GEO TAIL

The Willows Office Park,
559 Farm Road – Office E1,
The Willows, Pretoria, 0181

KHUMANI IRON ORE MINE

KING PDF

DAM BREAK ANALYSIS - 2021

Report prepared for

Khumani Mine

ASSMANG IRON ORE

Report prepared by

Bruce Randell

PhD (Eng), Pr Eng

GEO TAIL SA (Pty) Ltd.
Directors: GL de Swardt, RA Titus, J Swart | Reg No: 2014/093494/07

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REVISION TRACKING

Rev 0: Original document

Rev 1: Internal review comments addressed

Rev 2: Client review comments addressed

Rev 3: Power lines included as sensitive receptors

Disclaimer

The opinions expressed in this report have been based on the information supplied to Geo Tail SA (Pty) Ltd by the Client. The opinions in this report are provided in response to a specific request from the Client to do so. Geo Tail SA has exercised all due care in reviewing the supplied information. Whilst Geo Tail SA has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. Geo Tail SA does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features, as they existed at the time of Geo Tail's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this report, about which Geo Tail SA had no prior knowledge nor had the opportunity to evaluate.

1. INTRODUCTION

Geo Tail SA (Pty) Ltd (Geo Tail) was appointed by Khumani Iron Ore Mine to calculate a dam break analysis for the King Paste Disposal Facility. The original dam break analysis was calculated by Geo Tail in January 2020. This body of work is an update on that analysis, using updated survey, improved simulation resolution, updated breach hydrographs, and additional breach locations.

1.1 Battery Limits

The downstream battery limit for the dam break analysis is generally the extent that the water and slurry will flow after 2.5 hours. In some scenarios with significant overland storage, this is extended up to 6 hours. A battery limit has to be imposed as discharged water can flow into the Atlantic Ocean via the Ga-Mogara, Kuruman, Molopo and Orange River systems.

1.2 Regional Setting

Pertinent infrastructure and features are shown in Figure 1. The Ga-Mogara River flows from east to west, to the north of the PDF. The topography around the zone of influence is shown in Figure 2.

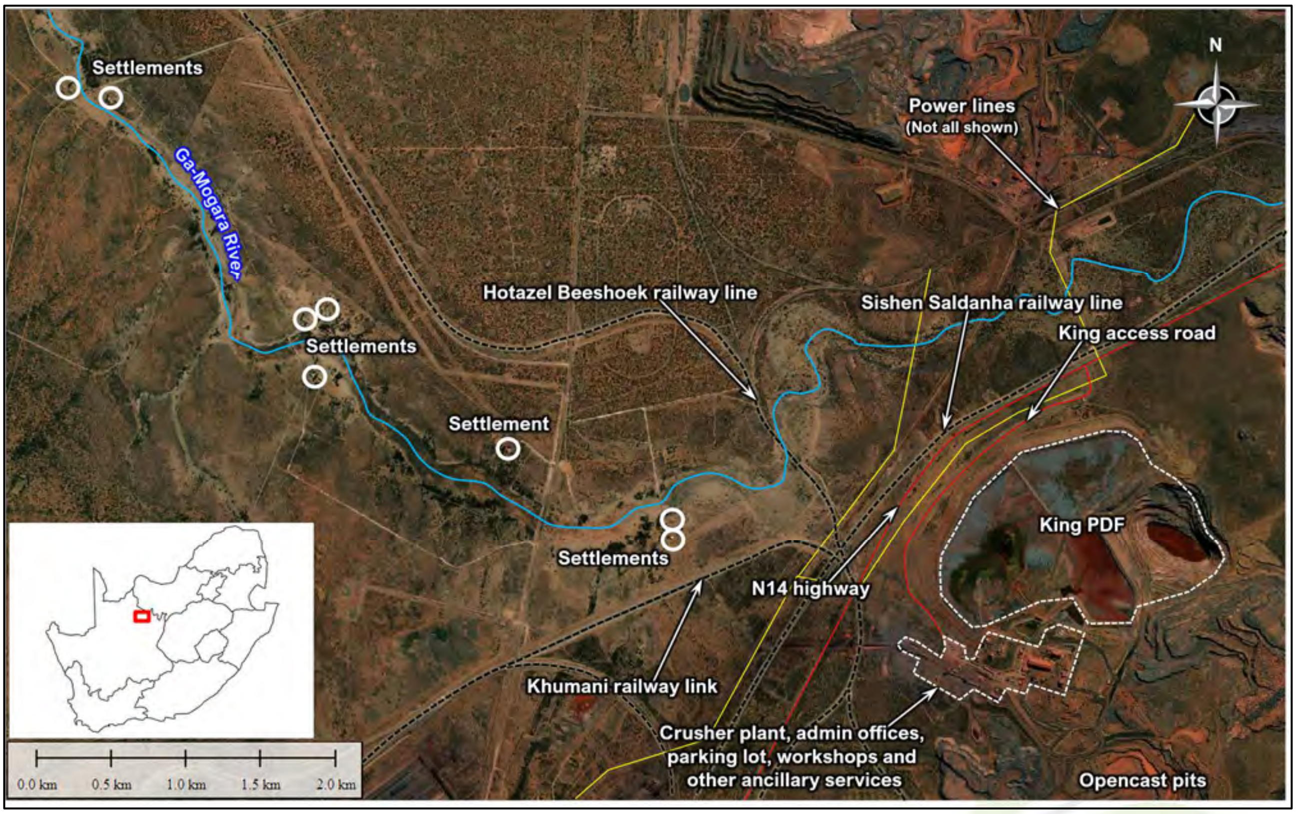


FIGURE 1: REGIONAL SETTING

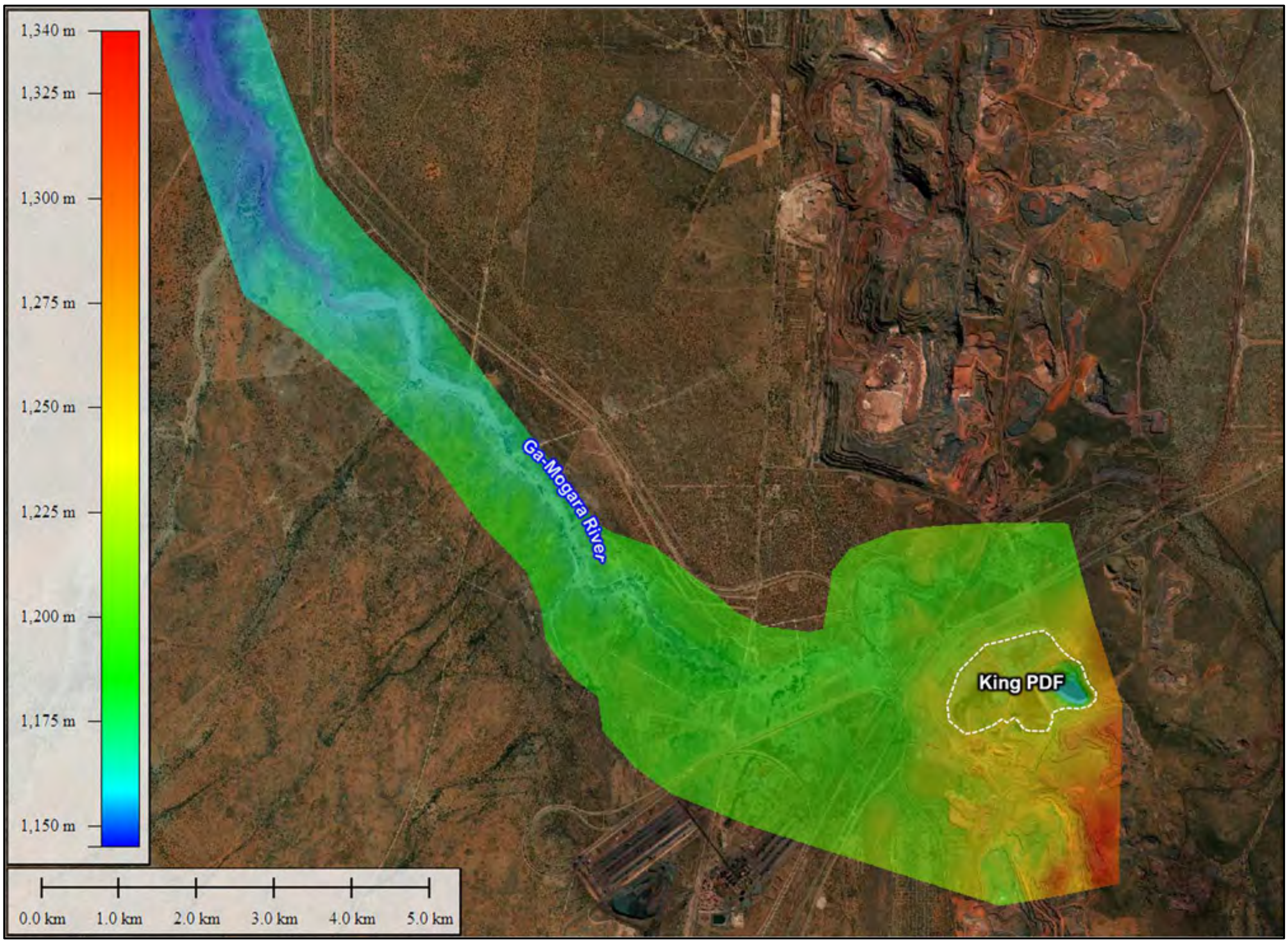


FIGURE 2: TOPOGRAPHY AROUND THE ZONE OF INFLUENCE

2. KHUMANI PASTE DISPOSAL FACILITY

The King Paste Disposal Facility (PDF) is Khumani Mine's only tailings storage facility. The PDF complex currently comprises four active paste deposition compartments (Compartments 1, 2, 3A and 3B) and two water storage dams – the return water dam (RWD) and the storm water dam (SWD). The layout of the PDF is shown in Figure 3.

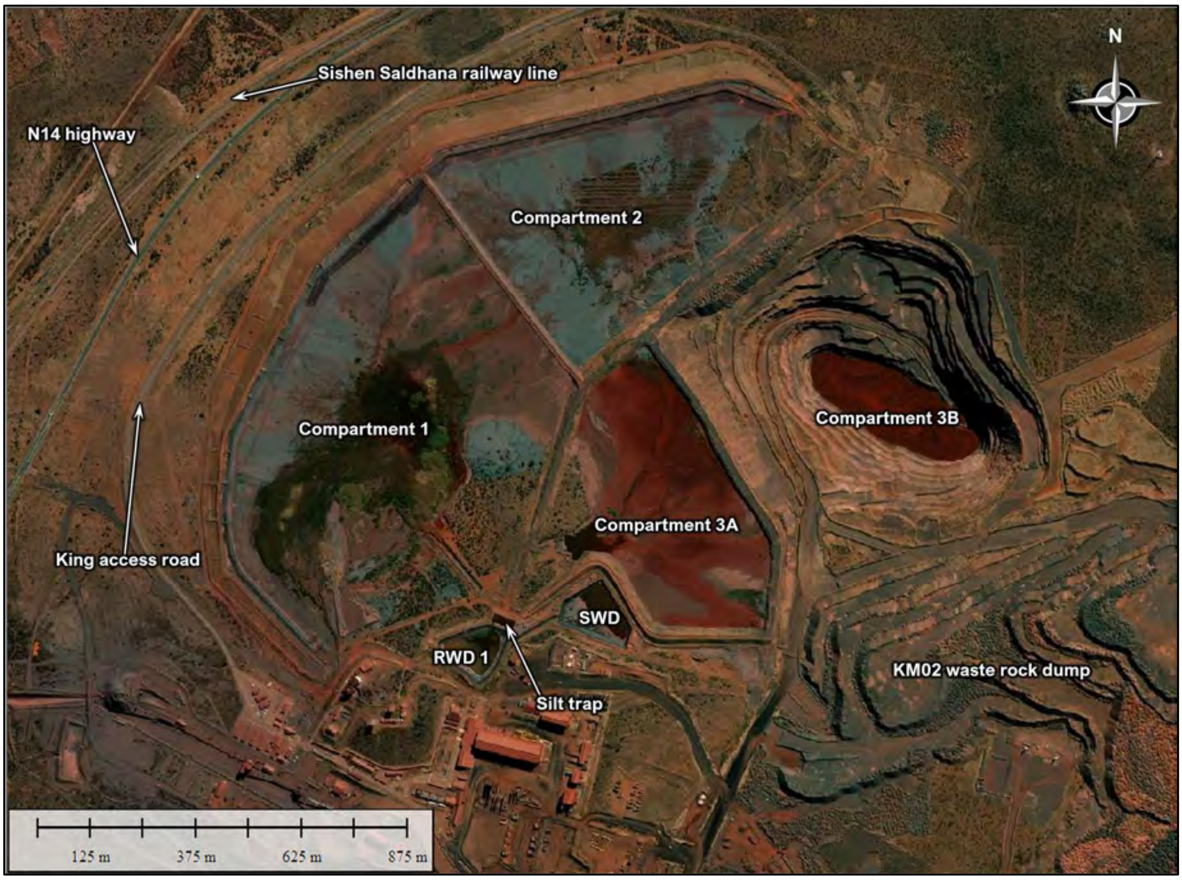


FIGURE 3: INFRASTRUCTURE LAYOUT

2.1 PDF Construction

The construction material used to form the outer embankments that face the N14 highway are shown in Figure 4.

The tailings are deposited as a dewatered paste. The allowable rate of rise is limited to less than 1 m per year to allow for desiccation of the paste.

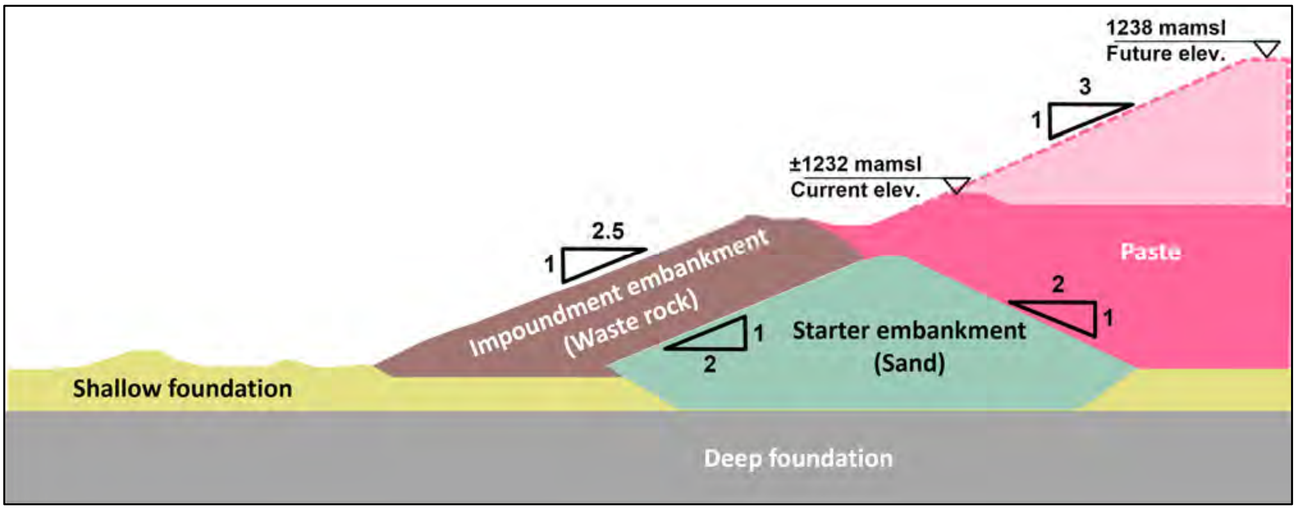


FIGURE 4: KING PDF CONSTRUCTION MATERIALS

2.2 Current PDF stability

2.2.1 Geotechnical laboratory testing

A representative disturbed paste sample was submitted to BM du Plessis Civil Engineering for geotechnical testing.

The following laboratory tests were undertaken:

- Particle Size Distribution (results summarised in Table 1)
- Specific Gravity (results summarised in Table 1)

The laboratory test results can be summarised as follows:

TABLE 1: SUMMARY - LABORATORY TEST RESULTS

Item	Geotechnical Property	Unit	Value
1	**Particle size distribution**		
1.1	< 2-micron	%	13
1.2	> 50-micron	%	50
1.3	> 75-micron	%	36
2	**Specific Gravity**	ratio	4.37

2.2.2 Piezometer readings

Two standpipe piezometer lines have been installed on the PDF. One line of three piezometers on the critical section of Compartment 1, as well as one line of three piezometers on the critical section of Compartment 2.

In general (SSMS historical monitoring data refers), the piezometer readings are dry, and it is therefore assumed that the standpipe piezometers are not effective in the clayey (undrained) paste material and/or that the tips are located within the drained zones.

2.2.3 Side slope stability analysis

Side slope stability analyses were undertaken in June 2021 for critical cross sections through the PDF (see Figure 5).

