

**Indiana High & Local-Resolution NHD Update Geosynchronization Grant
2010 Category 2: Framework Data Exchange through Automated Geosynchronization
Final Report**

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Project title: Indiana High & Local-Resolution NHD Update Geosynchronization

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Executive Summary

Indiana's NHD Geosynchronization project streamlines the workflows involved in communicating and integrating updates to our existing High-Resolution and new Local-Resolution National Hydrography Dataset (NHD) data. In our design, the updating process is facilitated through a suite of web services which include transmission, review, rejection or approval, and synchronization of NHD updates, as well as subscription and notification services for enabling user-specific information access. Collectively, this extensible framework of services is known as the Indiana Geosynchronization Suite (IGSS).

The IGSS provides updating and publishing functionality for NHD data within the current operating environment of Indiana's Geographic Information Office (NHD steward), Indiana Office of Technology, State and Local NHD data users, maintainers, and the USGS. Image Matters LLC successfully completed development and testing on the IGSS in Q1 2011. Presentations on the IGSS, including demonstrations, have included delivery to the CAP Category 2 group (via teleconferencing), two sessions at the 2011 Indiana GIS Conference (March 2), and are planned for the URSIA GIS-Pro Conference in Indianapolis (November 2011).

Project Narrative

The Indiana Geosynchronization Suite (IGSS) is designed to facilitate the work flow processes in which National Hydrography Dataset (NHD) geographic information is updated and distributed through the network of the Indiana geospatial community and the USGS. A graphical user interface provides authenticated users the capability to perform authorized processes for submitting, reviewing, approving, and publishing database updates. The suite is built on a series of Atom/PUB feeds for quickly identifying and distributing updates within a publish-subscribe-notify framework. The updating and geosynchronization of the NHD served as a pilot for the IGSS, which is extensible to other data types and similar workflows.

Architecture

The IGSS Suite is comprised of two major components. The Web 2.0 rich IGSS Web Console and the OGC Geosynchronization Service (GSS) web service. The IGSS Web Console provides an interactive web interface to the underlying GSS web service. The Web Console allows users to interactively manage Change Requests, user-defined feeds (Topics), and Subscriptions. The console also provides for the visual analysis of Change Request. Authorized users are allowed to review and accept/reject Change Requests within the system.

The GSS web service component is responsible for managing and synchronizing the life cycle of feature Change Requests within a distributed system for databases such as the NHD. The IGSS Web Console communicates through the standardized OGC web operations specified within the *OWS 7 Engineering Report -- Geosynchronization service* (OGC 10-069r2). The GSS component is also responsible for distributing and applying approved changes through the synchronization protocol to other ("remote") GSS instances (See Figure 1).

