Water Framework Directive
Western River Basin District

Programme of Measures

Unsewered Wastewater Treatment Systems National Study

Final Report

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in association with
White Young Green

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Summary

Unsewered wastewater treatment systems constitute a significant diffuse pressure acting on water. The pressure on *groundwater* is described as widespread in the Water Framework Directive National Summary Characterisation Report of 2004. With regard to *surface water*, the relative contribution of unsewered systems in terms of nutrient load amounts to 3% for nitrate and 7% for phosphorous, while pathogens have been identified as a particular risk.

With over 400,000 unsewered systems in use in Ireland and an estimated 200,000 wells and springs, the prevention of contamination of drinking water from on-site sewage effluent is of critical importance.

Local Authorities are aware of issues relating to unsewered systems and they operate controls ranging from strict planning approvals through to inspection and monitoring regimes backed up with bye-laws.

There are areas in Ireland where discharge to the ground and groundwater cannot occur throughout a significant proportion of the year, in particular areas with relatively impermeable soil and subsoil. In many of these areas, there will not be a permanent stream along the site boundary.

Measures are required to assist in regulation, monitoring and enforcement of unsewered systems. Supplementary measures have been prepared to identify and address water bodies potentially impacted by existing onsite systems and also to guide future decision making for new developments. The measures use a risk assessment procedure. They are considered here from a technical perspective only and will be subject to further assessment in a socio-economic context within river basin planning.

A key factor is to have a consistent approach across River Basin Districts to planning, site evaluation and assessment, use of guidance and certification of approved systems on installation.

Local authorities permit unsewered systems in Ireland through the Local Government Planning and Development Acts. In addition, duty of care is required in the Water Services Act. With regard to the assessment of sites, guidance is issued by the Environmental Protection Agency and Geological Survey of Ireland, and an updated version of guidance for single house treatment systems is currently at consultation stage. Special management issues arise in the case of large clusters of houses and commercial developments discharging to a single percolation area. Updated guidance will be prepared for such developments by the Environmental Protection Agency.

A risk assessment decision support tool has been prepared, providing pressure layer information, pathway risk mapping and receptor sensitivity mapping. This will allow Local Authorities to evaluate the potential impact of existing systems and to predict the potential impact of proposed systems. An action tracking procedure is recommended.

Validation has been carried out for surface waters by means of field surveys and review of data sources in a catchment in County Monaghan, which is representative of the most significant risk to surface water nationally. For this purpose, the 'National Source Protection Pilot Project' was extended in its duration and activities in line with the requirements of this study. The National Source Protection Pilot Project is continuing to apply the procedures of this study and it is being implemented by the National Centre for Freshwater Studies, Department of Applied Sciences, Dundalk Institute of Technology.

The following measures are proposed:

REDUCE

M1. Amend Building Regulations to confirm:

- Code of Practice for Single Houses (at consultation draft stage at present)
- New Code of Practice for Large Systems
- Certification of the construction of onsite wastewater treatment systems and percolation areas/polishing filters.

M2. Establish Expert Panels:

- Certified national panel of experts for site investigation and certification of installed systems. A second panel of hydrogeologists is required for clusters and large systems.
- National group for formulating polices and coordination of consistent approach.
- A technical advice section or advisory group to coordinate and give advice on emerging and innovative technologies.
- Installation and maintenance training by FAS.

M3. Control of New Development:

- At planning assessment stage, apply the GIS risk mapping / decision support system and codes of practice
- Notice to planning authority required immediately prior to the installation of onsite effluent treatment systems including percolation areas and polishing filters.

REMEDIATE

M4. Inspect Programme of Existing Systems:

- Use the GIS risk mapping / decision support system to prioritise locations to be targeted in a programme of inspections and maintenance
- Use a database and action tracking system

M5. Enforcement

- Enforce requirements for de-sludging and codes of practice.

RELOCATE

M6. Connection to Sewer

- Consider connection to municipal systems

EDUCATION AND AWARENESS

M7. Establish education and awareness programme on outline design, operation and maintenance of systems.

1 INTRODUCTION

Unsewered or on-site wastewater treatment systems constitute a significant diffuse pressure acting on water. The pressure on *groundwater* is described as widespread in the National Summary Characterisation Report prepared under the Water Framework Directive (WFD) (www.wfdireland.ie). With regard to *surface water*, the relative contribution of unsewered systems in terms of nutrient load amounts to 3% for nitrate and 7% for phosphorous, while pathogens have been identified as a particular risk.

The contribution to surface water is illustrated in Figure 1.1

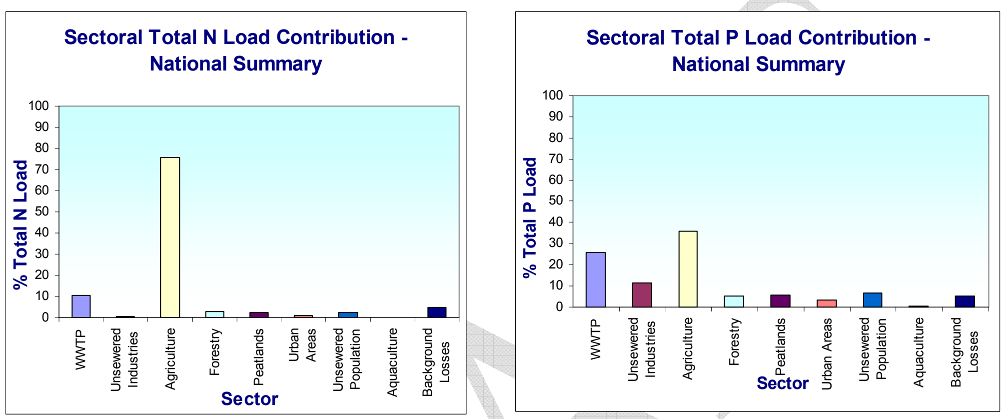

Figure 1.1 Sectoral Nutrient Load

These results were derived from an initial screening of risk to water quality and ecosystems and they indicated the need for further study of OSWTS, to better understand their potential impact on soils, groundwater and surface water downstream.

Septic tanks that are not working properly are thought to be one of the major sources of contamination of drinking water supplies (National Rural Water Monitoring Committee, 2003). With an estimated 200,000 wells and springs in use in Ireland (Wright, 1999), the prevention of groundwater contamination from on-site domestic sewage effluent is of critical importance (Gill *et al*. Environmental Protection Agency, 2005).

Surveys reveal a significant proportion of systems installed prior to current standards and a lack of regular desludging of tanks. Desludging requirements depend on measured scum and sludge buildup, generally related to size of tank and house occupancy level.

Sample inspections point to a majority of systems which are considered sub-standard when compared to current standards, and to a significant minority located in unsuitable soils which may be at serious risk of contaminating surface water bodies, dependant on location and proximity to waterbodies. Compliance with planning permission conditions is an issue that needs to be addressed.

Special management issues arise in the case of large clusters of houses and commercial developments discharging to a single percolation area.

The need for further study of unsewered systems was identified during the preparation of the WFD Characterisation Report, to better understand their potential impact on soils, groundwater and surface water downstream.

The key question is whether ground conditions are suitable. Hydrology of soils, subsoils and geology varies significantly throughout Ireland and hence the extent of treatment likely to be achieved varies. While guidance has been provided by Environmental Protection Agency (EPA) and Geological Survey of Ireland (GSI), additional procedures are required to assist local authorities in regulation, monitoring and enforcement of unsewered systems systems.

Therefore the objectives of this study are:

- to develop an increased understanding of the risk posed by onsite wastewater treatment systems to both surface water and groundwater status;
- to recommend measures to mitigate the risk from existing and future systems; and
- to develop a methodology that can be applied on a national basis in each river basin district.

The study is a contribution to the preparation of the 2008 Programme of Measures of the Water Framework Directive. The list of tasks undertaken is summarised below:

Baseline Pressure Information
Pathway Characterisation
Receptor Sensitivity
Field Survey Validation
Programme of Measures

A series of technical documents and reports were produced as part of this Unsewered Systems National Study and these are listed below:

(1) Unsewered systems contribution to WFD 'Water Matters' Booklet (www.westernrbd.ie)

(2) Presentations at a workshop held in June 2006 (www.westernrbd.ie)

(3) Framework for Site Assessment of Large-Scale On-Site Wastewater Treatment Systems Discharging to Groundwater (Document provided to EPA)

(4) National Source Protection Pilot Project, First and Second Interim Reports 2006-2008, National Rural Water Monitoring Committee

(5) Estimation of Flow Duration Curve for Ungauged Catchments, ESBI / EPA

(6) An Integrated Approach to Quantifying Groundwater and Surface Water Contributions of Stream Flow.

(7) Survey of Sewered Areas in Ireland.

Measures have been prepared using a risk assessment procedure.

2 RISK ASSESSMENT

A national risk assessment approach has been developed, based on a pressure-pathway-receptor framework as illustrated in Figure 2.1. The list of inputs to the risk assessment are discussed below.

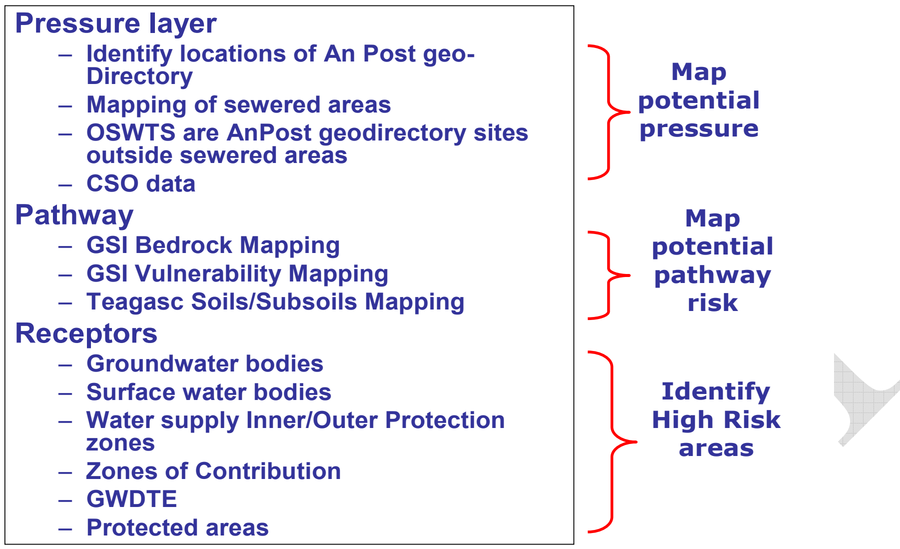

Figure 2.1 Unsewered Systems Pressure- Pathway-Receptor Approach

2.1 National Pressure Information

Data was derived from the Central Statistics Office (CSO) 2006 Census of Population to provide an indication of the extent of unsewered systems within Ireland and also to estimate the age of the individual systems.

In 2006, a total of 1,462,296 households were reported in the Census. 65% were connected to a public scheme, 29% had individual septic tanks and 2% had treatment other than septic tank. The age profile is shown in Figure 2.2 (note that the time interval plotted for the early years is greater than the standard ten years, and the final period is for 5.5 years). The rate of construction of unsewered systems more than doubled around 1970, and it increased significantly again in 2001.

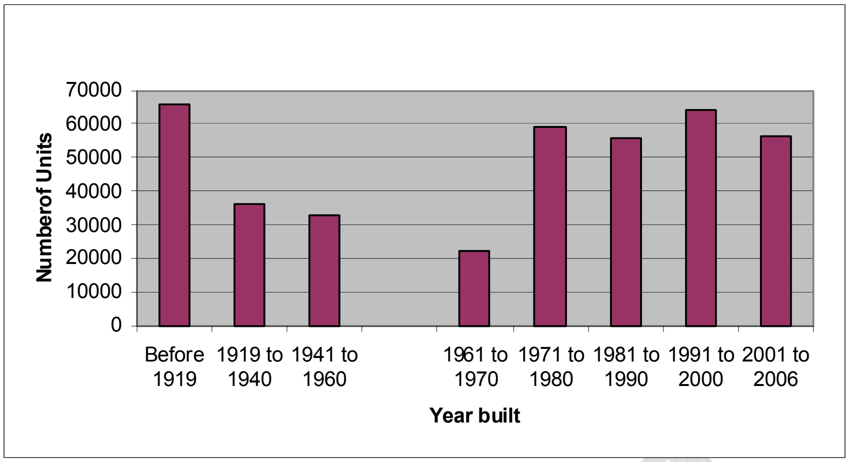

Figure 2.2 Age Profile of One-Off Housing with Unsewered Systems

The Central Statistics Office (CSO) 2006 Census of Population data is presented in Table 2.1 and Figure 2.2.

