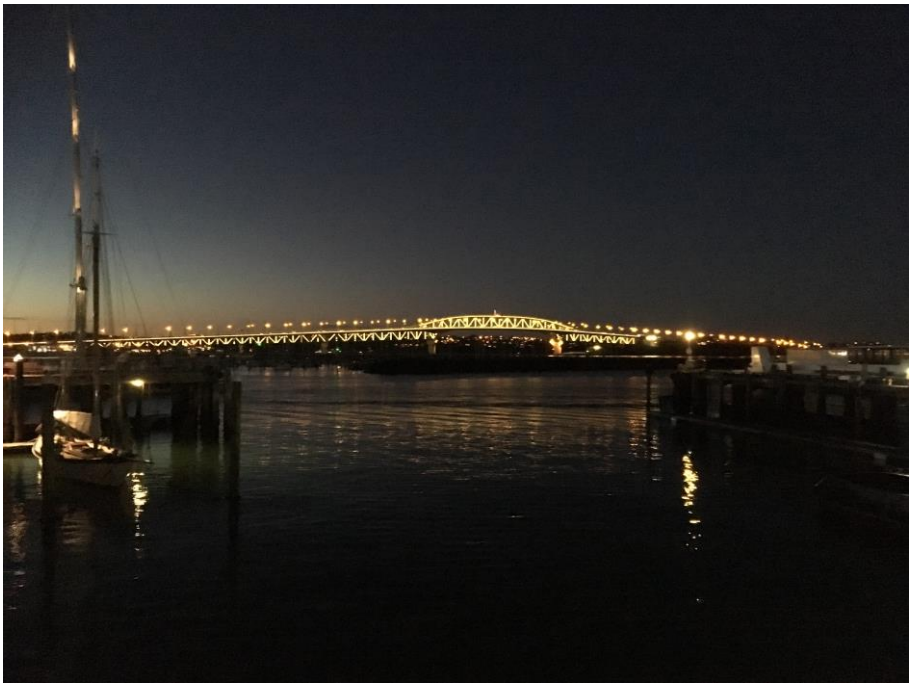

Resource & Environmental Management

Semester 1, 2021

Course Tutors

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Welcome to Resource & Environmental Management

Haere mai – Talofa lava

The aim of this course is to develop an understanding of how civil engineering processes impact on the natural environment and to mitigate against these effects to achieve a level of sustainability. In addition to design, examination of the legislation and the practical application of this legislation will provide a holistic approach to sustainability within the industry.

This course covers the following topics

Topic One: Resource Management Act and Urban Planning

Topic Two: Assessment of Environmental Effects

Topic Three: Environmental Management Plans

Topic Four: Sustainable Solutions for the Built Environment, including Water and Energy

Student's Guide to Success

It is essential that you attend **ALL** classes. Many of the ideas covered in class **are not found in text books and it may be difficult to catch up.**

Investigations will form part of your class work. These tasks are designed to extend your thinking and group work will be essential to complete these tasks. The grades from these investigations may not be included in your final grade for this course**.**

Anchoring new learning by practice and revision is extremely important in any subject, especially engineering. For every one hour of class time you are expected to do about one hour of self-directed study at home or in a study group. This means in a week you need to schedule in **4 hours** of self-directed study time on top of your class time. Assignments and homework will be given frequently to re-enforce your class work and completion of this is **essential** to your success.

Requirements to Pass

This course consists of two assignments, a number of short homework exercises and an exam. You must attempt all assignments to pass this course. Assignments may involve individual or group presentations and/or written work. Assignments are worth 60% of your final mark, assignment 1 (AEE) and assignment 2 (Sustainable design) are each worth 20% of the final mark. These projects should represent about 20 hours of work. There are 2 homework exercises, each worth between 10% of your final mark (representing about 7 hours work). The exam is worth 40% of your total course mark.

Originality and Referencing

Your assessed work must be your own. If you have quoted from or referred to someone else's work this is usually allowed, as long as you reference it correctly.

Late Assignments/Assessments Policy

Up to 5 days late with no communication

- Accepted or sit test within 5 days
- Assessment eligible only for 80% of the given mark
- Approved by lecturer

Application for an extension

- SAC form required (Special Assessment Circumstances application – student central)
- Students given 5 days grace
- Assessment marked as usual
- Approved by lecturer
- Approved by Programme Leader, in consultation with the lecturer/s involved and the Student Support person. Extension and new due date approval or decline to be communicated to student by PL.
- Appeals will be heard by the Programme Committee

Resits

- A student cannot resit an assignment or test they have not previously sat.
- Therefore, all students must undertake one of the above actions – or hand assignment/assessment in on time!

Before resitting a test you must make sure you understand the mathematics. If you need help, make an appointment for a tutorial with Te Puna Ako or Maia or with your tutor before the resit. Remember, we (the tutors) will help all we can. So talk to us, ask questions in class, come and see us privately and make use of the Unitec support services.

Student support

Your lecturers are here to help you with your work for this course. If you feel that you need extra support the following services are available:

For learning advice and support:
Mt Albert campus: Te Puna Ako Maia Centre for Pacific Development and Support
Waitakere campus: Te Whare Manaaki

Kia Kaha

Course Calendar

		Wednesday (11-1pm)	Friday (8:30-10:30am)
Week 1	1st March	Introduction to Resource Management Act	Assessment of Environmental Effects
Week 2	8th March	Land & Water	Site Visit – Kennedy Park
Week 3	15th March	Homework 1 Presentations	Individual Class Visits*
Week 4	22th March	Site visit – Auckland Zoo	Flora & Fauna
Week 5	29th March	Infrastructure, Traffic & Environmental Management	No Class (Easter Friday)*
Week 6	5th April	People & Social Impact Assessment	Māori Worldview
Week 7	12th April	Assignment 1 Presentations	Introduction to Sustainable Design
Mid Semester Study Break 19th April- 30th April			
Week 8	3rd May	Sustainable Materials	Green Buildings
Week 9	10th May	Site Visit – Green Buildings	Eco-brick 1
Week 10	17th May	Green Buildings – Green star	Sustainable Design (Homework 2 hand-in)
Week 11	24th May	Sus-design - Energy	Eco-brick 2
Week 12	31st May	Site Visit - Sustainable Communities	Water
Week 13	7th June	Assignment 2 Presentations	Revision
*Students are not required to attend class on these days			

(PROVIDER CODE) MG7109 RESOURCE AND ENVIRONMENTAL MANAGEMENT

Level 5 **Credits 15** **Version 25 Feb 13**

LEARNING TIME

Directed Hours	Self Directed Hours	Total Hours
75	75	150

PREREQUISITE
Nil

CO-REQUISITE
Nil

PURPOSE/AIMS
To develop an understanding of how civil engineering processes impact on the natural environment and to mitigate against their effects to achieve sustainability.

LEARNING OUTCOMES
On the successful completion of this course, the student will be able to:

1. Critically analyse the application of the Resource Management Act to the Civil Engineering industry.
2. Create and evaluate an Assessment of Environmental Effects (AEE) and translate its implications to an environmental management plan
3. Critically appraise the impact of Civil Engineering processes on the natural environment and sustainability.
4. Critically appraise the Resource Management Act from a Maori world view perspective including the consideration of any regional differences.

CONTENT

- Resource Management Act
- Urban Planning
- Assessment of Environmental Effects (AEE)
- Environmental Management Plans
- Sustainable solutions for the built environment, including water and energy.

ASSESSMENT

Assessment Type	Weighting	Outcomes Assessed
Assignments	60%	2-4
Exam	40%	1-4

*To pass this course, the student must achieve a minimum mark of 50% overall and attempt all assessments.

LEARNING AND TEACHING STRATEGIES

As appropriate to the practices and resources of the delivering institution. Typically a blend of the following.

- Lectures
- Tutorials
- Web technologies
- Computer Simulation
- Project Investigations
- Case Studies
- Site Visits
- Visiting Guest Lecturers
- Videos
- Laboratories
- Group work

LEARNING AND TEACHING RESOURCES

As selected by the delivering institution, consistent with indicative resources outlined in the BEngTech Teaching and Assessment Plans, and reviewed and approved annually by the Metro Management Group.

IPENZ BENGTECH GRADUATE ATTRIBUTES

	IPENZ BENGTECH GRADUATE ATTRIBUTES	OUTCOME
1.	Understanding of Engineering Science	1-4
2.	Problem Formulation, Analysis & Solution	1-4
3.	Design, Development & verification of Solutions	1-4
4.	Research and Experimentation	3-4
5.	Evaluation and Management of Risk	2-4
6.	Team Work	1-4
7.	Communication	1-4
8.	Ethics and Responsibility to Society	2-4
9.	Project and Business Management	4
10.	Product Synthesis	-

Course Assessments

This course has two types of assessment, which are collectively worth 60% of your final marks, these include:

1. Shorter **homework** exercises
2. Longer project based **assignments**

Both types of assessment are compulsory for this course and are an essential component of learning at level 7. The assignments are worth 20% each and comprise of two projects. Assignment 1 involves the creation of an assessment of environmental effects for a theoretical civil engineering development in a local location. Assignment 2 involves data collection and the creation of a sustainable housing design.

Table 1: Course breakdown: assessments and homework exercises

Assessment	Assessment type	Course Breakdown
Assignment 1 (AEE)	Presentation + written report	20%
Assignment 2 (Sustainable Design)	Presentation + written report	20%
Homework 1 (AEE Case Study)	Presentation	10%
Homework 2 (Sustainable Design)	Written Report	10%
Exam	Closed book	40%
Total		**100%**

Homework Exercises

There are two homework exercises for this course and each is worth 10% of the total course marks.

1. **Assessment of Environmental Effects - Case Study**

Your individual homework task is to investigate a case study of an AEE to achieve the following criteria:

- Summarise the main issues; you may like to consider them in the same order as the course to help with structure, e.g. Intro (set scene), land, water, flora and fauna (with a specific focus on native species affected), people and infrastructure and traffic.
- Describe how the effects have been minimised or mitigated.
- Discuss the potential benefits of this scheme (how has this been made attractive to the council?)
- What was the final decision? Were any conditions applied?

You will have to search on the internet for case studies. Try to avoid any very large projects like the Waterview tunnel (unless they have a good succinct executive summary).

Your feedback should be in the form of an oral presentation - 10 mins max. (there will be a time penalty for presentations over 11 mins) with references embedded into the presentation as supplied as a list (APA style).

2. **Sustainable Materials**

This is an individual assignment. You will be required to research and summarise sustainable building practice information about ONE country, including current legislation, building practice and construction materials used. You will be asked to discuss any legislation/guidelines or standards used and their impact on improving building practice. Your final output will be a written report.

Choose a city from your native country (or one that you are familiar with), if you are from NZ, please consider an alternative from the list provided below:

China, UK, India, Australia, USA, South Africa, Japan, Brazil, Mexico, Germany, France, Russia Singapore.

For the city you have chosen:

1. Prepare a short descriptive paragraph about your chosen city (this must NOT be cut and paste from Wikipedia). Each paragraph should include details such as location, climate, population size, topography and main industry etc.

2. Discuss how houses are built focusing on typical materials used, and whether these materials are sustainable? (for example, are the materials produced locally or transported from overseas; do they recycle their building products).

3. Investigate if there are any existing guidelines/standards (government/non-government or both?) on how to build a sustainable building for this location. If so, what is the guideline focus (e.g. greenhouse emissions, sustainable materials, human health). Summarise any the legislation, guidance and standards by providing the following detail:

· Whether from government or non-government agency

· When were these standards/guidelines created and when was the most recent version produced?

· Is this compulsory legislation/standards or just guidelines?

· Is there anything being done to encourage people to follow it?

· Is there any information available about the number of buildings currently using this guidance? (this will be easy to find for LEED, NZGBC etc. but trickier for government organisations).

4. In your opinion, are the houses adequate for the climate and geographic conditions of the city or country?

5. Using the diagram provided as an example (Fig 1), create your own diagram to summarise how well these buildings follow sustainable strategies in your chosen country.

Figure 1: Demonstration Sustainability in Buildings

Your feedback should be in the form of a short, written report (submitted to Turnitin)- no longer than 6 pages in length (including reference list for websites and relevant articles used).

Assignments

There are two assignments for this course as detailed in the following chapters. Each assignment is worth 20% of your total marks.

1. Creation of an AEE

This is a project involving the creation of an AEE for a theoretical development in the local area. Some of the possible options available are:

- Restoration of the Orakei basin
- Extension of the Takapuna wharf
- Creation of a bridge from Paremoremo to Greenhithe
- The creation of an extra lane for highway 16 at Te Atatu
- An alternative ferry service from Te Atatu to Westhaven
- Installation of a bike/pedestrian bridge alongside Pakuranga Highway
- The creation of a cycleway along the SW highway (20) to connect with Woodward Rd
- Development of a 3-storey high rise building in Pt Chevalier

The outputs include a written report detailing the likely impacts of the civil work and with suggestions for mitigation as directed by learning in the first part of the course. You should include a section which consider any native flora or fauna based on your fieldtrip experience plus previous course learning. Which species may be present? How vulnerable are they? How could they be protected? An oral component is also required in the form of a 10-minute feedback presentation. This project is worth 20% of the total mark.

PLEASE SEE INDIVIDUAL HANDOUTS FOR FULL DETAILS (to be distributed in week 3).

2. Sustainable design

There are two stages to this project for which both must be completed to achieve full marks. The first stage involves data collection which includes a waste audit and regular monitoring of water and energy usage and transportation mileage. There is also a comprehensive environmental assessment of your current accommodation. The second stage involves a proposed upgrade of your current property to a more sustainable home.

Stage 1

For the duration of this course, you will be required to carry out an audit of the energy, water and waste at your house. For the waste audit, you will be provided with a number of containers in which to separate and weigh your waste. In addition, you will need to produce an audit of your transportation.

Energy Audit

1. Do you have any alternative energy (Inc Solar, microhydro etc.)? If so determine how much energy is produced via these processes.
2. Using a spreadsheet format, collect weekly electrical energy usage data for your accommodation.
3. If you use any solid fuel, record your daily usage (approximate mass).
4. If you have gas on your property, make a record of your annual consumption

Water Audit

1. Do you have any water harvesting or water recycling at your property? If so determine how much water is produced via these processes.
2. Using a spreadsheet format, collect weekly water usage data for your accommodation.

Waste Audit

1. Using a set of bins, separate your waste into plastic recyclables, glass, metal, paper and card waste, non-recyclable waste and food waste.
2. Make a note of the weekly mass of each of the waste.
3. Using a spreadsheet, create a waste audit for your property.

Transport Audit

1. To produce a better assessment of your green footprint, keep a daily log of your journeys. Note the type of transportation and distance you travel each time and also note whether you are travelling singularly or as a group.
2. If you travel by car, try to estimate the fuel economy of this transportation.

This information will be used to complete your second project (which is worth 20% of the marks for this course). For this reason, it is extremely important that you carry out this task diligently and thoroughly.

Stage 2

Analysis

The next step in this project is to assess the environmental impact of your house and transport situation. You may use any on-line assessment tool. Tools currently available include the following:

- BRANZ (Http://alf.branz.co.nz)
- Healthy Housing Index (HHI)
- House energy rating (try EECA Energy wise)
- Centre for alternative technology (CAT)

You may need to use more than one tool to fully assess your current environment impact from your living//transportation situation, as the majority of on-line assessment tools are based on energy efficiency.

You will also need to produce a scale floor layout of your house and a description of the following points:

- Energy sources e.g. electricity, gas, solid fuel, solar etc. Please provide a definition for "energy usage".
- Orientation of the house (mark North on the map)
- Location of the key living areas (and indicate which direction they face if not clear)

- Thermal mass details e.g. wall and ceiling construction including insulation (type and location). Please provide definitions for "thermal conductivity" and "thermal resistivity".

Low budget and unlimited budget retrofits

Finally - the up-grade. You will be required to provide two options for the upgrade of your current living environment. The first upgrade involves a low budget retrofit (maximum cost $2000) which must be justified in terms of benefit. Costs must be assessed and be realistic therefore you should provide trade literature to support any estimates.

The second upgrade is an unlimited budget upgrade in which you must choose and justify improvements to minimise the environmental impact of your house. Your submission should include a concept plan (which is a basic floor plan with descriptions).

Please do not to forget to include discussion on the key challenges to any retrofit/changes. For example, adding insulation may not be possible for all types of wall without a considerable reduction in room size or adding a photovoltaic panel to the roof may not be feasible on a particular roof type or orientation.

A list of helpful sites is provided below and will be added to during the course so check regularly.

For information on energy try the following site: Passiv house, New Zealand:
http://www.phinz.org.nz/

The marking schedules for both assignments are available on the moodle site under the assignments button https://moodle.unitec.ac.nz/mod/book/view.php?id=212030&chapterid=19325

Resource Management Act

Environmental Legislation

On a global scale, environmental legislation includes both voluntary and non-voluntary compliance e.g.,

Agenda 21 - non-binding, voluntarily implemented action plan of the United Nations with regard to sustainable development.

Stockholm Convention on Persistent Organic Pollutants - international environmental treaty, aims to eliminate or restrict the production and use of persistent organic pollutants.

National environmental legislation is founded on the Resource Management Act (RMA). The Resource Management Act (RMA), 1991, is a framework which establishes environmental bottom lines to be acted upon by regional and district councils. The purpose of the RMA is to promote the sustainable management of natural and physical resources.

In this Act, "Sustainable Management" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while:

- Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
- Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
- Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

The RMA is used by councils to create statutory documents to carry out this purpose and this effectively means that for the majority of civil engineering projects, a resource consent of some description will be provided.

Resource consents may be issued for the following areas:

1. Land-use
2. Subdivision
3. Coastal permit
4. Water permit
5. Discharge permit

Consents include:

- permits to carry out an activity that would otherwise contravene a rule in a city or district plan
- permission for an activity that might affect the environment, and that isn't allowed 'as of right' in the district or regional plan

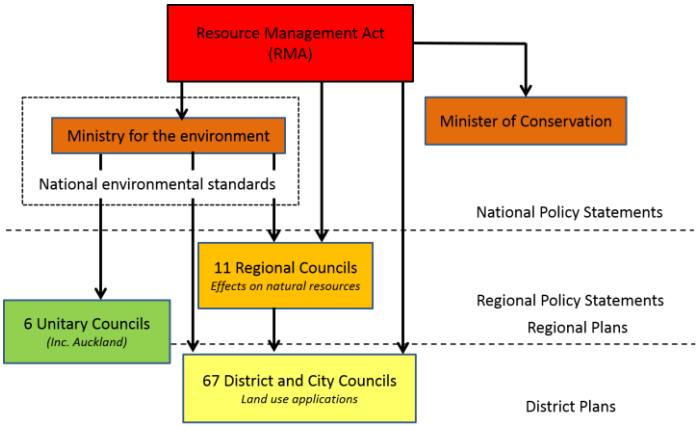
Activities may be deemed (by the council) as:

1. Permitted
2. Controlled
3. Restricted
4. Discretionary
5. Non-complying
6. Prohibited

The RMA framework allows those whose are directly affected to make the decisions. This decision-making authority is devolved to the most appropriate level. Therefore at national level, a consistent policy is set which can then be interpreted by the Ministry for the Environment and Councils. Below this level, decisions that directly impact on local communities are made by councils, which, under the RMA, are called local authorities.

Local authorities are responsible for implementing the bulk of the RMA, and are divided into two tiers (regional and district/city councils) for this purpose.

There are 12 regional councils which are responsible for:



- the taking, use, damming, and diversion of surface water, groundwater and geothermal water
- the discharge of contaminants to land, air or water
- the effects of activities in the coastal marine area (together with the Minister of Conservation)
- the introduction of plants into water bodies
- maintaining indigenous biodiversity
- land-use for matters such as soil conservation, maintaining and enhancing ecosystems in water bodies, water quality and quantity, and controlling natural hazards and hazardous substances
- the strategic integration of infrastructure with land-use.

*Please note: there are now 12 Regional Councils and 73 District and City Councils

There are 73 District and City Councils which are responsible for:

- the effects of land-use (including hazardous substances, natural hazards and indigenous biodiversity)
- noise
- the effects of activities on the surface of lakes and rivers.

Finally, there are 6 Unitary councils which are a combination of a regional and a city council. These Unitary councils include:

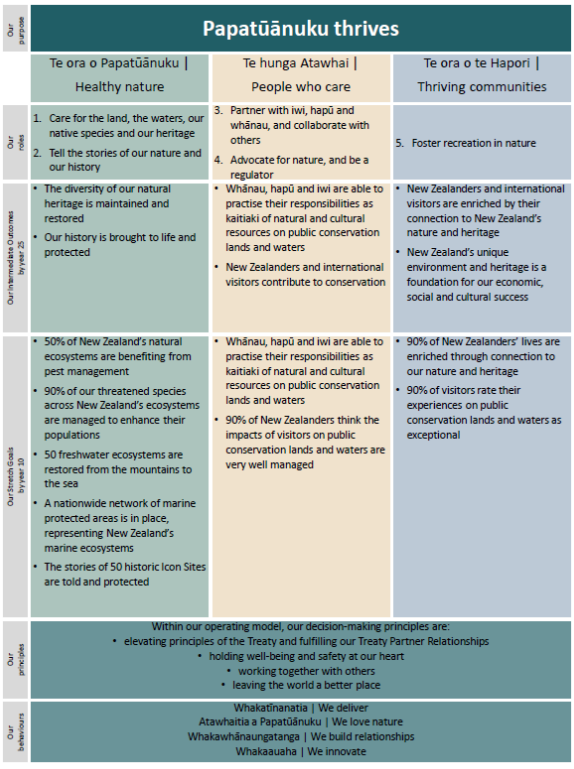
- Auckland
- Nelson City
- Marlborough
- Gisborne
- Chatham Islands
- Tasman

All councils are responsible for preparing policy statements and plans, issuing resource consents, taking enforcement action, and monitoring the state of the environment and the effect of their own decisions, all within the context of their functions under the RMA.