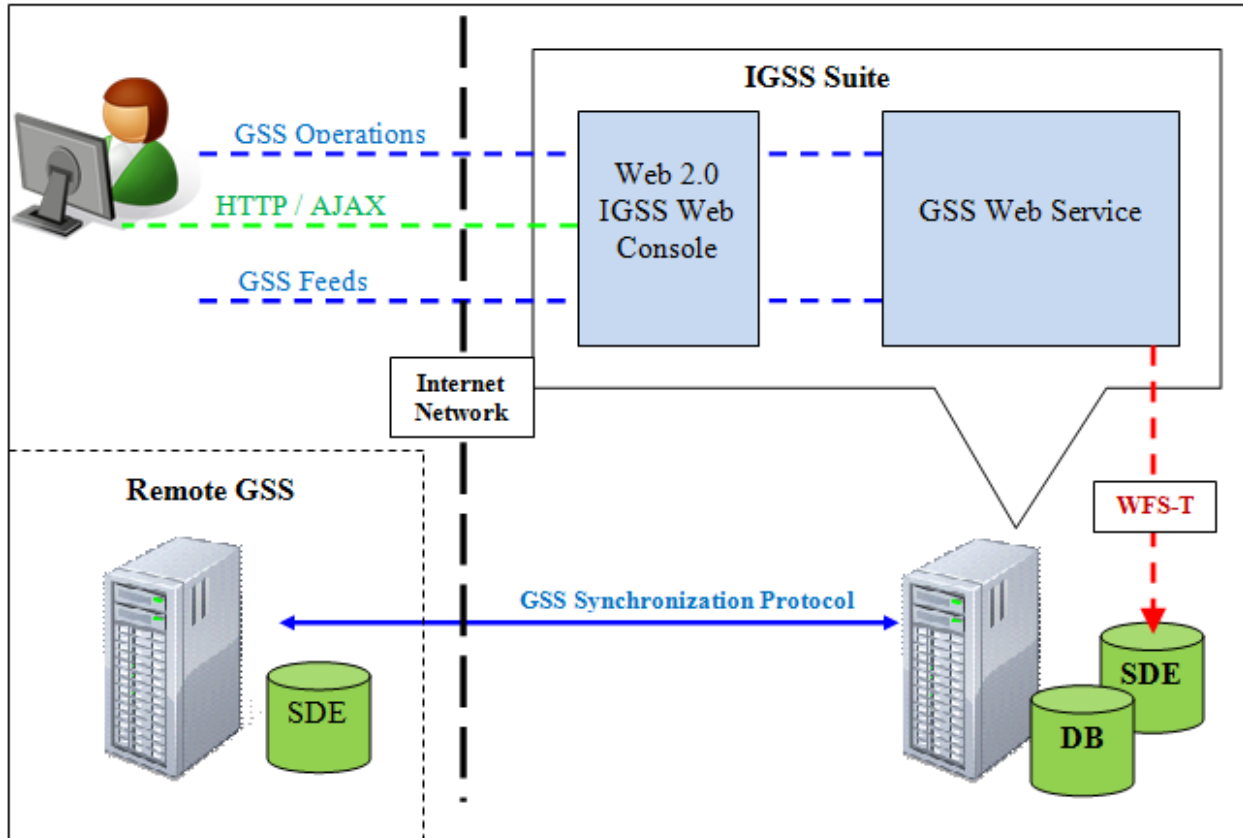


Figure 1

The IGSS Suite relies on Image Matters userSmarts™ technology to drive both the GSS web service as well as the IGSS Web Console interface. userSmarts™ provides an OWS (Open Web Services) framework foundation for rapid and robust development and implementations of OGC web services. Likewise, the RCP (Rich Client Platform) provides an Eclipse-like framework for rapidly developing Web 2.0 interfaces.

Figure 2 (below) shows the high level architecture of the IGSS. userSmarts™ RCP provides views, perspectives, and widgets for quickly generating a rich user interface. The RCP bundle relies heavily on JavaScript, and an XML marshalling framework is also bundled for easily consuming OGC services as well as AtomPub feeds (Figure 3, below).

userSmarts™ OWS package provides a robust framework for implementing OGC specifications. This framework will be the basis of the implementation of the GSS web service. Operations such as GetCapabilities and XML marshalling are available in this Java based framework. The framework also provides OGC clients for easily communicating with other OGC services – such as WFS-T. These mechanisms will be crucial in the synchronization and data application process among GSS instances. Along with these frameworks, userSmarts™ provides many data management interfaces (e.g. Shapefile and database utilities).