Table 2.1
Number and Percentage of One-Off Houses in Rural Areas, 2002 and 2006

YEAR	2002			2006		
One-Off Houses	**Total (A1)**	**One-off houses (B1)**	**Percentage of one-off houses (B1/A1)*100**	**Total (A2)**	**One-off houses (B2)**	**Percentage of one-off houses (B2/A2)*100**
Period in which built						
Before 1919	167,033	69,382	41	154,352	65,942	42
1919 to 1940	114,304	37,996	33	107,645	36,209	33
1941 to 1960	146,206	33,362	22	142,414	32,616	22
1961 to 1970	114,010	22,617	19	112,969	21,974	19
1971 to 1980	216,497	60,945	28	212,382	59,124	27
1981 to 1990	170,403	57,769	33	166,021	55,821	33
1991 to 1995	941,99	24,021	25	93,086	23,864	25
1996 to 2000	197,134	48,710	24	154,774	40,425	26
2001 or later	-	-	-	249,443	56,186	22
Not stated	59,831	4,177	6	69,210	4,325	6
Type of sewerage facility						
Public scheme	822,574	-	-	956,239	-	-
Individual septic tank	407,768	358,979	88	418,033	370,458	88
Individual treatment, not septic tank	-	-	-	29,685	26,028	87
Other	8,947	-	-	6,979	-	-
No sewerage facility	7,136	-	-	4,179	-	-
Not stated	33,192	-	-	47,181	-	-

40% of one-off housing was constructed prior to 1970 and 68% prior to 1991.

Of the 29% indicated as being on septic tank systems, 88% (370,458) are associated with one-off housing. The same percentage applies to the housing on individual systems other than septic tanks, ie 88% (26,028) are associated with one-off housing. A further 0.5% indicated other types of treatment systems and 0.3 % of housing indicated that they have no sewerage facilities.

The early systems may have higher potential impact in terms of type of system installed, such as, use of soakaway as opposed to a properly constructed percolation system. However, correct location and correct installation of treatment system and percolation area in accordance with the EPA Manual for Single House Wastewater Treatment Systems is key to minimising the impact on both surface and groundwater from such systems.

An Post Geo Directory provides the location of every postal delivery address nationally. This data has been incorporated into a GIS system and provides the location and distribution of all buildings. County Galway is illustrated as an example in Figure 2.3.

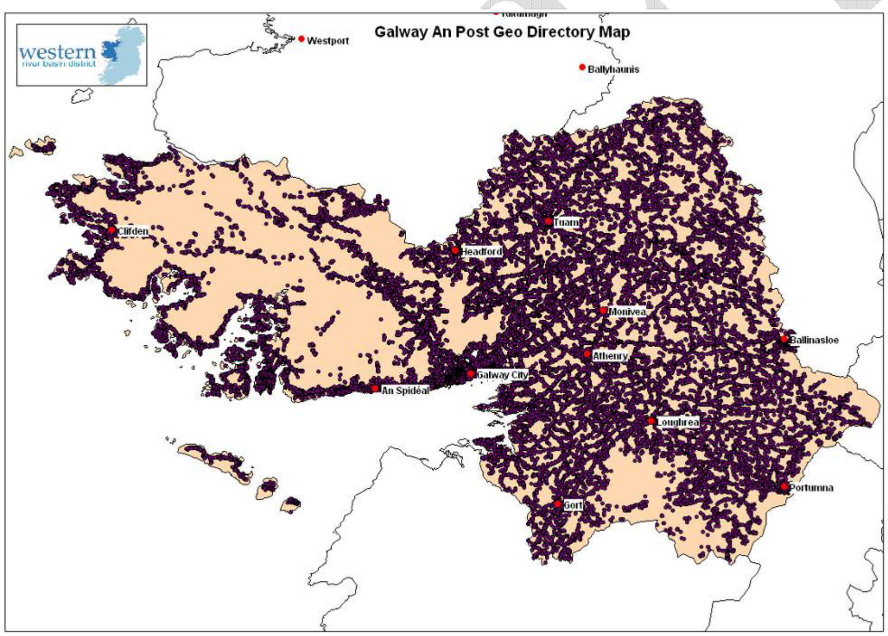

Figure 2.3 An Post GeoDirectory Property Locations in County Galway

To identify unsewered systems not connected to sewer networks, it was necessary to identify and map sewered areas and exclude these areas from the An Post locations database. GIS data for sewered areas with population equivalents greater than 2000 population equivalent (p.e.) was available through the National Urban Wastewater Study, 2004.

A team from the Western RBD Project, in conjunction with the 33 National Local Authorities, compiled maps of sewered areas with less than 2,000 population equivalent, together with additional information as to type of treatment provided, discharge location, population served, etc.

The result is as shown in Figure 2.4 for one sewered area and the distribution throughout the country is shown below in Figure 2.5.

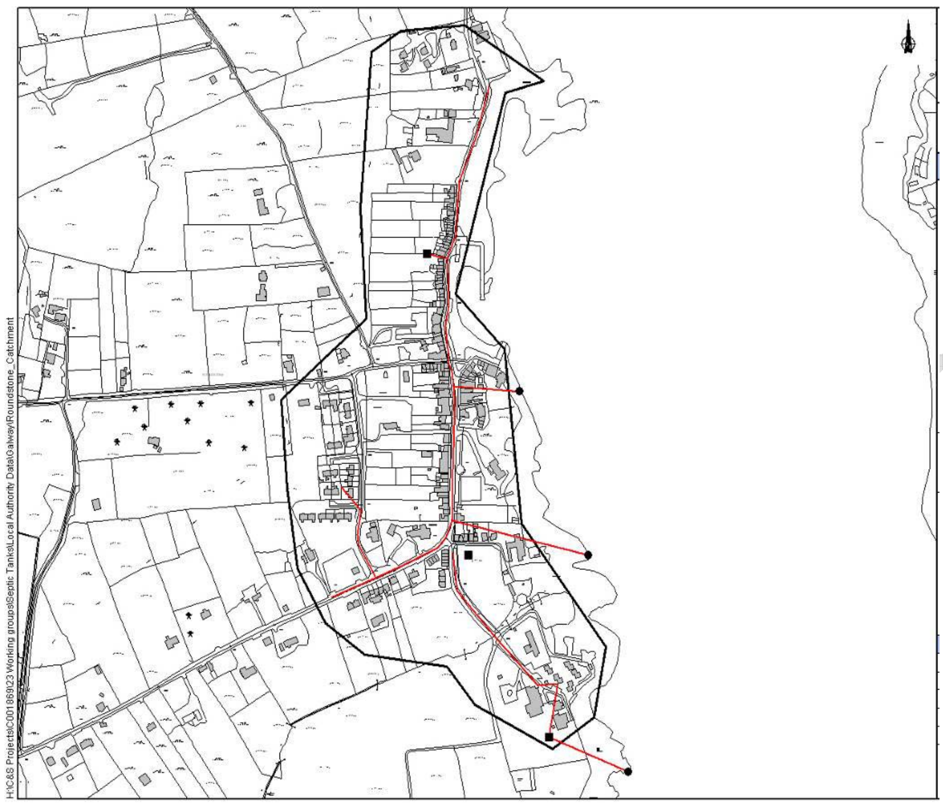

Figure 2.4 Example of Sewered Area Mapping with less than 2,000 pe

Buildings outside these areas have their own independent wastewater treatment system.

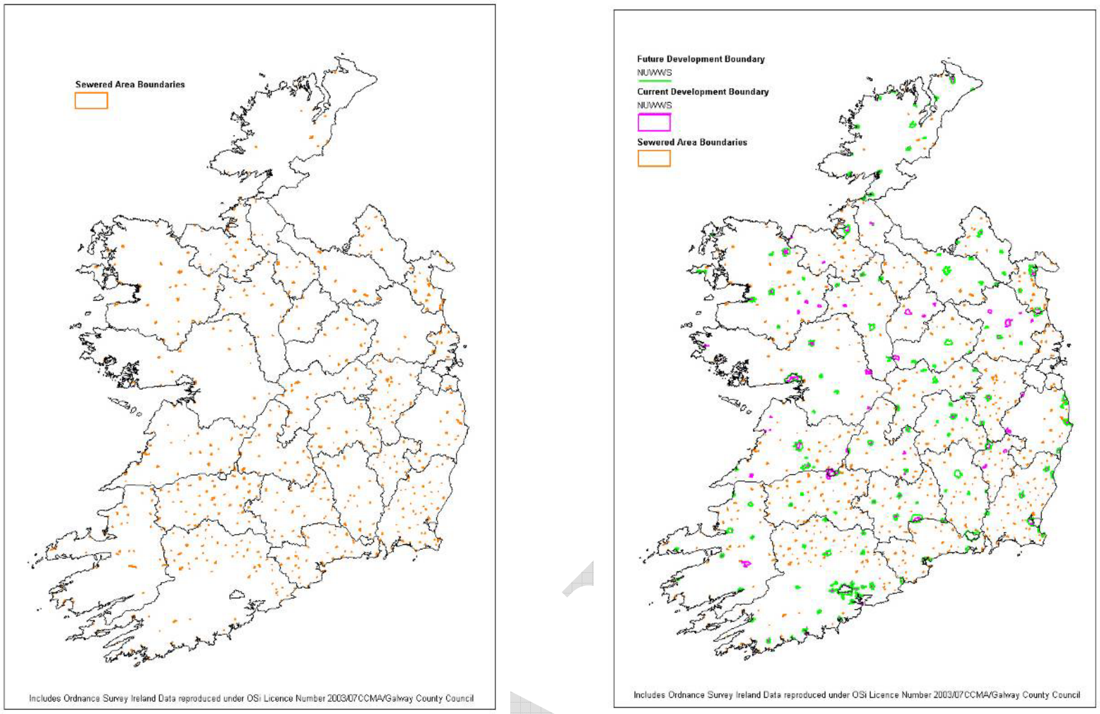

Figure 2.5 Sewered Boundaries, Current and Future Development Boundaries

2.2 Pathway Characterisation Mapping

Two pathway issues must be considered when assessing the adequacy of a site for effluent disposal:

- Will the effluent be treated adequately in the subsoil, prior to reaching groundwater.
- Will the effluent pond at the surface thereby potentially causing backup of effluent which would impair the treatment within the system, health risks and surface water impacts.

Most traditional systems rely on physical, biological, and chemical processes in the septic tank and in the biomat and unsaturated soil zone below the percolation area to remove or attenuate pollutants of concern.

Specific effluent flow pathways from percolation areas include:

(a) to deep groundwater by infiltration – particularly nitrogen, but in the case of vulnerable karst and other shallow rock areas, other pollutants, particularly microbial pathogens, will also persist;

(b) to surface water via soil interflow and shallow groundwater (also to surface water via deep groundwater flow particularly in karst areas); and

(c) to surface water directly overland where soil is saturated or where the percolation system is ineffective – particularly pathogens and phosphorus.

The pathway considers the soil, subsoil and geological settings on which the percolation area is situated.

Where soil depth is inadequate and where subsoil permeability is very high, rapid percolation of pollutants to groundwater can occur. However, the pathogen issue can be solved in most instances by engineering solutions, in particular getting a sufficient thickness of suitable subsoil.

On wet low-permeability subsoils, surface contamination is more likely to occur. The subsoil type, permeability and thickness are critical. A significant proportion of the country has subsoil conditions that are simply unsuitable for percolation areas; the effluent cannot get away.

Nitrogen

The percolation process converts nitrogen from organic matter and ammonia almost entirely into nitrite and then to nitrate. When nitrate reaches the ground water, it moves freely. Reduction of nitrate concentrations in ground water occurs primarily through dispersion and dilution in groundwater.

Phosphorus

Phosphorous is an element occurring naturally in the environment and it has the ability to promote growth in life (including plants). When phosphorous enters water in rivers and lakes, it encourages excessive plant growth. This eutrophication chokes river channels, causes algal blooms in lakes and reduces markedly oxygen levels, all of which effect fish (and other animal) life in the watercourses.

Contamination of surface waters will generally occur in areas with low permeable soils overlying poorly productive aquifers. It may also occur in areas of extreme vulnerability over karst aquifers, through a primary pathway to groundwater and subsequently through a rapid pathway to surface water such as emerging springs.