The Environmental Protection Agency (EPA) is a governmental body who can make decisions and give advice to council regarding resource consents.

Activity guides can indicate whether you need a district or a regional plan rule for non-unitary councils.

Department of Conservation (DoC) is a government agency charged with conserving NZ's natural and historic heritage. See description in table provided.



Our purpose	Papatūānuku thrives		
	Te ora o Papatūānuku | Healthy nature	Te hunga Atawhai | People who care	Te ora o te Hapori | Thriving communities
Our roles	1. Care for the land, the waters, our native species and our heritage 2. Tell the stories of our nature and our history	3. Partner with iwi, hapū and whānau, and collaborate with others 4. Advocate for nature, and be a regulator	5. Foster recreation in nature
Our intermediate Outcomes by year 25	• The diversity of our natural heritage is maintained and restored • Our history is brought to life and protected	• Whānau, hapū and iwi are able to practise their responsibilities as kaitiaki of natural and cultural resources on public conservation lands and waters • New Zealanders and international visitors contribute to conservation	• New Zealanders and international visitors are enriched by their connection to New Zealand's nature and heritage • New Zealand's unique environment and heritage is a foundation for our economic, social and cultural success
Our Stretch Goals by year 10	• 50% of New Zealand's natural ecosystems are benefiting from pest management • 90% of our threatened species across New Zealand's ecosystems are managed to enhance their populations • 50 freshwater ecosystems are restored from the mountains to the sea • A nationwide network of marine protected areas is in place, representing New Zealand's marine ecosystems • The stories of 50 historic Icon Sites are told and protected	• Whānau, hapū and iwi are able to practise their responsibilities as kaitiaki of natural and cultural resources on public conservation lands and waters • 90% of New Zealanders think the impacts of visitors on public conservation lands and waters are very well managed	• 90% of New Zealanders' lives are enriched through connection to our nature and heritage • 90% of visitors rate their experiences on public conservation lands and waters as exceptional
Our principles	Within our operating model, our decision-making principles are: • elevating principles of the Treaty and fulfilling our Treaty Partner Relationships • holding well-being and safety at our heart • working together with others • leaving the world a better place		
Our behaviours	Whakatīnanatia | We deliver Atawhaitia a Papatūānuku | We love nature Whakawhānaungatanga | We build relationships Whakaauaha | We innovate		

National Policy Statements

National policy statements (NPS) include:

- New Zealand Coastal Policy Statement - 2010 (includes the 1st 20m of coastline, a resource consent was required for discharge from Rena)
- National Policy Statement on Electrical Transmission - 2008
- National Policy statement on Freshwater Management - 2014 (includes objectives for management of rivers and streams, e.g. water quality limits are set as are abstraction volumes).
- National Policy statement on Renewable Electricity Generation - 2013

All NPS's are listed on the MfE website and all reports and district plans must give effect to NPS. More NPS are in development including NPS Urban Design and NPS Biodiversity (which includes the protection of indigenous vegetation).

Regional Policy Statements

Regional Policy Statements (RPS) (Chapter 2 of the Unitary plan) shouldn't need to be used too often but could be useful e.g. to support an application for an activity for example a 3rd Harbour Crossing.

RPS include:

- the significant resource management issues for the region including those of significance to iwi
- objectives and policies to address issues and an explanation of those policies.
- methods (excluding rules) used, or to be used, to implement the policies
- principal reasons for adopting the objectives, policies and methods of implementation
- environmental results anticipated from implementation of those policies and methods.

Regional Policy statement may contain information (which may be based on models) which may affect your activity, for example detailed information about where floodplains are located. The RPS is a key planning instrument because all Regional and District plans must give effect to the RPS. Key sections of the RPS include: water quality and quantity, air quality, natural hazards, climate change, contaminated land, hazardous substances, waste, earthworks and land development and transport.

National Environmental Standards

National Environmental standards are set by central government and developed by the ministry for the environment for example:

- Air quality
- Sources of human drinking water
- Assessing and managing contaminants in soil to protect human health (e.g. if digging more than 25m^3 soil, you must prove that it is not contaminated via a preliminary site investigation)
- Plus others including the development of a number of new standards e.g. ecological flows and water levels.

Regional Plans

Regional councils may have more than one plan although most will have a separate coastal plan. These plans are based on the natural environment and they classify activities and include standards, assessment criteria and information requirements.

Key provisions include: Water quality (in terms of discharge to land and water, structures and works in streams, rivers and lakes); air quality (controls discharges to air), natural hazards, waste and contaminated land and coastal structures, activities and discharges (coastal plans).

Both regional and district plan consents may be required.

District Plans

District plans are more about people and often follow a ten-year cycle before updating. They may include, for example, rules on building heights, tree protection (did you know that all trees on roads are protected under the Unitary plan?) and land-use. The functions of the district plan are listed in section 31 and are detailed below:

- integrated management of the effects of the use, development or protection of land and associated natural and physical resources of the district.
- control of any actual or potential effects of the use, development, or protection of land, including for the purpose of:
- the avoidance or mitigation of natural hazards: and
- the prevention or mitigation of any adverse effects of the storage, use, disposal or transportation of hazardous substance; and
- the prevention and mitigation of any adverse effects of the development, subdivision, or use of contaminated land:
- the maintenance of indigenous biological diversity
- the control of the emission of noise and the mitigation of the effects of noise
- other functions specified in this Act

The district plan must state the objectives for the district, policies to implement the objectives and any rules to implement the objectives. It must also state any issues that the plan seeks to address, methods for implementing policies, principal reasons for adopting policies and the environmental results expected. It is useful for finding which information must be included with an application for a resource consent and any cross-boundary issues.

Matters of Importance

In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:

- the preservation of the natural character of the **coastal environment** (including the coastal marine area), **wetlands**, and **lakes** and **rivers** and their margins, and the protection of them from inappropriate subdivision, use, and development.
- the protection of **outstanding natural features** and landscapes from inappropriate subdivision, use, and development.
- the protection of areas of significant **indigenous vegetation** and significant habitats of **indigenous fauna.**
- the maintenance and enhancement of **public access** to and along the coastal marine area, lakes, and rivers.
- the r**elationship of Maori and their culture** and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.
- the protection of **historic heritage** from inappropriate subdivision, use, and development:
- the protection of protected **customary rights**.

Other Parties

In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall have **particular regard to**:

- **Kaitiakitanga**
- the ethic of stewardship:
- the efficient **use and development of natural and physical resources:**
- the efficiency of the end use of **energy**:
- the maintenance and enhancement of **amenity values**:
- intrinsic values of **ecosystems**
- maintenance and enhancement of the **quality of the environment:**
- any **finite characteristics of natural and physical resources**
- the **protection of the habitat of trout and salmon**:
- the effects of **climate change**:
- the benefits to be derived from the use and development of **renewable energy.**

The Process

Fundamentally, any activity may require a resource consent and/or be subject to standards (e.g. you can build a road providing you have sufficient soil and erosion control).

1. The first step in this process for civil engineers is to determine the type of consent required by asking local council.
2. This is closely followed by determining how a consent may be met and which may include a multidisciplinary approach involving an **assessment of environmental effects (AEE).**
3. If an application for a consent is rejected, an appeal can be lodged through the **Environment Court,** which is an independent body.

Once the type of resource consent has been established, mitigation against the adverse effects of the activity needs to be provided. There are Australian and New Zealand standards available (at a cost) which can guide you or you can find solutions in the technical papers provided by the councils, e.g GD01 from Auckland council to provide solutions for stormwater and erosion and sediment control respectively. Alternatively, consultancies are available but at a greater cost still.

Further reading try "**The New Zealanders' Guide to the Resource Management Act, 1991" by Raewyn Peart.**

Assessment of Environmental Effects

Historical Context

The concepts underpinning the RMA were based on developments in both international and local thinking over the previous 20 years. The 1972 Stockholm *United Nations Conference on Environment and Developm*ent provided the first forum for international debate on concepts such as integrated environmental management and sustainable development. A subsequent audit of New Zealand's environmental management by the Organisation for Economic Co-operation and Development (OECD), in 1980, highlighted the need to improve environmental management locally.

In 1981, the Nature Conservation Council prepared a report titled *Integrating Conservation and Development: A Proposal for a New Zealand Conservation Strategy*. This was one of the first documents to identify how the key ideas underlying the concept of sustainable development could be applied in New Zealand.

During the early 1980s, there was a growing appreciation that key environmental legislation, including the Water and Soil Conservation Act 1967 and the Town and Country Planning Act 1977, needed to be reviewed.

Later that decade, the new Labour Government began to investigate and implement institutional reform for environmental management at both the national and local government levels. Work began on formally reviewing a number of environmental statutes in July 1988, after the Labour Government was re-elected to power. In December 1988, the government issued a proposal for a single integrated resource management statute that would replace the many existing statutory procedures. After an extensive consultation process, the Resource Management Bill was introduced into Parliament in December 1989, but the Labour Government lost power in 1990 before it was passed into law.

The new National Government decided to continue with the Bill, but first gave it to a Review Group for further consideration. As a result of the review, the minerals section was dropped from the Bill (and enacted separately as the Crown Minerals Act 1991) and other changes made. A revised Act was passed by Parliament in August 1991. When enacted, the RMA repealed 78 statutes and regulations, and amended numerous others, to provide a single piece of legislation for the management of land, water, soil and air throughout New Zealand. The Hazardous Substances and New Organisms Act 1996 subsequently replaced the hazardous substances section of the RMA, which never came into force.

Some significant resource management activities are outside the jurisdiction of the RMA, or have overlapping management regimes. These include the harvesting of fish, shellfish and seaweed stocks which are managed under the Fisheries Act 1996, the logging of indigenous forests on private land which are also managed under the Forests Act 1949 and marine pollution from ships and offshore structures which is also managed under the Maritime Transport Act 1994. The RMA does not, therefore, provide a fully integrated resource management regime.

An effects-based approach

The RMA's approach to environmental management is firmly rooted in the concepts of sustainable management and the integrated management of resources. Other approaches adopted included 'effects-based' assessments, principle- and policy-based environmental management and subsidiarity. The RMA focuses on managing the effects of activities rather than regulating the activities themselves.

This heralded a move away from a more prescriptive planning approach under the Town and Country Planning Act 1977. That Act sought to guide the location of activities and to separate incompatible activities.

The RMA adopts a more enabling approach which seeks only to intervene where activities are likely to result in unacceptable environmental impacts. This approach has the advantage of focusing on the reduction of environmental impacts. It can also, however, result in environmental planning being reactive rather than proactive, in plans being complex and difficult to understand, and in poor management of cumulative and diffuse impacts.

What is an AEE?

- Confirm with Council what consents are required.
- When you know which consents are required an assessment of environmental effects (AEE) is required to get a decision from the council on whether you can do what you want to do.
- An AEE should be seen as part of the process of shaping your proposal, or what you want to do, rather than a task to do once you have all your plans prepared.
- An AEE helps you identify the effects of your activity early on in the process and, if necessary, allows you to incorporate measures to reduce any adverse effects.
- It identifies who you should consult and, if required, from whom you should obtain written approval. It is used as the basis for the council's decision on whether to notify and grant an application, and, if granted, whether to impose any conditions to address any outstanding effects.
- The final outcome of the AEE process is an accurate and objective statement about the effects of your proposal on the environment. This statement will have taken into account whether the proposal has avoided, mitigated or remedied any adverse effects on the environment and people.

Defining Environment & Effect

Environment includes-

(a) Ecosystems and their constituent parts, including people and communities; and
(b) All natural and physical resources; and
(c) Amenity values; and
(d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters.

Effect includes-

(a) Any positive or adverse effect; and
(b) Any temporary or permanent effect; and
(c) Any past, present, or future effect; and
(d) Any cumulative effect which arises over time or in combination with other effects regardless of the scale, intensity, duration, or frequency of the effect, and also includes—
(e) Any potential effect of high probability; and
(f) Any potential effect of low probability which has a high potential impact.

What needs to be included in an AEE?

1. Your AEE should include the following (unless the council's plan states otherwise), as set out in section 88 and the Fourth Schedule of the RMA:
2. A description of your proposed activity.
3. An assessment of the actual and potential effects on the environment of your activity.
4. Where the above effects are likely to be significant, a description of available alternatives.
5. A discussion of the risk to the environment from hazardous substances and installations.
6. For contaminants, an assessment of the nature of the discharge and sensitivity of the receiving environment to the adverse effects and any possible alternative methods of discharge, including discharge into any other receiving environment.
7. A description of how the adverse effects may be avoided, remedied or mitigated.
8. Identification of the persons affected by the proposal, the consultation undertaken, if any, and any response to the views of any person consulted.
9. Where an effect needs to be controlled, a discussion of how it can be controlled and whether it needs to be monitored. Where appropriate, a description of how this will be done and by whom.

While an AEE is mandatory, the Fourth Schedule should be used as a guide rather than a blueprint for its preparation. The council's plan is also likely to list the information you need to supply.

Step by step guide to AEE

Step 1: Identify the activities for which a resource consent is sought

Fully understanding the environmental effects of an activity is essential for the proper preparation of an Assessment of Environmental Effects (AEE). You will need to think about your proposal and how it will change the site you intend to use/develop.

Step 2: Conduct a Site Inspection

What does it look like?

- Natural features
- Adjacent uses
- Physical features

For example:

- Is the site flat or sloping?
- Are there any significant trees or vegetation?
- Are there any unusual features?
- What is on the neighbouring properties?
- Is there access to Council services?
- Archaeological sites?

Step 3: Talk to staff at the Council

Once you have done your homework it is a good idea to talk to someone at the Council. The Council is likely to have pamphlets, checklists and forms to help you prepare an AEE. If you don't know how to use a regional/district plan, ask the Council staff to help you. A word of warning: some councils charge for information and time spent helping you.

Step 4: Identify the environmental effects

Understand the environmental issues arising from your proposal. An environmental effect is any change to the environment created by an activity. This includes effects on ecosystems, natural resources (land, air and water), buildings and people. Environmental effects can be:

- positive or negative
- temporary or permanent
- past, present or future
- cumulative (occur over time or in combination - with other effects)
- high probability
- low probability but high impact.

Check List

- degradation of historic or cultural sites
- vegetation loss
- decreases in water quality/quantity
- loss of privacy
- odour
- visual impact
- changes to coastal processes
- discharge of contaminants into air/water
- use of hazardous substances
- loss of recreational values.

AEEs should anticipate the unexpected. You need to look for specific environmental effects arising from your proposal in combination with the site and its locality. Once you have identified the actual and potential effects, you should consider how significant they are likely to be. You should also use the above list to help you consider the nature of the effects as well as their scale, intensity, duration and frequency. For example, an extension to an existing building may result in the following effects:

- temporary effects (while the extension is being built) - dust, noise and fewer parking spaces
- permanent effects - loss of privacy, shading, visual effects and the loss of significant trees cumulative effects - change in street character and loss of urban vegetation.

Step 5: How do I rank the effects?

A simple, scaled rating should be applied to each effect. Where you identify that the effect is likely to be more than minor, you should consider whether the effect can be:

- avoided?
- mitigated?
- remedied?

Activity: building a new house			
Examples of environmental effects	Ranking of effect	Avoid/remedy/mitigate effect	AEE action
Identify possible temporary effects: noise/dust/vibrations/emissions/hazardous substances/odour/land contamination from construction			
Noise from construction	Minor	Noise from construction will be minor due to the distance from the construction site to the neighbouring property.	May need specialist advice on noise levels. Mention in AEE.
Fewer parking spaces on street due to worker vehicles	No effect	The site is large enough to allow parking space for builders on site.	Mention in AEE.
Identify possible permanent effects: visual effects, loss of trees and vegetation, shading neighbouring property, soil stability, privacy, stormwater/sewer capacity, traffic generation, landscape changes, effects on water quality/quantity, cultural/spiritual values on iwi, effects on heritage sites/buildings/structures/objects, pollution, loss of recreational values of land etc.			
Visual effects	Significant	Negative visual effects of the new house on the natural landscape will be mitigated by extensive native planting, softening the appearance.	Need to show landscaping plan in AEE and discuss how visual impacts of the new house will be mitigated.
Loss of trees	Significant	Although some trees will be removed to construct the house, new trees will be planted as part of an extensive landscaping plan. Not all trees will be removed.	Discuss landscaping plan in AEE and show how it will mitigate effects of removing trees.
Shading neighbours property	No effect	The new house and trees will not shade the neighbour's property because of the distance between the two.	Mention in AEE.
Identify possible cumulative effects: change in character, loss of urban vegetation, effects on waterways, landscape, effects on infrastructure etc.			
Change in street character	Minor	Design of the house will be in keeping with the current dwellings.	Describe house and landscaping design. Show pictures of existing street character in AEE.
Disturbance to urban vegetation	Minor	Vegetation will be replanted following construction, therefore having no long term cumulative effects on urban vegetation. Restorative planting will improve the urban vegetation in the area.	Describe landscape design and ability to restore and add to urban vegetation in AEE.

Step 6: Pre- application meeting (Complex)

When is the application complex?

- Something usual about the site
- Issue pre-existing
- Technical details complex

What's the purpose of the meeting?

- Agree on information to provide
- Techniques or methods to be used

What's the procedure for the meeting?

- Depends on Council but usually recorded in minutes and Council may charge

Step 7: Re-evaluate your proposal

Use the AEE process to help design your proposal. You may decide that some environmental effects will be significant and that you need to change your proposal to avoid, remedy or mitigate them.

You should then think about alternative ways to achieve the same goals while considering the environmental effects each alternative may have. This process can result in a "win-win" situation, with better proposal design and better environmental outcomes.

"Avoid", "remedy" and "mitigate" are terms used in the Resource Management Act. Each represents a different way of addressing an adverse effect so that it is acceptable**.**

Step 8: Finalise the AEE

Check you have all the information to draft your AEE. This means you have all the information to:

- accurately describe the activity
- accurately describe the site and locality
- complete your effects checklist, including ranking and discussing how any adverse effects may be avoided, remedied or mitigated
- identify any consultation undertaken and its results
- clearly identify any restrictions on the consent where these have been imposed to resolve affected parties' concerns
- (where significant effects are likely to occur) identify alternatives you have considered and why they were rejected
- identify any proposals for monitoring potential and actual effects.

Summary: Remember

- You need to include enough information in your AEE so that the Council can evaluate your proposal. The amount of information should correspond to the scale and significance of the environmental effects that may be generated by your proposal.
- Some proposals will require more detail and analysis than others. For example, adding a carport onto the side of a house is likely to require much less information and detail than a multi storey development in an area that is valued for its natural attributes.

AEE needs to include:

- A full description of the proposal, including the site and locality (including a site plan and plans of your proposal)
- A description of the environmental effects, including the significance and nature of the effects (address specific environmental effects that you have identified as well as referring to issues identified in the district and/or regional plan)
- A description of alternatives to avoid, remedy or mitigate any significant environmental effects
- An assessment of any risks to the environment that may arise from hazardous substances and/or the discharge of contaminants
- A record of any consultation, including names and views of people you talked with
- A discussion of any effects that may need to be controlled or monitored, how the control or monitoring will be carried out and by whom.

References

- http://www.rmaguide.org.nz/rma/introduction/historical.cfm
- http://www.rmaguide.org.nz/rma/introduction/approach.cfm
- http://www.mfe.govt.nz/publications/rma/aee-guide-aug06/

The following template may be used for the creation of the AEE:

Title page

Executive Summary

1.0 Introduction including scene setting and project description

2.0 Effects:

Identification of the effects for each of the categories:

- Land
- Water
- People
- Flora & Fauna
- Traffic & Infrastructure
- Cumulative Effects

3.0 Significance

Assessment of the significance of the effects and a description of the alternatives. (For discharges this should include the nature of the discharge and the sensitivity of the receiving environment)

4.0 Risk

Assessment of the risk of the significant effects

5.0 Avoidance, Remedy or Mitigation

Description of avoidance, remedy or mitigation

6.0 Communities affected

Identification of persons affected by proposal

7.0 Control/monitoring

Description of how significant effect may be controlled and/or monitored

8.0 Benefits

Discussion of the benefits of scheme

9.0 Conclusions

Land – and how what we do affects it

We live in a complex and diverse environment; however, our land is changing every day, often with the loss of some of our truly natural environments (e.g wetlands and forests). Our population continues to increase and is predicted to reach between 3 and 5.5 million people by 2101. In addition, there are also considerable changes being made to urban and recreational areas as we strive to accommodate our ever-growing population.

Our land has a context because someone lives on the land and for them it has a value.

Within the AEE process, there are a number of steps (detailed below):

- Step 1: Identify the activities for which a resource consent is sought
- **Step 2: Conduct a Site Inspection**
- Step 3: Talk to staff at the Council
- Step 4: Identify the environmental effects
- Step 5: How do I rank the effects?
- Step 6: Pre-application meeting (Complex)
- Step 7: Re-evaluate your proposal
- Step 8: Finalise the AEE

The purpose of the site inspection:

To view the landforms and consider is there anything of community interest at a particular site? How do changes affect landform and how does this affect people living nearby. Consider that the NZ land area has approx. 270 000 km^2 with coastline approx. 15 000 km and that this is the second highest land area/coastline ratio in the World. Also remember that large changes to subterranean structures, such as new wastewater mains, can affect land especially during building and maintenance. Other land effects can arise from use and management of farms, changes to power infrastructure and mining activities.

