

Final Technical Memorandum

NW State Street Extension Study

Prepared by HDR for City of Ankeny

Ankeny, Iowa

November 8, 2017



I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

A handwritten signature in blue ink, appearing to read "Joseph J. Spradling".

Joseph J. Spradling
11/08/2017

My license renewal date is December 31, 2018.

Pages of sheets covered by this seal:
All Pages

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I. STREET REALIGNMENT STUDY DESCRIPTION

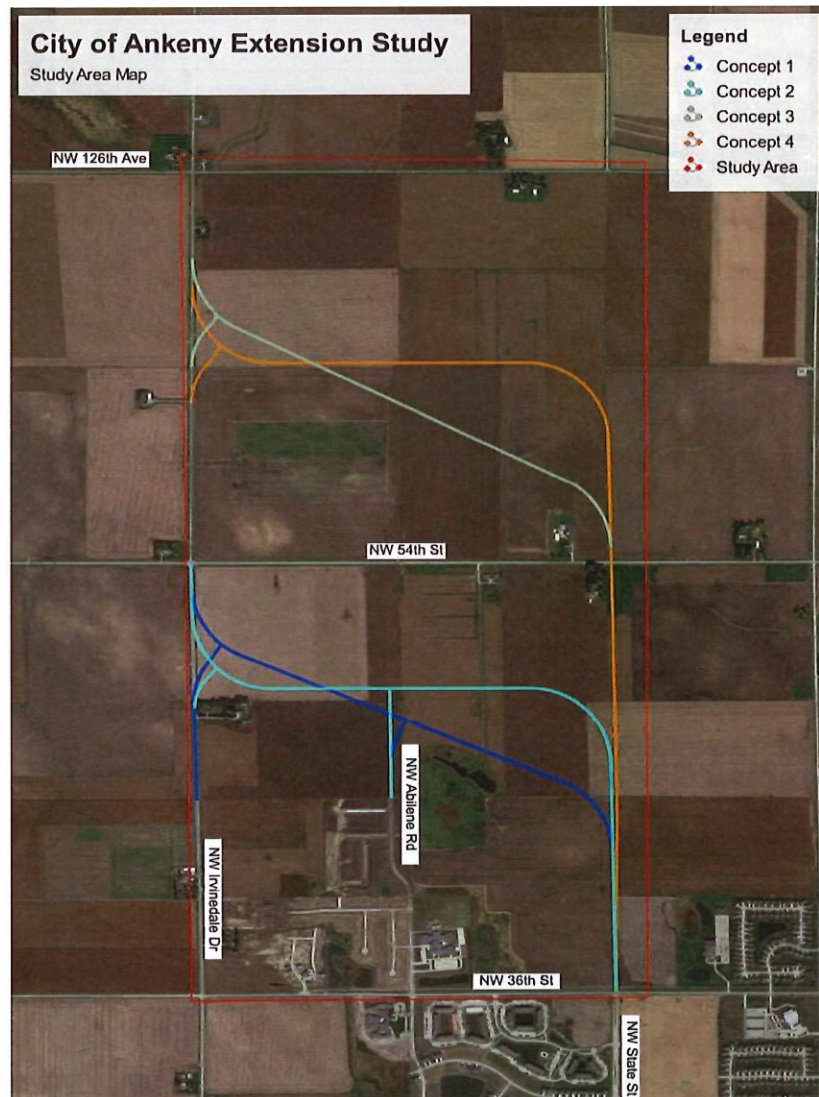
Study Description

This Study identifies and evaluates street alignment concepts to extend NW State Street northwesterly from NW 36th Street to tie in with NW Irvinedale Drive near NW 54th Street or County NW 126th Avenue. The objective for this Study is to assess the potential land use, drainage, environmental, and access impacts from extension of the major arterial street and provide the City of Ankeny (City) with information to assist with making decisions about the future street extension. The Study will identify potential street alignments and document opportunities and constraints for each concept.

Study Area

The Study Area is shown in Figure 1 bounded by County NW 126th Avenue to the north, NW Irvinedale Drive to the west and NW State Street extended north on the east.

Figure 1. Study Area



II. EXISTING CONDITIONS

NW State Street to the south of NW 36th Street is a 4-lane divided arterial route with left turn lanes and serves as a major north-south street corridor through the City of Ankeny. NW Irvinedale Drive extends from Oralabor Road and is a 2-lane arterial route from just north of 1st Street north to County NW 142nd Avenue west of Alleman. NW 36th Street is a 2-lane curbed street section with grading, public utilities, and right of way established to accommodate a 4-lane divided urban section in the future, west and east of NW State Street. NW Abilene Road is a 2-lane curbed street. NW 54th Street is a 2-lane rural street section. A desktop review of gathered information including aerial imagery, utility data, parcel information, as-built plans, plats, and new and future developments were used to develop base files for the concept alignments. The Study Area is primarily tilled agricultural land with residential and commercial development under construction or in planning phases in the southern portion of the Study Area. In addition to the development under construction, there are several existing farmsteads along NW Irvinedale Drive and NW 54th Street. There is also an established pond and a high voltage transmission line running through the Study Area.

III. CONCEPT ANALYSIS

In order to perform street conceptual analysis, a list of street design criteria was established for NW State Street. The majority of street design criteria were established from the Iowa Statewide Urban Design and Specifications (SUDAS) 2017 Design Manual. This manual provides design guidance through references to appropriate national standards and regulations in Iowa and is a generally accepted design manual for urban street projects in Iowa. Table 2 below defines project values for each criterion for each street in the Study Area. SUDAS preferred values have been used for this project where possible and, where not possible, have been noted below the table.

