

Web ESS, Automated Site Planning Usability Redefined.

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Abstract:

A current effort is underway to modernize the Explosives Safety Siting (ESS) software as a web-based application hosted on a cloud computing environment. ESS is an automated site planning (ASP) tool developed by Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC) and funded by the Department of Defense Explosives Safety Board (DDESB). The DoD has mandated the use of ASP by the military services for siting all facilities that store and handle ammunition and explosives (A/E). All Department of Defense (DoD) A/E facilities around the world require DDESB approval to ensure acceptable levels of risk to DoD personnel, assets and mission, as well as to the public are met. The current standard is to use the desktop version of the ESS application that was designed and launched on 2001 technology platform /environment. While the application functionality meets current needs, it is proving to be costly and cumbersome to continue to provide modern style functionality with antiquated code repositories. This is why the core ESS functionality is currently underway to be migrated to a modern web-based technology solution. The Army was recently granted a Certificate of Noteworthiness for ESS, but on the premise that efforts are underway to make the ESS application web-based.

Web-based solutions offer many benefits that would improve the use of ESS. The Web-based ESS will enhance seamless collaboration between multiple users on the same dataset which will promote data continuity DoD wide. Furthermore, this will establish a centralized digital repository to provide provisioned access to the latest standardized data across all contributing DoD organizations that handle and manage A/E. A Web-Based ESS will also allow for the software to be centrally housed which will simplify and comply with DoD information assurance policy because the process will only be required for one service/ordination. Another Web-based ESS benefit is that software updates will be accessible to end user sooner given the planned accelerated product deployment schedule. This will enable software updates and bug fixes in a fraction of the time compared to the desktop version and require no user action. An additional benefit is that Web-based ESS will not require software licensing for mapping resources and centralized cloud computing will provide consistent performance across the user base. As the application matures, there are plans to develop an electronic submission management that will promote enhanced communication about approval status and no loss of site submittal packages during transfer. Finally, the ESS datasets will be stored on a centralized server which will allow for queries on DoD explosives safety enterprise data, which will provide planners and policy makers with higher fidelity data that can be used to make better decision that support the warfighter and the mission.

Software development process for Web-based ESS is underway and consists of five spirals. Currently the software is in spiral 5. The development process includes a full re-write of the code transitioning from VB.NET framework to C#, JavaScript and Angular; however, the existing ESS desktop code will be leveraged when possible. The application will be hosted on Amazon Web Service (AWS) Secure GovCloud and will make use of ESRI ArcGIS Server Enterprise. An initial version of the application is planned for early 2019.

Introduction:

Explosives safety site plans are developed and submitted for DoD approval when planned construction or explosives operations change. The U.S Military Services have long recognized that planning and siting for explosives ordnance

storage and handling is a complex, high-risk, time-intensive, and error-prone activity that too often results in inefficient use of facilities and non-compliance with explosives safety criteria.

Efforts to automate the explosives safety siting process have been underway prior to the 1980s. Around 1990, a Tri-Service committee was formed to develop functional requirements and a technical approach to automate the quantity-distance (QD) analysis process and assist planners in the preparation of explosives safety site plans. In 1993, a Technical Plan and Statement of Work was published and Deputy Under Secretary of Defense, Installations and Environment (DUSD I&E), subsequently set up the Defense Environmental Corporate Information Management (DECIM) Program Office to (1) determine the state-of-the-art software requirement and (2) fund the migration of the best software applications into a DoD standard system. The goal was to automate up to 80% of the functional site analyses tasks associated with site planning and administrative decisions supporting waivers, exemptions, and special certifications.

In 1996, the DESCIM Program Management Office (PMO) embarked on an effort to automate the explosives safety planning and site approval request process. This effort has resulted in the development of the ESS software. In March 1998, the NAVFAC Engineering Service Center (now called NAVFAC EXWC) was tasked to become the Central Design Authority (CDA) for ESS and is currently providing technical and program guidance to this program. In 2002, program management of DESMS transferred from DESCIM to the Environmental Information Technology Management (EITM) Program. In 2006, program management of DESMS transferred from EITM to DDESB. In 2008, three explosives safety planning software applications were in significant use in the DoD: ASHS, ESS and MSS. These software applications were developed by the Air Force, DoD and Army, respectively, to meet specific needs of their target customers. All three software programs were developed in response to urgent, specific explosives safety siting requirements that differed from one Service to another. Even though each meets those needs very well, evolving DoD needs and requirements for the future brought explosives safety approval authorities together to develop plans to bring the best features of each of these software applications together into one “Best-of-Breed” system that is designed to meet the needs of explosives safety planners throughout all of the DoD. A unanimous agreement was reached among members of the Joint Service Automated Site Planning Working Committee to merge the best features of the MSS and ASHS software into the ESS software to create the hybrid software system that resulted in ESS Version 6.1. In 2009 the DoD mandated the use of automated site planning ASP by Services to perform explosives safety siting for all facilities that store and handle A/E and the DDESB has funded ESS to meet the Services ASP requirements.

