

## **Managing Your Assets More Efficiently With Mobile Technology**

In many ways, Pierce County, Washington is making the most of their GIS for Public Works. This presentation from different county departments explains how they have implemented their online and mobile solutions, including their assessment program planning, implementation and automation.

### **Part. 1**

Road Operations leverages new techniques for streamlining data collection processes prior to annual assessments. Use of ArcGIS Online, an enterprise database and map and feature services are key elements in planning assessment programs.

Michael Johnson - Pierce County

Bio:

GIS Specialist/Engineering Technician PW Road Operations. Focus on GIS mobile Field operations with iOS smart devices; planning and operations with core infrastructure roadside assets; integration of CMMS work order systems with spatial datasets; Mobile deployments for large work crews covering Pierce County Public ROW. Accomplishing all this using ArcGIS, spatial databases, GPS, ArcGIS Server, ArcCollector and ArcMap for iOS, Trimble, Pathfinder Office.

### **Part. 2**

Road Operations uses ArcGIS Online and ArcGIS for Server to manage field assessments that drive work orders for NPDES and Pavement Management programs. This system streamlines workflow processes for assessments and work order assignment. Mobile technology increases efficiency and versatility.

Matt George - Pierce County

Bio:

GIS Programmer Engineer GISP - Pierce County GIS IT Applications / PW Road Operations. Focus on GIS mobile operations with iOS smart devices; planning and operations with core infrastructure roadside assets; integration of CMMS work order systems with spatial datasets; Emergency Operations planning and tactical applications and first responder teams; and mobile deployments for large work crews covering Pierce County Public ROW. Accomplishing all this using ArcGIS, spatial databases, GPS, ArcGIS Server, ArcCollector and ArcMap for iOS, Trimble, Pathfinder Office, and custom Sencha Touch mobile applications

### **Part 3**

Road Operations uses Python scripts and scheduled tasks to automate the display of work order assignments on mobile devices. This significantly improves work processes, from assessments to work order completion. The entire process (parts 1-3) was piloted and a cost-benefit analysis completed before program implementation was initiated.

Chuck Buzzard, MS, GISP

**Bio:**

- BS Portland State University, Math and Computer Science.
- MS Portland State University, GIS.
- GIS Analyst Yakima County.
- GIS Programmer Pierce County.
- GIS Supervisor Pierce County.
- Contributor to State 911 GIS Subcommittee.
- WAURISA Past President and 2014 Conference Chair

**Introduction:**

Pierce County, Washington is located in the Puget Sound Region and is the second most populace county in the state. Fast growth has contributed to taxing county infrastructure such as roads and drainage systems. Facilities originally designed to support an agricultural economy must now support a sub-urban population of approximately 800,000 people. Supporting this level of service has stressed County Road Operations and was the primary driver of a search for improved efficiencies.

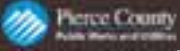
Road Ops has been a long time user of Esri technologies for almost 20 years, but until recently most of the focus was back-office users. With the purchase of a work-order management system, there was a push to move the assessment program to a digital process and ArcPad was implemented to support this effort. With the advent of GIS Online, it was apparent that further efficiencies could be obtained by moving to this new technology.

To test the technologies viability Road Operations teamed with the County GIS division to pilot and implement ArcGIS Online. This required making use of the enterprise database system and ArcGIS Server environment. Since County IT had just allowed the use of Apple iPad devices, their use as a field collection device was also tested.

This process is documented in this three part presentation. Part one covers the technology and how it is used by our field staff. Part two examines how the assessment program has been implemented to support reporting requirements. Part three covers how automation is used to support data dissemination across the enterprise and how the Cost/Benefit analysis allowed us to move from pilot to implementation. The presentation will focus on a mobile workforce with content management in mind and concentrate on mobile and web clients accessing geo spatial content hosted in an ArcSDE environment.

**Process:**


**Part 1.**




## Why ArcGIS Online?

With the majority of our assets currently housed in the existing enterprise ArcGIS SDE ArcGIS Online allows any ArcGIS Desktop content to be discoverable in multiple Lightweight mobile formats by publishing to ArcGIS Online.

### ArcGIS Online



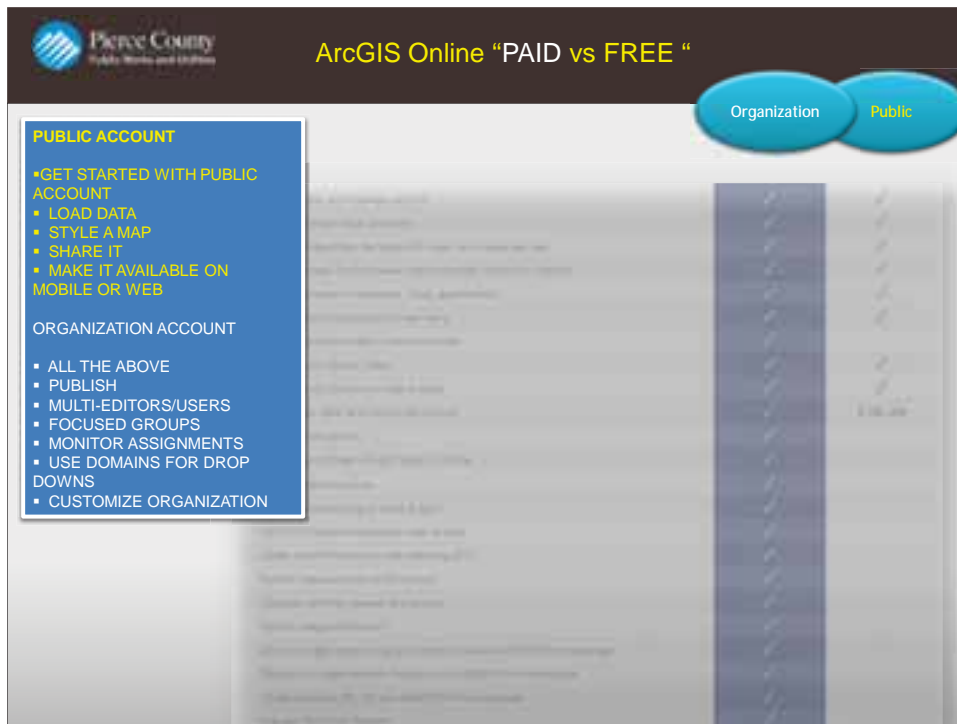
### SDE Desktop



Having worked in a heavily concentrated Esri environment for over 20 years PC has so many geo spatial ArcSDE layers it become obvious we were searching for a way to extend the infrasrustructure into a mobile and web friendly environment to support our departments needs. AGO fits the glove to make this possible. We're not re inventing the wheel, rather spotlighting our industry excellence by reaching a whole new level of customer support through leveraging AGO and associated tools.



We compared our industry and neighboring community's AGO accounts with similar content to get a better picture of how others are leveraging AGO. Naturally working directly in the business of PWU we took a look at other DOT organizations. WSDOT is a good example of a large org who are hosting many of their web services and applications in AGO. Customer service delivery is important which makes public facing media websites like ferry rider sites more available and user friendly by leveraging AGO. Public Works organizations with large data sets involving spatial components and transportation networks gain huge benefits through AGO with ready to go web and mobile clients.



After researching paid AGO organizations – it's best to use in conjunction with desktop in an ArcSDE support environment. This is the way to go no question. Makes for a very powerful addition to extend functionality to an already mature GIS. Benefits are limitless, if you purchase 50-100 licenses the rate per annual/user is \$200. 100+ or more users prices per user/per year go down o \$175.

### What are the costs to store Data vs Analysis?

#### What Uses Service Credits?

Service	Credits
Map The Datacenter	1 credit per 1,000 rows generated
Feature Service Storage	2.4 credits per 1 MB stored per month
The ArcGIS Storage	12 credits per 1 MB stored per month
Streaming	40 credits per 1,000 pixels
Simple Feature	100 credits per simple route
Optimised Route	10 credits per optimised route
Group Feature Service Asset	100 credits per share time
Optimised Feature	100 credits per 1,000 feature rows
Multi-Media Feature (MFF)	2 credits per multi-media row
Demographic and Change Data	10 credits per 1,000 map requests
Data Download	10 credits per 1,000 data download permissions
Information	10 credits per 1,000 views
Reports	10 credits per report
Feature Analysis	1 credit per 1,000 features

#### What Doesn't Use Service Credits?

- Interpreting your own ArcGIS for Server capabilities to host and publish map services
- Use of ArcGIS Online basemaps
- Use of World Traffic service as a host to a web map
- Data transfer
- The hosting
- Download (single address search)

#### UNDERSTANDING CREDITS

ANALYSIS = CREDIT BURN

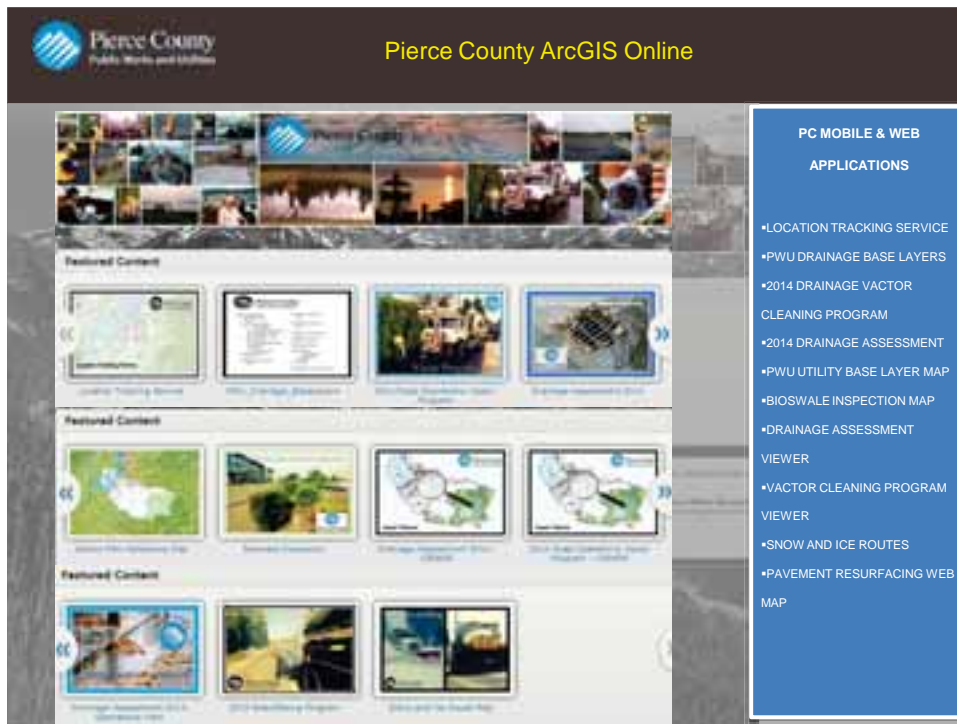
STORAGE COSTS ARE 2.4 CREDITS PER MEGABYTE = NOT BAD

Feature Service Storage EXAMPLE 20,000 point feature dataset at 14 megabyte layer file