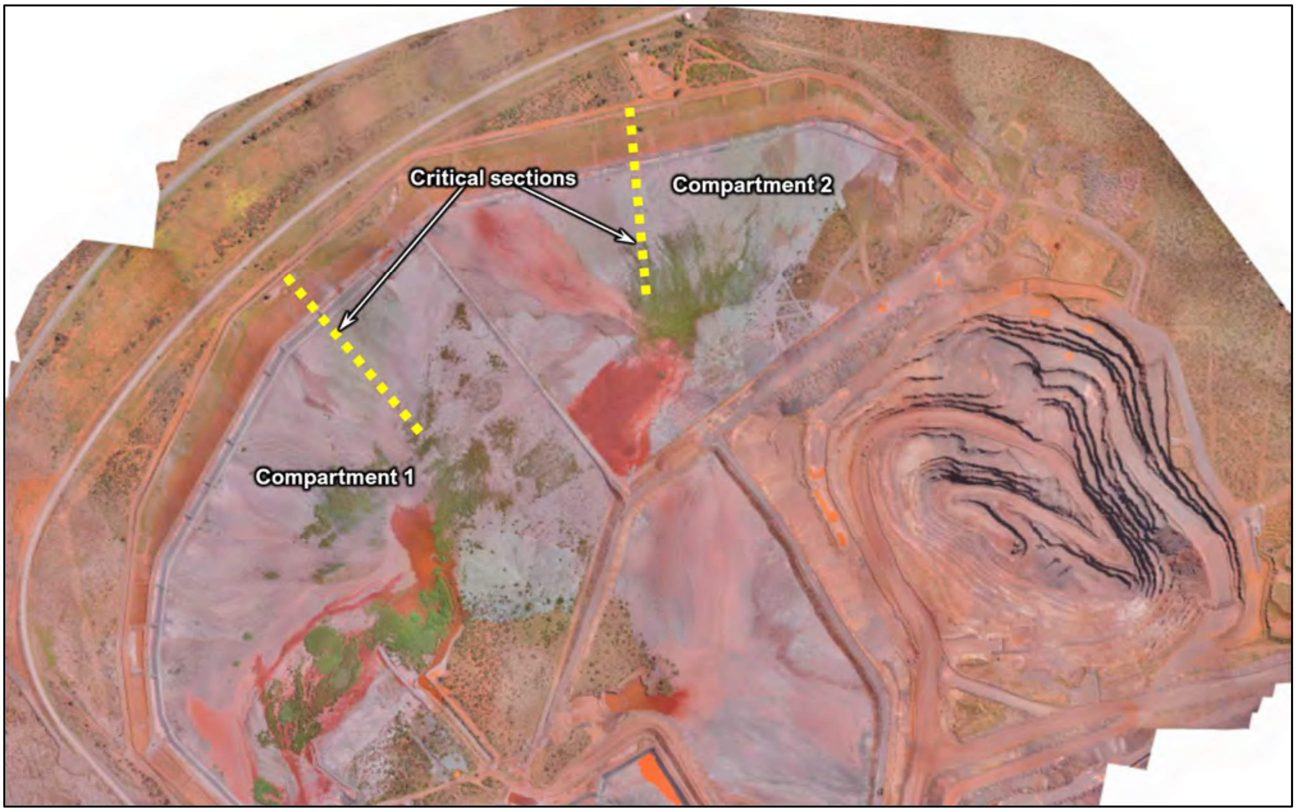


FIGURE 5: CRITICAL SECTIONS

The stability analysis results are summarised below.

TABLE 2: SUMMARY - FACTORS OF SAFETY FOR IMPOUNDMENT EMBANKMENT

Item	Method	Factor of Safety	
		Compartment 1	Compartment 2
1.0	Drained (peak strength)	2.16	2.39
2.0	Drained (incl. seismic loading)	1.82	2.01
3.0	Undrained (peak strength)		
3.1	Vertical Stress Ratio = 0.22	2.16	2.39
3.2	Constant strength = 60 kPa (min.)	2.58	2.99
4.0	Undrained (residual strength)		
4.1	Vertical Stress Ratio = 0.08	2.16	2.39
4.2	Constant strength = 20 kPa (min.)	1.10	2.11

2.3 Pool Analysis and Freeboard Analysis

The freeboard compliance is summarised in Table 3. The pool locations as a result of the PMP storm is shown in Figure 6.

TABLE 3: FREEBOARD COMPLIANCE SUMMARY

Compartment	Beach freeboard compliance	Total freeboard compliance	PMP
1	Yes	Yes	Yes
2	Yes	Yes	Yes
3A	N/A (internal compartment)	Yes	Yes
3B	N/A (internal compartment)	Yes	Yes

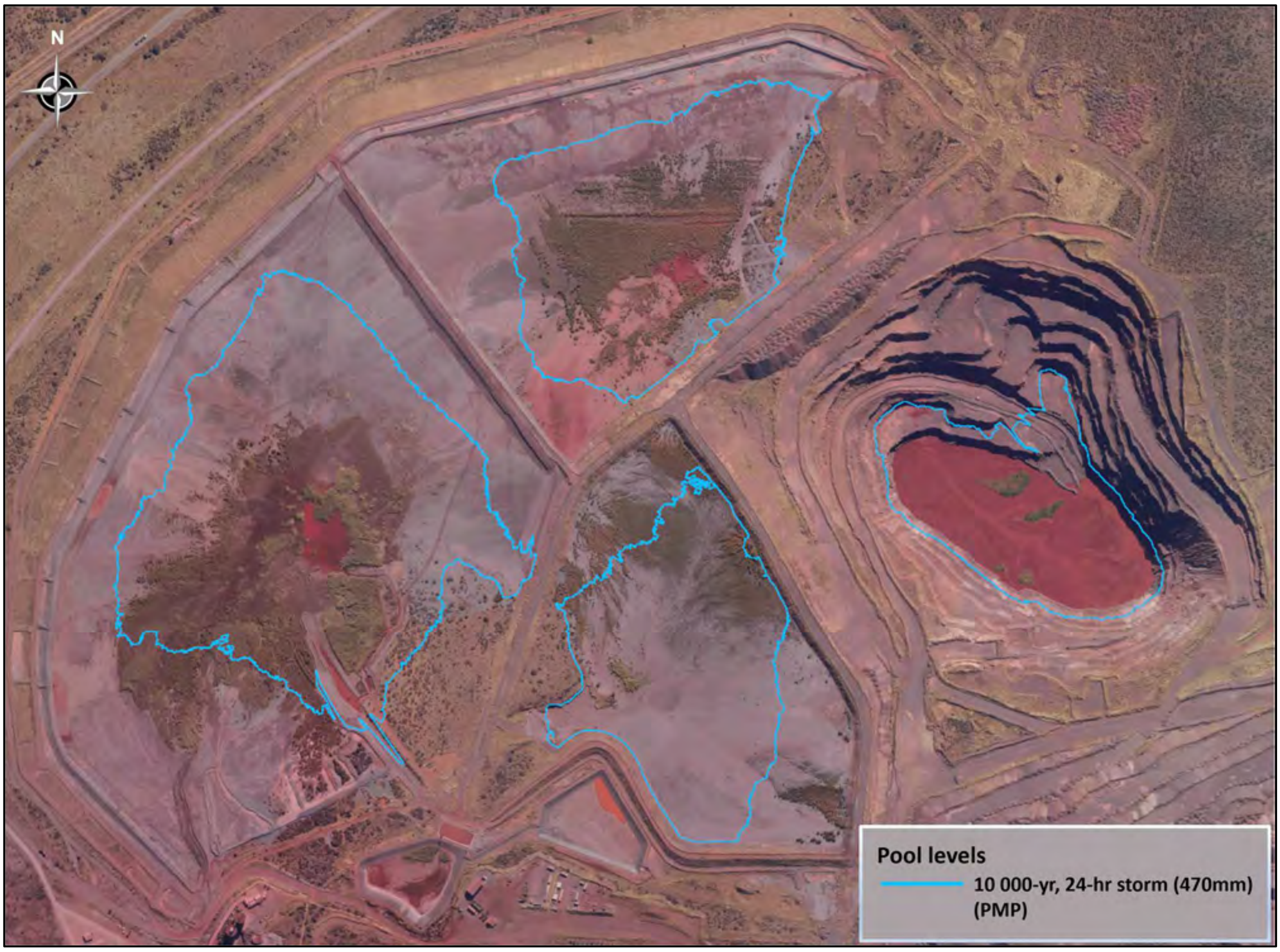


FIGURE 6: POOL LOCATIONS AS A RESULT OF THE PMP STORM

2.4 Tailings Rheology

Rheology data were available from three sources:

- A Paterson & Cooke Slurry Test Work report dated 2005 provides data on the specific gravity of the tailings particles as well as regression equations for the Bingham Plastic model parameters versus solids concentration.
- Tailings properties provided by Khumani Mine (2017 – 2019) and used in Geo Tail's annual audit reports.
- Three Boger slump tests performed by BM du Plessis Civil Engineering (2019).

FIGURE 7: BOGER SLUMP TEST

Discrepancies were noted when the specific gravity, and the Yield Stress of the in-situ material stated in the Patterson & Cooke test work and the Boger slump test sources were compared. The specific gravity results of the two more recent data sources agreed.

It was decided that the following set of parameters would be adopted for the study:

- Material specific gravity: 4.37
- Average in situ tailings dry density: 2.0 t/m^3
- Yield Stress as a function of solids concentration (by mass): $\tau_y = 3\,000 \,.\, C_M^{12.5}$
- Plastic viscosity as a function of solids concentration (by mass): $\mu_y = 0.001+16^* (CM\ -7\%)^{13.9}$

3. BREACH LOCATIONS

The PDF could overtop along its northern, western and southern perimeter. The topography to the south of the PDF ensures that the zone of influence of a breach to the south of the PDF will be very limited. This zone of influence is shown in Appendix A. Breach locations along the northern and western perimeter of the PDF were considered for modelling. Five breach locations (marked A to E in Figure 8) were selected to provide an indication of the zone of influence from breach locations across most of the western perimeter of the PDF.

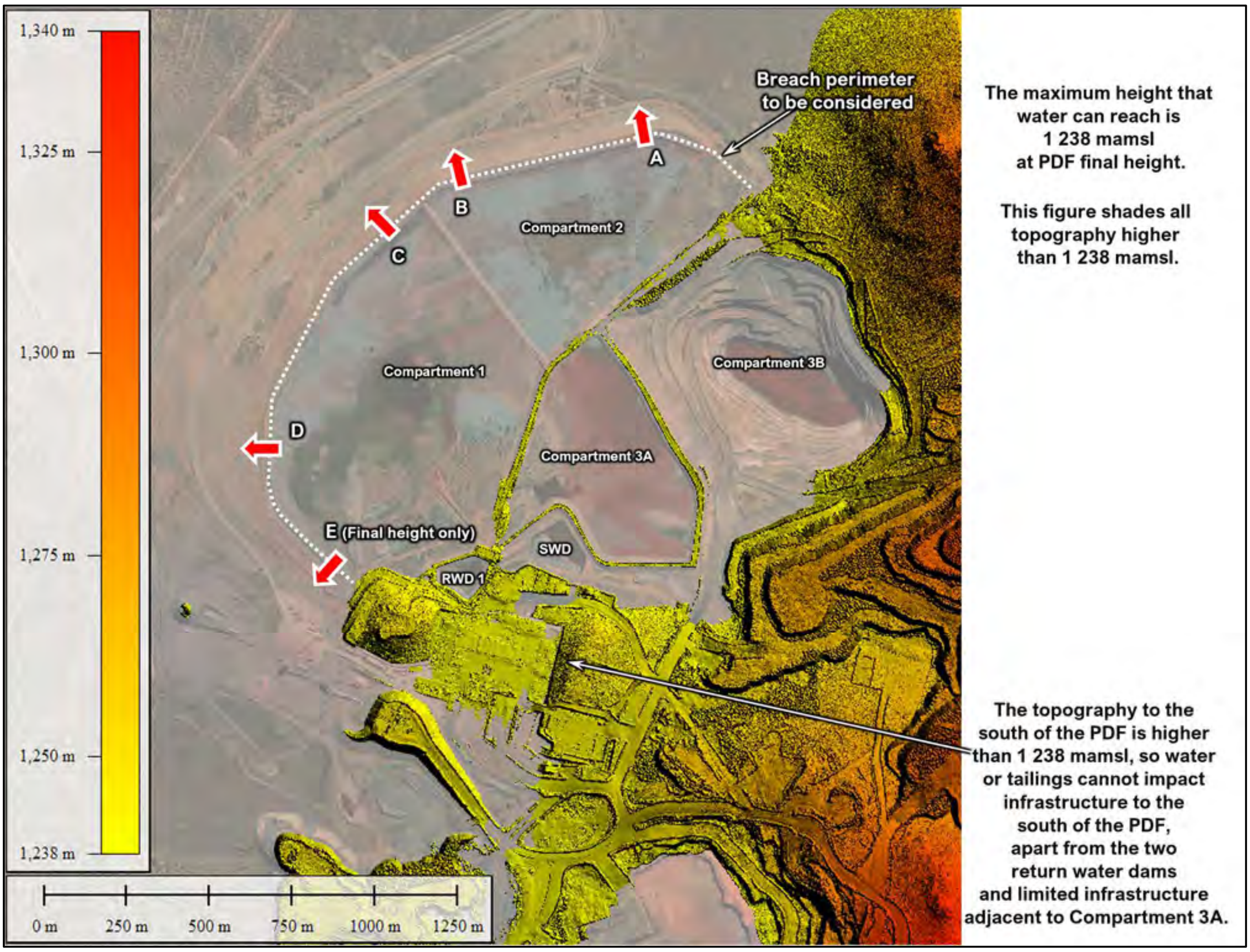


FIGURE 8: BREACH LOCATIONS

4. CREDIBLE FAILURE MODES

4.1 Summary

Item	Scenario	Compartment	Rainy-day	Sunny-day
1	Current height	1	Credible*	Not credible
2		2	Credible*	Not credible
3	Final height	1	Credible*	Credible
4		2	Credible*	Credible

** Rainy day failure mode only to be considered if large pools are carried on the PDF.*

This is discussed in more detail in Section 4.2 and Section 4.3.

4.2 Rainy-Day Failure

This scenario will only occur through very poor water management on the PDF. Currently water management practices are good and very little water is stored in the PDF pools. If proper water management practices continue, the PDF can accommodate the 10 000-yr (PMP) storm event without overtopping. **It must be noted that under the current water management practices, this failure mode should not be considered.** It was included for completeness or if water management practices deteriorate. This applies to both the current height and the final height scenarios.

If poor water management on the PDF occurs and large pools develop on the PDF, this failure mode would likely be triggered by an extreme storm such as the 10 000-yr storm. This process results in a two-wave hydrograph, i.e., two flood peaks. The initial water outflow is the first flood peak and then the tailings/water mixture outflow is the second flood peak. In the case of the PDF, the first flood peak is the larger of the two flood peaks and will have the largest zone of influence. The Ga-Mogara River is downstream of the PDF and water that is discharged from the PDF will flow into the Ga-Mogara River and create flood conditions in the river.

The resulting flood hydrographs and associated solids concentrations for compartments 1 and 2 are shown in Figure 9 and Figure 10. The rainy-day peak flows are very similar for the current height and final height scenarios. The rainy-day simulations and results are applicable to both current height and final height scenarios.

