-use planning legislation in some jurisdictions (e.g. NSW) while in others there are formal links to the planning process (e.g. Queensland). In some jurisdictions the NEPM is used in guidance provided to or being developed for planning authorities (e.g. South Australia and Tasmania). Even where there is no linkage the Site Assessment NEPM may be used as a tool by service providers for planning purposes, but no information about this has been collated (NEPC 2009).

Table 1 Roles and Processes in Contaminated Site Management across Australia (based on CRC Care 2009, NEPC 2009)

Jurisdiction	Legislation	Investigation and Assessment Criteria	Remediation Planning	Remediation and Land Use Planning	Aftercare
Australian Capital Territory	Environmental Protection Act 1997 Planning and Development Act 2007	Guidelines based on NEPM Site assessment are included in <i>Contaminated Sites Environment Protection Policy 2000</i>	Site remediation is triggered by serious or material environmental harm	All development applications are referred to the Environmental Protection Agency	Possibility to require long term monitoring and management of sites (both under contaminated land management and planning regimes).
New South Wales	Contaminated Land Management Act 1997 Environmental Planning and Assessment Act 1979 Contaminated Land Management Amendment Act 2008	Requirement to use NEPM Site assessment			Possibility to require long term monitoring and management of sites (both under contaminated land management and planning regimes).
Northern Territory	Waste Management & Pollution Control Act 1998	The NEPM Site assessment is used pending an Environmental Protection Order and associated guidance due 2009–10.	Proceeds via an audited remediation action plan		Possibility to require long term monitoring and management of sites
Queensland	Environmental Protection Act 1994 Integrated Planning Act 1997	NEPM Site assessment used, state guidelines are available as a draft	No statutory criteria for determining when remediation is required, but a site management plan and validation report (following any remediation) are	Applications for planning are subject to environmental approval for “sensitive” uses on land that is potentially contaminated	Aftercare requirements are recorded on a public Contaminated Land Register

Jurisdiction	Legislation	Investigation and Assessment Criteria	Remediation Planning	Remediation and Land Use Planning	Aftercare
			required		
South Australia	Environmental Protection Act 1993 Development Act 1993	State guidelines are used along with the Site Assessment NEPM	Legislation takes a risk-based approach to site remediation; that is, the response to managing a site is based on an evaluation of the degree of the risk presented by the contaminant, which is linked to the land use of that site.	No formal linkage	Possibility to require long term monitoring and management of sites
Tasmania	Environmental Management and Pollution Control Act 1994 Land Use Planning and Approvals Act 1993	The Site Assessment NEPM is used, where contaminants are not addressed "other" guidelines apply		Draft legislation will trigger site contamination assessments during changes to land use	No specific regulatory mechanism to impose aftercare requirements
Victoria	Environmental Protection Act 1970 Planning and Environment Act 1987	The Site Assessment NEPM is used, along with guidelines from the state regulator via the <i>Environmental Audit System (Contaminated Land)</i> and the <i>SEPP (Prevention and Management of Contamination of Land)</i> .		Planning applications subject to assessment of contaminated land considerations	Possibility to require long term monitoring and management of sites
Western Australia	Contaminated Sites Act 2003 Planning and Development Act 2005	Based on specified risk assessment methods	Site management plan required	Planning authorities must consider whether a site subject to development is contaminated	Possibility to require long term monitoring and management of sites

1.1 The boundary between "contaminated" and "not contaminated"

The Site Assessment NEPM (NEPC 1999; 2013) defines concepts relating to "contaminated land", and these are enacted into the legislation of States and Territories or are referred to when reaching conclusions regarding the acceptability of contamination, in particular:

- "Contamination" means the condition of land or water where any chemical substance or waste has been added at above background level and represents, or potentially represents, an adverse health or environmental impact.

- “Site” means the parcel of land being assessed for contamination.
- “Risk” means the probability in a certain timeframe that an adverse outcome will occur in a person, a group of people, plants, animals and/or the ecology of a specified area that is exposed to a particular dose or concentration of a hazardous agent, i.e. it depends on both the level of toxicity of the hazardous agent and the level of exposure.

These definitions may be modified in State legislation. For example in NSW (CRC CARE 2009) the definition of contamination is more explicitly related to risks to human health and the environment: ... the presence in, on or under the land of a substance at a concentration at which the substance is normally present in, on or under(respectively) land in the same locality, being a presence that presents a risk of harm to human health or any other aspect of the environment. Land that is sufficiently contaminated to warrant regulation under the Contaminated Land Management Act (NSW) is “significantly contaminated land”, or “regulated land”. It is probable that a site is “significantly contaminated land” when:

- Contamination is located in a place where there will be an impact on human health or the environment;
- There is a particularly toxic contaminant that may cause harm even in small quantities even when there is limited exposure;
- A contaminant is present at such concentrations or over such a large area as to present a high probability of harm; or
- The contaminant is already causing harm.

Where a site is not significantly contaminated the environmental or planning agency may still require site investigation if it believes it is reasonable to do so. Site management proposals can also be made on a voluntary basis.

In Australia the practice of assessing the risk that contamination poses to human health or the environment is outlined in the Site Contamination NEPM. In the case of human health risk assessment, policy direction is taken from enHealth, the Committee responsible for Australian health policy, which includes representatives from Commonwealth, State and Territory health departments. The current enHealth guidance document is Environmental Health Risk Assessment Guidelines for assessing human health risks from environmental hazards, 2002; this is currently undergoing revision. The approach adopted is broadly consistent with USEPA guidance on health and environmental risk assessment.

There is also Australian national standard AS4360 on risk assessment, based on the concept of the likelihood of particular consequences occurring. This was first drafted in 1995, and subsequently revised in 1999 and 2004. This standard has been applied in contaminated site management (Hobbs, 2005), although more often in the context of assessing the risk that failure of management controls might occur. It has now been superseded by a 2009 Australian and New Zealand standard on risk management⁴, which is based on ISO 31000:2009, *Risk management - Principles and guidelines*.

1.1.1 Role of number-based thresholds

In Australia human health and environmental risk assessment depends on evaluation of source-pathway-receptor linkages and whether the contamination will adversely affect the current or proposed use for the site (Power 2007). This might occur through effects on human health, aesthetics, and ecosystems that are specific to the use of the site. Similarly, remediation needs are site specific and depend on the characteristics of the site, the contamination and the current or envisaged land use (CRC CARE 2009). Remediation targets are typically determined on a case by case basis as part of the independent site audit process (Nadebaum 2009).

The Site Assessment NEPM (NEPC 1999; 2013) distinguishes between potential contamination which is indicated by the presence of structures or markers such as soil staining; and actual contamination indicated by levels of contaminants which are not naturally occurring, contaminants elevated above background levels or contaminants exceeding investigation levels. Determination can also be made on the basis of site-specific risk assessment.

The Site Assessment NEPM (NEPC 1999; 2013) describes broadly two environmental quality criteria for use in contaminated site assessment:

- “Investigation level” means the concentration of a contaminant above which further appropriate investigation and evaluation will be required. Investigation levels have been developed for soils (protection of human health for various land uses, and ecology), and groundwater (for protection of aquatic ecosystems, drinking water and agricultural use).
- “Response Level” is the concentration of a contaminant at a specific site based on site assessment for which some form of response is required to provide an adequate margin of safety to protect public health and/or the environment.

⁴ AS/NZS ISO 31000:2009 Risk management - Principles and guidelines,
<http://infostore.saiglobal.com/store/Details.aspx?ProductID=1378670>

A generic set of Investigation Levels has been formulated for different types of land use because of the differences in exposure pathways between them: residential, residential with minimal exposure, recreational, and commercial / industrial. Occupational health and safety plans for site management workers are considered in Site-Specific Safety Plans.

Derivation of human health guidelines makes use of toxicological reference data (e.g. Tolerable Daily Intake) and "Guideline Doses" for carcinogenic substances. No guideline is offered for acceptable excess cancer risk⁵, although a body of practice has evolved that generally accepts a total incremental lifetime risk of cancer of 1 in 10⁵, and this is being formalised in a revision of the Site Contamination NEPM. Human Health Investigation Levels have been estimated for a range of trace elements, various pesticides, asbestos, benzo(a)pyrene, phenol, PCBs and total petroleum hydrocarbons (NEPC 1999; 2013). Levels in excess of human health Investigation Levels are not necessarily unacceptable or likely to pose risks (e.g. to human health), but do trigger a requirement for further site investigation and risk assessment. No generic health based Response Levels have been derived, and generally it is required that the concentrations of contaminants should not result in an unacceptable excess cancer risk or hazard quotient, or an unacceptable impact on ecology where this is relevant. If the assumptions on which the Investigation Levels have been formulated are relevant to the site, then the Investigation Levels may form response levels.

Groundwater guidelines are derived from Australian water quality and drinking water quality guidelines and are intended to be protective of aquatic ecosystems, livestock and human health (NEPC 1999; 2013). One set of values are used as Investigation Levels at the point of extraction and Response Levels at the point of use, or point of discharge. Levels have been set for a range of metals and organic compounds including solvents, pesticides and phthalates. In practice, the more recent Australian Drinking Water Guidelines 2004 published by the National Health and Medical Research Council and the Natural Resource Management Ministerial Council are referred to for advice on potable water use, and the ANZECC Fresh and Marine Water Quality Guidelines 2000 for advice on a range of other water uses, including protection of aquatic ecosystems, irrigation, stock watering, and recreational water use.

Ecological investigation levels are to be drawn up by the States and Territories, but interim levels have been derived for some substances. The interim guidance (NEPC 1999) is based on consideration of phytotoxicity for copper, chromium and lead; and soil survey data from four Australian capital cities for barium, phosphorous and sulphur.

Guidance on the use of ecological risk assessment has been provided in the NEPM using a tiered approach. ANZECC (2000) has published guidance related to ecological impacts on aquatic systems.

The Site Assessment NEPM also considers impacts on buildings and sets a guideline warranting further investigation of 2,000 mg/kg of sulphate in soil.

Where there are no guideline values derived in the Site Assessment NEPM then site specific risk assessment is required, in compliance with the procedures set out in the NEPM. Additional State level guidance may be available (CRC CARE 2009). For example, in NSW guidelines have been produced that provide risk assessment processes for particular polluting activities (somewhat akin to Defra Industry Profiles).

The Site assessment NEPM describes a procedure for site investigation in two stages: preliminary and detailed site investigations. The preliminary investigation is based on a desk study and site walkover, with the detailed site investigation, if required, being based on intrusive investigations using a sampling plan based on the preliminary investigation. Site investigations may proceed in multiple stages in practice. Risk assessment is carried out by reference to Response Levels derived using standard default assumptions outlined in the NEPM. The Site Assessment NEPM specifically states that Investigation Levels are not to be considered as remediation targets. Remediation needs are determined on the basis of risk assessment, although the NEPM Site Assessment Procedure leaves open scope for remediation even where risk assessment is not considered necessary⁶ (NEPC 1999).

Detailed guidelines (NEPC 1999) are provided for Investigation Levels for soil and groundwater; data collection, sample design and reporting; laboratory analysis of potentially contaminated soils; health risk assessment methodology; ecological risk assessment; risk based assessment of groundwater contamination; health-based Investigation Levels; exposure scenarios and exposure settings; community consultation and risk communication; protection of health and the environment during the assessment of site contamination; and competencies and acceptance of environmental auditors and related professionals.

Wastes are regulated separately to contaminated soil. Hence if the excavated soil is classified as waste, a different regulatory regime applies (McFarland et al. 2008).

⁵ Nadebaum (2009) suggests that 1 in 10⁵ is typically used as a default

⁶ Outlined in NEPM Site Assessment *Schedule A*

1.1.2 *Health screening levels for petroleum hydrocarbons*

CRC CARE published health screening levels (HSL) for petroleum hydrocarbons (Friebel and Nademaum 2011a, b). The HSL are described as 'being designed for investigation and screening purposes only' (Friebel and Nadebaum 2011b p.35). The values place particular emphasis on the vapour exposure pathway and reflect Australian conditions. Exposure from the release of vapours from dissolved phase contamination is considered. Values are generated for a range of land uses (including construction workers) and types of structure (including basements). Some indication on what levels of exceedance of the HSL should trigger consideration of acute exposure is provided (Friebel and Nadebaum 2011b p22). Toxicological benchmarks for threshold and non threshold (excess lifetime cancer risk based on a linear dose-risk level basis) behaviour are reported. One of the reasons for changing the toxicological benchmark is reported as being 'regulatory purposes'.

1.2 Recent and ongoing Developments

The 2004 review of the Site Assessment NEPM made a series of recommendations (CRC CARE 2009). These included: clarifying the use, derivation and underpinning assumptions for Human Health Investigation Levels; extending the range of substances with Human Health Investigation Levels; developing Ecological Investigation Levels; harmonising Groundwater Investigation Levels with quality criteria for fresh and marine water; improvement of NEPM consideration of asbestos; updating and extending guidance for volatile compounds; and improvements in stakeholder and community consultation. The NEPC is developing a series of amendments to the Site Assessment NEPM in the light of this review, which was the subject of a public consultation in 2010. Nadebaum (2009) commented that an aim of the review work is to remove unnecessary conservatism in the approach. NEPC also recently announced the need to investigate links between climate change, water quality and soil health (NEPC 2010). Nadebaum (2011) recognised that the NEPM was complex and probably only understood well by 'a few'. He reported that the NEPM changes were to be finalised 'soon', and it now appears that this will occur late in 2012.

1.2.1 *Role of case-by-case decision making*

Across Australia site investigation and risk assessment follows a staged approach based on the Site Assessment NEPM, overseen by independent auditing. Decisions are made on a site specific basis by an independently audited process. Generic guidelines may be used to determine if further investigation and risk assessment of potentially contaminated land is necessary. However, decisions about risk management and

remediation are made on the basis of site specific risk assessment. Regulatory authorities are State or Territory based environmental agencies. Development planning decisions are made by local authorities, in consultation with environmental regulators in cases of suspect sites for many jurisdictions.

1.3 Approach's effectiveness

A number of case study examples are presented in this section, including manufactured gas plants, a "megasite" brownfield redevelopment, a former landfill site, monitored natural attenuation (MNA), and former agricultural sites.

Manufactured gas (from black coal) began in the 1840's in Australia and continued until the 1960s, and for some rural cities and towns until the late 1980s. The former West Melbourne Gasworks (in the state of Victoria) was redeveloped during urban regeneration between 1999 and 2005 (Mival et al. 2006). Construction of gasworks started in 1854 on swampy ground. The facility operated using black coal until 1962 when it switched to production from oil. Operations ceased in 1970. Above ground demolition left underground structures and contamination in place. Site specific acceptance criteria were derived based on health risks to workers and residents and ecological risks to the adjacent river and Victoria Harbour. An independent environmental auditor ensured compliance with human health based clean-up criteria derived to meet regulatory objectives. These criteria were derived on the basis of site specific quantitative human health and ecological risk assessment in consultation with the auditor. The site was excavated to a depth of 1.5 to 8 m. Excavated material was screened to remove scrap metal and reusable solids and concrete. Fines were treated by an undisclosed method and re-used where possible. 300,000 m³ of contaminated material was excavated, with the majority disposed of to landfill off-site. This volume greatly exceeded the amount initially estimated for. Capping and containment of the worst contaminated areas was considered, but was found to have minimal cost benefit. Groundwater was recovered and NAPLs were recovered in a treatment plant. Treated water was discharged under permit to foul sewer. The contract price was AUD\$44.35 million. A number of management difficulties occurred over the project, in particular in conjunction with dust and odour control. The site was one of the first to be regulated by a new state groundwater policy. The site was deemed a "source site" for aquifer pollution. The auditor undertook impact modelling for the potential impact of dissolved phase contamination from residual materials left after remediation and a number of aftercare monitoring measures were put in place.

Hobbs (2005) reports on the development of a megasite in the Australian Capital Territory remediated as part of a brownfield redevelopment. The site had been subject to a variety of uses, including: bulk fuel storage, electricity generation, timber mills and construction depots, blacksmiths and metal fabricators, maintenance workshops, rail yards, and bulk warehousing. Soil was contaminated by inorganic and organic contaminants over large areas at depths of up to 6.5m. Overall 40,000m³ of material was excavated and treated. The site had a shallow water table (<2.5m depth). Contamination included free phase NAPL and dissolved phase contaminants over many areas including one site of 1 ha. Over 4 megalitres of groundwater was recovered and treated. The site management required compliance with requirements of an Environmental Protection Agreement agreed with the ACT Land Development Agency and ACT Environmental Protection Agency, with the establishment of a site audit scheme, overseen by an independent government appointed advisor/reviewer. A staged approach was adopted which included the design of a site-specific audit protocol, but also to address higher risk areas and unlock valuable sites for early development. Soils and groundwater were treated on site by unspecified methods.

A complete 2009 remedial action plan for a former municipal landfill site which also accepted hazardous wastes is available from a NSW Department of Planning portal⁷. Also on the site was a disused brick pit apparently filled in with inert materials. The development area is to be redeveloped for retail, transport infrastructure and parking and includes the former landfill (Coffey Environments Pty Ltd 2009). The landfill ceased accepting wastes in the mid 1970s and the landfill areas were capped over 2004-6. Site investigation in 2008 found that the principal contamination problems at the surface (i.e. the landfill cap) are potentially elevated levels of asbestos (which was found in three out of 50 samples taken) in fill materials and methane migration. A hydrocarbon contaminated hot spot was also detected. The remedial approach suggested is a combination of passive and active venting for methane, excavation and removal for the hydrocarbon hotspot and asbestos contaminated materials. All works have to respect the integrity of the existing site capping. The key role of the auditor for the project is made clear in this remedial action plan including reviewing all working methods and ensuring protection of the existing landfill cap, with the landfill cap needing to be fully reinstated after any necessary works. The remedial action plan sets the remediation goals; selects the remedial approach; sets out working methods for the preferred remedial approach; sets out a requirements for remediation environmental and occupational health and safety planning; outlines regulatory compliance and validation requirements for the remedial works; and provides a framework for the long term aftercare. Groundwater is

⁷ <http://majorprojects.planning.nsw.gov.au/>

not likely to be used for potable water but may influence nearby surface water features. The investigation levels presented in the ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality were considered applicable and highly conservative for the groundwater at the site. Methane risks were assessed using 1996 NSW guidelines for solid waste landfill sites. Groundwater sampling indicated substantial impacts consistent with the landfill, breaching several of the groundwater thresholds previously agreed. These impacts were considered consistent with local groundwater quality, which was not being used as potable water. Consequently groundwater remediation was considered unnecessary for this site. Remediation acceptance criteria were the commercial or industrial health-based investigation levels set out in the NSW implementation of the Site Assessment NEPM (e.g. as reported in DEC 2006).

McLaughlin et al. (2006) reviewed the application of MNA in Australia. MNA is regulated at a State level; there are no protocols or guidance documents produced by the Commonwealth. The approach to regulation across all of the States reviewed is similar to that of the UK, being based on risk assessment and a lines of evidence approach, with a 30 year maximum timeframe. MNA is mainly considered for aquifers contaminated with petroleum hydrocarbons, BTEX and chlorinated solvents; largely shallow sand aquifer systems. Australian jurisdictions vary with regard to the circumstances in which MNA is allowable for example in Queensland source removal is necessary in the first instance, whereas this is not a requirement in NSW. Many jurisdictions have produced guidance and regulations for MNA use, and others are developing these. UK technical guidance is a strong influence on approaches across Australian jurisdictions.

A particular type of contaminated site problem in Australia is agricultural land that was used to produce fruit which has become contaminated by pesticides. For example, in NSW special guidance has been produced for former orchards and banana plantations. These sites may need to be remediated if they are to be used for residential purposes. Vertical mixing is often used for this purpose and NSW guidance allows for the use of Human Health Investigation Levels as remediation criteria (CRC CARE 2009).

1.3.1 Proportionate

Remediation in Australia is based on a suitable for use approach, with criteria delineated over a range of land-use options much as in the UK. The case studies above support a view that site investigation and remediation work is carried out in a highly pragmatic way. However, groundwater remediation criteria differ from soil remediation criteria. In NSW the preferred remediation objective is to clean groundwater to background levels, otherwise sufficiently to protect aquatic resources, or failing that to the maximum extent

practicable (CRC CARE 2009). It is not clear how this paradigm was applied to the groundwater remediation decision made in the NSW landfill case study.

1.3.2 Targeted

The Site Assessment NEPM is applied to a wide range of contaminated site types. The landfill case study indicates that its thresholds are used as remediation acceptance criteria, even although the Site Assessment NEPM expressly recommends against this. Operating mining sites may be separately regulated but closed and abandoned mining sites are assessed under the NEPM. For example in NSW operating mines are managed under the Department of Primary Industries (CRC CARE 2009).

1.3.3 Consistent

As far as they are reported the management steps for the contaminated sites in all of these examples appear to follow the sequence of steps summarised above. However, it is interesting that the NEPM Groundwater Investigation Levels were not used as a trigger for the landfill site assessment. Instead a measure was used that related to ecological impacts, presumably because the groundwater was not destined for potable use. The case studies also illustrate the use of independent auditing through site management and the use of site specific risk based remediation targets.

1.3.4 Transparent

Decision-making guidance for contaminated site management in Australia is published and available for use at national and state levels. In this regard contaminated land policy in Australia is transparent. Indeed it appears to be accompanied by large swath of technical guidance in several jurisdictions. The site audit process provides an independent level of scrutiny for site management decisions and several jurisdictions require public reporting of site environmental information. There would also appear to be some room to manoeuvre in terms of agreeing criteria for remediation objectives, and this may not be entirely consistent with published guidance, for example the use of Investigation Levels as remediation acceptance criteria..

1.3.5 Internal perception

Power (2007) suggests that most Australian environmental authorities prefer treatment based remediation approaches to minimise landfill of contaminated soil. He also suggests that the linkage between contaminated soil and groundwater is recognised in the "more mature" environmental regimes in Australia, particularly, Victoria, Queensland and New South Wales. Contaminated ground water responses include: source removal, containment or treatment based solutions. Van Deur (2009) states that surveys have

demonstrated a number of common concerns about the contaminated land regime in Australia, including: determining the original polluter/owner for historical pollution to assign liability, retrospectivity, the powers of the regulator, the management of orphan sites, the redevelopment of brownfields and the role of planning process, and the use of institutional controls. McFarland et al. (2008) comment on the assessment of PAH contamination, in particular in Australia, where it is based on consideration of levels of total PAH and benzo(a)pyrene. This includes a rule of thumb: "total PAH is 20 times benzo(a)pyrene levels". McFarland et al. argue for a more nuanced approach.

The independent auditing system is seen as very successful (Nadebaum 2009). It has been in operation for nearly 20 years and thousands of sites have been certified. It is a rigorous system because auditors can be personally liable. It is accepted by all parties and can provide for rapid certification. The approach shifts cost, liability and staffing requirements to the private sector, and provides for "independent review" when problems arise which facilitates regulation.

1.3.6 *External perception*

The International Committee for Contaminated Land⁸ (ICCL) carries out questionnaires of member countries, which include Australia. In 2007 it found that in Australia there was increasing reliance on site-based risk assessment to identify cost-effective approaches and a shift to in situ retention from 'dig and dump' approach (ICCL 2007).

1.4 Estimate of scale

1.4.1 *Estimates of the amount of potentially contaminated land*

Australia has an area of 7.7 million square kilometres and has 21.8 million inhabitants. Contaminated site data is typically compiled (if it is compiled) by individual States.

Hamblin (2001) in a chapter of the 2001 State of the Environment Report for Australia estimates the total number of contaminated sites in Australia to be in the region of 80,000, with the majority being in Victoria and NSW. This estimate encompasses mining and mineral processing, waste management, petrochemical industry, manufacturing and process industry sites. However, the true extent of land contamination problems is not known in detail, and Hamblin's estimate is based on the range and distribution of potentially polluting activities across Australia. A 2006 State of the Environment Report was published but does not contain any information about contaminated sites. A 2011

⁸ www.iccl.ch

report⁹ quotes CRC CARE estimates of some 160,000 contaminated sites across Australia, containing as many as 75,000 different contaminants ([s3.3.7](#)). CRC CARE's figures are based on unreported information regarding the number of contaminated sites and its figure of 160,000 contaminated sites comprises 60-80% within cities and 30% that are government owned (Peter Nadebaum pers comm. Relating to R Naidu, paper to ALGA and ACLCA 15 June 2011, paper to ALGA on 26 November 2011, also to Ecoforum 2011).

NEPC (2009) report that in Western Australia 1,029 sites were classified as potentially contaminated and 232 were listed on its public on-line register¹⁰ (2008-9). A "State of the Environment" report published by the Western Australia government in 2007 mentioned a 1995 study which estimated that there were 1,500 contaminated sites in the state. As of March 2007, 1358 contaminated sites had been formally reported, with numbers expected to rise sharply (EPA-WA 2007). Western Australia received 48 site audit reports over 2008-9.

A 2003 State of the Environment report for South Australia stated that the number of contaminated sites was unknown (EPA-SA 2003).

The Department of Environment, Climate Change and Water (DECCW) of NSW has published a State of the Environment Report for NSW (DECC 2009). This claims that all known significantly contaminated sites in NSW are recorded on the public contaminated land management register. The number of regulated contaminated sites grew from 243 sites in June 2006 to 272 in June 2009. However the rate of increase has slowed from a peak of 34 additional sites in 2002-03 to about 12 a year in 2009. Approximately 37 sites are reported to the NSW Government each year but after investigation usually less than half are found to be significantly contaminated and so requiring regulation. From June 2006 to June 2009 the number of remediated sites increased from 79 to 114. CRC CARE (2009) report that a 1997 estimate suggested that there were 60,000 contaminated sites in NSW of which 7,000 would be likely to require remediation.

Tasmania maintains an up to date inventory of properties where land use activities that may result in land contamination have occurred. The Hazardous Activities and Industries List (HAIL) is broken down into 53 categories of former land use (Table 2).

Table 2 Categories used in the Tasmanian Site Contamination Register

⁹ <http://www.environment.gov.au/soe/index.html>

¹⁰ <http://www.dec.wa.gov.au/content/view/5627/1557/>

	Category	Description
U	Unverified Hazardous Activity or Industry	A site for which past or present use has been reported as one that appears on the Hazardous Activities and Industries List, but the reported use has not been confirmed.
V	Verified Hazardous Activity or Industry - not sampled	A site with the potential for contamination, due to a confirmed past or present activity on the Hazardous Activities and Industries List, but the site has not been sampled.
1 (a)	Contaminated Land	A site which has been sampled in accordance with best practice, demonstrating that the hazardous substances present pose significant risks to people, and/or the likelihood of significant adverse effects on environmental receptors.
1 (b)	Managed for (identified) land use	A site which has been sampled in accordance with best practice, demonstrating that there were hazardous substances present at the site. However, risks to people and/or specific environmental receptors were regarded by Council as being managed at the report date.
1 (c)	Verified Hazardous Activity or Industry – limited sampling, risk not quantified.	A site which is a verified hazardous activities and/or industry and has been sampled, but not in sufficient detail to quantify risks to people and/or the environment from the hazardous substances present.
2 (a)	Remediated for current land use	A site that has been remediated. Validation sampling in accordance with best practice shows that the concentrations of hazardous substances are acceptably low and do not present risks to people and the environment.
2 (b)	Sampled and suitable for current land use	A site which has been sampled in accordance with best practice, demonstrating that the hazardous substances are acceptably low and do not present risks to people and the environment.
E	Not a HAIL	Information shows that either this site has never been associated with any of the specific activities or industries on the Hazardous Activities and Industries List, or the hazardous substances present are at, or below, background concentrations.

The Victoria Government published a State of the Environment Report in 2008, but this did not discuss contaminated site numbers of notifications¹¹.

The National Pollutant Inventory¹² provides a listing of emissions from operational facilities in Australia. It has emission estimates for 93 toxic substances and the source and location of these emissions.

1.4.2 *Estimates of progress*

The progress with contaminated land management has been reviewed in Section 1.3.1. Nadebaum (2009) commented that “thousands of sites have been certified” by the independent auditing system over its 20 years operation. Current numbers of audits being completed are in the order of 200 per year in NSW, and 200 per year in Victoria (Nadebaum *personal communication*).

¹¹ Commissioner for Environmental Sustainability, Victoria, *Living Well Within Our Environment*, <http://www.ces.vic.gov.au/CES/wcmn301.nsf/childdocs/-FCB9B8E076BEBA07CA2574F100040358-E19B7405977F2A4ECA2574F1001F15AC?open>

¹² <http://www.npi.gov.au/>

1.5 Deciding who pays

1.5.1 *'Polluter pays' principle*

In terms of civil liability, like other countries Australia's approach to contaminated land encompasses the "polluter pays" principle: the person causing the contamination is held responsible, but the owner or occupier may be held responsible as well. Liabilities are strict in that liability is independent of intention or negligence, and are retrospective. Liable parties may seek recompense from other parties who may be partly or wholly responsible for contamination, but preferably only after remediation has been completed. There are also criminal liabilities linked to various breaches of environmental legislation.

Jurisdictions have not imposed on their authorities a duty to proactively identify contaminated sites (CRC CARE 2009). There is a legal requirement to disclose land contamination to environmental authorities in New South Wales, Queensland, Victoria and the Australia Capital Territory (Power 2007). Several jurisdictions maintain a public register for contaminated sites: ACT, Queensland, South Australia and Western Australia; and some jurisdictions (Western Australia and Queensland) classify contaminated sites, e.g. with regard to their status. State authorities maintain contaminated land information for sites in more informal structures in NSW Tasmania and Victoria (CRC CARE 2009).

State governments have modified the Common Law principle of caveat emptor with legislation introducing a duty to disclose information about the title to and quality of land being sold. In some States and Territories this extends to a requirement to disclose environmental information. Disclosure may also be required under fair trading legislation. Purchasers of companies acquire all liabilities of the company, including those of land contamination on sites owned or occupied by the company, and historic land contamination from sites it no longer owns or occupies. Environmental indemnities offered by a vendor to a purchaser can be problematic for a purchaser, who would have to prove that the vendor was responsible, and not the purchaser itself or another previous site occupier. Liabilities for lenders vary between jurisdictions for example in terms of whether or not there is a hierarchy of liability, but also in some cases lenders may be liable for remediation costs (in general land contamination reduces property value and hence collateral) and also in some cases local authorities. Transfer of liabilities by contract is generally not possible. However, it is possible to allocate responsibility for remediation costs (CRC CARE 2009).

Insurances for risks from contamination can be difficult to purchase (Power 2007). Recent legislation in Western Australia allows the possibility of liability transfer (Van Deur 2009).

Nadebaum (2009) commented that there is “almost no litigation” because of its independent auditing system. However, actions under Common Law are possible in cases of negligence where a duty of care has been breached, and contract breach (CRC CARE 2009).

1.5.2 *Liability of the state*

Public organisations face the same liabilities for contaminated sites in their ambit as Private Sector organisations.

In 2003 the Australian Commonwealth Government published a report discussing the remediation of the Maralinga nuclear test site over 1993 to 2001. This was part paid for by a payment of £20million for the UK government in 1991, and part paid for by the Commonwealth government (Department of Education, Science and Training 2003)

1.5.3 *Liability of the owner/ occupier*

See Section 1.4.1.

1.5.4 *‘Orphan’ sites*

There are no orphan site funding regimes in most jurisdictions (CRC CARE 2009). However in Western Australia orphan sites are dealt with by the state (EPA-WA 2007). In addition Public Sector funding may be available for managing derelict mining sites, e.g. in NSW (CRC CARE 2009).

1.5.5 *Role of state funding.*

Western Australia has limited state funding for orphan sites. Otherwise across Australia jurisdictions may spend public money on contaminated site remediation on an ad hoc case by case basis. Similarly public-private partnerships play a role in brownfield redevelopment in Australia.

1.6 Contaminated land sector

1.6.1 *Size*

The US Commercial Service (2009) estimates the size of the Australian remediation sector to be US\$175 million. To put this in context, the total environmental market

(goods and services) was valued in 2007 at close to \$18 billion (US Commercial Service 2007). The 2009 US Commercial Service report suggested that the market size had peaked, with a focus shifting towards smaller sites. A wide range of remediation treatment technologies are available in Australia, and their prospects may be improved by an increasing scarcity of landfill space and cost of landfill disposal. However the growth of organisations such as ALGA and SuRF Australia and the continued vigour of annual events such as Ecoforum and CleanUp as well as the renewal of the funding for CRC CARE suggests otherwise.

A wide range of remediation technologies are available and have been used in Australia as shown in a series of case studies from the late 1990s in the NATO/CCMS Pilot Study Reports (US EPA 2003). In recent years there has been a shift to on-site treatment (eg thermal desorption) rather than landfill disposal, reflecting the limitations on landfill acceptance of certain wastes and the increased cost of landfill disposal. Australian remediation contractors have exported services to the UK, e.g. ex situ bioremediation carried out in Hull by EESI Consulting¹³.

1.6.2 Main drivers

It is estimated that 80% of contaminated land assessment and remediation is triggered by site redevelopment across Australia (CRC CARE 2009). The remainder is triggered either by regulatory order or on a voluntary basis to pre-empt an order of some kind. However, Fowler (2007) commented that there is limited if any Public Sector funding for brownfield redevelopments, and that the concept of “brownfields” is just emerging in Australia (in 2007). For example, in NSW there is no formalised policy relating to brownfields redevelopment (CRC CARE 2009).

1.7 Attributing financial liability

Since most remediation is redevelopment driven, most remediation costs are borne by the developer or land owner.

1.8 Success of the regime

There are established contaminated land management regimes under environmental protection and planning in Australia. The use of independent auditing to review contaminated land management and facilitate signoff is seen as a success story by both

¹³ Personal communication from National Grid Properties Ltd, 2009 & VHE website: <http://www.vhe.co.uk/news-article.aspx?gg=177§ion=News&title=Hull-Gasworks-Remediation-Shortlisted-for-the-Ground-Engineering-Awards-2008&x=2008>

regulators and consultants. There are concerns that in part the site assessment approach may be overly conservative (Nadebaum 2009; 2011), and exploring the concepts of “Sustainable Remediation” and achieving a balance between environmental protection, economic and social factors has been a particular focus of ALGA activities and will continue with the further CRC CARE program of research. The Site Assessment NEPM is currently under review, and this is involving a major review of the basis for the assessment of site contamination and will provide a more comprehensive set of contamination investigations levels. For a country of 22 million people there are a large number of jurisdictions which show some divergence in how contaminated land is managed. This may be a limit on market activities, although of course the vast size of the country is a factor in this. Brownfields remains a relatively unexplored area for policy in Australia, despite redevelopment being the overwhelming driver for contaminated land assessment and management, and through CRC CARE activities can be expected to become a focus in coming years.

1.8.1 *Positives*

- A strong technical base for the Site Assessment NEPM and subsequent contaminated land management regulation and guidance across Australia
- Independent auditing of site management is seen as facilitating operations and regulatory compliance
- Pragmatic approaches to establishing risk management objectives
- Recognition of the importance of site-specific risk assessment for determination of contamination and any subsequent remediation requirements
- A wide range of available treatment based remediation technologies
- Groundswell of interest in sustainable remediation

1.8.2 *Negatives*

- Low level of policy interest in brownfield renewal
- Contaminated sites management is to some extent fragmented over several jurisdictions
- Some concern over the degree of conservatism and complexity in the Site Assessment NEPM
- NEPM only considers assessment, not remediation; absence of national guidance on management and remediation

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APPENDIX 2 BELGIUM-FLANDERS

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2 BELGIUM-FLANDERS

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Belgium is a Federal kingdom composed of three (French, Flemish and German speaking) communities and three regions (Belgian House of Representatives, 2009). Belgium's three distinct administrative regions are Flanders, Wallonia and Brussels. This review has mainly concentrated on the Flemish speaking region of Flanders. A brief overview of policy in Wallonia and Brussels is given by Malien & Vandenberghe (2011). A more detailed review of Flemish policy is provided by van Dyck et al. (2010).

The aim of Flemish contaminated land policy is to remediate historical contamination, prevent and if necessary clean up new soil contamination and to use the soil certificate as an information management and sharing tool (Lutyens, 2011). Flanders first introduced land contamination legislation in 1995, which introduced a number of key elements:

- New and historic contamination are treated differently; new pollution should be prevented but there is flexibility in addressing historic contamination
- "new" contamination must be remediated immediately
- Polluters and site owners were not made liable for contamination but were given a "duty to remediate"
- Data on land quality was linked to property transfer of land with risk-activities, such that soil sampling is needed every time land bought or sold
- All investigations are conducted by experts licensed by the government (Dries et al., 2008)

Willie et al (2010) report a 40 year timescale within which Flanders aims to have remediated historic soil pollution however this timescale has not been reported by other Flemish and specifically OVAM writers.

Following a review of the initial legislation, a revised and updated Decree on Soil Remediation and Soil Protection was passed by the Flemish Parliament in October 2006 and came into force in June 2008 (Dries et al., 2008). The basic principles remain unchanged. Under this legislation, the Public Waste Agency of Flanders (OVAM) has a specific role in the management of contaminated land in Flanders including Maintaining a

Land Information Register and issuing Soil Certificates. The Land Information Register is an inventory of all the parcels of which data are known at the OVAM.

In addition to the Land Information Register, each municipality also maintains an inventory of the potentially contaminated land (soils with risk-activities) present within its territory (Decree on soil remediation and soil protection (11th October, 2006))

The purpose of the Soil Decree is to remediate contaminated land in Flanders and to prevent new contamination. In order to achieve this objective, the following measures are taken:

1. Attribution of soil certificates. Ever since October 1, 1996, a soil certificate is needed when transferring a piece of land. If the land is registered as contaminated, this is marked on the certificate. If not, the soil certificate is called 'blank'.
2. Follow up of preliminary and descriptive soil investigations. A preliminary soil investigation provides indications on the degree of soil contamination. Further steps depend on the degree of contamination and the time it has been established (new or historical). In the next step, a descriptive soil investigation tries to find out about the dispersion of the contamination and its future evolution. Moreover, the risks of the contamination are evaluated. If the contamination is more established, a soil remediation project must be worked out.
3. Evaluation of soil remediating projects involves verification of the completeness and sustainability of the remediating projects submitted, requesting necessary advice and supervision on the publication of the project, drafting a certificate of conformity or requesting changes/additions.
4. Follow up and control of remediation works in progress. If any safety or control measures are needed after finishing the works, OVAM provides a follow up. At the end, OVAM issues a final report, stating the results of the works.
5. OVAM actively participates in the policy of remediation, financing and development of 'brownfields', e.g. grounds that are contaminated as a consequence of toxic industrial activities and which will be given a new destination after remediation. OVAM pro-actively participates in alternative remediating methods as well.

In case where the parties involved are unable or refuse to remediate or have received an exemption of their duty to remediate, OVAM has the right to intervene in order to prevent the situation worsening. Its main objective is to restore, remediate and/or manage environmental damage. Initially these sites are listed on an official 'soil remediation list', established yearly by the Flemish government. Moreover, OVAM takes safety measures if soil contamination can cause immediate danger to man or the environment and the owner fails to solve the problem.

The soil management policy in Flanders is explicitly designed in the interests of sustainability (i.e. it fulfils the needs of the present generations without jeopardising future generations' possibilities of fulfilling their needs). The policy utilises target values

that “correspond to the level of contaminating substances or organisms on or in the soil, allowing the soil to fulfil all its functions without the need for imposing any restrictions”.

2.1 The boundary between “contaminated” and “not contaminated”

Under the 2006 Decree, “soil contamination” is defined as “the presence – as a result of human activities – of substances or organisms on or in the soil or the buildings and structures erected on it, which adversely affect or may affect the quality of the soil either directly or indirectly” and “severe soil contamination” is soil contamination which constitutes or may constitute a risk of adversely affecting man or the environment” In evaluating “severity” the legislation recognises a consideration of :

- a) the characteristics, functions, uses and properties of the soil;
- b) the nature and concentration of the contaminating factors;
- c) the possibility of dispersion of the contaminating factors (Decree on soil remediation and soil protection, October 11th, 2006)

There is a distinction between pre 29 October 1995 (old) contamination and post 28 October (new) contamination (Gommeren, 2007).

2.1.1 Role of number-based thresholds

Numeric thresholds are used in the assessment of land contamination in Flanders. The Soil Remediation Decree 1995 differentiates between “new” (i.e. since 1995) and “historical” contamination (i.e. before 1995):

- For historical contamination, number-based thresholds do not seem to have been set. Instead, remediation should reduce contamination to levels that do not “effectively or potentially constituting a risk of adversely affecting man or the environment by using the best available techniques not entailing excessive costs” (i.e. BATNEEC) (Dries *et al.*, 2008).
- For new contamination, remediation should aim to achieve **target values**, which are levels on or in the soil the allow “the soil to fulfil all its functions without the need for imposing and restrictions”. Where this cannot be achieved using a BATNEEC, the aim can be relaxed to a standard better than the **soil remediation standards**. If even this cannot be obtained by BATNEEC, then the aim can be further relaxed to that required for historical contamination (Dries *et al.*, 2008).

However, a number of changes to these procedures were made in the revised Decree.

These target values “correspond to the level of contaminating substances or organisms on or in the soil, allowing the soil to fulfil all its functions without the need for imposing any restrictions”. These values are set by the Flemish government and represent “the level of contaminating substances or organisms found as normal background level on and in noncontaminated soils with comparable soil characteristics” (Decree on soil

remediation and soil protection, October 11th, 2006). Flemish policy aims to ensure that these targets are maintained “as much as possible”.

The Flemish Government also set soil remediation standards. These values correspond to a level of soil contamination that entails a “considerable risk of harmful effects for man or the environment, taking into account the characteristics of the soil and the functions it fulfils” (Decree on soil remediation and soil protection, October 11th, 2006). Where these values are exceeded an immediate Site investigation is required. If this confirms that the standards are exceeded “soil remediation shall be initiated without delay.” (Decree on soil remediation and soil protection, October 11th, 2006).

The Vlier-humaan model (Flemish Instrument for the Evaluation of Human Health Risks) is used for site-specific human health risk assessment and for deriving soil remediation standards. It was developed in 1995 by VITO (Flemish Institute for Technological Research) and a commercial version was produced by the Dutch Van Hall Institute for use by accredited soil experts carrying out risk assessments under the Soil Decree (Ceenaeme & Van Gestel, 2010).

More recently, the S-RISK model is being developed by Vito to take account of scientific and user interface developments over the past 15 years (Ceenaeme & Van Gestel, 2010). S-Risk can be used to: calculate generic soil remediation standards protective of human health; calculate site specific human health assessment criteria (as part of a descriptive soil investigation); calculate site specific remediation objectives (within a soil remediation plan).

2.1.2 *Role of case-by-case decision making*

The Flemish Government is competent to accredit a natural or legal person as a soil remediation expert, as well as to suspend or withdraw the accreditation as a soil remediation expert (Decree on soil remediation and soil protection, October 11th, 2006).

2.2 Approach’s effectiveness

Flemish policy is the subject of frequent invited presentations at conferences and workshops across Europe. Over the past 15 years many thousands of sites have been investigated and remediated. Elements of Flemish practice can be seen in various drafts of the proposed soil framework directive. A review of progress to 2005 reported by Dries et al. (2008) suggested that the approach was effective but with scope for improvements.

Table 2-1. Contaminated land assessment and remediation case studies for Flanders

Site	Former Use	Assessment / Remediation Driver	References
Umicore	Production of non ferrous metals	Diffuse contamination of heavy metals (mainly Cd and Zn)	www.ovam.be
Gent 'Brugse Poort' and 'Rabot'	Now residential area, former industrial activities like gasworks, metal processing	Groundwater is not fit for consumption, partly remediation due to PAH	www.ovam.be
Lokeren	Tanning	Contamination with Mercury	www.ovam.be
Carcoke Zeebrugge	Cokes factory	Removal of tar	www.ovam.be

2.2.1 *Proportionate*

In codifying the revised Decree in 2006, several changes were made to streamline the process and reduce bureaucracy with the aim of making costs to problem holders more proportionate. These included removing obligations to submit preliminary information to the regulator and powers for the regulator to demand interim reports. It is also reported that these modification shave reduced the regulator's workload. Other changes have allowed the investigation and remediation to be phased, particularly at large/complex sites, for example DNAPL plumes (Dries et al., 2008).

Another innovation was the introduction of fast-track authorisation for small-scale remediation projects or phases of a larger remediation plan that will be completed in less than 180 days. The regulator has an obligation to review such applications within 30 days. Allowing such projects to proceed without undue delays (Dries et al., 2008). The new decree also introduces the potential for risk management actions where actual remediation is not technically feasible (Dries et al., 2008); in this situation the duty to remediate is suspended as long as risk management measures are being implemented.

Ter Meer (2005) describes how integrated management strategies were developed to mitigate risks at the megasites associated with multiple sources around the ports of Rotterdam and Antwerp. These strategies were possible within the provisions of the SRD but required the active cooperation and involvement of regulator (such as OVAM).

2.2.2 *Targeted*

Under the updated Decree, land transfer remains the most important trigger for the assessment of land contamination (Gommeren, 2007; Dries et al., 2008). An initial soil investigation was required before any property transfer where potentially contaminative processes were likely to have occurred. If this indicated that significant contamination was present a detailed soil investigation was required and, if remediation was needed, a Soil Remediation Plan plus a financial guarantee had to be submitted to OVAM, the Flemish regulator. However, this process could take more than 9 months and potentially effect land transfer deadlines.

Consequently, the original SRD provided that where the standard timescale was inappropriate the government could modify the procedure on a case-by case basis. To further facilitate property transfer, the updated decree allows for property transfers after only SI works but provides for arrangements between the buyer and seller to agree the likely remedial costs and for the buyer to assume the responsibility for remediation (Dries et al., 2008).

2.2.3 *Consistent*

No details relating to the consistency of the regime were identified in the various case studies. Indeed, the flexibility of the legislation appears to be regarded as one of its main strengths (De Smet et al., 2008; Dries et al., 2008; Maene, 2008; Van de Wiele et al., 2008). This implies that there is a potentially inconsistent case-by-case approach to some sites. In particular, this flexibility appears to be crucial in relation to complex sites (or regional contamination issues) as it allows the use of bespoke procedures agreed with the regulator or, in many cases, the active involvement of the regulators. It should also be noted that this flexibility was increased during the recent updating of the Decree. For example, the new decree allows for investigation and remediation of portions of the overall site (e.g. where a redevelopment or construction project is planned), before work commences on the site as a whole.

It is also notable that where areas of historic industrial activity have created complex regional contamination issues (i.e. megasites), such as Vilvoorde/Machelen (Van de Wiele et al., 2008) and Rabot-Blaisantvest (Maene, 2008), OVAM and its scientific support organisations (e.g. VITO) have been actively involved in detailed work with for example local authorities and development agencies to formulate master plans and local procedures that comply with the requirements of the Decree and yet facilitate the profitable redevelopment of these areas.

For example, in Vilvoorde/Machelen OVAM commissioned VITO to map contamination on a regional scale, to investigate the risks to groundwater and to determine regional groundwater solutions (Bronders et al., 2008; Van de Wiele et al., 2008). However, no cost-benefit assessment of this regulatory involvement has been presented in the literature and so it is not possible to determine if the development etc. would have proceeded in any case.

The central role of a single regulator, OVAM, also seems to improve the consistency of implementation.

2.2.4 *Transparent*

It is likely that the requirement for accredited soil remediation consultants to prepare and write the soil remediation plans and verification reports etc. required by the Soil Remediation Decree (SRD) improved both the consistency and transparency of contaminated land management in Flanders.

Another important transparency feature of the Flemish system is the publication of biannual summary reports by OVAM/VITO communicating “lessons learnt” to consultants and contractors (Gregoir et al., 2008).

The original decree only allowed the risks relating to current uses. Baring in mind that the Flanders regime, was initiated by property transfers, this approach lead to considerable uncertainty where the transfer would involve a change of use. Consequently, the new decree allows the consideration of both the original and proposed land uses (Dries et al., 2008). Consequently, the developer can obtain regulatory agreement relating to the new land use during the property transfer.

(1) Willie et al (2010) describe the complex remediation of 461 asbestos and zinc contaminated private plots, spread across a large urban area, within fourteen months. Recognising the particularly sensitivities surrounding asbestos, “OVAM provided intensive communication throughout the entire project, linked to a personal approach by the soil remediation expert and the contractor. In addition, OVAM ensured that there was intensive cooperation with the local governments and environmental services which often served as the first point of contact during the project.” They highlighted the importance of a personal approach to ensure a successful remediation.

2.2.5 *Internal perception*

OVAM funded an evaluation of the effectiveness of the original 1995 Decree provisions in 2006 involving questionnaires sent to over 2000 companies (Dries et al., 2008). Some of the findings of this research are outlined below. In general, the findings supported the objectives and procedures contained in the original decree. However, some shortcomings were also highlighted such as difficulties in linking remediation to subsequent redevelopment and problems applying it to large/complex sites. These have hopefully been addressed in the revised Decree of 2006 but no evaluation of that Decree has been carried out.

2.2.6 *Positives*

The following is based on the summary of the 2006 survey reported by Dries et al. (2008). Of the respondents who were problem holders (425 companies):

- 85% reported that the decree had been the critical element for them to starting to consider land contamination issues
- ~30% found the Flemish system of licenced experts “optimal” while only 20% described it as “bad”
- 43% approved of the use of land transfer as the trigger for site investigation and remediation being required, while only 15% considered it the wrong option
- 37% of respondents either rather disagreed or fully disagreed that the decree had retarded the growth of the company, while only 30% fully agreed or rather agreed
- 56% reported that they had not noticed any indirect effects of the decree such as project delays *etc.*
- 76% of companies reported that they now paid more attention to preventing pollution incidents than before the decree was enacted

Of the consultants and contractors who responded:

- Nearly 100% reported greater awareness and a change towards preventative actions in their clients
- 60% suggested that the decree had caused no noticeable delays to real estate development
- Only 40% reported that there had been an increase in the skill level of employees due to the decree but 90% reported an improvement in the quality of investigation and remedial activities

2.2.7 *Negatives*

Of the respondents who were problem holders (425 companies):

- Roughly 50% reported that the apportionment of costs on the “present owner/keeper of the land” was unjust

Of the consultants and contractors who responded:

- 82% suggested that the licensing of soil experts needed reviewing
- more than 50% considered contaminated land liabilities under the decree could force some companies in to bankruptcy

2.2.8 *External perception*

Note Section 2.2.

2.3 Estimate of scale

2.3.1 *Estimates of the amount of potentially contaminated land*

OVAM has estimated that there were 76200 potentially contaminated sites in 1995 (Dries et al., 2008).

Gommeren (2007) reported that between 1996 and 2007 more than 1.800.000 soil certificates had been issued.

2.3.2 *Estimates of progress*

By the end of 2010, 30657 of 76200 potentially contaminated sites had been subjected to initial investigations and 11502 sites had been identified that required more detailed

investigations. 4701 of the sites subject to detailed investigations were subsequently found to require remedial action. At the end of 2010, 3153 remediation works were under way and 1707 works had been completed. This equates to roughly one third of the potentially contaminated land having been assessed and action taken where needed within 15 years of the Decree's existence.

Cardon and van Dyck (2009) reported that between 1996 and 2008 60% of remediation was ex situ, 30% in situ and 10% involved 'isolation'. Ex situ remediation was estimated to involve some 20 Million tonnes of excavated soil per year. Most (75%) remediated soil is reused as soil, 20% as construction material and 5% is further treated before use.

2.4 Deciding who pays

Responsibility for remedial costs lies primarily with the present owner or keeper of the land. However under the new decree land can be transferred after the soil investigation has been completed and the remediation costs would transfer to the buyer (presumably with a suitable adjustment in the transfer price) (Dries et al., 2008).

2.4.1 *'Polluter pays' principle*

Flemish policy only partly adopts the polluter pays principle. The primary responsibility lies with the person permitted to operate a site and the secondary responsibility lies with the site owner (Wille et al. 2010).

2.4.2 *Liability of the state*

In a review of the operation of the original SRD and the likely performance of the updated decree Dries et al. (2008) concluded that the regime mainly used market instruments and required very little public money.

However, this limited cost to public funds appears to rely to some extent on the regulator (OVAM) utilising the flexibility afforded to its decisions under the SRD. For example, the City of Ghent authorities in driving the redevelopment of contaminated land in the Rabot and Blaisantvest areas of the city needed to attract private investment. Initially remediation cost estimates of between €50 and €30 million would have required considerable private subsidy to make the scheme viable. This subsidy was minimised by consultation with OVAM and an agreement to allowed a risk-based approach to be implemented (Maene, 2008). This apparently acknowledged by De Smet (2008) who describes the use of "tailor-made legal solutions", where needed, which are allowed for within the SRD.

OVAM also appears to have had to adopt a proactive role to facilitate the cost-effective management of complex sites, such as gas works (i.e. MGP sites), where cost effective remediation may not otherwise be possible. For example, OVAM has negotiated a "covenant" with those responsible for MGP sites that allows for "a phased approach" and allows for feasibility projects to allow cost-effective solutions to be identified (De Smet et al., 2008).

