Public Alerting: Options Assessment

INFORMATION FOR THE CDEM SECTOR [IS 10/09]

CIVIL DEFENCE

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Te Rākau Whakamarumaru
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Foreword

New Zealand is exposed to a wide range of hazards. Since we are able to monitor, analyse, and anticipate many types of hazard events, the Civil Defence Emergency Management (CDEM) and science communities carry a joint responsibility for providing effective public warnings and alerts as part of a comprehensive approach to managing our risks.

Warning systems must be capable of delivering timely and relevant messages or alerts to the at-risk public, for all New Zealand hazards for which warnings are possible. For example with flooding, even though there is usually low risk of loss of life, timely warnings can serve to reduce economic damage from stock losses and damage to re-locatable assets. For high-consequence, low-frequency events where there is little lead in time, warnings are primarily issued to enable people to move out of harms way or protect themselves. Development of effective warning systems that reduce harm and losses are an integral part of CDEM planning in New Zealand.

While the quest for a primary, effective and wide-reaching public alerting capability in New Zealand continues, we must accept that we will never be able to rely on a single public alerting mechanism only. We will always have to use complementary mechanisms and therefore have to be able to justify that those mechanisms we choose are adequate for the areas and hazards they are intended for. This document provides guidance, comparisons and tools in this regard. It is based on research of the public alerting mechanisms currently being used in New Zealand, those that can potentially be used and those used elsewhere in the world, as well as research on the social aspects related to effective warnings.

The result is a document and tool that can be applied by CDEM specifically at the local level to assess and/or plan their warning systems.

John Hamilton
Director
Ministry of Civil defence & Emergency Management

Introduction

Purpose of this document

This document aims to provide agencies responsible for warnings with information that can support them with:

- Considerations when planning or reviewing warning systems
- Evaluating the effectiveness of public alerting mechanisms currently used as part of warning systems
- Considering the effectiveness and advantages of one public alerting mechanism against another
- Deciding on the most appropriate public alerting mechanism (or suite of mechanisms) in relation to their budget and target areas' unique features like hazards and demographics.

Structure of this document

The document is presented in three sections:

Section 1 sets the context for public alerting in New Zealand and states some key considerations and principles that are central to public alerting in New Zealand. Some of these considerations and principles also form the basis for the subsequent sections of the document.

Section 2 provides a comparative analysis of twenty-nine public alerting mechanisms. Twenty-five of the mechanisms are currently in use or available for use in New Zealand and four are not currently available for use in New Zealand. Each mechanism is considered against a standard set of criteria.

Section 3 introduces a decision support tool that can be used by agencies to evaluate their existing public alerting arrangements or to help them with identifying the best fit for specific areas against budget, hazard and demographical features. It includes a link to the decision support tool (in Microsoft Excel format) as well as an explanatory step-by-step user guide.

Resources

This document is compiled from a study conducted by GNS Science: *Leonard et al, 2008, An evaluation and decision making support tool for public notification systems in New Zealand, GNS Science Report 2008/34, Lower Hutt.* It also takes account of a study conducted by the New Zealand Centre for Advanced Engineering; *New Zealand Telecommunications-based Public Alerting Systems Technology Study, Dec 2008*.

The studies were commissioned by the Ministry of Civil Defence & Emergency Management as part of its Tsunami Risk Management Programme. Both studies can be downloaded from the Publications page of the MCDEM website.

Section 1: Key considerations for Public Alerting

Warning and Public Alerting in New Zealand

When there is an imminent threat to life, health or property from hazard events the issue of official warnings is the responsibility of civil defence emergency management (CDEM) agencies. At the national level the responsibility for issuing official warnings to agencies and central government rests with the Ministry of Civil Defence & Emergency Management (MCDEM); at the local level the responsibility for issuing official warnings to local communities rests with CDEM Groups and their members.

MCDEM may issue warnings via its national warning system[1]. This system consists of email, fax and SMS messages sent to CDEM Groups and their members (all local authorities), a range of national agencies, lifeline utilities and when required, to the key (national) radio and television stations[2]. Information at the national level about events may also be publicly provided through the MCDEM website and media releases.

Due to its specific target groups and dissemination capability, the penetration of warnings issued via the national warning system to all levels of the community is limited. Therefore community-based public alerting arrangements at the local level are essential to provide for the wider dissemination of warnings to local communities and individuals.

Warnings issued by MCDEM via the national warning system are referred to as **National Warnings**. National Warnings will always be a trigger for further **Public Alerts** generated by local level CDEM. Public Alerts may also be issued by local level CDEM at their discretion (e.g. without a National Warning being issued).

Local level CDEM maintain their own warning systems that include arrangements for public alerting. These systems and their arrangements are not consistent across the country and may involve local radio announcements, sirens, telephone trees, mobile PA systems, aircraft based PA systems/sirens etc. A survey conducted among New Zealand local authorities in 2008 showed that at least 20 different public alerting mechanisms (mostly combinations of up to three mechanisms) are currently in use by local authorities as part of their local warning systems.

There are several reasons for the variable approach and application of public alerting mechanisms by local authorities in New Zealand. The most evident of these are:

- The wide range of geographical settings across the country and diversity of New Zealand communities: What works well in one area may not suit another.
- The funding capabilities and priorities of local authorities: Authorities can only provide what they have prioritised and can afford.
- The absence of national technical standards or guidelines:

A key purpose of this document is to provide nationally consistent guidance and a decision support tool for assessment of public alerting options available for application by local authorities.

New Zealand society – who are we trying to reach?

A principal consideration in assessing public alerting options is the characteristics of the communities that are to receive warnings. The variable distribution and demographics of our communities mean that warning systems must be capable of reaching diverse populations, sometimes spread over very large distances. The New Zealand population (~4,270,000) is primarily urban (84%), with over half of the population residing in the northern half of the North Island. As an example of variations that need to be considered, urban populations typically have greater percentages of residents who do not have English as a first language. It is important in planning warning systems that account is taken of specific target groups who have special

1 The national warning system is described in Section 19 of The Guide to The National CDEM Plan. (The Guide to the National CDEM Plan can be accessed on the MCDEM website)

2 The list of radio and television stations that can be requested to broadcast national warnings is contained in Section 22 of The Guide to The National CDEM Plan.

requirements for how warning information is received.

Another example of a group requiring special consideration is the tourist population. At any given time thousands of holiday-makers both domestic and from overseas are travelling throughout New Zealand. This transient population is vulnerable in several ways, for instance from lack of familiarity with local hazards, warning systems and procedures and lack of local support or communication systems such as usually provided in their home environment by friends, family and colleagues.

Features of an effective warning system

To be fully effective, warning systems must be capable of reaching all persons at risk, in time, no matter who they are, where they are or what they are doing. In response, people must successfully take actions that save lives, reduce damage and suffering, and assist recovery.

However, in some situations there is obvious difficulty notifying diffuse populations. For example, in rural areas and remote coastal or wilderness areas it may not be possible to reach all individuals. In such areas, warning systems must be appropriate to population density and be available to the majority of people in a targeted area.

The Partnership for Public Warning[3] in the USA concludes that an effective warning system should:

- Be focused on people at risk
- Be able to be understood by all in the same way
- Be capable of reaching people irrespective of what they are doing
- Be easy to access and use
- Not create added risk
- Be reliable
- Provide appropriate lead time so people can have a chance to protect themselves
- Generate authenticated messages

Measure of effectiveness – official and informal warnings

Mileti and Sorenson[4] have concluded that a warning is effective when it has reached 95% of the at-risk population. However, this number is not necessarily the level of effectiveness needed to be reached by official warnings. 'Informal' warnings almost always occur and authorities should not only count on this process happening, they should use it to their advantage. Informal warnings are those received from family, friends, other members of the public or the general media. Mileti and Kuligowski[5] suggest that for every two official (formal) first warnings, there is one informal first warning. Therefore an effective official warning system is theoretically one which has the capability to formally reach at least two-thirds (safely expressed as 70%) of the at-risk population as a further 25% can be expected to hear the warning the first time from someone who has received an official warning.

The effectiveness level of informal warnings may be much higher where informal warning systems are an established feature of local communities. It can therefore be argued that by enhancing the use of social networks as a planned means of disseminating informal warnings, lower rates of penetration of official warnings are required.

3 Partnership for Public Warning, A National Strategy for integrated Public Warning Policy and Capability. 2003. p. 37.

4 Mileti, D.S. and Sorenson, J.H., Communication of Emergency Public Warnings: A social science perspective and state-of-the-art assessment. 1990, Federal Emergency Management Agency. p. 104.

5 Mileti, D.S. and Kuligowski, E., Public Warnings and Response: Research Findings & Evidence-based Applications for Practice. 2008, University of Colorado at Boulder START Center, University of Maryland. p. 92.

It is recognised that up to 5% of the at-risk population will always be unreachable for any number of reasons (some people choose to isolate themselves from information/contact, some are isolated by circumstances e.g. homelessness and some have disabilities that make contact more problematic).

Use of multiple systems

It is important to have multiple public alerting mechanisms within a warning system. No single mechanism is foolproof as all mechanisms have a potential for failure, especially within the community affected by a hazard event.

However, in assessing the effectiveness of the respective public alerting options, the overlaps in coverage of different mechanisms means the reach percentages of single mechanisms usually cannot simply be summed to provide a percentage of the collective reach. Unless the proportion of coverage overlap amongst mechanisms is clear and guaranteed, at least one (preferably more) of the mechanisms should by itself reach 70% of the population, even if multiple mechanisms are used.

The role of public education

Public education is a key component of the successful implementation of any warning system. Comprehensive public education is essential prior to hazard events to raise awareness and understanding of the hazardscape and the warning systems in place that will provide notification of a threat. Special consideration needs to be given for groups with particular needs such as new immigrants and transient tourist populations.

Section 2: Public alerting options – a comparative assessment of systems available in New Zealand and overseas

Introduction

In this section twenty-nine public alerting mechanisms are assessed against a set of standard criteria. While most of the mechanisms assessed are currently in use in New Zealand, some are available in New Zealand but not currently used and some are not available in New Zealand (mainly due to the particular technology not currently being supported by domestic infrastructure).