Table 1. Geometric Design Criteria - Project Values

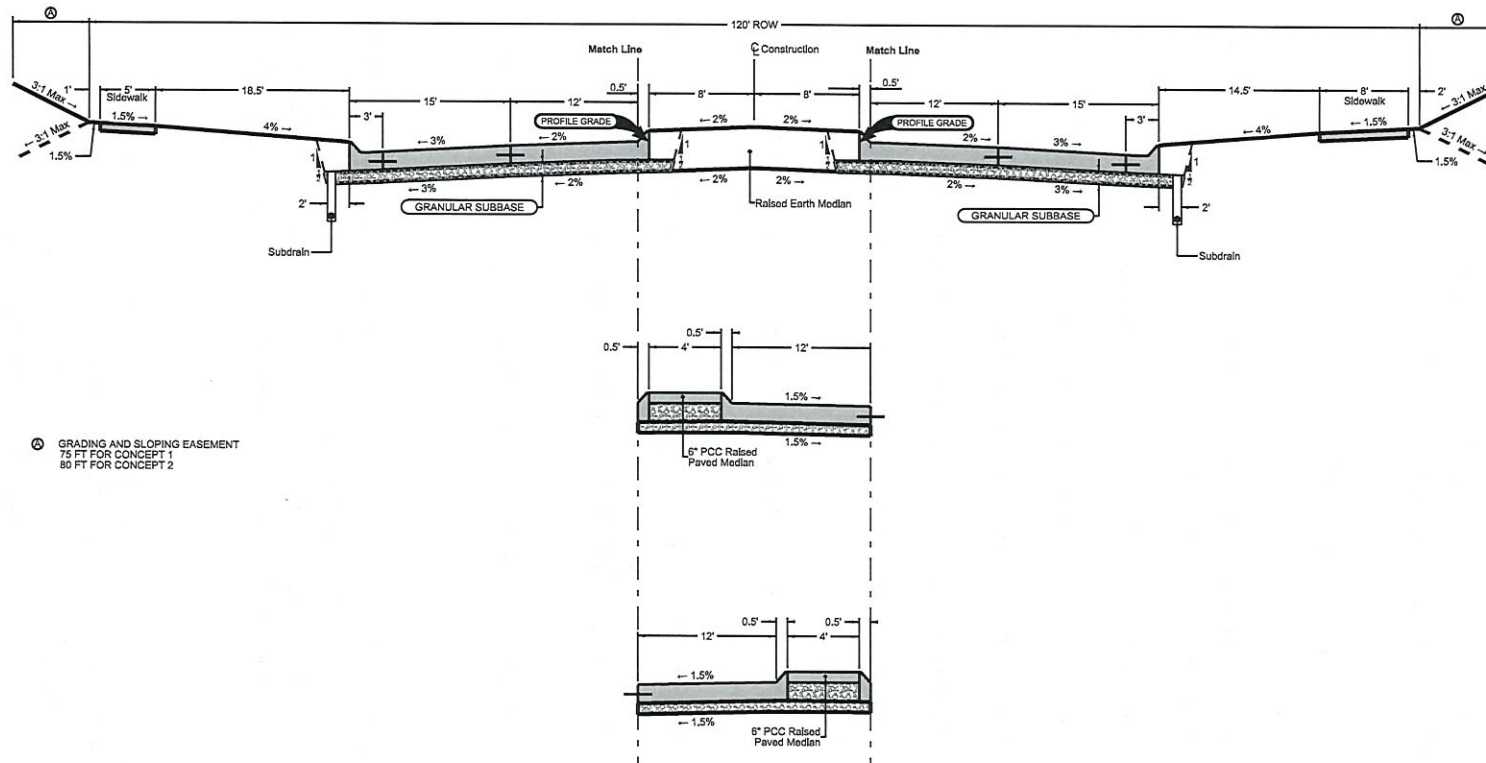
Street Design Criteria	NW State Street	NW Irvinedale Drive	NW Abilene Road	Comments
Design Speed (Posted Speed Limit)	45 (40) mph	40 (35) mph	30 (25) mph	
Design Vehicle	-	-	-	
Superelevation (e_{max})	NC	NC	NC	Normal Crown (NC = -2%)
Horizontal Alignment				
• Minimum Radius	1040 ft.	762 ft. ⁸	333 ft.	
• Turn Lane Taper	15:1	10:1	10:1	
• Maximum Deflection without a Curve ¹	1.5 Degrees	1.5 Degrees	1.5 Degrees	
Vertical Alignment				
• Minimum Grade	0.6%	0.6%	0.6%	
• Maximum Grade	5%	5%	5%	
• Crest "K" Value	98 / 61 ²	71 / 44 ²	30/19 ²	
• Sag "K" Value	79 / 44 ³	64 / 35 ³	37/20 ³	
• Minimum Vertical Curve Length	135 ft.	120 ft.	75 ft.	
• Stopping Sight Distance	360 ft.	305 ft.	200 ft.	
Street Clearances				
• Clear Zone ⁴	18 ft.	10 ft.	8 ft.	
• Object Setback ⁵	3 ft.	3 ft.	3 ft.	
Parkway Slope	4%	4%	4%	
Fill/Cut Slope	3:1	3:1	3:1	
Travel Lane Width	12 ft.	12 ft.	12 ft.	
Turn Lane Width	12 ft.	12 ft.	12 ft.	

Street Design Criteria	NW State Street	NW Irvinedale Drive	NW Abilene Road	Comments
Curb Type	6" Standard	6" Standard	6" Standard	
Curb Offset ⁶	3 ft.	3 ft.	2 ft.	
Raised Median with left-turn lane ⁷	20.5 ft.	N/A	N/A	
Median Width at Narrowest Point (back to back)	4 ft.	N/A	N/A	
Normal Cross Slope	Varies	2%	2%	NW State Street varies from 1.5% to 3% (See Figure 2)
Sidewalk Width	5 ft.	5 ft.	5 ft.	
Shared-Use Path Width	8 ft.	8 ft.	N/A	
Design Level of Service	C / D	C / D	C / D	

Notes:

1. From Iowa DOT Design Manual Chapter 2A-1.
2. Second value is the acceptable value for the design speed (SUDAS).
3. Second value is the acceptable value based on driver comfort/overhead lighting (SUDAS).
4. Clear zone measured from edge of the traveled way. Minimum clear zone behind the back of curb of 4' should be provided on turn lanes.
5. Object setback applies to breakaway support.
6. Values shown are measured from the edge of the traveled way to the back of curb. Curb offset is not required for turn lanes and inside through lane.
7. SUDAS Table 5C-1.01 – Median width is measured between the edges of traveled way of the inside lanes and includes the curb offset on each side of the median.
8. Horizontal curve on NW Irvinedale Drive tie-in is less than minimum, but is located near the stop condition.

Application of the street design criteria produces the proposed street typical cross sections for NW State Street, as shown in Figure 2.



NW STATE STREET

Initial Conceptual Alignments

Four concepts were initially considered by the City, as shown in Figure 1. Concepts 1 and 2 tie into NW Irvinedale Drive south of NW 54th Street, and Concepts 3 and 4 tie into NW Irvinedale Drive south of County NW 126th Avenue. Concepts 3 and 4 were eliminated from further consideration early in the study process because the City did not consider them to be feasible street corridors. Concepts 1 and 2 were carried forward for further analysis, as described in the sections below.

General Features & Assumptions

The following general features and assumptions were applied to the street concepts analysis and resulting conceptual plan drawings (Figures 5, 6, 7, 8).