2.4.3 *Liability of the owner/ occupier*

Flanders is reported to have "the most controlled approach" to liability transfer on sale of land (NICOLE, 2011).

The 2006 Flemish Decree on soil remediation and soil protection, distinguishes clearly between the obligation to remediate soil pollution and the liability regarding the damage caused by the soil pollution and the remediation measures. Thus, the Decree designates clearly the person whose obligation it is to remediate the soil pollution. The duty to remediate falls upon the following hierarchy of persons. First in the frame for liability is the operator of the installations present on the land where the soil contamination originated; secondly, the user of the land where the soil contamination originated, and; thirdly, the owner of the land where the soil contamination originated. The Decree also provides for a possibility to be exempt from the obligation to remediate. According to certain conditions and with regard to the status of the person (operator, land user or land owner), a person can be exempted from his obligation / duty to remediate. As for the liability for soil pollution: the Decree does not explicitly deal with liability rules but refers to the general rules of civil liability (Belgian Code Civil, articles 1382-1384) for historical contamination. For new contamination there is an 'objective liability'.

2.4.4 *'Orphan' sites*

If parties charged with a remediation obligation are unwilling or unable to clean up contamination that presents significant human or environmental risks, the Public Waste Agency of Flanders (OVAM) will take responsibility and add the polluted site to its remediation programme. OVAM will execute and finance the full cleanup in a first stage. Afterwards the liable party will be prosecuted to recover all remediation expenses.

2.4.5 *Role of state funding.*

Pursuant to the Soil Decree, the party with the obligation to undertake soil remediation is expected to take the initiative in soil survey and remedial procedures. In some cases the OVAM may itself undertake the remediation process (this constitutes an 'ex officio' intervention by the OVAM). In most cases where the OVAM acts in an ex officio capacity,

it pertains to cases in which the status of 'non-culpable owner' has been conferred. In other cases where no progress is reported, or when the party obligated to carry out remediation activities fails to accomplish its obligations, OVAM will proceed to a default notification. In the event that such a measure remains is not responded to, OVAM will draw up a decision to proceed to ex officio soil remediation action.

The planning of these ex officio interventions is updated on an annual basis, OVAM establishes every year the list of the soil remediation projects for which the implementation will be ex officio or continued by the OVAM in the course of the coming year. For 2008, this involved 2 million EUR for soil surveys and more than 25 million EUR for the actual remediation works and subsequent follow-up activities. The costs incurred as a result of an ex officio intervention can be recovered either from the party that has been negligent in the fulfilment of its obligations as established in the decree, or from the party liable for the contamination

The soil decree foresees some alternatives financing solutions:

1. Since 2004 fuel retail stations can rely on the Fund for soil remediation around petrol stations ([BOFAS](#))- for the execution and support of their soil remediation. BOFAS is financed on a 50/50 basis by producers and consumers (product tax). Petrol stations continuing their operations enjoy support up to 62.000 EUR while stations ending their activities receive full compensation for the cleanup of historical soil pollution.
2. Vlabotex is a fund supporting the remediation of pollution caused by dry cleaning activities before 29 October 1995 (Fonteyne et al. 2010)). Dry cleaning SMEs joining the fund, are able to transfer their remediation obligation and execution to Vlabotex. By means of compensation the applicant is obliged to pay a fixed annual contribution spread over a maximum of 30 years. The Vlabotex-fund is partly (50%) financed by a Flemish government grant.
3. Bankruptcy trustees charged with the liquidation of unsellable polluted sites can request support from OVAM. OVAM can take over the ownership and remediation obligation for one euro. OVAM will then finance and organize the soil remediation, and afterwards resell the site.
4. The Soil Decree introduced some new alternative financing concepts: co-financing and financial strength support. Through the mechanism of co-financing Flemish authorities subsidize the remediation of contaminated sites, hereby taking into account the degree of responsibility in causing of the pollution. Financial strength support will only finance those parties who cannot afford an expensive soil remediation. These instruments are not yet in to force due to the fact that there are no executive orders yet.

2.5 Contaminated land sector

2.5.1 Size

Although no details of the number of certified remediation experts have been obtained, the size of the contaminated land sector in Flanders is considerably small than the UKs

given the number of sites remediated over the past 15 years. Approximately 100 sites per year have been remediated 1995-2010 (Section 3.2.2).

2.5.2 Main drivers

The requirements of the SRD have led to considerable pressure to deal with highly contaminated urban sites, particularly former gas works. Together with resources or OVAM and state research agency VITO, significant experience of such sites has been gained by Flemish contractors who now have an international reputation in dealing with these sites and are consequent market opportunities (De Smet et al., 2008).

2.6 Attributing financial liability

The Soil Decree does not explicitly deal with liability rules for historical soil pollution but refers to the general rules of civil liability (Belgian Code Civil, articles 1382-1384). For new contamination the Decree mentions the 'objective liability'.

2.7 Success of the regime

Flanders is seen as having one of the more mature and sophisticated contaminated land management sectors in Europe. It relies on the centrally influential role of OVAM.

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APPENDIX 3 CANADA

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3 CANADA

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Canada is a constitutional monarchy and has a federal structure. It has 10 provinces and 3 territories. The three territories are Nunavut, Yukon, and Northwest Territories. The provinces are: Alberta, British Columbia, Manitoba, Saskatchewan, New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, Prince Edward Island, and Quebec.

Contaminated land in Canada is mainly legislated for by the Provinces and Territories (Keller 2007, SAIC 2005). There is no legislation in place that specifically addresses the designation and remediation of contaminated sites at the federal level. There is some over-arching national legislation that affects the management of contamination on land and water:

- The Canadian Environmental Assessment Act: a site remediation may fall within the scope of this Act and so be subject to an environmental assessment if a federal authority is a proponent or funder / partial funder, has an interest in the property or issues any kind of permit or licence for the project.
- The Canadian Environmental Protection Act, 1999: Guidelines or codes of practice for federal sites could be developed to address the release of substances that are contaminants or pollutants and the remediation of sites contaminated by these substances under this Act
- The Fisheries Act: prohibits the deposit of “deleterious” substances into water frequented by fish or in any place where the substance may enter water frequented by fish. The Act requires that “all reasonable steps” be taken to prevent the deposit or, if the deposit occurs, to remedy any adverse effects.
- The Migratory Birds Convention Act, 1994 places a duty on High Contracting Powers to “seek means to prevent damage to such birds and their environments, including damage resulting from pollution”
- The Species at Risk Act, 2002 requires anyone convicted of an offence, in addition to any punishment for that offence, to “take any action that the court considers appropriate to remedy or avoid any harm to any wildlife species that resulted or may result from the commission of the offence”.

In 2008 over 18,000 were listed in the Federal Contaminated Sites inventory (<http://www.federalcontaminatedsites.gc.ca>). These include orphan sites, including abandoned mining sites in the North, and former military sites.

3.1 The boundary between “contaminated” and “not contaminated”

A contaminated site is a “site at which substances occur at concentrations (1) above background levels (background is defined as an area not influenced by chemicals released from the site under evaluation) and posing or likely to pose an immediate or long-term hazard to human health or the environment, or (2) exceeding levels specified in policies and regulations” (Contaminated Sites Management Working Group 1999).

Both legislation and approach to the regulation of contaminated land varies among Canadian jurisdictions (Table 3-1). The Canadian Council of Ministers of the Environment¹ (CCME) includes 14 environment ministers from the federal, provincial and territorial governments. Its aim is to promote cooperation on and coordination of inter-jurisdictional environmental issues. One of its main objectives is to propose nationally consistent environmental guidelines and standards. However, the CCME has no authority to implement or enforce legislation and, therefore, it is up to each jurisdiction to decide whether to adopt the CCME guidelines and standards. It has developed comprehensive environmental quality criteria for substances in air, soil, sediment and water (CCME, 2003). Subsequent updates are available from: <http://ceqg-rcqe.ccme.ca/>. Soil guideline summary tables are generally dated September 2007 (CCME 2007) though there are more recent errata and some substance specific files. Guidelines include:

- The Canadian Soil Quality Guidelines (CSQG) which are based on published literature on the effects of substances on human and ecological receptors for four land uses: agricultural, residential/parkland, commercial and industrial (see Section 3.1.2).
- The Canada Wide Standards for Petroleum Hydrocarbons in Soil (CWS-PHC) (CCME, 2001) aims to provide a consistent method of managing and remediating petroleum hydrocarbon contaminated soil in Canada. The standards take a tiered, risk-based approach. Tier 1 uses conservative, generic values that are based on assumed site conditions; the remaining Tiers 2 and 3 allow modifications for actual site conditions based on risk assessment outcomes.
- The Canadian Water Quality Guidelines (CWQG) which relate to the intended use of the water: protection of aquatic life and protection of agricultural uses (irrigation water and livestock). The aquatic life category is further divided into marine and freshwater. Guideline values are typically based on toxicity data for the most sensitive of the ecological receptors used to calculate the guideline value.

Individual jurisdictions vary in their uptake of the CCME guidelines as indicated in Table 3-1.

¹ <http://www.ccme.ca>

Table 3-1 Legislation and Criteria in Contaminated Site Management across Canada (summarised from SAIC 2005 and the Miller Thomson *EnviroNotes!* Newsletters²)

Jurisdiction	Legislation	Assessment Criteria Documents	Full use made of CCME criteria			Definition of Contaminated Land / Site
			CSQG	CWS-PHC	CWQG	
Alberta	Environmental Protection and Enhancement Act (EPEA)	Tier 1 Criteria for Contaminated Soil Assessment and Remediation (March 1994) Surface Water Quality Guidelines for Use in Alberta (Nov. 1999) Guidelines for the Designation of Contaminated Sites under the Environmental Protection and Enhancement Act	No – also Alberta values are not land use specific	Yes – added a “natural areas” land use	Surface freshwater only	EPEA does not provide a definition for “contaminated site.” Identification of contaminated sites is based on the presence of a “substance” which has caused or is causing a significant “adverse effect.” A “substance” includes anything that is capable of becoming dispersed in the environment (including energy); an “adverse effect” means impairment of or damage to the environment, human health, safety or property.
British Columbia	Waste Management Act (repealed July 8, 2004) Spill Reporting Regulation Environmental Management Act Contaminated Sites Regulation	Contaminated Sites Regulation (CSR) of the British Columbia Waste Management Act (1995) August 1, 2008, Protocol 13: Screening Level Risk Assessment	Only for industrial and commercial land use	No	No	Contaminated site = an area of land in which the soil or any groundwater lying beneath it, or the water or the underlying sediment, contains (a) a hazardous waste, or (b) another prescribed substance in quantities or concentrations exceeding prescribed risk-based or numerical criteria or standards or conditions [set out in the <i>Contaminated Sites Regulation</i>] <i>Environmental Management Act</i>
Manitoba	Contaminated Sites Remediation Act 1997 (CSRA) Dangerous Goods Handling and Transportation Act Contaminated Sites Remediation Regulations	Guideline for the Designation of Contaminated Sites in Manitoba (1997) Manitoba Water Quality Standards, Objectives & Guidelines - Technical	Yes	Yes	Yes	CSRA defines “contaminant” in the context of contaminated sites, as “ any product, substance or organism that is foreign to or in excess of the natural constituents of the environment at the site and that (a) has affected, is affecting or may affect the natural, physical, chemical or biological quality of the environment, or (b) is, or is likely to be,

² http://www.aboutremediation.com/legalIssues/legal_env_bulletins.asp Accessed June 2010

Jurisdiction	Legislation	Assessment Criteria Documents	Full use made of CCME criteria			Definition of Contaminated Land / Site
			CSQG	CWS-PHC	CWQG	
		Draft (2001) Guideline for Site Environmental Investigations in Manitoba (June 1998)				injurious or damaging to the health or safety of a Person." According to the CSRA, soil, surface water or groundwater is contaminated if it has been permeated or infused with a contaminant
New Brunswick	Clean Environment Act (CEA) Petroleum Product Storage and Handling Regulation Water Quality Regulation	Guideline for the Management of Contaminated Sites Version 2 (November 2003) Record of Site Condition (version 2.0) Atlantic Risk-Based Corrective Action Version 2 (October 2003)	Only for industrial and agricultural land use	No, uses Atlantic Risk-Based Corrective Action Version 2	No	The CEA does not define "contaminated land", but prohibits the release of contaminants into the environment if they might cause harm.
Newfoundland and Labrador	Environmental Protection Act (EPA) The Storage and Handling of Gasoline and Associated Products Regulations Heating Oil Storage Tank System Regulations	Newfoundland Contaminated Sites Cleanup Criteria (March 1999) Guidance Document for the Management of Impacted Sites Atlantic Risk-Based Corrective Action Version 2 (October 2003)	Only for industrial and agricultural land use	Yes, but use of Atlantic Risk-Based Corrective Action Version 2 also possible	No	"Contaminated site" is defined by the EPA as a site designated by the Minister: where the minister is of the opinion that a substance that may cause, is causing or has caused an adverse effect is present in an area of the environment, the minister may designate that area of the environment as a contaminated site.
Northwest Territories	Environmental Protection Act	Environmental Guideline for Contaminated Site Remediation (2003) Spill Contingency Planning and Reporting Regulations	Partial use	Yes	Yes	The Environmental Protection Act does not define contaminated site and does not contain any provisions to designate a site as contaminated. A spill of a contaminant, in excess of an identified amount, must be immediately reported to the Department, and this information may be used to identify potentially contaminated sites.
Nova Scotia	Environment Act	[Voluntary] Guidelines for the Management of Contaminated Sites in Nova Scotia (March 1996) Guidelines for the	Only for industrial and agricultural land use	No, uses Atlantic Risk-Based Corrective Action Version 2	No	The Environment Act defines a contaminated site, as a site designated as a contaminated site by the Minister, who may designate a site as contaminated if he or she is of the opinion that a substance that may cause, is causing or has caused an adverse effect is present in an

Jurisdiction	Legislation	Assessment Criteria Documents	Full use made of CCME criteria			Definition of Contaminated Land / Site
			CSQG	CWS-PHC	CWQG	
		Designation of Contaminated Sites Atlantic Risk-Based Corrective Action v2 (October 2003)				area of the environment, based on the guidelines.
Nunavut	Environmental Protection Act	Environmental Guideline for Contaminated Site Remediation (2003) Guideline for Spill Contingency Planning (draft), 2004	No	Yes	Yes	Nunavut upon establishing itself as a territory, adopted the policies and guidelines of the Northwest Territories with the intent of developing its own over time.
Ontario	Environmental Protection Act (EPA), leading to: Ontario Regulation 153/04 Ontario Regulation 298/02 Brownfields' Regulation 511/09 (amending 153/04)	Ontario Regulation 153 Records of Site Condition — Part XV.1 of the Act Soil, Ground Water and Sediment Standards for Use Under Part XV.1 on the Environmental Protection Act (March 2004)	No Commercial and industrial land use criteria are not distinguished	No	No	The EPA does not define contaminated site and it does not specifically provide for the designation of contaminated sites. However, it provides broader powers that allow the regulator to identify a site as contaminated.
Prince Edward Island	Environmental Protection Act (EPA)	Petroleum Contaminated Sites Guidelines (1999) Atlantic Risk-Based Corrective Action Version 2 (October 2003)	Only for industrial and agricultural land use	No, uses Atlantic Risk-Based Corrective Action Version 2	No	The EPA defines "contaminated site" as an area of the environment designated as a contaminated site by the Minister, who may designate a site as contaminated after considering any relevant evidence, standards, criteria and regulations
Quebec	Environmental Quality Act (EQA) Sustainable Development Act 2006	Soil Protection and Contaminated Sites Rehabilitation Policy (June 1998) Land Protection and Rehabilitation Regulation Spill Contingency Planning and Reporting Regulations	No	No, provides one value for $C_{10} - C_{50}$.	No	The EQA does not define contaminated site. However, it provides broader powers that allow the province's minister of the Environment to identify a site as contaminated
Saskatchewan	Environmental Management and Protection Act, 2002	Upstream Petroleum Sites Remediation	Only for industrial	Yes for interim use	Marine only	"contaminated site" = area that is designated or re-designated as a contaminated site by the

Jurisdiction	Legislation	Assessment Criteria Documents	Full use made of CCME criteria			Definition of Contaminated Land / Site
			CSQG	CWS-PHC	CWQG	
	(EMPA) The Environmental Spill Control Regulations The Hazardous Substances Waste Dangerous Goods Regulations Oil and Gas legislation	Guideline (Final Draft, March 1999)	and commercial land use			minister who is of the opinion that a substance may cause, is causing or has caused an adverse effect is present in an area; adverse effect = as the impairment of or damage to the environment, or harm to human health, caused by one or any combination of any chemical, physical or biological alteration. EMPA
Yukon	Environment Act	Contaminated Sites Regulation – CSR – O.I.C.2002/171 (2002) Spills Regulations Special Waste Regulations	No	No	No	The Environment Act defines “contaminated site” as an area of land in which the soil, including any groundwater lying beneath it, or the water including the sediment and bed below it, contains a contaminant which is in an amount, concentration or level in excess of that prescribed by regulation or allowed under a permit. The CSR further define “contaminated site” based on land use and general numerical soil standards

Table 3-2 Approach to Assessment, Remediation and Registration of Contaminated Sites across Canada (summarised from SAIC (2005) and Miller Thomson EnviroNotes! Newsletter³)

Jurisdiction	Assessment	Registration	Remediation
Alberta	Alberta Environment has powers to deal with site contamination, including environmental protection orders for substance release and reclamation, conditions in approvals and codes of practice and the designation of contaminated sites, as well as orders requiring remediation. Decisions will be based on the criteria documents listed in Table 3-1.	All unauthorised spills or escapes of substances must be reported. [It is not clear how this requirement applies to historic contamination – this same query applies to other jurisdictions too]. If remediation and reclamation are satisfactorily complete on specified land, the EPEA allows the Director to issue a reclamation certificate	Remediation may be voluntary or under an environmental protection order issued by the regulator. The term “remediation” is not defined and there are no remediation criteria. End points for remediation criteria are determined on a case by case basis in an agreed remediation plan or in an environmental protection order.
British Columbia	The “Director of Waste Management” can order a site investigation to assist in determining whether a site is contaminated. The director may issue an order for site remediation to any responsible person. The <i>Screening Level Risk Assessment Protocol</i> outlines the requirements to complete a Screening Level Risk Assessment for a contaminated site. Guidelines are broader in range than the CCME categories and include generic values that reflect different site conditions and the risk factors associated with the human and environmental receptors.	All unauthorised spills or escapes of substances must be reported. Following successful site remediation, a Director may issue a certificate of compliance to verify that a site has been remediated in accordance with agreed criteria.	Remediation is defined as: “action to eliminate, limit, correct, counteract, mitigate or remove any contaminant or the adverse effects on the environment or human health of any contaminant”. Completion is related to meeting environmental quality criteria set out in the CSR. Remediation plans may be approved by the director. It is also possible for remediation based on site specific health and environmental risk assessment
Manitoba	Sites may be identified under the Dangerous Goods Handling and Transportation Act (DGHTA) or under the Contaminated Site Remediation Act (CSRA). Where the regulator reasonably believes that a site may be contaminated, they may order an	All unauthorised spills or escapes of substances must be reported (DGHTA). Under the CSRA the regulator may require that remediation plans are made available for public inspection and/or review. Following a successful remediation, the	Once a site has been designated as contaminated, the regulator can order any potentially responsible person to prepare a remediation plan for scrutiny. Whether agreed voluntarily or under an order, remediation completion is dependent on meeting environmental criteria set out in the guidance

³ http://www.aboutremediation.com/legalIssues/legal_env_bulletins.asp Accessed June 2010

Jurisdiction	Assessment	Registration	Remediation
	investigation. If they determine that contamination is at a level that may pose a risk to human health, safety or the environment, the site may be designated as contaminated. For designated sites the Regulator determines what further investigation and remediation will be required.	regulator is required to issue a certificate of compliance to any person named in a remediation order that applies for the certificate. A similar certificate or closure letter may also be issued where a voluntary remediation has taken place.	documents listed in Table 3-1.
New Brunswick	The regulator can require any person who releases a contaminant into the environment to remediate the site. Guidance for contaminated site assessment and remediation is based on the Atlantic RBCA (see Section 3.1).	All unauthorised spills or escapes of petroleum products must be reported. A Record of Site Condition, once acknowledged by the regulator, becomes a public document	If a site is successfully remediated those responsible or the work prepare closure documents, including a record of site condition, for submission to the regulator. Based on the closure documents the regulator will conclude its Management Process and forward an Acknowledgement of Receipt.
Newfoundland and Labrador	Where the regulator believes a substance is present that may cause, is causing or has caused an adverse effect, the area affected may be designated as a contaminated site. A mandatory management process exists for designated sites. Action can be enforced where efforts by the responsible party are not timely or appropriate.	All unauthorised spills or escapes of substances must be reported.	For designated contaminated sites, the responsible party is required to conduct an Environmental Site Assessment and submit a Remedial Action Plan for regulatory review. Although this process is considered voluntary for non-designated sites, following it greatly facilitates site closure.
Northwest Territories	The <i>Environmental Guideline for Contaminated Site Remediation</i> encourages any person who suspects that they have a contaminated site to conduct a site assessment.	All unauthorised spills or escapes of substances above specified amounts must be reported. Following a successful remediation and the delivery of a closure report, the regulator will issue a letter advising that no further remedial action is required on a site	Remediation may be required by the regulator. If a remediation action fails to manage the contamination problem, the regulator may require the intervention by a third party expert. The <i>Guideline</i> provides criteria to determine completion of remediation.
Nova Scotia	The regulator may designate a site as contaminated if it is of the opinion that a substance that may cause, is causing or has caused an adverse effect, based on environmental quality criteria. The voluntary Guidelines for Management of Contaminated Sites require that any owner of a site who is aware that the site may be contaminated should carry out a site evaluation to evaluate the risks associated with the site. If the owner finds off-site impacts,	All unauthorised spills or escapes of substances must be reported where they may cause harm or are over a specified amount. There are no provisions that require the regulator to validate the certificate of compliance.	All reasonable steps must be taken to remedy contamination. The regulator may require the person responsible for a contaminated site may prepare a remedial action plan for approval by the regulator. Remediation may take place on a voluntary basis, or under an order. Upon completion of remediation those responsible for the work provide a certificate of compliance for the regulator.

Jurisdiction	Assessment	Registration	Remediation
	unacceptable on-site impacts or risks to human health, safety or the environment, the owner must submit a contaminated site notification report to the regulator.		
Nunavut	Generally follows a similar approach to the North West Territories.	Generally follows a similar approach to the North West Territories.	Generally follows a similar approach to the North West Territories.
Ontario	<p>The regulator can identify a site as contaminated under different circumstances. A local regulator can determine that a site is possibly contaminated in which case a control order may be issued to a potentially responsible party (site owner or previous owner; polluter; site occupier at the time of the contamination; process manager for the source of the contamination).</p> <p>Ontario Regulation 153/04, modified by 511/09 provides detailed information on Phase I and Phase II sites assessments, site condition standards and risk assessments. Use of generic and site specific risk assessment criteria is possible.</p>	<p>All unauthorised spills or escapes of substances must be reported.</p> <p>Sites may also be identified during municipal land use planning processes. The regulator can issue a certificate of prohibition against a property, which can be filed with the land registry. This provides notice to anyone interested in the property that it is subject to an order or decision by the regulator.</p> <p>Legislation provides for an Environmental Site Registry⁴ where records of site condition may be filed. Before filing a record of site condition, specific criteria must be met.</p> <p>The regulator may issue a certificate of property use based on an acceptable risk assessment.</p>	<p>There are no specific provisions or powers to address the remediation of a contaminated site. However, there are several order-making powers that the regulator can use to require remediation where a contaminant has been released into the environment and is potentially causing harm or is as a result of a spill.</p> <p>Of possible relevance also is the Toxics Reduction Act (2009), which seeks to reduce use of toxic substances in processes.</p>
Prince Edward Island	<p>The regulator may designate a site as contaminated after considering any relevant evidence, standards, criteria and regulations, and can require site assessment and remediation.</p> <p>Mandatory reporting requirements for spills serve as the primary means of identifying a potentially contaminated site.</p>	All unauthorised spills or escapes of substances must be reported, and their impacts determined.	<p>Guidance for contaminated site assessment and remediation is based on the Atlantic RBCA (see Section X.1).</p> <p>Site closure requires the preparation of a closure report to be submitted to the regulator. Upon receipt and acceptance of the Closure Report, the regulator can conclude its management process by issuing a letter advising that no further remedial action is required.</p>
Quebec	Where the regulator has reasonable belief that contaminants may be present in land, it can order a characterisation study.	All unauthorised spills or escapes of substances that may cause harm must be reported.	Where the regulator believes that contaminants are present in the land in a concentration that exceeds regulatory limit values, a remediation plan may be

⁴ <http://www.ene.gov.on.ca/environet/BESR/index.htm>

Jurisdiction	Assessment	Registration	Remediation
	<p>Any person intending to change the use of land of an industrial or commercial activity must perform a site characterisation study. Regulations prescribe how this should take place. Local authorities determine whether a site is contaminated on the basis of regulatory limit values (see Table 3-1).</p> <p>Quebec does not identify a commercial land use category; such sites are regarded as industrial or residential depending on their context.</p>	<p>All municipalities or other designated bodies must maintain a land register that includes a list of contaminated lands situated in its territory.</p> <p>If the remediation is successful, the owner of the land may apply for a notice of decontamination in the land register.</p>	<p>required from whoever has custody of the site. Following completion work the person required to carry out the work must provide the regulator with a certificate of an expert stating that the work was carried out in accordance with the plan.</p> <p>Remediation criteria may be risk based, except for petroleum contaminated soils which must be treated to generic criteria (ICCL 2009).</p>
Saskatchewan	<p>The Minister has the power to require investigation of suspected contaminated sites.</p> <p>Criteria include several agricultural use scenarios, and also for contained contaminated subsoil.</p>	<p>All unauthorised spills or escapes of substances must be reported.</p>	<p>Any person who is responsible for a discharge is required to take remedial measures that may include preparation of a remedial action plan. This may be enforced by an order if it does not proceed in a timely way.</p>
Yukon	<p>The Contaminated Sites Regulation (CSR) defines "contaminated site" based on land use and general numerical soil standards. [It does not apply to federally owned land.]</p> <p>The regulator may designate a site as contaminated based on these criteria.</p> <p>Guidelines are broader in range than the CCME categories and include generic values that reflect different site conditions and the risk factors associated with the human and environmental receptors.</p>	<p>All unauthorised spills or escapes of substances above specified amounts must be reported.</p> <p>Once a site has been remediated in accordance with an approved plan, the regulator must issue a certificate of compliance. The certificate of compliance does not warrant that the area of land is free of contamination.</p>	<p>The regulator may require further investigation of a designated site and preparation of a remediation plan.</p> <p>Any person who owns land that has been designated a contaminated site is required to obtain authorisation before undertaking specific prescribed activities; until an agreed remediation plan has been carried out..</p>

Table 3-2 shows that while definitions of contaminated land vary among Canadian jurisdictions, they are generally linked to some concept of harm or adverse effect, rather than being based on the simple presence of a contaminant at elevated levels. Most jurisdictions provide an explicit or implicit definition of what constitutes a contaminated site, and these are generally linked to the environmental quality criteria of that particular jurisdiction. Definitions are linked to the presence of substances and not types of site.

Contaminated site management approaches vary from jurisdiction to jurisdiction (as shown in Tables 3-1 and 3-2). Jurisdictions vary in the level of detail specified for contaminated site management, the criteria to assess and designate contaminated land, the requirement to notify regulators of land contamination, and whether or not (and how) the regulator will “sign off” remediated sites. In general most jurisdictions require the reporting of new contamination, but dealing with historic contamination appears to be more ad hoc. SAIC (2005) suggest that in nearly all jurisdictions there is mandatory reporting of past and ongoing contaminant spills or releases, and that is the primary means by which contaminated sites are identified. A few jurisdictions link the identification and management of land contamination with land development planning processes. Site assessment is typically linked to environmental quality criteria set out in guidance, and sites designated as contaminated are required to be remediated to agreed criteria (see also Section 3.2). Remediation may proceed on a voluntary basis or can be required by some form of legislative order.

All four of the Atlantic Provinces (Prince Edward Island; Nova Scotia; Newfoundland and Labrador and New Brunswick) have implemented the Atlantic Risk Based Corrective Action process along with their own legislation and guidelines (SAIC 2005). The Risk Based Corrective Action (RBCA) process is based on risk management where the risks posed by the contaminants are assessed as well as the likelihood that people or environmental resources could be harmed by the contaminant, and is an adaptation of the U.S. RBCA process (Atlantic RBCA 2007). It is based on four land uses: four land uses: agricultural, residential, commercial and industrial. There are six steps in the Atlantic RBCA cleanup: (1) Initial Notification; (2) Site Evaluation - Tier 1; (3) Remedial Action Plan or an Expanded Site Evaluation - Tiers 2 and 3; (4) Review of the Remedial Action Plan; (5) Remedial Action Plan Implementation; and (6) Compliance Monitoring and Site Maintenance. The Atlantic RBCA process is supported by a detailed “tool kit”, which is available on line. Consultations on v3 closed on 17 June 2011 and a new release is due later in 2011⁵.

⁵ <http://www.atlanticrbca.com/eng/index.html>

There is variation in the legislative frameworks for the management of contaminated sites across Canada. The various jurisdictional approaches reviewed by SAIC in 2005 range from comprehensive statute-based programs to simple remediation policies as indicated in Table 3-1. Jurisdictions vary in the potential for using site specific risk assessment in decision making, the inventorying and reporting of suspect and contaminated sites, and in public access to information and what information is available for public inspection. Jurisdictions also vary in their approach to regulating and validating site management. Accredited professionals have taken a significant role in contaminated site management in Ontario and British Columbia (as in the Australian system – See Appendix 1). They have also done so since January 2008 Alberta (Fowler 2007; Alberta Environment 1995-2011).

3.1.1 *Role of number-based thresholds*

In Canada environmental quality criteria for soils, water and sediment have been developed by the CCME (See Section 3.1). However, the majority of jurisdictions have modified these to different extents (as shown in Table 3-1). Definitions of contaminated land or sites, while similar across jurisdictions, do vary; and the role of number-based thresholds also varies (also shown in Table 3-1).

The CCME criteria for soils, the soil quality guideline values, are intended to be protective of both environmental and human health. The lower of two guidelines obtained through the derivation values based on ecological risks assessment and human health risk assessment are used (CCME 2007C). The guidelines are intended to protect human health and key ecological receptors that sustain normal activities for four land use categories: agricultural, residential/parkland, commercial and industrial using generic land use scenarios. Two generic soil types are considered: coarse-textured soils (sand and gravel - defined as soils with a median grain size of 75 microns or greater), and fine-textured soils (silt and clay - defined as soils with a median grain diameter less than 75µm). Where possible separate guidelines are developed for coarse and fine-textured soils. These guidelines are for contaminated site assessment and remediation and are not intended for the management of pristine sites or directly to evaluate soil amendments prior to their addition to soil.

The level of ecological protection considered depends on site type. For agricultural, residential/parkland uses the guidelines are predicated on maintain ecological functioning that sustains the primary functions of the site. A range of ecological receptors are considered that are intended to be representative of maintaining this functioning. Both direct and indirect exposure pathways are considered, e.g. ingestion and via ground and surface water, respectively. The same ecological receptors are considered for,

commercial, and industrial land use scenarios, but the level of protection is reduced to correspond with the lower protection levels required by these land use categories.

Human health soil quality guidelines values are intended to be concentrations of contaminants in soil at or below which no appreciable human health risk is expected. Levels for threshold and non-threshold toxicants (e.g. carcinogens or germ cell mutagens) are derived differently, taking into account daily background exposure from air, water, soil, food, and consumer products. Indirect exposure pathways resulting from contaminated soils, such as contaminated groundwater, contaminated meat, milk and other produce, infiltration into indoor air and wind erosion resulting in deposition on neighbouring properties are also considered, using conservative models. For non-threshold substances excess lifetime cancer risks of 10^{-6} to 10^{-5} are used.

Soil quality guideline values (CCME 2007) are used both as a threshold for site assessment, and as criteria for remediation endpoints. A range of values have been estimated, including various trace elements, BTEX, phenol, PCBs, some PAHs, some pesticides, and PCDDs/PCDFs. Earlier remediation criteria derived by CCME in 1991 are used where they have not yet been replaced by the soil quality guideline values (CCME 1991).

The CCME has also developed indexing tools to assist site prioritisation. The Soil Quality Index (CCME 2007B) combines measurements across several contaminants and their relationship to guideline values as a single index, the Soil Quality Index (SoQI).

The SAIC review (2005) concluded that each jurisdiction takes a slightly different approach to the management of contaminated sites. However, in general, one of the following three approaches has been employed:

- adoption of the CCME environmental quality criteria (Manitoba, Newfoundland and Labrador, Northwest Territories and Nunavut);
- adoption of the criteria format for the soil, water and sediment categories but establishment of their own values or a combination of their own values and CCME values (British Columbia, Alberta, Saskatchewan, Québec, and Yukon); and,
- categorizing soil and water guideline values based on whether the medium is at the surface or subsurface and whether the water is for potable or non-potable uses or the soil overlies water that is for potable or non-potable uses (Ontario, New Brunswick, Nova Scotia and Prince Edward Island).

The CCME guidance is regularly updated, and there may be a time lag for the adoption of new developments by those jurisdictions that have used the CCME criteria. Jurisdictions

also vary in the range of substances for which criteria are available, with the broadest range being specified in Ontario, Quebec and British Columbia and Yukon, and more limited ranges in other jurisdictions.

SAIC (2005) also concluded that where jurisdictions that have adopted their own values within the CCME format, have generally established water values that are higher (i.e., more "lenient") than the CCME values. On the other hand, for soil values there was no general trend (i.e., some of the individual values adopted were higher and some were lower). Where provinces categorise their water criteria values as surface/subsurface potable/non-potable, generally the values associated with a potable water situation were more stringent than those associated with a non-potable water situation.

Unlike EU countries, excavated soil is not necessarily at risk of being regulated as a waste. For example in Quebec a soil can never be a waste and by extension, a contaminated soil can never be a hazardous waste. Soil and waste are not managed using the same criteria and are not directed to the same treatment or disposal facilities (ICCL 2009).

3.1.2 *Recent and ongoing Developments*

The Miller Thomson *EnviroNotes!* Newsletter⁶ indicates that policy and regulatory developments continue apace across the Canadian jurisdictions. Developments include a move in Alberta towards a more integrated approach to land use planning (under the Alberta Land Stewardship Act which came into effect in October 2009 and was amended in May 2011) and a more integrated approach to the sustainability impact evaluation of projects (considering environmental, economic and social impacts) under the draft Environmental Cumulative Effects Management Act.

Table 3-3 Characteristics of Cumulative effects management (After Government of Alberta, 1995-2011)

Outcomes-based	clearly defining, desired end-state
Place-based	meeting the differing needs of regions within the province
Performance management-based	using adaptive approaches to ensure results are measured and achieved
Collaborative	building on a culture of shared stewardship, using a shared knowledge base
Comprehensively implemented	using both regulatory and non-regulatory approaches

A particular concern is to ensure that projects are not focussed on achieving benefits in one compartment (e.g. soil) without also considering other compartments (e.g. air and

⁶ http://www.aboutremediation.com/legalIssues/legal_env_bulletins.asp Accessed June 2010

water). The 2009 revision to Brownfield Regulations in Ontario (see Table 3-1) has combined more stringent generic site assessment criteria with the possibility of taking a site based risk assessment approach. A possible impact of this is that site holders whose site information met previous generic criteria and so not had to submit site condition records will have to re-evaluate their site assessments.

3.1.3 *Role of case-by-case decision making*

While CCME guidelines have established a national approach for generic and site specific site assessment, the way this has been implemented varies from jurisdiction to jurisdiction. Many jurisdictions, but not it appears all, allow for decision making based on site specific criteria. For example Ontario (Ontario Ministry of Environment and Energy, 1996) allows for site specific human health criteria to be used. These criteria “cannot be expected to fall below the background concentrations for uncontaminated parkland sites [as defined]” (p. 5). The Ministry has also developed maximum values which site specific criteria cannot exceed (p. 5).

At a federal level, Health Canada is “Establishing scientifically defensible risk assessment tools and guidance materials on preliminary quantitative and complex site-specific human health risk assessments” however “Guidance on Complex Human Health Site-Specific Risk Assessment” is “Unavailable at this time” (Health Canada, 2011).

Alberta’s cumulative effects management system seeks to step back from the site and help decision makers “to see the big picture and help those on the landscape to be more strategic and responsible in their development activities” (Government of Alberta, 1995-2011).

3.2 Approach’s effectiveness

A number of case study examples are presented in this section, including urban brownfield initiatives in several cities from the early 2000s, a “megasite” the Sydney Tar Ponds, a mine site and a military site. A particular difficulty in Canada is that remediation may be required for remote sites, for example sites associated with Cold War radar early warning sites (Nahir et al. 2004)

De Souza (2006) describes urban brownfield regeneration in four Canadian cities in Ontario, Quebec and British Columbia. Bradford, Ontario is a small city which was a centre for manufacturing at the end of the 19th century. It now has a number of brownfield areas in the centre close to residential neighbourhoods. This has resulted in depressed land values for these brownfields compared with the outskirts of the city that

are far less than the investment that would be needed for site remediation. The local government has been trying to secure support for Public Sector project financing, and also considering a wider range of potential land uses. However, at the time of the paper these efforts had not yet secured development interest. Hamilton, Ontario is a mid-sized city with a brownfield legacy left by the decline of the local steel industry. The local authority for Hamilton found a way to work around public financing restrictions for supporting private redevelopment in Ontario, and so has been able to use Public municipal funds to stimulate brownfield regeneration in partnership with the Private Sector. The local authority investment of CAN\$ 1 million is thought to have leveraged CAN \$ 15 million of private investment. Montreal in Quebec is Canada's second largest city and has a number of areas of brownfield resulting from industrial change. The municipal authority developed a brownfields policy with the Quebec government in the late 1980s, and successfully executed a pilot brownfields regeneration project. This led to a brownfield redevelopment programme in Quebec (Revi Sols⁷). This ran from 1998 to 2005 and facilitated Private Sector remediation and redevelopment by supporting 50-70% of site investigation and remediation costs (the higher level of support was offered for treatment based remediation). Currently the ClimatSol programme, funded under the Quebec Sustainable Development Act 2006, provides similar support (2007-2010)⁸.

It was estimated in 2003 that the Revi-Sols programme had led to the rehabilitation of 200,000 ha of land across Quebec (Beaulieu 2003). Vancouver, British Columbia is a mid-sized city. In Vancouver higher land values have led to brownfield redevelopment by the Private Sector, particularly in waterside locations. The local authority has sought to facilitate brownfields redevelopment through its planning process, and has also sought to maximise public benefits from the redevelopment work. More recently there has been a greater interest in brownfields regeneration in Canada and a number of funding and support initiatives across several jurisdictions are published on the Canadian "About Remediation" web site⁹. Rose (2006) describes two examples of brownfields remediation in Ontario, and a brownfields regeneration programme initiated by a municipality (the Kingston REAP programme). This programme offers grants for initial site studies and tax incentives for site remediation.

⁷ For example, see (Accessed May 2010)

http://ville.montreal.qc.ca/portal/page?_dad=portal&_pageid=5798,44213568&_schema=PORTAL&id=5539&ret=http://ville.montreal.qc.ca/pls/portal/url/page/prt_vdm_fr/rep_ville_ser/rep_enviro/rep_comm_enviro/liste_comm_enviro

⁸ <http://www.mddep.gouv.qc.ca/sol/terrains/climatsol/index.htm>

⁹ http://www.aboutremediation.com/sustainableCommunities/sc_successStories.asp

The Sydney Tar Ponds Remediation Project¹⁰ is one of Canada's largest and most contaminated sites (Keller 2007). The governments of Canada and the province of Nova Scotia announced on May 12, 2004 funding approval for CAN \$400 million (STAT-USA 2004). Remediation is complicated as it is located on a tidal estuary in the middle of a residential area. Contamination has been caused by 100 years of steel and coke production. The 34-ha Tar Ponds contain some 745,000 tonnes of contaminated sludges and sediments. The contamination spread to four sites around the former steel mill: the North and South Tar Ponds; a former coke ovens property; an old dump uphill from the coke ovens and a stream that carried contaminants from the coke ovens to the tar ponds.

The main contaminants are heavy metals (e.g. lead, arsenic, copper and zinc), PAHs, PCBs etc. Remediation is scheduled to take place from 2007-2013 at a cost of CAN\$ 265 million. Preliminary groundwork - including the removal of derelict buildings, the capping of a municipal landfill, and the installation of an interceptor sewer and an extensive review of applicable technologies were completed prior to this. Work on site also included a number of preventative works: removal of a cooling pond, construction of a cofferdam to close off the Tar Ponds from harbour access, relocation of a key water main, and the reconstruction of on-site watercourses.

The Tar Ponds contents are being treated at an onsite facility by cement based stabilisation/ solidification before containing them within an engineered containment system using two cutoff walls and a surface cap. The surface cap will allow revegetation. The cutoff walls will serve to control the movement of clean and contaminated groundwater over the coke ovens site. The site will be subject to long term monitoring and maintenance. An on-site water treatment plant will operate for approximately 25 years and will treat groundwater coming from the coke ovens area for organic and inorganic contaminants. Discharge criteria have been established for the treated water, which will be released into the reconstructed Coke Ovens Brook. Debris materials on site, such as demolition wastes and excavated materials are sent to an on-site materials handling facility, where they are either designated for solidification/stabilisation after crushing, recycling or dispatch to an approved landfill site.

There are a number of abandoned mine sites in Canada which are being remediated using Federal funds under the FCSAP (see Section 3.4.5). An example of this is the Giant Mine site, currently co-managed by Indian Northern Affairs Canada and the Government

¹⁰ <http://www.tarpondscleanup.ca/>

of the Northwest Territories¹¹. The Remediation Plan calls for the long-term storage and maintenance of the 237,000 tonnes of arsenic trioxide dust using in situ freezing to isolate the dust deposits placed below ground.

Argentia is a large former military in site in Newfoundland (Janes and Worthman 2005). The site was handed over to the USA in 1941 on a 99 year lend lease. The 3,700 ha site became a US Navy Facility and airfield with 15,000 to 20,000 personnel, which ceased operations in 1994. An environmental site assessment was completed in 1993/94, which included over 700 groundwater monitoring wells and 500 trial pits. This found areas of contamination with hydrocarbon, heavy metals, organic and PCB concentrations in excess of CCME guidelines.

The federal government is responsible only for the remediation of contamination caused by the US activities. In 1996 the Canadian Treasury Board authorised a CAN 81 million remediation project¹² over 10 years. The project was extended in 2004 to CAN \$106 million, and was expected to be completed in 2006/7. At the end of 1996 the Voisey's Bay Nickel Company announced a state-of-the-art, \$150-million dollar research and development, Hydrometallurgy Demonstration Plant for the site, to take advantage of a major nickel deposit in Labrador.

The remediation objective was to remediate the site to CCME Guidelines for Commercial/Industrial use, maximising recycling levels and transferring all federal property. A large amount of material was recycled for hiking trails. Two landfills were created on site, an inerts landfill and a secure contained landfill for hazardous materials. Other technologies included multi-phase vapour extraction and a water treatment plant.

3.2.1 *Proportionate*

Remediation in Canada is based on a suitable for use approach, with risk based criteria delineated over a range of land-use options much as in the UK. However, these categories vary between different provinces and territories within Canada. Site specific risk based decision making is also allowed for in most jurisdictions, although in some cases (for example petroleum contaminated soils in Quebec) it is not.

3.2.2 *Targeted*

In general site assessment and remediation criteria in Canada are applied in a broadly similar way independent of the site type.

¹¹ <http://www.ainc-inac.gc.ca/ai/scr/nt/cnt/gm/index-eng.asp>

¹² <http://www.argentia.ca/remediation.html>

3.2.3 *Consistent*

In general across Canada site management follows a similar: investigation, risk assessment and risk management approach. However, the exact approach varies between jurisdictions, as does the degree to which approaches must follow specified procedures, and how information regarding contaminated sites is registered and reported. A significant difference is that a minority of jurisdictions use independent auditing as part of the validation of site assessment and remediation work.

3.2.4 *Transparent*

Decision-making guidance for contaminated site management in Canada is published and available for use at national and state levels. In this regard contaminated land policy in Canada is transparent. Indeed it appears to be accompanied by large amount of technical guidance in several jurisdictions.

3.2.5 *Internal perception*

The variety and range of initiatives, policy and regulations (SAIC 2005), and the numbers of bodies that may need to be consulted with, are seen as a barrier to contaminated site management in Canada, for example the “plethora of legislation” relating to mine site rehabilitation (NAOMI 2009). It may also be a barrier to the demonstration of new soil treatment technologies in Canada (see Section 3.4.5). There is also thought to be a skills shortage that limits both regulatory work and service providers (About Remediation 2008).

3.2.6 *External perception*

De Sousa (2006) carried out a survey of urban brownfield redevelopment interests across a number of cities in Canada over 2002-4. He found that brownfield sites were beginning to be seen as a problem, but that their redevelopment was impeded by the lower development costs for greenfield sites. Diverse contaminated land policies across Canadian jurisdictions and disparate market conditions were also a barrier to more effective brownfields management across the country. The Canadian “About Remediation web site indicates that there is an increasing amount of interest in brownfields regeneration across Canada. A national brownfield strategy was published in 2003 (National Round Table on the Environment and the Economy 2003) which included a number of suggestions for measures at federal, provincial and municipal level to promote brownfield regeneration.

3.3 Estimate of scale

3.3.1 *Estimates of the amount of potentially contaminated land*

Canada has an area of 9.97 million square kilometres and has 33.7 million inhabitants. There is no central inventory of all contaminated sites in Canada; however Fowler (2007) quotes a 2005 estimate of 30,000 sites across the country. There is an inventory of sites that are federal responsibility; the Federal Contaminated Sites Inventory, which is publicly accessible. To date in this inventory, departments, agencies and consolidated Crown corporations have identified and classified over 18,000 contaminated or suspected contaminated sites in urban, rural and remote areas across Canada¹³. The number as of 2007-8 was over 11,000 sites, so the inventory has increased. Some jurisdictions are also investigating their own landholdings. (Government of Canada 2010, Keller 2007).

In general most jurisdictions have mandatory reporting of new contamination. However, there is no structured approach to a national inventory of formerly contaminated land outside the federal Contaminated Sites Inventory. Contaminated site data for other sites are typically compiled (if compiled) by individual jurisdictions (see Table 3-2). Manitoba, New Brunswick, Ontario and Quebec either have contaminated site registers, or require information about site conditions to be included in other land registers or otherwise made publicly available. The Province of Quebec has identified 450 provincial government owned suspect sites. (Beaulieu 2008). The Indian and Northern Affairs Canada Contaminated Sites Program¹⁴ has identified 1,825 suspect sites (da Silva 2005). 976 of these have been assessed and either no further action is required or remediation is complete. 825 sites require assessment and may require action. There are 63 known contaminated sites representing CAN \$754 million in liability. 35 of these sites are known to have human and environmental hazards and legal obligations including abandoned mines (14) and former military installations (21). As of March 31st 2007, 328 sites still required assessment / action, and the total inventory had increased slightly to 1,828. Provincial funding for remediation of these sites in 2005 was in the region of CAN \$18.5 million per year from 2005 to 7, supplemented by substantially more funding from the FCSAP (Northern Affairs Organisation 2007).

3.3.2 *Estimates of progress*

See Sections 3.3.1 and 3.4.5.

¹³ <http://www.tbs-sct.gc.ca/fcsi-rscf/home-accueil.aspx>, Date Modified: 2010-04-14, Accessed June 2010

¹⁴ <http://www.ainc-inac.gc.ca/nth/ct/ncsp/index-eng.asp>

3.4 Deciding who pays

3.4.1 *‘Polluter pays’ principle*

The Polluter Pays Principle is applied across Canada (Keller 2007, SAIC 2005). Table 3-4 summarises who is liable for contamination and how liability is assigned across the Canadian jurisdictions. The nature of parties that are held responsible under legislation varies between the jurisdictions, with some jurisdictions offering no clear specification. However, in general current and former owners or occupiers of sites may be held liable; and producers, transporters and users of contaminating substances. There may be exclusions where a party can demonstrate that they did not cause or contribute to the contamination and/or complied with prevailing regulations. Limited liability may also be faced by financial organisations linked with a site such as banks, lenders, landlords, receivers, assignees – providing that they did not contribute to the contamination problem. Several jurisdictions explicitly exclude from liability authorities that have taken over sites in lieu of taxes. National CCME guidelines issued in 2006 allow for liability to be transferred between parties provided that an adequate form of financial assurance is put in place (Fowler 2007).

3.4.2 *Liability of the state*

See also Sections 3.4.4 and 3.4.5.

3.4.3 *Liability of the owner/ occupier*

See Section 3.4.1. Purchasers of contaminated sites become liable for the contamination but would not be exposed to possible prosecution (Hombach, 2011).

Innocent developers, who have no historical link to any contamination issues, who remediate contamination on a brownfield site to enable its reuse can file a record of site condition with the regulator and are then no longer liable for that contamination (Hombach, 2011).

Table 3-4 Approach to Liability for Contaminated Sites across Canada (summarised from SAIC 2005)

Jurisdiction	Responsible Parties	Assigning Liability
Alberta	<p>Any person responsible for the substance that is in, on or under the contaminated site, or who the regulator considers caused or contributed to the contamination; the owner of the contaminated site; any previous owner who was the owner at any time when the contamination was in, on or under the site; a successor, assignee, executor, administrator, receiver, receiver-manager, trustee, agent or principal of any of the persons listed above.</p> <p>Specially excluded from liability are: a municipality that takes possession only because of tax arrears, and has not contributed to the contamination, and a person who investigates or tests a parcel of land for the purpose of determining the environmental condition, and has not contributed to the contamination.</p>	<p>The regulator can apportion the cost of remediation through an environmental protection order, depending on a set of "fairness" criteria. Responsible parties may enter into a voluntary agreement to effect remediation.</p> <p>Once an order has been issued, any person named in the order who fails to comply is jointly and severally liable for all costs necessary to carry out the order. The liability of executors, administrators, receivers, receiver-managers and trustees, is limited to the value of the assets that they are administering unless they contributed to contamination by gross negligence or wilful misconduct.</p>
British Columbia	<p>Current/previous owner or operator of the site; producer or transporter of a substance where they disposed of handled or treated in a way that caused the contamination.</p> <p>Liabilities are reduced for: transporters and arrangers; sureties; insurers and insurance brokers; • certain owners; producers arranging for transportation; construction on contaminated sites; secured creditors; receivers, receiver managers and bankruptcy trustees; trustees, executors, administrators and other fiduciaries; innocent acquisitions; lessors; municipalities; and transporters of contaminated soil.</p>	<p>Liability is joint and several. The regulator can assist responsible parties in deciding how to share liability, but can also impose how liability is to be allocated.</p> <p>The British Columbia Environmental Management Act ("EMA") gives those who have incurred costs of remediation a statutory right of action to recover costs from responsible persons.</p>
Manitoba	<p>Current or previous owner or occupier of the site when the contamination occurred or after it occurred; anyone who owns/owned or has/had possession, charge or control of a contaminant on the site; anyone who contaminated the site or directed someone else to contaminate; any creditor or principle if they contributed to the contamination. Liability can be assigned to individual directors and trustees.</p> <p>Exemptions are possible where a party demonstrated due diligence; for a municipality that became the site owner as the result of a tax sale; a person who acquired the land under the Expropriation Act; an owner or occupier whose land is contaminated only by migration from another property; an owner or occupier whose land was contaminated before they took possession and could not reasonably have been aware of the contamination; service providers who exercise due diligence.</p>	<p>Liability is joint and several. The regulator can assist responsible parties in deciding how to share liability, but can also impose how liability is to be allocated.</p>
New Brunswick	<p>Legislation does not define "responsible person" or provide any clear direction on the identification of responsible parties. Regulators can issue orders requiring clean-up to any person, and these are also binding on their heirs, successors, executors, administrators and assignees. The available guidance is that anyone whose conduct or failure to act caused or contributed to the contamination may be a responsible party.</p>	<p>Liability is determined by civil proceedings among the responsible parties.</p>

Jurisdiction	Responsible Parties	Assigning Liability
Newfoundland and Labrador	Any person responsible for a substance that is over, in, on or under the contaminated site; any other person whom the Minister considers to be responsible for causing or contributing to the contamination; the current or previous owner or occupier of, or operator on, the contaminated site. There may be limited liability for a successor, assignee, executor, administrator, receiver, receiver manager trustee; principal or agent.	Liability is joint and several. The regulator can assist responsible parties in deciding how to share liability, but can also impose how liability is to be allocated.
Northwest Territories	Responsible parties specified for spills and discharges, but apparently not historic contamination.	Liability is joint and several.
Nova Scotia	Any person responsible for a substance that is over, in, on or under the contaminated site; any other person whom the Minister considers to be responsible for causing or contributing to the contamination; the current or previous owner or occupier of, or operator on, the contaminated site. There is limited liability for a successor, assignee, executor, administrator, receiver, receiver manager trustee; principal or agent. These individuals are not liable for any amount beyond the value of the assets they are administering, unless they fail to exercise due diligence in the administration. Municipalities that acquire property through a tax sale are exempt from liability.	Liability is joint and several. The regulator can assist responsible parties in deciding how to share liability, but can also impose how liability is to be allocated.
Nunavut	Responsible parties specified for spills and discharges, but apparently not historic contamination.	Liability is joint and several.
Ontario	The current or previous owner of the source of contaminant; current or previous person in occupation of the source or contaminant; person who has or had charge, management or control of a source of contaminant; person who causes or permits the discharge of a contaminant.	Civil liability for compensation owing to loss or damage resulting from the spill of a pollutant is joint and several.
Prince Edward Island	The owner or previous owner of the contaminant or the source of the contaminant; the person who is or was in occupation of the contaminant or the source of the contaminant; the person who has, or had, the charge, management, or control of the contaminant or the source of the contaminant; those contravening regulations.	There are no legislative provisions that address the allocation of liability among potentially responsible parties.
Quebec	Remedial orders issued following the release of a contaminant may be directed at any person or municipality who has emitted, deposited, released or discharged the contaminant, with some exceptions to protect those not at fault. If urgent action is required, an order can be issued to any person or municipality that owns or has control of the contaminants.	The regulator can recover costs from any person or municipality that had custody of or control over the contaminants or is responsible for the discharge of contaminants. Liability is joint and several.
Saskatchewan	Includes owners and previous owners of the substance, any person who has possession, care or control of the substance; owners and previous owners of the land, principles, agents, etc. There are exclusions for municipalities, secured creditors, persons who demonstrated due diligence in the handling of the substance, and an owner of the land who could not be expected to know of the discharge	No specific provisions for assigning liability between parties; but liability is joint and several.
Yukon	The person who had possession, charge or control of the contaminant at the time of its release into the natural environment.	Unspecified

3.4.4 ‘Orphan’ sites

Abandoned mines exist within all mining jurisdictions in Canada. These sites, however, are not well documented with respect to either their numbers or their associated physical/health/environmental impacts and liabilities. There is a federal programme for managing orphan mining sites, the National Orphaned/Abandoned Mines Initiative¹⁵ (NOAMI). NOAMI is a co-operative program guided by an multi-stakeholder Advisory Committee. The committee assesses key issues and makes recommendations on collaborative approaches in the implementation of remediation programs across Canada. It includes mining industry, federal/provincial/territorial governments, environmental non-government organizations and First¹⁶ Nations. NAOMI's funding level is low, currently in the region of CAN \$350,000 per year (NAOMI 2009), and its role is limited to fostering collaboration between the various Canadian jurisdictions for: information gathering and inventory of mine sites; community involvement; reviewing barriers to progress; legislative and policy reviews across the jurisdictions and developing finding approaches.