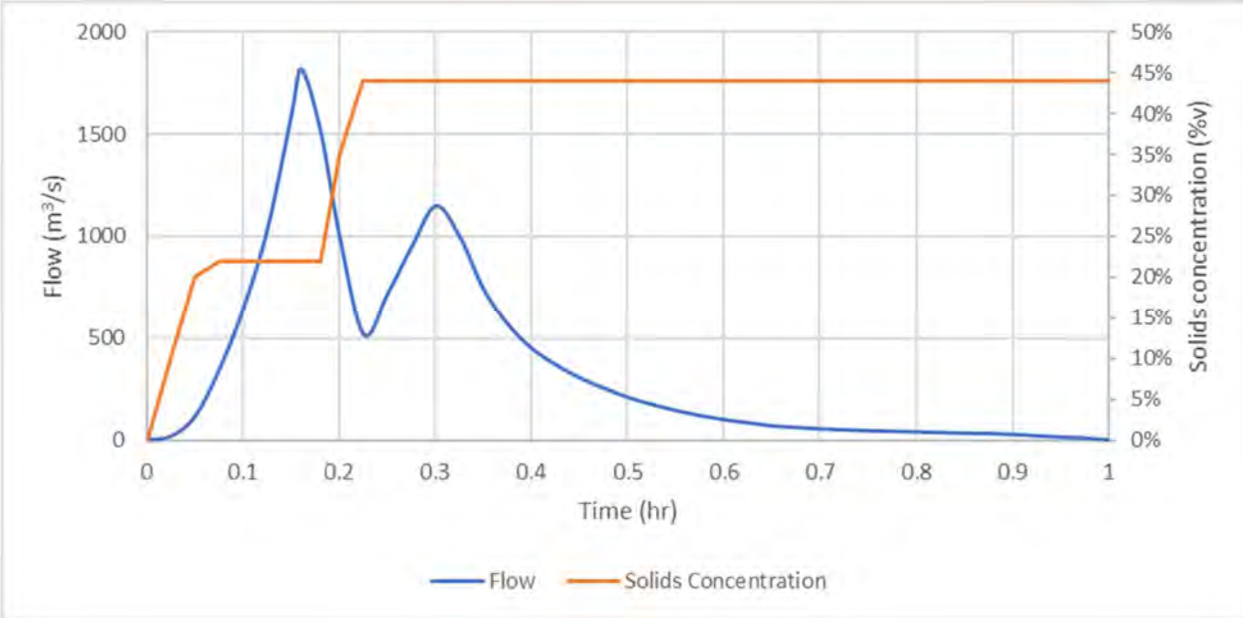


FIGURE 9: RAINY DAY FLOOD HYDROGRAPH (COMPARTMENT 1)

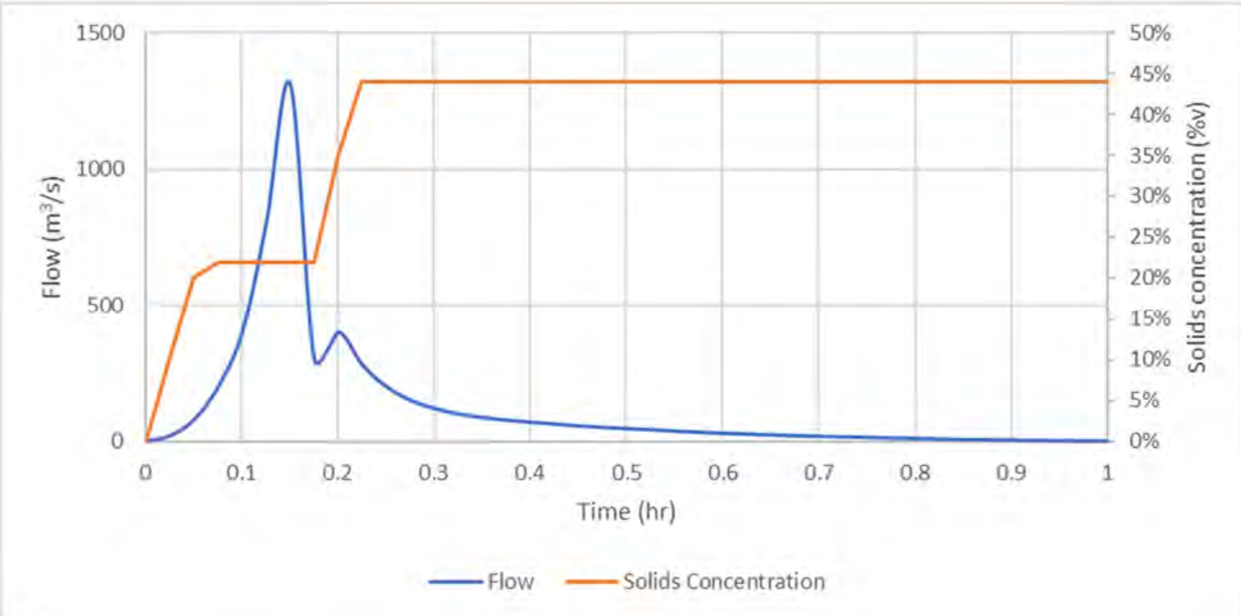


FIGURE 10: RAINY DAY FLOOD HYDROGRAPH (COMPARTMENT 2)

4.3 Sunny-Day Failure

The sunny day failure mode is not considered a credible failure mode at the current height due to the PDF construction materials used, the stability of the PDF, the likely failure zone, as well as the height of the paste above the starter wall and the impoundment embankment. In the event of a failure, the volume of material that will be mobilised will be insufficient to extend the breach beyond the waste rock outer embankment.

The geotechnical test work done to date (refer to Section 2.2) shows that the paste will contract when sheared. It is therefore assumed that the paste is liquefiable. The sunny day failure is considered a credible failure mode for the final height scenario.

The resulting flood hydrographs and associated solids concentrations for compartments 1 and 2 are shown in Figure 11 and Figure 12.

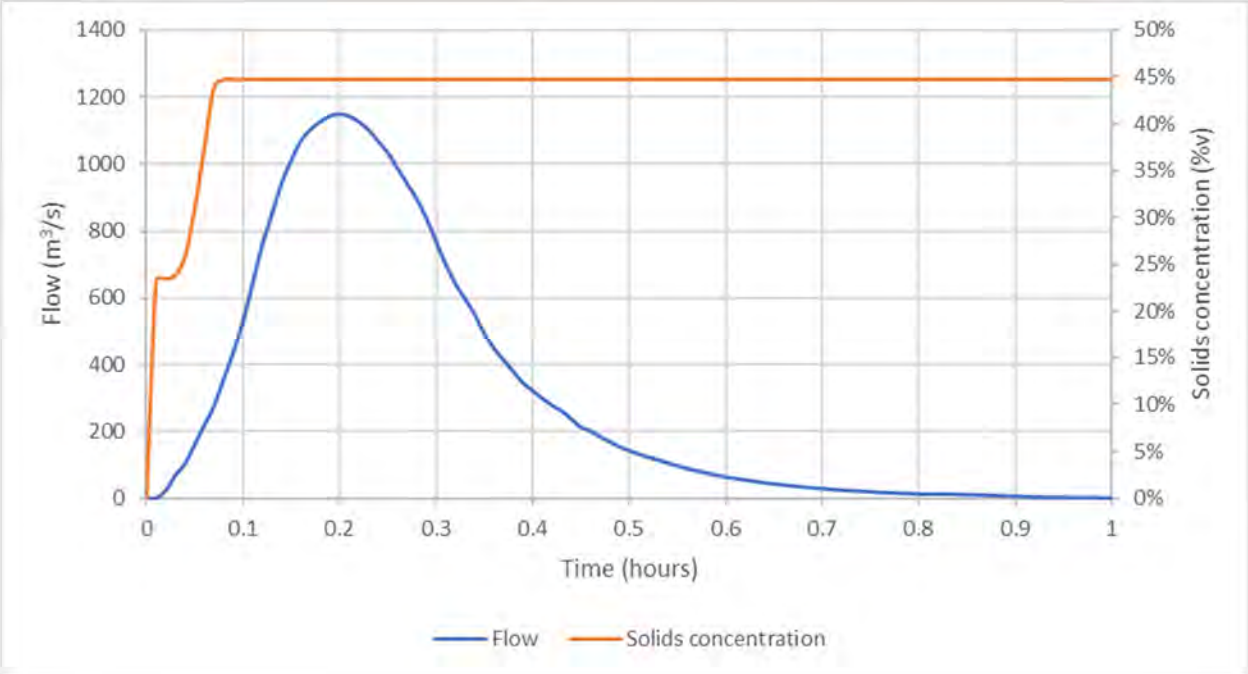


FIGURE 11: SUNNY DAY FLOOD HYDROGRAPH (COMPARTMENT 1)

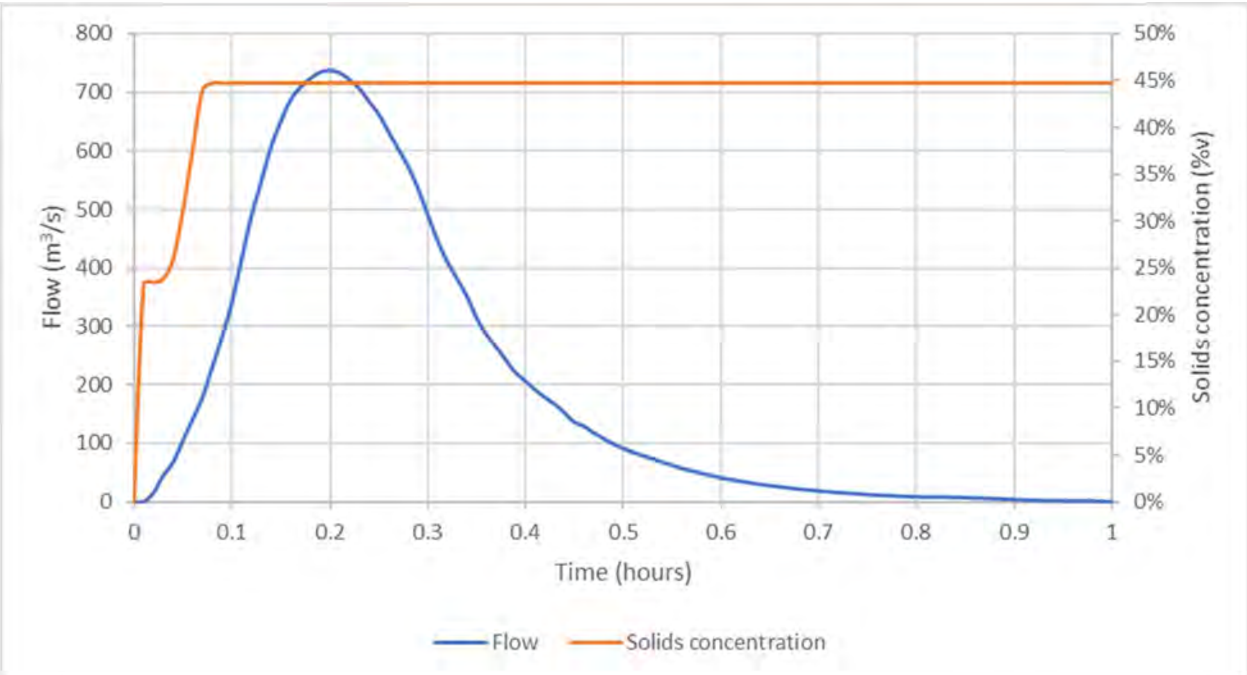


FIGURE 12: SUNNY DAY FLOOD HYDROGRAPH (COMPARTMENT 2)

5. SENSITIVE RECEPTORS

A number of sensitive receptors are located close to the PDF. These are shown in Figure 13 and elaborated upon in Table 4.

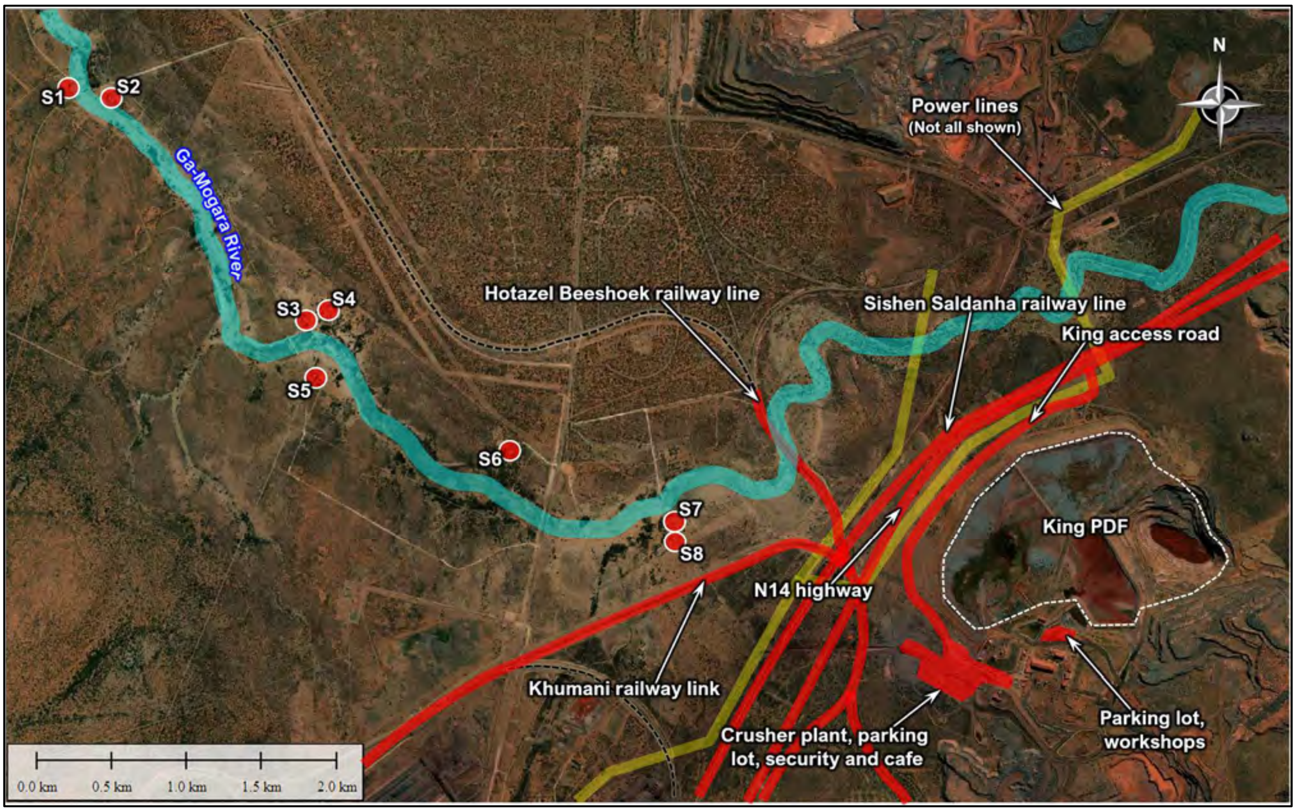


FIGURE 13: SENSITIVE RECEPTORS

TABLE 4: SENSITIVE RECEPTOR DETAILS

Item	Name (refer to Figure 13)	Type/description	Comments/Remarks
1	N14 highway	National highway	Multiple vehicles per hour
2	King access road	Local road	Multiple vehicles per hour
3	Parking lot, workshops		Truck parking lot
4	Crusher plant, parking lot, security, cafe		Staff parking lot
5	Sishen Saldanha railway line	National railway line	Multiple trains per day

6	Khumani railway link	Local branch line	Multiple trains per week
7	Hotazel Beeshoek railway line	Local branch line	Multiple trains per week
8	Ga-Mogara River	Non-perennial river	
9	S1	Farmhouse complex	Permanent residents assumed
10	S2	Farmhouse complex	Permanent residents assumed
11	S3	Farmhouse complex	Permanent residents assumed
12	S4	House	Permanent residents assumed
13	S5	Farmhouse complex	Permanent residents assumed
14	S6	Farmhouse complex	Permanent residents assumed
15	S7	Farmhouse complex	Permanent residents assumed
16	S8	House	Permanent residents assumed
17	Power lines	132kV, 22kV and 11kV lines	Not all power lines shown for clarity

6. DOWNSTREAM FLOOD WAVE HAZARD CALCULATION

Flood wave analyses were performed to estimate the hydraulic characteristics of the breach outflows as they travel downstream of the PDF. Numerical modelling was performed using the Flo2D software. A Manning's roughness value of 0.04 was selected to represent the hydraulic roughness of overland flow areas. Parts of the Ga-Mogara River channel were assigned a Manning's roughness of 0.03. A grid size of 10 m was used.

The area of inundation (zone of influence) is shown in Appendix A. Other detailed results of the analysis are presented in Appendix B to Appendix F. The following data is shown:

- Hazard potential. The hazard potential calculation methodology is described in the following section.
- Maximum flow depth.
- Maximum flow velocity.
- Time taken from the start of the breach to reach 0.6 m deep.

- Time taken from the start of the breach to reach 0.3 m deep.

6.1 Hazard Potential Calculation Methodology

The hazard potential is calculated from the product of the flow velocity and flow depth. The hazard potential changes as the flood wave passes a point. The maximum hazard potential is recorded and presented as output. Three hazard classification levels are determined, as detailed in Table 5.

TABLE 5: HAZARD POTENTIAL

Item	Hazard classification	Maximum depth h (m)	Logical operation	Product of max velocity v times max depth h (m^2/s)	Remarks
1	Low	0.1 <= h < 0.5	AND	0.1 <= vh < 0.5	Likely to pose minimal threat to life. Damage likely limited to water damage.
2	Medium	0.5 <= h < 1.5	OR	0.5 <= vh < 1.5	Likely to pose a threat to life in some circumstances. Damage likely to include structural damage and water damage.
3	High	h >= 1.5	OR	vh >= 1.5	Likely to pose a significant threat to life. Damage likely to include structural damage and water damage.

7. GISTM CONSEQUENCE CLASSIFICATION

The GISTM consequence classification is considered to be **VERY HIGH**. The potential population at risk and potential loss of life inputs as detailed in Table 6. Other factors are listed after Table 6.

