Where we go and what we do: mapping the extension footprint of Animal Science

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Summary

We trialled a process to map the footprint of Animal Science (AS) extension activities. This included aggregating existing extension records from eight separate datasets, mapping these records to agricultural property locations, and developing a set of tools and data sets with which AS staff can interrogate and present the spatialised data.

We were able to map more than 4996 interactions with agricultural producers on agricultural properties covering 30% of the state. While not a complete record of AS extension activities, this is the most substantial attempt to map extension activities in AS from February 2002 to date, and for many of the contributing projects, the first time they were able to see their work mapped.

We also generated four tiers of tools and datasets with which AS staff can investigate and summarise their extension data. These include a full spatial file geodatabase which support advanced analysis in ArcGIS software; map packages ready for use in ArcReader software and suitable for users with very limited spatial skills; Excel spreadsheets and pivot tables for analysis by staff with moderate data analysis skills; and prepared PDF maps suitable for simple presentation of footprint areas.

We also developed a plan for future mapping of the AS extension footprint. The plan is not for a simple continuation of the work done here. It defines a clear goal for future work, and identifies five critical requirements for a viable long term effort that produces timely accessible spatial information for all levels of staff. These requirements should improve on the efficiency of the current work without adding to the workload of the extension staff.

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Background

Understanding where we have worked and our impact has significant implications for our ultimate success as a business, as project groups, and as individuals in Animal Science (AS). Extension and other industry support needs to be targeted in the right places at the right times, and this cannot be done without an understanding of our historic footprint. Unfortunately, mapping this footprint in a timely, sustained and accurate manner has proven difficult. As a result, we still have limited capacity to incorporate such information in our planning and reporting.

The last four decades have seen remarkable changes in the way we use computing in our work, including in the capacity of groups such as AS to exploit GIS technology. In the last decade, the pace of change has increased with the rise of smartphones and tablets that routinely include GPS technology and access to inexpensive applications that allow users to collect and share spatial information. This boom in spatial data exploitation has radically changed the way business and government tracks its clients and its services.

Historically, efforts to track and document our extension footprint in AS has been a piecemeal process, largely project-based, and subject to the factors including client confidentiality, project duration and availability of mapping tools and skills. The outcome of this is that AS has never had a comprehensive ability to show where we have been and what we did while we were there. This has had a number of important consequences for our effectiveness:

- inability to clearly show stakeholders the extent of our work
- inability to objectively identify and quantify the areas we have missed in our field activities
- limited ability to relate where we have been to other factors, such as disaster zones
- limited ability to plan future work that optimally builds on past work.

The aim of this project was to develop and trial a single footprint mapping process for AS extension activities. The system is intended to deliver a timely, open analysis of our footprint and its relationship to industry and the grazing landscape. In doing so, the project addresses multiple departmental priorities including building organisational agility, improved agricultural sustainability, supporting a modern capable workforce and driving innovation through better targeted RD&E.

Project Objectives

As noted above, the goal of this work was to develop and trial a single footprint mapping process for AS extension activities. This goal was underpinned by four objectives:

1. *Aggregate the extension records of AS.* This involves locating, collecting, collating and standardising the extension records from our extension staff in a range of project teams and science groups.
2. *Spatialise the aggregated extension records.* This process uses a number of corporate and customised tools to join the aggregated extension records to appropriate agricultural property boundaries in a spatial geodatabase.
3. *Develop tools for AS staff to access the spatialised data*. These should allow access for staff with varying spatial and data analysis skills. It will include specialised GIS analysis, basic map viewing and printing, and analysis of footprint data spreadsheet and pivot table analysis.
4. *Outline a plan for ongoing work in this area*. The proposed plan should build on the learnings of this current project, and in particular, address the methods, costs and logistics that might best ensure a long term, sustainable capacity for mapping our extension footprint in AS.

Methodology

Our methodology followed a four part process (Figure 1), that aligns closely to the project objectives listed above. These are each detailed below.