Quebec has put in place the ClimatSol programme which provides support for remediation, but not complete funding for orphan sites. There appear to be no other federal or provincial orphan site programmes.

3.4.5 *Role of state funding.*

The Sustainable Development Technology Canada¹⁷ – SDTC (Keller 2007) has made up to CAN\$200 million available for sustainable soil remediation technology demonstration projects (taking into account the environmental economic and social elements of sustainability). The amount of interest in this scheme has been less than expected, and this is thought to be connected with the difficulties in developing demonstration scale proposals. 154 projects were approved by December 2008 (Robinson Research 2009); 13 of these were primarily focussed on soil, the others were in other focus areas for the scheme (climate change, clean air and clean water).

There are several Canadian federal brownfields initiatives (Keller 2007): the Brownfields National Round Table on the Environment and the Economy (NRTEE); the Canadian Brownfield Network (CBN) and “Green Municipal Funds”. The CBN delivers outreach and capacity-building initiatives, creates linkages between private industry, government agencies and non-governmental organisations and consolidates regional and local issues

¹⁵ <http://www.abandoned-mines.org/>

¹⁶ Indigenous

into an integrated plan for national and provincial action. Green Municipal Funds are managed by the Federation of Canadian Municipalities (FCM). These funds are for loans to municipalities for the remediation and redevelopment of brownfields. \$300 million has been allocated to the Green Municipal Fund, \$150 million of which is earmarked for brownfield redevelopment. There are also several further provincial funding initiatives related to brownfields regeneration (see Section 3.2).

40% of Canada's land mass is owned by the (federal) Canadian government. The Federal Contaminated Sites Action Plan¹⁷ (FCSAP) is co-ordinated across a number of arms of government by the Canadian federal Treasury Board. It has assigned \$3.5 billion over 15 years, from 2005-6, for the assessment/ risk management and remediation of federal contaminated sites. Its key objectives are to reduce ecological and human health risks, and reduce federal financial liabilities (national debt) associated with cleaning up federal sites. The FCSAP expands on the previous Federal Contaminated Sites Accelerated Action Plan (FCSAAP) which ran during 2003-04 and 2004-05. Canadian Council of Ministers of the Environment (CCME) guidelines applied or similar standards are applied to the sites. Federal site managers are required to maintain a current, complete and accurate record in the FCSI of known or suspected contaminated sites for which they are accountable, with the exception of sites that were remediated or sold before April 1, 1998.

The most recent FCSAP report is for the period 2007-8 (Government of Canada 2010, Keller 2007). In 2007-08 activity was reported at 276 remediation / risk management projects, and 590 assessment projects. However, as of March 31, 2008, a liability of \$3.332 billion was recorded for approximately 2360 contaminated sites, compared with a liability of \$3.014 billion for 2630 sites in 20072. This increase in federal environmental liability was primarily attributed to changes recorded to planned cost estimates for remediation activities of large projects. It was also attributed to the fact that increased spending on assessment activities results in a more accurate estimate of liability, often leading to an increase. Figure 3-1 illustrates the year on year expenditure for the FCSAP and its predecessor and the number of risk management / remediation projects under way.

The province of Quebec has also initiated a policy to inventory its government held land holdings in 2006, which identified 450 suspect sites by 2008, with numbers expected to increase until 2010. A 2008 estimate of the clean-up liability for these sites was CAN \$ 468 million (Beaulieu 2008).

¹⁷ www.sdtc.ca/en/about/index.htm

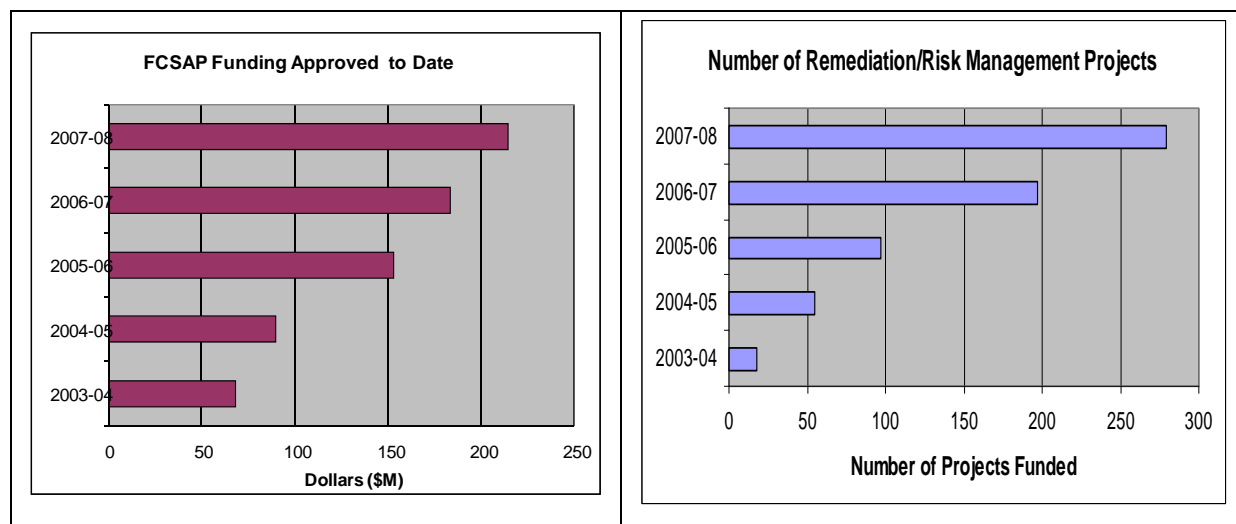


Figure 3-1 The FCSAP as of 2007-8

In addition, provincial and federal agencies are estimated to have spent nearly CAN \$ 1 billion from 2002 to 2008 on abandoned mine sites; some of this came from the FCSAP (NAOMI 2009).

3.5 Contaminated land sector

3.5.1 Size

Industry Canada statistics indicate that GDP in the Waste Management and Remediation Services Sector (code NAICS 562) increased \$1.5 billion in 1999 to \$3.2 billion in 2008, a compound annual rate of 8.1%¹⁹. The increase in GDP reported between 1999 and 2008 represented a compound annual rate of 4.0%²⁰, with a dip between 2004 and 2007. 2,800 employers active in the Sector. Only 146 of these have more than 50 employees. Although data are not separated between waste management and remediation, company profiles are available in a subcategory Remediation and Other Waste Management Services (5629)²¹.

A news item from About Remediation (2008) mention a survey that estimated 400-700 Canadian firms offer soil remediation technologies and services. The same item also suggests that the level of "significant", assumed to mean technology based, remediation projects in Canada is not high, but might be stimulated by the FSCAP.

¹⁸ http://www.federalcontaminatedsites.gc.ca/fcsap_pascf/index-eng.aspx

¹⁹ <http://www.ic.gc.ca/cis-sic/cis-sic.nsf/IDE/cis-sic562vlae.html> Accessed June 2010

²⁰ Expressed in basic prices and presented in chained 2002 dollars

²¹ <http://strategis.ic.gc.ca/app/ccc/sld/cmpny.do?lang=eng&profileId=1461&naics=5629>

A wide range of remediation treatment technologies are available in Canada and have been for some time (US EPA 2003). In some jurisdictions policies are in place to promote treatment based solutions. For example, in Quebec around 500,000 tonnes of contaminated soil are excavated per year. Most of this is treated biologically (ICCL 2009), and generally used as landfill cover. If a soil is contaminated above a certain level, it is compulsory to treat it before landfilling it, if there is an available treatment technology. In addition, contaminated soil cannot be deposited in a less contaminated soil. The regulator maintains an on-line listing of soil treatment centres²², and aims to provide a listing of in situ treatment providers. There are around 30 privately owned treatment centres in Quebec. Detailed reporting to the regulator is required for the origin and fate of all soils.

3.5.2 *Main drivers*

Brownfields regeneration is emerging as a driver for contaminated land remediation in parts of Canada (see Section 3.2). Otherwise the main driver would appear to regulatory compliance for environmental legislation. However, Fowler (2007) suggests that regulatory orders for site investigation or remediation tend to be used only in more serious cases, with voluntary action to reduce liability being more common place.

3.6 *Attributing financial liability*

3.6.1 *Approach*

Reviewed by jurisdiction in Table 3-4.

3.6.2 *Success*

SAIC (2005) found that the process to determine the parties responsible for a contaminated site and allocating liability for remediation of the site is the most complicated and contentious aspect of remediation in Canada. Most – but not all - jurisdictions take a wide view of potentially responsible parties to avoid an undue burden on the Public Sector or relatively few parties. Jurisdictions taking a broad view also vary in how this approach is implemented, and in the support available for finding a mediated solution between several responsible parties.

3.7 *Success of the regime*

Canada is a large country with a relatively small population of some 34 million. Within this small population are a wide variety of policy, regulatory and assessment criteria for

²² <http://www.mddep.gouv.qc.ca/sol/lieux/centres.pdf>

contaminated site management. Although there are some similar strands rung through the approach in each jurisdiction, and a co-ordinating body, the CCME; the practice of contaminated land management requires a detailed knowledge for each jurisdiction. This combined with the apparent skills shortage is a barrier to a national remediation industry or market, even although there is excellent availability of information resources on-line. This may be manifest in the lower than expected uptake of soil technology demonstration projects under a national funding scheme

3.7.1 *Positives*

- A strong technical knowledge base for contaminated site management across the country
- Several national co-ordinating bodies working on assessment criteria (CCME) and issues such as brownfields
- A major programme to management federally held contaminated sites
- Recognition of the importance of site specific risk assessment for determination of contamination and any subsequent remediation requirements
- A wide range of available treatment based remediation technologies.

3.7.2 *Negatives*

- A somewhat fractured approach to site evaluation, management, regulation and liability across the country.
- Some concern over skills shortages
- Some concern over the extent to which technology based remediation solutions are used.

3.8 References

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APPENDIX 4 CZECH REPUBLIC

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4 CZECH REPUBLIC

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4.1 Legal Contexts

Throughout the New Independent States (NIS) and Central and Eastern Europe (CEE), decades of heavy industrialisation and extensive exploitation of natural resources during the Soviet period left many areas in the region heavily contaminated (UNDP, 2004). These countries have since moved from a Soviet-state controlled economy, with government ownership and management of the means of production, towards free market economies with varying levels of privatisation. Subsequent attempts to address the issue of historical environmental contamination in these countries have consisted of environmental and privatisation laws and specific government resolutions (Boyd, 1996; Earnhart, 2004; Panayotou et al., 1994; UNDP, 2004).

An overview of the most important legislative Acts and Government Resolutions for addressing contaminated land in the Czech Republic up until 2004 is given by UNDP (2004). Since 2004, some additional legislative Acts have come into force in the Czech Republic and have made amendments to the legislation identified by UNDP (2004). These acts and resolutions are summarised below:

- Privatisation Act 92/1991 Coll., and subsequent amendments
- Government Resolutions No. 455/1992, 123/1993, 810/1997, and 51/2001 relating to assessment and remediation of historical contamination through privatisation
- Government Resolution No. 577/1991 and 2/1993 relating to the assessment and remediation of historical contamination at Former Soviet Army sites
- Water Act 254/2001 and subsequent amendments
- Act 167/2008 Coll. on prevention and remedying of environmental damage and amendment on some laws
- Act 334/1992 Coll. on Agricultural Soil Protection
- Decree 13/1994 Coll. Specifying some details of the protection of agricultural soil
- Decree 382/2001 Coll. on use of sewage sludge on agricultural soil
- Decree 257/2009 Coll. on use of sediments on agricultural soil
- Decree 17/2009 Coll. on determination and remediation of ecological damage on soil

And also some important methodical guidelines:

- Methodical guideline: Criteria for pollution of soil and groundwater. Gazette of Ministry of Environment of the Czech Republic. No. XV, 2005.
- Methodical guideline: Procedure for risk assessment analyses of contaminated sites. Gazette of Ministry of Environment of the Czech Republic, No. XV, 2005.
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4.2 Former Soviet Army Site Legislation

Government resolutions relating to the assessment and remediation of historical land contamination at Former Soviet Army sites (Resolution No. 577/1991 and No. 2/1993) were responsible for the first wave of contaminated land and groundwater remediation in the Czech Republic (James & Kovalick, 2000; UNDP, 2004). In September 1991, the Czech-Slovak Federative Republic Government, through Resolution No. 577/1991, established "Authority for dealing with the consequences of the stay of the Soviet Army". This authority was set up to determine the costs of remediation of the sites which was hoped to be passed on to the Soviet government. However, Soviet authorities negotiated that the value of buildings and infrastructure left behind by the Soviet army was equal to the value of the environmental contamination caused. Therefore, in November 1992, the authority for dealing with the consequences of the stay of the Soviet Army was abolished in connection with the dissolution of the Czech-Slovak Federal Republic. The agenda as well as the competence for remediation of these sites was transferred to the Czech Ministry of the Environment (MoE) by Government Resolution No.2/1993.

4.3 Privatisation Legislation

Privatisation legislation (Privatisation Act 92/1991 and subsequent amendments) along with associated government resolutions (No. 455/1992, 123/1993, 810/1997, and 51/2001) have been a major driving force behind the assessment and remediation of historical industrial contamination at sites in the Czech Republic since 1992 (UNDP, 2004). The aim was to provide financial support to new owners of sites blighted with environmental contamination caused prior to privatisation. An overview of the assessment and remediation procedures for a typical privatised property in Czech Republic is detailed by UNDP (2004). The first step is to undertake an "ecological audit" which provides an initial assessment of environmental damages including historical contamination. The ecological audit is submitted for approval by the Ministry of Environment (MoE), Czech Environmental Inspection (CEI) agency, National Property Fund (NPF), and the Czech Government. If approved, the new site owner and the NPF sign an "environmental liability agreement". Once signed, all consequent steps in the assessment and remediation process are financed by the NPF.

4.3.1 Water Legislation

The 2004 version of the Water Act in the Czech Republic (Act No 20/2004 Coll.) established regional water protection authorities at 14 Regional Districts and made

provisions for funding for emergency cases of endangered surface water or groundwater. In specific cases, the funding was also intended to cover remediation of historical contamination (UNDP, 2004).

4.3.2 *Environmental Liability Legislation*

The Act No. 167/2008 Coll. on prevention and remedying environmental damage and amendment on some laws (termed the 'Environmental Liability Act' – 'ELA') came into force on 17th August 2008 in the Czech Republic. It is a transposition of the Directive 2004/35/CE of the European Parliament and of the Council of the 21st April 2004 on environmental liability with regard to the prevention and remedying of environmental damage. In addition to protected species, natural habitats, and water, the ELA also applies to 'land damage' which is defined as "any land contamination that creates a significant risk to human health by adversely affected as a result of the direct or indirect introduction on or under the land surface, of substances, preparations, organism, or microorganisms".

4.3.3 *Soil protection legislation*

In Czech legislation, soil is not conceptually considered as an environmental compartment. There is, however, specific legislation for the protection of agricultural soil: Act 334/1992 Coll. on Agricultural Soil Protection. In the decree to this Act (Decree 13/1994 Coll. Specifying some details of the protection of agricultural soil) there are the only legislatively valid limit values of risk elements and risk substances in soils. There are also "preventive values" set out in decrees 382/2001 Coll. on the use of sewage sludge on agricultural soil and 257/2009 Coll. on the use of sediments on agricultural soil, in order to limit inputs of toxic substances into the (agricultural) soil.

4.4 The boundary between "contaminated" and "not contaminated"

There is no single legally binding definition of contaminated land or contaminated site in the Czech Republic (Czech response to Common Forum 2009 questionnaire). The need for remediation is determined on a risk basis with the aim of ensuring the fitness for purpose of the land. However outwith the privatised or former Soviet sites, consideration of historic contamination is neither well resourced nor specifically legislated.

The institutional framework for the management of environmental contamination in the Czech Republic in 2004 was described by UNDP (2004). Two key institutions identified were the National Property Fund of the Czech Republic (NPF) and the Czech Ministry of the Environment (MoE). An additional institution identified was the Czech Environmental Inspection (CEI) agency, an independent authority responsible for setting and controlling

remediation targets and criteria. More recent information on the institutional framework is by the MoE. It is the Environmental Damage Department of the Ministry of the Environment which is responsible for the management of contaminated sites under the ELA.

4.4.1 *Role of number-based thresholds*

The large number of contaminated sites identified during privatisation resulted in the need for clear guidelines, methodologies and recommendations which would facilitate data collection, data processing and the decision making process (UNDP, 2004). Consequently, guidelines for undertaking the ecological audit and risk assessment under the privatisation process were published by the MoE. The requirements of the risk assessment were first published by the MoE in 1996 and included 'soil, water and soil-gas contamination criteria' (UNDP, 2004). It was reported that the criteria in 1996 mostly followed the Dutch list of reference and intervention values (UNDP, 2004). However, it was reported by the UNDP (2004) that these criteria were not used as remediation criteria, but as indicators for designing follow-up activities of field survey and site-specific risk assessment.

More recent guidance on the derivation of number-based criteria for the assessment and remediation of contaminated land using risk assessment has been published by the MoE (2011), however these documents are currently available in Czech only. It is understood that this guidance is also applicable when assessing land contamination under other legal contexts within the Czech Republic (e.g. the ELA). At the April 2011 Common Forum, it was reported that it was being considered replacing the legislative maximal tolerable values for toxic substances in soil with two levels: prevention and maximum tolerable values (Darmendrail, 2011).

4.4.2 *Role of case-by-case decision making*

Case-by-case decision making is fundamental to the procedure for the assessment and remediation of historical land contamination following privatisation. In the period between 1991 and 2003, there had been more than 6500 ecological audits undertaken at privatised sites (UNDP, 2004). Based on site-specific information presented within these ecological audits, only 269 Environmental Liability Agreements had been issued by the NPF in 2003 (UNDP, 2004), each on a case-by-case basis.

4.5 Approach's effectiveness

James & Kovalick (2000) identify three types of contaminated sites in the Czech Republic: (i) former Soviet Army sites; (ii) Czech military sites; and (iii) other sites

undergoing privatisation where contamination has been caused by past industrial activities.

A small number of case studies describing the assessment and remediation of historical land and groundwater contamination in the Czech Republic have been identified in the published literature (Table 4-1). Information on a much larger number of sites can be obtained from the SEKM database (SEKM, 2011).

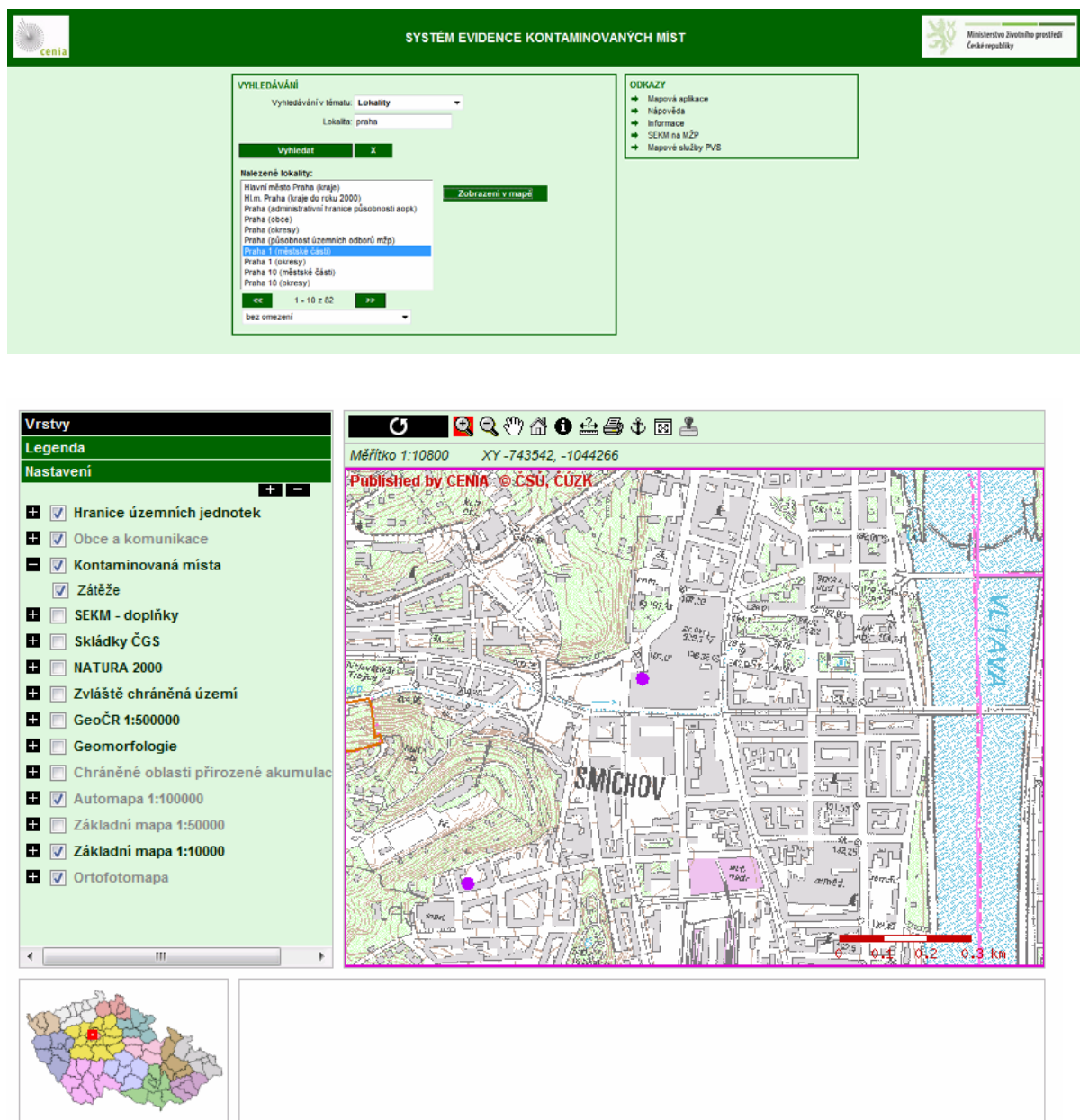


Figure 4-1 Extract from an entry on the SEKM Database

The main driver for the assessment and / or remediation of historical land contamination in these published case studies was the privatisation process (i.e. selling off of state-

owned industries and land to private investors). As such, the approaches used were intended to relinquish the private investor of potential liabilities arising from contamination through risk assessment and remediation. No case studies were identified that described the assessment and / or remediation of historical land contamination under other legal contexts (i.e. the Water Act, ELA). However, one case study was identified which described the assessment and remediation of land and groundwater contamination at a former Soviet Army air base (Table 4-1).

A Strategy for the examination and recording of contaminated sites was set out as an important part of the National Implementation Plan (NIP) for fulfilling obligations under the Stockholm Convention on Persistent Organic Pollutants. The NIP was processed by Research Centre for Toxic Compounds in the Environment (RECETOX) in co-operation with many other institutes in 2004. In the updated version of the NIP, there is a task to conduct a proper recording of contaminated sites, including preliminary health and ecological risk assessment, by 2014.

Table 4-1. Contaminated land assessment and remediation case studies for the Czech Republic

Site	Site Use	Assessment / Remediation Driver	References
Un-named, Prague	Automobile Parts Manufacturing Facility	Environmental Liability Agreement through the privatisation process	UNDP (2004)
Un-named, Prague	Industrial Fertiliser Manufacturer	Environmental Liability Agreement through the privatisation process	UNDP (2004)
Karolina Site, Ostrava	Former industrial site	Environmental Liability Agreement through the privatisation process	Cizkova et al. (1998)
Former Soviet Army Air Base, Hradcany	Former Soviet Army Site	Funded by the Czech State budget for remediation of former Soviet Army sites under the control of the MoE	Machackova <i>et al.</i> , (2008)
Zatec military airport	Former Czech military airport	Funded by the Ministry of Defence	Raschman & Vanek (2008)
Spolana Neratovice	Chemical works industrial site	Risk assessment study for contamination by POPs / BCD remediation company	Holoubek et al., (2008)
Generally for the Czech Republic	All industrial sites	Recording of old ecological burden sites contaminated by POPs	Hosnéd et al., (2010)

In years 2009-2010, a report on the inventory of old ecological burden with contamination by POPs was prepared by RMT VZ. In total, some 1,010 probably contaminated sites were identified, of which 541 were by POPs covered by the Stockholm convention and 469 by newly identified pollutants and polyaromatic hydrocarbons. All these localities are consequently introduced into the NIKM (Czech acronym for National Inventory of contaminated sites). Presently, there are 18,462 potentially contaminated sites recorded in the database.

4.5.1 Proportionate

The strategies for dealing with historical land contamination in the Czech Republic have been largely based on the principles of risk assessment from the outset. This approach assumes that there are socially acceptable levels of residual environmental and health risks and that attaining “zero risk” through remediation (i.e. absolute elimination of contamination) is likely to incur remediation costs which are disproportionate to the environmental and health benefits. This risk-based approach is evident in the majority of case studies identified in Table 4-1.

One of the first sites to be addressed under the Privatisation process in the Czech Republic was the Karolina Site in Ostrava at which remediation began in 1997 (Cizkova et al., 1998). Risk assessment principles were used to derive site-specific remediation criteria for the proposed future use of the Karolina site which were intended to ensure that the level of remediation undertaken was proportionate to the level of risk posed by the site. In doing this, remediation criteria were derived for soil and groundwater under different exposure scenarios at which the Incremental Lifetime Cancer Risk (ILCR) was <0.0001 (less than 1 in 10,000) or the Hazard Quotient (HQ) was <1 . Furthermore, it was reported that cost-benefit analysis was undertaken to ensure that the cost of remediation was proportionate to the risk reduction provided. It was reported that remediation costs would disproportionately increase if a residual risk level (i.e. ILCR) of <0.000001 (less than 1 in 1,000,000) was adopted. Risk reduction approaches considered included source removal, pathway interruption, and receptor management (i.e. excluding proposed residential zones from areas with the highest levels of contamination). In doing this, the MoE arranged for international technical assistance with human health and ecological risk assessment provided by US EPA and INERIS from France.

However, surprisingly, despite the efforts made to derive site-specific remediation criteria for the Karolina site using risk assessment principles and international technical assistance, Cizkova et al., (1998) reported that it was ultimately decided that traditional excavation of the entire risk source followed by ex-situ treatment was “less risky” than to use in-situ clean-up methods which may leave a residual risk. Only small peripheral areas of the site which were inaccessible to excavation were treated by in-situ methods.

Case studies described by UNDP (UNDP, 2004) for both an automobile parts manufacturing facility and a fertiliser manufacturing facility also indicate that risk-based remediation criteria were derived for soils and groundwater at the respective sites to ensure a proportionate remedial response. Remedial techniques employed at the sites

included steam enhanced extraction, groundwater pump and treat, in-situ and ex-situ bioremediation, and soil vapour extraction.

4.5.2 Targeted

Legislative tools for driving the assessment and remediation of land contamination in the Czech Republic target a range of site types including: former Soviet Army sites; Czech Military sites; and sites undergoing privatisation where contamination has been caused by past industrial activities (James & Kovalick, 2000). Furthermore, the risk assessment process utilised under these legal contexts considers risks to receptors under either current or intended future land use.

Until recently, sites affected by industrial contamination which have not attracted interest from foreign investors and therefore have not been sold by the state may not have been addressed under the legislative tools in the Czech Republic. However, this situation may have been rectified through the introduction of the ELA in the Czech Republic 2008 which seeks to remedy land damage caused by specific occupational activities. Despite this, no case studies were identified in the published literature to show that this is the case.

4.5.3 Consistent

The main remediation effort focused on privatised sites and former Soviet military bases in the immediate aftermath of the velvet revolution and subsequent dissolution of the CSSR. The main driver appears to have been the availability of resources (privatisation funds and international assistance) and a desire to attract and protect inward investment in the transition to a free market.

4.5.4 Transparent

In the early stages of the post-communist era in Central and Eastern European countries, it was reported that a lack of information on the potential contamination issues at a site at the time of sale acted as a deterrent to potential foreign investors (Earnhart, 2004). This was because the investor was unable to establish the extent of environmental liability that they may be taking on through acquisition of the site (Earnhart, 2004).

There is little evidence in the literature to suggest whether this lack of transparency has been a deterrent for foreign investors in potentially contaminated sites in the Czech Republic. However, the environmental audit undertaken as part of the privatisation process, which provides the initial identification and description of probable environmental damages, is funded by the new site owner (UNDP, 2004). Therefore, it is likely that the site is sold with little or no information on potential environmental liabilities. While any remediation costs incurred by the new site owner may be refunded

following successful application for an environmental liability agreement, there is no guarantee that this agreement will be granted and the funding released.

In 1996, the MoE designed a Database of Past Environmental Damages known as 'SESEZ' (a Czech acronym) to collated information about sites with environmental burdens relating to past activities in the Czech Republic and to make it publicly available (UNDP, 2004). The results of the risk assessment undertaken as part of the privatisation process are included into the database.

In 2005, a new database was created based on the structure of SESEZ called the Contaminated Sites Database System (SEKM) (a Czech acronym) (MoE website 2010). SEKM is a publicly available database which is compatible with the requirements of the European Environment Agency and contains a priority evaluation and risk profile for each contaminated site. It is understood that SEKM stores information on historically contaminated sites brought to the attention of the MoE under all legal contexts.

4.5.5 *Internal perception*

No specific information on the internal perception of the Czech approach to contaminated land has been obtained. However Garb & Jackson (2010) commenting on efforts to deal with brownfield sites between 1989 and 2009 observe that the Czech Republic has seen a progression from "non-recognition to labelling of the issue, and then a gradual maturation of conceptions, institutional capacities, policies, legal frameworks and financing". This has been accompanied by a realisation that contamination is only one, and often a minor, aspect of dealing with urban land management and community regeneration issues.

4.5.6 *External perception*

Some studies have described the cautious perception of potential foreign private investors with regard to liability for historical environmental contamination that may be incurred through investment and privatisation in Central and Eastern European countries including the Czech Republic (Boyd, 1996; Earnhart, 2004).

The Czech hypothecation of some of the proceeds of early privatisation for the remediation of privatised sites stands out as a unique experiment. By building capacity and capability in its contaminated land sector, the Czech republic prepared for the technical aspects of implementing EU environmental requirements both in the run to and since joining the European Union in 2004.

4.6 Estimate of scale

4.6.1 *Estimates of the amount of potentially contaminated land*

Květoslav & Josef (2007) report more than 7000 locations of undifferentiated industrial and agricultural plants, military bases and landfills throughout the Czech Republic.

With respect to former Soviet Army sites, there were reportedly 73 sites in the Czech Republic which had been used by the Soviet Army between 1968 and 1991. According to Machackova et al. (2008) Sixty of these sites were estimated to have significant environmental contamination, the most contaminated being the 15 hectares Hradcany airfield.

During 2009-2010, a study of persistent organic pollutant (POPs) contamination identified 1010 probably contaminated sites, of which 541 were impacted by original POPs covered by the Stockholm convention and 469 by newly identified pollutants and polyaromatic hydrocarbons. All these localities are consequently brought into the NIKM (Czech acronym for the National Inventory of Contaminated Sites). Presently, there are 18,462 potentially contaminated sites recorded in the inventory (Darmendrail, 2011).

4.6.2 *Estimates of progress*

With respect to privatised sites, between 1991 and 2003, there were 269 Environmental Liability Agreements concluded and 61 had been terminated (UNDP, 2004). By 2007, 281 Environmental liability agreements had been concluded and 98 had been terminated (Kačabová, 2007).

In 2003, it was reported that decontamination activities had been undertaken at 5 out of the 73 sites formerly occupied by the Soviet Army (Kačabová, 2007). Kačabová also predicted that the process of dealing with former Soviet bases would be completed by 2014.

In 2003, under the Water Act, remediation works (including supervision) were ongoing at three sites; post-remediation monitoring at one site and risk assessment was being undertaken at a further 12 sites (UNDP, 2004).

No sites investigated under Environmental Liability Act were identified.

4.7 Deciding who pays

There are three sources of financing for the assessment and remediation of environmental contamination in the Czech Republic: (a) the State Budget; (b) the State

Environmental Fund (created mostly by pollution levies e.g., for emissions or for waste disposal); and (c) the National Property Fund (created by money from privatisation) (James & Kovalick, 2000). Clean-up activities at military sites if the former Czechoslovakian army are funded by the Ministry of Defence (Anderson, 2000).

4.7.1 ‘Polluter pays’ principle

The polluter pays principle is encapsulated within the state environmental policy of the Czech Republic and is implemented through a number of Czech Laws. However, in the case of costs associated with the assessment and management of historical land contamination within the Czech Republic, it is apparent that the polluter pays principle is only partially employed.

The polluter pays principle is successfully applied in the Czech Republic in the context of privatisation, where the state was the former owner and polluter of industrially contaminated sites (UNDP, 2004). While the new owner of the site is legally responsible for remediation, the owner may apply for reimbursement of the remediation costs from the state through the National Property Fund (NPF) by signing an “environmental liability agreement”. State guarantees for past environmental liabilities in privatised state companies correspond to the purchase price of the privatised properties and form the upper limit for possible reimbursement of site assessment and remediation costs. Between 1991 and 2003, there were 269 Environmental Liability Agreements concluded up to the amount of 5382 million US Dollars (USD) (UNDP, 2004).

One example of where the polluter pays principle has not been successfully applied in the Czech Republic is provided by the significant environmental contamination which resulted from the presence of the former Soviet Army in the Czech Republic Territory between 1968 and 1991 (UNDP, 2004). This is due to the loss of any financial compensation from the Soviet side in 1991. Instead, assessment and remediation of environmental contamination at former Soviet Army sites is funded directly from the Czech State budget. Between 1990 and 2003, the total expenditures for remediation work at former Soviet Army sites, including risk assessment and monitoring, was approximately 44.6 million USD (UNDP, 2004). Furthermore, it was expected that an additional 9.3 million USD would be necessary to address these sites until the year 2011 (UNDP, 2004). A case study describing the assessment and remediation of a former Soviet Army Air Base funded by the Czech State budget is provided by Machackova et al., (2008).

Another example of failure to apply the polluter pays principle in the Czech Republic is provided by the assessment and remediation of historical contamination using funds guaranteed by the Water Act in the Czech Republic (UNDP, 2004). In 2003, remediation

works were being funded at three sites, post-monitoring at one site, and risk assessment at 12 sites through the Water Act (UNDP, 2004). Details of these sites were not provided.

4.7.2 *Liability of the state*

The NPF is used to fund the costs of assessment and remediation of contaminated land through the privatisation process (UNDP, 2004). This fund is generated from the sale of state owned assets rather than through taxation. However, the state budget is used to fund assessment and remediation of land contamination at former Soviet Army sites and sites where remediation is required under the Water Act which is generated through taxation. The state environmental fund

4.7.3 *Liability of the owner/ occupier*

Following site privatisation, the new site owner covers the costs of the initial “ecological audit” which provides the initial identification and description of probable environmental damages at a site, including historical contamination. In the case that an Environmental Liability Agreement is issued, all consequent steps in the assessment and remediation process are financed by the NPF. However, the new owner of the contaminated site remains legally responsible for its assessment and remediation, but may apply for reimbursement of the costs from the state through the NPF.

4.7.4 *Site owner ‘Orphan’ sites*

The Czech response to a Common Forum questionnaire reports that Czech Regions have funds under the Law on Waters for dealing with historical and current contamination at orphan sites. In addition, the Operational Programme Environment can deal with historically contaminated orphan (Common Forum, 2010).

4.7.5 *Role of state funding*

Given the historic state ownership of most industrial facilities, the state is liable for most historic contamination. State funding has been used to fund risk assessment and remediation at formerly state owned enterprises and former Soviet military sites. State funds are also made available to national and regional organisations for dealing with orphan sites.

4.8 Contaminated land sector

4.8.1 *Size*

In April 2011, it was reported that there were 18,462 potentially contaminated sites recorded in the Czech inventory (Darmendrail, 2011).

4.8.2 *Main drivers*

The assessment and remediation of historically contaminated land in the Czech Republic has been mainly driven by an ongoing process of widespread privatisation and dealing with the legacy of former Soviet military bases. More recently new and anticipated EU legislation has led to a programme of inventory and cataloguing sites.

4.9 *Attributing financial liability*

4.9.1 *Approach*

The State covers most costs largely because the state was the polluter in many cases. The liability of former Soviet army sites has also been taken on by the State.

4.9.2 *Success*

The Czech approach appears to have been successful in dealing with the sites addressed so far, but has relied on an investor being willing to buy the site in the first place. The scale of undealt with sites shows there is much still to be done.

4.10 *Success of the regime*

4.10.1 *Positives*

The Czech Republic has a history of dealing with its contaminated land legacy. It hypothecated privatisation proceeds to pay for remediation and also dealt with the legacy of former Soviet military bases.

Recent effort has been in developing a comprehensive inventory of potentially contaminated sites in response to and anticipation of EU legislation.

4.10.2 *Negatives*

The absence of a specific definition of contaminated land and specific legislation appears to have led to a slow down in remediation in recent years.

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APPENDIX 5 FRANCE

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5 FRANCE

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France is a Republic divided into 26 regions and 101 departments, 4 of which are overseas.

5.1 Legal Context

France has no specific legislation for dealing with historically contaminated land (Bourgoin, 2006; Darmendrail, 2010; NICOLE, 2005; Sauvalle & Darmendrail, 1999). However, several pieces of legislation exist within France which partially address issues associated with the management of historically contaminated. This legislation is listed below:

- Law of 15th July 1975 on the elimination of waste and recovery materials
- Law of 19 July 1976 (no. 76-663) on authorised installations for the protection of the environment (annulled and replaced since September 2000 by the Environment Act) – when an installation requiring authorisation is put up for sale, the vendor is required to inform the buyer of major hazards or drawbacks relating to the operation, including contamination.
- Law of 2nd February 1995 (Barnier Law) which refers to the principle of the “polluter pays”. It also levies a tax on Special Industrial Waste which is intended to finance the remediation of “orphan” sites or sites for which the owner is not solvent.
- Law of 30th July 2003 (no. 2003-669) on the prevention of technical and natural risks and the reparation of damage

In the absence of a clear legal framework for dealing with historical land contamination, the French Ministry for Environment initiated its soil contamination and remediation policy in 1993 with a circular addressed to all local environmental authorities setting out the National soil remediation and cleanup policy (Bourgoin, 2006). This policy is part of the law of 19 July 1976 on authorised installations for the protection of the environment. This circular was subsequently supplemented by two further circular issued in 1996 and 1999.

5.2 The boundary between “contaminated” and “not contaminated”

5.2.1 *Role of number-based thresholds*

Bonin et al., (2005) describes the role of number-based thresholds in the assessment of contaminated soils in France. It was identified that no generic threshold values existed for generic exposure scenarios below which the soil could be considered to be free from contamination. However, it was also identified that, within the context of the Law of 1976

on authorised installations for the protection of the environment, a detailed risk evaluation is required to determine whether the soil at an authorised industrial installation requires remediation and establishes the soil treatment thresholds on site specific basis and according to the future use of the site. In the absence of a set of generic threshold values for generic exposure scenarios, Bonin et al., (2005) attempted to derive generic thresholds for use in France for three land use classes based on a summary of the range of generic thresholds used in other European countries. However, the thresholds derived by Bonin et al., (2005) were aimed primarily at assessing the re-use of 'remediated' soils originating from authorised industrial installations as opposed to the assessment of historically contaminated soils in situ.

Darmendrail (2010) describes the three-class system of "Interpretation de l'Etat des Milieux" (interpretation of the state of the environments) developed to assess risks to offsite receptors. It identifies three levels of response: "Do nothing; Complementary assessment; and, Remediation. The boundaries are defined by hazard quotients (<0.2 , $0.2-5$, >5) and excess lifetime cancer risks ($<10^{-6}$; 10^{-6} to 10^{-4} ; $>10^{-4}$) (Darmendrail, pers. Comm.).

5.2.2 *Role of case-by-case decision making*

As discussed in Section 5.2.1, within the context of the Law of 1976 on authorised installations for the protection of the environment, a site specific detailed risk evaluation is required to determine whether the soil at an authorised industrial installation requires remediation and establishes the site specific soil treatment thresholds according to the proposed future use of the site. However, it was pointed out by Bonin et al. (2005) that this requirement is restricted to soils present in authorised industrial installations and does not apply to other urban soils which have been impacted by air pollution or contaminated backfill from other sites.

5.3 Approach's effectiveness

Few case studies describing the assessment and remediation of historical land contamination in France have been identified in the literature which had been published in English. However, in 2005 the Industrial FZK/TNO Conference on Soil-Water Systems was hosted at the Bordeaux Convention Centre, France. As such, the conference proceedings included several papers which described case studies of contaminated sites in France. Some of these case studies and others identified in the literature are listed in Table 5-1.

Table 5-1. Contaminated land assessment and remediation case studies for France

Site	Site Use	Assessment / Remediation Driver	References
Un-named Site, Northern France	Former Coke-Oven Plant	-	Gourry et al., (2005)
Metaleurop Nord, Noyelles-Godault, Nord-pas-de-Calais	Non-ferrous metals factory	-	Mazzuca et al., (2005)
Un-named site, South Vincennes	Former industrial site	-	Hazebrouck & Ledrans (2005)
Ferronneries du Midi (Toulouse, south of France)	Former ironworks	Regeneration	Darmendrail (2010)

5.3.1 *Proportionate*

The absence of a specific law makes it difficult to judge proportionality. However the evidence of the IEM suggests a risk based approach is recognised which will ensure intervention is focused on the highest risk sites.

5.3.2 *Targeted*

The Law of 1976 on authorised installations is targeted specifically at the assessment and remediation of contaminated soils at authorised industrial facilities.

5.3.3 *Consistent*

No information was identified on the consistency or otherwise of the French approach.

5.3.4 *Transparent*

Hazebrouck & Ledrans (2005) describe a case study of stakeholder participation in the assessment and management of a contaminated industrial site in South Vincennes. It was reported that the Health Ministry set up an independent scientific committee in charge of designing the risk assessment studies, reviewing results, and issuing recommendations concerning management actions. The Prefect directed a Participation Committee gathering all stakeholders in the aim of sharing all information available about the site, discussing the results of the studies and the conclusions of the Scientific Committee and collecting opinions and expectations of each stakeholder in order to prepare decisions. It was found that the stakeholder participation increased transparency in the decision making process and thus helped to increase public support.

In addition to site specific attempts to increase stakeholder participation in the assessment and management of contaminated industrial sites as demonstrated by Hazebrouck & Ledrans (2005), the Ministry of Environment has developed several databases containing information on potentially contaminated sites in order to raise

public awareness and to maintain records of contaminated land in France, including both existing contaminated sites and formerly contaminated sites (Bourgoin, 2006). The two main pollution registers are called 'Basol' and 'Basias', both of which were initiated in 1993. Basol contains information on all contaminated sites identified by environmental authorities whereas Basias contains information on former industrial and pollution-related sites (Bourgoin, 2006).

5.3.5 *Internal perception*

Within France the approach is seen by commentators as mature and largely effective. CABERNET (2003) commenting on brownfield rather than contaminated site issues per se reported that "... brownfield redevelopment policies are successful in certain regions, due to financial and operational tools as Etablissements Publics Fonciers."

5.3.6 *External perception*

No specific information has been found.

5.4 Estimate of scale

5.4.1 *Estimates of the amount of potentially contaminated land*

No estimations of the number of contaminated sites in France were identified. However, work undertaken by CABERNET (2003) reported that there were approximately 200,000 former industrial and service sites in France, and about 200 former mines. Based on this, CABERNET estimated the stock of brownfields (which may be contaminated) to be 20,000 hectares. It was thought that these sites were concentrated in the traditional industrial areas of the northern and eastern part of the country, especially in the region of Nord-Pas de Calais and Lothringen.

As part of President Sarkozy's Grenelle de l'Environnement, Darmendrail (2009) reports Phillipe Bodenez's presentation on an investigation of sensitive land uses close to industrial facilities. The aim is to secure the safety of children and teenagers from pollution. Having inventorised some 2000 schools and nurseries, Darmendrail (2011) reported that 280 such sites had been investigated.

5.4.2 *Estimates of progress*

However, CABERNET (2003) reported that the stock of brownfields in France has not decreased in the last decade (1993 – 2003) despite considerable reclamation activities during this period. As of April 2011, 280 of 2000 sensitive sites have been investigated under the auspices of the Grenelle de l'Environnement (Darmendrail, 2011).

5.5 Deciding who pays

In the absence of specific legislation on historically contaminated land in France, the liability for soil contamination has been dealt with through other liability regimes. The liability regimes that apply to soil contamination are contained in various legal frameworks which rarely address soil contamination directly and are often inconsistent (Bourgoin 2006). These regimes include (Bourgoin, 2006): (i) the French industrial law regime (Law of 1976 on Industrial Installations) which mainly targets the site operator; (ii) the Waste Regime which targets the waste producer and the waste holder; (iii) the Civil Law regime which is the general tort system and targets any person who causes damage; (iv) the Water Regime; and (v) other regimes or provisions contained within the Rural Code, the nuclear installations regime, or the mining regime. However, it is the first three regimes which are most commonly used to identify the person liable for remediation costs (Bourgoin, 2006).

5.5.1 ‘Polluter pays’ principle

France employs the polluter pays principle ((principe pollueur-payeur), as set out in Article 110-1 -II of the Environment Code (Faure, 2006), with regard to historically contaminated land only in part. Darmendrail (2010) reports that current operators are responsible for protecting the environment and neighbouring populations. However she points out that on former industrial sites, where there is no current operator, it is the current owner or developer who is considered liable.

5.5.2 Liability of the state

While the polluter pays principle is used within French law, public money is still required to fund some contaminated site remediation activities in France. This is due to the limited applicability of the polluter pays principle in the case of orphan sites (i.e. sites where the legally responsible polluter either no longer exists, cannot be identified, or are insolvent). According to a survey undertaken by the European Environment Agency (EEA, 2010), approximately 7 % of total expenditure on remediation of contaminated sites is derived from public budgets. However, in order to assist with the financial liability associated with the cleanup of orphan sites, the Law of 2 February 1995 (Barnier Law) levies a tax on Special Industrial Waste which is intended to finance their remediation (Bonin et al., 2005).

5.5.3 Liability of the owner/ occupier

Under the French Industrial Law Regime (Law of 1976), it is the ‘site operator’ rather than the site owner that is considered liable for environmental cleanup costs relating to contamination (Bourgoin, 2006; Darmendrail, 2010). Liability for environmental clean-up

costs for sites which are subject to the Industrial Law Regime is placed primarily on the 'current' or 'last' operator of the site rather than a 'former' owner. An operator is defined as the person who controls the activities and the site on a daily basis (and / or holds the environmental permit). The last site operator is not only liable for contamination which it causes itself, but also for that caused by the installations/activities it has taken over from former site operators. Provided that the change of site operator is notified to the public authorities, the former site operator is no longer liable for remedial action imposed by the authorities. Furthermore, remedial action may be imposed on the last site operator for a period of 30 years from the date on which the closure of the installation was properly notified to the authorities, unless any dangers or risks to the environment were deliberately concealed from authorities. The last site operator is not entitled to claim that the former operator caused the pollution as a defence to the authorities. However, the last site operator is free to commence civil proceedings against the former operator before the courts.

Interestingly, until September 2005, where the site operator failed to comply with clean-up obligations, environmental authorities attempted to impose the obligation on the 'site owner' (Bourgoin, 2006). However, after 15 years of conflicting court decisions, recent case law has confirmed that the main and primary party liable is the site operator and that a site owner cannot be charged for cleanup costs in his capacity as a site owner (Bourgoin, 2006).

Because environmental authorities could not always successfully impose clean-up obligations on any person other than the last site operator under the Industrial Law Regime, they have also tried to impose liability based on French waste law (Law No. 75-633 of 15 Jul 1975) on waste elimination (Bourgoin, 2006). Waste law has the advantage that not only does it target the waste producer but also the waste holder. In the absence of a site operator, the site owner may be deemed to be the waste holder and may therefore be liable for waste disposal (Bourgoin, 2006).

Under the general provisions of the French Civil Law regime, a person (including a site operator or owner) can be held liable to third parties if it is considered to be responsible for damage (including environmental damage such as site contamination) (Bourgoin, 2006).

5.5.4 '*Orphan*' sites

The remediation of orphan sites is partly financed through a tax levied on the treatment of Special Industrial Waste (see Section 5.5.2). In 1998, the rate of tax on the treatment of the waste was 40 French Francs per tonne (Ferguson, 1999). The money raised from

the tax (which was about 100 million French Francs in 1998) is allocated to site investigation and cleanup of orphan sites (Ferguson, 1999). Although orphan sites were considered in a 2010 Common Forum questionnaire, there was no response from France.

5.5.5 *Role of state funding*

State funding has long had a role in remediation and reclamation of polluted sites (CABERNET, 2003). Indeed the current initiative on sensitive sites is driven by presidential decree and forms part of a state led stakeholder engagement process.

5.6 Contaminated land sector

5.6.1 *Size*

Market research reports are available which discuss the size of the market sector in France which is associated with the assessment and remediation of contaminated land. However, these reports are typically prepared by private companies for dissemination to investors and are not freely available within the public domain.

The NICOLE service providers group had three French members.

5.6.2 *Main drivers*

According to a report prepared by the US Commercial Service (2008) aimed at providing US companies with an overview of the environmental sector opportunities in Europe, financial and environmental legal liabilities have been key drivers for the strong and continued growth in the risk assessment, characterisation and soil remediation market in France. The report goes on to state that “French Ministry of Environment has identified approximately 4,000 potentially polluted industrial sites to date. The Ministry is scheduled to survey and classify 300,000 public and private industrial land sites and brownfields within the next year, thus, stimulating demand for remediation equipment and services. The market, estimated at USD 1.24 billion (1 billion euros), is expected to grown at 10 to 15 percent over the next decade”.