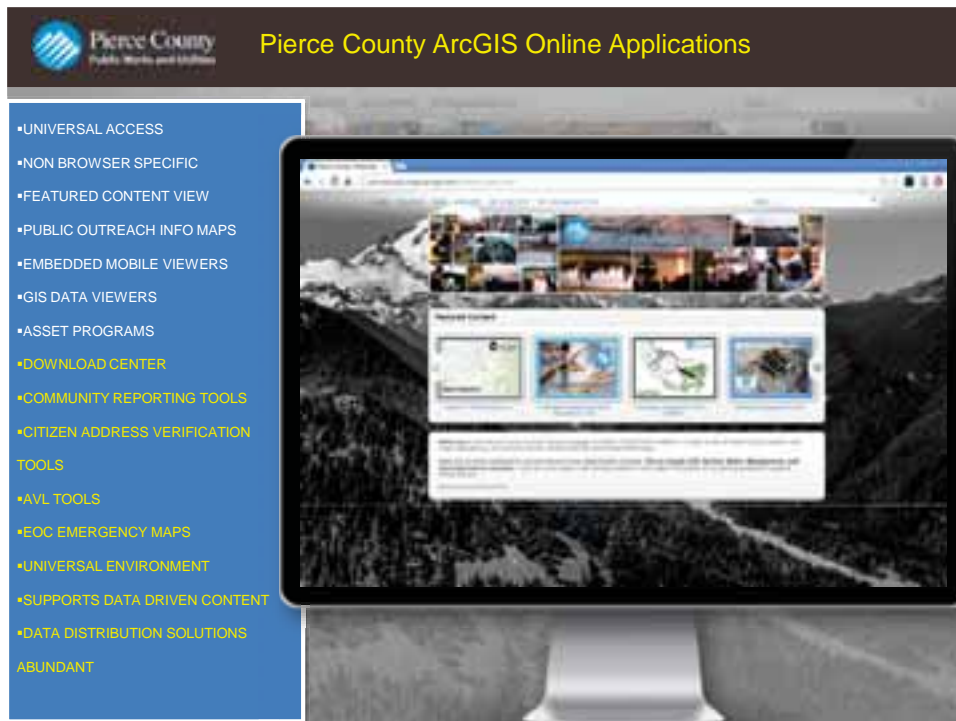
$2.4 \text{ credits} \times 14 \text{ mbs} = 33 \text{ credits per month for storage}$

We have 10,000 and stand to lose 70% of credits this year **because we leverage desktop**

My research breaks down what's really going on here with AGO credit usage. After all said and done. The main reason to use AGO within an ArcSDE environment is to have your data connected to AGO through database connections in desktop. This avoids "HEAVY" credit burn rates for Analysis operations. Some operations can burn up to 5-20 credit per function. Totally unacceptable. This does one of two things. Forces user into using SDE in conjunction with AGO, or ticks off customer because the system becomes more powerful after adding extended use/functionality with desktop products. Storage costs, however aren't bad. ESRI could do a better job of standardizing price point plans out and documenting in more simplistic format for users with less experience. Confusing to many beginner users.



Pierce County AGO interface showing “Postcard Apps” Postcard Apps are graphical thumbnail representing AGO web services – for feature and map services. PC has between 12-15 services running in mobile/web/desktop environment with AGO. Things like Utility reference maps, drainage and vactor cleaning program, Resurfacing Pavement management web maps, and Snow and Ice Routes for public display. Including some are in ArcGIS Online Web App format above and beyond the standard Web map viewer which are also available through the AGO interface.



Things PC are currently doing shown in white on slide. Giving users universal access to Geo Spatial databases across the board for reference base maps and other important county division layers. Web Maps, Apps, are not browser specific and run in any browser with responsive rendering. As the screen layout changes so does the map controls. Or run these same web maps/apps in esri's suite of mobile apps like Explorer, ArcGIS, and Collector.

Items shown in yellow on slide represent things PC plan to do with AGO. Launch community reporting web maps for awareness, response, and status. We're currently researching address verification tools. We also want to add a connection from a wms layer hosted on our AVL server. We even plan to eventually create a connection from WebEOC into AGO/SDE to display past, current Emergency response records. PC will plan to continue to developing more data driven mobile and web apps to extend reach of current datasets out to other county department/div users.





People get confused and often don't understand how AGO is an extension of an organizations spatial core data. AGO is a tool used to bridge the gap between an organizations work planning and execution process. It works in conjunction with your organizations database schema and is seamless through the desktop, mobile and web environment. It's the medium for leveraging existing geo spatial databases used for editing, updating, and creating data.

A common work flow example is – Going from top left downward following the arrows.

Locate Source Data: 1. Choose your type. Shape, FC, KML, GPX. We'll use FC's in a GDB for example. 2. Style FC in ArcMap for desktop. 3. Sign into AGO from desktop. Publish/Create/Share a service from mxd through ArcMap. Must be on 10.1 or higher. Check permission properties for create, edit, delete, query data. Uncheck Tile Cache, write a short summary. Name your Feature service definition layer file name. Check for errors. And Publish the map. Be sure to sign into AGO from ArcMap desktop

4. After the service is published AGO have many vehicles to choose from for making your organizational data available to users. I list 6 common vessels for delivering your data. ArcGIS Marketplace Apps, ArcMap Web Maps, ESRI maps for office, iBook Maps apps, and our focus Mobile Apps for display, update, collection, and reference. There's an app for that!



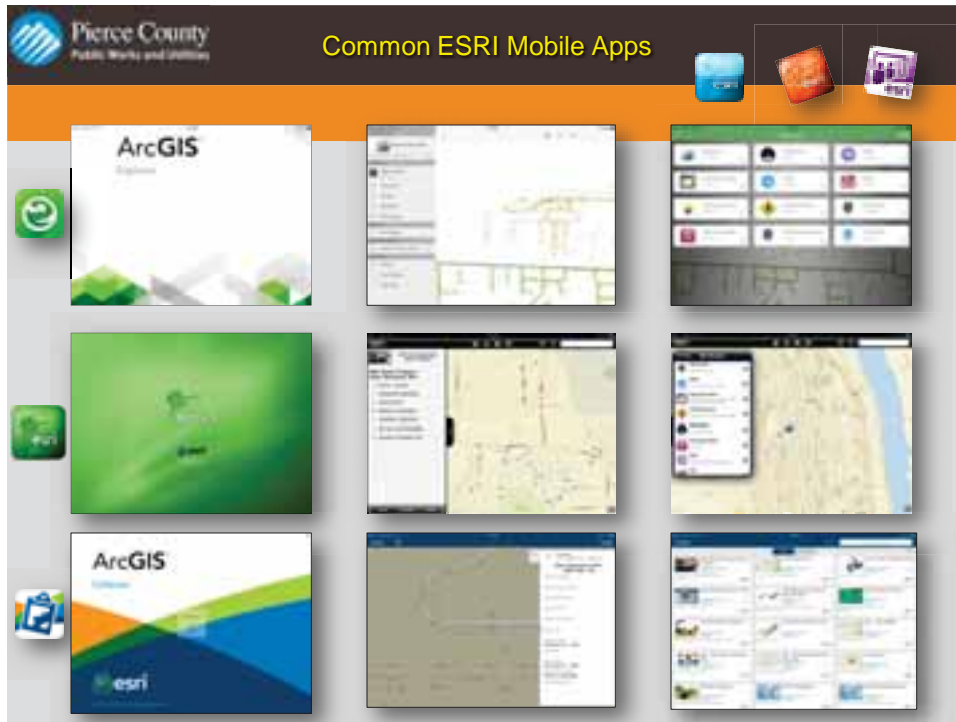
The point trying to be made here is about flexibility in the system for managing geo spatial content.

After data is added into desktop, styled with needed parameters giving the desired look and feel an AGO feature/map service is generated.

Upward Green arrows begin the flexibility part

1. Data is delivered to the user securely, is/can be editable on mobile or web and can be changed on the fly. (The on fly part is the top icon....cloud icon with settings green dot icon)
2. Data/Maps can be made available to single or multi users on mobile or web (securely persists from prior column), and again can be adjusted on the fly.
3. Data is available to single or multi user accounts and is customizable on the fly in the form of web maps.
4. Data can be made publicly available and shared through social media outlets and is reversible at anytime
5. Data can be downloaded, available for informational purpose, maps can be sent via email, messaging services, and changed post invitation at any time.

Extremely flexible



ESRI has 8 focused mobile applications to discover geo spatial data driven content.

Here are three of the most common mobile applications. Each application has specific focused areas.

The next slide details the focus areas.

Shown here is the Splash, map view UI, and organization by group look and feel

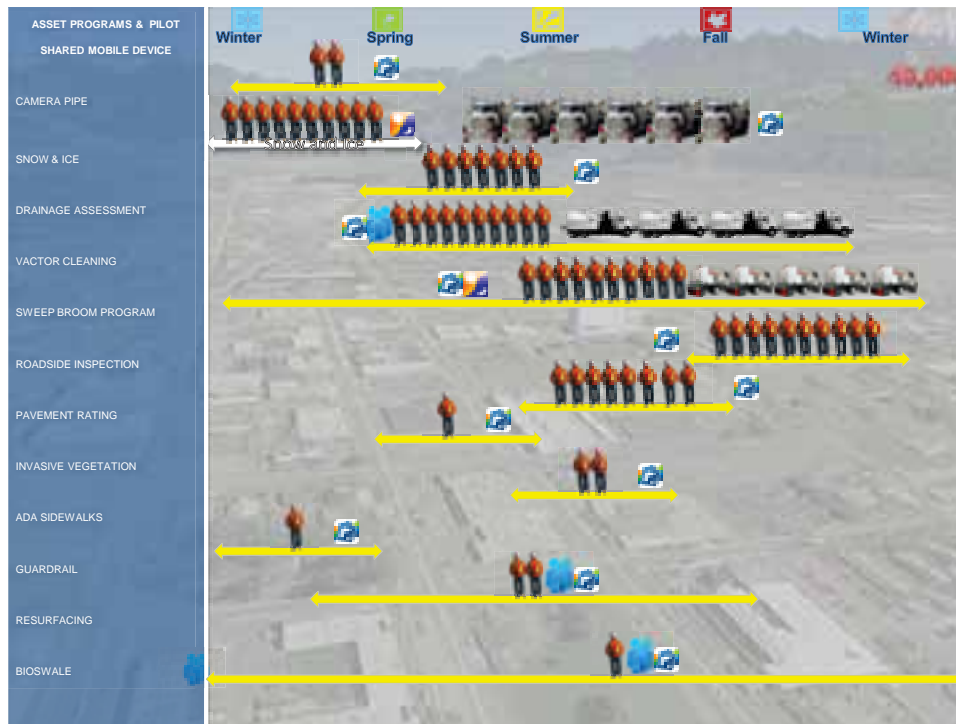
ESRI have 8 focused mobile applications to discover geo spatial data driven content. These applications become the tools for Public Works Work planning and execution process.

Here are three of the most common mobile applications. Each of the three has specific focused areas.

Explorer is the newest edition to the esri mobile app suite. Explorer is not an editing environment. But great for sharing map data, has sketch tool, perfect for presenting data in a clean clear interface. A lot of future development will be focused on this application.

ArcGIS is the oldest focused mobile app. Still powerful, it discover data, edit data, share content, maps, collect data, create, delete, query, update attributes, and measure tool.

Collector is the focused mobile app for field operations. Where Pierce County spend a lot of their time. Offline editing, sync changes, routing, directions, add media to assets in attachment form, hooks directly up to Ops Dashboards.



Now that we understand what tools are associated with AGO, it's important to understand how they fit into the strategic plan of PWU Road Operations or similar related DOT organization with similar needs.

PWU list 12 shown in graphic but now have (15) dedicated Asset Programs eligible to gain benefit from using AGO as their geo spatial management tool. This system feeds our CMMS system which handles our work execution process. With a large DOT like Road Operations the division has many operational programs going on year-round as noted.