The ESS software has been developed as previously described and is fielded for use. ESS is a geographic information system (GIS) software program that links graphic map data with non-graphic real property inventory (RPI) data and explosives data to build electronic GIS datasets. These maps are then analyzed using automated procedures to determine actual separation distances between facilities, which are evaluated against DoD explosives safety regulation for quantity-distance (QD). ESS is used to identify violations of the regulations when they are found to exist, and it provides tools to automate the creation of site approval request package documentation that includes tabular and graphical information that is required by approval authorities. ESS Version 6.1.3 is the currently approved software for DoD use.

The existing version of ESS is a desktop application that satisfies a significant ESS user and explosives safety approval authority requirements. Its greatest strengths are that it produces accurate QD results, it eliminates math errors that occur when site planning by hand, it produces site plans that conform to a DoD standard, and it can efficiently perform multiple “what if” scenarios in a relatively short amount of time.

ESS, however, also has multiple limitations that motivate change in the software’s inherent architecture. A major cost for implementation of ESS by the Services is the time and funding required to build a dataset at an installation. This dataset often persists on individual user’s workstation which is prone to getting lost due to employ turnover or IT failures. The dataset can also get corrupted or becomes significantly out-of-date when editing procedures are not in place of if the software is underused. The current implementation of ESS where data rests on individual user’s computers also introduces complexity when collaboration is required between multiple users. Separate datasets quickly become out-of-sync when parallel editing occurs. ESS requires an ArcGIS license per desktop, which adds license costs, certification and accreditation cost for each military service, and can limit ESS usability depending on approval and funding limitations. Finally, the desktop version of ESS was developed with 2009 software technology resulting in a software code that has become difficult to maintain and has the potential to become obsolete. The

technology environment employed during the development of the current version of the ESS has also driven the continued use of a document based submission system by the DoD explosives safety approval process. This reliance on documents substantially limits the ability of approval authorities to track and query enterprise data.

As a result, a current effort is underway to modernize the ESS software as a web-based application hosted on a cloud computing environment. The ASP ESS configuration control board identified a web-enabled ESS application as a technical solution to the problems described above. A web-based ESS solution provides several attributes not available in the current desktop application, which include: centralized host to ensure data integrity; simplified IA compliance; access to latest standardized data; accelerated product deployment and updates; electronic submission management; centralized system to provide DoD explosives safety enterprise data.

For this project a partnership has been established between EXWC and the Defense Installations Spatial Data Infrastructure (DISDI) Portal with the Army. The DISDI Portal will provide the internet facing portal and CAC authenticated in which ESS users can access via a web link. ESS integration with the DISDI Portal is part of the DISDI Portal modernization, which is currently under way.

Benefits of Web-Based ESS

Web-based solutions offer many benefits that are anticipated to improve the use of ESS DoD wide. The Web-based ESS will enhance seamless collaboration between multiple users on the same dataset which will promote data continuity DoD wide. Furthermore, this will establish a centralized digital repository to provide provisioned access to the latest standardized data across all contributing DoD organizations that handle and manage A/E. A Web-Based ESS will also allow for the software to be centrally housed which will simplify and comply with DoD information assurance policy because the process will only be required for one service/ordination. Another Web-based ESS benefit is that software updates will be accessible to end user sooner given the planned accelerated product deployment schedule. This will enable software updates and bug fixes in a fraction of the time compared to the desktop version and require no user action. An additional benefit is that Web-based ESS will not require software licensing for mapping resources and centralized cloud computing will provide consistent performance across the user base. This means individual users will no longer have to go through the tedious process of getting approval to install ArcGIS on their local machines. Lastly, the ESS datasets will be stored on a centralized server which will allow for queries on explosives safety enterprise data DoD wide, which will provide planners and policy makers with higher fidelity data that can be used to make better decisions that support the warfighter and the mission.

Additional net benefits of a web-enabled ESS are gained in the implementation of the web-enabled solution in the field where the site planning process becomes more efficient. This benefit is attributed to reduced operation and sustainment cost through reduced labor hours associated with the process improvements realized through site planning, research, analysis, and coordination efficiencies. It is anticipated that this cost avoidance / savings will be used by the Joint Services' to increase the rate at which explosives safety site plans are submitted.

The benefits are summarized in Table 1 which compares improvements in the process between the "as-is" ESS application with the planned "to-be" web-enabled ESS.