5.7 Attributing financial liability

5.7.1 *Approach*

The approach for attributing financial liability for the assessment and remediation of land contamination in France is discussed in Section 5.5. No information has been obtained on the approach for apportioning liability in the event that there are more than one polluter

5.7.2 Success

Court challenges have been successful in current owners and operators avoiding some liability for historic contamination that they had not caused.

5.8 Success of the regime

5.8.1 Positives

A long standing tradition of making publically owned information widely and freely available has created openness and transparency.

Large, high profile sites have received considerable resources and attention.

5.8.2 Negatives

The absence of specific legislation has resulted in a variety of legal tools being used to achieve similar aims in different circumstances.

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**APPENDIX 6 FEDERAL REPUBLIC OF
GERMANY**

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6 FEDERAL REPUBLIC OF GERMANY

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The Federal Republic of Germany is a federal parliamentary republic comprised of 16 Federal States (Länder). There are three administrative levels in Germany: the Federal government (Bund), the state governments (Länder) and the municipal governments (Städte und Gemeinden). Germany covers an area of 357,000 square kilometres and has 83 million inhabitants.

Contaminated land in Germany is primarily regulated under legislation for soil and water protection. Responsibility for soil and water management legislation is divided between the Federal and State (Land) authorities, in common with other environmental legislation (Frauenstein 2009)¹.

The states are responsible for regional planning. From the point of view of spatial planning authorities, within each State are district administrations (for the larger States), counties, towns and "county-free towns" (RESCUE Consortium 2005).

It is important to note that contaminated land has varied in its significance among the Länder over time. Hence one Land may have developed guidance at one time and then been overtaken by another Land. The development of contaminated land management practice in Germany cannot be seen as linear or even homogenous across the country. It is also important to note that the term 'hazard' is used to mean a situation which represents a very high level of danger (which in UK or USA parlance would be termed an unacceptable risk and perhaps may equate to a significant possibility of significant harm).

Soil is regulated by the Federal Soil Protection Act (BBodSchG), which came into force on March 1 1999 (Federal Ministry for the Environment 1999). The Act covers both preventive soil protection and the management of contaminated soil, and so the management of contaminated sites. It also expands / supplements a range of other sectoral legislation where impacts on soil were not hitherto covered (e.g. Federal mining law and Federal Pollution Law: Bundes-Bodenschutz –und Altlastenverordnung (BBodSchV) vom 12.7.1999)

¹ Federal government web page for environmental law (includes some downloads in English)
http://www.bmu.de/gesetze_verordnungen/alle_gesetze_verordnungen_bmu/doc/35501.php

6.1 The boundary between “contaminated” and “not contaminated”

The Federal Soil Protection Act sets out regulatory responsibilities for Federal authorities. Individual States have been responsible for the enforcement of Act and Ordinance. For example, the identification, inventorying, risk assessment and remediation of contaminated sites are regulated at State level while the setting of soil quality assessment values is regulated at a Federal level. In addition, some Länder have introduced additional State-wide legislation and policies dealing with issues outside the Act, for example to stimulate brownfield redevelopment (Gloger and Fahle 2007). Table 6-1 sets out the broad areas regulated at Federal and State levels in Germany. Box 6-1 illustrates the separation of regulation and policy between Federal and State levels with the example of Baden-Württemberg.

Contaminated sites are defined by the BBodSchG as being;

- Closed down waste management installations, and other sites, in/on which waste has been treated, stored or landfilled
- Sites of closed-down installations, and other sites on which environmentally harmful substances have been handled, except for installations that can be closed down only under a license pursuant to the Atomic Energy Act that cause harmful soil changes or other hazards for individuals or the general public.

Table 6-1. Regulation of contaminated land management at Federal and State Levels in Germany

Federal Level	State Level
<ul style="list-style-type: none"> • Setting generic environmental quality benchmarks for soil quality • Setting generic environmental quality benchmarks for water and groundwater quality • Setting generic environmental quality benchmarks for waste disposal and re-use • Federally funded research and development 	<ul style="list-style-type: none"> • Identification, risk assessment and remediation of contaminated sites • Contaminated site inventories • Regional implementation of water legislation (including variance of threshold values to take into account specific issues of high regional background levels) • Implementation of permitting waste management and recycling • Brownfield development policy • Funding programmes, e.g. for orphan sites • Regional planning (any specific link to contaminated land which is regulated on the local level)

Operational facilities and mining areas fall outside the Soil Protection Act definition of contaminated sites. The legal basis for all mining activity in Germany is the Federal Mining Law (BBergG) of August 13th 1980 as amended 21st August 2002. This law also legislates for the aftercare and re-use of former mining areas since 1980, via State level mining control authorities.

Most brownfield sites projects are regulated by the waste law

Box 6-1: Management of Contaminated Sites (Altlasten) in the German State of Baden-Württemberg

Baden-Württemberg was the first Federal State in 1988 to legislate a systematic management programme to deal with the legacy of contaminated sites (Altlasten). This was superseded by the Federal Soil Protection Act in 1998. The State Soil Protection Act of 14.12.2004 follows the Federal Soil Protection Act. Baden-Württemberg has developed a standardised site prioritisation system based on the criteria in the Soil Protection Act, to systematically investigate the suspect sites in the State-wide inventory. The latest state of progress dates from 2008 (LUBW 2008).

Contaminated site regulation is carried out at a district level under the jurisdiction of the Ministry for Environment, Nature Protection and Transport of Baden-Württemberg (UVM). The State Institute for Environment, Congresses and Nature Protection of Baden-Württemberg provides technical and advisory services to local / district authorities and the public; collates the contaminated site inventory at State level and ensures measurements are in compliance with Federal requirements. It also acts to co-ordinate with the Federal Environmental Protection Agency, for example reporting its site inventory. The Institute provides a wide range of guidance and decision support software to assist consistent reporting of contaminated site information, as well as specific support for hydrogeological modelling, toxicology, materials properties, ensuring compliance and comparing data with environmental quality criteria. An on-line technical library is also provided.

UVM has supported extensive networking and promotional activities to promote urban brownfield regeneration (Gloger and Fahle 2007). Research work reported in 2007 surveyed brownfield land across Stuttgart (in Baden-Württemberg). Three quarters of the area surveyed were subject to legally binding planning agreements. However, these agreements were insufficient "incentive" to bring investment to redevelop these areas (Grossmann *et al.* 2007). The definition of brownfields used was not elaborated, but it would seem likely that a number of these stalled sites were also contaminated. What seems to be implied by this research and other research projects in Stuttgart (Shrenk *et al.* 2007b), is an interest in a Federal and State level in providing frameworks for prioritising and valuing brownfield development in a technical / quantitative way, and that the drive for brownfield regeneration is led by the local authority, rather than creating the conditions for market-led redevelopment. So the potential opportunity is being evaluated and a "rough" prognosis of financial value is offered, but no mechanism or incentives appear to be put in place for this to be exploited by the Private Sector. However, new developments in the German real estate market may now begin provide this incentive, as well as the possible adoption of recommendations from the German Council for Sustainable Development on how to reduce current German rates of Greenfield use (Malburg-Graf *et al.* 2007). The European *Revit* project² reports that Stuttgart is one of the fastest growing urban areas in Germany. Its development plan (as of 2010) is to encourage growth within the city limits. The largest single brownfield in the city (22 ha) is a former railroad area acquired by the city in 2001. Its redevelopment is being supported by Public Sector investment, including €2.2 million of ERDF funding.

One might have expected to see a Private Sector lead on such a project in the UK, given the economic drivers and planning controls.

In part summarised from the German language web sites of the Ministry for Environment, Nature Protection and Transport (Ministerium für Umwelt, Naturschutz und Verkehr - UVM) <http://www.uvm.baden-wuerttemberg.de/> State Institute for Environment, Congresses and Nature Protection of Baden-Württemberg Landesanstalt für Umwelt, Messung und Naturschutz Baden-Württemberg – LUBW) <http://www.lubw.baden-wuerttemberg.de/servlet/is/1208/>

The Federal Soil Protection and Contaminated Sites Ordinance (BBodSchV) extends the BBodSchG and governs the key elements of contaminated site management. It includes detailed annexes providing guidance on sampling, analysis and quality assurance to prepare site surveys, on the derivation of pathway values for measures, tests and prevention, and on requirements for remediation examination and planning.

Framework legislation for water protection exists at a Federal level, under the Federal Water Act (WHG). This framework is fleshed out by the Länders' own water state-wide legislation. The importance of water as a pathway from contaminated land and as a

² <http://www.revit-nweurope.org/stuttgart.php> accessed September 2011

resource means that groundwater contamination is a common determinant of site remediation targets, which is legislated by the WHG. The WHG sets out a comprehensive approach to groundwater protection including a general requirement that groundwater quality must not deteriorate. However, this principle is often difficult to realise where damage to groundwater has already occurred. The efficiency and costs of groundwater rehabilitation measures impose constraints on what is possible or feasible. Consequently, remediation target values for groundwater are set on a case-by-case basis. "Insignificance" thresholds are used to determine the occurrence of groundwater contamination. Leachate testing is used to support estimating the contaminant load reaching groundwater.

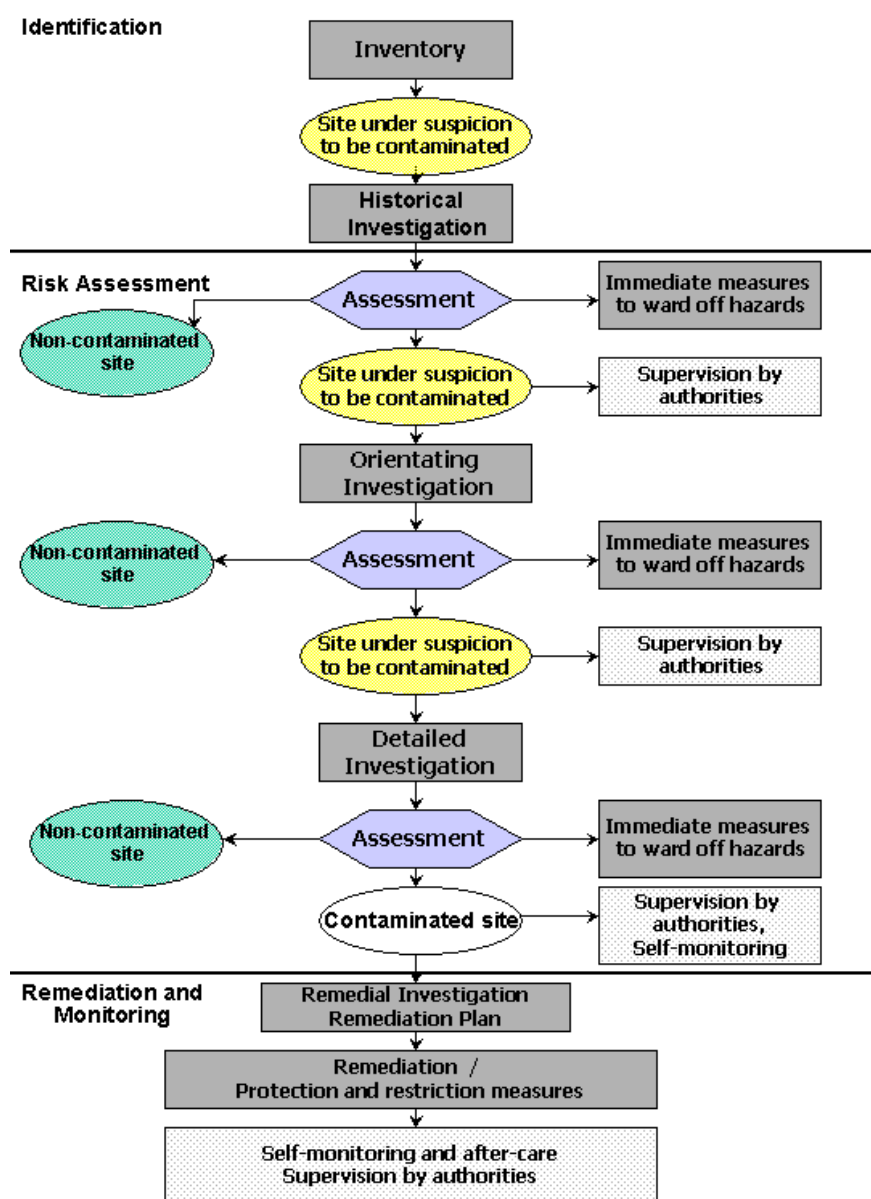


Figure 6-1. Flow chart of contaminated land management in Germany (from Umweltbundesamt, undated)

Waste disposal and re-use of materials to soil is regulated at a Federal level under the Soil Protection Act (input to soils), the 1994 Closed Substance Cycle and Waste Management Act - KrW-/AbfG (NICOLE 2008. RECUE Consortium 2005). Under the 1994 Act excavated soil is classified as waste. Federal guidance is provided to classify excavation and demolition materials, developed by the Federal Working Group for Waste (LAGA) and published in 2003³. The guidance is currently under revision. This provides reference values for a range of substances on which reuse and recycling can be permitted. Waste management legislation in Germany recognises waste avoidance as the top priority. If wastes cannot be avoided, then the priority is substance recycling or energy recovery, with disposal to contained landfill as a last resort.

The "Federal Immission Control Act" governs pollution prevention control in Germany for active sites (Bundes-Immissionsschutzgesetz - BImSchG 26 September 2002 and amended 23 October 2007.) The inspection of active industrial sites is carried out by inspectorates established by the Federal States, the exact responsibilities of which vary between the Federal States.

The principles of risk assessment, including the source-pathway-receptor paradigm, are adopted in German contaminated land regulation (Carlson 2007). The sequence from identification of a suspect contaminated site through: historical site investigation (desk studies and site visits); preliminary and detailed intrusive site investigation and risk assessment, remediation and monitoring is set out in Figure 6-1. The principles are based on expert opinion provided by the German Council of Environmental Advisors⁴ (Bundestagsdrucksache 11/6191). This guidance was first produced in 1990 and has been updated following changes in legislation: Sachverständigenrat für Umweltfragen - Sondergutachten: (Bundestags-Drucksache 11/6191). 15.12.1989.

Within this pathway different assessments are used in a sequential way to determine whether a suspected site is "not contaminated", "under suspicion of being contaminated" or "contaminated". Site investigation and risk assessment are applied at increasing levels of detail at each successive step so that sites with low or no risks can be excluded from the further investigation procedure at an early stage without incurring large costs, and acute hazards can be rapidly identified.

There is no specific legislation in Germany related to brownfields regeneration. Contaminated soil and water aspects are dealt with as described above. There is

³ Laenderarbeitsgemeinschaft Abfall: Anforderungen an die stoffliche Verwertung von mineralischen Reststoffen / Abfällen, Technische Regeln, November 2003 (LAGA-Liste)

⁴ Sondergutachten Altlasten des Rates von Sachverständigen für Umweltfragen

legislation related to building codes and regional planning. But in general these measures are not seen as strong enough to “enforce successful brownfield development” (RESCUE Consortium 2005).

6.1.1 *Role of number-based thresholds*

During the “orientating investigation”, if historical investigations confirm a suspicion of contamination, the boundary between “not contaminated”, “under suspicion of being contaminated” are based on generic numerical thresholds established under the Soil Protection Act. Where these thresholds are exceeded, determination of whether or not a site is “contaminated” is based on site specific risk assessment. (so most sites are just a waste topic). Where the historical investigations show no potentially contaminating land use then the site may be considered to be “not contaminated”.

The Soil Protection Act, via the “Promulgation of Methods and Standards for Derivation of Test Thresholds and Measures Thresholds pursuant to the Federal Ordinance on Soil Protection and Contaminated Sites”, provides, in Annex 2⁵, three categories of assessment criteria against which soil concentrations of substances of concern are compared at this generic stage (Bieber 2007, Frauenstein 2009).

- “Action levels” indicating as a rule an immediate hazard which has to be dealt with, usually leading to remediation work. In this case further investigations to ascertain the hazard are considered usually unnecessary. Sites affected are confirmed as “contaminated”. Where possible bioavailable soil concentrations are used for the “action levels”.
- “Trigger levels” are used to determine whether further risk assessment is necessary to confirm whether or not a site is contaminated. Where concentrations of a contaminant exceed trigger levels, further investigation and site specific risk assessment is usually triggered. Remediation needs are determined on the basis of this further investigation, taking into account the type of soil, the mobility of the hazardous substances and other specific circumstances. If no trigger levels are exceeded the site is not further considered as “contaminated”.
- “Precaution levels” are used to flag elevated levels of contamination which may be important from a soil protection point of view. These consider risks to: microbial processes, soil fauna, plants and the above ground ecosystem (Carlson 2007). Maximum soil concentrations are set, along with maximum soil inputs over time. Their function is to control input of materials such as fertilisers, composts or sewage

⁵ <http://www.gesetze-im-internet.de/bundesrecht/bbodschv/gesamt.pdf>

sludge to soil, (Vogel *et al.* 2004) and are used in *Ordinance on Biowastes* and the *Ordinance on Sewage Sludge* which also result from the Soil Protection Act.

The laboratory approach and the methods for soil analysis are specified according to German Industry Standards (DIN) and European Standards (CEN). These generic values are intended to facilitate the screening of large numbers of sites by the responsible authorities. If a trigger value is exceeded, further investigations are required to confirm whether or not the site is contaminated and what remediation measures might be necessary. If the measured contaminant levels are lower than the trigger values, then the responsible authority can exclude risk for human health and the environment can be excluded.

The action levels and the trigger levels are risk-based using source-pathway-receptor models (Bieber 2007). The action levels and the trigger levels are related to the use of the respective site. The decision whether the soil contamination implies a hazard (or does not) has to take into account how the site is actually used and what future use can reasonably be expected.

Separate trigger values for soil quality are provided for human health via direct contact; human health via plant uptake (for agriculture, gardening and recreational green space) and via groundwater.

The list of trigger values for the "direct contact" pathway consists of 13 substances and four categories according to the sensitivity of use: play-grounds for children, residential areas, parks and recreational facilities, industrial areas. Derivation makes use of toxicological reference data (e.g. Tolerable Daily Intake) and a lifetime cancer risk of $10E-5$ is considered tolerable for carcinogenic substances. Two pathways are taken into consideration: the uptake of contaminated soil by playing children and; the inhalation of soil particles. For children's playgrounds, residential areas and parks the exposure scenarios "soil ingestion" (including via leaching to groundwater) and "dust inhalation" are used. For industrial sites the exposure scenario "soil/dust inhalation" is used. Soil leaching to groundwater is not considered in combination with these other exposure pathways, as this is considered via leaching tests (see below). Further details on the risk assessment approach used and how it compares with approaches used elsewhere in Europe are provided by Carlon (2007).

Under the Soil Protection Act groundwater contamination risks from contaminated soil are considered on the basis of comparing leachable contamination against trigger values. There are 27 substances considered in this "soil-groundwater" pathway. These trigger levels apply to the transition zone between the unsaturated and the saturated soil zone

for industrial sites but not former waste disposal sites. However, direct measurements of groundwater quality may also be used in the determination of contaminated sites where the contaminated soil is in the saturated zone.

Groundwater can be classified as uncontaminated if background levels of substances are not exceeded. Otherwise groundwater may be classified as “contaminated” or “changed in its chemical status to only an insignificant extent” (i.e. uncontaminated in a legal sense) according to the Groundwater Ordinance, under the Federal Water Act. The “insignificance” classification occurs where despite an increase in substance concentration compared to regional background values, no relevant ecotoxicological effects occur and the demands of the Drinking Water Ordinance or values derived accordingly are met. These “insignificance” thresholds are set at a Federal level, but are not intended to set a quality goal for groundwater. Where regional naturally occurring background values exceed insignificance, regional authorities can set exceptional values that correspond with regional conditions. Groundwater that is contaminated by polluted soil has to be remediated.

If the orientating investigation has confirmed a substantial suspicion of contamination, a detailed investigation is initiated. Its objectives are a final hazard assessment and the setting of criteria for further treatment. In general, data are required relating to the contamination source, the pathways of concern and the receptors to be protected. As a result of the detailed investigation, a remediation proposal is compiled, proposing an optimum remediation technology for the individual sites and the target values the remediation needs to achieve. The proposal may suggest several different alternatives for the remediation or the combination of several remediation technologies.

Within the “LAGA-Liste” three reference values are provided for permitting re-use, for example back-filling, of excavation and demolition materials: unrestricted use; restricted use and restricted use with specified technical “securing measures” such as containment (NICOLE 2008). Uncontrolled re-use of materials is not permitted if contamination concentrations exceed the “precaution levels” provided for by the Soil Protection Act. However, an exception is made for re-use on remediation project sites where “adverse soil effects” have already occurred. Such re-use is possible when the “trigger levels” are not exceeded (or leaching behaviour is acceptable); when the material being re-used has met an agreed remediation target and/or where re-used material is to be contained and otherwise fulfils the requirements of the BBodSchV. Reuse of contaminated site materials is not permitted in any case in certain protected areas (for example forests, nature conservation areas and specific water protection areas).

6.1.2 *Recent and ongoing Developments*

Federal soil protection legislation has been under review since 2007 (Frauenstein 2009). The review considerations include: experience gained since the introduction of the BBodSchV and the BBodSchG; technical and methodological developments; the re-use of soil and other materials; trigger values and their human toxicological basis; soil ecological impacts of contaminants in materials added to soil; and whether and how natural attenuation processes should be taken into account. Substantial revisions to site investigation requirements are envisaged. The review is also considering how to ensure a timely site management response, in particular taking into account human health considerations. Trigger values for additional substances will be introduced:

- Organic pollutants will be added to trigger values for the soil–plant pathway
- Antimony, cobalt and thallium trigger values will be added for the soil–human being pathway, along with a number of explosives compounds.
- For the soil–groundwater pathway, harmonisation of trigger values with the marginal thresholds of the Joint Water Commission of the Federal States (Länderarbeitsgemeinschaft Wasser, LAWA) has been considered for some substances. Points under discussion include the adoption of marginal thresholds as trigger values for the boundary area between the water-unsaturated and water-saturated zones, the introduction of additional trigger values for evaluating the leachability of pollutant source material, and the integration of transport processes into site risk assessment on a case-by-case basis.
- The soil-groundwater trigger values also impact on the re-use and recycling of waste derived materials (for example derived from incinerator bottom ash). The development of a specific set of leach tests for re-use of “granular waste materials” has been included in the review process (Lopez Meza et al. 2008).

6.1.3 *Role of case-by-case decision making*

A driving principle underpinning the risk assessment and handling suspected contaminated sites in Germany is a phased examination and evaluation strategy. In general, detailed risk assessment is carried out case by case and decisions depend on the kind of land use as well as on the extent of pollution, on the relevant targets and exposure pathways.

The local authorities are normally the decision-makers but polluters and land owners are also involved. The individuals or institutions who may be affected by any remedial actions must be informed under the Federal Soil Protection Act, and they may demand

consultation and involvement in all stages of the decision-making process. The documents required to assess potential contamination at a site and those relating to remedial measures proposed are made available for public consultation. Where commercial and/or confidential information is included, full summaries must be provided as alternatives to the original documents. There is no handling or recording of risk assessment results at the federal level. If risk assessments have been made the results will usually form part of the regional registers of (potentially) contaminated land.

6.2 Approach's effectiveness

A very large number of remediation projects have been reported in the technical literature, although often in German language publications such as Altlasten Spectrum⁶. English language publications have been dominated by publications from a range of substantial research and demonstration projects funded nationally and at an EU level. There are also many case studies from the 1980's to the early 2000's in various NATO/CCMS Pilot Study Reports (US EPA 2003).

Several different examples of the decision making for determination of contaminated land in very different contexts: redevelopment of former industrial land, redevelopment of former military areas (which are fairly common in Germany), the Bitterfeld megasite in the former DDR; gasworks remediation and remediation technology demonstrations. These examples are drawn from the more recent sources (post 2005).

The RESCUE Consortium (2005) describe the reuse of former industrial land near the city of Hamm in the Ruhr (Federal State of North Rhine-Westphalia). The site is a former coal mine and coking site of 21 ha and is owned by subsidiaries of RAG AG (formerly Ruhrkohle AG). The site was remediated by excavation and removal as dictated by site investigation findings and "lightly" contaminated soils were used as fill on-site. Its re-use is largely for industrial and commercial purposes, with some of the former industrial buildings remaining for industrial heritage purposes. The EU and the local government subsidized 80% of the costs for necessary measures in planning, remediation and development.

In 1996 the French armed forces left a 20 ha site in Pforzheim (Baden-Württemberg). This site is outside the contaminated site definition of the Federal Soil Protection Act. Attempts to redevelop the site foundered until 2006, in part because of uncertainty over site contamination. In 2006 plans were put in place to develop the site to mixed retail and residential usage. The site, which was federally owned, was sold to a public-private

⁶ <http://www.altlastendigital.de/homepage.html>

partnership at the end of 2006. It is in a water protection zone. The site has a history of fuel and lubricating oil spillages until 1998. From 1990-1996 contaminated soil was moved to specific areas of the site. In 1998 an extensive site desk study review was carried out using historical information, leading to recommendations for intrusive site investigation. Detailed investigations were then carried out in seven areas of the site where contamination problems had been found. Limited remediation was proposed based on excavation and removal to deal with contaminated soil. Groundwater risks were judged to be low since the site was underlain by low permeability layers, and the depth to the water table was > 50 m. Groundwater monitoring was carried out in 1987 and 1998 after fuel spillages, which confirmed the view that risks to groundwater were low. Predicted remediation costs were greatly exceeded by demolition costs for the site (Phillips and Lambrecht 2007). Noé (2007, 2008) reports a partnership between two municipalities that led to redevelopment of an 80 ha former military airfield. The site was bought from Federal authorities by the two municipalities. The site included contaminated soil and groundwater, and also munitions. A remediation plan for the site was developed in accordance with the Federal Soil Protection Act. Contaminated soil was dealt with by excavation and removal. A large amount of munitions were removed and disposed of. Built development work began on the site in 2006, with sales to “users and investors” envisaged.

The Bitterfeld “megasite” is a former industrial area of around 1,300 ha situated in the centre of eastern Germany (NICOLE 2003), with an industrial history spanning over a century. By 1990 more than 5,000 different products and compounds were produced. Over time these activities have resulted in large-scale contamination of the subsurface, with an estimated 100 million m³ of contaminated groundwater. This megasite also contains more than fifteen chemical waste disposal landfills in abandoned open-cast lignite mines. The remediation of the megasite is managed as part a large-scale ecological rehabilitation project at a strategic level by the State Authority for Exemption from Pollution Liability (LAF). Remediation planning for this site was included in an EU funded research project⁷ called “Welcome” (Grossman et al. 2005). The two main aquifers in Bitterfeld are separated by a lignite layer: a Quaternary aquifer and a Tertiary aquifer and a range of surface water systems. Cessation of pumping related to past mining activities has caused a rise in groundwater level and a change in direction of groundwater flow. Risk management for the groundwater at Bitterfeld has followed a phased approach consisting of the following steps:

- Risk-based assessment of groundwater quality using EU-threshold values.

⁷ www.euwelcome.nl

- Risk-based site assessment.
- Transfer based assessment of potential receptors.
- Derivation of suitable and acceptable remediation measures.

The overall risk management and remediation for these sites is likely to cost an estimated €1.2 billion. A derogation from the Water Framework Directive has been sought for the site because complete decontamination of the site is seen as neither technically nor economically feasible, and a risk management zone has been delineated for the site consisting of the industrial area and surrounding impacted groundwater (Grossman et al. 2005, Keil et al. 2005).

Bitterfeld is located in the State of Saxony-Anhalt which has carried out a further negotiation with the Federal government resulting in the Federal Government being able to end its financial commitments (see Section 6.4.2) in return for handing over a lump sum, which must be invested and used solely for financing remediation projects. This lump sum is managed by the LAF (NICOLE 2003).

In 2006 Grosscurth et al. reported the remediation of a 7 ha gasworks site in Hamburg over 2004-5 as part of a project led by the city authorities. A gasworks was first built on the site in 1844, and gasworks operations continued until 1976. The site itself was constructed after the land surface had been raised by 4.5 to 5.5 m using a variety of fill materials. The gasworks was decommissioned and above ground structures demolished in 1976, covered with a further 2 m layer of fill and used as a terminal until 2001. As a gasworks, production was interrupted by heavy bombing in 1943. The facility was repaired and went back into production in 1951. The site was grossly contaminated by the usual gasworks contaminants (PAHs, ammonium, BTEX, cyanides), but in addition needed to be carefully checked for munitions and unexploded bombs from World War Two. Project work started with a historical survey and desk study in 2001, followed by intrusive site investigation at the end of 2001 (which was limited by many buried obstacles). A site remediation plan was put in place and executed. Choice of remediation approach was limited because the site master plan envisaged underground car parking. Remediation was therefore carried out by excavation and removal. The project encountered a substantial cost over-run, in part due to the difficulties of dealing with a site with potentially unexploded military ordinance and a greater (and deeper) amount of soil contamination than predicted by the site investigation work. Ultimately no bombs were found and it is suspected that these were removed before 1951, however, there is no documentation recording this. Remediation of another gasworks is planned by the city authorities. Funding appears to come from the State authorities.

Meicht and Born (2008) describe the remediation of a smaller 3 ha gasworks also in Hamburg, also funded by city authorities. The site was remediated by extensive excavation and removal of soil and replacement with clean fill (115,000 tonnes of soil was removed). The principal driver for this was groundwater protection, following site investigation work indicating substantial exceedances of groundwater trigger values. Excavation and filling took place using a mosaic of small pits (area 3-4 m²) contained by sheet piling to avoid the need to lower the water table across the whole site and its consequent groundwater treatment requirements. This site was also heavily bombed and management of risks from unexploded ordinance was a major part of the site operational planning.

The German Federal Ministry for Research and Technology (BMFT) has funded an enormous Funnel and GateTM permeable reactive barrier (PRB) at a former gasworks in Munich as a technology research and demonstration project (Weindl et al. 2006, 2008). The work was funded as part of a large dedicated research programme focussed on PRBs, RUBIN⁸. The gasworks was first built 1906 to 1909 and the site covers an area of around 32 ha. A natural gas "cracking" plant was added in 1957. Coal gas production ceased in 1967, natural gas cracking ceased in 1975. Buildings and equipment were removed in phases over 1975 to 1997. The site is underlain by Quaternary and Tertiary aquifers found to be contaminated by dense non aqueous phase liquids (DNAPLs). Soil contamination problems included inorganic components, volatile organic compounds and PAHs and were found to depths of as much as 8m. Remediation work also needed to deal with the clearance of unexploded bombs from WW2. Nearly one million tonnes of contaminated soil has been removed from the site⁹. The PRB was brought into replace a pump and treat operation which had been running since 1992 with an annual energy consumption in the region of 600 MWh. The PRB design was based on detailed groundwater modelling. It includes a "funnel" and four "gates" based on activated carbon filtration. The impervious funnel wall extends to the aquitard of the second aquifer (a depth of 25 m) and has a total length of 1.2 km. Commissioning work began in 2005, with regular operations from Spring 2006.

EURODEMO was an EU-funded project which collated information on remediation technology pilot and demonstration projects from across Europe. The site continues to be maintained by the Austrian Environmental Protection Agency¹⁰. Its demonstration project database includes a demonstration project for in situ soil heating at a former

⁸ www.rubin-online.de

⁹ It is assumed that MBFT only paid for the PRB work and that State authorities paid for the excavation and removal and other site works

¹⁰ www.eurodemo.info

metal-working enterprise where the aquifer and unsaturated zone beneath is contaminated with perchloroethene (PCE) near Tübingen¹¹. Pump-and-treat and soil vapour extraction had been operated on the site for almost 10 years. As extraction rates decreased it was decided, in 2001, to stop them. However the high concentration of PCE remaining in the groundwater, meant that remediation was still seen as necessary. The local authorities proposed a thermally enhanced remediation by steam-air injection (TSVE) with the aim of source removal within three to four months. The treatment volume was small (<500 m³). The site had a new use as a printer and the aim was that this should not be disturbed by the remediation. The actual project ran for seven months from August 2003. Compliance with remediation targets was achieved in January 2005. Remediation targets were negotiated-based on limit values in the German Soil Protection Act (BBodSchG) as follows: PCE-concentration at monitoring well < 0.05 mg/L; PCE-concentration from SVE < 5 ppm; daily mass flux leaving the site < 2 g/d.

Rügner et al. (2006) described the uptake and regulation of monitored natural attenuation (MNA) in Germany. MNA has only been used infrequently in Germany. Guidance on MNA use has been produced by LABO, which is predicated on the groundwater itself being a receptor (see discussion of in 6.1.1). This allows for natural attenuation processes in the unsaturated zone to be considered, but if "seepage" water reaching the water table is still considered as contaminated, then the need for remediation has to be assessed. This decision is affected by a principle of proportionality. However, only in "very unfavourable" conditions will contamination of groundwater be tolerated. Rügner et al. described a Public Sector financed research and demonstration project in Baden-Württemberg. In this project an argument in favour of MNA over pump and treat was made on proportionality grounds and was allowed because evidence supported a view that steady state conditions for the plume had been achieved and would be stable in the long term.

6.2.1 Proportionate

The Federal Soil Protection Act is based on a suitable for use approach, with criteria delineated over a range of options much as in the UK. The case studies above support a view that site investigation and remediation work is carried out in a highly pragmatic way. The majority of investment in remediation and site investigation appears to come from Public Sector sources, with authorities taking a substantive role in the management of land, creation of development opportunities and development of funding (including public-private partnerships). There is some evidence that the approach to generic soil quality values for contaminated site determination (at least at initial stages) is a barrier

¹¹ Information on EURODEMO last updated: 08/10/2007

to land redevelopment (Müller and Rindfleisch 2005). However, there is no case-study related evidence of this. It would appear that Private Sector interests in land regeneration is limited more by market conditions, see Section 6.7. Dealing with unexploded ordinance (munitions) is a major feature of contaminated land management in many sites in Germany, and the deaths in 2010 on a site in Goettingen show the seriousness of this problem¹².

The strict adherence to concepts of groundwater as a receptor appears to have inhibited the use of MNA in Germany, and potentially to a greater use of excavation and pump and treat based interventions. The International Committee for Contaminated Land (2009) report that around 4.4 million tonnes of contaminated soil are excavated across Germany per year.

6.2.2 Targeted

The Soil Protection Act regime is targeted at abandoned waste and industrial sites and does not extend to land contamination problems at active sites. Other sources of contamination, for example from mining operations or military sites are regulated separately. It would appear that the generic environmental quality criteria set out in the Federal Soil Protection and Water Act are used more widely across other domains, for example at the Bitterfeld megasite. Bitterfeld is also interesting in that a special case has been made to provide a derogation for the megasite area from the Water Framework Directive. None of the case studies apply soil quality criteria originating from outside of Germany.

6.2.3 Consistent

As far as they are reported the management steps for the contaminated sites in all of these examples appear to follow the sequence of steps in the flow chart of Figure 6-1. The case studies bear out the general remarks in Section 6.5 that practical remediation work for contaminated soils is dominated by excavation and removal. The excavated soil seems to be sent in large part to fixed site treatment installations. The case studies also illustrate that while a Federal generic soil quality values have been set to prompt an immediate response, or further investigation, risk management goals may be set in a negotiated process taking into account technical and economic feasibility.

6.2.4 Transparent

Decision-making criteria for contaminated site management in Germany are published and available for use. They are enacted at Federal level and applied by the States. In

¹² BBC News (2010) World War II bomb kills three in Germany, <http://news.bbc.co.uk/1/hi/world/europe/10212890.stm>

this regard contaminated land policy in Germany is transparent. Indeed it appears to be accompanied by large swathes of technical guidance and research projects. The case studies illustrate that what is less obviously transparent, at least for a foreign organisation, is the process of forming partnerships for regeneration of contaminated brownfields, which appears to be led mostly by the Public Sector. There would also appear to be some room to manoeuvre in terms of agreeing criteria for risk management objectives.

6.2.5 *Internal perception*

The Federal Environmental Protection Agency (2007) published an assessment of German contaminated land management policy with the early proposals for the Soil Framework Directive (see also Frauenstein 2009). No additional administrative burden on Germany was identified from the proposed EU Soil Framework Directive, and it was not anticipated to lead to significant changes in existing German soil protection law. It was felt that that reporting to the Commission might be more time-consuming should the data required not already be available. Since then Germany has been a member of the blocking minority of member states on the basis that soil is not a transnational issue and therefore should not be the subject of EU legislation.

6.2.6 *External perception*

NICOLE (2010) perceives only a modest contaminated brownfield rehabilitation market in Germany. Most brownfield regeneration related contamination is dealt with under waste law. NICOLE (2008) reviewed German waste policy as it relates to soil re-use, and the EU funded Heracles project reviewed the soil quality criteria used under German Soil Protection Law (Carlson 2007), comparing it with that of other European countries. Neither review has “critiqued” German policy, for example in a way that shows “strengths and weaknesses”. Federal German organisations take a leading role in the Common Forum on Contaminated Land¹³, and its researchers are well represented in European funded projects¹⁴. Although several German businesses are members in NICOLE¹⁵, Germany is seen as under-represented compared with other countries, especially in terms of companies that are problem-holders. Mezger and Spierenburg (2009) report that for a privately owned former industrial area its sales contract included an indemnification for contaminated land remediation, backed by an insurance policy. The buyer subsequently discovered contamination, and claimed under the insurance policy. The insurers and the regulatory authorities entered into a legal dispute over the nature of

¹³ www.commonforum.eu

¹⁴ Relevant projects under FP5, 6 and 7 programmes are listed at <http://www.eugris.info/projects.aspx?h=1>

¹⁵ www.nicole.org

the remediation solution that should be employed, and this lasted over 20 years until 2007.

Despite its historically leading role in the EU, German contaminated land management practices and technology have not had a major impact on other countries.

6.3 Estimate of scale

6.3.1 *Estimates of the amount of potentially contaminated land*

Contaminated site data is typically compiled (if it is compiled at all) by individual States. No Federal register exists. However, a compilation is produced by the Joint Länder Working Group on Soil Protection¹⁶, called the Ständiger Ausschuss Altlasten (LABO). This has been summarised in English by Frauenstein 2009, summarised in Table 6-2. Data reported by individual Länder was provided between October 2008 and July 2009. In total more than 300,000 sites suspected to be contaminated were registered across Germany. Of these 30% were suspected abandoned waste disposal sites and the remainder suspected abandoned industrial sites. Former mining sites, military sites and active industrial facilities fall outside the remit of the German contaminated land definition. This is particularly an issue in western Germany as such sites were inventorised in eastern Germany following reunification (Ferber, pers. comm.). Earlier estimates of suspect sites in Germany from circa 2000 were substantially higher at 363,000 possible contaminated sites (STAT-USA 2000).

Germany has a mining tradition that dates back centuries. While potash and rock salt resources together with hard coal and lignite are still extracted, mining of copper, uranium and other metals stopped after reunification. The reclamation of former lignite mining areas remains one of the main environmental rehabilitation issues in Germany. Lignite mining rehabilitation goes beyond the scope of the Federal Soil Protection Act. Most of the former mining sites and suspected contaminated sites are subject to the Federal Mining Act, which came into force in the "New Länder" in 1990.

Marr (2005) reports that there some 3,500 km² of military areas in Germany. Work by the Federal Ministry of Defence on assessing and remediating contaminated military sites has proceeded in three phases: identification and initial assessment; site investigation and risk assessment; and remediation. As of January 1st 2005 remediation was underway at 111 sites; 1,367 sites were under investigation and risk assessment and a further 367 sites were assumed to be contaminated.

¹⁶ Bund/Länder-Arbeitsgemeinschaft Bodenschutz (LABO) <http://www.labo-deutschland.de/Veroeffentlichungen.html>

Table 6-2 Suspect Contaminated Site Registrations in Germany and Their Ongoing Management (based on Frauenstein 2009)

State	Survey date	Registered suspected sites	Suspected abandoned waste disposal sites	Suspected abandoned industrial sites	Contaminated sites (confirmed)	Remediation (finalised)	Risk Assessment (finalised)	Remediation (ongoing)	Contaminated sites (under monitoring)
Baden-Württemberg	12/2008	13987	2048	11939	2020	2278	13396	642	411
Bavaria	03/2009	16131	11256	4857	1398	1393	4584	1330	68
Berlin	06/2009	4730	1122	4220	855	172	n.d.	71	68
Brandenburg	06/2009	20929	7398	12894	1426	3749	3924	120	154
Bremen	06/2009	3589	30	3559	411	573	823	50	163
Hamburg	07/2009	1909	276	1659	469	418	2851	133	122
Hesse	07/2009	1007	519	488	425	708	1356	146	192
Mecklenburg Western Pomerania	12/2008	6064	2688	3376	910	1178	329	368	604
Lower Saxony	07/2009	91626	9344	82282	2410	1298	3581	343	246
North Rhine-Westphalia	10/2008	63313	27199	36114	n.d.	6070	17614	n.d.	n.d.
Rhineland-Palatina	06/2008	13415	10563	2852	405	712	1365	167	206
Saarland	06/2009	1958	1646	317	456	148	362	36	63
Saxony	04/2009	20363	6903	13460	725	2658	6241	515	1308
Saxony-Anhalt	05/2009	17529	5315	12214	166	1366	3080	71	25
Schleswig-Holstein	12/2008	13690	2100	11590	269	906	2576	56	36
Thuringia	03/2009	14369	4277	10092	726	950	3537	n.d.	65
Totals		304609	92684	211913	13071	24577	65619	4048	3731
% of suspect sites		100	30.4	69.6	4.3	8.1	21.5	1.3	1.2

6.3.2 *Estimates of progress*

The distribution of registrations across a range of categories, including stages in the site management process, is shown in Table 6-2. Aggregating the data across all Länder indicates that nationally:

- Risk assessment has been finalised at 21.5% of suspect sites.
- 4.3% have been confirmed as contaminated sites.
- Remediation has been finalised at 8.1% of sites and was ongoing at 1.3%. 1.2% of sites were subject to ongoing monitoring.

A unique factor in German progress on managing contaminated land was the reunification of the Federal (BRD) and Democratic (DDR) Republics of Germany in 1990. As a result of this process very large liabilities for contaminated land were taken on by the German Nation. These liabilities, and progress in their management, are discussed in Section 6.4.2.

6.4 **Deciding who pays**

6.4.1 *‘Polluter pays’ principle*

In line with other European countries Germany's approach to contaminated land encompasses the “polluter pays” principle: the person causing the contamination is held responsible, but the owner or occupier may be held responsible as well (Müller and Rindfleisch 2005). The Federal Soil Protection Act is based on strict liability. The only defence is innocent past (but not current) ownership. The cost of remediation is to be borne by the parties obliged to carry out such measures. The Act does however provide a right of compensation or contribution from other liable parties. The property owner and the occupier of the property being obliged to take measures to prevent harmful soil changes originating from their property. The party who damaged the soil or contaminated the site, and his universal successor, as well as the relevant property owner and the occupant of the property are obliged to remediate the soil and contaminated areas including ground and surface water. Where there are several potentially responsible parties, it is open to them to agree a contract between them and the regulatory authority to mutually agree division of liabilities under “Public Law”.

The extent of liability may be limited, specifically in the event that it is unreasonable to impose the costs of decontamination or revitalisation upon the landowner, which depends on the relationship between funding requirements for decontamination and the fair market value of the property, in particular where the land is private property that represents a substantial part of an individual's livelihood. If costs exceed the fair market

value this would be equivalent to expropriation without compensation. However, liability is unlimited where the owner has knowingly (or negligently) accepted the risk of hazard (with the degree of negligence being decisive).

There is a limit to liabilities set in the German Constitution (Section 14, Para. 1, Clause 2). This means that each case requires a specific judgement about whether or not to impose the full decontamination costs upon the person liable. An unknown factor is the relationship between the limitation of claim within the compensation according to s. 24 Federal Soil Protection Act 1999 and the general legal statutory period of limitation according to s. 548 Civil Code. This will be ruled upon by the Federal Supreme Court.

Liabilities can be transferred by contract under "Private Law", and this is done on a routine basis. Typically contaminated site transfers take place with some kind of indemnity from the buyer to the seller in case of future claims, perhaps backed up with an environmental insurance (NICOLE 2010). Note: this said indemnity or exemption is effective between the contracting parties only and does not remove statutory or public-law obligations. At least one major consultancy in Germany is selling a guaranteed fixed price remediation service, with financial risks covered by a cost cap insurance policy that protects both service provider and the client (Robold 2007). This service is also sold internationally.

Properties owned by the State in the former DDR form a special case in that liabilities became the responsibility of the Federal German state.

6.4.2 *Liability of the state*

After Germany's reunification the restructuring of the eastern German economy to a competitive market economy has been mainly based on privatising state owned industry, and was the task of the Treuhand Agency, for the Federal Government. The Treuhand Agency included regulations on the contractual release from risks of contaminated sites in its privatisation contracts.

Following negotiations between the Federal government and the New Länder, the properties and thus the financial responsibility for contaminated sites owned by the former German Democratic Republic were handed over to the Federal Government. The often massive contamination on those properties was deemed a substantial risk for private investors who were seen as vital to securing economic development in the former DDR. In 1992 the Federal Government and the New Länder drew up an Administrative Agreement on the financing of contaminated site remediation (Frauenstein 2009, Keil 2004). Under this agreement, the Federal Government and the Länder established 22 large-scale projects where remediation costs were shared between the Federal

Government (75%) and the New Länder (25%). Projects included the rehabilitation of large-scale industrial complexes (e.g. at Leuna, Buna and Bitterfeld-Wolfen), former mining areas, refineries, steelworks and dockyards. The total costs included in the agreement were in excess of €3 billion. The aims of the remediation measures in these large scale projects are:

- Immediate measures for averting dangers
- Remediation and reclamation of landscapes degraded by industrial use or former mining activities
- Groundwater protection to enable continued drinking water abstraction
- Maintenance of industrial sites including their infrastructure.
- The boundary between “contaminated” and “not contaminated”

Beside the large sites, there was a release of liability (“Freistellungsregelung”) for all private investment on sites registered before 1994.

Apparently the group of small and medium size companies was sold for 1 DM with the clause that the new owner would pay the whole costs of the cleanup;

Under the Administrative Agreement between the Federal Government and the New Länder the ownership of mines passed into the hands of the Federal Government, which became responsible for mining site remediation in the former DDR. The cost sharing ratio between Federal Government and Länder is similar to the large scale projects. For reclamation of lignite mining sites alone the budget allocated to the end of 2007 was approximately €7.8 billion. The agreement has been extended, in effect from 2008 to 2012, and the extension provides for a total budget of nearly €1 billion Euros to provide continued financing of the costs of reclamation measures. The measures have been primarily aimed at improving groundwater conditions and the rehabilitation of technical and tourist infrastructure in these regions.

The financial responsibility for former uranium mining sites belongs solely to the Federal Government. Their remediation programme will continue until 2015 with an expected budget of €6.2 billion. More than 60% of the planned remediation measures were reported as complete by Frauenstein (2009).

The German Ministry of Defence operates a site remediation programme (Marr 2005), see Section 6.3.2.

6.4.3 *Liability of the owner/ occupier*

See Section 6.4.1.

6.4.4 *‘Orphan’ sites*

No explicit Federal funding mechanism for managing orphan sites exists in Germany (Bieber 2005). Where the responsible party is insolvent the site is an orphan site and responsibility for remediation falls to the Länder, who may have specific funding programmes to support this (Schirmeisen 2005).

6.4.5 *Role of state funding.*

The role of federal and state funding in eastern Germany is summarised in Section 6.4.2. The Federal Soil Protection Act recognises a more general role for public funding in site remediation, which appears to be mediated principally by the Länder. Where public funds have led to an uplift in land value, then the public funding needs to be repaid to the funding authority. Exclusions exist for measures supporting local authority development schemes, and for reasons relating to public interest or hardship (ref SPA translation).

There are no specific fiscal incentives to support the re-use of treated site materials (NICOLE 2008).

6.5 Contaminated land sector

6.5.1 *Size*

Germany is considered to be the largest market for soil remediation in Europe, accounting for approximately 30% of the estimated €5.2 billion pa EU 25 market for “remediation and clean-up” in 2004 based on EUROSTAT data (Ernst and Young 2006). It is however, also seen in the Ernst and Young report as a mature market, with only moderate future growth predicted. Note GHK et al. (2007) estimated the EU27 market for direct “remediation and clean up of soil and groundwater” to have been €4.6 billion in 2000. These data are compiled on the basis of industry codes (NACE) used by EUROSTAT and a very limited number of stakeholder interviews. This indicates a large contaminated land management sector in Germany. However, the German Federal Environment Agency is not aware of any generic contaminated land sector market reports for Germany.

An interesting finding is the view of the NICOLE Brownfield Working Group (NICOLE 2010) that the level of transactions for brownfield sites is “minimal” compared with the then “dynamic” market of the UK which was driven by a government policy of preferring brownfield reuse over greenfield development. There has been large scale Public Sector

interest in stimulating brownfield renewal in Germany at Federal, State and municipality levels. This is linked to increasing concern at the high rate of greenfield land consumption in Germany, where the Federal Government has set a target to reduce current consumption levels of 9317 ha per day to 30 ha per day in 2020¹⁸ (EEA 2010, Malburg-Graf et al. 2007). A central part of these recommendations is the imposition of spatial planning control of greenfield use and targets for brownfield re-use. It is not clear whether this would take place at State or local levels, and no financial incentives or tax breaks have been included in the recommendations. The use of tradable planning permits, based on municipalities being allocated shares in an allowable Greenfield consumption (of say 30 ha per day) has also been suggested (EEA 2010).

A range of Public Sector supported contaminated land and brownfield site initiatives have been showcased at a European level in projects such as REVIT, EUBRA and RESCUE, and CABERNET and HOMBRE, TIMBRE (Grimski et al. 2007). This would seem to imply that the main driver for this apparently large contaminated land sector in Germany is regulatory compliance and public investment in brownfield renewal, with Private Sector brownfield regeneration playing only a minor role, although examples of public-private partnerships are reported. It is noteworthy that in Germany landowners are expected to pay for infrastructure improvements that raise the value of their locations (EEA 2010).

For brownfield projects at least the dominant remediation approaches appear to be excavation and removal and use of pump and treat (Schrenk et al 2007), although a wide range of technologies are available and are in use or under piloting at a minority of sites. This is despite large Federal investment in contaminated land remediation technology research, piloting and demonstration for a range of in situ approaches including extraction techniques, monitored natural attenuation and permeable reactive barriers listed by Frauenstein 2009. The Federally funded "TASK" initiative seeks to improve the transfer of German contaminated land technology research into practical use¹⁹. This predominance of excavation and removal is serviced by a wide range of fixed treatment facilities.

A recent survey of the fixed remediation installations in Germany (Frauenstein 2009, Frauenstein and Mahrle 2009) indicates capacity of 7.2 million tonnes per year based on biological treatment, 4.2 million tonnes per year based on physico-chemical treatment

¹⁷ This is the 2010 figure from the EEA; Malburg-Graf *et al.* In 2007 suggest a rate of use of around 100 ha / day

¹⁸ Perspectives for Germany - Our Strategy for Sustainable Development, http://www.bundesregierung.de/nsc_true/Content/DE/_Anlagen/2006-2007/perspektives-for-germany-langfassung.property=publicationFile.pdf/perspektives-for-germany-langfassung (version in English)

¹⁹ The TASK web site is at: <http://www.task.ufz.de/>

and 2.5 million tonnes per year based on thermal treatment, distributed across most of the Federal States. This is provided by nine thermal (combustion) soil treatment facilities, 20 physico-chemical facilities and 71 stationary biological soil treatment centres. The outputs from these facilities are used in road construction and noise barriers or are landfilled. Summersgill (2006) reports that over 2001 to 2005 a range of onsite remediation techniques were in use in Germany, including soil washing, immobilisation and bioremediation. Compared with other European countries, unit costs for remediation in Germany appeared to be low to mid ranging.

6.5.2 Main drivers

The main drivers for the contaminated land remediation in Germany appear to be a combination of pressure for redevelopment of brownfield sites and regulatory drivers resulting from the site inventorying and assessment approach being carried out by each State. Also European funding programs supporting brownfield regeneration have been used on some former industrial sites (www.brachflächenrevitalisierung-sachsen.de) An expert committee²⁰ has been formed to advise on the development of this land bank policy, and the integration of formerly used land into this land bank (Müller and Rindfleisch 2005).

6.6 Success of the regime

It has been reported that the use of prescriptive evaluation criteria, i.e. trigger values, has blocked the reuse of land or sites by Müller and Rindfleisch 2005, which is consistent with the NICOLE view (NICOLE 2010) that the level of brownfield transactions in Germany is “minimal”. Müller and Rindfleisch argue that a practical benchmark for “decontamination” based on future land use could be an important tool for freeing up sites for re-use. This discussion appears to be analogous to the recent deliberations of the SGV Task Force (ref) in the UK. However, low levels of Private Sector brownfield transactions may be related to more fundamental market circumstances. The US Commercial Service report that property values tend to be “undervalued” compared with US and UK values (US Commercial Service 2007), in which case the value-chain driving brownfield redevelopment may be less strong. The same US Commercial Service Report suggests that new legislation to create investment vehicles in Germany similar to those already existing in the UK and USA will stimulate the German property sector, which may presumably be a driver for enhanced Private Sector Interest in brownfield redevelopment and hence remediation.