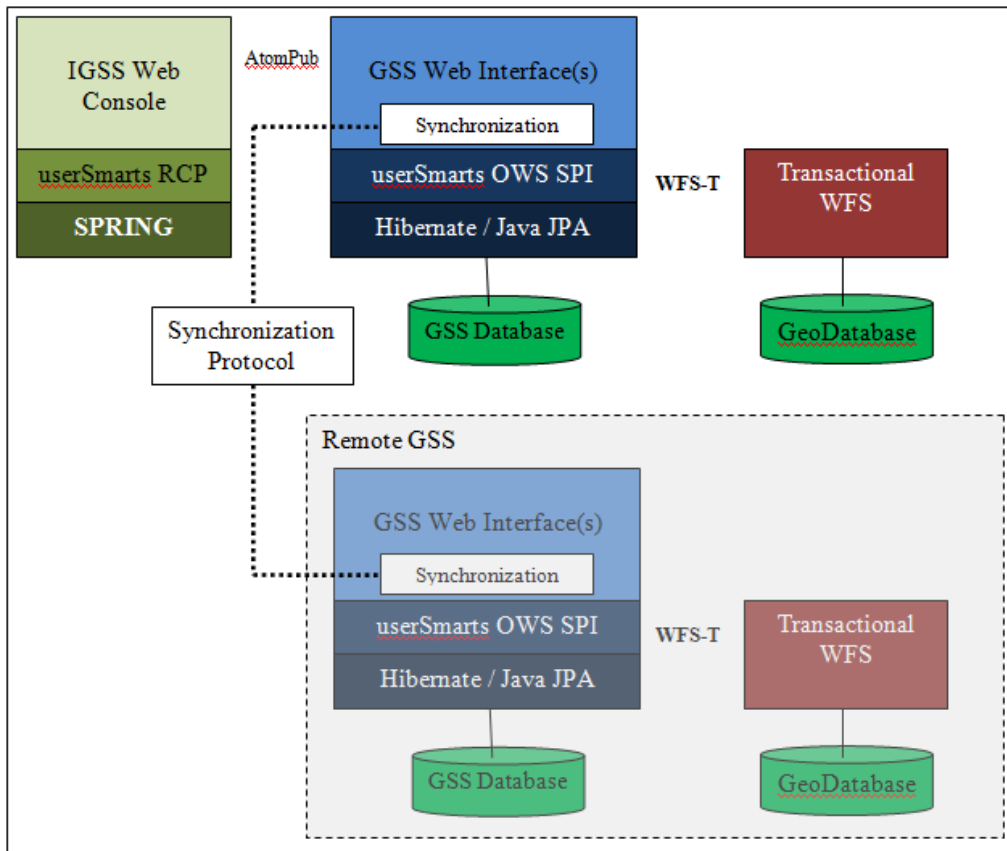


Figure 2

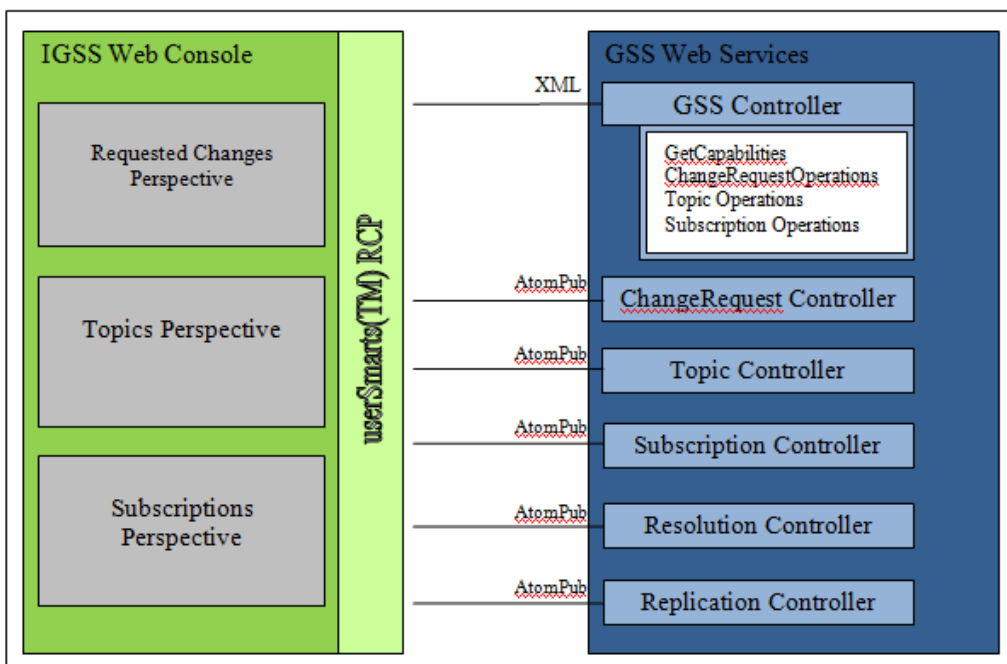


Figure 3

Use Cases and Actors

The Indiana team spent significant effort to learn, define and document both our current NHD maintenance workflow and a more streamlined automated process that was achieved through this project. The following Actors participated in the use cases for Indiana’s IGSS and the GSS:

- "Steward": Indiana NHD Steward (Jim Sparks, Indiana GIO; or proxy)
- "Editor": IGIC, DNR, IDEM, Contractors, and other Waters Workgroup Member (various personnel in Indiana). [AKA "Publisher"]
- "Indiana Reviewer": Appointee of Steward that reviews the proposed NHD updates at some point in the process prior to submitting to USGS Reviewer. (This could be Dave Nail, Indiana USGS Liaison, or other personnel in Indiana).
- "USGS Reviewer": USGS NHD Reviewer (Elizabeth McCartney, Technical POC for NHD)
- "Data Follower": any party that wants to keep their Indiana NHD holdings current, including USGS Denver, IGIC and the IndianaMap. [AKA "Subscriber"]

Figure 4¹, depicts the general connections made between the three primary actors listed above, the "Publisher" who proposes the updates, the "Reviewer" of the proposed updates", and the "Subscriber" who wishes to synchronize their database with the portion of the proposed updates that are approved.