Table 1: Comparison between ESS Desktop and Web-based ESS

Business Process	ESS Desktop	Web-based ESS
ESS - ASP database and site plan package development	<ul style="list-style-type: none"> Explosives site planning database is developed for each installation by combining GIS, RPI, and PES data from Service Specific repositories. ASP tool analyzes installation and creates explosives safety site plan package 	<ul style="list-style-type: none"> Explosives site planning database is developed for each installation by combining GIS, RPI, and PES data from Service Specific repositories. ASP tool analyzes installation and creates explosives safety site plan package.
Maintenance of DoD explosives safety data	<ul style="list-style-type: none"> Data stored at installation level. Manual procedures are used to update GIS, RPI, and PES data. Installation ASP databases are lost due to employee turnover, non-standard storage practices, and multiple users creating multiple databases that become out-of-sync. Collaboration by team members is achieved by sharing data via file transfers between individual desktop work stations. 	<ul style="list-style-type: none"> Data stored at centralized location. Data integrity is ensured through backup procedures. Collaboration is available through web access. Multiple users access to data is managed through permissions and rules to prevent corruption or out-of-sync datasets. Automated procedures are used to update GIS, RPI, and PES data.
Site plan approval process	<ul style="list-style-type: none"> PDF documents are produced. E-mail is used to transfer information back and forth between installation site planner, military service reviewer, and the DDESB. Records are maintained as letters and memorandum. 	<ul style="list-style-type: none"> Digital submission of site plans to centralized server database. Datasets are basis for review process. Personnel in the approval process have access to data in accordance with their approval authority. Stakeholders can view status of package approval process with tracking measures. Records are maintained as data that is backed up and easily retrievable.
Enterprise Explosives Safety Data	<ul style="list-style-type: none"> Collection of explosives safety enterprise data requires manual data calls. 	<ul style="list-style-type: none"> Centralized database hosted on a web system will have capability to conduct queries of DoD explosives safety data for information such as number of sited facilities, PES storage limits, explosives safety violation mitigations, etc.
ASP tool	<ul style="list-style-type: none"> Tool is developed for desktop with multiple user configurations. Minimum software and hardware requirements for user's desktop workstation to access tool (i.e. O/S, ArcGIS, CPU, RAM, disk space, etc.). Tool is deployed to military services using four different methods for certification and accreditation. Tool testing is achieved by transferring copies of software via CD, e-mail, or file transfer servers. 	<ul style="list-style-type: none"> Tool is developed for a single configuration on the web. Minimum requirement for user is web browser.

Technical Approach:

Software development process for Web-based ESS is underway and consists of five spirals for ESS Web Version 1.0. Currently the software is in spiral 4 which is the last development cycle for the initial release. The development process includes a full re-write of the existing ESS desktop version. The core functionality is in the process of being transitioning from Microsoft Visual Basic.NET (VB.NET) framework to C#, JavaScript, Angular5, and .NETCore. Some of the ESS desktop code repositories can be utilized without a complete rewrite, therefore those repositories will be leveraged when possible. The application will be hosted on Amazon Web Service (AWS) Secure GovCloud and will be categorized as Impact Level 4. ESRI ArcGIS Server Enterprise will be fully integrated, as well as Docker and Microsoft SQL Server. Microsoft Windows Server 2016 will be used as well as Linux Redhat for the tasks servers. ESS Version 1.0 will include a large amount of the key functionality leading up to creating a site plan package.

The development of new ESS web software will follow DoD spatial data standards identified in the DoD Spatial Data Standards for Facilities, Installation and Environment (SDSFIE). Additionally, the ESS web software will follow DoD real property inventory (RPI) Standards. The development of new ESS software enhancements will be compatible with other DoD enterprise databases for RPI and GIS data. Web ESS will also be developing explosives database using the Navy Enterprise Explosives System (NEES) available through ESS v6.1.4 as the prototype.

ESS Web Version 1.0 ports the base functionality of ESS Desktop to the web application. The ESS Web Beta version shall allow users to CAC authenticate, launch the web application from the host site, generate a new database, import an existing database, perform GIS editing, navigate GIS map and underlying data, perform spatial and QD analysis, map the QD analysis results, view arcs and mitigations, generate and view reports, and input violation mitigations. Software version 1.1 will include site submittal packages. ESS 1.1 requirements are currently being drafted and are anticipated to be an additional 3-4 spirals. These spirals will include the functionality required to create a site plan package.

In regards to accreditation and ATO; the ESS Web application is being developed to meet the DoD Risk Management Framework (RMF) accreditation utilizing DoD Instruction 8510.01 RMF for DoD Information Technology (IT); National Institute of Standards and Technology (NIST) 800-53r4, Security and Privacy Controls for Federal Information Systems and Organizations; DoD Application Development Checklist Security Technical Implementation Guide (STIG); for both the Web Application, and Database tiers. The software will also be compliant with the DoD Information Assurance Vulnerability Management (IAVM) program. The software is in the process to officially receive an authority to operate (ATO).