Landscape Assessments (LSA)

As part of the AEE process, it may be necessary to provide a landscape assessment. Landscape architects control landscape assessments. These are a very recent type of assessment which are very specialized and require a need to engage and understand the architects as this can be greatly influential in obtaining a consent. As a general guide, matters to be considered when deciding an application for resource consent or a NoR (Notice of Requirement) are set out in RMA s104 and s171 respectively, and those relevant to an LSA include:

- Landscape and visual effects of the proposal
- Policy statement and plan provisions relating to landscape and visual issues
- Alternative locations or methods
- Other relevant matters (e.g. non-statutory documents such as existing district-wide landscape assessment reports).

Sections of Part 2 likely to be most relevant to an LSA are:

- Section 5 Purpose and principles of the RMA
- Section 6 (a) Preservation of the natural character of the coastal environment … wetlands, lakes, rivers and their margins, and the protection of them from inappropriate subdivision, use and development
- Section 6(b) Protection of outstanding natural features and landscapes from inappropriate subdivision, use and development
- Section 7(c) Maintenance and enhancement of amenity values
- Section 7 (f) Maintenance and enhancement of the quality of the environment

Factors that can help in identifying valued landscapes include:

- Presence/absence of statutory landscape designations;
- Presence/absence of local landscape designations and associated controls;
- Landscape quality/condition;
- Scenic quality (designated height sensitive areas help to prevent blocking of views such at the volcanic cones of Auckland)
- Rarity of particular elements/features;
- Representiveness;
- Conservation interest;
- Recreation value;
- Perceptual aspects; and
- Cultural / iwi.

In determining the nature of the effect, it is important to consider that magnitude may be assessed by considering four separate factors, namely:

- Size/scale;
- Geographical extent;
- Duration;
- Reversibility

The format for the LSA should include:

- Executive Summary Description of Proposal
- Relevant Statutory and Non-Statutory Provisions
- Existing Landscape
- Alternatives
- Landscape and Visual Effects
- Design and Mitigation Measures

Such a structure addresses the matters that need to be included in an AEE as listed in RMA Schedule 4(1).

Subdivision Consent

A subdivision consent may also be required. The resource consent may be obtained under the relevant district plan or Proposed Auckland Unitary Plan for subdivision activities, including:

- Creation of a new freehold title
- Creation of a cross-lease
- Creation of a unit title development, for example a block of flats
- Adjustment to a boundary.

A subdivision consent will normally have a number of conditions which may require building consent and engineering approvals. As well as fulfilling these other requirements, you will need to engage a licensed cadastral surveyor to prepare the necessary scheme/survey plan.

Land Use Consents

A land use consent may also be required for the following activities:

- Any activity done on the land, e.g. retail, horticulture, vegetation removal building, additions and alterations to buildings, and controls on buildings and structures.
- Land modification such as earthworks.
- The use of land also includes development on, under or over the beds of streams, rivers and lakes. This includes, for instance: constructing, using, or demolishing any structure such as a bridge or jetty.
- Depositing any material or disturbing the river, stream or lake bed introducing any plant into a body of water.

Normally a land use consent is granted for unlimited duration, as long as the development detailed in the consent has been implemented to a significant level within five years (or a different period as written in the consent). If not, your consent will lapse. Any land use consent that is granted is attached to the property (as opposed to a specific person).

Tree Consent

If a tree on your property is protected, you will need a resource consent to remove it, prune it, or carry out construction work near it (Auckland Council, n.d)

You may need to check any rules around trees on a property before you start work.

Contaminated Sites

These types of sites may also be considered from at least two perspectives, namely a site that is currently contaminated but in consideration for development and also for a site which may become contaminated due to an activity (both during and afterwards). The RMA purpose (Section 5) is to promote “sustainable management of resources” For activities on contaminated land this includes:

- Safeguarding the life-supporting capacity of air, water, soil, and ecosystems.
- Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

It is important to assess the nature of the discharge and sensitivity of the receiving environment to adverse effects. National Environmental Standards (NES) for contaminated land are useful → http://www.legislation.govt.nz/regulation/public/2011/0361/latest/DLM4052228.html?search=ts_regulation_contaminants_resel&p=1&sr=1

Environment

According to the RMA, the environment considers "Ecosystems and their constituent parts, including people and communities". Within this environment, activities may be deemed **permitted, controlled, restricted** or **discretionary** where permitted activities represent the baseline. (No consent may be required usually due to small scale, short duration or low health risk activities on contaminated land). If permitted activity criteria not met consent as required as defined by the NES regulations or Regional Plan Rules:

- AEE will cover contaminant control and discharge etc.
- PSI, DSI reports will also accompany consent (preliminary and detailed site investigations).

WATER

There are approximately 180 000km of rivers in New Zealand, of which the longest river is the Waikato (425m) and the largest is the Clutha (mean discharge of 533 m^3 s^{-1}). Freshwater networks are comprised Lotic and Lentic systems.

Lotic systems such as rivers are diverse ranging from glacial rivers and huge braided river systems to small urban streams. These natural systems are vital for water resources, especially for agriculture as well as for recreational purposes.

Lentic systems include closed environments such as ponds and lakes are susceptible to anthropogenic influences, for example, discharges of stormwater, wastewater or agricultural runoff.

In New Zealand, there are:

- 41 lakes (surface area > 10 km^2)
- 229 lakes greater > 0.5 km^2
- 3820 lakes greater > 0.01 km^2
- Largest lake: Lake Taupo – 616km2
- Deepest lake: Lake Hauroko– 462 m

An **estuary** is a partly enclosed coastal body of brackish water with one or more rivers or streams flowing into it, and with a free connection to the open sea. Estuaries form a transition zone between river environments and maritime environments and are subject to both marine influences, such as tides, waves, and the influx of saline water; and riverine influences, such as flows of fresh water and sediment. Estuaries can provide areas for the settling of particulate discharges so accumulation of contaminants may be significant in these regions. Estuaries are varied across New Zealand and their characteristics may depend on many factors including:

- size
- depth
- type
- extent of mixing with seawater.

In the North Island of New Zealand, estuarine systems may contain mangroves (plants which have adapted to living in seawater).

Estuary Types

Rising sea level since the Ice Age (when major continental glaciers began melting) created four types of estuary:

- **Coastal Plain Estuary** - Formed by sea level rises and the flooding of existing river valleys. E.g, Okura Estuary, North Auckland.
- **Fjord** - High sided "U" shaped valley which forms as sea level rises and floods a glaciated valley. The glacier leaves a deep channel with a shallow barrier or narrow sill near the ocean. This sill restricts the amount of seawater entering the Fjord and lack of deep water mixing can cause anoxia at the lower levels

- **Bar-built Estuary** - Occur when sandbars or barrier islands are built up by ocean waves and currents along coastal areas fed by one or more rivers or streams.
- The streams or rivers flowing into bar-built estuaries typically have a very low water volume
- **Tectonic Estuary** - Faulting/folding of rocks creates a restricted downdropped area into which sea floods.

How water may be affected

Activities, processes or structures which may affect water include:

- Roads / Transport (Pollution)
- Developments (Hydrology)
- Coastal infrastructure (Harbours)
- Water infrastructure (Abstraction)
- Agriculture / Farming (Nutrients
- Power infrastructure (Damming)
- Mining (Tailings- Acid)
- Discharges (from all sources e.g. spills).

However freshwater systems may also be affected by environmental changes that maybe both natural or anthropogenically mediated. For example, rainfall patterns and intensity can affect the water quality of our rivers and lakes. Often very dry periods, which are succeeded by heavy rainfall, result in the deposition of contaminants such as hydrocarbons and heavy metals into these systems. In addition, activities on land which may affect groundwater may include:

- Accidental spills
- Intentional leaks
- Industrial processes

Thermal pollution is **"The degradation of water quality by any process that changes ambient water temperature"**. Sources of elevated water temperatures can arise from urban road runoff and the use of water as coolants by power plants. Most organisms will tolerant only a fairly narrow range of ambient temperatures. Natural variation in temperature occurs due to diurnal and seasonal fluctuations however man-made changes may cause changes which may be temporary or permanent.

These include:

- Discharges from industry
- Riparian vegetation removal
- Drainage network alteration
- Increased imperviousness

Thermal stress can impact the biodiversity in an ecosystem in many ways. Firstly, most organisms live within a limited range of temperatures both internal and external to their bodies. As temperatures increase organisms are subject to an increasing scale of stress reflexes including, increased metabolic rate (which can reduce ambient oxygen concentrations for aerobic organisms), reduced immunity, reduced enzyme activity and damage to genetic structures. In addition, temperature changes can affect oxygen solubility, which decreases with increasing temperature. Biodiversity may be impacted in a number of ways including:

- Organisms sensitive to fluctuations in oxygen concentrations may either move to a more suitable environment or perish.
- Adverse effects on cellular biology due to elevated temperatures is specific to each organism (larger organisms are generally more sensitive).
- Anaerobic conditions encourage bacterial growth which may out-compete other species.

Determining the impact of a discharge

The impact of a discharge to an aquatic system can depend on at least some of the following factors:

- Magnitude (maximum & range)
- Duration of exposure
- Frequency of exposure
- Spatial extent of effects

Types of consent

Three types - land-use, water or discharge, may be applicable for any activity affecting freshwater water systems.

Land-use Consents

May be required for the following activities:

- Different land uses which can affect water quality, land stability and the incidence of flooding.
- Land use consents which identify, control and minimise the impacts of activities on people and the environment.

The following activities may require a land-use consent; build or alter a bridge; construct or alter a well; construct or alter a culvert; drain a wetland area; drill, tunnel, excavate or otherwise disturb the bed of a river or lake; carry out soil disturbance (earthworks); vegetation clearance, roading or tracking; place cleanfill onto land; erect an erosion control structure; construct or alter a ford across a waterway; remove sand or gravel from the bed of a watercourse; carry out soil cultivation near a watercourse.

Water Consents

These may be required for damming, diverting and taking water which can affect people's ability to use the water, as well as affecting stream plant and animal life. Water consents identify, control and minimise the impacts of an activity on people and the environment.

The following activities may require a water consent; take or use water from a river, stream, dam, lake or spring; take or use water from an underground source (groundwater); take or use geothermal water, heat or energy; construct or alter a dam or stopbank and impound water behind the structure; divert a watercourse.

Discharge consents

Discharge consents cover activities which discharge contaminants into water into or onto land to air.

You may need a discharge consent if your activity is likely to; discharge potentially contaminated water (or water containing sediment) into water, or onto or into land; discharge farm animal effluent into water, or onto or into land; discharge treated human sewage onto or into land or water; discharge treated or untreated wastes into water, or onto or into land involve dumping or landfills; create offending odours; involve intensive indoor farming of pigs, broiler chickens or mushrooms; discharge dust, steam or other matter into the air.

Assessment tools for Water Quality

Aside from chemical water quality markers, there are a number of other assessment tools and treatment guidelines including:

- Stream Ecological Evaluation
- Macroinvertebrate Community Index (MCI)
- The trophic level index is used to measure of nutrient status of lakes.
- ANSECC Guidelines Sediment Quality
- TP 108
- Hec hms (a modelling tool for flow assessment)
- Bespoke Modelling Tools (flow/nutrients)

Ecological function markers may be assessed as a measure of aquatic health (Table 1). Assessment parameters allow a quantitative and/or qualitative comparison between streams and in addition a number of ecological function markers can be used.

Table 1: Ecological Function Markers

Ecological Categories	Ecological Functions
Hydraulic functions	- Natural flow regime - Floodplain effectiveness - Connectivity for natural species migrations - Natural connectivity to groundwater
Biogeochemical functions	- Water temperature control - Dissolved oxygen levels - Organic matter input - In-stream particle retention - Decontamination of pollutants
Habitat Provision functions	- Fish spawning habitat - Habitat for aquatic fauna
Biotic Provision functions	- Fish fauna intact - Invertebrate fauna intact - Riparian vegetation intact

MCI test (Macroinvertebrate Community Index Test)

The MCI test requires the identification of a number of different species which may be biological quality markers.

Species may be deemed "**sensitive**" (their presence indicating a high level of water quality), **moderately sensitive** or **tolerant** (whose presence would be expected in most streams).

Trophic State

The trophic state of a water body is an assessment of its ecological condition. This measurement is based upon the total weight of living biological material or biomass in a water body as at specific location and time. Trophic state is assessed using a variety of markers which may include, phosphorus concentration, and chlorophyll measurements.

FLORA AND FAUNA

New Zealand is a hugely diverse environment, including many different types of habitat which all influence native biodiversity, e.g.:

- Dunes
- Lakes
- Forests
- Marine / Freshwater
- Riverine
- Subterranean
- Alpine

Ecology

The term is **Ecology** is given to the scientific study of the interactions between organisms and the environment. Natural selection is a process in which individuals that have certain inheritable characteristics survive and reproduce at a higher rate than other individuals. The process of natural selection allows us to adapt over many generations to changes in the environment. If a species is unable to adapt to an environment then its distribution may change therefore, interactions between organisms and the environment limit the distribution of species. Factors affecting where and why species occur in certain places are divided into two groups:

- Biotic (or living factors). The inability to survive and reproduce may be due to predation, parasitism or competition with other species. Introduction of exotic predators or pathogens can wipe out species.
- Abiotic (non-living factors). These non-living factors include: temperature, water, salinity, rocks and soil amongst others.

Endemic Species

Our country contains a high level of endemic species, one of the most varied and unique on earth due to its long isolation from other continental landmasses. Walking worms (*Peripatus*), who still resemble their ancestors who lived hundreds of millions of years ago, are still found here. Other examples include:

- Kiwi bird, Kea, Tui, Bellbird, Wood pigeon, Morepork, Fantail, NZ Robin, Stitchbird, Tomtit, NZ falcon
- Lesser short-tailed bat
- Hector's and Maui Dolphins
- Hamilton's Frog
- Yellow-eyed Penguins & Little Blue Penguins
- New Zealand Fur seal and the Hooker's sealion
- Tuatara and chevron skinks

Extinctions

These unique species include many plants, skinks, lizards and birds, all of which have been impacted by our activities. For example, the Huia bird is now extinct as the last 50 individuals were taken to form collections. The Black robin was reduced down to the last 11 individuals before conservation efforts boosted numbers back to 200 - which is still very low.

Current Ecological Condition

The nature and quality of the ecology in an area will determine the effects of activities such as building roads. Activities affecting flora and fauna include:

- Roads / Transport (Fragmentation / Safety)
- Developments (invasive species)
- Coastal infrastructure (marine impacts)
- Water infrastructure (habitat disturbance/ Discharges)
- Agriculture / Farming (biodiversity)
- Power infrastructure (Bird strike)
- Mining (Tailings- Acid)
- Discharges (from all sources e.g. spills)

Example – Fragmentation

Fragmentation may present problems when building transportation routes, including:

- Separation of ecological communities from new roads through the physical barrier they represent
- Change of nature of the physical environment – habitat impacts
- Increases in pedestrian or road traffic resulting in dispersal of weeds and pest species.

Other factors affecting habitat may include:

- Discharging of nutrients upstream can adversely affect the ecology of an aquatic environment.
- An extreme example of this is observed in concrete channels which lack riperian zones.
- These channels types are now no longer an option in Auckland but may be elsewhere in NZ.
- Species Loss, e.g. the installation of windmills as an alternative energy source at Te Uku require monitoring of the potential for the loss of bird life (in particular falcons).

International Standards

Although there are no national standards for assessing flora and fauna with the exception of the MCI (Macroinvertebrate Community Index). The ANZECC guidelines (Australian and New Zealand guidelines for freshwater and marine water quality) are a useful tool for comparing results.

Current methodologies for assessing ecology include:

- MCI
- Pit Trapping
- 5 Min Bird Counts
- Environmental Response Criteria (ERC)
- Vegetation Survey (significant trees or biodiversity may be listed in the district or regional plans).

5 min bird counts

- The five-minute bird count (5MBC) method was developed in New Zealand in the early 1970s by the DSIR for monitoring forest birds.
- Nearly 40 years of research has led to a large resource of counts (over 200 000).
- Sole historical baseline measure of multi-species bird populations in New Zealand forests

Environmental Response Criteria (ERC)

	ERC (ARC 2004a)		
Substance	**Green**	**Amber**	**Red**
Copper	<19	19-34	>34
Lead	<30	30-50	>50
Zinc	<124	124-150	>150
HWPAH	<0.66	0.66-1.7	>1.7

Where: Green - low level of impact; Amber – showing signs of contamination; Red – higher impact, significant degradation observed.

Case study - Pūhoi to Warkworth highway

River and Mahurangi River catchments have low ecological values with poor quality habitat and in-stream conditions. Permanent streams in the few areas of native bush within the catchments, or with native riparian corridors, are of higher ecological value.

Actual/Potential Effects on Freshwater Ecology

- Sedimentation of watercourses during the construction phase
- Loss of habitat through culverting of streams and watercourses and disposal of fill during construction
- Disruption to fish passage during both construction and operational phases
- Effects of contaminated discharges from construction and operational stormwater discharges.

Effects on Marine Ecology

Adverse effects on marine ecological values may occur from:

- Discharge of construction sediment into the marine environment
- Construction of piers
- Discharge of stormwater from the motorway surfaces to the marine environment

Potential Effects on Terrestrial Ecology

- Direct loss, edge effects
- Changes in soil moisture related to surface hydrological changes may affect some wetland site
- Shading and rain shadow effects of bridges and viaduct
- Excess dust deposition
- Reduction in the height of vegetation under bridges and viaducts

Overall findings on greatest effects

High/long-term/regional effects due to:

- Habitat loss (due to culverting of streams and the disposal of spoil
- Habitat loss and direct mortality of bats (vegetation clearance)
- Direct loss of native forest vegetation

PEOPLE

NZ Demographics

There are 4.7 million people living in New Zealand.

- Over three-quarters of New Zealand's population live in the North Island (76%) with one-third of the total population living in the Auckland region.
- This region is also the fastest growing, accounting for 46% of New Zealand's total population growth.
- Most Māori live in the North Island (87%), although less than a quarter (24%) live in Auckland.

Urban or Rural?

- New Zealand is a predominantly urban country, with 86% of the population living in an urban area.
- About 72% of the population live in the 16 main urban areas (population of 30,000 or more) and 53% live in the four largest cities of Auckland, Christchurch, Wellington, and Hamilton.

Activities which may affect people include:

- Roads / Transport (Fragmentation / Safety). There are a number of ways in which we may be affected by road development including the separation of communities from new roads through the physical barrier they represent, the change of nature of the aesthetic environment – landscape impacts or increases in pedestrian or road traffic resulting in safety effects including stranger danger
- Developments (Hydrology)
- Coastal infrastructure (Harbours)
- Water infrastructure (Abstraction / Discharges)
- Agriculture / Farming (Nutrients)
- Power infrastructure (Damming)
- Mining (Tailings- Acid)
- Discharges (from all sources e.g. spills)

Assessment Tools & Considerations

Investigating how people may be affected by a proposed activity may require the use of one or more of the following assessment tools or considerations:

- Social Impact Assessments
- CPTED
- Historic Places
- Landscape Assessment
- Consultation

Social Impact Assessment (SIA)

A Brief History of SIA

The legal basis of SIA (and increasing public awareness) first emerged in 1969/1970 when the US National Environment Policy Act (NEPA) introduced a requirement to ensure that major federal actions significantly affecting the quality of the human environment should be assessed for the likely impact of such actions (see Burdge and Vanclay, 1995).

The inquiry into the proposed Mackenzie Valley gas pipeline from Yukon Territory to Alberta, Canada (1974-1978) was the first major Environmental Impact Assessment (EIA) case that was overturned for social reasons. The proposed project was rejected due to a failure to consider the impacts on the local tribes.

Since then, SIA has been progressively introduced to many countries around the world.

What is SIA?

The International Principles for Social Impact Assessment defines SIA as "the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions".

Simply put, SIA is the process of identifying and managing the social issues of project development. This process includes the effective engagement of affected communities in participatory processes of identification, assessment and management of social impacts.

Why do we need to conduct a SIA?

The following are some of the reasons for conducting a SIA:

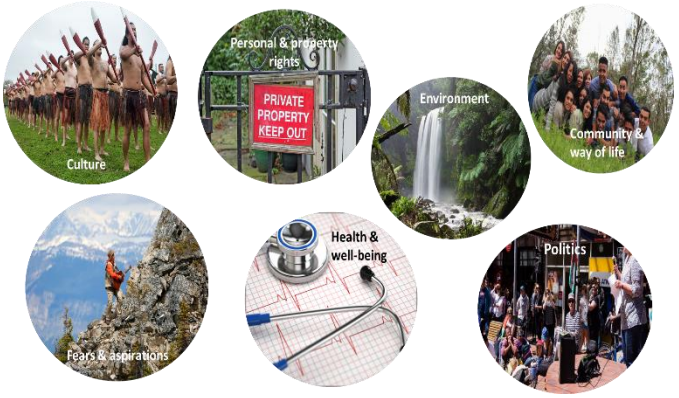
- SIA has the potential to identify local knowledge that could guide project siting decisions and reduce cost to companies that comes from poor siting decisions.
- Better decisions can be made about which interventions should proceed and how they should proceed.
- Mitigation measures can be implemented to minimise the harm and maximise the benefits from a specific planned intervention or related activity.
- Reduces likely future costs in the form of litigation, delays to approval, managing protest actions or addressing violence against staff and/or property.
- Enables a more sustainable and equitable biophysical and human environment.