TABLE 6: GISTM POPULATION CONSEQUENCE CLASSIFICATION INPUTS

Item	Name (refer to Figure 13)	Hazard calculated	Potential population at risk	Potential loss of life	Time to 0.6m flow depth*	Comments/remarks
1	N14 highway	High	0-50	0-25	<5 minutes	Minibus taxis and buses frequently use this highway
2	King access road	High	0-50	0-25	<5 minutes	Minibus taxis and buses use this road
3	Parking lot, workshops	High	1-6	1-6	<5 minutes	
4	Crusher plant, parking lot, security, cafe	High	2-50	1-25	<5 minutes	This is the main entrance to the King plant
5	Sishen Saldanha railway line	High	0-2	0-1	<5 minutes	
6	Khumani railway link	High	0-2	0-1	<10 minutes	
7	Hotazel Beeshoek railway line	High	0-2	0-1	<10 minutes	
8	Ga-Mogara River	High	0	0	<15 minutes	
9	S1	None	0	0		
10	S2	None	0	0		

11	S3	Medium	1-4	0-1	<2 hours	
12	S4	None	0	0		
13	S5	None	0	0		
14	S6	None	0	0		
15	S7	None	0	0		
16	S8	None	0	0		
17	Power lines	High	0	0	<5 minutes	
18	**Total**		**4-159**	**2-83**		The potential population at risk and loss of life classification is **VERY HIGH**

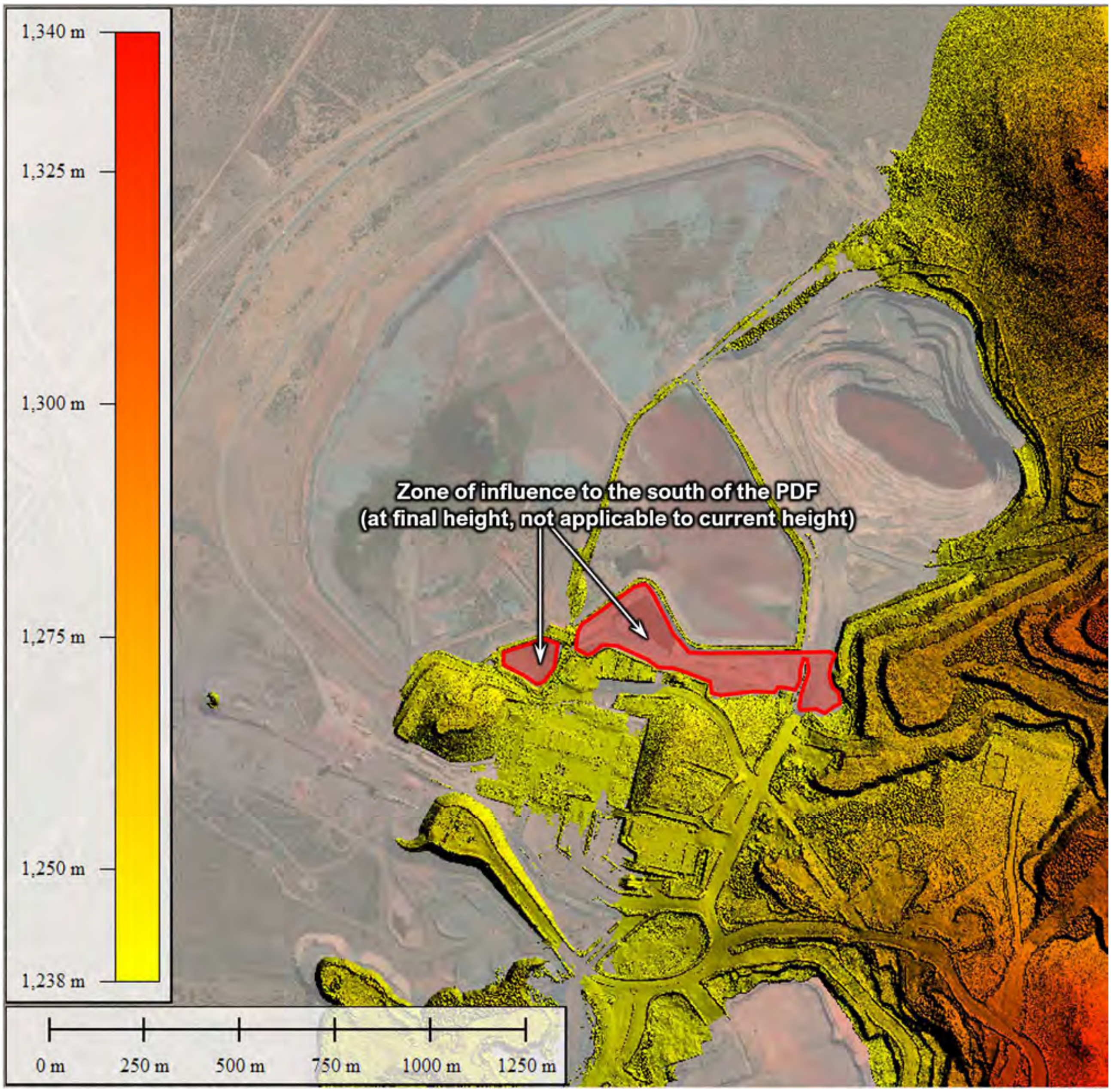
** time from the start of the breach. Initial flows are low and will likely go unnoticed until larger flows develop.*

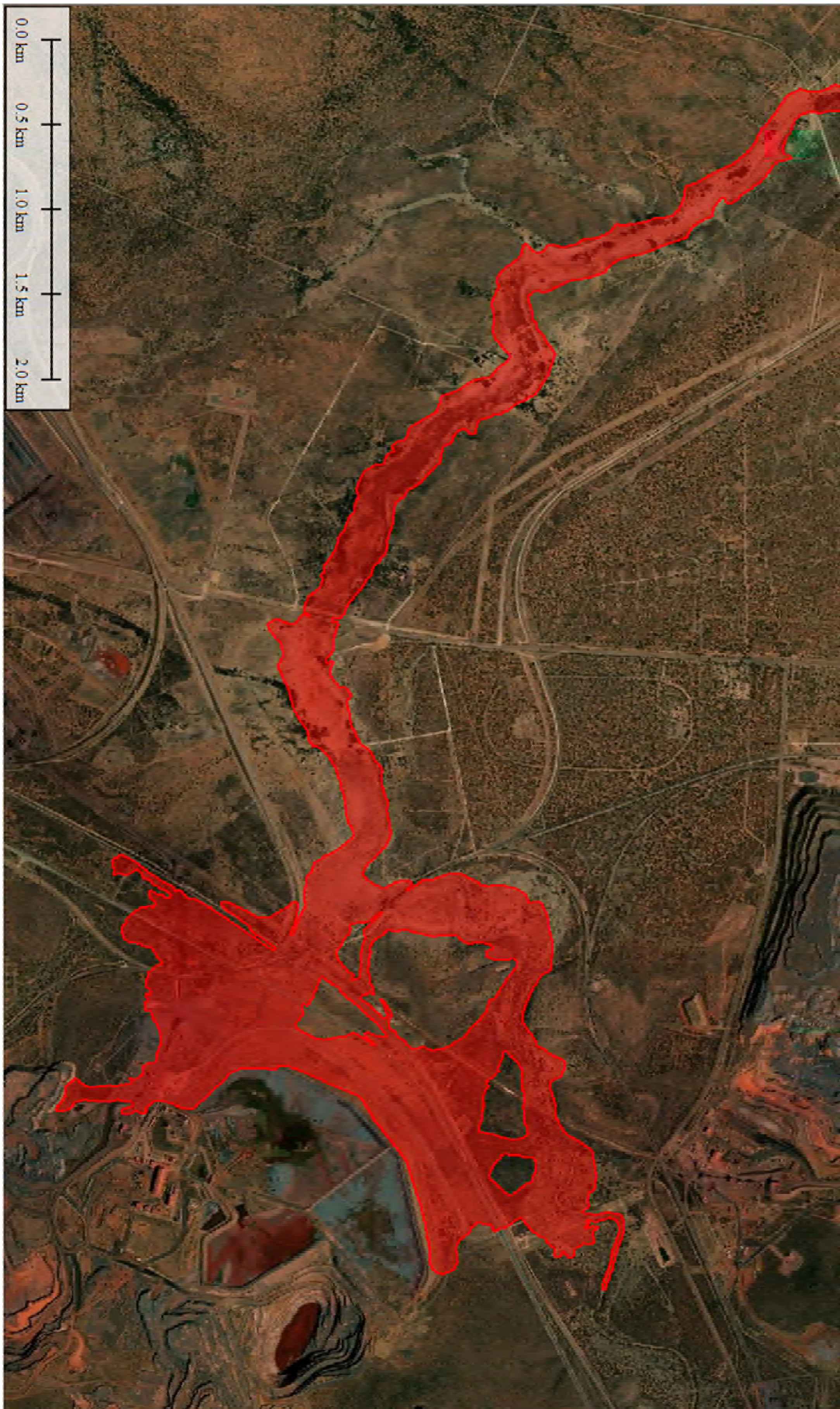
The totals presented in Table 6 are the sum of all items excluding item 3. Item 3 is applicable for a failure along the southern boundary. All other items are common to the failure zones shown in Figure 8.

Other GISTM classifications are:

- The environmental impact classification is rated as **HIGH**. Sensitive aquatic species are not likely to be present since the Ga-Mogara River is usually dry. Natural flood waters are generally very turbid, but the infrequent flow in the river means that it may take several seasons for iron ore tailings to be washed out of the river system.
- The Health, Social and Cultural impact classification is rated as **HIGH**. The Ga-Mogara River is a sporadic river, and its water is not relied upon for domestic, agricultural and recreational purposes. Natural flood waters are generally very turbid, but the infrequent flow in the river means that it may take several seasons for iron ore tailings to be washed out of the river system.
- The Infrastructure and Economics classification is rated as **VERY HIGH**. The railway lines, N14 national highway and the King access road will be inundated. Culverts and bridges may be damaged or blocked. The lost production on the Sishen-Saldanha and Beeshoek-Hotazel railway lines will be significant. The power lines close to the PDF may be damaged.

Appendix A: Total Inundation Zones (Zone of influence)




0.0 km
0.5 km
1.0 km
1.5 km
2.0 km

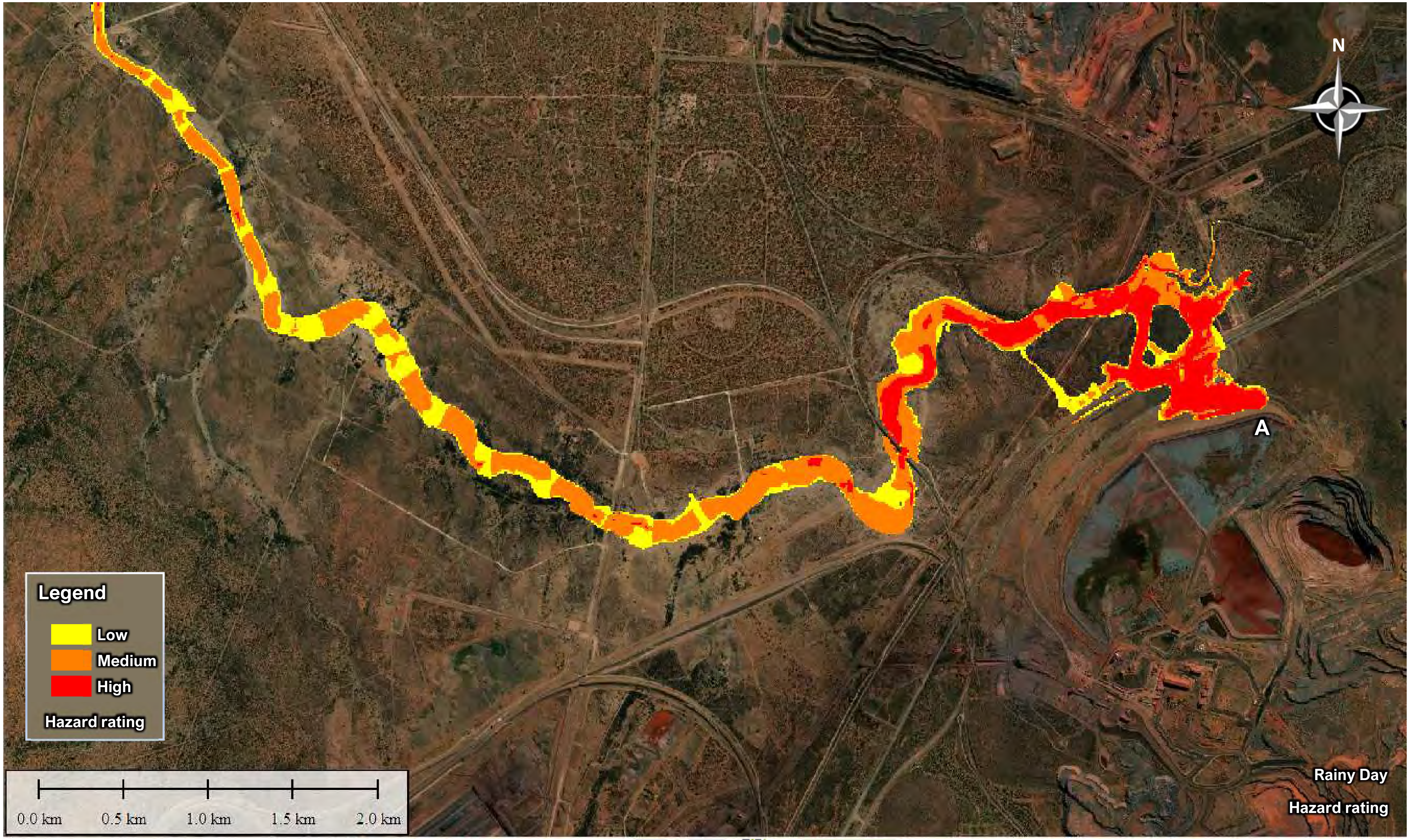
Appendix B: Hazard Potential

Appendix C: Maximum flow depth

Appendix D: Maximum velocity

Appendix E: Time to reach 0.6m flow depth

Appendix F: Time to reach 0.3m flow depth


N
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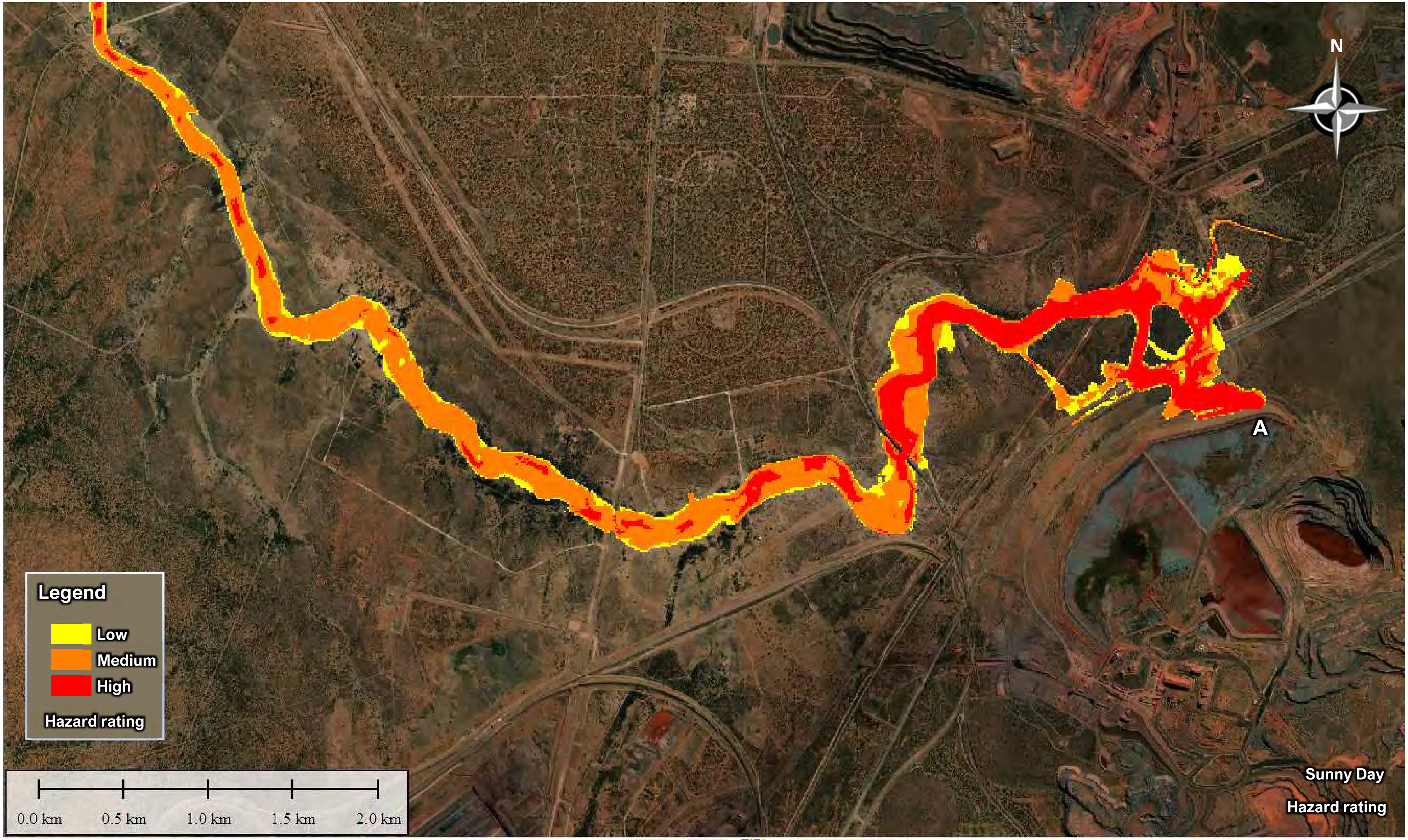
Legend
Low
Medium
High
Hazard rating
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Rainy Day
Hazard rating


