2. WATER SUPPLY BACKFLOW PREVENTION RR 9029

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The purpose of this report is to advise on work that has been undertaken on water supply backflow prevention and to explain the background for the request in the draft 1999/2000 Annual Plan for additional funds for the continuation of this work.

BACKGROUND

Historically, the water supply industry in New Zealand (and throughout the world) has made a determined effort to provide the consumer with a virtually unlimited quantity of high quality water. Much of this effort has, however, been concentrated on the production of quality water with less attention paid to protecting its quality once it has entered into the distribution system. However regulatory authorities around the world, including the New Zealand Ministry of Health, are now placing significant emphasis on ensuring that the water quality in the distribution systems is maintained and customers receive it at an acceptable known standard. This emphasis of requiring supply authorities to demonstrate that their customers can rely on receiving a consistent and known quality product is reflected in the Ministry's current review of the *Public Health Grading of Drinking Water Supplies* and in their major review of the *Water Supplies Protection Regulations*.

The need to deliver good wholesome water to customers has been included in water supply related regulations for many years, but *good wholesome water* (and similar terms used in past legislation) has not been defined until the recent reviews commenced. Nor has the acceptable means of establishing that a supply authority is taking due care in this respect been defined.

One of the potential risks to a public water supply is the possibility/likelihood of contaminated water flowing from a private consumer's property back into the public pipework and hence being redistributed to other third party customers. This particular risk has received considerable interest in recent years and the current reviews mentioned above places emphasis on this issue. The new *Water Supply*

Protection Regulations will almost certainly place emphasis on backflow prevention and the means of demonstrating compliance with the laws relating to this. In turn the new the *Public Health Grading of Drinking Water Supplies* will continue to give significant number of demerit points to a Supply that is not satisfactorily complying with the regulations. In the case of Christchurch, because it is an unchlorinated supply, the number of demerit points involved could be such that the distribution system grading could slip from an (a) to a (b) if compliance cannot be demonstrated.

HOW COMMON IS BACKFLOW?

"Backflow" can be defined as, *"The unplanned reversal of flow of water or mixtures of water and contaminants into the water supply system."* Associated with backflow prevention is the term "cross-connection" which can be defined as, *"Any actual or potential connection between a potable water supply and a source of contaminant."*

All water supply distribution systems, to some extent, have connections between pipe work or processes that contain (or could contain) contaminants or non-potable substances, and the potable water supply piping. Backflow and cross connections occur almost daily and most are relatively harmless and go unnoticed. Waterworks maintenance crews regularly encounter backflow of hot water from consumers' hot water systems when carrying out service pipe repairs. While this may be relatively harmless it serves to demonstrate the backflow threat.

However there are many documented cases both overseas and in New Zealand of dangerous substances flowing back into a supply authorities pipework. Reported New Zealand incidents include 1986 Wellington (dry cleaning fluid); 1998 Dunedin (caustic soda); 1994 Waitoa (caustic soda); Christchurch 1996 (chemically dosed process water); 1995 a rural water supply (fungicide). Overseas incidents include 83 football team members being stricken with infectious hepatitis and the death of a patient dependent on a dialysis machine.

The simplest and safest method of eliminating the risk of backflow contamination is for all water to be drawn from the plumbing system via an outlet that has an air gap, such as a tap located above the top level of a basin. However this is not always achievable and a number of approved mechanical devices have been developed for installation in plumbing systems that shut when a flow reversal begins to occur. Different devices with increasing reliability (and cost) are approved for increasingly dangerous circumstances. These mechanical devices need to be tested at least annually to ensure they continue to function correctly.