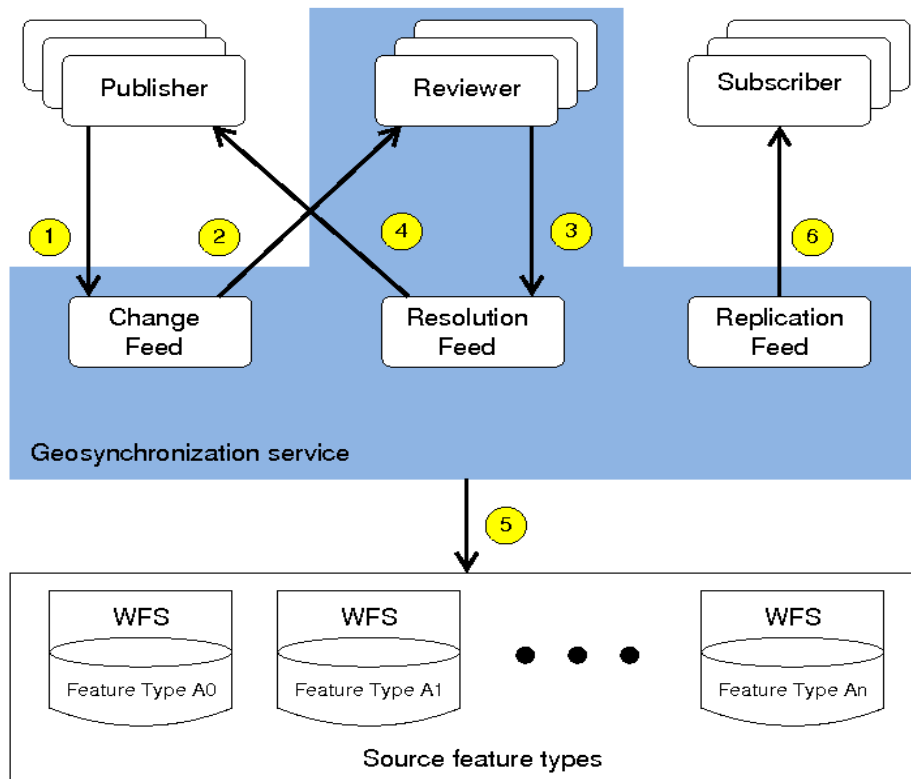


Figure 4

¹ "Figure 16 – Geosynchronization Wiring Diagram, from OGC 10-069r2, Vretanos.

The IGSS's subscription and notification services add necessary functionality to the above general wiring framework. In addition to the fundamental connections in Figure 4, and in order to notify the various actors of the status of updates in the IGSS, several more steps in our workflow addressing the creation of feeds, subscriptions, and notifications are necessary. The set of use cases supported by the IGSS are as follows:

GSS Web Service Use Cases

- Data Publisher Posts Proposed Change(s) to GSS Service
- Proposed change(s) is/are read from the Change Feed direct from GSS
- Reviewer submits approval for proposed change(s) directly to GSS
- Reviewer submits rejection for proposed change(s) directly to GSS
- User creates a Topic directly through the GSS
- User deletes a Topic directly through the GSS
- User lists Topics directly through the GSS
- User subscribes to be notified of changes to a specific Topic directly through the GSS
- User lists Subscriptions directly through the GSS
- User pauses notification subscription of changes to a specific Topic directly
- User resumes notification subscription of changes to a specific Topic directly
- User cancels notification subscription of changes to a specific Topic directly
- Follower creates synchronization feed for Accepted Changes, specifying WFS-T service endpoint, feature type to be updated, and synchronization (manual or automatic) and notification method (email or instant messaging), with support for XSLT.
- Changes discovered by slave GSS are propagated to underlying WFS-T

IGSS Console Use Cases

- Editor posts proposed change
- Proposed change(s) is/are observed from the Change Request Browser
- Reviewer submits approval for multiple proposed change(s)
- Reviewer submits approval for proposed change(s)
- Reviewer submits rejection for multiple proposed change(s)
- Reviewer submits rejection for proposed change(s)
- User creates a Topic, with optional constraints based on geography, or the following Change Request properties:
 - Publisher (any user type or specific user)
 - Feature Type (e.g., Shoreline, Stream/River, Canal/Ditch, or Lake/Pond)
 - Dimensionality (i.e., 1, 2, 3, 4, or 5)
 - Feature Name
 - HUC Code
 - Transaction Type (e.g., create, modify, or delete)
 - Publish Date (specific date, or range)
 - Review Date (specific date, or range)

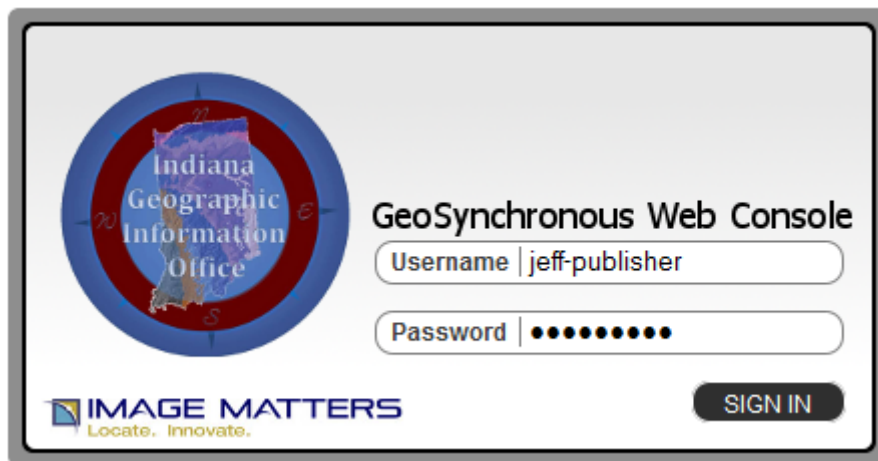
- User deletes a Topic
- User lists Topics
- User subscribes to be notified of changes to a specific Topic
- User lists Subscriptions
- User pauses notification subscription of changes to a specific Topic
- User resumes notification subscription of changes to a specific Topic
- User cancels notification subscription of changes to a specific Topic