Pathogens

Pathogens (pathogenic organisms) can cause gastro-enteritis, polio, hepatitis, meningitis and eye infections. Organisms such as *E. coli*, *streptococci* and faecal coliforms, with the same enteric origin as pathogens, indicate whether pathogens may be present or not in wastewater.

The sizes of bacteria range from 0.2 to 5 microns; thus, physical removal through filtration occurs when soil micropores and surface water film interstices are smaller than this.

Persistent organic chemicals are not considered in this study as these are the subject of a separate study by the WFD Dangerous Substances Working Group.

The pathway concept is illustrated in Figure 2.6 for risk to groundwater. Similar procedures have been developed for risk to surface water.

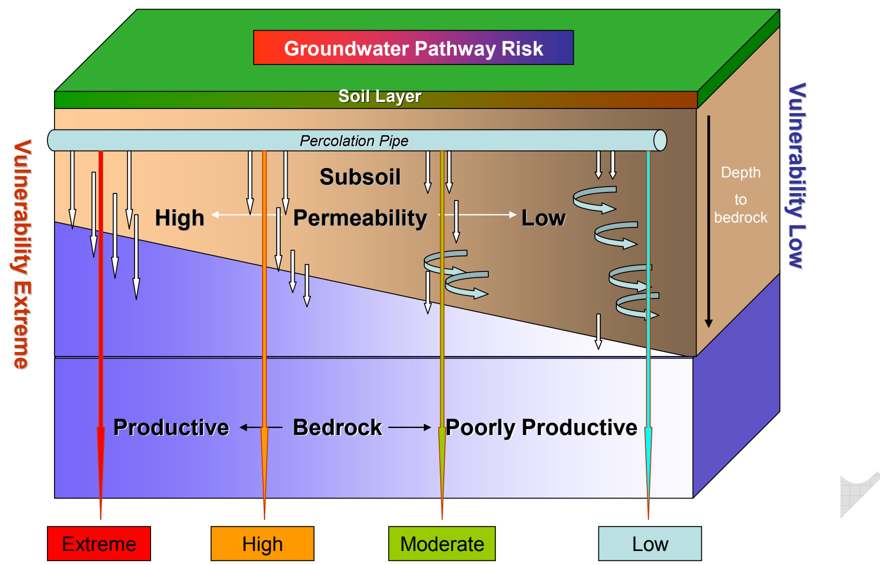

Figure 2.6 Groundwater Pathway Risk Concept

Subsoil permeability, aquifer categories and vulnerability are defined below.

Table 2.2 Subsoil Permeability

Subsoil Permeability	Description
High	High Permeability Subsoil ~ (> 3m thick and with permeability >10-4 m/s); Broadly equate to BS5930 Gravel, sandy Gravel and Sand
Moderate	Moderate permeability subsoil ~ (Subsoil >3m thick and with permeability in range 10-4 - 10-8 m/s.) Broadly equates to BS5930; silty SAND, clayey SAND, SILT, sandy SILT, some SILT/CLAY and some sandy SILT/CLAY (as well as the gravelly equivalents of each of these).
Undifferentiated	Undifferentiated Moderate to Low Permeability Subsoil (percolation rates are variable)
Low	Low Permeability Subsoil ~ (>3m thick and with permeability <~10-8 m/s.); Broadly equates to BS 5930;some SILT/CLAY, some sandy SILT/CLAY, CLAY, sandy CLAY, and the gravelly equivalents of each of these.

Table 2.3 Aquifer Categories

Rk	Regionally important karstified aquifer	Productive
Rf	Regionally important bedrock aquifer with fissure flow	Productive
Rg	Regionally important sand/gravel aquifer (<10sq km)	Productive
Lm	Locally important aquifer, bedrock that is moderately productive	Productive
Lg	Locally important aquifer, sand and gravel (>1sq km, < 10 sq km)	Productive
Ll	Locally important aquifer, bedrock that is moderately productive in localised zones	Poorly Productive
Pl	Poor aquifer, bedrock, except in localised zones	Poorly Productive
Pu	Poor aquifer, bedrock	Poorly Productive

Vulnerability to groundwater depends on subsoil type and depth of subsoil as indicated in Table 2.4.

Table 2.4 Vulnerability Categories

X	(1) Outcropping bedrock at the land surface or (2) subcrop within 1m of the surface
E	(1) Depth to bedrock less than 3m, permeability variable, (2) within 15m of karst features
High	(1) High permeability sand and gravel, more than 3m depth, (2) Moderate perbility subsoil, more than 3m and less than 10m depth, (3)low permeability subsoil, 3 – 5m depth
Moderate	Moderate permeability subsoil, more than 10m depth, (2) Low permability subsoil, 3-5m depth
H/M/L	Depth to bedrock more than 3m, exact depth and type of subsoil not mapped
L	Greater than 10m low permeability subsoil

Pathway Risk Matrices

Risk assessment matrices were developed to map the potential pathway risk to both surface water and groundwater for pathogens, for phosphorus and for percolation impairment. The nitrate potential impact pathway has been considered separately by the WFD National Groundwater Working Group.

The geology and hydrogeology of any region have a major bearing on: (i) the availability of suitable areas for discharge to ground from unsewered systems; (ii) the level of natural protection for groundwater and surface water from contamination by treated wastewater; and (iii) the design, operation and maintenance of unsewered systems.

Groundwater protection schemes, supported by detailed investigations, provide hydrogeological information. They are used to identify areas where firstly, unsewered systems pose a significant threat to groundwater, therebv requiring special measures to prevent pollution and secondly, areas where they are less likely to pose a risk to groundwater or surface water.

Site assessors and installers of new systems should have regard both to the resource potential and the vulnerability of the underlying and adjacent aquifers. The risk matrices of contamination from pathogens, nitrate and phosphate combine these factors into a matrix which facilitates rational decisions on the acceptability or otherwise of unsewered systems from a hydrogeological point of view.

The matrices will allow:

- an evaluation of the areas where the risk of various pollutants reaching large scale drinking water supplies is at its highest;
- an evaluation of the areas where the risk of various pollutants reaching domestic wells is at its highest;
- ranking of which areas have the highest possibility of pollution of aquifers by various contaminants;
- ranking of which areas have the highest possibility of pollution of surface waters by various contaminants;
- correlation of the above risk areas with monitored and sampled data, to examine relationships between interpreted risks and actual target status;
- an examination of where best to potentially site future drinking water supplies in areas of low risk and low contamination loading.

Risk Matrices for Pathogens and Phosphates

The matrices for pathogens and phosphorous risk assume a release point of contaminants within the subsoil, and bypassing the topsoil, i.e. between 1m and 2m below ground level. They take into account vulnerability, presence of alluvium and aquifer class for pathogens (i.e. aquifer, subsoil depth and subsoil permeability); data on vulnerability, aquifer class, mineral versus non-mineral subsoil, wetness, and permeability of the subsoil.

The existing response matrices for unsewered systems should not be utilised in conjunction with these matrices, as these are designed to guide assessors and planners to what is required on-site when an investigation has actually been made, and when actual 3-D point information is known about the site. With the risk matrices here, the intention is to 'virtually' assess the risk related to the presence of existing systems, without the site specific 3-D information. This matrix will therefore allow sites to be ranked as to their risk as is; the next step may or may not include prescribing an actual assessment of the site using trial holes and tests, whereby the existing response matrices for on-site systems will come into play.

There are four colour codings on the matrices which can notionally be equated to

- red = extreme (80-100),
- orange = high (50-70),
- green = moderate (25-40) and
- blue = low (10-20).

The number coding is arbitrary, rather than being linked to a percentage score. Multiples of 5 are used as these allow easier breakdown/display both conceptually and within the GIS.

Combining aquifer bedrock type and vulnerability rating in a GIS identified the full range of areas from severe to low pathway risk rating, for each pollutant type. For example, the risk matrix for pathogen pathway to groundwater is shown in Table 2.5. High scores in the tables below indicate high pathway risk to groundwater.

Table 2.5 Risk to Groundwater based on Vulnerability - Pathogens

Aquifer		Rk/Lk	Rf/Lm	Rg/Lg	Ll	Pl/Pu
Alluvium [1]		100	100	100	100	100
Vulnerability	X [2]	100	100	N/A	90	90
	E [3]	90	90	70	80	80
	High [4]	60	40	40	40	40
	Moderate [5]	20	20	N/A	20	20
	M/L [6]	20	40	N/A	40	40
	Low [7]	10	10	N/A	10	10

Notes:

1 Risk at a maximum and constant across all areas liable to flood within the landscape.
2 Risk at a maximum in regionally important aquifers, and very high and constant across all 'X' areas within the landscape.
3 Risk is slightly reduced where thin topsoil and subsoil cover extends over bedrock subcrop, but still very high.
4 Risk lower here as all pathogens should be treated within the 3m of subsoil present; however, still a slightly higher risk in karst areas owing to a highly uneven and fractured subsoil/bedrock interface.
5 Risk again much lower across all aquifers (where applicable).
6 Risk must be assumed for the worst-case scenario, hence the risk classes for 'high' vulnerability are repeated here.
7 Risk constant and at a virtual minimum across all aquifer types. There is still a potential risk, however, hence the positive rating, rather than one of 'zero'.

Table 2.6 Risk to Groundwater based on Vulnerability - Phosphorous

Aquifer		Rk/Lk		Rf/Lm		Rg/Lg		Ll		Pl/Pu	
Topsoil		*Mineral*	*Peat*	*Mineral*	*Peat*	*Mineral*	*Peat*	*Mineral*	*Peat*	*Mineral*	*Peat*
Vulnerability	E and X [2]	100	95	100	95	100	95	100	95	100	95
	High [3]	45	60	45	60	45	60	45	60	45	60
	Moderate [4]	30	30	20	20	N/A	N/A	20	20	20	20
	M/L [5]	45	60	45	60	N/A	N/A	45	60	45	60
	Low [6]	10	10	10	10	N/A	N/A	10	10	10	10

Notes:

1 It should be noted that, though P does not pose a threat to groundwater as a receptor, the risk matrix can still be applied and helps in the conceptual modelling of areas under threat from potential surface water P enrichment.

2 Risk very high in all areas of extreme vulnerability. With thin, peaty soils, the risk is slightly lower, as less 'P' infiltrates.

3 Risk much lower here as there exists deeper subsoil, but there is still a relatively high possibility of chemical contamination of groundwater following leaching through 3m of subsoil, hence the risk is again higher than for pathogens. The same principle as above for peat soils and subsoils holds.

4 Risk drops significantly here, as we are in only moderate and low permeability subsoils of considerable depth.

5 Risk must be assumed for the worst-case scenario, hence the risk classes for 'high' vulnerability are repeated here.

6 Risk constant and at a virtual minimum across all aquifer types (where applicable). There is still a potential risk, however, hence the positive rating, rather than one of 'zero'.

Table 2.7 Risk to Surface Water, based on Vulnerability and Subsoil - Pathogens

Aquifer		Rk/Lk	Rf/Lm	Rg/Lg	Ll	Pl	Pu
Vulnerability	X [1]	90	50	N/A	50	80	90
	E [2]	80	20	20	50	80	90
Subsoil Permeability	High [3]	20	20	20	30	50	50
	Moderate [4]	40	40	N/A	50	50	50
	M/L [5]	100	100	N/A	100	100	100
	Low [6]	100	100	N/A	100	100	100

Notes:

1 With outcropping karst, the risk to surface water is very high as there is no attenuation in the karst system, followed by discharge. Over unproductive aquifers (often with outcrops/subcrop with few fractures) the risk is also very high.

2 Again risk quite low only on the non-karst and moderate productivity aquifers.

3 Risk low here as there is deeper (>3m), permeable subsoil which should attenuate and filter out pathogens before they reach the water table.

4 Risk again relatively low across all aquifers, as deep subsoil of moderate permeability should attenuate contaminants as they pass vertically through the material, excepting sand and gravel aquifer where moderate permeability subsoil is absent.

5 Risk must be assumed for the worst-case scenario, hence the risk classes for 'low' permeability which follow are repeated here.

6 Risk at a maximum and constant across all 'L' areas within the landscape, excepting sand and gravel aquifer where low permeability subsoil is absent.