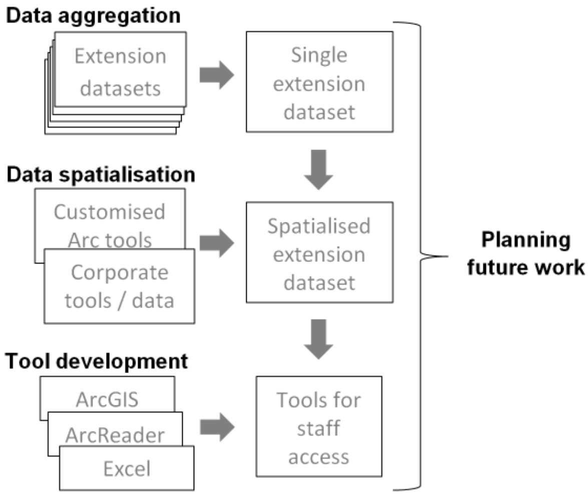

Figure 1: Overall project methodology.

Data aggregation

Key extension staff who manage extension records for groups and/or projects within AS were identified and asked to supply recent records from their work. Mapping AS's full extension footprint has proven beyond the resources of the project, but the work did map a substantial proportion of available data. Nine datasets were included in the project (Appendix A), including data from beef, sheep, dairy and poultry work.

We mapped interactions in our work. An interaction is defined as one or more personnel (e.g. staff, owners, family) from the same land parcel(s) attending an event where AS staff assist, educate or train attendees. So, interactions are defined by land areas and not by individual people; events can include multiple interactions (where multiple land parcel groups are represented at an event); and land parcels can appear in multiple interactions only by attendance at multiple separate events.

We tabulated records to conform to a common format across all datasets. This included reassigning records to the interaction format described above and, where possible, deriving seven core attributes (Appendix B) we identified as useful extension record attributes.

Data spatialisation

We used existing internal databases (BQ Maps, APS) and a number of customised ArcGIS models and datasets to map the extension records, by identifying the land parcel(s) represented by clients in any interaction, and linking these to extension data using a unique identifier for each (set of) parcel(s). The extension data varied substantially in terms of the spatial data included. We attempted to map properties from street address, property identification code (PIC), property name, lot on plan, business name, phone number and owner/manager name, depending on the data provided. Consequently, there was no single process for mapping a property, and these investigations were the most time consuming part of the work, taking about 5-10 minutes per record from commencement to inclusion in the spatial data.

Tool development

We developed four tiers of tools for interrogating the map data. This work aimed to provide a range of tools to allow users of varying abilities access to the data, from full analysis in GIS software, to simple copying of PDF maps. We also built the tools for use in standard AS software, including ArcGIS, ArcReader, Excel and PDF readers.

Planning future work

Finally, and based on the experience of this work, we developed a plan for the future mapping of AS's extension footprint. The plan we drafted (Appendix C) outlines a feasible goal for future work, lists and explains the key requirements for the proposed system to work, and discusses what a working version of the plan would look like and deliver.

Results

Aggregated extension records

We aggregated 5370 interactions from nine AS extension datasets, including work from poultry, beef, sheep and dairy staff (Table 1). Three points should be noted about these results:

- The data recorded represent a very substantial number of interactions. However, they are not a full census of interactions with clients over any period.
- There are substantial gaps in the data we have for some core attributes. In some cases data were not recorded because they were not required by the project. In many cases gaps could be filled if necessary through review by project staff, but at this point, we have not requested this of dataset providers. The effort required in some cases to forensically fill these gaps would be substantial, and this needs to be balanced against the planned use of these data.
- While activity data are complete for all datasets, projects vary in terms of the numbers of activity types listed, with three datasets listing more than 50 separate activity types. Activity numbers were in some cases inflated by typographic errors (e.g. Workshop / Worksop), inconsistent labelling (Nutrition Edge / Nutrition Edge Workshop) and potentially unnecessary differentiation (Stocktake Workshop (Gayndah) / Stocktake workshop (Durong)). We corrected these as best as possible in the spatialised data, but large numbers of activity types clearly complicate analysis of such data.

Table 1: Summary of aggregated extension data. Bold numbers are raw values and italicised figures are percentage of interactions in that dataset for which the attribute was recorded. See Appendix A for fuller descriptions of individual datasets.

