Regina Flood Mapping Study

Flood Mapping Study Report

Water Security Agency

60706173

December 2025

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December 19, 2025

Project #
60706173

Subject: Regina Flood Mapping Study – Flood Mapping Study Report & Deliverables

Dear Mr. Shayne MacDonald,

We are pleased to submit the Final Report and Deliverables for the Regina Flood Mapping Study, based on the recently revised provincial 1:200-year regulatory flood.

Sincerely,
AECOM Canada ULC



John Campbell, P.Eng.
Project Manager, Water

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D	2025-12-19	AECOM	Final Report Submission – Revised Based on the Updated Regulatory Flood (1:200-Y)

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Executive Summary

AECOM was retained by Water Security Agency (WSA) to conduct a flood mapping study and associated field survey with the goal of creating flood maps for the City of Regina.

During the final review of the report in June 2025, the Province of Saskatchewan released an amendment to the Statement of Provincial Interest Regulation (SPI), revising the regulatory flood from a 1:500-year to a 1:200-year event. As a result, WSA requested an update to the Flood Criteria Maps and Flood Hazard Maps to reflect the new regulatory flood standard, while retaining the 1:500-year Flood Hazard Maps for informational purposes.

The Area of Interest (AOI), defined by WSA, includes five watercourses within the City of Regina and the surrounding area: Wascana Creek, Chuka Creek, Pilot Butte Creek, South Storm Channel, and the North Storm Channel including two upstream branches.

The upstream and downstream limits of the mainstem watercourse (Wascana Creek) and its tributaries are as follows:

- Wascana Creek from Richardson, SK in 31-16-18-W2M to approximately 7.5 km downstream of the Sherwood Forest Country Club in 09-18-21-W2M. A total of approximately 64 km
- Chuka Creek from White City to Wascana Creek, approximately 14 km
- Pilot Butte Creek south of the railway tracks in 34-17-18-W2M to Wascana Creek, approximately 20 km
- South Storm Channel from Rae St. to Wascana Creek, approximately 4 km
- North Storm Channel where both branches of the channel intersect Albert St. to Wascana Creek, approximately 9 km in total

South and North storm channels were included in the model geometry, but storm channel-specific flooding was not included in the flood scenario mapping.

AECOM conducted a field survey of hydraulic structures including bridges, culverts, weirs, dykes, and complementary cross sections to refine the digital elevation model (DEM). A total of 165 hydraulic structures, 13 dykes and 600 cross-sections were surveyed. The DEM flown in May 2019 was provided by WSA for this study.

HEC-RAS 6.4.1 was used for 2D modelling of 1:10-, 1:25-, 1:50-, 1:100-, 1:200-, and 1:500-year flood events to develop flood inundation maps for all scenarios and flood hazard and flood criteria maps for the regulatory flood (1:200-year) and flood hazard awareness maps for the 1:500-year event.

In January 2024, WSA provided the updated maximum instantaneous flow rate for the design floods; therefore, quasi-unsteady flow rates were used to establish stable conditions for the inundation area.

April 1974 and April 2011 flood events are the first and second recorded highest flooding events in the City of Regina. April 2011 event was used for the calibration and April 1974 event was used for the validation of the model.

Land cover and building footprints data, obtained from the City of Regina GIS database, was used to delineate areas of varying Manning's “n” roughness. Values were assigned to each land use type.

Inundation maps were developed for 1:10- to 1:500-year events, flood hazard and flood criteria maps were produced for the 1:200-year regulatory flood event, and additional flood hazard awareness maps were created for the 1:500-year event. Definitions from the updated SPI Regulations, in 2025, were used to determine floodway and flood fringe for flood hazard and criteria maps.

The deliverables of this study are:

- A 2D HEC-RAS model incorporating all design scenario simulations
- Flood inundation maps for all scenarios
- Flood criteria and flood hazard maps for the 1:200-year regulatory flood event and flood hazard awareness maps for the 1:500-year event
- Water surface profile along watercourse thalweg for design flow events, including channel bed elevation and hydraulic structures in the AOI
- A technical report describing the work conducted for modelling and mapping
- GIS geodatabase and raster files for flood inundation, flood hazard, and flood criteria map results

The following is a summary of key results obtained from the study:

- Certain dykes are either broken or discontinuous, allowing floodwater to bypass behind them before overtopping.
- For the flood events ranging from 1:10- to 1:50-year, overtopping can be expected along the dykes mostly due to the gaps.
- Nearly all dykes are overtopped or bypassed by a 1:100-year flood event.
- The CP Rail culvert (a 1400 mm CSP pipe) on Pilot Butte Creek has a maximum capacity of approximately 6 m^3/sec. Floods exceeding this capacity will overtop Victoria Ave. to the south, primarily inundating the area between CP Rail and Anaquod Rd. and eventually flowing into Chuka Creek and/or Wascana Creek.
- Compared to the previous provincial flood mapping study conducted in 1982, the regulatory flood peak flow in Wascana Creek has decreased slightly (by approximately 4%), mainly because the regulatory flood changed from a 1:500-year to a 1:200-year event. As a result, the water surface elevations decreased slightly both far downstream and upstream along Wascana Creek in areas where no significant development has occurred. However, locations that have experienced more development exhibit more notable changes in water surface elevation. Additionally, the regulatory flood peak flows in Pilot Butte and Chuka Creeks have increased. Therefore, these changes suggest that the existing flood protection infrastructure may be insufficient for larger flood events. Notably, several bridges, culvert crossings, and dykes are at risk of overtopping during significant floods.

Funding Acknowledgment

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Canada

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Abbreviations/Acronyms

Abbreviation/Acronym	Description
AOI	Area of Interest
Ave.	Avenue
Blvd.	Boulevard
Br.	Bridge
CN Railway/Br.	Canadian National Railway/Bridge
CP Railway/Br.	Canadian Pacific Railway/Bridge
Cres.	Crescent
DEM	Digital Elevation Model
E	East
GIS	Geographic Information System
GPS	Global Positioning System
ID	Identification
Lidar	Light Detection and Ranging
Ln	Lane
N	North
QA	Quality Assurance
QC	Quality Control
Rd.	Road
RFMS	Regina Flood Mapping Study
S	South
SK-LAMP	Saskatchewan Lidar and Mapping Program
SK	Saskatchewan
SPI	Statement of Provincial Interest
St.	Street
W	West
WSA	Water Security Agency

1. INTRODUCTION

The Water Security Agency (WSA) retained AECOM to develop flood maps for the City of Regina in accordance with the Statements of Provincial Interest (SPI) as part of the Saskatchewan Lidar and Mapping Program (SK-LAMP). These flood maps have been developed to simulate events ranging from the 1:10-year to the 1:500-year floods. This study replaces the previous provincial flood maps, which were created in 1982 under the Canada-Saskatchewan Flood Damage Reduction Program.

During the final review of the report in June 2025, the Province of Saskatchewan released an amendment to the Statement of Provincial Interest Regulation (SPI), revising the regulatory flood from a 1:500-year to a 1:200-year event. As a result, WSA requested an update to the Flood Criteria Maps and Flood Hazard Maps to reflect the new regulatory flood standard, while retaining the 1:500-year Flood Hazard Maps for informational purposes.

1.1 Previous Studies

Provincial government studies into flooding within the Wascana Creek watershed were conducted in 1970 and 1973. After those studies were completed, several above normal spring runoff events created flooding conditions within the City of Regina, with the flooding event of 1974 becoming the largest flood on record (104 m^3/s). Meanwhile, substantial drainage developments within the City of Regina (north and south storm channels) and in the sub-watersheds of Pilot Butte Creek and Chuka Creek were taking place. To incorporate these additional rural and urban drainage developments and significant flood events on the hydrology of the Creeks, flood peak potential studies were conducted for Wascana Creek (Saskatchewan Environment, 1980); Pilot Butte Creek (Department of the Environment, 1977); and the two storm channels, Chuka Creek and Pilot Butte Creek (Department of the Environment, 1980).

In 1982, the Regina Hydraulic Study produced 1:500-year water surface profiles and hazard maps for Wascana Creek, Pilot Butte Creek, Chuka Creek, and the two storm channels (Department of the Environment, 1982) under the Canada-Saskatchewan Flood Damage Reduction Program. These flood levels were produced by developing a HEC-2 hydraulic model. It is understood that this model was later upgraded by WSA to a HEC-RAS model in 2004. The 1:500-year flow rates used in this study are presented in Table 1-1. The resulting flood hazard maps have been designated for regulatory use and remain in effect to date.

Table 1-1: Regina Hydraulic Study (1982) Peak Flows

Creek	1:500-year Peak Flow (m^3/s)
Wascana Creek	180
Pilot Butte Creek	24
Chuka Creek	15
North Storm Channel	49
South Storm Channel	17

During the significant flooding event of 2011, the City of Regina experienced challenges associated with its flood response which was then assessed by the Wascana Creek Spring Runoff Study (City of Regina, 2013). This study utilized a 1D hydraulic model (updated from the 2004 version), split into two sections, upstream and downstream of the Albert St. weir, to assess flooding along Wascana Creek and recommended upgrades for various elements of the City's flood mitigation infrastructure including dykes, flood control valves and assessed the effects of weir operations on water surface elevations. Figure 1-1 and Figure 1-2 below illustrate two separate flooding events within the Wascana Creek watershed. Lidar data was collected in 2019 to support an updated flood mapping program.



Figure 1-1: Kronau Marsh (2013) – About 20km Upstream of Regina Along Wascana Creek (photo provided by WSA)



Figure 1-2: Wascana Lake (2011) – Legislature Building in Background (photo provided by WSA)

1.2 Scope and Assumptions

AECOM has been hired by WSA to develop, calibrate, and validate a hydraulic model of the watercourses within the City of Regina flood study area that will be used to evaluate flooding scenarios and produce flood maps for the following return period events: 1:10-, 25-, 50-, 100-, 200-, and 500-year floods. The 1:200-year flood scenario is the regulatory flood event for the province of Saskatchewan. The scope of work includes:

- Developing a HEC-RAS hydraulic model to evaluate the design flow events
- Developing flood inundation maps for all scenarios
- Developing flood criteria and flood hazard maps for the 1:200-year regulatory flood event in accordance with the SPI
- Developing flood hazard awareness maps for the 1:500-year flood event
- Creating a water surface profile along the watercourse thalweg for design flow events, which include channel bed elevation and all crossings and hydraulic structures in the AOI)
- Develop detailed technical reports describing the work conducted for survey, modelling, and mapping

The following assumptions were made in this study:

- Flooding due to ice jams was not modeled in this study.
- To stabilize flood inundation conditions, hydrographs with a peak flow rate maintained for a duration of four days were assumed at the boundaries. Therefore, quasi-unsteady discharges were used in the model simulations instead of complete flow hydrographs.
- The flow rate in Wascana Creek remains constant along the study reach and no inflow or outflow is allowed between the upstream and downstream boundaries.
- Peak flood events in Wascana Creek are not expected to coincide with those in the tributaries within the study area, whereas, peak flood events in Pilot Butte and Chuka Creeks are assumed to coincide.
- The assessment was assumed valid for current land use, based on the lidar digital elevation model (DEM) from 2019 and 2023 field surveys. Potential developments in overbank areas as of 2019 and future developments were not included in the model.
- The model initially assumed a full reservoir condition (with Albert Street Weir fully open), while other watercourses and reaches were considered dry.
- The Albert St. weir and sluiceways were modeled with fully opened gates or stop logs removed for all scenarios, including calibration and validation events.
- This study did not account for operational activities or flood protection measures, particularly around the dykes.
- All dykes and flood protection high grounds remain intact, as such, breach analysis was not accounted for.
- The calibrated roughness and parameters remain constant for all flood events.
- No infiltration or precipitation was allowed within the study area during the simulation.

- Only inline structures within the main channel of the watercourses and identified dykes were modeled, therefore, underground storm sewer networks or culverts within the flood plain were not included in this model and overbank flooding scenarios represent open-water conditions.

1.3 Study Area

Within the study area, there are five watercourses: Wascana Creek, its tributaries Chuka Creek and Pilot Butte Creek, and the North and South Storm Channels. This study considers the three natural watercourses in its assessment of flooding but does not include the rainfall-driven flood events that are conveyed by the two storm channels.

The upper reaches of Wascana Creek originate southeast of Regina near Vibank and pass through the Kronau Marsh where significant flooding was observed in the spring of 2013 and provides a significant amount of flood attenuation for the creek. Major tributaries of Wascana Creek upstream of Regina include Pilot Butte Creek, Chuka Creek, and Hunter Creek and contribute to a gross drainage area of about 3400 km^2. Wascana Creek outlets into the Qu'Appelle River about 28 km downstream of Regina, where it has a total gross drainage area of approximately 3850 km^2. Chuka Creek and Pilot Butte Creek have watershed areas of 40 km^2 and 118 km^2, respectively. The watershed of Wascana Creek is primarily developed agricultural land and urban municipalities with about 45% of its area considered effective during average annual springtime runoff events. Hunter Creek was not included in the study area as its watercourse does not directly enter the Regina city limits.

The upstream and downstream limits of the mainstem watercourse (Wascana Creek) and two tributaries (Chuka Creek and Pilot Butte Creek) are as follows (see Figure 1-3):

- Wascana Creek, from Richardson, SK in 31-16-18-W2M to approximately 7.5 km downstream of the Sherwood Forest Country Club in 09-18-21-W2M. A total of approximately 64 km
- Chuka Creek, from White City to Wascana Creek, approximately 14 km
- Pilot Butte Creek south of the railway tracks in 34-17-18-W2M to Wascana Creek, approximately 20 km

Also included in the study area are the following lengths of storm channels:

- South Storm Channel, from Rae St. to Wascana Creek, approximately 4 km
- North Storm Channel, where both branches of the channel intersect Albert St. to Wascana Creek, approximately 9 km in total

REGINA FLOOD MAPPING STUDY

STUDY AREA

WATER SECURITY AGENCY
Project No.: 60706173 Date: 2024-09-13

AECOM

Figure: 1-3

Figure 1-3: Study Area

2. DATA COLLECTION

2.1 Existing Information

Existing information that was collected for this project included:

- As-built drawings for bridges, culverts, and weir crossings, provided by WSA
- GIS data from the City of Regina's online infrastructure viewer
- Lidar DEM at 0.5 m resolution, dated May 28th, 2019, provided by WSA
- Previous studies (detailed in Section 1.1), provided by WSA from various sources
- Hydrology Update for the City of Regina, Memo, WSA, 2024
- Photos from previous flood events, provided by WSA from various sources

2.2 Survey Data Collection Summary

The survey data required to carry out the modelling effort included a lidar dataset of the study area, topographic survey data of hydraulic structures, and bathymetric data of each watercourse including Wascana Lake. Lidar data was provided by WSA to AECOM for the purpose of the model construction, but additional topographic and bathymetric data needed to be collected. Between April and October 2023, AECOM conducted both topographic and bathymetric surveys which are detailed in the Survey Report (WSA, 2024). An additional survey described in the Survey Report took place in the fall of 2024, discussed in Section 5.1.

2.2.1 Digital Elevation Model

A 0.50 m x 0.50 m DEM flown in May 2019, with a Horizontal Datum of NAD 1983 (CSRS) UTM Zone 13N and Canadian Geodetic Vertical Datum of 2013 (CGVD2013), was provided by WSA for this study. The Survey Report describes the GPS ground truthing AECOM conducted before using it in the model. Figure 1-3 shows the limits of the study area, which coincide with the limits of the DEM.

2.2.2 Topographic Survey

The topographic survey was conducted using RTK GPS systems. Important topographic data include bridges, culverts, weirs, walls, dykes, and roadways.

2.2.3 Hydraulic Structures

The GPS survey data was the primary source of structure information for the hydraulic model, however, in a few cases, record drawings and the City of Regina's online infrastructure viewer were used to establish structure geometry where survey data was unable to be collected in the field. In some cases, a reflectorless total station was used where GPS was not suitable. A total of 165 inline structures have been surveyed and are summarized in the Survey Report.

2.2.4 Dykes

We identified and surveyed 12 discrete dykes along Wascana Creek. WSA provided the location of five dykes along Wascana Creek downstream of Albert St., some of them have been changed/upgraded since the construction in the 1970s. Additional dykes and high grounds were identified during the field survey. Table 2-1 shows the list of flood protection structures identified as dykes.

Table 2-1: Location of Dykes and Approximate Lengths

Location	Length - km	Notes
Albert St. to Elphinstone St. – Right Bank	1.20	As-built plan provided by WSA
Albert St. to Retallack St. – Left Bank	0.28	
Near Regina Ave St. to Elphinstone St. – Left Bank	0.59	
Coronation St. to Pasqua St. – Left Bank	0.31	
Pasqua St. to 17 Ave. – Left Bank	0.07	
Pasqua St. to Lewvan Dr. – Right Bank	0.21	
Lewvan Dr. to CP Rail - Right Bank	0.69	As-built plan provided by WSA
Starting at 100 m Downstream of CP Rail – Right Bank	0.19	
South of Dewdney Ave. - Right Bank	0.15	As-built plan provided by WSA
South of Dewdney Ave. – Left Bank	0.16	
North of Dewdney Ave. - Right Bank	0.13	As-built plan provided by WSA
Dewdney Ave. to Southam St. - Left Bank	1.30	As-built plan provided by WSA

2.2.5 Bathymetric Surveys

The bathymetric survey was conducted using three different methodologies:

- Standard GPS equipment, whenever it was possible to directly wade into the water and collect survey points. These instances were limited, especially upstream of weirs where soft sediment had accumulated.
- Single beam echo sounding from a remote-controlled Bathycat portable survey catamaran, wherever wading was not possible and the water was deep.
- Standard GPS equipment utilized from a canoe, where neither wading nor the use of the Bathycat were possible. These situations occurred wherever there was a soft bottom, heavy aquatic vegetation, and restricted access to the banks.

In total, 600 full or partial cross sections were surveyed, however, not all were considered useful for hydraulic modelling or appropriate for developing the bathymetric surfaces due to incomplete data as a result of challenging access to one side of the creek, safety, or faulty readings (often from sedimentation or vegetation within the channel). For the purposes of modelling, 553 cross sections were used to establish suitable main channel bathymetry. Table 2-2 provides the total number of cross sections per watercourse.

Table 2-2: Cross Section Summary

Watercourse	Number of Complete Cross Sections
Wascana Creek	255
Pilot Butte Creek	130
Chuka Creek	88
North Storm Channel	52
South Storm Channel	28

The Survey Report highlights specific areas where challenging field conditions hindered the data collection process. Cross sections that were not collected are not expected to have any adverse effects on the modelling effort or the accuracy of the results.

2.2.6 High Water Marks

Several historical photos were taken of previous flood events throughout the city. In some cases, an estimate of the water elevation was provided with the photo, or the structure experiencing the flooding could be surveyed to estimate the water elevation at the time. However, in many historical cases, the structure that was flooded had been replaced or modified, making it difficult to estimate the historical water level. Dykes have also been constructed near the structures that had experienced flooding along Wascana Creek making these estimates of water levels inaccurate. It is also difficult to estimate the peak flow rate at several flooding locations in the past due to a lack of information regarding the time or day of flooding or the lack of flow information measured along the creeks. As a result, recorded flood measurements and air photos from the 1974 and 2011 floodings were found to be the most reliable information for the model calibration/validation. Additionally, some level measurements from the Marina, upstream of the Albert St. Weir, and Cameron St. stations in conjunction with the flow measurements in Kronau Marsh were also found useful for validation.

This process is described in more detail in Section 5.3 and is considered the most accurate dataset of known water levels observed during a flood event. The Survey Report provides a summary of all historical high-water marks provided to AECOM by WSA or local residents during the data collection phase.

2.2.7 Description of Channel & Floodplain Morphology

Each of the five watercourses was inspected and provided a bed and bank characterization. This informed the selection of Manning's roughness values, provided a description of the general condition of the watercourses, identifying locations of riffles, erosion, and tall vegetation. With the exception of the two storm channels, the watercourses have a variety of channel and floodplain characteristics that are challenging to generalize given the combination of rural and urban environments. A breakdown of each watercourse's characteristics is provided with references to stationing in the Survey Report.

3. FLOOD PROTECTION MEASURES & CONTROL STRUCTURES

3.1 Flood Protecting Measures

Based on the hydrometric records, a significant flood occurred in the City in 1971 (92 m^3/s), this flood event was the most destructive in Regina. Although the 1974 flood (104 m^3/s) had the highest peak flow, it was contained with the dykes constructed after the 1971 flood. Subsequent to the 1974 flood, the dykes were further raised, and modifications were made to the Albert St. weir along with the construction of other hydraulic structures and other channel modifications (Department of the Environment 1982).

The City of Regina drafted a report summarizing the Wascana Creek spring runoff study to provide an update on the hydraulic analysis of the Creek and determine the potential shortcomings and recommendations for the future improvements of the flood control measures. Based on the report, the flood event experienced in April 2011 revealed several shortcomings with the City's flood responses (mostly installed, upgraded, or constructed after the 1974 flood event) including outdated temporary dyking plans, operational issues with flood control valves, and stoplog removal at the weirs. Therefore, part of the scope of the 2013 study was to address the City's concerns regarding flood responses, recommendations for improvements to dykes, flood control valves and weirs (City of Regina 2013).

3.2 Flood Control Structures

According to the Wascana Creek Spring Runoff Study, currently, the City incorporates both temporary and permanent dyking strategies to contain the high water levels along Wascana Creek. The study identifies the Riverside Dyke, located along the north side of Wascana Creek between Albert St. and Elphinstone St., as the only permanent dyke structure. On the south side of Wascana Creek opposite the Riverside Dyke, the City currently relies on temporary dykes constructed using sandbags and tiger dams to contain flooding. The height requirements and locations of temporary dykes are based on the spring flood forecast from WSA each year.

The City currently relies on spring runoff flood maps and flood response manuals to plan for spring flood protection works each year. In 2011, the City set up temporary dykes at the four major locations including Rotary Park, 17th Avenue (Ave.) between Elphinstone and Edward St., Empress Drive between Royal and Forget St., and Horace St. (City of Regina 2013).

Twelve flood control dykes were identified during the 2023 field survey along Wascana Creek. The dykes are described in Table 3-1 and shown in the flood maps in Appendices B to D.

Table 3-1: Flood Control Dykes in the Study Area

River	Dykes	Construction Dates	Dyke/Location	Notes *
Wascana	Riverside Dyke	Not Available – Upgraded in 1979 and recently**	Albert St. to Elphinstone St. – Right Bank	Permanent – As-Built plan provided by WSA
Wascana	Rotary Park	2011	Albert St. to Retallack St. – Left Bank	Temporary - Broken
Wascana	Kiwanis Park	Not Available	Near Regina Ave. to Elphinstone St. – Left Bank	Temporary
Wascana	17th Ave.	2011	Coronation St. to Pasqua St. – Left Bank	Temporary - Broken
Wascana	17th Ave.	2011	Pasqua St. to 17 Ave. – Left Bank	Temporary
Wascana		Not Available	Pasqua St. to Lewvan Dr. – Right Bank	Temporary
Wascana		Not Available	Lewvan Dr. to CP Rail - Right Bank	As-Built plan provided by WSA
Wascana	Empress Drive	2011	Starting at 100 m Downstream of CP Rail – Right Bank	Temporary
Wascana	Horace St.	1979- Upgraded/Extended in 2011	South of Dewdney Ave. - Right Bank	Temporary - As-Built plan provided by WSA
Wascana		Not Available	South of Dewdney Ave. – Left Bank	
Wascana		1979	North of Dewdney Ave. - Right Bank	Dyke and High ground
Wascana		1979 – Upgraded in 2006	Dewdney Ave. to Southam St. - Left Bank	Broken -As-Built plan provided by WSA –

* The Classification of permanent/temporary dykes is based on the City of Regina, 2013. Wascana Creek Spring Runoff Study

** The City of Regina 2013, Wascana Creek Spring Runoff Study indicates that the dyke was recently reconstructed/rehabilitated, however it does not specify the year of the reconstruction/rehabilitation.

4. HYDROLOGY

WSA provided hydrological data for Wascana, Pilot Butte and Chuka Creeks in a memorandum (Hydrology Update for the City of Regina) dated January 2024. The memorandum provides instantaneous peak flow rates for various return periods (1:10- to 1:500-year) at the upstream boundary of Wascana Creek, four locations along Chuka Creek and five locations along Pilot Butte Creek. Only peak flow and mean daily flow rates were provided for the watercourses. Refer to Appendix A for detailed hydrology information.

According to the background information, the previous hydrology study for Wascana, Pilot Butte and Chuka Creeks, conducted in 1980, was used in the City of Regina's 1982 hydraulic modelling. Another peak flow estimation from 2012, only for Wascana Creek, was used in the Wascana Creek Spring Runoff Study in 2013.

The recent hydrology results show significant variations in flow rates for Pilot Butte and Chuka Creeks compared to the 1980 study. While only the 1:500-year flow rate was estimated in 1980, the recent estimates indicate an increase of 63% for Pilot Butte and 33% for Chuka in the peak flow rates for this return period. However, the rise for Wascana Creek remains below 15%. Table 4-1 compares the updated hydrology results from 2024 with those from the 1980 study.

Table 4-1: Instantaneous Peak Flow Rate for the Creeks (m^3/s)

Return Period	Wascana Creek			Pilot Butte Creek		Chuka Creek	
	1980*	2012**	2024	1980	2024	1980	2024
1:10	60	52	53	NA	9.6	NA	6.8
1:25	85	74	87	NA	15	NA	10
1:50	105	88	116	NA	19	NA	13
1:100	130	100	144	18	24	12	16
1:200	NA	NA	172	NA	30	NA	18
1:500	180	180	209	24	39	15	20

* Department of the Environment, 1982

** City of Regina, 2013

5. HYDRAULIC MODEL DEVELOPMENT

A 2D model was developed for the entire study area using the US Army Corps of Engineers software, HEC-RAS Version 6.4.1, to delineate flood extents throughout the area.

The modelling approach included the following steps:

- Refining the DEM: Enhancing the DEM to include channel profile and accurate terrain representation.
- Creating the geometry and setting up the model: Developing the model's spatial framework and configuring its parameters.
- Calibrating and validating the model: Adjusting the model to match observed data and improve accuracy.
- Simulating design events: Running simulations to assess flood scenarios and design events.

5.1 Hydraulic Model Domain

The model was developed for five watercourses within the City of Regina and the surrounding area: Wascana Creek, Chuka Creek, Pilot Butte Creek, South Storm Channel, and North Storm Channel. However, the hydraulic modelling of the North and South Storm Channels only accounts for inundation caused by backflow from Wascana Creek and no boundary conditions were applied to these tributaries.

After running the model, it was observed that significant backwater occurs upstream of the 1400 mm culvert under the CP Rail crossing of Pilot Butte Creek (PB13). This issue arises due to the elevated embankment of the railroad, which is higher than Victoria Ave. to the south, and insufficient capacity of the culvert barrel. As a result, floodwaters overflow to the south, affecting Chuka and Wascana Creeks and cause inundation between these creeks.

To address this, the area affected by flooding from the CP railroad to Anaquod Road (Rd.) and the western region was included in the model to estimate the approximate inundation area. It should be noted that the hydraulic modelling in this area is approximate and includes only major crossings to estimate potential inundation. The model does not account for all structures, culverts, or the underground stormwater network in this area.

More details of the study area are provided in Section 1.3.

5.2 Model Development

After collecting, pre-processing, and preparing the necessary information, the model development was initiated. During the model setup process, all basic and complementary information including modified terrain data, hydraulic structures, energy loss coefficients, land cover, and boundary conditions were introduced to the model.

The modelling approach included the following tasks:

- Setting the Spatial Reference Projection: NAD83 (CSRS), UTM Zone 13N, was used as the spatial reference of the model.
- DEM Refinement: Surveyed cross-section data was used to refine the lidar DEM, incorporating details of the main channel and underwater terrain using the RAS Mapper and ArcGIS Pro.

- Creation of the Terrain Model: The refined lidar DEM was introduced to the model. Subsequent refinements and modifications were made using breaklines and modification tools. This iterative process was based on the geometry of structures, high grounds such as roads and dykes, and the extent of design floods.
- Defining a 2D Boundary and Mesh Creation: A 2D boundary was established to cover the maximum potential inundation area for the regulatory event (1:200-year return period).
- Introducing Hydraulic Structures: The model included all structure centerlines such as bridges, culverts, and weirs. Associated physical data, obtained from field surveys and background information, were populated and appropriate hydraulic loss coefficients were assigned.
- Land Cover: A land cover layer, obtained from the City of Regina zoning GIS dataset, was used to classify areas and assign appropriate roughness factors (Manning's "n"). Additionally, manual delineations of land cover were used outside of the city boundary.
- Model Pre-processing: After data introduction and geometry construction, the 2D geometric preprocessor was run to identify and correct errors and create cell and face hydraulic property tables. This step was performed iteratively during the modelling process and included refinement, editing, and computational mesh modification, considering channel and structure dimensions, break lines, expected accuracy, and model limitations.

5.2.1 DEM Construction

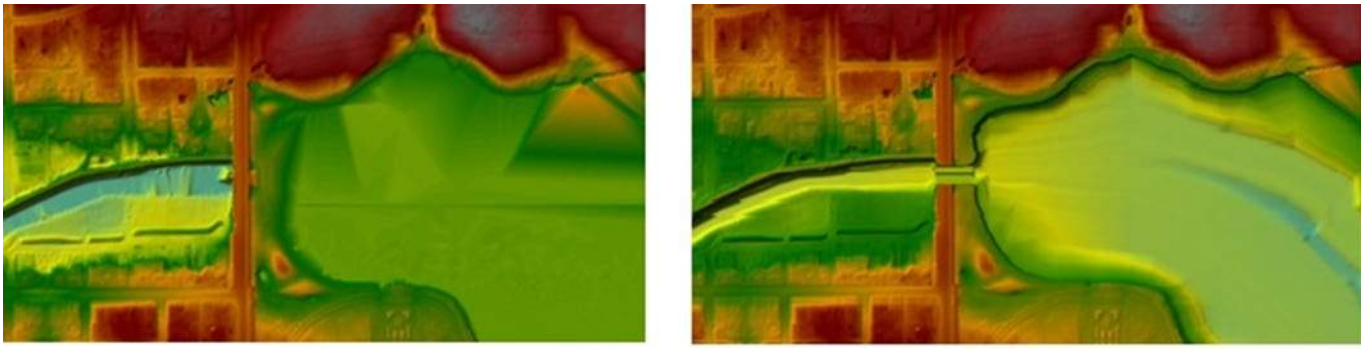
The lidar DEM from May 28, 2019, was used as the primary terrain data for the model. The consistency of the lidar data with field survey measurements was verified during the field survey. Table 5-1 presents the results of this verification.

Table 5-1: Geosys Lidar Vertical Accuracy

Lidar Control Statistics (meter)	
Average difference	-0.001
Minimum difference	-0.078
Maximum difference	+0.084
Average magnitude	0.021
Root mean square	0.027
Absolute Vertical Accuracy (95% confidence interval)	0.053

To refine the lidar DEM, cross-section data, including bathymetry and topography, obtained from field surveys, were utilized. These cross-sectional data were used to enhance the terrain model for the underwater areas of the main channel and integrate them into the lidar DEM. A total of 553 cross-section data points were used in this refinement process. ArcGIS Pro and RAS Mapper were used to build a seamless terrain model incorporating the surveyed cross-sections. Number of surveyed cross sections in each creek is shown in Table 2-2.

Figure 5-1 indicates an example of the surveyed data incorporation to lidar DEM.



Before Refinement

After Refinement

Figure 5-1: Lidar DEM Refinement

Further small and localized refinements were made using modification tools in the HEC-RAS GIS program RAS Mapper to adjust the terrain and achieve the most accurate inundation conditions. A summary of these modifications and the features used is as follows:

- Terrain Modification at Culvert Inlets/Outlets: Where the elevations of culvert inlets or outlets were lower than the surrounding terrain, the terrain elevation was locally reduced to accommodate the software limitations.
- Notching at Culverts and Crossings: Notches were created in the floodplain at the locations of culverts and crossings to account for areas where there is no structure data and the lidar DEM could obstruct backwater flow and unrealistically limit inundation area.
- Modelling Culverts and Bridges: Most culverts and all bridges were incorporated into the model by burning them into the terrain during refinement. In areas where high grounds extended due to long culvert barrels, the terrain was adjusted to reflect the high grounds more realistically. These modifications were implemented to represent the structures in the hydraulic model as a 2D area. The IDs and locations of these structures are as follows:
  - SC9: South Storm Channel, Lewvan Drive
  - NC4: North Storm Channel, Lewvan Drive
  - CH11: Chuka Creek, 7th Ave. North
  - CH13: Chuka Creek, CN Rail - CS6
  - PBCK1-PBCK15: The culverts between the Pilot Butte, Chuka and Wascana Creeks

5.2.2 Structures and Dykes

Structure data was primarily obtained from field surveys. However, in some locations where surveying was not feasible due to land access limitations, background information or data from the City of Regina Map Viewer (City of Regina, 2024) was used to incorporate the structures into the model. Table 5-2 lists the identifications (IDs) and locations of these structures and the utilized background information is detailed in the Regina Flood Mapping Study, Survey Report (WSA, 2024).

Table 5-2: Structures Background Information Data Sources

Watercourse	Structure ID	Location	Data Source
North Storm Ch.	NC1 - Culvert	CN Rail - CS5	City Map Viewer
	NC13 - Culvert	CN Rail - CS6	City Map Viewer
Pilot Butte Cr.	PB0, PB01, PB1, PB1-1, PB1-2 Culverts	Saum Property	Sketches
	PB23	Heseltine Rd.	City Map Viewer
	PB24*	Heseltine Rd. Br. & Weir	Record Drawings, checked by Survey
Wascana Cr.	W14W**	Albert St. Weir	Record Drawings, Elevations Adjusted
	W16W*	Elphinstone Br. & Weir	Record Drawings, checked by Survey
	W18W*	Edward St. Weir	Record Drawings, checked by Survey
	W30	8th Ave. Weir & Br.	Record Drawings and Survey
	W36*	AE Wilson Park Weir	Record Drawings, checked by Survey
	W47*	Goulet Golf Weir	Record Drawings, Checked by Survey
	W48	Pinkie Rd.	Future Construction Drawings

** The weir was built into the terrain.*

*** The Albert St. weir and sluiceways were assumed to remain fully open during all simulation events.*

Note: Weir crest elevations were assumed constant during the simulations, no operations were considered.

Table 5-3 indicates the energy loss coefficients that were used for the structures.

Table 5-3: Energy Loss Coefficients of Structures

Coefficient/Roughness	Bridges	CSP Pipes - Projected		Concrete Pipes	Steel Pipes
		Projected	Mitered		
Entrance Loss	0.1-0.3	0.9	0.7	0.9	0.9
Exit Loss	0.1-0.5	1	1	1	1
Manning's "n"	0.015 - Concrete	0.025	0.025	0.015	0.015
Weir Discharge	1.5	1.6 for the culvert locations			
Albert St. Weir*	1.63				
Albert St. Sluiceways**	Sluice Discharge Coefficient=0.5, Orifice Coefficient=0.8				

** Albert St. Weir Dimensions: Width: 5 m, Height: 2.4 m, Number of Openings: 4, Crest Elevation: 569.676 m*

*** Albert St. Sluiceways Dimensions: Width:1.2 m, Height: 1.2 m, Number of Openings: 2, Invert Elevation: 567.50 m*

Dyke crest elevations along Wascana Creek, from Albert St. to the Mount Royal neighborhood, were surveyed. These survey points were compared to the DEM and were found to be consistent (average difference of 0.09 m), so no modifications to the DEM were necessary for modelling purposes.

Dykes were modeled as 2D areas and break lines were established along the dyke crests to prevent leakage. Additionally, areas where the dykes are broken or discontinuous were identified. The elevations of these areas were cross-checked against the surveyed data to verify the locations of the breaks.

5.2.3 Land Cover

The base land cover map, obtained from the City of Regina zoning GIS dataset (City of Regina, 2023), was used to assign roughness factors (Manning's "n") to each land use. Manning's "n" values for each land use were selected based on industry-accepted manuals and references (US Army Corps of Engineers, 2023; US Federal Highway Administration, 1989) as well as photos taken during the field survey. However, due to the complexity and variability of the main channel and floodplain land cover, each land-use area is represented by a range of roughness values. Consequently, the assigned factor reflects the average roughness of the area, determined through engineering judgment. Furthermore, 17 complementary land use areas were identified along the creeks and reasonable roughness factors were assigned to each. Figure 5-2 indicates a sample of utilized land cover in the model.

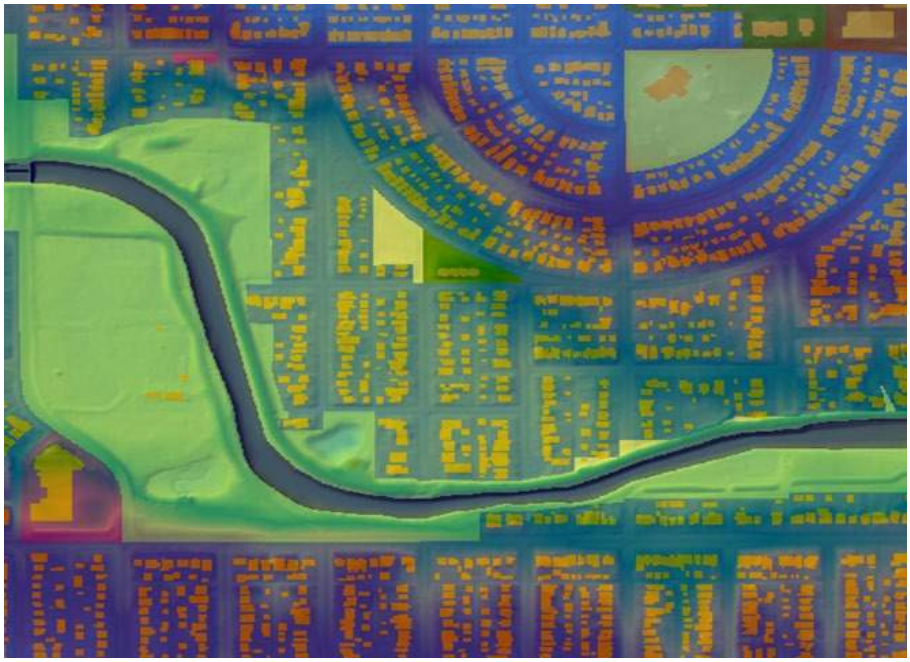


Figure 5-2: Land Cover Sample

Table 5-4 provides an overview of the land uses, the range of Manning's "n" values, and the average roughness assigned to each land use area.

Further refinements were done during calibration to adjust the roughness factor within accepted ranges. To this end, either the base Manning's "n" layer was overridden or additional calibration regions were added.

Table 5-4: Land Cover and Manning's "n"

Land Use	Manning's "n"		Land Use	Manning's "n"	
	Range	Assigned		Range	Assigned
Airport	0.06-0.12	0.06	Open Water	0.025-0.05	0.03-0.05
Building	10	10	Pond	0.025-0.05	0.04
Commercial	0.06-0.12	0.06	Railway	0.03-0.05	0.04
Cropland	0.02-0.05	0.04	Residential HD	0.12-0.2	0.15
Developed, Low Intensity	0.06-0.12	0.06	Residential LD	0.06-0.12	0.08
Developed, Open Space	0.03-0.05	0.045	Residential MD	0.08-0.16	0.12
Grassland	0.025-0.05	0.05	Residential Urban	0.06-0.12	0.08
Industrial HI	0.08-0.16	0.1	Riprap	0.04-0.07	0.05
Industrial LI	0.06-0.12	0.06	Rural	0.06-0.12	0.06
Industrial MI	0.06-0.12	0.08	Shrub/Scrub	0.07-0.16	0.07
Island	0.045-0.15	0.1	Urban Holdings	0.03-0.05	0.04
Open Space-Recreation	0.03-0.05	0.04	Woody Wetlands	0.045-0.15	0.05

5.2.4 Mesh Independence Study

The model was evaluated using various mesh sizes: 10 m, 20 m, and 30 m. The results showed that, with refinements along the main channel, dykes, high grounds, and structures, finer general patterns did not significantly alter the water surface elevation or flood extent. However, finer meshes substantially increased simulation time. Consequently, a 20 m x 20 m mesh size was selected as the general mesh resolution with additional refinement applied along the main channel, dykes, and structures using a mesh size ranging from 2 m to 10 m. Figure 5-3 illustrates an example of these mesh refinements.

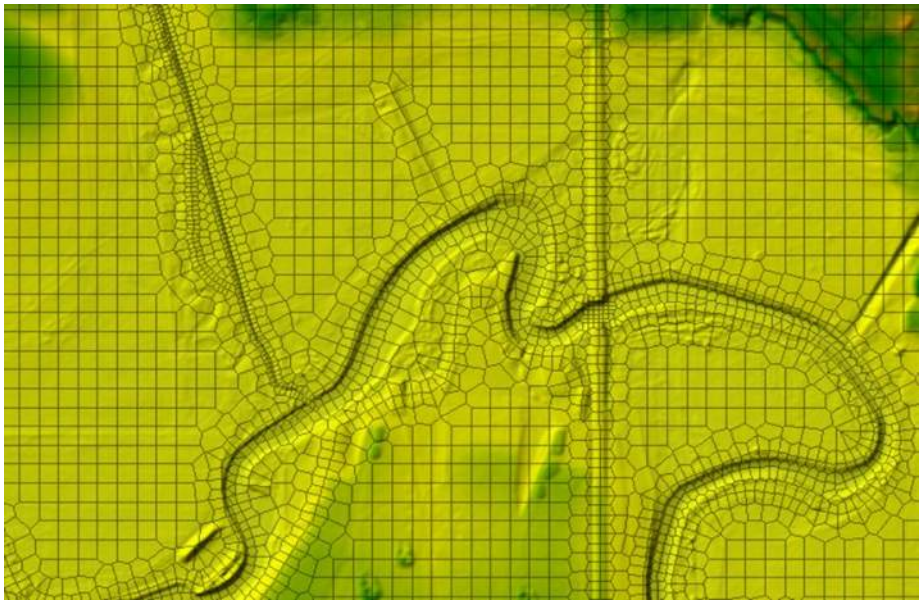


Figure 5-3: Mesh Refinement Sample

5.2.5 Model Boundary Conditions

Since only peak flow data was provided for the watercourses in the hydrology memorandum, a quasi-unsteady flow hydrograph representing the instantaneous peak flow rate was developed to stabilize the flood inundation boundary for each creek during the design flow events. The model incorporated four external boundary conditions and seven internal boundary conditions to account for flow changes at specified locations. A single geometry was constructed for the entire area with the following assumptions made to create a cohesive hydraulic analysis model:

- For the simulation of the design flows in Wascana Creek, no flow was assumed from the tributaries during the design flood events.
- Wascana Creek was treated as the main watercourse, with one upstream boundary condition (flow hydrograph) and one downstream boundary condition (normal depth).
- For Pilot Butte and Chuka Creeks, the downstream boundary conditions were set with a constant flow rate of 30 m^3/s at the upstream boundary of Wascana Creek.
- To stabilize flood inundation conditions, hydrographs with a peak flow lasting four days were assumed at the boundaries.
- Chuka Creek had four boundary conditions, including one external (upstream) and three internal to account for flow change locations.
- Pilot Butte Creek had five boundary conditions, including one external (upstream) and four internal to account for flow change locations.
- The simulation was initiated with a full reservoir condition (with Albert St. Weir fully open), while other watercourses and reaches were considered dry.
- Average flow rates were applied within reaches confined by two consecutive flow change locations.

Table 5-5 summarizes the flow rates applied at the boundary conditions and Figure 5-4 shows the boundary condition and flow change locations within the study area.

Table 5-5: Flow Rates Applied at Boundaries and Flow Change Locations – 2024 Hydrology Memo

Watercourse	Return Period	Flowrate at Boundary Location – m^3/sec					
		#1 (U/S)	#2	#3	#4	#5 (HWY33)	Total
Chuka	10	1.45	1.95	2.3	1.1*		6.8
	25	2.2	3	3.3	1.5*		10
	50	2.8	3.8	4.35	2.05*		13
	100	3.35	4.7	5.45	2.5*		16
	200	3.85	5.1	6.05	3*		18
	500	4.3	6	6.7	3*		20
Pilot Butte	10	5.7	1.3	0.95	1.2	0.45	9.6
	25	8.5	2	1.5	2	1	15
	50	10.85	2.65	1.5	2.5	1.5	19
	100	14.5	3	2.5	3	1	24
	200	17.5	4.5	3	3.5	1.5	30
	500	23.5	5.5	4	4.5	1.5	39
Wascana	10	53					53
	25	87					87
	50	116					116
	100	144					144
	200	172					172
	500	209					209

REGINA FLOOD MAPPING STUDY

Boundary Condition Locations

WATER SECURITY AGENCY

Project No.: 60706173 Date: 2024-12-17

AECOM

Figure: 5-4

Figure 5-4: Boundary Condition Locations

5.3 Calibration & Validation

Model calibration was carried out to assess the accuracy of the model outputs against the observed flow level and extent. This process involved iteratively adjusting model parameters focusing primarily on surface roughness, hydraulic structure parameters, and discharge coefficients. Additional measures included mesh refinement, sensitivity analysis of downstream boundary conditions, and mesh size to improve the accuracy of flood extents.

Adjustments continued until the calibration was met with simulated water levels matching observed data within a tolerance of ±0.10 m. The calibrated model was then validated using historical data to verify its performance against independent datasets and assess its suitability for estimating design flow scenarios.

5.3.1 Historical Data for Model Calibration & Validation

There is no observed data available for calibration purposes for Pilot Butte and Chuka Creeks. However, historical data for Wascana Creek, provided by Environment Canada since 1943, offered valuable information (Government of Canada, 2024). The highest observed daily flow rate recorded was 104 m³/s on April 23, 1974, at Kronau Marsh. Other notable flood events include April 11, 1971, at Richardson with a peak flow of 74.8 m³/s, and April 25, 2011, at Kronau Marsh with a peak flow of 74.7 m³/s.

Measurements from Wascana Creek and Wascana Lake during the 1974 and 2011 events are considered the most reliable for calibration and validation. Due to significant changes in the creek since 1974 that may impact flood levels and extents, the 2011 flood event was used for calibration, while the 1974 event served as a validation reference.

Additional water surface elevation data for Wascana Creek is available since 1924 and water level data at Cameron St., below the Albert St. Weir, is available from 2002 (City of Regina, 2023). This data along with the flow rates at Kronau Marsh was used for further validation of smaller flow rates.

Table 5-6 summarizes the data used for validation. Kronau Marsh Hydrometric Station is located approximately 25 km upstream of Albert St. Weir, therefore, the flow rates at the location of level measurements may be slightly higher than those recorded at the hydrometric station at Kronau Marsh.

Table 5-6: Validation Data

Date	Station	Flowrate (m^3/sec)	Date	Location	Observed Level (m)*
1997-04-20	Kronau Marsh	53.4	1997-04-21	Marina	571.08
2015-04-01	Kronau Marsh	31.9	2015-04-02	Marina	570.71
2005-04-09	Kronau Marsh	25.4	2005-04-10	Cameron St.	568.25
2015-04-01	Kronau Marsh	31.9	2015-03-30	Cameron St.	568.58

** CGVD28 adjusted by -0.31 m*

5.3.2 Calibration

Due to the lack of observed data for Pilot Butte and Chuka Creeks, only Wascana Creek was examined for calibration. The calibration focused on measurements from Wascana Creek on April 26, 2011, which are deemed the most reliable. The calibration utilized the maximum instantaneous flow rate of 78 m³/s, as reported in Wascana Creek Spring Runoff Study (City of Regina, 2013), with the peak flow rate maintained for four days to ensure stable conditions across the study area.

Flood water levels surveyed by the City of Regina at 18 locations, as reported in Wascana Creek Spring Runoff Study (City of Regina, 2013), served as indicators for the calibration process.

The roughness factor (Manning's n) and discharge coefficients of structures were adjusted within reasonable ranges for the creek reaches to achieve the target accuracy, with a tolerance of ±0.10 m.

Table 5-7 presents the final calibration results.

Table 5-7: Model Calibration Results Based on the Observed Water Surface Elevations on April 26, 2011

Structures ID	Structure Location	Water Surface Elevation - m			Var. - m
		April 26th, 2011		Model Results	
		CGVD28	CGVD2013*	CGVD2013	
W6	Fleet St. Br. (approx. 30 m U/S)	572.23	571.92	571.83	-0.09
W7	Ring Rd. Br. (approx. 10 m U/S)	571.75	571.44	571.5	0.06
W14	Albert St. Br. Upstream- Wascana Lake	571.66	571.35	571.29	-0.06
W15	Cameron St. Br. (approx. 125 m U/S)	569.75	569.44	569.5	0.06
W16	Elphinstone St. Br. (approx. 8 m U/S)	569.69	569.38	569.37	-0.01
W17	Coronation St. Br. (at the Br.)	569.65	569.34	569.29	-0.05
W18	Pasqua St. Br. (approx. 30 m U/S)	569.52	569.21	569.21	0
W19	Lewvan Br. (approx. 34 m upstream)	569.41	569.1	569.11	0.01
W21	13th Ave. Br. (approx. 28 m U/S)	569.2	568.89	568.89	0
W22	CP Rail Br. (approx. 42 m U/S)	568.95	568.64	568.69	0.05
W28	11th Ave. Br. (approx. 30 m U/S)	568.64	568.33	568.35	0.02
W29	Dewdney Ave. Br. (approx. 9 m U/S)	568.36	568.05	567.98	-0.07
W30	8th Ave. Pedestrian Br. (approx. 90 m US	568.24	567.93	567.9	-0.03
W31	McCarthy Boulevard (Blvd.) Br. (approx. 30 m U/S)	567.89	567.58	567.63	0.05
W37	Ritter Ave. Br. (approx. 30 m U/S)	567.5	567.19	567.18	-0.01
W38	CN Rail Trestle Br. (approx. 30 m U/S)	567.25	566.94	566.92	-0.02
W48	Pinkie Rd. Br. (approx. 50 m U/S)	566.43	566.12	566.09	-0.03
W51	Regina Sewage Lagoons (approx. 30 m U/S)	564.45	564.14	564.18	0.04

** CGVD28 adjusted by -0.31 m*

The calibration results indicate that the discrepancy between the observed water elevation and simulated water levels remains within the desired tolerance limit of ± 0.1 m.

Figure 5-5 to Figure 5-7 compare the flood extent from the model results with the air imagery taken on April 26, 2011, at selected locations.



Figure 5-5: Simulated Flood Inundation in Wascana Creek at Albert St. (Blue Line) Against Observed Flood Extension on April 26, 2011 (Aerial Photo)

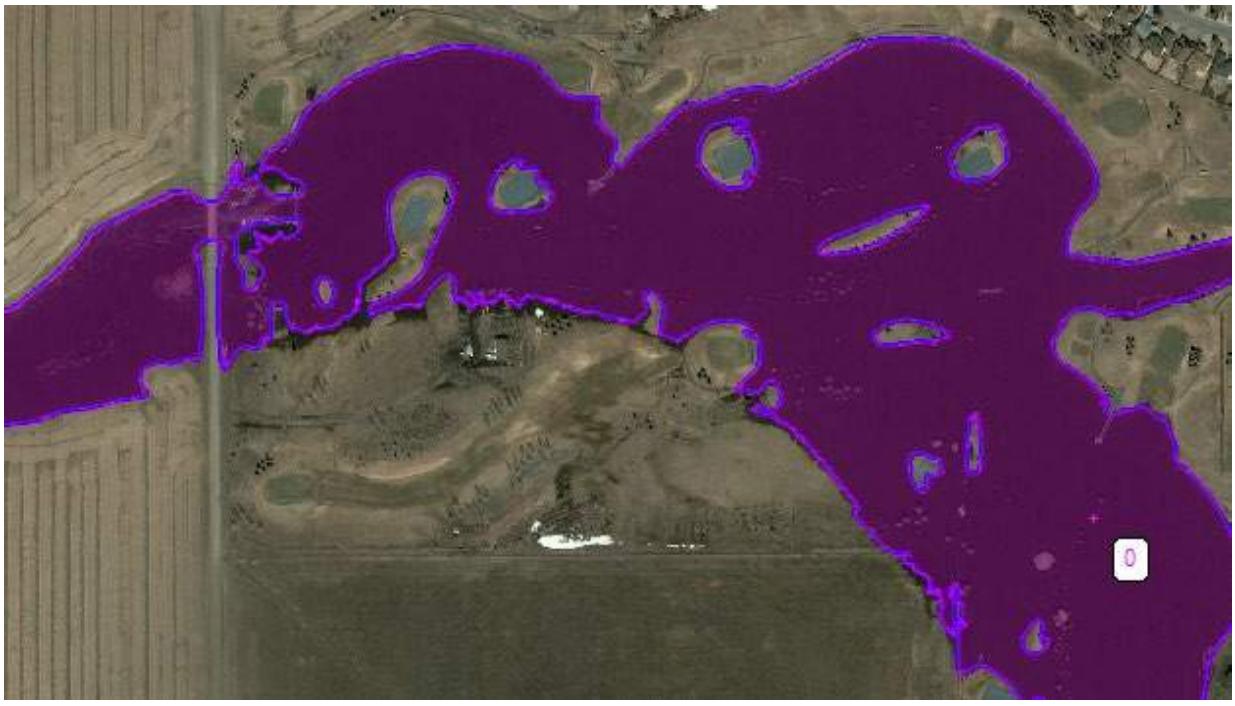


Figure 5-6: Simulated Flood Inundation in Wascana Creek Upstream of Pinkie Rd. (Blue Line) Against Observed Flood Extension on April 26, 2011 (Aerial Photo)

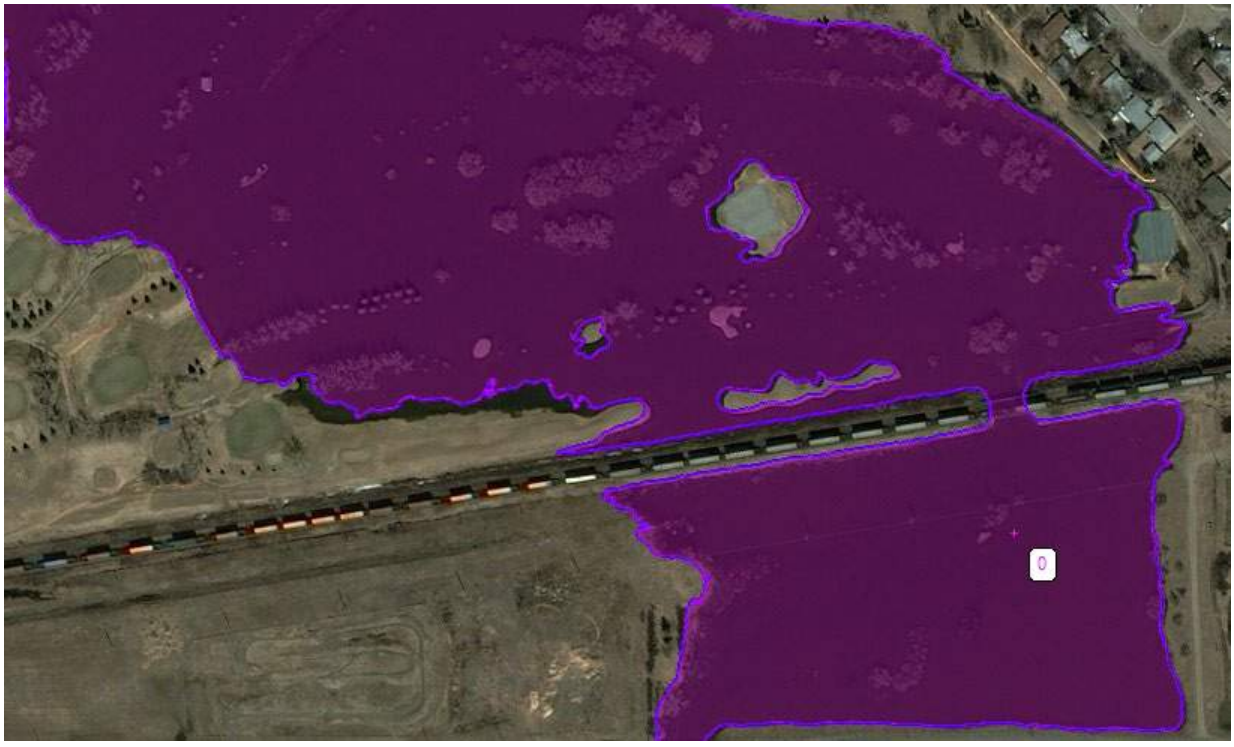


Figure 5-7: Simulated Flood Inundation in Wascana Creek at CP Rail (Blue Line) Against Observed Flood Extension on April 26, 2011 (Aerial Photo)

5.3.3 Validation

Measurements along Wascana Creek from April 21-23, 1974, are considered the most reliable for validation purposes. The validation used the maximum daily flow rate of 104 m³/s with the peak flow sustained for four days. This duration ensures stable conditions across the entire study area and aligns with the observed hydrograph from the 1974 flood.

Flood water levels available at 12 locations, reported in Regina Hydraulic Study (Department of the Environment, 1982), were utilized as indicators for the validation.

Table 5-8 presents the results of the model in comparison with the observed data from the 1974 flood.

Table 5-8: Model Results in Comparison with the 1974 Flood Event

Structures ID	Structure Location	Water Surface Elevation - m			Var. - m
		April, 1974		Model Results	
		CGVD28	CGVD2013*	CGVD2013	
W2	E/W Grid (US face) - Estimated **	573.24	572.93	573.08	0.15
W6	Fleet St. Br. (U/S face) **	572.34	572.03	572.08	0.05
W14	Albert Steet Br. Upstream- Wascana Lake	572.23	571.92	571.68	-0.24
W15	Cameron St. Br. (U/S face)	569.99	569.68	569.94	0.26
W16	Elphinstone St. Br. (U/S face)	569.85	569.54	569.83	0.29
W18	Pasqua St. Br. (U/S face)	569.72	569.41	569.62	0.21

Structures ID	Structure Location	Water Surface Elevation - m			Var. - m
		April, 1974		Model Results	
		CGVD28	CGVD2013*	CGVD2013	
W19	Lewvan Br. (U/S face)	569.52	569.21	569.48	0.27
W22	CP Rail Br. (U/S face)	568.96	568.65	569.02	0.37
W29	Dewdney Ave. Br. (U/S face)	568.42	568.11	568.38	0.27
W38	CN Rail Trestle Br. (U/S face)	567.14	566.83	567.19	0.36
W48	Pinkie Rd. Br. (U/S face)	565.82	565.51	565.64	0.13
W51	Regina Sewage Lagoons (U/S)	564.79	564.48	564.57	0.09

** CGVD28 adjusted by -0.31 m*

*** Estimated from air photos*

The results indicate a decrease in water surface elevation upstream of the Albert St. Weir, which aligns with the one-foot reduction in the weir crest elevation following the 1974 flood. The backwater effect from the weir diminishes as one moves upstream, with the water level at Fleet St. (W2) approaching normal levels.

Downstream of the lake, the model shows an increase of nearly 0.3 m in water surface elevation. This increase is likely associated with developments since 1974, including the construction Goulet Golf weir in 1990s, since the observed 1974 flood levels are almost equal or even less than 2011 flood level between Lewvan Br. and CN Rail Br. and the water level downstream of the Pinkie Rd., where development is less pronounced, is closer to the observed levels.

Additional spot elevations were examined for various flow rates based on the available observed data. Table 5-9 presents the results of the model compared to the observed data.

Table 5-9: Model Results in Comparison with the Observed Level for Various Flow Rates

Date	Station	Flowrate (m^3/sec)	Date	Location	Observed Level (m)	Model Result
1997-04-20	Kronau Marsh	53.4*	1997-04-21	Marina	571.08	571.08
2015-04-01	Kronau Marsh	31.9	2015-04-02	Marina	570.71	570.72
2005-04-09	Kronau Marsh	25.4	2005-04-10	Cameron St.	568.24	568.15
2015-04-01	Kronau Marsh	31.9	2015-03-30	Cameron St.	568.58	568.40

** Almost 10-year flood*

The results indicate that the difference between the simulation and the observed data is reasonable. Given that the flow rate at Cameron St. is expected to be slightly higher than at Kronau Marsh, it is sensible that the observed water levels at Cameron St. are slightly higher than those predicted by the model.

Figure 5-8 and Figure 5-9 compare the flood extent from the model results with the air photos taken on April 22, 1974, at the selected locations.



Figure 5-8: Simulated Flood Inundation in Wascana Creek at Albert St. (Right) Against Observed Flood Extension on April 22, 1974 (Left)



Figure 5-9: Simulated Flood Inundation in Wascana Creek at Lagoons (Right) Against Observed Flood Extension on April 22, 1974 (Left)

5.4 Sensitivity Analysis

In addition to the sensitivity analysis conducted during the calibration process, which focused on Manning's “n” and discharge coefficients for inline structures, we also assessed the model's sensitivity to changes in the downstream boundary conditions. Furthermore, we evaluated the impact of a 10% increase or decrease in Manning's “n” along Wascana Creek in conjunction with the 2011 flood event.

A summary of these findings is presented in this section.

5.4.1 Model Sensitivity to Manning’s Roughness

The sensitivity of the model results was assessed by varying Manning’s “n” values by ±10%. The model was run with these adjusted Manning’s “n” values for the 2011 calibration flood event. Table 5-10 summarizes the results of this sensitivity analysis.

Table 5-10: Results of Model Sensitivity to Manning's Roughness Factor "n" – 2011 Flood Event

Structures ID	Structure Location	Water Surface Elevation - Model Results - m				
		Calibrated Manning's "n"	Manning's "n" -10%	Var.	Manning's "n" +10%	Var.
W6	Fleet St. Br. (approx. 30 m U/S)	571.86	571.82	-0.04	571.89	0.03
W7	Ring Rd. Br. (approx. 10 m U/S)	571.56	571.54	-0.02	571.59	0.03
W14	Albert St. Br. Upstream- Wascana Lake	571.35	571.35	0	571.35	0
W15	Cameron St. Br. (approx. 125 m U/S)	569.5	569.4	-0.1	569.6	0.1
W16	Elphinstone St. Br. (approx. 8 m U/S)	569.38	569.29	-0.09	569.47	0.09
W17	Coronation St. Br. (at the Br.)	569.29	569.2	-0.09	569.37	0.08
W18	Pasqua St. Br. (approx. 30 m U/S)	569.21	569.13	-0.08	569.28	0.07
W19	Lewvan Br. (approx. 34 m upstream)	569.1	569.03	-0.07	569.17	0.07
W21	13th Ave. Br. (approx. 28 m U/S)	568.88	568.83	-0.05	568.93	0.05
W22	CP Rail Br. (approx. 42 m U/S)	568.69	568.64	-0.05	568.74	0.05
W28	11th Ave. Br. (approx. 30 m U/S)	568.35	568.29	-0.06	568.4	0.05
W29	Dewdney Ave. Br. (approx. 9 m U/S)	567.98	567.93	-0.05	568.03	0.05
W30	8th Ave. Pedestrian Br. (approx. 90 m US)	567.9	567.85	-0.05	567.96	0.06
W31	McCarthy Blvd. Br. (approx. 30 m U/S)	567.63	567.55	-0.08	567.72	0.09
W37	Ritter Ave. Br. (approx. 30 m U/S)	567.18	567.1	-0.08	567.25	0.07
W38	CN Rail Trestle Br. (approx. 30 m U/S)	566.92	566.84	-0.08	566.99	0.07
W48	Pinkie Rd. Br. (approx. 50 m U/S)	566.06	566.04	-0.02	566.11	0.05
W51	Regina Sewage Lagoons (approx. 30 m U/S)	564.18	564.07	-0.11	564.29	0.11
W52	N/S Grid Rd. D/S of Regina Sewage Lagoons	560.91	560.8	-0.11	561.02	0.11
W54	Range Rd. 2212 - Abandoned Arch Br.	557.71	557.52	-0.19	557.9	0.19
D/S	Downstream Boundary	550.89	550.68	-0.21	551.1	0.21

The results indicate that upstream of the Albert St. weir, the flow is less sensitive to roughness factors and is primarily controlled by the lake. The presence of numerous structures within the reach of the Albert St. Weir and Pinkie Rd. bridge significantly affects the water level. However, as we proceed downstream, the impact of roughness becomes increasingly evident. This suggests that a 10% change in roughness upstream of the lake can result in nearly a 1% change in water depth. Upstream of Pinkie Rd., the change in depth is predicted approximately 2%, while downstream of Pinkie Rd. the change ranges from 3% to 7%.

5.4.2 Model Sensitivity to Downstream Boundary Condition

For this model, normal depth was used as the downstream boundary condition. The friction slope was assumed to be the same as the main channel slope at the downstream reach. However, given the mild slope of the channel, the downstream water surface and nearby structures can influence the energy slope, which may differ from the channel slope.

To evaluate potential variations in the downstream boundary condition, a reasonable distance was examined based on satellite imagery. The nearest structure along the river is a bridge located approximately 4-4.5 km away, with no significant abrupt changes or drops within this reach.

To account for possible changes or uncertainty at the downstream boundary, the 2011 flood and the 1:500-year flood events were re-modeled with friction slopes set at 50% and 200% of the original value. The findings are summarized as follows:

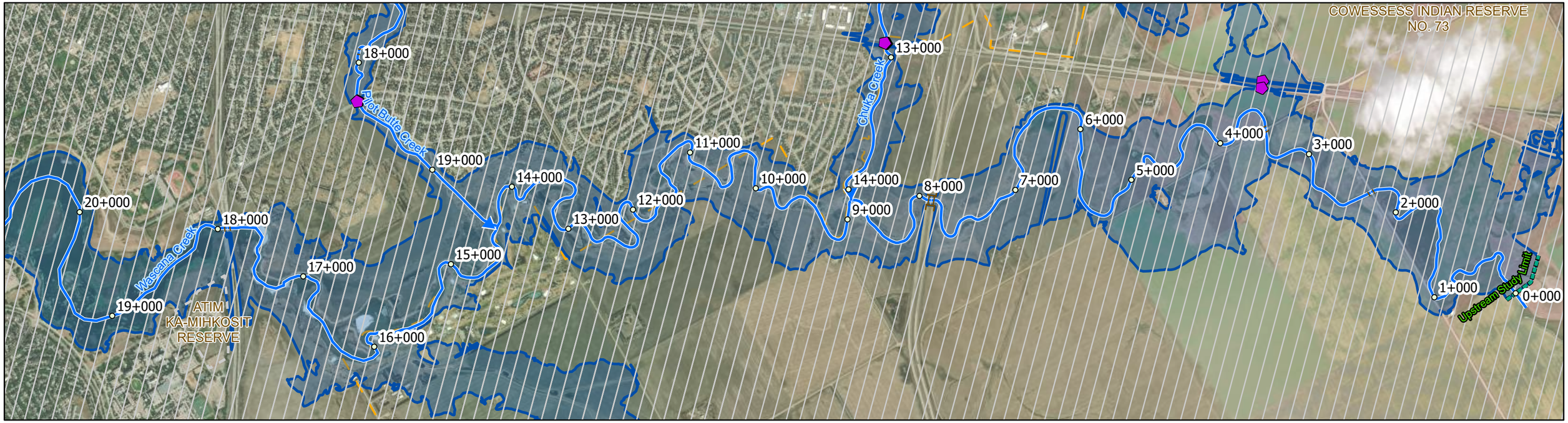
- Reduction to 50% of Original Slope: This adjustment resulted in a 32% increase in water depth at the downstream boundary, reaching an elevation of 551.75 m. This reduction created backwater upstream of the boundary, which was attenuated over an approximate distance of 3 km. As the flow rate increases, these differences decrease, so that for the regulatory flood, the increase in depth reaches 17%, and the flow depth approaches the normal depth within a 3 km distance.
- Increase to 200% of Original Slope: This adjustment led to a 22% decrease in water depth at the downstream boundary, reaching an elevation of 550.25 m. This increase created a dropdown upstream of the boundary, which was attenuated over an approximate distance of 2 km. Similarly, with the flow rate increases, these differences decrease, so that for the regulatory flood, the depth difference remains 17%, and the flow depth approaches the normal depth in less than a 3 km distance.

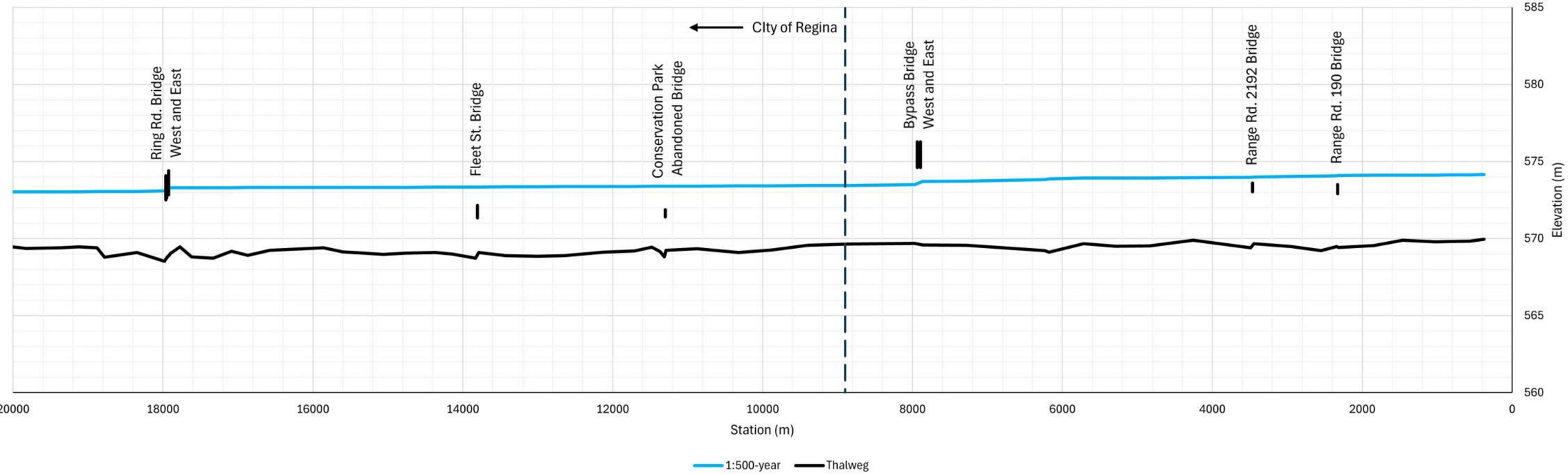
Therefore, potential changes in the downstream slope, ranging from -50% to +200%, may impact the flood extent downstream of Station 60+000. However, these changes will not affect the flood inundation map upstream of the City boundary (Station 47+500).

Table 5-11 summarizes the results and Figures 5-10 to 5-12 illustrate the effects of potential changes to the downstream boundary condition.

Table 5-11: Summary of Downstream Boundary Condition Sensitivity Analysis – 2011 & 1:500-Year Flood Events

Station - Km	2011 Flood - Water Surface Elevation - m			1:500 Year - Water Surface Elevation - m		
	50% Slope	Existing Slope	200% Slope	50% Slope	Existing Slope	200% Slope
62+610	551.75	550.88	550.25	554.02	553.31	552.48
61+000	552.82	552.66	552.61	554.80	554.61	554.48
60+000	553.76	553.8	553.75	555.67	555.61	555.56





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AECOM

Study Limits
1:500 Year Flood
Flow Direction
Culverts
Weir
Dams
Dykes
Bridge
Highway
Local Road
Railway
Regina City Limit
Indigenous Land
Chainage

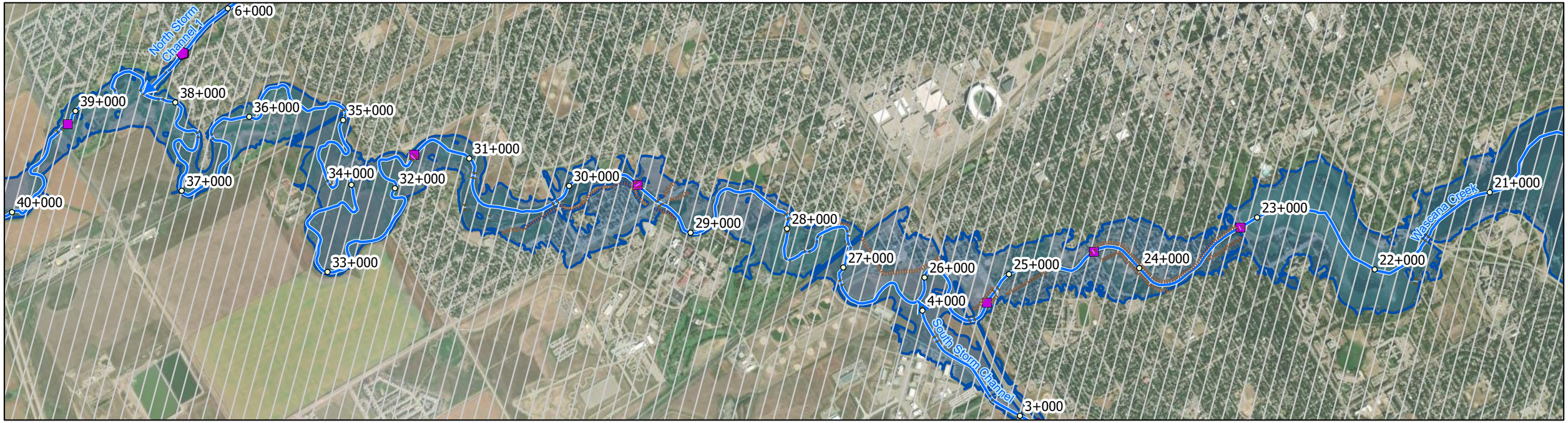
TITLE
CITY OF REGINA FLOOD MAPPING STUDY

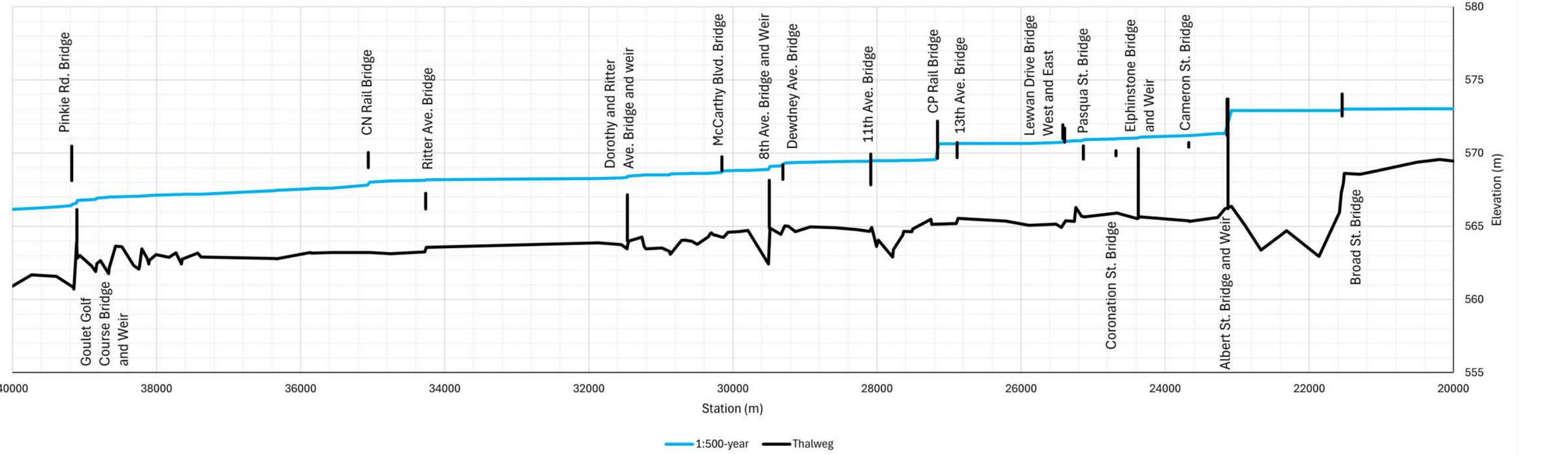
FIGURE
1:500-YEAR WATER SURFACE PROFILE

PROJECT NUMBER: 60706173

FIGURE 5-10

Figure 5-10: Sensitivity of the Model to Downstream Boundary Condition,1:500-year Water Surface Profile (Downstream)





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AECOM

- Study Limits
- 1:500 Year Flood
- Flow Direction
- Culverts
- Weir
- Dams
- Dykes
- Bridge
- Highway
- Local Road
- Railway
- Regina City Limit
- Indigenous Land
- Chainage

TITLE
CITY OF REGINA FLOOD MAPPING STUDY

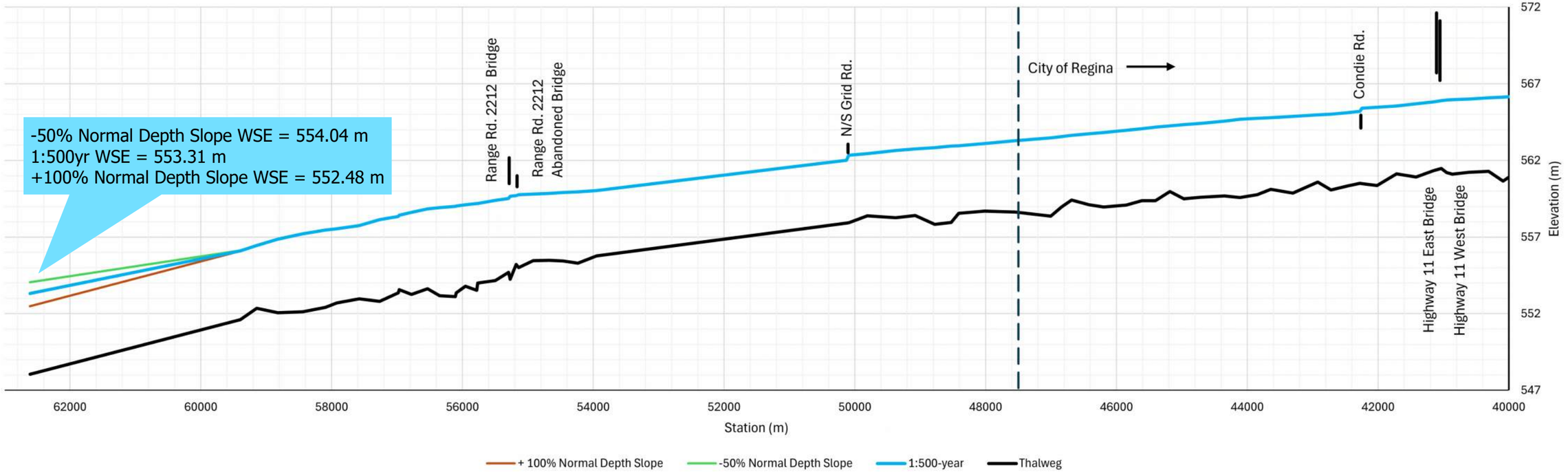
FIGURE
1:500-YEAR WATER SURFACE PROFILE

PROJECT NUMBER: 60706173

FIGURE 5-11

Figure 5-11: Sensitivity of the Model to Downstream Boundary Condition,1:500-year Water Surface Profile (Central)





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AECOM

Study Limits
1:500 Year Flood
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TITLE
CITY OF REGINA FLOOD MAPPING STUDY

FIGURE
1:500-YEAR WATER SURFACE PROFILE

PROJECT NUMBER: 60706173

FIGURE 5-12

Figure 5-12: Sensitivity of the Model to Downstream Boundary Condition,1:500-year Water Surface Profile (Upstream)

6. SIMULATION RESULTS

6.1 Summary of Modelled Scenarios

The calibrated hydraulic model was used to simulate six design flow scenarios. The following scenarios were simulated to produce the flood maps along Wascana, Pilot Butte, and Chuka Creeks:

- 1:10-, 1:25-, 1:50-, and 1:100-year floods with peak flows lasting four days to develop flood inundation maps and water surface profiles.
- 1:200-year flood with peak flow lasting four days to develop flood inundation maps, flood criteria maps, flood hazard maps, and water surface profiles.
- A 1:500-year flood with peak flow lasting four days was used to develop flood inundation maps, surface profiles, and additional flood criteria and hazard awareness maps.

6.2 Model Limitations and Uncertainties

Although sound and practical engineering principles were applied in developing the 2D model and mapping, the results are based on simulations of predicted flow rates. Therefore, the actual flood events may not exactly align with the simulated flood extent and levels. This discrepancy arises from the inherent approximations in the mathematical equations used by the software, the use of average and constant parameters in the model, and other project-specific assumptions. Moreover, the software used is constantly evolving to incorporate the latest knowledge and address limitations or bugs. As a result, these limitations may introduce uncertainties in certain aspects of the current model.

Some of the uncertainties and limitations associated with this study are outlined as follows:

- The model setup and results represent the estimated flood levels, depths, and velocities based on the assumptions made in this study. Future changes to land use, new developments, encroachment, additional flood protection measures, changes in hydrology, or the implementation of a formalized flood response plan may necessitate updates or amendments to the model.
- Due to limited high-water mark data, validation data were sometimes approximated from photos.
- As of the 1974 flood event (the selected validation event), the terrain used in this study may not adequately represent that event in the entire study area due to changes in land use, new constructions, and developments. Therefore, more uncertainties are expected for the validation results.
- The calibration and validation flow rates in Wascana Creek are closely aligned with the 25-year and 50-year events, respectively. While reasonable roughness factors have been selected, river channel and/or floodplain roughness may vary at higher levels. As a result, greater uncertainties are expected for more extreme flood events.
- Due to the lack of flood data for calibration and validation of the model in Pilot Butte and Chuka Creeks, uncertainties are expected for all simulated events along these watercourses.
- Floodway extensions along the storm channels and tributaries result from the backwater effect of Wascana, Pilot Butte, and Chuka Creeks. Therefore, without dedicated studies of these channels

and tributaries, flood hazard maps in these areas should not be considered reliable for informing future development decisions.

- Only major crossings were considered to estimate the approximate inundation between Pilot Butte and Chuka Creeks. As a result, the flood inundation estimates for this area may not be precise and should be viewed as approximate.
- This study relies on fluvial flooding results provided in the 2024 hydrology memo for the subject watercourses; therefore, the mapping shall not be used to assess potential pluvial flooding.

6.3 Model Results

- Flooding is contained within the dykes for a 1:10-year event except for the 17th Ave. Dyke (between Coronation St. and Pasqua St.), where the dyke has gaps to allow surface drainage toward the creek (these gaps are understood to be filled with sandbags during flooding events).
- For a 1:25-year flood event, flooding occurs behind the Rotary Park Dyke in addition to the 17th Ave. Dyke, where gaps along the dyke allow surface drainage toward the creek.
- In addition to the above dykes (17th Ave. and Rotary Park) a 1:50-year flood overtops the Kiwanis Park Dyke and the right bank dyke South of Dewdney Ave. North of Dewdney Ave, flooding occurs due to a gap between the left bank dyke and the road and inundates the nearby residential area. Additionally, flooding occurs behind the dyke located at 100 m downstream of the CP Rail due to a gap along the dyke.
- Nearly all dykes are overtopped or bypassed by a 1:100-year flood event. However, north of Dewdney Ave, flooding occurs due to a gap between the left bank dyke and the road. Similarly, the Riverside Dyke is overtopped due to a gap in the approach access to the Cameron St. Br.
- Similar to the 1:100-year event, the Riverside and north of Dewdney Ave. Dykes, are overtopped by the 1:200 flood only due to a gap in the approach access to the Cameron St. Br. and a gap between the left dyke and Dewdney Ave.
- All dykes are overtopped completely or partially by the 1:500-year flood event.
- Except for the Albert St. Weir and Goulet Golf Weir, other weirs have insignificant impacts on the water surface profile, indicating that they function as short structures hydraulically.
- The CP Rail (PB13) culvert (a 1400 mm CSP pipe) has a maximum capacity of almost 6 m³/s. Floods exceeding this capacity will overtop Victoria Ave. to the south, primarily inundating the area between CP Rail and Anaquod Rd., eventually flowing into Chuka Creek and Wascana.
- A maximum flow of 0.40 m³/sec is directed west of Anaquod Rd. through two small 500 mm culverts. The indicated flood inundation is valid under the modelling assumptions and may not accurately reflect a realistic condition due to the presence of the drainage system and potential infiltration.
- A maximum flow of 1.65 m³/sec is directed west of Anaquod Rd. through a double-barrel culvert (2x800 mm). This flow is primarily collected by a north-south drain channel and directed to Chuka Creek via an underground drainage network. However, since the detailed underground network was not included in this study, the results for this area may not be entirely accurate.

Water surface elevation profiles can be found in Appendix E.

6.3.1 Comparison with 1982 Provincial Flood Study

As described in Section 1.1, Saskatchewan Environment produced a water surface profile for the 1:500-year flood for Wascana Creek in 1982. However, during the final review of the report in June 2025, the Province of Saskatchewan released an amendment to the SPI Regulation, revising the regulatory flood from a 1:500-year to a 1:200-year event. As a result, the 1982 water surface profile was compared to both the current 1:200-year (now the regulatory flood) and 1:500-year flood events. It should be noted that the peak flow rate used in the 1982 study for the 1:500-year event was 180 m³/s, which is comparable to the current 1:200-year flow rate of 172 m³/s.

Table 6-1 compares water surface elevations between the 1982 study and 1:200- and 1:500-year events from the current study.

1982 Regulatory Flood (1:500-year) comparison to the current Regulatory Flood (1:200-year) event: Overall, the water surface elevations show a slight decrease (approximately 0.1 m) both far downstream and upstream along Wascana Creek in areas where no significant development has occurred. In contrast, locations that have experienced development exhibit a more notable increase in water surface elevation. The maximum increase between the current 1:200-year simulation and the 1982 study is 0.54 m, occurring immediately upstream of the CP Rail crossing.

1982 Regulatory Flood (1:500-year) comparison to the current 1:500-year flood: In general, there has been an increase in estimated water levels for a 1:500-year flood event between the 1982 study and the present simulation, driven largely by an increase in the estimated 1:500-year discharge, 180 m^3/s in 1982 and 209 m^3/s for the present study. The largest difference between 1982 and the present study is the reach between the Albert St. weir and the CP Rail crossing between 13th Ave. and 11th Ave., with the largest difference being just upstream of the rail crossing. At this location, the present study provides a 1:500-year water surface elevation that is 1.02 m higher than the 1982 estimate. A significant portion of this difference can be explained by the increase in design flow.

Subsequent to the profiles developed in the 1980s, a bike path was constructed under the CP rail bridge, which may further raise water levels compared to the estimated amount. From the 1982 study, it is understood that the geometry for the model was as-of 1978, and the bike path was constructed afterward according to drawings provided by CP Rail. Other differences between past studies and this one would include the technological difference in the modelling methodologies, predominantly the difference between 1D modelling conducted previously and the current 2D hydraulic model and updated high-resolution topography. Other developments within the vicinity of the CP Rail crossing may contribute to differences in estimated water surface elevations, particularly the construction of the Goulet Golf weir in the 1990s. Furthermore, the reconstruction of the Broad Street Bridge in the 2000s may have influenced hydraulic conditions, resulting in reduced upstream water surface elevations.

Figure 6-1 to Figure 6-3 illustrate the difference between the two flood studies.

Table 6-1: Comparison with 1982 1:500-year Water Surface Elevations

Location	Station (m)*	WSE_2025 Study (m)		WSE_1982 Study (m)	Difference (m)	
		1:500-year	1:200-year	1:500-year	2025/500Y-1982/500Y	2025/200Y-1982/500Y
15m Upstream of Grid Rd. at Sewage Lagoon	42+245	565.41	565.22	565.32	0.09	-0.1
Upstream of CNR Trestle at Toothill St.	35+050	568.01	567.77	567.46	0.55	0.31
Upstream of AE Wilson Weir	31+441	568.42	568.22	568.03	0.39	0.19
Upstream of McCarthy Blvd.	30+129	568.79	568.54	568.46	0.33	0.08
Upstream of 8th Ave. Footbridge	29+491	569.09	568.88	568.91	0.18	-0.03

Location	Station (m)*	WSE_2025 Study (m)		WSE_1982 Study (m)	Difference (m)	
		1:500-year	1:200-year	1:500-year	2025/500Y-1982/500Y	2025/200Y-1982/500Y
Upstream of Dewdney Ave.	29+287	569.32	569.12	569	0.32	0.12
Horace St.	28+682	569.4	569.2	569.07	0.33	0.13
Upstream of 11th Ave.	28+076	569.48	569.27	569.17	0.31	0.1
Upstream of CPR Br.	27+154	570.62	570.14	569.6	1.02	0.54
Upstream of 13th Ave.	26+879	570.65	570.23	569.74	0.91	0.49
Upstream of CNR Trestle (Lewvan Drive)	25+385	570.8	570.4	570.01	0.79	0.39
Upstream of Edward St. Weir	25+245	570.84	570.44	570.09	0.75	0.35
Upstream of Pasqua St.	25+123	570.92	570.57	570.18	0.74	0.39
Coronation St.	24+679	570.98	570.63	570.31	0.67	0.32
Upstream of Elphinstone St.	24+359	571.1	570.78	570.41	0.69	0.37
Upstream of Cameron St. Footbridge	23+669	571.2	570.9	570.6	0.6	0.3
Downstream of Albert St.	23+161	571.34	571.03	570.72	0.62	0.31
Upstream of Broad St.	21+520	573.01	572.68	573.08	-0.07	-0.4
Upstream of HWY 1 Bypass	7+871	573.68	573.33	573.44	0.24	-0.11

* *Refer to Figures 5-10 to 5-12 for stationing.*

Figure 6-1: Wascana Creek 1:200-year and 1:500-year Water Surface Profile Comparison (Upstream)

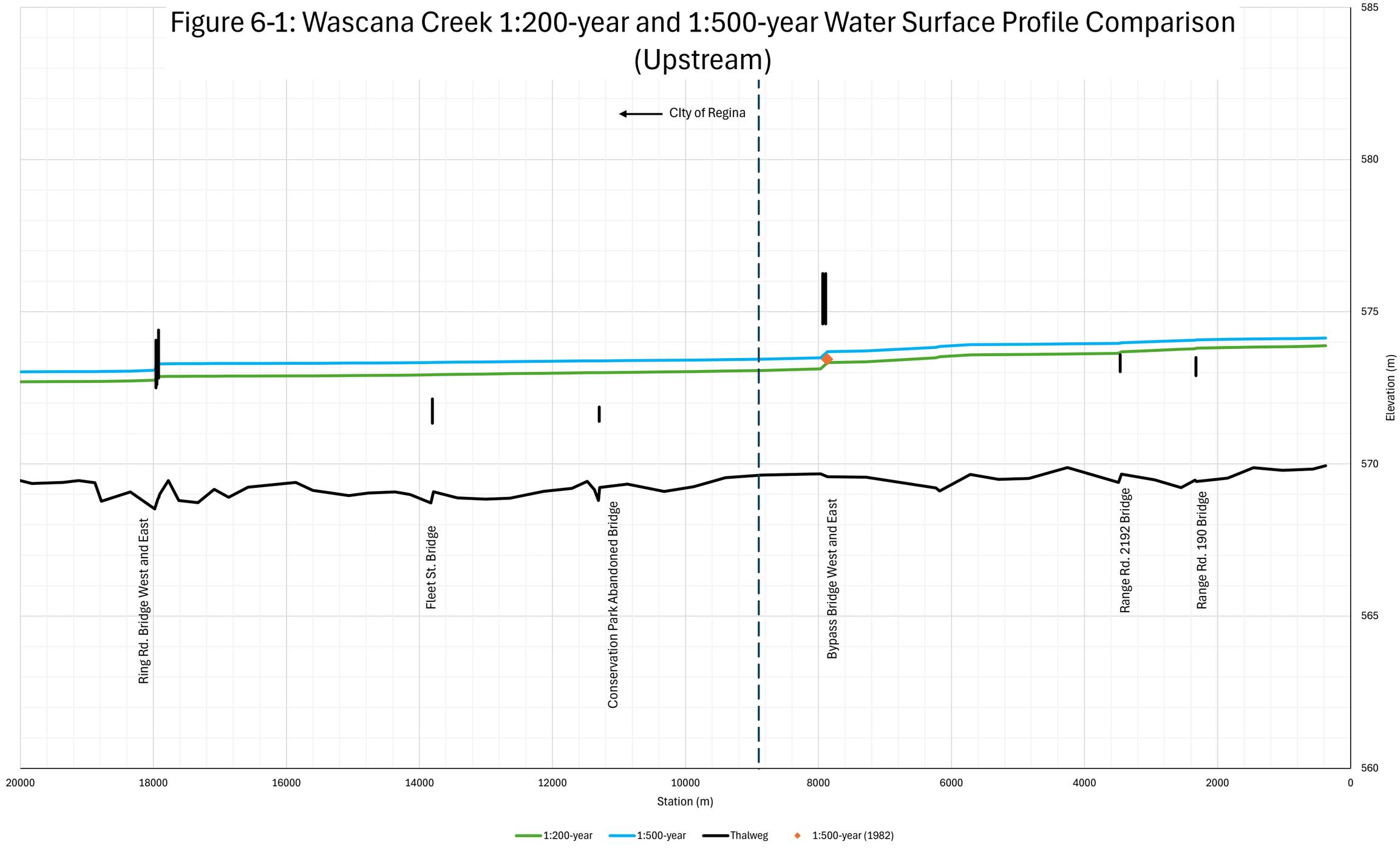


Figure 6-2: Wascana Creek 1:200-year and 1:500-year Water Surface Profile Comparison (Central)

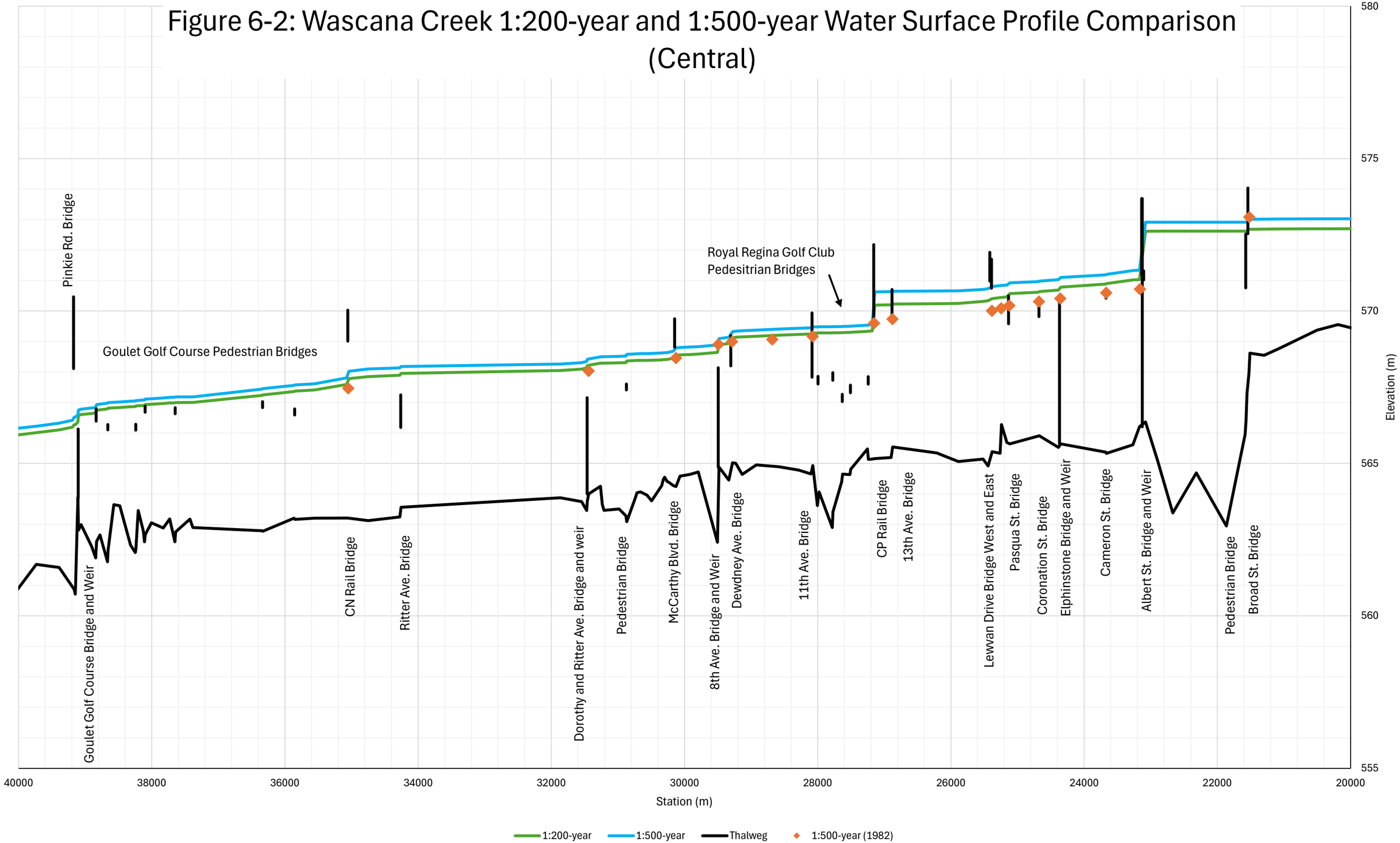
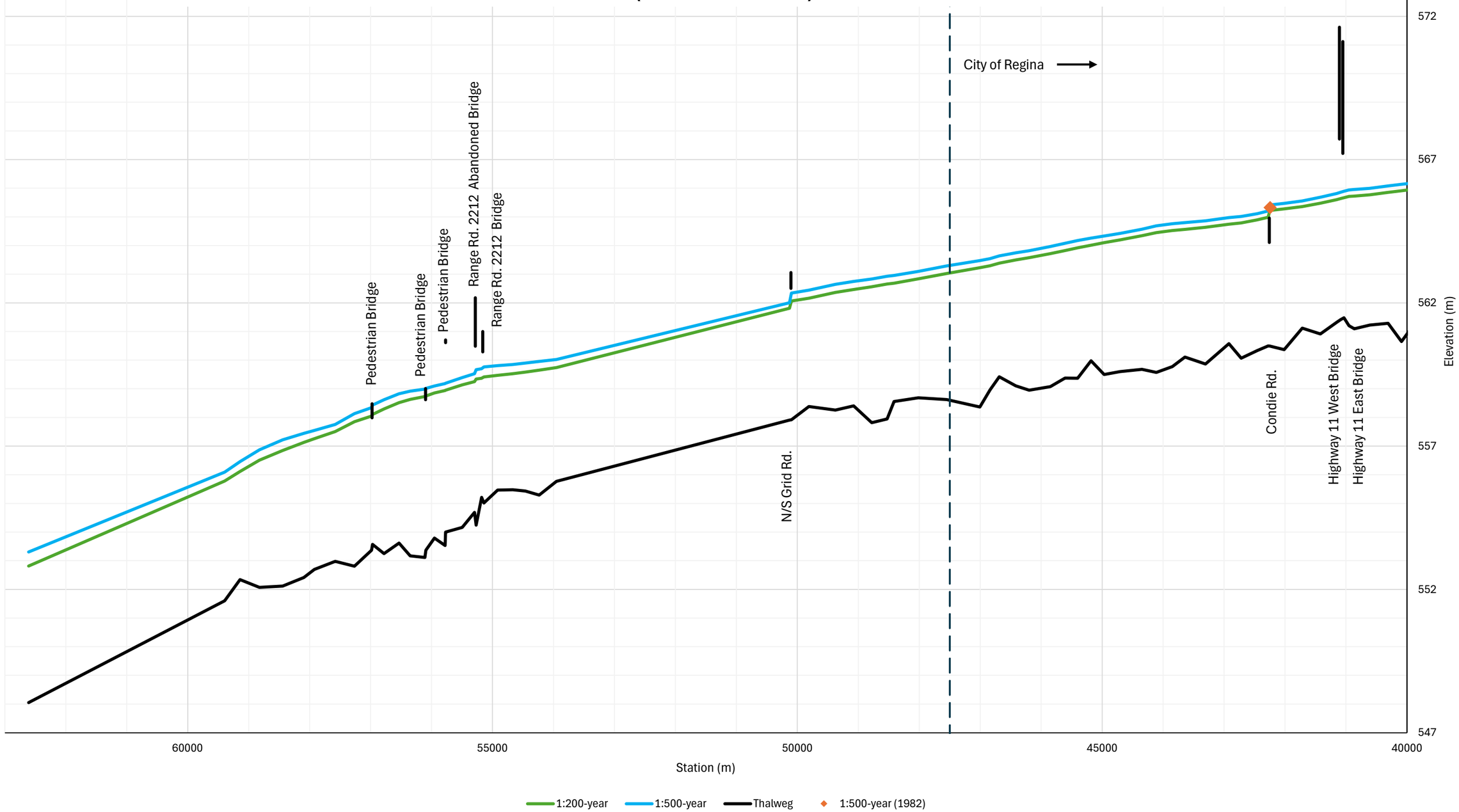


Figure 6-3: Wascana Creek 1:200-year and 1:500-year Water Surface Profile Comparison (Downstream)



7. FLOOD INUNDATION MAPS

7.1 Mapping Methodology

The post-processing of model results was completed with ArcGIS Pro software and utilized a number of geoprocessing tools. These post-processing steps involved removing isolated polygons outside of the main inundation area (artifacts from modelling that are not considered to be part of the floodplain), deleting small internal "holes" (<250 m^2) within the inundation area, and smoothing the inundation polygon edges (using the Smooth Polygon tool with a 10 m buffer tolerance). The tools and tolerances selected for post-processing were selected after a trial-and-error process that refined the results to best reflect the floodplain.

Four types of maps have been produced and submitted as Appendices B-D:

- Flood Inundation Maps, illustrate the maximum extents of flooding for Wascana Creek, Pilot Butte Creek, and Chuka Creek for all return periods (Appendix B).
- Flood Criteria Maps, show the distinction between depth and velocity zones which contribute to the definition of the floodway and flood fringe (Appendix C).
- Flood Hazard Maps, illustrate the delineation between the floodway and flood fringe for the regulatory flood (1:200-year). Where the floodway is defined as any location where the depth of flooding is greater than or equal to 1.0 m or the velocity is greater than or equal to 1.0 m/s. The flood fringe is the remainder of the inundation area which does not meet either of those two criteria. See Figure 8-1 for a definition sketch of flood hazard areas (Appendix D).
- Flood Hazard Awareness Maps illustrate the delineation between the floodway and flood fringe for a 1:500-year flood, for information only (Appendix F).

7.2 Areas Affected by Flooding

A summary of the areas impacted by the simulated flood events, including the regulatory flood, is presented in Table 7-1. The list is not comprehensive. For detailed maps of the areas impacted by each flood event, refer to the flood inundation maps in Appendix B. Given that calibration and validation of the model for Pilot Butte and Chuka Creeks were not conducted, greater caution should be exercised when interpreting the results for these watercourses

Table 7-1: Areas Affected by the Design Flood Events*

Watercourse	Major Affected Area	Flood Event - Year					
		1:10	1:25	1:50	1:100	1:200	1:500
Wascana	South of Old 16 Rd. - Single House (Kinookirnaw)						
Wascana	McKell Conservation Park						
Wascana	Wascana Creek Park Playground						
Wascana	South of Wascana Drive - Wascana Lake						
Wascana	Racing Canoe Clube and Surrounding Area						
Wascana	Legislative Building Area						

Watercourse	Major Affected Area	Flood Event - Year					
		1:10	1:25	1:50	1:100	1:200	1:500
Wascana	Residential Area Between Albert St. and Lewvan Dr. - North						
Wascana	Residential Area Between Albert St. and Lewvan Dr. - South						
Wascana	Residential area Between Lewvan Dr. and CP Rail - North						
Wascana	West of Sanda Schmirler Way - Near South Storm Channel						
Wascana	Residential Area - Empress Drive						
Wascana	Royal Regina Golf Club Area						
Wascana	Residential Area - Grassick Park						
Wascana	Residential Area North of Dewdney Ave. - East Bank						
Wascana	Residential Area North of Dewdney Ave. - West Bank						
Wascana	All Golf Courses between Pinkie Rd and CN Rail						
Wascana	Sherwood Forest Club Area						
Pilot Butte	U/S of PB4 (624) - Bardel Cres						
Pilot Butte	D/S of PB4 (624) - Single house						
Pilot Butte	US of PB10 (Range Rd.) - Petro Canada & Surrounding area						
Pilot Butte	US of PB13 (CP Rail)						
Pilot Butte	South of Victoria - East of Campground Regina						
Pilot Butte	South of Victoria to Wascana- Between CP Rail and Anaquod Rd.						
Chuka	West of Chuka Between CP Rail and Wascana Creek						

* *The highlighted cells indicate the flood events that could impact the subject area*

7.3 Treatment of Dykes

Dykes are represented in the DEM explicitly. No breach analyses were included in this assessment and any inundation shown on the maps behind dyke structures is a result of overtopping conditions or existing gaps in the dykes where it is understood that the City employs sandbagging during times of flooding.

The areas of concern regarding the dykes with gaps, which permit floodwater to seep behind them before overtopping, are as follows:

- Rotary Park Dyke, between Albert St. to Retallack St.
- 17th Ave. Dyke, between Coronation St. Br. and Pasqua St. Br.
- Left bank dyke immediately downstream of Dewdney Ave. Br. (W29)
- The dyke located approximately 100 m downstream of the CP Rail

7.4 Hydraulic Structures Affected by Flooding

The potential impact of flooding on bridge and culvert crossings for Wascana, Pilot Butte, and Chuka Creeks was investigated for all flood scenarios. Table 7-2 and Table 7-3 indicate the overtopping flood event for all major bridges and culverts. Given that calibration and validation of the model for Pilot Butte and Chuka Creeks were not conducted, greater caution should be exercised when interpreting the results for these watercourses.

Table 7-2: Simulated Flood Events for Bridges Within the Study Area*

Watercourse	Bridge ID	Bridge Name/Location	Minimum Deck Elevation (m)	Minimum Low Chord Elevation (m)	Simulated Flood Levels (m) US of the Structure						Clearance for the Events (m)		Pressure Flow Design Event (1:year)	Overtopping Design Event (1:year)
					1:10 year	1:25 year	1:50 year	1:100 year	1:200 year	1:500 year	1:500 year	1:200 year		
Wascana	W1	N/S Grid Rd. Br. D/S of Richardson	573.40	572.90	572.79	573.13	573.37	573.59	573.80	574.08	-1.2	-0.9	25	100
Wascana	W2	E/W Grid Rd. Br.	573.59	573.03	572.62	572.94	573.20	573.43	573.68	573.98	-0.9	-0.6	50	200
Wascana	W3	Bypass Br.	576.26	574.60	572.07	572.45	572.73	573.01	573.32	573.68	0.9	1.3	N/A	N/A
Wascana	W4	Bypass Br.	576.26	574.60	572.01	572.36	572.62	572.89	573.18	573.55	1.1	1.4	N/A	N/A
Wascana	W5	McKell Wascana Conservation Park- Abandoned Br.	571.42	571.40	571.69	572.07	572.35	572.67	573.00	573.39	-2.0	-1.6	10	10
Wascana	W6	Fleet St. Br.	572.05	571.34	571.52	571.94	572.24	572.58	572.93	573.34	-2.0	-1.6	10	50
Wascana	W7	Ring Rd. Br. - East	573.60	572.82	571.12	571.68	572.09	572.48	572.86	573.28	-0.5	0.0	200	N/A
Wascana	W8	Ring Rd. Br. - Center	573.25	572.61	571.10	571.66	572.07	572.46	572.84	573.21	-0.6	-0.2	200	N/A
Wascana	W9	Ring Rd. Br. - West	573.08	572.50	571.10	571.65	572.06	572.45	572.83	573.20	-0.7	-0.3	200	N/A
Wascana	W10	Broad St. Br.	573.22	572.54	570.90	571.49	571.92	572.31	572.68	573.00	-0.5	-0.1	200	N/A
Wascana	W14	Albert St. Br.	572.61	571.05	569.14	569.90	570.48	570.94	571.84	572.25	-1.2	-0.8	200	N/A
Wascana	W15	Cameron St. Br.	570.72	570.42	568.99	569.69	570.18	570.54	570.90	571.20	-0.8	-0.5	100	200
Wascana	W16	Elphinstone Br. & Weir	570.30	569.43	568.91	569.58	570.06	570.41	570.78	571.10	-1.7	-1.3	50	100
Wascana	W18	Pasqua St. Br.	570.50	569.58	568.77	569.39	569.82	570.15	570.57	570.92	-1.3	-1.0	50	200
Wascana	W19	Lewvan Br. - East	571.66	570.75	568.68	569.23	569.63	569.91	570.36	570.78	0.0	0.4	500	N/A
Wascana	W20	Lewvan Br. - West	571.50	570.73	568.66	569.25	569.62	569.90	570.36	570.75	0.0	0.4	500	N/A
Wascana	W21	13th Ave. Br.	570.42	569.68	568.46	569.05	569.44	569.71	570.23	570.65	-1.0	-0.5	100	500
Wascana	W22	CP Rail Br.	572.18	569.65	568.29	568.83	569.21	569.57	570.18	570.62	-1.0	-0.5	200	N/A
Wascana	W28	11th Ave. Br.	569.11	567.83	567.96	568.48	568.79	569.07	569.28	569.48	-1.6	-1.4	10	200
Wascana	W29	Dewdney Ave. Br.	568.90	568.20	567.60	568.16	568.57	568.90	569.12	569.32	-1.1	-0.9	50	200
Wascana	W30	8th Ave. Pedestrian Br.	568.43	568.14	567.53	568.04	568.38	568.67	568.89	569.09	-1.0	-0.7	50	100
Wascana	W31	McCarthy Blvd. Br.	569.75	568.81	567.29	567.79	568.10	568.34	568.53	568.77	0.0	0.3	N/A	N/A
Wascana	W37	Ritter Ave. Br.	567.25	566.18	566.80	567.32	567.59	567.78	567.95	568.18	-2.0	-1.8	10	25
Wascana	W38	CN Rail Br.	569.98	569.00	566.60	567.05	567.33	567.56	567.77	568.01	1.0	1.2	N/A	N/A
Wascana	W48	Pinkie Rd. New Br.	570.47	568.45	564.87	565.47	565.80	566.06	566.27	566.51	1.9	2.2	N/A	N/A
Wascana	W49	HW. 11 - East	570.88	567.22	564.18	564.83	565.19	565.45	565.65	565.88	1.3	1.6	N/A	N/A
Wascana	W50	HW. 11 - West	571.36	567.72	564.16	564.81	565.17	565.43	565.63	565.85	1.9	2.1	N/A	N/A
Wascana	W51	Regina Sewage Lagoons	564.96	564.11	563.73	564.37	564.76	565.03	565.22	565.41	-1.3	-1.1	25	100
Wascana	W52	N/S Grid Rd. D/S of Regina Sewage Lagoons	563.06	562.51	560.43	561.11	561.50	561.82	562.05	562.32	0.2	0.5	N/A	N/A
Wascana	W53	Range Rd. 2212	561.09	560.29	557.39	558.07	558.66	559.09	559.41	559.76	0.5	0.9	N/A	N/A
Wascana	W54	Range Rd. 2212 - Abandoned Arch Br.	562.23	560.46	557.07	557.98	558.58	559.01	559.33	559.66	0.8	1.1	N/A	N/A
Pilot Butte	PB20-1	Eastgate Drive Br. - Closed	579.48	578.56	576.37	576.46	576.51	576.57	576.74	577.11	1.4	1.8	N/A	N/A
Pilot Butte	PB28	Highway 33	575.53	574.93	573.67	573.80	573.88	573.91	574.13	574.85	0.1	0.8	N/A	N/A
Chuka	CH6	CN - CS4 Rail Br.	596.38	595.63	593.19	593.24	593.28	593.33	593.37	593.39	2.2	2.3	N/A	N/A

** Pilot Butte crossings downstream of the CP rail (PB14) would be affected if there was no flood overtopping to the south, upstream of PB14.*

Table 7-3: Simulated Flood Events for Culverts Within the Study Area*

Watercourse	Structure ID	Culvert Name/Location	Minimum Roadway Elevation	Simulated Flood Levels (m)						Freeboard for the Events (m)		Overtopping Design Event (1:Year)
				1:10- year	1:25 -year	1:50 -year	1:100 -year	1:200 -year	1:500 -year	1:500 -year	1:200 -year	
Pilot Butte	PB0	Saum's Property	612.52	612.73	612.77	612.81	612.85	612.89	612.95	-0.43	-0.37	10
Pilot Butte	PB01	Saum's Property	611.95	612.50	612.55	612.59	612.64	612.67	612.74	-0.79	-0.72	10
Pilot Butte	PB1	Saum's Property	612.48	612.49	612.55	612.58	612.62	612.66	612.71	-0.23	-0.18	10
Pilot Butte	PB1-1	Saum's Property	611.70	611.93	611.99	612.04	612.10	612.15	612.23	-0.53	-0.45	10
Pilot Butte	PB1-2	Saum's Property	611.06	611.80	611.85	611.89	611.95	611.99	612.05	-0.99	-0.93	10
Pilot Butte	PB2	Butte St.	611.51	611.79	611.84	611.87	611.92	611.95	612.00	-0.49	-0.44	10
Pilot Butte	PB3	Bardel Cres.	606.71	606.85	606.90	606.92	606.96	606.98	607.03	-0.31	-0.27	10
Pilot Butte	PB4	624 Access Rd.	605.09	605.08	605.09	605.10	605.12	605.13	605.15	-0.06	-0.04	25
Pilot Butte	PB5		602.86	602.93	602.97	602.99	603.02	603.04	603.08	-0.22	-0.18	10
Pilot Butte	PB7	Amarillo Ln.	601.51	601.56	601.59	601.61	601.65	601.67	601.71	-0.20	-0.16	10
Pilot Butte	PB9	East Dewdney Ave.	595.12	595.31	595.35	595.38	595.42	595.44	595.49	-0.37	-0.32	10
Pilot Butte	PB10	Range Rd. 2185	593.88	593.95	593.99	594.01	594.04	594.06	594.09	-0.21	-0.18	10
Pilot Butte	PB11	Grid Rd. N/S	587.02	586.68	586.80	586.89	586.98	587.03	587.08	-0.06	-0.01	200
Pilot Butte	PB12	Sherwood Greenhouse	585.89	586.02	586.11	586.21	586.38	586.47	586.55	-0.66	-0.58	10
Pilot Butte	PB13	CP Rail	586.77	585.77	586.02	586.17	586.36	586.46	586.53	0.24	0.31	N/A
Pilot Butte	PB14	Toer Rd.	582.72	582.80	582.81	582.81	582.82	582.85	582.90	-0.18	-0.13	10
Pilot Butte	PB15	E Dewdney Ave.	581.45	581.41	581.43	581.44	581.45	581.52	581.60	-0.15	-0.07	200
Pilot Butte	PB16	Prince of Wales Dr.	580.50	578.06	578.20	578.29	578.39	578.78	579.89	0.61	1.72	N/A
Pilot Butte	PB17	Dewdney Ave East	579.30	577.54	577.70	577.80	577.89	578.21	578.80	0.50	1.09	N/A
Pilot Butte	PB19	Eastgate Dr.	578.42	576.39	576.49	576.54	576.60	576.78	577.16	1.26	1.64	N/A
Pilot Butte	PB20-2	Victoria Ave.	579.35	576.37	576.46	576.51	576.57	576.74	577.11	2.24	2.61	N/A
Pilot Butte	PB21	Coleman St.	577.80	576.27	576.36	576.40	576.45	576.62	576.96	0.84	1.18	N/A
Pilot Butte	PB22	Quance St.	577.60	575.18	575.25	575.30	575.34	575.53	576.22	1.38	2.07	N/A
Pilot Butte	PB23	Heseltine Rd.	575.57	575.04	575.08	575.11	575.15	575.32	576.08	-0.51	0.25	500
Pilot Butte	PB24	Heseltine Rd. & Weir	575.18	574.11	574.29	574.40	574.49	574.93	576.05	-0.87	0.25	500
Pilot Butte	PB25	E Arens Rd.	575.98	574.00	574.17	574.27	574.34	574.71	576.03	-0.05	1.27	500
Pilot Butte	PB27	Truesdale Rd.	575.89	573.81	573.96	574.06	574.11	574.40	575.45	0.44	1.49	N/A
Pilot Butte	PB30	Assiniboine Ave. East	574.34	572.15	572.40	572.60	572.66	573.24	574.40	-0.06	1.10	500
Chuka	CH1	Wind Sail Park Culvert	605.00	605.16	605.23	605.27	605.30	605.33	605.35	-0.35	-0.33	10
Chuka	CH2	Emerald Gate	604.00	604.05	604.15	604.19	604.22	604.24	604.26	-0.26	-0.24	50
Chuka	CH3	Betteridge Rd.	599.37	598.17	598.24	598.28	598.32	598.36	598.39	0.98	1.01	N/A
Chuka	CH4	N/S Grid Emeral Park Rd.	595.58	595.63	596.49	597.39	597.71	597.72	597.72	-2.14	-2.14	10
Chuka	CH5	Royal Park Blvd.	597.70	595.34	596.49	597.39	597.71	597.72	597.72	-0.02	-0.02	100
Chuka	CH7	Oswald Dam	593.24	593.02	593.07	593.10	593.13	593.16	593.17	0.07	0.08	N/A
Chuka	CH8	Saskatchewan 624	591.43	590.48	590.69	590.82	591.03	591.19	591.31	0.12	0.25	N/A
Chuka	CH9	N/S Grid Rd.	580.56	580.33	580.59	580.62	580.64	580.65	580.67	-0.11	-0.09	25
Chuka	CH10	N/S Grid Rd.	576.42	575.80	576.37	577.15	578.00	578.40	578.56	-2.14	-1.98	50
Chuka	CH11	CN Rail - CS3 - Transload Yard	578.79	575.32	576.28	577.15	578.00	578.40	578.56	0.23	0.39	N/A
Chuka	CH12	D/S of CN Rail - Transload Yard	576.82	574.59	575.57	575.99	576.39	576.59	576.69	0.13	0.23	N/A
Chuka	CH13	Highway 1	576.84	574.51	575.45	575.80	576.13	576.30	576.39	0.45	0.54	N/A
Chuka	CH14	Anaquod Rd.	575.06	574.20	575.06	575.16	575.21	575.23	575.24	-0.18	-0.17	50
Chuka	CH15	Highway 33	574.38	573.09	574.04	574.57	574.68	574.71	574.72	-0.34	-0.33	50

** Pilot Butte crossings downstream of the CP rail (PB14) would be more severely affected if there was no flood overtopping to the south, upstream of PB14.*

8. FLOOD HAZARD MAPS

Flood Hazard Maps display the results of hydrologic and hydraulic investigations that show flooded areas for specified return periods or design storms. In addition to floodwater extents, a map may also delineate flood zones, including floodway and flood fringe, based on estimated water depth and/or velocity of a specified return period. These maps are used for regulatory purposes related to land use planning and flood mitigation (Natural Resources Canada, 2023).

The map has two zones: floodway and flood fringe (defined per Figure 8-1).

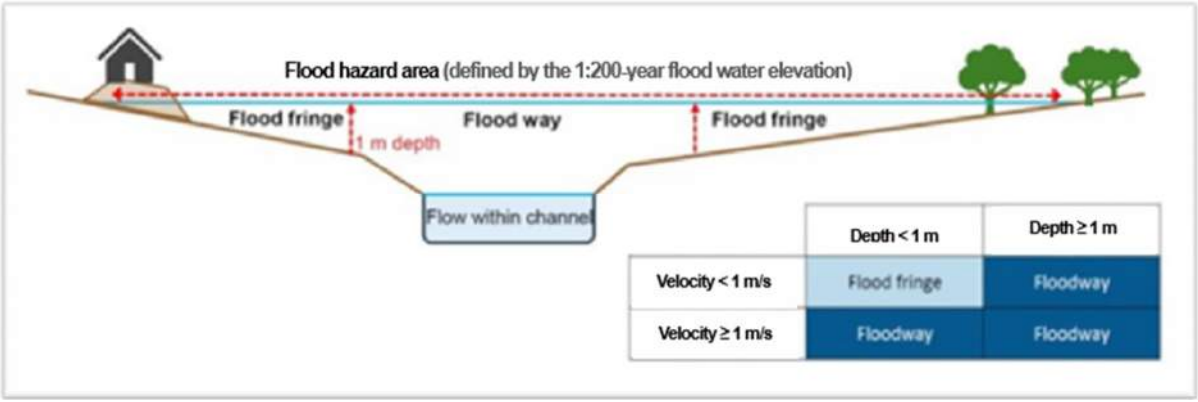


Figure 8-1: Flood Hazard Area Definitions (WSA, 2025)

8.1 Floodway and Flood Fringe Definitions

The June 2025 update of the SPI Regulations in Saskatchewan (Government of SK, 2025) designates the 1:200-year flood as the regulatory flood event. This designation serves as a basis for addressing the province's public safety interests in development planning. The following are the relevant definitions from the SPI Regulations for flood criteria maps.

- Flood Plain: the area inundated by water from a watercourse or water body during a 1:200-year flood and is made up of the Floodway and the Flood Fringe.
- Floodway: the portion of the flood plain adjoining the channel where the waters in the 1:200-year flood are projected to:
  - Meet or exceed a depth of one meter; or
  - Meet or exceed a velocity of one meter per second
- Flood Fringe: the portion of the flood plain inundated by the 1:200-year flood that is not a floodway.

8.2 Floodway Determination Criteria

Floodway and flood fringe maps were defined using the following criteria and the 1:200-year simulation outputs:

- Quality Assurance and Control (QA / QC) checks were conducted to ensure that simulated water surface profiles were hydraulically reasonable approximations of the simulated events.

- Simulated water depths of 1.0 m or greater or velocities of 1.0 m/s or higher were mapped as floodways, while the remaining portion of the flood hazard area was mapped as flood fringe. These areas were separated in the criteria maps to clearly distinguish between the two classifications.
- The main channel was included in the floodway. Locations within the main channel that did not meet the depth or velocity criterion were still considered part of the floodway to ensure map continuity. Where the banks of the main channel were unclear, such as in the upstream portions of Pilot Butte and Chuka Creeks, engineering judgment was applied based on the topography and criteria to define a continuous proposed floodway.
- Isolated inundated areas with a water depth equal to or more than one meter that was hydraulically connected to the main channel were included as part of the floodway. However, depressions and ponds within the flood fringe area were exempted from the floodway.
- Backwaters upstream of the structures were included in the floodway if the parameters met the defined criteria.
- No encroachment analysis was conducted to define the floodway; therefore, the criteria maps were developed based on existing conditions.

8.3 Floodway Criteria Maps

The criteria maps use the results from the regulatory flood (1:200-year) simulations to identify the areas alongside each watercourse that should be included in the floodway and flood fringe. Floodway criteria maps show the main channel and areas adjacent to the main channel, where water depth and velocities exceed the criteria and are used to delineate flood zones for the regulatory flood hazard maps. The criteria maps (Appendix C) show all the considerations for delineating the flood hazard area.

The computed depth and velocity of the criteria are shown on the map. Proposed boundaries for the floodway and flood fringe are also shown. The maps ultimately depict how the above criteria, together with engineering judgment, were used in generating the floodway and flood fringe maps. It can be seen from the maps that the depth criterion mainly controlled which areas were considered as floodways or flood fringe. This is mainly because of mild slopes, which are typical in the Prairies.

8.4 Flood Hazard Maps

Based on the floodway criteria maps, the flood hazard maps were generated (Appendix D). Some existing developments are located within the floodway, including permanent buildings between Albert St. and the CP Railroad on the north bank; and between Dewdney Ave. and Southam St. on the south bank of Wascana Creek. Additionally, a significant portion of the development in the Sherwood Forest County Club area also falls within the floodway.

9. CONCLUSIONS AND RECOMMENDATIONS

This report outlines the modelling process and results for the Flood Mapping Study of Regina, aimed at updating the flood inundation boundary and flood hazard map within the AOI along Wascana, Pilot Butte, and Chuka Creeks. The model was developed using updated flow data (January 2024), the most recent DEM (2019 lidar), and up-to-date land cover and land use information from the City of Regina GIS database and field surveys conducted in 2023 and 2024.

Survey data was incorporated to refine the channel profile and include the current conditions of structures and flood protection dykes within the model.

The model was developed using HEC-RAS 6.4.1 software and the sensitivity of mesh size was examined to select an appropriate resolution and identify refinement areas. The model was calibrated and validated based on available data, with the results thoroughly reviewed. These results are considered suitable for community planning purposes, given the assumptions made and the available information.

Since the previous model results (1982), changes in flow rates, developed areas, and flood protection structures can result in changes in flood inundation extent and hazard maps.

In most cases, the existing dykes are overtopped or bypassed by a 1:100-year flood event. However, north of Dewdney Ave, flooding occurs due to a gap between the left bank dyke and the road. Similarly, the Riverside Dyke is overtopped because of a gap in the approach to the Cameron St. Br. If these gaps are filled, these dykes will remain intact against floods up to a 1:200-year flood event.

Recommendations based on the results of this study are as follows:

.1 Significant overtopping upstream of CP Rail along Pilot Butte (nearly 65% of a 1:200-year flood) means that flood maps may not accurately represent future inundation conditions downstream of this crossing if it is upgraded in the future. Similarly, flood inundation estimates for Chuka Creek, downstream of CP Rail and for a certain distance upstream, might be overestimated. It is recommended to conduct an analysis considering modifications at this crossing to develop separate flood maps for future construction projects to accommodate reliable planning.

.2 All dykes should be upgraded, repaired, or raised to accommodate the regulatory flood.

.3 This study did not account for operational activities and flood protection measures (such as sandbagging), particularly around the dykes. Including these activities in future assessments could provide a more accurate prediction of flood-prone areas.

.4 The study did not account for maintenance or a flood management plan; therefore, during flood events, it is crucial to monitor structures and bridges that may be susceptible to pressure flow or overtopping. The presence of obstructions, debris, and ice can significantly exacerbate flood extension.

.5 To support future modelling updates, it is recommended to survey flood water levels and estimate the flow rates at accessible bridge and culvert crossings throughout the city.

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Appendix A. Hydrology Update for the City of Regina (WSA 2024)

Saskatchewan

Memorandum

From: Hafiz Faizan Ahmed
Hydrologist,
Hydrology Services South.

Date: January 22, 2024

Email: Hafiz.ahmed@wsask.ca
Phone: (306) 630-4685

To: Cesar Perez-Valdivia
Manager,
Hydrology Services North.

File: H5-5

Re: Hydrology Update for the City of Regina

A flood mapping study for the city of Regina was completed by Tetra Tech (Report # 1099-001-3.2.1.3-R004 R0) in June 2020. The flood estimates for different return periods were reported for Wascana Creek at Albert Street as well as for its two tributaries: (1) Pilot Butte Creek and (2) Chuka Creek. These locations are illustrated in the above referenced report (refer to Map 01 - Sheet 01). The prior flood assessments for the city were based on the Saskatchewan Environment 1980 hydrology study. Tetra Tech adopted the same results of 1980 hydrology study for their work based on the cursory analysis i.e., after reviewing flood frequency results for a downstream hydrometric station (Wascana Creek near Lumsden, 05JF005) and approximately estimated flows for Wascana Creek in Wascana Lake Hydrology Study (2017) by Water Security Agency. Martin Grajczyk (Manager Hydrology Services South) reviewed Tetra Tech report and noted that the recent 40+ years of data must be used in the current hydrological analysis. The present analysis addresses this deficiency and reevaluates the hydrology for the city of Regina. Furthermore, seven additional flow locations (three on Chuka Creek and four on Pilot Butte Creek) were considered in this analysis on AECOM's request to support the Regina Flood Modelling and Mapping Study. These locations are shown on the map in Appendix A.

CATCHMENT HYDROLOGY AND SCOPE OF WORK

The Wascana Creek is a major tributary of the Qu'Appelle River, with its headwater located near the village of Vibank. The Wascana Creek watershed drains about 3,400 km^2 to the city of Regina.

A large area of this watershed, about 3,000 km^2 (88% of the total area) passes through the Kronau Marsh, which influences downstream flows depending upon its available storage capacity. About 7 km downstream of the Kronau Marsh, a tributary namely "Hunter Creek" joins the Wascana Creek near Richardson. The gross and effective drainage areas for Hunter Creek are 143 km^2 and 105 km^2, respectively. Further downstream (between 5 to 10 km), two other tributaries (Chuka Creek and Pilot Butte Creek) join the Wascana Creek in the City of Regina. The gross drainage area of Chuka Creek was estimated as 40 km^2, all of which was considered effective. Similarly, the gross and effective drainage areas of Pilot Butte Creek were estimated as 118 km^2 and 64 km^2, respectively. In addition to these two tributaries, the city uses two storm channels (north storm channel and south storm channel) to discharge urban runoff into the Wascana Creek. Typically, the hydrograph is dominated by spring snowmelt in the region. However, it was observed by the Saskatchewan Environment staff that urban runoff from the spring snowmelt is a long and gradual process (Flood Peak Potential Regina Storm Channels, 1980, Saskatchewan Environment Hydrology Branch, Report No. HYD-5-51). Accordingly, the previous flood estimates for the storm channels were derived by summer rainfall events unlike rest of the watershed. The highest spring snowmelt event was recorded in 1974 along with observing several other high spring runoff years e.g., 1971, 1982, 1996, and 2011. The scope of this study is limited to determining flood potentials for the Wascana Creek along with its two tributaries (Chuka Creek and Pilot Butte Creek) and storm channels were not considered.