The SIA process can begin with a preliminary SIA which is usually done prior to a full SIA. A preliminary SIA involves a desk-based research approach to gathering relevant data and information on project area, demographics, history, etc.

(Why are IA's important?: https://www.youtube.com/watch?v=XqhhERNeIYY)

Some examples of Social Impact

Social impacts are changes to one or more of the following:



- Culture – that is, shared beliefs, customs, values and language or dialect.
- Fears and aspirations – perceptions about safety, fears about the future of the community, and aspirations for the future and the future of the children.
- Personal and property rights – particularly whether people are economically affected, or experience personal disadvantage which may include a violation of their civil liberties.
- health and wellbeing – health is a state of complete physical, mental, social and spiritual wellbeing and not merely the absence of disease or infirmity.
- Environment – the quality of the air and water people use, the availability and quality of the food they eat, the level of hazard or risk, dust and noise they are exposed to, the adequacy of sanitation, their physical safety, and their access to and control over resources.
- Community and way of life – the community's cohesion, stability, character, services and facilities, how they live, work, play and interact with one another on a day-to-day basis.
- Political systems – the extent to which people are able to participate in decisions that affect their lives.

SMA in RMA

Consideration of social effects is required in addressing the fourth schedule of the RMA 1991 (assessment of effects on the environment). Within the RMA, effects that must be addressed when preparing an assessment of effects on the environment include:

- any effect on those in the neighbourhood and, where relevant, the wider community including any socioeconomic and cultural effects;
- any physical effect on the locality, including any landscape and visual effects;
- any effect on natural and physical resources having aesthetic, recreational, scientific, historical, spiritual, or cultural, or other special value for present or future generations.

Note that the Resource Management Act 1991 will be repealed and replaced with new laws.

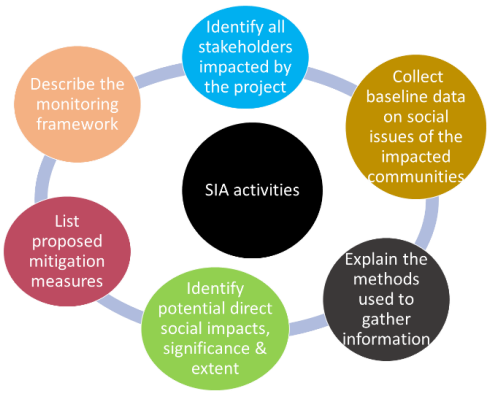
The three new Acts will be the:

- Natural and Built Environments Act (NBA) to provide for land use and environmental regulation (this would be the primary replacement for the RMA).
- Strategic Planning Act (SPA) to integrate with other legislation relevant to development, and require long-term regional spatial strategies.
- Climate Change Adaptation Act (CAA) to address complex issues associated with managed retreat and funding and financing adaptation.

It is expected that the complete NBA and the SPA will be formally introduced into Parliament by the end of 2021, with the NBA passed by the end of 2022.

Some activities within an SIA

The activities when conducting an SIA include, but is not limited to the following:



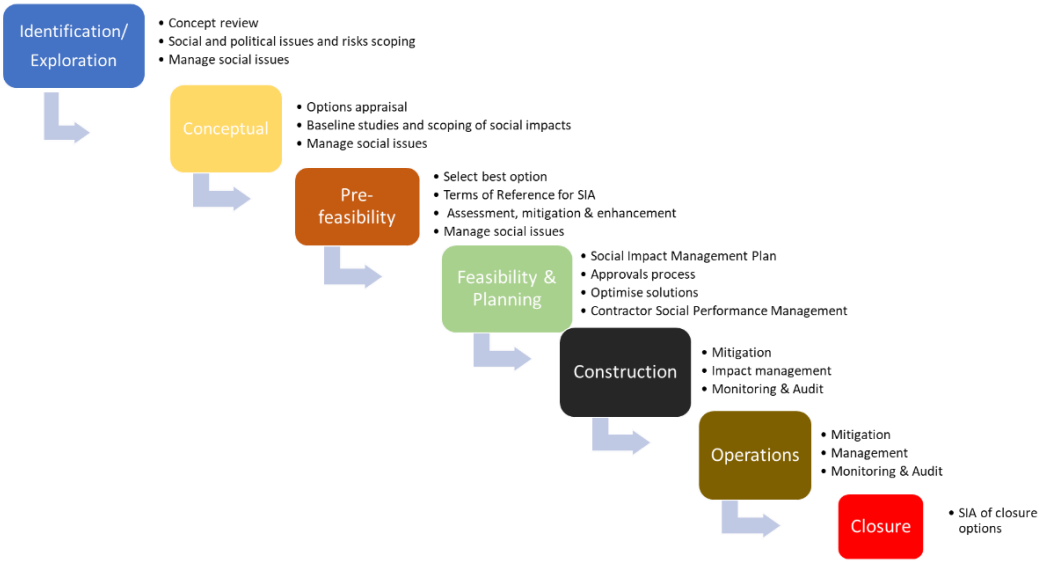
- Identify stakeholders, groups and communities impacted by the project.
- Collect baseline data covering key social issues of the impacted communities such as community history, indigenous communities, culture and key events that have shaped economic and social development, current and previous key industries within the community.
- Explain the methods used to gather information, including a description of how the communities of interest were engaged during the development of the SIA.
- Identify potential direct social impacts and prediction of the significance, duration and extent of any impacts.
- List proposed mitigation measures.
- Describe the monitoring framework that informs stakeholders on the progress of the project.

It is important to note that social impacts start long before project approval is required – they start with rumours of a possible project. Managing the social issues (and thus SIA), therefore, needs to start as soon as possible – after projects are conceived.

Applications of SIA in project cycles

SIA plays a potential role in a typical project cycle and thus, can be applied in all phases of the project cycle. While the project cycle is usually depicted as a linear process, the reality is not so straight forward. Projects do not necessarily transition smoothly from phase to phase, and may become stalled at a certain phase, or may be sent back to earlier stage. Thus, the SIA needs to be responsive and quickly adapt to the changing needs of a project.

The diagram shows the role of SIA in each phase of a typical project cycle.



Source: Vanclay, F. et al. (2015). Social Impact Assessment: Guidance for assessing and managing the social impacts of projects.

The phases and tasks of SIA

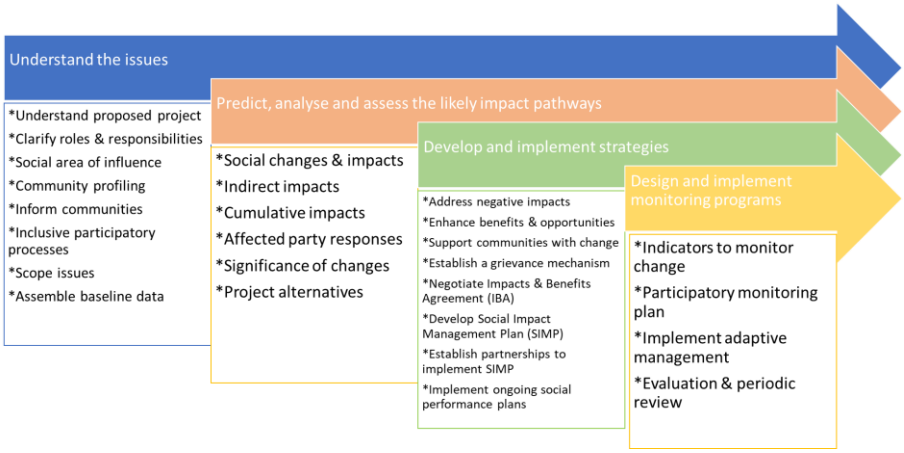
The International Association for Impact Assessment (IAIA) (one of the leading associations within the SIA field) has categorised the phases and tasks within SIA as follows:

Phase 1: Understand the issues

Phase 2: Predict, analyse and assess the likely impact pathways

Phase 3: Develop and implement strategies

Phase 4: Design and implement monitoring programs



Source: Vanclay, F. et al. (2015). Social Impact Assessment: Guidance for assessing and managing the social impacts of projects.

Preparing for SIA

During the SIA process, usually, there will be requirements for specific reports and plans at different times, particularly as inputs to project approval.

It is important to understand that the SIA is a process rather than a product or document. However, there are guiding documents and reports that will provide direction throughout the process. These documents include:

1) **A Social Impact Management Plan**
   A Social Impact Management Plan includes details of:

   (a) the measures to be taken during the implementation and operation of project activities to eliminate adverse social impacts, or to reduce them to acceptable levels, and

   (b) the actions needed to implement these measures.

   In summary, in case of a social impact, what will you do? How will you do it? Who will do it?

2) **Community Health & Safety Plan**
   The Community Health and Safety Standard recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Potential negative impacts affecting health and safety may arise from a broad range of supported activities, including from infrastructure development and construction activities, changes in the nature and volume of traffic and transportation, water and sanitation issues, use and management of hazardous materials and chemicals, impacts on natural resources and ecosystems, the influx of project labour, and potential abuses by security personnel.

   The Community & Health Safety Plan addresses the need and how to avoid or minimize the risks and impacts to community health, safety and security that may arise from project-related activities, with particular attention given to disadvantaged and marginalized groups.

3) **Resettlement Action Plan**
   Resettlement Action Plan includes the need to provide resettlement, compensation, and / or livelihood restoration assistance to persons that are currently utilising project affected land.

   - Survey administration, initial scoping and early resettlement planning
   - Formulation of compensation
   - Development of a framework for benefits and asset valuation
   - Community consultation
   - Identification of resettlement and livelihood restoration measures
   - Preparation of resettlement database
   - Development of grievance redress mechanisms
   - Development of a monitoring and evaluation framework
   - Preparation of an implementation plan

4) **Stakeholder Engagement Plan**
   The stakeholder engagement plan allows the project manager to devise a systematic approach to ensure expectations, decisions, risk/issues and project progress information is delivered to the right person at the right time with the most efficient level of information. The engagement of stakeholders is not something that happens towards the end of the SIA procedure; it needs to be part of the whole process from onset to conclusion.

   Your plan should include, but is not limited to:

   - Defining target groups
   - Specifying objectives
   - Determining your main messages
   - Selecting appropriate tools for communication
   - Identifying spokespersons
   - Monitoring and reviewing action steps.

These documents collectively provide an integrated set of actions and procedures to manage the social issues created by the project.

A case study of SIA

The project: Ruataniwha Plains Water Storage Scheme, Central Hawke's Bay.

Project background: In 2012, there was a proposal for a deal between the Department of Conservation and Hawke's Bay Regional Council to acquire part of the protected Ruahine Forest Park so it could be flooded for the $900 million water storage and irrigation project. The scheme would dam 22ha of formerly-protected land and give the Department of Conservation 170ha of nearby farmland in return.

As part of the investigations for water storage, irrigation and intensified land uses, the Council has consulted with farmers and key stakeholders and established the Ruataniwha Stakeholder Group (RSG). The RSG represents a wide range of interests with members including the respective councils, Maori, land owners and water users, recreation, conservation and environmental interests.

Potential social effects/impacts:

- Changes in farming practices
- Changes in land ownership
- Demographic changes (numbers and composition of the population)
- Strengthening rural communities (education, health, commerce, clubs etc)
- Value conflicts associated with new / intensified land uses versus traditional dryland farming practices
- Wider regional socio-economic effects including construction effects.

Initiatives for managing impacts:

- Develop a coordinated employment strategy with agencies and training providers for future land uses and off-farm opportunities including training and skills development, with an emphasis on local placement, including working closely with Maori.
- Build on community, youth and sports and recreation development in the district to enhance community benefits from incoming population.
- Establish a programme to assist the integration of newcomers into the community, including migrants from outside the district and overseas workers.
- Develop a strategy to encourage to identify and retain important landscape values in the face of land-use change.

The problem: Forest & Bird challenged the deal

The outcome: The Supreme court ruled against the project. The reason given was that the Conservation Act allowed the responsible Minister to revoke protected status "only where its intrinsic conservation values no longer warrant such protection".

What the ruling meant was that protected conservation land across the country could not be sold or swapped for commercial ventures.

Class activities

Scenario 1

A dam is to be built across a village in the mountain. What are the likely impacts?

Consider the following: resident livestock herders, caves used for shelter, alternative grazing on valley floors when they could not go to the mountains, presence of traditional healers, neighbouring villages.

Scenario 2

Imagine you are a parent with children, living in a neighbourhood with access to park facilities. Then you receive a letter in the mailbox saying that the new park will now be used for housing development. You are then encouraged to use the next closest park, which is 20 minutes ride by car. How would you react? What would you be losing? What would you be gaining?

CPTED

This is a crime prevention strategy to outline how physical environments can be designed in order to lessen the opportunity for crime.

This is achieved by creating environmental and social conditions that:

- maximise risk to offenders (increasing the likelihood of detection, challenge and apprehension)
- maximise the effort required to commit crime (increasing the time, energy and resources required to commit crime)
- minimise the actual and perceived benefits of crime (removing, minimising or concealing crime attractors and rewards)
- minimise excuse making opportunities (removing conditions that encourage/facilitate rationalisation of inappropriate behaviour).

CPTED Guidelines

- Consider design and use to identify aspects of the physical environment which affect the behaviour of people.
- Use these factors to allow for the most productive use of space while reducing the opportunity of crime. This might include changes to poor environmental design such as street lighting and landscaping.
- CPTED concepts and principles are ideally incorporated at the design stage of a development, but can also be applied to existing developments and areas where crime and safety are a concern.

Historic Heritage

Places which may have significant aesthetic, archaeological, architectural, cultural, historical, scientific, social, spiritual, technological or traditional value, and be appreciated by the public for their contribution to New Zealand's heritage environment.

As defined in the RMA (s2), includes:

- historic buildings and structures
- archaeological sites
- places of significance to Māori including waahi tapu (sacred places) – these may include natural features such as trees, springs, rivers or mountains which were associated with historical or cultural activities or events but which have no known physical remains of those activities or events, the surroundings of buildings, sites and places.

When do you need to address cultural heritage?

You will need to address cultural heritage in your resource consent application if applicable to your activity:

- If your activity affects a Registered or scheduled historic place, historic area, wähi tapu or wähi tapu area.
- If your activity affects an archaeological site.
- If your activity affects a place of significance to tängata whenua.
- If your development area has been occupied by people for more than 100 years.
- If your development area is located within 2km of the coast.
- If your consent involves any earthworks or ground disturbance.
- If you are applying for a consent to subdivide your property.

The following organisations can help you to identify a cultural heritage site:

- The New Zealand Historic Places Trust (NZHPT) - for the Register of historic places, historic areas, wähi tapu and wähi tapu areas.
- The ARC - for the Regional Plan: Coastal 2004 schedules of protected and preserved historic and cultural heritage sites.
- District and city councils (territorial authorities) – for plan schedules of protected cultural heritage resources, related rules and provisions, and whether you require any additional consents.
- Iwi agencies - for taonga and wähi tapu.
- The New Zealand Archaeological Association -for archaeological sites in the Site Record File.
- Other agencies and sources of information include local museums, historical societies and heritage protection authorities (under the RMA).

The importance of consultation

In the context of seeking a resource consent, consultation is the process of communicating with people or groups who may be interested in or affected by your proposal. Early consultation can help avoid or ease opposition to your proposal later in the process. Consultation is important because public participation is one of the key principles underlying the RMA. The RMA does not require you, as an applicant, to consult anyone about your application for resource consent, but sometimes there's a duty under another Act to consult; these duties must still be complied with. Also the RMA does require people applying for resource consent to submit a record of any consultation undertaken and the responses received. This can give decision-makers the information they need to make well-founded decisions. Finally, there may be benefits for an applicant where consultation is concerned.

Consultation Principles

A number of principles that help define the meaning of good consultation have emerged from case law under the RMA:

i. **Early consultation** - Consult as soon as possible when the details of your proposal are less 'set in concrete' and you have more flexibility to make changes to address issues raised by interested and affected persons.
ii. **Transparency** - Be open about what you want to achieve, what scope you may have to change certain aspects of your proposal, and why there might be elements that you may not be able to change.

iii. **Open mind** - Keep your views open to people's responses and to the benefits that might arise from consultation.

iv. **Two-Way Process** - Consultation is intended as an exchange of information and requires both you and those consulted to put forward their points of view, and to listen to and consider other perspectives.

v. **Not a means to an end** - While consultation is not an open-ended, never-ending process, it should not be seen merely as an item on a list of things to do that should be crossed off as soon as possible.

vi. **Ongoing** - It may be that consultation, or at least ongoing communication, will continue after your application has been lodged or even after a decision has been made.

vii. **Agreement Not Necessary** - Consultation does not mean that all parties have to agree to a proposal, although it is expected that all parties will make a genuine effort. While agreement may not be reached on all issues, points of difference will become clearer or more specific.

Benefits of Consultation

- **Improving outcomes**
- ***Gaining local knowledge*** – consultation may reveal information on a range of issues (including things such as local traffic or flooding conditions) that is important to your proposal but that you might not otherwise be aware of.
- ***Incorporating tāngata whenua values and interests*** there may be matters of significance to Māori, such as traditional burial sites, that can be accommodated into your proposal.
- ***Enhanced proposals and improved environmental outcomes*** – consultation may provide input that will improve your project or idea and reduce its impact on the natural, physical, cultural and social environment.
- ***Making the consent process easier*** – consultation may lessen any concern, doubt or confusion people may have about your proposal (in the absence of accurate information). This can reduce potential opposition, and improve the chances of consent being non-notified and granted

Tāngata Whenua

- ***Benefit by understanding the Māori world view*** – tāngata whenua (iwi, hapū, whānau) have a long-standing association with the natural environment. Understanding these cultural values and interests can result in improved proposals.
- ***Unique to New Zealand and our national identity*** – tāngata whenua participation in the resource consent process can foster *kaitiakitanga* (the exercise of guardianship expressed in part through an ethic of stewardship) and other Māori concepts that are unique to our country. These may be used to enhance your proposal.
- ***Helping council assess RMA obligations*** – ensure the council can see how your proposal has addressed RMA requirements relating to Māori and the Treaty of Waitangi, and strengthen relationships.

Pre-Consultation

Consider the **nature, extent and size** of potential effects, e.g:

- What kind of effects will your proposed activity create – visual effects, traffic, noise, dust?
- How far will they extend – to adjoining properties, to the whole neighbourhood, to a stream catchment?
- How large are those effects in the context of the environment – minor, moderate, significant?

Who should you consult with?

Those who may be consulted include:

- owners, occupiers and users of adjacent and nearby land
- downstream water users
- users of the same groundwater resource
- occupiers of land living down-wind of a proposed discharge to air
- people or groups with a specific interest in the site or area (such as guardians of an estuary)
- tāngata whenua (iwi, hapū, whānau)
- statutory, infrastructure and utility organisations (such as government departments, councils, and roading and rail authorities).

Where do I start?

- Discuss the proposal with the council who may be able to help you list the parties to consult.
- Prepare consultation material such as:
    - a brief written description and plans of your idea/proposal
    - a tentative assessment of environmental effects
    - measures you would propose to reduce the extent or impact of those effects.
- Consult with identified persons and groups:
    - by letter (usually) in the first instance with an offer of follow-up contact to discuss the proposal in the following days
    - by telephone (where possible) to confirm that they've received the information you sent, and to arrange further communication (preferably face-to-face) to determine any issues
    - at an on-site meeting, where you explain your proposal.

Useful points to consider when consulting:

- listen to what others have to say and consider the responses
- allow sufficient time for consultation
- making a genuine effort to consult
- conduct the process in mutual good faith
- provide enough information to enable the party being consulted to make intelligent and useful responses
- keep an open mind and be ready to change the proposal

- hold meetings, providing relevant and further information on request
- wait until those being consulted have had a say before making a decision
- re-open the consultation process if necessary

NOISE AND THE ENVIRONMENT

What is it?

- **Noise is unwanted sound**

The environmental and social definitions of noise take account of the effect of the sound rather than its technical nature.

The results of national surveys of typical exposure to noise show that

- >50% of the population are exposed to day-time noise levels that exceed the World Health Organisation (WHO) ratings for significant community annoyance.
- Other surveys report that around 50% of people find their home in some way unsatisfactory because of noise.

Noise Problems

- **Hearing damage** - many people are exposed to work and leisure noise levels that slowly but relentlessly cause deafness
- The construction industry has high levels of noise that can damage workers hearing and health
- Aim of NZ building regulations for sound insulation: safeguard people from illness or lack of amenity as a result of undue noise transmission
- On a positive note: room acoustics – good quality sound helps communication - and gives pleasure.

Other Problems

- **Quality of life –** e.g. busy roads or airports are considered unpleasant and undesirable as places to live.
- **Interference -** Disruption of speech or music can be annoying and, in some situations, dangerous.
- **Distraction -** from a particular task can cause inefficiency and inattention – and may be dangerous.
- **Expense -** Control of noise is expensive. Businesses can suffer loss of revenue in a noisy environment.

Hearing Loss

Excessive exposure to noise cause loss of hearing.

The most damaging type affects the Inner Ear – the **Cochlea** which contains nerve endings that connect to the brain and provide our sense of 'hearing'.

- **Temporary Hearing Loss** – (Temporary Threshold Shift) - Ok if you allow 48 hours for recovery
- **Permanent Hearing Loss** – (Permanent Threshold Shift) from exposure every day. E.g. bar staff, construction staff. This loss is permanent.

All hearing losses are added to the continuous hearing loss that accumulates with age – from the time of birth!

