SCIRT Rebuilding Infrastructure

LEARNING LEGACY

Lessons learned from one of New Zealand's most challenging civil engineering projects: rebuilding the earthquake damaged pipes, roads, bridges and retaining walls in the city of Christchurch 2011 - 2016.

What to rebuild, where and when

Story: Project Prioritisation

Theme: Programme Management

A presentation given at the New Zealand Geospatial Research Conference 2015.

This document has been provided as an example of a tool that might be useful for other organisations undertaking complex disaster recovery or infrastructure rebuild programmes.

For more information about this document, visit www.scirtlearninglegacy.org.nz

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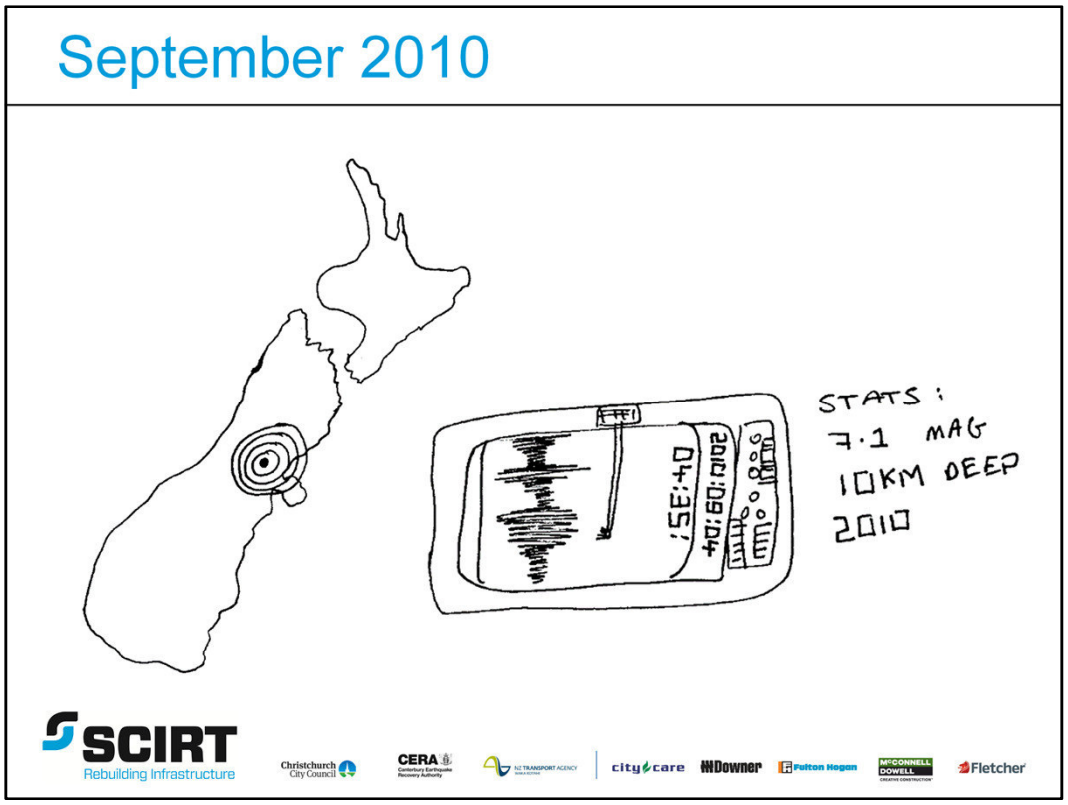
My name is Abigail and I have been part of a really neat GIS team at SCIRT for the past 4 years, my home organisation is Jacobs.

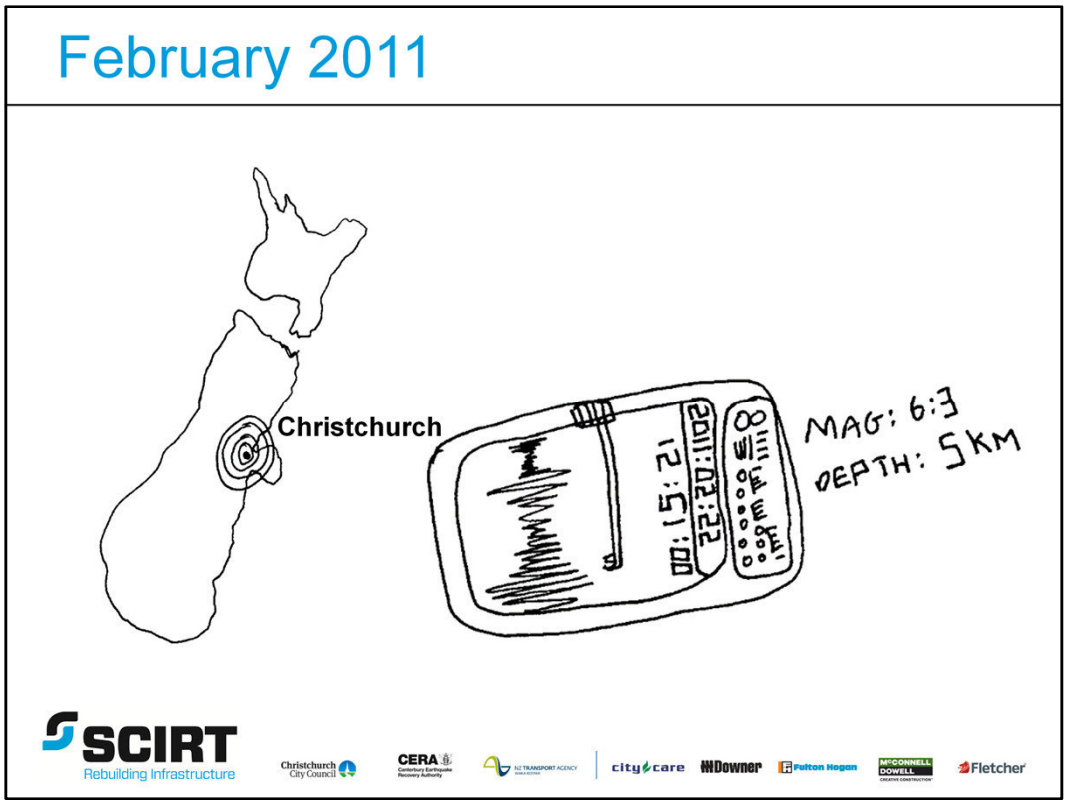
For those of you that might not be familiar with SCIRT it stands for the Stronger Christchurch Infrasturcture Rebuild Team created following the earthquakes of 2010/2011 to undertake the horizontal infrastructure repairs to the wastewater, storm water, water supply and roading assets including retaining walls and bridges.
My talk today is about the early prioritisation process that was run at SCIRT and the role of GIS and data in this.

To begin with I will do a brief overview to help set the scene, then describe the challenge that was facing us, followed by a description of the approach taken and finishing with some key learnings from this.



Following the September quake CCC discovered that the most damaged infrastructure was concentrated in four areas of Christchurch.

