

Integration of Tax Ditch Drainage System Data into the Statewide Enterprise GIS

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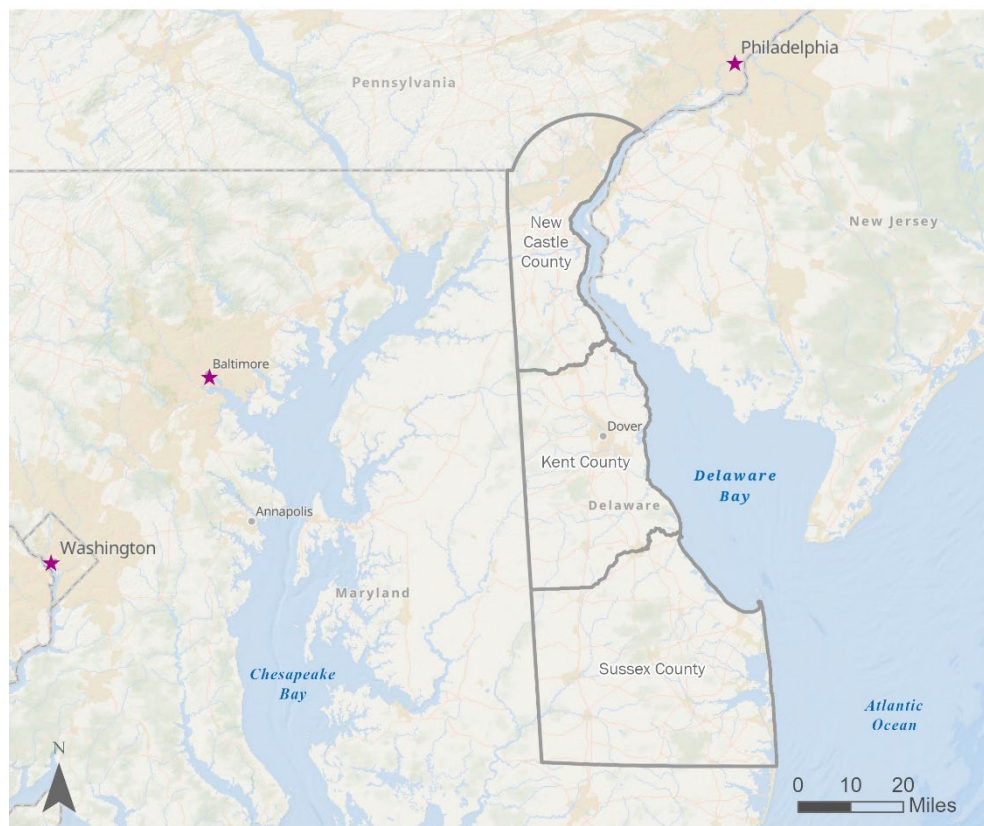
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Background

Across the state of Delaware 234 individual tax ditch organizations, often simply referred to as tax ditches, are in existence. These organizations are a governmental subdivision of the state formed under Tax Ditch Law in 1951 that provide for maintenance of watershed-based drainage networks (State of Delaware, 2022). Each tax ditch organization is composed of and run by the landowners that own land within the watershed with the assistance of the Delaware Department of Natural Resources and Environmental Control (DNREC) and the county Conservation Districts.

Delaware is the second smallest state in the United States, with three counties (Kent, New Castle, and Sussex) and is made up of approximately 1,982 square miles of land. It is situated on the east coast and bordered by Maryland at its southern and western ends, Pennsylvania at its northern end, and New Jersey off its east coast (Figure 1). Its waters drain into the Chesapeake Bay, Delaware Bay, or Atlantic Ocean watersheds. Major metropolitan areas, such as Washington D.C., Baltimore, and Philadelphia, are approximately 2 hours' drive away and the state's chief industries are agriculture, fishing, manufacturing, and mining (State of Delaware, 2011). For these homes and industries to remain sustainable, proper drainage of the land is required.

The State of Delaware



- ★ Major Cities
- State and County Boundaries

Sources: VITA, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, Esri, GEBCO, DeLorme, NaturalVue
Map Created by Brittany Haywood on 2/17/2022

Figure 1 Map of the state of Delaware highlighting three major cities which are within two hours commute, Baltimore, Philadelphia, and Washington D.C., waterbodies, and Delaware counties.

State of Delaware Land Elevations

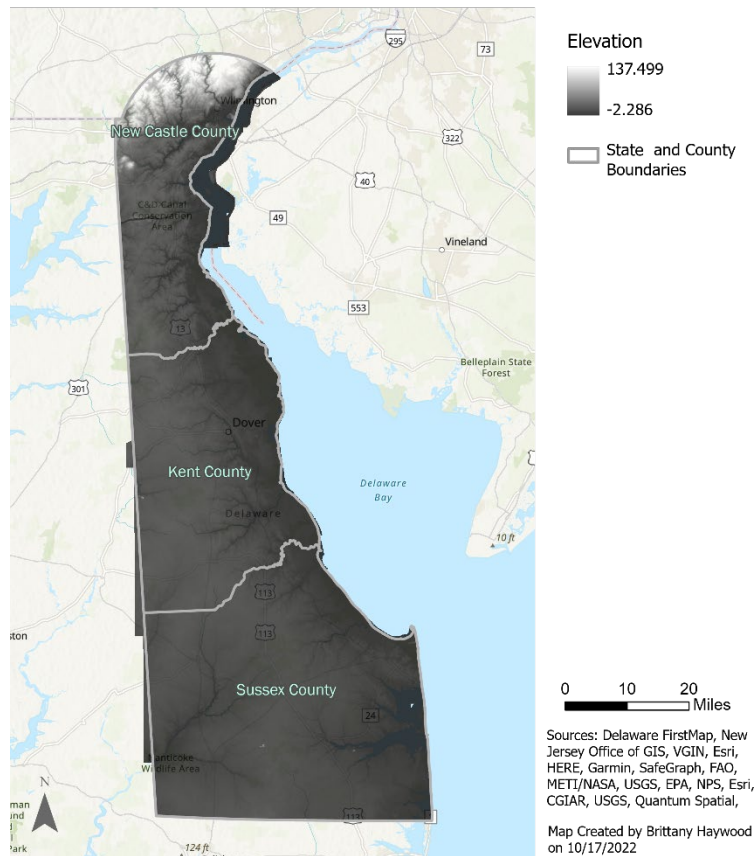


Figure 2 Topography data for the state of Delaware.

Tax ditches are an integral part of the state's drainage infrastructure as Delaware lacks significant topography (Figure 2) which in turn allows for water to pool and cause flooding (University of Delaware, 2022). These ditches provide for approximately 2,000 miles of drainage that benefits almost half of the state-maintained roads and an estimated 100,000 people (Delaware Department of Natural Resources and Environmental Control, 2022). They help to ensure that agricultural fields remain dry enough to produce viable crops and urban areas have an outlet for surface water. Each ditch is made up of a channel and right-of-way. The channel is the water flow pathway. The right-of-way is a type of legal easement that allows for access and disposal for tax ditch maintenance work and prevents the building of structures within that zone next to the ditch (State of Delaware, 2022). Ultimately tax ditches have multiple implications on private property including, but not limited to drainage,

annual taxes, and the location that structures can be built.

The majority of tax ditches were formed between 1951, when the Tax Ditch Law was created, and the late 1980s as seen in Figure 3 (State of Delaware, 2022). The Clean Water Act was established on October 18, 1972, and heavily influenced the ability to design new tax ditches, especially when the U.S. Army Corps of Engineers (ACOE) and Environmental Protection Agency (EPA) combined their definitions of "Waters of the United States" between 1980 and 1982 into one. This "new" definition called out regulation of "all waters that are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide" and "intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands," and was used from the late 1980s until updates occurred around 2015 or so (Mihelcic, 2020 and U.S. Environmental Protection Agency, 2013). As tax ditches were designed to move water off lands by potentially draining historic or current wetlands and channelizing natural streams, this regulation had an impact on tax ditch design, implementation, and maintenance processes, effectively slowing down their creation in the late 1980s.

Since its inception in 1951, the development and maintenance of tax ditches have been a collaborative effort across federal, state, county, and local stakeholders. These stakeholders have and continue to

work together to perform tasks such as the establishment of new tax ditches, tracking of finances, ensuring regulatory compliance, and scheduling ditch maintenance activities, all for the benefit of public health and safety (State of Delaware, 2022). These partnerships have made great strides to accomplish work but limitations to access of data and new opportunities with geographic information system (GIS) technologies have inspired an effort to improve tax ditch tasks.

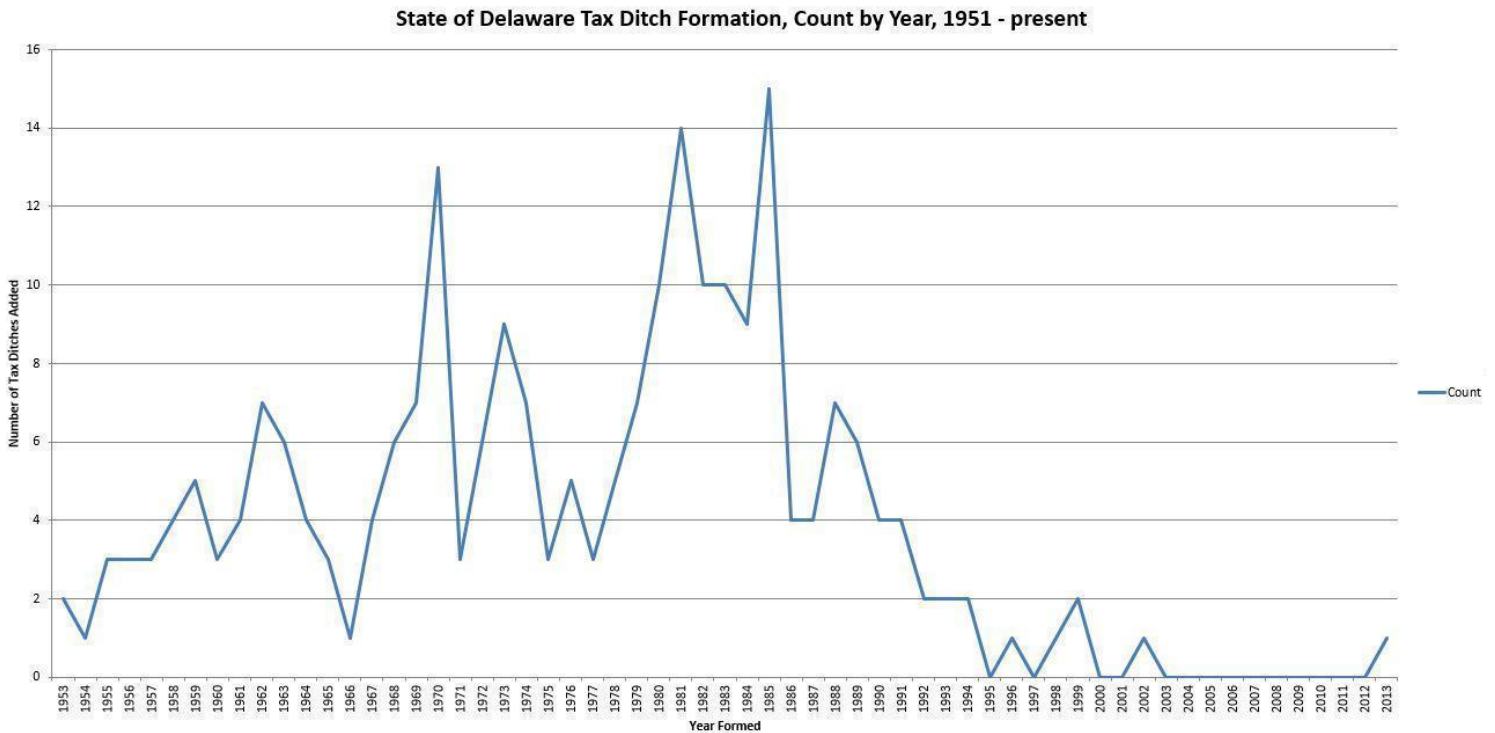


Figure 3 Graph depicting when tax ditches were formed during each year from 1953 to 2013. (Delaware Department of Natural Resources and Environmental Control, 2022)

