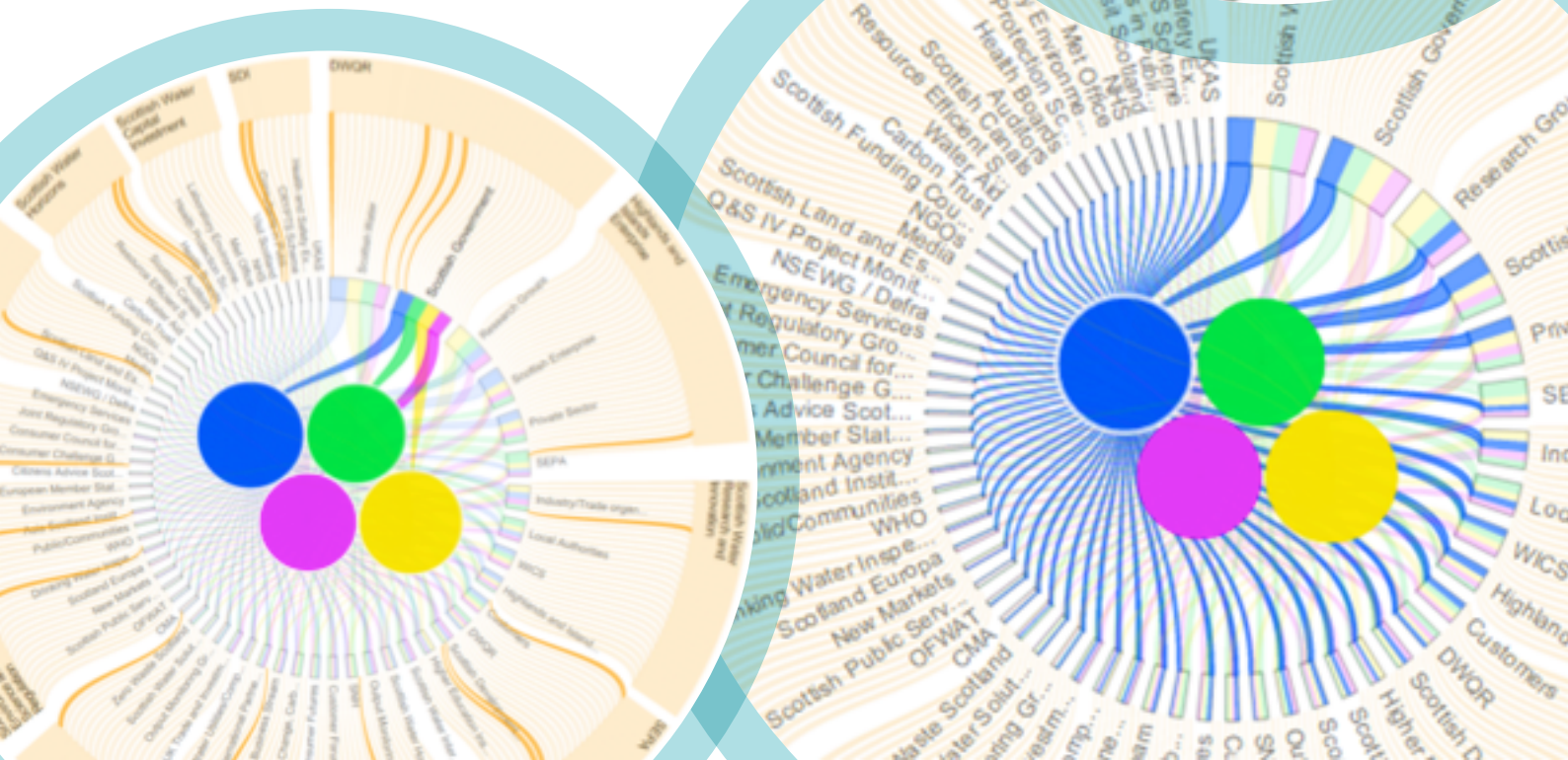




Scotland's centre of expertise for waters

# Scotland's water sector: An overview





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# Executive summary

## The question

What is the scope and the scale of Scotland's water sector, and the interactions and decision making processes therein that are relevant to Scotland's Hydro Nation Strategy?

## Key findings

- The research presents policy makers with an overview of businesses working within Scotland's water sector and an interactive tool. The tool can be used to identify established linkages within Scotland's water sector and where additional effort may be required to support development of the Hydro Nation Strategy.
- The outputs allow for interpretation and communication of technical, institutional and economic issues supporting capacity development for all water users, operators and decision makers.
- The methodology used can be replicated to measure the impact of policy decisions on Scotland's water sector over time.
- The data presented provides a baseline that can be updated in the future and used to measure progress in key areas of growth.
- Access to the interactive maps is available at: [http://save.abertay.ac.uk/abertay\\_watermaps/](http://save.abertay.ac.uk/abertay_watermaps/)

## Background

The purpose of the research was to produce a map that demonstrates the scope and scale of Scotland's water sector and demonstrates how the different parts of the sector link together. It demonstrates how the decision making processes that influence, manage and control Scotland's water resources are distributed throughout the sector. This research supports the Scottish Government's Hydro Nation Strategy.