AVAILABLE DATA

The flow data from several hydrometric stations are available, both within the catchment of interest as well as in the nearby regions. The hydrometric station at Wascana Creek below Kronau Marsh (05JF012) is the most important dataset because it accounts for about 88% of the Wascana Creek watershed to the City of Regina. The flow data from this hydrometric station is available from 1974 to the present. The continuous flow record isn't directly available from Chuka Creek and Pilot Butte Creek; however, the hydrometric station at Hunter Creek near Richardson (05JF014) is in a very close proximity to these tributaries and represent these watershed characteristics very well. This station (05JF014) has a continuous flow record from 1979 to the present. There are three hydrometric stations in the vicinity of the catchment of interest where the flow record extends back to 1944. These stations are: (1) Wascana Creek near Sedley, 05JF004 (GDA = 860 km^2, EDA = 220 km^2); (2) Wascana Creek near Lumsden, 05JF005 (GDA = 3,868 km^2, EDA = 1,760 km^2); and (3) Boggy Creek near Lumsden, 05JF006 (GDA = 442 km^2, EDA = 234 km^2). These three stations were considered to extend the annual peak flow record for 05JF012 and 05JF014.

METHODOLOGY

A correlation analysis was conducted on the annual mean daily peak flows to determine the suitability of the hydrometric stations for the flow record extension of the designated hydrometric station. Two hydrometric stations (05JF004 and 05JF005) were considered for extending the flow record at Wascana Creek below Kronau Marsh (05JF012). The results of the correlation analysis

are presented in Table 1, suggesting a very strong correlation between Wascana Creek below Kronau Marsh (05JF012) and Wascana Creek near Lumsden (05JF005). Similarly, a correlation analysis was conducted to determine the suitable hydrometric station for extending the annual mean daily peak flows for Hunter Creek near Richardson (05JF014). The results are presented in Table 2 and Boggy Creek near Lumsden (05JF006) was chosen based on the results. The flow records were extended using the standard "Maintenance of Variance Type 3 (MOVE 3)" method as recommended in "Guidelines for determining flood flow frequency – Bulletin 17C".

Table 1. Correlation Matrix for the selected hydrometric stations

	Wascana Creek below Kronau Marsh (05JF012)	Wascana Creek near Lumsden (05JF005)	Wascana Creek near Sedley (05JF004)
Wascana Creek below Kronau Marsh (05JF012)	1	-	-
Wascana Creek near Lumsden (05JF005)	0.97	1	-
Wascana Creek near Sedley (05JF004)	0.90	0.80	1

Table 2. Correlation Matrix for the selected hydrometric stations.

	Hunter Creek near Richardson (05JF014)	Wascana Creek near Sedley (05JF004)	Boggy Creek near Lumsden (05JF006)
Hunter Creek near Richardson (05JF014)	1	-	-
Wascana Creek near Sedley (05JF004)	0.65	1	-
Boggy Creek near Lumsden (05JF006)	0.88	0.74	1

The extended flow record for Wascana Creek below Kronau Marsh (05JF012) and Hunter Creek near Richardson (05JF014) were used for the flood frequency analysis. The HEC-SSP (version 2.3 beta.4) statistical software package, from Hydrologic Engineering Center of US Army Corps of Engineers, was used for the purpose. The Bulletin 17C method was adopted, which fits the Log Pearson Type III distribution while its moments/parameters are estimated using the Expected

Moments Algorithm (EMA), for Wascana Creek below Kronau Marsh (05JF012). The Bulletin 17C method didn't work well for Hunter Creek (05JF014) and it was determined that Gamma distribution with Maximum Likelihood Estimation (MLE) method for its parametrization produced best results. The flood frequency results for Wascana Creek below Kronau Marsh and Hunter Creek near Richardson are presented in Appendix B. The estimated peak potential flows for the Hunter Creek near Richardson (05JF014) were transferred to the Chuka Creek and Pilot Butte Creek at their intersection with Highway #33 following single station transfer technique as outlined in the 1993 Sask Water Report "Magnitude and Frequency of Peak Flows and Volumes in Saskatchewan". The flows at additional requested locations on Chuka Creek and Pilot Butte Creek (Appendix A) were derived from the estimated flows of these creeks at Highway #33 proportional to their respective gross drainage areas.

PEAK FLOW TIMING

The observed peak flows for the highest spring snowmelt year (1974) suggested that the peak flow passed through the tributaries of Wascana Creek (i.e., Hunter Creek, Chuka Creek, and Pilot Butte Creek) about 5-6 days in advance compared to the Wascana Creek mainstem. The continuous flow record indicated that the flows at Hunter Creek were only 7% of its peak at the time of peak flows at Wascana Creek below Kronau Marsh. The difference in peak flow timing between Hunter Creek and Wascana Creek below Kronau Marsh was about 2 weeks for the second highest recorded flood in 2011. The continuous flow record indicated that the flows at Hunter Creek were about 11% of its peak at the time of peak flows at Wascana Creek below Kronau Marsh for this year. It should be noted that the lag time for peak flow from Wascana Creek below Kronau Marsh to Wascana Creek at Albert Street has been reported to be 24-48 hours. Thus, the contribution from the tributaries into the peak flows for Wascana Creek can be considered to be negligible, particularly for the low frequency floods. The same was concluded in "Flood Peak Potential Wascana Creek at Regina (1980) – Saskatchewan Environment, Hydrology Branch (Report No. HYD-5-50)". A more recent study "Wascana Creek Water Control Study – Final Report, Step 1 (1998)", which was conducted by Marshal Macklin Monaghan (MMM) for the City of Regina, also suggested that the peak flow at Wascana Creek below Kronau Marsh and Wascana Creek at Albert Street are very similar in magnitude and only lagged by time. The study identified storage in the channel and floodplains as one of the controlling factors.

PEAK INSTANTANEOUS FLOW

The flood frequency analysis was completed using the peak mean daily flow data; however, peak instantaneous flows can be expected to be higher than peak mean daily flows. The percent increase factor was determined based on the observed peak instantaneous and peak mean daily flow data at Hunter Creek near Richardson (05JF014) and Wascana Creek below Kronau Marsh (05JF012). The estimated peak mean daily flows were increased by 5% for Wascana Creek mainstem, and by 20% for Pilot Butte Creek and Chuka Creek.

FLOOD ASSESSMENT RESULTS

The estimated flood potentials for different return periods at Wascana Creek below Kronau Marsh, Chuka Creek, and Pilot Butte Creek are summarized in Table 3. The previous 1: 500-Year peak instantaneous flow for Wascana Creek was 180 m^3/s (based on 1980 Hydrology Study) and the current estimate is 16% higher than the previous estimate. Similarly, the 1: 500-year peak instantaneous flow estimates of this study are 18% and 33% higher than previous estimates for Pilot Butte and Chuka creeks, respectively. The estimated flood potential at additional flow locations on Chuka Creek and Pilot Butte Creek are provided in Table 4 and Table 5, respectively along with their estimated effective and gross drainage areas.

Table 3. Estimated spring snowmelt runoff potentials for the City of Regina at desired Locations.

Return Period	Wascana Creek below Kronau Marsh		Pilot Butte Creek at Highway #33		Chuka Creek at Highway #33	
	Mean daily flow (m^3/s)	Instantaneous flow (m^3/s)	Mean daily flow (m^3/s)	Instantaneous flow (m^3/s)	Mean daily flow (m^3/s)	Instantaneous flow (m^3/s)
1: 10 Year	50	53	8.0	9.6	5.7	6.8
1: 25 Year	83	87	12	15	8.7	10
1: 50 Year	110	116	15	19	11	13
1: 100 Year	137	144	20	24	13	16
1:200 Year	164	172	25	30	15	18
1: 500 Year	199	209	33	39	17	20

Table 4. Estimated spring snowmelt runoff potentials for Chuka Creek (Additional Locations)

Return Period	Chuka Creek 1: Below Intersection of White City Dr. and Lott Rd. (Lat: 50.44, Long: -104.37).		Chuka Creek 2: Below first local confluence (Lat: 50.42, Long: -104.42).		Chuka Creek 3: Below second local confluence (Lat: 50.41, Long: -104.47).	
	GDA & EDA = 4 km^2		GDA & EDA = 13 km^2		GDA & EDA = 27 km^2	
	Mean daily flow (m^3/s)	Instantaneous flow (m^3/s)	Mean daily flow (m^3/s)	Instantaneous flow (m^3/s)	Mean daily flow (m^3/s)	Instantaneous flow (m^3/s)
1: 10 Year	0.6	0.7	1.9	2.2	3.8	4.6
1: 25 Year	0.9	1.0	2.8	3.4	5.9	7.0
1: 50 Year	1.1	1.3	3.6	4.3	7.4	8.9
1:100 Year	1.3	1.6	4.2	5.1	8.8	11
1: 200 Year	1.5	1.8	4.9	5.9	10	12
1: 500 Year	1.7	2.0	5.5	6.6	11	14

Table 5. Estimated spring snowmelt runoff potentials for Pilot Butte Creek (Additional Locations)

Return Period	Pilot Butte 1: Upstream model boundary (Lat: 50.47, Long: -104.41).		Pilot Butte 2: West of Sherwood Greenhouse and Garden Centre (Lat: 50.45, Long: -104.49).		Pilot Butte 3: Northwest of Coffard Street (Lat: 50.45, Long: -104.49).		Pilot Butte 4: Northwest of VOS Industries and Dewdney Avenue East (Lat: 50.46, Long: -104.52).	
	GDA = 57 & EDA = 7 km^2		GDA = 84 & EDA = 30 km^2		GDA = 89 & EDA = 35 km^2		GDA = 107 & EDA = 53 km^2	
	Mean daily flow (m^3/s)	Instantaneous flow (m^3/s)	Mean daily flow (m^3/s)	Instantaneous flow (m^3/s)	Mean daily flow (m^3/s)	Instantaneous flow (m^3/s)	Mean daily flow (m^3/s)	Instantaneous flow (m^3/s)
1: 10 Year	3.9	4.6	5.7	6.8	6.0	7.2	7.3	8.7
1: 25 Year	5.8	7.0	8.5	10	9.1	11	11	13
1: 50 Year	7.2	8.7	11	13	11	14	14	16
1:100 Year	10	12	14	17	15	18	18	22
1: 200 Year	12	14	18	21	19	23	23	27
1: 500 Year	16	19	23	28	25	30	30	36

CLIMATE CHANGE

The timing and magnitude of future stream flows were not adjusted for potential impacts of climate and/or land-use changes. Due to the relatively short period of recorded stream flows, and wide natural variability in the prairies, there is presently no consensus on the magnitude of climate change impacts on the prairie stream flows.

Should you have any questions or concerns, please contact me.

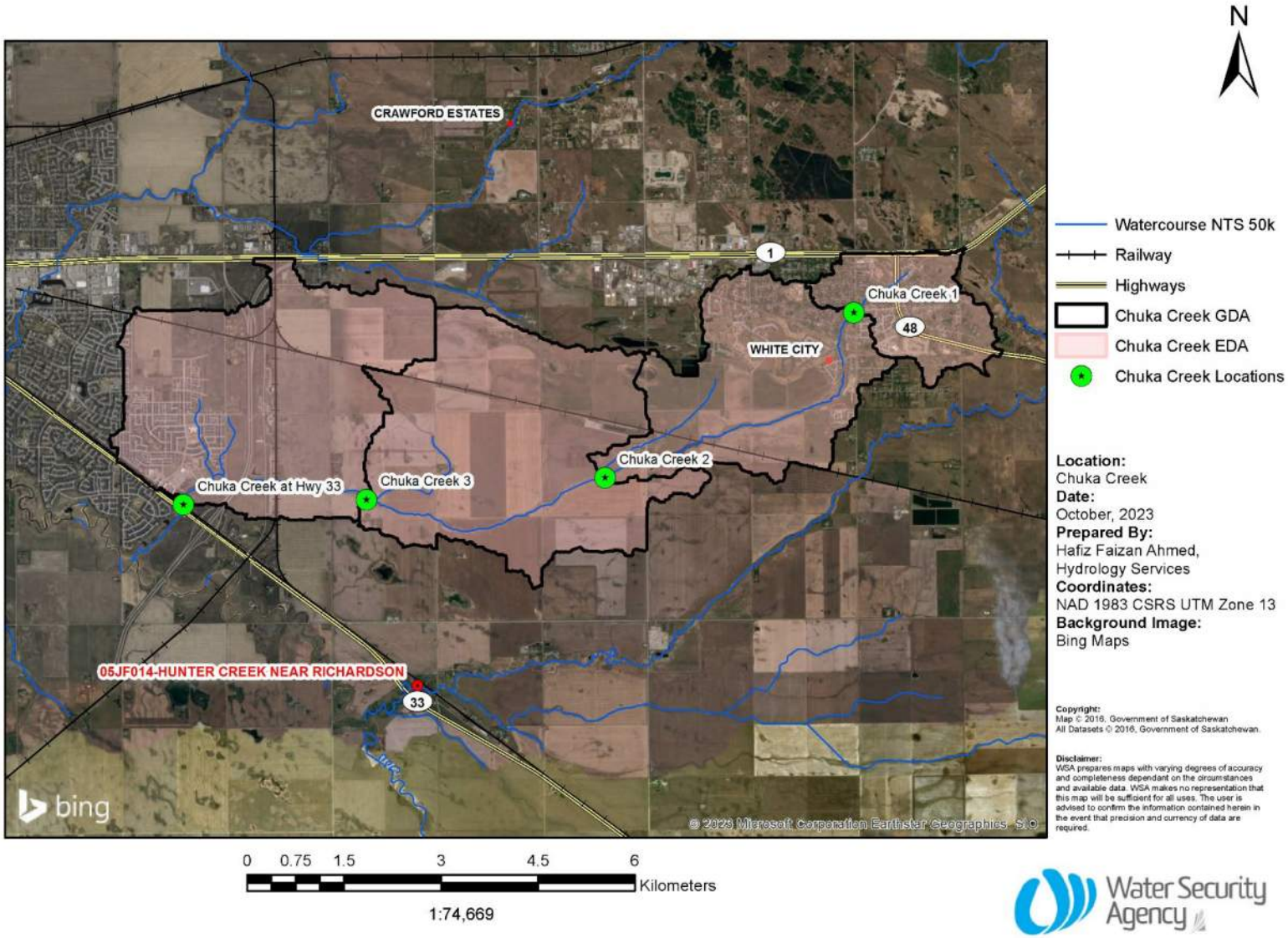
Best Regards,





Hafiz Ahmed (Ph.D., P.Eng., P.Ag.)

Appendix A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October, 2023
Prepared By:
Hafiz Faizan Ahmed,
Hydrology Services
Coordinates:
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Background Image:
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Copyright:
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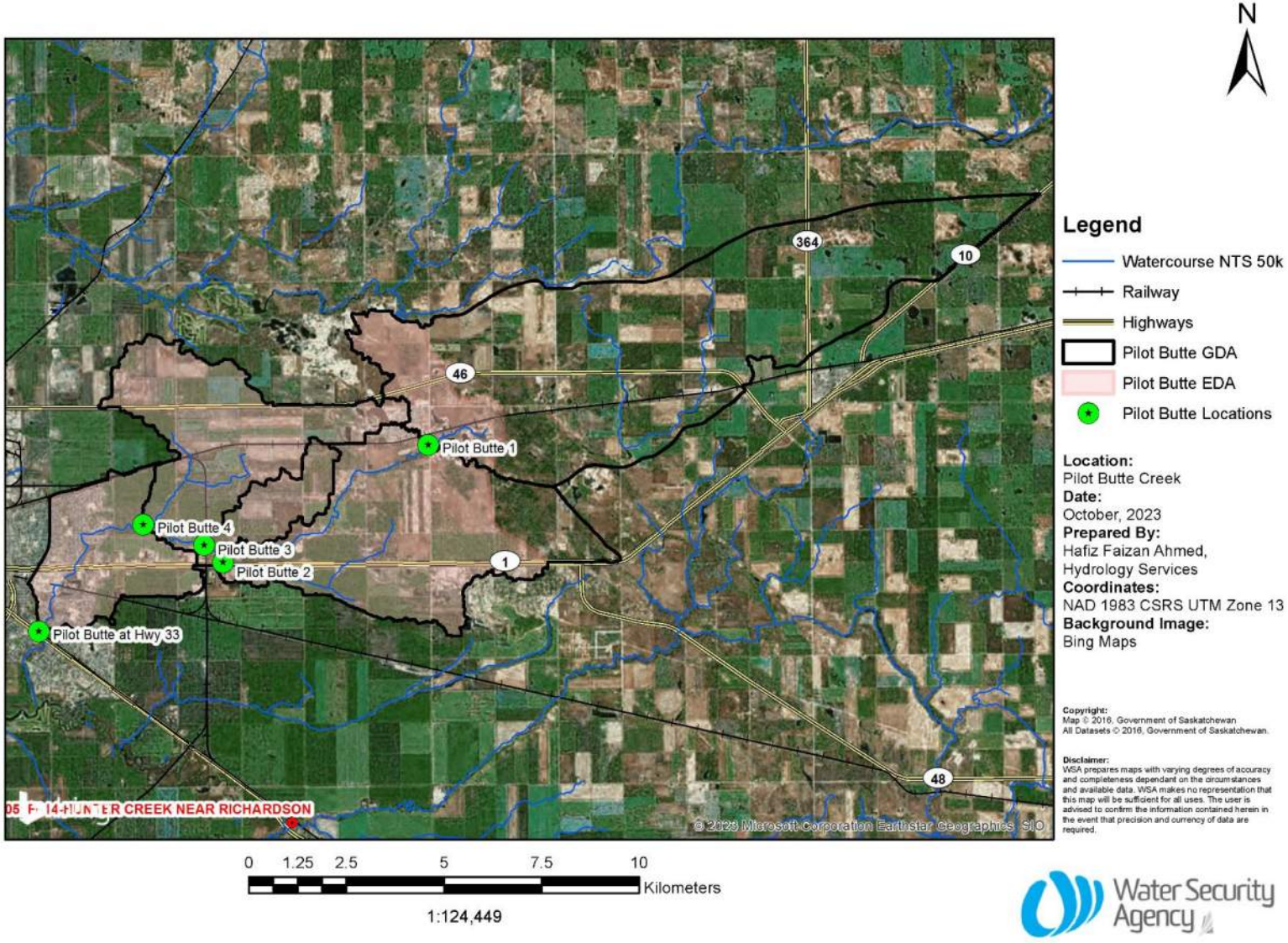
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Date:
October, 2023
Prepared By:
Hafiz Faizan Ahmed,
Hydrology Services
Coordinates:
NAD 1983 CSRS UTM Zone 13
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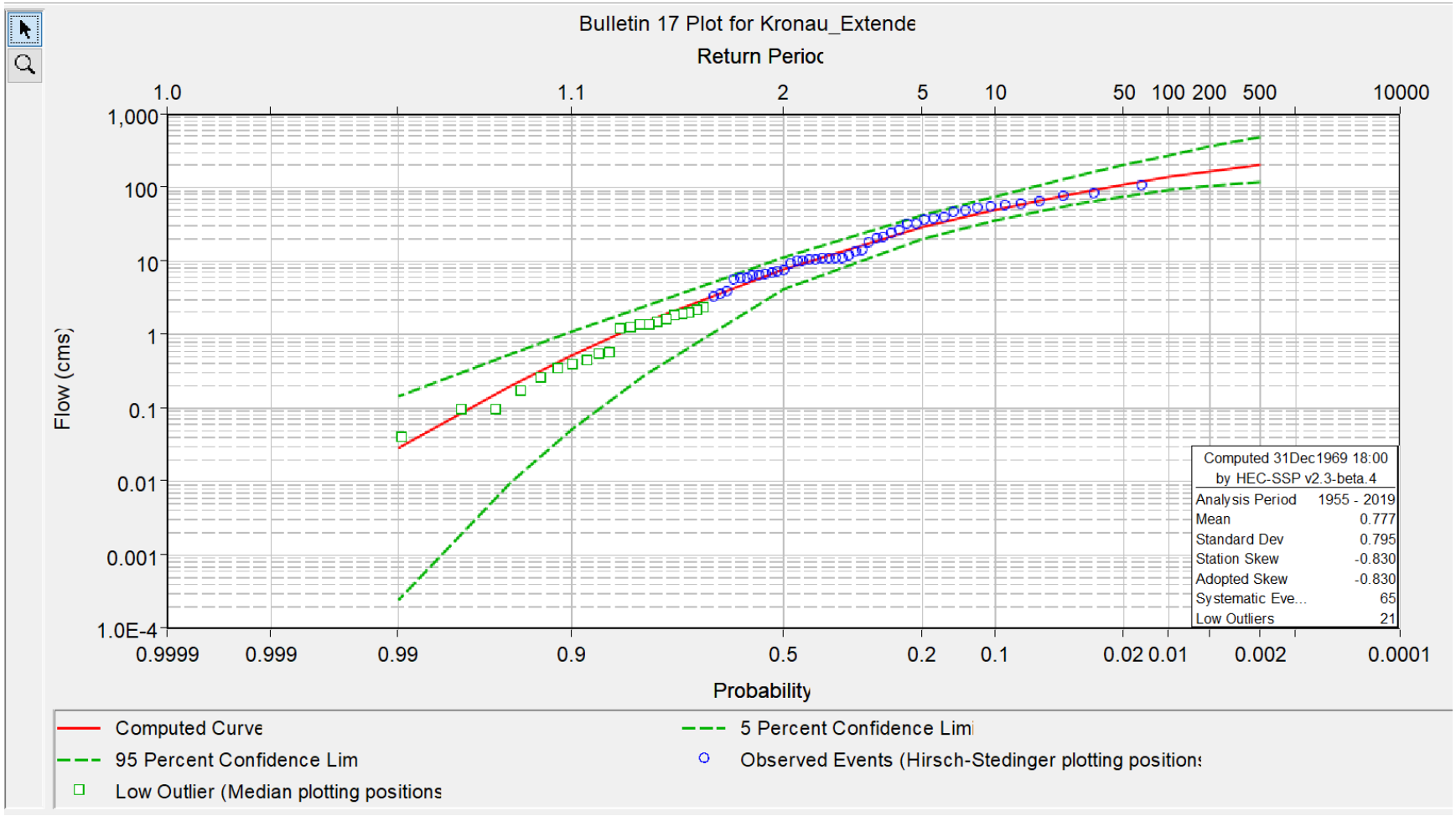
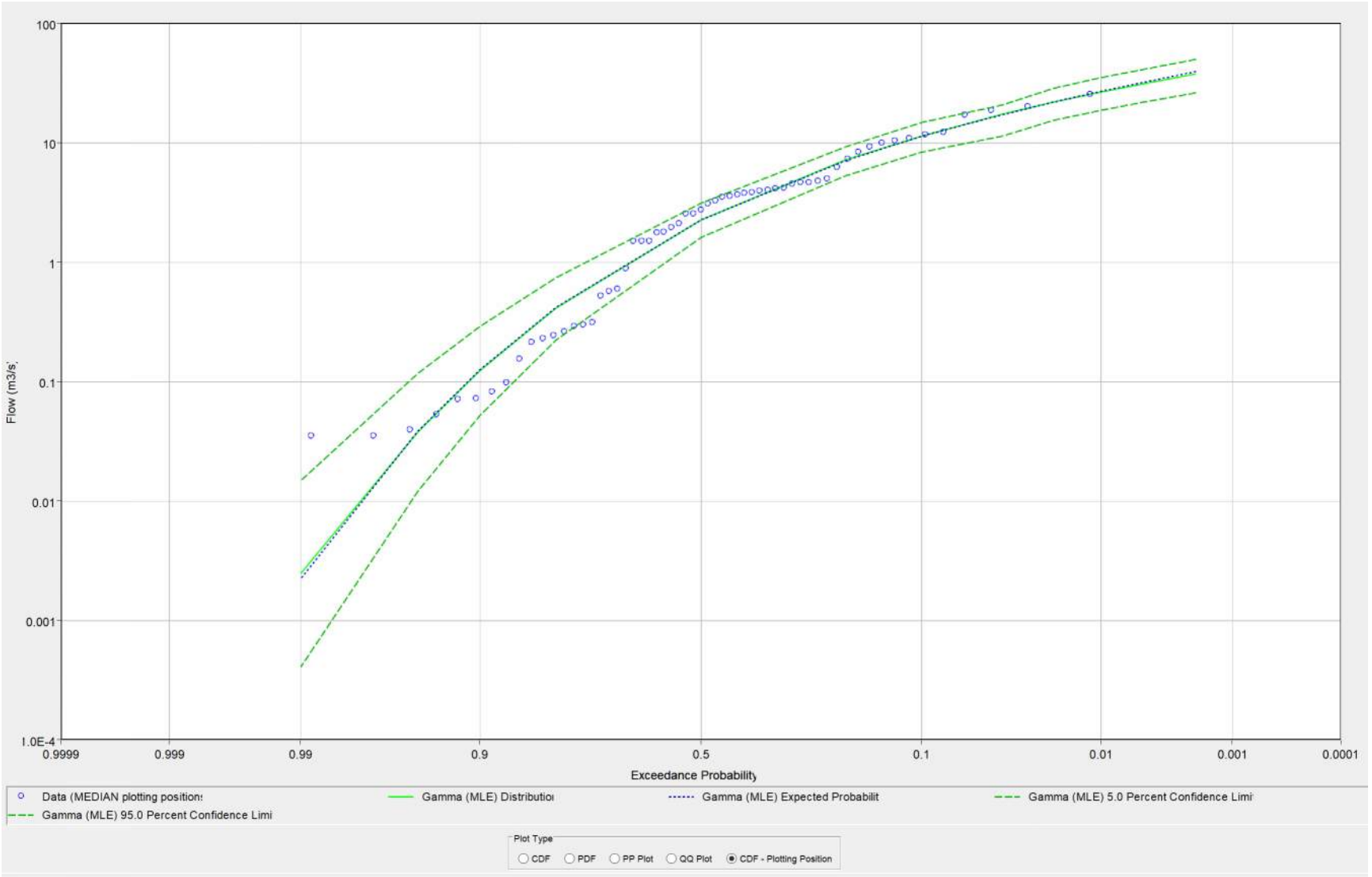
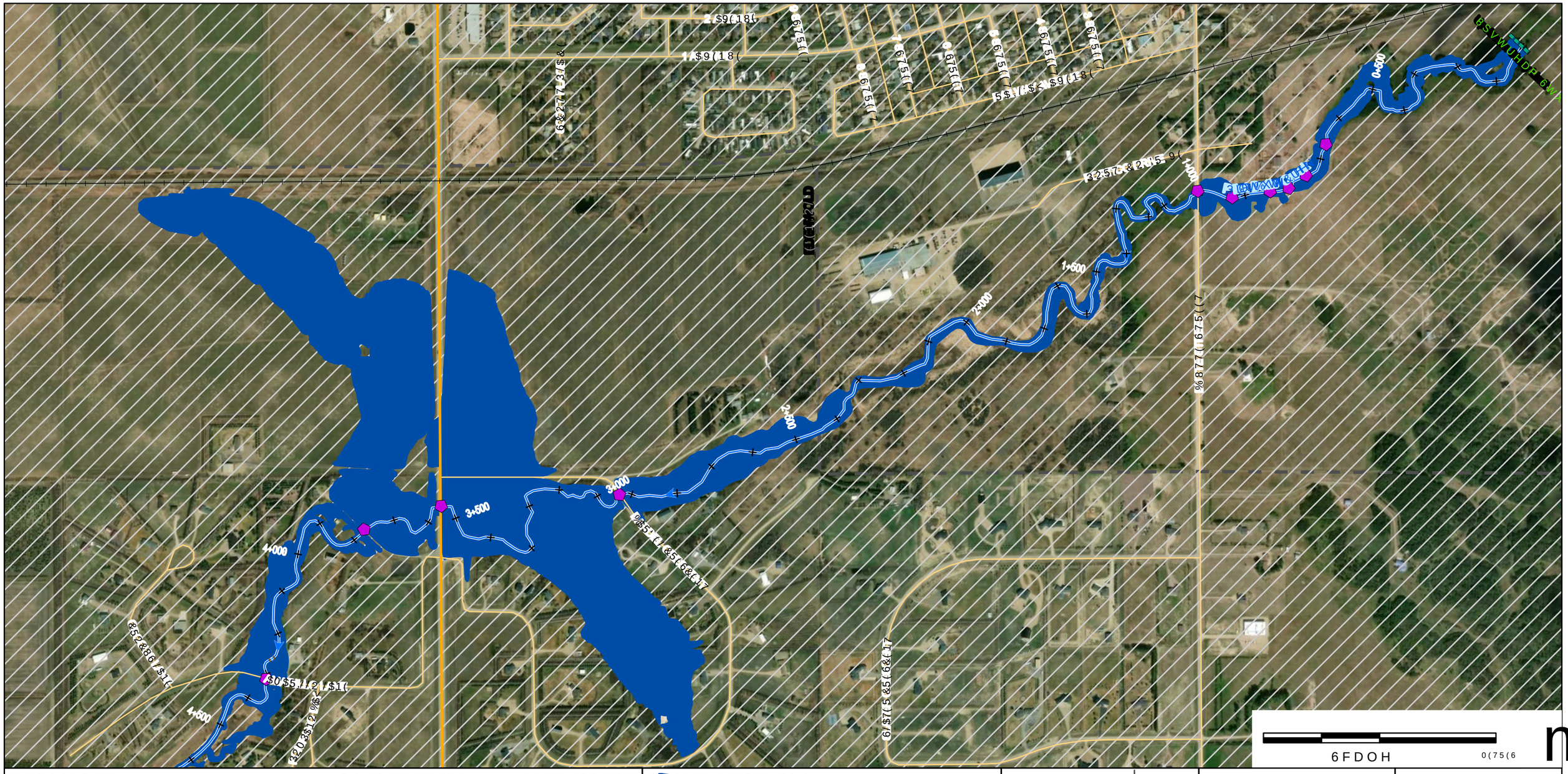
Frequency plot for Wascana Creek below Kronau Marsh.



Frequency plot for Hunter Creek near Richardson.



Appendix B. FLOOD INUNDATION MAPS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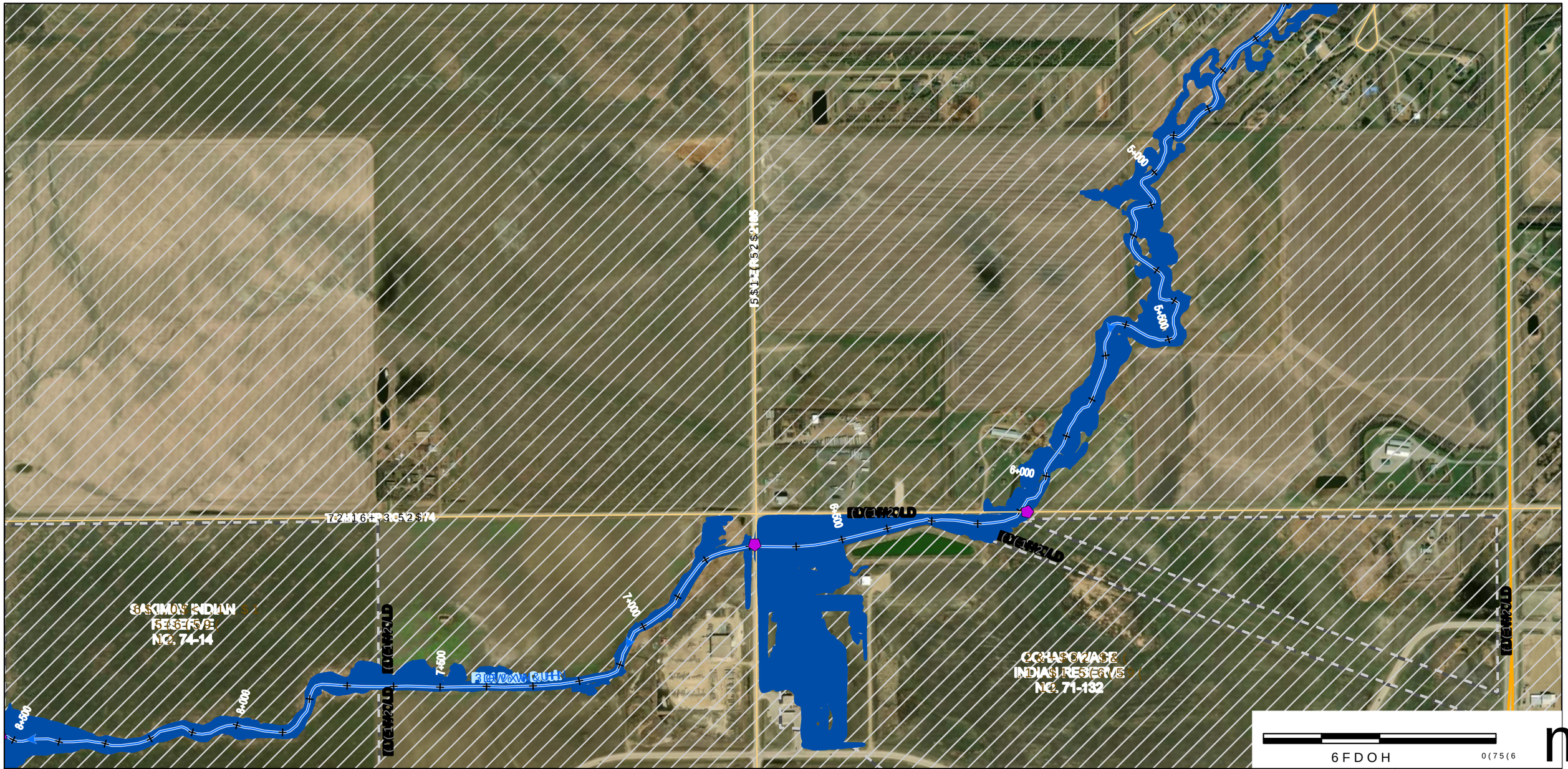
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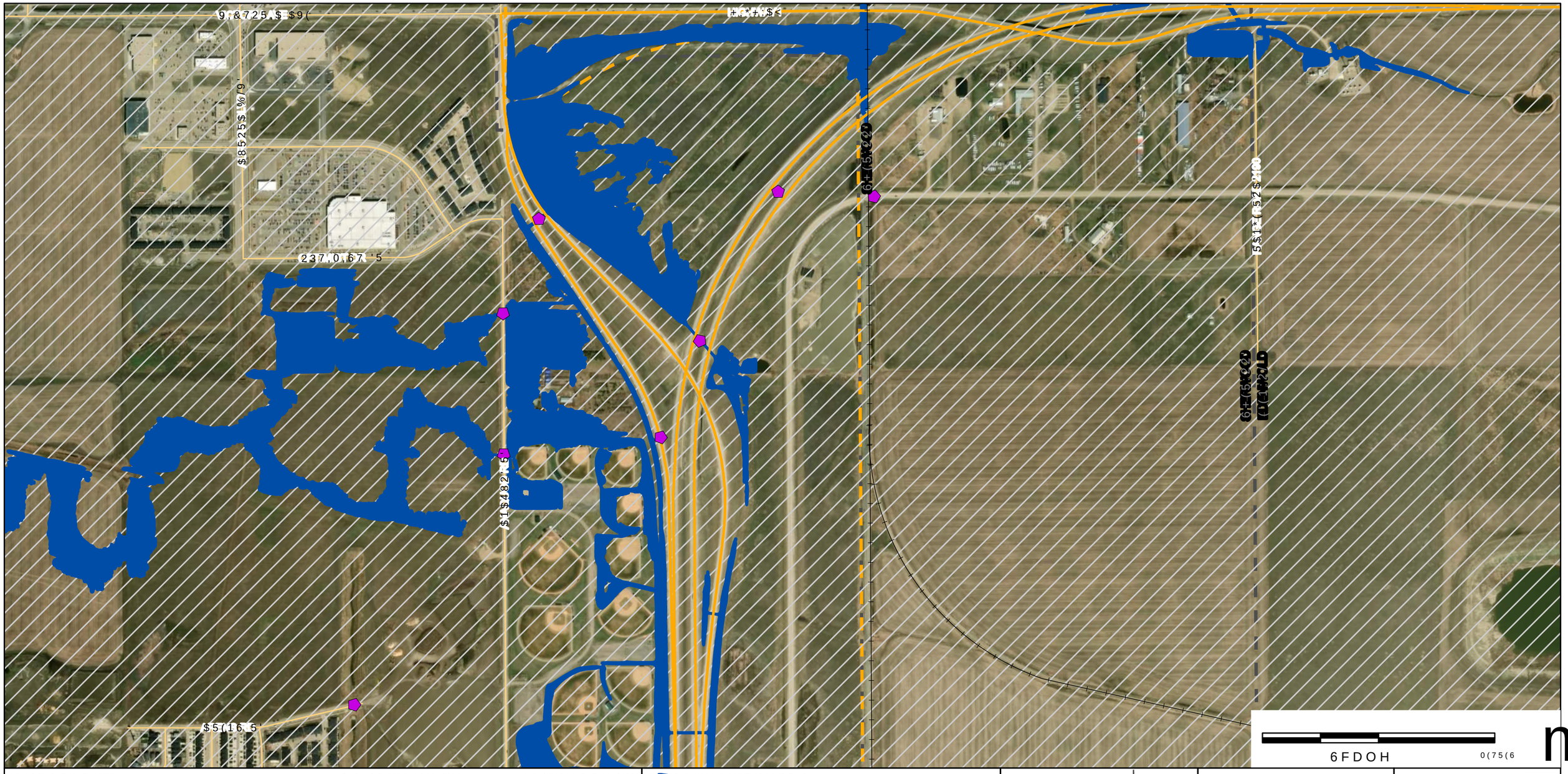

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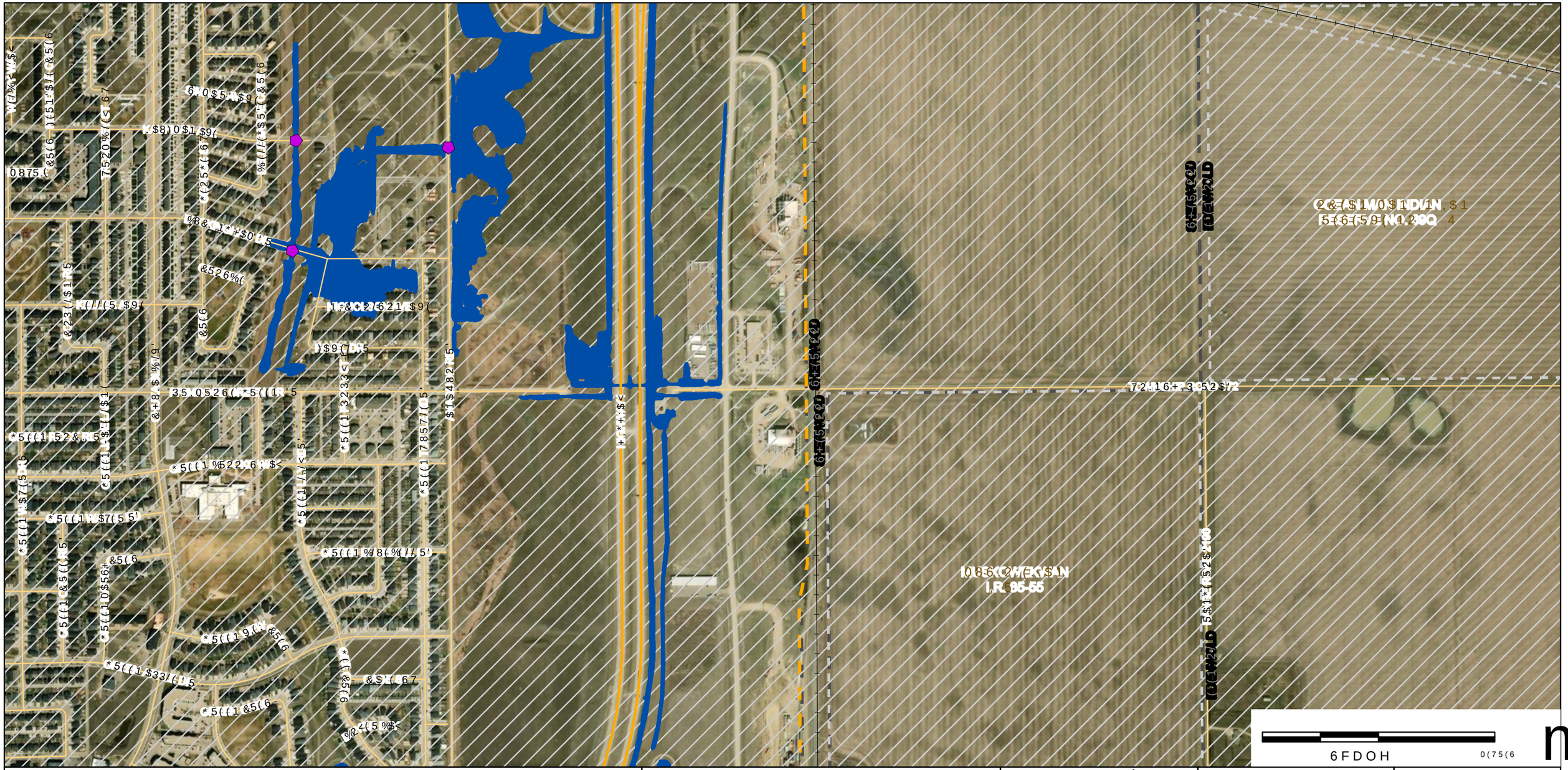

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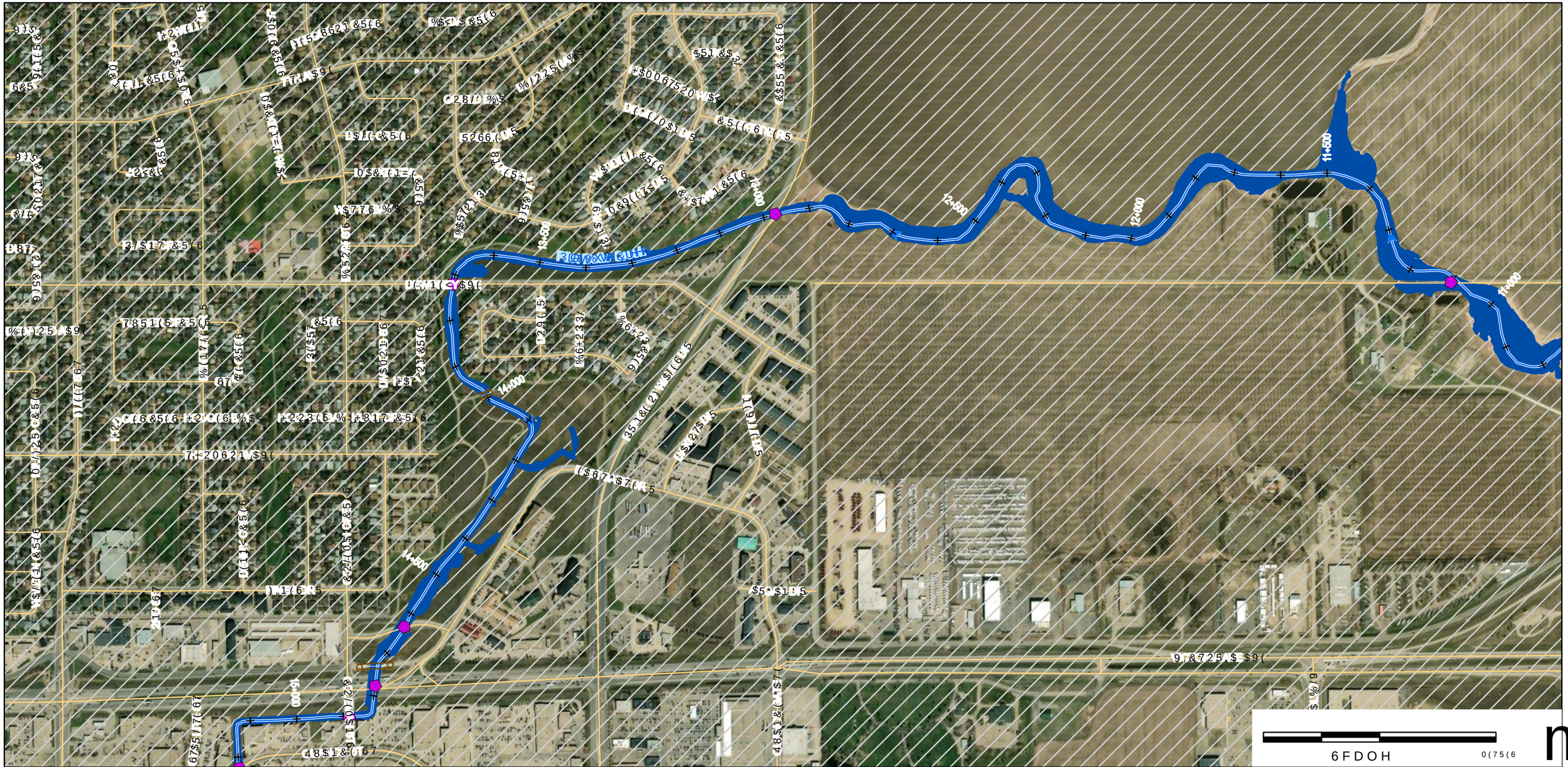

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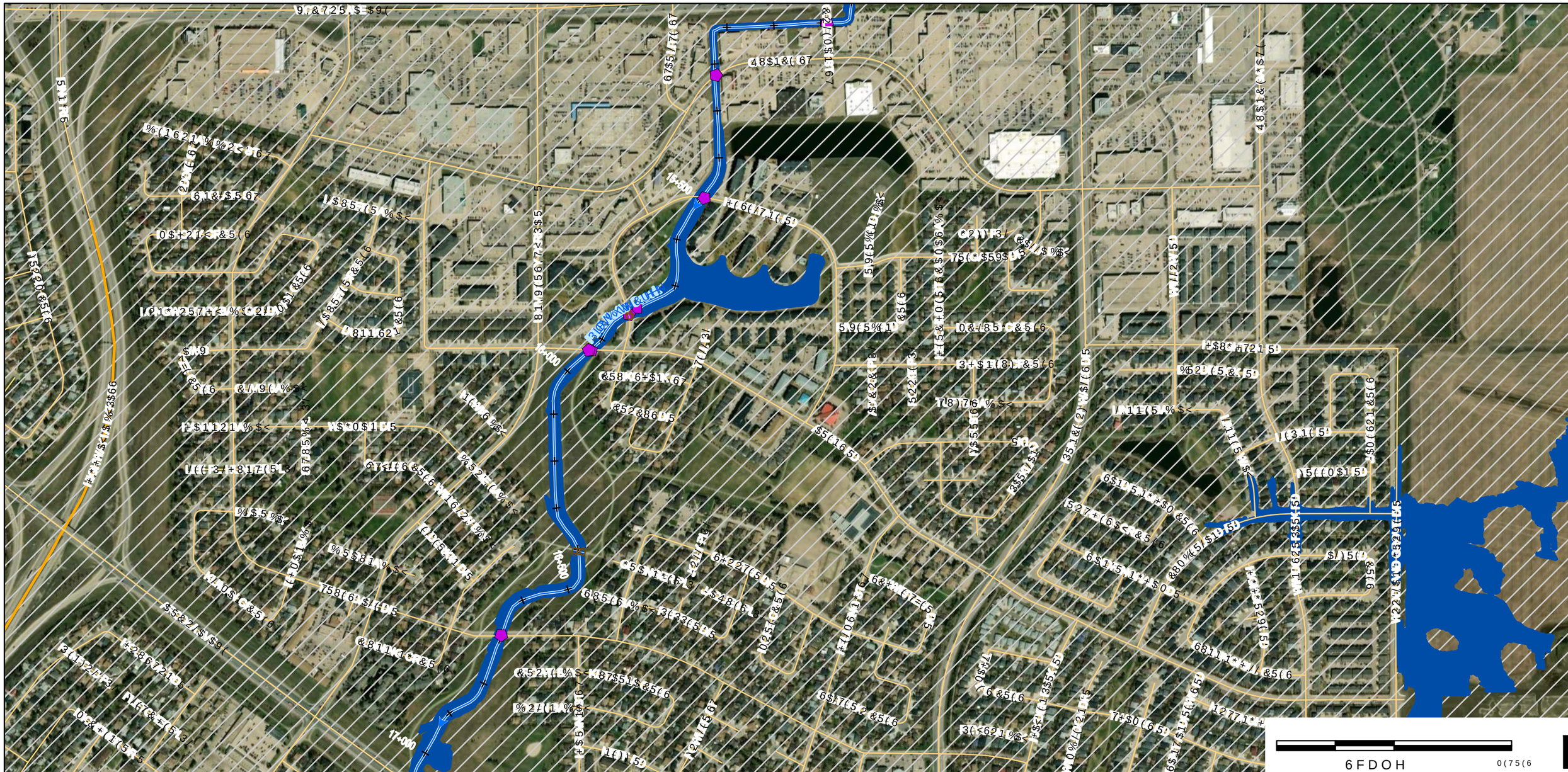

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ERUGHUOLQH SURSHUWLHV
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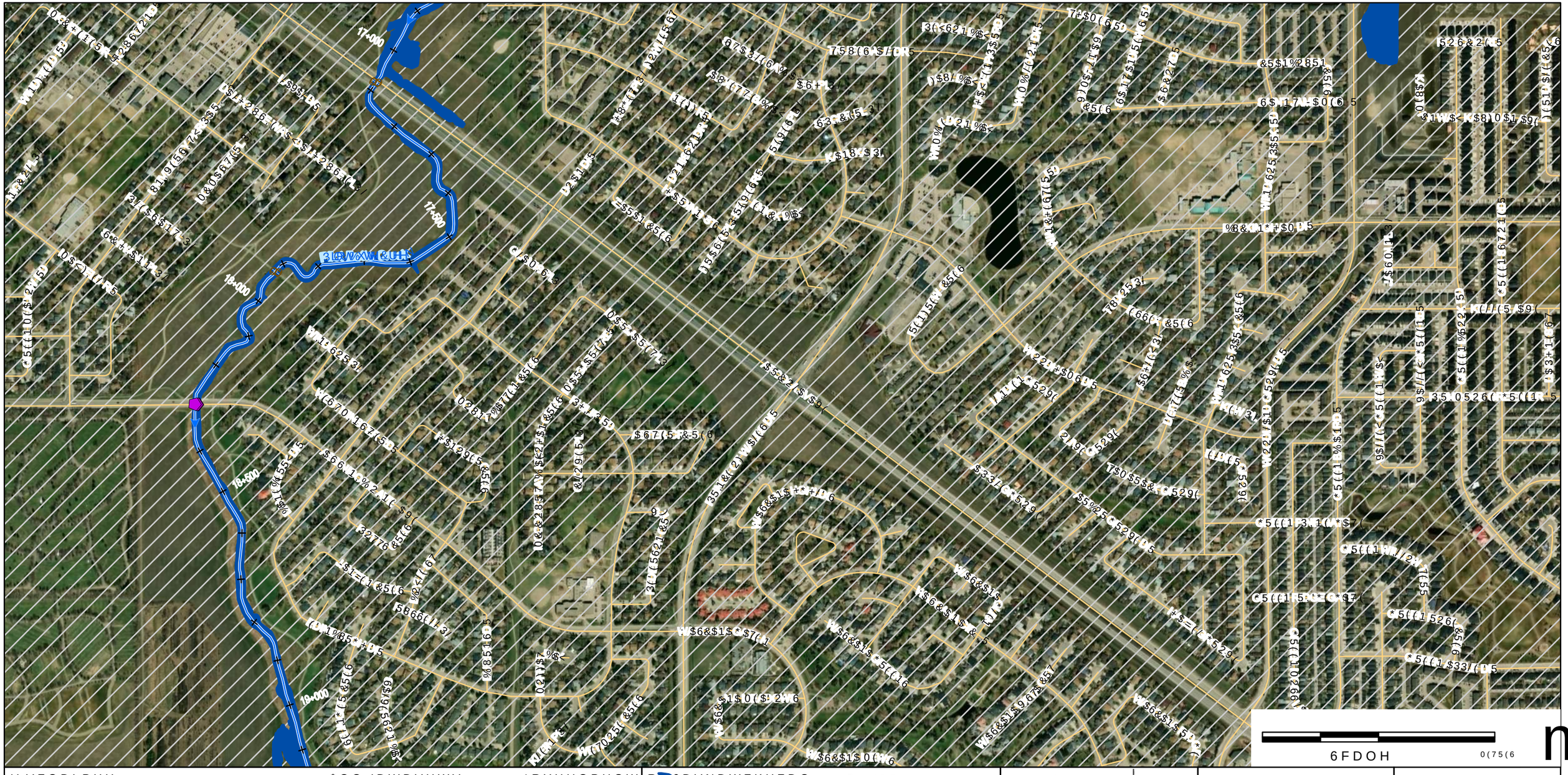

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UHSUHVHQWDWLRQ WKDW WKLV PDS
7KH
XVHU LV DGYLVHG WR FRQILUP WKH
LQ
WKH HYHQW WKDW SUHFLVLRQ DQG
:6$ UHFRPPHQGV FRQILUPLQJ WKH
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6RRG &DQDGD VWDWXV RI
1RWHV
6KHHWV DQG PD\ QRW EH LQFOXGHG LQ WKH PDS VHULHV LI
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6WXG\ /LPLWV
:DWHUFRXUVH &HQWHUOLQH
)ORZ 'LUHFWLRQ
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+\GURPHWULF *DXJLQJ 6WDWLRQ
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VQGLJHQRXV /DQG
5HJLQD &LW\ /LPLW
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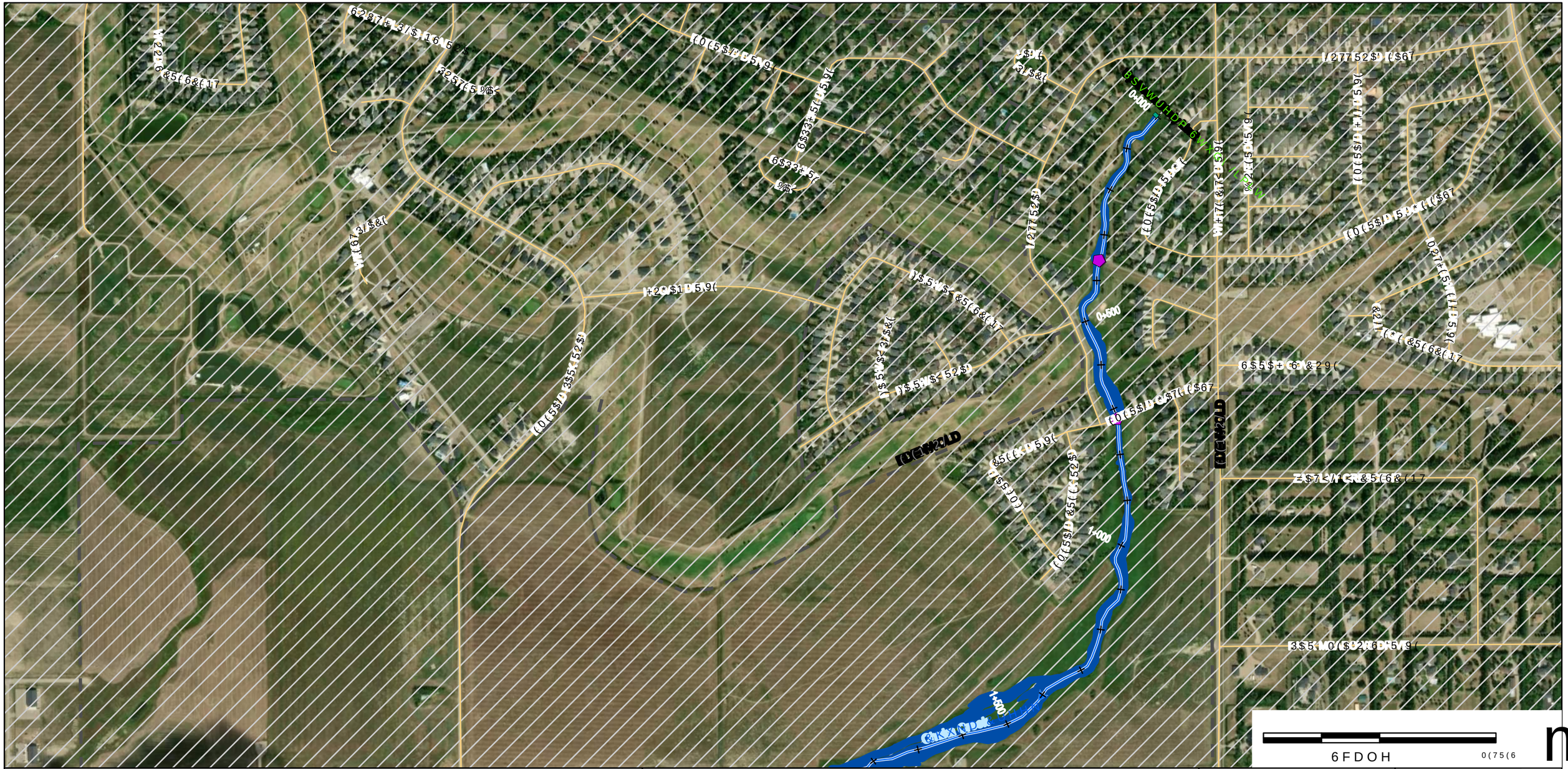

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0DS 3URGXFHG %\

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1RWHV

6KHHWV DQG PD\ QRW EH LQFOXGHG LQ WKH PDS VHULHV WKHUH LV QR IORRGLQJ LQ WKLV DUHD

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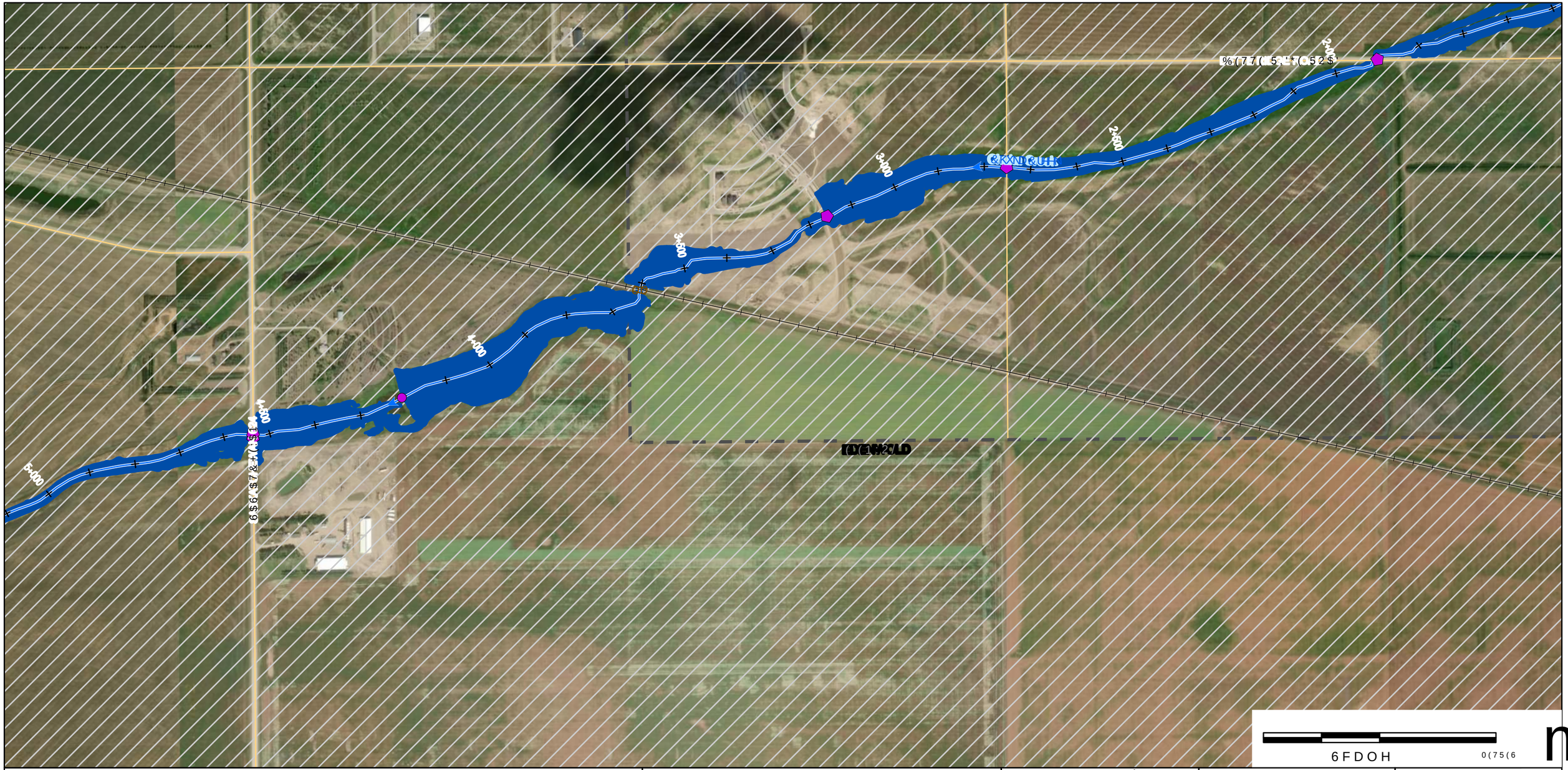

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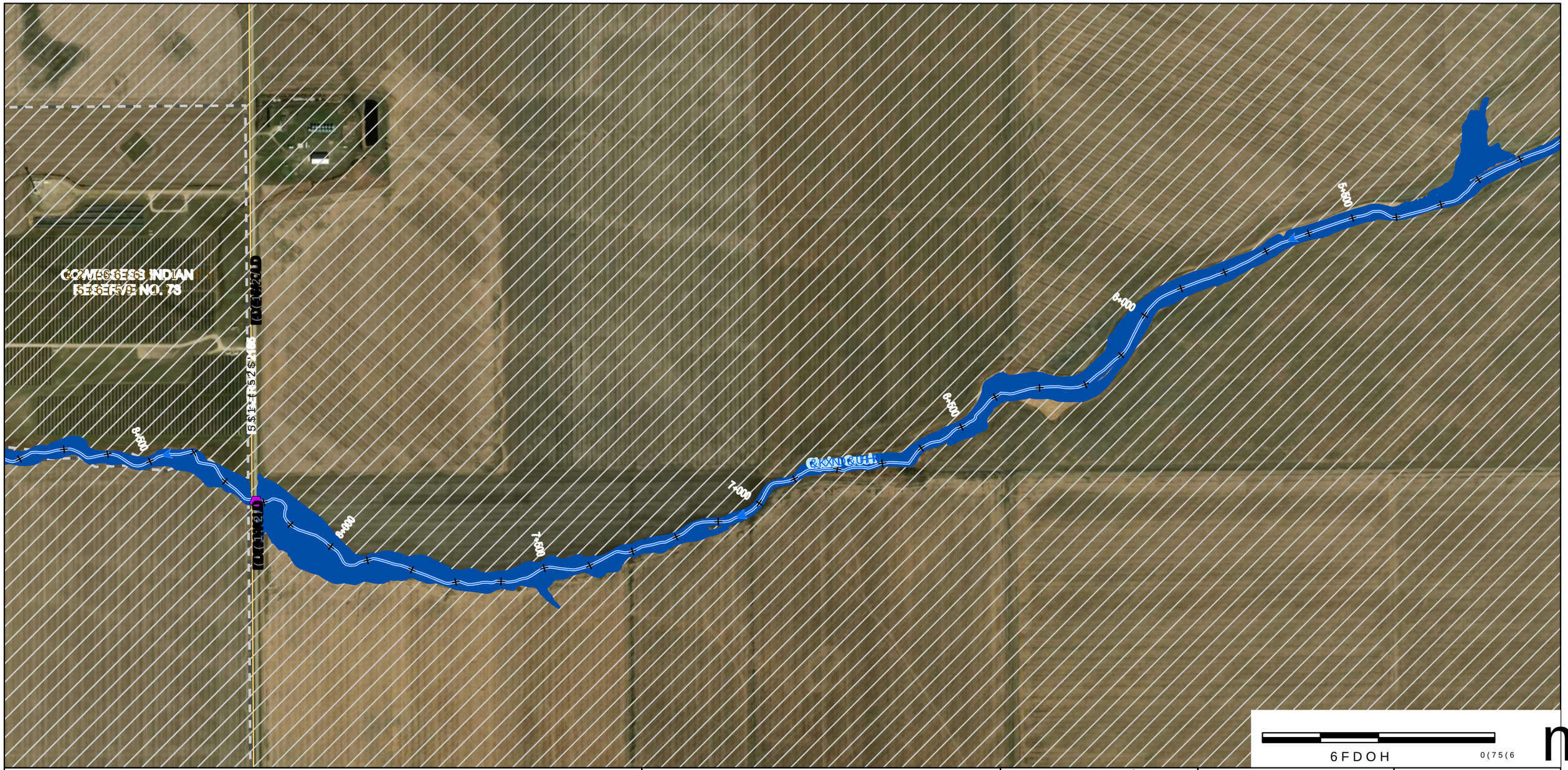

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FLUFXPVWDQFHV DQG DYDLODEOH GDWDU:6$ DWDH5VHQUHQFH 6\VWHP
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XVHU LV DGYLVHG WR FRQILUP WKH*HRLG PRWLRQ &*RQWDLQHG KHUHLQ
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0DS 3URMHFWLRQ 870 &656 ([WHQGHG =RQH 1RUWK

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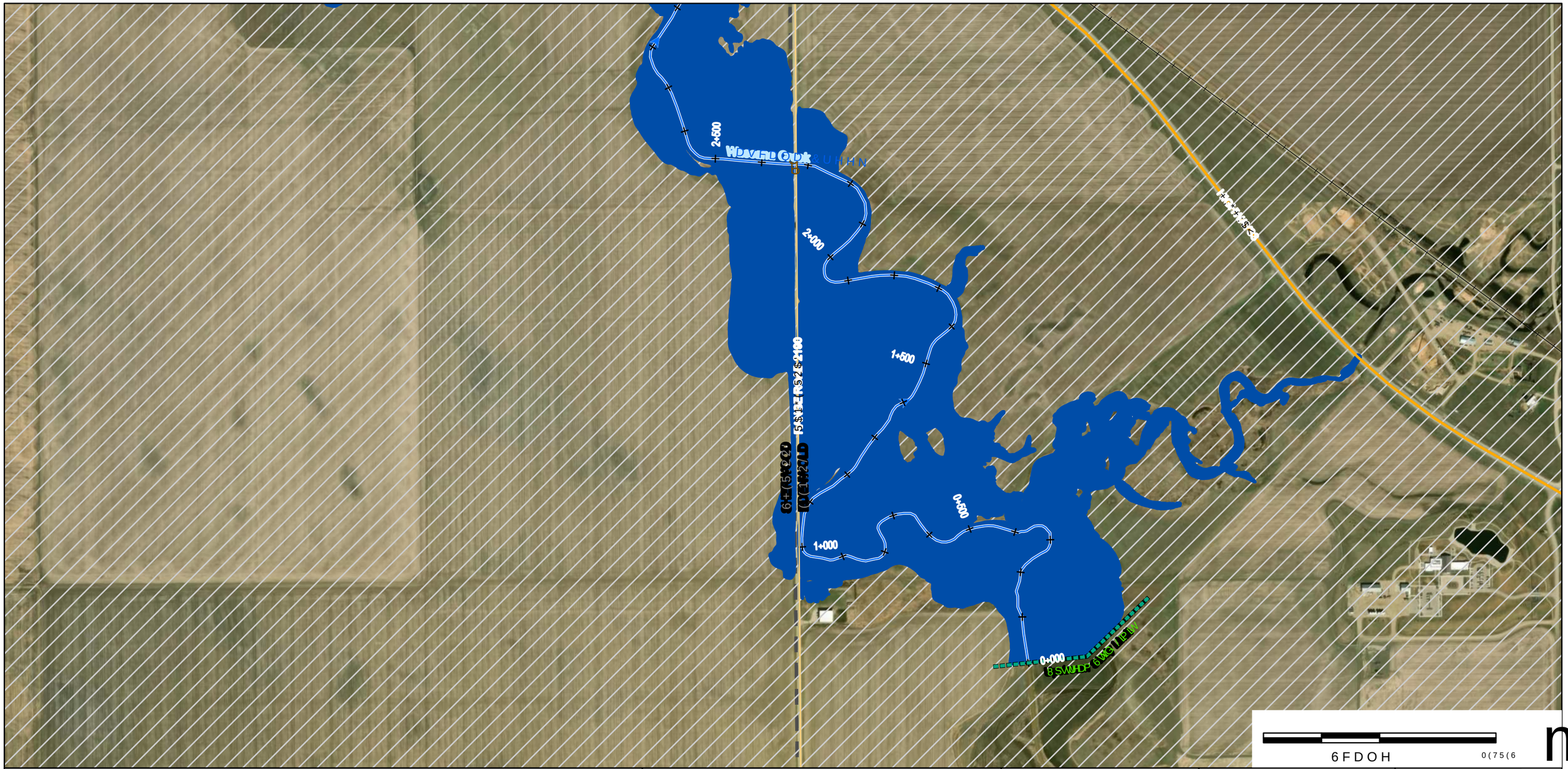

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$OO 'DWDVHWV ‹ *RYHUQPHQW RI 6DVNDWFKHZDQ 3URYLGHG E\ :DWHU 6HFXULW\ $JHQF\ DQG FRPSLOHG LQ WKH 6DVNDWFKHZDQ *HRVSDWLDO (QYLURQPHQW 6\VWHP 7KH 9HUWLFDO 'DWXP &*9' +HLJKWV DUH UHODWLYH WR &KDQJH P LQ WHUUDLQ HOHYDWLRQ 0DS 3URMHFWLRQ 870 &65 ([WHQGHG =RQH 1RUWK 6KHHWV DQG PD\ QRW EH LQFOXGHG LQ WKH PDS VHULHV 1RWHV WKHUH LV QR IORRGLQJ LQ WKLV DUHD

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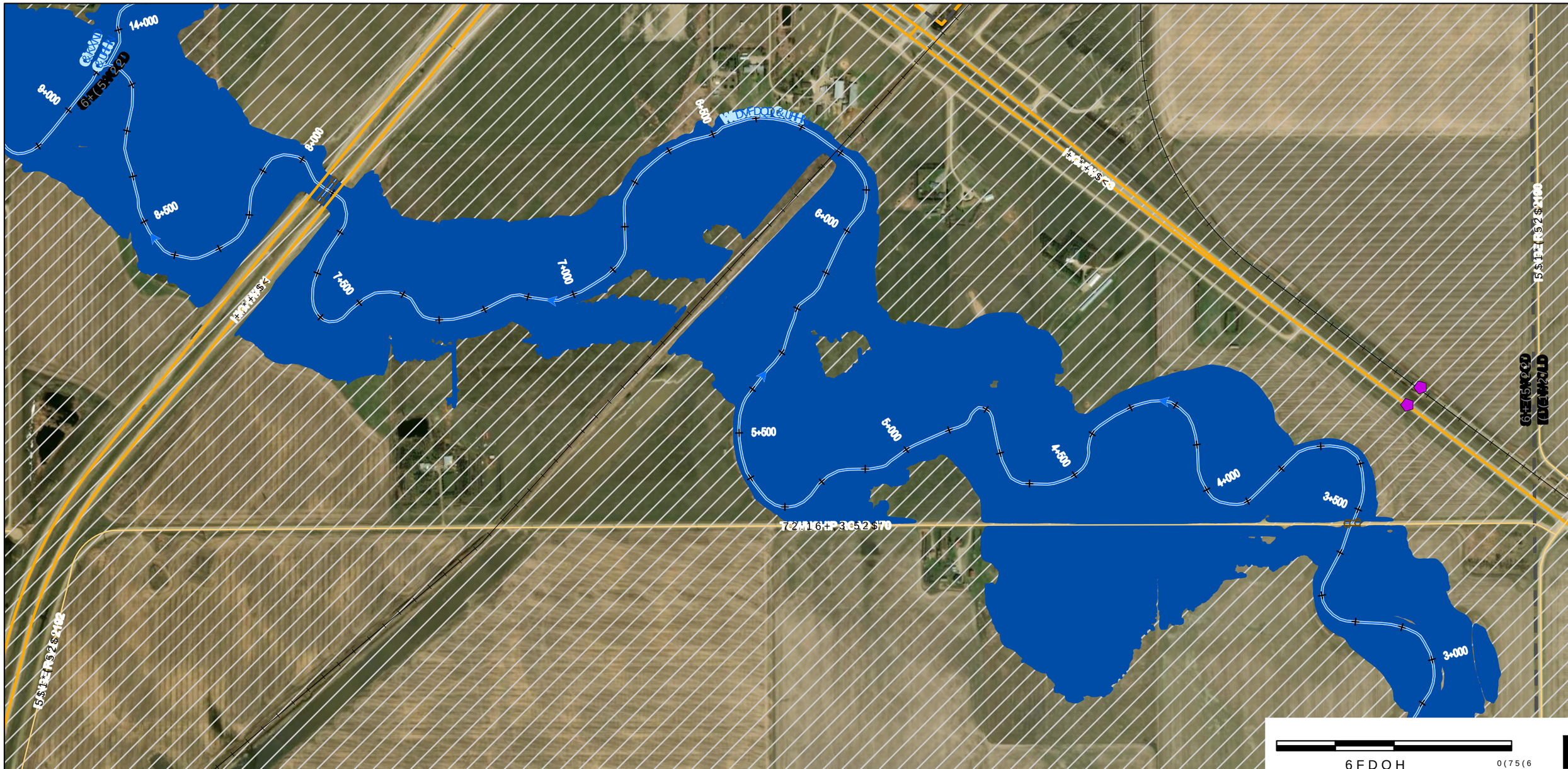

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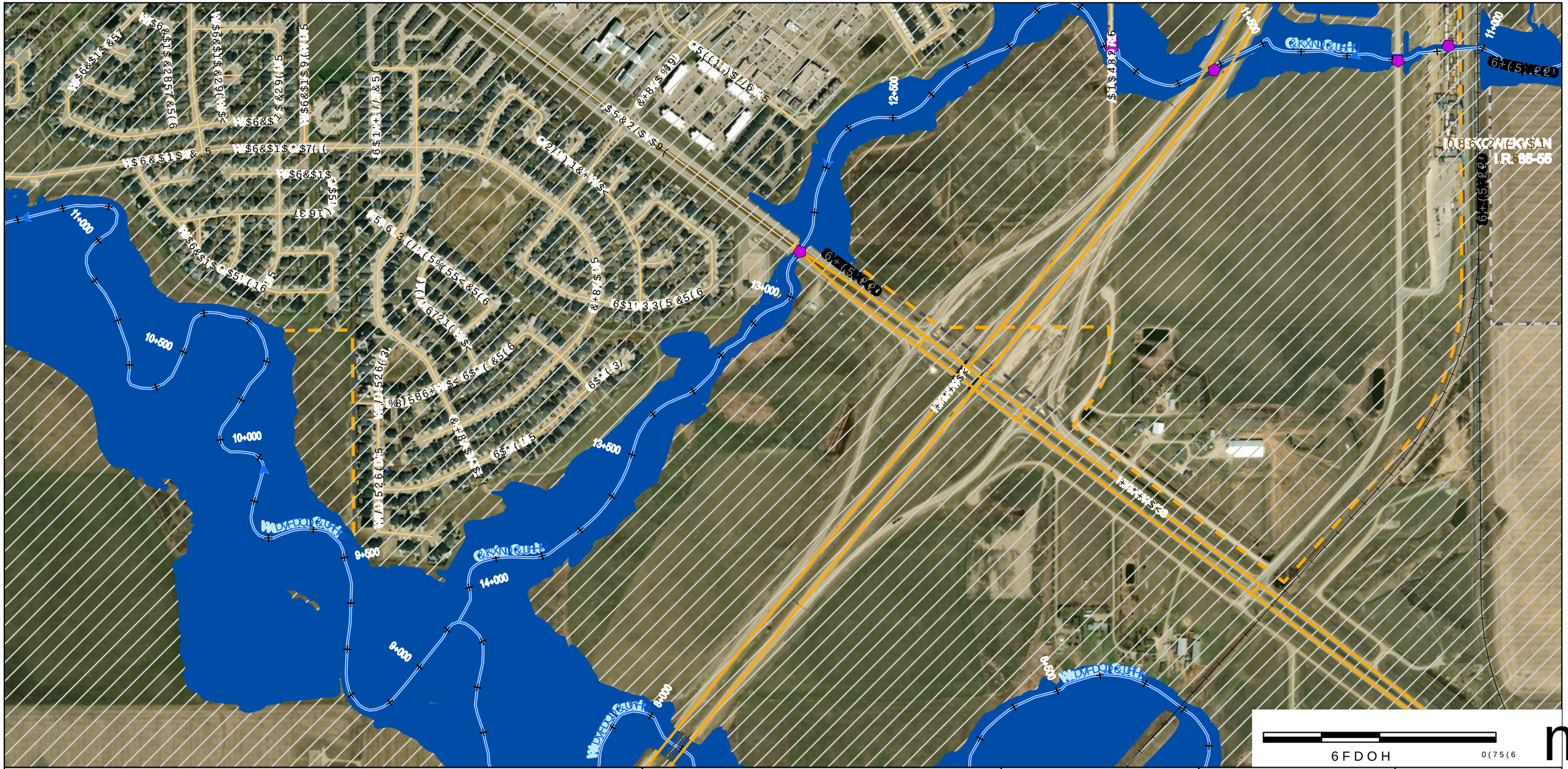

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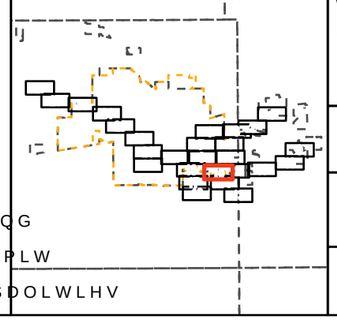

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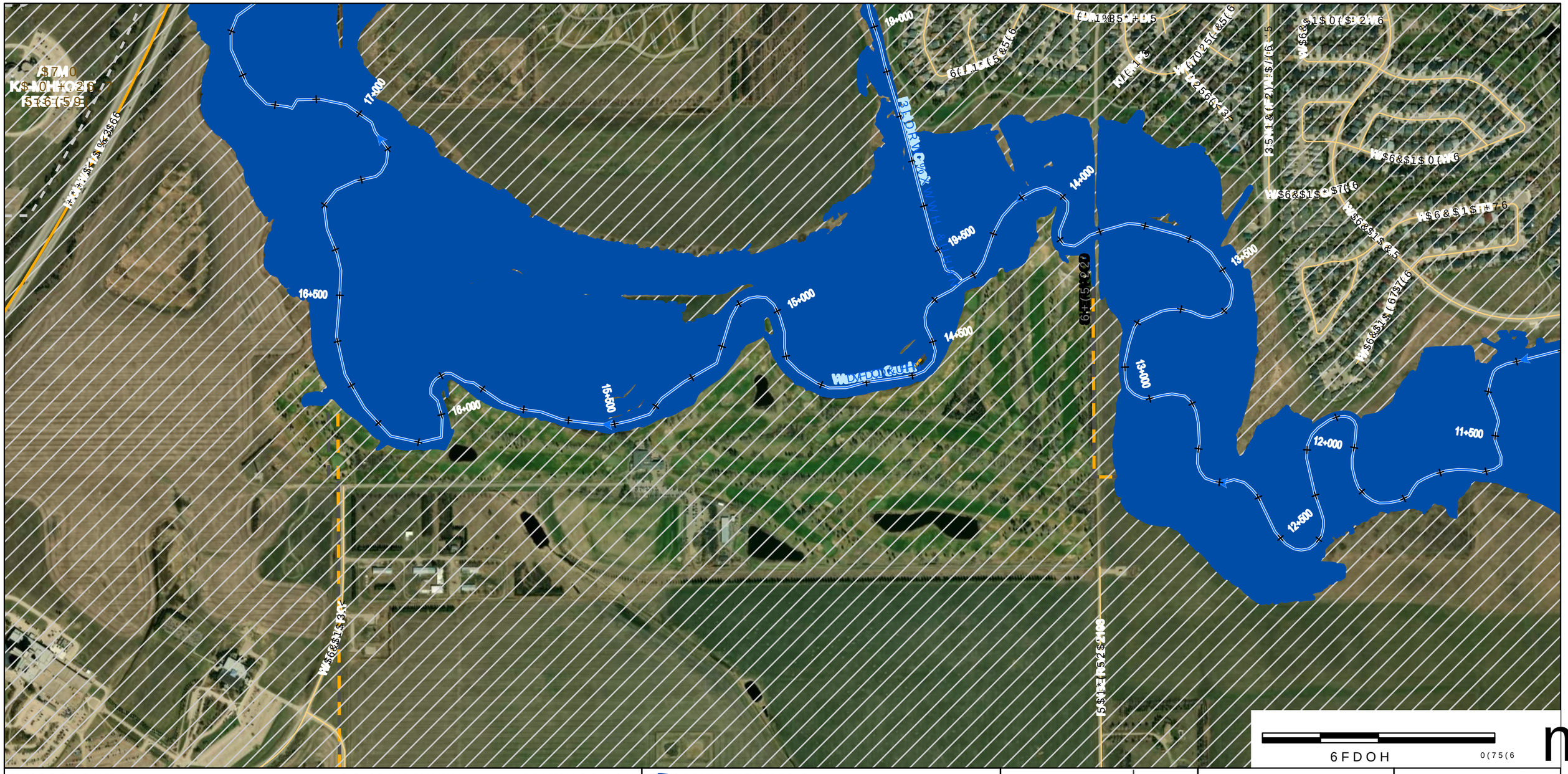

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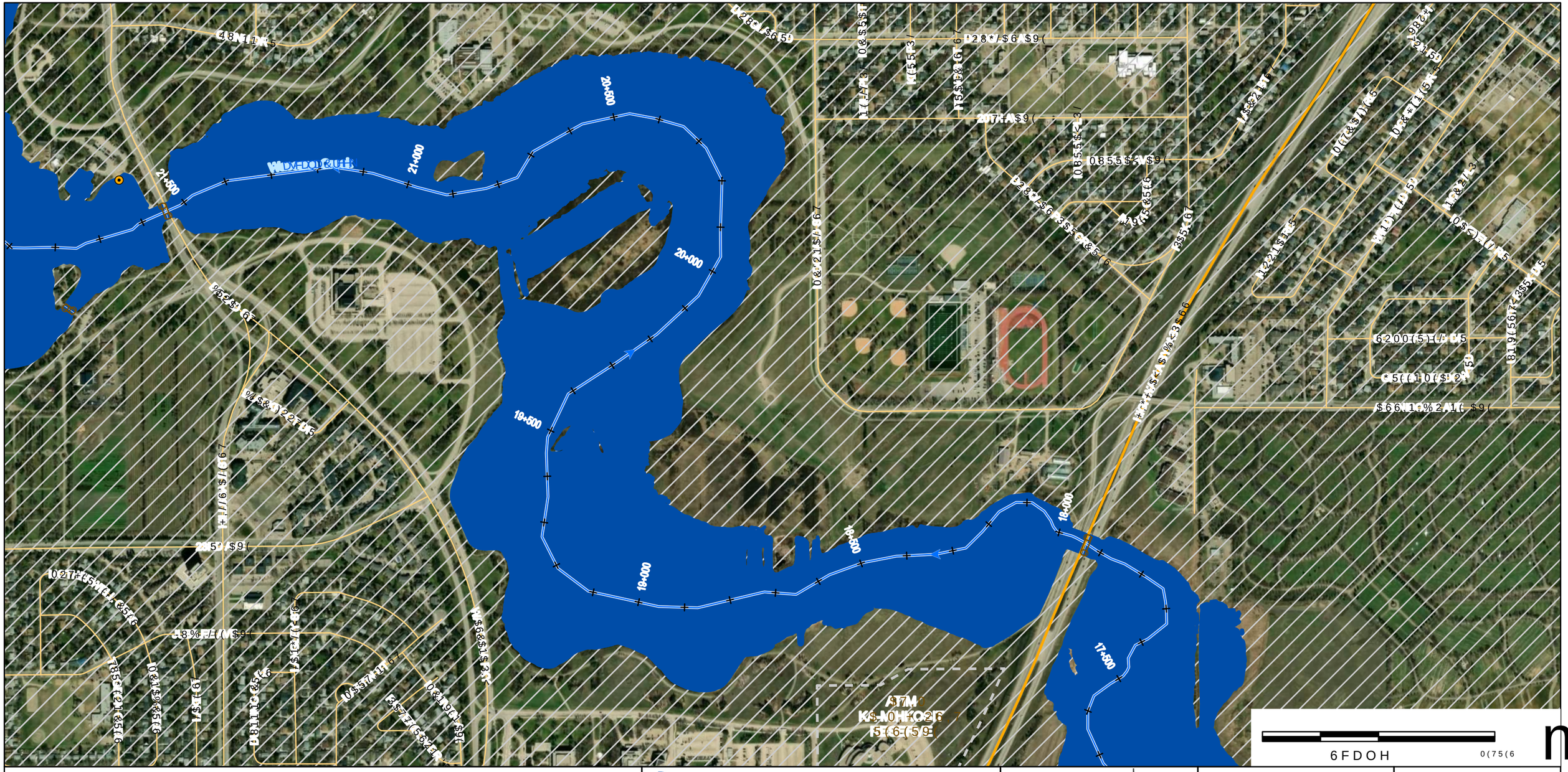

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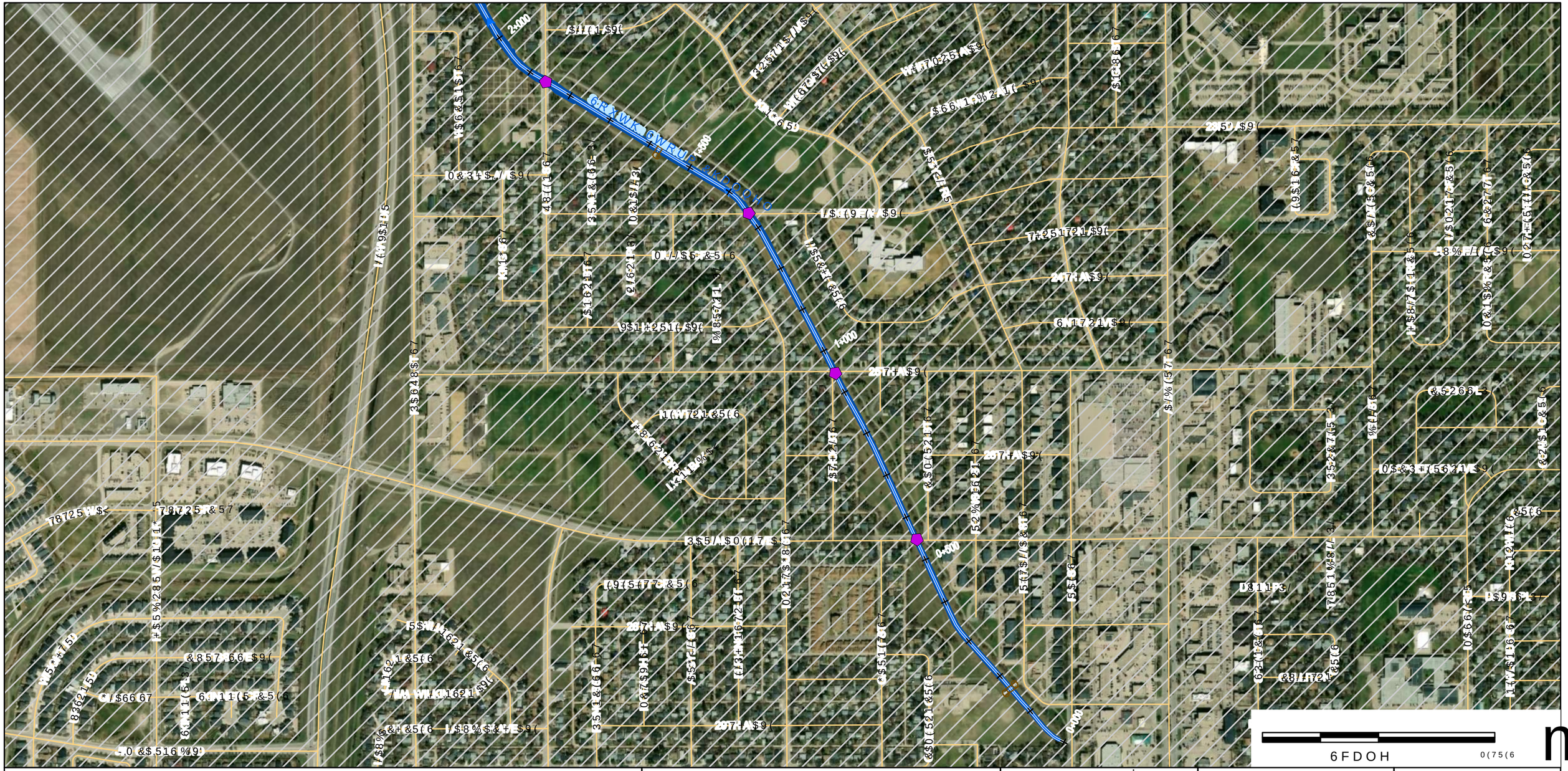
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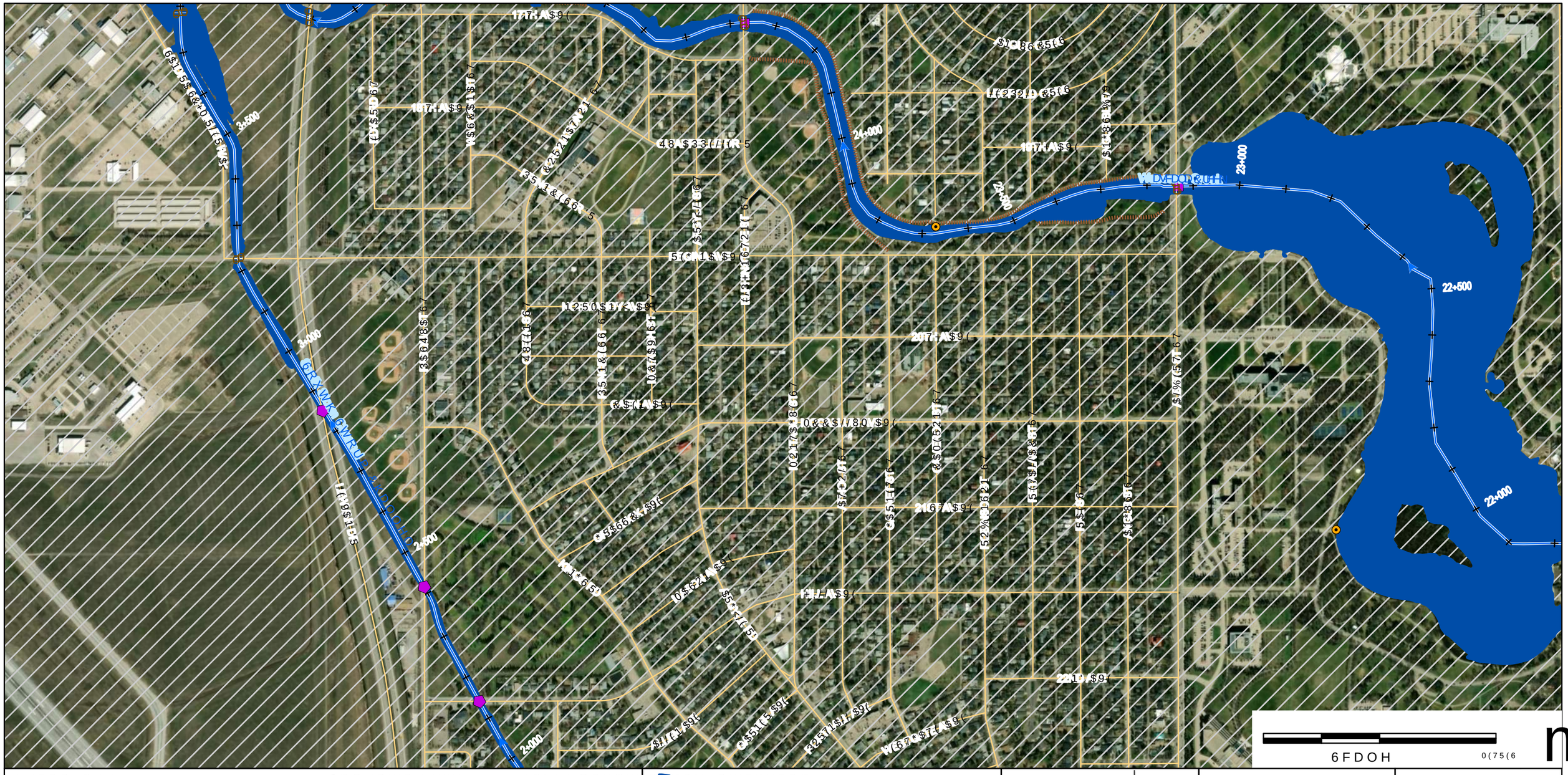

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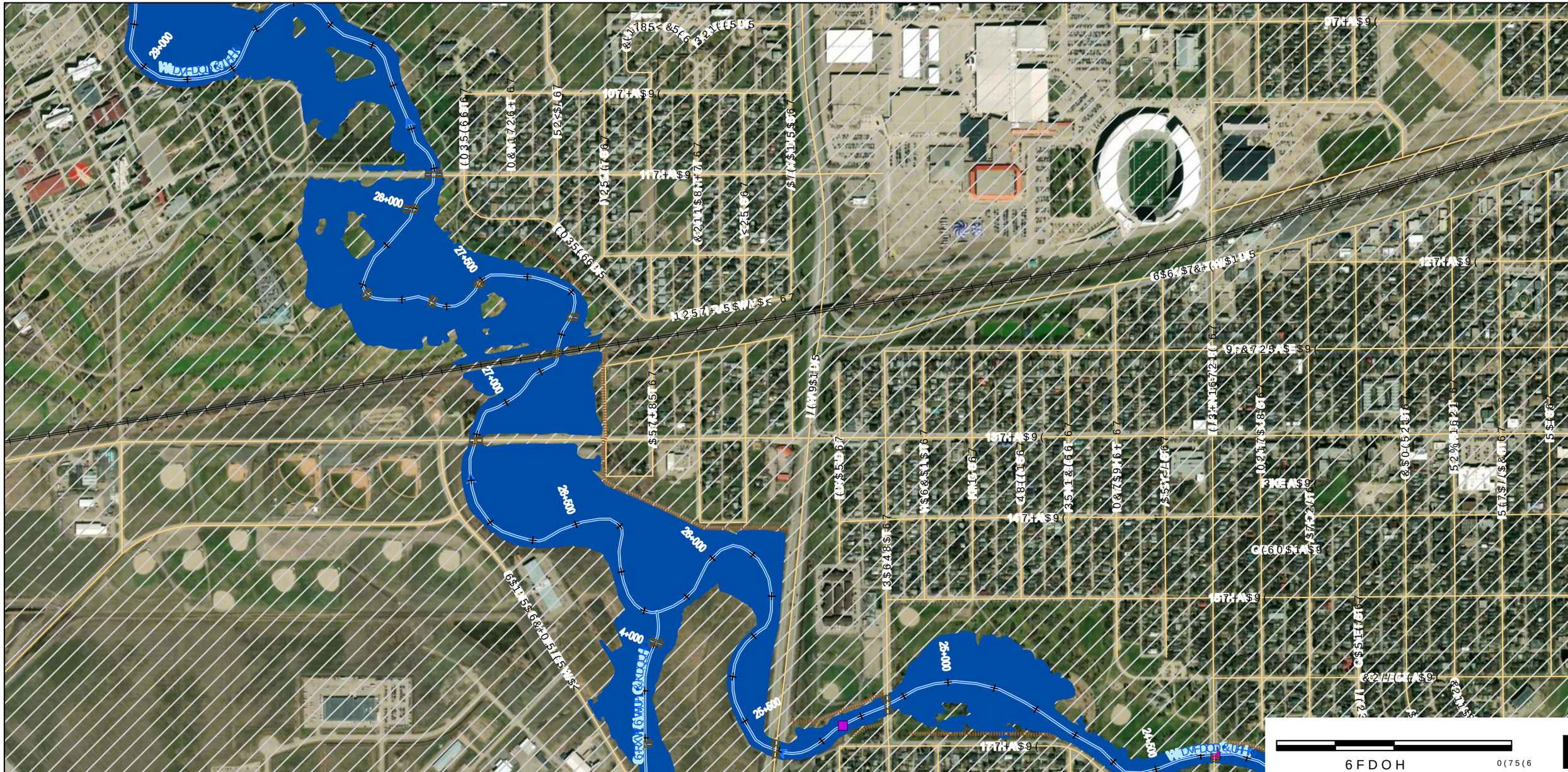

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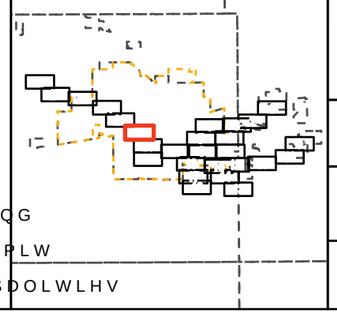

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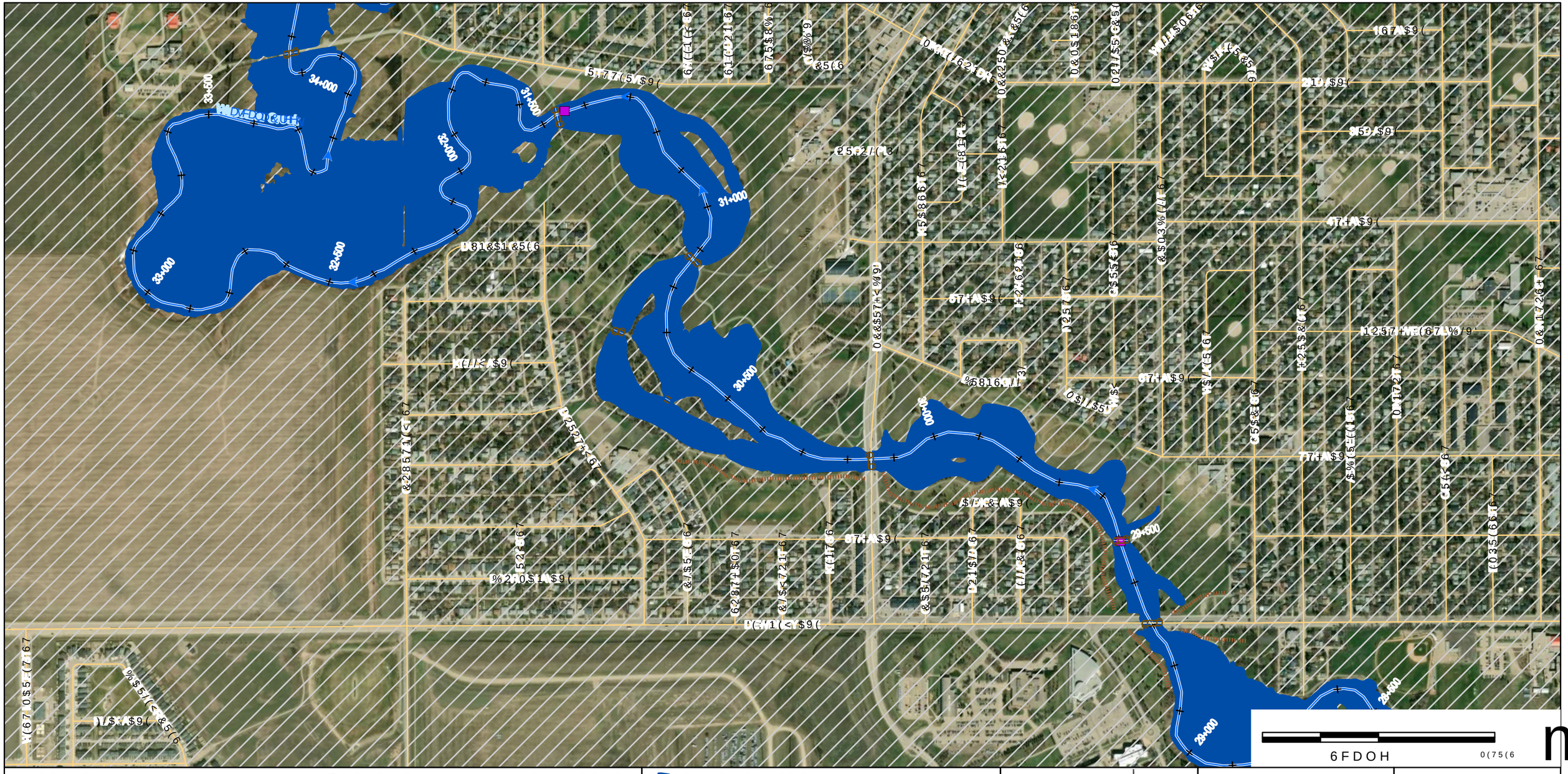

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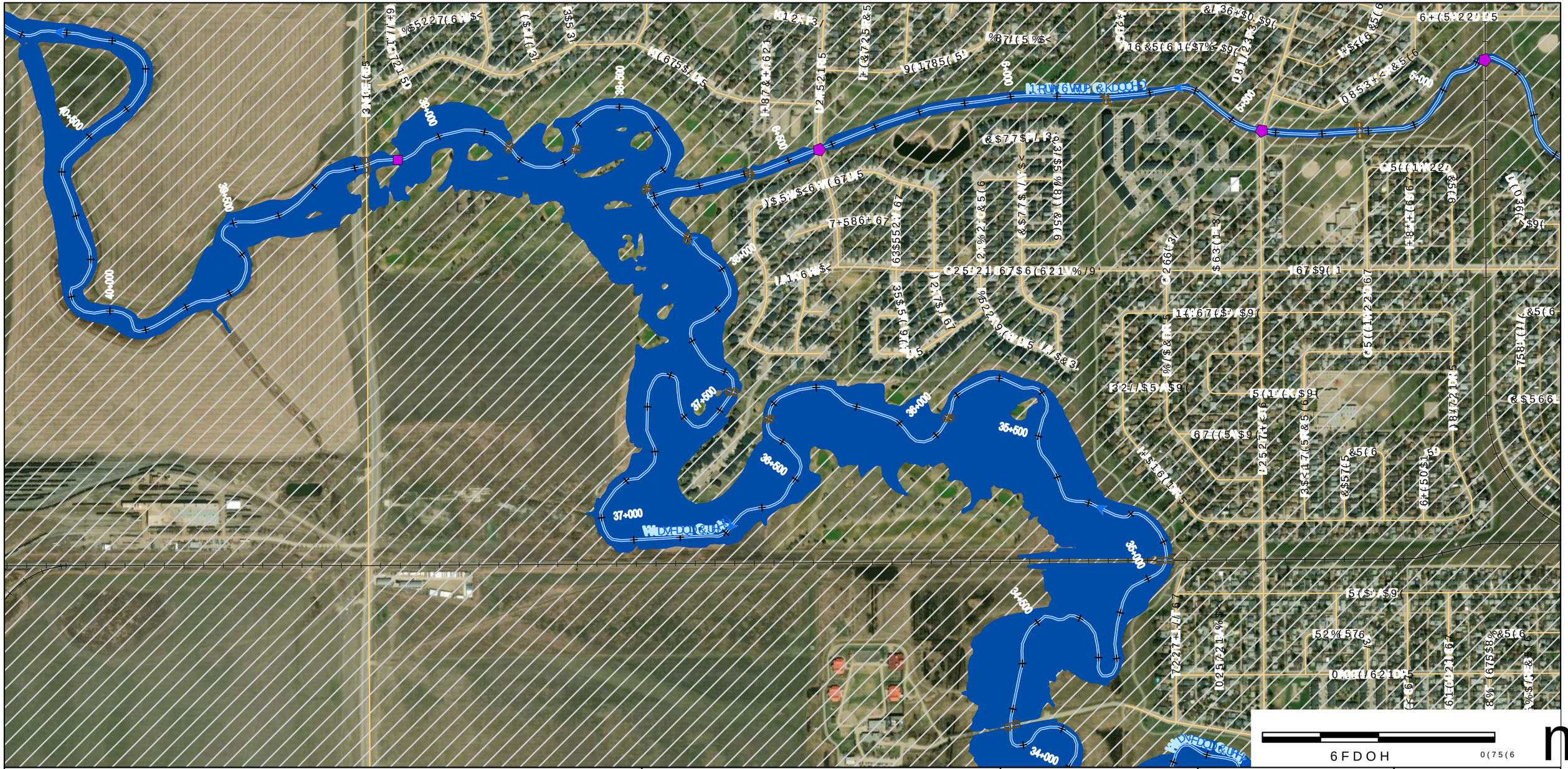
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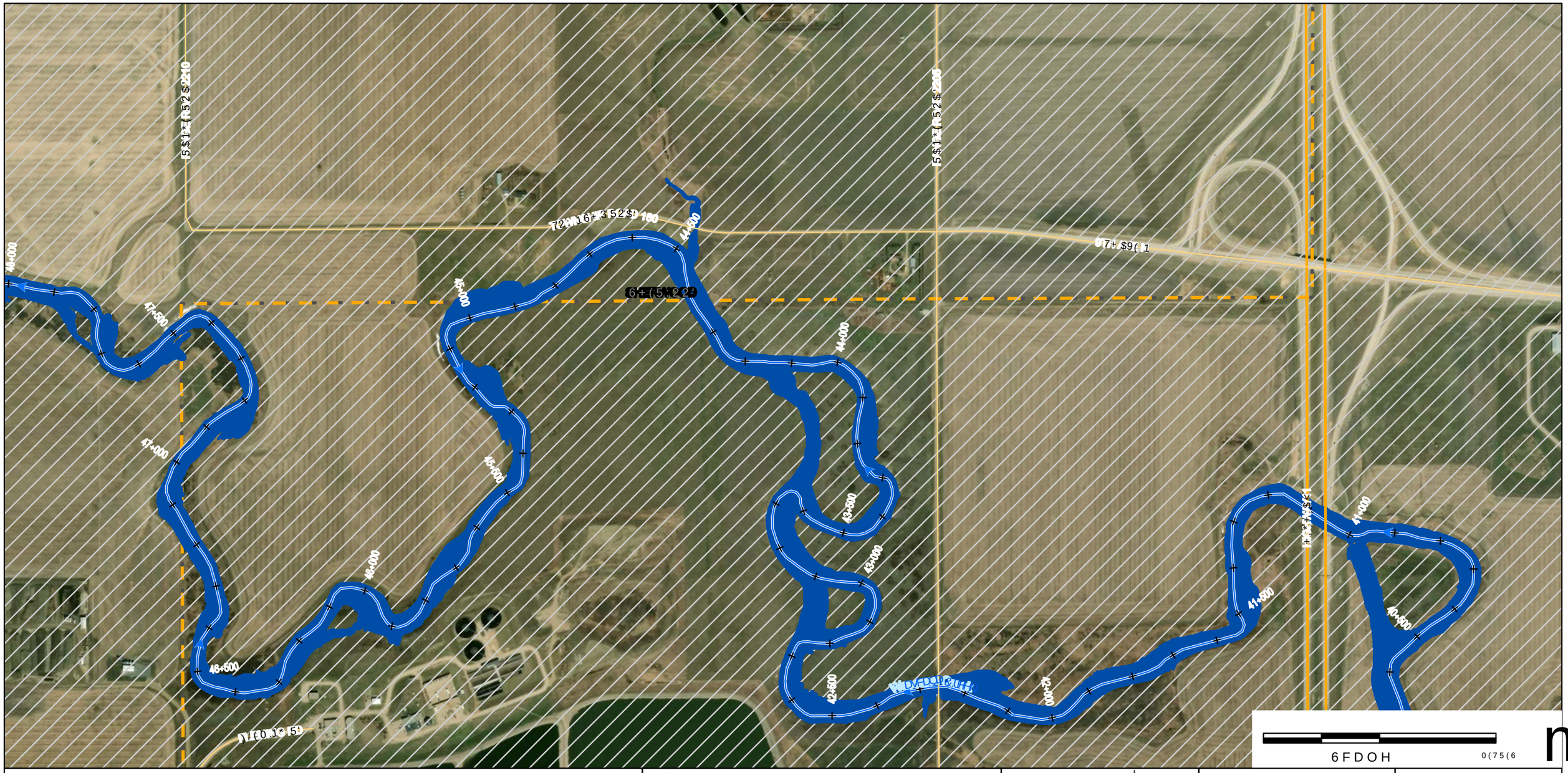

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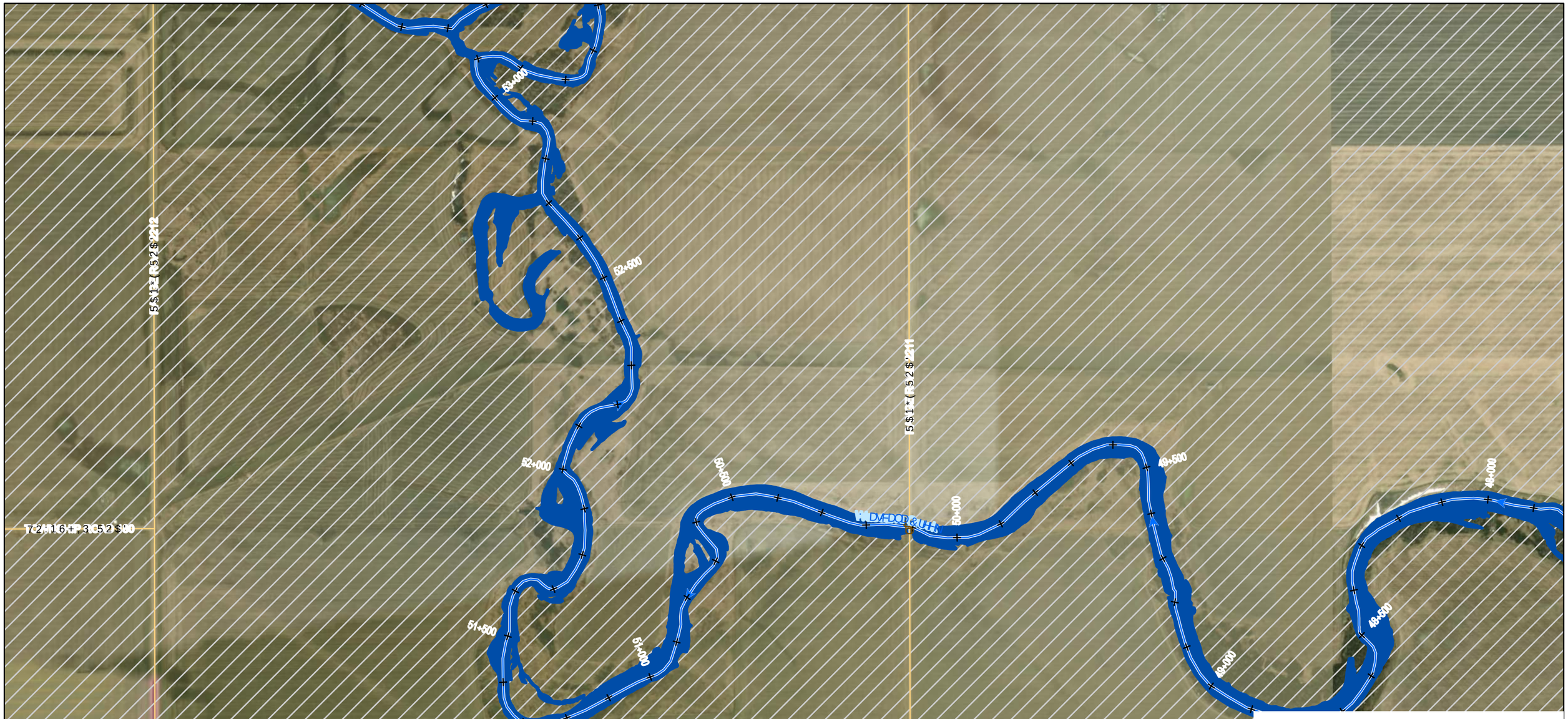

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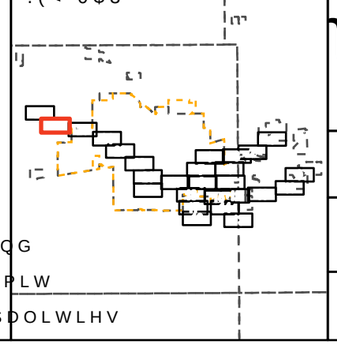

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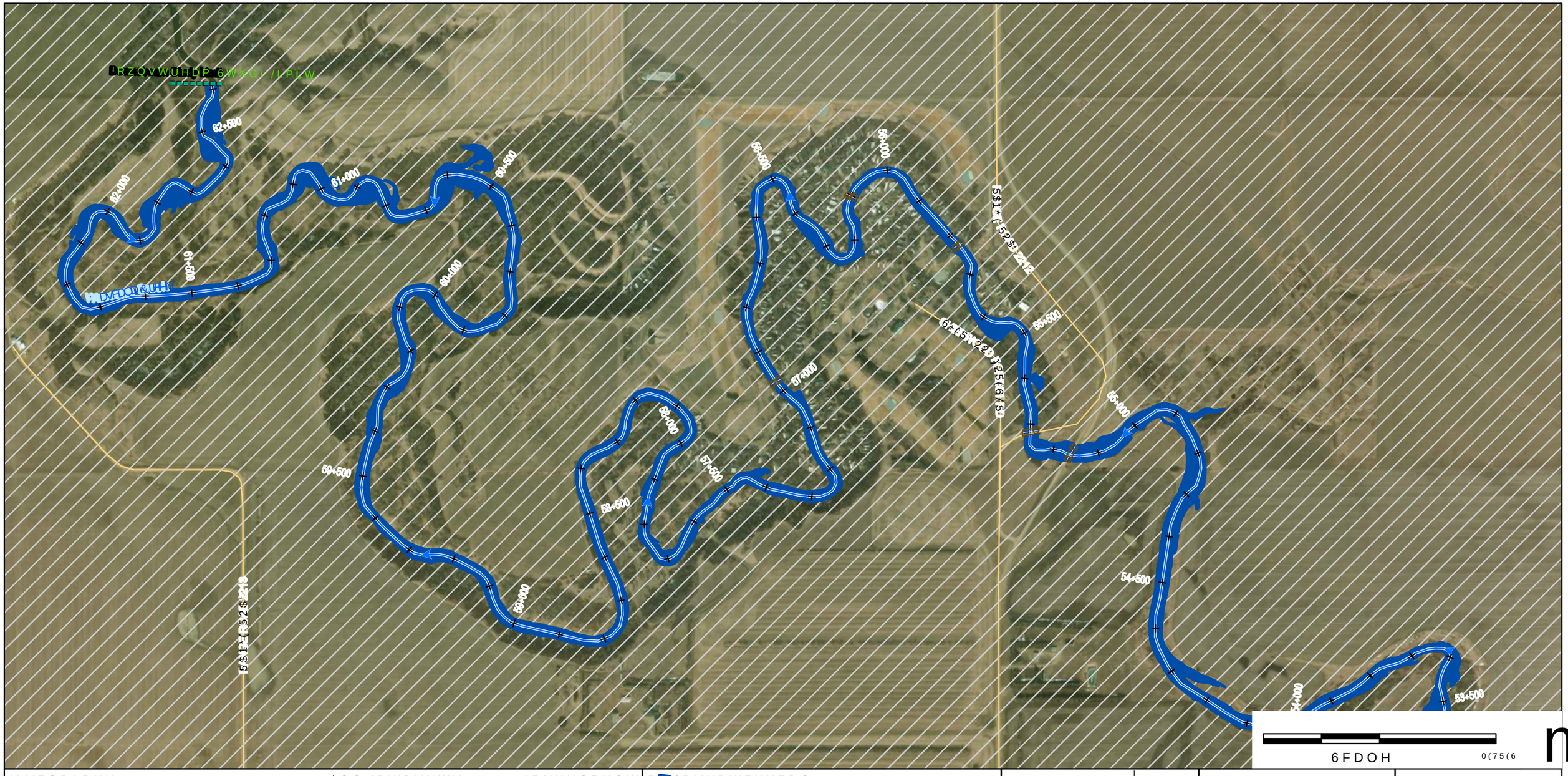

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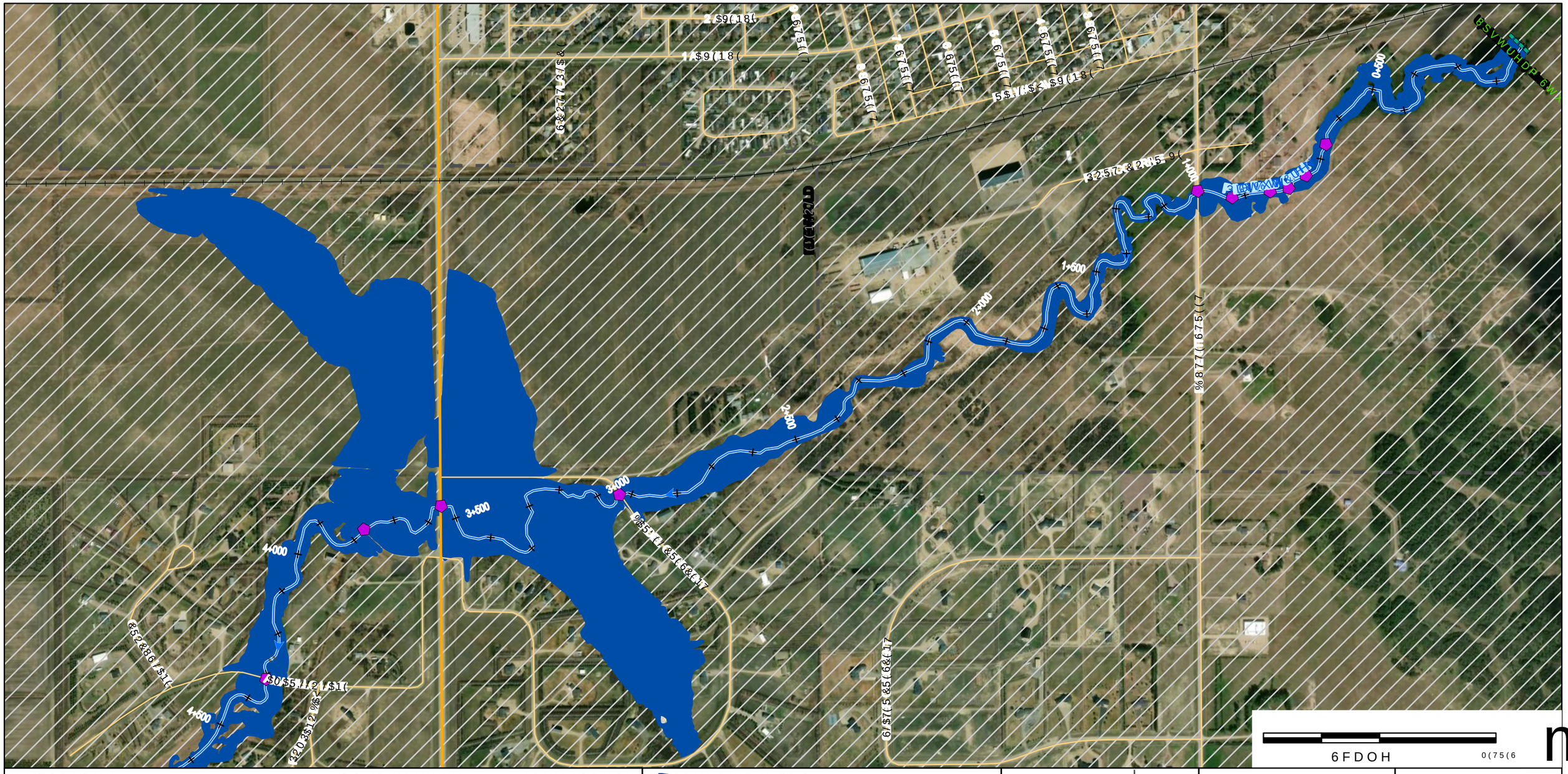
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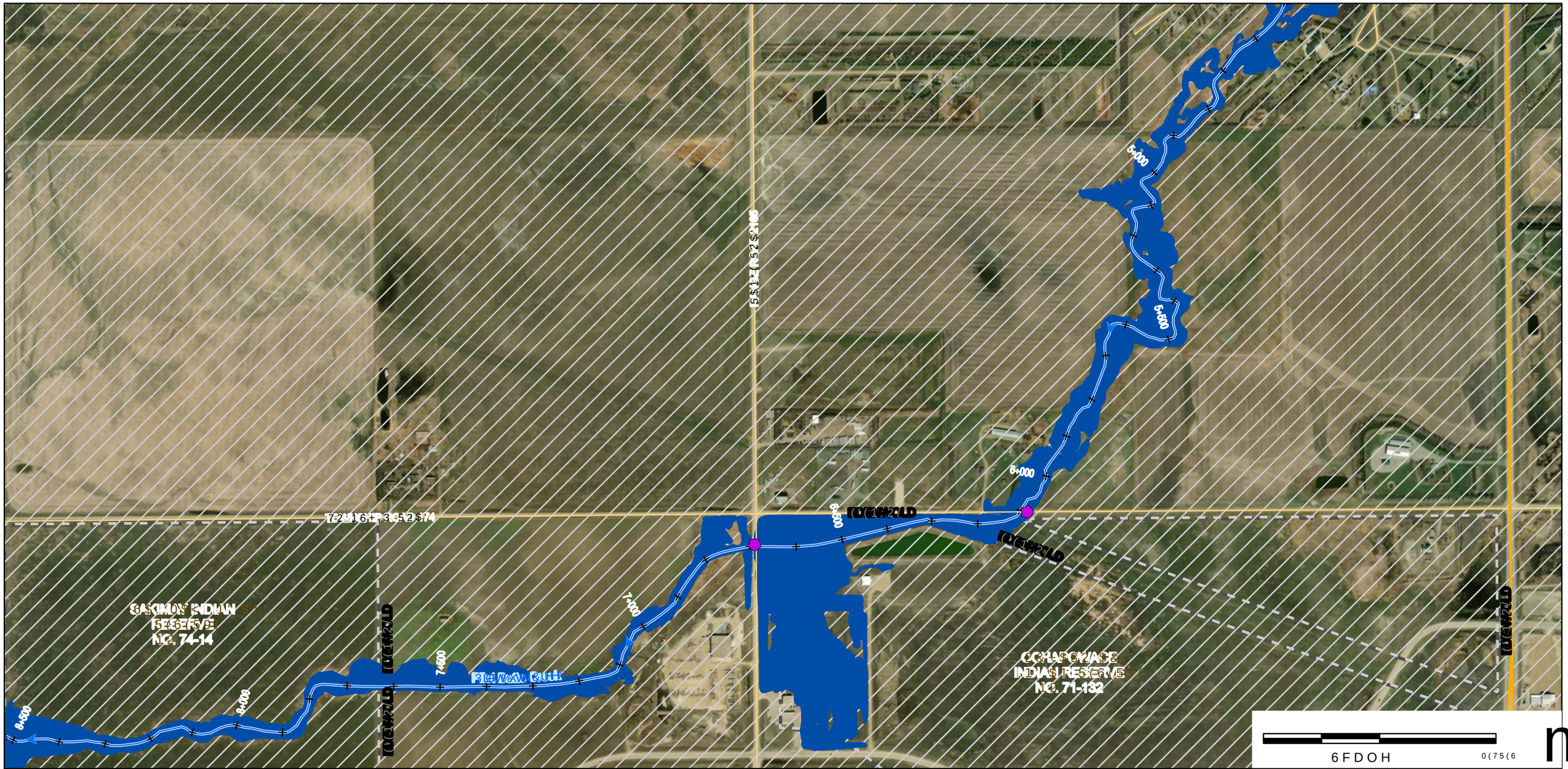

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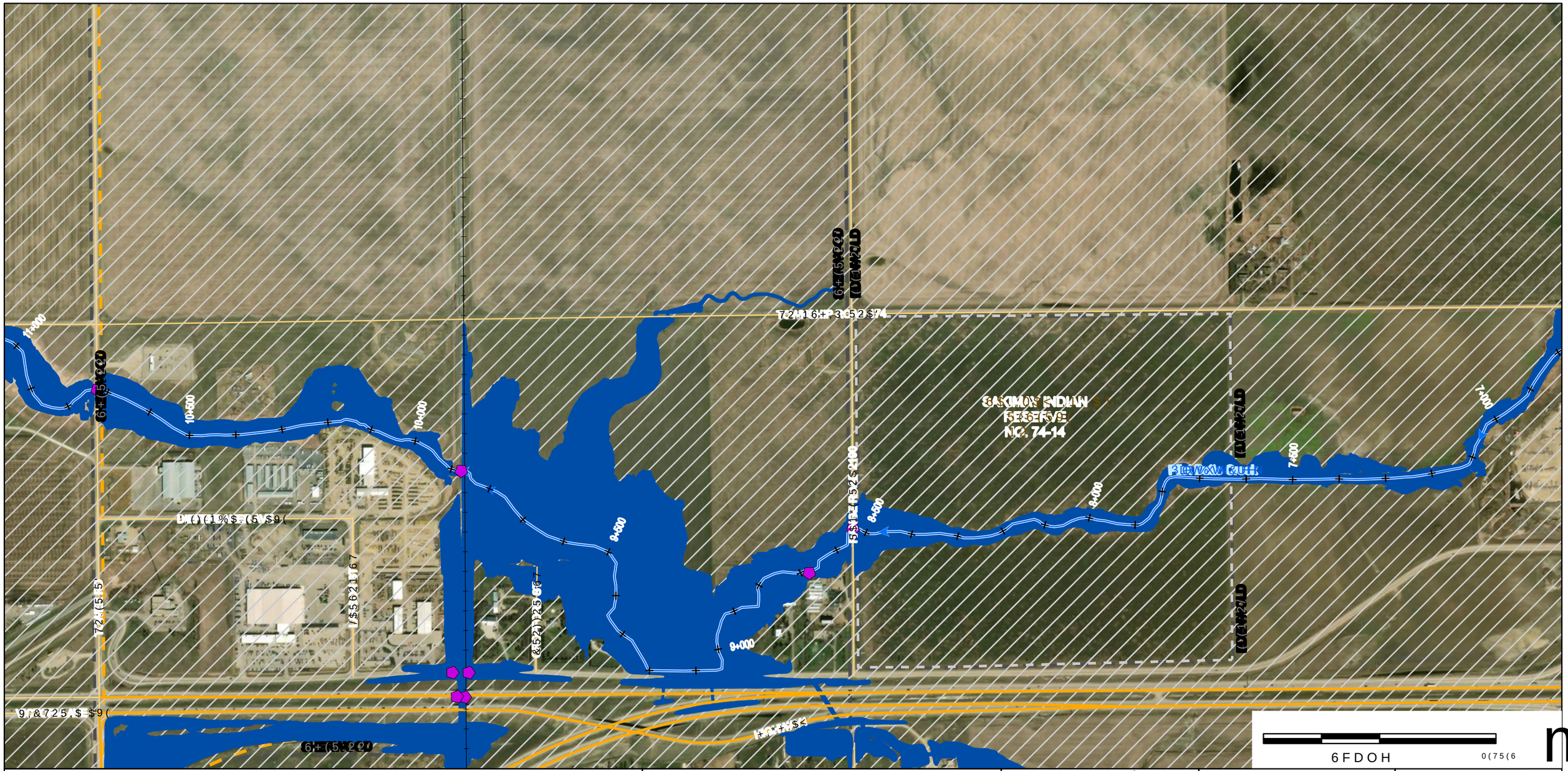

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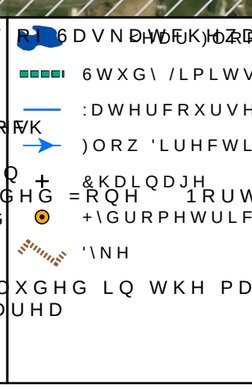

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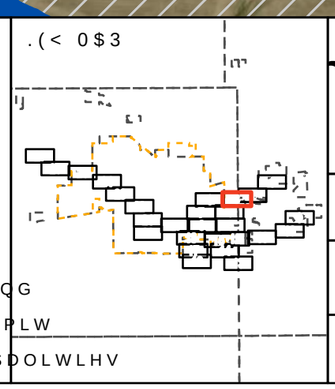

