Primera

Smarter Aviation Infrastructure:

How Civil 3D Utility Basemapping with Extended Data Prioritizes Safety, Schedule, and Cost

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In aviation design and construction, where projects are typically large-scale, high-risk, and tightly scheduled, understanding what lies beneath the surface is critical. Utility conflicts are one of the most common and costly causes of project delays, redesigns, and safety issues. However, by strategically using utility basemapping and Extended Data in Autodesk Civil 3D, design teams can dramatically reduce these risks, saving time and money, and most importantly, preventing safety incidents before they happen.

This strategy is currently being implemented at Philadelphia International Airport (PHL) through the Utility Infrastructure Master Plan (UIMP) project, a collaborative effort between Primera Engineers, Urban Engineers, and Burns Engineering. Together, the team is building a comprehensive 3D utility model that will transform how infrastructure is visualized, understood, and managed across the airport. Our team has successfully applied Civil 3D utility basemapping to support safer and smarter aviation infrastructure projects. In this overview, we highlight the key components that support the effective execution of this integration.

Start with What You Know: Organizing Utility Records

The foundation of any highly effective utility basemap is data organization. Before modeling begins, teams must review and catalog record drawings from past projects. At PHL, this meant digging into decades of documentation in different formats to understand what utilities were installed, modified, or removed, and where the most reliable information could be found. Investing this time upfront to review and organize record drawings from past projects is essential to make the 3D modeling process as efficient and productive as possible.

To support accurate modeling, we developed a tracking spreadsheet that cataloged what sector each completed project covered, what utility types were installed or removed, what year the project was completed, and where the latest and best information could be found to help us model the utilities. This spreadsheet has become a central resource, helping teams prioritize modeling efforts and locate the most accurate data quickly. It also supports efficient task assignments and helps identify areas where survey support may be needed.

Focus Where It Matters: Prioritizing Sectors for Modeling

At PHL, we divided the airport into manageable sectors. Rather than modeling the entire airport at once, we prioritized sectors based on the airport's needs. Considerations in this way of sequencing included upcoming

design projects occurring in a specific area, or stakeholder needs for airside utility information near a terminal. This sector system gives us the flexibility to meet the client's needs.

Build with Precision: Modeling Utilities in Civil 3D

Once the data is organized, we begin 3D modeling the utility systems in Civil 3D. Using record drawing information from the tracking spreadsheet, multiple team members can work in separate files, each assigned to a specific project, sector, and utility type. The parts list in the master utility model can be updated to create custom structures and pipe materials and sizes. From there, the utility from the project assigned is modeled as a 3D pipe network with the correct pipe sizes, inverts, and structure sizes. Once the 3D modeling is complete for a project, this pipe network is merged into the master utility file containing the full utility system and standardized parts list. This workflow allows teams to collaborate seamlessly without needing to take turns modeling in the master utility file.

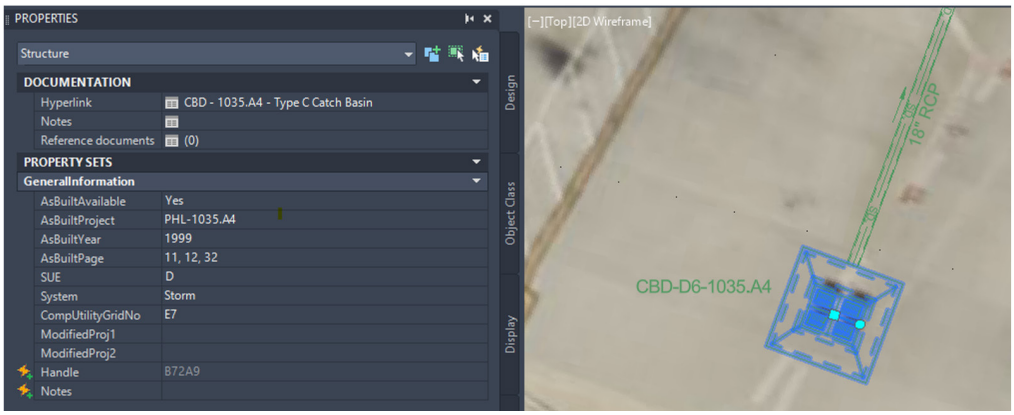
At PHL, the model includes not only traditional utilities like storm and sanitary systems, but also lift stations, aircraft deicing fluid storage tanks, light poles, taxiway edge and centerline lights, and various other infrastructure elements.