N
A
Legend
Low
Medium
High
Hazard rating
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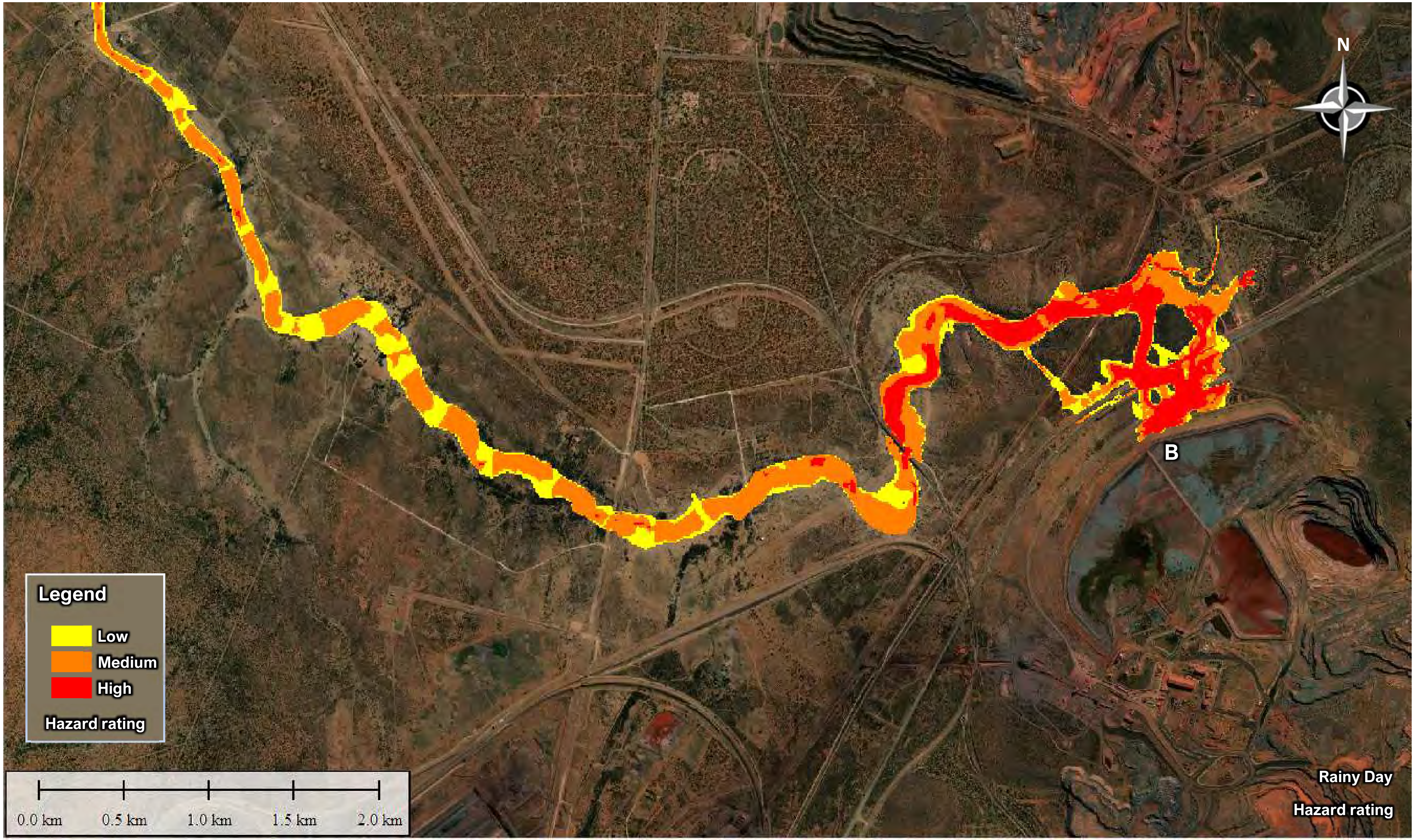
0.5 km
1.0 km
1.5 km
2.0 km
Sunny Day
Hazard rating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Hazard rating
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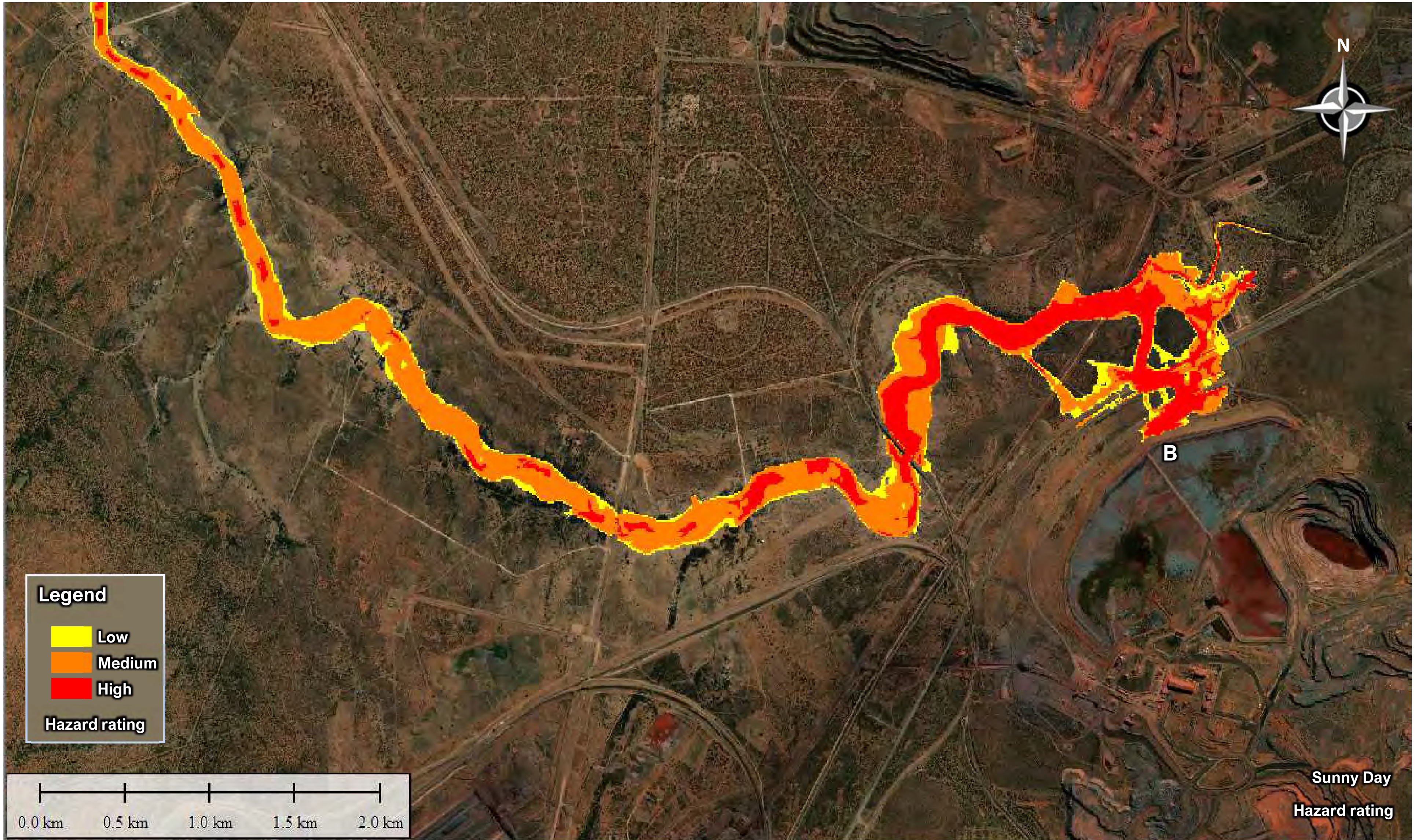
2.0 km
Rainy Day
Hazard rating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Hazard rating
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0.5 km
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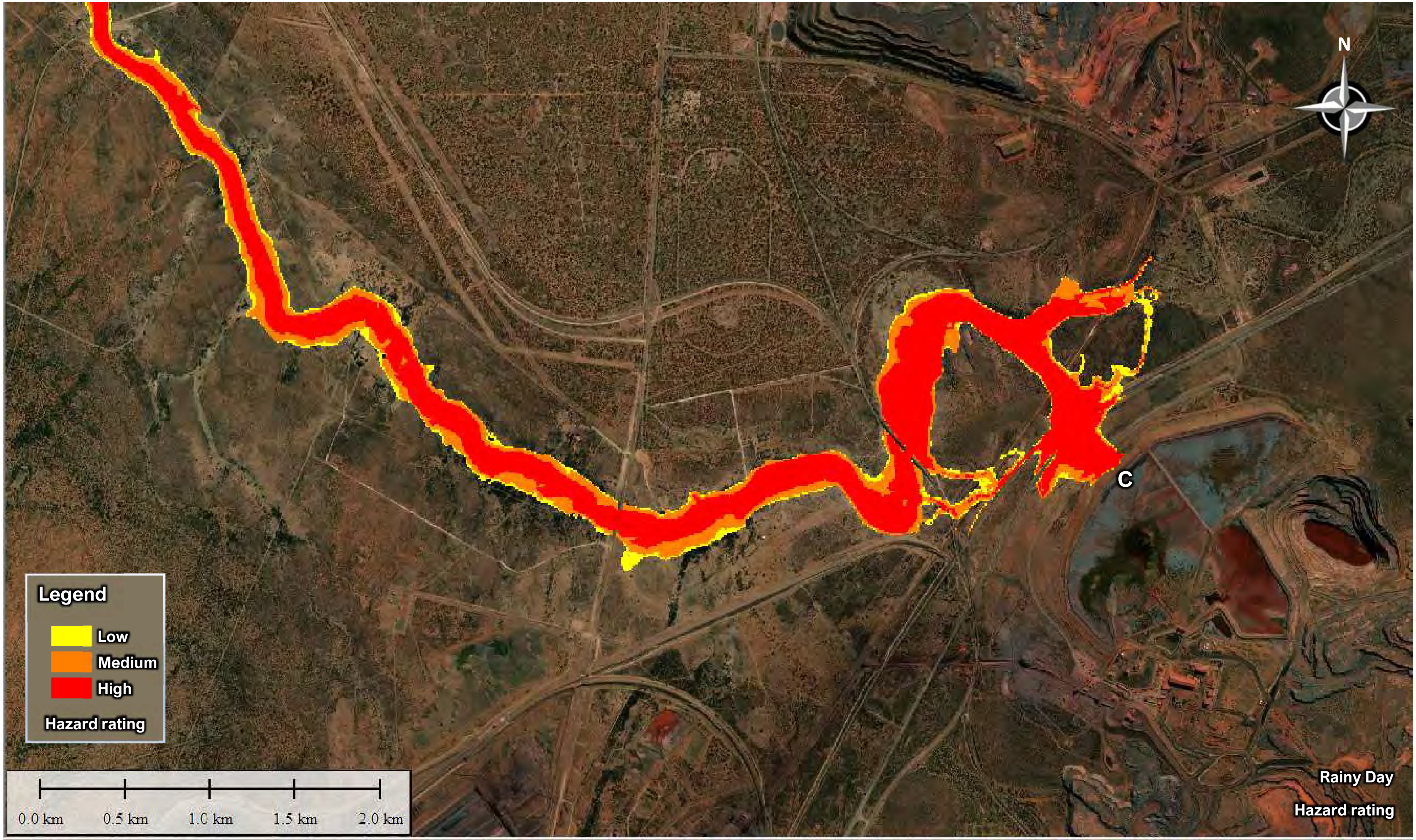
2.0 km
Sunny Day
Hazard rating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0.0 km
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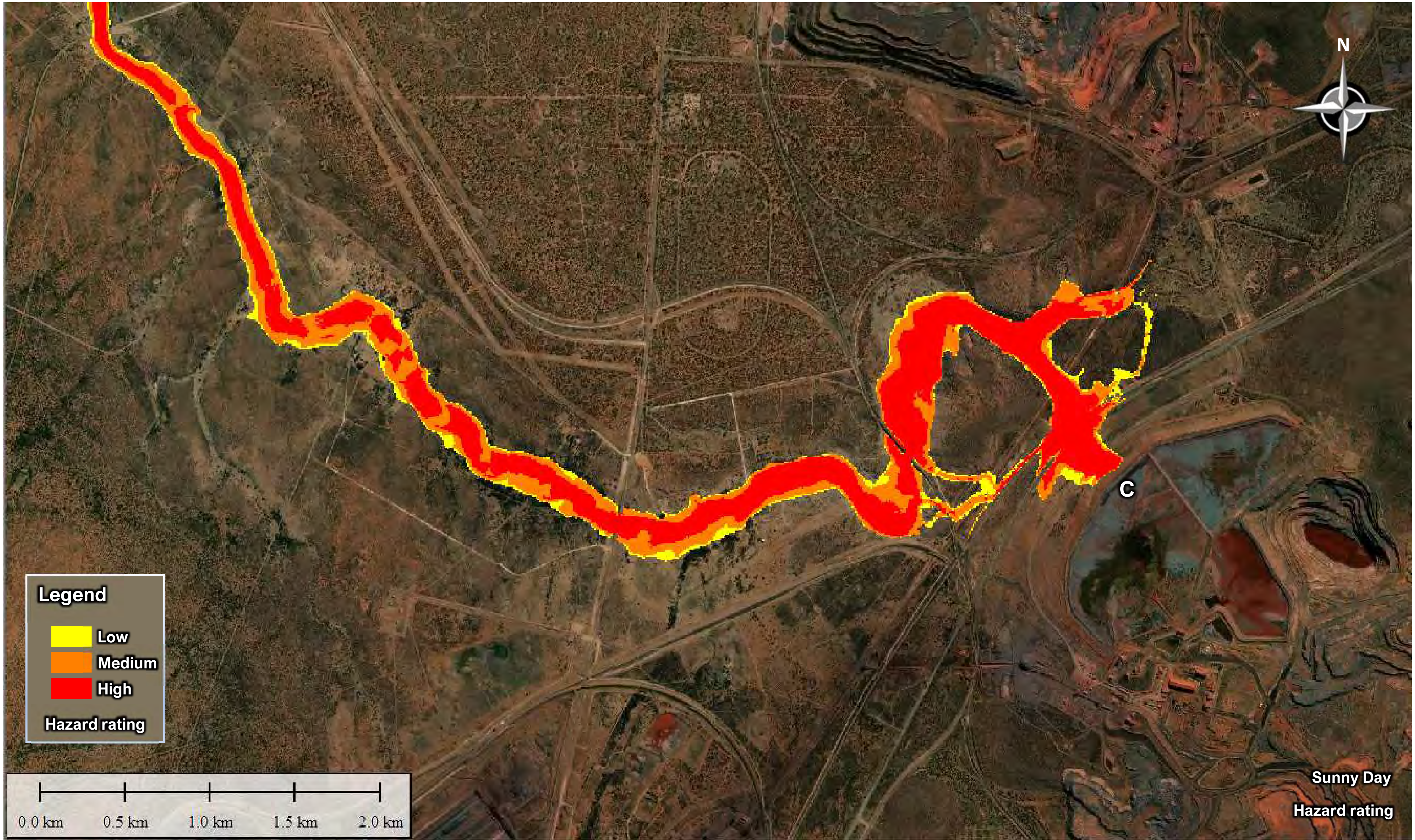
Rainy Day