Table 2.8 Risk to Surface Water, based on Vulnerability and Topsoil/Subsoil Type and Permeability- MRP and Total Phosphorous

Aquifer		Rk/Lk		Rf/Lm		Rg/Lg		Ll		Pl/Pu	
Topsoil		*Dry soil*	*Peat/Wet soil*	*Dry soil*	*Peat/Wet soil*	*Dry soil*	*Peat/Wet soil*	*Dry soil*	*Peat/Wet soil*	*Dry soil*	*Peat/Wet soil*
Vulnerability	X [1]	90	80	30	90	N/A	N/A	50	90	80	90
	E [2]	75	80	30	60	20	50	50	60	80	90
Subsoil Permeability	High [3]	20	80	20	80	20	80	20	80	20	80
	Moderate [4]	30	90	30	90	N/A	N/A	30	80	30	80
	Low [5]	90	100	90	100	N/A	N/A	90	100	90	100
	M/L [6]	90	100	90	100	N/A	N/A	90	100	90	100

Notes:

1 Risk very high in outcropping karst, and high with thin, peat/wet soil over fractured aquifers; decreases slightly in non-karst bedrock aquifers with dry soil but high in poor aquifers regardless of soil type (related to lack of fractures).

2 Where 1m-3m of soil and subsoil, risk to surface water is relatively low in productive and fissured aquifers, but increases on karstified and poor aquifers.

3 With high K subsoil and dry soil, infilltration occurs and phosphorous risk to surface water is minimal. However, with peat or wet soils, and thick sediment, the risk increases markedly .

4 With moderate K subsoil and dry soil, infilltration occurs and phosphorous risk to surface water is still low. However, with peat or wet soils, and thick sediment, the risk increases markedly .

5 With low permeability subsoil and sediment >3m thick, runoff dominates and the risk to surface water is at very high, and a maximum with wet soil or peat.

6 Here we assume worst-case scenario, where low permeability subsoil and sediment >3m thick exists, therefore the conceptual model is of runoff dominating and the risk to surface water very high or at a maximum.

Groundwater risk

The risk to groundwater from pathogen contamination depends in the majority on the vulnerability at the site, i.e. the depth and permeability of the subsoils. For pathogen risk, the greatest risk is within the top 3m, hence the consistent high weighting in ‘E’ (less than 3m) and ‘X’ (outcrop and less than 1m) areas only. When assessing risk to groundwater from pathogen contamination, all 'X' vulnerability areas have a maximum score. Particular attention should be given to the thin bands of 'X' along sinking rivers; this may be a band on either side of the watercourse, and not the watercourse itself.

Where depth and permeability of subsoil outside sand and gravel areas has not been mapped, then the precautionary principle applies, i.e. high vulnerability.

For phosphorous risk, the contaminant has usually disappeared by the time the treated wastewater reaches the water table, where there is more than 3m of subsoil. Areas of mineral subsoil and peat subsoil have been ranked separately, as less 'P' infiltrates in peat subsoil material.

Examples of the resulting risk maps are shown below for County Galway.

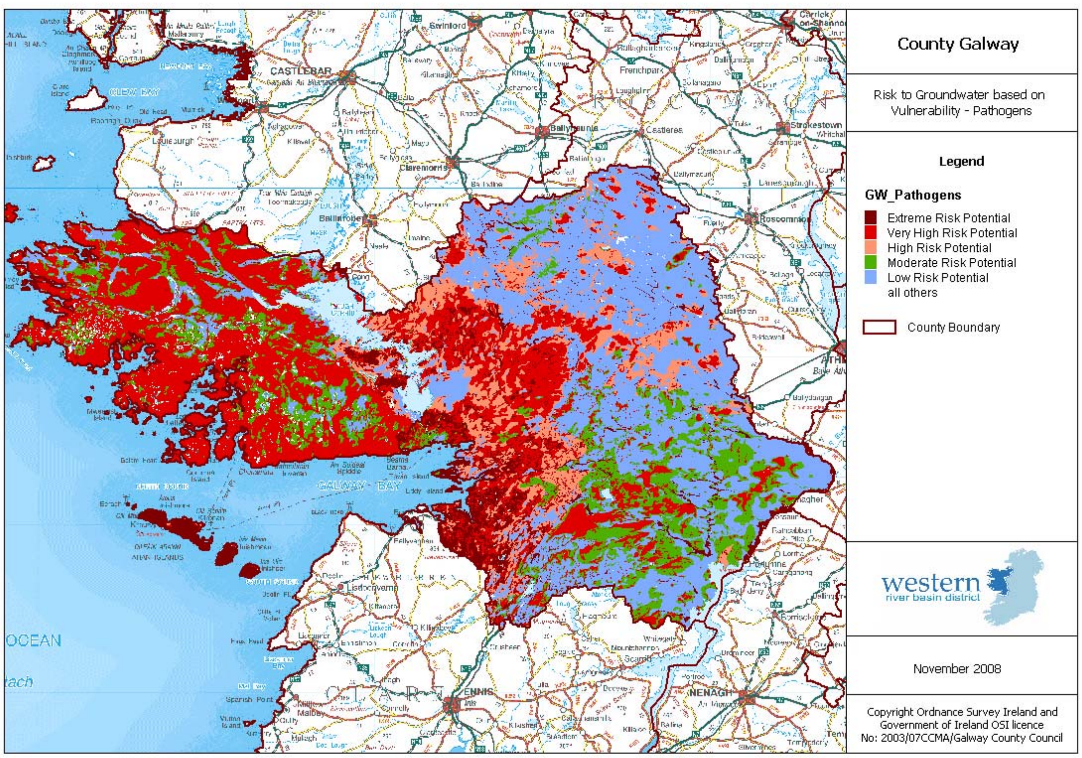

Figure 2.7 Pathogen Risk to Groundwater

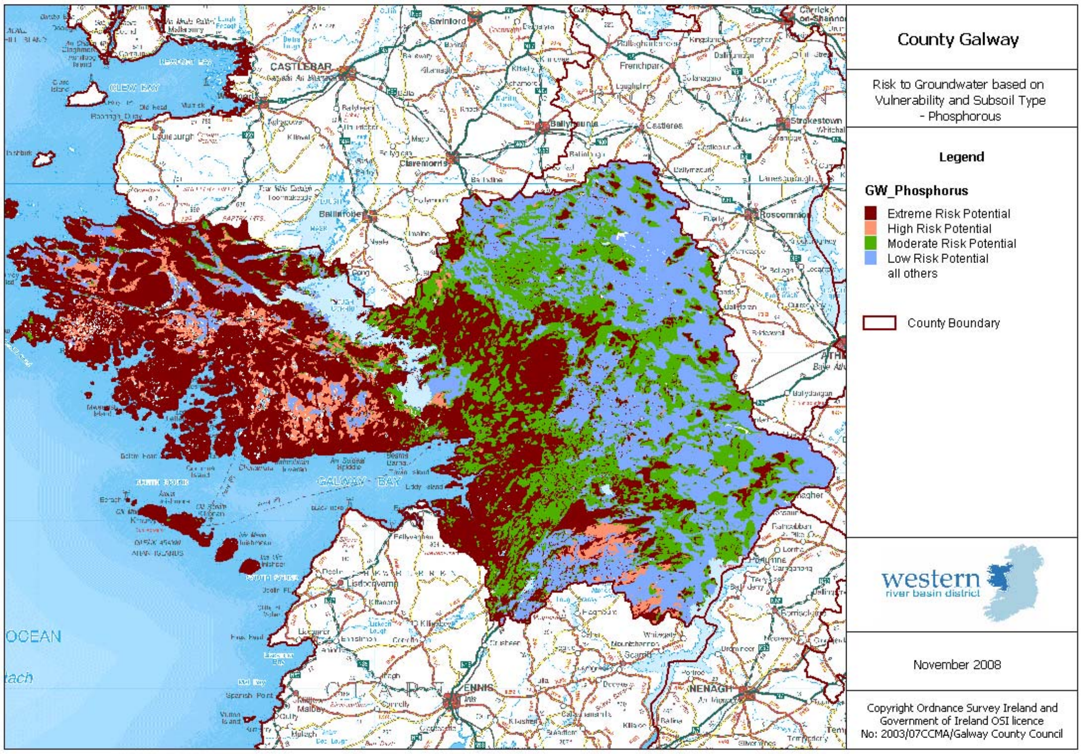

Figure 2.8 Phosphorous Risk to Groundwater

Surface water risk

When ranking risk to surface water from phosphorous, areas of well drained topsoil, poorly drained topsoil, and peaty topsoils have been ranked separately, as more 'P' runs-off the land surface in poorly drained and peaty soils. Where depth and permeability of subsoil has not been mapped in Groundwater Protection Schemes, then the precautionary principle applies, i.e. low vulnerability.

All low vulnerability areas have a maximum risk score (the surface water matrices in these areas are a 'mirror' of the groundwater ones).

Notionally, it might be expected that the Groundwater Risk and Surface Water risk add up to 100 in all classes. However, as risk to groundwater is based chiefly on vulnerability, but as risk to surface water includes information on vulnerability and aquifer type, as well as soil wetness, 'peatyness' and subsoil permeability, this is not the case.