Noise factors to measure

1. Energy level - The hearing system reacts to the Sound Pressure Level (SPL) usually measured in decibels (dB)

2. Frequency structure

Some frequencies are more annoying or harmful than others

E.g. high whining frequencies

3. Time Duration

Short periods of noise are less likely to annoy than prolonged exposure

Sound Levels

Decibel (dB) scale used to –

- give a manageable scale of numbers
- match the non-linear response of human hearing

$$SPL = 20\log_{10}\left\{\frac{p}{p_0}\right\}$$

Pressure of the sound (Pa)

Pressure of threshold of hearing (Pa)

The decibel is a logarithmic ratio of two quantities

Usually measured in terms of pressure

Typical Sound Levels

Sound pressure in Pa	Sound level in dB	Typical environment
200	140	Threshold of pain
	130	Aircraft take-off
20	120	Loud discotheque
	110	
2	100	Noisy factory
	90	Heavy lorry
0.2	80	High Street corner
	70	Vacuum cleaner
0.02	60	Normal conversation
	50	
0.002	40	Suburban living room
	30	Quiet countryside
0.0002	20	
	10	
0.00002	0	Threshold of hearing

Changes in sound levels

Sound level change	*Effect on hearing*
+/– 1 dB	negligible
+/– 3 dB	just noticeable
+ 10 dB	twice as loud
– 10 dB	half as loud
+ 20 dB	four times as loud
– 20 dB	one-quarter as loud

Hearing Risks from Construction

- The risk of damage to hearing is dependent on the total energy reaching the ear in a given period
- *$L_{A,eq}$ is the basis of safe exposure to noise during an 8 hour working day.*
- Current Noise Dose Limit in NZ:

$L_{Aeq,8hr}$ = 85 dB

Sound Energy

The equivalent continuous sound level compares a varying sound level to a theoretical constant sound which gives an equivalent amount of sound *energy*.

Equivalent continuous sound level, $L_{Aeq,T}$ is that constant sound level which, over the same period of time T, provides the same total sound energy as the varying sound.

Unit: dB(A)

Although human hearing does not judge loudness in terms of energy, the L_{Aeq} measurement of accumulated sound energy is found to correlate well to – the annoyance caused by noise and also to damage to hearing.

Remember: A sound level increase of just 3 dB may not be noticed but:

- The sound energy received doubles
- The hearing damage doubles

Energy Equivalents

- 3 dB increase corresponds to double the energy
- By reducing time to half = equivalent 'dose' of energy over an 8-hour period.
- Assumptions include a continuous noise output from machinery

90 dB(A) for 8 hours
or
93 dB(A) for 4 hours
or
99 dB(A) for 1 hour

All give the same value of $L_{Aeq,8hr}$ = 90 dB

- In situations where noise varies – use integrating sound level meters which sample regularly

Noise Control – Action Areas

1. Source of Sound – E.g. from outside the building, or within the building

2. Sound Path – E.g. through the air, or through the building structure

3. Receptor/Receiver of Sound – E.g. the building itself, a particular room, or a person.

Noise Control – Treatments

When controlling noise it is sensible to work through the action areas in the following order.

1. **Source of sound** – can it be stopped or reduced in energy.

    E.g. changing or treating noisy machinery, noisy people

2. Path of sound – can the noise be reduced during its transmission through the air or a structure

    E.g. distance from source, stopping air gaps, increasing sound insulation of structures

3. Receiver of sound - can it be protected

    E.g. Insulating a building, or room. Wearing ear defenders

Permissible Noise Levels and Times

Construction work within residential areas:

Where * L_{10} refers to a noise level which can only be exceeded for 10 percent of the time. E.g. L_{10}75 dBA means that over a 30 minute period, the noise may only go above 75 dBA for three minutes.

Machine/process	*Noise level* $L_{Aeq,T}$ *(dB(A))*	*Time for exposure limit to be exceeded*
Angle grinder	104	6 mins
Power hacksaw	88	4 hrs
Chipping hammer	98	24 mins
Welding	92	1.6 hrs
Ambient noise	85	8 hrs

NZ Department of Labour www.osh.dol.govt.nz

Day	Time	L_{10} * at any affected property
Monday-Friday	7.30am - 6.00pm	75 dBA
Monday-Friday	6.00pm - 8.00pm	70 dBA
Saturdays	7.30am - 6.00pm	75 dBA
Sundays and Public Holidays	Noisy construction is not permitted	Noisy construction is not permitted

Construction Noise Examples

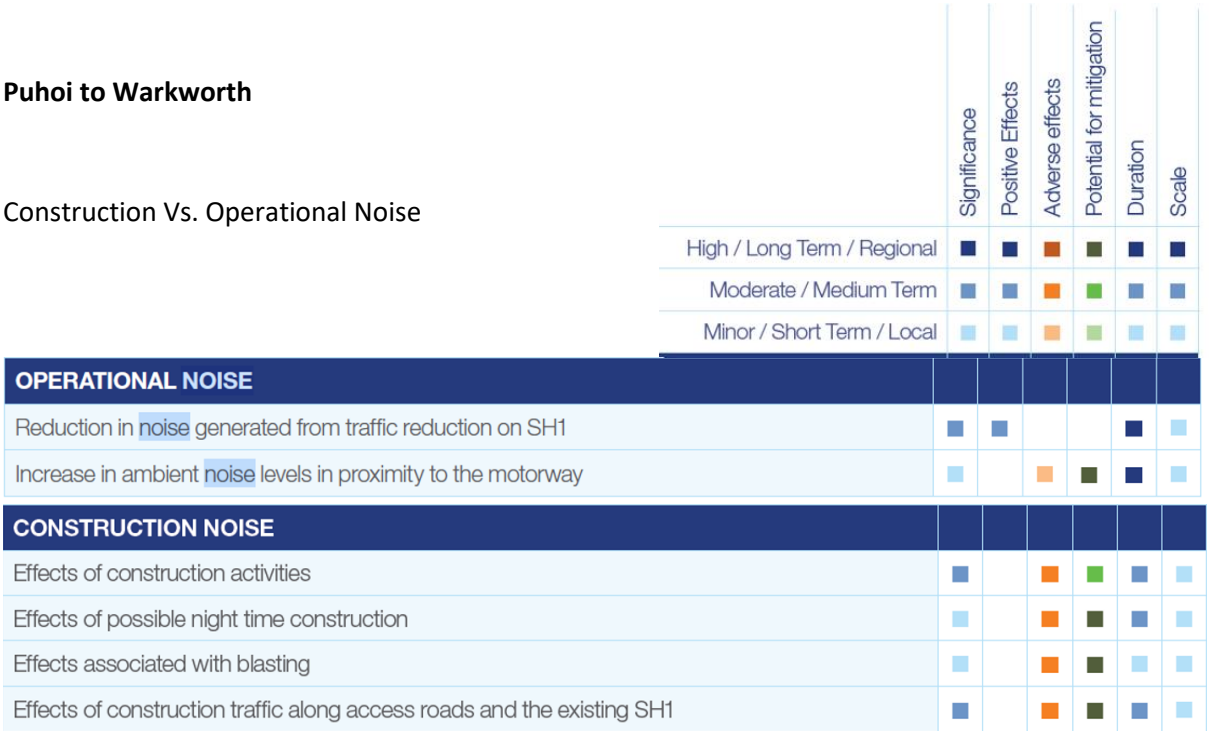
TABLE 4.1 Measured noise source data from Newmarket Connection project

Equipment/activity	Sound pressure level at 10m (dB)	Equipment/activity	Sound pressure level at 10m (dB)
Asphalt paver	60-68	Generator	55-71
Bobcat S185	61	Hiab	82
Chainsaw	96	Loader	74
Chainsaw - electric	77	Miling machine	75
Cherry picker	69-79	Piling	79-80
Circular saw	81	Power pack	74
Concrete pour/pump	70-75	Reversing alarm	73-75
Crane	49-82	Rockbreaker	79-91
Drilling	66-92	Scissor jack	66
Drum roller	62-79	Streetsweeper	67-83
Dynapac PC/32	61	Wall saw	81-84
Excavator	70-81	Water blasting	75-94
Franner	74	Wire saw	71-75

NZ Transport Agency | State highway construction and maintenance noise and vibration guide | SP/M/023 | August 2013 / version 1.0

Puhoi to Warkworth

Construction Vs. Operational Noise



Evaluation

Ambient noise levels in the Project area are relatively low in most locations due to the absence of major local roads and industry. Noise levels ranged from 40dB LAeq in rural areas to 73dB LAeq adjacent to SH1.

Identify/Quantify

A Construction Noise Assessment Report was prepared for the Project, which assesses noise effects relating to the construction phase of the Project. Operational noise effects were addressed in AEE

Recommended upper limits for construction noise received in residential zones and dwellings in rural areas:

Time of week	Time period	Long-term duration	
		dB $L_{Aeq(T)}$*	dB L_{Amax}
Weekdays	0630-0730	55	75
	0730-1800	70	85
	1800-2000	65	80
	2000-0630	45	75
Saturdays	0630-0730	45	75
	0730-1800	70	85
	1800-2000	45	75
	2000-0630	45	75
Sundays and Public Holidays	0630-0730	45	75
	0730-1800	55	85
	1800-2000	45	75
	2000-0630	45	75

Note: shading shows the low noise times in accordance with NZS 6803:1999.

Assessing Risk

Monitor and Mitigate

On-site measures incl. training of personnel, maintenance of equipment, noise barriers and enclosures and considerate behaviour and use of equipment.

Off-site measures include public liaison and communication, temporary barriers, offers of resident relocation and noise level monitoring.

Any potential exceedances of the recommended criteria can be managed and mitigated through a **Construction Noise and Vibration Management Plan.**

Table 15-4: Risk of exceeding daytime noise criteria (70 dB L_{Aeq})

Activity	Activity Sound Power Level	Risk distances	Sector	Potential addresses (depending on alignment within designation)
Bulk earthworks Ground improvement Retainment pond excavation Haul road Spoil disposal	118	High: <65m Medium: 65 – 90m Low: >90m	Pūhoi Sector Schedewys Hill Sector Perry Road Sector Carran Road Sector	M: 24, 26 Billings Road, 466 SH1 M: 187 Moirs Hill Road M: 70, 75, 161, 217, 221 Wyllie Road M: 63, 102, 104 SH1
Rock breaking	120	High: <75m Medium: 75 – 110m Low: >110m	N/A	L: No receivers within 110m of breaking
Piling / foundations	110	High: <30m Medium: 30 – 40m Low: >40m	N/A	L: No receivers within 40m of works
Viaduct construction	110	High: <30m Medium: 30 – 40m Low: >40m	N/A	L: No receivers within 40m of works
Pavement construction	110	High: <30m Medium: 30 – 40m Low: >40m	N/A	L: No receivers within 40m of works

Managing noise through enforcement

Extracted and summarised from *Managing Noise Through Enforcement* at qualityplanning.org.nz [a good resource site]

The primary duty relating to noise under the RMA (Resource Management Act) is contained in s16. Section 16 of the RMA requires that noise is kept to a reasonable level by adopting the best practicable option. The duty applies to every person who occupies or carries out an activity within New Zealand's territorial boundaries, including its coastal waters and the airspace above the land and water

District plans and regional plans may set out rules controlling noise, whether at **source** or **receptor.**

- **Noise controlled at source example:** noise being **emitted** from a factory as measured at the site boundary
- **Noise controlled at receptor example:** emission controls that require acoustic design of living apartments in commercial centres, to reduce the level of noise to specific levels as received by occupants.

Excessive noise definition

Key features of the definition in s326 of the RMA are:

- It applies only to noise under human control (including that from a musical instrument, electrical appliance, machine, or explosion or vibration).
- It can apply to noise from a person or group or persons (such as people in the outdoor courtyard of a bar).
- The noise has to be of such a nature as to unreasonably interfere with the peace, comfort and convenience of any person (other than the person responsible for it).
- It does not include noise form aircraft in flight (or immediately before or after flight), vehicles driven on roads, or trains (other than when being tested, maintained, loaded/unloaded).

Which procedures?

The difference between the powers and procedures available under the RMA for managing noise should be understood in terms of the *outcomes* sought, rather than the type or nature of the noise.

Nature of noise	Outcome sought	Tool
Noise from an on-going activity	Having operators consider methods that will best ensure reasonable levels are achieved over the long term.	Section 16 - Best practicable option. This requires the person responsible to consider alternatives, but also allows the local authority to educate the offender and negotiate the best possible outcomes in the longer term.
Short-term noise	Immediate cessation or reduction of the noise to a reasonable level.	Section 327 - Excessive noise direction. This direction will last 72 hours. If the noise does not stop, the enforcement officer, accompanied by a constable, can physically intervene to stop the noise.

When section 16 is applied the interaction between the operator and the local authority may result in an unopposed.

An abatement notice issued under s322(1)(c) of the RMA is usually the most effective and efficient enforcement procedure for contravention of s16. In practice, however, a local authority should be aware that enforcing the s16 duty may be quite time-consuming.

Identifying and implementing the 'best practicable option' may take months to implement because of the requirements of design, sourcing new equipment and skills, testing the solution, and building it. Alternatively, relocating the activity to an environment where the noise will have less impact may also take considerable time.

TRANSPORTATION

Under the legislation environmental effects includes just about every type of activity that will impact on the environment including:

- Noise and vibration
- Discharge to air, water and environment
- Emission of contaminants
- Odours
- Visual effects particularly where they are negative
- Overshadowing other properties
- Increased traffic flow
- Reduction of privacy

Infrastructure and transportation includes:

- Transport- Roads / Rail / Air / Sea
- Urban Rural and City Development
- Ports
- Power Generation
- All networks – phone, power, gas, water
- Transport

Infrastructure projects requiring AEE's may include the following:

- Roads / Transport Developments (Hydrology)
- Coastal infrastructure (Harbours)
- Water infrastructure (Abstraction / Discharges)
- Agriculture / Farming (Nutrients)
- Power infrastructure (Damming)
- Mining (Tailings- Acid)
- Discharges (e.g. spills)

Assessment tools

1. **Noise Management Plan** – these may include the following steps: Assess; Monitor; Report; Consult; Controls and Feedback
2. **Integrated Transport Assessment**.
3. Landscape Assessment
4. Social Impact Assessment
5. Consultation
6. CPTED

Integrated Transport Assessment

For an activity that results in significant adverse effects on the environment, applicants must describe possible alternative? Locations and methods for undertaking the activity The alternatives must assess both the costs and the benefits. Preparation of an ITA will often be required as part of the AEE to consider the physical and environmental issues associated with the proposal. AEE and accompanying

analysis must be publicly available and accompany proposal when advertised. The AEE for transportation issues considers both:

- the effects of the development and use of land on transportation and
- the effects of transportation on the development environment and adjacent land uses

The following actions are necessary:

- Focus on all potential effects including cumulative effects
- Consider the issues of congestion, induced traffic, social effects, land transport noise, air quality and climate change
- Consider all proposals in the context of supporting a broader transport strategy
- Be aware of changing public attitudes, expectations and perceptions concerning acceptable effects and acceptable levels of transportations accessibility in relation to land transport.

Table 6.1 ITA scope definitions

ITA scope	Geographic	Policy
Simple	Expected to have an effect within the site and at the interface with the transport network.	Expected to be compliant with statutory rules
Moderate	Expected to have an effect over a small area or neighbourhood	Expected to align with local policies
Broad	Expected to have an effect over a larger area, eg part of or a whole suburb	Expected to align with local and regional policies and objectives
Extensive	Expected to have impacts over a wide area, district or region	Expected to align with regional and national policies, objectives and visions.

ITA Content – Simple

- Restricted assessment in terms of area.
- Scope may include access, on-site provisions and/or safety issues.

ITA Content – Moderate

- Wider area also consider adjacent streets and possible nearest main intersection.
- Wider scope to consider e.g land-use characteristics, zoning provisions for area in the district plan.
- May include some local –site modelling including pedestrian effects and on-site and off-site vehicle traffic

ITA Content – Broad

- Extended area from moderate ITA to include adjacent blocks, including access from both mainstream and minor traffic generators
- Scope may include strategic assessment of location, evaluation of neighbouring land uses, consideration of a range of travel modes, surveys and more extensive modelling.
- May also include degree of effect on other road users or improving traffic facilities

ITA Content – Extensive

- Widest consideration of issues which could include a district or larger regional matters.
- Significant thought and appropriate expertise required
- More extensive transportation modelling is likely to be needed, and the possible assumptions and associated variables might be very wide and more complex.
- Consider district and regional effects in the context of longer term planning objectives.

Auckland Requirements

Under the Proposed Unitary Plan, ITAs are required when an application is:

- A plan change
- A Notice of Requirement
- A structure plan
- A resource consent application for a subdivision or development which is not specifically provided for
- A framework plan

The ITA must be prepared early in the development of the proposal so that the findings of the ITA can influence the development

ITAs must also be prepared when the thresholds below are exceeded

Land Use Type	Threshold
Residential	120 dwellings
Retail	1,000 m^2 Gross Floor Area (GFA)
Office	5,000 m^2 Gross Floor Area (GFA)
Industrial	10,000 m^2 Gross Floor Area (GFA)
Warehousing	10.000 m^2 Gross Floor Area (GFA)
Education	100 students
general	Land uses generating 100 vehicle trips in the peak hour

Auckland Transport has prepared guidelines for the content of ITAs

ITA guidelines can be accessed by following the link below on moodle:
https://moodle.unitec.ac.nz/mod/book/view.php?id=212018&chapterid=21979

SUMMARY

AEE Summary

- Identifies to consult (written approval).
- Basis for the council's decision on notification and granting an application (any conditions)
- The final outcome of the AEE process is an accurate and objective statement about the effects of your proposal on the environment.
- Takes into account whether the proposal has avoided, mitigated or remedied any adverse effects on the environment and people.

Step 1-Define environment and effect

- Ecosystems
- People
- Species
- Resources
- Communities
- Amenity Value
- Temporary
- Permanent
- Past
- Present
- Future
- Cumulative

Step 2 – Consent Type

- Land-use
- Water
- Discharge
- Subdivision
- Coastal

Step 3 – Activity Status

- **Permitted Activities**

Permitted activities are allowed 'as of right' subject to complying with any conditions set out in the plan. A permitted activity is the only category that does not require you to apply for resource consent.

- **Controlled Activities**

A council must grant consent if you apply for a controlled activity unless it has insufficient information to determine whether or not the activity is a controlled activity. The council may grant consent subject to conditions that must be complied with. These conditions may only be imposed when they relate to matters specified in the plan.

Activity Status

- **Restricted - Discretionary Activities**

A council may grant or decline consent for a restricted discretionary activity. If granted, conditions may only relate to matters specified in the plan.

- **Discretionary Activities (also called unrestricted)**

A council can grant or decline an application for a discretionary activity. If granted, it can impose conditions in relation to any matter that helps to control any of the activity's potential adverse effect.

Prohibited Activities

- You cannot apply for a resource consent for a prohibited active
- There is one other type of activity: a restricted coastal activity, which is either a discretionary or non-complying activity that is listed in a regional coastal plan as a restricted coastal activity. The Minister of Conservation issues consent for these activities

Step 4 - Proposal Description

A description of your proposed activity

Including:

- Location
- Extent
- Scale
- Construction elements
- Physical changes to the build and natural environment

Step 5: Actual or Potential Effects

An assessment of the actual and potential effects on the environment of your activity.

- positive or negative
- temporary or permanent
- past, present or future
- cumulative (occur over time or in combination - with other effects)
- of high probability
- of low probability but high impact.

Step 6 – Specialists

- Landscape Assessments
- CPTED
- Social Impact Assessment
- Ecological Assessments (e,g Bird Counts, Pit traps, MCI)
- Water quality Assessments (e.g flow modelling, quality analysis, Trophic Level Index)

- Soil Contamination Assessment (PSI, DSI etc)
- Noise management plan
- Integrated Transport Assessment

Other Help

- Historic Heritage Sites
- Local Authorities
- Communities
- CONSULTATION !!!!!

Step 7 – Consultation

Step 8 – Alternatives

Where the above effects are likely to be significant, a description of available alternatives.

- Locations
- Scale
- Method

Step 9 – Hazardous Substances

A discussion of the risk to the environment from hazardous substances and installations.

- Construction
- Operational
- Storage
- Accidental Discharge

Step 10 – Mitigation

A description of how the adverse effects may be avoided, remedied or mitigated.

- Sediment Control Plans
- Noise Management
- Landscape Plan
- Alternative Methods
- Remediation Plans
- Environmental Management Plans

Step 11 – Monitoring

Where an effect needs to be controlled, a discussion of how it can be controlled and whether it needs to be monitored. Where appropriate, a description of how this will be done and by whom.

Summary: Remember

- You need to include enough information in your AEE so that the Council can evaluate your proposal. The amount of information should correspond to the scale and significance of the environmental effects that may be generated by your proposal.
- Some proposals will require more detail and analysis than others. For example, adding a carport onto the side of a house is likely to require much less information and detail than a multi storey development in an area that is valued for its natural attributes.

Summary: AEE Needs to Include

- A full description of the proposal, including the site and locality (including a site plan and plans of your proposal)
- A description of the environmental effects, including the significance and nature of the effects (address specific environmental effects that you have identified as well as referring to issues identified in the district and/or regional plan)
- A description of alternatives to avoid, remedy or mitigate any significant environmental effects

Summary: AEE Needs to Include

- An assessment of any risks to the environment that may arise from hazardous substances and/or the discharge of contaminants
- a record of any consultation, including names and views of people you talked with
- a discussion of any effects that may need to be controlled or monitored, how the control or monitoring will be carried out and by whom.