## Research undertaken

The research presented two key challenges: Firstly, to examine the scope and the scale of Scotland's water sector, and secondly

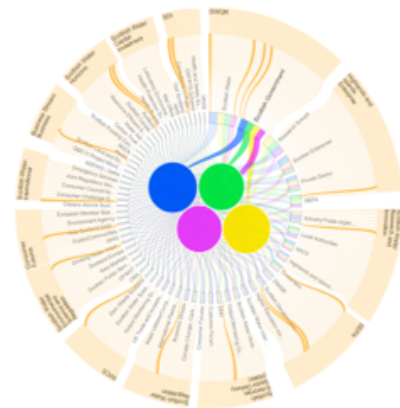
to identify the key interactions occurring in the water sector that impact upon the Hydro Nation Strategy.

For the scope and scale, information was collected to identify the number and type of private sector companies working within Scotland's water sector. This was carried out through a combination of desk based analysis of industry sector groups, trade body member lists, and business directories, as well as through an analysis of Scottish Water contractors. A scope and scale map was produced to present the number, type and activity of businesses involved in the water sector on a geographical basis.

For the sector interactions, information was collected through interviews with 14 stakeholders. Interviews identified the number, type and importance of information flows that exist between interviewees and other stakeholders throughout Scotland's water sector. The information flows were scored for the type of information flow (Managing, Influence and Control) and for importance based on the four Hydro Nation themes:

- Economic opportunities
- Environmental protection
- Research and development
- Governance and international development.

An interactive wheel was produced demonstrating the interactions between key actors, and their relative level of influence. The outputs of the research include an interactive scope and scale map identifying businesses involved in the sector and an interactive wheel detailing interactions between key groups in the sector and their relative importance to the Hydro Nation themes. Access to these interactive maps is available at: [http://save.abertay.ac.uk/abertay\\_watermaps/](http://save.abertay.ac.uk/abertay_watermaps/)



# 1.0 Introduction

This report presents the development of a water map, and interactive wheel showing the number and type of businesses working within Scotland's water sector and the complex inter-sectorial links. This report presents the key features for each map and the findings of the research.

## 1.1 Background

Scotland's water sector has undergone significant changes over the past half century. Building upon foundation legislation including the Sewerage (Scotland) Act 1968, Water (Scotland) Act 1980, Water Industry (Scotland) Act 2002, Water Environment and Water Services (Scotland) Act 2003, and the Water Services etc. (Scotland) Act 2005, a unique service and governance structure for Scotland's water and waste water services has emerged. The Hydro Nation Strategy, being advanced by the Scottish Government, seeks to cultivate and build upon existing strengths in the water sector in order to deliver further benefits for Scotland.

The Hydro Nation Strategy and Proposals for Legislation (Scottish Government, 2012) recognises key areas of strength in the Scottish water sector. These include:

- **Economic Opportunities:** The value in the water resource, technologies and services attracting investment and business activity.
- **Environmental Protection:** Low carbon and sustainable approaches to water supply and waste water management, helping to reduce the carbon footprint of Scottish Water, and become recognised as an exemplar for others.
- **Research and Development:** Strength in the Scottish research community contributing to international research programmes.
- **Governance and International Development:** Expertise in governance of water resources providing an opportunity to partner with other nations in developing their own water governance frameworks.

The Hydro Nation Strategy is targeted towards supporting a range of actions that will enhance and protect Scotland's environment and water resource, whilst promoting innovation and development of commercial opportunities within the water sector.

## 1.2 Review of research objectives

The overall aim of this project was to support the Hydro Nation Strategy by producing an overview of Scotland's water sector in the form of a map. The map was required to provide a sense of the size and scale of the water sector in Scotland, and show how different parts of the sector link together as well as provide information to support decision making by illustrating management, influence and control aspects of the water sector.

The brief identified four specific objectives:

1. To identify the different parts of the Scottish water sector
2. To collate information on each of these parts
3. To demonstrate how these parts are linked to form the overall water sector in Scotland
4. To illustrate these data and connections in the form of a map.

In order to deliver on these objectives, it was agreed that the project would produce a map illustrating the scope and scale of the sector and a map demonstrating the interconnectedness of stakeholders within the sector. This map would utilise computer graphic technologies to emphasise readability and design to ensure it can support water policy by offering a clear and immediate picture of the sector linkages. Throughout the development of the project it became clear that two "maps" would be more appropriate than a single illustration. First, a map illustrating the scope and the scale of the water sector would be produced using private sector data on a geographical basis. Second, an interactive "map" would be produced illustrating the linkages between actors and groups within the water sector, taking into account the relative level of influence, management and control.

The remainder of this report presents the methodology applied to produce the maps, and an illustration of the outputs of the research.

## 2.0 Methodology

During this research, both a scope and scale map and an interactive illustration displaying the interconnectivity of Scotland's water sector have been developed. In order to address Objectives 1, 2 and 3, a decision and knowledge mapping approach used previously by Blackwood et al (2000) and others (Bouchart, Blackwood, and Jowitt, 2002; Butler et al, 2003; Gilmour and Blackwood, 2006; Ashley et al., 2008; Gilmour et al., 2011) was applied. Additional desktop research was also carried out. The following sections describe the methodology applied and the data used in the production of the maps.