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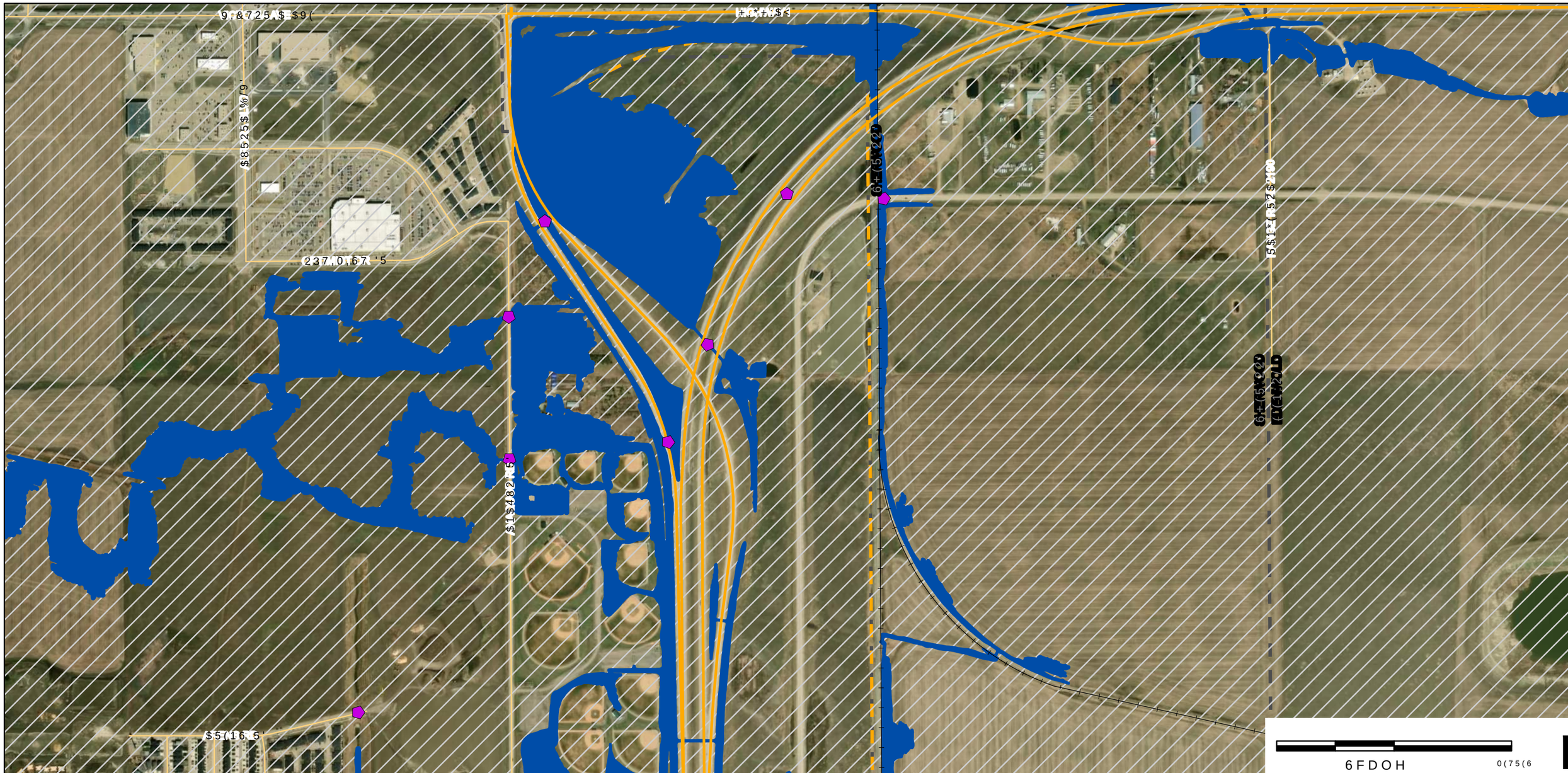

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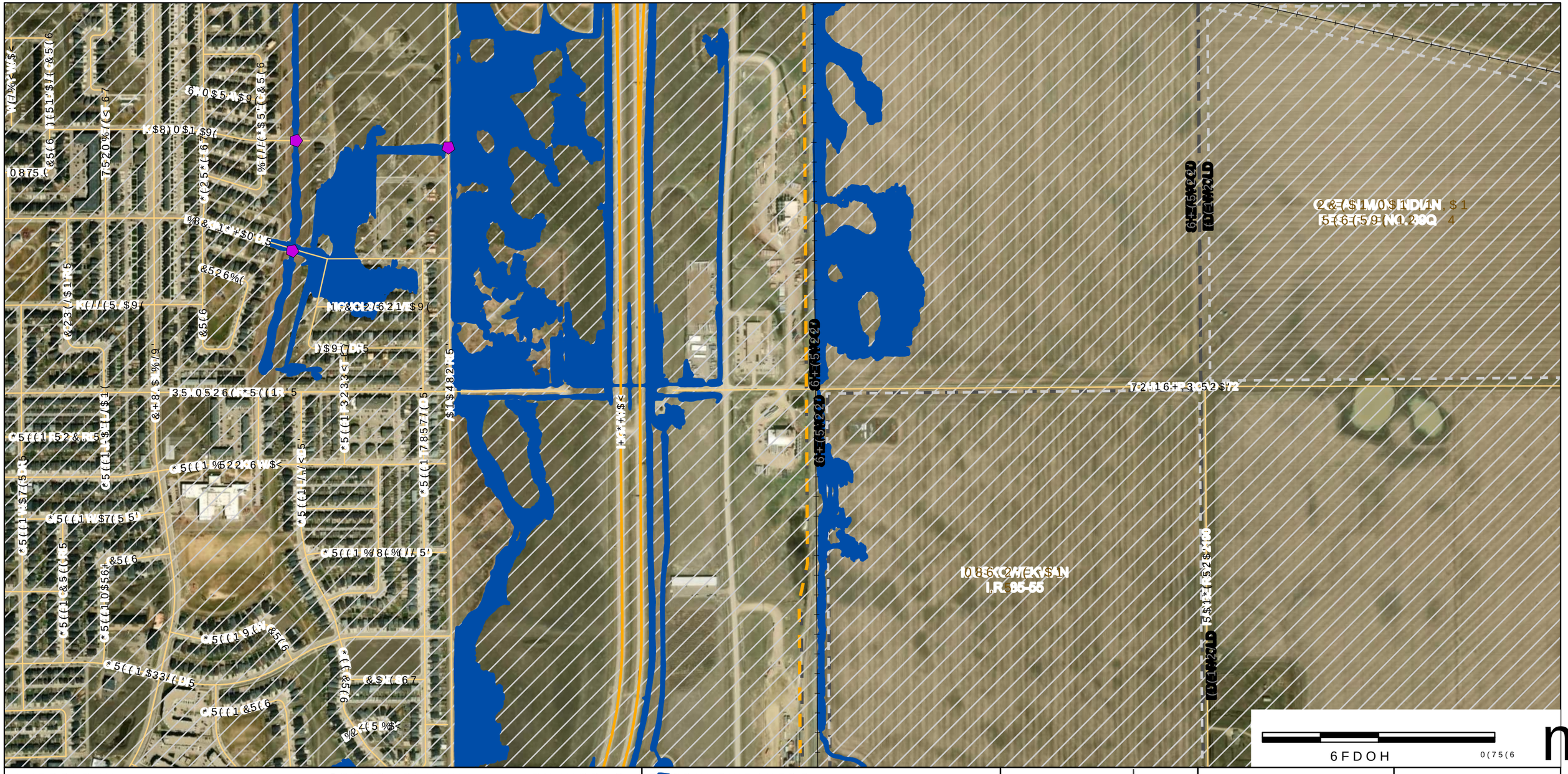

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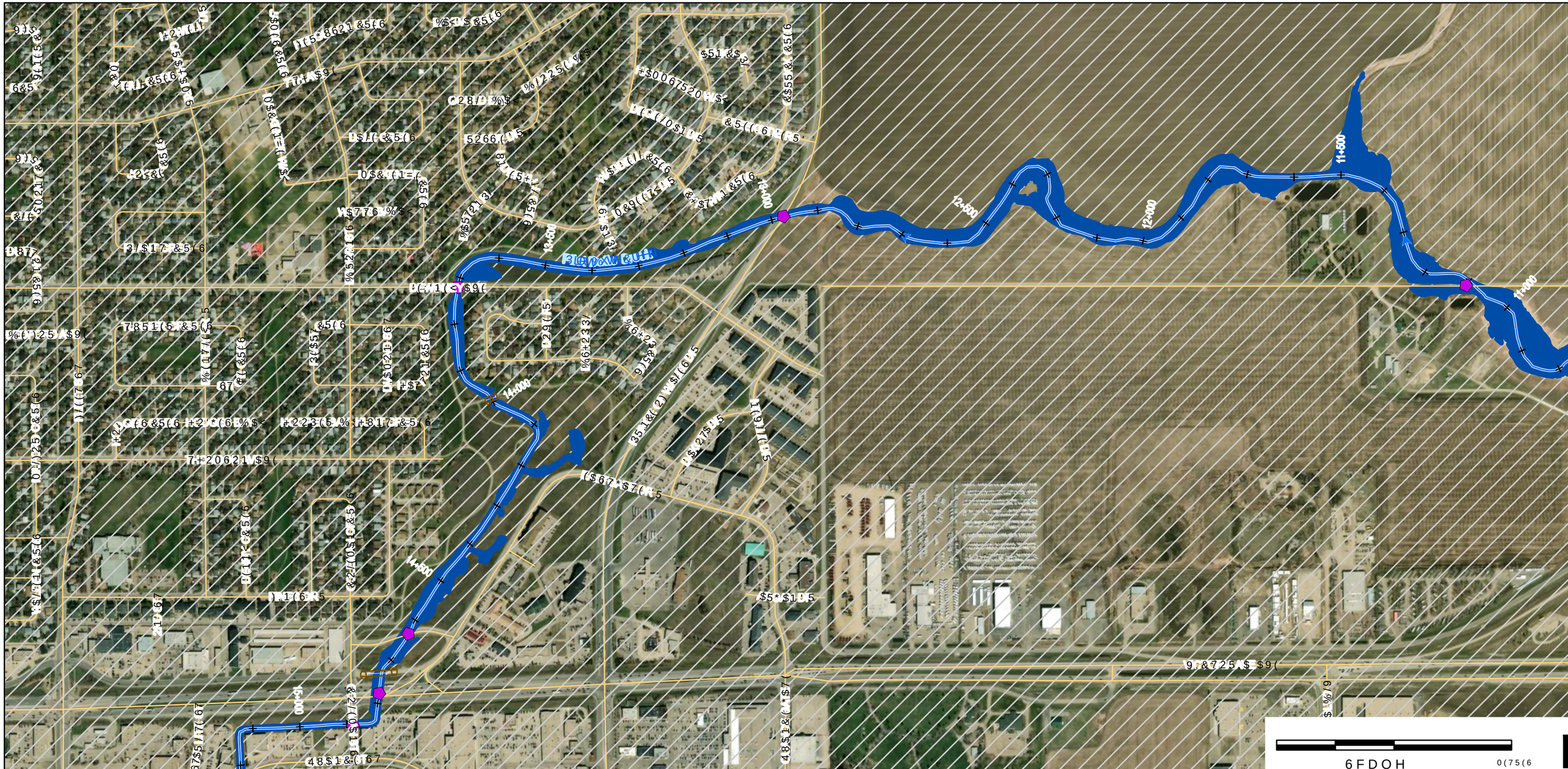

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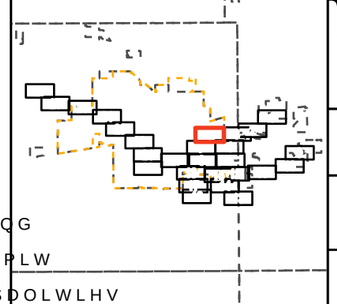

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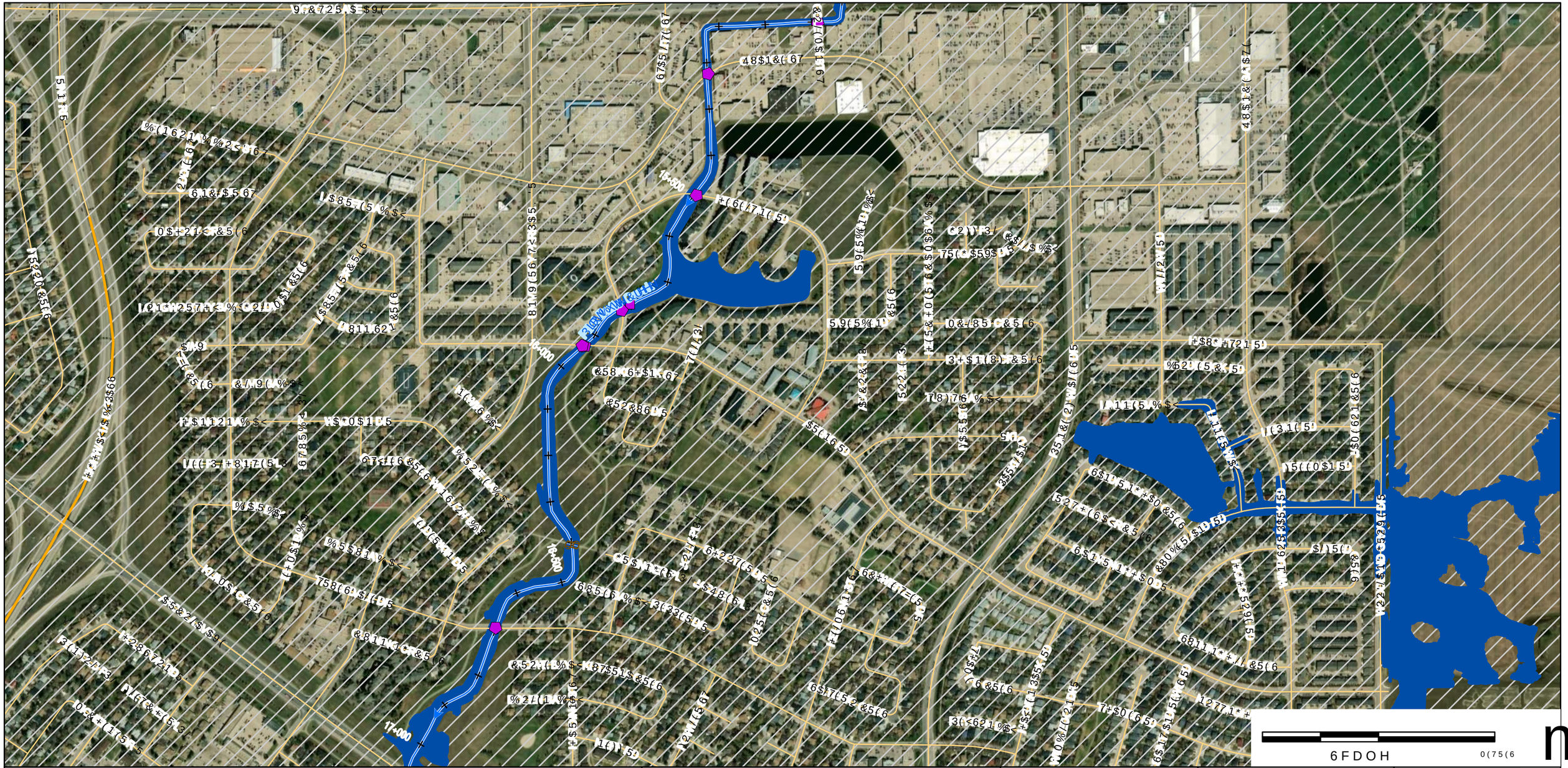

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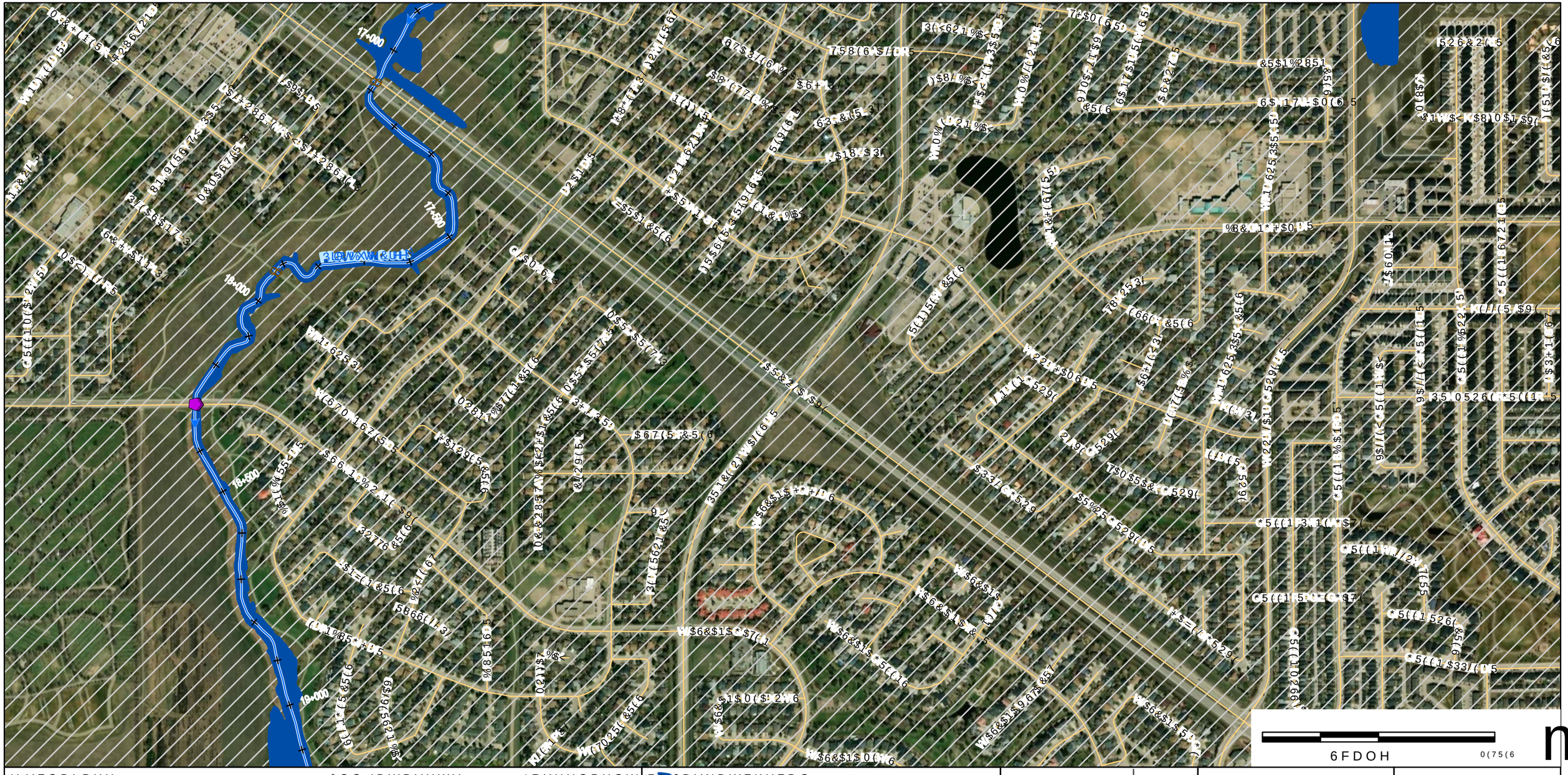

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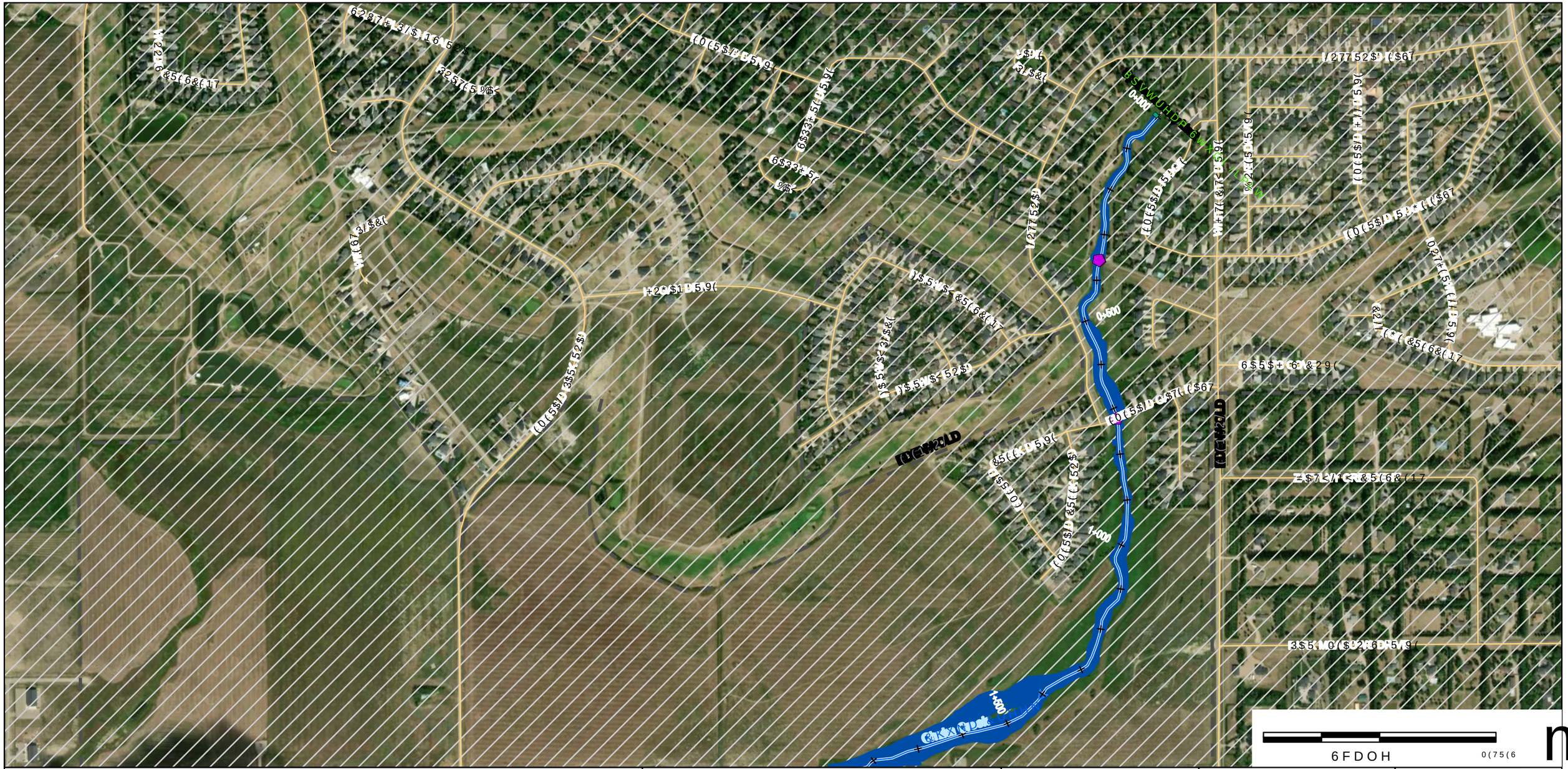

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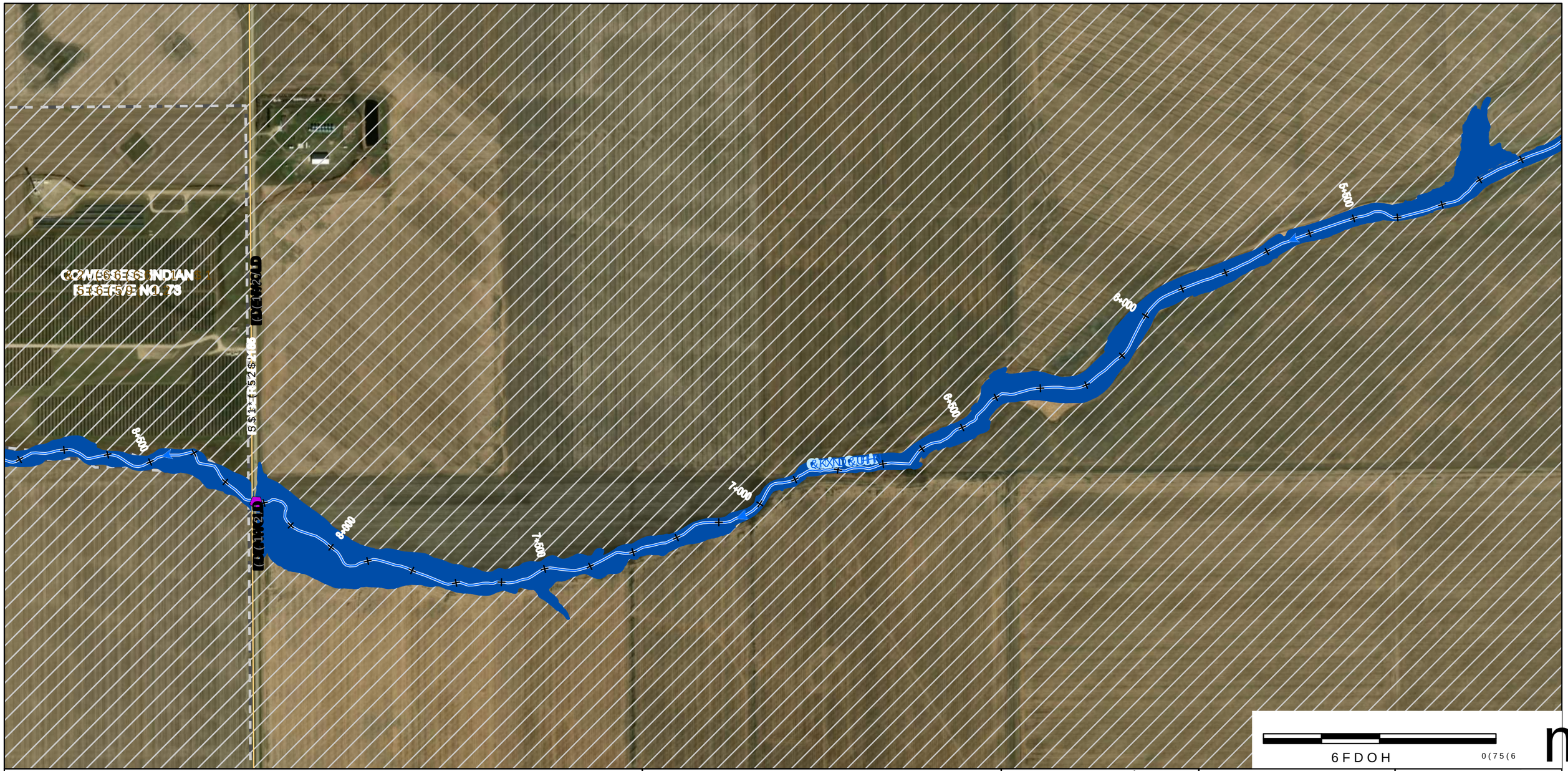

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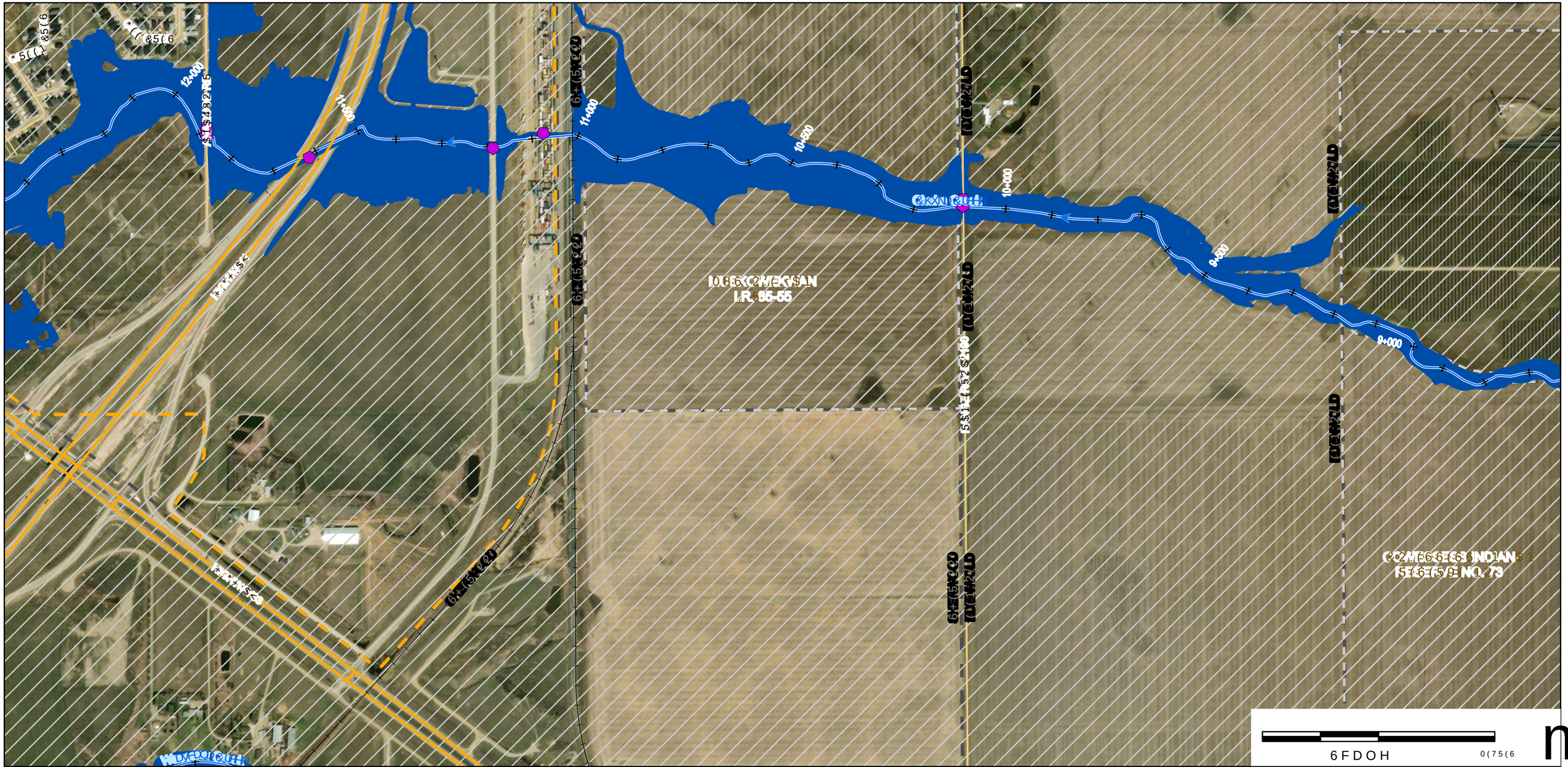
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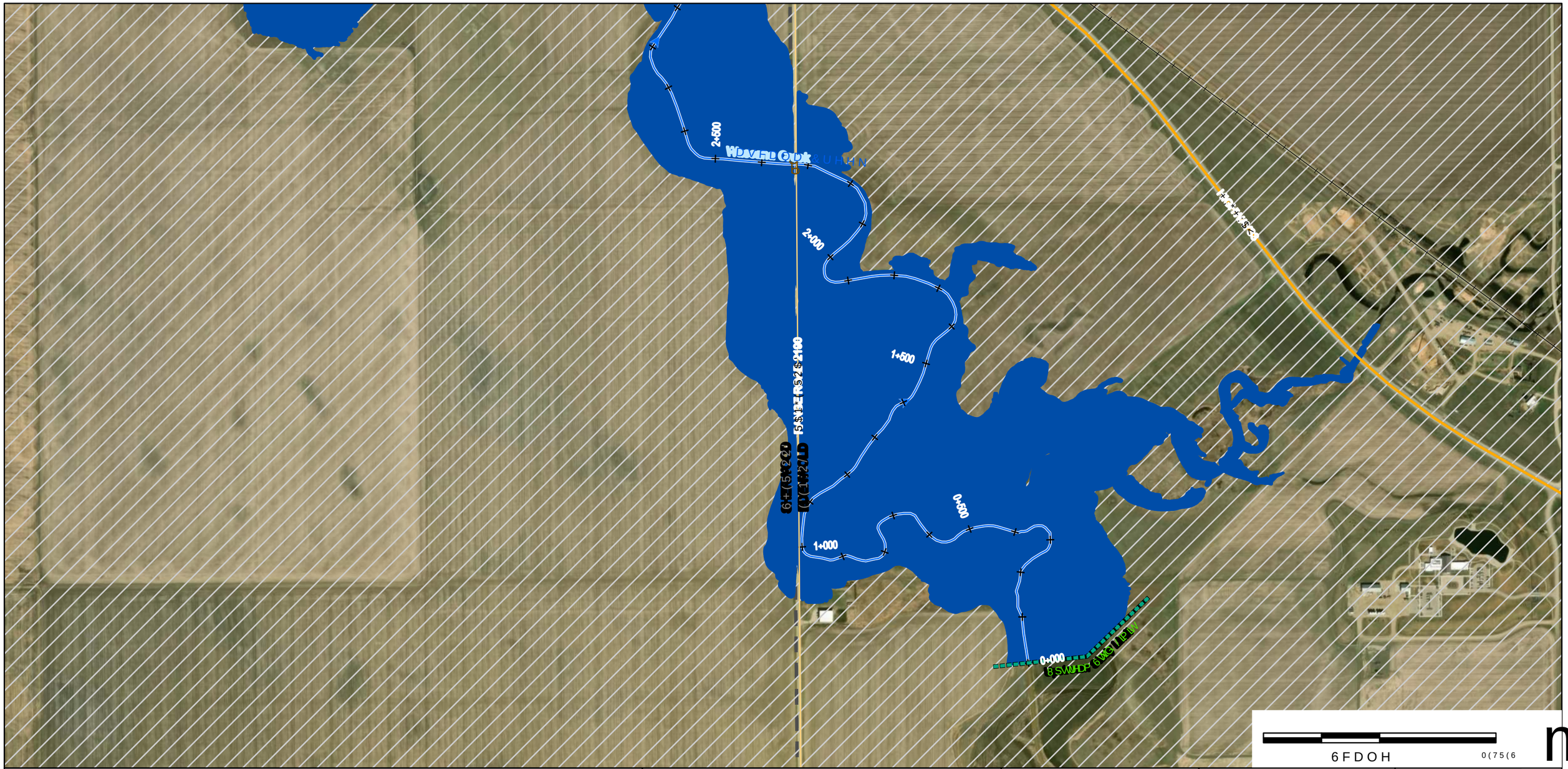

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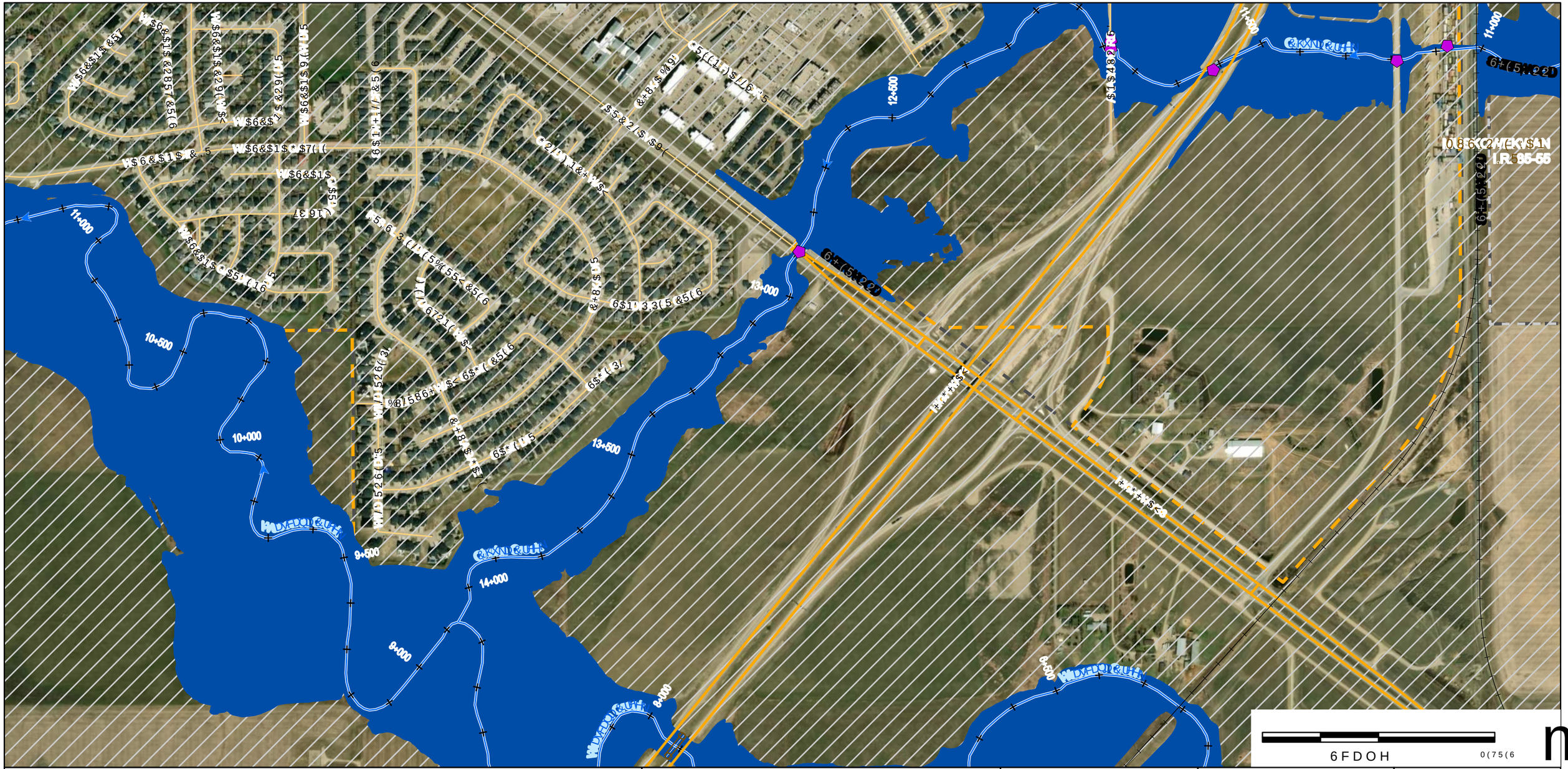

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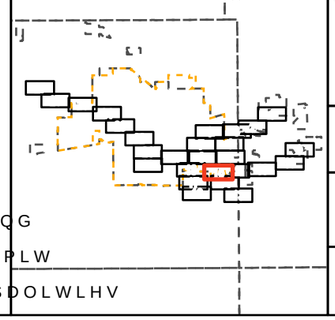

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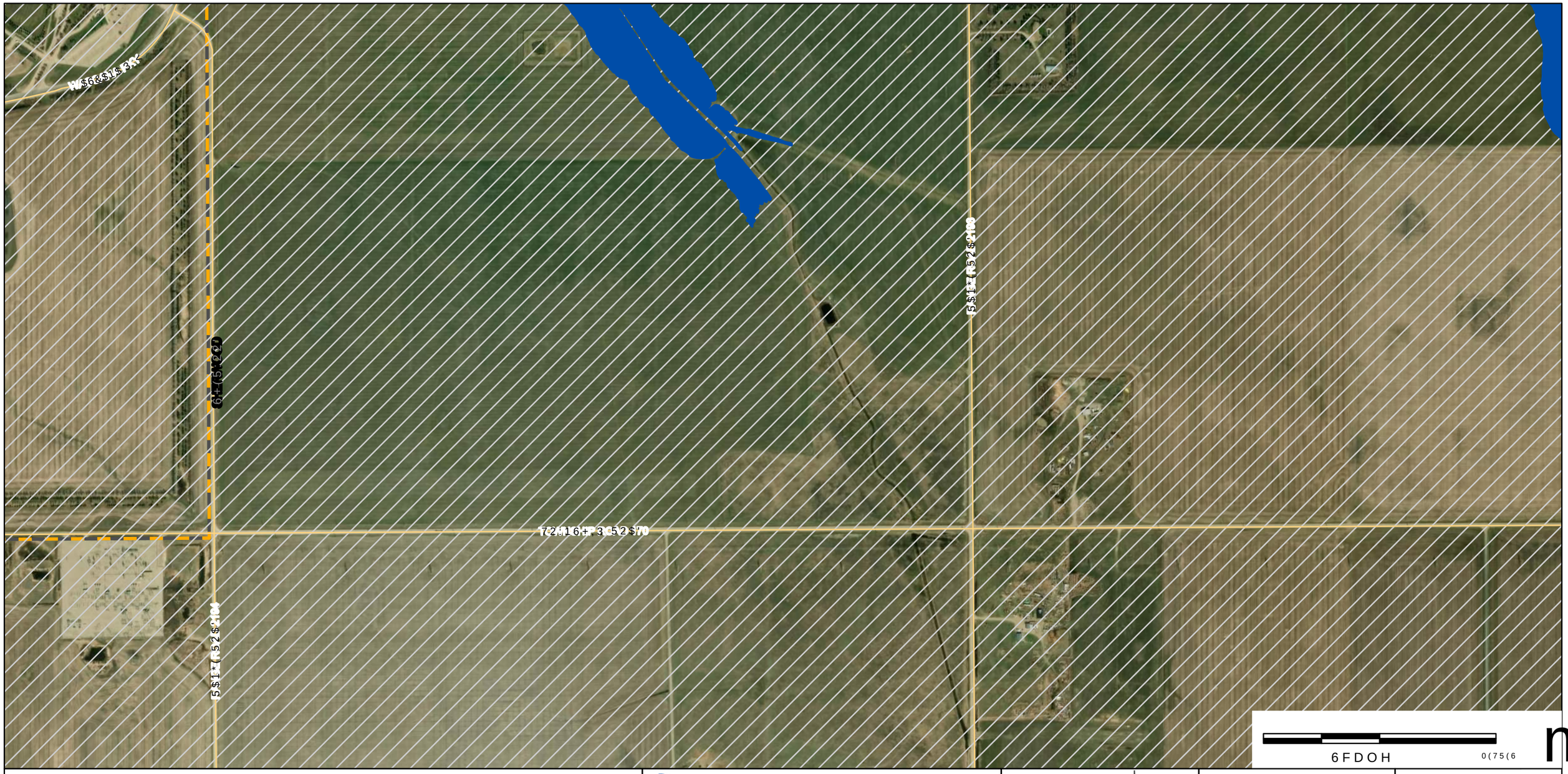

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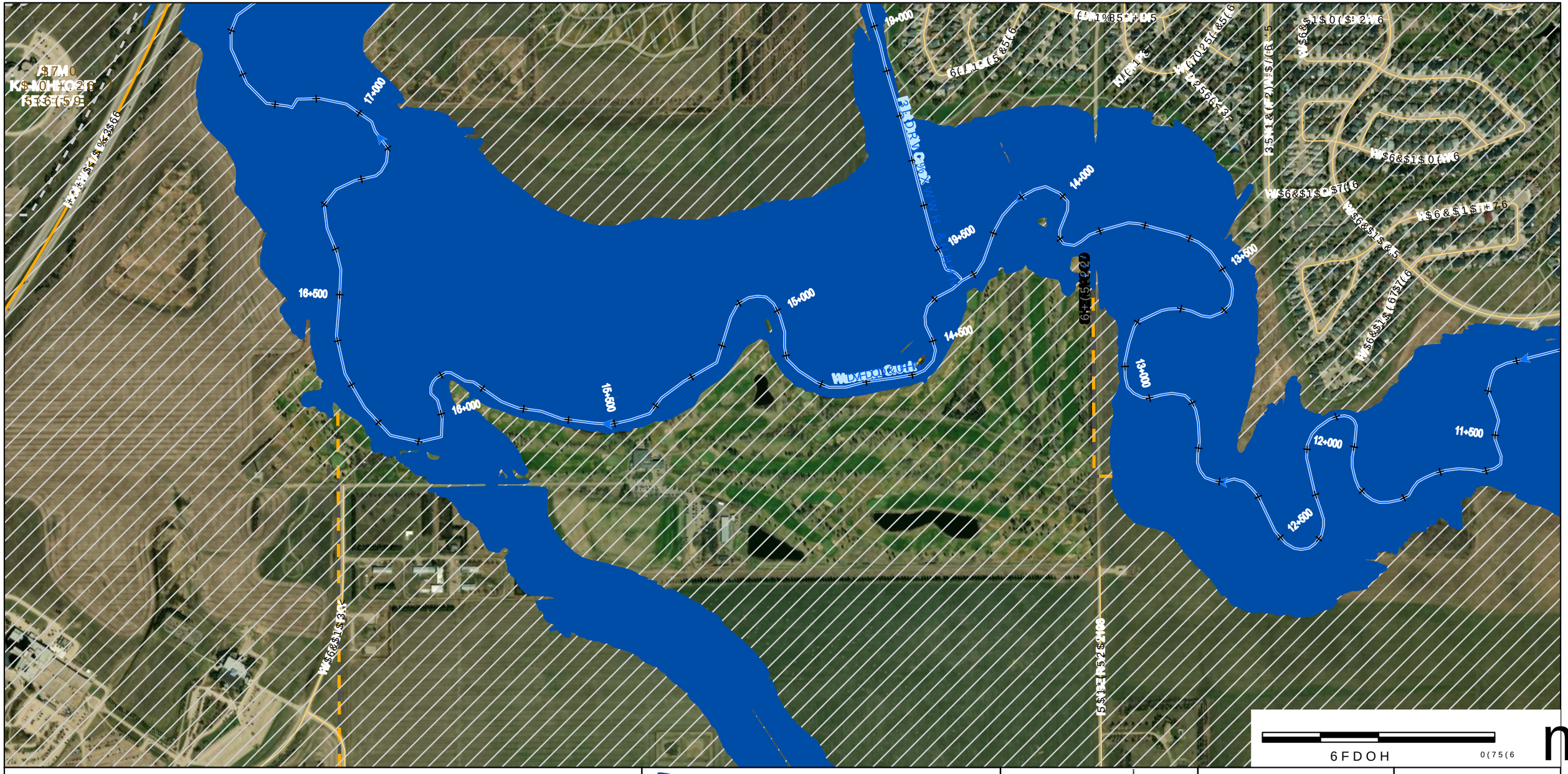

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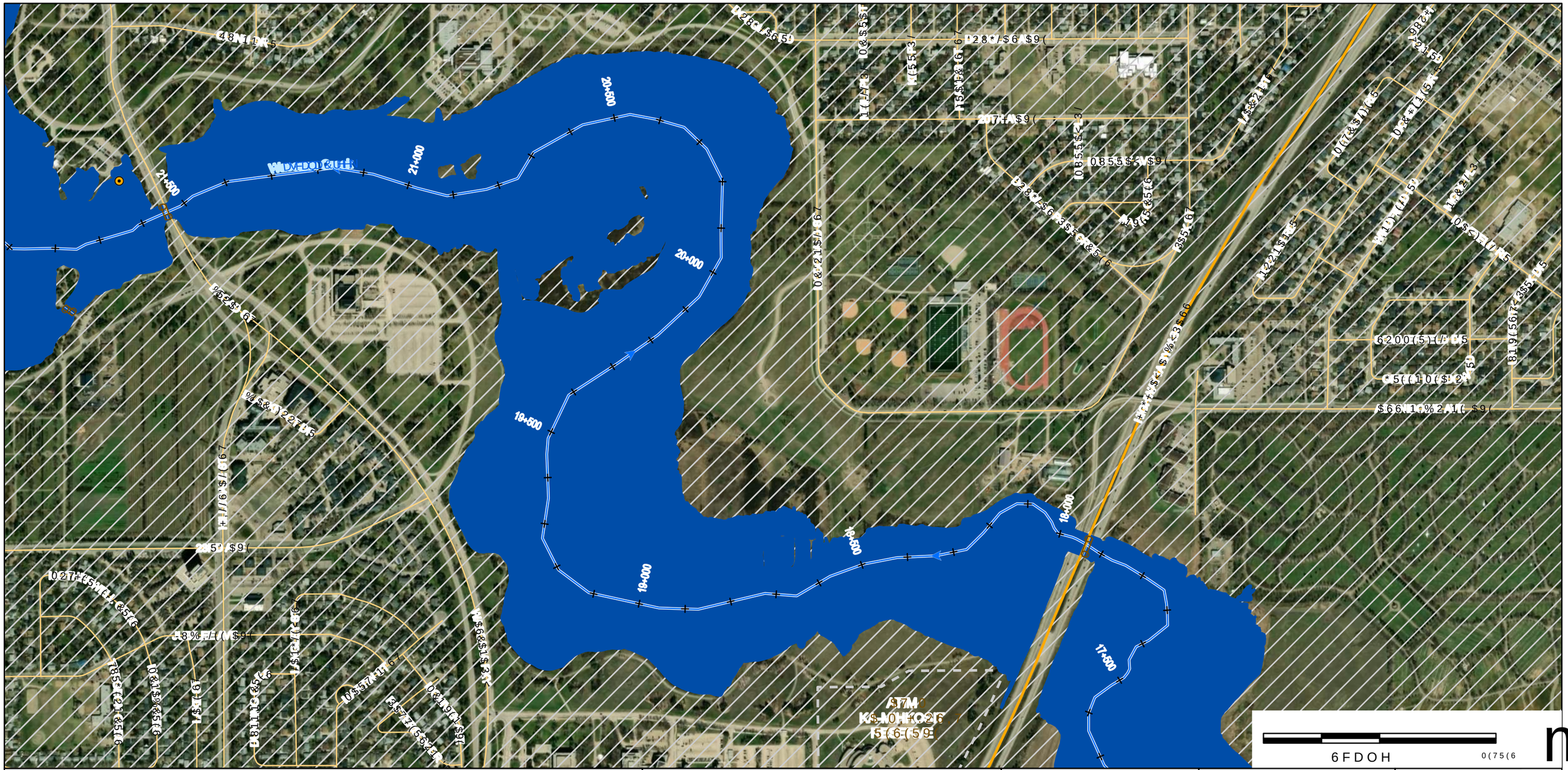

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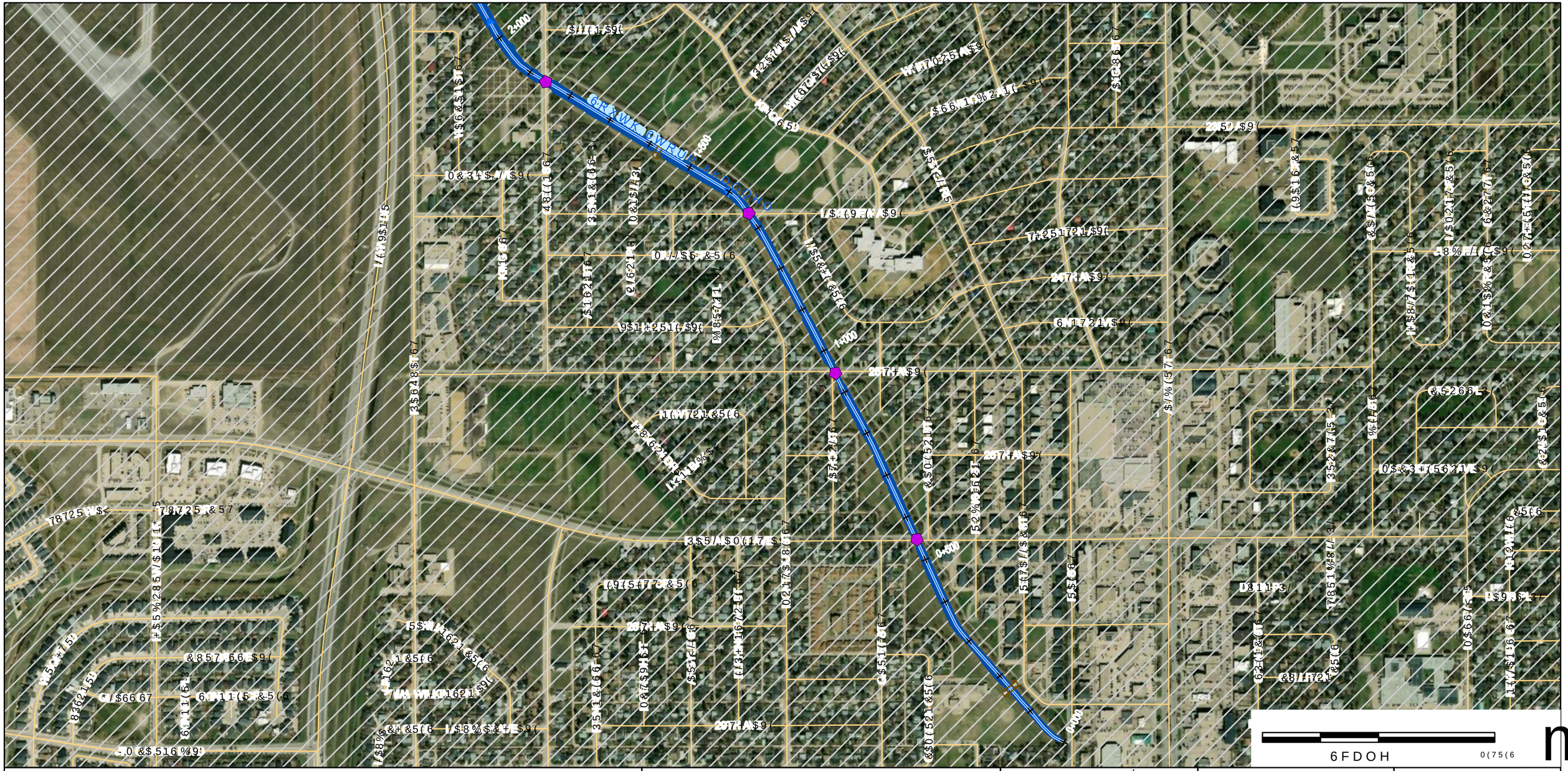
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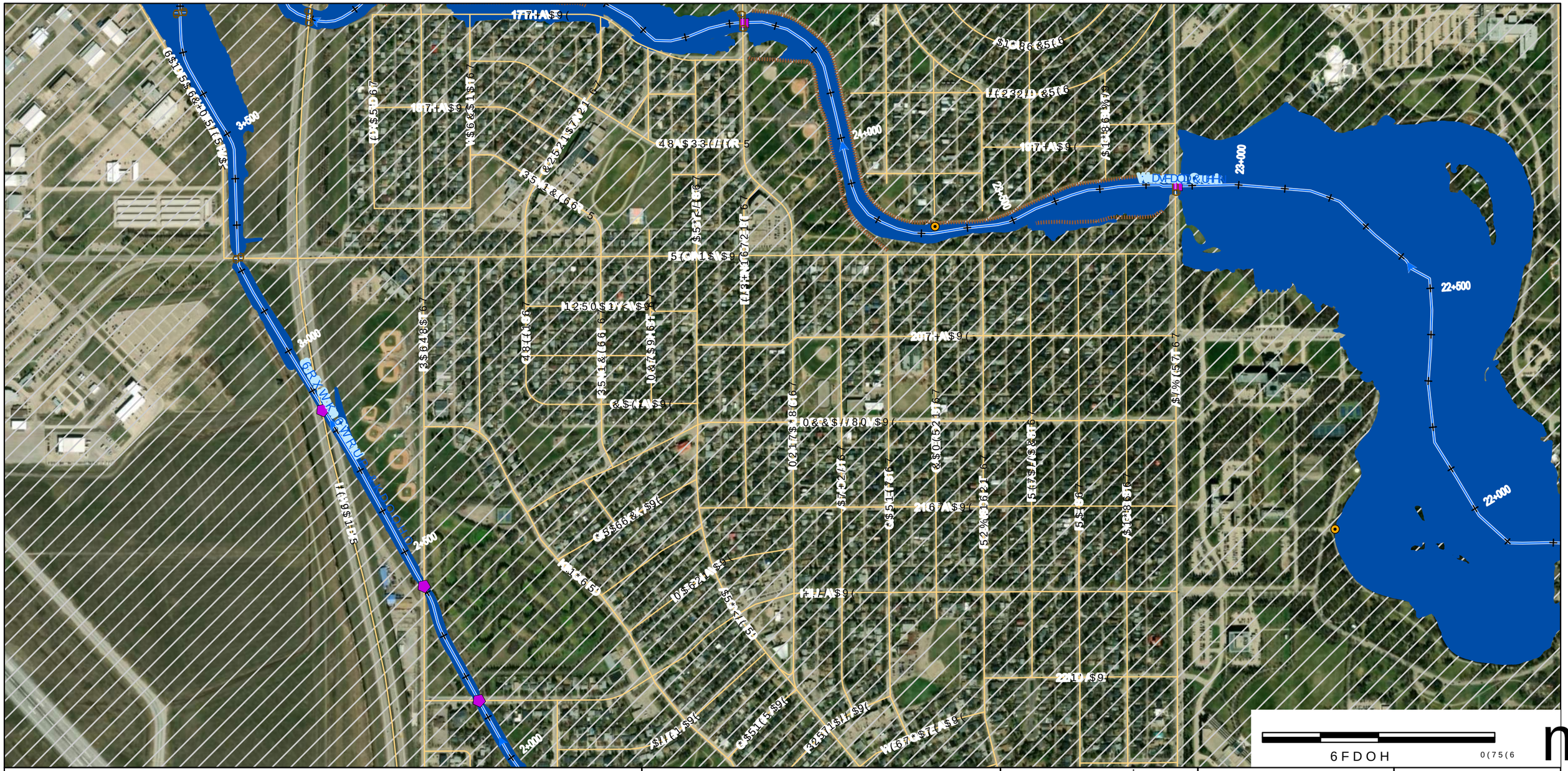

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7KH
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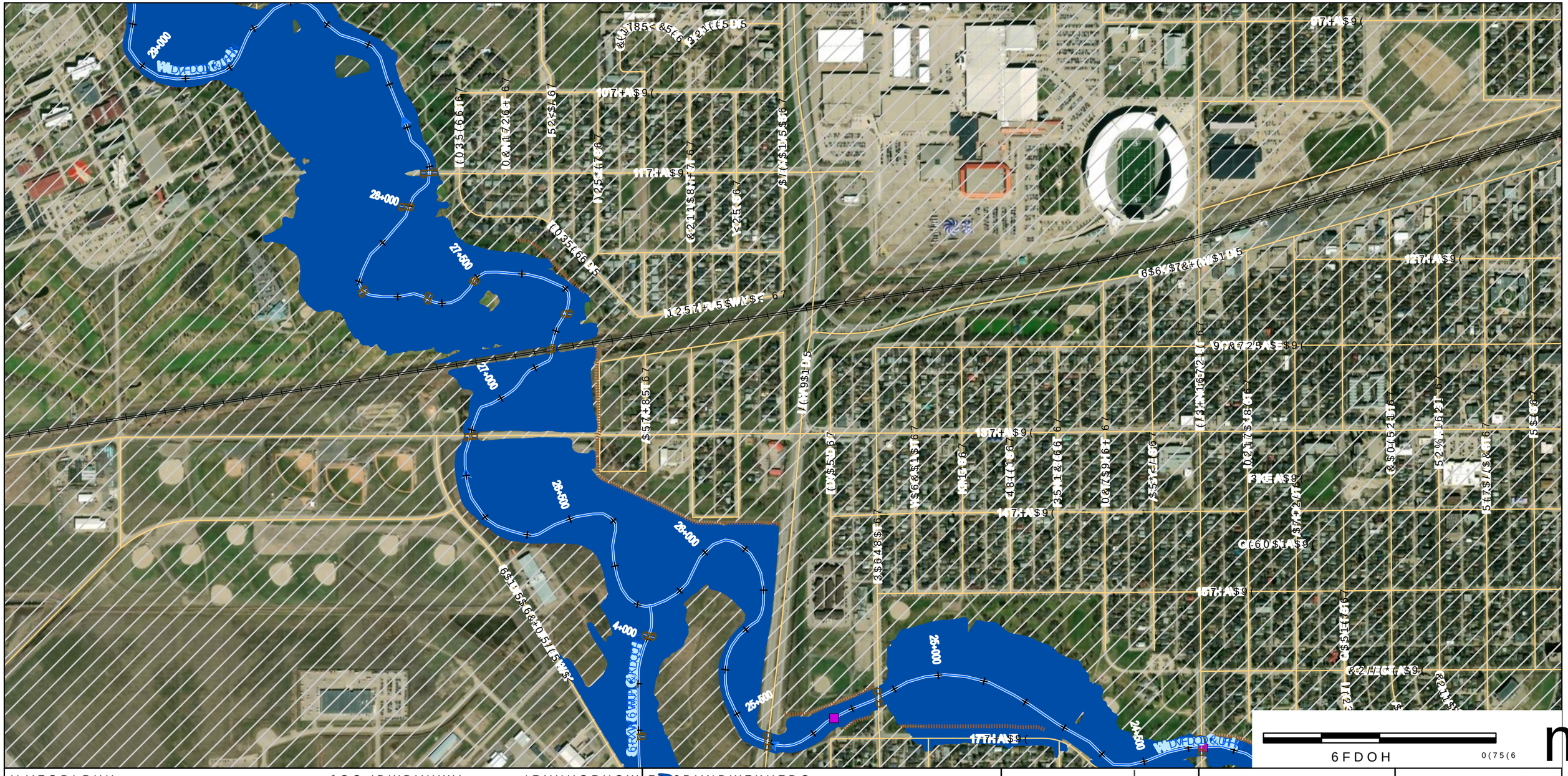
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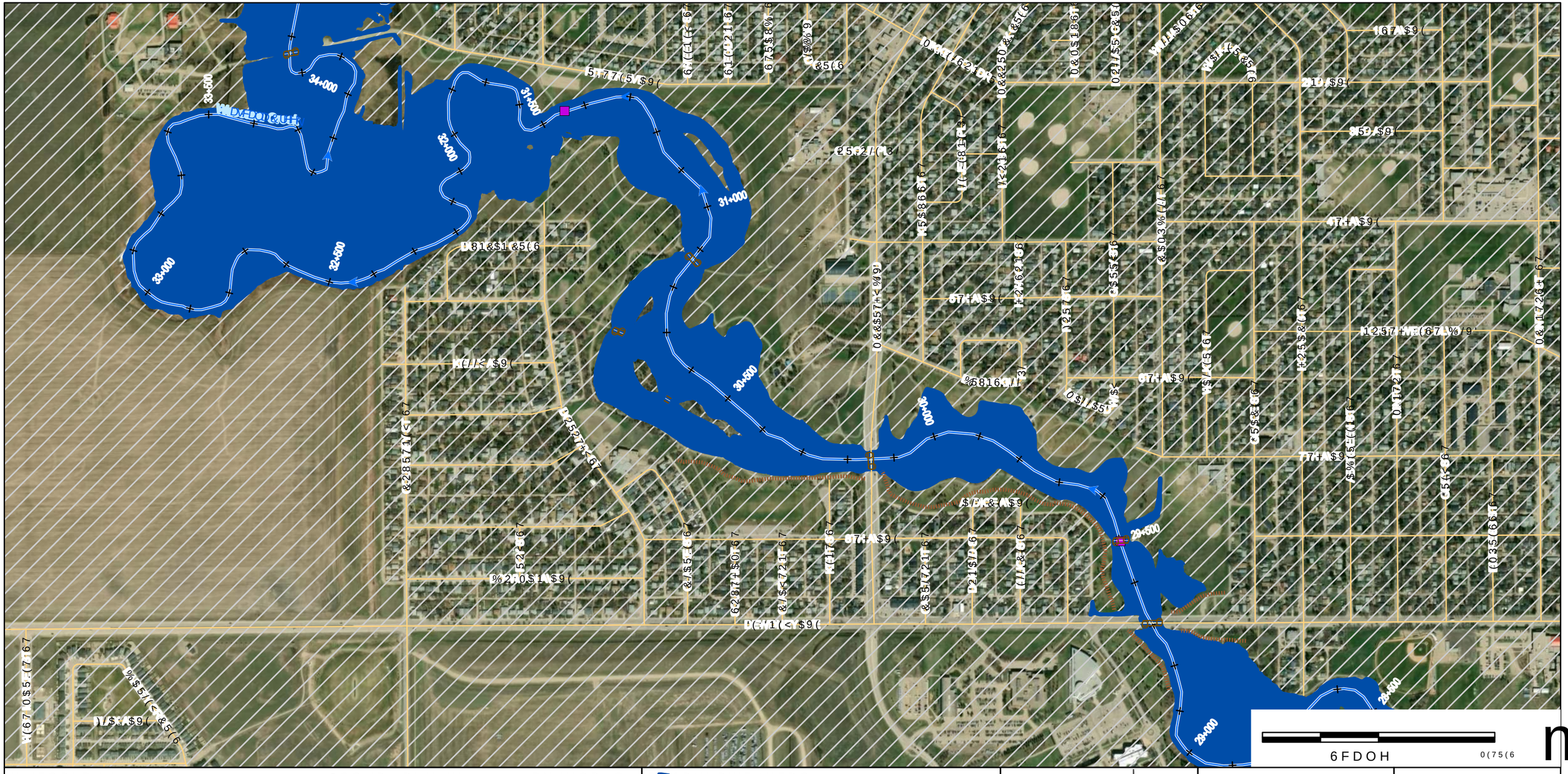

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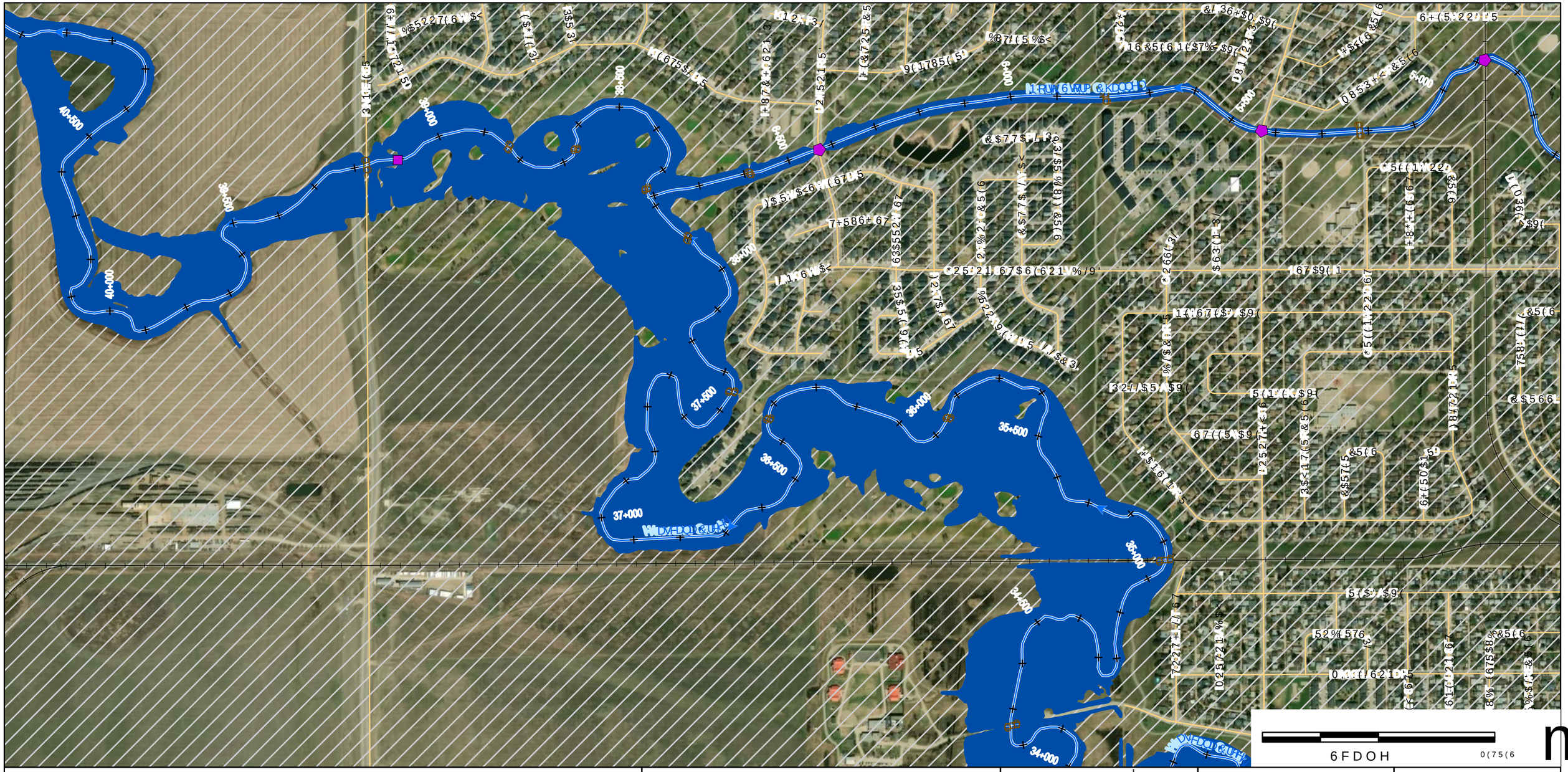

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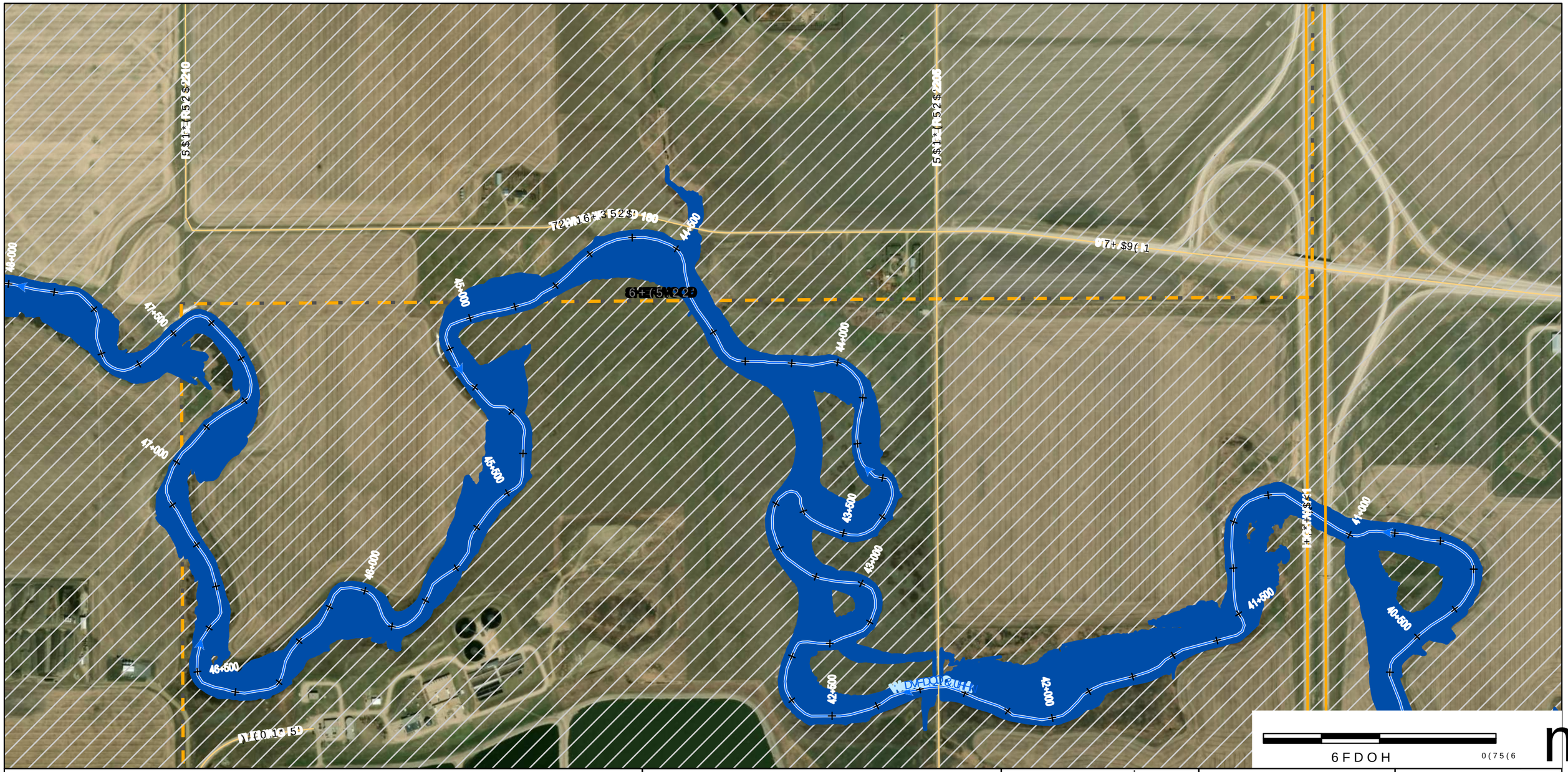

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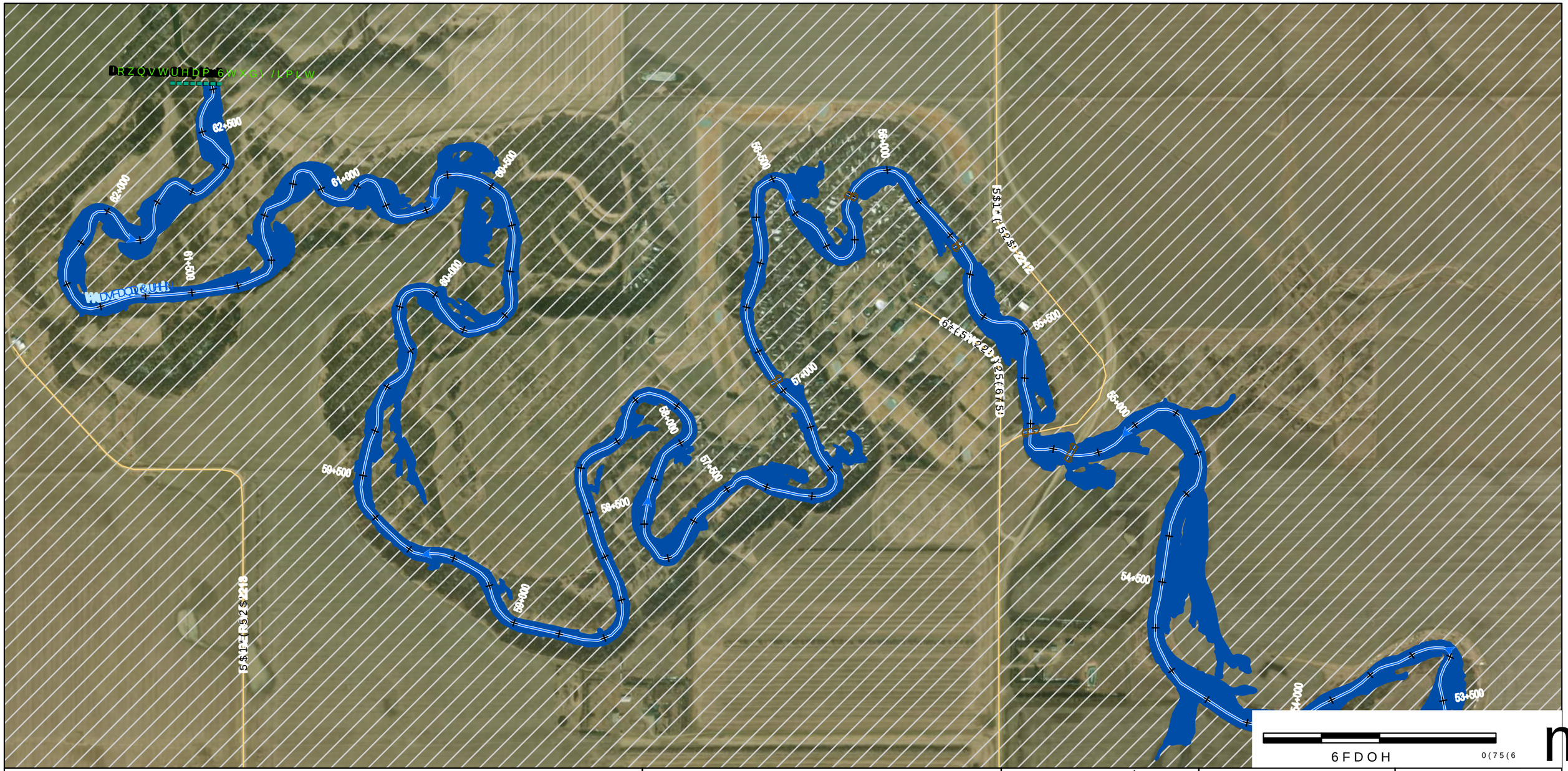

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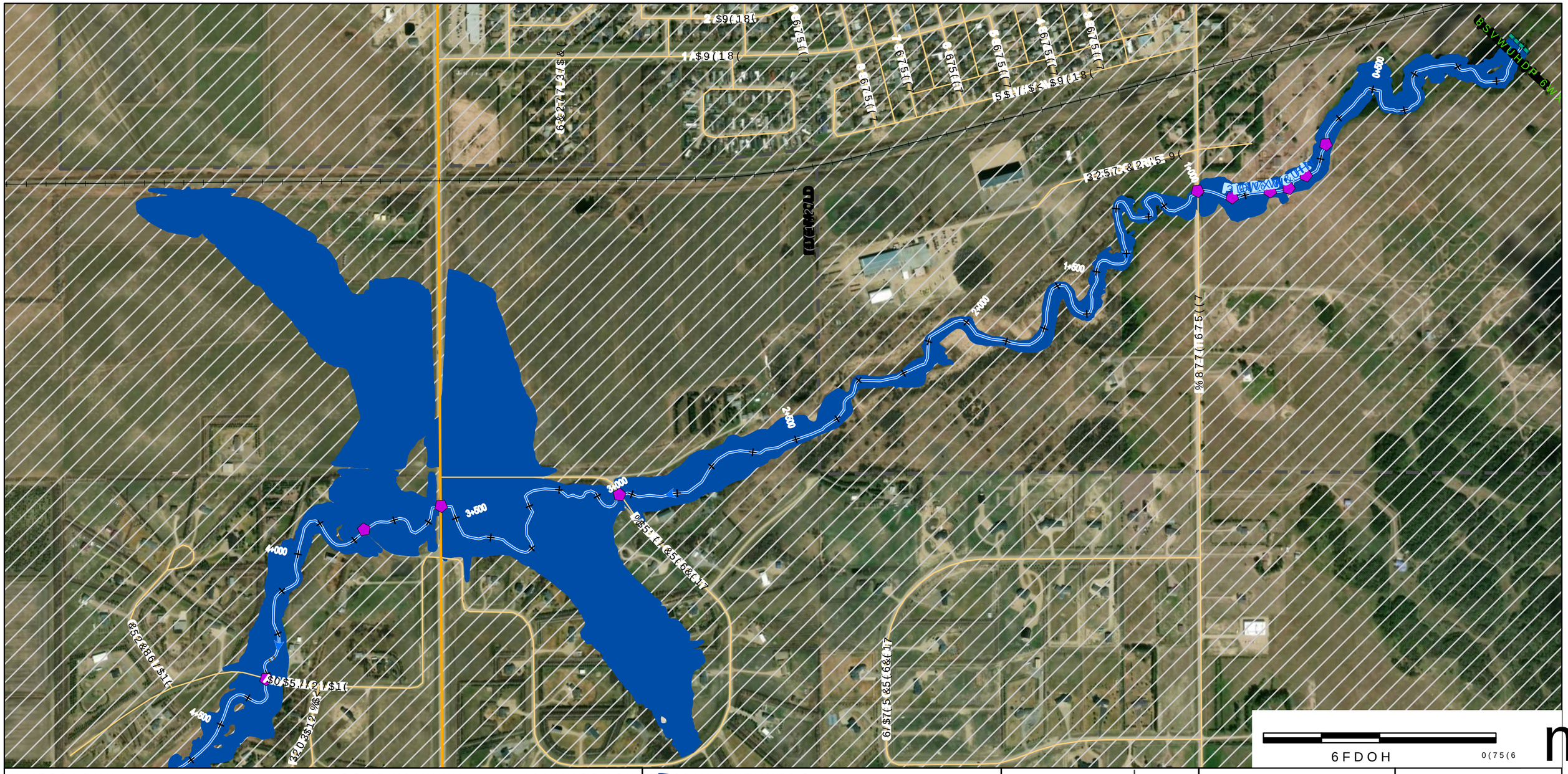
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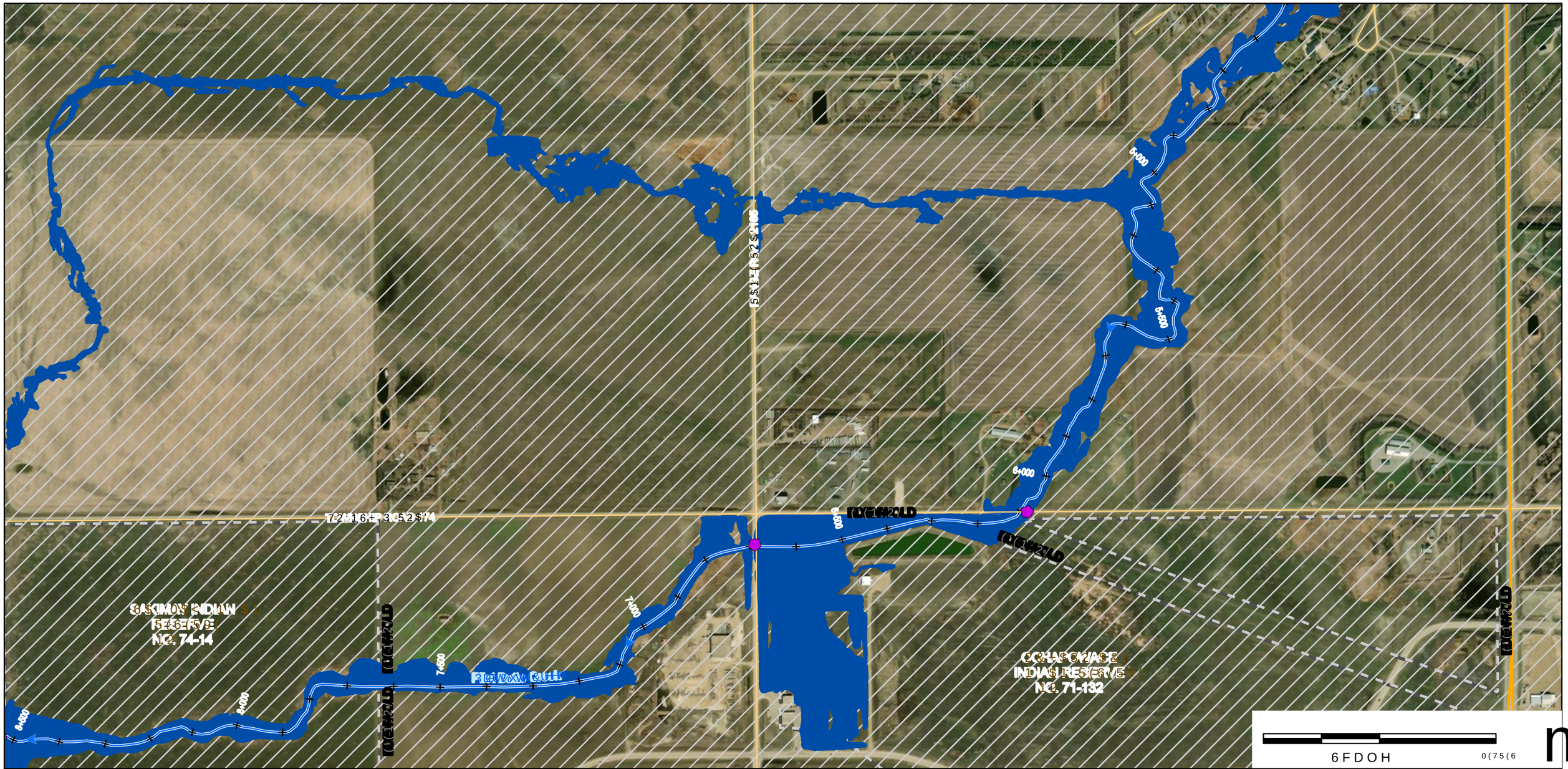

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XVHU LV DGYLVHG WR FRQILUP WKH*HRUHIHUHQFH &RQWDLQHG KHUHLQ
LQ
WKH HYHQW WKDW SUHFLVLRQ DQG &XUUHQWO\ GDWD DUH UHTXLUHG
:6$ UHFRPPHQGV FRQILUPLQJ WKH ,QGHSHQGHQW VWDWXV RI
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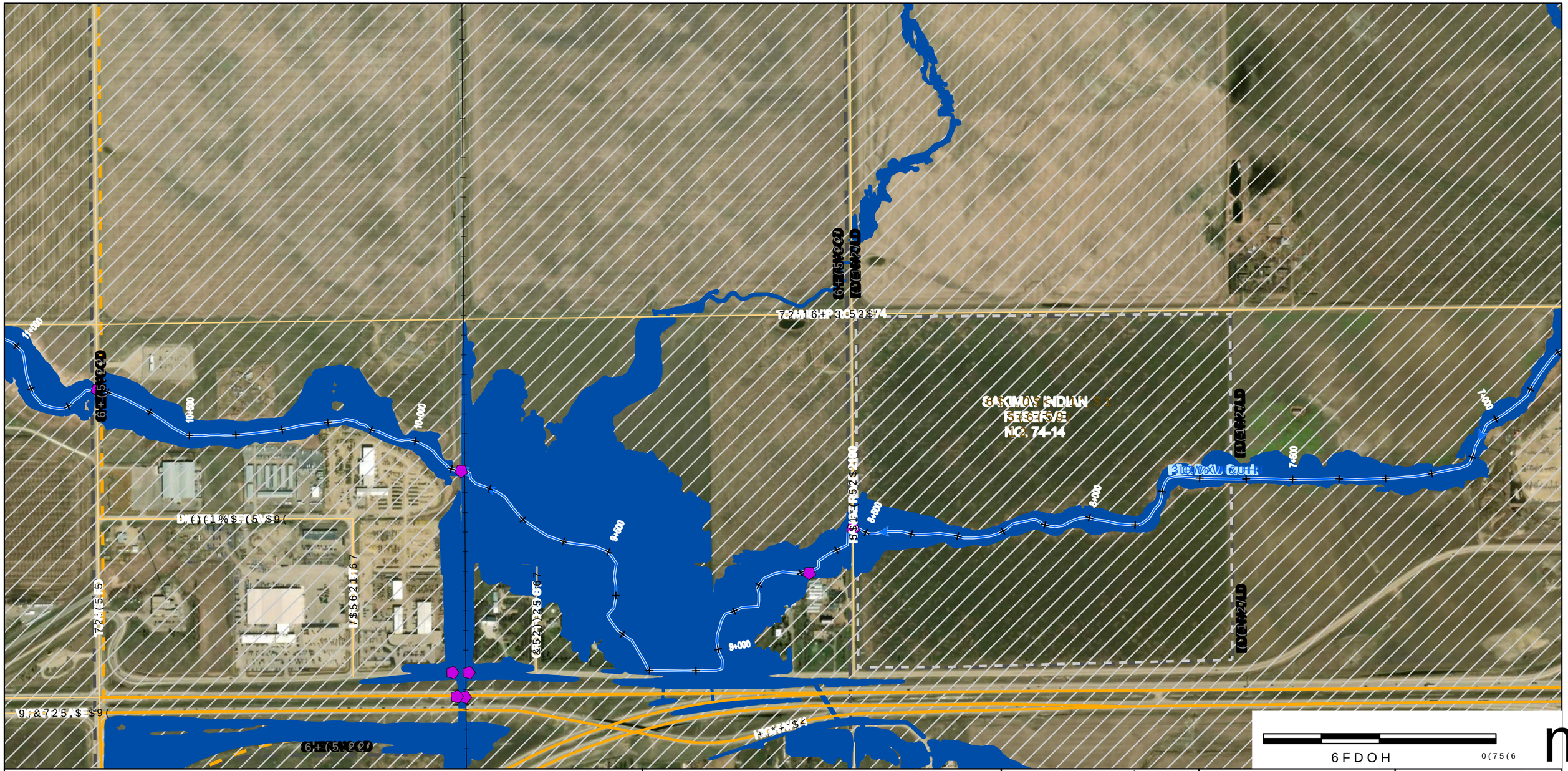

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XVHU LV DGYLVHG WR FRQILUP WKH *HRLG PRWHQ &*RQWDLQHG KHUHLQ
LQ
WKH HYHQW WKDW SUHFLVLRQ DQG &XUUHQF\ RI GDWD DUH UHTXLUHG
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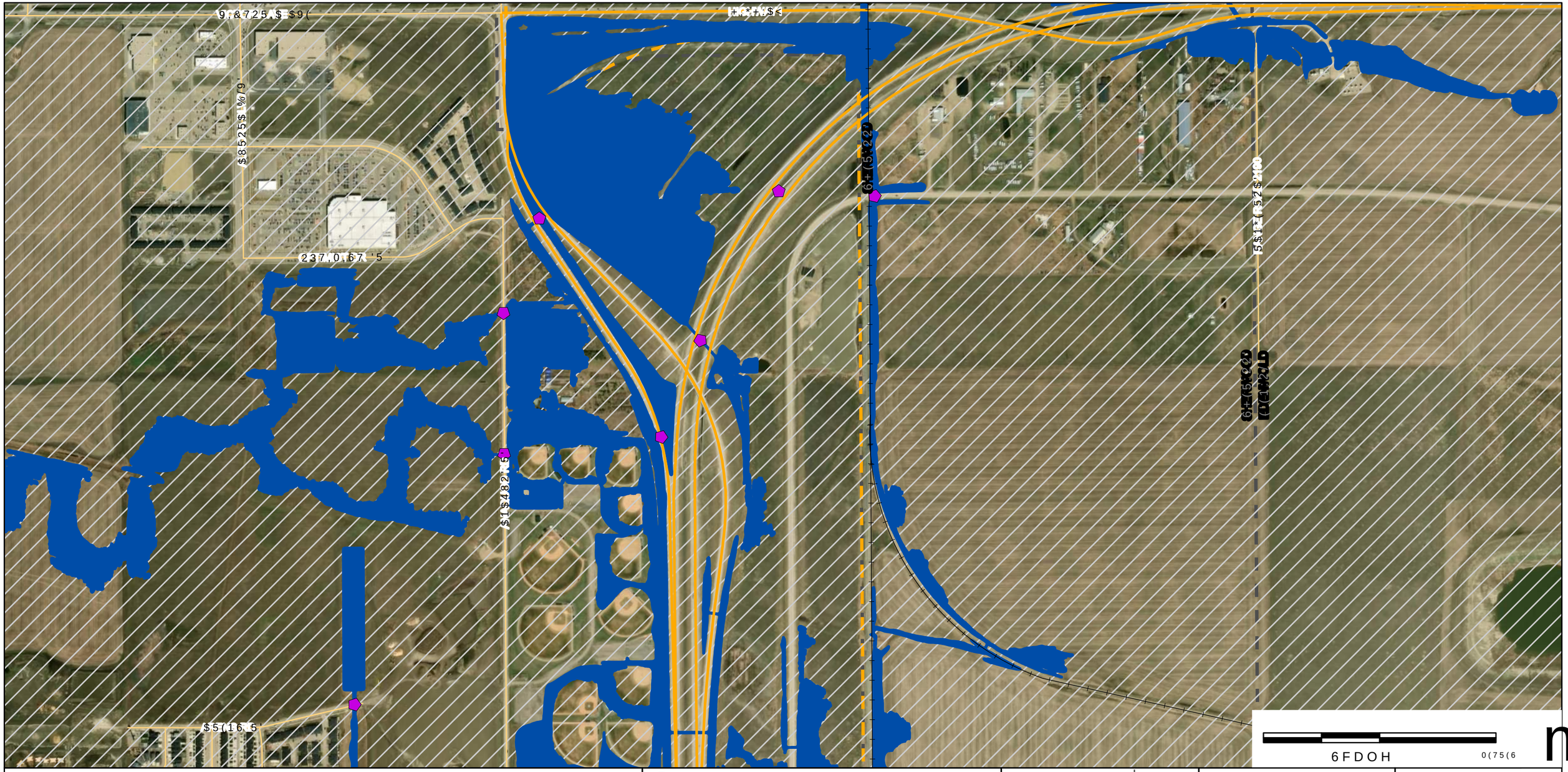

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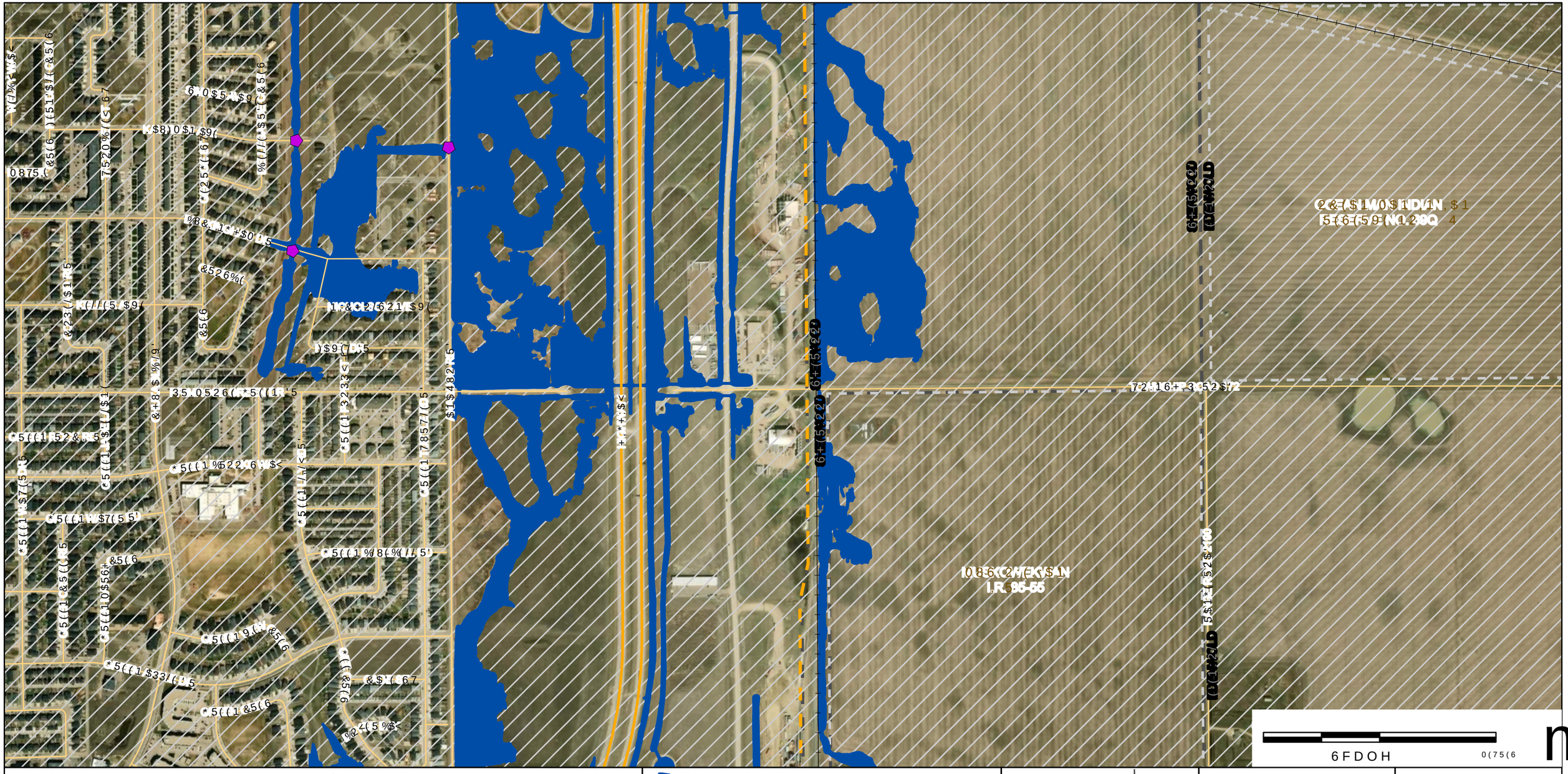

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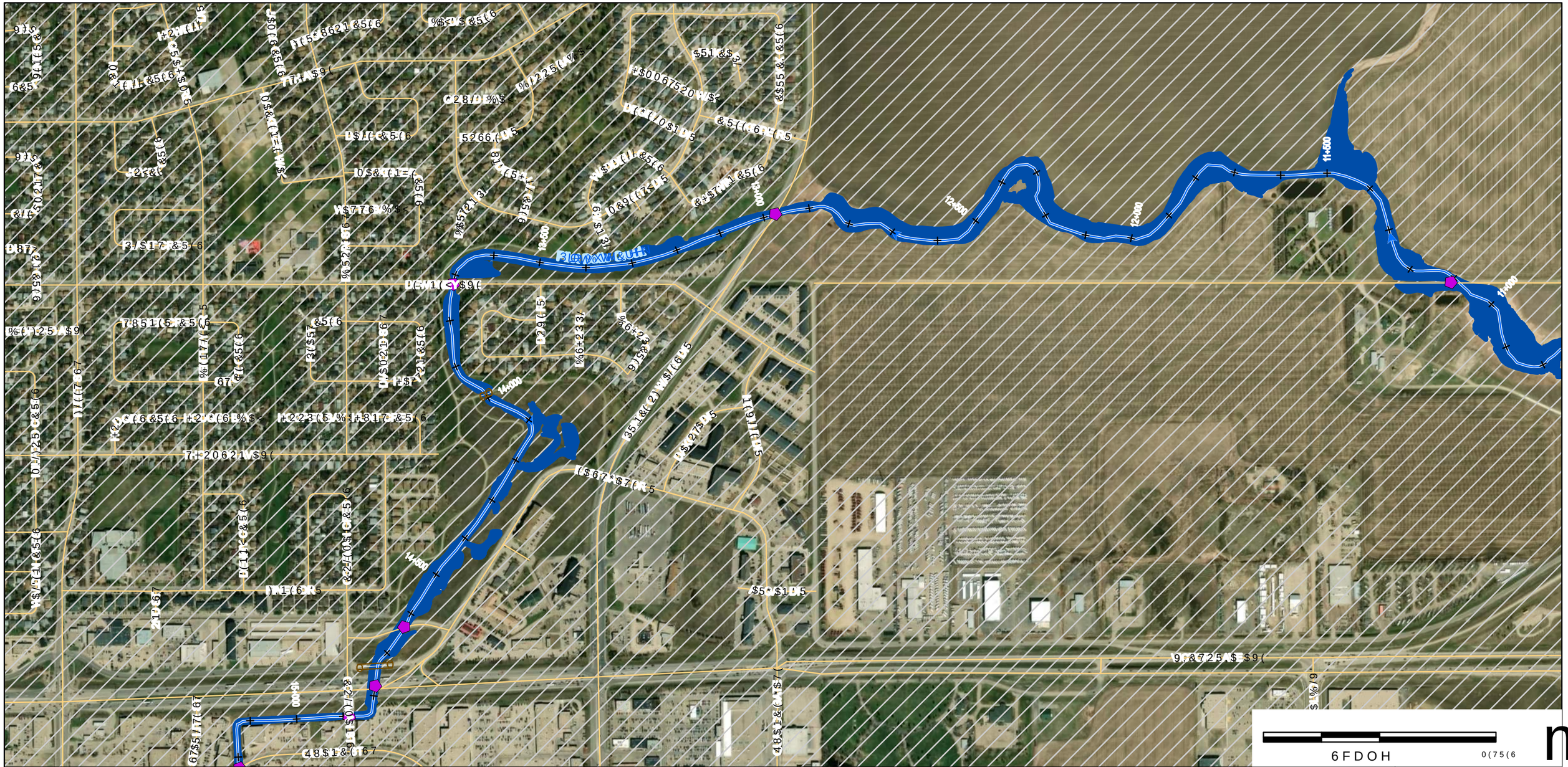

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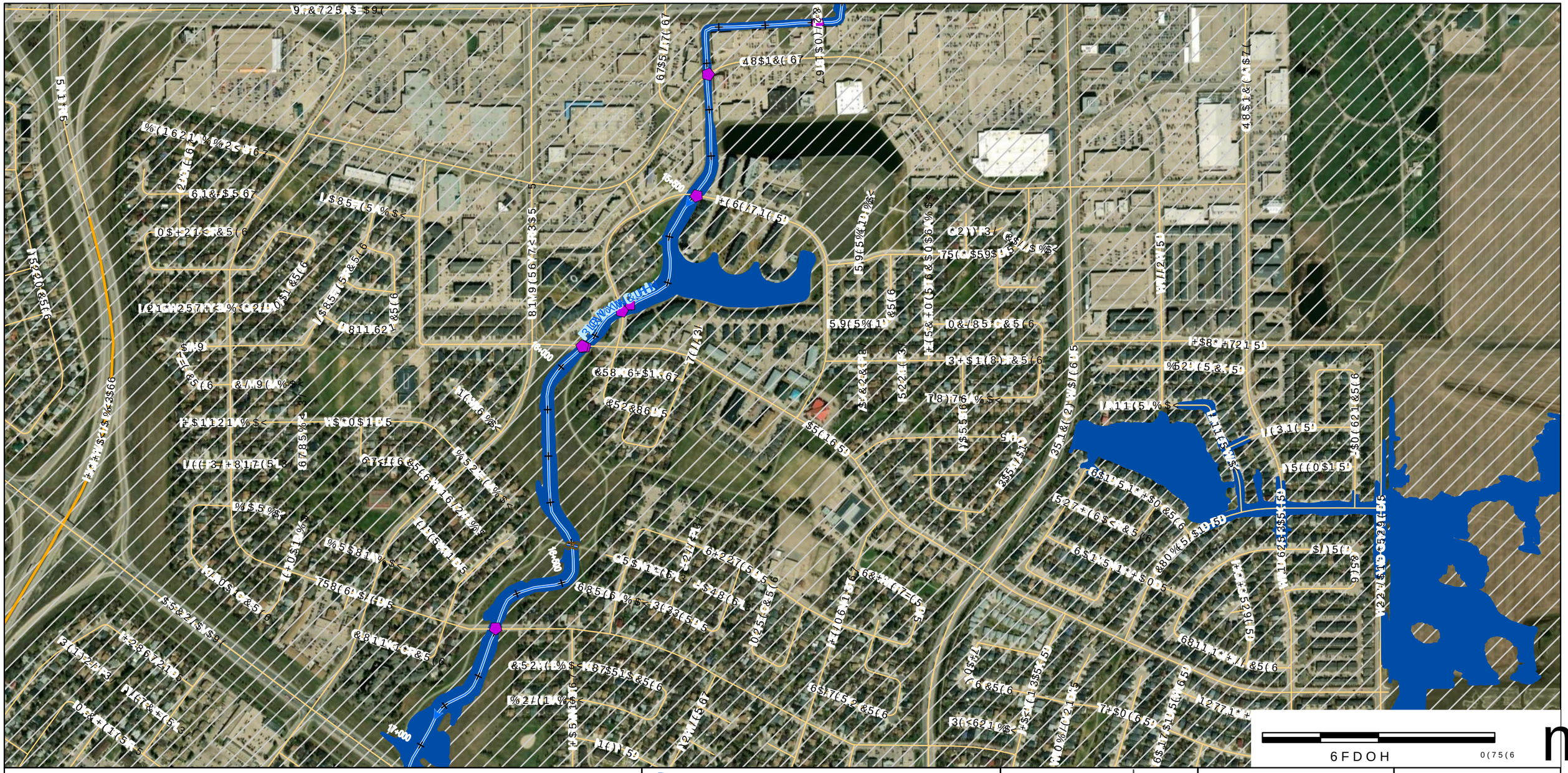

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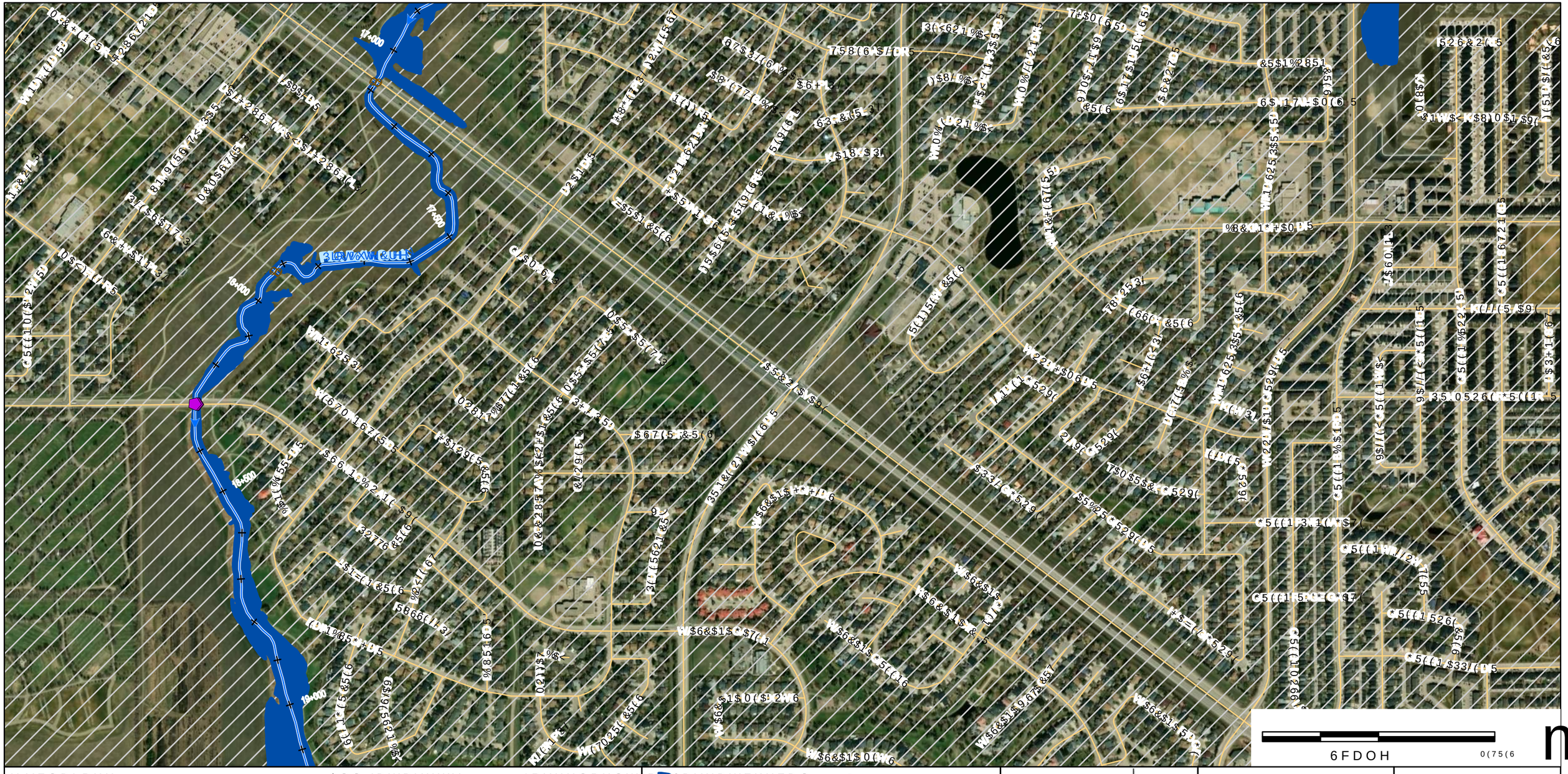

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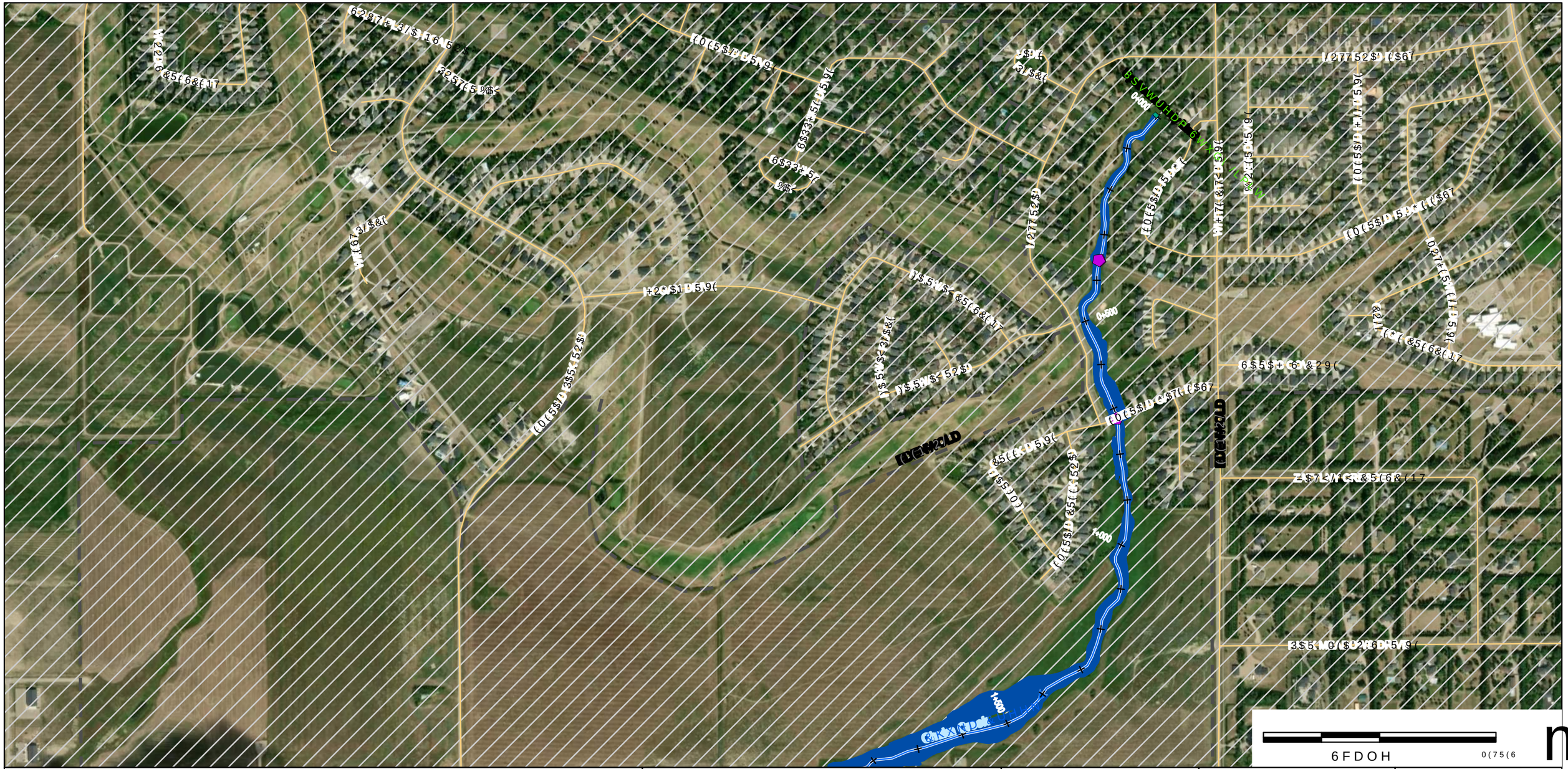

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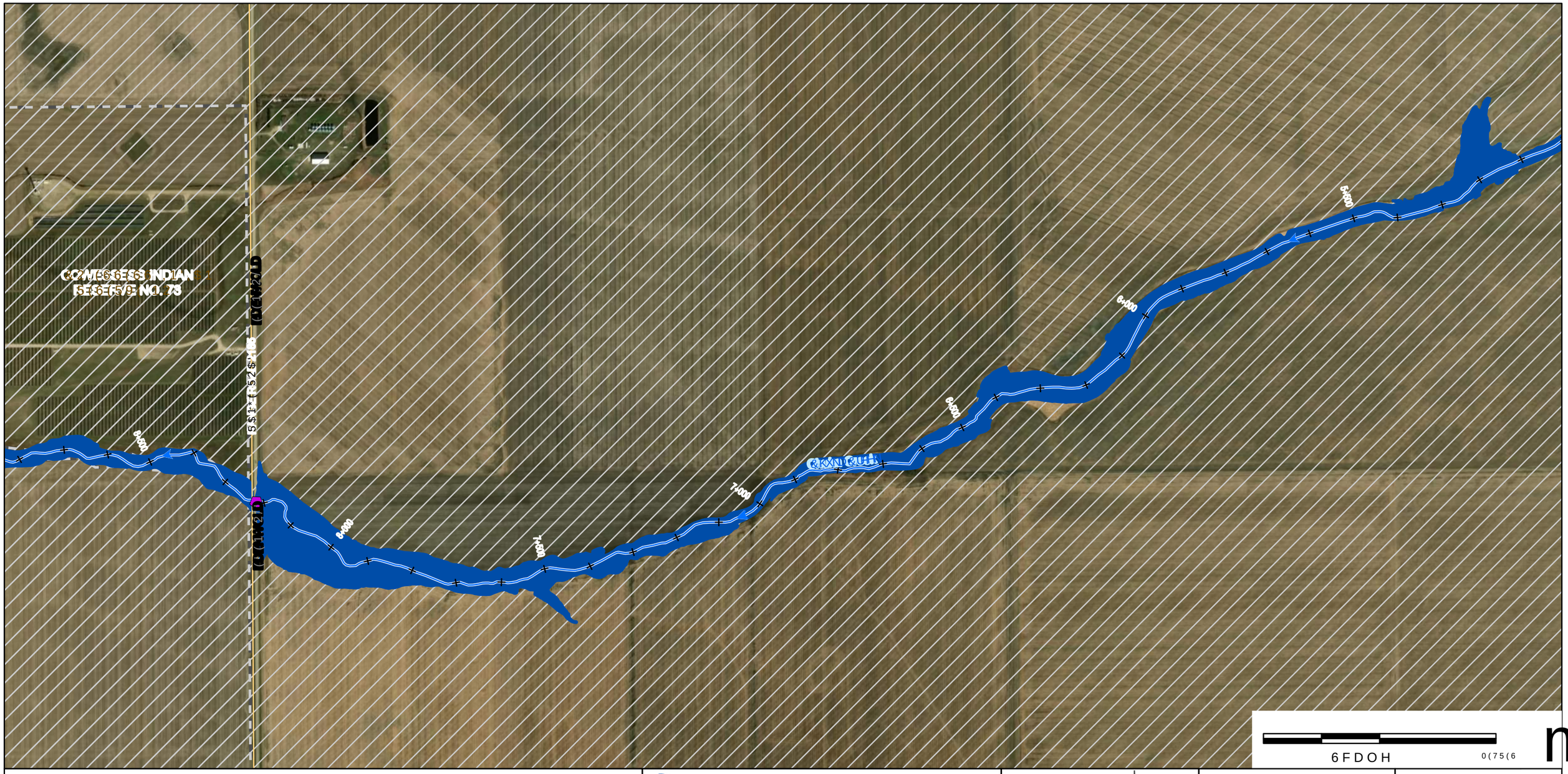

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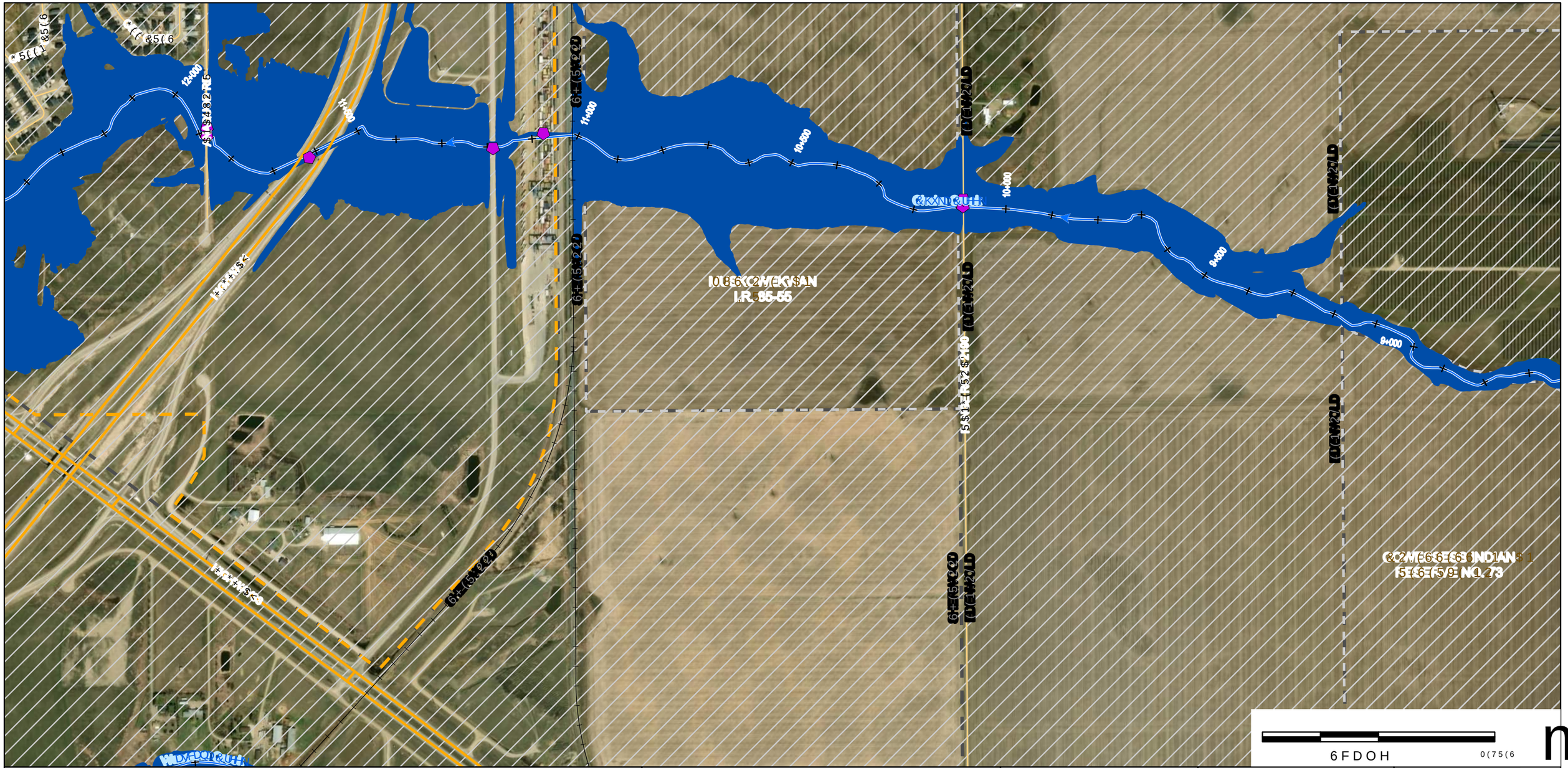
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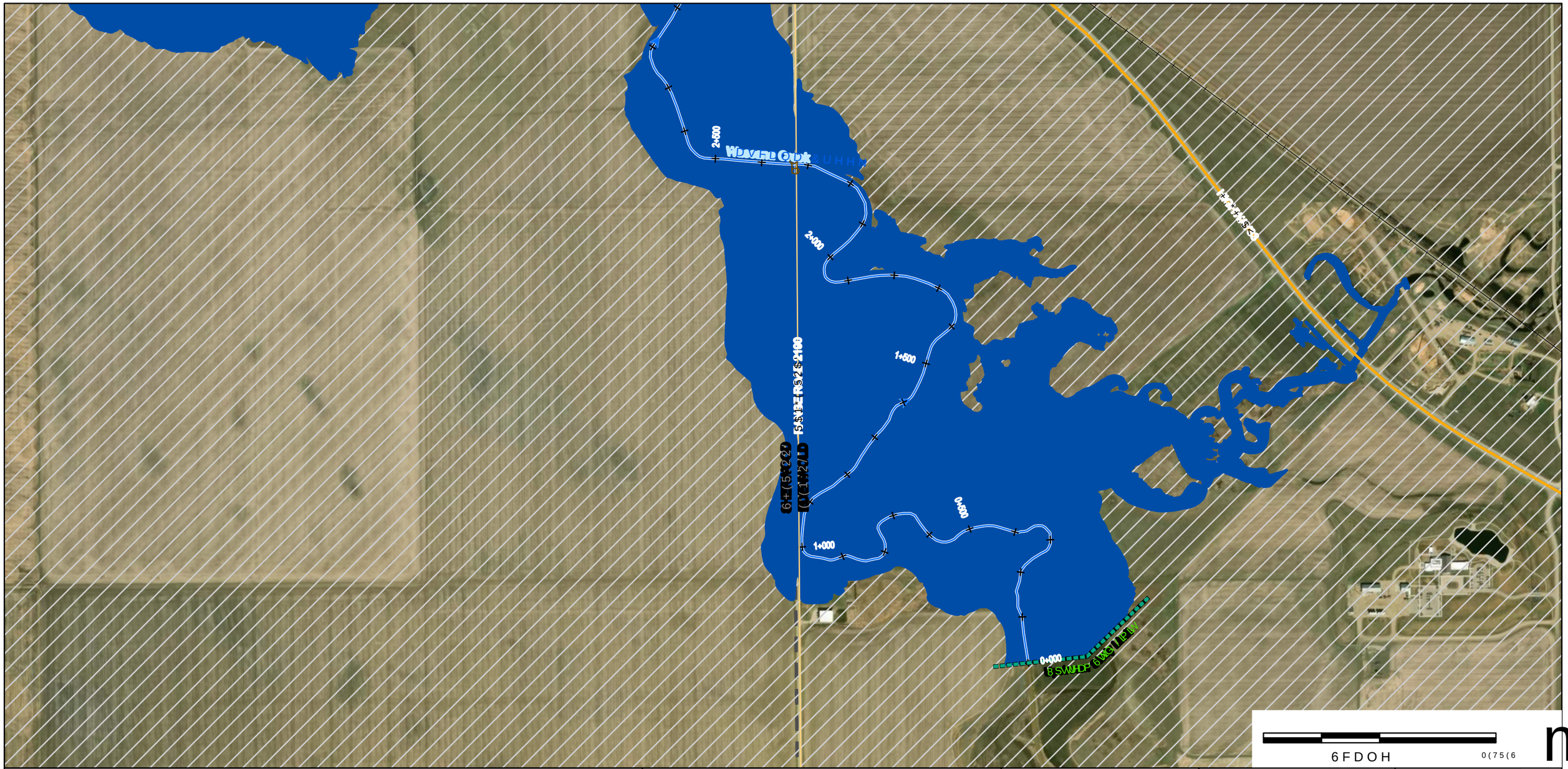

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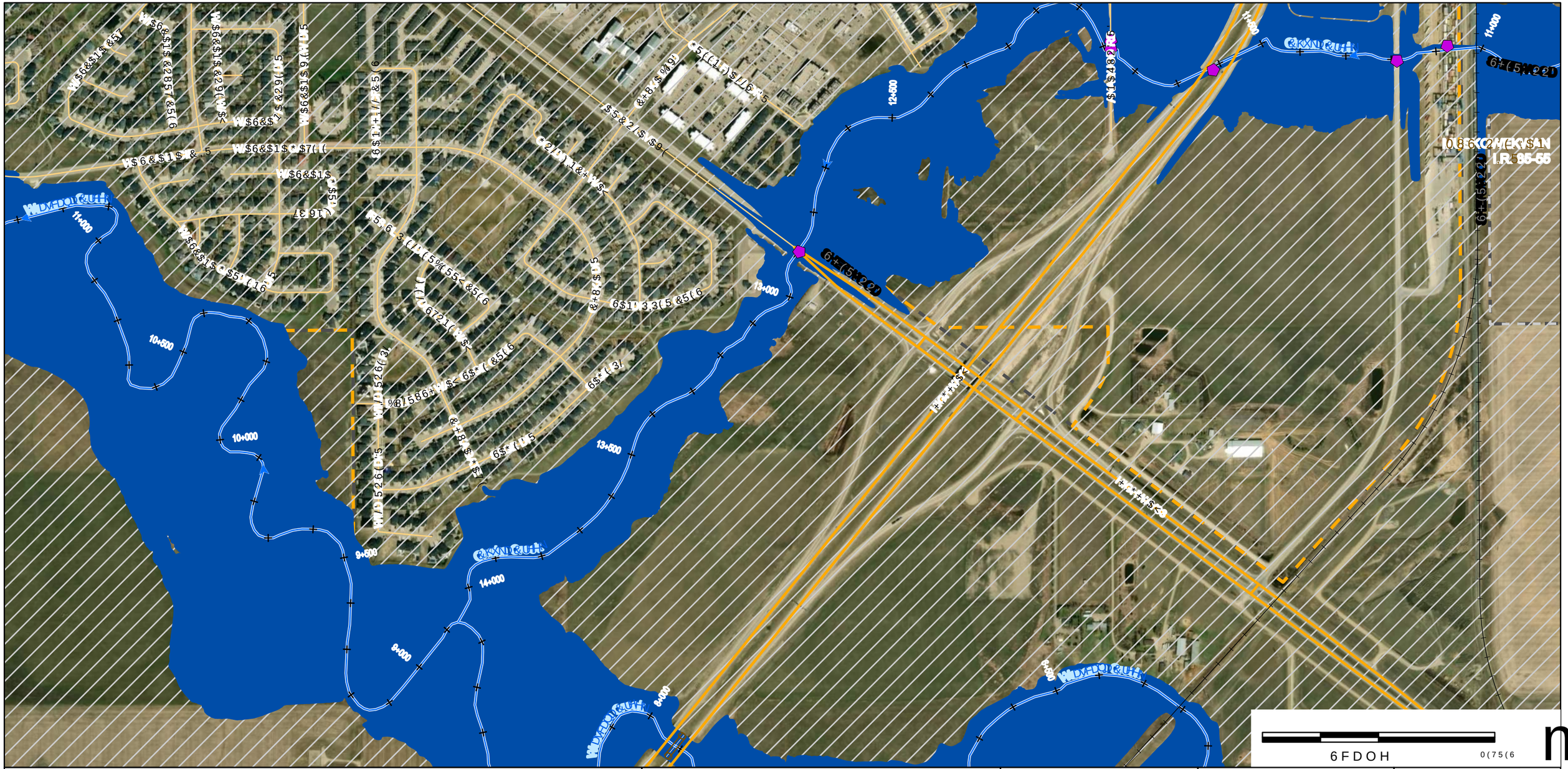
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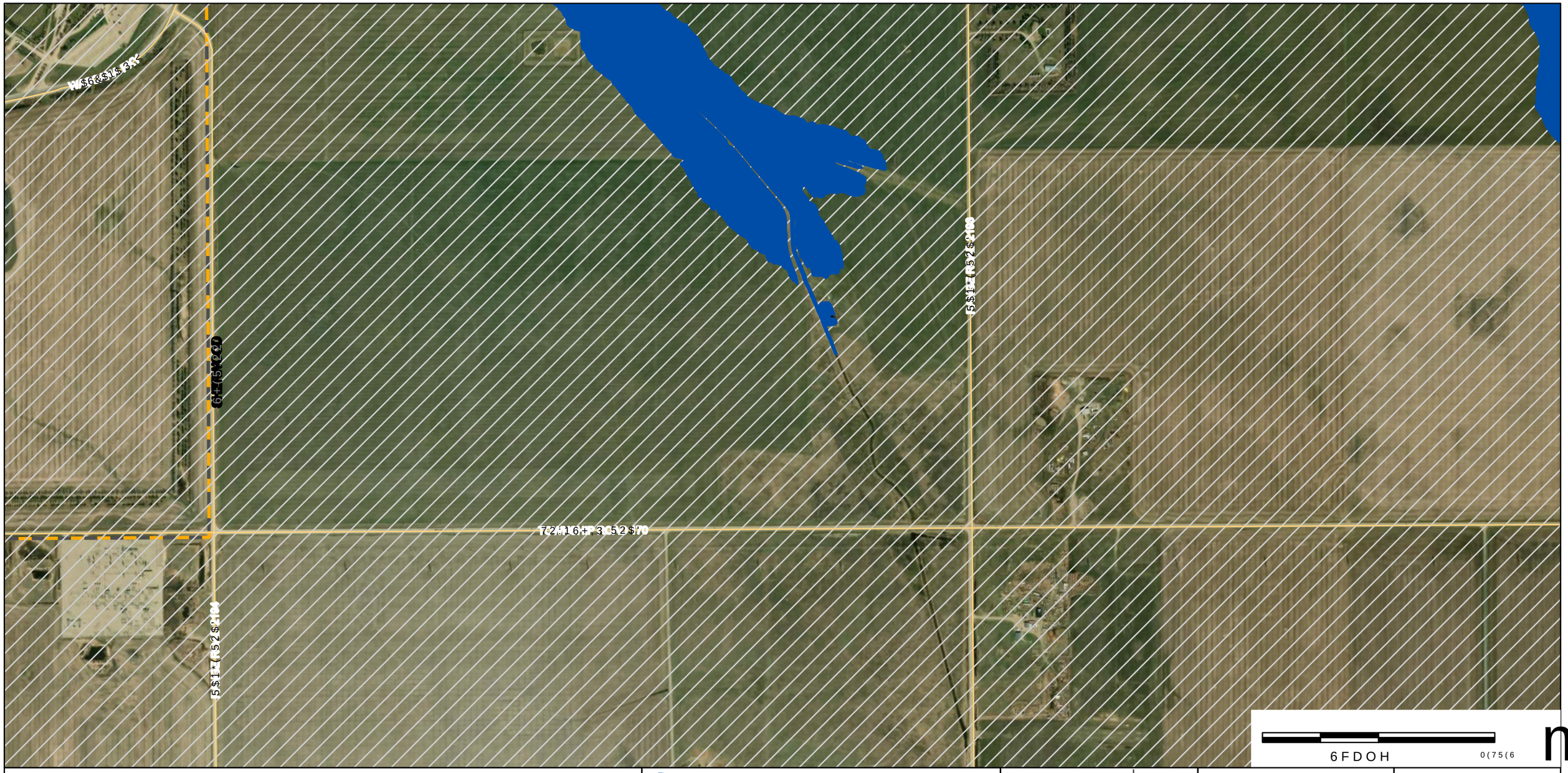