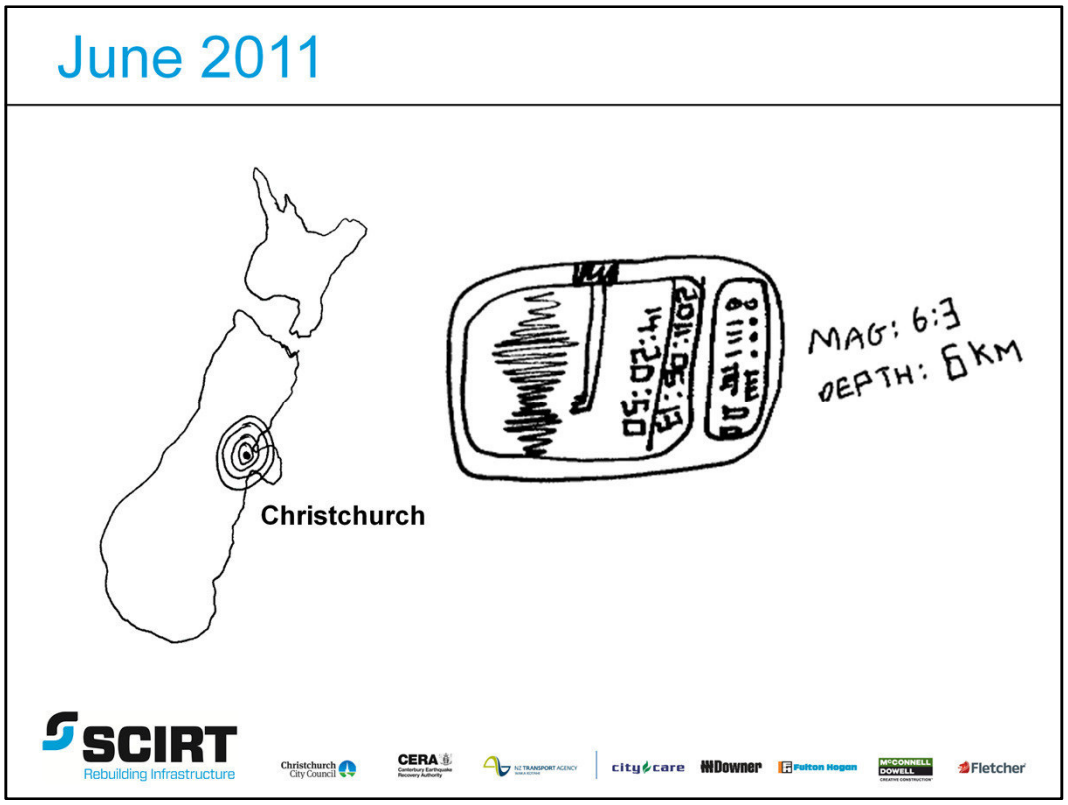
The aim was to repair the worst affected areas as quickly as possible. The Infrastructure Rebuild Management Office (IRMO) with a team of 20-30 staff was created to manage the reinstatement of infrastructure and oversee repairs.



The second earthquake in February caused much more widespread damage than the first but the major difference being that 185 people lost their lives.

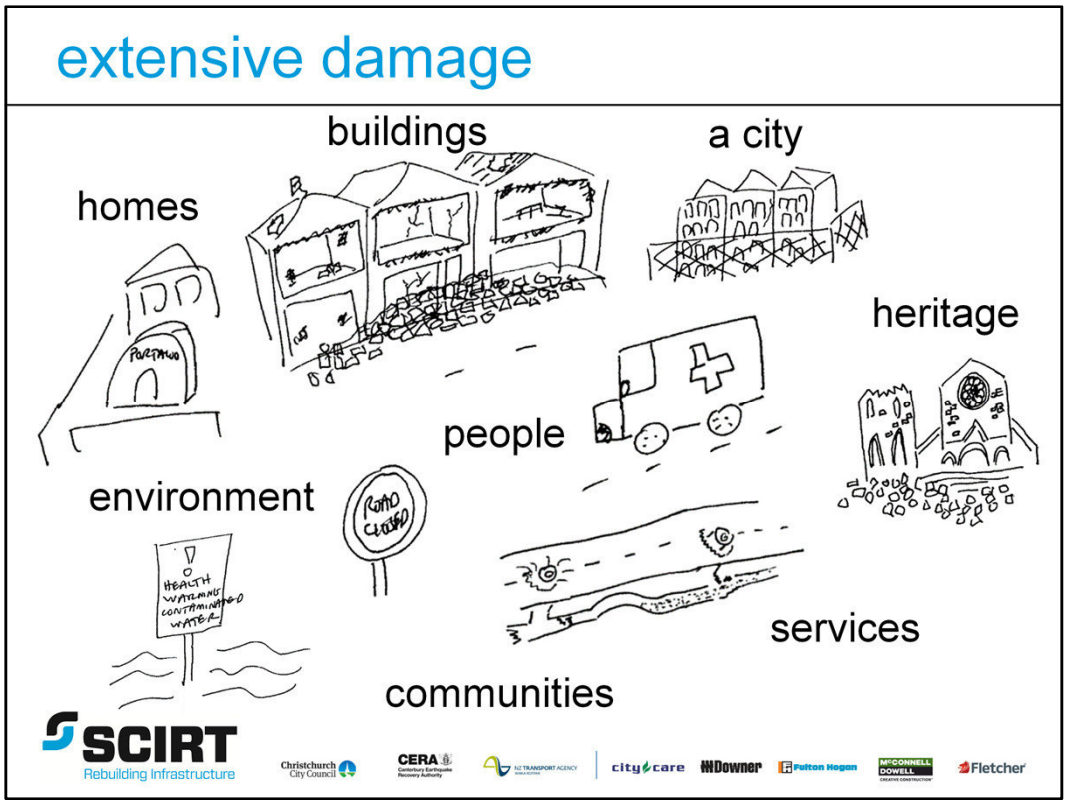
It was soon recognised that IRMO was no longer suitable for the larger size and scale of the task at hand and this is where SCIRT came into being but it would be September 2011 before it would be fully operational, with an integrated services team, made up of about 300 engineers, SCIRT would provide the overarching tactical co-ordination for the infrastructure rebuild right through from the initial project definition to asset assessment, design, costing, construction, construction as-builting of assets and the final handover of data back to ccc.

GIS would be a key part of this and sat within the business systems team, under the commercial team.



Another significant earthquake happened in june. At this stage repairs had been going on for several months but now things that had been fixed were now broken again, only adding more confusion to what needed to be done, that must have felt like going backwards.

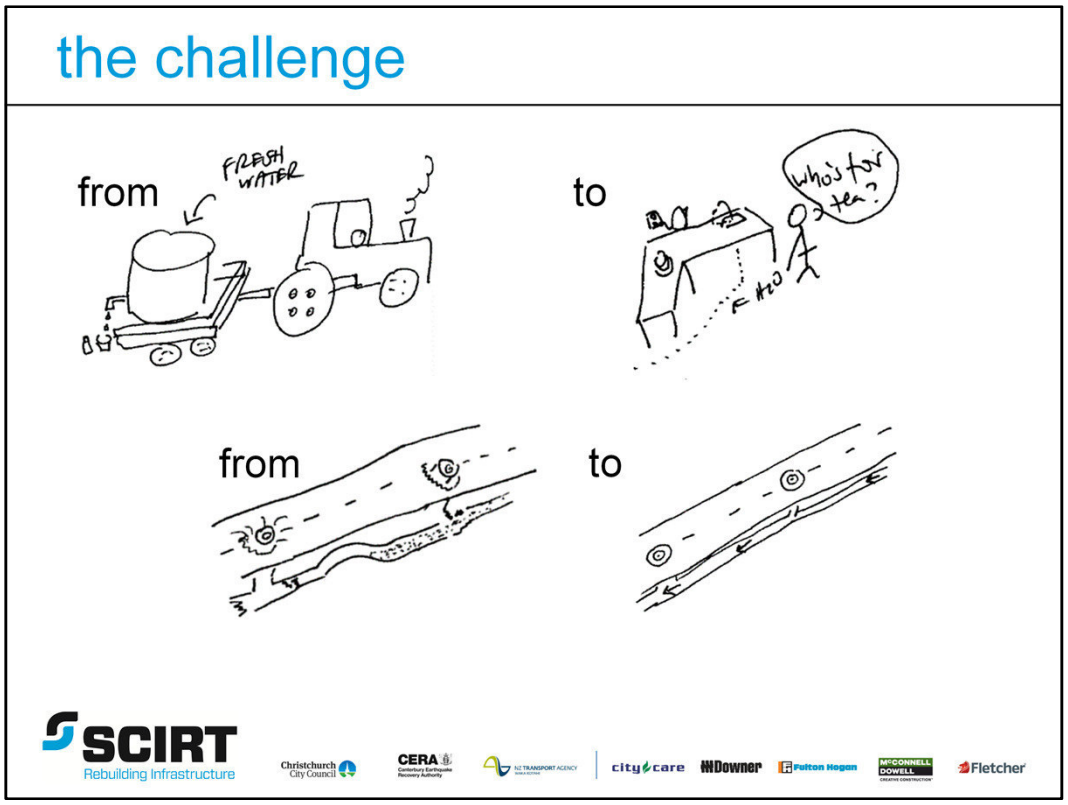
The damage caused by the june quake would see a number of our layers on the SCIRT GIS change to be able to differentiate not only between pre/post quake but now between differentiate between the significant events sept/feb/june.



The damage caused by the quakes was not just to things like buildings, services, homes, heritage, environment, the ground – land slides, rock falls, liquefaction but it was also about the damage caused to the people, what was once familiar and functioning was now broken/gone/not working.