1. The NW State Street existing curbed 4-lane street with left turn lanes, sidewalk and shared use path will be extended north and west to tie directly in-line with NW Irvinedale Drive to the north.
2. NW Irvinedale Drive and future NW Abilene Road will tie-in to the NW State Street extension.
3. NW 36th Street is assumed to be widened to a curbed 4-lane street section prior to extension of NW State Street.
4. Avoid direct impacts to existing homes, established ponds and the high voltage transmission line.
5. Maintain existing drainage patterns as practical to allow for conveyance of existing drainage ways.
6. A concept street profile for NW State Street was generated with the objective of matching existing ground while still maintaining surface runoff throughout the corridor.
7. The 4-lane to 2-lane transition at the north tie-in will be detailed during the design phase with consideration for a future extension, construction staging and right of way.
8. Access locations and storm drainage design will be detailed during the design phase. The recommended full access spacing (median breaks) of 660 ft. appears reasonable for the corridor. Specific access locations will need to consider profile grade, area drainage, street culvert locations, high voltage transmission lines, and development plans.
9. Proposed right-of-way (ROW) is assumed to be 120 ft. wide for NW State Street, 100 ft. wide for NW Irvinedale Drive and 70 ft. wide for NW Abilene Road.

Concept 1 Description (Figures 5 & 6)

Concept 1 alignment extends approximately 9,100 ft. north from NW 36th Street and turns to a northwesterly direction prior to turning north to tie-in to existing NW Irvinedale Drive at NW 54th Street. Based on the concept street profile, a grading easement of 75 ft. from the proposed right of way lines has been estimated for this concept. This alignment avoids the existing pond and a high voltage transmission line easement (approximately 100 ft. wide). Horizontal curves are used to tie-in NW Irvinedale Drive and NW Abilene Road to Concept 1.

Concept 2 Description (Figures 7 & 8)

Concept 2 alignment extends approximately 10,300 ft. north from NW 36th Street and turns to a westerly direction prior to turning north to tie-in to existing NW Irvinedale Drive at NW 54th Street. This alignment crosses under a high voltage transmission line 2 times and runs parallel to the approximately 100 ft. wide utility easement for about 1/2 mile. Based on concept street profile, a grading easement of 80 ft. from the proposed right of way lines has been estimated for this concept. Proposed NW Irvinedale Drive ties-in to Concept 2 alignment with a horizontal curve. Proposed NW Abilene Road ties-in to Concept 2 alignment with a tangent section.

IV. STORM WATER MANAGEMENT REVIEW

The proposed NW State Street extension alignment concepts are in the Upper Fourmile Creek watershed, just north of the Rock Creek watershed evaluated as part of the 2013 North Growth Area Storm water Study. The storm water runoff from the drainage areas generally flows in a northerly and easterly direction under the proposed street alignment concepts, as shown in Figures 5 and 7. Concept 1 has 5 drainage areas with approximately 199 acres and Concept 2 has 7 drainage areas with approximately 256 acres. This land is primarily agricultural with some recently-developed residential areas located to the southwest. As the Study Area develops, the City should enforce SUDAS criteria and City standards to address increases in runoff volume and decreases in time of concentration that can result from building impervious areas and conveyance features (storm sewers, swales, and ditches). Contour mapping was reviewed to identify the potential locations of storm water management features, including culverts and storm water detention basins located adjacent to the street. This area includes several local depressions (prairie potholes), that influence localized drainage but do not impact the general direction of flow in the watershed. Flow redirection may be required where the street intersects local drainage paths to these depressions.

Storm water runoff calculations will be required to size and design detention basins and culverts along the street. None of the basins exceed two square miles, so Iowa DNR floodplain development permits will not be required. Sizing should comply with SUDAS criteria for storm water conveyance facilities. Culverts should have capacity to convey the following:

- 10 year storm without headwater depth exceeding the diameter of the culvert
- 50 year storm without headwater depth exceeding 1 foot over the top of the culvert
- 100 year storm should be conveyed through the culvert without the headwater depth exceeding 1 foot below the low point of the street embankment, unless there are more restrictive elevations.

Storm water detention basins should be designed to the following minimum standards. These standards, discussed in SUDAS Chapter 2, include:

- Capacity to retain a 100 year storm at critical duration or safely pass the 100-year discharge over an auxiliary spillway
- Top of detention embankment should be at least 1 foot above 100 year ponding elevation
- Provide peak-discharge control for events up to the post-developed 100-year that limit outflow to the pre-developed peak 5-year flow rate.
- Meet Iowa DNR criteria for dams, if required

Storm water detention basins, which could be designed to reduce runoff volume downstream, can be incorporated at street culvert features by excavating the surrounding area and installing a riser structure to regulate outflow from the detention basin. Based on existing drainage patterns in relation to the street alignment concepts, Figures 5 and 7 identify potential locations for storm water detention basins. These potential storm water detention basin locations should be reviewed during storm sewer and drainage design phase to confirm roadway runoff can be conveyed to these locations, otherwise consideration should be given to additional storm water detention locations or practices. These basins can also be designed to provide storage for the water quality volume (runoff resulting from storm of 1.25 inches of rain). Proper storm water management as part of the NW State Street extension will reduce flash flood risk for downstream areas and improve water quality for the Upper Fourmile Creek.

V. GEOTECHNICAL REVIEW

The Study Area was evaluated to identify areas where the subsurface conditions should be conducive to street construction and to identify areas that may be less desirable for street construction. This evaluation was made using the following published resources:

- Web Soil Survey – Natural Resources Conservation Service (NRCS)
- GeoSam – Iowa Geological Survey (IGS)









The surface soil mapping units were obtained from the Web Soil Survey and these mapping units were used to develop Figure 3. The mapping units include soils with the following geologic origins:

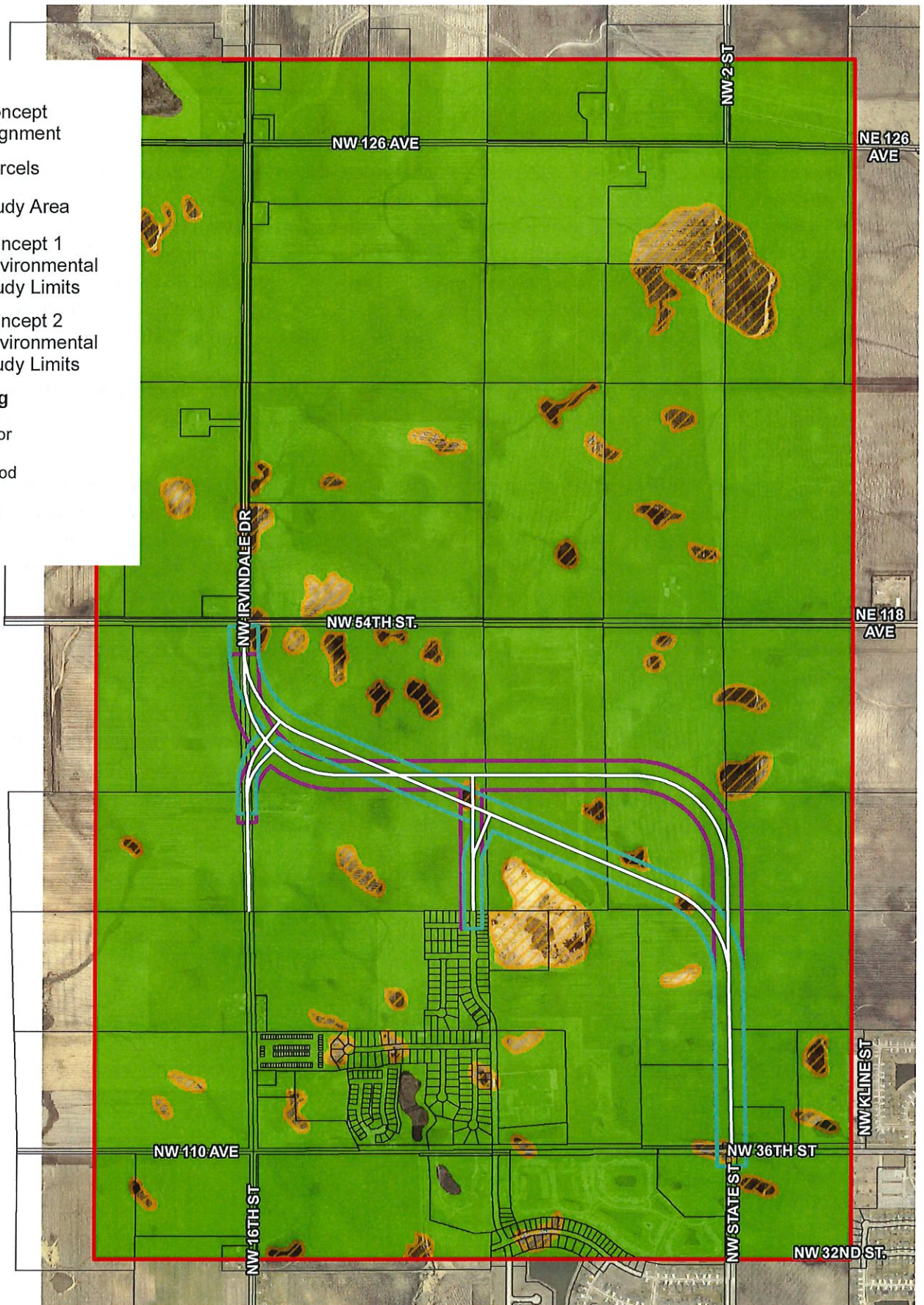
- organic material over alluvium
- alluvium over glacial till
- glacial till
- glaciolacustrine (glacial lake) deposits
- glacial outwash

The glacial till and glacial outwash soils are expected to provide reasonable subgrade support for new pavements and are preferred to support the proposed street alignments. The glaciolacustrine deposits, alluvium and organic material may be weaker and/or more compressible than the glacial till and glacial outwash and are less desirable to support the proposed street alignments. The Web Soil Survey indicates that the glacial till and glacial outwash soils comprise the majority (approximately 95%) of the Study Area. From a qualitative review of Figure 3, Concept 1 potentially impacts more “poor” soil areas as compared to Concept 2; however, detailed geotechnical analysis of street soil borings will need to be performed during design to determine whether these areas will affect street pavement and hydraulic structure designs.

Several water well logs were reviewed in the vicinity of the project site from the GeoSam database to determine the depth to bedrock in the area of this Study. Bedrock appears to be deep at the Study Area and is not expected to be a factor in selection of the preferred street alignment.

LEGEND

-  Concept Alignment
-  Parcels
-  Study Area
-  Concept 1 Environmental Study Limits
-  Concept 2 Environmental Study Limits
- Soil Rating**
 -  Poor
 -  Good
 -  NA



SOIL RATING ANKENY - NW STATE STREET EXTENSION ALIGNMENT STUDY

FIGURE 3

VI. ENVIRONMENTAL RESOURCES SCREENING

The environmental review and screening was based on desktop data, with no field verification or field studies. If federal funds would be acquired and used for this project, requirements of the National Environmental Policy Act (NEPA) would apply, and field surveys would be needed to review the Study Area for the presence of potential environmental constraints. A Categorical Exclusion or an Environmental Assessment would need to be prepared to meet NEPA requirements. If federal funds are not allocated to this project, some environmental requirements could still apply to the project. Field reviews to determine the presence or absence of wetlands would need to be done, and if it is determined that wetlands are present and would be impacted by the project, a Section 404 permit of the Clean Water Act would be required. The U.S. Army Corps of Engineers requires a review of the presence and potential impacts to threatened and endangered species and historic sites as part of the Section 404 permit application. Subsequently, field reviews for species habitat would be needed (but could be done in conjunction with the wetland reviews), and reviews of potential historic sites would be needed to meet requirements for Section 404 permitting.

Desktop analysis of several environmental constraints, accessing information via publicly available websites and data sets, was performed for the Study Area; however, no field visit or field surveys were conducted of the Study Area. The environmental constraints are shown in Figure 4 and Table 2 summarizes the environmental constraints reviewed for both Concepts 1 and 2. A potential impact area buffer of 100 feet on either side of proposed right-of-way (ROW) was included in the environmental constraints review for both concepts evaluated. The inclusion of potential impact area buffers is a standard practice for environmental studies at this level of concept development and can help account for potential environmental impacts resulting from further design development. The inclusion of these buffer areas results in a conservative estimate of potential impacts at this stage of concept development and actual impacts are likely to be less as design development progresses.

Potential wetlands were reviewed by searching U.S. Fish and Wildlife Service (USFWS) shape files of National Wetlands Inventory (NWI) database and recent aerial photography image showing potential wetland areas in agricultural fields (which were digitized into a geographic information system (GIS)). Threatened and endangered species habitat was reviewed by accessing the USFWS list of potential species in Polk County, and viewing aerial photographs and Google Earth®. A review of floodplains was conducted using Flood Insurance Rate Map GIS files from the Federal Emergency Management Agency (FEMA). Potential historic resources were reviewed using a series of different years of aerial photographs on the Iowa Department of Natural Resources (Iowa DNR) GIS map; if residences and other structures were observed older than 50 years, they were assumed to potentially be historic. The National Park Service database of National Register of Historic Places sites was reviewed, and there were no listed sites in the Study Area. The Office of the State Archaeologist I-Sites database was also reviewed for potential historic properties. The Iowa DNR One-Stop Facility Explorer interactive map, as well as the Iowa DNR contaminated sites and underground storage tank (UST)/ leaking underground storage tank databases, were reviewed for regulated materials sites. The Iowa DNR GIS database was reviewed for groundwater well locations. The Polk County Interactive GIS map was reviewed for existing or planned park and recreational facilities.