Before 2010, when the more recent tax ditches were formed, maps were meticulously drawn by hand, and data was recorded in typewritten papers (or pages). Eventually as computers became more common in the workplace, documents were digitally drafted. Now, all files have been converted to digital PDFs or images and are referenced individually when the need arises. This review and data retrieval process by key stakeholders has created difficulties in efficiently performing daily tasks, large-scale data processing and analysis of tax ditch systems.

Stakeholders directly involved with tax ditch organizations include: the public, more specifically, the landowners who own land within the tax ditch watershed, called taxables (State of Delaware, 2022), volunteer tax ditch officers, DNREC, Conservation Districts, state and county land use or stormwater planning and permitting entities, county tax collection agencies, county courts, maintenance contractors, elected officials, and the Delaware Department of Transportation (DelDOT). The key stakeholders that are involved in every day decisions are the tax ditch officers, DNREC and county Conservation Districts.

1. **Taxables** include members of the general public at the local level such as individuals, businesses, organizations and state agencies who own land within the tax ditch watershed. They are

responsible for paying their tax to assist in the maintenance of these systems and ensuring the right-of-way is free and clear of obstructions.

2. **Officers** are elected from the taxables and are responsible for inspecting the ditch for maintenance needs, hiring contractors to perform maintenance work, determine tax rates, and allocating the collected tax monies to ensure the tax ditch organization's operations run smoothly and in accordance with Tax Ditch Law (State of Delaware, 2022).
3. The **DNREC's** Division of Watershed Stewardship, Drainage Program is tasked with providing administrative and technical assistance to the officers and taxables of each tax ditch organization. The Program also houses historical and design data for tax ditches and provides oversight on tax ditch operations. DNREC works collaboratively with multiple stakeholders, including each Conservation District, to accomplish tasks on the ground and build relationships at the local level.
4. Each of the three counties in Delaware hosts a **Conservation District**: Kent Conservation District (KCD), New Castle Conservation District (NCCD), and Sussex Conservation District (SCD). Each District works closely with the DNREC and landowners in their county to address tax ditch drainage or maintenance concerns and may also provide administrative assistance.
5. At the state, county and local levels, there are **land use and stormwater planning and permitting agencies** that are responsible for the review of proposed construction activities. As tax ditches and their associated rights-of-way affect what can or cannot be built on a property, these agencies must independently review projects for tax ditch impacts or coordinate their reviews with DNREC.
6. Tax ditches collect their monies through each counties' **tax collection agency**. These agencies solicit tax ditch monies from taxables on their annual tax bill and then distribute those funds as appropriate to each individual tax ditch organization.
7. Each tax ditch is formed by a prescribed legal process, as such, it depends heavily on each **county's court systems** to officially deem a ditch as a tax ditch and record any subsequent changes to it. Each county has a Board of Ditch Commissioners that are officers of the Superior Court and assist during the ditch formation process. After final ditch determinations are made, all associated documentation, the Ditch Order, is filed within each county Prothonotary and Recorder of Deeds offices. Any future alterations to the tax ditch, require additional filings.
8. Tax ditch organizations hire **maintenance contractors** to perform work on the tax ditch. These contractors must understand which ditches are tax ditches and where they are allowed to travel and perform work, i.e., the rights-of-way.
9. **Elected officials** are often included in the tax ditch conversation when reoccurring or significant drainage concerns are brought to their attention. These stakeholders often request reports on the different tax ditches in their district and what is being done to address the maintenance needs of the system.
10. **DeIDOT** is a major beneficiary of tax ditches. Many roadside ditches outlet to a tax ditch or tax ditch cross state-maintained roads. Communication about roadside drainage needs and tax ditch needs between the two entities is crucial for effective function of the tax ditch.

As there are multiple stakeholders involved in ensuring a tax ditch organization runs smoothly, it is imperative that data be readily available and consistent across all partners (U.S. Environmental Protection Agency, 1997). To address the issues associated with tax ditch data transference and maintenance planning, the goal of this project is to develop a request for proposals (RFP) that will allow

the state of Delaware to select a vendor to implement the integration of tax ditch drainage system data into the statewide enterprise geographic information system (GIS).

Methodology

Determining Needs

To determine what data should be included in the new tax ditch GIS geodatabases, two different needs assessment efforts were undertaken. One involved interviewing DNREC staff and the other sought input from a wide range of stakeholders via a workgroup. According to Soriano (2013), a “needs assessment refers to a well-thought-out and impartial systematic effort to collect objective data or information that brings to light or enhances understanding of the need for services or programs.” The below outlines the processes that were undertaken to obtain this information.

Stakeholder Inquiry

DNREC Staff Interviews

DNREC is the repository for most tax ditch information and is designated for providing administrative and technical support to all 234 tax ditch organizations. As DNREC is currently the primary user of the information, all staff members of the DNREC Tax Ditch Program were interviewed in 2021 to determine their needs in relation to performing their duties. Notes were taken during these interviews and used to create a list of potential attributes and associated application needs. There were five people in total who were interviewed and were asked questions regarding their daily workflow including:

- What were their daily tasks?
- What data did they need to accomplish their duties?
- How did they go about obtaining the information they need?
- How often did they use it?
- If they felt comfortable using a GIS application to assist in performing their duties.

One of the concerns DNREC staff expressed was the cumbersome process of obtaining needed data. Information required in daily tasks is stored in multiple formats including:

- GIS data of the location of the tax ditch and rights-of-way.
- GIS location data of tax ditch structures and issues collected via Survey123, an application designed to collect data while in the field using a tablet or smartphone.
- Portable document formats (PDF) of legal documents relaying administrative information or changes to the maintenance responsibilities of portions of ditches.
- PDFs of the original hand-drawn maps and profiles that convey ditch design information at the formation of the tax ditch.

All data fields and types mentioned during these interviews were written down in a table and flushed out in a document that included the current location, description of the data type and any associated domains. The final version of these attribute tables is viewable in Tables 3 – 19.

DNREC staff all were agreeable to incorporating more of the data into a GIS geodatabase, and using a GIS based application for the data retrieval as staff already use GIS applications in their day-to-day

workflow. The only caveat mentioned was that any additions had to work within or replace a step in their workflow processes as to not add to their workload.

Workgroup

In 2021, DNREC gathered over 50 stakeholders representing the ten stakeholder groups previously mentioned, nine times throughout the year as part of the 2021 Tax Ditch Modernization Workgroup. This effort was performed to identify areas of improvement to tax ditch operations and potential solutions. One of the topics that was consistently mentioned was a need for maintenance planning tools that compiled all the relevant data to assist tax ditch officers in making decisions, and GIS was posed as the potential solution (Delaware Department of Natural Resources and Environmental Control, 2022). The use of GIS geodatabases to develop impactful analyses, maps, and reports to assist with tax ditch organization efforts was seen as a much-needed resource.

The data needed to capture the workgroup's request was outlined and used to further refine data collected during the staff interviews- the two tables building upon each other. Information recorded included field names, descriptions, domains, and the location of the data. The final version of these attribute tables is viewable in Tables 3 – 19.

Database Review

DNREC currently maintains a few GIS databases containing incomplete tax ditch data. To determine the status and locations of these datasets and if GIS is the best path forward, a review of the DNREC Tax Ditch Program's existing GIS data was conducted. There were nine databases reviewed. Through this review, the attribute tables were studied for:

- Relevance,
- Consistency in naming, domains, and data types within datasets,
- Redundancy,
- Naming convention accuracy with tax ditch law, and
- File storage locations.

The review revealed that existing datasets contained highly variable attributes with regards to consistency, were incomplete with regards to fulfilling the needs of the stakeholders and were stored in multiple places including network drives, ArcGIS Online and the DNREC Enterprise Server creating difficulties in finding the databases. However, databases that could be found were conducive to geographic querying and reporting.

Considering the geographic nature of tax ditches, existing tax ditch GIS data, and the needs of the stakeholders, GIS was deemed to be a natural fit for the improvement and expansion of tax ditch data moving forward. GIS has been proven to effectively manage, analyze, and allow for the coordination of environmental resources (Rissman, 2019, Tzemos, 1995, Udovyyk, 2006, and Williams, 2006). The outcome of this review is such that the integration of these types of tax ditch data into standardized platforms will allow tax ditch organizations to function in a similar format to GIS-based watershed and land use planning entities (Gerber, 2012, Ujaval, 2021, Uearth, 2022, U.S. Environmental Protection Agency, 1997), and achieve the following workflow (Figure 3):

1. **Resource inventory** of the locations of tax ditch features; organizational information; design specifications; inspection data; maintenance responsibilities; and technical assistance provided by and/ or for stakeholders.
2. **Data analysis** of socioeconomic and environmental data to assist in future maintenance decisions (Olivera, 1998). An example of this would be to perform analyses of low-income communities in relation to sea level rise impacts to see if access to tax ditch drainage outlets is affected and if the tax ditches' maintenance activities should change to provide a greater drainage benefit.
3. A system of **maps** and/or plans to visually convey tax ditch locations, maintenance responsibilities, climate change impacts such as sea level rise, or areas in need of maintenance.
4. **Reporting**, which may include customized write-ups for tax ditch organization officers to address specific maintenance and operation needs, or overview reports targeted to specific stakeholders (Gosain, 2004).
5. **Application** for key stakeholders to access and update the data on-demand to improve customer service and provide support for tasks.



Figure 4 Chart depicting the operations of the resulting GIS enterprise system. The development of the resource inventory is the fundamental step from which all others build, and the application will allow for updates into the resource inventory.

Due to the vast amount of GIS data to capture and organize, needed data analyses, map, reports, and applications development needed, a request for proposals (RFP) process was determined by DNREC to be the most feasible method for accomplishing the needed tasks. By utilizing the RFP process, staff would be minimally impacted, and the project could be completed within a designated timetable.