Hazard rating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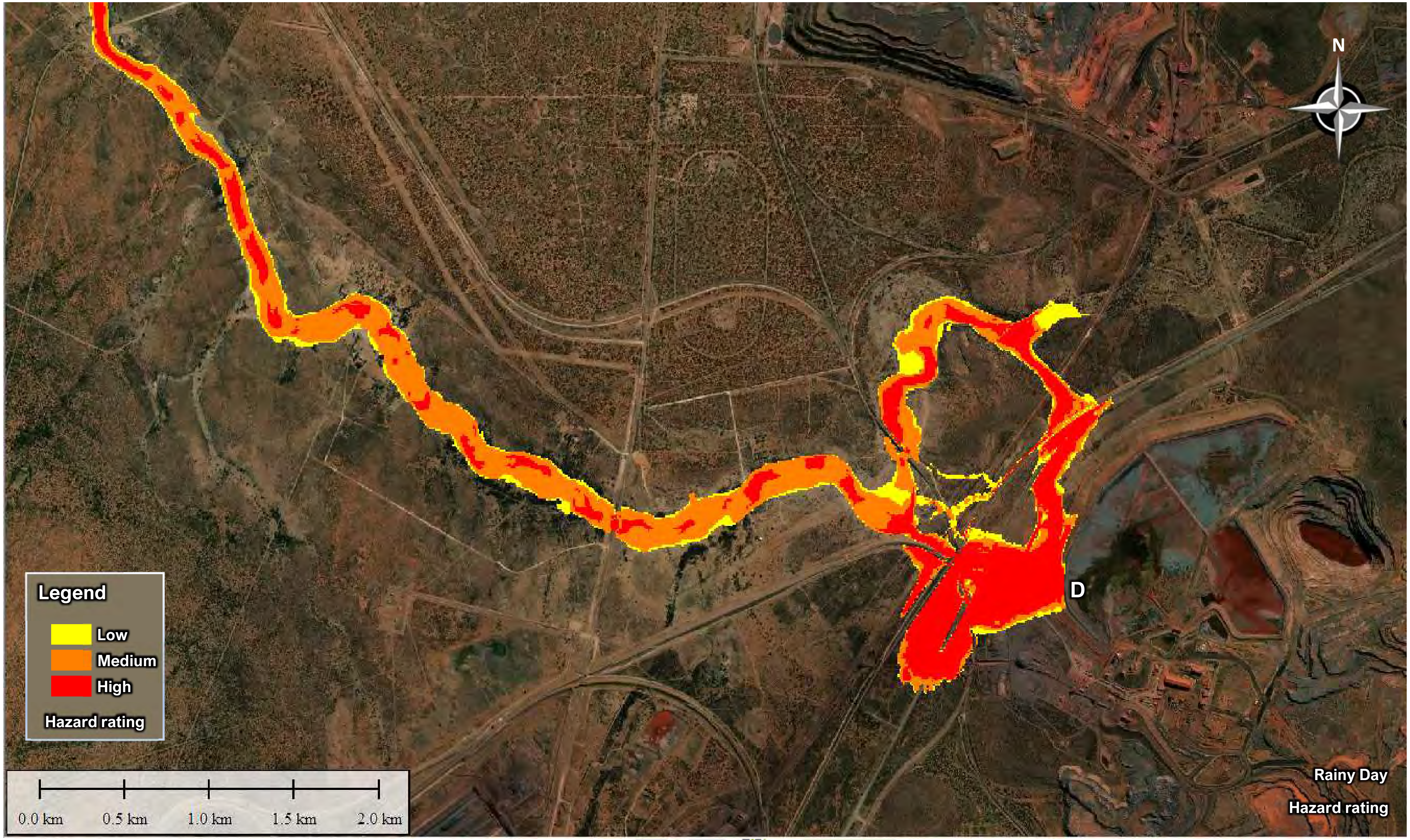
2.0 km
Sunny Day
Hazard rating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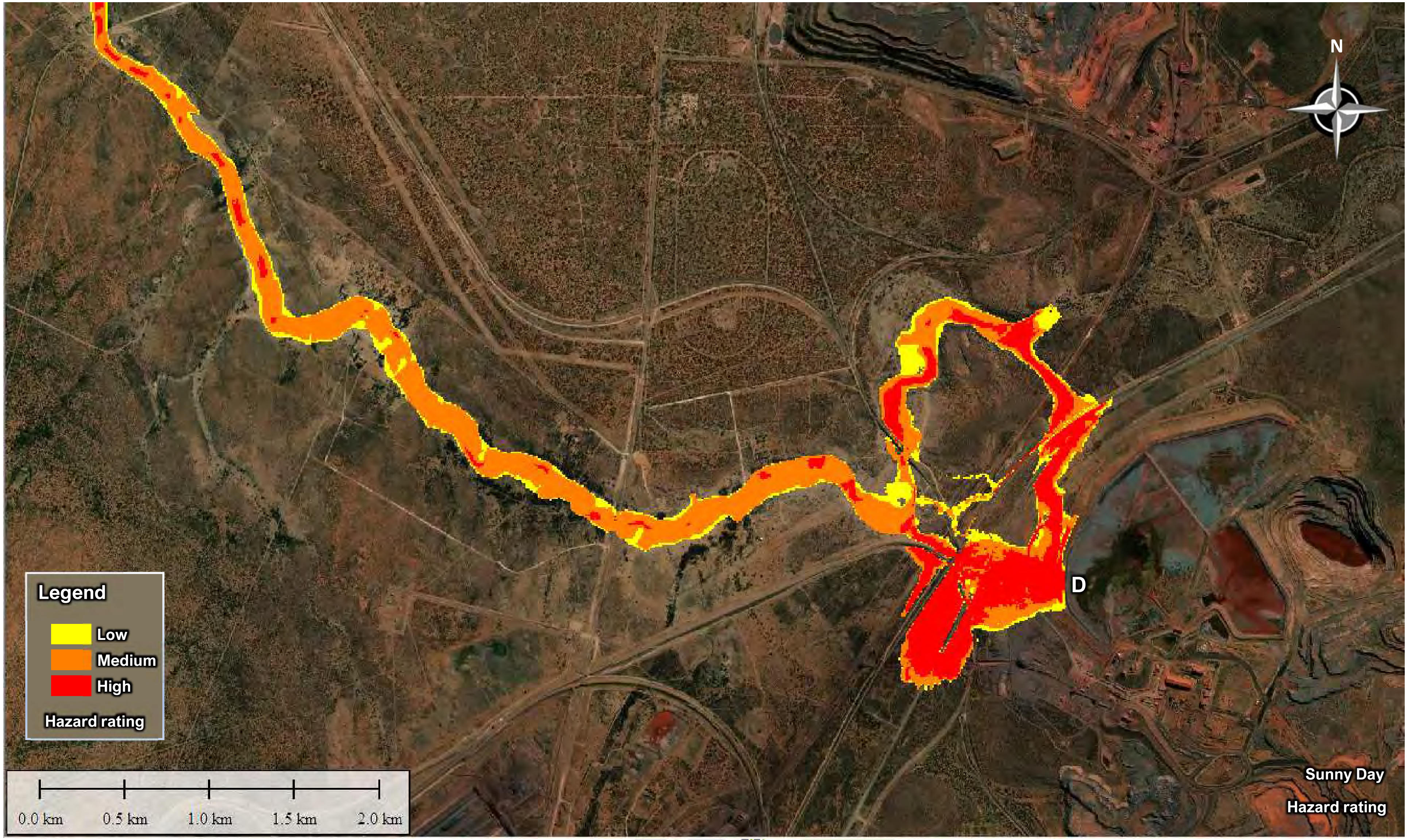
Hazard rating
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Rainy Day
Hazard rating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Hazard rating
0.0 km
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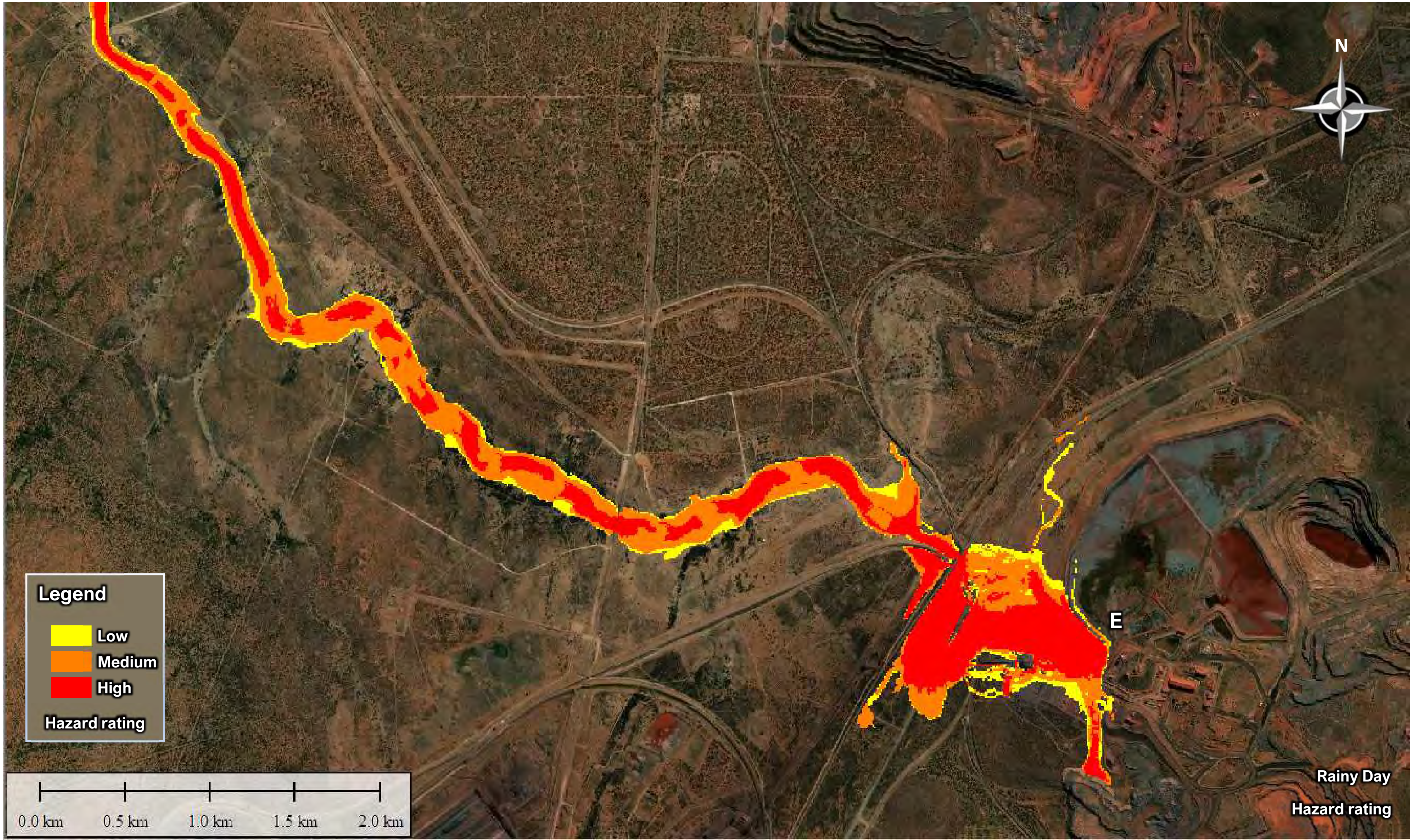
Sunny Day
Hazard rating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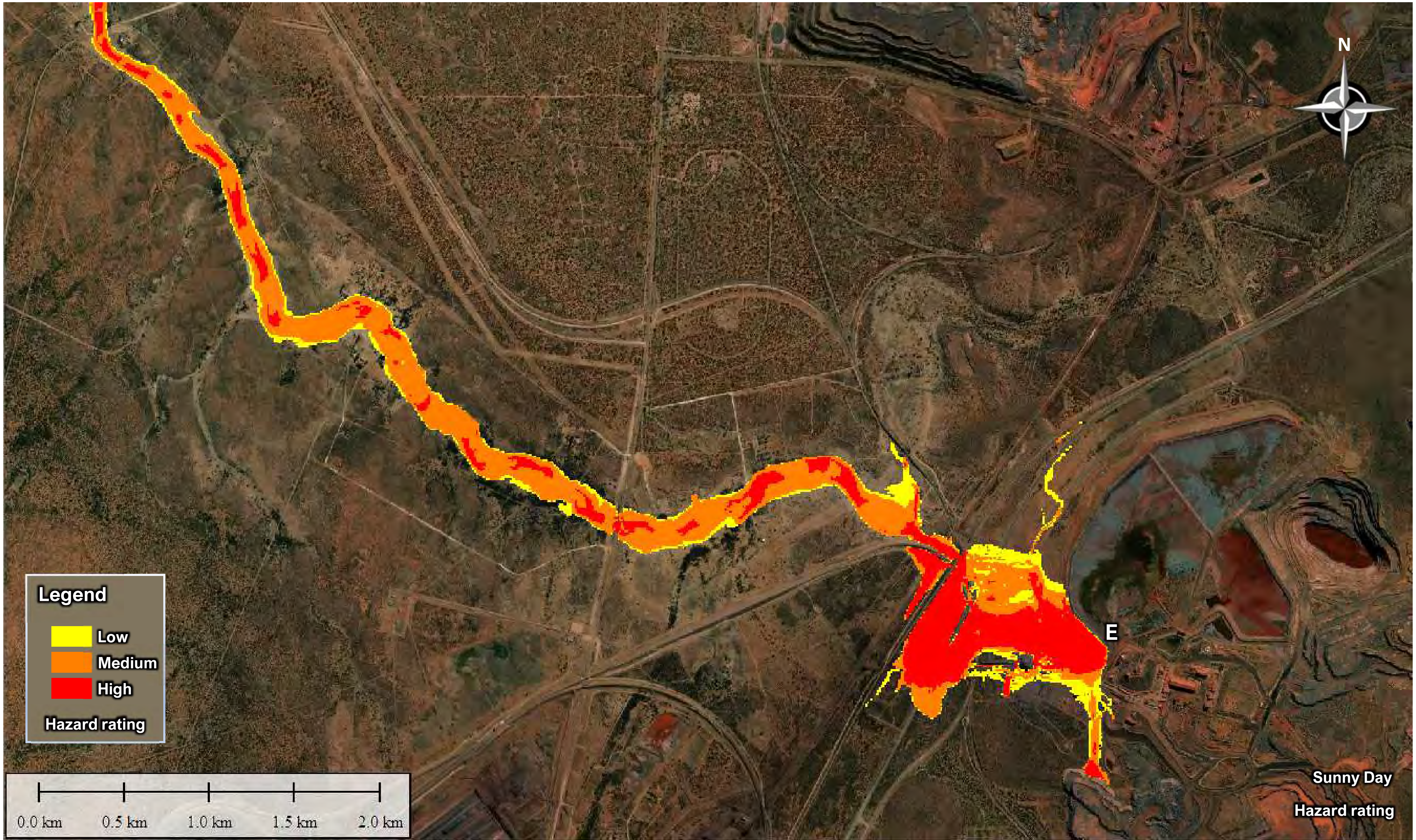
2.0 km
Rainy Day
Hazard rating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Medium
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Hazard rating
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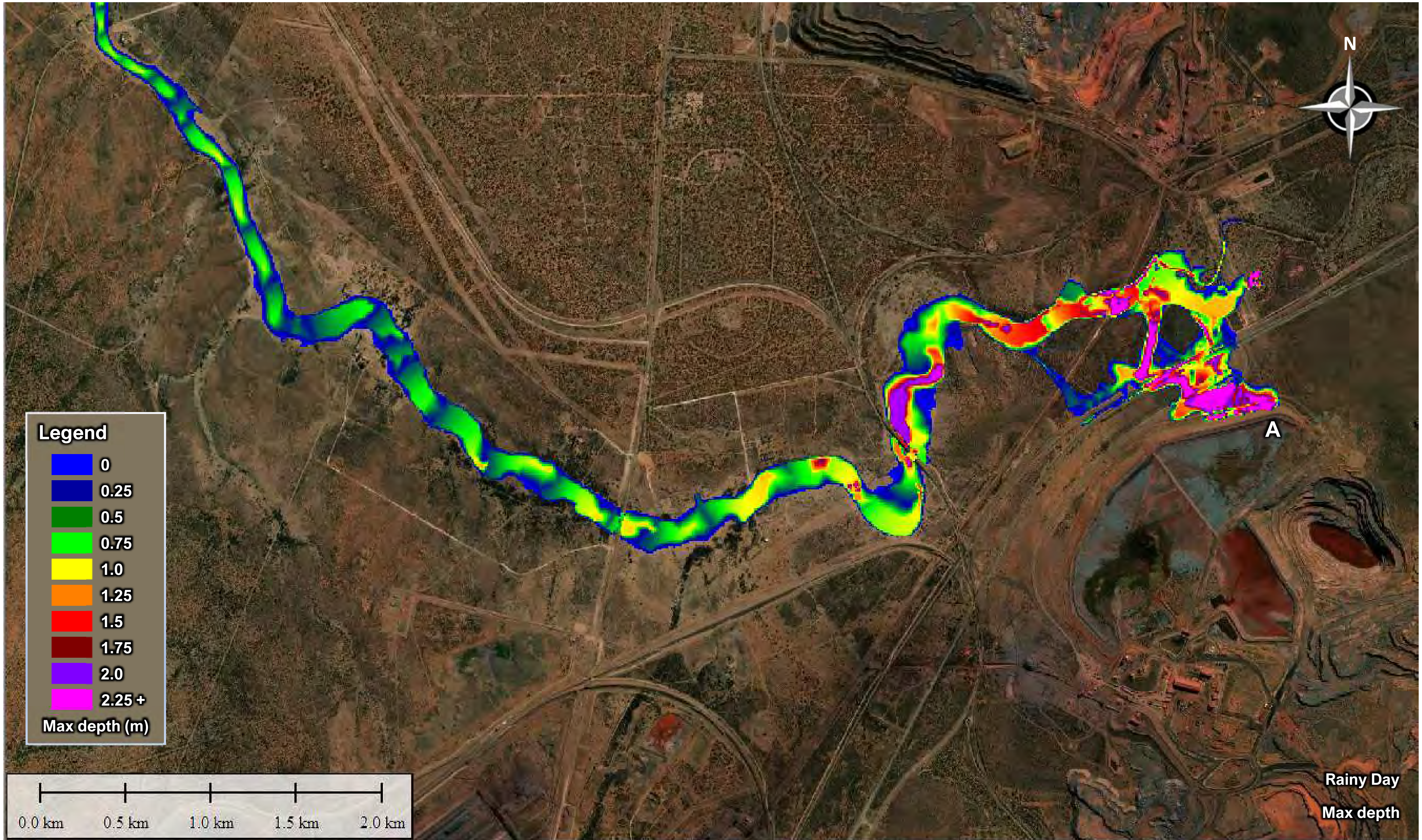
