

BIPOLE III TRANSMISSION PROJECT

Soil Productivity Monitoring for Agricultural Lands - 2017



Prepared for :



Submitted by:



**Bipole III Transmission Project Soil
Productivity Monitoring for
Agricultural Lands – 2017**

Final Report



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BIPOLE III TRANSMISSION PROJECT SOIL PRODUCTIVITY MONITORING FOR AGRICULTURAL LANDS – 2017

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1.0 INTRODUCTION

Manitoba Hydro retained Stantec Consulting Ltd. (Stantec) to conduct monitoring of soil productivity along the portion of the Bipole III Transmission Project (the “Project”) under agricultural crop production. This report represents the second annual report¹ on this monitoring component and includes monitoring information on construction phase conditions along some portions of the Project.

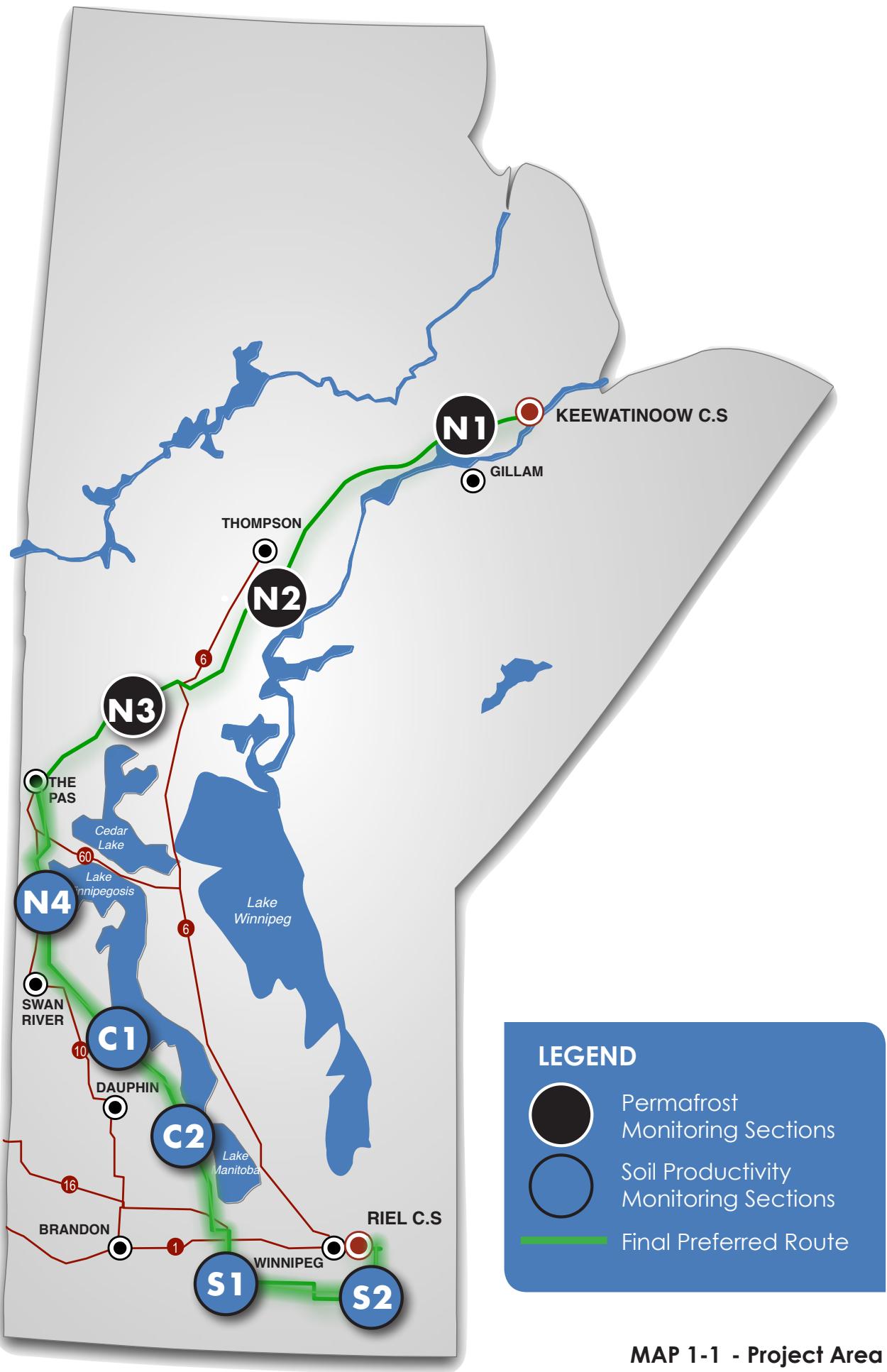
In agro-Manitoba, primarily in the southern portion of the Project, the productivity of soils for arable agriculture is valued by agricultural producers as a primary source of income. Agricultural production is also of general benefit to society. Soil productivity could be affected primarily due to the use of heavy equipment and vehicles, disturbance of surface materials during grading, excavation of foundations, and removal of vegetation. The mechanisms of effects of construction activities on soil productivity are primarily physical, but secondary or indirect effects to productivity may occur through chemical and biological changes as a result of physical disturbances. Soil productivity is a result of numerous soil environmental factors and conditions and is difficult to measure or assess. However, these direct effects on soil properties are typically manifested in and can be assessed using vegetation productivity. Therefore, a vegetation productivity indicator can be used as an effective proxy for soil productivity. As such, vegetation productivity was used as an effective screening tool in areas of agricultural production to assess the effectiveness of prescribed mitigation in the maintenance and reclamation of soil productivity following construction activities.

The soil productivity monitoring program relies primarily on the use of the Normalized Difference Vegetation Index (NDVI) calculated from remotely-sensed data collected through satellite imagery and evaluates the difference between NDVI values on the right of way (RoW) and adjacent, comparable off RoW areas. This program is supplemented by field assessments to confirm effects, where necessitated.

1.1 OBJECTIVE

The objective of the monitoring program is to monitor crop performance in agricultural portions of the Project RoW as a key indicator of Project effects to soil productivity. Monitoring is to be conducted for one year prior to construction, an assumed two-year construction period and for two years following construction. Applicable Project components include N4, C1, C2, S1, and S2 (**Map 1-1**), with portions of these components under crop production included in the monitoring program.

¹ The first annual report was submitted in 2016 and included monitoring information on the preconstruction (baseline) phase and preliminary construction phase.



MAP 1-1 - Project Area

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A three-tiered approach to monitor and assess soil productivity is being undertaken. This approach relies primarily on desktop-based activities, namely remote sensing of vegetative productivity using the Normalized Difference Vegetation Index (NDVI). The Tier 1 approach for initial crop productivity screening was implemented. Tiers 2 and 3 were not warranted for 2017 (**Figure 1-1**).

The monitoring activities being undertaken are outlined in **Table 1-1**.

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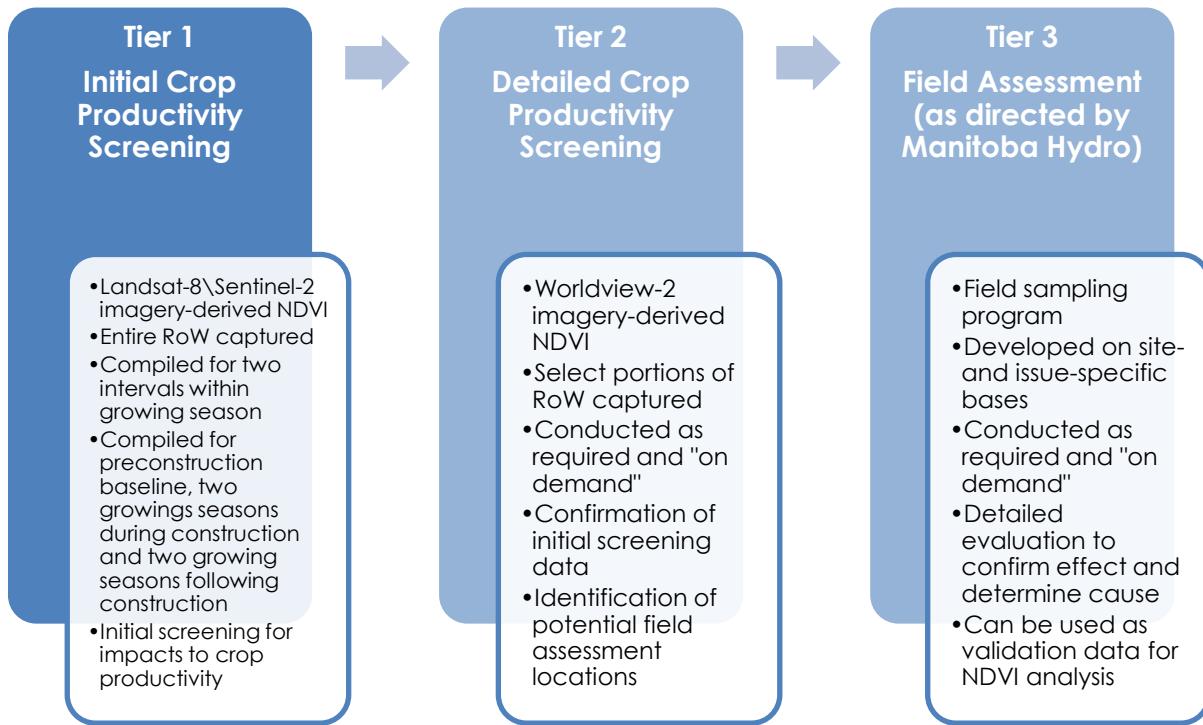


Figure 1-1 Key Aspects of a Proposed Three-Tiered Soil Productivity Monitoring and Assessment Approach for Bipole III Transmission Project

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Table 1-1 Monitoring Activities

Phase	Task Description	Parameters	Duration	Frequency	Timing	Measurable Indicator(s)
Tier 1 Preconstruction phase (baseline)	Map crop productivity and crop type along RoW, access roads, and other temporary project footprints, plus a non-disturbed buffer area	Crop performance	One year prior to construction (pre-construction baseline) for all segments (N4, C1, C2, S1 and S2). Actual calendar year will align with construction schedule.	Semi-annually	Summer	NDVI
Tier 1 Construction phase	Map crop productivity and crop type along RoW, access roads, and other temporary project footprints, plus a non-disturbed buffer area, using Landsat-8 or Sentinel-2 imagery	Crop performance	Year 1 and Year 2 of construction phase. Actual calendar years will align with construction schedule.	Semi-annually	Summer	NDVI
Tier 2 and Tier 3 Post-construction phase (if required)	Map crop productivity at targeted locations and crop type along RoW, access roads, and other temporary project footprints, plus a non-disturbed buffer area, using Worldview-2 imagery. Field assessments at targeted locations to determine soil and crop productivity on-RoW and off-RoW where differences were determined using NDVI analysis.	Crop performance; Soil conditions	Year 3 and Year 4 (two years following construction). Actual calendar years will align with construction schedule.	Semi-annually	Summer	NDVI and/or specific field assessment measurements for soil and crop conditions

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2.0 METHODOLOGY

The methods used to conduct the soil productivity monitoring program are summarized below.

2.1 IMAGE ACQUISITION

For the 2017 monitoring season, imagery was collected from the Sentinel-2 satellite to support the Tier 1 Initial Productivity Screening². The Sentinel-2 sensors provide an ideal radiometric and spatial resolution to capture crop conditions across a landscape in a cost-effective manner.

The Sentinel-2 satellite collects multispectral data, including Blue (465-520 um), Green (540-575 um), Red (650-685 um) and Near Infrared (NIR) (800-915) wavelengths. It collects this data at 10 meter resolution and on a 10-day revisit period. The sensor is affected by atmospheric interference such as clouds, fog, rain or smoke and requires cloud free conditions to collect surface spectral reflectance information. Satellite image acquisition for the Bipole III RoW required multiple orbital paths due to the sheer extent of the area of interest. Due to cloud cover, a long repeat coverage period and a high level of orbital overlap, multiple orbital tracks were required over varying dates to compile a single imagery mosaic for the RoW sections N4 to S2 in 2017. Sentinel-2 imagery was collected where cloud free data was available (**Table 2-1**).

Table 2-1 Image Acquisition Dates for 2017 NDVI (Sentinel-2)

July 25, 2017	August 27, 2017
August 14, 2017	September 9, 2017

Tier 2 Detailed Crop Productivity Screening using WorldView-2 imagery is planned for post-construction years and was not collected during 2017.

2.2 IMAGE PROCESSING

All satellite imagery was atmospherically corrected using PCI Geomatica 2017 – ATCOR software. Top of atmosphere (TOA) reflectance values were used to convert raw pixel values to spectral reflectance signatures using the radiometric calibration coefficients from the Sentinel-2 sensors. Haze removal was performed as part of the atmospheric correction allowing for precise vegetation measurements. ATCOR successfully normalized solar illumination conditions at different time periods allowing for accurate change detection analysis. Individual images were clipped and mosaicked together creating continuous coverages of agricultural land use areas of N4-S2 for 2017.

² In previous years data was used from a combination of Landsat-8 (2015 and 2016) and Sentinel-2 (2016 only) satellites.

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2.3 NORMALIZED DIFFERENCE VEGETATION INDEX

Imagery was processed to quantify agricultural crop health by implementing the NDVI formula. NDVI is a measure of vegetative vigor or plant health using the Red and NIR channels of the electromagnetic spectrum. NIR energy is highly reflected by healthy vegetation while Red wavelengths are highly absorbed by vibrant vegetation (**Figure 2-1**). This relationship is not as strong in stressed vegetation and is non-existent in dead vegetation. This unique vegetative property, provides detail on vegetation health and is exemplified in the NDVI formula;

$$(NIR - RED) / (NIR + RED) = NDVI$$

NDVI values range from 1 (healthy vegetation) to -1 (non-vegetation). Results of the NDVI formula can vary from one landscape to another but typically areas of water, sand, or infrastructure show very low NDVI values (for example, -0.5 or less). Bare soil usually scores near 0.0 on the NDVI scale range. Sparse vegetation such as shrubs and grasslands or senescing crops may result in moderate NDVI values (approximately 0.1 to 0.4). High NDVI values (approximately 0.5 to 0.9) correspond to dense vegetation such as that found in temperate and tropical forests or crops at their peak growth stage.

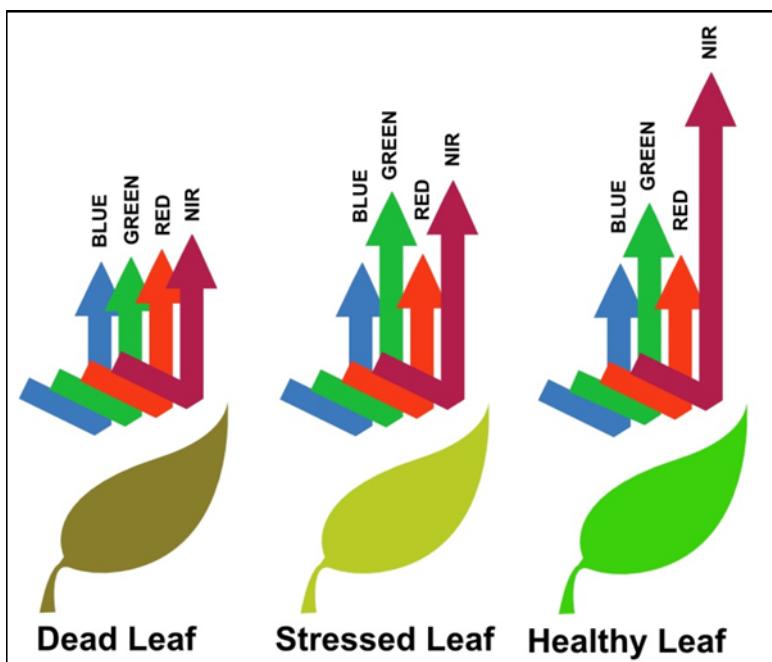


Figure 2-1 Spectral Reflectance Amount Variations for Blue, Green, Red and NIR Energy of Dead, Stressed and Healthy Crops Leaves

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2.4 DATA ANALYSIS

2.4.1 Study Area Definition

2.4.1.1 On RoW and Off RoW Study Areas

In order to analyze data and evaluate for potential effects to crop productivity on the RoW from construction activities, “On RoW” and “Off RoW” study areas were established. Two On RoW areas were identified for the 2017 program³: 1) a 66-m Corridor centered on the Bipole III route centerline, and 2) a 20-m Corridor centered on the Bipole III route centreline. The 66-m-wide RoW was then buffered by 66 m on both sides to create the Off RoW study areas (**Figure 2-2**). The creation of these areas for sections N4-S2 (752 km in length) allows for the comparison of NDVI values in areas likely to be disturbed by construction (i.e., On RoW) and adjacent, comparable areas not disturbed by construction (i.e., Off RoW).

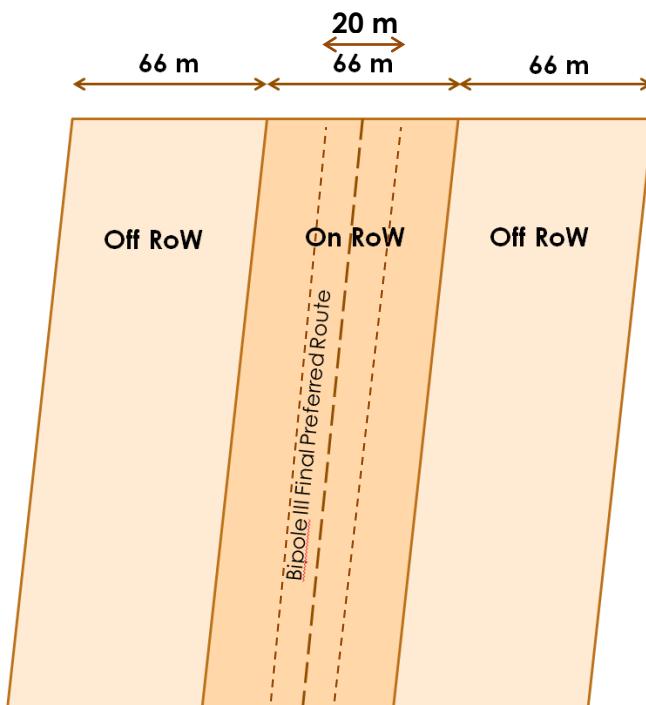


Figure 2-2 Conceptual Drawing of On RoW and Off RoW Study Area Corridors

³ For the evaluation of 2015 and 2016 cropping seasons only a 66-m-wide On RoW corridor was used. However, a learning and recommendation from the outcomes of this evaluation was to include a second, narrower (i.e., 20-m) corridor in recognition that much of the disturbance along the transmission line in agricultural fields is **generally** confined to a narrower portion of the entire RoW typically centered on the centreline. The two On RoW evaluation approach was developed to better identify differences between On RoW and Off RoW areas.

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2.4.1.2 Agricultural Field Management Units

The corridor study areas were “clipped” by quarter section boundaries and then further delineated into Field Management Units (FMUs), or areas within a given quarter-section that are under agricultural crop production and with a management unit for the purposes of crop production⁴. The location and orientation of the RoW in some cases is such that Off RoW areas on either side of the RoW may be in a different FMU with a different crop being grown in a given monitoring year. Through the delineation of FMUs, non-agricultural land uses (e.g., infrastructure such as road, rail and other transmission lines, tree/forest cover, wetlands, abandoned land, etc.) were removed from the evaluation, and the resulting On RoW and Off RoW polygon pairs allowed for a better “apples-to-apples” comparison (**Figure 2-3**).

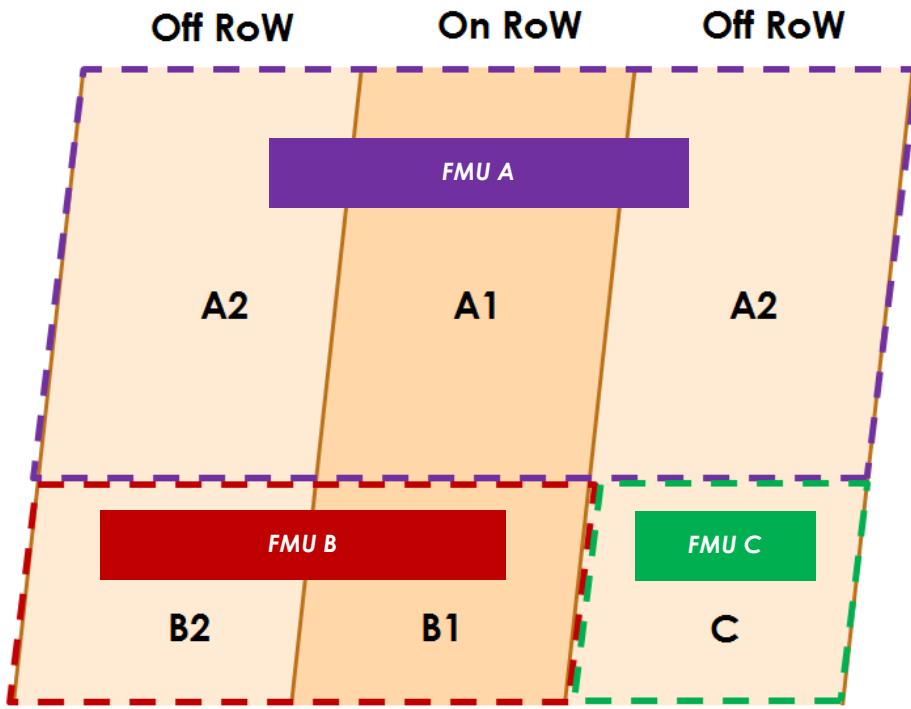
In cases where multiple FMUs were delineated within a given quarter section, these FMUs were labelled successively with “A”, “B”, and “C” to yield unique identifiers for data management and comparative evaluation purposes.

A total of 762 FMUs were defined within the agricultural study area in 2017.

⁴ The delineation of FMUs was recommended following the evaluation of 2015 and 2016 cropping seasons in order to improve comparative evaluation between On RoW and Off RoW areas. It was determined that comparisons would be improved with the identification and delineation of areas within a field that are managed as the same unit (i.e., there are often multiple field management units within a given quarter section, or non-agricultural land uses). The use of FMUs replaced the use of Agriculture and Agri-Food Canada crop type inventory data that was used for evaluation of 2015 and 2016 data.

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Within FMU A (purple), the On RoW area "A1" is compared against the Off RoW "A2" areas to determine the NDVI difference. Within FMU B (red), the On RoW area "B1" is compared against area "B2" to determine the NDVI difference. FMU C (green) is eliminated from the evaluation as it does not have a comparable area On RoW.

Figure 2-3 Conceptual Drawing of Use of Field Management Units (FMU) to Determine On RoW and Off RoW Areas for Comparison

2.4.2 Statistical Analysis

Some basic statistical analyses were conducted on NDVI values for On RoW areas, comparable Off RoW areas and differences between On RoW and Off RoW. The objective of these analyses was to better understand the differences and to evaluate the potential of establishing a "threshold" value that can be used to determine with statistical confidence when a negative difference value is indicative of a practically-meaningful reduction in NDVI value On RoW relative to Off RoW.

Statistical analyses included frequency histograms and quartile analysis to understand the character and distribution of mean On RoW and Off RoW values. For difference values, values were plotted against the expected normal distribution, quartiles were determined, and percentiles and residuals (difference between actual difference values and expected values

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[i.e., no difference between On RoW and Off RoW] were evaluated to visually assess distribution and identify “outliers”.

2.4.3 Visual Assessment

A manual visual review of the select portions of the RoW was conducted for 2017 NDVI data in order to identify visual evidence of construction effects along the agricultural RoW. This was completed due to an absence of reliable spatial data on construction activities that could be used to direct targeted data reviews and to confirm the sensitivity of the statistical approach in determining “real” differences relative to what the NDVI data is showing visually. The visual review was used to identify NDVI value patterns indicative of construction disturbances around tower footprints, and linear disturbances along centreline for select FMUs identified as “negative outliers” and “positive outliers”, as well as a selection of other FMUs.

2.4.4 Tower Construction Areas

Following review of 2015 and 2016 NDVI data, a recommendation was made to include evaluation of NDVI values in close proximity to tower locations. This recommendation was made in recognition that, generally, more intensive construction activity occurs associated with tower erection than other activities throughout the RoW. In order to complete this evaluation, a 33 m buffer was applied to tower locations (66-m diameter in total) that fell within delineated FMUs. The NDVI values within these buffered areas were evaluated against the comparable Off RoW portion of the given FMU.

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3.0 RESULTS

Results are presented below for NDVI evaluation by section and segment, by agricultural crop type and by agricultural capability class. Additionally, some findings from “hot spot” analysis are presented.

Tabular based results are complemented with map books of the change detection or differences between On RoW and Off RoW values along the entire length of the agricultural RoW for the 2017 Sentinel-2 NDVI data. These maps are presented in **Appendix C** as follows: **Map Series 4-100 (N4)**, **Map Series 4-200 (C1)**, **4-300 (C2)**, **4-400 (S1)**, and **4-500 (S2)**.

3.1 NDVI FOR THE ENTIRE AGRICULTURAL ROW

While the NDVI comparative analysis for the entire agricultural study area in N4 to S2 for 2015 and 2016 coverages revealed minimal NDVI differences when On RoW was compared to Off Row, the difference was notably higher in 2017 data (**Table 3-1**). As a reminder, NDVI output values have an absolute range from +1 to -1. NDVI differences within the entire agricultural study area of -0.010, 0.001 and -0.010 for 2015 (Landsat-8), 2016 (Landsat-8) and 2016 (Sentinel-2), respectively, were considered negligible. This was not unexpected due to the minimal amount of construction that had occurred in agricultural areas by the end of 2016, and the small proportion of the RoW that was disturbed in agricultural fields where construction has occurred.

However, it is apparent in 2017 data for both the 66-m Corridor and 20-m Corridor that a greater negative difference in NDVI values has emerged. Differences between mean values of On RoW and Off RoW for the entire agricultural study area were -0.024 (-3.71% of Off RoW values) and -0.038 (-5.80% of Off RoW values) for the 66-m and 20-m corridors, respectively. These higher negative values appear to be evidence that Project construction disturbance has resulted in lower NDVI values On RoW compared with similar Off RoW areas. The greater difference value found for the 20-m RoW suggests that using the smaller corridor width provides a more “sensitive” approach to screening for potential construction disturbance along the RoW.

Table 3-1 Comparison of NDVI for Entire Agricultural Study Area for 2015 to 2017

Entire Agricultural RoW (N4 to S2)	NDVI Values					
	On RoW Mean	Off RoW Mean	Difference (On RoW – Off RoW)	Difference (% Off RoW)	Difference (% NDVI Range)	Source
2015	0.667	0.677	-0.010	-1.48%	-0.50%	Landsat 8
2016	0.673	0.672	0.001	0.15%	0.05%	Landsat-8
2016	0.511	0.521	-0.010	-1.92%	-0.50%	Sentinel-2

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Table 3-1 Comparison of NDVI for Entire Agricultural Study Area for 2015 to 2017

Entire Agricultural RoW (N4 to S2)	NDVI Values					
	On RoW Mean	Off RoW Mean	Difference (On RoW – Off RoW)	Difference (%) Off RoW	Difference (%) NDVI Range)	Source
2017 (66-m On RoW corridor)	0.633	0.657	-0.024	-3.71%	-1.22%	Sentinel-2
2017 (20-m On RoW corridor)	0.617	0.655	-0.038	-5.80%	-1.90%	Sentinel-2

Note:
Absolute values are not comparable between years and data sources as these data were collected during different time periods (with different crop type distribution and at crop stages) within a given year and between years. However, it is valid to compare differences expressed as percentages between years.

3.2 NDVI BY PROJECT SECTION AND SEGMENT

When analyzing the NDVI coverages by Project section, similar change detection results were found as for the entire agricultural study area (**Table 3-2** and **Table 3-3**). All Sections within the agricultural study area displayed negative differences between On RoW and Off RoW NDVI values. Compared with results from 2015 and 2016 (not presented here), when differences were generally considered negligible and in some cases were positive, the 2017 results at the Project section level appear to provide confirmation that construction disturbances have occurred within each Section, albeit to a different degree. When the differences were compared to Off RoW areas, % differences were found to range from -0.61% to -4.81% for the 66-m Corridor and from -2.24% to -7.05% for the 20-m Corridor.

A couple of interesting patterns in the data include:

- Negative % differences were greater in a “north to south” direction (N1 > C1 & C2 > S1 & S2). It is unclear the reason behind this pattern, however it could be related to variable amounts of construction across the sections (e.g., more construction completed in southern sections?), the seasonal timing of construction activities (e.g., winter construction would be expected to result in less disturbance to soil and crop productivity), or the nature of construction activities (e.g., helicopter tower erection would be expected to result in less disturbance to soil and crop productivity).
- Negative % differences were greater for the 20-m Corridor compared to the 66-m Corridor. As mentioned above, this provides support that the 20-m Corridor approach is more “sensitive” in screening for potential differences along the RoW.

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Table 3-2 Comparison of NDVI by Project Section for 2017 for 66-m Corridor

Agricultural RoW Section	NDVI Values				
	On RoW Mean	Off RoW Mean	Difference (On RoW – Off RoW)	Difference (% of NDVI Range)	Difference (% of Off RoW Mean)
N4	0.527	0.530	-0.003	-0.61%	-0.16%
C1	0.635	0.655	-0.020	-3.05%	-1.00%
C2	0.612	0.628	-0.016	-2.53%	-0.79%
S1	0.664	0.689	-0.026	-3.71%	-1.28%
S2	0.624	0.655	-0.031	-4.81%	-1.57%

Table 3-3 Comparison of NDVI by Project Section for 2017 for 20-m Corridor

Agricultural RoW Section	NDVI Values				
	On RoW Mean	Off RoW Mean	Difference (On RoW – Off RoW)	Difference (% of NDVI Range)	Difference (% of Off RoW Mean)
N4	0.517	0.529	-0.012	-2.24%	-0.59%
C1	0.628	0.653	-0.024	-3.74%	-1.22%
C2	0.606	0.622	-0.017	-2.65%	-0.83%
S1	0.643	0.692	-0.049	-7.05%	-2.44%
S2	0.609	0.653	-0.044	-6.78%	-2.22%

3.3 NDVI VALUES FOR INDIVIDUAL FIELD MANAGEMENT UNITS

Following review of NDVI values and differences between On RoW and Off RoW for the entire agricultural study area and by Project section, it was determined that evaluation of the 20-m Corridor would be more effective in determining potential disturbances from Project construction activities. Therefore, further discussion of results are for the 20-m Corridor only.

A summary of basic statistics for On RoW, Off RoW and differences between On Row and Off RoW is found in **Table 3-4**. The median and mean (already presented above for the entire agricultural study area) values were found to be lower for On RoW FMUs than Off RoW FMUs resulting in negative values for the median and mean difference between On RoW and Off RoW. Of the 762 FMUs, differences were found to be negative in 548 (72%) and positive in 213 (28%), confirming a negative “skew” in data relative to the expected “0” difference if crop productivity was the same on and off the RoW.

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Table 3-4 Basic Statistics for 2017 NDVI Results for FMUs – 20-m Corridor

Parameter	On RoW	Off RoW	Difference (On RoW - Off RoW)
Count	762	762	762
Mean	0.617	0.655	-0.038
Minimum	0.180	0.166	-0.555
Median	0.653	0.698	-0.045
Maximum	0.906	0.950	0.401
Range	0.726	0.784	0.957
Count of Negatives	N/A	N/A	548
% Negatives	N/A	N/A	72%
Count of Positives	N/A	N/A	213
% Positives	N/A	N/A	28%

Additional statistical analyses were completed to further characterize the data (see **Appendix B**) and determine a threshold level that could be used to support the use of the Tier 1 remotely-sensed NDVI approach in determining FMUs where differences between On RoW and Off RoW are such that Project disturbances are likely the reason for the difference. In other words, the threshold should be at a level at which values that do not exceed it are those within the normal variation of differences between On RoW and Off RoW in the absence of a major disturbance. The values that exceed the threshold in a positive direction are considered “positive outliers” and are likely due to incorrect FMU delineation or some other anomaly, while those that exceed the threshold in the negative direction are likely the result of disturbance within the RoW reducing crop productivity. A combination of approaches was used in an attempt to identify a threshold, including reviewing quartile ranges, visually examining the shape of percentiles curve and the distribution of residual values (see **Appendix B**). Through this evaluation, it was determined a threshold value of +/-0.11 should be used.

Using a threshold value of +/-0.11 yielded 109 negative values (14% of FMUs) and 16 positive values (2% of FMUs). For the negative values, this equates to a difference of approximately 15% of the Off RoW (or expected) values. Of the 109 negative values that exceeded the threshold, the majority were in sections S1 and S2, with counts by section as follows: N4 – 2, C1 – 12, C2 – 1, S1 – 37, S2 – 57. These counts by section provide further validation that there was greater Project disturbance to crop productivity in a “north to south” direction, as stated above in the NDVI by Project Section and Segment discussion. Again, this is indicative of variable amounts of construction across the sections, the seasonal timing of construction activities, or the nature of construction activities.

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3.4 VISUAL ASSESSMENT

A visual assessment of NDVI values On RoW and Off RoW was completed to identify visual evidence in NDVI data of construction effects along the agricultural RoW and to validate the statistical approach discussed above. A select number of FMUs were reviewed as it was not practical to visually review all 762 FMUs.

Of the 16 “positive outliers”, 9 were visually reviewed. In almost all cases, these appeared to be the result of FMU delineations that weren’t appropriately capturing the field management unit. These FMUs should be updated for subsequent years.

Of the 109 “negative outliers” 45 were visually reviewed. In almost all cases, the visual review of the FMUs confirmed notable/observable negative differences in NDVI values On RoW. The character of reduced values was variable. In most cases, only a portion of the RoW appeared to be disturbed by construction activities. Observable disturbances varied from only tower area disturbances to noticeable tower footprints and centerline disturbance between towers. Areas of disturbance around towers were highly variable. In some cases, disturbances appeared to occur outside of the RoW, and are likely the result of access to the RoW or may be marshalling yards or laydown areas; however, the nature of these disturbances have not been confirmed. A couple of examples of the appearance of “negative outliers” are found in **Figure 3-1**. The visual review of “negative outliers” validated the use of the identified threshold in identifying FMUs with observable differences in NDVI and likely disturbances from construction activities on crop (and soil) productivity.

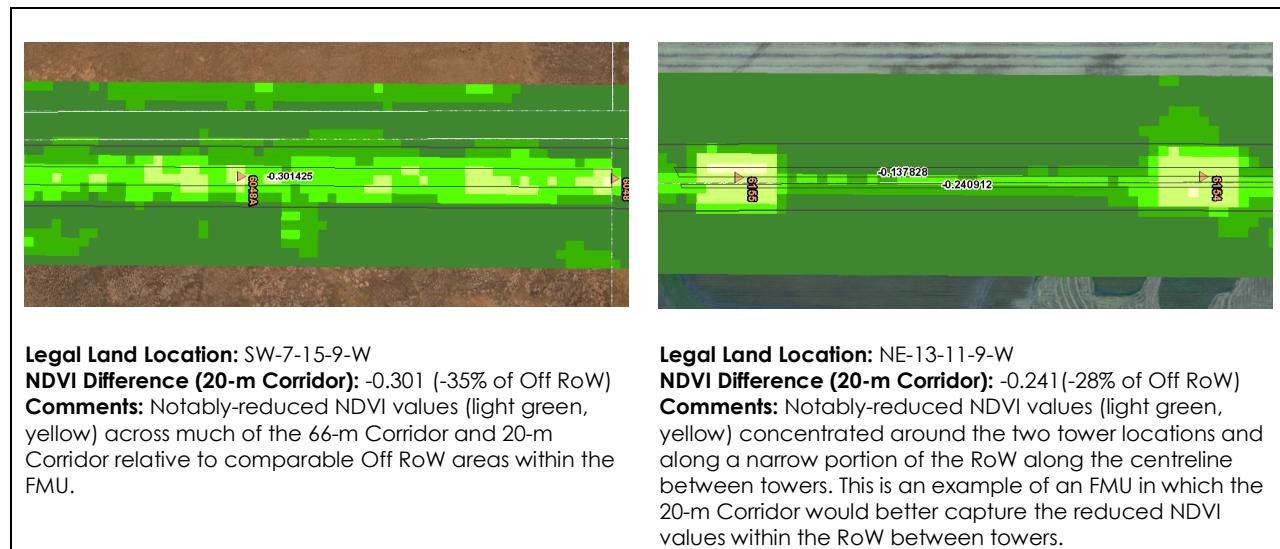


Figure 3-1 Examples of Negative NDVI Differences Above Threshold Level

An approximate 100 km of the RoW within the agricultural study area was visually reviewed to determine if there were On RoW FMUs with visual evidence of potential Project construction

BIPOLE III TRANSMISSION PROJECT SOIL PRODUCTIVITY MONITORING FOR AGRICULTURAL LANDS – 2017

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disturbance that weren't in exceedance of the established threshold. Within the approximate 100-km portion of the route examined, 10 FMUs were found to have noticeably-observable reduced NDVI values On RoW relative to the comparable Off RoW areas. For these 10 FMUs, the difference values were below the identified threshold value, so were not "flagged" as "negative outliers". This suggests either there is room to "tighten" up threshold to better capture these smaller negative differences or that visual review is not as reliable an approach to determining negative differences or that a combined approach is most favorable.

3.5 NDVI VALUES AT TOWER CONSTRUCTION AREAS

A total of 893 tower areas were evaluated within the agricultural study area in 2017. The comparison between 30 m buffered tower areas and comparable Off RoW areas within the same FMU yielded the following results:

- 709 of 893 tower locations (79% of all tower locations evaluated) had a negative difference in NDVI values On RoW vs. Off RoW, while 184 tower locations (21% of all tower locations evaluated) had a positive difference in NDVI values
- When the negative NDVI differences were examined:
 - 3 of 893 towers (0.3%) had a difference less than -0.5 (~ -55% difference)
 - 13 of 893 towers (1.5%) had a difference less than -0.4 (~ -45% difference)
 - 56 of 893 towers (6.3%) had a difference less than -0.3 (~ -35% difference)
 - 121 of 893 towers (14%) had a difference less than -0.2 (~ -25% difference)
 - 267 of 893 towers (30%) had a difference greater than -0.11 (the threshold value used for RoW evaluation; ~ -10 to -15% difference)
- When the positive NDVI differences were examined:
 - 4 of 893 (0.5%) towers had a difference greater than +0.2
 - 14 of 893 towers (1.6%) had a difference greater than +0.11 (the threshold value used for RoW evaluation)

A sizeable proportion (29.9%) of evaluated tower locations showed substantively reduced NDVI values (i.e., in exceedance of the threshold value) relative to comparable Off RoW areas, while a very small proportion (1.6%) of tower locations were found to be above the threshold in the positive direction. The results indicate that the approach appears to be an effective means of screening tower locations for substantively-reduced NDVI values, indicative of practically-meaningful levels of disturbance to crop (and soil) productivity around tower locations. This construction phase data will provide a good foundation on which to monitor and track post-construction response in NDVI values in proximity to towers.



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Summary and Conclusions
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4.0 SUMMARY AND CONCLUSIONS

The NDVI On RoW and Off RoW analysis demonstrated there have been measurable reductions in On RoW NDVI values when the entire agricultural study area was evaluated, as well as within each Project section when they were evaluated individually. These results strongly suggest the Project construction activities have resulted in disturbance to crop and soil productivity over much of the Project RoW within the area of agricultural crop production.

The differences between On RoW and Off RoW were more noticeable when the 20-m Corridor around the centreline was examined relative to the 66-m Corridor representative of the entire RoW width. This provides some validation to evaluating a narrower corridor along the centerline, in recognition that construction activities (e.g., vehicle traffic between tower locations) tend to be more intensive or concentrated in close proximity to the centreline (as opposed to the same level of intensity and disturbance across the entire RoW width).

A threshold value of an NDVI difference of +/-0.11 (approximately 10-15% of the Off RoW NDVI value) was established based on a statistical and qualitative review of the 2017 NDVI values On RoW and Off RoW. A visual assessment of select FMUs provided validation for the use of this threshold value. Therefore, the threshold value of +/-0.11 (or 10-15% of the Off RoW NDVI value) appears to be reasonable to screen for negative differences in NDVI values (On RoW – Off RoW) and potential Project effects to crop (and soil) productivity within the agricultural RoW.

An evaluation of buffered tower location areas indicated a large proportion (79%) of these areas had substantively-reduced NDVI values relative to comparable Off RoW areas. This is indicative of Project disturbance in these areas, which is an expected results due to the intensive nature of construction activities related to tower erection.

The Tier 1 Initial Crop Productivity Screening Approach appears to be providing an effective approach to detecting changes in crop (and soil) productivity along the agricultural RoW and at tower locations. The continued use of this approach should provide an effective means of monitoring crop (and soil) productivity during the post-construction phase of the Project. The incorporation of Tier 2 Detailed Crop Productivity Screening during the post-construction phase will provide a more detailed desktop-based, remotely-sensed NDVI approach to evaluating select areas of the agricultural portion of the Project RoW.

Additionally, Tier 3 Field Assessments may be conducted during the post-construction phase, if and as required, to confirm the nature and degree of effects to crop and soil productivity in areas that do not appear to be recovering post-construction. These field assessments would be developed on a site- and issue-specific case and will be conducted as directed by Manitoba Hydro

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5.0 RECOMMENDATIONS

The following recommendations are made to continue to improve the soil productivity monitoring program in subsequent years:

- Continued review and revision of FMUs, particularly those identified as FMUs requiring improvement following review of 2017 monitoring data. Improved FMU delineation will result in more reliable Tier 1 Crop Productivity Screening results.
- Evaluate NDVI values in relation to the location and timing of construction activities, to better understand the relationship between construction activities (e.g., timing, type of activity) and NDVI values indicative of Project effects on crop productivity (and, therefore, soil productivity).
- Tier 2 Detailed Crop Productivity Screening should be completed along select portions of the RoW starting in 2018 (assuming this represents the first post-construction growing season), per the proposed monitoring plan. This more detailed screening will be completed using higher-resolution Worldview-2 imagery. Areas for Tier 2 assessments should be selected based on review of the Sentinel-2 imagery and consideration of areas of notably reduced On RoW NDVI values from 2016 and 2017 construction phase monitoring seasons.
- Tier 3 Field Assessments should be completed if and as required. Areas requiring field assessment would be those that had notably-reduced On RoW NDVI values (as confirmed by Tier 1 and/or Tier 2 assessments) that do not appear to be recovering post-construction. Field assessment may also be considered in response to landowner-identified post-construction concerns with crop or soil productivity. Field assessments should be developed on a site- and issue-specific case, and will be conducted as directed by Manitoba Hydro.

5.1 DATA NEEDS

The following data (if available) would assist Stantec in improving NDVI data analysis and the ongoing monitoring for residual Project effects:

- Spatial files on key construction activity timelines, for example when major activities that may cause soil disturbance (geotechnical drilling, tower foundation installation, stringing) were undertaken by segment.

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References
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6.0 REFERENCES

AAFC, 2013. Overview of Classification Methodology for Determining Land Capability For Agriculture, Agriculture and Agri-Food Canada. May 31, 2013.
<http://sis.agr.gc.ca/cansis/nsdb/cli/classdesc.html>.

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Appendix A Tables
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Appendix A TABLES

BIPOLE III TRANSMISSION PROJECT SOIL PRODUCTIVITY MONITORING FOR AGRICULTURAL LANDS – 2017

Appendix A Tables
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Table A-1 Bipole III On/Off RoW Agricultural Extent NDVI Comparative Analysis by Section Segment for 2017

Section-Segment	NDVI Values - 66-m RoW				NDVI Values - 20-m RoW			
	On RoW Mean	Off Row Mean	Difference (On RoW - Off RoW)	Difference (% of Off RoW)	On RoW Mean	Off Row Mean	Difference (On RoW - Off RoW)	Difference (% of Off RoW)
N4-S9	0.759	0.734	0.025	3.40%	0.760	0.734	0.026	3.61%
N4-S16	0.702	0.728	-0.026	-3.54%	0.690	0.728	-0.038	-5.20%
N4-S17	0.501	0.485	0.016	3.28%	0.482	0.485	-0.004	-0.74%
N4-S19	0.389	0.384	0.005	1.31%	0.383	0.384	-0.001	-0.23%
N4-S20	0.568	0.566	0.002	0.44%	0.591	0.595	-0.003	-0.55%
N4-S21	0.413	0.410	0.003	0.78%	0.429	0.429	0.000	-0.03%
N4-S23	0.683	0.717	-0.034	-4.78%	0.641	0.712	-0.071	-9.97%
N4-S24	0.753	0.764	-0.011	-1.45%	0.752	0.764	-0.012	-1.56%
N4-S25	0.714	0.733	-0.019	-2.58%	0.715	0.738	-0.023	-3.09%
C1-S1	0.706	0.749	-0.043	-5.77%	0.702	0.749	-0.047	-6.27%
C1-S2	0.708	0.749	-0.041	-5.52%	0.698	0.749	-0.051	-6.86%
C1-S3	0.553	0.599	-0.045	-7.53%	0.529	0.599	-0.070	-11.63%
C1-S4	0.585	0.573	0.012	2.14%	0.572	0.573	-0.001	-0.20%
C1-S6	0.763	0.797	-0.034	-4.27%	0.768	0.797	-0.029	-3.59%
C1-S7	0.613	0.618	-0.004	-0.71%	0.612	0.618	-0.006	-0.92%
C1-S8	0.575	0.640	-0.065	-10.12%	0.571	0.640	-0.069	-10.71%
C1-S9	0.659	0.648	0.011	1.76%	0.649	0.648	0.001	0.14%
C1-S10	0.650	0.651	-0.002	-0.26%	0.634	0.641	-0.007	-1.15%
C1-S11	0.610	0.663	-0.053	-7.98%	0.601	0.663	-0.062	-9.31%
C1-S12	0.594	0.615	-0.021	-3.38%	0.589	0.612	-0.024	-3.89%
C2-S2	0.595	0.611	-0.016	-2.69%	0.580	0.601	-0.020	-3.34%
C2-S3	0.643	0.668	-0.025	-3.70%	0.646	0.670	-0.024	-3.65%
C2-S4	0.697	0.696	0.001	0.14%	0.698	0.697	0.001	0.15%
C2-S5	0.643	0.643	-0.001	-0.10%	0.650	0.643	0.007	1.11%
C2-S6	0.520	0.525	-0.005	-0.97%	0.511	0.525	-0.014	-2.67%
C2-S7	0.609	0.620	-0.011	-1.75%	0.619	0.620	-0.002	-0.26%
C2-S8	0.529	0.550	-0.020	-3.70%	0.538	0.550	-0.012	-2.19%
C2-S9	0.569	0.585	-0.017	-2.84%	0.559	0.577	-0.018	-3.16%
S1-01	0.670	0.671	-0.001	-0.12%	0.674	0.693	-0.019	-2.76%
S1-02	0.718	0.756	-0.038	-4.97%	0.704	0.743	-0.039	-5.29%
S1-03	0.450	0.457	-0.008	-1.69%	0.446	0.451	-0.006	-1.28%
S1-04	0.352	0.345	0.007	2.06%	0.353	0.345	0.008	2.38%

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Appendix A Tables
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Table A-1 Bipole III On/Off RoW Agricultural Extent NDVI Comparative Analysis by Section Segment for 2017

Section-Segment	NDVI Values - 66-m RoW				NDVI Values - 20-m RoW			
	On RoW Mean	Off Row Mean	Difference (On RoW - Off RoW)	Difference (% of Off RoW)	On RoW Mean	Off Row Mean	Difference (On RoW - Off RoW)	Difference (% of Off RoW)
S1-05	0.481	0.480	0.001	0.11%	0.459	0.462	-0.004	-0.80%
S1-06	0.675	0.757	-0.082	-10.86%	0.680	0.757	-0.077	-10.23%
S1-07	0.732	0.789	-0.057	-7.27%	0.598	0.789	-0.191	-24.20%
S1-08	0.575	0.592	-0.017	-2.87%	0.565	0.592	-0.027	-4.55%
S1-09	0.666	0.710	-0.044	-6.22%	0.640	0.697	-0.057	-8.12%
S1-S10	0.626	0.739	-0.114	-15.40%	0.614	0.739	-0.125	-16.90%
S1-S14	0.666	0.703	-0.036	-5.13%	0.653	0.703	-0.049	-7.01%
S1-S15	0.637	0.721	-0.085	-11.72%	0.636	0.724	-0.088	-12.11%
S1-S16	0.696	0.786	-0.090	-11.49%	0.701	0.791	-0.090	-11.38%
S1-S17	0.651	0.698	-0.048	-6.84%	0.645	0.698	-0.054	-7.67%
S1-S18	0.751	0.773	-0.021	-2.78%	0.719	0.754	-0.035	-4.63%
S1-S19	0.733	0.760	-0.027	-3.59%	0.705	0.759	-0.054	-7.16%
S1-S20	0.709	0.721	-0.012	-1.69%	0.678	0.721	-0.043	-5.93%
S1-S21	0.793	0.797	-0.004	-0.47%	0.773	0.805	-0.031	-3.88%
S1-S22	0.808	0.855	-0.046	-5.42%	0.770	0.855	-0.084	-9.87%
S1-S23	0.744	0.729	0.015	2.01%	0.732	0.729	0.003	0.39%
S1-S24	0.775	0.822	-0.047	-5.76%	0.736	0.820	-0.084	-10.21%
S2-S01	0.830	0.868	-0.037	-4.31%	0.808	0.868	-0.060	-6.92%
S2-S02	0.807	0.818	-0.011	-1.31%	0.788	0.818	-0.030	-3.63%
S2-S03	0.722	0.854	-0.132	-15.45%	0.619	0.854	-0.235	-27.50%
S2-S04	0.837	0.845	-0.007	-0.87%	0.818	0.839	-0.022	-2.61%
S2-S05	0.638	0.683	-0.045	-6.55%	0.626	0.683	-0.056	-8.27%
S2-S06	0.707	0.715	-0.008	-1.12%	0.697	0.715	-0.018	-2.51%
S2-S07	0.692	0.745	-0.053	-7.07%	0.645	0.745	-0.100	-13.48%
S2-S08	0.658	0.714	-0.056	-7.80%	0.647	0.714	-0.067	-9.37%
S2-S09	0.563	0.644	-0.081	-12.62%	0.535	0.644	-0.108	-16.84%
S2-S10	0.647	0.664	-0.017	-2.52%	0.631	0.664	-0.033	-4.98%
S2-S12	0.724	0.738	-0.014	-1.84%	0.718	0.738	-0.020	-2.65%
S2-S13	0.722	0.737	-0.015	-2.01%	0.713	0.737	-0.024	-3.31%
S2-S14	0.399	0.423	-0.024	-5.66%	0.373	0.423	-0.050	-11.77%
S2-S15	0.651	0.650	0.001	0.11%	0.649	0.650	-0.002	-0.25%
S2-S16	0.652	0.661	-0.009	-1.43%	0.618	0.637	-0.019	-2.91%

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Appendix A Tables
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Section-Segment	NDVI Values - 66-m RoW				NDVI Values - 20-m RoW			
	On RoW Mean	Off Row Mean	Difference (On RoW - Off RoW)	Difference (% of Off RoW)	On RoW Mean	Off Row Mean	Difference (On RoW - Off RoW)	Difference (% of Off RoW)
S2-S17	0.470	0.520	-0.051	-9.75%	0.454	0.520	-0.067	-12.84%
S2-S18	0.420	0.438	-0.018	-4.20%	0.414	0.438	-0.024	-5.40%
S2-S19	0.534	0.543	-0.009	-1.62%	0.518	0.543	-0.025	-4.63%
S2-S21	0.401	0.602	-0.202	-33.49%	0.395	0.602	-0.208	-34.48%
S2-S22	0.599	0.644	-0.045	-7.00%	0.597	0.644	-0.047	-7.23%
S2-S24	0.547	0.614	-0.067	-10.93%	0.552	0.614	-0.063	-10.19%
S2-S25	0.685	0.733	-0.048	-6.49%	0.686	0.736	-0.050	-6.79%
S2-S26	0.453	0.471	-0.018	-3.86%	0.454	0.471	-0.017	-3.57%
S2-S28	0.495	0.503	-0.008	-1.53%	0.502	0.503	-0.001	-0.10%
S2-S29	0.611	0.643	-0.032	-5.04%	0.603	0.643	-0.040	-6.26%
S2-S30	0.489	0.615	-0.126	-20.44%	0.451	0.615	-0.164	-26.68%
S2-S31	0.636	0.658	-0.022	-3.40%	0.617	0.658	-0.042	-6.33%
S2-S32	0.601	0.637	-0.036	-5.63%	0.587	0.637	-0.050	-7.87%
S2-S33	0.697	0.775	-0.078	-10.12%	0.668	0.775	-0.107	-13.86%
S2-S34	0.648	0.679	-0.031	-4.61%	0.634	0.679	-0.046	-6.71%
S2-S35	0.552	0.586	-0.034	-5.81%	0.539	0.580	-0.041	-7.02%
S2-S36	0.536	0.717	-0.181	-25.24%	0.452	0.544	-0.092	-16.93%
S2-S37	0.725	0.760	-0.035	-4.61%	0.723	0.760	-0.037	-4.82%
S2-S38	0.556	0.608	-0.051	-8.43%	0.545	0.608	-0.062	-10.23%
S2-S40	0.481	0.503	-0.022	-4.29%	0.480	0.520	-0.040	-7.78%
S2-S43	0.812	0.885	-0.073	-8.25%	0.772	0.885	-0.113	-12.73%

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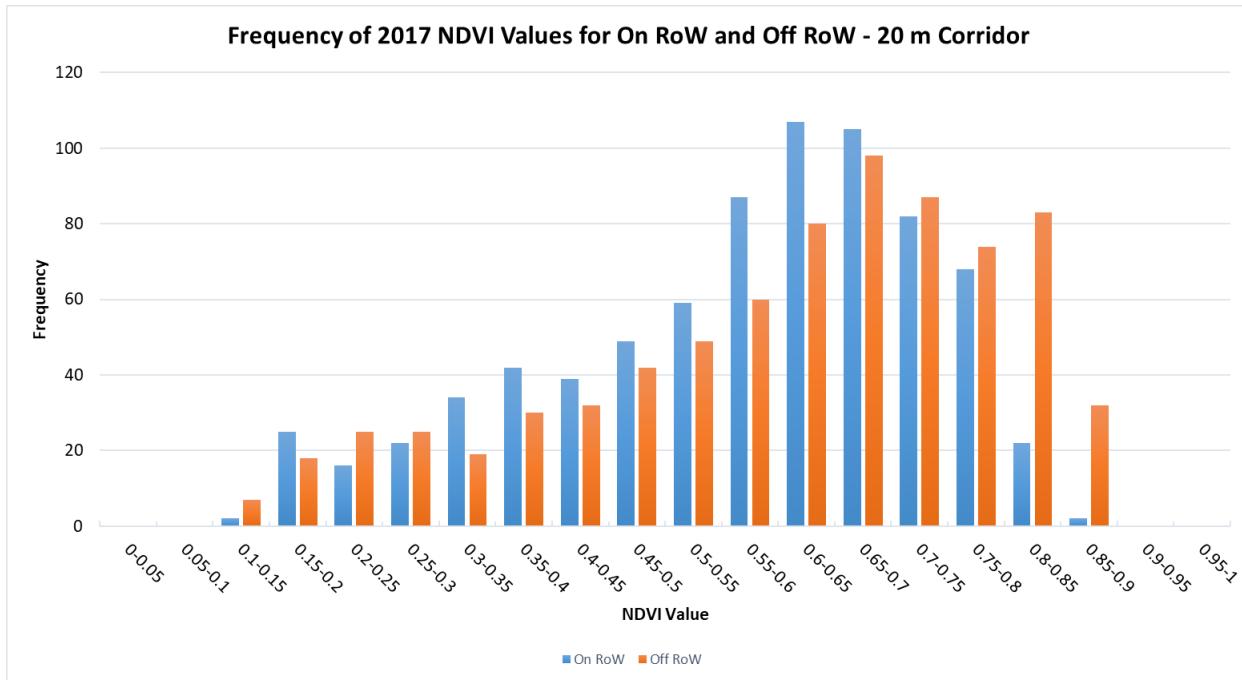
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Appendix B STATISTICAL ANALYSES



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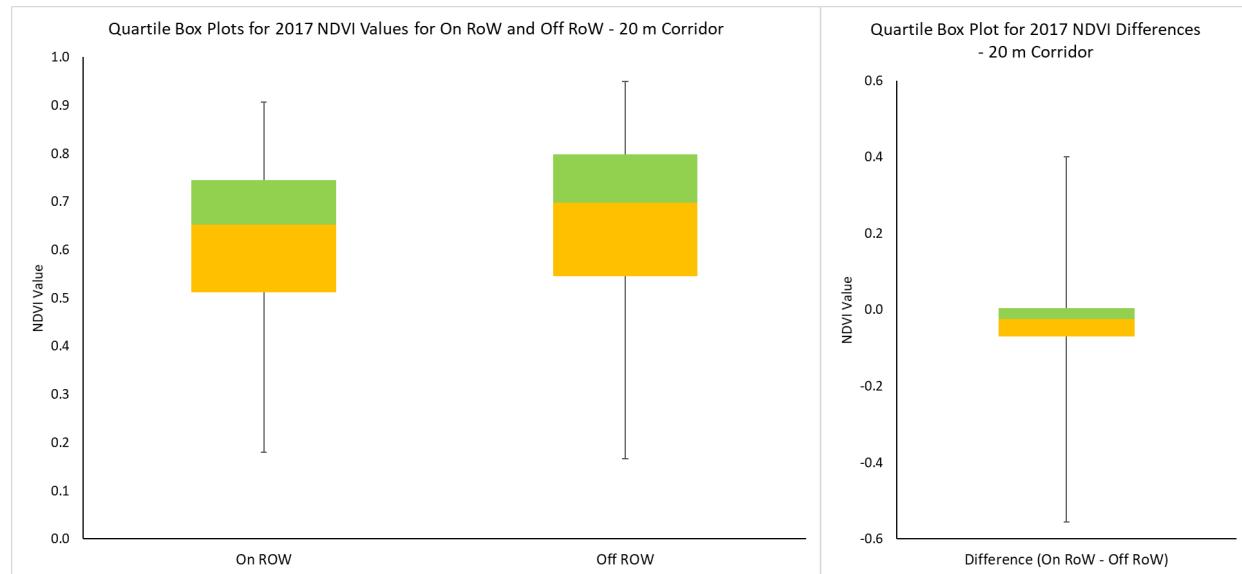


The frequency histogram above shows that there is a higher frequency of high NDVI values (> 0.7) Off RoW and a higher frequency of low NDVI values (< 0.7).

Figure B-1 Frequency of 2017 NDVI Values for On RoW and Off RoW – 20-m Corridor

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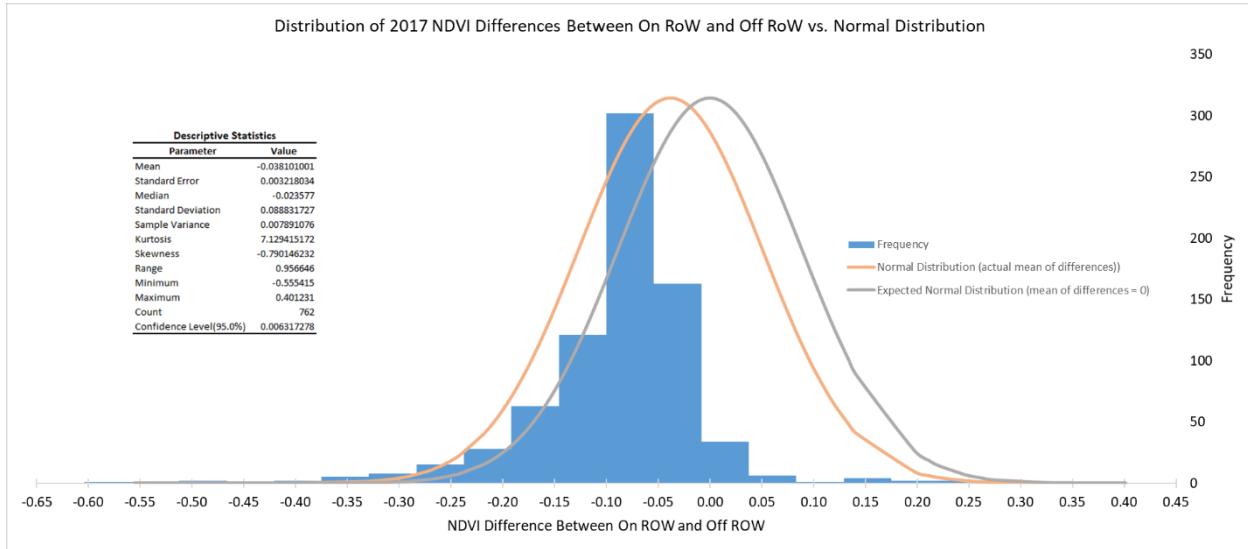


The quartile box plots for On RoW and Off RoW display the ranges (between minimum and maximum values shown by the “whiskers”) are fairly similar between On RoW and Off RoW, the median value (centre of box) as well as the first quartile (25th percentile) and third quartile (75th percentile) are lower for On RoW values than Off RoW. When the box plot for NDVI differences is examined, it shows the median is negative and most of the data (between 25th and 75th percentile) are in a fairly tight range (narrow distribution) and mostly negative in value, while the maximum and minimum values are much wider ranging (suggests “extreme” values).

Figure B-2 Quartile Box Plots for 2017 NDVI Values for On RoW and Off RoW and for Differences – 20-m Corridor

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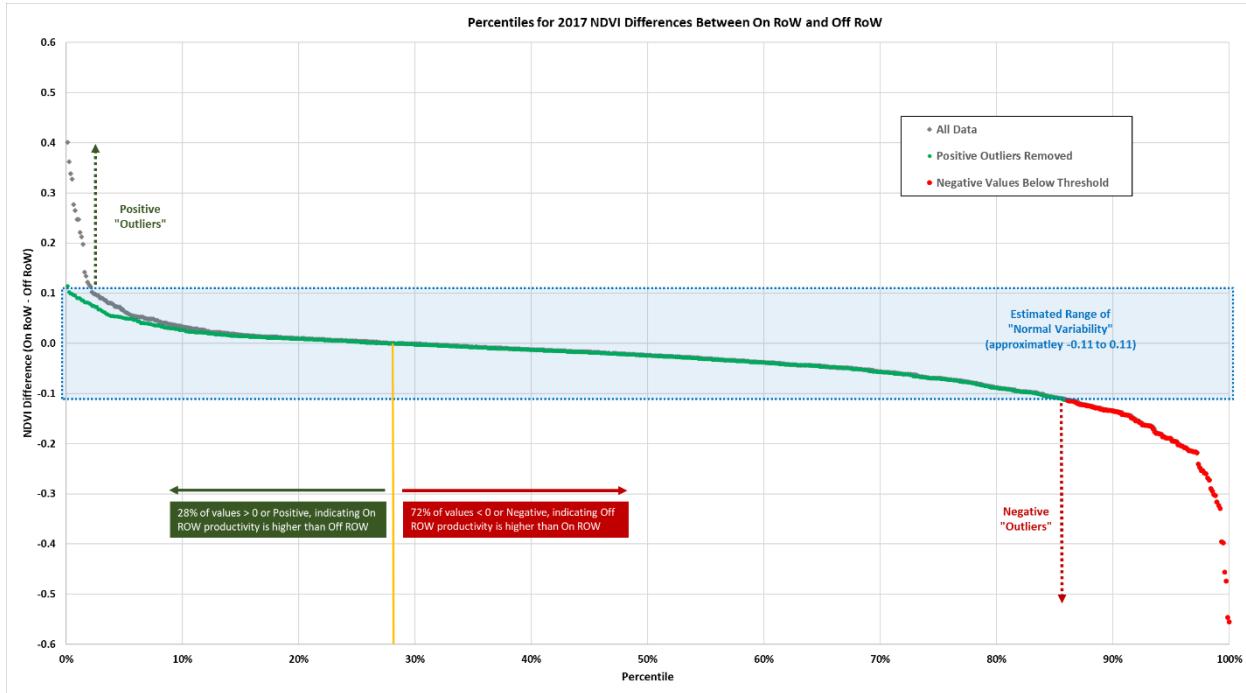


The frequency of difference values is displayed in columns (blue bars) relative to the normal distribution curve (orange line; based on actual data around the actual mean value of -0.038) and the "expected" normal distribution curve (grey line; assumed mean difference of 0 and same shape of curve as the actual normal distribution). These demonstrates that the actual difference data is "skewed" in a negative direction.

Figure B-3 Distribution of 2017 NDVI Differences Between On RoW and Off RoW – 20-m Corridor

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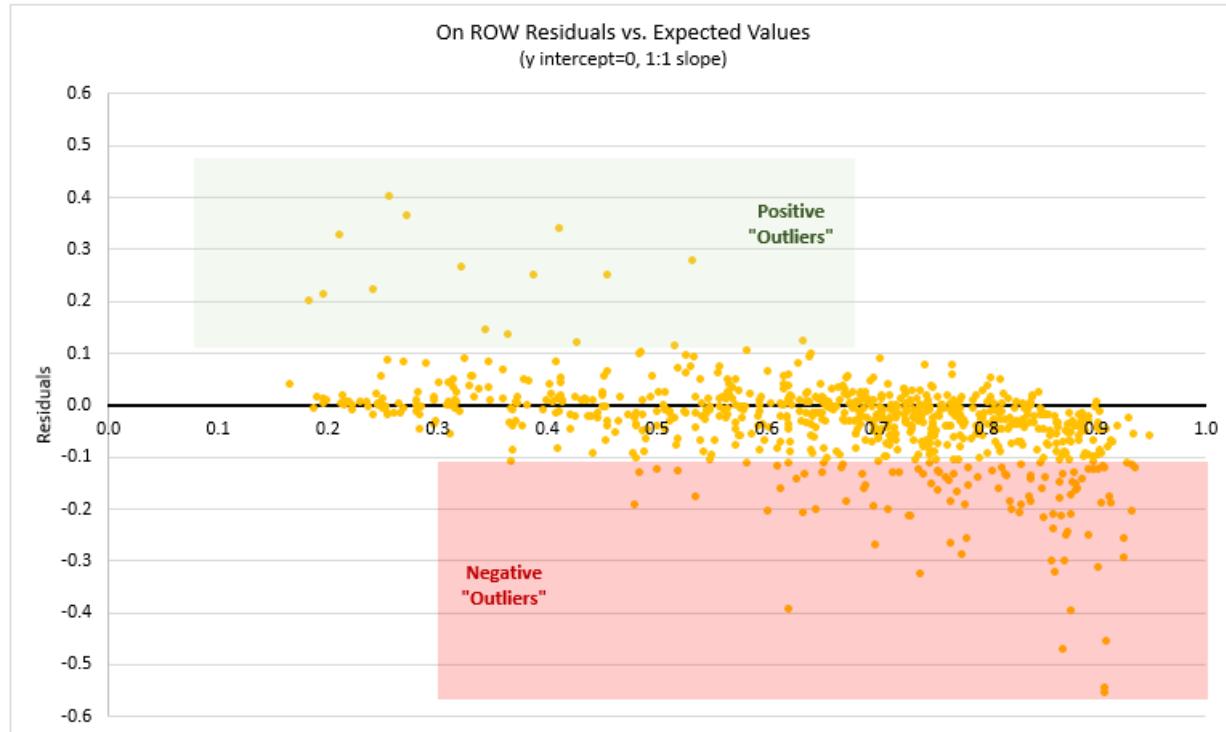


The percentiles chart provides a visual display of the difference values from individual FMUs. Approximately 28% of differences were found to be positive (On RoW – Off RoW = >0), while 72% were found to be negative (On RoW – Off RoW = <0). This is further evidence of the “skewness” of the data. The estimated range of “normal variability” around an expected difference of 0 is estimated to be approximately -0.11 to 0.11. Values above 0.1 can be considered “positive outliers” while values below -0.1 can be considered “negative outliers”. Based on this analysis there are many more “negative outliers” than “positive outliers”. Approximately 15% of FMUs are considered in the “negative outlier” range, while only 2% of FMUs are considered in the “positive outlier” range.

Figure B-4 Percentiles for 2017 NDVI Differences Between On RoW and Off RoW – 20-m Corridor

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November 30, 2017



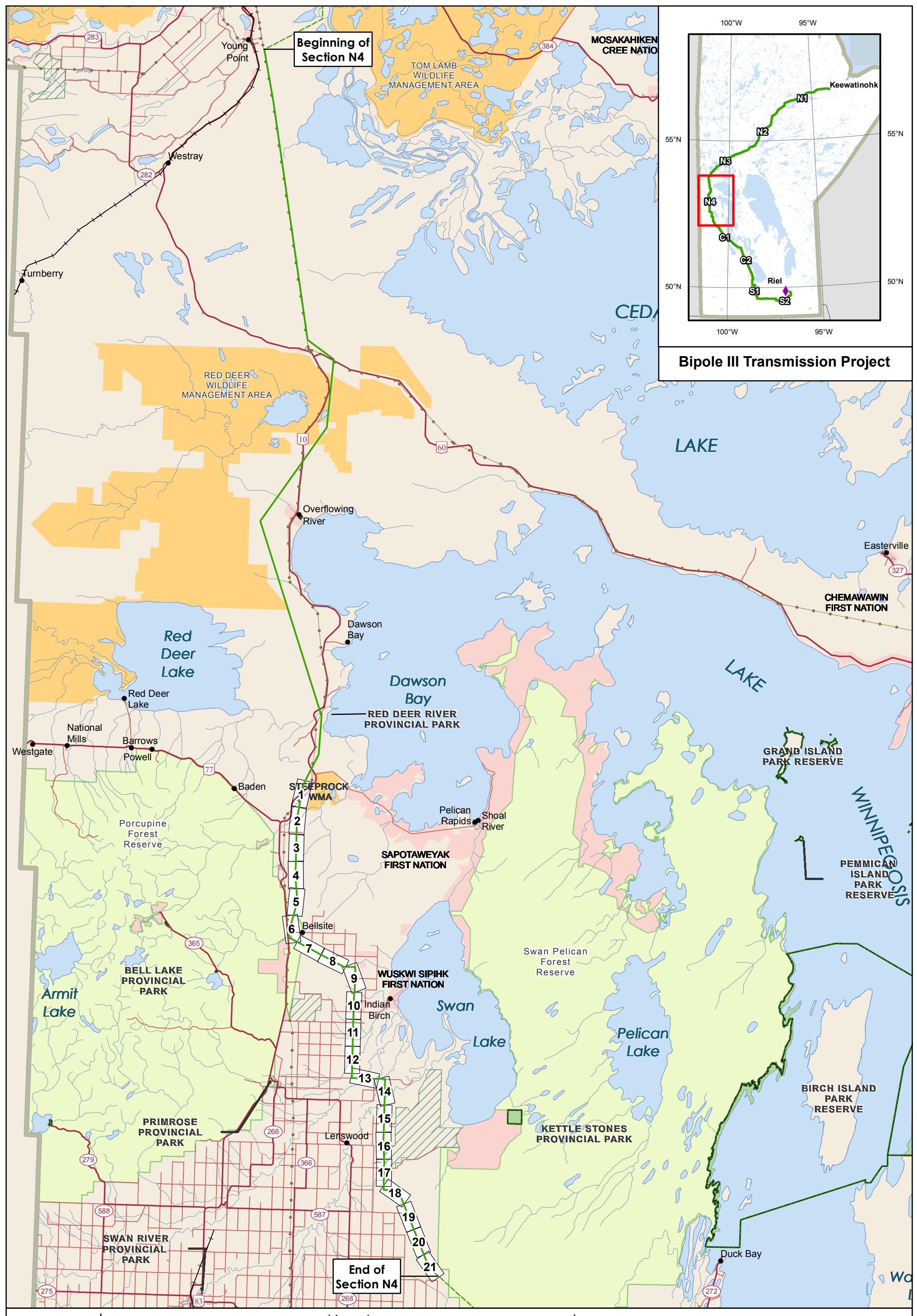
The residuals chart above was created by plotting residual values (difference between actual and expected values) for On RoW against expected values for On RoW (assuming On RoW and Off RoW are expected to be the same). This provides another means to visually assess the distribution of differences for each FMU against expected values. The plotted distribution indicates “positive outliers” (those differences >0.11) are fewer and tended to be found in the lower range of NDVI values (<0.7) while the “negative outliers” are much more numerous and occur in the higher range of NDVI values (>0.4). The pattern of the residuals (more negative than positive residuals; more “positive outliers” in the lower range and more “negative outliers” in the higher range of expected values) is further evidence the difference values are being affected systematically. The likely explanations for this systematic variability is incorrect FMU delineations in the case of “positive outliers” and disturbances to crop productivity by construction activities in the case of “negative outliers”.

Figure B-5 Residuals for 2017 NDVI Values for On RoW vs. Expected Values – 20-m Corridor

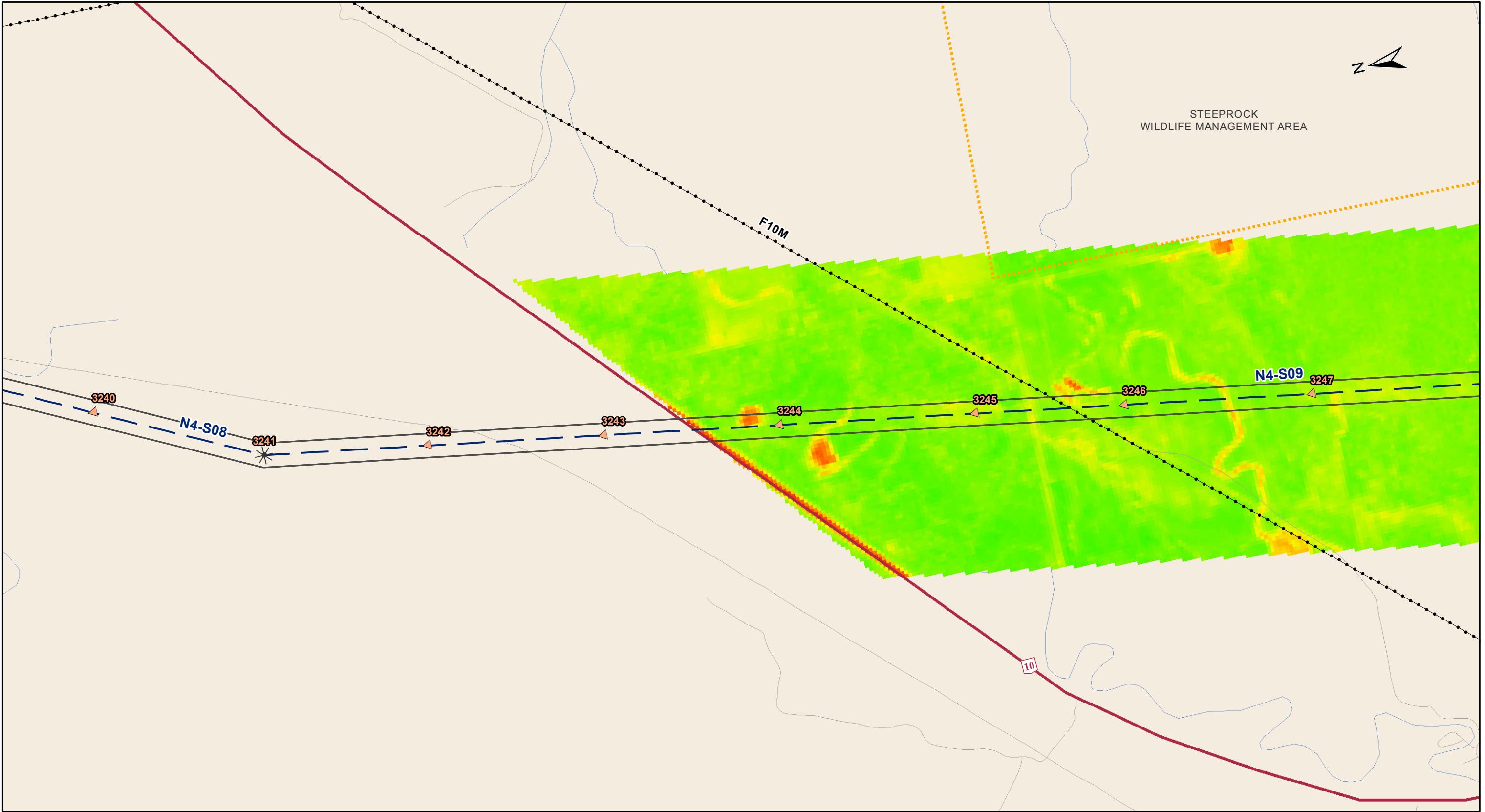
**BIPOLE III TRANSMISSION PROJECT SOIL PRODUCTIVITY MONITORING FOR AGRICULTURAL LANDS –
2017**

Appendix C Maps
November 30, 2017

Appendix C MAPS

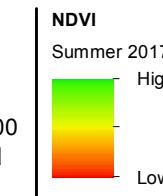


**Bipole III Transmission Project
Normalized Difference Vegetation Index (NDVI)
Section N4 - Key Map Index**



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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Metres
1:10,000

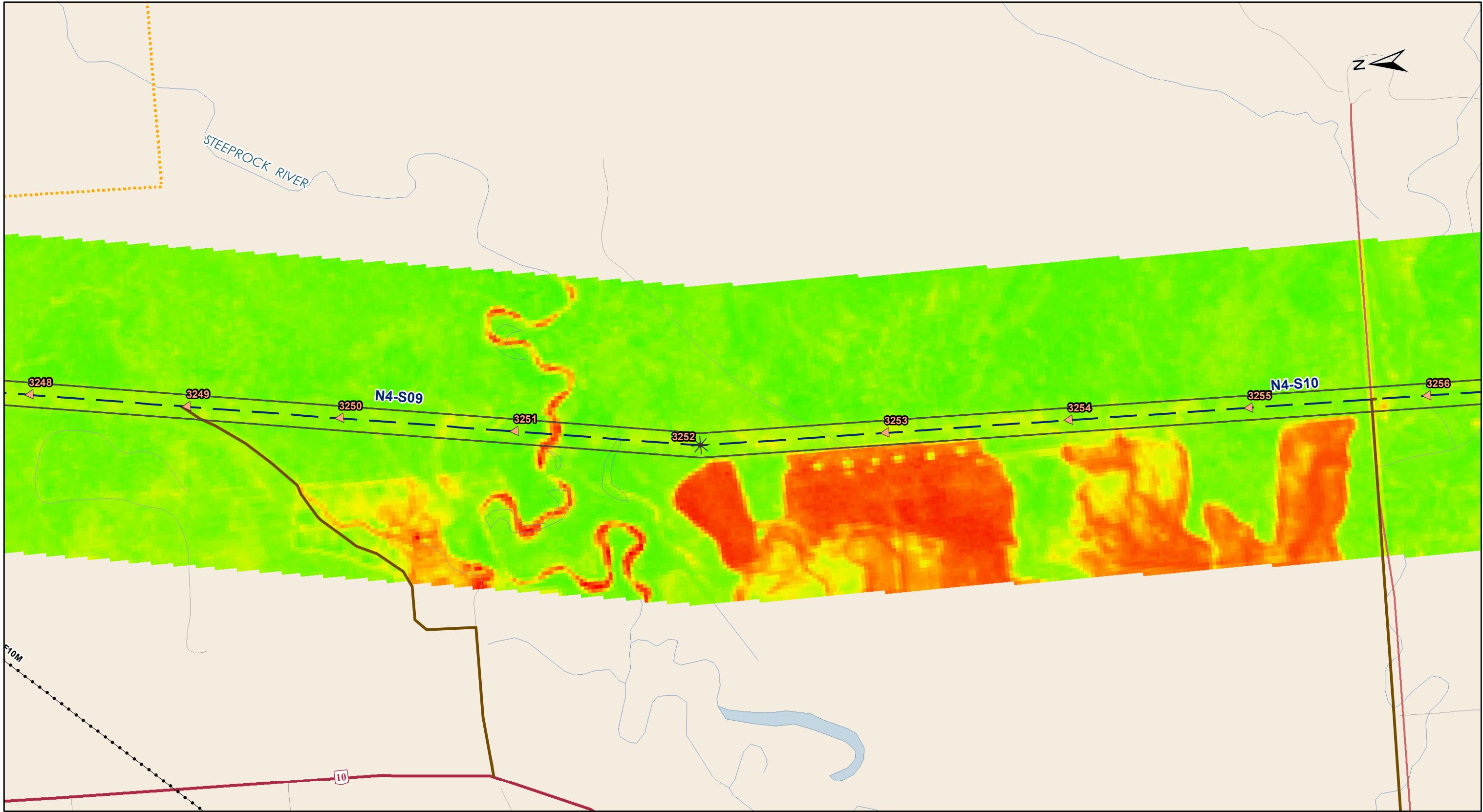


Project Infrastructure
BPIII Final Preferred Route
66m ROW
Angle Towers (Preliminary)
Towers (Preliminary)
Proposed Access Route

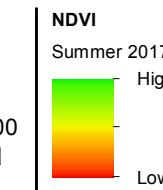
Landbase
Highway
Local Road
Transmission Line
Watercourse
Wildlife Management Area

Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017
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Metres
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Project Infrastructure
BPIII Final Preferred Route
66m ROW
Angle Towers (Preliminary)
Towers (Preliminary)
Proposed Access Route

Landbase
Highway
Major Road
Local Road
Transmission Line
Watercourse
Waterbody



Bipole III Transmission Project

Section N4

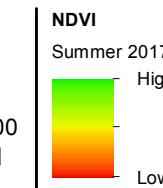
Normalized Difference Vegetation Index (NDVI)

Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
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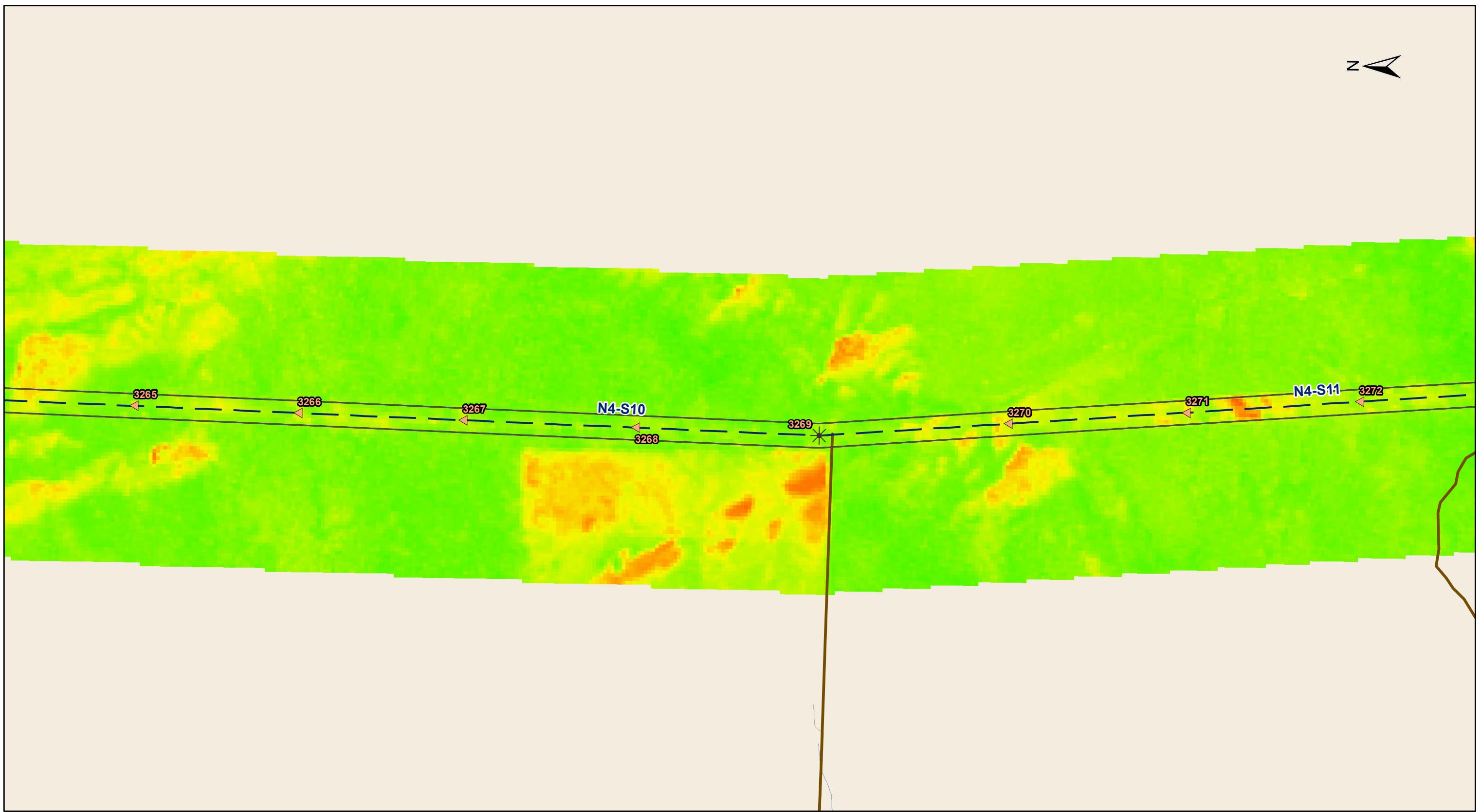


Project Infrastructure
BPIII Final Preferred Route
66m ROW
Towers (Preliminary)
Proposed Access Route

Landbase
Local Road
Watercourse

Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

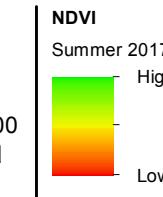
DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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Metres

1:10,000



Project Infrastructure
Summer 2017

- BPIII Final Preferred Route
- 66m ROW
- ★ Angle Towers (Preliminary)
- ▲ Towers (Preliminary)
- Proposed Access Route

Landbase

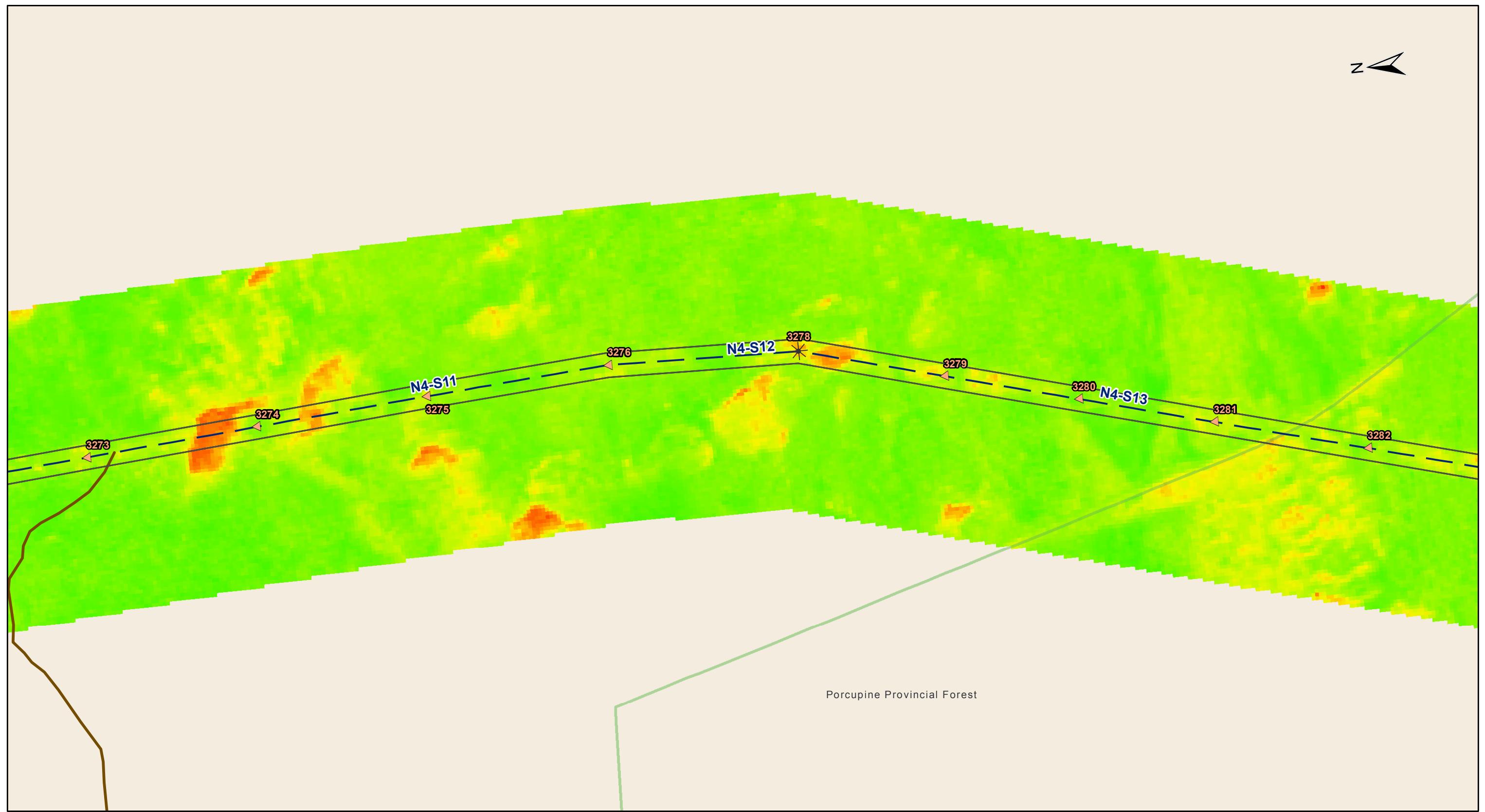
- Local Road
- Watercourse

Bipole III Transmission Project

Section N4

Normalized Difference Vegetation Index (NDVI) Summer 2017

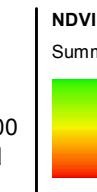
DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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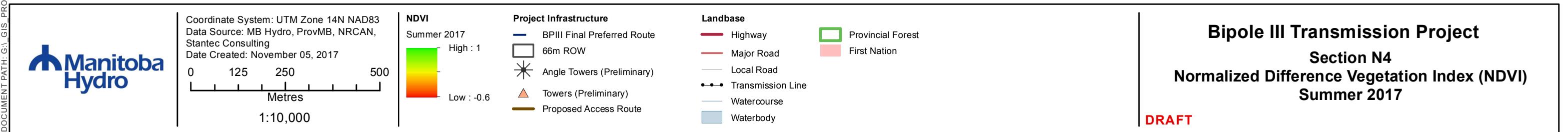
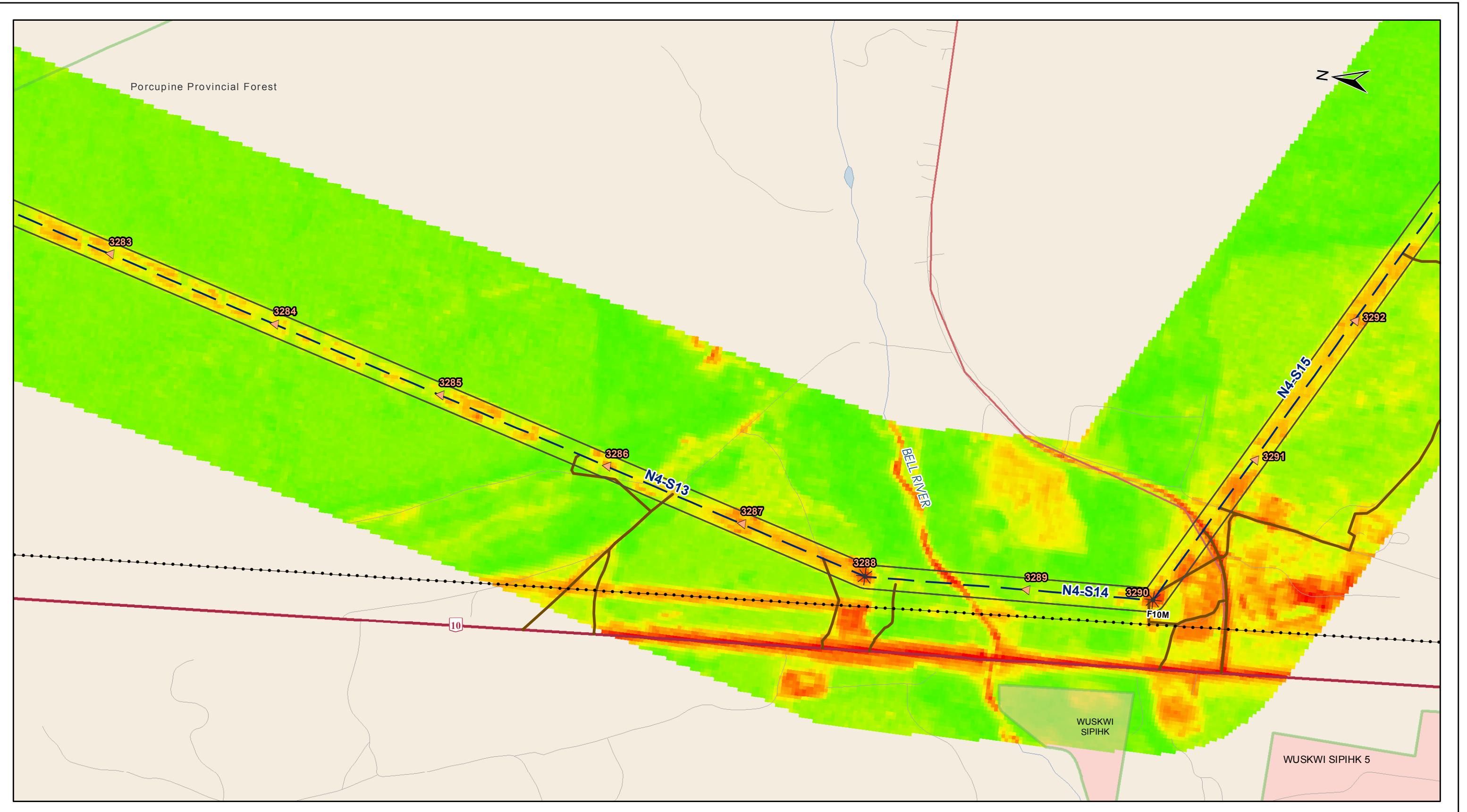