### 2.1 Scope and scale:

A desk-based study and review of the Scottish Water contractor database was used to begin to populate a database of private sector operators working in Scotland's water sector. Additional companies were identified by an in-depth review of business directories, industry sector groups, and trade body member lists. The following information on each company was collected:

- Postcode/location
- Size (SME/non-SME)
- Company activity (as categorised in Table 1)
- Characterisation as head office or branch locations
- Characterisation based on level of involvement in the water sector:
  - Water sector only
  - Work in the water sector but not exclusively (i.e. construction)
  - Non water sector but providing products/services to Scottish Water (i.e. legal, hospitality)

The collected data were then superimposed on a geographical map, using web-based interactive 3D visualisation methods. Background sector information was collected to provide additional infographics to the map.

### 2.2 Sector interactions

The data utilised for the production of the interactive map was derived from semi-structured interviews and knowledge mapping activities with key stakeholders across the water sector. These organisations/individuals were identified in initial interviews with the project steering group. Table 2 lists the organisations interviewed.

Each interviewee was asked to identify the key groups/individuals they share information with across Scotland's water sector. For each of these identified groups/individuals, the interviewee was asked to identify the purpose of the information transfer, direction of information flow, and provide a relative percentage of the information flows that relate to the following three categories:

- Report/Manage (R/M),
- Influence and Information sharing (I)
- Control (C).

For many of the interviewees, direct interactions were identified (primary flows) where the interviewee communicated directly with another organisation. These primary information flows were scored in terms of the type of information transfer and

**Table 1** Categorisation of businesses working in or with Scotland's water sector

Category	Example activities
Business Services (primarily to Scottish Water)	waste management utilities training security property management and real estate legal landscaping IT health and safety financial and accounting business consultancy catering travel recruitment
Construction and Engineering	project management construction civil engineering consultancy design and planning
Operation and Maintenance	services – operational controls services – electrical and data communications services – cleaning and tankering services – repair and maintenance
Renewables	supply of renewable energy solutions (to Scottish Water)
Scientific Consultancy	services – scientific consultancy
Supplier	supply of vehicles supply of materials and consumables supply of equipment
Water treatment	water and wastewater treatment technology and services

**Table 2** Organisations interviewed for identification of interactions in Scotland's water sector

Interactive Map Interviewees	
Scottish Government*	Highlands and Islands Enterprise
Cobalt Management Solutions*	DWQR
Scottish Water (SW) Regulation	SW Business Stream
SW Env. Sci and Regulation	SEPA
SW Research and Innovation	SW Horizons
SW International	Consumer Futures
SW Capital Investment	WICS
Scottish Enterprise	Scottish Development International

\*interviewees assisted in identification of key stakeholders, though interviews were not scored

relative importance against the four key Hydro Nation Strategy themes listed below:

- Economic Opportunities
- Environmental Protection
- Research and Development
- Governance and International Development

Several indirect interactions were also identified (secondary flows) where someone within the department communicated with outside groups, but not the interviewee themselves. Information on secondary flows was collected in order to capture all organisations interacting within the sector. These flows were not scored.

Due to the large number of individual departments and organisations mentioned within the interview process, a grouping exercise was carried out in order to simplify the data analysis. Appendix 1 lists the groupings utilised in the final analysis and mapping exercise. Appendix 2 provides an example of the data output from a single interview.

## 3.0 Results

### 3.1 Scope and Scale MAP

The research identified 616 business locations working in the water sector in Scotland. These represent 318 head offices and 298 branch offices. Of these, 371 are SME locations. Table 3 provides an overview of all business data collected. Table 4 provides a summary of only head office locations identifying

the number of individual companies with a head office based in Scotland.

The data collected on business location and type are presented as a web-based interactive map that allows the user to interrogate the map to gain a greater level of detail. This is shown in Figure 1.

