



**Smarter Regulation of Waste in Europe  
(LIFE13 ENV-UK-000549)  
LIFE SMART Waste Project**

Action B6 – Recommendations Report:

**Assessment of Financial Indicators to  
Detect Waste Crime**

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# 1 Introduction

This report collates the results of Phase 1 & 2 of the LIFE SMART Waste Project completed for SEPA and examines the extent to which financial indicators can be used to detect waste crime. Where identified, discussion then focuses on their development and feasibility of use and associated implications in regulatory practice. An outline proposal for the final stage of this research in Phase 3 is then explained.

Development and the product of Phase 1 provide a review of the research literature that examines the availability and use of financial indicators to predict and/ or detect the likelihood or activity of waste crime. A wide range of research sources are examined for this purpose. In parallel with this research, a series of interviews examined awareness of indicators of waste crime with sector experts.

Phase 2 of the research programme reviews the output from Phase 1 and discusses the implications of the findings to provide recommendations to address 2 objectives:

- Analysis of information collected in Phase 1 to produce a report outlining the potential range of tools and techniques (Section 0).
- Assess the feasibility and applicability of these approaches for use by environmental authorities specifically dealing with the issue of how these techniques could be used by officers who are not trained in financial investigation approaches (Section 5).

Using a process of research review within a workshop setting the project team synthesised the findings from the two work programme elements to conclude their recommendations (Section 6).

In reaching these recommendations, the project team is mindful of the original project aim, i.e. to develop a model that employs financial indicators to predict and or detect waste crime. However, the team is also mindful of the need for this model to be useable by the regulator on a day-to-day basis. Therefore the logical conclusions reached reflect both a synthesis of evidence as well as recognition of the practical implications that directs the project to Phase 3 – the model development.

## **2 Phase 1 - Literature review**

### **2.1 Introduction**

This report provides a review of the academic literature and other appropriate sources of information, relating to the use of financial investigation approaches, tools and techniques in relation to waste crime. A key aspect of this research is to identify whether such information exists and where it is available, to then assess how these findings can be applied to address waste crime activities, including for example; the abandonment of waste through poorly managed and failing business operations and deliberate criminal waste management activities.

From the initial scope defined in Section 2.2 the review outlines two stages; an initial stage that uses a series of keywords related to review the characteristics and incentives for waste crime. This uses search terms including, 'waste crime', 'fly-tipping' and 'illegal waste' in Sections 2 and reports the findings of this in Sections 3-4.

Section 5 then considers the extent to which financial indicators are readily available, evident in other sectors, in use or can be adopted from other sectors. The objective is to identify whether indicators are available to determine the likelihood of crime taking place, or there being a high likelihood of it taking place in future. The report is structured in this manner to discriminate between the properties of waste crime and the use of indicators of crime and the opportunity to use these.

### **2.2 Scope**

The review of academic and other literature sources covered the following areas:

- waste crime categories and sector patterns
- economic patterns of waste crime behaviours
- understanding business drivers, behaviours and motivations for waste crime
- financial tools and business modelling techniques applied to waste crime investigations
- innovative approaches to environmental and waste crime investigations
- evaluations of waste crime initiatives.

The overarching aim of this project is to identify business and financial models that lead to non-compliant waste management practices occurring. This will allow a pro-active approach to be taken in assessing waste-related activities to identify those that at greatest risk of poor performance, those where the business model or market is not robust or resilient and those with weak financial and financing positions.

An objective of the project is to, "pilot the use of a proactive financial investigatory approach in the early-stage identification of waste crime offending so that prevention and interventions are designed to deter and divert potential offenders from illicit behaviour." This review addresses the specific objectives to:

1. identify any literature, publications, academic studies and research available on financial investigation techniques and approaches, including the use of professional expertise, knowledge and networks
2. assess the applicability and feasibility of incorporating these approaches in a risk based tool to assess waste management activities. A key component of the project will be to identify tools and techniques that can be used by regulatory officers and are not restricted under the law only to "authorised" officers
3. identify the tools and techniques that are applicable for use by non-specialists

4. develop a financial investigations tool for use by environmental authorities with associated guidance and training documents
5. develop indicators of failing or criminal waste management activities
6. pilot the use of the tools developed in a case study example.

## 2.3 Search strategy

The literature search was carried out on four databases, Scopus, Web of Science, Environment Complete and ABI/Inform Complete for published papers from 2005 to 2016. The keywords “waste crime”, “fly-tipping” and “illegal waste” were used in the search. The search yielded 387 records from the four databases, of which 169 were duplicates.

A search of the so-called “grey literature” was also carried out on Google using the keywords and the names of relevant organisations.

After discussion with SEPA Project Advisory Panel, this approach was then extended to include the original research database and grey literature sources, referred to in Section 2.5, based on the following search terms and a synthesis of these terms:

- indicators of criminal behaviour
- financial indicators of criminal behaviour
- indicators of waste crime
- financial indicators of waste crime

## 2.4 Literature review findings

The academic literature focuses mainly on the characteristics of waste crime. Our review indicates that there is little academic research on the use of different financial indicators or tools and techniques for waste crime related activities. However, as part of this project we will be interviewing those who assess business and financial cases on a routine basis to understand what approaches they take and why.

The importance of waste crime, including the abandonment of waste, has been widely recognised as a major business, social and public policy issue as evidenced by a number of government consultations and reports on this topic in Scotland, Wales and England. In the sections below, we discuss the financial and business drivers of waste crime and the means of addressing them.

### 2.4.1 Drivers of waste crime

A recent Defra consultation defines waste crime in three categories (Defra, 2015):

- violations of permit conditions or other illegal acts by operators who are already part of the regulatory system
- acts that would be illegal whether or not the perpetrator is within the regulatory system
- acts committed by offenders outside the regulatory system.

In addition, in a report for the Environmental Services Association Educational Trust (ESAET), (Eunomia Research & Consulting, 2014) observes that:

*“...waste crime is at root economic in character, [and that] the factors which lead people to commit waste crime are fundamentally concerned with the costs and benefits of criminal activity” (pp.28)*

Three factors associated with these costs and benefits are said to lead to criminal activities:

- profits from waste crime can be significant

- the perception of the likelihood of enforcement action being taken is low
- the perception that the cost of enforcement action is unlikely to outweigh the revenue gained from the crime.

The analysis by Eunomia indicates that waste crime costs the UK economy £568 million a year.

According to Defra (2015), in addition to fly-tipping, waste crime includes illegal waste sites that operate without an environmental permit or registered exemption, the deliberate miss-description of waste linked to landfill tax evasion, and the illegal export of waste. However, Eunomia notes that the Environment Agency makes a distinction between dumping on a large scale, or of hazardous materials, or where organised criminal activities are involved and fly-tipping of smaller scale illegal deposits where these are typically dealt with by local authorities.

Waste crime activities have a wide range of impacts as summarised in Table 1.

**Table 1. The actors impacted by waste crime activities**

Actors	Impacts of waste crime
<b>Legitimate waste operators</b>	Undercuts their business
<b>Government</b>	Reduces tax income through evasion of landfill tax, VAT and corporation tax
<b>Local environmental impacts</b>	Health, nuisance, amenity and environmental impacts
<b>Other countries</b>	Health and environmental impacts if illegally exported waste is processed in inappropriate ways
<b>Government agencies or individuals</b>	Removal and clear up costs

Source: Adapted from: Eunomia Research & Consulting (2014)

It is also reported that waste crime is increasingly associated with organised criminal gangs (Eunomia Research & Consulting, 2014).