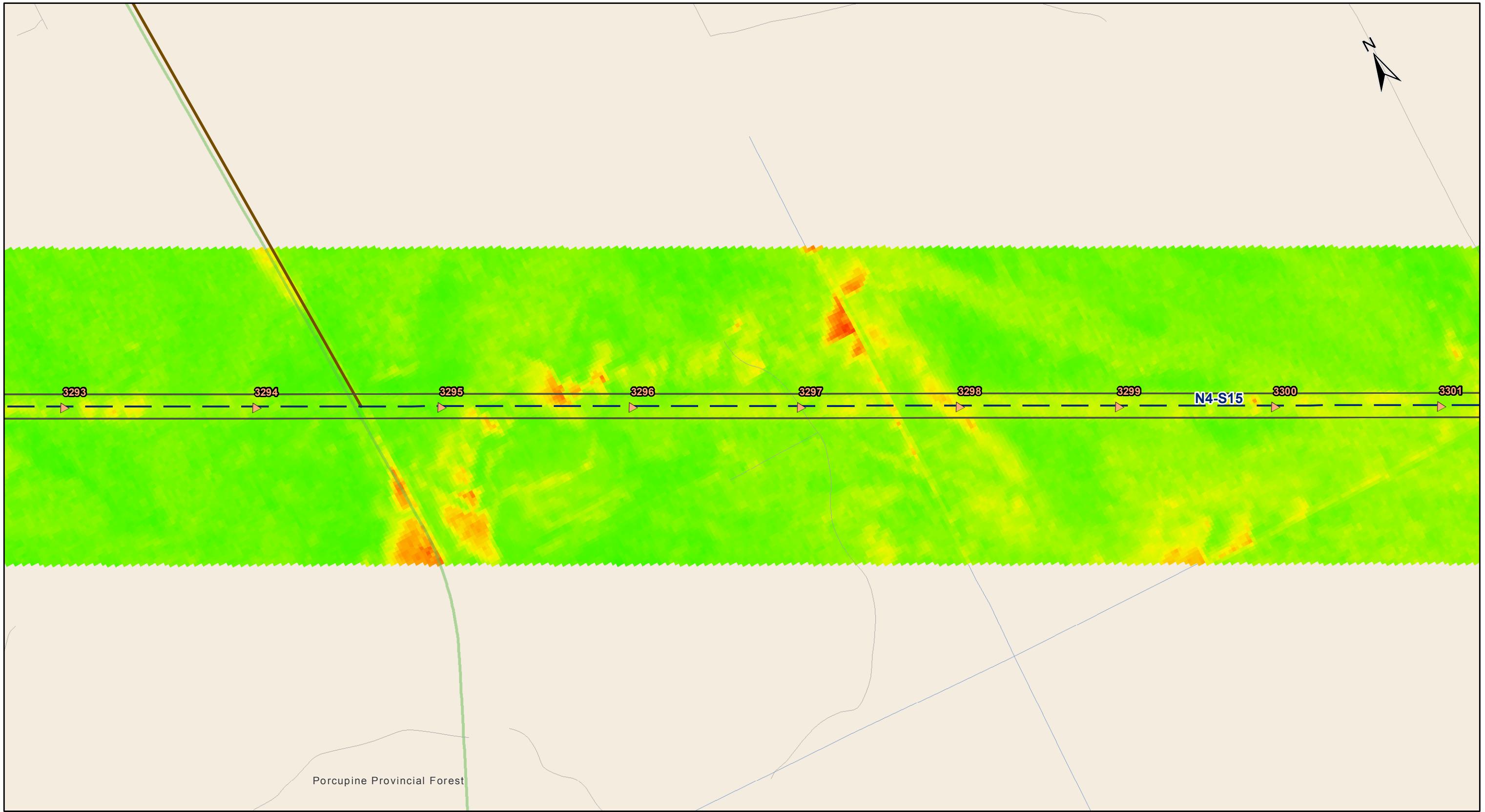
- Project Infrastructure**
- BPIII Final Preferred Route
 - 66m ROW
 - ★ Angle Towers (Preliminary)
 - ▲ Towers (Preliminary)
 - Proposed Access Route

- Landbase**
- Provincial Forest

Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT

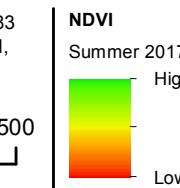




Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres

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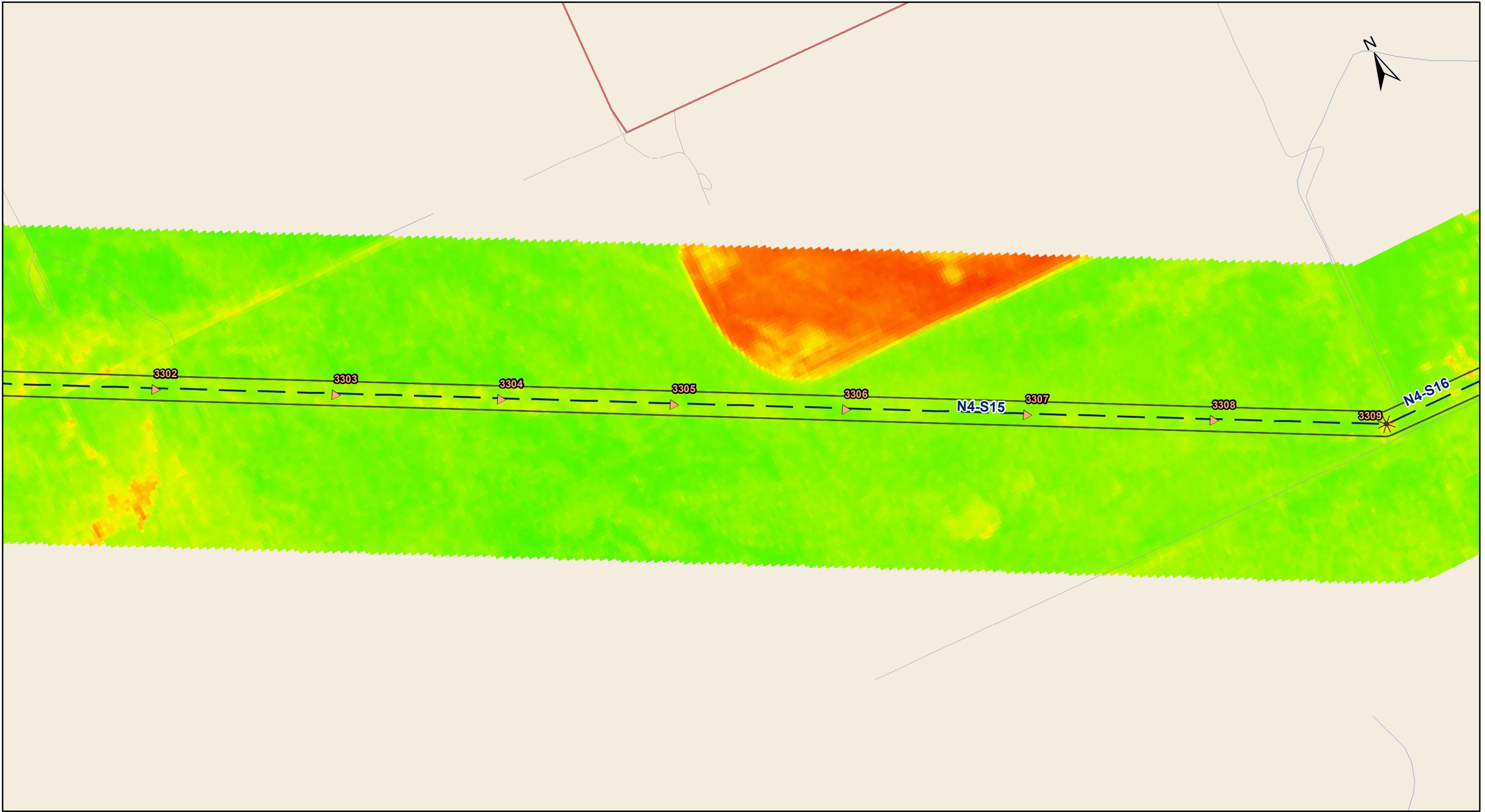
Project Infrastructure
BPIII Final Preferred Route
66m ROW
Towers (Preliminary)
Proposed Access Route

Landbase
Local Road
Provincial Forest
Watercourse

Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT

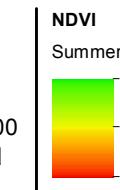
MAP 4-100-7



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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Metres

1:10,000



Project Infrastructure

— BPIII Final Preferred Route
□ 66m ROW
★ Angle Towers (Preliminary)
▲ Towers (Preliminary)

Landbase

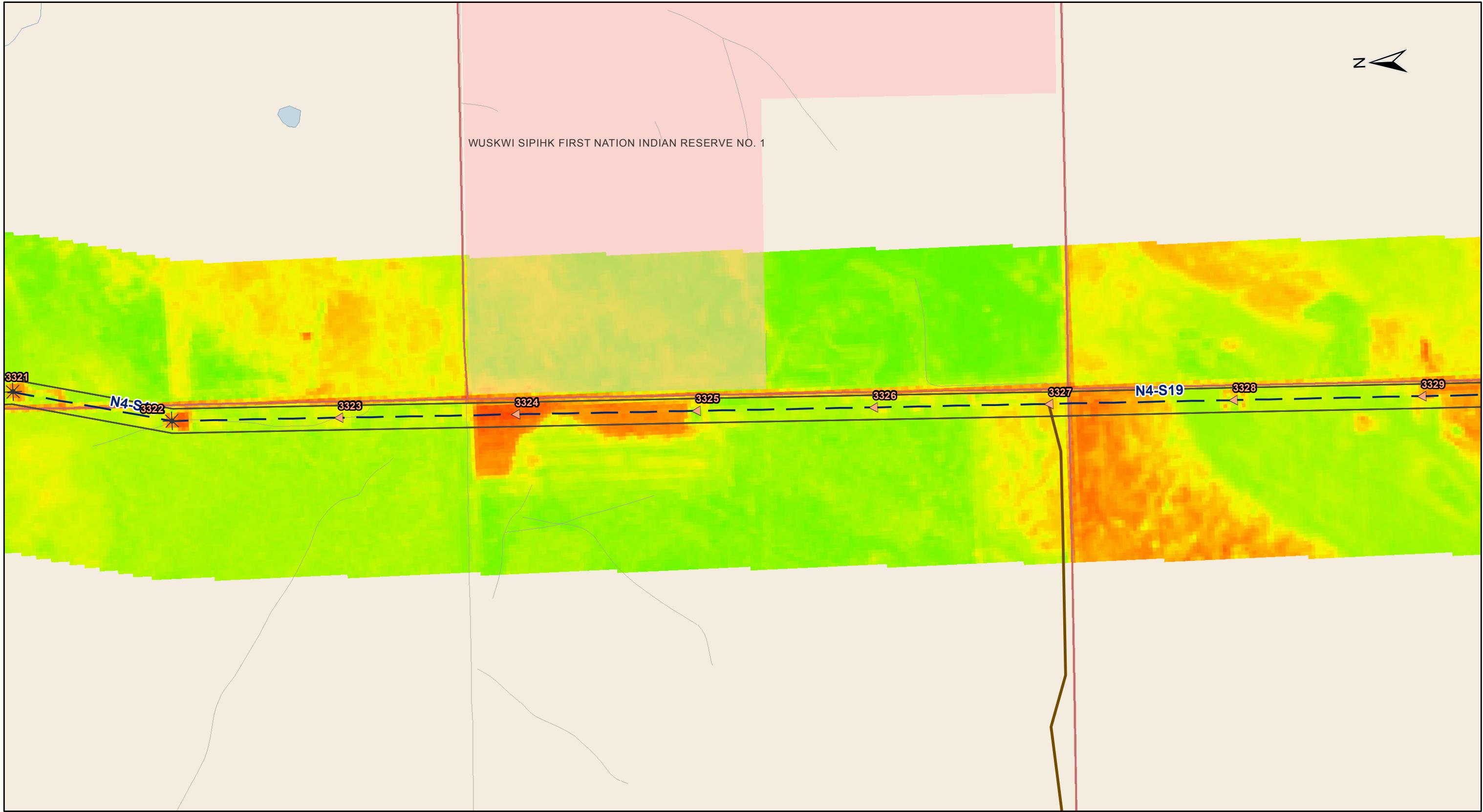
— Major Road
— Local Road
— Watercourse

Bipole III Transmission Project

Section N4

Normalized Difference Vegetation Index (NDVI) Summer 2017

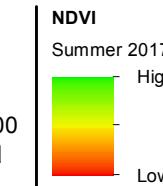
DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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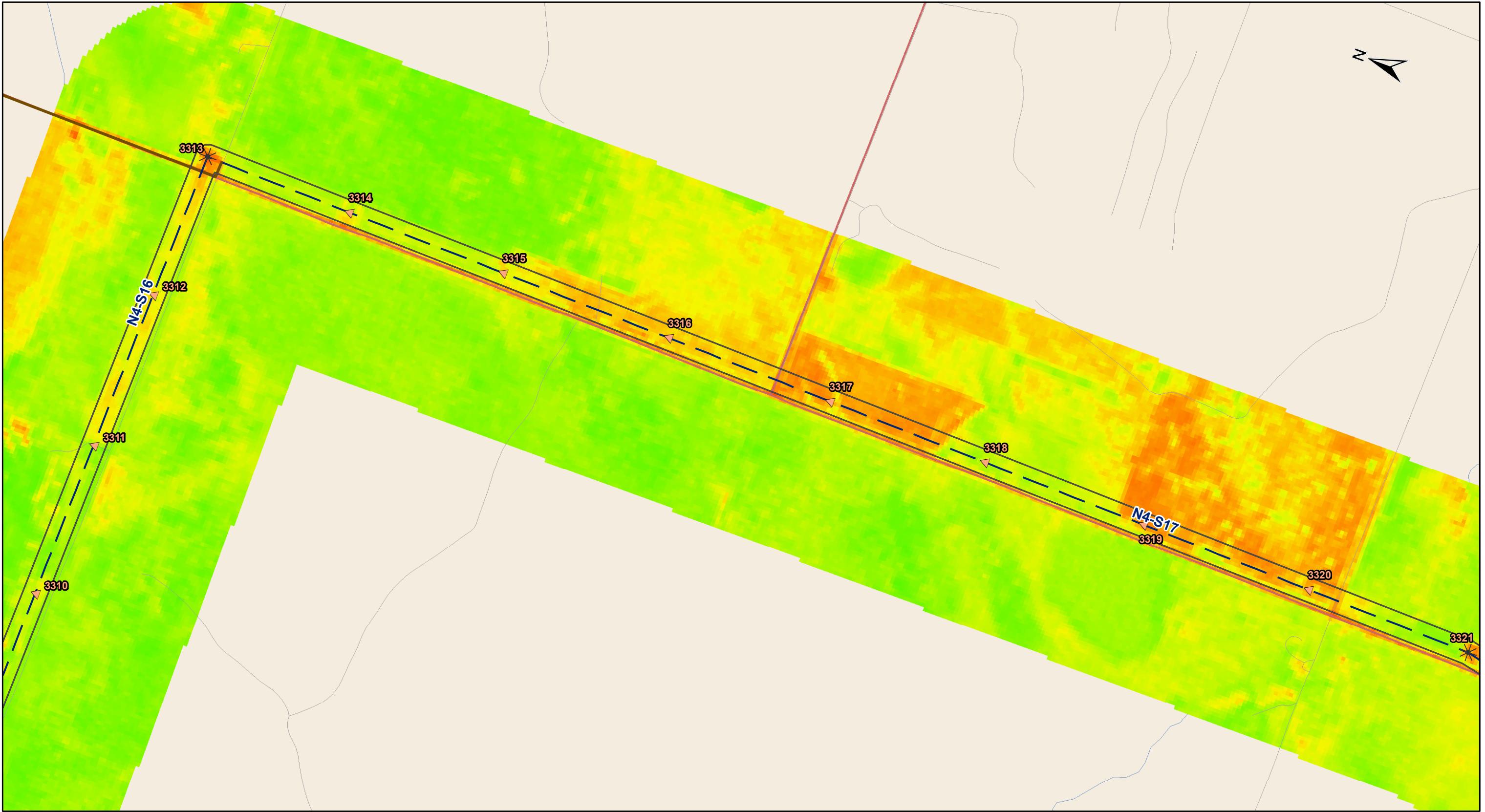
- Project Infrastructure**
- BPIII Final Preferred Route
 - 66m ROW
 - * Angle Towers (Preliminary)
 - ▲ Towers (Preliminary)
 - Proposed Access Route

- Landbase**
- Major Road
 - Local Road
 - Watercourse
 - Waterbody
 - First Nation

Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT

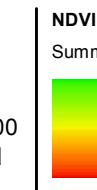
MAP 4-100-10



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres

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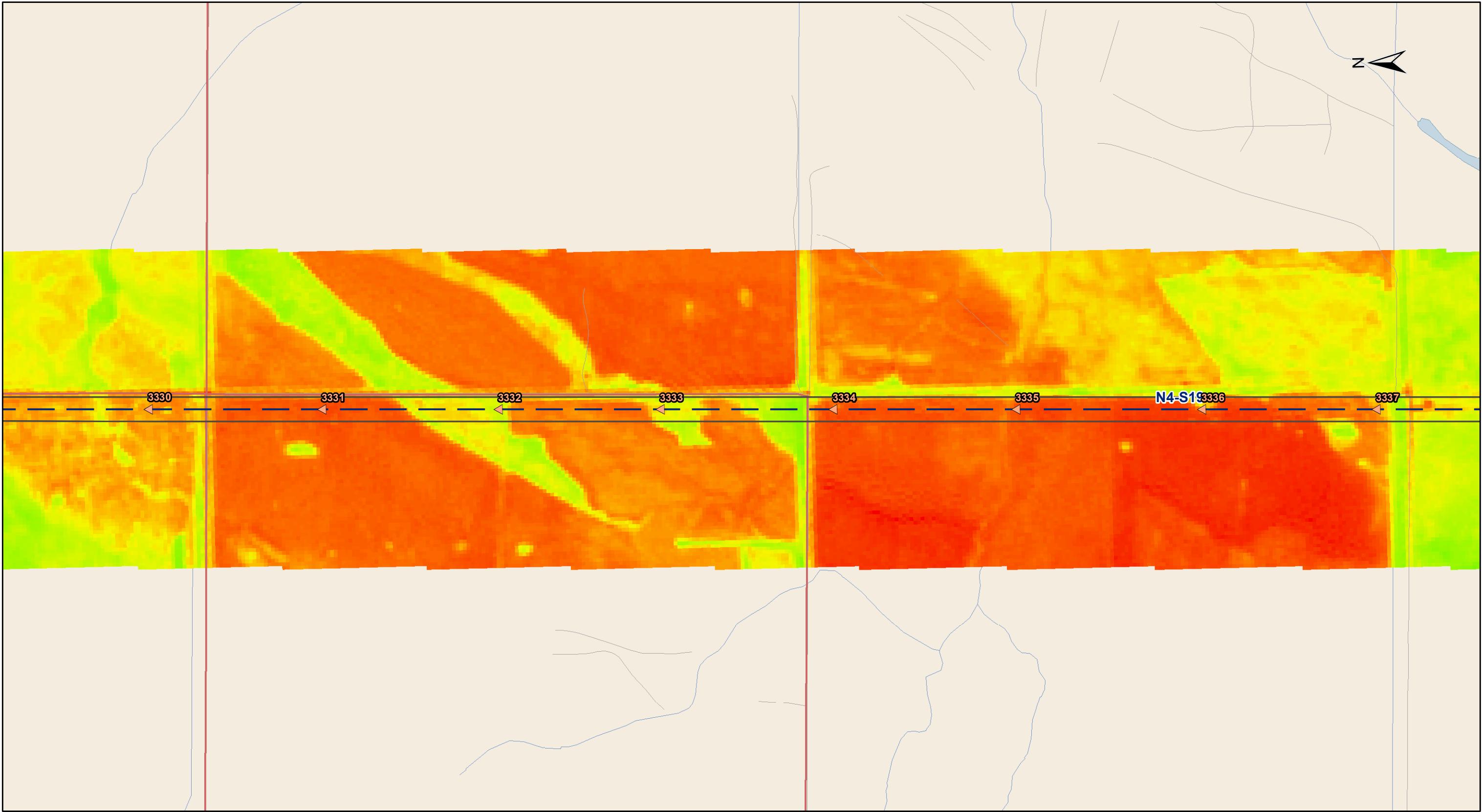


Project Infrastructure	
—	BPIII Final Preferred Route
□	66m ROW
★	Angle Towers (Preliminary)
▲	Towers (Preliminary)
—	Proposed Access Route

Landbase	
—	Major Road
—	Local Road
—	Watercourse

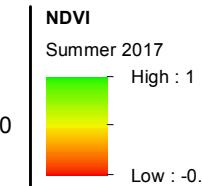
Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres
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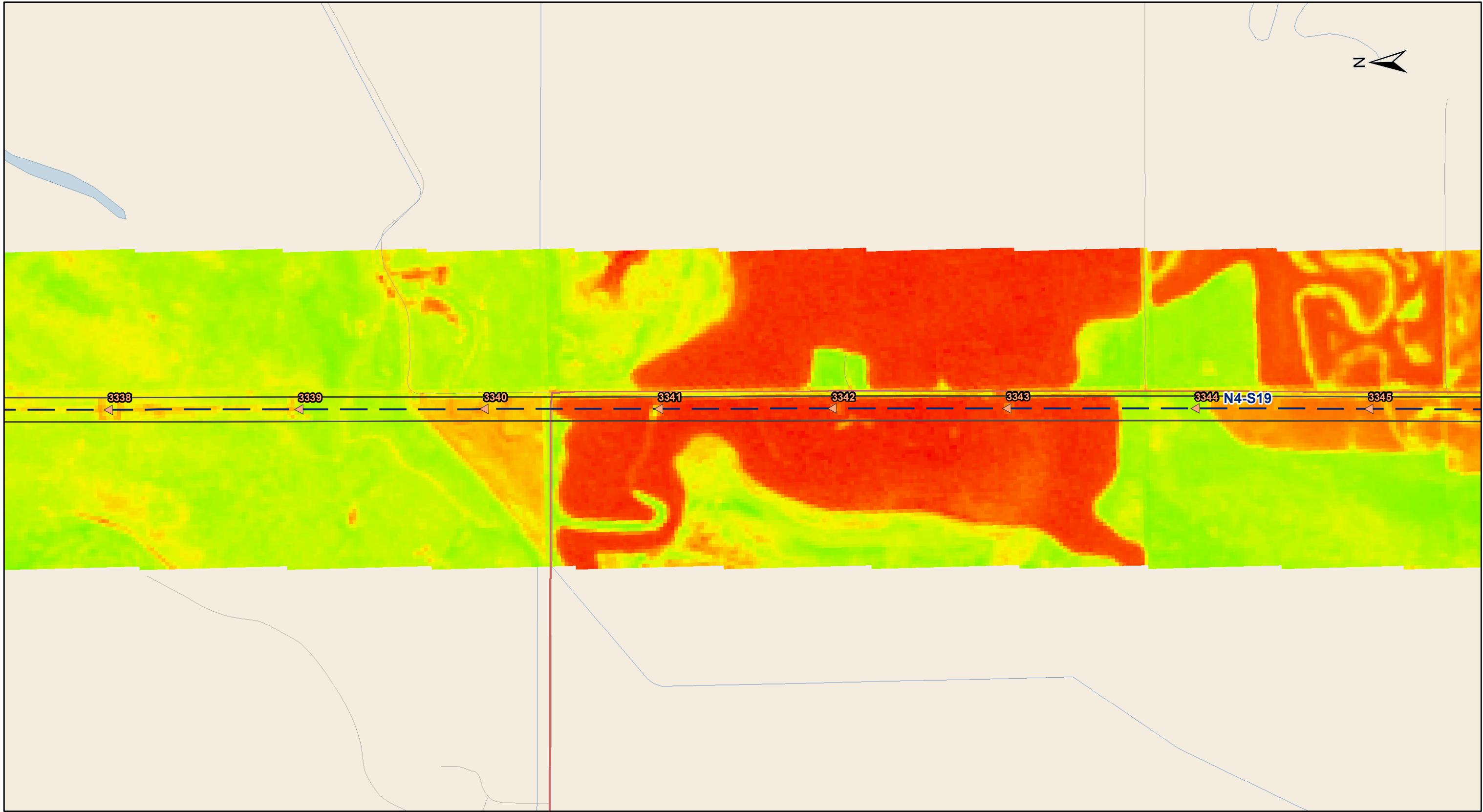
Project Infrastructure
BPIII Final Preferred Route
66m ROW
Towers (Preliminary)

Landbase
Major Road
Local Road
Watercourse
Waterbody

Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT

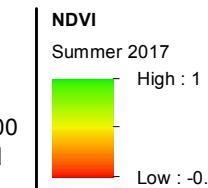
MAP 4-100-11



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
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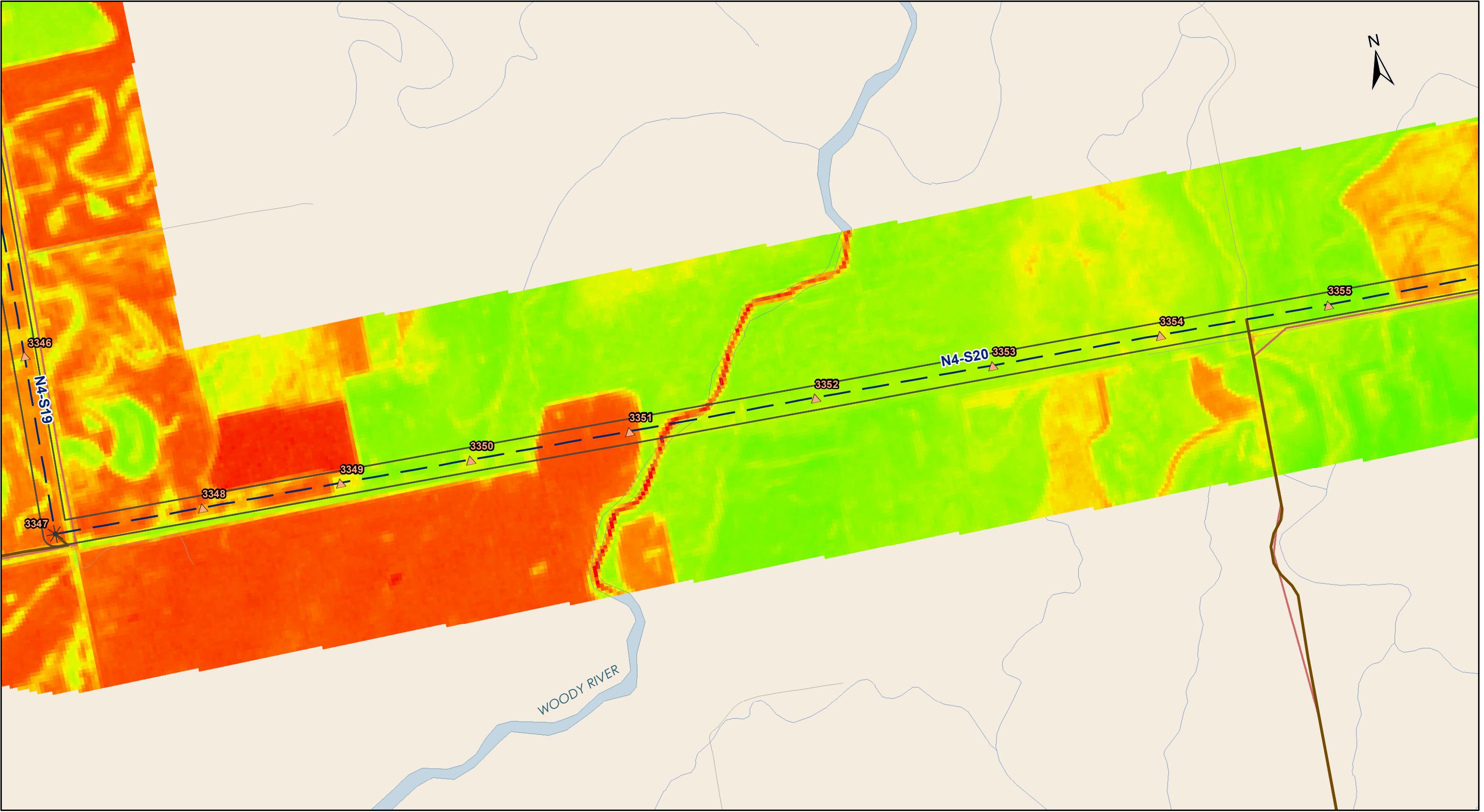
Project Infrastructure
BPIII Final Preferred Route
66m ROW
Towers (Preliminary)

Landbase
Major Road
Local Road
Watercourse
Waterbody

Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

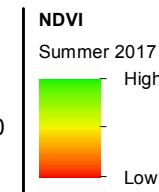
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MAP 4-100-12



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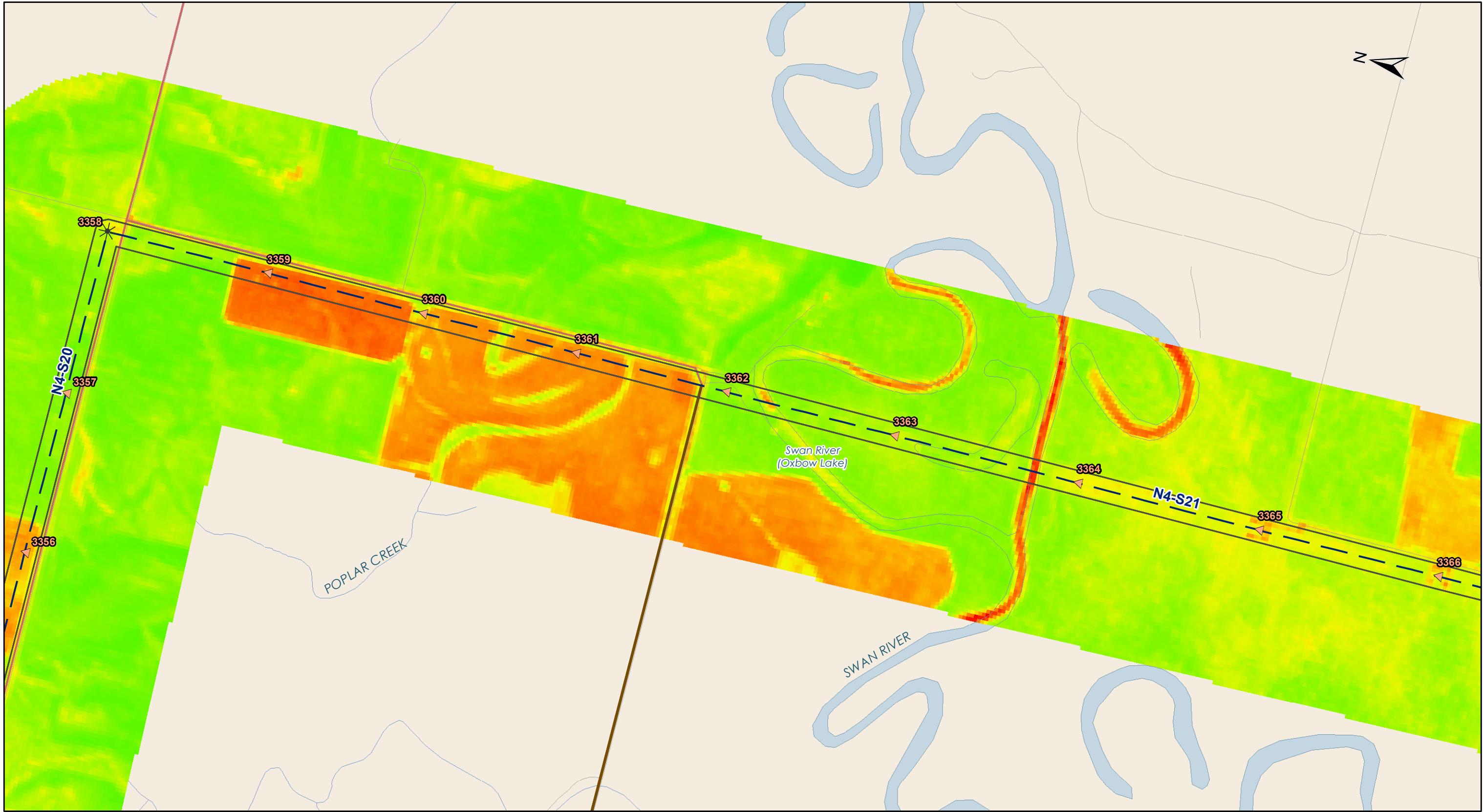


Project Infrastructure
BPIII Final Preferred Route
66m ROW
Angle Towers (Preliminary)
Towers (Preliminary)

Landbase
Major Road
Local Road
Watercourse
Waterbody

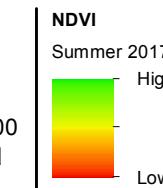
Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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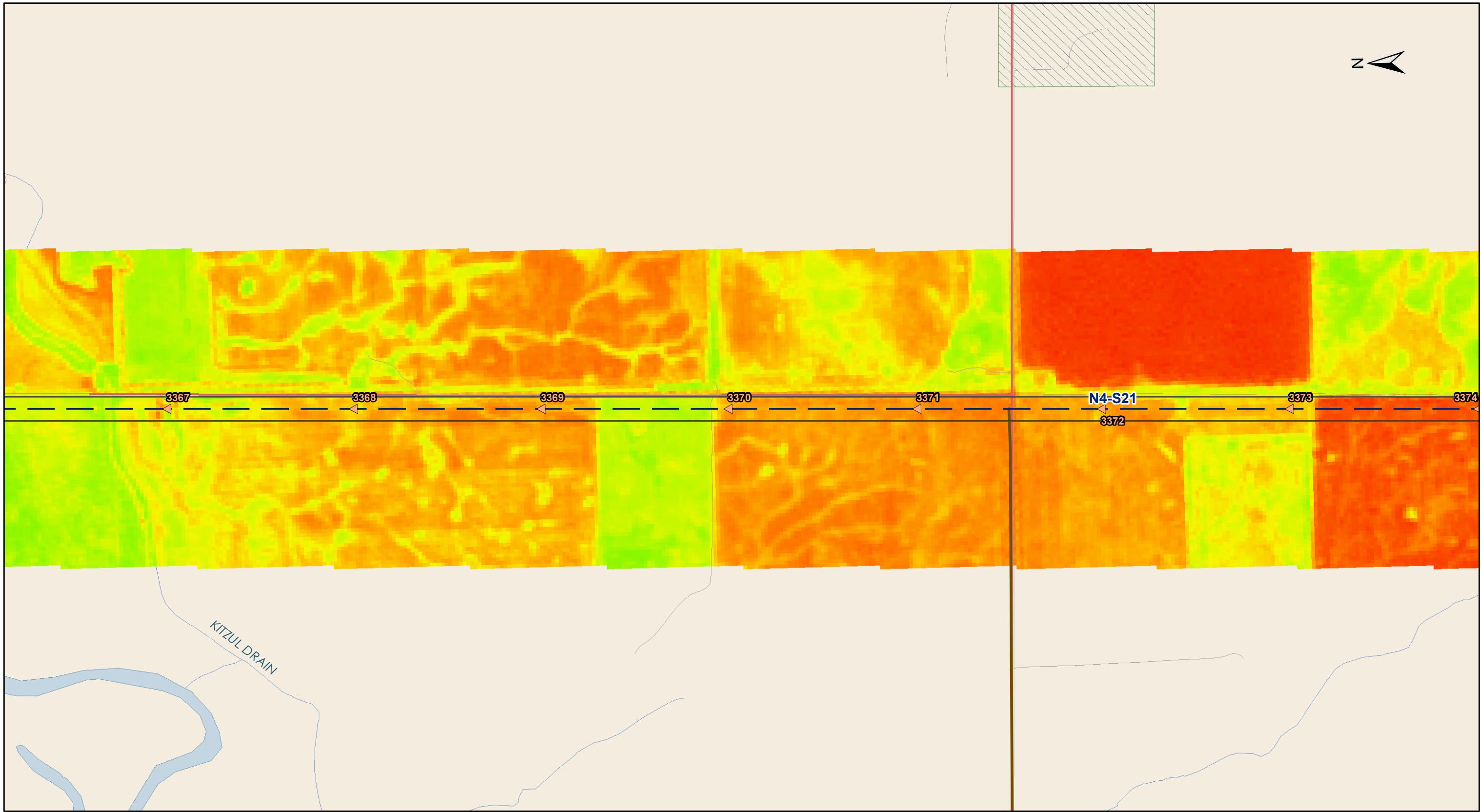


- Project Infrastructure**
- BPIII Final Preferred Route
 - 66m ROW
 - ★ Angle Towers (Preliminary)
 - ▲ Towers (Preliminary)
 - Proposed Access Route

- Landbase**
- Major Road
 - Local Road
 - Watercourse
 - Waterbody

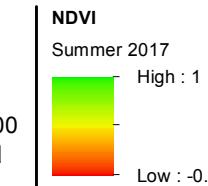
Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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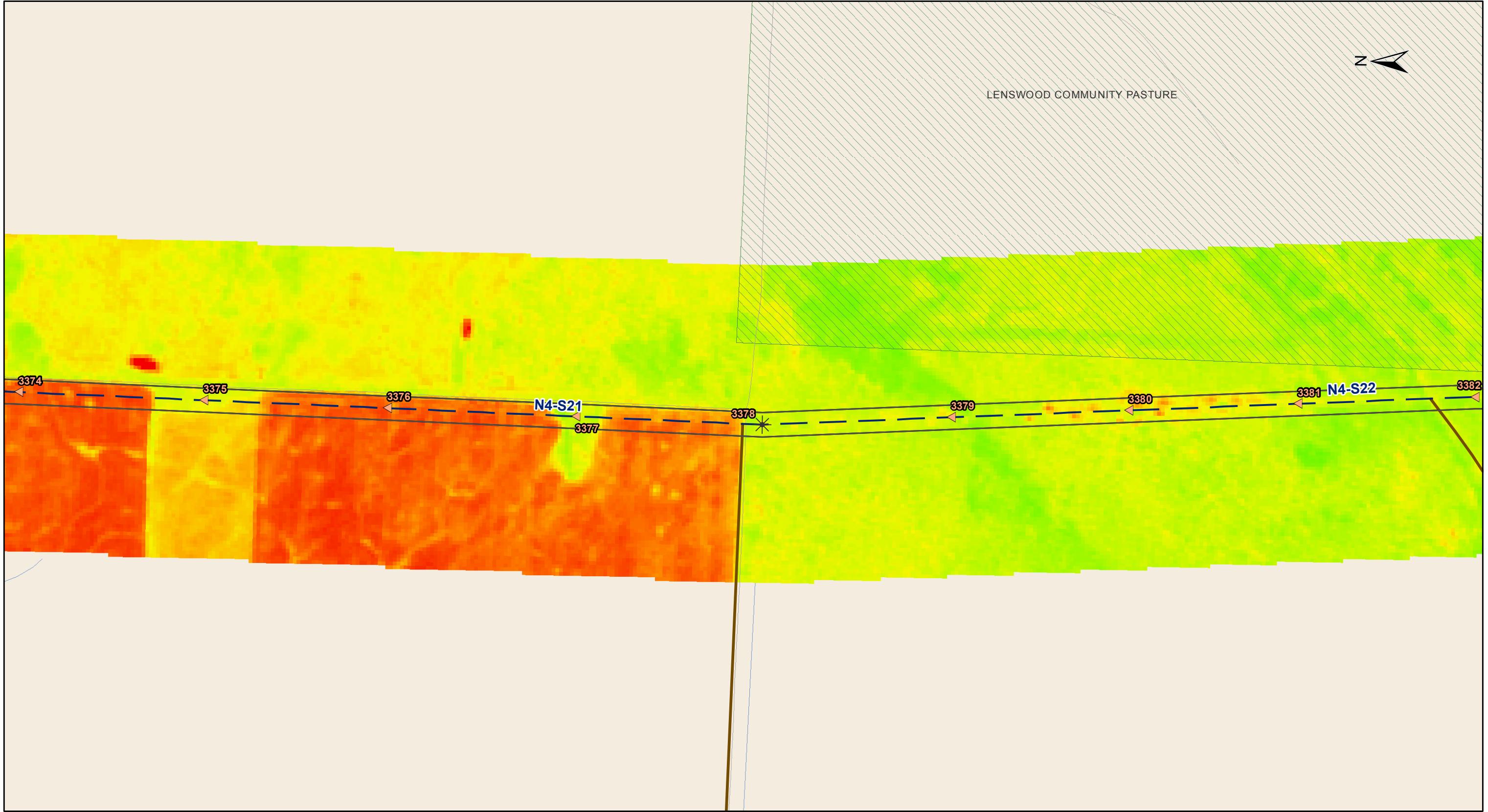


Project Infrastructure
BPIII Final Preferred Route
66m ROW
Towers (Preliminary)
Proposed Access Route

Landbase
Major Road
Local Road
Watercourse
Waterbody
Community Pasture

Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

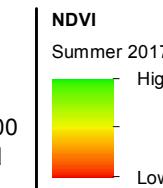
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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres

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- Project Infrastructure**
- BPIII Final Preferred Route
 - 66m ROW
 - Angle Towers (Preliminary)
 - Towers (Preliminary)
 - Proposed Access Route

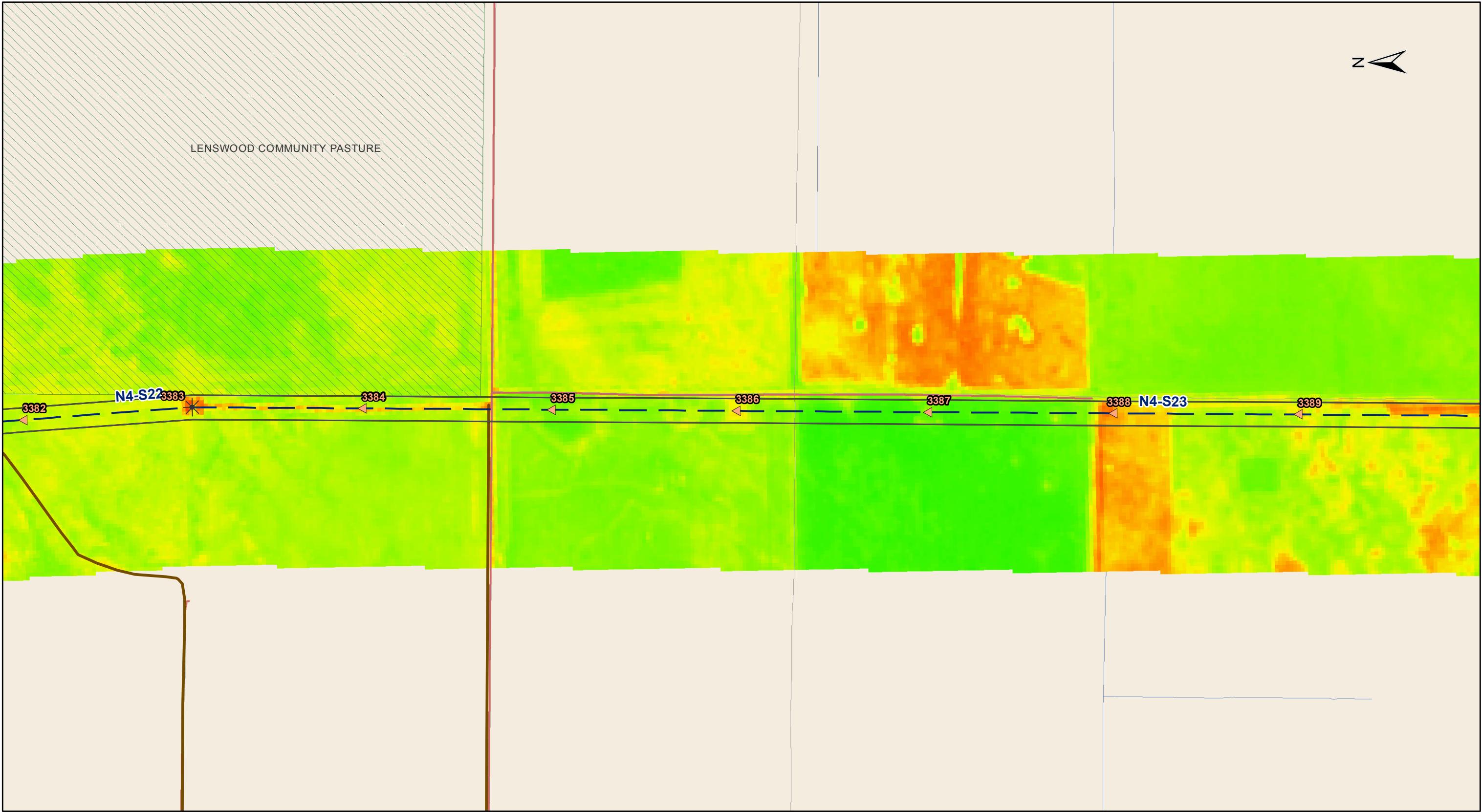
- Landbase**
- Local Road
 - Watercourse
 - Community Pasture

Bipole III Transmission Project

Section N4

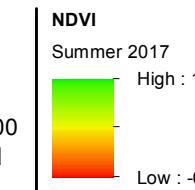
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route (Blue line)
- 66m ROW (White box)
- Angle Towers (Preliminary) (Star symbol)
- Towers (Preliminary) (Orange triangle)
- Proposed Access Route (Brown line)

Landbase

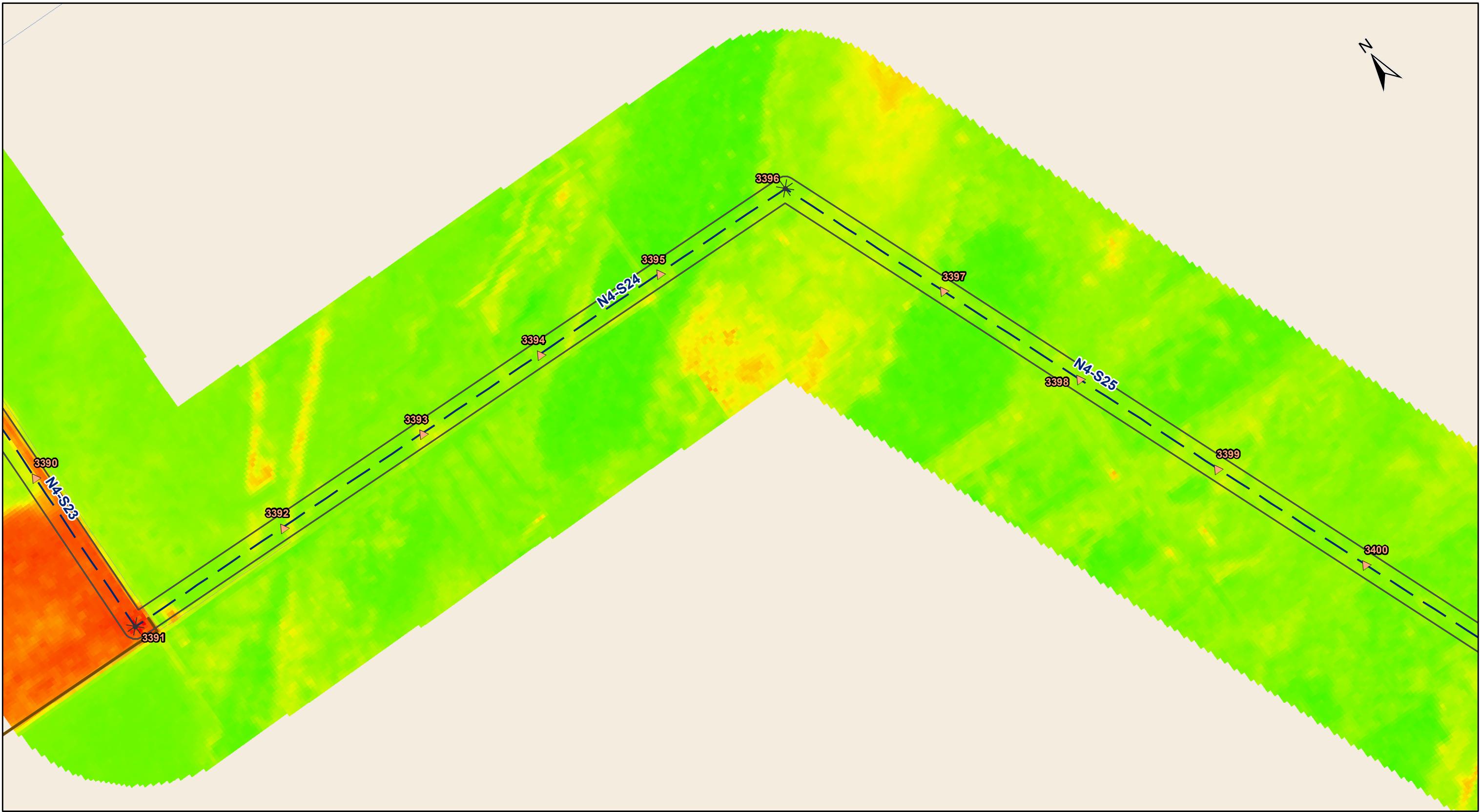
- Major Road (Red line)
- Local Road (Grey line)
- Watercourse (Light blue line)
- Community Pasture (Diagonal hatching)

Bipole III Transmission Project

Section N4

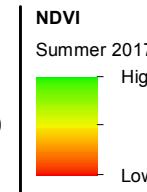
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure
BPIII Final Preferred Route
66m ROW
Angle Towers (Preliminary)
Towers (Preliminary)
Proposed Access Route

Landbase
Local Road
Watercourse

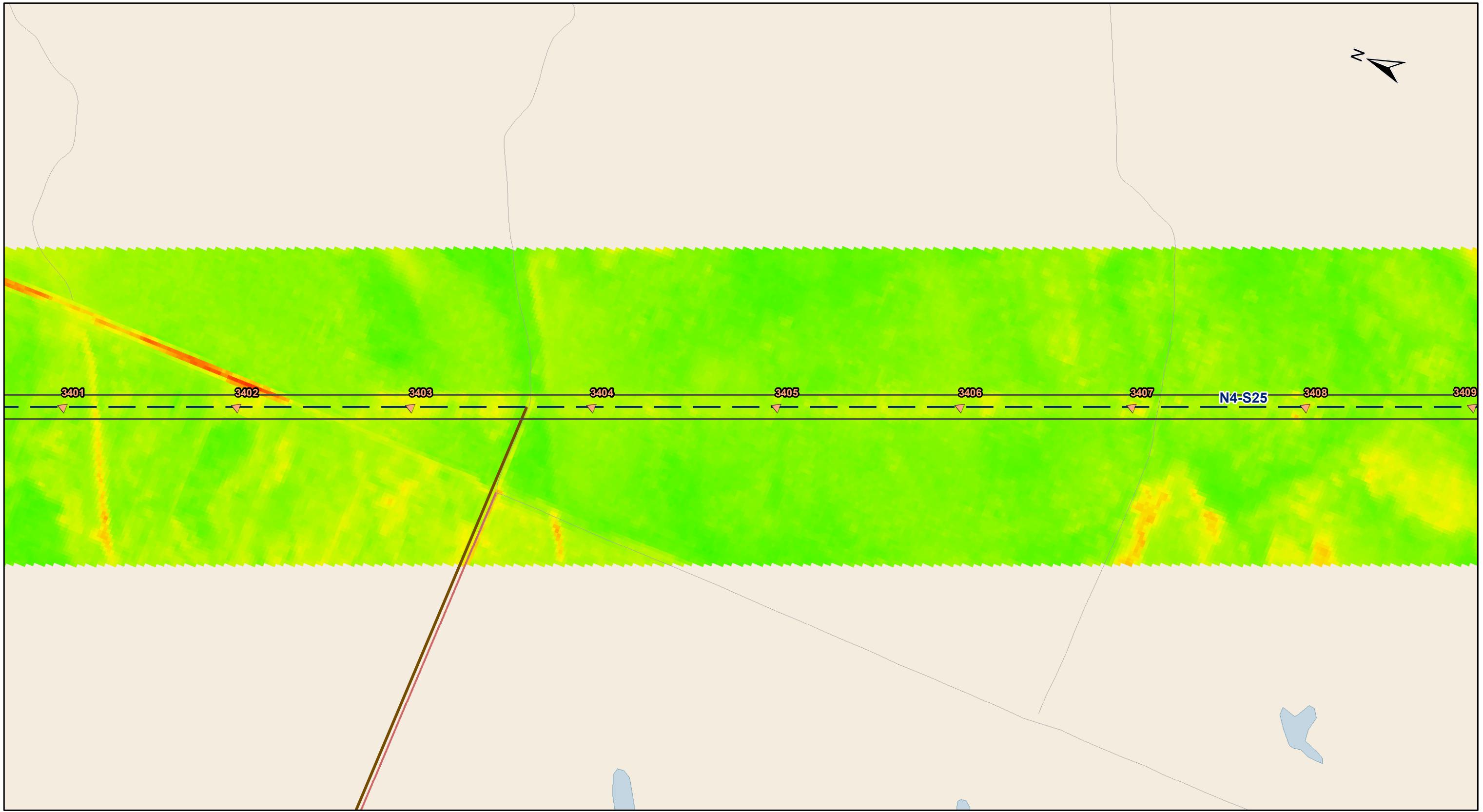
Bipole III Transmission Project

Section N4

Normalized Difference Vegetation Index (NDVI)

Summer 2017

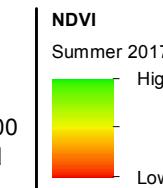
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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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Metres

1:10,000



Project Infrastructure
Summer 2017

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

Landbase

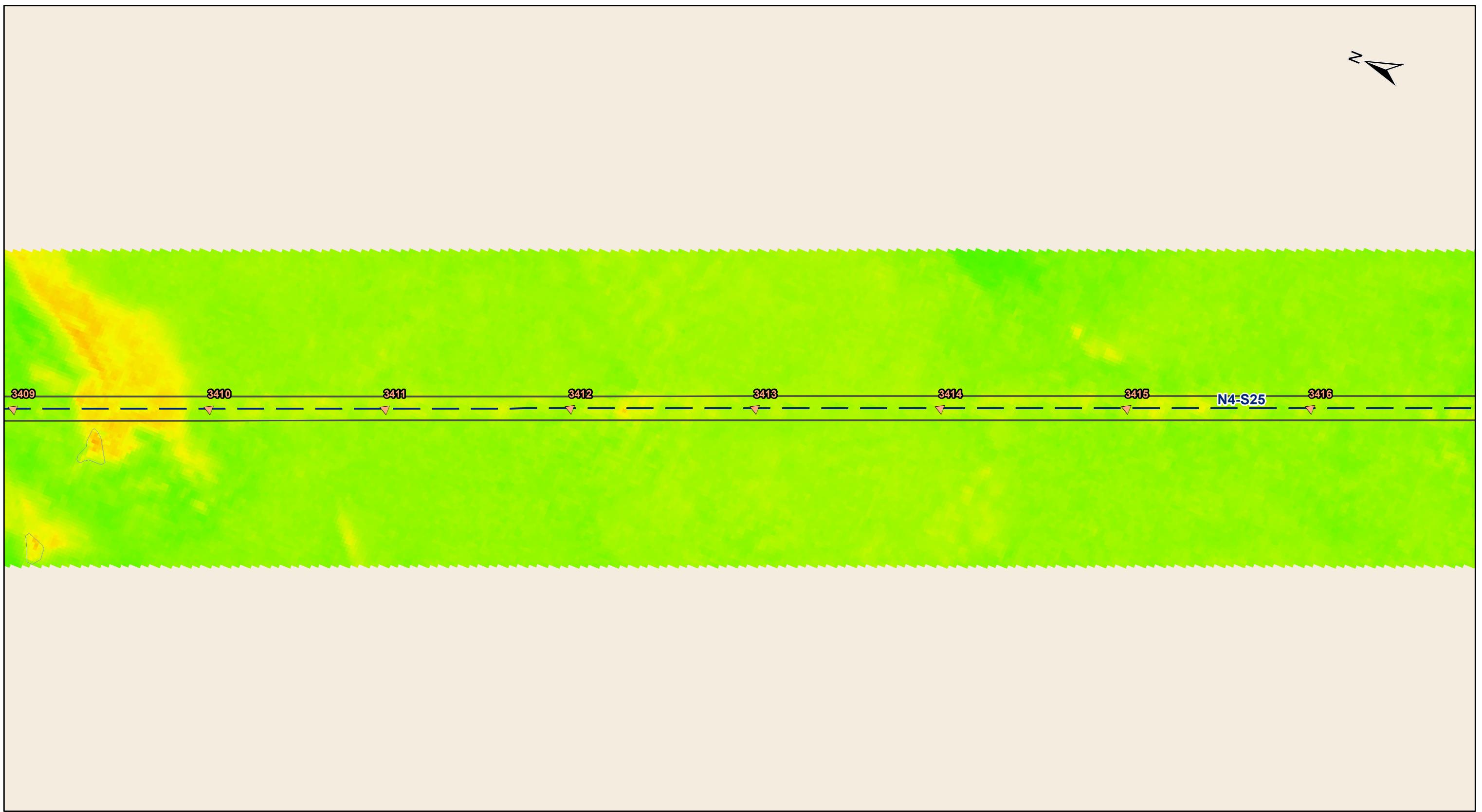
- Major Road
- Local Road
- Waterbody

Bipole III Transmission Project

Section N4

Normalized Difference Vegetation Index (NDVI) Summer 2017

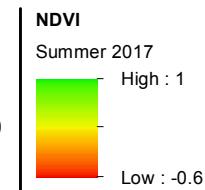
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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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Metres

1:10,000

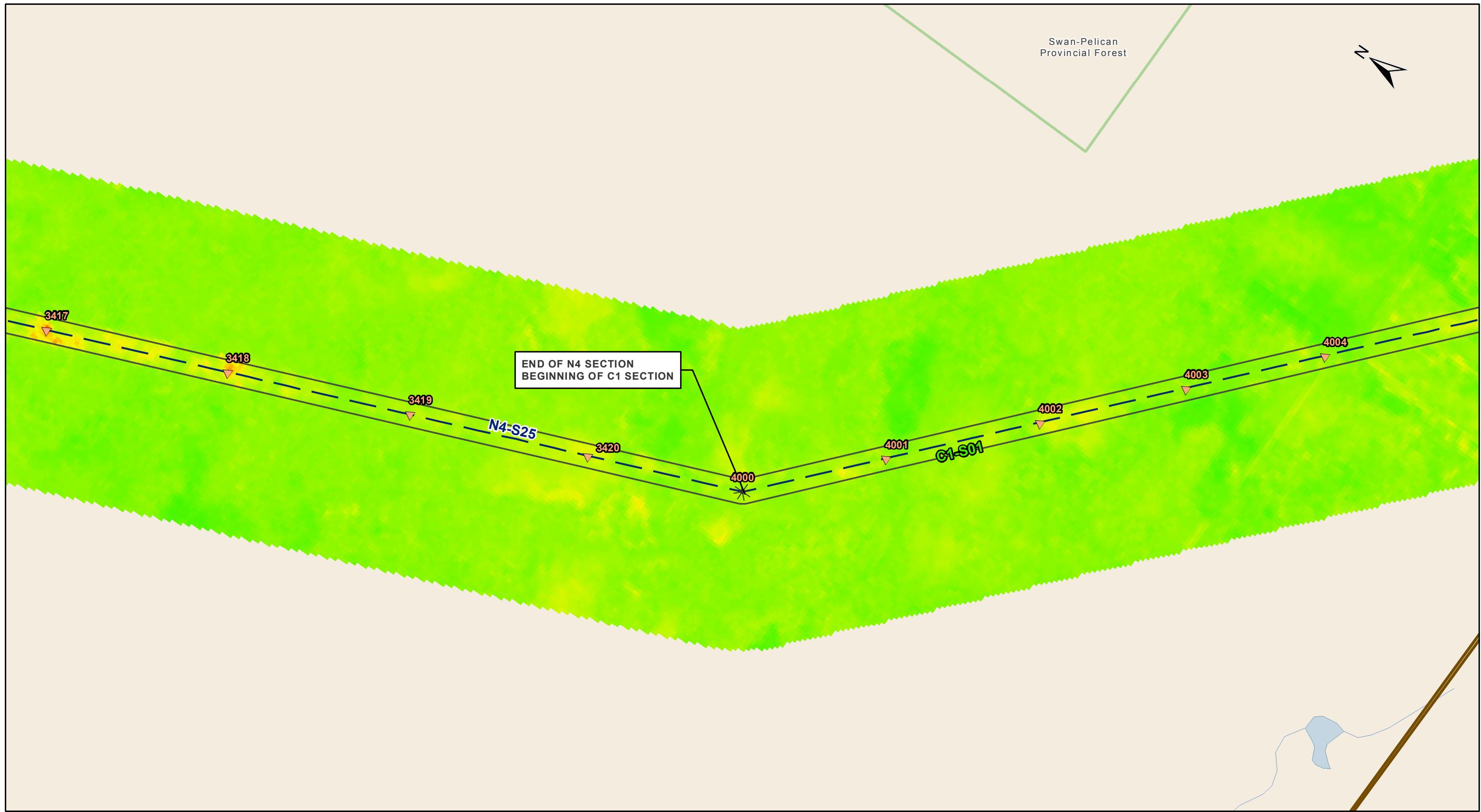


Project Infrastructure
BPIII Final Preferred Route
66m ROW
Towers (Preliminary)

Landbase
Waterbody

Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

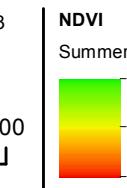
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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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Metres

1:10,000

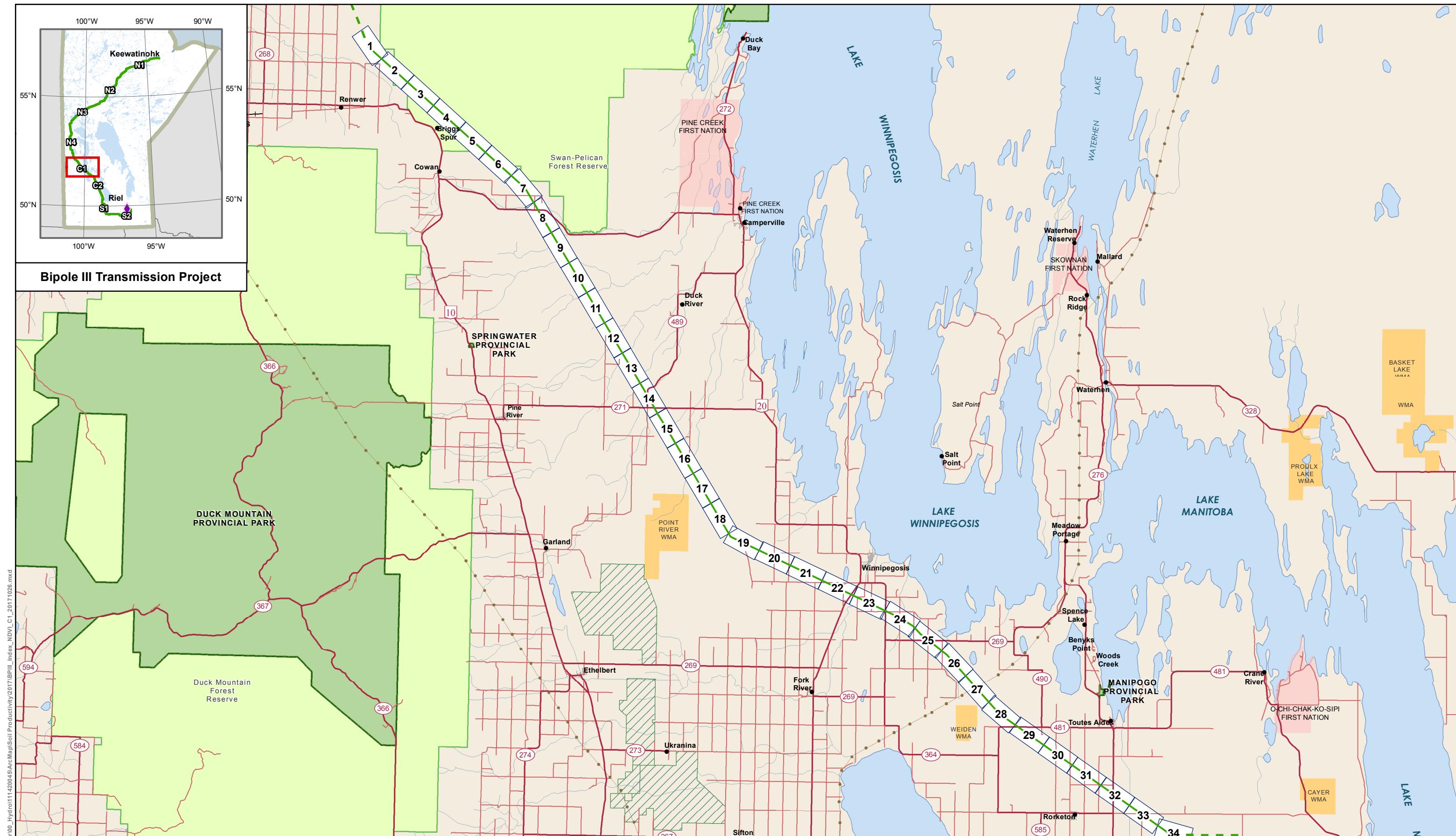


- Project Infrastructure**
- BPIII Final Preferred Route
 - 66m ROW
 - ★ Angle Towers (Preliminary)
 - ▲ Towers (Preliminary)
 - Proposed Access Route

- Landbase**
- Major Road
 - Local Road
 - Watercourse
 - Provincial Forest
 - Waterbody

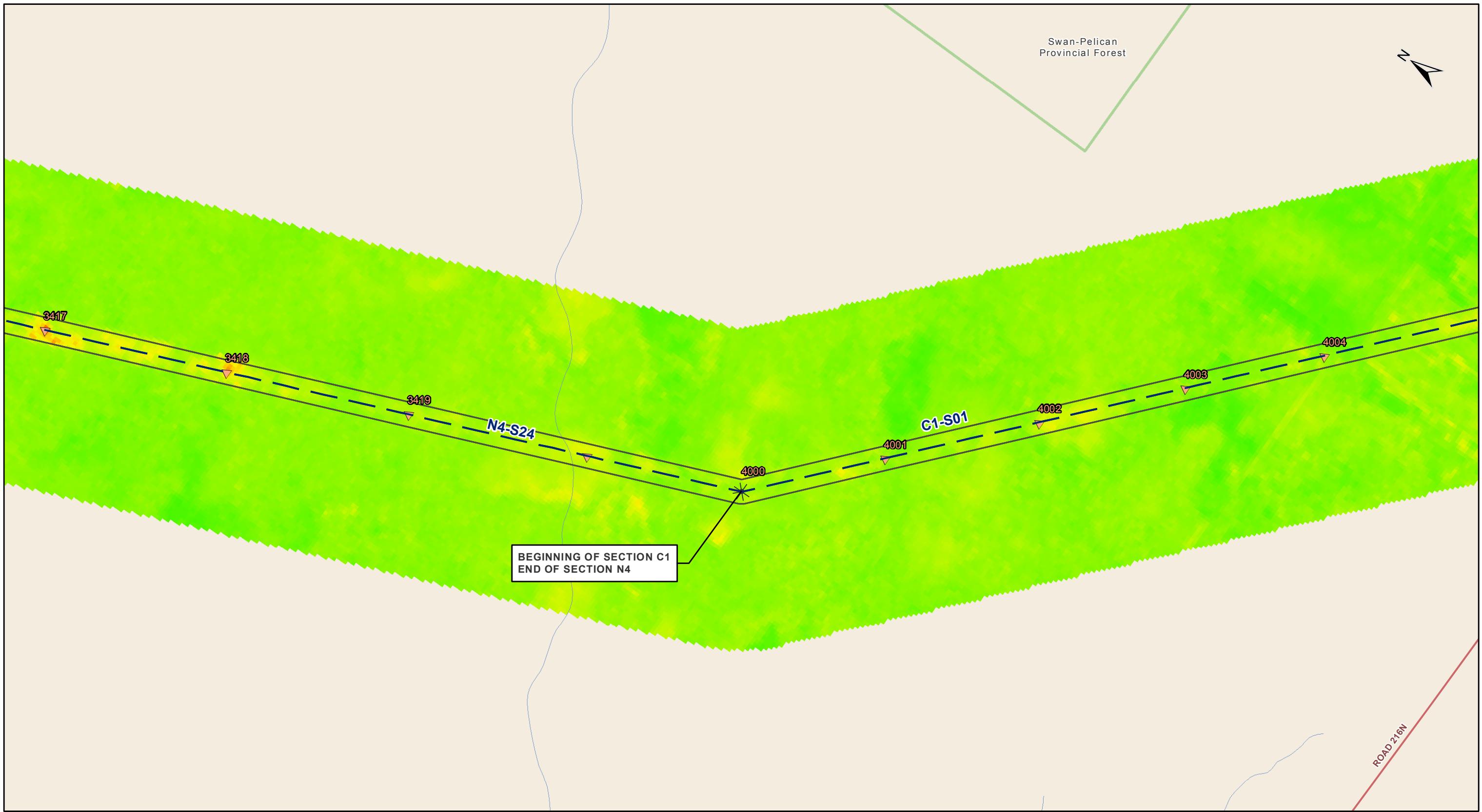
Bipole III Transmission Project
Section N4
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



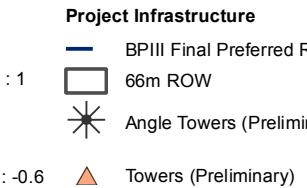
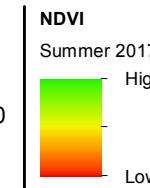
**Bipole III Transmission Project
Normalized Difference Vegetation Index (NDVI)
Section C1 - Key Map Index**



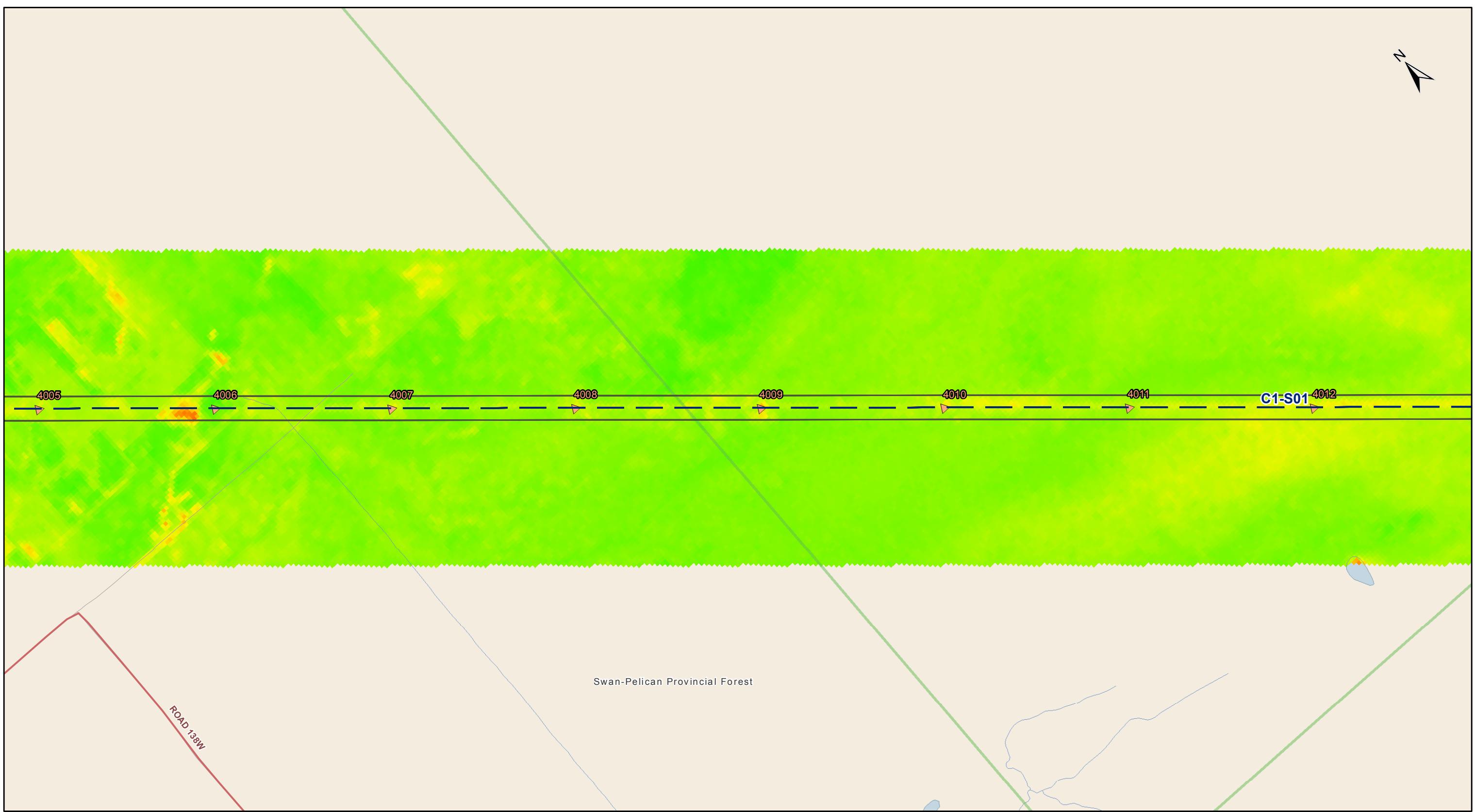


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Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
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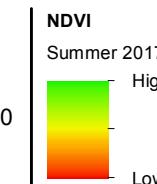
Bipole III Transmission Project
Section C1
Normalized Difference Vegetation Index (NDVI)
Summer 2017



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres

1:10,000



Project Infrastructure

- BP III Final Preferred Route
- 66m ROW
- Towers (Preliminary)

Landbase

- Major Road
- Local Road
- Provincial Forest
- Watercourse
- Waterbody

Bipole III Transmission Project
Section C1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

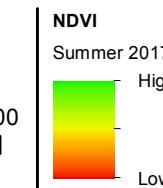
DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN
Date Created: November 05, 2017

0 125 250 500
Metres

1:10,000



Project Infrastructure
BPIII Final Preferred Route
66m ROW
Towers (Preliminary)

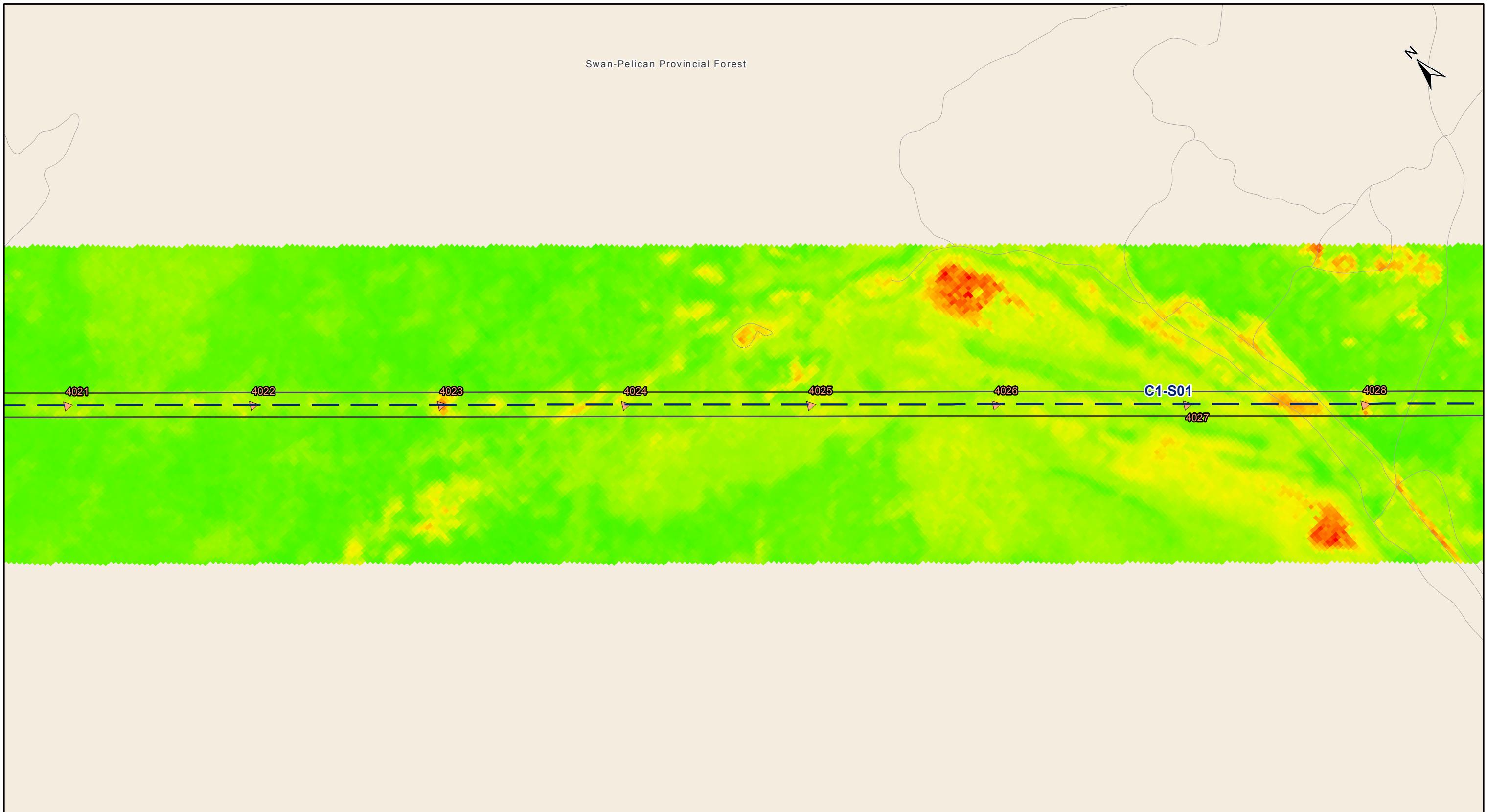
Landbase
Local Road
Provincial Forest
Waterbody

Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI) Summer 2017

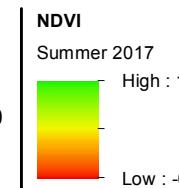
DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN
Date Created: November 05, 2017

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Metres

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Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)

Landbase

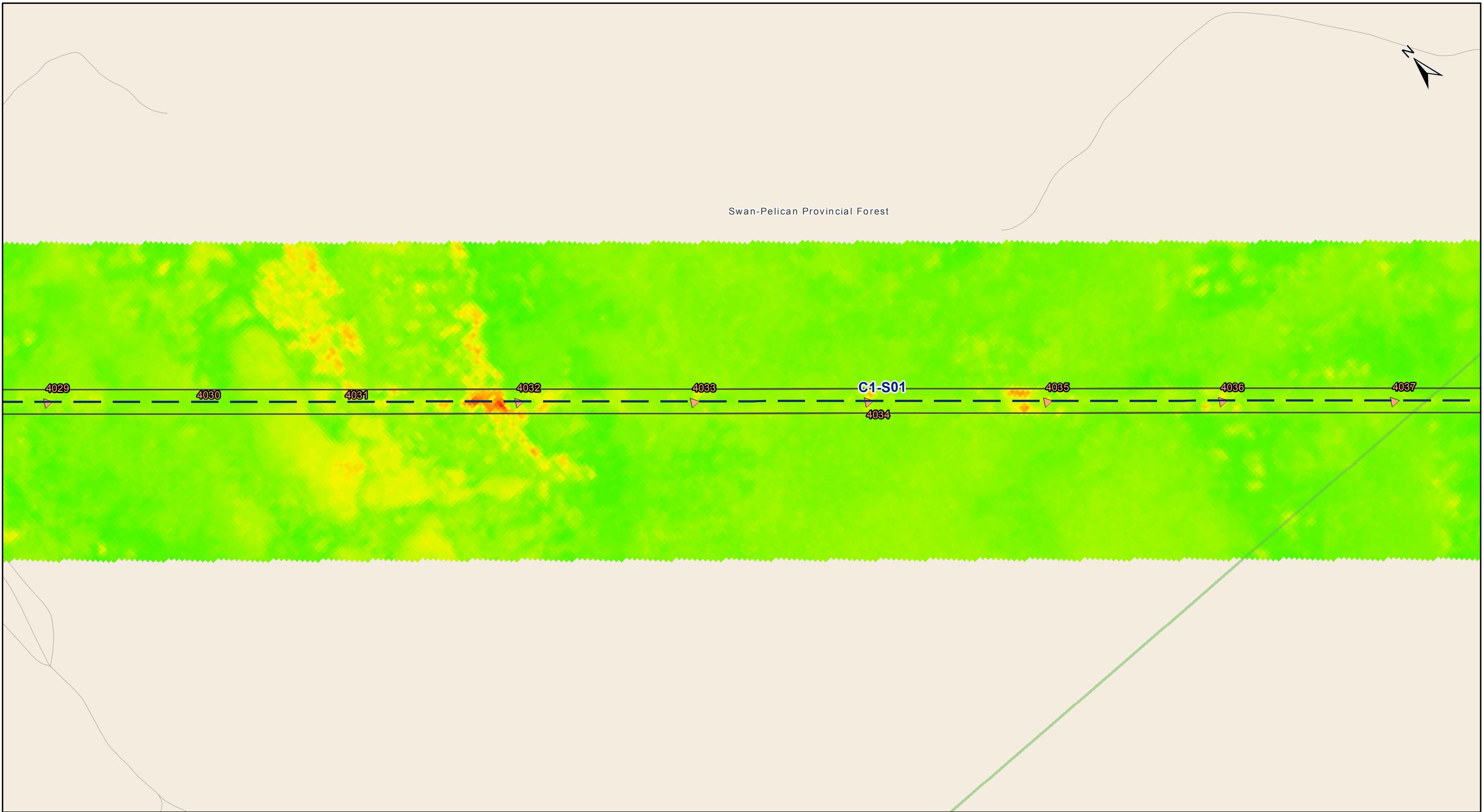
- Local Road
- Provincial Forest
- Waterbody

Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI) Summer 2017

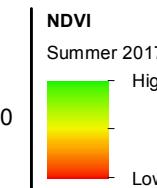
DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres

1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)

Landbase

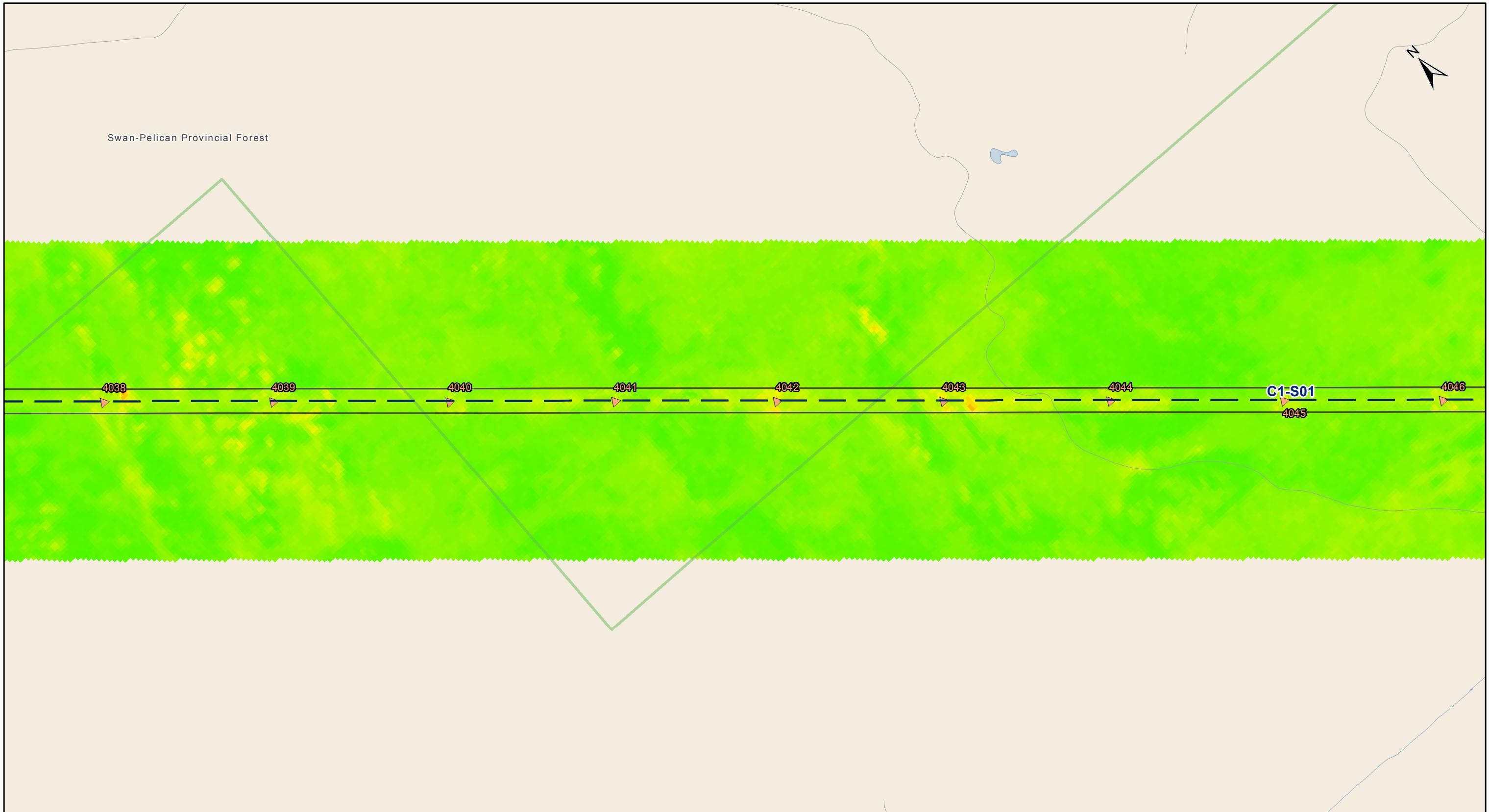
- Local Road
- Provincial Forest

Bipole III Transmission Project

Section C1

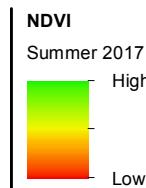
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

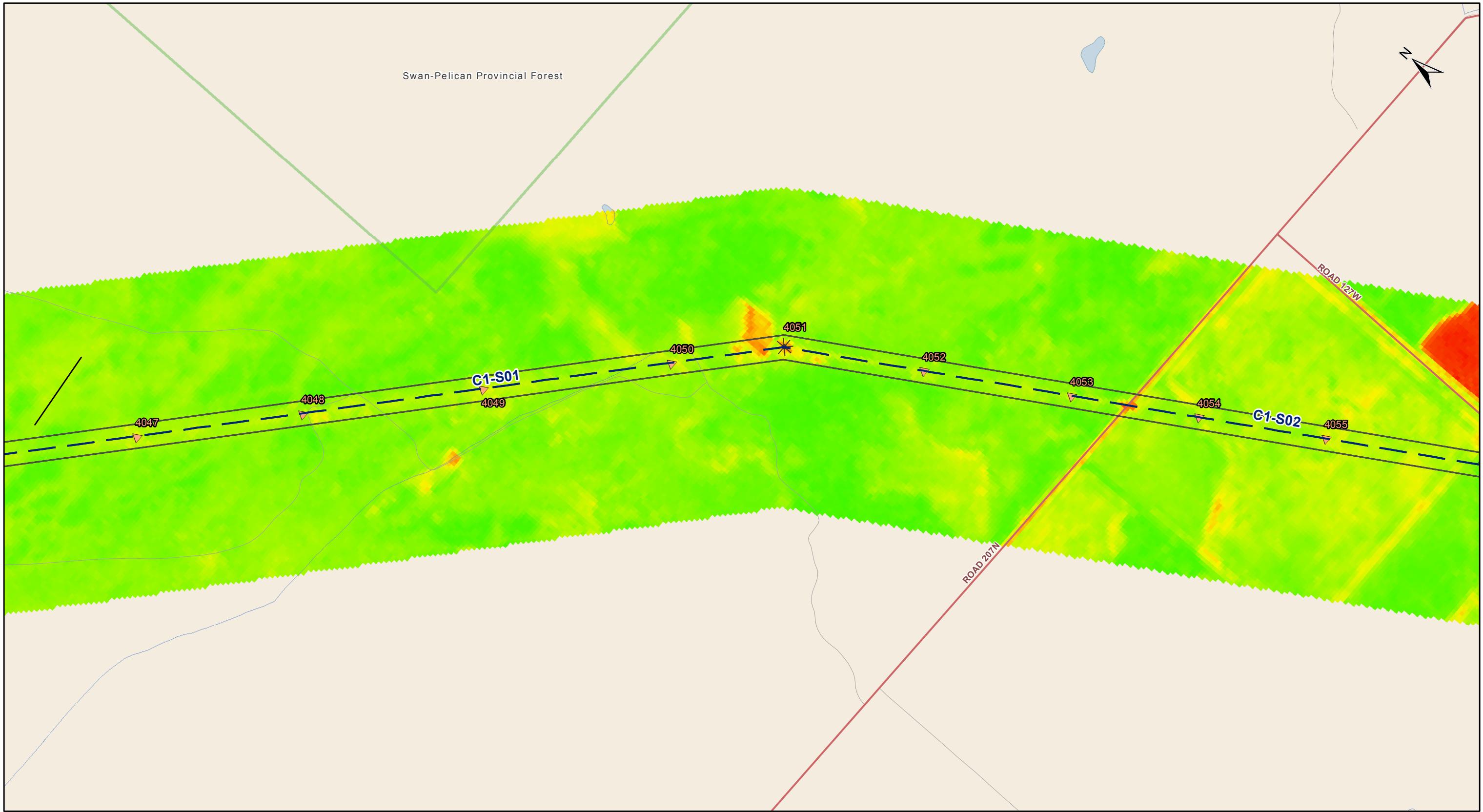
- Local Road
- Provincial Forest
- Watercourse
- Waterbody

Bipole III Transmission Project

Section C1

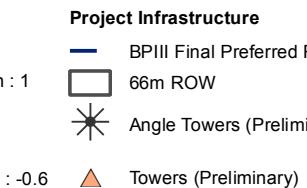
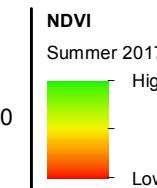
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN
Date Created: November 05, 2017