Table 2. Comparison of Environmental Constraints for Concepts 1 and 2

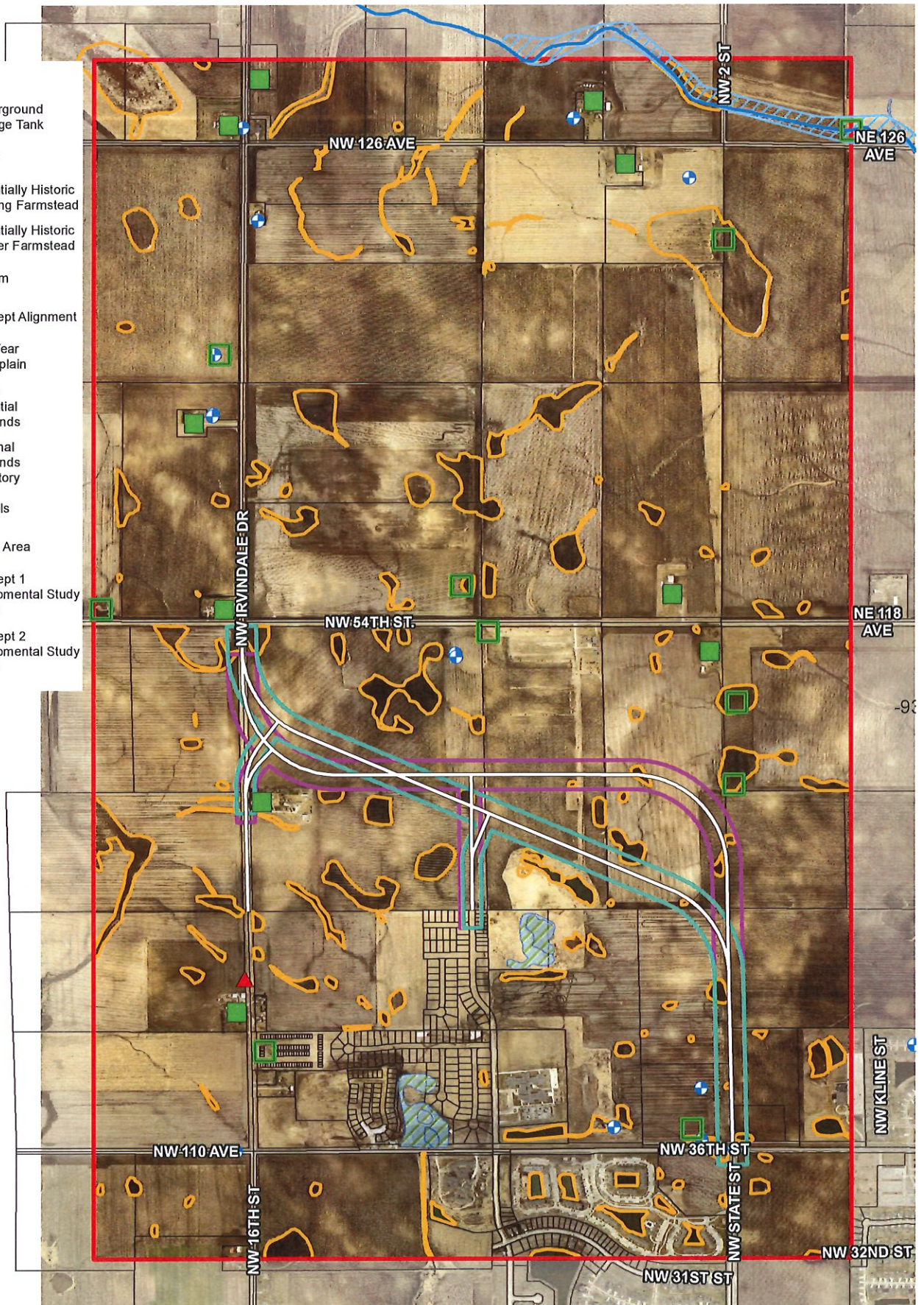
Constraint	Concept 1	Concept 2
Wetlands	3.06 Acres Potential Agricultural Wetlands	3.26 Acres Potential Agricultural Wetlands
Threatened and Endangered Species	Potential habitat	Potential habitat
Floodplain	Not present	Not present
Historic Resources	One potential impact	One potential impact
Regulated Materials	No known sites	No known sites
Groundwater wells	One	One
Park and Recreational Properties	None	None

Although there were no NWI wetlands in the street alignment concept corridors, slightly more potential agricultural wetlands were located in the Concept 2 corridor than in Concept 1. USFWS lists the following threatened or endangered species as occurring within the Study Area: Indiana bat, northern long-eared bat, least tern, prairie bush-clover, and the western prairie fringed orchid. There is no suitable habitat for the Indiana bat, northern long-eared bat, or least tern within the potential impact corridors for Concepts 1 and 2; as there are no woodlands in the project area for hosting bats, and no streams with sand bars for least tern habitat. There is potentially suitable habitat for prairie bush-clover and the western prairie fringed orchid within small areas (approximately an acre or two of prairie) of the potential impact corridors for both Concepts 1 and 2. A review of aerial photography suggests that the potential prairie area within Concept 1 is slightly larger than within Concept 2.

There is no FEMA-mapped 100-year floodplain within either concept corridor. Both concepts could affect a potentially historic farmstead (based solely on aerial photography review) on the east side of NW Irvinedale Drive, approximately 1,700 feet south of NW 54th Street. There are no known regulated material sites within or adjacent to either concept corridor; the closest site is a UST located approximately 1,800 feet outside the concept corridors. One well is shown within both corridors, but is reported to be plugged (properly abandoned). The Polk County Interactive GIS map does not show any existing or planned park or recreational facilities within the project Study Area.

LEGEND

-  Underground Storage Tank
-  Wells
-  Potentially Historic Existing Farmstead
-  Potentially Historic Former Farmstead
-  Stream
-  Concept Alignment
-  100-Year Floodplain
-  Other Potential Wetlands
-  National Wetlands Inventory
-  Parcels
-  Study Area
-  Concept 1 Environmental Study Limits
-  Concept 2 Environmental Study Limits



ENVIRONMENTAL CONSTRAINTS

ANKENY - NW STATE STREET
EXTENSION ALIGNMENT STUDY

FIGURE 4



VII. SUMMARY

The following is a summary of comparative advantages and disadvantages for Concepts 1 and 2 based on the reviews performed in report sections above. The advantages of one concept translate to a disadvantage of the other concept and have been documented as such.

Concept 1 (Figures 5 & 6)

Advantages:

- Concept 1 is 1,200 ft. shorter in total alignment length, which could result in lower land acquisition and construction costs.
- The street alignment avoids crossing the high voltage transmission line located in the central portion of the Study Area.
- The tie-in alignment for NW Irvinedale Drive reduces the potential for impacts to the potentially historic farmstead in the Study Area.
- This concept impacts less potential agricultural wetlands.
- The Concept 1 total drainage basin area that needs to be conveyed under the Street alignment is approximately 200 acres, whereas Concept 2 includes a total drainage basin area of approximately 250 acres. This difference in drainage area would translate to a reduction in surface runoff and, subsequently, smaller culvert sizes.