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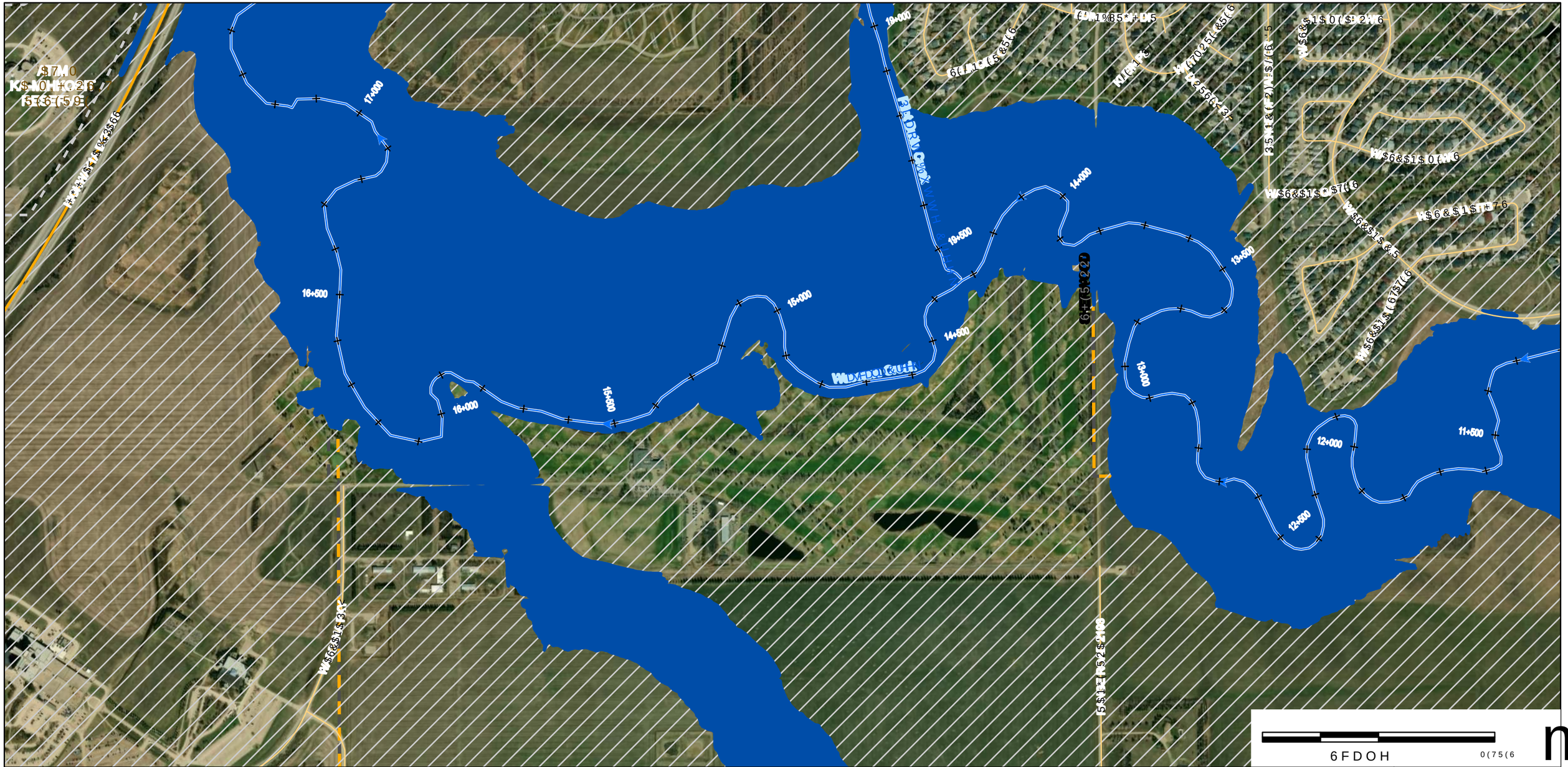

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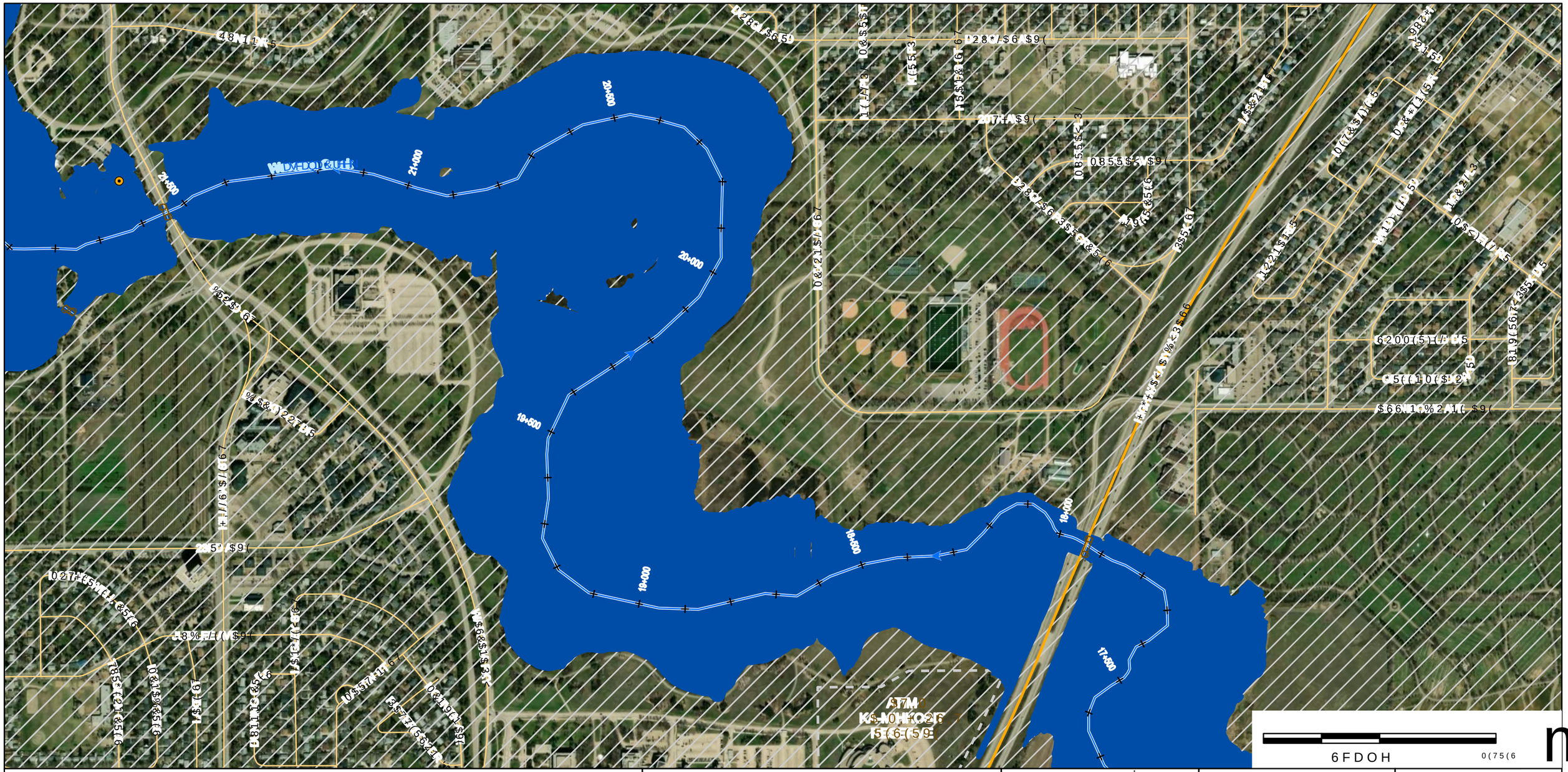

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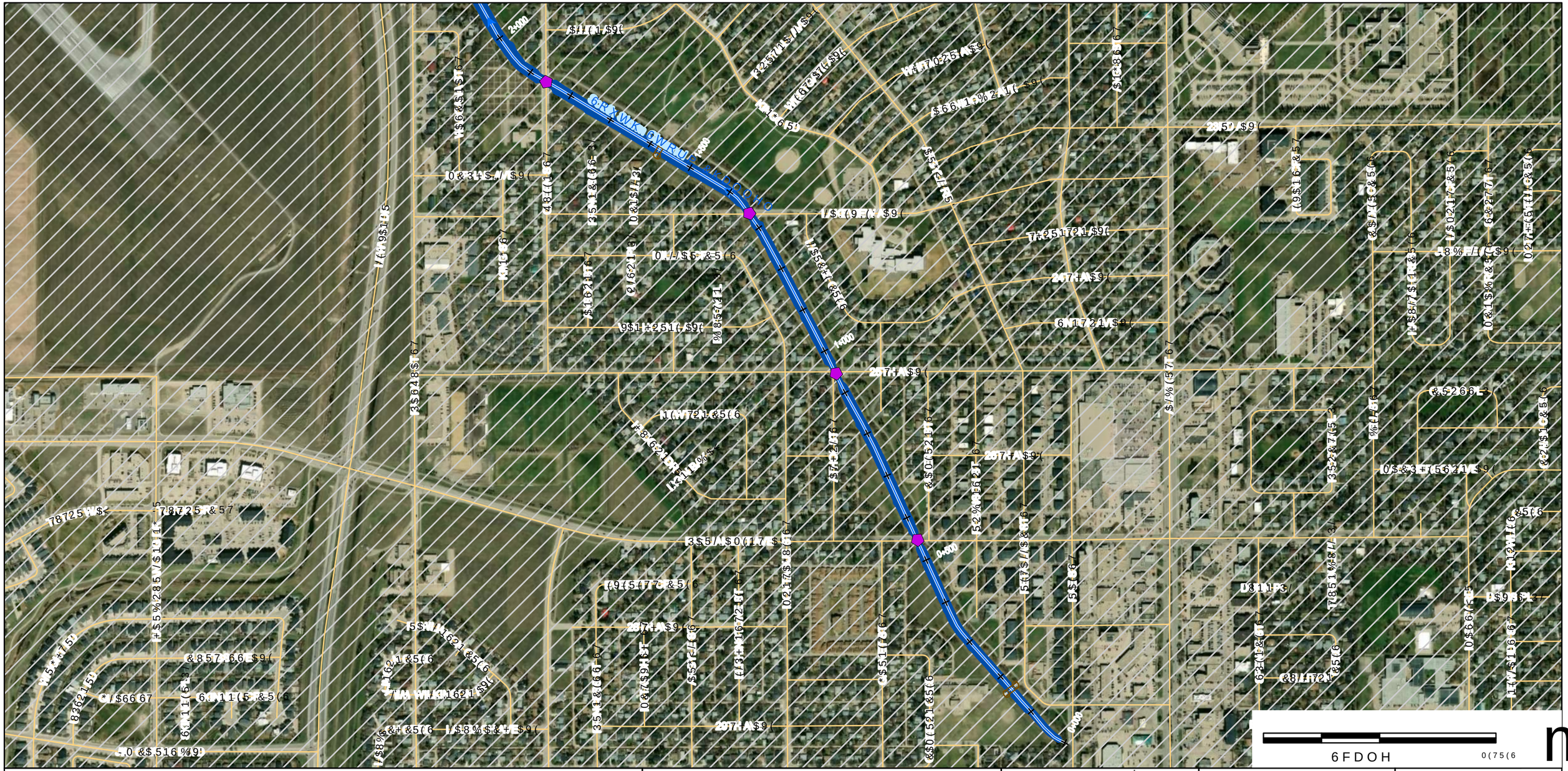
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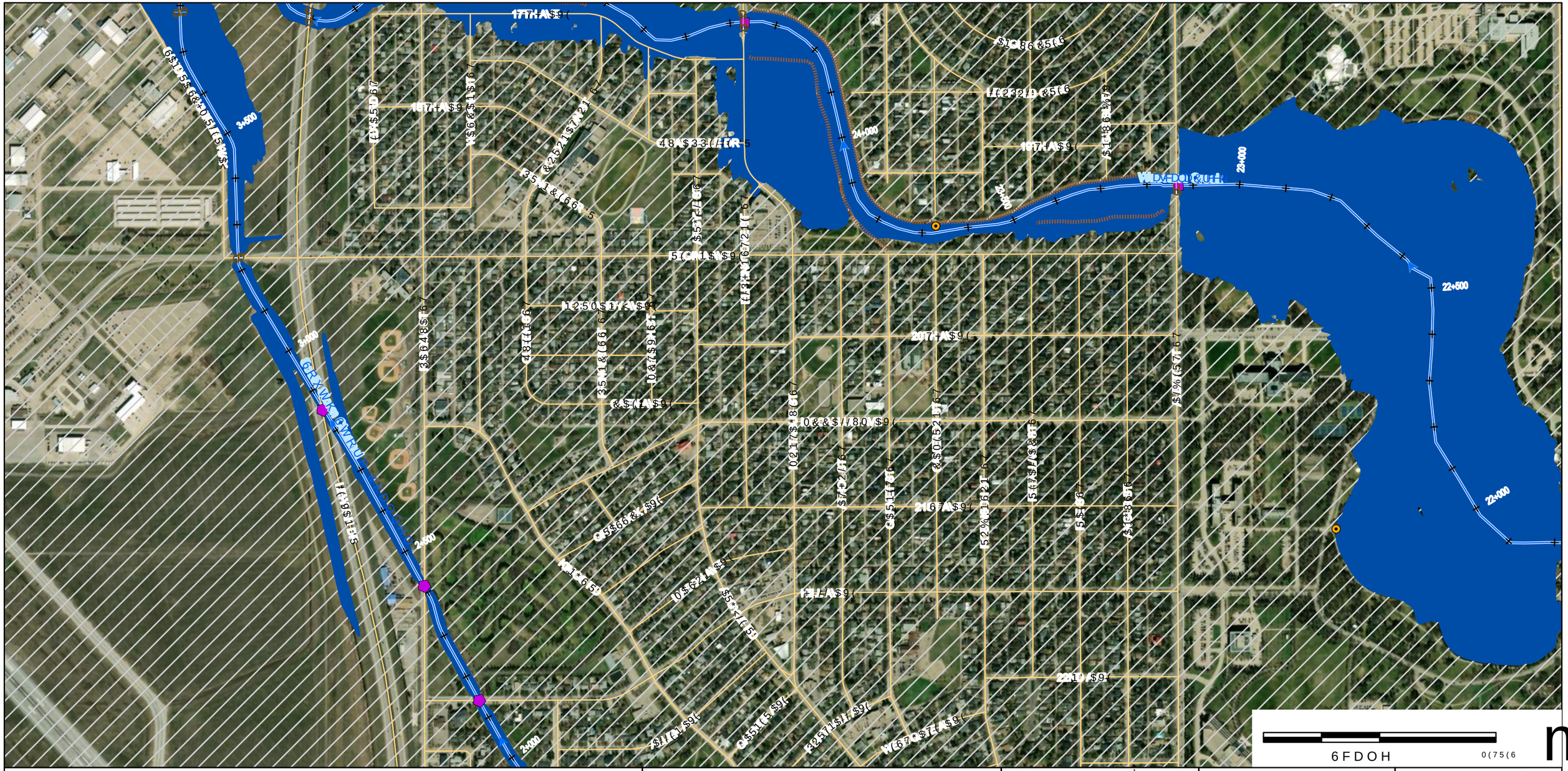

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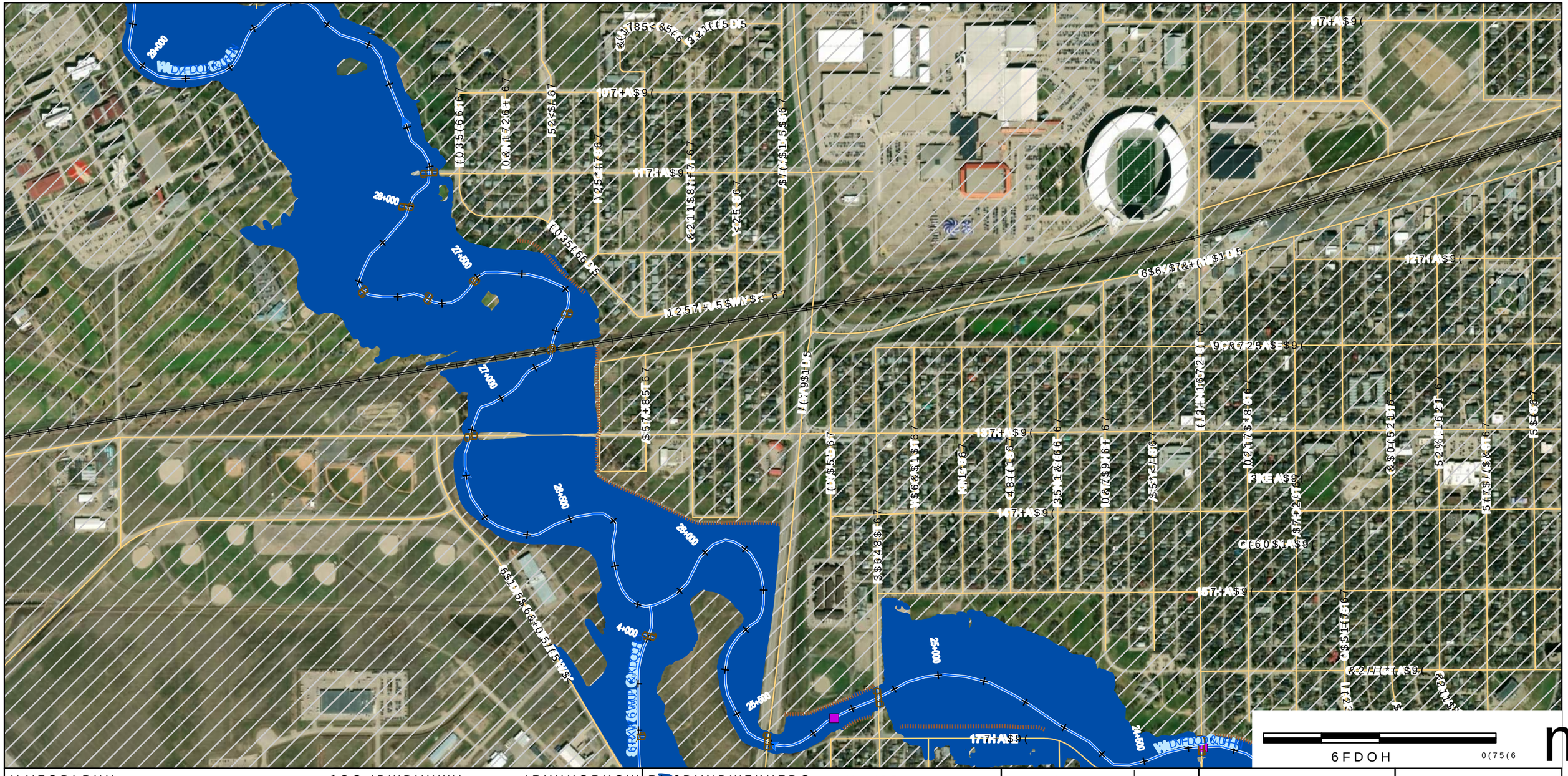

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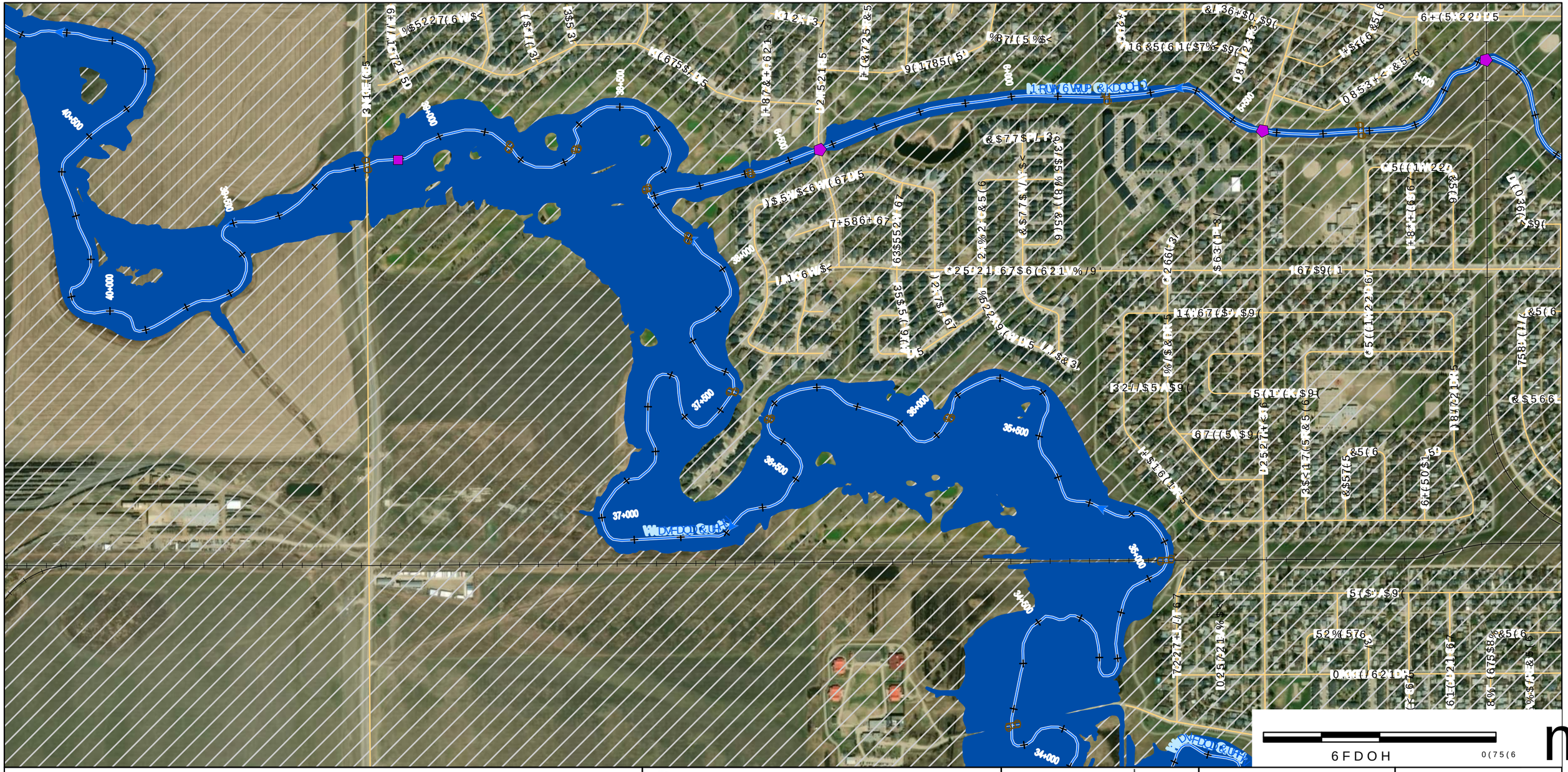

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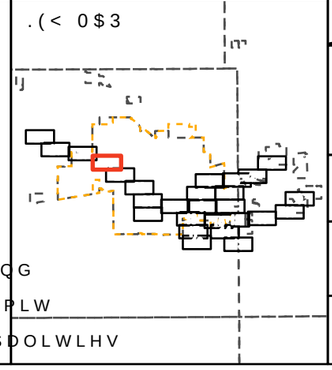

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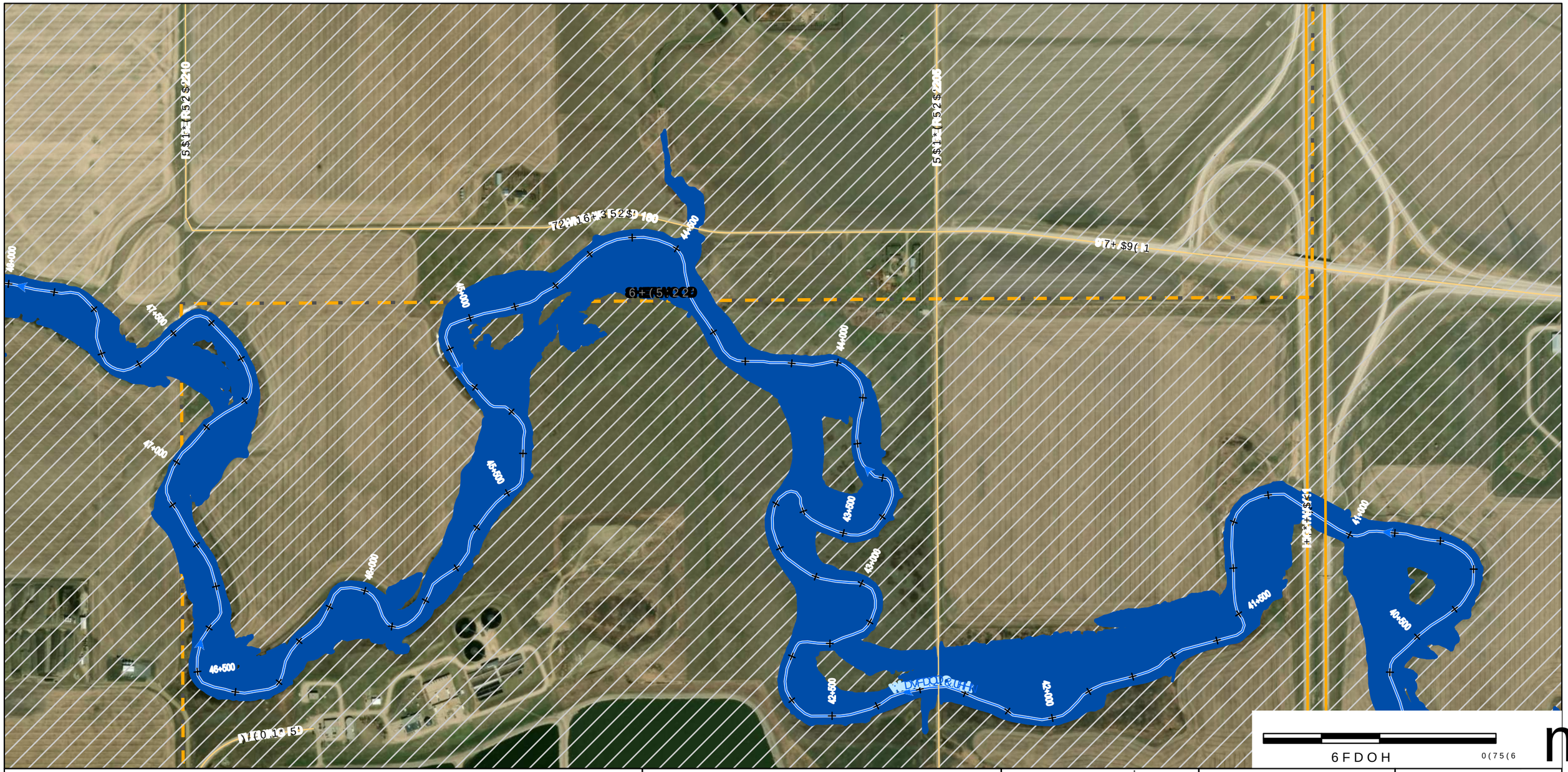

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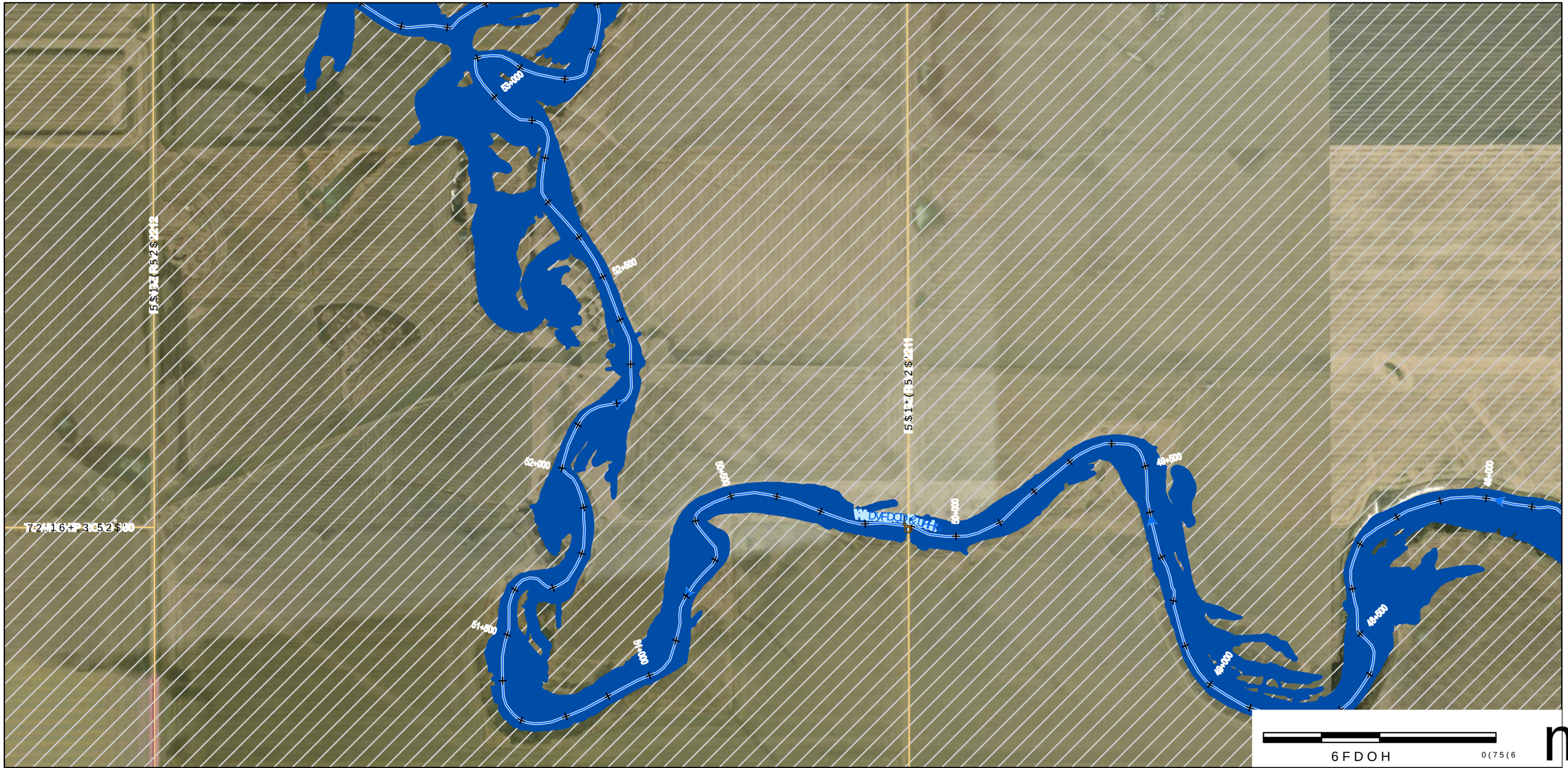

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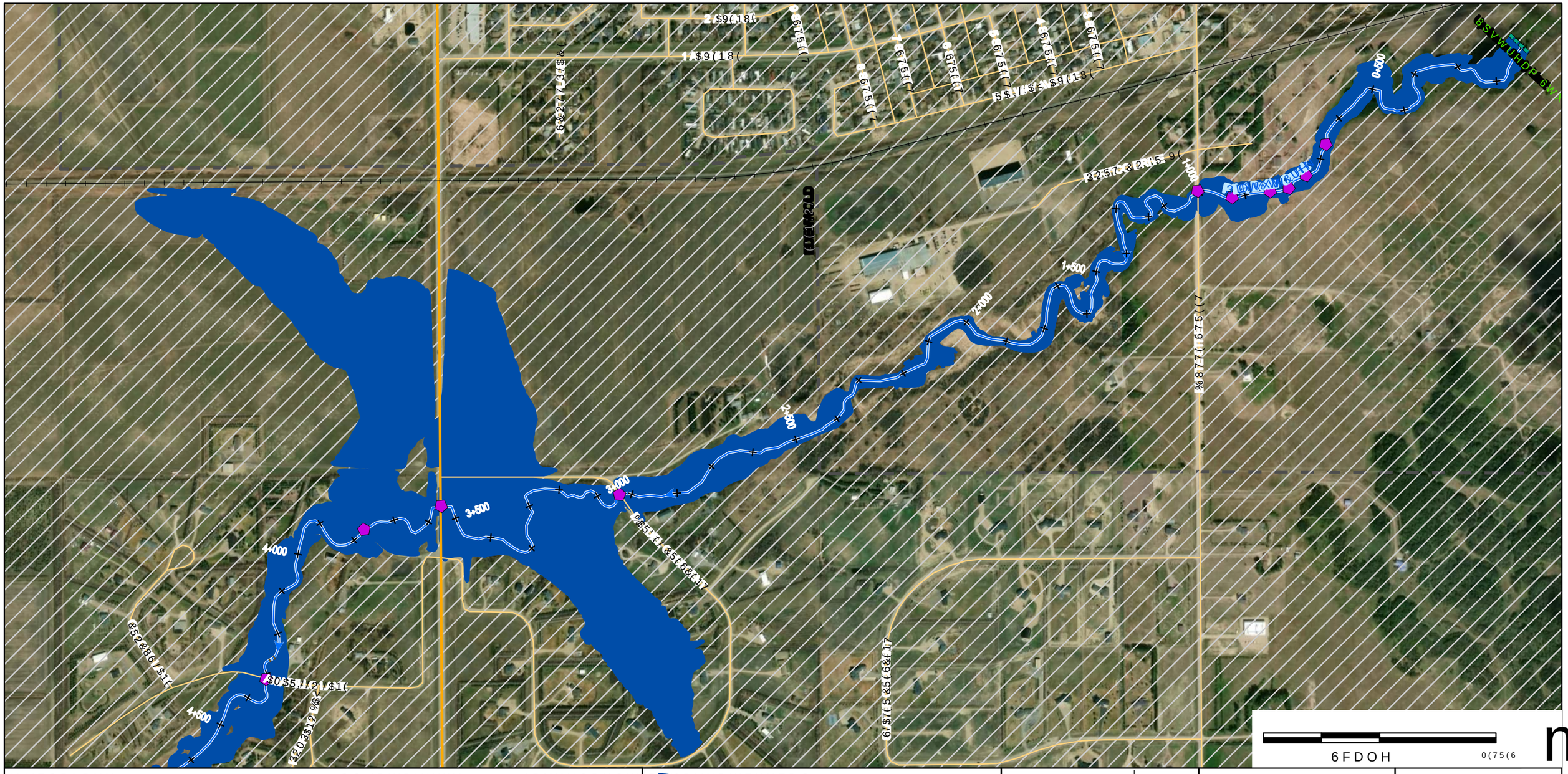

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$OO 'DWDVHWV ‹ *RYHUQPHQW RI 6DVNDWFKHZDQ 3URYLGHG E\ :DWHU 6HFXULW\ $JHQF\ 9HUWLFDO 'DWXP &*9' HRLGU HDWHR &RQGLWLRQV 0DS 3URMHFWLRQ 870 &656 ([WHQGHG =RQH 1RUWK $FFXUDF\ RI GDWD DUH UHTXLUHG :6$ UHFRPPHQGV FRQILUPLQJ WKH IORRG &RQGLWLRQV RQ WKH PDS 1RWHV 6KHHWV DQG PD\ QRW EH LQFOXGHG LQ WKH PDS VHULHV WKHUH LV QR IORRGLQJ LQ WKLV DUHD

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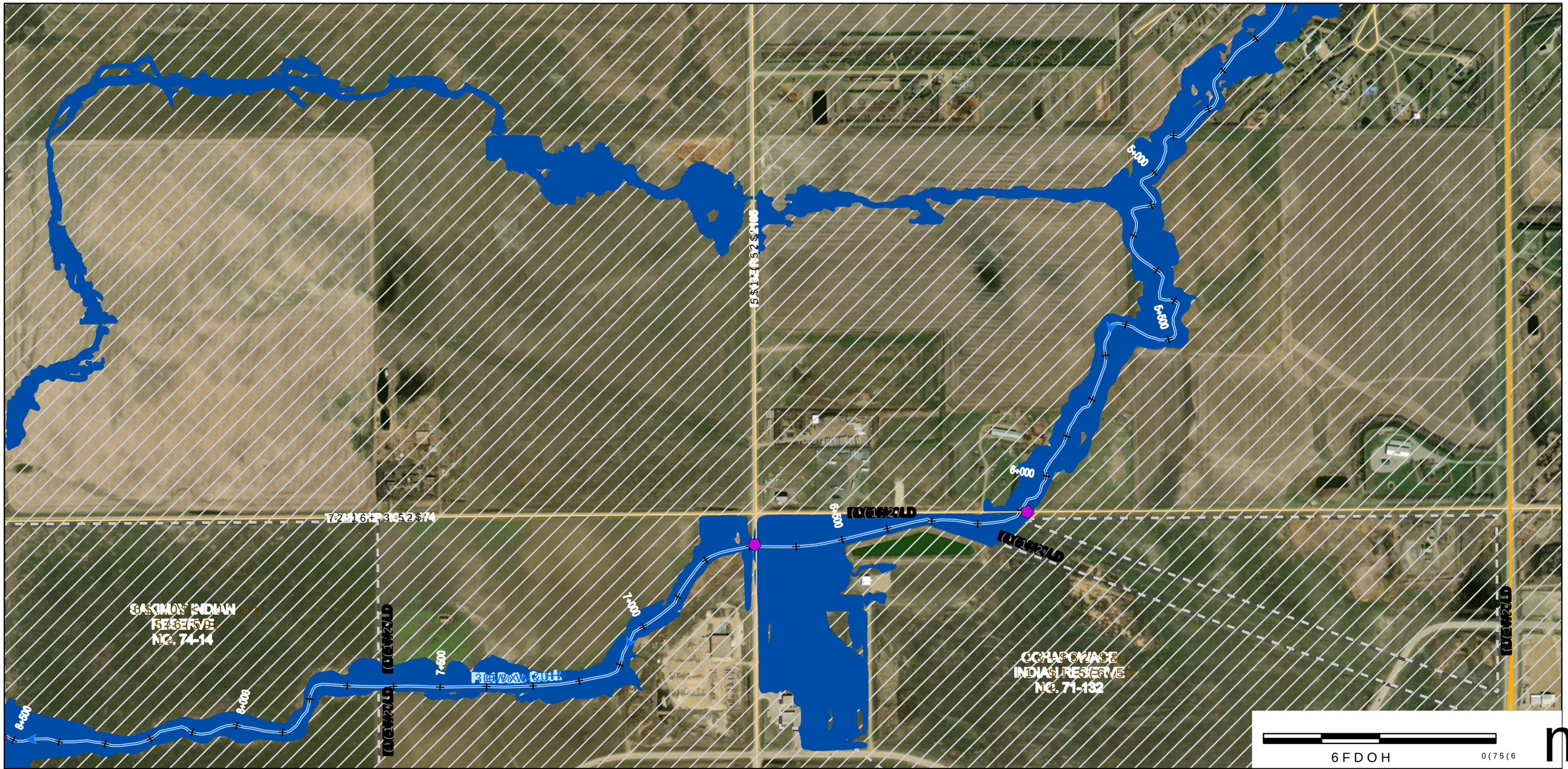

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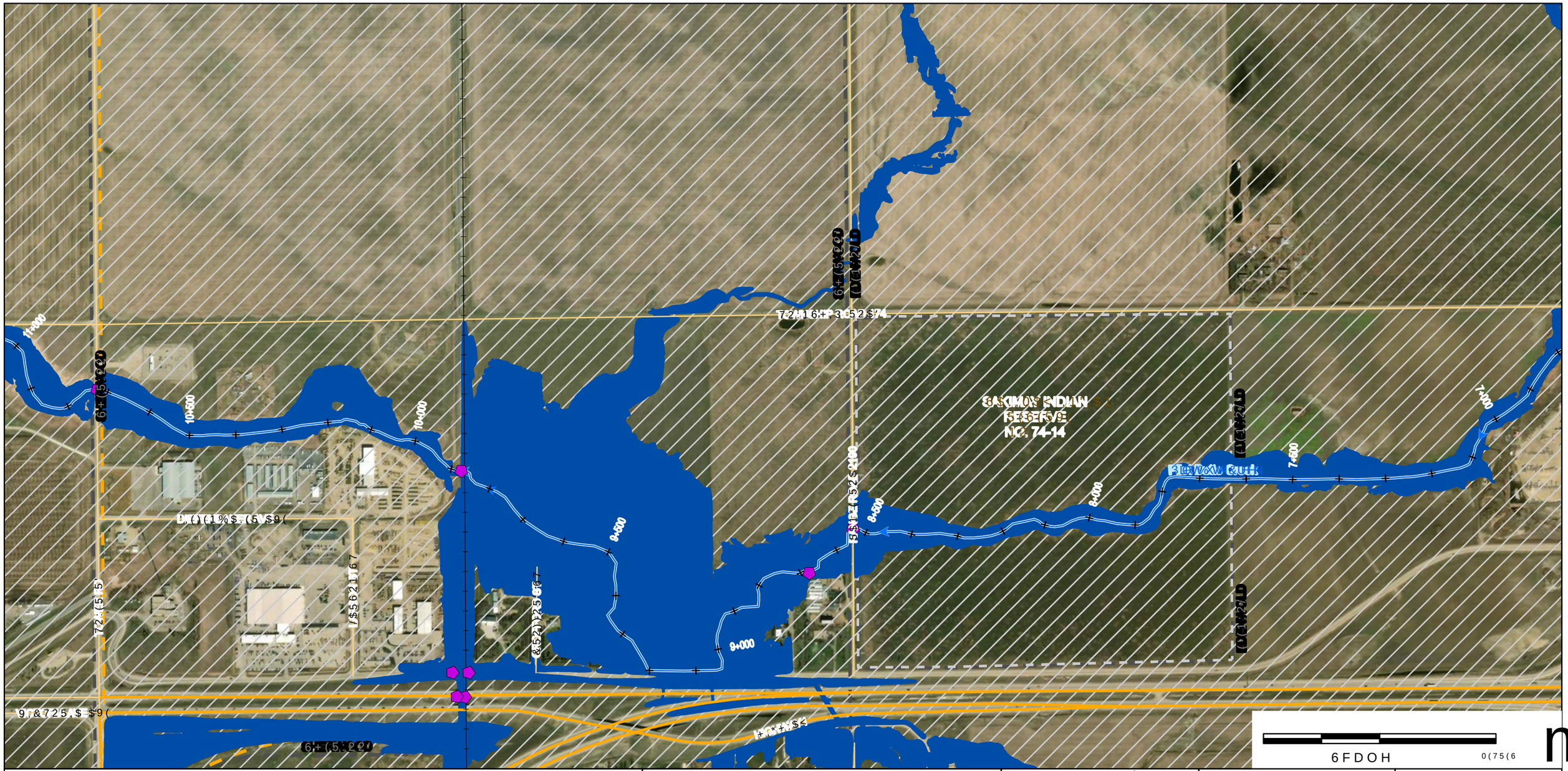

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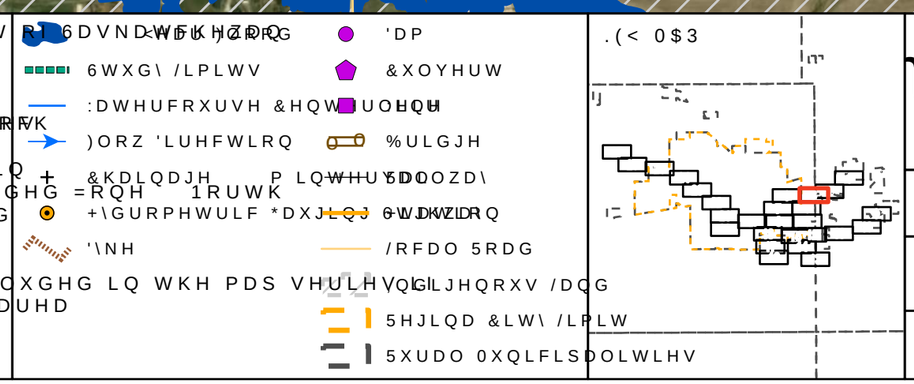

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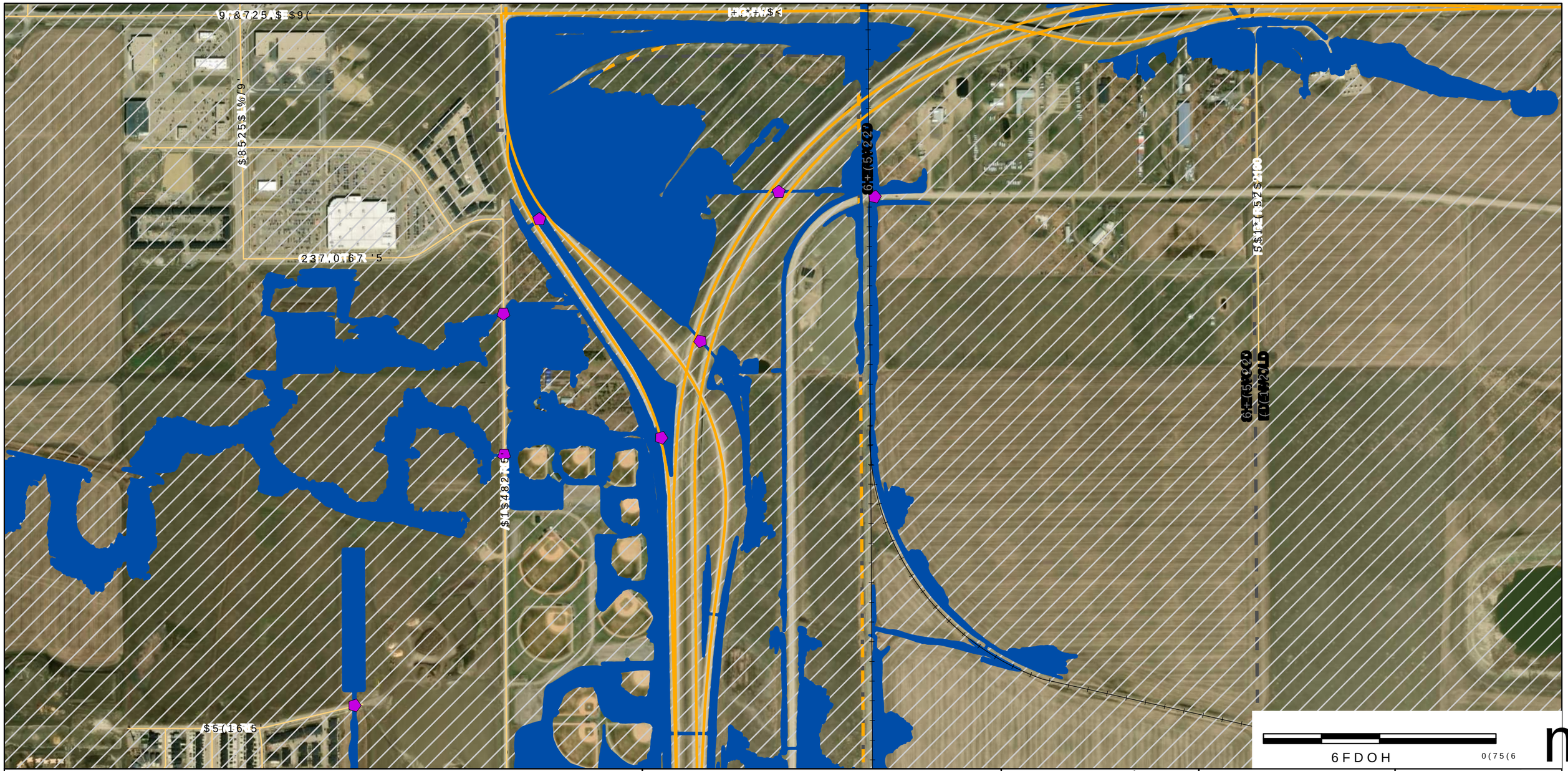

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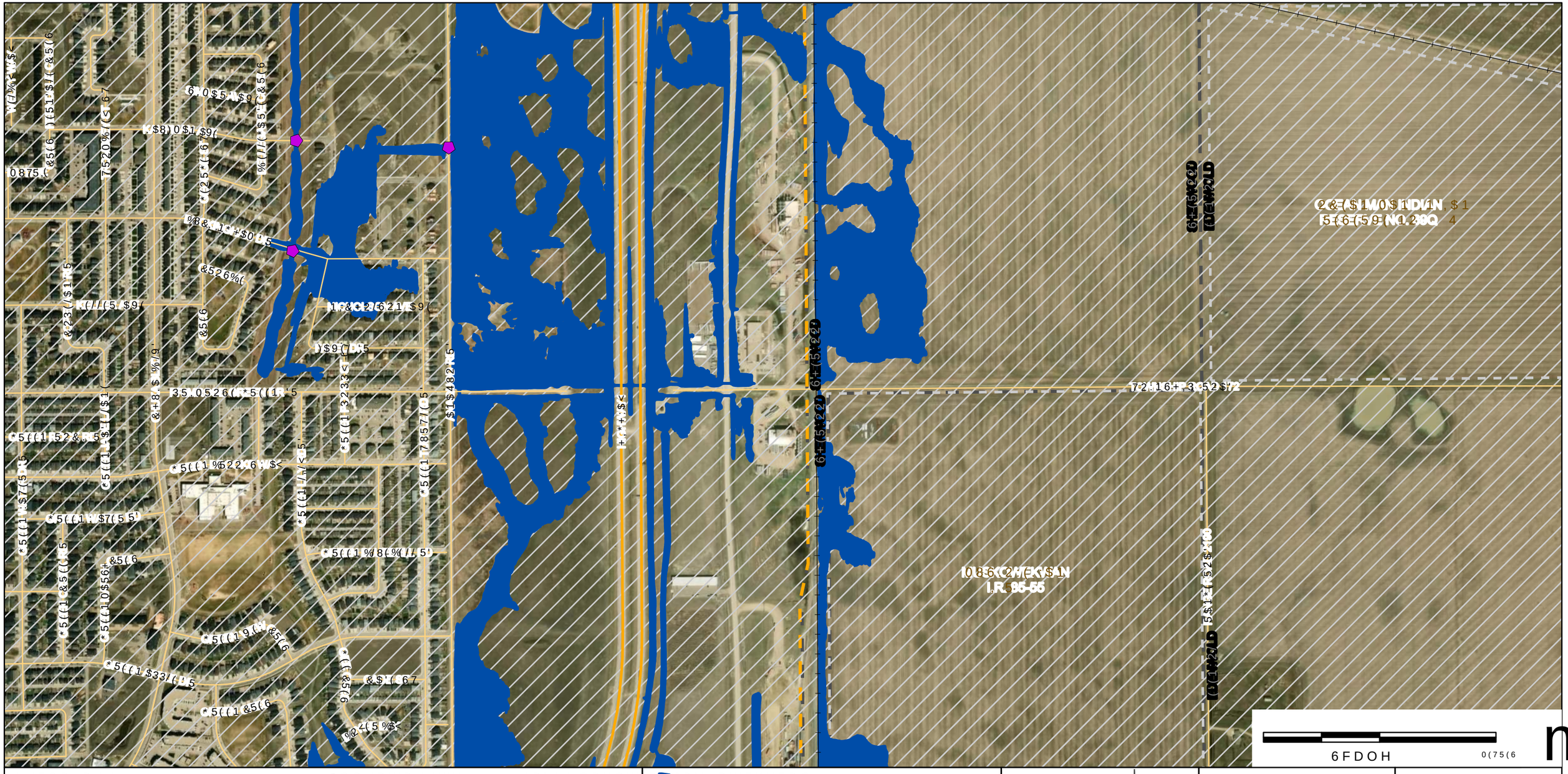

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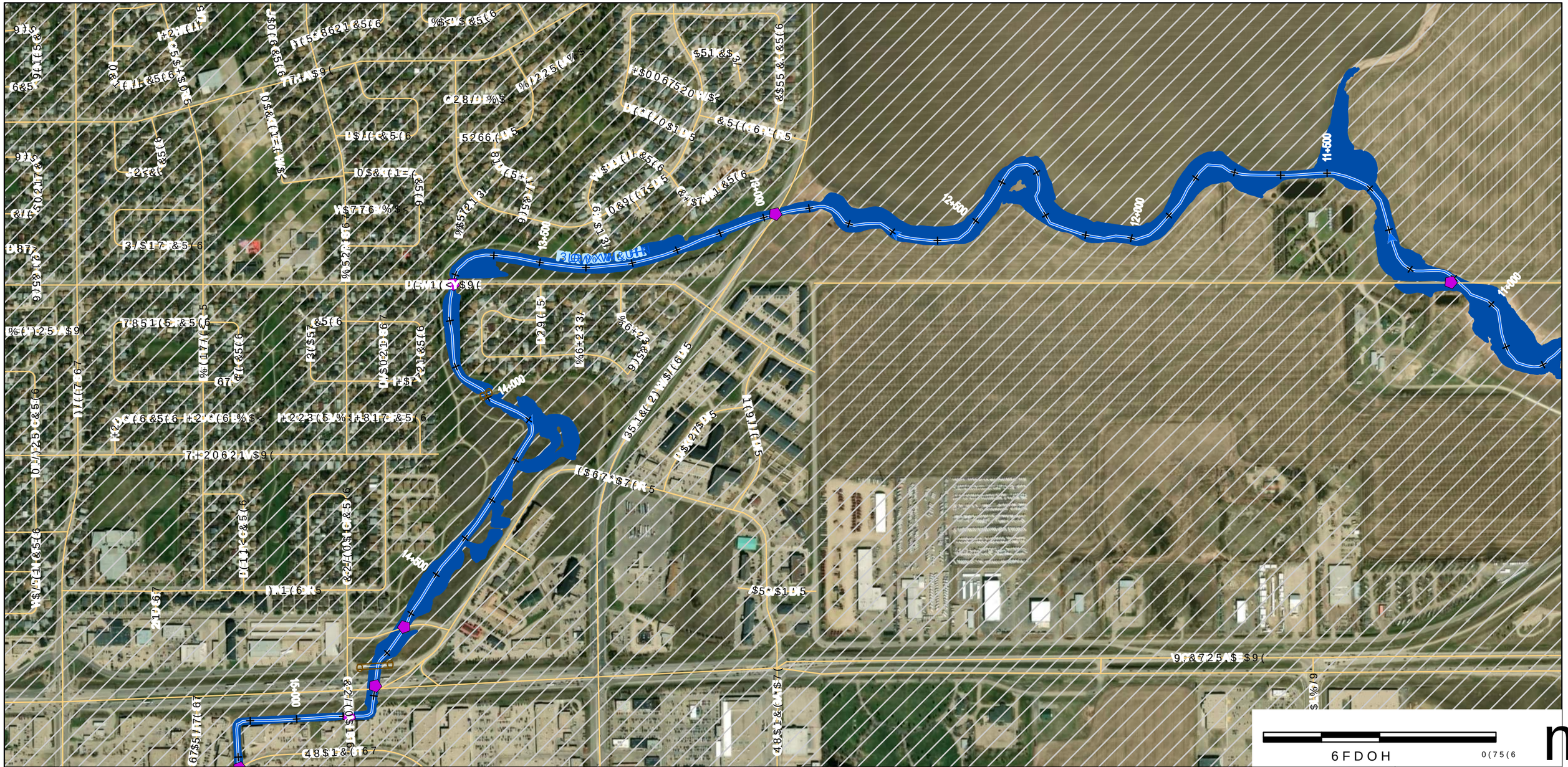

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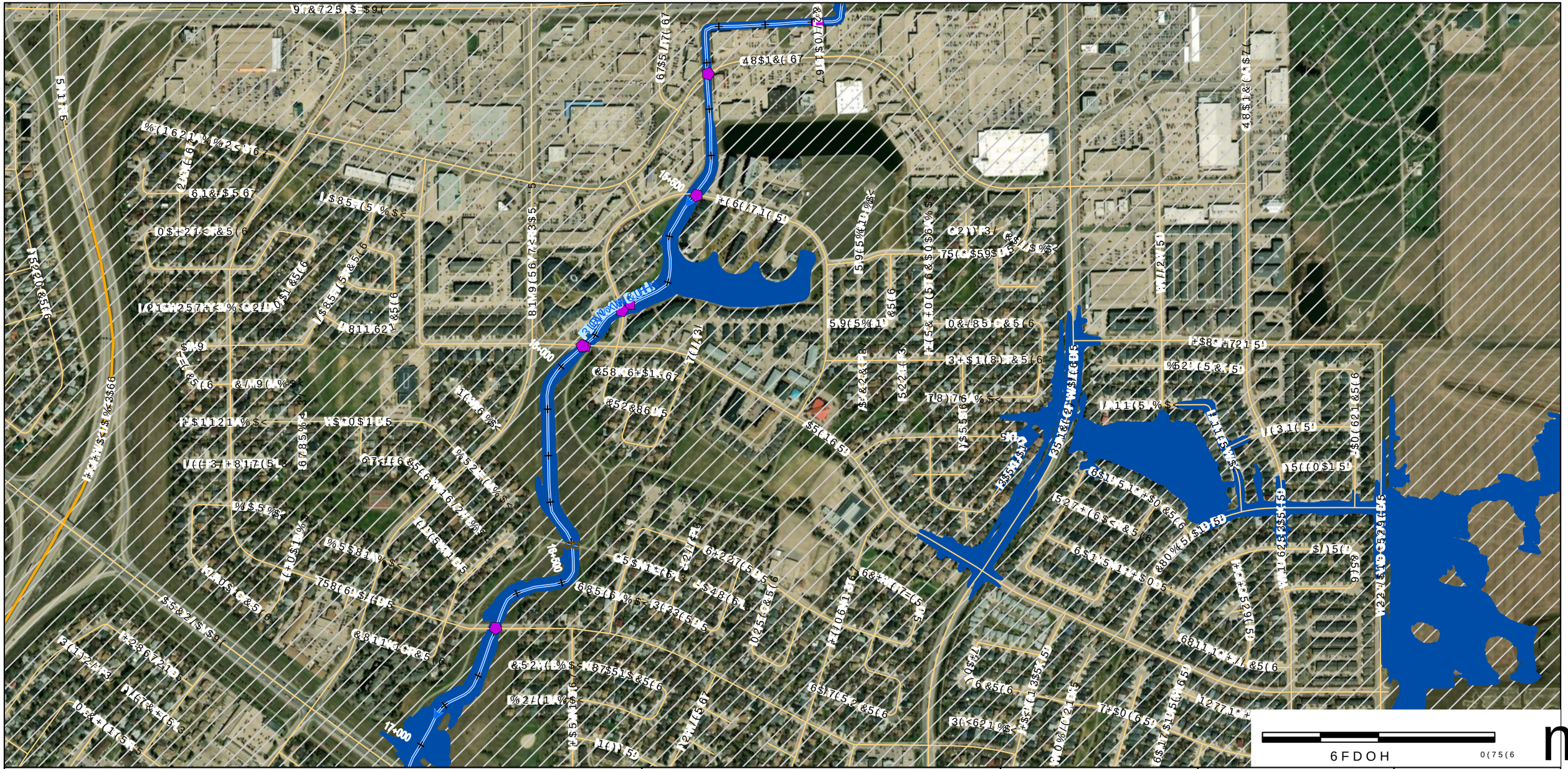

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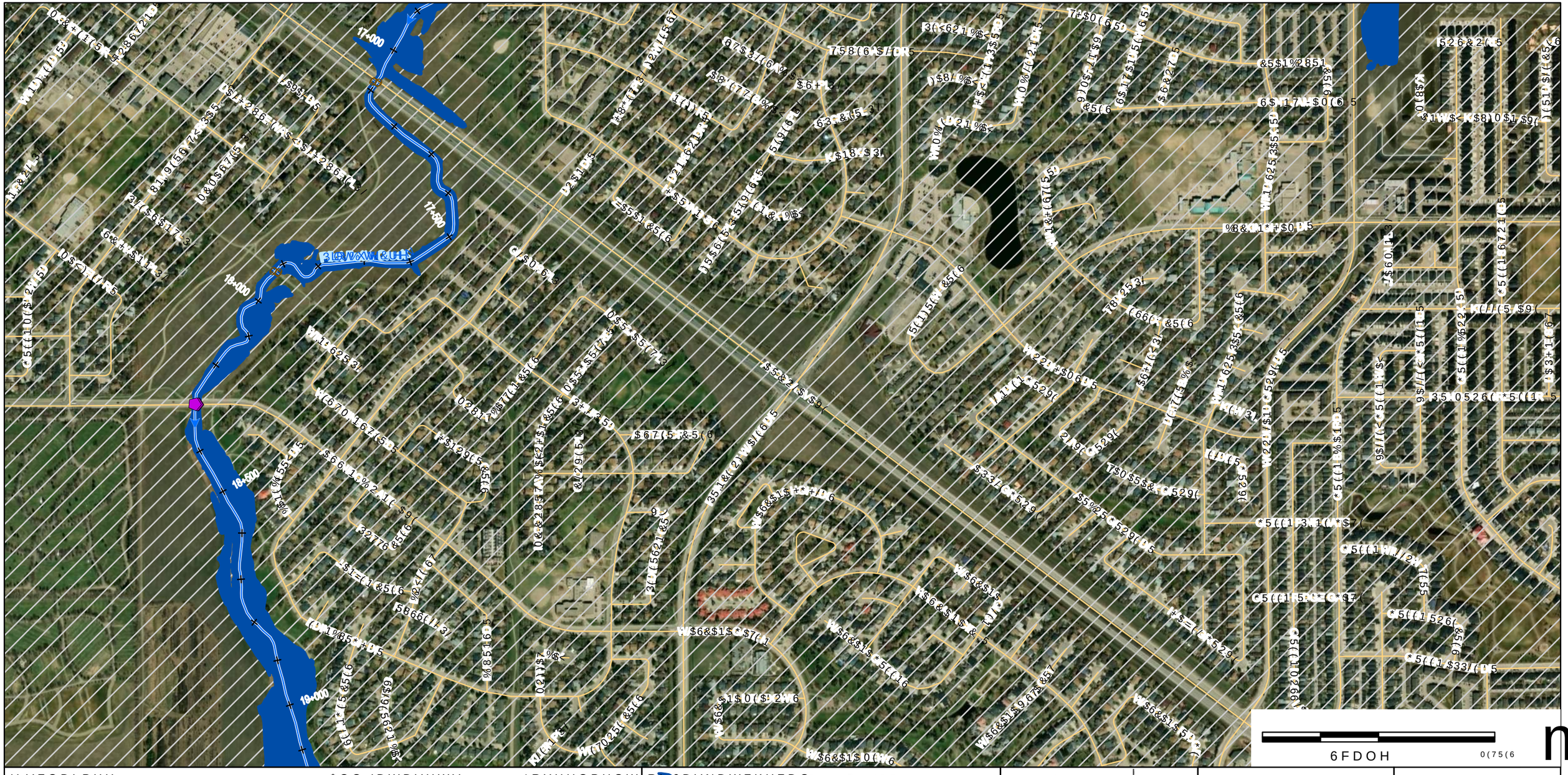

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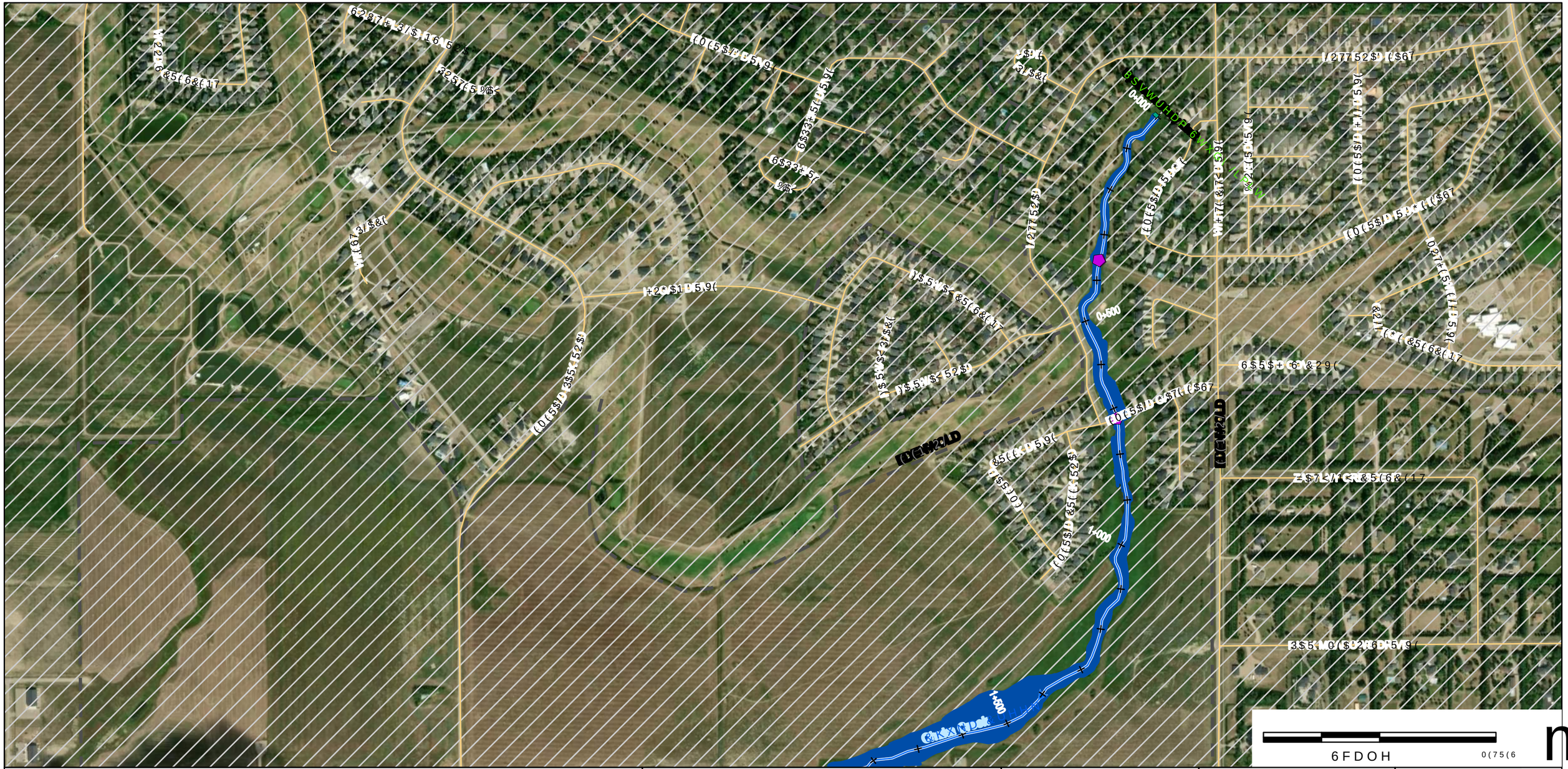

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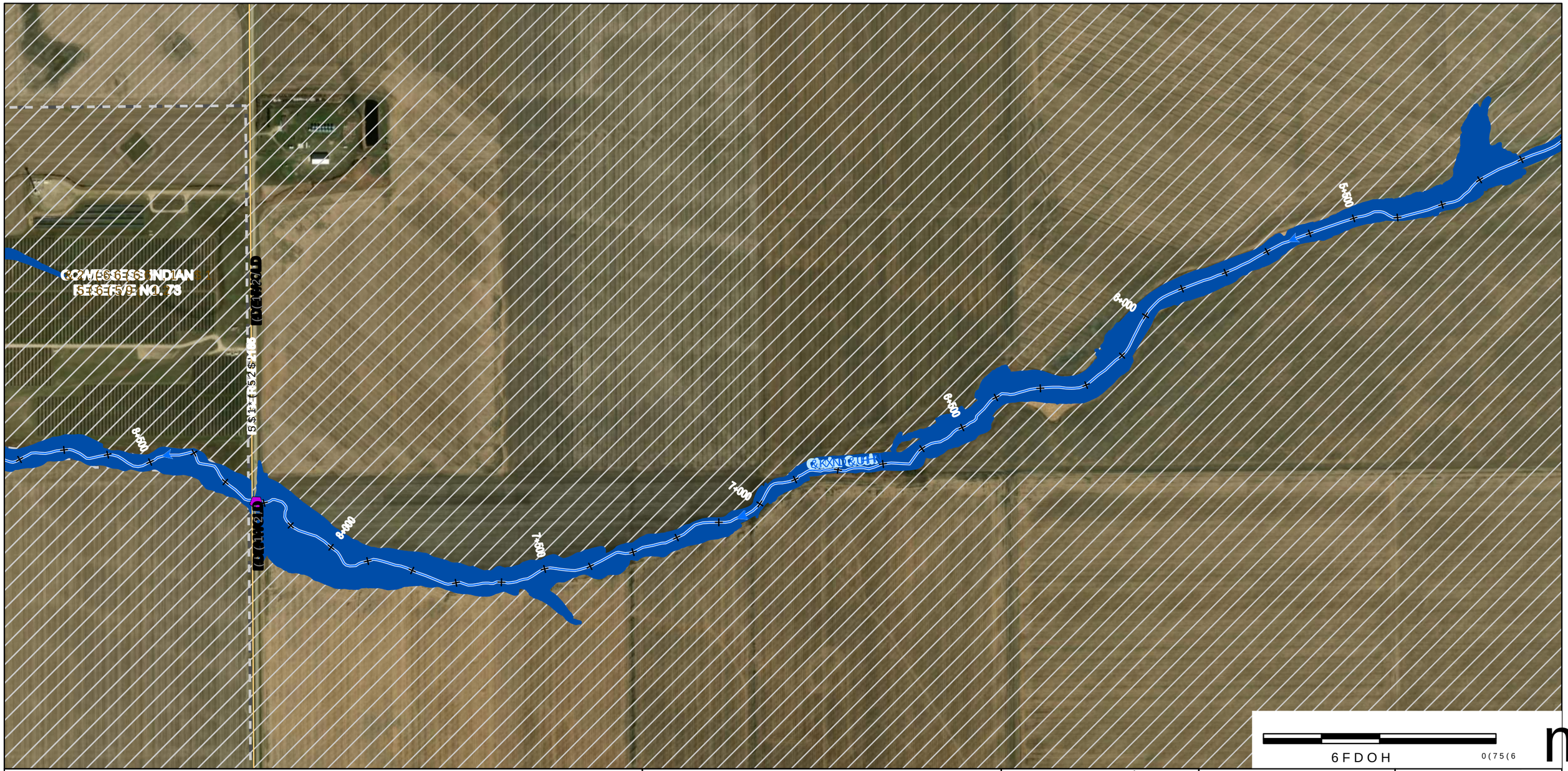

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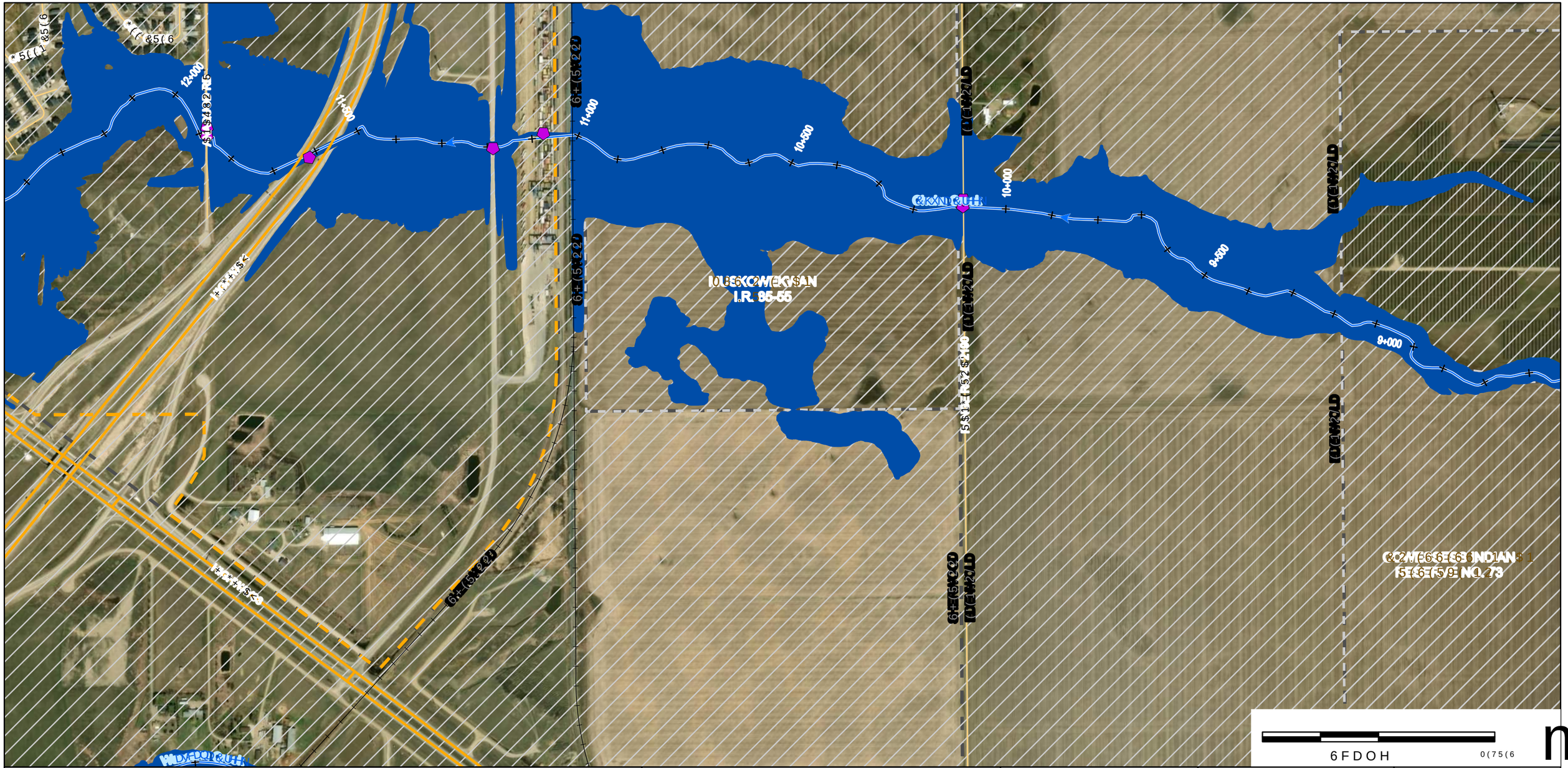
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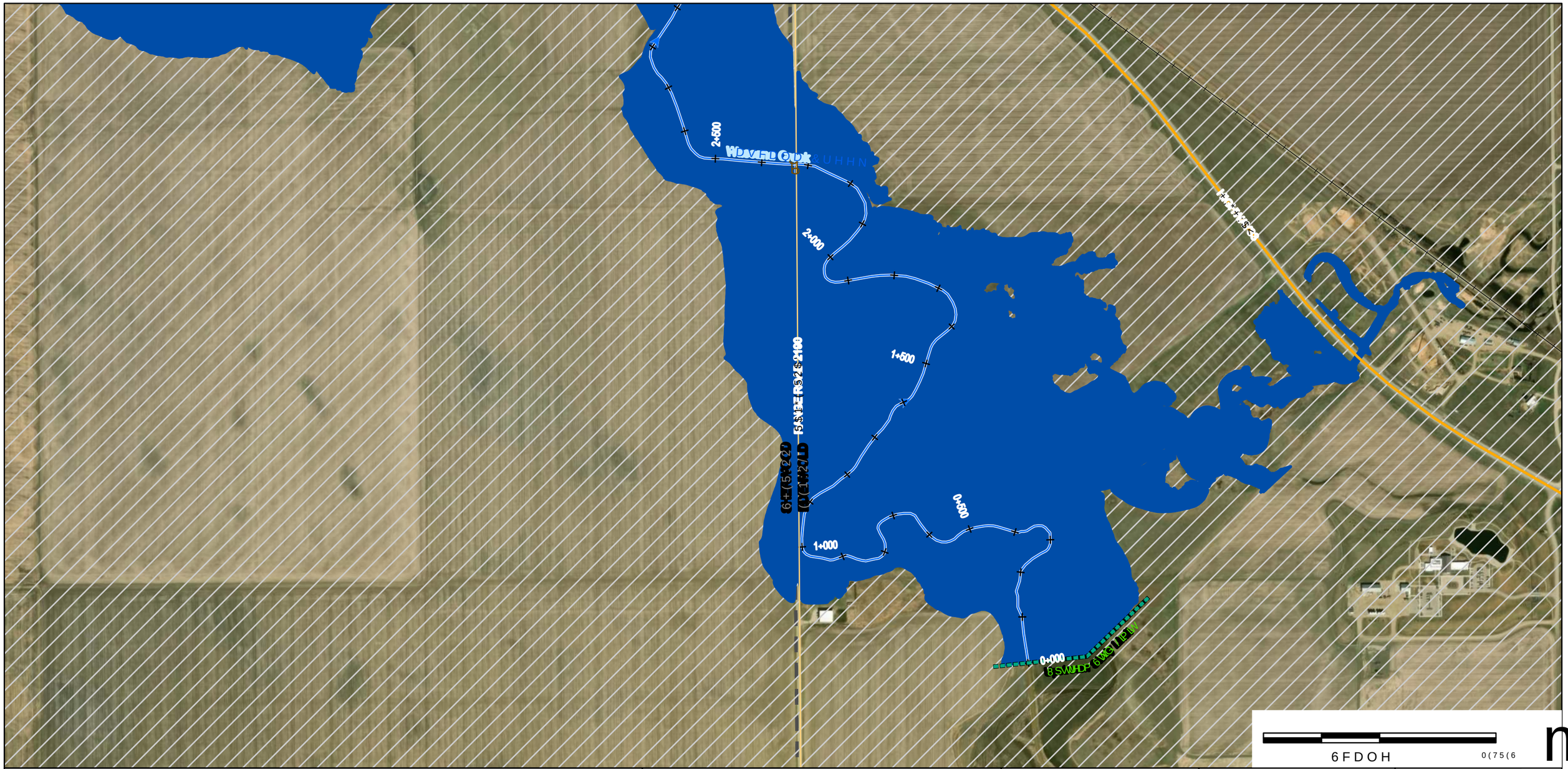

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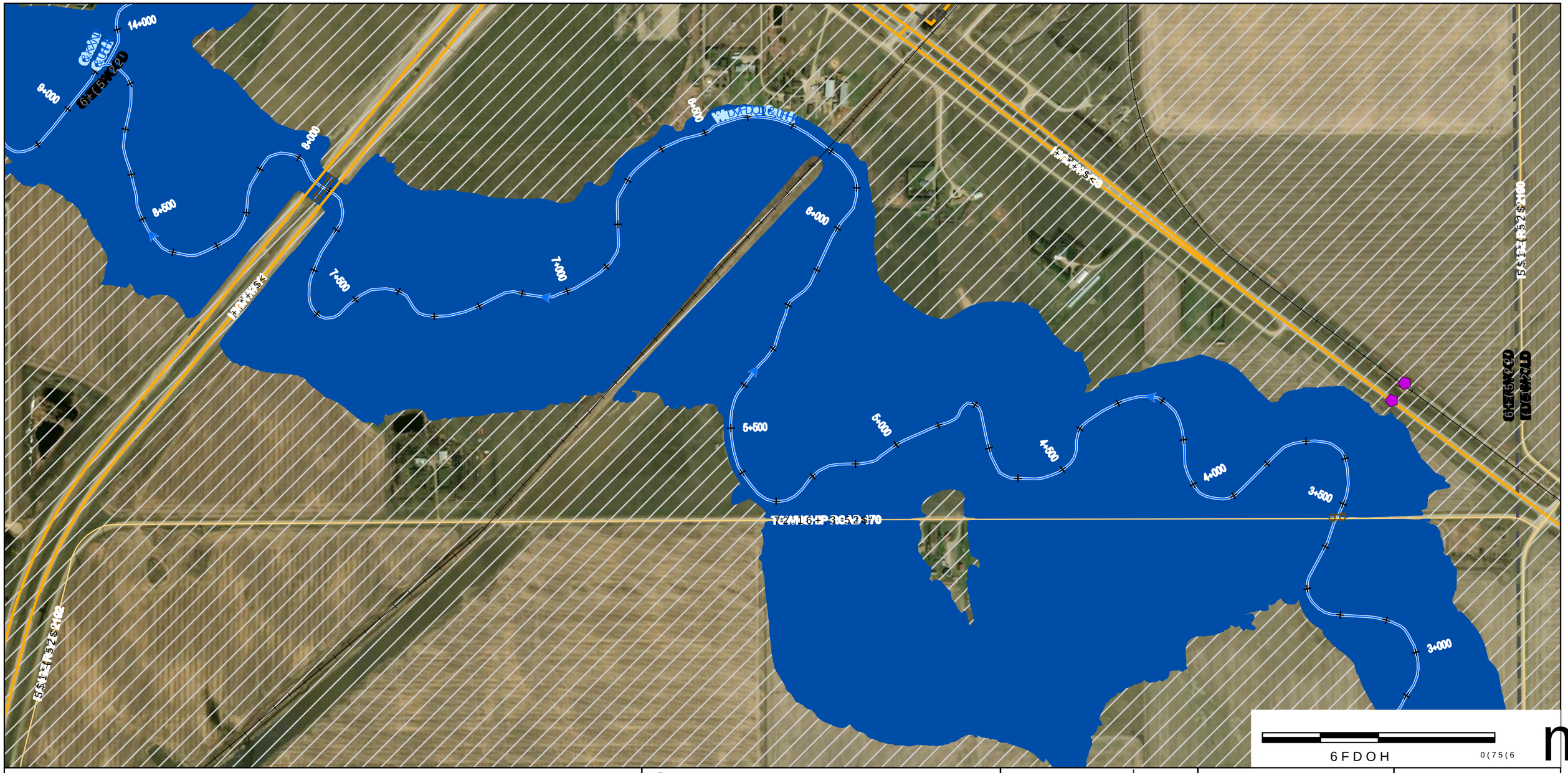

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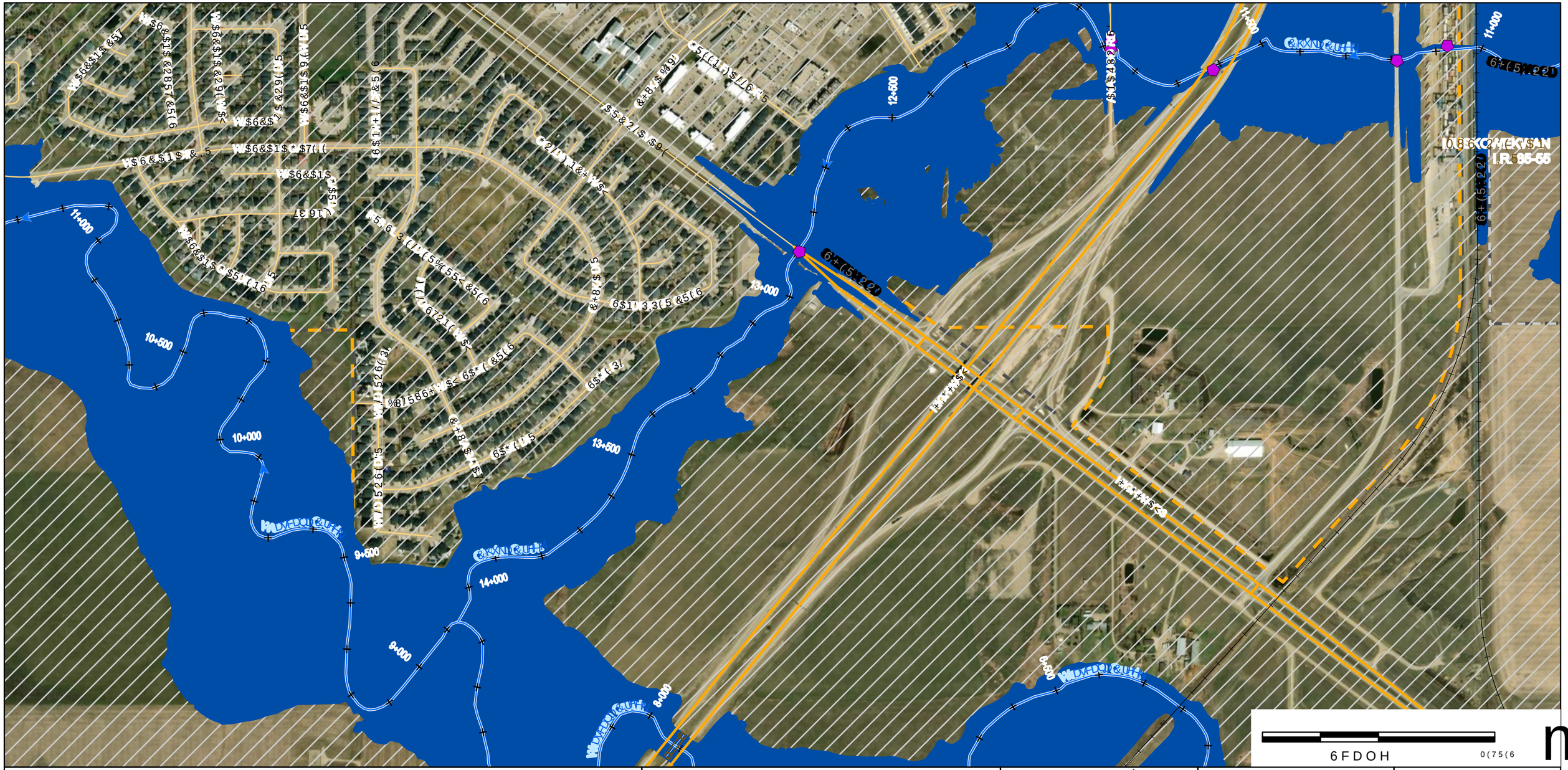

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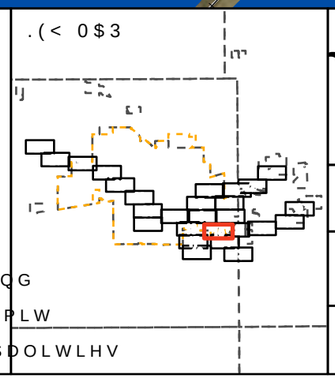

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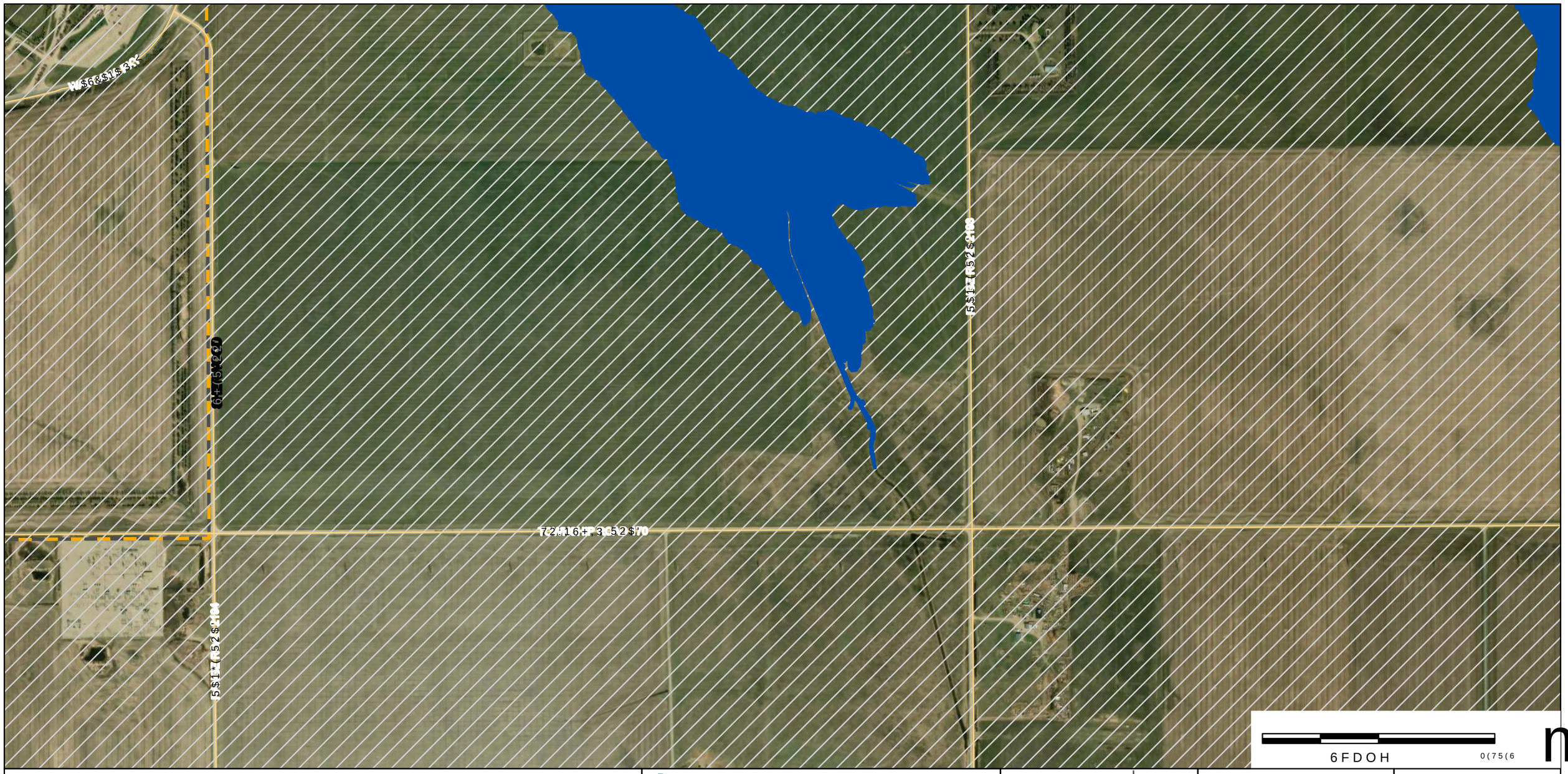
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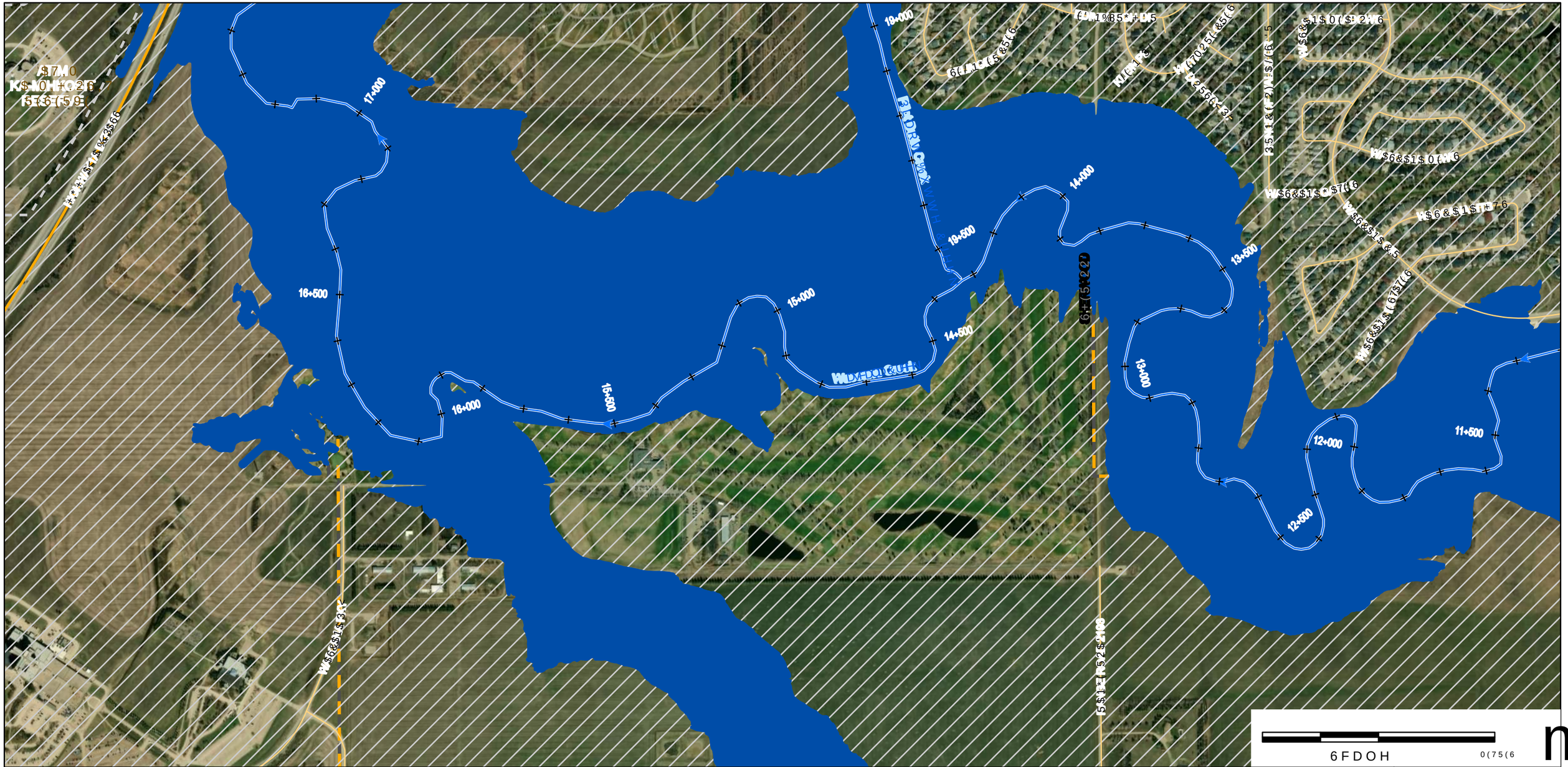

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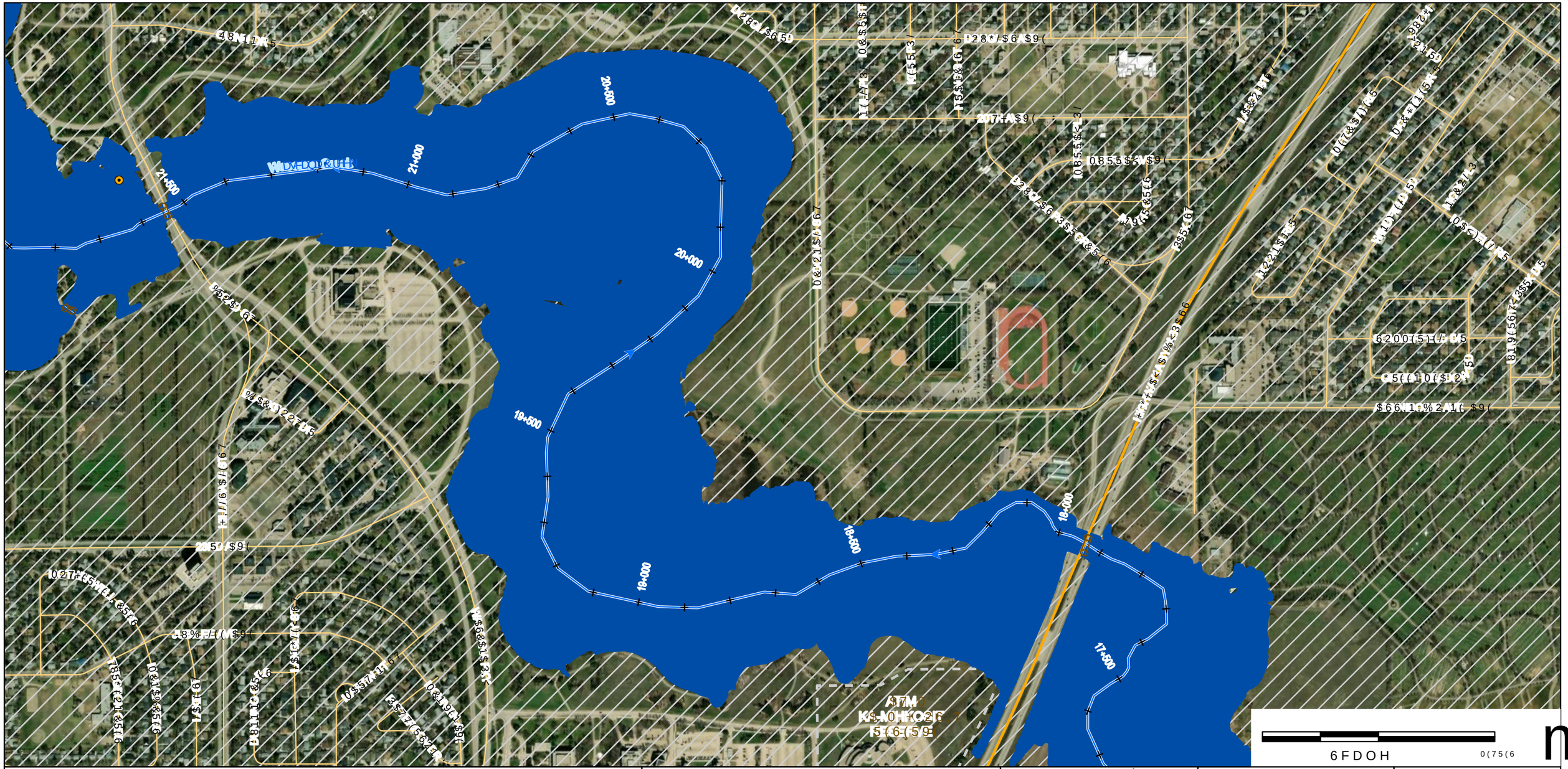

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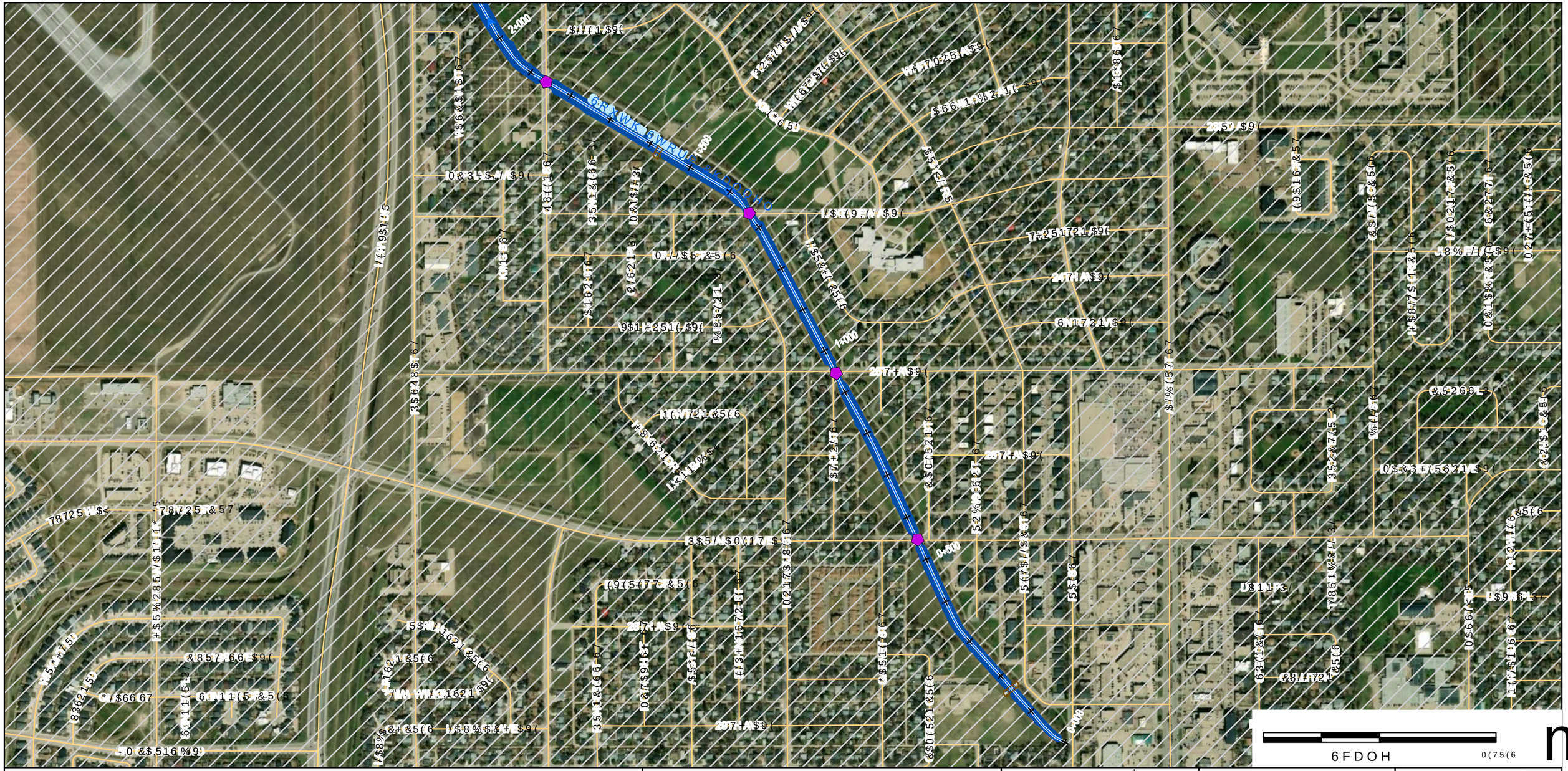

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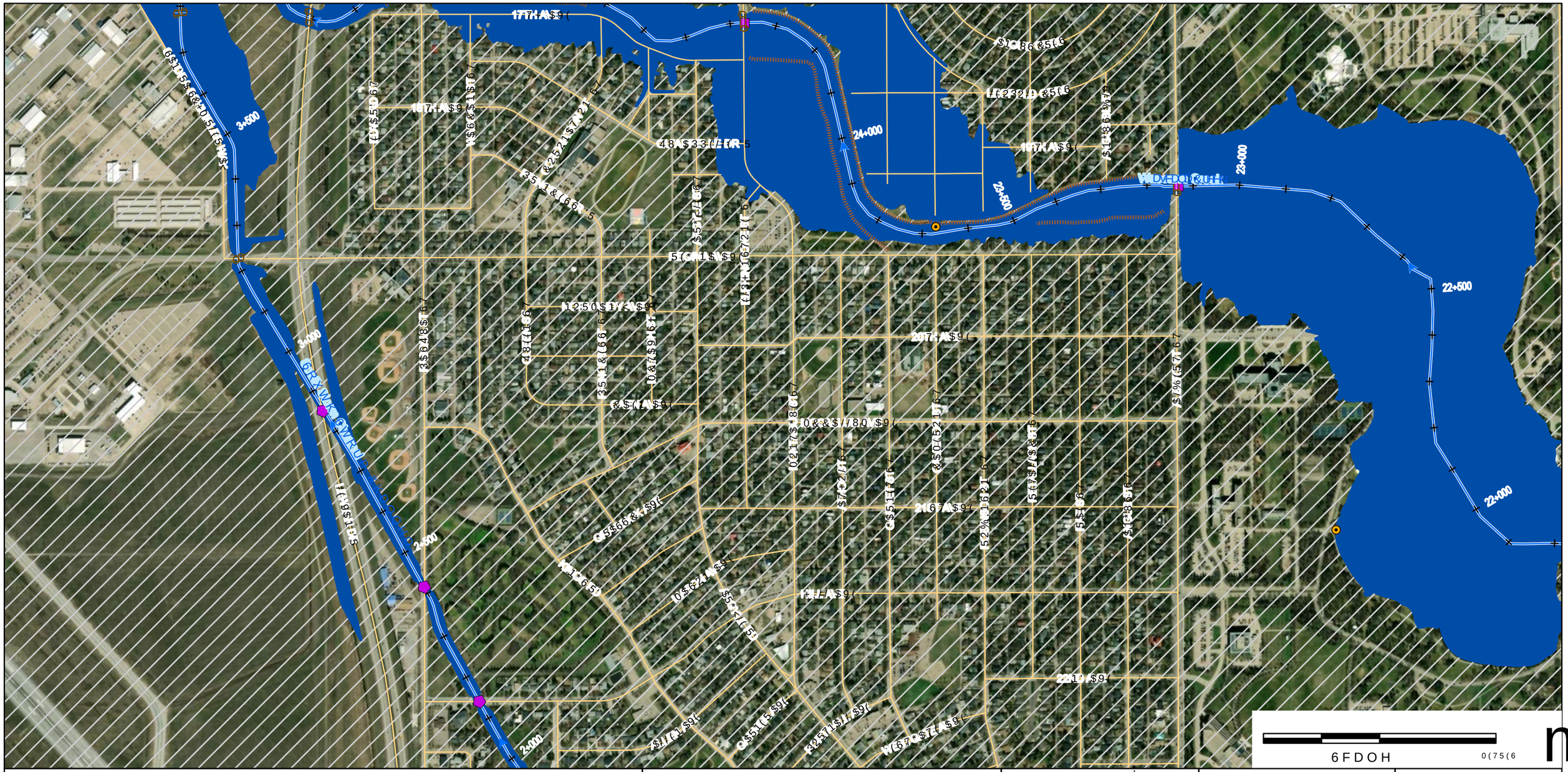

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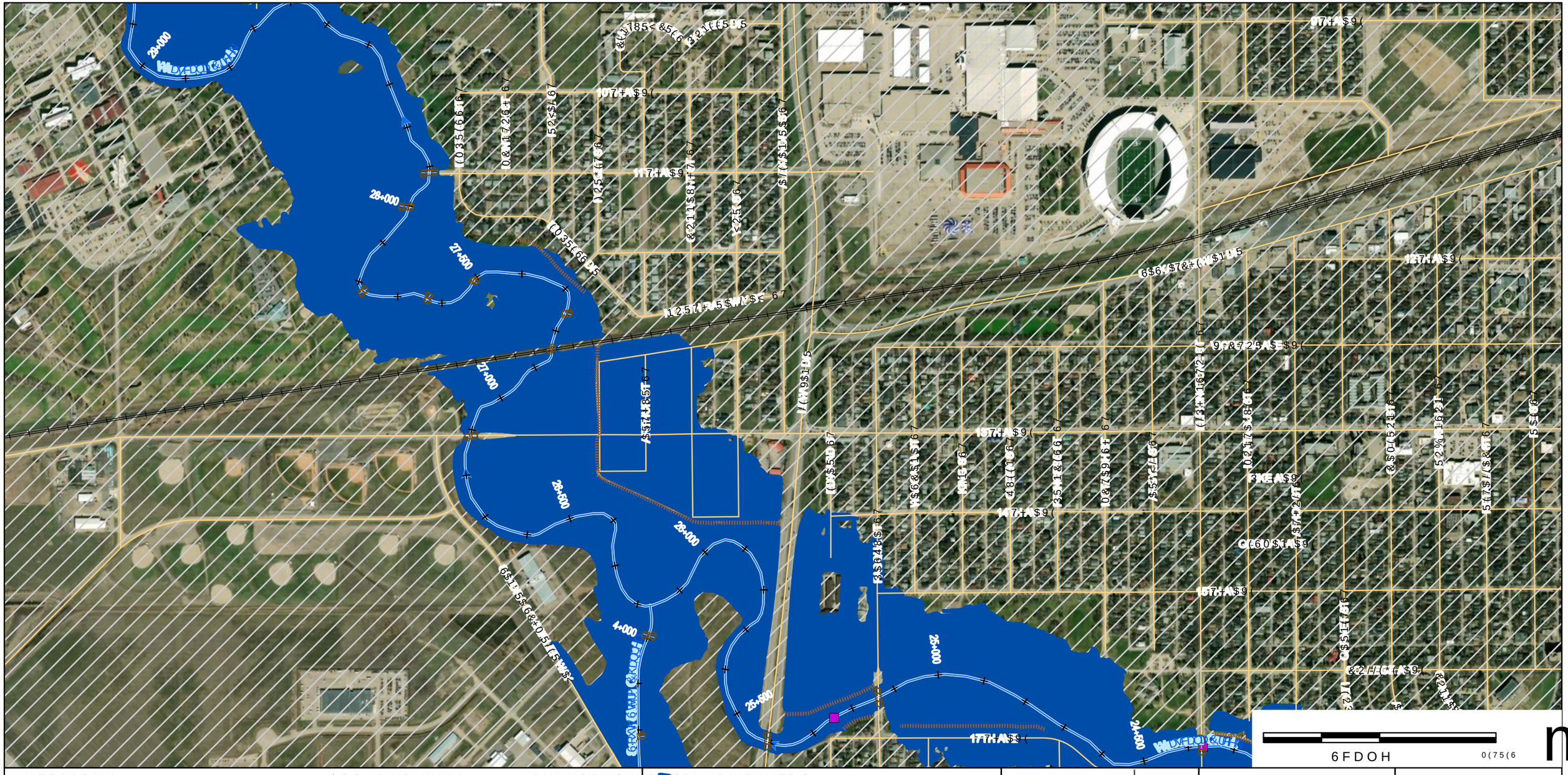

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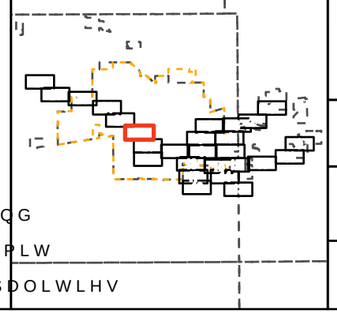

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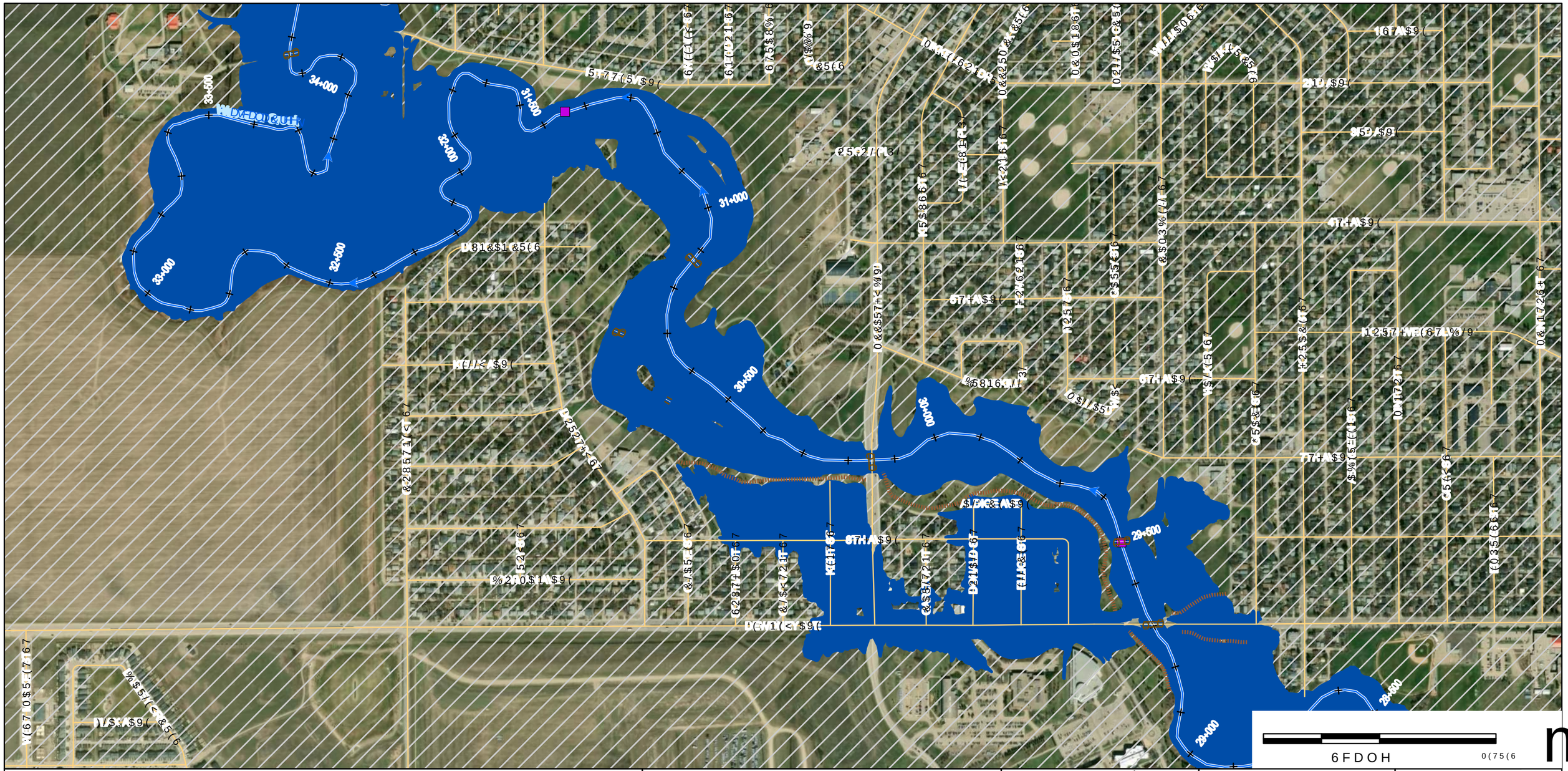

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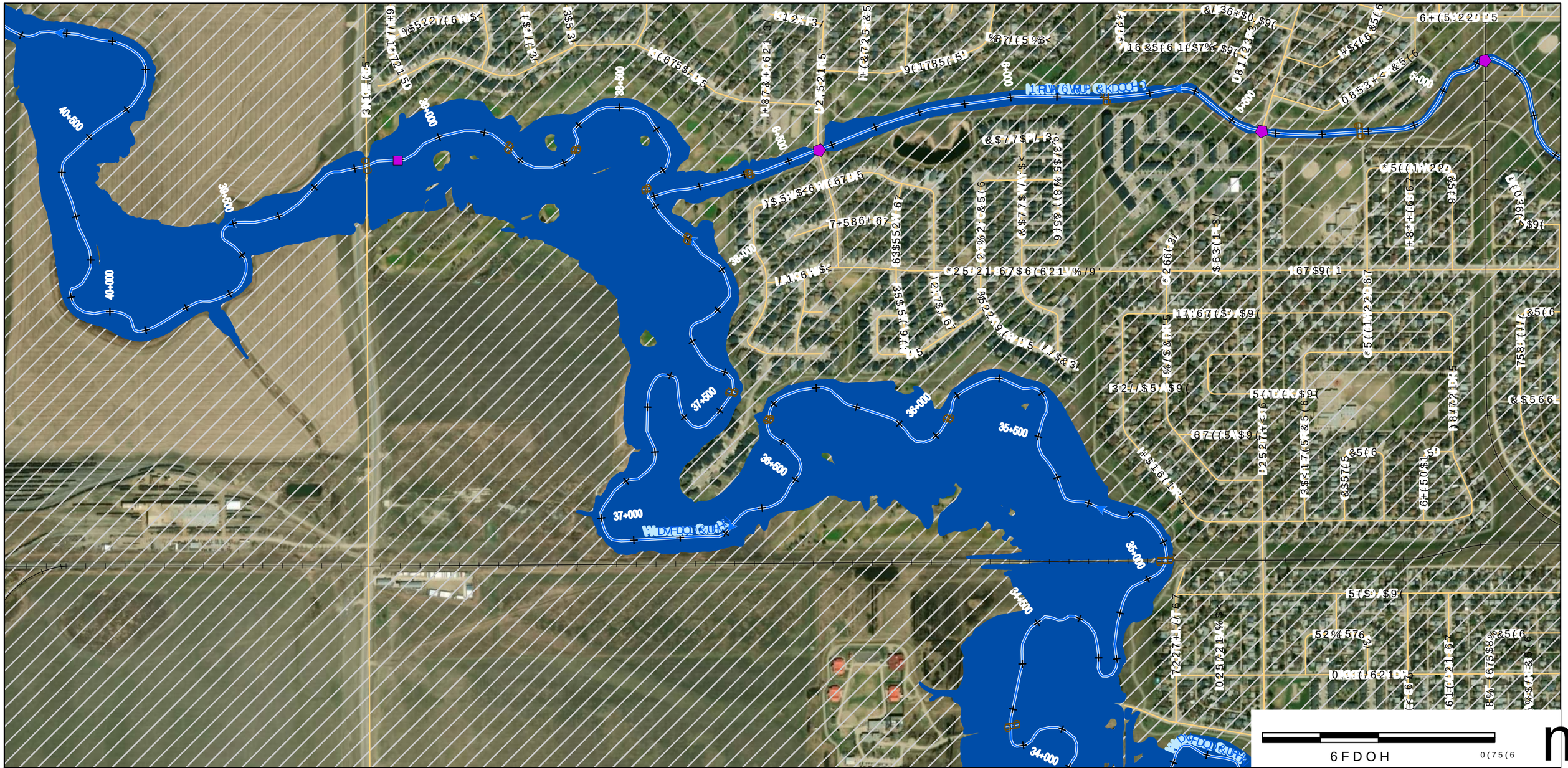

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$HQ HVV GHSHQGHQW RQ WKH
&DRUG:6$ DVDH 5HIHUHQFH 6\VWHP
+ZLOD EH DXIIDWXPQ 1'RU &656 XSRFK
9HUWLFDO 'DWXP &*9'
*HRLG PRWLRQ &*RQWDLQHG KHUHLQ
0DS 3URMHFWLRQ 870 &656 ([WHQGHG =RQH 1RUWK
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1RWHV
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WKHUH LV QR IORRGLQJ LQ WKLV DUHD

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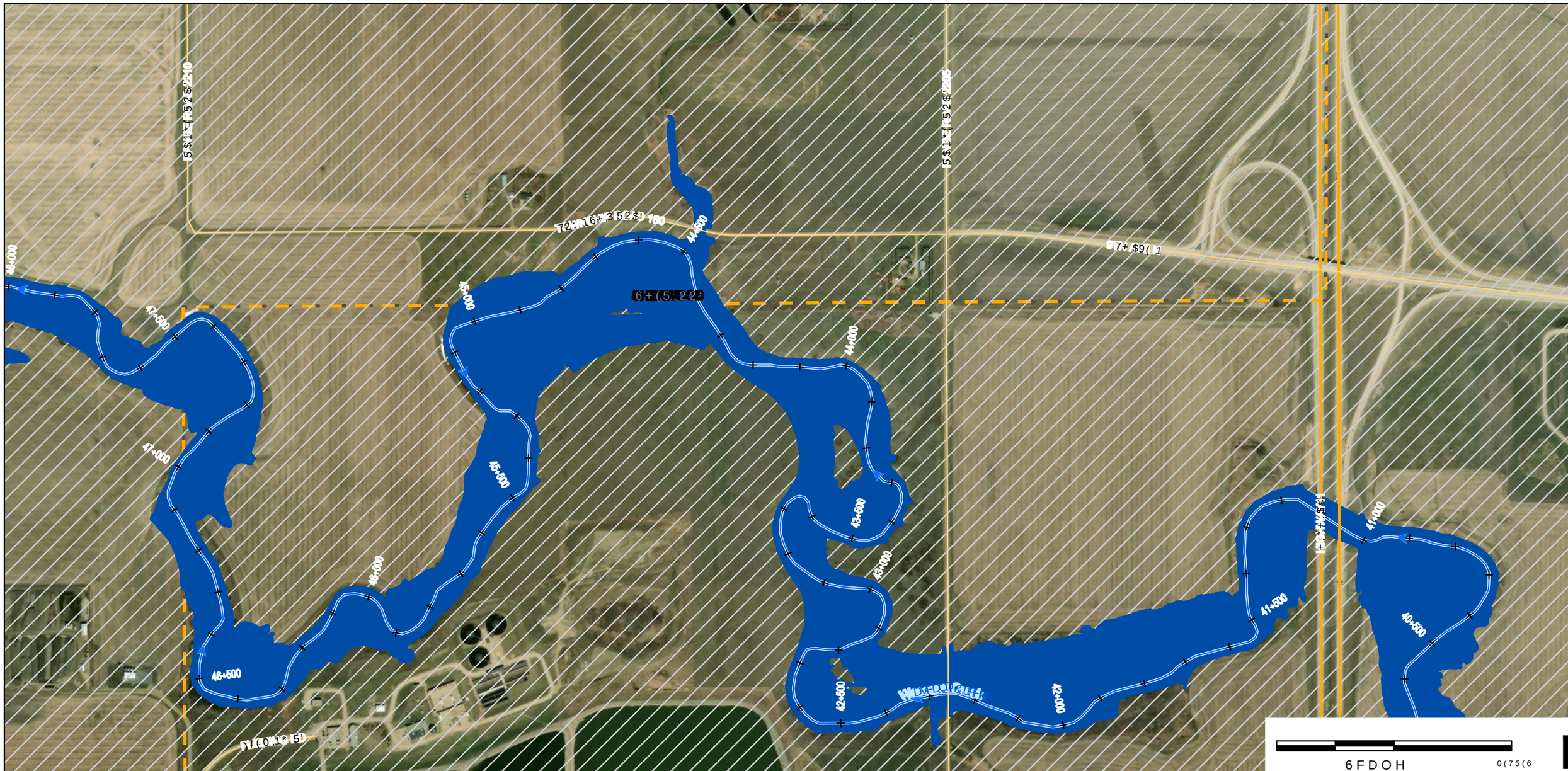

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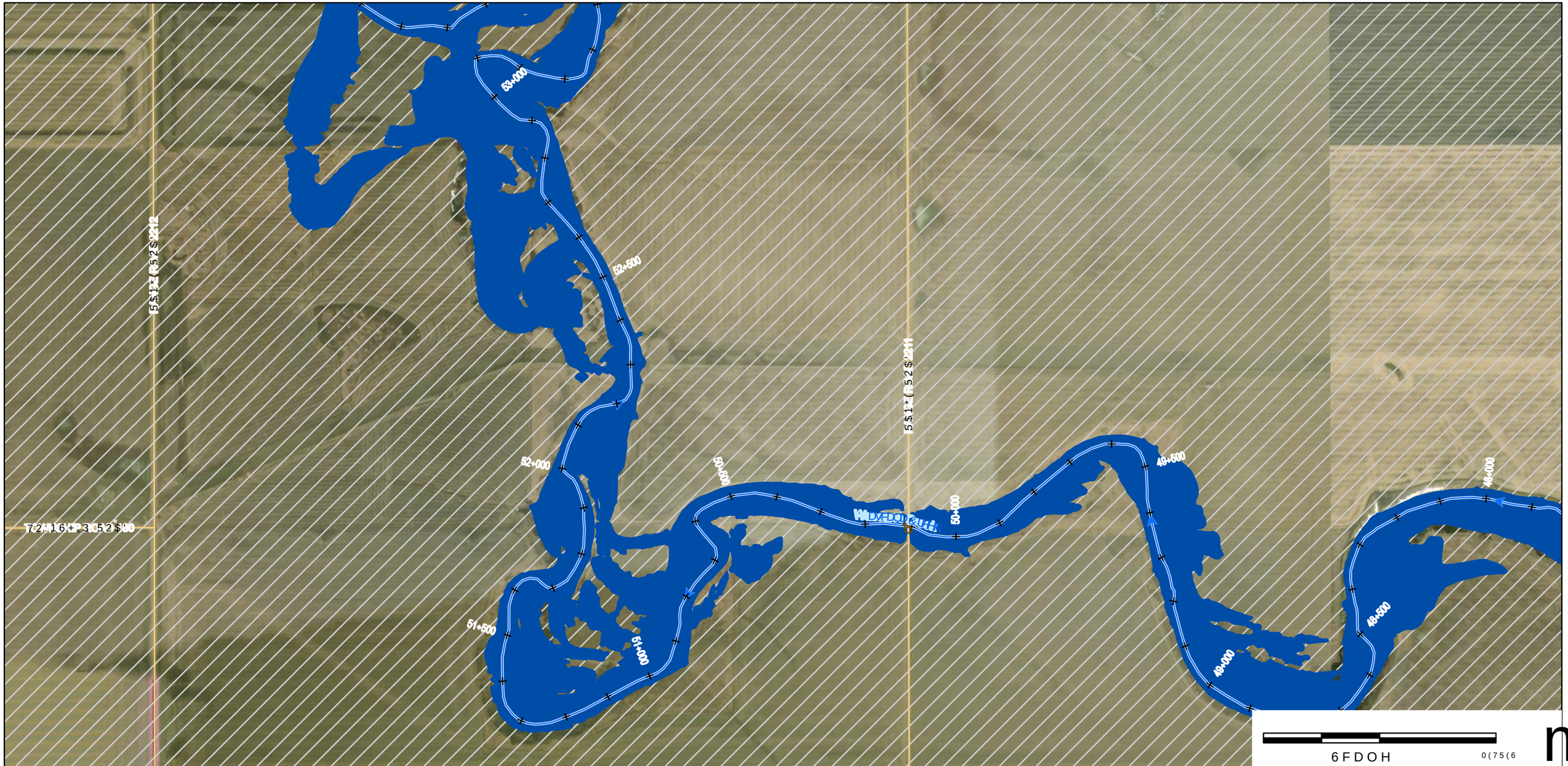

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$OO 'DWDVHWV ‹ *RYHUQPHQW RI 6DVNDWFKHZDQ 3DUWQHUVKLS 3URMHFW 0DS 3URMHFWLRQ 870 &656 ([HQGHG =RQH 1RUWK &RRUGLQDWH 6\VWHP RI GDWD DUH UHTXLUHG 6RXUFH DQG GHVWDXV RI 1RWHV 6KHHWV DQG PD\ QRW EH LQFOXGHG LQ WKH PDSVHULHV WKHUH LV QR IORRGLQJ LQ WKLV DUHD

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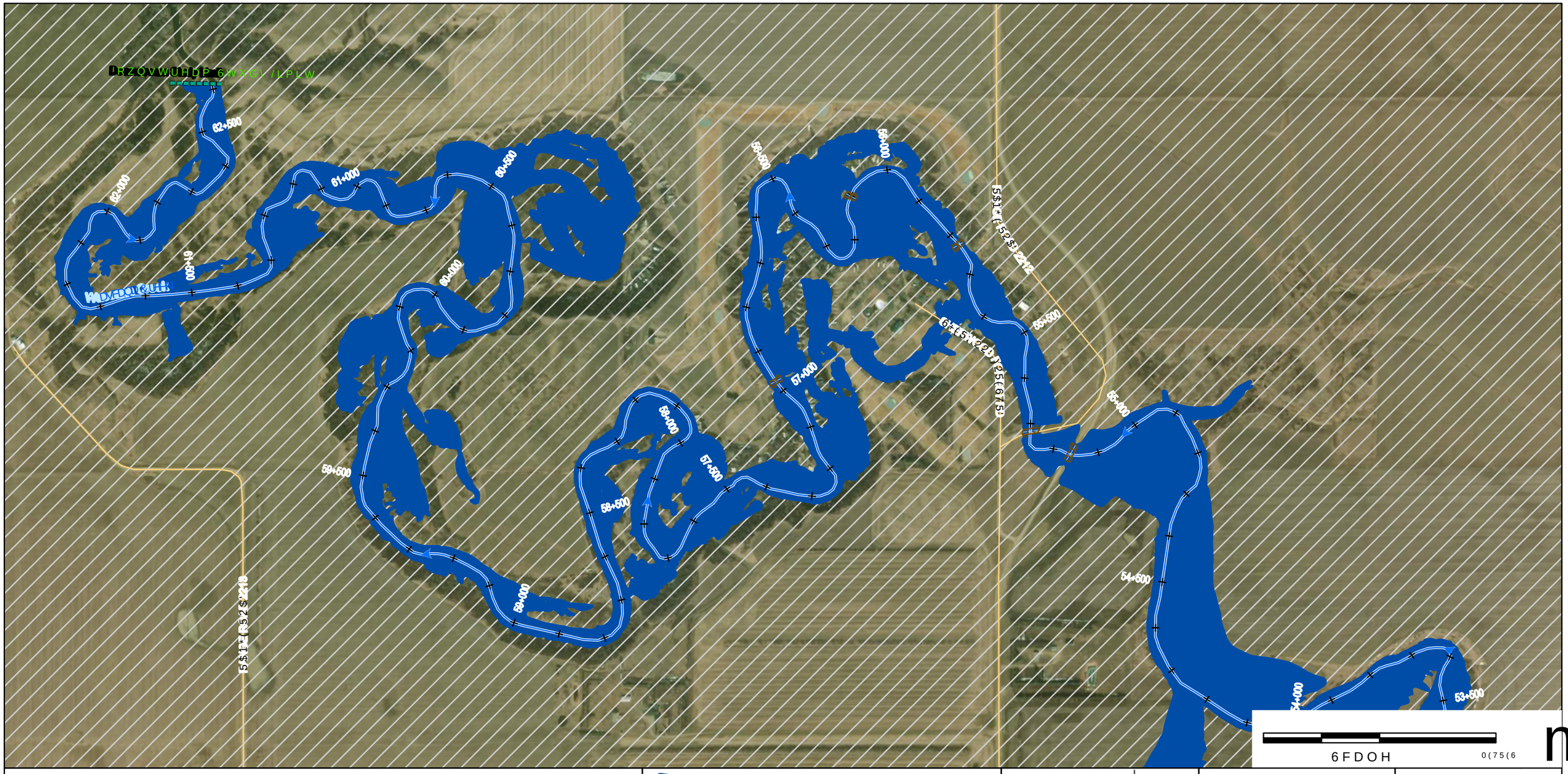