Listed by the season represents an annual Asset Program lifecycle of Maintenance, Operations, and Preservation Programs.

Listed from the bottom up represent number of assets associated by program.

Horizontal yellow lines show duration of program and how many crew are involved with the assessment/maintenance/inspection of selected program.

Crews use Collector with AGO to update attribute values associated with assets. Blue icon represents whether or not the program uses a shared device for asset updates.



In order to support PWU/DOT type mobile/web field operational crews we found it necessary to implement a new configuration in MDM Mobile Device management to better handle our Mobile ops used for Asset Management. Pierce County implemented a new cutting edge smart device shared (iPad) program.

Pierce County uses an MDM client to manage their mobile workforce. PC adopted Apple products to be their device of choice. iPad's/iPhone's are running the MDM client Airwatch for user assignment, organization, application deployment, security which are used to run ArcGIS Online mobile applications.

IT Network staff along with PWU Roads technical staff wrote a project proposal to develop a "Shared" device program. This allows staff to share an iPad by signing in with their employee network Ad login. The device is loaded with a standard profile set of applications generic enough to meet the needs of any user type. This works for Program specific mobile users, extra hires, summer hires, temp workers, etc. We load the esri mobile applications onto the device for all access upon logging in with ArcGIS Online credentials.

Important key elements with the share program include:

Employee Mail

Home directory folder access

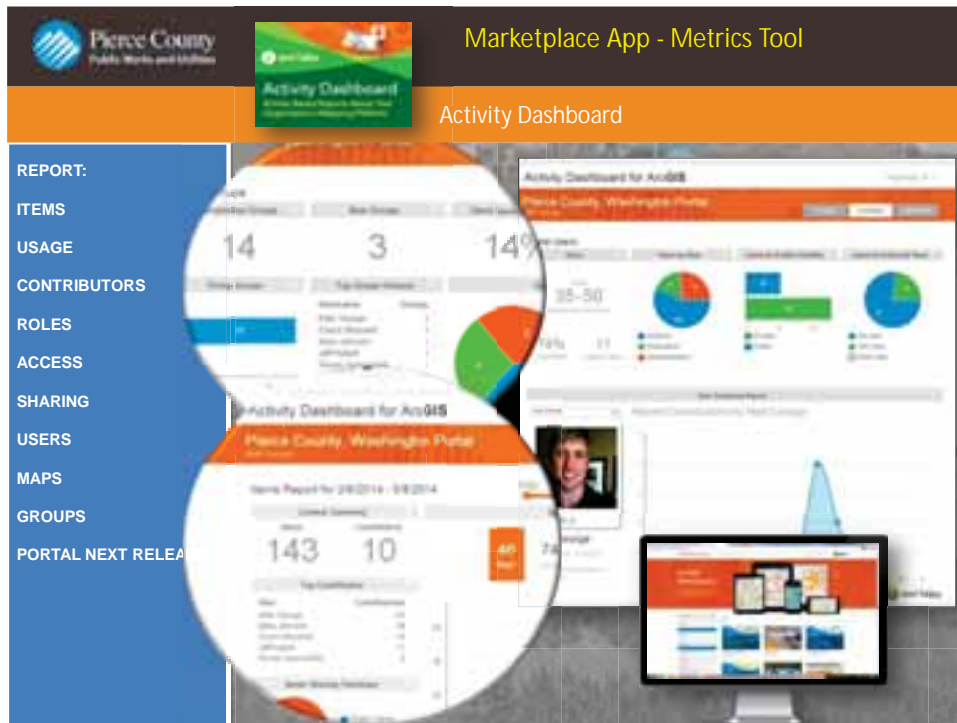
Remote desktop access

ESRI access

Messaging services (in this case iMessage) for instant messaging

Face time

Part 2.



Example of an ArcGIS Marketplace mobile/web application. Activity Dashboard is from one of the 6 main AGO vessels shown in earlier slide. Activity Dash is an account metrics dashboard detailing user activity – AGO specific account activity. Useful for seeing how much content is available, credit usage, burn rate, available shared data/map resources, content ownership, group membership, percentage of contributions, user role status. A real handy little .net application which runs on windows based systems.





Real working example of DOT crew dynamic AGO mapping program for NPDES driven storm drainage assessment and Vector cleaning program.

This was PWU Road Operations first ArcSDE/Server – mobile collector asset program we launched in early 2014.

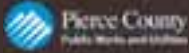
Pay close attention to details pertaining to how we setup a dynamic database relationship between two separate field ops crews. Drainage Assessment/Vector Cleaning operations.

Crew members on the left visit a selection of drainage structures on public ROW and score a “sediment level” attribute field noted by a score of 0, 3, 6, 9. Status is recorded through a secure VPN connection using AGO Collector backed by our ArcSDE database which uses ArcGIS Server. When a determination is made for the structure sediment level crews then update a second field for Action required. “Needs cleaning”, etc. Domains are placed on that field and are represented by a color value.

A second wemap is published as a feature service also using SDE/Server from the same database connection using the identical field and color choice. If the structure is determined it needs cleaned it turns Red. The Vector truck operator cleans a selection of structures indicated by score/color value. This is how we setup a dynamic web/mobile feature map service. NPDES regulations require PWU Roads to clean structures within a 6 month timeline after initial assessment of the asset. Using AGO is a game changer by having the ability to track assets in real time with verification of data being stored in a secure SDE environment. This also helps streamline repeated or secondary annual assessment of critical datasets. Publish once, modify database if needed and re-launch the feature service the following year.

Note: Red equals Needs cleaned

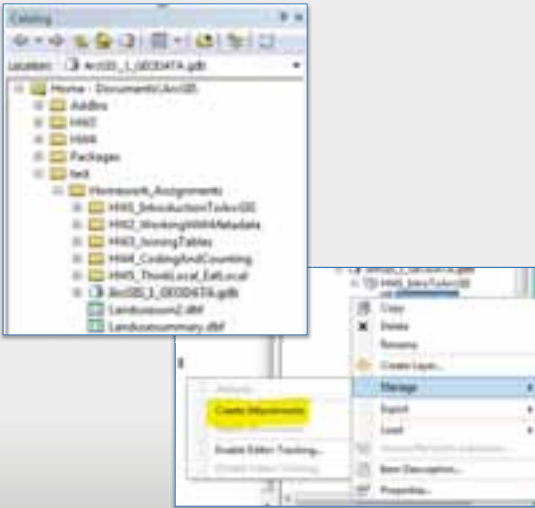
Blue: Cleaning Not required (also shows in some blue structures are sediment but not enough to register a 6, 9 on assessment scale.



Preparing your data

Its very easy setting up your data for publishing to ArcGIS online. A few things to take in to consideration before you publish.

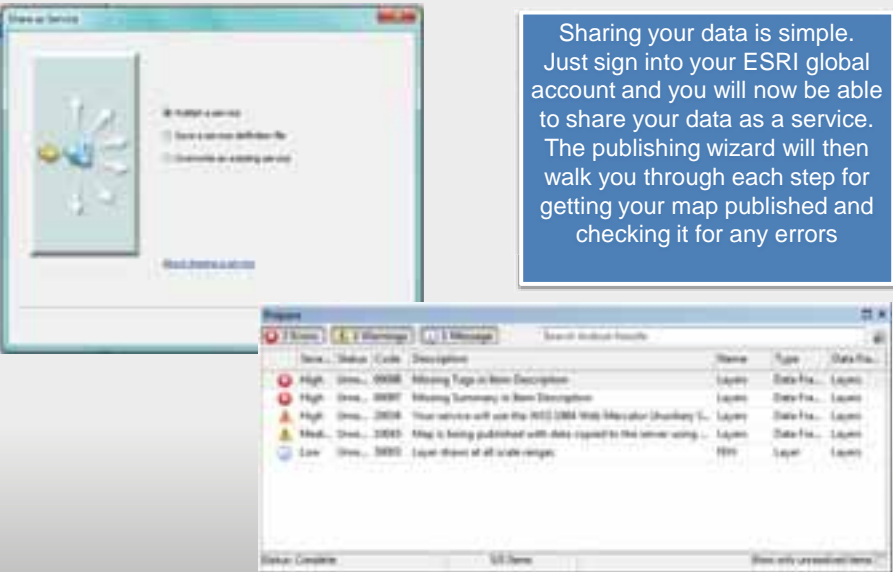
- Type of data being collected point, line, polygon
- Shapefile, or feature class?
- How many editors?
- Attachment needs?
- Who is the audience?



This slide shows the process in preparing your data to be published to ArcGIS Online. Starting with the creation of a geodatabase and feature class as well as enabling attachments at this level. It also touches on common questions you should be asking yourself when preparing a map for ArcGIS online. Who is the map intended to reach? How is the map going to be used? And what type of data is going to be represented with the online map.



## Getting Started

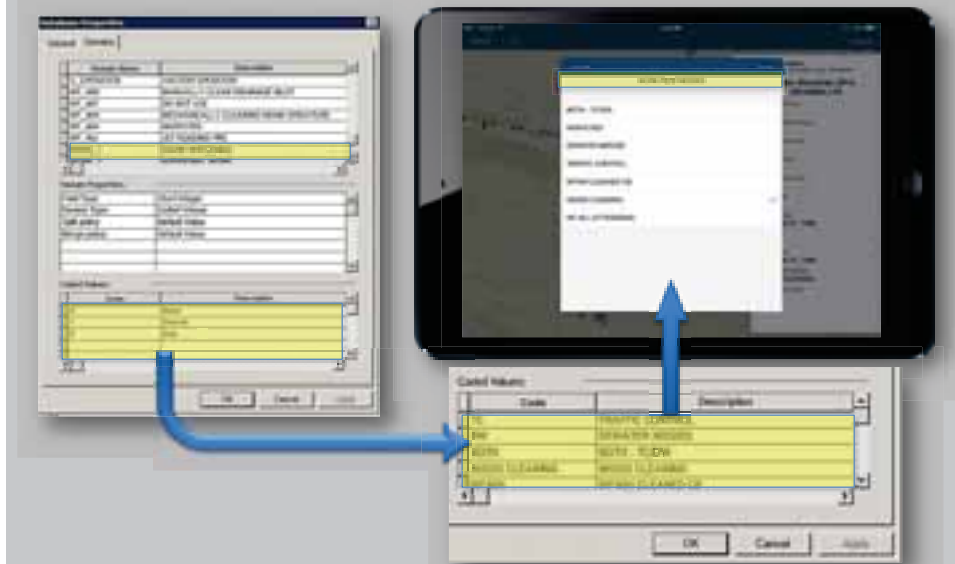


Sharing your data is simple. Just sign into your ESRI global account and you will now be able to share your data as a service. The publishing wizard will then walk you through each step for getting your map published and checking it for any errors

Name	Status	Code	Description	Type	Data File
High	On...	00000	Missing Page in Item Description	Layer	Data File...
High	On...	00001	Missing Summary in Item Description	Layer	Data File...
High	On...	00002	Your service will use the 2011 100k Map of Pierce County	Layer	Data File...
Med	On...	00003	Map is being published with data exposed to the internet using...	Layer	Data File...
Low	On...	00004	Layer shown at all scale ranges	Layer	Data File...

This slide shows the ease of publishing your data to ArcGIS online using the Publishing wizard in ArcGIS Desktop. The wizard walks you through each step to publish your data online. It also shows the analyze option in the publication wizard. This feature allows you to find any problems that may inhibit the data being published from working correctly once published online.