Disadvantages:

- Future extension of NW Abilene Road, north of NW State Street could be impacted by having to cross the high voltage transmission line easement.
- Concept 1 alignment runs diagonal to the parcel lines, which could have greater potential for uneconomic remnant parcels. However, some remnant parcels could be suitable for storm water detention or recreational uses.
- There is a slightly larger area for potential impact to prairie habitat.

Concept 2 (Figures 7 & 8)

Advantages:

- Future extension of NW Abilene Road would not be impacted by having to cross the high voltage transmission line easement.
- Longer segments of street alignment run parallel to the parcel lines, which reduces the potential for uneconomical remnant parcels. However, some remnant parcels could be suitable for storm water detention areas or parks.

Disadvantages:

- Concept 2 is 1,200 ft. longer, which could result in higher land acquisition and construction costs.
- The street alignment passes underneath the high voltage transmission line at 2 locations. The Street horizontal and vertical alignment will need to maintain proper clearances.

- The tie-in alignment for NW Irvinedale Drive could have more potential impacts to the adjacent property owner/potential historic farmstead.
- More potential impacts to agricultural wetlands.
- Immediate frontage development will only be available on the north side of NW State Street in the ½ mile segment where the street alignment is adjacent to the high voltage transmission line easement.
- The total drainage basin area is approximately 50 acres higher, which would translate to additional surface runoff and, subsequently, larger culvert sizes.

Potential Land Use

As noted, the primary current land use is agriculture with residential and commercial development starting along the north side of NW 36th Street. Both concepts offer suitable areas for development; however, the Concept 1 alignment runs diagonal to the parcel lines, which could have greater potential for uneconomic remnant parcels. There is also a high voltage transmission line running through the Study Area that will have an impact on future development. Concept 2 crosses under the transmission line 2 times, running parallel and adjacent for approximately 1/2 mile. The Street ROW adjacent to the transmission line easement will impact immediate frontage development along the south side of NW State Street.

Drainage

As the Study Area develops, the City should enforce SUDAS criteria and City standards to address increases in runoff volume and decreases in time of concentration that can result from building impervious areas and conveyance features (storm sewers, swales, and ditches). The total drainage area to convey through the NW State Street corridor is larger for Concept 2.

Environmental

Although there were no NWI wetlands in the concept corridors, slightly more potential agricultural wetlands were located in the Concept 2 corridor. Slightly more potential prairie area is located in the Concept 1 corridor. Both concepts could affect a potentially historic farmstead in the northwest quadrant of the Study Area.

Access

The recommended full access spacing (median breaks) of 660 ft. seems reasonable for each corridor. Specific access locations will need to consider profile grade, area drainage, street culvert locations, high voltage transmission lines, and development plans.

Construction Phasing

The street project could be constructed and opened in phases to better distribute construction costs and meet travel demand. An interim build option would include construction of the inside lanes with curbed median and defer the construction of outside lanes to a future date (See Figure 9). The interim build option would also include construction of the full-build embankment and storm sewer system with the shared-use path and sidewalk. An interim granular shoulder could be placed adjacent to the inside lanes with a swale ditch to carry drainage to the storm sewer intakes with modified tops. At established or planned access locations like NW Irvinedale Drive and NW Abilene Road, the left turn lanes in the median could be constructed. Turn lanes for other access points could also be built initially or added as development occurs. A short segment of the outside lane could be paved for the side road to tie-in, with temporary return pavement. This phasing eliminates the cost associated with temporary widening and traffic control to construct left turn lanes at side roads which would then have to be removed and replaced with new pavement. Consideration should be given during the design phase for the width of paving for the inside lane in the interim build option. It may be desirable to shift the 12 ft. inside lane joint into the 12 ft. outside lane by 1 ft. making

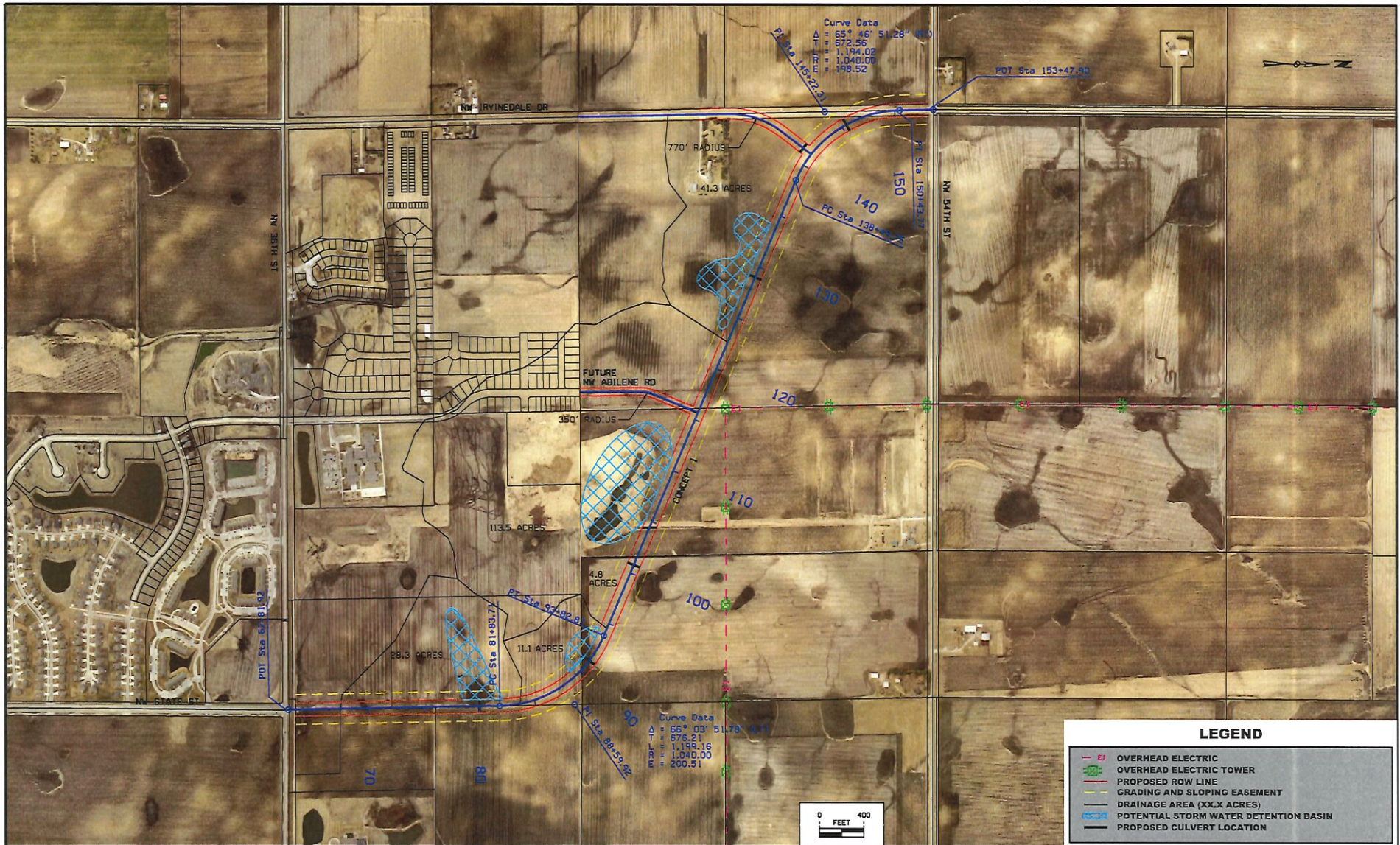
the lane widths 13 ft. and 11 ft., respectively, to account for traffic control channelizing devices and contractor working space during construction of the outside lanes.