²⁰ Ingenieurtechnischer Verband für Altlasten e.V. (ITVA) Expert Committee C5. The expert committee’s remit also includes topics such as property management, facility management, sustainable construction, and fiscal policy or socio-cultural aspects.

6.6.1 *Positives*

- A consistent and transparent policy across all Federal States for the management of suspected contaminated land, linked to the envisaged use of the site
- Strong Public Sector investment in contaminated land remediation and brownfield rehabilitation
- Very strong contaminated land management research base and well regarded technical capabilities
- A large *ex situ* soil treatment capacity
- Pragmatic approaches to establishing risk management objectives
- Recognition of the importance of site specific risk assessment for determination of contamination and any subsequent remediation requirements
- Thought to be the largest European contaminated land management market place

6.6.2 *Negatives*

- Low level of Private Sector involvement in contaminated brownfield renewal not true in non contaminated sites
- Contaminated sites management is to some extent fragmented over several regimes (Federal Soil Protection, Water, Waste, Pollution and Mining Acts)
- Very large investments of Public money have been required (although in the former DDR this has perhaps been inevitable)
- Some concern and examples of difficulties in negotiating risk management plans
- Lack of penetration of on site or in situ remediation technologies

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APPENDIX 7 REPUBLIC OF IRELAND

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7 REPUBLIC OF IRELAND

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7.1 The boundary between “contaminated” and “not contaminated”

The Republic of Ireland currently lacks specific legislation for dealing with historically contaminated land (Burden, 2009; McCarthy & Shields, 2011). Instead, the issue of contamination is addressed by a number of existing legislative acts which are focussed primarily on ensuring the prevention of pollution from ongoing activities rather than driving clean up from historical use (Brogan et al., 1999):

- The Waste Management Acts 1996 to 2010
- The Environmental Protection Agency Act 1992-2003
- The Local Government (Water Pollution) Acts 1977-2007
- The Air Pollution Act 1987
- Derelict Sites Act 1990
- Local Government (Planning and Development) Acts 2000-2010
- The Building Control Act 1990
- Building Regulations 1997-2010

Until recent times, remedial action with respect to contaminated land in the Republic of Ireland has been largely driven by the planning and development process (Burden, 2009). However, the EU directive on environmental liability (Directive 2004/35/CE) (EPA, 2006b) and the requirement of local authorities to assess unregulated waste disposal sites under the Waste Management Acts 1996 to 2005 (EPA, 2007) have provided additional drivers for the assessment and remediation of land contamination in Ireland.

The principles of risk assessment, including the concept of the source-pathway-receptor paradigm, have been adopted by the Irish Environmental Protection Agency (EPA) for the assessment of environmental liabilities (EPA, 2006b) and unregulated waste disposal sites (EPA, 2007). A formalised approach to the assessment of risks from contaminated land for the purposes of the Environmental Liability Directive regime is being developed by the EPA. (EPA, 2008). No formalised approach to assessment of risk to contaminated land more generally has been published yet although one based on CLR 11 is being considered at the time of writing (June 2011).

In the absence of relevant Irish guidance, it has become general practice to draw upon the principles of risk assessment enshrined within the UK approach of CLR 11 (Environment Agency, 2004) and the CLEA model (Environment Agency, 2009) when faced with the issue of land contamination. However, in practice, detailed quantitative

risk assessment, such as that described in UK technical guidance, is rarely applied in Ireland (Burden, 2009). Instead, risk assessment tends to be confined to the generic quantitative stage with dependence on generic assessment criteria (GAC) derived by other nations (in particular Netherlands and the UK) (Burden, 2009).

As such, the boundary between “contaminated” and “not-contaminated” is often based on numerical thresholds. However, the basis for the derivation of these numerical thresholds may be highly variable ranging from risk assessment principles through to non risk-based approaches.

7.1.1 *Role of number-based thresholds*

There are currently no statutory or non-statutory guideline values for contaminants in soils set in Ireland (CLARINET, 2002). However, the development of non-statutory values for soil is being considered by the EPA (EPA, 2005).

Burden (2009) reported that it has become general practice in the Republic of Ireland for practitioners to use generic assessment criteria derived using generic quantitative risk assessment techniques, as described in UK technical guidance, for the assessment of contaminated land. However, it was noted that detailed quantitative risk assessment was rarely undertaken in Ireland. Furthermore, Burden (2009) also highlighted that it was not uncommon for practitioners in Ireland to use assessment criteria derived for contaminated land alongside regulatory standards derived for other purposes. An example given was the use of Waste Acceptance Criteria (WAC) alongside generic assessment criteria for land contamination leading to considerable confusion amongst environmental practitioners, planners and regulators about the fundamental differences between waste and contaminated land.

7.1.2 *Role of case-by-case decision making*

Contaminated sites in Ireland are reportedly assessed on a site by site basis (CLARINET, 2002). Unlike many other jurisdictions, Ireland does not have in place a dedicated legislative regime to systematically identify, assess and ensure the remediation of contaminated land (Shields, 2008). It lacks a strategic and proactive approach to identifying, assessing and ensuring the remediation of contaminated land (Shields, 2011).

7.2 *Approach’s effectiveness*

A small number of case studies describing the assessment and remediation of historical land and groundwater contamination in the Republic of Ireland have been identified

within the published literature (Table 7-1). The main driver for the assessment and / or remediation of historical land contamination in these case studies was redevelopment and regeneration of former industrial areas. As such, the approach used was intended to make the land suitable for planned future use. No case studies were identified that described the assessment and / or remediation of historical land contamination based on considerations of the current use of the land.

In addition to the small number of case studies identified in Table 7-1, it is also understood that many other contaminated sites have also undergone assessment and remediation in Ireland. These include former and current railway sidings, tanneries, oil and storage sites, commercial warehouses, and for industrial manufacturing plants (e.g. Irish Steel) (Keane, 2008). However, no published case studies for these sites were available in the public domain.

Table 7-1. Contaminated land assessment and remediation case studies for Republic of Ireland

Site	Former Use	Assessment / Remediation Driver	References
Sir John Rogerson's Quay Gas Works, Dublin	Gas Works	Redevelopment	Doak (2004); Evans (2006); Brown & Crowther (2006)
Cork Docklands	Mixed use including fuel storage and creosoting works	Redevelopment	CDD (2010)
Irish Glass Bottle Works, Poolbeg, Dublin	Glass bottle manufacturing	Redevelopment	IPPC Licence No.PO-164-01- transfer and surrender documentation available from EPA offices (transfer documentation available online)
Cork City Gas Works	Gas works	Redevelopment	
Industrial Workshop, Waterford	Spray painting and panel beating workshop	Redevelopment for residential housing	Envirotrat (2010)
Waterford Gas Works	Gas Works	Redevelopment for commercial and residential	Doak (2004) SIAC (2010) EPA Waste Licence 190-1

7.2.1 Proportionate

For all case studies identified in Table 7-1, it was reported that the land underwent assessment and remediation with the ultimate goal of making the land "suitable for the proposed end use". According to Doak (2004), remediation strategies submitted to the Irish EPA (for the purpose of waste management licensing) are typically based on

quantified site-specific risk assessment. Therefore, it may be assumed that the level of remediation is proportionate to the level of risk at the sites. This assumption is supported by some of the case studies which describe the use of site-specific risk assessment and risk-based remedial options within the overall site remediation strategies. For example, Doak (2004) reported the use of monitored natural attenuation as a remedial option for contaminated groundwater at four sites in Dublin. Furthermore, Evans (2006) describe the development of a risk-based remediation strategy for Sir John Rogerson's Quay, Dublin, which used soil mixing techniques to stabilise the contaminated soils in-situ and install a low permeability cut off wall to prevent future migration.

However, the assumption that the level of remediation is proportionate to the level of risk is unlikely to hold true for all sites in Ireland. This is demonstrated by Keane (2008) who reported that, faced with retaining potential liability issues on sites cleaned to defined risk assessed levels, many Irish developers have instead opted to remove the liability completely and so clean up to background levels. This has reportedly occurred on many of the Dublin sites developed as apartments (Keane, 2008). Furthermore, some Irish developers have reportedly isolated the 'remediated' sites from the possible migration of contaminants back onto the site by the use of secant piling walls driven into the bedrock and base sediments (Keane, 2008).

7.2.2 *Targeted*

The current legislative acts which address land contamination in the Republic of Ireland are targeted primarily at ensuring the prevention of pollution from on-going activities rather than driving cleanup from historical use (Burden, 2009). While the planning and development system is an effective means for dealing with land contamination issues at sites with an intended change of use, the application of this approach has been primarily restricted to the main port cities where brownfield redevelopment is considered to be profitable. Consequently, the approaches for dealing with land contamination in the Republic of Ireland are poorly targeted at sites which not intended for a change in land use and are unlikely to increase in value following redevelopment.

7.2.3 *Consistent*

There is no evidence in the literature reviewed to suggest that there is an inconsistent application of legislation affecting land contamination in the Republic of Ireland between regulators (e.g. between different local authorities). However, a review of the literature indicates that legislation for addressing land contamination in the Republic of Ireland is often inconsistently interpreted between practitioners. This inconsistent interpretation is most notable for the planning and development system and is largely associated with the

type of assessment criteria and remediation criteria considered suitable by the practitioner. While many of the case studies identified in the literature (Table 7-1) indicate that some Irish practitioners make use of risk assessment principles to derive risk-based assessment and remediation criteria (Doak, 2004; Evans, 2006), there is also evidence to suggest that many practitioners rely solely on non risk-based criteria to assess and remediate land contamination. For example, Doak (2004) indicated that the Irish EPA often received reports based on Dutch Intervention Values / Target Values and UK ICRCL (which were withdrawn in 2000). Furthermore, reports received by the Irish EPA often strived to achieve an end result of a clean soil rather than factor in the end use, causing the unnecessary removal of large amounts of soil sand waste (Doak, 2004).

7.2.4 *Transparent*

Much of the information in relation to action taken to manage contaminated land when remediated pursuant to an IPPC licence, waste licence or planning condition is made available to the public and can be accessed at the offices of the EPA and County Councils. The EPA is obliged to keep a public register of IPPC and waste licences and related documents. The planning authority is required to make planning files available to the public (EPA Act, Planning and Development Act). The Environmental Liability Directive regime explicitly enables the public to participate in the process of remediating contaminated land. (Environmental Liability Regulations 2008). It is unclear from the Environmental Liability Regulations whether the register of enforcement action taken in relation to a contaminated site under the regime is to be made public (Shields, 2011). A public register of closed hazardous and non hazardous waste sites, derelict sites and closed and abandoned extractive waste facilities also provides a level of transparency in relation to potential contaminated land risk (Shields, 2011).

7.2.5 *Internal perception*

There is widespread agreement on the current approach to managing land contamination. Regulators and practitioners agree on the use of UK or other international approaches where no specific Irish guidance exists. However this is recognised as being unsatisfactory and moves to formalise the national approach are currently underway.

7.2.6 *External perception*

Ireland is seen as a potential export market for many UK based environmental consultancies.

7.3 Estimate of scale

7.3.1 *Estimates of the amount of potentially contaminated land*

Historical industrial development within the Republic of Ireland has been restricted primarily to the main port cities and therefore land affected by contamination is less widespread than in other industrialised nations (Burden, 2009). As such, it has been estimated that the extent of contaminated land in Ireland is modest, in the region of 2000 sites (Brogan et al., 1999; Doak, 2004). A similar number (<2500 sites) has also been reported by the Irish EPA (EPA, 2006a). This number is understood to include former gas works sites, waste disposal sites, closed mining sites, older fertiliser plants, tanneries, timber treatment facilities, petroleum depots and retail stations, dockyards, scrap yards, and agricultural areas where sheep dipping and pesticide application has occurred. Most of these sites are generally located in urban areas, around major cities and towns particularly Dublin and around the Cork region.

More recently, an inventory of potentially contaminated historic mine sites was undertaken for Ireland (EPA & GSI, 2009). This study identified 27 sites of which three were thought to require full risk assessments to be undertaken due to their potential risk to sensitive receptors.

7.3.2 *Estimates of progress*

Progress in dealing with land contamination issues in Ireland has largely been achieved through the planning and development process (Burden, 2009). In addition, the waste and IPPC regimes are also relied on to deal with contaminated land issues as is the County Council's powers under the Water Pollution Act relied on, where contaminated land gives rise to water pollution (Shields, 2011). Furthermore, the more recent requirement for local authorities to identify and assess unregulated waste disposal sites under the Waste Management Acts (EPA, 2007) has provided an additional driver for the assessment and remediation of land contamination in Ireland. To date the relatively recently adopted Environmental Liability Regulations 2008 have yet to be relied on to deal with land contamination.

Despite the various drivers for assessing and remediating contaminated land in Ireland, no estimates of progress were identified as part of this review. However, CLARINET (2002) reported that the recent economic boom of the mid to late 2000s led to considerable development and clean-up of several contaminated sites in urban areas such as Dublin and Cork through redevelopment.

However, the progress made by the planning system is likely to be biased towards areas around the main port cities where redeveloped is considered profitable. Therefore there may be contaminated land existing in areas which are not desirable for development which is not being addressed.

7.4 Deciding who pays

7.4.1 *'Polluter pays' principal*

In line with other European countries, Ireland's approach to contaminated land encompasses the polluter pays principle (Brogan et al., 1999). This principle is included within the Irish Government's waste management policy informed by the Waste Management Acts 1996 to 2010. The polluter pays principle has been applied to the assessment and remediation of land contamination arising from waste activities under the waste management legislation in for example the case of Wicklow County Council v. Fenton (2003) and Cork County Council v. Louis O'Regan (2005). The principle also applies in the context of the IPPC, ELD and water pollution regimes each of which can regulate to an extent the assessment and remediation of contaminated land. (Aoife Shields, 2011)

In practice, because the majority of contaminated land has been dealt with through the planning and development process in Ireland, the cost of assessment and remediation is largely covered by public and private investment into the development. An example of this is provided by the redevelopment of Sir Rogerson's Quay Gas Works (Brown & Crowther, 2006). This redevelopment project was undertaken under the auspices of the Dublin Docklands Development Authority (DDDA) which is a public body created in 1997 to manage public and private investment used to rejuvenate the Dublin Docklands.

7.4.2 *Liability of the state*

Under the Waste Management legislation in Ireland, where a local authority has taken steps to recover or dispose of wastes, the local authority may recover the costs of such steps as a simple contract debt in a court of law from such a person whose act or omission necessitated the steps.

7.4.3 *Liability of the owner/ occupier*

Under the Water Pollution Act an owner or occupier may be liable under the Water Pollution Act where contaminated land gives rise to water pollution and this may entail the remediation of contaminated land, even where the owner or occupier may not have caused the land contamination. (Aoife Shields, 2011) Furthermore, under the law of

negligence the owner or occupier of land may be liable for damage to person or property arising from contaminated land even though the owner or occupier is not the creator of the contamination. In addition, an owner or occupier may be required to remediate contaminated land where it poses a nuisance to person or property or injury to public health under the Public Health Act

7.4.4 *‘Orphan’ sites*

There is a lack of a strategic or proactive regulatory approach to dealing with orphan sites. The responsiveness to historical contaminated land is particularly weak (Shields, 2011).

7.4.5 *Role of state funding.*

Outside of urban renewal schemes such as the Dublin Dockland development and Part 9 of the Energy Miscellaneous Provisions Act 2006 in relation to remediating orphan mining sites and exchequer funding earmarked for the assessment and remediation of local authority owned closed landfill sites, there appears to be little by way of state funding for the assessment and remediation of land contamination.

7.5 Contaminated land sector

7.5.1 *Size*

InterTradeIreland & Forfas (2008) undertook an analysis of the environmental goods and services (EGS) market on the island of Ireland providing data for both Northern Ireland and the Republic of Ireland. The analysis identified two main sub-sectors EGS directly applicable to the assessment and remediation of contaminated land; environmental consultancy and soil remediation. No statistics on the size of the environmental consultancy sub-sector in Ireland in 2008 were provided in the report, however it was estimated that the soil remediation sub-sector was valued at €30 - €40 million annually in Ireland and an approximate market value of €16 - €18 million in Northern Ireland (InterTradeIreland & Forfas, 2008).

7.5.2 *Main drivers*

The main drivers for the sub-sectors related to contaminated land in Ireland are: brownfield redevelopment; (ii) compliance with national and European environmental legislation; and (iii) investment plans. Examples of key European environmental legislation being the Environmental Liabilities Directive and the impending Soil Framework Directive. An example of a key investment plan being the National Development Plan (NDP) 2007 – 2013.

Another driver for the soil remediation sub-sector is the limited landfill capacity within Ireland for the disposal of contaminated soils. As such, large remediation projects have made use of on-site in-situ process-based remediation technologies where possible to minimise input to landfill. This is illustrated by the remediation of Sir John Rogerson's Quay gasworks where the lack of landfill capacity forced the investigation and use of alternative treatment technologies (gravel jet washing, thermal treatment, and soil washing) for which there had previously been little or no market in the Republic of Ireland (Brown & Crowther, 2006).

7.6 Attributing financial liability

There is no mechanism for apportioning liability as there is no specific contaminated land liability regime.

7.7 Success of the regime

In the absence of specific legislation for dealing with historically contaminated land in Ireland, it is not possible to comment upon the positives and negatives of such a regime. However, as the majority of land contamination is dealt with through the Planning and Development system, the positives and negatives of this approach can be considered.

7.7.1 Positives

- Relatively fast assessment and remediation of land
- Focussed on land which will become economically valuable following cleanup
- Cleanup can be undertaken to standards which are fit for purpose

7.7.2 Negatives

- The planning system does not make polluter pay
- Land which will not become economically valuable following cleanup is not addressed.
- The planning system is a reactive approach to managing contaminated land.
- Large remediation projects may be partly funded by public money as well as private investment
- Practitioners may often try to cleanup to background levels instead of risk based levels thus indicating that remediation costs are unnecessarily high.

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APPENDIX 8 ITALY

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8 ITALY

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Italy claims to have been the first country in Europe to enact legislation, in 1986, to repair environmental damage. Article 18 of LD 349/86 allows public authorities to bring civil action before a judicial court in order to achieve the recovery and/or economic compensation of damages caused to natural resources by illegal activities (D'Aprile & Romano, 2009). This legislation still applies to damage that occurred prior to 2002 whereas damage that occurred after that date is regulated under Part VI of LD 152/06, which enacts the Environmental Damages directive 2004/35/CE.

Under direct responsibility of the Ministry for the Environment are the "Sites of National Interest", defined in article 15 of D.M. 471/99 as sites with high complexity and extension of the contamination, high population density, and relevant human health¹ and ecological risks. Remediation projects for these sites are promoted by the Ministry for the Environment and public funding is regulated by 'National Remediation Plan' (L.426/98, L.388/00, D.M.468/01, L.179/02). (www.eugris.info accessed 15th April 2010)

At the time of writing Italy was also facing EU sanctions for failing to clean up two out of three hazardous waste landfills that were the subject of a 2004 European Court of Justice ruling (<http://www.endseurope.com/24948>).

8.1 The boundary between "contaminated" and "not contaminated"

The term "contaminated site" refers to "all areas where, following previous or current human activities, an alteration of the land, surface and underground waters has been certified with concentrations exceeding standards established by regulations" (APAT, 2010a) However, the regulations relating to contaminated land are undergoing regular change in response to the frequent changes in Government in Italy.

Ministerial Decree no. 471/99 (MD 471/99) on "Regulations containing criteria, procedures and modalities for the environmental security, reclamation and recovery of polluted sites" set maximum "Limit Values" for a number of contaminants in soil and

¹ Human health risks tend to be referred to as "sanitary risks" in the Italian context.

groundwater for various land uses. Under this legislation, site-specific risk assessment was only permitted under specific circumstances such as where sites could not be cleaned up to the prescribed standard by the “Best available technology not entailing excessive costs” (BATNEEC). In these situations risk assessment was permitted to demonstrate that the residual levels of contamination did not represent a hazard to human health or the environment (Scazzola et al., 2008; APAT 2010a).

To promote cost-effectiveness, target higher risk sites and promote uptake of more sustainable remedial options, MD 471/99 was replaced in 2006 by Section V “Reclamation of contaminated sites”, Chapter Four of Legislative Decree no. 152/06 (LD 152/06). This introduced a focus on risk assessment and site-specific Limit Values. The former Limit Values are now regarded as screening values or Contaminant Threshold Concentrations (CSCs) above which site specific assessments should be conducted to determine a Risk Threshold Concentration (CSRs); the maximum allowable soil concentration that results in an acceptable risk to human health (Scazzola et al., 2008).

LD 152/06 itself has been further amended by Legislative Decree 4/08. The introduction of the Environmental Damages directive has also complicated current moves to regulate contaminated land in Italy (D'Aprile & Romano, 2009).

8.1.1 Definitions

The following definitions of “potentially contaminated site”, “contaminated site” and “not contaminated site” were reported (Common Forum 2013):

Potentially Contaminated Site: “a site where the concentrations of one or more chemicals in the environmental media (soil, sub-soil and groundwater) exceed „Contamination Threshold Concentrations□ (CTCs, i.e. screening values for residential and industrial commercial land uses) and needs a detailed site investigation followed by a site-specific risk assessment to evaluate the contamination level and the „Risk Threshold Concentrations□ (RTCs, i.e. site specific target values)”

Contaminated Site: “a site where „Risk Threshold Concentrations□, derived by a site-specific risk assessment carried out on the basis of a detailed site investigation, are exceeded”

Uncontaminated Site: “a site where contamination in the environmental media (soil, sub-soil and groundwater) is below CTCs or, if CTCs are exceeded, is below the RTCs derived by a site-specific risk assessment.

8.1.2 *Role of number-based thresholds*

Under MD 471/99, a site was classed as contaminated wherever one or more Limit Values was exceeded and clean up was also expected to achieve this standard. Limit values were derived for around 100 organic and inorganic substances for two standard land uses: "Residential/public green spaces" and "Commercial/Industrial". Groundwater standards were based on drinking standards (D'Aprile & Romano, 2009; Scazzola et al., 2008).

The Limit Values originally laid down in MD 471/99 have been retained under LD 152/06 as screening values or Contaminant Threshold Concentrations (CSCs) above which more detailed assessment is required (D'Aprile & Romano, 2009; Scazzola et al., 2008).

8.1.2.1 *Level of risk represented*

The CSC have been described as "only partly risk-based" and so they are not always coherent with the risk-based Risk Threshold Values described below (D'Aprile et al., 2009). D'Aprile et al. (2009) however report that under 2008 regulations, the uppermost acceptable levels of excess lifetime cancer risk are 1E-06 for a single substance and 1E-05 for mixtures. For non carcinogens a maximum of either a hazard index or a hazard quotient of 1 are acceptable.

8.1.2.2 *Sources of limit values*

The Limit Values within MD 471/99 were published by the Ministry of the Environment but it is unclear how or who derived these values.

The national regulatory bodies in Italy have also recently been through considerable change, with the former Italian Environment Protection and Technical Services Agency (APAT), National Institute for Wildlife (INFS) and Central Institute for Scientific and Technological Research applied to the Sea (ICRAM) having merged to form the Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA).

In deriving much of the available guidance ISPRA (or previously APAT) have worked in conjunction with a wide variety of other regulators, authorities and stakeholders/problem owners, including the National Health Institute (ISS), National Institute for Prevention and Safety at work (ISPESL) and regional environmental authorities (ARPA/APPA) (D'Aprile et al., 2009).

8.1.3 *Role of case-by-case decision making*

8.1.3.1 *Setting criteria*

Under LD 152/06, where the Limit Values (CSC) are exceeded a site-specific human health risk assessment must be carried out to derive Risk Threshold Levels (CSR) using

appropriate guidance (D'Aprile & Romano, 2009; Scazzola et al., 2008). A site is considered contaminated only when this CSR is exceeded for one or more contaminants.

The production of national risk assessment guidance was coordinated by the former APAT and resulted in the "Criteri metodologici per l'applicazione dell'analisi assoluta di rischio ai siti contaminati" (Method criteria for applying the absolute risk analysis to contaminated sites) and "Criteri metodologici per l'applicazione dell'analisi assoluta di rischio alle discariche" (Method criteria for applying the absolute risk analysis to dumps). These documents contain theoretical and practical guidance for technical staff of public administrations, researchers, professionals and businesses who prepare and/or evaluate reclamation projects for contaminated sites (ISPRA, 2010). This guidance has been updated at least twice since it was initially released in 2005 (Baciocchi et al., 2005; D'Aprile et al., 2009). This guidance was derived from a consideration of Italian, European and US guidance documents such as:

- ASTM E1739, 1995 "Standard guide for risk-based corrective actions applied at petroleum release sites" and other documents
- US EPA "Technical background document for soil screening guidance" and other documents
- UNICHIM "Manuale n. 196/1 Suoli e falde contaminate, analisi di rischio sito-specifica, criteri e parametrici"
- CONCAWE "Report 3/03: European oil industry guideline for risk based assessment of contaminated sites"
- RBCA Toolkit ver 2.0
- BP-RISC Ver 4.0
- And other documents

Home-grown risk assessment models (such as ROME and Giuditta) appear to have been produced but their availability and uptake by industry is unclear. ROME (Reasonable Maximum Exposure) was developed by the National Agency for Protection of the Environment (ANPA) as a risk assessment tool for human health and water resources, which is itself derived from RBCA. A second model named "Giuditta" appears to have been developed by Province of Milan and Dames & Moore International (EUGRIS, 2010). However, the original RBCA software appears to be widely used within Italy to implement site-specific assessments (Capretti et al., 2008; Scazzola et al., 2008).

In addition, to guidance and models, Italy has also collated a database of toxicological and chemical/physical base needed to calculate fate and transport for over 120 compounds, which is available for download (APAT, 2010b)

Under LD 152/06, risk assessment techniques are used to ensure that any soil contamination only poses an "acceptable risk", which is defined as:

- For non-carcinogenic substances, a hazard index of <1 for either a single substance or for multiple cumulative substances
- For carcinogenic substances, a risk of $<10^{-6}$ for a single substance or $<10^{-5}$ for multiple cumulative substances (D'Aprile et al., 2009; Scazzola et al., 2008)

The exposure pathways that should be analysed are those identified within the ASTM RBCA guidance; the ingestion of vegetables pathway is not currently considered (D'Aprile et al., 2009). The default exposure parameters adopted are those presented in the US EPA documentation (D'Aprile et al., 2009).

8.1.3.2 Deciding when to stop

Remediation of water aims to achieve generic Limit Value levels. Site specific criteria may be used as clean up criteria where BATNEEC cannot achieve remediation to Limit Values. Remediation to protect human health should achieve the the maximum allowable levels of lifetime cancer or hazard quotient/ index mentioned above.

8.1.3.3 Choosing remediation options

There is no reported standardised procedure for remediation option selection.

8.2 Approach's effectiveness

Given that changes to the legislation in 2008 (i.e. LD 4/08) have only been recently implemented it seems unlikely that the contaminated land community are currently aware of the true long-term effectiveness of the present contaminated land regime in Italy. However, the recent changes to the Italy approach appear to have been widely appreciated as they allow a more practical approach to legacy land contamination than the previous legislation (Hill & Scott, 2008). As may be expected the change to the more risk based approach has lead to some confusion and differing regional interpretation (Hill & Scott, 2008).

The explosion at the ICMESA (Industrie Chimiche Meda Soc. Azionaria) trichlorophenol (TCP) factory in Seveso on 10th July 1976 resulted in the release of TCDD (2,3,7,8-tetrachlorodibenzodioxin) over an area of about 2.8 km² (700 acres) (Hombberger et al. 1979). Two years after the event, the impacts on human and animal health and on the environment seemed minimal or at least temporary in most cases. "Only a few of the cases which were directly exposed to the chemical at the moment of the explosion still present today the typical skin manifestations (Fig. 2) in those parts of the body (earlobe, armpit) which can be considered a defining characteristic of the exposure to some halogenated aromatic compounds." (Hombberger et al., 1979). A longer term study reported that "An excess mortality from cardiovascular and respiratory diseases was uncovered, possibly related to the psychosocial consequences of the accident in addition

to the chemical contamination.” (Bertazzi et al. 1998). Parent company, Roche, reported that “The contaminated soil and rubble from the demolished buildings were landfilled near the factory site using an impermeable containment system.” (Roche, 2007).

Table 8-1 Contaminated land assessment and remediation case studies for Italy

Site	Former Use	Assessment / Remediation Driver	References
Between Avigliana and Buttigliera Alta, near Turin	Industrial landfill	Water protection	Zolla et al. 2007
La Maddalena, Sardinia	Naval Base	Hosting the G8 Summit, 2009	http://www.publicspace.org/en/works/f176-ex-arsenale ; http://www.supsalv.org/pdf/FACEPLATE_April%2008.pdf
ACNA	Explosives, pharmaceutical, dye, sulphuric & nitric acid, phenol manufacture;	Multi-km impact on river fauna	Quercia et al. 2006.

The Seveso incident spawned the eponymous European Union Directive (EU Directive 82/501/EEC). The directive was amended twice in response to the Union Carbide factory at Bhopal, India in 1984 and the Sandoz warehouse in Basel, Switzerland in 1986 where fire-fighting water contaminated with mercury, organophosphate pesticides and other chemicals caused massive pollution of the Rhine and the death of half a million fish (EC DG Environment, 2010). It was replaced in 1996 by Seveso II (Council Directive 96/82/EC) which also had to be amended following a series of industrial accidents (Toulouse, France; Baia Mare, Romania and; Enschede, Netherlands). However Italian commentators on contaminated land policy and practice do not seem to refer to the incident as being formative in any way on the approach Italy adopted to manage historic land contamination.

The documentary film *Blue Vinyl* describes a court case involving workers whose respiratory tracts were claimed to have been damaged by chronic exposure to fumes as a result of working in vinyl chloride factories in the hinterland of Venice at the Porto Mageira megasite. The cases were settled out of court.

Zolla et al. (2007) describe the first zero valent iron permeable reactive barrier in Italy. Their preliminary conclusions, based on some two years of post installation monitoring, suggest the PRB may be becoming less effective due to mineral precipitation and gas phase accumulation. Remediation was driven by concentrations of perchloroethylene (PCE, maximum concentrations of 40 µg/L), trichloroethylene (TCE, 130 µg/L) and 1,2-

dichloroethylene (1,2-DCE, 135 µg/L) exceeding Italian maximum concentration levels (MCLs). A risk based clean up target for combined carcinogenic chlorinated solvents of 30ug/l was derived. The PRB was installed to prevent contaminated groundwater reaching the Dora river.

Quercia et al. (2006) reported on the former ACNA chemical works which caused significant impact on river fauna up to some 70km downstream of the site. A multiple technology risk reduction programme costing some 190M euros was devised. This included on site entombing of some 2Mm³ of waste and contaminated soil and the export of some 140,000 tons (sic) of lagoon material to Germany.

8.2.1 *Proportionate*

It is generally acknowledged that the current risk-based legislation is considerable more proportionate than the regime implemented under MD 471/99, which generally required expensive and long-term remedial approaches (Scazzola et al., 2008). Scazzola et al. suggests that the new regime will promote a "cost-effective approach...to allocate financial resources mainly where harmful effects were expected", the approach is also expected to stimulate the use of innovative remedial technologies.

For example, the cost-effective management of manufactured gas plant (MGP), or gasworks, site portfolios becomes possible under the recent updated legislation (Scazzola et al., 2008).

8.2.2 *Targeted*

Italy operates a National Priority List (NPL) system for the most seriously contaminated sites. This system has been influenced by several pieces of legislation including LD 426/98, 388/00 and 179/02 and MD 468/01. LD 426/98 originally prioritised "sites of national interest". This list appears to have evolved into the current NPL.

In 2009, the National Priority List covered 57 sites but these collectively cover more than 3% of the Italian territory (including 330,000 ha of marine environment). These sites are managed by the Ministry of the Environment with the technical support of specialist national bodies (e.g. ISPRA)

8.2.3 *Consistent*

Scazzola et al. (2008) states that consistent implementation of the new risk-based regime took a number of years to occur due to resistance from regulatory bodies who lacked the appropriate skills and guidance. It was reported that since the publication of

national guidance on the application of risk assessment, the new regime is generally accepted by regulators in most parts of Italy.

However, at the same conference, Hill & Scott (2008) suggested that risk-based decisions were still regularly over-ruled, resulting in the available resources not being focussed on the greatest environmental risks. In particular, they highlighted the exclusion of water resources from regulation under LD 152/06 and the consequential application of drinking water standards being applied universally to groundwater even when it was unlikely to be useful or productive as a potable supply. They suggested that a greater understanding of risk-based decision making was still required, particularly with respect to groundwater issues.

8.2.4 *Transparent*

Italian case studies are frequently presented in the scientific literature as both journal papers and in conference proceedings. International workshops hosted in Italy frequently include visits to contaminated industrial sites.

8.2.5 *Internal perception*

It has been reported that the transition from a mandatory limit system to a risk-based system has been resisted and complicated by ideological and practical issues; with a risk based system being more difficult to enforcement. In 2008, public and private sector organisations were still reportedly working on the transition. However, following guidance from the National Environment Protection Agency (APAT) risk-based approaches were reportedly accepted in most regions by 2008 (Scazzola et al., 2008).

Implementation of the 2006 decree has reportedly made the redevelopment of gaswork sites in Italy more commercially viable, particularly where residential redevelopment is desirable (Scazzola et al., 2008).

Ongoing projects have reported that the current regime and practice has allowed cost-effective solutions to be implemented. For example, a pragmatic and risk based approach at a pesticide manufacturing plant reportedly allowed cost savings in the region of US\$10 million.

8.2.6 *External perception*

Italy has been a strong market for contaminated land services in recent. Several UK based consultants' second European offices have been in Italy. However the constraints posed by legally binding contaminant levels and a focus on a small number of cause celebre sites has meant that there is little to be imported from Italian practices.

8.2.7 *External projection – what they say about themselves*

In 2009, ISPRA the national regulatory body (D'Aprile & Romano, 2009) concluded in a presentation to the ICCL that "The complexity of the regulatory framework (now pending revision) and the lack of clear technical indications on characterization, risk assessment and remediation bring to time (and money!) consuming legal actions in the field of contaminated sites: the development of guidelines and standards will hopefully help to reduce this actions between P.A. and private companies". And went on "Detailed technical indications cannot be included in the legislation in any case since in this field scientific and technical progress is very fast and guidelines/protocols need to be frequently updated. In this sense ISPRA is assuming an important role by developing and updating guidelines and protocols that are widely used as technical support by both P.A. and private stakeholders."

8.3 **Estimate of scale**

Earlier estimates relating to just 41 sites in the national remediation plan, suggested that the clean up costs would be in the region of 3,149.30 M€. The initial Government funding available was 547.34 M€ over three years (i.e. 17.4% of total). This spending had allowed several site investigations and emergency projects together with a few remediation projects (www.eugris.info accessed 15th April 2010) (CABERNET, 2003).

8.3.1 *Estimates of the amount of potentially contaminated land*

See section 8.2.2.

8.3.2 *Estimates of progress*

8.3.2.1 **Prioritisation**

Sites are placed on the NPL list based on general features of the site, the type and degree of contamination, risk posed to health and the environment and impact on cultural or environmental heritage (D'Aprile & Romano, 2009).

8.3.2.2 **Investigation/assessment**

No information about the rate of progress in the investigation or assessment of sites on the NPL was recovered.

8.3.2.3 **Remediation**

In 2003, it was noted that "the full spectrum" of remedial technologies were employed in Italy; from capping and "dig and dump", to SVE and biological methods, but that in situ methods involving injection of materials were seldom used due to "stringent rules" (Jarre, 2003). Data presented in this paper relating to the clean up of 34 petrol stations

indicates that treatment train approaches (i.e. multiple technologies in combination) were utilised at many of the sites. D'Aprile (2009) reported that most excavated soil is disposed of to landfill. However a range of treatment technologies (i.e. soil washing, In Situ Chemical Oxidation, Bioremediation (Biopiles, Phytoremediation), Solidification/Stabilization) "are frequently applied".

8.4 Deciding who pays

8.4.1 'Polluter pays' principal

The 1999 legislation (MD 471/99) implemented the "polluter pays" principle. Where a Limit Value was exceeded, those responsible or owner were required to submit plans for remediation (D'Aprile & Romano, 2009). Similarly, under LD152/06 where the CSR value is exceeded those responsible/owner must submit proposals for remediation or ongoing monitoring (D'Aprile & Romano, 2009).

8.4.2 Liability of the state

The state (*i.e.* regional authorities *etc.*) appears to be liable for costs relating to the remediation of public land, presumable where the original polluter cannot be identified - See Section 8.4.5 below.

8.4.3 Liability of the owner/ occupier

Where necessary, the owner of a contaminated site may be held liable for contamination (D'Aprile & Romano, 2009).

8.4.4 'Orphan' sites

See Section 8.4.5 below.

8.4.5 Role of state funding

Public funding for characterization and remediation of contaminated sites is provided by Regions and/or Municipality in this two cases:

- Sites of public property
- 'Orphan sites' where site owner or responsible party cannot be identified

These sites are included in the Regional Plans, as regulated by D.M. 471/99. (EUGRIS, 2010).

8.5 Contaminated land sector

8.5.1 *Size*

Italy's recent history has resulted in significant areas of potentially contaminated land. Jarre (2003) presented a summary of the historic and economic forces that have resulted in potentially contaminated sites, including refineries, gas works and ancient mines, being closed and made available for redevelopment but did not provide any estimates of the areas of land involved.

8.5.2 *Main drivers*

The main drivers for remediation seem to be compliance with EU legislation and voluntary remediation by industry to avoid the need for regulatory action.

8.5.3 *Skills/Qualifications*

No specific contaminated land related qualifications were discussed in the literature reviewed or in the various workshops and conferences attended. Nor were any such qualifications mentioned by those asked during this project.

8.6 Attributing financial liability

8.6.1 *Approach*

The Italian approach adopts the polluter pays principal and requires clean-up activities to be funded by the polluter or owner. The primary focus of the approach appears to be large heavily contaminated sites which form the National Priority List. Many of these are current or recently closed manufacturing sites, where the polluter is still present and aware of the need for remedial action

8.6.2 *Success*

The Italian approach seems to have focused on the high profile megasites and little seems to have been documented on the approach to the more numerous but smaller sites such as former petrol stations. Industry has been in a position to pay for voluntary remediation or at least for pilot studies of such remediation. The vinyl chloride related court case was settled out of court.

8.7 Success of the regime

8.7.1 *Positives*

A strategic approach to identifying potentially contaminated land allows resources to be targeted. Italy has attracted offices of several international consultancies and thereby built up capacity in risk based contaminated land management. Its large land owning and potentially contaminative industries have recognised their responsibility and funded some remediation infrastructure.

Italy has been at the forefront of knowledge exchange networks in Europe having had delegates in all the major EU funded concerted actions including CARACAS, NICOLE, SEDNET, CLARINET and CABERNET. Italy's willingness to host international meetings at the world heritage sites associated with Venice and couple those meetings to the Porto Mageira megasite have successfully attracted large numbers of delegates to such meetings.

8.7.2 *Negatives*

The legal regime, and in particular enshrining soil levels in legislation, held back Italian contaminated land management for several years and became a refrain at international meetings by Italian delegates.

Tardiness in responding to industrial incidents including those depicted in the documentary *Blue Vinyl* and arising from the incidents at Seveso suggest an unwillingness to fully confront the externalities created by Italy's industrial past.

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APPENDIX 9 JAPAN

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9 JAPAN

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9.1 Legal Contexts

Contamination became a widespread concern in Japan with the occurrence of 'Itai Itai' disease (literally translated as "it hurts, it hurts disease"), resulting from rice contaminated by cadmium and the tragic effects of mercury poisoning in Minamata that recently led to the International Minamata Convention on Mercury.

A review of the legislation associated with soil pollution up until 1994 is provided by Tokunaga (1996). During this period, the legislation was largely aimed at preventing new pollution of soils and was prompted largely by large-scale pollution incidents of agricultural soils which resulted in the exposure of local people to high levels of hazardous contaminants through the food chain.

However, due to increased concerns over soil pollution in urban areas, the Japanese Government introduced the Soil Contamination Countermeasures Act (Act No. 53 of 2002) (Ogata & Murakawa, 2008). This Act was proclaimed in May 2002 and came into effect in February 2003. It is the primary legislation driving the assessment and remediation of land contamination in Japan. The Act was amended in 2009 and the majority of new amendments came into effect on 1st April 2010.

9.2 The boundary between “contaminated” and “not contaminated”

9.2.1 *Role of number-based thresholds*

In 1991, the Japanese Environment Agency set Environmental Quality Standards (EQS) for Soil Pollution for 10 hazardous chemicals (Fukumorita, 1998; Tokunaga, 1996). According to the Standard, it was reported that local governments could inspect soil pollution and take necessary countermeasures to remedy polluted soil (Tokunaga, 1996). In 1994, the Standard was amended to tighten the guidelines for arsenic and lead and to include standards for an additional 15 substances (Fukumorita, 1998; Tokunaga, 1996). In 1998, the Japanese Ministry of Environment (MoE) further amended the EQS for soil by adding values for two more substances (Ogata & Murakawa, 2008).

In general, the EQS for soil comprised concentrations of substances in soil leachate, however, some of the EQS also comprised concentrations in dry soil (Ogata & Murakawa,

2008). It was reported that these EQS were derived to protect human health from the consumption of groundwater and crops (Fukumorita, 1998), however the mathematical basis for their derivation was unclear from the information provided in the literature reviewed.

In 2003 when the Soil Contamination Countermeasures Act was enforced, its aim was to protect human health from 'designated hazardous substances' present in soil and to ensure remediation of contaminated soils where human health is likely to be at risk. The Act requires that, under certain circumstances (see Section 9.3.2), a 'soil contamination survey' is undertaken during which concentrations of designated hazardous substances are compared with the EQS that were established by the Japanese MoE (Ogata & Murakawa, 2008). In the case that levels of substances in the soils exceed the EQS, and there was a human health risk, then the land is classified as a "Designated Area" and remedial measures may be undertaken, the nature of which depend on whether the main risk to human health is considered to be through direct soil ingestion or groundwater consumption (Ogata & Murakawa, 2008).

9.2.2 *Role of case-by-case decision making*

While the Soil Contamination Countermeasures Act requires that a soil contamination survey is undertaken on a case-by-case basis, the criteria against which the measured concentrations are compared (i.e. the EQS) are 'fixed' values (Ogata & Murakawa, 2008). Consequently, the EQS do not consider site-specific factors such as land-use, soil type, and critical receptor characteristics, all of which influence the extent to which the critical receptor is likely to be exposed to the substances in soil. This 'one size fits all' approach has been highlighted by a number of authors to be a major limitation of the current approach for dealing with historical land contamination in Japan (Fujinaga et al., 2008; Yasutaka & Nakamura, 2008).

However, amendments made to the Soil Contamination Countermeasures Act on 1st April 2010 have sought to address the lack of case-by-case decision making described by authors such as Funjinaga et al., (2008) and Yatsutaka & Nakamura (2008). In particular, these amendments sub-classify Designated Areas defined under the Act into two sub-classifications depending on the existence or likelihood of a risk of harm to human health (Ohta, 2010). These sub-classifications are: (i) areas requiring remediation (due to the existence or likelihood of a risk of harm to human health); and (ii) areas where authorities must be notified when the area is developed (due to the absence or unlikelihood of a risk of harm to human health).

9.3 Approach's effectiveness

Two case studies describing the assessment and remediation of historical land contamination in Japan have been identified in the peer reviewed literature which had been published in English (Table 9-1). Several other case studies were identified which had been published in Japanese and were available through Science Links Japan (<http://sciencelinks.jp>), a search engine for Japanese scientific and technical information. Four projects were described briefly by Ryuzo TAZAWA during the SuRF 21 meeting held in Washington DC (Tazawa 2012).

The main driver for the assessment and / or remediation of historical land contamination in the two case studies identified, which had been published in English, was the Soil Contamination Countermeasures Act (Table 9-1).

Table 9-1. Contaminated land assessment and remediation case studies for Japan

Site	Site Use	Assessment / Remediation Driver	References
Glass manufacturing site	Glass manufacturing	Soil Contamination Countermeasures Act	Yasutaka & Nakamura (2008)
Hyogo Prefecture	Factory	Soil Contamination Countermeasures Act	Fujinaga <i>et al</i> (2008); Yamamura <i>et al</i> (2008)
Tokyo (ca. 2011)	Gas manufacturing plant	Redevelopment to Seafood Market	Tazawa 2012
Shinsyu (2010)	Factory (electrical devices)	Redevelopment to shopping mall; prevent spread of contaminated groundwater	Tazawa 2012
Kansai (2009)	Mineal oil tanks	Redevelopment to Logistics warehouse	Tazawa 2012
Tohoku (2007)	Factory (electrical devices)	prevent spread of contaminated groundwater	Tazawa 2012

9.3.1 Proportionate

The 'one size fits all' EQS employed as part of the Soil Contamination Countermeasures Act in Japan are reported to make the contamination assessment process very easy to conduct (Fujinaga *et al.*, 2008). However, because the EQS do not account for site-specific factors which influence the exposure scenario, it has been reported that the remediation may be undertaken to address soil contamination issues at sites where there is not necessarily an unacceptable risk to human health (Fujinaga *et al.*, 2008; Yasutaka & Nakamura, 2008). This has raised concerns that unnecessary remediation costs, which are disproportionate to the risks posed by a site, may waste valuable financial resources

which could be allocated elsewhere within environmental conservation (Fujinaga et al., 2008).

However, despite the amendments to the Soil Contamination Countermeasures Act made in April 2010 (Ohta, 2010), which partially address the issues of disproportionate remediation costs (relative to the risk posed by the site) which may arise (Section 9.2.2), there is no discussion of a level of risk which can be considered to be 'acceptable' or 'unacceptable'. As such, there remains a possibility for disproportionate remediation responses (in relation to risk posed by the site) for sites where a risk of harm to human health exists or is likely but the risk is low.

9.3.2 Targeted

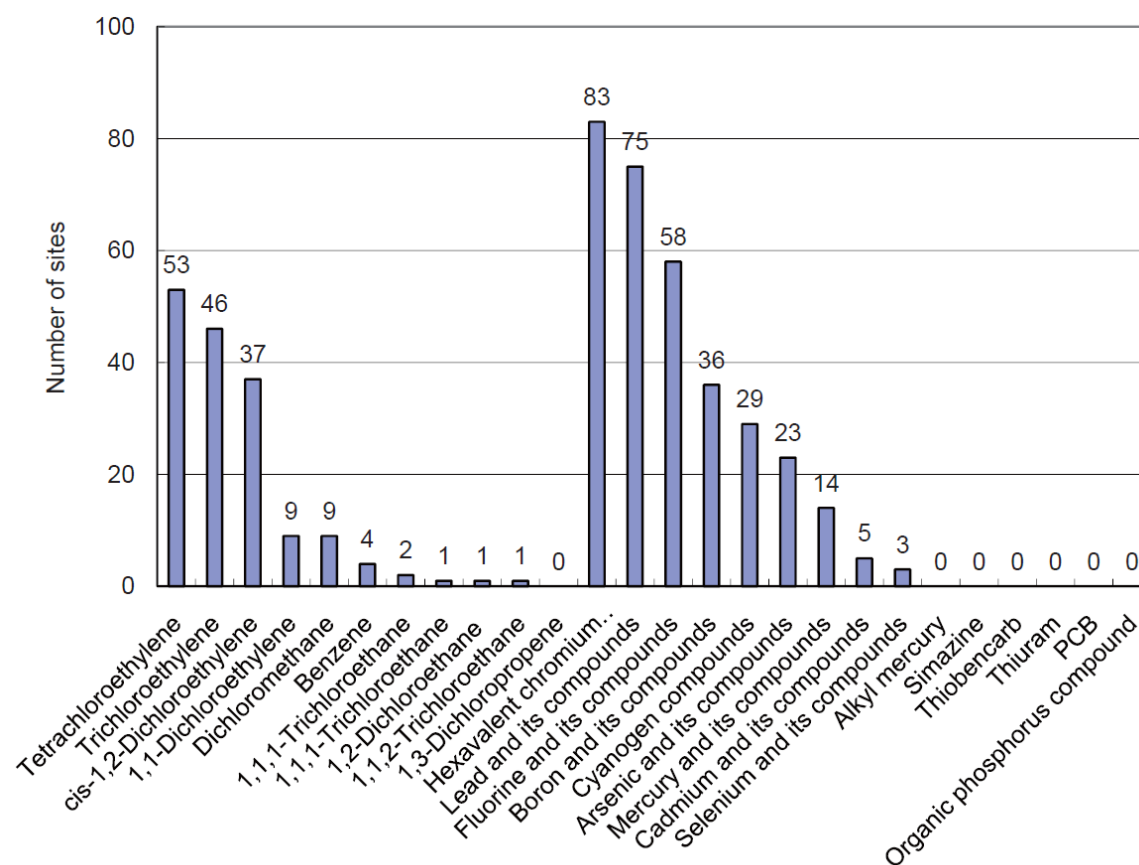
The Soil Contamination Countermeasures Act enforced in 2003 specified two types of sites at which a soil contamination survey was obligatory. These were: (i) sites housing specific manufacturing facilities which were closing down; and (ii) sites at which operations included the handling of harmful substances established by the Water Pollution Control Law; (Ogata & Murakawa, 2008). Furthermore, the Act allowed other landowners to have a soil contamination survey undertaken on a voluntary basis (Ogata & Murakawa, 2008). As such, it is apparent that the Act was initially targeted largely at two specific types of sites.

However, a number of amendments were made to the scope of the Soil Contamination Countermeasures Act which came into effect on 1st April 2010 (Ohta, 2010). One of these amendments was to include provisions that trigger a soil contamination survey at sites whenever changes are made to an area of land cover 3,000 square metres in size. This had the effect of broadening the scope of the Act to target a wider range of sites. Ohta (2010) reported that this amendment was necessary due to a relatively small number of surveys being undertaken under the pre-amended Act. Furthermore, it was reported that under the pre-amended act, where a survey was obligatory, the prefectural governor was entitled to, and often did, waive the survey (Ohta, 2010). As such, surveys were usually only being triggered where the land's use as a manufacturing facility was discontinued (Ohta, 2010).

The SCCA identifies three classes of hazardous substances ([Takei 2010](#)). He then shows the cumulative number of sites designated by substance. This shows that the vast majority of sites designated due to First Class substances were due to tetrachloroethylene, trichloroethylene and dichloroethylene. Those designated due to Second Class substances were mainly due to hexavalent chromium, lead and fluorine (or their compounds).

Table 9-2. Designated hazardous substances prescribed in the Soil Contamination Countermeasures Act (After Takei 2010)

First-class designated hazardous substances (volatile organic compounds, 11 substances)	Second-class designated hazardous substances (heavy metals, etc., 9 substances)	Third-class designated hazardous substances (agricultural chemicals, 5 substances)
Carbon tetrachloride 1,2-Dichloroethane 1,1-Dichloroethylene cis-1,2-Dichloroethylene 1,3-Dichloropropene Dichloromethane Tetrachloroethylene 1,1,1-Trichloroethane 1,1,2-Trichloroethane Trichloroethylene Benzene	Cadmium and its compounds Hexavalent chromium compounds Cyanogen compounds Mercury and its compounds Selenium and its compounds Lead and its compounds Arsenic and its compounds Fluorine and its compounds Boron and its compounds	Simazine Thiobencarb Thiuram PCB Organic phosphorus compound



NOTE: Some sites are contaminated by multiple substances, and as such, the total sum is not 270.

Figure 9-1 Number of sites designated as designated areas by hazardous substance (cumulative number between fiscal 2002 [when the Act was enforced] and 2007) (After Takei 2010)

9.3.3 Consistent

Recent amendments to the Soil Contamination Countermeasures Act which came into effect on 1st April 2010 (Ohta, 2010) have altered the definition of a "Designated Area". Prior to the amendments, land became a Designated Area when a prefectural governor

finds, based on the soil contamination survey, that the concentrations of designated hazardous substances in the soil did not conform to EQS. Under the amended Act, Designated Areas are sub-classified into two types: (i) areas requiring remediation (due to the existence or likelihood of a risk of harm to human health); and (ii) areas where authorities must be notified when the area is developed (due to the absence or unlikelihood of a risk of harm to human health). It is unclear as to how the amendments affect sites which were designated under the pre-amended Act raising issues over consistency. For example, it is possible that changes in the definition of 'designated area' will have meant that some sites were remediated in the absence of development thus wasting financial resources.

9.3.4 *Transparent*

No information was identified on transparency of legal regime.