News stories about waste crime indicate that typically these activities involve small companies, as shown in Table 2.

**Table 2. Indicative list of waste crimes and company sizes**

Waste crime	Company type	Company size	Reference
<b>Illegal burning of waste (no licence)</b>	Skip Hire	SME	(Commercial Motor, 2011)
<b>Operating illegal waste site (no licence)</b>	Skip Hire	SME	(Commercial Motor, 2005)
<b>Burial of asbestos on own land</b>	Skip Hire	SME	(Commercial Motor, 2010)
<b>Illegal burning, storing and treatment of waste (no licence)</b>	Skip Hire	SME	("Huge fine for waste racket," 2005)
<b>Operating illegal waste site (no licence)</b>	Skip Hire	SME	(Commercial Motor, 2012a)

Waste crime	Company type	Company size	Reference
<b>Operating illegal waste site (no licence)</b>	Skip Hire	SME	(Commercial Motor, 2012b)
<b>Operating illegal waste site (no licence)</b>	Skip Hire	SME	(ENDS Report, 2009)
<b>Illegal disposal of waste to land (fly tipping)</b>	4x companies (transport, construction and tipper hire)	All SMEs	(ENDS Report, 2010a)
<b>Illegal waste handling (stockpiling of waste on own site)</b>	Caravan site	SME	(ENDS Report, 2010b)

Money is made through the avoidance of costs, including landfill tax that would be incurred if legitimate disposal routes were used. Although it would appear to be largely SMEs that are carrying out the illegal activities there is evidence that some do handle material from large companies or public sector organisations and that on occasions illegal waste goes back into legitimate waste handling activities.

Based on the findings of the Eunomia Research and Consulting Report 2014 and from personal communications there are a number of indicators and issues that require further investigation to determine their significance. These include:

1. the level of resourcing of the regulatory authorities and agencies to identify and investigate illegal waste activities
2. difficulties in identifying illegal waste sites, carriers and exports
3. the perceived risk of detection and enforcement being lower than for other crimes
4. a lack of confidence in the reporting mechanisms for waste crime
5. the regulatory authorities being perceived to be slow at taking actions
6. legislative arrangements not in place to allow illegal activities to be closed down quickly
7. the regulatory authorities lacking certain investigative powers
8. fines typically being considered to be too low to be a deterrent
9. barriers of entry to start up waste activities are low with potentially high rewards
10. high landfill tax creating opportunities for illegal cheap disposal routes via tax evasion
11. the public not being able to tell the difference between legal and illegal waste management activities
12. some waste producers having limited understanding of their legal obligations

#### 2.4.2 Broad characteristics of waste crime

The academic literature focuses on the broad characteristics of waste crime and the use of spatial analysis tools to identify waste deposits. Table 3 summarises key findings of these studies.

**Table 3. Review of waste crime academic studies**

Source	Key findings
Baird, Curry and Cruz (2014)	Factors leading to waste crime include new legislation and its weak regulatory enforcement, the economics of waste treatment, the complexity of the waste sector, waste can be hidden or disguised



Tompson and Chainey (2011)	Using crime scripts in a tool to analyse illegal waste processes
Almer and Goeschl (2015)	Econometric analysis to assess the general deterrence effect of enforcement intensity on the amount of waste crime
Bernard (2015)	Modeling transboundary shipments of waste between the stylised economies of Northern and Southern hemisphere
Biotto et al. (2009)	Spatial statistical analysis to select factors and criteria associated with known waste deposits
Bo and Yamamoto (2010)	Comparison of processes and issues of recycling systems in Japan and China for electrical and electronic wastes

### 2.4.3 Waste crime categories and sector patterns

A recent analysis by the Environment Agency (2013) of illegal waste sites by type for England in 2013 (Figure 1) indicates that construction and demolition waste is the predominant material stream, followed by household and commercial waste. However Eunomia observe that this analysis excludes illegal municipal waste and scrap metal sites (Eunomia Research & Consulting, 2014) and therefore the actual distribution of illegal waste sites by material streams may be significantly different.

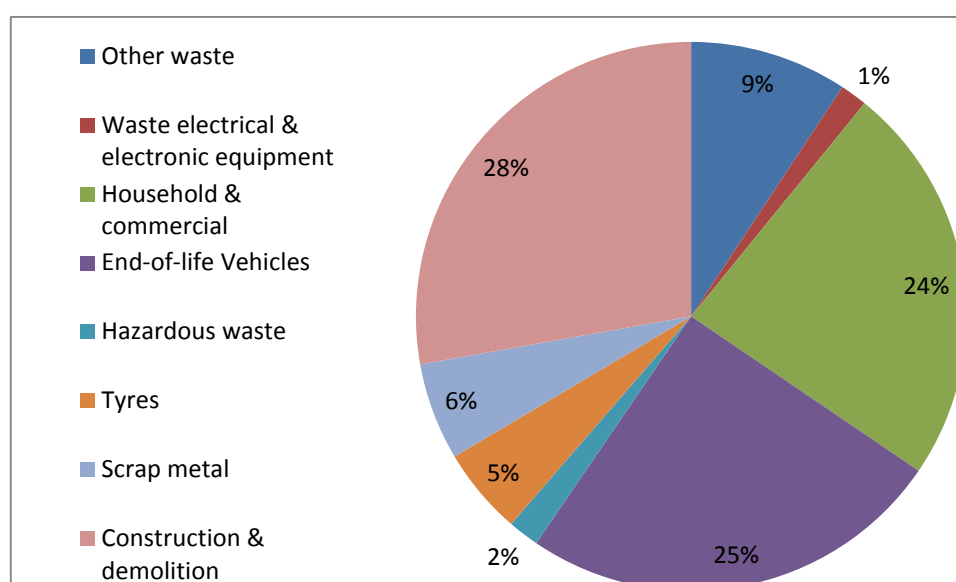


Figure 1. Type of active illegal waste sites in England in 2013

Source: Environment Agency (2013)

One of the difficulties encountered by the regulatory authorities is the relative ease with which companies can be created and wound up (Eunomia Research & Consulting, 2014). This may explain in part the difficulties regulatory authorities have in significantly disrupting illegal operations.

In discussing the vulnerabilities of different waste streams, Baird, Curry and Cruz (2014) highlight that increasing legislative standards can provide a motivation to handle materials illegally. They argue that the European directive on waste electronic and electrical equipment (WEEE) increasing the recovery targets to 85%, and requiring each Member State to provide the additional evidence that more of this waste stream is being treated, may lead to illegal exports.

#### 2.4.4 Enforcement activities

Given the importance of enforcement activities in deterring waste crimes, the devolved administrations and England have been focusing on improving the effectiveness of enforcement activities.