Figure 2 provides a high level representation of the ESS Web application architecture. The application entry point (https) is housed on the DISDI's web portal. Once the user goes to the site and is authenticated via their PKI certificate found on their Common Access Card (CAC) then the user is either authenticated or directed to a generic ESS splash screen which allows them to request access if desired. Once the user is granted access to the application programming interface (API) then the user profile and permission provide access to the appropriate datasets and tools. At this point the user's action will provide sever level tools on either the GIS Tasks servers (Windows) or the Workload Tasks Servers (Linux). At this point in the diagram, take note how the entire application has been architected with scalability in mind. The servers have been built in a standard and repeatable way to allow for scalability which are indicated with the lighter colored servers in the diagram. These extra servers can be turned on and back off during high and low traffic times. The data generated from the user action are then pushed to Microsoft SQL Server 2016 and then sent back to the API for the user to consume.

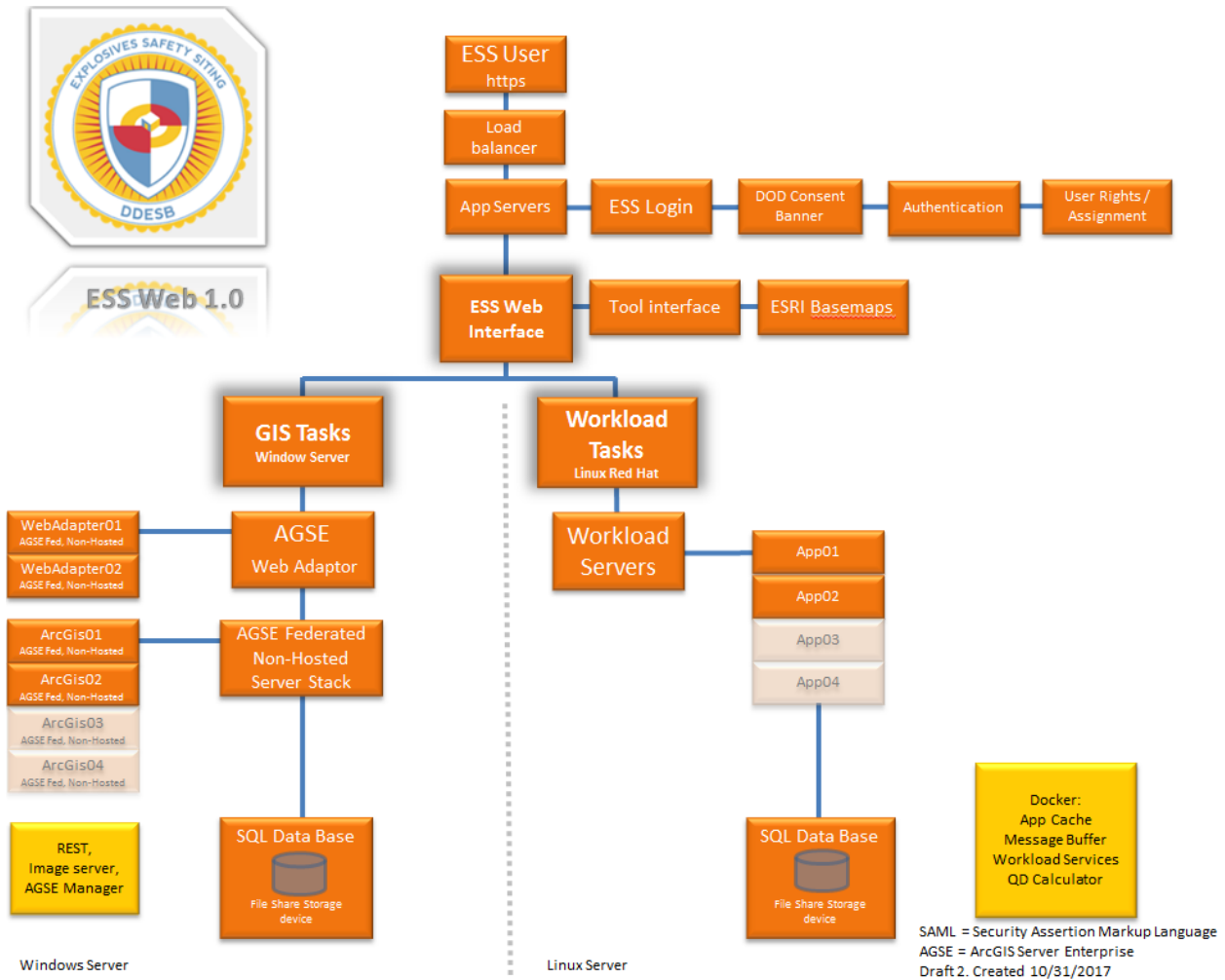


Figure 1: Web-based ESS System Diagram

Figure 2 displays a diagram that represent how the ESS Web application plans to manage the proposed global dataset for Web-based ESS. Scenerio 1 represents the data management workflow on the server sided when a user opens a given installation. The server pulls a copy of the master data version and creates a new table associated with the users account. When an edit is made by the user the application only tacks the changes made to the data in the table. Once the user is done editing the user will need to submit their changes for review by an administrative point of contact (POC) before other ESS user can see the changes take effect in the Master Dataset. Once the administrative POC reviews and approves the changes the application code merges the changes with the master dataset.