9.3.5 *Internal perception*

The implementation of the Soil Contamination Countermeasures Act in 2003 generated concerns amongst land buyers and the real estate agents with respect to the impact of the Act on the value of land and land transactions. In particular, it was feared that the Act would result in a rise in the number of 'brownfield sites' which were defined as "lands which are un-used or with extremely limited use compared to their intrinsic value because of the existence or potential existence of soil contamination" (MoE, 2007). Concerns were such that the Japanese Government set up an 'expert study group for countermeasures against brownfields' which provided an interim report in 2007 (MoE, 2007). The report stated that an increase in brownfield sites in Japan, resulting from the Act, could cause multiple problems including adverse effects on land use, industrial promotion, and regional development, in addition to the abandonment of land which contains contaminated soil (MoE, 2007).

One of the amendments to the Act in April 2010 (i.e. the newly created sub-classification of Designated Area – i.e. land that does not require remediation until it is developed) was hoped to resolve the issue of increased brownfields in Japan (Ohta, 2010). However, because the amendments also increased the costs of excavation and removal of contaminated soil by imposing additional regulation on this activity, it was feared that landowners may abandon contaminated land as un-saleable and / or not worth developing if remediation is required, thus resulting in an expanded number of designated brownfields, but having no improvement on brownfield remediation (Ohta, 2010).

9.3.6 *External perception*

No information was identified on the external perception of the Japanese system for dealing with land contamination. However the impression obtained from the literature suggests that Japan has a technologically mature approach to remediation coupled with a robust policy monitoring and evaluation process but a rather weaker adoption of risk based land management.

9.4 **Estimate of scale**

9.4.1 *Estimates of the amount of potentially contaminated land*

Several estimates of the amount of potentially contaminated land in Japan were identified in the literature. Tokunaga (1996) reported that 232 sites in urban areas of Japan had been identified to have been polluted by hazardous chemicals in 1996. The MoE (2007) estimated that about 113,000 hectares of land assets within Japan were likely to be affected by contamination. Tazawa (2012) reported a Ministry of the Environment of Japan from 1 September 2012 figure of 719 designated zones of which 83 required 'counter measures' and 636 required notification for changing land use.

9.4.2 *Estimates of progress*

Ogata & Murakawa (2008) reported that in 2002, just prior to the enforcement of the Soil Contamination Countermeasures Law, approximately 650 soil contamination surveys were undertaken, of which just less than 300 demonstrated contaminant concentrations exceeding EQS. In 2005, over 1100 soil contamination surveys were undertaken, of which just less than 700 demonstrated contaminant concentrations exceeding EQS (Ogata & Murakawa, 2008). It is unclear how many designated sites have been remediated and removed from register. Tazawa (2012) citing 'GEPC 2011' reported that in 2011 contracts were awarded on some 7000 sites.

9.5 **Deciding who pays**

9.5.1 *'Polluter pays' principal*

The liability of the polluter for paying assessment and remediation costs for contaminated soils under the Soil Contamination Countermeasures Act is discussed by Ozawa & Moroi (2010). Under the Act, if the land is found to be contaminated and is to be cleaned up to protect human health, the governor may order the polluter to clean up the contamination. However, if it is not appropriate to order the polluter to pay for the clean up (e.g. in the case where the polluter cannot be identified), the governor may order the landowner to clean up the contamination even if the landowner was not the one who

caused the contamination (Ozawa & Moroi, 2010). As such, parties involved in land transactions are compelled to take a great interest in the existence or non-existence of land contamination (MoE, 2007; Ozawa & Moroi, 2010).

In cases where there is more than one polluter, the clean up must be performed by all the polluters in a manner that is proportionate to their responsibility for the contamination (Ozawa & Moroi, 2010). Furthermore, under the Civil Code of Japan, when a person is injured as a result of contamination caused by more than one polluter, the injured person can claim compensation from the polluters as a joint tortfeaser. The polluters would therefore be jointly and severally liable, however, between the polluters themselves, each polluter would owe compensation at a rate which is proportional to its respective individual responsibility (Ozawa & Moroi, 2010).

9.5.2 *Liability of the state*

Liability issues associated with assessment and remediation costs for contaminated soils under the Soil Contamination Countermeasures Act is discussed by Ozawa & Moroi (2010). It is apparent that the polluter or land owner may become liable for costs, however there is no discussion of the liability of the state. It is therefore assumed that the state does not become liable for such costs.

9.5.3 *Liability of the owner/ occupier*

See Section 9.5.1.

9.5.4 *‘Orphan’ sites*

It has been reported that amendments to the Soil Contamination Countermeasures Act made on 1st April 2010 also further regulate excavation and removal of contaminated soil, and will increase excavation and removal costs (Ohta, 2010). As such, it has been suggested that landowners may abandon contaminated land as unsellable and / or not worth developing if remediation is required, thus resulting in an expanded number of designated brownfields, but no improvement in brownfield remediation (Ohta, 2010).

9.5.5 *Role of state funding*

Under the Soil Contamination Countermeasures Act, the MoE can designate a legal entity to support the business of soil contamination assessment and remediation. In particular, the designated support legal entity is intended to deliver a grant fund to local public bodies which provide promotion to the persons who takes measures such as the removal of the contamination in a Designated Area. The fund comprises monies donated partly by the government.

9.6 Contaminated land sector

9.6.1 *Size*

Tazawa (2012) indicates that works on several thousand sites are awarded each year. However a review of soil contamination countermeasures in Japan drafted by an international working group including 7 experts from Japan ([Anon](#) 2011) reports that as of 31 August 2008 some 1030 investigations had been reported under Article 3 of the former law.

9.6.2 *Main drivers*

The main driver for the assessment and remediation of contaminated land is the Soil Contamination Countermeasures Act. However, other drivers may include the Japanese environmental liability scheme which draws heavily on the polluter pays principle as an environmental waste remediation tool (Larsen, 2005).

9.7 Attributing financial liability

9.7.1 *Approach*

As discussed in Section 9.5.1, financial liability is primarily attributed to the polluter. However, in the case that the polluter cannot be found, liability falls to the land owner.

9.7.2 *Success*

No information was obtained discussing the success of the legislation for attributing financial liability to the polluter.

9.8 Success of the regime

9.8.1 *Positives*

The main positive of the Soil Contamination Countermeasures Act is that, since its introduction in 2003, it had contributed to a significant increase in the number of soil contamination surveys being undertaken in Japan (Ogata & Murakawa, 2008).

9.8.2 *Negatives*

The mathematical basis for the derivation of the EQS values used within the Soil Contamination Countermeasures Act is unclear based on the literature reviewed

The EQS values are applied at every site and therefore do not account for site-specific factors which alter the exposure scenario

The site circumstances that trigger the requirement for a soil contamination survey are limited and the prefectural governor reserves the right to waive the requirement thus reducing the number of soil contamination surveys undertaken.

The Soil Contamination Countermeasures Act may result in areas being designated but not remediated thus leading to a rise in the number of abandoned brownfield sites which are not economically attractive for redevelopment

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APPENDIX 10 NETHERLANDS

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10 NETHERLANDS

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10.1 The boundary between “contaminated” and “not contaminated”

The Netherlands is a constitutional monarchy, and has some autonomous territories in the Caribbean. The (European) Netherlands is divided into twelve administrative regions, called provinces: Northern Netherlands (Friesland, Groningen, Drenthe); Southern Netherlands (Zeeland, North Brabant, Limburg), Western Netherlands (North Holland, South Holland, Utrecht) and Eastern Netherlands (Gelderland, Overijssel, Flevoland). The provinces are divided into 435 municipalities (*gemeenten*). The country is also subdivided into 26 water districts, (*waterschap* or *hoogheemraadschap*). The Netherlands is a geographically low-lying country, with about 20% of its area and 21% of its population located below sea level, with 50% of its land lying less than one metre above sea level.

Legislation to protect soil had been in discussion in the Netherlands since 1971, but the first legislation was not introduced until 1983, the Interim Soil Remediation Act, which was greatly shaped by the Lekkerkerk incident where the village of Lekkerkerk had been found to have been partly built on a landfill containing hazardous materials (Veenman 2008, Veraat *et al.* 2005), which was followed by the Soil Protection Act in 1987. This legislation foresaw the restoration of land to a “multifunctional” condition, i.e. suitable for any land use (Denneman 1999). Determination of the condition of soil (whether or not it was contaminated) was made on the basis of a series of environmental quality criteria, the so called “Dutch List” or ABC values (Visser 1993), which combined considerations of human health risks, ecological risks, background levels and detection limits depending on the substance and type of threshold (e.g. whether it triggered a remediation action or showed an uncontaminated soil). This policy began to be questioned over the 1990s because of concerns over its economic viability and its impact of reducing the re-use of contaminated land (de Groof 2005, Veenman 2008, Veraat *et al.* 2005). The Netherlands subsequently moved to a functional, or end-use related, approach to determining risk management for contaminated sites (CABERNET 2003, Swartjes 2007), using the following categories: agriculture and nature, the built environment, extensive use of (public) green areas and extensive use of (public) green areas. Generic environmental quality thresholds for these land uses were developed, the Land-Use Specific Remediation Values (Bodengebruikswaarden – BGWs).

(1) Over the past few years soil policy in the Netherlands has been further reviewed, for example generic thresholds are now applied to slightly different range of end-uses: agricultural, nature, residential and industrial. This annex focuses on the current policy position, as past circumstances have already been extensively reviewed (e.g. Denneman 199, Swartjes 2007).

The Ministry of Housing, Spatial Planning and the Environment (VROM)¹ is responsible for defining general soil policy. Contaminated land policy in the Netherlands is legislated for by the Soil Protection Act 1987 extended with a soil clean up paragraph in 1994. The National Institute of Public Health and Environmental Protection (RIVM) provides the scientific basis for soil quality objectives and risk assessment procedures.

The Soil Protection Act (*Wet Bodembescherming*) was most recently amended in 2006², (legislated 15 September 2005) with the amendments entering into force in 2008, and a regulatory circular issued in 2009 (VROM 2009). The 2009 circular also updates the "Soil Remediation Circular 2006" and its 2008 "Ministerial Letter" update.

The 2009 circular replaces:

- Circular on Determining the Remediation Deadline (1997)
- Circular on the Assessment and Coordination of the Soil Protection Act Remediation Regulations (1998)
- The Location-specific Conditions Decree and Regulations (2002)
- Soil Usage Values
- Circular on target values and intervention values for soil remediation

VROM 2009 provides a full overview of Soil Protection Act regulations on soil remediation as of 1 April 2009. Soil ecosystem risks are derived from the tiered TRIAD approach that enables the site specific assessment of ecological risks on the basis of three lines of evidence: soil chemistry, toxicity and ecology (RIVM 2010b).

In addition, also enacted under the Soil Protection Act is the Soil Quality Decree³. The first part of this, which regulates the use of soil and dredging sludge in surface water, entered into force on 1 January 2008. The second phase of the Soil Quality Decree, which regulates the use of soil and dredging sludge on land and the use of building materials on or in the soil and in surface water, entered into force on 1 July 2008. The

¹ <http://international.vrom.nl/pagina.html?id=37600>

² <http://international.vrom.nl/Docs/internationaal/Soilprotectionact2006.pdf>

³ 469, Decree of 22 November 2007 containing rules with respect to the quality of soil (Soil Quality Decree). In English at: http://www.senternovem.nl/bodemplus/downloads/bodembeheer/20071122soil_quality_decree.asp Enacted via the "Soil Quality Regulation" available at the same link (Accessed July 2010)

threshold values used for soil remediation have been harmonised with the soil protection thresholds used for adding materials to land under this decree in the 2009 Soil Remediation Circular (VROM 2009).

Since 10 July 2009, under the Covenant on Soil Development Policy and Strategy for Urgent Sites (*convenant Bodemontwikkelingsbeleid en aanpak spoedlocaties*), financial and legal measures for contaminated land management in the Netherlands are set at a national level with regulation implemented by the provinces (with planning issues dealt with at a municipality level) and 26 water quality authorities (RIVM 2010). Under the Covenant the municipal councils, provincial councils and water boards are responsible for implementing strategy for remediating contaminated sites and areas of extensive groundwater contamination, and for incorporating the use of the subsoil into spatial planning (RIVM 2010).

Dutch legislation recognises “soil pollution” as being the entry into soil of substances above background levels. A critical date for soil protection policy in the Netherlands is 1987. All soil pollution occurring after this date has to be dealt with immediately (Versluijs *et al.* 2008). Soil pollution from before this date is historic contamination and is dealt with under the Soil Protection Act. After 1987 organisations in the Netherlands were under a duty of care to prevent soil pollution, and mitigate any such pollution fully if it occurred. For historic contamination a site requires intervention, risk assessment and if necessary remediation, if it is “seriously contaminated”.

The Soil Remediation Circular 2009 sets out an expected site assessment approach (VROM 2009). Suspect sites are initially assessed comparing site investigation analytical data with conservative generic threshold criteria for soil and water contamination reviewed in Section 10.1.1. These criteria can be used in any location in the Netherlands except for the beds of water courses; so-called “water bottoms”. This assessment considers risks for humans, risks for the ecosystem and risks of the contamination spreading to the surrounding area. The site assessment consists of two compulsory steps and an additional third step in a situation where contamination is deemed to be serious and urgent.

- Step 1: Determination whether contamination is serious, using generic criteria.
- Step 2: Determination if any part of contamination poses unacceptable risks, using generic criteria. Where unacceptable risks are found, the site contamination is designated as “serious” and “urgent”.
- Step 3: Site specific risk assessment where there are grounds to suspect that the use of generic criteria may be overly conservative.

These steps are supported by a computer model called Sanscrit (RIVM 2010).

It is possible for “more complex situations” to undertake a site specific risk assessment to determine severity, urgency and remediation need, using a standard approach set out by RIVM (summarised in Lijzen *et al.* 2008). Remediation plans must be submitted to the regulator for scrutiny, and it is the regulator who determines whether they are acceptable, including their cost-effectiveness in this decision. Remediation plans can take a phased approach, including the use of interim measures and partial remediation, to provide a flexible approach to managing risks in a cost effective way over time.

A case of serious contamination is deemed to exist (VROM 2009) if the average concentration measured of at least one substance in a soil volume of at least 25 m³ in the case of soil contamination, or a pore-saturated soil volume of at least 100 m³ in the case of groundwater contamination, is higher than the “intervention value” (see Section 10.1.1). In cases of soil contamination with asbestos, the volume criterion is not applicable for determining the seriousness of the contamination. There may be a case of serious contamination in some cases even though the intervention value has not been exceeded. A case of serious contamination may also exist in cases of contamination with substances for which no intervention value has been derived. Section 10.1.1 discusses threshold values.

If a location's soil is contaminated but it is not a case of serious contamination, there is no need to determine whether remediation is an urgent matter. Improving soil quality cannot be prescribed on the grounds of the rules for soil remediation. If a local authority has determined the quality level for a given area on the basis of the Soil Quality Decree, it may encourage that quality level to be taken as the starting point during development activities, for example. This may also be made compulsory if soil has to be used. However, it is not so in cases of serious soil contamination that an obligation may be imposed to make the soil cleaner on the grounds of soil regulations. This is because no risk or potential risk exists that would justify any such obligation.

If a case of serious contamination is determined, a potential risk exists that requires a form of remediation or management. The need for intervention is further assessed to see if the need for remediation is “urgent” or “non-urgent”. The starting point for soil remediation is that it will be carried out for all cases of serious contamination. However, if the situation is “urgent” then remediation should start: within 4 years of the date on which a “severity” and “urgency” decision was issued. This decision is end-use related. Section 37 of the Soil Protection Act prescribes the determination of whether the risk is such that urgent remediation is required owing to the present or future use of the soil. The 2009 circular states “risks are directly related to the use of the soil and therefore to its function. If the soils use within the scope of its existing or future function involves

unacceptable risks, taking measures as soon as possible is of paramount importance". The reasons for reason for urgent remediation are divided into: a) risks for humans, b) risks for the ecosystem and c) risks of the contamination spreading to the surrounding area. These risks are determined on the basis of the criteria reviewed in Section 10.1.1.

Unacceptable risks for humans requiring urgent remediation are deemed to exist if the site's present or intended use results in a situation in which: chronic adverse impacts on health may occur; acute adverse impacts on health may occur. In addition, if the existence of soil contamination in the current use of the soil presents a demonstrable nuisance for humans (e.g. skin irritation and smells), it likewise is deemed to require urgent remediation.

Unacceptable risks for the ecosystem requiring urgent remediation are deemed to exist if the site's present or intended use means that: biodiversity may be harmed (protection of species); [soil biological] recycling functions may be disturbed (protection of processes); or bioaccumulation and biomagnification could occur.

Unacceptable risks of the contamination spreading to the surrounding area requiring urgent remediation are deemed to exist in the following situations:

- The ecosystem or the soil's use by humans is jeopardised by contamination spreading through the groundwater;
- An uncontrollable situation exists, i.e., if: there is a layer of floating groundwater contamination which could be moved by activities and processes in the soil, which would result in the contamination spreading;
- There is a layer of sinking groundwater contamination which could be moved by activities and processes in the soil, which would result in the contamination spreading; spreading contamination has resulted in major groundwater contamination and the contamination continues to spread.

A tiered approach for the assessment of the risk assessment for groundwater contamination spreading (Zijp *et al.* 2008). An initial screening (Tier 0) is based on the presence of free phase NAPLs, the presence of "vulnerable" objects, or concentrations above intervention values in 6,000 m³ of groundwater or more. Any one of these triggers an "urgent" need for remediation. For sites "passing" Tier 0, generic risk assessment is carried out (Tier 1). This may also lead to a determination of need for urgent remediation. Subsequent tiers allow for site specific assessment.

If it is determined that non-urgent remediation is required, no deadline for completing remediation applies. Control measures, possibly for the long term, may be imposed, for

example groundwater monitoring. Therefore, in “non-urgent” cases remediation contamination usually takes place as a result of site redevelopment or change in use. Where construction activities on or in seriously contaminated soil may reduce or displace the contamination, a compulsory report must be made to the regulator and a remediation plan must be drawn up before these activities take place.

Since 1 January 2006, planning permission must be withheld for sites with serious contamination. If regulator decrees that a situation requiring urgent remediation does not exist, the withdrawal ceases to apply (section 52, subsection a, of the Housing Act).

The Soil Protection Act also describes remediation objective setting. Soil remediation operations must be carried out so that the soil is at least made suitable for the function designated to it after remediation. Moreover, remediation should be carried out in a way that as far as possible reduces the necessity of taking follow-up measures and imposing restrictions on use after remediation, providing that costs must be commensurate with the effects of remediation. If follow-up measures are necessary to maintain and check the results of remediation, they must be sufficient to ensure that the contamination remaining after remediation will not result in a reduction in the quality of the soil that is achieved after remediation.

Remediation measures are intended to be protective of topsoil and to mitigate mobile contamination in the topsoil and subsoil. Remediation measures for groundwater are expected to meet “target values” for ground water quality which have been derived for a series of substances (see Section 10.1.1).

The former “soil usage or target values” set for top soil remediation objective setting have been withdrawn and are superseded by the Soil Quality Decree. Under the Soil Quality Decree, the regulator must opt for a generic or area-specific policy for their area. The regulator is generally a municipality in this instance, but not always. For a generic approach Background Values and Maximum Values for housing and industry are used as post-remediation values. For a local approach the regulator establishes Local Maximum Values. There may also be specific local circumstances that affect remediation objective setting, for example the extensive diffuse soil contamination in the Kempen region. The rationale for local values is to allow a more finely tuned objective setting that better reflects local environmental conditions (Dirven-van Breeman *et al.* 2008, Otte *et al.* 2008, Swartjes 2007, Walthaus and Wezenbeek 2008).

Contamination is described as mobile or “spreading” if groundwater could spread the contamination to the extent that it could possibly present risks for humans, plants or animals. The contamination source may be in topsoil and/or subsoil, but typically the

plume is in the subsoil. The remediation of mobile contamination must result in the soil and groundwater being of the required quality to make the intended use of the topsoil and subsoil possible, and minimisation of the spread of residual contamination and of the follow-up measures it requires. The regulator has the option of adopting an area-specific quality objective for the soil and groundwater (typically determined using site specific risk assessment). Complete source removal is recognised as not always being feasible. Typically remediation projects are expected to be effective fairly promptly. However, longer remediation periods for mobile contamination may be allowed depending on the evidence provided in support of a long term approach. The remediation of mobile contamination situations must not take longer than 30 years. More detailed guidance on assessing remedial options for mobile contamination are set out in the *Robuust Saneringsvarianten Afwegen* (ROSA) guidance (Slenders *et al.* 2005).

All sites with “serious” contamination have to be registered with regulators. This process now forms part of the general site reporting and inventory activities described in Section 10.3.1.

Excavated contaminated soil is considered as a waste when storage, processing or transport are involved. The 1999 Building Materials Decree (*Bouwstoffenbesluit*) regulates the re-use of such excavated contaminated soil, including treated soils, (NICOLE 2008), and is legislated for by the 2003 Environmental Management Act (*Wet Milieubeheer*). It is not permitted to landfill treatable contaminated soil.

Simplified procedures were introduced for sites with “standard contamination” problems. BUS (Besluit Uniforme Saneringen): Uniform Remediations Decree. This Decree is intended to simplify the rules regarding soil remediation, reducing requirements for registering and discussing site investigation information with local authorities, to speed up soil remediation procedures and to reduce the costs for contractors performing the remediation process. Under BUS remediation operations (especially smaller ones) can be performed more easily and, so more cheaply (RIVM 2007).

Figure 10.1 overviews current Dutch soil legislation and is taken from RIVM 2010b

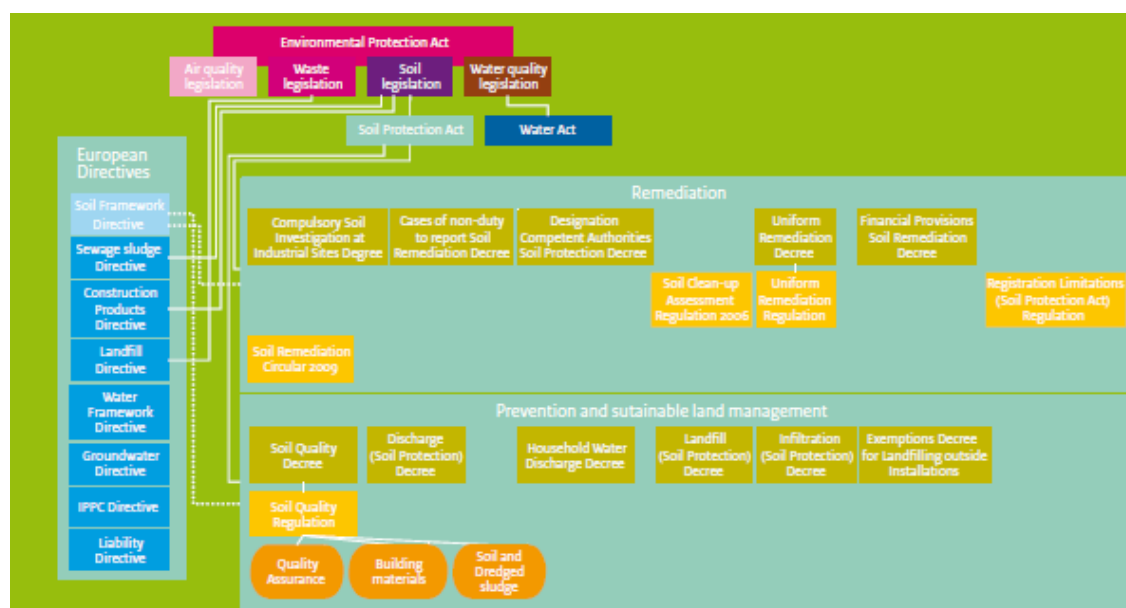


Figure 10.1 Overview of current Dutch soil legislation, together with related European Directives (from RIVM 2010b)

10.1.1 *Role of number-based thresholds*

Threshold values currently used in the Netherlands are collated in the Soil Remediation Circular 2009 (VROM 2009).

Target values (“S-values”) are used to determine if the groundwater is “clean” or “multi-functional”, and as a remediation target. Criteria set under the Soil Quality Decree are used to determine if soil is acceptable, and as a remediation target. These are end use related, and may be set at a local level (as described in paragraph xx).

Where site investigation measurements are above the groundwater target levels or the Soil Quality Decree criteria, contamination may be deemed to be “serious”.

“Intervention” values (“I-values”) are used to determine if contamination poses unacceptable risks, and therefore a need for “urgent” remediation.

Soil remediation intervention values were originally published in 2000 in the “Circular for Soil Remediation Target and Intervention Values”. A number of these values have been revised subsequently, although the others remain in use (Swartjes 2007, VROM 2009). The soil remediation intervention values indicate when the functional properties of the soil for humans, plants and animals is seriously impaired or threatened (i.e. they encompass both risks to human health and to ecosystems).

Soil intervention values are quoted for a "standard" soil containing 10% organic matter and 25% clay. These may be converted to values that apply to the actual soil being assessed on the basis of measured organic matter and clay using standard formulae in VROM 2009.

Water bottom intervention values have been drawn up separately in the Soil Quality Regulations (Government Gazette 20 December 2007, no. 247) and in the Circular on the remediation of water bottoms 2008 (Government Gazette 2007, no. 245).

Groundwater intervention values remain unrevised from the Circular for Soil Remediation Target and Intervention Values (2000). "Target Values" for groundwater provide a benchmark for environmental quality in the long term on the basis of negligible risks for ecosystems. These are also exactly as stated in the Circular for Soil Remediation Target and Intervention Values (2000). Target values depend on depth, with > 10 m being classed as "deep" groundwater, because background concentrations vary with depth.

Target and intervention values have been provided for a range of trace elements, cyanides, chloride, BTEX, various PAHs, chlorinated hydrocarbons, pesticides and other substances including asbestos, phthalates, mineral oil, pyridine, tetrahydrofuran, tetrahydrothiophene and tribromomethane.

A case of unacceptable risks for humans is deemed to exist if the site's present or intended use results in a situation in which: chronic adverse impacts on health may occur; acute adverse impacts on health may occur. Chronic impacts occur at lower concentrations than those that lead to acute impacts. Hence the generic criteria are focussed on chronic impacts to "automatically cover" acute impacts. Risk modelling is based on the Dutch C-soil model (Swartjes 2007). The model distinguishes between various exposure scenarios which are used to describe the site's use and the associated risks.

The ecotoxicological risk limit has been defined as the HC50 (Hazardous Concentration 50, i.e. 50% of the ecosystem could be affected). The soil intervention value adopted is based on the lowest human health or ecosystem derived value (Swartjes 2007)

Groundwater intervention values are based on the lowest value derived from three scenarios: ecosystem impacts on human health, possible consumption of contaminated groundwater as drinking, and possible contamination of soil by groundwater (Swartjes 2007).

A set of "indicative levels" is also set for a range of additional trace elements and organic substances for which standardised measurements are not available and/or

ecotoxicological evidence is lacking. The indicative levels therefore have a greater degree of uncertainty than the intervention levels, and so are not prescriptive of serious contamination, but are advisory and should be used in conjunction with other site assessment evidence.

In a few specific situations there may be a case of serious contamination even if the concentrations are below the intervention values. This applies to what are termed susceptible land use functions: vegetable garden/allotment, places where there are volatile compounds in the groundwater in combination with high groundwater levels and/or unsaturated soil underneath buildings.

Determination of the severity of spreading contamination is made on the basis of whether the additional soil volume that will become contaminated annually with groundwater containing one or more substances in concentrations exceeding the intervention values will be no larger than 1,000 m³. Where contamination is spreading, or "unmanageable" then remediation is deemed to be "urgent". Unmanageable situations are where there is a layer of floating groundwater contamination or a layer of sinking groundwater contamination.

The Soil Quality Decree sets out the following values.

- Background Values, these are required for agriculture, nature conservation and vegetable gardens/allotments;
- Maximum Housing Values, these are required for residential properties with a garden, places where children play, green areas with ecological values; and
- Maximum Industrial Value, these are required for other green areas, development, infrastructure and industry.

Values are determined on the basis of risk scenarios which consider: amount of human contact with the soil; amount of crop consumption; protection of agricultural production; protection of ecology taking into account biomagnification; as appropriate.

These values are intended to represent sustainable soil quality of the upper soil layer, varying from 0,5 meter to 1 meter in depth depending on land-use; or for application of a layer of soil material. Laying replacement topsoil is typically the standard approach for: residential with garden, places where children play, green areas with ecological values and other green areas (Swartjes 2007, VROM 2009).

"Slightly" contaminated excavated soil (i.e. soil where contamination is below intervention levels) can be re-used as soil under certain conditions, principally that there

are ongoing environmental controls on the site and the location of the soil is mapped and considered in site management planning. “Slightly” contaminated excavated soil can also be re-used as a building material depending on results of leach tests set out in the Building Materials Decree.

Treated soil is considered “clean” when contamination levels are below the thresholds set out in the Soil Quality Decree, and can then be used without restriction (NICOLE 2008).

10.1.2 Recent and ongoing Developments

Further developments have been taking place over 2009, in particular relating to priority setting based on ecological risks.

10.1.3 Role of case-by-case decision making

The Dutch approach has a strong capacity for case by case decision making, and specifically allows for site specific risk assessments if there is evidence to suggest that generic threshold values are overly conservative for a particular contaminated site situation.

10.2 Approach’s effectiveness

An enormous number of remediation projects have been carried out in the Netherlands, many of which have involved in situ remediation techniques and the use of offsite treatment facilities. A long legacy of treatment based projects from the mid 1980s to the early years of the 2000s is described in various NATO/CCMS Pilot Study Reports (US EPA 2003), and more recent examples are listed in the EURODEMO and [Soilection](#) databases⁴. A few recent case studies have been provided below to highlight an emerging trend in the Netherlands of using wider environmental drivers to facilitate remediation work, which is seen as having decreasing importance as a project driver in the Netherlands, except for “serious urgent” sites which are planned to have been dealt with by 2015 (see Section 10.3.1)

There is increasing interest in the Netherlands in combining groundwater remediation with in-ground heat storage in the Netherlands (Molenaar and Slenders 2010, Slenders 2008, Slenders et al. 2009). An important driver for this is that the benefit from renewable energy is sufficient to support ongoing in situ remediation. One of the first projects combining in situ remediation with groundwater heat storage is in the city centre of Eindhoven. The site is a former manufacturing area of 27 ha, which at its peak

⁴ Available via <http://www.eurodemo.info/project-information-1/> (Accessed July 2010)

employed some 10,000 people. Redevelopment of the site began in 2005. Contamination problems at the site were mainly chlorinated solvents in the saturated zone (cis-dichloroethylene and vinyl chloride) from 30 to 60 m below the ground surface. These contaminants had started to move since the groundwater extraction that had taken place while the site was active had stopped.

Sustainable energy can be obtained from groundwater by pumping large flows, with large reductions in carbon intensity. In the winter heat can be extracted with a heat-pump, in the summer heat can be deposited to provide a cooling effect.

The combination of heat-pumping and remediation with remediation creates a number of potential design paradoxes. The aim of a groundwater energy system is to maximise the energy transfer capacity, which requires large groundwater flows. This is the first paradox with the remediation of groundwater. Normally the remediation of contaminated groundwater is designed with minimal flows to reduce cost. The second paradox lies in the containment of groundwater. Conventionally, in the Heat-Cold-Storage (HCS) approach, groundwater is pumped from a cold zone to a warm zone. With such an approach contaminants would have been moved and spread as well. A remediation system is primarily designed to contain and reduce the extent of contaminants. The approach taken to resolve these paradoxes and create a synergy was to use large groundwater flows both for hydraulic containment of contaminants and heat transfer. Natural degradation at the site is limited by the rate of the mixing of bacteria, nutrients and contaminants. The large volumes of water circulation greatly increase mixing to create a "biowashing machine". In case natural conditions are insufficient, or if there is a lack of nutrients, the set up offers the opportunity to add the necessary substances into the in situ treatment zone created.

Another example of an integrated approach was carried out in the municipality of Tilberg over a 100 ha site which had been used as a sewage farm (Dijcker 2009) which had led to significant trace element contamination of the top soil to 40 cm depth. Conventional remediation by excavation, removal and treatment and infilling was simply not feasible from an economic point of view. The driver for the restoration of the site was the establishment of forest parkland. Risk management was achieved by zoning recreational areas on less polluted areas of the site, and on more contaminated areas using dense tree planting to prevent access. The site restoration was accompanied by ongoing monitoring of ecological impacts using bioassays, which indicated that significant ecological risks were not occurring.

Ilperveld is the most important habitat for the Godwit, genus *Limosa*, a long-billed shorebird, known in the Netherlands as the Grutto. Within Ilperveld is a former landfill

the area of the centre of Amsterdam, remediation of which may increase the habitat area for these shorebirds, increasing their populations and bring the land back into use (Hensens 2009). A collaborative project to achieve this remediation has been established between the Provincial (North Holland) Government, a nature conservation organisation, the local water board and local municipality department.

Removal of the former landfill site is not feasible, so its remediation is based on containment using cover layers of locally sourced dried sediments that are highly organic, and so will form an impervious cap. The project is technically complex relating to soils, sediments and water, but must also have to consider a wide range of stakeholder viewpoints, including authorities, NGOs and recreational (e.g. fishing, birdwatchers), agricultural and ecological interests. These viewpoints may be in conflict with each other. Conflicts included different conservation interests favouring different habitats, and recreational use versus ecological protection. Furthermore, local inhabitants had not seen the former landfill site as a problem, and were concerned about the impacts of the remediation work proposed. A major part of the project management has therefore been the resolution of these conflicts and proposal of compromises.

10.2.1 Proportionate

Contaminated land determination and remediation requirements in the Netherlands are based on a suitable for use approach, with criteria delineated over a range of land-use options much as in the UK. The general approach to site management, including the simplified BUS procedure and the case studies above support a view that site investigation and remediation work is carried out in a highly pragmatic way. Investment in remediation and site investigation appears to be evenly divided between Private and Public Sector sources (See Section 10.5.1). Innovation and treatment based remediation projects are widespread. Removal of contaminated soils does take place, involving large volumes of soil, but the landfill of treatable soil is prohibited.

10.2.2 Targeted

The Soil Protection Act and Soil Quality Decree provide a broad framework for contaminated land management, with the implementation of the Water Framework Directive also being influential (RIVM 2010).

10.2.3 Consistent

A centrally derived national regime for contaminated land assessment and management, registration and record keeping is applied by local level regulators, although there is some evidence that compliance is not complete (see Section 10.2.5).

10.2.4 *Transparent*

Decision-making criteria for contaminated site management in the Netherlands are published and available for use. These are enacted at be central government and applied by local regulators. In this regard contaminated land policy in the Netherlands is transparent.

10.2.5 *Internal perception*

Franken et al. and Versluijs et al. (2008) report a societal cost-benefit analysis for different Dutch contaminated land policy options for remediation in the Netherlands. This analysis considered a number of issues related to health, drinking water, property values, ecology and public perception. It broadly concluded that, despite considerable uncertainties, the more sites remediated the better, in terms of net benefit. This was taken as an endorsement of the current Dutch approach to managing all urgent sites by 2015 and providing for the management of serious sites under land use planning (as described in Section 10.1). However, it was also noted that at current rates of spend on remediation in the NL, the goal of dealing with all sites with unacceptable risks (serious and urgent sites) by 2015 would not possible.

An interesting report on threat assessment from organised crime (Netherlands Police Agency 2009) includes a review of the extent of “soil remediation crime” in the Netherlands. It finds that while there are relatively few instances of serious prosecuted crime, there is evidence that in a large proportion of vases regulatory criteria for soil remediation are not fully enforced.

10.2.6 *External perception*

NICOLE (2010) perceives only a moderate brownfield rehabilitation market in the Netherlands. Recently NICOLE (2008) has published a review of Dutch waste policy as it relates to soil re-use, and the EU funded Heracles project has reviewed the soil quality criteria used in the Netherlands (Carlton 2007), comparing it with that of other European countries. Neither review has “critiqued” the Dutch approach, for example in a way that shows “strengths and weaknesses”. Dutch organisations take a leading role in the Common Forum on Contaminated Land⁵ and in NICOLE⁶. Its research performers are well represented in European funded projects⁷.

⁵ www.commonforum.eu

⁶ www.nicole.org

⁷ Contaminated land projects funded under FP5, 6 and 7 programmes are listed on www.eugris.info

10.3 Estimate of scale

10.3.1 *Estimates of the amount of potentially contaminated land*

The Netherlands (Europe) covers an area of 41,526 square kilometres and has 16.4 million inhabitants. National reporting of sites being remediated started in 1995 in the Netherlands (Versluijs et al. 2008). In 2004/5 VROM completed a detailed inventory project (Harmsma 2010). This has been added to – for example in 2012 53 new urgent sites were added (Meijer 2012). This has been based on searching all archives in the provinces back to the 1850s for potentially contaminated activities, via a central soil data system, at a cost of €100 million. The system includes a cost model to predict the management costs for the sites identified. Data have been inconsistently reported, but the general impression is provided below.

This process has identified over 1,700,000 polluting activities, and based on these, 760,000 suspect sites, although the quality of returns varied between provinces. Of these 420,000 possibly need management (i.e. slightly contaminated or worse). This number includes 20,000 dump sites, 100,000 private oil storage tanks, 100,000 backfilled ditches and 200,000 industrial sites. The industrial sites include 380 gasworks, 2,000 dry cleaners and 50,000 petrol stations. All information is publicly available via www.bodemloket.nl, in compliance with the Aarhus Treaty. This has been used as a rationale for environmental budget setting. Some 1,500 to 2,500 of these sites are expected to have “serious” and “urgent” remediation problems (i.e. posing human health risks under current or proposed use). These are to be remediated or isolated by 2015 (Harmsma 2010). However, Franken et al. (2008) suggest that number of cases requiring urgent remediation is in the region of 11,000 sites. They estimate 56,000 sites will be classified as “serious” and so likely be managed. This is similar to an estimate from VROM of 50,000 to 60,000 sites⁸. These will be managed under the planning system (as described above). Some 25-30% of Dutch contaminated land management professionals are engaged in data management of one kind or another. However, RIVM (2010b) estimate that in 2009 there were 19,000 sites requiring urgent remediation.

10.3.2 *Estimates of progress*

Around 1,400 to 1,600 detailed site investigations are carried out per year in the Netherlands. There are 1,200 to 1,500 site remediations carried out in the Netherlands per year over 200-300 ha (Versluijs et al. 2008). 50% deal with “surface” and groundwater, 10% with groundwater alone and 40% with surface alone. Over 2005 to 2009 more than 28,000 sites have been investigated and, on the basis of the results,

⁸ Personal communication from VROM, 7 July 2010

have been declared not to contain serious contamination. Over the same period than 8,000 sites have been remediated (RIVM 2010). RIVM (2010b) suggest that by 2009 246,000 sites had been dealt with by sustainable land management (including sites investigated where no need for remediation was found).

RIVM (2010) reports that in 2009 soil remediation operations were completed at almost 2,000 sites. Half of all completed remediation projects were BUS remediations.

10.4 Deciding who pays

10.4.1 ‘Polluter pays’ principle

The Polluter Pays Principle has been embodied as a guiding principle in Dutch contaminated land policy and legislation since 1989 (Veenman 2008). If a polluter sells land, it will not be relinquished from its obligations and liability under the Soil Protection Act (NICOLE 2010). Although it can make contractual arrangements for liability transfer via an indemnification, for example from a purchaser, but this does not alter the legal point at which liability accrues.

Dutch law requires the seller to deliver land that is fit for the intended use. Therefore, if pollution prevents the buyer from using the land for the intended purpose, the seller is in default. In practice, before entering into a contract of sale, the seller or the buyer will conduct a soil investigation and depending on the outcome of that investigation agree on any transfer of liabilities.

10.4.2 Liability of the state

The State is liable as a land owner or occupier for its own contaminated sites, and also meets costs for the management of orphan sites.

10.4.3 Liability of the owner/ occupier

The Soil Protection Act does not give priority to either the landowner (or leaseholder) or the polluter as being primarily responsible for the clean-up. However, the wording of the Act clearly implies that its purport is to hold the polluter primarily responsible for pollution and that if the polluter no longer exists, cannot be found or is not creditworthy, the landowner will be held responsible (NICOLE 2010, Visser 2007, Practical Law Company 2012). However, The Soil Protection Act does not grant the authorities power to require an occupant who is not the polluter is able to prove this, to conduct a clean-up. In this case there can still be a requirement for the occupant to conduct a soil investigation or take measures in order to prevent migration of the pollution to adjacent sites. The situation is more complicated for landowners. Any landowner can be ordered

to deal with a site if the contamination is deemed to be “serious” and the remediation need “urgent”. However, there are three linked criteria for exclusion from this liability, that the owner is able to prove that

- It did not have a permanent legal relationship with the polluters at the time the pollution was caused,
- It was not directly or indirectly involved in the activity that caused the pollution and that
- At the time the landowner became the owner, it was unaware of the pollution and could not reasonably be expected to have knowledge of the pollution.

Third parties can claim damages for the reduced value of its premises or costs incurred for having the pollution cleaned up, or require a clean-up performed by the polluter (NICOLE 2010).

NICOLE (2010) also reports that environmental liability transfer and management mechanisms are fairly routine in the Netherlands, including: through corporate restructuring, contract (e.g. warranties and indemnities) environmental insurance and other financial mechanisms (bonds, escrow accounts etc).

10.4.4 ‘Orphan’ sites

Ultimately, if no polluter or entity responsible for a clean-up can be found, the State will conduct the clean-up (NICOLE 2010).

10.4.5 Role of state funding.

2009 was the final year of the second Urban Renewal Investment Budget (ISV) programme period, which ran from 2005 to the end of 2009 under the Major City Policy⁹. The first period ran from 2000-2005. The budget supports construction measures in the field of housing, space, environment, urban economics (up to 2004), large-scale green areas, and culture. This includes actions for environmental improvement, noise abatement, soil decontamination, improving cultural-historic qualities and greening areas.

10.5 Contaminated land sector

10.5.1 Size

⁹ <http://www.vrom.nl/pagina.html?id=37443> Accessed July 2010

The overall Pollution Management and Resource Management expenditure in Netherlands for 2004 was estimated at €14 billion (Ernst and Young 2006 p. 26 & p30), with €1.06 billion being spent on “remediation and cleanup” based on EUROSTAT data. However, Van Veen (2005, 2007) suggests that the remediation market in the Netherlands is in the order of €400 to €500 million per year. This figure is repeated by Versluijs et al. (2008) who suggest approximately 50% of this money is from Public Sector sources and 50% from Private Sector sources. RIVM (2010) report that in 2009 about €320 million were spent on soil surveys and remediation. The vast majority of expenditure over recent years (more than 85%) has been on soil remediation, while the remainder went on surveys, including the identification of urgent sites.

Based on the average costs of remediating 3,800 sites in the past, the Dutch site inventory leads to an estimated spend requirement for the putative 56,000 seriously contaminated sites of €12 billion by 2030. The serious and urgent sites, assuming a number of 11,000, are expected to cost €3 billion by 2015 (Harmsma 2010, Franken et al. 2008). The rate of spend required is therefore higher than the current Dutch remediation market (Versluijs et al. 2008). It also seems that spend requirements will be higher given the number of Dutch soil professionals involved in data management (and regulation etc), see Section 10.3.1.

Pruijn and Walthaus (2008) estimate that 3.4 million tonnes of excavated soil was dealt with in the Netherlands in 2006. 1.4 million tonnes of this was treated and 1.2 million tonnes was reused without treatment. 0.8 million tonnes was landfilled or stored. Annual costs of dealing with excavated soil from contaminated sites are estimated to be €100 million. Pruijn and Walthaus reported that landfill costs in the Netherlands were €30-70 per tonne of soil, and treatment costs €20-50 per tonne of soil.

10.5.2 Main drivers

The annual survey of projects in the Netherlands (Versluijs et al. 2008) carried out by RIVM suggests that 20% of site remediations are triggered by risk assessment (presumably “serious” “urgent” sites). For 20% of sites the reason for action is unknown. For the remainder the reason is a change in use or ownership (redevelopment, restructuring, or sale). NICOLE (2010) suggests that brownfields concept is not yet as strongly developed in the Netherlands as in the UK.

RIVM (2010) suggests that recovery in the construction industry is not expected for some time yet, which will lead to a decrease in the amount of soil remediation work associated with construction projects. The impacts of this in 2009 were reported as slight, but may

be greater over the next few years as government cutbacks also lead to reduced levels of investment in soil remediation.

Quality assurance in soil management is based on a system of certification under the auspices of the Foundation Infrastructure for Quality Assurance of Soil Management (SIKB), founded in 2000. (NB certification is obligatory for companies involved with building materials). A mandatory scheme was set up in 2006 by VROM and the Ministry of Transport, Public Works and Water Management (V&W). This scheme, Quality Assurance for Soil Management Intermediaries, is generally known as 'Kwalibo' (de Groof and Ruwiel 2005). Companies operating in the remediation sector can apply for certification and accreditation under the Kwalibo system. . Failure to achieve adequate quality management can result in exclusion from the scheme. RIVM (2010) reports that in 2009 two firms were stripped of their Kwalibo accreditation.

10.6 Attributing financial liability

10.6.1 Approach

See Section 10.4.3.

10.6.2 Success

There is no evidence of challenges to attribution or that attribution has been contested.

10.7 Success of the regime

The Netherlands was a pioneering country in contaminated land legislation. Over the years since the 1980s its approach has evolved as the scale of land contamination has become clearer, and better methods have become available to determine its significance. While some of its pioneering concepts like "multi-functionality" have receded in importance, they remain an aspiration for many working in the sector. Perhaps a measure of the success of Dutch work on contaminated site management is that their policy believes the remediation of all sites posing significant human health risks ("serious urgent" sites) is feasible by 2015.

10.7.1 Positives

- A consistent and transparent policy across the country for the management of suspected contaminated land, linked to the envisaged use of the site
- Strong Public Sector and Private Sector investment in contaminated land remediation and land re-use
- Very strong contaminated land management research base and well regarded technical capabilities

- A well established and innovative remediation sector with a strong track record in treatment based solutions, both *in situ* and *ex situ*.
- Pragmatic approaches to site management, such as the BUS regime
- Recognition of the importance of site specific risk assessment for determination of contamination and any subsequent remediation requirements

10.7.2 Negatives

- Perhaps some failure to achieve compliance with regulatory criteria in land remediation projects in practice – although perhaps this is evident because their police force has actually made an investigation of this (Netherlands Police Agency 2009).
- Substantial Public Sector investments have been required, for example in the national site inventorying system.

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APPENDIX 11 POLAND

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11 POLAND

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11.1 The boundary between “contaminated” and “not contaminated”

On 27 April 2001, Parliament adopted the Act on Environmental Protection Law (AEPA). The Act came into force on 1 October 2001. The EPA is the main Polish legislation concerned with contaminated land. Poland applies its contaminated land legislation at a national level. Within Poland are 16 provinces (voivodships), each with a number of counties (powiat) led by a governor (starosta), and within each a county a series of municipalities (RESCUE Consortium 2005). The starosta is the enforcement authority under the AEPA contaminated land regime. The local starosta may either impose clean-up obligations on a site holder, or, in certain cases, may enforce the clean-up obligation by remediating the property and then charging the holder with the costs of remediation (Skarżyńska et al. 2003).

Threshold values to determine whether or not a site is contaminated were issued as required under Article 105 of the AEPA on 9 September 2002: the Ordinance of the Ministry of Environment on Soil Quality Standards (OSQS). Under this ordinance land is regarded as contaminated when the concentration of one or more substances exceeds thresholds set out in the QSDS (described in Section 11.1.1). Three categories of land use are distinguished under these thresholds (Wcislo and Korcz 2007, Krupanek and Wcislo 2007, RESCUE Consortium 2005):

Nature reserves and groundwater protection areas established under the Water Protection Act and Nature Protection laws (Group A). In this case, unless contamination poses a threat to human health or to the environment, no special action is required. However, this land may also fall under Group B or C (see below)

Agricultural land - except land under water in ponds and ditches, forest land and tree-covered or shrub-covered wasteland - and developed / urbanised land - except industrial land, mining land and land used for transportation (Group B)

Land used for industrial, mining or transportation purposes (Group C)

¹ Official Journal of Laws of the Republic of Poland No. 62, item 627

Contaminated site assessment was intended to be a three-phase process but this process is not described in the QSDS regulation (Krupanek and Wcislo 2007).

On 18 July 2001 the Polish Parliament adopted the Act on Water Law² (WA) and was published with amendments 11 October 2001. Following the WA an ordinance of the Ministry of Environment including limit values for groundwater quality across several groundwater classes was issued on 11 February 2004 (OGQS 2004). However this ordinance expired on 1 January 2005.

The Ordinance of the Ministry of Environment on the criteria and ways of groundwater status assessment (OGSA 2008) issued on 23 July 2008 includes: definitions, classification, ways of interpretation of physical-chemical and quantitative data and presentations of groundwater status.

Some other legislation of the Ministry of Environment related to the Water Law and the implementation of the Water Framework Directive (2000/60/EC) and Groundwater Directive (2006/118/EC) include:

the Ordinance on the way of classifying the status of surface water bodies issued on 20 August 2008,

the Ordinance on the forms and ways of surface and groundwater monitoring from 13 May 2009,

the Ordinance on the classification of ecological status and potential, and chemical status of surface water bodies from 22 July 2009, the Ordinance on the register of priority substances in water policy issued on 2 July 2010,

the Ordinance on the quality of water intended for consumption by humans from 29 March 2007,

the Ordinance on the conditions of discharging wastewater to water and soil, and on substances particularly hazardous for aquatic environment from 24 July 2006

The Act on Waste Law from 27 of April 2001 (with amendments) and its implementation acts define requirements on operating and past landfills.

The transposition of the Environmental Liability Directive into Polish Environmental Law (Act on Prevention of Environmental Damage and Remediation of 13 April 2007) has included changes in responsibilities of regional authorities concerning abandoned sites

² Official Journal of Laws of the Republic of Poland No. 115, item 1229

and established responsibilities for operators of industrial installation for land contamination.

Some other relevant legislation newly introduced in Poland concerning these issues comprises the Ordinance of:

the Council of Ministers on undertakings that may have significant impact on the environment from 9 November 2010,

the Ministry of Environment on: (i) the assessment criteria of damages occurring in the environment issued on 30 April 2008, and (ii) the types of remediation measures and conditions and ways of their realisation from 4 June 2008

the Ministry of Health on: the criteria and ways of classification of chemical preparations and substances from 2 September 2003

11.1.1 Role of number-based thresholds

The OSQS are a set of soil quality thresholds (SQS) indicating the maximum tolerable levels of contamination. Corrective actions are needed wherever values are exceeded. However, if soil quality standards are exceeded as a result of naturally occurring substances, it is considered that standards are not exceeded (Krupanek and Wcislo 2007). Detailed site sampling requirements exist under this regime (RESCUE Consortium 2005). However, the technical and scientific rationale for these thresholds is not specified (Wcislo and Korcz 2007), but they are ostensibly linked to human health protection (Carlon 2007). There is no scope for site specific risk assessment in the Polish system (Carlon 2007). Limit values vary across two levels of soil saturated hydraulic conductivity, ostensibly based on a groundwater protection rationale. Risk based decision making has been developed within Poland under the ambit of EU funded research (Wcislo et al 2003), but appears not to have been taken forward into the regulatory approach.

Under the OGSA, the classification of chemical groundwater status comprises five classes:

Class I – very good water quality: (a) physical-chemical parameters are resulting exclusively from natural processes in groundwater and are within the range of concentrations characteristic for given groundwater (hydrogeochemical background), (b) values of chemical-physical parameters do not indicate anthropogenic impact

Class II – good water quality: (a) some physical-chemical parameters are increased due to natural processes occurring in groundwater, (b) some physical-chemical parameters do not or slightly indicate anthropogenic impact

Class III – satisfactory water quality: physical-chemical parameters are increased due to natural processes occurring in groundwater or weak anthropogenic impact;

Class IV – unsatisfactory water quality: physical-chemical parameters are increased due to natural processes occurring in groundwater or clear anthropogenic impact

Class V – bad water quality: physical-chemical parameters confirm significant anthropogenic impact

The classification is based on threshold values defined in an annex. Groundwater classes I, II and III represent good, while IV and V poor chemical status.

Quality thresholds set for each class are not directly related to protected receptors although requirements for drinking water are partly incorporated into them. They are not related to the soil quality values (Wcislo and Korcz 2008).