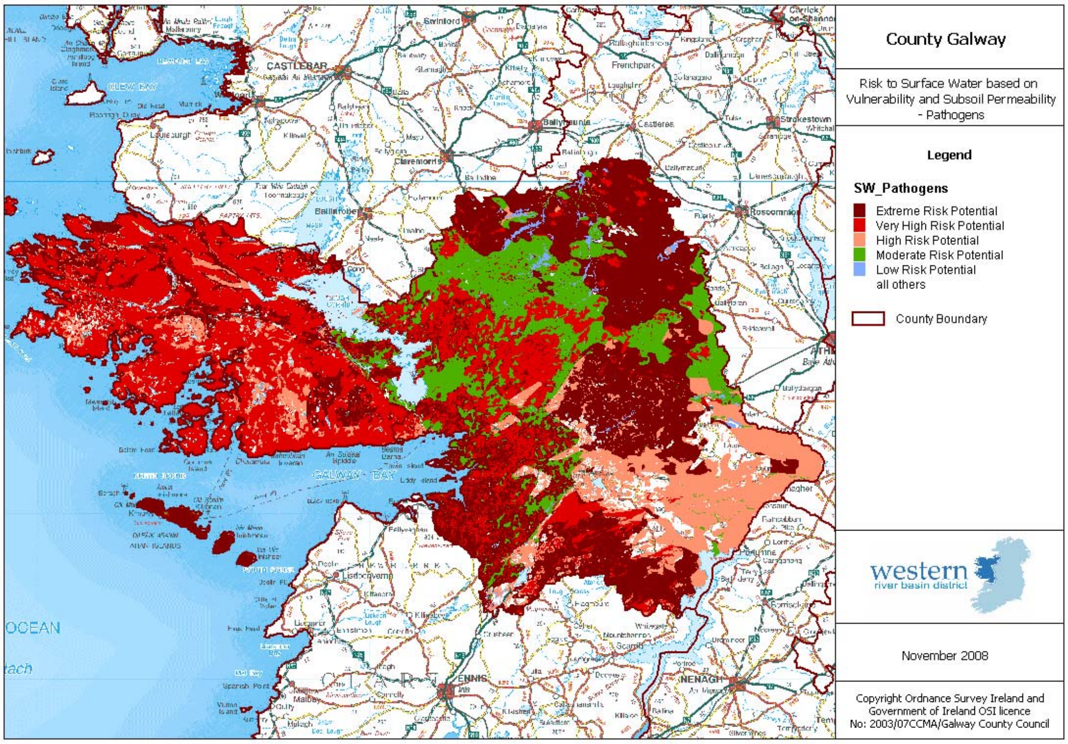

Figure 2.9 Pathogen Risk to Surface Water

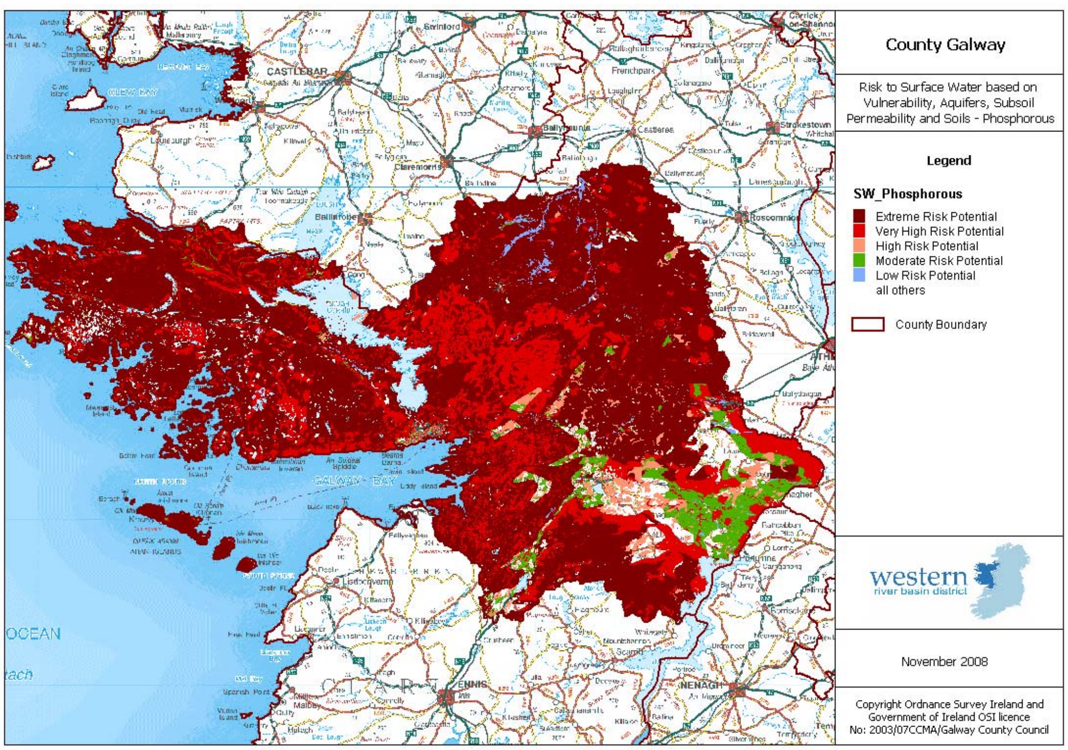

Figure 2.10 Phosphorous Risk to Surface Water

Likelihood of Inadequate Percolation from Single House

This matrix ranks the likelihood of unsewered systems having an inadequate percolation rate based on their aquifer type, vulnerability and subsoil permeability. The rankings are intended to give a general guide to percolation conditions in the different geological and hydrogeological settings present in Ireland. However, as these settings are complex in some areas, exceptions can be expected. Therefore the site suitability assessment procedure given in the EPA Wastewater Treatment Manual (2000) should be used to decide on site-scale conditions.

Where subsoil is absent or very thin, vulnerability is extreme. In bedrock areas where the vulnerability is classed as extreme (with soil/subsoil <3 m thick), the subsoil permeability can be variable and therefore has not been mapped by the GSI. The percolation rate is often influenced by the type and permeability of the underlying bedrock.

Elsewhere in the landscape, subsoil permeability is the primary determinant of the percolation rate, and hence of its adequacy or inadequacy for discharge to groundwater. Permeability is ranked as being high, moderate or low, with quoted permeabilities associated with British Standard descriptions, and empirical permeability values, intended as a guide. The matrix assumes that where permeability is taken account of, a minimum level of subsoil is present over the bedrock aquifer.

In the matrix the associated conditions within each aquifer and vulnerability/permeability combination are described, with respect to the factors affecting percolation rate, whether or not there are potential constraints relating to water table or to the expected soil conditions. Groundwater discharge zones, low lying areas and flat areas may have groundwater levels close to surface in winter and may have water table constraint issues.

There are four colour codings on the matrix which can notionally be equated to the ranking of the likelihood of inadequate percolation *i.e.*

- green = low,
- yellow = moderate,
- orange = high,
- purple = very high.

The likelihood of inadequate percolation arising at a site is subdivided into seven categories

- low -high confidence,
- low - low confidence,
- moderate- high confidence,
- moderate - low confidence,
- high,
- very high,
- undifferentiated high to low.

These reflect the confidence levels in the permeability data, relating to whether or not extensive or reconnaissance mapping of subsoil permeability has been carried out by the GSI. High confidence classes occur in areas with completed Groundwater Protection Schemes.

Where Groundwater Protection Schemes have not been fully developed (shown by areas of undifferentiated high to low vulnerability), subsoil permeabilities are assigned by the GSI on the basis of subsoil maps. Hence, confidence in the risk assessment will be reduced for these areas. Low confidence areas include areas where subsoil permeabilty has only recently been mapped but not finalised or not mapped but predicted on the basis of mapping similar subsoils in adjacent or other counties.

Where areas are mapped as undifferentiated moderate to low permeability subsoil, the precautionary principle applies and the setting defaults to low permeability.

Table 2.9
Likelihood of Inadequate Percolation for Single House Treatment Systems
Extreme Vulnerability

Aquifer: *Vulnerability /Subsoil Permeability:*	*Karst (Rk, Lk) (conduit flows, high velocities)*	*Sand and Gravel (Rg, Lg) (intergranular flow with high transmissivity)*	*Productive bedrock (Rf, Lm) (high to moderate transmissivity, long underground flowpaths)*	*Poorly Productive Bedrock (Ll) (low transmissivity, short flowpaths)*	*Poorly Productive Bedrock (Pl, Pu), (very low transmissivity, short flowpath*
Extreme Vulnerability (Subsoil thickness 0-3m and in vicinity of karst features). (Subsoil permeability variable and not considered in assessment; this should be considered in the site assessment).	*Percolation rate depends on depth to bedrock, subsoil type and the potential presence of preferential flowpaths owing to shallow depths to bedrock but generally satisfacfactory; water table not a constraint; well drained soils dominate.*	*Percolation rate high; water table <3m from surface but not usually a constraint; well drained soils dominate*	*Percolation rate depends on depth to bedrock and subsoil type; but generally satisfactory; water table not a constraint; wll drained soils dominate.*	*Percolation rate variable; winter water table may be high in low lying or flat areas; lateral groundwater movement may be limited in some circumstances; variable soils or bare rock dominate.*	*Percolation rate variable but often problematical; lateral groundwater movement limited; rainfall runoff predominates; shallow water table especially in winter; poorly drained soils, peats or bare rock dominate.*
Likelihood of inadequate percolation	*Low*	*Low*	*Low*	*High*	*Very high*
Single House OSWTS percolation issues	*Percolation generally adequate and no hydraulic issue*	*Percolation generally adequate and no hydraulic issue.*	*Percolation generally adequate and no hydraulic issue*	*Percolation may be variable and in low lying or flat areas hydraulic issues may arise; careful site assessments focussing on potential hydraulic problems required.*	*Percolation often inadequate and lateral groundwater movement often restricted, thereby giving rise to hydraulic issues*

Table 2.10
Likelihood of Inadequate Percolation for Single House Treatment Systems
High Permeability Subsoil

Aquifer: / Vulnerability /Subsoil Permeability:	Karst (Rk, Lk) (conduit flows, high velocities)	Sand and Gravel (Rg, Lg) (intergranular flow with high transmissivity)	Productive bedrock (Rf, Lm) (high to moderate transmissivity, long underground flowpaths)	Poorly Productive Bedrock (Ll) (low transmissivity, short flowpaths)	Poorly Productive Bedrock (Pl, Pu), (very low transmissivity, short flowpath
High Permeability Subsoil ~ (> 3m thick and with permeability >10-4 m/s); Broadly equate to BS5930 Gravel, sandy Gravel and Sand	Percolation rate high; water table not a constraint; well drained soils dominate.	Percolation rate high; > 3m of subsoil; water table not a constraint; well drained soils dominate.	Percolation rate high; water table not a constraint; well drained soils dominate.	Percolation rate high; water table may be near-surface or deeper depending on depth of sand/gravel subsoil; lateral groundwater movement may be limited in bedrock; well drained soils dominate.	Percolation rate high; water table may be near-surface or deeper depending on depth of sand/gravel subsoil; lateral groundwater movement may be limited in bedrock; well drained soils dominate.
Likelihood of inadequate percolation	Low	Low	Low	Moderate	Moderate
Single House OSWTS percolation issues	Percolation generally adequate and no hydraulic issue	Percolation generally adequate and no hydraulic issue	Percolation generally adequate and no hydraulic issue	Percolation generally adequate and no hydraulic issue but lateral groundwater movement may be limited if water table a constraint	Percolation generally adequate and no hydraulic issue but lateral groundwater movement may be limited if water table a constraint

Table 2.11
Likelihood of Inadequate Percolation for Single House Treatment Systems
Moderate Permeability Subsoil

Aquifer: / Vulnerability /Subsoil Permeability:	Karst (Rk, Lk) (conduit flows, high velocities)	Sand and Gravel (Rg, Lg) (intergranular flow with high transmissivity)	Productive bedrock (Rf, Lm) (high to moderate transmissivity, long underground flowpaths)	Poorly Productive Bedrock (Ll) (low transmissivity, short flowpaths)	Poorly Productive Bedrock (Pl, Pu), (very low transmissivity, short flowpath
Moderate permeability subsoil ~ (Subsoil >3m thick and with permeability in range 10-4 - 10-8 m/s.) Broadly equates to BS5930; silty SAND, clayey SAND, SILT, sandy SILT, some SILT/CLAY and some sandy SILT/CLAY (as well as the gravelly equivalents of each of these).	Percolation rate moderate, water table not a constraint; well drained soils dominate.	Limited to small areas of country only	Percolation rate moderate; water table not a constraint; well drained soils usually dominate.	Percolation rate moderate; water table often not a constraint but this depends on a) the depth of subsoil, b) the permeability of the subsoil (i.e. proximity to lower permeability figure) and upper aquifer layers and c) the topographic setting; soils variable.	Percolation rate moderate; water table often not a constraint but this depends on a) the depth of subsoil, b) the permeability of the subsoil (i.e. proximity to lower permeability figure) and upper aquifer layers and c) the topographic setting; soils variable.
Likelihood of inadequate percolation	Low	Moderate where this setting occurs	Low	Moderate	Moderate
Single House OSWTS percolation issues	Percolation generally adequate and no hydraulic issue	Limited to small areas of country	Percolation generally adequate and no hydraulic issue.	Percolation generally adequate and no hydraulic issue but lateral groundwater movement may be limited if water table a constraint	Percolation generally adequate and no hydraulic issue but lateral groundwater movement may be limited if water table a constraint

Table 2.12
Likelihood of Inadequate Percolation for Single House Treatment Systems
Low Permeability Subsoil

Aquifer: ***Vulnerability /Subsoil Permeability:***	***Karst (Rk, Lk) (conduit flows, high velocities)***	***Sand and Gravel (Rg, Lg) (intergranular flow with high transmissivity)***	***Productive bedrock (Rf, Lm) (high to moderate transmissivity, long underground flowpaths)***	***Poorly Productive Bedrock (Ll) (low transmissivity, short flowpaths)***	***Poorly Productive Bedrock (Pl, Pu), (very low transmissivity, short flowpath***
Low Permeability Subsoil ~ (>3m thick and with permeability <~10-8 m/s.); Broadly equates to BS 5930;some SILT/CLAY, some sandy SILT/CLAY, CLAY, sandy CLAY, and the gravelly equivalents of each of these.	***Percolation rate low except at karst features (e.g. swallow holes, dolines); rainfall runoff predominates; generally shallow 'perched' water table in winter; poorly drained soils dominate. Preferential flowpaths may assist percolation where subsoil thickness is <5m)***	***Limited to small areas of country***	***Percolation rate low; rainfall runoff predominates; generally shallow 'perched' water table; poorly drained soils dominate. Preferential flowpaths may assist percolation where subsoil thickness is <5m)***	***Percolation rate frequently low; rainfall runoff predominates; generally shallow 'perched' water table; poorly drained soils dominate.***	***Percolation rate low; rainfall runoff predominates; generally shallow 'perched' water table; poorly drained soils dominate.***
Likelyhood of inadequate percolation	***High***	***Possibly Very High where this setting occurs***	***High***	***Very High***	***Very High***
Single House OSWTS percolation issues	***Percolation often inadequate and therefore water table a constraint in winter. Hydraulic issues likely.***	***Limited to small areas of the country***	***Percolation often inadequate and therefore water table a constraint in winter. Hydraulic issues likely.***	***Percolation frequently inadequate and therefore water table a contraint in winter. Hydraulic issues highly likely.***	***Percolation frequently inadequate and therefore water table a contraint in winter. Hydraulic issues highly likely.***

The tables above are intended to give a general guide to percolation conditions in the different geological and hydrogeological settings present in Ireland. However, as these settings are complex in some areas, exceptions can be expected. Therefore the site suitability assessment procedure given in the EPA Wastewater Treatment Manual (2000) should be used to decide on site-scale conditions. Where areas are mapped as undifferentiated moderate to low permeability subsoil, the precautionary principle applies and the setting defaults to low permeability. Groundwater discharge zones, low lying areas and flat areas may have groundwater levels close to surface in winter and may have water table constraint issues.