## Coded Domains - Data driven forms and drop downs



Coded domain values are shown in this slide. We are showing how we are able to create some customization to the forms used in AGO and with the collector app. The coded domain values are useful in controlling any data entry error keeping your data collection consistent when you have many users inputting data.

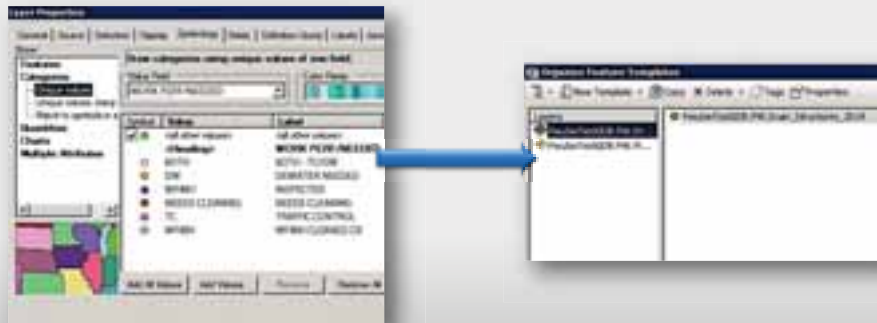
The coded domain values are created within the Geodatabase. This is one of the components of preparing your data for publishing.

## Setting up Symbology in ArcMap – Data Visualization

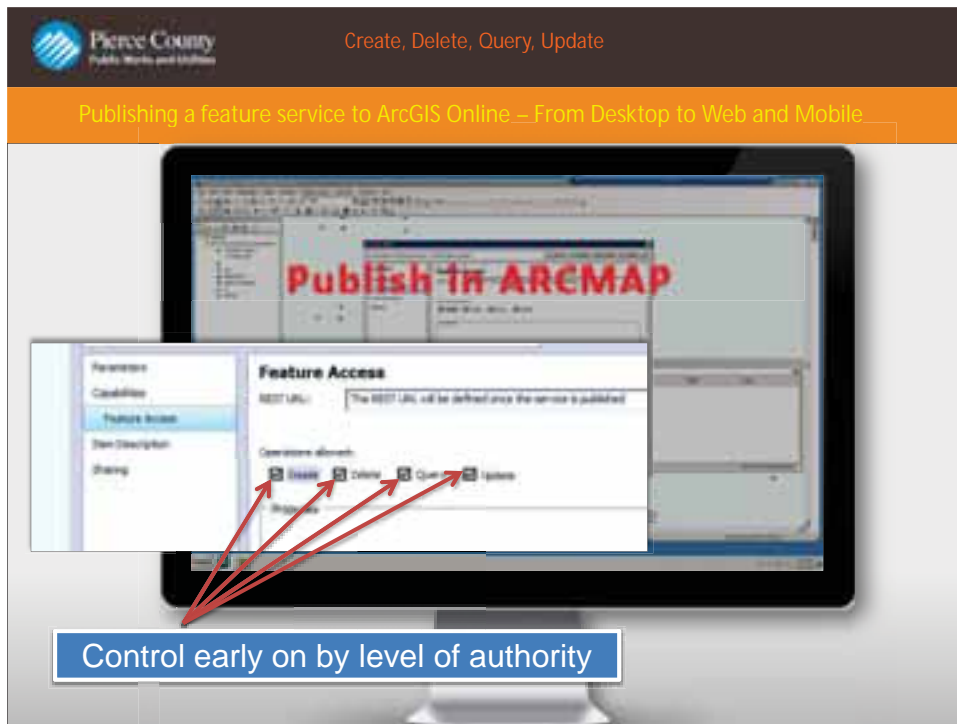
**Symbology** – So Important to understand relationship between Desktop and Mobile

**Unique Values** - How to get the Editable Layer to change symbology on edit

**Generate a New Template in Arcmap** – Single Most important thing to remember

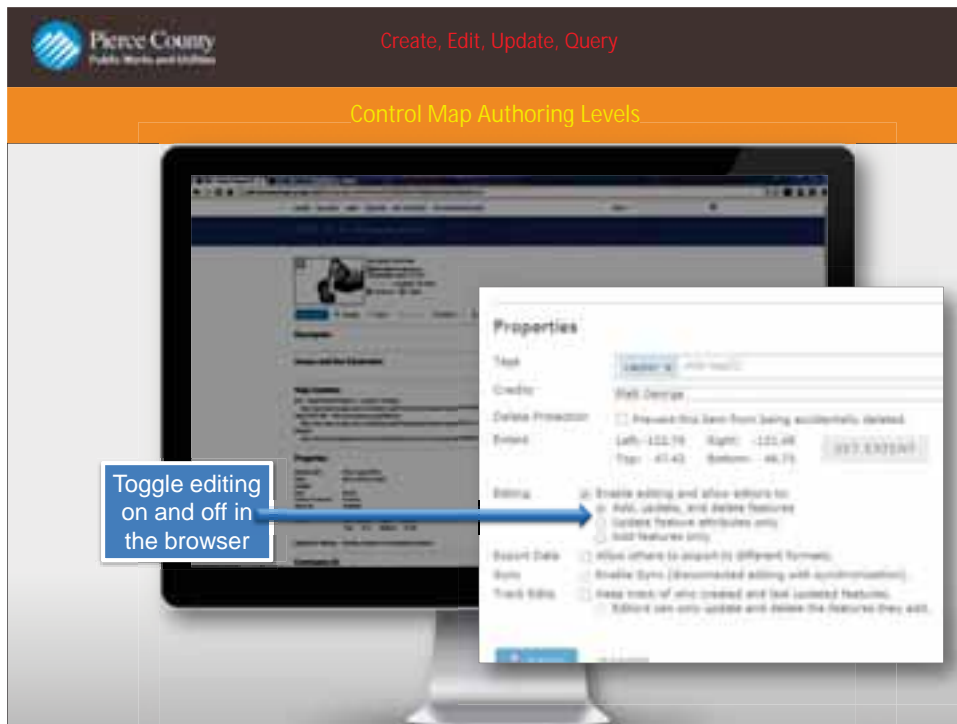


The importance of symbology for our programs is huge. This is set up by creating feature templates. By having control over the symbology it helps our crews see what work has been completed. This slide shows the process of setting up a feature template to keep symbology once it is published to ArcGIS online. Also it is important to know that there is a disconnect between symbology that is available on Desktop vs the symbology that is available on ArcGIS Online. It is really up to the publisher and the users.



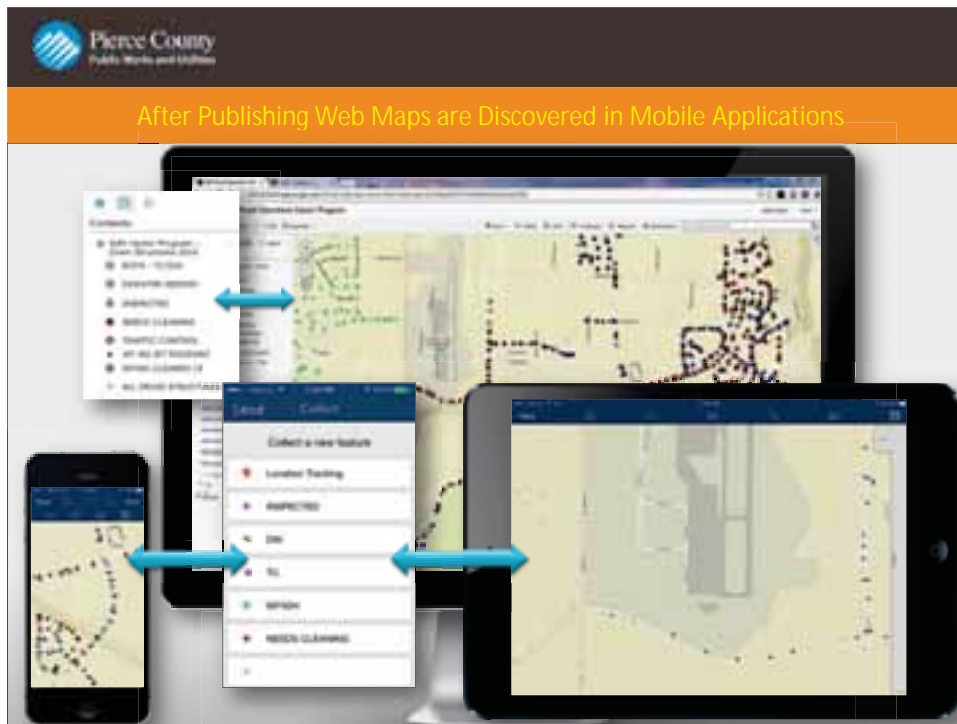
This slide shows more of the publishing wizard and the options for your data once its published to ArcGIS online. We are also detailing the importance of enabling the level of user control of the published data. From the wizard we are able to toggle on and off the access control options. Edit, Update, Query, and Delete are the all options that users will be able to do with the data that is being published. We suggest that all options are selected upon publication because these can all be changed once published. However if these options are not selected when published they will not be available to toggle on and off when the data is published online.

When the data is online you have the ability to selected these options in the data details section.



This shows the data once it is published to ArcGIS Online and the data control options. This shows that the publisher is allowed to toggle on and off the options that were selected from the publishing wizard in ArcGIS Desktop.

This details the ability to control user rights and access controls to the data once it is published online. Its not only controlled from the desktop side, which gives you the option to make data access and controls specific to the group or people the map will be published to.



By setting up the feature template from desktop you can see here in this slide that the symbology carries over from the desktop version to ArcGIS Online exactly how the publisher set it up. Again symbology is key in maps where data is being edited by many users. Also users that may be used to specific symbology it keeps them comfortable with new formats of data collection.



This slide shows a look at the mobile applications that are available through ESRI which are available via the App Store, Google Play, Windows and Amazon Marketplace.



Here at Roads our drainage assessment program is driven by the national NPDES permit. This requires drainage features to be inspected and cleaned within 6 months of the inspection. With that requirement we needed to be able to set up a map that showed inspected catch basins that needed cleaning to the vector crew which is responsible for cleaning flagged catch basins.



Once the data is published online you are able to control which fields from the database are able to be viewed and edited to each map the data has been published to. This details the two separate maps from the one feature service. Also the interface in which the publisher is able to control which fields are viewed and edited in the forms for each map. The forms are opened by selecting the feature on your online map or mobile application.

## ArcGIS Online Extras

Requires ArcCollector on iPhone or iPad

**Location Tracking Service** – Uses mobile device GPS location updates 30 seconds

**Most recent position**

- Breadcrumb trails
- Timestamps
- Controlled by device not vehicle
- When activity occurs in a mobile database location is gathered in background.