11.1.2 Recent and ongoing Developments

Wcislo and Korcz (2007) state that screening values for groundwater and soil are under development in Poland (see also Krupanek and Wcislo 2007). Poland may be looking to the Soil Framework Directive to drive future legislative change. Implementation of the Directive as previously constituted (to 2009) in Poland would require amendments to the Act on Environmental Protection Law (AEPA), 27 April 2001, the establishment of a national inventory of contaminated sites; the identification of contaminated sites which may pose a significant risk to human health or the environment and the establishment of a National Remediation Strategy (Krupanek and Wcislo 2007). The Soil Framework Directive has not been completed so far and it is still a proposal. However, the implementation of the so-called "Soil status report" as mentioned in the proposal of Soil Framework Directive may be an effective tool for contaminated soil identification and monitoring in Poland (Kwiatkowska-Malina, 2011)

11.1.3 Role of case-by-case decision making

There appears to be no scope for site specific risk based decision making in the Polish contaminated land management regime.

11.2 Approach's effectiveness

A selection of case studies have been summarised below.

Kolwzan et al. (2008) describe the remediation of a former railway station in Warsaw whose site was to be reused for a shopping centre development. The principal contaminants on the site were BTEX, fuel oils and PAHs, mainly in the soil profile, although toluene contamination of groundwater in the vicinity of the site was also detected. Ex situ bioremediation was carried out in biopiles using bioaugmentation with organisms propagated in vitro from the site. The treated soil was re-used on site. The technical approach is described in some detail but no information is provided about how the operations achieved regulatory compliance. A bioremediation case study from Poland is also listed in the EURODEMO database³, again with no detail on regulatory compliance requirements.

A relatively large amount has been published about the "mega-site" Tarnowskie Góry, which was included in the EU funded Welcome project⁴. The chemical plant in Tarnowskie Góry (Silesia) had been operating since 1921 and was closed down in 1990s. Approximately 1.7 million tonnes of hazardous waste containing Ba, B, Zn, Cu and Sr have been dumped on the site across an area of 3,000 ha (Malina and Pruszkowska 2003, Malina 2004). Prior to this the site had had a number of mining and industrial production uses for many centuries. There is substantial trace element contamination of the quaternary aquifer in the area underlain by a fractured Triassic limestone aquifer, as well as of a river which passes through the site (The Stola) (Grotenhuis et al. 2005). Contamination of groundwater has spread 2 km from the site. The aquifer is an important drinking water resource. The remediation work required Public Sector funding, however, the starosta had very limited financial resources to effect site remediation (Krupanek et al. 2003, Janikowski and Korcz 2003). The remedial approach being investigated was based on changing geochemical conditions such as pH on abiotic natural attenuation processes (Zabochnicka-Swiatek et al. 2004, 2005) and surface amendments to prevent dust blow and stabilise contaminants in situ (Vanbroekhoven et al. 2005, Diels et al. 2006). Regulatory compliance issues were not discussed in any of the papers reviewed. The integrated management strategy was proposed to deal with contaminated soil and groundwater (Malina et al., 2005, 2006),

A particular problem in Poland is a large number of pesticide disposal sites from agricultural co-operatives, which often also contain unused pharmaceuticals. These are often located in former military bunkers and fortifications. This practice took place from

³ <http://www.eurodemo.eugris.info/DisplayIntroduction.asp?EURODEMOprojectID=77>

the mid-1960s to the mid-1980s (Wołkowicz et al. 2003). There may be as many as 300 such deposits in Poland. This problem is largely being dealt with by excavation and removal, disposing of the deposit and surrounding concrete in hazardous waste sites. The void space is filled with clay and clean fill. However, on occasion excavated concrete from the removal process has been used in building local roads.

Benoit et al. (2005) report the initiation of a combination of in situ interventions, including hydrofracturing, bioventing and steam injection for dealing with jet fuel contamination at an air base. The air base at Kluczewo is on the watershed of Miedwie Lake which has major recreational value and is used for water supply to half a million people. The project was funded at least in part as part of an EU funded R&D project. Benoit et al make no mention of how regulatory compliance was to be achieved on the site. Wcislo (2006) reports the 0.3 ha site demonstration of use of bioremediation at an oil refinery site sludge lagoon for acidic petroleum sludges.

Some studies were also done on risk evaluation and reduction of groundwater contamination from petrol stations (Malina, 2005), at post industrial areas (Malina, 2007) and at military airports (Woźniak et al. 2005a,b).

11.2.1 Proportionate

Contaminated land determination and remediation requirements in Poland are based on a suitable for use approach, with criteria delineated over a range of land-use options much as in the UK. However, none of the case studies reviewed describe how this achieved in practice.

11.2.2 Targeted

It is not at all clear how the Polish contaminated land regime is applied in practice. Cost constraints appear to have a dominant influence on remedial approach. Olszewska and Irminski (2007) describe the re-use of brownfield land for urban development in Northern Poland. They imply that remediation performance requirements are set by the municipality who apply the threshold values provided nationally.

11.2.3 Consistent

There is no information available from the case studies to provide a view on how consistently the Polish contaminated land regime is applied. However, it would appear that the implementation of some tasks (for example County wide registers) is not supported by any kind of national guidance.

4 www.euwelcome.nl/

11.2.4 *Transparent*

The Polish contaminated land regime is not truly transparent, not least because the rationale for its number based thresholds is not disclosed. Gorgon and Starzewska-Sikorska (2007) describe a very open process of stakeholder engagement in developing a brownfield redevelopment strategy in two towns in Poland.

11.2.5 *Internal perception*

Syrczynski (2003) critiques in detail what he sees as a failure by the State to deal with liability in a transparent way and deal with what he sees as its duties as inheritors of the state industries of the former communist state (see also Section 11.4). Wcislo and Korcz (2007) critique the lack of a published scientific rationale for the threshold criteria used in Poland to determine when site remediation should take place (see also Section 11.1.1).

Olszewska and Irminski (2007) describe a situation where a national agency is offering former military sites to local administrations at no cost, but the local administration is not interested, presumably because of liability concerns.

11.2.6 *External perception*

The EU funded Heracles project has reviewed the soil quality criteria used in Poland (Carlson 2007), comparing it with that of other European countries. It concluded that the Polish threshold approach to having maximum permissible concentrations was unique in the countries surveyed.

National and regional organisations from Poland take part in the Common Forum on Contaminated Land⁵, and it has research performers in a number European funded projects⁶.

11.3 Estimate of scale

11.3.1 *Estimates of the amount of potentially contaminated land*

Poland covers an area of 312,683 square kilometres and has 38.1 million inhabitants. Contaminated site data is not collated at a national level. Janikowski and Korcz (2003) estimate that the area of heavily or moderately degraded land in Poland is 8,000 km² or 2.7% of the country's land area. This estimate includes areas of diffuse contamination in urban areas, agricultural soils and forests and also "morphologically degraded" areas.

⁵ www.commonforum.eu

⁶ Contaminated land projects funded under FP5, 6 and 7 programmes are listed on www.eugris.info

The area of post industrial land and waste disposal sites is estimated at 120-140 km². Stat-USA (2003) reports that land contamination is concentrated in particular regions of Poland, in particular Upper Silesia. It reports that the Polish government estimated 0.5% of the country's land area to be degraded to a high and a very high degree, and 2.2% degraded to medium or low degree. IETU have estimated the number of contaminated sites to be in the region of 3,000, based on anthropogenic land area uses recorded on the European Environment Agency Corinne land use database⁷.

The AEPA placed a duty on counties to maintain a register of contaminated land to be updated on an annual basis. However, no guidance on how this was to be done was provided (Skarżyńska et al. 2003). The CABERNET network (2003) reported that pilot contaminated site inventories were being tested by several counties in Poland. However, Krupanek and Wcislo (2007) reported that no detailed estimation of the area of contaminated land in Poland had been carried out.

11.3.2 Estimates of progress

The Polish Ministry of the Environment maintain an English language web site (<http://www.mos.gov.pl/?j=en>). However this contains little information about contaminated land management progress. Contaminated land management does not appear to be a major policy issue in Poland. In 2008 the Council of Ministers concluded that: "In 1990-2006, the [area] of both degraded and devastated land (e.g. waste heaps at mine and power plants) requiring application of the land reclamation measures diminished by 30%. In 2006, this type of waste land occupied 65 thousand ha area, including only 1,400 ha where land reclamation measures were applied. That is by 50% lesser than in 1990, thus proving insignificant interest in such type treatment on the part of self-governmental authorities in the areas under whose jurisdiction such land is situated."

At the turn of the century the Polish government set out to achieve a series of objectives for the management of post-industrial land by 2010 (Janikowski and Korcz 2003): a comprehensive approach to the management of closed landfill sites and industrial wasteland; ending food crop production on agricultural land contaminated with high levels of trace elements; completion of the restoration of bases occupied by the Russian army; reclamation of pesticide storage facilities; and a general degraded land management policy. A goal set for 2025 was that the area of land reclaimed annually should not be smaller than the area of land designated for remediation.

⁷ <http://www.eea.europa.eu/themes/landuse/clc-download>

A Framework of the Governmental Programme for Post-industrial Areas (REWITARE) was passed by the Polish Government in April 2004⁸. Its strategic objective is to set up conditions and mechanisms to develop for post-industrial areas according to the principles of sustainable development (Krupanek and Wcislo 2007). Its specific aims are to limit greenfield development; remediate brownfields and bring them back into economic use; develop and promote the best available technologies and techniques for remediation and redevelopment; encourage the economic revitalisation of post-industrial areas; and stimulate remediation businesses.

11.4 Deciding who pays

11.4.1 'Polluter pays' principle

In line with other European countries Polish legislation (AEPA Article 102) stipulates that polluters have the responsibility for remediating sites (Janikowski and Korcz 2003). Under the AEPA any holder of land on which soil contamination or damage of natural land's lay-out exist, is liable for its remediation to bring it back to conditions which meet soil quality standards, unless the pollution occurred after s/he took title and was caused by another party without his/her consent. The Law on Real Estate and Environmental Protection (October 2001), required firms to report soil damage to local authorities by June 30, 2004 (U.S. International Trade Commission 2004).

If the entity obliged to clean up the contaminated land proves that the contamination occurred before September 1, 1980, its obligations are limited to conducting actions to preclude any threat to life or health, risk of further contamination, or possibility of spreading the present contamination.

11.4.2 Liability of the state

In common with other former communist countries in central and Eastern Europe Poland has a large legacy of land contamination problems from military occupation and formerly state owned industrial production (Malina, 2007). Syrczynski (2003) reviews how the liabilities for these contaminated sites have been managed (or not). The Polish government provides no guarantees over site liabilities arising from the possible cost of future remediation. However, the Polish government has taken on the liability for the restoration of former Russian military bases over 1992-99. Attempts to address responsibilities for past contamination in the legislation were made in the late 1990s, but were blocked before 2001. Costs for restoration of contaminated brownfield have in some cases been met by local authorities and in some cases by the State, but in an ad

⁸ http://www.mos.gov.pl/1materialy_informacyjne/raporty_opracowania/zalozenia.pdf

hoc way. Polish legislation does set out a local authority duty for restoring orphan sites (see Section 11.4.4).

11.4.3 *Liability of the owner/ occupier*

In principle, the owner or occupier of land is liable for remediation costs (see Section 11.4.1). In the late 1990s a National Investment Fund (NIF) Programme (Syryczynski 2003) took over the management of more than 450 formerly state owned entities, accompanied with a share ownership scheme for all adults in Poland. Annual funding for clean-up was organised on the basis of discounting the market value of NIF entities, which effectively meant that “every adult Polish citizen involuntarily paid an amount of money for restoration work” via the value of their shareholding. Syryczynski (2003) also suggests that some liabilities have been picked up by banks in Poland because of their inexperience in dealing with contaminated land assets, leading to some financial losses.

11.4.4 *‘Orphan’ sites*

Starosta have the responsibility to reclaim land (Janikowski and Korcz 2003) under certain circumstances where the polluter does not have title to the affected land, where enforcement of a duty to remediate land cannot be enforced, or where pollution has occurred as a result of a natural disaster. This appears to encompass a duty for local authorities to deal with orphan site problems, but not in an explicit way.

11.4.5 *Role of state funding.*

See also Section 11.4.2.

A small research programme, the “Governmental Programme for Post-Industrial Areas” has run from 2004-2010⁹.

11.5 Contaminated land sector

11.5.1 *Size*

In 1999 the Polish remediation market was estimated to be \$113 million (US International Trade Commission 2004). The overall Pollution Management and Resource Management expenditure in Poland for 2004 was estimated at €6.6 billion (Ernst and Young 2006 p26 & 30), with €63million being spent on “remediation and cleanup” based on EUROSTAT data. Ernst and Young saw Poland as a dynamic market for soil remediation with potential for strong growth. However, their estimate of the 2004 Polish remediation market is only 56% of the 1999 market.

The cost of reclaiming all industrially degraded land in Poland was estimated by the Institute for Ecology of Industrial Area (IETU) in 2001 to be €266 billion at 2000 prices, indicating an annual requirement of €10 billion across Poland to reach the 2025 policy target for post-industrial land (Janikowski and Korcz 2003). This estimated annual requirement has been used to indicate a strong potential remediation market in Poland (Stat USA 2003). However, the reported remediation market size is less than 1% of this annual requirement. The case studies reviewed in Section 11.2 indicate that a range of remediation technologies are available and used in Poland.

11.5.2 *Main drivers*

The major driver for the remediation of contaminated land in Poland appears to be related to mergers and acquisitions of State owned companies and of land holdings. Otherwise work appears to be initiated at a local (county) level as and when resources allow. A concerted programme to manage the legacy of Russian military bases was also carried out. There appears to be no consolidated policy driver for an organised programme of contaminated land management in Poland.

11.6 *Attributing financial liability*

The attribution of liability has largely been to the public sector.

11.7 *Success of the regime*

The regime can at best only be said to be partially successful due to the reliance of EU funding for major remediation projects..

11.7.1 *Positives*

Potentially a dynamic remediation sector with strong interest in brownfield redevelopment in some municipalities

A reasonably strong national expertise base

11.7.2 *Negatives*

Lack of transparency in contaminated land determination and decision making thresholds and decision-making processes

Major land contamination problems exists but do not appear to be a policy priority

⁹ <http://www.eugris.info/displayFunding.asp?FundingID=54&cat=Funding>

Site assessment and remediation objectives do not appear to be risk based, and there appears to be no scope for site specific risk based decision making

Large reliance on EU funding

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APPENDIX 12 SPAIN

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12 SPAIN

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12.1 The boundary between “contaminated” and “not contaminated”

Contaminated land in Spain has been primarily regulated under Articles 27 and 28 of Spanish Waste Law (Ministerio de Presidencia, 1998¹) which deals exclusively with soils polluted by industrial activities, both active and closed sites. This Waste Law transposes the European Waste Directives 75/442/EEC and 91/156/EEC into Spanish legislation.

Spain is a federal country with 17 autonomous regions and two autonomous cities (referred to as Autonomous Communities or Autonomous Administrations). It has 8,105 municipalities. Responsibility for soil and water management legislation is divided between the Federal and Autonomous Administrations. Nationally, the Royal Decree 9/2005, of January 14th established a list of potentially soil polluting activities (PSPA) and criteria and standards for declaring contaminated sites (Ministry of the Presidency 2005)².

The 2005 Royal Decree, discussed below, states that prior to the enactment of the Spanish Wastes Law 10/1998 of April 21 there were no legal regulations in place to ensure that soils were effectively protected from contamination or to allow for the identification and characterization of already contaminated sites based on a standardized and technically rigorous methodology. However, de la Peña Varona (2008) states that contaminated land recovery policies were launched in the Basque region as early as 1994, which was a national pioneer of contaminated land management in Spain (Menger 2007).

National law sets guidelines and limit values, however some factors used in site specific risk assessment, for example assumptions about body weight or ingestion rate may vary from Community to Community (Boronat 2008). The Autonomous Communities are responsible for implementing the Royal Decree, for example determine whether sites are contaminated or not, or need further investigation and are also responsible for carrying out contaminated site inventories (there is no nation-wide inventory). Autonomous

¹ Ley 10/1998, de 21 de abril, de Residuos. BOE número 96 de 22 de abril de 1998.

² http://www.mma.es/portal/secciones/calidad_contaminacion/

Administrations can also decide how to combine contaminated site management reporting requirements with Integrated Pollution Prevention and Control requirements³. Box 12-1 describes the contaminated land regime in the Basque country to illustrate the implementation of the national legislation.

The Royal Decree defines “contaminated soil” as soil whose characteristics have been negatively altered by the presence of man-made chemical components of a hazardous nature in concentrations that imply an unacceptable risk for human health or the environment, and that have been declared contaminated by express decision. Potentially soil-contaminating activities are defined as: industrial or commercial activities that may result in soil contamination due to the use of hazardous substances or the generation of waste products. Hazardous substances are defined elsewhere in Spanish legislation⁴. Military sites are excluded, but a parallel initiative by the Ministry of Defence following the same technical approach is expected.

A site is declared as contaminated when it is determined that there are unacceptable risks with regard to the protection of human health or ecosystems due to the presence of any of the contaminants listed in the Royal Decree or of any other chemical contaminants.

Sites declared as contaminated are those which pose unacceptable risk for human health or the environment. This risk assessment is based on current or future land use in three categories: industrial, housing and “without restrictions”, and considers human health and environmental risks on a site specific basis. The risk assessment uses a series of “Generic Values of Reference” for human health and ecological receptors, at least as a first stage. Sites designated as contaminated must be recorded in a property registry. The designation is deleted when the site is declared as remediated. It is compulsory to report to the Autonomous Administrations sales of PSPA sites. Section 12.1.1 discusses the threshold values used to make these determinations.

In practice, potentially soil polluting activities (PSPA) are identified on the basis of: the hazards of the substances and raw materials used in the activity; facilities’ size and potential risks associated to the processes involved in; and the number of existing companies and how these are grouped (López de Velasco 2008). A “situation report” must be submitted by every company that has carried out potentially soil polluting activities. A preliminary situation report describes: raw materials used in the process; products; storage; surface conditions (including spill containments, drains etc);

³ Set out in Law 16/2002 of 1 July 2002 on Integrated Pollution Prevention and Control

⁴ Spanish National Classification of Economic Activities (CNAE-93), modified by Royal Decree 330/2003 of 14 March 2003

underground conditions and soil protection measures; site access and security; waste management and historical activities (if these are known). The Autonomous Administration may then require more detailed site information. Whether or not the site is declared as contaminated is the decision of the local regulator, who will take into account: the soil composition and other physical and chemical data; distance to surface water and water wells; distance to population groups; impacts on local water quality and habitats and meteorological conditions. When a site which is PSPA is to be sold enlarged or closed, it is compulsory to make a soil status report. If site activity and/or land use changes a further situation report is required. Where sites are active and PSPA are ongoing, regular situation reports are required.

The 2005 Royal Decree also sets out how a site can be declared decontaminated. Remediation must follow a plan agreed with the Autonomous Administration. For a site to be decontaminated the scope and performance of remediation actions must be such as to guarantee that any remaining contamination translates into acceptable risk levels in relation to current land use and anticipated future uses. Note under Spanish Waste Law (Article 36.1 polluters are obliged to remediate to its original condition before the contamination took place).

Figure 12-1 (Boronat 2008) summarises the general site assessment approach in Spain. Legal requirements in Spain under the Waste Law and Royal Decree identify a number of phases in which the parties involved have to comply with particular procedures and legal requirements, encompassing:

- Providing information to the competent authorities.
- Designation of a soil as contaminated (soil is assessed according to nationally set criteria and standards).
- Obligations for contaminated soil remediation
- Publicity for soil contamination situations

The 2005 Royal Decree criteria consider groundwater protection only in the context of ecological risk assessment, and do not directly deal with groundwater contamination. However, if during the site assessment processes evidence of groundwater contamination resulting from soil contamination is revealed, the competent water authority must be notified immediately. Human health related groundwater thresholds are not described.

Water protection in Spain is regulated by Law 29/1985, on Water, as amended by Legislative Royal Decree 1/2001, which approved revised water regulations (the "Water Act"). Infringements are categorised as very serious, serious, and slight, depending on

their impact on water quality, natural resources and human health. This establishes sanctions for those dumping or spilling waste material into freshwater and coastal water resources so causing water contamination (NICOLE 2010).

Box 12-1: Management of Contaminated Sites in the Basque Country (Menger 2008; Alzola 2012)

In 2008 in the Basque Autonomous Community (BAC) there were 8,587 *potentially* contaminated sites, accounting for 7,898 hectares or 16.5 % of the total useful land surface in the region. Of these, 3,100 ha or 6.5% of the total useful land surface in the region were thought to be heavily contaminated. Sites that could be brought back into use in the medium term were thought to account for 8% of the total useful land surface in the region. These sites tended to be concentrated in urban centres and nearby areas. The Master Plan for Soil Protection in the BAC was promulgated in 1994, followed by Law 1/2005 of 4th February 2005, on the prevention and correction of soil contamination in the and the Royal Decree 9/2005 (relating to the identification of sites with potentially contaminating activities). Currently the contaminated land management related legislation of the BAC includes:

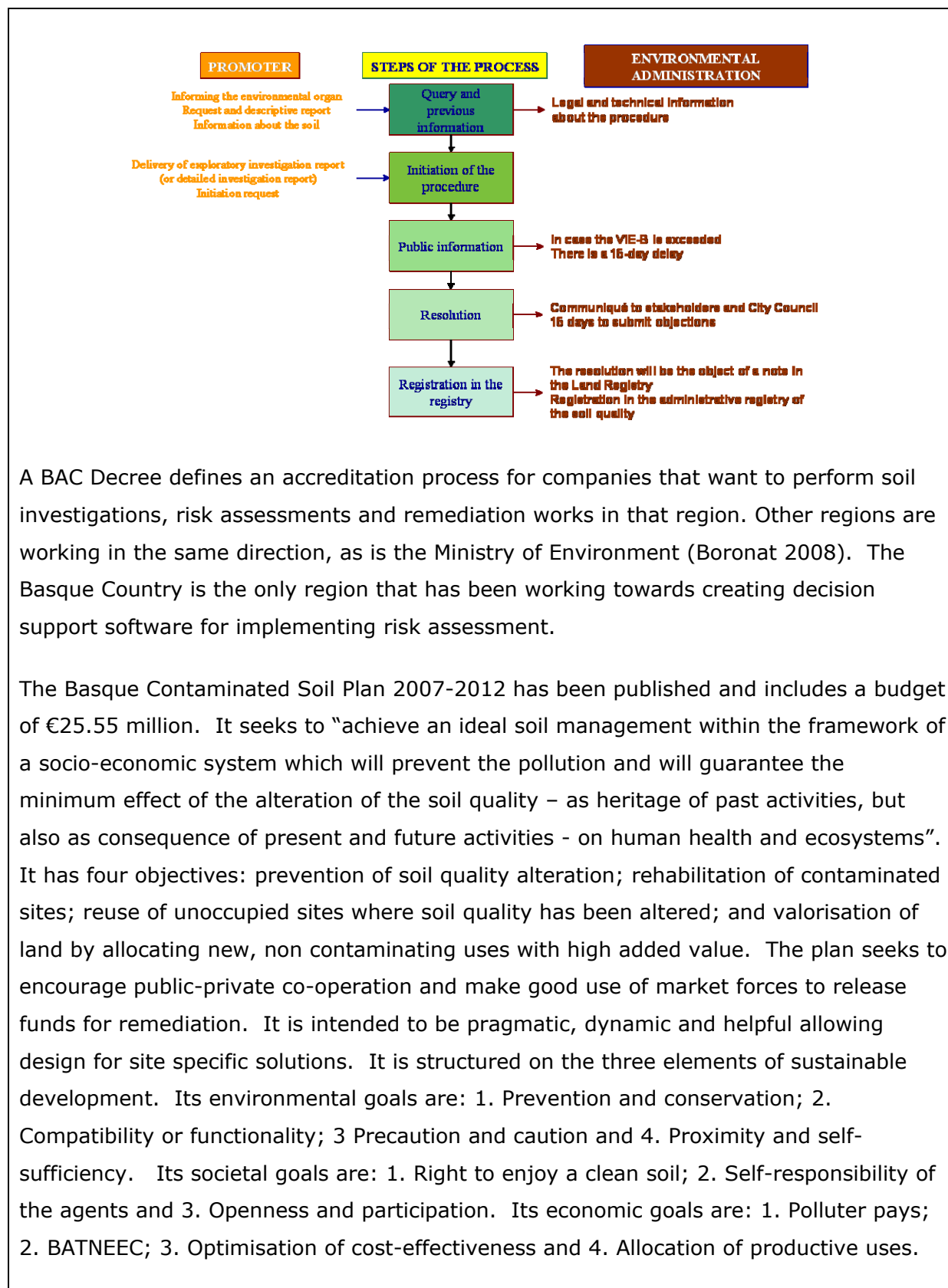
General Law 3/1998 on the protection of the environment in the Basque Country

Law 1/2005 for the prevention and correction of the soil contamination

Decree 199/2006, which establishes a system of accreditation for consultants, determines content and scope of contaminated site investigation

Decree 9/2005 which approves and regulates the Inventory of sites with potentially soil contaminating activities. The key steps in this soil quality declaration process are illustrated in the Figure below.

Law 22/11 on waste and contaminated sites



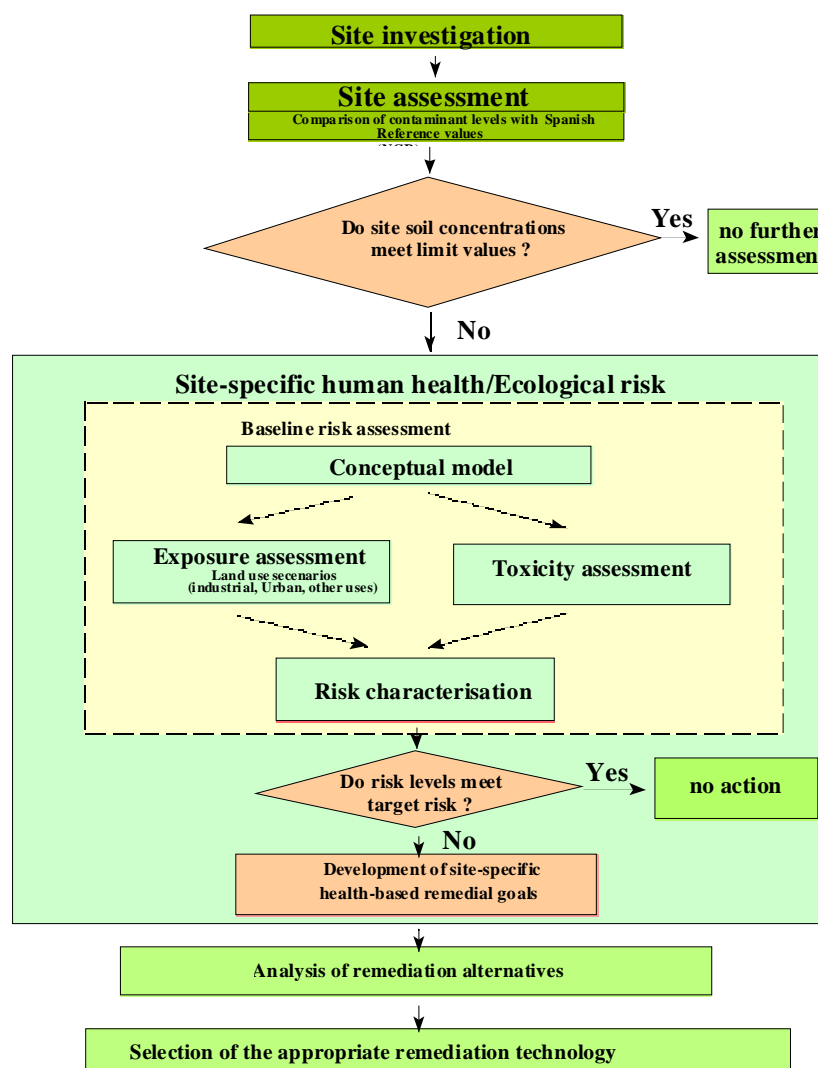


Figure 12-12-1 Generic Site Assessment Approach, Spain (Boronat 2008)

Contaminated soil is considered waste under Spanish law when the holder disposes of it or intends to dispose of it. In practice this means that excavated soil is regulated as a waste. Landfill criteria are used to assess excavated soil, regardless of its future management (NICOLE 2008). Excavated soil is considered decontaminated if it is treated so that if it was replaced in situ it would not be considered as contaminated. However, no generic soil treatment criteria to support excavated contaminated soil re-use exist in Spain, and decisions are taken by Autonomous Communities on a site by site basis, although some have developed their own regional criteria, e.g. the Basque Community.

Restoration of mine sites is the subject of two Royal Decrees: Royal Decree about the Restoration of the Natural Space Affected by Mining Activities (2994/1984, 15 October 1984); and Royal Decree about the Restoration of the Natural Space Affected by Coal Open Pits and the Rational Exploitation of these Energetic Resources (1116/1984 9 May

1984) and the 1998 waste law (ERMITE Consortium 2002). The 2005 Royal Decree includes only "Mining of non-ferrous metal ores, except uranium and thorium ores" under its PSPA.

12.1.1 Role of number-based thresholds

Spain applies a tiered system using "Generic Values of Reference" (GVRs) specified in the Royal Decree for a range of substances (Annex I) the *Valor Indictivo de Evaluación*, with possible use of Site-Specific Values (SSVs).

Human health risk based GVRs for a range of organic compounds have been derived nationally (Ministry of the Presidency 2005, Vega *et al.* 2007) using a methodology defined in the Royal Decree. GVRs are compared with the based maximum concentration of contaminants in soil. They have been derived for the three different land uses (industrial, urban and natural use), the *Valor Indictivo de Evaluación – VIE-B*. For genotoxic carcinogens, the non-threshold assumption is adopted and the GVR is set at the cancer exceeding a probability of 10^{-5} . For other chemicals the risk is seen as acceptable when the ratio between the long-term exposure dose and the maximum admissible dose is lower than 1. Acceptable Daily Intakes (ADIs) are based on toxicological information for each contaminant. What is acceptable in terms of the contaminated soil has to take into account that exposures are possible from other sources. Hence, for example for organic contaminants 80 to 95% of exposure is assumed from other sources. However, the 2005 Royal Decree does not cover the development of GVRs for metals or petroleum hydrocarbons.

Responsibility for deriving metal and other trace element GVRs is delegated to the Autonomous Administrations. As of 2008, only a few of the 17 Autonomous Regions (Basque Country, Catalonia, Madrid and Andalucía) have published their own metals Generic Reference Values.

For example, Catalonia has developed risk based standards considering human health, leaching to groundwater, farm animals and ecosystems (de Pablo *et al.* 2005). GVR's have been produced for 18 trace elements considering three types of land use: industrial, urban and other including agricultural use⁵. The 54 trace element "human health" GVRs applied by Catalonia include values derived by other considerations. In some cases GVRs based on soil background concentrations take precedence over these risk base standards (Marti *et al.* 2008), for example when risk based values are lower than background concentrations; or conversely are very high. Values were also amended based on a view

that industrial use scenarios could be very close to more sensitive scenarios following the Royal Decree "Contiguity Rule" described below. Values (for "other" use) were also harmonised with soil reference values those in the sewage sludge Directive and amendments were made on phytotoxicity grounds⁶.

Where ecosystems are a priority, Catalonia uses local or regional background levels of trace elements combined with a set of bioassays as a screening measure to determine if site specific ecological risk assessment is required (Marti *et al.* 2008b).

The Royal Decree allows for the regional definition of site-specific reference levels as the mean plus two times the standard deviation of background levels as measured in a surrounding clean area of similar physico-chemical characteristics. These values, the *Valor Indictivo de Evaluación – VIE-A*⁷, are applied for any land use and for both the protection of human health and of ecosystems (Boronat 2008). However, the approach described for Catalonia is more stringent.

For petrol hydrocarbons the Royal Decree establishes a GVR of 50 mg/kg soil based on total hydrocarbon measurements. This level is set on the basis of avoiding false positives, so effectively the presence of petroleum hydrocarbons would trigger a risk assessment.

Following a site investigation, on the basis of a comparison of contamination data GVRs, an Autonomous Administration may: declare the soil to be contaminated; require a site-specific risk assessment; or consider that the risk is low enough that no additional measurements are required, based on the decision criteria in Table 12-1.

Under the Royal Decree the human health GVRs prevail over those derived for the protection of ecosystems. The designation of sites where the protection of ecosystems is the main priority is carried out by the local authority. It generally applies to protected habitats and nature reserves. Ecological GVRs are applied only for these sites. It is in this context that impacts on the water environment are considered via impacts on aquatic organisms.

Ecosystem GVRs (Ministry of the Presidency 2005, Vega *et al.* 2007) are provided for three groups of organisms: soil organisms, aquatic organisms and terrestrial

⁵ The Basque approaches defines risk based GVRs for four types of land use: industrial, public garden, urban, playground. Exceedence of the GVR triggers site specific risk assessment, and determination of whether or not a site is contaminated is based on this site specific risk assessment. (Menger Pers Comm)

⁶ See also "General Reference Levels (GRL). Values of GRL for metals and metalloids and protection to the human health applicable to Catalonia <http://www.arc.cat/en/altres/sols/ngr.html> Accessed May 2010

⁷ "A" signifies that these are background based

vertebrates. Local authorities can decide which organisms are of significance for a particular site. Table 12-2 sets out the ecological receptors and exposure routes used for setting ecosystem GVRs. Derivation of environmental GVRs is based on a set of Risk Characterization Ratios (RCRs) which are defined as the ratio between the Predicted Environmental Concentration (PEC) and the Predicted No-Effect Concentration (PNEC) for each environmental compartment. Soil GVR concentrations are back-calculated as those which would give a RCR of 1 according to the EU risk assessment scheme. Methodology for PEC and PNEC derivation follows the Technical Guidance Document for the Environmental Risk Assessment of the European Community (EC 2003).

Table 12-1. Criteria for Site Determination in Spain (from Annexes III and IV of the 2005 Royal Decree - Ministry of the Presidency 2005)

In the absence of a specific risk assessment, a site is contaminated if:	A site requires further risk assessment if:
<p><i>Where protection of human health is regarded as the main priority</i></p> <ul style="list-style-type: none"> Where the concentration of any soil substance is 100 times or more the GRV <p><i>Where protection of ecosystems is regarded as the main priority</i></p> <ul style="list-style-type: none"> Where lethality or inhibitory thresholds for tests specified by the Minister of the Environment are exceeded by 10 mg or less of soil, or by specified dilutions of soil leachate for aquatic organisms. 	<ul style="list-style-type: none"> Where sites present soil concentrations of oil hydrocarbons higher than 50 mg/kg Where GRVs for human health are exceeded <p><i>Where protection of ecosystems is regarded as the main priority</i></p> <ul style="list-style-type: none"> Where GRVs for ecosystems are exceeded Where toxicity is demonstrated based on bioassays specified in the Royal Decree

A site is considered not contaminated if it can fulfil the following two conditions simultaneously: that the concentration of expected chemicals in the soil is below the GVRs, and that there is no indication of ecotoxicity for the soil and the aquatic organisms using undiluted samples.

Contaminated site risk assessment is carried out by the site owner or operator, who must report its outcomes to the local regulator. Sites are then designated as contaminated or not by the regulator if they identify unacceptable risks with regard to the protection of human health or ecosystems (Boronat 2008).

Additional to the use of the GVRs the following rules are applied to both human health and ecosystem issues. The "Reduction Principle" states that screening values for synthetic substances, the cannot exceed 100 mg/kg soil. The "Contiguity Rule" sets out that the GVR for urban soils cannot be more than ten times greater than that for "natural areas, and the GVR for the industrial soils cannot be more than ten times greater GVRs established for urban soils. The "Limit of Detection Rule" allows setting the screening values to the limit of detection of the analytical technique, when the estimated value is

too low to be measured based on available technologies, and the limit of the analytical detection is considered sufficiently accurate to assure an acceptable protection.

Table 12-2. Ecological receptors and exposure routes used for setting ecosystem GVRs (Vega et al. 2007)

Ecological receptor	Organisms covered	Exposure routes
Soil organisms	Soil microbial functions Terrestrial plants Soil invertebrates	Soil
Aquatic organisms	Fish Aquatic invertebrates Algae and aquatic plants	Interstitial Pore water
Terrestrial vertebrates	Mammals Birds Other vertebrates	Consumption of contaminated food (plants, invertebrates and vertebrates)

Risk assessment requirements are specified by the local authority, but will include to a lesser or greater degree the following (Boronat 2008): delineation of contamination identifying types and levels; identification of soil texture and components; identification of possible receptors (human, ecological); a description of the immediate physical environment identifying possible pathways from source(s) to receptor(s); quantified foreseeable exposure assessment. The risk assessment approach must be agreed with the local authority. At minimum, the following exposure pathways shall be considered:

- For industrial land use: inhalation of soil vapours, inhalation of contaminated soil particles, and ingestion of contaminated soil.
- For urban land use: inhalation of soil vapours, inhalation of contaminated soil particles, ingestion of contaminated soil, and dermal contact with soil.
- For other land uses: inhalation of soil vapours, inhalation of contaminated soil particles, ingestion of contaminated soil, ingestion of contaminated food products, and dermal contact with soil.

The methodology for human health site specific thresholds is not specified in the Royal Decree. However, a justification of the toxicological basis for the site specific risk assessment is expected, along with an analysis of the uncertainties associated with the risk assessment carried out, including appropriate conclusions regarding the validity and reliability of the results of the assessment.

There are as yet no nationally standardised contaminated land water assessment criteria. Regulation is delegated to the Autonomous Communities. Drinking water quality

objectives are often used for groundwater assessment, based on the revised 2006 Groundwater Directive⁸ (Boronat 2008). Regions differ in their approaches.

For example, in the Basque Autonomous Community no Basque regional values have been derived. Intervention Values from the Dutch regulatory regime are used⁹. If the Intervention Value is exceeded by site monitoring data then the Basque Water Agency (URA) must be informed, who generally ask for a more detailed investigation which may include quantitative risk assessment and water quality monitoring over one year to see how contamination varies over time (taking into account seasonal changes in water flows). Water extracted during site management work requires authorisation from the URA or local water supply organisation (including ingress of groundwater into excavations). Discharges are regulated by the Basque Environment Agency (IHOBE) in conjunction with the URA or local supply organisations.

The Catalanian water agency has developed human health risk based criteria for groundwater (Orejudo et al. 2008) in response to the 2006 Groundwater "Daughter" Directive. Five scenarios have been modelled: agricultural, domestic, urban, industrial and recreational. A range of trace element and micro-organic pollutants have been considered. These reference levels are intended for transitory use until "good chemical status", as described by the Directive, is achieved.

Soil properties are not considered in deriving the GVRs, except that where background levels are to be used as a criterion, they should be derived from soils of similar "physico-chemical" characteristics (Carlton 2007).

12.1.2 Recent and ongoing Developments

While Vega et al. (2007) suggest a number of possible future enhancements to the contaminated land regime in Spain, there is not current policy review. Boronat (2008) reports that some regions are working together to develop a professional accreditation processes. The Basque Country's Decree 199/2006 defines the accreditation process for companies that want to perform soil investigations, risk assessments and remediation works in that region. Other regions are working in the same direction, as is the Ministry of Environment. However, the accreditation processes are not homogeneous.

⁸ EC Directive 2006/118/EC on the protection of groundwater against pollution and deterioration following the Water Framework Directive 2000/60/EC ("Groundwater Daughter Directive").

⁹ February 4th, 2000 Circular on target values and intervention values for soil remediation, see Appendix 10.

12.1.3 *Role of case-by-case decision making*

Boronat (2008) identifies a number of conditions which indicate some variability on how contaminated land regulation is implemented at a regional and local basis across Spain. He points out that risk assessment is a relatively approach for contaminated land management in Spain, and no common framework existed before 2005 entered into force. Although the 2005 Royal Decree defines guidelines for developing risk assessment, many decisions are still in the hands of the Autonomous Communities. These decisions include the degree of detail necessary in risk assessment, the establishment of GVRs for metals and the designation of sites where ecological risk assessment is necessary.

The local authorities are normally the decision-makers; polluters and land owners are also involved. The individuals or institutions who may be affected by any remedial actions must also be and may demand consultation and involvement in all stages of the decision-making process. The documents required to assess potential contamination at a site and those relating to remedial measures proposed have to be made available for public consultation. Where commercial and/or confidential information is included, full summaries must be provided as alternatives to the original documents. This site management information is managed at the level of the Autonomous Administrations and not at a national level. If risk assessments have been made the results will usually form part of the regional registers of (potentially) contaminated land.

12.2 Approach's effectiveness

A selection of case studies have been summarised below.

A €1.3 million LIFE funded demonstration project, called Biosoil, has evaluated *ex situ* bioremediation as a remediation technology over November 2004 to the end of October 2007 in the Basque region of Spain. Much of the project web site is not open to general access (www.lifebiosoil.com/in_index.asp). The technology is based on mixing composts made from urban wastes with excavated contaminated soils in biopiles, and has apparently been tested on brownfield remediation sites. EUGRIS¹⁰ reports that the project has produced a guide describing Best Available Technologies (BATs) for remediation of contaminated soils, and technology selection tool. Small scale trials were carried out two sites, one a former paper mill and the other a former fuel storage and distribution site (Biosoil Consortium 2007). Costs are said to be €23 per tonne, said to be 80% lower than costs for standard landfill based remediation.

¹⁰ (1) <http://www.eugris.info/displayProject.asp?ProjectID=4676&Aw=BiOSOIL&Cat=Project>

Mezger and Spierenburg (2009) report a former paint factory close by a Mediterranean beach owned by a multinational corporation. The site has a high asset value and is intended to be redeveloped for residential use. The sales contract included indemnification for site remediation to industrial related use based on what was the current legislation in Spain. The developer would then carry out remediation to residential use requirements. Shortly after the sale contract was agreed the 2005 Royal Decree came into force which includes more stringent criteria for groundwater quality, leading to uncertainty about how to assess the cost boundary in the original contract. The stakeholders involved have agreed that the decision about dividing costs will be based on the judgement of three independent consultants.

Some of the most substantial brownfield redevelopment in Spain has taken place in and around Bilbao in the Basque region (Menger 2007). Urban redevelopment has now taken place over 65% of the contaminated land area of the Bilbao Estuary following regional plans initiated in the late 1980s. Much of the brownfield land was in Public Sector ownership and a consortium was formed between a number of these Public Sector organisations and local and regional authorities and regulators to facilitate brownfield regeneration in the area. This consortium has facilitated the re-use of a number of major former industrial complexes, including steelworks; pesticide and fertiliser production facilities; non ferrous metal and sulphuric acid production; shipyards; a power station and an open cast iron ore mining site. A range of end uses have taken place including residential, retail, leisure, renewable energy, commercial and industrial and the extension of the Bilbao Airport. Financing has come from public-private sector partnerships and also EU funding. Financing discussions were reported as stalled at one site. Remediation has largely been based on excavation and removal to containment sites. Remediation at the former steel works at Bizkaia included soil washing and cement based stabilisation of residues. These projects have been broadly seen as successful and have catalysed some adjacent Private Sector brownfield remediation projects in at least one case. Projects were still ongoing (as of 2007) and likely to continue for 20 years at some sites.

Perhaps the most famous land contamination incident in Spain followed the breach of a tailings dam at the Boliden Apirsa mine, Aznalcóllar in 1998 which resulted in the release of an estimated 4 million m³ of acid mine water and 2 million m³ of mining sludge into the Agro river. The sludge spread over 2,100 ha along 40 km and acid mine water penetrated 20 km along the river, where it was stopped by emergency dams built to protect the Doñana National Park. The total land surface affected was 4,286 ha including 2,557 ha of agricultural soils, 1,054 of forest soils and 98 ha of the Doñana National Park, having been exacerbated by water transport and dust blow. The principle contaminants of concern are arsenic, antimony, cadmium, copper, lead, thallium and zinc

(Bernal et al. 2008). The remediation response was to remove the coating and soil. Following this some 15-20% of the soil surface was still determined as contaminated. The determination was based on levels of water extractable arsenic and local trace element background concentrations. This determination predated the 2005 Royal Decree, which includes nonferrous mining as a Potentially soil-contaminating activities. The direct comparison with regional background levels is not consistent with a reference value based on "mean plus two times the standard deviation of background levels". A vegetative cover based approach was conceived to deal in part with the remaining contaminated area to provide forest and recreational land cover over 1999-2003 (WWF 2004). This was also seen as offering the additional benefit for a "green corridor" between the National Park and the Sierra Morena, following substantial lime treatments to deal with the acidity caused by the pyritic material. This included the expropriation of contaminated farmland. The Andalucía Autonomous Administration allocated 11 billion Pesetas for remediation and compensation (an estimated €66 million). Funding also came from the national government and the EU Social Fund. Some costs were borne by the mining company, who paid compensation to farmers for crops that had to be destroyed and clean-up operations in the vicinity of its operations. They estimated (in 1999) the cost of closure of the tailings pond to be US\$37 million¹¹.

A further scheme was established in 2005: "Doñana 2005" to restore the regions hydrology, which the National government expects to fund largely through Spain's 2000-2006 entitlement under the EU Structural Funds.

There is some controversy over the Aznalcóllar response concerning: the working relationships between national and regional administrations and agencies; the appropriateness of the Green Corridor and Doñana 2005 strategies; and the extent to which the polluter pays principle has been achieved¹². The mining company and its owners have disputed liability and court actions have continued until 2008 without resolution. At that date the accumulated claim for environmental rehabilitation costs was €89 million¹³. The mining company closed its operations in the area in 2001.

Small scale trial plantings have been carried out to investigate prospects for phytoremediation, funded by the national government (Bernal et al. 2008). Both phyto-extraction based remediation and approaches based on stabilising the soil surface using

¹¹ Accessed May 2010

[www.boliden.com/www/en/bolidenen.nsf/\(LookupWebAttachment\)/Library%20Lectures/\\$file/Pond_failure_spain.pdf](http://www.boliden.com/www/en/bolidenen.nsf/(LookupWebAttachment)/Library%20Lectures/$file/Pond_failure_spain.pdf)

¹² Centro Informático Científica de Andalucía – CICA – web page on Aznalcóllar by Ginige, T. (University of Wales, Aberystwyth) <http://huespedes.cica.es/aliens/gimadus/aznalcollar.html> Accessed May 2010.

plant cover have been investigated. Phyto-stabilisation approaches were found to be far better following this trial work, with phyto-extraction described as a “non-starter”.

12.2.1 *Proportionate*

Contaminated land determination and remediation requirements in Spain are based on a suitable for use approach, with criteria delineated over a range of options much as in the UK. The case studies above support a view that site investigation and remediation work is carried out in a highly pragmatic way. The majority of investment in remediation and site investigation appears to come from Public Sector sources, with authorities taking a substantive role in the management of land, creation of development opportunities and development of funding (including public-private partnerships). The vast majority of remediation tends to be via excavation and removal (for example > 95% of projects in the Basque Region (ICCL 2009). 3.2 million tonnes of contaminated soil is thought to have been excavated in the region from 2005-8, with the amount of uncontaminated soil being far greater (90 million tonnes over 1998-2007).

12.2.2 *Targeted*

The 2005 Royal Decree is targeted at active and disused industrial sites. It does not extend to waste disposal, nor coal and ferrous metal mining. At a national level a set of soil quality criteria have been developed for a set of organic substances to provide a trigger for when site specific risk assessment is needed (and in some cases to directly determine if a site is to be regarded as contaminated. These focus on soil quality and groundwater criteria are only offered in the context of ecosystem protection. In the case of water quality criteria originating from outside of Spain may be used.

12.2.3 *Consistent*

As far as they are reported, the management steps for the contaminated sites in all of these examples appear to follow the sequence of steps in the flow chart of Figure 12-12-1. The case studies indicate that practical remediation work for contaminated soils is dominated by excavation and removal. The excavated soil seems to be sent in large part to (landfill) containment sites. Risk management goals tend to be set on the basis of site specific risk assessment and negotiation. There is some variability in how generic soil quality values are used, and how site specific risk assessment is accomplished between regions in Spain.

¹³ World Information Service on Energy (WISE) The Los Frailes tailings dam failure (Aznalcóllar, Spain) last updated 23 May 2012 <http://www.wise-uranium.org/mdaflf.html> (accessed March 2013).

12.2.4 *Transparent*

Decision-making criteria for contaminated site management in Spain is published and available for use, but principally in national and regional languages. The Royal Decree enacted at a national level and applied by the Autonomous Administrations. In this regard contaminated land policy in Spain is transparent. The case studies illustrate that what is less obviously transparent is the process of forming partnerships for brownfields regeneration, which appears to be led mostly by the Public Sector. There would also appear to be some room to manoeuvre in terms of agreeing criteria for risk management objectives, and negotiations may be protracted.

12.2.5 *Internal perception*

No direct evidence of internal perception has been identified (See Section 12.7). However indirectly it can be seen that Spain recognises it has a contaminated sites challenge and that it can gain by importing and adapting technologies and tools to suit its specific circumstances. The decision of the Basque Country in the mid-1990s to work with the late Colin Ferguson to modify the then probabilistic CLEA model to suit Basque circumstances and the invitation from Invest in Spain (undated) suggest a long term strategy to develop rather than import tools and technologies.

12.2.6 *External perception*

NICOLE (2010) perceives a moderate level of brownfield transactions in Spain. The US International Trade Commission (2004) perceives Spain as having a growing demand for remediation services. Recently NICOLE (2008) has published a review of Spanish waste policy as it relates to soil re-use, which concluded legislation in Spain was relatively recent and not fully elaborated with technical guidance. No consistent guidance exists on determining when a treated soil can be re-used. Its annex on Spain suggests that this has hindered the re-use of contaminated soil in Spain.

The EU funded Heracles project has reviewed the soil quality criteria used in Spain (Carlson 2007), comparing it with that of other European countries. The review has not “critiqued” Spanish policy, for example in a way that shows “strengths and weaknesses”. However, in an annex (Vega et al.) it is pointed out that because GVRs do not take into account soil properties, site specific risk assessment may often be necessary. Boronat (2008) comments that specifications for input data for developing a risk assessment are vary greatly from region to region. For example, there are differences in the use of toxicological data, exposure factors (exposure duration, exposure frequency, dermal exposure, skin surface, soil-dermal adherence factor), and transport modelling approaches. Few autonomous communities have produced a published position. A

further complication is that soil and groundwater issues are dealt with by different authorities inside each autonomous community, and groundwater contamination regulations are not well developed.

Boronat goes on to say that human resources in the Autonomous Communities are limited compared with the amount of projects that are awaiting resolution. Furthermore, experience in risk assessment application is limited in both the regulatory and consultancy sectors, given the short period that the Royal Decree has been in force. He also suggests that it would be preferable for all of the autonomous communities in Spain to use a homogenous accreditation process.

National and regional organisations from Spain take part in the Common Forum on Contaminated Land¹⁴. The Basque Country has hosted Common Forum meetings, most recently in October 2012. Spain has research performers in a number European funded projects¹⁵. A number of Spanish businesses and Agencies are members in NICOLE¹⁶, and several NICOLE meetings have been hosted in Spain. AquaConsoil, the 12th International UFZ-Deltares Conference on Groundwater-Soil-Systems and Water Resource Management [was] held in Barcelona during April 2013.

12.3 Estimate of scale

12.3.1 *Estimates of the amount of potentially contaminated land*

Spain covers an area of 504,750 square kilometres and has 46.7 million inhabitants. Contaminated site data is typically compiled (if it is compiled) by Autonomous Administrations. For example, in the Basque Country there are 12,400 potentially contaminated sites. Of these, 3500 ha are thought to be contaminated land (Alzola, 2012). These sites tend to be concentrated in urban centres and nearby areas (Menger 2008). 22% of the total number of potentially contaminated sites were in the region of the Bilbao Estuary (Menger 2007). 2001 data for Catalonia identified almost 5000 sites with potentially polluting activities (de Pablo et al. 2005).

Grima (2009) indicates that there were two phases of work to inventory numbers of contaminated sites at a national level in 1990 and 1994-5. By 1995 18,142 industrial activities were identified and 4,902 sites were considered potentially contaminated. 370 of these sites have been investigated.

¹⁴ www.commonforum.eu

¹⁵ Contaminated land projects funded under FP5, 6 and 7 programmes are listed on www.eugris.info

¹⁶ www.nicole.org

While no recent central inventory exists, Spain reports its progress on contaminated land management to the European Environment Agency (EEA) through the EIONET system. 2004 and 2001 data is downloadable from the EEA¹⁷ from its 2007 progress report on contaminated land management in Europe (EEA 2007). This records a projection of 33,595 suspect sites in Spain, with the actual number of identified suspect sites being 15,126. Site investigation (initial or intrusive) was reported at 349 of these sites, with measures completed at 288 (including 139 sites where remediation had taken place). There is an upwards trend in site numbers. 2001 data report a projection of 18,142 sites with the actual number of identified suspect sites being 4,910, and measures completed on 59 sites. (Rather confusingly the 2001 data for sites under investigation report 370 sites). The 2004 data was compiled using a standard questionnaire by the Instituto Geológico y Minero de España (IGME) in Madrid, with data coming from several Spanish autonomous regions. Data from the inventories collated under the 2005 Royal Decree has yet to be collated.