The vision created by SCIRT to 'create resilient infrastructure to give people the security and confidence in the future of Christchurch', would be something that everyone could relate to and work towards to come up with ways of doing the best job that they could.

The life time of SCIRT was initially tied to the lifetime of CERA and would be due to finish April 2016 but given the initial impression and an understanding of the extent and scale of the damage caused following the February quake the life time of SCIRT was extended to December 2016.



The challenge facing the team was huge.

How would we go from communities collecting bottled water to being able to boil the kettle and make a cup of tea for your neighbour, or you granny, or to fill a hot water bottle.

How would we be able to go from road restrictions, traffic backlog or constantly changing detours to being able to get from A to B easily, as well as portaloos and chemical toilets being a thing of the past.

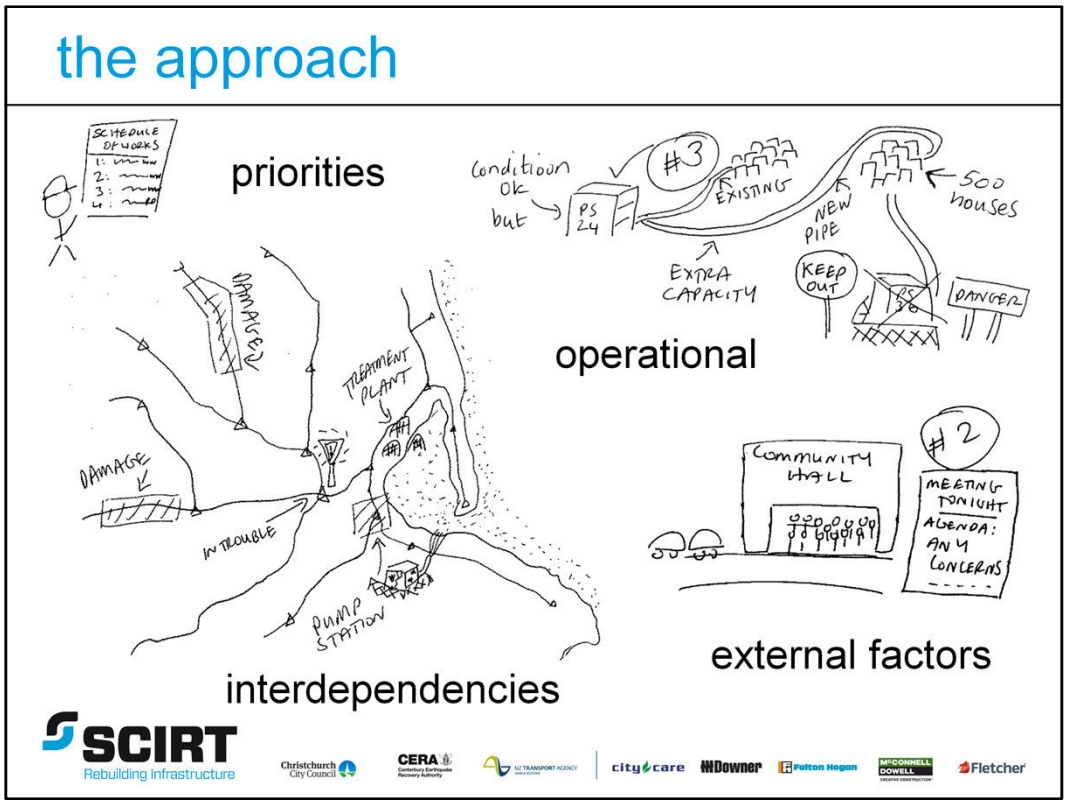
How would we go from having to discharge sewage to the rivers to having fully functioning network back again?

How were we going to do this?

With a budget of almost $2bn and a life span of 5 years, the infrastructure rebuild in Christchurch was set to be the largest engineering project undertaken in nz.

To ensure that SCIRT was going to meet this challenge we had to make sure that we would fix the right things, in the right order, at the right time and within budget, to do this a process for prioritising projects was developed.

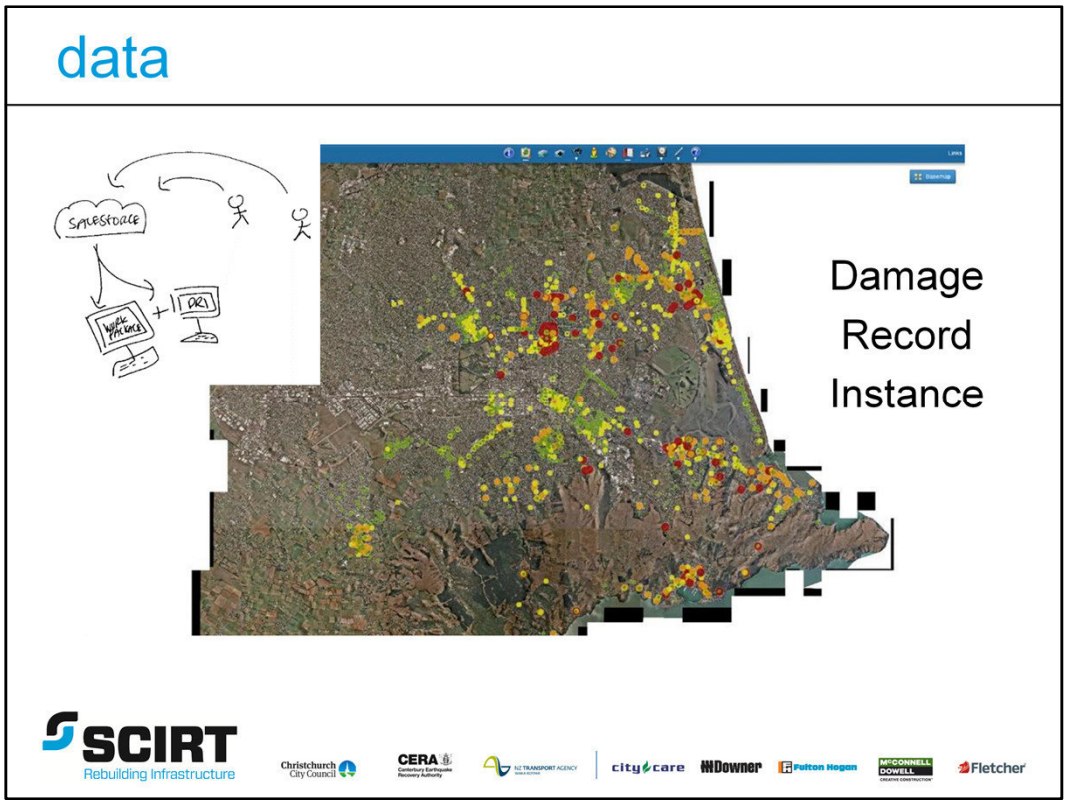
This drive for value and making sure we were always doing the right thing would also see SCIRT going through three major re-design approach focuses throughout the programme.



The project prioritisation process would incorporate and balance a number of factors like