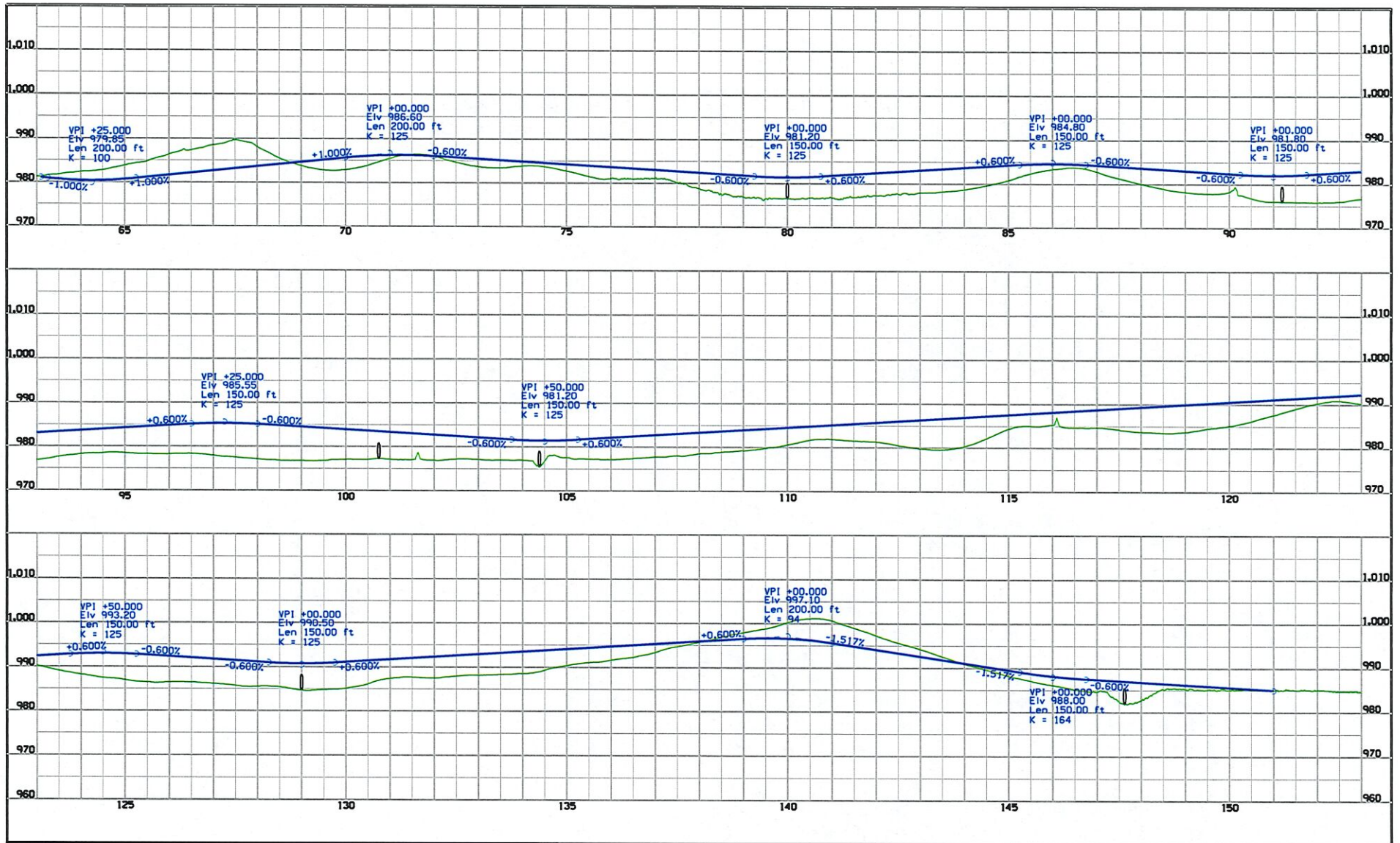
Recommendations

Both of the analyzed concepts are feasible options for the extension of NW State Street. However, Concept 1 is recommended to move forward for further project development for the following main reasons:

1. Proposes a shorter street alignment, which should result in less land acquisition and construction costs;
2. Reduces the drainage area by approximately 20% and, subsequently, the stormwater runoff volume that needs to be detained and ultimately conveyed under the street alignment.
3. Avoids the high voltage transmission line easement, which eliminates the need for street crossing easements and provides more developable frontage along public ROW;
4. Minimizes risk to impact potentially historic farmstead near northern terminus of street extension.

This study also recommends that speed studies and traffic impact studies be performed once NW State Street is extended and as development continues in the Study Area. These additional studies will help determine appropriate posted speed limits, street capacity improvements, and intersection improvements within the corridor.