Options assessed

The public alerting mechanisms assessed are presented in four categories:

1. Natural warnings
2. Mechanisms that are independent and self-maintained
3. Mechanisms reliant on third party hardware and/or staff
4. Mechanisms that require dedicated hardware (but controlled by the warning agency)

Assessment criteria

The table below explains the assessment criteria that are applied:

Criteria	Explanation
Limitations	A short summary of the main limitations of the mechanism
Time-frame	How long it will reasonably take to prepare and send a warning via the mechanism and for it to be received
Heads-up and instruction	Whether the mechanism can be used for alerting (heads-up) or for instruction, or for both
Effectiveness residents	Effectiveness for the normal resident population
Effectiveness transients	Effectiveness for people that are unfamiliar with the area or local arrangements e.g. tourists
Effectiveness institutions	Effectiveness for people that are inside institutions like work places, places of learning, hospitals and prisons
Vulnerable & immobile	Effectiveness for people that are suffering from some type of disability e.g. the blind, deaf and elderly
Robustness/resilience	Vulnerability of the mechanism
Ongoing effectiveness	Ongoing effectiveness after the first warning has been issued, e.g. for further information
Terrain suitability	Suitability or unsuitability for different geographical features
Population density	Suitability for high and low density areas
Cost basis	The basis on which cost is estimated
Cost	Approximate estimates based on research as at late 2008. These estimates are not regarded adequate for final decision making
Hazards	The type(s) of hazards that the mechanism can effectively be used for
Target population	The particular segment or part of the population that the mechanism will be able to reach

1. Natural warnings

Introduction

Natural warnings are where a hazard effect or precursor (e.g. an earthquake for a tsunami) is actually experienced by the public. A natural warning is not a technological mechanism comparable with the other options described in this document but is analysed in order to assess its potential in the absence of any system and its value against other systems.

Criteria	Explanation
Limitations	Reliant on understanding of the hazard/awareness of meaning of the felt/visual experience and resultant appropriate response
Time-frame	Seconds to hours
Heads-up and instruction	Heads-up only
Effective residents	Yes, but effective and ongoing public education required
Effectiveness transients	Not suitable (unless familiar with similar hazards in home region/ country or sufficient public notices in tourist areas)
Effectiveness institutions	Yes but effective and ongoing public education required
Vulnerable & immobile	Limited by perception of precursors and comprehension
Robustness/resilience	Hazard must exhibit precursor activity
Ongoing effectiveness	Likely to increase in effectiveness along with frequency of or acquaintance with felt experience
Terrain suitability	All terrain
Population density	More effective in high density areas due to resultant informal warnings but also effective for isolated or diffused population centres
Cost basis	Based on education pre-event. Heads-up time depends on hazard. Development of community resilience (capacity, intention and action) through education and other interventions- 4 FTE staff per 100,000 people required. $1 per person annual education cost.
Terrain suitability	All
Hazards	All hazards, but more suitable for hazards with distinct signs or effects
Target population	All local (resident) population

2. Independent and self-maintained networks

Introduction

Volunteer and community networks have the potential to reach many people without any effort on the part of emergency management to maintain those networks. However, there is no obligation for those networks to act as a public alerting mechanism so reliability of this pathway will always vary to some degree. However, these networks may offer the important potential to reach English as a second language populations, cultural groups and rural groups.

Criteria	Explanation
Limitations	Hardware (e.g. telephone, internet) relied upon; duty person required at all hours; volunteer only - no legal obligation
Time-frame	Minutes to hours
Heads-up and instruction	Yes – provides both
Effectiveness residents	Yes
Effectiveness transients	Depends on the group
Effectiveness institution	Yes
Vulnerable and immobile	Yes
Robustness/resilience	Reliant on trained volunteer pool, there could be issues of conflicting priorities if own household is at risk
Ongoing effectiveness	High
Terrain suitability	All terrain
Population density	More effective in high density areas due to resultant informal warnings but also effective for isolated or diffused population centres
Cost basis	Based on staff effort to maintain relationships and testing. No direct start-up cost. Ongoing: plans and exercises
Hazards	Possible for all hazards, but may not suit very short lead in times
Target population	Residents and organisations and any visitors/tourists that the networks are in contact with
Target population	All local (resident) population

Further comments

Volunteer and community organisations often operate self-maintaining networks that could be used to warn the public within their immediate reach. These organisations may include:

- Surf Lifesaving
- Neighbourhood Support
- Rural Fire
- Royal New Zealand Volunteer Coastguard
- St Johns
- Red Cross
- Salvation Army
- Community Link response call trees and route alerts in remote areas

3. Mechanisms reliant on third party hardware and/or staff

Aircraft banners

Introduction

Aircraft banners are used to communicate a written message to the general public in specific targeted areas.

Criteria	Explanation
Limitations	Available aircraft, CAA Regulations (flight path and equipment certification), agreements with operators. Limited coverage – prioritising of at-risk areas. Banners with appropriate message need to be available. Weather conditions may hamper visibility or flying
Time-frame	Minutes to hours
Heads-up and instruction	Instruction only unless in an area where aircraft are unusual and will create interest
Effective residents	Effective for residents who are outdoors, but more effective if both sound and visual effect is used
Effectiveness transients	Effective if transient population who are outdoors, but more effective if both sound and visual effect is used
Effectiveness institutions	Low effectiveness (not visible)
Vulnerable & immobile	No difference
Robustness/resilience	Aircraft and agreements with operators are maintained to a robust standard. Airport operability, weather conditions.
Ongoing effectiveness	Will only remain effective while reaching un-warned population (as the aircraft relocates to new areas), and up to the point when adequate time for public response expires
Terrain suitability	All
Population density	All – better for remote areas with some population clustering. Less effective per minute for rural diffuse populations
Cost basis	Retainer, equipment purchase and flight costs for one craft
Cost (for each craft)	Start-up:$5k, ongoing (helicopter $1k/hr, effort, planning and exercises). Banner $3k each
Dense	Two aircraft units for 100,000 people, ten hours use per year (five per aircraft)
Diffuse	Eight aircraft units for 100,000 people, forty hours use per year (five per aircraft)
Hazards	All hazards with a lead in time of more than tens of minutes
Target population	All within visual range

Aircraft PA loudspeakers or sirens

Introduction

Aircraft loudspeakers or sirens are used to alert the public in specific areas. In the case of a siren only, the intent is to alert people to conduct some other action in order to establish the warning content (e.g. listening to their local radio station), or to take certain action in accordance with pre-established instructions. With loudspeakers the instruction can be given directly.

Criteria	Explanation
Limitations	Available aircraft, CAA Regulations (flight path and equipment certification, agreements with operators. Limited coverage – prioritising of at risk areas.
Time-frame	Minutes to hours
Heads-up and instruction	PA both, siren heads-up only
Effective residents	Effective for residents who are outdoors
Effectiveness transients	Effective if transient population are outdoors
Effectiveness institutions	Low effectiveness (sound dulled)
Vulnerable & immobile	Low effectiveness (sound dulled)
Robustness/resilience	Aircraft and agreements with operators are maintained to a robust standard. Airport operability, weather conditions
Ongoing effectiveness	Will only remain effective while reaching un-warned population (as the aircraft relocates to new areas), and up to the point when adequate time for public response expires
Terrain suitability	All
Population density	All – better for remote areas with some population clustering. Less effective per minute for rural diffuse populations
Cost basis	Retainer, equipment purchase and flight time costs
Cost (for each aircraft)	Start-up:$20k+, ongoing (helicopter $1k/hr, effort, planning and exercises)
Dense	Two aircraft units for 100,000 people, ten hours use per year (five per aircraft)
Diffuse	Eight aircraft units for 100,000 people, forty hours use per year (five per aircraft)
Hazards	All hazards with a lead in time of more than tens of minutes
Target population	All within audible range

Billboards

Introduction

Billboards are used to communicate written warning messages in specific target areas. They normally have limited space for text and can be electronic or printed/written.

Criteria	Explanation
Limitations	Time to erect, exposure only to those who view message, agreements required for electronic billboards. Mobile billboards may be affected by certain hazards. Only suitable for events with long lead in times. Will never or only slowly reach 70% of the population as the primary warning
Time-frame	Hours to days
Heads-up and instruction	Instruction only
Effective residents	Yes
Effectiveness transients	Yes
Effectiveness institutions	No – they target the mobile population viewing the alert
Vulnerable & immobile	Less effective
Robustness/resilience	Fixed billboards relatively robust, mobile billboards less robust (depending on conditions)
Ongoing effectiveness	Effectiveness decreases with time unless new viewers are constantly exposed
Terrain suitability	Good visibility and targeted placement increases effectiveness. Less suitable for convoluted road networks
Population density	Can reach people in both high and low population density areas for longer lead time hazards.
Cost basis	Based on monthly rental, reaching 10k people per board
Cost	Start-up:$3.5k+, ongoing (rental of site from $3.5k/month), installation, planning. Mobile (trailer) billboards available for $300/day + printing costs.
Dense	One board reaches 10,000 people
Diffuse	No difference
Hazards	All hazards that have long lead in times
Target population	Commuters/travellers that pass billboard and can see it.

Break-in broadcasting (not currently available in New Zealand)

Introduction

A typical example of break-in broadcasting is the Emergency Alert System (EAS) in the USA that requires broadcasters, cable television systems, wireless cable systems, satellite digital audio radio service (SDARS) providers and, direct broadcast satellite (DBS) service providers to provide the communications capability to the President to address the American public within 10 minutes of a warning being issued. The Federal Communications Commission (FCC), in conjunction with the Federal Emergency Management Agency (FEMA) and the National Oceanic and Atmospheric Administration (NOAA) implement the EAS at the federal level.

The President has sole responsibility for determining when the EAS will be activated at the federal level, and has delegated this authority to the director of FEMA. FEMA is therefore responsible for implementation of the national-level activation of EAS, tests and exercises. The EAS has never been used at federal level for a real event. The system can however also be used by state and local authorities to deliver important emergency information targeted to a specific area. Each state and several territories have their own EAS plan.

Criteria	Explanation
Limitations	Technology not currently available in New Zealand, legislation may be required. Likely to be used only for life-threatening situations only. Warning agencies need to have broadcasting and trained staff capability.
Time-frame	Minutes
Heads-up and instruction	Provides both
Effective residents	Yes
Effectiveness transients	Yes
Effectiveness institutions	Yes
Vulnerable & immobile	Yes
Robustness/resilience	Unknown
Ongoing effectiveness	Can be continuously updated – highly effective.
Terrain suitability	All
Population density	All
Cost basis	Unknown but likely to be expensive
Hazards	All hazards
Target population	All with radio or television

Further comments

The arrangements for the broadcast of emergency announcements maintained by the Ministry of Civil Defence & Emergency Management (MCDEM) with Radio and TV, as well as those maintained at local level with local broadcasters (see page 25) do not constitute this technology.

Call-in telephone line

Introduction

The ‘Call-in telephone line’ mechanism involves the establishment and maintenance of a call centre capability to provide information to callers about an event. It is not a ‘primary’ warning mechanism as it requires the public to be prompted to call in by some other mechanism. A call-in telephone line may be useful for the confirmation of warnings.