Demonstrated Use Case

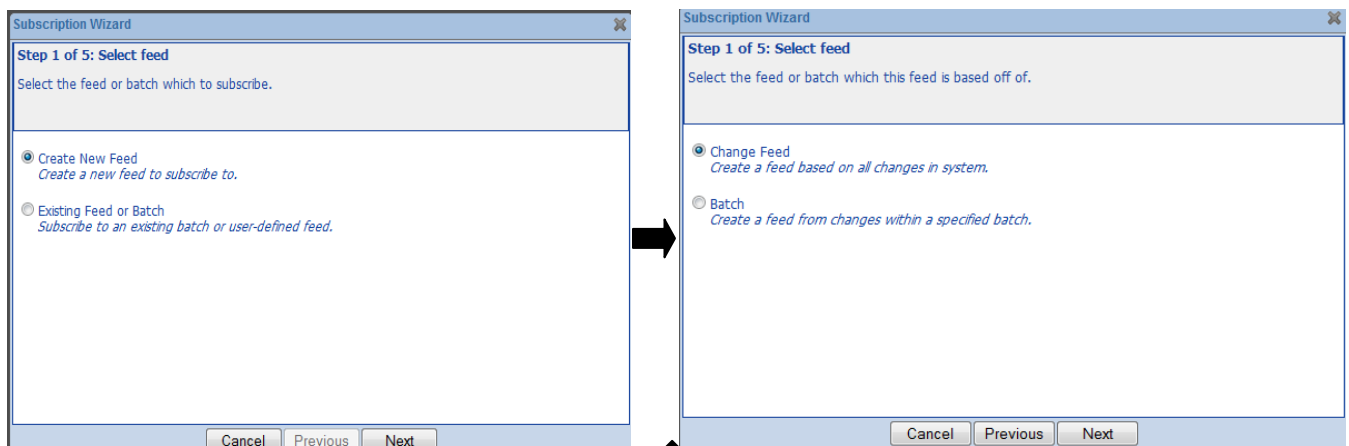
The IGSS Application for NHD Updating, is accessible at: <http://beta.usersmarts.com/igic/index.rcp>

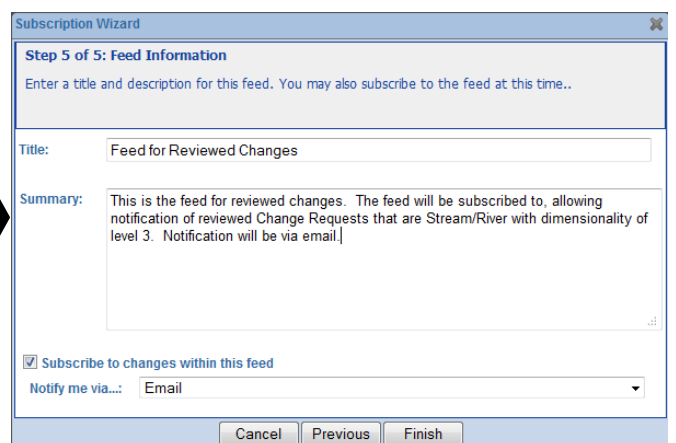
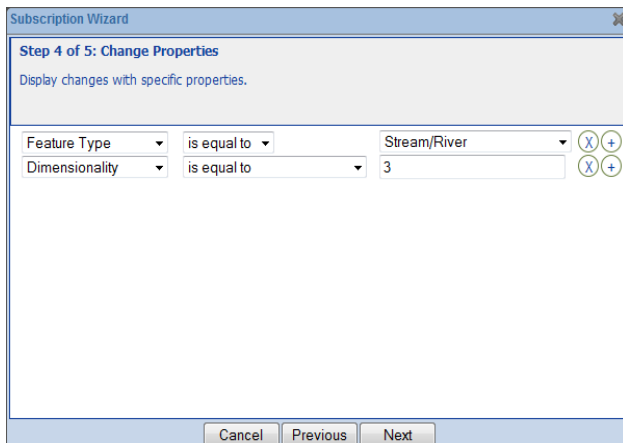
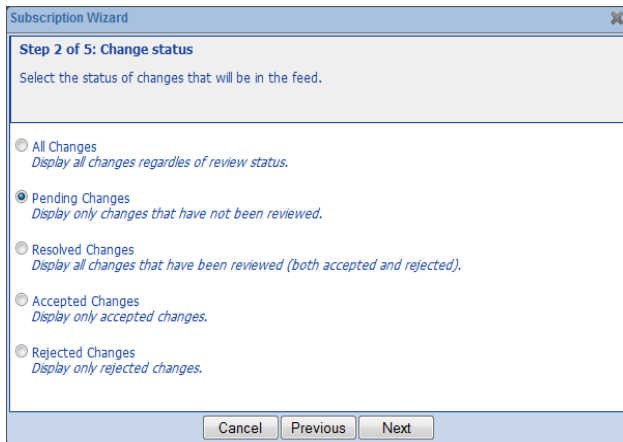
The following steps, with corresponding screen captures to illustrate the GUIs involved, were developed to demonstrate the IGSS. These were presented, either in entirety or in part, to: the 2010 CAP Category 2 group (via teleconferencing), two sessions at the 2011 Indiana GIS Conference (March 2), and are planned for the URSIA Conference in Indianapolis (November 2011).