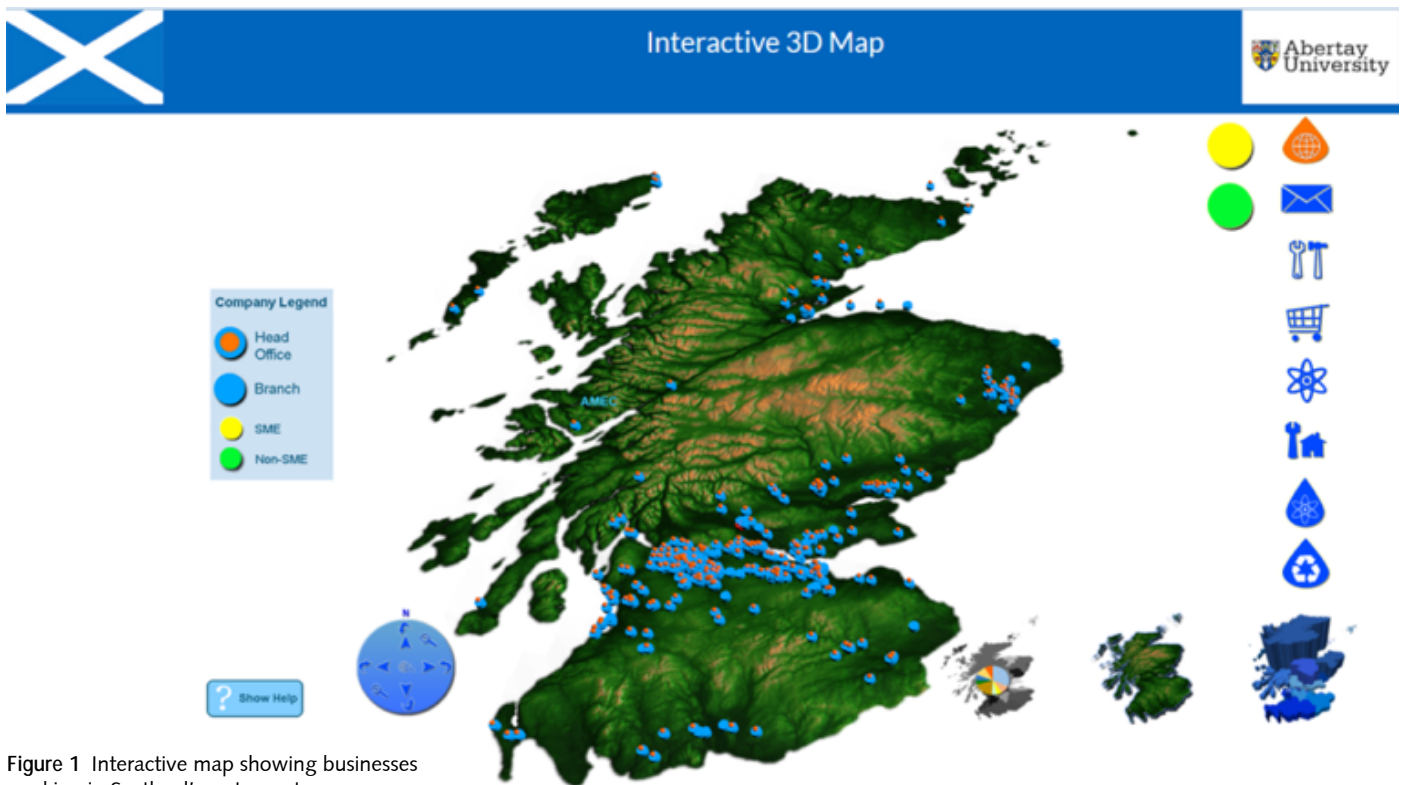


Figure 1 Interactive map showing businesses working in Scotland's water sector

Table 3 Categorisation of business locations working in or with Scotland's water sector

	Total of Branches and Head Office locations in Scotland	SME locations	Non-SME locations
Scottish Water contractor	349	176	173
Non-Scottish Water contractor	267	195	72
Business Services	92	36	56
Operations and Maintenance	72	45	27
Supplier (Equipment, materials and vehicles)	164	104	60
Scientific Consultancy	83	29	54
Construction and Engineering	257	119	138
Water Treatment	29	23	6
Renewables	13	12	1
ALL	616	371	245

Table 4 Categorisation of only Head Office locations working in or with Scotland's water sector

	Total Scottish Head Offices	SME	Non-SME
Scottish Water contractor	148	125	23
Non-Scottish Water contractor	170	156	14
Business Services	31	27	4
Operations and Maintenance	36	33	3
Supplier (Equipment, materials and vehicles)	95	80	15
Scientific Consultancy	17	14	3
Construction and Engineering	95	86	9
Water Treatment	23	21	2
Renewables	6	5	1
ALL	318	281	37



Figure 2 Additional taps to the interactive map showing higher education institutions (Left) and relative density of water sector businesses by local authority (right).

Additional features including mapping of the higher education institutions, and their capabilities relative to the water sector is shown as a separate tab, as is the relative density of businesses by local authority areas as shown in Figure 2.

The map and additional tabs can be viewed at the following link: [http://save.abertay.ac.uk/abertay\\_watermaps/](http://save.abertay.ac.uk/abertay_watermaps/)

### 3.2 Interactive wheel

Data from all interviews were compiled into a single database and scoring applied to evaluate the number and

type of information flow, and the relative importance of interconnections to the Hydro Nation themes.

#### 3.2.1 Number of interconnections

The research identified 252 direct connections between interviewees and 55 other groups/organisations in the sector, and 343 direct and indirect connections with 63 groups/organisations. The data were analysed to determine which organisations had the greatest number of connections to others in the sector as shown in Figure 3 (Direct connections), and Figure 4 (Direct and Indirect connections).