Criteria	Explanation
Limitations	Congestion, access to telephone, awareness of system. Will never reach 70% of the population as the primary warning.
Time-frame	Minutes to not at all
Heads-up and instruction	Instruction only
Effective residents	Yes
Effectiveness transients	Yes
Effectiveness institutions	Yes
Vulnerable & immobile	Yes for immobile – less effective for the deaf population and those with English as a second language
Robustness/resilience	Congestion problems could arise
Ongoing effectiveness	Can update the message as required
Terrain suitability	All
Population density	All
Cost basis	100 lines, plus hardware
Cost (all areas)	Start-up:$20k+ Ongoing: $20k+/yr and testing
Awareness campaign	One board reaches 10,000 people
Dense/Diffuse	3000 people reached in 30 minutes
Hazards	Hazards with long lead in time, and with a primary system to have notified the existence of a risk
Target population	All with access to a phone (can operate for disabled if special telephony catered for)

E-mail

Introduction

Email has become a normal method of day-to-day communication and is widely used to pass information

Criteria	Explanation
Limitations	Effective for only to those connected to and checking email, relies on internet and related hardware systems, accuracy (maintenance) of email list, possible delays due to congestion. Will never reach 70% of the population as the primary warning
Time-frame	Minutes to hours
Heads-up and instruction	Primarily used for instruction unless recipient has live email updating and is online when first 'heads up' warning is sent
Effective residents	Yes
Effectiveness transients	No
Effectiveness institutions	Yes, provided the institution employs 24/7 duty staff
Vulnerable & immobile	Yes (less effective for those with English as second language)
Robustness/resilience	As robust as email service provider
Ongoing effectiveness	Messages can be updated but if congestion occurs messages could take longer to transmit as events unfold
Terrain suitability	All – but some rural areas have restricted access to broadband
Population density	All (areas with higher population density generally have faster speed broadband)
Cost basis	Free national emails, internet hardware in place. Database main cost.
Cost (all areas)	Start-up database including list development, ongoing (list maintenance, awareness)
Hazards	All hazards, delays in email delivery may exclude hazards with minutes of lead in time
Target population	All with email

GPS receivers (not currently available in New Zealand)

Introduction

Warning to GPS receiver units is possible via a new set of GPS geostationary satellites. GPS inherently can locate the receiver and thus control the area of warning. These messages can be received on existing GPS units (e.g. in-car and hand-held). However, coverage is currently not available in New Zealand.

Criteria	Explanation
Limitations	Not feasible in NZ at present , access only to those with GPS units and monitoring them. **Will never reach 70% of the population as the primary warning**
Time-frame	Unknown
Heads-up and instruction	Both, dependent on handset design
Effective residents	Yes (dependant on being in proximity of GPS unit)
Effectiveness transients	No (possibly those with GPS or where rental cars have GPS)
Effectiveness institutions	Potentially, depending on monitoring of GPS unit and clear signal from satellite
Vulnerable & immobile	Yes (dependant on being in proximity of GPS unit)
Robustness/resilience	Reliant on good satellite signal. Not affected by power cuts or telecommunications outages
Ongoing effectiveness	Message can be updated
Terrain suitability	Need clear sight/signal of satellite, therefore not suitable for all terrains (particularly hill shadow or forested areas)
Population density	All
Cost basis	Existing hardware, but costs of implementation unknown
Cost (all areas)	Unknown
Hazards	All hazards
Target population	All with GPS units

Marine radio

Introduction

Marine radio is used by the maritime Operations, Coast Guard and 'boaties' to communicate with commercial and recreational boat owners.

Criteria	Explanation
Limitations	Limited audience, agreements with coastguard would be required. **Will never reach 70% of the population as the primary warning**
Time-frame	Minutes to hours
Heads-up and instruction	Yes – provides both
Effective residents	No – only those in coastal areas with at-home radio receivers those in boats
Effectiveness transients	No
Effectiveness institutions	No
Vulnerable & immobile	Not suitable for the deaf
Robustness/resilience	Robust, well maintained.
Ongoing effectiveness	Can only target those within range, however message can be changed as necessary
Terrain suitability	Coverage over all of coastal NZ, lake Taupo (HF) and offshore including the Chatham Islands
Population density	All densities- shore areas
Cost basis	Users will have radio as standard equipment already. Ongoing effort only (awareness, agreements, exercises)
Hazards	All coastal hazards
Target population	Boaters – coastal people with radio receivers

Mobile-device broadcasting (not currently available in New Zealand)

Introduction

Whereas SMS-PP (Short Message Service - Point to Point - see page 27) is a one-to-one and one-to-a-few service, Mobile-device Broadcasting is a one-to-many, geographically focused messaging service (point to multi-point/area). Targeted network cell sites are activated to send a broadcast message content to all devices within its coverage area at that point in time. Mobile-device Broadcasting has no limitations on capacity (number of messages sent), can be geo-located and can in theory deliver to end-users very rapidly with pre-programming of messages and content (although mobile telephone users can switch the receiving of broadcast messages on or off).

It includes the outdated technology of 'Cell Broadcasting' and emerging technologies such as 'Mobile Broadcast Multicast Service' (MBMS). This type of broadcasting is an unconfirmed push service, meaning that the originator of the message does not know who has received the message.

Criteria	Explanation
Limitations	Technology implementation (development, national agreements with carriers, possible legislative requirements, future carriers must participate). Not all current mobile telephones have the capacity. Users may need to activate functionality on handset.
Time-frame	Seconds to minutes
Heads-up and instruction	Provides both (up to 1350 characters)
Effective residents	Yes
Effectiveness transients	Yes, if they have functionality on their handsets, functionality is activated and the channel being used in their country is the same as in New Zealand
Effectiveness institutions	Yes
Vulnerable & immobile	Yes - except the blind (who can use text content to speech conversion software)
Robustness/resilience	Untried in NZ – Cell Broadcasting implemented in a small number of countries internationally and further trials currently underway overseas
Ongoing effectiveness	Message can be updated as long as telecommunications infrastructure is in place and functioning. Not prone to congestion (as is the case with SMS-PP)
Terrain suitability	Mobile telephone coverage in NZ is limited or non-existent in some areas due to terrain. Mobile coverage in at least 97% of the country
Population density	More effective in greater density areas
Cost basis	Outdated Cell Broadcast, new technology and development estimates only (no running/use costs)
Cost (whole country)	Start-up: Suitable systems on emerging network types unknown. Outdated Cell Broadcasting estimated up to millions of dollars across all networks (programming, maintenance cost, planning, agreement, testing and exercising, end-user awareness development and keeping awareness maintained)
Hazards	All hazards
Dense/Diffuse	All
Target population	All with capable mobile telephones

Mobile PA announcements – NZ Police & NZ Fire Service

Introduction

Both the NZ Police and NZ Fire Service are closely aligned with local-level CDEM response but specific arrangements for the availability of their staff and hardware to be used as part of local warning systems at short or immediate notice will have to be agreed, which may prove to be practically unachievable. However, there is a common expectation that NZ Police and NZ Fire Service will have some role in most, if not all, public alerts at the local level.

Criteria	Explanation
Limitations	Availability of staff, equipment and vehicles. Deployment time, planning, agreements
Time-frame	Realistically 30 minutes or more, theoretically a few minutes
Heads-up and instruction	Yes – provides both
Effective residents	Yes, but less effective for those indoors
Effectiveness transients	Yes, but less effective for those indoors
Effectiveness institutions	Not suitable (most will be indoors)
Vulnerable & immobile	Yes – but less effective for those indoors
Robustness/resilience	Robust (regular maintenance assumed)
Ongoing effectiveness	Effective throughout event as message can be updated, would need to re-visit target areas if message changes
Terrain suitability	All terrain suitable for vehicles
Population density	More effective in high density areas but also effective for isolated population centres if start area is located nearby.
Cost basis	Effort to arrange and exercise only. Depends on local arrangement with NZ Police/NZFS
Cost	Effort- setting retainer arrangement, planning, ongoing (testing, awareness, exercises)
Hazards	All hazards, but response will take minutes
Target population	All

Pagers

Introduction

'Paging' is based on telecommunications technology and is a common means for 'heads- up' notifications to agency staff. They are used to alert the 'paged' staff to take some kind of action in accordance with established procedures.

Criteria	Explanation
Limitations	Access only to those with pagers, accuracy and maintenance of numbers lists, relies on third-party hardware, system coverage
Time-frame	Minutes
Heads-up and instruction	Both but instruction message size limited
Effective residents	Not suitable (more suitable to individual agencies and own agency staff)
Effectiveness transients	Not suitable
Effectiveness institutions	Suitable where institutions have 24/7 duty staff.
Vulnerable & immobile	Yes – could target specific individuals for pager allocation
Robustness/resilience	Robust system but relies upon third party hardware
Ongoing effectiveness	New messages or alerts can be transmitted as required
Terrain suitability	All
Population density	All
Cost basis	$312 per person per year, with that person notifying 200 people. Up to 100 pages per month.
Hazards	All hazards
Target population	Those with pagers

Power mains messaging

Introduction

Power mains messaging is based on the application of 'ripple control' by power companies (at the request of a warning agency) via existing power infrastructure to activate tone or code alert on devices plugged into power outlets. The technology has been trialled in New Zealand and is currently being deployed on a limited scale.

Criteria	Explanation
Limitations	Technology to transmit alerts available but not yet implemented on large scale for warnings in New Zealand. Hardware to receive alerts requires mass production. Agreement(s) required with power carrier(s), relies on power network. Access to only those with a receiver and within audible distance of receiver
Time-frame	Seconds to hours
Heads-up and Instruction	Heads-up only or limited instruction through coding
Effective residents	Yes
Effectiveness transients	No (unless clear notices in hotel/motel rooms)
Effectiveness institutions	Yes
Vulnerable & Immobile	Yes
Robustness/resilience	New warning technology in NZ but the concept is already used by power carriers to control peak power demand
Ongoing effectiveness	Once household/institution is alerted another information source is required, therefore less effective as event progresses
Terrain suitability	All
Population density	All
Cost basis	Further research would be needed to look at the feasibility and cost structure for New Zealand
Cost (all areas)	Start up: software and agreement costs, ~$50 per unit in households (2.5 people per house, 2006 census). Minimum 5000 units need to be manufactured for a realistic pilot.
Hazards	All hazards
Target population	All near receiver on mains power

Radio and TV broadcasts

Introduction

Radio broadcasts are commonly applied to convey warning information to the public. The broadcasts are made upon the request of warning agencies to radio stations on the basis of prior arrangements. Television broadcasts are applied on the same basis although to a lesser extent. In this case the television station will normally announce the warning by broadcasting a scrolling banner over the existing programme.