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Metres
1:10,000



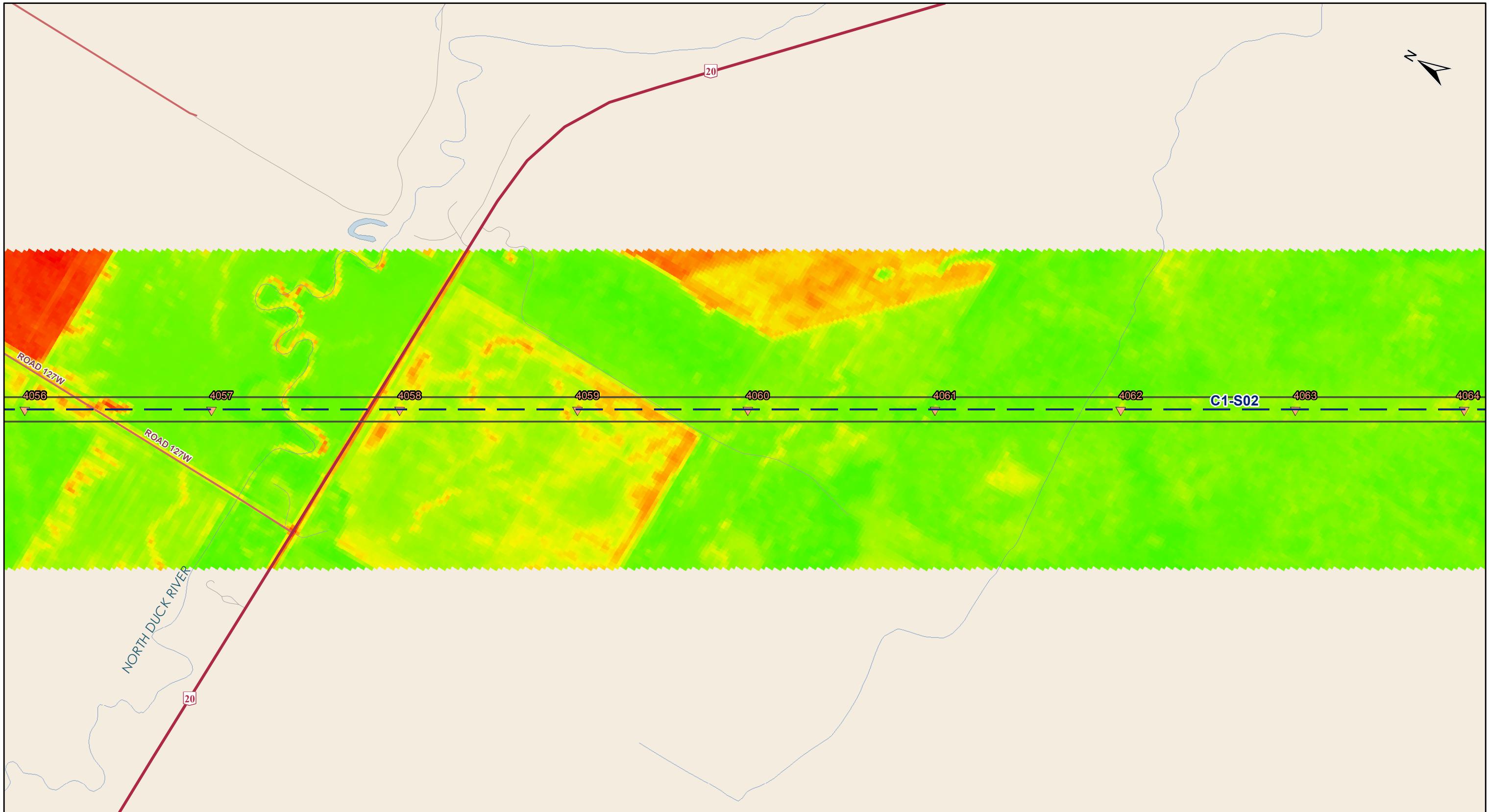
Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI)

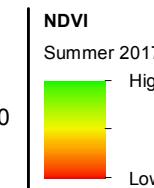
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000

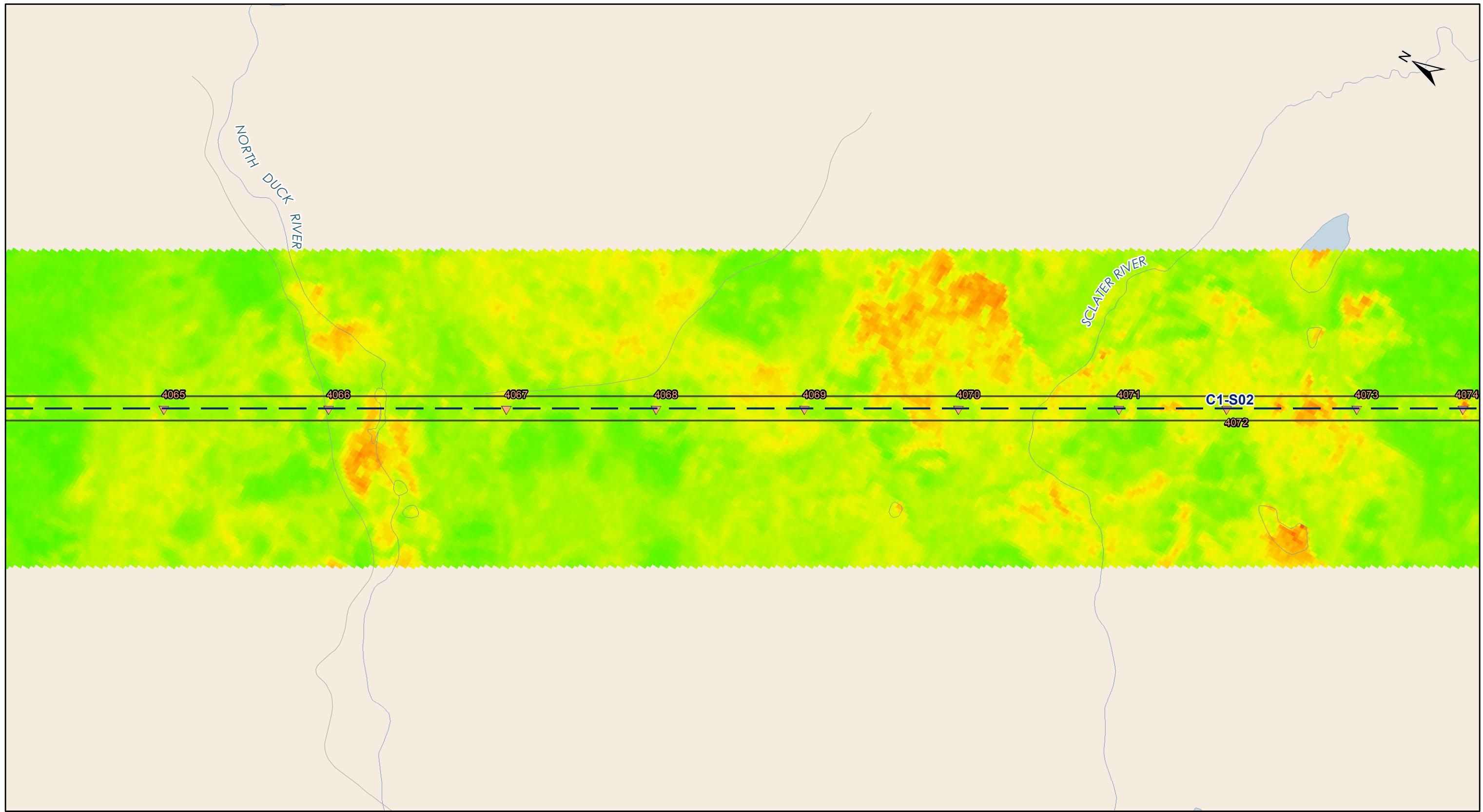


Project Infrastructure
 BPII Final Preferred Route
 66m ROW
 Towers (Preliminary)

Landbase
 Highway
 Major Road
 Local Road
 Watercourse
 Waterbody

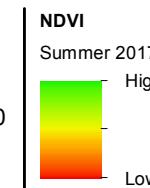
Bipole III Transmission Project
Section C1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure
Summer 2017

- BP III Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

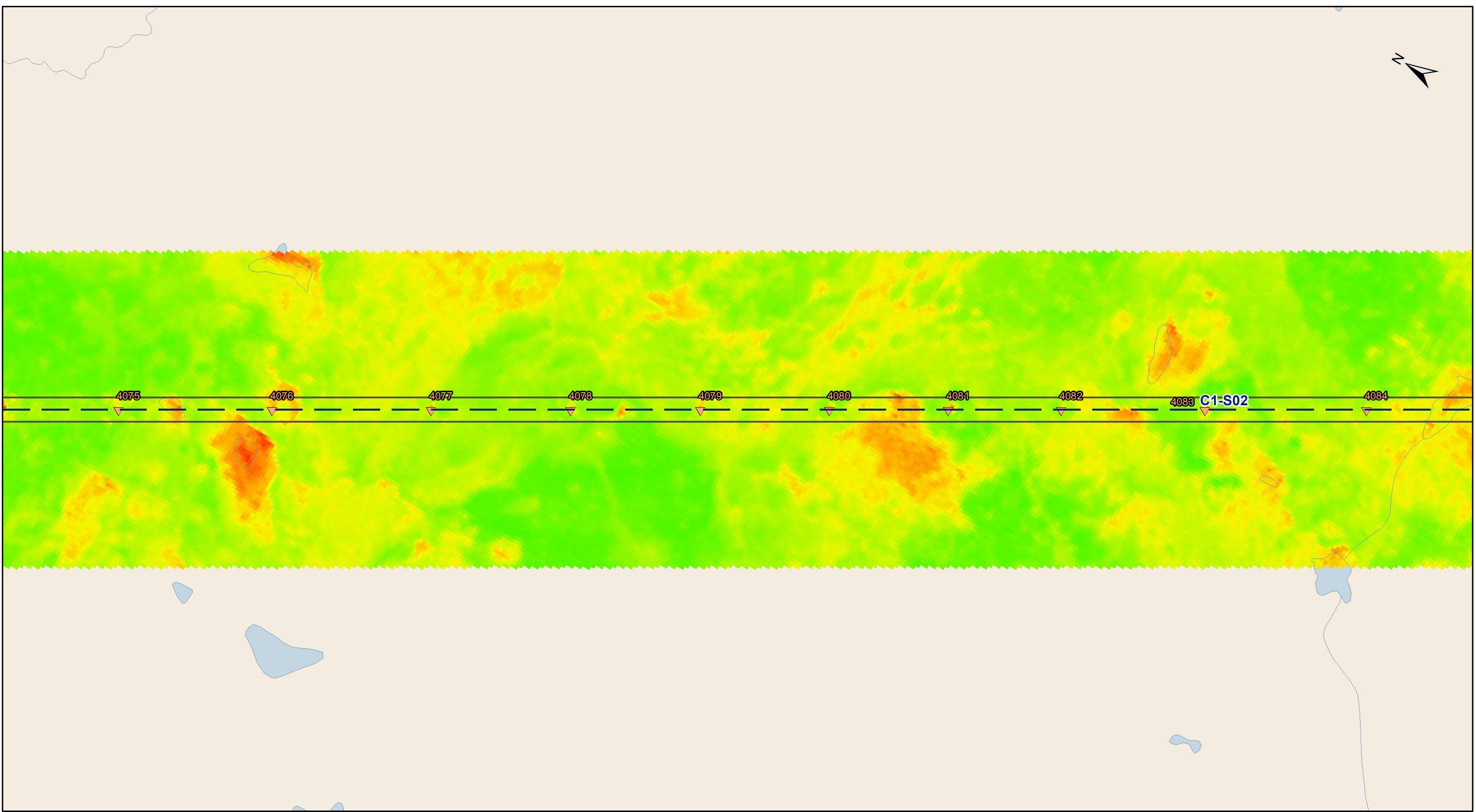
- Local Road
- Watercourse
- Waterbody

Bipole III Transmission Project

Section C1

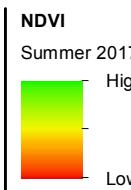
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure

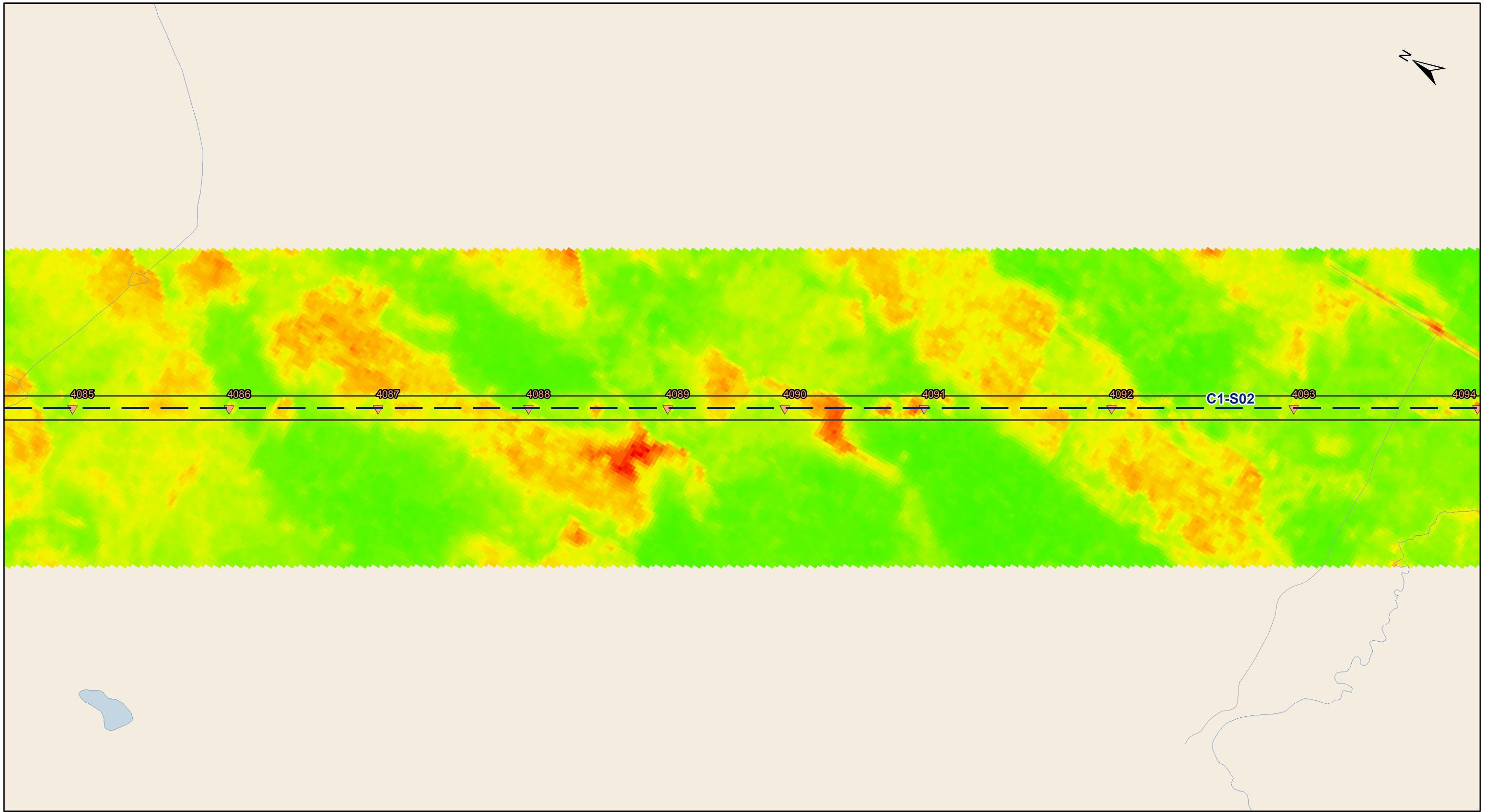
- BP III Final Preferred Route
- 66m ROW
- Towers (Preliminary)

Landbase

- Watercourse
- Waterbody

Bipole III Transmission Project
Section C1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

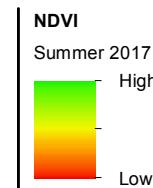
DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres

1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

- Local Road
- Watercourse
- Waterbody

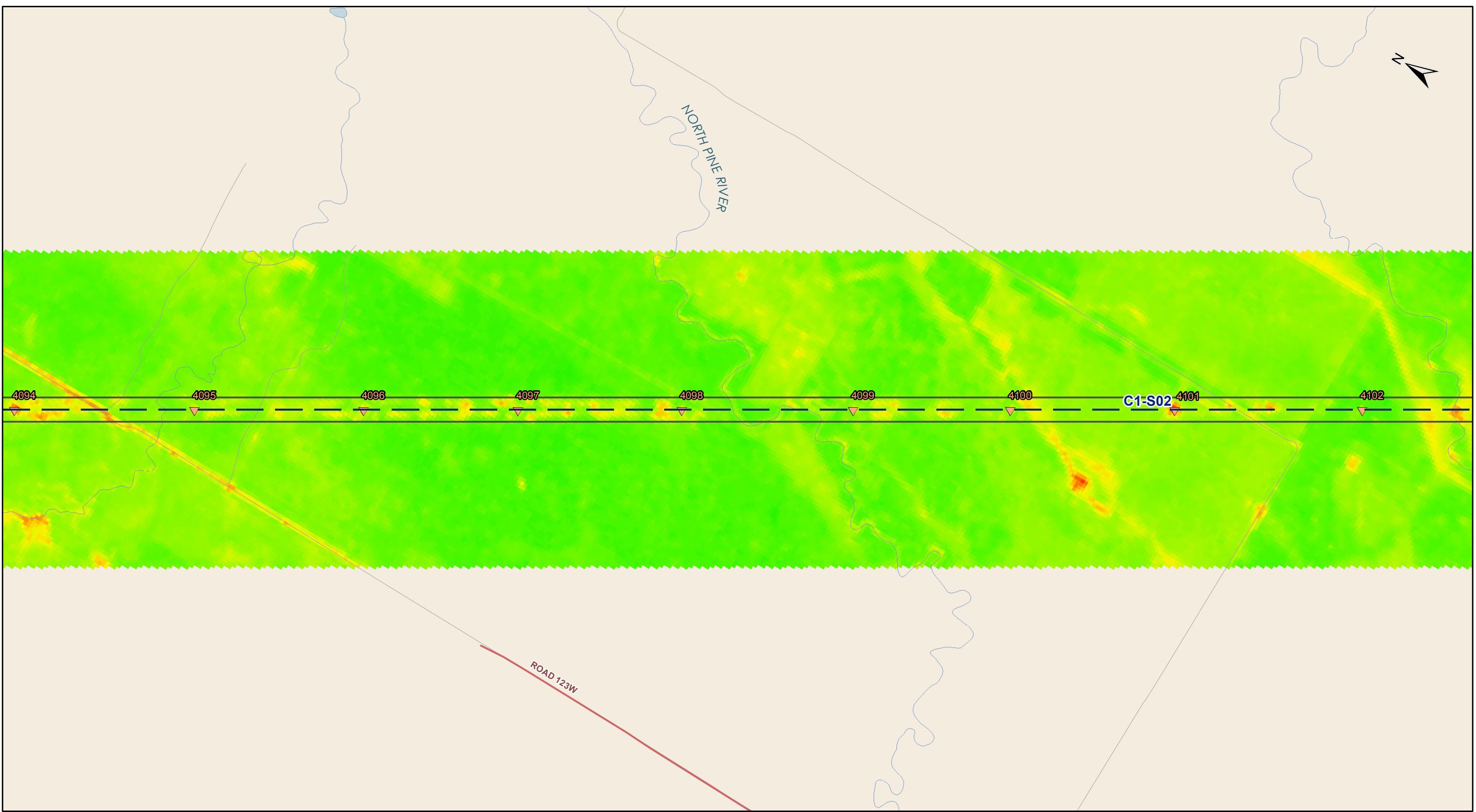
Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI)

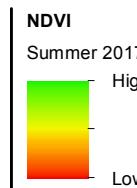
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure
Summer 2017

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

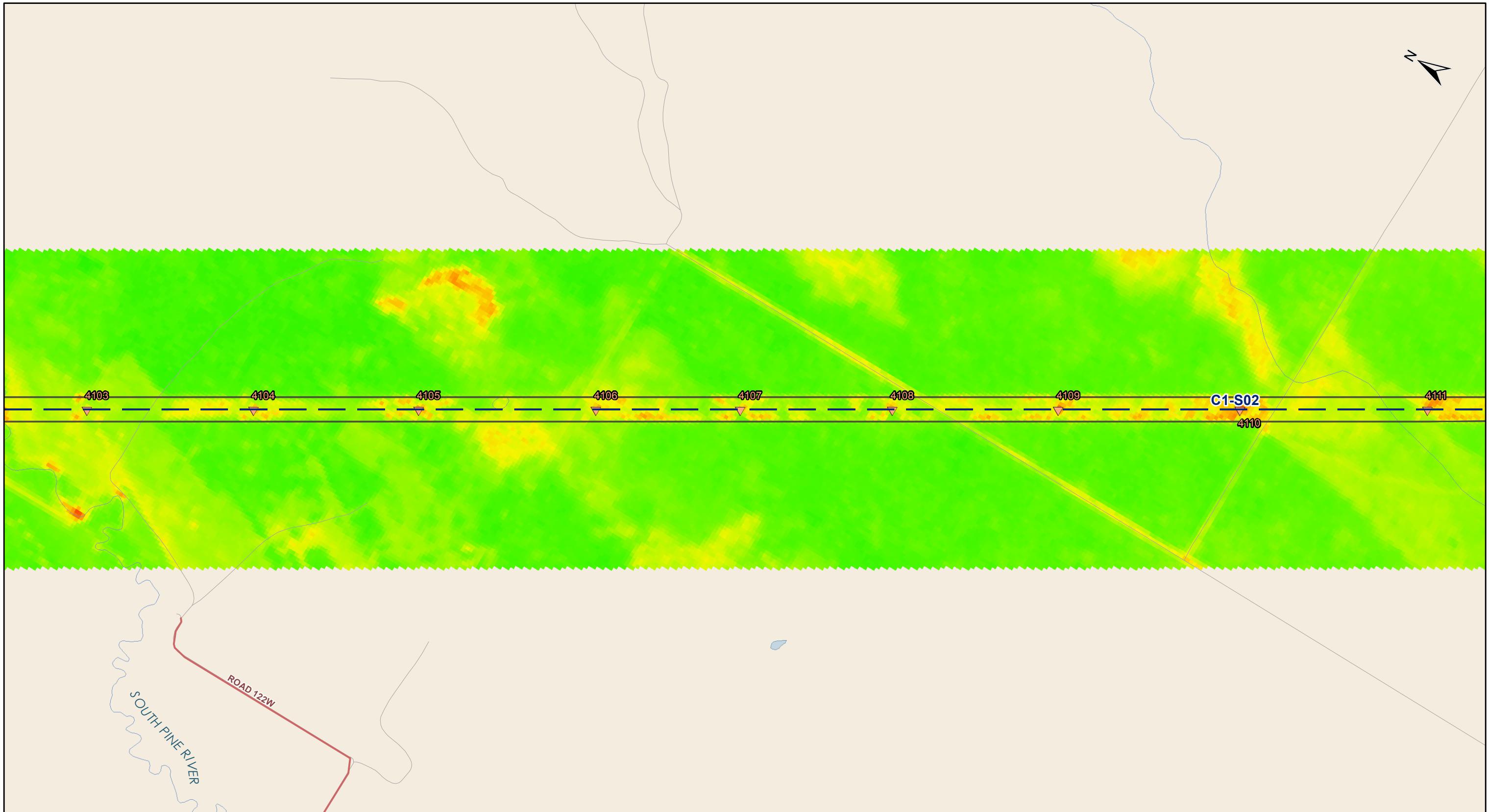
- Major Road
- Local Road
- Watercourse
- Waterbody

Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI) Summer 2017

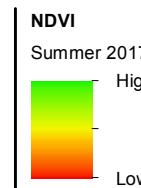
DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres

1:10,000



Project Infrastructure

- BP III Final Preferred Route
- 66m ROW
- Towers (Preliminary)

Landbase

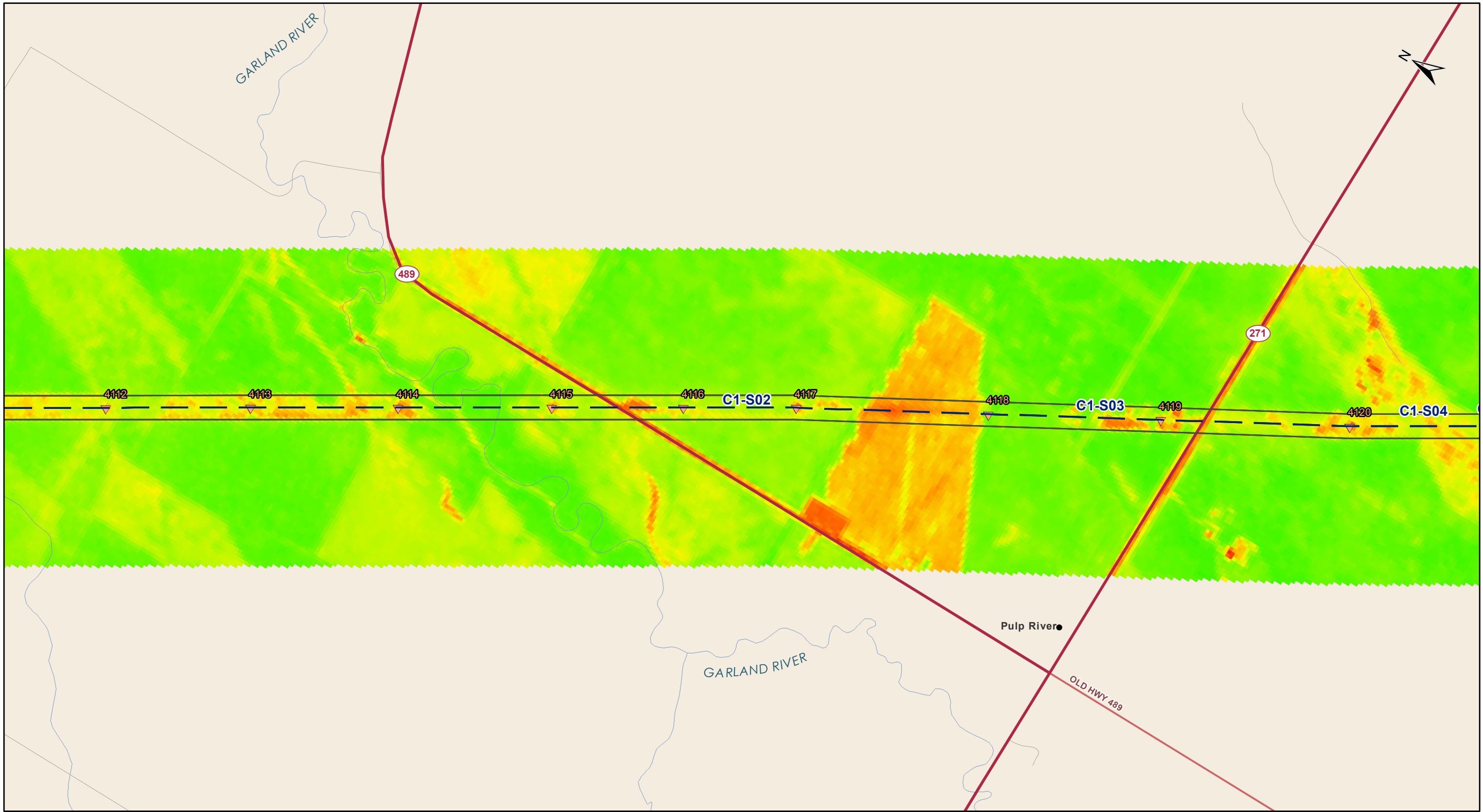
- Major Road
- Local Road
- Watercourse
- Waterbody

Bipole III Transmission Project

Section C1

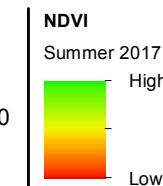
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure

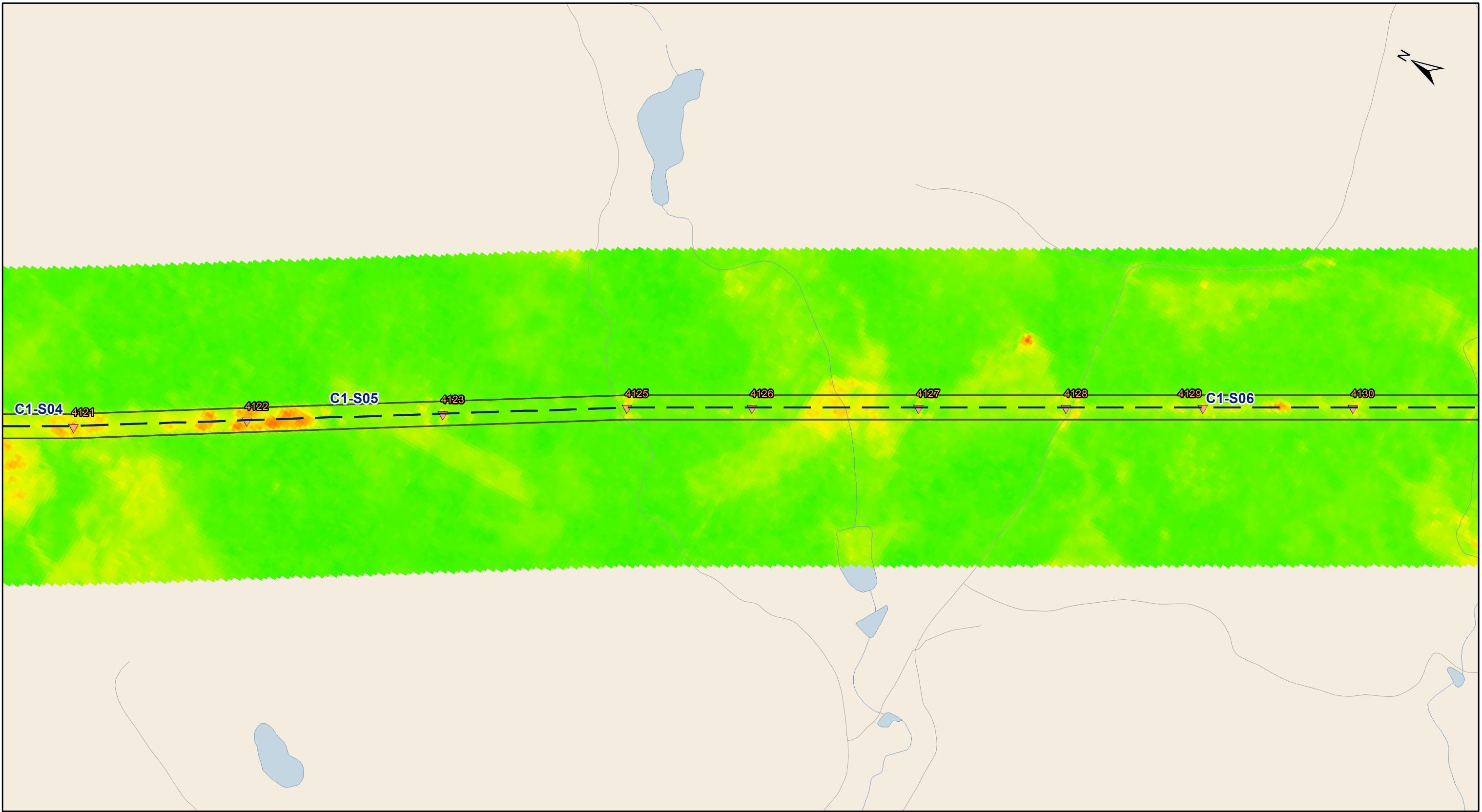
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

- Highway
- Major Road
- Local Road
- Watercourse

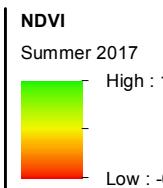
Bipole III Transmission Project
Section C1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure
Summer 2017

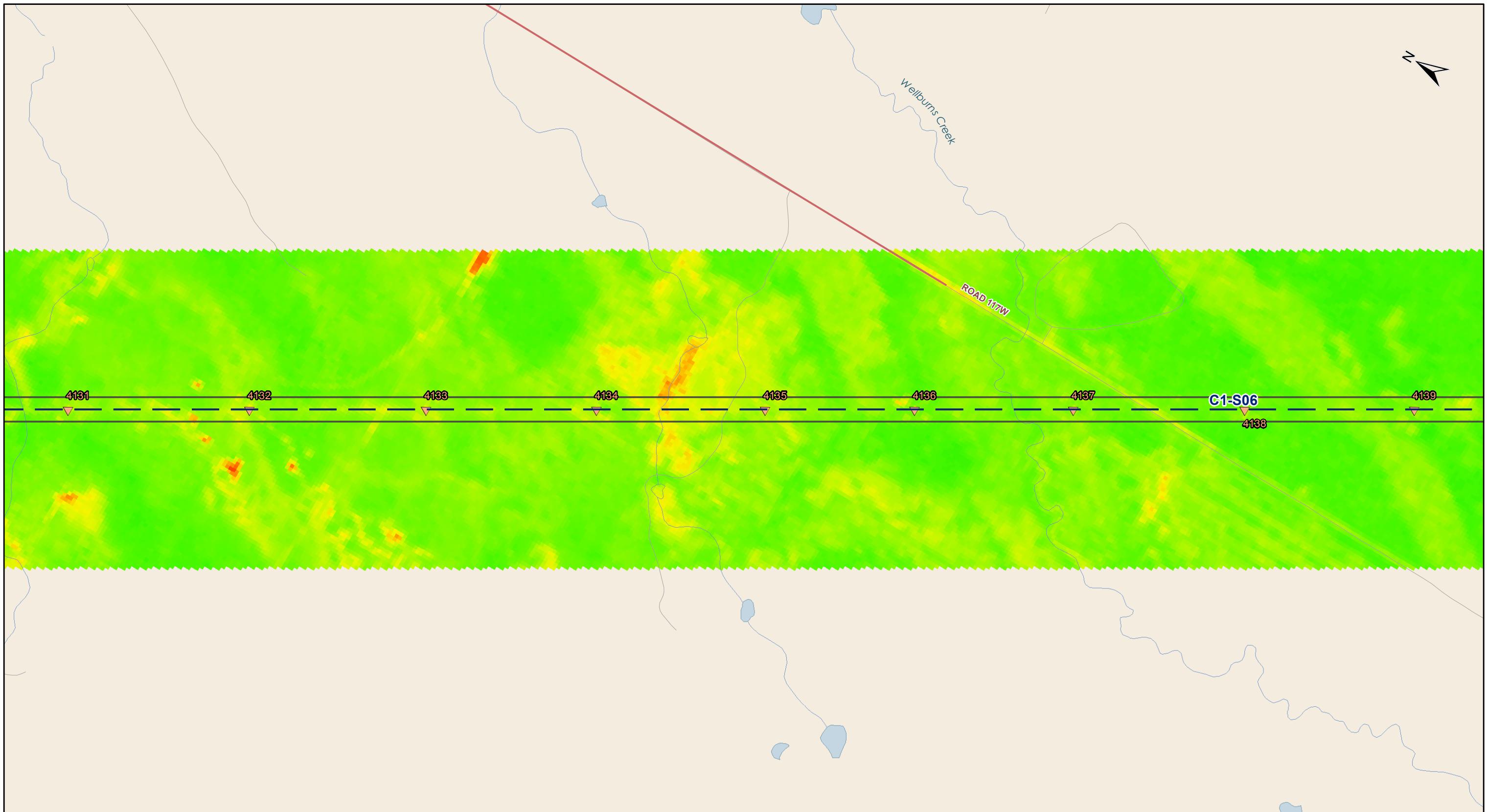
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

- Local Road
- Watercourse
- Waterbody

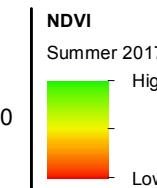
Bipole III Transmission Project
Section C1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure
Summer 2017

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

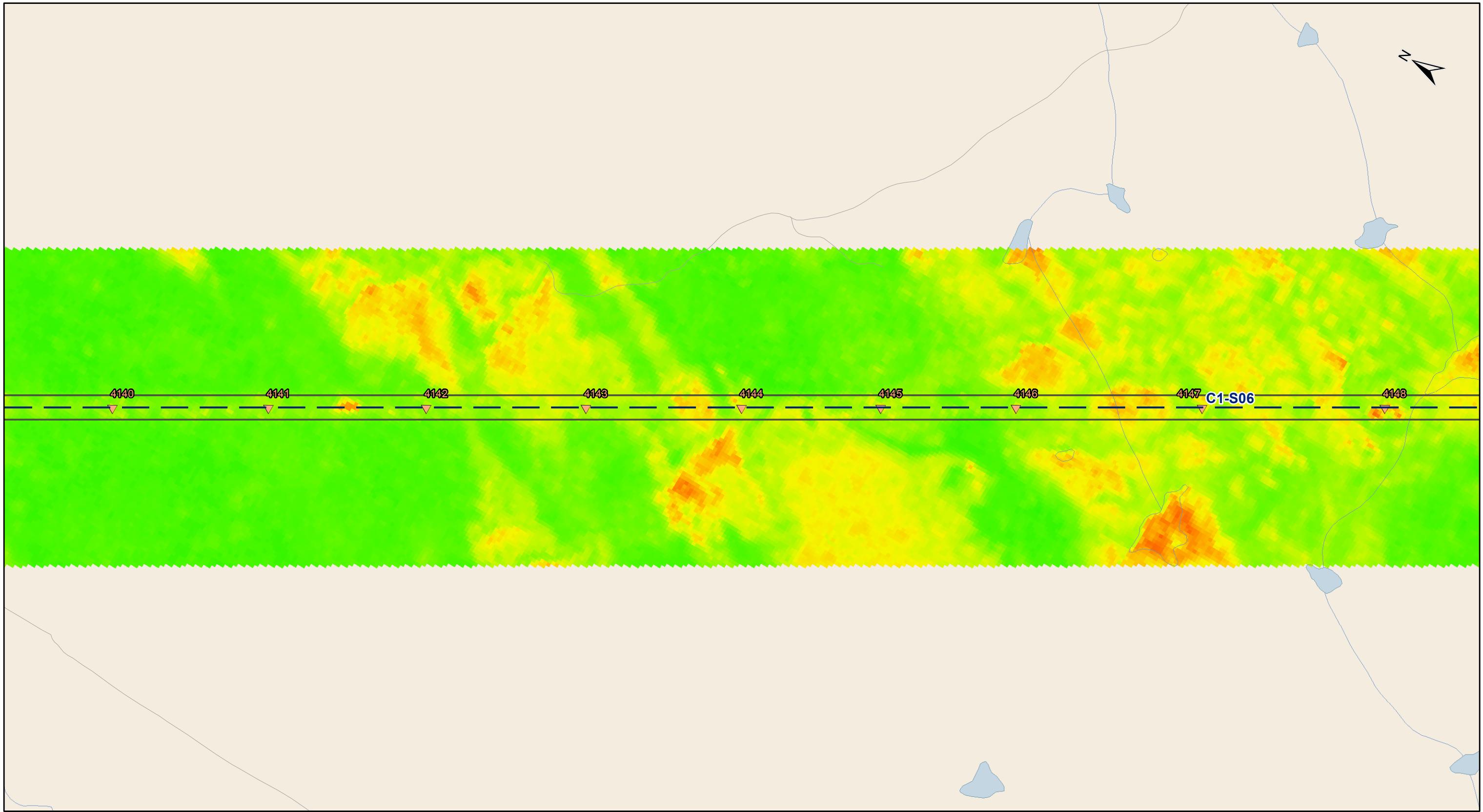
- Major Road
- Local Road
- Watercourse
- Waterbody

Bipole III Transmission Project

Section C1

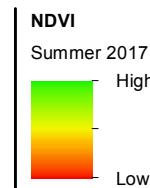
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure
Summer 2017

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

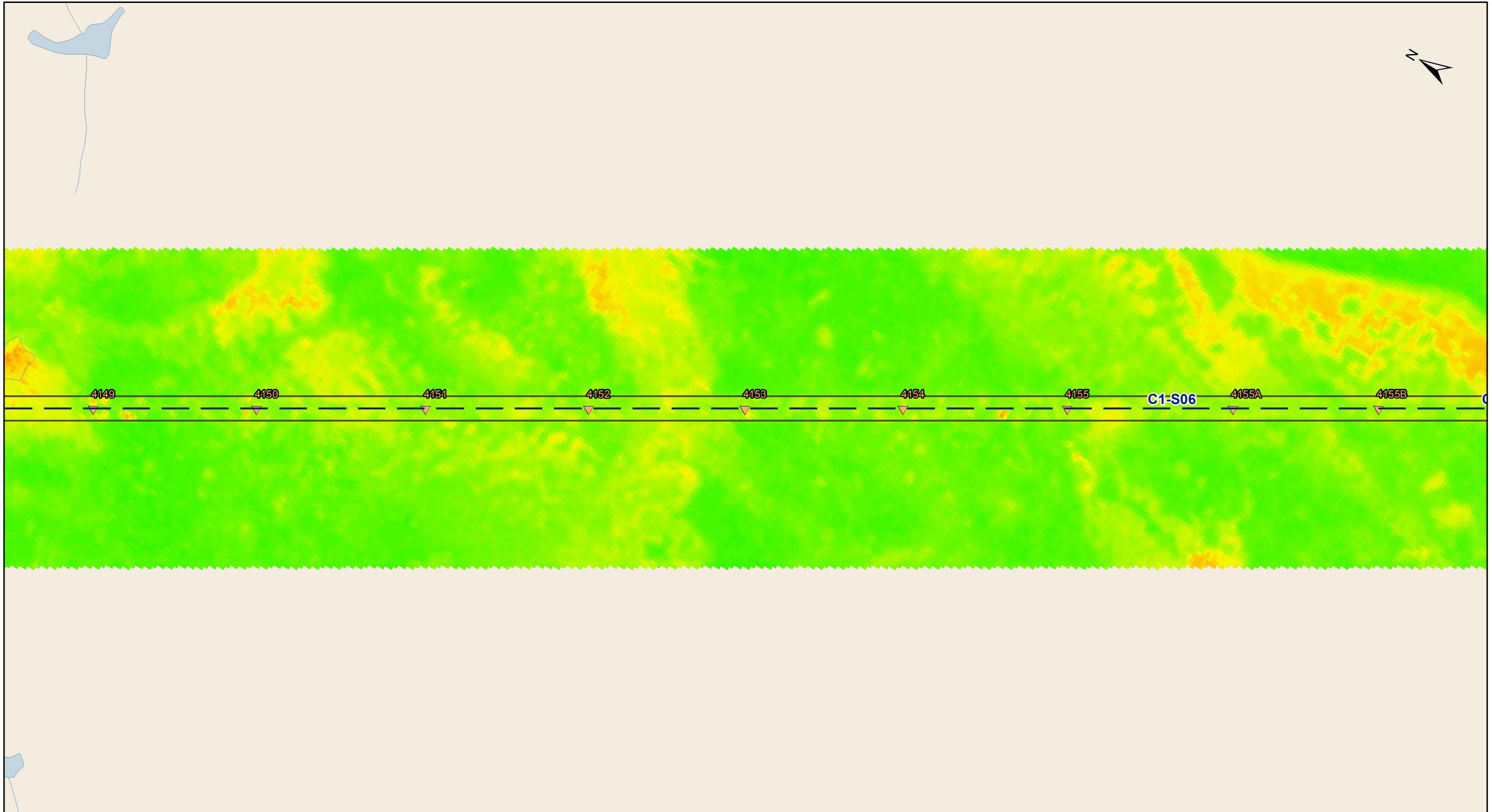
- Local Road
- Watercourse
- Waterbody

Bipole III Transmission Project

Section C1

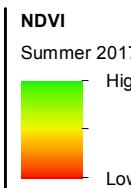
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure
BPIII Final Preferred Route
66m ROW
Towers (Preliminary)

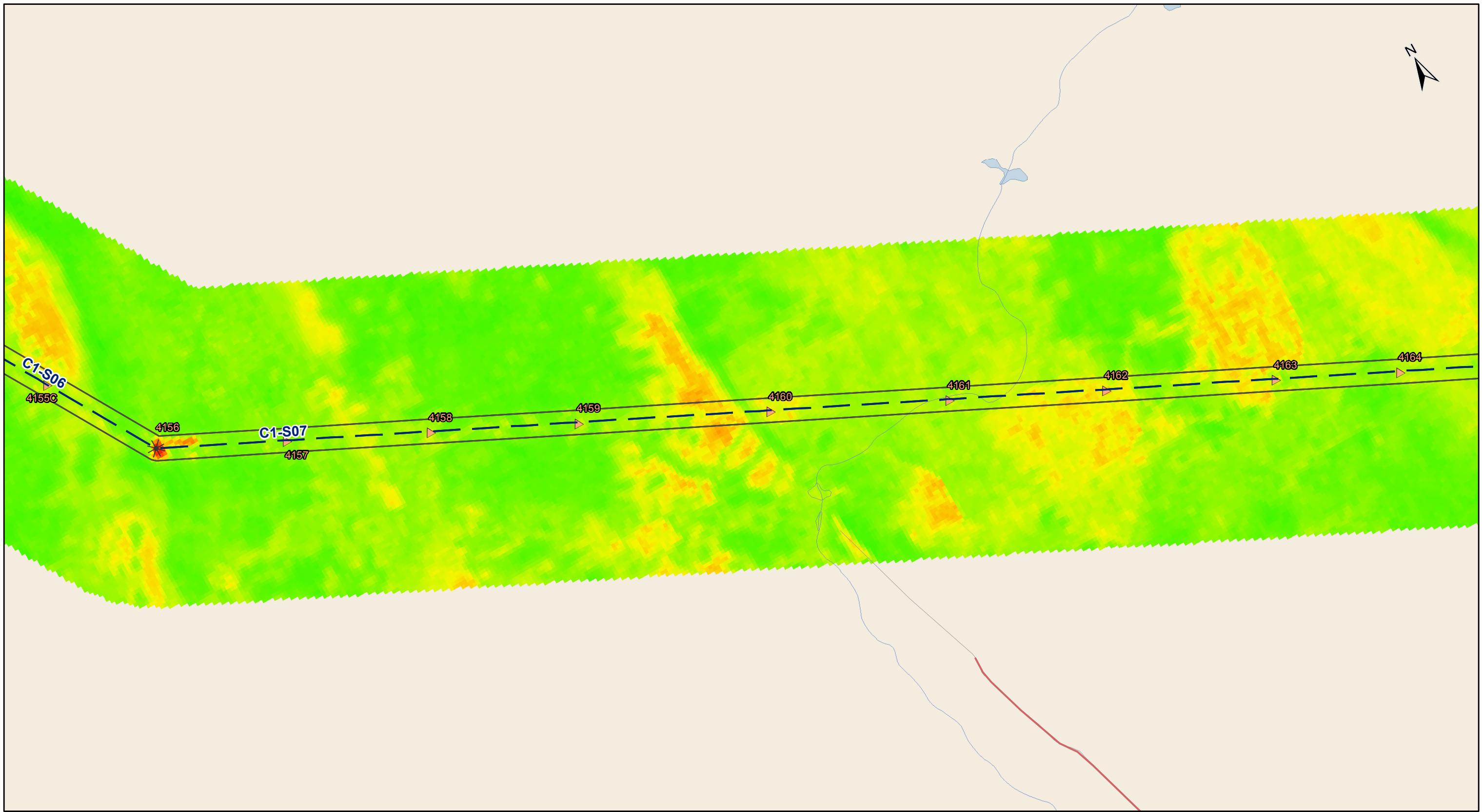
Landbase
Watercourse
Waterbody

Bipole III Transmission Project

Section C1

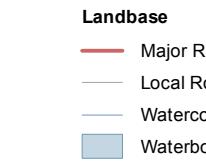
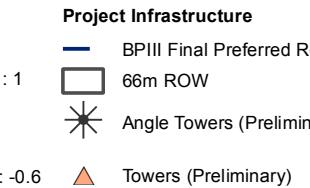
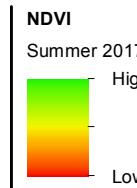
Normalized Difference Vegetation Index (NDVI) Summer 2017

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Date Created: November 05, 2017

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Metres
1:10,000



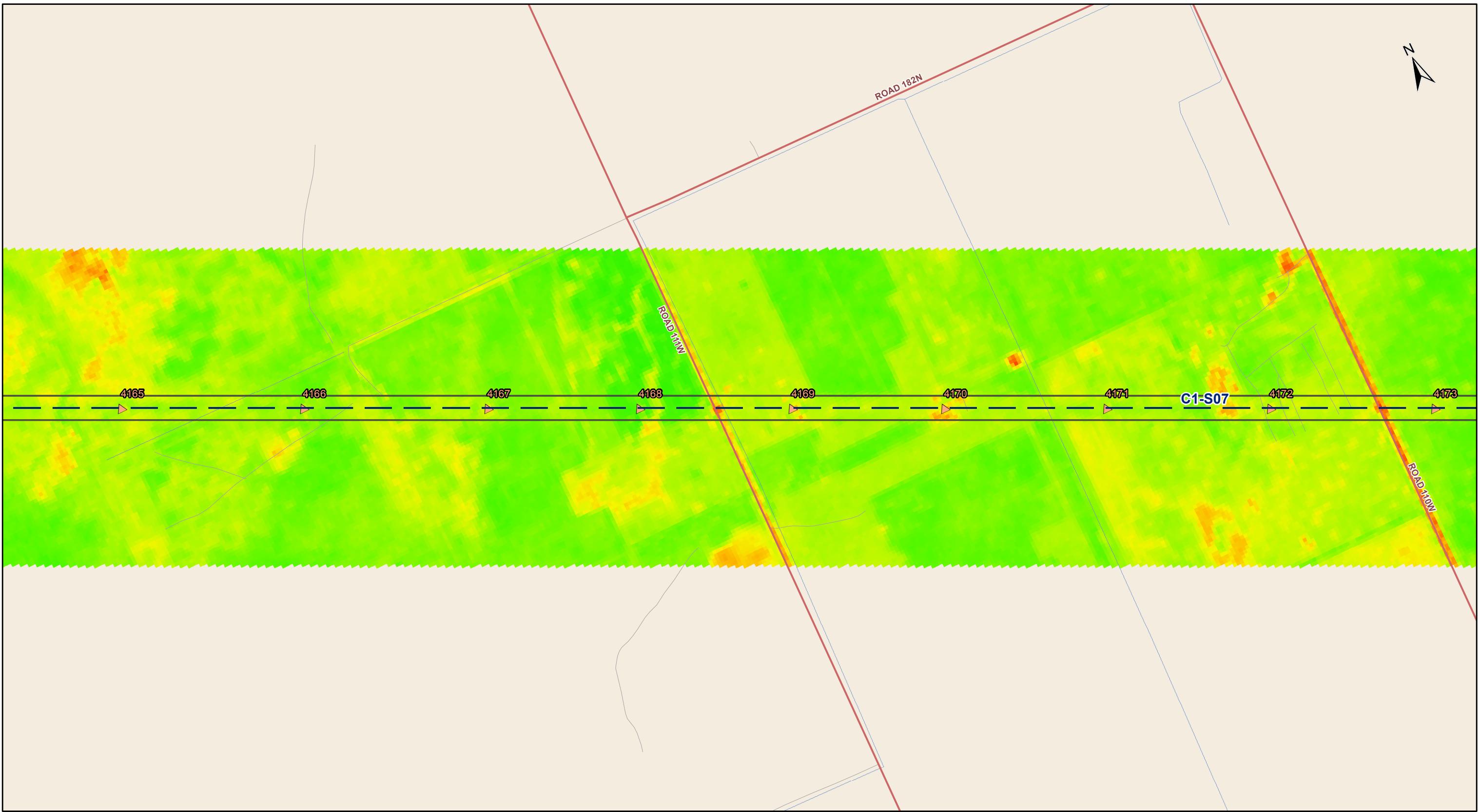
Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI)

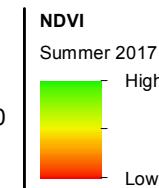
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

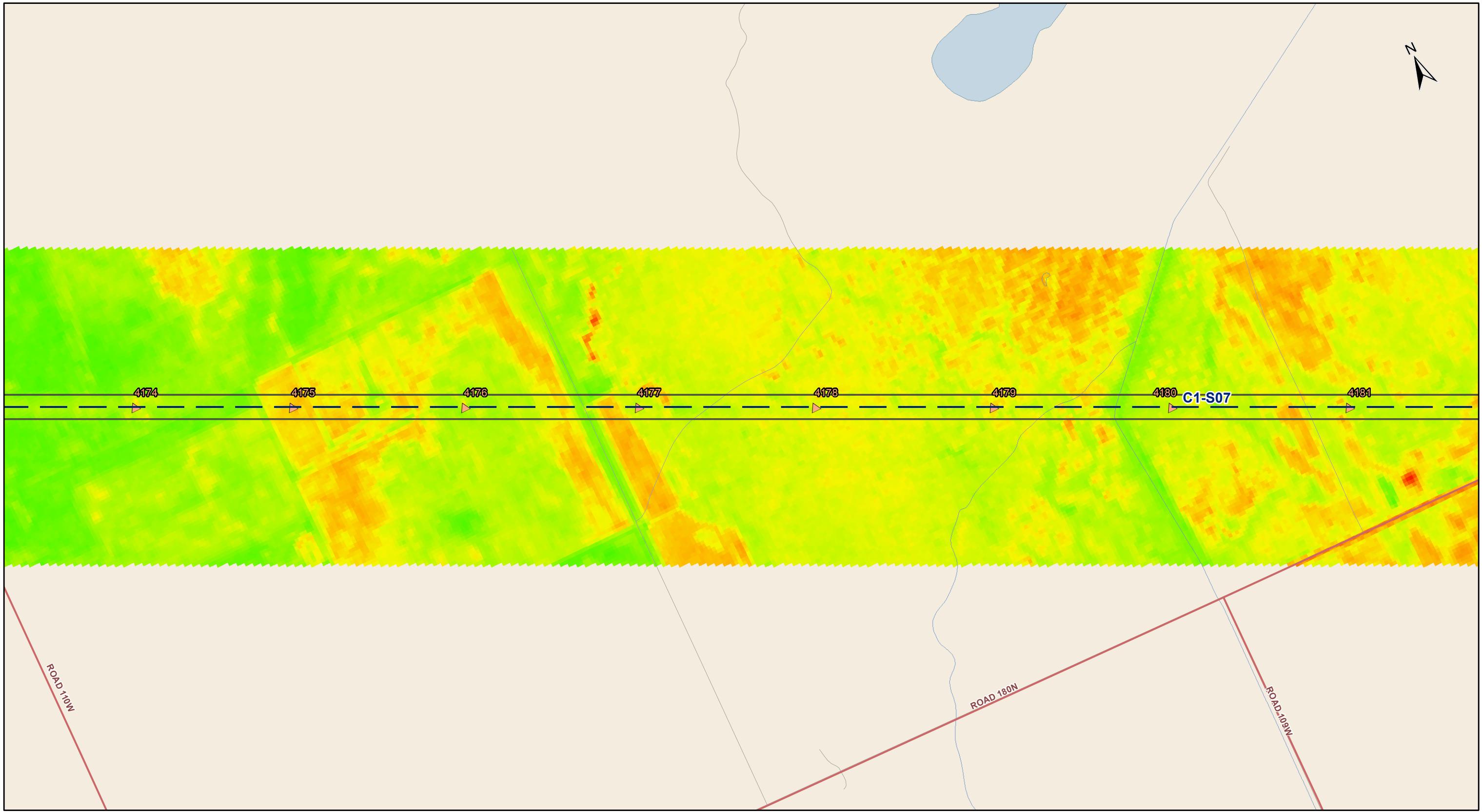
- Major Road
- Local Road
- Watercourse

Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI) Summer 2017

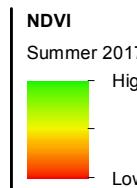
DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres

1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

- Major Road
- Local Road
- Watercourse
- Waterbody

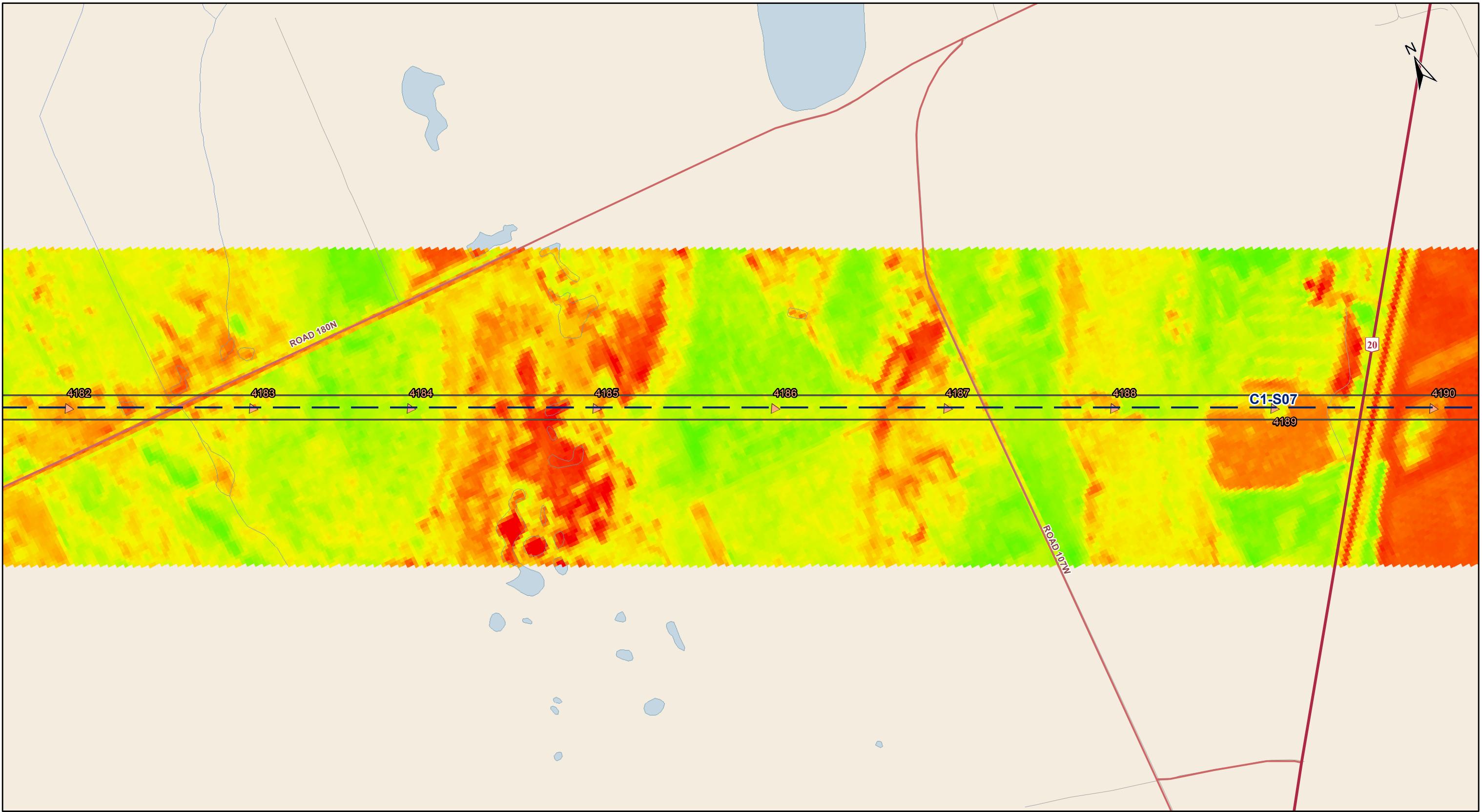
Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI)

Summer 2017

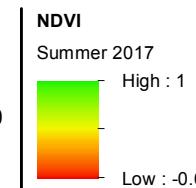
DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres

1:10,000



Project Infrastructure

- BP III Final Preferred Route
- 66m ROW
- Towers (Preliminary)

Landbase

- Highway
- Major Road
- Local Road
- Watercourse
- Waterbody

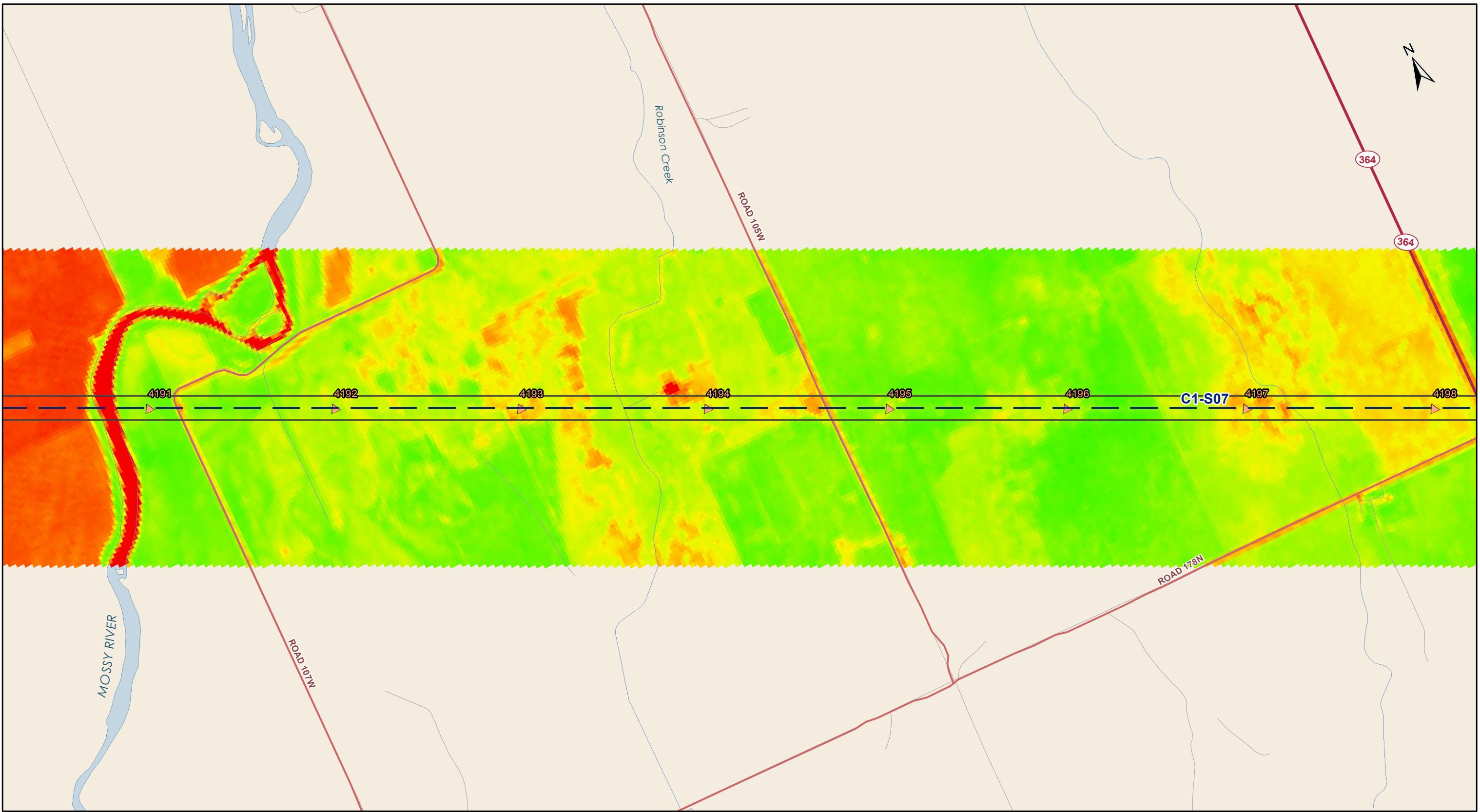
Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI)

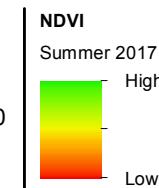
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN
Date Created: November 05, 2017

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Metres
1:10,000

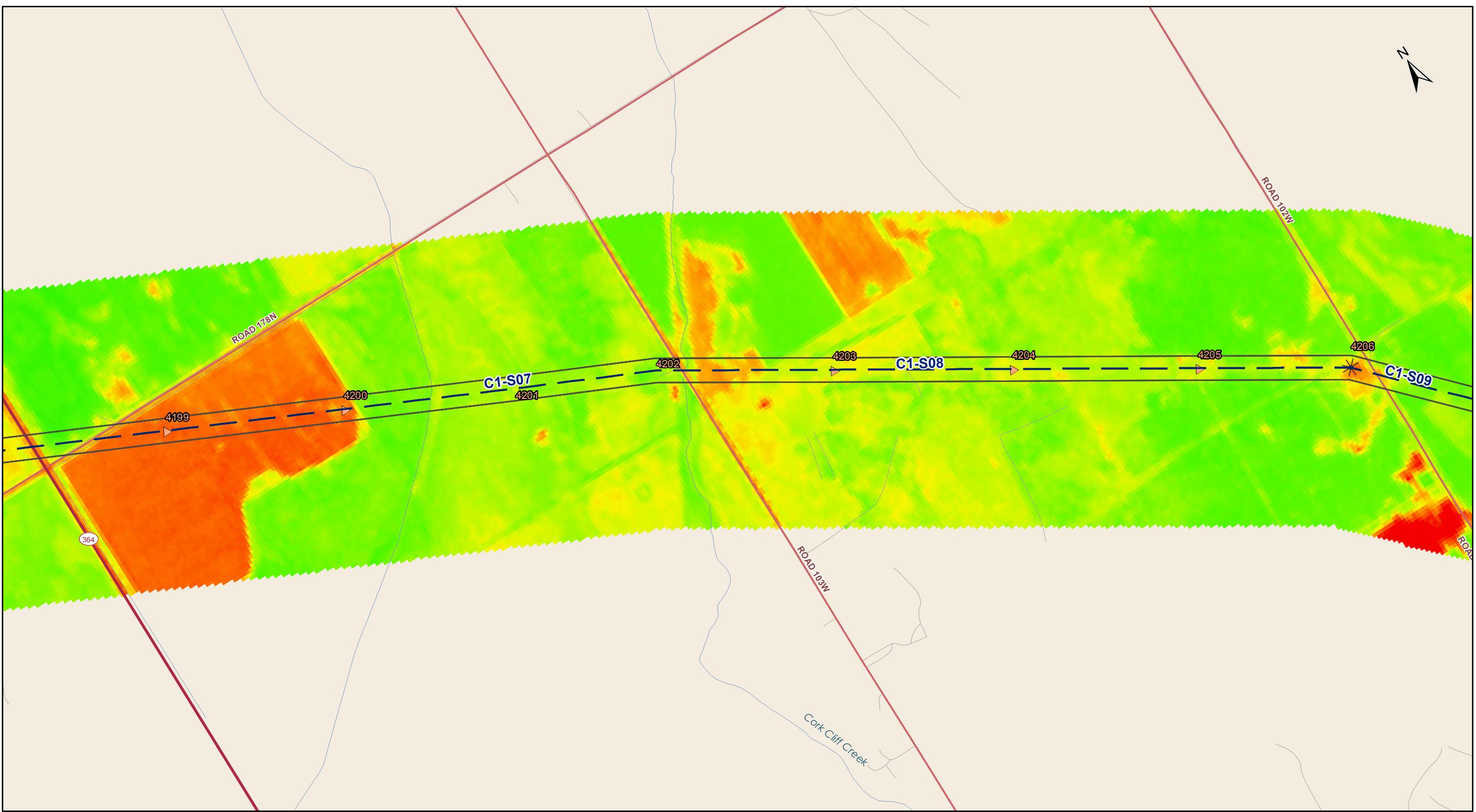


Project Infrastructure
BPIII Final Preferred Route
66m ROW
Towers (Preliminary)

Landbase
Highway
Major Road
Local Road
Watercourse
Waterbody

Bipole III Transmission Project
Section C1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres

1:10,000

NDVI

Summer 2017

High : 1

Low : -0.6

■

Project Infrastructure

BP III Final Preferred Route

66m ROW

Angle Towers (Preliminary)

Towers (Preliminary)

Landbase

Highway

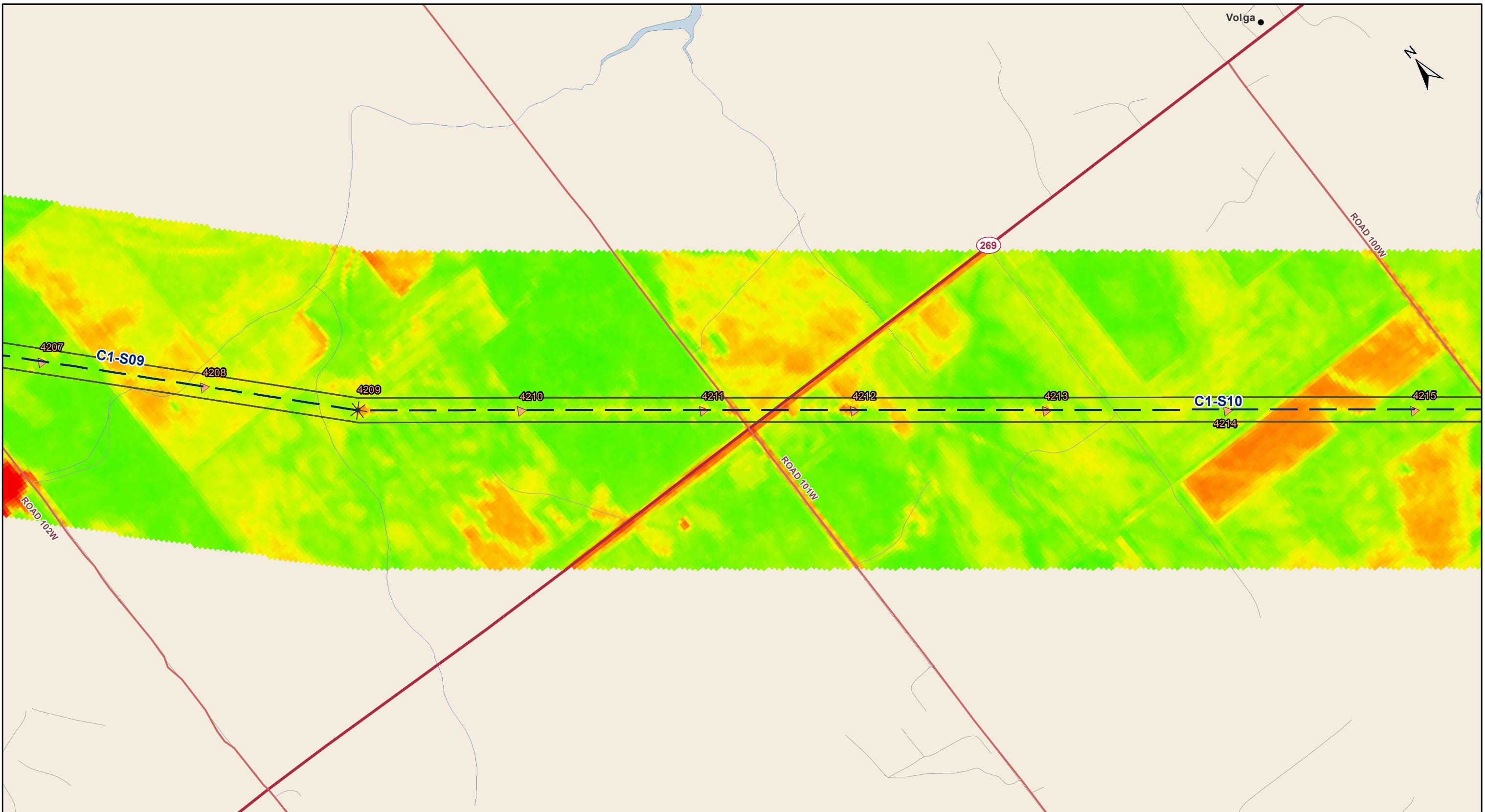
Major Road

Local Road

Watercourse

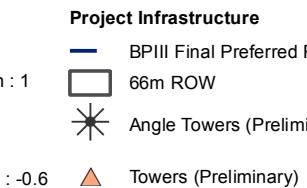
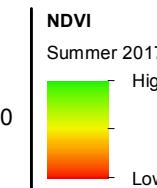
Bipole III Transmission Project
Section C1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



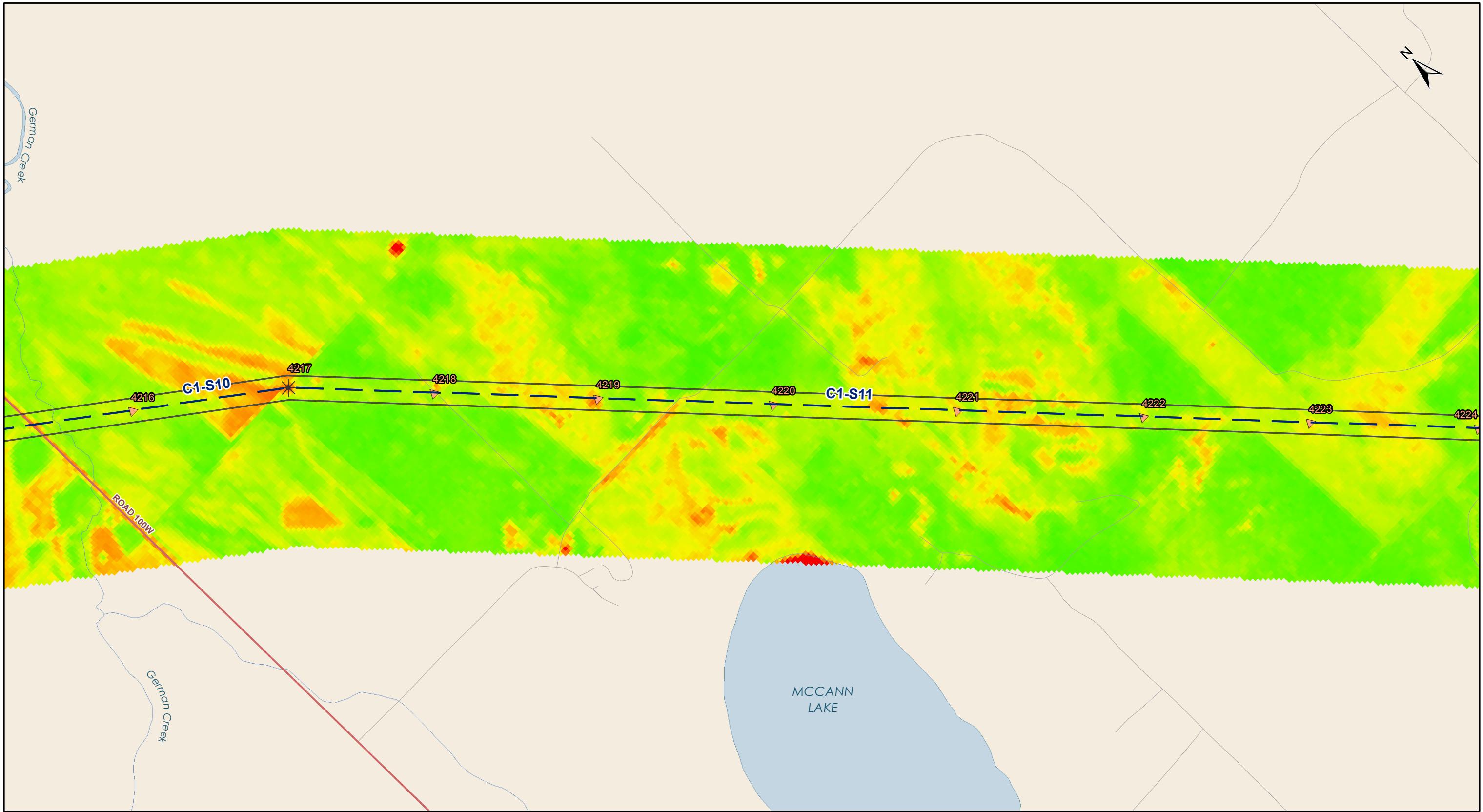
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Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



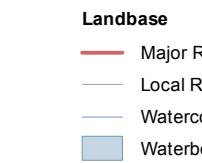
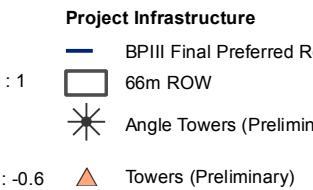
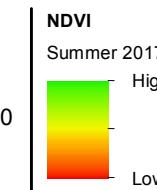
Bipole III Transmission Project
Section C1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



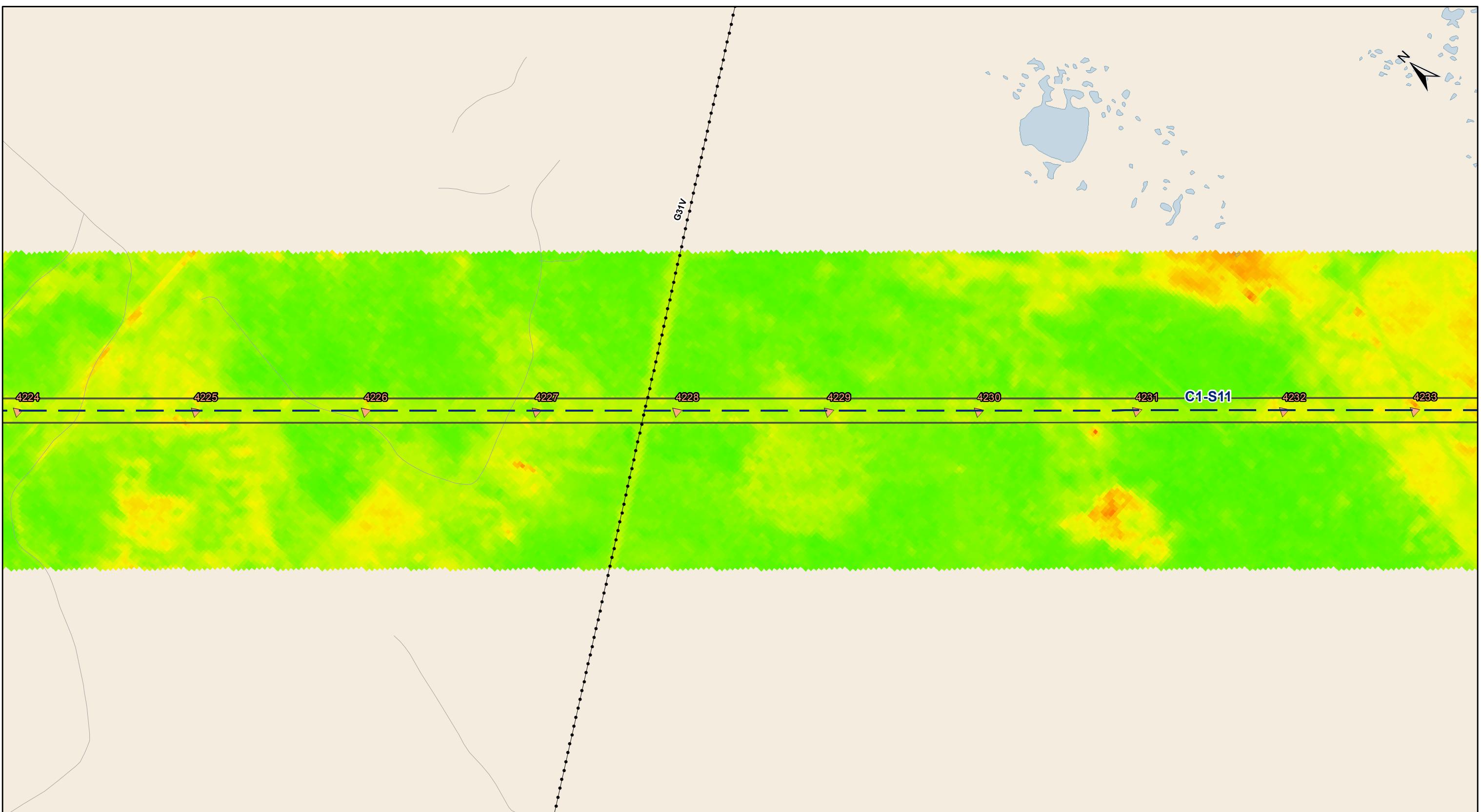
Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI)

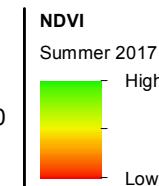
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

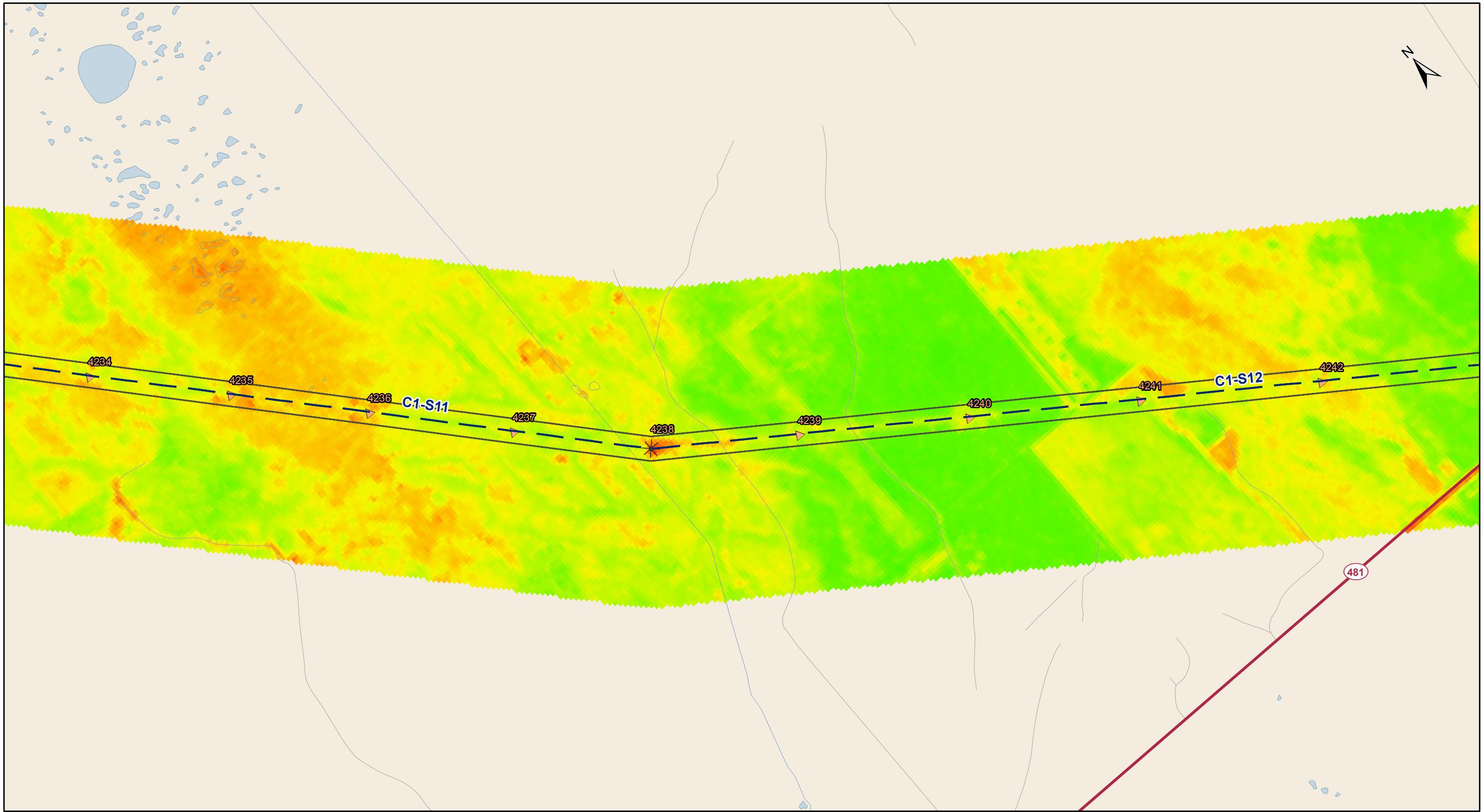
- Local Road
- Transmission Line
- Waterbody

Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres

1:10,000

NDVI
Summer 2017 High : 1

 Low : -0.6

Project Infrastructure

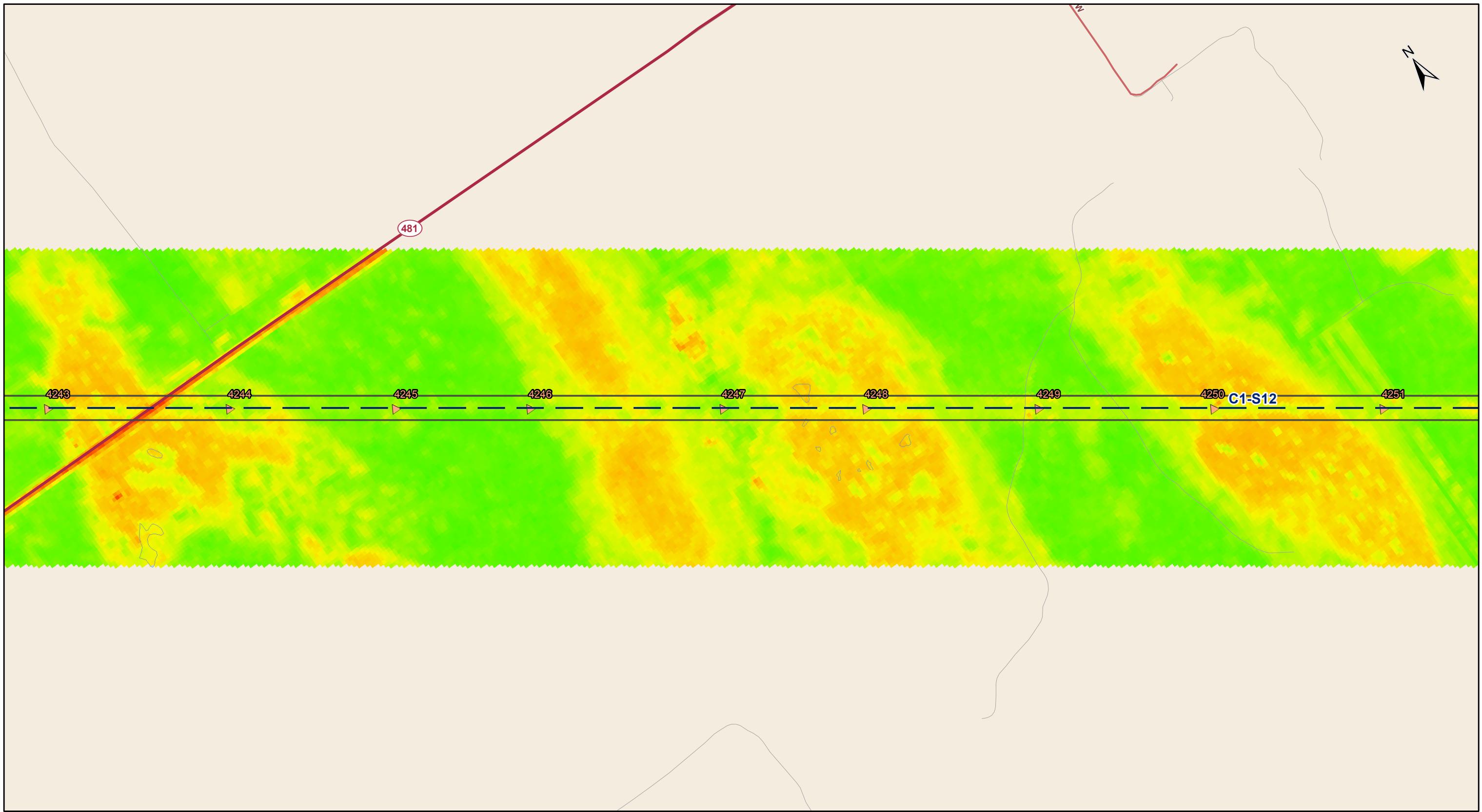
- BP III Final Preferred Route
- 66m ROW
- ★ Angle Towers (Preliminary)
- ▲ Towers (Preliminary)

Landbase

- Highway
- Local Road
- Watercourse
- Waterbody

Bipole III Transmission Project
Section C1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

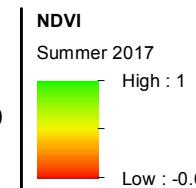
DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres

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Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

- Highway
- Major Road
- Local Road
- Waterbody

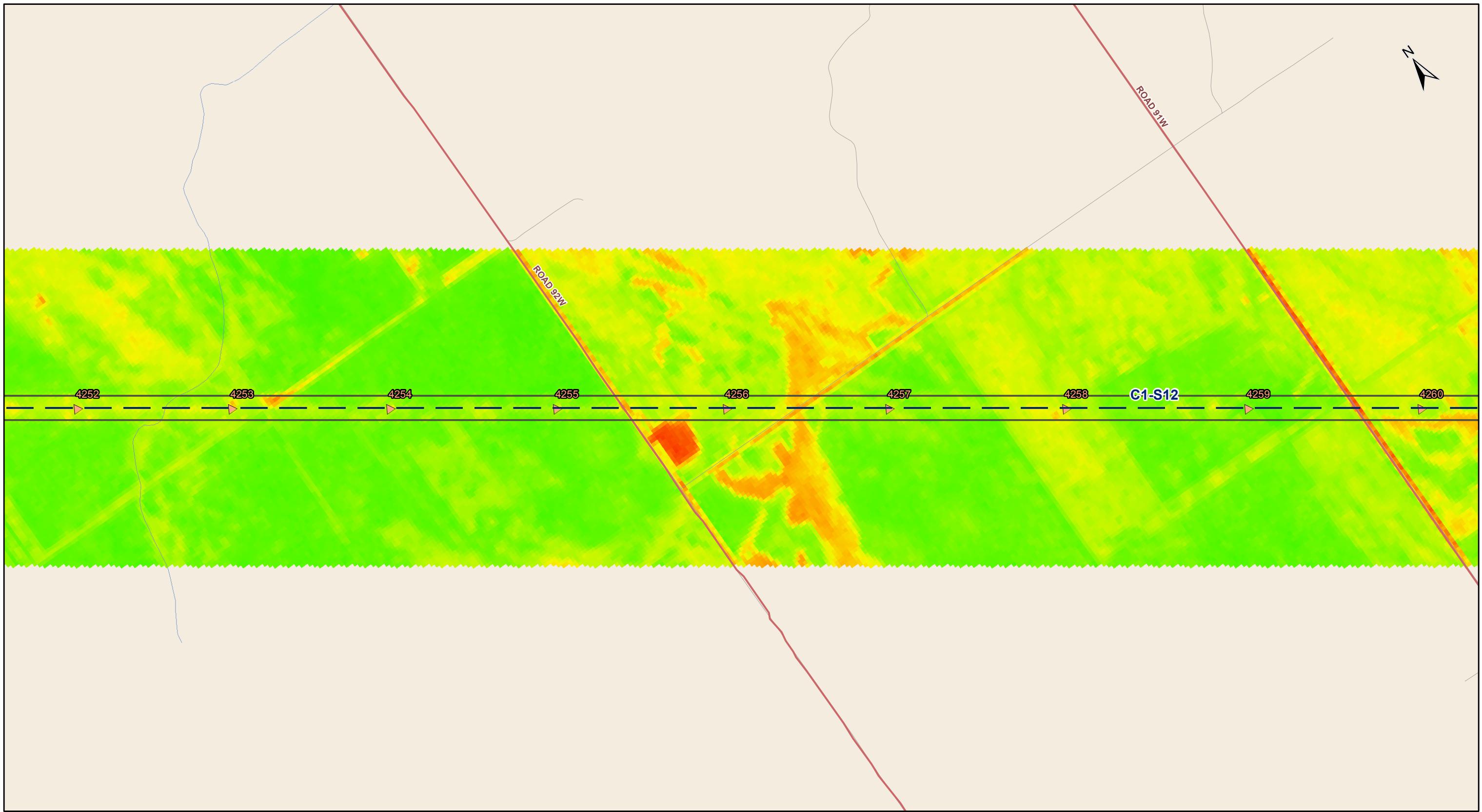
Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI)

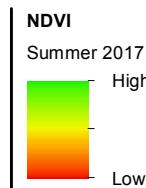
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure
Summer 2017