ENVIRONMENTAL MANAGEMENT PLANS

What are Environmental Management Plans (EMPs)?

Plans or procedures to deliver the intended environmental outcomes of construction, operation and maintenance activities undertaken for a civil's project

- Developed under RMA to manage environmental effects.
- Based on initial understanding of what the effects might be for a particular site or project.
- Practical application of AEE and more…
- Set up to monitor and inform management decisions on site

Managing Environmental Effects

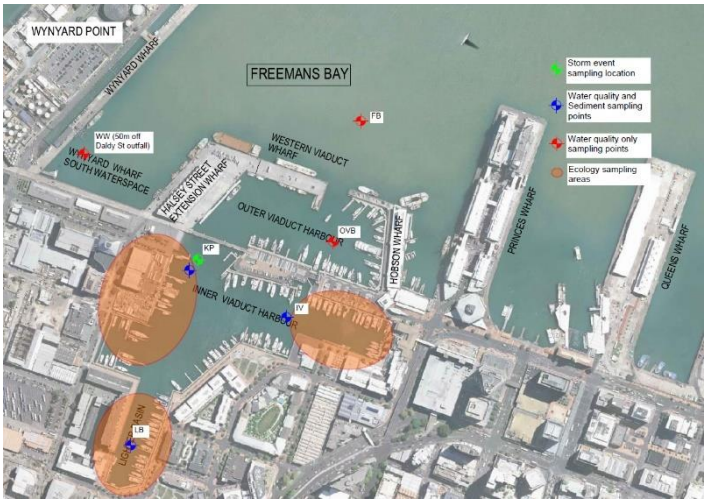
Step 1 - Evaluation

- What is there at the moment?
- What is the quality of this resource?

36th America's Cup:

Works planned included consenting, design and construction of the infrastructure, sediment dredging, installation of breakwaters and pontoons, Hobson Wharf extension, Halsey Wharf conversion to house Emirates Team New Zealand.

Transforming waterfront, e.g. extension to Silo Park & new waka-inspired shade structure, Te Nukuao.



America's Cup Assessment – image kindly shared by Ray Chang, 2020

AC36 Plans

Air Quality – Design Standards (see 2nd row below)

- MFE – Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions (2001)
- AS/NZ 3580.1.1: 2007 Method for sampling and analysis of ambient air – Guide to siting air monitoring equipment
- National Environmental Standard for Air Quality (AQNES)

Sub-Plan	Technical Assessment Report
Construction Noise and Vibration Management Plan	G.5: Assessment of Construction Noise Effects G.19: Assessment of Vibration Effects G 31: Technical Addendum Report
Construction Air Quality Management Plan	G.1: Assessment of Air Quality Effects G 31: Technical Addendum Report
Erosion and Sediment Control Plan	G.22: Erosion and Sediment Control Plan (duplicated) G 30: Assessment of Associated Sediment and Contaminant Loads
Temporary Stormwater Management Plan	G.15: Assessment of Stormwater and Streamworks Effects G 27: Stormwater Design Philosophy Statement
Ecological Management Plan	G.8: Assessment of Herpetofauna Ecological Effects G.3: Assessment of Avian Ecological Effects G.17: Assessment of Terrestrial Vegetation Effects G 31: Technical Addendum Report G.11: Assessment of Marine Ecological Effects G 31: Technical Addendum Report G.6: Assessment of Freshwater Ecological Effects G 31: Technical Addendum Report
Groundwater Management Plan	G.7: Assessment of Groundwater Effects G 31: Technical Addendum Report
Settlement Effects Management Plan	G.13: Assessment of Ground Settlement Effects G 31: Technical Addendum Report
Contaminated Soils Management Plan	G.9: Assessment of Land and Groundwater Contamination G 31: Technical Addendum Report
Archaeological Site Management Plan	G.2: Assessment of Archaeological Effects G 31: Technical Addendum Report
Construction Traffic Management Plan	G.16: Assessment of Temporary Traffic Effects

Step 2 - Identify/Quantify Effects

- What are the effects likely to be?
- What is the nature/timescale of effects?

Experts provide their opinion on each of the effects considered relevant.

WVT project produced 30+ technical reports with one or two experts from applicant and Council presenting evidence to committee.

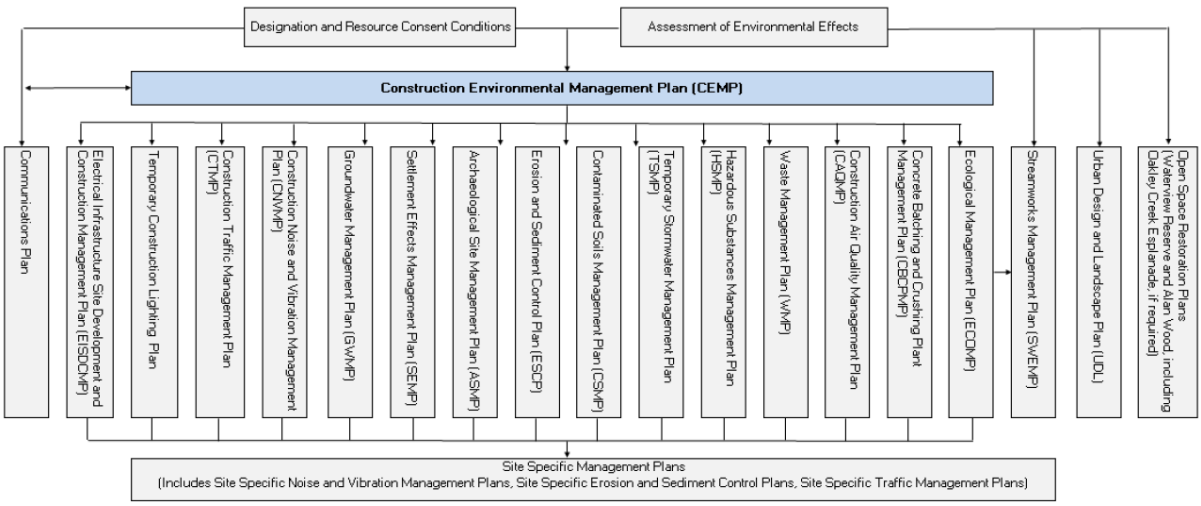
Waterview Tunnel Plan

Construction Environmental Management Plans (CEMP)

The CEMP defines details of who, what, where and when environmental management and mitigation measures are to be implemented. The CEMP covers the anticipated construction elements for the stage of work and presents a framework of principles, environmental policy, objectives and performance standards as well as processes for implementing good environmental management.

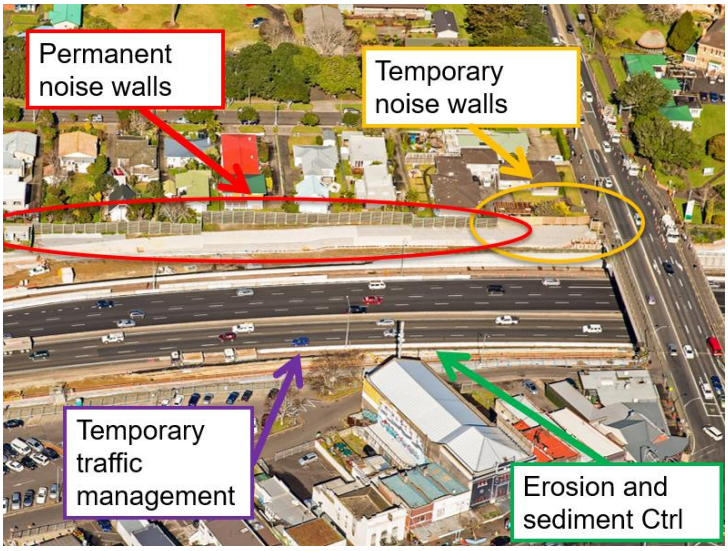
Environmental Sub Plans

Detailed environmental management plans (sub-plans) required to manage specific effects (e.g. construction air quality, noise, vibration, etc.) of the proposed work are provided as appendices to this CEMP. Contained within each of the sub-plans are the associated monitoring and reporting requirements and "site specific" plans (e.g. noise, vibration, traffic and erosion and sediment control). The suite of management plans required by the consent conditions under condition CEMP.3 is shown here:



Special Effects Management Plans

- Certain effects need even more specificity to provide comfort.
- Site-Specific **Noise Management Plans.**
- Managed by the over-arching Construction Environmental Management Plan and sub plans.



WVT Application Documents

1. Application documents

Assessment of environmental effects

- Part A, B and C (PDF, 6.8 MB, 278 pages)
- Part D (PDF, 10 MB, 591 pages)

Technical reports

- G.1 Assessment of Air Quality Effects (PDF, 7.7 MB)
- G.2 Assessment of Archaeological Effects (PDF, 9.6 MB)
- G.3 Assessment of Avian Ecological Effects (PDF, 9.4 MB)
- G.4 Assessment of Coastal Processes (PDF, 7.3 MB)
- G.5 Assessment of Construction Noise Effects (PDF, 2.1 MB)
- G.6 Assessment of Freshwater Effects (PDF, 2.4 MB)
- G.7 Assessment of Groundwater Effects (PDF, 432 KB)
- G.8 Assessment of Herpetofauna Effects (PDF, 1.15 MB)
- G.9 Assessment of Land and Groundwater Contamination (PDF, 3.1 MB)
- G.10 Assessment of Lighting Effects report (PDF, 404 KB)
- G.11 Assessment Marine Ecological Effects report (PDF, 5 MB)
- G.11 Assessment Marine Ecological Effects report (PDF, 5 MB)
- G.12 Assessment of Operational Noise Effects (PDF, 1.2 MB)
- G.13 Assessment of Ground Settlement Effects (PDF, 1 MB)
- G.14 Assessment of Social Effects (PDF, 4.3 MB)
- G.15 Assessment of Stormwater and Streamworks Effects (PDF, 7.5 MB)
- G.16 Assessment of Temporary Traffic Effects (PDF, 6.8 MB)
- G.17 Assessment of Terrestrial Vegetation Effects (PDF, 1.2 MB)
- G.18 Assessment of Transport Effects (PDF, 7.3 MB)
- G.19 Assessment of Vibration Effects (PDF, 544 KB)
- G.20 Assessment of Landscape and Visual Effects (PDF, 2.5 MB)
- G.21 Construction Enviornmental Management Plan (PDF, 6.1 MB)
- G.22 Erosion and Sediment Control Plan Report (PDF, 1.1 MB)
- G.23 Coastal Works Report (PDF, 2.2 MB)
- G.24 Geotechnical Interpretive Report (PDF, 608 KB)
- G.25 Traffic Modelling Report (PDF, 2.7 MB)
- G.26 Operational Model Validation Report (PDF, 965 KB)
- G.27 Stormwater and Streamworks Design Philosophy Statement (PDF, 500 KB)
- G.30 Assessment of Associated Sediment Containment Loads (PDF, 446 KB)
- G.31 Technical Addendum Report (PDF, 326 KB)

Construction Effects Vs Operational Effects

Construction effects may include:

Noise

- Beeping
- Conveyor belt operation
- General site works

Air Quality

- Dust

Water quality

- Sedimentation
- pH, nutrients, metals, etc.

Disturbance of soils

- Exposure of contaminated soils

Step 3 - Monitoring

- Check what has changed.
- Is any further action required?

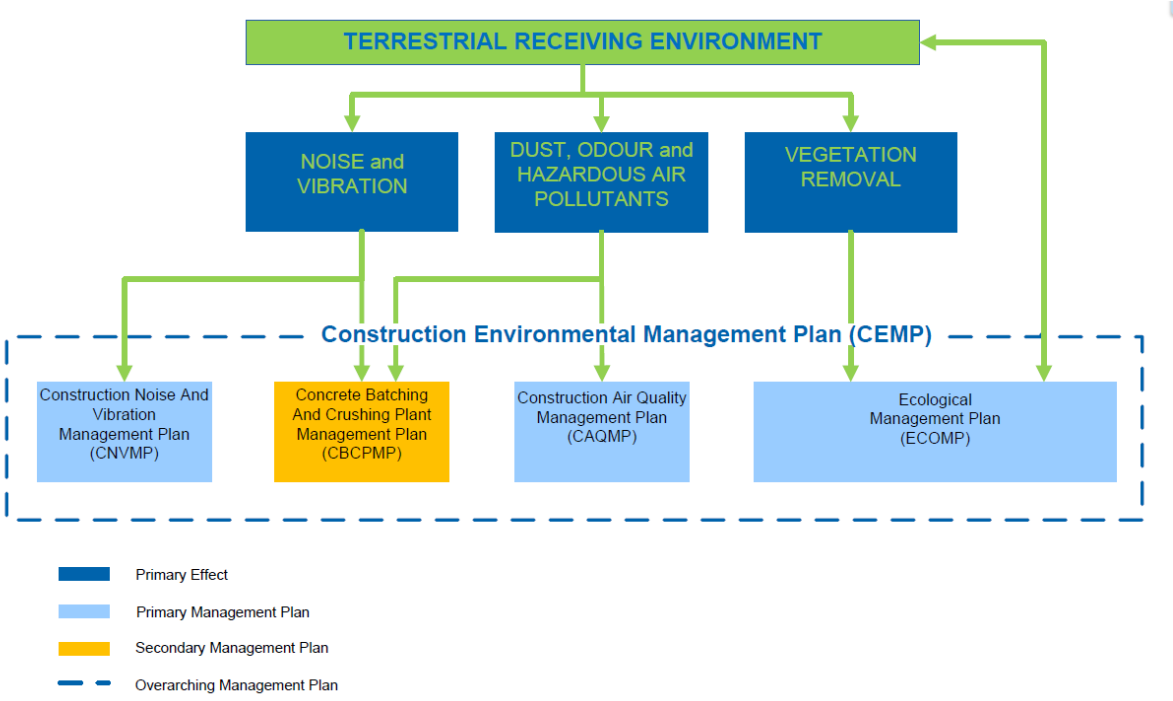
Construction Phase Requirements for AC36 include:

- Monthly monitoring of water quality.
- Monitoring of water quality in response to storm events.
- Review of ecological assembly within the Inner Viaduct Harbour.
- Baseline samples.
- Post-construction samples (Monitor potential change in water quality / ecology as a result of new structures in the CMA).
- Technical report evaluating changes.

America's Cup Venue pre-construction – image kindly shared by Ray Chang, 2020

Partnership with Mana Whenua

Wynyard Edge Alliance (WEA) partnered with mana whenua to construct the infrastructure for AC36. 19 iwi/hapū invited to establish the America's Cup Kaitiaki Engagement Plan (ACKEP) and had a major contribution to project's environmental management principles. Principles of partnership, reciprocity, active protection, and equity were honoured.



Activities affecting cultural values

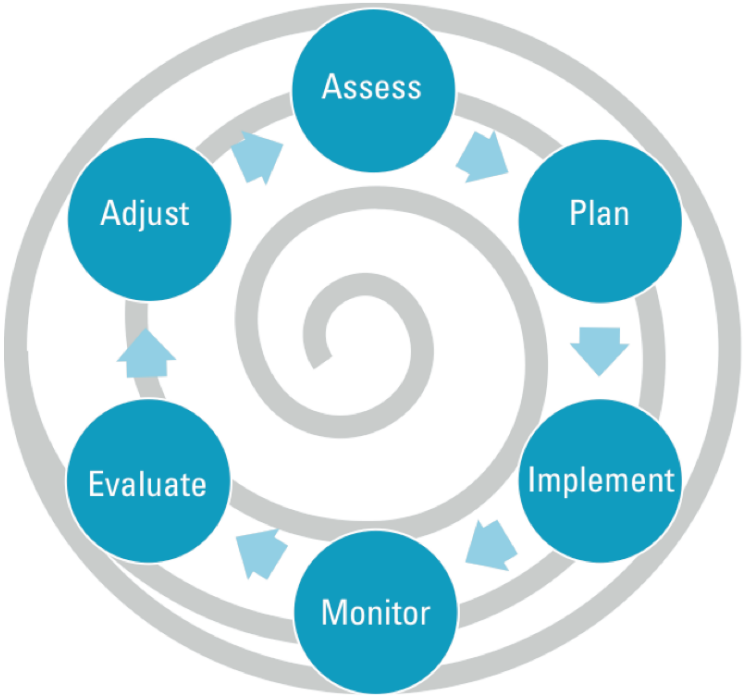
Of particular concern

- Managing water quality
- Managing underwater noise as to protect marine animals
- Protecting the waters of the area from biosecurity risks
- Providing cultural markers within the infrastructure that recognise the historical associations of mana whenua with the whenua and moana.
- Enabling the use of infrastructure for cultural activities.

Mana whenua were involved in the preparation and implementation in a range of management plans.

Benefits of EMPs

- Outcomes based solution
- Promise to achieve a certain result (might require time)
- Allows flexibility in how you achieve compliance with a parameter
- Can be altered depending on circumstances



Proposed mitigation plan – image kindly sharde by Ray Chang, 2020

GREEN BUILDINGS

Sustainability

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Report, 1987)

Sustainability is often defined as being supported by 3 main pillars: social, environmental and economic.

What Makes a Green Building?

Supportive city, committed client, knowledgeable architect, engineers and designers, building management and maintenance and occupants.

Green Assessment Systems

There are number of assessment systems available, including LEED (USA), BREEAM (UK) and Green Star (AUS, NZ, SA).

LEED (Leadership in Energy and Environmental Design) – residential and commercial buildings score points based on performance against the following measures: sustainable sites, water efficiency, energy & atmosphere, materials & resources, indoor environmental quality, innovation. Certification (e.g. silver, gold or platinum) based on number of points scored.

BREEAM (Building Research Establishment Environmental Assessment Method) is a third party certification of sustainability performance for new and existing buildings. Covers management, health & wellbeing, energy, transport, water, materials, land use & ecology, pollution.

Green Star assessment system awards from 1-6 green stars (4+ stars generally indicate high performance). 9 categories are assessed (management, indoor environment, energy, transport, water, materials, land-use and ecology, emissions, innovation) and number of green stars awarded based on % of total points available.

Cradle to Cradle

When considering materials for use in the building industry, it is important to address both the toxicity during production, use and disposal of the material.

What are Green Materials?

Green materials are “those that use the Earth's resources in an environmentally responsible way" (Speigel & Meadows,1999).

Desired characteristics of green materials include:

- High recycled content
- reused building materials
- Locally/regionally sourced products
- Certified wood products
- Wood products made from rapidly renewable resources

Ecolabels

Ecolabelling is a voluntary labelling system based on sustainability measurement, aimed at helping consumers take environmental concerns into account when buying products. Some ecolabels quantify pollution or energy consumption, others record compliance with sustainability measures, and others focus on reducing environmental impacts from primary production or resource extraction through sustainability standards. A certification process is used to measure a primary producer's (e.g. farm, forestry, mining) compliance with these standards, enabling them to sell as certified through the supply chain.

The ecolabelling system is not perfect. There is an increasing number of ecolabelling programs around the world, making it more difficult for consumers to make clear comparisons between certified products. Ecolabelling is often not comprehensive, for example does not provide information about the impact of transportation. As ecolabels are voluntary they are not well adopted. There are also no clear guidelines for what is a "green material".

Some examples of ecolabels include Blue Angel in Germany (the oldest ecolabel in the world, covering 10,000 products across 80 categories) and Fairtrade (since 1997, established to promote economic trade, considers producers first).

Green Materials vs Green Production

Materials = components of products which may be used in a building or may be standalone units.

Products = Building components which are preferable to a number of alternatives (not necessarily made of green material).

An example of a green product made from non-green materials is the use of photovoltaic panels for solar energy capture. The environmental impact of producing, maintaining, operating and disposing of the PV panels is very high.

Environmental Product Declaration

EPD is an "international standard of communication to objectively compare and describe a product's environmental impact throughout its entire life cycle from cradle to grave" (National Sanitation Foundation). It is a kind of LCA which provides environmental information in a common format, based on common rules (Product Category Rules (PCR)).

- PCR (ISO 14025) - which data and how data is collected and reported.

- LCA analyses the data specified in the PCR (inputs, outputs and environmental impacts of a product across its lifespan)
- EPD provides a summary document of data collected in LCA to enable comparison.
- Verification follows EPD

EPDs and EBDs

Environmental Product Declarations (EPDs) - impact of a product.

Environmental Building Declarations (EBDs) - impact of the whole building.

EPDs offer comparison between products whereas EBDs allow trade-off between systems in order to minimise total impact.

Life Cycle Analysis

Provides information about a product from its manufacture to its disposal, including resources used and emissions generated. Emphasis is on energy reduction. Other options may focus more on recycling products regardless of energy inputs. LCA includes the complete life cycle of the product, process or activity, i.e the extraction and processing of raw materials, manufacturing, transportation and distribution, use, maintenance, recycling, reuse and final disposal.

Benefits include: Select the building materials, systems and strategies which have the least impact on the environment; Understand and quantify financial and environmental costs associated; Reduce design and construction costs whilst providing a sustainable solution.

LCA study can be divided into four steps:

1. Goal and scope definition
2. Inventory analysis
3. Impact assessment
4. Interpretation

Goal and Scope definition - provides aim and subject of study and definition of ‘functional unit’. Example of goal or aim: "To compare the impacts from extraction to end of life of installing fibreglass insulation made from recycled bottles compared with wool based insulation treated with boron". The study focus or ‘scope’ may be: Well to wheel; Cradle to grave; Cradle to gate; Cradle to cradle.

