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Dear George

INFORMATION LETTER 5/2003

DISTRIBUTION OPERATION AND MAINTENANCE STRATEGY (DOMS)

Purpose

1. The purpose of this Information Letter is to set out DWQU requirements and expectations for the preparation and implementation of a strategy for the proactive management of drinking water distribution systems, so that Scottish Water (SW) meets and continues to meet drinking water quality standards. Explanatory notes on the scope and form such a strategy may be expected to take are attached for illustration.

2. Key parts of the strategy document need to be in place in sufficient time for them to be included in the assessment by SW of its future operation and maintenance needs for incorporation into the Q and S III process.

Summary of actions arising from this Letter

3. Key actions are summarised as follows.

- **By 31 December 2003**, SW to submit a DOMS incorporating

- arrangements for pro-active, periodic, medium-term, system-by-system investigations (as in paragraph 10a below), and

- monitoring of water quality at a local level leading to timely responsive maintenance (as in paragraph 10b below).

- **By 28 February 2004**, DWQU to respond to these submissions.

- **By 30 June 2004**, SW to submit a further revised DOMS incorporating mechanisms for or links to

- control of operational activities related to risks to water quality (as in paragraph 10c below), and

- regular inspection and maintenance for certain components of the distribution system related to risks to water quality (as in paragraph 10d below).

- **By 31 December 2005**, SW to review the functioning of the DOMS, taking account of feedback on its effectiveness, the interaction between its components, and incorporate improved knowledge and methods (as in paragraph 10e below).

Background

4. Since 1990, renovation of distribution systems to secure compliance with various standards, including those for iron, manganese, aluminium, turbidity and benzo 3,4 pyrene has been carried out. Compliance with drinking water quality standards will continue to be a key driver in the renovation of distribution systems.

5. DWQU wishes to ensure that recent improvements in the quality of drinking water are not compromised by inadequacies in the maintenance and operation of SW's asset base, including new, renovated and existing assets. Although the improvement programmes carried out in some areas are substantial, DWQU is concerned that many assets were untouched by these programmes.

6. It continues to be the responsibility of SW to operate and maintain its supply systems so as to minimise the risk of failure to meet water quality standards, to maintain service to consumers, and to maintain the serviceability of its assets. DWQU draws SW's attention to the requirement in the 2001 Regulations for SW to investigate the causes of likely failures, as well as failures that have occurred[1].

7. In setting out its requirements and expectations, DWQU seeks to balance the proper expectations of SW to manage autonomously the operation and maintenance of its assets, with DWQU's objective to secure drinking water quality for consumers in the long term.

[1] Regulation 17(1) of the 'Water Supply (Water Quality) (Scotland) Regulations 2001' which comes into force on 25 December 2003, requires Scottish Water, where it has reason to believe that a water supply fails, *or is likely to fail*, to meet standards of wholesomeness, to investigate the cause of that failure or likely failure, leading to appropriate action where necessary.

8. The requirement to provide a DOMS is intended to be an integral part of SW's Integrated Network Management System. A draft submission should be made in accordance with the timetable in paragraph 3 above.

DWQU Expectations for DOMS

9. DWQU expects the DOMS adopted by SW to take account of the risks to water quality, that is the combination of the likelihood (probability) of a failure in asset or operational performance and the consequence (extent and seriousness) of the failure on the quality of water received by consumers. The objectives for DOMS should include (but need not be limited to) the following:

   - to identify the activities necessary to improve water quality where it is not satisfactory, and to quantify them;
   - to identify the risks to drinking water quality in the distribution system, and to quantify their likelihood and consequence by reference to water quality standards and internal operating criteria;
   - to identify the activities necessary to safeguard water quality on a continuing basis where it is already satisfactory, and to quantify them; and
   - to ensure that procedures are in place to implement these activities so as to maintain water quality at acceptable levels on a continuing basis into the future, and to inform the process of funding for these activities.

10. The shape of the DOMS adopted, and its integration with other aspects of SW's activities, is for SW to decide. However, to gain the acceptance of DWQU, at least the following components should be incorporated.

a) Pro-active, periodic investigations on a system-by-system basis, in which actual and impending water quality performance, causes of problems and the condition and deterioration of assets are considered in context. These should have a medium-term horizon (say 5 – 7 years), quantify performance with reference to water quality standards and internal operating criteria, take account of risks to water quality, and lead to quantified activities which may include
   - programmes of 'capital' maintenance work,
   - programmes of 'operational' maintenance activity,
   - reconsideration of requirements for treated water quality, or
   - reconsideration of operational procedures.

b) Monitoring of water quality at a local level leading to timely responsive maintenance (say within the current year).

c) Control of operational activities related to risks to water quality;
   - where risks vary between individual actions of the same type, risk assessments should precede each such action,
   - where risks do not vary appreciably, or cannot realistically be estimated, standard procedures are appropriate.

d) Regular inspection and maintenance for certain components of the distribution system related to risks to water quality.
e) Cyclic review of the DOMS and its components; this review should
   - incorporate feedback on the effectiveness of the approaches and procedures adopted,
   - improve the integration of the activities covered by the DOMS, including maintenance and operation, and
   - incorporate improvements in knowledge and techniques, such as improved data gathering, better methods of quantifying risks and better methods of quantifying the activities needed to control them.