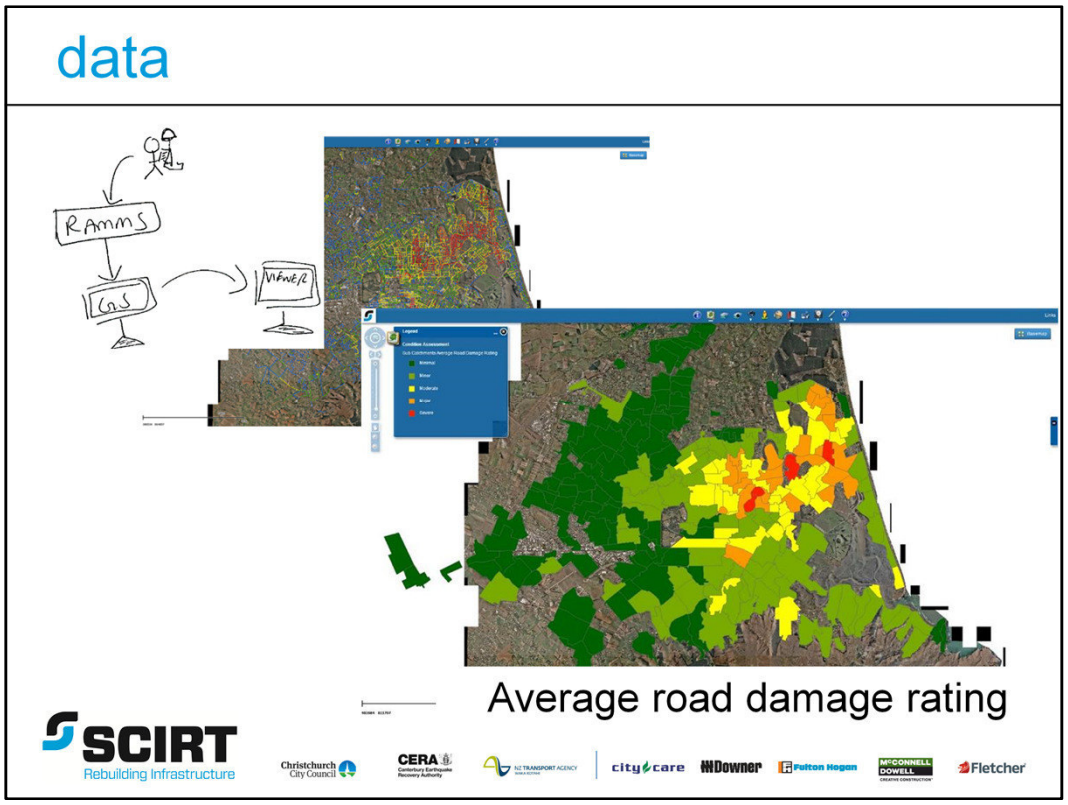
1. Interdependencies e.g. fix downstream issues first then address the upstream issues. Team (asset owner reps, project definintion, GIS and a few others) sat down in a room together and decided what catchments relied on each other
2. Operational priorities e.g. are there existing stations or assets that are going to have an increased work load on them because the land so badly damaged in an area that have to put in completely new approach – new pressure mains feeding extra capacity into existing stations – would the station be ok. Would we need to upgrade things that not broken.
3. External factors e.g. who else was doing work in the area, the work planned by utilities companies, schools, hospitals services would also be taken into account – who else would need to do work in the area
4. Community factors e.g. are there particular issues in the community that need to be considered? Are there particular communities that needed to be considered e.g. sumner. Our communications team were also involved in the process

Project definition team also created network area plans that would looked at all the issues in an area that needed to be considered, how many trees, suburban centres programmes, how much cctv, how much repairs, how many pipes etc GIS team set up process to summarise all these things G:\GIS\Processing\fme\Project Scoping Report Summaries.
We have also recently started working more closely with RedCross – if we had done this sooner could we have made use of their data and expertise in this process?



The data available was ever evolving and continually improving and we were going to need a lot of it.

One of the first datasets I was made aware of depicting damage was the Damage record from Salesforce. Salesforce is cloud based computer system and was being used by the contractors in the field to record instances of damage, load it to salesforce, GIS team would download it and make it visible on the SCIRT GIS viewer. These DRI would then be created into work packages. The information was good but we would need more.



The RAMM road damage ratings was another dataset we had. c.40,000 GPS points collected detailing location of damage for Cordons, Drainage repairs, Footpath, General, K&c repairs, Make safe, Pave failures, signs.
In September 2011 we created average road damage rating to a subcatchment level and it was one of the first representations of a city wide depiction of the damage.
This data was also good but just a once off collection and just relating to what visible above ground.

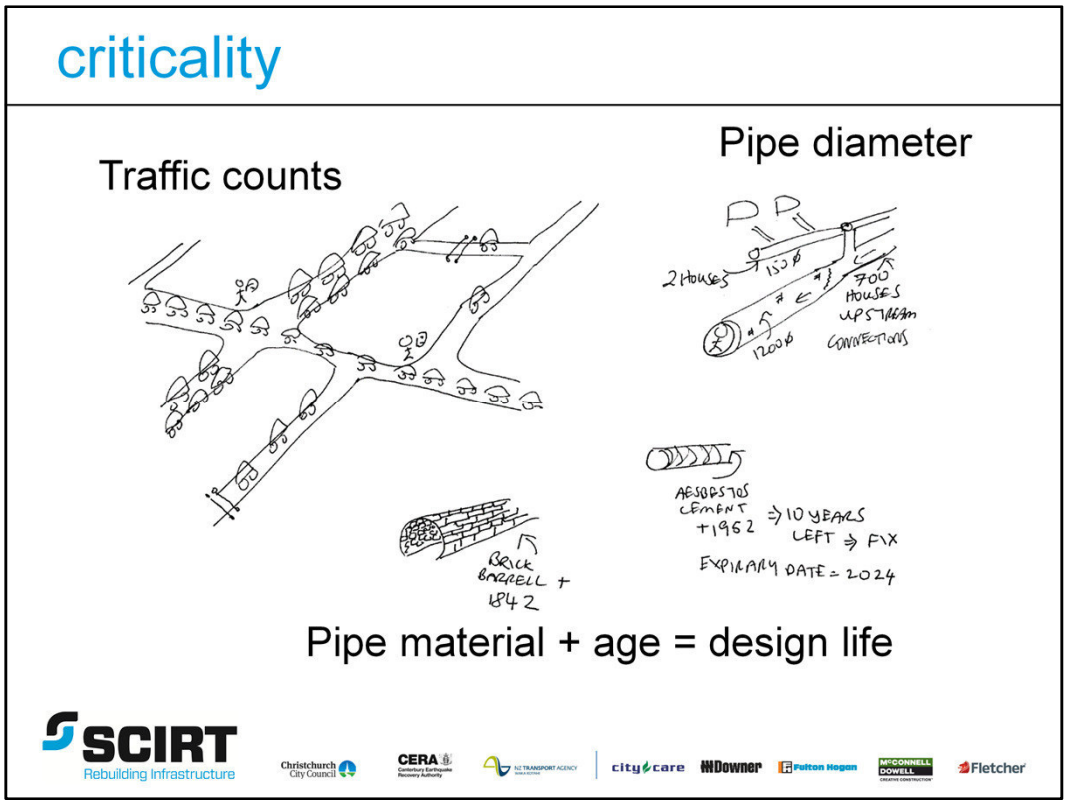
But to really understand where to rebuild and when we would need to understand the extent and scale of the damage caused to the underground assets.

We would not only need information about the about the assets but would also need a whole lot of other stuff – where did the ground liquefy, where is the red zone, where are the projects underway and what's already finished it help create the bigger picture.

It's important to remember that the scope of works was still being defined as asset assessment, design and construction was underway. Data and information was being collected as we created a strategy for rebuilding.

Bottom point we needed data and quite specific data relating to a number of factors

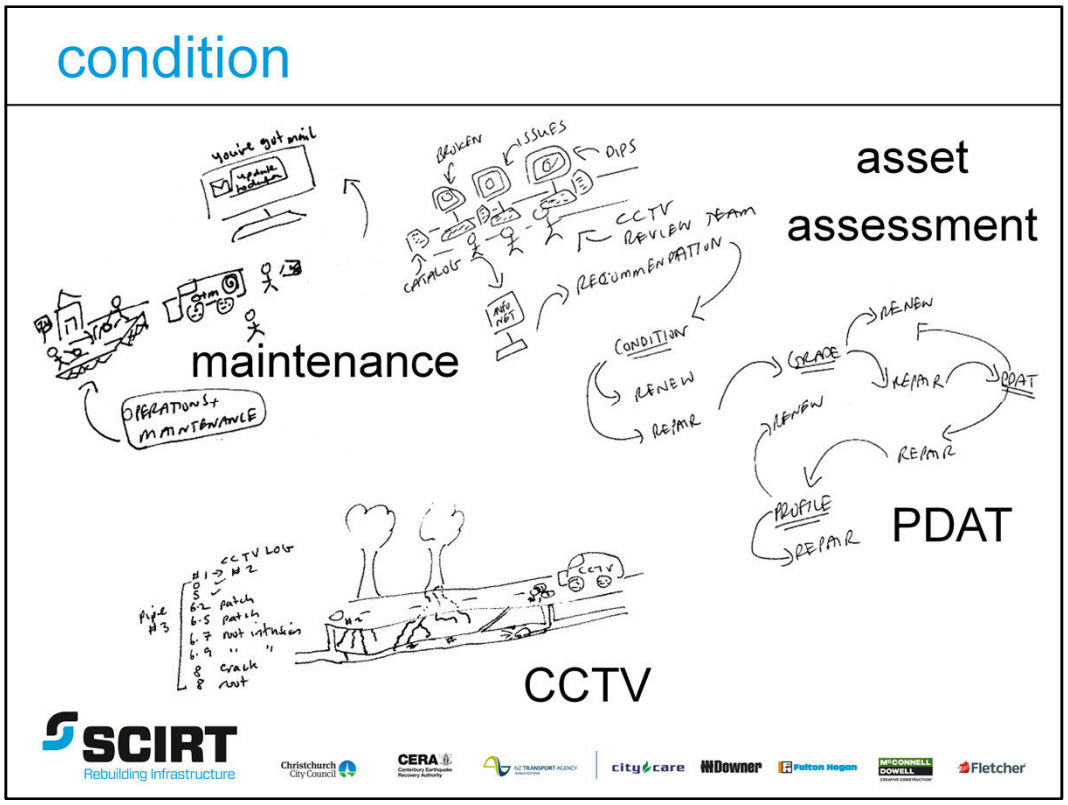
1. Criticality
2. Condition
3. Level of service
4. Maintenance cost



We would need to know what our critical assets were?