Criteria	Explanation
Limitations	Possible edits to the warning message by the broadcaster, time-lag, only reaches those listening or watching
Time-frame	Realistically 30 minutes or more. Theoretically seconds to a few minutes with dedicated automated tested broadcast 'break-in' technology (see page15)
Heads-up and instruction	Provides both
Effective residents	Yes
Effectiveness transients	Yes, if listening/watching
Effectiveness institutions	Yes
Vulnerable & immobile	Yes
Robustness/resilience	Generally robust with redundancy built in and quick repair times for faults
Ongoing effectiveness	Highly effective throughout as new messages can be broadcast as event progresses
Terrain suitability	All, provided area is covered by station(s)
Population density	All
Cost basis	'Public good' role for stations (no cost). Possibly minor effort cost
Cost (all areas)	Start up: $0, effort and planning, ongoing (planning, exercises)
Hazards	All
Target population	All 'tuned in'

Further comments

The Ministry of Civil Defence & Emergency Management (MCDEM) maintains MOUs with Radio NZ, the Radio Broadcast Association, TVNZ and TV3 for the broadcast of emergency announcements[1]. Several CDEM Groups and CDEM Group members maintain arrangements with local radio stations for similar broadcasts.

1 These arrangements are described in Section 22 of The Guide to the National CDEM Plan.

Route alert (door-to-door)

Introduction

Route alert involves the physical door-to-door delivery of a warning by persons. Normally route alert would in the first instance be undertaken by staff from NZ Police and NZ Fire Service. Door-to-door notification is also commonly applied via volunteer networks (e.g. CDEM volunteers and neighbourhood watch groups).

Criteria	Explanation
Limitations	Staff availability and area to be covered
Time-frame	Minutes to hours
Heads-up and instruction	Provides both
Effective residents	Yes
Effectiveness transients	Yes
Effectiveness institutions	Yes
Vulnerable & immobile	Yes
Robustness/resilience	Relies on adequate number of staff/volunteers
Ongoing effectiveness	Time consuming, less effective where hazard conditions change and updated messages must be conveyed
Terrain suitability	All
Population density	Not suitable for areas of diffuse populations
Cost basis	Using available staff
Cost	Start up: $0, planning effort, ongoing (training and exercises)
Hazards	All hazards with hours or more lead in time
Target population	All within reach of staff/volunteers

SMS-PP (Short Message Service - Point to Point)

Introduction

SMS-PP has become a common means of communication of short text messages via cell phones to the public. Through SMS-PP a message is sent from one point to one or many specifically targeted cell phone numbers. Similar to e-mail, the message is sent on a one-by-one basis to all the targeted numbers.

Criteria	Explanation
Limitations	Congestion during high traffic periods is highly likely to cause delays in messages reaching target populations within the desired time for short lead time (minutes) hazards. Third party reliance may also cause this option to be more vulnerable. Only has potential to reach those with mobile phones.
Time-frame	2-3 hours nationally, more to target only specific regions or cells, if no congestion (includes coordination time). With an existing numbers database smaller areas can be reached faster.
Heads-up and Instruction	Yes – can provide both
Effective residents	Yes
Effectiveness transients	Not suitable
Effectiveness institutions	Yes
Vulnerable & Immobile	Yes
Robustness/resilience	Currently SMS services can be slowed considerably during unplanned high traffic periods, congestion would be exacerbated as those who receive messages forward them to others and call others for confirmation. It relies on telecommunication infrastructure being in place, and functioning.
Ongoing effectiveness	If congestion issues do not arise and infrastructure failure does not occur updated messages could be provided as event progresses
Terrain suitability	Some parts of NZ have no or limited mobile coverage. Overall mobile coverage is at least 97% of the country.
Population density	All
Cost basis	Depends on the agreement with carriers and third party system providers.
Cost (whole country)	Planning and agreements as effort at start-up. Ongoing: Median cost for a national system and database ($200k per year nationwide). One 20c message per person per year. Limited number of messages per hour. Ongoing planning and exercising effort.
Hazards	All hazards with longer (hours) lead time
Target population	All with mobile phones (switched on)

Further comments

Currently geo-location of SMS text messaging (targeting only the areas under threat) is either not possible or would take several hours to achieve. This means a warning via SMS text messaging must be very specific with regards to stating the areas under threat to prevent inappropriate response from those not at risk (for example evacuation of safe areas). The inability to geo-locate SMS text warnings also directly contributes to the potential of congestion/delivery delay.

The reach of SMS text messaging systems are reliant on the data (numbers) contained in them. This data is either entered manually and selectively by the agency responsible for warnings or via public subscription to the system. Therefore the SMS text warning is directed to only those numbers contained in the particular system. None of these systems contain or have access to all the public cell phone numbers in their particular target areas. That data is currently protected by the respective telecommunications carriers.

SMS with geo-location would be the preferred option (not currently implemented) reducing the time to spatially locate mobile phones.

Telephone auto-dialling (landline)

Introduction

Telephone auto-dialling is based on the communication of a recorded voice message by a warning agency via telephone to a targeted numbers list. Similar to SMS-PP, the message is sent on a one-by-one basis to all the targeted numbers. Telephone auto-dialling is technically possible but not currently applied much in New Zealand. The main reasons are access to public number data and complex, potentially expensive agreements have to be established with the telecommunications carriers.

Criteria	Explanation
Limitations	System vulnerability, system capacity, congestion, time per call, number list availability and maintenance, coverage
Time-frame	First calls in minutes but up to hours to complete in high density areas
Heads-up and instruction	Yes – provides both
Effective residents	Yes if indoors
Effectiveness transients	No
Effectiveness institutions	Yes
Vulnerable & immobile	Yes
Robustness/resilience	Tests of systems overseas have experienced overloading and delays
Ongoing effectiveness	Message can be updated but may be out of date by the time it reaches some of the target population
Terrain suitability	All
Population density	More efficient in lower population densities
Cost basis	Equipment, software and 100 lines
Cost (all areas)	NZ$6.5k start-up unit (4 lines). List development[2] estimated at $200k for a small region. Ongoing: $52/month/line, 8 lines, 1 line = 150 people (60 households). Additional ongoing effort is also required
Areas suitable	All
Not suitable	Will miss people not near a ‘land-line’ or not on the list
Hazards	Only those with long lead in time
Target population	All near a telephone that is listed

2 Public number data held by telecommunications carriers is protected information. Provided the legalities in this regard can be overcome, further development will be required to access this data in the form of a public numbers database.

Telephone trees

Introduction

Telephone trees are mostly used in rural areas where a warning agency relies on the existing (and normally well established) population to pass a warning from one to the other, using their normal telephones. Telephone trees require careful planning and regular checking by the warning agency for points for currency of numbers and understanding by residents of their responsibilities.

Criteria	Explanation
Limitations	Accuracy of lists, relies on third-party hardware, single point of failure, time, needs regular check calls across branches
Time-frame	Minutes to hours
Heads-up and instruction	Yes – provides both
Effective residents	Yes if indoors
Effectiveness transients	No
Effectiveness institutions	Yes
Vulnerable & immobile	Yes, but depends on capacity of recipients to pass on accurate messages
Robustness/resilience	Constant updating of lists required
Ongoing effectiveness	Message can be updated but may be out of date by the time it reaches all in the tree. Therefore better suited for rural/diffuse populations
Cost basis	Labour to develop and maintain list only
Cost (all areas)	Start-up: List and relationship development at 4 FTE per 100,000 people. Ongoing: List maintenance at same rate
Areas suitable	All with telephone coverage
Hazards	All hazards, more suitable for slower lead in time
Target population	All with telephone coverage

Tourist advisory radio

Introduction

Tourist radio is common in areas with high tourist traffic. Often these areas' attractions are associated with natural hazards, making tourist radio a useful instrument to educate and warn particularly tourists of those hazards.

Criteria	Explanation
Limitations	Third party reliant, radio station coverage, agreement, Exposure only to those listening to this station. **Will never reach 70% of the population as the primary warning**
Time-frame	Seconds to minutes
Heads-up and instruction	Provides both
Effective residents	Yes if listening (low percentage audience among local residents likely to be tuned in to the tourist station)
Effectiveness transients	Dependent on access to radio and listening
Effectiveness institutions	No – not target audience
Vulnerable & immobile	Yes, if listening
Robustness/resilience	Operate usually on low power frequencies; may not have live staff (i.e. pre-recorded loops)
Ongoing effectiveness	Messages can be updated (if staffed station)
Terrain suitability	Limited range and loss of signal through topographic blockage
Population density	All
Cost basis	Agreement with station, start up: planning, ongoing effort (exercises)
Hazards	All hazards
Target population	All listening to the station carrying tourist information

Websites/WAP

Introduction

The internet is widely accessible at home, work and via some cell phones through Wireless Application Protocol (WAP) making it a commonly applied mechanism for the communication of information. A dedicated website is required.

Criteria	Explanation
Limitations	Third party hardware, target population required to be connected and waiting for message (end-user alerting software may work, but would need to be installed). **Will never reach 70% of the population as the primary warning**
Time-frame	Seconds to hours
Heads-up and instruction	Primarily Instruction, Heads-up technically possible
Effective residents	Yes if logged onto website
Effectiveness transients	Only if aware of website and logged on
Effectiveness institutions	Yes if monitoring website
Vulnerable & immobile	Only if logged onto website
Robustness/resilience	Websites can become overloaded, reliant on server resilience, website robustness (no bugs) and home hardware resilience
Ongoing effectiveness	Can be updated but requires viewers to keep checking webpage
Terrain suitability	All
Population density	All
Cost basis	Existing hardware, some programming. Price of one website and hosting, but limited to people viewing
Cost (all areas)	Start-up: $5k minimum. Ongoing: $0.10 per person awareness, traffic and maintenance
Areas suitable	All with connection to internet
Not suitable	Any with no connection to internet
Hazards	All hazards
Target population	All with internet connection and with some alerting software installed

Website banners

Introduction

Internet service providers have the capability to push banners across web browsers connected to the internet via their service. This is currently used for ISP related communications. It has not been explored for public alerting but is theoretically feasible.