	Dairy (Murphy)	Beef (Nelson)	Beef (Phelps)	Beef/sheep (Delaney pre 2011)	Beef/sheep (Delaney post 2011)	Your data (BMP)	Poultry (Osmond)	Sheep (Sallur)	Beef (Rolfe)
Interactions	**403**	**984**	**564**	**1646**	**157**	**196**	**17**	**1382**	**21**
Activity types	**3**	**74**	**9**	**14**	**4**	**52**	**2**	**80**	**18**
Date	*35*	*32*	*86*	*90*	*100*	*100*	*100*	*100*	*100*
Activity	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	100
Business	*17*	*0*	*0*	*0*	*24*	*100*	*65*	*0*	0
Attendees	*100*	*26*	*100*	*14*	*39*	*100*	*35*	*100*	0
DAF staff	*0*	*24*	*92*	*0*	*39*	*100*	*100*	*0*	100
Location	*24*	*48*	*100*	*99*	*39*	*98*	*82*	*100*	0
Property	*57*	*100*	*100*	*99*	*85*	*76*	*100*	*97*	100

Spatialised extension records

We were able to map 4996 DAF–client interactions on 2326 agricultural properties[1]. The remaining interactions included insufficient data to locate the associated property, or involved non-landholders such as bank staff, consultants and public servants. Figure 2 maps the full coverage of the spatialised footprint data. The full area covered, excluding all but the first interaction on any property, is 565 000 km^2, or 30% of the state. Figure 3 provides an example of how the data can be intersected with other biological, social or economic data for planning and reporting at project scale.

Planning for future work

Based on the work to date, we have developed a plan for the ongoing mapping of AS's extension footprint (Appendix C). Our original intent was to base the plan around simply continuing the methodology used in this project. However, as the project has progressed, it has become clear that the current design requires adjustment for it to be a viable long term model. These adjustments are discussed in Appendix C, and include a better defined goal for the future footprint mapping, and five key requirements for future mapping, all of which represent adjustments to the current methodology.

[1] Property numbers are difficult to calculate definitively; properties are split and amalgamated regularly, parcels of land move in and out of lease and agistment, and property owners can arbitrarily class contiguous and non-contiguous groups of land parcels as one or multiple properties. Our estimate uses the Rural Properties layer from qldspatial.information.qld.gov.au, and counts any property in that dataset that has >90% of its area inside our footprint (Figure 2) as included in the AS footprint.

Conclusions/Significance/Recommendations

The work of this project is the biggest extension mapping effort within AS to date, and gives an impressive picture of the reach of AS into Queensland agriculture. For most of the groups that contributed datasets, this has also been their first opportunity to see their work mapped. In these respects, the work has been a success. Missing data, in the form of undocumented or under-documented interactions, is the biggest limitation of the work, though this still allows for substantial use of the data and tools we created.

This work shows that it is feasible to map our extension footprint. Data can be aggregated and mapped, and tools can be built that allow a variety of users to utilise what is otherwise inaccessible information.

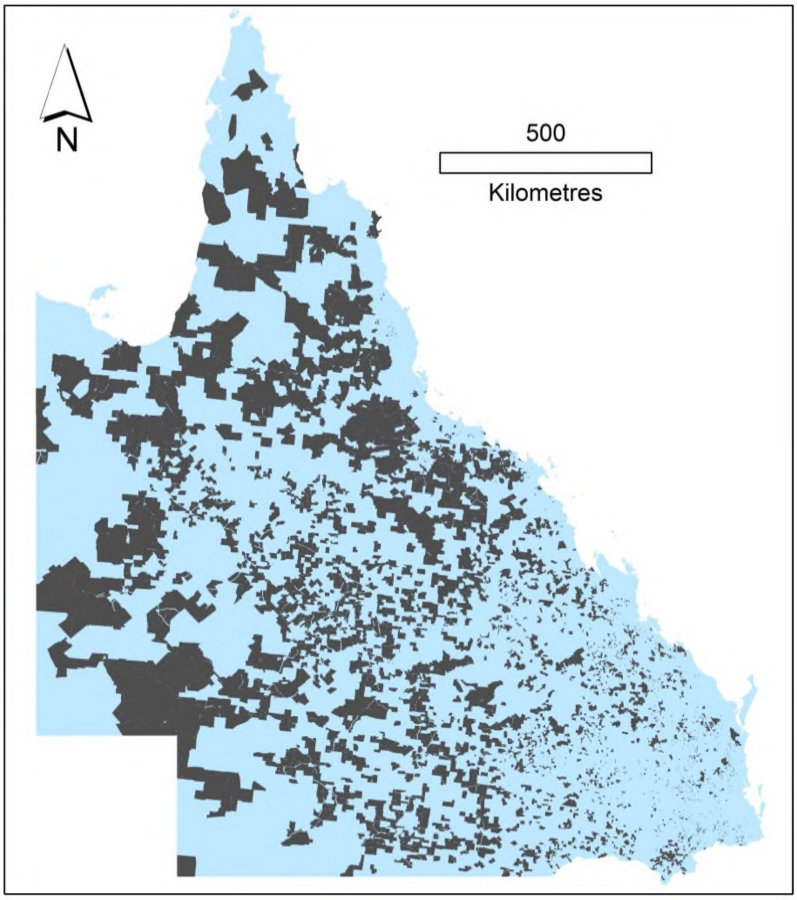

Figure 2: Extent of Animal Science extension footprint.