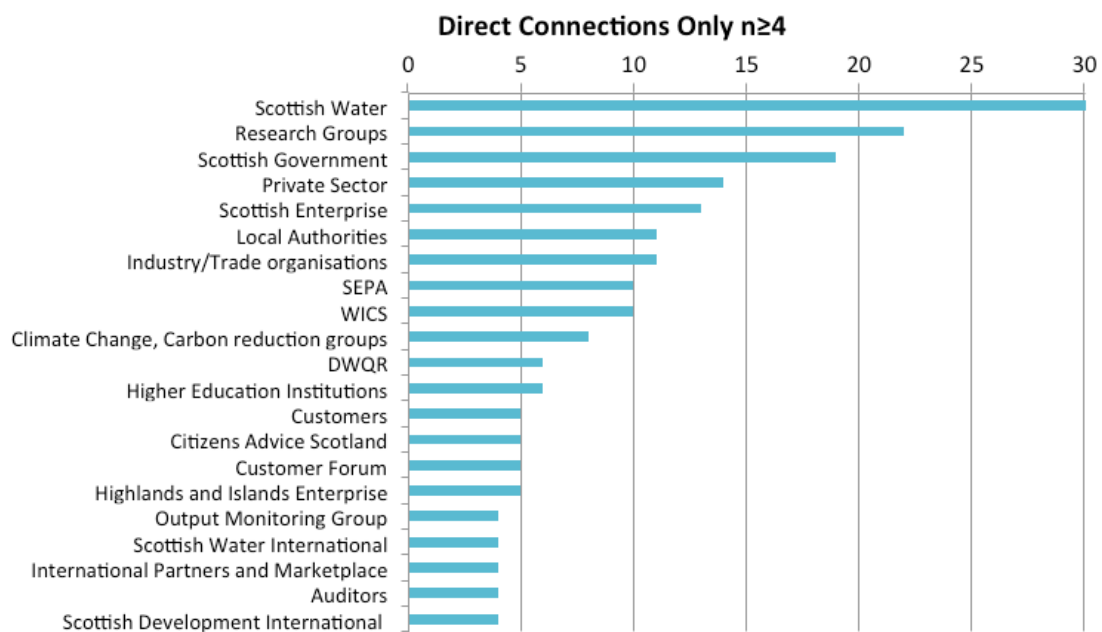


Figure 3 Groups with the largest number of Primary (Direct) connections to other organisations.



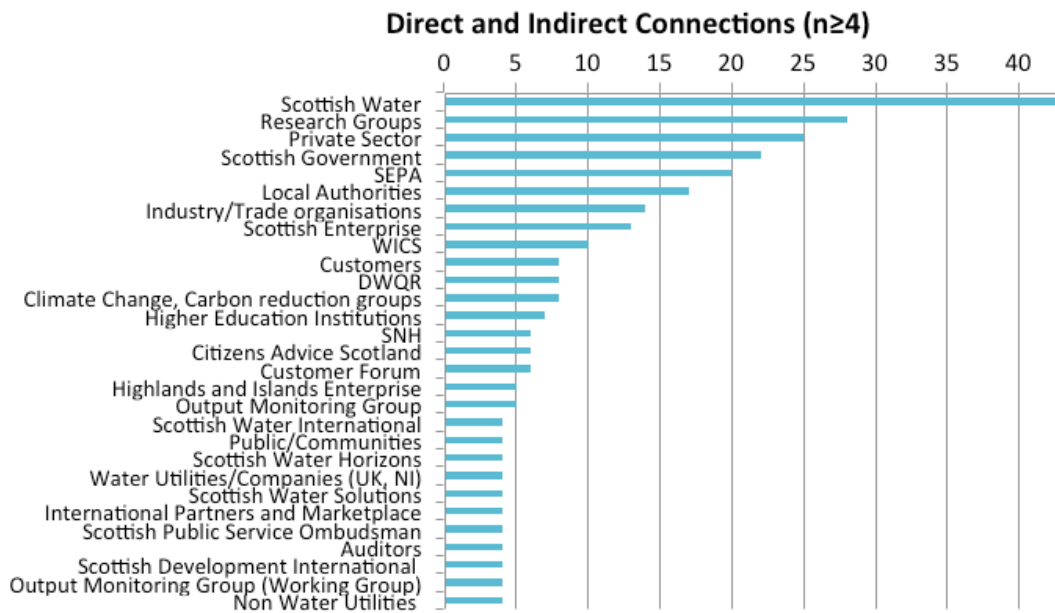


Figure 4 Groups with the largest number of Primary (Direct) and Secondary (Indirect) connections to other organisations.

### 3.2.2 Types of information flows

The type of information flowing between groups/organisations was recorded only for direct connections. These were scored based on the percentage of communication that was related to reporting/managing (R/M), influence and information sharing (I), or control (C). Data on the direction of flow was also collected; the type of information shared differed for some depending on the direction of flow. Across the sector, the primary type of information flow both to the interviewee and from the interviewee is influence/information sharing at 65%, followed by reporting/managing at 25% and control/regulation at 10% (Figure 5).

Information Flow Type: Average of IN and OUT information flows

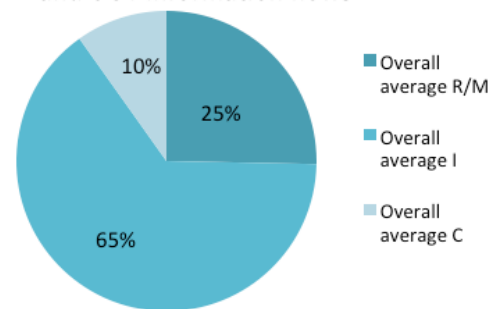


Figure 5 Type of information flow across the sector, both IN and OUT

Additional analysis was carried out to identify how the information flow differed by main groups of actors within the sector. Seven sub-groupings were established as shown in Table 5. Information flow types for each grouping are indicated as an average score of interactions with these groups.

Table 5 Sub-groupings for information flow analysis

Grouping	Description of grouping (and number of direct connections, n)	Type of information flow (%)		
		Reporting and Managing	Influence and Information Exchange	Control and Regulation
1. Regulators	Ex. Scottish Gov, SEPA, WICS, DWQR, CMA, Ofwat etc (n=73)	28	57	15
2. Scottish Water core business	Ex. All departments and functions relating to the core business (n=44)	40	41	19
3. Scottish Water non-core	Ex. Solutions, Horizons, International (n=12)	39	53	8
4. Private sector	Ex. Private sector customers, supply chain, developers, trade bodies and industry associations (n=69)	20	71	9
5. Research entities	Ex. Higher Education Institutions, Research groups such as UKWIR, CIRIA, ESKTN, SETN, Interface, TSB (n=37)	9	90	1
6. Public agencies	Ex. All other public agencies including local authorities, SNH, SPSO, Consumer Future, Customer Forum, Enterprise agencies (n=93)	26	70	4
7. Public/ Communities	Ex. Members of the public, landowners, communities (n=15)	26	50	24