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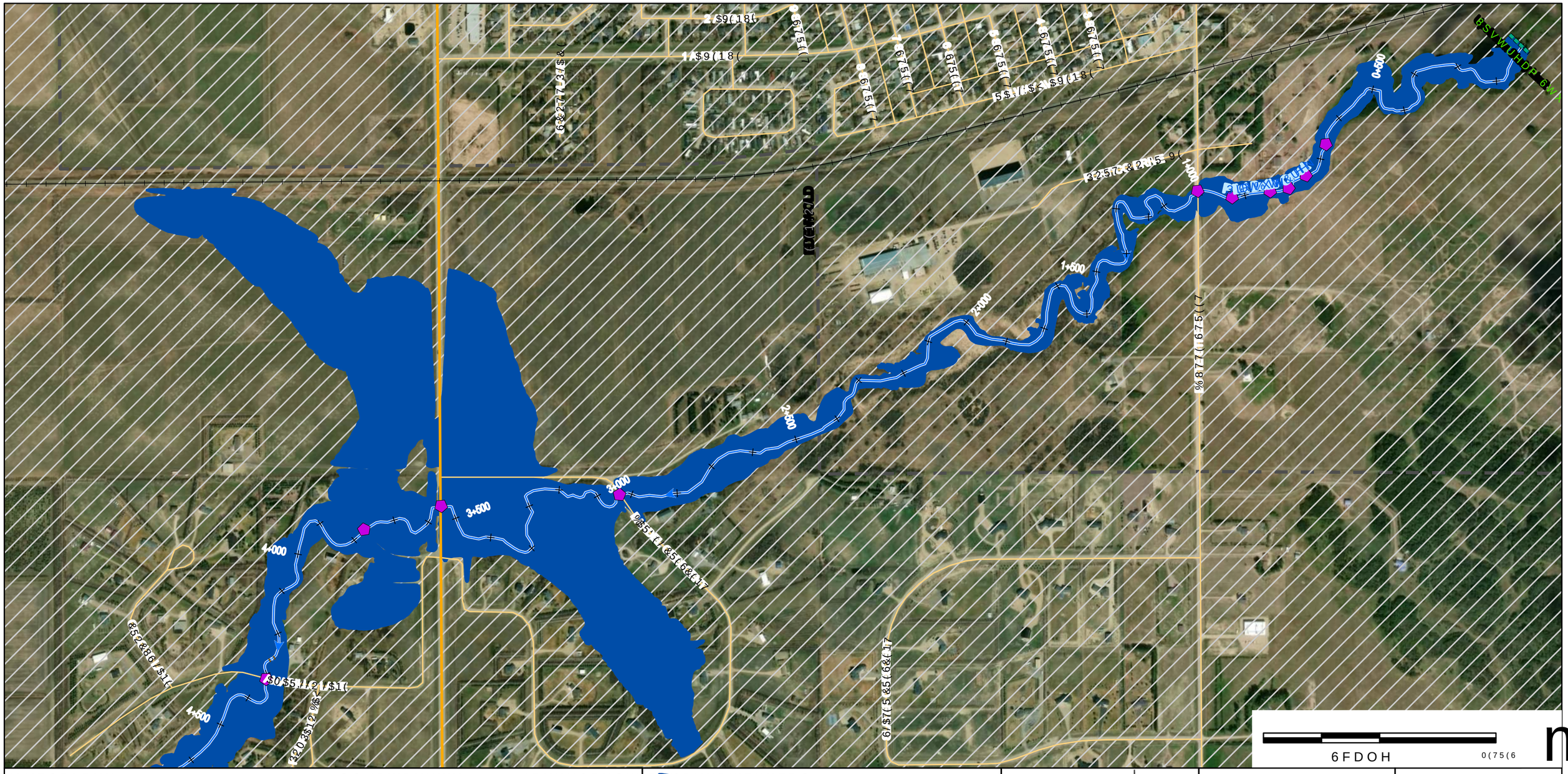
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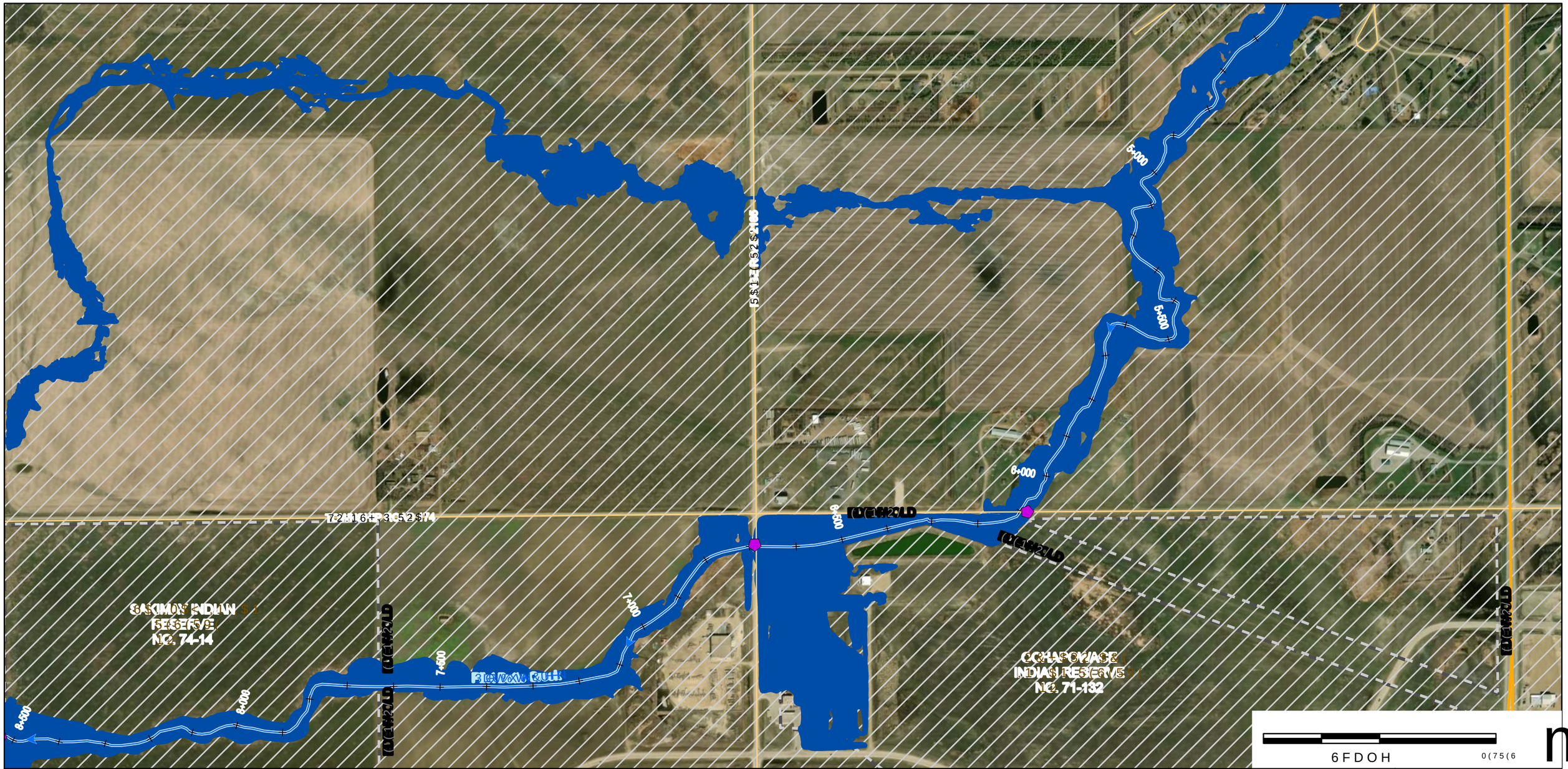

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7KH
XVHU LV DGYLVHG WR FRQILUP WKH
LQ
WKH HYHQW WKDW SUHFLVLRQ DQG
:6$ UHFRPPHQGV FRQILUPLQJ WKH
ERUHKROH SURSHUWLHV
0DS 3URGX FHG %\
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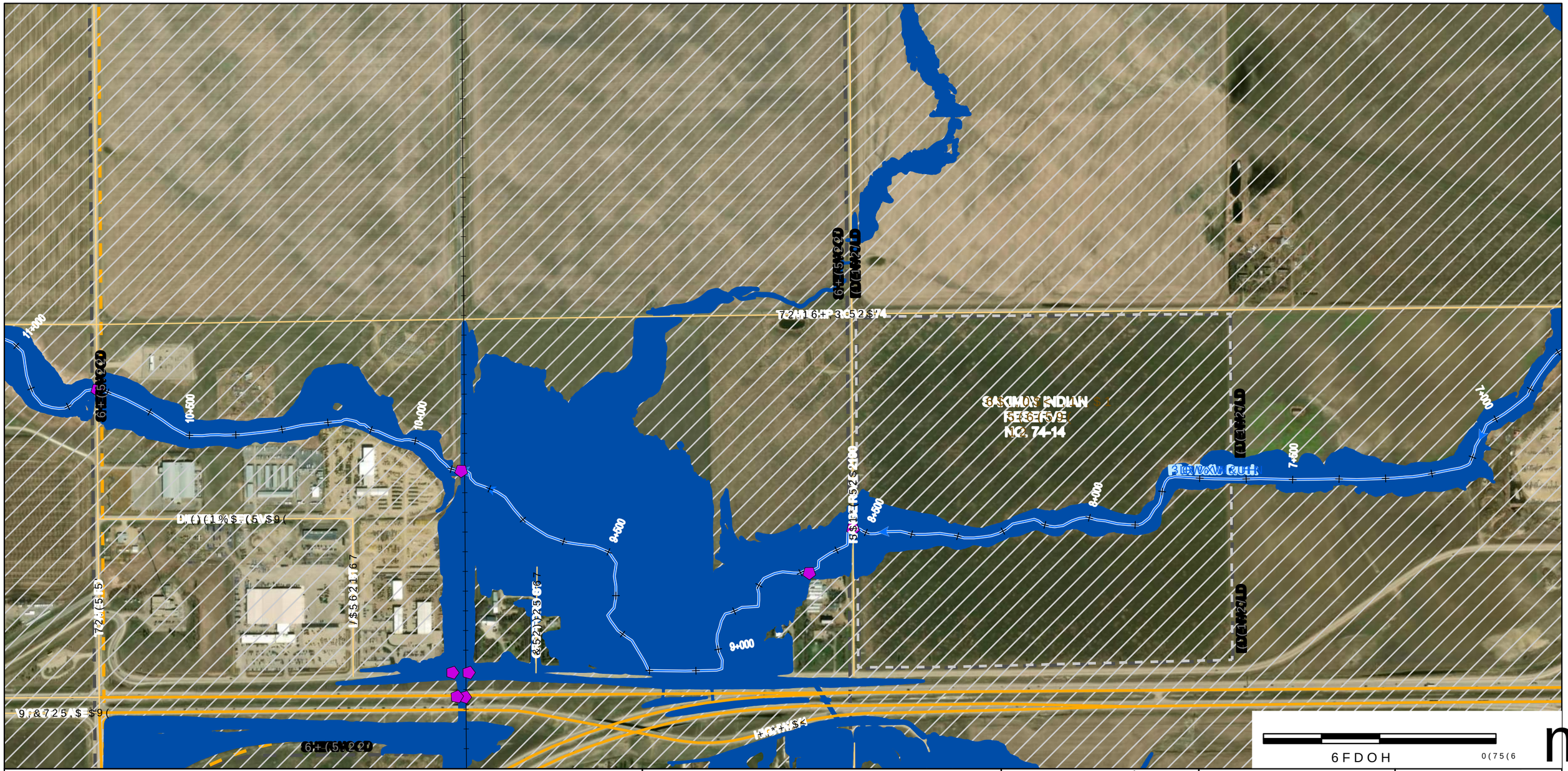

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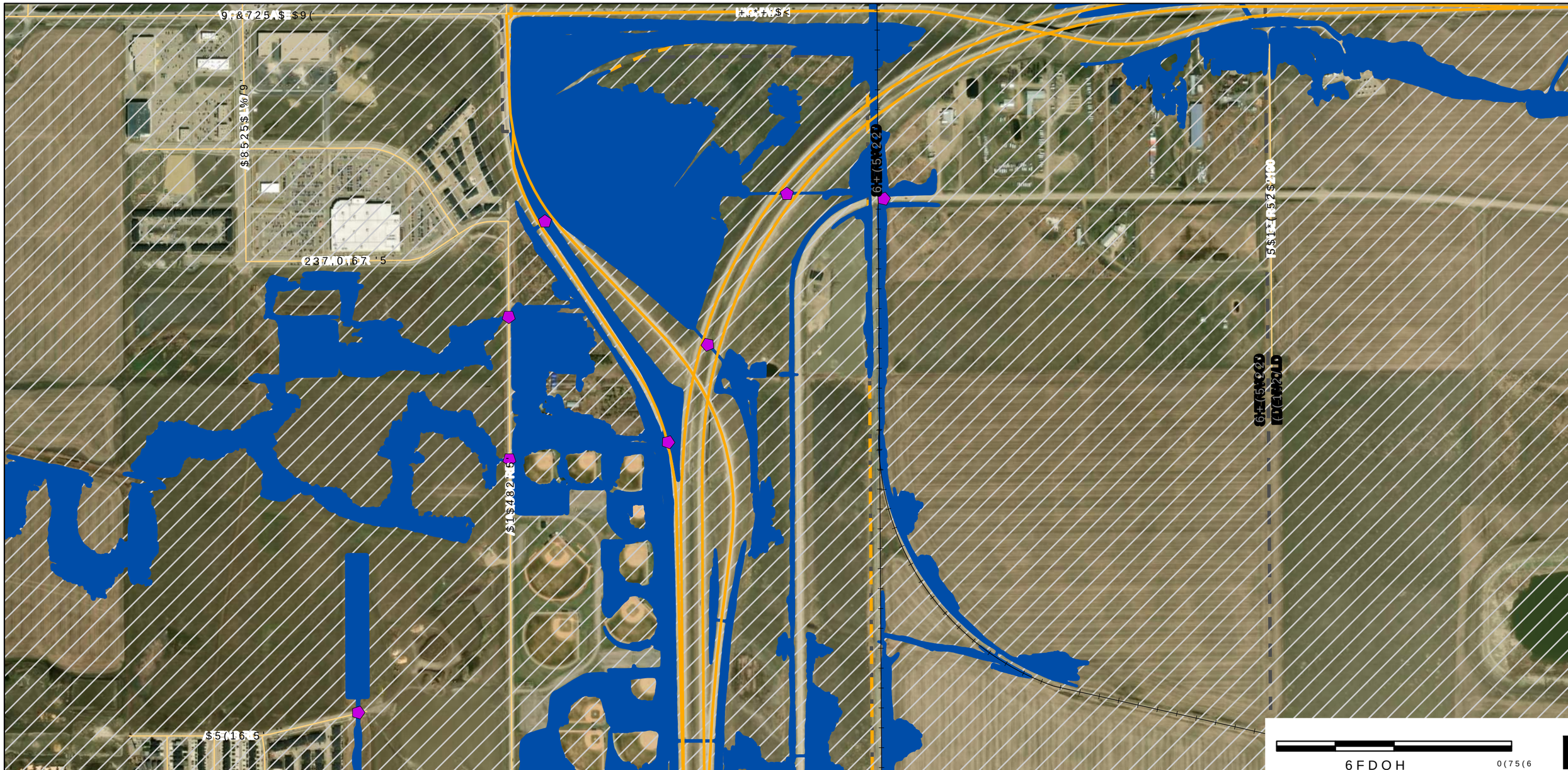

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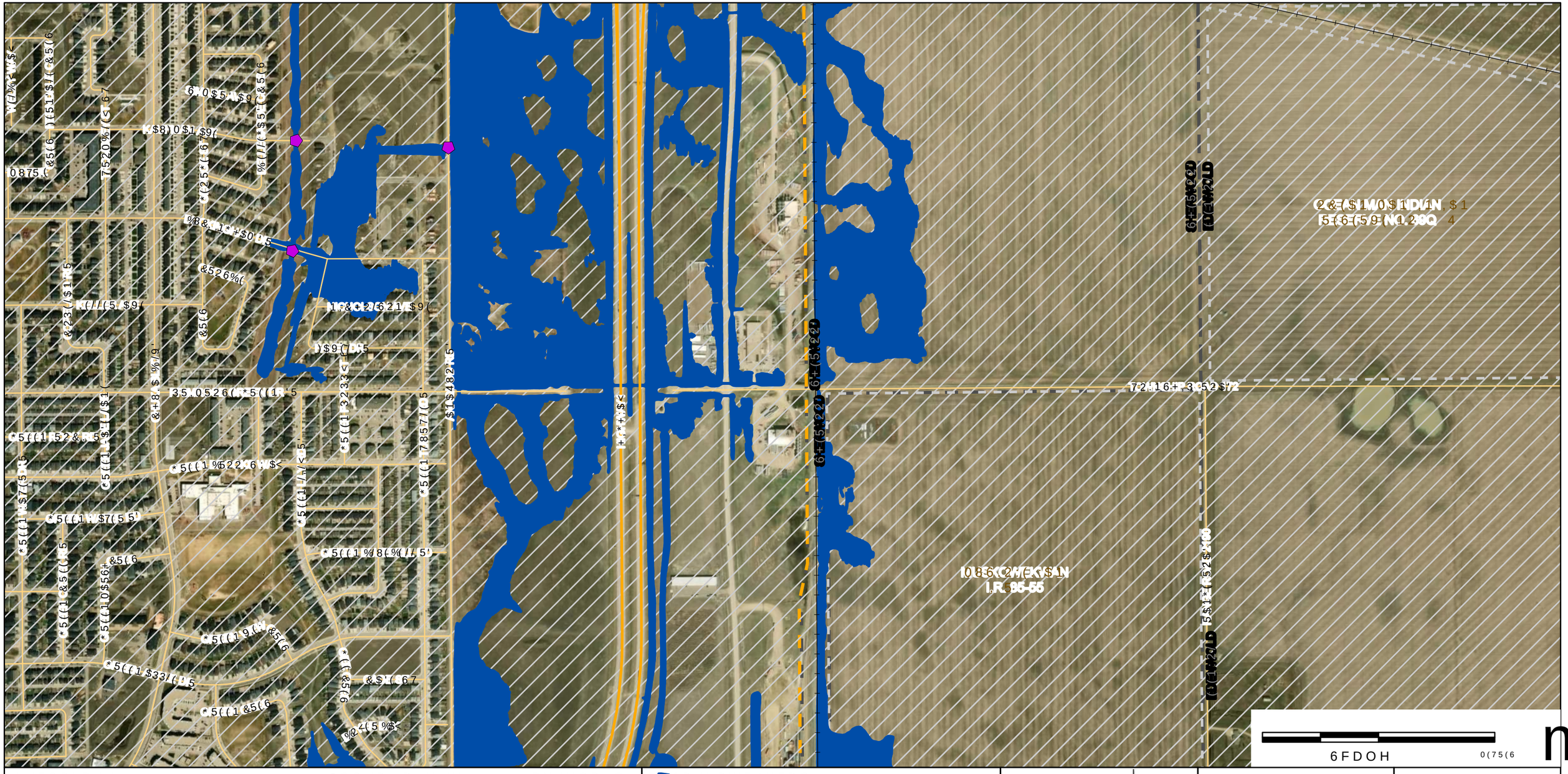

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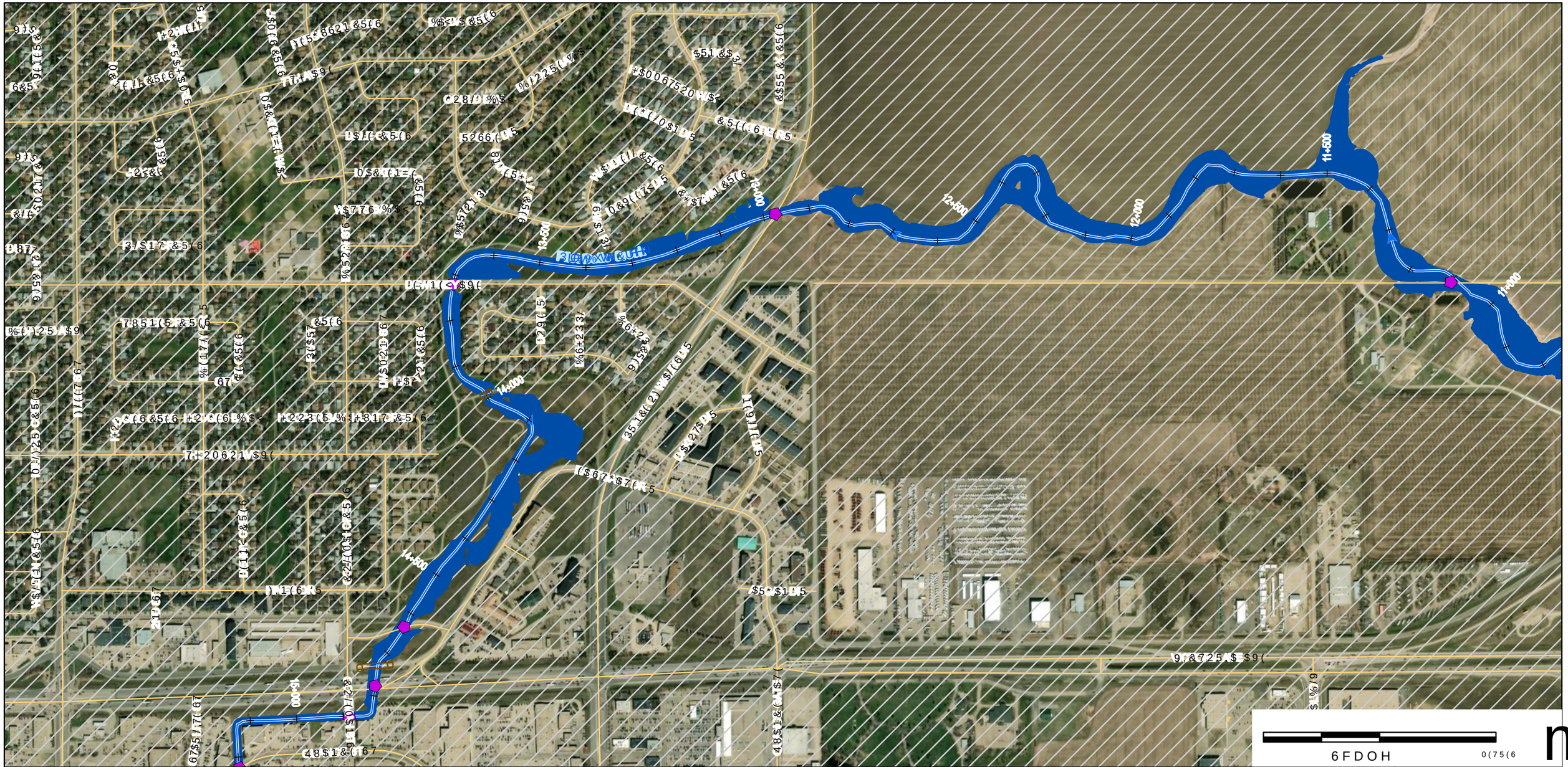

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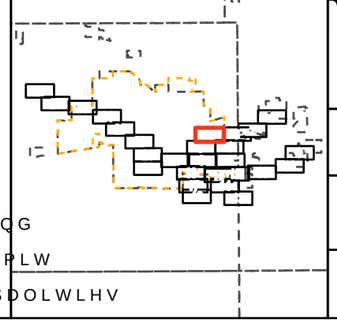

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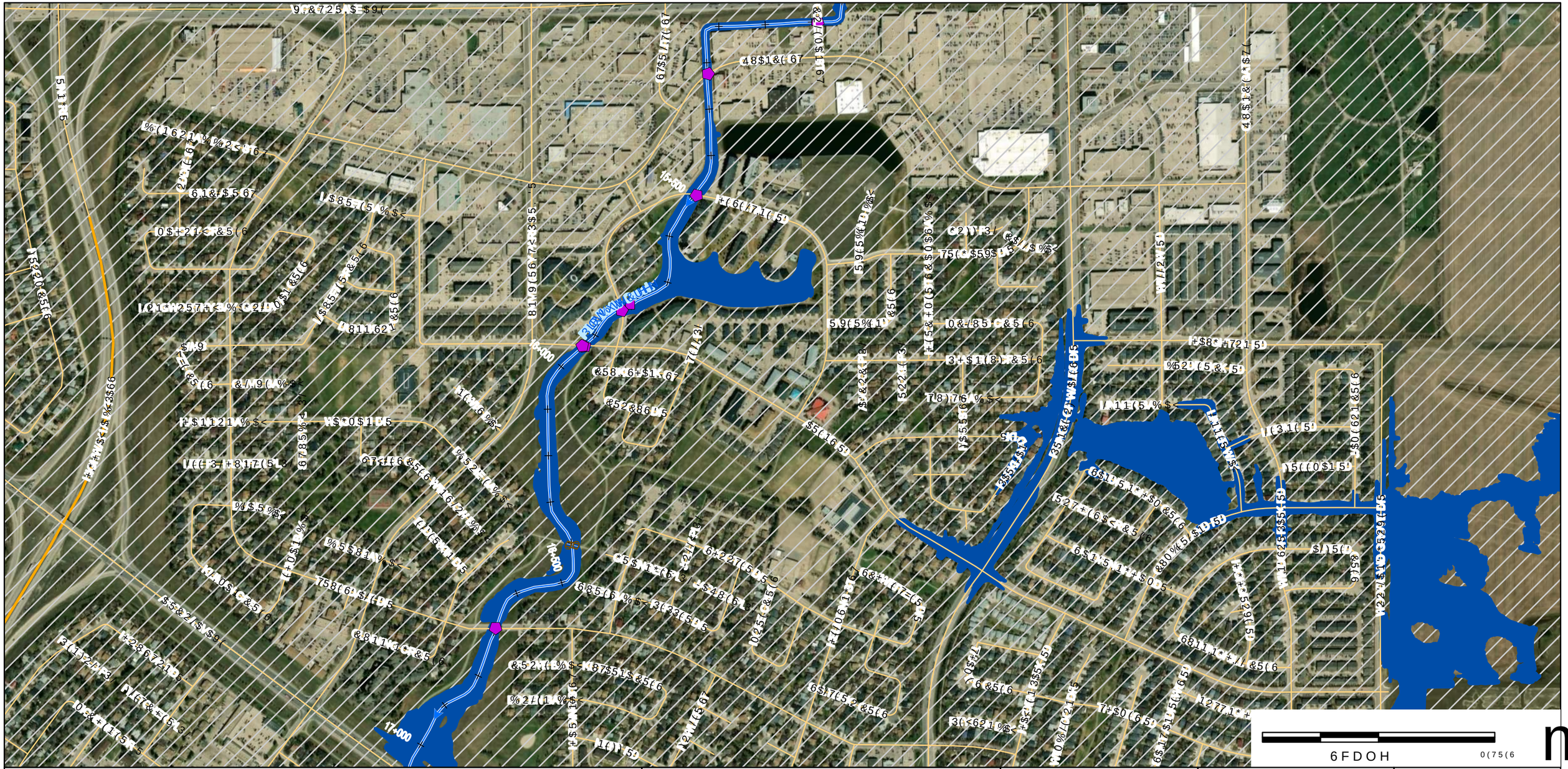
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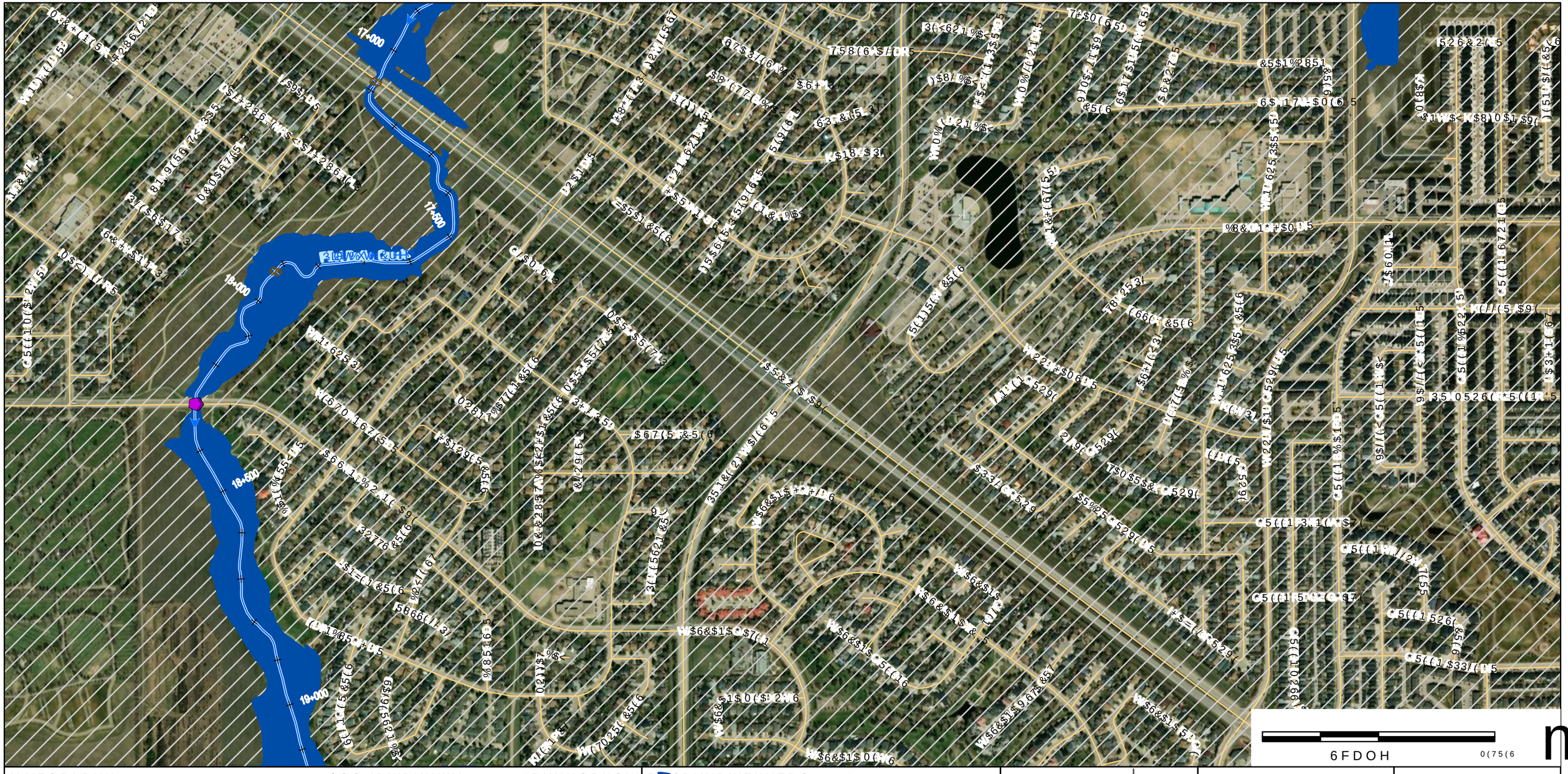

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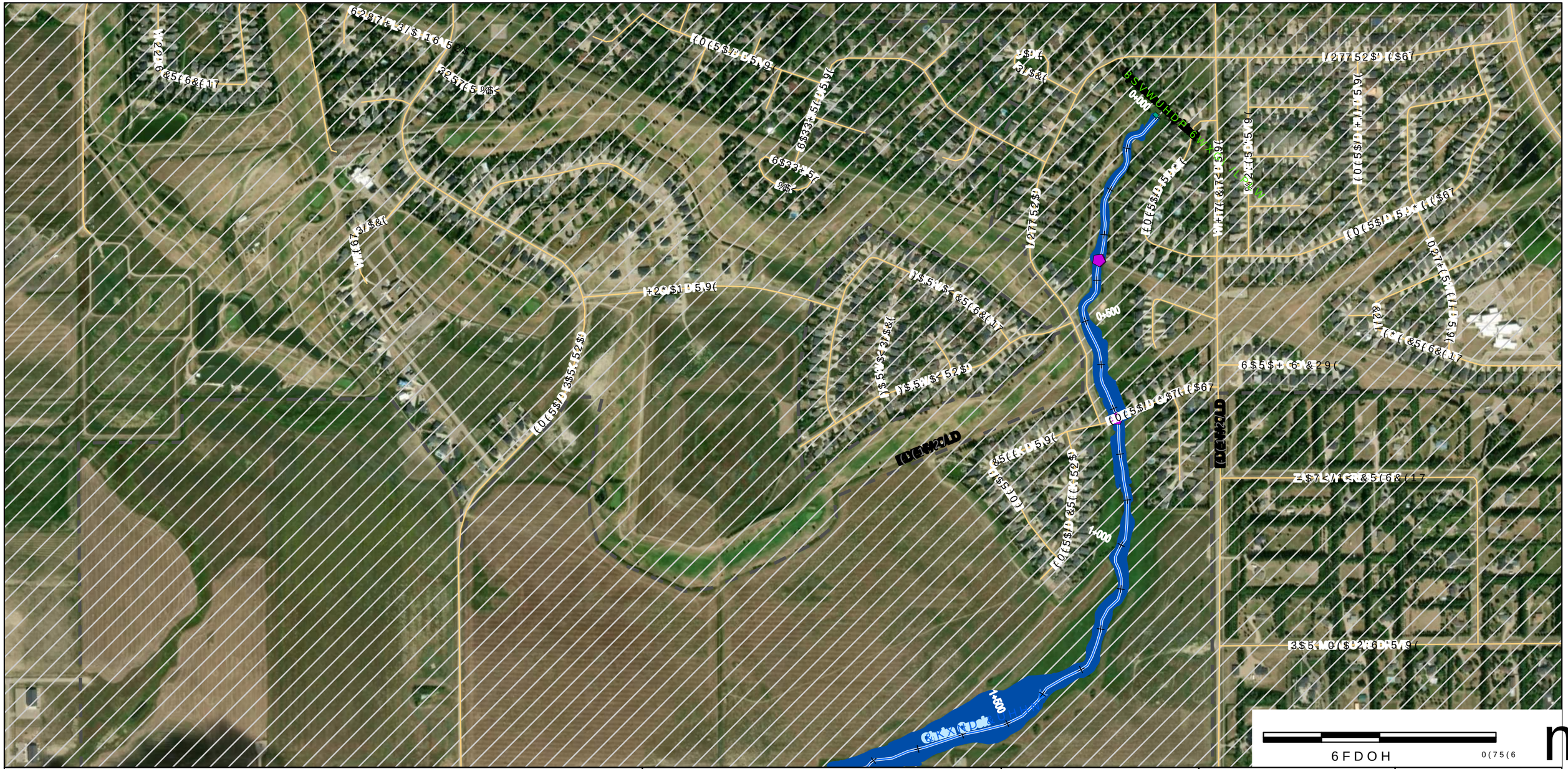

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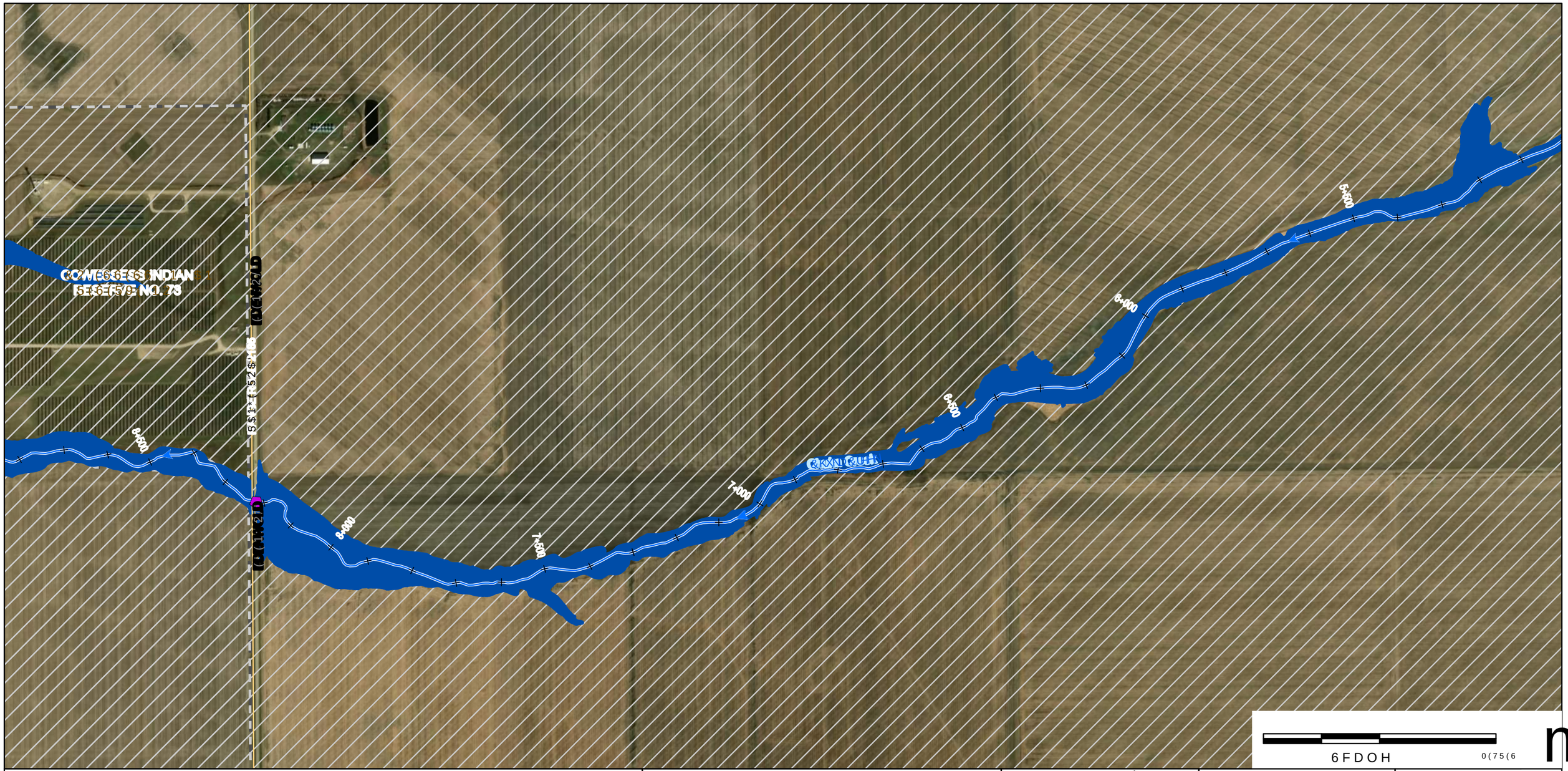

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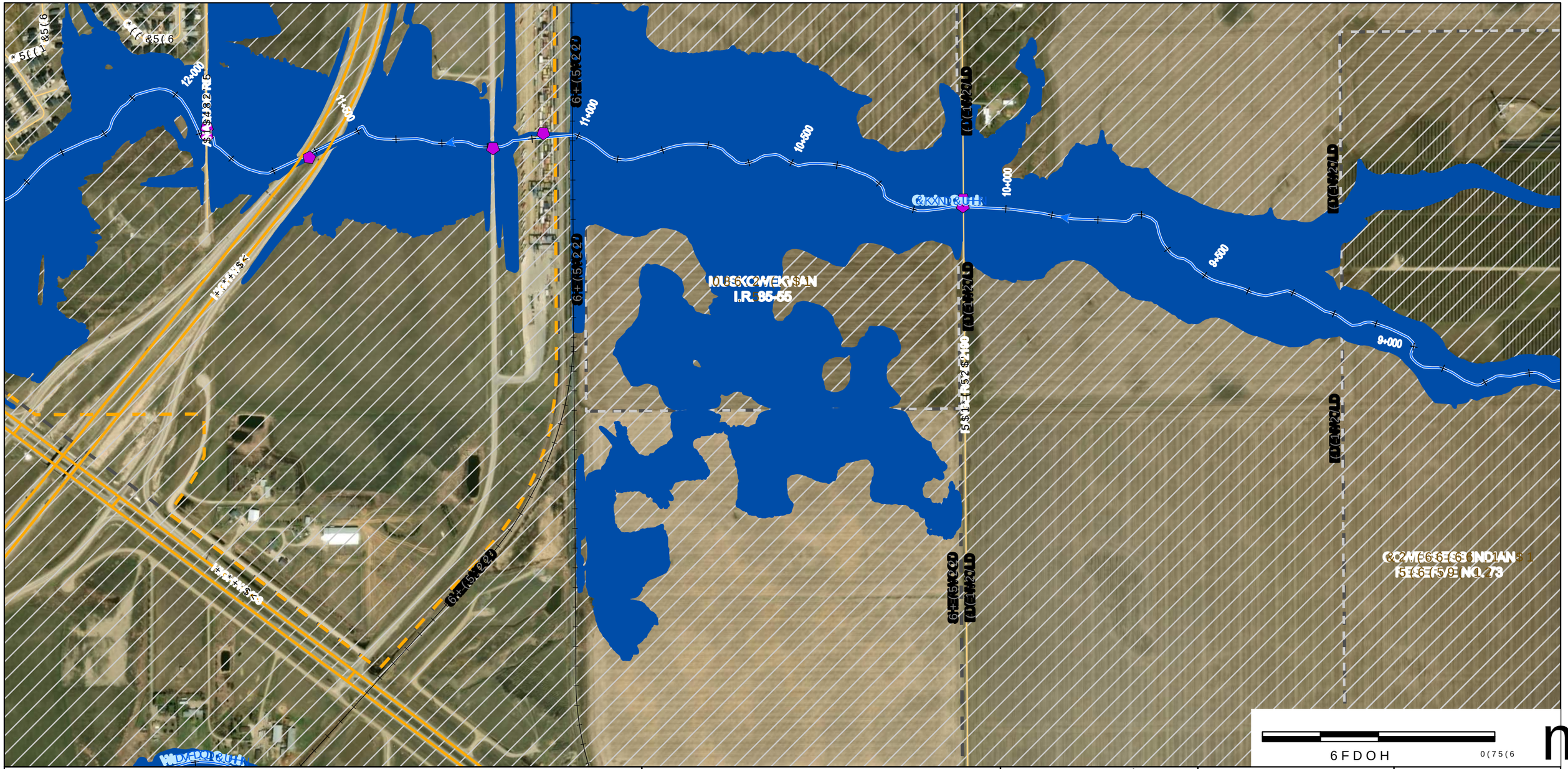

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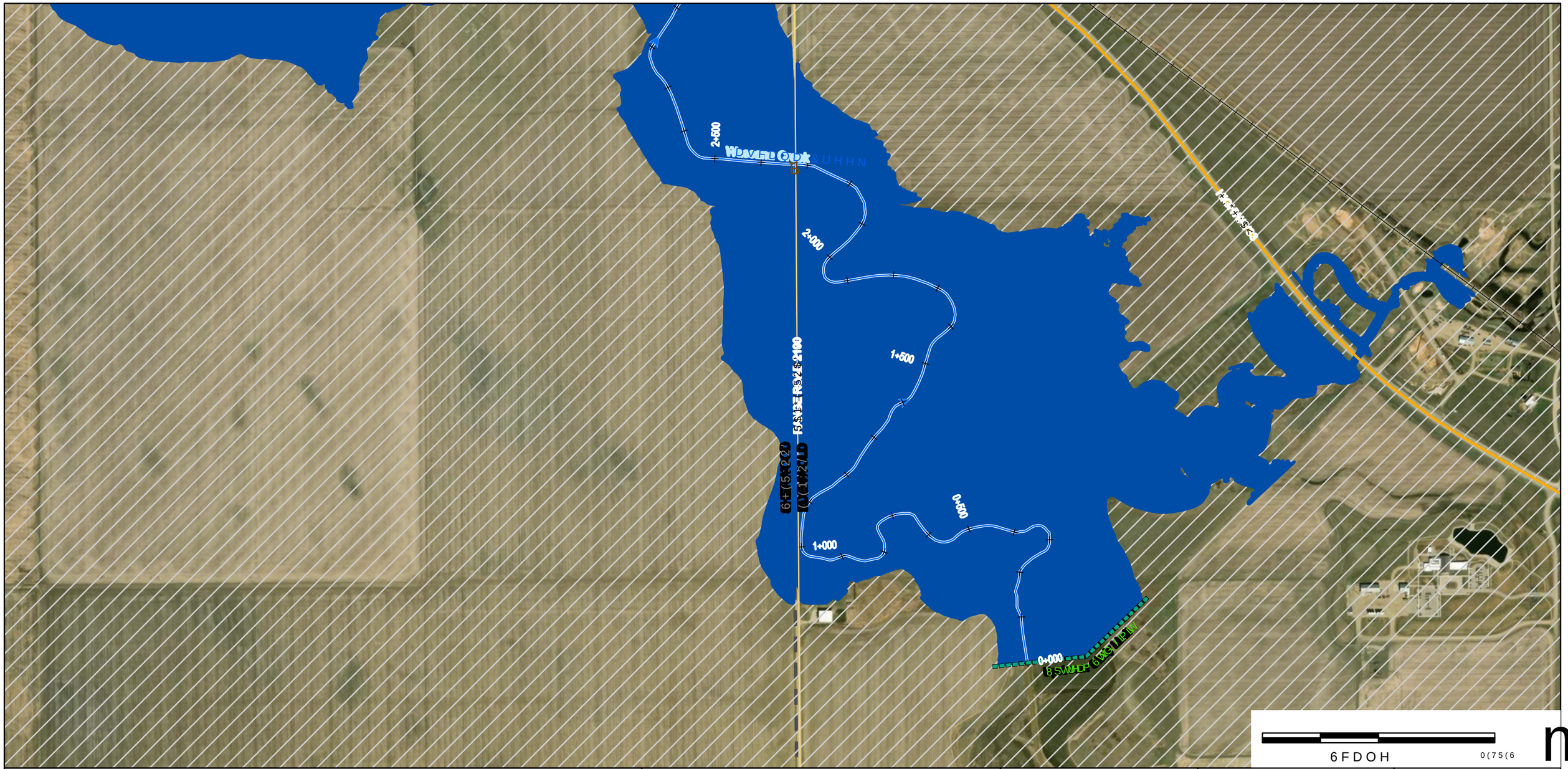

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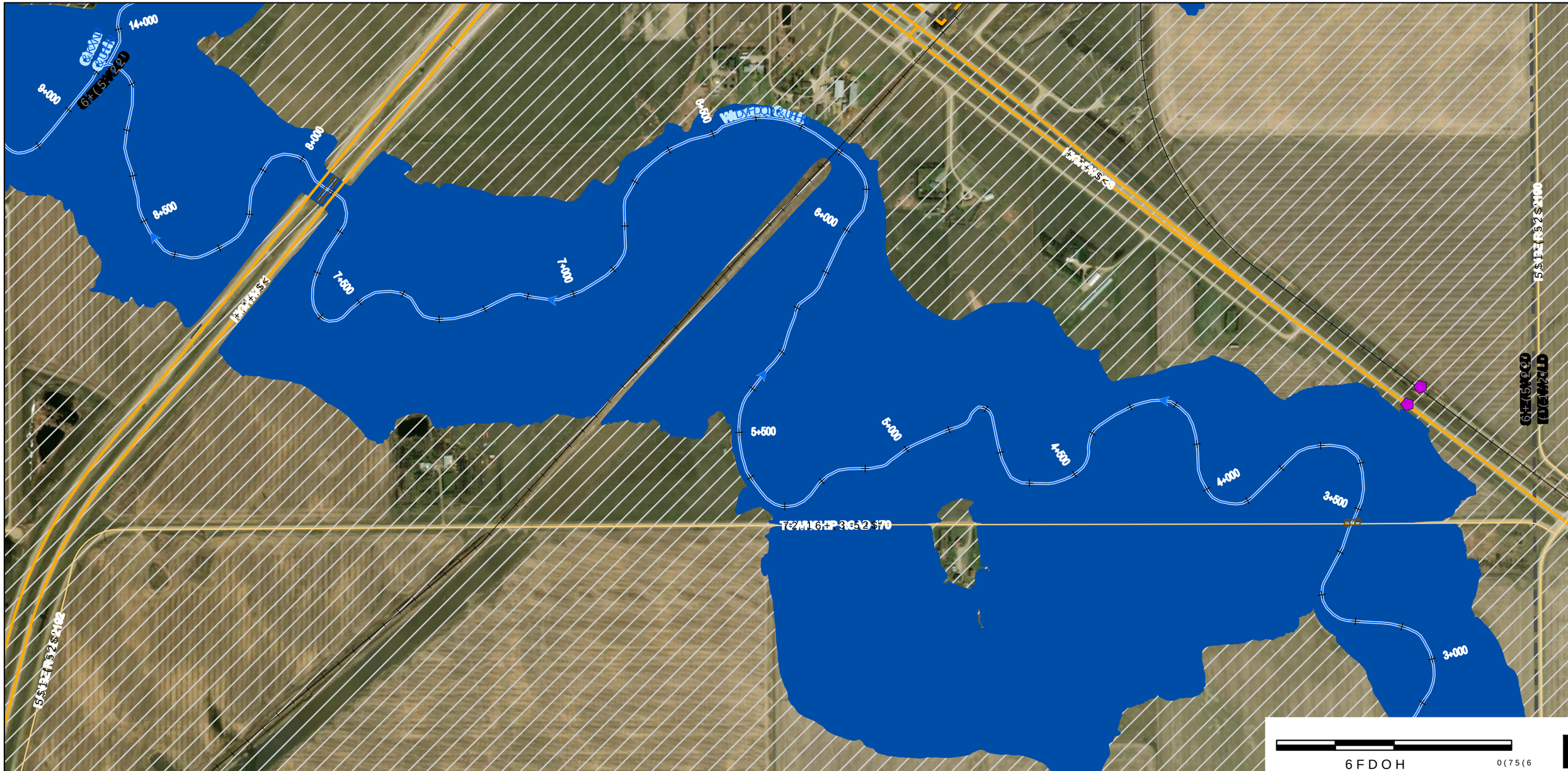

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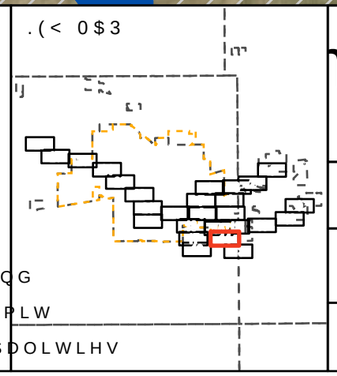

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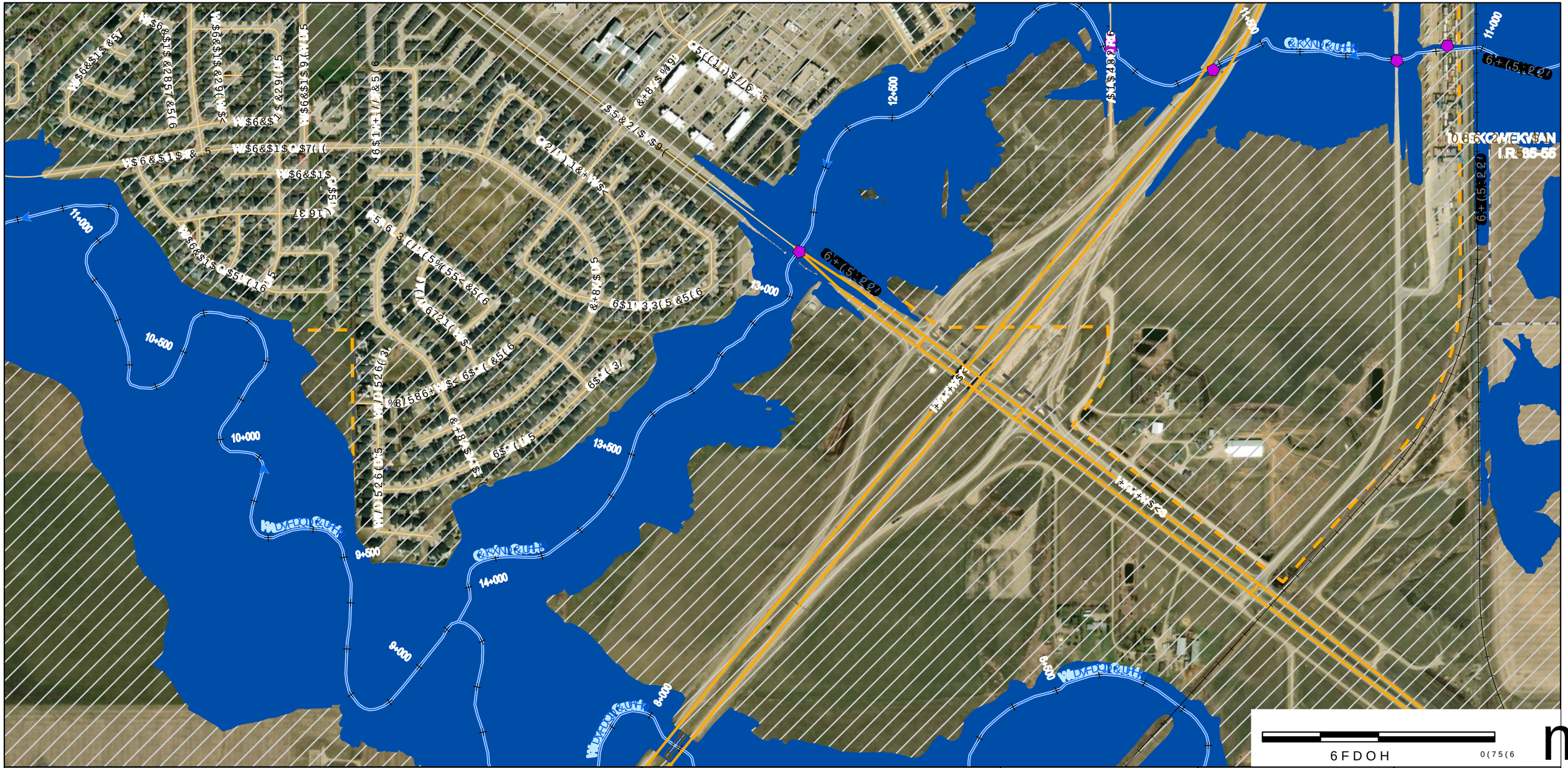

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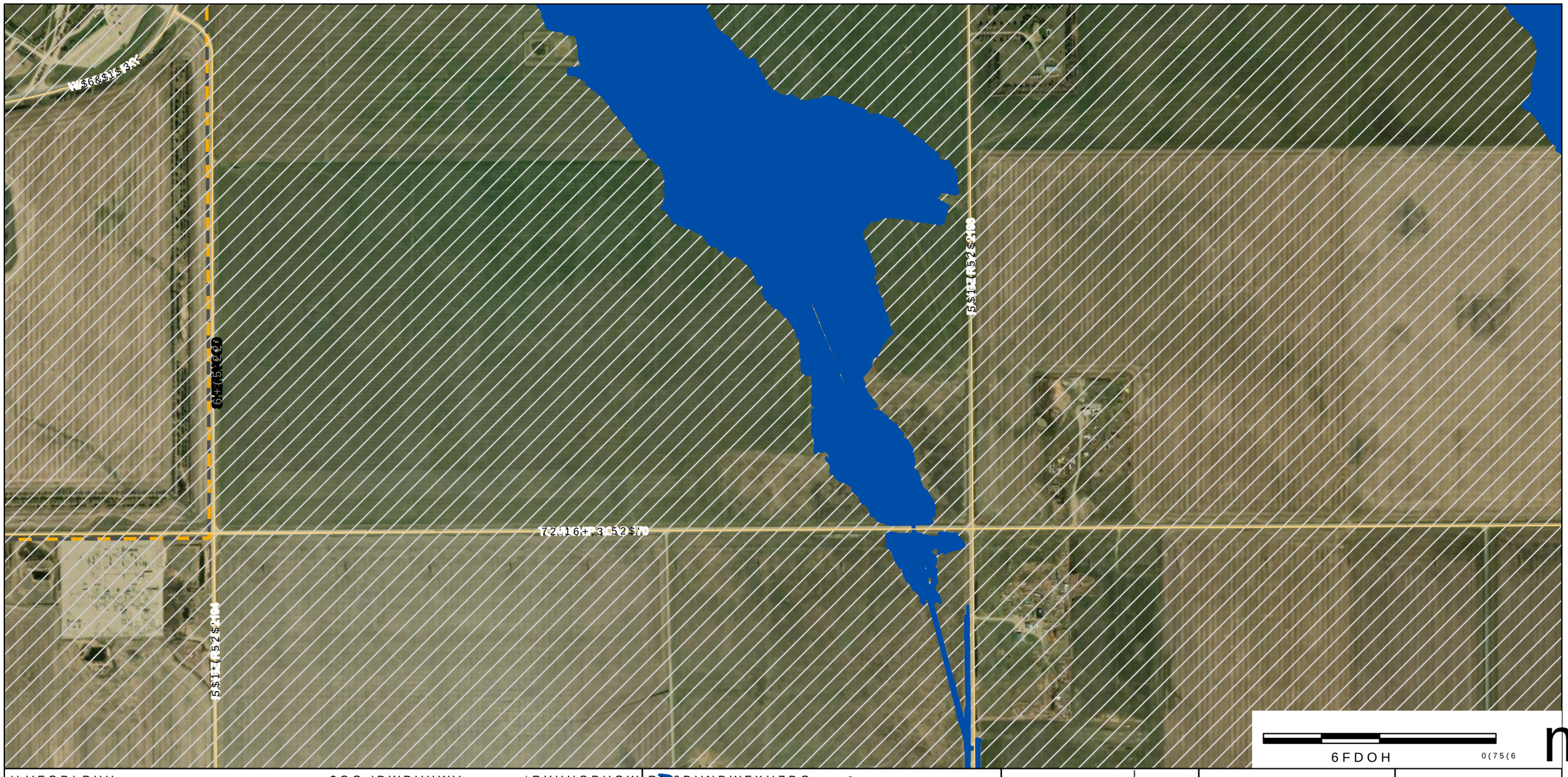

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:6$ UHFRPPHQGV FRQILUPLQJ WKH IORRG &DQDGD VWDWXV RI
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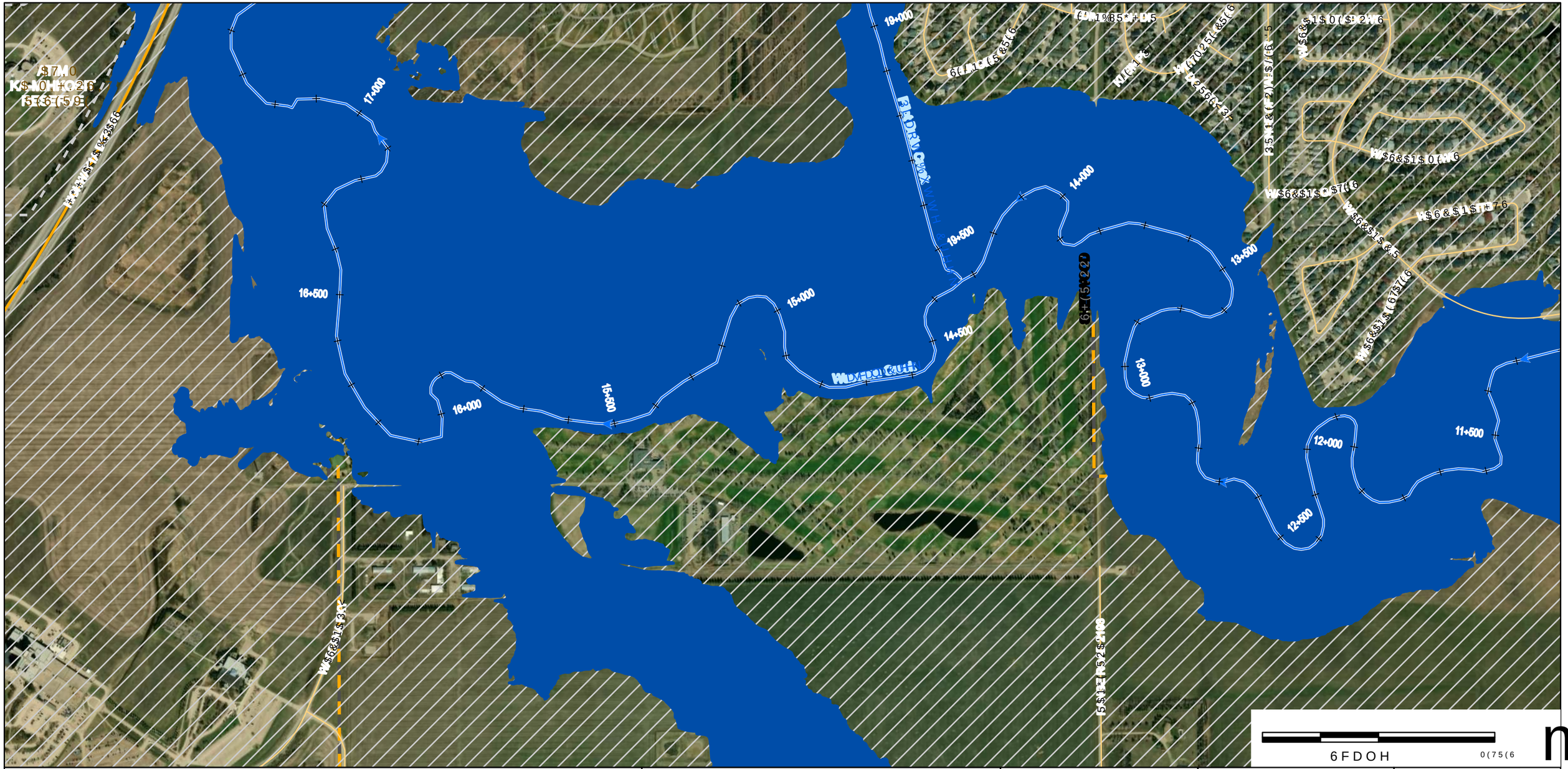
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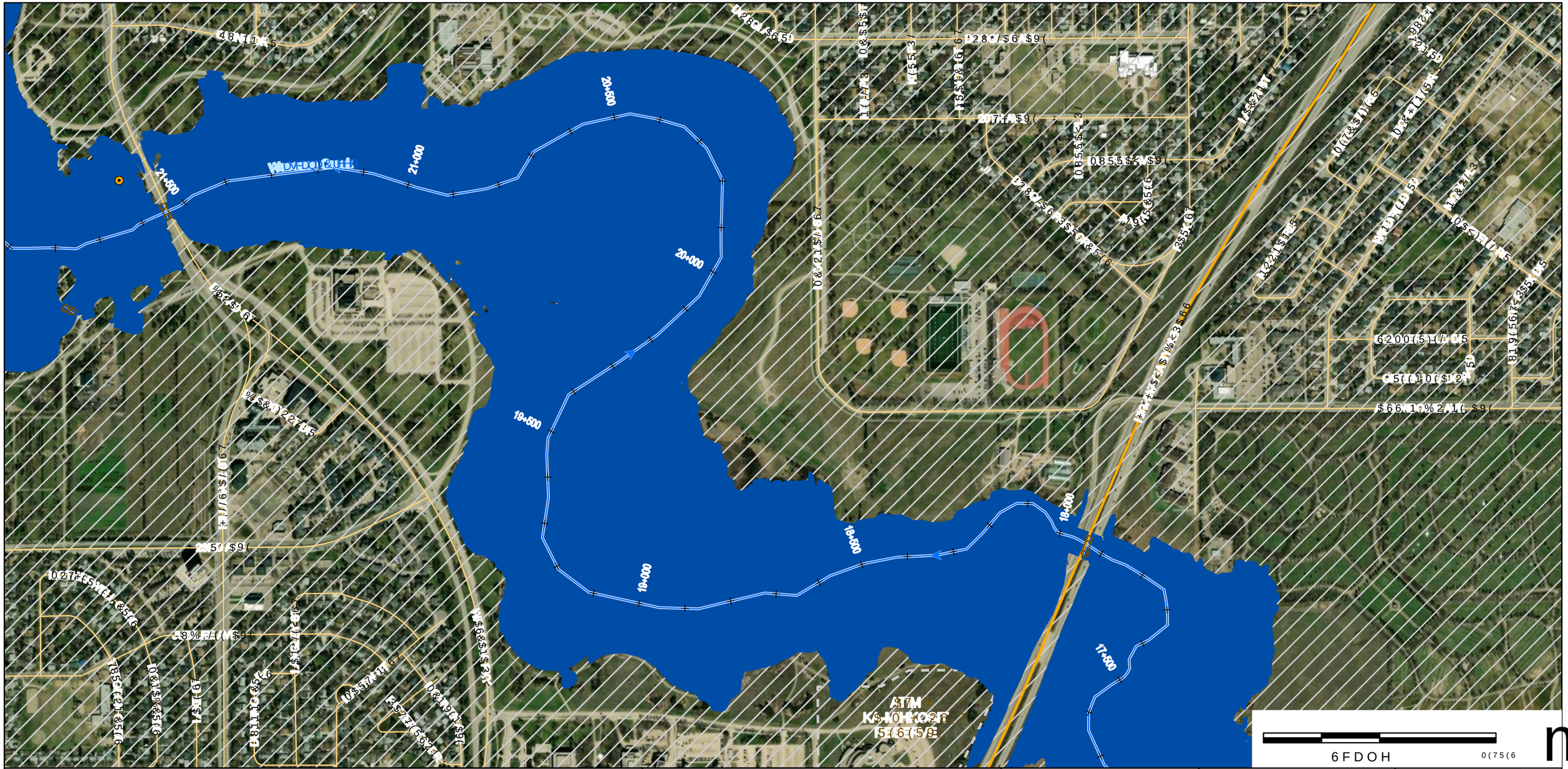

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LQ
WKH HYHQW WKDW SUHFLVLRQ DQG &XUUHQF\ RI GDWD DUH UHTXLUHG
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&DWD &LQ DVH 5HIHUHQFH 6\VWHP
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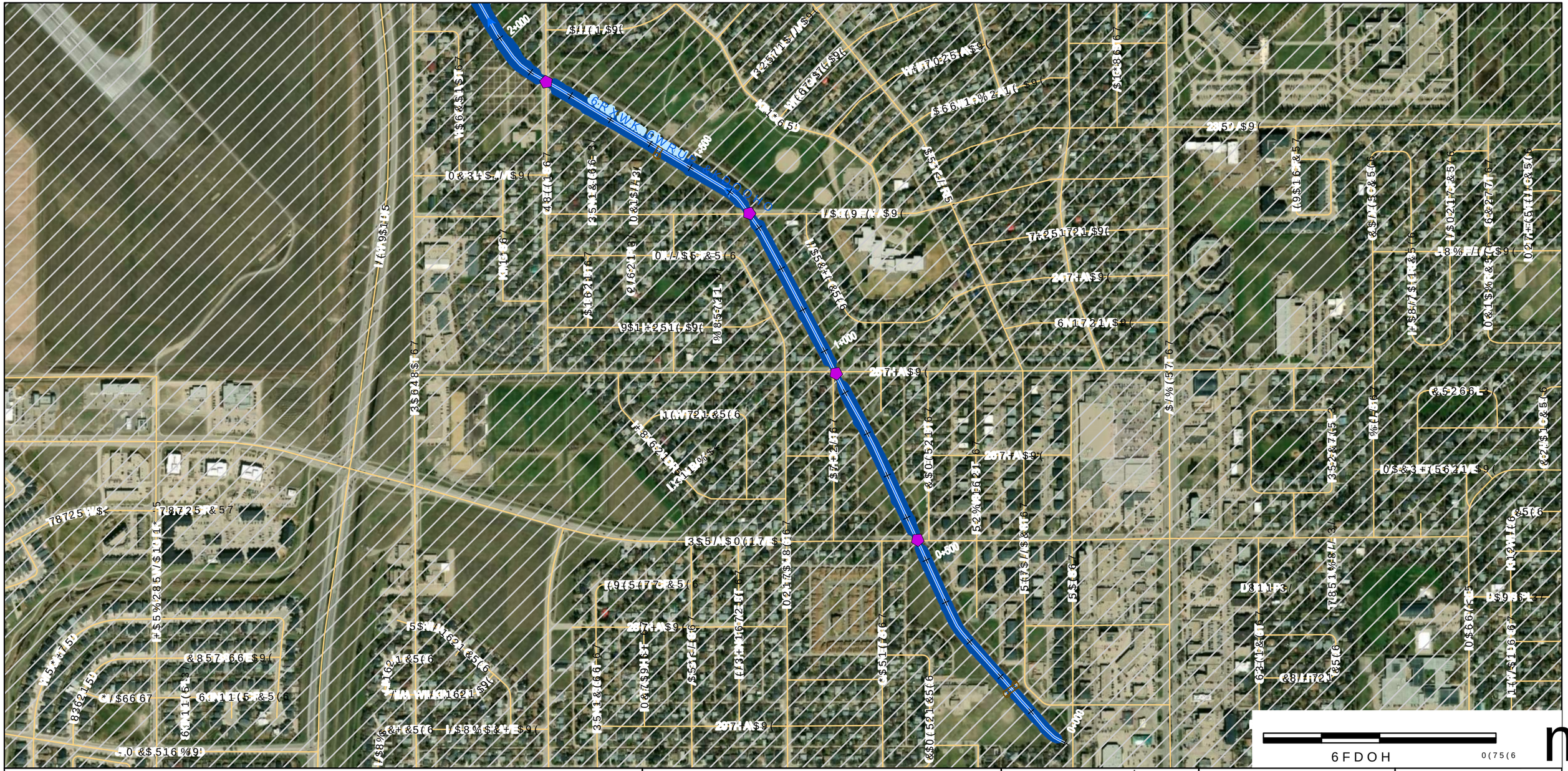

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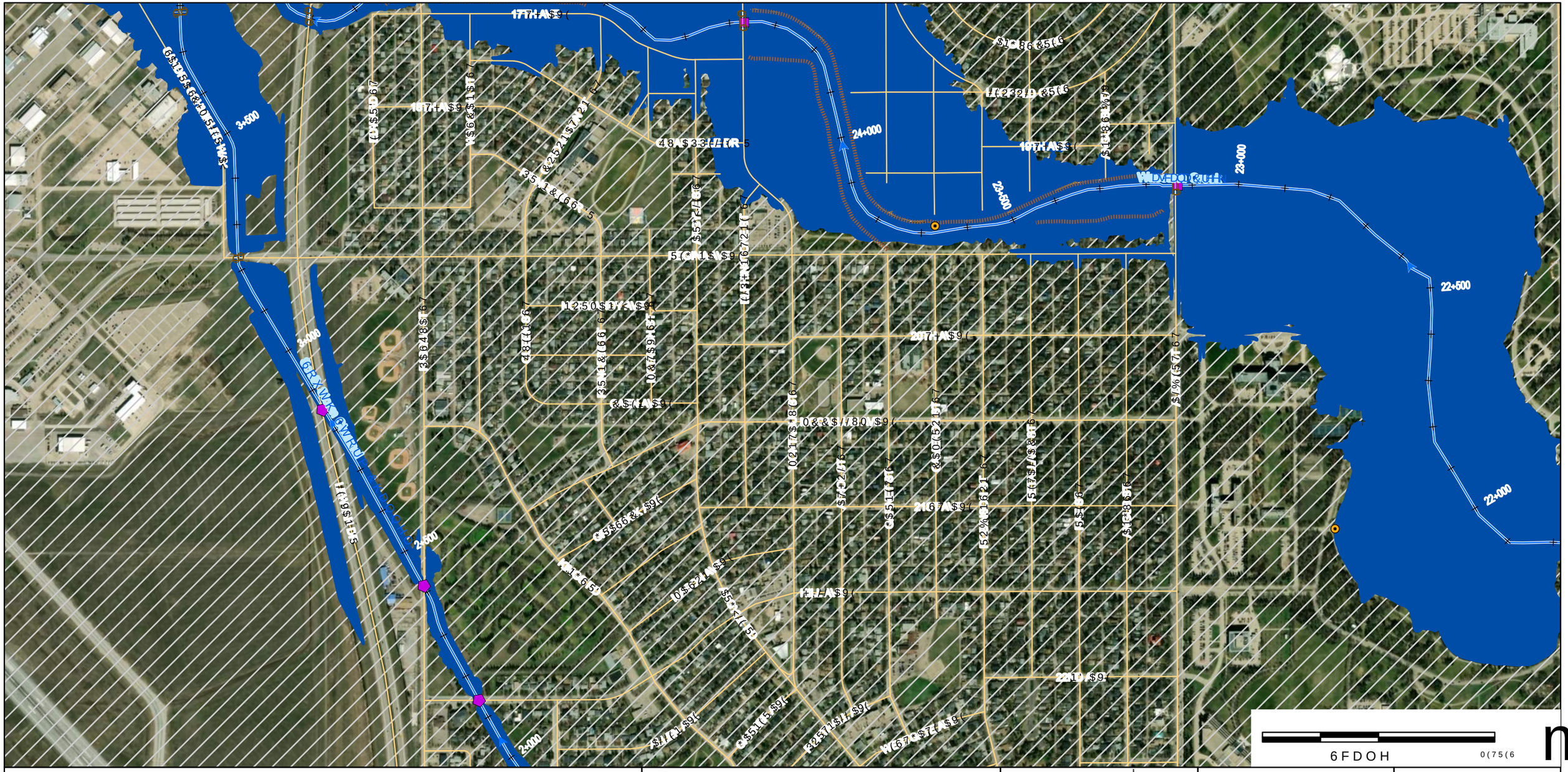

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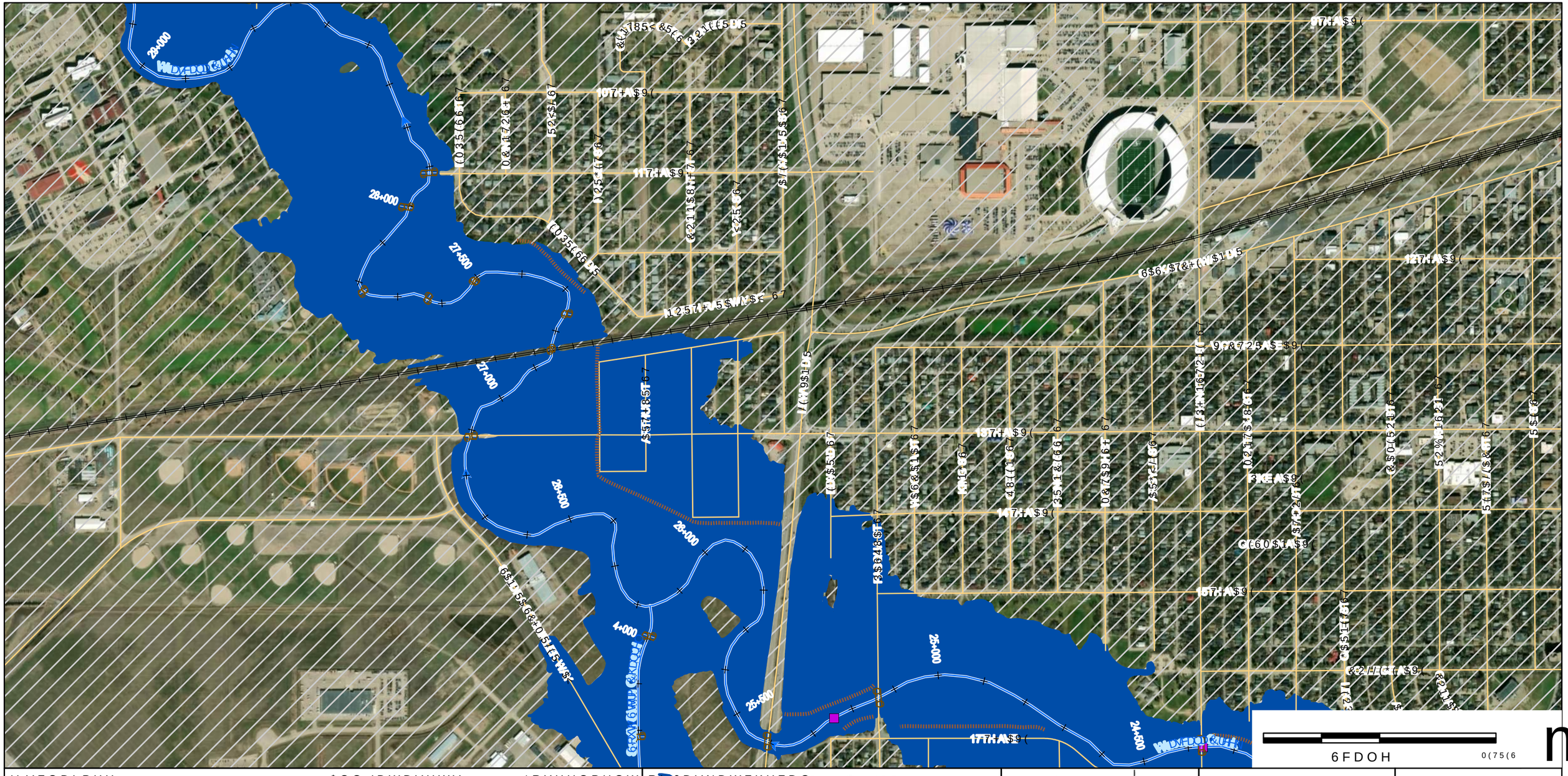

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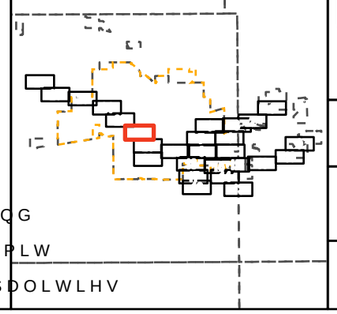

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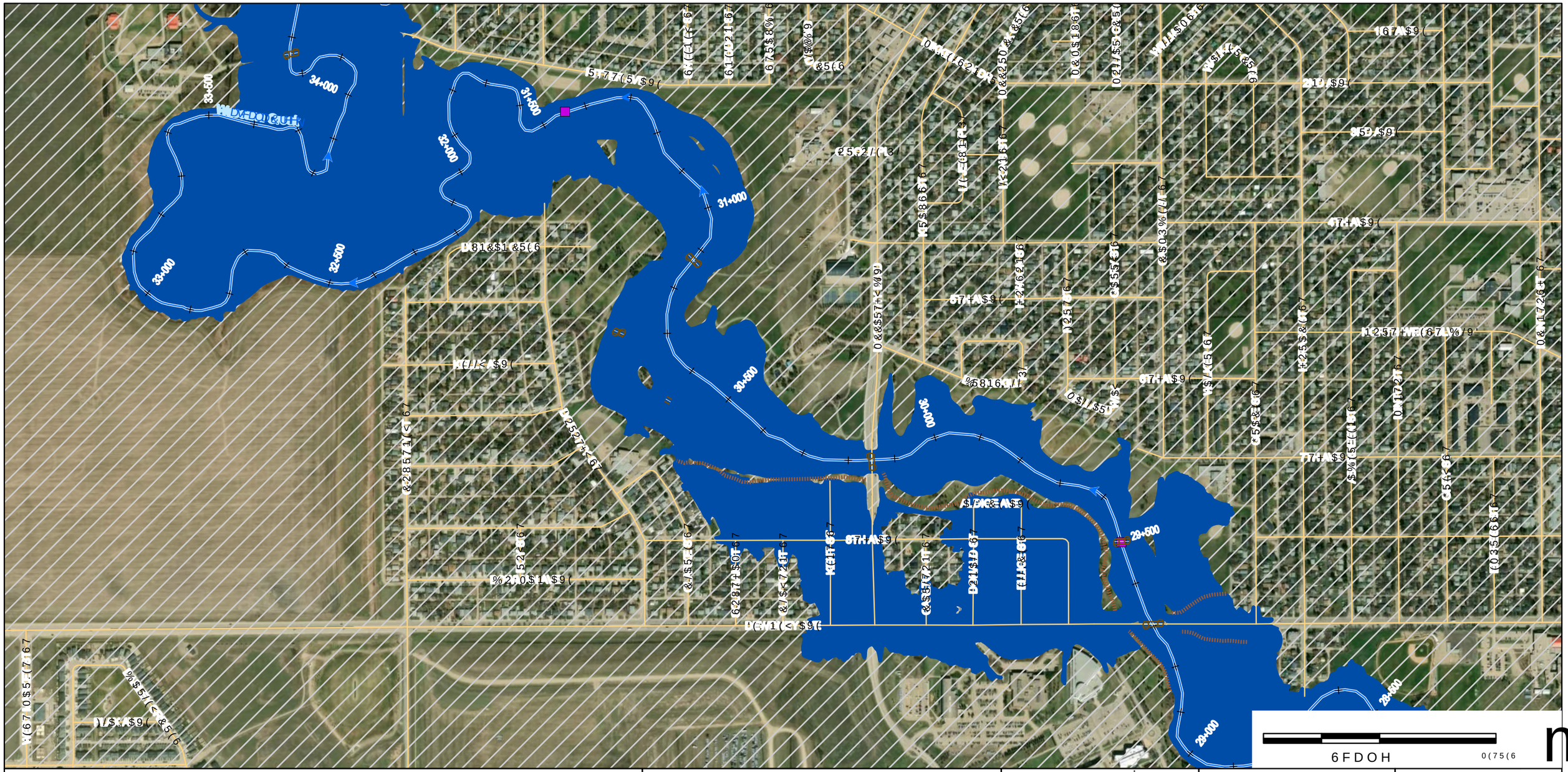

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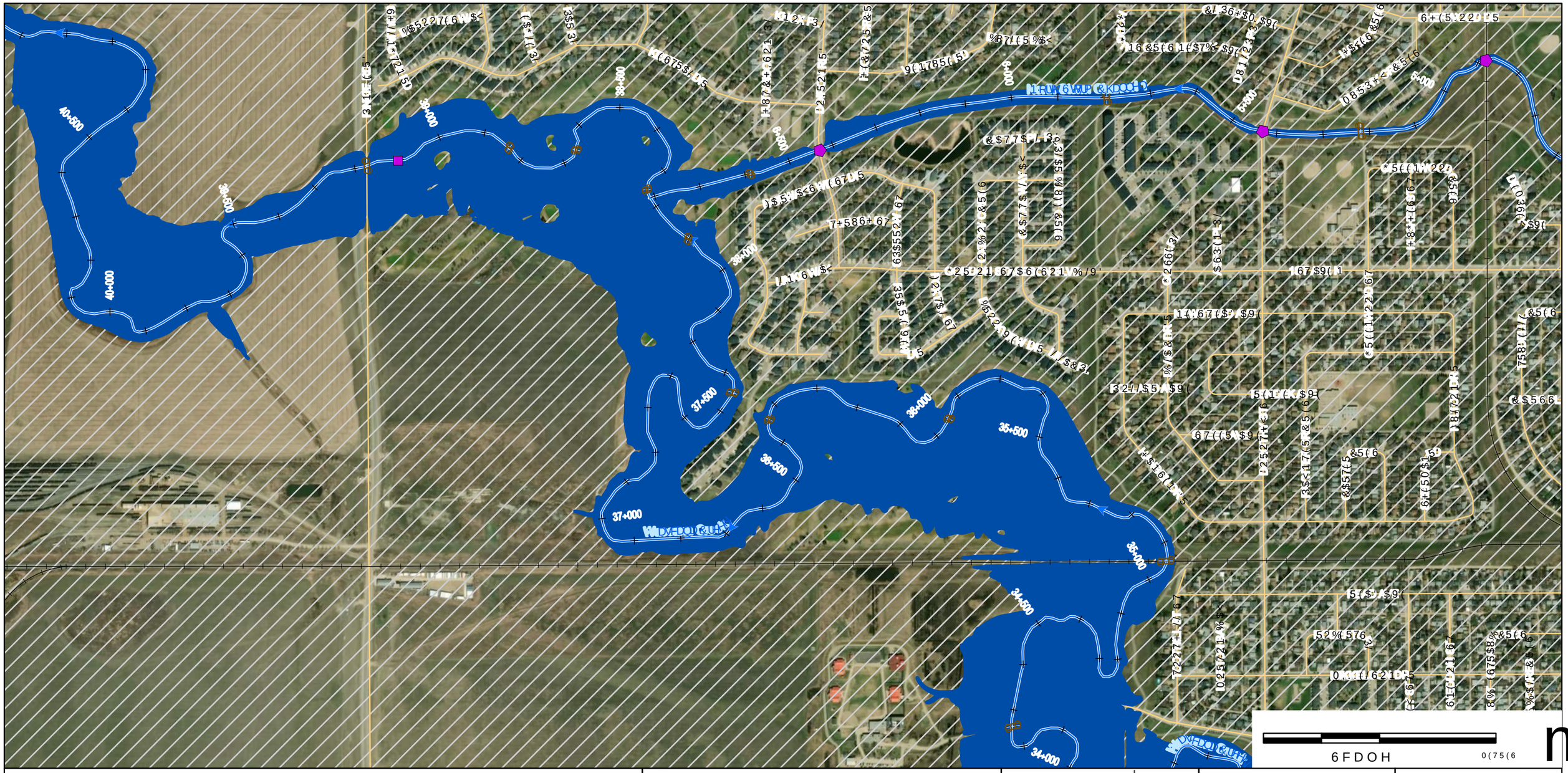

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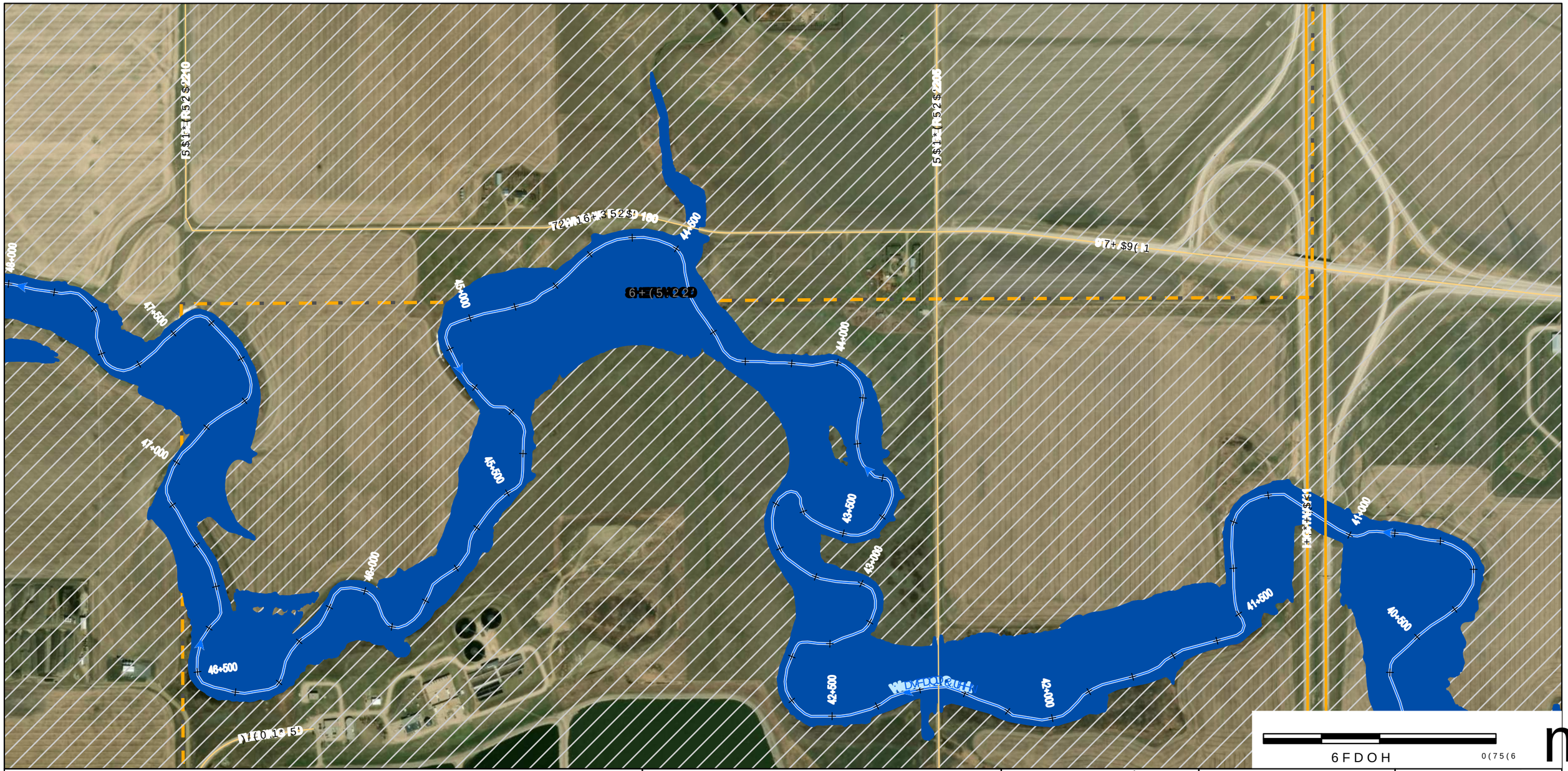

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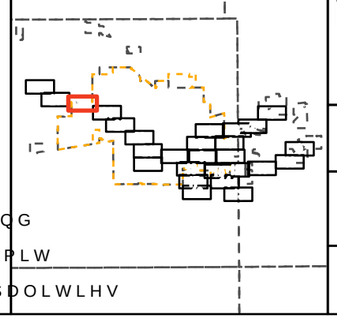

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:DWHU 6HFXULW\ $JHQF\ :6$ SUHSDUHG WKLV PDS IRU LQIRUPDWLRQDO SXUSRVHV RQO\ :DWHU OHYHOV GHJUHHV RI DFFXUDF\ DQG FRPSOHWHQHVV YDU\ RQ WKH FLUFXPVWDQFHV DQG DYDLODELOLW\ RI GDWD 7KH UHSUHVHQWDWLRQ WKDW WKLV PDS PD\ QRW EH DFFXUDWH &RPSOHWH RU XS WR GDWH 7KH XVHU LV DGYLVHG WR FRQILUP WKH FXUUHQW VWDWXV RI DQ\ LQIRUPDWLRQ SURYLGHG RQ WKLV PDS E\ FRQWDFWLQJ WKH HYHQW WKDW SUHFLSLWDWLRQ DQG &XUUHQW\ RI GDWD DUH UHTXLUHG :6$ UHFRPPHQGV FRQILUPLQJ WKH ILQDO GHVLJQV DQG VWDWXV RI ERUURZHOLQH SURWHFWLRQ %\ $(&20 &DQDGD 8/& &RS\ULJKW 0DS <URJXFHG 0DWHULDO &RSUULJKW &URZQ &RSSULJKW DQG PD\ QRW EH UHSURGXFHG LQ WKLV PDS VHULHV RU LQ SDUW ZLWKRXW SHUPLVVLRQ RI WKH &URZQ LQ 5LJKW RI &DQDGD DQG $(&20 &DQDGD /WG

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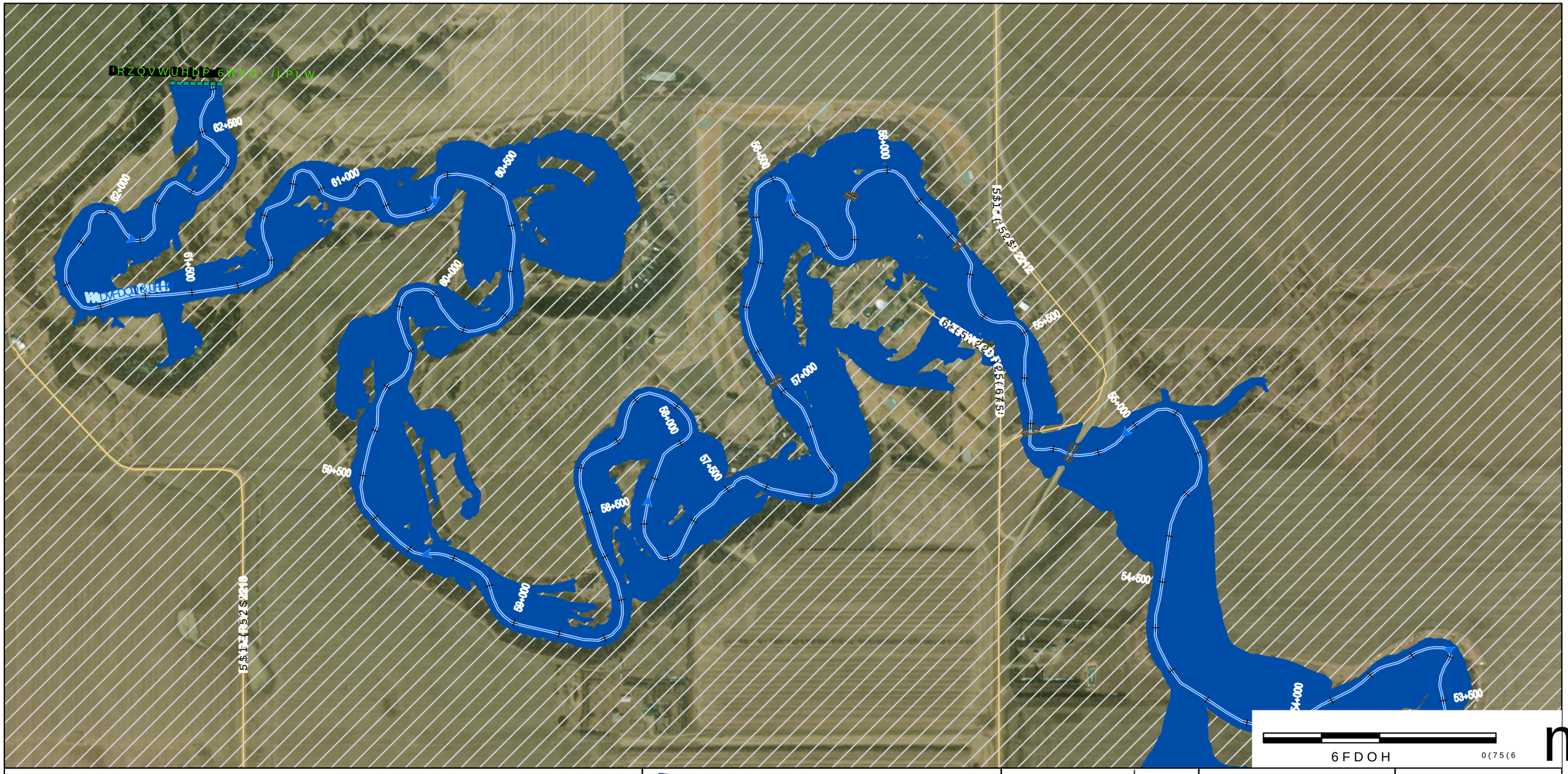

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$OO 'DWDVHWV ‹ *RYHUQPHQW RI 6DVNDWFKHZDQ 3URSHUW\ %RXQGDULHV 6KRZQ RQ WKH 6\VWHP DUH &RPSLODWLRQV RI 'DWD &ROOHFWHG IURP 9DULRXV 6RXUFHV 1RW DOO 6RXUFHV DUH 6XUYH\HG WR WKH 6DPH 6WDQGDUG 6RPH 3URSHUWLHV DUH 1RW 6KRZQ &RUUHFWO\ DQG PD\ QRW EH LQFOXGHG LQ WKH PDS VHULHV DW DOO :DWHUFRXUVH &HQWUHOLQH %XLOGLQJ)ORRGZD\ 'LWFK &DQDO 5RDG &XOYHUW 5DLOZD\ &URVVLQJ 5HJLQD &LW\ /LPLW 5XUDO 0XQLFLSDOLWLHV

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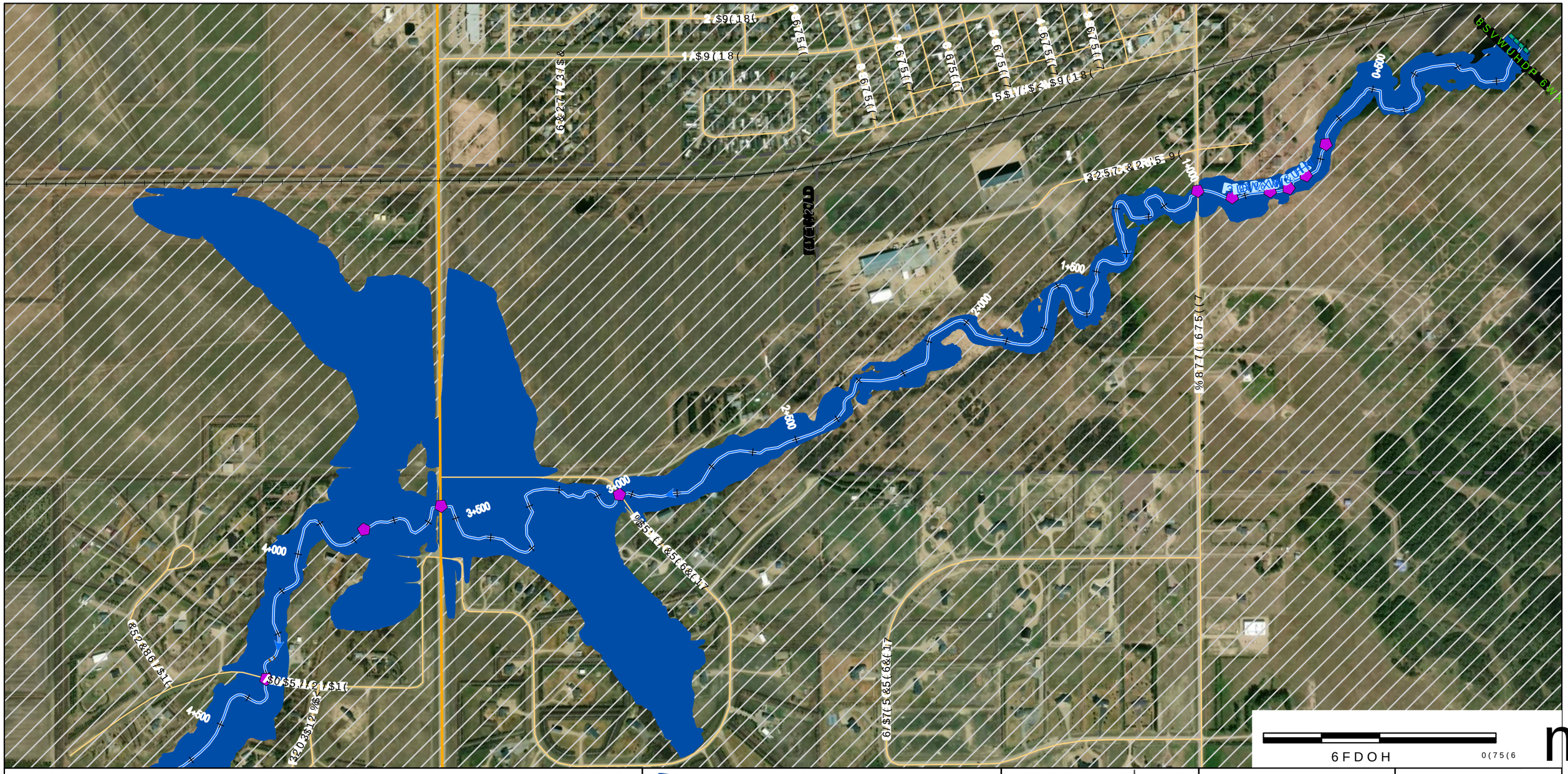

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$OO 'DWDVHWV ‹ *RYHUQPHQW RI 6DVNDWFKHZDQ 3URYLGHG E\ :DWHU 6HFXULW\ $JHQF\ DQG &RQWULEXWRUV 7KH 'DWD &RQWDLQHG :LWKLQ 7KLV 3URGXFW ,V 3URYLGHG 9HUWLFDO 'DWXP &*9' +RUL]RQWDO &RRUGLQDWH 5HIHUHQFH 6\VWHP 1$'&6 &DQDGD 0DS 3URMHFWLRQ 870 &656 ([WHQGHG =RQH 1RUWK &RRUGLQDWH 5HIHUHQFH 6\VWHP RI GDWD DUH UHTXLUHG :6$ &RQWDFW &HQWUH 1RWHV 6KHHWV DQG PD\ QRW EH LQFOXGHG LQ WKH PDS VHULHV WKHUH LV QR IORRGLQJ LQ WKLV DUHD

6DVNDWFKHZDQ :DWHU &RUSRUDWLRQ 'DP &XOYHUW 6WXG\ /LPLWV &LW\ /LPLWV %ULGJH :DWHUFRXUVH &HQWUHOLQH /DNH)ORZ 'LUHFWLRQ 6WXG\ $UHD +\GURPHWULF *DXJLQJ 6WDWLRQ '\NH /RFDO 5RDG 5HJLRQD &LW\ /LPLW 5XUDO 0XQLFLSDOLWLHV

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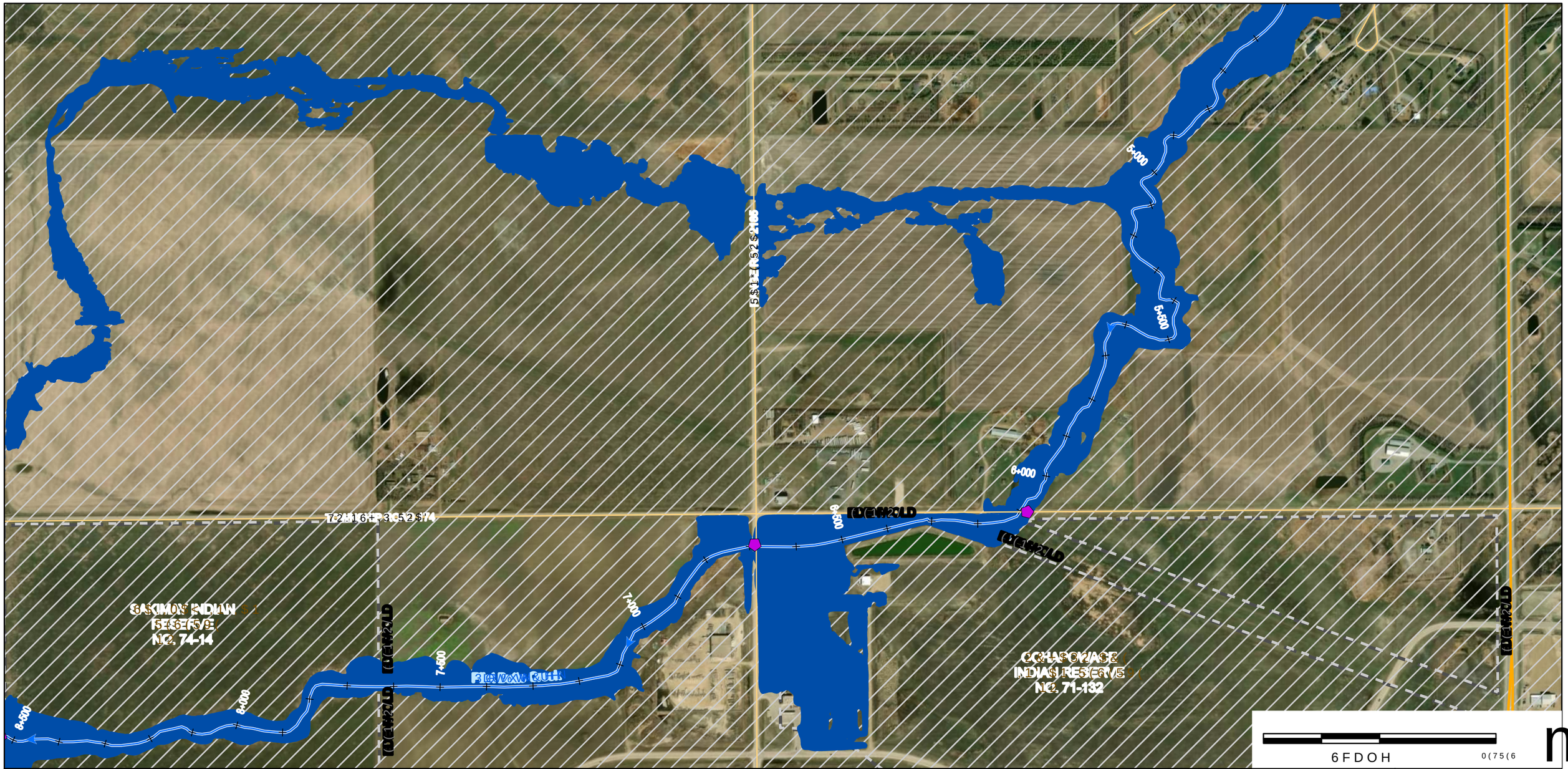

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GHJUHHV RI DFFXUDF\ DQG FRPSOHWHQHVV GHSHQGKHQW RQ WKH
FLUFXPVWDQFHV DQG DYDLODEOH GDWD &LQDVDH 6\VWHP
UHSUHVHQWDWLRQ WKDW WKLV PDS+ZLOD EH DXIIDFXPQW1 &RU&656 XVRFK
7KH
XVHU LV DGYLVHG WR FRQILUP WKH*HRLG PRWLRQ &PRQWDLQHG KHUHLQ
LQ
WKH HYHQW WKDW SUHFLVLRQ DQG &XUUHQF\ RI GDWD DUH UHTXLUHG
:6$ UHFRPPHQGV FRQILUPLQJ WKH IORRG &DQDGD
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&DRU &DQDGD 5HQHQFH 6\VWHP
+ZLOD EH DXIIDFXPQW1 &RU&656 XVRFK
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&XUUHQF\ RI GDWD DUH UHTXLUHG
'ORR &DQDGD VWDWXV RI
1RWHV
6KHHWV DQG PD\ QRW EH LQFOXGHG LQ WKH PDS VHULHV LI
WKHUH LV QR IORRGLQJ LQ WKLV DUHD

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:DWHUFRXUVH &HQWHUOLQH
)ORZ 'LUHFWLRQ
&KDLQDJH P LQWHUYDOOZD\
+\GURPHWULF *DXJLQJ 6WDWLRQ
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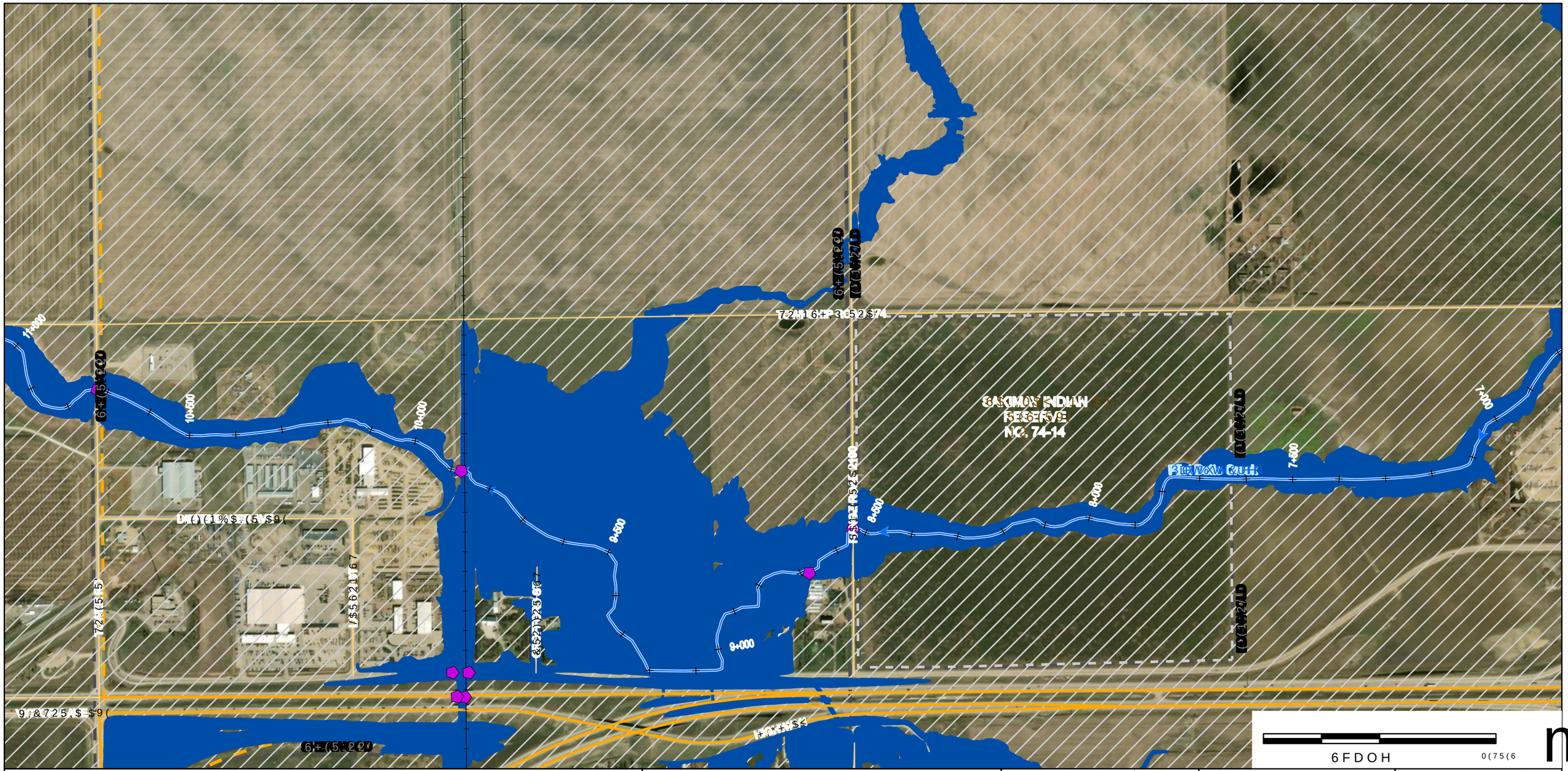

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GHJUHHV RI DFFXUDF\ DQG FRPSOHWHQHVV GHSHQGKHQW RQ WKH
FLUFXPVWDQFHV DQG DYDLODEOH GDWDU GLQDDH 5HIQUHQFH 6\VWHP
UHSUHVHQWDWLRQ WKDW WKLV PDS+ZLOD DWDXIDWXP 1$'&6 XVRFK
7KH
XVHU LV DGYLVHG WR FRQILUP WKH*HRLG PRWHQ &*RQWDLQHG KHUHLQ
LQ
WKH HYHQW WKDW SUHFLVLRQ DQG &XUUHQF\ RI GDWD DUH UHTXLUHG
:6$ UHFRPPHQGV FRQILUPLQJ WKH IORRG DQDDG VWDWXV RI
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&DWDU GLQDDH 5HIQUHQFH 6\VWHP
+ZLOD DWDXIDWXP 1$'&6 XVRFK
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0DS 3URGXFHG %\

$(&20 &DQDGD 8/&

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9HUWLFDO 'DWXP &*9' 'HSWK &RQWRXU %ULGJH &XOYHUW)ORZ 'LUHFWLRQ

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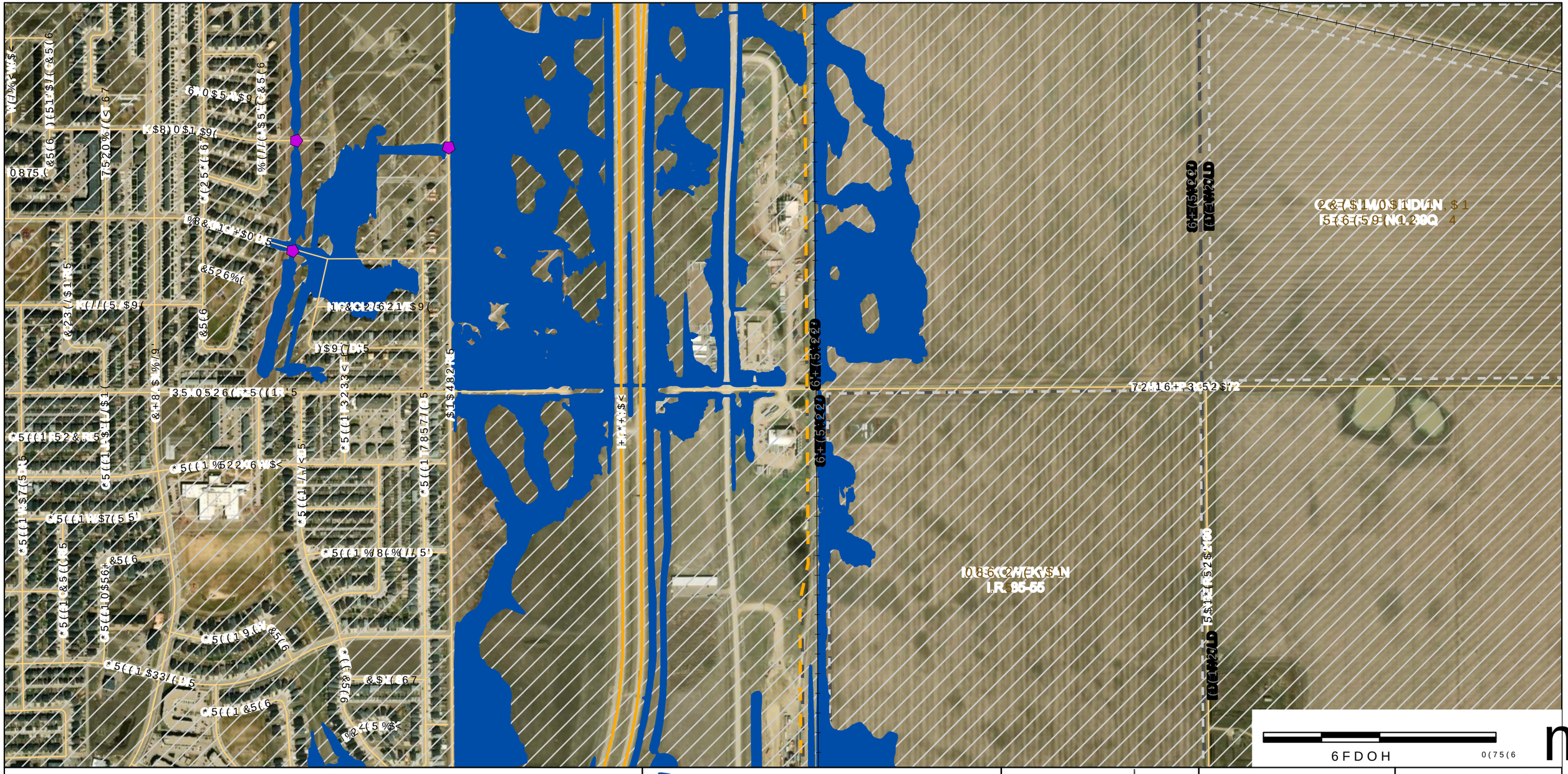

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FLUFXPVWDQFHV DQG DYDLODEOH GDWD :6$ DWDN 5HIHUHQFH 6\VWHP
UHSUHVHQWDWLRQ WKDW WKLV PDS+ZLOO DWDXIIDWXP 1$'&56 XVRFK
7KH 9HUWLFDO 'DWXP &*9'
XVHU LV DGYLVHG WR FRQILUP WKH*HRLG PRWHQ&*RQWDLQHG KHUHLQ
LQ 0DS 3URMHFWLRQ 870 &656 ([WHQGHG =RQH 1RUWK
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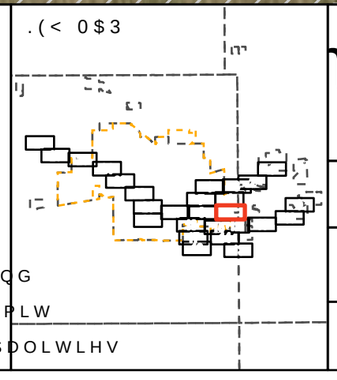

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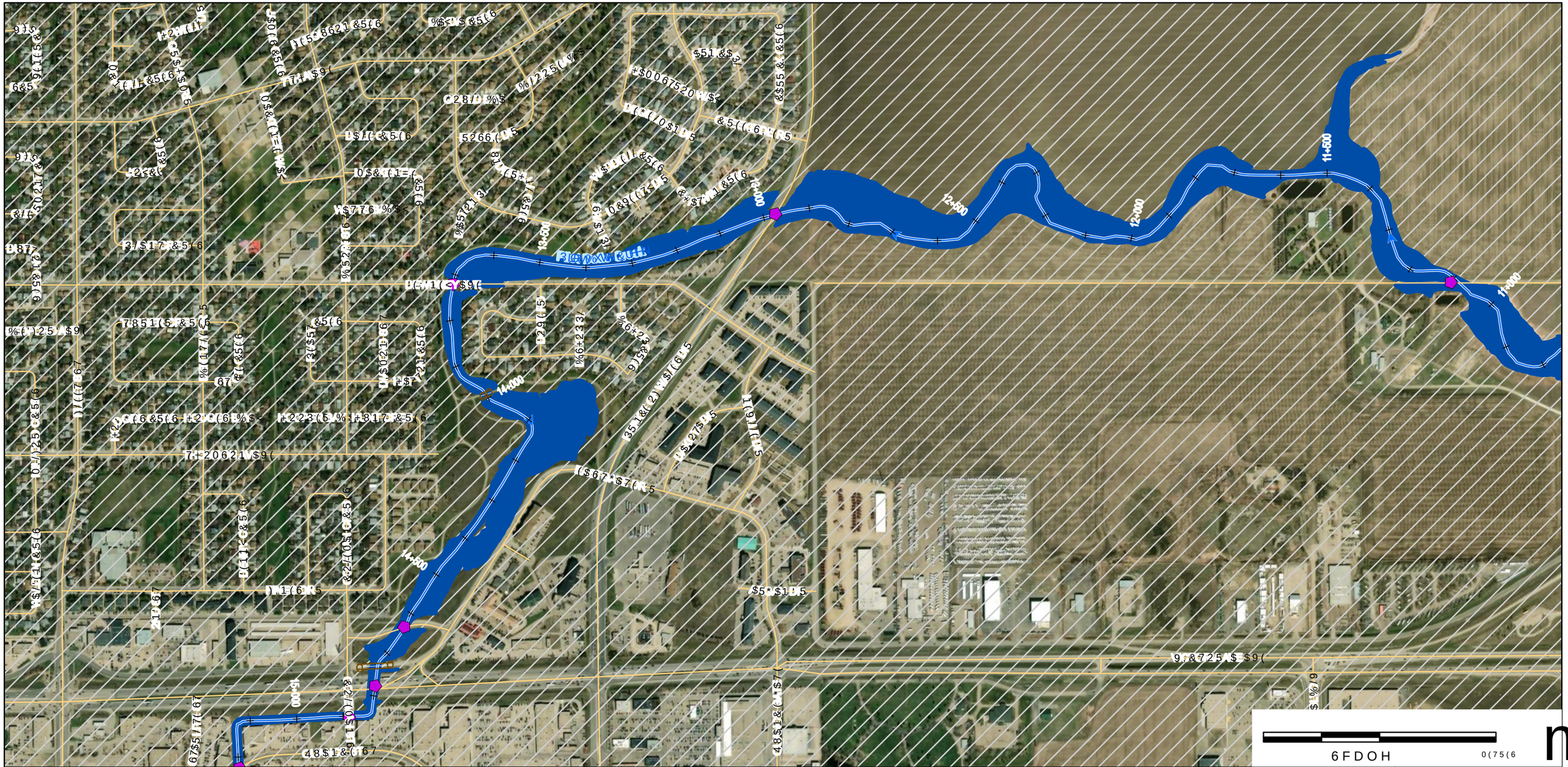

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FLUFXPVWDQFHV DQG DYDLODEOH GDWD :6$ DDHUHQFH 6\VWHP
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XVHU LV DGYLVHG WR FRQILUP WKH *HRLG PRWHQ &*RQWDLQHG KHUHLQ
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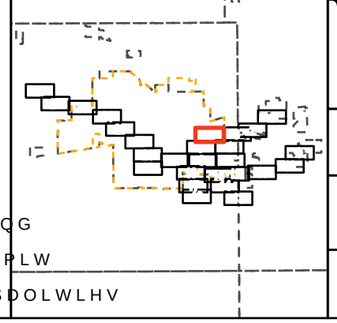

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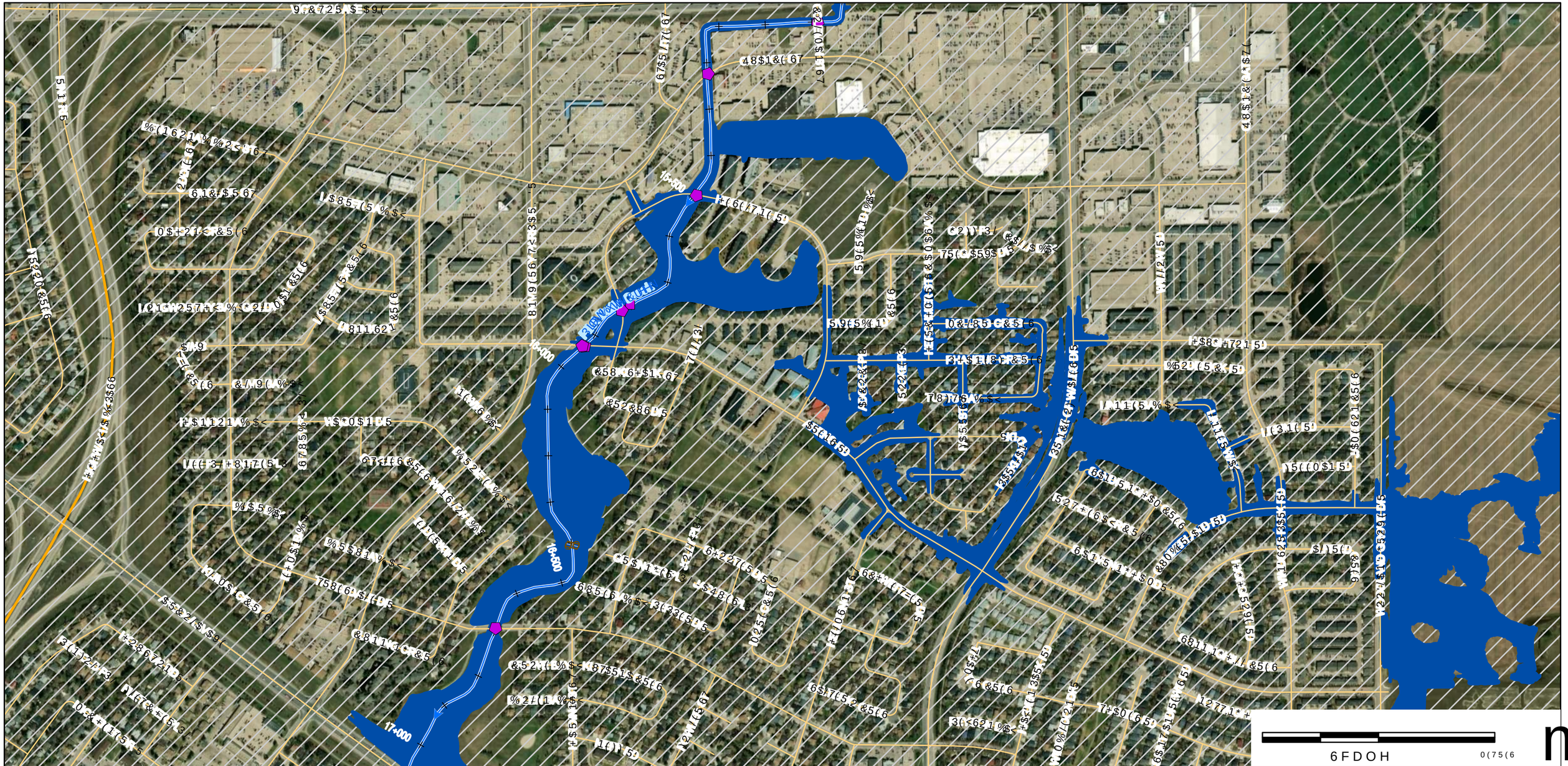

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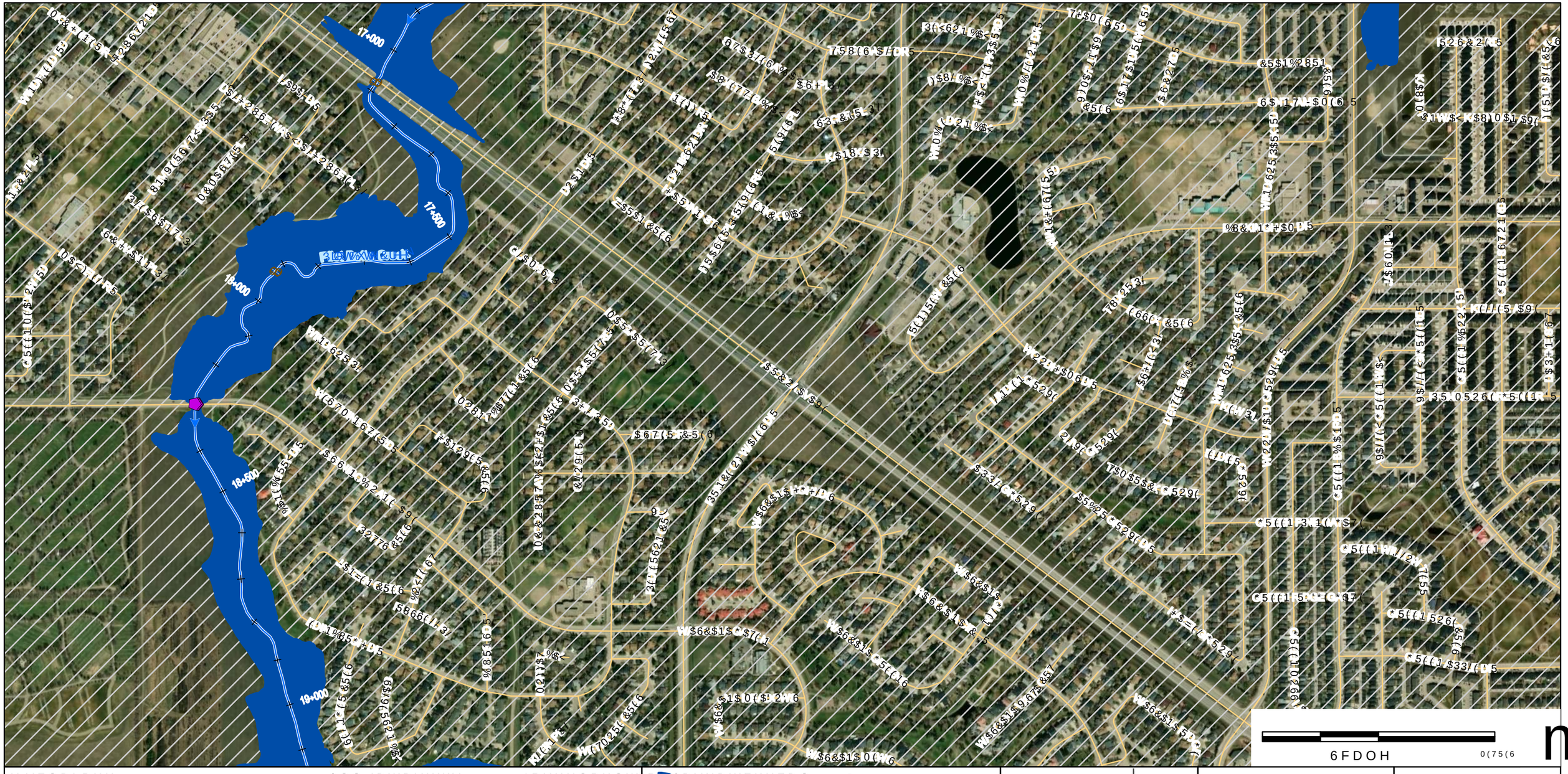