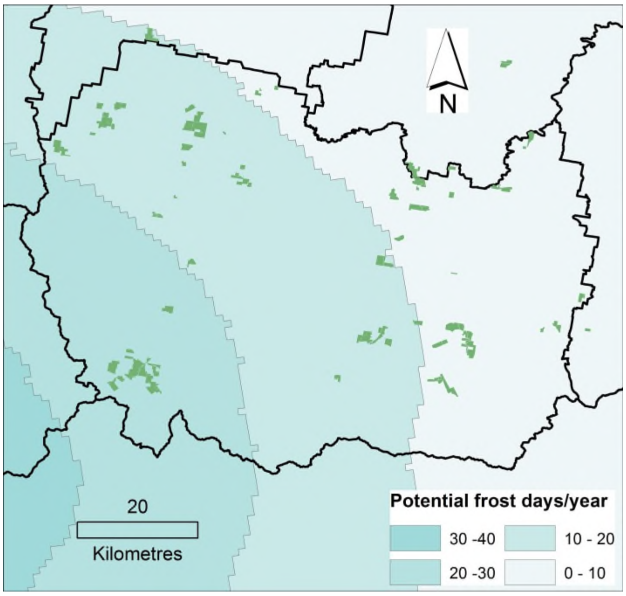

Figure 3: Dairy extension footprint in the Scenic Rim shire intersected with frost risk mapping.

There are, however, a number of challenges in building a viable long term mapping system. We need a clearly defined goal for footprint mapping; it is a potentially time- and resource-hungry exercise and requires a carefully considered goal to ensure an adequate return on investment. We also need to overcome two potentially competing requirements; the need for staff to collect more complete information on their clients and client property locations, but to do this without creating more work for those same staff. These are substantial challenges, but the plan outlined in Appendix C describes a possible path forward, suggesting both a goal and the key requirements for a viable future system.

If there is a single recommendation from this work, it is that any choice to go forward with footprint mapping requires a coordinated effort. We need staff to collect the correct data; we need tools to make data collection easy for staff; we need systems and expertise to take raw data and efficiently convert it into a range of tailored products; and we need institutional support in the form of both resources to maintain the system and encouragement to apply the system at project level. The cost of doing this won't necessarily be high, but it will require a coordinated effort across AS.

Key Messages

1. We have been able to map a substantial proportion of AS's recent extension footprint in this project. This covers 4996 separate interactions with land holders and land managers on 2326 properties, covering 30% of the state.
2. We have also built example spatial and data analysis tools around these data. These will allow staff to interrogate their project footprint(s) and demonstrate their impact on agriculture in Queensland.
3. The DAF-client interactions we aggregated contain significant data gaps. This is due to a number of factors, not least of all, retrofitting a range of quality but diverse datasets to a single mapping process. Future work in this area can improve by ensuring client data from projects includes a core set of common measures.

4. The process of identifying the specific parcel(s) of land associated with DAF-client interactions was the largest time cost in this project. Future work in this area will continue to face this cost unless a more efficient means of spatialising our work is adopted.
5. We have proposed a plan for future footprint mapping in AS. It narrows the goal of footprint mapping and details five core requirements for the system to work: clearly defined core questions; clearly defined subjects; smarter data entry; alignment to existing system; and future resourcing. It also includes an outline of what the working system would look like.

Where to Next?

An obvious next step is for AS to consider its response to the plan in Appendix C. If we adopt this plan, the next steps will be: to define core questions; ask project teams to designate their subjects; rollout of the Collector application and its supporting suite of tools to aggregate; analyse and distribute the resulting data products.

The work of the groups that contributed datasets here is mostly ongoing, and for a number of these, mapping their footprint is a key part of their overall work. These groups will be provided with map tools and products we have developed, as well as the findings of the report.