Request for Proposals (RFP)

An RFP is a method many agencies employ to solicit for and receive bids to select a company for needed services, equipment, or projects. Software development RFPs usually involve an introduction to the project's organization, a description of the need, scope and expected deliverables, timeline, submission requirements that must be in each proposal, the agencies' selection criteria, and contract terms (Crowell, 2009, Khalimonchuk, 2021 and Reh, 2019). This RFP will be used to: describe the need for tax ditch data synthesis, outline geodatabase structure and attributes to be compiled or created and provide guidance on the development of an application for DNREC and Conservation District staff to retrieve information from and update the geodatabases.

Results: RFP Scope

The following information is from Appendix A: Project Scope within the State of Delaware’s RFP template. The project scope uses the example template, [City of Metropolis RFP](https://www.e-education.psu.edu/geog871/home.html), from Penn State University’s GEOG 871 open educational resource (OER) webpage at <https://www.e-education.psu.edu/geog871/home.html> (2022).

RFP: Project Summary

The DNREC Drainage Program wishes to engage a professional Contractor to develop an up-to-date GIS database with the following GIS database features:

1. Tax ditch existing features that include channels, rights-of-way, stationing, and watersheds.
2. Tax ditch deleted features of channels, rights-of-way, and watersheds.
3. A tax ditch assessment layer to include all current and historic tax information.
4. Structures within tax ditch channels and rights-of-way.
5. Maintenance concerns within the tax ditch channels and rights-of-way.
6. Technical assistance provided to tax ditch organizations.

This GIS data will be compiled using existing data sources and performed by the selected Contractor to this RFP. Collection will require retrieval of information from geodatabases, Excel files, portable document formats (PDF) or images. Data will be captured and subjected to quality control procedures by the Contractor and delivered as ArcGIS geodatabase Feature Classes for loading to the state’s enterprise GIS database. In addition to the delivered data, the Contractor will prepare GIS-based application(s) to support the retrieval and update of tax ditch data, and printable reporting on recurring tax ditch activities.

The Contractor will carry out all work described in this RFP in coordination with and support from the DNREC Drainage Program Project Manager and Project Team.

The main work elements associated with this project include:

- Work with DNREC Drainage Program to confirm specific scope, deliverables, and timing– including a detailed Work Plan for all project activities. The Work Plan should include all work tasks and submittal of data deliverables.
- Review of existing databases and records that will support the Contractor’s work. NOTE: Existing sources will provide a basis for project planning but current DNREC Drainage Program records on tax ditches are not complete. For example, not all tax ditch organizations have maintenance concerns documented. The intent is for the data to be fully populated and updated in the future as DNREC Drainage Program staff perform in-field system inspections.
- Preparation of tools and procedures for capturing data from Excel files, PDFs, or images.
- Design and execution of a pilot project, for a select number of tax ditch organizations, to test the database design, procedures, and tools. Pilot project results will be reviewed by the Contractor and DNREC Drainage Program and adjustments to the design or procedures will be made prior to

initiating the full database development work.

- Capture all required data (tax ditch features, deleted features, assessment, structures, maintenance concerns, etc.) using existing databases.
- Perform all necessary quality control work to adhere to stated data quality criteria and deliver data to the DNREC Drainage Program. The DNREC Drainage Program will perform its own quality assurance review (with support from the Contractor) and accept or reject data deliverables from the Contractor.
- Fix any data errors or quality problems discovered in the DNREC Drainage Program's quality assurance review of data deliverables from the Contractor.
- Provide and load complete GIS data, as geodatabase feature class(es) on the DNREC Drainage Program's geodatabase and ensure that it is fully operational and accessible by DNREC Drainage Program users.
- From the results of the pilot project, fully develop a web-based application for DNREC Drainage Program staff to retrieve and update tax ditch information and generate printable reports to share with the public.
- Provide the DNREC Drainage Program with a tool for staff to review deliverables.
- Provide monthly status reports and other communications as necessary to support project execution.

The timing for project execution will be based on the selected Contractor's proposal and negotiations with the DNREC Drainage Program. The DNREC Drainage Program is interested in a full project completion by the end of December 2023 but is willing to entertain completion dates before or after this date.

The subsequent Sections of this proposal provide detailed information about the project scope and deliverables.

RFP: Project Information

DNREC Drainage Program Project Personnel and Management

The project is being conducted for the DNREC Drainage Program which has responsibility for providing administrative and technical assistance to Delaware's tax ditch organizations. A DNREC Drainage Program Project Manager and team will be assigned to oversee the project and provide necessary information and support to the selected Contractor. The DNREC Drainage Program Project Team will consist of the DNREC Drainage Program Project Manager and individuals from multiple state of Delaware Departments and offices as shown below.

- Project Manager: Brittany Haywood, Environmental Program Manager I, DNREC Tax Ditch Program
- Team Member: John Inkster, Sr. Application Support Specialist, DNREC Tax Ditch Program
- Team Member: To Be Determined, Permit and Data Specialist, DNREC Tax Ditch Program
- Team Member: Michael Townshend, Sr. Software Engineer- GIS, Department of Technology, and Information

- Team Member: Kymberlie Kelly, Software Engineer, Strategic Enterprise Services

Existing Source Data

The Contractor will use existing DNREC Drainage Program data sources, to the extent feasible, to compile the GIS data required for this project. Table 1 summarizes existing data sources that the DNREC Drainage Program believes may be of value to this project. The Contractor, as part of the work on this project, will be required to evaluate these data sources and use them in a way that best supports project work. The Contractor may identify and use other existing source data sources that may be useful to meet the data compilation requirements of this RFP.

Table 1 Description of Main Source Data

Data Source	Description
DE_TaxDitch (FeatureServer)	A GIS FeatureServer publicly available on Delaware FirstMap that contains information related to tax ditch channels (segments), maximum rights-of-way (ROW) and watersheds (areas). Information can be accessed and downloaded from: https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer . Information is also regularly updated with change requests from the landowner (Court Order Changes).
Delaware FirstMap	Contains information about Delaware specific Map, Feature, Imagery, and Geocoder Services. Layers pertain to county, legislative districts, watersheds, streets, streams, imagery, etc. Available at: https://firstmap.gis.delaware.gov/index.shtml?dc=data
Kent, Sussex and New Castle Formation .DBF Files	These internal files contain tax ditch formation information that will assist in populating Table 4 which contains information that pertains to the formation of the tax ditch.
Tax Ditch Assessments Databases	These files are internal. Tax ditch assessments information is key for tax ditch organization to allocate and secure funding for maintenance. The DNREC Drainage Program maintains this data set, and historically, data has been stored by year.
Tax Ditch Inspection Database	These data contain internal information to assist tax ditch organizations with maintenance decisions. It was originally developed from a ArcGIS Survey123, a mobile data gathering application, for the inspection of tax ditches in the field using a mobile device. The data is hosted on ArcGIS Online and available internally. https://services2.arcgis.com/JSw5FPLGACZknOZv/arcgis/rest/services/survey123_1f188b85d8c842e5a51f4ac941b05c5d_stakeholder/FeatureServer
Tax Ditch Formation Documents	These documents provide information regarding the technical and administrative aspects of tax ditches. Valuable information is held within these Excel files, PDFs, or images to assist the DNREC Drainage Program in performing everyday tasks. Information will have to be manually retrieved from these documents, and they are currently only available from within the state's network.
Drainage Concerns Database	This is a database which houses all calls the DNREC Drainage Program has received regarding questions around drainage. This database will need to be linked to in the applications.

Description of Work and Project Deliverables

The Contractor will carry out all work described in this RFP in coordination with and support from the DNREC Drainage Program Project Manager and Project Team. Specific deliverables that support the work elements listed in the RFP: Project Summary section are described in Table 2. These Deliverables are organized into a) main deliverables specific to GIS products and services to be provided to the

DNREC Drainage Program, and b) supporting deliverables that support technical work and associated project planning and management. The RFP Respondent may propose additional deliverables which may support project work or provide the DNREC Drainage Program with additional products or services which could improve or enhance the implementation and the DNREC Drainage Program’s management of Delaware’s tax ditches.

Table 2 Summary of Project Deliverables

Deliverable	Description
Main Deliverables (MD):	
MD1: GIS data	Populated geodatabase feature classes with up-to-date features and attribute data for the required data (tax ditch features, deleted features, assessment, structures, maintenance concerns).
MD2: GIS technical assistance geodatabase development	Development of geodatabase structure to support tax ditch organization technical assistance feature reporting.
MD3: GIS metadata development	Compilation and capture of geospatial metadata associated with the feature classes in the geodatabase. The metadata format and content should comply with the Delaware Geospatial Metadata Standard (https://firstmap.gis.delaware.gov/contentFolder/pdfs/public/delaware_geospatial_metadata_standard2.pdf).
MD4: Design and development of custom GIS application(s) to support retrieval and update of data and printable reporting for public tax ditch requests	Custom application(s) that support the retrieval of information by tax ditch organization and ongoing update of the GIS data. This will primarily be office-based data manipulation. The applications should provide an intuitive interface usable by employees without GIS technical expertise or experience with ArcGIS Desktop and include printable reporting features of analyses. A single application or entry point to multiple applications is preferred. Written user documentation should also be included. For more resources that may be of assistance in the development of the application visit https://firstmap.gis.delaware.gov/index.shtml?dc=resources .
MD5: Training services	Training services for personnel for the custom application(s) (Deliverable MD4. This includes the preparation of training materials, organizing the sessions, and presenting the training to selected employees (approximately 30 employees))
MD6: Final Project Report	A written report that describes how the project work was conducted and the results of the work. This should include a description of procedures, technical standards, tools, and applications used for the project. A description of results should explain the database format and content and counts for features captured. The report should also include a “lessons learned” summary describing challenges, how effective the project procedures were, and potential improvements for future projects.
Supporting Deliverables (SD):	
SD1: Project Work Plan	Detailed work plan that identified tasks, timing, and responsibilities for project work associated with the main deliverables. This includes any adjustments to the work plan(s) required during the project. This Work Plan should follow the description of scope in the Respondent’s proposals but may be more detailed and with updated timing to be used as a blueprint for executing the work.
SD2: Monthly Status Reports	Monthly status reports that indicate percentage completion for each task with notes on status, major accomplishments in reporting period, key objectives for next period, and any issues or problems that need to be addressed.