THE LAW

There are over 36 items of legislation that relate in some way to drinking water. Of these, seven are directly applicable to backflow prevention. These are:

- Health Act 1956
- Water Supply Protection Regulations 1961
- Local Government Act 1974
- Building Act 1991
- Health in Employment Act 1992
- Consumers Guarantees Act 1993
- Christchurch City Water Related Bylaw 1992

The tone of the legislation is two-fold. Firstly the water supplier has a duty of care to ensure the water delivered is drinkable, and secondly that the customers connected to the water supply have a duty of care to not allow contaminated water to re-enter the supplier's pipework and thus create a health hazard. The Water Supplies Protection Regulations also make it clear that the supply authority has a responsibility to satisfy itself that its customers are complying with the regulations in this respect. It is not sufficient to blindly assume consumers are aware of their obligations and are complying.

THE PRESENT SITUATION IN CHRISTCHURCH

Prior to 1991 Christchurch City generally understood its responsibility in respect to the Water Supply Protection Regulations 1961 and was undertaking surveillance along the lines that were considered acceptable normal practice at the time. However the 1991 Building Act introduced requirements which for a few years were considered to move much of the responsibility away from the water supplier and towards requiring the customers (who were putting the supply at risk) to mitigate against the hazard. It was widely believed throughout New Zealand that the Building Act overruled the Water Supply Protection Regulations and placed the responsibility squarely with property owner/occupiers and with the building regulation administrators to ensure backflow could not occur.

More recently it has become clear that the Building Act requirements are additional to (rather than over-ruling) those in the Water Supply Protection Regulations and thus it has been reconfirmed that water supply authorities are required to be active in respect to backflow prevention. Furthermore, experience with the Building Act has identified that the building regulatory administrators are unable to effectively monitor the uses buildings are put to and thus they are unable to monitor to ensure that building owners/occupiers

are complying with the regulations in this regard. Equally alarming is that it is clear most users of industrial and commercial processes that could potentially put the water supply at risk are genuinely unaware of the risks their processes pose and of the means to mitigate against the risk.

As mentioned earlier, the Christchurch water supply is not chlorinated and thus there is no defence barrier within the supply to kill off any biological contamination that may occur as a result of backflow or other reasons. The lack of chlorination does not affect risk in respect to chemical contamination.

TYPES OF PROCESSES THAT POSE A RISK

The list of processes that potentially put a water supply at risk is almost inexhaustive, but the following give an indication of the scope:

- Irrigation schemes (parks, nurseries and private dwellings)
- Swimming pools (public and private)
- Manufacturing plants
- Premises with boilers, and/or chillers
- Processing plants (wool scouring, meat works, tanneries, canneries etc)
- Breweries and bottling plants
- Photographic and x-ray laboratories
- Hospitals, medical facilities, veterinary facilities etc
- Metal plating plants
- Automatic car and other wash facilities
- Chemical and dyeing plants
- Research and educational laboratories
- Dry cleaner and laundries
- Timber treatment plants
- Sewage treatment and pumping stations

WHAT CHRISTCHURCH IS PRESENTLY DOING

This Council's main emphasis with respect to backflow prevention presently revolves around the Building Act's requirements in respect to the Building Warrant of Fitness (WOF) system. The Environmental Services Unit administers the Building Act requirements. Essentially this part of the Act requires the owner of a building that contains certain safety features (including backflow preventers and fire sprinkler systems) and essential systems (eg emergency lighting, ventilation systems, lifts) to supply, to the Council, a list of such systems installed in the building and to forward annually a certificate (WOF) showing that those systems have been inspected by an IQP (Independent Qualified Person) and found to be in good working order. While these requirements are well understood in respect of some aspects (eg lifts, fire sprinkler systems, emergency lighting) and attract

reasonable compliance, other aspects, including backflow prevention, are generally not well understood and attract poor compliance. Many building owners have little knowledge of the plumbing systems within their building or the exact nature of the processes they or their tenants are undertaking. Often they are totally unfamiliar with the concept of backflow, the potential risk their building could be exposing the water supply system to, or to their legal obligations in this area.

The Building Act also requires owners to advise the Council when a change of building use is proposed, but this is not occurring in the majority of cases. It is not uncommon for a building to be constructed as an empty shell with its end use unknown. It is then sold or leased at completion of construction and at some stage (days, months or years later) an item of machinery, or a process, is installed and connected to the water supply. The Council is usually totally unaware this has occurred.