Budget Summary

The total budget for this project was $33 860. As planned, it was spent entirely on wages and wage on-costs.

Acknowledgements

We would like to thank the staff who kindly contributed their datasets to this project.

Appendix A: Extension datasets provided by AS staff

Table A1: Extension datasets contributed by AS staff.

Name	Description
Dairy (Murphy)	Data contributed by Ray Murphy from the Dairy group. Date range largely unknown as date was missing from data, some data from 2014
Beef (Nelson)	Data contributed by Brigid Nelson largely concerning work by the Burdekin extension team in reef related activities. Dates range from August 2014 to October 2016.
Beef (Phelps)	Data contributed by David Phelps regarding a range of projects and activities including GLM, mostly in beef enterprises. Dates range from June 2002 to November 2009.
Beef/sheep (Delaney pre 2011)	Historical dataset compiled by Cathy Delaney regarding work in extensive grazing enterprises. Dates range from February 2002 to November 2011.
Beef/sheep (Delaney post 2011)	Historical dataset compiled by Cathy Delaney and Chris Holloway regarding work in extensive grazing enterprises. Dates range from August 2012 to August 2014.
Your data (BMP)	Data extracted from the new Your Data database which will predominantly be used to capture BMP follow up activities in the reef catchments. Dates range from March 2015 to May 2016.
Poultry (Osmond)	Data contributed by Rachele Osmond of the Poultry extension activities in south east Queensland. Dates range from July 2015 to November 2015.
Sheep (Sallur)	Data contributed by Nicole Sallur, largely relating to extension work with the sheep industry in western Queensland. Dates range from March 2011 to October 2015.
Beef (Rolfe)	Data contributed by Joe Rolfe largely concerning beef businesses in northern and northwest Queensland. Dates range from January 2016 to December 2016.

Appendix B: Core data collected per client interaction

Table B1: Core attributes recorded from DAF-client interactions.

Attribute	Definition	Notes
Date	Date of activity	Start and finish dates were provided in some cases, but values followed many formats including year, calendar date, season and blank.
Activity	Name of activity	Name for activity provided by project teams. We corrected obvious typographic errors and grouped obviously identical activities under common names to facilitate mapping and reporting.
Business	Name of agricultural business interacting	Business name. This appears to have been entered under a number of formats including actual business name, owner name(s) and property name.
Attendees	Name of clients participating in interaction.	These data were stored as a text string only in our data. Formats varied between and within datasets, including, full names, first names and blanks.
DAF staff	Name of DAF staff participating in interaction.	We recorded up to three staff names involved in the work, in order of contribution where data were available. The data in Table 1 indicate only whether DAF staff were recorded in the interaction, not their contribution.
Location	Location of activity	Primary location of interaction.
Property	Name of property / properties interacting	We used names provided. Typographic errors were corrected where obvious.

Appendix C: Mapping our future footprint

It is feasible to build an ongoing system for mapping our extension footprint. Below we outline a plan that takes into account the findings of this project, including a goal for future footprint mapping, its key requirements, resourcing, and a picture of what it might look like.

The goal of the work

Any future footprint analysis requires a goal, and the plan outlined here is based on the goal of *providing timely and accessible spatial information about our project interactions with industry at the property level*. It is not a plan to capture every interaction we have with industry, nor an attempt to replace other corporate systems like CRM (Client Relations Management) or Your Data. However, it does aim to improve substantially on current capacity, and to integrate, where possible, with existing tools and systems.

System requirements

Below we identify five key needs to make footprint mapping work in AS. These are the questions we ask, the subjects asked these questions, a better process for data handling, alignment to existing systems and resources to make the system work.

1. *A clear set of questions.* An effective footprint mapping system requires a clearly defined set of questions we ask our clients in each interaction. Data gaps limit the ability to interrogate our footprint effectively, as was seen in the work to date. We suggest a small set of queries with pre-set responses are most likely to be completed by clients, and therefore most useful. These questions need to apply across AS as well. The list used in our work is a starting point, but should be reviewed and possibly amended in consultation with a range of staff. Individual projects may collect additional data as well, but the common set of baseline questions is critical to any mapping process.

2. *A clear set of subjects*. We should carefully consider which interactions we record. No system will capture all our interactions with clients, not all interactions are important, and not every interaction provides the opportunity to collect information we want about the client. Consequently, there is some risk of building a system where we miss important interactions, capture insignificant ones, and collect incomplete or unusable data. We should choose what we map carefully.