0.5 km
1.0 km
1.5 km
2.0 km
Sunny Day
Hazard rating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Legend
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0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25 +
Max depth (m)
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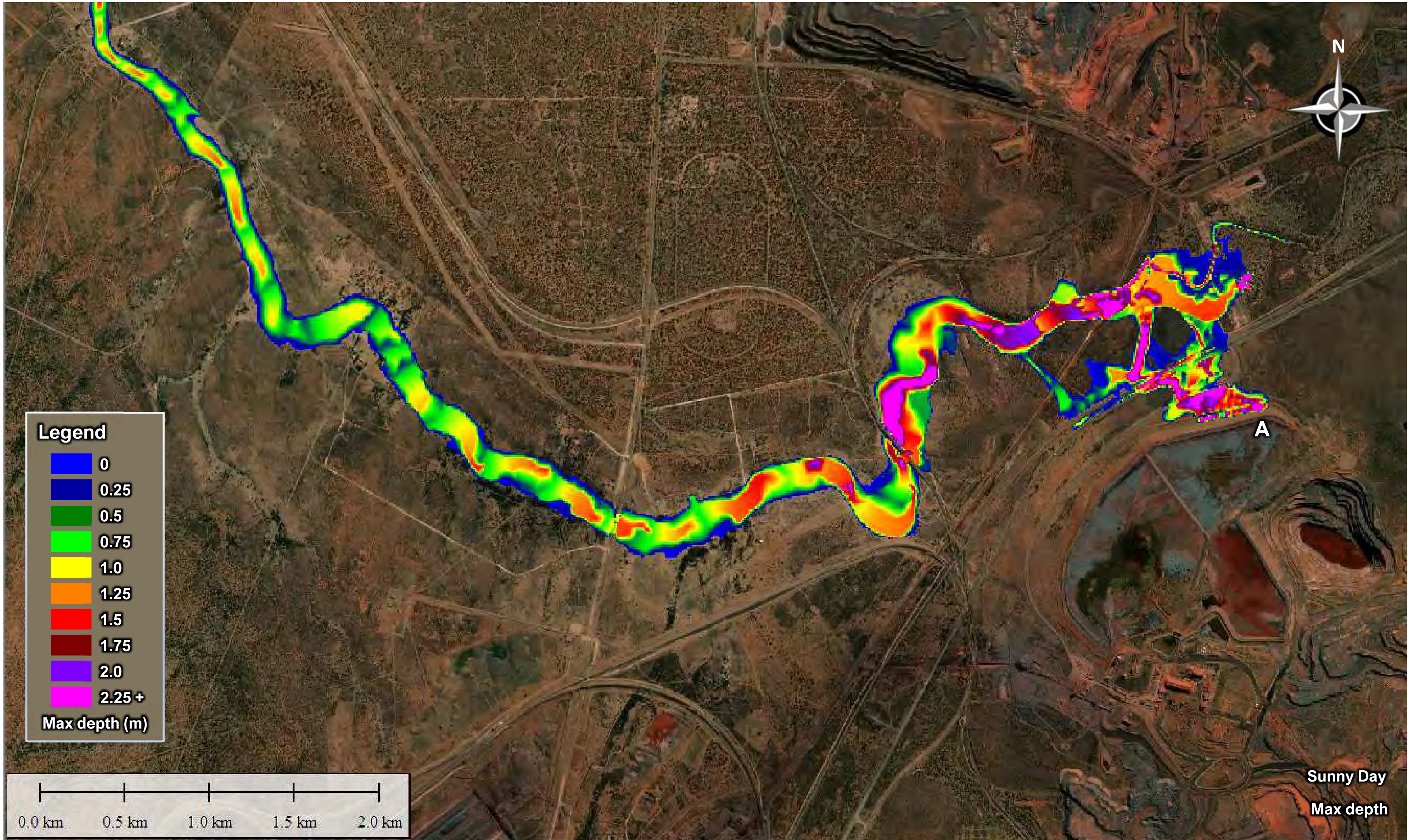
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Rainy Day
Max depth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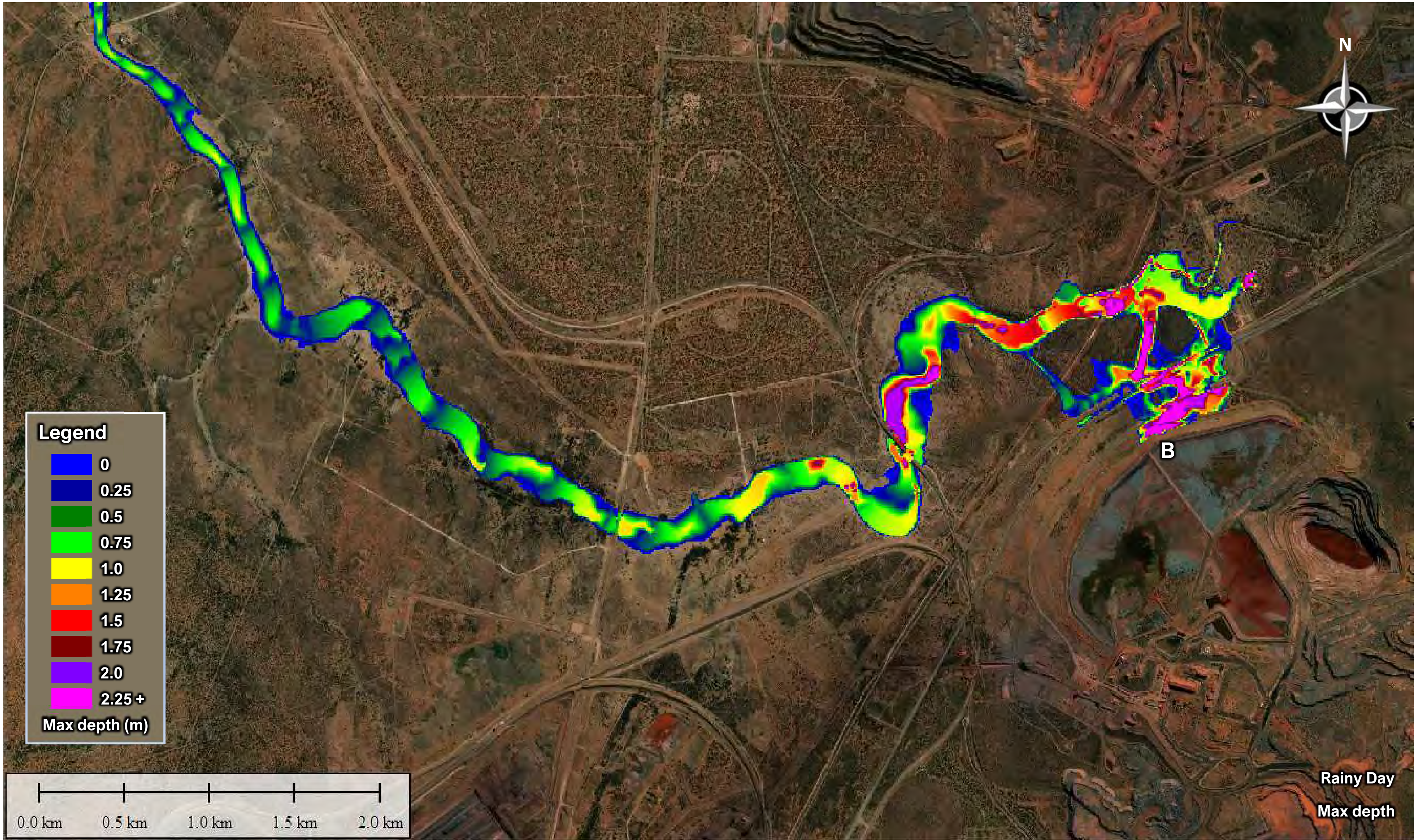
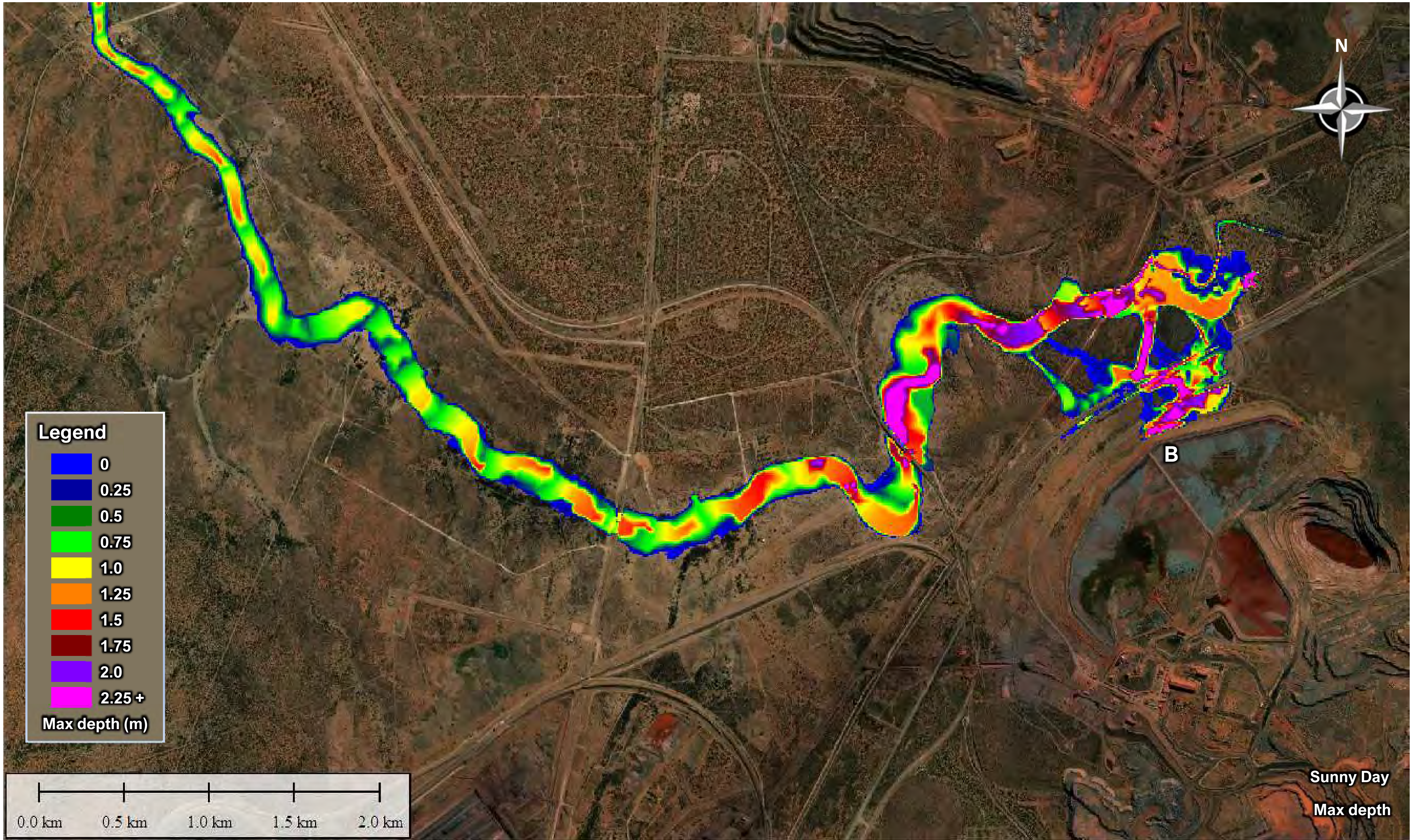
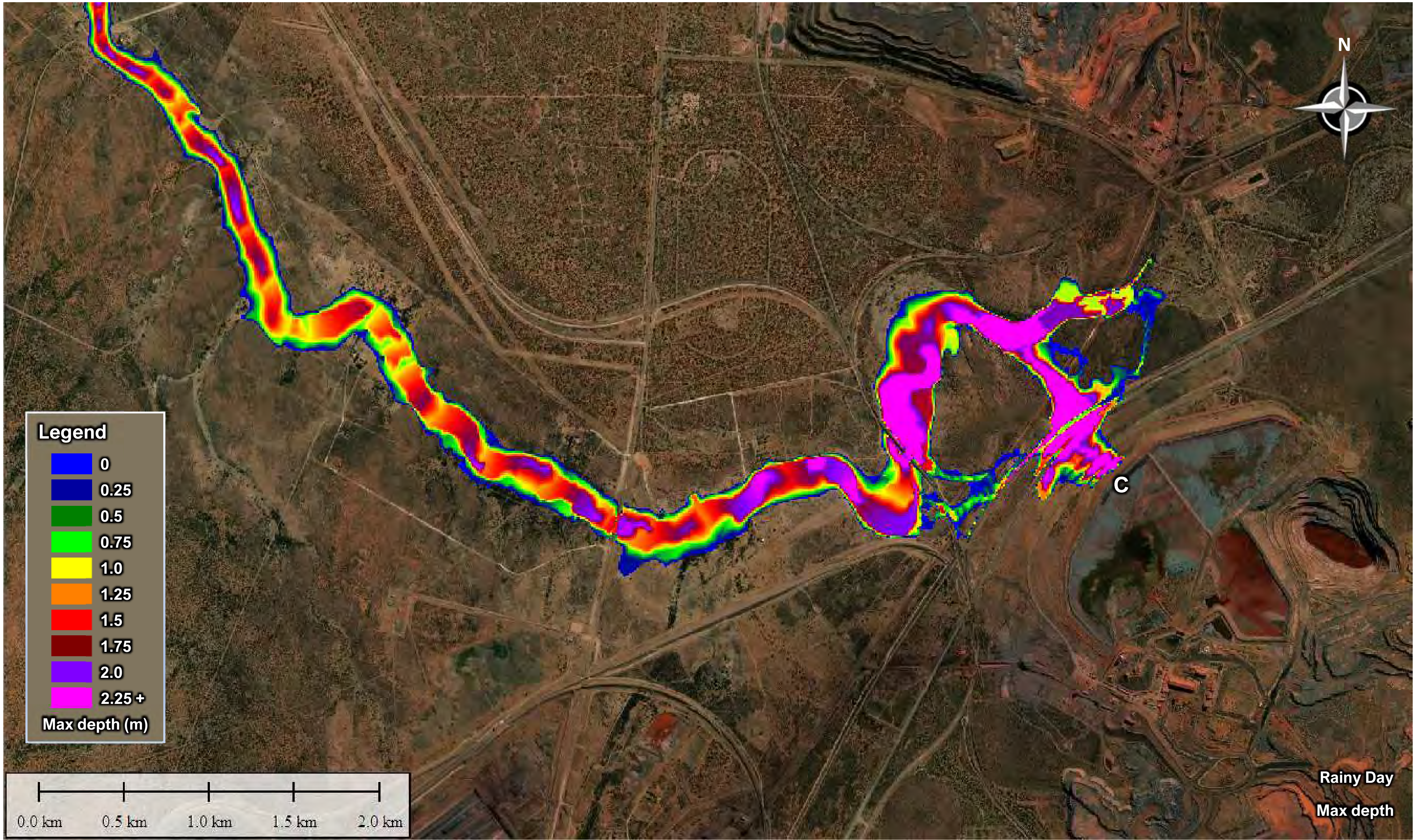
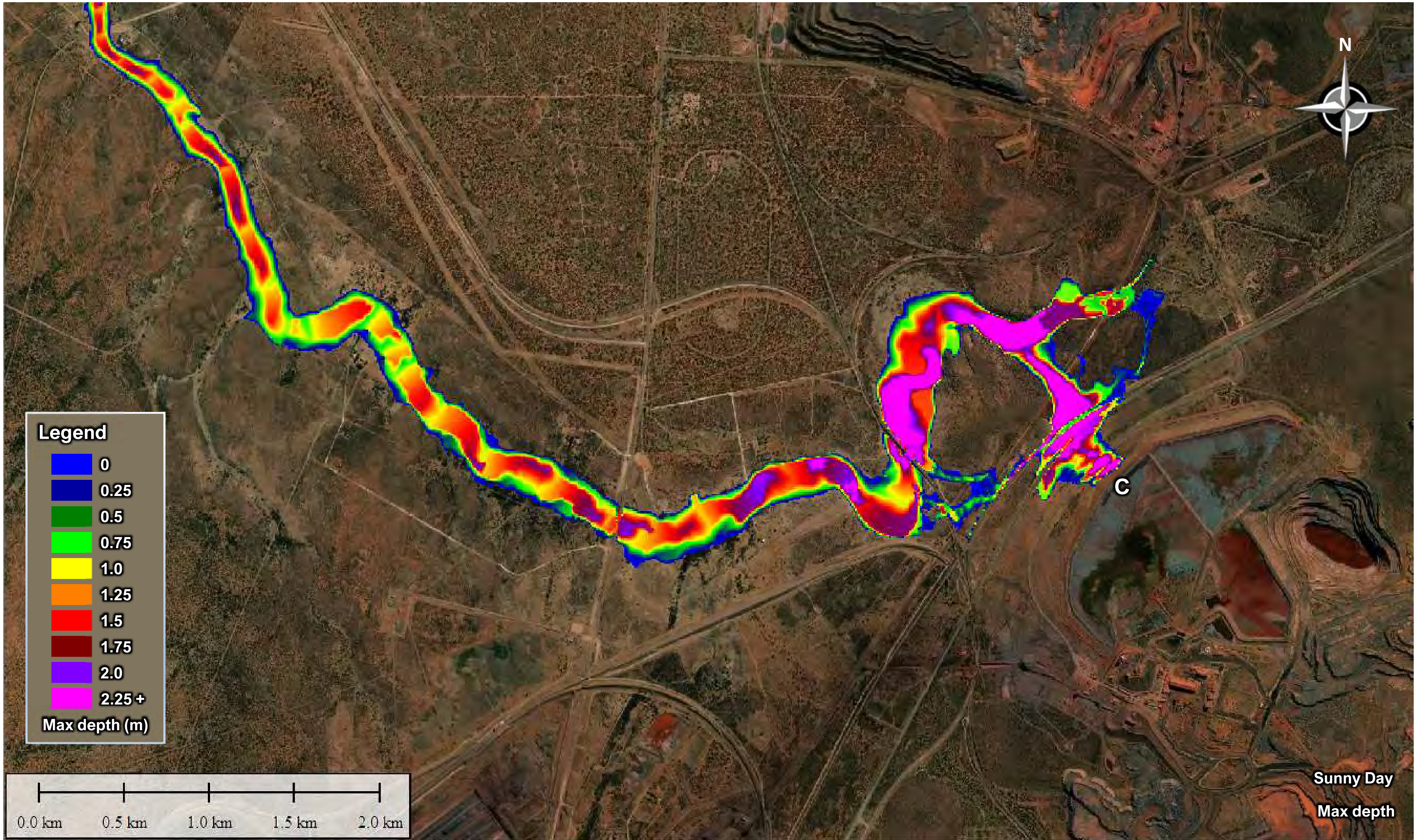
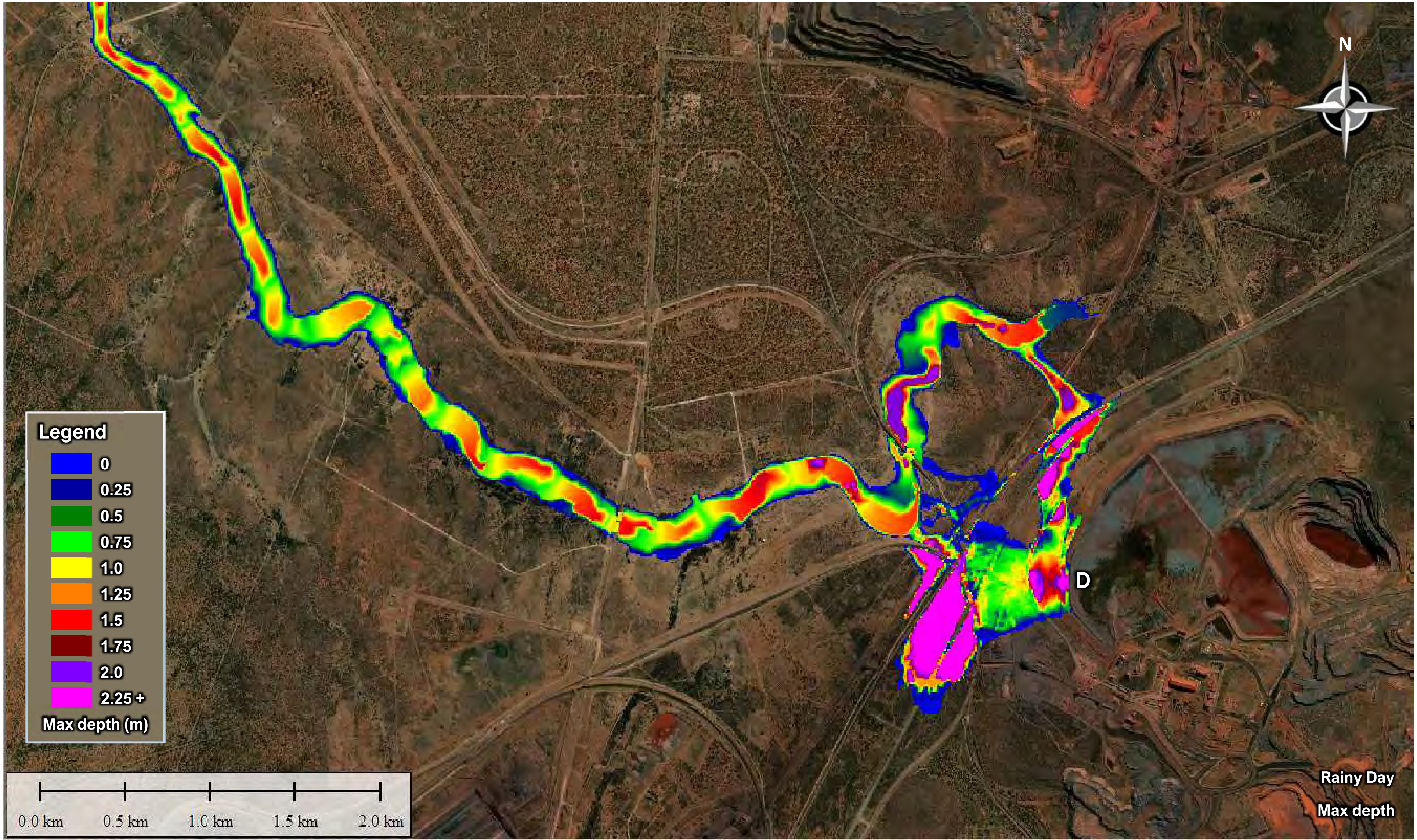
Legend
0
0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25 +
Max depth (m)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Sunny Day
Max depth