The resulting risk for County Galway is shown in Figure 2.11.

In County Limerick, an inspection programme has documented locations and status of unsewered systems. These are shown below in Figure 2.12. Many systems located in high risk areas passed the suitability inspection (shown in blue). This highlights the fact that, although the mapping indicates a likelihood of inadequate percolation, in many instances an engineering solution can be found. The solution needs to pay particular attention to subsoil conditions.

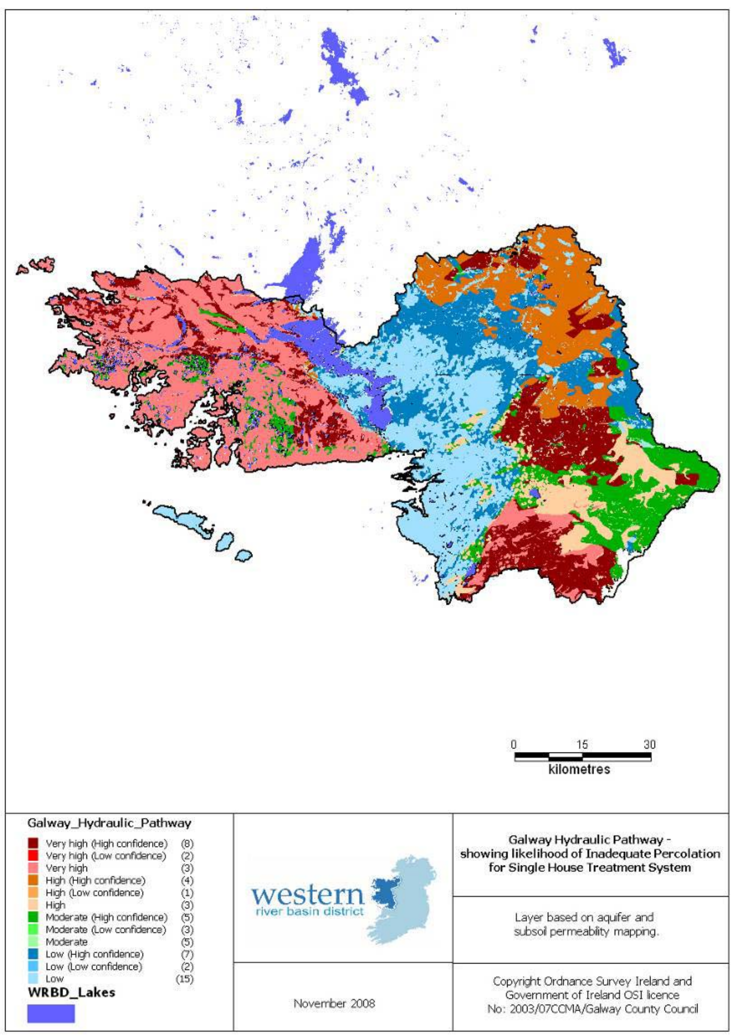

Figure 2.11 Likelihood of Inadequate Percolation in County Galway

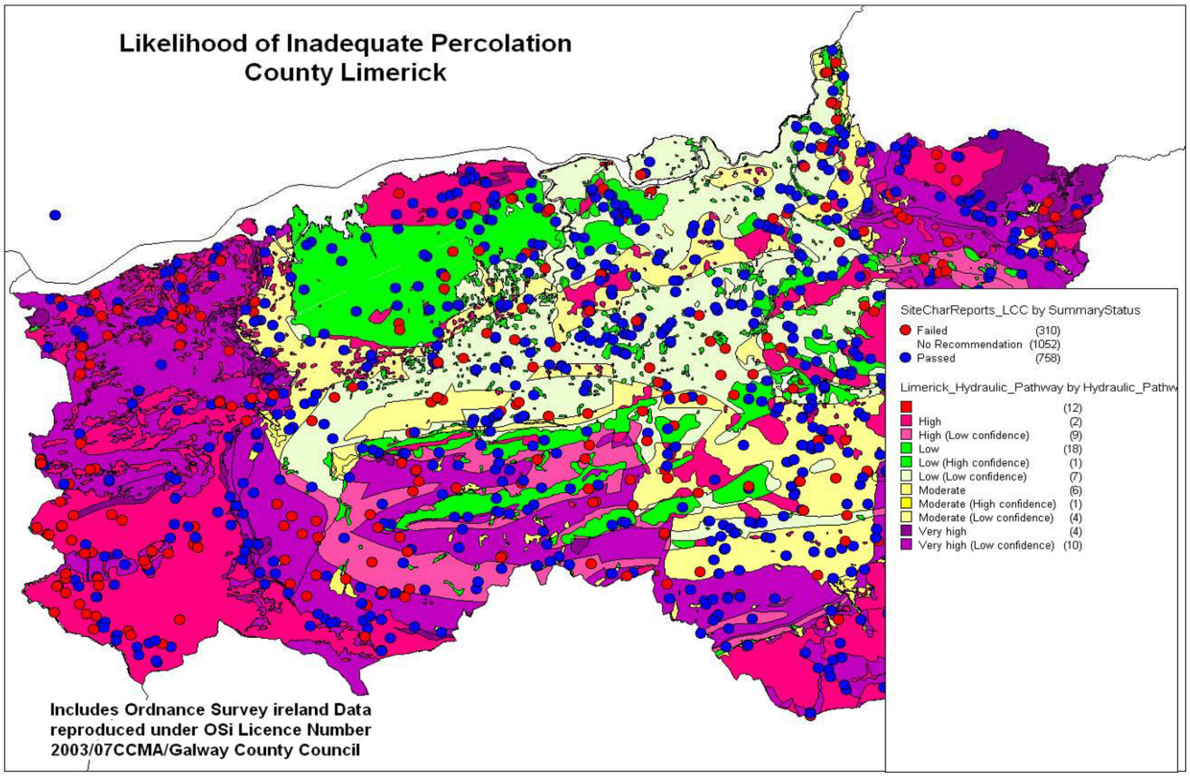

Figure 2.12 Likelihood of Inadequate Percolation in County Limerick

Similar risk maps have been rolled out to all Local Authorities.

The results are generally in line with those from a project underway in Northern Ireland on unsewered systems. This SNIFFER project has highlighted incidence of high risk systems (up to 35% overall) and evidence of nutrient levels and ecological observation, showing that septic tank problems are not evenly distributed. Clusters of poorly maintained systems cause particular problems.

2.3 Receptors

Receptors include both surface and groundwater, such as aquifers, rivers, lakes, estuaries and coastal areas. Receptors also include protected areas and groundwater and surface water dependent terrestrial ecosystems.

A wide range of receptors must be considered in the risk assessment:

- Surface Water Drinking Water Abstraction: Where severe or very high pathway risk to surface water are mapped within Safeguard Zones (WFD - Article 7)
- Groundwater Drinking Water Abstraction: Where severe or very high pathway risk to groundwater are mapped within Safeguard Zones (WFD - Article 7)

- Bathing waters: Where severe or very high pathway risk are mapped within catchments contributing to surface or ground water flow to designated bathing areas.
- Shellfish Waters: Where severe or very high pathway risk are mapped within catchments contributing to surface or ground water flow to designated shellfish waters.
- Protected Habitats and Species, including Groundwater Dependent Terrestrial Ecosystems: Areas protected under the Habitats Directive etc.
- Salmonid Waters
- Groundwater Bodies with Low Recharge: Where severe or very high pathway risk to groundwater are mapped within low recharge areas.
- Surface Water Bodies with Low Flow: Where severe or very high pathway risk to surface water are mapped within low flow catchments
- Flood storage in surface water bodies and its effect on effluent migration.

The location and extent of receptors, as well as their sensitivities, is included in the receptor layer of the GIS.

Source Protection Zones have very high sensitivity. Septic tanks that are not working properly are thought to be one of the major sources of contamination of drinking water supplies (National Rural Water Monitoring Committee, 2003). With an estimated 200,000 wells and springs in use in Ireland (Wright, 1999), the prevention of groundwater contamination from on-site domestic sewage effluent is of critical importance (Gill *et al*. Environmental Protection Agency, 2005).

Particular issues and information on receptor sensitivity is considered further in supporting documents for this study:

- ‘Estimation of Flow Duration Curve for Ungauged Catchments’, and
- ‘An Integrated Approach to Quantifying Groundwater and Surface Water Contributions of Stream Flow’.

Results of an ecological risk assessment procedure developed by Western RBD and EPA for small streams: ‘First-Order Stream Score System’, where available, will also contribute to receptor sensitivity.

3 SCHEDULE OF INTERVENTIONS AND TRACKING SYSTEM

3.1 Interventions

Conventional septic tank systems require a slightly different approach for proper maintenance than secondary systems such as mechanical aeration systems or advanced filter systems. Septic tanks do not normally require the use of mechanical parts, electrical components or sensitive equipment, which may be used in more sophisticated systems. Therefore, in the case of septic tank systems visual inspection of the system on a periodic basis together with regular de-sludging is often all that is required to ensure that the system continues to operate effectively. Guidance for the maintenance of septic tanks can therefore be seen as more universally prescriptive and the approaches taken to the maintenance of all septic tank systems will be similar.

Mechanical aeration treatment systems (such as RBF's, BAF's, SBR's and micro-filtration systems) rely on the precise functioning of mechanical and/or electrical components for proper operation. For this reason a higher level of maintenance is required and the inspection and maintenance functions are generally more complex than in the case of conventional septic tank systems. Apart form carrying out periodic visual inspections of the system, there will also be a requirement to repair, service or even replace components which become worn out through use, over time. Different manufactures design and configure their products in different ways, so the maintenance regime will vary from system to system. With mechanical treatment systems the user is advised to consult the manufacturer's instructions in all cases in order to determine the appropriate inspection and maintenance approaches regime. All treatment systems should be examined regularly by a competent person to check for the depth of sludge and for visible signs of malfunction. Any maintenance requirements should be dealt with immediately.

Proprietary wastewater treatment systems, which incorporate mechanical or electrical components, should not be serviced by the homeowner. Units may be powered by mains electricity and unqualified persons should not attempt to perform maintenance operations on them. To avoid a risk of serious injury or electrocution, maintenance should only be carried out by the system suppliers or by qualified service engineers.

Inspection and maintenance should be undertaken to an appropriate frequency, which is dependent on the type of system in place. Table 1a and Table 1b below set out a suggested approach including a schedule for inspection, maintenance and monitoring of on-site wastewater treatment systems:

Table 3.1
Installation and Commissioning of On-Site Wastewater Systems

Type of System	Certification of Installation	Certification of Commissioning
Septic Tank System	Competent person with appropriate Professional Indemnity Insurance [A]	Not Applicable
Filter Systems	System Supplier [B], or competent person with appropriate Professional Indemnity Insurance [A]	[A] or [B]
Mechanical Aeration Systems	System Supplier [B], or competent person with appropriate Professional Indemnity Insurance [A]	[A] or [B]

Table 3.2
Schedule of Inspection and Maintenance

Type of System	Inspection Frequency	Maintenance Frequency	Monitoring (Sampling & Analysis) Frequency
Septic Tank System	Not Applicable	De-sludging every 24 months at a minimum.	Not Applicable
Filter Systems	Every 12 months at a minimum by System Supplier [B], or by a competent person with appropriate Professional Indemnity Insurance [A]	Every 12 months at a minimum including de-sludging of septic tank component [A] or [B]	Every 12- 24 months Sample to be taken at outlet from Filter
Mechanical Aeration Systems	Every 12 months at a minimum [A] or [B]	Every 12 months at a minimum including planned preventive maintenance and de-sludging of system [A] or [B]	Every 12- 24 months. Sample to be taken at outlet from System

A suggested form for the Certification of an On-site System is presented at the end of this section.

A dedicated Training Programme and Competency Scheme for Site Suitability Assessment for Unsewered Systems is currently offered by the Environmental Training Unit in FAS, the National Training & Employment Agency. The Unit is looking at developing a further Training Programme and Competency Scheme for Installation, Inspection and Monitoring of On-Site Wastewater Treatment Systems. Pending the setting up of such a Programme it is suggested that Certification of Installation should be carried out by one of the following persons:

- Authorised person representing system supplier;
- Person on the appropriate Panel of Suitable Persons to carry Out Site Assessments (where applicable – i.e. where such a Panel is in place); or
- By persons who have FETAC Certification for Site Suitability Assessment for Unsewered Systems.