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

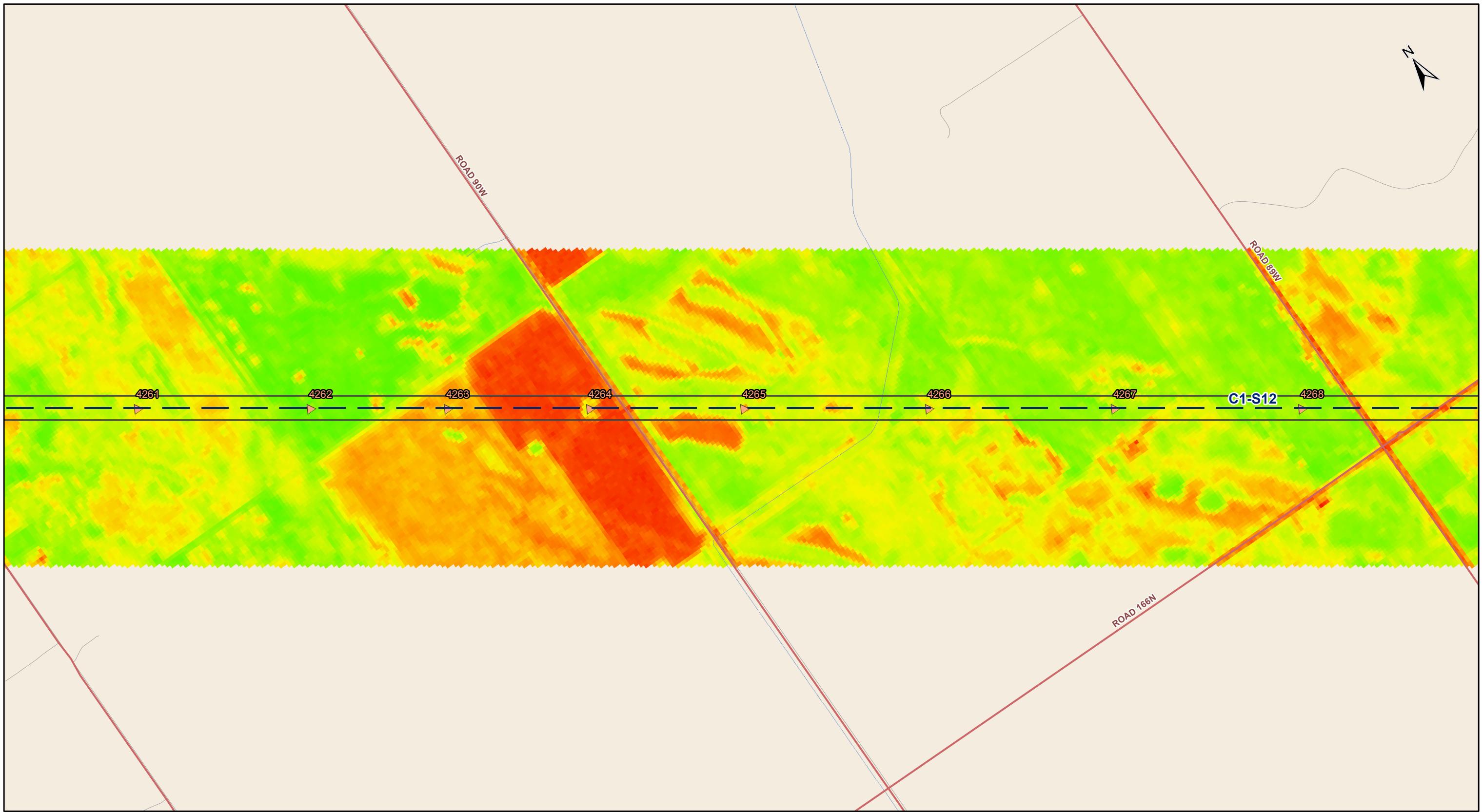
- Major Road
- Local Road
- Watercourse

Bipole III Transmission Project

Section C1

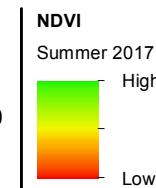
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure
Summer 2017

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

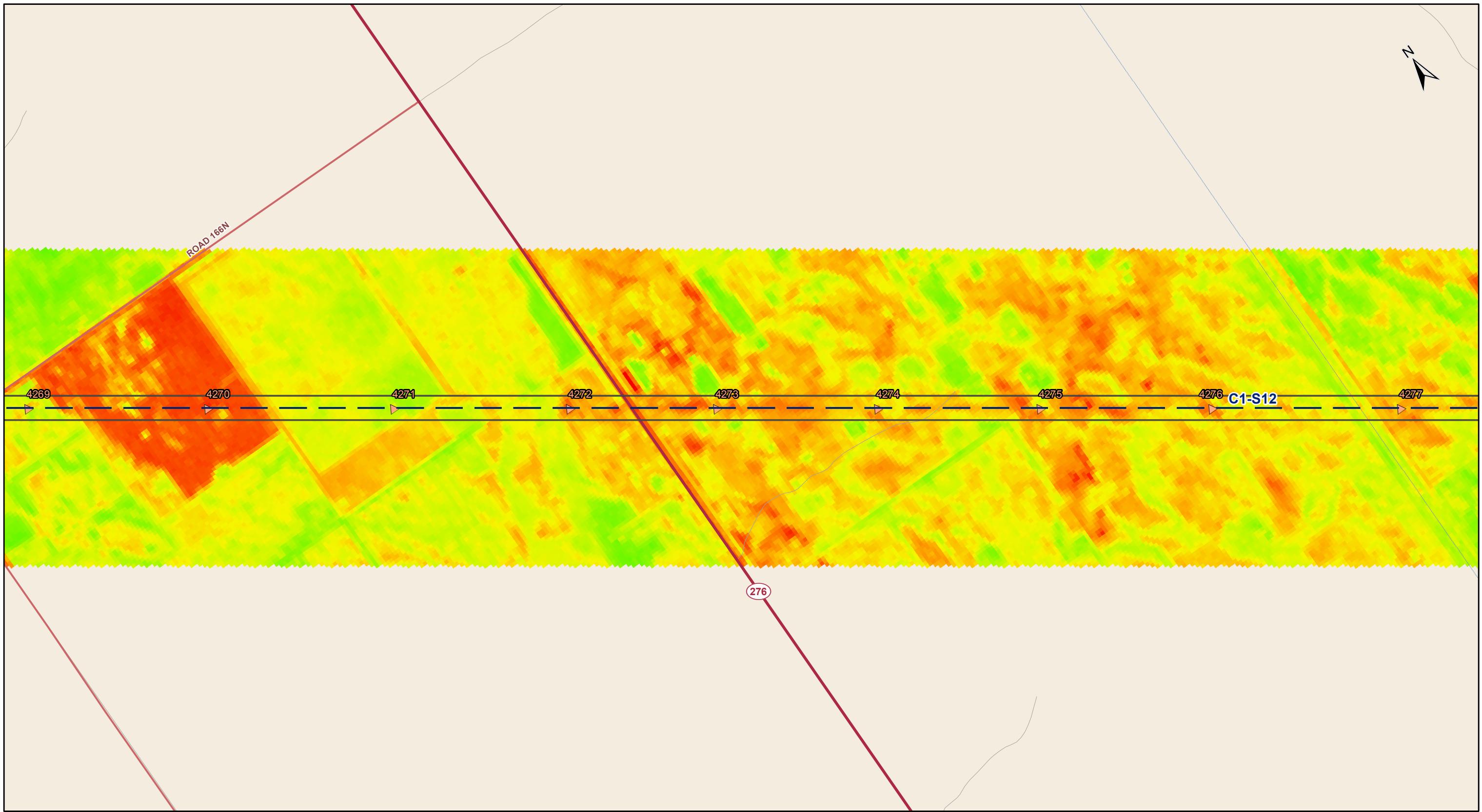
- Major Road
- Local Road
- Watercourse

Bipole III Transmission Project

Section C1

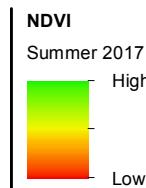
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure
Summer 2017

- BPII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

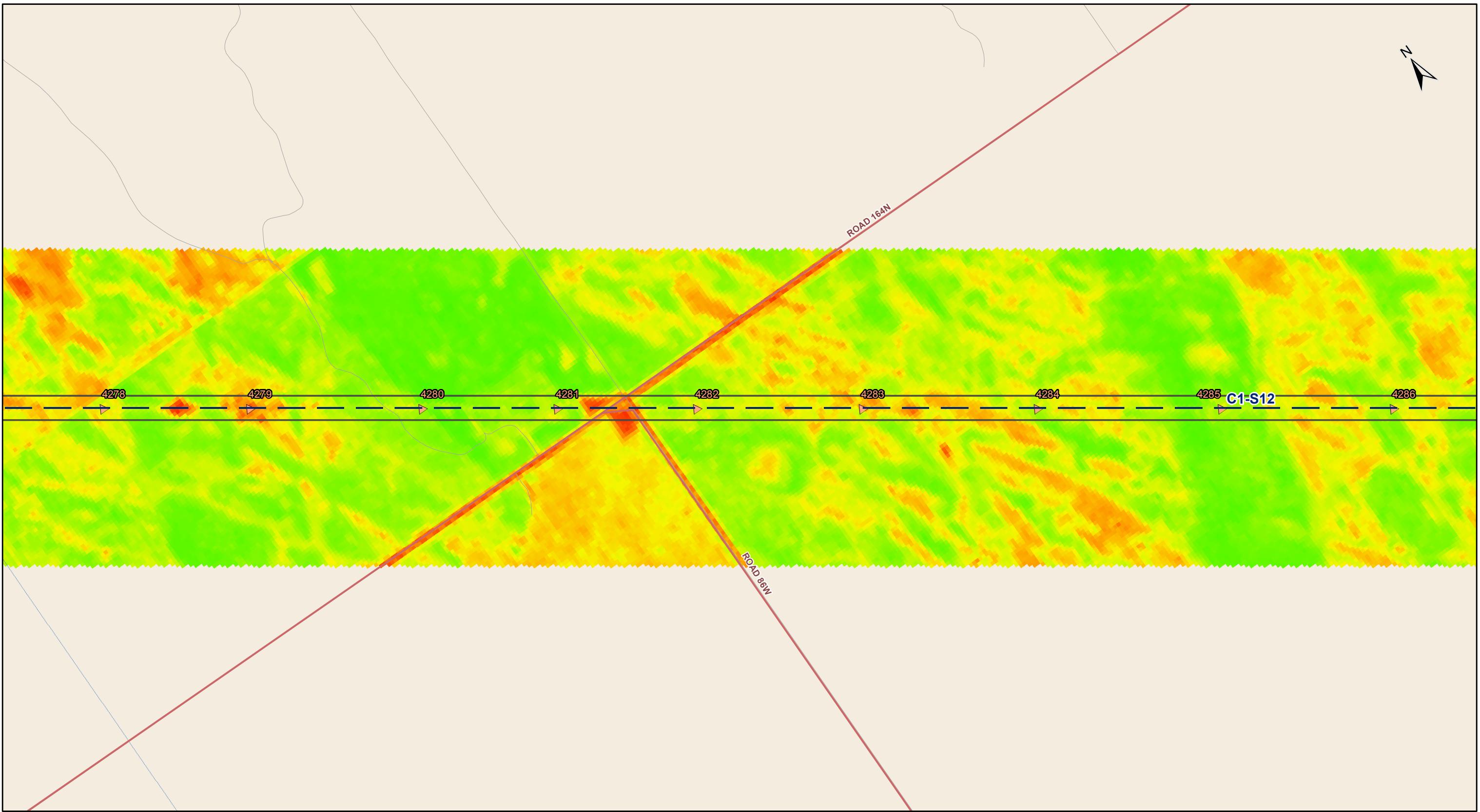
- Highway
- Major Road
- Local Road
- Watercourse

Bipole III Transmission Project

Section C1

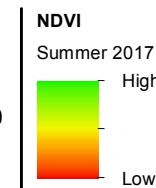
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure
Summer 2017

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

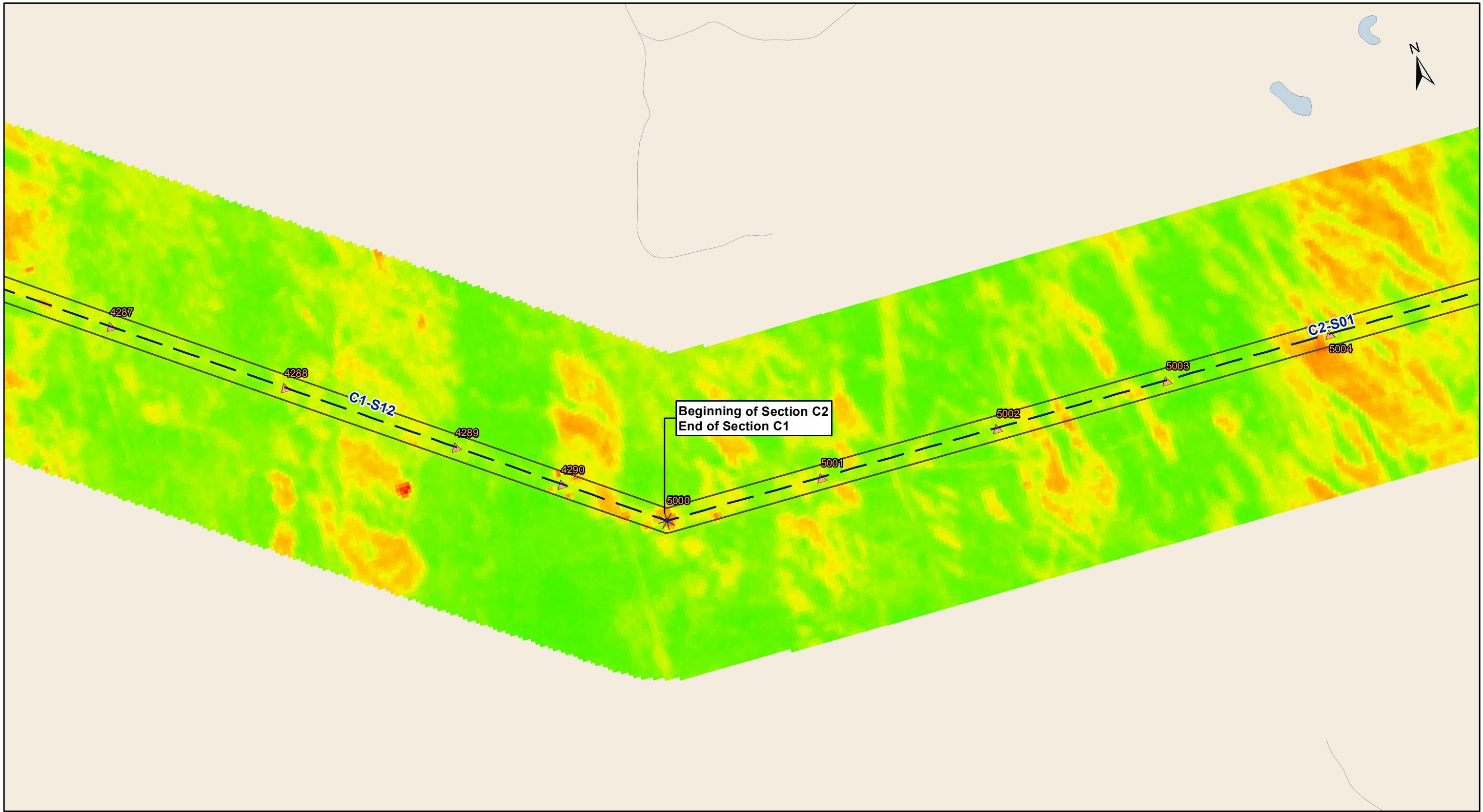
- Major Road
- Local Road
- Watercourse

Bipole III Transmission Project

Section C1

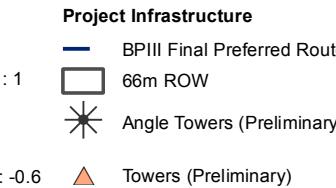
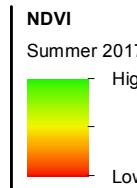
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCan
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



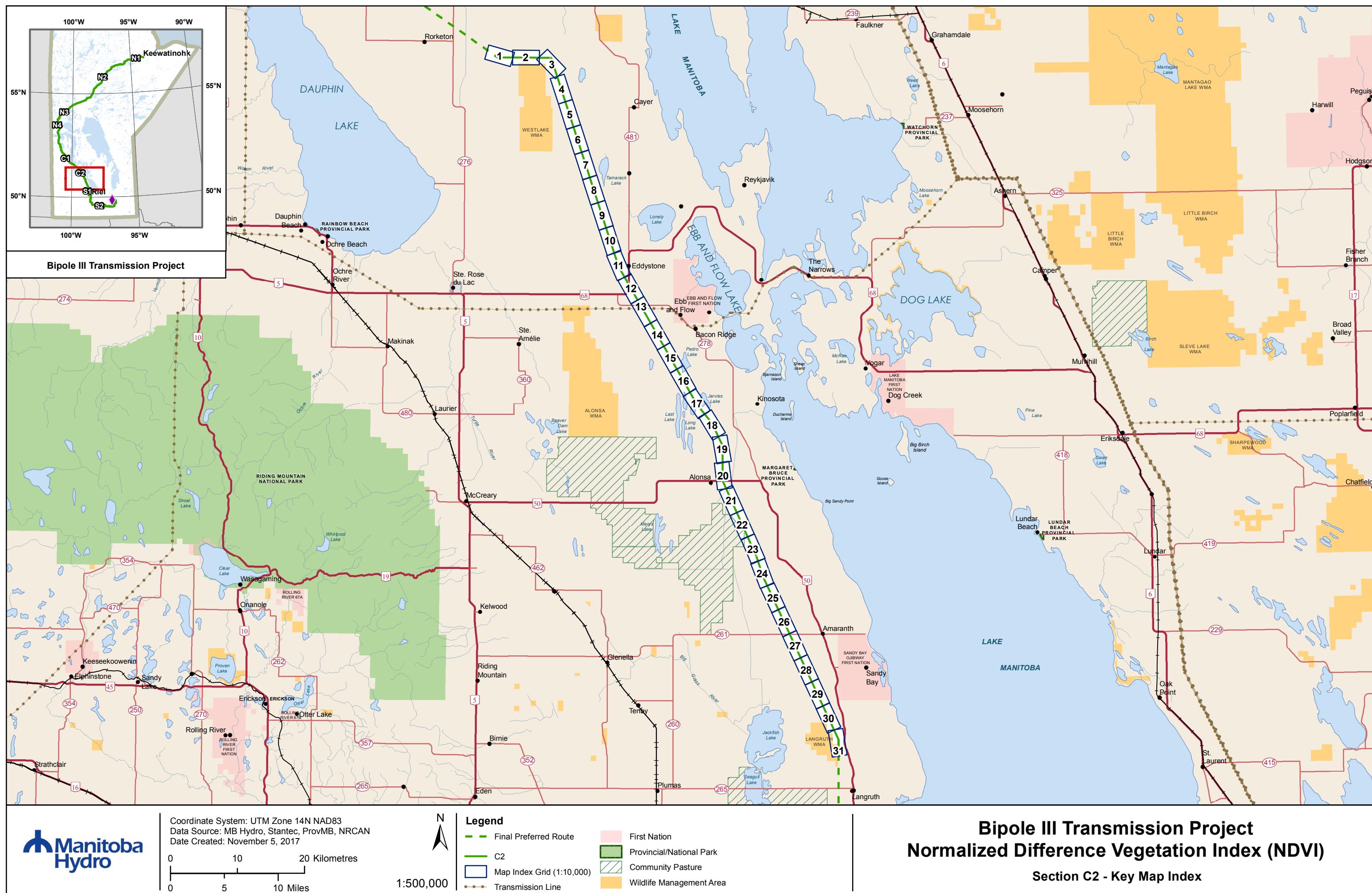
Bipole III Transmission Project

Section C1

Normalized Difference Vegetation Index (NDVI)

Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, Stantec, ProvMB, NRCAN
Date Created: November 5, 2017

0 10 20 Kilometres
0 5 10 Miles
1:500,000

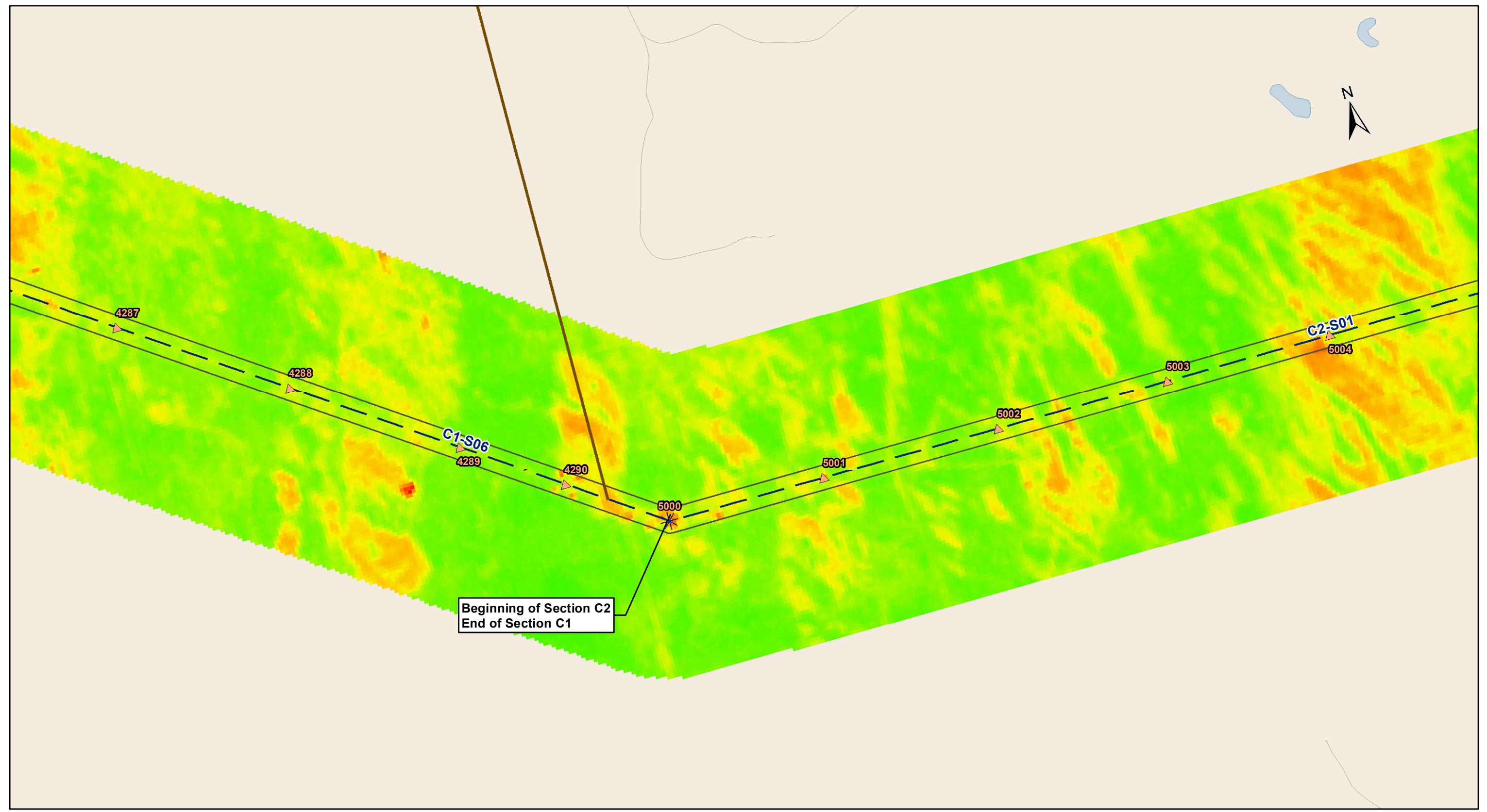
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Legend

- Final Preferred Route
- C2
- Map Index Grid (1:10,000)
- Transmission Line
- First Nation
- Provincial/National Park
- Community Pasture
- Wildlife Management Area

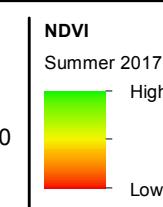
**Bipole III Transmission Project
Normalized Difference Vegetation Index (NDVI)
Section C2 - Key Map Index**



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres

1:10,000



Project Infrastructure
Summer 2017

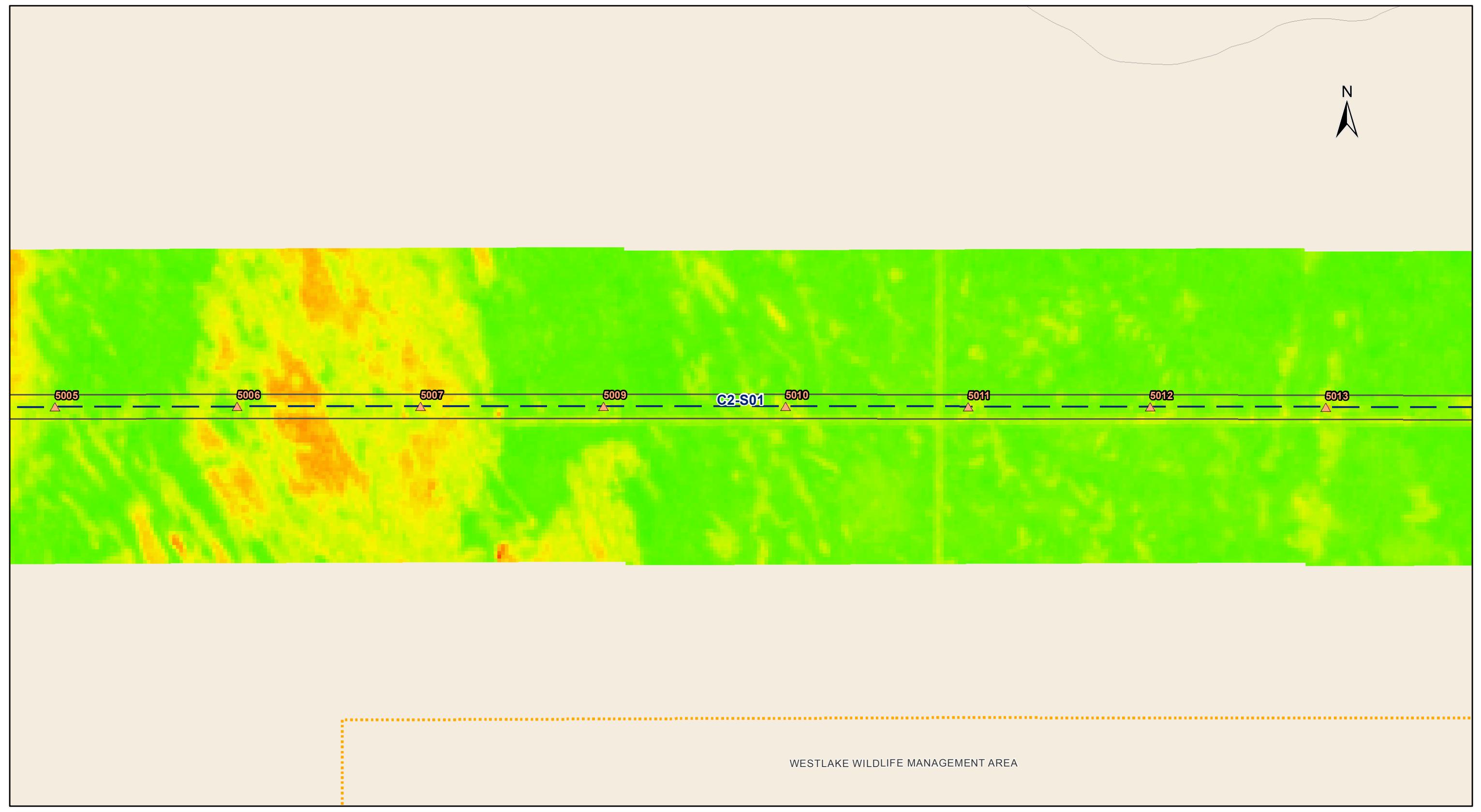
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Towers (Preliminary)
- Proposed Access Route

Landbase

- Local Road / Cart Track
- Waterbodies

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

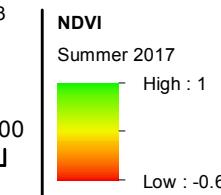
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Coordinate System: UTM Zone 14N NAD83
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Date Created: November 05, 2017

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Metres

1:10,000



Project Infrastructure

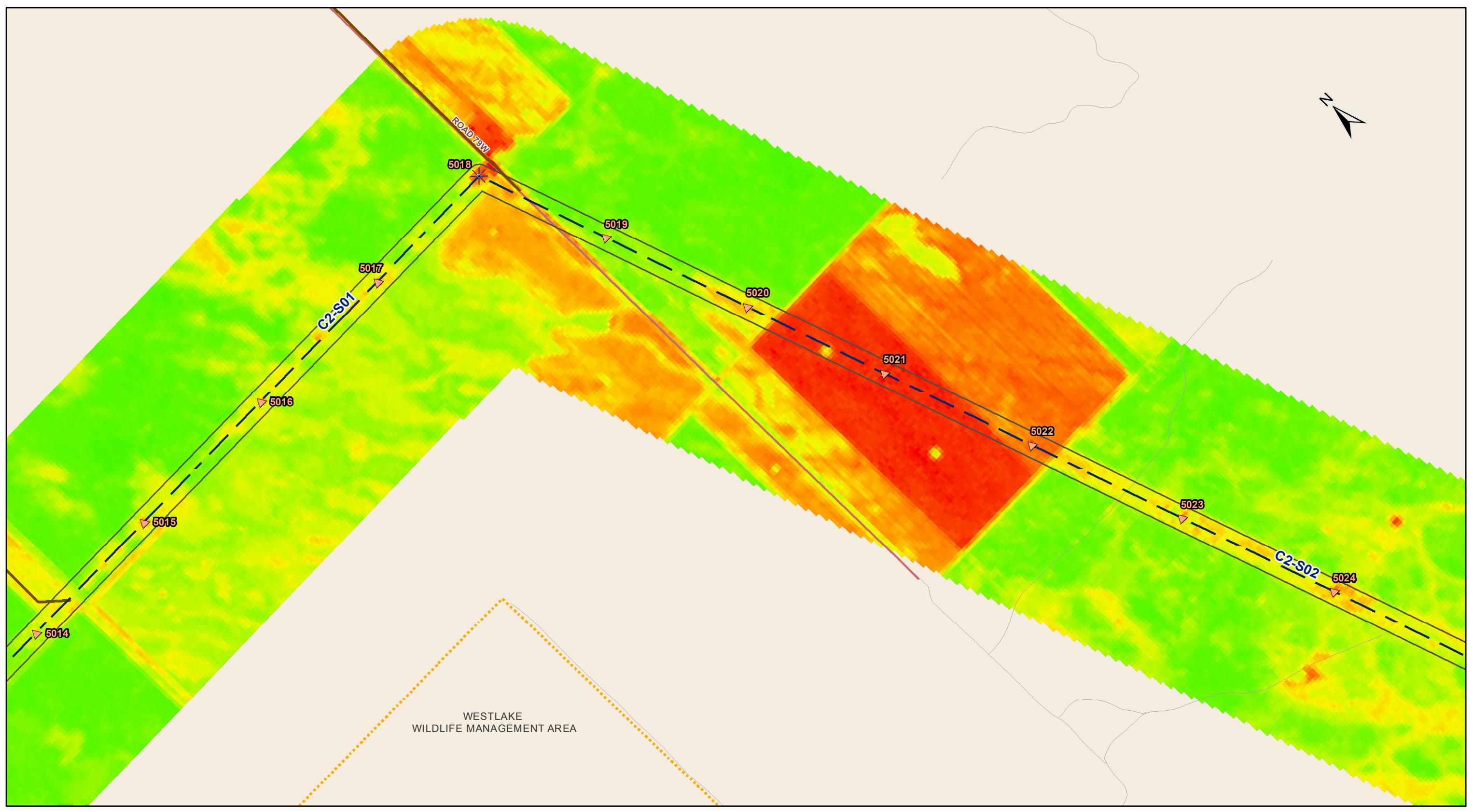
- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)

Landbase

- Local Road / Cart Track
- Wildlife Management Area

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres
1:10,000

NDVI

Summer 2017

High : 1
Low : -0.6

Project Infrastructure

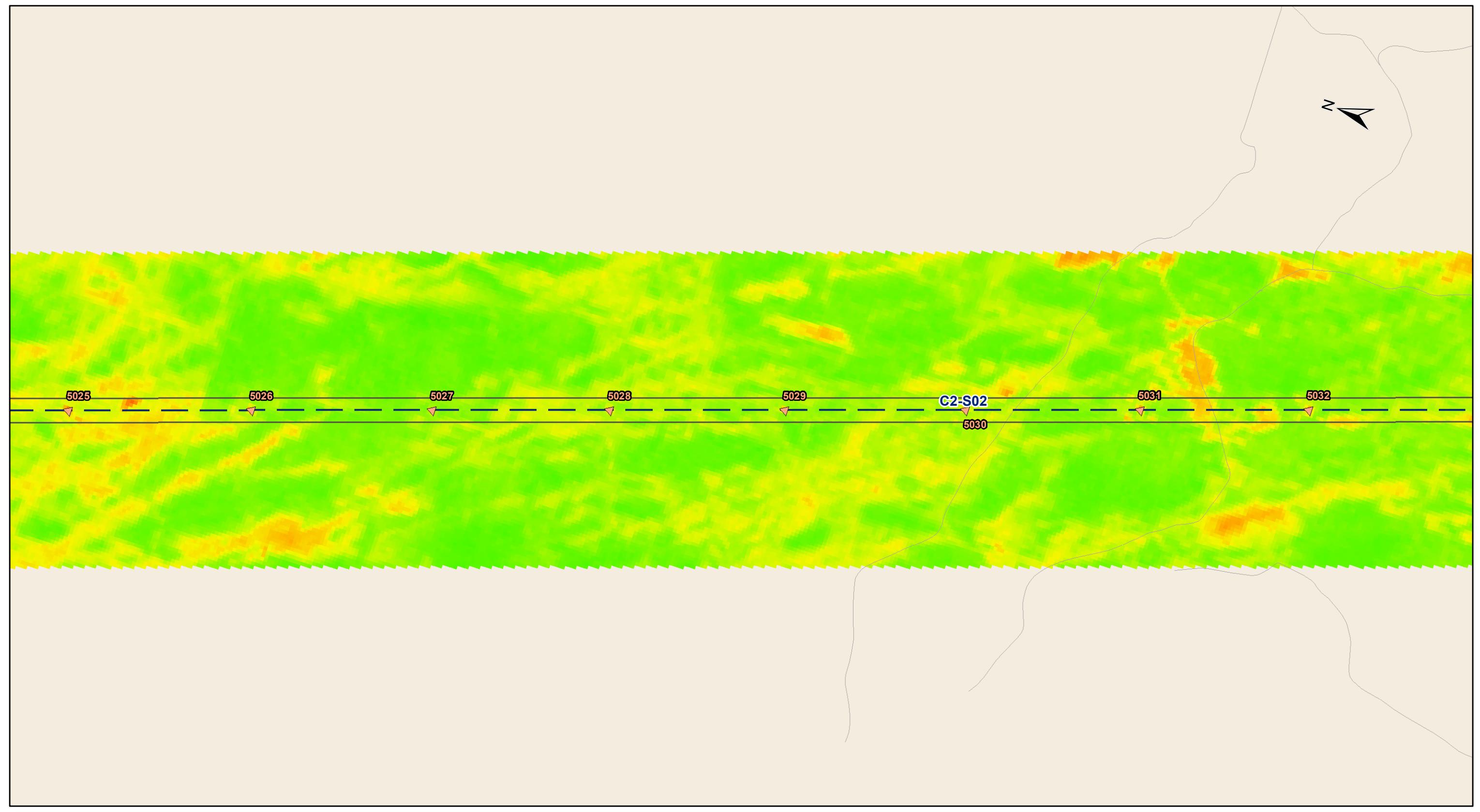
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- Proposed Access Route

Landbase

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- Local Road / Cart Track
- Wildlife Management Area

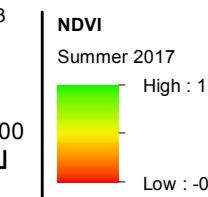
Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
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Date Created: November 05, 2017

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Metres
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Project Infrastructure
Summer 2017

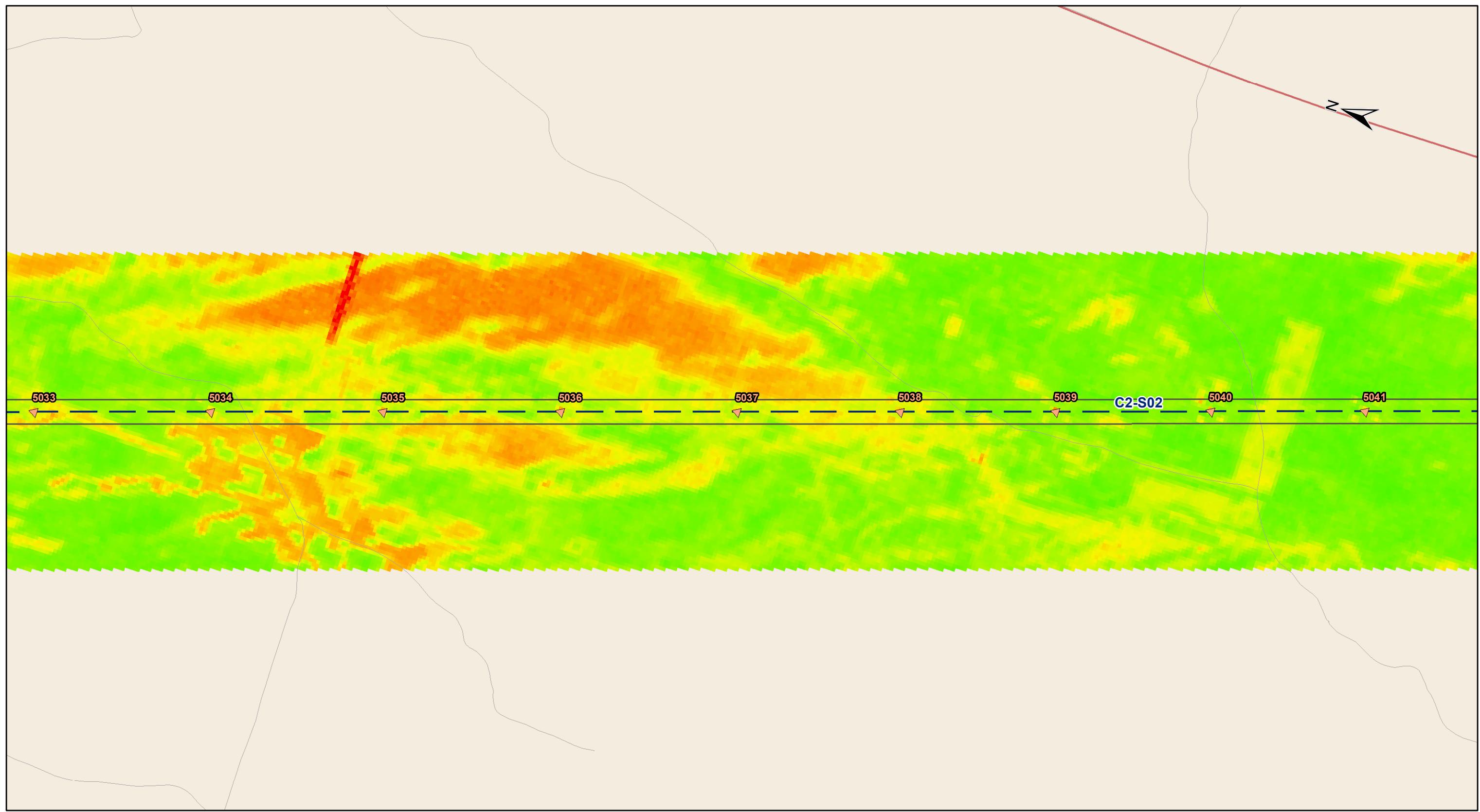
- BPIII Final Preferred Route
- 66m ROW
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Landbase

- Local Road / Cart Track

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

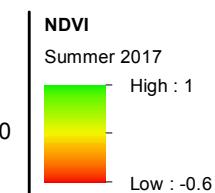
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Project Infrastructure
Summer 2017

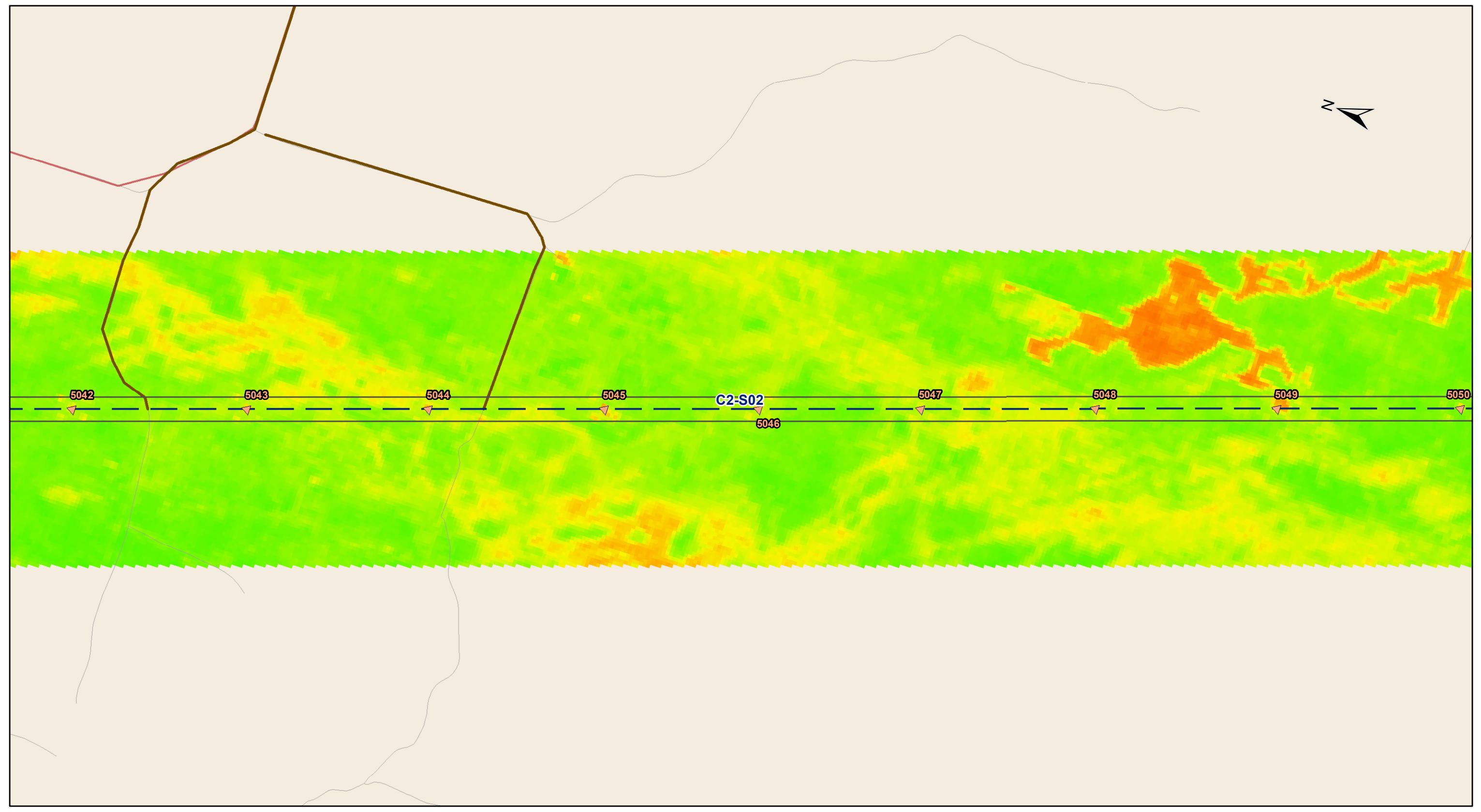
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Landbase

- Major Road
- Local Road / Cart Track
- Waterbodies

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

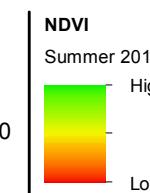
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Date Created: November 05, 2017

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Project Infrastructure
Summer 2017

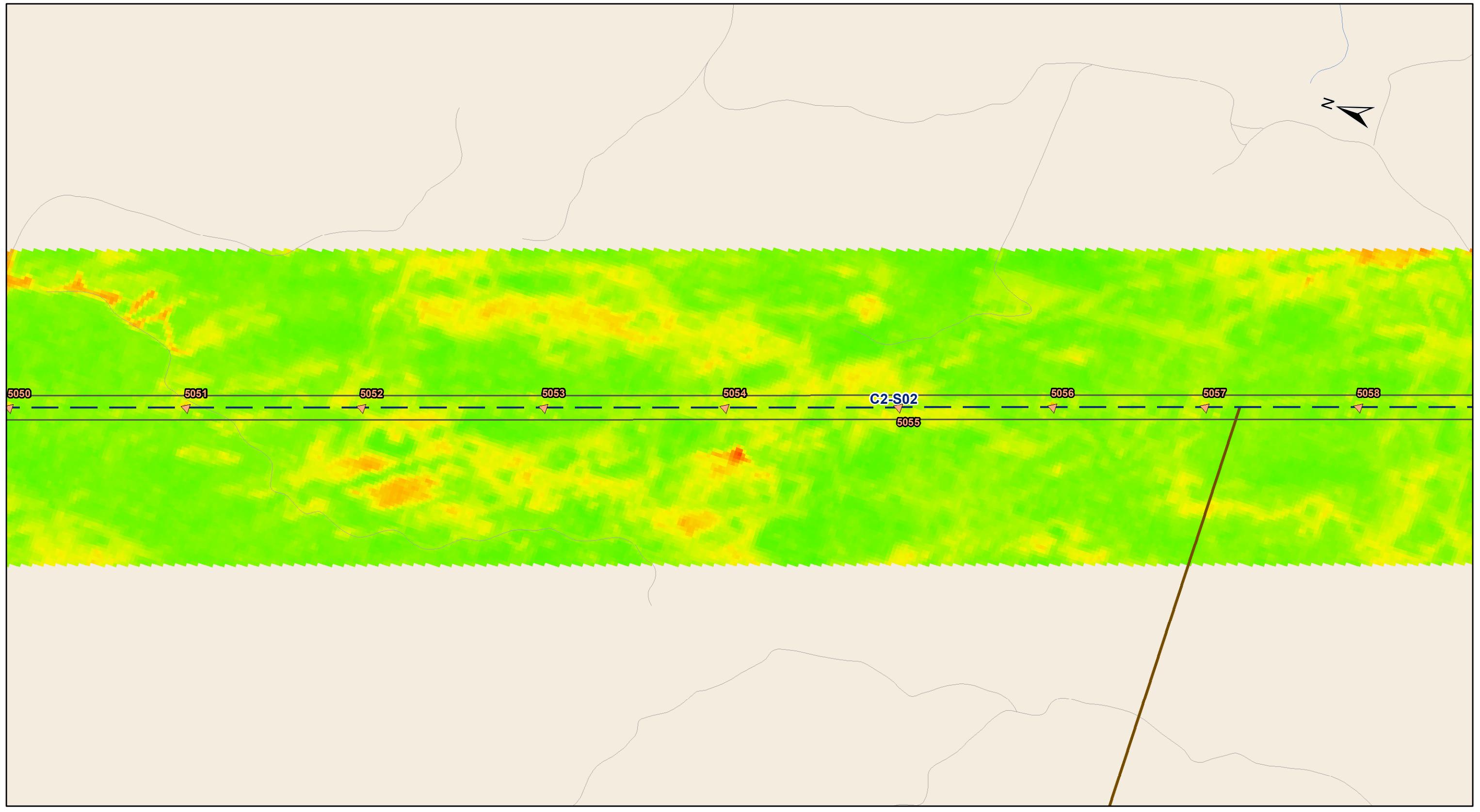
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- Proposed Access Route

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- Local Road / Cart Track

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

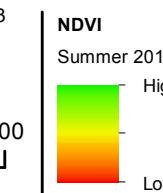
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Coordinate System: UTM Zone 14N NAD83
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Stantec Consulting
Date Created: November 05, 2017

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Metres

1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

Landbase

- Local Road / Cart Track
- Watercourse

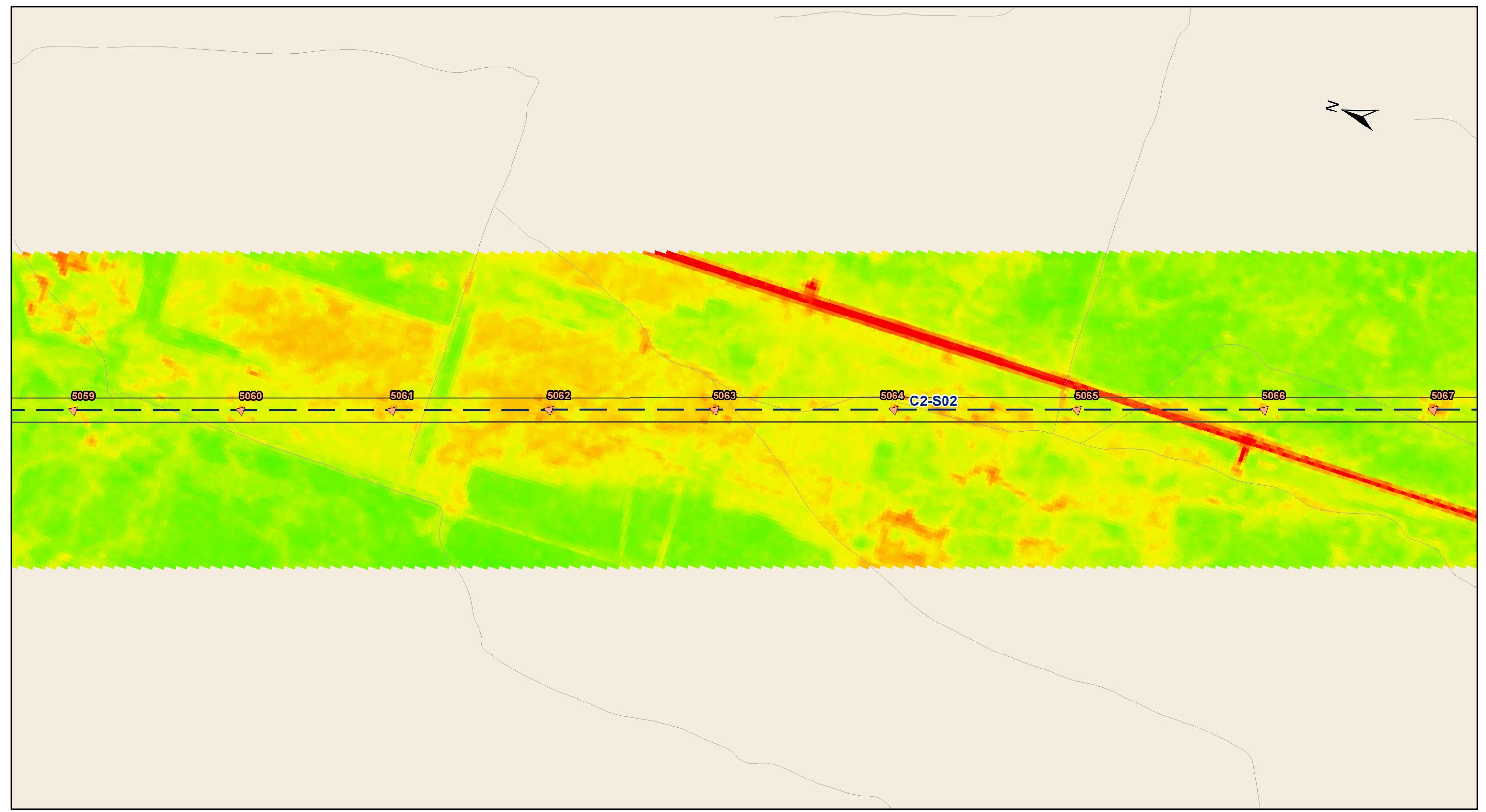
Bipole III Transmission Project

Section C2

Normalized Difference Vegetation Index (NDVI)

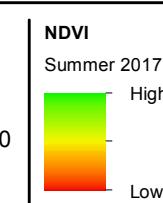
Summer 2017

DRAFT



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Metres
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Project Infrastructure
Summer 2017

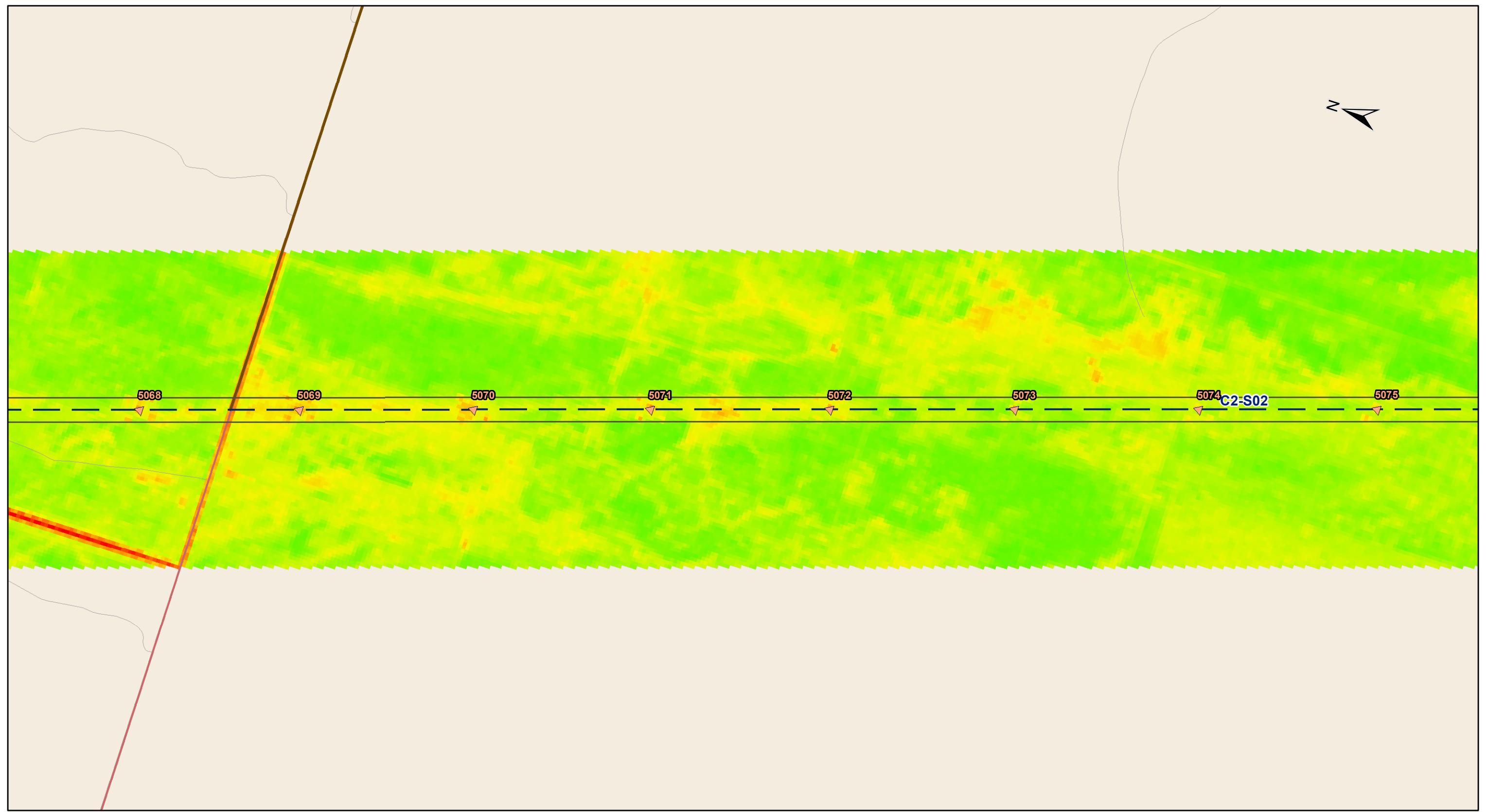
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

- Local Road / Cart Track

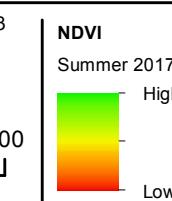
Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



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Project Infrastructure
Summer 2017

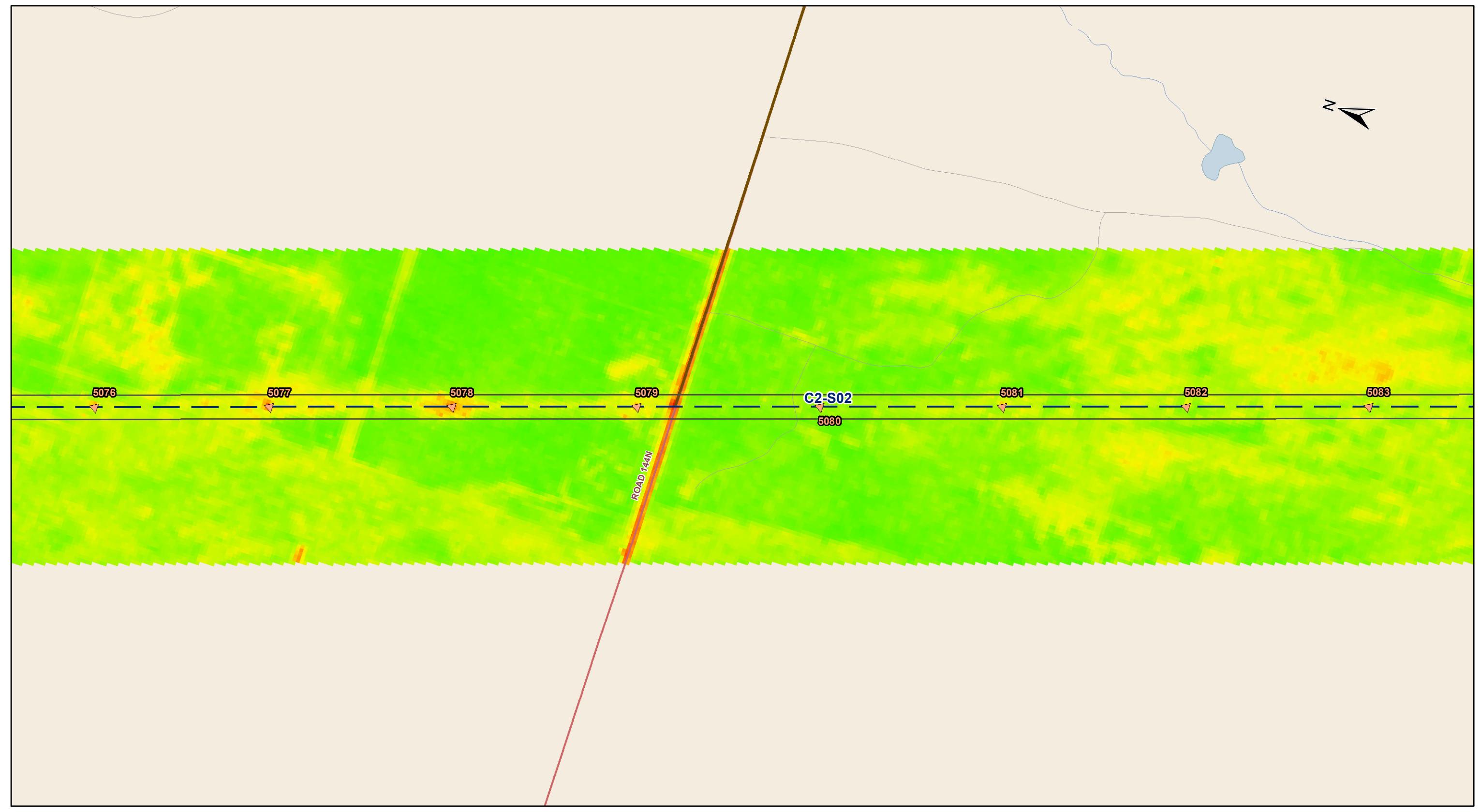
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

Landbase

- Major Road
- Local Road / Cart Track

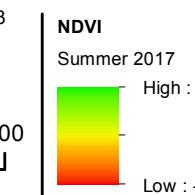
Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



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Stantec Consulting
Date Created: November 05, 2017

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Metres
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Project Infrastructure
Summer 2017

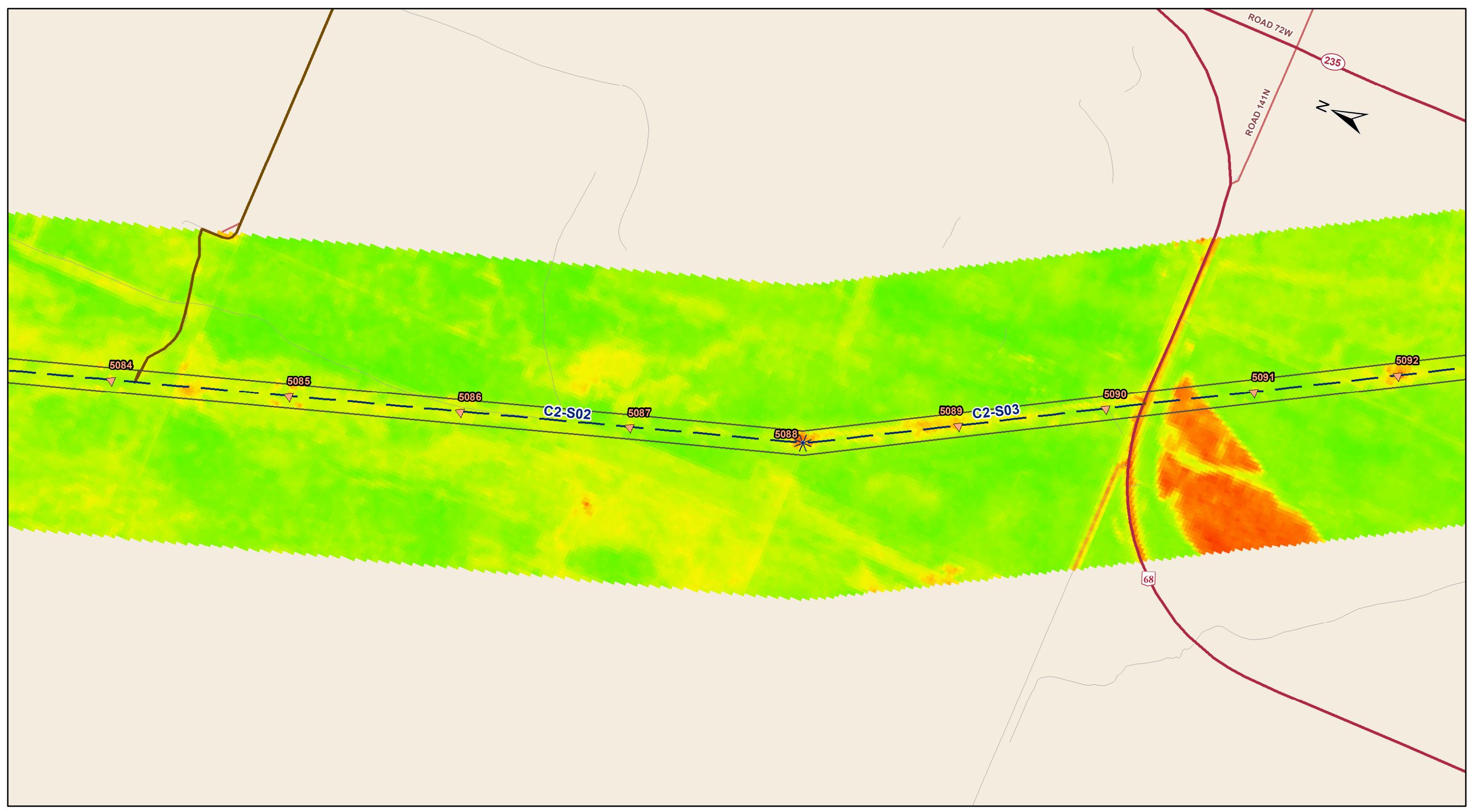
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

Landbase

- Major Road
- Local Road / Cart Track
- Waterbodies
- Watercourse

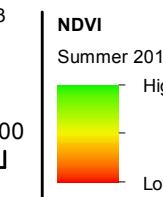
Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



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Stantec Consulting
Date Created: November 05, 2017

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Metres
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Project Infrastructure

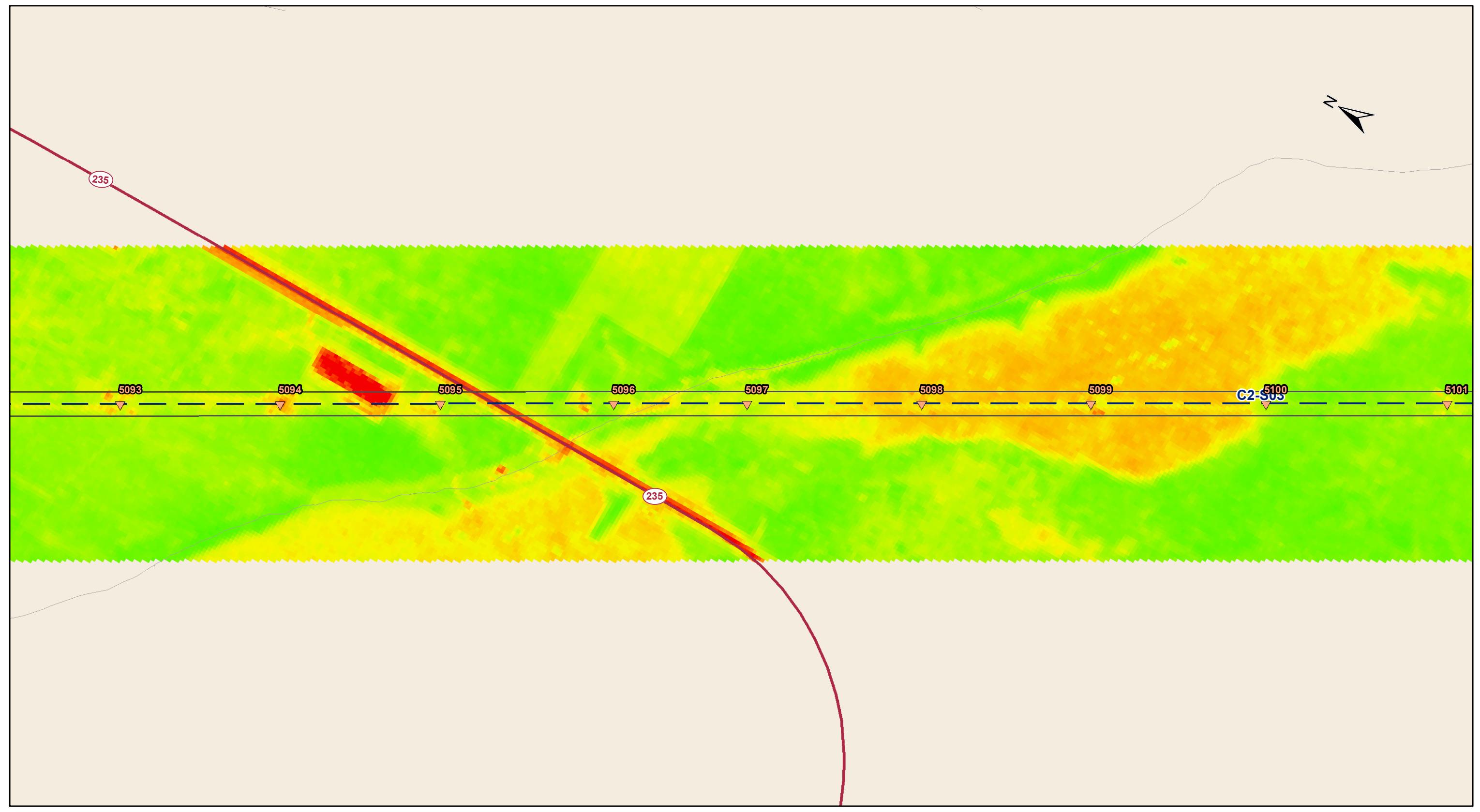
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Towers (Preliminary)
- Proposed Access Route

Landbase

- Highway
- Major Road
- Local Road / Cart Track
- Watercourse

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

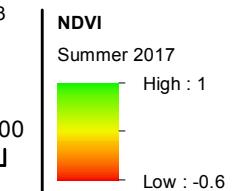
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Project Infrastructure
Summer 2017

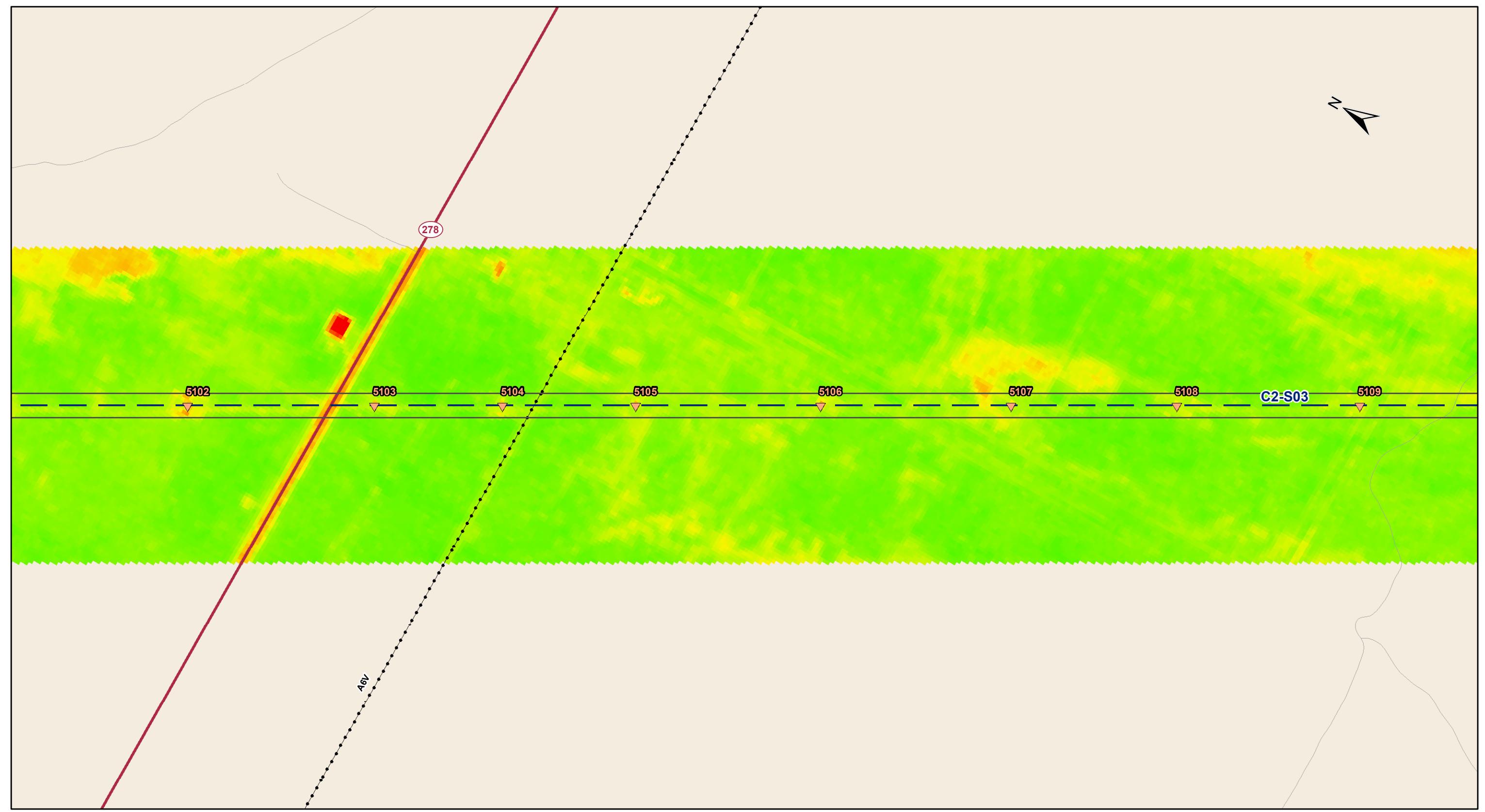
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

Landbase

- Highway
- Local Road / Cart Track

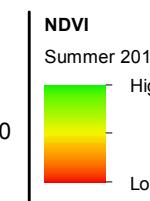
Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)
- Transmission Line
- Proposed Access Route

Landbase

- Highway
- Local Road / Cart Track
- Transmission Line

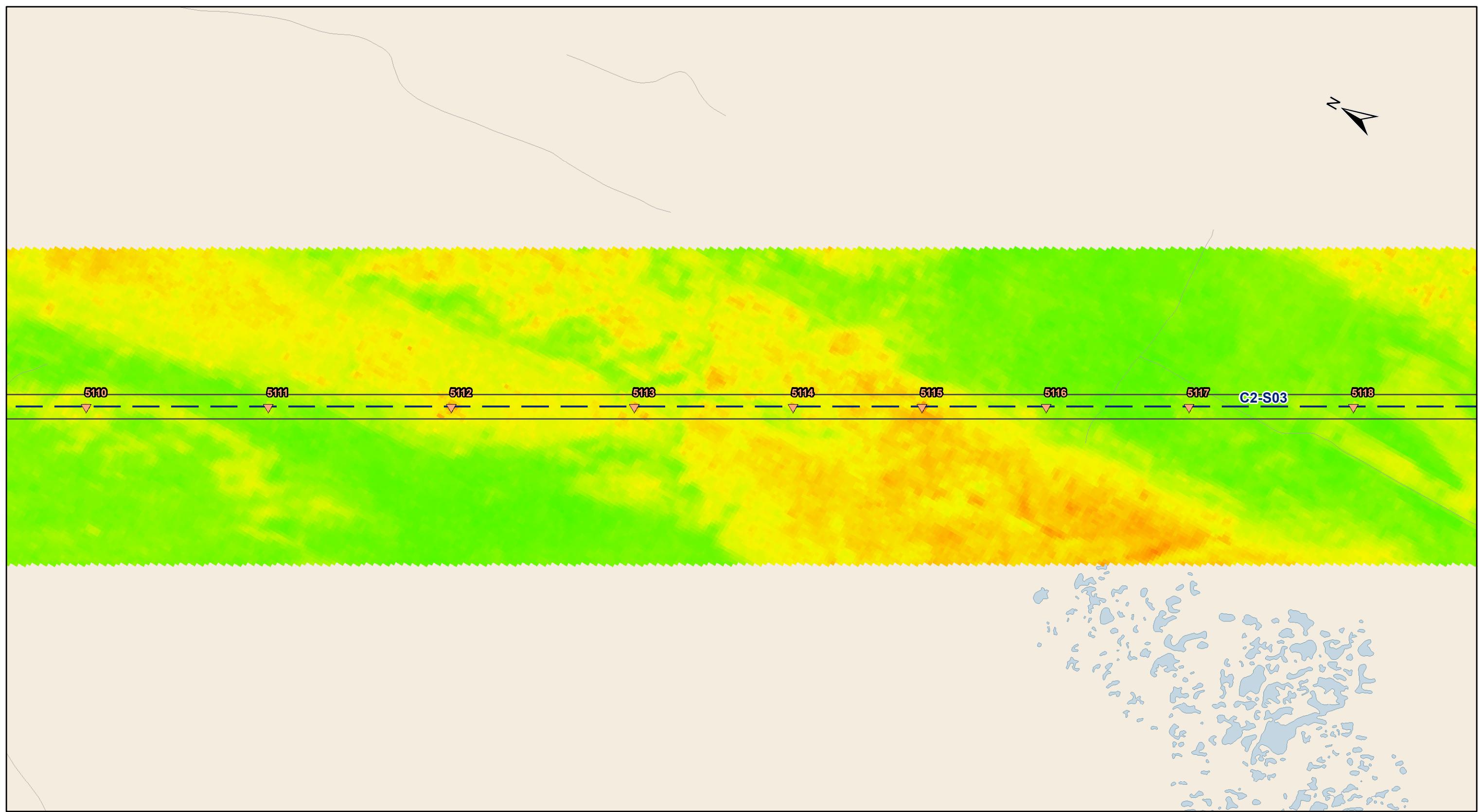
Bipole III Transmission Project

Section C2

Normalized Difference Vegetation Index (NDVI)

Summer 2017

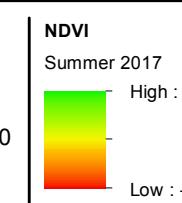
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Coordinate System: UTM Zone 14N NAD83
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Stantec Consulting
Date Created: November 05, 2017

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Project Infrastructure
Summer 2017

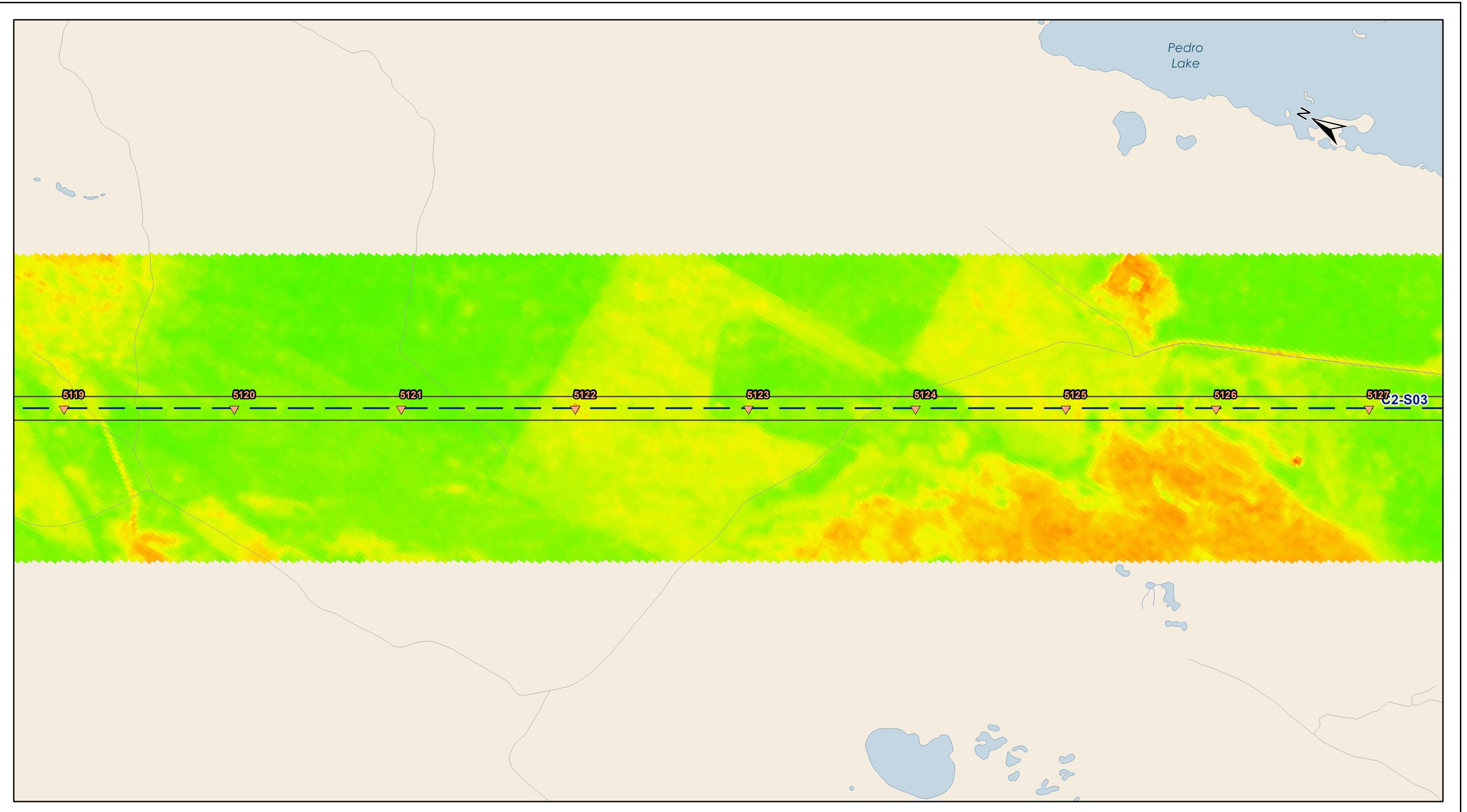
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

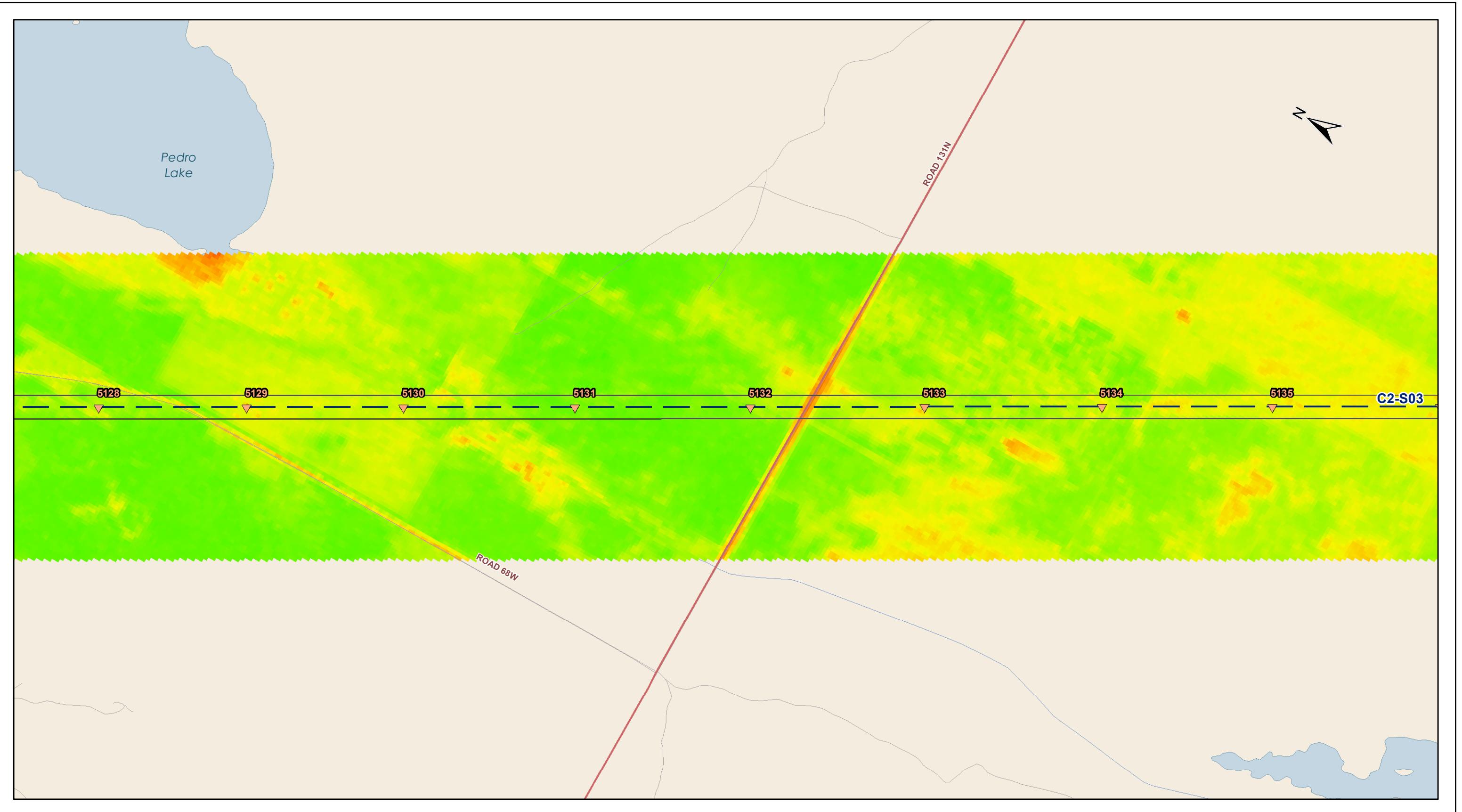
Landbase

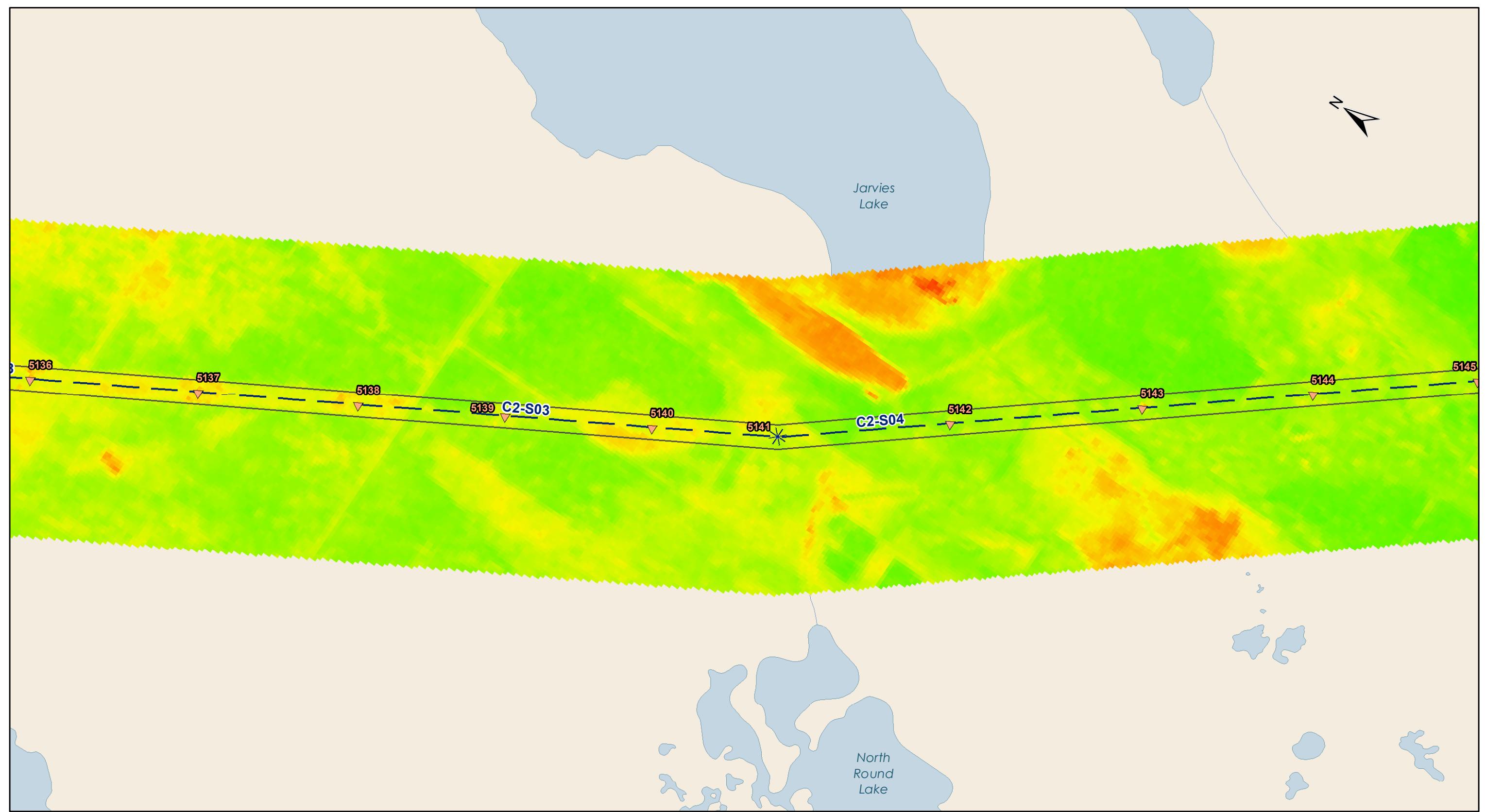
- Local Road / Cart Track
- Waterbodies
- Watercourse

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



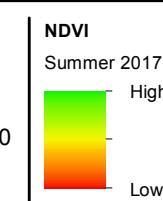




Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres

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Project Infrastructure

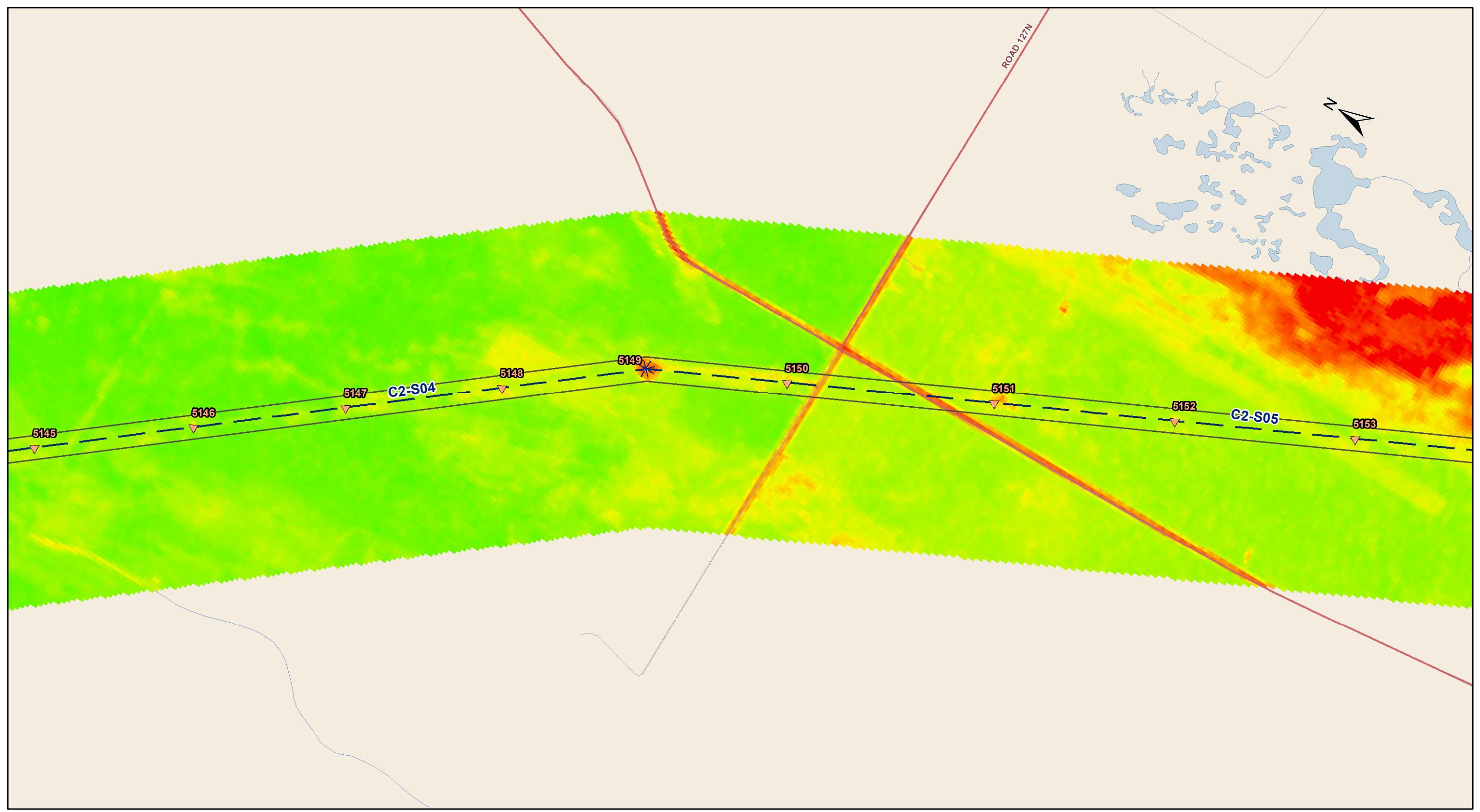
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
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Landbase

- Waterbodies
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Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

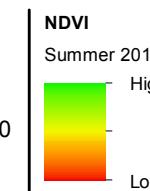
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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres

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Project Infrastructure

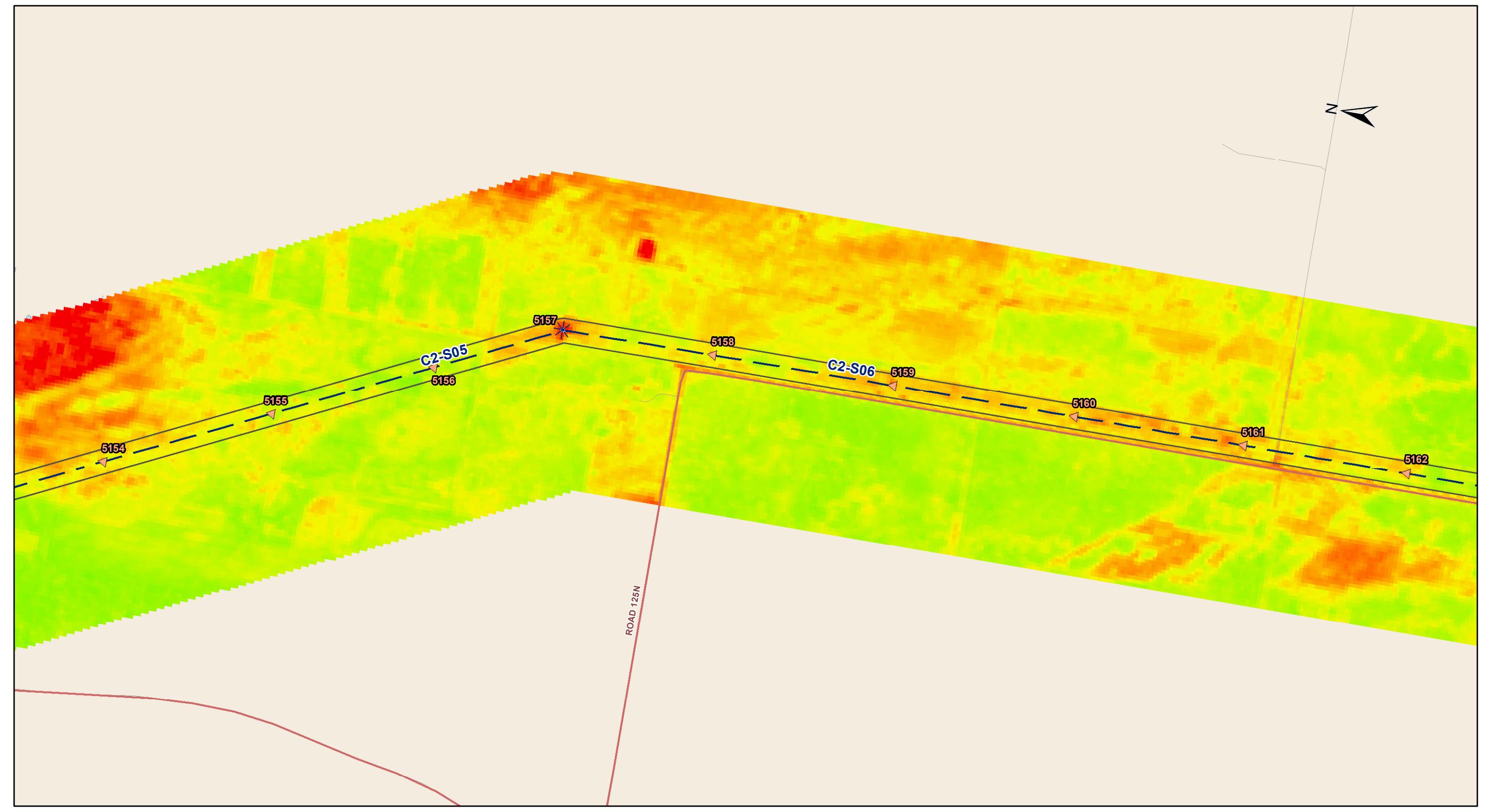
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- Major Road
- Local Road
- Local Road / Cart Track
- Waterbodies
- Watercourse

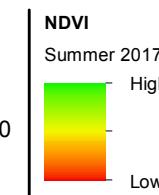
Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Towers (Preliminary)

Landbase

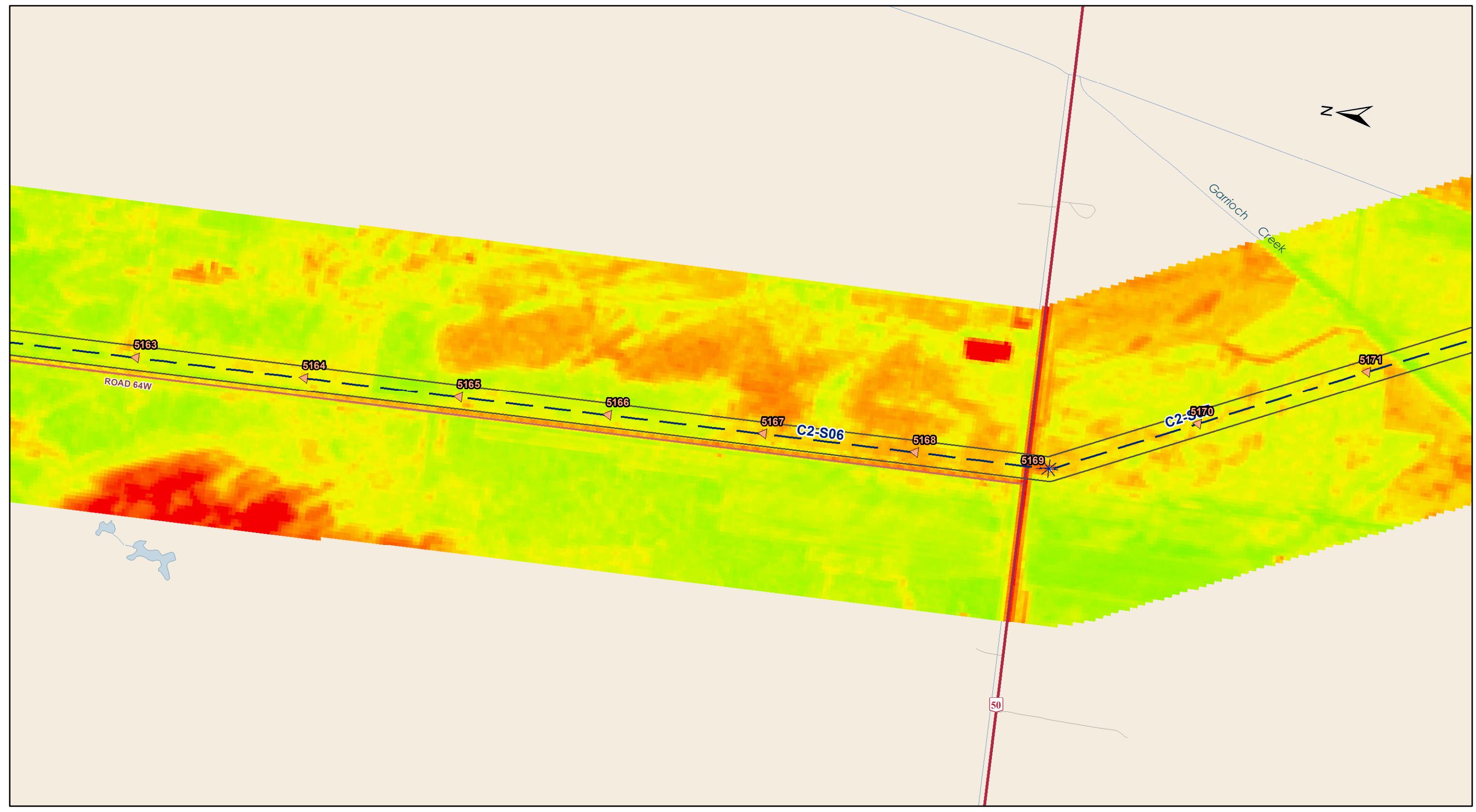
- Major Road
- Local Road / Cart Track
- Waterbodies
- Watercourse

Bipole III Transmission Project

Section C2

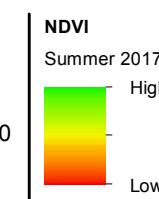
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres
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Project Infrastructure

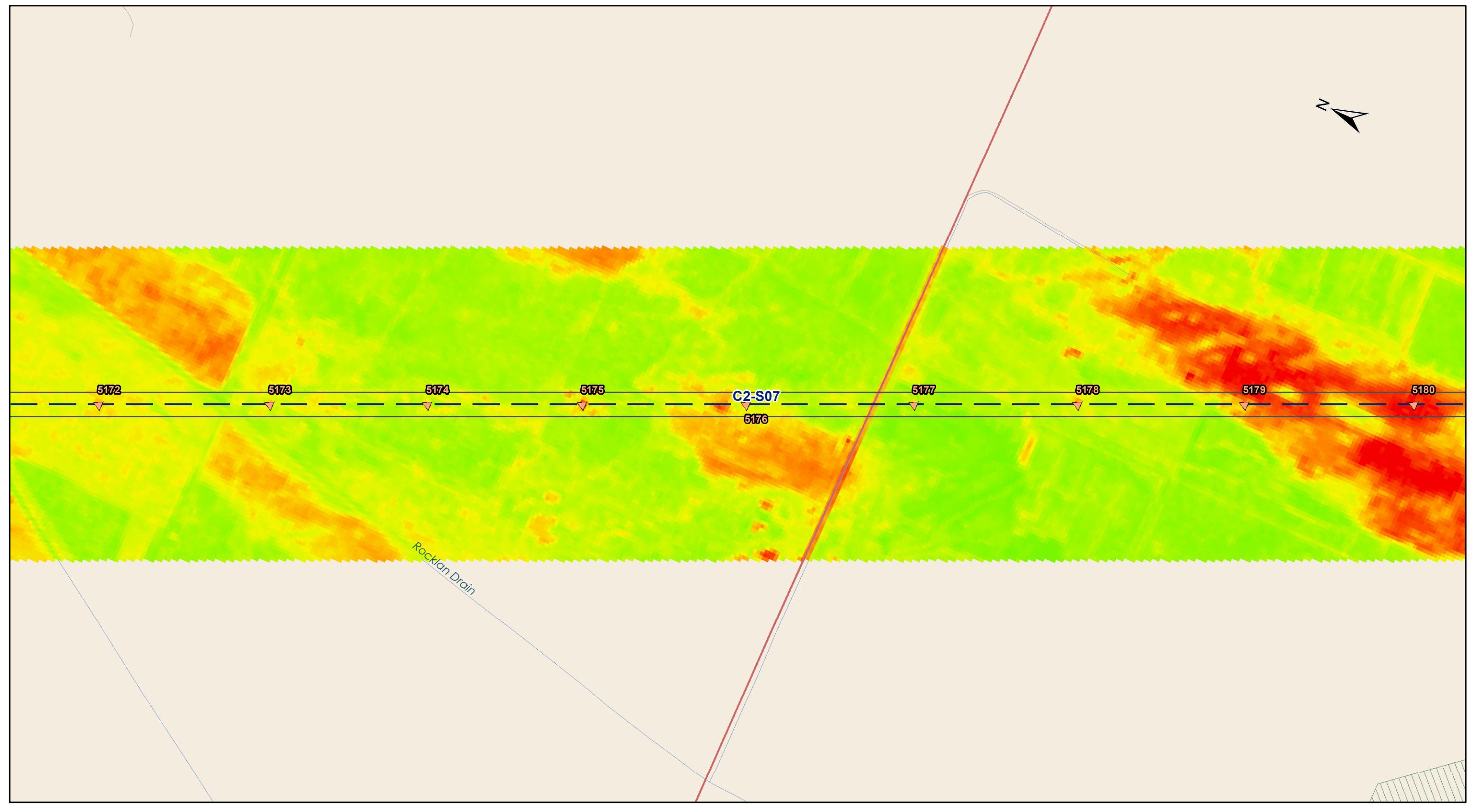
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Towers (Preliminary)
- Proposed Access Route

Landbase

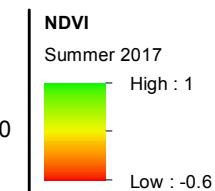
- Highway
- Major Road
- Local Road / Cart Track
- Waterbodies
- Watercourse

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



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Date Created: November 05, 2017
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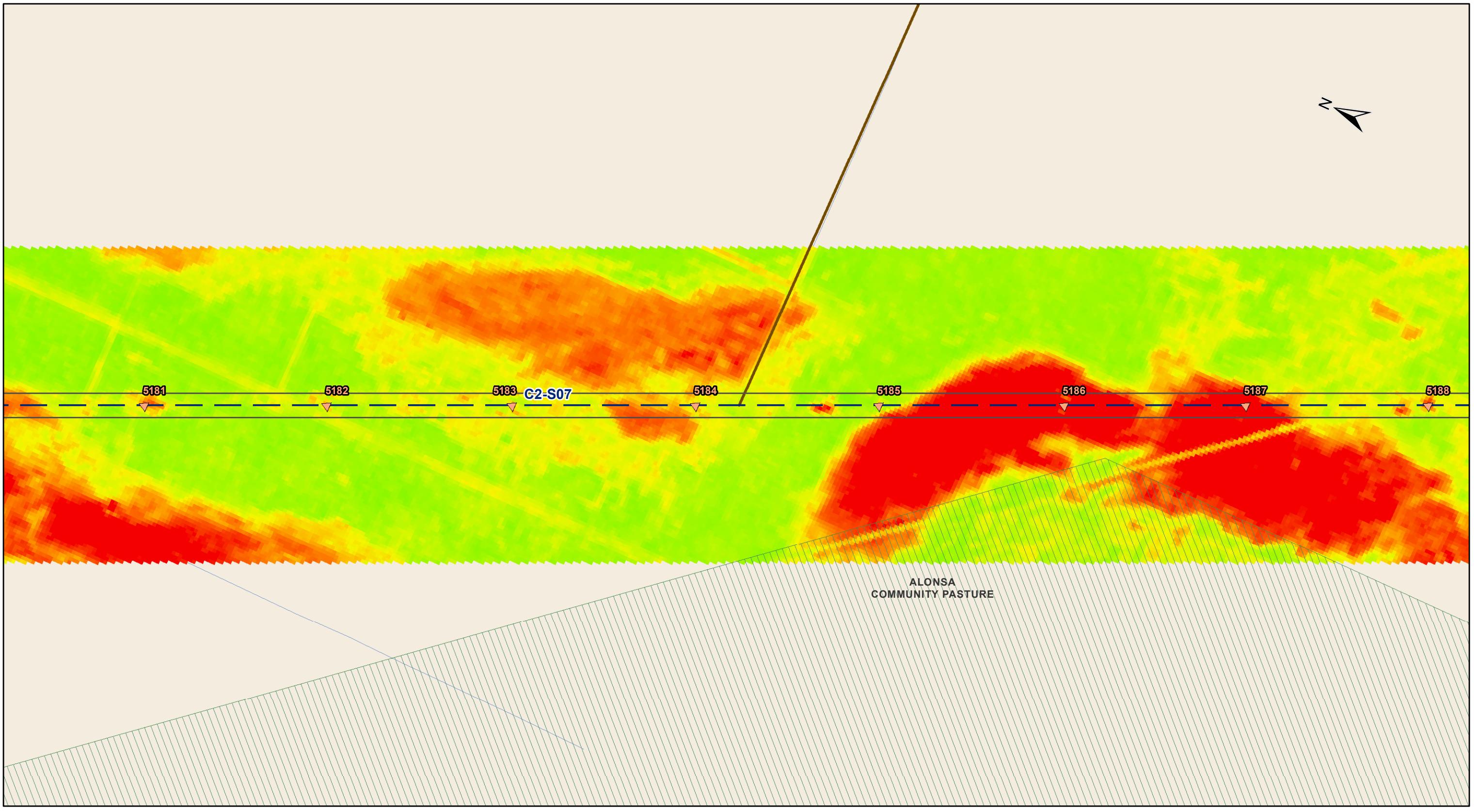


Project Infrastructure
BPIII Final Preferred Route
66m ROW
Towers (Preliminary)

Landbase
Major Road
Local Road / Cart Track
Community Pasture
Watercourse

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

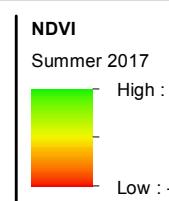
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Coordinate System: UTM Zone 14N NAD83
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Stantec Consulting
Date Created: November 05, 2017

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Project Infrastructure
Summer 2017

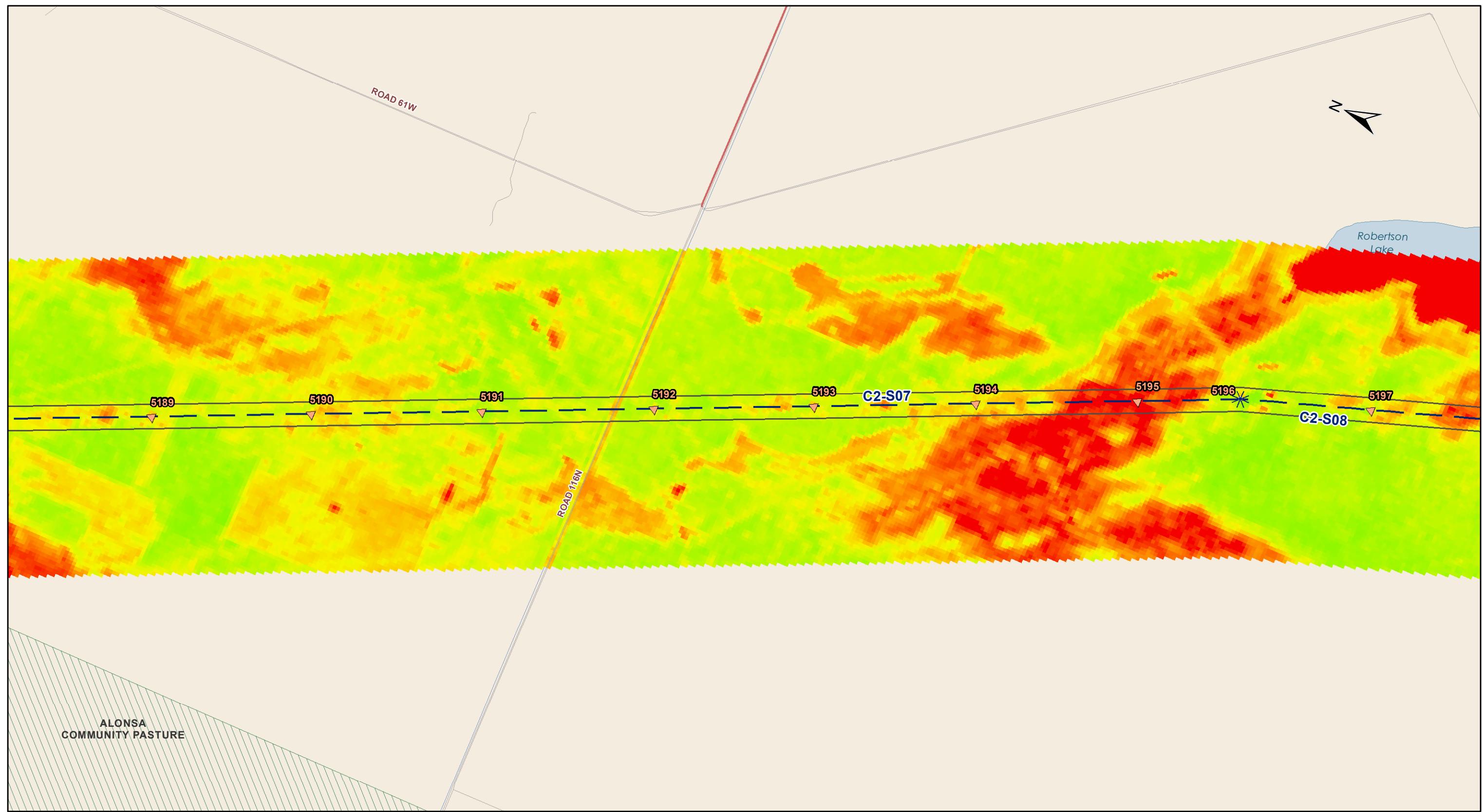
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

Landbase

- ▨ Community Pasture
- Watercourse

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

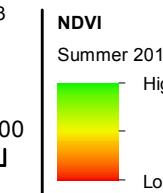
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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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Project Infrastructure

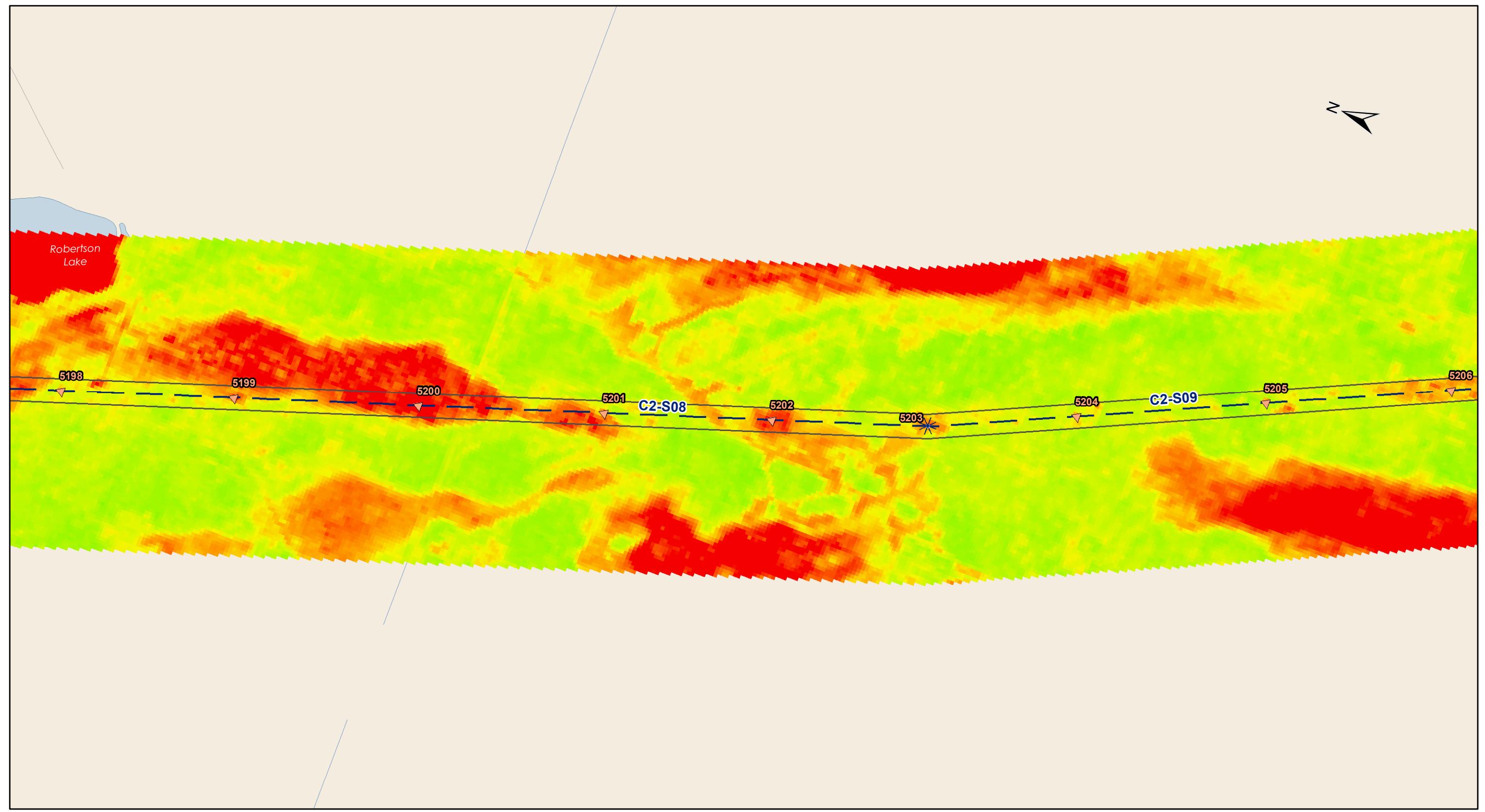
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Towers (Preliminary)

Landbase

- Major Road
- Local Road
- Local Road / Cart Track
- ▨ Community Pasture
- Waterbodies
- Watercourse

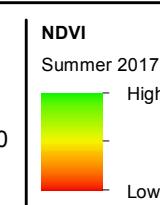
Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
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0 125 250 500
Metres
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Project Infrastructure
Summer 2017

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Towers (Preliminary)

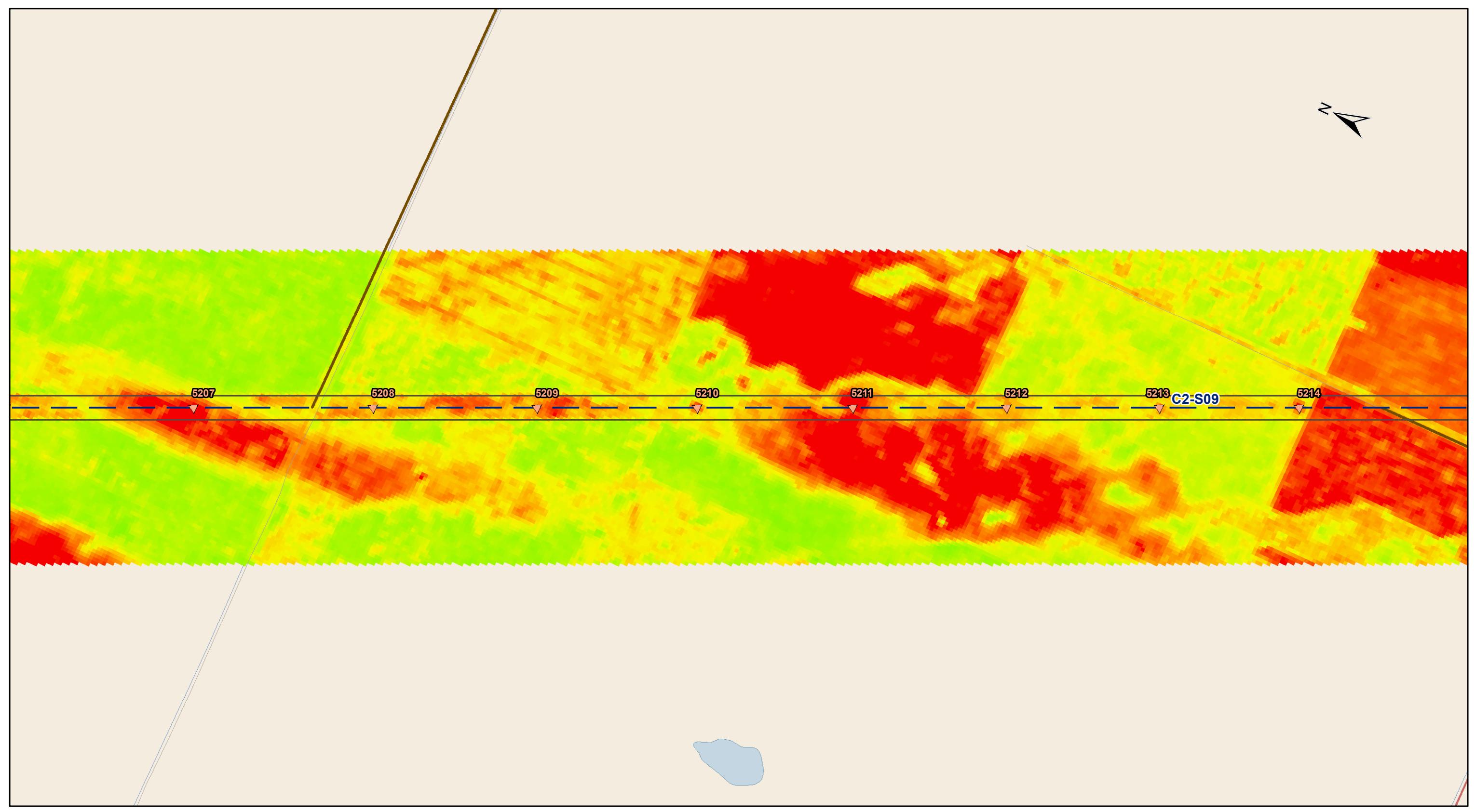
Landbase

- Local Road / Cart Track
- Waterbodies
- Watercourse



Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

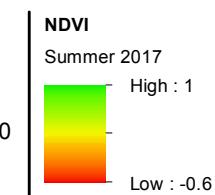
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Coordinate System: UTM Zone 14N NAD83
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Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres

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Project Infrastructure
Summer 2017

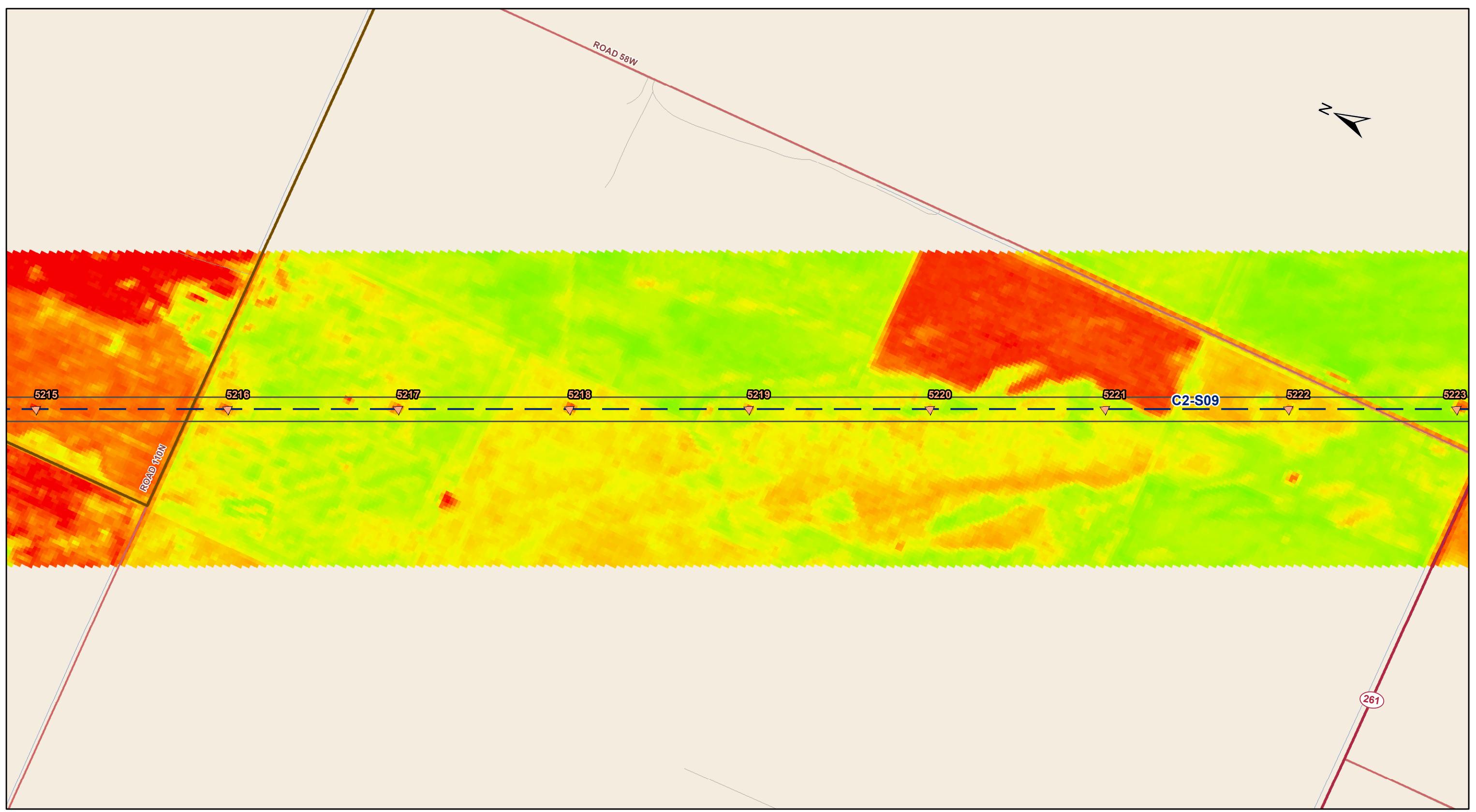
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

Landbase

- Major Road
- Local Road / Cart Track
- Waterbodies
- Watercourse

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

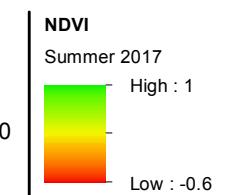
DRAFT



Coordinate System: UTM Zone 14N NAD83
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Stantec Consulting
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0 125 250 500
Metres

1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

Landbase

- Highway
- Major Road
- Local Road / Cart Track
- Waterbodies
- Watercourse

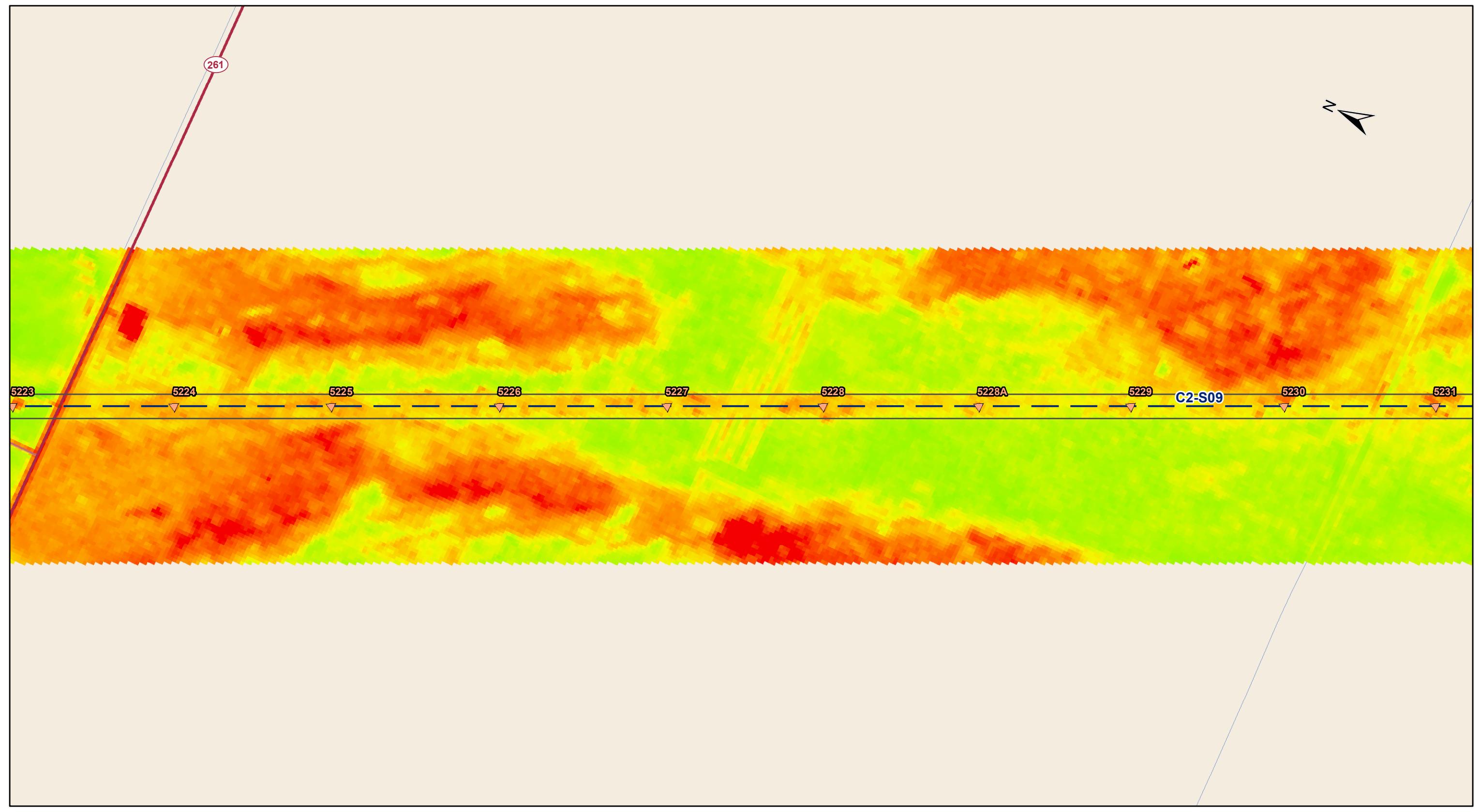
Bipole III Transmission Project

Section C2

Normalized Difference Vegetation Index (NDVI)

Summer 2017

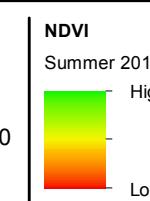
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Coordinate System: UTM Zone 14N NAD83
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Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres

1:10,000



Project Infrastructure
Summer 2017

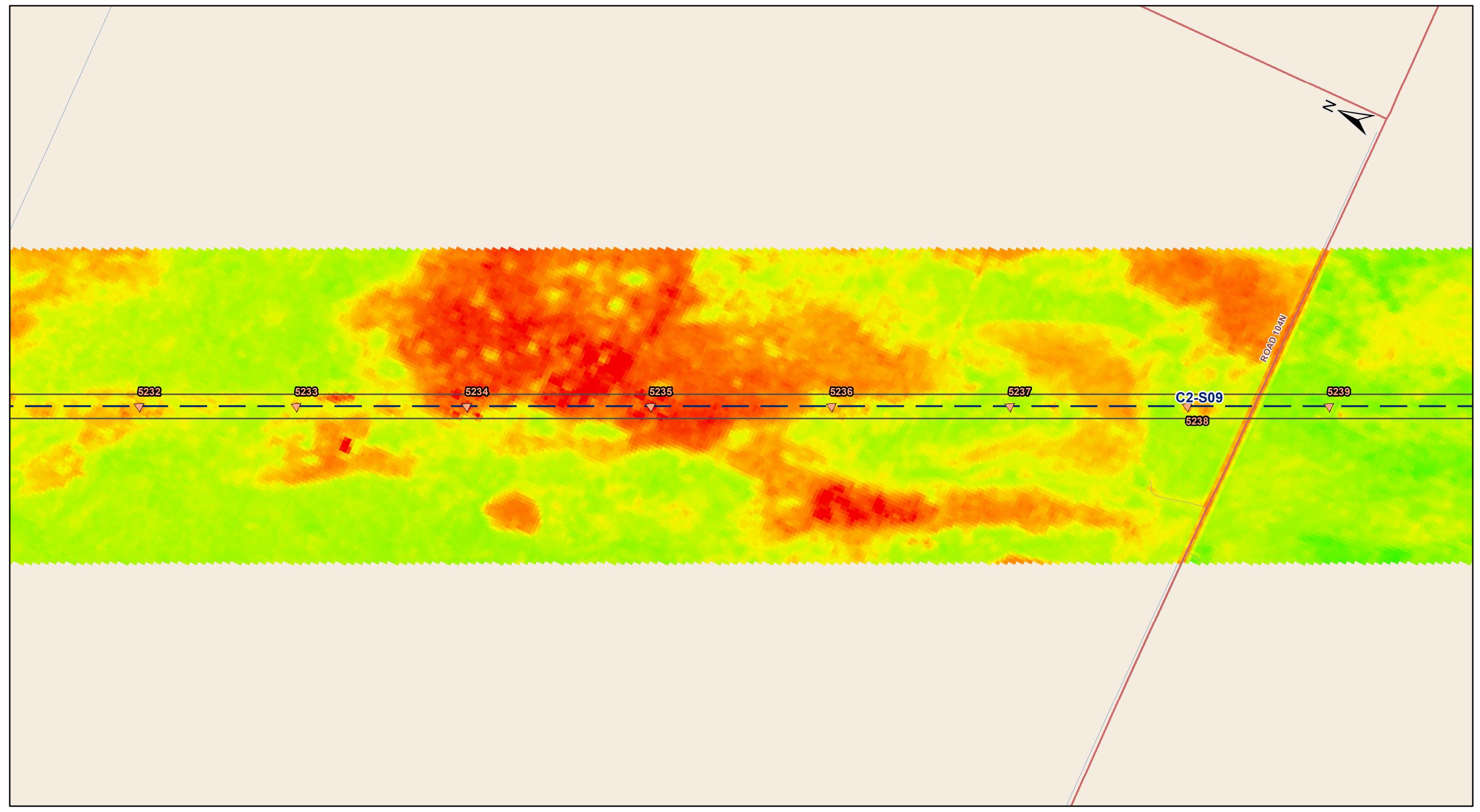
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

Landbase

- Highway
- Major Road
- Local Road / Cart Track
- Watercourse

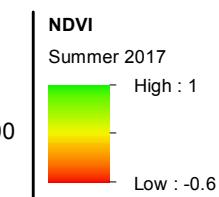
Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



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Stantec Consulting
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure
Summer 2017

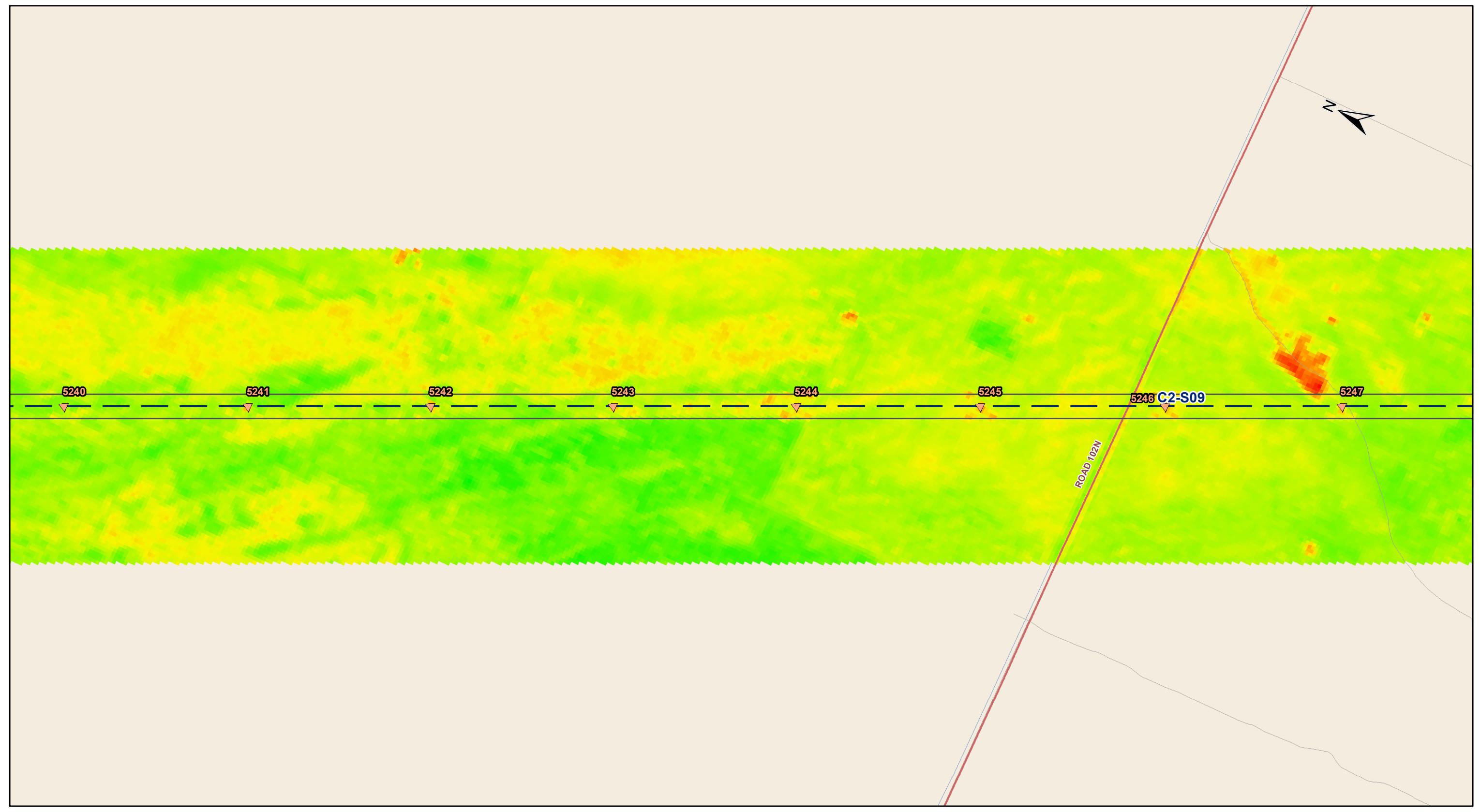
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

- Major Road
- Local Road / Cart Track
- Watercourse

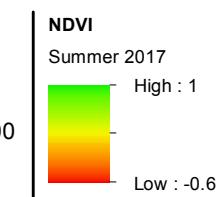
Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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0 125 250 500
Metres
1:10,000



Project Infrastructure

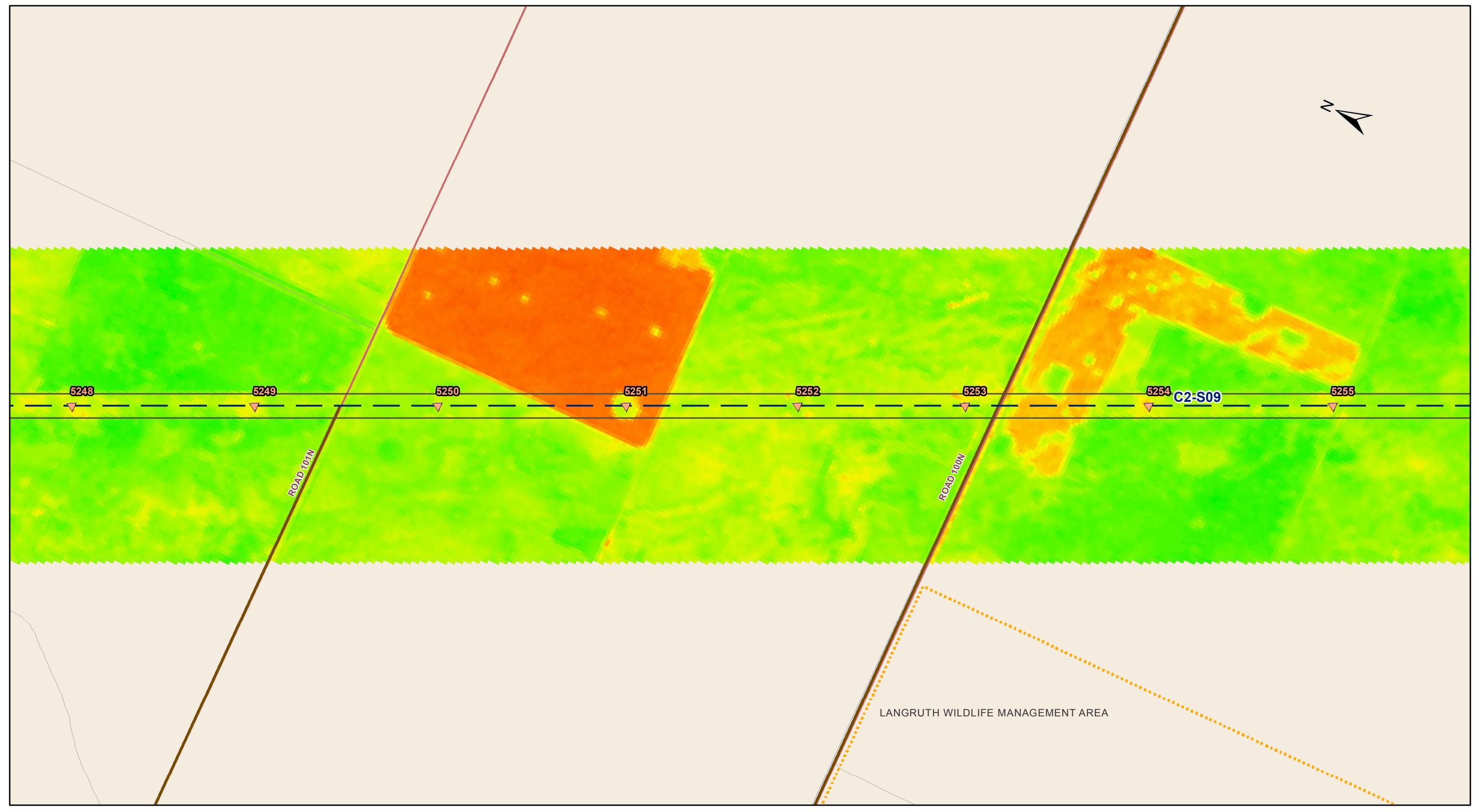
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

- Major Road
- Local Road / Cart Track
- Waterbodies
- Watercourse

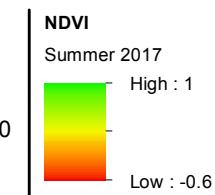
Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



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Date Created: November 05, 2017

0 125 250 500
Metres
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Project Infrastructure

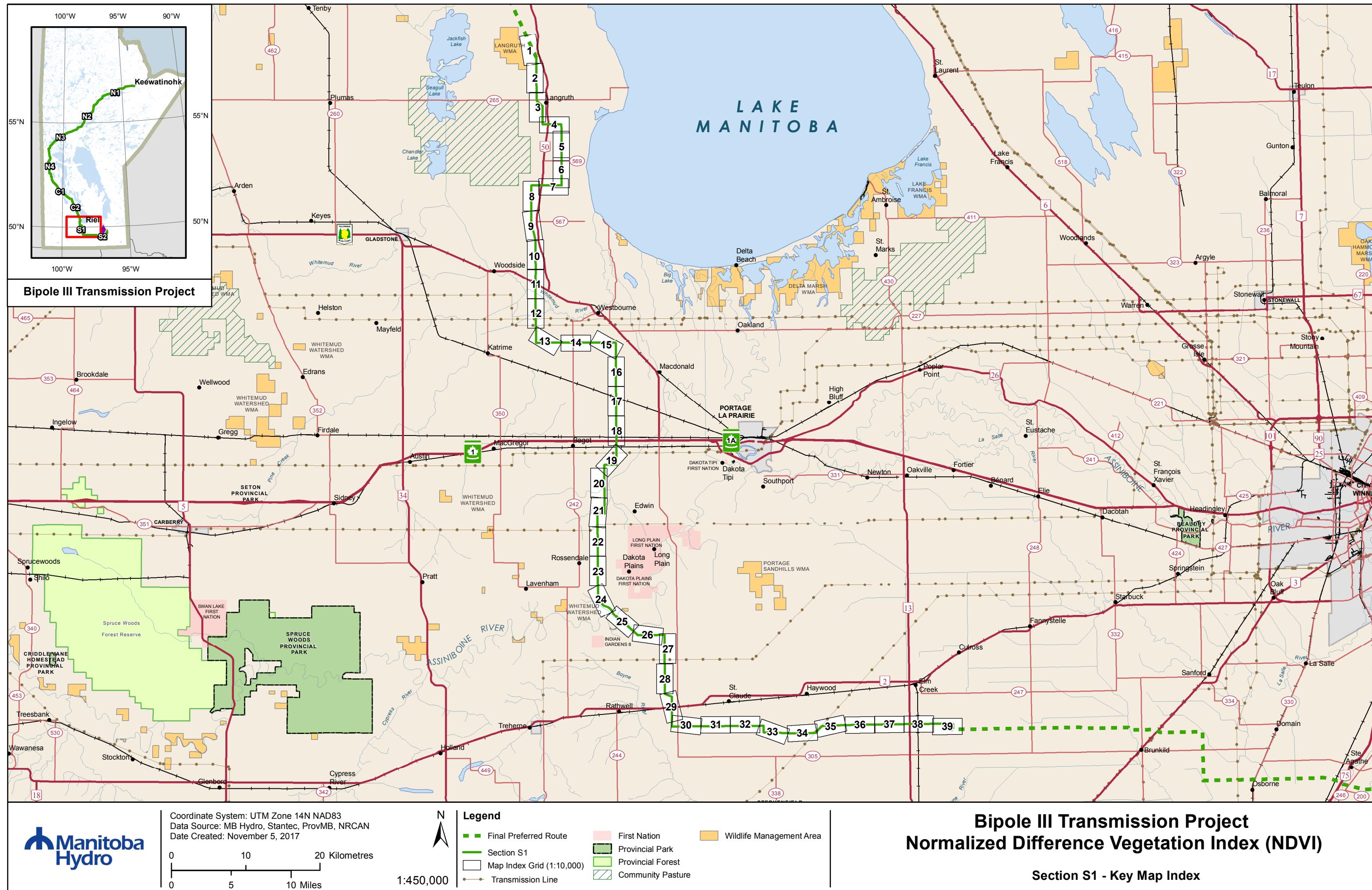
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

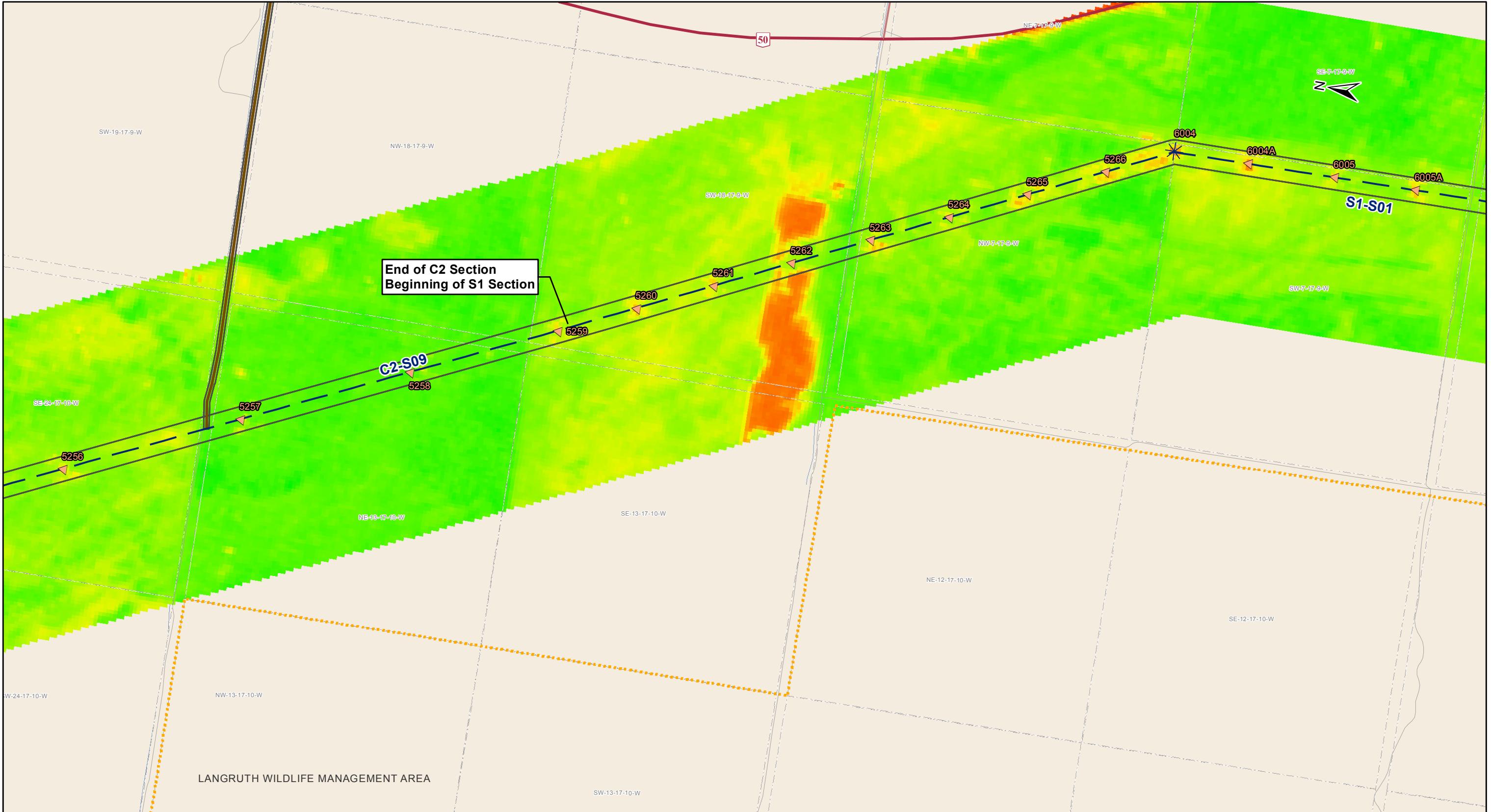
Landbase

- Major Road
- Local Road / Cart Track
- Wildlife Management Area
- Waterbodies
- Watercourse

Bipole III Transmission Project
Section C2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

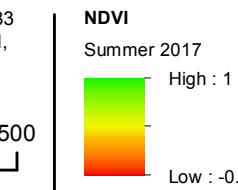
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Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- Proposed Access Route
- Angle Towers (Preliminary)
- Towers (Preliminary)

Landbase

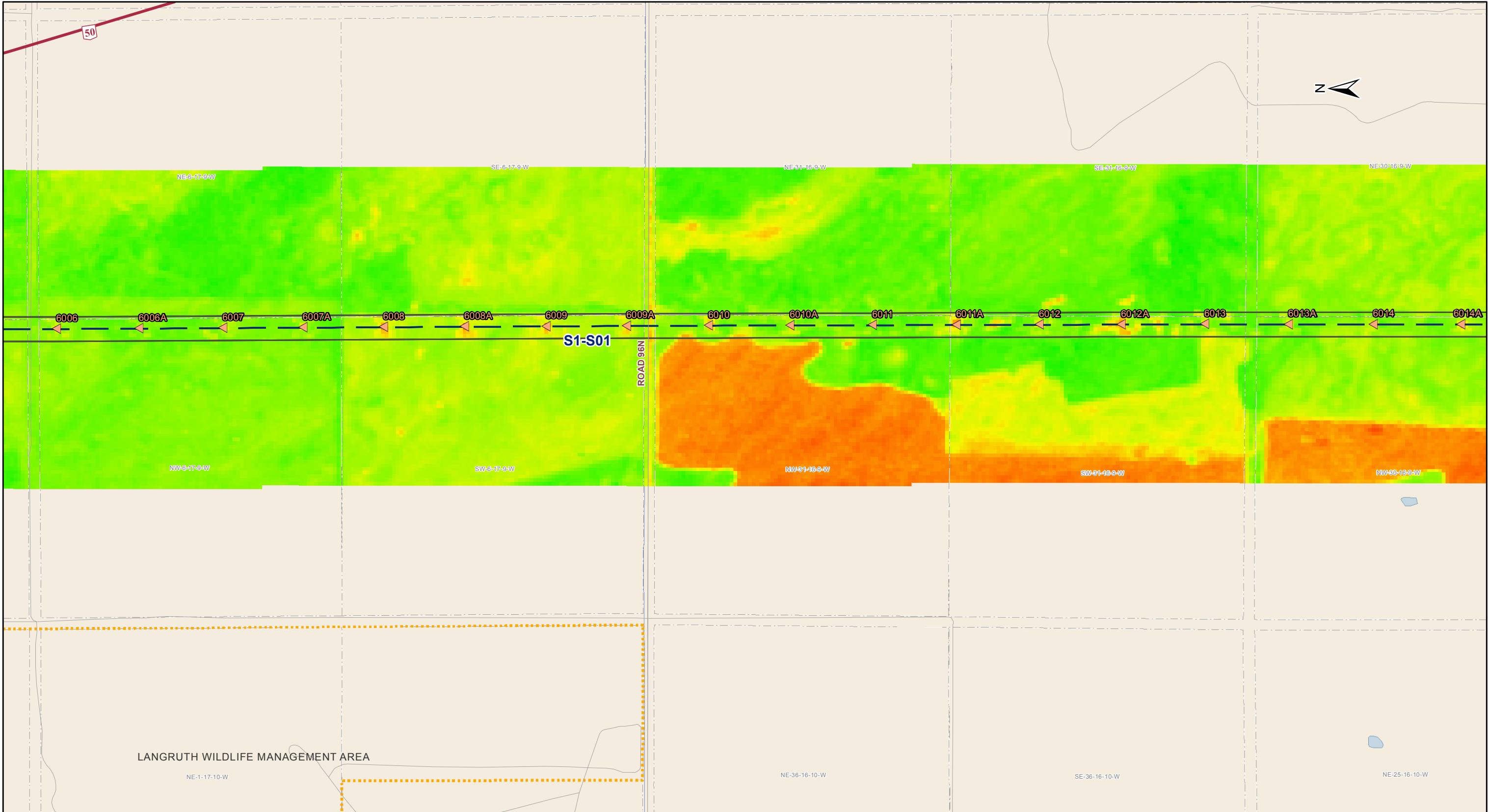
- Highway
- Major Road
- Local Road
- Wildlife Management Area
- Parcel Fabric
- Watercourse

Bipole III Transmission Project

Section S1

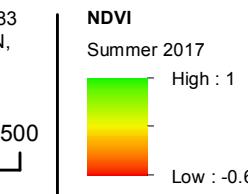
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BP III Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

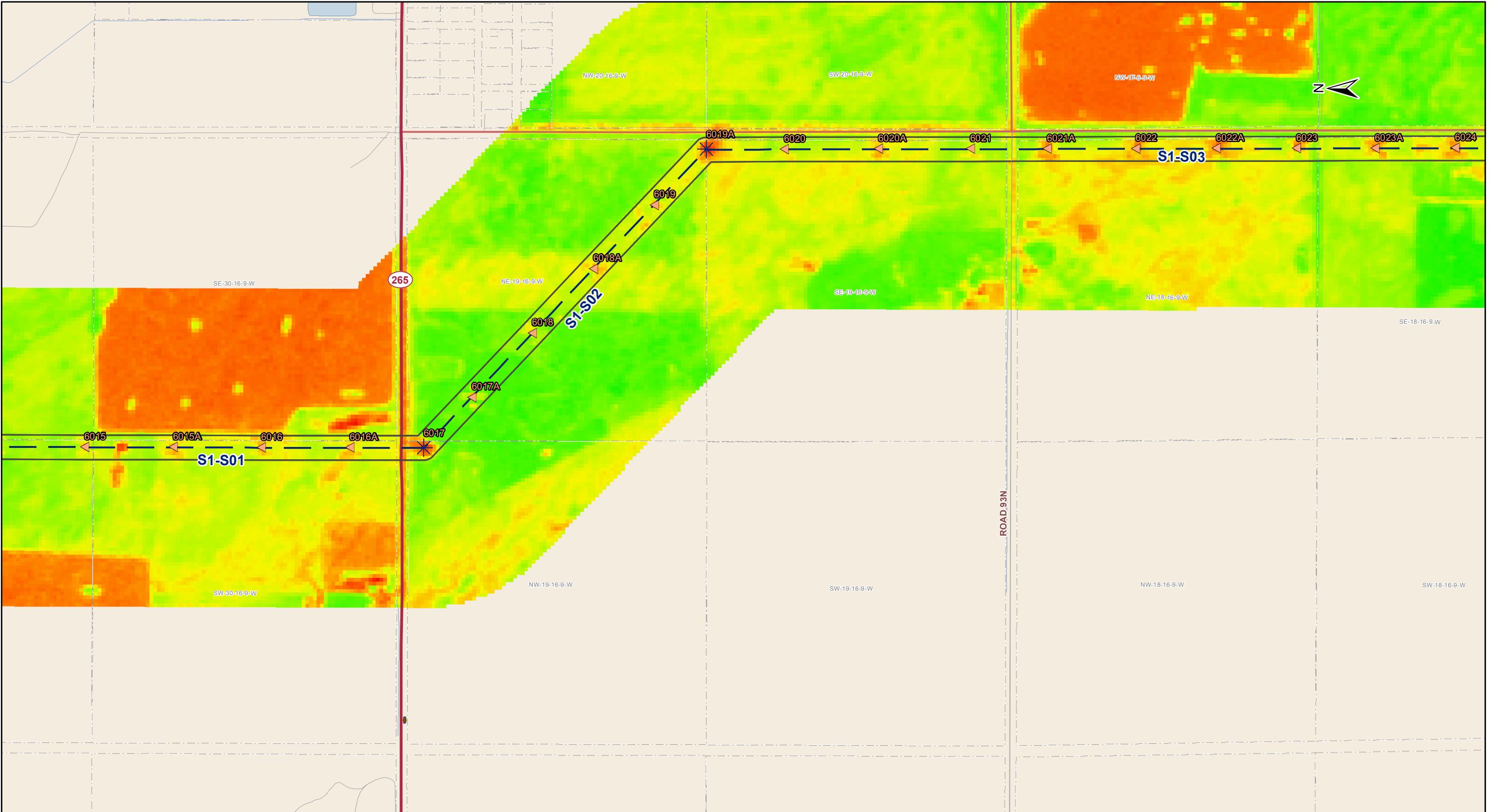
- Highway
- Local Road
- Waterbody
- Watercourse
- Wildlife Management Area
- Parcel Fabric

Bipole III Transmission Project

Section S1

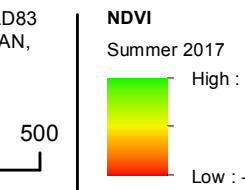
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- Proposed Access Route
- * Angle Towers (Preliminary)
- ▲ Towers (Preliminary)

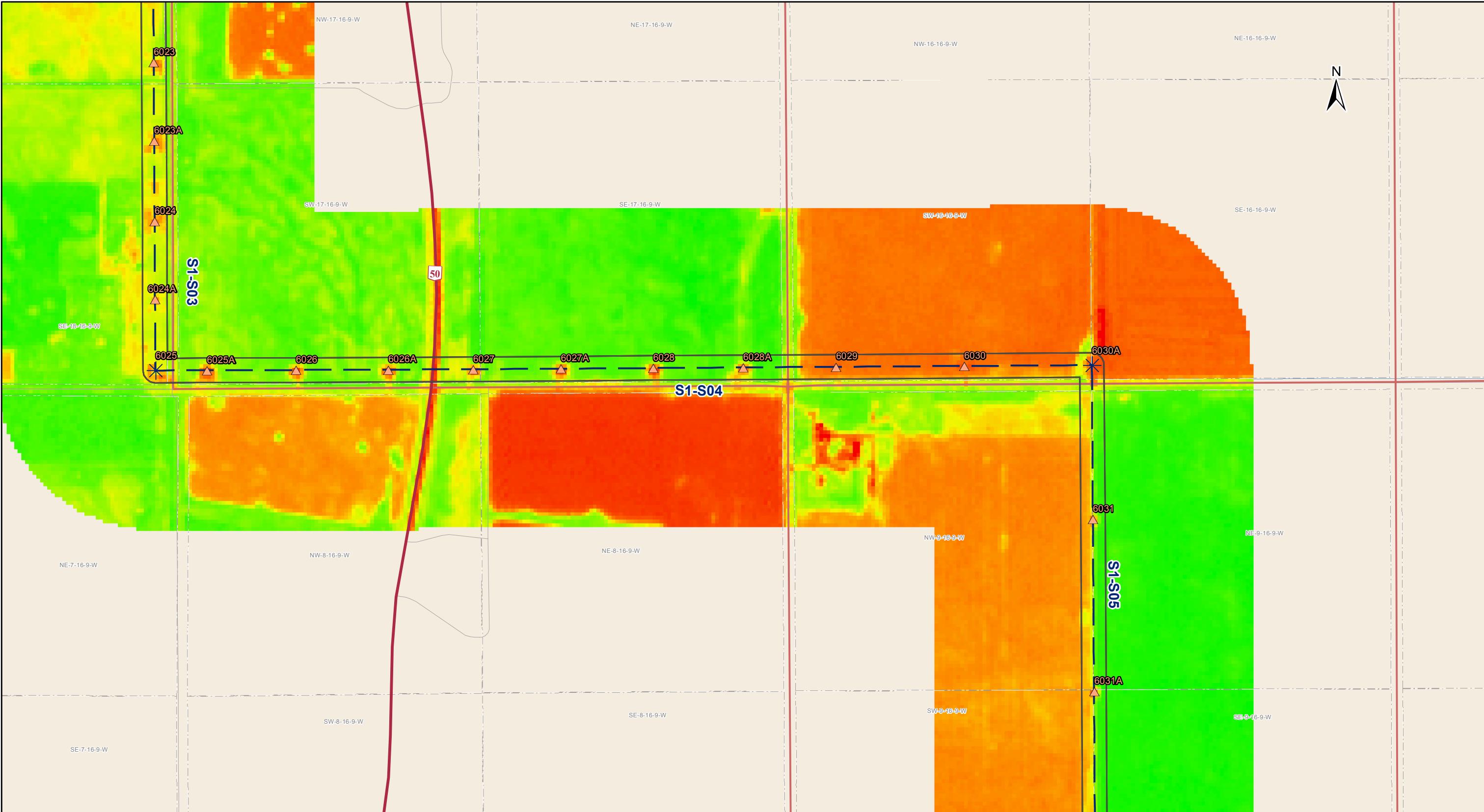
Landbase

- Highway
- Major Road
- Local Road
- Parcel Fabric

Waterbody
Watercourse

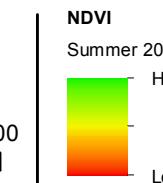
Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure
BP III Final Preferred Route
66m ROW
Angle Towers (Preliminary)
Towers (Preliminary)

Landbase
Highway
Major Road
Local Road
Parcel Fabric
Watercourse

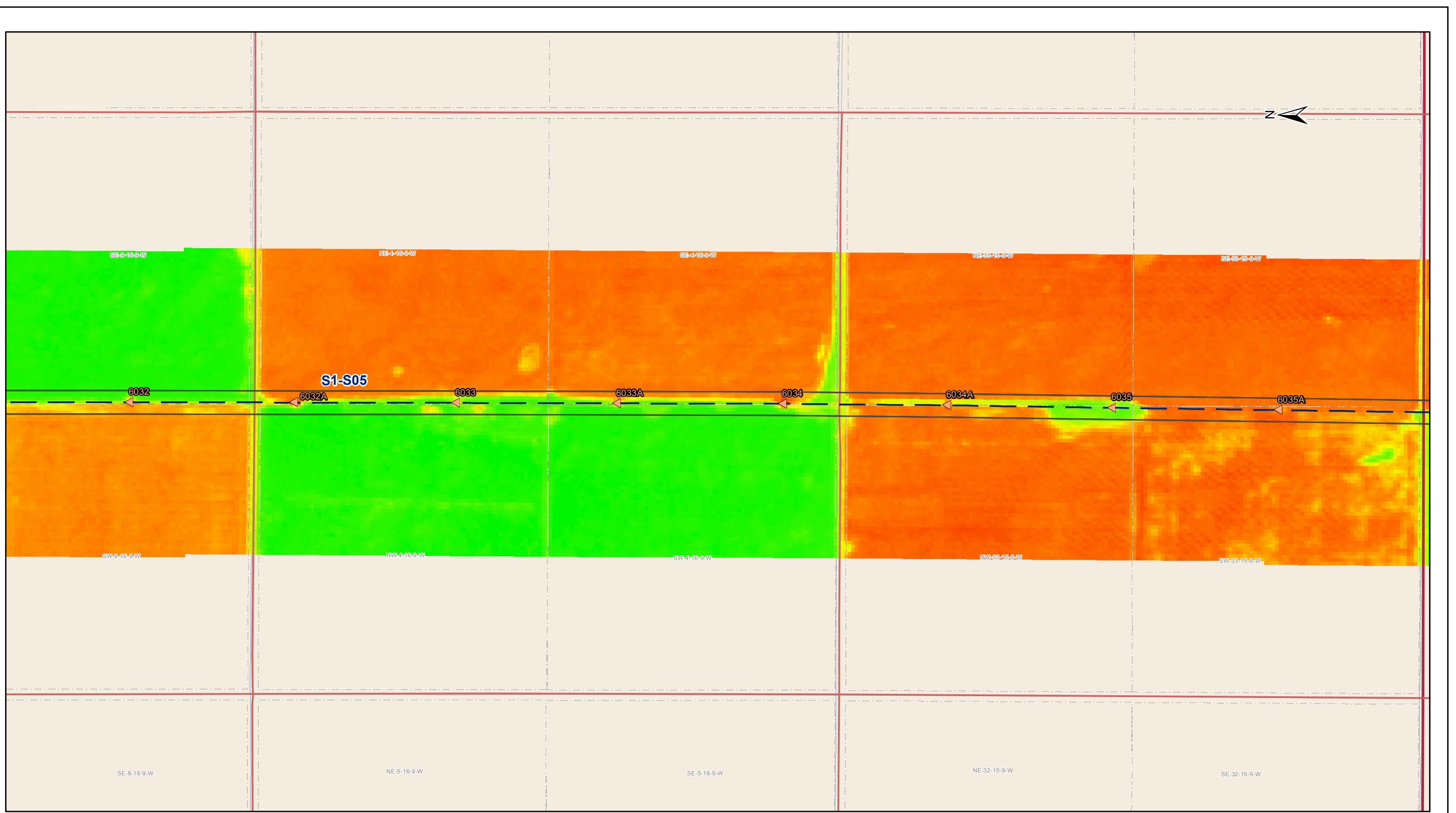
Bipole III Transmission Project

Section S1

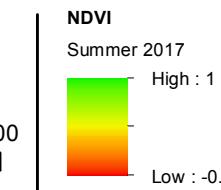
Normalized Difference Vegetation Index (NDVI)

Summer 2017

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Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017



0 125 250 500
Metres
1:10,000

Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

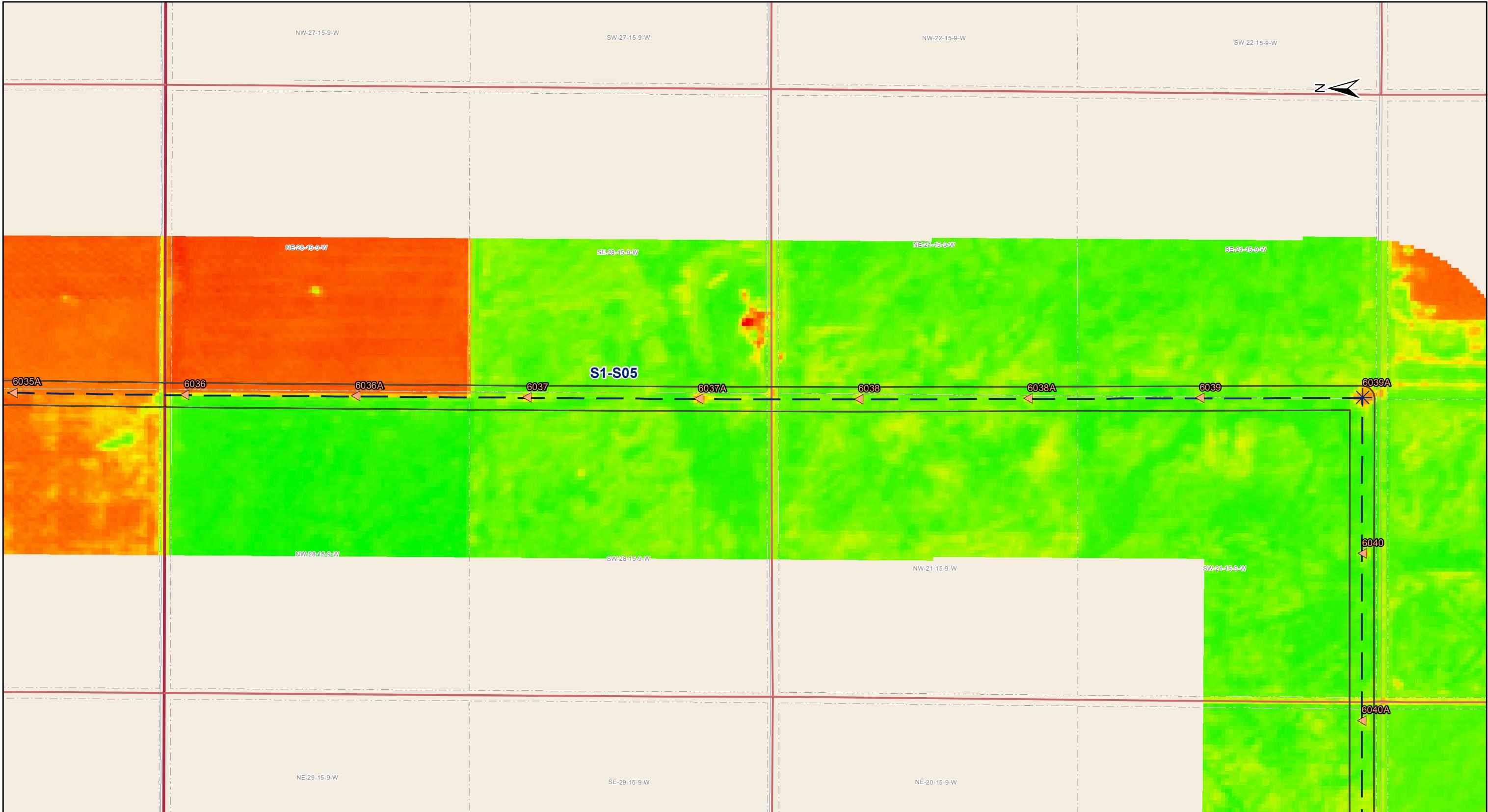
- Highway
- Major Road
- Local Road
- Parcel Fabric
- Watercourse



Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

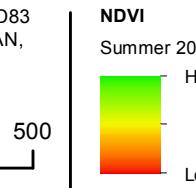
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Map 4-400-5



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ★ Angle Towers (Preliminary)
- ▲ Towers (Preliminary)

Landbase

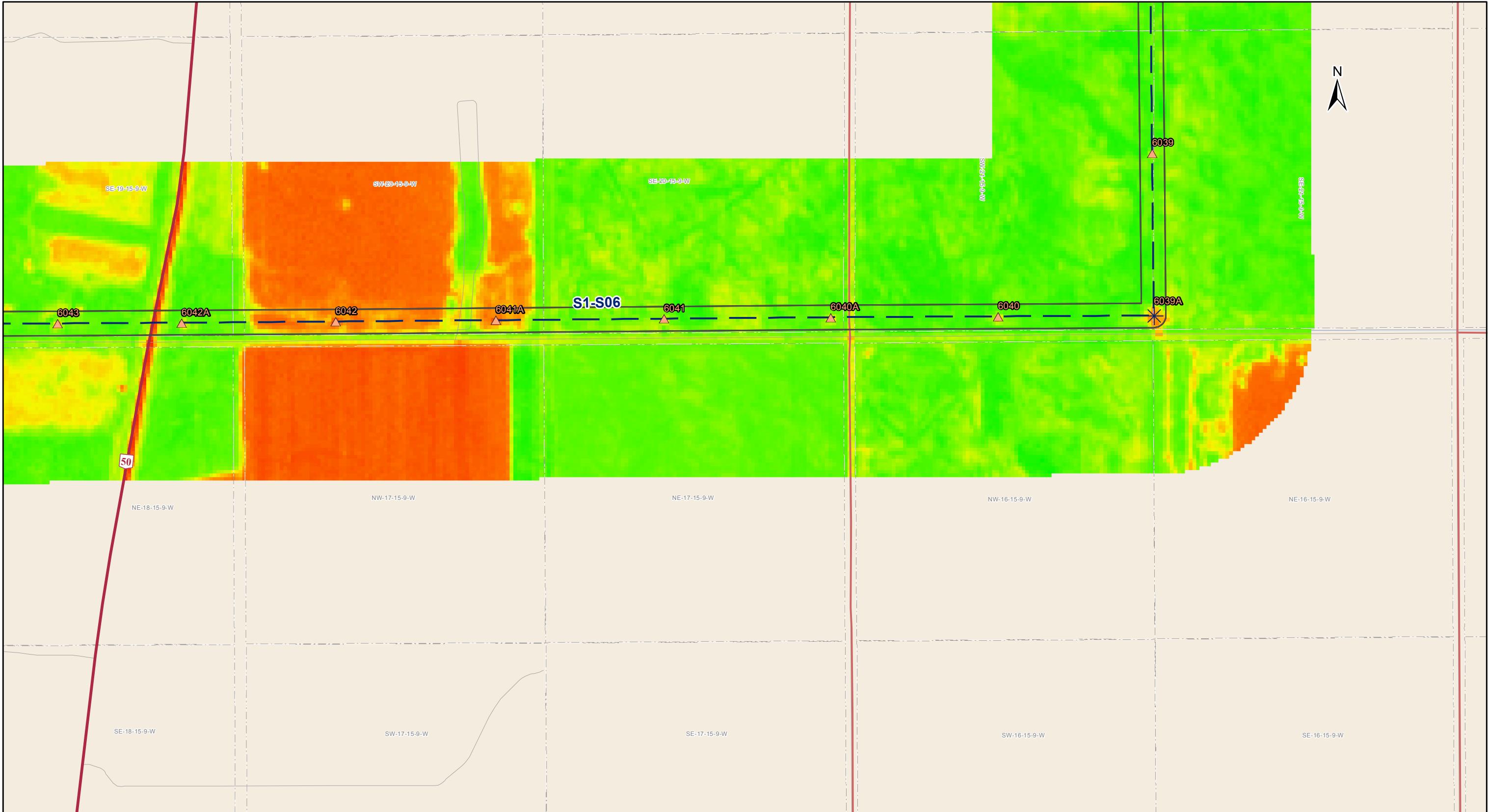
- Highway
- Major Road
- Local Road
- Parcel Fabric
- Watercourse

Bipole III Transmission Project

Section S1

Normalized Difference Vegetation Index (NDVI) Summer 2017

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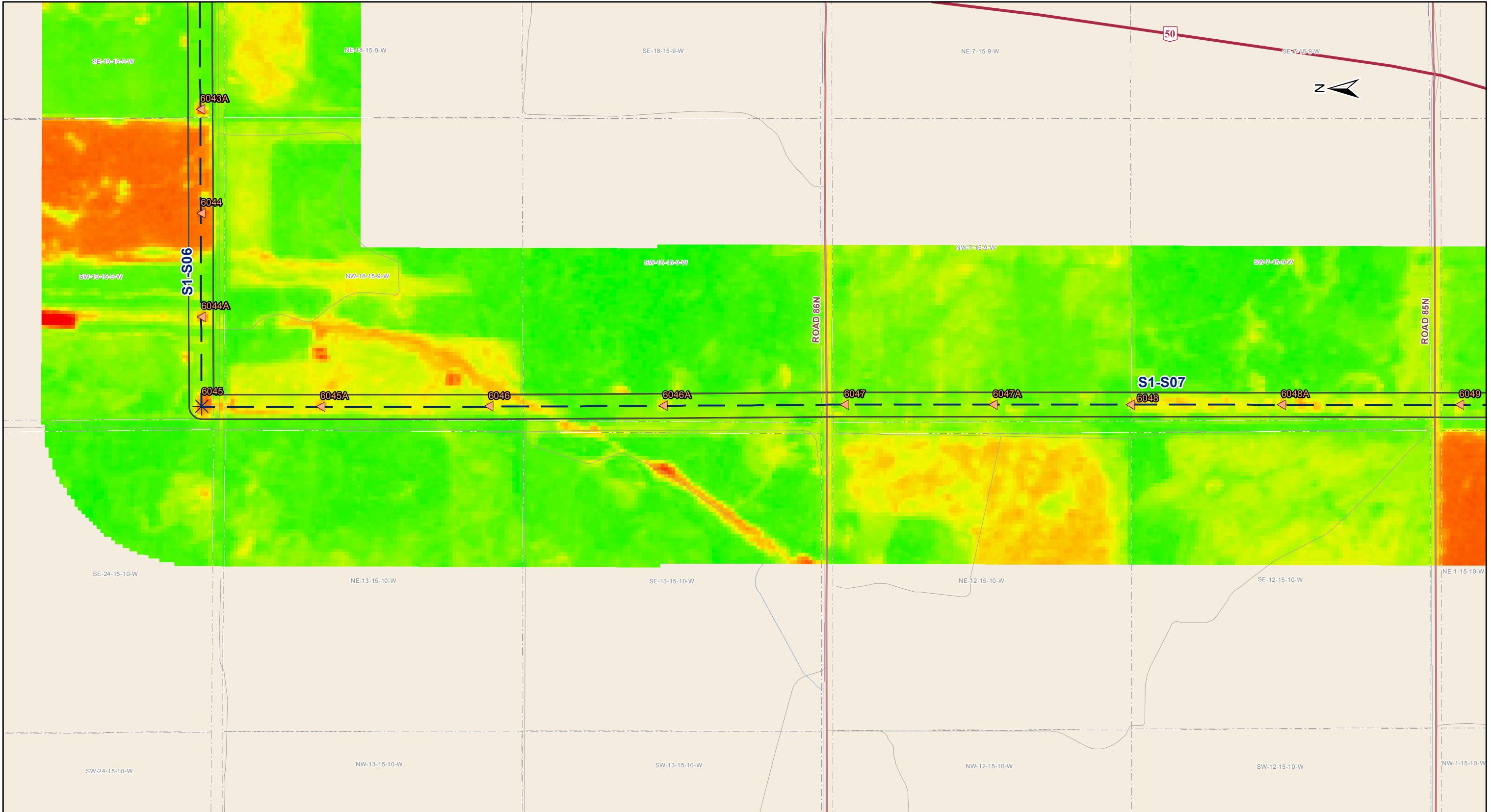


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Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres
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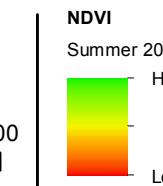
Bipole III Transmission Project Section S1 Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
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Stantec Consulting
Date Created: November 05, 2017

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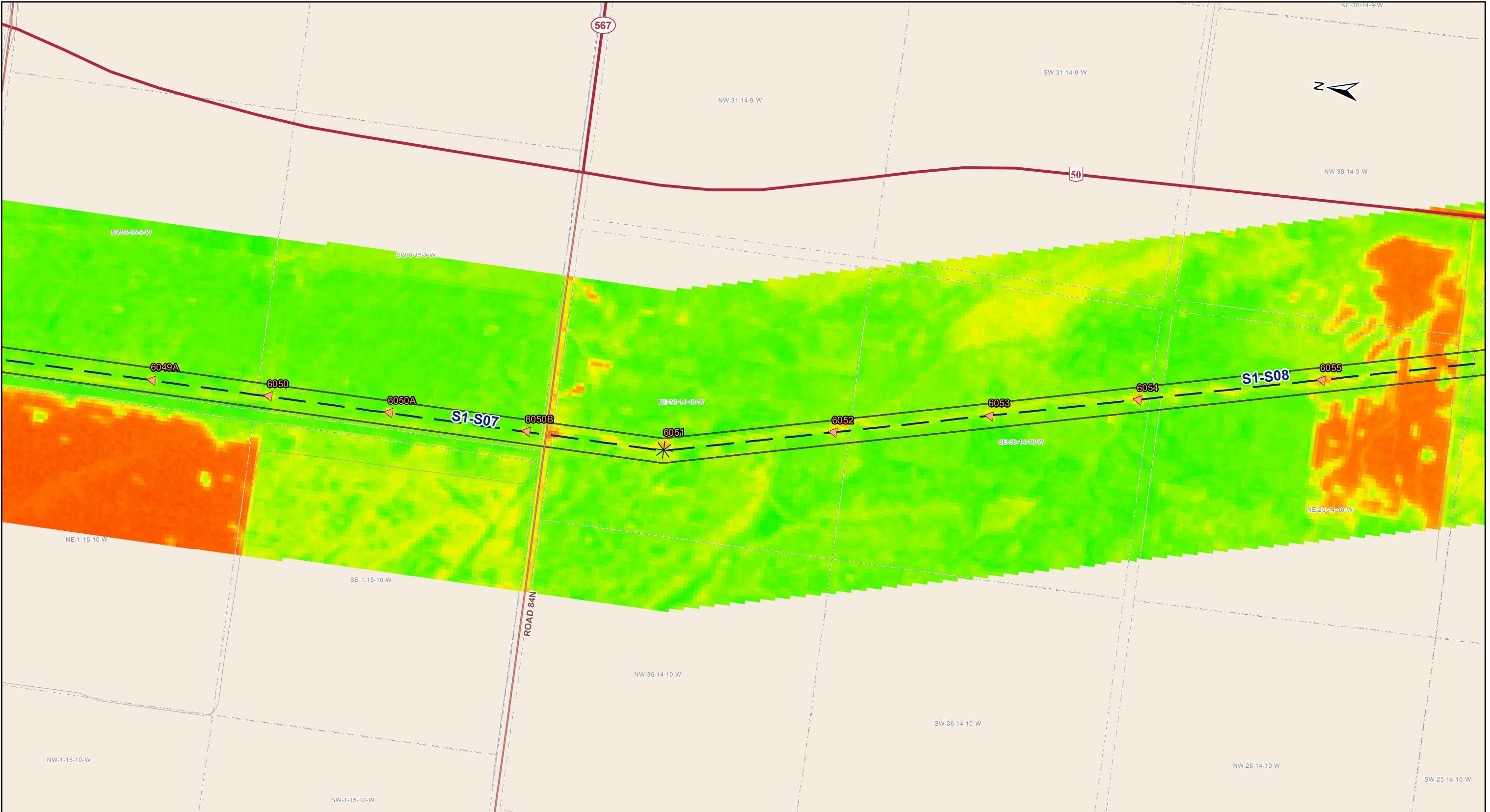


Project Infrastructure
— BPIII Final Preferred Route
□ 66m ROW
★ Angle Towers (Preliminary)
▲ Towers (Preliminary)

Landbase
— Highway
— Major Road
— Local Road
□ Parcel Fabric
— Watercourse

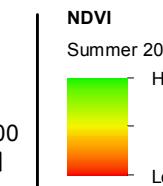
Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
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Metres
1:10,000

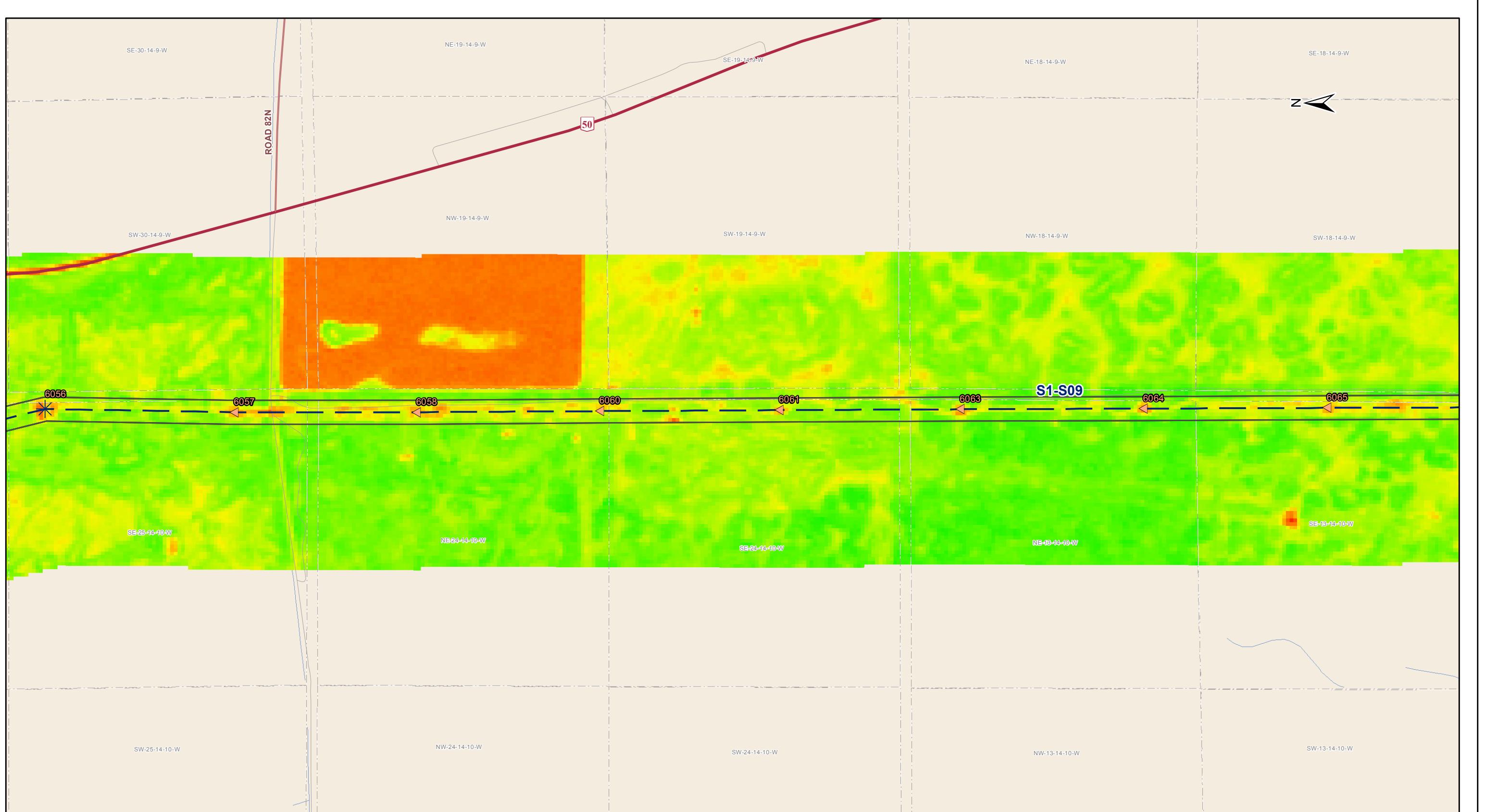


Project Infrastructure
BP III Final Preferred Route
66m ROW
Angle Towers (Preliminary)
Towers (Preliminary)

Landbase
Highway
Major Road
Local Road
Parcel Fabric
Watercourse

Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
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Stantec Consulting
Date Created: November 05, 2017



NDVI
Summer 2017
High : 1
Low : -0.6

0 125 250 500
Metres
1:10,000

Project Infrastructure
— BPIII Final Preferred Route
□ 66m ROW
★ Angle Towers (Preliminary)
▲ Towers (Preliminary)