What were the things that might break, what were the things that were nearing the end of their life, what were the things that we had to make sure were still workable.

The busier the road, the bigger the pipe, a combination of the age and material of the pipes would essentially give us an expiry date on the pipes. All of these things were things that had to be considered and would be provided by the respective organisations.



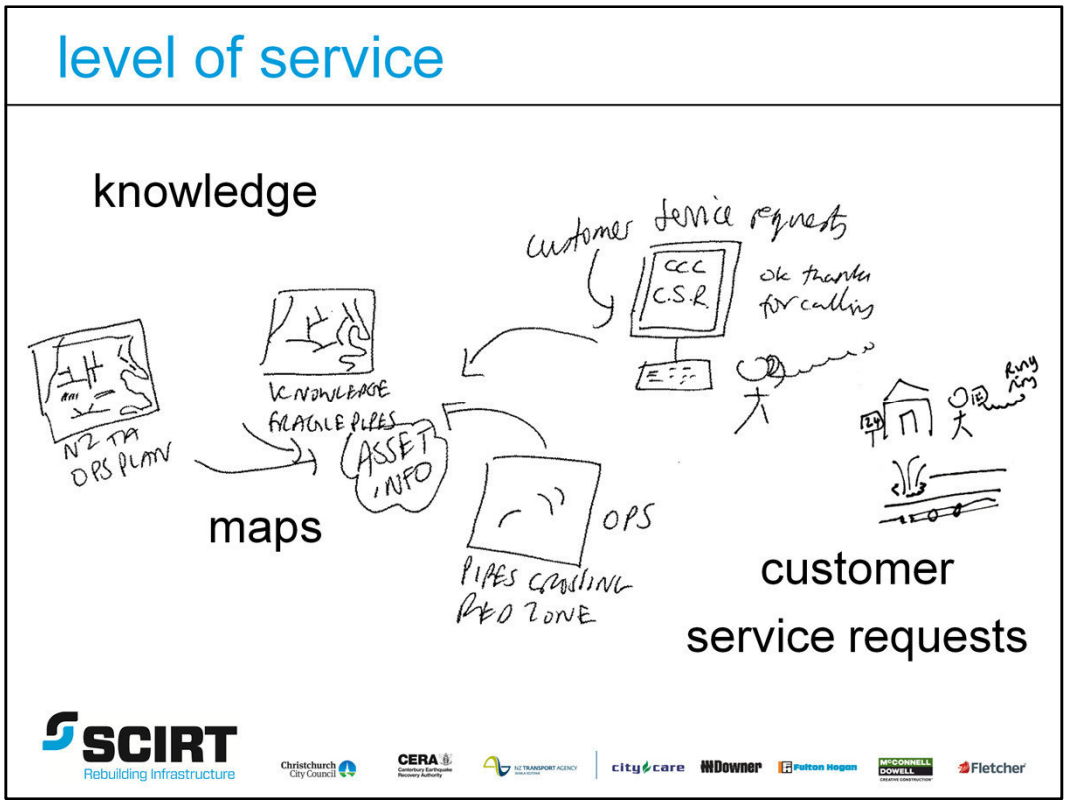
We would need to know what condition was the asset in?

The main asset assessment tool was CCTV (camera goes down a pipe and video taken creating a catalog of defects on pipes) this would be an invaluable source for the city of the condition of its network – CCTV done on over 65% of the network, 1000km of ww gravity cctv, 460km of sw cctv.
100,000 inspections, total footage 30 tb, 530,000 pctures.
2 years cctv programme of 45km/month ccc used to run 10km/year.

Asset assessment was always getting better and in places where no CCTV, we would use a pipe damage assessment tool (PDAT) developed to fill in the gaps – look at results of CCTV in the area and take other things into consideration and give a confidence of the likely hood of that pipe being same as those that cctv'd.

We would also use the city care repairs dataset detailing the maintenance repairs made to the network to infer a condition of the pipe e.g. on water supply if more than 5 breaks pipe was renewed, between 3-5 then it was considered, less than 3 fine – the repair strategy for watersupply and all assets would go through several reprioritising initiatives (IRTSG, Level of Service, network approach).

The city care repairs data also contained data relating to operational issues e.g. blockages, smells that would go on to be used in the three major re-design approach focuses to reprioritis the rules which we applied repairs.



Data representing how everything works – is the service Good, ok, bad, is the network working yes/no/sort of.
One the hardest ones to define digitally! Most varied formats not a lot of digitally available data. We relied a lot on operational netowrk knowledge – how do you assign that back to an asset level?

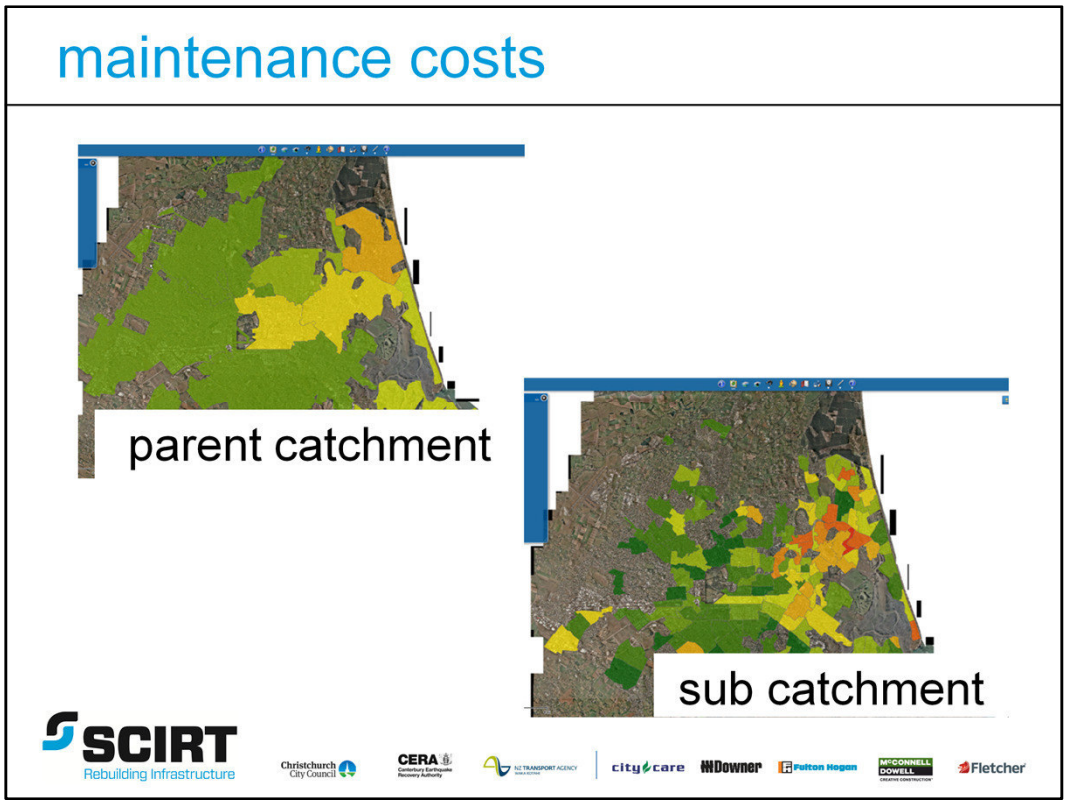
We would be given maps

- NZTA ops plans – highlighted with notes.
- Fragile pipes – operational knowledge of the network by area managers – plan highlighted with different colors.
- Pipes crossing red zone again from operational knowledge.