**Disconnected editing**

- Cache Maps and Features on device

**Adding Images to your Assets**

- View on mobile, web, and desktop

**Dashboards**

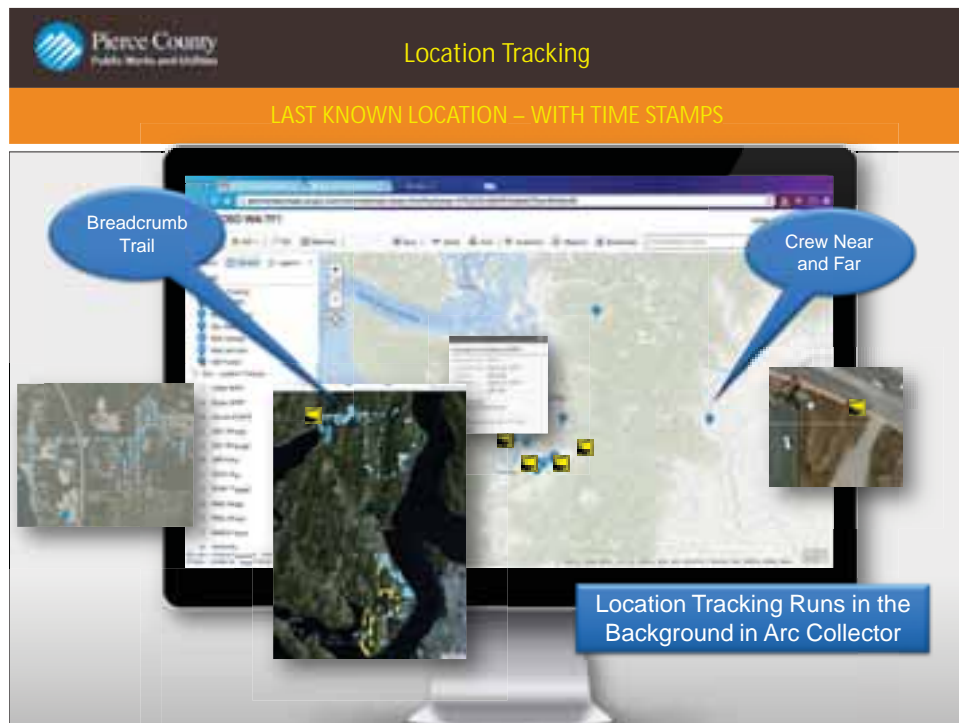
- Create dashboard to display important organizational KPI's

**Creating a Web Application Map Viewer**

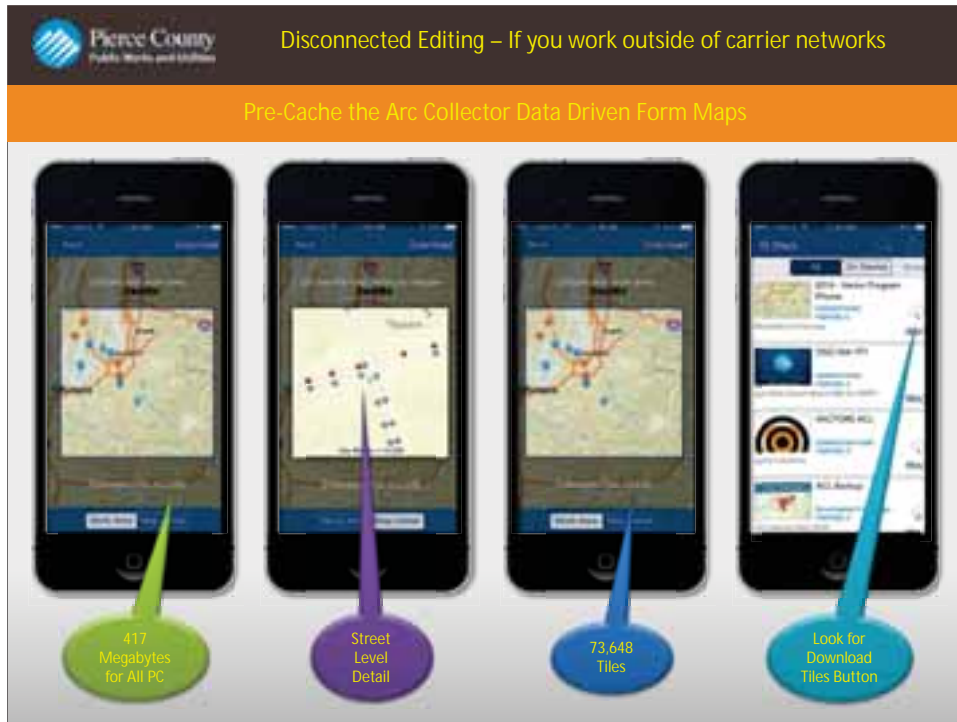
- Access data in Real-time from Mobile or Web



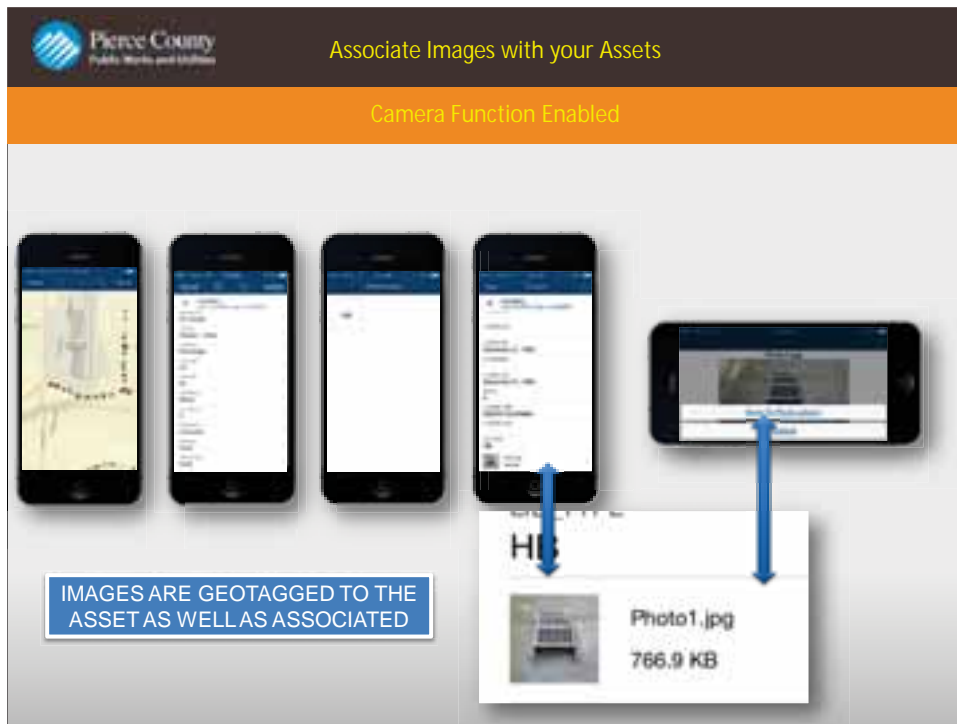
These are some of the options that are available for your data in ArcGIS online.



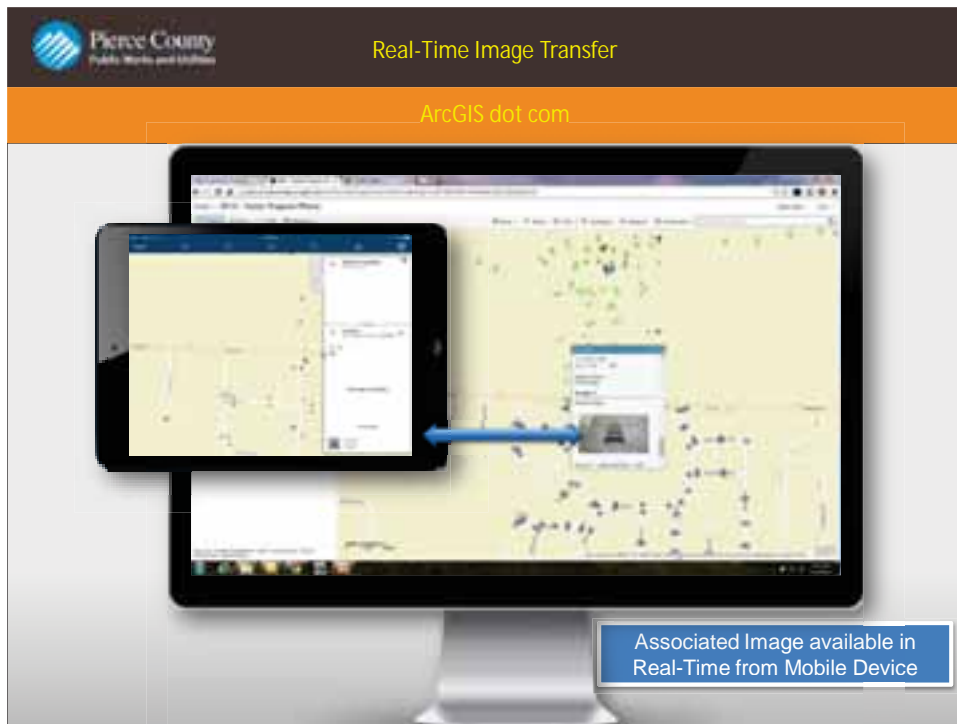
This slide shows an example of location tracking and the different ways it can be applied to your data in ArcGIS Online. With most recent position updates or bread crumb trail tracking. This can be useful in many different applications and programs for organizations with fleet services.



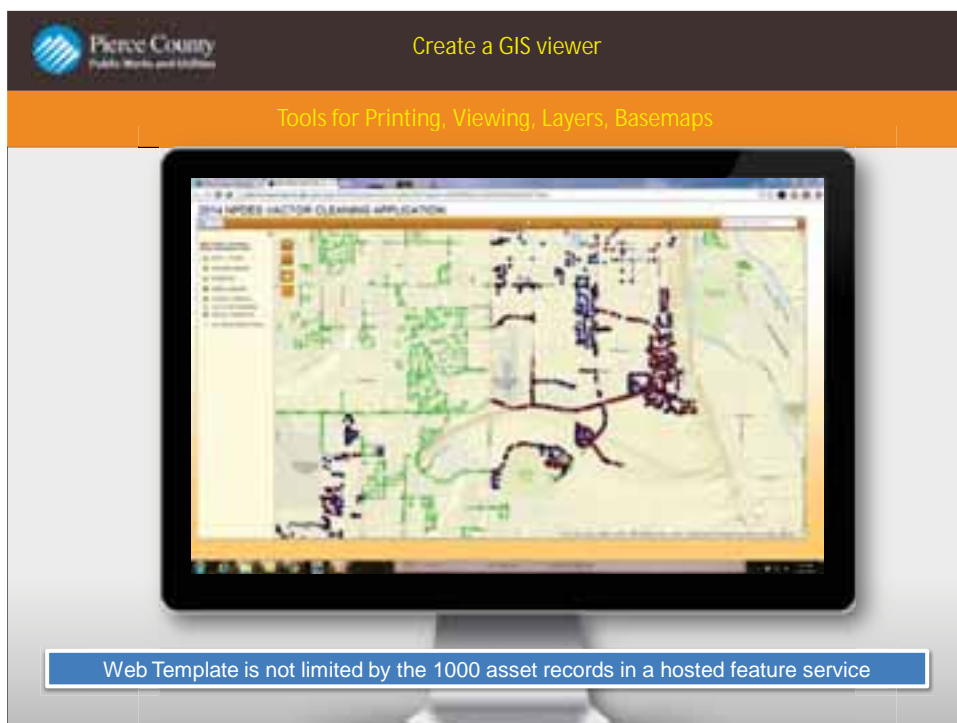
This slide shows an example of setting up your map for offline editing. This is a way to pre-cache your map or work area to allow mobile users to update the data in the field where cellular service is not available. This is important for our group because we cover such a large area with remote locations that have limited or no cellular service. It is easy to do using the ArcGIS Collector application on Apple or android products. The slide details the steps needed to enable your map for offline editing.