Landbase
— Highway
— Major Road
— Local Road
— Parcel Fabric
— Watercourse

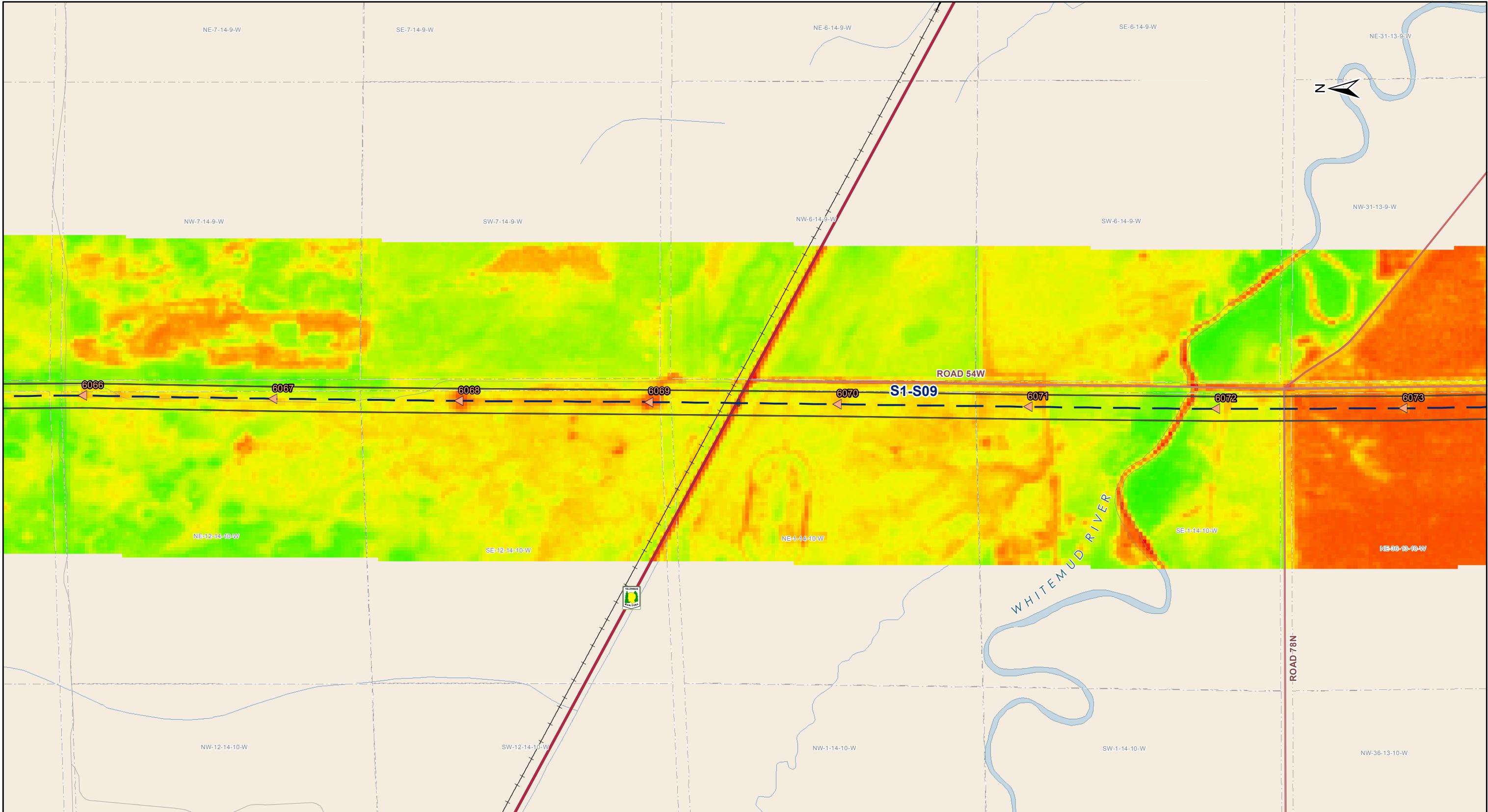
Bipole III Transmission Project

Section S1

Normalized Difference Vegetation Index (NDVI)

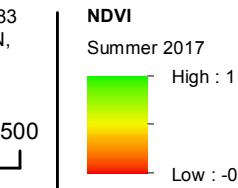
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- Proposed Access Route
- ▲ Towers (Preliminary)

Landbase

- Highway
- Major Road
- Local Road
- Railway (Operational)
- Parcel Fabric

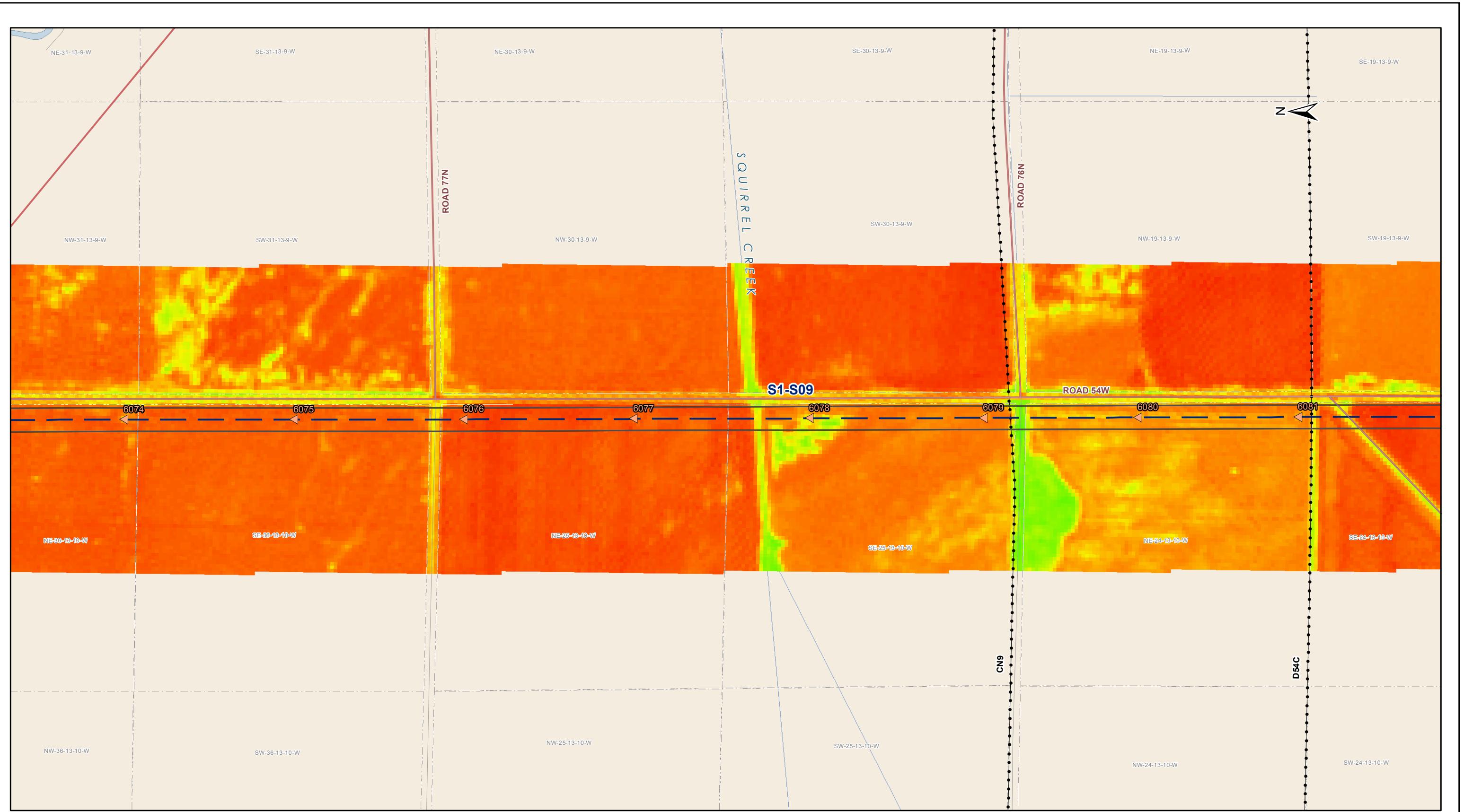


Bipole III Transmission Project

Section S1

Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000

NDVI
Summer 2017
High : 1
Low : -0.6

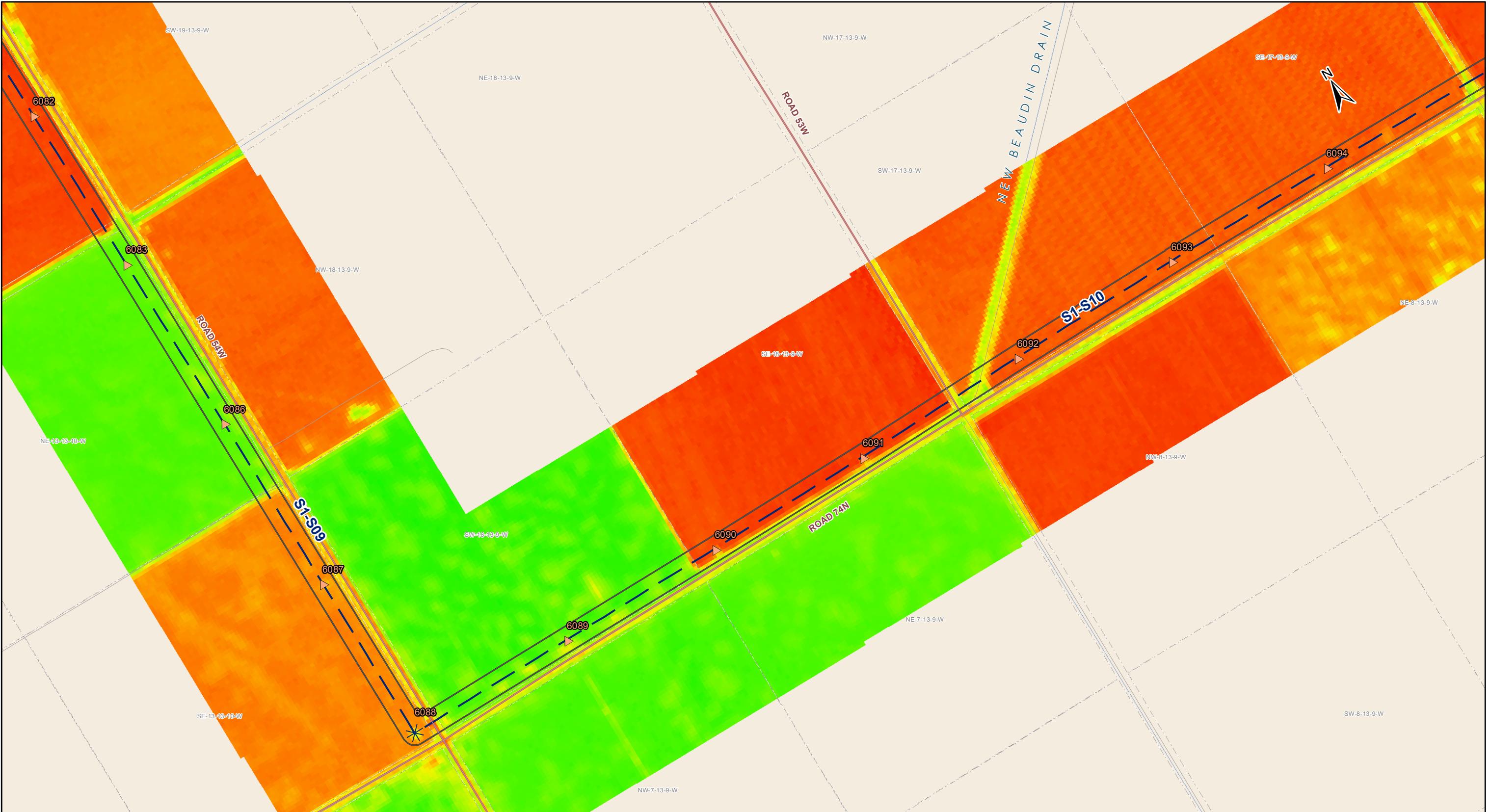
Project Infrastructure
BP III Final Preferred Route
66m ROW
Towers (Preliminary)

Landbase
Major Road
Local Road
Transmission Line
Parcel Fabric
Waterbody
Watercourse

Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

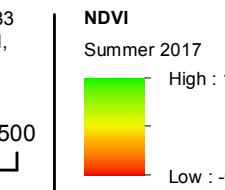
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0 125 250 500
Metres
1:10,000



Project Infrastructure

- BP III Final Preferred Route
- 66m ROW
- ★ Angle Towers (Preliminary)
- ▲ Towers (Preliminary)

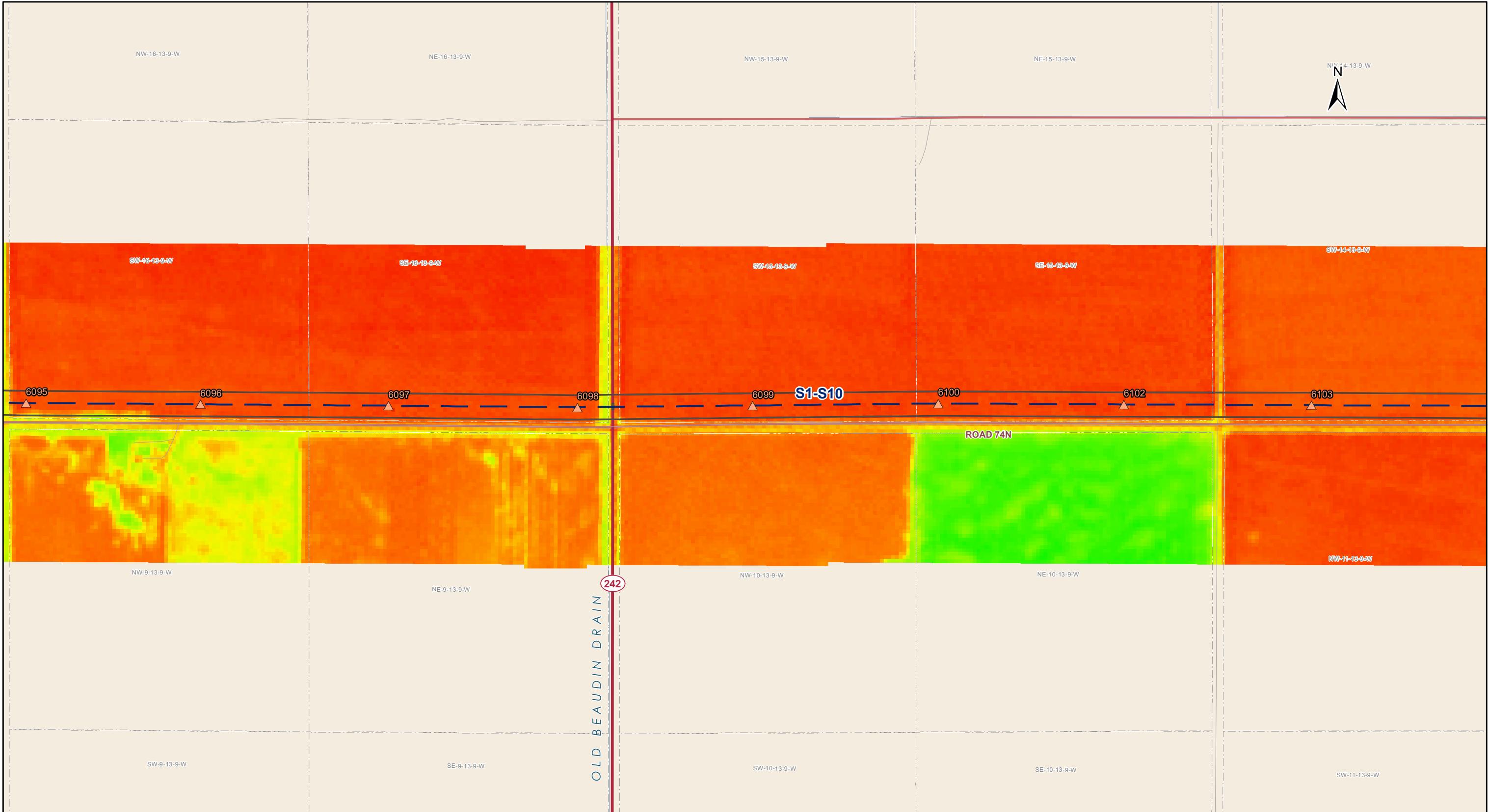
Landbase

- Major Road
- Local Road
- Parcel Fabric
- Watercourse



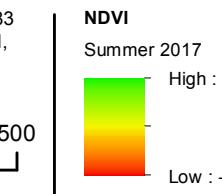
Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- Proposed Access Route
- ▲ Towers (Preliminary)

Landbase

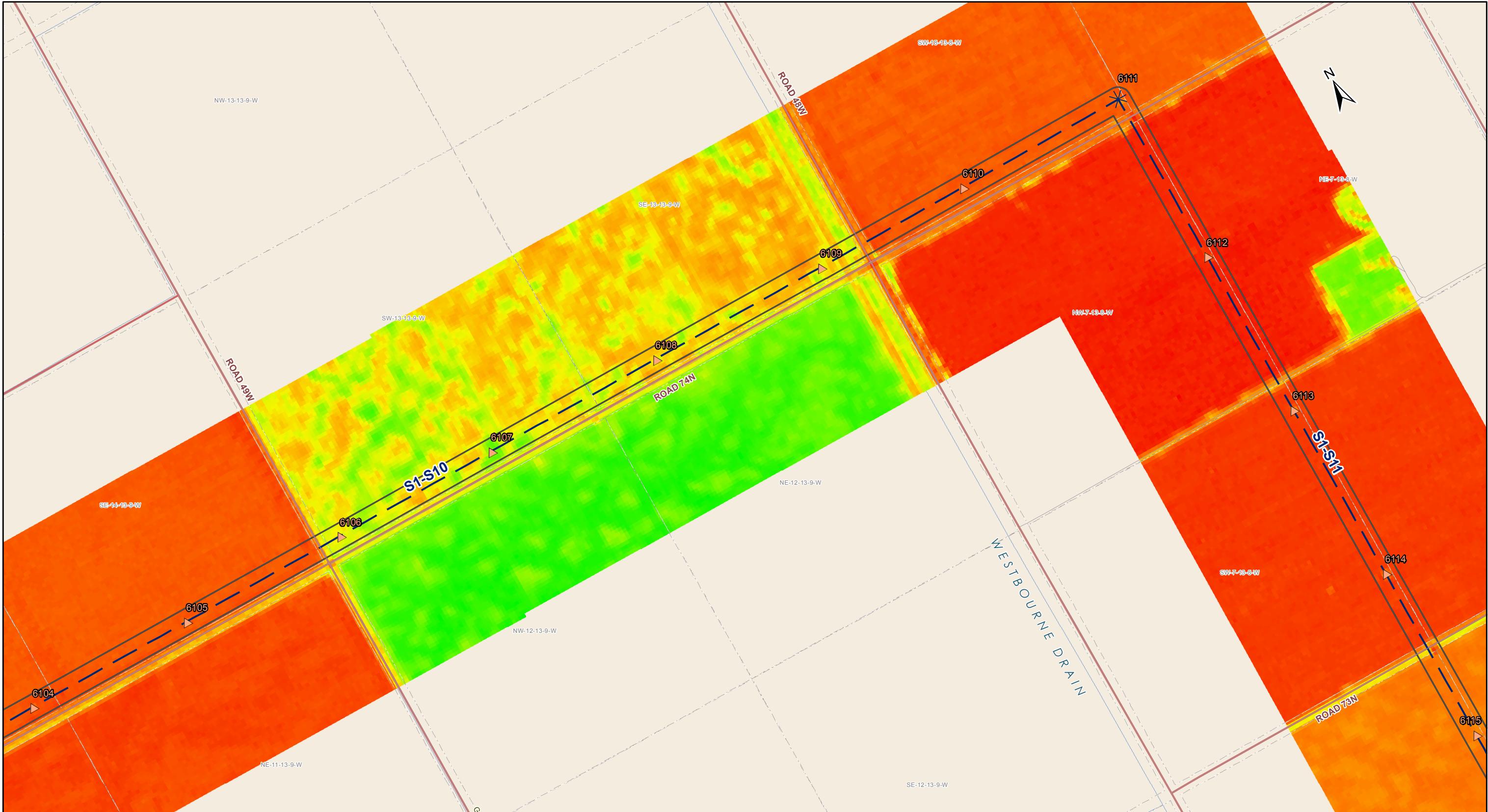
- Highway
- Major Road
- Local Road
- Parcel Fabric
- Watercourse

Bipole III Transmission Project

Section S1

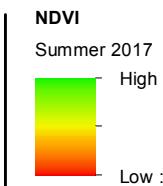
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BP III Final Preferred Route
- 66m ROW
- ★ Angle Towers (Preliminary)
- ▲ Towers (Preliminary)

Landbase

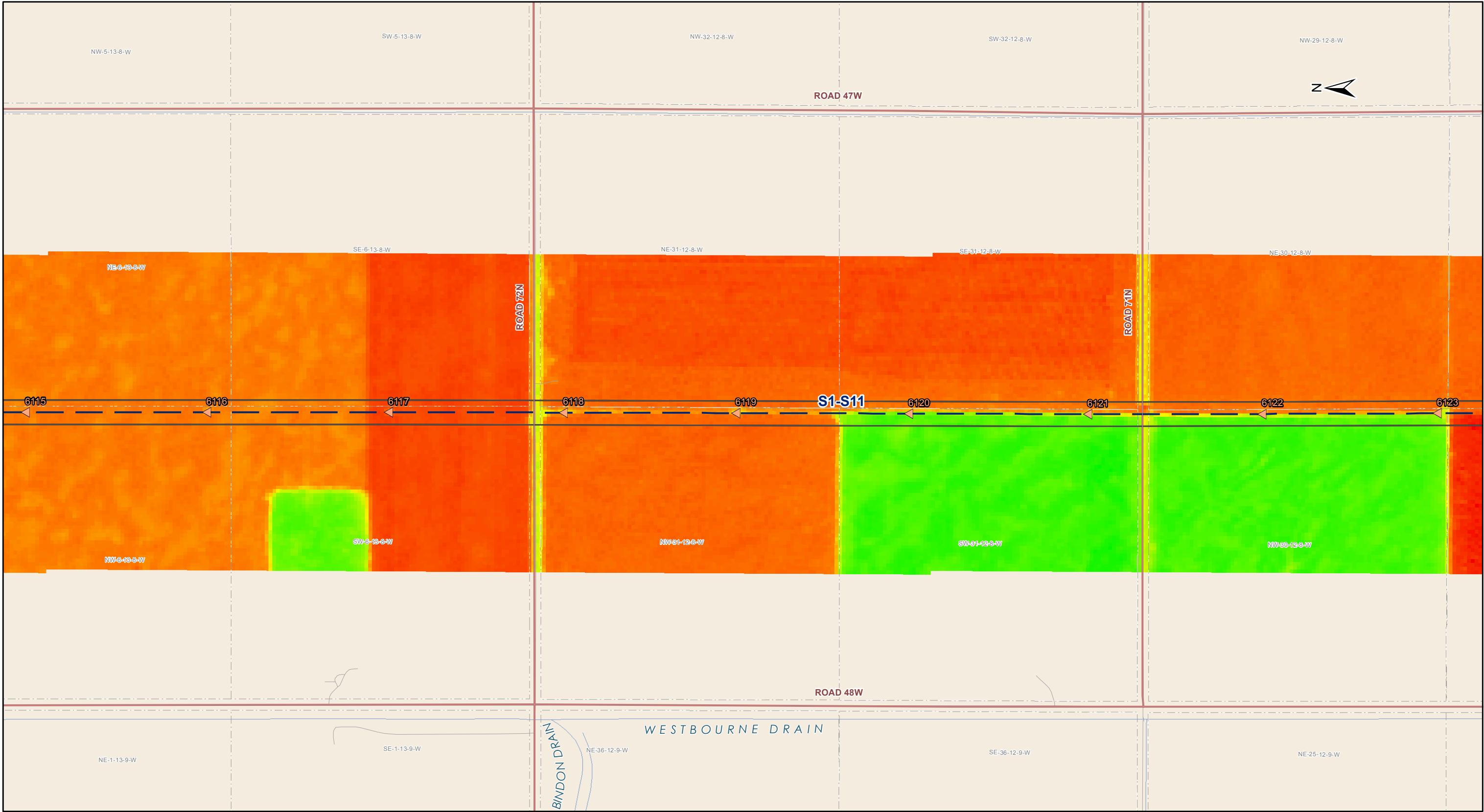
- Major Road
- Local Road
- Parcel Fabric
- Watercourse

Bipole III Transmission Project

Section S1

Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
 Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
 Date Created: November 05, 2017

0 125 250 500
 Metres
 1:10,000

NDVI
 Summer 2017
 High : 1
 Low : -0.6

Project Infrastructure

- BPIII Final Preferred Route (Blue line)
- 66m ROW (White box)
- Towers (Preliminary) (Orange triangle)

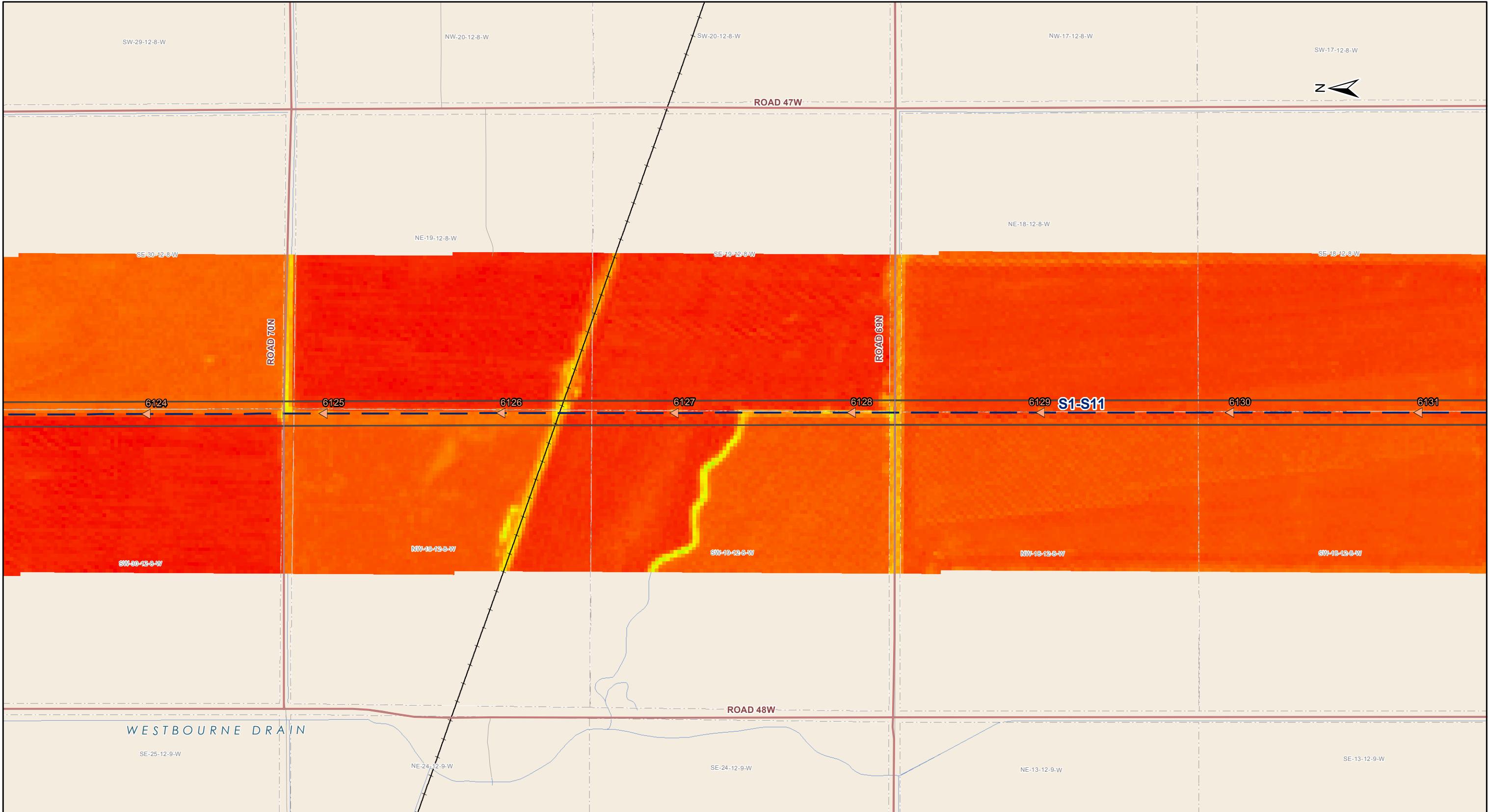
Landbase

- Major Road (Red line)
- Local Road (Grey line)
- Parcel Fabric (Dashed line)
- Watercourse (Blue line)

Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

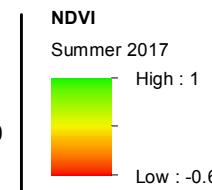
DRAFT

Map 4-400-16



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure

- BP III Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

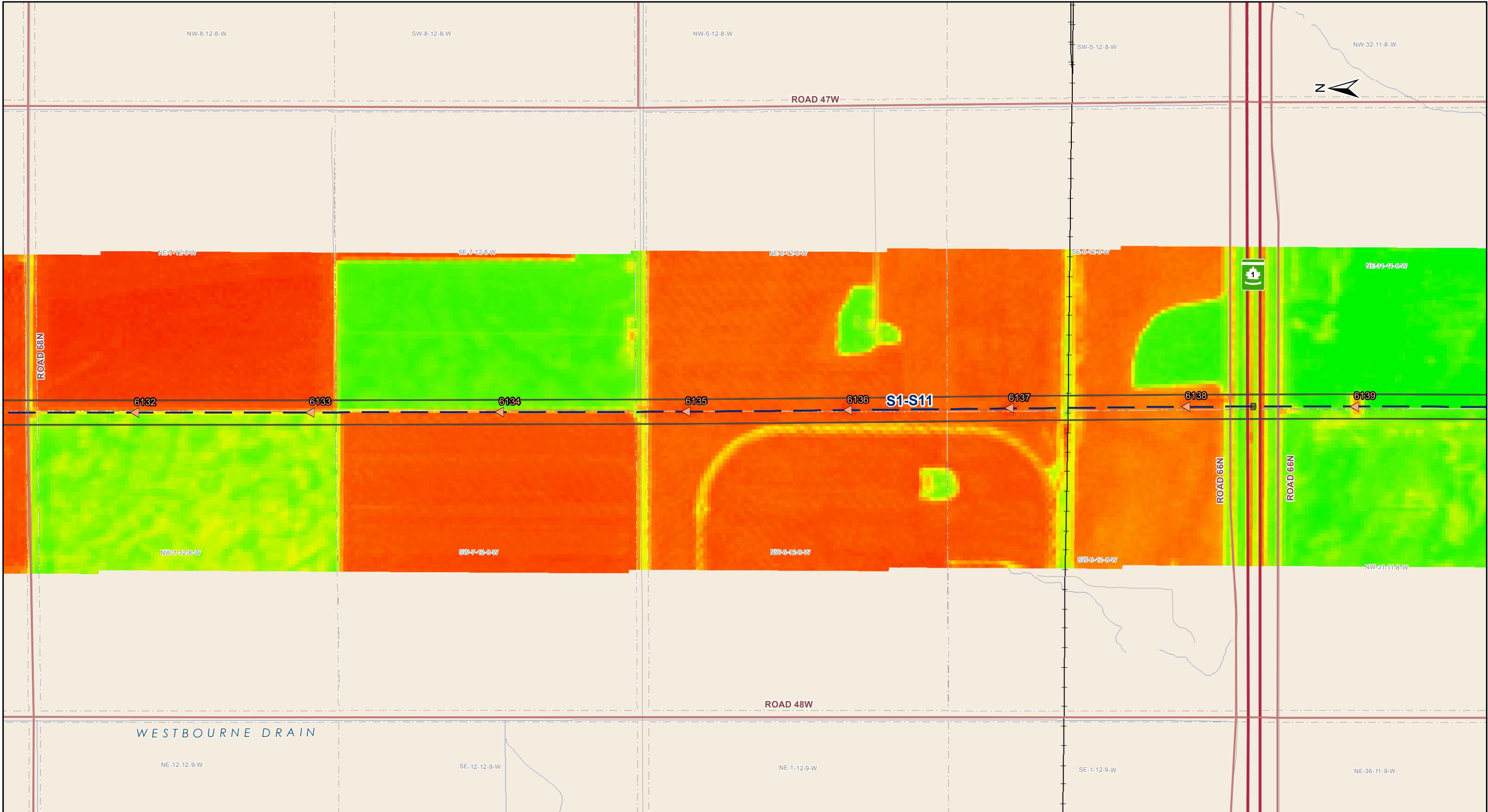
- Major Road
- Local Road
- Railway (Operational)
- Parcel Fabric
- Watercourse

Bipole III Transmission Project

Section S1

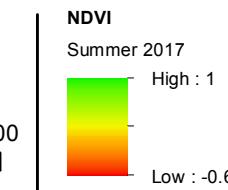
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
 Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
 Date Created: November 05, 2017

0 125 250 500
 Metres
 1:10,000



Project Infrastructure

- BPIII Final Preferred Route (Dashed Blue Line)
- 66m ROW (White Box)
- Proposed Access Route (Brown Line)
- Towers (Preliminary) (Orange Triangle)

Landbase

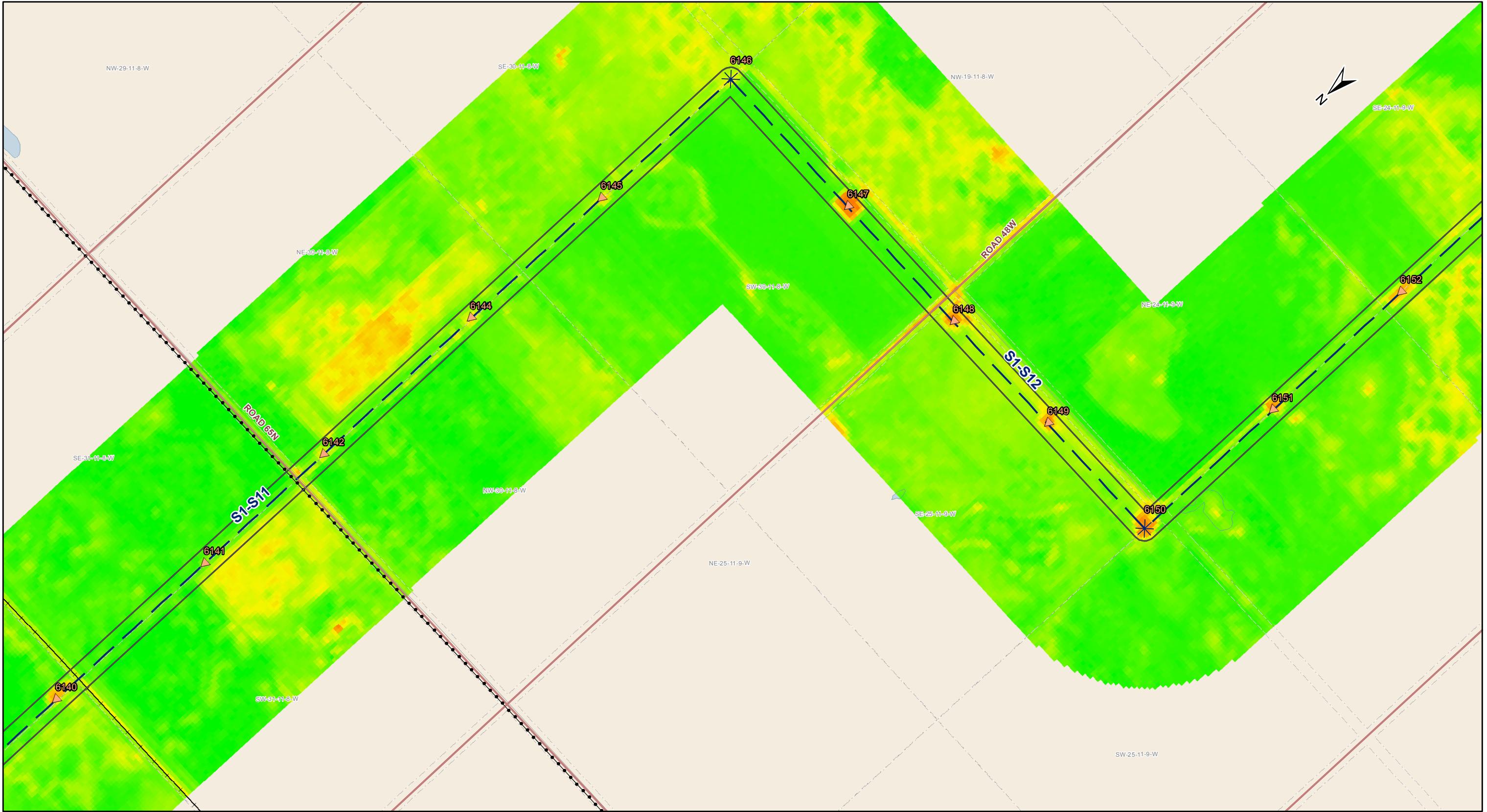
- Highway (Red Line)
- Major Road (Red Line)
- Local Road (Grey Line)
- Railway (Operational) (Black Line)
- Parcel Fabric (Light Blue Box)
- Watercourse (Blue Line)

Bipole III Transmission Project

Section S1

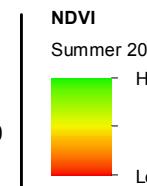
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



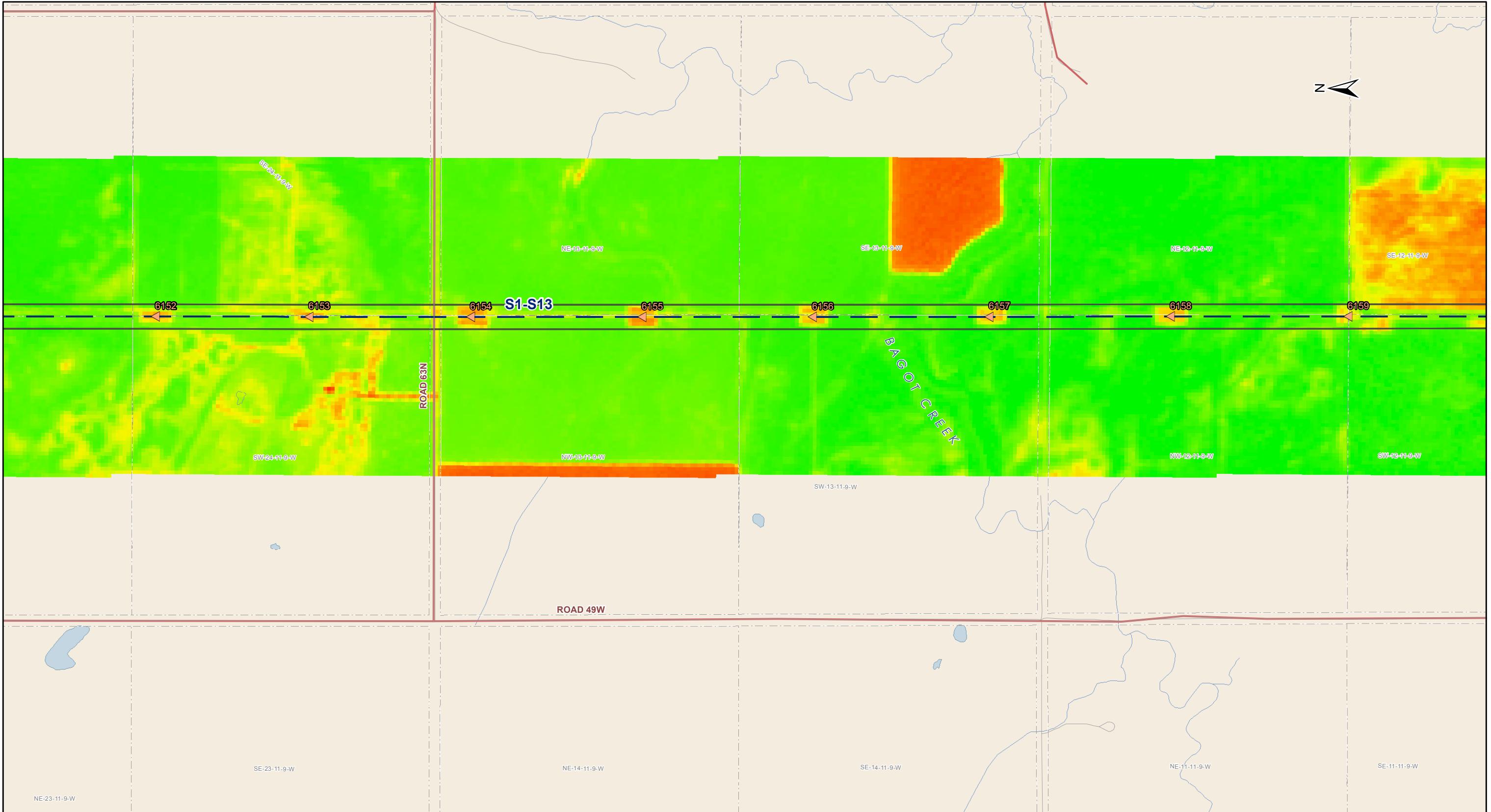
Project Infrastructure
— BP III Final Preferred Route
□ 66m ROW
★ Angle Towers (Preliminary)
▲ Towers (Preliminary)

Landbase
— Major Road
— Local Road
— Railway (Operational)
••• Transmission Line
□ Parcel Fabric



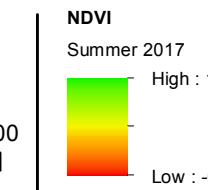
Bipole III Transmission Project Section S1 Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

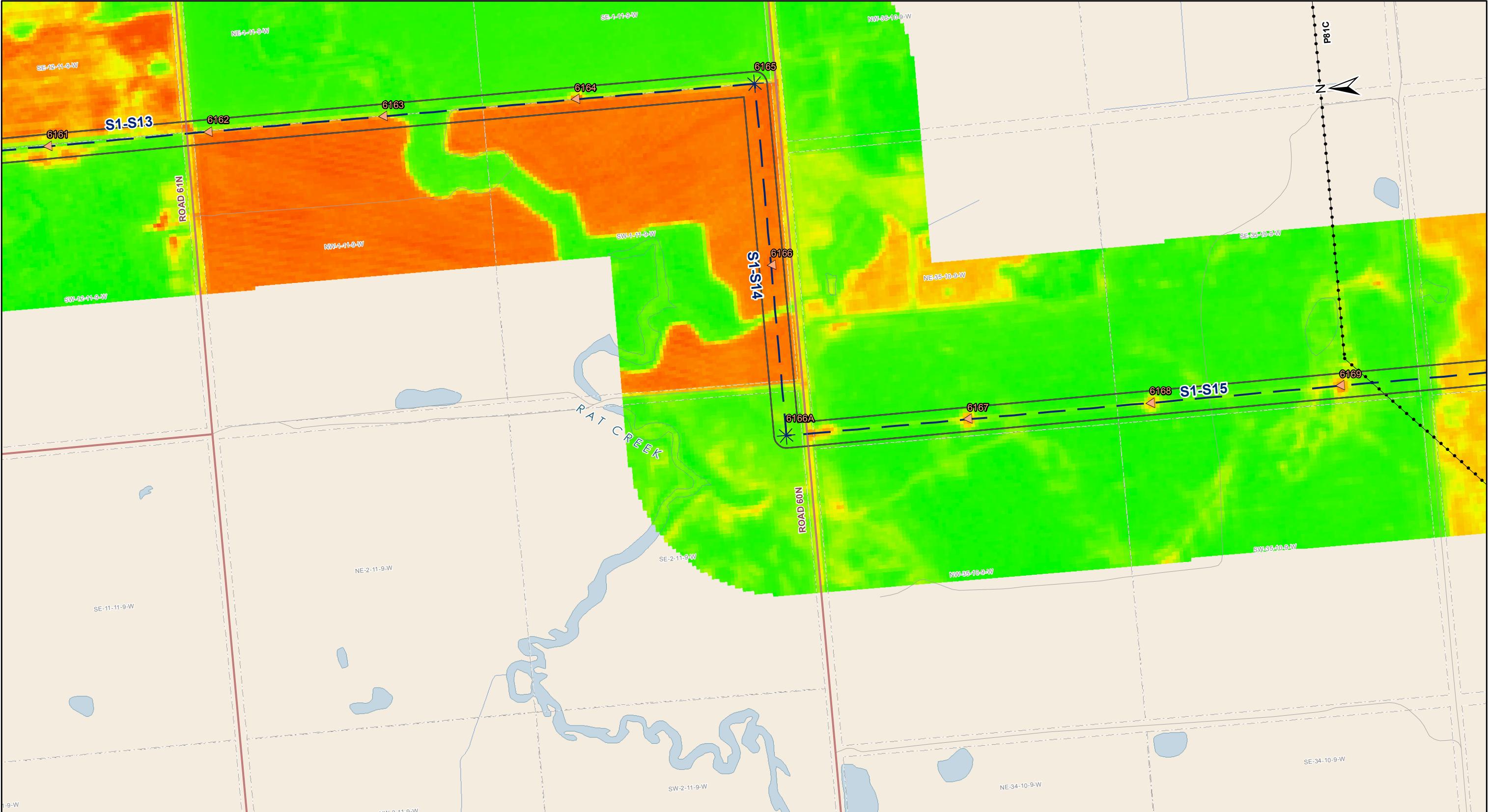
Landbase

- Major Road
- Local Road
- Parcel Fabric
- Waterbody
- Watercourse

Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

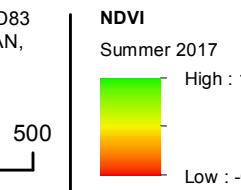
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Map 4-400-20



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



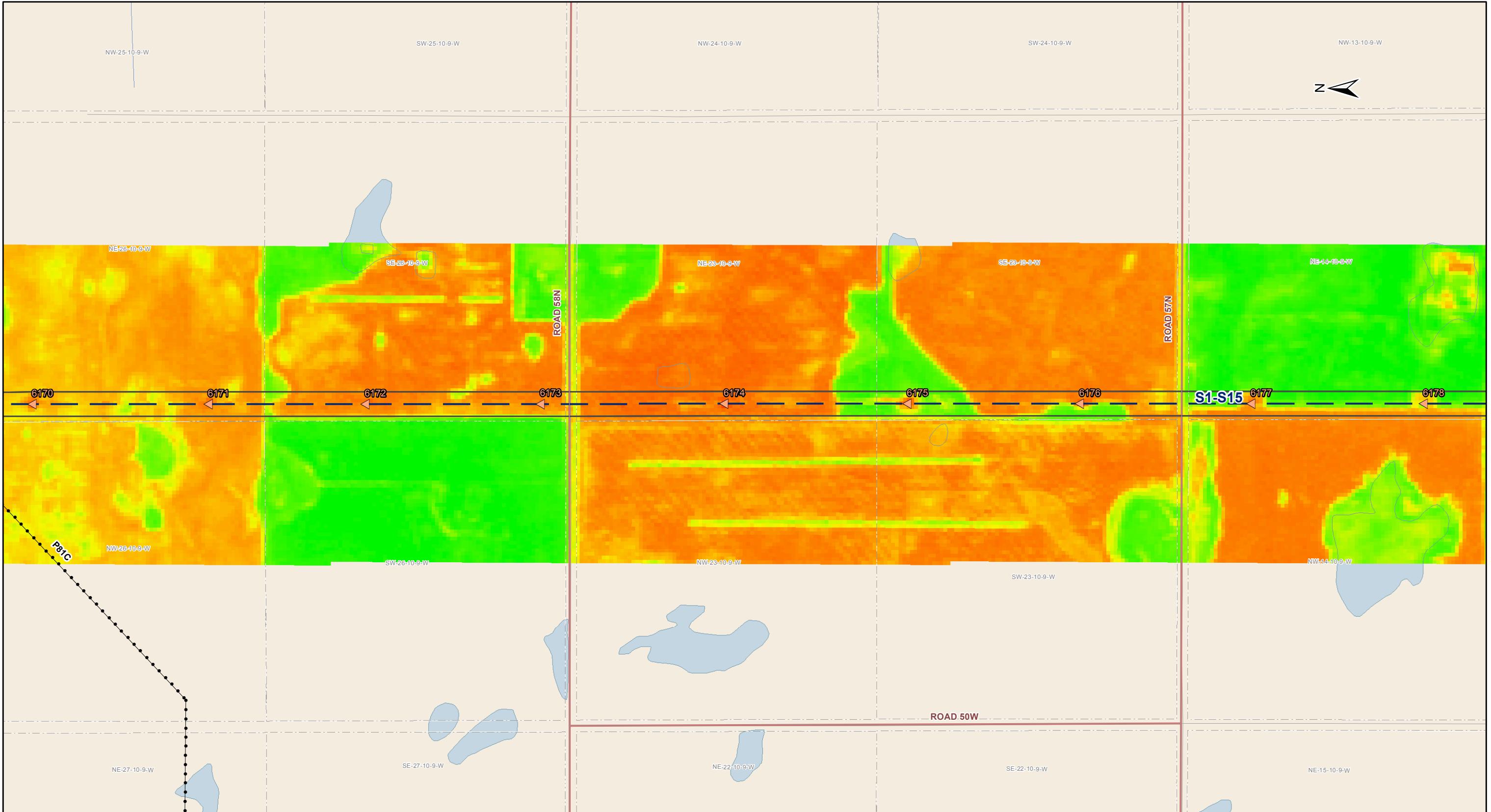
- Project Infrastructure**
- BPIII Final Preferred Route
 - 66m ROW
 - Angle Towers (Preliminary)
 - Towers (Preliminary)

- Landbase**
- Major Road
 - Local Road
 - Transmission Line
 - Parcel Fabric
- Waterbody
Watercourse



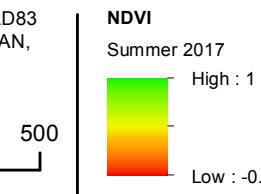
Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BP III Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

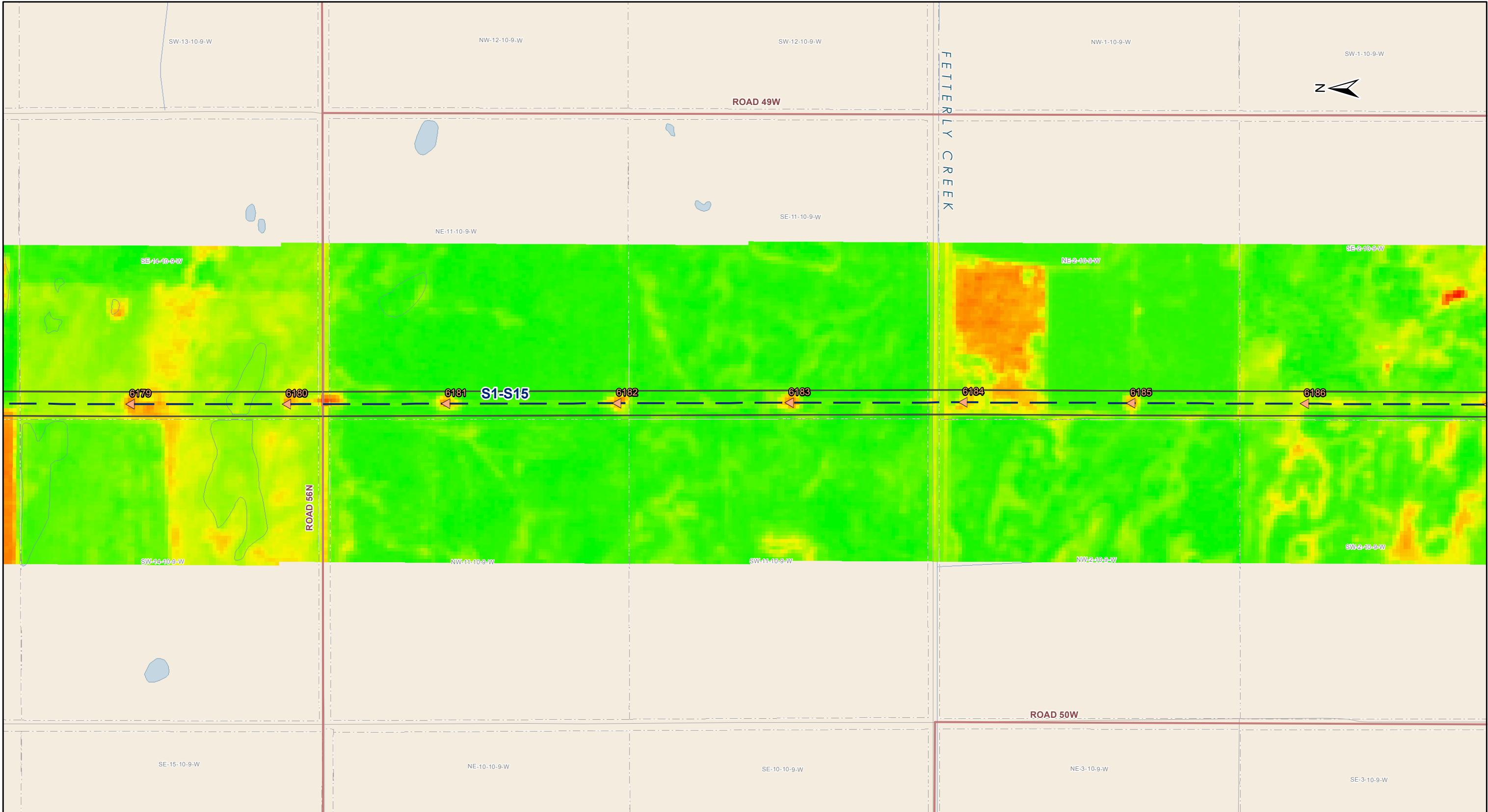
- Major Road
- Local Road
- Transmission Line
- Parcel Fabric
- Waterbody
- Watercourse

Bipole III Transmission Project

Section S1

Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000

NDVI
Summer 2017
High : 1
Low : -0.6

Project Infrastructure
— BPIII Final Preferred Route
□ 66m ROW
▲ Towers (Preliminary)

Landbase
— Major Road
— Local Road
□ Parcel Fabric
■ Waterbody
— Watercourse

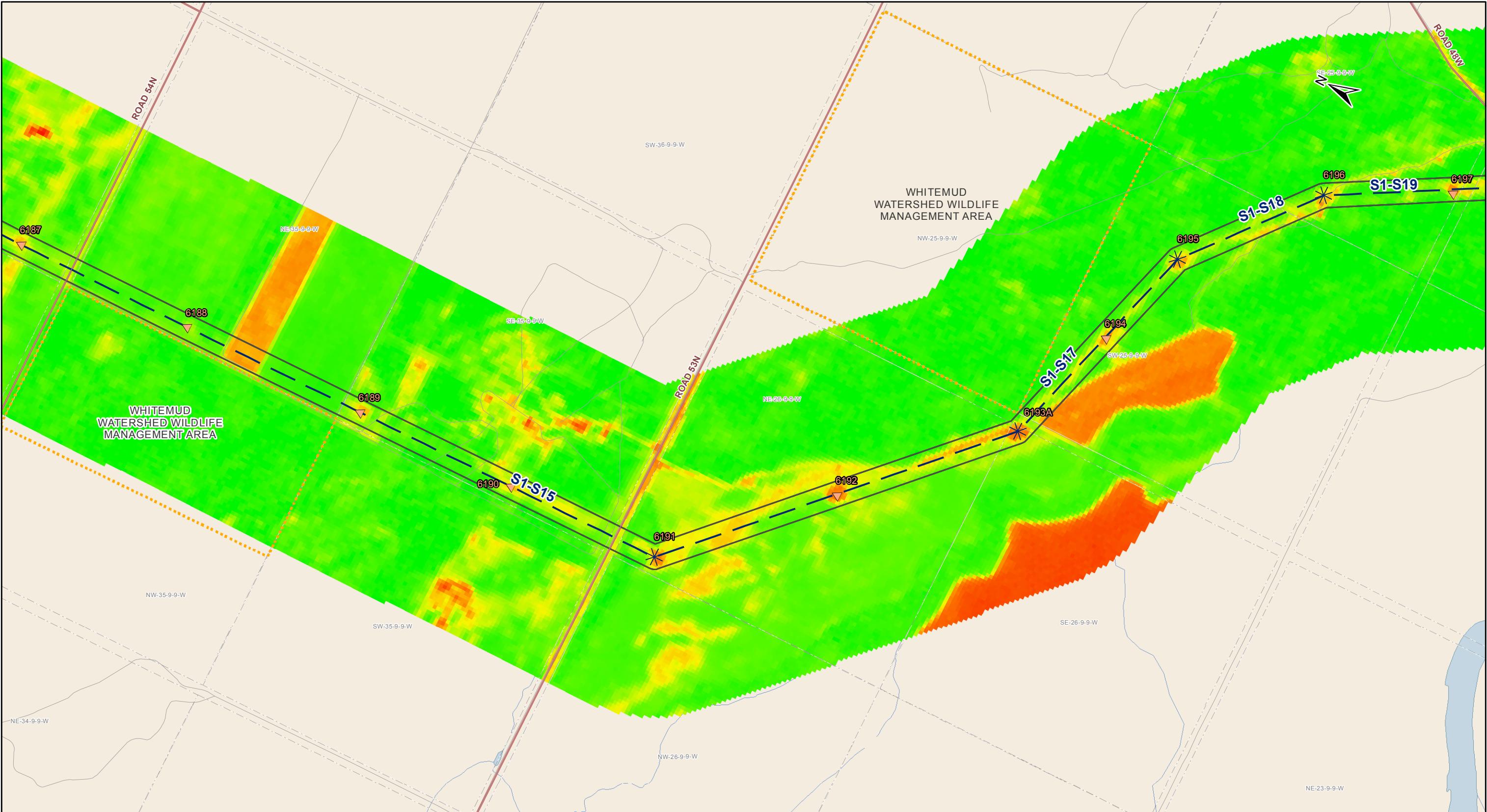


Bipole III Transmission Project

Section S1

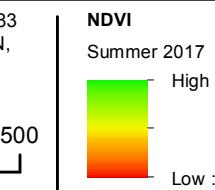
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- Angle Towers (Preliminary)
- Towers (Preliminary)

Landbase

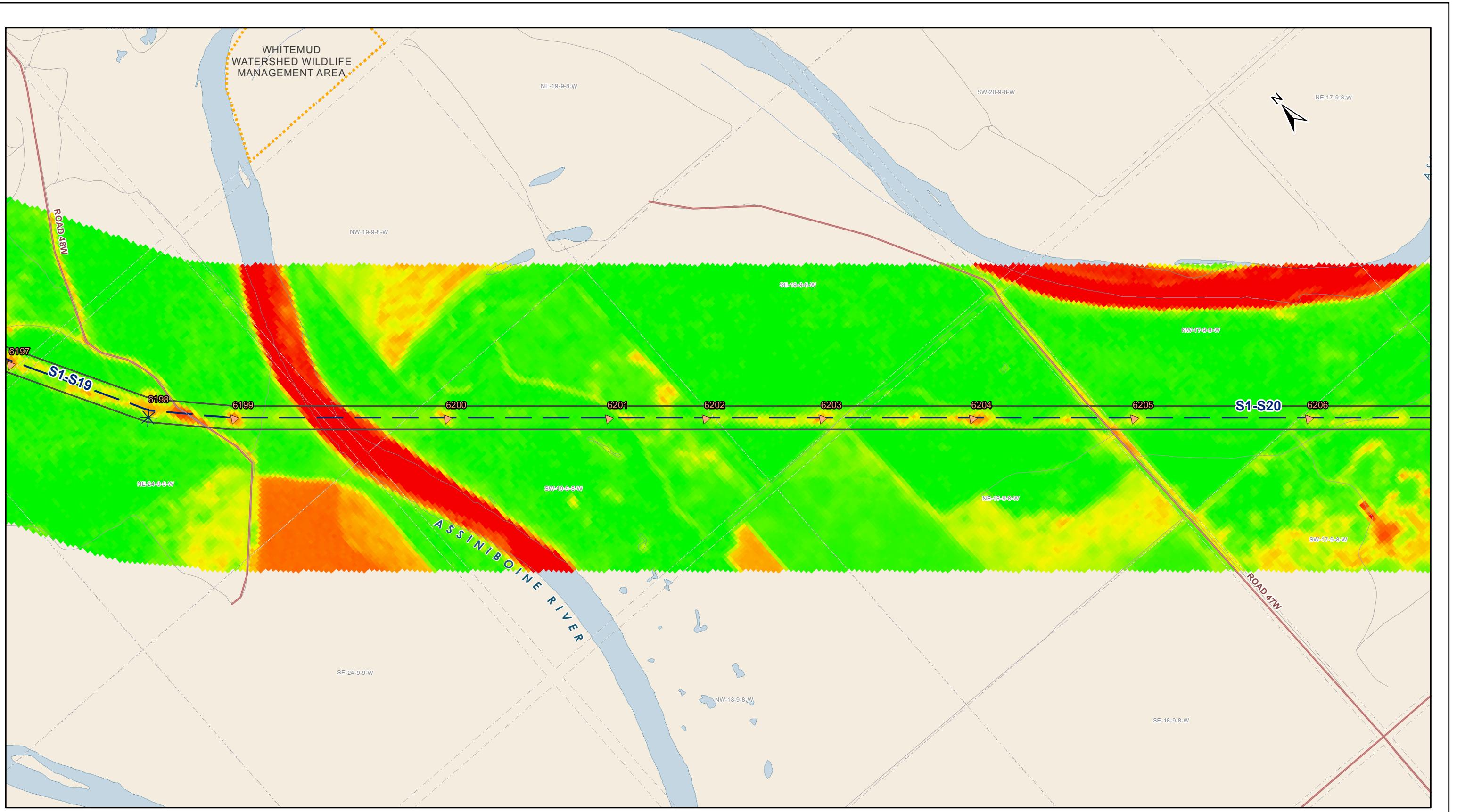
- Major Road
- Local Road
- Wildlife Management Area
- Parcel Fabric
- Waterbody
- Watercourse

Bipole III Transmission Project

Section S1

Normalized Difference Vegetation Index (NDVI) Summer 2017

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DOCUMENT PATH: G:\GIS PROJECT FOLDER\00 HYDRO\111420045\ARCMAP\SOIL PRODUCTIVITY\2017BPIII NDVI_S1_20171105.MXD



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000

NDVI
Summer 2017
High : 1
Low : -0.6

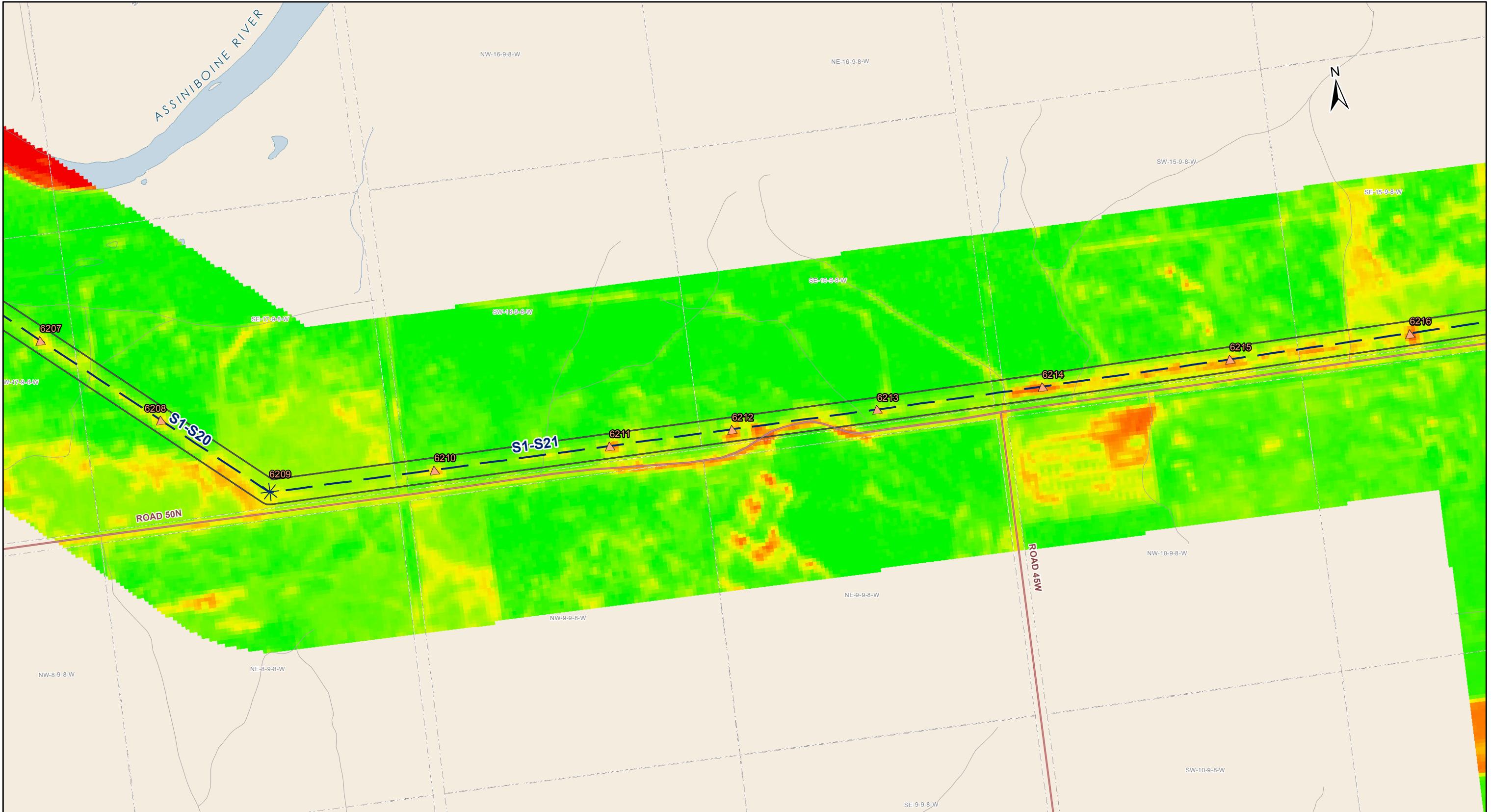
Project Infrastructure
— BPIII Final Preferred Route
□ 66m ROW
★ Angle Towers (Preliminary)
▲ Towers (Preliminary)

Landbase
— Major Road
— Local Road
— Waterbody
— Watercourse
— Wildlife Management Area
— Parcel Fabric

Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

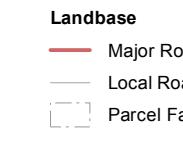
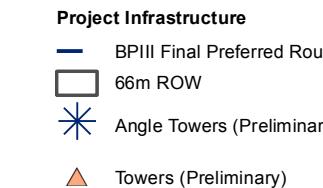
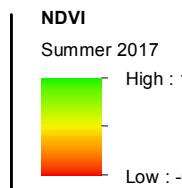
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Map 4-400-25



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

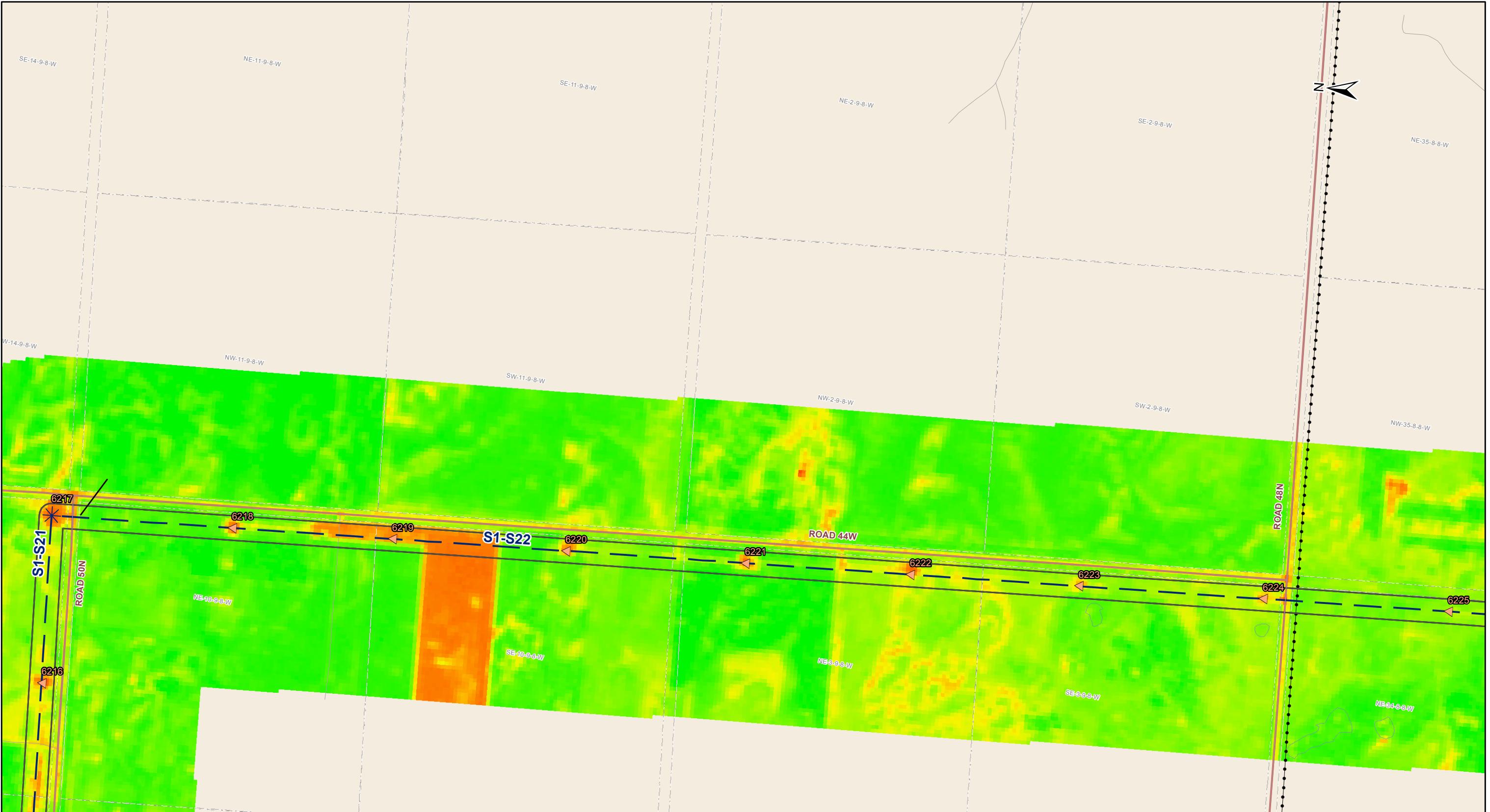
0 125 250 500
Metres
1:10,000



Waterbody
Watercourse

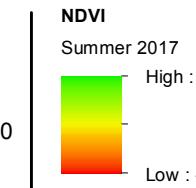
Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

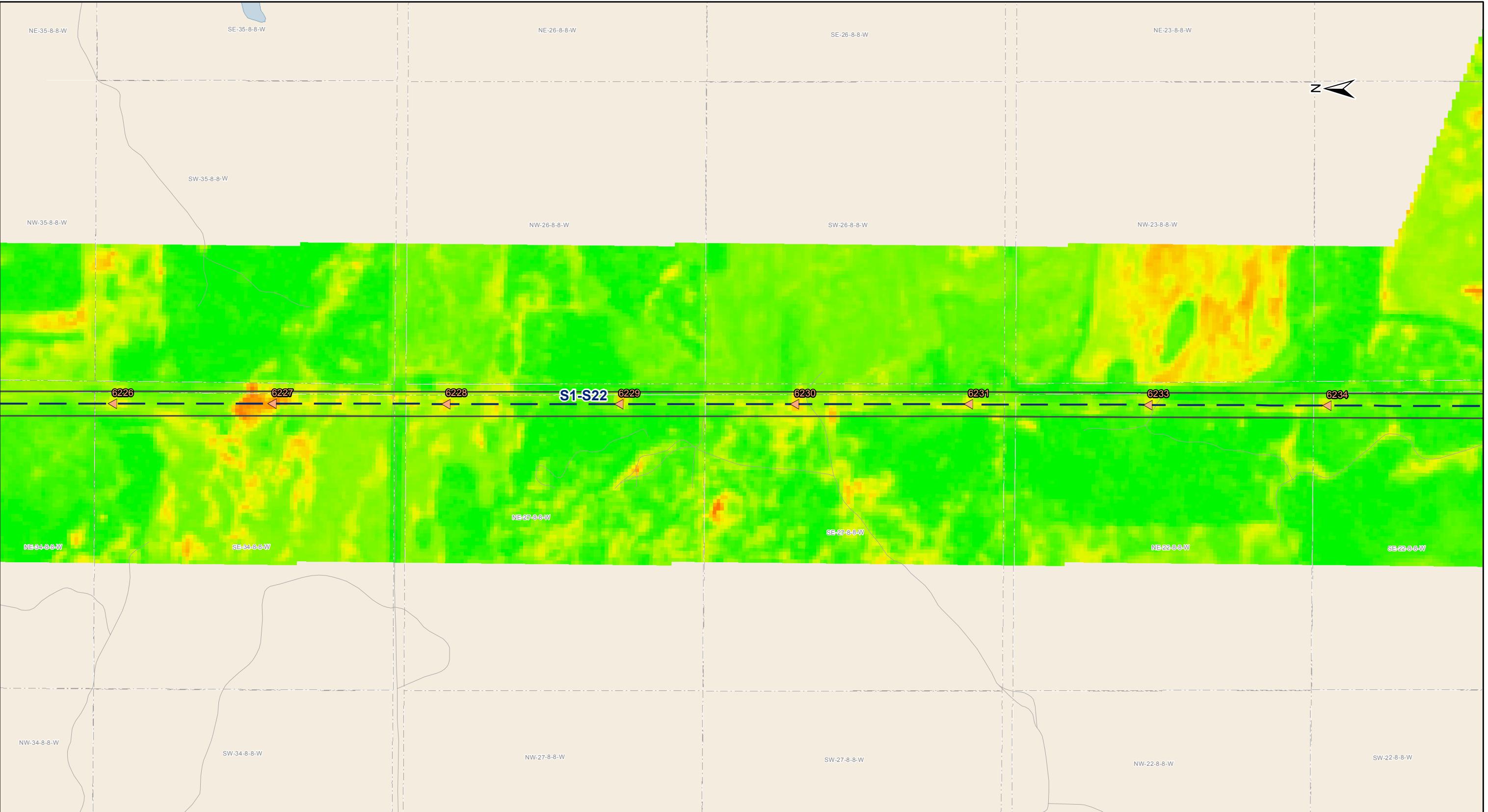
- BPIII Final Preferred Route
- 66m ROW
- * Angle Towers (Preliminary)
- ▲ Towers (Preliminary)

Landbase

- Major Road
- Local Road
- Transmission Line
- Parcel Fabric
- Waterbody
- Watercourse

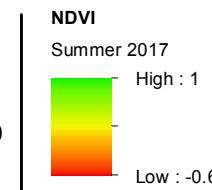
Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure
— BPIII Final Preferred Route
□ 66m ROW
▲ Towers (Preliminary)

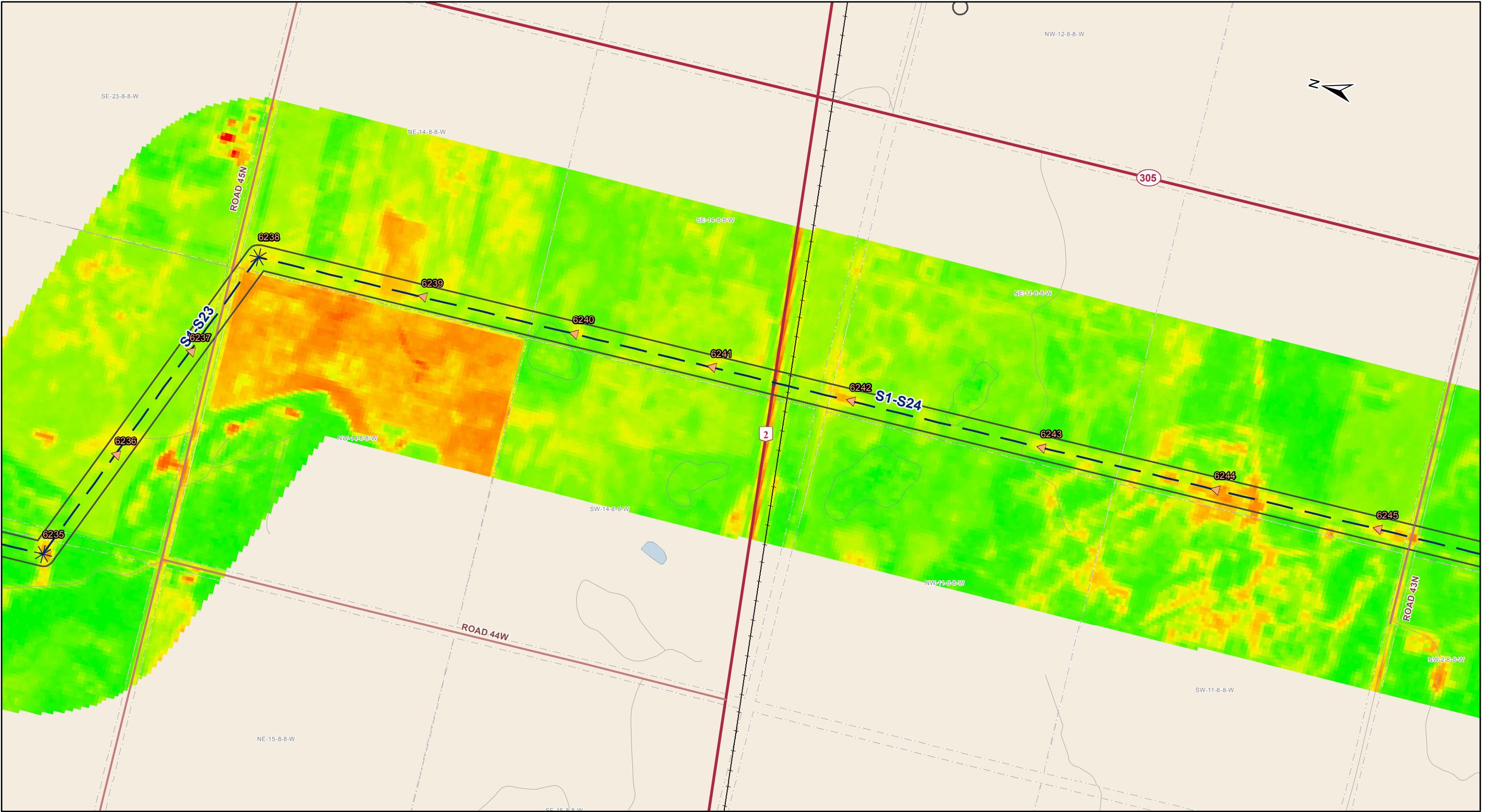
Landbase
— Local Road
□ Waterbody
— Parcel Fabric

Bipole III Transmission Project

Section S1

Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000

NDVI
Summer 2017
High : 1
Low : -0.6

Project Infrastructure
BPIII Final Preferred Route
66m ROW
Proposed Access Route
Angle Towers (Preliminary)
Towers (Preliminary)

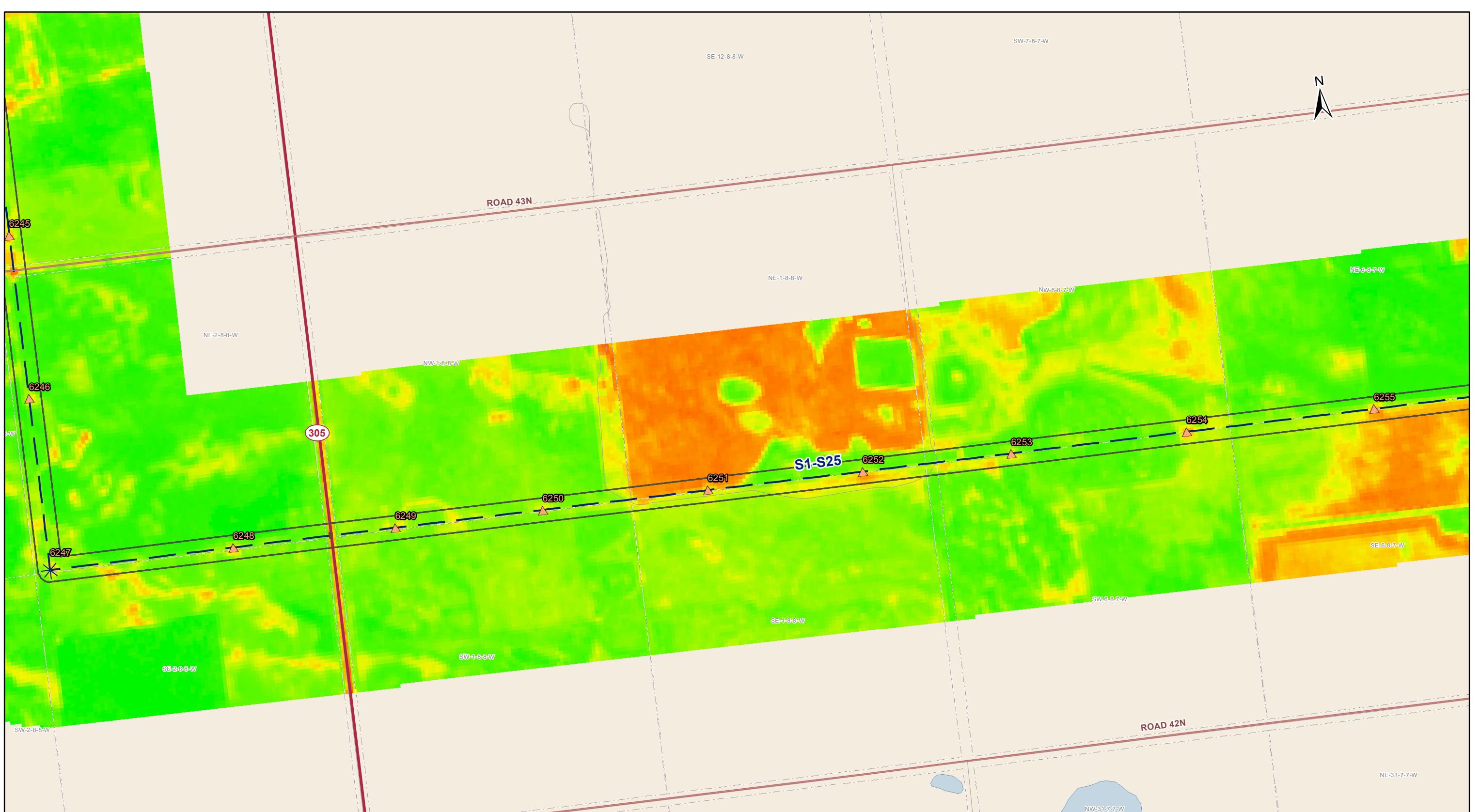
Landbase
Highway
Major Road
Local Road
Railway (Operational)
Parcel Fabric

Waterbody



Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

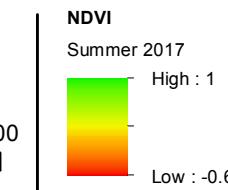
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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

0 125 250 500 Metres

1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- Proposed Access Route
- * Angle Towers (Preliminary)
- △ Towers (Preliminary)

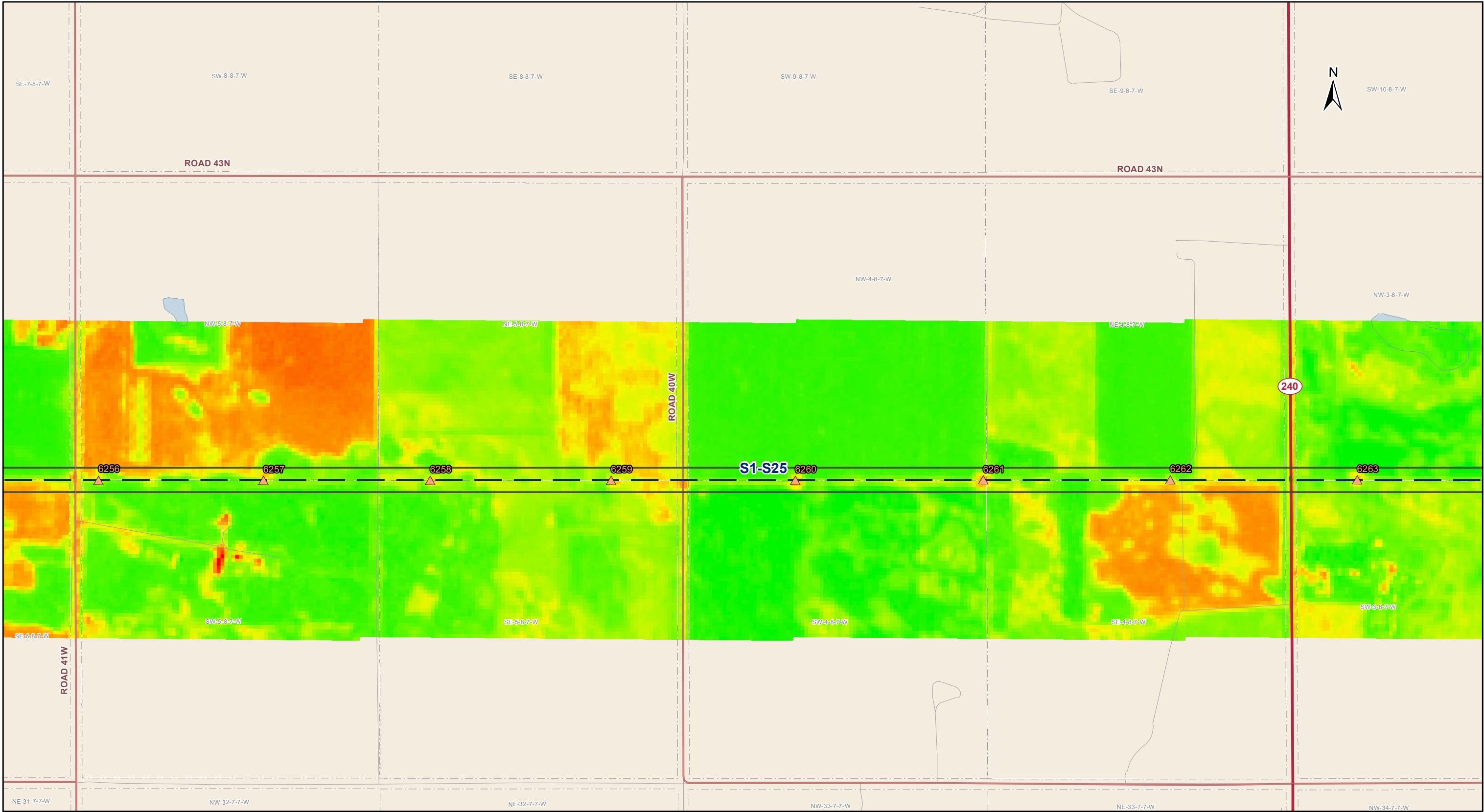
Landbase

- Highway
- Waterbody
- Major Road
- Local Road
- Parcel Fabric

Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

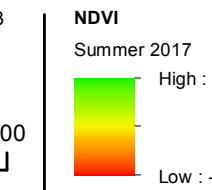
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Map 4-400-30



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres
1:10,000

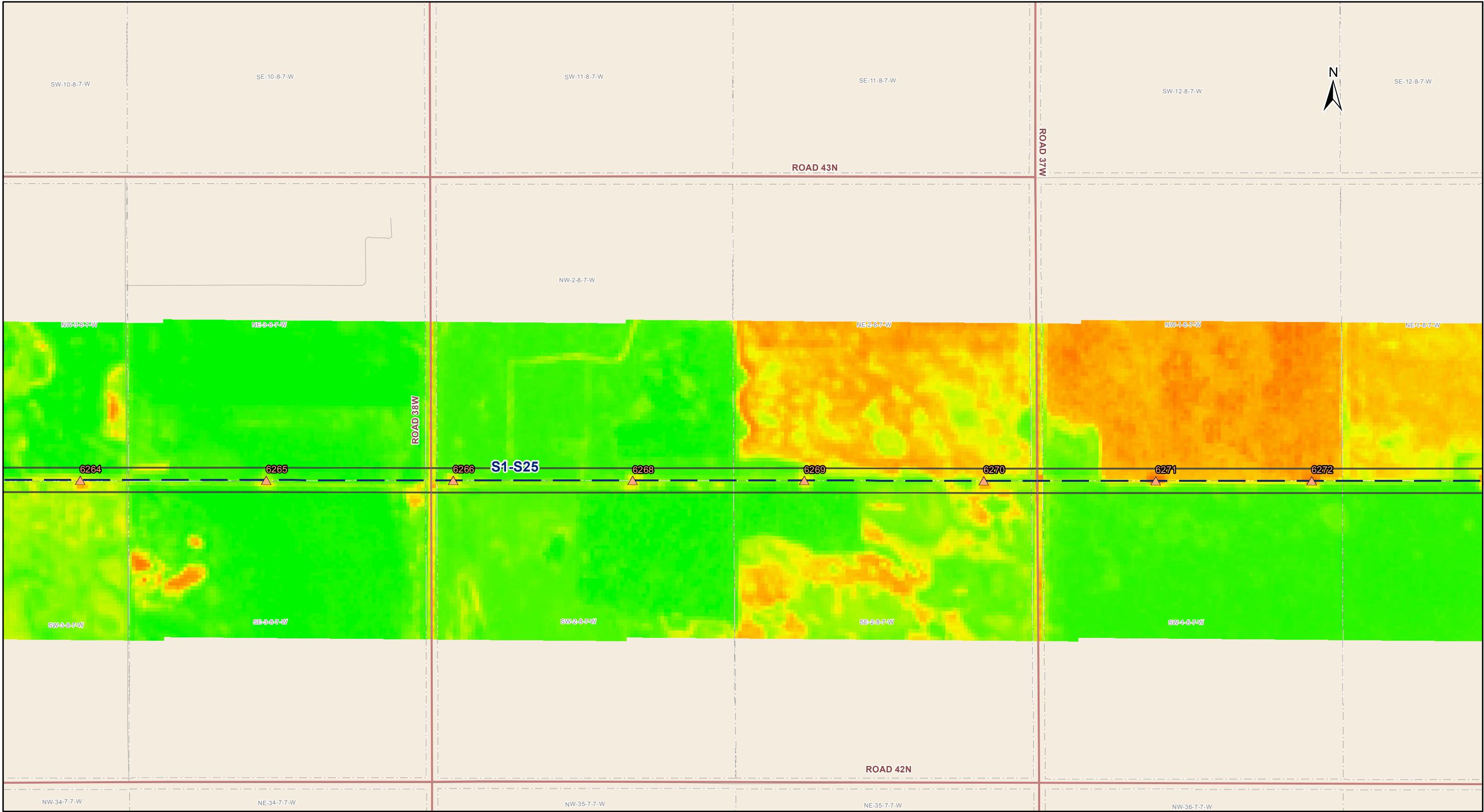


Project Infrastructure
BPIII Final Preferred Route
66m ROW
Proposed Access Route
Towers (Preliminary)

Landbase
Highway
Major Road
Local Road
Parcel Fabric
Waterbody

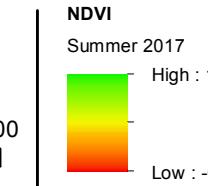
Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000