12.3.2 Estimates of progress

Section 12.3.1 reports the available data for contaminated site management across Spain. The scale of the contaminated site problem appears yet to be fully established, with measures under way or completed at around 2-3% of identified suspect sites.

Over 1995 to 2005 the First National Plan of Remediation of Contaminated Soils was implemented. This aimed to characterise 1,650 sites and conduct 275 remediation projects. The Second National Plan of Remediation of Contaminated Soils (2008- 2015) was launched by the Ministry of Environment and Rural and Marine Affairs (López de Velasco 2008).

The First National Plan The plan was implemented by the regions with 50% financing from The Ministry of Environment. It focused on public and orphan sites. €150 million was invested, of which €45 million came from EU funds. This is consistent with an EEA (2007) report that annual public expenditure on contaminated land management in Spain is in the region of €10.2 million for 2004. The plan resulted directly in the remediation of 245 sites, and indirectly the remediation of 350 sites by the Private Sector (López de Velasco 2008).

Under the Second National Plan the Public Sector, financed by Ministry of Environment and Rural and Marine Affairs, will support the remediation of public sites. These include: military harbours (zones without private industries); public sea-land areas; airports;

¹⁷ From: <http://www.eea.europa.eu/data-and-maps/data/soil-contamination-1> accessed May 2010. Note data reported by EEA about the % distribution of sites by type in 2007 dates back to a national inventory in Spain

railways; public companies; river banks; orphan sites and brownfields. Preliminary reports have already been made for these facilities. Over 2006-2007, a more detailed investigation was been made for 46 military bases, and by 2008 eight military bases were being cleaned up (López de Velasco 2008).

Martínez (2008) described how potentially contaminated sites were administered by the Spanish oil company Repsol. Their site assessment considers risks to human health, ecosystems and groundwater vulnerability. In broad terms two different characterisation strategies are adopted. The choice between them depends on whether the operations will continue on the site, or abandonment and a change in land use are expected. In the first case, "contamination-focused" investigations are used to provide detailed characterisation within the impacted areas in order to support a sound in situ remediation design. When the site is to be abandoned investigation is taken to verify those areas that do not require remediation, and anticipate the remedial solutions to be adopted in case of contamination and focus the investigations on the data needed for remedial design, regulatory compliance and liability transfer.

López de Velasco (2008) describes the general situation for privately owned sites is as follows. Regulators are looking for the potentially polluting companies that have yet to submit preliminary report for a site, as required by the Royal Decree. Where reports have been submitted, the regulator may ask for additional investigations to better establish site risks. In all cases the regulator must monitor the implementation of any remediation.

Autonomous administrations undertake their own regional contaminated land management planning, for example, the Basque Contaminated Soil Plan 2007-2012 described in Box 12-1 (Menger 2008).

12.4 Deciding who pays

12.4.1 'Polluter pays' principle

In line with other European countries (López de Velasco 2008) private owners have the responsibility for the pollution produced as a result of their activities, and therefore have the responsibility for cleaning up their sites. The Polluter Pays Principle is applied, but in some cases Public Sector support is possible (López de Velasco 2008).

12.4.2 *Liability of the state*

The case studies in Section 12.2 indicate that the Public Sector at national and regional level may bear the cost of contaminated land remediation where cost recovery from site owners has not been possible (e.g. as in the case of Aznalcóllar), or as part of a public-private partnership. The Public Sector also bears remediation costs where the site is in public ownership or an orphan site under the national remediation plans (see Section 12.3.2).

12.4.3 *Liability of the owner/ occupier*

Under the 2005 Royal Decree site owners are obliged to submit situation reports where potentially soil polluting activities have been carried out. Additional situation reports are required if site activity and/or land use changes, or if activities are ongoing (Ministry of the Presidency 2005). When a site which is PSPA is to be sold enlarged or closed, it is compulsory to make a soil status report.

Where title to a site has been acquired after the cessation of PSPA, the site owners are exempted some of from the detailed requirements of the situation report, but must declare ownership information and knowledge of the historical use of the site.

The Royal Decree includes a system to publicly communicate the current status of a site's soil assessment within the Land Registry. Declaring a site to be contaminated implies that the owners are obliged to take risk reduction measures.

NICOLE (2010) country report for Spain outlines the liability regime in Spain under the Spanish Waste Law. Liability lies with the party which caused the contamination and in the event of various parties, to all of them jointly and severally. If the party which caused the contamination is not found, liability falls to the "possessors" of the land, and if there is no available possessor to the owner of the land. Liability does not transfer in the following circumstance: liability does not transfer to the creditor who receives contaminated land in compulsory debt collection, provided that the creditor disposes of the land within one year of acquiring ownership. Criminal sanctions / liability apply to those who cause contamination of land where contamination has been caused by a failure in compliance with environmental regulations. There are also sanctions for failure to comply with regulatory requirements to remediate contaminated land. NICOLE suggests that the regime is unclear how liability of historical contamination where a potentially responsible party claims that the contamination was not regarded as contamination when it was caused. However, under Law 22/2011, owners and occupiers of land (at the time the contaminating event or activity occurred) can be held liable for the clean-up of the contaminated land on a secondary liability basis, regardless of their

fault or negligence if there is no operator or if the polluter cannot be found (Practical Law Company 2012).

Third parties are able to claim damages for land contamination, but are not necessarily able to enforce cleanup (NICOLE 2010; Practical Law Company 2012). The Government of Spain is currently drafting legislation concerning civil liability arising from activities with environmental impact.

NICOLE (2010) reports that there are only limited opportunities for liability transfer under contract (for example as part of site divestment or acquisition), with a number of liability types being non-transferable. NICOLE's assessment was based on the views of three major service providers operating in Spain. However where shares are sold then liability transfers to the new owner unless a case of joint and several liability arises (Practical Law Company 2012).

12.4.4 *'Orphan' sites*

The publicly funded First and Second National Plans of Remediation include orphan sites (see Section 12.3.2).

12.4.5 *Role of state funding.*

Limited state funding has been made available through the national remediation plans, for a relatively limited budget (see 12.3.2). European money is seen as a contributor to these plans and also in dealing with the Aznalcóllar mine site rehabilitation.

The Ministry of the Environment has the option to fund a remediation and later recover the costs. Costs can be recovered either directly or by the transfer of an appropriate portion of the remediated property. Cost recovery can take place over a 10-15 year period (ICCL 2009).

12.5 **Contaminated land sector**

12.5.1 *Size*

Public Sector investment in contaminated land management in Spain was estimated as around €10 million for 2004 (EEA 2007). The overall Pollution Management and Resource Management expenditure in Spain for 2004 was estimated at €9 billion (Ernst and Young 2006 p26 & 30), with €207million being spent on "remediation and cleanup" based on EUROSTAT data. Ernst and Young saw Spain as an emerging market for soil remediation with potential for strong growth. An Invest in Spain presentation (undated but uploaded 23/1/2012) suggest Spain is a strong market for process based remediation

technologies that would offer cost and efficiency savings over established approaches to remediation.

The view of the NICOLE Brownfield Working Group (NICOLE 2010) is that the level of transactions for brownfield sites in Spain is “moderate” compared with the “dynamic” market of the UK. In some regions there has been large scale Public Sector interest in stimulating brownfield renewal where there is a shortage of development land (e.g. Menger 2008). The NICOLE 2010 Report’s country profile for Spain suggests 10-20% of development in Spain takes place on formerly developed land (based on the views of two service providers).

For brownfield projects at least the dominant remediation approaches appear to be excavation a wide range of technologies are available and are in use (see Section 12.2). A survey of remediation process costs in Europe (Summersgill 2006) found only “sparse” data for Spain, where in the first part of the 2000s the remediation market was “in its infancy”.

12.5.2 *Main drivers*

A major driver for the remediation of contaminated land in Spain would appear to be the 2005 Royal Decree, and in particular the publicly accessible registers its sets up for contaminated site status. However, at least until 2004 progress appeared to be slow with site investigation initiated on less than 3% of identified suspect sites and relatively few remediation projects carried out. This is a generalisation across Spain. There are no signs of substantial progress since. In some regions (e.g. the Basque community – see Section 12.2) large scale remediation work has been carried out as part of urban brownfields redevelopment. NICOLE (2010) suggest that nationally there only weak drivers for brownfield markets (e.g. legislative, and possibly policy and regulatory). However, there are also only weak obstacles to the brownfield market (e.g. lack of financial incentives, availability of greenfield sites and lack of liability management opportunities). In line with the case studies described in Section 12.3, NICOLE (2010) found that the brownfield market was relatively dynamic in urban areas with scarcity of land (Basque Country, Barcelona and Madrid) but outside those areas the availability of green areas is a blocker for brownfield development.

12.6 *Attributing financial liability*

12.6.1 *Approach*

Practical Law Company (2012) reviews liability for contaminated land. Liability rests with the polluter as long as the polluting event was no more than 30 years ago. Innocent

owners are not liable unless they owned a site at the time pollution occurred and the polluter cannot be found. Arms length lenders cannot be liable. However lenders can acquire liability if they become owners or are in effect [a] controlling mind.

12.6.2 Success

No information about challenges to liability have been found.

12.7 Success of the regime

The contaminated land market and brownfields markets in Spain have been described as emerging. A regionally based system for inventorying suspect sites, investigating them and carrying out remediation if required has been set up. However the apparent rate of progress is relatively slow at a national level. Nonetheless in a number of urban areas development pressures have led to large scale rehabilitation of brownfield sites.

There are some concerns over the regional variability in how risk assessment and management is regulated, and there are also concerns about the availability of suitably qualified personnel. However, Public Sector environmental agencies in some regions (Basque Community and Catalonia) demonstrate competence and engagement in their work and a significant degree of international engagement with both networks and multinational projects.

12.7.1 Positives

- A consistent and transparent national policy for the management of suspected contaminated land, linked to the envisaged use of the site
- Strong Public Sector investment in contaminated land remediation and brownfield rehabilitation in some regions and some world class brownfield redevelopment (e.g. in Bilbao)
- A number of Agencies with strong competencies and international engagement
- Recognition of the importance of site specific risk assessment for determination of contamination and any subsequent remediation requirements

12.7.2 Negatives

- Not all regions are progressing at the same pace
- Regional variability in how the national contaminated land regime is applied
- Limited level of Private Sector involvement in brownfield renewal
- Contaminated sites management is to some extent fragmented over several regimes (contaminated Sites, Water, and Mining)
- Large reliance on EU funding

- Lack of penetration of remediation technologies

12.8 References

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**APPENDIX 13 UNITED KINGDOM
(CONCENTRATING ON ENGLAND)**

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13 UNITED KINGDOM (CONCENTRATING ON ENGLAND)

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13.1 The boundary between “contaminated” and “not contaminated”

The United Kingdom comprises four countries. Contaminated land legislation is devolved to the parliament of Scotland and the Assemblies of Wales and Northern Ireland. At the time of writing (June 2013), England, Wales and Scotland have specific contaminated land legislation in force whereas Northern Ireland has yet to enact its legislation. This chapter focuses on the situation as it applies to England.

There are two significant legal regimes relating to land contamination; Part 2A of the Environmental Protection Act 1990 (the Part 2A regime) and the planning regime under the Town and Country Planning system (various dates).

The Part 2A regime requires local authorities to inspect their areas from time to time for the purpose of identifying land that meets the statutory definition of “Contaminated Land” and subsequently to ensure that suitable risk management actions are taken to control any significant risks to prescribed receptors, including human health, the water environment, specific ecosystems and property. The planning system has a far wider remit to ensure that all development occurs in a rational and sustainable manner and that all construction complies with relevant standards for safety, quality and sustainability. Land contamination is a material consideration in both the development of local and neighbourhood plans and in the consideration of applications for planning permission. It is important to note that the planning regime requires developers to ensure the development is safe whereas Part 2A requires the demonstration that unacceptable risks as defined in Part 2A exist. This is a fundamental difference between the two regimes. It reflects an asymmetry in the question being asked as well as the level of risk being considered. Whereas the Local Authority has to demonstrate land is posing a high level of risk before it can be determined as contaminated land and thereby trigger remediation, the developer or owner has to show proposed development will be safe in order to avoid the need to remediate.

In general, Part 2A deals with the definition of “contaminated land” and “not contaminated land” and the Planning regime, in an overarching context of sustainable development, requires development to be safe and suitable for use. This means that an area of land may be suitable for a low sensitivity land use (e.g. commercial/light

industrial) but not for a high sensitivity land use (e.g. residential) but that does not mean that the land would be considered “not contaminated land” in the first instance and “contaminated land” under the second.

However, as one of the requirements of the planning regime is to ensure that land, once remediated, as a minimum, should not be capable of being determined as Part 2A “Contaminated Land”, the statutory definition under Part 2A does have an indirect, minor but recognisable impact on the treatment of land contamination under the Planning regime.

13.1.1 Role of number-based thresholds

The Statutory Guidance underpinning the Part 2A regime (Defra, 2012) is generally not prescriptive in how the regulator should undertake the first three, technical, stages of risk assessment that helps them evaluate whether land meets the definition of contaminated land instead directing the local authority to good practice guidance on risk assessment. However the Guidance does identify a role for generic assessment criteria (GAC) and proposes a new set of generic screening levels (which the associated the Regulatory Impact Assessment referred to as Category 4 Screening Levels).

Likewise the National Planning Policy Framework (DCLG, 2012) which sets out the Government’s planning policies for England and how these should be applied makes reference to the application of established procedures in the risk assessment process.

UK good practice technical guidance, such as CLR11 (Environment Agency, 2004), allows for but does not prescribe the use of number-based thresholds during the risk assessment process. These thresholds include:

Generic Assessment Criteria (GAC) for use as screening values to identify levels of contamination that do not warrant further consideration as they are negligible and highly unlikely to pose any appreciable risk; and

Site-Specific Assessment Criteria (SSAC) for use in more detailed risk assessment to estimate if the level of risk posed is significant and warrants intervention.

A non-statutory approach for deriving GAC has been published by the Environment Agency in the SR2 (Environment Agency, 2009b) and SR3 (Environment Agency, 2009c) guidance on toxicology and exposure assessment respectively. This approach has been the basis for the publication of a number of Soil Guideline Values (SGVs) and associated documents by the Environment Agency. Other organisations have also published robust GACs on a similar basis, e.g. Land Quality Management Ltd/Chartered Institute of

Environmental Health (LQM/CIEH) covers some 82 substances for which there is no SGV (Nathanail et al. 2009) and, for set of land uses that excludes the residential-with-homegrown produce, the Environmental Industries Commission (EIC) cover a further 35 or so substances. In addition, many organisations have produced (but not published) in-house GAC for their own use. Although in some instances it is not possible to assess the technical robustness of these in-house GAC as the supporting information is often not provided.

The Statutory Guidance (Defra, 2012) supporting the Part 2A regime makes specific reference to the use of generic assessment criteria (GACs), recognising their use as screening tools in generic quantitative human health risk assessment is common practice in contaminated land risk assessment. A footnote to the Statutory Guidance refers to GACs as the Soil Guideline Values produced by the Environment Agency (published in 2009/10 for a total of 11 substances); and other GAC produced on a similar basis by LQM/CIEH and the EIC using the Environment Agency's Contaminated Land Exposure Assessment (CLEA) Model.

The Statutory Guidance states that local authorities (the primary regulator under the Part 2A regime) may use GACs to inform certain decisions under the Part 2A regime providing that (i) they understand their derivation and how they can be used appropriately; (ii) they have been produced in an objective, scientifically robust and expert manner by reputable organisations; and (iii) they are only used in manner that is in accordance with the Part 2A regime and the Statutory Guidance.

Under the Part 2A regime GACs for human health should only be used to screen out low risk sites i.e. to indicate when land is very unlikely to pose a 'significant possibility of significant harm' to human health (a requirement to meet the definition of contaminated land) let alone have caused significant harm. The Statutory Guidance is clear in that GACs should not be used as (i) direct indicators of whether a 'significant possibility of significant harm' exists; or (ii) levels above which detailed risk assessment is automatically required; or (iii) generic remediation targets under the Part 2A regime.

Generic assessment criteria were always intended to be cautious and are normally calculated based on worst case or reasonable worst case assumptions. These values have been widely used to identify low risk sites where further action is not warranted. However, despite explicit guidance, they have also been used inappropriately by some consultants and Local Authorities as default remediation or clean-up criteria or levels above which land should be determined under the Part 2A regime. The recent revised Statutory Guidance (Defra, 2012) is much more explicit on the use of GACs and this

should prevent their inappropriate use in the Part 2A context and perhaps even under the planning regime.

In 2012 Defra commissioned research project SP1010 for the development of a methodology to derive Category 4 Screening Levels (C4SLs) for land contamination for use primarily in the Part 2A context. It is intended that these C4SLs will be less cautious than the currently published GAC but still highly precautionary and will be used to demonstrate that land poses a low level of risk and can be placed in Category 4: Human Health (Defra, 2012). The results of this project are due to be published in late 2013.

UK guidance recommends that decisions relating to the detailed inspection of land under the Part 2A regime and the development of remediation or clean-up criteria should be based on more detailed risk assessment, which may involve the calculation of Site-Specific Assessment Criteria (SSAC). SSAC are generally calculated in a similar manner to GACs but make allowance for site-specific parameters (clay content, pH, bioaccessibility, land use *etc.*) but also allow some of the conservatism in input criteria to be reduced and more realistic values to be adopted. However, it is still intended that SSAC values indicate the boundary of an acceptable level of risk. Consequently, such values are primarily useful in determining the need for remediation under the planning regime and the level of remediation required. Such values are generally of only limited assistance in determining statutory Contaminated Land under Part 2A, although they can inform decisions as to when land is not 'contaminated land'.

Other UK guidance recommends numeric thresholds for assessing the risks posed by land contamination to the water environment and other possible receptors, including (Environment Agency, 2006; Environment Agency, 2008a; Environment Agency, 2008b). It should be noted that for some contaminants these values may be more stringent than those for human health and may drive the need for remedial intervention.

13.1.2 Role of case-by-case decision making

While the use of generic and site specific assessment criteria is supported within UK guidance, the importance of pragmatic, professional judgement on a case-by-case basis is also accepted. In particular, it should be noted that GACs and SSACs are intended to be part of the risk estimation stage of the assessment process, which should be followed by a risk evaluation. This latter step should take account of the uncertainty within all aspects of the assessment and allow the application of experience, empirical knowledge *etc.* to arrive at a reasoned and supported decision on the need for any risk management at that particular site based on all site-specific factors and 'lines of evidence' available at the time the assessment is being made and in light of the legal context. For example, it

is generally accepted that remedial action may be warranted during redevelopment (planning regime) to provide certainty that the site could not be determined as Contaminated Land at a later date, and to satisfy the other planning policy requirements, even if there is little likelihood that the local authority could demonstrate that action under Part 2A is necessary.

13.2 Approach's effectiveness

Since 2000, the UK approach to contaminated land management has led to the remediation of many thousands of sites through private sector redevelopment efforts and a few hundred of statutory contaminated land sites. Historically the UK through the Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) was a pioneer in risk based approaches to the reuse of contaminated land. Promotion of this approach during the 1990s at fora such as the Ad Hoc working group on contaminated land and during the EU CARACAS network led to widespread adoption of risk based land management across Europe and beyond – though without the UK necessarily receiving the credit.

13.2.1 Proportionate

In general (see Section 13.2.3), the UK development industry consider the approach to land contamination under the planning system adopted by many local authorities as overly cautious and stringent. Indeed the Defra regulatory impact assessment for the then proposed changes to Part 2A reported that “20%-40% of current remediation work is ‘unnecessary’” (Defra 2011) This can be attributed, in part at least, to the inappropriate use by professional advisors appointed by developers of GACs as levels above which remedial or risk management intervention is required or indeed as remediation/clean-up criteria and a lack of regulatory confidence in the detailed quantitative risk assessment process fuelled by assessments and reporting that are not technically robust or compliant with the legislative requirements.

Likewise there has been criticism of the Part 2A regime and the approach adopted by some local authorities to its application, specifically around the inappropriate use of GACs. Defra observed that “In the past, some authorities have intervened at extremely low levels of contamination (where the health impacts and other costs of intervention are very likely to outweigh any demonstrable benefits). In some cases land has been determined at “normal” background levels of contamination, and if such decisions were applied nationally large parts of urban and rural England and Wales would be caught by the regime with hugely disproportionate effects.” (Defra 2011 para 29).

13.2.2 Targeted

Information collated by the Environment Agency for the period between 2000 (when Part 2A came into force) regime and 2007 (Environment Agency, 2009a) indicates that there have been approximately 650 determinations of land as contaminated land. Although care should be exercised in the use of this data as some of these are multiple determinations within a single area, e.g. individual properties within a residential estate.

However Government recognised in their consultation on the revisions to the Statutory Guidance (Defra, 2010) that the regime has not always been appropriately targeted with some of the sites determined as contaminated land appearing to pose only marginal risks and other sites where risks would appear to be greater not yet scrutinized under the regime.

13.2.3 Consistent

As with many branches of environmental regulation, there is a significant degree of variation in its implementation across the country. As contaminated land legislation (both Part 2A and planning) is implemented primarily by local authorities, this variation primarily reflects differences in local political influences, the arrangement of the relevant departments and the qualification, training, attitude to risk and experience of those implementing the legislation, . For example, some Councils employ dedicated Contaminated Land Officers who co-ordinate the authorities approach to both planning and Part 2A, and who are in general relatively experienced. In contrast other Councils rely on a generalist staff within a multidisciplinary department, normally Environmental Health, to take on contaminated land duties as required. This diversity of regulatory experience has led to sites being determined as contaminated land, some of which it has been suggested may not actually meet the statutory definition (e.g. small exceedance of an SGV).

Likewise there is variation within the planning regime between local authorities and sometimes even within local authorities with respect to the consideration of land contamination. There are many potential causes of this variation, including staff resources, staff skills and training, the internal consultation process and liaison with the Planning Department or it may be as a result of local influences underpinning Council policy on determination of applications. For example some local authorities located within regions where there are high levels of naturally occurring substances e.g. arsenic associated with the underlying geology have undertaken additional research to refine the approach considered appropriate in their area however others similarly affected have not done so.

13.2.4 *Transparent*

Most local authorities make their inspection strategy which should detail how they will go about identifying land as contaminated land and a requirement under the Part 2A regime readily available, generally by putting it on their website.

Under the Part 2A regime where land has been investigated and found not to meet the definition of contaminated land the local authority must issue a written statement to that effect. Where land has been investigated and the local authority concludes that it is likely that the land may be determined as contaminated land the local authority should produce a risk summary, explaining its understanding of the risks and other factors considered relevant. In accordance with the Statutory Guidance (Defra, 2012) the record of determination of land as contaminated land should be made publically available.

Under the planning regime most local authorities are making information more readily available on their websites or via the planning portal, the Government's online planning and building regulations resource for England and Wales. Increasingly local authorities are publishing Council decisions and minutes of Council or committee meetings together with the supporting information on their websites.

13.2.5 *Internal perception*

Note Section 13.7

13.2.6 *External perception*

The contaminated land regime of England is well known internationally. The UK has been a leading country in policy sharing fora such as the Common Forum (previously Ad Hoc working group) and networks such as CARACAS and CLARINET. UK expertise has been used to translate risk assessment protocols for the Basque Country and China.

Technical guidance from the Environment Agency is routinely used in Wales, Scotland and Northern Ireland as well as the Republic of Ireland. In these four countries, where no local policy guidance exists, reference is frequently made to the English equivalent. However the overall success of the UK approach to managing land contamination has not led to the take up of policy instruments with explicit recognition of their country of origin elsewhere. Recently Scotland has begun a process of reviewing its approach to risk assessment with a view to develop a specifically Scottish approach rather than continuing to mirror the approach in England, for example on the toxicological basis of human health risk assessment.

Sector led initiatives such as the LQM/CIEH GAC and the SURF-UK guidance have been warmly received – and in cases drawn from – in countries such as Australia and Japan.

Outside the EU, countries such as South Africa, Australia and New Zealand have variously adopted UK practices and guidance documents. However this is not to the same extent as documents and practices from the US EPA and the Netherlands have been adopted.

Overall external awareness of the effectiveness of the UK approach is limited to the detriment of the UK's contaminated land consultancy and remediation sector.

13.3 Estimate of scale

13.3.1 Estimates of the amount of potentially contaminated land

Most land contamination in England and Wales is dealt with via the planning system. Local authorities estimate that around 10% of contaminated sites are dealt with via the Part 2A regime (Environment Agency, 2009a).

In 2005 the Environment Agency had estimated that there might be around 300,000 hectares of land affected by industrial activity in England and Wales which may be contaminated (approximately 2% of the land area).

By the end of March 2007, 659 sites had been determined as contaminated land (including 35 Special Sites, sites which meet the designated criteria set out in the Contaminated Land (England) Regulations 2006 and where regulation passes to the Environment Agency). Care is required when considering this data as some of this number were multiple determinations on a single site. By this date, 145 of the contaminated sites had been remediated (approximately 22%).

13.3.2 Estimates of progress

By the end of March 2007 most local authorities in England had inspected less than 10% of their areas for contaminated land.

The 659 determinations in England were made by 74 local authorities (out of a total at that time of 375).

13.4 Deciding who pays

The Part 2A regime was implemented based on the 'Polluter pays' principal and with a carefully thought out but complex process for apportioning liability for remedial works. The main provisions for the establishment of liability are set out in the legislation i.e. Part

2A of the Environmental Protection Act 1990 with more detailed guidance on the procedure for determining, apportioning and attributing liabilities provided in the Statutory Guidance. It is clear that financial liability for any required remediation for each significant contaminant linkage lies with persons “who caused or knowingly permitted” the contamination. The Statutory Guidance refers to these as Class A “Appropriate person(s)”. Where a Class A Appropriate Person cannot be found the liability passes to the owner/occupier i.e. “the Class B Appropriate Person” (except in the cases of linkages that rely solely to the pollution of controlled waters). The persons responsible make up a liability group for that significant contaminant linkage. However, there are also a number of situations where an appropriate person may be exempted from liability. These include liability arising from water pollution caused by an abandoned mine, persons “acting in a relevant capacity” (e.g. insolvency practitioners *etc.*). For each pollutant linkage involved, the identified appropriate persons can be arranged into “Liability Groups”. If no Class A or Class B persons can be found liable for a linkage that linkage becomes an Orphan Linkage which may result in the local authority, or the Environment Agency for special sites, bearing the costs of remediation (although this is more complicated where there are two or more significant contaminant linkages and some of these are orphan linkages).

However, there are a number of Exclusion Tests contained within the Statutory Guidance which are applied in a prescribed order. For a Class A Person these tests include:

Test 1 “Excluded activities”, which exclude parties who have only marginal responsibilities. This includes banks, insurers, regulators and consultants previously involved with the site, owners who are licensing or leasing the land to the party who caused or knowingly permitted the pollution, or others who provided goods or services (including employees) at the site.

Test 2 “Payment made for remediation”, which is intended to exclude those who have previously met their obligation by making certain types of payment in kind (e.g. land transfer agreements that accounts for likely remedial costs).

Test 3 “Sold with information”, which excludes a seller if the buyer was aware of the contamination at the time of the sale.

Test 4 “Changes to substances”, is designed to exclude parties who released innocuous substances that later react due to the releases of a second part to create the source of the pollutant linkage.

Test 5 “Escaped substances”, under specific circumstances, those whose land was contaminated as a result of substances escaping from another site are excluded from liability.

Test 6 “Introduction of pathways or receptors”, which excludes people who are only liable due to pathways or receptors subsequently introduced by others.

There are separate tests for the exclusion of members of a Class B liability group aimed at excluding those who do not have an interest in the capital value of the land. However the tests should not be applied if it would result in the exclusion of all members of the liability group.

Although these rules govern the apportionment of liability, they do not necessarily relate to the actual cost each Appropriate Person will eventually pay as some may have applicable insurance cover in place.

13.4.1 ‘Polluter pays’ principle

The UK has always relied on the ‘Polluter pays’ principle as a cornerstone to its environmental legislation; and it has continued to be a fundamental component of the Part 2A regime, where Class A Appropriate person is intended first and foremost to apply to the “polluter”.

In cases of historic pollution, the original polluter can be very hard to identify or may no longer exist. Furthermore, many polluters have subsequently sold their contaminated sites, either with payments for remedial costs or with information, and so may no longer be liable under Part 2A.

There are few case laws relevant to the Part 2A regime but the Bawtry Gasworks Case (House of Lords: National Grid Gas plc (formerly Transco plc) vs Environment Agency June 2007) is important in that the Courts held that British Gas (and later companies such as Transco) who have not occupied a site could not be held liable for contamination which had occurred at the site during its operation by the East Midlands Gas Board prior to privatisation and take over by British Gas in 1986.

Finally, some historic polluters took significant steps to minimise their liability to the regime, both before and following its implementation. This includes placing contaminated land assets in separate legal entities, which either minimise the financial exposure of the parent company or allow them to be selectively sacrificed creating orphan sites.

13.4.2 *Liability of the state*

13.4.3 *Liability of the owner/ occupier*

Liability can only be attributed to the innocent owner/occupier (*i.e.* Class B persons) under certain specific circumstances, most importantly where no Class A person can be identified. Consequently, this does not result in contravention of the “polluter pays” principle. Furthermore, there are additional exclusion tests for Class B persons designed to exclude parties that do not have an interest in the capital value of the land in question.

13.4.4 *‘Orphan’ sites*

The Part 2A Statutory Guidance goes further than orphan sites and considers “orphan linkages”, which may arise where: (a) the significant contaminant linkage relates solely to the significant pollution of controlled waters (and not to significant harm) and no Class A person can be found; (b) no Class A or Class B persons can be found; or (c) those who would otherwise be liable are exempted by one of the relevant statutory provisions (*i.e.* sections 78J(3), 78K or 78X(3)).

The enforcing authority will bear the cost of any remediation carried out to deal with an orphan linkage, or indeed entire sites where all of the linkages are orphan.. It is likely that such sites will be funded indirectly by central government in most cases.

13.4.5 *Role of state funding*

Even before the introduction of the Part 2A regime Defra have made funds available for dealing with potentially contaminated land to local authorities and the Environment Agency who bid for the monies.

In the financial year 2009/10 Defra made £17.5million available via the Contaminated Land Capital Grants Programme for dealing with capital projects (including site investigations and remediation and excluding preliminary works such as desk studies, site reconnaissance) under the Part 2A regime. By 2013/14 this has dropped significantly to £2million per annum. The Programme will effectively close in 2017 (Defra 2013).

In 2012/13 the Capital Grants Programme received 86bids from local authorities and the Environment Agency (for Special Sites) to the total value of £10.7million, significantly exceeding the available budget. Eighty one bids were deemed eligible and the total value of works approved in principle was £6.6million. The Environment Agency used their prioritisation tool to allocate the available funds resulting in the funding of 49 projects.

13.5 Contaminated land sector

Some data is available on the size of the contaminated land sector (*i.e.* the assessment and remediation of contaminated land) in the UK. Although it is difficult to verify such estimates.

13.5.1 Size

A widely cited market review by MBD provides estimates of the UK market for 2004 through 2008, which range from £356.1 million to £446.1 million. Between 2004 and 2007 there was on average a 8.25% increase in the market value. However, due to the economic downturn and the major impact on redevelopment, there was negligible growth in 2008. Forecasts presented in the report indicate that growth in the sector was expected to commence in 2011 but with annual increases of only ~2% over the forecast period (2009-2013). More recent signs suggest that the land contamination has continued to reduce in size with prices softening as well.

13.5.2 Main drivers

By far the greatest driver for contaminated land assessment and remediation in the UK is redevelopment. This drive has been supported by government targets and incentives that promote the redevelopment of “previously developed land” (PDL), this does not always relate to derelict sites, ahead of “greenfield” sites.

The Part 2A regime, however, should not be discounted as an insignificant influence. As its retrospective remit has served to significantly enhance the consideration of contaminated land issues by all parts of the redevelopment industry (planning authorities, developers, land owners and consultants *etc.*). There have also been a considerable number of determinations under the Part 2A regime, which have contributed to the further development of contaminated land assessment and remediation experience in the UK. The lack of direct impact of the Part2A regime, is partly an intentional consequence of the statutory and other guidance produced under the regime, which specifically promotes the use of the Planning regime and voluntary action to address contaminated land issues whenever possible. This was intended to minimise the impact on the public purse and on liable parties for instance by using the profits from redevelopment to fund remedial actions in most cases.

13.6 Attributing financial liability

The attributing of financial liability is a fundamental part of the Part 2A legislation but under a redevelopment scenario it is assumed that adequate due diligence procedures *etc.* ensure that financial liabilities are dealt with via normal market processes.

13.6.1 Approach

As many sites determined under Part 2A are expected to have complex histories and ownership arrangements *etc.*, the arrangements for attributing financial liability under the regime are likewise complex.

A multi-stage iterative process is then used to assign all or parts of the total remedial costs. The first step in this process is to make “reasonable enquiry” in order to identify the relevant Appropriate Person(s) for each pollutant linkage. The second step involves identifying all the “Remediation Actions” (*i.e.* individual tasks) that are required to adequately manage all the pollutant linkages. The third step requires the remediation actions to be allocated to the relevant Liability Group(s) and the fourth step that the relevant costs are apportioned between the members of that Liability Group (*i.e.* the appropriate persons) based on the “relative responsibility” of each party.

13.6.2 Success

Most remediation has been paid for by private sector developers or public regeneration bodies (notably English Partnerships and its successor Homes and Communities Agency) through the planning regime or the public sector using public funds. As such very few sites have been remediated as a result of remediation notices served on third parties. Some larger organisations have gone through a programme of voluntary remediation to avoid regulatory intervention.

Legal challenges of liability have been made. While a high profile early case involved a House of Lords decision against the regulator, a more recent case found in favour of the regulator.

Overall therefore the regime has had some success in apportioning liability to those who caused or permitted the problem to arise but has had much greater success in encouraging organisations to undertake voluntary remediation.

13.7 Success of the regime

The implementation of the Part 2A regime is generally considered to have had an impact on how land contamination is addressed in the UK. However, as intended, this has

mainly been an indirect effect. Although some sites have been assessed and dealt with by Local Authorities using Part 2A legislation, its influence has been far more wide ranging and has had a particular influence on the consideration of land contamination under the Planning regime.

Although there has been considerable criticism of the Part 2A regime both from Local Authorities and the Contaminated Land industry, this criticism has mainly been aimed at the implementation of the regime (particularly issues relating to the applicability of the Statutory Guidance, slow progress in publishing appropriate Soil Guideline Values and the exact definition of “significant possibility of significant harm”) rather than at the primary legislation itself.

13.7.1 *Positives*

The implementation of the Part 2A regime is generally considered to have raised the profile of contaminated land issues in the UK, to have boosted the capabilities and professionalism of the contaminated land industry and to have provided a route of last resort in dealing with sites where contamination may result in a significant impact on local residents, the water environment and property *etc.*

The potential for prosecution under the regime provides a driver for good practice with respect to land contamination issues within the redevelopment industry. This has “raised the Game” of developers and their advisors, planners and other regulatory staff involved in approving and policing the development process. This has also meant that there has been some improvement in the level of competence of those within the major consultancies employed to provide advice to both sides. However, this does not mean that all the historic shortcomings of the contaminated land industry have been done away with, as the competitive nature of the development industry means that “lowest bidder” policies can still result in poor quality work by inexperienced or unprofessional operators.

It is generally accepted that the Part 2A regime gives the Local Authorities and, in the case of special sites, the Environment Agency, a legitimate tool to deal with our potentially hazardous industrial heritage, where previously there had been only ad hoc arrangements under statutory nuisance provisions. Furthermore, the balance between cost and effect that the regime tries to maintain is generally appreciated. To date the regime has been used successfully at well over 1000 sites.

13.7.2 *Negatives*

There has been considerable criticism and complaint regarding the implementation of Part 2A regime at both local and national levels, and this has led to a succession of changes and publications that attempted to address these issues.

Some enforcing authorities and their consultants seem to have struggled to grasp the potential magnitude of Part 2A decisions and the considerable complexity and multidisciplinary nature of contaminated land assessment and management.

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APPENDIX 14 USA

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14. United States of America (USA)

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The United States of America (USA) legal system comprises federal, state and local legislation. At the local level different bodies have responsibility for water, land use planning and other aspects. The borders of administrative authorities below state level do not necessarily either coincide or aggregate. This means that at the site level there could be several different regulatory bodies with varying degrees of spatial overlap. Here we have mainly considered only country-wide federal legislation dealing with contaminated land. The principal federal laws relevant to land affected or perceived to be affected by contamination are:

The Comprehensive Environmental Response, Compensation, and Liability Act, 1980 (CERCLA), which is commonly referred to as “superfund”. The original legislation was modified and updated by the Superfund Amendments and Reauthorization Act of 1986 (SARA). Superfund legislation provides a mechanism to fund the long-term clean-up of hazardous waste sites on the National Priorities List (NPL). It performs a similar function to Part 2A of the Environmental Protection Act, 1990. Superfund is administered at a federal level by the US Environmental Protection Agency (US EPA). The US EPA is organised into ten regions covering the country, including dependent territories and the District of Columbia.

- a. The Resource Conservation and Recovery Act, 1976 (RCRA) governs the disposal of [solid](#) and [hazardous wastes](#). RCRA applies to the management of current waste generation, while CERCLA in general applies to historic contamination. However, both pieces of legislation contain provisions to require ‘cleanup’ of historic contamination. RCRA also covers the licencing of land treatment units.
- b. The Safe Drinking Water Act (SDWA) was passed by Congress in 1974 (and amended in 1986 and 1996) to protect public health by regulating the nation's public drinking water supply. It requires action to protect drinking water and its sources: rivers, lakes, reservoirs, springs and groundwater wells. It requires the US EPA to set Maximum Contaminant Level Goals (MCLG) and Maximum Contaminant Levels (MCL) for natural and manmade contaminants.
- c. The Small Business Liability Relief and Brownfields Revitalization Act, 2002, commonly known as the “Brownfields Law”, amends and clarifies the requirements of CERCLA. Significantly it makes provision for the US EPA to provide grants and

assistance at the local level to remediate and enable the reuse of formally declared brownfield sites.

State laws cover sites that do not come under CERCLA or RCRA. Many states have laws to secure the remediation of leaking underground storage tanks. Many brownfield programs are administered through the State.

Civil actions are also used by plaintiffs to remedy their loss. High profile cases have been the subject of popular films:

- a. *A Civil Action* recounts the case of a group of residents seeking compensation from a premier specialty chemicals and materials company. It is based on a journalist's account of the case (Harr 1996).
- b. Hexavalent Chromium pollution of groundwater in the Mojave Desert town of Hinkley, California, resulted in a legal case and a multi-million-dollar settlement made famous by the 2000 *Erin Brokovich* film.

14.1 The boundary between “contaminated” and “not contaminated”

There is no specific definition of “contaminated” land or sites under CERCLA. Under Section 105(a)(8)(B) of CERCLA as amended, sites with known, or threatened, releases of hazardous substances, pollutants, or contaminants throughout the United States are awarded superfund status if they fulfil statutory criteria based on the Hazard Ranking System (HRS). Once potential sites are identified by the US EPA, a Preliminary Assessment/Site Inspection is conducted (analogous to a Phase 1 desk study and site reconnaissance visit). Based on the information obtained, risks to human health and the environment are assessed using the HRS; a score of 28.5 warrants inclusion on the NPL. The US EPA reports that “The HRS uses a structured analysis approach to scoring sites. This approach assigns numerical values to factors that relate to risk based on conditions at the site. The factors are grouped into three categories:

- a. likelihood that a site has released or has the potential to release hazardous substances into the environment;
- b. characteristics of the waste (e.g. toxicity and waste quantity); and
- c. people or sensitive environments (targets) affected by the release.

Four pathways can be scored under the HRS:

- a. ground water migration (drinking water);

- b. surface water migration (drinking water, human food chain, sensitive environments);
- c. soil exposure (resident population, nearby population, sensitive environments); and
- d. air migration (population, sensitive environments)."

These sites are listed the National Priorities List (NPL). The [US EPA](#) is at pains to point out that *"Inclusion of a site on the NPL does not in itself reflect a judgment of the activities of its owner or operator, it does not require those persons to undertake any action, nor does it assign liability to any person. The NPL serves primarily informational purposes, identifying for the States and the public those sites or other releases that appear to warrant remedial actions."*

At these sites, a Remedial Investigation/Feasibility Study is then undertaken (analogous to a Phase 2 site investigation, risk assessment and Phase 3 Options appraisal). The outcome of this process is documented in a formal Record of Decision (ROD). This may conclude that no action is required, or specify preferred remedial option(s) for the site. RODs are legally binding documents which usually take a long time to agree and are therefore difficult to deviate from. Some RODs (for example that at Test Area North at the Idaho National Laboratory) are acknowledged to have been written with a welcome degree of flexibility to allow for new developments in technology and/ or scientific knowledge.

14.1.1 Role of number-based thresholds

The US EPA has developed the PREscore software to assist the HRS and ensure decisions are uniform and well documented. However, this system is not primarily based on number-based thresholds for environmental contaminant concentrations.

At the Federal Level the US EPA has published guidance to develop Soil Screening Levels (SSL) to be used under CERCLA within a tiered risk assessment framework much like the UK Soil Guideline Values and other equivalent generic assessment criteria (See Appendix 13). The generic SSL are based on a target cancer risk of 10^{-6} and a hazard index of 1.

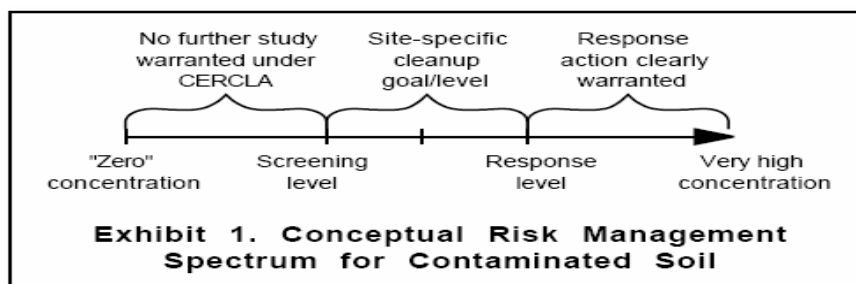


Figure 1 Soil screening levels below which no further action or study would be required

ITRC (2005) reported that State “Screening values, intended to be protective of human health and/or the environment, are often defined as chemical concentrations in environmental media below which no additional regulatory attention is warranted.”

The “Risk assessment guidance for Superfund” series (RAGS) contains overarching guidance relating to risk assessment during the Remedial Investigation/Feasibility Study phase. Part B of this series describes a process for the derivation of risk-based preliminary remediation goals (PRGs), which are intended to “provide remedial design staff with long-term targets to use during analysis and selection of remedial alternatives” <http://www.epa.gov/oswer/riskassessment/ragsb/index.htm>. Based on this guidance, several US EPA regions have previously published regional generic thresholds for a variety of contaminants, including Region 3’s Regional Screening Values (covering Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia), Region 6’s Human Health Medium-Specific Screening Levels (covering Arkansas, Louisiana, New Mexico, Oklahoma, Texas) and Region 9’s Provisional Remediation Goals (covering Arizona, California, Hawaii, Nevada and the Pacific Islands). Since 2008, the work by these three regions has been harmonised by DOE’s Oak Ridge National Laboratory to generate single Regional Screening Levels (RSLs) http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.

14.1.2 Role of case-by-case decision making

Although generic RSLs are available, the RAGS guidance is clear that risk assessments should be site-specific and that decisions on what, if any, remedial intervention is required should take all the circumstances of the site into account.

14.2 Approach’s effectiveness**14.2.1 Proportionate**

The US EPA prefers cleanup – that is remediation to a standard which permits unrestricted use and unlimited exposure (UU/UE). Five-Year Reviews generally are required by CERCLA or program policy when hazardous substances remain on site above levels which permit unrestricted use and unlimited exposure (US EPA 2013c). While remediation of brownfields are driven by ensuring suitability for use and carried out in an expedited fashion, Superfund remediation can be very long term and to standards that are achievable rather than necessarily necessary.

14.2.2 Targeted

CERCLA is targeted on sites that exceed a HRS threshold of 28.5. Generally sites on the NPL have obviously high potential for land contamination: landfill sites, major industrial facilities, military installations. Given the size of the USA and its long track record, the relatively small number of sites on, deleted from or proposed to be added to the NPL (Table 14-1) suggests the system is effective are targeting high priority sites.

Table 14-1 Federal and general sites for each status and milestone as of 24 May 2013
(<http://www.epa.gov/superfund/sites/npl/>)

1. Status	Non-Federal (General)	Federal	Total
Proposed Sites	50	4	54
Final Sites	1163	157	1320
Deleted Sites	348	17	365
Milestone	Non-Federal (General)	Federal	Total
Partial Deletions	41	17	58*
Construction Completions	1074	71	1145
Sites that have achieved these milestones are included in one of the three NPL status categories.			
* 75 partial deletions have occurred at these 58 sites.			

14.2.3 Consistent

Inevitably in a country the size of the USA and an organisation the size of the US EPA, consistency is virtually impossible to achieve. However tremendous resources are put into training, information dissemination and transparency to try and ensure all have access to the relevant guidance, tools and skills. The series of online training delivered through the Interstate technology and Regulatory Council (<http://www.itrcweb.org/>) and the regular US EPA CluIn email bulletin are two excellent examples of efforts to ensure consistency.

14.2.4 Transparent

One of the strong points of the US approach is the very high degree of transparency concerning CERCLA sites. During annual visits to the USA the author has taken groups to visit Regional EPA offices and archives and to participate in well attended public meetings of on-going remediation projects. The web sites of each US EPA Region contain full details of each site on the NPL with full copies of reports and where relevant monitoring data. Public meetings are held to brief local residents on progress. These can be fairly technical in detail and the US EPA provides Technical Advice Grants (TAG) to local groups to ensure they have independent technical insight into the details of site work.

14.2.5 Internal perception

While many within the USA recognise the significance and success of pioneering work in site characterisation and remediation, there is a growing body of opinion that past

practices may no longer be justifiable or even affordable. The National Research Council, an arm of the National Academy of Sciences (NAS), concluded that *"Despite nearly 40 years of intensive efforts in the United States as well as in other industrialized countries worldwide, restoration of groundwater contaminated by releases of anthropogenic chemicals to a condition allowing for unrestricted use and unlimited exposure (UU/UE) remains a significant technical and institutional challenge. Recent (2004) estimates by EPA indicate that expenditures for soil and groundwater cleanup at over 300,000 sites through 2033 may exceed \$200 billion (not adjusted for inflation), and many of these sites have experienced groundwater impacts"* (National Academy of Sciences 2012). In contrast the European Environment Agency (2012 p8) claimed that in 2009 80% of 13,000 European groundwater bodies had good chemical status and predicted this would be some 89% by 2015.

Industry has been accused of seeking to dilute the impact of federal law. Investigative journalists claim that some

14.2.6 External perception

The USA, and US EPA specifically, is globally acknowledged to be a source of reliable and authoritative guidance and tools. This is a combination of a long standing tradition of both funding high quality regulatory science and making the results widely and freely available both in hard copy and online thereby facilitating both access and outreach.

Federal organisations (e.g. US EPA, DoD, DoE) have funded the development of new site characterisation (e.g. Rapid Optical Screening Tool (ROST); Laser-Induced Fluorescence (LIF);) and remediation techniques (e.g.) has added, if not largely stocked, the global arsenal of techniques.

However there is also a realisation that what may be possible or even desirable in the USA may not be elsewhere. For example the UK did not enshrine joint and several liability in its contaminated land legislation (Appendix 13).

14.3 Estimate of scale

A recent review of the USA remediation sector estimated its size to be ca \$8B in 2012 (Environmental Business International 2013).

14.3.1 Estimates of the amount of potentially contaminated land

The USA has an established programme of identifying potentially contaminated land. "As of September 2011, EPA's programs for assessing and cleaning up contaminated lands track roughly 22 million acres of land across the United States, or nearly 1% of the entire U.S. land mass" (US EPA 2013d p95).

14.3.2 *Estimates of progress*

As of October 2012, there were 1,676 sites on the NPL (US EPA 2013a,b). However, in May 2013, the US EPA added another 9 sites to the NPL and named 9 further candidate sites. Remediation has commenced at 68% of sites and 36% are ready for reuse (but not necessarily complete).

14.4 Deciding who pays

14.4.1 *‘Polluter pays’ principle*

CERCLA is very much based on a “polluter pays” principle. The US EPA have stated that ensuring that Potentially Responsible Parties (PRPs) pay for cleanup is one of their top priorities. Cleanup is either carried out by the PRP under EPA supervision, or by the EPA with the legal action to recover costs. However, provisions are made for funding the cleanup of “orphan sites” (i.e. sites where the potentially responsible parties cannot be identified or located, or when they fail to act).

14.4.2 *Liability of the state*

Many sites on the NPL are Federal facilities – owned and/ or operated by the Departments of Defense (DoD) or Energy (DoE). Since the Superfund tax was allowed to expire in 1995 and ran out of funds in 2003, the US taxpayer has been paying for abandoned or orphaned sites.

14.4.3 *Liability of the owner/ occupier*

Since 2002, landowners who meet the criteria of a bona fide prospective purchaser, innocent landowner, or contiguous property owner are protected from Superfund liability. Current owner-operators and past owner-operators who caused pollution are not exempt and indeed are subject to joint and several liability.

14.4.4 *‘Orphan’ sites*

The epithet “superfund” relates to the original trust fund established under the 1980 Act, which accumulated funds from a tax on the petroleum and chemical industries. This fund was intended to pay for the remediation of orphan sites. The tax ended in 1995 and the accumulated funds were spent by 2003. Since then the costs of remediating orphan sites has been funded by the US EPA from general taxation. In 2012, these costs reached \$ 625 million.

The President of the United States considered restoring the tax in 2011 with a potential revenue of \$1B. In their budget for Financial year 2014, the US EPA have again called for the restoration of the tax. In May 2013 the Acting Administrator of the US EPA repeated a call to reinstate the Superfund tax. This has not been universally welcome.

The American Petroleum Institute (API undated) pointed out that “Reinstatement of expired Superfund taxes is not necessary because responsible parties continue to pay for more than 70 percent of clean-ups, according to the U.S. Environmental Protection Agency.”

14.4.5 Role of state funding.

Stimulus funds provided a boost to many State brownfield programs. However recently California’s incoming Governor announced the closure of long standing redevelopment agencies and enterprise zones – a decision described as “a guarantee that contaminated land in areas where economic activity is light will remain unassessed and unremediated for a long time”

The FY 2014 US EPA budget contains provision for spending \$1.18 billion on Superfund cleanup and has called for the reinstatement of the Superfund Tax to fund further works. (US EPA 2013b). Total spending on all land cleanup programs is \$1.34 billion.

14.5 Contaminated land sector

14.5.1 Size

In a 2012 review, the US National Research Council (NRC) reported at least 126,000 sites across the U.S. have contaminated groundwater that requires remediation. The NRC study estimated that about 10 percent of these sites are so "complex" that restoration is unlikely to be achieved in the next 50 to 100 years due to technological limitations. The estimated cost of complete cleanup at these sites ranges from \$110 billion to \$127 billion. Speaking at the June 2013 Battelle Bioremediation conference, the study’s lead author stated that the figures for both the number of sites and costs are likely underestimates. EBI (2013) quote a headline \$8B of revenues in 2012 for the US remediation sector.

14.5.2 Main drivers

The main driver historically has been to avoid or manage liability under CERCLA and RCRA. However more recently the attention is switching to more conventional brownfield redevelopment projects. Indeed many formerly unusable Superfund sites are being brought back into beneficial reuse. The former Bourne Chemicals site in New Jersey is now a much sought after waterfront development. Many closed landfills have had photovoltaic generation schemes installed (so called brightfields).

14.6 Attributing financial liability

14.6.1 Approach

Superfund adopts a 'joint and several' liability approach. This means that any responsible party could be liable for all the costs however small their contribution to the problem may have been.

14.6.2 Success

Technologically the USA has been at the forefront of most remediation technology developments and introductions to the market place. Its contractors and consultants are leaders in most fields in contaminated land management. However all too often remediation is carried out for little or even no tangible risk reduction and there is a reluctance to close projects. This has not been a serious issue while the economy was strong and private sector PRPs were able to offset costs against other profitable parts of their business or see such expenditure as reputation management costs. Federal organisations (DOD, branches of the armed forces, DOE) have also been able to spend with largesse across the USA until relatively recently.

14.7 Success of the regime

14.7.1 Positives

The USA has pioneered many of the technologies used around the world to characterise and remediate soil and groundwater contamination. This has both helped their internal efforts and created huge export opportunities for US consultants and contractors.

14.7.2 Negatives

Perhaps as a result of their pioneering work or perhaps due to unrealistic expectations of what can be achieved and it is reasonable to achieve the USA has embarked on remediation projects 'just because' they can. However in recent years the move towards reusing brownfields and even bringing superfund sites back into use has shown that an absolute focus on total clean up is not practical.

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