1. DATA REVIEWER LOGS IN

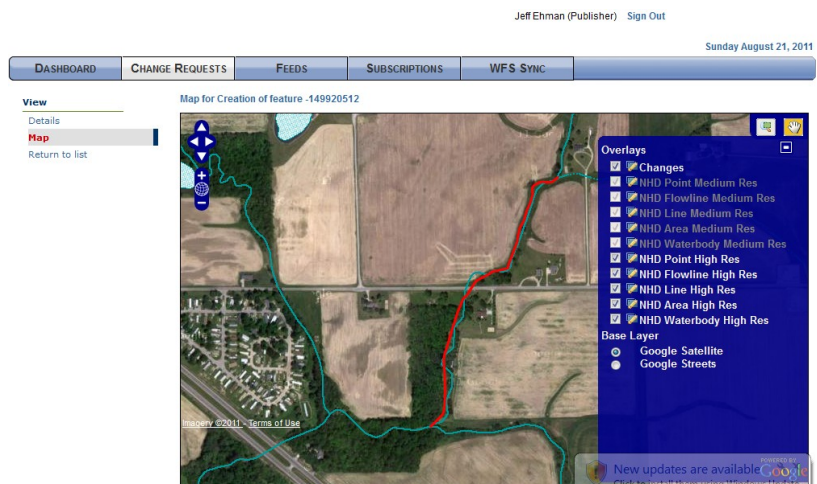


2. Reviewer subscribes to Feed of Pending Change Requests, with email notification

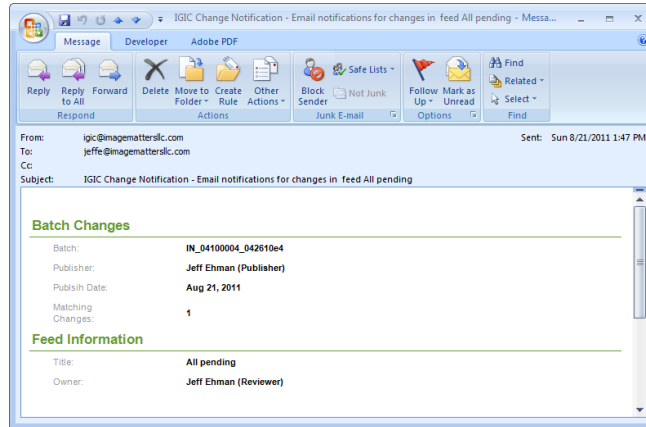




3. DATA REVIEWER LOGS OUT
4. DATA FOLLOWER LOGS IN
5. Data Follower subscribes New Topic Feed of Accepted Change Requests
 - a. WSFT: <http://beta.usersmarts.com/wfst/api/wfs?>
 - b. Feature Name: *usgs:nhd*
 - c. Manual synchronization, with email notification
6. DATA FOLLOWER LOGS OUT
7. DATA EDITOR LOGS IN
8. Editor publishes Change Requests, and subscribes to Resolution Feed in same GUI, with email notification
9. Editor takes a look at his Change Request for quality control purposes →
10. DATA EDITOR LOGS OUT