A further concern is that the Building Act only applies to buildings as defined in the Act. Accordingly the Act does not apply to facilities that may have water connections but are not classed as buildings. For example a water connection to a vacant lot, irrigation schemes (golf courses, parks, sports fields) and stand-alone items of machinery.

In addition to the Environmental Services Unit's work in respect of the building WOF system, the Water Services Unit follows up any indications that suggest a property or process has the potential to cause a backflow incident.

In summary, while this Council is administering the requirement of the Building Act in respect of backflow protection, property owners' lack of knowledge of their obligations in respect of change of building use and to backflow issues, results in little confidence that the water supply is satisfactorily safeguarded against contaminants entering from private property. Also, the present understanding that backflow requirements of the Water Supply Protection Regulations have not been superseded by the Building Act strongly suggests that this Council, as a water supply authority, should significantly increase its effort to meet its obligations in respect of the Water Supplies Protection Regulations. That is, it may be argued that the Council cannot satisfy itself that the water supply is sufficiently protected from this point of view.

The consequences of a backflow incident resulting in serious harm or death would almost certainly involve an extensive investigation. The vulnerability of a Council (and its advisers) is relatively high, as it must be able to defend its position as a supplier of goods (Consumer Guarantees Act), identifier of risk (Health Act), technical expert in water supply

protection and cross connection control, and as inspectors, ensuring that the regulations are being complied with. The Council, building owner, engineer/designer, plumbing installer and IQP could all be implicated in legal action. It should be noted that in common law, ***every person*** is encumbered with a duty to exercise a standard of care sufficient to protect others from unreasonable risks or harm.

WHAT OTHER SUPPLY AUTHORITIES ARE DOING

Seven water supply authorities (Auckland, Waitakere, Dunedin, Palmerston North, Hutt, Hamilton and Timaru) have been contacted to gain an indication of the action others are taking in respect to this issue.

Six of the seven authorities have, or are in the process of, or are committed to, undertaking a detailed survey of the industrial and commercial premises in their supply district, starting with those that have processes with high risk potential and working down to lower risk premises. Where properties are found to be in breach of the regulations they are required to modify their pipework to totally eliminate the risk or install an approved backflow prevention device. The experience of these authorities is that most owners, when they are made aware of the problem, co-operate and comply. In conjunction with this is a strong emphasis on raising the awareness of backflow issues and how to mitigate against them. The councils undertaking these surveys are also establishing information systems that will ensure appropriate monitoring and administration in the future.

SUMMARY OF THE PRESENT SITUATION

Summarising the present situation, the Christchurch City Council has an obligation to actively ensure that the water supplied from its system is safe and does not pose a health risk. To ensure this, amongst other things, it is necessary for the Water Services Unit to undertake monitoring and surveillance to demonstrate the risk of backflow from private property re-entering the public pipework is minimised. It could be argued that the present measures being undertaken in this regard are not sufficient to demonstrate that such risk is at a satisfactory level.

WHAT SHOULD BE DONE IN CHRISTCHURCH

Unfortunately, there are no easy ways to reduce the level of risk. The level of assurance required by water supply regulatory bodies worldwide (and the Health Act) demand the inspection (and ongoing re-inspection), of industrial and commercial premises, as well as some degree of control over all other water supply connection, including private dwellings. The widespread use of convenience and leisure appliances in homes (automatic dishwashers, inground irrigation systems, swimming and spa pools etc) and the array of manufacturing and processing equipment being used in a modern society

virtually ensures that every connection to a water supply system has the potential for backflow. The issue is not so much whether the risk is present, but one of how big the risk is.