11. It should be an aim to develop a holistic approach covering all relevant aspects of operation and maintenance. All aspects of water quality that may be affected by the state or operation of the distribution system should be considered, including the risks of contamination posed by inadequate physical integrity of the system. All elements of the supply system downstream of treatment works should be covered. (The scope of DOMS is discussed further in Section 6 of Annex A.)

12. DWQU expects the DOMS document to set out the methods for investigation and for determining the level of maintenance activity (capital and operating) required. It is likely that some aspects of the DOMS will take time to develop, so that the methods will need to be regularly reviewed. SW's INMS is likely to deal with many of the operational activities relevant to DOMS. DWQU expects the DOMS document to act as an 'umbrella', and show links to more detailed procedures on these operational activities, but the detailed procedures themselves would not form part of the DOMS document. However, in due course their interaction with other aspects of the strategy should be considered, and changes made as necessary.

Regulatory position of DOMS

13. The preparation and implementation of a DOMS itself is not a new regulatory obligation; it is a development and reinforcement of current good practice, and consistent with the requirements of Regulation 17(1) of the 2001 Regulations. The issue of this Information Letter is a statement by DWQU of its expectations of the steps SW will need to consider to prevent a deterioration of water quality supplied to consumers. DWQU considers that this is best achieved by a strategy of the type described here or of equivalent rigour. The lack of a DOMS conforming to these expectations would not of itself be a matter for enforcement action. However, it is difficult to envisage how a competent water undertaker might manage its distribution system proactively, and systematically maintain water quality standards, without a DOMS or equivalent. Also, in the event of a drinking water quality incident that may have been affected by the operation or maintenance of the distribution system, the lack of a DOMS would be a material consideration.

Integration of the DOMS into the Q and S III process

14. DWQU expects adequate provision to be made in the Q and S III process for the implementation of DOMS. DWQU will facilitate this process by supporting SW in the development of DOMS, and by confirming by desk-top assessment that a DOMS submitted by SW incorporates the main elements of this guidance. This will be carried out to the timetable in paragraph 3 above, which takes account of the Q and S III process timetable. The DWQU assessment process will be helped if SW is able to provide clear and well-presented DOMS that broadly conform to the outline given in Annex A. Where DWQU is satisfied, it will confirm this acceptance to SW.

15. DWQU would also draw SW's attention to the particular relevance for the integration of DOMS into the Q and S process of, the 'Common Framework'[1]. DWQU expects DOMS to be developed by taking a risk-based approach in determining an economic level of maintenance. This theme is further developed in the 'Common Framework' approach. This Framework enables water undertakers to justify appropriate and economic requirements for maintenance. It allows for all intervention options, including operational solutions, and enables water undertakers not only to take account of historic data on service performance, but also to take a forward look by considering the risk of failure to meet requirements. DWQU considers that DOMS should be an integral part of the 'Common Framework' approach and used in that context by SW to support the justification for appropriate and adequate funding for operations and maintenance activity.

16. DWQU expects SW to make rapid and significant progress to improve their investigation and data collection arrangements necessary for efficient decision-making within DOMS.

Timetable for development and implementation

17. It is recognised that a DOMS is far reaching and may affect many aspects of SW's activities. Also, techniques and data may need to be improved, particularly in anticipating water quality problems and quantifying the levels of activity necessary to avoid them. In the interim, methods relying more heavily on professional judgements will need to be used by SW to cover gaps in the information available.

[1] Capital Maintenance Planning: A Common Framework. UKWIR , 2002.

18. The immediate aim for SW should be to put into place a DOMS that underpins an unambiguous commitment to a policy for proactively maintaining satisfactory water quality into the future. To succeed, the process will need to lead to quantifiable activities, and to demonstrate that activity is both necessary and sufficient.

19. By the start of the Q+SIII period, DWQU expects relevant parts of the DOMS to be fully consistent with the risk-based approach described in the 'Common Framework'.