Attachments are important to the Roads department for data collection. Many times a picture will best describe the situation that is taking place in the field. With attachments enabled to your data the field user is able to attach photos or documents that correspond the feature the field staff is editing. It is easily done in ArcCollector or ArcGIS application. The data must be set up to allow attachments for this option to be available.

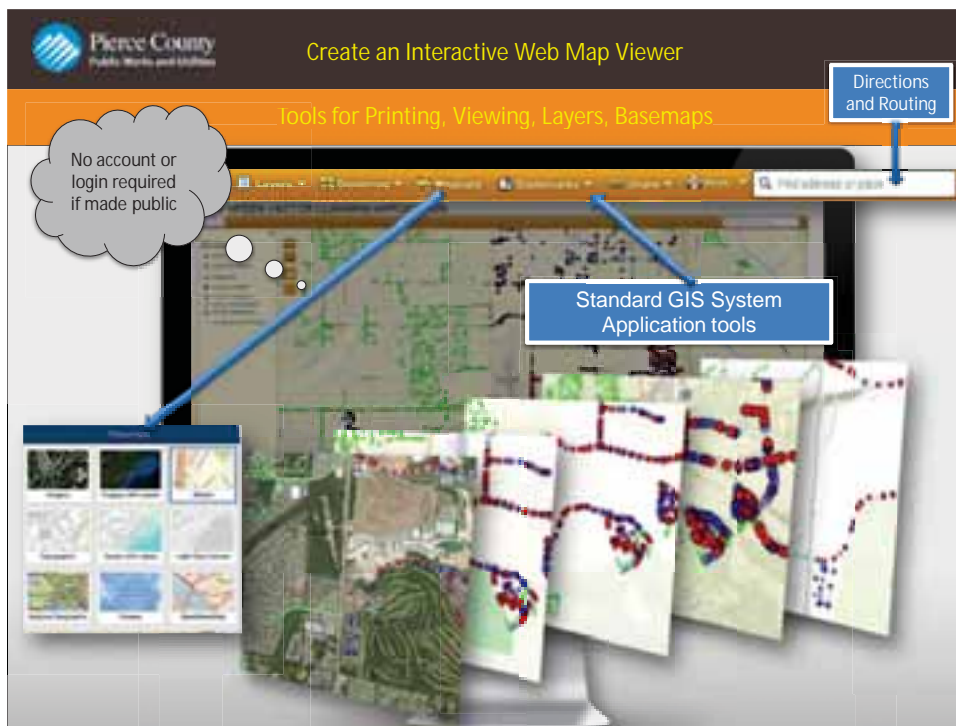


Once an attachment is saved to the feature being edited it can be viewed online. This slide shows how it looks in the field and on the web map.



Web map application is a useful tool created by publishers to create map views to share to public or other organizational users. The advantage of a web application map view is the speed in which the data refreshes. Also with a web map application the publisher has the ability to share the application view social media platforms such as Twitter and Facebook by sharing a link directly upon creation of the web application map. You also have the ability to embed maps on websites.

Another advantage of web map applications are the custom templates that are available through ArcGIS online. They have multiple web application formats that are geared to fit the needs of your organization. Public outreach, Social Media, Story Maps, Information Maps, and many others available through ArcGIS Online.



Web Application Maps also allow the users tools such as Printing, Routing Services, Base map layer options and Measurement tools. These are free services available when using the web map applications.

## Asset Collection Process

Data collection is done annually and requests are generated from multiple sources. Data is collected using a Trimble GeoXH 6000 Data logger

- **Assessments** – Assessment crews use comment codes to notify staff of missing features.
- **PALS (Planning and Land Services)** – Send notification of CRP projects or permitted construction projects via mail.
- **RFA requests** – Roads supervisors will notify collection staff of any additions discovered from site visits.



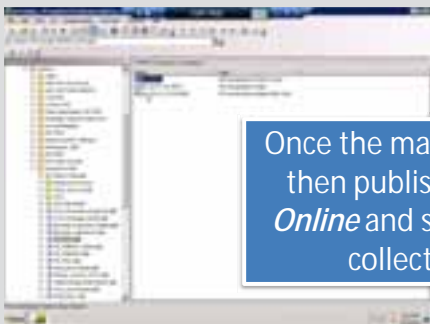
The collection of assets is key in keeping the County asset data up to date. This slide covers the different ways that the Roads department is notified of new assets installed in the county right of way for collection. There are 3 main sources of notification which are from the annual Assessment Programs, PALS, and RFA's that have been investigated.

I also included the device that is used for the data collection the Trimble GEOXH 6000

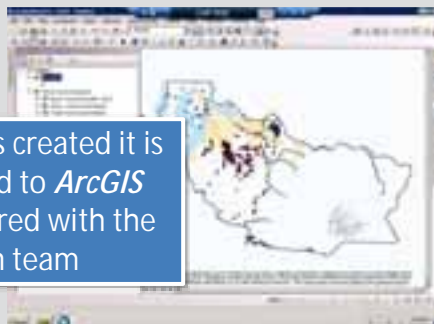
## Asset Collection Process

Using *ArcCatalog* a geodatabase is created containing a point feature class.

In *ArcGIS Desktop* a map is made using the point feature class to display collection locations.



Once the map is created it is then published to *ArcGIS Online* and shared with the collection team



This slide shows how I create a map used to find the locations where collection is needed. I combine all 3 sources requests for mapping into one map. Each point represents a location where a request has come in providing the collector with a location for each request.

## Asset Collection Process



The data collection team uses the map to find the collection locations. Custom forms created using coded domain values allow collection teams to track any details about the collection site and track which locations have been collected.

Using ArcGIS Online to publish the data to a map is created to be accessed via ArcCollector or ArcGIS Online. Custom forms are made to be able to track collected sites and any specific details about the data being mapped. Symbology has been set up to show which sites have been collected so that it is easy to track progress of overall collection.

Part Three.

## **ArcGIS Online/Collector Pilot Study**

### **Project Purpose/Background:**

Smart phone and tablet technologies are becoming widespread in the government enterprise. Over the preceding two years internal and external GIS customers have expressed a requirement to make better use of these mobile devices in their day-to-day operations. Much of the interest by Public Works Departments has been instigated by the National Pollutant Discharge Elimination System (NPDES) permit program. In order to support this regulation some of the GIS software vendors have aggressively gone after this market and currently have successful Commercial Off the Shelf Systems (COTS) available. Many of the internal and external customers of the Applications and GIS Services Division (AGIS) have also seen demonstrations of these systems, and they have expressed the need to actively seek a mobile solution for their GIS field collection/assessment programs. Because of these requirements, the AGIS division in collaboration with Public Works personnel and ESRI consultants embarked on a study to explore the possibilities of taking advantage of COTS solutions that fit within the County's vendor and IT assets standards.

The purpose of this pilot project was to conduct an assessment of current ESRI offerings that could improve the editing of GIS and asset related data in the field. Currently ArcPad, Arc Explorer, in-house developed applications and manual paper methods are utilized to collect and update data in the field. With the County's move to iPhone's and iPad's, there are many opportunities to enhance the usage of these devices. This pilot focused on two process areas where improvement opportunities could be quantified and qualified. The two process areas are in the Surface Water Management (SWM) and Road Operations (Roads) Divisions of the County Public Works Department, and are good examples of many other areas needing improvement. Process workflows have been included for more information on the "As-Is" and potential "To-Be" assessments of these two areas.



**Scope:**

The scope of the current assessment is limited to the internal collection and consumption of GIS related data, with an emphasis on either replacing ArcPad licenses or eliminating the need to purchase additional licenses. In addition, existing mobile devices such as the iPad or iPhone are the preferred device of choice for reliability and other inherent peripheral functions such as integrated Geo camera, GPS, proximity sensors, leveling attribute, and a full suite of messaging functions. The solutions that are being evaluated could be utilized for external and internal client requirements, but at this time we are limiting the pilot to internal County business and specifically the two documented process areas for SWM and Roads.

**Business Needs:**

Over the years a wide variety of business needs have been expressed for viewing, collecting and editing asset data in situ and monitoring field crew status. With this project examining improvements to two workflow processes, the expressed needs will be limited to these programs within the existing GIS environment. In this pilot the following business needs will be examined:

- Broaden the assessment and collection program
- Reduce vehicle trips and collection duration
- Reduce data management and data redundancy
- Eliminate paper products
- Improve process tracking
- Increase situational awareness
- Shorten implementation cycle
- Extend use of existing smart mobile devices
- Enable a solution that integrates natively with the County 's GIS architecture

**Goals and Objectives:**

Listed below are the goals, objectives, and deliverables expected from this pilot.

- Determine the data, process, applications/services, and infrastructure requirements.

- Discover if any changes are needed to data structures or where additional data sets are required.
- Identify what components/services (e.g. Collector, ArcServer, ArcGIS Online, etc.) are required from ESRI to enable the real-time data collection.
- Design a systems architecture drawing.
- Evaluate the ESRI products given their current and future systems directions.
  - Ensure those investments required to set up and use the ESRI software will not have to be duplicated in the future, because of changes in the ESRI's technical directions. This objective is also aimed at confirming the useful life of the various related products in use today and in the future.
- Determine the potential costs and evaluate the software costs against our current ELA.
- Document the benefits to be realized.
- Prepare a white paper and associated presentation for the IT Director and other key stakeholders that documents the findings.

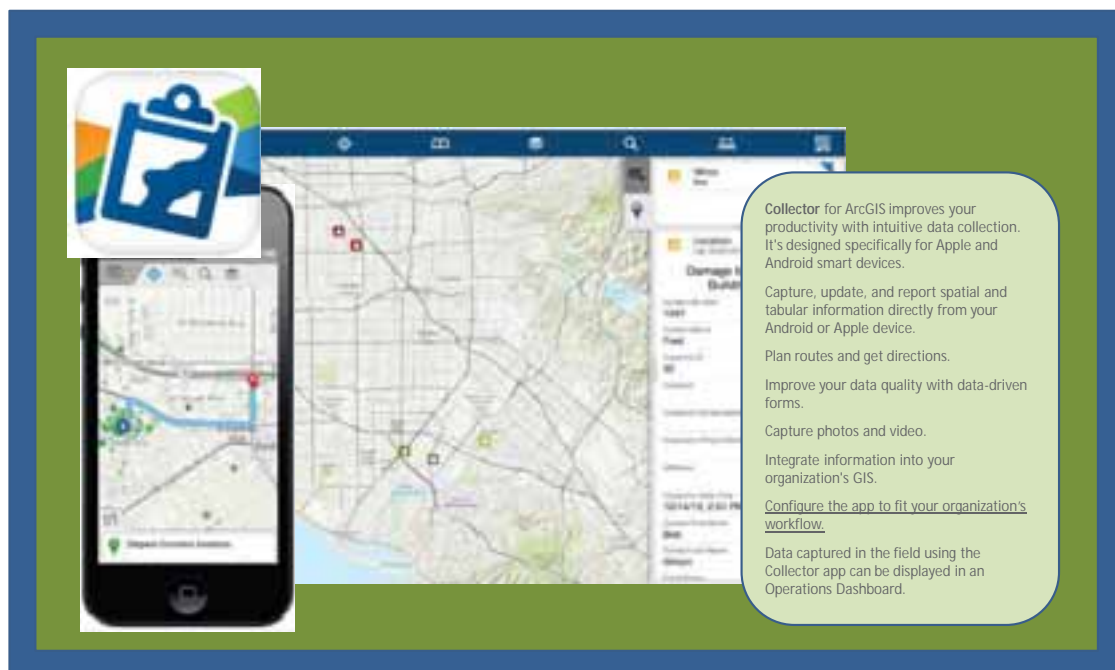
### **Project Description:**

Two field collection projects were identified as suitable for this examination. The first was a project conducted by Surface Water Management that annually examines levees and their associated assets, rates them on a set of criteria and generates work orders on deficient assets. The current project is primarily a paper process augmented by some technologies. A folder is kept on each levee that contains assessment forms, pictures and maps that record each levee's assets and condition. Historic data is often removed when deemed redundant or no longer pertinent to the levee record. Multiple Microsoft Excel spreadsheets are used to track the program and produce status reports. Digital cameras have replaced film over the past few years. Also, forms are now scanned to provide digital access to the assessment forms. All of the data collected for the project is only accessible by one person and data requests by other staff are a constant resource drain. The pilot project: converted the paper based procedure into a digital process, used iPhones/iPads to view GIS and tabular data, located/rated assets, and tracked/reported project status in near real time and made the data available to other SWM staff.