Simpson and De Vries (2014) note that in Scotland 20% of the serious organised crime groups are related to the waste sector. At the beginning of 2014, SEPA launched a new Waste Crime Team to tackle the most serious offenders, working in partnership with law enforcement agencies including Police Scotland, to identify and disrupt serious waste crime, including that associated with organised crime. Simpson and De Vries (2014) undertook a benefit-cost analysis of each regulatory action (inspections, letters, statutory notices and referral to the Procurator Fiscal) that SEPA uses to pursue compliance with environmental legislation. Following a case study approach, they find benefit-cost ratios of 15:1 and 31:1. These figures are significantly higher than Eunomia Research & Consulting (2014) finding of 4:1 benefit-cost ratio for England and Wales. Simpson and De Vries (2014) argue that this difference is driven by their focusing on most serious sites rather than covering a wide variety of waste crime from minor through to more serious cases.

In 2014, a Waste Crime Action Plan was developed jointly by Defra and Environment Agency (Defra, 2015). This plan identifies four themes:

- speedy and tough enforcement action
- greater intelligence sharing
- making the polluter pay
- making better use of regulatory controls.

Defra defines enforcement action as any action that the regulators take where they suspect an offence has been committed, or in some cases is about to be committed (Defra, 2015). Such enforcement actions vary from providing advice and guidance, to serving notices through to prosecution, or any combination that best achieves the desired outcome. In this definition, regulators can also take other preventive or remedial action necessary to protect people and the environment.

To reduce illegal waste activity and improve the flexibility to adopt the most effective compliance or enforcement option by the regulators Defra ran a consultation on proposals to enhance enforcement powers in 2015 (Defra, 2015). This consultation sought views on the following options:

1. suspension of permits where an operator has failed to meet the conditions of an enforcement notice
2. issuing notices that include steps an operator must take to prevent the breach of a permit getting worse, for example, key actions to stop more waste coming onto poorly managed sites
3. taking physical steps to prevent further breaches by an operator of their permit, for example, physically stop waste coming onto sites that are not complying with their permits
4. taking steps to remove a risk of serious pollution, whether or not a facility is under a permit
5. making an application to the High Court more readily by removing preconditions
6. widening the regulators' ability to require the removal of waste from land.

By reducing the number of waste sites that pose a high risk to the environment, Defra expects to achieve a reduction in enforcement costs to the regulators and in the bill for clean up. In 2013/14, the Environment Agency spent £16 million on enforcement at illegal or poorly performing sites. In Wales, the cost of disposing of the waste in fires at waste sites was estimated to be over £2 million.

In parallel to gathering views to enhance enforcement actions, Defra ran a 'call for evidence' on other measures to tackle waste crime. These other measures included the options and case for introducing fixed penalty notices for fly-tipping, actions to improve landowner awareness of

potential liabilities for waste, operator competence, options to address abandoned or orphaned waste management sites, powers to recharge for pollution works, exemptions from environmental permitting. Among these measures, operator competence is particularly relevant for this project as it included operator competence, technical competence and financial provision.

#### 2.4.5 Financial provision for waste management activities

The costs associated with addressing waste crimes including those incurred maintaining pollution control systems or dealing with abandoned sites is an issue faced by many regulatory authorities within the European Union member states. The European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL) held a workshop on environmental liabilities and financial securities for accidents and insolvency/ bankruptcies in early 2014 (EPA Network, 2014). One of the key recommendations from this workshop was to promote pan-European guidance on the practicalities of providing financial security both for accidents and bankruptcies. At the subsequent plenary meeting of the European Network of the Heads of Environment Protection Agencies (EPA Network) opportunities for the creation of a pan-European financial instrument was raised.

More specifically within the UK, both SEPA and Defra are exploring the use of financial provision instruments for waste management activities.

SEPA ran consultation in late 2015 to collect views on the calculation of the financial liability for a waste management site and to identify financial provision mechanisms (SEPA, 2015). The consultation highlighted that these mechanisms will be relevant for existing as well as new sites in certain circumstances (Table 4).

**Table 4. Situations that will be effected by the proposed SEPA requirements**

	New application	Modification/ variation	Transfer
<b>Landfill</b>	√	√ (to various aspects)	X (except in specific circumstances)
<b>Non-landfill</b>	√	√ (to various aspects)	√

Source: Adapted from SEPA (2015, p. 6)

The aim is to develop a risk-based approach, taking into account both likelihood and consequence. The likelihood is informed by the specific waste management activity and market factors while the consequence considers the amount of financial liability associated with the waste type and quantity. The types of financial provision mechanisms included in the consultation are summarised in Table 5.

**Table 5. Financial provision instruments assessed in SEPA consultation**

Options	Characteristics	Advantages	Disadvantages
<b>Renewable bonds</b>	Issued by a third party under which the issuer undertakes to pay sums which can be used to remediate the site if the	Most likely to demonstrate that adequate financial provision is being made. Bond performance agreement can be varied	Need to be in place for the duration of the expected period of operation of the site Costs to the applicant Reluctance of issuers to issue

Options	Characteristics	Advantages	Disadvantages
	applicant fails to meet obligations	over time to reflect changes in restoration cost.	bonds for the potential lifespan of a waste site.
<b>Bank guarantees</b>	<p>A bank issues a guarantee on behalf of an applicant and undertakes the due diligence to ensure that the company can afford to pay the guarantee.</p> <p>It can be in the form of a performance bond or a form of letter of credit.</p>	<p>It can be varied over time to take account of changes in restoration cost.</p> <p>In the event of business failure it is the bank which pays rather than the operator.</p>	<p>A bank will almost invariably require an indemnity from the applicant and bank guarantees are likely to reduce existing lines of credit.</p> <p>It may not be available to those other than large, financially stable organisations.</p>
<b>Escrow accounts</b>	<p>A fund is deposited in a joint account so that sums are ear marked for remediation works. Clear criteria are set out for release of funds to one or other party.</p>		<p>Capital of the applicant is tied up in the account and funds cannot be accessed by the applicant (or its liquidator or executor).</p> <p>Costs may be prohibitive to small businesses.</p>
<b>Trust funds</b>	<p>Funds are placed in a designated account of the applicant and a trust is declared by the applicant. The beneficiaries under the trust would be SEPA and the applicant.</p>	<p>The deposited sums result in funds being ring fenced for the site remediation work. Documentation can be drafted to allow for funds to be released from the trust with SEPA consent to allow the works to be carried out avoiding a perceived double cost to the applicant.</p>	<p>Capital of the applicant is being tied up well in advance of any cost arising.</p>
<b>Local authority deed agreements</b>	<p>More appropriate where a local authority or public body is carrying on its own waste activities or where waste activities are undertaken by a company whose shares are wholly owned by a local authority or public body.</p>		
<b>Other financial provision instruments not capable of ensuring funds are secure and available</b>			
<b>Credit check</b>	<p>Issued by credit reference agency, it provides a summary of the historical credit performance of the entity.</p>		<p>Does not provide assurance regarding future performance or ability to pay remediation works costs when due.</p>
<b>Statutory planning agreements</b>			<p>Relying on the local authority to ensure that the requirements of the agreement are enforced. Either the interests of the local authority and SEPA may not be exactly aligned and certain restoration work may be seen</p>

Options	Characteristics	Advantages	Disadvantages
			as going beyond the local authority remit.
<b>Parent company guarantee</b>	It provides for the parent company to undertake the subsidiaries remediation works obligations or compensate SEPA for any claims against the subsidiary.		The financial standing of the granter of the guarantee may change over the period of time. Reliance on the parent company and its ability to pay the costs at the relevant time.
<b>Security</b>	Security is granted by the licence holder over identified assets of a value sufficient, if enforced, to cover the cost of site remediation works. It may be effective in the insolvency or death of the licence holder.	Paperwork between the SEPA security and the funders security may allow relevant consents and ranking arrangements put in place.	Taking of security may risk making it very difficult for applicants to carry on business as normal. This may be viewed as inconsistent with SEPA's role as regulator.
<b>Insurance</b>	Refers to a traditional insurance approach whereby the payee under the insurance would be the applicant. The insurance is only designed to cover the situation where the applicant cannot complete the works themselves.		Failing to comply with insurance conditions or disclose all circumstances required by the insurance company or to pay insurance premiums when due, the insurance may not pay out fully or at all. Potentially the applicant pay for insurance which is not used and still have to pay for costs of the works.
<b>Cash deposits with SEPA</b>	Cash transferred by the applicant to SEPA under condition that funds will be released if all obligations arising from the licence are carried out satisfactorily or that funds may be utilised by SEPA to complete the site remediation works if the applicant fails to do so.	Funds are immediately available and remove exposure to applicant or third party solvency risk.	Cash of the applicant is being tied up well in advance of any cost arising.