Deliverable	Description
SD3: Pilot Project Plan, Execution, and Report	<p>Includes design and execution of a pilot project with the objective of testing and adjusting procedures and methodologies for GIS database development, quality control, associated source material handling, and final application design. There are three main pilot projects objectives to address:</p> <ol style="list-style-type: none"> 1. Evaluation and refinement of the geodatabase design 2. Overall testing of GIS data retrieval, update and reporting approach and tools 3. Testing of quality control procedures <p>The pilot project should include pilot project design document, carrying out data collection work for a select number of tax ditch organizations, review of procedures and results, identification (in a written report) of the pilot projects results, and adjustments to the geodatabase design and data retrieval, updates and reporting procedures based on the pilot project.</p>
SD4: Deliverable QA Support Tools and Assistance	<p>Define procedures and develop and deploy necessary tools for DNREC Drainage Program Project Team to review and accept deliverables from the Contractor. This includes procedures and/or tools for review and comment on custom application development and database deliverables (for adherence to content, format, and quality criteria).</p>
SD5: Work Sessions with the DNREC Drainage Program	<p>Any necessary on-site work sessions with DNREC Drainage Program personnel. This includes meetings or specifying time onsite at the DNREC Drainage Program facility for access to the tax ditch formation documents. The Respondents will describe, in their proposal, the anticipated on-site meetings. At a minimum, the virtual or on-site meetings should include sessions for pilot project review, and custom application review, custom application training. Respondents may identify additional on-site sessions as needed.</p>

GIS Database Collection and Compilation Approach

It is the Respondent’s responsibility to design an approach that meets all requirements for database content, format, and quality. The following expectations should guide the design of database collection and compilation procedures and tools for data noted within Tables 3 - 19:

- Specific ArcGIS geodatabase feature classes defined should optimize the efficiency of data access and update.
- The Contractor will use existing data sources to the greatest extent possible (see Table 1) but should understand the limitations of these sources. These sources will provide a starting point.
- The Contractor will employ appropriate procedures and tools for in-office processing of the collected data—for quality control and loading to the DNREC Drainage Program’s geodatabase.
- The Contractor will employ suitable methods and tools for quality control and quality problem. Correction prior to delivery to the DNREC Drainage Program.
- The Contractor will NOT adjust positions of the tax ditch channels, rights-of-way and watersheds GIS data.
- The GIS features should have standard symbology and annotation applied—using standards agreed to during the pilot project.
- In some cases, file and document management will be conducted within the geodatabase, and in others it will be steered through the state of Delaware’s OnBase system. The OnBase system will be set up and organized by the DNREC Drainage Program. It is the Contractor’s responsibility to ensure that the geodatabase is set up to accept any URLs the OnBase system may generate for documents.

Description of the GIS Data to be Developed

The six categories of data will be compiled and delivered as ArcGIS geodatabase feature classes. Due to the unique nature of tax ditches and their operations, significant forethought regarding the geodatabase composition and application development was necessitated (Kennelly and Croswell, 2020). The geodatabase structure has been proposed in the below Tables 3 - 19, and it will be up to the Contractor to enter, format, and review the data. Figure 5 also demonstrates a proposed database relationship diagram.

Some metrics useful for projecting time and cost for this project are listed below. These numbers are estimates.

- Mileage of DNREC Drainage Program tax ditch channels: 2,030 miles
- Number of tax ditch organizations: 234
- Each tax ditch organization has a number of documents that will need to be manually reviewed to retrieve information to be entered into the attribute tables. These include Court Order Changes (COC), as built drawings, and formation documents: 10 – 75 documents per tax ditch.
 - Note: Depending on Project timing, one DNREC Drainage Program staff member may be able to assist with this effort.

Tax Ditch Inventory Relationship Diagram

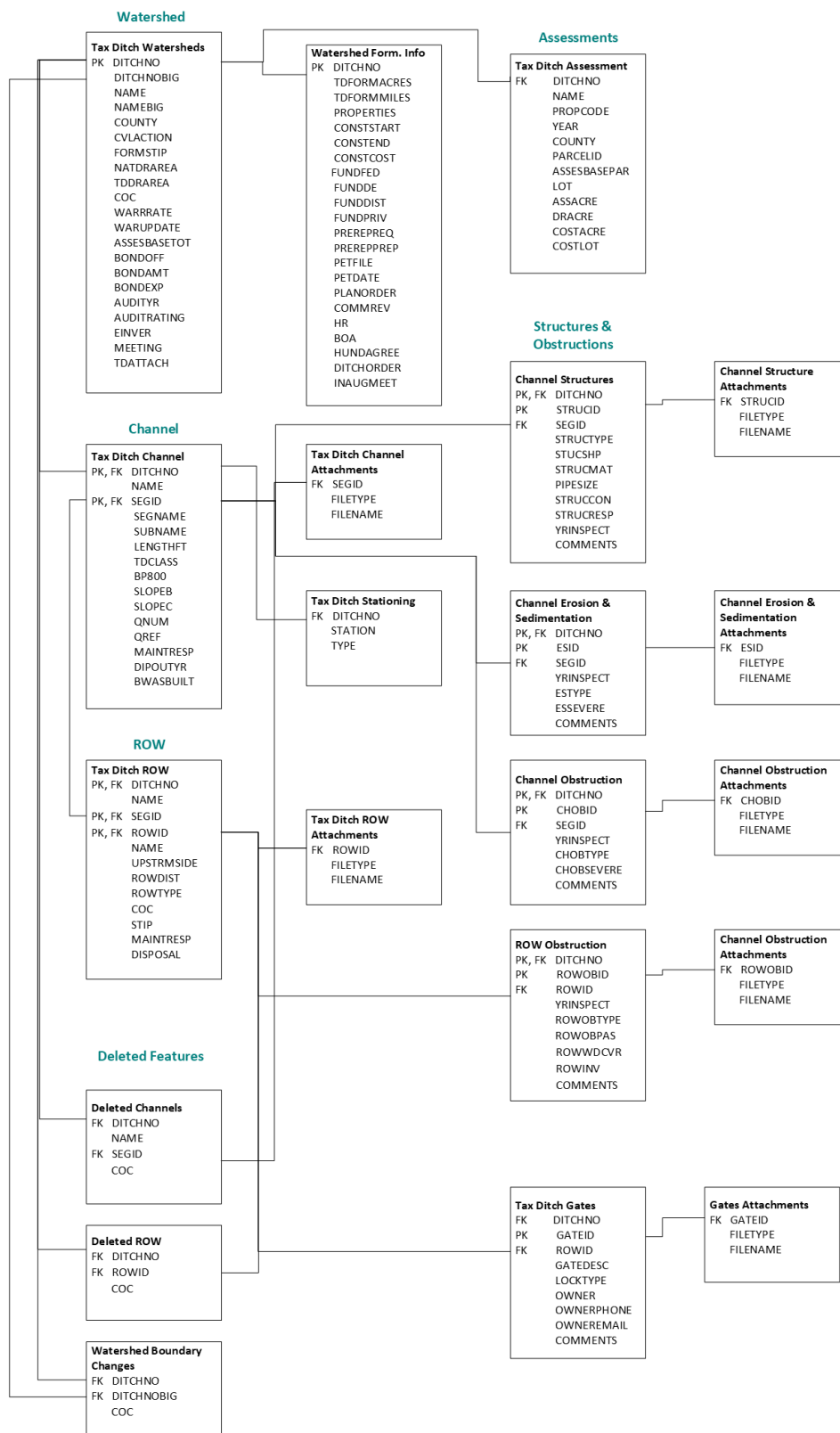


Figure 5 Proposed tax ditch geodatabase relationship diagram for tax ditch features, deleted features, assessment, structures, and maintenance concerns. The diagram does not contain information related to technical assistance features.

Tax Ditch Features Geodatabase

Tax ditches contain features that are consistent across all tax ditch systems in Delaware. These features include the channel – a line feature, its associated rights-of-way- a polygon feature, and their watershed boundary – a polygon feature. In addition, tax ditch stationing allows the user to know where changes occur at specific points on the ditch in feet. For example, where the bottom width of the ditch changes. Tables 3 – 7A contain information that is associated with these three data types and are used on a regular basis when it comes to answering questions, determining maintenance needs, or performing legal updates to the system.

- *Tax Ditch Watersheds & Attachments Current and Formation (formerly Tax Ditch Areas) (Table 3 & 4)*
- *Tax Ditch Channel & Attachments (formerly Tax Ditch Channel Segments) (Table 5 & 5a)*
- *Tax Ditch Stationing (Table 6)*
- *Tax Ditch ROW & Attachments (formerly Tax Ditch Maximum ROWs) (Table 7 & 7a)*

Table 3 Tax Ditch Watersheds (TDWAT) – Polygon Layer (Public)

Contains information related to the <u>current</u> operations of the Tax Ditch Organization and its associated watershed boundary. Information related to the natural and tax ditch drainage areas is to be supplied, along with any Court Order Change (COC) documents that created a change to the boundary. Attachments will be stored with ECM/OnBase in this layer with a OnBase URL that links all like tax ditch organization documents. Blue text in Description denotes domains.				
Field ID	Alias	Data Type	Description and/or Domains	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key (Formerly DNOLITL)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
DITCHNOBIG	Ditch Number Big	Text - 4	The number associated with forming the larger watershed of the ditch, Primary Key (Formerly DNOBIG)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
NAME	Sub-Watershed Tax Ditch Name	Text - 50	Sub-watershed name	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
NAMEBIG	Watershed Tax Ditch Name	Text - 50	Larger watershed name	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
COUNTY	Primary County	Text - 10	County the tax ditch is located within, if the tax ditch resides in two counties, then it will appear twice in the listing	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
CVLACTION	Civil Action Number	Text - 10	The unique number assigned to each tax ditch when filed in the counties' court system	G:\Tax Ditch Financial\A - TD HISTORY\TD HISTORY.xlsx (Civil Action Number field)
FORMSTIP	Formation Stipulations	Text - 250	Stipulations that are placed in the formation or commissioners report documents	Review of the Commissioner's Reports for each tax ditch organization
NATDRAREA*	Natural Watershed Drainage	Double	The drainage area of the natural watershed. How much land area the tax ditch outlet is actually draining?	Needs to be calculated