Criteria	Explanation
Limitations	End-user hardware required to be connected and waiting for message (end-user alerting software may work, but would need to be installed). **Will never reach 70% of the population as the primary warning**
Time-frame	Seconds to hours
Heads-up and instruction	Primarily instruction, heads-up technically possible
Effectiveness residents	Yes if logged on
Effectiveness transients	Only if aware of website and logged on (education campaign required)
Effectiveness institutions	Yes – especially those with 24/7 staff monitoring other live data
Vulnerable & immobile	Only if logged on
Robustness/resilience	Websites can become overloaded, reliant on server resilience, website robustness (no bugs) and home hardware resilience
Ongoing effectiveness	Increases with time
Terrain suitability	All
Population density	All
Cost basis	Existing hardware, some programming
Cost (all areas)	Assumes effort to set up agreements only
Areas suitable	All with connection to internet
Not suitable	Any with no connection to internet
Hazards	All hazards
Target population	All connected to internet and with some alerting software installed

4. Mechanisms that require dedicated hardware (but controlled by the warning agency)

Fixed PA loudspeakers

Introduction

Fixed PA loudspeakers are installed in target areas to communicate voice messages directly from the warning agency to the public. They are normally installed in high traffic public areas and in high density residential areas.

Criteria	Explanation
Limitations	Cost, coverage, complex system, resource consent required
Time-frame	Seconds
Heads-up and instruction	Yes – provides both
Effective residents	Yes but effectiveness reduced for those indoors
Effectiveness transients	Yes but effectiveness reduced for those indoors
Effectiveness institutions	Less suitable- populations are generally indoors
Vulnerable & immobile	Not suitable for the deaf population, less effective for those with English as a second language
Robustness/resilience	Depends on initial spend, location (e.g. exposure to the elements) and ongoing maintenance
Ongoing effectiveness	Can only target those within range, however message can be changed as necessary
Terrain suitability	Best suited where terrain is flat or amplifies sound Topographic features may create sound barriers
Population density	More effective in high density areas but can be used in rural population hubs or specific at-risk localities. Not suitable for diffuse populations
Cost basis	Hardware
Cost	Village: Start-up $6k (limited range) to 50k (larger range) Urban: Start-up: $100k-1M+, planning, ongoing (maintenance, exercises) Rural communities: Start-up: $500k-5M+, planning, ongoing (maintenance and exercises)
Hazards	All hazards
Target population	All within audible range

Further comments

Loudspeaker announcements are one of the more effective forms of transmission warning messages to specific target areas, e.g. ski fields and sea fronts. They do, however, have a substantial start-up and ongoing testing, exercising and maintenance costs associated.

Mobile PA loudspeakers

Introduction

In this instance specifically dedicated mobile PA loudspeakers attached to land vehicles are used by warning agencies to communicate warnings to the public. (Aircraft mounted loudspeakers are assessed separately on page 13).

Criteria	Explanation
Limitations	Availability of vehicles and drivers, complex systems. Effective only for those that can be reached during lead in time
Time-frame	Minutes to hours
Heads-up and instruction	Yes – provides both
Effective residents	Yes, but less effective for those indoors
Effectiveness transients	Yes, but less effective for those indoors
Effectiveness institutions	Less suitable (most will be indoors)
Vulnerable & immobile	Yes – but less effective for those indoors
Robustness/resilience	Robust with regular maintenance, arrangements in place
Ongoing effectiveness	Effective throughout event as message can be updated, would have to re-visit target areas if message changes
Terrain suitability	All terrain as long as vehicle suitable
Population density	More effective in high density areas but also effective for isolated population centres if located nearby start point
Cost basis	Build your own. $50k for 12, reaches 400 people/sq km in dense areas, 1/4 of that in diffuse areas. 10% annual maintenance
Cost	$10k per unit start-up, $1 per person ongoing and effort (maintenance and exercises)
Hazards	All hazards for areas that can be reached
Target population	All within audible range

Flares, explosives

Introduction

Flares and explosives are not commonly used as a public alerting mechanism.

Criteria	Explanation
Limitations	Safety aspect, potential to cause panic, public understanding of meaning, coverage. **Will never reach 70% of the population as the primary warning**
Time-frame	Seconds to hours
Heads-up and instruction	Heads-up only
Effective residents	Yes but less effective for those indoors
Effectiveness transients	Yes but less effective for those indoors
Effectiveness institutions	Not suitable
Vulnerable & immobile	Not suitable: could be misconstrued
Robustness/resilience	Resilient and robust
Ongoing effectiveness	Effectiveness likely to decrease if used over a period of time with no other information provided
Terrain suitability	Topographic features could impede visual or audible impact
Population density	Better suited for high density areas
Cost basis	Consumables alone, would take unknown hardware to trigger remotely
Cost	Pack of 30 = $3k, flare reaches a few people in diffuse areas and a few hundred in dense areas. Replace 20% every year
Hazards	All hazards
Target population	All within audible/visible range depending on type

Radio data systems

Introduction

Radio data systems are used to communicate data via HF or VHF radio. It requires special software and hardware capable of this functionality.

Criteria	Explanation
Limitations	Agreements, hardware for transmission, exposure to only those with compatible receiving radios, potentially cost
Time-frame	Seconds to hours
Heads-up and instruction	Instruction only
Effective residents	Yes
Effectiveness transients	Not suitable
Effectiveness institutions	Yes
Vulnerable & immobile	Yes
Robustness/resilience	Untested in New Zealand
Ongoing effectiveness	Theoretically remains highly effective as has the capacity to transmit updated messages as event progresses
Terrain suitability	All
Population density	All
Cost basis	Hardware, software and installation
Cost (all areas)	See HF and VHF radio (next page). $25k minimum hardware and software. $0.10 per person to reach given one unit notifies pockets of 200 people
Hazards	All hazards
Target population	All near receiver who can hear/view it

Radio (UHF, VHF and HF)

Introduction

Radio communications forms part of the communications arrangements of all local emergency management offices or Emergency Operations Centres (EOCs). Warnings via these mechanisms are based on radio-to-radio communication and they are therefore not commonly used as public alerting mechanisms.

Criteria	Explanation
Limitations	Access to radio users only, radio licenses required from Ministry of Economic Development, training and equipment required for operation.
Time-frame	Seconds to minutes
Heads-up and instruction	Instruction only
Effective residents	Yes – but very limited numbers (only those with equipment and listening/scanning).
Effectiveness transients	Not suitable
Effectiveness institutions	Yes – but must have equipment and listening.
Vulnerable & immobile	Yes – could connect person to person with support.
Robustness/resilience	Robust technology, equipment (antennae) may be vulnerable to some hazards. Reliant on power supply.
Ongoing effectiveness	Able to update message continuously.
Terrain suitability	All
Population density	All (especially remote, diffuse populations)
Cost basis	Equipment, installation, annual licence fees.
Cost	Start-up: equipment ~$5k per base station, licence from ~$100 to $250/yr per base station, planning, ongoing (maintenance, training, exercises).
Dense/Diffuse	Unlimited those that own radios.
Hazards	All hazards.
Target population	All within range and receiving radio signal.

Sirens (tone, no voice capability)

Introduction

Sirens are used for tone alert only. Upon hearing the tone alert, the public is expected to take some form of pre-determined action e.g. listening to the radio or evacuating.

Criteria	Explanation
Limitations	Coverage, complexity, maintenance/testing, understanding meaning, differentiating hazards, need for resource consent
Time-frame	Realistically minutes, theoretically a few seconds (but significantly longer for appropriate response in reality, as extra information is sought)
Heads-up and instruction	Heads-up only
Effective residents	Yes but less effective for those indoors
Effectiveness transients	No – lack of understanding will render broadcast meaningless
Effectiveness institutions	Less suitable (most in institutional care will be indoors)
Vulnerable & immobile	Not suitable where vulnerability is linked to learning difficulties (comprehension) or for the deaf
Robustness/resilience	Have been used by Rural Fire for many years, could be less robust in exposed coastal locations (sea spray)
Ongoing effectiveness	Continued broadcast by this means could reduce effectiveness due to normalisation and lack of information on threat
Terrain suitability	Most; where topography creates sound barriers (need to be positioned for maximum range)
Population density	All but more cost-effective with increasing density
Cost basis	Network design, hardware, implementation
Cost	$475k for 30 sirens including installation and project management, ongoing maintenance (battery replacement every 5 years (~$400 per replacement), public education, exercising)
Hazards	All hazards
Target population	Local residents and organisations within audible reach (not visitors/tourists)

Further comments

Sirens are commonly the first suggestion when new public alerting hardware is considered in New Zealand, however, there are substantial limitations to their effectiveness. They are cheaper than voice PA loud-hailers (except self-designed and built) and technically less complex, but understanding the meaning of the siren relies entirely on public awareness. One could assume that a community would eventually seek the meaning of a siren if it continued indefinitely, but the timeframe for seeking that advice is uncertain. Therefore, sirens are not considered to be ideal for short-lead-time hazards where there are only minutes of warning time.

The public is also likely to find differentiating between or interpreting the different and often inconsistent siren tone codes used in different areas problematic. Sirens are likely to be affordable and feasible in urban and rural communities, but most likely not in rural areas with diffuse populations. This means that they are inappropriate as the primary source of warning for rural hazards such as bushfire or biological disease such as foot and mouth.

Tone-activated alert radio (not currently available in New Zealand)

Introduction

Two systems are considered:

Tone alert radio is used widely throughout the USA for weather information and warnings. It is based on the broadcast of weather information by the US National Oceanic and Atmospheric Administration (NOAA) to dedicated receivers ('weather radios') in homes, workplaces etc. For warnings the system "wakes up" receivers that are not switched on and sends a distinctive alarm tone to all receivers followed by information about the warning. This means all receivers whether switched on at the time of the warning or not will receive the alert tone and warning information.

FM RDS is a commercial public alerting mechanism that relies on agreements with national broadcasters on FM frequencies to 'piggy back' on their transmission capacity. Some systems can also transmit to televisions and car radios. In case of an emergency situation a signal is transmitted by the agency responsible for warnings via RDS over an Early Warning (EW) FM Transmitter. An EW FM receiver in the radio station switches over to the EW-FM frequency automatically and the normal programme is interrupted by an alert tone. If the receiver is not switched on the signal will wake it up and then begin transmission of the alert tones and warning messages. A running text with warning information is displayed on the LCD display of the EW receiver in the radio station enabling them to broadcast the warning to the public via their normal audio channel. This system is in use in several countries including Germany, Switzerland, Sri Lanka, Singapore and Indonesia.