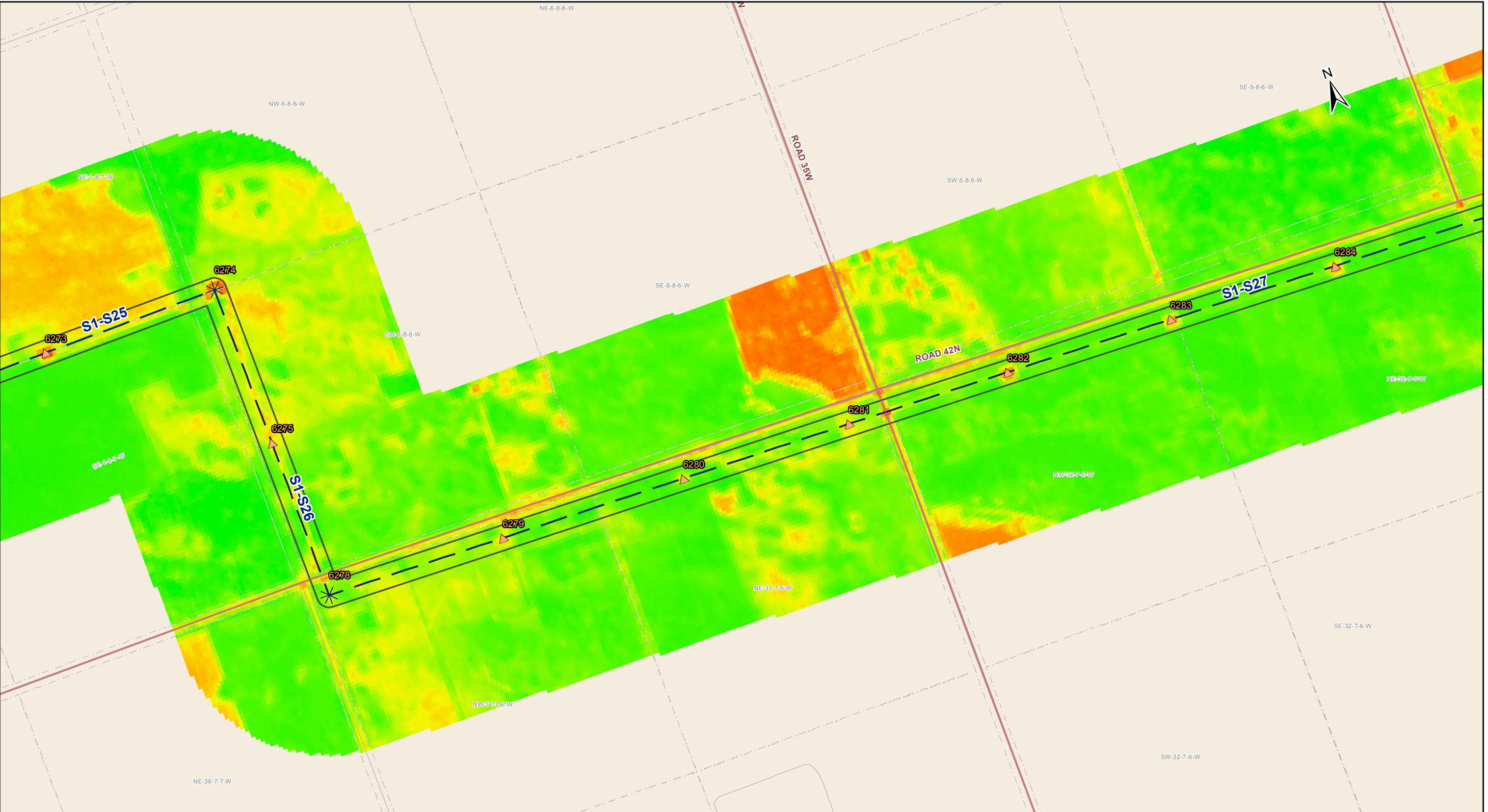


Project Infrastructure
BP III Final Preferred Route
66m ROW
Towers (Preliminary)

Landbase
Major Road
Local Road
Parcel Fabric
Waterbody

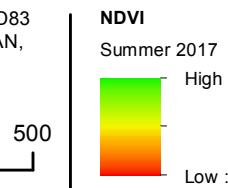
Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BP III Final Preferred Route
- 66m ROW
- ★ Angle Towers (Preliminary)
- ▲ Towers (Preliminary)

Landbase

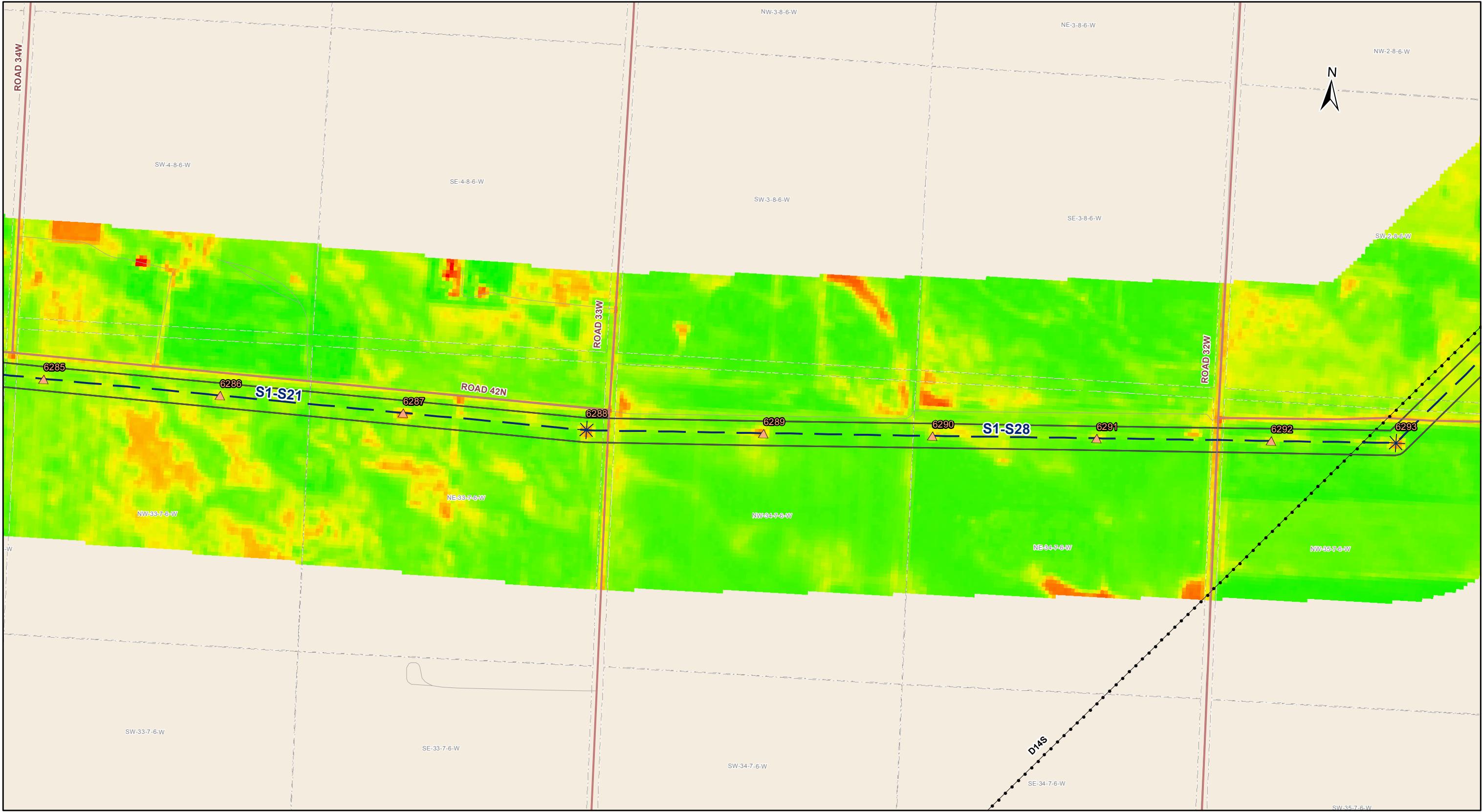
- Major Road
- Local Road
- Parcel Fabric

Bipole III Transmission Project

Section S1

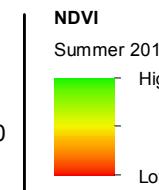
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



- Project Infrastructure**
- BPIII Final Preferred Route
 - 66m ROW
 - * Angle Towers (Preliminary)
 - ▲ Towers (Preliminary)

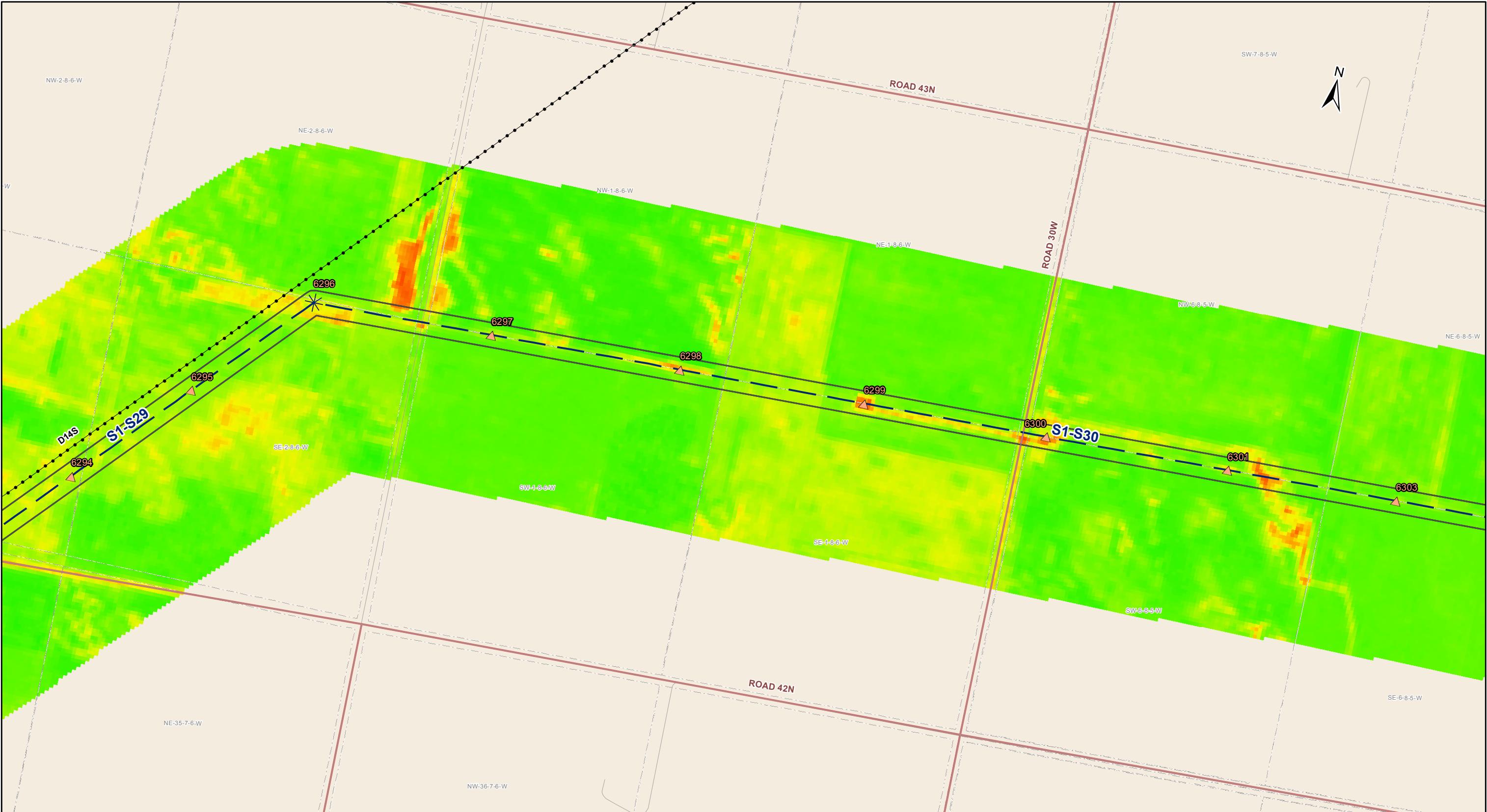
- Landbase**
- Major Road
 - Local Road
 - Transmission Line
 - Parcel Fabric

Bipole III Transmission Project

Section S1

Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000

NDVI
Summer 2017
High : 1
Low : -0.6

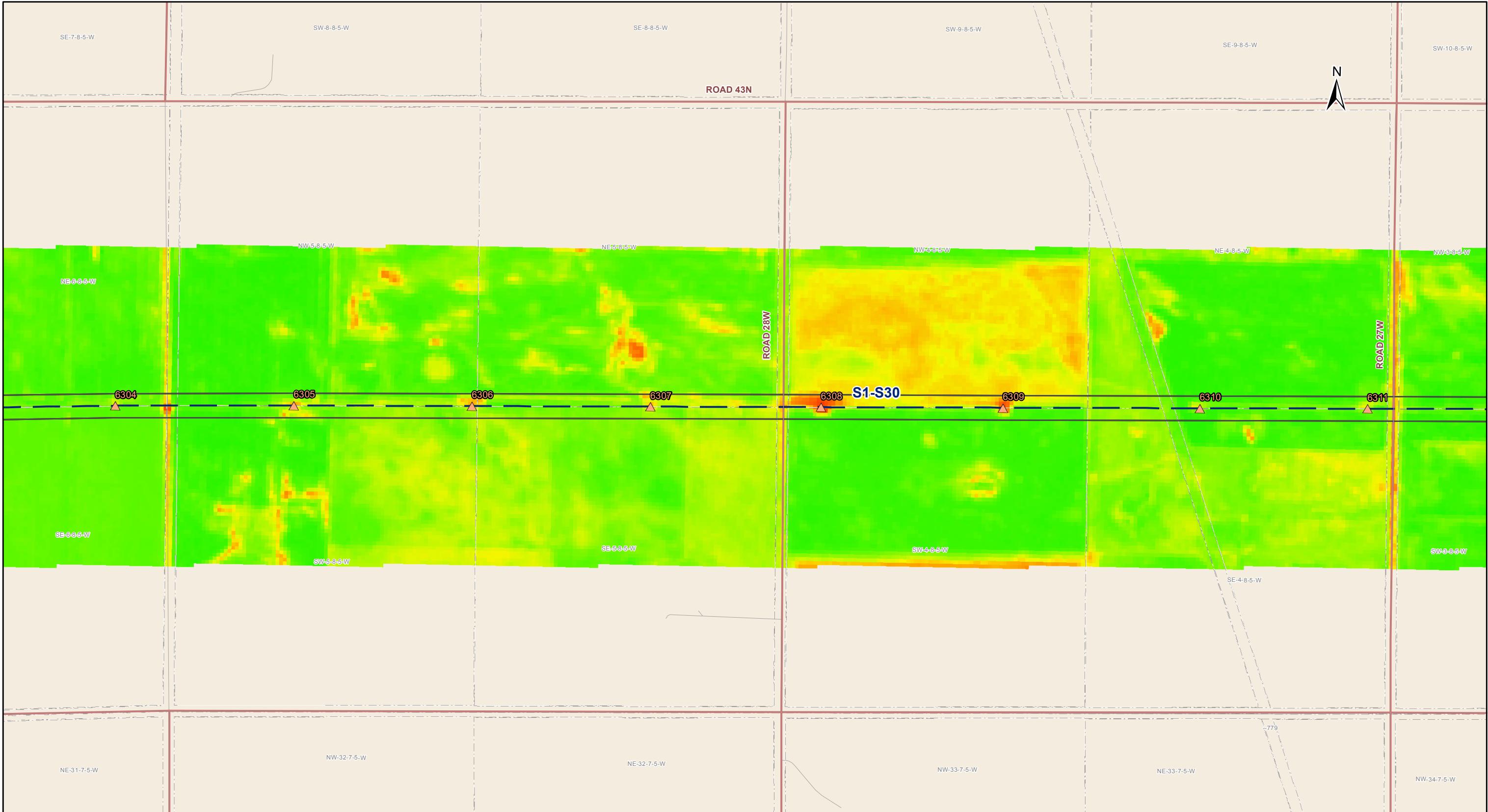
Project Infrastructure
BP III Final Preferred Route
66m ROW
Angle Towers (Preliminary)
Towers (Preliminary)

Landbase
Major Road
Local Road
Transmission Line
Parcel Fabric



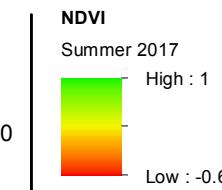
Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

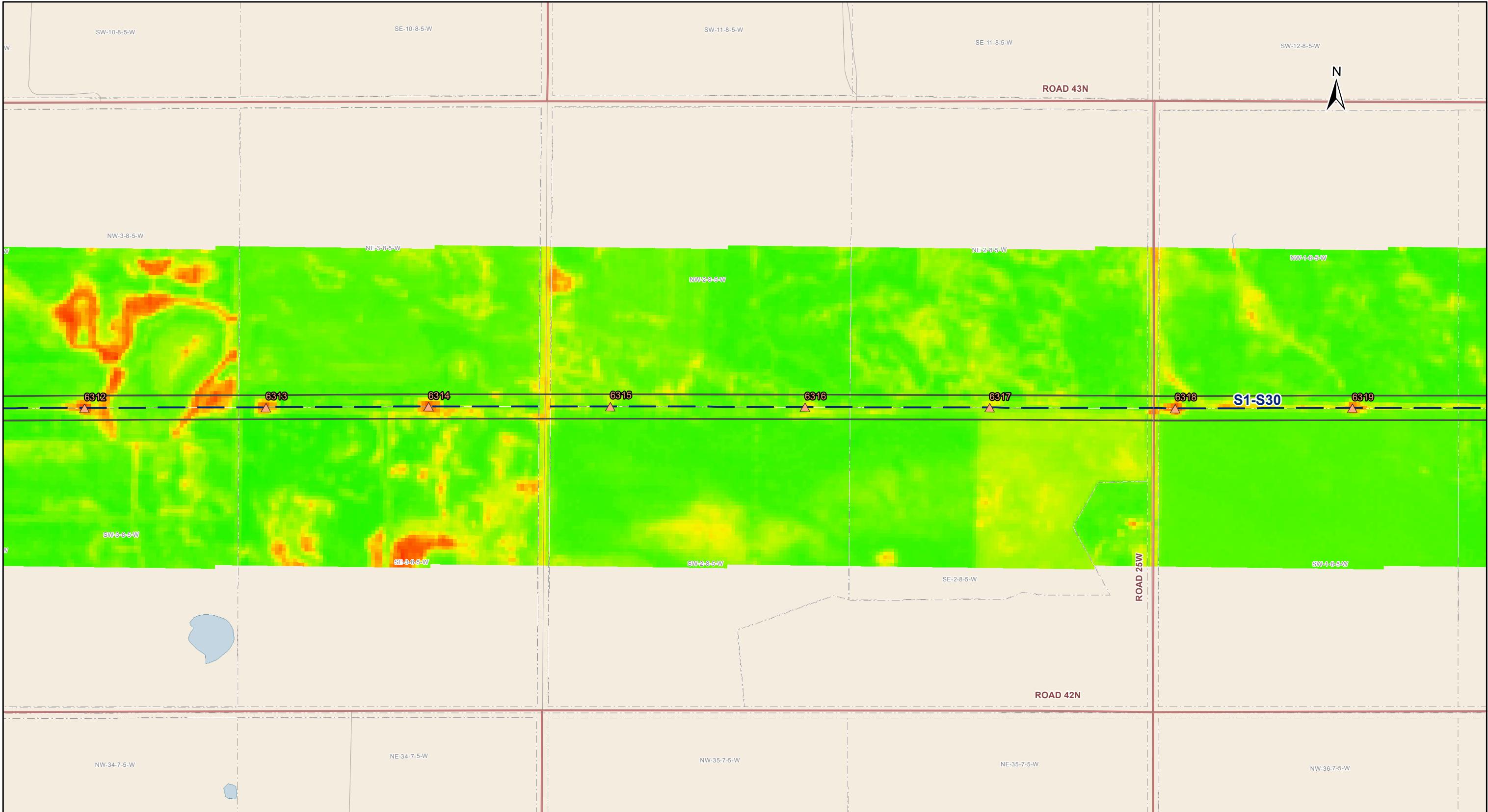
- Major Road
- Local Road
- Parcel Fabric

Bipole III Transmission Project

Section S1

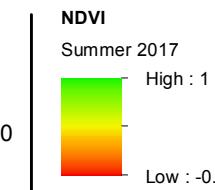
Normalized Difference Vegetation Index (NDVI) Summer 2017

DRAFT



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000

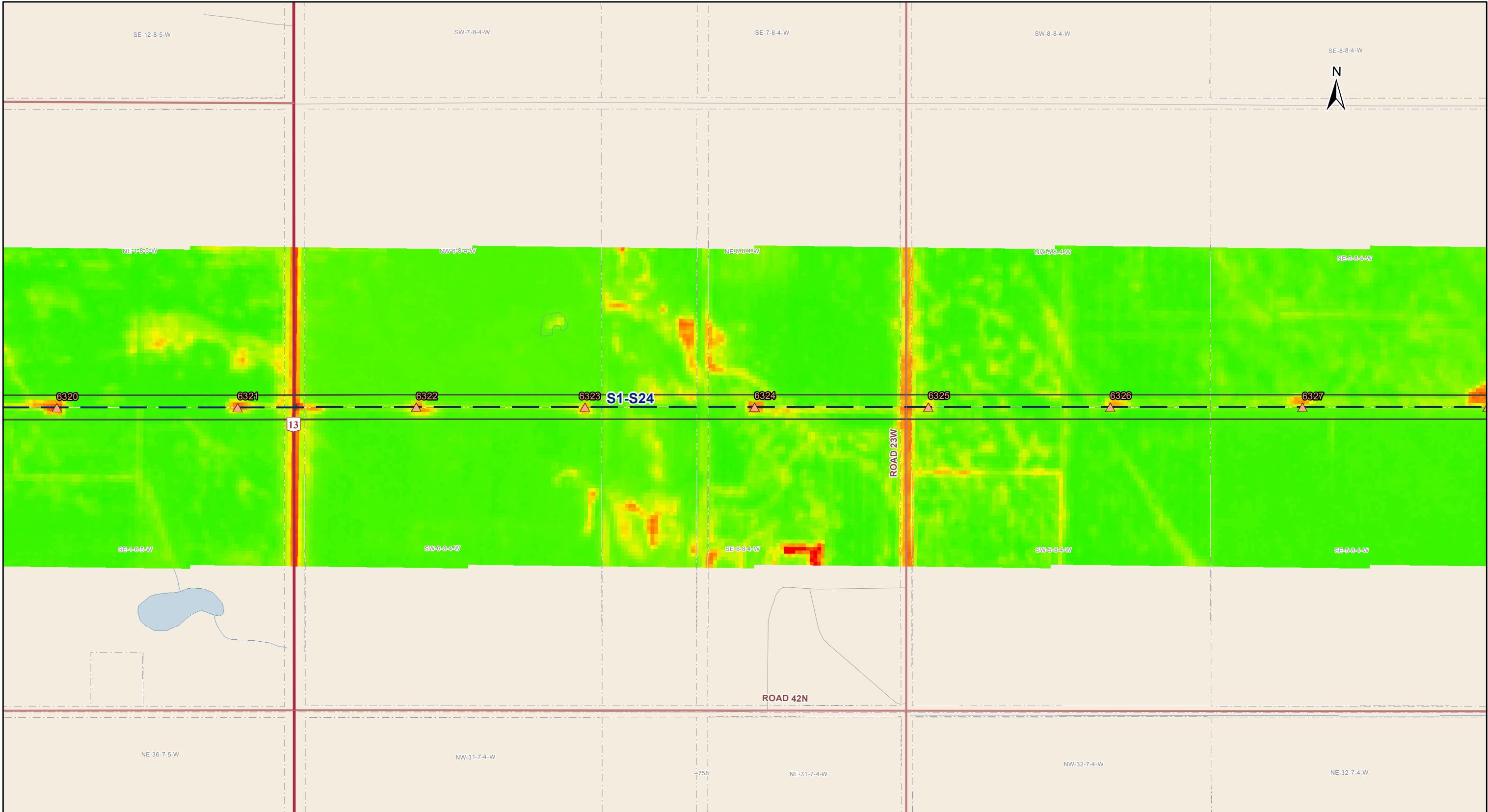


Project Infrastructure
BP III Final Preferred Route
66m ROW
Towers (Preliminary)

Landbase
Major Road
Local Road
Parcel Fabric
Waterbody
Watercourse

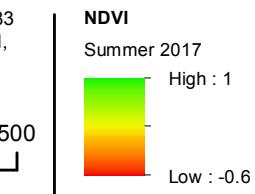
Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure
BPIII Final Preferred Route
66m ROW
Proposed Access Route
Towers (Preliminary)

Landbase
Highway
Major Road
Local Road
Parcel Fabric

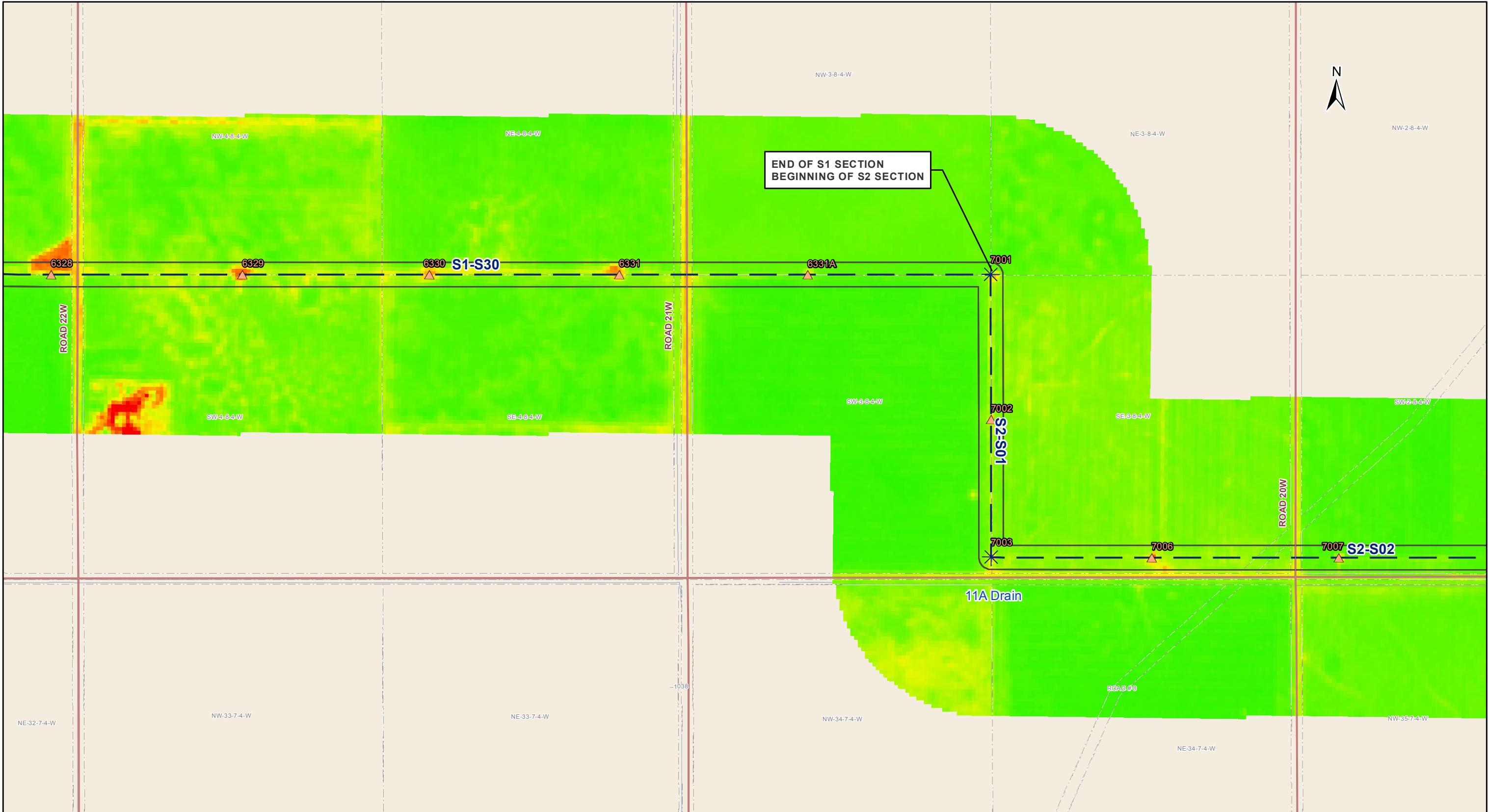
Waterbody
Watercourse

Bipole III Transmission Project

Section S1

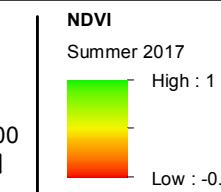
Normalized Difference Vegetation Index (NDVI) Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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Metres
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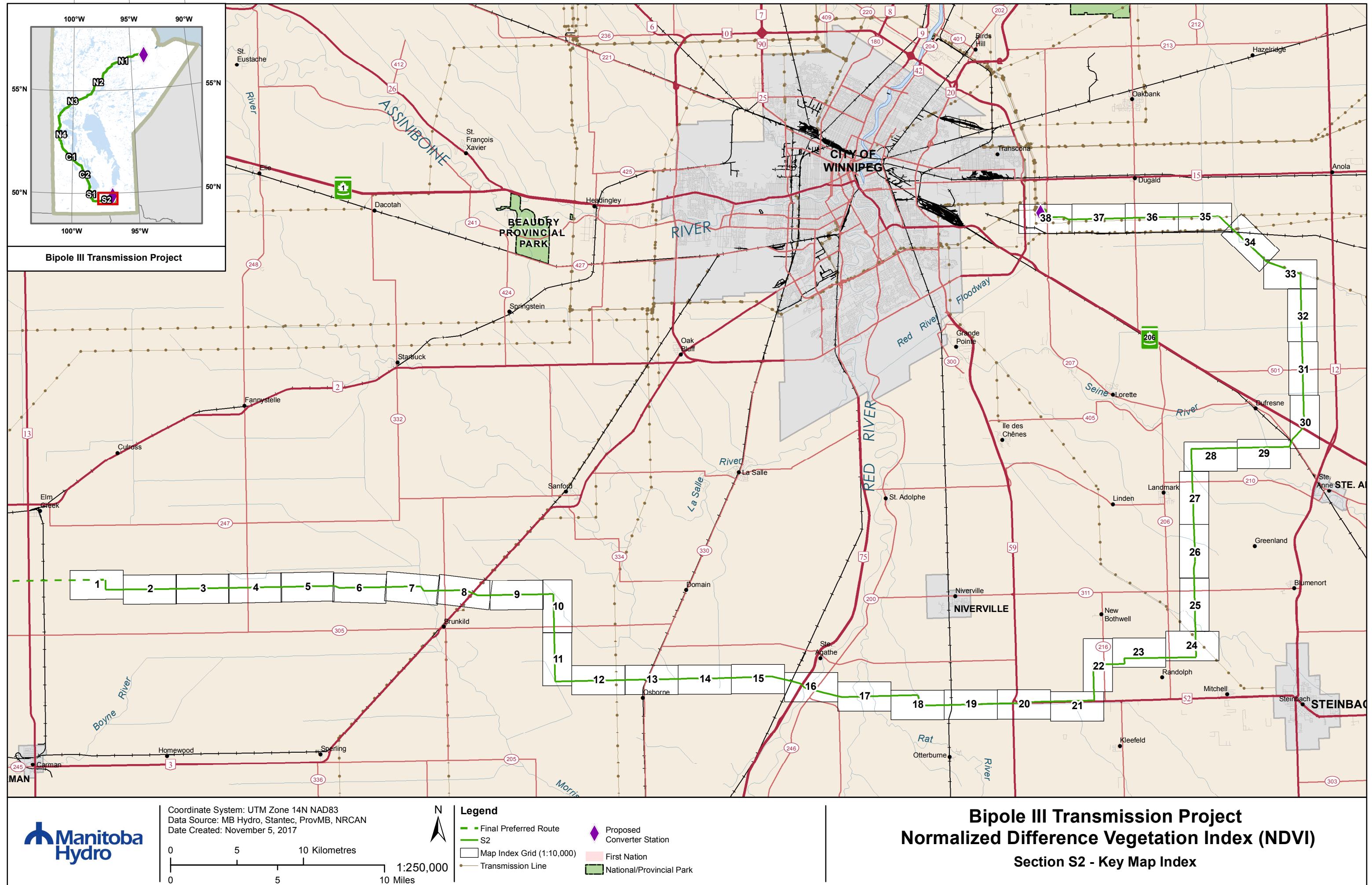


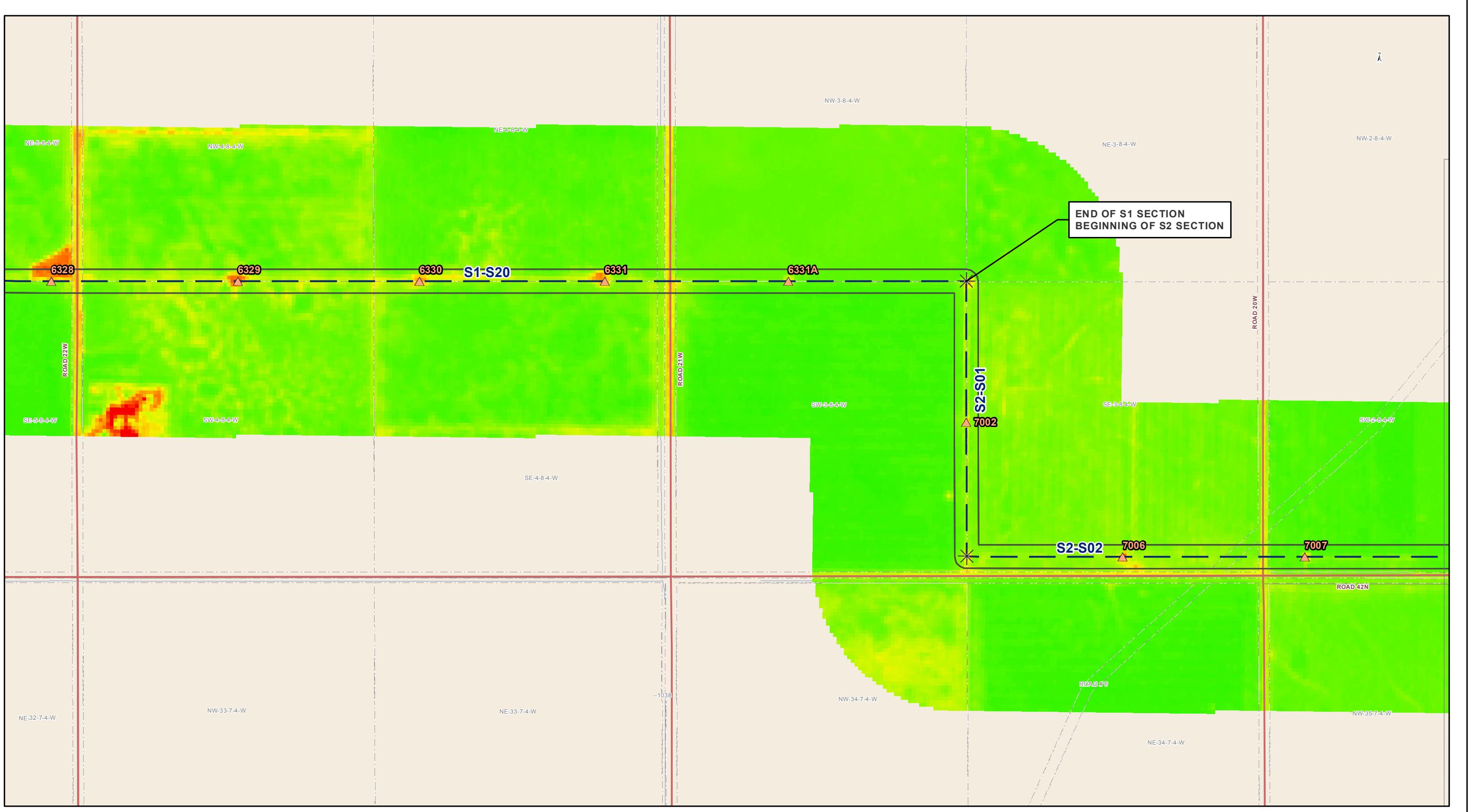
- Project Infrastructure**
- BPIII Final Preferred Route
 - 66m ROW
 - * Angle Towers (Preliminary)
 - ▲ Towers (Preliminary)

- Landbase**
- Major Road
 - Local Road
 - Parcel Fabric
 - Watercourse

Bipole III Transmission Project
Section S1
Normalized Difference Vegetation Index (NDVI)
Summer 2017

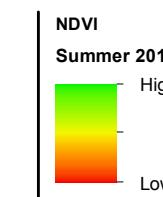
DRAFT





Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

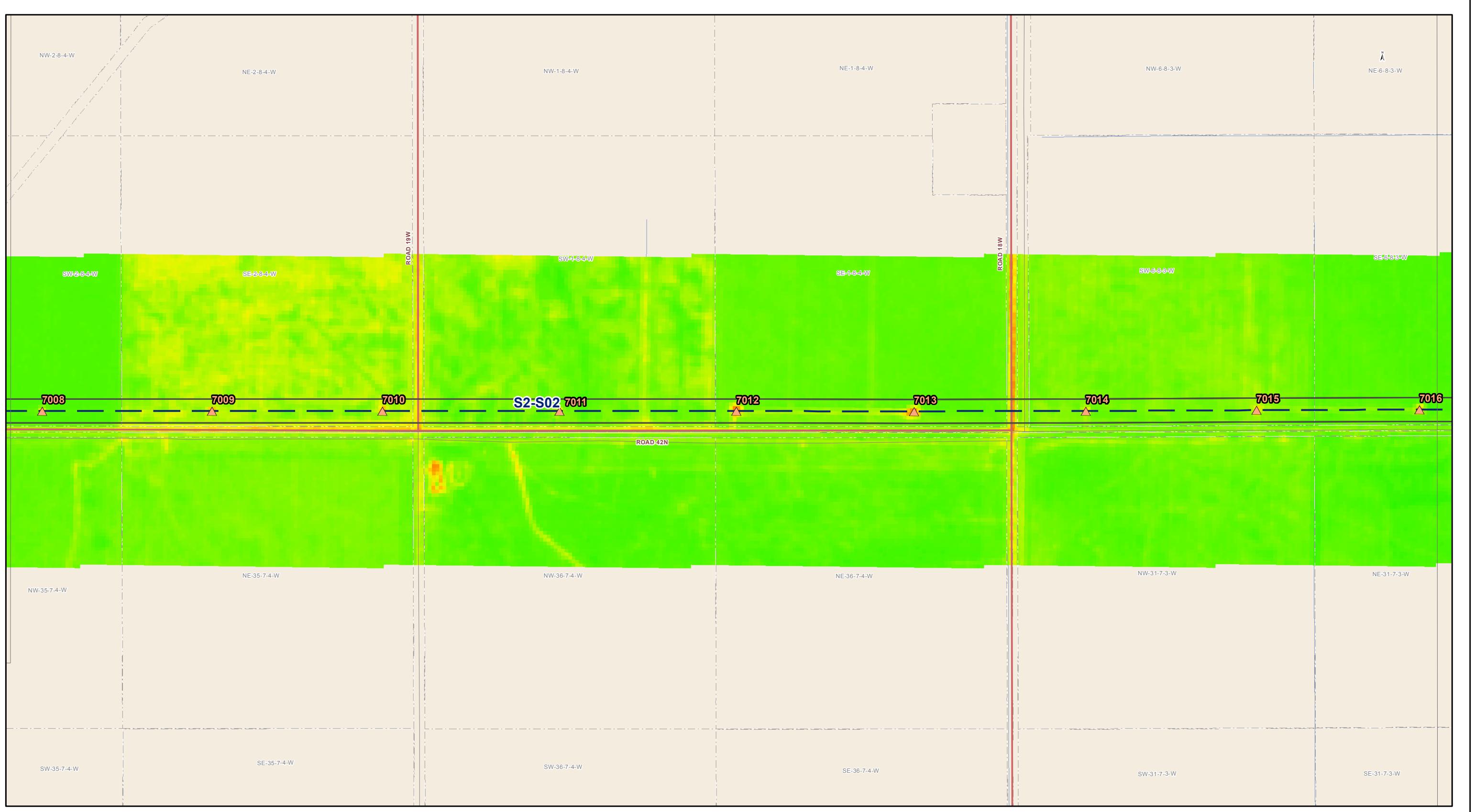
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Tower Locations (Preliminary)

Landbase

- Major Road
- Parcel Fabric
- Watercourse

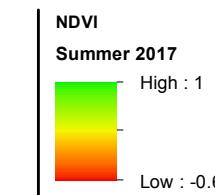
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

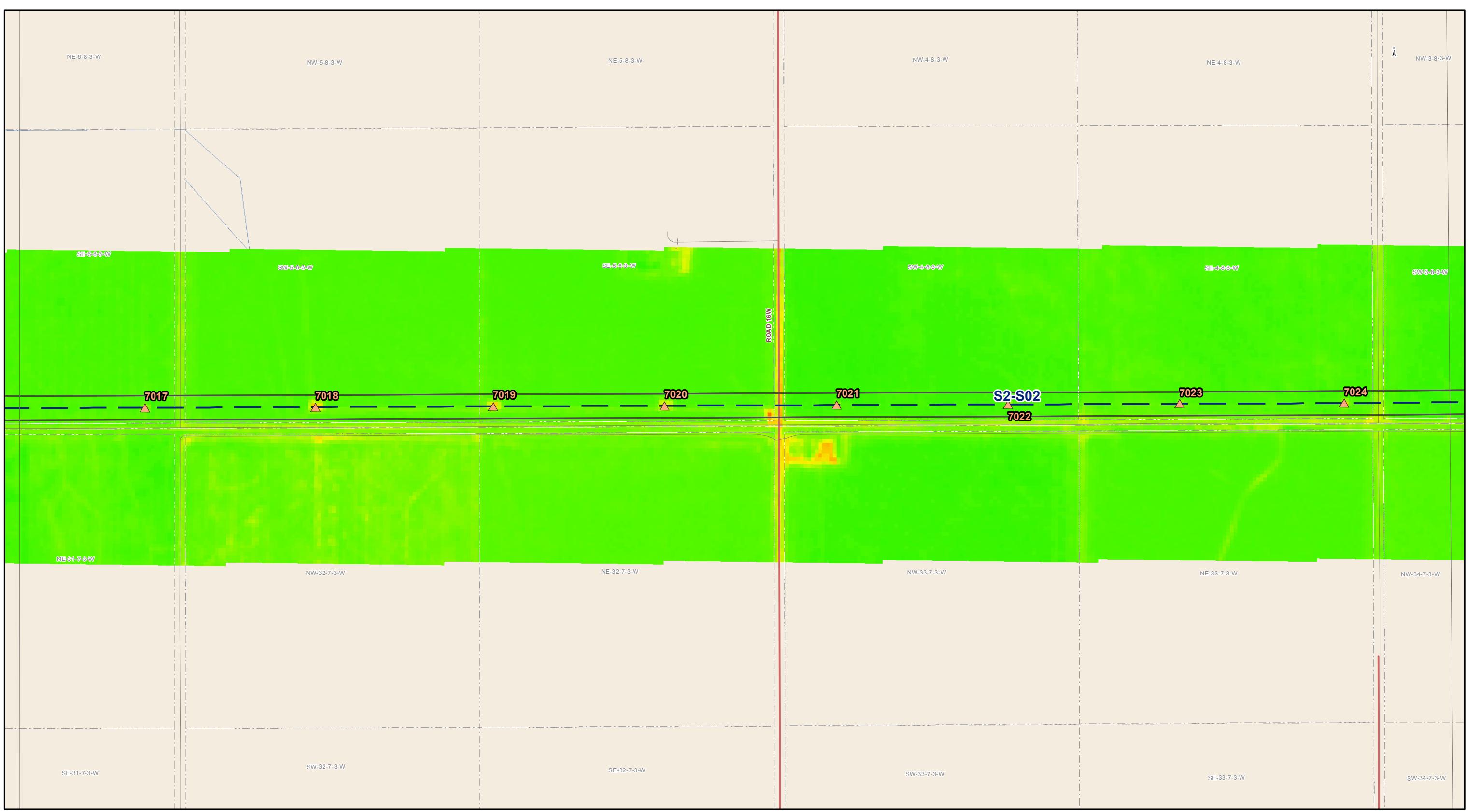
Landbase

- Major Road
- Parcel Fabric
- Watercourse

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Map 4-500-2

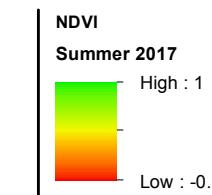


Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

Metres

0 125 250 500

1:10,000



Project Infrastructure

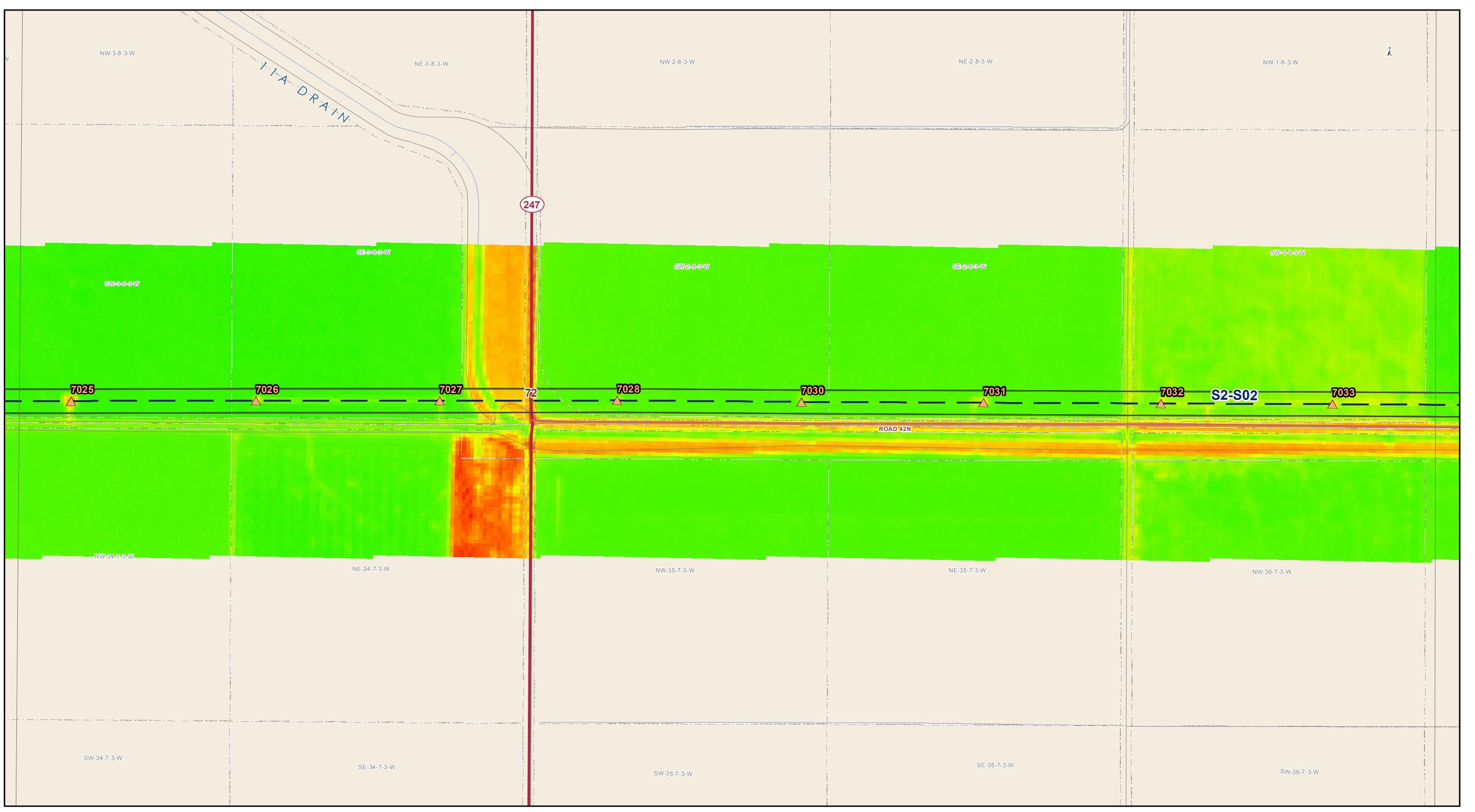
- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)

Landbase

- Major Road
- Parcel Fabric
- Watercourse

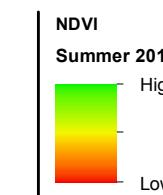
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

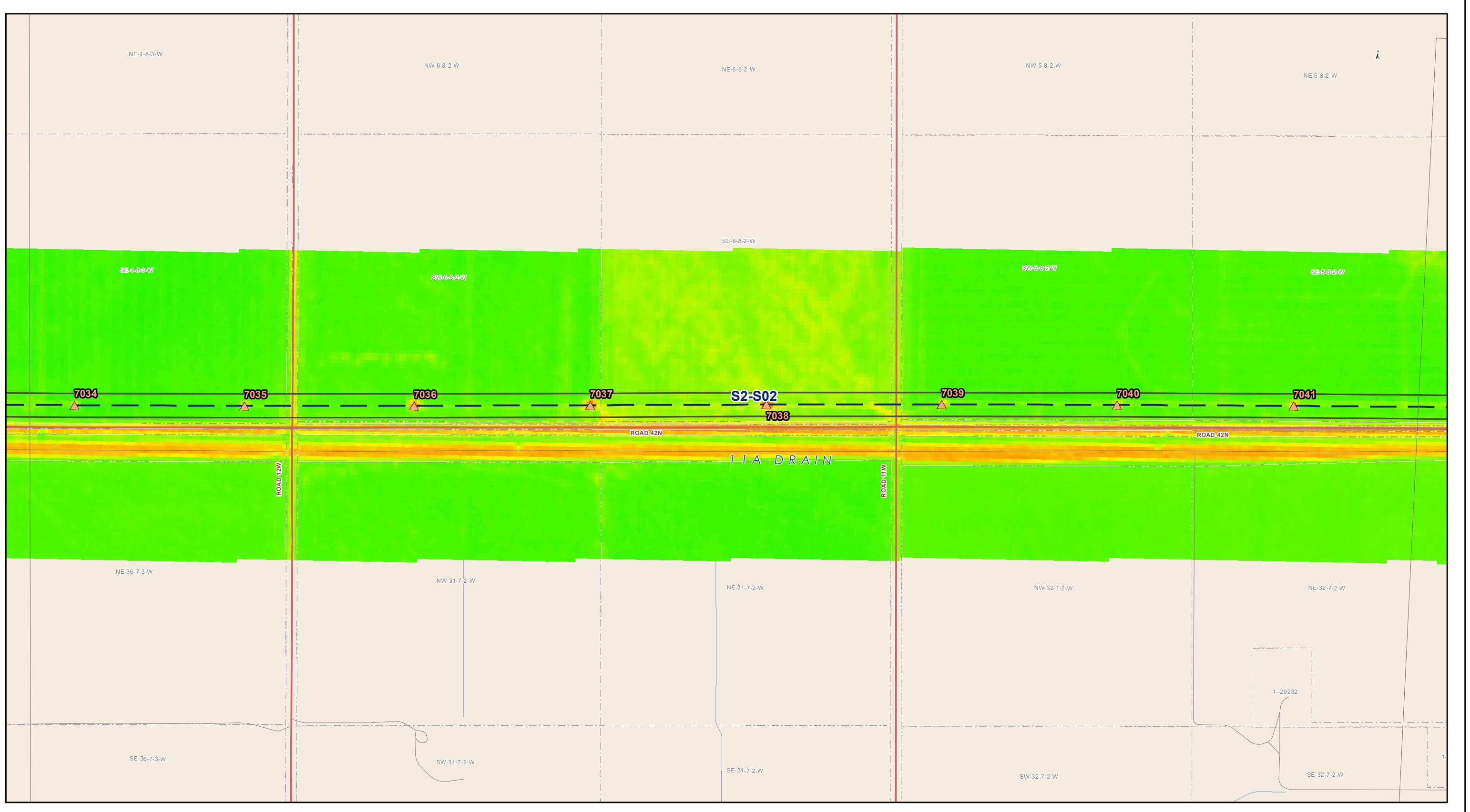
- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)
- Proposed Access Route

Landbase

- Highway
- Major Road
- Parcel Fabric
- Watercourse

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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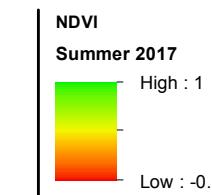


Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

Metres

0 125 250 500

1:10,000



Project Infrastructure

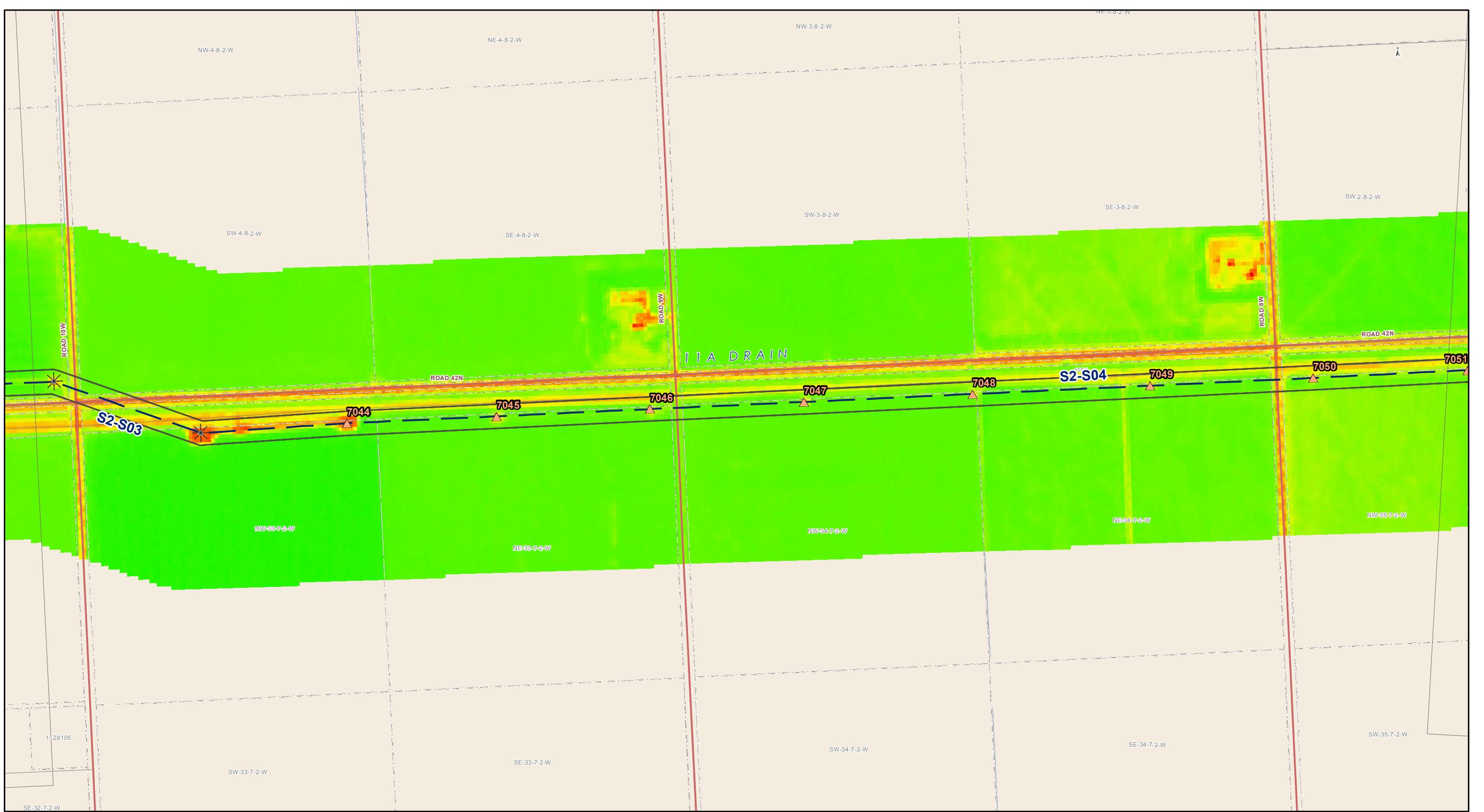
- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)

Landbase

- Major Road
- Parcel Fabric
- Watercourse

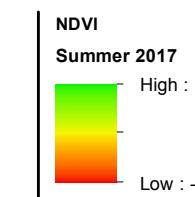
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

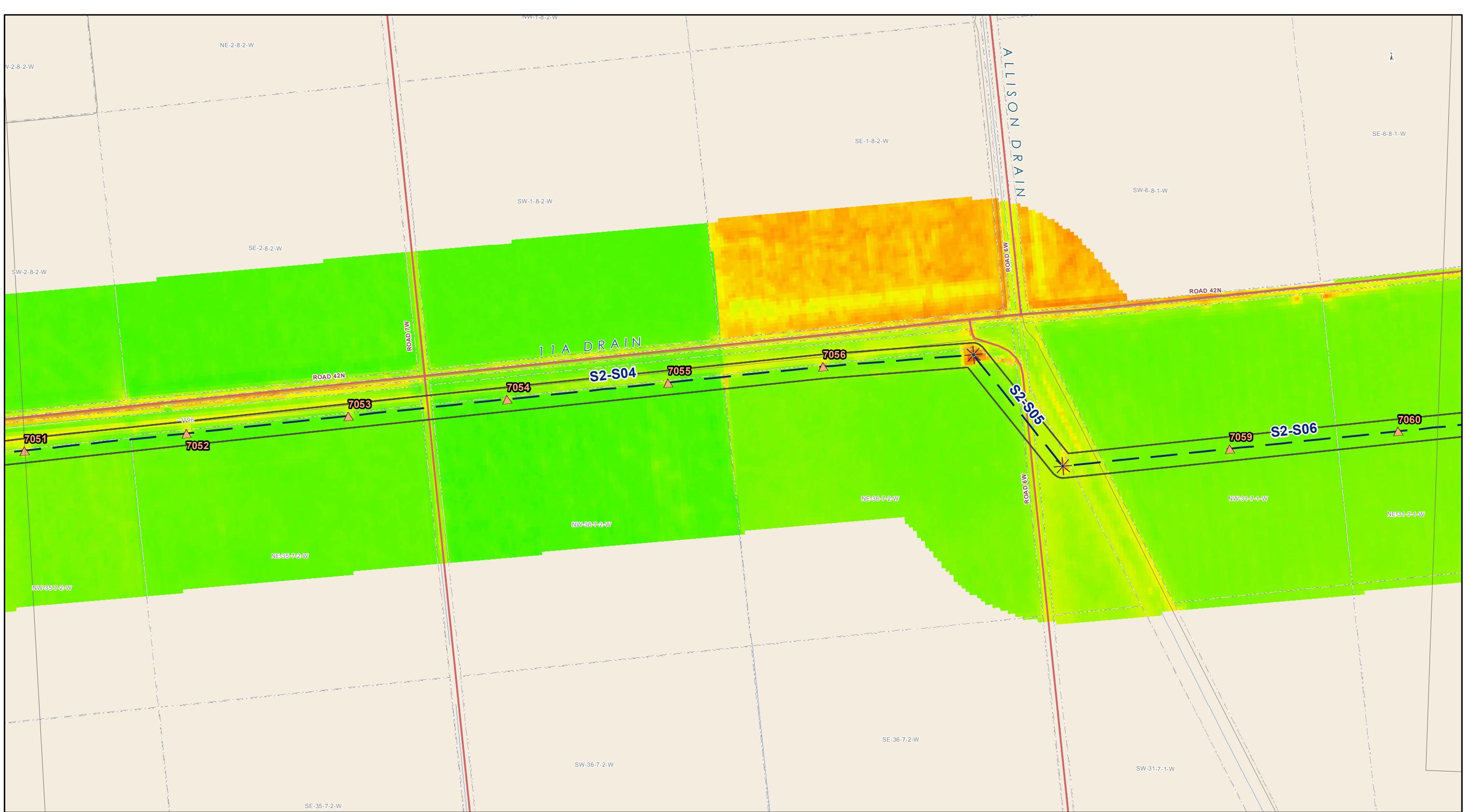
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Tower Locations (Preliminary)

Landbase

- Major Road
- Parcel Fabric
- Watercourse

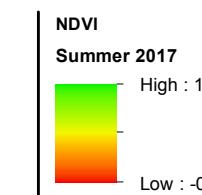
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

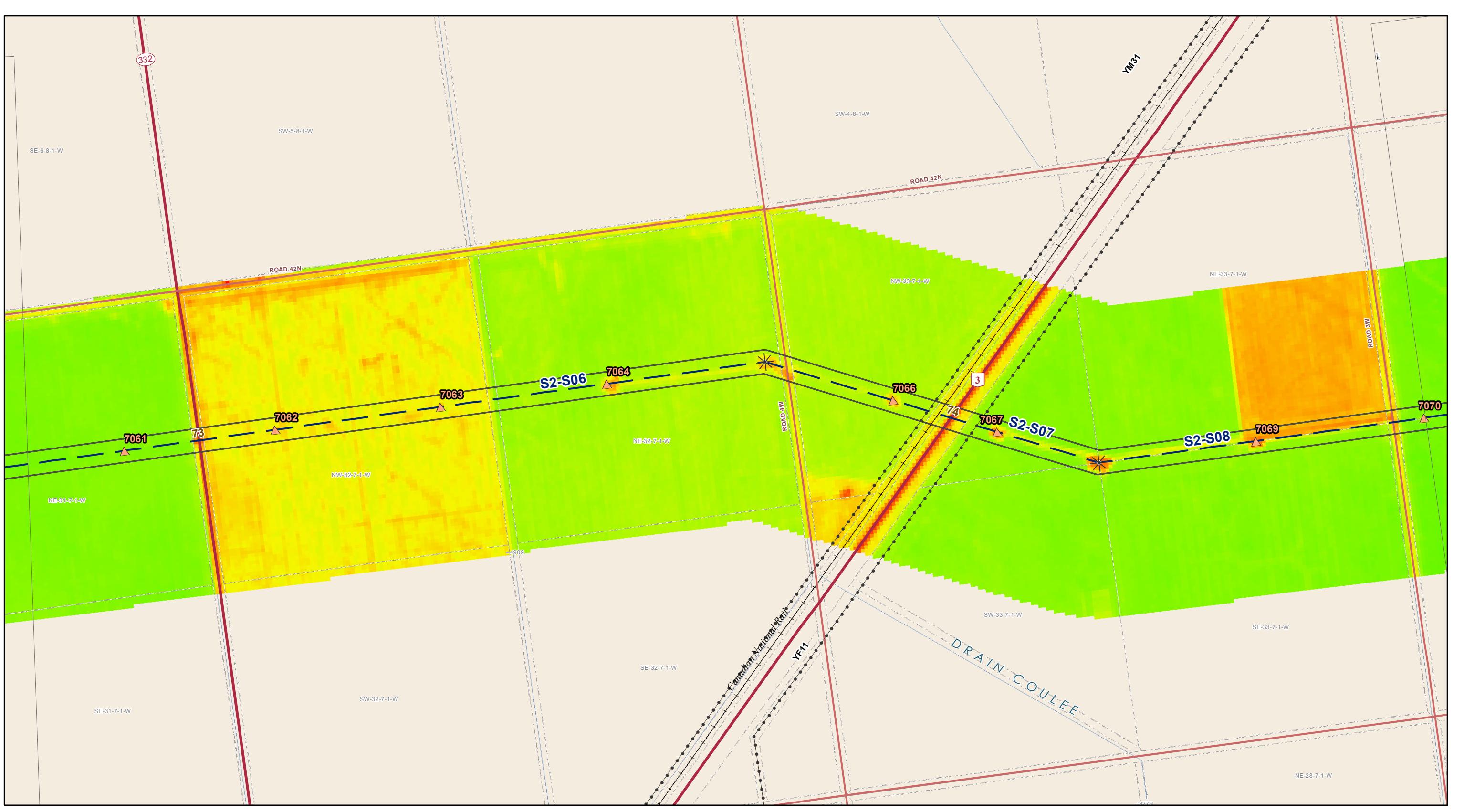
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Tower Locations (Preliminary)

Landbase

- Major Road
- Parcel Fabric
- Watercourse

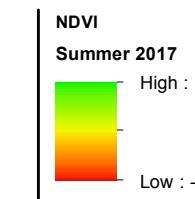
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

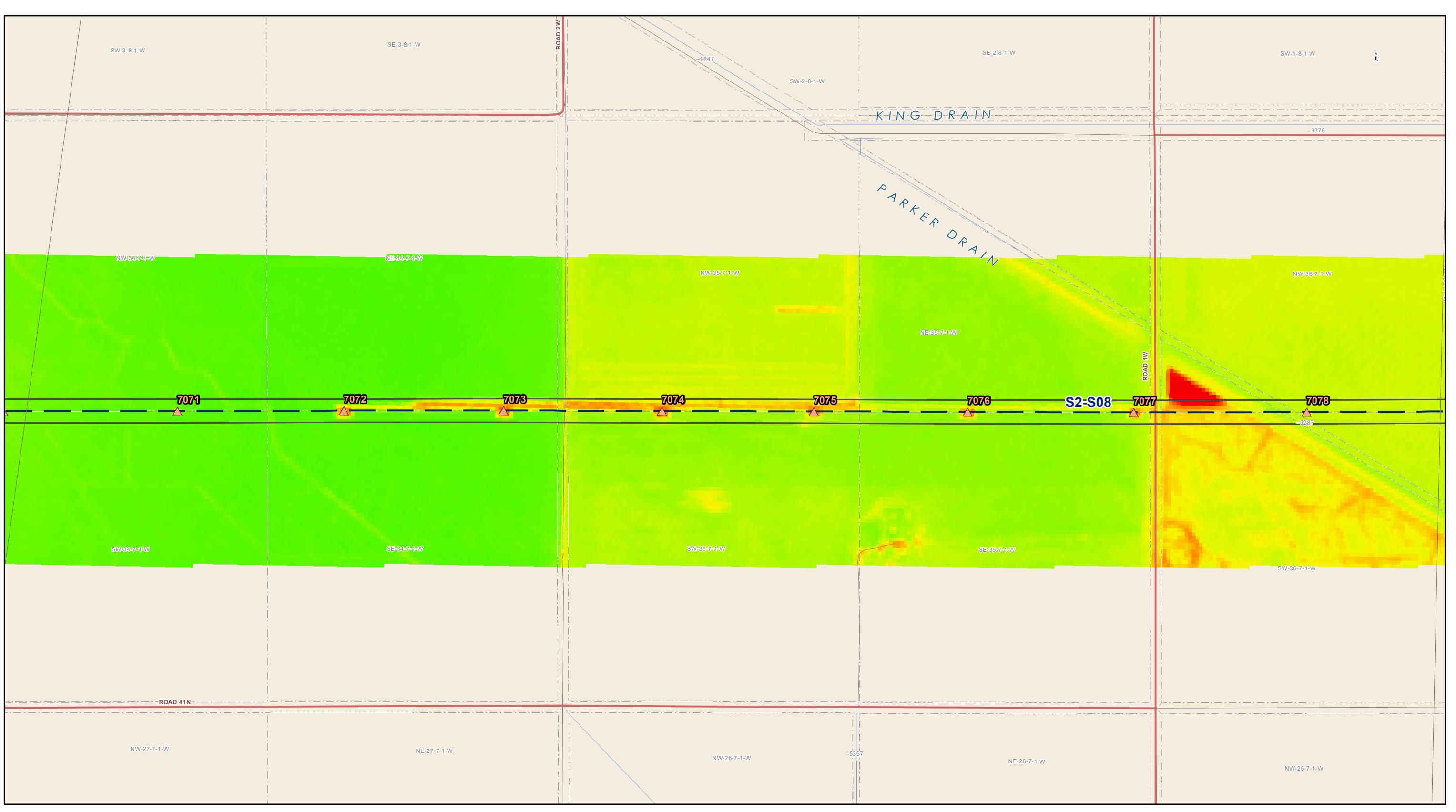
- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)
- Angle Tower Locations (Preliminary)
- Proposed Access Route

Landbase

- Highway
- Major Road
- Railway (Operational)
- Transmission Line
- Parcel Fabric
- Watercourse

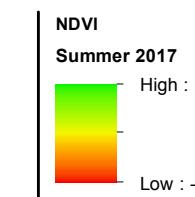
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

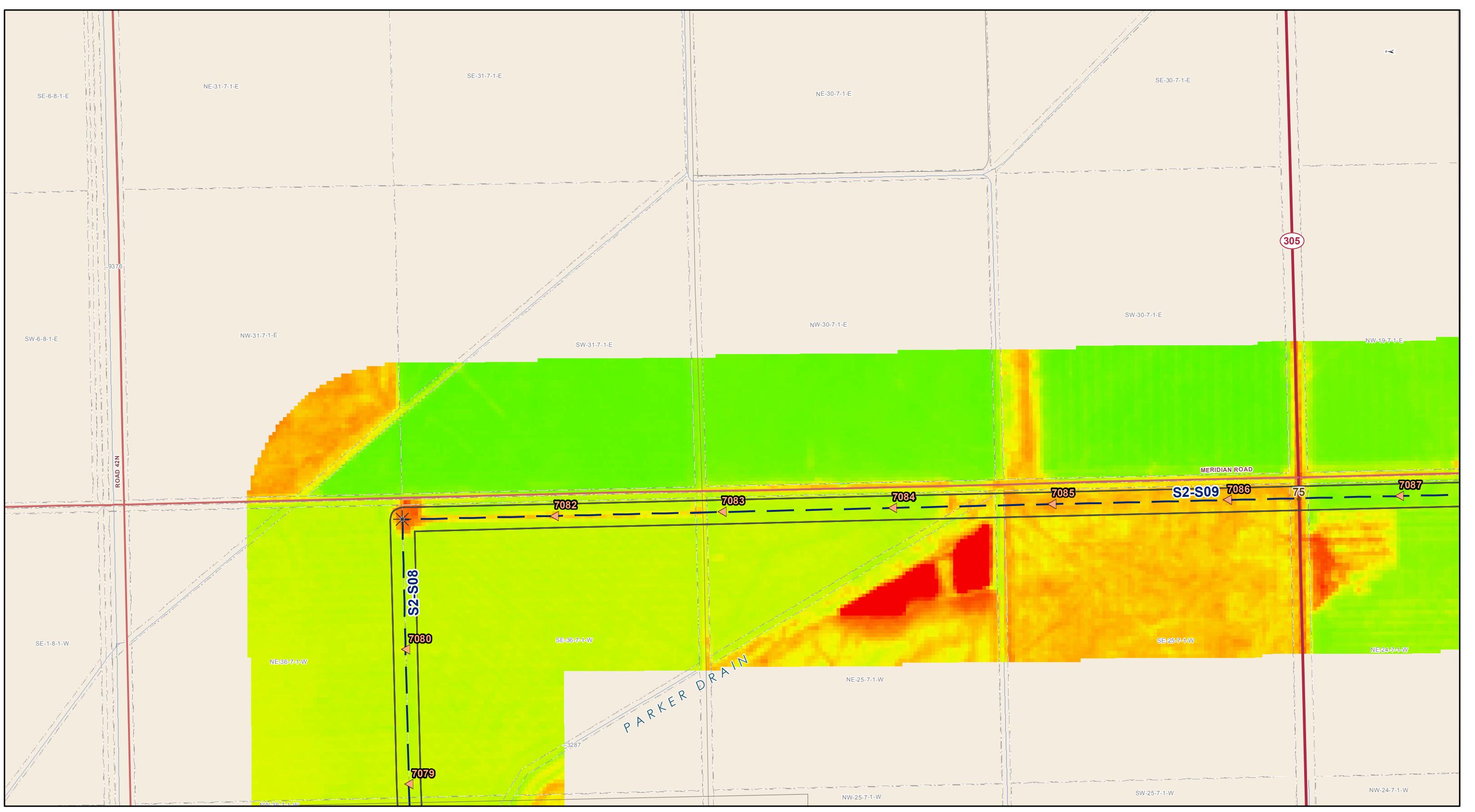
- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)

Landbase

- Major Road
- Parcel Fabric
- Watercourse

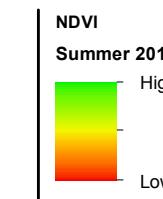
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
 Data Source: MB Hydro, ProvMB, NRCAN,
 Stantec Consulting
 Date Created: November 05, 2017

0 125 250 500
 Metres
 1:10,000

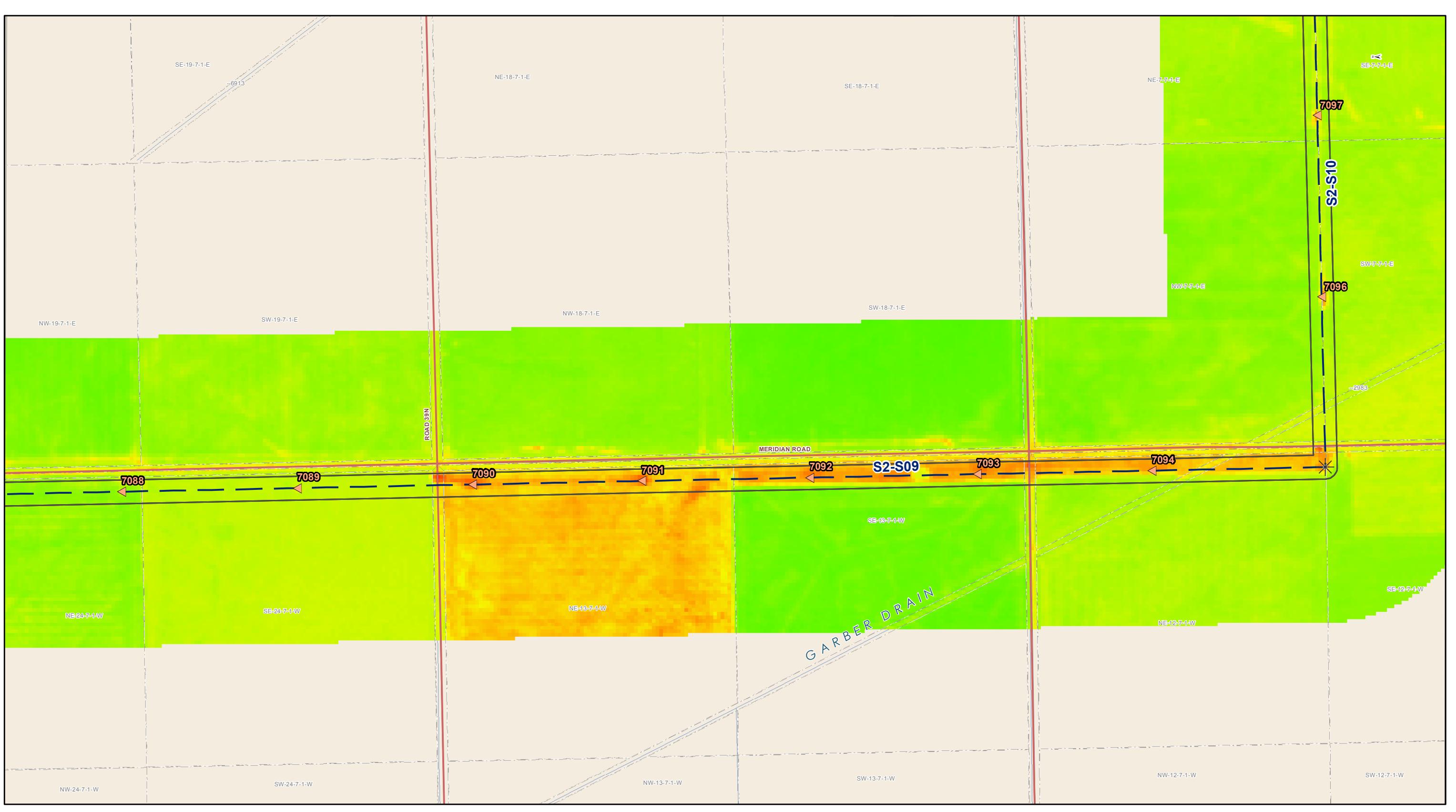


- Project Infrastructure**
- BPIII Final Preferred Route
 - 66m ROW
 - ▲ Towers (Preliminary)
 - * Angle Tower Locations (Preliminary)
 - Proposed Access Route

- Landbase**
- Highway
 - Major Road
 - Parcel Fabric

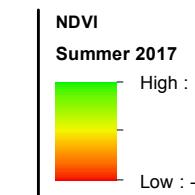
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



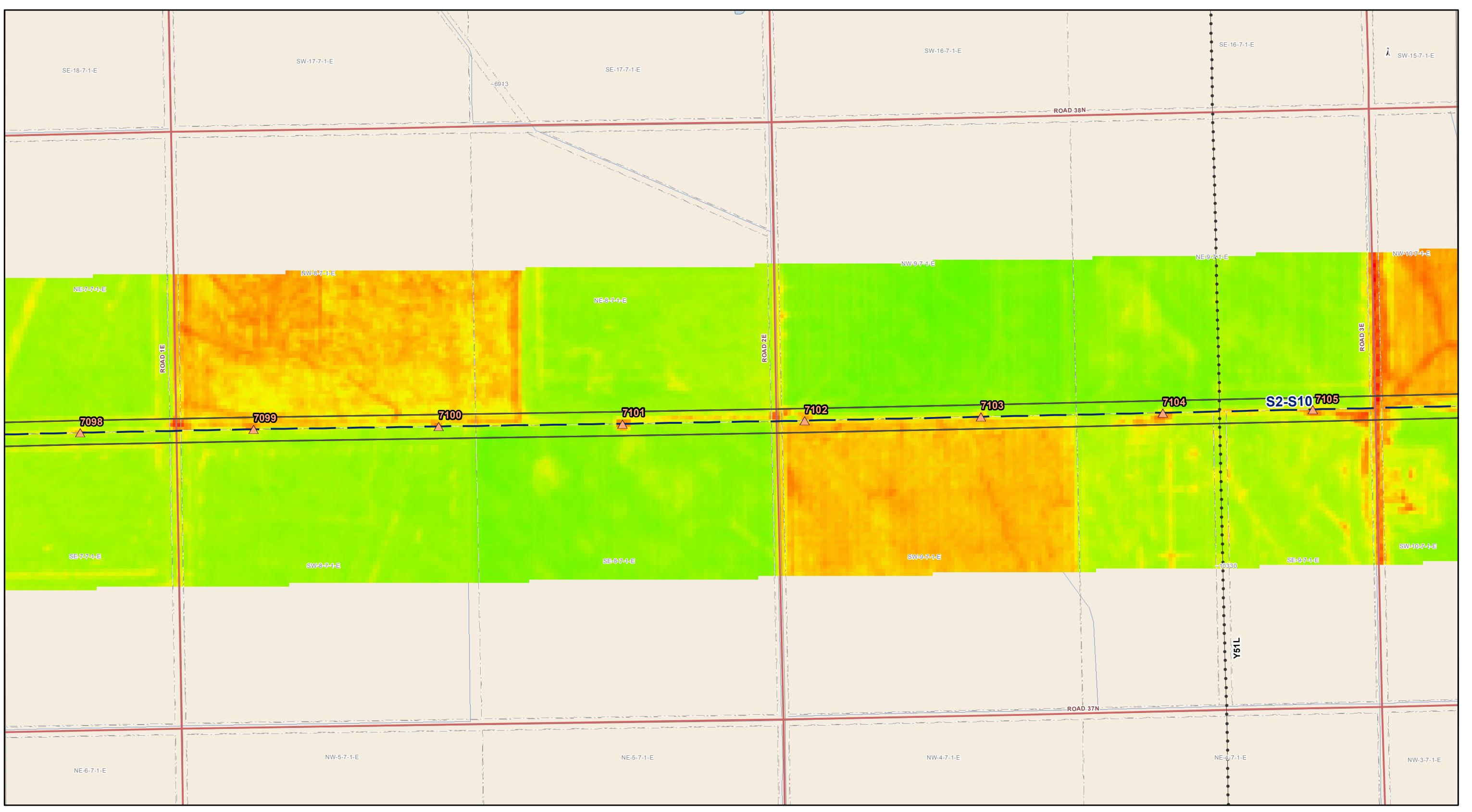
Project Infrastructure
— BPIII Final Preferred Route
□ 66m ROW
▲ Towers (Preliminary)
★ Angle Tower Locations (Preliminary)

Landbase
— Major Road
□ Parcel Fabric
— Watercourse

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Map 4-500-11



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000

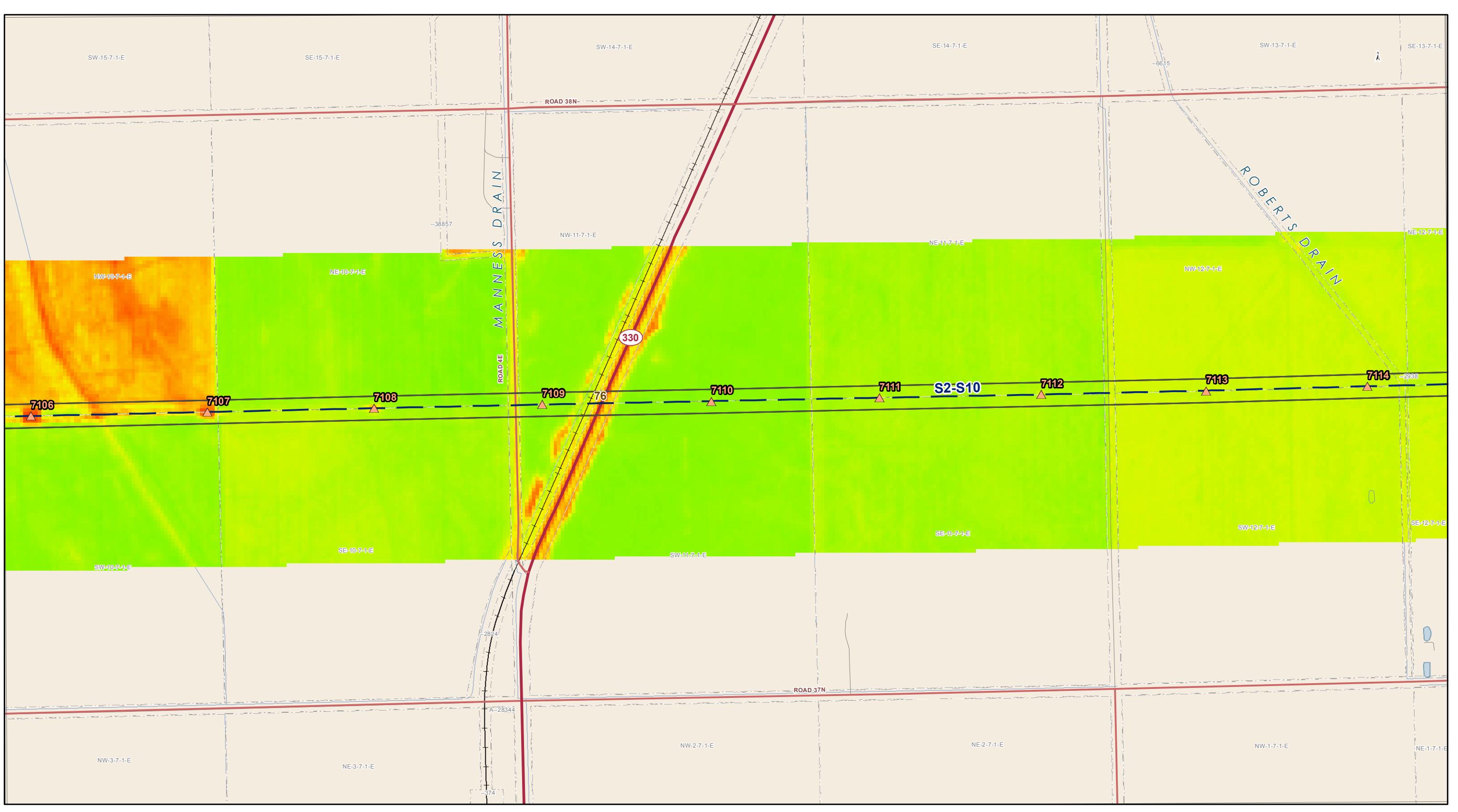
Project Infrastructure
BPIII Final Preferred Route
66m ROW
Towers (Preliminary)

Landbase
Major Road
Transmission
Waterbodies
Parcel Fabric

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

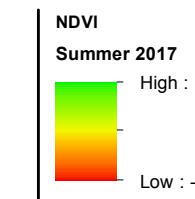
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Map 4-500-12



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

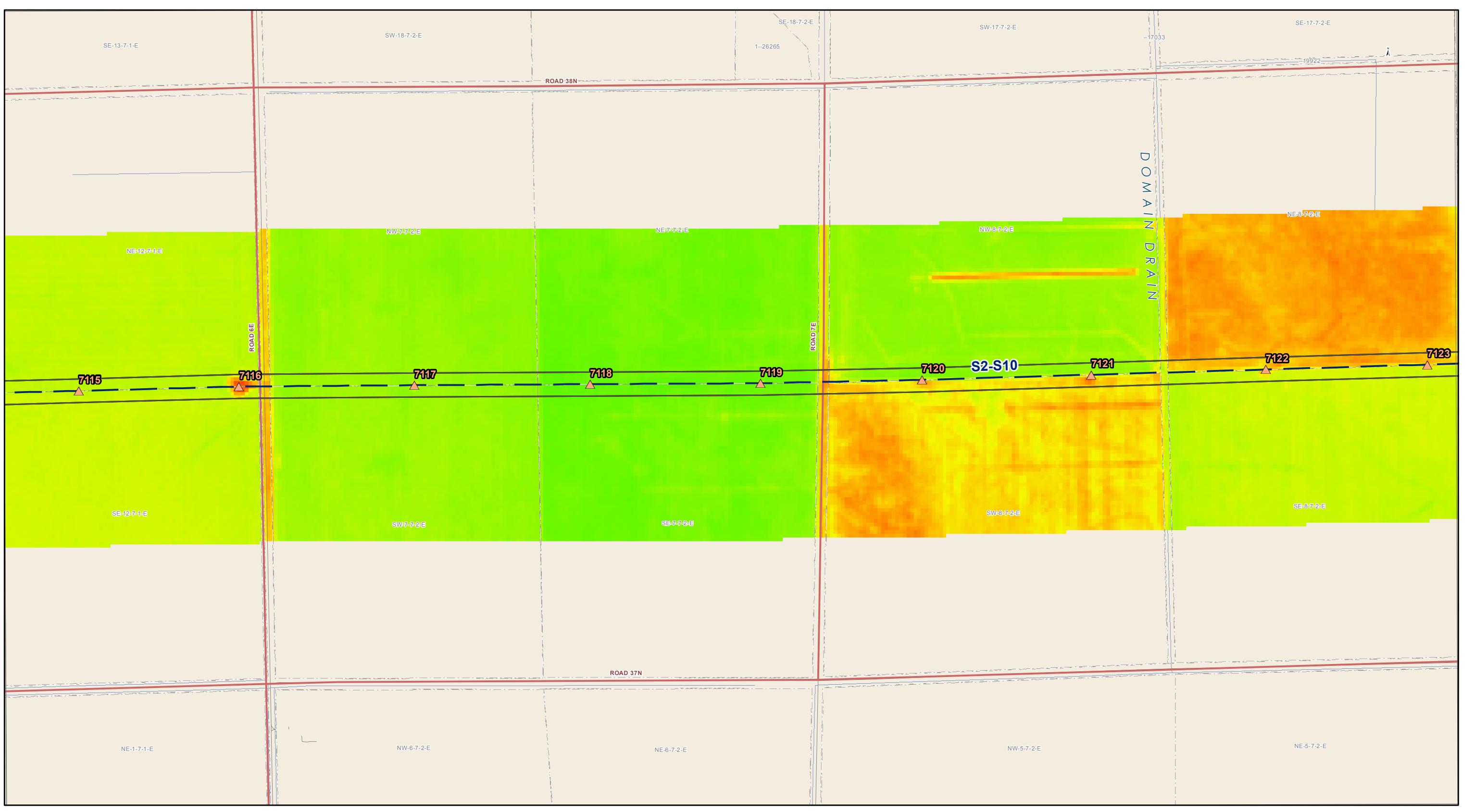
Landbase

- Highway
- Major Road
- Railway (Operational)
- Parcel Fabric
- Waterbodies
- Watercourse

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

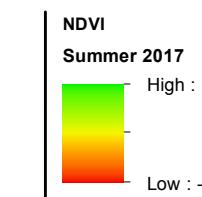
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Map 4-500-13



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

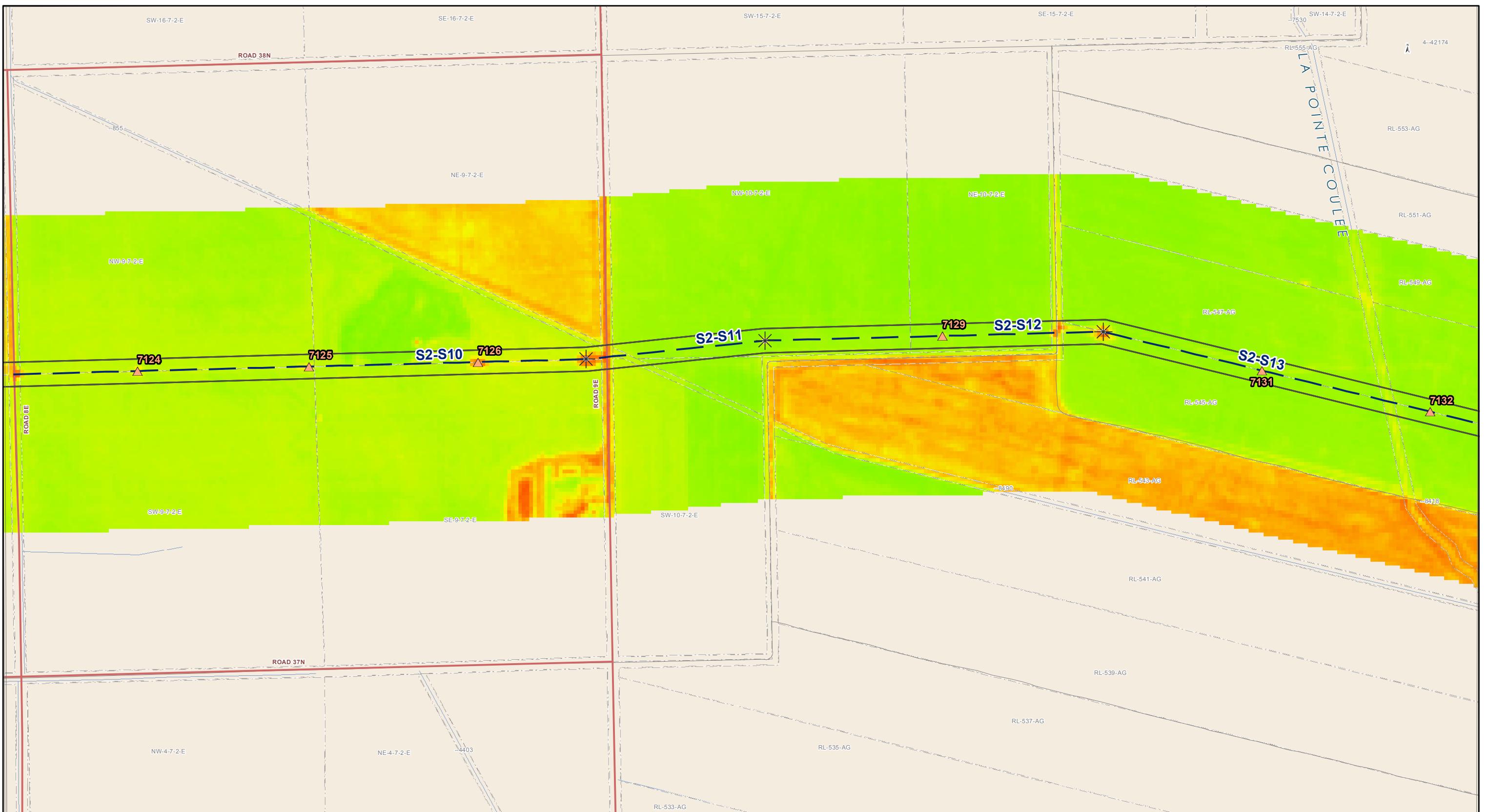
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)

Landbase

- Major Road
- Parcel Fabric
- Watercourse

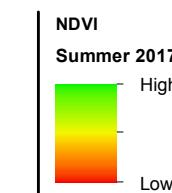
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