Monitoring of secondary systems is considered important in order to ensure the proper functioning of the systems. The frequency of monitoring may be increased where targets at risk are particularly sensitive (e.g. in areas overlying regionally important aquifers with high vulnerability, or areas with poor percolation – 'T'-values greater than 50, etc.).

3.2 Tracking System

It is important that each Local Authority has some system for ensuring that all individual wastewater treatment systems are properly inspected, maintained (where appropriate) and monitored (where applicable). What is required is the development of a Local Authority held, Geographical Information System (GIS)–based system, which would track:

- Certification of installation of each new unsewered system (e.g. septic tank systems, secondary systems, etc.) for one-off rural houses;

- All inspection, maintenance and monitoring interventions related to such systems (See Table 3.2 above).

The focus should ideally be on establishing a readily transferable model (i.e. a GIS-based software package) which is compatible with the existing software systems in current use (e.g. IPLAN, CIS, etc.), which are in widespread use within the Local Authority system. The package would ideally incorporate drop-down menus and IT calendar-based prompts.

Operating the Tracking System would require a Local Authority person (i.e. technician, engineer or clerical officer) to load all information submitted on installation, inspection, maintenance and monitoring onto a Local Authority database and to follow up on the IT prompts. The person responsible should be in a position to confirm the coordinates, to review the installation certificate and to generally verify the information submitted. It is suggested that an Annual Report be submitted to the Department of Environment Heritage and Local Government by each Planning Authority on the information gained from the system.

It is suggested that any Tracking System should incorporate the following components:

- **Stage 1**: This Stage is up to the planning decision stage (i.e. up to the grant of planning permission).

  This stage should cover an internal Local Authority review of the Site Suitability Assessment carried out and submitted with the application for planning permission. It is important that the Site Characterisation Report submitted contains detailed design proposals for the unsewered system proposed, with particular attention to the design of the percolation area or polishing filter as appropriate. It is crucial that the proposed design solution fully integrates with the site suitability assessment carried out.

- **Stage 2**: This Stage covers the Tracking System and is a structured process following the grant of planning permission.

  Where the Planning Authority grants planning permission for an unsewered system it is important that the grant of planning contains appropriate conditions relating to:
  (a) Installation and Commissioning, and
  (b) Inspection, Maintenance and Monitoring (where required);

- It is suggested that the key event to trigger the Tracking System should be the Commencement Notice. The Commencement Notice (CN) is required to be submitted by the applicant to the Building Control Section of the Local Authority. Where the CN is submitted to the Local Authority it is suggested that the following steps should apply:

  - The Building Control Section (or the Section that deals with CN's), should map receipt of all CN's for further use by the Planning Section.

  - The Planning Section should cross-reference the CN with the grant of planning permission and identify an appropriate reference number. The fact that development has commenced should be captured on the Planning Register (on iPlan, GIS system, etc.). This can be done by a colour-coding system on the Local Authority-held GIS map. Limerick County Council currently operated such a colour-coding system;

  - The Planning Section having updated the GIS map should notify the Section responsible for implementing the Tracking System (e.g. Environment Section, the Water Services Section, etc.). It is suggested that the Planning Section would forward a batch of relevant 'live' Planning Permissions, on a weekly basis;

  - Generic letters should be sent out automatically (e.g. by Planning Enforcement Section, Environment Section, Water Services Section, etc.) referring to the Conditions attached to the grant of planning permission which require applicants to send in details on (a) Installation and Commissioning, and on (b) Inspection, Maintenance and Monitoring (as appropriate). The information should be loaded on the software system which should ideally incorporate drop-down menus and IT calendar-based prompts.

- **Certificate of Installation & Commissioning:**

  - Where Certificate of Installation is submitted:
    The relevant Section of the Local Authority should be notified. This Section should record receipt of the Certificate on the system and follow up, carry out spot checks, etc., as considered appropriate;

  - Where Certificate of Installation is not sent in (within 6 months):
    The Planning Enforcement Section to follow up (this task should be capable of being carried out automatically) in relation to non-compliance of one of the Conditions of planning permission.

- **Certificate of Inspection/Maintenance/Monitoring (as appropriate)**

  - Where Certificate of Inspection, Maintenance and Monitoring is submitted:
    The relevant Section of the Local Authority should be notified. This Section should record receipt of the Certificate on the system and follow up, carry out spot checks, etc., as considered appropriate;

  - Where Certificate of Inspection, Maintenance and Monitoring not sent in (within 12 months):
    The Planning Enforcement Section to follow up (this task should be capable of being carried out automatically) in relation to non-compliance of one of the Conditions of planning permission.

The type of practical intervention described above should ideally be piloted in a small number of selected planning authorities. This would allow for the development of a ‘Best Practice’ Tracking System Protocol for on-site wastewater treatment systems, driven by the Planning Section within a Local Authority and supported by the Environmental Section and the Water Services Section.

EXAMPLE:

CERTIFICATE OF INSTALLATION OF ON-SITE SYSTEM

DETAILS OF PERSON CERTIFYING INSTALLATION:

Name:…………………… ………………………………………………………

Address:…………………………………………………………………………….

Telephone Number:…………………………………………………………….

Email Address:……………………………………………………………….

Qualifications:…………………………………………………………………..

Organisation (if applicable):……………………………………………………

Details of Professional Indemnity Insurance:……………………………………

……………………………………………………………………………………

PLANNING REFERENCE:

Details of owner/applicant:………………………………………………………

…………………………………………………………………………………….

Planning Authority:…………………………………………………………….

Planning Reference Number:…………………………………………………..

CERTIFICATE:

I hereby certify that the on-site wastewater treatment system has been installed and completed in accordance with the planning permission issued on (date)……………., with the appropriate plans and specifications for the development, and with good practice for the installation of on-site systems.

Signature & Title   Date

4 CLUSTERS OF HOUSES AND COMMERCIAL DEVELOPMENTS

Large systems discharging to groundwater are subject to licensing when the discharge is greater than 5 m^3 / day.

It is recommended that site investigation comprising a minimum of three boreholes and soil permeability testing is undertaken in all such cases. A report on the investigation should be prepared by a hydrogeologist, including an assessment of adequate percolation and treatment.

One of the boreholes should be located at the site boundary and retained for compliance monitoring.

A separate report providing an outline framework for a Code of Practice has been prepared within this study. It addresses the need for the following series of activities in the site investigation:

Overview
- Risk based approach
- Site suitability

Collation of supporting information
- Preliminary consultation
- Collation of relevant environmental data
  - Topography, Local Pressures, Soil. Subsoil and Bedrock Pathways, Surface Water and Low Flow sensitivity, Groundwater Recharge, Flora, Fauna and Cultural Heritage, Drainage, Public Utilities, General Planning
- Interpreting the results

Visual assessment
- On-site hazard evaluation
- Visual assessment of pressures, pathways and receptors
- Interpreting the results of the visual assessment

Site investigation
- General
- Conducting and logging boreholes and trial holes
- Interpreting the findings from the site investigation

Assessment
- Hydraulic Calculations, Adequate percolation and Treatment

Decision process and preparation of recommendations
- Report by a Hydrogeologist or Soils Expert

5 FIELD VALIDATION

Validation of the risk assessment methodology is an important step to refine the approach and to make the methodology more generally applicable on a national basis. Validation has been carried out for surface waters by means of field surveys and review of data sources in a catchment in County Monaghan, which is representative of the most significant risk to surface water nationally.

This study was linked to a separate study called the 'National Source Protection Pilot Project', and the latter was extended in its duration and activities in line with the requirements of this study. The National Source Protection Pilot Project is continuing to apply the procedures of this study and it is being implemented by the National Centre for Freshwater Studies, Department of Applied Sciences, Dundalk Institute of Technology.

5.1 Investigations

The Churchill and Oram Catchment in County Monaghan has been examined in terms of:

- Land-use
- Locations with known surface water quality problems linked to OSWTS where the combination of pressures, soil conditions and receiving water degradation is a cause for concern;
- Areas with specific soil percolation, interflow and runoff characteristics;
- Availability of existing data sets of water quality and flow measurement

The existing range of subsurface water monitoring wells in the catchment was extended to include defined controls (clear of the influence of the percolation area) and zones between percolation areas and nearest surface water.

The risk assessment GIS procedure is being applied successfully on the catchment. This is supplemented with additional receptor sensitivity models developed for this study:

- Estimation of surface low flows at ungauged sites and
- Use of the MIKE-NAM model in relation to groundwater recharge where the percentage contribution of groundwater is required to the river downstream.

Identified unsewered systems have been characterised by non-intrusive inspection and also by intrusive surveys. A number of inspection visits to unsewered systems were carried out to examine the layout and condition at specific locations, where a direct source of surface water pollution was suspected.

Sampling of surface waters has been carried out to determine the extent and impact of the systems.

A total of 154 households were surveyed and asked questions relating to the age and type of their system, the frequency of desludging and the number of occupants in the house. The age profile and the frequency of desludging is illustrated in Figure 5.1. Plate 5.1 shows common problems and Plate 5.2 shows intrusive testing.

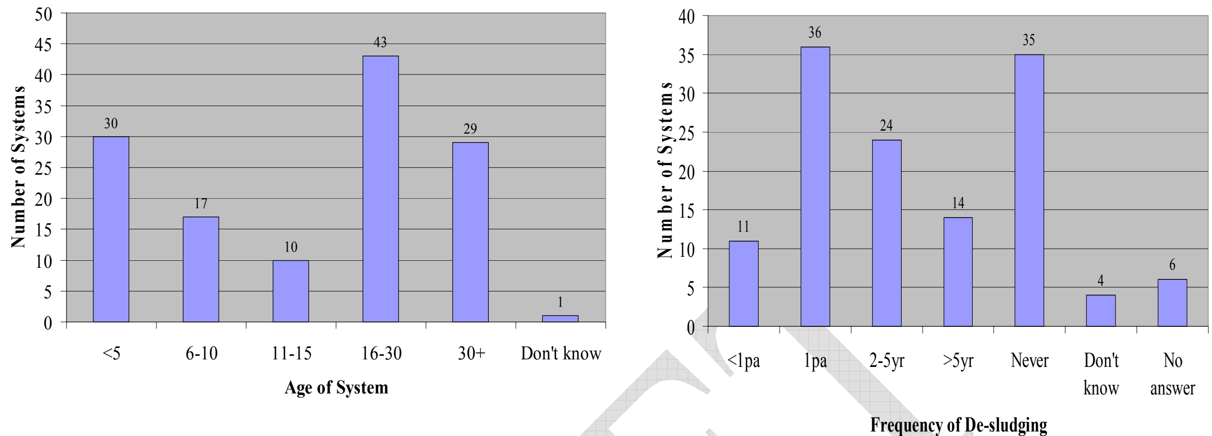

Figure 5.1 Age Profile and Frequency of Desludging

Malfunctioning system and no percolation area

Ponding on surface of septic tank, water springs in close proximity

Plates 5.1(a) and (b) Common Problems

Plate 5.2 Intrusive inspections

5.2 Validation Results

Planning permissions

The review of planning permissions for the systems reveals three distinct chronological phases.

(a) Permissions granted prior to 1991: All of these applications were for septic tanks; many did not specifically state a method of effluent disposal. The conditions imposed by Monaghan County Council reflected the standards of SR6:1975 (*Recommendations for Domestic Effluent Treatment and Disposal from a Single Dwelling House*), the earlier Standard Recommendation on unsewered systems.

(b) Permissions granted between 1992 and 2001: Most of these applications were for septic tanks with percolation areas; a minority were for proprietary systems. The conditions imposed by Monaghan County Council referred directly to SR6:1991 (*Recommendations for Domestic Effluent Treatment and Disposal from a Single Dwelling House*), the revised version of the 1975 Standard Recommendation on unsewered systems.

(c) Permissions Granted since 2002: The vast majority of these were for proprietary systems, rather than septic tanks. The conditions imposed required compliance with *Wastewater Treatment Manual: Treatment Systems for Single Houses*, published by the Environmental Protection Agency in 2000, and required the post-permission submissions to the County Council, typically certification by a competent person that the system was correctly installed and evidence that a maintenance contract was in place.

None of these files contain evidence of the required submissions or of enforcement action due to breach of these conditions.

Non-intrusive inspections

Forty-two systems were inspected to establish the type of system installed, the material used to contruct the tank, the number of chambers and the type of effluent dispersal used.