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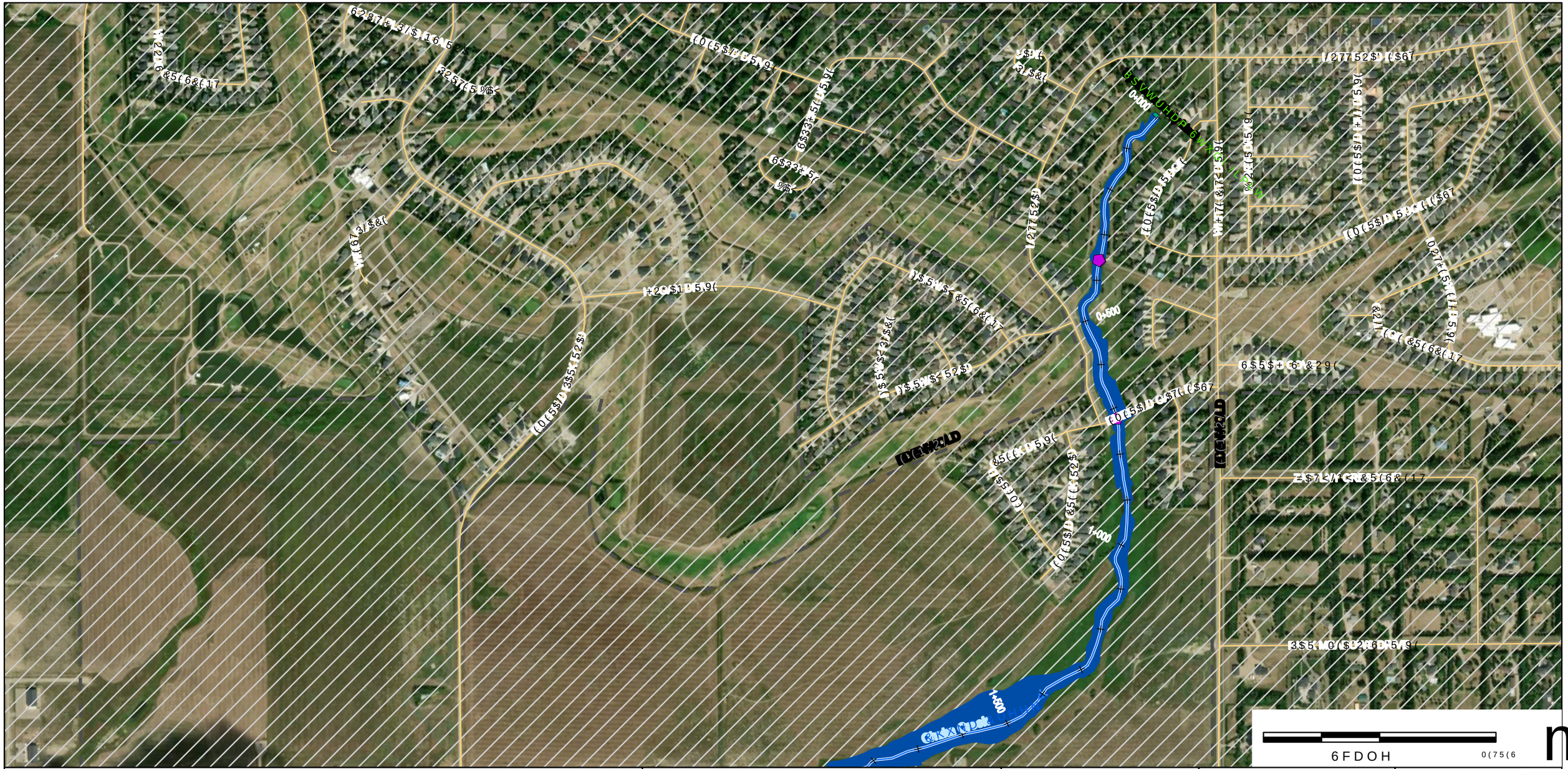

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7KH
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LQ
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:6$ UHFRPPHQGV FRQILUPLQJ WKH IORRG &DQDGD
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&DWDUG:6$ DWWHPSWHQFH 6\VWHP
+ZLOD DWDXIDFXPQWLRU &656 XVRFK
9HUWLFDO 'DWXP &*9'
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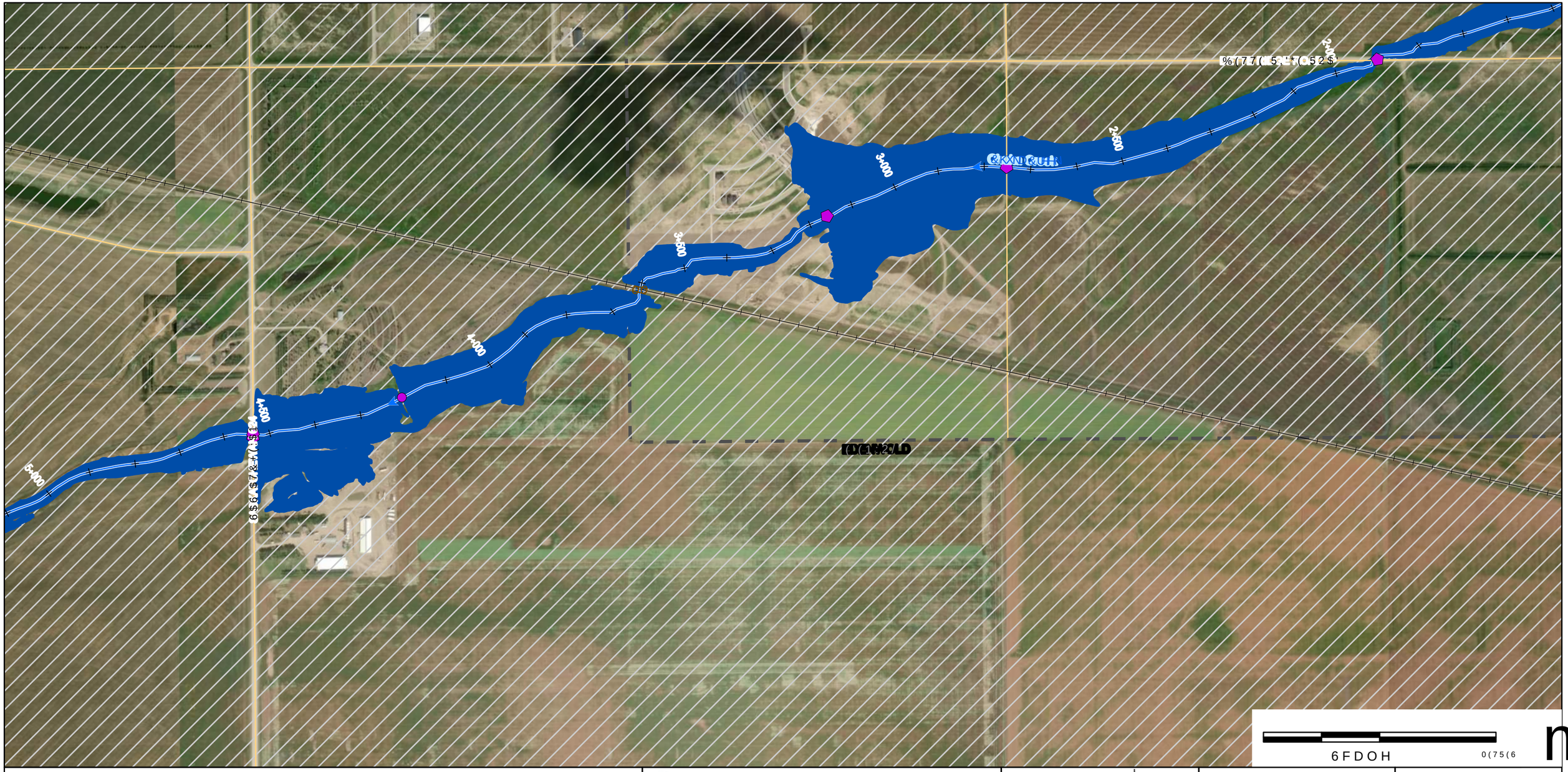

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FLUFXPVWDQFHV DQG DYDLODEOH GDWD :6$ DVVHVHQ
UHSUHVHQWDWLRQ WKDW WKLV PDS +ZLOH DWDXIDWXP 1$'&656 XVRFK
7KH
XVHU LV DGYLVHG WR FRQILUP WKH *HRLG PRWHQ &*
LQ
WKH HYHQW WKDW SUHFLVLRQ DQG &XHUHQF\ RI GDWD DUH UHTXLUHG
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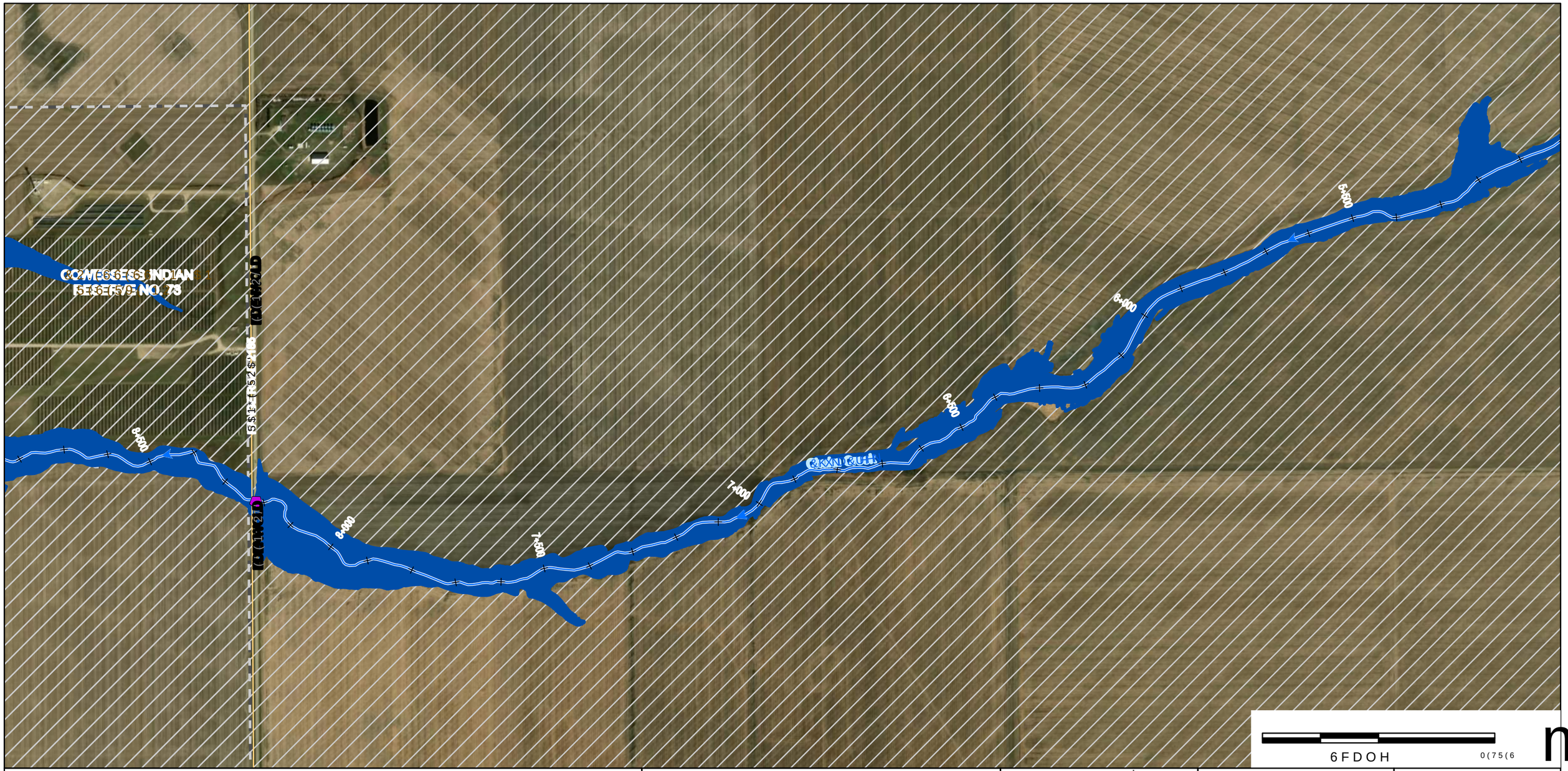

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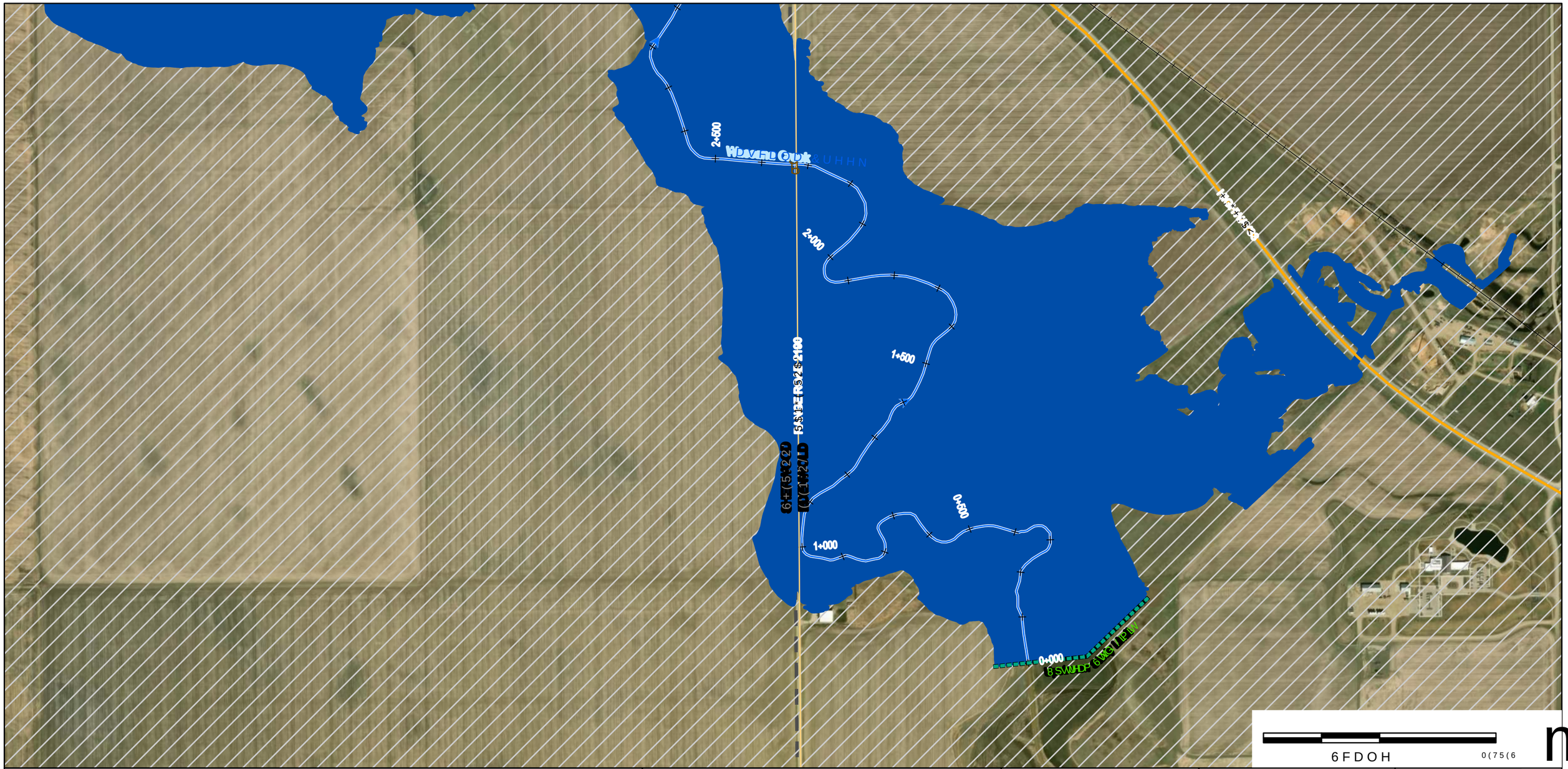

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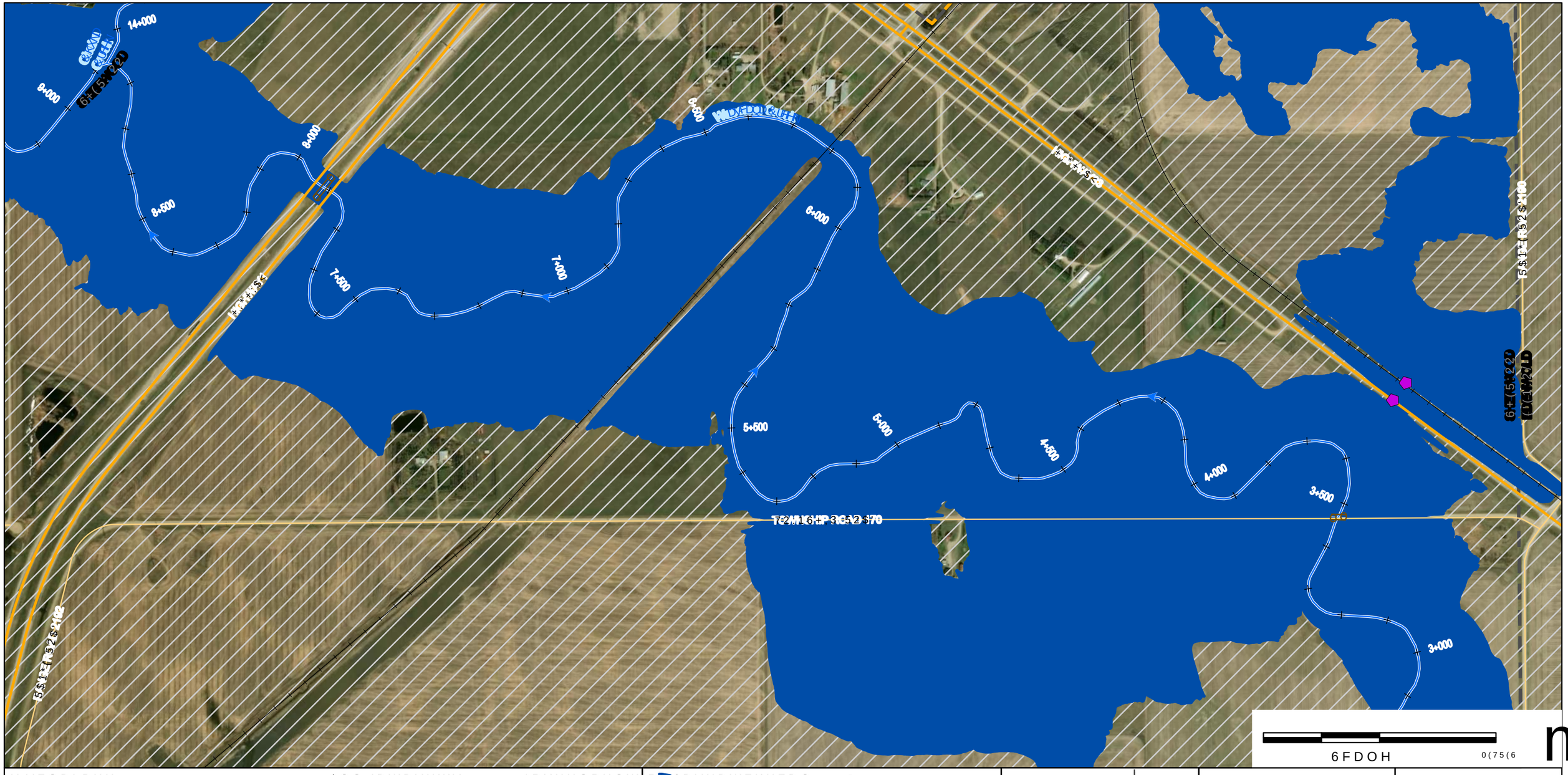

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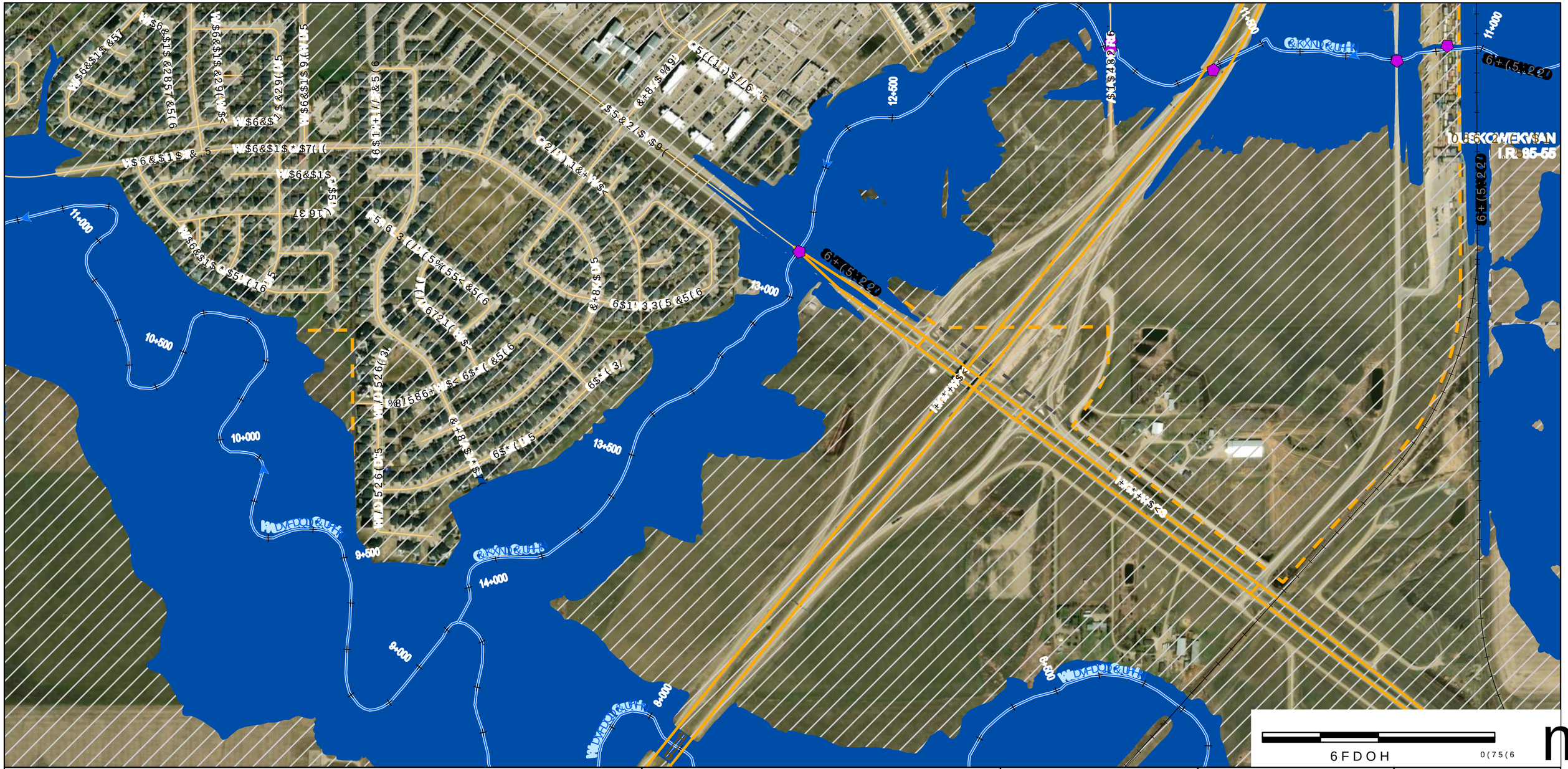

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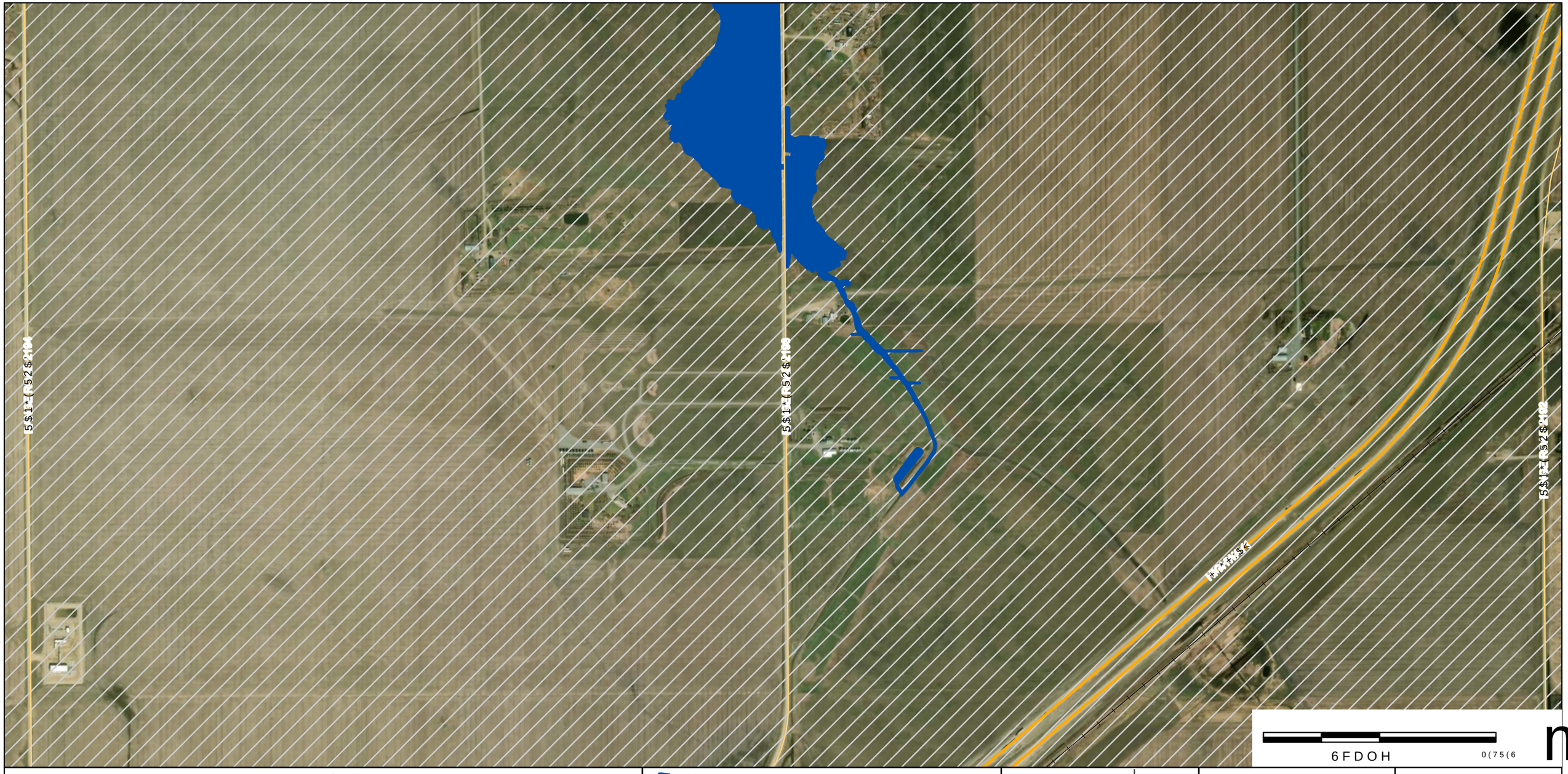

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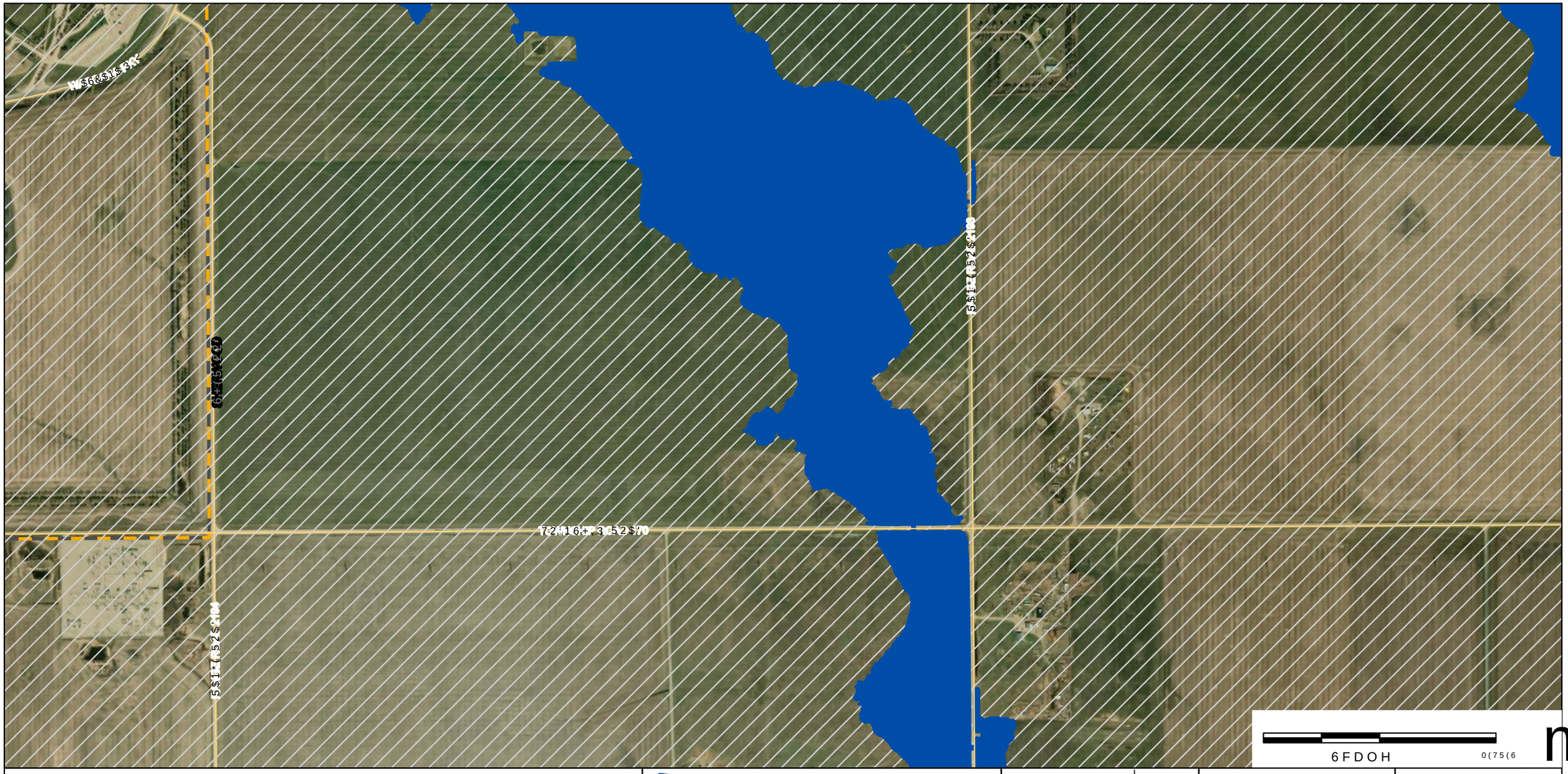

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$OO 'DWDVHWV ‹ *RYHUQPHQW RI 6DVNDWFKHZDQ 3URYLQFH RI DOWHUHG YDULQJ 9HUWLFDO 'DWXP &*9' HRLGU HDWHR &RQWDLQHG KHUHLQ + &DQDGD P LQWHUVHFW 0DS 3URMHFWLRQ 870 &656 ([WHQGHG =RQH 1RUWK +\GURPHWULF *DXJLQJ 6WDWLRQ '\NH 1RWHV 6KHHWV DQG PD\ QRW EH LQFOXGHG LQ WKH PDS VHULHV WKHUH LV QR IORRGLQJ LQ WKLV DUHD

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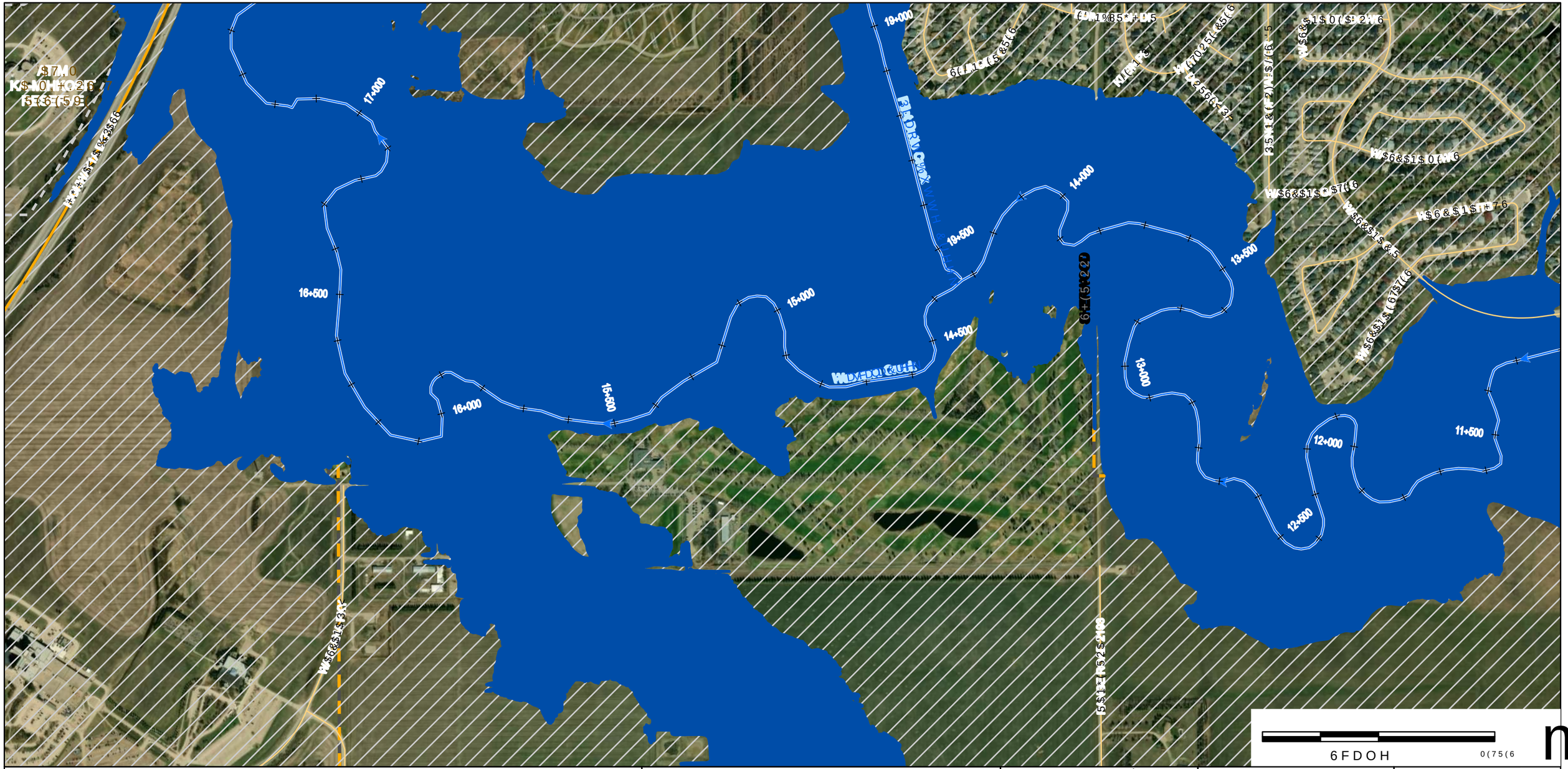

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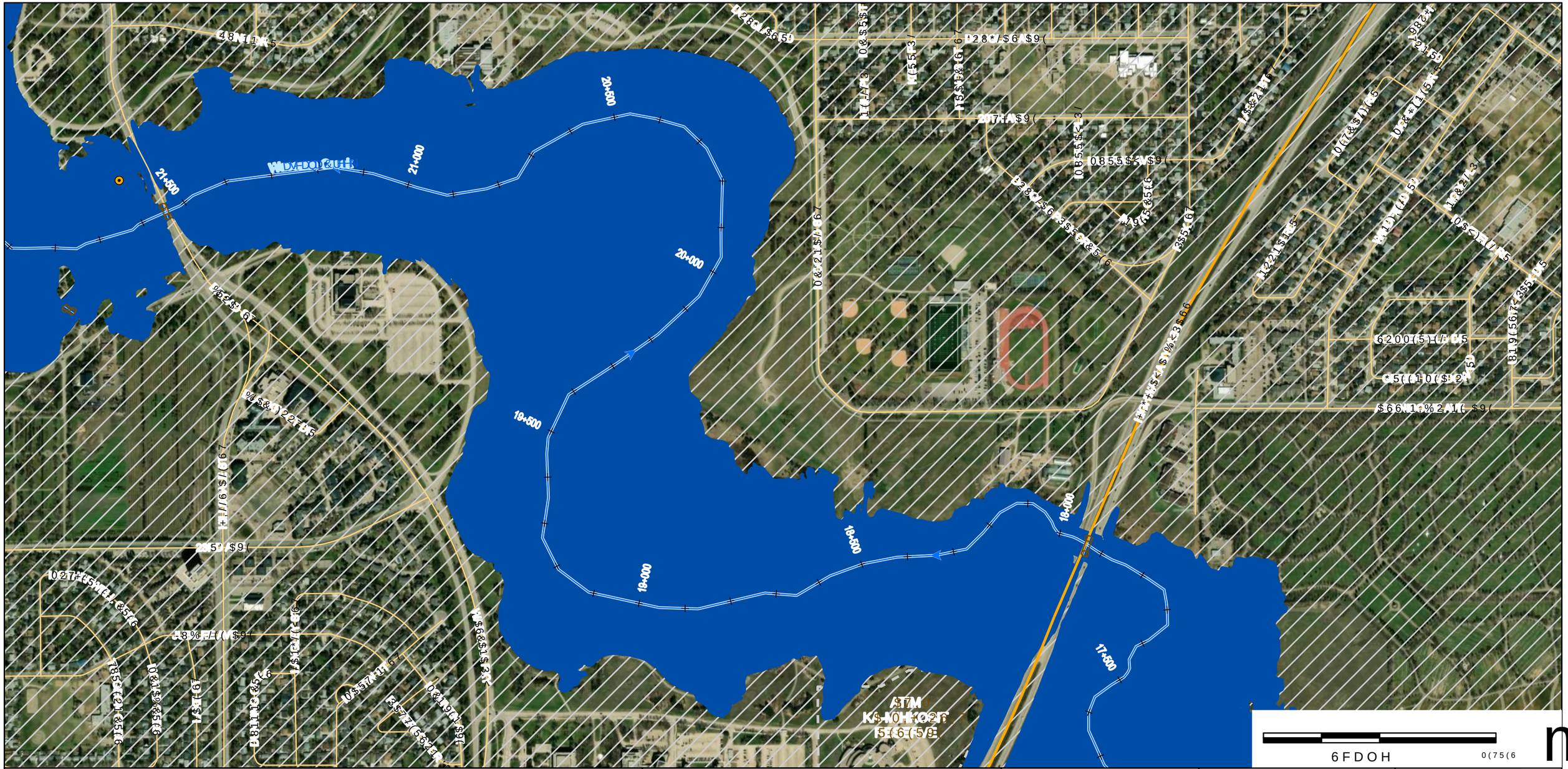
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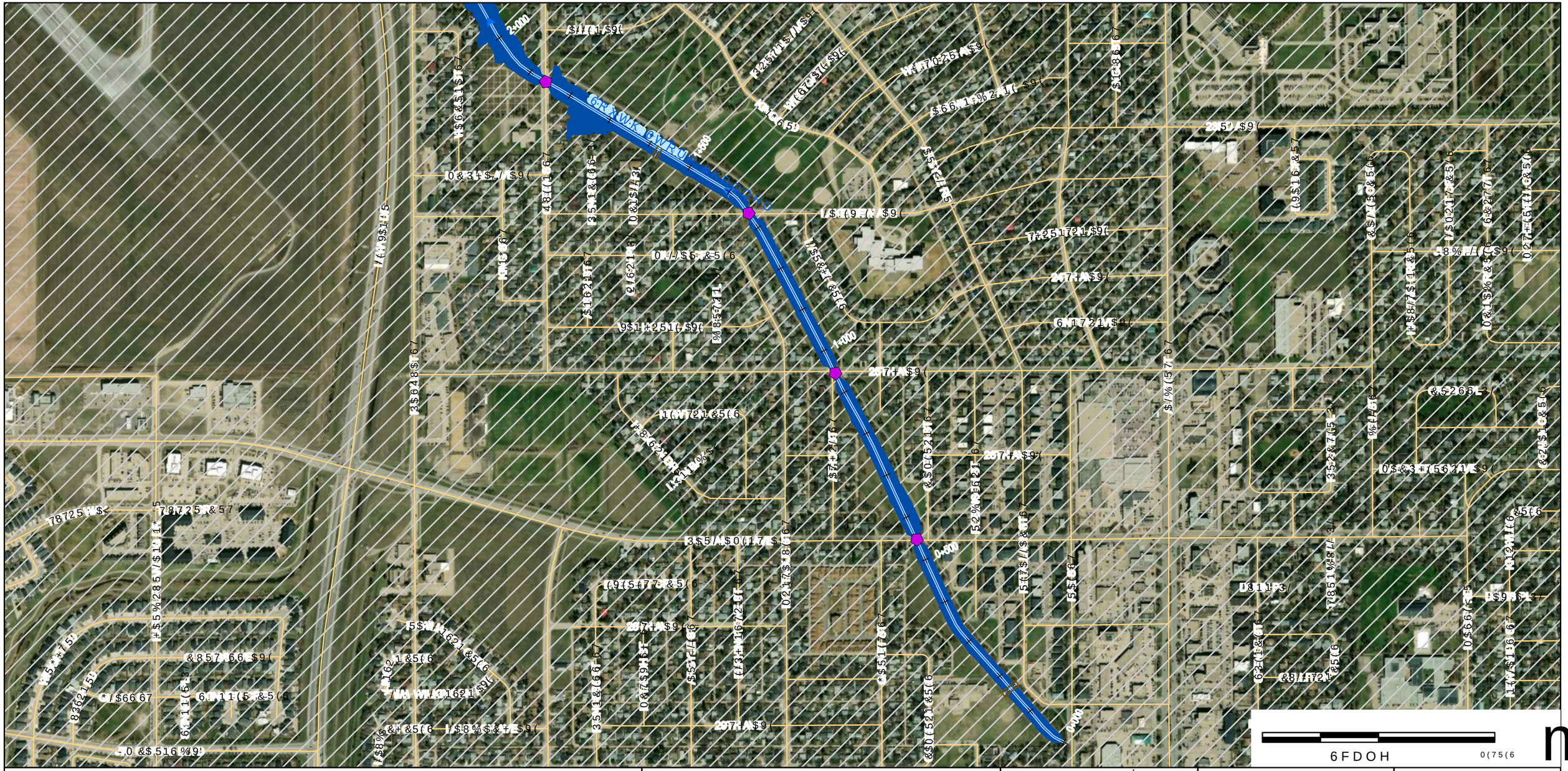

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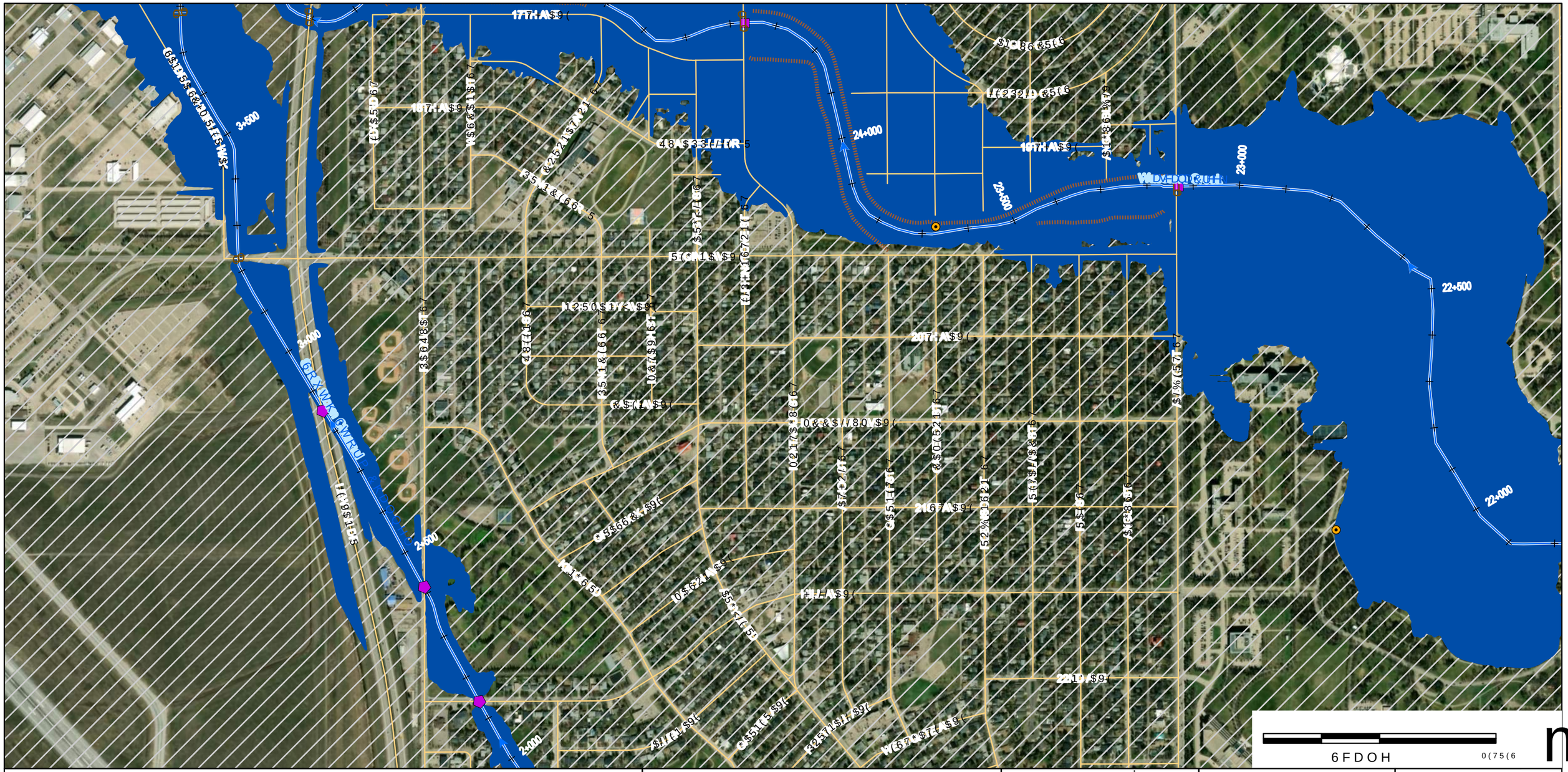

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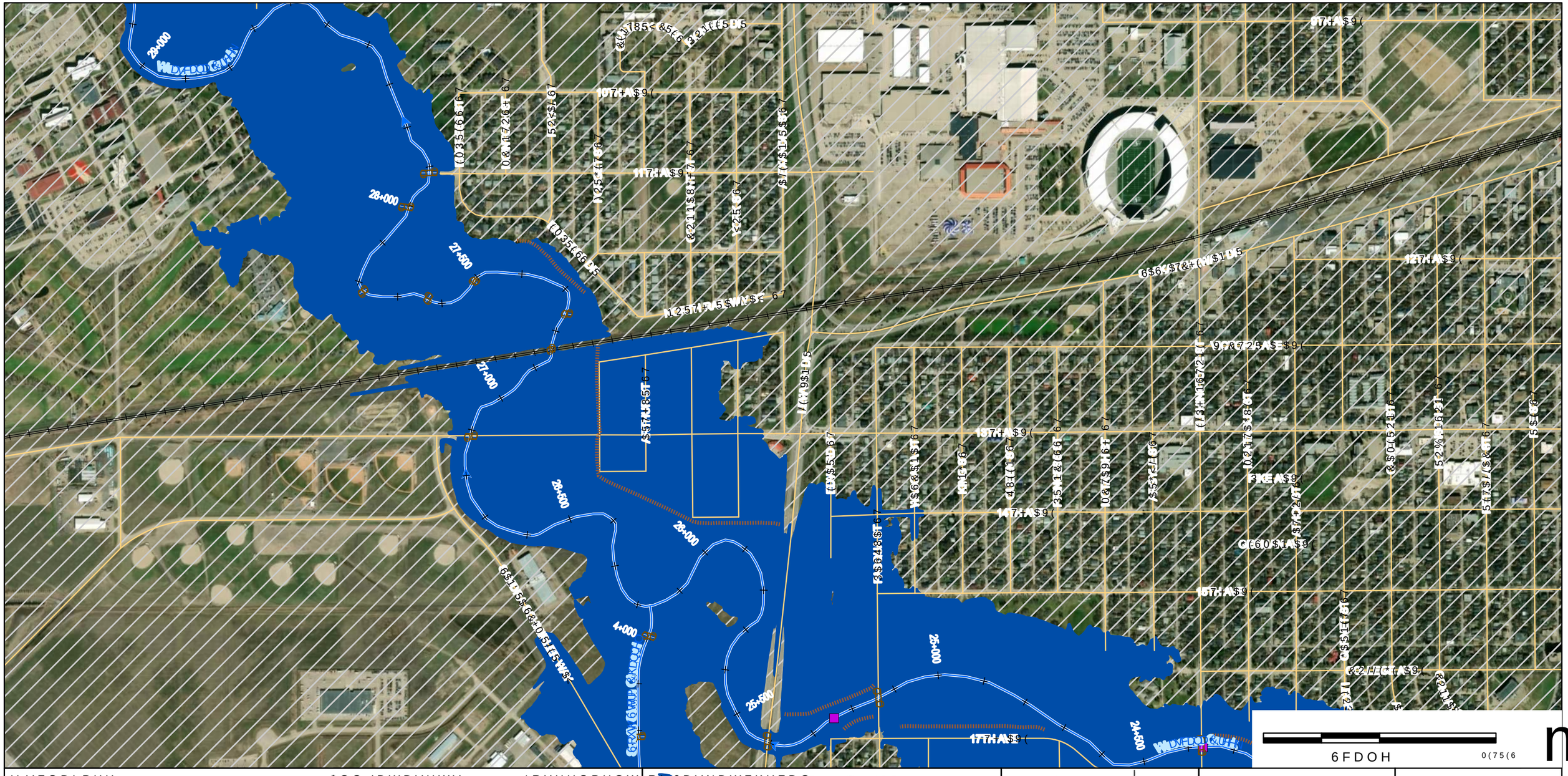

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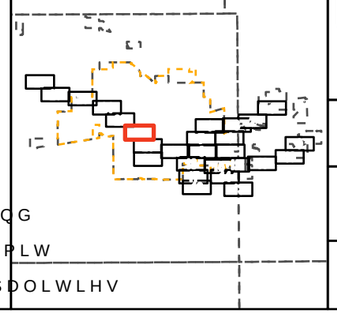

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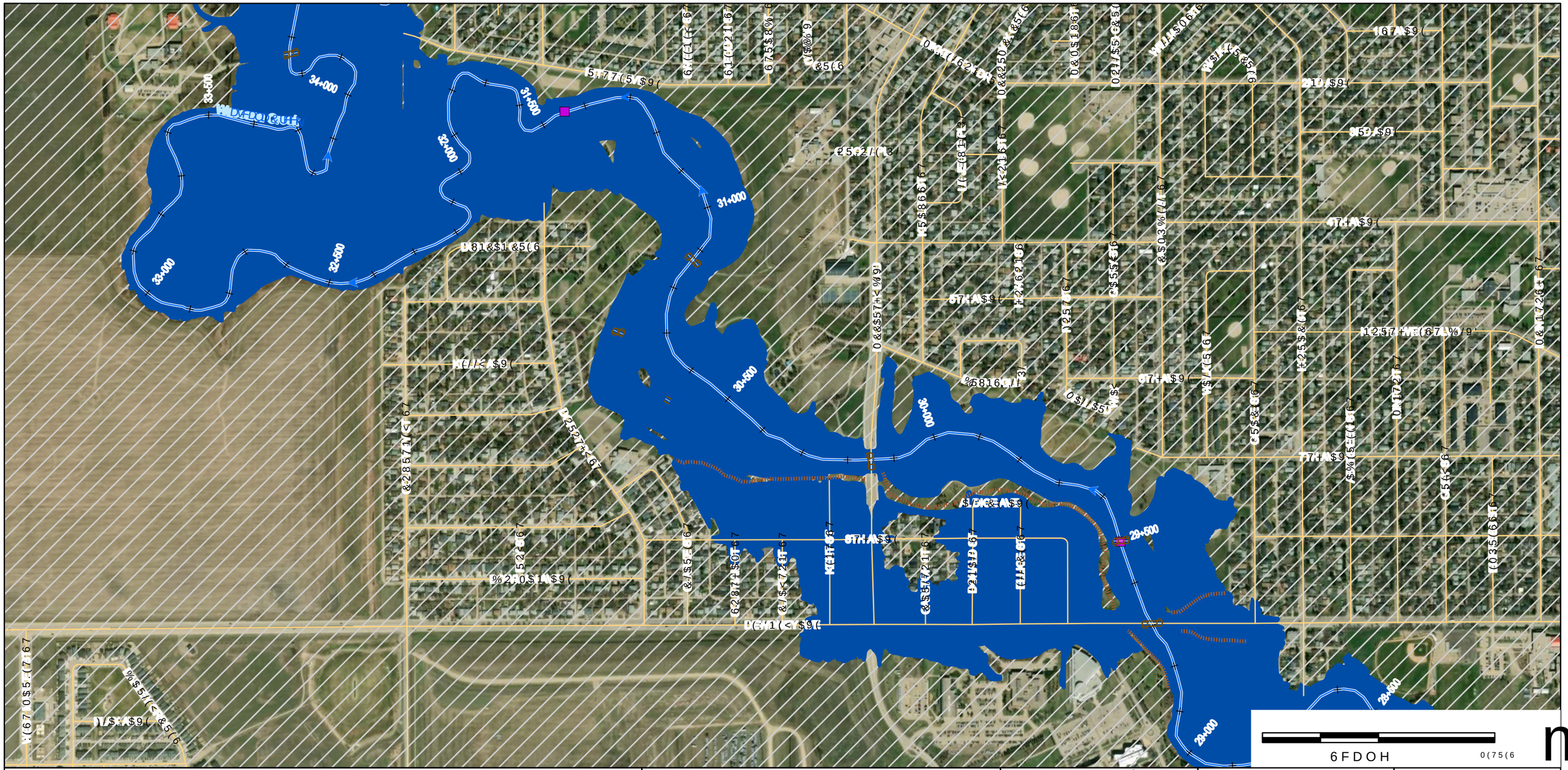

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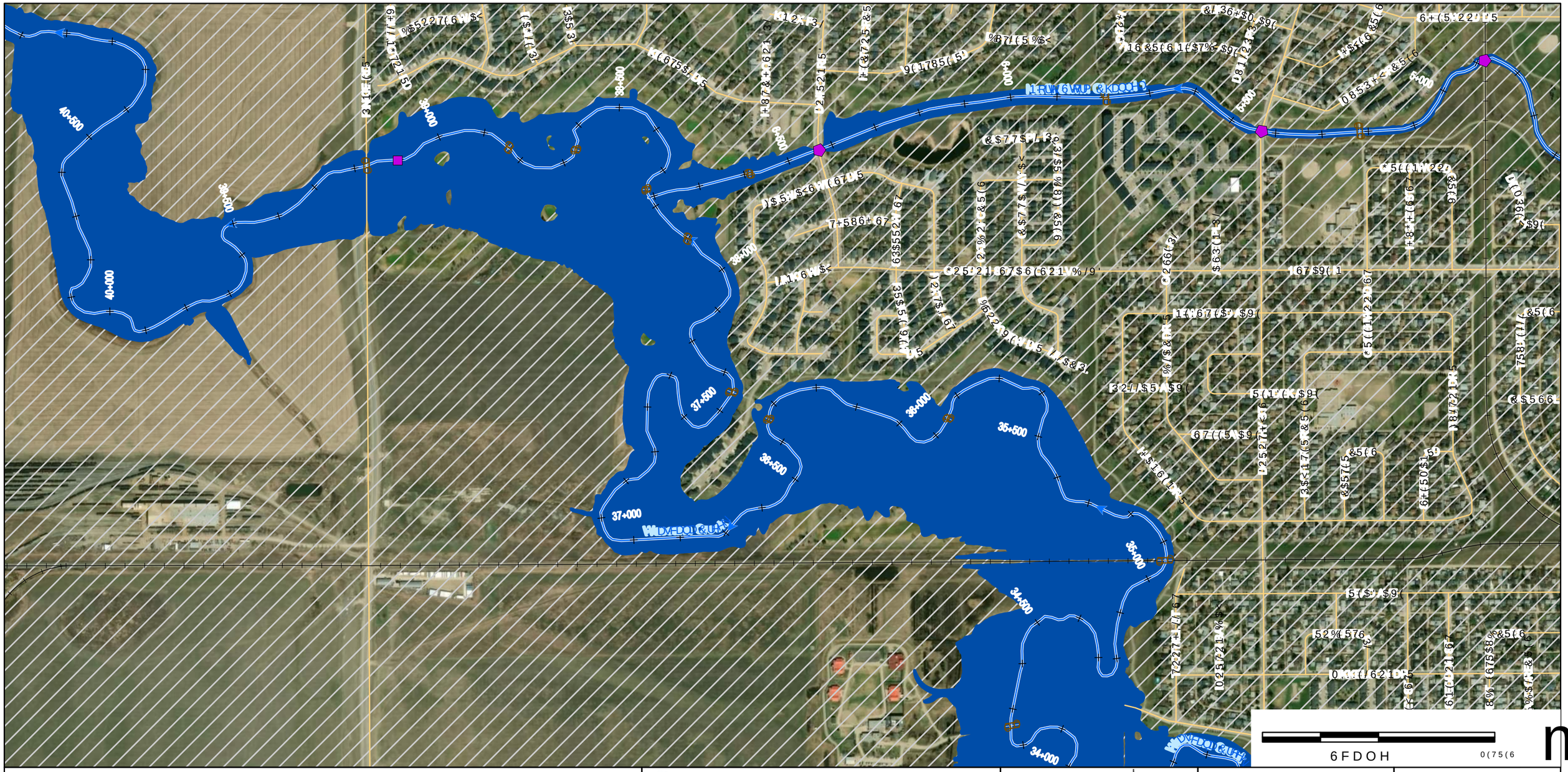
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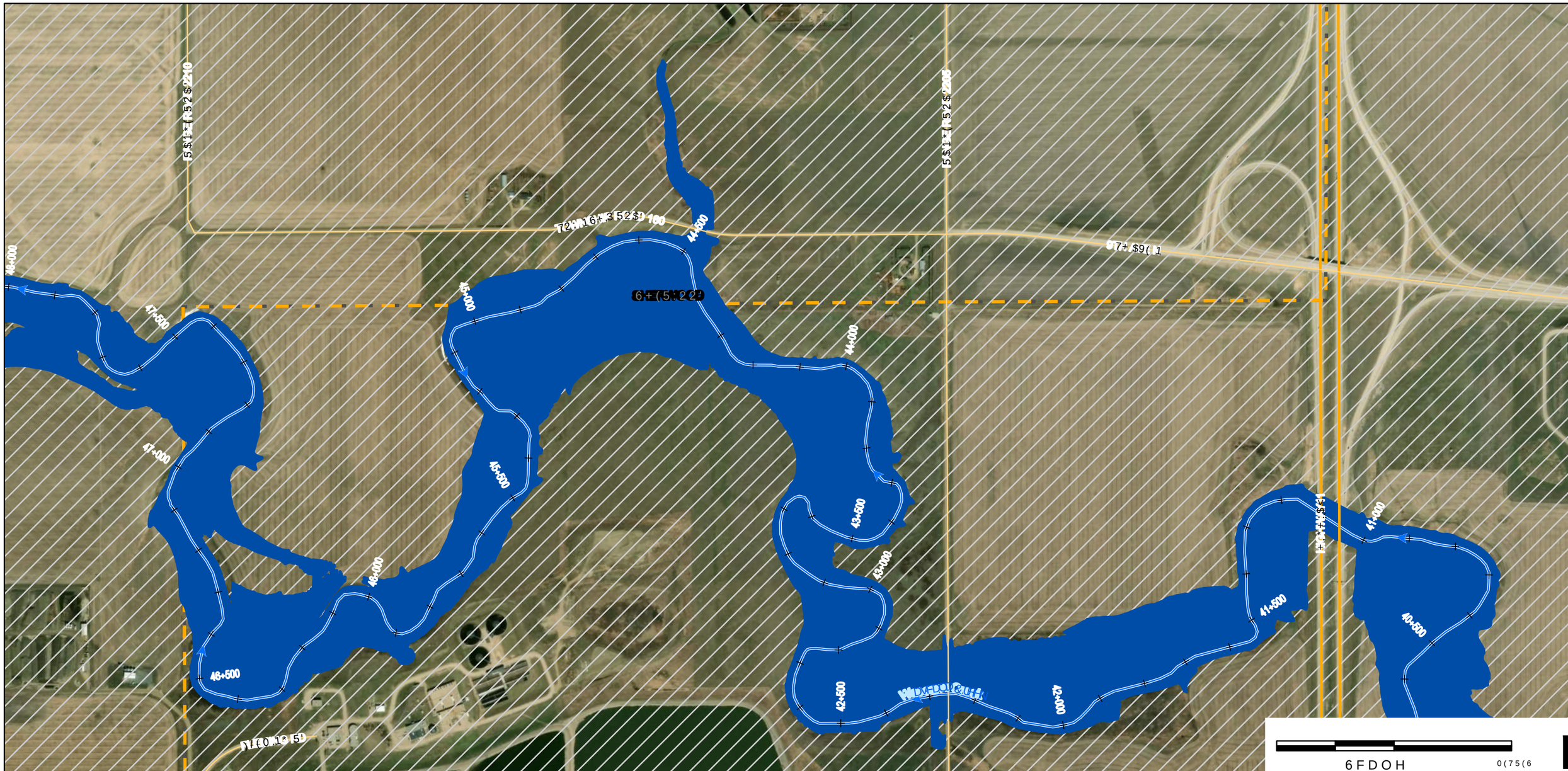

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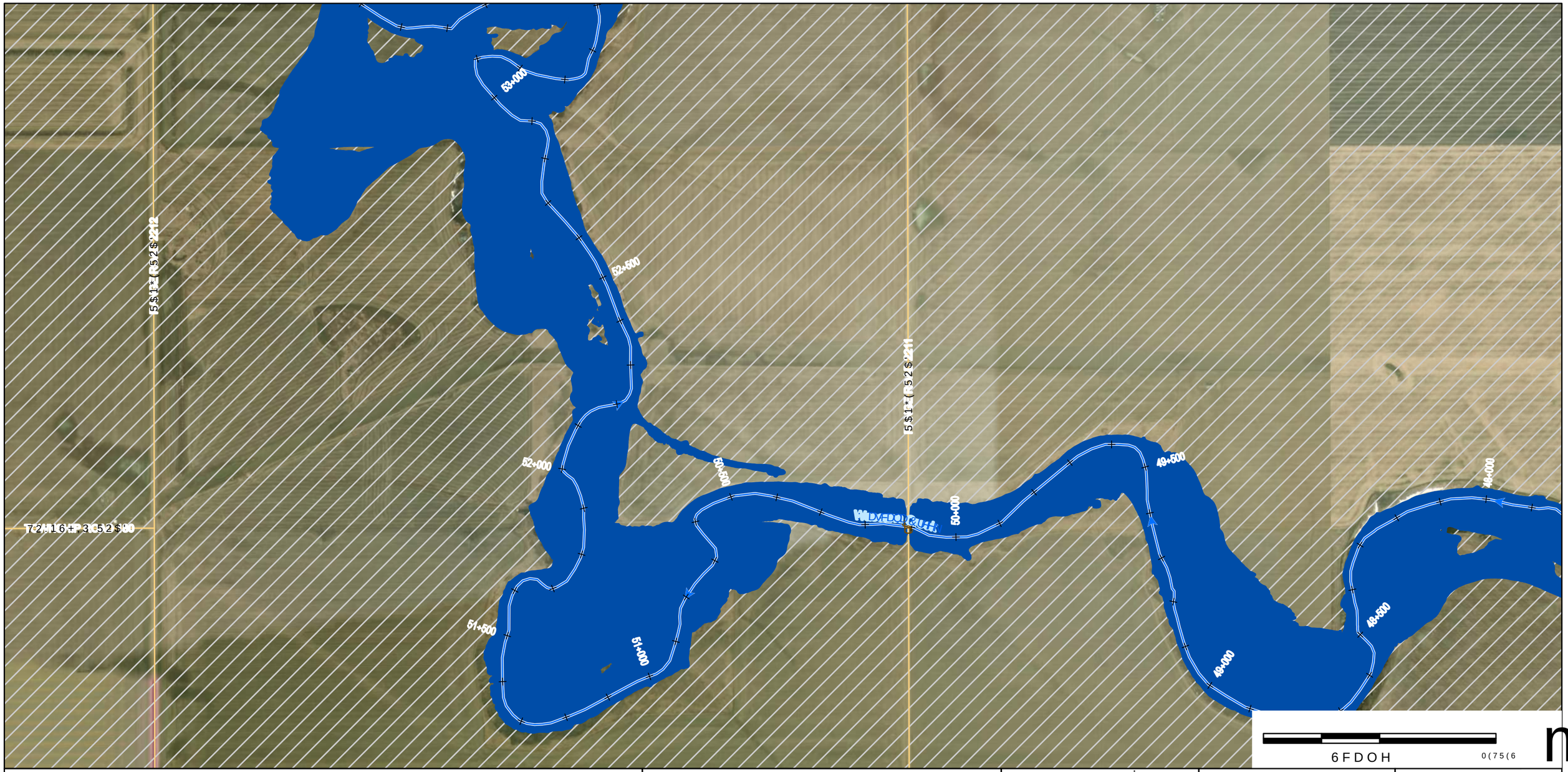

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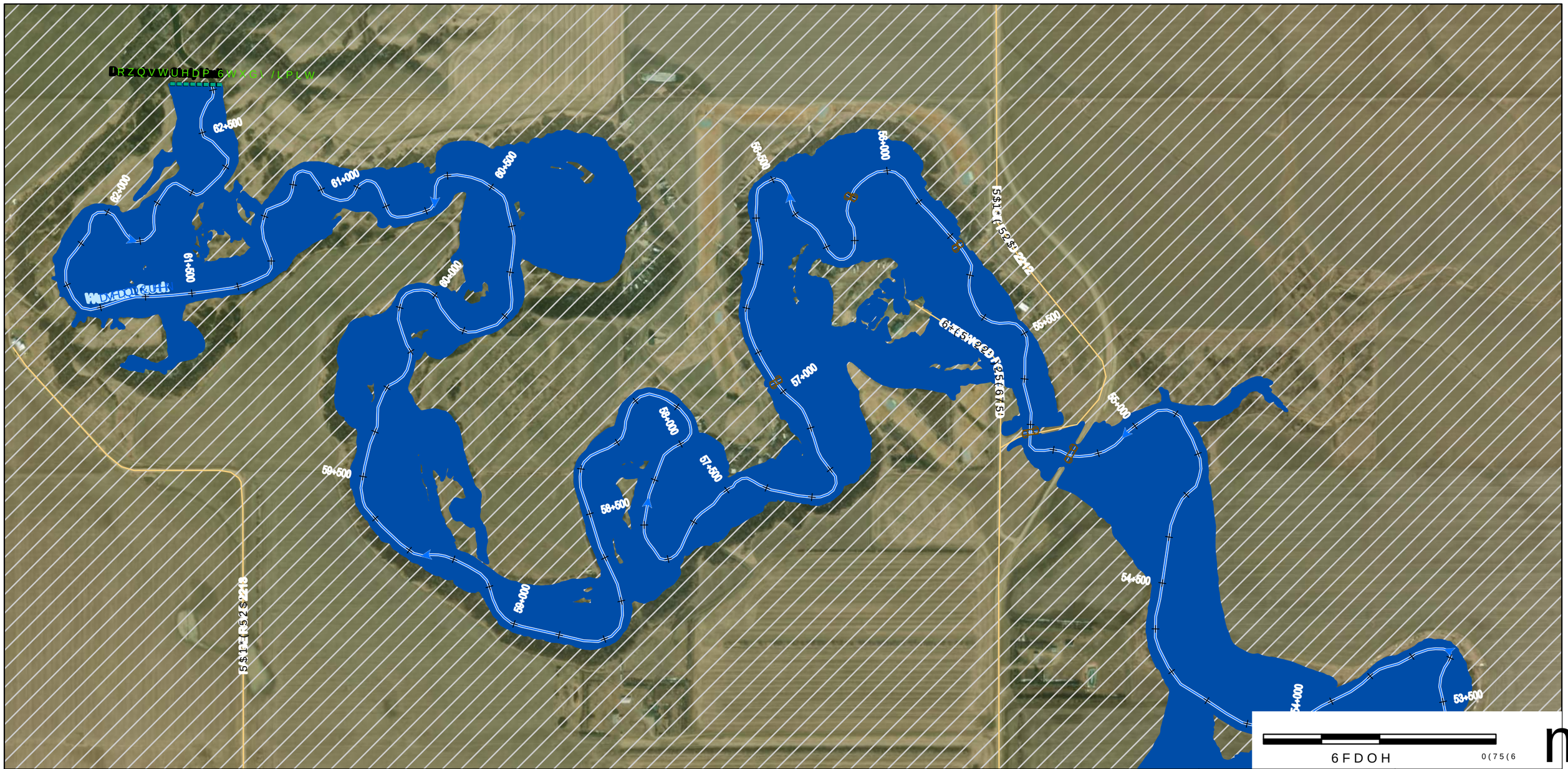

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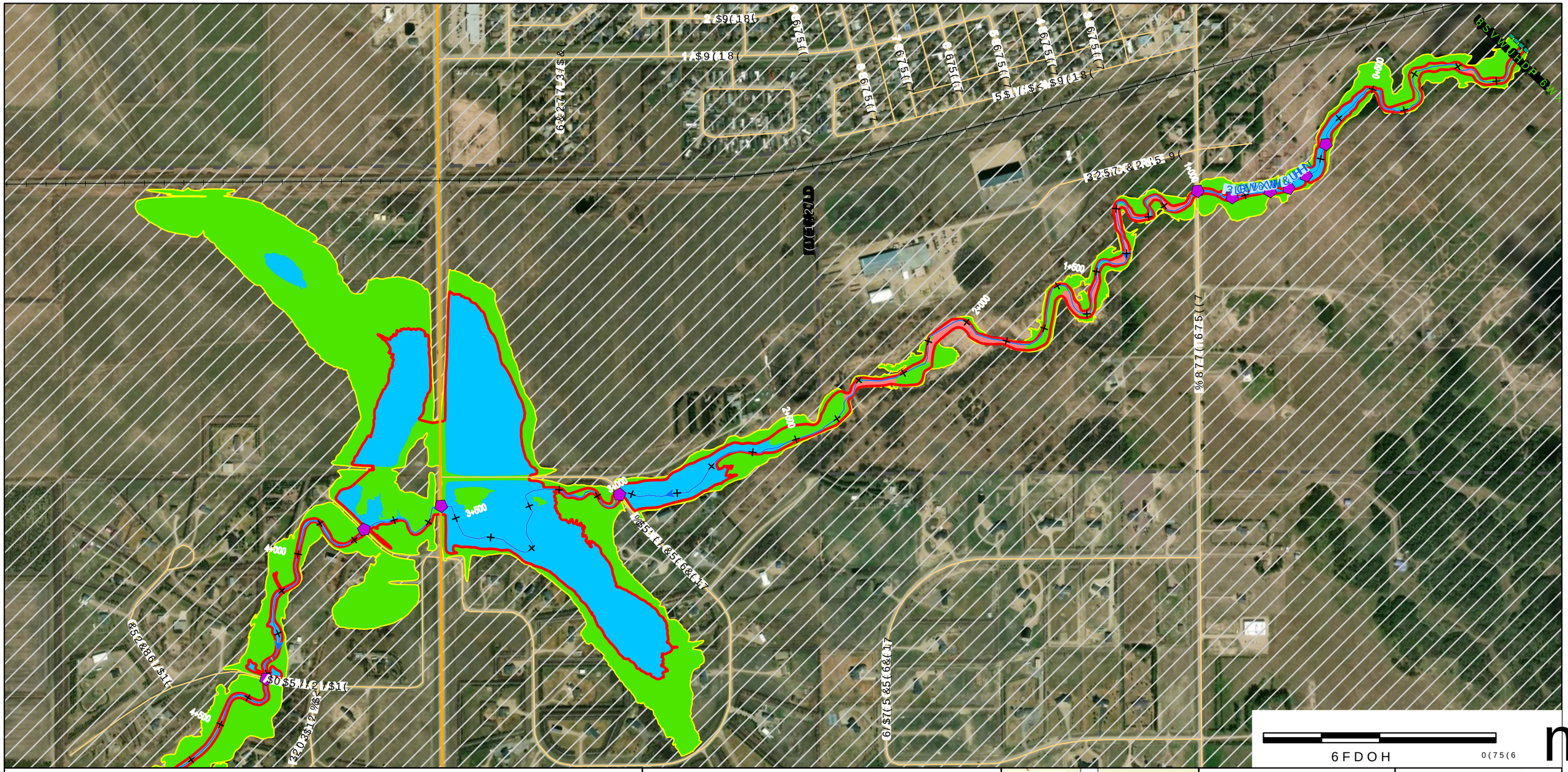
Appendix C. FLOOD CRITERIA MAPS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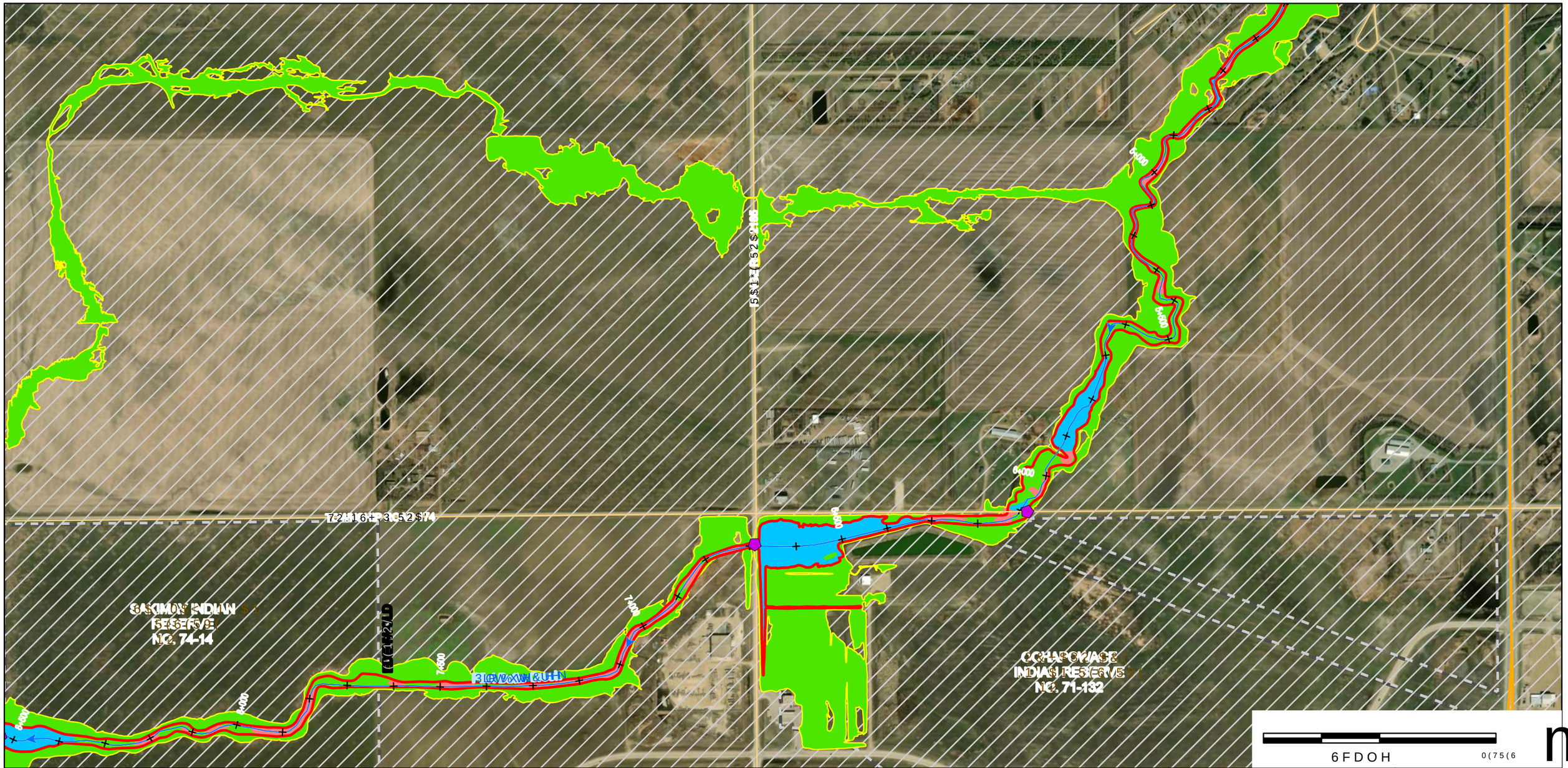

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FLUFXPVWDQFHV DQG DYDLODEOH GDWD ULFRPPHQGV DQRXP 1$' &656 HS
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XVHU LV DGYLVHG WR FRQILUP WKH LQHRUPDWLRQ FRQWDLQHG KHUHLQ LQ
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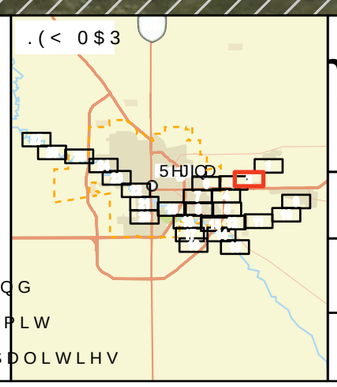

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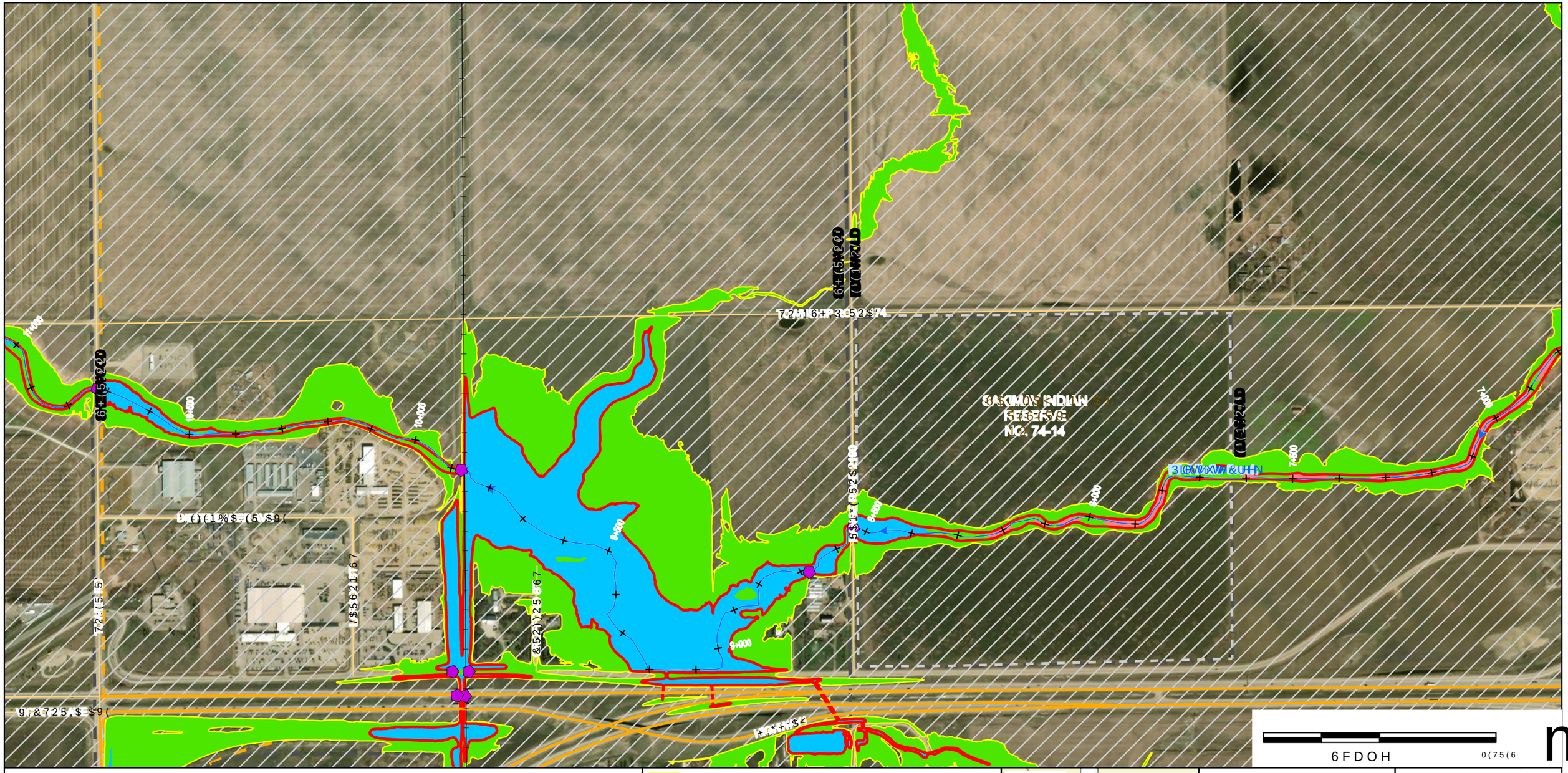

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UHSUHVHQWDWLRQ WKDW WKLV PDS ZHUH DOO XVHV /KH
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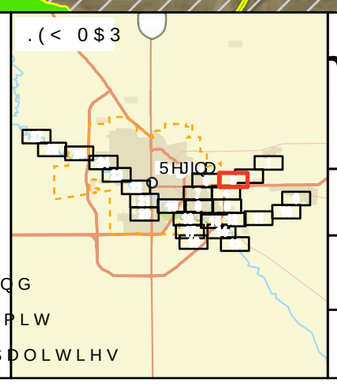

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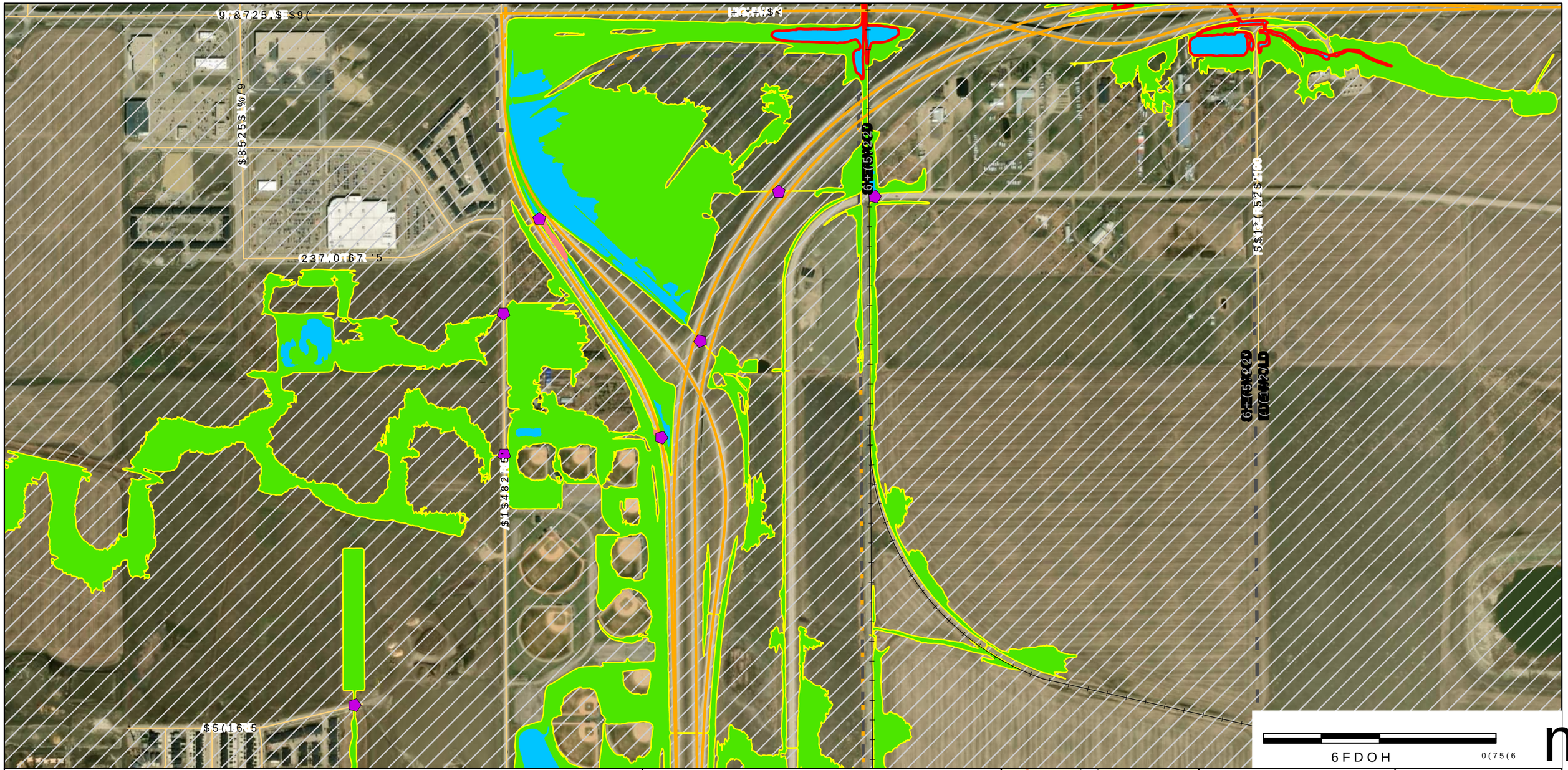

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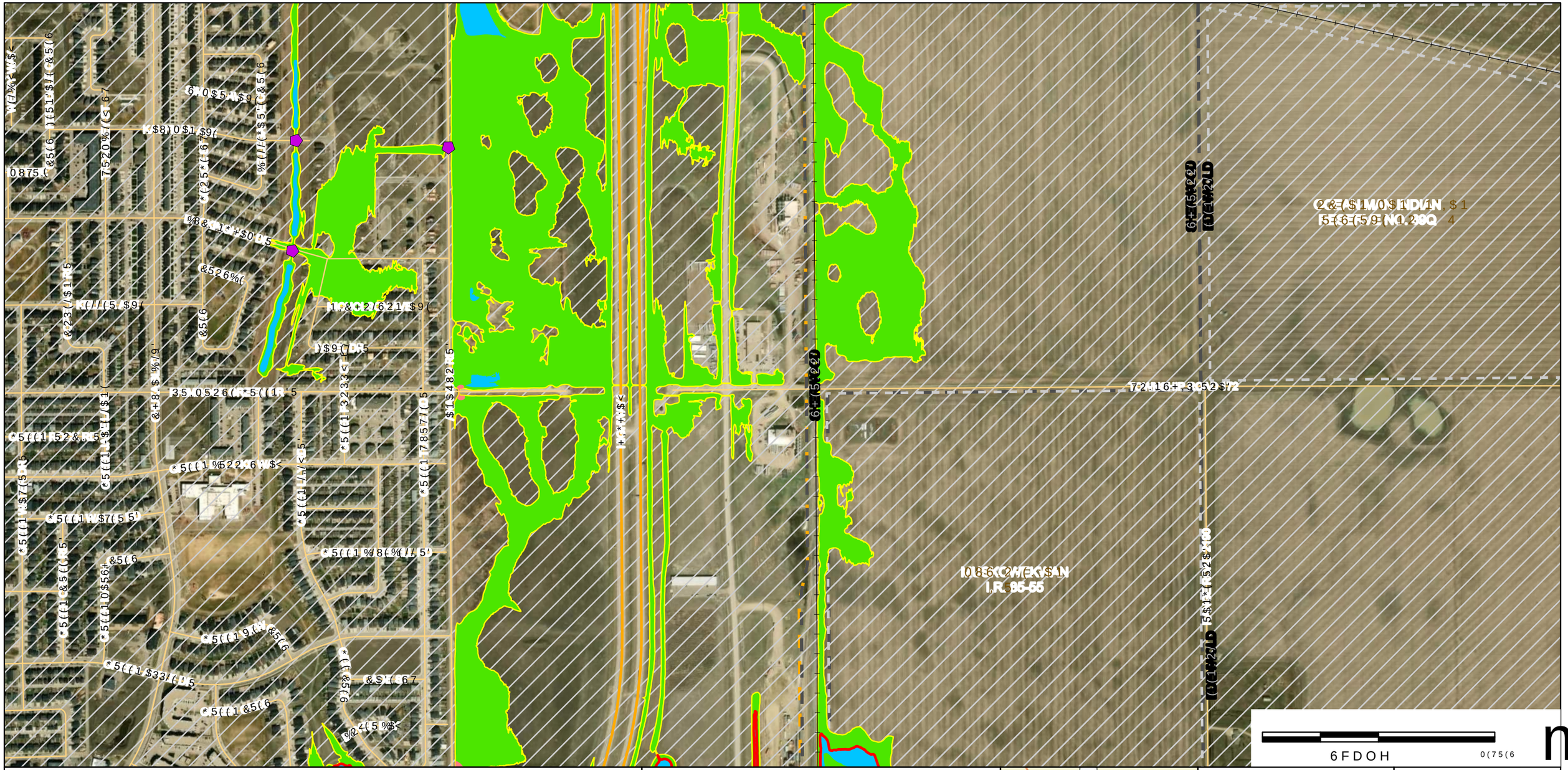

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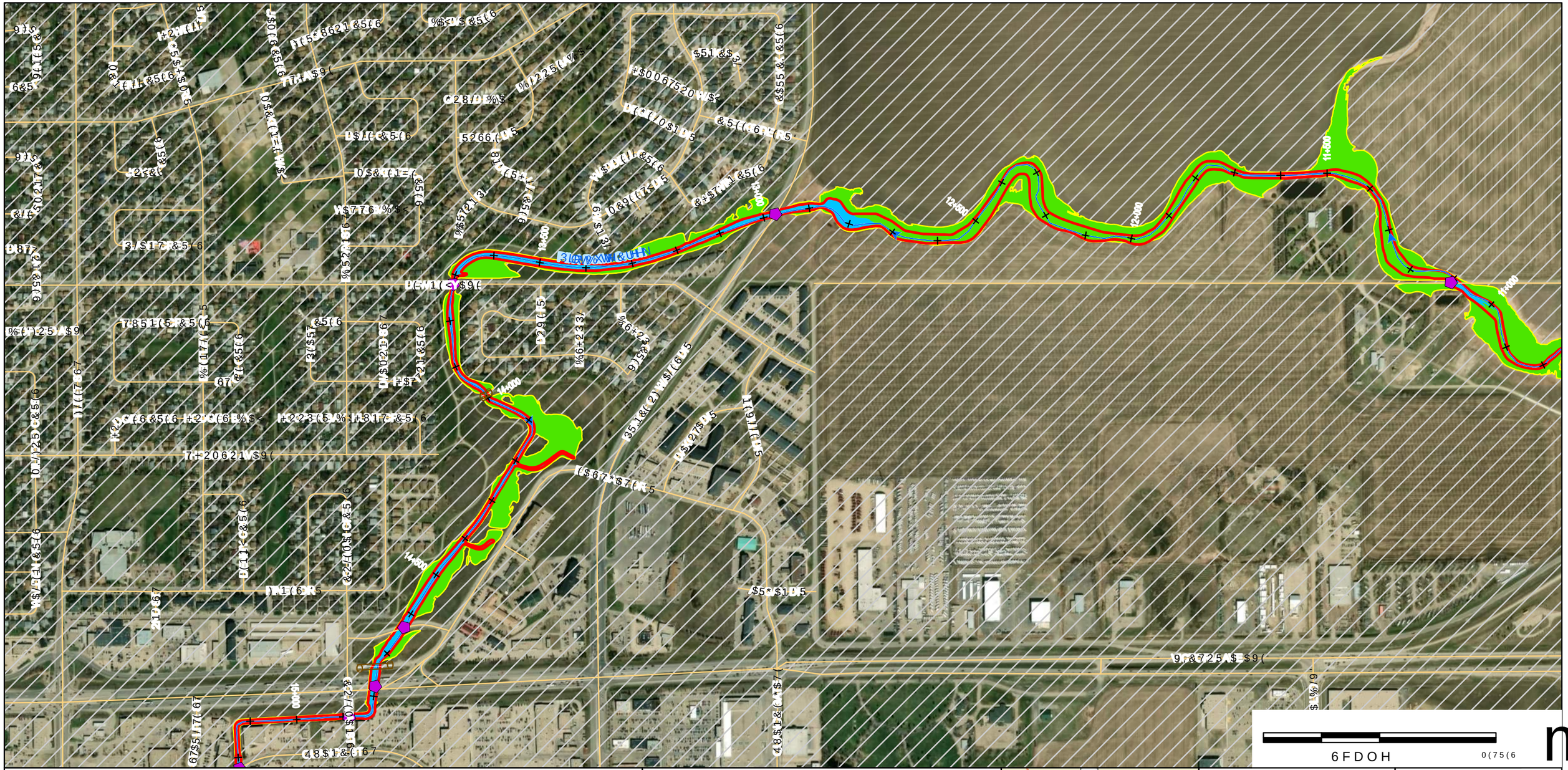

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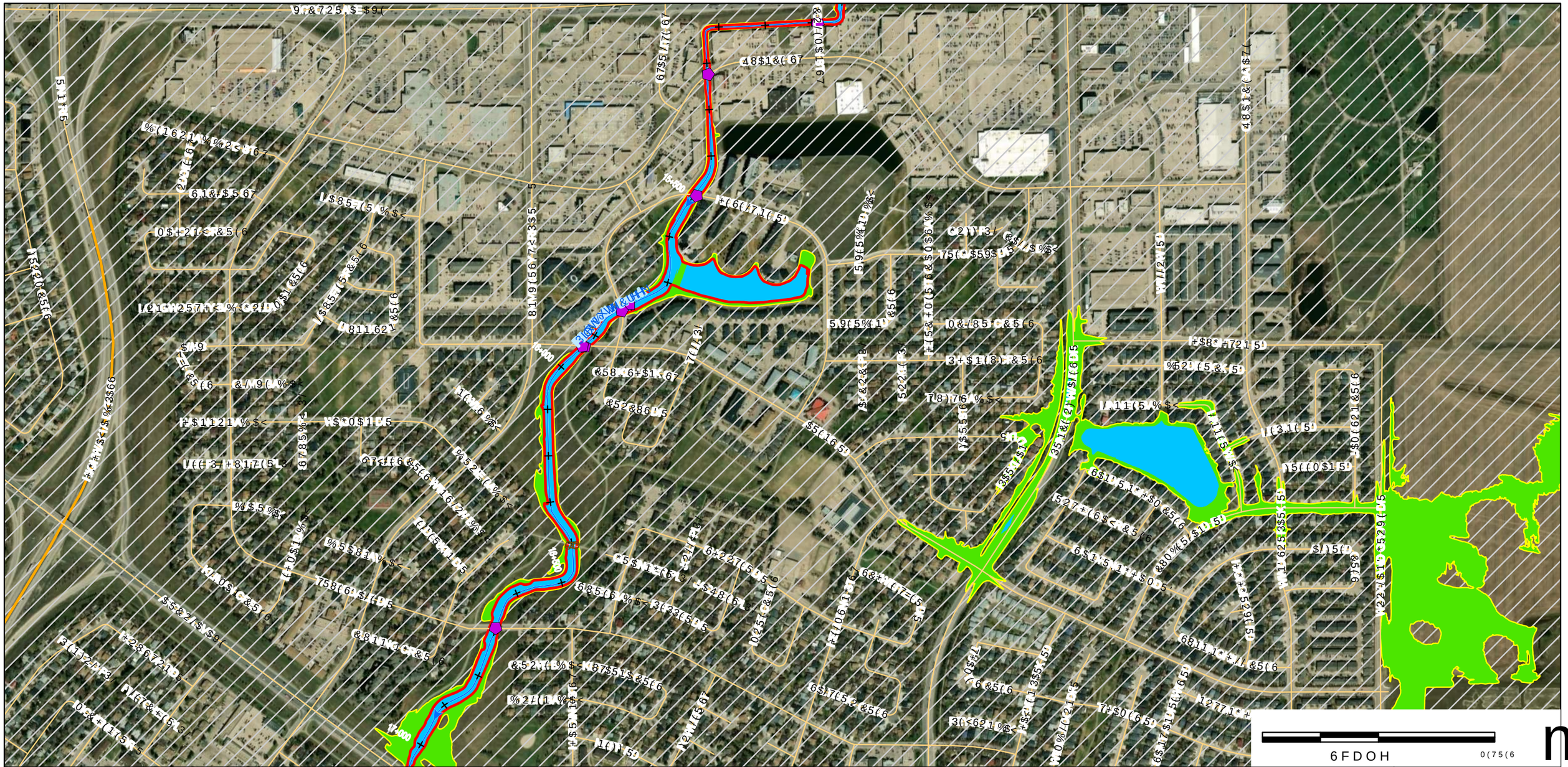

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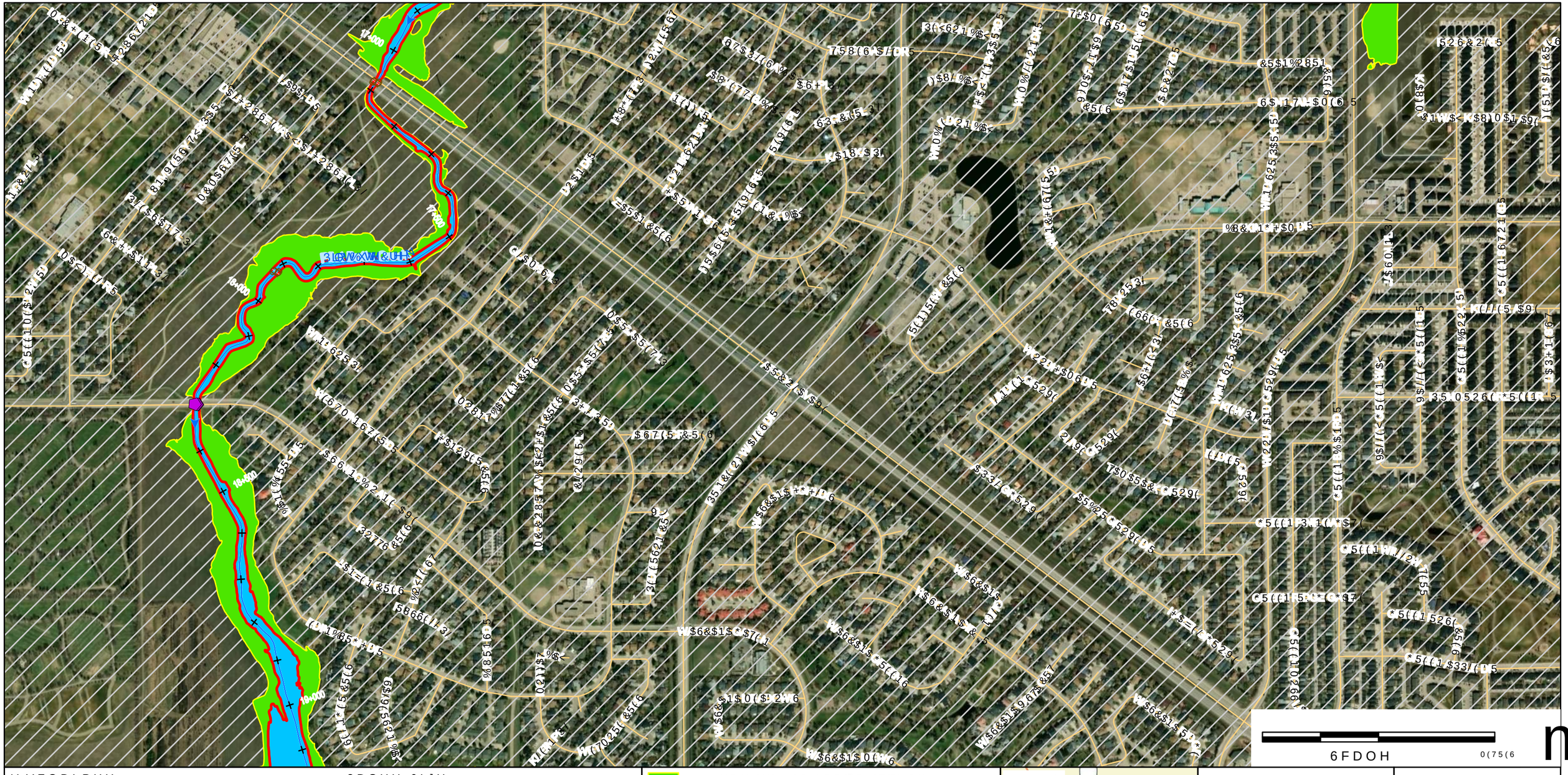

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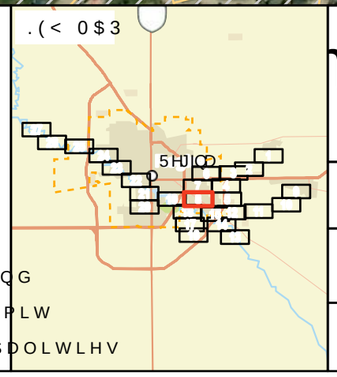

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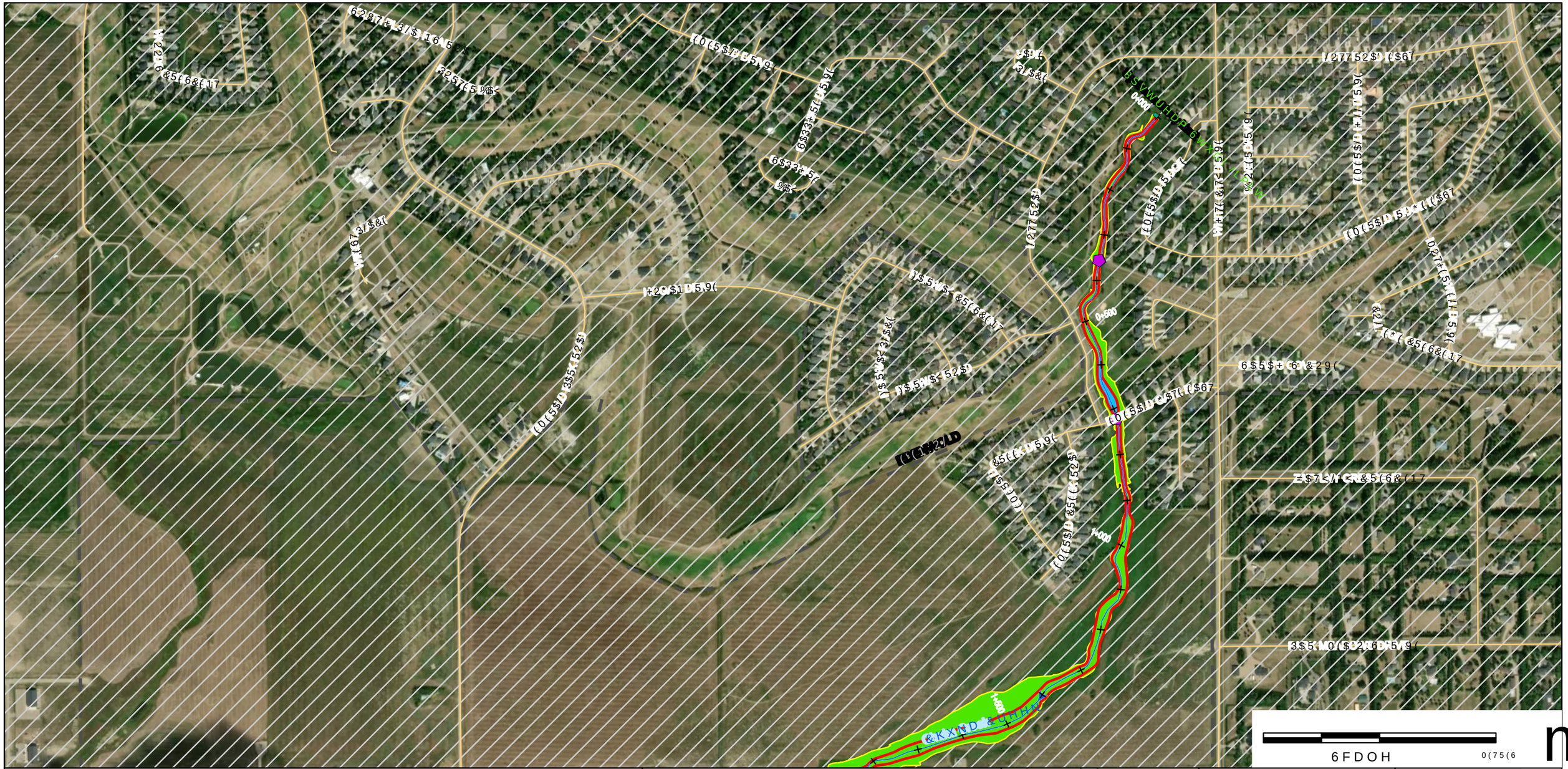
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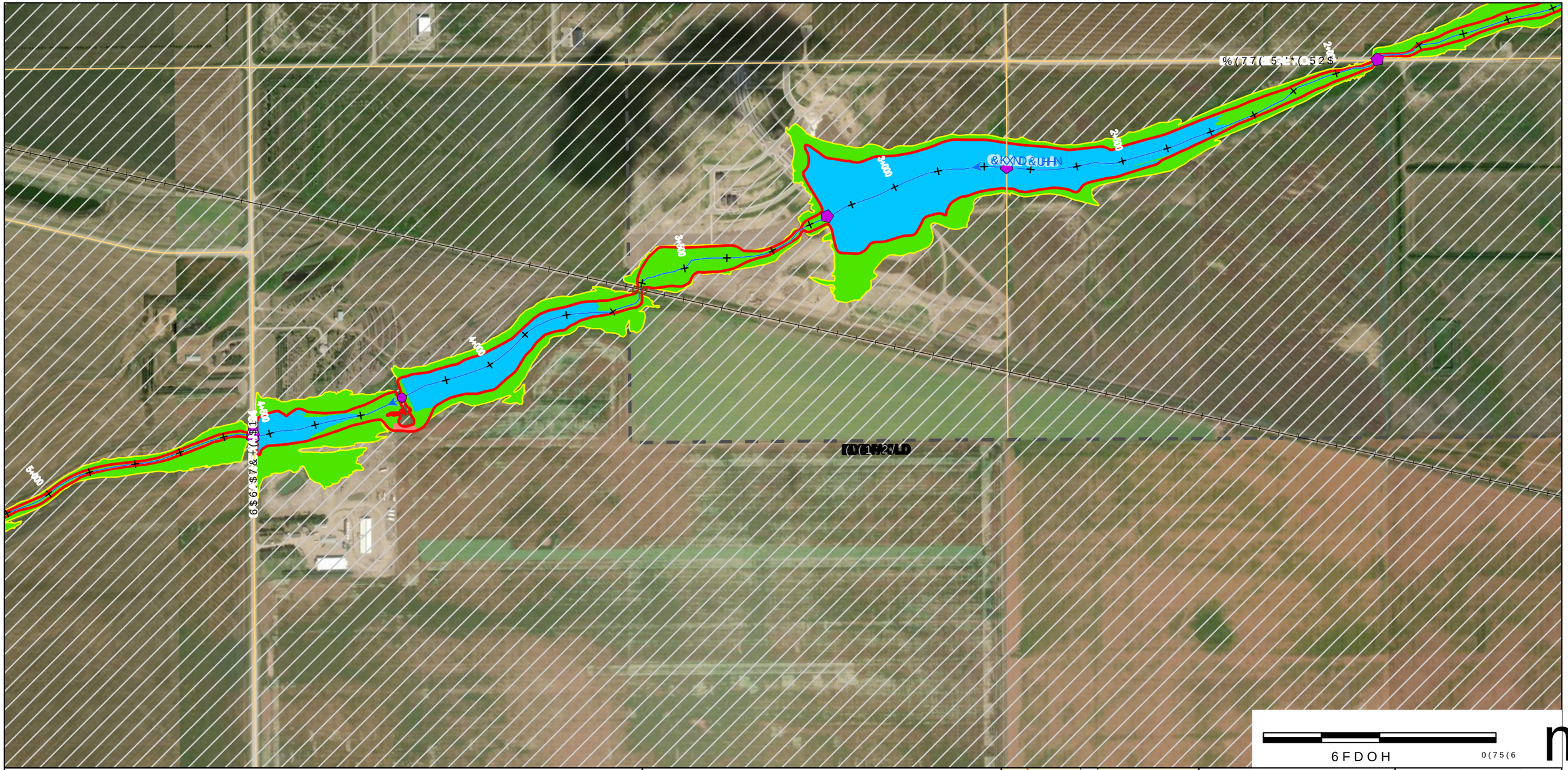

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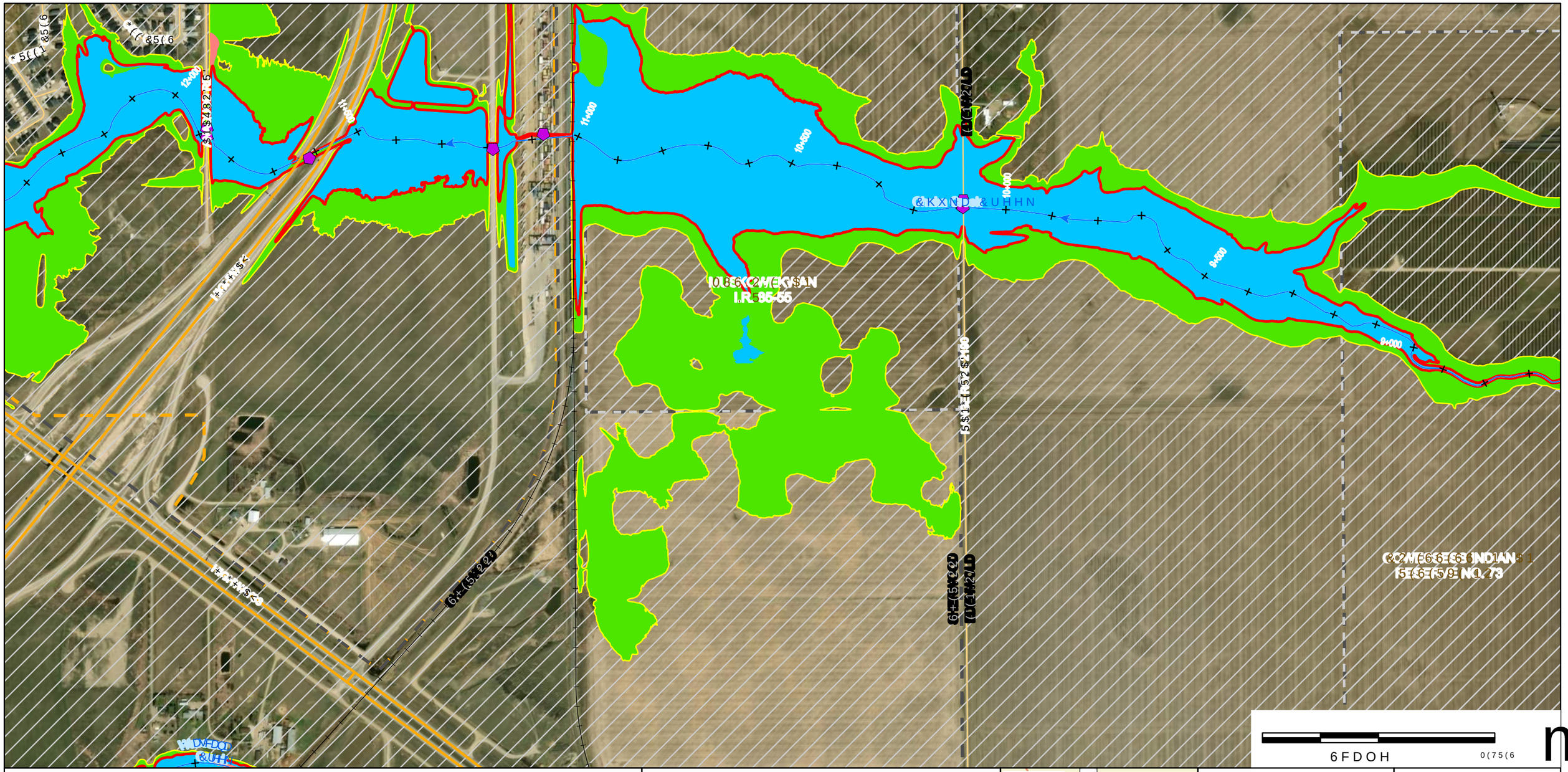

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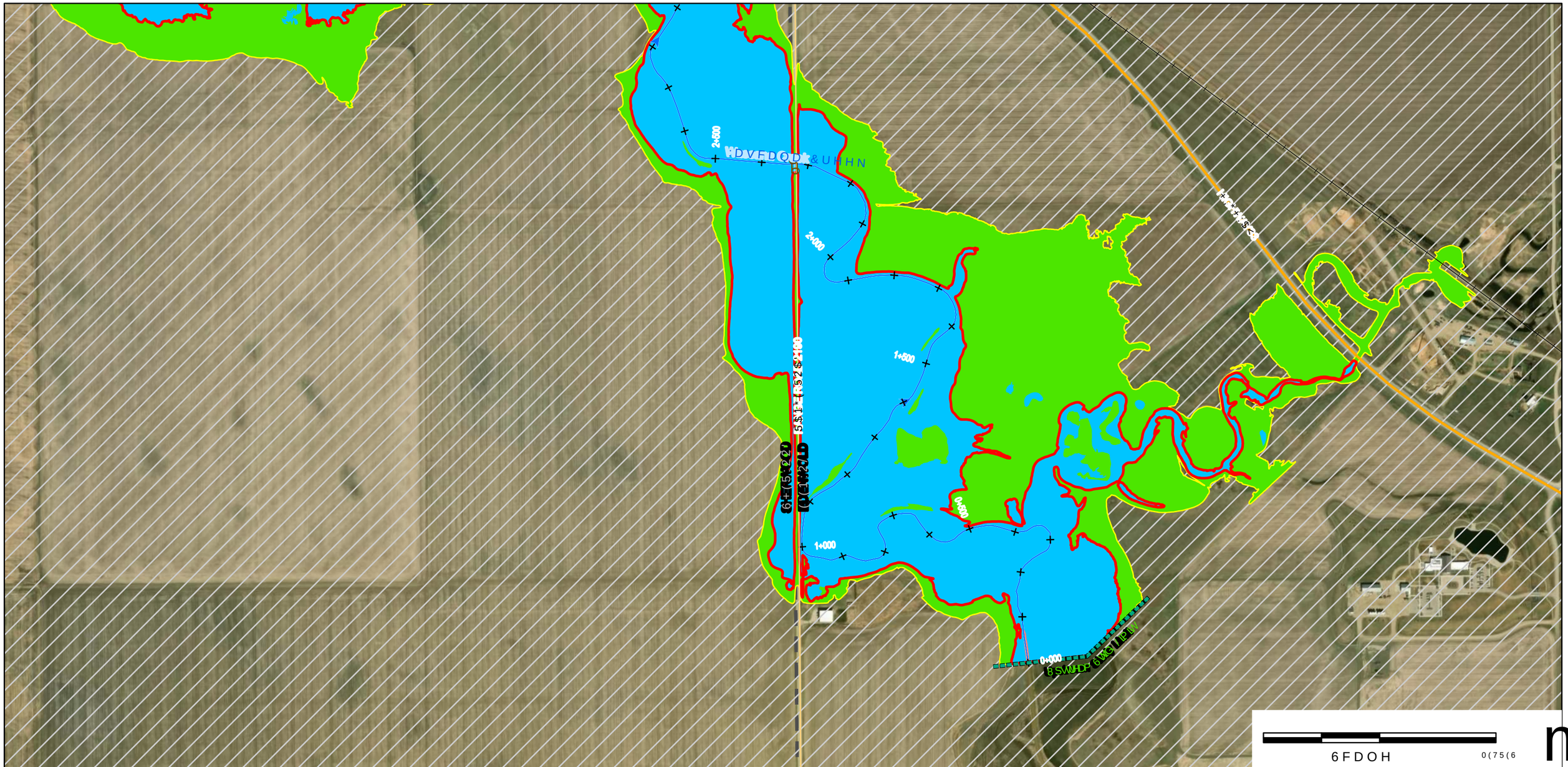

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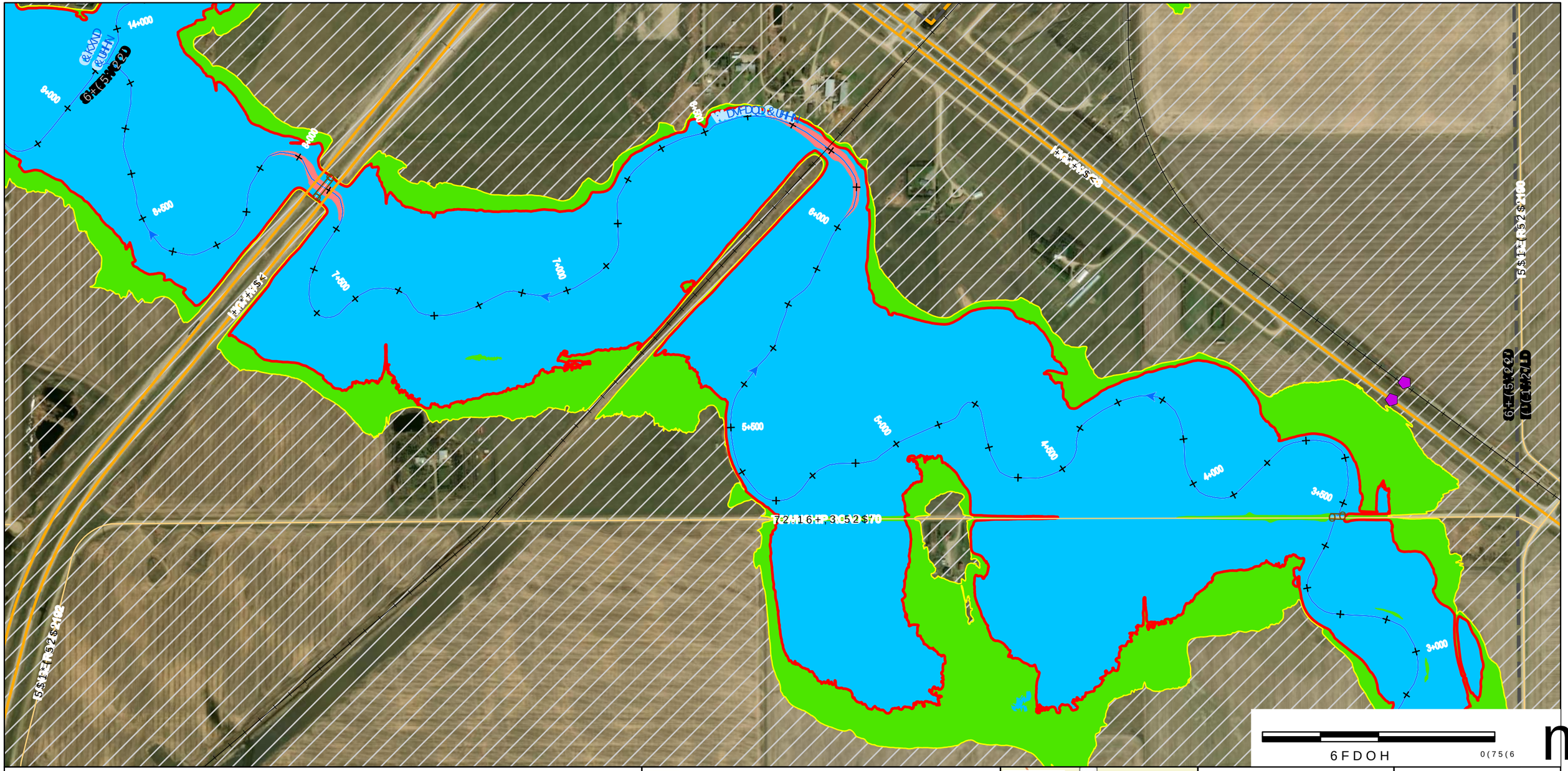

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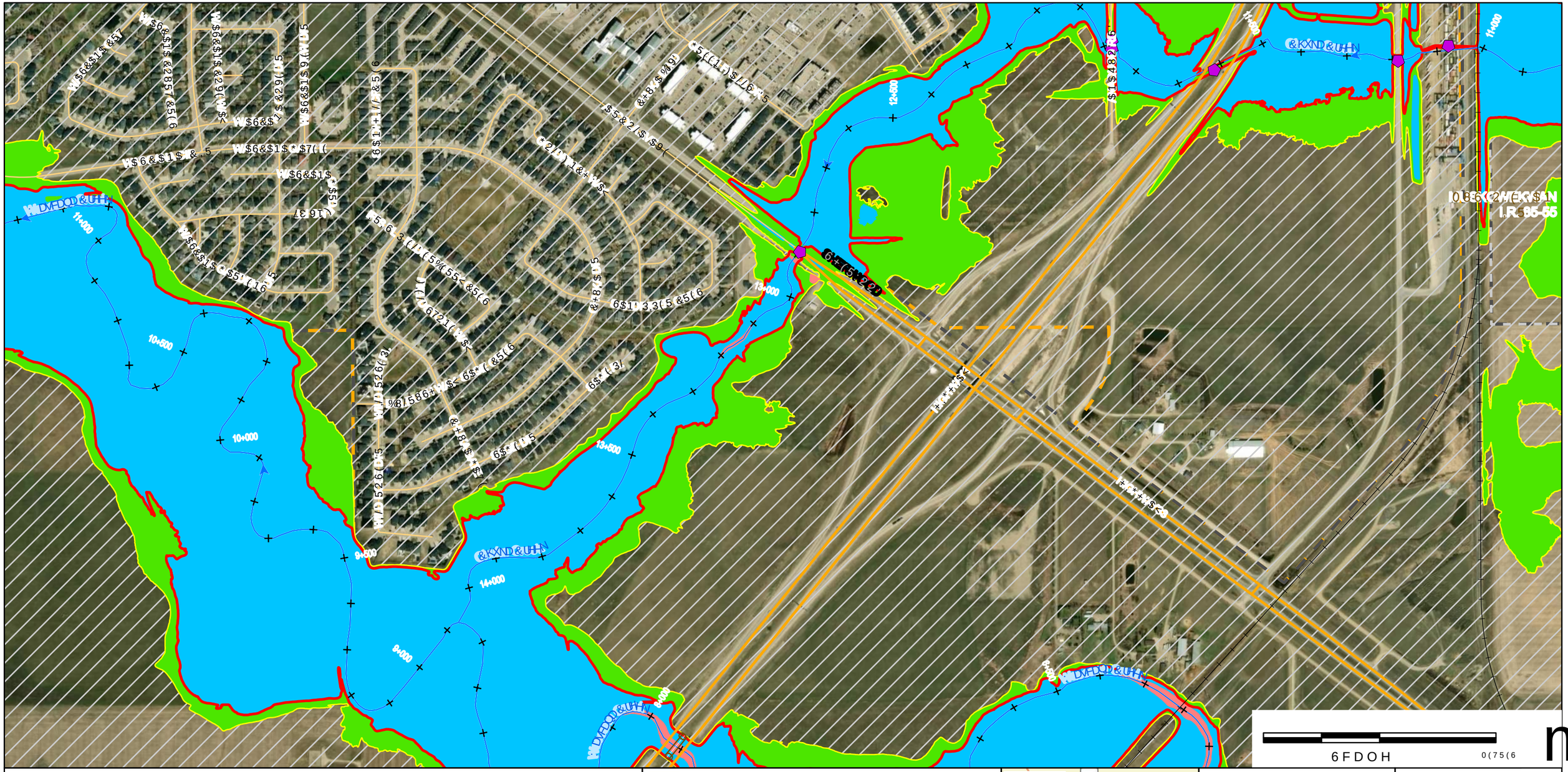

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GHJUHHV RI DFFXUDF\ DQG FRPSOHWHQHVV GHSHQGHQW RQ WKH VWHP
FLUFXPVWDQFHV DQG DYDLODEOH GDWRU :6$ WDNHV QR XP 1$' &656 HS
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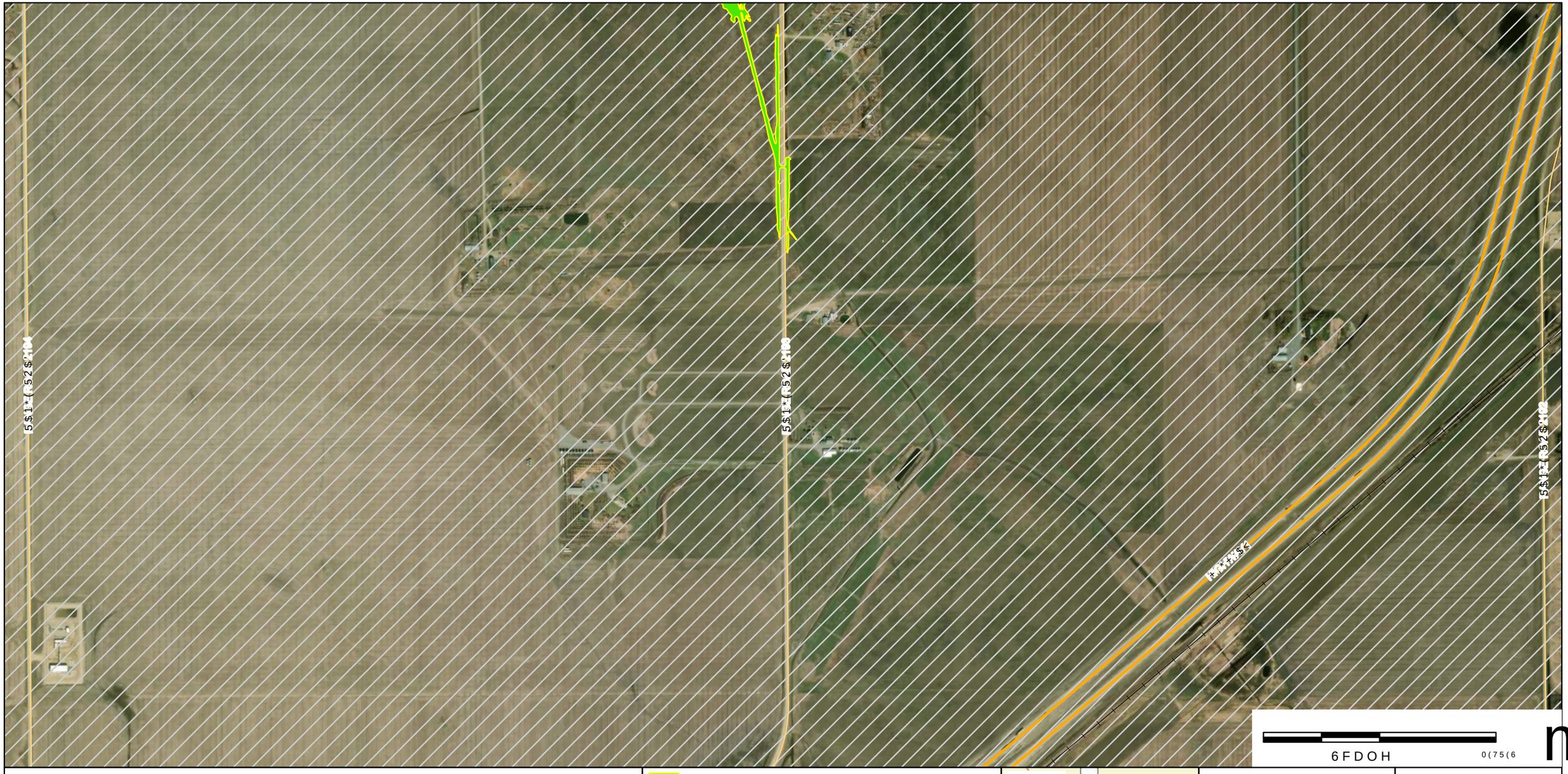

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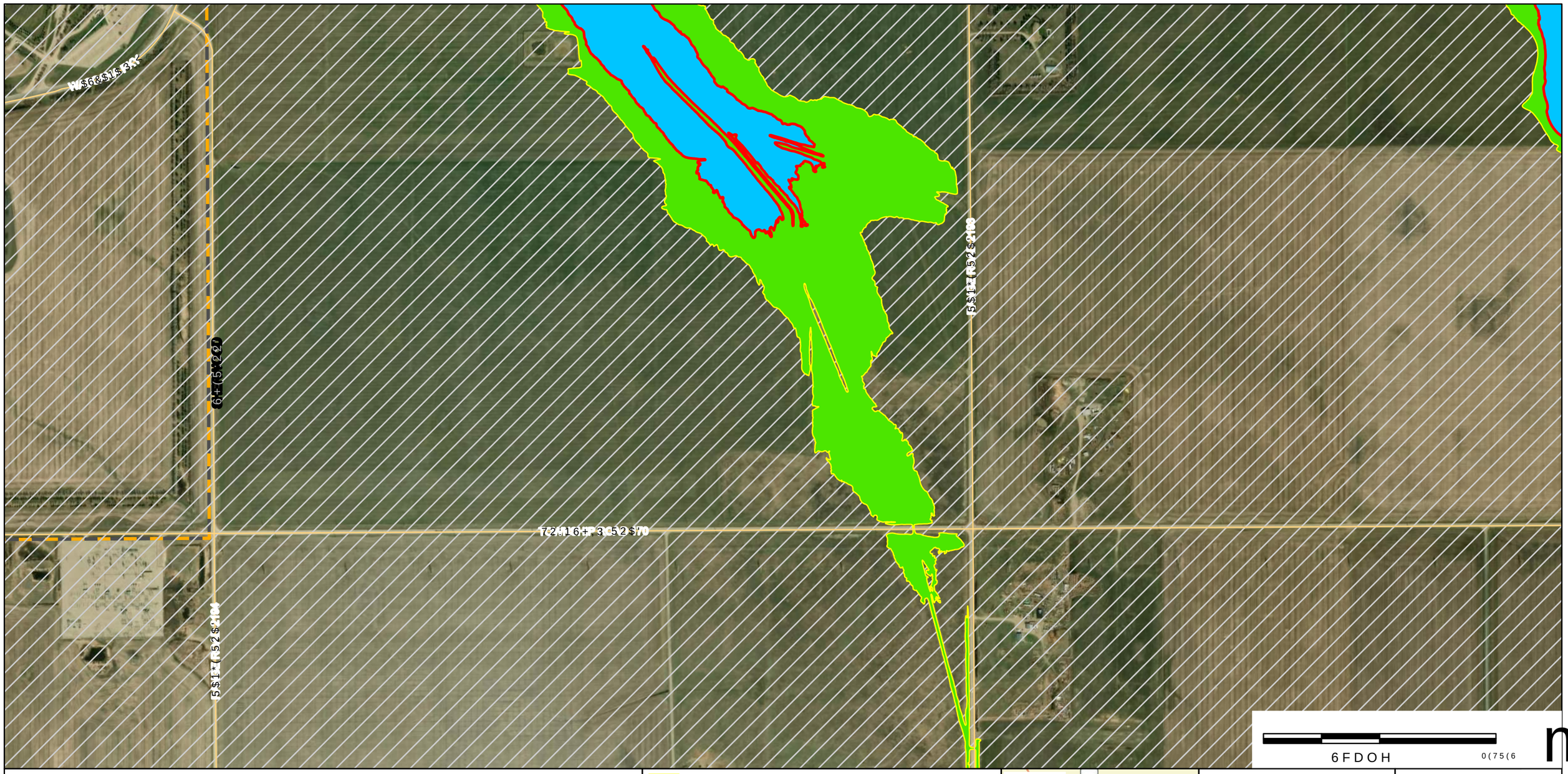