We would use Customer service requests from CCC, match them to a road based on the address and attribute a level of service based on the number of compalints – the more complaints attributed to a road the lower the level of service.

What about chemical toilet distribution – this would be something a design engineer would ask for later to help determine what kind of service was in an area at a particular time.

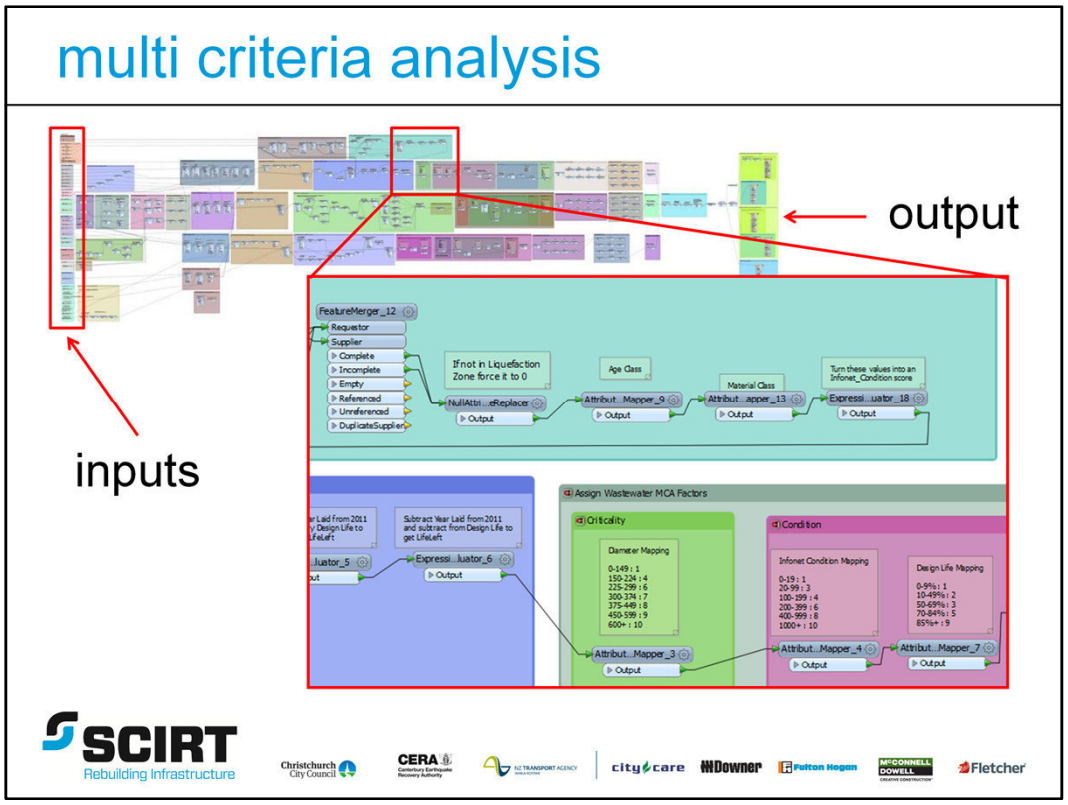
How can we better capture the operational knowledge about the networks? How much other information was there available that we could have used?



The cost of maintaining damaged assets to keep them operational was another thing we would have to consider.

Initially supplied only at a parent catchment level but then sub catchment for 6 months previous but still valuable information as could now see what assets were within the areas that were costing more to maintain.

Does not necessarily take into account environmental costs e.g. overpumping to the Avon.

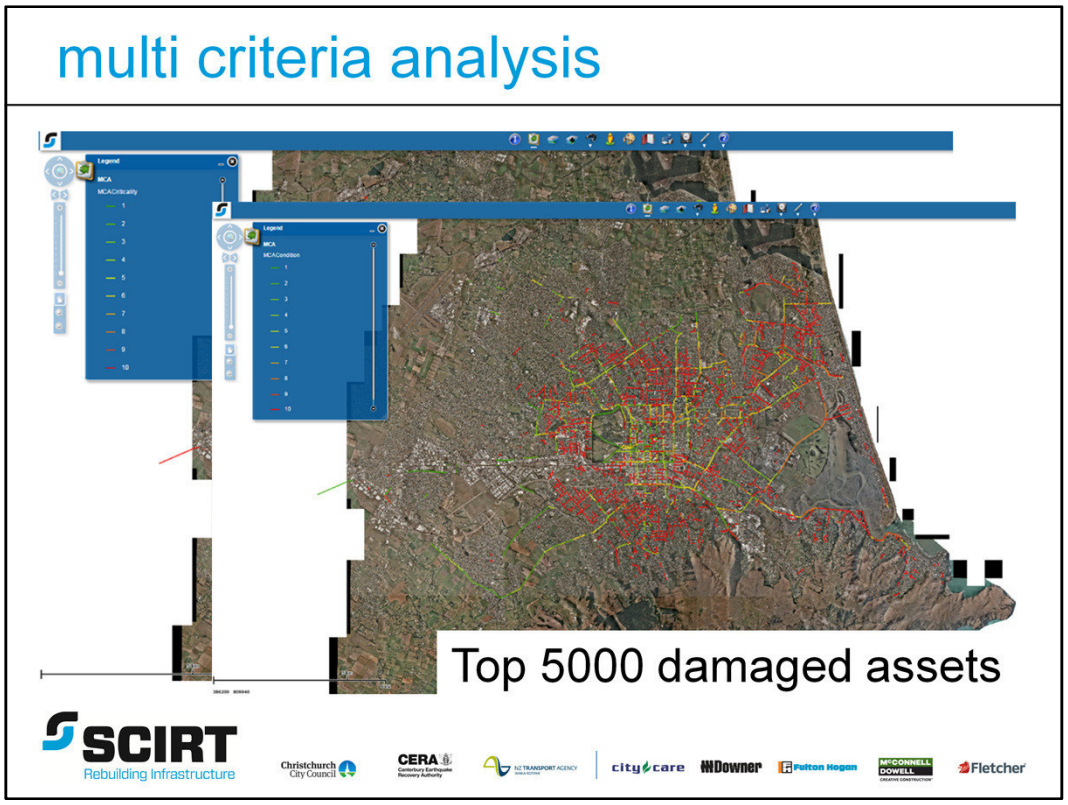


So what did we do with all of this data?

A multi criteria analysis tool with condition assessment data as its primary input was developed that would assign a score to individual assets based on asset condition, criticality, level of service and maintenance costs.

The tool was developed using FME (feature manipulation engine) by Safe Software. It was a tool that evolved over time and allowed us to take data from many sources and put it through a streamlined process.

- It was easy to add data to – as new data became available we could add it in, as better data available we could replace it.
- It was Flexible – set up and run with different parameters, run in testing/production parameters (check data), run with different weightings on different factors
- It was Auditable – output date stamped and essentially apply science to the numbers, NZTA auditors have been taken through the tool to get an understanding of the process applied
- It was Repeatable – run every three months – not a consuming task – making sure data inputs up to date more consuming!
- It was Current – data was continually being updated, condition started with cctv then added profile and pdat depending on what available, all incoming data updated first



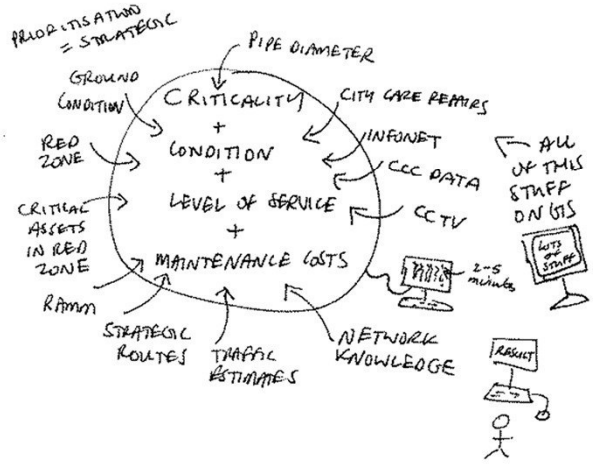
The tool would take the data defined for the asset (criticality, condition, level of service and maintenance coasts) and assign a total score as well as an individual score for each factor on the asset.