Source: Adapted from SEPA (2015)

In 2015, Defra also ran a 'call for evidence' on the assessment of different options for financial provision (Defra, 2015). The options are summarised in Table 6.

**Table 6. Assessment of different options for financial provision in Defra document**

Options	Advantages	Disadvantages
<b>Bonds/bank guarantees – third parties assess risk and require an appropriate level of security</b>	<p>Shifts the burden to the operator to demonstrate to a third party that they have an effective business plan and sufficient assets/resources.</p> <p>Can work well if terms are clearly specified.</p>	<p>Can tie up a significant amount of company capital and the costs for small businesses may be prohibitive.</p> <p>In some cases the regulators have experienced difficulties accessing funds, for example if the operator goes into liquidation.</p> <p>Limited market for bonds.</p>
<b>Assessment of business plans/ expenditure plans.</b>	<p>Forward looking, rather than just a snapshot view at the time of application.</p> <p>Could be outsourced to a third party for independent assessment.</p>	<p>May not take account of the impact of unforeseen changes in the market.</p> <p>A poor business plan may not provide sufficient justification for the regulator to take enforcement action against an operator that is already permitted.</p>
<b>Escrow accounts - the regulator holds joint funds with the site operator</b>	<p>Reduces the regulators’ risk of financial exposure.</p> <p>Can work well if the terms are clearly specified.</p> <p>Potential flexibility on draw down of funds for necessary site</p>	<p>Can tie up a significant amount of company capital and the costs for small businesses may be prohibitive.</p> <p>Additional administrative burden for the regulators.</p>
<b>Insurance</b>	<p>Introducing this as a requirement could create a market for the insurance industry to provide a product.</p> <p>Reduces the regulators’ risk of financial exposure.</p>	<p>A suitable insurance product does not currently exist and the costs for small businesses may be prohibitive. Insurers will only offer insurance to those they consider to be a “good risk”.</p> <p>Any insurance needs to be maintained, this would require regular checks by the regulators. Insurance would also have to survive the business if it went into liquidation.</p>

Source: Defra (2015, p.42)

Wide ranging reviews of regulatory evidence have been completed to support the examination of a breadth of policy initiatives (Sniffer, 2012). Earlier analysis of a range of business drivers for good environmental behaviour provides a comprehensive analysis of motivation for improved

performance within the supply chain (Sniffer, 2011). It is clear that where organisations choose to perform beyond compliance commercial benefit can on occasions be gained within the market.

## **2.5 Potential indicators – applications for waste crime**

The overall project, to which this review contributes, focuses principally on financial indicators with the objective of using these to predict waste crime. In considering how categories of waste crime may be detected or anticipated by financial evidence it is relevant to briefly review the origin and visibility of indicators that relate to company compliance.

Indicators of criminal behaviour or the likelihood of criminal intent can be divided into a series of sub-categories. The wider theoretical and empirical literature on assessing risk to predict as well as manage criminal behaviour is extensive (Heilbrun, 1997). The fields covered deal with developing taxonomies and understanding motivations for individual behaviour; the cognitive and behavioural patterns of individuals, culture and practice within organisations, as well as the external or environmental influences on both individuals and organisations. The underlying objective throughout the majority of studies on indicators of crime is to assess risk. This then enables prediction and management of the influences and outcomes of crime.

### **2.5.1 Individual cognition or patterns of behaviour**

In the context of violent or antisocial behaviour, i.e. away from environmental or waste crime, approaches to predicting the risk of individuals undertaking these actions is well established. These approaches are used widely in probation and many stages of the criminal justice system as well as clinical practice. A wide range of studies have been completed to review the accuracy of a number of methods used for these assessments. The importance of understanding the accuracy of these predictive models has led to meta-reviews and large-scale studies being completed (Fazel et al., 2012). However, despite widespread application, evidence suggests that the accuracy of these methods is largely determined by how they are used, as opposed to the indicators adopted. It appears that high levels of accuracy can only be reliably achieved when identifying those individuals who are considered to be low risk (ibid.). Despite the evidence being well supported to diagnose the origins or explain the antecedents of criminal behaviour; using indicators to predict violent or antisocial behaviour proves difficult to apply and in general unreliable without a prior history.

### **2.5.2 Culture, practice and influences on individuals within organisations**

If we consider the probability of criminal action or intent in a firm or larger company setting, we can review evidence for the accuracy in predicting crime or non-compliance at an organisational level. In the regulatory context a breadth of research has been reported on the organisational typologies and motivations for corporate environmental compliance as well as over-compliance. Studies of organisations exceeding compliance points to firms responding to 'social license' as well as economic advantage rather than regulation as the motivation (Gunningham et al., 2005; Rorie, 2015). The implication is that those firms with a high regard for their social context are less likely to offend.

In contrast, there is recognition that an integrated theory is needed to bring together the range of influences that cause individuals within organisations to decide to offend (Rorie, 2015). Whilst a variety of studies cite evidence that explains the causes or origin of organisational misbehaviour, these retrospective explanations use differing theories to understand these outcomes (Pinto et al., 2008; Simpson et al., 2013; Vardi and Weitz, 2002). Despite the varied perspectives used to explain compliance in its widest form, in general there is no agreed conceptual bases in use to predict the likelihood of firms not complying with regulation (Bajo et al., 2009). However, examples such as corporate ethos, and increased degrees of separation of ownership from company control, have proved more influential in predicting regulatory compliance, than explicit corporate governance structures (ibid.).

Internal, cultural influences such as these are valuable when working within a company or when an auditor has internal knowledge of an organisation. Whereas, when an external regulator reviews a company independently with limited knowledge of the firm, identifying these indicators from an external perspective is difficult. To identify indicators of value to a regulatory agency the information must be visible and accessible.

### **2.5.3 Indicators for waste crime**

From the above, it follows that if indicators for waste crime are available, they are likely to reflect one of two components; namely,

- indicators will reflect the behaviour of individuals, or
- indicators will identify a cultural likelihood of non-compliance within the organisation.

In addition, the indicator(s) will then have external properties or factors that can be observed, ideally by a regulator. Equally, this pattern of factors would need to be evident and justified from an evidence base. The extent to which these patterns have been observed could then be used as potential predictors.