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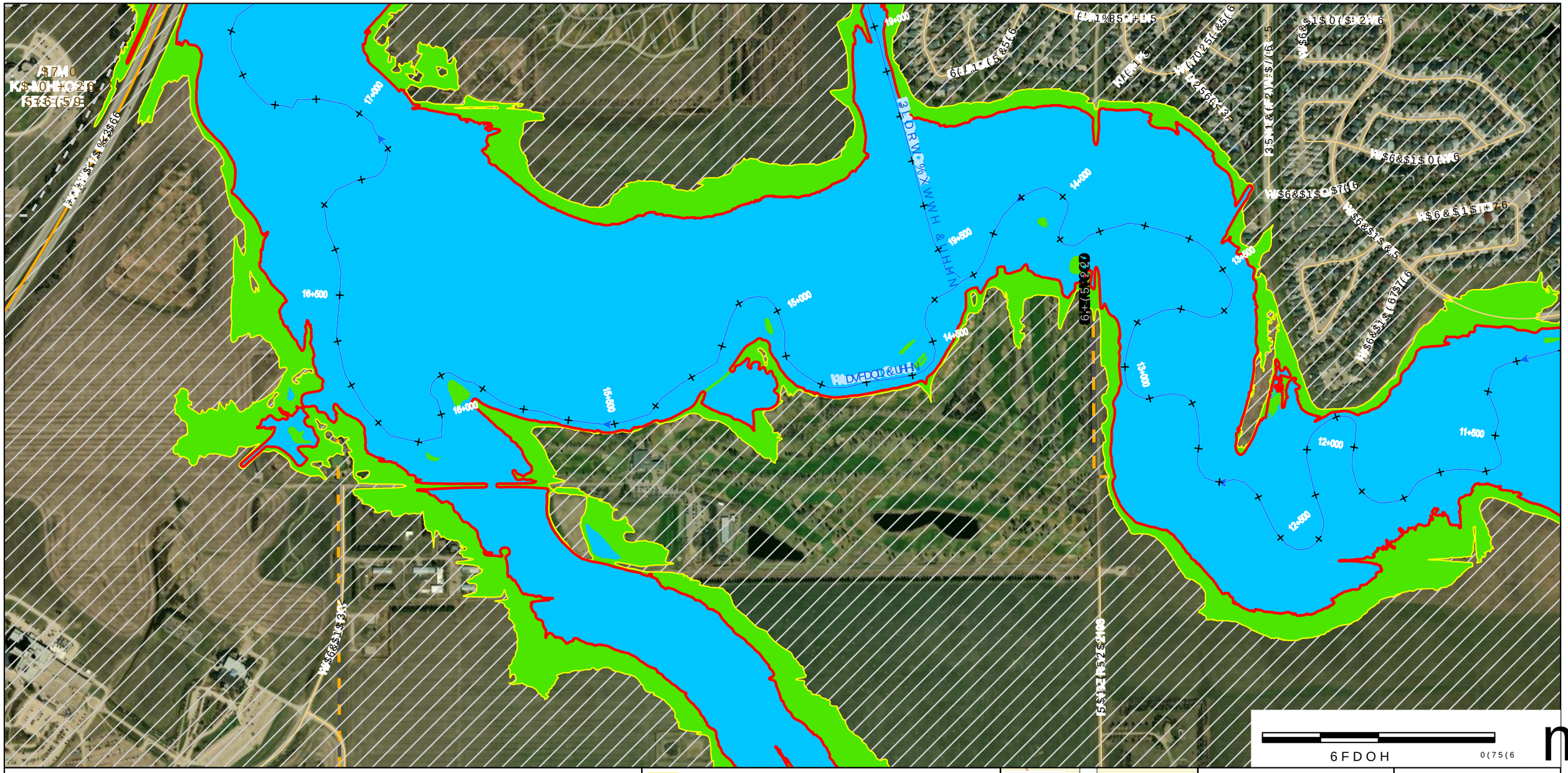
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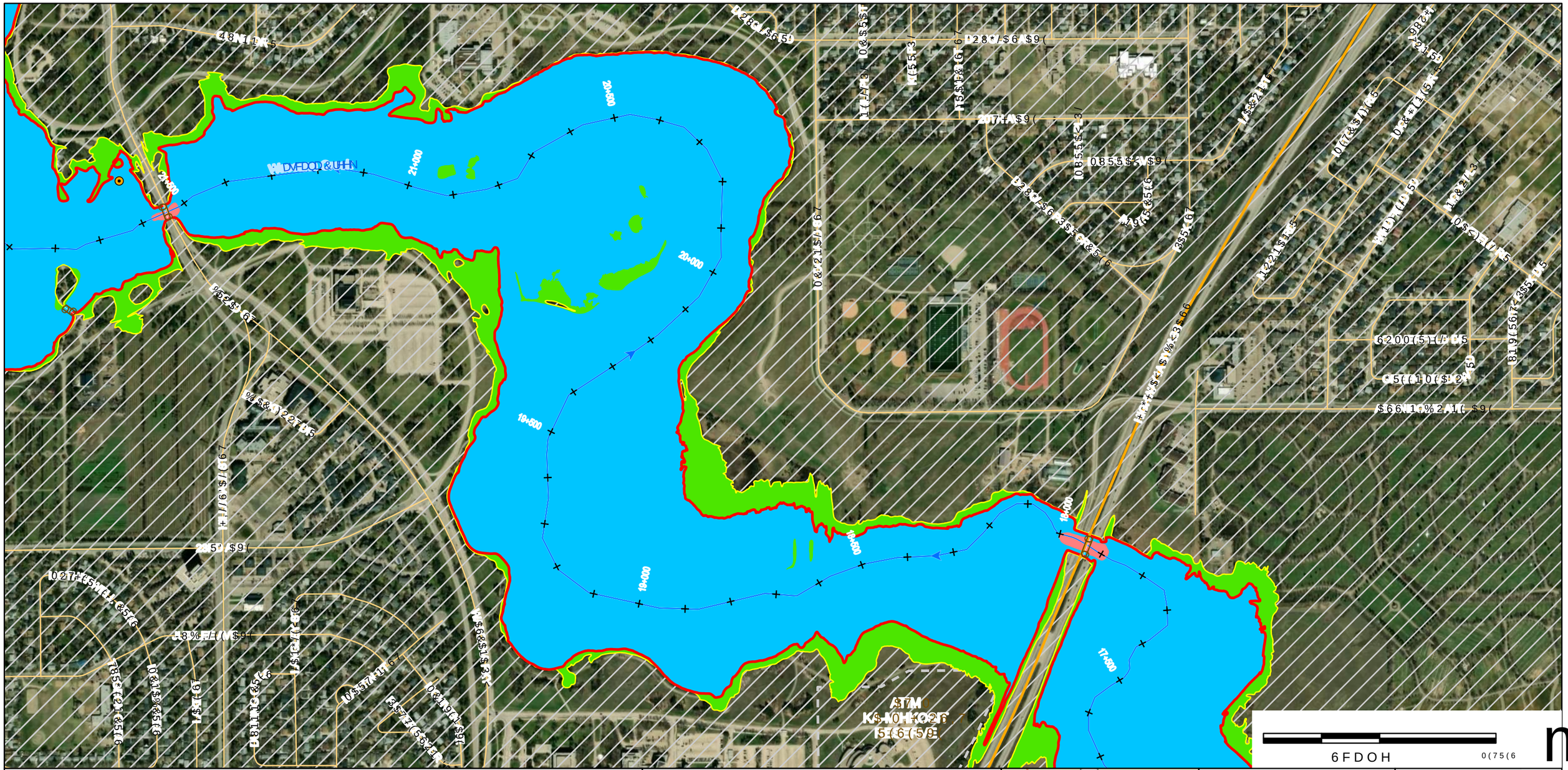

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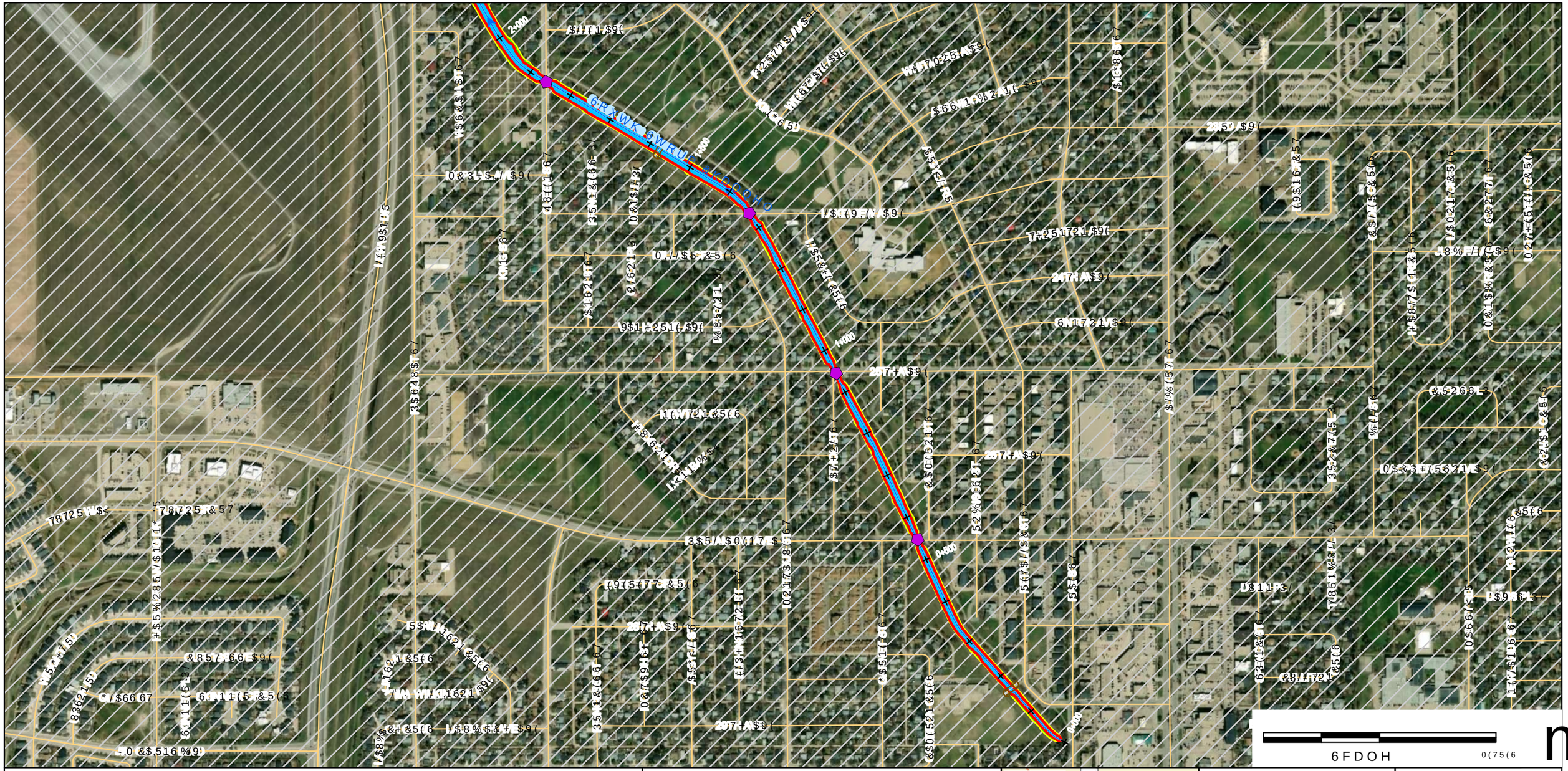
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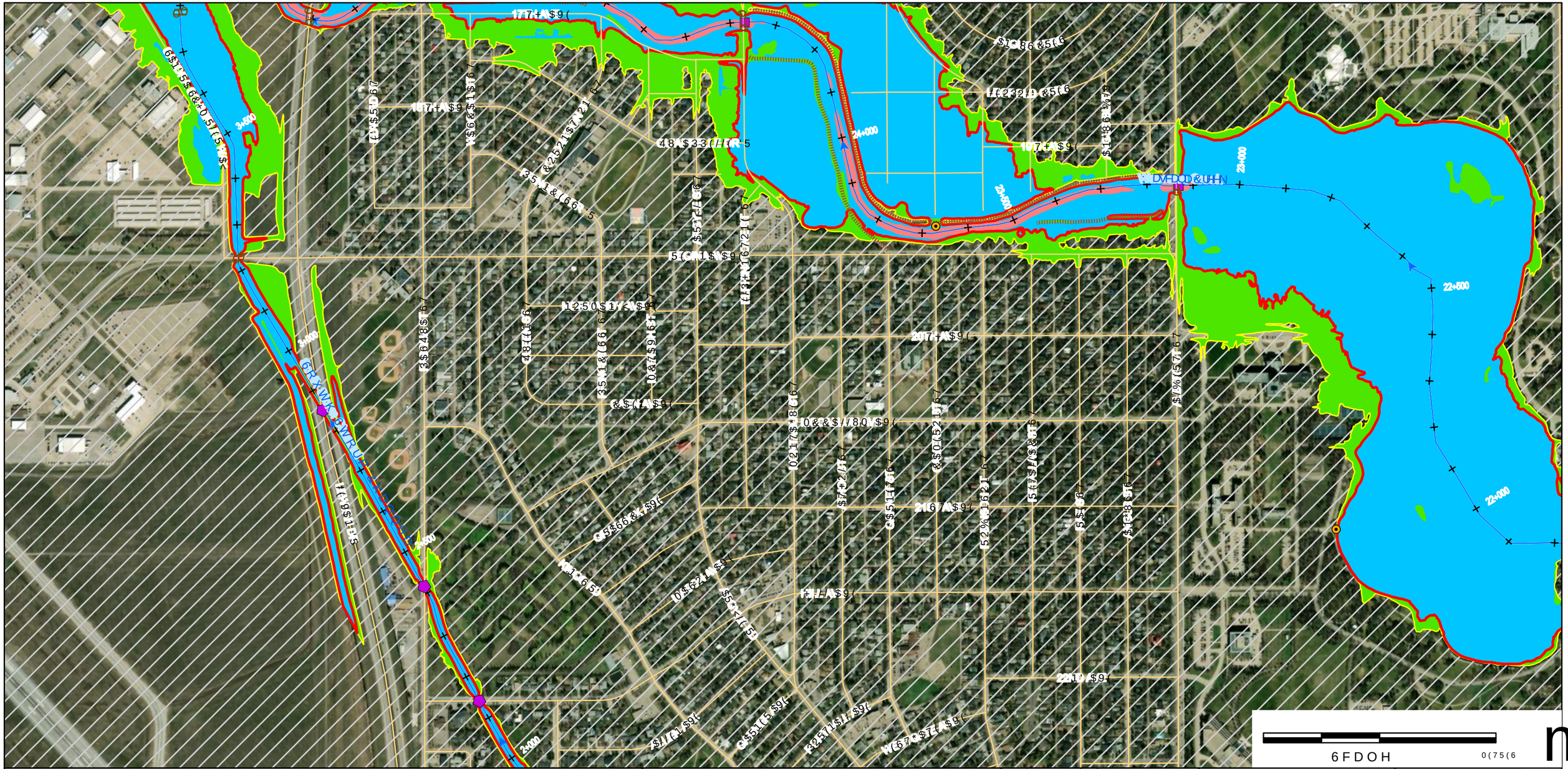

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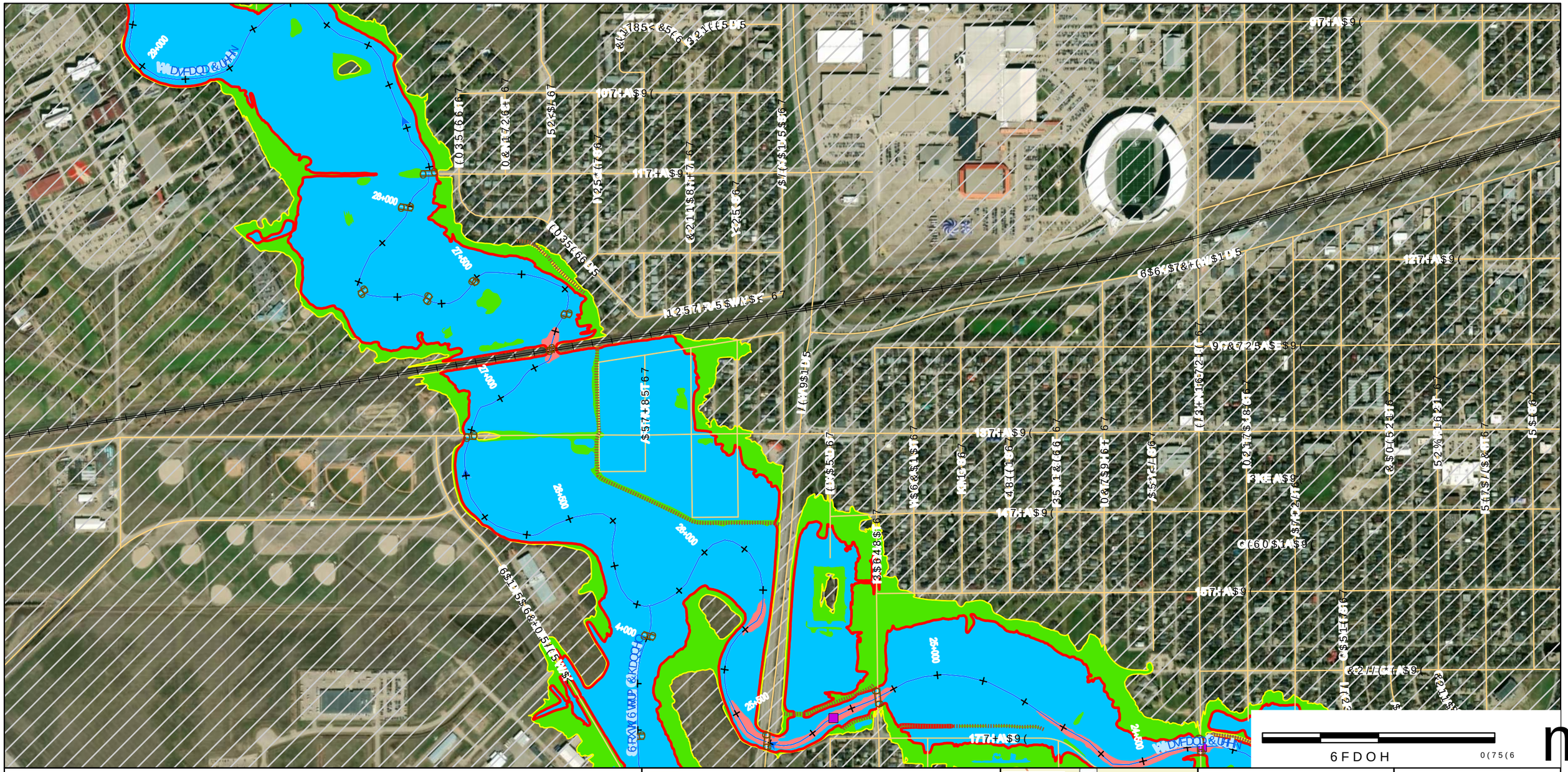

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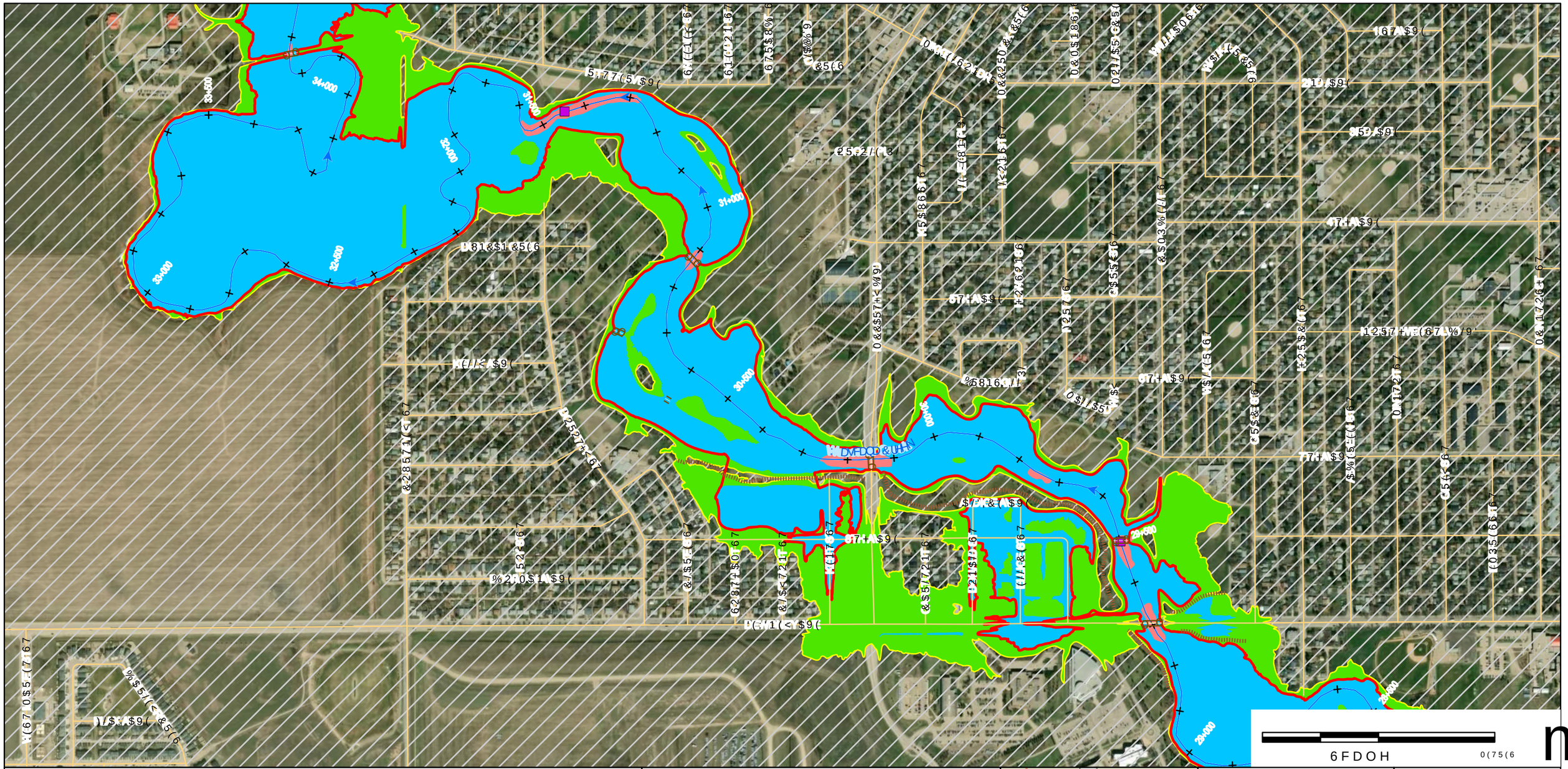

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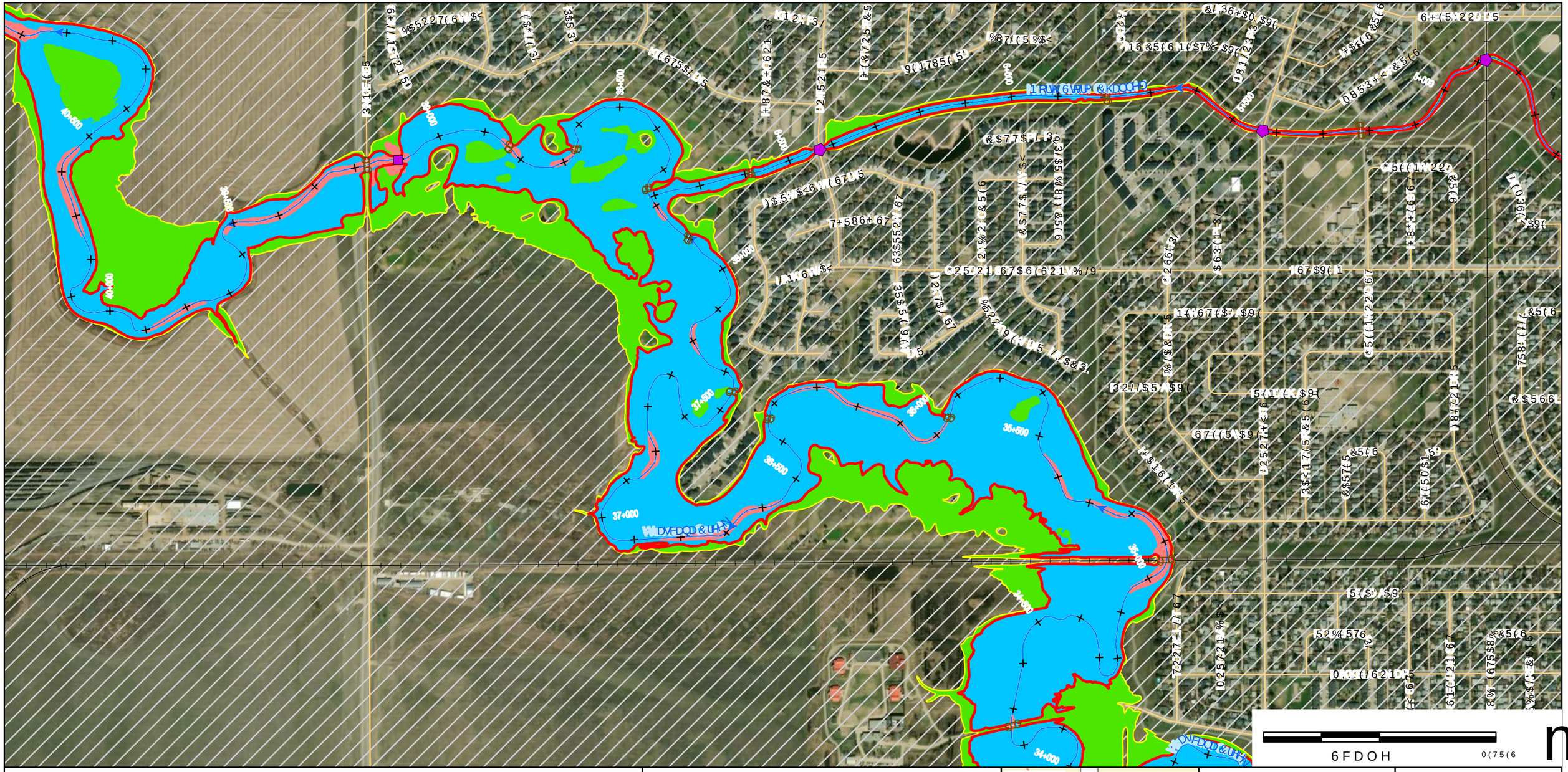

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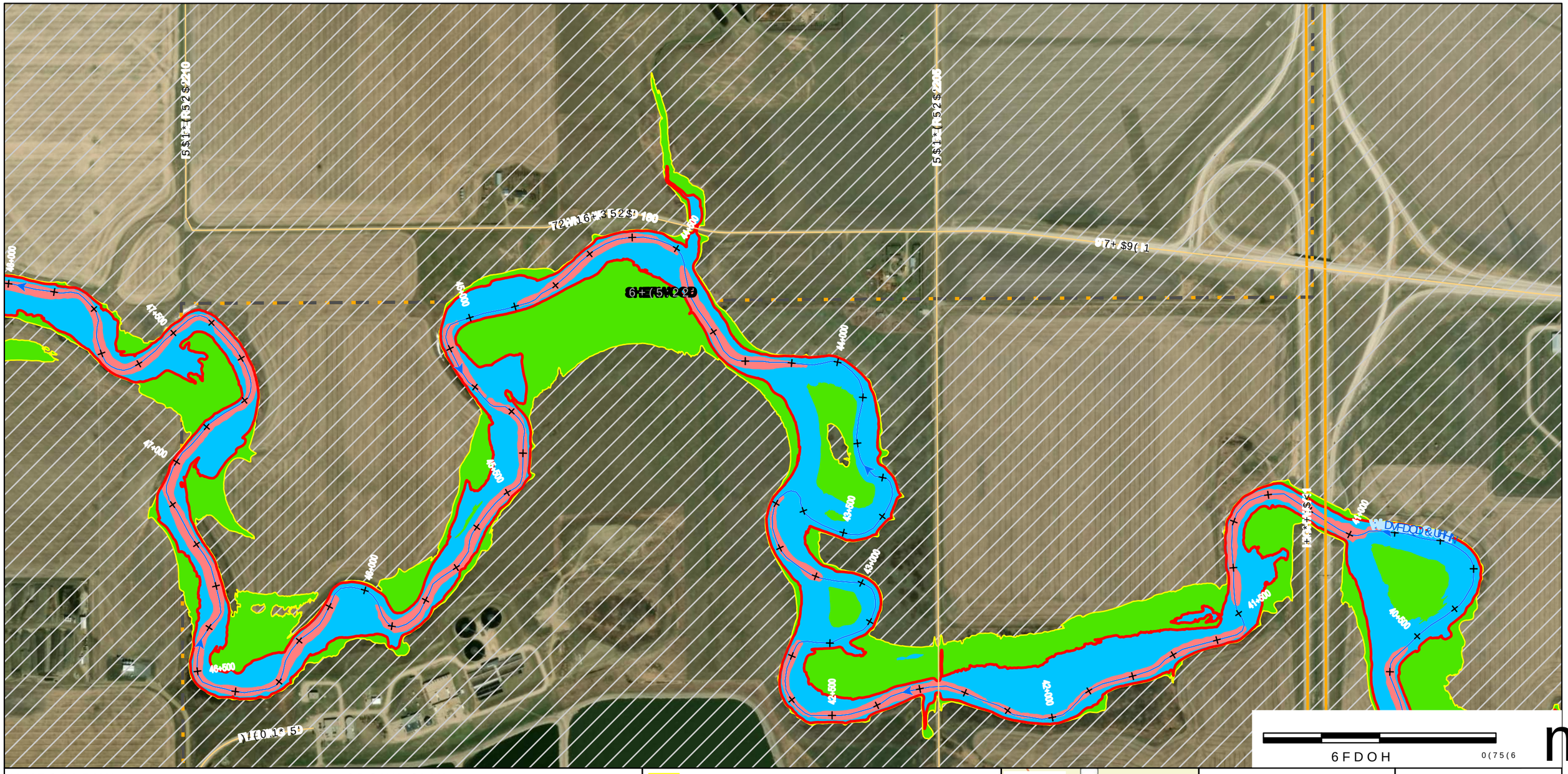

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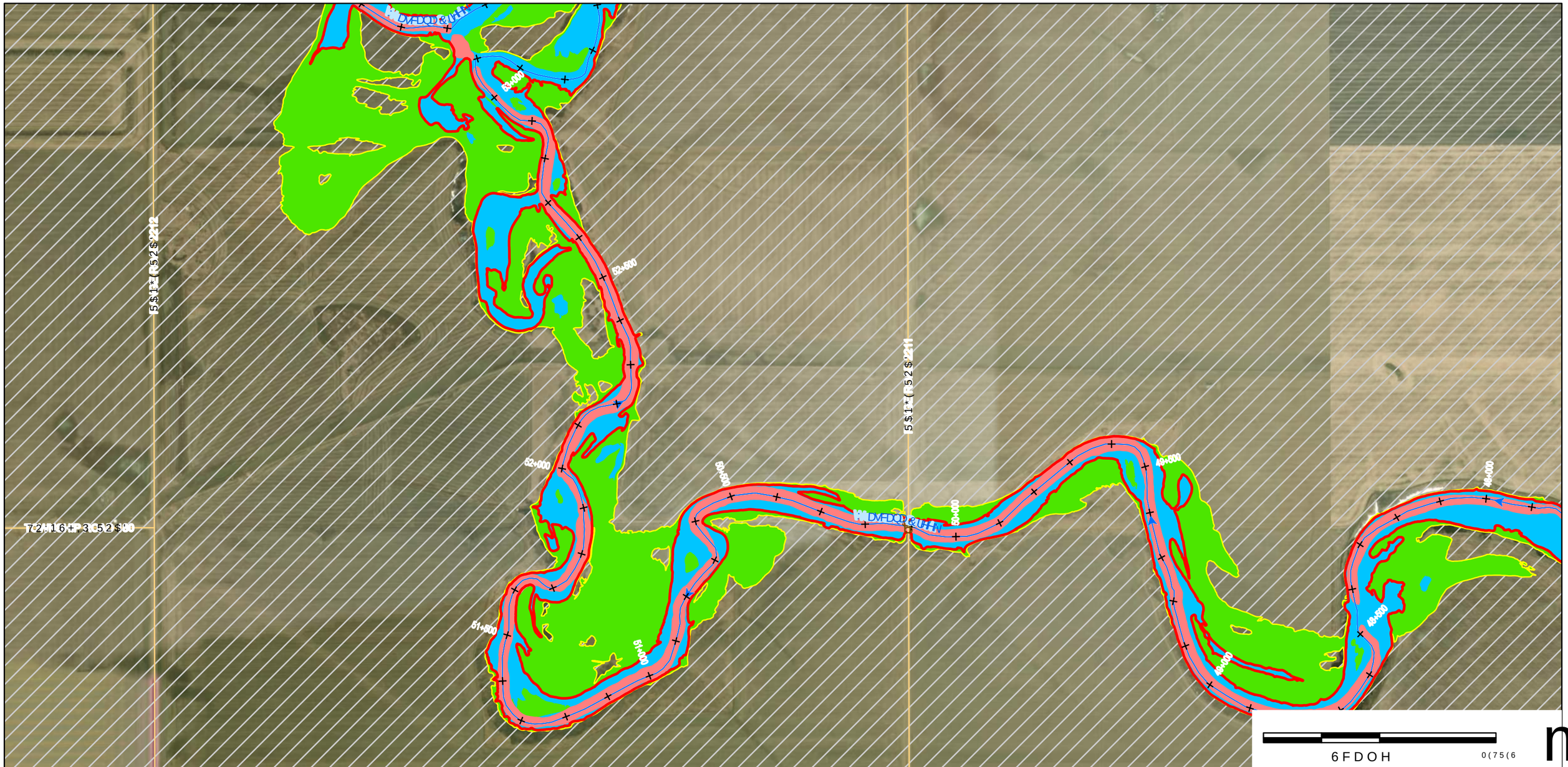

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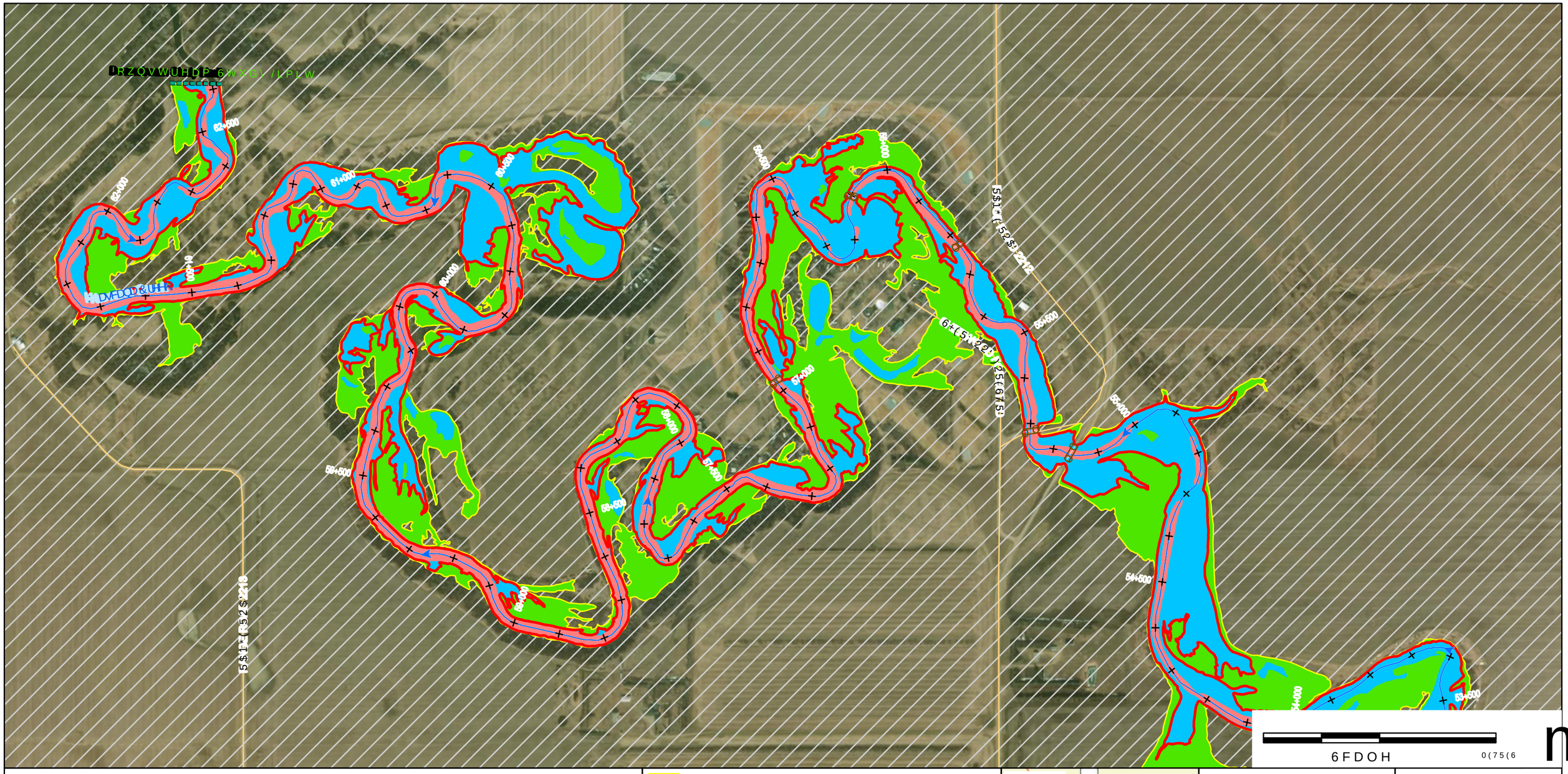

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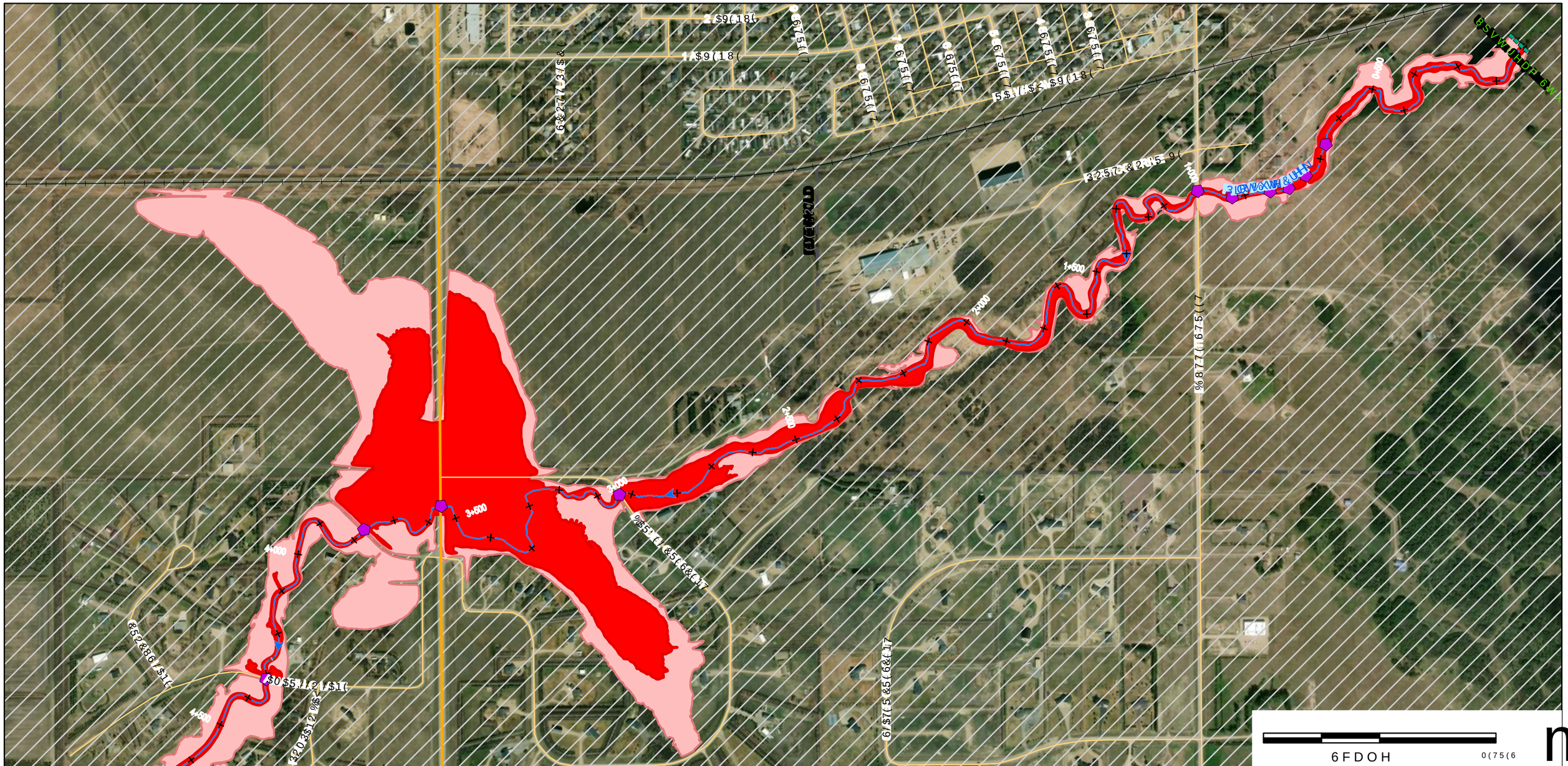
Appendix D. FLOOD HAZARD MAPS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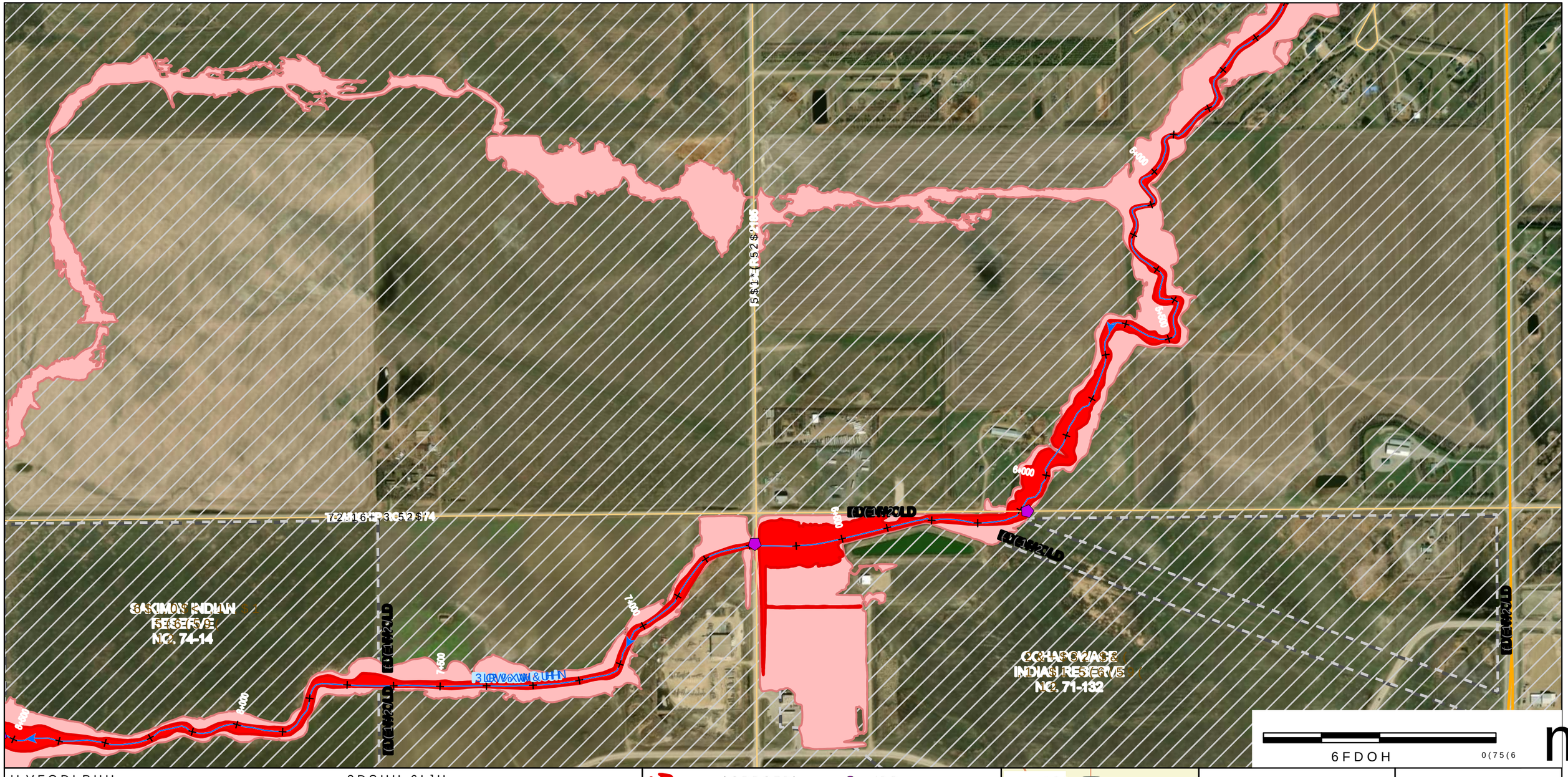
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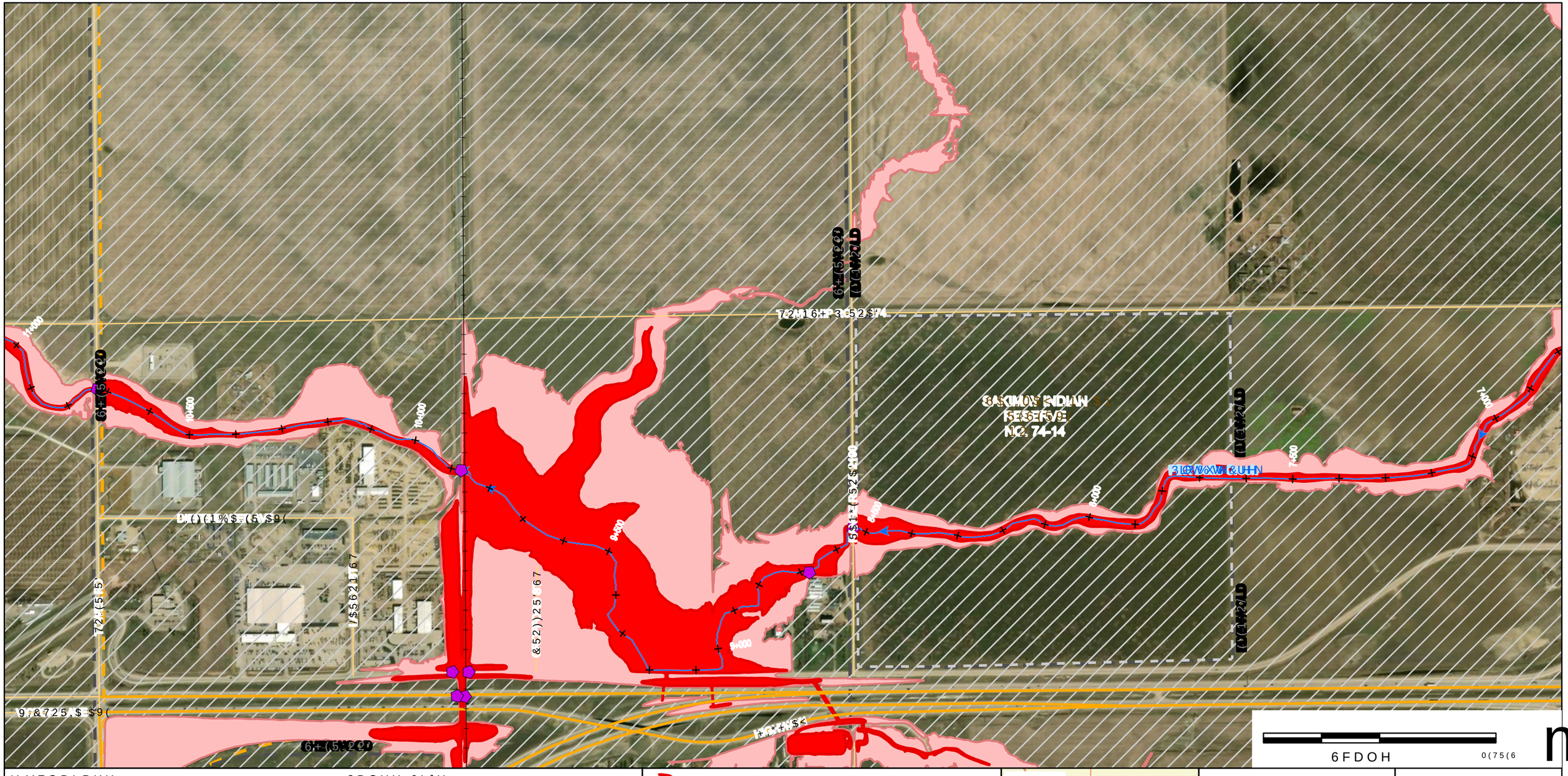

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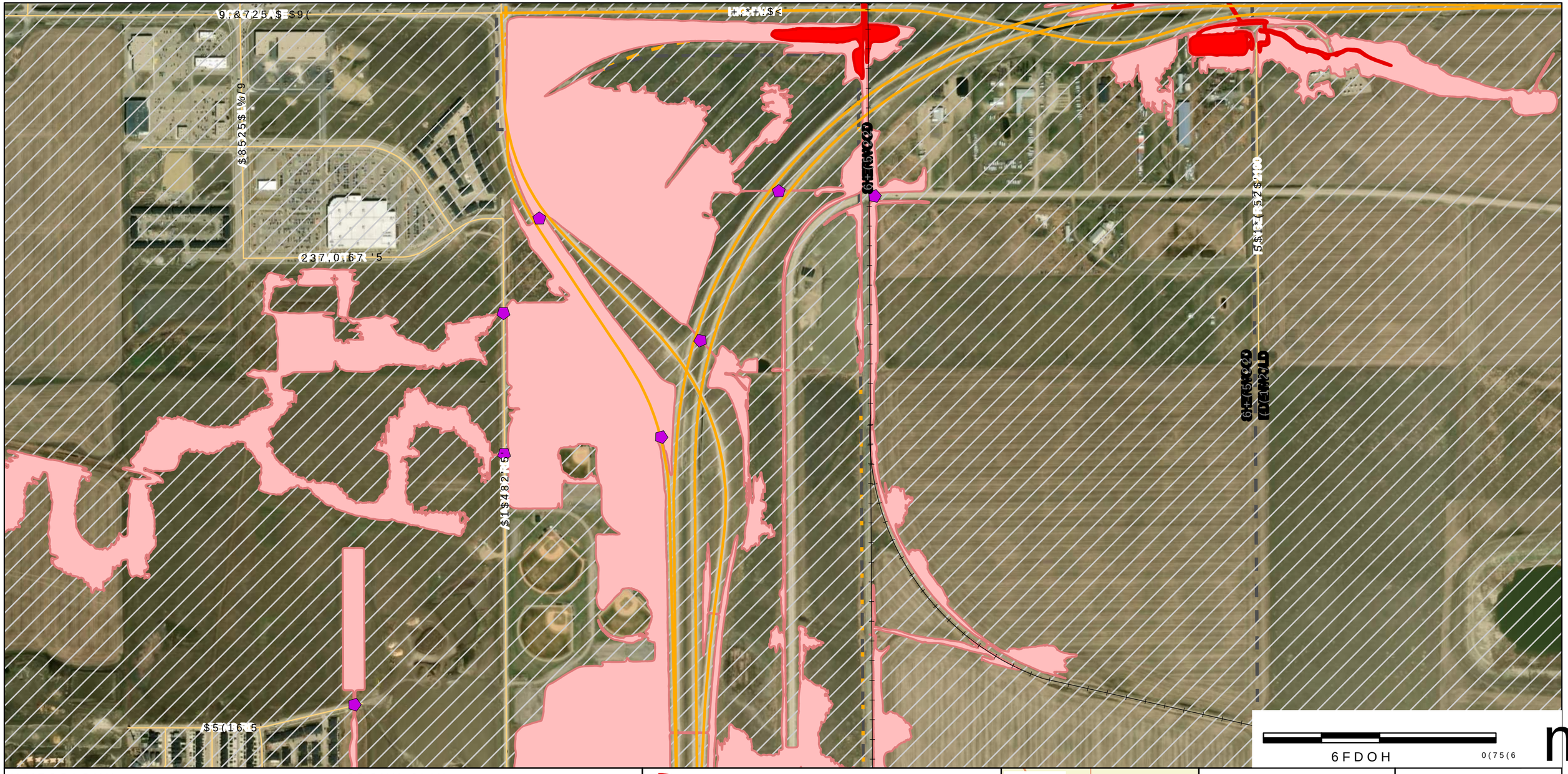

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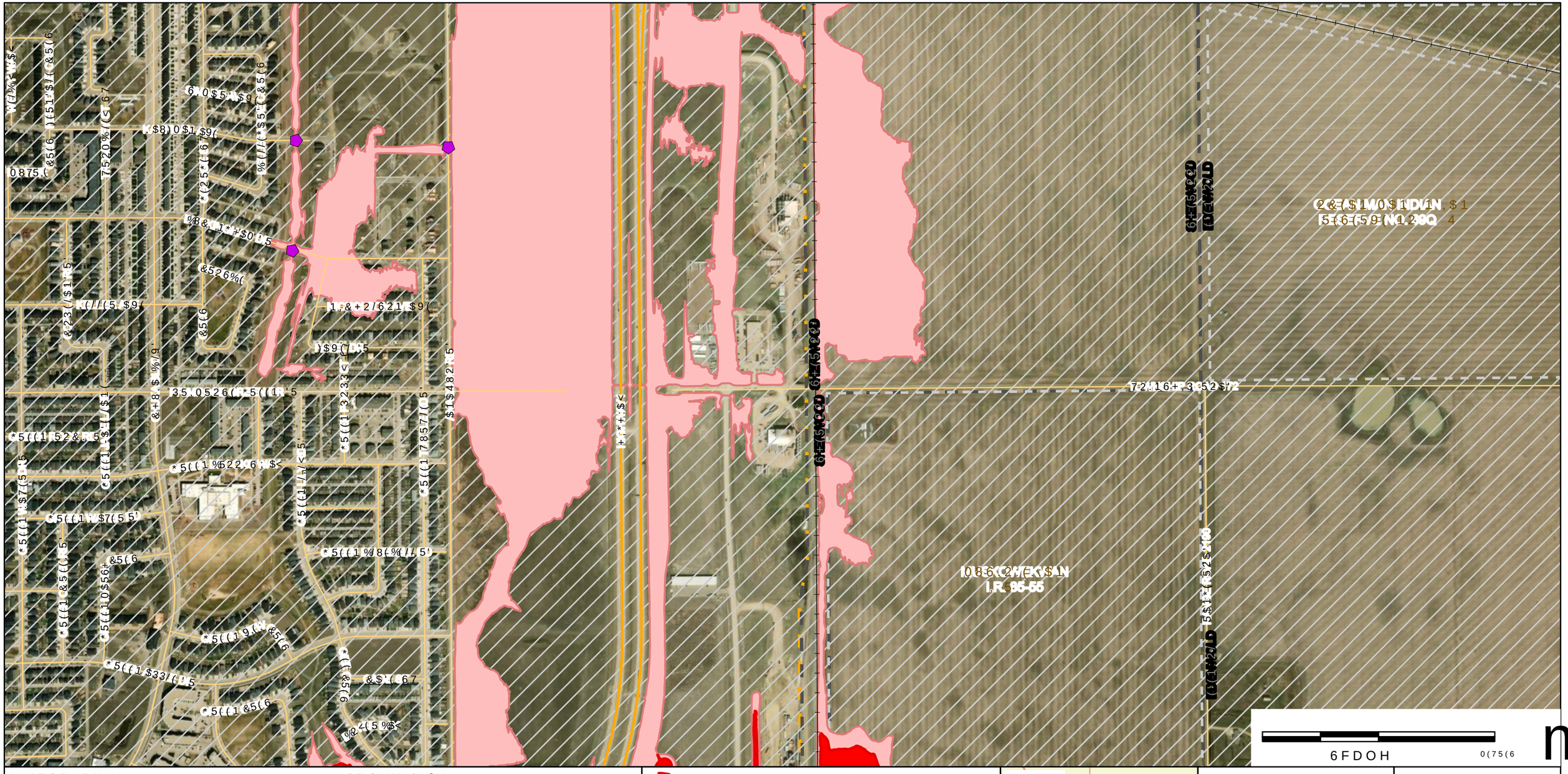

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WKH HYHQW WKDW SUHFLVLRQ DQG FXUDSHQFRWHFWLRQ DUH &HUWLQHG
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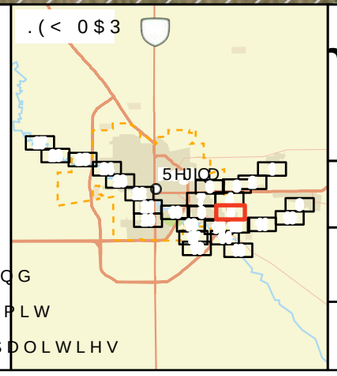

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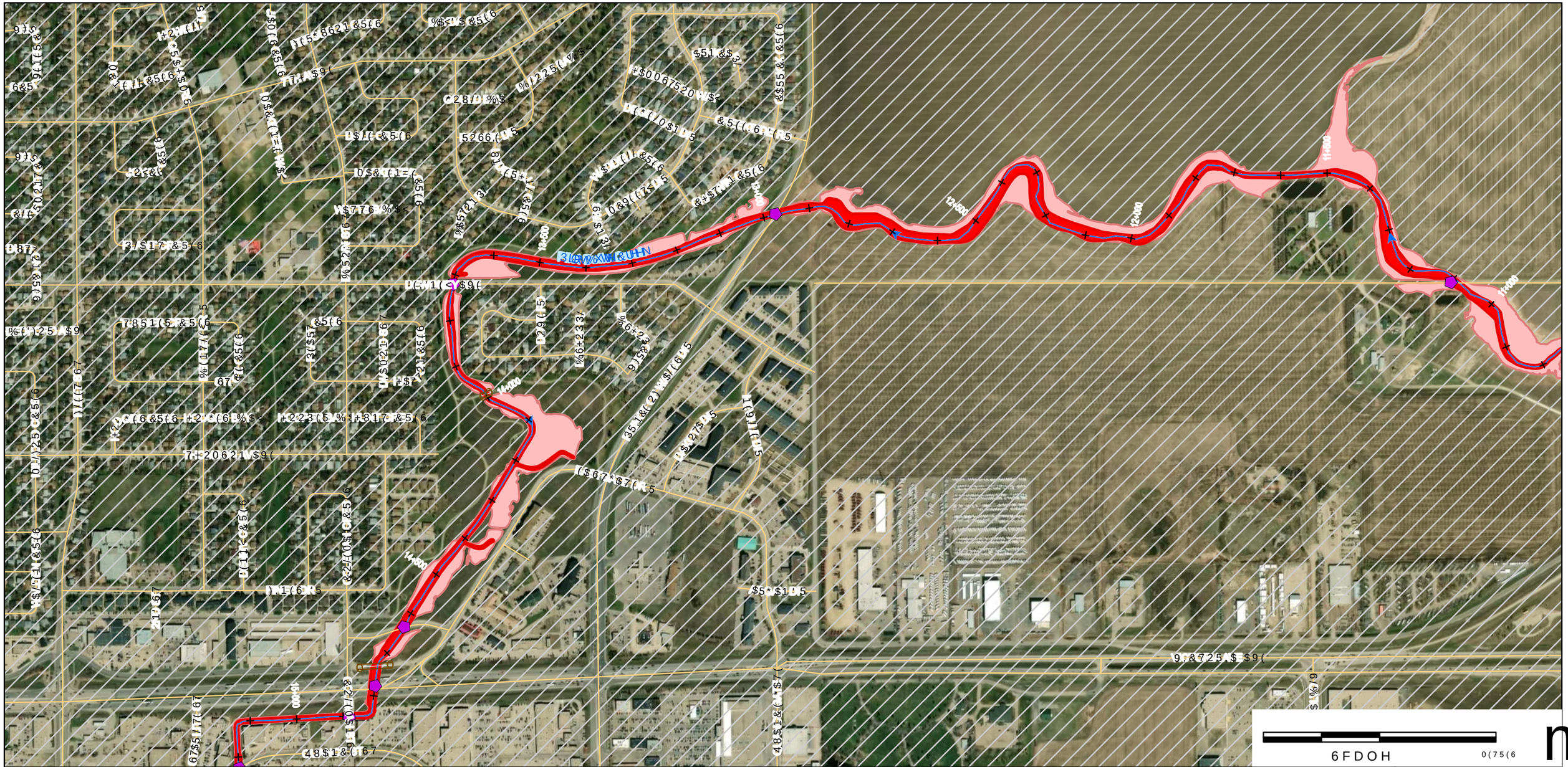

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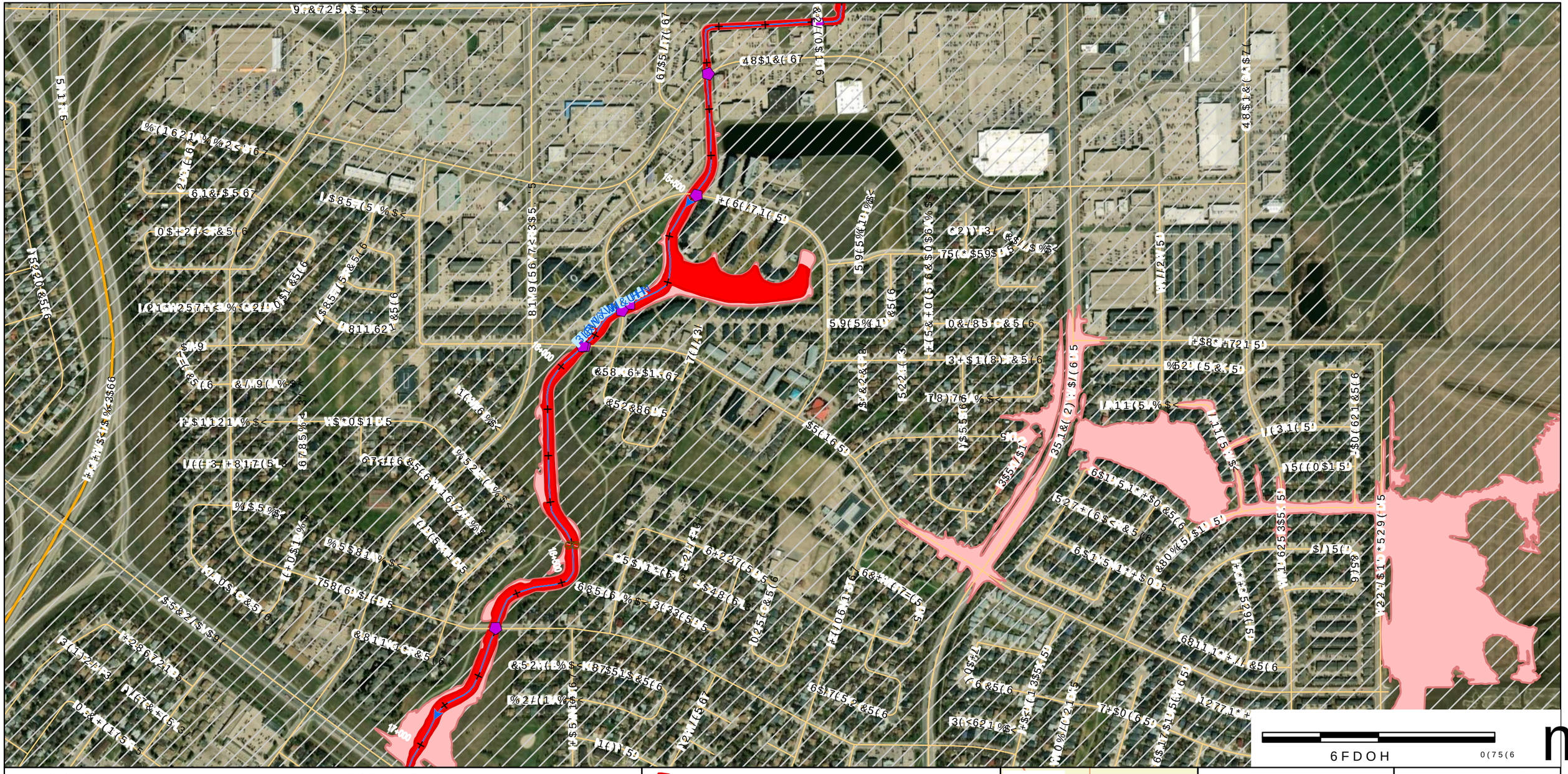
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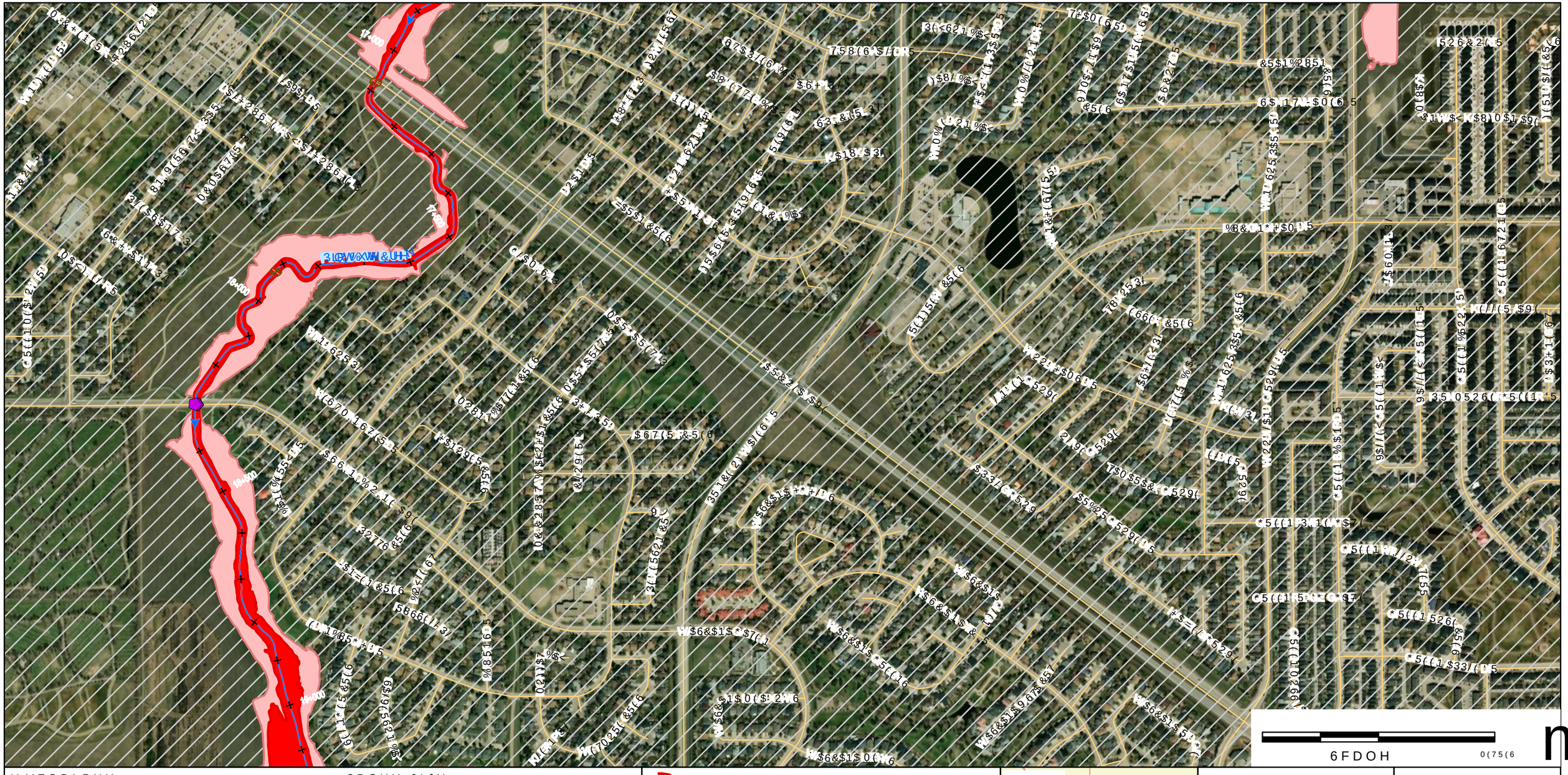

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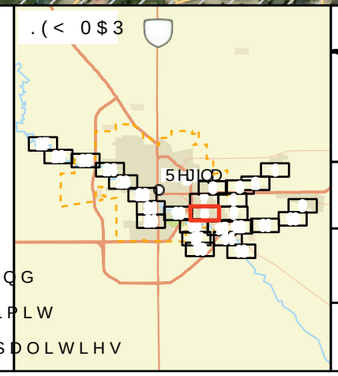

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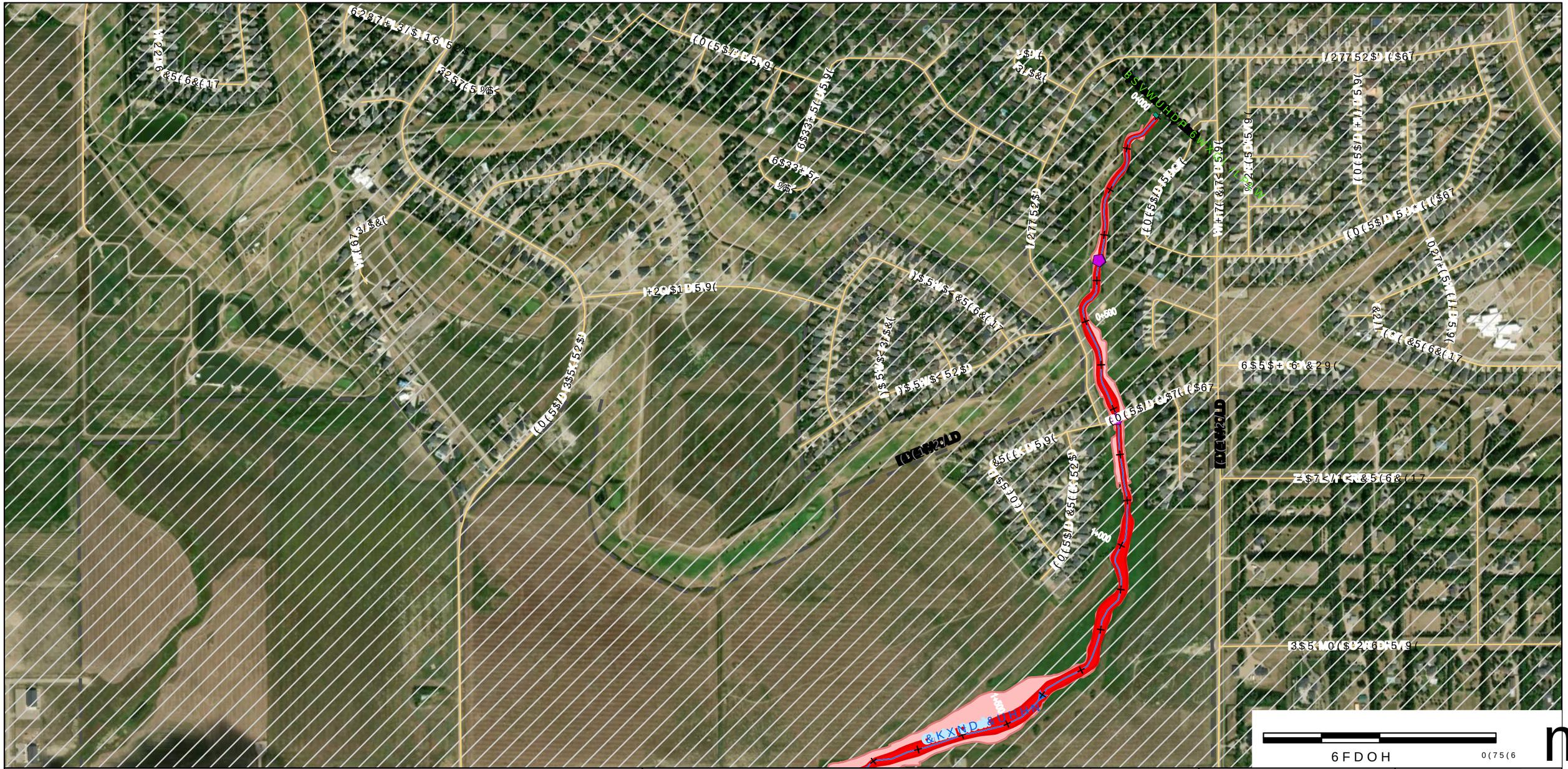

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XVHU LV DGYLVHG WR FRQILUP WKH LQHRUHDWLRQ FRQWDLQHG KHUHLQ LQ
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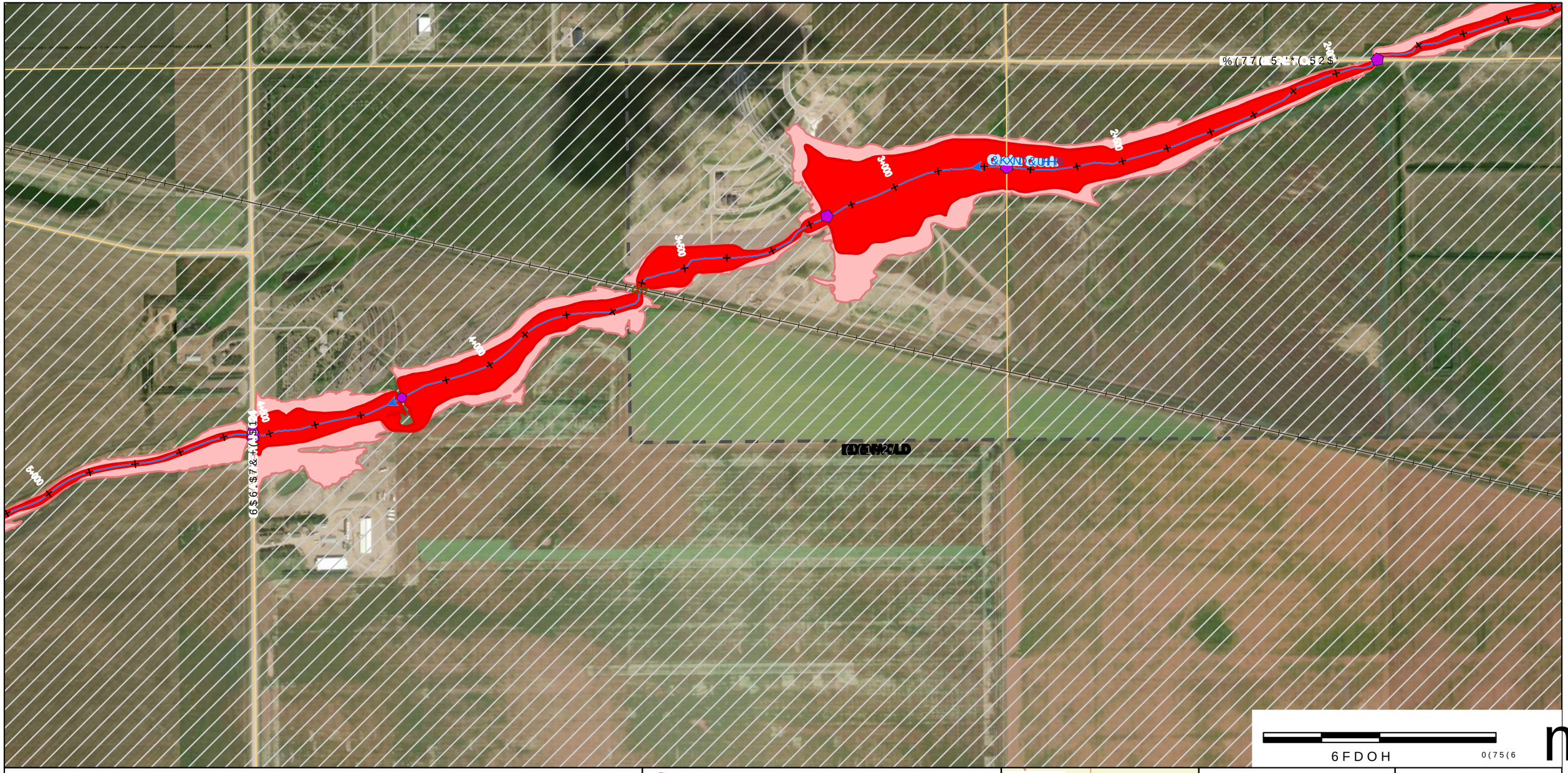

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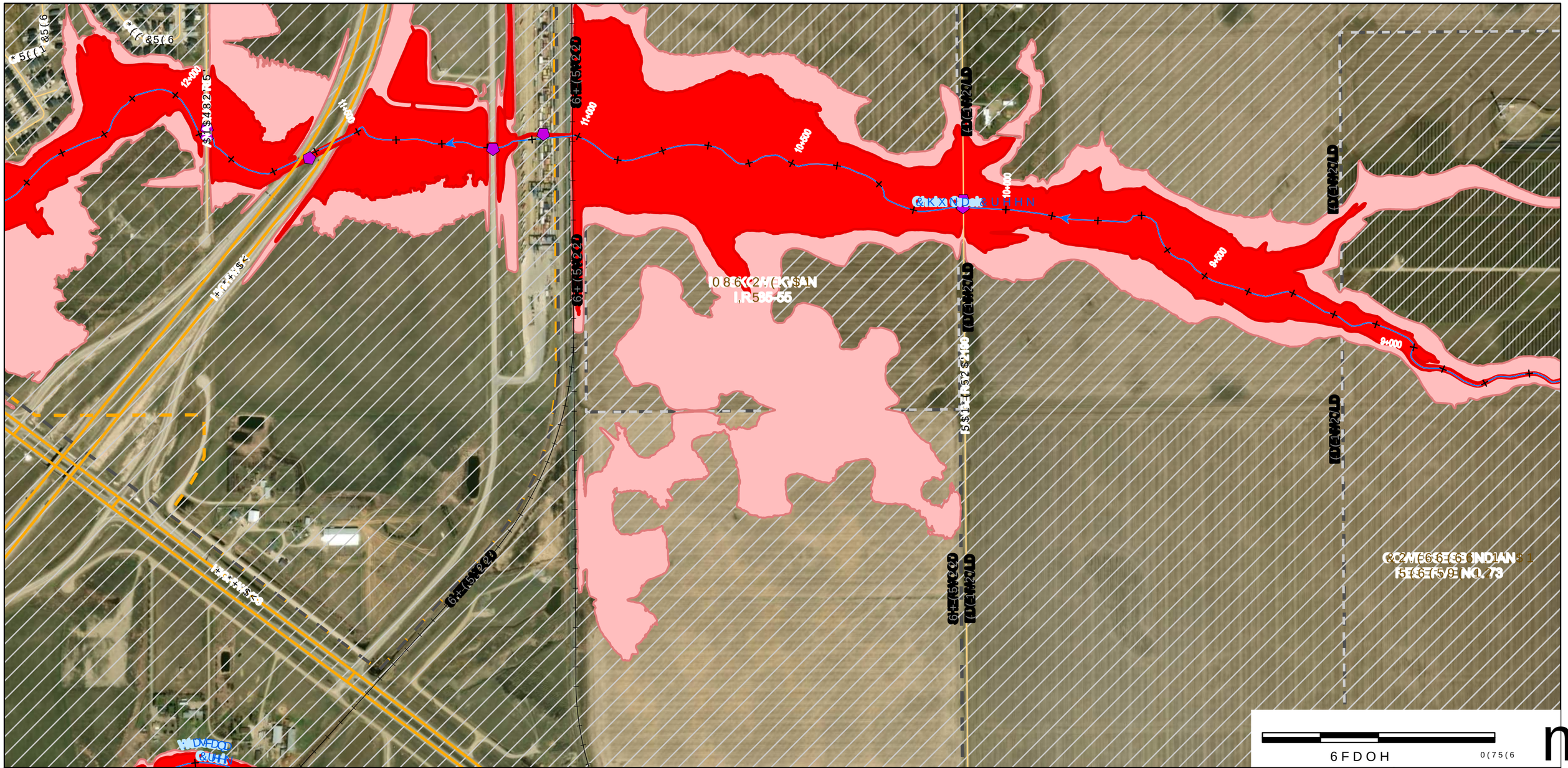
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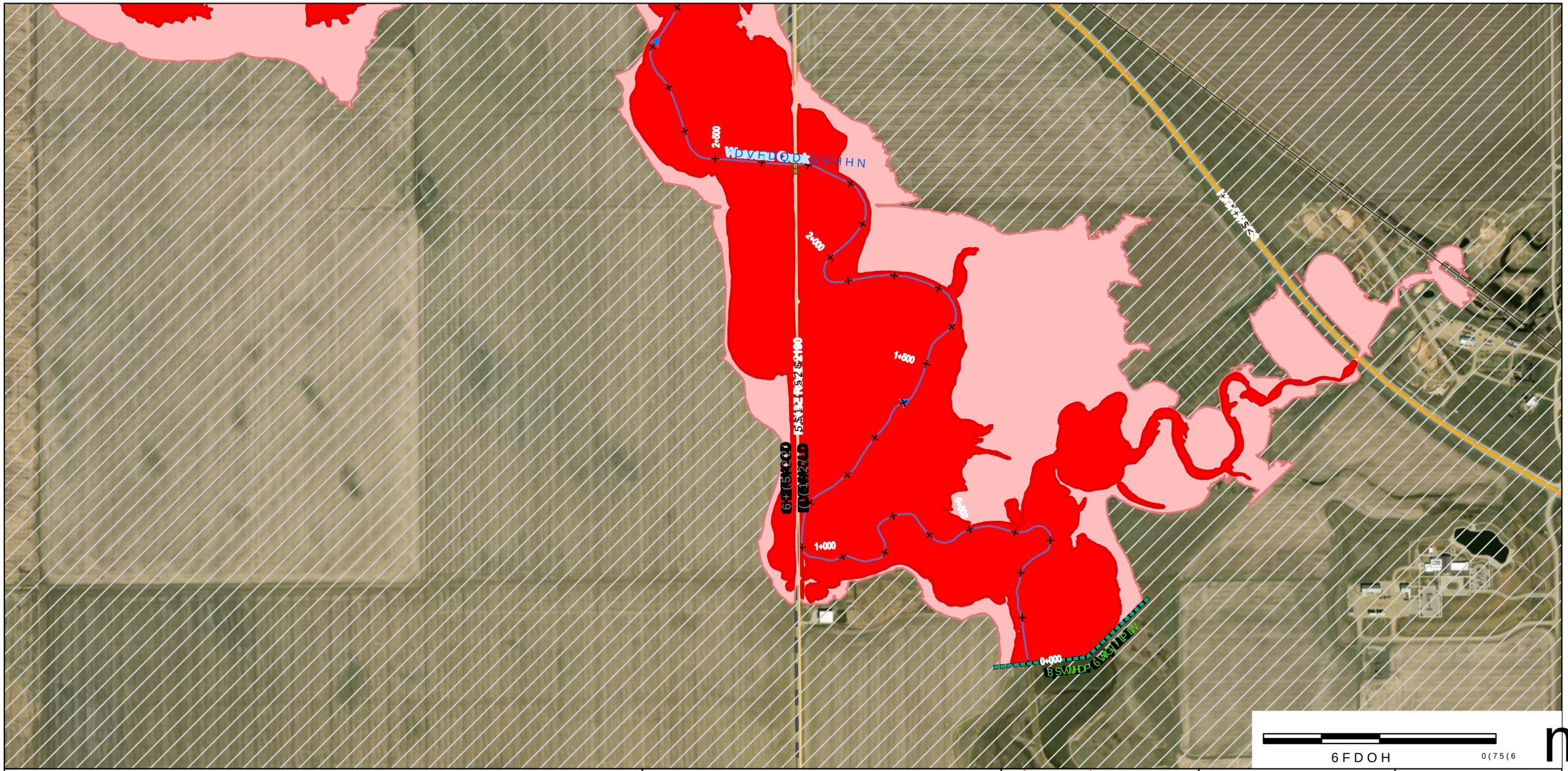

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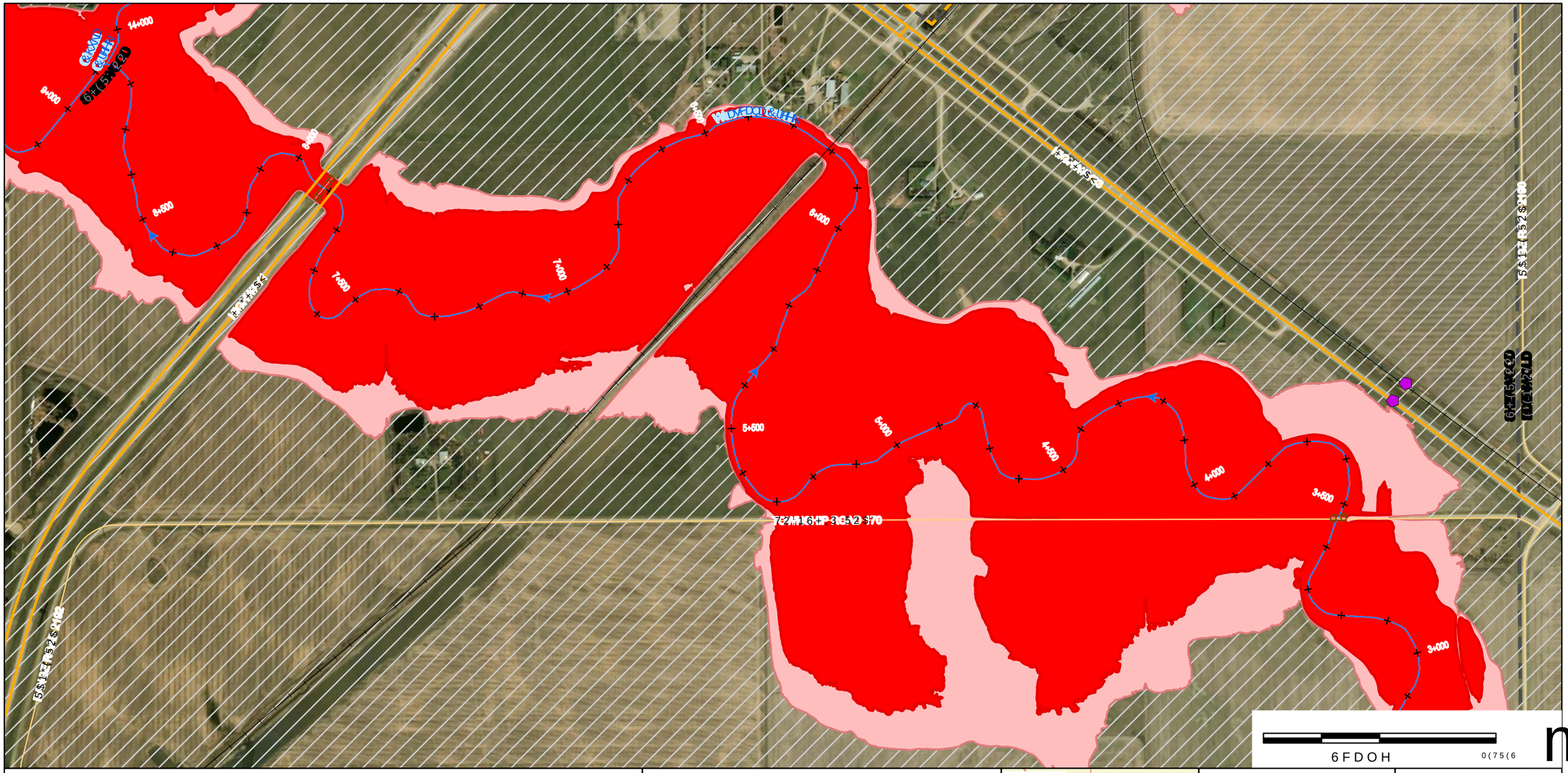

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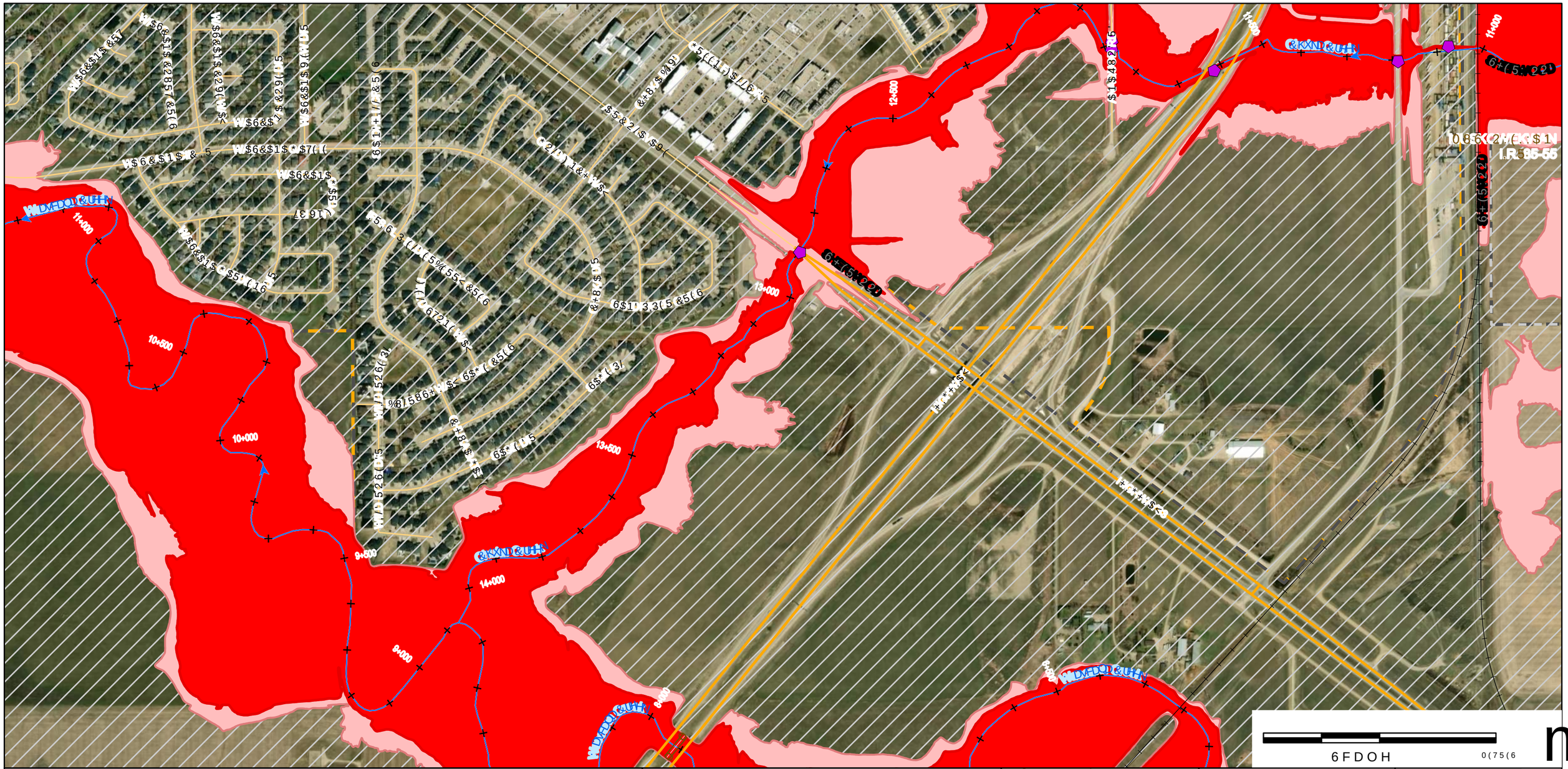

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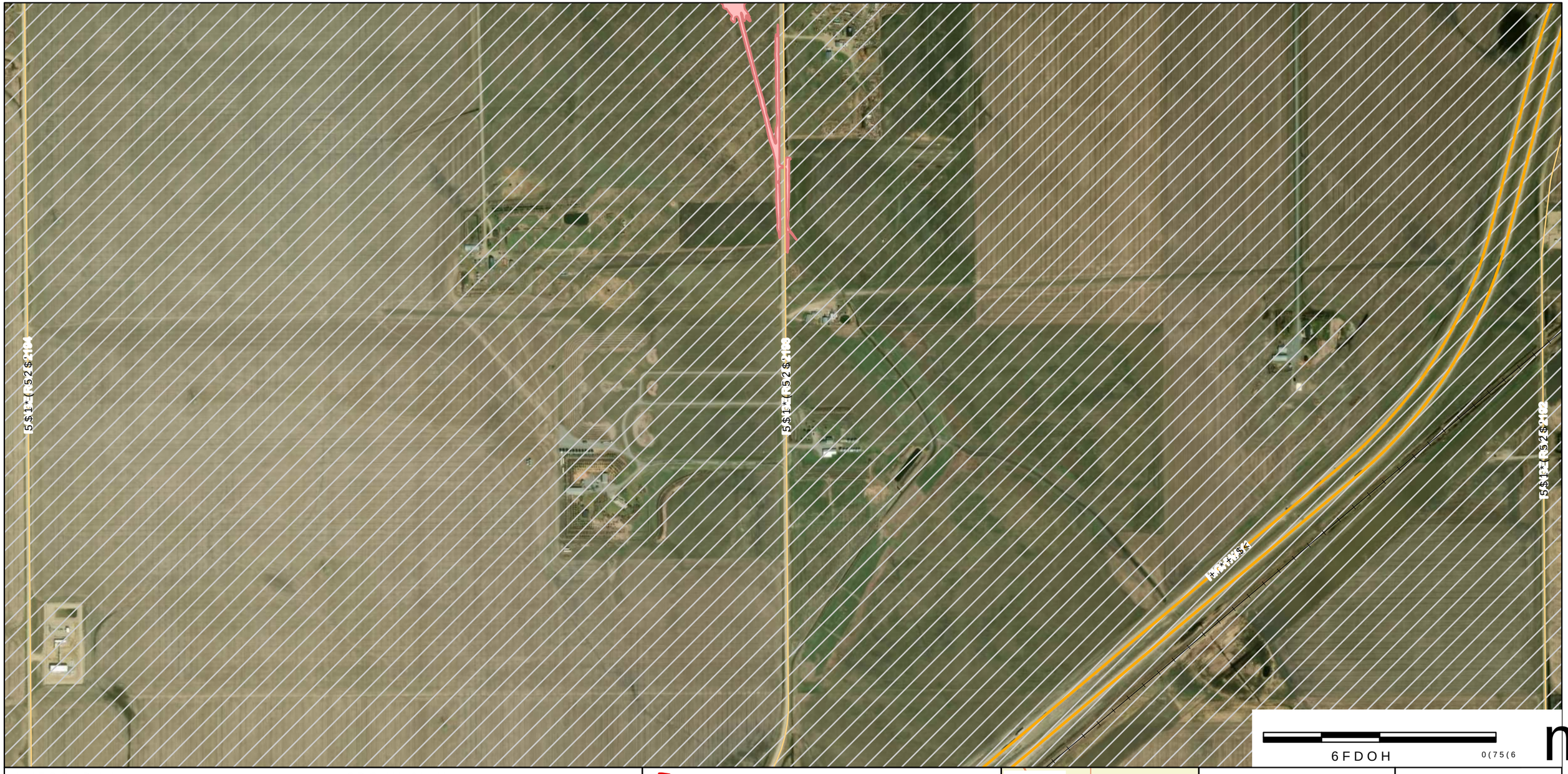

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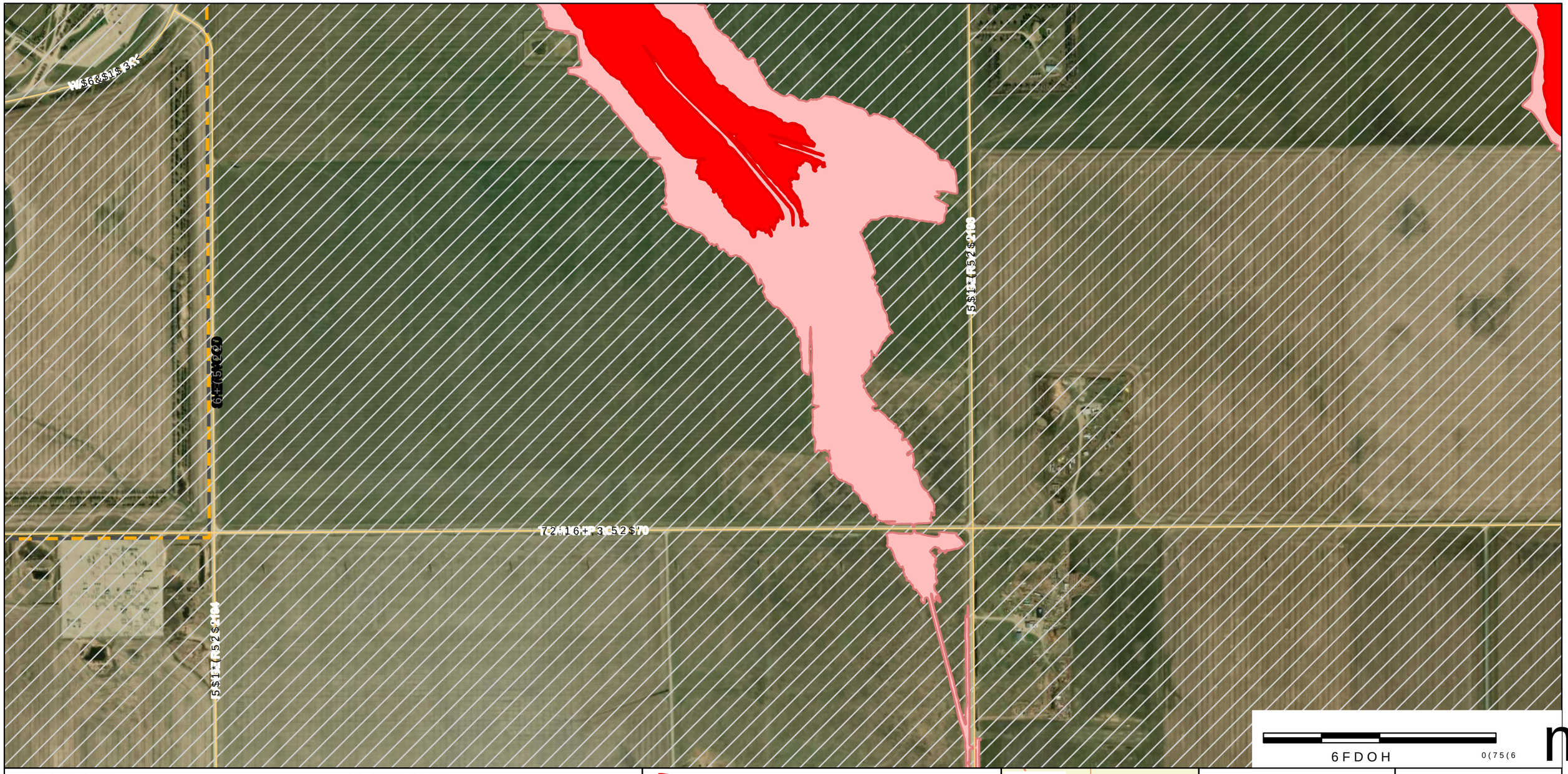

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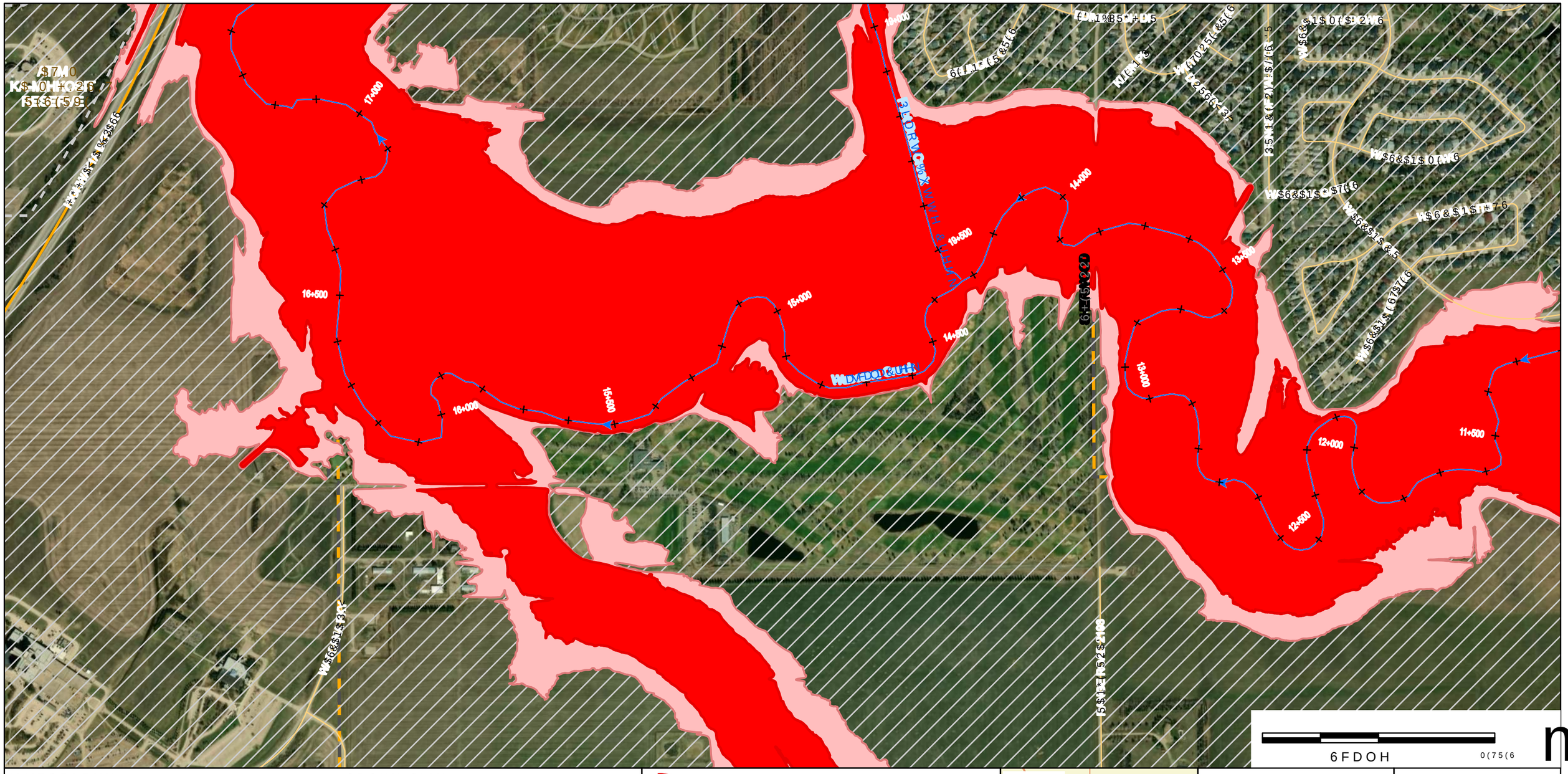

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:HLU
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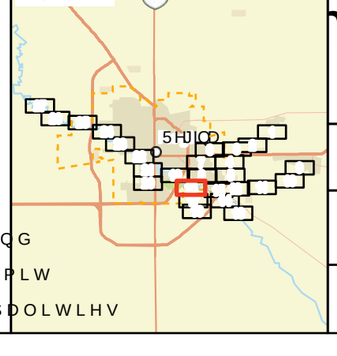

Water Security Agency

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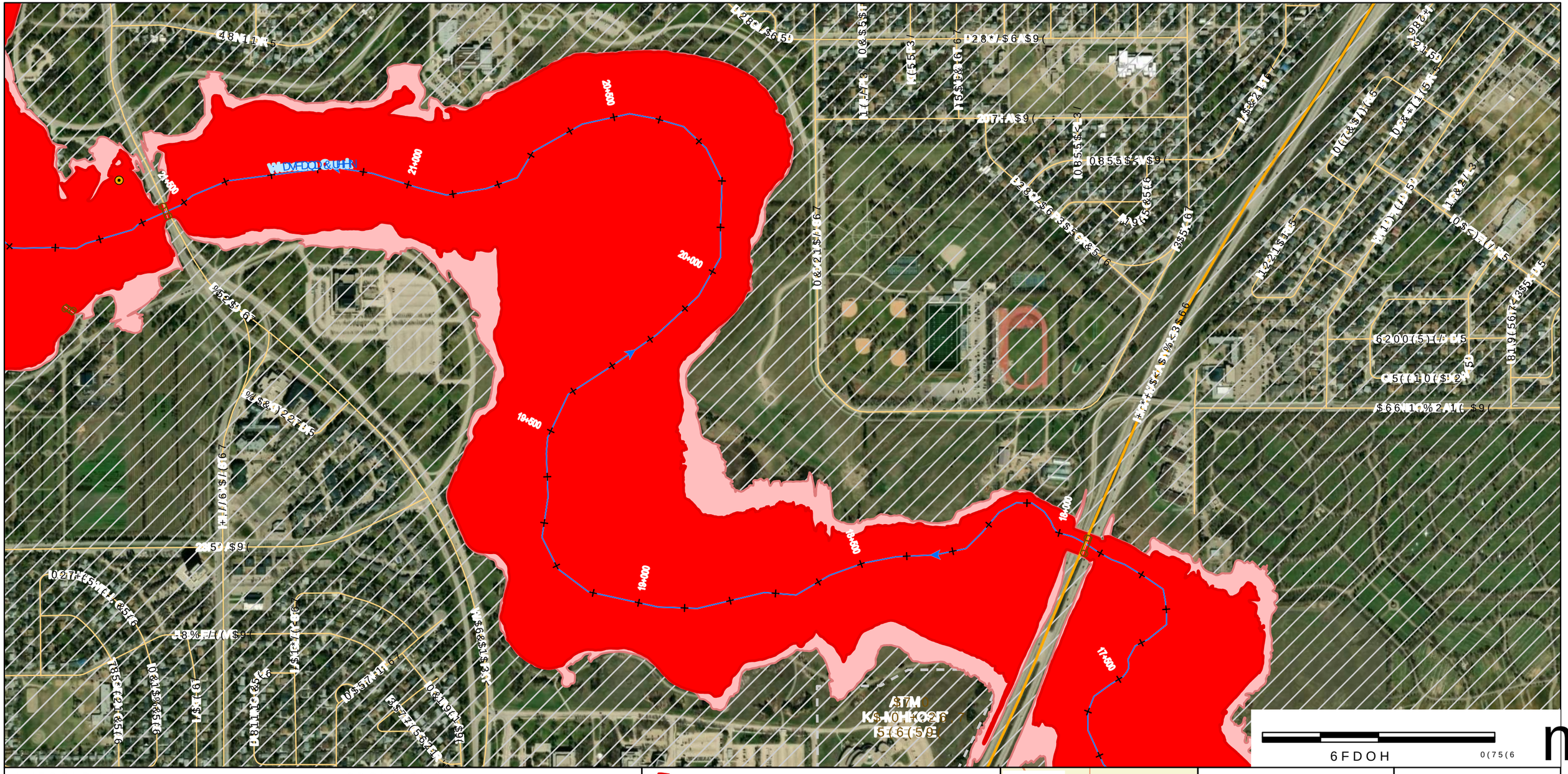

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Water Security Agency

Canada

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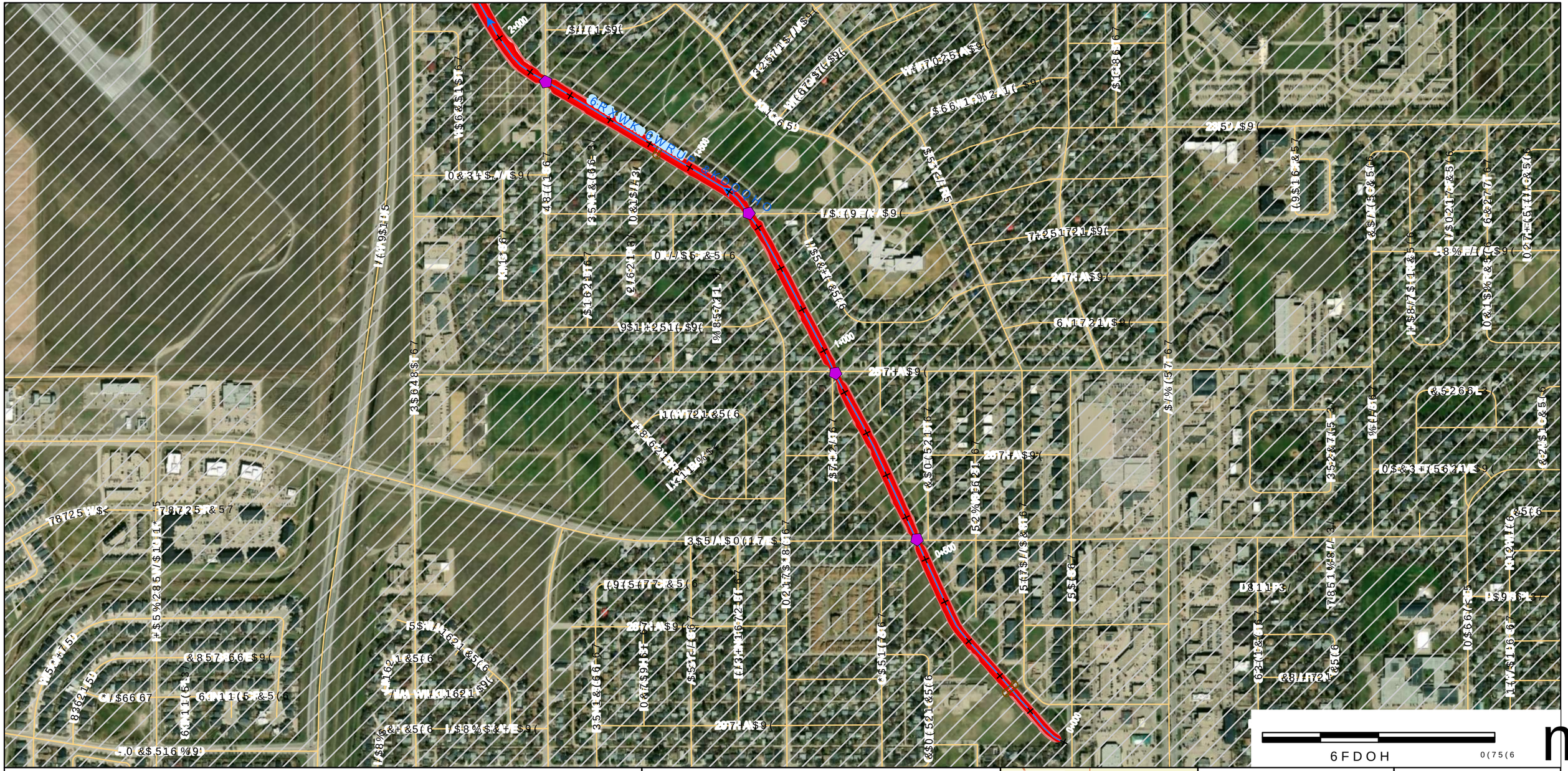
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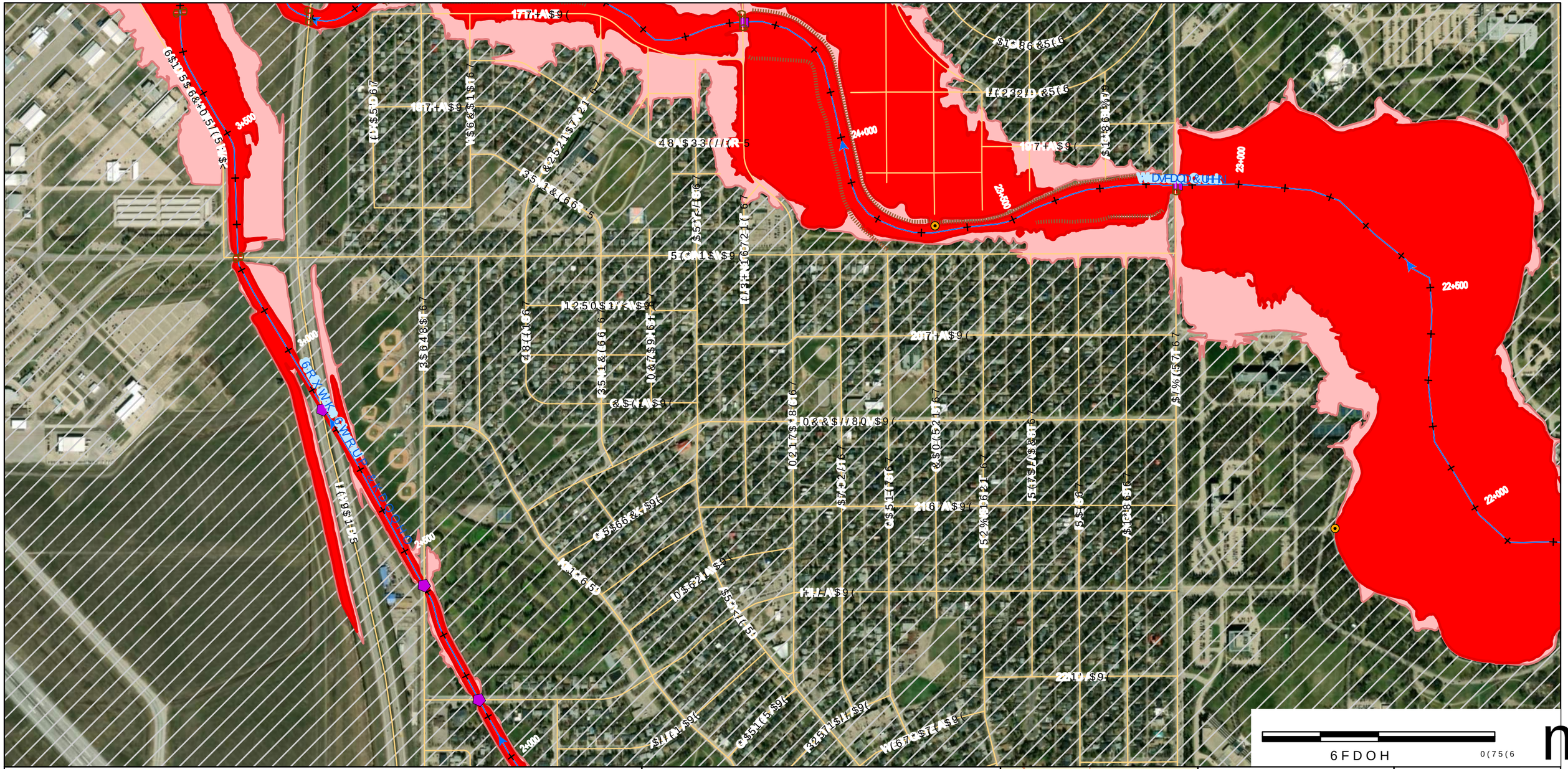

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Water Security Agency

Canada

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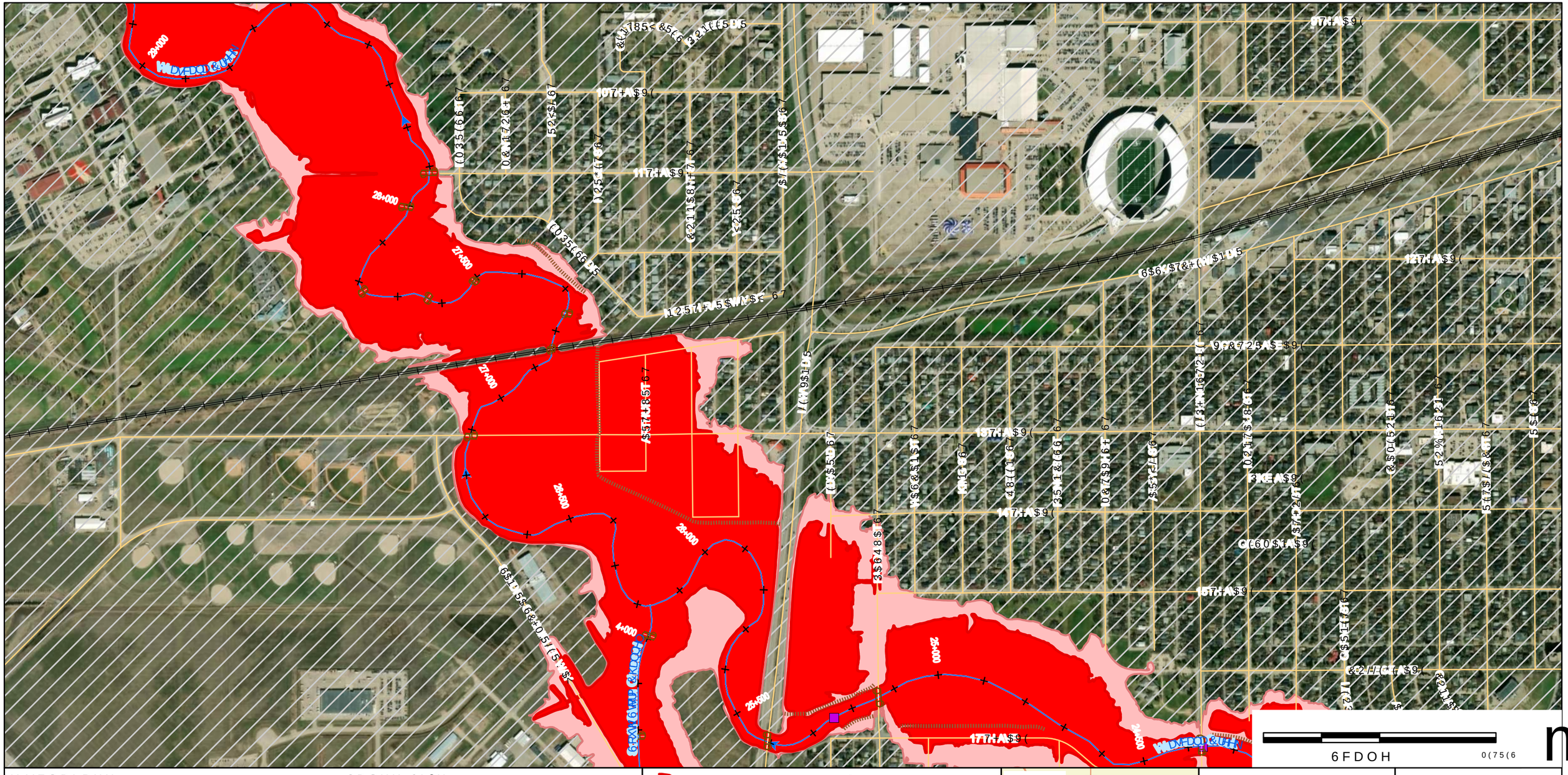

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0DS 3URGXFHG %\
$(&20 &DQDGD 8/&
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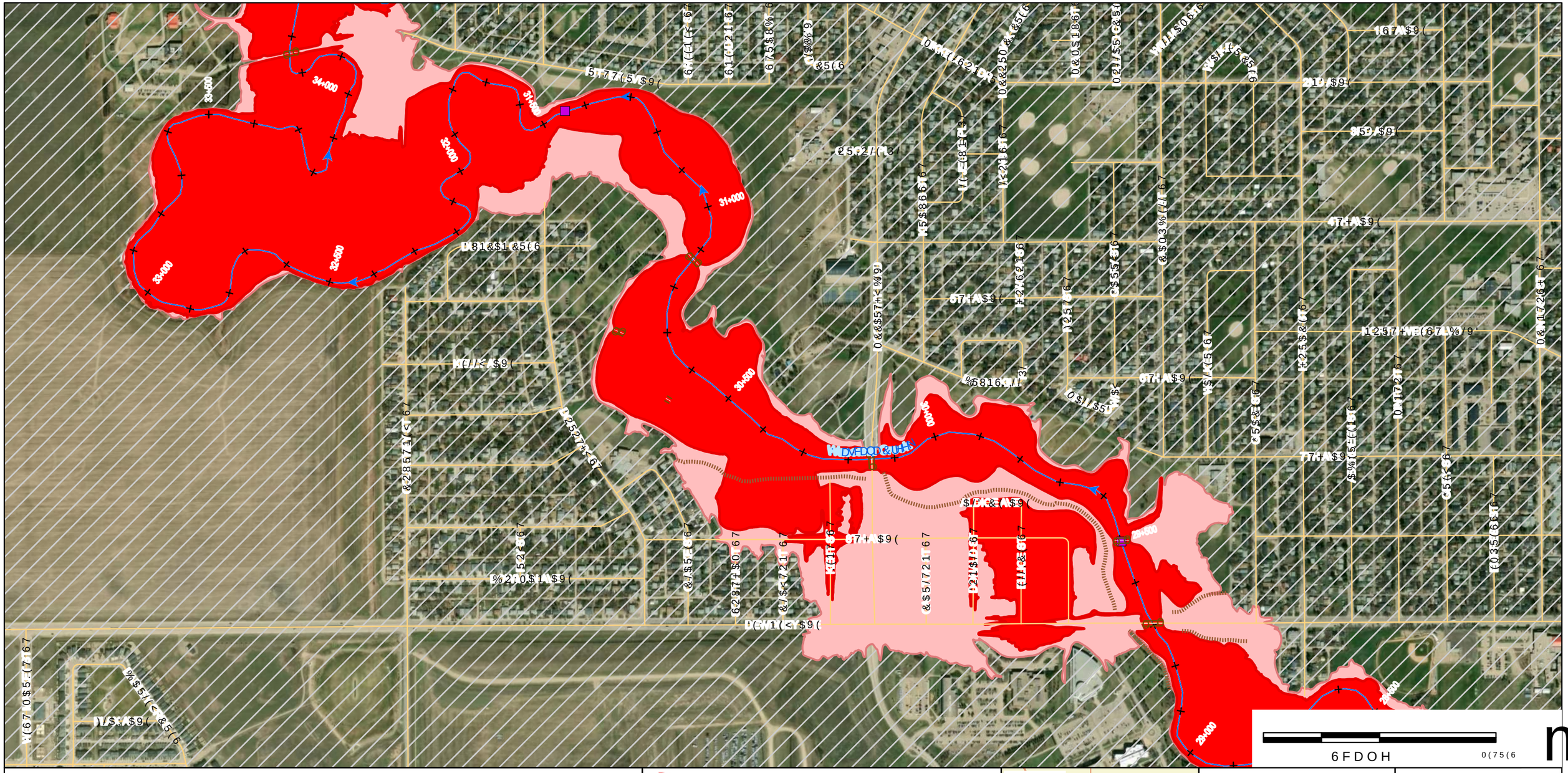

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Water Security Agency

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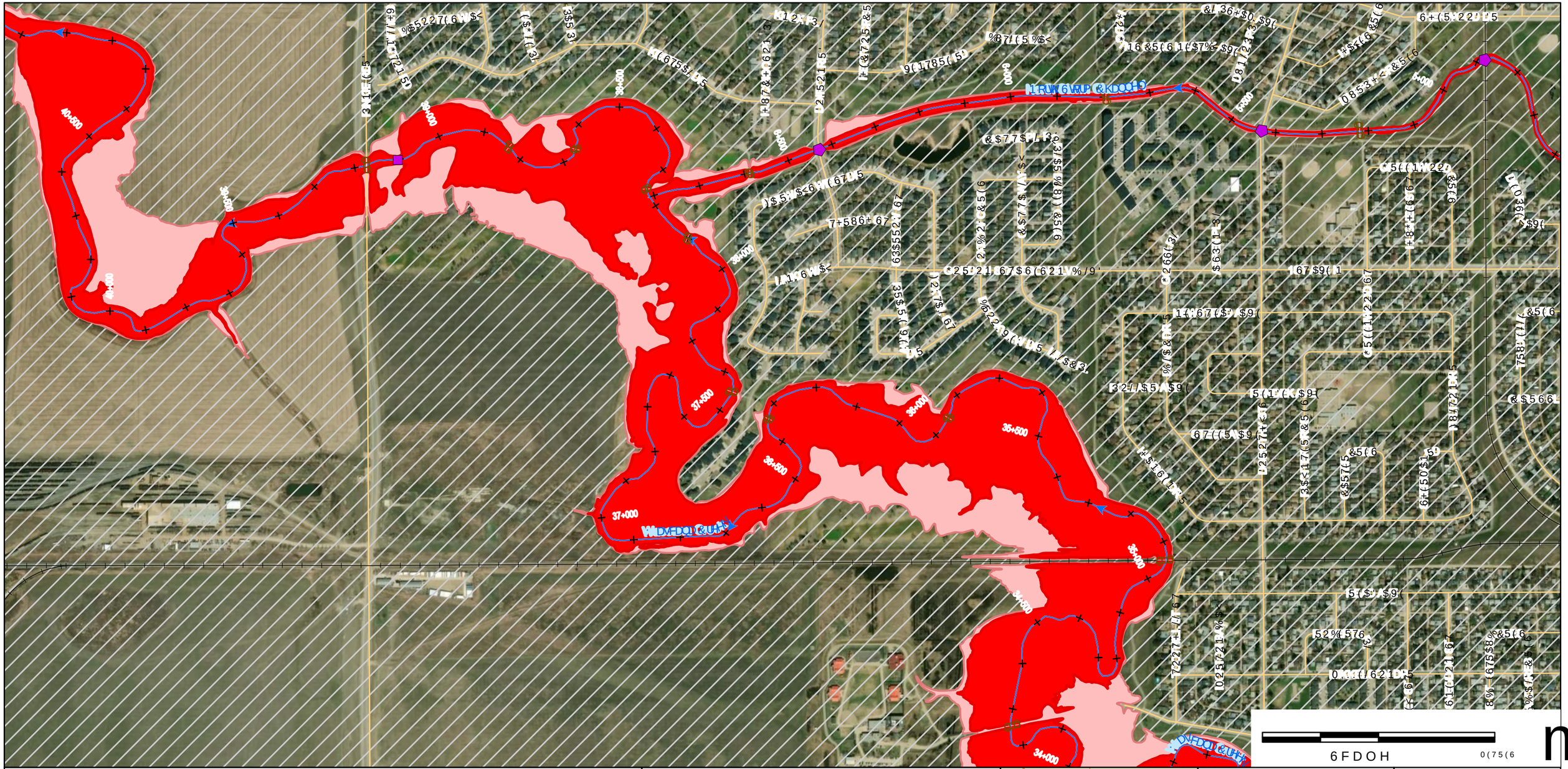
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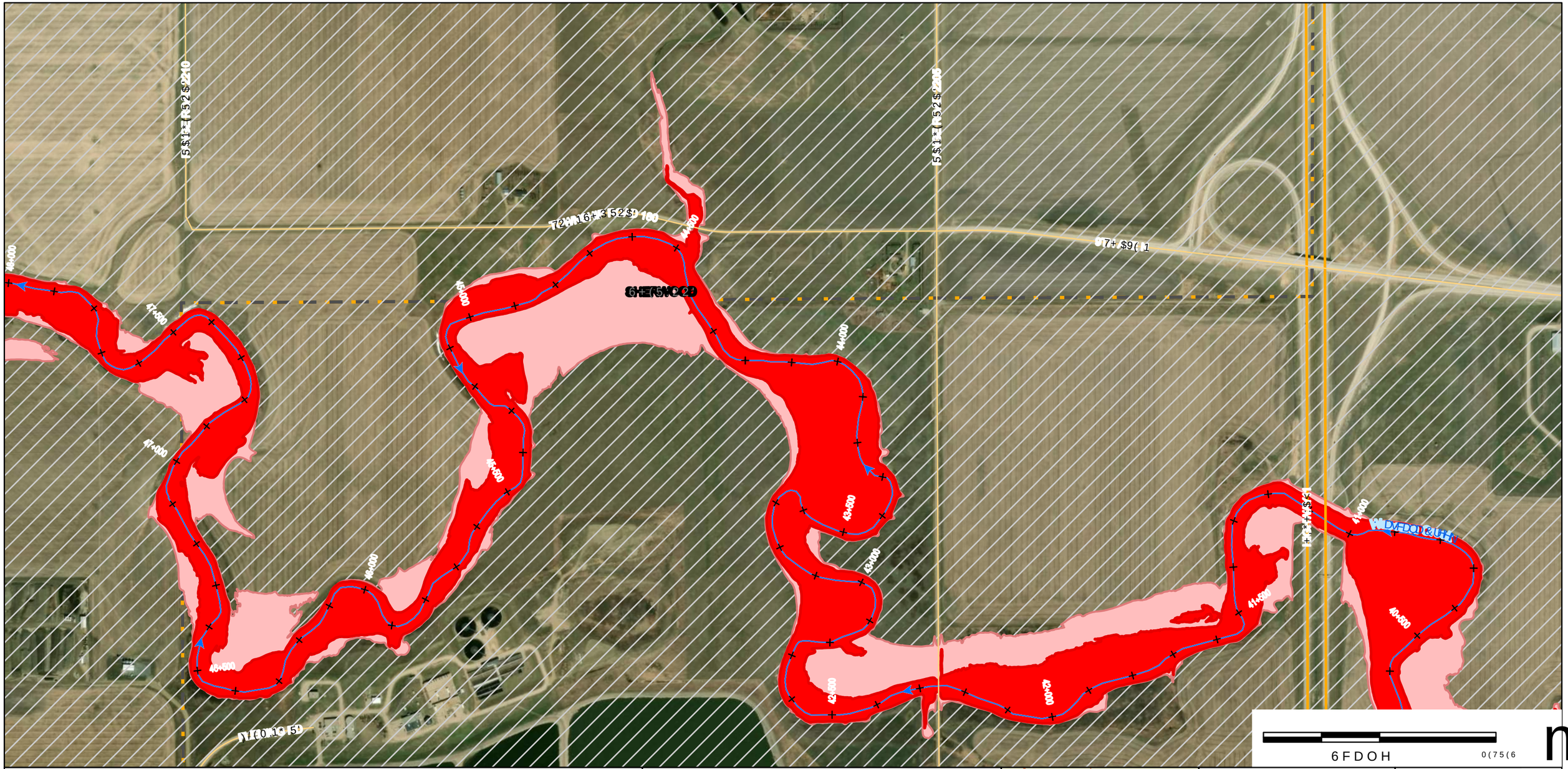

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FLUFXPVWDQFHV DQG DYDLODEOH GDWD 1$ &656 HSRFK
UHSUHVHQWDWLRQ WKDW WKLV PDS ZLOO EH DX'DWXHQW *RU DOO XVHV 7KH
XVHU LV DGYLVHG WR FRQILUP WKH LQHRUPDWLRQ FRQWDLQHG KHUHLQ LQ
WKH HYHQW WKDW SUHFLVLRQ DQG FXUUHQFRRI GDWD 8/0 &656 (UHSQGHG =RQH 1RUWK
:6$ UHFRPPHQGV FRQILUPLQJ WKH IORRG KDWDUG VWDWXV RI
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WRU 6$ PDNH DQRXP 1$' &656 HSRFK
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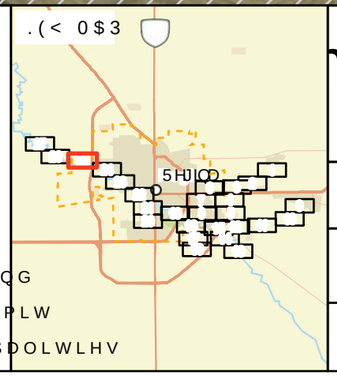

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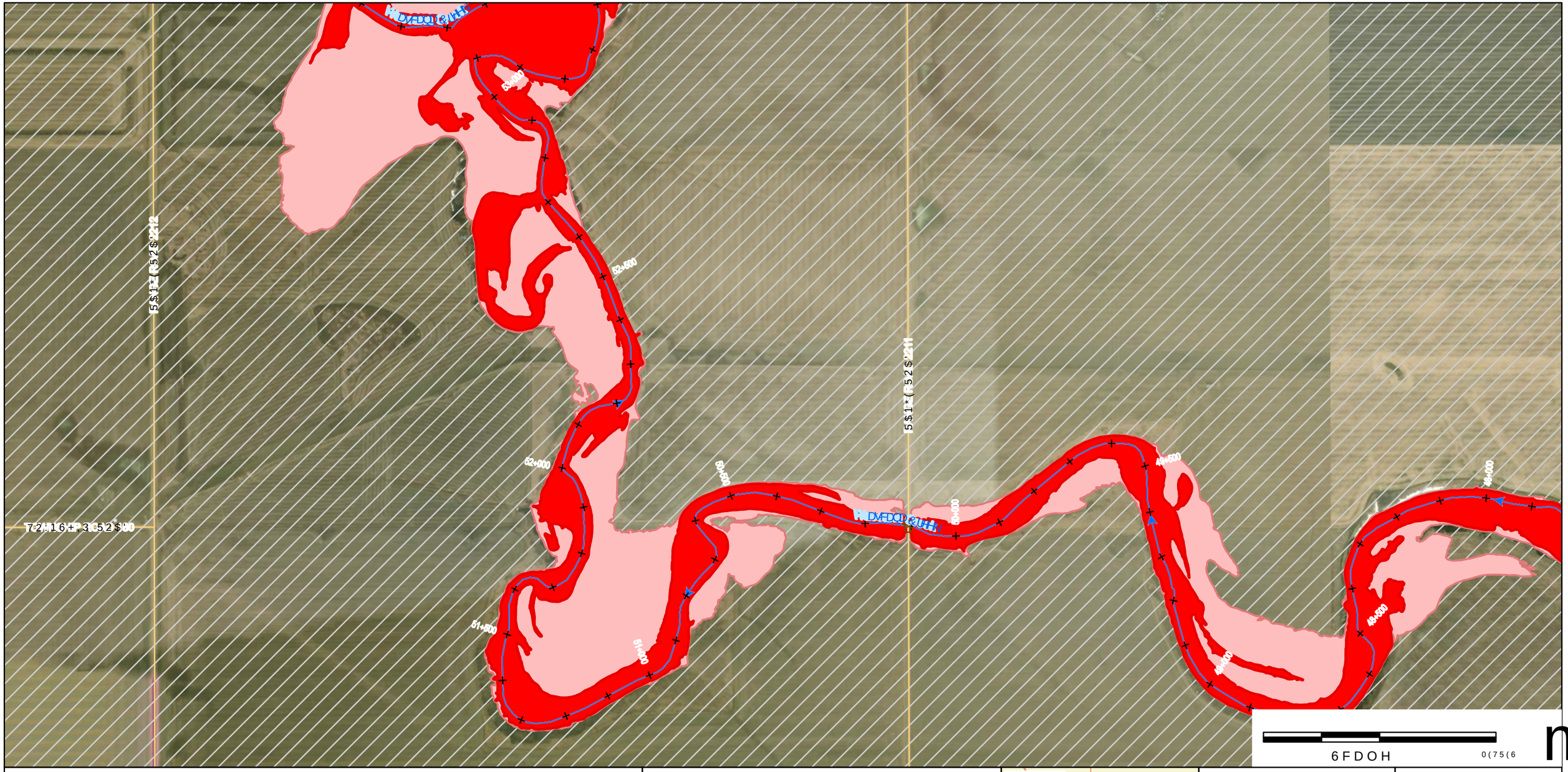

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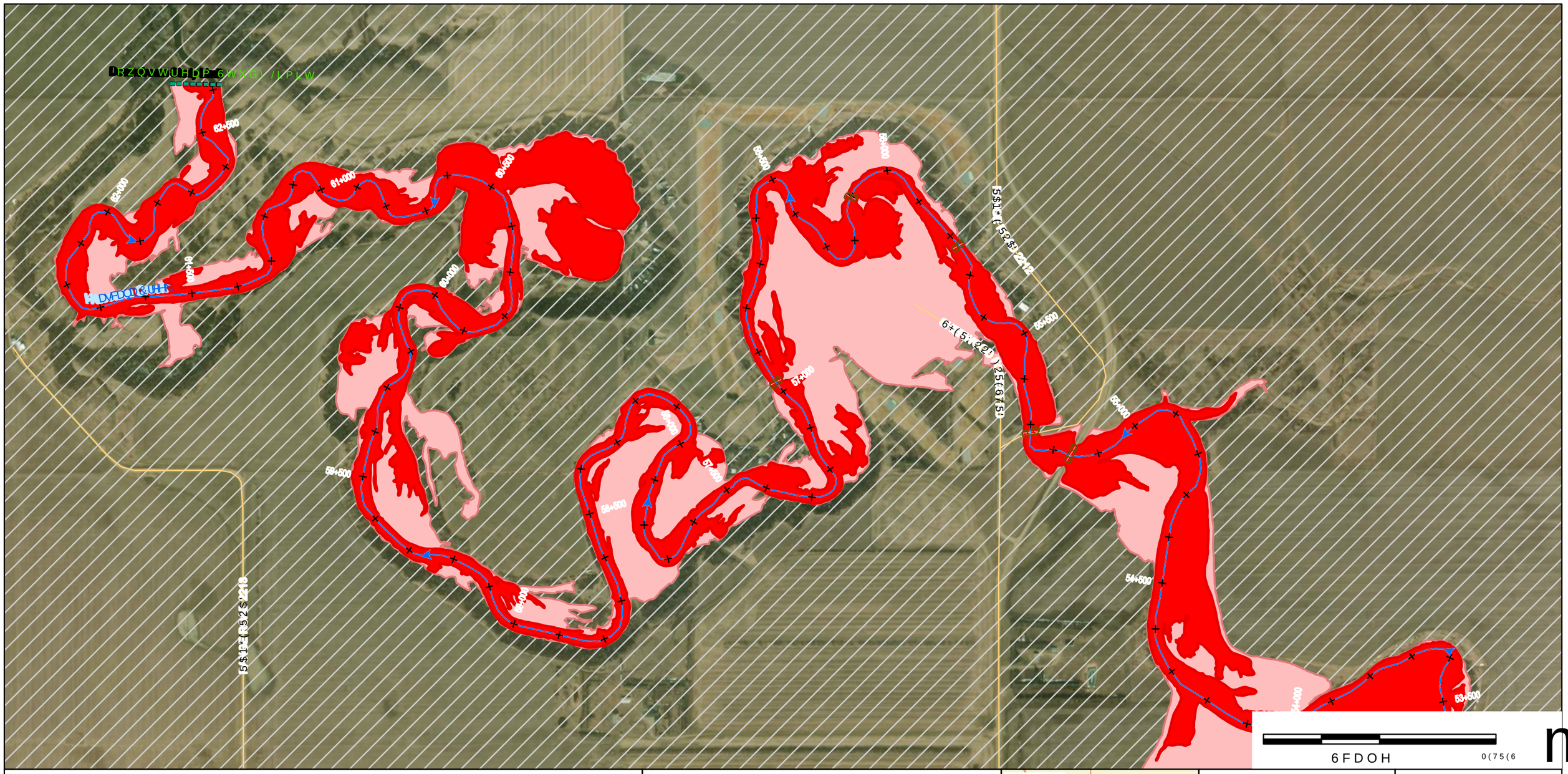

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0DS 3URGXFHG %\

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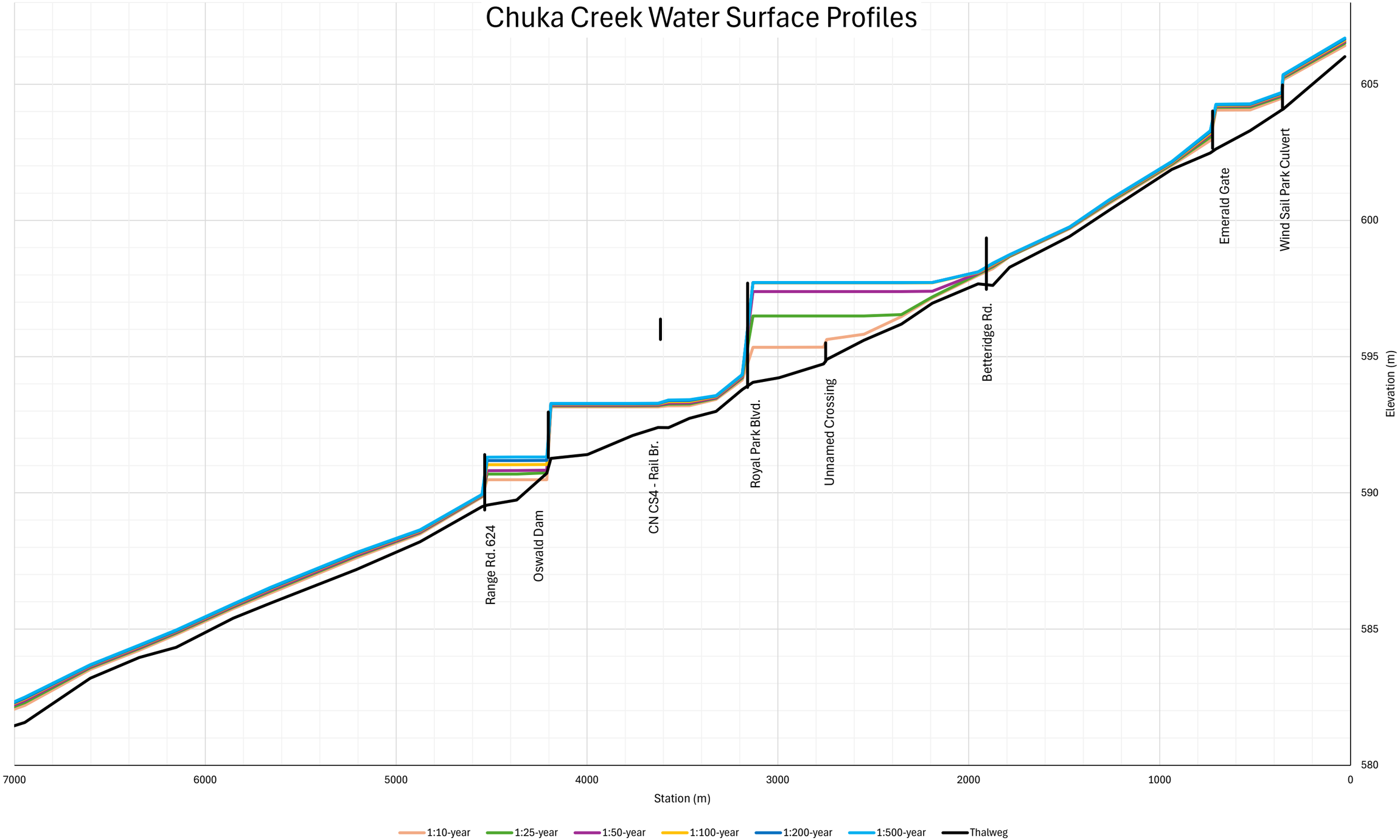
Appendix E. FLOOD PROFILES

Chuka Creek Water Surface Profiles



Chuka Creek Water Surface Profiles

City of Regina

Highway 33

Anaquod Rd.