Criteria	Explanation
Limitations	Not currently used in New Zealand. National arrangement required. Access only to people with receivers (NOAA 'weather radio' type), complex systems, regular testing
Time-frame	Minutes
Heads-up and instruction	Provides both
Effective residents	Yes, if indoors and have receiver unit (NOAA type system) or FM radio (FM RDS)
Effectiveness transients	Yes, depending on receiver units (NOAA type system) or FM radio (FM RDS) in accommodation
Effectiveness institutions	Yes
Vulnerable & immobile	Yes
Robustness/resilience	Yes
Ongoing effectiveness	Yes – broadcast message can be updated
Terrain suitability	All
Population density	All
Cost	Start up: Broadcasting equipment and frequencies likely 100k+ (NOAA type system) plus about $100-150 per receiver, FM RDS about 60 Euro per receiver, ongoing effort (exercises, awareness)
Areas suitable	All areas with reception
Hazards	All hazards
Target population	All with receivers (NOAA type system) or FM radios (FM RDS)

Section 3: Public alerting options decision support tool

Introduction

A decision support tool has been developed on a Microsoft Excel spreadsheet to help decision makers evaluate and compare the cost vs. benefit of different public alerting mechanisms. The tool can separately evaluate high and low density population areas because the cost per capita changes with density for some systems. The input is in dollars and staff effort (i.e. 'cost') and effectiveness (i.e. 'benefit') that can be adjusted for local circumstances.

The tool needs to be opened with Microsoft Excel 2002 or later and 'Macros' must be enabled when opening the file. It consists of eight spreadsheet pages (and additional hidden calculation pages). The pages are:

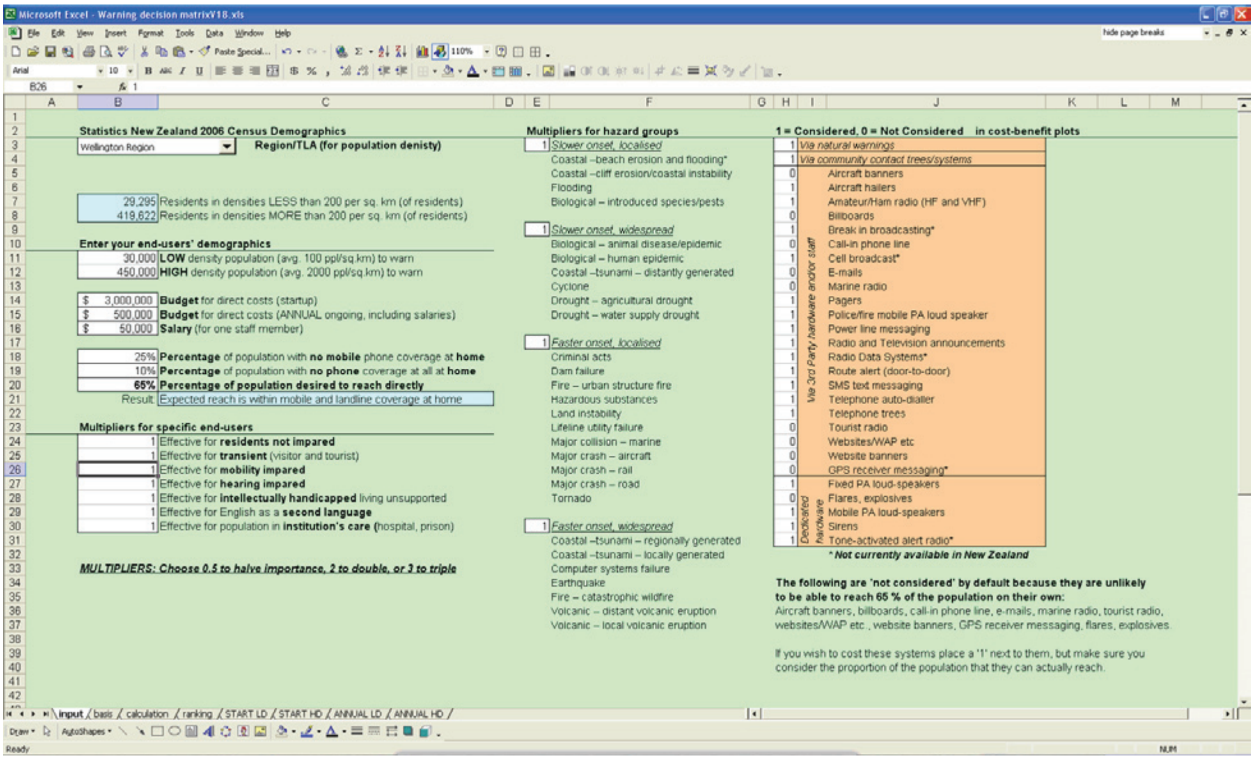
Input	The user enters their location-specific data here
Basis	Qualitative scoring and quantitative cost data is stored here
Calculation	Calculations based on the Input and Basis page data are shown
Ranking	Notification options are ranked by calculated score
START LD	Plot of start up (one-off) cost vs. score for low-density populations
START HD	Plot of start up (one-off) cost vs. score for high-density populations
ANNUAL LD	Plot of annual (ongoing) cost vs. score for low-density populations
ANNUAL HD	Plot of annual (ongoing) cost vs. score for high-density populations

Scores use a qualitative scale of 1 (lowest) to 5 (highest). Total scores for each mechanism are calculated as a percentage of a perfect '5' across all.

The decision support tool can be downloaded from the publications page of the MCDEM website (www.civildefence.govt.nz) under 'public alerting'.

Setting up the tool – the ‘Input’ page

The user needs to set the tool up to reflect certain special considerations as well as the area under consideration’s demographical characteristics. The tool is configured for an area’s demographics and special considerations by adjusting specific fields on the ‘Input’ page (illustrated below).



Population density field

The tool treats low density (on average 100 people per square kilometre) and high density (on average 2500 people per square kilometre) populations separately. The user must enter the population to be reached in the area at stake. Comparisons can be made at any scale from small community to the entire nation.

A region or district can be selected from the 2006 Statistics New Zealand Census data to get an idea of how many usually resident people fall above and below 200 people per square kilometre. The threshold of 200 people provides an approximate value for the boundary between high and low density populations (urban and rural).

Instructions

Step 1: Decide which area to consider for public alerting.

Step 2: On the ‘Input’ page, use the drop-down list at the top to get indicative density values from the 2006 census[1] and then enter the area’s low and/or high density populations.

Note: The indicative values are ‘usually-resident’ so they do not allow for daytime population swelling such as at a beach or central business district, or for holidaymakers. The user need to add the population expected in these extra high density sub-areas in addition to the ‘usually resident’ value.

1 Density is calculated by dividing the population for each ‘mesh block’ by its area in square km. The populations in mesh blocks with a ‘low’ or ‘high’ value are then summed for each of the drop-down menu spatial areas.

For example:

Usually resident	100,000
CBD extra people (max)	50,000
Tourists in places not considered high-density resident areas (max)	10,000
Total population in high density areas	**160,000**

The user may wish to calculate both low and high density options for an entire region, or opt for a specific settlement that is either low or high density.

Step 3: On the 'Input' page, under the 'Enter your end-users' demographics' heading, enter the estimated population in the Low and/or High density population fields.

Budget and cost field

The user must enter their budget for start up and annual on-going costs (including salaries) as well as the average annual salary for one Full Time Employee (FTE).

Instructions:

Step 4: On the 'Input' page, under the 'Enter your end-users' demographics' heading, enter the budget for direct costs (startup) for this project

Step 5: Enter the budget for direct costs (annual on-going, including salaries)

Step 6: Enter the salary (FTE) cost for a typical operational person who will be maintaining this mechanism, conducting community engagement, etc.

Reach and phone coverage field

The user must enter the proportion of the population with no mobile and/or phone coverage at home. This is compared to the desired reach to check for any gap in expected coverage. Default values for New Zealand are provided in the tool. Census data for particular areas in this regard can be obtained from the Statistics New Zealand website, www.stats.govt.nz.

The user may also want to change the proportion of the population in the target area they wish to be able to reach. The default is set at 70 % because research has shown that at least 2/3 of the population needs to be reached by the first official notification for informal warnings to then reach the remainder of the population (see Section 1).

Instructions

Step 7: On the 'Input' page, under the 'Enter your end-users' demographics' heading, enter the percentage of the population with no mobile phone coverage at home

Step 8: Enter the percentage of the population with no landline phone coverage at home.

Step 9: Enter the proportion of the population that the mechanism must reach (we suggest that this is set to a minimum of 70%)

Setting values for specific population target groups field

The user can set 'multipliers' for specific population target groups or population characteristics in a particular location. The multipliers are factored against scores on the 'Basis' page with the result visible on the 'Calculation' page. For example, in an area with a high transient target population (visitors and tourists), the user may choose to set the multiplier to '3' for that particular group if they want it to be three times as important. If it is one third as important the factor must be set at '0.33'. Setting any multiplier to '0' excludes that criteria from the assessment.

Instruction

Step 10: On the 'Input' page, under the 'Multipliers for specific end-users' heading, adjust the multiplier values for any target group(s) that are more or less important in terms of effective notification.

Setting values for specific hazard groups

Similar to specific population target groups, the multipliers can be adjusted for specific hazard groups. For example, if the user feels that tsunami is roughly twice as important as any of the other hazards (due to risk) the multiplier for the groups of hazards that include tsunami must be set at '2'. If it is half as important the factor must be set at '0.5'. Setting any multiplier to '0' excludes that hazard group from the assessment.

Instruction

Step 11: On the 'Input' page, under the 'Multipliers for hazard groups' heading, adjust the multiplier values for any hazard group that is more or less important in terms of the area's specific hazardscape.

Hiding specific options

The tool allows for specific mechanisms to be discounted. This may be desirable if a mechanism is not functional in a particular area or the cost of a mechanism is dwarfing more economical options on the output plots. For example, a user will probably not want to consider fixed PA loudspeaker announcements in low density areas because of the large cost per person. The large cost will also dwarf the other options in the cost chart.