Research references to studies of waste crime indicators are very limited. For example, using the term “waste crime indicators” on Scopus gives only 10 search results, only one of which directly relates to ‘waste-related indicators’ but which proves to focus solely on environmental quality and not crime (Nicolli, 2012). All others are irrelevant.

To develop or apply an indicator for waste crime a sequence from the previous example can be applied:

- Firstly, the indicator must be relevant to the waste context, e.g. concerned with categories of crime that have been cited in Sections 2.2 to 2.4.
- Secondly the indicator must be transferable to the sector in some form, i.e. it cannot be so narrowly defined that symptoms on the waste context are either irrelevant or could not be detected.
- Then finally, there must be some likelihood that the indicator can be identified from some form of public or restricted access data source.

Searches of; Scopus, Web of Science, Researchgate, Mendeley and Google Scholar result in no references supported by research evidence of financial indicators for waste crime, despite each of these terms being included within the text.

Despite this, experience referred to within the interviews highlights that financial and other forms of indicators are likely to be available and yet not evident within the public domain or routinely accessible to the regulator.

### **2.5.4 Non-financial - operational indicators**

As is the case for crime in general, patterns of behaviour can be observed that lead to an increased, albeit unproven probability of crime taking place or being likely. In the case of indicators for crime in general, these may be initially based on assumptions with limited evidence, e.g. where a company is led by owners with a track-record of offences. Whilst this may be based on assumptions and thus unreliable it can be argued that for organisations, such signals are a reasonable trigger for increased attention or further investigation.

It is recognised, in the previous sections that many forms of crime, e.g. breaches of permit conditions, inadequate controls of waste materials, ground-water pollution, etc. may offer visible, early-stage, albeit non-financial indicators. Symptoms such as increased odour, excess vehicle movements, significant or increased noise levels, site drainage problems, may all be observable factors indicating significant levels of underlying non-compliance. This sub-set of indicators which



can be regarded as behavioural or 'operational' indicators may then provide the basis for more structured financial investigation.

#### **2.5.4.1 Supply-chain and the haulage sector - to prompt financial investigation**

Waste management until fairly recently has principally been a logistics and storage industry that has only recently evolved to focus on material processing as an intermediate stage. The importance of logistics for the sector results in the vast majority of wastes being moved by road at some point within the supply chain. Clearly the haulage sector plays a central role in waste industry.

The haulage sector is important from multiple perspectives as not only is it a critical path in most supply chains at a variety of stages, but vehicle movements are monitored and recorded through a number of mechanisms. This includes a range of checks which may make non-compliance easy to observe as 'indicators'. Examples of this include the DVSA (Driver and Vehicle Standards Agency – previously VOSA, Vehicle and Operator Services Agency), routinely monitoring road vehicles for; MOTs, operator licensing and Vehicle Identity Checks (VICs). In addition, driver behaviour, tachograph, payload and speed checks could all be used as indicators for further investigation. Therefore it is logical to search within the haulage sector for indicators of criminal intent or the likelihood of crimes being underway as a preliminary signal or symptom.

It is important to note that these are not financial indicators. More importantly, this discriminates indicators from those that are "financial" – and not reported in the research of grey literature, i.e. indicators that are difficult to identify and/or access in a form of use to the regulator; and those that are "operational", e.g. the visible signs of 'bad or illegal behaviour'. These operational signs are out of scope. However, they may not be wholly irrelevant as they may be the trigger(s) for a financial investigation.

In following this line of haulage as an operational indicator, evidence from a recent European wide-study shows that people who commit offences characteristic of antisocial attitudes are more likely to have road traffic accidents and infringe traffic laws (Castillo-Manzano et al., 2015). Prompted by interest from insurers, a more targeted analysis of infringements of legislation for drivers, e.g. rules for working times and resting times, also showed wider levels of non-compliance with vehicle legislation as well as increases in road traffic accidents (Zalcmanis et al., 2014).

These symptomatic observations form the basis of police organisational models for crime reduction strategies (Santos, 2013). Here impact evaluations of crime alongside practices of problem-oriented policing, and the identification of hot spots, allows policing to prioritise the identification and reduction of a range of types of crime.

The majority of haulage / vehicle crime detection is through observation and image detection, e.g. DVSA license, MOT and insurance checks. Currently, limited use is made of carrier documentation and the application of this online. However, recent cross-border detection where fraudulent shipments are compared with matching shipping documents and phone records has shown that routine sources of data linked to vehicle movements can trigger successful investigations. Such practical approaches to using analytic technology and existing data records offers the potential for future automated checks on the legitimacy of vehicle movements (Jędrzejek et al., 2013).

Despite these opportunities there are no reports of a structured analysis and links established between haulage/vehicle crime and waste crime.

## **3 Phase 1 - Primary data collection**

### **3.1 Introduction**

Following a thorough review of the available literature it was concluded that there are a number of indicators which might be applicable. However, there was little evidence that potential financial indicators have been applied in the waste crime context. Due to the gaps in the evidence base a programme of interviews was planned to gather new data. Interviews were undertaken with key individuals across the waste sector, along with experts in the financial and investment sectors, to provide further insight into the viability of using financial indicators in tackling waste crime.

### **3.2 Methodology**

Interviews were carried out with the following individuals:

1. Independent waste consultant with previous experience as a Chief Executive Officer of a waste management company;
2. Waste experts from the Chartered Institute of Waste Management [CIWM];
3. Environment Agency [EA] staff;
4. Scottish Environment Protection Agency [SEPA] staff;
5. An asset fund manager, with a history in corporate risk;
6. A senior compliance officer from a UK building society;
7. Former head of legal compliance in one of the UK's largest property management companies;
8. Insolvency practitioner and risk manager for a professional services company;
9. A partner within a major London law firm;
10. Trading standards specialist;
11. Her Majesty's Revenue and Customs [HMRC] staff;
12. Food Standards Agency [FSA].

The interviews were based around five main questions, particularly during interviews with individuals with direct expertise in the waste industry. The answers to these questions led on to a range of fruitful and instructive discussions. In all cases interviews were carried out over the phone, except for CIWM which was in person. The questions agreed with SEPA in advance of the interviews are:

1. What types of waste are most commonly abandoned (not flytipped)?
2. What was the root cause of the material being abandoned: financing arrangements, business acumen, poor performance, contract arrangements, price fluctuations, technical competence, knowledge and experience of the operator?
3. What are the indicators you look for to assess whether or not a company is in financial difficulty or the business model is failing - working capital, requests for loans, financing from elsewhere, basis for the market.
4. How easy is it to access financial, business and contract information – are there ways this could be improved? Is it possible to access detailed accounts?
5. How easy is it to access information on contract pricing and changes in the prices obtained for materials leaving the site and the implications this has for a business?

## 3.3 Results and discussion

### 3.3.1 Interviews with waste sector experts and other regulators

Following the discussions with those with direct expertise in the waste sector, the following findings are summarised for each question.

1. What types of waste are most commonly abandoned (not flytipped)?

Typically wastes have a low value but a relatively high cost to dispose of. Examples cited by all interviewees include

- Tyres
- Commercial and industrial [C&I]
- Construction and demolition [C&D]
- End-of-life vehicles
- Trommel fines - often in relation to the mis-description of waste for tax purposes
- Contaminated soils
- Asbestos (though usually amongst other abandoned waste)
- Refuse-derived fuel with poor fuel qualities

It was noted that waste electronic and electrical equipment [WEEE] tended to be involved in illegal exports rather than abandoned sites.