Highway 1

D/S of CN Rail - Transload Yard

CN Rail - CS3 - Transload Yard

N/S Grid R.

N/S Grid R.

595
590
585
580
575
570
565

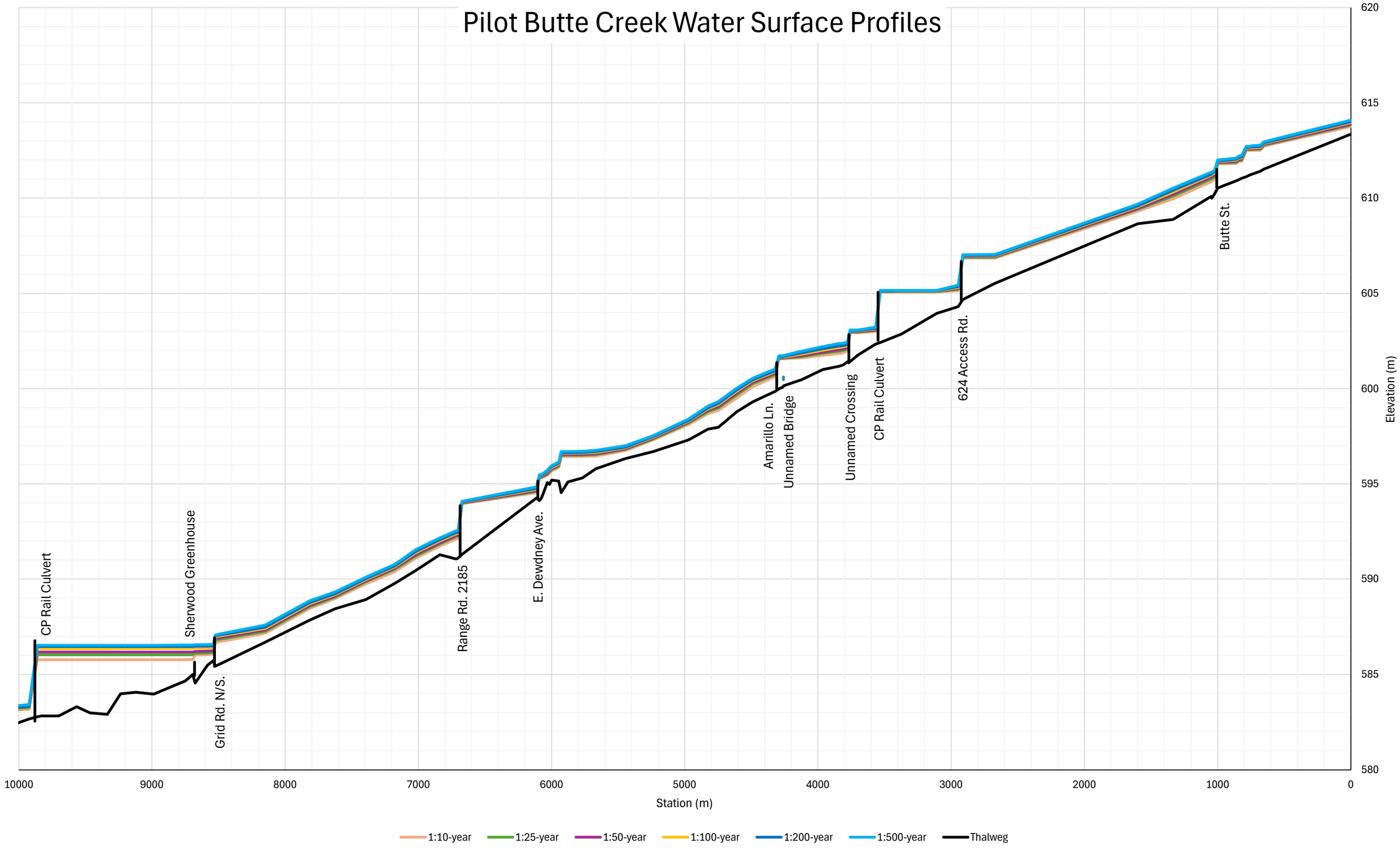
Elevation (m)

14000
13000
12000
11000
10000
9000
8000
7000

Station (m)

1:10-year
1:25-year
1:50-year
1:100-year
1:200-year
1:500-year
Thalweg

Pilot Butte Creek Water Surface Profiles



Pilot Butte Creek Water Surface Profiles

City of Regina

Assiniboine Ave. E.
Westminister Park Pedestrian Br.
Highway 33 Bridge
Truesdale Rd.
Pedestrian Bridge
E. Arens Rd.
Haseltine Rd. & Weir
Haseltine Rd.
Quance St.
Coleman St.
Victoria Ave.
Eastgate Drive Bridge
East Gate Park Bridge
Dewdney Ave. E.
Prince of Wales Dr.
E. Dewdney Ave.
Toer Rd.

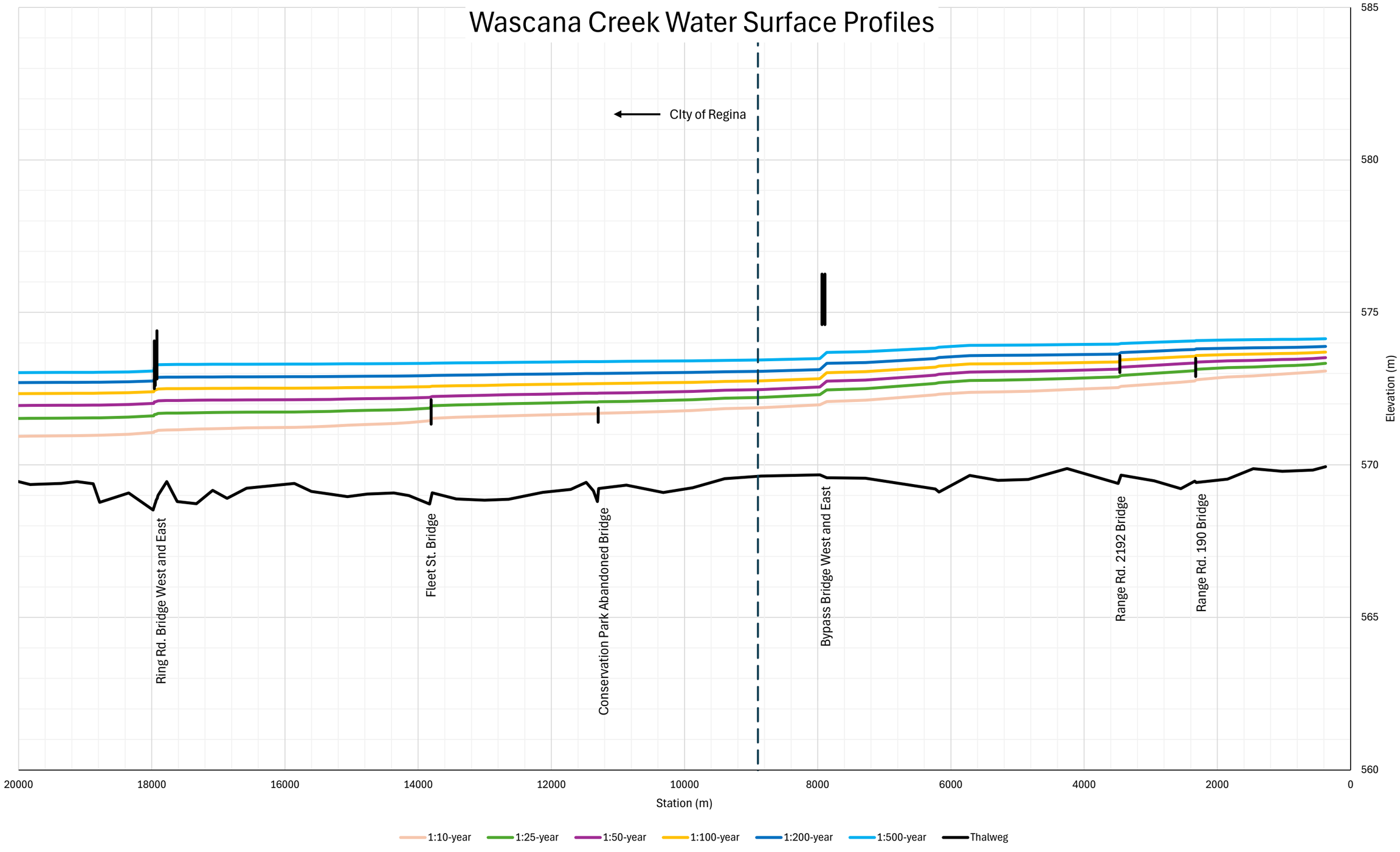
Elevation (m)
600
595
590
585
580
575
570
565
560

20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000

Station (m)

1:10-year
1:25-year
1:50-year
1:100-year
1:200-year
1:500-year
Thalweg

Wascana Creek Water Surface Profiles



Wascana Creek Water Surface Profiles

Pinkie Rd. Bridge
Goulet Golf Course Pedestrian Bridges
Royal Regina Golf Club
Pedesitrian Bridges
CN Rail Bridge
Ritter Ave. Bridge
Dorothy and Ritter Ave. Bridge and weir
Pedestrian Bridge
McCarthy Blvd. Bridge
8th Ave. Bridge and Weir
Dewdney Ave. Bridge
11th Ave. Bridge
CP Rail Bridge
13th Ave. Bridge
Lewvan Drive Bridge West and East
Pasqua St. Bridge
Coronation St. Bridge
Elphinstone Bridge and Weir
Cameron St. Bridge
Albert St. Bridge and Weir
Pedestrian Bridge
Broad St. Bridge
Goulet Golf Course Bridge and Weir

580
575
570
565
560
555
Elevation (m)

40000
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
Station (m)

1:10-year
1:25-year
1:50-year
1:100-year
1:200-year
1:500-year
Thalweg

Wascana Creek Water Surface Profiles

City of Regina

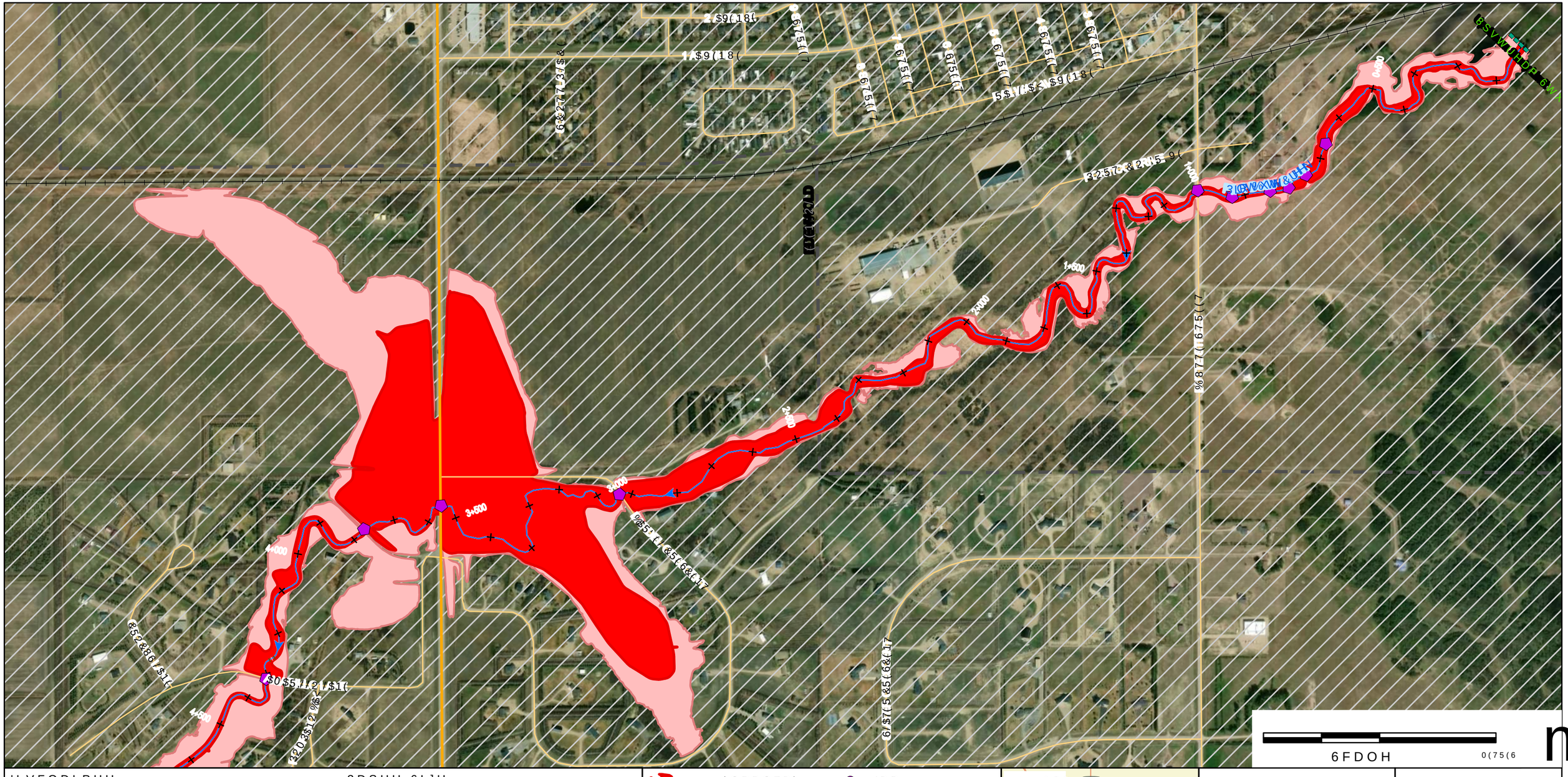
Pedestrian Bridge
Pedestrian Bridge
Range Rd. 2212 Bridge
Range Rd. 2212 Abandoned Bridge
Pedestrian Bridge
N/S Grid Rd.
Condie Rd.
Highway 11 West Bridge
Highway 11 East Bridge

575
570
565
560
555
550
Elevation (m)

60000
58000
56000
54000
52000
50000
48000
46000
44000
42000
40000
Station (m)

1:10-year
1:25-year
1:50-year
1:100-year
1:200-year
1:500-year
Thalweg

Appendix F. FLOOD HAZARD AWARENESS MAPS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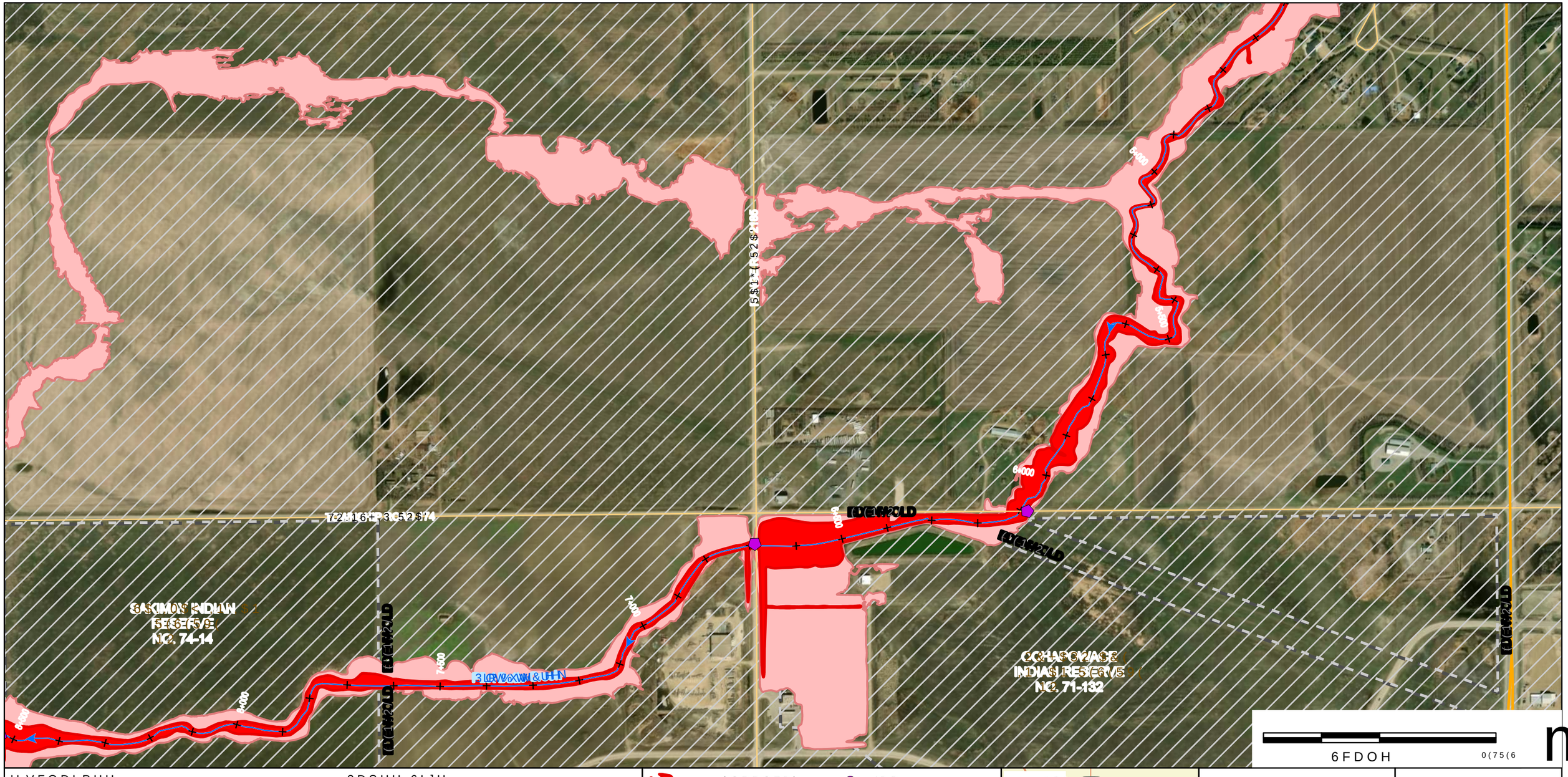
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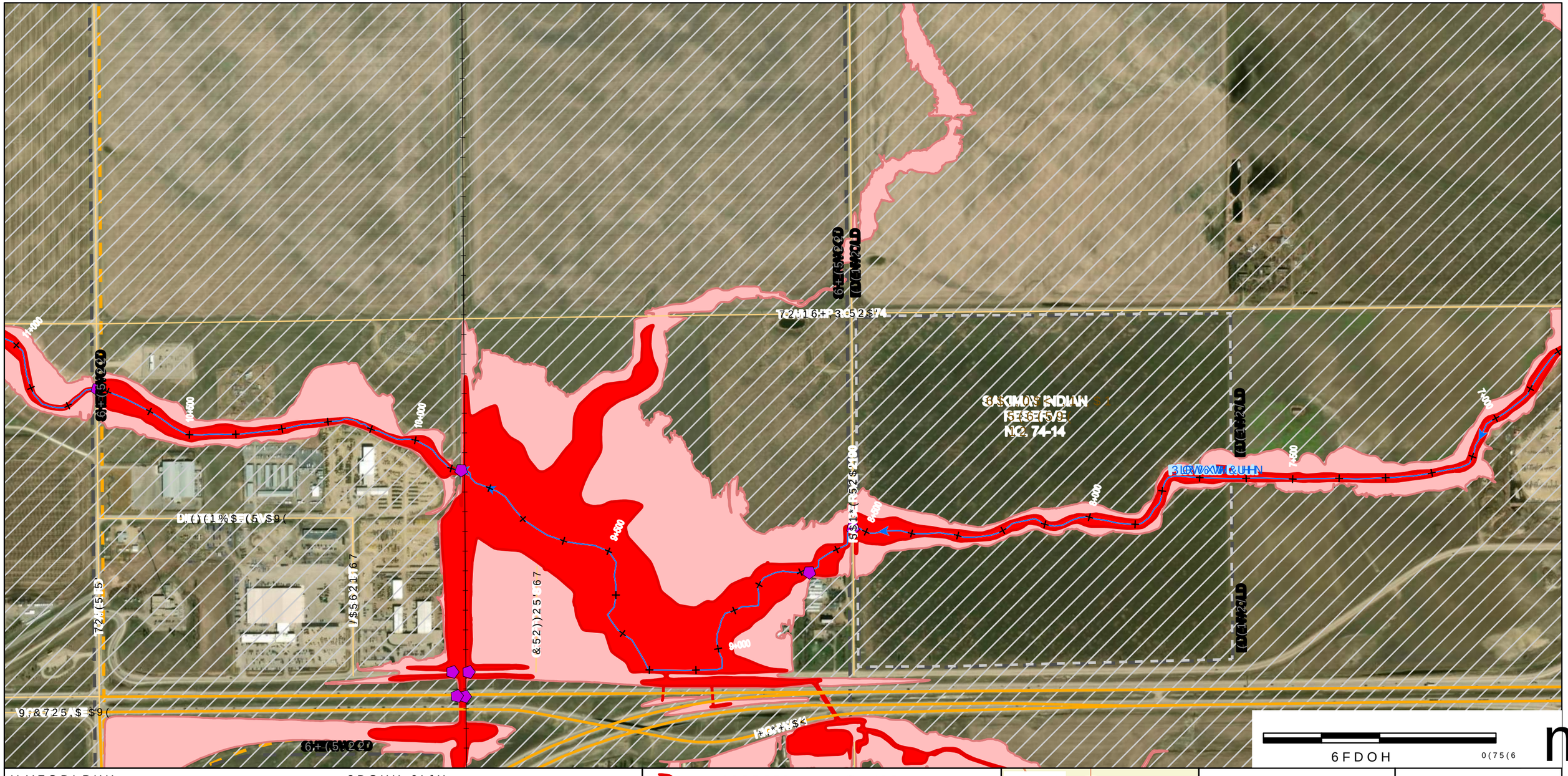
43+00
44+00
45+00



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FLUFXPVWDQFHV DQG DYDLODEOH GDWDUL 6$ PDNH VDQR P 1$' &656 HSRFK
UHSUHVHQWDWLRQ WKDW WKLV PDS ZLOOWEH DXIDWXHQW*RU DOO XVHV 7KH
XVHU LV DGYLVHG WR FRQILUP WKH LQHRUPDWLRQ FRQWDLQHG KHUHLQ LQ
WKH HYHQW WKDW SUHFLVLRQ DQG FXDUSHQFRRI WLWRQ DUH &656 LUHBQGHG =ROH 1RUWK
:6$ UHFRPPHQGV FRQILUPLQJ WKH IORRG KDWDUG VWDWXV RI
ERUGHUOLQH SURSHUWLHV
0DS 3URGXFHG %\
$(&20 &DQDGD 8/&
&RS\ULJKW
0DS ‹ *RYHUQPHQW RI 6DVNDWFKHZDQ
$OO 'DWDVHWV ‹ *RYHUQPHQW RI 6DVNDWFKHZDQ

3DSHU 6L]H
$16,%SV [ZLWQFKHVLQJ
&RRUGGHSHQGHQW RQ WKH
WRUL 6$ PDNH VDQR P 1$' &656 HSRFK
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*HRUPDWLRQ FRQWDLQHG KHUHLQ LQ
XDUSHQFRRI WLWRQ DUH &656 LUHBQGHG =ROH 1RUWK
&RUGKDWDUG VWDWXV RI
(65, &DQDGD

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)ORRG)ULQJH
6WXG\ /LPLWV
&KDLQDJH
:DWHUFRXUVH &HQWHUOLQH
)ORZ 'LUHFWLRQ
+\GURPHWULF *DXJLQJ 6WDWLRQ
'\NH

'DP
&XOYHUW
:HLU
%UUGJH
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+LJKZD\
,QGLJHQRXV /DQG
5HJLQD &LW\ /LPLW
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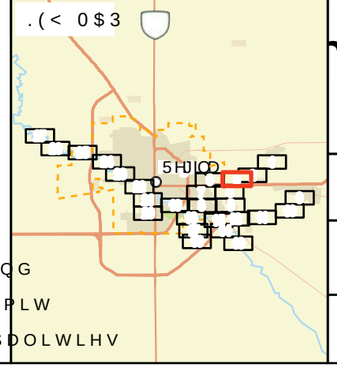
.(< 0$3



Water Security Agency

Canada
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<($5)/22' +$=$5' $:$5(1(66 0$3

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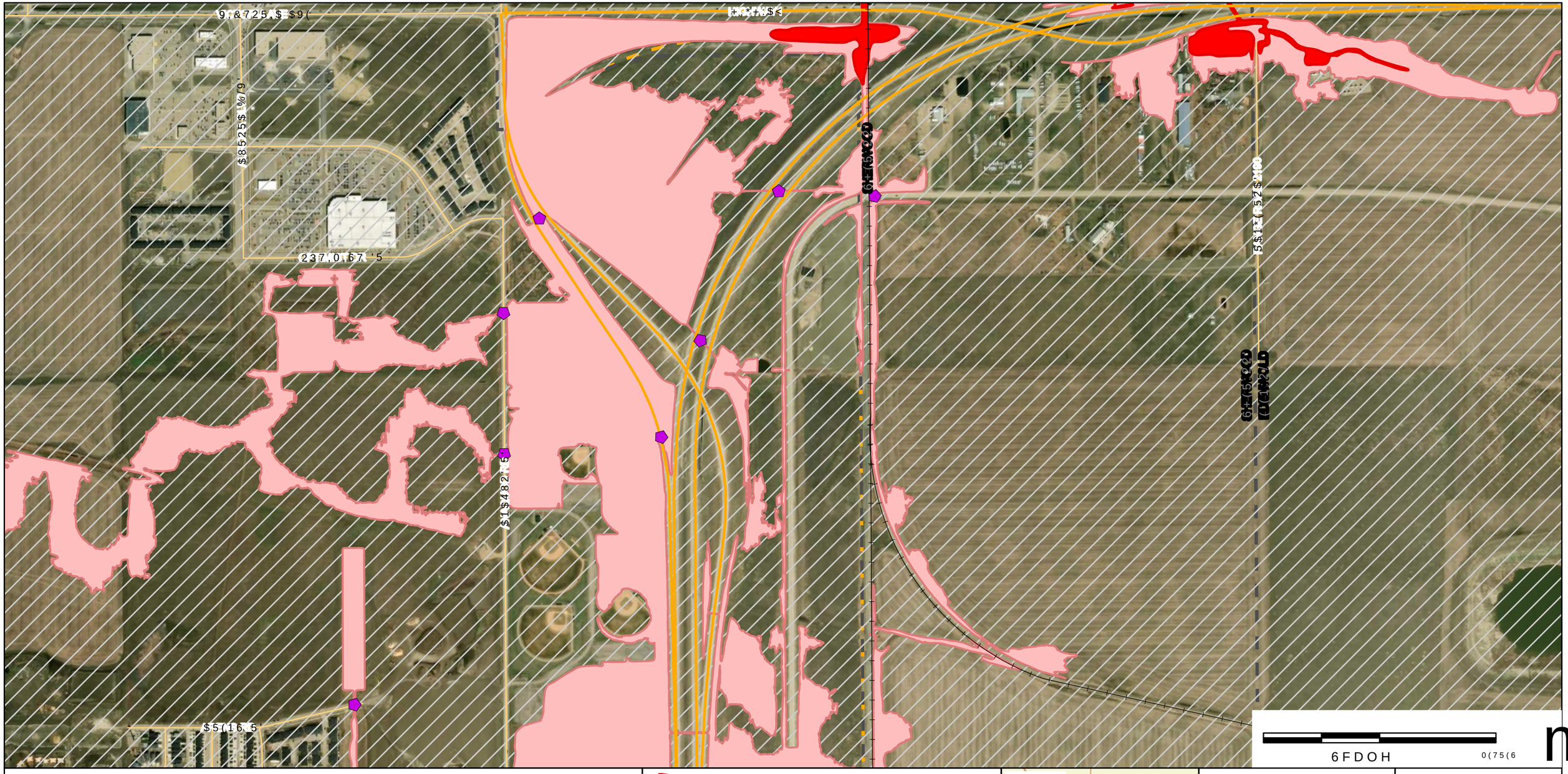
RI



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FLUFXPVWDQFHV DQG DYDLODEOH GDWD :6$ PDNHV QR
UHSUHVHQWDWLRQ WKDW WKLV PDS ZLOO EH DOO XVHV 7KH
XVHU LV DGYLVHG WR FRQILUP WKH LQIRUPDWLRQ FRQWDLQHG KHUHLQ LQ
WKH HYHQW WKDW SUHFLVLRQ DQG FXUUHQFRPHFWLRQ DUH &RS\ULJKW
:6$ UHFRPPHQGV FRQILUPLQJ WKH IORRG KDWD
ERUGHUOLQH SURSHUWLHV
0DS 3URGXFHG %\
$(&20 &DQDGD 8/&
&RS\ULJKW
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$OO 'DWDVHWV ‹ *RYHUQPHQW RI 6DVNDWFKHZDQ

3DSHU 6L]H
$16,%SV ZLWKRXW
&RRUGLQDWH 5HQHUHQFH
WRU :6$ PDNHV QR
UHSUHVHQWDWLRQ WKDW WKLV PDS ZLOO EH DOO XVHV 7KH
XVHU LV DGYLVHG WR FRQILUP WKH LQIRUPDWLRQ FRQWDLQHG KHUHLQ LQ
WKH HYHQW WKDW SUHFLVLRQ DQG FXUUHQFRPHFWLRQ DUH &RS\ULJKW
&RUGLQDWH VWDWXV RI
(65, &DQDGD

)ORRGZD\
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6WXG\ /LPLWV
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+\GURPHWULF *DXJLQJ 6WDWLRQ
'\NH
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&XOYHUW
:HLU
%UUGJH
5LQLQ
+LJKZD\
6WDWLRQ
,QGLJHQRXV /DQG
5HJLQD &LW\ /LPLW
5XUDO 0XQLFLSDOLWLHV

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5HJLQ

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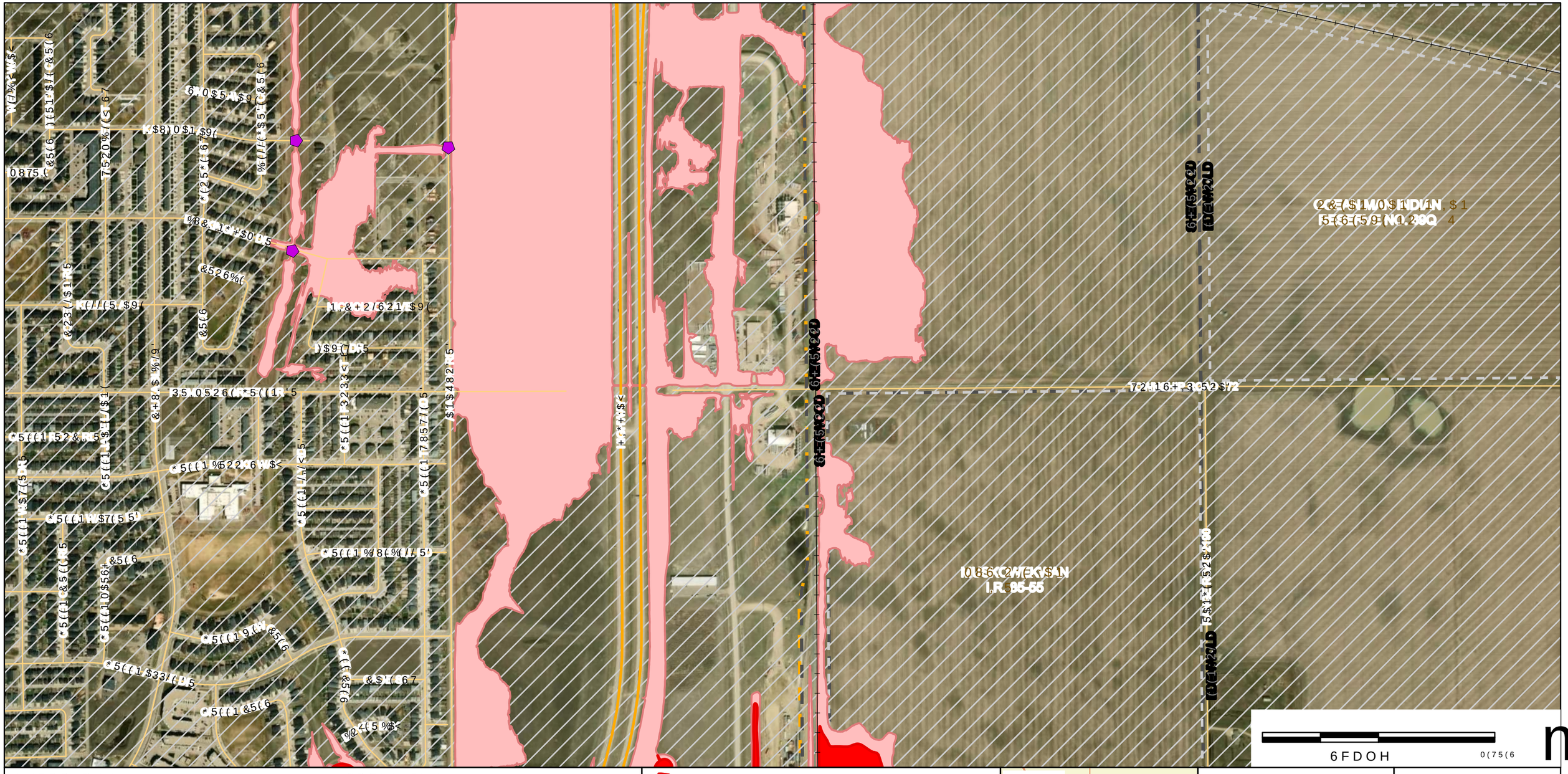
RI



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XVHU LV DGYLVHG WR FRQILUP WKH LQIRUPDWLRQ
WKH HYHQW WKDW SUHFLVLRQ DQG FXUDSHQFRRH DWLRQ
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ERUGHUOLQH SURSHUWLHV
0DS 3URGXFHG %\
$(&20 &DQDGD 8/&
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$16,%SV ZLWKRXW
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WRU :6$ PDNHV DQR
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XVHU LV DGYLVHG WR FRQILUP WKH LQIRUPDWLRQ
WKH HYHQW WKDW SUHFLVLRQ DQG FXUDSHQFRRH DWLRQ
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ERUGHUOLQH SURSHUWLHV
(65, &DQDGD

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)ORRG)ULQJH
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&KDLQDJH
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)ORZ 'LUHFWLRQ
+\GURPHWULF *DXJLQJ
'\NH
'DP
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:HLU
&DUYDOLGJH
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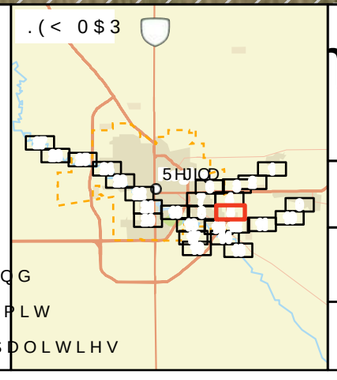

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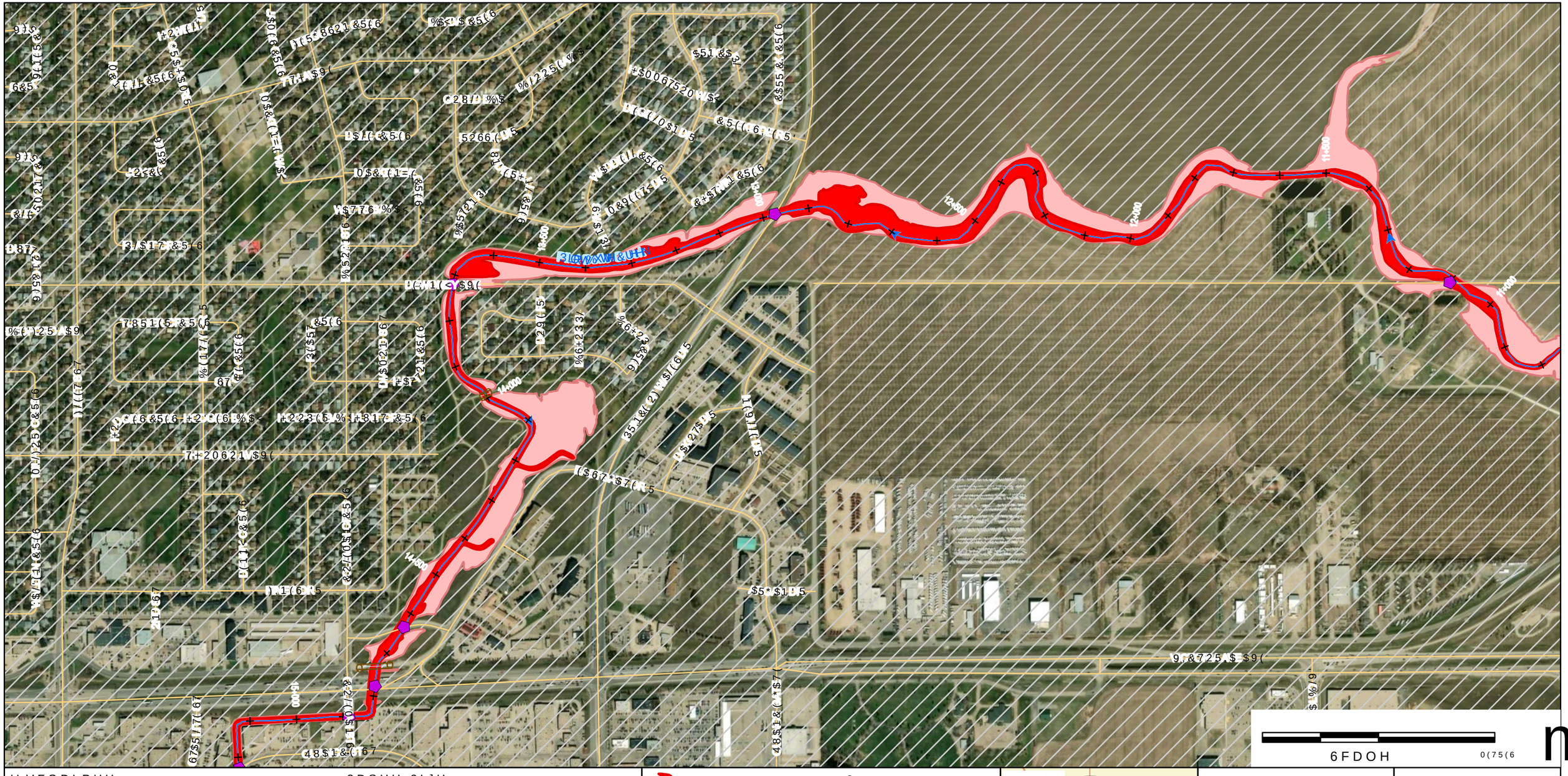

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(65, &DQDGD

0DS 3URMHFW %\

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)ORRGZD\

)ORRG)ULQJH

6WXG\ /LPLWV

&KDQQHO

&URVV 6HFWLRQ

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'DP

&XOYHUW

:HLU

3URSRVHG %ULGJH

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5HJLRQDO &LW\ /LPLW

5XUDO 0XQLFLSDOLWLHV

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)XQGHG LQ SDUW E\ WKH *RYHUQPHQW RI &DQDGD

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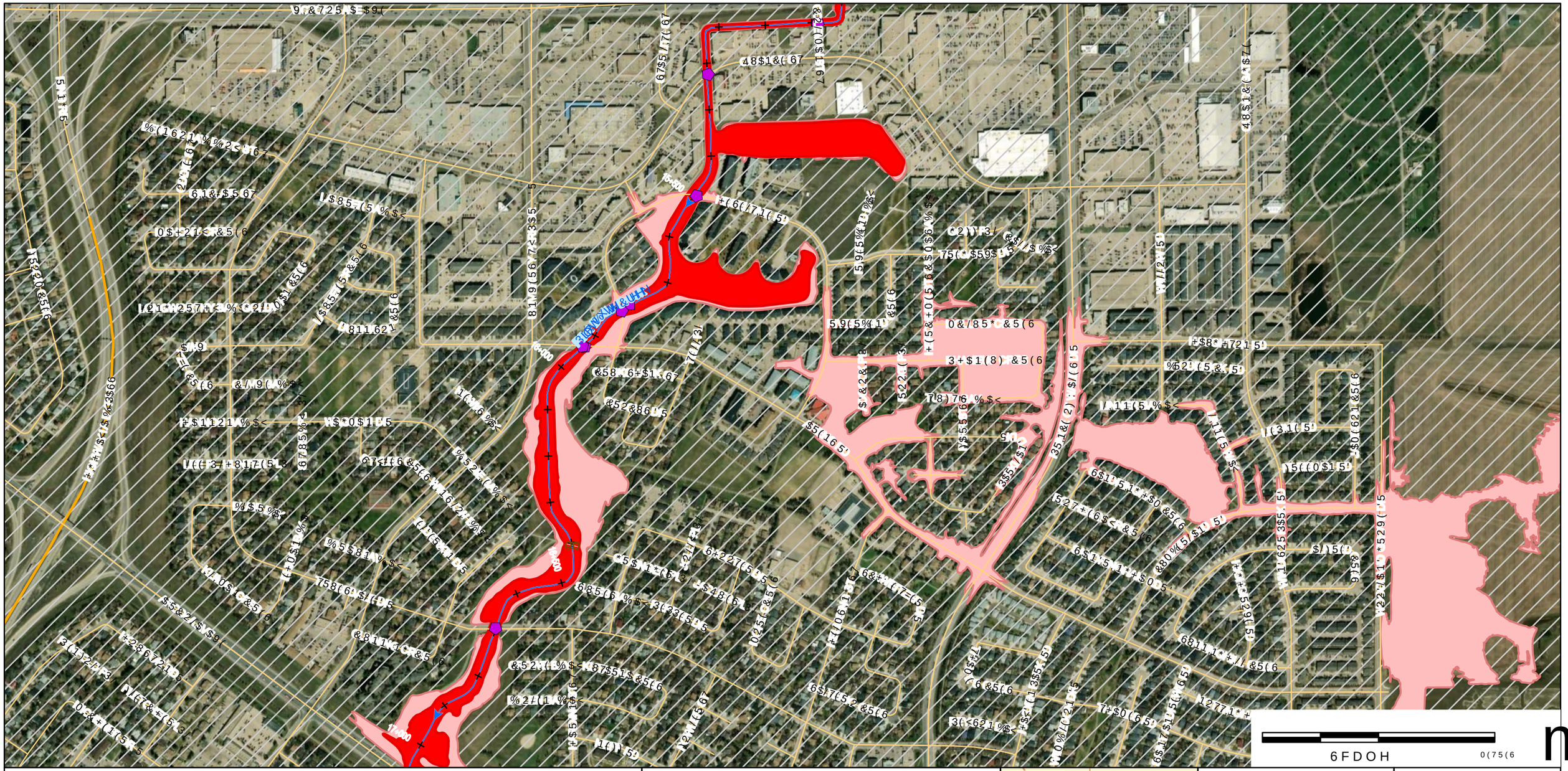

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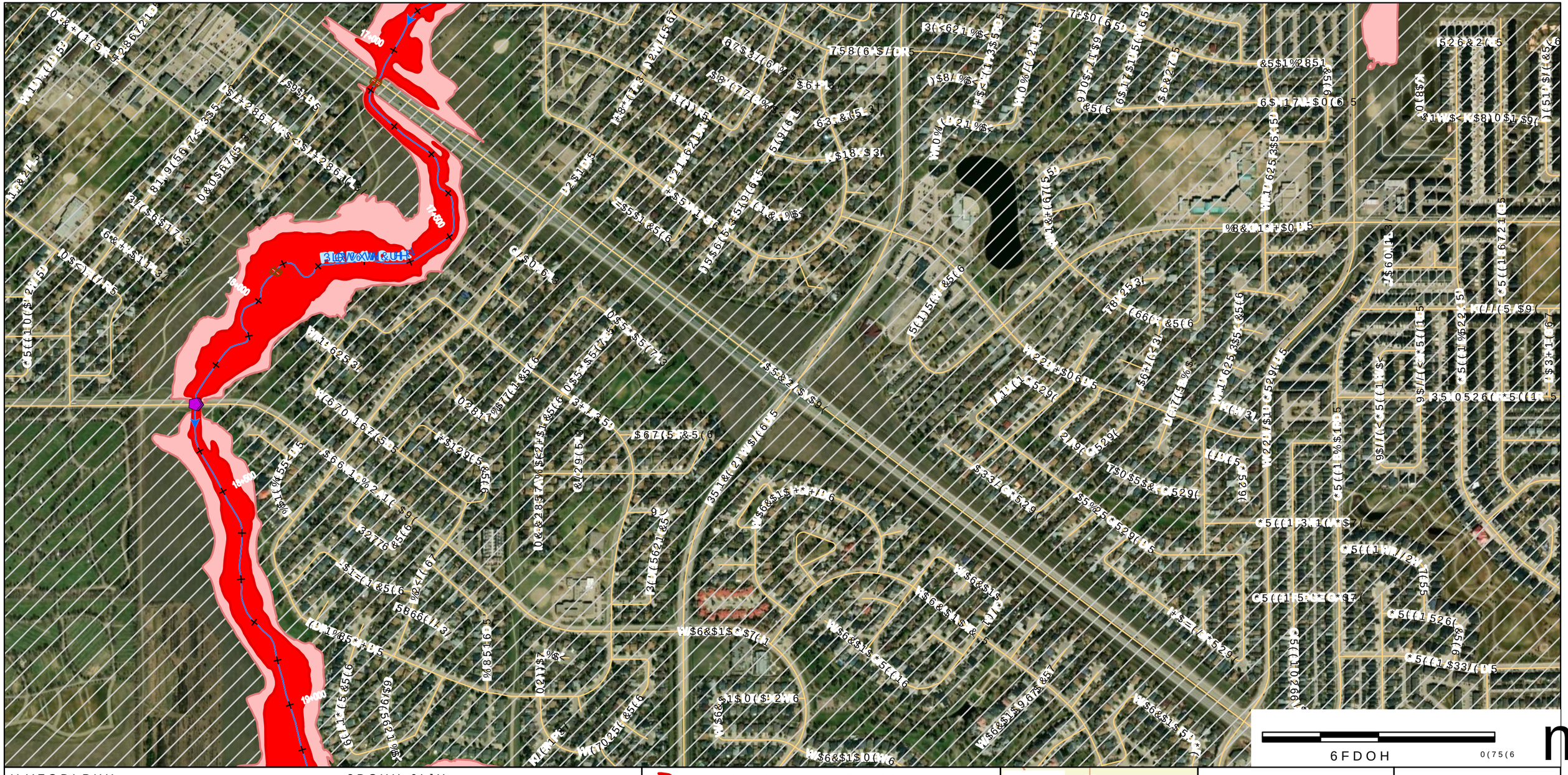

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0DS 3URGXFHG %\

$(&20 &DQDGD 8/&

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&RRUGLQDWH 6\VWHP

:HE 0HUFDWRU $X[LOLDU\ 6SKHUH

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Water Security Agency

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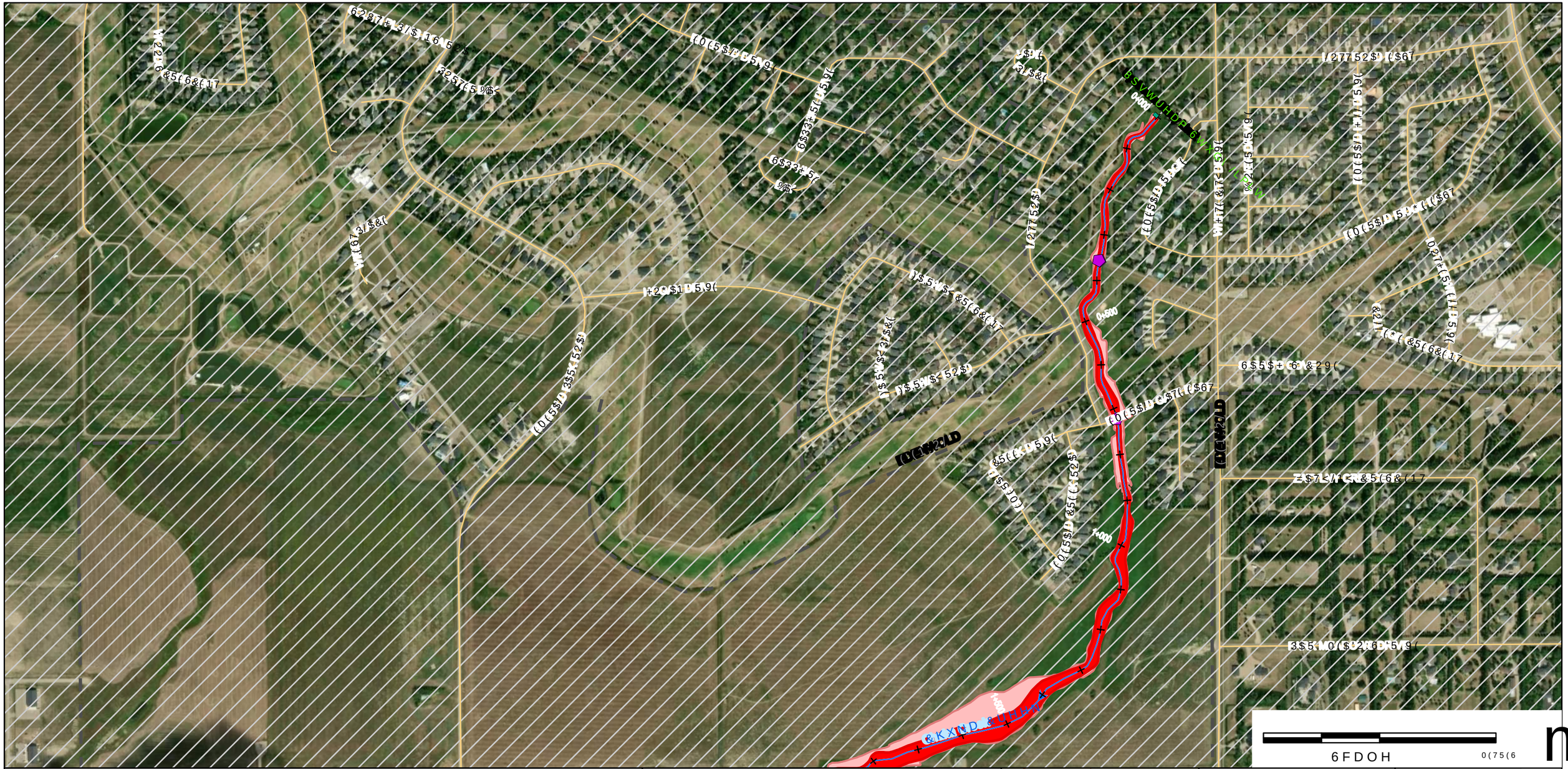
RI

6FDOH 0(75(6



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+1 [P] [P] 6WXG\ /LPLWV

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5HJLQD

Water Security Agency

Canada

)XQGHG LQ SDUW E\ WKH *RYHUQPHQW RI &DQDGD

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&,7< 2) 5(*,1$)/22' 0$33,1* 678'<

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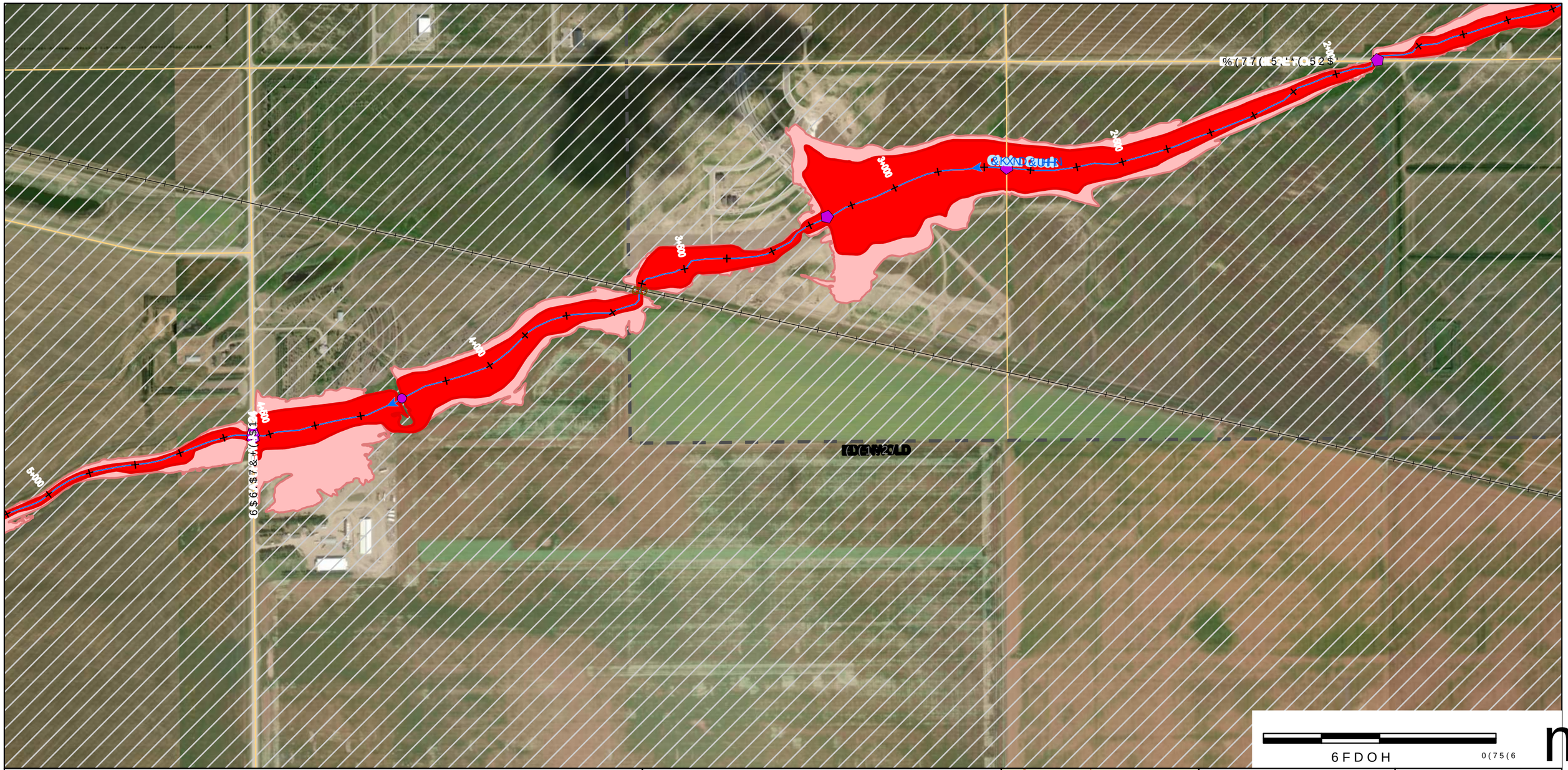
352-(&7 180%(5 5(9 6+((7

RI



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FLUFXPVWDQFHV DQG DYDLODEOH GDWD ULFKPDNHVDQRXP 1$' &656 HSRFK
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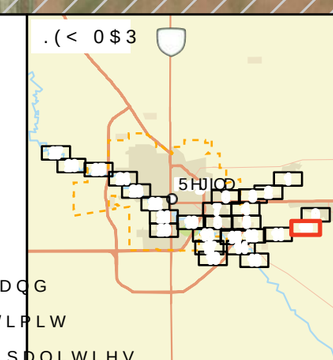

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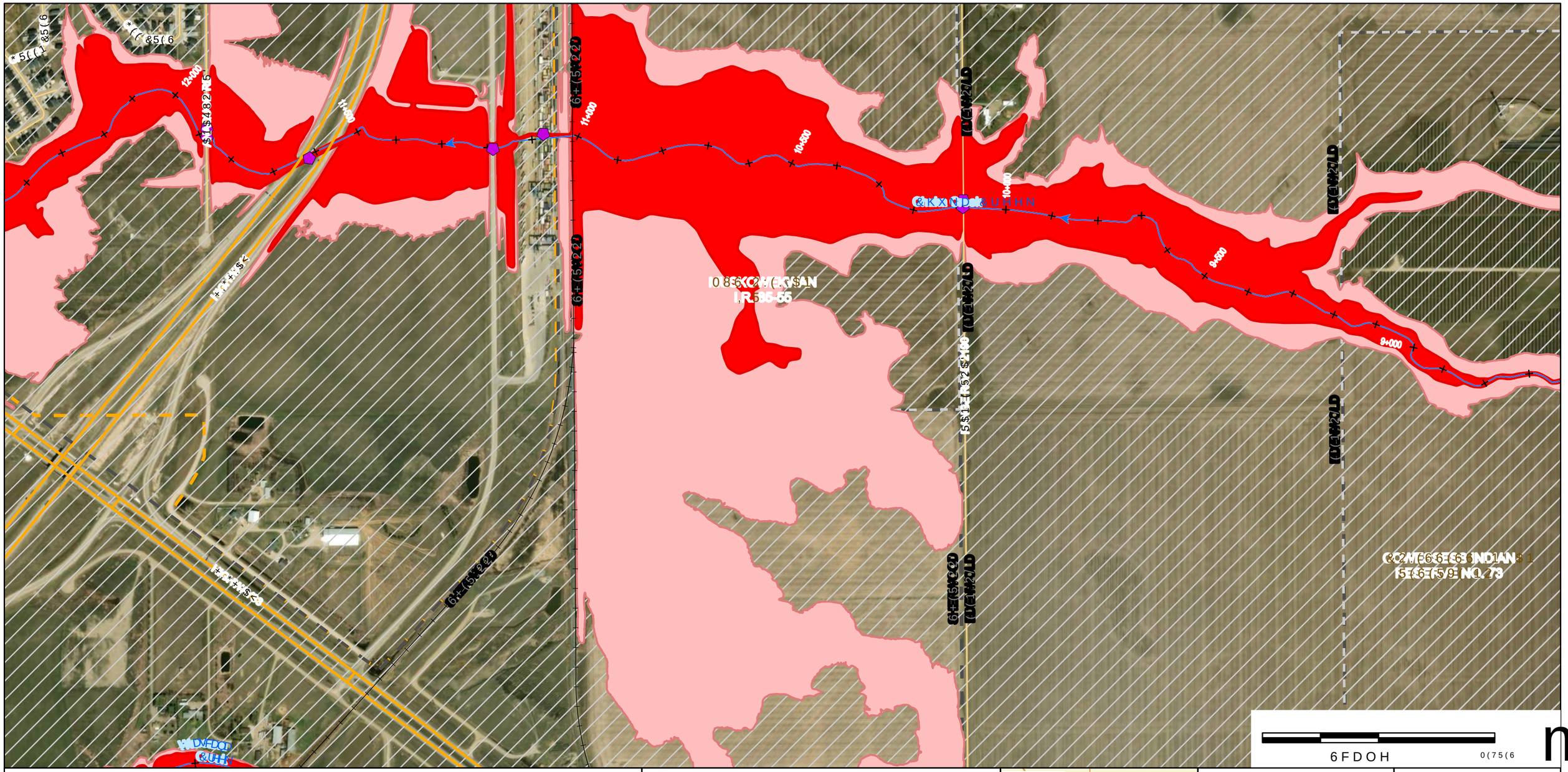
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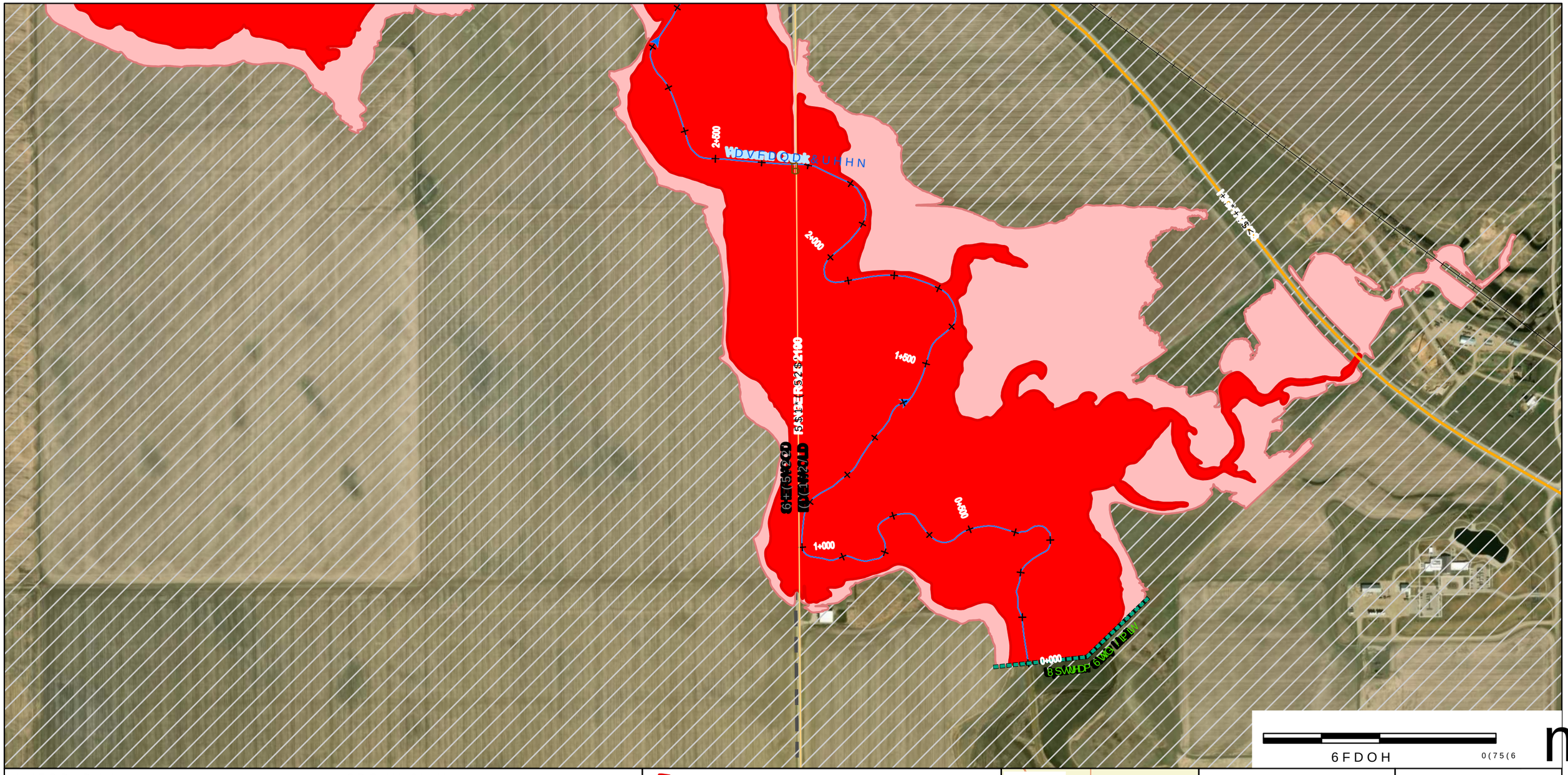

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Water Security Agency

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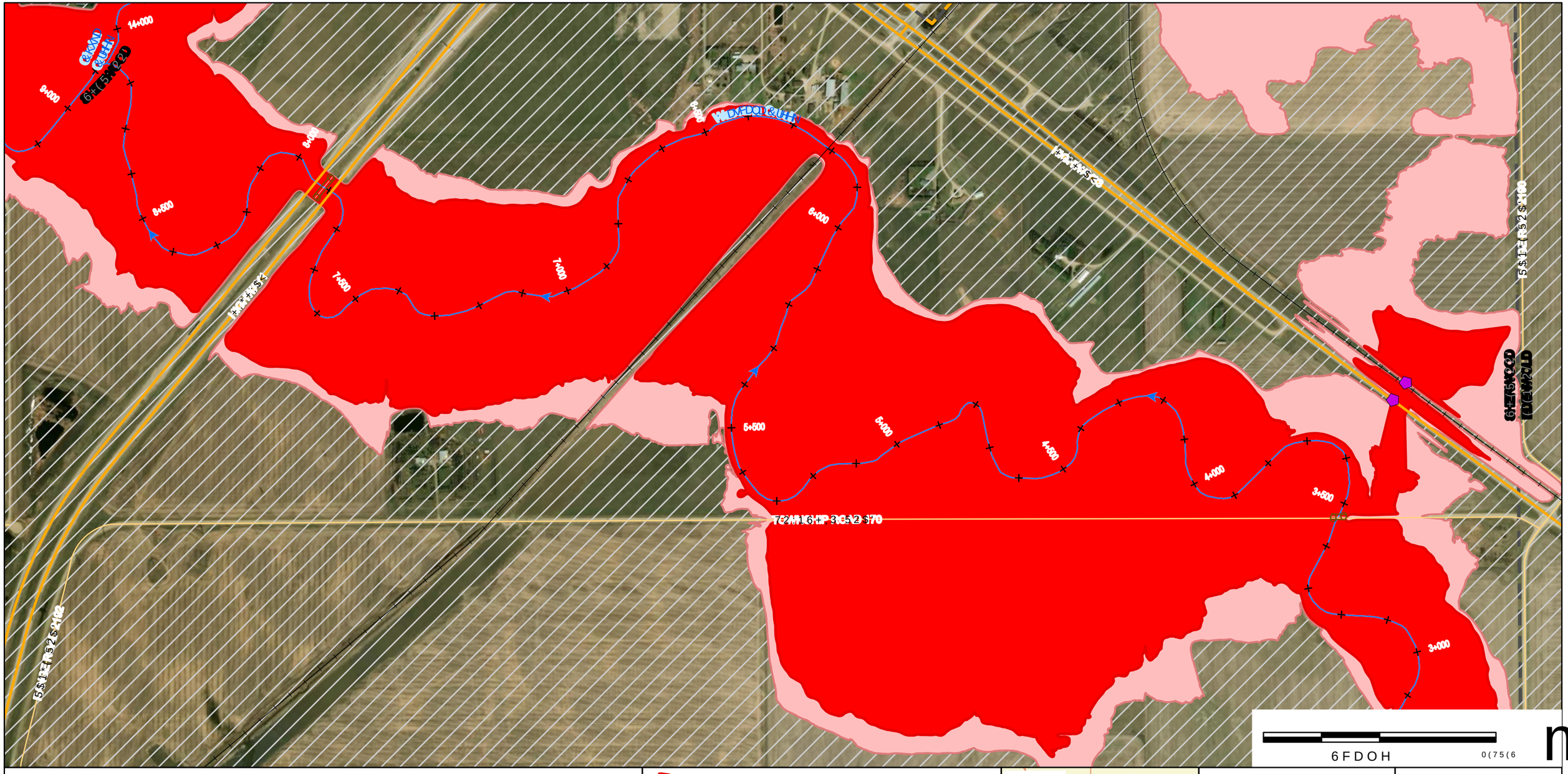

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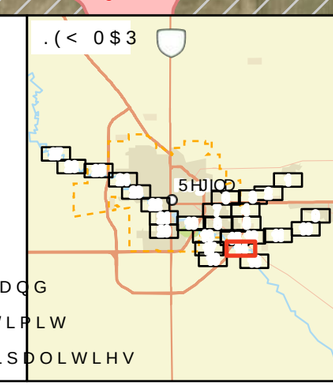

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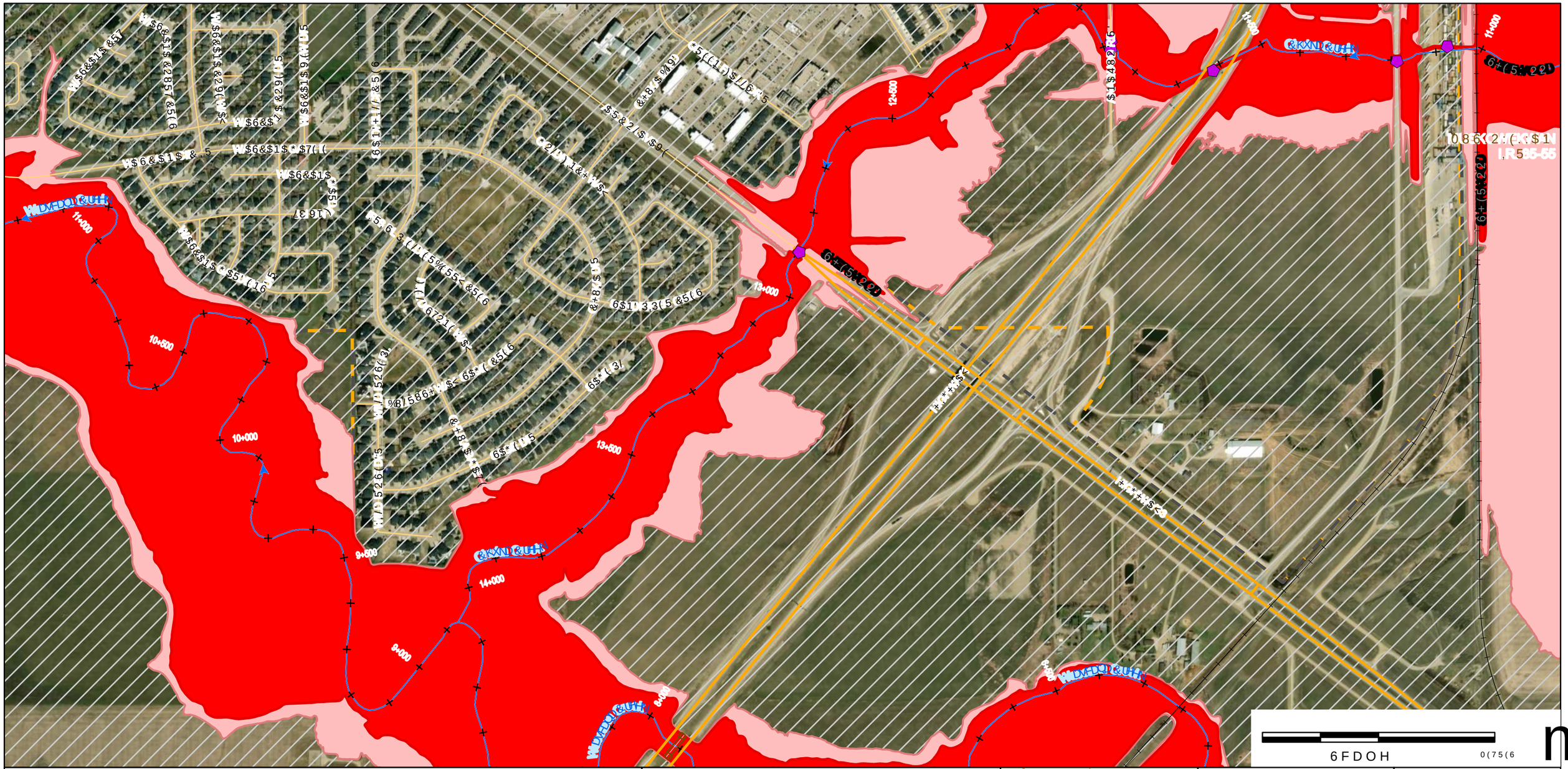
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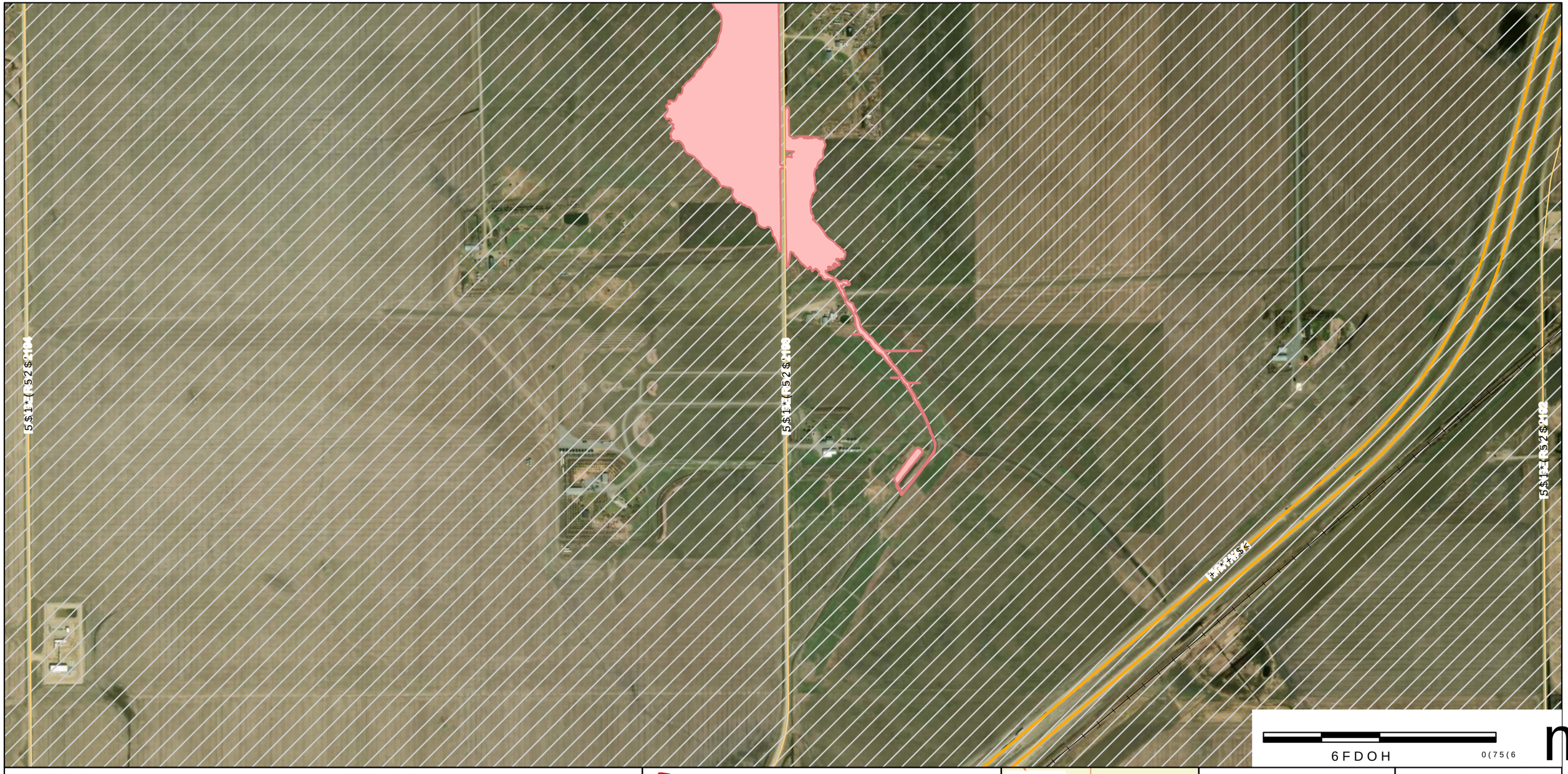

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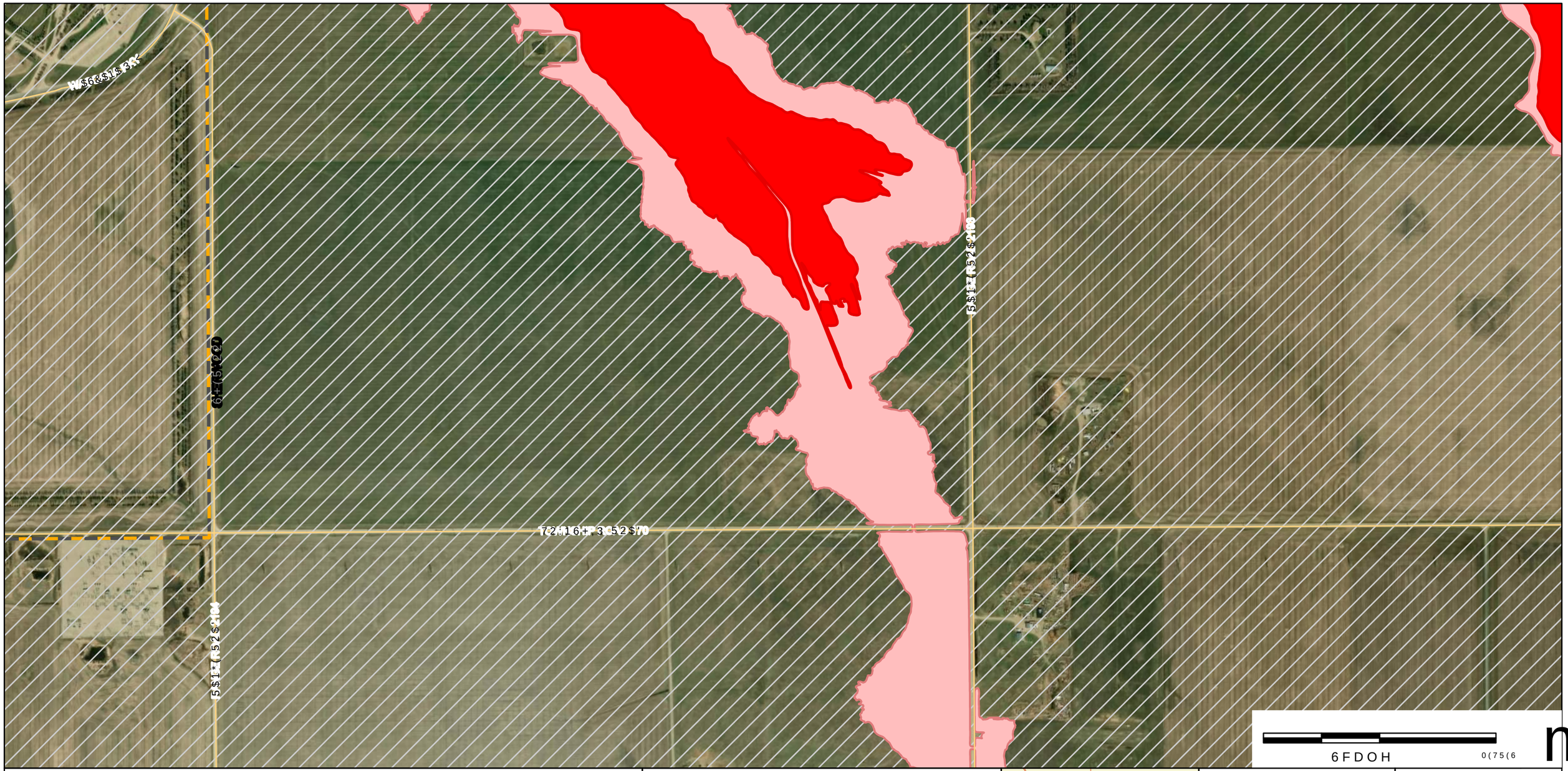

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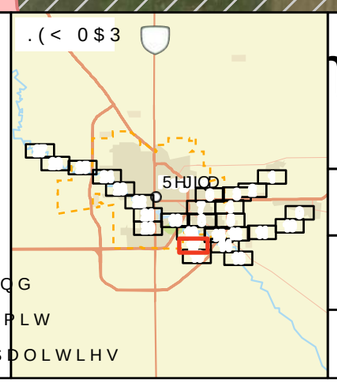

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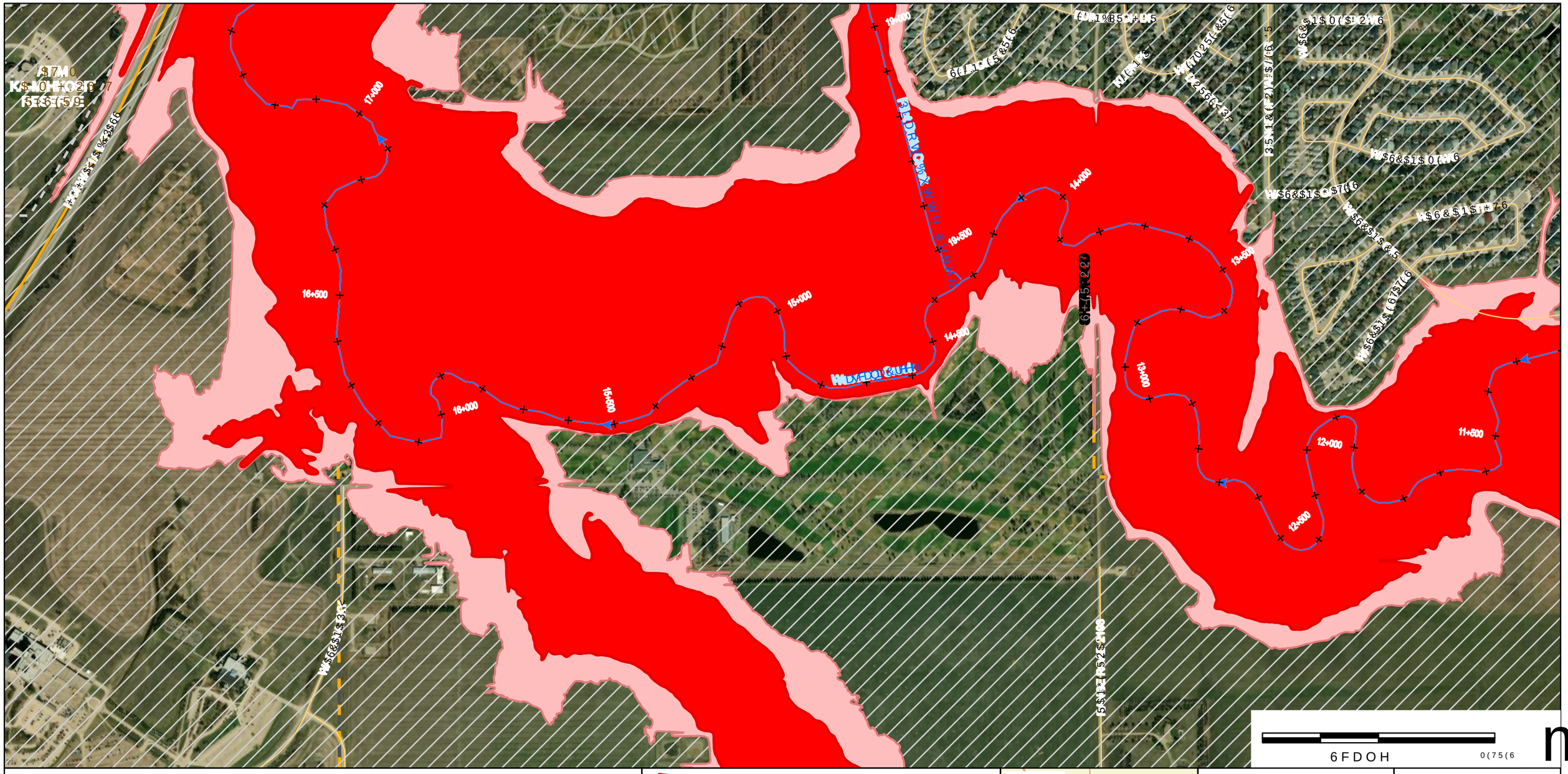

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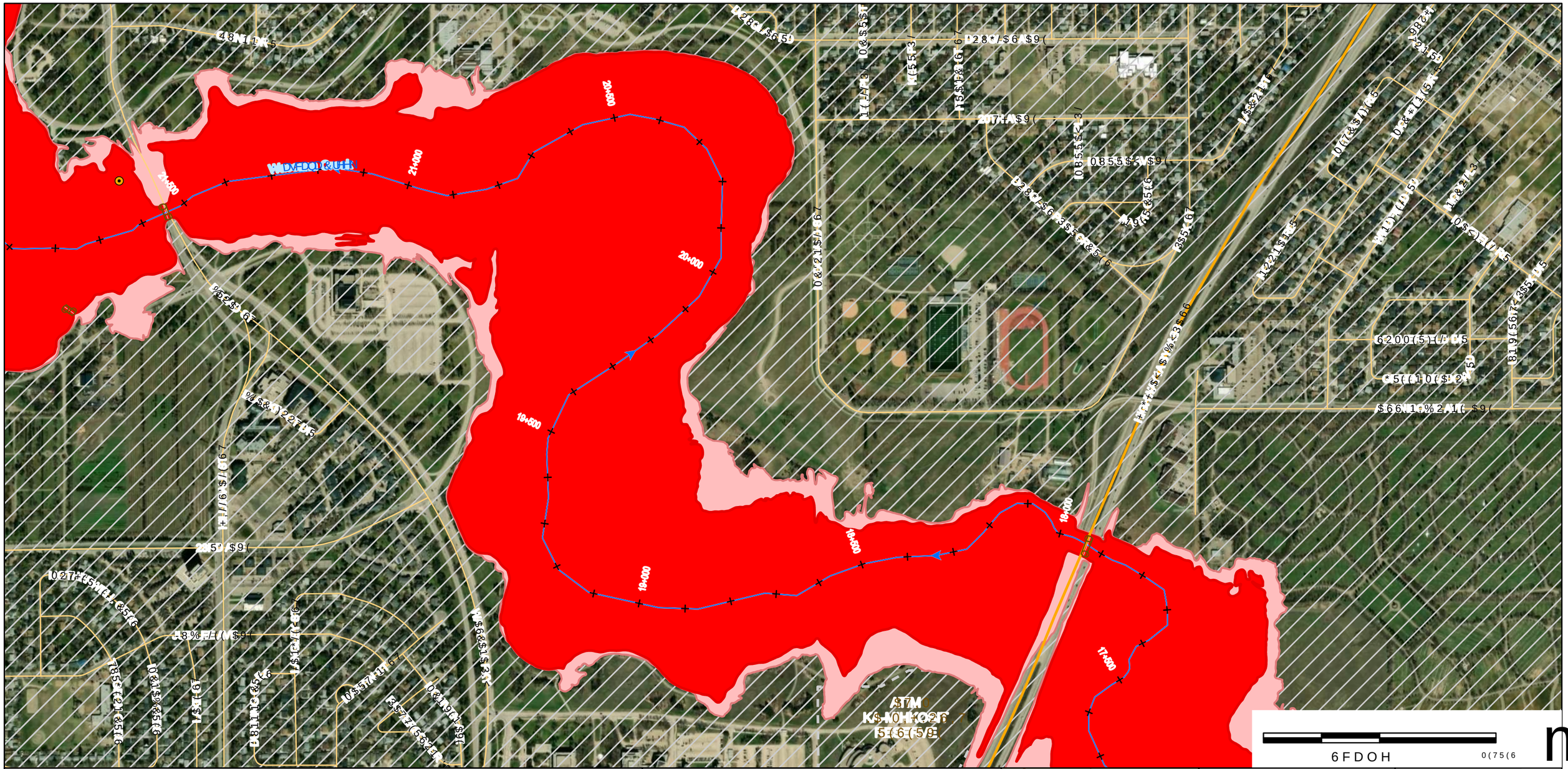

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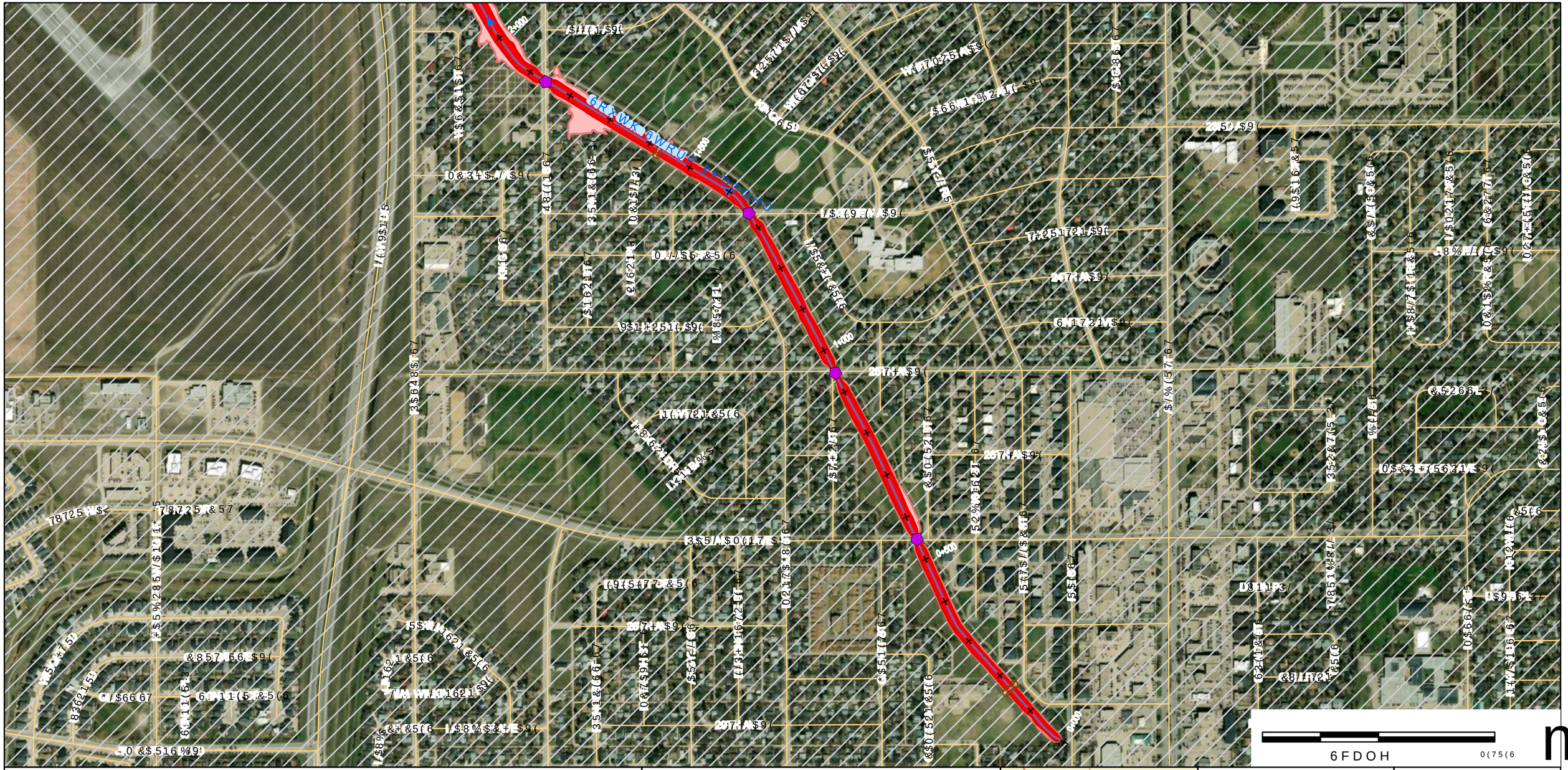

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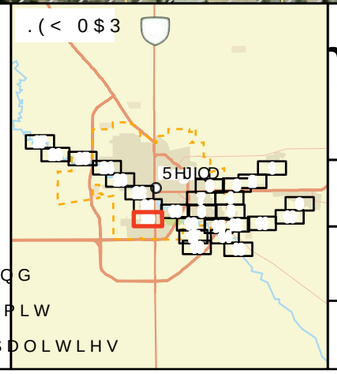

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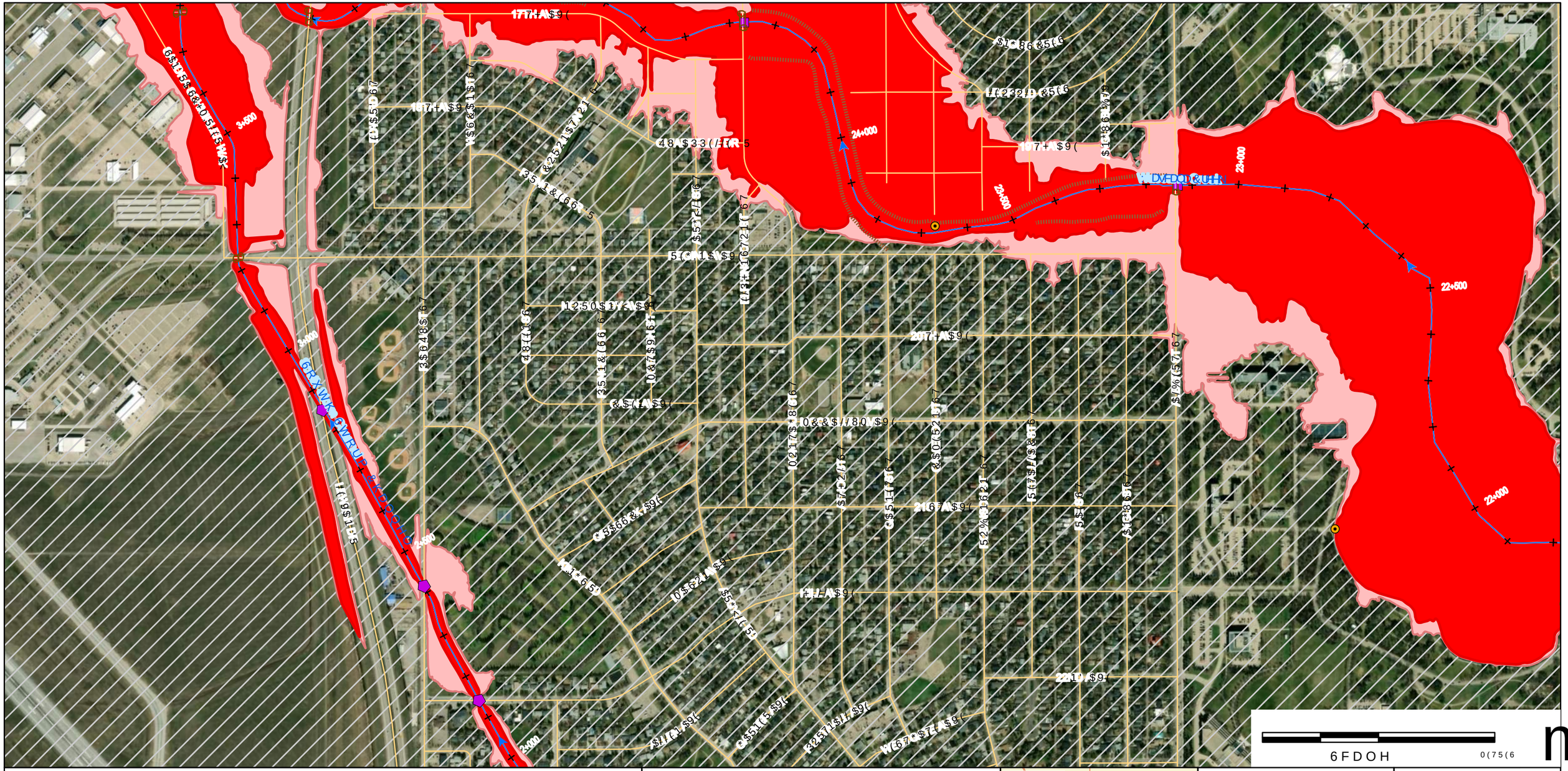

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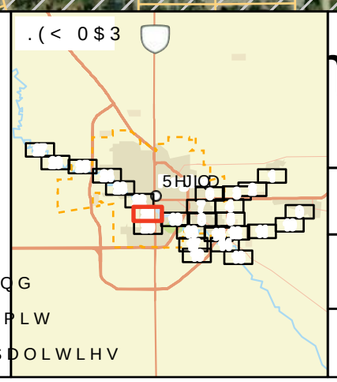

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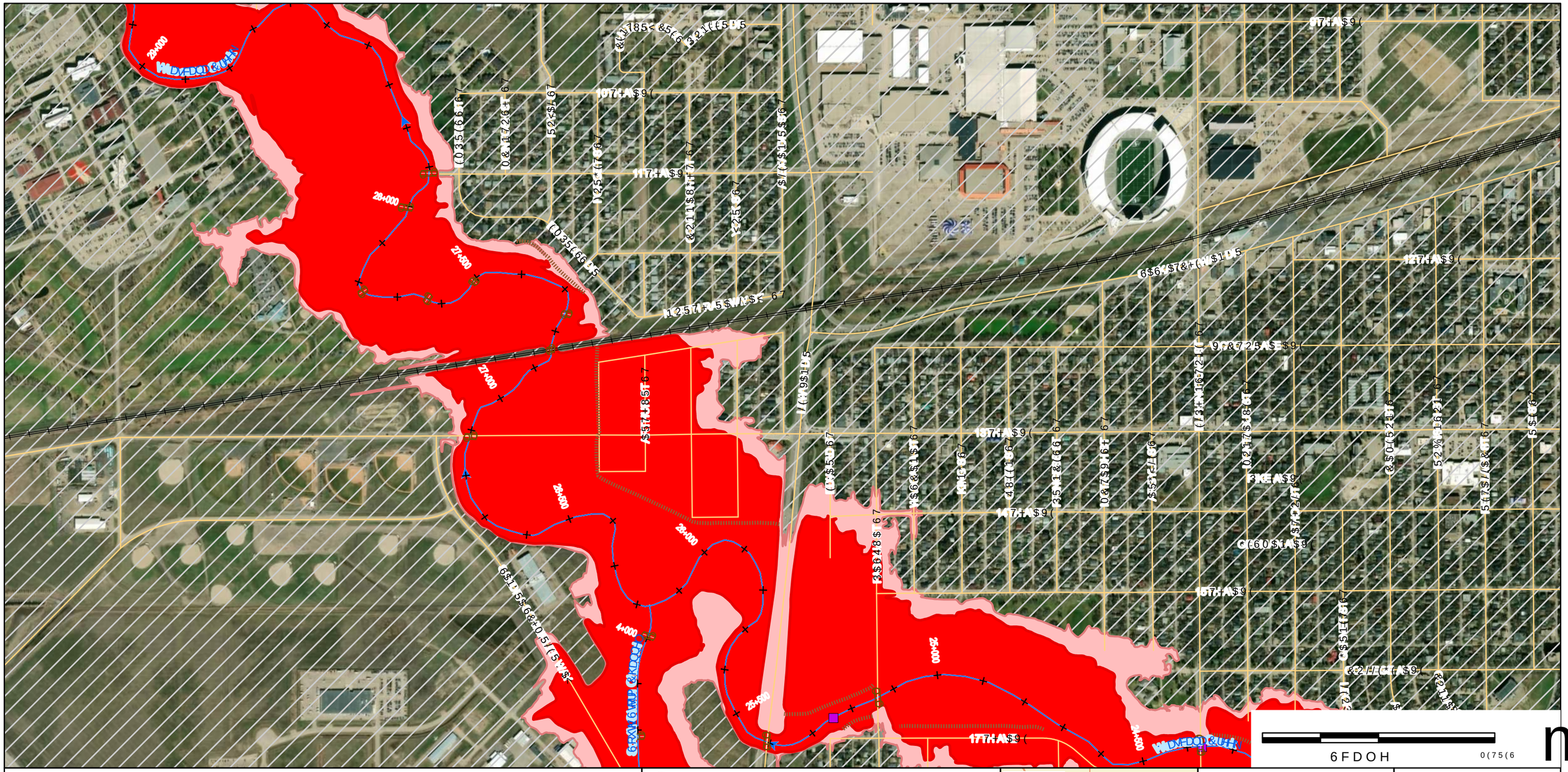
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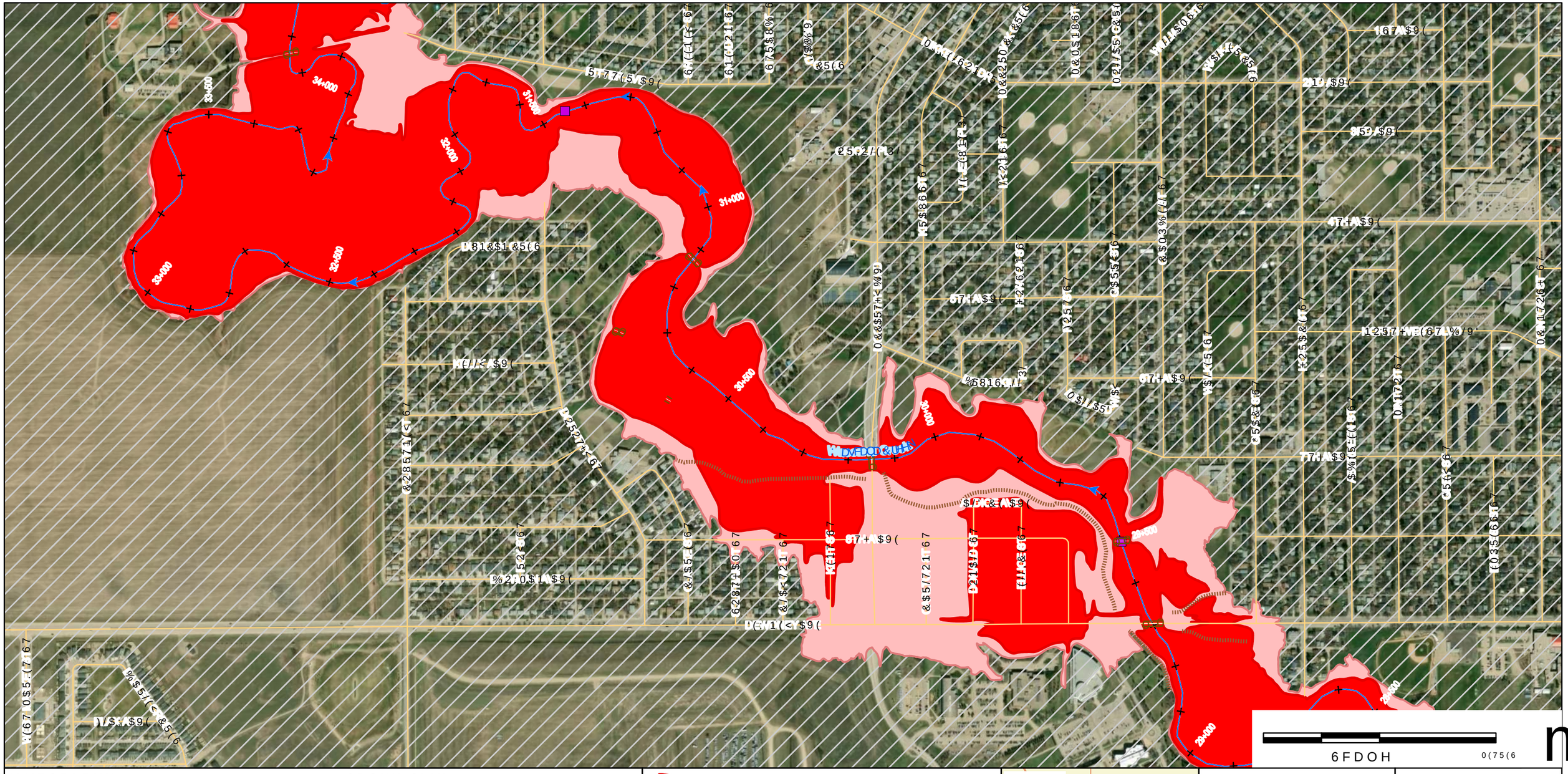

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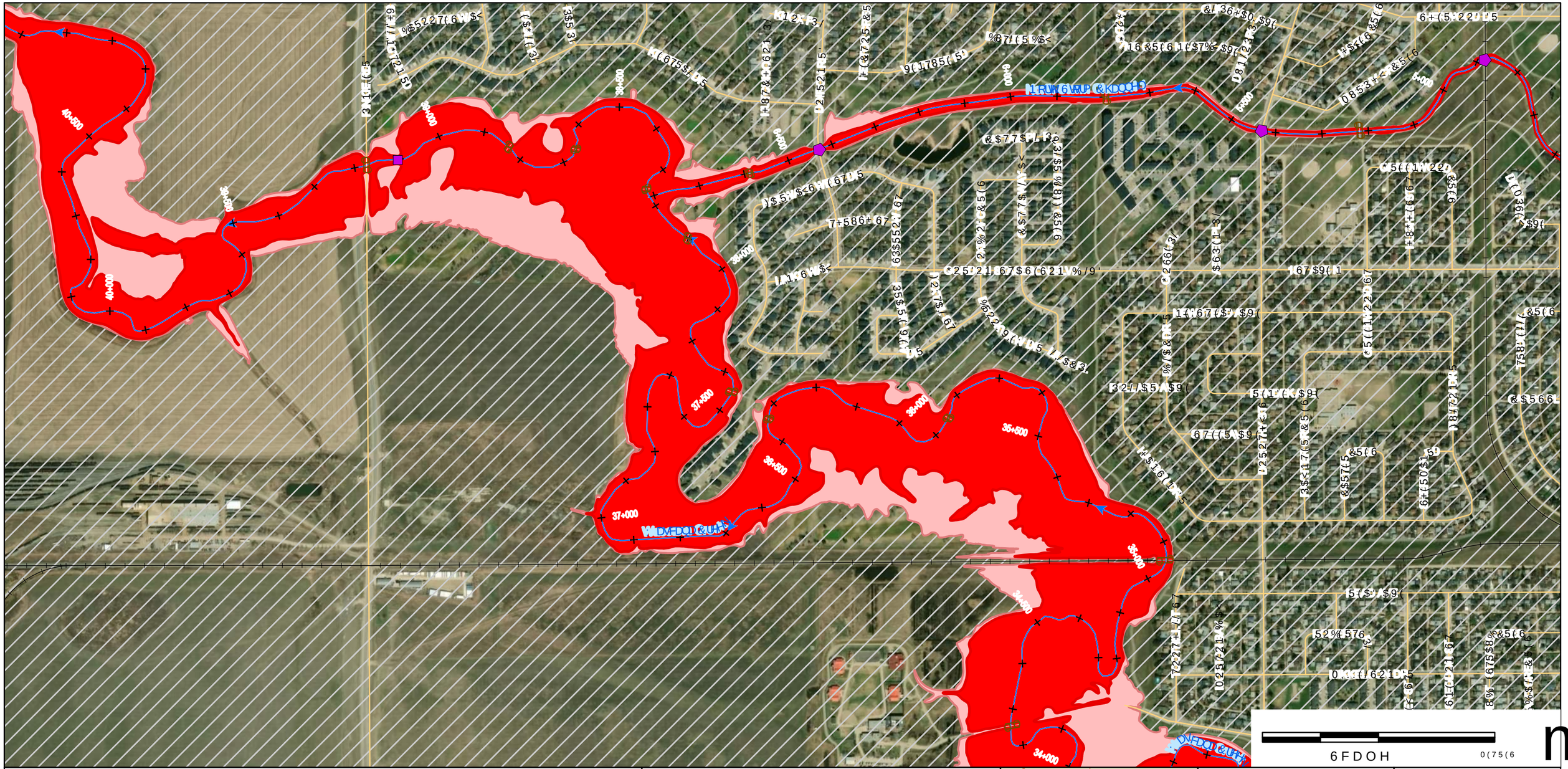

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UHSUHVHQWDWLRQ WKDW WKLV PDS ZLOO EH DV
XVHU LV DGYLVHG WR FRQILUP WKH LQIRUPDWLRQ
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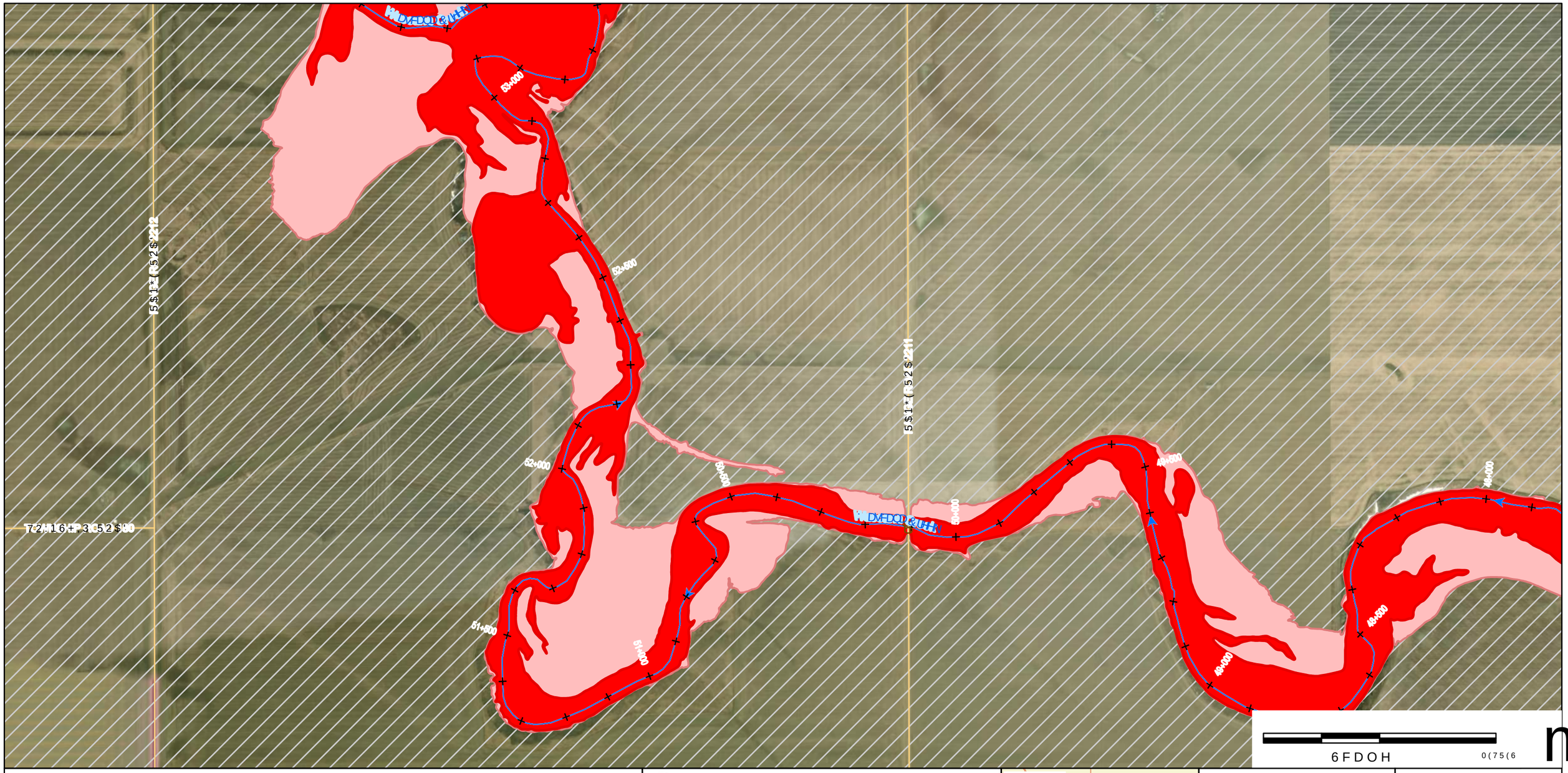

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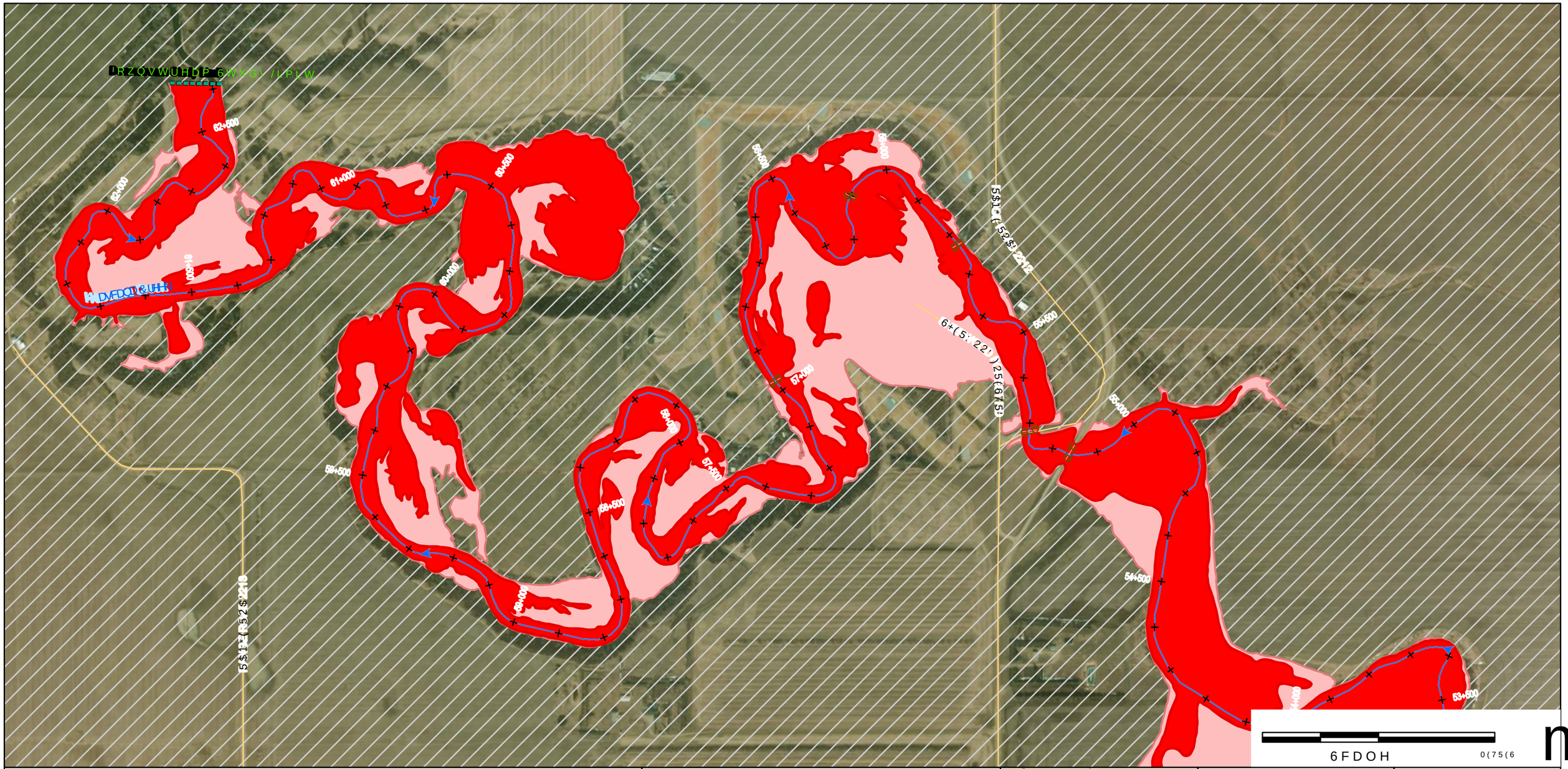

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