20. To facilitate this development, milestones will be set for the delivery of DOMS in stages, giving priority to the points that are most important for the Q and S process, and DWQU accepts that DOMS will continue to evolve as methods and information improve. The timetable for the submission of DOMS to DWQU is set out in paragraph 3 above.

Further explanation

21. Annex A provides further explanation of DWQU's views and expectations in this area, and consideration of topics that may be addressed in, or linked to, a DOMS. This is provided for illustration, and as a basis for dialogue with SW. It is not intended as a definitive list of requirements, and DWQU would accept alternative approaches that can be shown to be effective at safeguarding the quality of water supplied to the consumer in the long term.

Dialogue with SW

22. DWQU would welcome discussions with SW about issues concerning DOMS.

Enquiries

23. Enquiries about this letter should be addressed to Philip Anderson (philip.anderson@scotland.gsi.gov.uk, 0131 244 0188).

24. This letter is being sent electronically. Please acknowledge its receipt by e-mail. Hard copies are not being sent. This letter may be freely copied.

25. Copies of this letter are being sent to Alan Sutherland, Water Industry Commissioner for Scotland; Ian Smith, Convenor, Water Customer Consultation Panels; and Andrew Scott, Head of Water Services Unit, SEERAD.

Yours sincerely

TIM HOOTON
Head of Drinking Water Quality Unit

Attachment: Annex A: Explanatory notes on the scope and form of Distribution Operation and Maintenance Strategies

Annex A: Explanatory notes on the scope and form of Distribution Operation and Maintenance Strategies

CONTENTS

1. Introduction

DWQU expects SW to develop and put into practice a strategy for the operation and maintenance of their distribution systems to safeguard the quality of water reaching the consumer (Distribution Operation and Maintenance Strategy, DOMS). The purpose of this Annex is to form the basis for dialogue with SW during the development of its DOMS.

2. Background

Twelve years ago, substantial parts of the Scottish distribution system were in poor condition, leading to obvious water quality problems. Since then, some work has been carried out but there is still a significant backlog of renovation work. Ideally DWQU would like to move to a position where the emphasis is on ensuring that sufficient maintenance and rehabilitation is carried out to prevent deterioration in water quality, and on managing the operation of the system so as to reduce the risk of episodes of unsatisfactory water quality, particularly those which are short-term intermittent problems for consumers. Development of the DOMS will require improvements in information, understanding and delivery, because they will need to be forward-looking. Also, they will involve integrating many aspects of the management of distribution systems: short-term, medium-term and long-term considerations, and all activities and practices that may affect any aspect of water quality. The DWQU is aware of the progress being made by SW with its INMS and considers this system as providing the basis for building a DOMS.

3. Risk

In a situation where the problems being addressed are anticipated problems or potential problems, common sense and efficiency require that action is directed to the problems which are mostly likely to occur and/or have the most serious consequences, i.e. a 'risk-based approach'. DWQU expects some form of risk analysis or assessment to be used to inform the approaches adopted. The term risk assessment is applied to approaches that range from an informal consideration of the possible consequences of an action, through to a numerical discipline involving the quantification of the probabilities and consequences of the risks associated with various alternatives. For some of the minor operational decisions, the former may be adequate; for strategic decisions and forecasts, the latter would be desirable, particularly when determining such matters as the medium-term or long-term rate of renewal activity. This is discussed further in later sections.

4. Physical integrity and operability

The physical integrity of the distribution system and the operability of its components can have an effect on water quality. In a system where water is treated to a high standard and monitored intensively at the treatment works, occurrences such as mains bursts, pressure losses, flow reversals, inability to operate valves and the like may represent an appreciable part of the risk of contaminated water reaching the consumer. Bursts and other physical failures pose a risk of microbiological contamination that is poorly quantified. Thus there is an argument for maintaining a robust distribution system for water quality reasons, and for taking action to reduce the effect of physical failures on water quality. DWQU would like to see the risks to water quality posed by the physical unreliability of the distribution system addressed in DOMS. Specifically, DWQU would encourage SW to develop methods for appraising and minimising the risk of contamination posed by bursts and their repair.

5. Towards a more integrated approach

In developing a strategy that addresses both operation and maintenance, it is acknowledged, not just that both may affect water quality, and a potential problem may be addressed by either or both, but also that there is a balance to be struck between them, and the balance between activities may vary according to local circumstances. For example, as loose deposits are removed and pipe condition improved, there is likely to be a smaller risk of causing discoloured water by low level changes to the network such as rezoning. This may enable operational procedures to be more flexible as the system becomes more robust.