2. What was the root cause of the material being abandoned: financing arrangements, business acumen, poor performance, contract arrangements, price fluctuations, technical competence, knowledge and experience of the operator?

Generally all of the causes outlined within the question were cited as typical reasons for operators abandoning waste on a site. An unsustainable business model was the main cause with the business not understanding the true operating costs or the amount of movement in commodity prices that can occur.

Operators setting out from the onset to operate illegally would often seek a quick profit through the mis-description of waste to benefit from the difference in the landfill tax for active and inactive waste.

Respondents from SEPA observed that most operators started with the intention of being fully compliant. However, a number turned to non-compliance due to poor business planning. A conservative estimate of 75% was provided for the proportion of illegal sites being run by operators who initially intended complying in full with their permit. It was also observed that there can be a high incidence of waste crime on islands due to significant transportation costs.

It was observed that larger non-waste companies would seek to grow margins through lowering costs, driving competitive agreements from waste operators. These contracts though prove to be unsustainable for the waste company.

There are also pressures on local authorities to seek best value. As a result, waste management companies are having to be highly competitive in order to secure new contracts, lowering their margins and potentially leading to companies operating in a commercially unsustainable way.

3. What are the indicators you look for to assess whether or not a company is in financial difficulty or the business model is failing - working capital, requests for loans, financing from elsewhere, basis for the market.

Other indicators include:

- Losing contracts;
- Making staff redundant;

- Failure to maintain site, equipment and vehicles;
- The amount of waste on site increasing;
- Sudden growth of business (cutting prices to win work, but unsustainably).

It was acknowledged that current investigations are largely 'reactive' whereas a tool would be valuable and enable a 'proactive' approach. One interviewee mentioned that a very basic model for profit/loss would enable regulators to assess the site based on the true cost of managing the waste (see Q4 responses).

Typically regulators will investigate companies as a result of routine inspections identifying non-compliance, or through complaints (environmental, odour, noise etc).

Apart from HMRC, other regulators, including Food Standards and Trading Standards, are not able to access financial information relating to an ongoing business with an environmental permit unless it is part of a formal investigation. HMRC can only readily share information related to landfill tax.

It is not possible for regulators to undertake general 'fishing' exercises in relation to finances.

4. How easy is it to access financial, business and contract information – are there ways this could be improved? Is it possible to access detailed accounts?

As captured in the previous question, it is possible that certain financial indicators would be beneficial. However, this information is not accessible as stated above outside of a formal investigation. It was also noted that even if such indicators or financial data were available it is unclear whether regulators would know how to interpret information.

5. How easy is it to access information on contract pricing and changes in the prices obtained for materials leaving the site and the implications this has for a business?

Contract pricing is sensitive and confidential, so can only be obtained through formal investigation and auditing. Other information, such as the values of commodities, is available through sources such as Let's Recycle, however this is not reliable enough where longer-term contracts are in place.

### **3.3.2 Interviews with financial experts**

From a lenders perspective it is important to assess the '5Cs of Credit'. The lender will assess the following aspects of the customer:

- Character – credit history, business records
- Capacity – capacity to repay loan
- Capital – stock of business capital assets
- Collateral – cash and assets used to secure loan
- Conditions – conditions of loan – interest rates etc.

For the type of operator we are interested in there is unlikely to be any lending from large financial institutions. If the money was being raised from a bank it is likely to be from a branch and it was the respondent's view that small branches were unlikely to have the budget to perform detailed checks. The respondent felt that most of the checks are driven by money laundering checks and the ability of the customer to pay back the loan. At the moment there is no driver for environmental checks.

There is a threshold of 15,000 euros, above which the transaction (or loan) falls within the remit of the 2007 money laundering regulations and lenders must undertake specified due diligence checks. However it was stated that some lenders often carry out checks on loans of £5,000 or more.

Lenders often use reports from 3rd parties such as 'Experian'. More 3rd party credit check companies are entering the market, offering more choice. Other databases used include the

insolvency service, and other government sites that cross-reference whether customers are facing UN or other financial restriction sanctions. Where the value at risk is higher banks will undertake unsophisticated checks on google, looking up for information on the customer and their reputation.

Lenders are unlikely to lend when they detect one, or a combination of these following conditions:

- No credit history
- County court judgements
- Records of insolvency
- A limited period of business operation
- A sole trader
- No, or irregular tax returns.

There has been a recent trend for pension companies to buy out property management firms. These pension companies have driven tighter due diligence procedures, usually around the issues of corporate governance, but not on environmental performance. It was reported by one of the interviewees that for environmental performance to become an important part of due diligence it needs to come from the CEO.

The pressure for more rigorous due diligence has meant that companies have reduced their list of contractors. Therefore, new contractors are usually big enough to pass due diligence checks. However, these contractors may not undertake due diligence checks on their sub-contractors. Much of due diligence in such circumstances can be a box ticking exercise. Firms can tick a box saying they have a management standard in place, but it can be difficult and expensive to verify this.

Companies that fail due diligence tests are on occasions reported to the authorities. However, it was reported that the authorities may just put them on file because they are small.

### **3.4 Implications for defining indicators from Phase 1**

There are many reported instances of waste crime. These are often high profile with significant sums of money involved including substantial clean-up costs. Abandoned waste is often for commercial and industrial or construction and demolition sources. It may contain hazardous materials, such as asbestos. Poor quality refuse derived fuel is also a common waste material that is abandoned.

The main driver for abandonment is financial, either as a result of poor business planning, unsustainable arrangements with waste producers or simply for quick profit. The latter is an example of an operator having a criminal attitude from the outset rather than the former examples where operators start with the intention of complying with their site permit conditions.

From a comprehensive review of the literature it is apparent that financial measures and criteria are not commonly used as indicators of illegal activity in the waste sector, or indeed in any non-financial sector. The generally available financial information is not sufficiently detailed or timely to be an indicator of potential illegal activity.

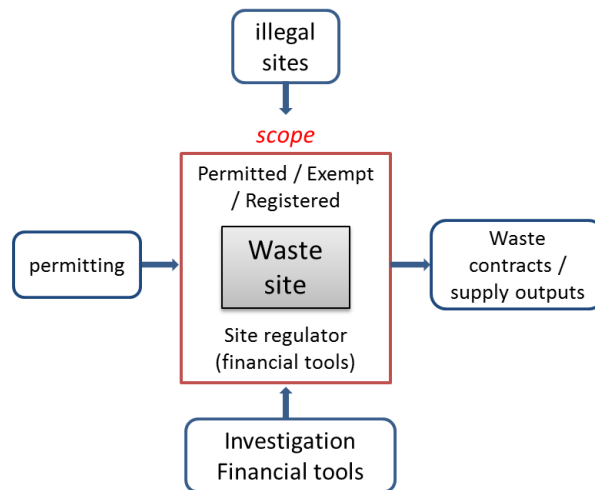
Apart from HMRC, other regulators are not able to access financial information relating to an ongoing business with an environmental permit unless it is part of a formal investigation. HMRC can only readily share information related to landfill tax. Environmental regulators are not allowed to carry out wide ranging or routine reviews of businesses financial information

It was also noted that even if such indicators or financial data were available it is unclear whether regulators would know how to interpret information. Most regulators use trained financial investigators as part of formal investigations and certain regulations require this.