TDDRAREA	Tax Ditch Watershed Drainage	Double	Drainage area for the current tax ditch watershed	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
COC	Court Order Change Number	Text	The number(s) of the Court Order Change(s) (COC) affected on a watershed boundary change. Cells can remain empty, but only numbers and “,” should be present. The symbol “#” is not to be used.	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
WARRRATE	Warrant Rate	Double	The current warrant rate of the tax ditch.	Excel file
WARUPDATE	Warrant Updated	Short integer	The year the current warrant rate was last updated (Special or Adjusted Maintenance Warrants).	Excel file
ASSESBASETOT	Assessment Base Total	Double	The most current assessment base for the tax ditch organization	Excel file
BONDOFF	Sec Tres Bonded	Text - 3	At a minimum, is the Secretary/Treasurer bonded: Yes, No	G:\Tax Ditch Financial\A - TD HISTORY\TD HISTORY.xlsx (BONDING YES OR NO FILE ORGIN IN BONDING FILE & COPY IN TD field)
BONDAMT	Bond Amount	Double	Amount bond covers	G:\Tax Ditch Financial\A - TD HISTORY\TD HISTORY.xlsx (BOND AMOUNT field)
BONDEXP	Bond Expiration	Text	Date bond expires, format MM/DD/YYYY/XX/XXXX	G:\Tax Ditch Financial\A - TD HISTORY\TD HISTORY.xlsx (BOND EXPIRES DATE field)
AUDITYR	Year of Last Audit	Short Integer	Last audited year of the Tax Ditch Organization	G:\Tax Ditch Financial\A - TD HISTORY\TD HISTORY.xlsx (Check for years field)
AUDITRATING	Audit Rating	Text - 34	Rating of the last audit, Pass, Pass with Immaterial Deficiencies, Fail	G:\Tax Ditch Financial\A - TD HISTORY\TD HISTORY.xlsx (check for years field)
EINVER	EIN Verified	Text - 3	Does the DNREC Drainage Program have record of a verified EIN number. Yes, No	G:\Tax Ditch Financial\A - TD HISTORY\TD HISTORY.xlsx (VERIFIED EIN ON FILE Y/N field)
MEETING	Year of Last Annual Meeting	Short Integer	Year the Tax Ditch Organization last had an annual meeting, not a meeting of the officers. (Known to DNREC)	G:\Tax Ditch Financial\A - TD HISTORY\TD HISTORY.xlsx (LAST KNOWN MTG DATE field)
TDATTACH	Attachments		Link to OnBase webpage that lists and links all relevant documents to a particular tax ditch.	OnBase

Table 4 Watershed Formation Info (TDWATFORM) – Table (Not Public)

Contains any relevant dates, funding and acreage and mileage relating to the <u>formation</u> of the tax ditch organization. Blue text in Description denotes domains. Sources: Kent – KTDSTAT.DBF (G:\gisdata\DITINFO) / Sussex – STDSTAT.DBF (G:\gisdata\DITINFO) / New Castle – NTDSTAT.DBF (G:\gisdata\DITINFO); corresponding field names from .DBF files (and black DBASE notebook) are listed below				
Field ID	Alias	Data Type	Description and/or Domains	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key (Formerly DNOLITL)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
TDFORMACRES	Formation Drainage Area	Double	Drainage area of tax ditch at formation of the system in acres	ACRES (ACRES)

TDFORMMILES	Formation Channel Length	Double	Miles of tax ditch channel at formation of the ditch	MILES (MILES)
PROPERTIES	Number of Properties	Double	Number of properties or parcels that were in the tax ditch at the time of formation	LNDO (Properties)
CONSTSTART	Construction Start Date	Date	Date the construction of the ditch started	SDATE (Cons. start)
CONSTEND	Construction End Date	Date	Date the construction of the ditch ended	EDATE (Construction End)
CONSTCOST	Cost of Construction	Short Integer	Cost to construct the tax ditch based off the Commissioner's Report	COST (Cost)
FUNDFED	Federal Funding	Short Integer	Percentage of funding covered by Federal assistance	FED (Fed)
FUNDDE	State Funding	Short Integer	Percentage of funding covered by state of Delaware assistance	DE (DE)
FUNDDIST	District Funding	Short Integer	Percentage of funding covered by Conservation District assistance	DIS (Dist)
FUNDPRIV	Private Funding	Short Integer	Percentage of funding covered by private entities such as loans	PRI (Pr)
PREREPREQ	Preliminary Report Request	Date	Date Preliminary Report requested	PRREQ (Pre. Report requested)
PREREPPREP	Preliminary Report Prepared	Date	Date Preliminary Report was prepared and submitted to Conservation District board	PRPRE (Prepared)
PETFILE	Petition Filed	Date	Date Petition was filed	PFILED (Pet. Filed)
PETDATE	Petition Date	Date	Date the Petition was approved	PDATE (Petition date)
PLANORDER	Planning Order	Date	Date the Planning Order was issued to allow the ditch to be planned	COPLAN (Plan CO)
COMMREV	Commissioner Review	Date	Date the Board of Ditch Commissioners reviewed	TDCOMM (Comm. Rev)
HR	Hearing and Referendum	Date	Date the Hearing and Referendum was held. Note: some ditches will not have this as they were formed by 100% Agreement	HRDATE (H&R)
BOA		Short Integer	Board of Assessment number	BOA (BOA No.)
HUNDAGREE	All Agreed	Text - 3	If the tax ditch was formed by 100% agreement: Yes, No	(Remarks from the DBASE black notebook)
DITCHORDER	Ditch Order	Date	Date the Ditch order was issued, and the tax ditch was created.	FODATE (Final CO)
INAUGMEET	Inaugural Meeting	Date	First meeting of the tax ditch organization.	ORGMTG (Org Meet)

Table 5 Tax Ditch Channel (TDCHANNEL) – Polyline Layer (Public)

This table contains information specific to the tax ditch channel. Channel segments that drain greater than 800 acres of land will be identified to assist in permitting processes. Court Order Changes (COC)s are not referenced in this table, but in the Tax Ditch ROW and Watersheds table. Attachments will be stored with ECM/OnBase and linked in a separate table to this layer as there will be multiple file types that pertain to a particular segment. [Blue text in Description denotes domains.](#)

Field ID	Alias	Data Type	Description and/or Domains	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
NAME	Sub-Watershed Tax Ditch Name	Text - 50	Sub-watershed name (Formerly TDNAME)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
SEGID	Segment ID Number	Text – 10	ID number associated with the segment of the ditch, Primary Key	To be created
SEGNAME	Segment Name	Text - 25	Main or prong name	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/0
SUBNAME	Sub Name	Text - 25	Name of Sub prong name	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/0 (from SEGNAME)
LENGTHFT	Length - Feet	Double	Length of channel (ft)	To be calculated
TDCLASS	Tax Ditch Classification	Text - 15	Classification of the ditch: Pipe, Pond, Open channel (Formerly contained DITCHTAX, DITCHCOC, DITCHDEL, DITCHPIPE, DITCHROW, DITCHPOND)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/0
BP800	Greater 800 Acres Breakpoint	Text - 3	Does the channel fall into an area that naturally drains (NATDRAREA) greater than 800 acres of land: Yes= greater than 800 acres, No=less than 800 acres	This data will have to be created
SLOPEB	Bank Design Slope	Double	Slope of ditch bank as designed	This will have to be pulled from the formation maps/ as built from each tax ditch.
SLOPEC	Channel Design Slope	Double	Slope of ditch channel as designed	This will have to be pulled from the formation maps/ as built from each tax ditch.
QNUM	Design Q	Double	The calculated design Q or flow rate of the channel segment at a particular location	This will have to be pulled from the formation maps/ as built from each tax ditch.
QREF	Design Q Determined	Text - 50	Where Q came from or how determined	This will have to be pulled from the formation maps/ as built from each tax ditch.
MAINTRESP	Maintenance Responsibility	Text - 25	Denotes maintenance responsibility of channel or pipe: Tax Ditch, Landowner, DelDOT, Partial, Municipality	Determined from tax ditch formation documents, and subsequent court order changes.
DIPOUTYR	Last Dip Out	Short integer	The year the channel was last dipped out	To be determined from eNOI accounts, standard plans or other.
BWASBUILT	Bottom Width (ft)	Short integer	The bottom width of the channel in feet as described in the original as-built information.	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/0

Table 5A Tax Ditch Channel Attachments (TDCHANNELATTACH) – Table (Public)

Contains any relevant attachments that relate to the tax ditch channel. Documents could include as built maps. These are to be individually linked from OnBase.				
Field ID	Alias	Data Type	Description and/or Domains	Source
SEGID	Segment ID Number	Text – 10	ID number associated with the segment of the ditch, Foreign Key	Table 3 - Tax Ditch Channel (TDCHANNEL) – Polyline Layer

FILETYPE	File Type	BLOB	File type for linked video, image or PDF attachments	
FILENAME	File Name	Text – 250	File URL for video or images	OnBase

Table 6 Tax Ditch Stationing (TDSTATIONS) - Point Layer (Not public)

Contains data related to the stationing of the tax ditch channels as per the as built maps. This data set would have to be created and georeferenced. Blue text in Description denotes domains.

Field ID	Alias	Data Type	Description and/or Domains	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Foreign Key (Formerly DNOLITL)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
STATION	Station	Text – 10	Known tax ditch stationing	
TYPE	Type	Text – 7	Signifies whether the station came from the as built information or the COC: COC, As Built	

Table 7 Tax Ditch ROW (TDROW) – Polygon Layer (Public)

Contains data relating to the tax ditch right-of-way (ROW) and includes any affected Court Order Change (COC) documents, stipulations, and maintenance responsibilities of ROW and channel. Attachments will be stored with ECM/OnBase and linked in a separate table to this layer as there will be multiple file types that pertain to a particular segment. Blue text in Description denotes domains.

Field ID	Alias	Data Type	Description and/or Domains	Source
SEGID	Channel Segment ID Number	Text - 10	ID number associated with the segment of the ditch, Primary Key, Foreign Key	Table 3 - Tax Ditch Channel (TDCHANNEL) – Polyline Layer
ROWID	ROW ID Number	Text - 10	ID number associated with the segment of the right-of-way (ROW), Primary Key	Needs to be created
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
NAME	Sub-Watershed Tax Ditch Name	Text - 50	Sub-watershed name (Formerly TDNAME)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
UPSTRMSIDE	ROW Location	Text - 5	Describes whether ROW is on the Left or Right side of the bank looking upstream	Needs to be created
ROWDIST	ROW Distance	Text - 10	Width of the right-of-way top of bank (TOB) or center line (CL)	Data is available for Major, Channel, and Special Access, will needs to be created for Minor
ROWTYPE	ROW Type	Text - 25	Types of rights-of-way, not legal definition: Major , Minor , Channel , Special Access ROW , and Special Disposal	ROW types will have to be pulled from multiple sources. Major, SAR and Special Disposal is displayed here: https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/1 . Minor's are available in an Excel spreadsheet, but not mapped.
COC	Court Order Change Number	Text	The number(s) of the COC impacting a particular ROW. Cells can remain empty, but only numbers and “,” should be present. The symbol “#” is not to be used.	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/1 To be separated out from the Comments field.

STIP	Stipulations	Text - 50	Stipulations expressed in the COC or Elsewhere: Spoil Removal on Landowner, Spoil to be Hauled Offsite by Tax Ditch, or Has Special Disposal Right-of-Way	To be determined by reviewing Court Order Change (COC) Documents
MAINTRESP	Maintenance Responsibility	Text - 25	Denotes maintenance responsibility of ROW: Tax Ditch, Landowner, DelDOT, or Partial, Municipality	To be determined by reviewing Court Order Change (COC) Documents
DISPOSAL	Spoil Disposal Location	Text - 3	Yes or No for whether the ROW is used for spoil disposal	To be determined by reaching out to tax ditch officers/ maintenance contractors

Table 7A - Tax Ditch ROW Attachments (TDROWATTACH) – Table (Public)

Contains tax ditch right-of-way (ROW) related documents. Documents could include Court Order Changes (COC). These documents are to be linked individually from OnBase.				
Field ID	Alias	Data Type	Description and/or Domains	Source
ROWID	ROW ID Number	Text - 10	ID number associated with the segment of the right-of-way (ROW), Foreign Key	
FILETYPE	File Type	BLOB	File type for linked video, image, or PDF attachments	
FILENAME	File Name	Text – 250	File URL for video or images	OnBase

Tax Ditch Deleted Features Geodatabase

With changing land use and development, comes changing tax ditches. Channels are moved or removed along with their associated rights-of-way (ROW), and watershed boundaries are changed as drainage areas across lands are shifted. There are instances where having information about what use to be present can assist in solving an issue in the present. The deleted channels and ROWs table, and watershed boundary changes tables holds information about tax ditches that have either been eliminated or ditches turned back over to private landowner control for maintenance.