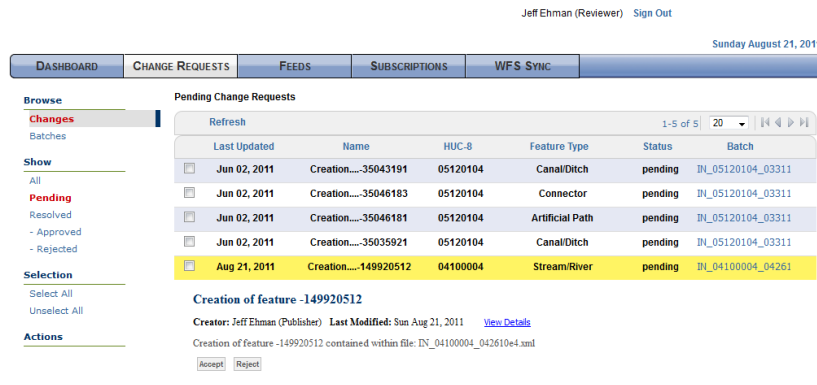
11. Reviewer is notified of new Change Requests, via email:



12. DATA REVIEWER LOGS IN

13. Reviewer reviews Change Requests

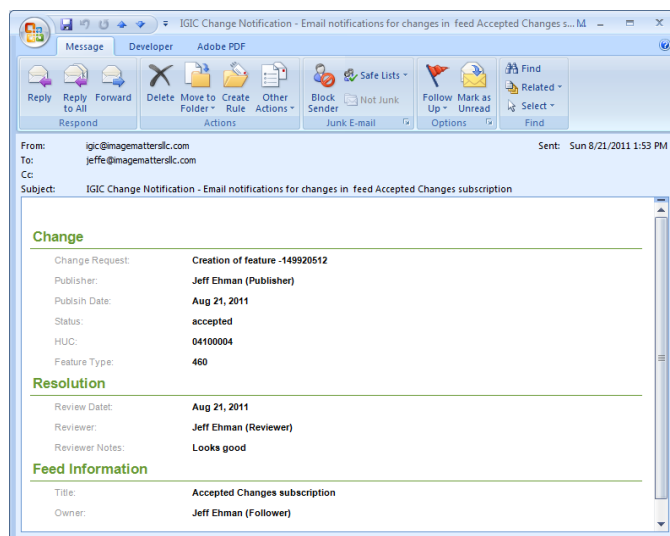
14. Reviewer accepts / rejects Change Requests:



15. DATA REVIEWER LOGS OUT

16. Editor is notified of new Resolutions, via email

17. Follower is notified of new accepted changes, and available synch transaction that was made or is available to be made, via email

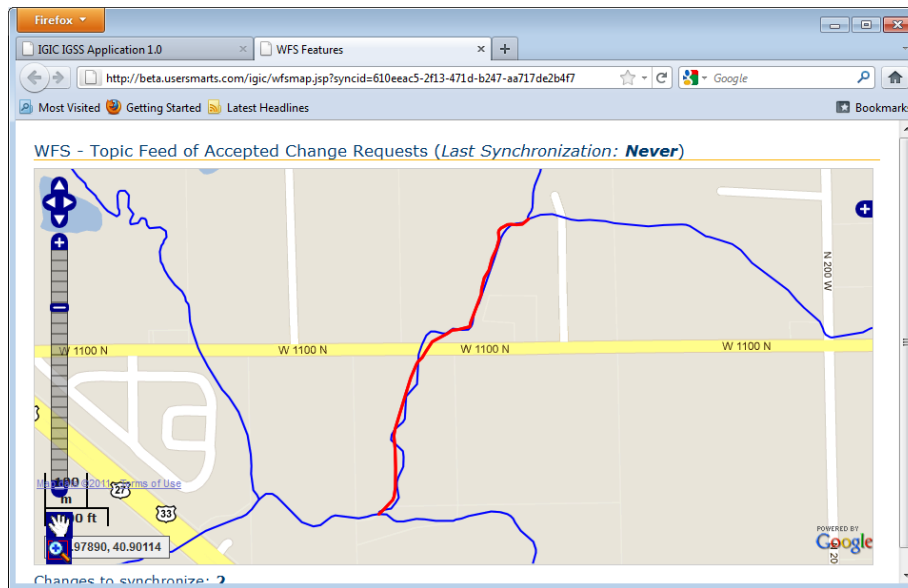


18. DATA FOLLOWER LOGS IN

19. Follower can take the following synchronization actions on the Accepted Change Request, with *usgs:nhd* feature(s) in ready for syncing in <http://beta.usersmarts.com/wfst/api/wfs?>