The second project is one of many assessment programs conducted by Road Operations and focused on a small subset of assets from the roadside assessment program. This project examined ditches and culverts within the County right-of-way. The assets were rated based on condition criteria. Depending on the rating, the assessment issued a work order to clean or replace the asset. A digital assessment process has been in place for several years, so the pilot project looked for opportunities to enhance or optimize the process.

The current GIS editing environment consists of ESRI ArcGIS software running on Windows servers in a secure network. GIS data is stored using the spatial database engine SDE in the Microsoft SQL Server

database or Windows file system. Access is through remote desktop clients. Field staff use ArcGIS to extract standalone data from the GIS onto laptop devices, use ArcPad to edit data in the field, then sync the modified data back into the GIS. Custom developed web browser applications are used to view GIS data and they use either ArcIMS or GeoServer to render the map. ArcGIS Server is used to produce several tile cache basemaps that speed map rendering for web map applications. External access to the GIS is available through a VPN client. This pilot examined the use of cloud based ArcGIS Online to secure basemap and editable feature data for the field crews. The ArcGIS Collector client was used to view, update and track progress of the assessment programs. An examination of cloud versus county data storage was examined.



### Project Implementation:

A 90 day evaluation license of ArcGIS Online was obtained from ESRI and weekly meetings were scheduled to discuss pilot status and identify and address any concerns about the system. SWM and Roads staff began system and data design efforts. The first two weeks were spent examining the data security capability of ArcGIS Online and getting it setup to support the process. Roads modified their existing database design to support data-driven forms and pushed data into the cloud for testing. SWM designed and created GIS layers to support the digital process. Roads used the second two weeks for learning the capabilities of the collector application, testing the system and scheduling crews for pilot

collection. SWM incorporated paper forms and spreadsheet information into the spatial database and designed the database to support data-driven forms. Then they began examination of Collector capabilities. At the end of 30 days the ArcGIS Online security system was in place, data was ready for assessment, the application was tested, capabilities were documented and crews were trained and scheduled.



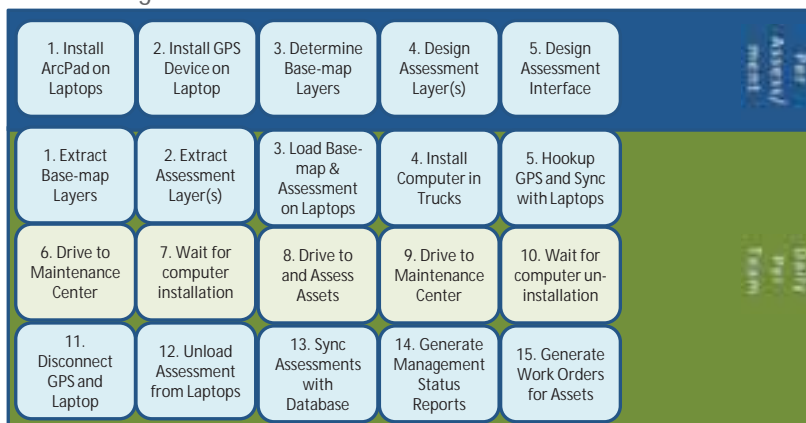
The following two weeks Roads began assessments on ditches and culverts, optimized the collection process and setup a management dashboard. With data being collected directly into the database, GIS staff no longer had to check in or check out data and it was now available for use by others and to issue work orders. Since the dashboard provides a real-time view of field operations, supervisors used it to monitor the assessment status and direct field crews. During this same period SWM began field testing and optimizing the database and collection process and scheduling field crews. GPS tracking and photo capture were incorporated into the Collector process and field crews were trained. The next two weeks saw productivity increase as Roads field crews quickly adapted to the new workflow. For the first time crews were able to dispatch directly from satellite facilities. SWM began sending out field crews, optimizing the collection process and developed an operations dashboard for supervisors. During this time GIS worked through the server and security environment to make feature editing between ArcGIS Collector and Pierce County's SQL Server instance a reality. This eliminated the need for the ESRI cloud storage. At the end of 60 days two assessment crews were collecting assessments and posting updates directly into the Pierce County GIS database; supervisors had real-time data on program status and could direct crews from the office; and significant cost savings were occurring through the elimination of data management and trip reductions.

With the success of the project, the last 30 days of the pilot were primarily concerned with managing expectations. As other managers and supervisors heard about the project they wanted demonstrations and their own pilots. While the test environment worked well for a proof-of-concept project it was not designed for a production implementation. Not surprisingly field crews in the outer reaches of the county ran into cell service problems, but this only affects 2-3 percent of the assets. In addition, a major concern was that this technology stack needed the blessing of executive management. This period was primarily spent monitoring the field crews; documenting the process; and preparing to solicit management support.

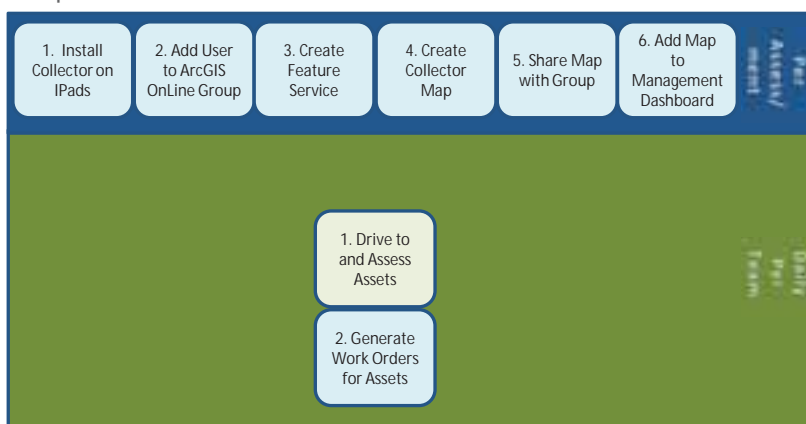
## Project Results:

The figure below describes the “As-Is” (current) and “To-Be” (proposed) workflows for Road Operations. The workflows consist of a per assessment step (dark blue) and a per day step (dark green). Each element of these steps is numbered in the order it is preformed and some elements are completed by GIS Specialists (light blue) and others by field staff (light green). Both workflows consist of the same per assessment elements with the addition of a dashboard creation step in the “To-Be” workflow. This element takes the place of the status report element in the “As-Is” step. The main differences appear in the daily steps where all data management and office trips are eliminated.

Current Digital Assessment Process

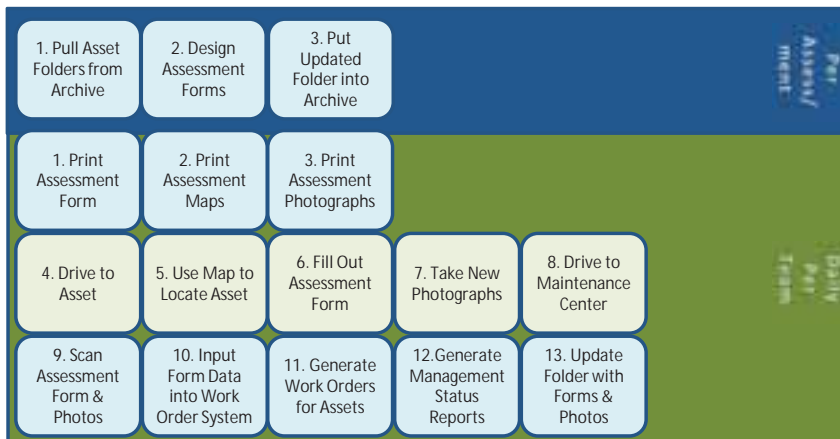


Proposed Assessment Process

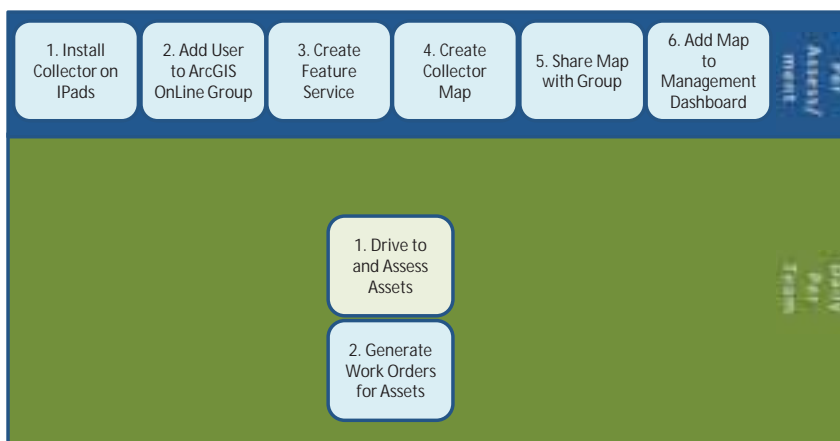


In similar fashion the Surface Water Management workflows resulted in the elimination of many data management steps. This change not only improves the process, but converting the primary technology from paper to digital allows many capabilities lacking in the “As-Is” workflow. See the figure below.

## Current Paper Assessment Process



## Proposed Assessment Process



As can be seen from SWM and Roads' workflow figures, this process dramatically reduced vehicle trips. The ability to drive directly to the day's assets is an enormous savings in fuel costs. The Road Operations Division estimates that fuel reductions saved them \$3,780 for this pilot. The new workflow also allows the duration of the collection project to be reduced by about 1.5 hours per person per day and resulted in a cost savings of \$3,621 for Roads. Daily data management is eliminated since field crews put their assessments directly into the database and eliminate several hours per day for GIS Specialists at Roads, which saved them \$4,950 for the duration of the pilot. Since data quality assurance could be completed in near real time this save one week of staff time saving an additional \$3178. The total savings to Road Operations was \$15,529 for the two months that the three 2-person crews were assessing ditches and culverts.

While it isn't possible to separate the cost savings of converting the data management process to digital from paper, just the removal of handling data could save SWM \$12,000. It is difficult to estimate SWM's savings with regards to time of collection, since the process is quite different. The cost of printing documents can be determined since printing is totally eliminated and saved SWM \$40 in paper. The costs of project tracking improvements is more tricky to quantify, since it not only eliminates the time required to gather project status data and produce status reports, it also allows for the reduction of field trips by supervisors, thus saving time and fuel costs. A rough estimate of these costs for just a single trip every two weeks would result in \$4,800 of savings over the pilot's duration. The total savings to Surface Water Management was \$16,840 for the two months three people were assessing levees and associated assets.