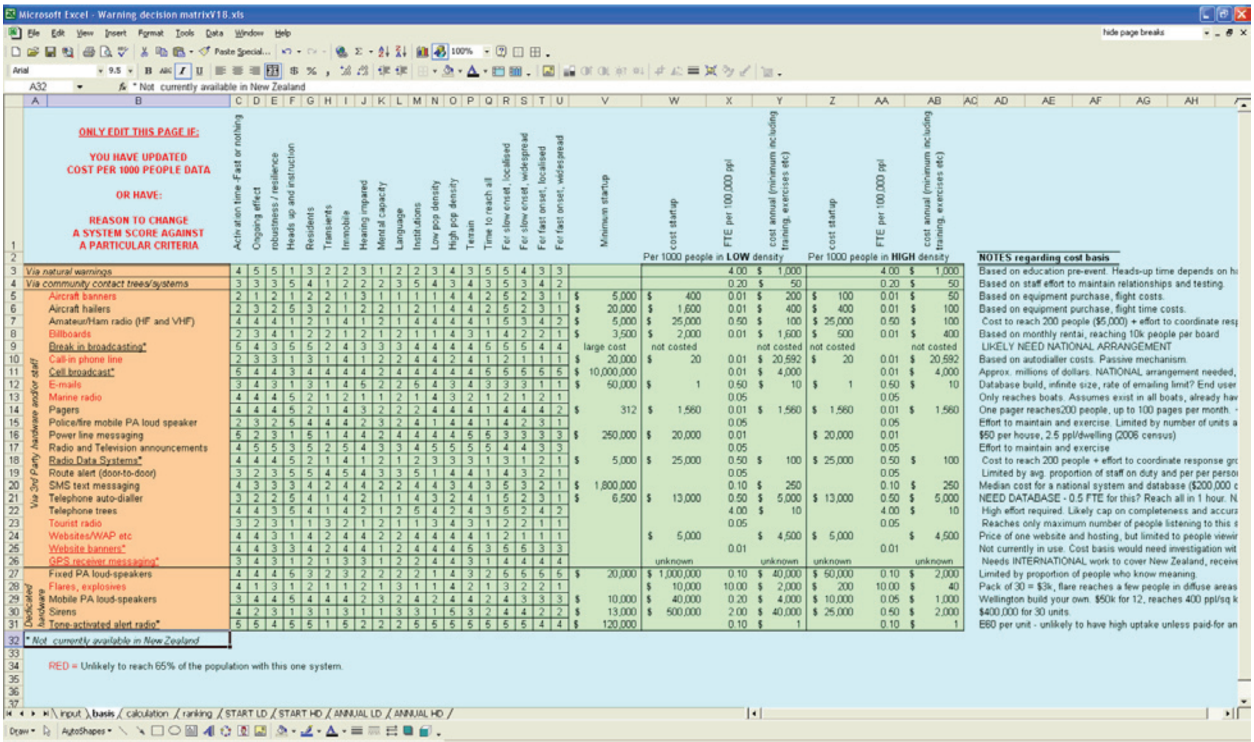
Instruction

Step 12: On the 'Input' page, set any public alert mechanisms that must not be considered to '0' instead of the default '1'.

Steps 1-12 completes the preparation of the 'Input' page.

The ‘Basis’ page

The ‘Basis’ page contains the calculation basis in terms of costs and system effectiveness score.



The numbers in the matrix of public alerting options vs. criteria are qualitative scores from 1 (lowest) to 5 (highest) based on the assessments presented in Section 2.

The default basis for calculating costs as established on the ‘Basis’ page is:

- Per 1000 people for direct costs[2], in Dollars
- Per 100,000 people for effort, in FTEs

Costs on the ‘Basis’ page are multiplied by the population and expected reach from the ‘input’ page. The result is given on the ‘Calculation’ page.

In some cases the user may choose to change the calculation basis for costs, or change a mechanism score against a particular criteria on the ‘Basis’ page.

Note: Any change to the default cost estimates should be based on the real conditions such as the local population density and vendor costing quotes.

Instruction (optional)

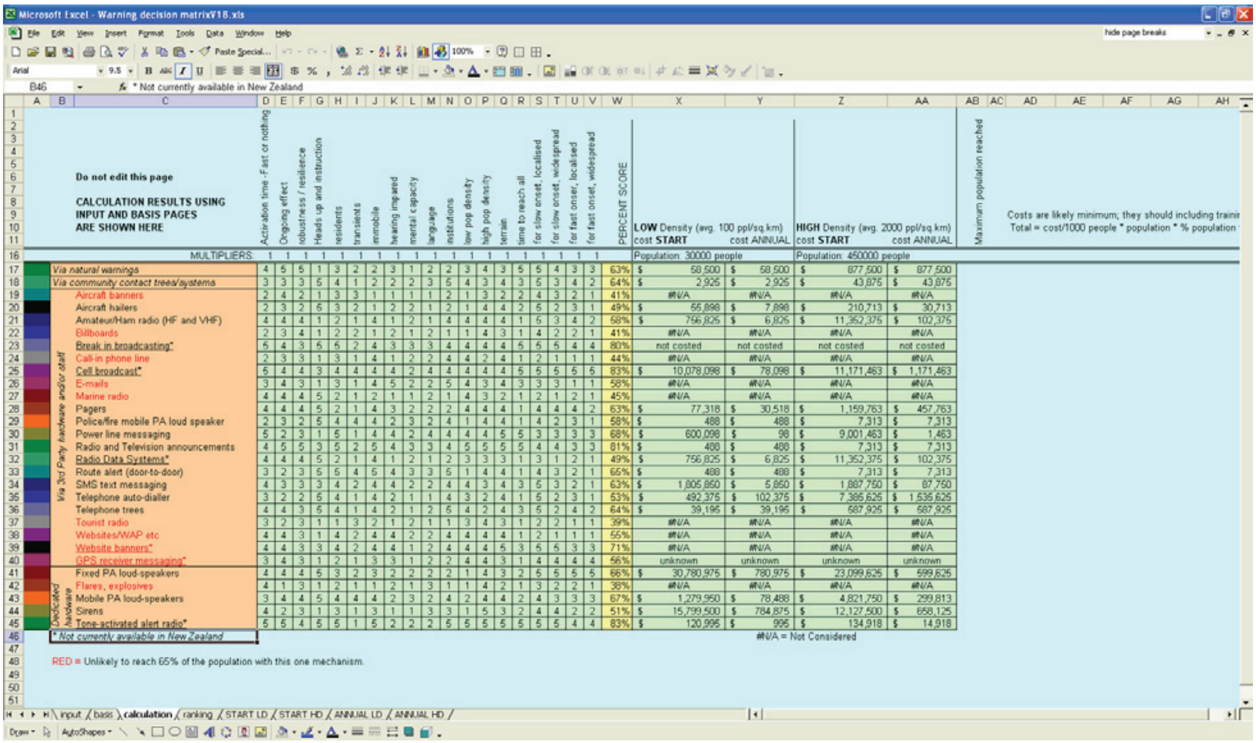
Step 13 (optional): On the ‘Basis’ page change the costing figures for low and/or high density areas under the ‘Per 1000 people in LOW density’ and ‘Per 1000 people in HIGH density’ headings.

2 The dollar values are start up and ongoing cost and salary effort to reach 1000 people, listed for both low and high density populations.

The ‘Calculation’ page

In the ‘Calculation’ page scores and dollar values have been multiplied against the ‘population’, ‘costs’ and ‘factors’ that the user entered on the ‘Input’ page. The values are also totalled here.

The total score for each system is used to rank it on the ‘Ranking’ page



Group	System	Activation time - Fast or nothing	Ongoing effect	robustness / resilience	Heads up and instruction	residents	transients	immobile	hearing impaired	mental capacity	language	institutions	low pop density	high pop density	terrain	time to reach all	for slow onset, localised	for slow onset, widespread	for fast onset, localised	for fast onset, widespread	PERCENT SCORE
	MULTIPLIERS:	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Via natural warnings	4	5	5	1	3	2	2	3	1	2	2	3	4	3	5	5	4	3	3	63%
	Via community contact trees/systems	3	3	3	5	4	1	2	2	2	3	5	4	3	4	3	5	3	4	2	64%
Via 3rd Party hardware and/or staff	Aircraft banners	2	4	2	1	3	3	1	1	1	1	2	1	3	2	2	4	3	2	1	41%
	Aircraft hailers	2	3	2	5	3	2	1	2	2	1	2	1	4	4	2	5	2	3	1	49%
	Amateur/Ham radio (HF and VHF)	4	4	4	1	2	1	4	1	2	1	4	4	4	4	1	5	3	4	2	58%
	Billboards	2	3	4	1	2	2	1	2	1	2	1	1	4	3	1	4	2	2	1	41%
	Break in broadcasting*	5	4	3	5	5	2	4	3	3	3	4	4	4	4	5	5	5	4	4	80%
	Call-in phone line	2	3	3	1	3	1	4	1	2	2	4	4	2	4	1	2	1	1	1	44%
	Cell broadcast*	5	4	4	3	4	4	4	4	2	4	4	4	4	4	5	5	5	5	5	83%
	E-mails	3	4	3	1	3	1	4	5	2	2	5	4	3	4	3	3	3	1	1	58%
	Marine radio	4	4	4	5	2	1	2	1	1	2	1	4	3	2	1	2	1	2	1	45%
	Pagers	4	4	4	5	2	1	4	3	2	2	2	4	4	4	1	4	4	4	2	63%
	Police/fire mobile PA loud speaker	2	3	2	5	4	4	4	2	3	2	4	1	4	4	1	4	2	3	1	58%
	Power line messaging	5	2	3	1	5	1	4	4	2	4	4	4	4	5	5	3	3	3	3	68%
	Radio and Television announcements	4	5	5	3	5	2	5	4	3	3	4	5	5	5	5	4	4	3	3	81%
	Radio Data Systems*	4	4	4	5	2	1	4	1	2	1	2	3	3	3	1	3	1	2	1	49%
	Route alert (door-to-door)	3	2	3	5	5	4	5	4	3	3	5	1	4	4	1	4	3	2	1	65%
	SMS text messaging	4	3	3	3	4	2	4	4	2	2	4	4	3	4	3	5	3	2	1	63%
	Telephone auto-dialler	3	2	2	5	4	1	4	2	1	1	4	3	2	4	1	5	2	3	1	53%
	Telephone trees	4	4	3	5	4	1	4	2	1	2	5	4	2	4	3	5	2	4	2	64%
	Tourist radio	3	2	3	1	1	3	2	1	2	1	1	3	4	3	1	2	2	1	1	39%
	Websites/WAP etc	4	4	3	1	4	2	4	4	2	2	4	4	4	4	1	2	1	1	1	55%
	Website banners*	4	4	3	3	4	2	4	4	1	2	4	4	4	5	3	5	5	3	3	71%
	GPS receiver messaging*	3	4	3	1	2	1	3	3	1	2	2	4	4	3	1	4	4	4	4	56%
Dedicated hardware	Fixed PA loud-speakers	4	4	4	5	3	2	3	2	2	2	2	1	4	3	2	5	5	5	5	66%
	Flares, explosives	4	1	3	1	2	1	1	2	1	3	1	1	4	2	1	3	2	2	1	38%
	Mobile PA loud-speakers	3	4	4	5	4	4	4	2	3	2	4	2	4	4	2	4	3	3	3	67%
	Sirens	4	2	3	1	3	1	3	1	1	3	3	1	5	3	2	4	4	2	2	51%
	Tone-activated alert radio*	5	5	4	5	5	1	5	2	2	2	5	5	5	5	5	5	5	4	4	83%