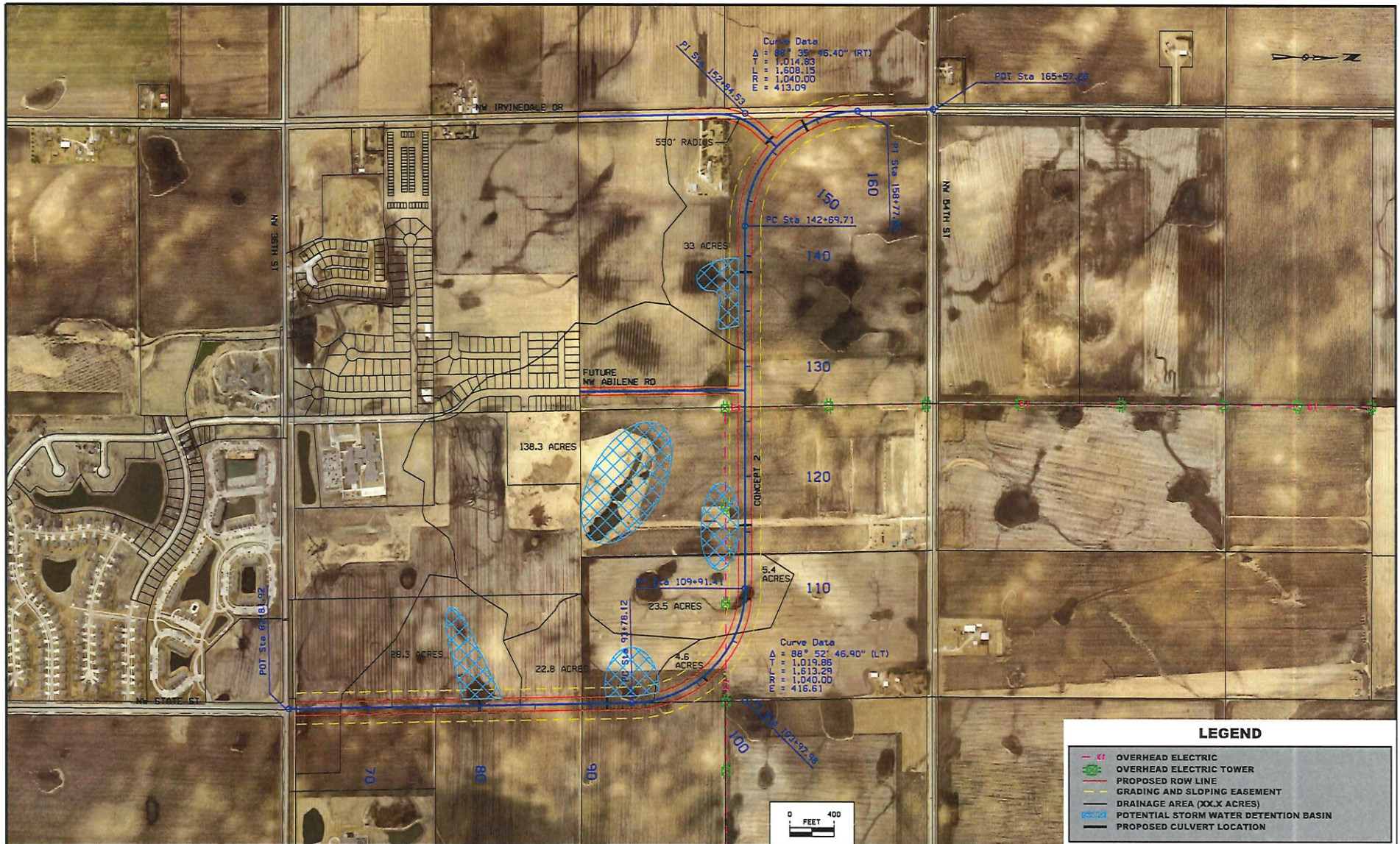


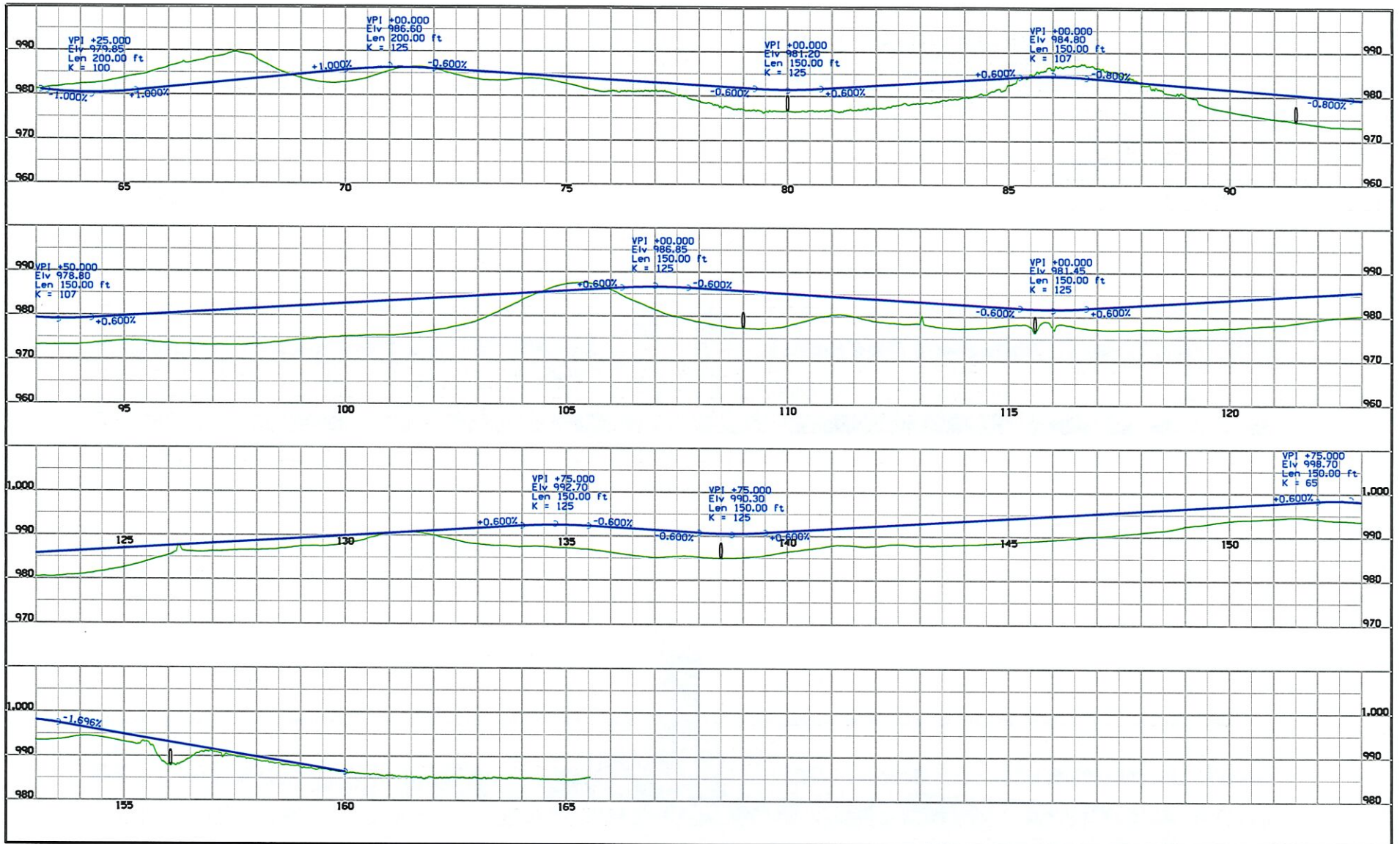


ANKENY - NW STATE STREET
ALIGNMENT EXTENSION STUDY
CONCEPT 1 PROFILE

DATE
OCTOBER 2017

FIGURE





ANKENY - NW STATE STREET
ALIGNMENT EXTENSION STUDY
CONCEPT 2 PROFILE

DATE
OCTOBER 2017

FIGURE