- Deleted Channels (Table 8)
- Deleted ROWs (Table 9)
- Watershed Boundary Changes (Table 10)

Table 8 Deleted Channels (CHANNELDEL) – Polyline Layer (Internal)

Contains tax ditch channels that have been eliminated and designates which Court Order Change (COC) they were eliminated by.				
Field ID	Alias	Data Type	Description and/or Domains	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)	Request John Inkster for layer and edit as needed
NAME	Sub-Watershed Tax Ditch Name	Text - 50	Sub-watershed name (Formerly TDNAME)	
SEGID	Segment ID Number	Text – 10	ID number associated with the segment of the ditch, Primary Key	
COC	Court Order Change Number	Text	The number(s) of the COC impacting a particular ROW. Cells can remain empty, but only numbers and “,” should be present. The symbol “#” is not to be used.	

Table 9 Deleted ROW (ROWDEL) – Polygon Layer (Internal)

Contains tax ditch rights-of-way that have been eliminated and designates which Court Order Change (COC) they were eliminated by.				
Field ID	Alias	Data Type	Description and/or Domains	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)	Request John Inkster for layer and edit as needed
ROWID	ROW ID Number	Text - 10	ID number associated with the segment of the right-of-way (ROW), Primary and Foreign Key	
COC	Court Order Change Number	Short integer	The number(s) of the COC impacting a particular ROW.	

Table 10 Watershed Boundary Changes (TDWATCHANGE) – Polyline Layer (Internal)

Contains tax ditch watershed boundaries that no longer exist due to moving the watershed boundary line and their associated Court Order Change (COC) which allowed it to be performed.				
Field ID	Alias	Data Type	Description and/or Domains	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)	Request John Inkster for layer and edit as needed
DITCHNOBIG	Ditch Number Big	Text - 4	The number associated with forming the larger watershed of the ditch, Primary Key (Formerly DNOBIG)	
COC	Court Order Change Number	Short integer	The number(s) of the Court Order Change(s) (COC) affected on a watershed boundary change.	

Tax Ditch Assessment

Each tax ditch organization charges a tax to the landowners to assist in covering maintenance costs. Not only is the tax rate for each tax ditch organization unique, but so is the amount landowner pays. The landowners tax portion is proportionate to the drainage benefits their property receives. In other words, if the ditch moves more water off the property, the landowner pays more tax. This data set tracks the assessment or tax information of each parcel by year.

- Tax Ditch Assessments (Table 11)

Table 11 Tax Ditch Assessment (TDASSESS) – Point Layer (Internal)

The intent of this dataset is to easily identify Tax Ditch property codes, parcel assessment bases and taxes for parcels located in all three counties for all years. Blue text Description denotes Domains.				
Field ID	Name	Data Type	Description	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)	Request John Inkster for layer and edit as needed
NAME	Sub-Watershed Tax Ditch Name	Text - 50	Sub-watershed name (Formerly TDNAME)	
PROPCODE	Property Code	Text - 5	Tax ditch specific identifier to cross reference parcels on the map and the original assessment list.	

YEAR	Year	Double	The year the assessment pertains to.
COUNTY	County	Text - 10	The county the parcel is located in. (Kent , New Castle , Sussex)
PARCELID	Tax Map ID	Text - 50	Parcel ID number from tax map via the county, Foreign Key
ASSESBASEPAR	Parcel Assessment Base	Double	The assessment base of the individual parcel. It is either based on the cost of the lot or cost per acre.
LOT	Lot	Text - 3	Is the parcel at a lot rate? Yes , No
ASSACRE	County Assessed Acreage	Double	Formerly called Assessed Acreage, is the total acreage assigned to the parcel by the county.
DRACRE	Tax Ditch Assessed Acreage	Double	The acres of a parcel that the tax ditch drains. If not entirely within the watershed an acreage ratio is used. Drainage Acreage could equal taxable acreage if the entire parcel is within the watershed.
COSTACRE	Cost Acre	Double	If the Lot = No, this field represents the cost per acre rate, if Lot = Yes, this field equals 0.
COSTLOT	Cost Lot	Double	If the Lot = Yes, this field represents the cost of the entire parcel or lot rate, if Lot = No, this field equals 0.

Tax Ditch Structures Geodatabase

Each tax ditch has associated structures within the system. These structures include items such as pipes, bridges, water control structures, and gates. These datasets capture the location of these structures and other beneficial information such as pipe size, condition, and who is responsible for maintenance. The knowledge of the presence of gates is key for gaining access to the tax ditch rights-of-way, including if it is keyed, coded, or dummy locked, and who to go to for access.

- *Channel Structures & Attachments (Table 12 & 12a)*
- *Tax Ditch Gates (Table 13 & 13a)*

Table 12 Channel Structures (CHANSTRUCT) – Point Layer (Internal)

Content in this table identifies structures that lie within or across the tax ditch channel, specifications, status, and maintenance responsibilities. Blue text Description denotes Domains.				
Field ID	Alias	Data Type	Description and/or Domains	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
STRUCID	Channel Structure ID	Text – 10	Unique value for each structure, Primary Key	From existing Survey123 survey
SEGID	Channel Segment ID Number	Text – 10	ID number for tax ditch channels, Foreign Key	
STRUCTYPE	Structure Type	Text - 25	Type of Structure: Bridge, CI Pipe, Culvert, Outfall, Pipe, Riprap, Water Control Structure	
STRUCSHP	Structure Shape	Text - 25	Shape of Structure: Arch, Box, Circular, Concrete Open-Bottom Arch, ConSpan, Elliptical, High-Profile Arch, Low-Profile Arch, Metal Box, Pipe-Arch, Other	
STRUCMAT	Structure Material	Text - 25	Material structure is constructed of: Aluminum Structural, Corrugated Aluminum, Corrugated PE, Steel, PVC, Reinforced Concrete, Rock, Smooth HDPE, Steel Structural Plate, Wood	
PIPESIZE	Pipe Size	Double	Inner diameter of pipe in inches	
STRUCCON	Structure Condition	Text - 25	Condition of structure: Collapsing, Corroded, Sound	
STRUCRESP	Structure Responsibility	Text - 25	Who is responsible for maintaining the structure: DelDOT, Landowner, Tax Ditch, Unknown, HOA, Municipality	
YRINSPECT	Year Inspected	Short integer	Year the structure was last inspected	
COMMENTS	Inspection Comments	Text - 250	Comments of the inspection.	

Table 12A - Channel Structure Attachments (CHANSTRUCATTACH) - Table

This table hold video or photos of the channel structures as attachments in relation to the channel structures table. These attachments are to be managed from ArcGIS Online.				
Field ID	Alias	Data Type	Description and/or Domains	Source
STRUCID	Channel Structure ID	Text – 10	Unique value for each structure, Foreign Key	From existing Survey123 survey

FILETYPE	File Type	BLOB	File type for linked video or image attachments	
FILENAME	File Name	Text – 25	File name for video or images	

Table 13 Tax Ditch Gates (TD Gates) – Point Layer (Internal)

Contents in this layer identify gated access points to the tax ditch right-of-way, known point of contact for keys, and or entry codes. Blue text Description denotes Domains.				
Field ID	Name	Data Type	Description	Source
GATEID	Gate ID	Text - 10	Unique value for each gate, Primary Key	To be created by Contractor
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Foreign Key (Formerly DNOLITL)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
ROWID	ROW ID Number	Text - 10	ID number associated with the segment of the right-of-way (ROW), Foreign Key	Tax Ditch ROW (TDROW) – Polygon Layer
GATEDESC	Gate Description	Text	Gate description	Request John Inkster for layer and edit as needed
LOCKTYPE	Type of Lock	Text - 12	Combination, Key, Lock Box, Other	
OWNER	Gate Owner	Text	Owner of gate	
OWNERPHONE	Phone Number	Text	Contact phone of owner	
OWNEREMAIL	Email	Text	Email address of owner	
COMMENTS	Gate Comments	Text - 250	Comments related to access through the gate	

Table 13A - Gates Attachments (GATESATTACH) - Table

This table hold video or photos of the gates as attachments in relation to the channel structures table. These attachments are to be managed from ArcGIS Online.				
Field ID	Alias	Data Type	Description and/or Domains	Source
GATEID	Gate ID	Text – 10	Unique value for each structure, Foreign Key	Tax Ditch Gates (TD Gates) – Point Layer
FILETYPE	File Type	BLOB	File type for linked video or image attachments	From existing Survey123 survey
FILENAME	File Name	Text – 25	File name for video or images	

Tax Ditch Maintenance Concerns Geodatabase (Internal)

Tax ditches face all sorts of obstacles to performing routine maintenance, and often need assistance in prioritizing maintenance activities. The Channel Erosion and Sedimentation table allows for the documentation of in field issues regarding the tax ditch channel and banks. The Channel and Right-of-Way Obstruction tables document issues with access to the ditch or structures that block flow. These tables are point layers and can be used to garner a larger picture of what is happening throughout each system.