The DWQU would like to see the DOMS deal with the significant backlog of maintenance work, affecting water quality. SW should be aiming to move towards a more normal circumstance, that of maintaining the performance and reliability of a system that is already in reasonable condition, taking all aspects of service and serviceability into account.

Integration of DOMS into the Q and S III process, and into operation and maintenance practice, also implies internal integration within SW when dealing with strategic asset management to safeguard water quality. For example, risk studies may best be carried out by multi-disciplinary teams, co-ordinated centrally to achieve a consistent, objective and transparent approach. The impact on water quality should be seen as part of the overall process, which will also include consideration of loss of supply, low pressure, health and safety etc. Best practice in this area is evolving, but there are a number of documented recent case studies, which SW is encouraged to emulate (e.g. the 'Common Framework', Volume 4, and Risk Assessment for Environmental Professionals, CIWEM, 2001). The Capital Maintenance Planning Good Practice Manual from UKWIR[1] will

[1] Capital Maintenance Planning Manual, UKWIR, 2003

also be a helpful guide. SW's INMS should already be following best practice, but the DWQU is keen to ensure the System is implemented fully across SW's area.

6. Scope

The remit of DWQU is restricted to water quality. For practical reasons, DWQU will presently restrict its attention to a strategy concerning the distribution system. Thus, the scope of the strategy envisaged includes actions taken in the distribution system which may affect water quality, either for better or worse, and aspects of water quality affected by the condition or operation of the distribution system. It includes all elements of the supply system downstream of treatment works, including trunk mains, service reservoirs and tanks, pumping within distribution, and the small diameter reticulation. Relevant water quality considerations comprise microbiological quality (including indicator organisms, pathogens, disinfectant decay and growth of biofilms), discoloured water (including iron, manganese and turbidity), taste and odour, pH, leachates from or through materials used in the distribution system (including benzo-3,4-pyrene) and infestations by small animals. The water quality aspects of structural integrity should be included, such as the potential for contamination from mains bursts, and the water quality implications of activities for other purposes, such as leakage control.

There are a few water quality problems where the symptoms may appear in distribution, but cause and solution both lie elsewhere, e.g. THM formation. These would not be included in the scope of the DOMS. The presence of lead at consumers' taps will be dealt with by means of a separate strategy, but there may be some interaction between the two strategies, e.g. the possible effect of orthophosphate dosing on the behaviour of iron in the distribution system and on the formation of biofilms.

Inevitably, consideration of many aspects of water quality can only be carried out effectively if these boundaries are crossed; for example when investigating taste and odour problems, one may need to consider all possible causes from raw water to consumers' installations. The implication of the scope defined above is that the treatment works is assumed to supply water of defined characteristics to the distribution system. If SW develops a strategy that covers the operation and maintenance of treatment works, either integrated with the DOMS or as a separate entity, DWQU would not presently wish to comment on those aspects not covered by the scope as defined above. Also, SW may find it convenient or efficient to combine actions considered here with work done for other reasons. For example, they may conduct Distribution Zone Studies into all aspects of service, and to integrate remedial action for water quality and other reasons. DWQU would encourage such synergies, but will confine its attention to water quality aspects.

7. Main components of a Distribution Operation and Maintenance Strategy

DWQU considers that an effective approach is likely to comprise all of the following main components:

- pro-active investigations of water quality within a supply system leading to, *inter alia*, programmes of planned maintenance work where necessary,
- monitoring of actual or impending water quality problems at a local level leading to timely responsive maintenance (say within the current year),
- control of operational activities
- risk assessment preceding individual actions, and
- standard procedures where risks do not vary appreciably,
- regular inspection and maintenance related to risks to water quality, and
- cyclic review of the DOMS and its components.

These are discussed in the following sections.

8. Pro-active investigation and planned maintenance

8.1 The approach

DWQU assumes a need for SW to have in place a programme of strategic investigations of water quality leading to programmes of planned maintenance work where necessary. Each investigation would probably cover a fairly extensive area (a WSZ or similar), and should have a medium-term horizon (say 5 – 7 years). The work that results from these investigations would depend on their findings: modifications to treatment may be called for, as well as improvements to distribution. Specifically, it is expected that it may include programmes of mains renovation work. The intention should be that, taken together, these investigations and the consequent work result in the safeguarding of water quality into the medium or long term in a robust distribution system.

In principle, the approach DWQU would wish to see adopted would comprise

- identification of the risks to water quality (including burst mains and ingress due to pressure changes)
- determining the levels of risk for the various aspects of poor water quality which SW is prepared to carry,
- investigating the performance and characteristics of the network,
- forecasting future performance, and
- identifying a level of pro-active maintenance that is consistent with economically preventing actual risks from exceeding acceptable levels in the long term.