### 3.2.3 Importance of interactions and information flows to the Hydro Nation themes

Interviewees scored the importance of each connection to the Hydro Nation themes on a 1-5 Likert Scale of importance with 1 being not important, and 5 being extremely important or essential. The scores averaged across the sector, were not surprisingly very similar, suggesting equal importance of the themes across the sector. There was a slightly greater importance of connections with respect to "economic opportunities" over the other themes. The average importance scores for each theme were as follows:

- Economic Opportunities: 2.5
- Environmental Protection: 2.3
- Research and Development: 2.3
- Governance and International Development: 2.1

The themes were analysed separately for the connections showing the highest average importance to the theme. When all connections were included, some connections with only one or two mentions were shown to score very high or very low on importance due to a single interviewee opinion. Therefore, only groups with three or more connections providing a theme score were included. Connections with an average importance score of >2.5 were included. For each of the themes, the top five most important connections are listed in Table 6.

### 3.2.4 Interactive Wheel Development

Using the interview and scoring data, an interactive wheel was developed to allow users to interrogate the database in a more user friendly and visually appealing manner. The form of the interactive wheel includes 14 of the initial key stakeholders as an outer circle of the wheel, and all direct connections as an inner circle (Figure 6).

All connections identified by the interviewees are included in the inner circle of the wheel. Hovering over an organisation name within the inner circle allows the user to see what other groups the organisation interacts with, and the relative total influence with respect to the Hydro Nation themes (which is a function of the number of interconnections and the relative importance score for each theme). A total influence score is

Table 6 Organisations ranked as most important connections for developing the Hydro Nation themes	
Theme	Top 5 connections scored as most important in this theme
Economic Opportunities	Highlands and Islands Enterprise Scottish Enterprise Scottish Water Horizons Scottish Development International Water Utilities/Companies (UK, NI)
Research and Development	Highlands and Islands Enterprise Scottish Water Horizons Water Utilities/Companies (UK, NI) Higher Education Institutions Scottish Government
Environmental Protection	SEPA SNH Climate Change, Carbon reduction groups Customers Output Monitoring Group
Governance and International Developments	Scotland Europa Scottish Development International Highlands and Islands Enterprise Scottish Water International Scottish Water Horizons

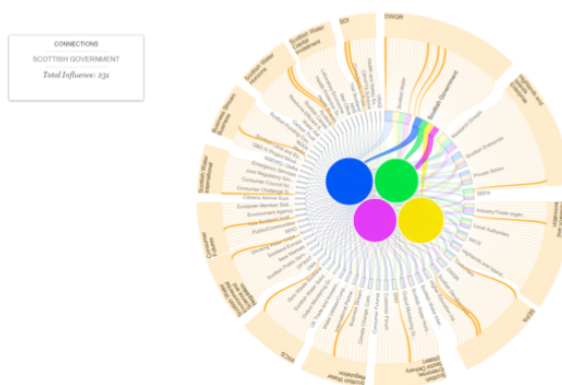


Figure 6 Scotland's water sector interactive wheel.

provided for each organisation, along with a theme based score, which can be viewed by selecting the appropriate coloured circle in the centre of the wheel (Figure 7).

The interactive wheel can be viewed alongside the sector map at: [http://save.abertay.ac.uk/abertay\\_watermaps/](http://save.abertay.ac.uk/abertay_watermaps/)