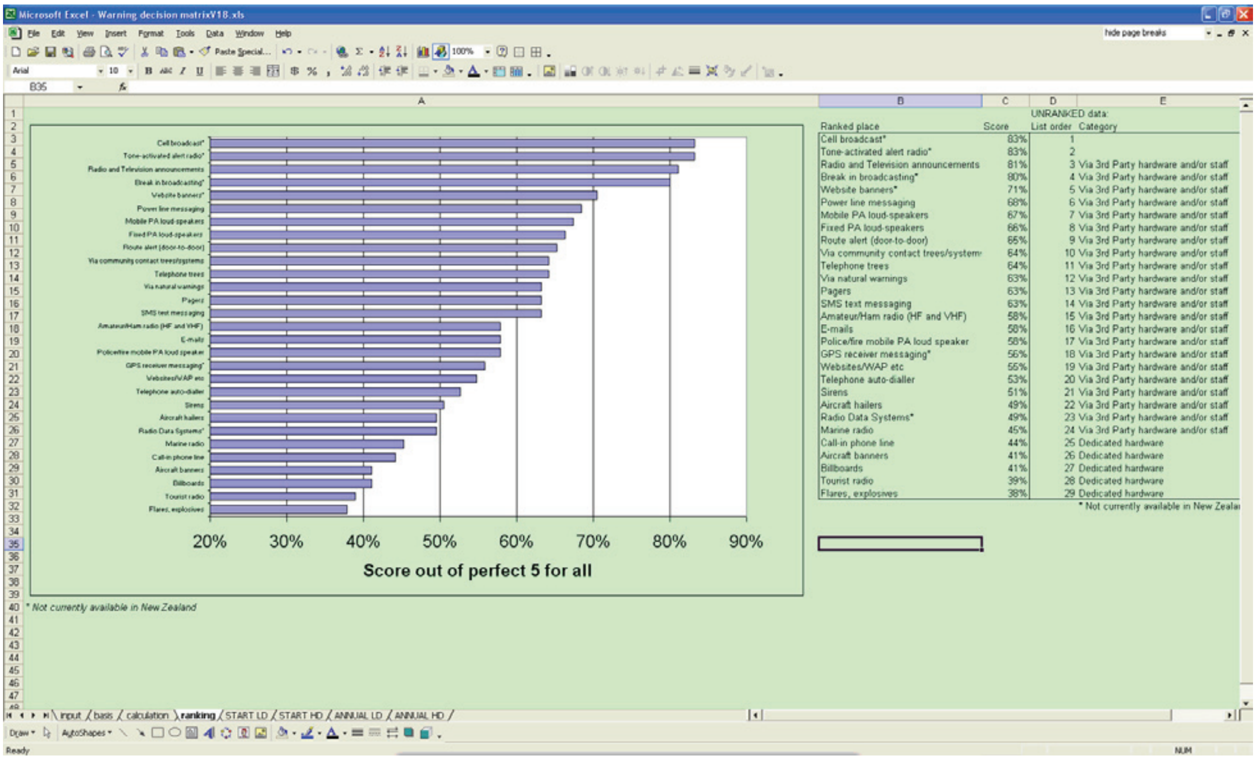
*Not currently available in New Zealand

System	LOW Density (avg. 100 ppl/sq.km) cost START	cost ANNUAL	HIGH Density (avg. 2000 ppl/sq.km) cost START	cost ANNUAL
	Population: 30000 people		Population: 450000 people	
Via natural warnings	$ 58,500	$ 58,500	$ 877,500	$ 877,500
Via community contact trees/systems	$ 2,925	$ 2,925	$ 43,875	$ 43,875
Aircraft banners	#N/A	#N/A	#N/A	#N/A
Aircraft hailers	$ 55,898	$ 7,898	$ 210,713	$ 30,713
Amateur/Ham radio (HF and VHF)	$ 756,825	$ 6,825	$ 11,352,375	$ 102,375
Billboards	#N/A	#N/A	#N/A	#N/A
Break in broadcasting*	not costed	not costed	not costed	not costed
Call-in phone line	#N/A	#N/A	#N/A	#N/A
Cell broadcast*	$ 10,078,098	$ 78,098	$ 11,171,463	$ 1,171,463
E-mails	#N/A	#N/A	#N/A	#N/A
Marine radio	#N/A	#N/A	#N/A	#N/A
Pagers	$ 77,318	$ 30,518	$ 1,159,763	$ 457,763
Police/fire mobile PA loud speaker	$ 488	$ 488	$ 7,313	$ 7,313
Power line messaging	$ 600,098	$ 98	$ 9,001,463	$ 1,463
Radio and Television announcements	$ 488	$ 488	$ 7,313	$ 7,313
Radio Data Systems*	$ 756,825	$ 6,825	$ 11,352,375	$ 102,375
Route alert (door-to-door)	$ 488	$ 488	$ 7,313	$ 7,313
SMS text messaging	$ 1,805,850	$ 5,850	$ 1,887,750	$ 87,750
Telephone auto-dialler	$ 492,375	$ 102,375	$ 7,385,625	$ 1,535,625
Telephone trees	$ 39,195	$ 39,195	$ 587,925	$ 587,925
Tourist radio	#N/A	#N/A	#N/A	#N/A
Websites/WAP etc	#N/A	#N/A	#N/A	#N/A
Website banners*	#N/A	#N/A	#N/A	#N/A
GPS receiver messaging*	unknown	unknown	unknown	unknown
Fixed PA loud-speakers	$ 30,780,975	$ 780,975	$ 23,099,625	$ 599,625
Flares, explosives	#N/A	#N/A	#N/A	#N/A
Mobile PA loud-speakers	$ 1,279,950	$ 78,488	$ 4,821,750	$ 299,813
Sirens	$ 15,799,500	$ 784,875	$ 12,127,500	$ 658,125
Tone-activated alert radio*	$ 120,996	$ 996	$ 134,918	$ 14,918

#N/A = Not Considered

The ‘Ranking’ page

The ‘Ranking’ page shows the systems ranked by total percentage score, as derived on the ‘Calculation’ page.

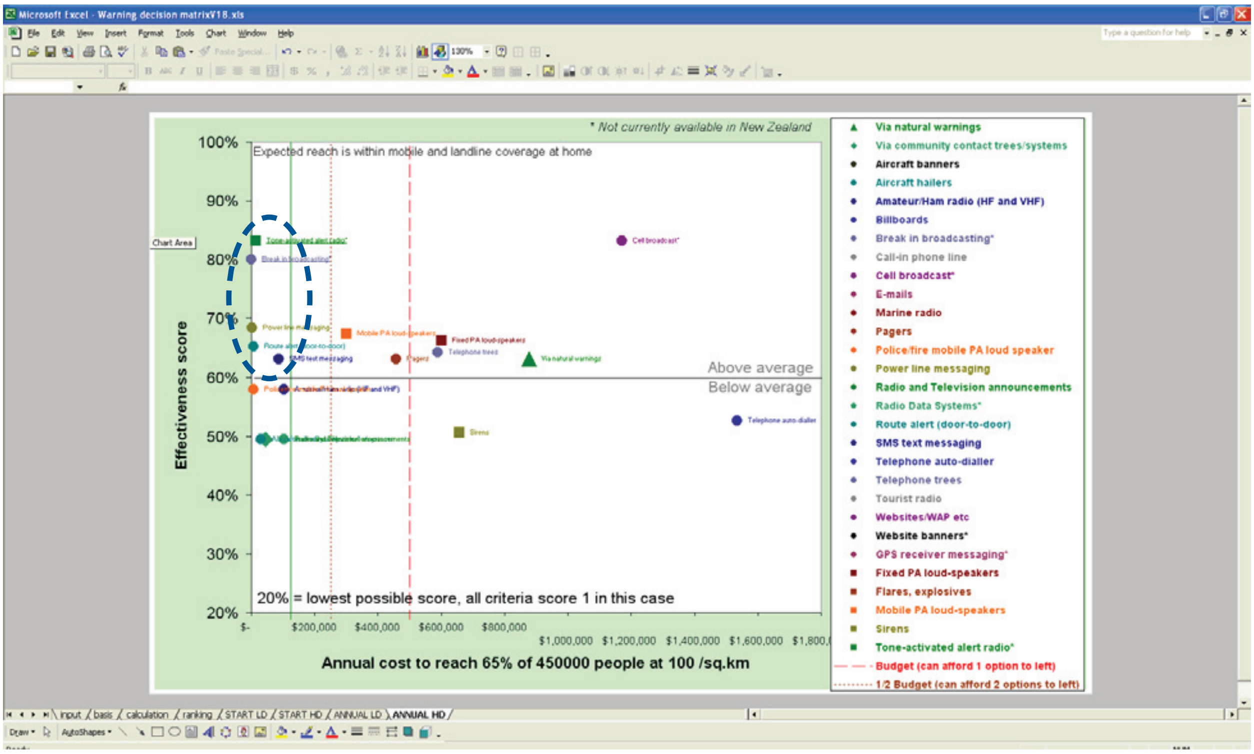


Cost-benefit pages

From the four cost-benefit pages the user can identify what mechanisms or combination of mechanisms they can afford and what mechanisms meet their circumstances or criteria the best. The four pages provide plots for cost-benefit data for respectively Start-up (low and high density areas), and Annual (low and high density areas).

Benefit (score) improves from bottom to top, and cost increases from left to right.

The budget, half-of-budget and one-quarter-of-budget are shown as vertical lines. An above-average/below-average score line is drawn at 60%[3]. Therefore, the best cost benefit mechanisms are shown in the upper left. Generally, selecting a few or several mechanisms that plot up in the top left of the graph will give the best result.



Example of the 'ANNUAL LD' (Annual Low Density) page. The blue dashed line highlights the best cost-benefit.

Refining the results

Once the user has an idea of the mechanisms to focus on from the 'Cost-benefit' pages they can go back to the 'Calculation' page to see the exact values being plotted for the options they are interested in.

The user may also consider exploring individual aspects of the initial results further with the tool. The user could, for example:

- Turn off some overly-expensive options on the 'Input' page – this will rescale the plot and show the cost-effective options better
- Consider separately smaller, sub-areas
- Provide revised cost bases for specific population densities within an area

3 Percentage is of a perfect score of all '5's. The worst score would be 20% of all '5's - all '1's.

List of abbreviations

CAA .... Civil Aviation Authority
CDEM .... Civil defence emergency management
EAS .... Emergency Alert System (USA)
FM RDS .... Frequency modulation radio data system
FTE .... Full time employee
GPS .... Global positioning system
HF .... High frequency (radio)
ISP .... Internet service provider
LCD .... Liquid crystal display
MBMS .... Mobile Broadcast Multicast Service
MCDEM .... Ministry of Civil Defence & Emergency Management
MOU .... Memorandum of understanding
PA .... Public address (system)
SMS-PP .... Short message service- point to point
UHF .... Ultra high frequency (radio)
VHF .... Very high frequency (radio)
WAP .... Wireless application protocol

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