By the commencement of the Q+SIII period, DWQU expects approaches to be consistent with the type of risk based approach described in "Capital Maintenance Planning: A Common Framework" (UKWIR). However, in practice the appropriateness of serviceability indicators, current forecasting techniques and the availability of suitable data are likely to constrain the full and proper use of the 'Common Framework'

approach. There is an urgent need for development of effective methods and collection of suitable data.

Meanwhile, for many aspects of water quality, an interim approach is likely to be mainly based on asset performance data and indicators of serviceability, with judgements being made by SW about the likelihood of episodes of poor water quality up to a medium-term planning horizon (say 5 – 7 years). (Long-term predictions are likely to be poor, so long horizons are likely to be ineffective or wasteful.) These judgements may be informed by comparisons with similar situations. DWQU encourages integration with other aspects of performance – leakage, hydraulic performance, reliability of supply etc. and supports the use of SW's Integrated Network Management System. DWQU expects the approach developed to take account of risk in determining an economic level of capital maintenance activity. DWQU expects SW to use DOMS as an integral part of the 'Common Framework' approach to take account of historic data on service performance, and to take a forward look by considering the risk of failure to meet requirements to justify appropriate and economic maintenance activity as part of submissions for Q and S III.

8.2 The need for periodic system-wide appraisal

Some approaches to maintenance concentrate on the characteristics of individual assets. Interventions (inspection, testing and/or maintenance) are scheduled on a periodic basis, depending on such characteristics as rates of deterioration and rates of increase in the likelihood of failure. The asset is considered largely in isolation from other components of the system of which it is a part, and large numbers of such assets can be programmed for attention as a more or less continual stream of jobs. Such an approach is appropriate where the asset can be regarded as failing discretely (see Section 11).

However, important aspects of the performance of distribution systems are the result of the contribution of many components of the system, and there are alternative ways of maintaining or restoring satisfactory performance. Most obviously, discoloured water at the consumer's tap can arise as a result of the interaction between the water entering the system from the treatment works and the pipework and other components of the distribution system. Characteristics contributing to the quality of water supplied include changes in the quality of the treated water, the condition and degree of deterioration of a very large number of pipelines and many aspects of the operation of the distribution system. Deterioration is usually gradual and its effects cumulative. Thus, to speak of the failure of a component of the system and a need for its maintenance is only meaningful in a particular context. Understanding that context is not straightforward, and attempting to do so separately for individual components is likely to lead to a mechanistic and over simplistic approach.

Following from this, DWQU sees a need for periodic investigation and appraisal on a system-by-system basis, in which aspects of the operation, performance, specification, condition, age and deterioration of assets can be considered in context, and an attempt made to understand the functioning of the system. It is in the context of the functioning

of the system that the serviceability of assets can be meaningfully assessed. What would constitute 'the system' may vary with the complexity of supply arrangements. Generally, the area should be large enough to allow real thought to be applied efficiently to processes of deterioration, causes of impending problems and potential solutions. In the simple situation where a single treatment works serves a distribution system of moderate size, these could conveniently comprise 'the system'. Multiple sources or very large areas served may call for a different approach.

8.3 Overall rates of activity

While the need for work and its nature are best identified by periodic zonal investigations, DWQU expects SW to aggregate the results of these local findings and decisions to provide information on rates of activity across the whole of SW's area and across broad categories of asset, such as an annual rate of renewal of pipework. The long-term implications of these rates should be considered.

8.4 Defining an approach

DWQU does not wish to prescribe in detail the approach to be adopted, for example, SW may find it beneficial to investigate different geographic areas or different combinations of aspects of water quality, but DWQU expects to see SW's approach defined broadly in the following ways.

- The definition of areas to be monitored and areas to be investigated. These may be different. It may be sensible to investigate at one time the processes of deterioration in a relatively large area with a common water source. However, the objective of the DOMS should be, not merely to keep average water quality in any large area acceptable but, as far as is practicable, to prevent individual consumers receiving unsatisfactory water. Thus, areas for monitoring performance may need to be smaller.
- A programme of monitoring of performance and condition, including regular sampling, assessment of compliance with standards and SW internal criteria, consumer complaints, incidents and events and "serviceability indicators".
- A trigger for detailed investigation of an area. This could be the exceedence of internal operating criteria, a fixed programme, or a combination of the two. Thus it may include methods of monitoring system performance and condition, a periodic structured review of several kinds of data, and a mechanism for ranking areas for detailed investigation.
- The scope of investigations with respect to aspects of water quality and other aspects of service included. A system approach from input to the distribution system to consumer's tap is favoured (see 8.2 above), including quantification of performance and consideration of causes such as output from treatment works, corrosivity, particulates etc.
- A suite of methods or approaches for detailed investigation, including
    - ascertaining the significant processes of deterioration and causes of problems,
    - assessing the risk of future water quality problems on the basis of current information,

- assessing current and projected performance with respect to relevant water quality parameters against internally defined criteria.