## 4 Phase 2 - Assessment of findings from Phase 1 data collection

### 4.1 Financial indicators

Research within Phase 1 of the study focused on identifying financial indicators with the potential to indicate the likelihood or presence of waste crime taking place at regulated sites. Permitted, exempt or registered sites all fall within this scope. Whilst illegal operations remain a concern for SEPA they are out of scope in this context as the regulator becomes aware of these sites only when they are operational, i.e. precluding any form of advance review or assessment. The research scope is illustrated in Figure 2.



**Figure 2. Research scope**

Research within Phase 1 identified that assessments of financial information and indicators, in relation to operational permitted sites can be useful in identifying illegal activity. However, it is only possible to access this information once a decision has been taken to undertake a formal investigation, i.e. the data is not routinely available to an environment officer carrying out routine compliance activities. Such investigations have to be authorised by a relevant senior manager in the regulatory body or in some cases requires a judge’s signature. Some investigations require the person accessing the financial information to be a registered financial investigator.

### 4.2 Operational indicators

Although it is not possible to access routinely the financial and contractual information that specifically relates to a business’s activities, ‘operational indicators’ are available that can be used as part of a risk based approach to target compliance work on specific activities. These are indicators of potential illegal activity that are worthy of further investigation. Recognised either in the research literature, ‘grey’ literature or by professionals with expertise in the sector, these indicators can broadly be categorised as follows:

- Site
- Non-site “supply-chain”
- Non-site “market”

#### 4.2.1 Site indicators

Phase 1 results, summarised in Figure 3, show some of the variables identified. Typically these are characteristic patterns of behaviour exhibited by the operator or there are changes in the supply chain dynamics. Regulators are readily aware of ‘site’ operational indicators that draw their

attention to the likelihood of an increased chance of non-compliance or crime. Noise, odour, unusual operating hour patterns, etc. are common causes for concern and are often causes of complaints.

#### 4.2.2 Non-site indicators

‘Non-site’ operational indicators have been classed here under two headings; “supply chain” and “market”. ‘Non-site’ supply chain typically includes those factors such as the movement of materials between sites and operators which ‘flag’ potential illegal activities such as an inconsistent pattern of site use, and incongruent or illogical supply-chain relationships in moving wastes between sites. However, such information will not always be available to those who are focused on site based compliance activities.

‘Non-site’ market indicators are factors which are likely to increase the risk of financially vulnerable sites embarking on non-compliant operations. This will include such things as movements in commodity and scrap metal prices which can for example encourage metal theft or could mean that a disposal route for the material on a site is no longer commercially viable. In addition, the differences in the landfill tax rate between active and inactive waste and the disposal costs of hazardous and non-hazardous waste means there is a considerable temptation for some operators to miss-describe waste.

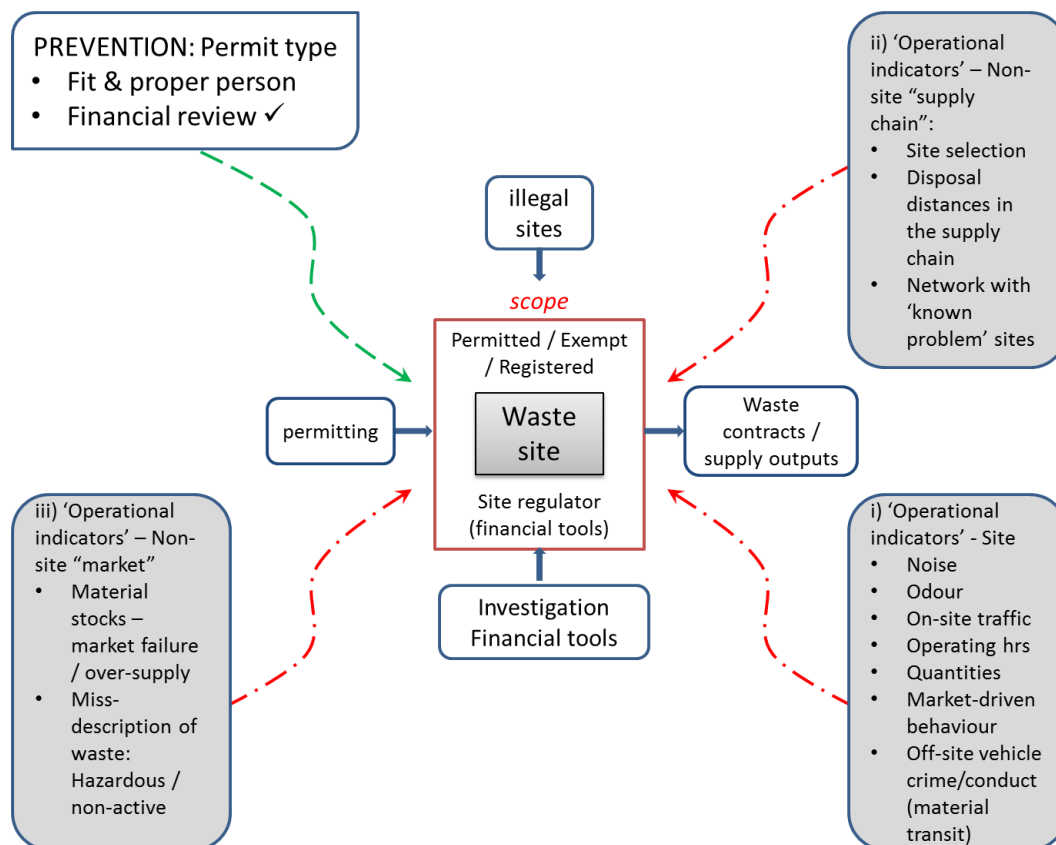


Figure 3. Operational indicators and crime prevention

#### 4.3 Assessment of indicators

Once the permitting stage is concluded, i.e. after a site has been issued with its permit, the project team understand that the ability to use financial measures is very limited for an environment officer. At one end of the spectrum a financial investigation can proceed under regulatory powers, e.g. if using POCA then a registered financial investigator needs to be involved in the process. However, at the other end of the spectrum regulators are not allowed to *just go fishing* to see if there is something interesting.

## 5 Opportunities to employ financial indicators

As stated above and in the Phase 1 report it was concluded that it is not possible to use financial indicators as part of routine compliance activities. However, it is believed that there is considerable opportunity to make greater use of financial indicators during the permitting process. These indicators can be used by SEPA to assess the risks associated with a particular operator and the specific activities they will undertake.

The project team recognise that there is a considerable legacy of existing sites with permits. The approach being proposed will be limited to new permit applicants but could potentially include operators seeking permit changes or renewals.

It is evident that currently limited amounts of information are examined at the pre-permitting stage in relation to testing whether:

- an applicant is technically competent and a fit and proper person to operate a site;
- there is sufficient financial resilience in the business and the sources of funding are appropriate;
- there is a credible business model and market for the outputs produced.

We are aware that applicants with financial debts have not been barred from being issued with permits.

Sometimes concerns are expressed that additional financial and technical competency checks, as outlined above, are unacceptable barriers to entry for new operators into the waste industry. However, evidence from Phase 1 interviews suggests that greater scrutiny of financial, market and technical aspects at the application review stage could provide useful intelligence in relation to whether or not an operator is more likely to be a high compliance risk.