In our past basemapping work at O'Hare International Airport (ORD), the master utility pipe and pressure networks were split up by quadrant due to the size of the airport. This way, based on the location at the airport for which you need the information, you can reference data in the appropriate sector (northeast, northwest, central, southeast, or southwest) that applies to the area. If a single utility pipe or pressure network were created for ORD, the resulting file could end up being so large that it crashes any system trying to process it. An important consideration is whether to maintain a single, centralized utility data reference for the entire airport or to divide it into separate sections based on specific needs and areas.

Centralize Your Data: A One-Stop Shop for Utility Intelligence

Extended Data transforms this utility basemap from simply functional to truly powerful. As each utility system is modeled, detailed data is attached to every component, from pipes and structures to elbows and other elements, turning the model into a centralized hub for utility information and context.

With a single click on any utility element, users can access existing as-built drawings; the project number and sheet number where the utility was documented; the Subsurface Utility Engineering (SUE) level; utility type; any modifications made by later projects; and additional notes from the design team, such as structure modification.



Example of a storm catch basin at PHL with the Extended Data incorporated into the part.

For utility elements that require more information needed, additional property sets can be added in Extended Data. For example, a taxiway edge light at PHL will also include the circuit number, fixture number, fixture type and color, fixture manufacturer, and light base type.

This level of detail allows the team to understand the full background of each utility. Designers, planners, and field crews no longer need to dig through folders of PDFs or CAD files as they can simply click and learn.

Transform Utility Data: Visualization Tools in Navisworks and GIS

As the 3D utility model takes shape, Navisworks and ArcGIS become valuable tools for not just internal quality control, but for client engagement. While they can be used during modeling to run clash detection and query utility data for backchecking, their primary value lies in visualization.

These platforms allow clients and stakeholders, especially those unfamiliar with CAD, to explore the final utility model in a user-friendly, interactive format. In ArcGIS, users can view the model in 3D, navigate through utility systems, identify vertical clearances, run queries, filter by utility type or project number, and access all the extended data embedded in Civil 3D. The Civil 3D model files are linked to the ArcGIS system, creating a dynamic link so the client can always have the latest information.

This accessibility transforms the utility basemap into a living, interactive resource that supports informed decision-making, long-term asset management, and cross-disciplinary collaboration across airport operations, planning, and design teams.

Begin with Surveying: Then Model for Smarter Decisions

While this 3D utility basemap is a powerful tool, it doesn't eliminate the need for survey. Instead, it allows design teams to hit the ground running. By starting with a well-organized, data-rich model, design teams can save time on background research and begin their design with confidence. Survey crews can then be used to fill in gaps, refine utility locations, and validate the model. This collaborative approach ensures that both historical data and field data are leveraged effectively.

Saving Time, Saving Money, and Saving Lives

The benefits of this approach are clear. Design teams save valuable time by spending less effort sifting through record drawings and more time focused on actual design. Modeling becomes more efficient with existing 3D information, allowing survey crews to refine known data rather than start from scratch. Cost savings follow naturally as early identification of utility conflicts helps prevent redesigns, change orders, and construction delays, while accurate data leads to better bids and fewer surprises in the field. Safety also improves significantly. When teams know where utilities are, and what they are, the risk of strikes, injuries, and emergency repairs is reduced. With 3D utility basemapping enhanced by Extended Data, high-risk utilities are flagged, and critical context is provided to support safe excavation and installation.

Utility basemapping in Civil 3D is a strategic asset in aviation design and construction, not just a technical task. By organizing historical data, modeling utility networks in 3D, and integrating with GIS, teams can create a dynamic, living model that enhances safety, accelerates project timelines, and reduces costs. The addition of Extended Data transforms this model into a powerful decision-making tool, enabling deeper insight and collaboration. Ultimately, this approach builds institutional knowledge, mitigates risk, and delivers smarter outcomes for airports and the communities they support.

About the Author

Lindsey Davis, PE is a leading civil engineer in Primera's aviation group. Her experience includes designing and overseeing the construction of aviation projects at airports across the country. Lindsey specializes in pavement design, pavement rehabilitation, pavement life-cycle cost analysis, drainage design, utility design, airfield geometry, Federal Aviation Administration (FAA) engineering, design, and construction standards for taxiway, roadway, runway, apron, and hangar projects. Lindsey is an active member of Airport Consultants Council (ACC) and WTS's Transportation YOU, teaching high school students in the Chicago area about careers in transportation.