The recent tendency is for water supply authorities to have all connections fitted with some form of backflow prevention device. For domestic premises and small commercial premises (eg shops and offices) without an identified high risk, two non-testable check valves are often used. The small water meters used in Christchurch have one such valve fitted in them as standard and a second could very easily (and cheaply) be incorporated into the stop tap or a pipe fitting in the connection box. These devices could be renewed every time a meter gets renewed or repair work carried out. The installation of a second check valve would add approximately $20 to the presently proposed (for 1999/2000) new connection fee of $325. Given that the installation of new connections is about to be competitively tendered, there is the possibility that some of the actual additional cost may be able to be absorbed. When a site is identified as having a potential a risk, an upgrade, or installation of a complying device, would be required at the owner's expense.

It must be appreciated that the installation of two check valves, as just described, does not mean that the connection meets the requirements of the Water Supply Protection Regulations if an identified (medium or high hazard) risk is present on the premises. It does however give a reasonable degree of risk reduction in case there is an unidentified risk on the site. A fully complying backflow prevention device for a 15mm domestic connection costs in the order of $80.

It is a reasonable assumption that virtually all large connections (ie larger than 40mm diameter) will serve premises that have complex plumbing systems and/or processes that require, by law, some form of backflow prevention device. Thus it is not unreasonable, as a condition on connection, for a large supply that the premises have an appropriate backflow device installed with the connection, and that the owner is responsible for testing it at least annually (similar to, or in conjunction with the Building Warrant of Fitness). An annual test by an IQP costs in the order of $100.

While these initiatives would take care of new and upgraded (water supply-wise) premises, they would not affect the majority of existing connections. Thus some form of retrofitting programme is be needed. The most cost effective way to undertake this would be to upgrade the connection when the meter is changed or major work is undertaken on the connection. While the cost is reasonable the time to complete the programme at the present rate that meters are renewed would be approximately 60 years. A specific

upgrade not undertaken in conjunction with normal work is likely to cost in the order of $150 for each standard 15mm (house) connection. This equates to approximately $15 million in total and compares with approximately $2 million if undertaken over time in conjunction with meter renewals.

It is believed that the risk of a serious backflow incident could be reduced considerably by undertaking a targeted education and inspection programme starting with premises with larger connections and those using large volumes of water. There are approx. 250 commercial premises with a connection 50mm diameter or larger, or 1,000 with a connection 25mm or larger. When considered in this light an active inspection programme is not such a daunting prospect.

When considering this issue it must be remembered that many of the City Council controlled activities are customers/users of the water supply system. The Council is the water supply system's largest customer with over 2,500 connections taking over 1,000,000 cubic metres of water per annum (2% of total). Indeed the Parks Unit is the largest single customer. Thus it is important to appreciate that any programme entered into will need to co-ordinate with other Council activities. The Council would need to be seen to be committed to complying with the requirements in conjunction with requiring other customers to do so.

As part of any increased effort with backflow prevention there will be the need to have good information systems that allow a co-operative approach with the Environmental Services Unit (building WOF system), the tracking and history of inspections, and assurance that installed backflow preventor devices are being tested annually by IQPs. Targeted publicity and friendly literature, aimed at raising the public's awareness of backflow and its consequences, will need to be prepared.

A request has been made in the 1999/2000 draft Water Services Annual Plan for an additional $100,000 (ie $120,000 in total) for backflow prevention work. This funding would be used to produce publicity on the topic, to employ resources to set up the required information systems and to undertake a programme to identify industry/ processes that are potentially putting the water supply system at risk. The owners/ operators of any non-complying process will be required to modify their operations to comply with the regulations.

Recommendation:

1. That all future new connections, 40mm diameter or smaller, be fitted with dual non-testable check valves, and that the extra cost of these be incorporated into the connection charge.

2. That all future new connections 50mm and larger be required to be fitted an appropriate testable backflow prevention device and that this device be tested at least annually at the owner's cost.

3. That dual non testable check valves be retrospectively installed on existing connections up to 40mm in diameter as meters are required to be renewed, or when other major work is required to be undertaken on such connections.

4. That a programme specifically to retrofit existing connections with back flow devices not be commenced at present but the issue be reviewed in two years' time.

5. That the survey of existing connections focus on large industrial and other industrial connections.