(a) Type of system: Of the 42 systems inspected, 35 (83%) were conventional septic tanks and 7 (17%) were proprietary systems. All of the proprietary systems had been installed within the past 10 years. Of these, three were bio-filter systems and four were air-flow systems. Three of the proprietary systems were broken or were not operating correctly (e.g. turned off) and six were still under maintenance contracts, including annual desludging.

(b) Material used to construct tank: Twenty-four (57%) of the systems inspected had tanks constructed of concrete; all of these were conventional septic tanks. Fourteen (33%) had PVC tanks (5 of which were proprietary systems) and two (5%) had fibreglass tanks (both proprietary systems). The remaining two (5%) systems had no settlement tank and discharged untreated wastewater directly to a drain.

(c) Number of chambers in tank: The number of chambers in the tanks inspected varied from one to four. Twenty-seven (64%) systems were single-chambered, seven (17%) double-chambered, four (10%) triple-chambered and two (5%) quadruple chambered. The remaining two (5%) systems had no tank, as detailed above.

(d) Method of effluent dispersal: Sixteen (38%) systems relied on soakaways; all of these were conventional septic tanks and nineteen (45%) had percolation areas, including seven proprietary systems. The remaining seven (17%) had direct discharge, two of these without a settlement tank.

Based on these visual inspections, 37 (88%) of the systems were assessed as not complying with current standards. These included:

- systems with a single-chambered tank;
- systems relying on a soakaway (i.e. pits filled with stone) for dispersal of effluent;
- systems with no settlement tank;
- systems discharging directly to a drain; and,
- proprietary systems which were broken or turned off.

However, it should be noted that some of these, in particular those in the first two categories, may have complied with the standards current at their time of installation. Present standards require a double-chambered tank discharging to a percolation area (i.e. perforated pipes laid in trenches filled with stone).

The last three categories listed above, comprising ten systems (24%), are considered to have the potential to present a serious risk of contaminating surface water which contributes to the source water.

Intrusive examinations

Only preliminary sampling has been undertaken at five sites, and wells for control sampling (i.e. clear of the influence of the percolation area to show the level of background contamination) have not been installed. Therefore the results to date must be treated with caution. Nevertheless, these initial analyses have indicated a high level of contamination associated with faecal matter and further investigation is planned.

Three of the four conventional septic tank systems examined had mean water table level within 0.8m of ground level. On this basis alone, these three sites would be deemed unsuitable for conventional septic tanks.

5.3 Conclusions

The results to-date do not provide any definitive evidence of actual contamination of source water by unsewered systems but do provide indications of risk of contamination.

The questionnaire survey reveals a significant proportion of systems installed prior to current standards and a lack of regular desludging. The non-intrusive inspections point to a majority of systems which are considered sub-standard when compared to current standards, and a significant minority which may be at serious risk of contaminating surface water bodies, but this is dependant on location and proximity to nearby water courses. The intrusive examinations revealed that the majority of the chosen sites are unsuitable for the conventional septic tanks installed due to the high water table. In addition, soil profiles indicate that the soil type on each of the sites probably renders them unsuitable for septic tanks.

Little or no evidence of compliance with planning permission conditions was found.

6 PROGRAMME OF MEASURES

Under the Water Framework Directive (WFD), River Basin Management Plans must include a set of management measures aimed at achieving the default objectives within the 15-year time frame from the date of entry into force of the Directive, i.e. by 2015, unless alternative objectives are established. The required Programme of Measures (POM) (Water Framework Directive Article 11) can be divided into two broad categories, Basic Measures and Supplementary Measures.

Basic Measures are listed in Annex VI, Part A of the WFD and are set out below. These are “obligatory” and include measures required to implement existing Community legislation for the protection of water, (EU Directives and statutory obligations associated with their implementation), they may also require new additional legislation.

“Obligatory” means they are enforced through National Legislation which sets specific objectives and standards or which have designated specific areas, e.g. areas designated as Special Areas of Conservation under the Habitats Directive.

Basic Measures may be target specific, such as the control of pesticides under the Plant Products Directive (91/414/EEC) (also draft “sustainable use of pesticides” Directive) and protection of specific designated species under the Habitats Directive, and/or may have spatial application such as the Habitat designated areas (SACs) with water dependent habitats and species, catchment areas of designated species such as the Freshwater Pearl Mussel (*Margaritifera margaritifera*) or catchment areas of water abstraction locations or bathing waters.

Any actions or new legislative instruments supporting the implementation of the “Basic Measures” or which are applicable to specific targets or spatial areas designated by the basic measures are considered as basic measures themselves.

Supplementary measures are optional but not exhaustive. Examples are provided in the directive (Annex VI, Part B), such as; administrative arrangements, economic or fiscal instruments, negotiated environmental agreements, emission controls, codes of good practice, re-creation and restoration of wetlands and rehabilitation projects.

Actions in support of basic measures can also be seen as supplementary measures if they are applied to areas outside of the basic measures. Supplementary measures may also become Basic Measures through obligatory requirements.

The designation of actions for unsewered areas as either Basic Measure or Supplementary Measure will be dependent on the location.

6.1 Basic Measures

This section discusses the basic measures and their relevance to unsewered systems. These measures which are obligatory and which must be complied with are set out in Tables 6.1 and 6.2.

Table 6.1
Basic Measures, Directives and Relevance to Unsewered Systems

Basic Measure and Directive	Transposing Legislation	Relevant to Unsewered Systems	Comment
New EU Bathing Water Directive (Directive 2006/7/EC of 15 February 2006)	Bathing Water Quality Regulations 2008, S.I. No. 79 of 2008	Yes	May be relevant where unsewered systems exist within the catchment area of bathing waters
The Habitats Directive (92/43/EEC) and Birds Directive (79/409/EEC)	The European Union (Natural Habitats) Regulations, S.I. 94/1997 (which have been amended twice with S.I. 233/1998 & S.I. 378/2005) transpose the requirements of both directives	Yes	If unsewered system is likely to have a significant impact on a designated area it requires an appropriate assessment regardless of whether or not the property is in the designated area (ex-situ effects). Cumulative effects must also be taken into account.
The Drinking Water Directive (80/778/EEC) as amended by Directive (98/83/EC)	Drinking Water Regulations (S.I. 278 of 2007)	Yes	Where unsewered systems are within the zone of contribution of water abstraction area
The Major Accidents (Seveso) Directive (96/82/EC)	European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations (SI 74 of 2006)	No	
The Environmental Impact Assessment Directive (85/337/EEC	Planning and Development Acts 2000 and 2001 and the Planning and Development Regulations 2001 to 2002.	Yes	While unsewered systems are not prescribed within the EIS requirements, they may form part of a development that is prescribed.

Basic Measure and Directive	Transposing Legislation	Relevant to Unsewered Systems	Comment
The Sewage Sludge Directive (86/278/EEC)	Waste management (Use of Sewage Sludge in Agriculture) Regulations (S.I. No. 183 of 1991, S.I. No. 148 of 1998 and S.I. No. 267 of 2001).	No	
The Urban Waste-water Treatment Directive (91/271/EEC)	Environmental Protection Agency Act 1992 (Urban Waste Water Treatment Regulations (S.I. No. 419 of 1994, S.I. No. 208 of 1999, S.I. No. 254 of 2001 and S.I. No. 440 of 2004). Waste Water Discharge (Authorisation) Regulations, 2007, S.I. No. 684 Of 2007	Yes	Duty of Care for wastewater discharges
The Plant Protection Products Directive (91/414/EEC) (also draft "sustainable use of pesticides" Directive (proposal of 2006))	S.I No. 320 of 1981 as amended, S.I. No. 83 of 2003 and S.I. No. 624 of 2001.	No	
The Nitrates Directive (91/676/EEC	European Communities (good agricultural practice for protection of waters) Regulations (S.I. No. 526 of 2007).	No	
The Integrated Pollution Prevention Control Directive (96/61/EC	Environmental Protection Agency Acts of 1992 and 2003 and the associated licensing regulations	No	

Table 6.2
Other Basic Measures and Relevance to Unsewered Systems

Other Basic Measure	Transposing Legislation	Relevant to Unsewered Systems	Comment
Practical steps and measures taken to apply the principle of recovery of costs for water use and measures to promote efficient and sustainable water use	National Water Pricing Policy Framework (1998)	No	.
Measures taken to protect drinking water sources	groundwater and surface water bodies that are used, or may be used in the future, as a source of drinking water for 50 persons or more, or where the rate of abstraction is more than 10m^3 per day	Yes	Where unsewered systems exist within the zone of contribution of water abstraction location.
Controls on abstraction and impoundment with an impact on the status of water	register or registers of water abstractions and a requirement of prior authorisation for abstraction and impoundment	No	
Controls on point source and diffuse source discharges with an impact on the status of water	IPPC, LA Section 4 and 16 Waste Water Discharge (Authorisation) Regulations 2007 (SI No. 684 of 2007). Unsewered areas - Water Services Act 2007	Yes	Duty of Care
Authorisations of direct discharges to groundwater	Waste Water Discharge (Authorisation) Regulations 2007 (SI No. 684 of 2007)	Yes	Large systems
Measures to deal with priority substances	33 priority substances and 8 other pollutants. Eliminate and phase out priority hazardous substances. Regulations are expected to be made in early 2008	Yes	Where such substances are discharged in unsewered systems

Controls on physical modifications to surface waters with an impact on the status of water	considering the introduction of regulations to control physical modifications to surface waters	No	
Controls on other activities with an impact on the status of water	Introduction of regulations under Section 52(6)(a) of the Wildlife Act, 1976, for the purpose of prohibiting the possession or introduction of any species of wild bird, wild animal or wild flora or any part, product or derivative of such wild bird, wild animal or wild flora which may be detrimental to native species" .	No	
Measures taken to prevent or reduce the impact of accidental pollution incidents	"Framework for Major Emergency Management" was published by the Office of Emergency Planning (an agency of the Department of defence) in 2006	No	

6.2 *Actions to Support Existing Legislative Measures*

Local Authorities are aware of issues relating to unsewered systems and they operate controls ranging from strict planning approvals through to inspection and monitoring regimes backed up with bye-laws.

While guidance has been provided by Environmental Protection Agency and Geological Survey of Ireland, additional measures are required to assist in regulation, monitoring and enforcement of unsewered systems. Supplementary measures to identify and address areas potentially impacted by existing onsite systems and also to guide future decision making for new developments have been prepared using a risk assessment procedure. A key factor is to have a consistent approach to the use of onsite wastewater systems across the country.

Local authorities permit unsewered systems in Ireland through the Local Government Planning and Development Acts. In addition, duty of care is required in the Water Services Act. With regard to the assessment of sites guidance is issued by the Environmental Protection Agency and an updated version of guidance for single house treatment systems is currently at consultation stage. Special management issues arise in the case of large clusters of houses and commercial developments discharging to a single percolation area. Updated guidance will be prepared for such developments by the Environmental Protection Agency.

Critical to ensuring good governance is the need to have a consistent approach to the planning process, site evaluation and assessment, use of guidance and certification of approved systems on installation. Supplementary measures have been identified below to support existing legislative measures and to reduce significantly the risk from future onsite wastewater treatment systems.

Proposed Measures

REDUCE

M1. Amend Building Regulations to confirm:
- Code of Practice for Single Houses (at consultation draft stage at present)
- New Code of Practice for Large Systems
- Certification of the construction of onsite wastewater treatment systems and percolation areas/polishing filters.

M2. Establish Expert Panels:
- Certified national panel of experts for site investigation and certification of installed systems. A second panel of hydrogeologists is required for clusters and large systems.
- National group for formulating polices and coordination of consistent approach.
- A technical advice section or advisory group to coordinate and give advice on emerging and innovative technologies.
- Installation and maintenance training by FAS.

M3. Control of New Development:
- At planning assessment stage, apply the GIS risk mapping / decision support system and codes of practice
- Notice to planning authority required immediately prior to the installation of onsite effluent treatment systems including percolation areas and polishing filters.

REMEDIATE

M4. Inspect Programme of Existing Systems:
- Use the GIS risk mapping / decision support system to prioritise locations to be targeted in a programme of inspections and maintenance
- Use a database and action tracking system

M5. Enforcement
- Enforce requirements for de-sludging and codes of practice.

RELOCATE

M6. Connection to Sewer
- Consider connection to municipal systems

EDUCATION AND AWARENESS

M7. Establish education and awareness programme on outline design, operation and maintenance of systems.

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