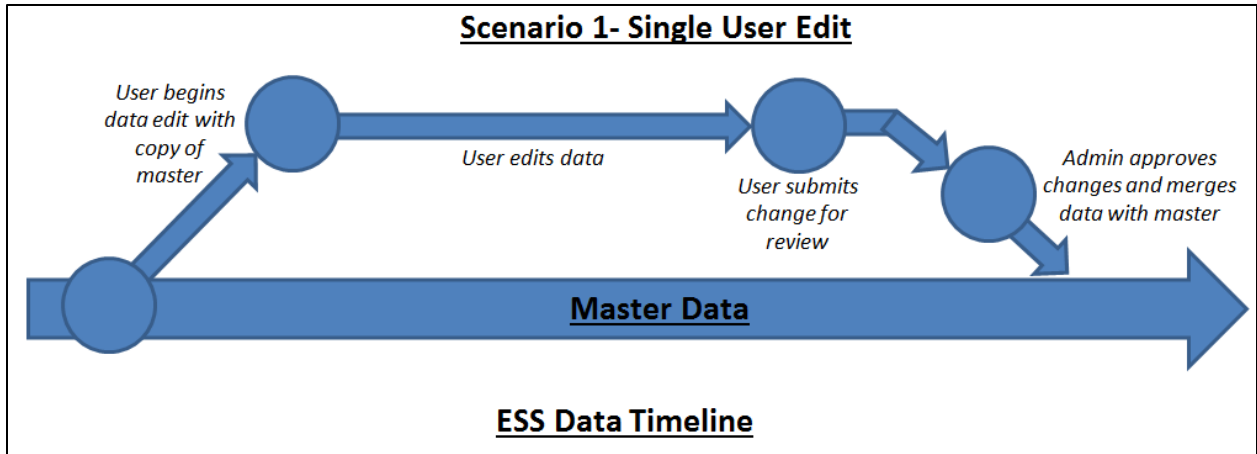


Figure 2: Dataflow for Single User Edits to ESS Dataset

Figure 3 represents a dataflow when multiple users are working on the same installation. An anticipated scenario is that multiple users potentially could attempt to create multiple dataset versions of a given installation before an authoritative version is reviewed and checked back in to the master dataset. To account for this every time a change is made by one user Web-based, ESS will notify all other users of the change(s) and provide the option to accept or reject the proposed changes. Once edits are completed, the user can submit their changes for review by an administrative POC before other ESS users can then see the edits.