Inventory Analysis - Data gathering step (for materials that cause environmental effects). Consider both direct and indirect effects. Total flows are examined including resources used (inputs) and all wastes produced (outputs).

Impact assessment – several methods available to convert inventory data to impacts such as climate change and human toxicity. Impact assessment involves (1) Classification of substances into environmental themes; (2) Characterisation of substances by multiplying by a factor based on the relative contribution to environmental impact; (3) Normalisation of impacts based on reference values (where available); (4) Weighting of impacts based on criticality.

Interpretation - For this stage, ISO 14040 requires the results of the inventory and the impact assessment to be evaluated with the aim of deriving conclusions and providing recommendations. 3

main stages: (1) Identify of the critical parameters from the inventory and impact assessment (i.e which processes make the largest contribution to an indicator); (2) Assess completeness and data quality; (3) Provide conclusions (including limits of applicability).

One of the disadvantages of the LCA is that technical, societal and economic matters are not addressed.

Concrete Vs Steel

As well as all the materials used in the construction of the building, the life cycle assessment must also cover all the relevant processes of energy provision (e.g for heating, air conditioning and ventilation).

Embodied Energy

An approximate measure of the energy (per unit mass) typically needed to produce a building product. Needs to include energy requirements for:

- Raw material acquisition
- Product manufacture
- Upstream energy use (e.g. construction and operation of factory)

Full environmental picture should also consider climate, site, building design and life cycle as a whole system.

Green energy

Conventional Energy Sources (eg. gas, petrol, coal)

Conventional energy sources are generally non-renewable. Most of the energy we use comes from fossil fuels, such as coal, natural gas and petroleum. Fossil fuels are formed by anaerobic decomposition of ancient organic matter, and are typically formed over hundreds of millions of years old.

Fossil fuels are put through a process called combustion in order to produce energy. Combustion releases pollution, such as carbon monoxide and sulfur dioxide, which can contribute to acid rain and global warming.

Coal is a black or brown rock which is burnt to create energy. It has been a common energy source for many countries worldwide. Using coal can be harmful however, and coal mining is one of the most dangerous jobs in the world. Coal miners are exposed to toxic dust and face the dangers of cave-ins and explosions at work. Mining for coal can also cause the ground to cave in and create underground fires that burn for decades at a time. When coal is burned, it releases many toxic gases and pollutants into the atmosphere.

Petroleum is a liquid fossil fuel, also known as crude oil. It is trapped by underground rock formations and is extracted mainly through oil drilling. Petroleum is relatively inexpensive to extract and is a reliable and dependable source of energy and money for the local community. Petroleum can be refined by distillation into various high value products such as gasoline (petrol) and kerosene. Petroleum is also an ingredient in many items that we depend on such as roads, plastics, pesticides and pharmaceuticals. Burning petroleum products however releases harmful gases into the air we breathe as well as contributing greenhouse gases leading to global warming and ocean acidification. Oil spills due to machinery failure have occasionally created major environmental disasters, both on land and within the ocean, seriously affecting the habitat and lives of many animal species.

Natural gas is also trapped underground in reservoirs, usually as methane. It is relatively inexpensive to extract, and is a “cleaner” fossil fuel than oil or coal as it only releases carbon dioxide and water vapor when burned (the same gases that we exhale!). Extracting natural gas relies on fracturing rocks (“fracking”) by pumping high pressure water and chemicals underground. This process can cause small earthquakes and contamination of water supplies, making it unsafe for consumption.

Nuclear energy and biomass

Nuclear energy is produced by “fission” (i.e. splitting) of uranium atoms, which releases heat that is converted into steam which drives turbine engines to produce energy. While the uranium mined to produce nuclear energy is a non-renewable resource, it is not considered a fossil fuel as it does not originate from organic matter. Nuclear energy is often considered a cleaner form of energy than conventional energy sources, as it does not produce air pollution or greenhouse gas emissions. Nuclear power plants are complex plants to operate and need highly skilled scientists and engineers to develop a safe and reliable nuclear energy program. Nuclear energy also produces radioactive waste material which can be extremely toxic, causing burns and increasing the risk for cancer, blood diseases, and bone decay among people who are exposed to it.

Biomass energy uses the energy found in plants and is therefore a renewable energy source. It relies on biomass feedstocks - plants that are grown, harvested, processed and then burned to create electricity. Biomass feedstocks can include crops such as corn and soya, as well as wood. Biomass energy can be obtained from agriculture wastes therefore providing a secondary product for existing agricultural crops. However where feedstocks are grown specifically for biomass energy production, this can compete for land which could be used for other purposes, such as farming, conservation, or recreation. Biomass feedstocks can also lead to high water consumption and erosion of land.

Renewable Energy Sources

Renewable sources of energy can be used over and over again. Renewable resources include solar energy, wind, geothermal energy, biomass and hydropower. In general, they generate much less pollution, both in gathering and production, than non-renewable sources.

Solar Energy uses sunlight to generate electricity and can be passive or active. Active solar energy uses special technology to capture the sun's rays, e.g. photovoltaic (PV) cells and mirrors that focus sunlight in a specific spot. Passive solar energy collects energy from the way sunlight naturally changes throughout the day, e.g. house windows oriented to face the path of the sun, to absorb more heat, requiring less energy from other sources to heat the house. Solar energy production does not generate pollution, however the fabrication of PV cells requires large amounts of water and electricity (creating greenhouse emissions) as well as caustic chemicals. PV cells can be expensive to install and complex to recycle at the end of life (20 years). Solar availability can also be unreliable e.g. due to cloud cover, and is only occurs during the day. Battery technology for storing energy generated during peak (high sunlight) times for use during offpeak (low sunlight) times still requires further development to make solar energy more viable.

Wind energy is captured by wind turbines, which look like giant windmills - a tall tower and two or three propeller-like blades at the top, which are turned by the wind. The blades turn a generator (inside the tower), which creates electricity. Wind energy can be very efficient. Site selection is important, ideally in wind corridors in valleys or along coasts. Wind energy can be a cheap, reliable source of electricity. Wind turbines do not burn fuel or emit any pollutants into the air, so are considered a clean form of renewable energy. However, wind is not always a steady source of energy. Wind speed changes constantly, depending on the time of day, weather, and geographic location. Battery technology for storing energy generated during peak (high wind) times for use during offpeak (low wind) times still requires further development to make wind energy more viable. Wind turbines can be also dangerous for bats and birds, which cannot always judge how fast the blades are moving and fly into them.

Geothermal energy is heat generated and stored underground below the earth's crust. This heat is transferred as steam or geothermal fluid to power turbines for electricity generation. Geothermal energy can is independent of weather and time of day and does not require any fuel or emit any harmful pollutants into the air. Geothermal often requires large amounts of water to convert the heat energy into steam, which could otherwise be used for drinking, cooking or bathing. Geothermal plants require careful monitoring to avoid land subsidence and depletion. Geothermal fluids also produce some greenhouse emissions, so although clean are not the cleanest form of energy.

Hydroelectric Energy is generated where dams block the river and create an artificial lake, or reservoir, and a controlled amount of water is released through tunnels in the dam. The water flowing through these tunnels turns huge turbines to generate electricity. Hydroelectric energy is fairly inexpensive to

harness. Dams do not need to be complex, and the resources to build them are not difficult to obtain. Due to the reserve of water in the dam, hydroelectric energy is a fairly reliable source compared with solar and wind energy. However the construction of dams is today a very sensitive environmental topic due to the resulting destruction of environment and habitat loss as well as the alteration of the water course.

Energy efficient buildings

What is a green building? Green building, or sustainable design, is the practice of increasing the efficiency with which buildings and their sites use energy, water, and materials, and of reducing impacts on human health and the environment for the entire lifecycle of a building. Green-building concepts extend beyond the walls of buildings and include site planning, community and land-use planning issues as well.

Why is green building important? The growth and development of our communities has a large impact on our natural environment. The manufacturing, design, construction and operation of the buildings in which we live and work are responsible for the consumption of many of our natural resources.

Environmental benefits of green building:

- Enhance and protect biodiversity and ecosystems
- Improve air and water quality
- Reduce waste streams
- Conserve and restore natural resources

Economic benefits of green building:

- Reduce operating costs
- Improve occupant productivity
- Enhance asset value and profits
- Optimize life-cycle economic performance

Social benefits of green building:

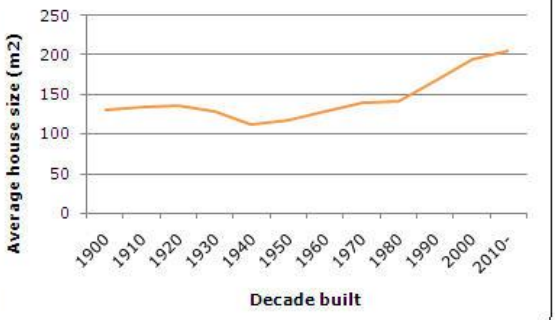
- Enhance occupant health and comfort
- Improve indoor air quality
- Minimize strain on local utility infrastructure
- Improve overall quality of life

Video >> https://www.youtube.com/watch?v=g1YcZ1J4oIc

Size of houses

The average size of a house in New Zealand, based on floor area, is 149 square metres.

Decade built	Average size (m2)
1900	131.7
1910	135.3
1920	136.7
1930	129.8
1940	112.7
1950	117.5
1960	128.2
1970	140.2
1980	142.4
1990	166.4
2000	194.2
2010-	205.3



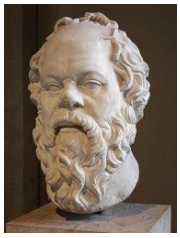
Keeping buildings small = reduction in building materials, land space and operational energy requirements.

How small can you go? http://www.livingbiginatinyhouse.com/large-tiny-house-mansion/

Video >> https://www.youtube.com/watch?v=1FR0fSI_mEI

The Tiny House Movement is a sweeping phenomenon in the United States, largely as a result of the recent economic troubles where many have lost their homes. Tiny Homes are about living simply, beautifully and yet still with everything you need. It's about freedom from debt and having the economic freedom to live a bigger life, instead of having a bigger house.

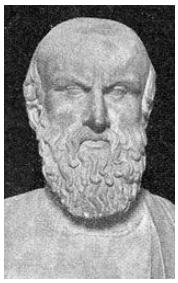
Case Studies of Green Design in History



Over 2,300 years ago, Socrates declared:

"Now in houses with a south aspect, the sun's rays penetrate into the porticos in winter, but in the summer the path of the sun is right over our heads and above the

roof, so that there is shade. If, then, this is the best arrangement, we should build the south side loftier to get the winter sun and the north side lower to keep out the winter winds."



The ancient Greek playwright Aeschylus, who preceded Socrates by a hundred years, stated:

"Only primitives & barbarians lack knowledge of houses turned to face the Winter sun."

The huge ancient buildings of Greece have both thermal mass and south-facing orientations. They were not the only ancients who used the sun's seasonal orientation to build. The Anasazi also built passive solar homes and building complexes in Mesa Verde, Grand Gulch and Chaco Canyon.

Parthenon, Greece

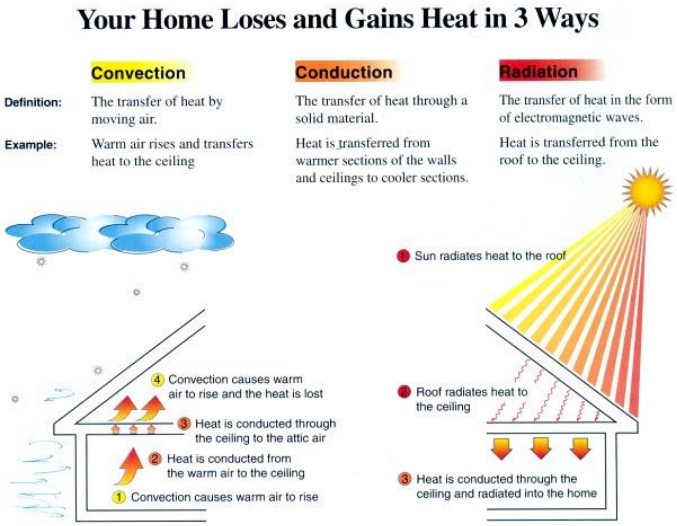
Cliff Palace, Mesa Verde, Colorado

Many Greek islands in the Aegean Sea, such as Santorini, experience hot summers with bright sun for several months a year. To make their houses tolerable and heat-resistant, the buildings are painted stark white to reflect the sun's rays.

Radiation, convection, conduction

Radiation is the transfer of heat from a warmer to a cooler body. Solar radiation can be reflected by using light coloured materials, absorbed using dark coloured materials, or transmitted using transparent materials. Radiation can also be reduced by using reflective surfaces e.g. Reflective roofs

to prevent solar heat gain; Radiant barriers in small seldom used rooms to reflect heat back into living spaces; Minimising paved external areas -reduce a building's cooling load.

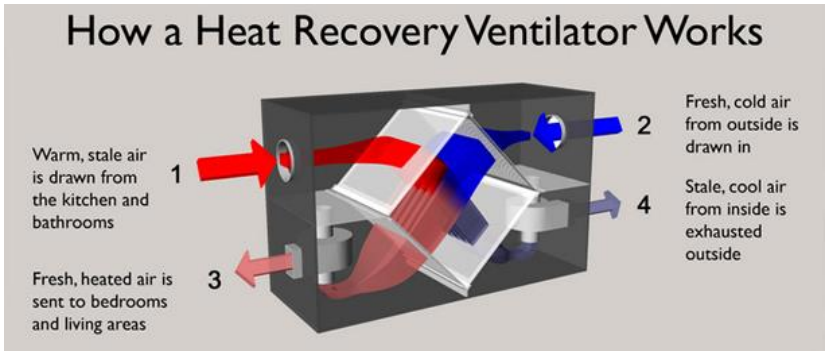


Convection is the transfer of heat in a fluid or gas and can be prevented through the use of: Air barriers; Sealing gaps around windows, doors and other openings to the exterior; Air-lock entrances; Heat recovery ventilators.

Conduction is the transfer of heat through a solid substance. Insulating materials have high resistance to conduction and are important for the prevention of heat transfer. The amount of insulation required, and benefits of insulation increase in climates which have significant temperature differences between indoor and outdoor environments.

Energy devices

Heat Recovery Ventilation (HRV)



Video >> https://www.youtube.com/watch?v=Ut9wQmbUY7I

Daylighting - Efficient lighting (in particular use of daylighting) has two main benefits: (1) A reduction in wasted heat energy and therefore reduced energy consumption; (2) A reduction in a buildings cooling load from unwanted heat energy. Daylighting has other added benefits including: Better visual activity; Enhanced productivity and well-being; Connection to nature.

Video >> https://www.youtube.com/watch?v=hPXjzsXJ1Y0

The “Solar Bottle” is a lighting invention that reduces plastic waste while improving lighting in many homes in poorer countries. Around 1.5 billion people have no access to lighting either due to the lack of availability or affordability of electricity. Upcycling old plastic bottles into solar lights by filling with water and attached in a hole in the roof, to refract the sun’s rays provides the equivalent of a 50 watt

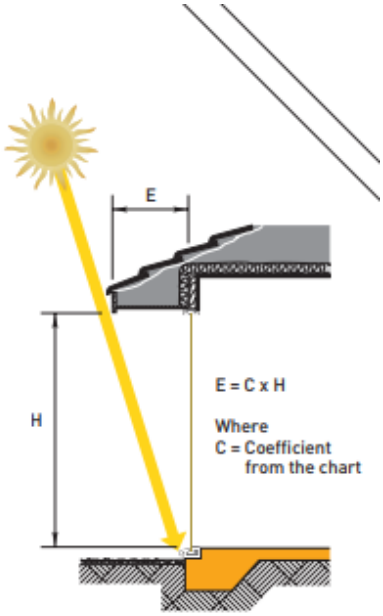
bulb. Is helping to light 350,000 homes in over 15 countries, such as Philippines and Senegal.

Passive Solar Design (Orientation, house design, materials, insulation)

Orientation

Residential buildings with good passive solar design will orientate the building layout such that living areas receive the sun in the cooler months. To design a house that is naturally warmer in winter and cooler in summer, you need to allow for the combined effects of:

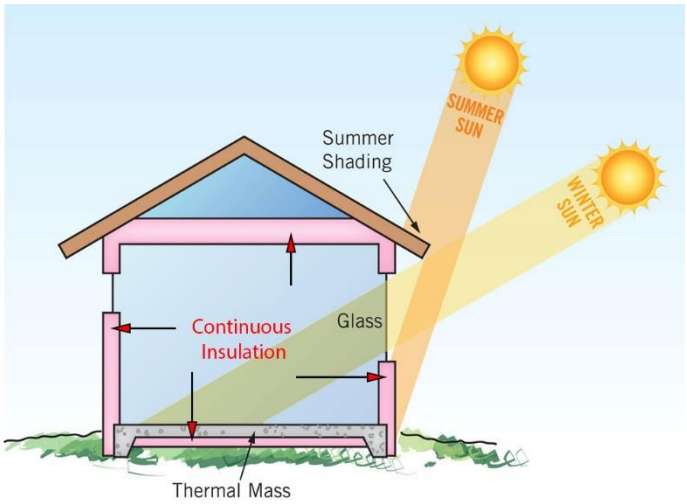
(1) The earth's diurnal rotation about its axis, which causes the change from night to day;
(2) The tilt of the earth's axis in relation to its orbit around the sun, which produces summer and winter as the earth orbits the sun.



These effects cause the sun's position in the sky to appear higher at noon in summer than in winter and daylight to extend for a longer period in summer.

When windows face north, an eaves overhang should be provided which allows sun penetration in winter but excludes provides shade in summer. Design charts can be used to easily calculate this overhang.

Insulation



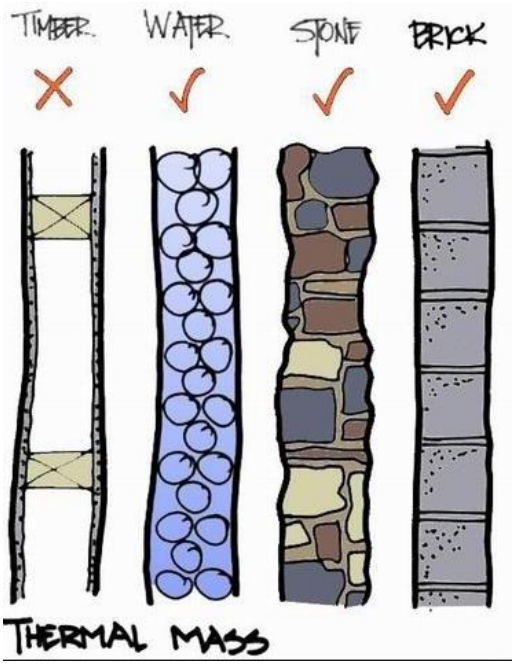
Insulation acts as a barrier to heat flow, reducing heat loss in winter to keep the house warm, and reducing heat gain in summer to keep the house cool. Inadequate insulation and air leakage are the main causes of heat loss in homes.

Current building codes specify only a minimum level of insulation that may be less than the optimum for heat conservation. Installing insulation above the building code requirements is beneficial, especially in colder climates.

When thinking about insulation, it's important that you think of all the following areas: Ceiling, under the floor, walls and windows. These four areas form the 'thermal envelope'. The thermal envelope is the barrier between heated and unheated spaces. It protects the inside of the home from the outside climate. The better insulated your thermal envelope is, the warmer your home will be.

Thermal mass

Thermal mass is the ability of a material to absorb and store heat energy. High density materials such as concrete, bricks and tiles require a lot of heat energy to change the temperature and therefore have high thermal mass. Lighter materials such as timber have low thermal mass. Appropriate use of thermal mass throughout the home can make a big difference to comfort and heating and cooling bills.



Thermal mass can store solar energy during the day and release it at night. Thermal mass used well can moderate internal temperatures by averaging out diurnal (day−night) peaks. This increases comfort and reduces energy costs. Poor use of thermal mass can exacerbate peak temperatures resulting in severe discomfort (e.g. radiate heat at night during summer, making it difficult to sleep; or absorb heat at night during winter, making the room feel colder) and increased energy bills.

Material	Density(Kg/m3)	Specific heat(kJ/kg.K)	Thermal mass (kJ/m3.K)
Water	1000	4.186	4186
Concrete	2240	0.920	2060
AAC	500	1.100	550
Brick	1700	0.920	1360
Stone (Sandstone)	2000	0.900	1800
FC Sheet (compressed)	1700	0.900	1530
Earth Wall (Adobe)	1550	0.837	1300
Rammed Earth	2000	0.837	1673
Compressed Earth Blocks	2080	0.837	1740

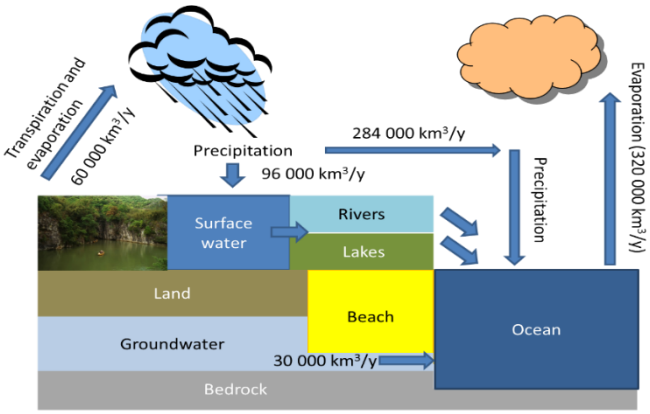
WATER

Harvest, Recycle & Reuse

Introduction

Water is the only commodity on Earth for which there is no economic substitute, however there are multiple pressures on fresh water availability driven by economic development, increasing population, urbanisation and climate change.