- Channel Erosion & Sedimentation (Table 14 & 14a)
- Channel Obstruction (Table 14 & 14a)
- Right-of-Way Obstruction (Table 16 & 16a)

Table 14 Channel Erosion & Sedimentation (CHANEROSSED) – Point Layer (Internal)

Data hosted here relates to channel erosion and sedimentation issues identified during an inspection of the tax ditch. Blue text Description denotes Domains.				
Field ID	Alias	Data Type	Description and/or Domains	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
ESID	ES ID Number	Text - 10	Unique identifying value for each erosion and sedimentation concern, Primary Key	To be created by Contractor
SEGID	Channel Segment ID Number	Text - 10	ID number for tax ditch channels, Foreign Key	Channel Structures (CHANSTRUCT) – Point Layer
YRINSPECT	Year Inspected	Short integer	Year the channel was last inspected	From existing Survey123 survey
ESTYPE	Erosion & Sedimentation Type	Text - 25	Type of erosion or sedimentation: Around structure, rills & gullies, undercut bank, vertical bank/unstable bank, animal crossing, silted in, sand bar	
ESSEVERE	Erosion & Sedimentation Severity	Text - 10	Severity of issue: High, Medium, Low	
COMMENTS	Erosion & Sedimentation Comments	Text - 250	Comments of the issue	

Table 14A - Erosion & Sedimentation Attachments (EROSSEDATTACH) – Table (Internal)

Contains erosion and sedimentation related photos or videos. These attachments are to be managed from ArcGIS Online.				
Field ID	Alias	Data Type	Description and/or Domains	Source
ESID	ES ID Number	Text – 10	Unique identifying value for each erosion and sedimentation concern, Foreign Key	Channel Erosion & Sedimentation (CHANEROSSED) – Point Layer
FILETYPE	File Type	BLOB	File type for linked video or image attachments	From existing Survey123 survey

FILENAME	File Name	Text – 25	File name for video or images	
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Table 15 Channel Obstruction (CHANOBST) – Point Layer (Internal)

Contains data related to obstructions in the tax ditch channel as noted during tax ditch inspections. Blue text Description denotes Domains.				
Field ID	Alias	Data Type	Description and/or Domains	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
CHOBID	Obstruction ID Number	Text - 10	Unique identifying value for each obstruction, Primary Key	To be created
SEGID	Channel Segment ID Number	Text - 10	ID number for tax ditch channels, Foreign Key	Table 10- Channel Structures (CHANSTRUCT) – Point Layer
YRINSPECT	Year Inspected	Short integer	Year the obstruction was last inspected	From existing Survey123 survey
CHOBTYP	Channel Obstruction Type	Text - 35	Type of obstruction: Beaver Dam, Blocked/Collapsed Pipe, Invasive Plant Species, Large Downed Wood, Trash Dumping, Live Trees	
CHOBSV	Channel Obstruction Severity	Text - 10	Severity of issue: High, Medium, Low	
COMMENTS	Channel Obstruction Comments	Text - 250	Comments of the issue	

Table 15A - Channel Obstruction Attachments (CHANOBSTATTACH) – Table (Internal)

Contains channel obstruction related photos or videos. These attachments are to be managed from ArcGIS Online.				
Field ID	Alias	Data Type	Description and/or Domains	Source
CHOBID	Obstruction ID Number	Text – 10	Unique identifying value for each obstruction concern, Foreign Key	Table 13- Channel Obstruction (CHANOBST) – Point Layer
FILETYPE	File Type	BLOB	File type for linked video or image attachments	From existing Survey123 survey
FILENAME	File Name	Text – 25	File name for video or images	

Table 16 ROW Obstruction (ROWOBST) – Point Layer (Internal)

Contains data related to right-of-way (ROW) obstructions. Data collected during tax ditch inspections. Blue text Description denotes Domains.				
Field ID	Alias	Data Type	Description and/or Domains	Source
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)	https://enterprise.firstmap.delaware.gov/arcgis/rest/services/Hydrology/DE_TaxDitch/FeatureServer/2
ROWOBID	ROW Obstruction ID Number	Text - 10	Unique identifying value for each obstruction, Primary Key	To be created
ROWID	ROW ID Number	Text - 10	ID number associated with the segment of the right-of-way (ROW), Foreign Key	Table 5- Tax Ditch ROW (TDROW) – Polygon Layer

YRINSPECT	Year Inspected	Short integer	Year the obstruction was last inspected	From existing Survey123 survey
ROWOBTYP	ROW Obstruction Type	Text - 35	Type of right-of-way (ROW) obstruction: Live woody or invasive plants, debris, gate, large downed wood, structure, trash, unstable ground	
ROWOBPAS	Obstruction Passable	Text - 3	Is the obstruction passable with greater than 25 feet of clearance – it can be driven around: Yes, No	
ROWWDCVR	Woody Plant Coverage	Text - 50	Is right-of-way covered in greater than 10% woody vegetation: No, Yes, Trunk Widths Finger Size, Yes, Trunk Widths Fist size or larger	
ROWINV	Invasive Species Blockage	Text - 3	Are invasive plant species causing right-of-way access issues: Yes, No	
COMMENTS	ROW Obstruction Comments	Text - 250	Comments of the issue	

Table 16A - ROW Obstruction Attachments (ROWOBSTATTACH) – Table (Internal)

Contains right-of-way (ROW) related photos or videos. These attachments are to be managed from ArcGIS Online.				
Field ID	Alias	Data Type	Description and/or Domains	Source
ROWOBID	ROW Obstruction ID Number	Text – 10	Unique identifying value for each obstruction concern, Foreign Key	Table 5- Tax Ditch ROW (TDROW) – Polygon Layer
FILETYPE	File Type	BLOB	File type for linked video or image attachments	From existing Survey123 survey
FILENAME	File Name	Text – 25	File name for video or images	

Tax Ditch Technical Assistance Geodatabase (Internal, Tax Ditch Officers)

The DNREC Drainage Program provides technical assistance to tax ditch organizations including stakeout of tax ditches to the design as-builts, reviewing land development plans for tax ditches, and applying for permits on behalf of the tax ditches. Quite frequently officers and the public request information as to how we have assisted tax ditches. These tables provide information on the status of projects on the DNREC’s Drainage Program work log. They will require further assessment and review of the database design to ensure all needed aspects are captured and integration into existing workflow is feasible. A database design for Court Order Changes has not been developed.

- Land Development Review (Table 17)
- Stake Out Completed (Table 18)
- Permit Assistance (Table 19)

Table 17 Tax Ditch Land Development Review (TDLREV)– Point Layer

Contains information about projects the DNREC Tax Ditch Program has received to review for tax ditch impacts. The goal with this dataset will be to provide a platform to easily share this information with Tax Ditch Officers.			
Field ID	Name	Data Type	Description
DITCHNO	Ditch Number	Text - 4	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)
NAME	Sub-Watershed Tax Ditch Name	Text - 50	Sub-watershed name (Formerly TDNAME)
PARCELNO	Primary Parcel Number	Text - 50	In some cases, multiple parcels, how to handle
NAME	Project Name	Text - 150	Development/Project Name
PROIMPACT	Proposed impacts	Text - 50	The primary impact of the land development project to the tax ditch: Re-alignment , ROW reduction , Discharge , No Impact
DESCRPT	Description	Text - 250	Description of activity
REVSTAT	Review Status	Text - 25	Status of the Project review within the DNREC Tax Ditch Program: Received , In Que , Reviewing , Processing LONO/COC , Complete
COCND	COC Needed	Text - 10	Yes/No/ Number when complete?
LONODT	Date LONO Issued	Text	Date the project was issued a Letter of No Objection (LONO) and allowed to proceed.

Table 18 Tax Ditch Stake Out Completed

Contains information related to the DNREC Drainage Program stakeout of tax ditch features.		
Field ID	Name	Description
TDNAME	Tax Ditch Name	One entry per tax ditch affected
DITCH	Tax Ditch Number	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)
SEGNAME	Segment Name	Main or prong name
SODATE	Stake Out Date	The date the stakeout was performed in field
SOLENGT	Stake Out Length	The length in feet of the stakeout performed
Attachments	Photos	Any photos associated with the stakeout.

Table 19 Tax Ditch Dip Out Permits– New - line

Contains information related to the processing of permits by DNREC Drainage Program for tax ditch maintenance activities.		
Field ID	Name	Description
TDNAME	Tax Ditch Name	One entry per tax ditch affected
DITCH	Tax Ditch Number	The number associated with forming the ditch, Primary Key, Foreign Key (Formerly DNOLITL)
SEGNAME	Segment Name	Main or prong name
COVYR	Coverage Year	The year the permits were obtained
COV EXP	Coverage Expiration	The year the permit expires
ACTIVITY	Permitted Activity	Type of activity permitted: Pipes - Crossing , Pipe- CI , Dip Out , Stabilization
STATUS	STATUS	Is the project in the queue, working on, or complete
Attachments	Photos	Any documents or photos associated with the permitted activity

Custom GIS Applications

Deliverable MD4 (see Table 2) describes the custom applications needed to support ongoing DNREC Drainage Program staff work on responding to tax ditch organization inquiries. This work includes the retrieval and update of data and creation of various reports based off data analyses or annual updates of tax ditch activities (see Table 20).

The applications should use off-the-shelf ArcGIS tools and functions with a custom, simplified interface providing intuitive workflows for data retrieval and update. These applications should be developed for office-based work on a PC workstation. These application user environments should be web browser based with access to ArcGIS for Server (not ArcGIS desktop). Each application user environment should support editing of existing attributes (not features) with the implementation of domains. The applications may use existing, off-the-shelf application software integrated with ArcGIS with any configuration needed to support DNREC Drainage Program needs. The assumption is that office-based workers will access the GIS via a web-based interface and have available one or two large format, high-resolution monitors. The application will also use the state’s Geocoder service to support search functions (<https://firstmap.gis.delaware.gov/index.shtml?dc=data>).

Table 20 summarizes the expectations of the application(s) based on the needs of key stakeholders, analyses, and maps (Getto, 2016, Kingman, 2020, Koh, 2016, Lloyd, et al., 2008 and Rosson, 2002) It is preferential that users enter the applications through a single point. Reports should represent information in a printable, DNREC branded, user-friendly product. DNREC Branding Guidelines documentation will be provided to the selected Contractor for more information related to common look and feel for the applications and reports. Testing and training with key stakeholders in the use of the application will also be required (Bestebreurtje, 1997 and Jones, 2019).

Table 20 Summary of Applications Expectations

Content Category	Operations	Outputs
Overview	Searchable by:	County, Watershed, Legislative district
	Data to View:	Number of tax ditches, Miles of channel, Assessment totals, Average warrant rate, Number of properties, Percentage of officers bonded, Percentage of tax ditches audited, and Percentage of tax ditches in compliance <i>Non-GIS data to consider including</i> Calendar of tax ditch meetings, Notices of deadlines, Tax Ditch Commissioners, Link to officer database, Link to Drainage Concerns
	Data Analyses	Tax Ditches in Compliance (meets audit and bonded requirements for current calendar year)
	Maps	Interactive map zoomed into searched location
	Reports:	<ul style="list-style-type: none"> Summary of Tax Ditch Organizations by “Searchable by” Type
Administrative Assistance	Searchable by:	Tax ditch organization (name, prong name, COC#), Parcel number, or Street address

	Data to View:	Formation date, Formation stipulations, Last annual meeting, Bonding, Last audit, Audit rating, Warrant rate, Assessment base, Revenue, Verified EIN, Civil action number, Ditch number (s), Number of properties, Property assessments, Miles of channel, Number and list of Court Order Changes, Stationing, ROW, Maintenance responsibility, Disposal sides, and Deleted features <i>Non-GIS data to consider including Officer positions</i>
	Data Analyses	Tax Ditch in Compliance (meets audit and bonded requirements for current calendar year)
	Maps	Interactive map zoomed into searched location; information updated by “Searchable by” selection
	Reports:	<ul style="list-style-type: none"> • Tax Ditch Organization Taxable Assessment Lists • Tax Ditch Organization Certification Lists • Tax Ditch Organization Taxable Mailing Labels
Technical Assistance	Searchable by:	Tax ditch organization (name, prong name, COC#), Parcel number, Street address or Drainage Concern ID
	Data to View:	Formation stipulations, Structures and condition, Design Q, Source, Slope, Bottom width, Maintenance responsibilities, Natural drainage area, Actual drainage area, Formation drainage area, Channel length in feet, Greater than 800 acres breakpoint, Last dipout year, Stationing, Disposal sides, Maintenance concerns, Gates, Land development review projects, Stake out complete, Permit status, and Photo attachments
	Data Analyses	<ul style="list-style-type: none"> • Maintenance prioritization – using data in the Maintenance Concerns features, determine & rank locations that are in need of maintenance • Climate change impacts – Sea level rise impacts to channels. • Maintenance cost estimation – using a calculation, select a portion of channel, and estimate costs for mowing, dipout, hand clearing and weed wiper. • Spreading width estimation – use bottom width to calculate spreading width at a certain depth and certain amount of material removed
	Maps	Interactive map zoomed into searched location, option to select areas of tax ditch on map and have information generated from that selection.
	Reports:	<ul style="list-style-type: none"> • Operations and Maintenance Plans • Inspection Reports • Tax Ditch Organization Year End Summary Reports

RFP: Quality Control Requirements and Data Acceptance Criteria

In the context of this database development project, data quality may broadly be defined as, “the level of conformance, of the delivered data and products, with stated specifications.”