A less quantitative consequence of this system is the availability of near real time project status to other county staff, which will have a positive impact on departmental coordination and public access to pertinent information. Since the pilot only deals with a small subset of assets managed by SWM and Roads and with the interest expressed by other divisions with assessment programs, the use of ArcGIS Online and the Collector app would be game changers in the way field data is assessed and maintained. Also, thanks to a user-friendly configurable interface, the ease and speed of creating web maps for long- or short-term field projects removes development time from the equation, significantly shortening the timeframe to implementation and freeing developers for bigger projects. Finally, this pilot worked on existing hardware and ran on existing software without any customization.

### Assessment Questions:

Listed below are questions that were evaluated:

1. What data structures do ArcGIS and the Online Collector support? Will any changes or additional data sets be needed?

In order to edit data from ArcGIS Online data must be served from a multiuser database so it can reside on ArcGIS Online or within an SDE enabled database. In this pilot data was tested in both environments and the results were more than adequate for assessments and asset collection purposes. If datasets were designed for data-driven forms, no changes will be required.

2. How does the Arc Collector mobile application's scope relate to our GPS devices and associated data collection?

- a. A comparison matrix of functionality is listed below:



	Trimble GPS	Collector
Device	GeoXH (can buy data plan, Windows Mobile)	iPad, iPhone, Android, Windows Mobile
GPS Accuracy	Sub-foot	Not documented
Screen Size	3.5 x 3.5	6 x 8
Data Accessibility	Check In/Out	Enterprise Database
Function	GPS Collection	Full Computer
Native Geo-database	No	Yes
Menu Creation	Manual	Data Driven Forms
Real Time Updates	No	Yes
Local Tile Cache Use	No	Yes
Location Tracking	No	Yes
Laser Distance Finder	Yes	Yes

- b. Notes: Trimble devices can be purchased with cell service and data plan which allows it internet access. One device also includes a phone, but GPS accuracy is in the 1-3 meter range. The small screen size and button interface is most often the limiting factor for users. It also should be noted that this pilot project was not aimed at replacing the Trimble GPS devices being used.
3. Cost:
- a. What are the ArcGIS Online costs?

To utilize Arc Collector and take advantage of the County owned Ipads and Iphones, ArcGIS Online licenses are required. The licenses are sold in bundles with the price of each license being less depending on the number of licenses purchased. The licenses are named licenses. With a purchase of 50 licenses the cost of each license is about \$195 for a total of \$9,769. The purchase of each license drops down to \$175 each if 100 or more licenses are purchased. There is also a credit use that goes along with each license to utilize the ArcGIS online infrastructure. For the most part though, the County's GIS community will not need the credits, because the plan is to utilize the existing PC GIS infrastructure.

- b. What are the implications for the ESRI ELA and the County's GIS cost allocation model?

The recommendation is to not adjust the ELA at this time and instead buy the ArcGIS Online licenses like we have done in the recent past for ArcPad licenses. The ELA expires at the end of 2015, which means the ELA would need to be renegotiated in early 2015 for the 2016 budget. The recommendation is to include ArcGIS online annual maintenance discussions and needs into the ELA at that time.

The 2015 cost allocation model would have to be slightly adjusted. However, because the costs are relatively cost neutral for PWU, the adjustments would be more about a new service and product being offered than an actual allocation change.

- c. Are there any associated database/infrastructure costs for implementing online collection?

Collector will operate as designed within our current GIS software and hardware environment.

d. What are the potential cost savings?

The potential cost savings are a combination of soft and hard dollar savings. The soft savings are labor savings where employee time is saved, but there wouldn't be a plan to actually layoff employees. The time saved allows for more work to be accomplished and data collected, resulting in a more effective asset management program. Hard savings include gas expense, paper costs, and not paying for new ArcPad licenses or the annual maintenance of existing ArcPad licenses for example. The results section above provides more details around the process improvement savings.

The following information summarizes the potential cost savings found in the limited scope of the pilot project. The expectation is that cost savings could increase dramatically as this effort is extended to other teams.

- \$16,840 – SWM pilot process savings
- \$15,529 – Roads pilot process savings
- \$ 6,950 – One time savings of not buying 10 additional ArcPad licenses
- \$ 7,500 – Annual maintenance savings for the County's 25 ArcPad licenses

4. What devices will Arc Collector support?

Currently Arc Collector can be run on iPhone, iPad, Android, Windows phones, and most browsers.

5. How will the piloted approach work if Internet access is not available?

This is an issue that ESRI is currently working on and disconnected editing is expected to be released in first quarter of 2014.

6. What are the functionality comparisons between ArcPad and Arc Collector?

- a. A matrix of functionality comparison is shown below:

## Functionality Matrix for Esri's Mobile Solutions

	ArcPad	ArcGIS for Windows Mobile and Windows Tablet	ArcGIS for iOS	ArcGIS for Windows Phone	ArcGIS for Android
<b>Supported Devices</b>					
Smartphones	N	N	Y	Y	Y
Tablets	Y (Windows Tablet)	Y	Y	N	Y
Laptops	Y	Y	N	N	N
External Devices	Y	Y	N	N	N
Operating Systems	Windows Mobile 5, 6, XP, Vista, 7	Windows Mobile 5, 6, XP, Vista, 7	iOS	Windows Phone	Android
<b>Network Connectivity</b>					
Wi-Fi	Y	Y	Y	Y	Y
Cell	Y	Y	Y	Y	Y
Bluetooth	Y	Y	Y	Y	Y
<b>In-Field Functionality</b>					
Task and Workflow Drives	N	Y	Y	Y	Y
Disconnected Editing	Y	Y	Y (3rd 1/4 2014)	Y (3rd 1/4 2014)	Y (3rd 1/4 2014)
Data Collection	Y	Y	Y	Y	Y
Photo Collection	Y	Y	Y	Y	Y
Ad Hoc Data Collection	Y	N	N	N	N
Editing of Layer Display Properties (symbolology, color, etc.)	Y	N	N	N	N
Map Services (via ArcGIS for Server)	Y	Y	Y	Y	Y
ArcGIS Online Services	Y	Y	Y	Y	Y
Share Maps (SMS, e-mail, social media)	N	N	Y	Y	Y
<b>Customization</b>					
Developer SDK	ArcPad Studio	ArcGIS Runtime SDK for Windows Mobile	ArcGIS Runtime SDK for iOS	ArcGIS Runtime SDK for Windows Phone	ArcGIS Runtime SDK for Android
Customize ArcGIS Application via SDK	Y	Y	Y	Y	Y
Application Extensions/Add-ins	Y	Y	N	N	N
<b>App Deployment</b>					
Enterprise	ActiveSync	ActiveSync	iTunes	Windows Phone SDK Tools	Android SDK Tools
Webstore	N	N	Y (Enterprise)	Y	Y
Application Store/Marketplace	N	N	Y	Y	Y

7. What does it take to set up ArcServer, Arc Collector, etc. and is there any development required?

The pilot environment required a standard installation of a multiuser database like SQL Server with an instance of ArcSDE and a standard ArcGIS Server installation with VPN access. No custom development was required. To serve a feature class for editing the publisher creates a standard ArcMap document and creates an optimized server document. The server document is published to Arc Server with feature access. The feature service is added to an Arc Online map and shared with the editing group. The user opens Arc Collector, clicks on the map and begins editing features.

8. What are the training requirements for moving from either manual or ArcPad data collection to Arc Collector?

The switch from ArcPad to Arc Collector can be achieved in 10 to 15 minutes. Getting used to the iPad interface when moving from a laptop will take longer.

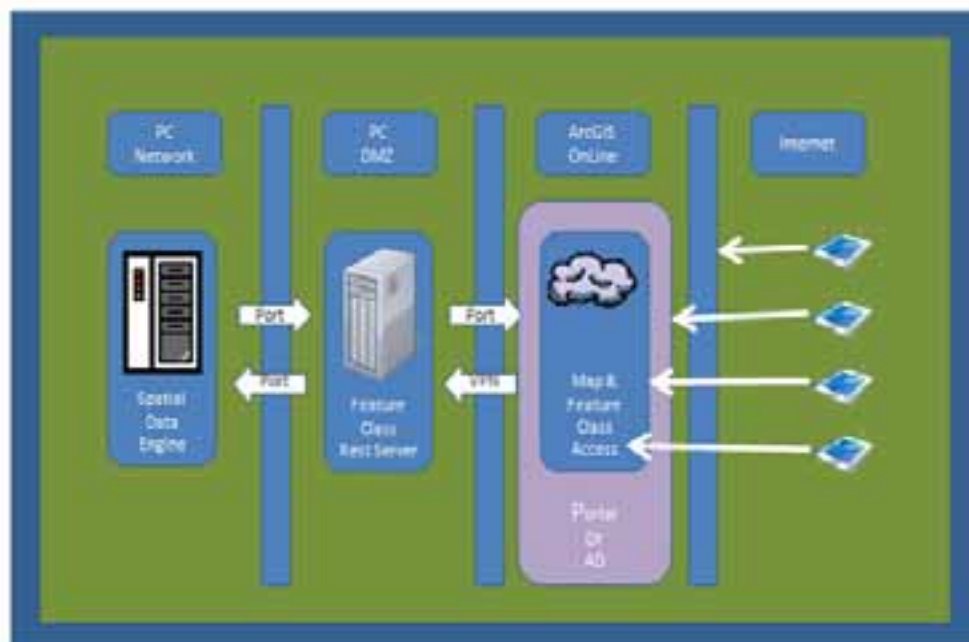
9. Which departments/divisions could benefit from this approach?

Any county department that edits data in the field could make use of this technology, but those that use map data and GPS will see significant productivity improvements and cost savings. Most of the divisions in Public Works, Planning staff like development engineering, building inspectors or wild life biologists, Assessors, Public Health food inspectors, law enforcement and others could all be users of this system.

10. What other potential benefits of Arc Server, ArcGIS Online, or Arc Collector were identified in this specific assessment project?

The main benefit was the ability to see field staff and monitor their work in near real time. This allowed supervisors to direct field crews' work from the office, thus saved supervisors trips to the field.

11. System Diagram



## Conclusion:

This study has been a collaborative effort with ESRI, PWU, and IT personnel. The study started from a process improvement and fiscally responsible perspective, with a fairly narrow scope of objectives to determine costs, benefits, and fit within County IT standards. The scope of the project was primarily focused on the ArcGIS Online offering of Arc Collector, along with the more effective use of Ipads and Iphones for asset assessments.

The below points summarize the findings from the pilot study:

- The initial costs are relatively cost neutral when comparing the purchase and use of ArcPad against the more current offering of ArcGIS Online Collector.
- The potential savings in time and money are significant.
- Collector enables more effective use of recently purchased hardware (i.e. Ipads and Iphones).
- The processes were improved considerably by providing access to real-time data and eliminating many manual data collection and data sharing steps.
- The data quality and quantity collected were enhanced by enabling more data to be captured faster and the data is naturally shareable in the County's GIS database. Storing the data in the County's SDE for example helps enhance the use of the Countywide GIS in comparison to the current ArcPad related methodology.
- While the study identified many specific benefits within the scope of the pilot project, there were also other potential benefits revealed as the team learned more about ArcGIS Online. Examples of these include the use of Excel with ArcGIS, the use of Cognos BI with ArcGIS, and other small applications that could help with other process areas.
- Finally and most importantly, the asset management program for PWU can be dramatically improved. The team believes this is one of those rare opportunities where reengineering along with exploiting current technologies can enable transformational change.