We were able to view the assets in terms of multiple factors from one single output.
We could view the assets in terms of where the most damaged were based on condition, where the most critical were, where the most expensive were in terms of maintenance.

The outputs from the MCA tool would kickstart the prioritisation process.

prioritisation

update data



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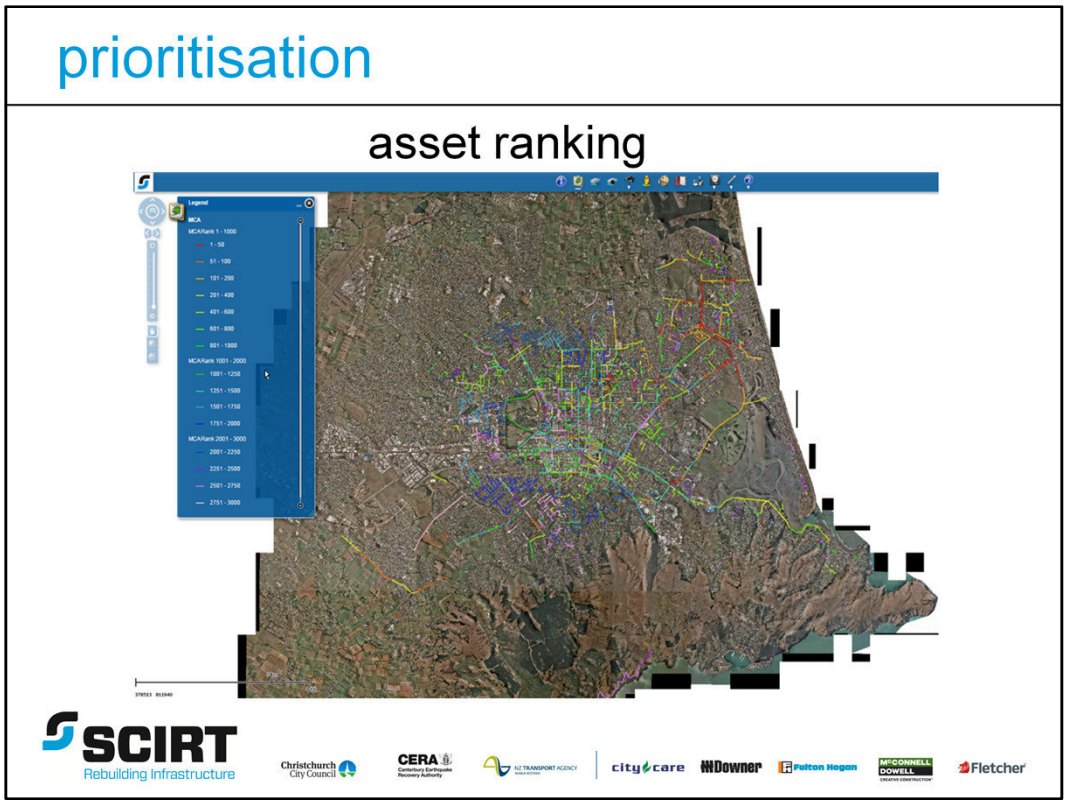
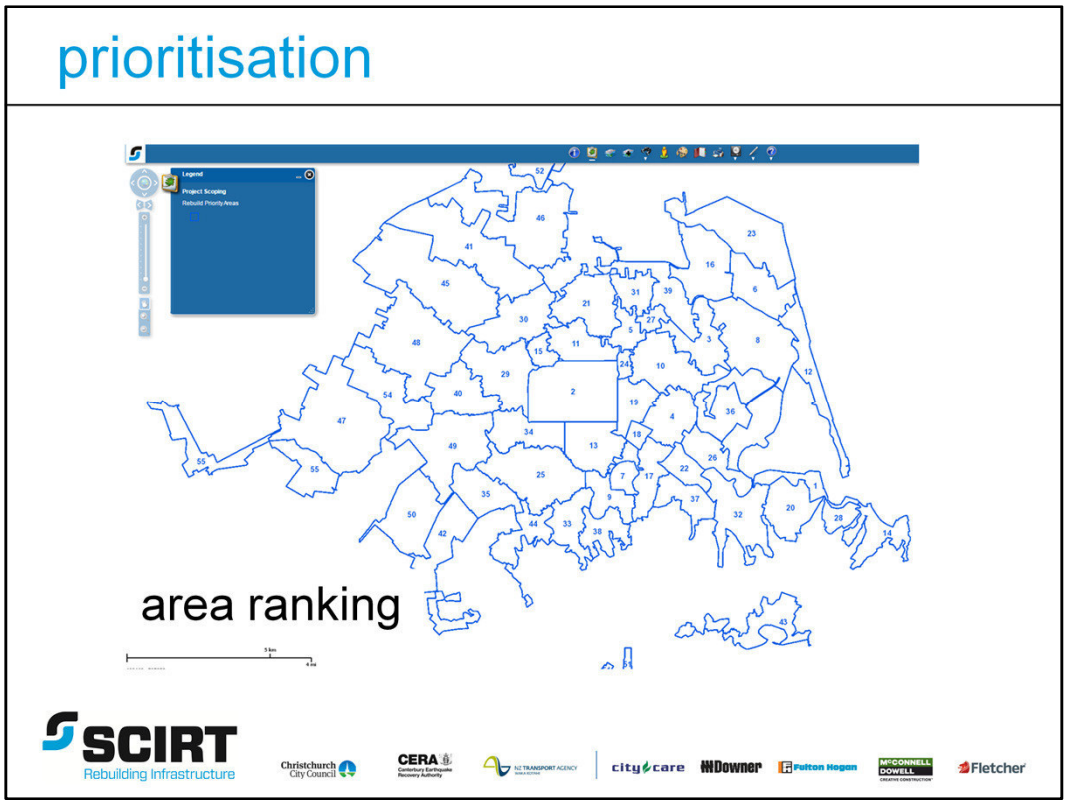
As the process was run every three months more info available and more assets being repaired therefore constant refinement. Updating the existing data or making sure that we had the most relevant/current data available was the first step in the prioritisation process before running the MCA tool.



Asset ranking

Once the MCA tool was run a list of assets was created that would assign as score to each asset based on a combination of the four factors representing criticality, condition, level of service, maintenance cost.

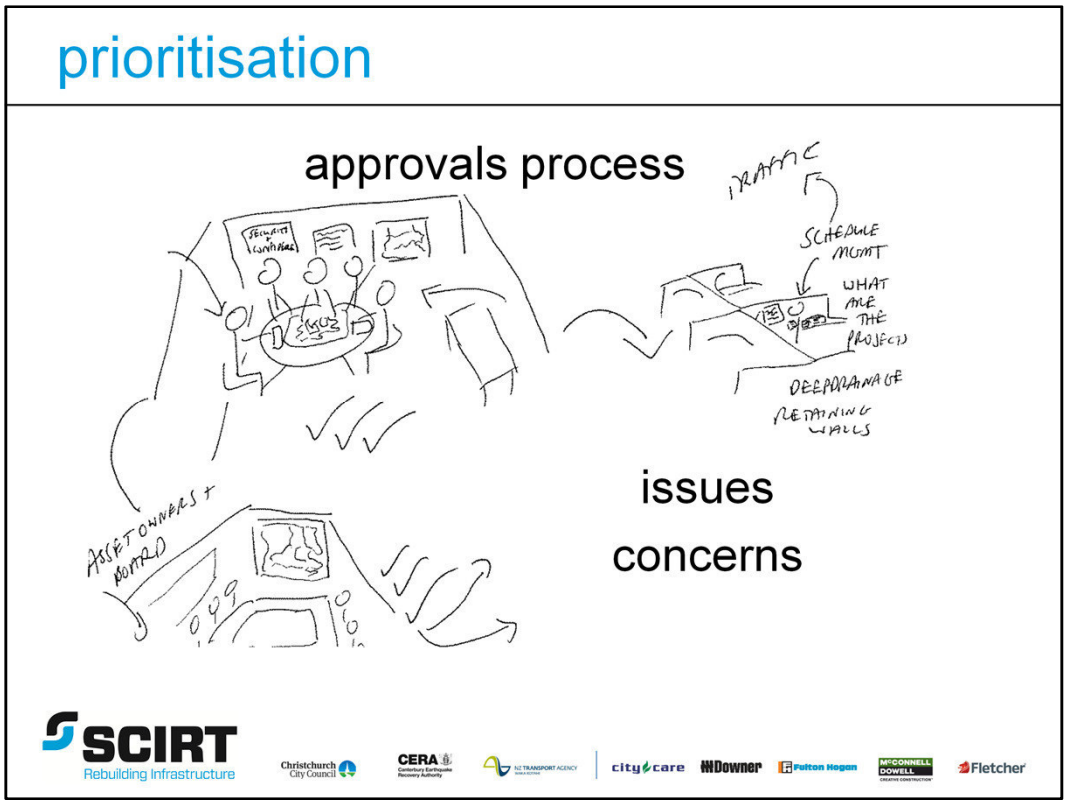


Area ranking summarised up the damage scores.