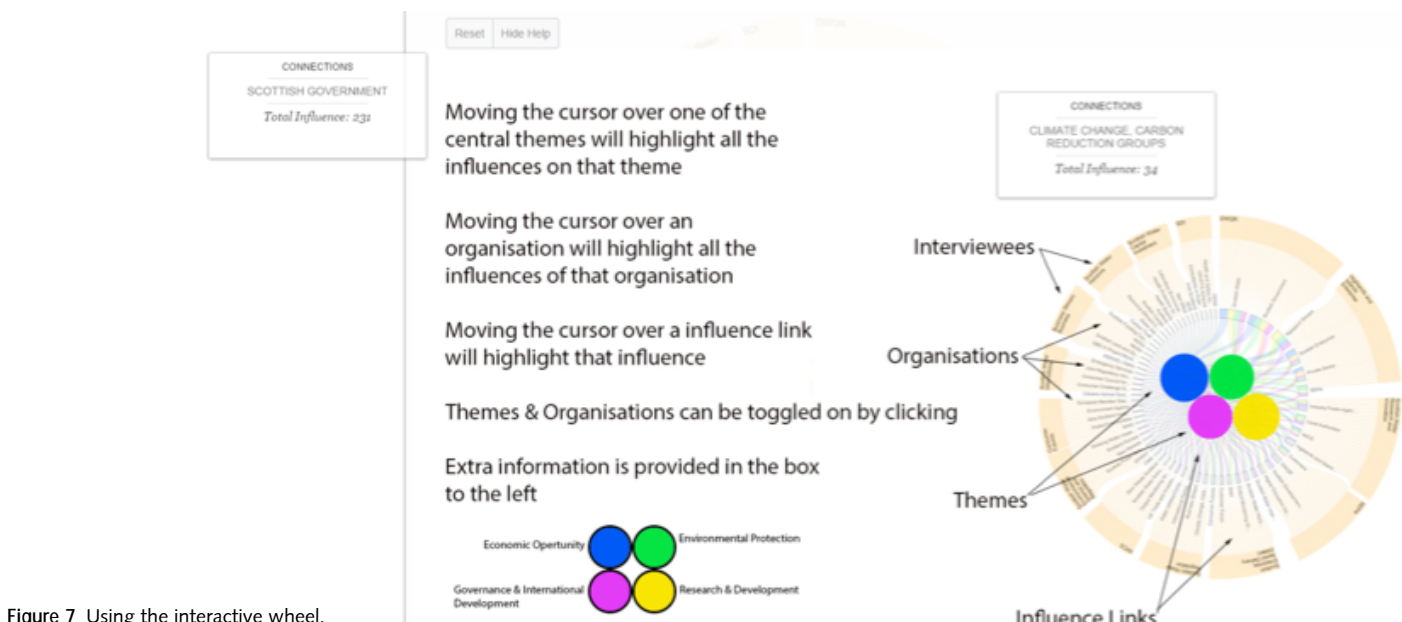


Figure 7 Using the interactive wheel.

## 4.0 Conclusions

The research successfully applied a decision and knowledge mapping approach to examine the interconnectivity of Scotland's water sector in detail. This approach has been successfully applied to allow the network of information flows, complexity of the pattern of communications, and decision making to be mapped across Scotland's water sector. The methodology identified what information is transferred, how it is used and assists in providing a full understanding of the decision making process and sector linkages. This was supplemented by additional sector data on the number and types of businesses working across the sector to provide a more detailed evaluation of Scotland's water sector and provide a baseline for future monitoring.

The interactive maps were created in a similar fashion to the interactive visualization and modelling tools previously developed to support decision-making and understanding in sustainable urban planning and the water industry (Isaacs, et al., 2011; Falconer et al., 2012). Both the sector map and the interactive wheel can be used as a transitioning tool enabling decision makers to project the impact of Hydro Nation interventions on the sector.

The type of meaning and function that can be extracted from the interactive map and wheel includes:

- Demonstration of the strength, breadth of a growing sector
- Assistance in directing resources and support to build a resilient water supply and demand system
- Identification of weak linkages or interconnections in order to direct support to improving these where needed to realise the Hydro Nation Strategy.

The database behind the scope and scale map and interactive wheel provides a useful dataset that could be interrogated further. Future development plans could include developing a dynamic map that can be used to manage investment and show shifting trends and transitions in the sector (e.g. decrease in concrete and construction companies and increase in the scientific and sensor technology).

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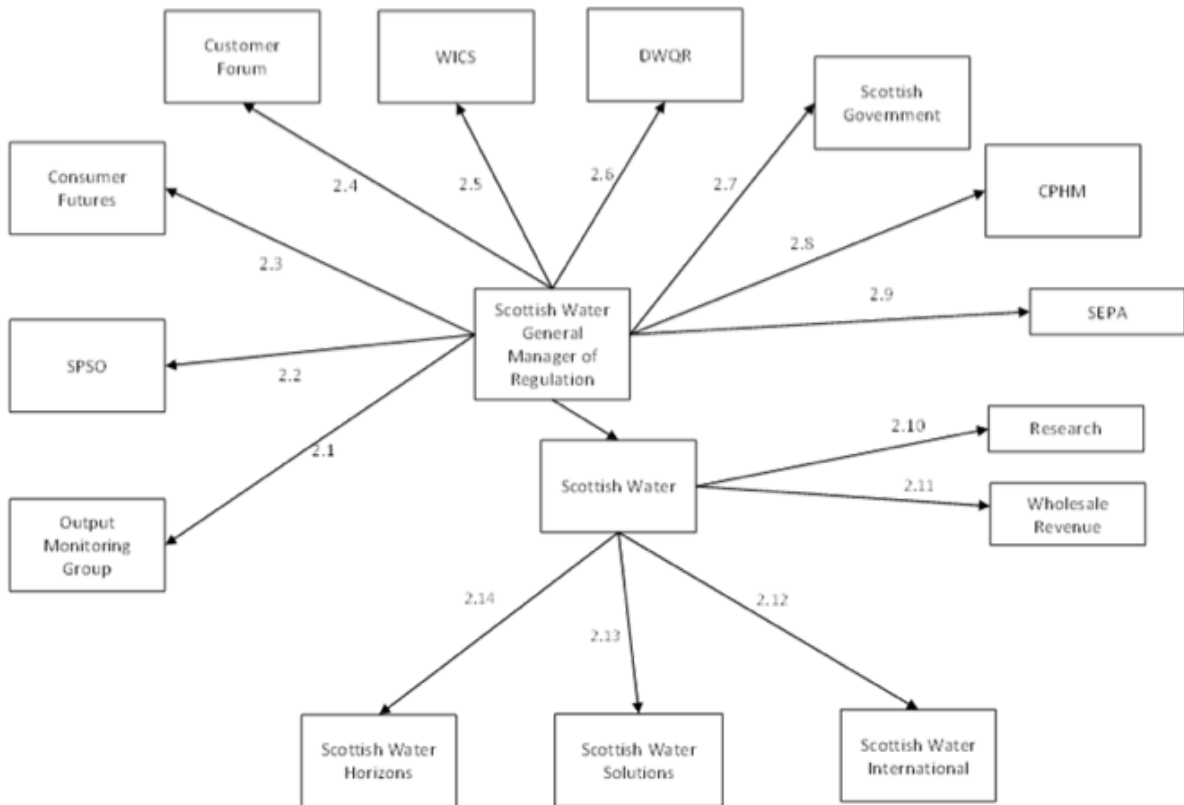
## 6.0 APPENDICES