The Contractor will use sound procedures in the database development process to ensure proper quality meeting specifications stated in Section 4. In general, these procedures should include such practices as:

- Proper documentation of database development procedures and mapping rules and communication and training of all staff involved in the project.
- Automated checks, at appropriate steps in the database development process, to identify and correct attribute errors. Automated checks may use any available software packages or custom applications to identify errors of spelling, attribute completeness, attribute value domain consistency, and other quality criteria that lend themselves to automated checking.
- Appropriate manual inspection at steps in the database development process to catch and correct errors that are not found through automated means.
- Appropriate validity checks to ensure proper compliance with the geodatabase design and logical connectivity rules included in the final GIS database deliverables.

- Final testing of data with ArcGIS software before it is completed as a formal submission to the DNREC Drainage Program.

Quality control should be approached with the goal that each submission will fully meet stated specifications. Each submission should be accompanied with documentation indicating that it has passed quality control procedures. Technical specifications for data content and format along with specific data quality criteria stated in this subsection are collectively described as “data acceptance criteria” (DAC).

The DNREC Drainage Program will put in place quality assurance checking procedures to identify the quality of the Contractor’s deliverables and the level to which data acceptance criteria are met. This QA checking for data products will include tests for attribute value validation, compliance with logical and connectivity rules, and other checks that will be performed on the entire deliverable. In addition, there will be visual checks of a sample of locations in the deliverable to check for compliance with accuracy, symbology, and annotation requirements. The results of the quality assurance checks will determine whether a deliverable is accepted or returned to the Contractor for additional work.

The Respondent will describe quality control procedures and tools (manual and automated) that will be used during the database development process to ensure that deliverables meet the data acceptance criteria explained in this Section.

File Naming and Organization

Proper File Format and Spelling

All files will be delivered with properly spelled and formatted names and the names of all feature datasets, feature classes, and data entities will be properly spelled 100 percent of the time.

Feature Class Content and Organization

All geodatabase feature classes will be organized as stated in the data model and all feature datasets will be delivered with their proper, associated feature classes 100 percent of the time.

Attribute Accuracy

The Contractor will deliver data with an attribute accuracy rate (for all feature classes) of at least 98.5 percent (unless a different acceptance level is indicated below). This percentage is based on the total set of attributes for map features for which values can be reliably determined from source materials or from information provided by the DNREC Drainage Program Project Team. The following rules contribute to attribute accuracy:

- All attribute table schemas are correct 99.9 percent of the time (considering limitations of source materials)
- Relationship classes have proper cardinality (origin-destination) and the Primary and Foreign keys are properly assigned and all Primary keys have properly formatted unique values 100 percent of the time.
- Subtype attributes, when used, will be properly entered 99.5 percent of the time.
- No null values for attribute fields where null entries are not valid.
- Entry is consistent with the data type format (e.g., integer, decimal, date) for the attribute field:

100 percent compliance required.

- Adherence to all domain rules (lists of valid entries or within stated range for numeric fields).
- Proper spelling for all text entries.

RFP: Project Operations, Logistics, and Management

Roles and Responsibilities

The DNREC Drainage Program has assigned Brittany Haywood, DNREC Drainage Program, Environmental Program Manager I, as project manager for this project. This person will be the primary point of contact for all project activities, contract issues, and the enforcement of data acceptance criteria for all deliverables. The DNREC Drainage Program's Project team members are identified in the RFP: Project Information on page 12. As needed, additional DNREC Drainage Program personnel will be assigned to provide support throughout the project. The basic responsibilities of the DNREC Drainage Program include:

- Providing hard copy source materials and digital files in a manner that supports the work of the Contractor.
- Prompt quality assurance (QA) review and a decision for acceptance or rejection of Contractor deliverables.
- Prompt response to questions from the Contractor in all design, database development, and application development activities.
- Providing access to all resources for data loading and application development.
- Lead resolution of any issues with data sources.

The Respondent will identify a project manager who will be the principal contact for the DNREC Drainage Program and will oversee all work described in this RFP. The Respondent will include an organizational chart showing all proposed project personnel and their roles in the project.

The Respondent will state any assumptions or expectations on responsibilities of and resources to be provided by the DNREC Drainage Program during this project.

Data Deliverable Submittal Requirements

GIS data deliverables should be submitted by tax ditch organization as identified during the project initiation phase and finalized at the project start-up meeting. Digital document deliverables should be organized in a manner that supports efficient quality assurance checks by the DNREC Drainage Program. All deliverables should be accompanied by a written report that identifies the contents and which confirms that the data has been subjected to all QC checks by the Contractor. The contractor will also provide deliverable data on DVD for archive purposes to the DNREC Drainage Program office within five business days after the data is available on cloud storage. The Contractor may set up a web-based project portal as a means for deliverable submittal and DNREC Drainage Program review and comment.

Work Plan Preparation

As summarized in Table 2 (see Deliverable SD2), the Contractor will be required to prepare detailed Work Plan(s) as an initial project step. The Work Plan(s) should cover the following topics:

- Description of tasks and deliverables.
- Timing of tasks and milestones and relationships and dependencies between them.
- Handling of source materials and procedures for source preparation.
- Responsibilities for Contractor and DNREC Drainage Program personnel for specific tasks.
- Pilot project development, execution, and follow-up and basis for pilot results that may drive design or procedural changes.
- Quality control and delivery procedures by Contractor.
- DNREC Drainage Program quality assurance and acceptance procedures.
- Procedures for flagging issues and resolving them in an efficient manner (problem resolution).
- Procedures for making potential changes in design or specifications.
- Project Manager and team member roles and contact information.
- Management, monitoring, reporting, and communication procedures.

Respondents shall state their acceptance of this Work Plan requirement and provide proposed ideas for the content and format of such a Work Plan.

Location of Database Development Work and Source Material Handling

The Respondent shall explain where the database development work will be carried out. If different locations will be used for different parts of the database development work, this should be specified. Unless specifically allowed, no original source documents maintained by the DNREC Drainage Program will be removed from the premises.

Quality Assurance and Acceptance Procedures

The DNREC Drainage Program will perform a prompt QA check on all data deliverables and will inform the Contractor about acceptance or rejection of each deliverable. QA will include automated and manual checks using GIS software for certain format and quality criteria of a large sample of the deliverable products (GIS and digital document indexes).

Managing Updates during Database Development

There will be cases in which updates to the location of the tax ditch channel, rights-of-way or watershed boundary will occur during this Project. The Respondent shall provide suggestions on how the database update will occur for areas that have already been converted. Options may include a) in-house database development by the DNREC Drainage Program, b) updates performed by the Contractor during the project, or c) updated performed by the Contractor at the end of the database development project.

Status Reporting Requirements

Status reporting by the Contractor will include the following:

- Monthly written status report that document work completed and in progress during the reporting period, percentage completion for each project deliverable, any project issues that need to be dealt with, and key goals for work in the next reporting period.
- Periodic status meetings (virtual, in person or by phone) as needed during the project.
- A tool, accessible by the Contractor and the DNREC Drainage Program that provides status of GIS database development work, delivery status, and QA/Acceptance status by the DNREC Drainage Program.
- In person, email messages and/or phone contact as needed during the project.

Warranty on Deliverables

After the database and custom application deliverables have been accepted by the DNREC Drainage, the Contractor will provide a written warranty, in a form acceptable to the DNREC Drainage Program, for a period of twelve (12) months after acceptance of each deliverable. If any errors are found or cases in which data acceptance criteria have not been met are discovered within the warranty period, the Contractor will be obligated correct these problems.

Conclusion

Successful projects are ones that understand their stakeholders and provide a product that is easily interpreted and implemented into workflows. While the success of this project remains to be seen, a few common themes stood out during the review of existing geodatabases. First and foremost, the need for a plan when creating datasets was evident. Existing tax ditch databases were created for serving an immediate need and it was evident that figuring out how the data would fit into existing or future geodatabases took a back seat. Second, ensuring the database is catered to users could save time in application development. While a lot of emphasis in the industry is placed on the end product or application being user friendly, there is something to be said for being able to open a table and understand its contents without having it to be interpreted through an application. DNREC staff are willing and able to open attribute tables to garner information, they just did not have a clear understanding of what the data represented. Third, balancing database size versus efficiency can be challenging as we consider staff expectations. For example, some staff wanted the tax ditch name, unique identifier, and prong name in every attribute table. In some cases, it made sense to have the data in multiple data sets, and in others it did not. Fourth, if there is a need to link large attachments into the geodatabase, a file sharing service may be able to assist. This allows the file sizes of GIS geodatabases to be smaller while still allowing for the attachment functionality.

From review of existing datasets and needs to finalization of attribute tables listed within the RFP project scope, a well-defined RFP can serve multiple purposes. One unintended outcome was that it served to convey the scope of the project to upper management not familiar with GIS. Often, we are requested to supply data or analyses that we aren't able to perform due to data unavailability. The scope within the RFP shows all the steps and expectations that are involved with creating a project such as this. In addition, the RFP also set expectations for tax ditch geodatabase structure to DNREC staff. DNREC staff continue to move forward in its operations and develop data and applications to serve purposes. This RFP sets the stage for field names and domain names of additional attribute tables or geodatabases not outlined within the project scope.

While the RFP has not yet been posted, lessons were learned, and the hope is that once implemented, the integration of tax ditch drainage system data into the statewide enterprise geographic information system (GIS) will set the foundation for future tax ditch GIS integrations. It will allow for improved stakeholder operations including enhancements to data storage and data quality, increase in the understanding and expectations of each tax ditch organization, adapt planning in the face of climate change, reduce agency response time to inquiries, and allow for consistent information to and from all stakeholders. All these aspects will benefit Delawareans and improve drainage operations across the state.

Acknowledgement

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