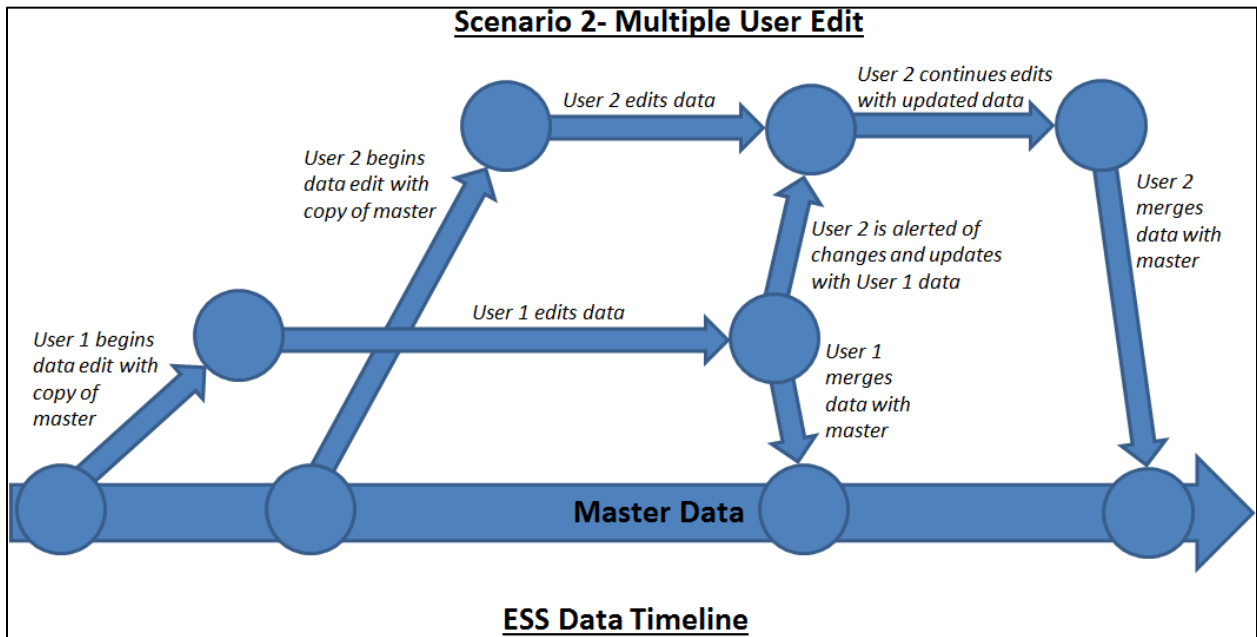


Figure 3: Dataflow for Multiple User Edits to ESS Dataset

Figure 4 illustrates the dataflow when multiple scenarios are required to be generated when working on the same installation. The CDA team is planning for Web-based ESS to be able to handle up to 4 different scenarios with various geometries and NEW values. The 4 different scenarios can be saved out and shared, however only one scenario can be approved, replicated and merged back down to the master dataset as shown. Once the user is done editing and determines what scenario is optimal to move forward with the site submittal then the user need to submit their changes for that one given scenario for review by an administrative POC. Once the administrative POC reviews and approves the changes the application code will merge the changes with the master dataset.

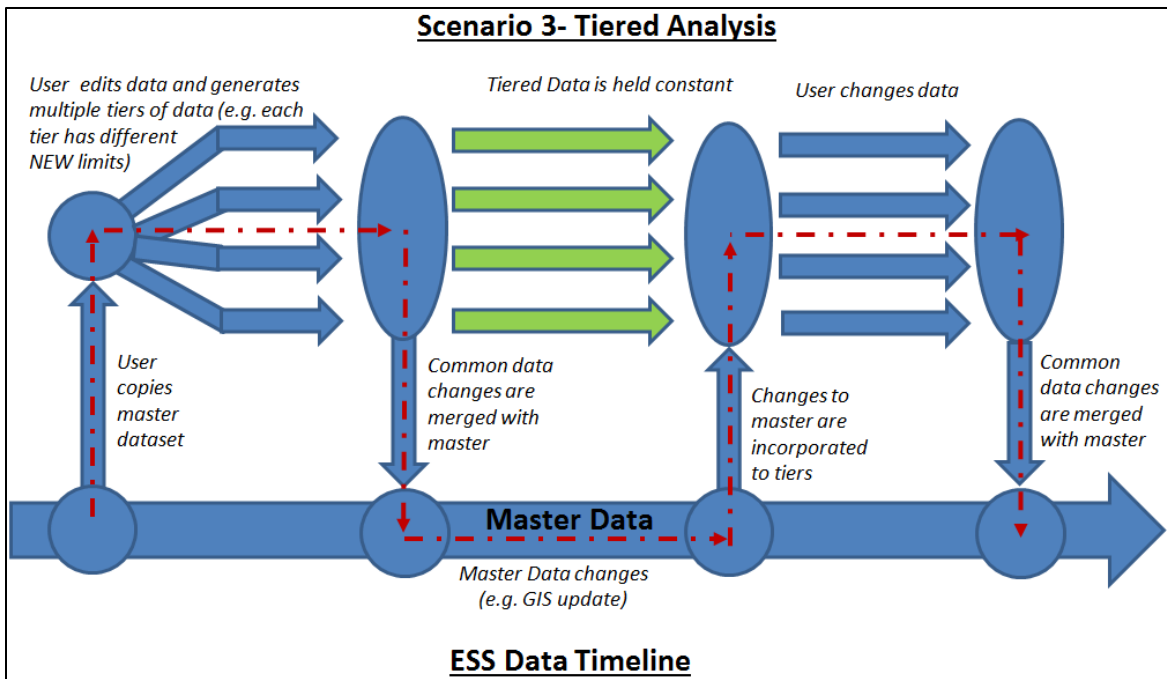


Figure 4: Dataflow for Tiered Analysis with an ESS Dataset

Figure 5 provides a high level representation of the ESS Web application interface. A returning user can pick an existing installation from the table on the left, or they can navigate the map to select a new installation on the right. Note how easily the user will be able to navigate to any installation on the map; however they will only be able to view ESS data for the installation that they are provisioned for.



Figure 5: ESS Web Application Interface (All displayed maps and data do not represent existing explosives sites)

Figure 6 represents the dashboard view of ESS Web. The dashboard on the left provides a high level view of the current state of the installations A/E data in an intuitive and easy to digest format. This is a new proposed feature

and while it is in the early stages of design, it is anticipated to be a very helpful tool in ESS Web. Various configuration of the dashboard are still under review.