We suggest that there would be merit in investigating the use of a more in depth review of business, financial and market information at the permitting stage as a proactive mechanism to reduce crime from regulated operators. We would recommend that this should form the basis of Phase 3 of this project.

The review of technical competence and the fit and proper person aspects of permit applications and site operations are outside of the scope of this project but are worthy of further investigation as a means of reducing illegal activities on a permitted site.

### 5.1 Financial indicators at the permitting stage

Developing a risk-based approach for permit applications where an evidence-based model is used to provide guidance on answers received at the permitting stage has the potential to screen *high risk* applicants, or existing operators if permit modification/renewal is included.

Risk factors can be set-up for sites that would inform the level of compliance activity likely to be required. These can be based on information such as: the type of waste – industrial or commercial, refuse derived fuels (RDF); part of large business or not; self-financing; and first-time operators where a track-record of competency and business support is not evident.

The list of financial indicators is as follows:

- Track record
- Source of funding
- Type of material
- Process and technology risk
- Business model characteristics
- Insurance cover of the site



- Financial provision arrangements

### **5.1.1 Track record**

An assessment of an applicant's track record would take into account the number of sites a business is operating in the UK, the compliance record on the sites as well as the size and reputation of the company. It is likely that a lender will also look at a business's track record. Lenders often use reports from third parties such as 'Experian'. Some will use more detailed third party credit checks by companies such as Dun and Bradstreet but these are more expensive than the basic checks. Other databases that can be searched include the insolvency service, Companies House, and other government sites that cross-reference whether organisations and individuals are facing UN or other financial restriction sanctions. Interviewees also stated that lenders will undertake searches using tools such as Google and Yahoo, looking up any information on an organisation and their reputation.

If the track record reveals one or a combination of the following conditions, more detailed checks or even a rejection of the application might be warranted:

- No credit history
- Court judgements
- Records of insolvency
- A limited period of business operation
- Disqualification as a director
- Unpaid debts
- No, or irregular tax returns.

### **5.1.2 Source of funding**

Our interviews with lenders revealed the importance of assessing the '5cs of Credit':

- Character – credit history, business records
- Capacity – capacity to repay loan
- Capital – stock of business capital assets
- Collateral – cash and assets used to secure loan
- Conditions – conditions of loan – interest rates etc.

If the funding is coming from a reputable bank, it is highly likely that no further action will be needed. However, if the operator is self-funding, then are more detailed checks need to be made.

### **5.1.3 Type of material**

The material being handled can pose a variety of risks including in relation to its value and hazardous properties. Certain materials provide opportunities for miss-description or other illegal activities such as dilution of the hazardous content. There can also be risks associated with the fluctuations in the price of materials entering or leaving a site or there may be an undersupply of inputs or oversupply of outputs which put the business at risk. In addition, some materials can be collected in expectation of a market developing which then fails to materialise.

### **5.1.4 Business model characteristics**

The aim here is to check the soundness of the business model. In particular, the operator would be asked to provide information on the following variables:

- Expected throughput in a week
- Number of people on the site
- Rate of investment (including opex costs for labour, power and transport)
- Gate price
- Source of the material and it's certainty
- Output of the site and its volatility.

Such information could be benchmarked against other operators and market information. The financial information could also be analysed to determine whether the cost basis and the returns look reasonable.

#### **5.1.5 Processes and technology risk**

There can also be a technology risk if an operator is using a novel process, or there is a significant increase in throughput compared with other sites, or a company or individual does not have a track record of operating in the sector. In addition certain technologies and treatment approaches provide greater opportunities for miss-description of waste or illegal processing activities such as dilution. Information such as this can be built up by SEPA and then incorporated into the risk assessment tool.

#### **5.1.6 Insurance cover of the site**

Whether or not a site has insurance could be a significant risk indicator. In addition, the nature of any cover should be reviewed to determine what is and isn't included. Some operators may not be able to obtain insurance and this will increase the risks associated with that activity.

#### **5.1.7 Financial provision arrangements**

Financial provisions have to be made by operators for certain waste activities to fund ongoing monitoring and maintenance activities or clean-up costs when a site can no longer accept further waste or if it is abandoned. The way in which such funding is provided will provide an indication of the financial standing of the applicant.

## 6 Conclusions from Phase 2 and recommendations for Phase 3

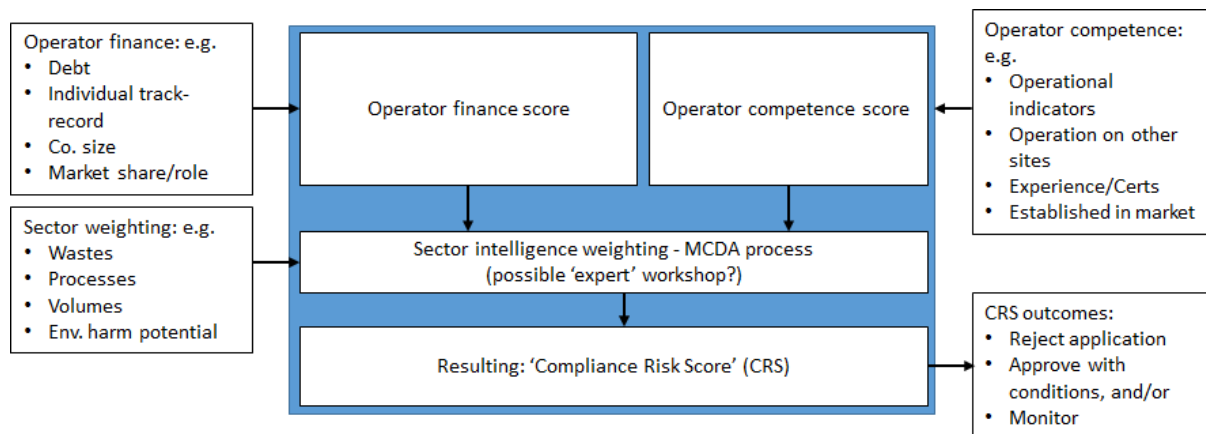
### 6.1 Objectives of the Phase 2 report

The focus of this project is on those sites which have or could be issued with permits. Waste activities covered by registrations and exemptions do not fall within the scope of the project. The objectives of this Phase 2 report were to:

- Identify financial factors that potentially can be used by environment officers as early indicators of illegal activity
- Assess the feasibility of applying these indicators to existing permitted sites by environment officers

Following discussion within the project and client team, it has been agreed that Phase 3 of the project should now focus on the development of a risk based assessment approach relating to the financial and market information that could be available to the regulator during the permitting (and potential permit renewal) stage.

**Figure 4. Conceptual characteristics of financial tool**



### 6.2 Tool development and validation

The criteria that could be used to assess the potential financial risks associated with waste management activities at the permitting stage are outlined in Figure 4. Such a risk assessment tool will take into account both the nature of the material and the likelihood of abandonment. Both inputs to the site and outputs have to be considered. The potential for harm needs to be considered in terms of the likelihood of an event happening, the environmental and health risks, the site location and its proximity to sensitive receptors. In addition, clean up and disposal costs need to be factored in to an overall assessment.

One means of validating this approach would be for the Cranfield team to use the information that could be gleaned from the 20 most recent waste crime investigations and prosecutions SEPA has undertaken.

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