- Appraisal of suitable preventive actions, including capital and operational solutions, taking account of whole life costs, and demonstrating the need for any actions proposed. The actions may include any of the following:
  - programmes of 'capital' maintenance work,
  - programmes of 'operational' maintenance activity,
  - reconsideration of requirements for treated water quality, or
  - reconsideration of operational procedures.
- A system for ranking actions, giving priority to protection of public health and drinking water quality requirements.
- An appraisal and feedback mechanism to give evidence that programmes of work and operational changes have been successful, and to provide data for subsequent review of the effectiveness of the process.
- A mechanism for providing assurance that sufficient is being done to safeguard water quality into the medium or long term. This will involve comparing rates of deterioration with levels of activity. It will be necessary to develop methods for this purpose, and to arrange for the relevant data to be collected (but see Section 14).

9. Monitoring and responsive maintenance

Successful application of pro-active investigation and maintenance described in Section 8 above should mean that the incidence of actual problems is low, but it would be unrealistic to expect it to be zero. Thus, there is also likely to be a need for timely reaction to actual or impending water quality problems. This would entail arrangements for monitoring quality related parameters, and for responsive maintenance and correction of faults, for example where an internal operating criterion or water quality standard is exceeded, or complaints about water quality are made. These actions are, in general, likely to be more local and/or more short-term (mostly within the current year) than those resulting from the strategic, pro-active investigations described in Section 8 above. DWQU expects to see SW's approach defined in the following ways.

- Arrangements for suitable monitoring and frequent reviews of data or other means of quickly flagging problems.
- The definition of triggers for identifying water quality as being unsatisfactory, including internal operating criteria and levels of consumer complaints, as well as water quality standards.
- Methods of investigation appropriate to the scale of the identified problem.
- A means of determining whether a 'strategic' investigation is required.
- A system for assigning priority to remedial action.
- A feedback mechanism to give evidence that the work was successful, and to provide data for subsequent review.

10. Control of operational activities

10.1 Precautionary procedures related to risk

A very large number of activities can have a deliberate or unintended effect on water quality in the distribution system. DWQU expects SW to review the water quality implications of these activities, to identify and assess the risks to water quality involved, and to have procedures in place to mitigate the significant risks. The approach adopted should be consistent with the risks and with the serviceability of the system: a fragile system requires sensitive operation whereas a robust system may allow more flexible operation.

Where the risks may vary appreciably between instances of the same type of action, it is helpful to assess the risks associated with individual actions (Section 10.2). For example, where boundary valves are to be opened, the likelihood of a discoloured water event will vary markedly depending on the disposition of the mains concerned, the flows they normally carry and the flows they are expected to carry after the valve is opened. On the other hand, where the risks associated with individual actions do not vary appreciably between instances of the same type of action, or it is unrealistic to attempt to assess them individually, it would be appropriate to apply standard routine procedures (Section 10.3). In effect, the risk assessment is applied generically, and the routine procedure is developed to take account of its results. For example, except in extreme cases, it would be unrealistic to attempt to assess the risk of microbiological contamination while repairing individual local distribution mains (as distinct from subsequent microbiological testing). A routine procedure for cleanliness and disinfection should be applied; failure to do so for any reason should be an internally reportable occurrence.

10.2 Procedures where risk is assessed for individual actions

The term risk assessment is applied to approaches that range from an informal consideration of the possible consequences of an action, through to a numerical discipline involving the quantification of the probabilities and consequences of the risks associated with various alternatives. In the context of the operation of distribution systems, there is probably most scope for strengthening these assessments by incorporating hydraulic calculations. These provide such information as whether velocities in a particular main are likely to be high enough to re-suspend deposits, and the geographic spread of effects.

DWQU expects to see a requirement for risk assessment to precede a range of operational activities. DWQU also expects to see a graded approach, the rigour of the assessment varying with the scale of potential consequences. For example,

- for the opening of a small diameter boundary valve, a ‘tick box’ approach might be suitable,
- for bringing a previously isolated main back into use, a method statement might be suitable, and

- for the introduction of new source to an area, one might expect to see a documented comparison of alternatives with supporting data, and a detailed execution plan including provision for contingencies.

Procedures should provide for escalation as the apparent risk of an operation increases, allowing more data, more rigorous calculation, more expertise, and/or more senior decision makers to be called on.