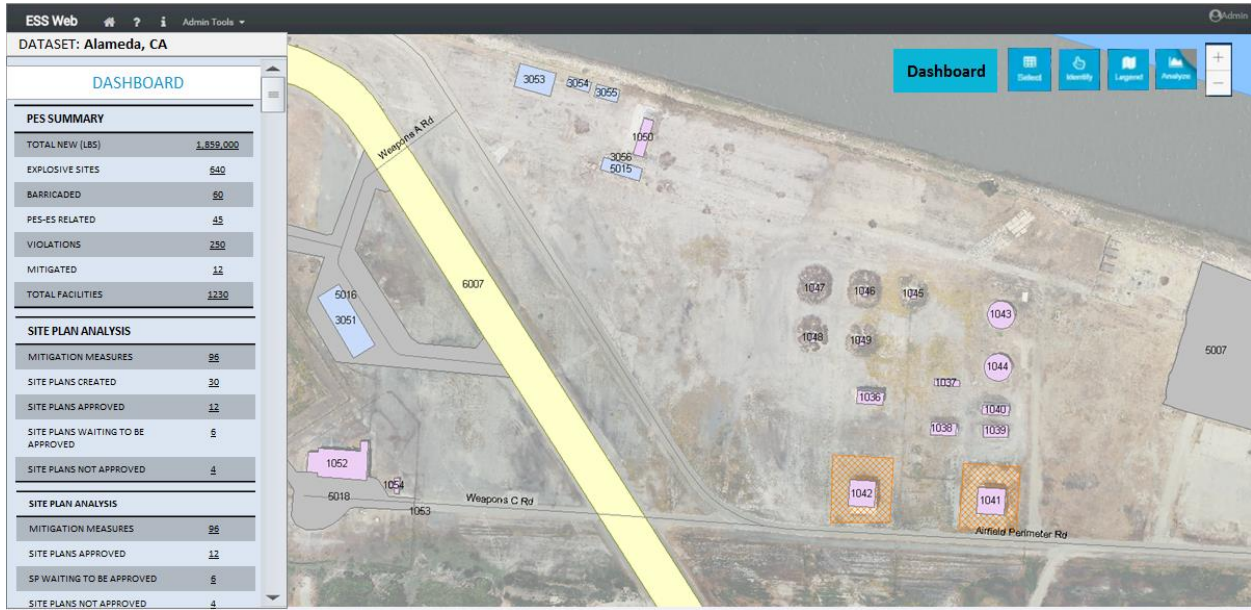


Figure 6: Web ESS Dashboard (All displayed maps and data do not represent existing explosives sites).

Figure 7 shows the ESS Web facility editor general interface design and layout. The goal here was to provide easy to understand steps to walk the users through viewing; editing and saving the facility attribute data. This tab displays the explosive attributes again in an edible format found at the bottom of the screen.

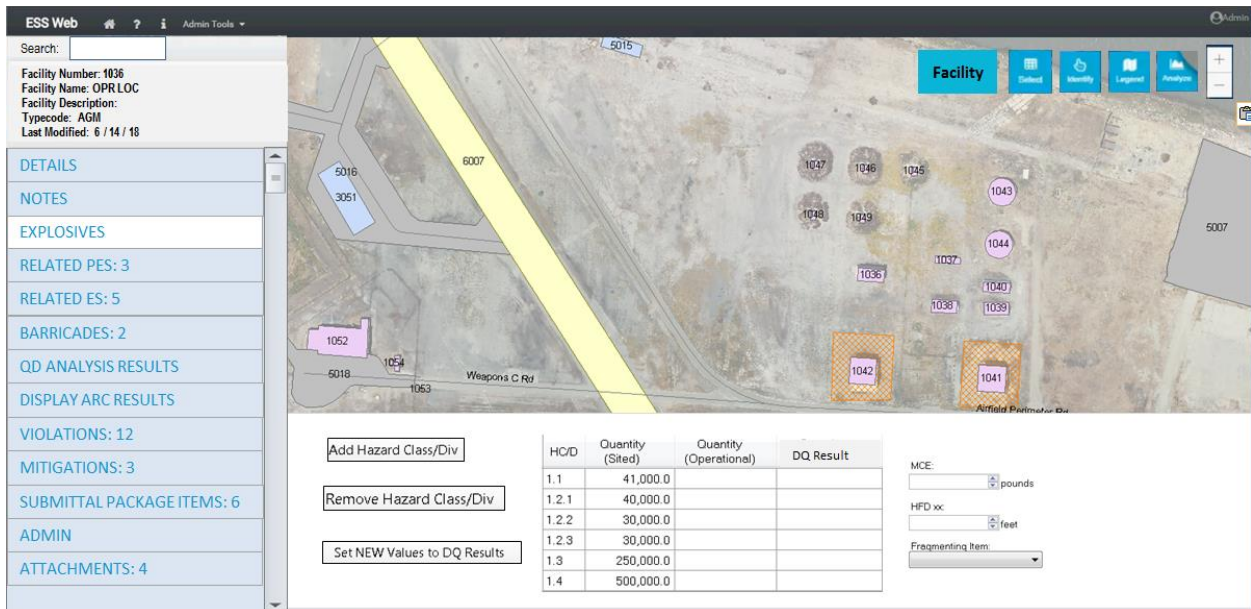


Figure 7: Web ESS Facility Editor (All displayed maps and data do not represent existing explosives sites).