The hydrological cycle drives the continual movement of water across the Earth due to evaporation, condensation or precipitation.



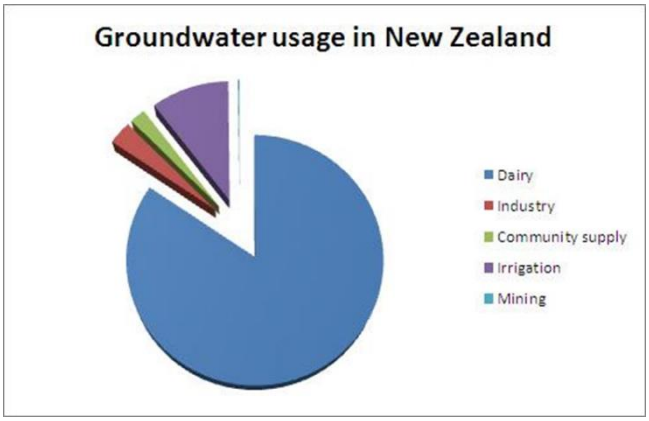
Note: flux from continent to oceans includes groundwater, surface water, rivers and lakes.

In liquid form, there are three major water sources exist on Earth:

- **Groundwater**
- **Surface water** (e.g. streams, rivers and lakes)
- **Marine** (e.g. estuaries, seas and oceans)

Groundwater

Represents 95% of the freshwater available on Earth (and provides 1500 - 2750 million people with potable water). Highly valuable resource for industry and agriculture. Around ⅓ water used in NZ comes from groundwater (612 billion cubic metres groundwater storage)



Surface Water (Lentic and Lotic systems)

Consists of ponds, lakes, rivers and streams and less than 0.01% of total global water exists as surface water.

Lentic – non-flowing waters such as lakes, ponds, lagoons etc.

Lotic – flowing water systems such as springs, creeks, rivers etc

Marine Water

A major water source limited by salinity

Water Harvesting

The harvesting of rainwater simply involves the collection of water from surfaces on which rain falls, and subsequently storing this water for later use" (Sustainable Earth Technologies, AU)

The collection of any kind of water for domestic, agriculture or other purposes for which benefits include security of supply, flooding prevention and reduced reliance on mains water (saving cost).

Water Sources

- Runoff may be harvested from roofs and ground surfaces as well as from intermittent or ephemeral watercourses.
- Water harvesting techniques which harvest runoff from roofs or ground surfaces fall under the term: ***Rainwater Harvesting.***
- While all systems which collect discharges from watercourses are grouped under the term: ***Floodwater Harvesting***.

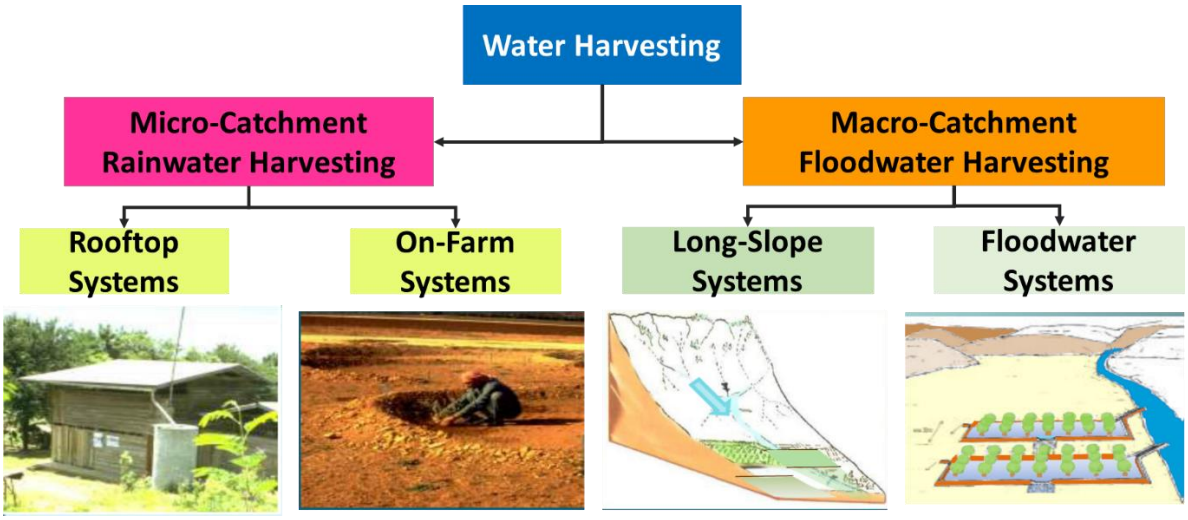


Image courtesy of Dr Kris Latu

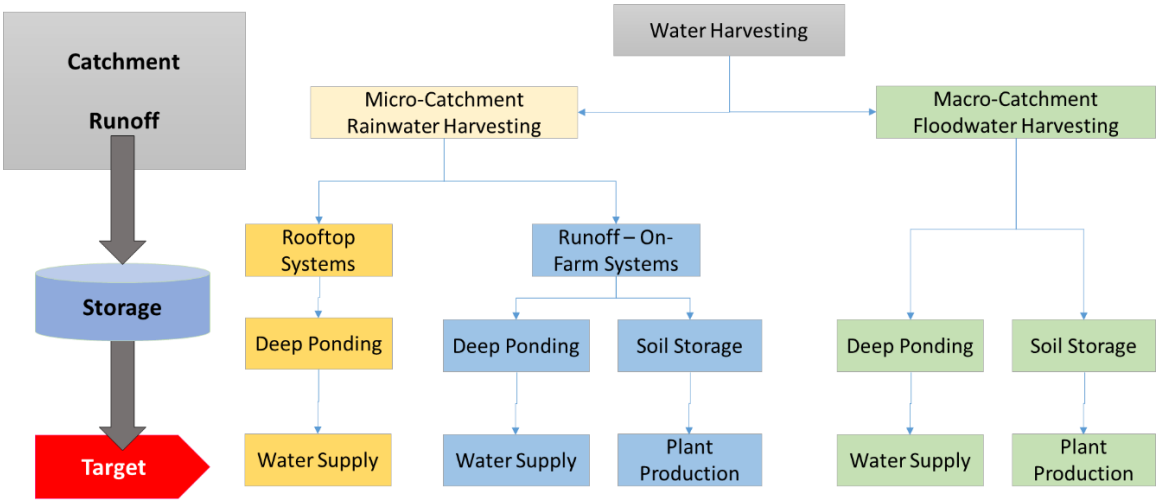


Image courtesy of Dr Kris Latu

Micro-catchment Solutions

Main Characteristics

- Overland flow harvested from short catchment length
- Catchment length usually between 1 and 30 metres
- Runoff stored in soil profile or tanks
- Normally no provision for overflow
- Less expensive

Urban Solutions - Rooftop Harvesting

Benefits	Disadvantages
A simple technology that does not require complex engineering designs It is cheap, decentralised and can be managed according to household needs	Initial quality and change in quality over time Possibility of contamination Limitation of storage capacity (cost and space) Flow at low rainfall periods

Design decisions

Including:

1. The collection area (roof material?)
2. Storage method and size
3. Problems associated with storage tank to avoid

Amount collected depends on the area of the roof

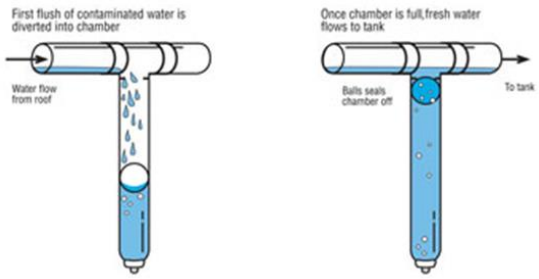
Quality depends on roofing material and level of maintenance

Conveyance Systems

The first flush diverter – to prevent dust and debris entering the tank.

Closing a valve for the first 5-10 mins to prevent initial rain flow reaching the tank

Adequate enclosure (minimise external contamination) and a tight cover (prevent algal growth and mosquito breeding)

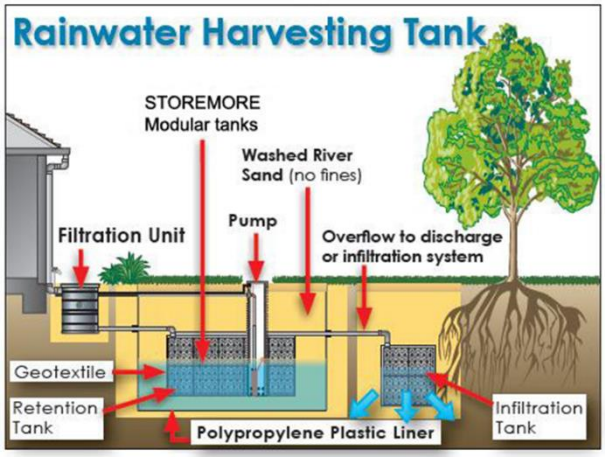


Storage Tanks

Factors to consider for determining the optimal system include:

- Water demand
- Quantity available
- Tank size
- Tank shape
- Tank materials

Plus regular maintenance and cleaning of the gutter and storage tank is essential



Volume Available

Volume harvested per household can be determined by the following equation:

$$VR = \frac{R \; x \; HRA \; x \; RC}{1000}$$

- VR = vol of rainwater harvested per household (m^3)
- R = rainfall depth (mm)
- H_{RA} = Household roof area (m^2)
- R_C = runoff coefficient (no unit) 0.8-0.85

Table 7-1

Runoff Coefficients for Common Roof Materials	
Metal	0.95
Asphalt	0.90
Concrete	0.90
Tar and gravel	0.80-0.85

www.permadesign.com

Example

Calculate the highest and lowest volumes of rainwater that can be harvested for the following:

- Ave rainfall for month (highest) R = 192.52mm
- Ave rainfall for month (lowest)R = 4.67mm
- Household roof area, H_{RA} = 80m^2
- Runoff coefficient, R_C – 0.8

Volume = 12.32 m^3 highest and 0.30 m^3 lowest

Water Use

The average home **uses** (based on a 2.7 people per household): 422 litres/day (Hienrich, 2008). For a 200m^2 home, a home on average will **harvest** around 168 m^3/year or 460 litres/day. (based on Auckland rainfall patterns)

Macro-Catchment

Main Characteristics

- Overland flow or rill flow harvested
- Runoff stored in soil profile
- Catchment usually > 30 metres in length
- Provision for overflow of excess water
- Uneven plant growth unless land levelled
- More expensive

Examples:

Long Slope (usually for crops)

- Trapezoidal Bunds
- Contour Stone Bunds

Floodwater harvesting (usually for crops)

- Permeable Rock Dams
- Water Spreading Bunds

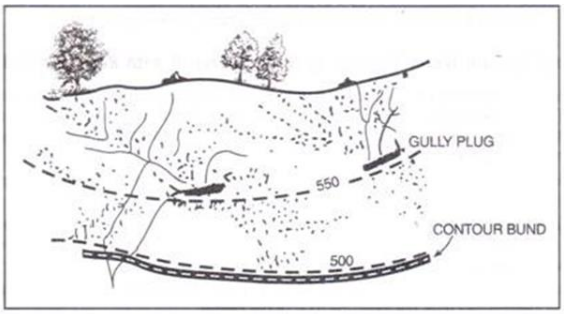


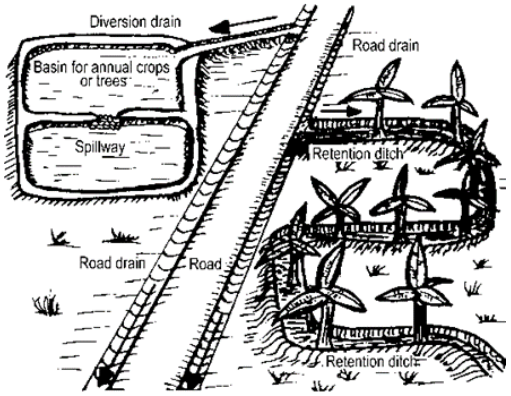
FIG. 16.10. Rain water harvesting through gully plug and contour bund

Managed Aquifer Recharge (MAR)

The recharge of an aquifer under controlled conditions to store the water for later abstraction or to achieve environmental benefits.

Water can be added to the aquifer by infiltration (via structures such as ponds, basins, galleries and trenches) or injection via wells.

There are many potential sources of recharge water including stormwater (excess or redirected), treated wastewater and water from watercourses or aquifers. Pre-treatment may be required.



Benefits of MAR

- Potential to increase water availability by generating water supplies from sources that may otherwise be wasted.
- Improved maintenance of wetlands and caves
- Opportunity for storage of water (in times of surplus to meet need in times of demand)
- Prevention of salt-water intrusion
- The potential to improve water quality (natural removal of nutrients, degradation of chemicals and pathogens).

Disadvantages of MAR

- Will not be feasible everywhere, due to hydrogeological, environmental or cost constraints.
- There are a number of environmental, health and social issues associated with the process that need to be addressed.
- Pre-treatment may incur costs.

Greywater Recycling Drivers (NZ)

- Freshwater availability
- Reduce pressure on local infrastructure (e.g septic tanks)*
- Reduced loading on septic / sewer systems
- Irrigation
- Climate change?

Water Recycling

Greywater (from showers, baths, bathrooms, sinks and laundry) can account for up to 75% of the wastewater from a domestic household.

Water from kitchens may also be included in greywater but will require some form of treatment prior to use.

May contain bacteria, protozoa and viruses as well as chemical contaminants from pharmaceuticals and cleaning products.

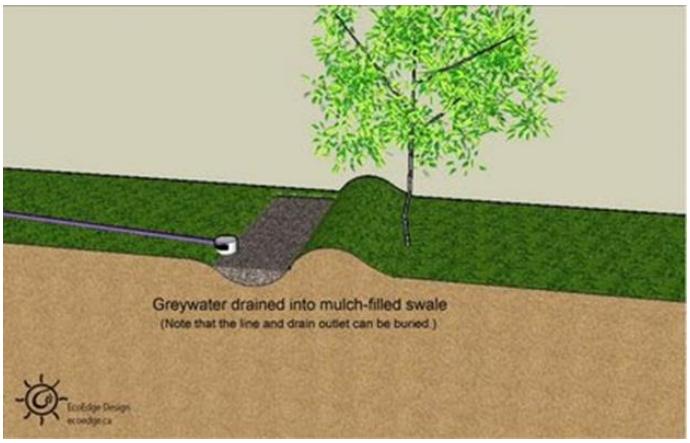


Image from www.permaculturereflections.com

Greywater Recycling NZ

Improvements in non-residential buildings (BRANZ, 2014)

Plus a growing number of NZ households are using some form of unregulated and unreported greywater disposal systems (Siggins *et al*. 2014)

NZ Legislations/Standards

- No current national greywater reuse standards
- Information in AS/NZS 1547:2012, TP58 and NZS 4404:2010 but none specific to greywater use
- Must comply with RMA 1991, Buildings Act 2004, Health Act 1956 and Local Government Act 2002.
- Most regional councils – permitted activity
- Greywater reuse mentioned in few District and City plans.

Greywater Reuse

- Greywater must be treated prior to reuse for toilet flushing, washing clothes or surface irrigation
- Can be used untreated for sub-surface irrigation of grass areas (not food crops)

Greywater Treatment

May include:

- filtering
- settlement of solids
- flotation and separation of lighter solids
- anaerobic or aerobic digestion
- chemical or UV disinfection.
- Greywater used for irrigation should be filtered as it still contains high levels of solids and is otherwise likely to clog the irrigation system.

Filtering may be:

- a filter to catch the lint, e.g. a muslin bag, or
- use of large diameter pipes that allow solids to pass through the system without causing blockages.

Barriers to GW Recycling

- Requirements between different regions can be confusing and variable*
- Lack of clear legislation*
- Lack of understanding of the requirements for GW use*
- Complexity and rigidity of greywater legislation

*NZ

How Greywater Recycling works

Diversion of laundry and bathroom greywater for pumped diversion

This can only be done if there is sufficient distance between the floor level and the outside ground level to allow a gravity feed to the surge tank. It entails a valve on the appropriate waste pipes to divert the wastewater to the surge tank. The pipes may be individual or combined wastes from the laundry and bathroom (but not from the kitchen). Water is then pumped to the irrigated area.

Example: Kapiti Coast District Council

- Code of practise for Greywater Recycling
- Aims to ensure best practice solutions are put in place while allowing for innovation in materials and methods.
- Provides guidance to the owner/occupier of the dwelling with a rainwater and/or greywater system on their responsibilities in the safe use of non-potable water and ongoing maintenance.
- Does not provide guidance on greywater treatment systems.

Water Sensitive Urban Design

An approach to water management in towns and cities that addresses both water quantity and water quality.

However in some guides, the focus is very much on stormwater design. AKL includes ecological/social value.

WSUD measures:

- Swales
- Rain gardens
- Tree pits
- Roof water storage ponds
- Green roofs/walls
- Rainwater harvesting
- Permeable paving
- Increased vegetative cover
- Detention ponds
- Wetlands

SUSTAINABLE COMMUNITIES

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These are communities that incorporate urban planning, engineering design and architecture, often through integrated solutions, to achieve certain environmental outcomes for both the short and long term prosperity and resilience of the community.

Sustainable Transport

Many initiatives are evolving in communities around the world which are changing how we traditionally commute around our cities.

Carpooling

Many cities such as Auckland have dedicated T2 and T3 lanes for cars travelling with more than 1 person, to encourage carpooling.

New York City has a rideshare app which connects commuters to make carpooling easier, with 10% carpooling, compared with 2% taking taxis.

Bicycle Infrastructure

Copenhagen, Denmark has a well-developed bike network, with a 3rd lane on most inner city roads dedicated for cyclists, improved bike storage, maintenance and safety systems and innovation (e.g footrests at intersections), e-bikes with touchscreen navigation etc. Currently 36% of people cycle to work, uni or school and the target is 50% by 2025.

Congestion-based Toll System

Singapore is a high density city which is isolated within an island and as such have had to deal with significant issues with traffic congestion. Singapore has now become the first city in the world to implement electronic road toll system to address congestion. The system monitors the traffic across the road networks and calculates the toll accordingly to control the flow of traffic (as opposed to raising revenue to fund roads).

Bus Rapid Transit System

BRT systems or busways are dedicated roads or lanes specifically for buses, which include giving priority over other traffic lanes at intersections. BRT systems have been implemented in more than 166 cities around the world, mainly in Latin America, China and Indonesia. Jakarta, Indonesia has the largest BRT system (TransJakarta) with over 250km of road network. The Transmilenio system in Bogota, Colombia has a network of dedicated lines and stations like a metro system, buses are electric, so the system has reduced carbon footprint and construction footprint than a metro system.

E-scooters

Auckland amongst other cities has started introducing e-scooters. These e-scooters are dockless and electric. E-scooters present a convenient and affordable means of transport for many commuters.

WASTE MANAGEMENT

The 3 R's of waste management hierarchy (in order of priority) are Reduce, Reuse, Recycle.

Zero waste

San Francisco is ranked 1st in USA for waste management. 80% of waste currently diverted from landfills. Reuse, recycling and composting. Community based activities - reuse and backyard composting. Municipal recycling and organics collections. Aiming for Zero Waste by 2020

Recycling

Swedes recycle nearly 100 per cent of their household waste. Recyclables are separated in the home (newspapers, plastic, metal, glass, electric appliances, light bulbs and batteries) and then left in special containers at the end of the street for collection.

Waste to energy

In Sweden, 50% of household waste gets burnt to produce energy ("waste to energy") which is fed back into the grid. They sometimes have to import waste to have something to burn, to turn waste into energy.

WATER SUSTAINABILITY

Rotterdam

Rotterdam in The Netherlands have implemented a variety of water sustainable initiatives including green roofs, water plazas and integrated stormwater solutions. Green roofs (rainwater harvesting) reduce runoff and pressure on pipe networks. Water plazas are public open spaces designed to be control-filled with stormwater to prevent flooding of surrounding areas. Multifunctional carparks have been built to incorporate large underground storage to temporarily store stormwater to protect the city's sewage system in heavy rain events. The Museumpark has a large underground water reservoir with capacity of around 10,000 m3 for temporarily storing storm flows.

Curitiba (Brazil) – Green City

Curitiba has been referred to as the "greenest city in the world" with 52m2 green space per person. Parks double as stormwater management facilities. Citizens are empowered to keep the city clean through trash & recycling programs in exchange for bus tokens, food and cash, which encourages the population to respect and care for their city.

SUSTAINABLE HOUSING

Hobsonville Point

New Zealand's towns have traditionally grown organically. The problem with organic growth is that the facilities (sewer, water, roads, public transport, schools, hospitals, shops etc) are always one step behind. The Hobsonville Land Company has taken the opposite approach by building a master-planned community.

This involves a well-designed Urban Plan, i.e. by the time the houses are built, the community will have everything it needs to thrive, purpose-built to the right scale and located in the right place, including parks, well-planned roads, schools, community hall, jobs in the neighbourhood, access to

public transport to the CBD, shopping centres a short drive away and local restaurants, bars and cafes, homes by the water.

The project covers 167 hectares of land, located 11km from Auckland CBD. Diverse housing including heat pump/solar hot water, insulation levels above the building code and double glazing, north-facing homes, energy efficient lights, rainwater tank to collect water from roof for use in toilets, laundry and garden, water efficient showers, toilets and taps, fold away washing lines so that you don't have to use the dryer as much.