For a number of activities, a combination of risk assessment and routine operational procedure (see 10.3 below) may be appropriate.

DWQU expects SW procedures on these risk assessments to include

- the categories of work that should be subject to them,
- a graded approach
- a mechanism for escalation
- methodologies appropriate to different types and scales of work, including data to be considered, guidance on appropriate calculations or software to use,
- precautions to consider to mitigate consequences in various circumstances,
- reference to further sources of information or advice,
- assessment of alternatives and preparation of execution plans for high risk, large scale or high level activities, and
- a feedback mechanism to help in refining the process for the future.

10.3 Routine procedures which allow for generic assessment of risk

DWQU expects SW arrangements for these routine operational activities to specify

- the categories of work that should be subject to them,
- the underlying findings and assumptions concerning risks to water quality,
- a written procedure or task instruction for each type of task, including any precautions to take in various circumstances for water quality reasons, and
- a feedback mechanism to help in refining the task definition for the future.

For the DOMS, it would be sufficient to refer to the relevant written procedures or task instructions, together with a brief description of the risks identified and the key features of the procedure to counter them.

11. Regular inspection and maintenance

These are recurrent activities scheduled on the calendar. Often, they are likely to be small jobs carried out on parts of the system most easily dealt with in isolation, and are appropriate where the asset can be regarded as failing discretely. For example, it may be appropriate to test the operability and marking of sluice valves at a fixed interval, carrying out any repairs as needed. SW may also expect to carry out a more substantial proportion of its maintenance activity by means of regular programmes of cleaning, tailored to the needs of individual areas. DWQU expects the choice of this approach for a particular task, and the frequencies adopted, to be related to the likelihood and

consequence of risks to water quality. DWQU expects SW procedures on these regular tasks to include

- the categories of work that should be subject to them,
- the underlying findings and assumptions concerning risks to water quality,
- the frequency for each task,
- a written procedure or task instruction for each type of task, including any precautions to take in various circumstances for water quality reasons, and
- a feedback mechanism to help in refining the task definition and frequency for the future.

For the routine precautionary tasks such as valve testing, it would be sufficient to refer in the DOMS to the relevant written procedures or task instructions, together with very brief description of key features. Where a substantial proportion of the cleaning is scheduled, the means by which programmes and frequencies are derived should be outlined in the DOMS.

12. Cyclic review of the DOMS and its components

The DOMS should be subject to review on a periodic basis. It is recognised that some parts of the DOMS may be new and will need proving in practice, and all parts should be subject to change as circumstances change or methods improve.

- Review of the DOMS may identify gaps requiring new or modified procedures.
- Changes in SW policies and practices may have an effect on the DOMS.
- The collection of data on the functioning and effectiveness of individual procedures will allow their modification or refinement as necessary.
- Review of data on the overall performance of the network may prompt a change of approach. For example, SW may reconsider whether mains cleaning should be mainly responsive, a scheduled activity, or both.
- The balance between activities may change. For example, as loose deposits are removed and pipe condition improved, there is likely to be a lower risk of causing discoloured water by low level changes to the network such as rezoning. This may allow operational procedures to be relaxed as the system becomes more robust.

13. Application

There is no definitive list of the activities that should be dealt with in each of the above ways and there may be quite valid alternative ways of tackling the same topic. For example, SW may decide, given its water types and other circumstances, to opt for regular cleaning of service reservoirs, say every five years. Or it may opt for regular remote inspection and measurement of sediment, say every three years, and to determine the need for cleaning on the basis of the results.

A list of topics to consider is given in Appendix I as an *aide mémoire*. This is neither a definitive requirement, nor a complete list of the topics that should be considered.

However, DWQU expects SW to address most of them, mainly by means of prescribed procedures as described in Section 10. SW is likely to already have practices in place for most of these topics, although it would be beneficial to review their effectiveness in maintaining water quality from time to time.

14. Development of DOMS

The DOMS touch on many aspects of SW's organisation and activities. DWQU recognises that they will take time to develop and implement, and that they will continue to evolve. In early versions, DWQU expects to see evidence that SW is addressing all of the issues outlined above. However, DWQU acknowledges that there may be gaps in detail; DWQU encourages SW not to wait until all elements are in place, but to discuss early working versions with DWQU and to implement those parts they consider viable. In particular, SW may not yet have developed methods or have available data to determine whether levels of activity are sufficient for the long term. However, DWQU expects the issue to be addressed now in order that a process may be put into place and data collected so that improved assessments may be made in the medium term.