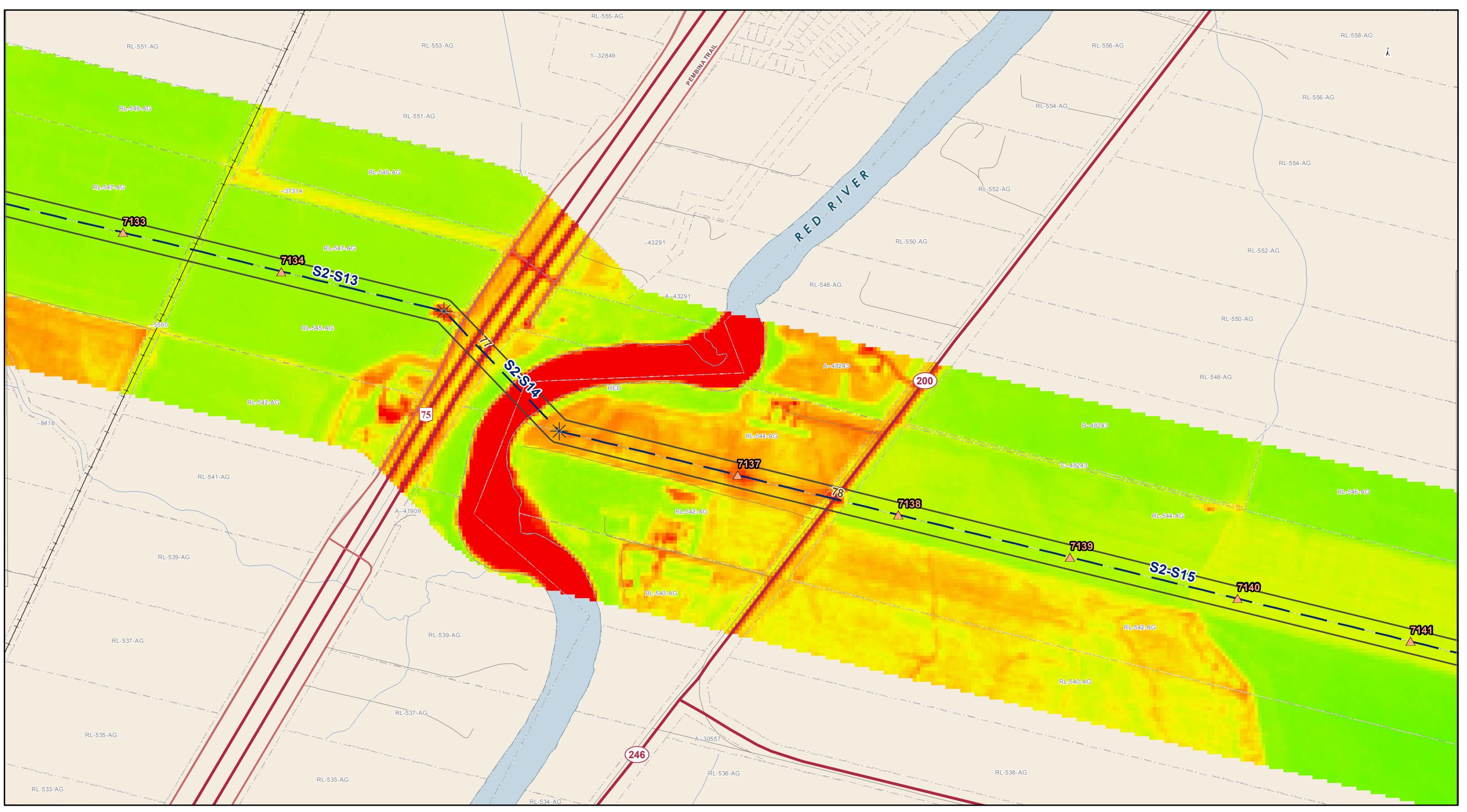
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Tower Locations (Preliminary)

Landbase

- Major Road
- Parcel Fabric
- Watercourse

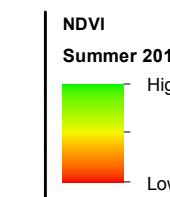
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



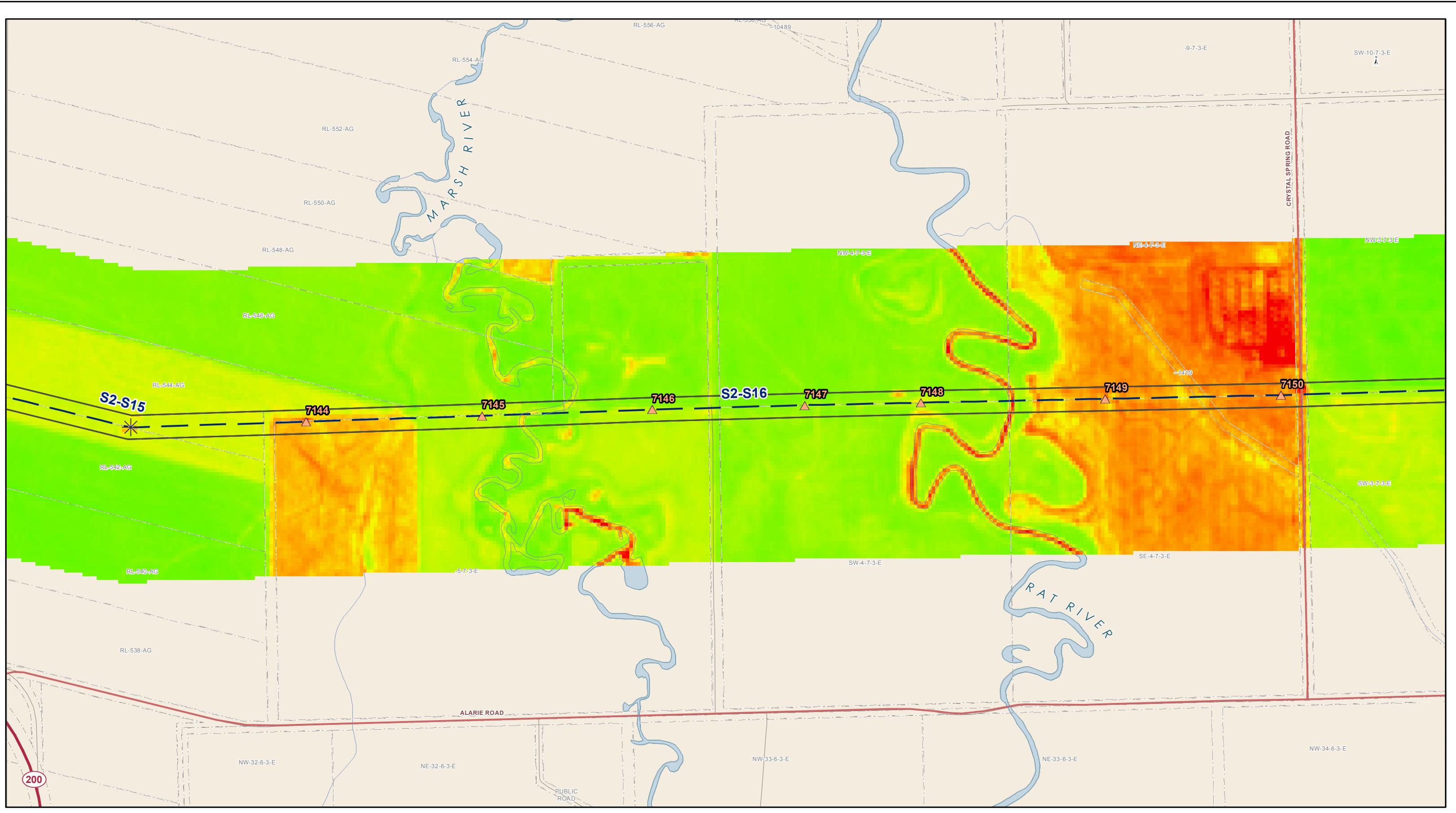
- Project Infrastructure**
- BP III Final Preferred Route
 - 66m ROW
 - Towers (Preliminary)
 - Angle Tower Locations (Preliminary)
 - Proposed Access Route

- Landbase**
- Highway
 - Major Road
 - Railway
 - Parcel Fabric



Bipole III Transmission Project Section S2 Normalized Difference Vegetation Index (NDVI) Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000

NDVI
Summer 2017
High : 1
Low : -0.6

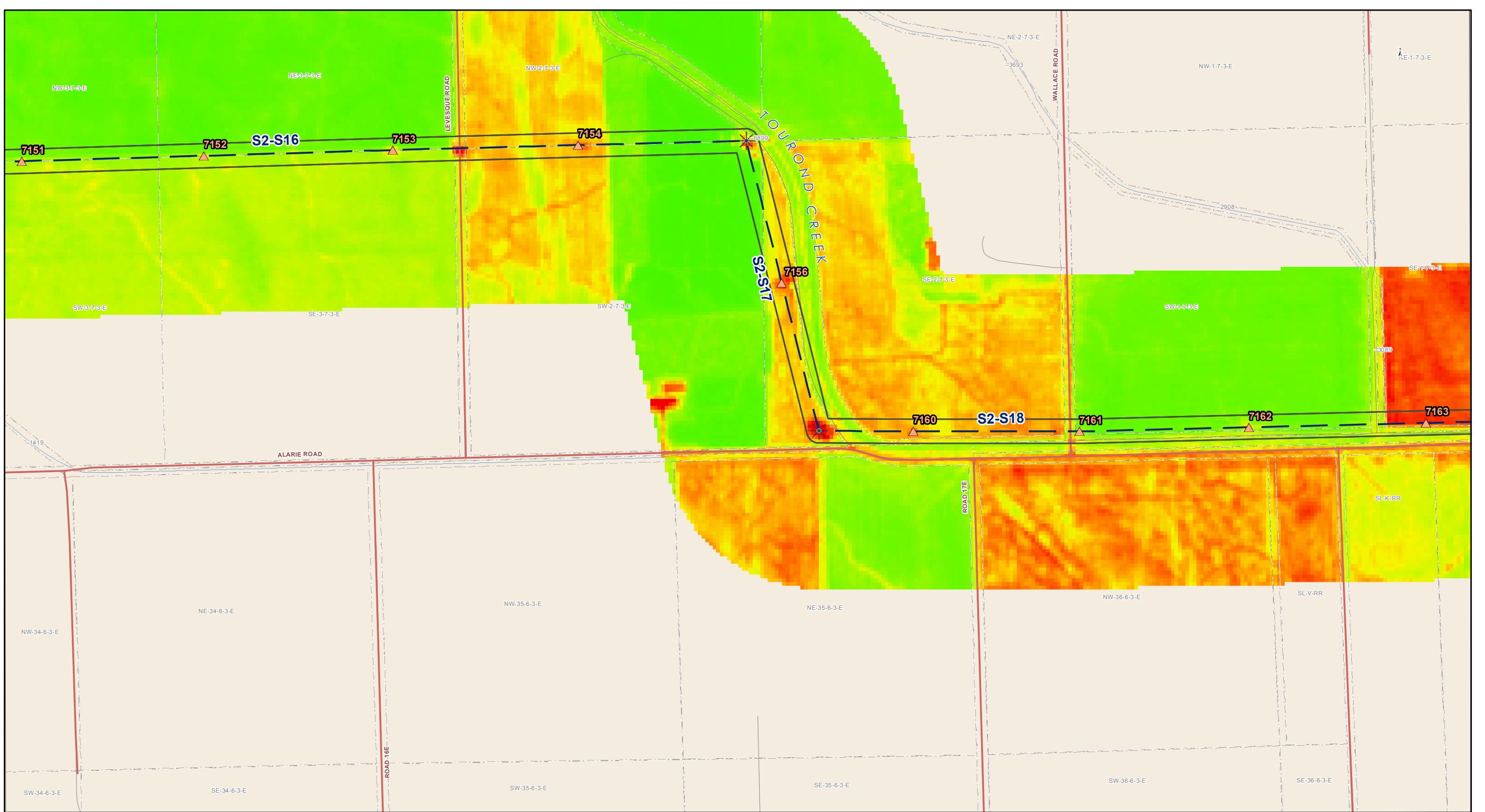
Project Infrastructure
— BPIII Final Preferred Route
□ 66m ROW
▲ Towers (Preliminary)
★ Angle Tower Locations (Preliminary)

Landbase
— Highway
— Major Road
□ Parcel Fabric
Waterbodies
Watercourse

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

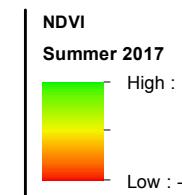
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Map 4-500-17



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



- Project Infrastructure**
- BPIII Final Preferred Route
 - 66m ROW
 - Towers (Preliminary)
 - Angle Tower Locations (Preliminary)

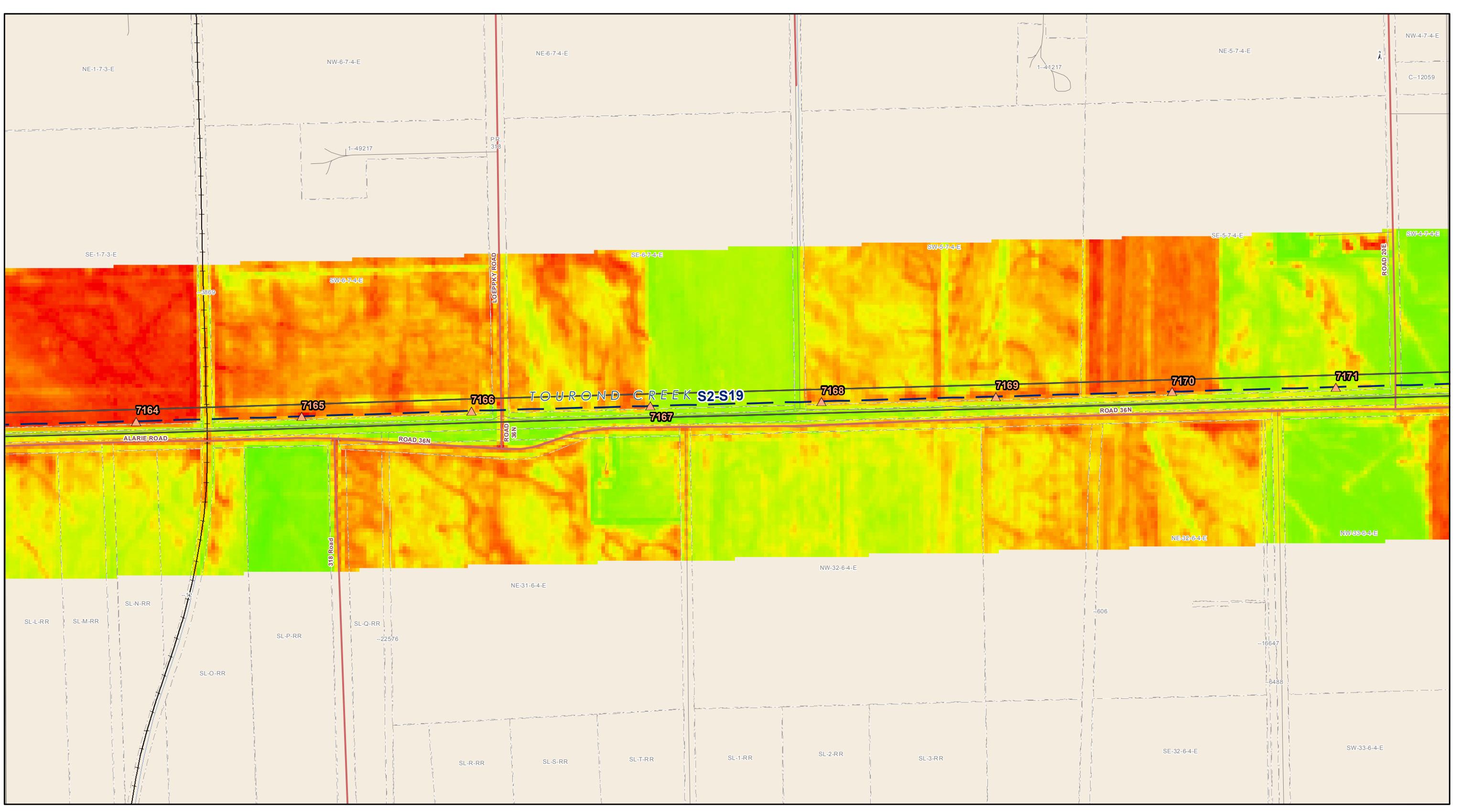
- Landbase**
- Major Road
 - Waterbodies
 - Parcel Fabric
 - Watercourse

Bipole III Transmission Project

Section S2

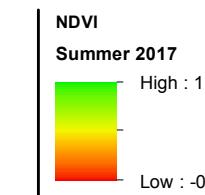
Normalized Difference Vegetation Index (NDVI) Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

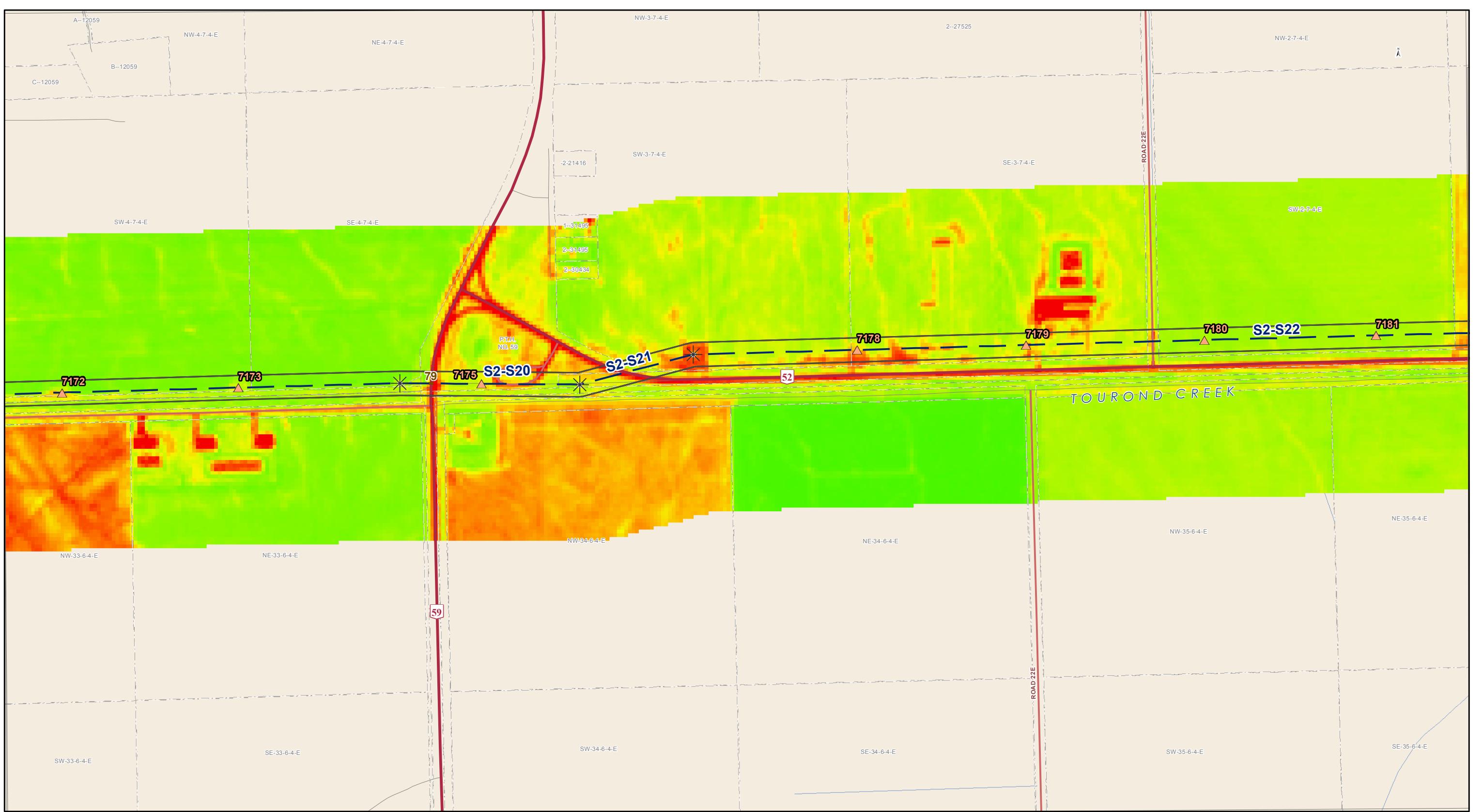
- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)

Landbase

- Major Road
- Railway (Operational)
- Parcel Fabric
- Watercourse

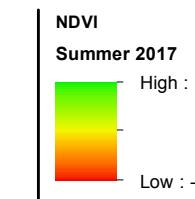
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
 Data Source: MB Hydro, ProvMB, NRCAN,
 Stantec Consulting
 Date Created: November 05, 2017

0 125 250 500
 Metres
 1:10,000



Project Infrastructure

- BP III Final Preferred Route (Blue line)
- 66m ROW (White box)
- Towers (Preliminary) (Orange triangle)
- Angle Tower Locations (Preliminary) (Orange asterisk)
- Proposed Access Route (Brown line)

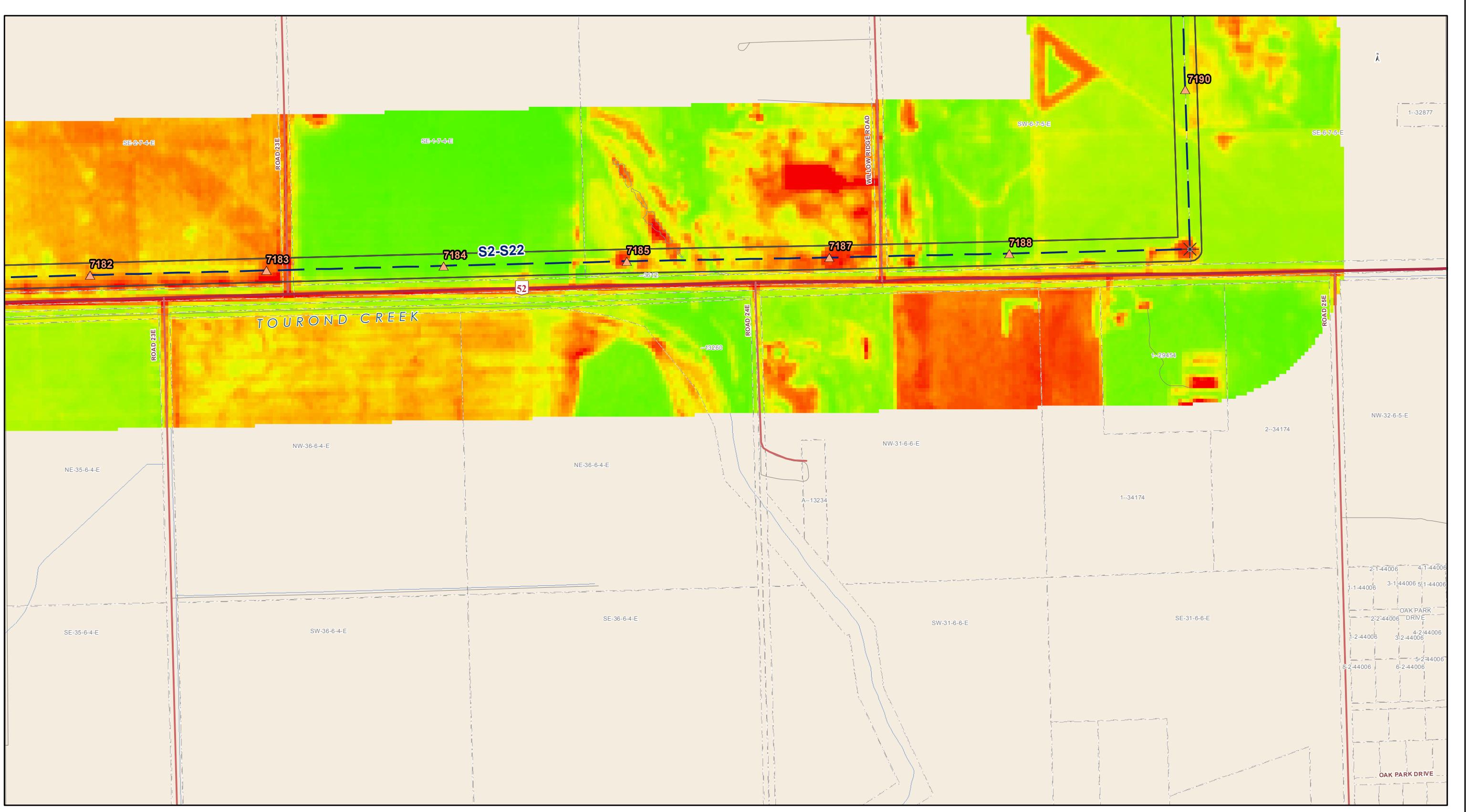
Landbase

- Highway (Red line)
- Major Road (Thin red line)
- Parcel Fabric (Dashed grey line)
- Watercourse (Blue line)

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

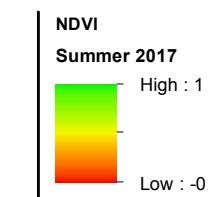
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Map 4-500-20



Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

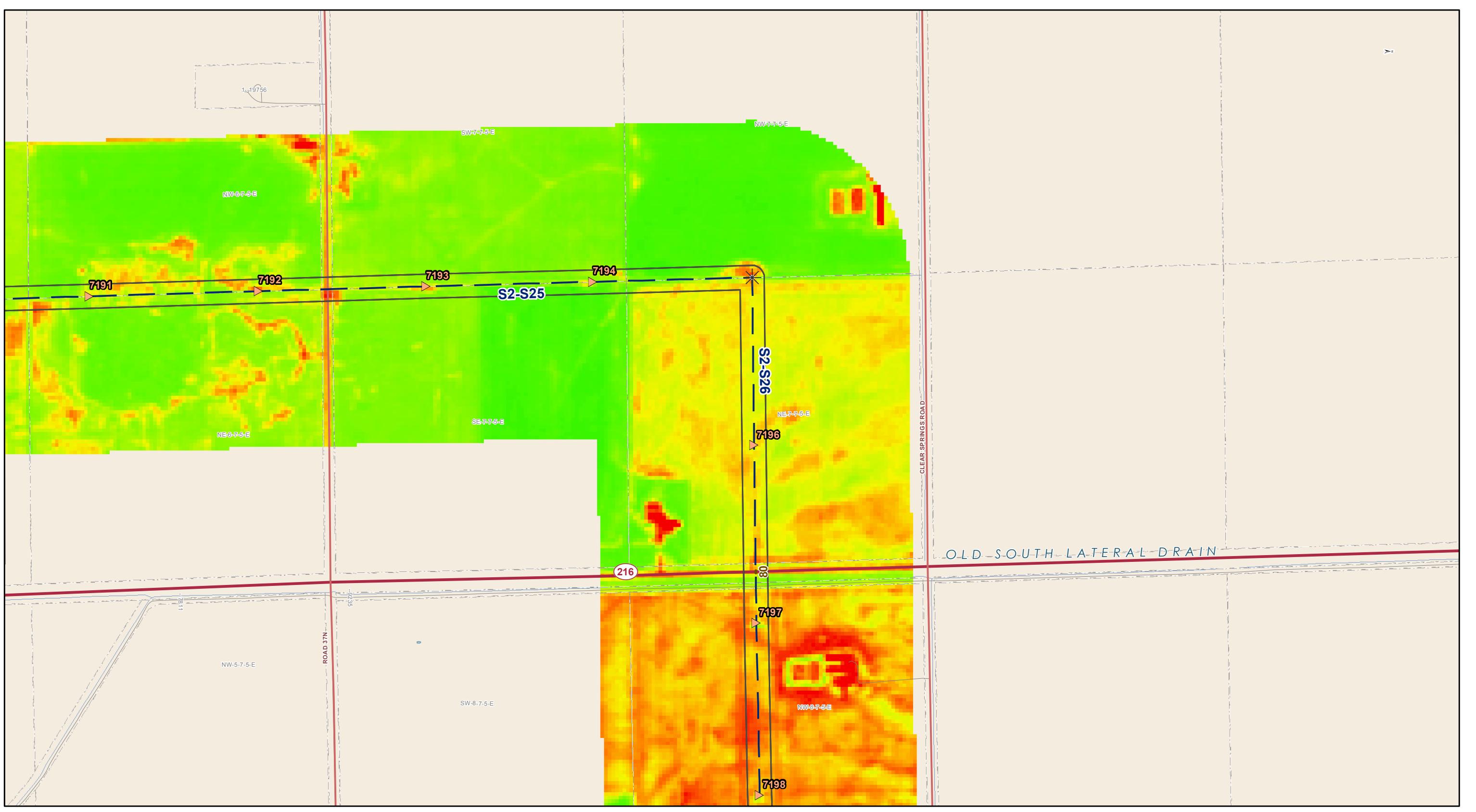
- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)
- Angle Tower Locations (Preliminary)

Landbase

- Highway
- Major Road
- Parcel Fabric
- Waterbodies
- Watercourse

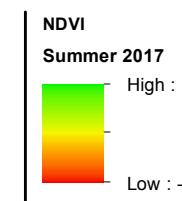
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

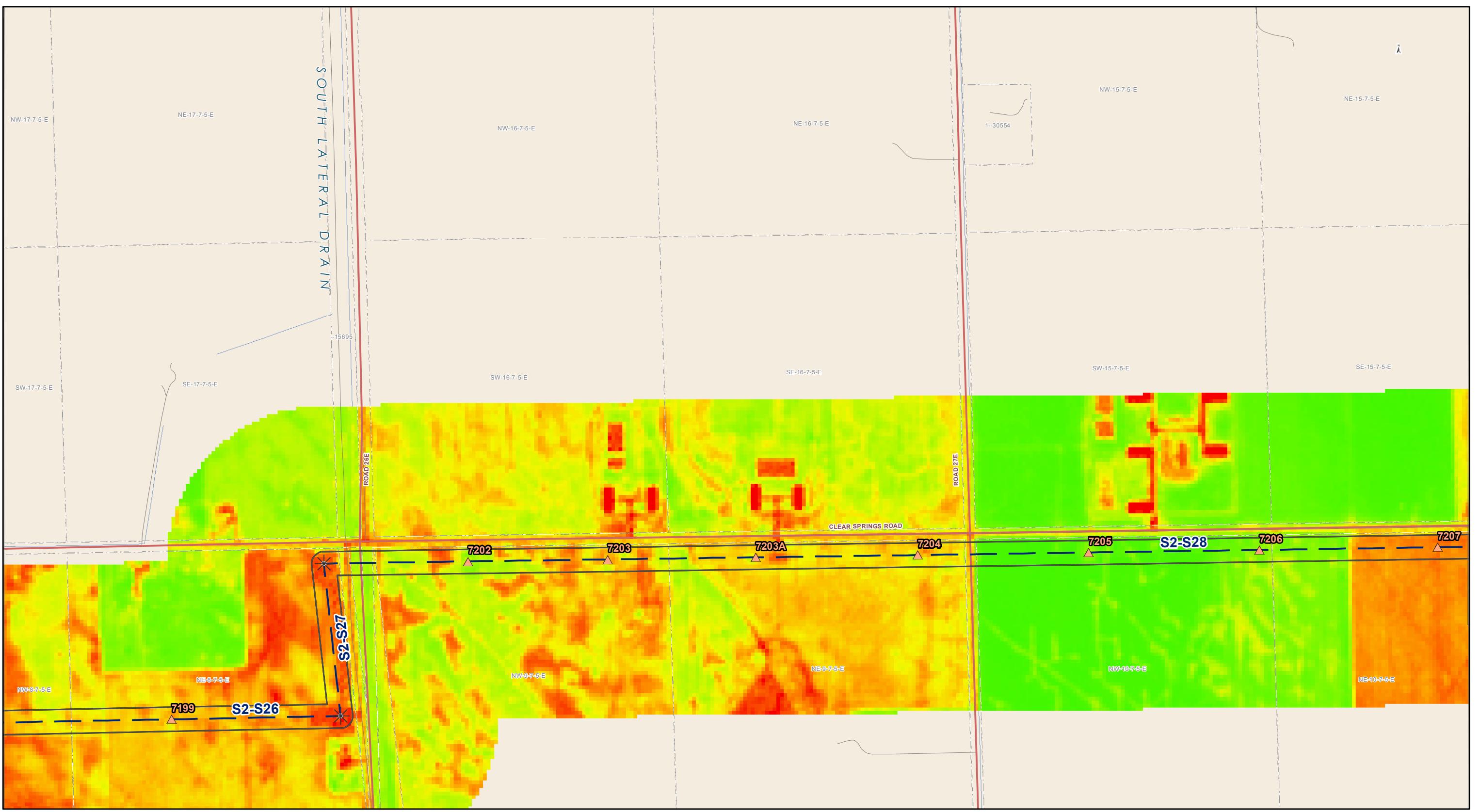
- BP III Final Preferred Route (Blue line)
- 66m ROW (White box)
- Towers (Preliminary) (Orange triangle)
- Angle Tower Locations (Preliminary) (Star)
- Proposed Access Route (Brown line)

Landbase

- Highway (Red line)
- Major Road (Red line)
- Waterbodies (Light blue)
- Watercourse (Dark blue)
- Parcel Fabric (Grey box)

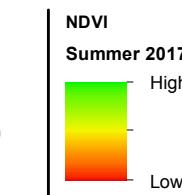
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure

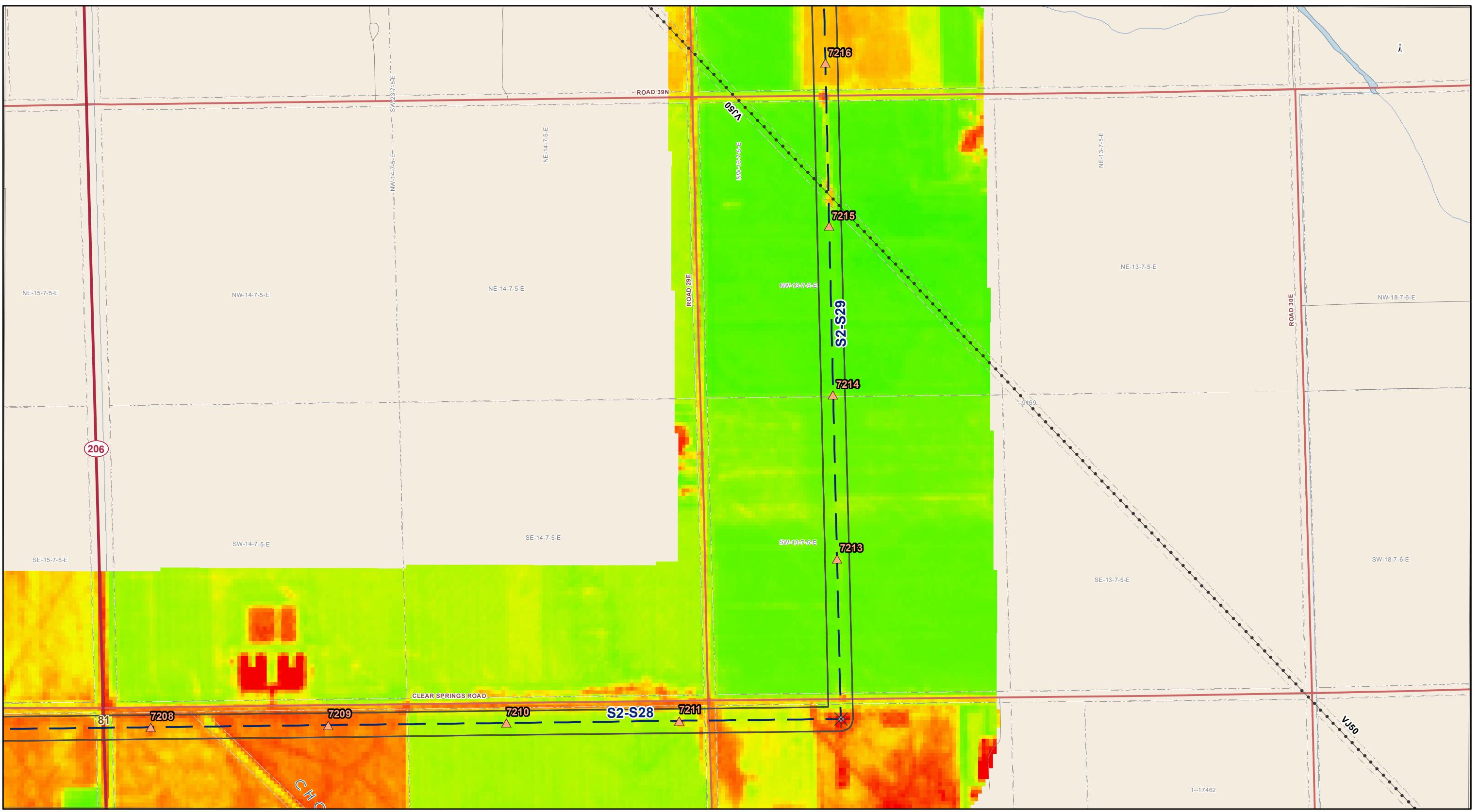
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Tower Locations (Preliminary)

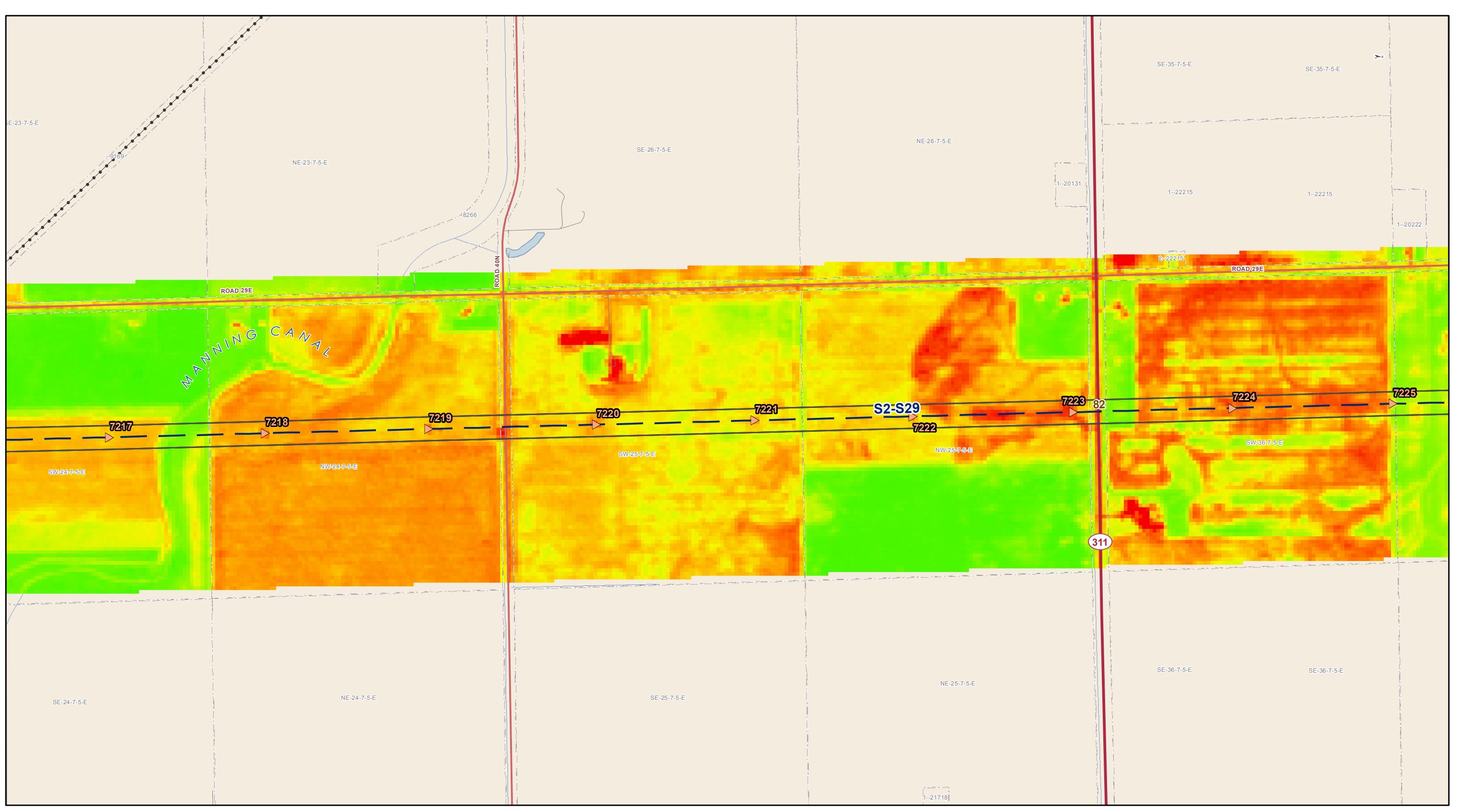
Landbase

- Major Road
- Parcel Fabric
- Watercourse

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

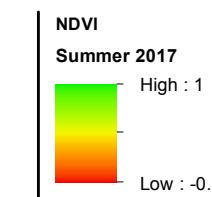
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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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Project Infrastructure

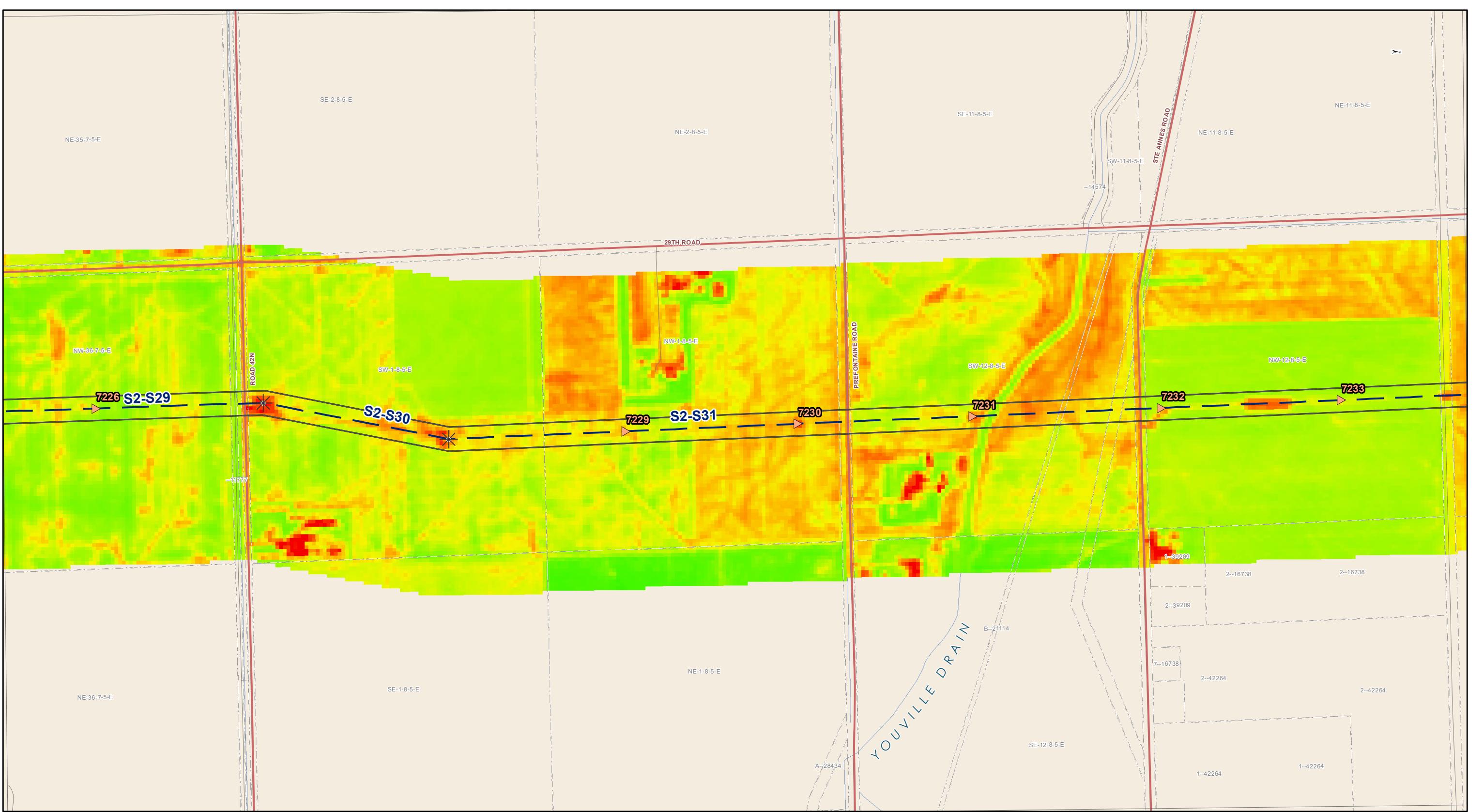
- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)
- Proposed Access Route

Landbase

- Highway
- Major Road
- Transmission Line
- Waterbodies
- Watercourse
- Parcel Fabric

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Date Created: November 05, 2017
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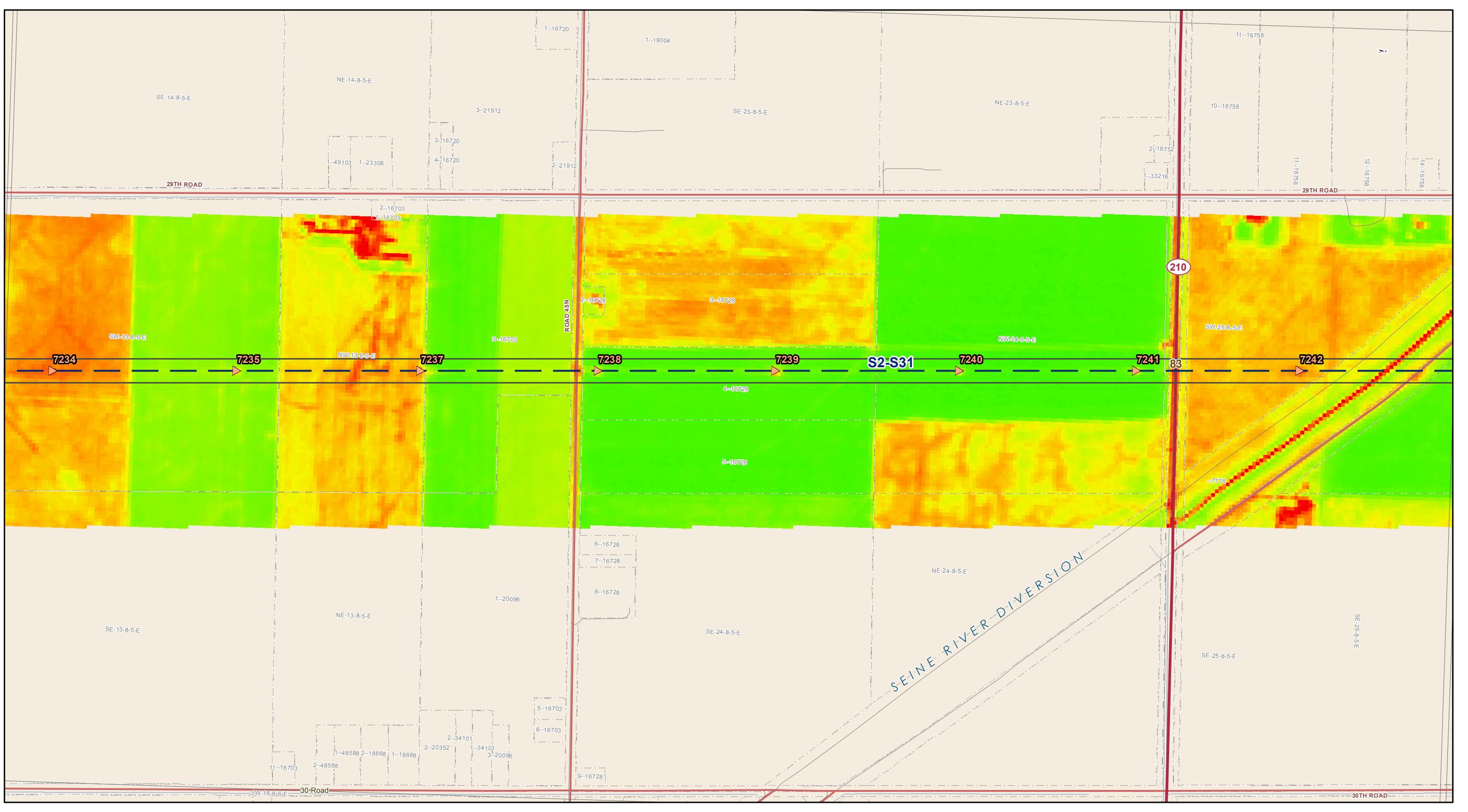
NDVI
Summer 2017
High : 1
Low : -0.6

Project Infrastructure
— BPIII Final Preferred Route
□ 66m ROW
▲ Towers (Preliminary)
★ Angle Tower Locations (Preliminary)

Landbase
— Major Road
□ Parcel Fabric
— Watercourse

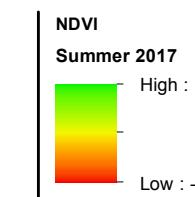
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres
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Project Infrastructure

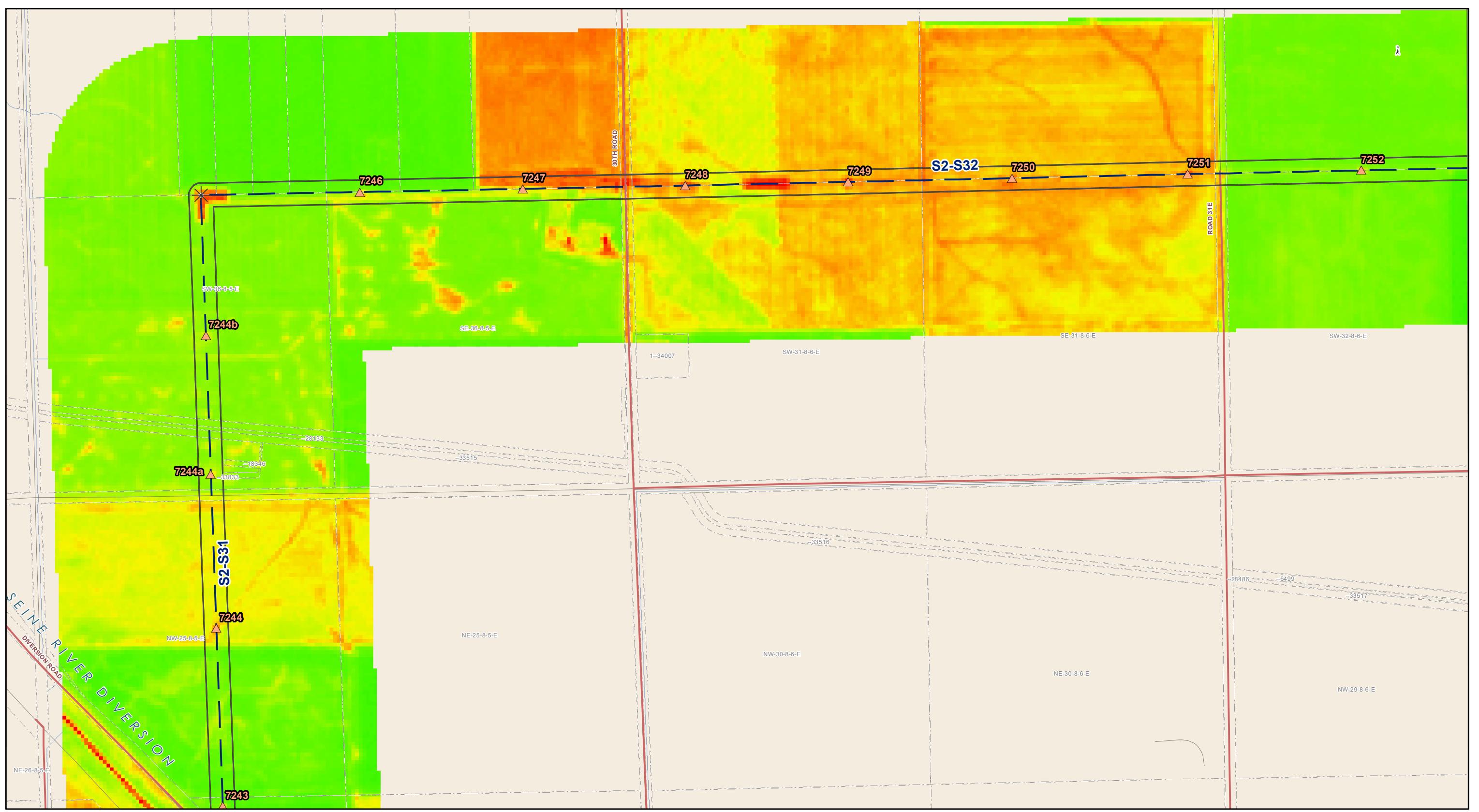
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- Proposed Access Route

Landbase

- Highway
- Major Road
- Parcel Fabric
- Watercourse

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

0 125 250 500 Metres

1:10,000

NDVI
Summer 2017

High : 1
Low : -0.6

Project Infrastructure

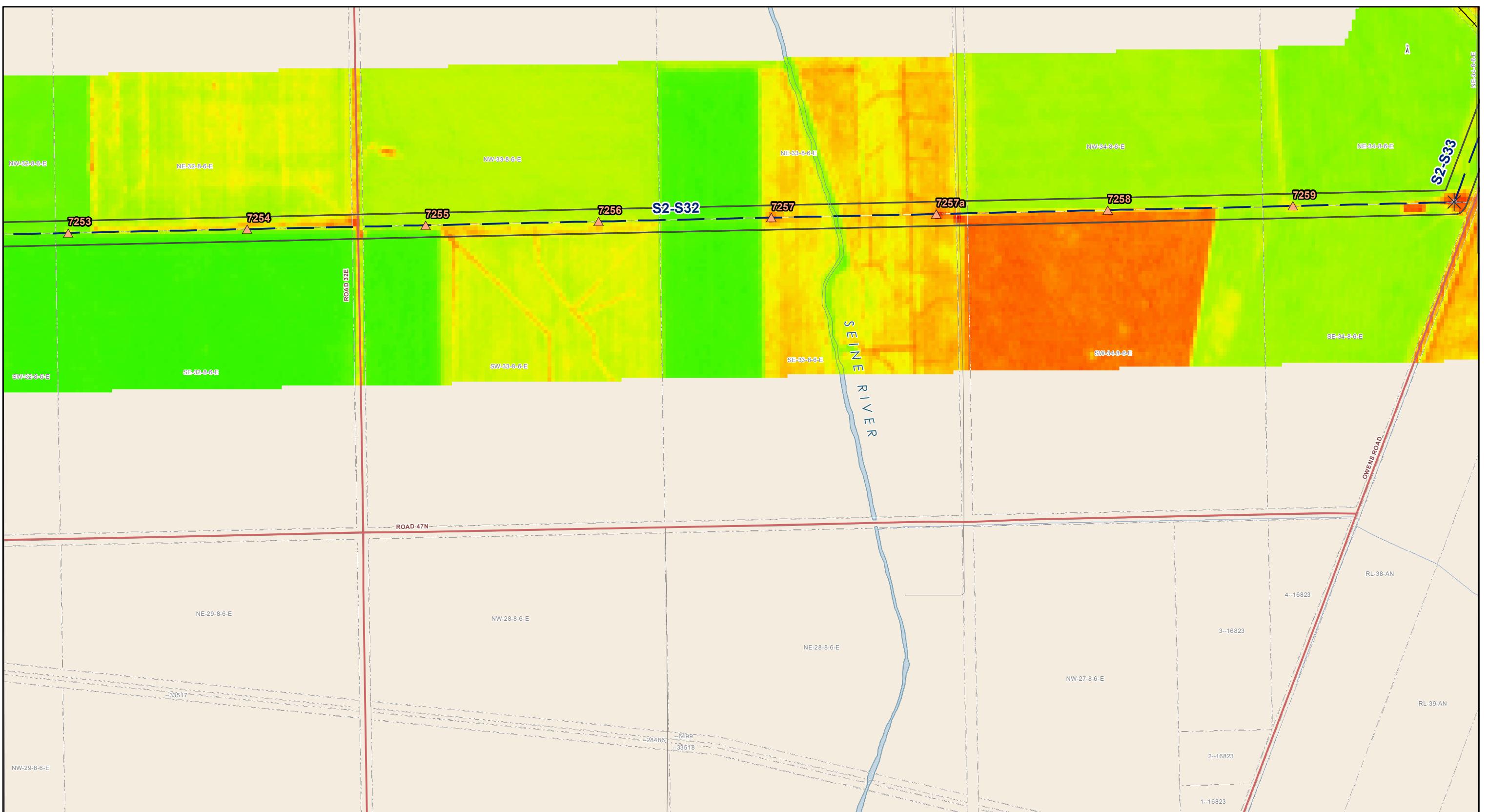
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Tower Locations (Preliminary)

Landbase

- Major Road
- Parcel Fabric
- Watercourse

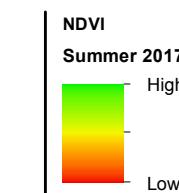
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

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Metres
1:10,000



Project Infrastructure

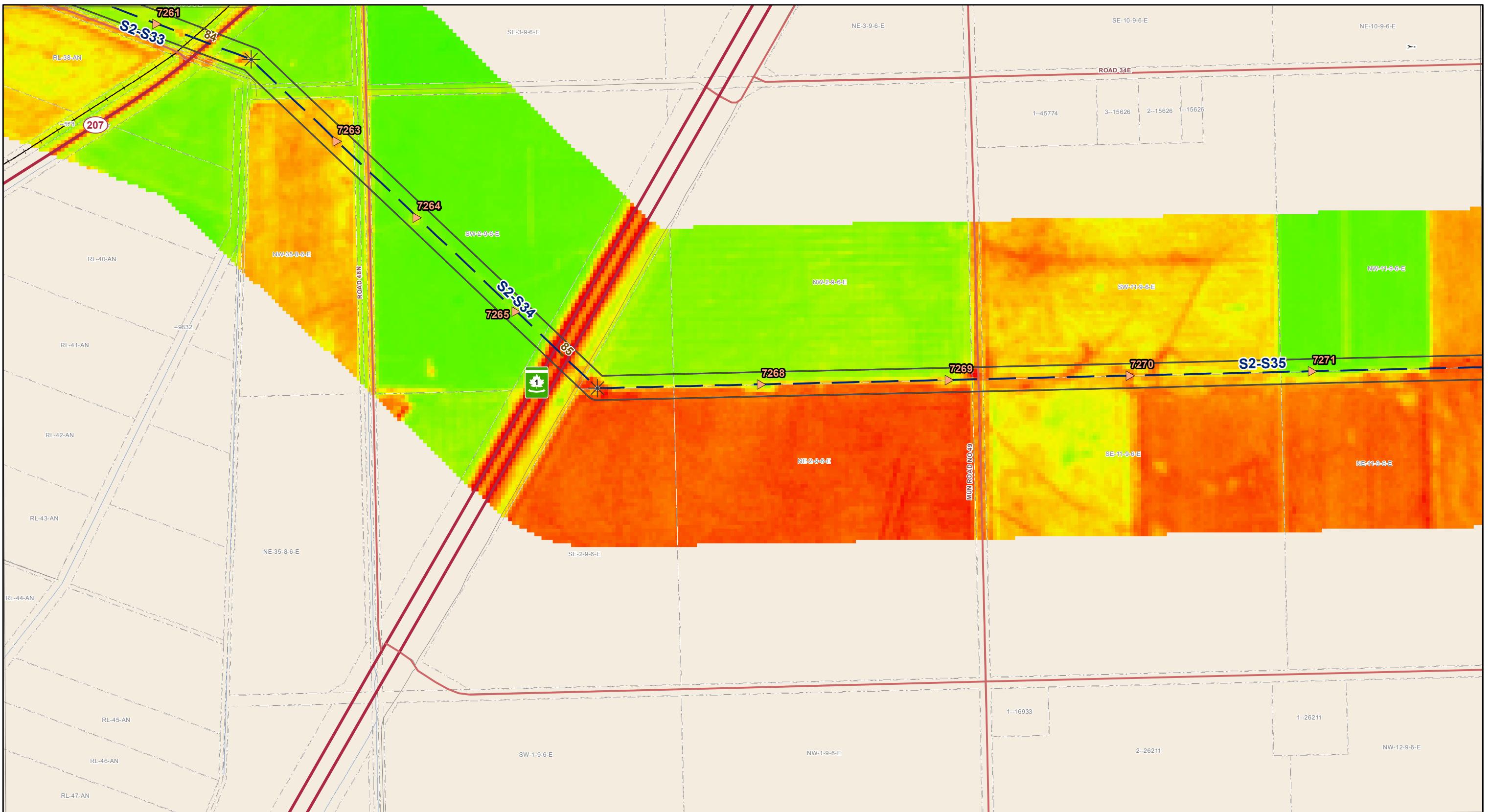
- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)
- Angle Tower Locations (Preliminary)

Landbase

- Highway
- Major Road
- Railway
- Parcel Fabric
- Waterbodies
- Watercourse

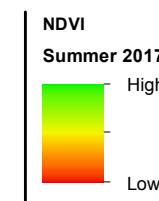
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
Stantec Consulting
Date Created: November 05, 2017

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Metres
1:10,000

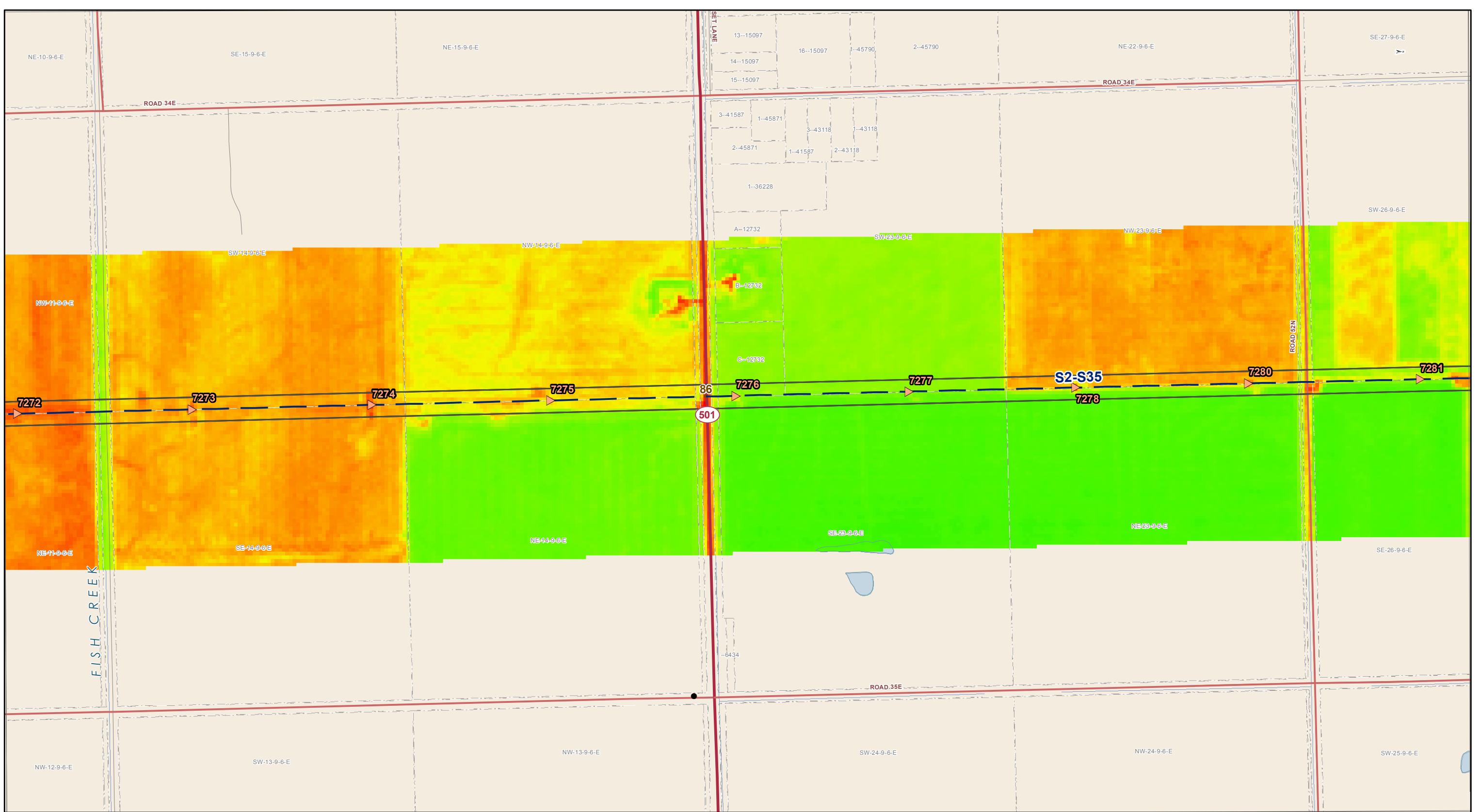


- Project Infrastructure**
- BP III Final Preferred Route
 - 66m ROW
 - ▲ Towers (Preliminary)
 - * Angle Tower Locations (Preliminary)
 - Proposed Access Route

- Landbase**
- Highway
 - Major Road
 - Railway (Operational)
 - Parcel Fabric
 - Watercourse

Bipole III Transmission Project Section S2 Normalized Difference Vegetation Index (NDVI) Summer 2017

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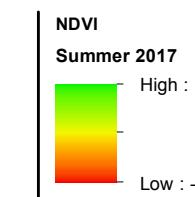
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Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

NDVI
Summer 2017

High : 1
Low : -0.6

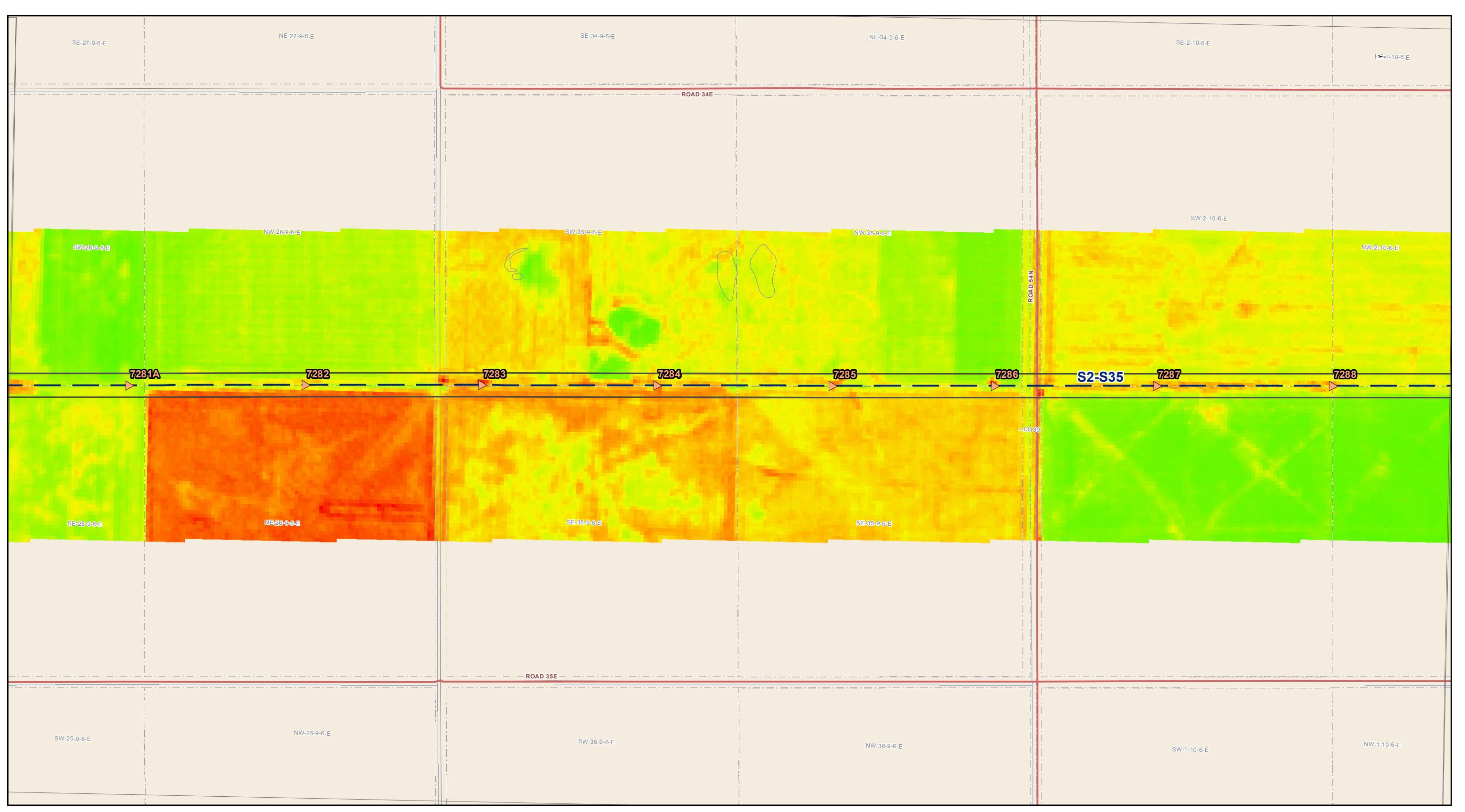
Metres
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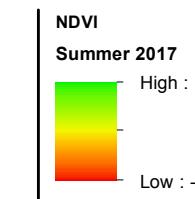
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN,
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Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



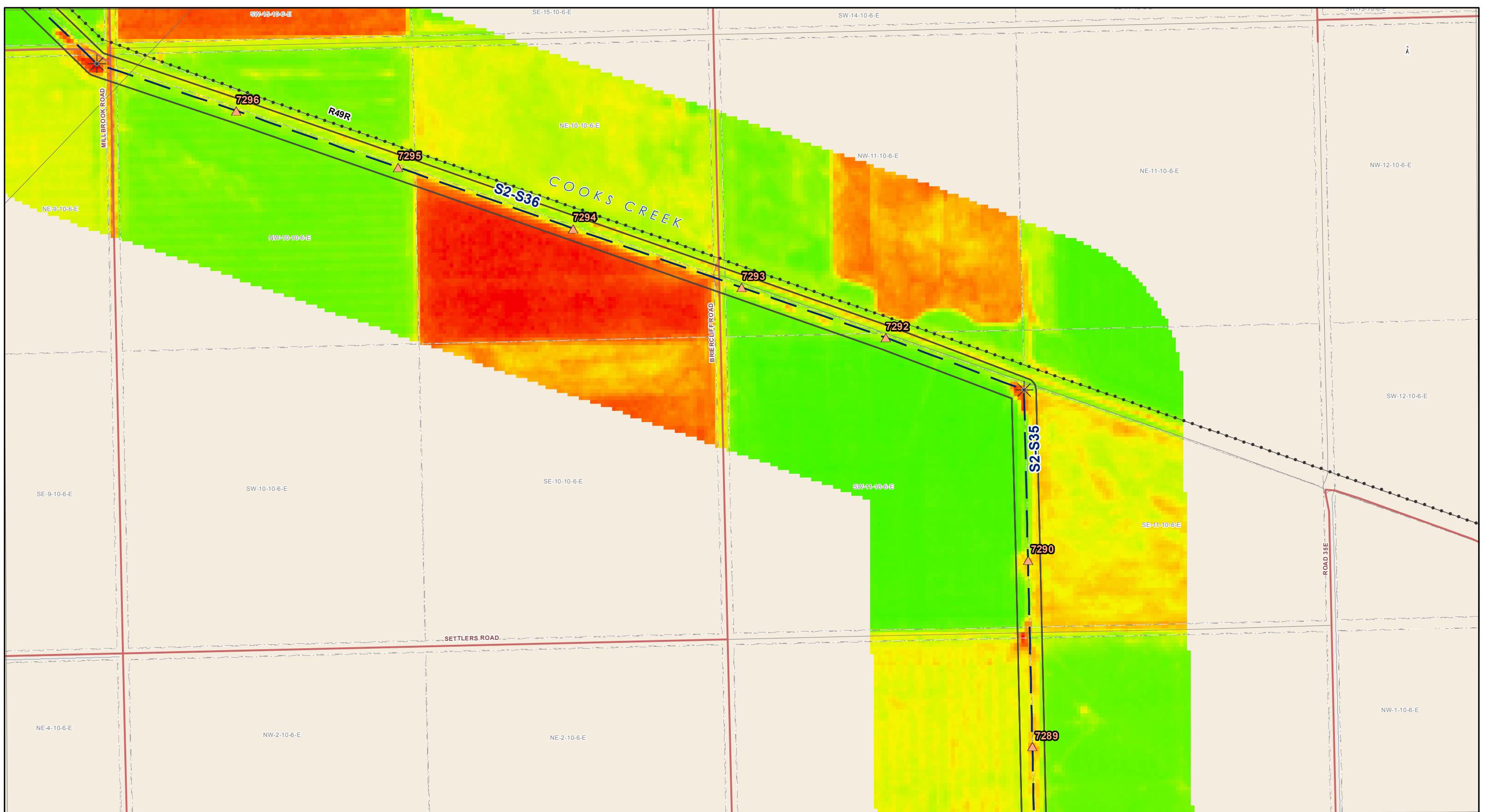
Project Infrastructure
— BPIII Final Preferred Route
□ 66m ROW
▲ Towers (Preliminary)

Landbase

— Major Road	■ Waterbodies
□ Parcel Fabric	— Watercourse

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000

NDVI
Summer 2017
High : 1
Low : -0.6

Project Infrastructure

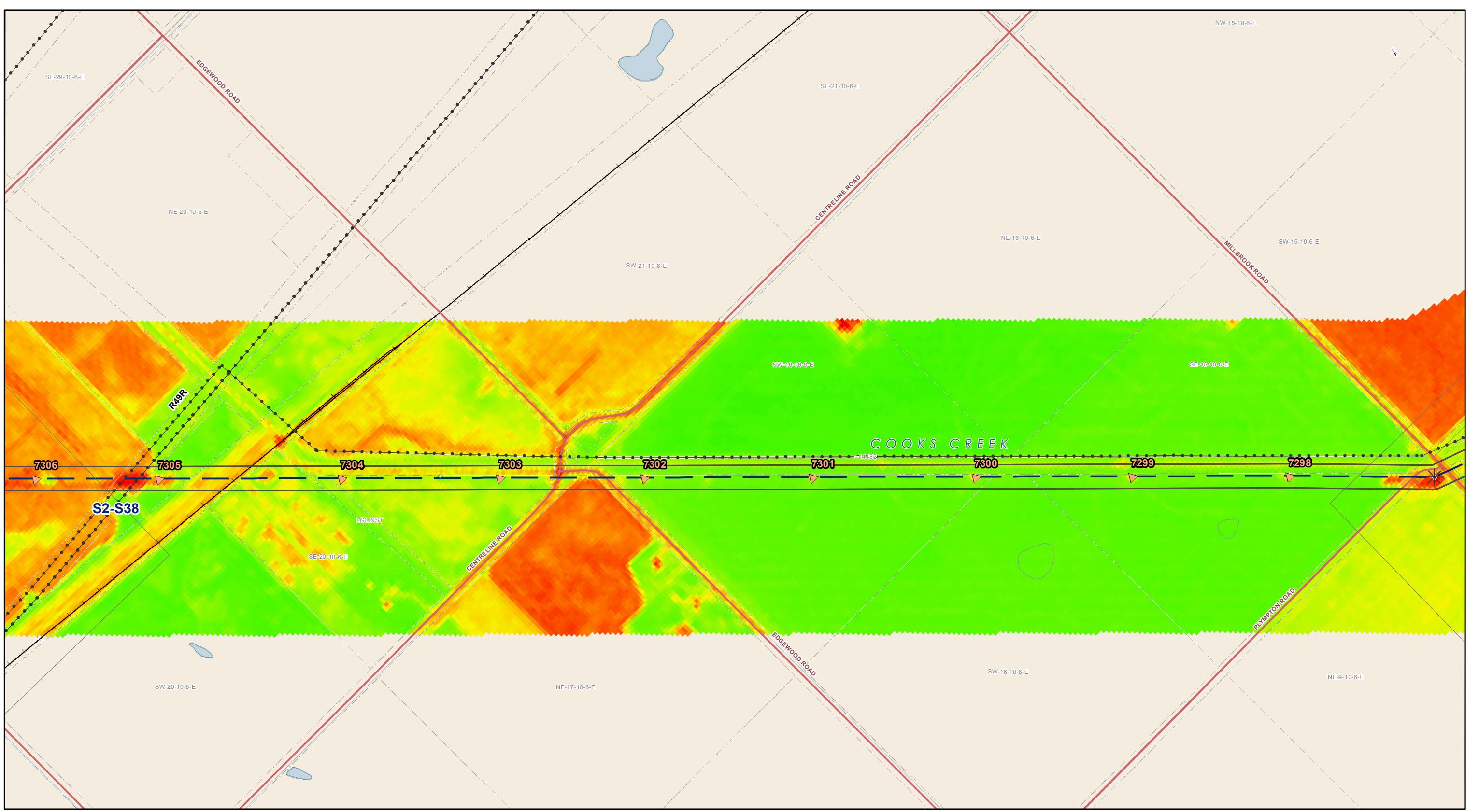
- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)
- Angle Tower Locations (Preliminary)

Landbase

- Major Road
- Transmission Line
- Parcel Fabric
- Watercourse

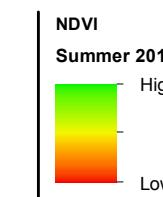
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
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Date Created: November 05, 2017

0 125 250 500
Metres
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Project Infrastructure

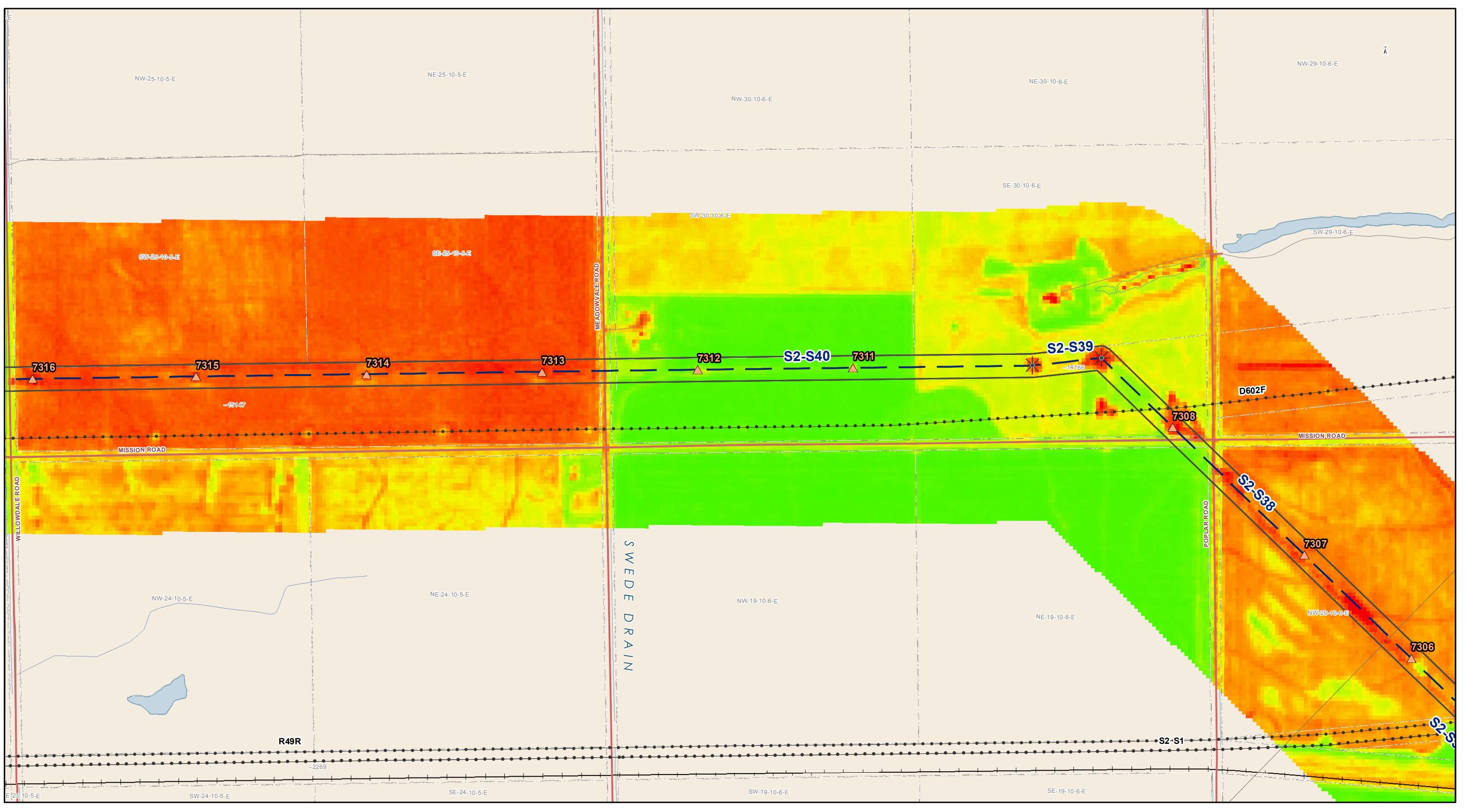
- BPIII Final Preferred Route
- 66m ROW
- ▲ Towers (Preliminary)
- * Angle Tower Locations (Preliminary)

Landbase

- Major Road
- Railway (Operational)
- Transmission Line
- Parcel Fabric
- Waterbodies
- Watercourse

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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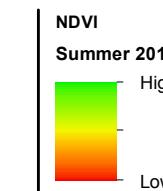


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Date Created: November 05, 2017

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Metres

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Project Infrastructure

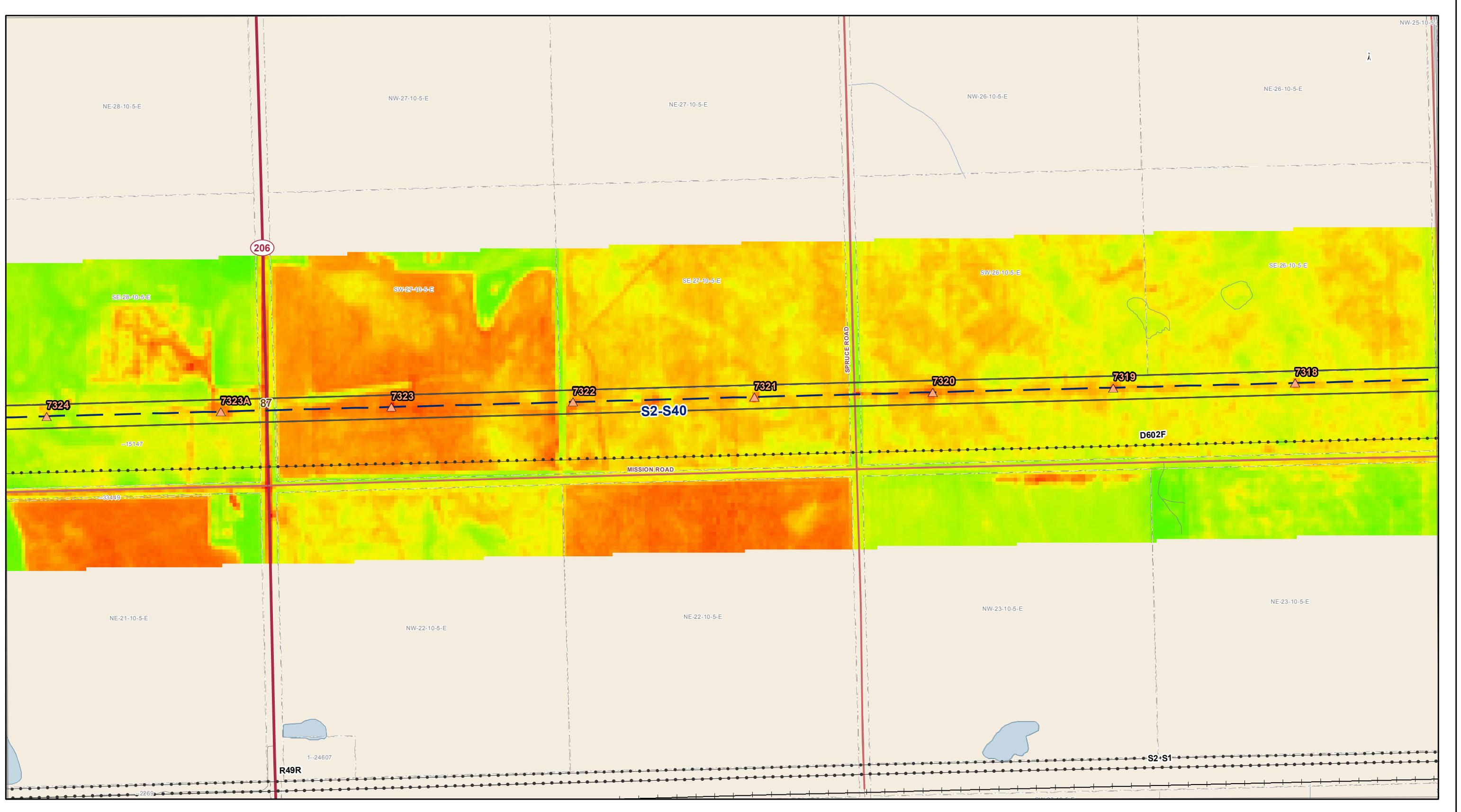
- BP III Final Preferred Route
- 66m ROW
- Towers (Preliminary)
- Angle Tower Locations (Preliminary)

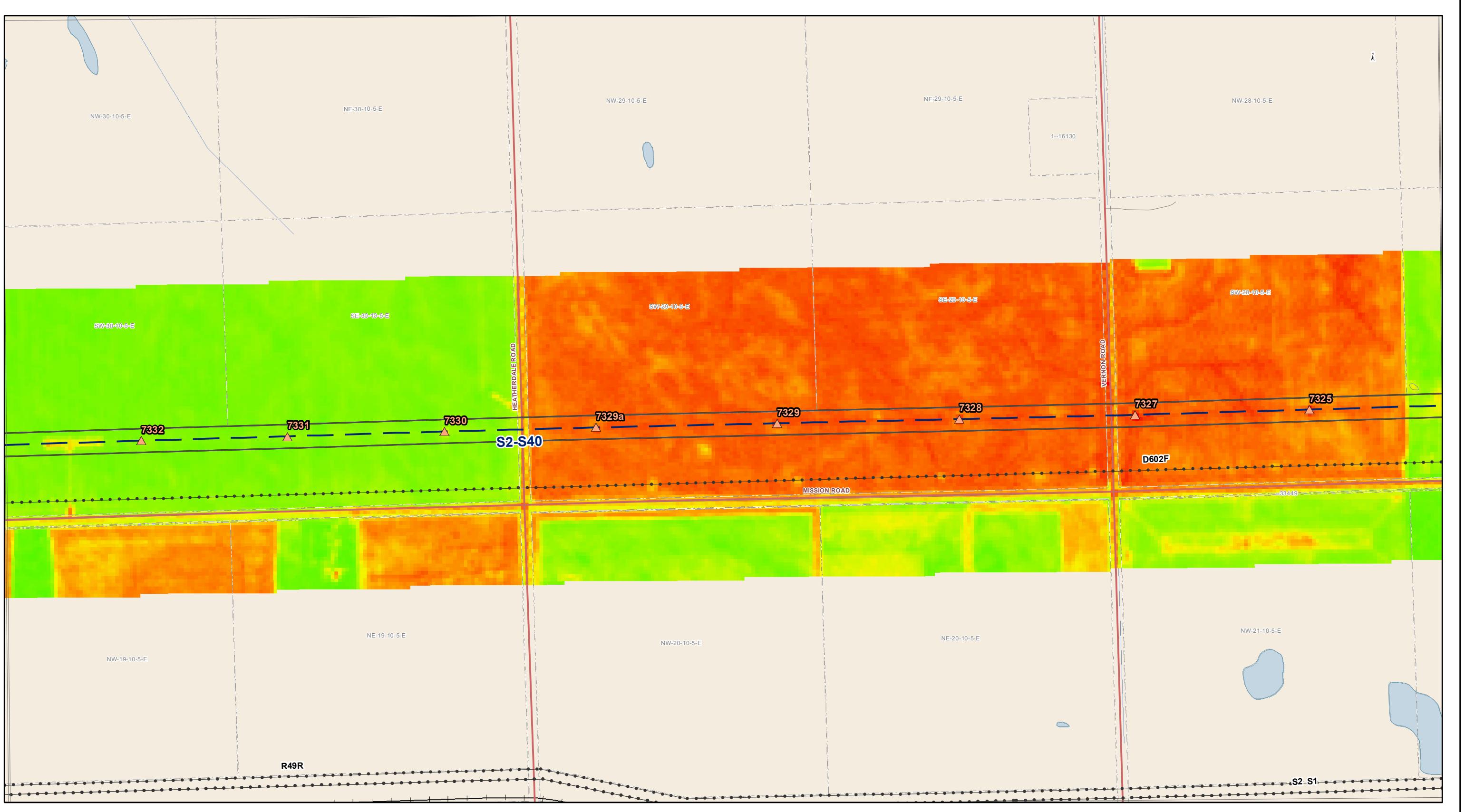
Landbase

- Major Road
- Railway (Operational)
- Transmission Line
- Waterbodies
- Watercourse
- Parcel Fabric

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

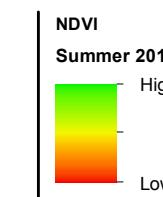
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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
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Project Infrastructure

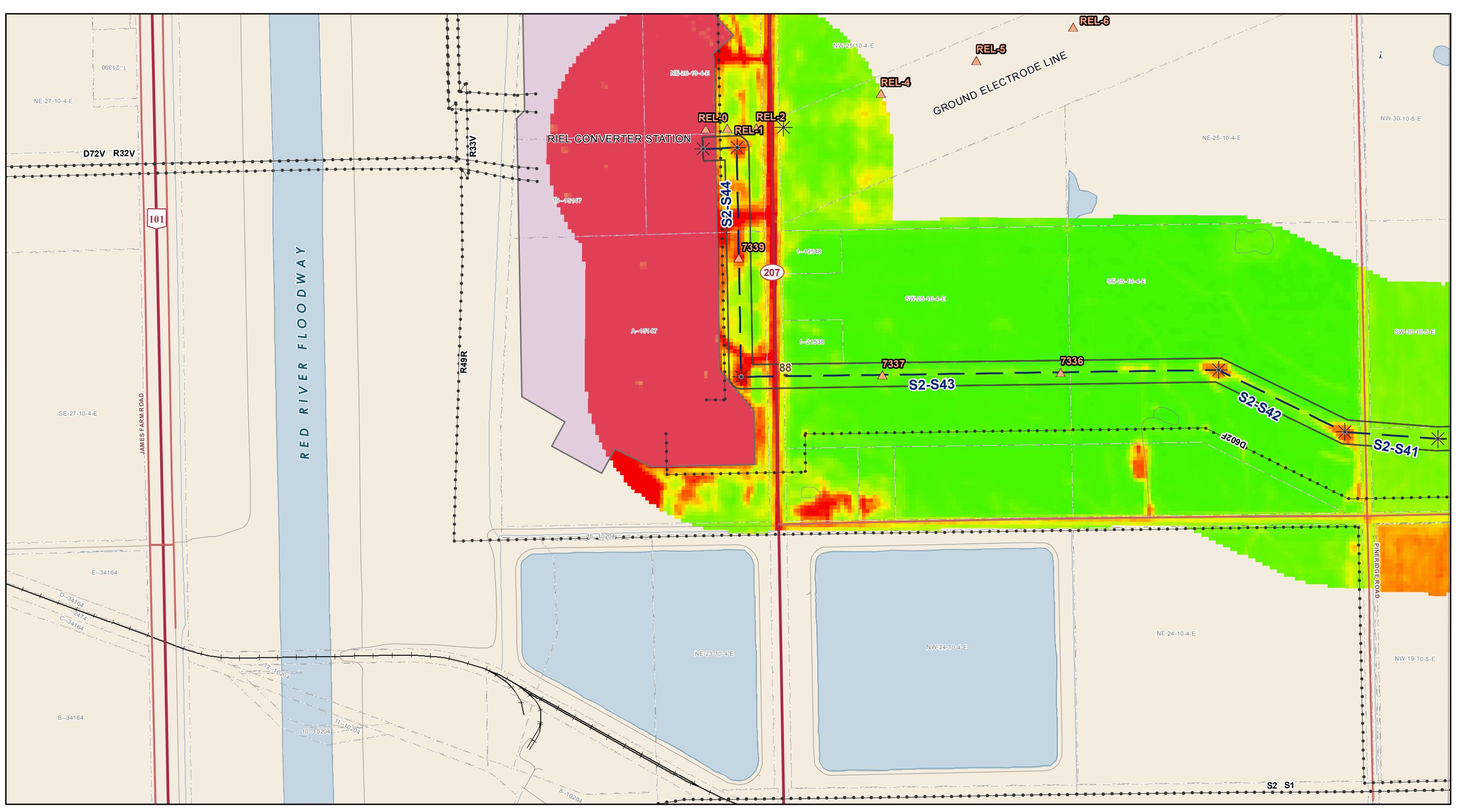
- BPIII Final Preferred Route (Blue line)
- 66m ROW (White box)
- Towers (Preliminary) (Orange triangle)

Landbase

- Major Road (Red line)
- Railway (Operational) (Black line)
- Transmission Line (Dotted line)
- Parcel Fabric (Grey box)
- Waterbodies (Blue shape)
- Watercourse (Light blue line)

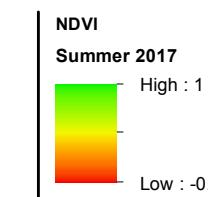
Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Coordinate System: UTM Zone 14N NAD83
Data Source: MB Hydro, ProvMB, NRCAN, Stantec Consulting
Date Created: November 05, 2017

0 125 250 500
Metres
1:10,000



Project Infrastructure

- BPIII Final Preferred Route
- 66m ROW
- Towers (Preliminary)
- Angle Tower Locations (Preliminary)

Landbase

- Proposed Converter Station
- Highway
- Major Road
- Railway (Operational)
- Transmission Line
- Waterbodies
- Watercourse
- Parcel Fabric

Bipole III Transmission Project
Section S2
Normalized Difference Vegetation Index (NDVI)
Summer 2017

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Available in accessible formats upon request