The assets with a total score would then be summarised to a priority catchment and project level using the area of the catchment/project as a way to normalise the data.

These priority areas had been created earlier in the process when interdependent catchment were defined and grouped into priority areas. The areas with the most damage would be further up in the area ranking.

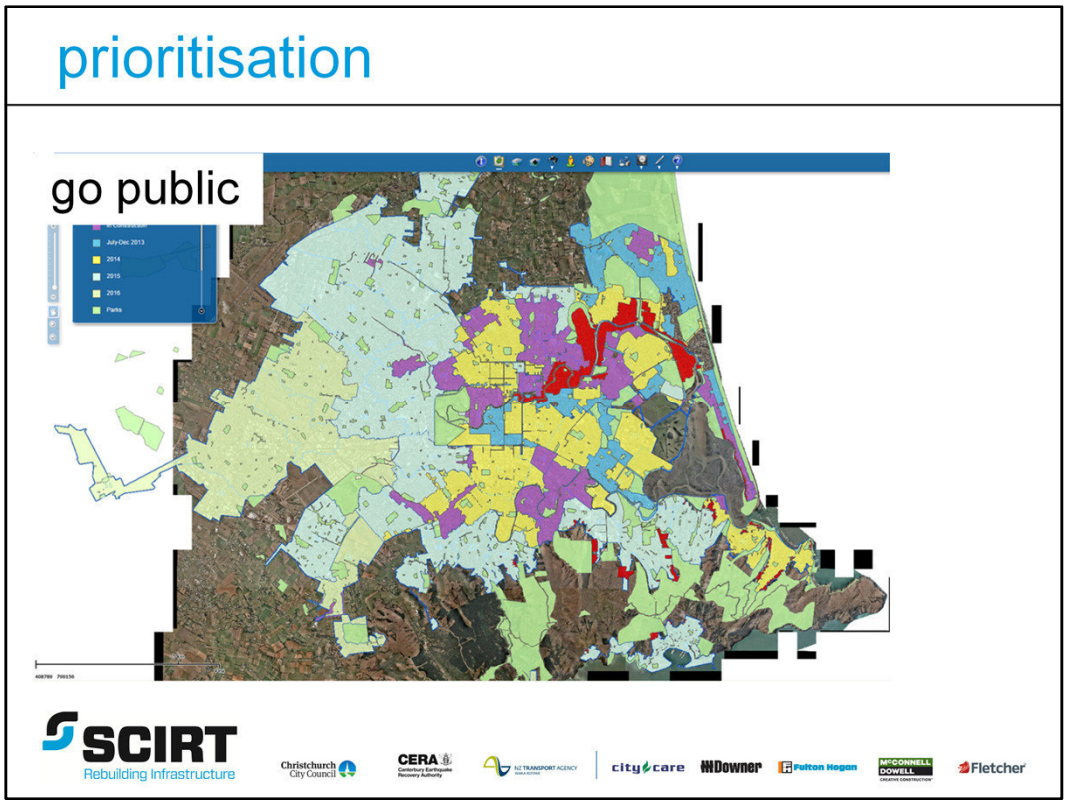
Whilst the areas were ranked from most damaged to least damaged it did not necessarily mean that we did all the work in area 1, 2, 3 then moved through the areas but as the damage was city wide multiple areas would have work going on at same time and within each of these areas there would be a prioritised order of projects beneath.



Approvals process, issues/concerns.

An important thing to point out whilst MCA an automated process, a key part of the prioritisation was the human interactions and it was these that issues which we could not replicate or have data for would be addressed. There were several levels of approvals where external issues addressed.

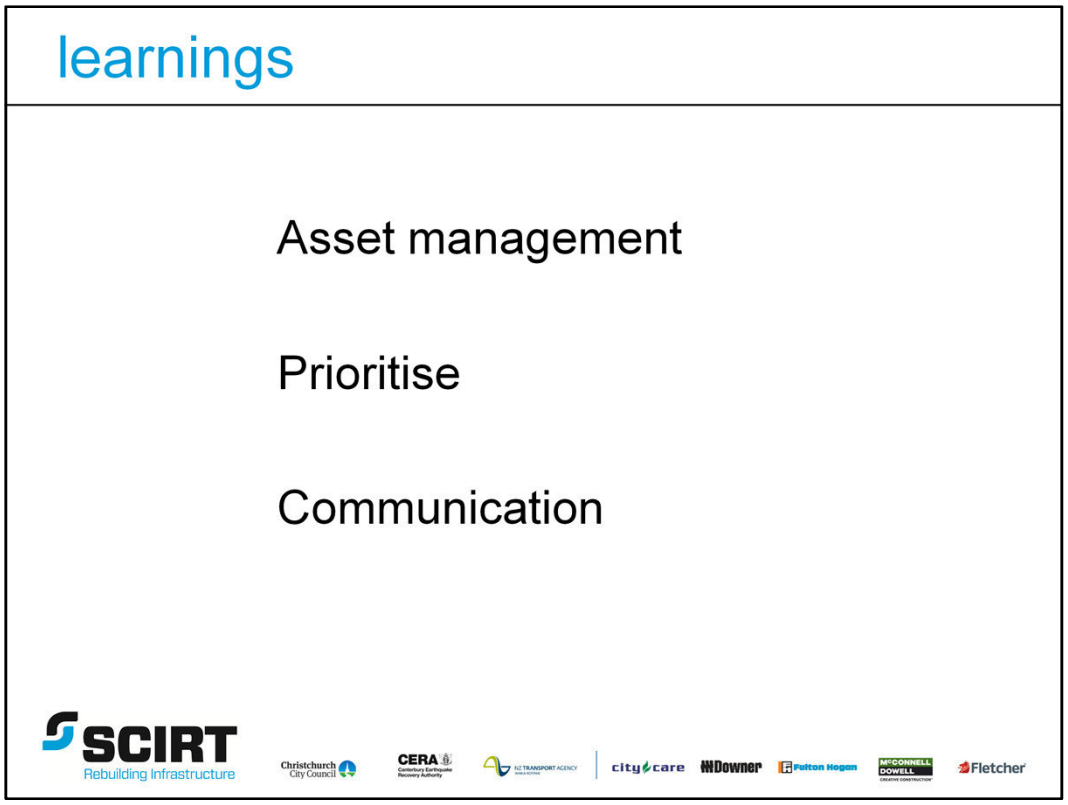
The prioritisation process at this stage and scale was focused on strategic area wide priorities and would go on to inform detailed street rebuild through schedule.



Go public – this a strategic high level prioritisation of area wide rebuild for the city.

At this level it was an area wide not individual street level approach, several prioritised projects at a time in different areas. The detailed street level interactions would be done by the delivery teams.

Worked with the communications team to get this message to the public, every quarter rebuild areas created with 6 month time frame.



To understand where to rebuild and when you need to understand the extent and scale of the damage caused. To understand the extent and scale of the damage caused you need to understand the data available that represents this. To understand the data available you need to know where to get it and what the value of this information is.

Having data represented at an individual asset level, meant that the asset could be tracked through all the stages of SCIRT's integrated process of design and construction, starting with initial assessment to design to construction and back again through the as built process, which would update existing data therefore starting the cycle all over again.

1. Asset management – its key, know your assets, where they are and the condition of them, it will help you focus your renewal strategies.
2. Prioritise - you will provide value by doing things in the right order and at the right time, take a little bit of time at the start to think about this.
3. Communication – not only to the public but also internally to the different teams, it really helped that all in same building. Deciding what to communicate and when, is an important thing to consider. We ran the process several times but did not always make the information public for several reasons – not much changed, we had to get on and get things done, sometimes we could not take all community issues into account and would have to make tough decisions.

questions?

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