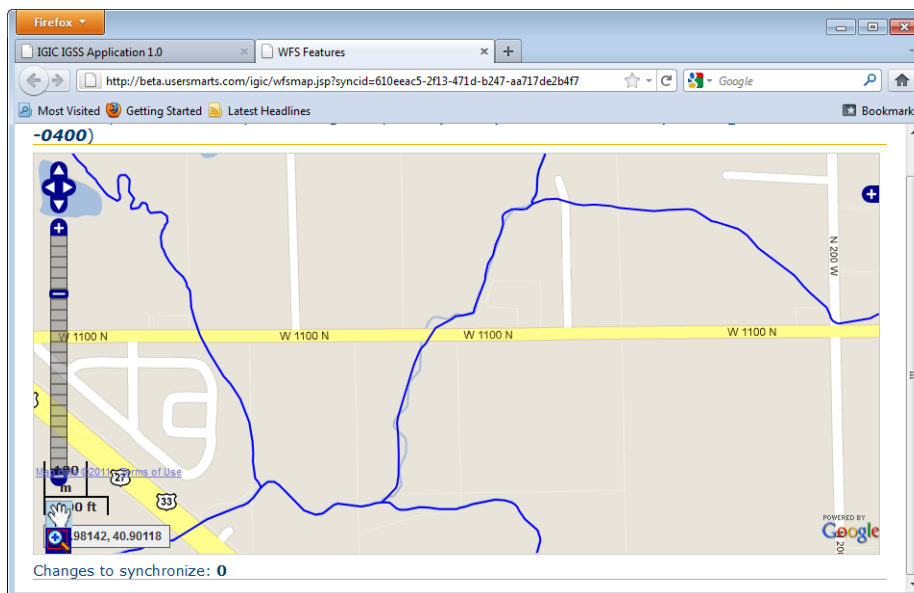
- a. Pause/Resume
- b. Sync [for manual only]
- c. Show Features (in XML format)
- d. Show Map

20. Data Follower looks at database before syncing:



21. Data Follower synchs local database manually

22. Data Follower looks at database after syncing



23. DATA FOLLOWER LOGS OUT

Feedback on 2010 CAP Category 2 Program

The Indiana team benefitted greatly from the CAP Program's assistance! There are several specific aspects of this Category 2 Program, were the Indiana Team benefitted from or had issues with during our development process, that are worthy of noting for FGDC's consideration on future grants:

Benefit 1: Without the grant, and the technical assistance, Indiana could not have built the IGSS or be currently positioned to implement it for NHD GNIS Names, Broadband Mapping and potentially other statewide data sets. Thank You!

Benefit 2: The two other 2010 FGDC Category 2 CAP Grant recipients, Cubewerx and Carbon Project, were both already familiar with (and worked on) the OGC Engineering Report on Geosynchronization (OGC 10-069r2). The discussion, Q&A, and demonstrations during our regular group meetings were very helpful in our implementation of the service specification.

Issue 1: Indiana's geosynchronization project development would have benefitted from the sharing of a draft version of the OGC Engineering Report on Geosynchronization (OGC 10-069r2) earlier in the project process. Fortunately, we were still in the requirements gathering and early design stages of the project when we did receive the OGC 10-069r2 document. Thus, the backtracking was doable when we were informed that our services should adhere to the specifications of OGC 10-069r2.

Issue 2: Toward the end of Indiana's geosynchronization project development the USGS's National Hydrography Dataset (NHD) development team implemented a completely different methodology for providing NHD updates to the USGS. The NHD Team introduced an Esri (vendor and software specific) Database Replication methodology to replace the existing XML format for delivery of changes to the NHD at USGS. This change removes the USGS NHD Team completely out of the IGSS process.

The original XML delivery format was already tightly integrated in the architecture of the Indiana Geosynchronization Suite (IGSS), as well as our current NHD update delivery practices with the USGS. Additionally, this XML format also allowed for direct support of NHD updates coming from Crowd-Sourced (web) and other software vendor NHD tools.

Recovery Plan: As a result, for Indiana to implement IGSS with this new NHD methodology, we will first need to revise our existing internal NHD data maintenance and stewardship architecture to interface with the USGS at Esri Database Replication level, and then develop a new state-side process to collect and ingest updates from IGSS into our replicated NHD database(s) before delivery (database synchronization) with the USGS NHD master database.

Next Steps

Implementation of the IGSS is expected in FY2012, with implementation of our Recovery Plan, as well as opportunities that include application to support Indiana's Broadband Mapping initiative, and we also hope to work with USGS GNIS Names Team to begin using IGSS to support our ongoing NHD GNIS Names updates. Note: The GNIS Names database is a different USGS database supported by a different team than NHD.

Our Indiana Team is committed to IGSS, and we see this upcoming work as a unique opportunity to leverage IGSS to significantly improve our NHD updates, develop a new GNIS Names update workflow with the USGS, as well as expand geosynchronization solutions to our Broadband Mapping and other IndianaMap statewide datasets.

The Indiana Team is grateful for the 2010 Category 2 CAP grant, and wants to thank the FGDC, USGS, and our fellow CAP 2 group members for all of their support for our project.