### 6.1 Appendix 1: Groupings of information flows

Name of group	Sub-groups included
Scottish Government	Scottish Government, Q&S, Energy Unit, Flooding, Regulatory, WSU, SG Health, Housing, Ministers Energy Sector, Press Office, SWG, Ministers
Scottish Water	Scottish Water (Core Business), SW Board, SW Business Improvement Group, SW Cap Investment, SW Cap invest delivery, Investment Planning, Commercial Team, Environmental Innovation Group, Environmental Reg and Climate Change; Executive Leadership Team, Innovation Leadership group, Innovation Panel, Internal Capital Maintenance Group, Internal Capital Programme Group, Investment Planning, Operations, Planning Portfolio Team, Regulation, Research and Innovation, Specialist Services Team, Water Innovation Group, Wholesale Revenue, SW (Infrastructure and Equipment), SW (Licence and Supply), SW Consumer Issues, Parent Company, SW PMT, SW Policy and Regulation,
Scottish Enterprise	Scottish Enterprise, Account manager, Appraisal and Evaluation Team, Commercial Team, Energy and Low Carbon Sector Team, Innovation Specialists, Sustainability Specialists, Water and Waste Water sub-team
Local Authorities	LA (Env Health), LA Planning, LA Roads, Local Authorities, COSLA, COSLA Flooding, COSLA Regulatory, COSLA Statutory
Scottish Water Horizons	SW Horizons, Horizons Board
Scottish Water International	SW International, International Consulting Team, International Board
Scottish Water Solutions	SW Solutions, Solutions Joint Venture, Solutions Board
Private sector	Private Sector, Contractors, Consultants, Design Consultants, Cobalt Management, Equipment Manufacturers, Commercial partnerships, Developers; Isle Utilities, Stakeholder groups (Business)
Industry/Trade organisations	Association of Consulting Engineers (ACE); Civil Engineering Contractors Association (CECA); Scottish Environmental Technology Network; Institute of Chartered Engineers (ICE); VIBES; Scotland Food and Drink; Federation of Small Businesses; Scottish Environmental Technology Network, British Water; International Water Association ; IWA Steering Group, Institute of Water
Non Water Utilities	Digital Broadband providers, British Telecom, Electric and Gas Utilities; Wireless Infrastructure Group
Water Utilities/ Companies (UK, NI)	English and NI Water Utilities, Water Companies
Research groups	CAMERAS, CREW, UKWIR, GWRc, UKWRIP, UK Water Co R&D Network, WSSTP, TSB, Research Councils, ESKTN, SNIFFER, IW Science Panel, CIRIA, Interface, Research UNESCO, CENSIS
Climate change, carbon reduction groups	Public Sector Pan Highland Carbon Reduction Group, Climate 2020 Group, Climate Change Leaders Group
Customers	Customers, Drinking Water Customers, Industrial Sector Customers, Public Sector Customers, Horizons Customers, Commercial Sector Companies
Public/ Communities	Public/Communities, Public, Landowners, Small Communities Supply Network
WHO	WHO, and Small communities supply network
Scottish Development International	SDI, SDI Aid Funded Business Unit, SDI Int Field Staff Unit
Drinking Water Inspectorate	DWI (UK/NI), DWI NI and DWI UK
NHS	NHS and NHS Highland

## 6.2 Appendix 2: Example interview outputs

Example information flow diagram



Example scoring data from single interview

Interviewee	Information Flow	Primary (P), Secondary (S)	Organisation	Flow type IN			Flow type OUT			Hydro Nation Theme importance			
				R/M - IN	I - IN	C - IN	R/M - OUT	I - OUT	C - OUT	Governance and International Development	Environmental Protection	Economic Opportunities	Research and Development
4. Scottish Water Environmental Science and Regulation	4.1	P	SEPA	25	25	50	50	50	0	3	5	3	4
	4.1.1	S	Scottish Water Investment Planning										
	4.2	P	Scottish Government	10	10	80	60	40	0	5	5	5	5
	4.2.1	S	SEPA										
	4.3	P	UK Water Industry Research (UKWIR)	60	20	20	10	80	10	1	3	2	3
	4.3.1	S	Water UK										
	4.3.2	S	Global Water Research Coalition										
	4.3.3	S	Higher Education Institutions										
	4.3.4	S	SEPA										
	4.4	P	Local Authorities	20	80	0	5	95	0	2	2	3	1
	4.5	P	SNH	10	40	50	20	80	0	1	3	1	3
	4.6	P	NGOs	10	90	0	90	10	0	3	2	2	2
	4.7a	P	Highlands and Islands Enterprise	0	100	0	0	100	0	1	3	4	4
	4.7a.1	S	SEPA										
	4.7a.2	S	Private Sector										
	4.7b	P	Scottish Enterprise	0	100	0	0	100	0	1	3	4	4
4.7b.1	S	SEPA											
4.7b.2	S	Private Sector											
4.8	P	WICS	10	60	30	60	40	0	2	4	4	4	



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