Figure 8 shows the anticipated layout of the QD analysis results. The QD results are built into the editor for easy consumption and viewing. Notice how only the selected arcs at the bottom of the screen are active on the map.

Selecting multiple arcs will result in all the selected features being displayed on the screen. The goal here being to attempt to provide an easy to use interface that allows the user to become more familiar with the QD results.



Figure 8: Web ESS QD Analysis Results (All displayed maps and data do not represent existing explosives sites).

Figure 9 shows the projected layout of the submittal package menu in ESS Web 1.1. This view is anticipated to evolve; however, at this time this is what the interface is likely to look like. Note how the document displayed on the map is the one selected in the selection window at the bottom of the screen. The goal here again is to provide a simple to use interface to help manage often complex and cumbersome submittal documents.

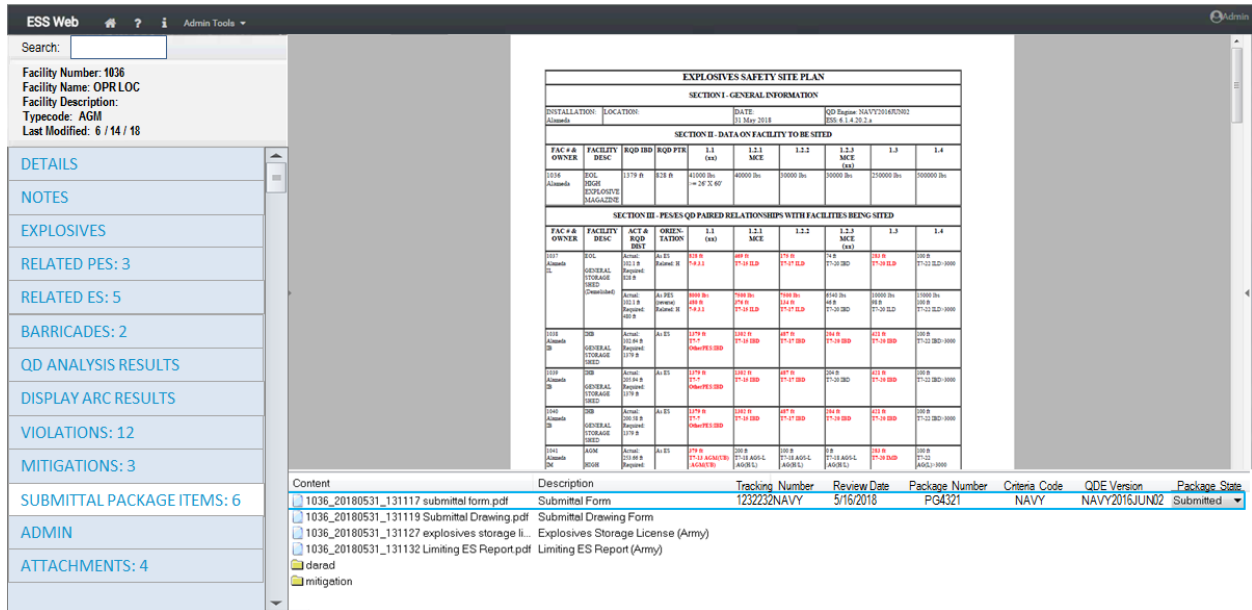


Figure 9: Web ESS Submittal Package (All displayed maps and data do not represent existing explosives sites).

Conclusion:

A current effort is underway to modernize the ESS software as a web-based application hosted on a cloud computing environment. The ASP ESS configuration control board identified a web-enabled ESS application as a technical solution to the problems described above and the DDESB funded NAVFAC EXWC to lead the development effort. While the existing version of the ESS desktop platform currently satisfies explosives safety approval authority requirements, it was discussed how it has multiple limitations given the software's inherent architecture. This in turn was the driving force behind the push to modernize ESS into a web hosted solution.

The Web-based ESS has many advantages. It is the enhancement of the seamless collaboration between multiple users on a centralized dataset that promotes data continuity DoD wide. This result will have a positive impact on the maintenance of enterprise explosives safety data. This will enhance the capability of all DoD organizations to effectively manage and handle risk inherently with A/E facilities worldwide.

An initial version of the application is planned to be released for user testing starting in early 2019. As the application matures, there are plans to enhance overall capabilities to include items such as risk based methods and a web based site plan review and approval process. Development of new functionality will leverage the latest web technologies to the furthest extent possible with the overall objective of making management of explosives safety for all DoD A/E facilities more efficient and effective.