15. Pre- and Post- Rehabilitation Assessments and DOMS

DWQU would like to agree a rolling twelve-month water mains rehabilitation programme with SW that covers defined Water Supply Zones. Rehabilitation carried out under the rolling programme would be subject to Pre- and Post-Renovation Assessment methodologies. There is likely to be considerable overlap between the scope of the programme and the pro-active investigation and maintenance described in Section 8. It could be argued that the risk of poor water quality is higher in those zones within the programme, so that there is a greater need there for the precautionary measures described in Section 10. Accordingly, it would be appropriate to apply attention under Section 8 to Water Supply Zones that were *not* part of the rolling programme, and to apply attention under Sections 9 to 12 to all Water Supply Zones.

Attachment: APPENDIX I : Topics that may have an effect on water quality in distribution

APPENDIX I : Topics that may have an effect on water quality in distribution

Abnormal finished water quality
Access to distribution system by SW personnel and SW contractors
Access to distribution system by external users e.g. local authority, fire service, contractors
Alternative supplies – prepared plans for programmed work (e.g. service reservoir maintenance) and unprogrammed events (e.g. major bursts)
Animals - monitoring populations in distribution system
Animals – controlling infestations
Animals – restricting growth in populations in distribution system
Asset records
Asset condition data – collection and availability
Biofilm formation
Bowser filling
Burst mains – isolation
Burst mains – repair and disinfection
Burst mains – recharging and reconnection
Change in supply arrangements – high level e.g. change in source or treatment
Change in supply arrangements – permanent
Change in supply arrangements – temporary
Cleaning of mains- systematic unidirectional flushing
Cleaning of mains- swabbing
Cleaning of mains- air scouring
Deposition / resuspension propensity in mains
Design standards for new assets
Design of system - access points for cleaning e.g. swab insertion
Design of system – 'age' of water
Design of system – bypasses on control valves etc. needing maintenance
Design of system – minimise dead ends
Design of system – incorporate washouts at zone boundaries
Disinfectant residues – acceptable values
Disinfection - secondary dosing of disinfectant in distribution
Disinfection of new mains, rehabilitated mains and repaired mains
Disinfection and installation of fittings
Disinfection of large diameter mains
Execution plans – for high-risk activities
Future demands and changes
Finished water specification – particulates, corrosivity, AOC or TOC
Fire fighting, fire brigade flow tests
Fluctuation in demand – design to avoid tidal flow in reticulation
Hydrants and standpipes - operation
Hydrants - maintenance
Hygiene code
Incidents and events - management

Integration of supply systems
Intermittent pumping regimes
Leakage control operations - formation of metered districts
Leakage control operations – step tests and waste metering
Leakage control operations – zero pressure testing
Leakage control operations - pressure reduction schemes
Mains – inspection of sensitive and/or trunk mains
Materials – policy for use of materials to avoid leachates or migration, including Regulation 25 and Water Byelaws 2000
Mixing of different supplies
New or refurbished mains, fittings, meters, etc., installation and commissioning
Power failures
Pressure reduction
Pumping regimes
Pumping stations - operation
Rezoning
Recharging of mains
Recommissioning of mains that have been out of service
Rehabilitation of mains – methods
Rehabilitation of mains – execution
Restricted Area working, Restricted Operation working
Reviews of water quality data
Rezoning
Sampling programmes
Sensitive consumers
Sensitive mains
Sequestrants (silicates, polyphosphates) – dosing for control of discoloured water
Service reservoirs and tanks – design, including existing reservoirs
Service reservoirs and tanks – external inspection, maintaining vents, overflows and access covers
Service reservoirs and tanks – isolation and providing alternative supplies
Service reservoirs and tanks – internal inspection and integrity testing
Service reservoirs and tanks - cleaning, disinfection and maintaining structure
Service reservoirs and tanks - operation (throughput, diurnal variation in levels etc,)
Trunk mains – surface inspection, testing operability of valves etc.
Trunk mains – internal condition
Trunk mains - operation
Trunk mains - reliability
Unusual demands
Valves – inspection and maintenance of sluice valves
Valves – operation of sluice valves
Valves – inspection and maintenance of air valves
Valves – inspection, maintenance and operation of control valves (PRVs, PSVs, NRVs)
Valves – register of critical valves and their status
Valves – recording status
Water Byelaws- enforcement

Please complete the acknowledgement below and return it to:

Ewan Young
The Scottish Executive
Drinking Water Quality Unit
1-H
Victoria Quay
EDINBURGH
EH6 6QQ

I acknowledge receipt of Information Letter 5/2003:
DISTRIBUTION OPERATION AND MAINTENANCE STRATEGY (DOMS)

Signed _____

Name _____

Position _____

Authority _____

Address _____

_____

_____

Date _____