   The decision of what interactions to record is likely best set at project level. The interactions that staff are most motivated to record are project achievements, because these are already part of their project reporting. Projects generally have specific targets, and project teams could use these to nominate what they will map in their project. This approach puts a clear boundary around the mapping requirements for a project; produces a product that project staff can use for project evaluation and reporting; and provides management with a substantial insight into our industry contact for both project overview and reporting upwards and outwards. It also gives project staff more scope to meet the confidential requirements of their work by not distributing data unnecessarily to the broader AS group.

3. *Smarter data entry*. Substantial effort was required to spatialise the extension records we used in this project, and streamlining spatialisation to improve the efficiency of footprint mapping should be addressed in future work. To this end, we trialled the ESRI Collector app. Collector is freeware aligned to the ArcGIS software suite which operates on Android, Apple, and Windows devices.

Collector functions on or offline, and allows users to easily connect form data to physical locations via a map.

In the context of footprint mapping, staff could have the application installed on their phone or tablet, along with appropriate mapping and the footprint question form. To record an interaction, they tap on the map at the location of the property, fill in the form and save the result. When the device is next online, their data synchronises online with a master database, and their data are immediately available for the footprint mapping team. From this point, the footprint team has both the data and its location, and can use customised tools to quickly return quality datasets and maps to project teams and the broader footprint project. This kind of approach, whether with Collector or another application, has many advantages. It centralises data faster; greatly simplifies finding the property to map it; gives staff access to near real time map products; and has the potential to align with other reporting systems (see next point).

4. *Alignment to existing systems.* There are already a number of existing systems to record our client interactions, including Grazing BMP (Best Management Practice), CRM, Your Data, and the datasets contributed to our work. Though none of these are explicitly spatial, it is important to note that any footprint mapping should align with, rather than replace, existing systems. However, alignment should not come at a cost of extra data entry for staff. The most obvious way to align footprint work without creating extra workload for our staff is to ensure data entered via the Collector app (or similar) can be bulk exported into systems such as CRM and Your Data.

   Making this possible would require initial coordination initially to ensure other databases can import data from footprint mapping, and require the footprint team to provide the data in suitable format to input. Our discussions with CRM and Your Data management suggest both these tasks are feasible, and both would be issues that only affect extension staff in as far as they will avoid double entry of any data entered via Collector, or whichever application is ultimately selected.

5. *Ongoing support*. Further footprint mapping will require corporate resources. It is difficult to specify an exact cost for ongoing footprint mapping in AS, but Table C1 lists the major components, assuming the model outlined in our proposal. The largest part of this is salaries and operating for the team mapping the footprint data, and would likely require about 50% of one full time equivalent (FTE) split between several staff. This number should decrease in subsequent years after establishment. Other costs are potentially minor relating to software, and assuming the system does not impose significant extra work loads on extension staff.

Table C1: Major components and costs for footprint mapping proposal.

Item	Resources required
Salaries and operating (phones, computers etc.) for footprint staff	Approximately 50% FTE first year
Salaries and associated costs (Extension staff)	Unknown, although close to nil if system does not impose new data entry requirements
ESRI software licences	~$1000/year for footprint team
Collector app and online accounts (footprint and extension staff)	Free under current ESRI enterprise agreement

How might this look?

The best case outcome for this plan is that AS will have a system for quickly and efficiently mapping the major components of our work. The main features of the system would function as follows:

- Project teams to identify and nominate aspects of their work that they will map over the course of their project. These should relate to the specific goals, objectives or milestones (e.g. provide training to 25 properties, to map and document those properties).
- Field staff to use a phone/tablet app (or their computer) to collect extension data via the Collector application or similar. These data are entered into standard forms and include the location of the property, a core set of standard AS questions, plus other questions the project team require.
- Collector software will automatically synchronise the new data to a master dataset. This provides the dedicated footprint mapping team immediate access to the data.
- At regular intervals (e.g. quarterly), the footprint mapping team uses a set of customised tools, some already developed in this work, to reconfigure the master dataset into multiple products for multiple users. These could include the following:
    - a tiered system of data and map products similar to those produced in this project
    - cleaned data and spatial products distributed back to project teams for project reporting purposes
    - data tailored for upload to other recording systems, such as CRM and Your Data as needed.