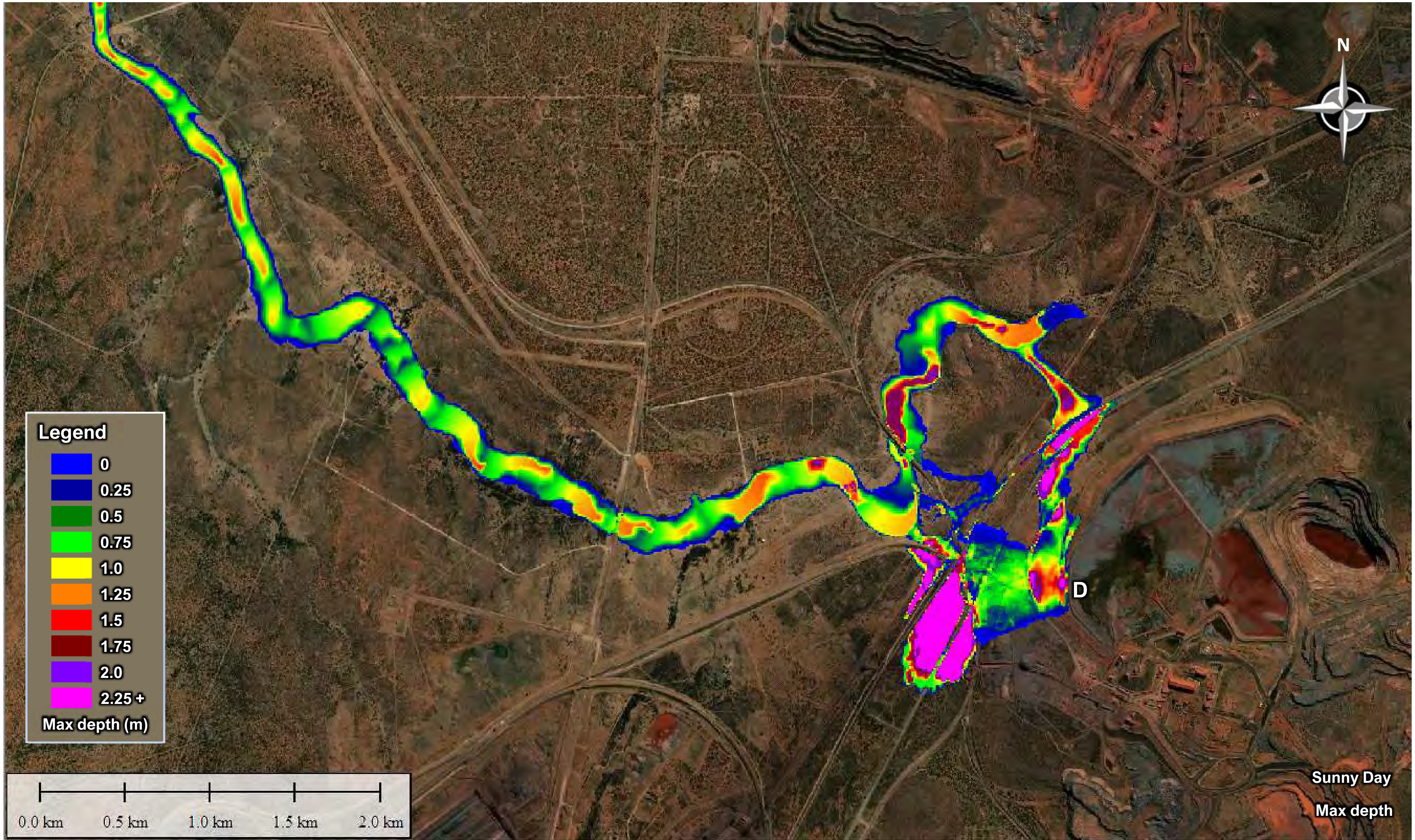

N
B
Legend
0
0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25 +
Max depth (m)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Rainy Day
Max depth

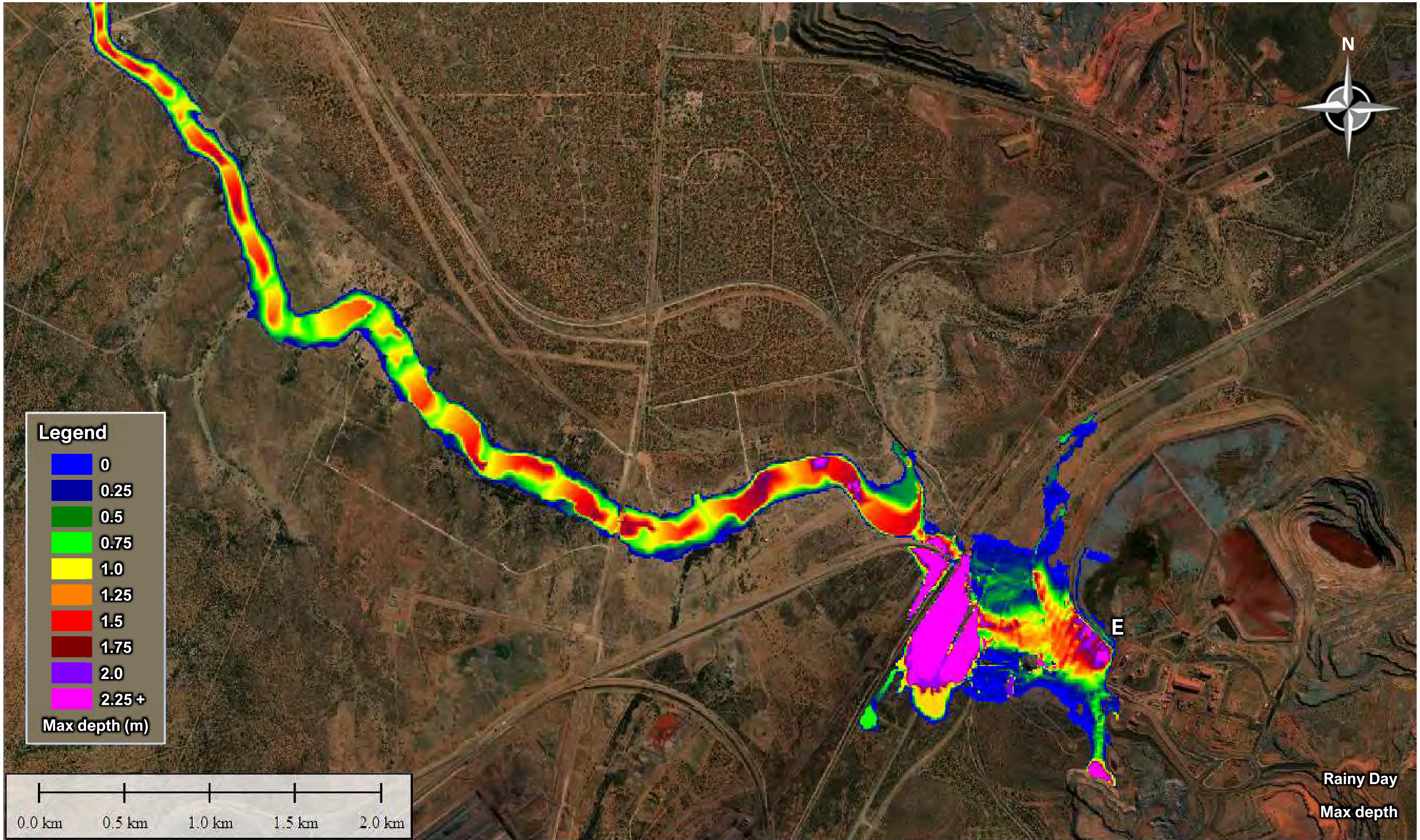

N
Legend
0
0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25 +
Max depth (m)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
B
Sunny Day
Max depth

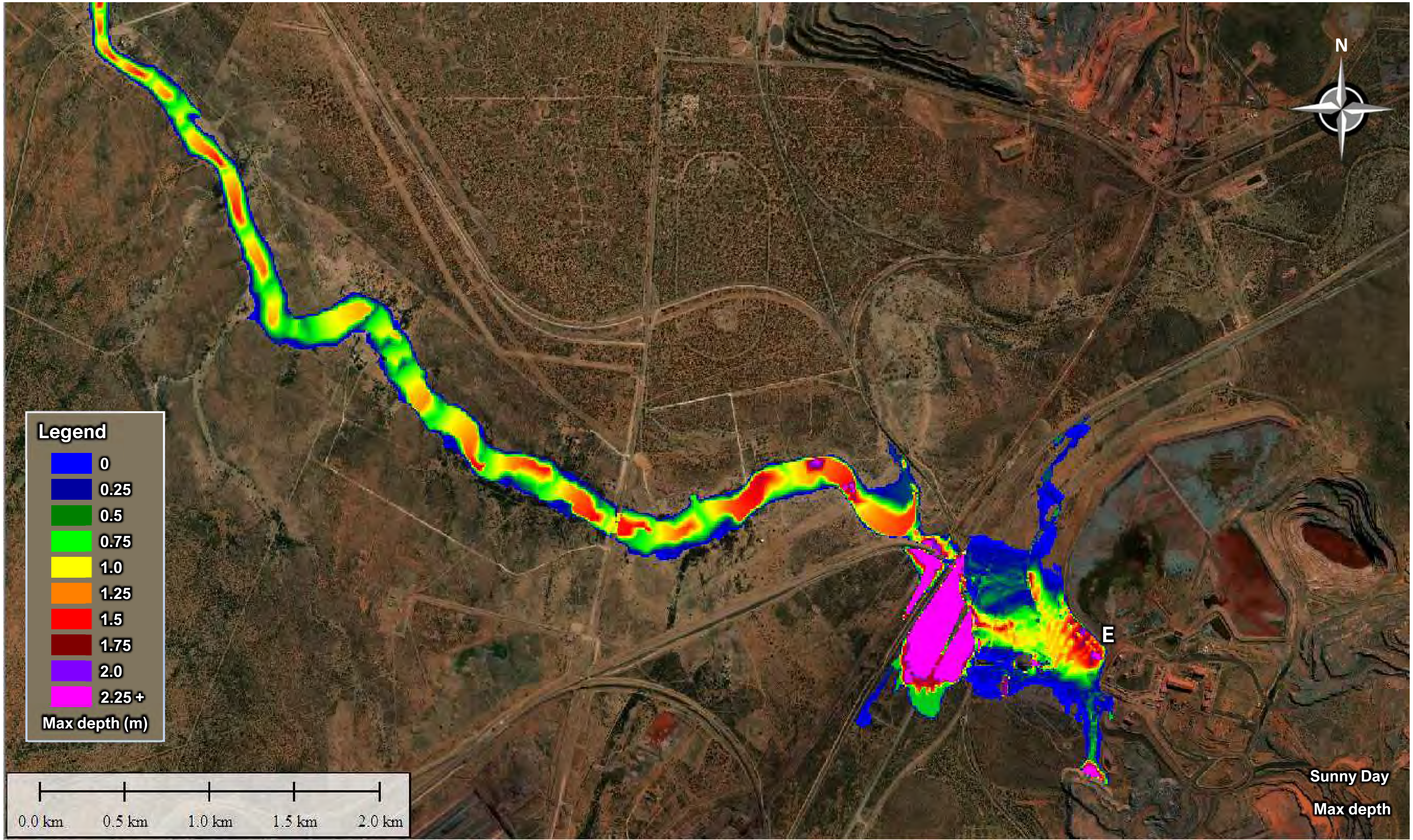

N
Legend
0
0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25 +
Max depth (m)
C
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Rainy Day
Max depth


N
Legend
0
0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25 +
Max depth (m)
C
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Sunny Day
Max depth

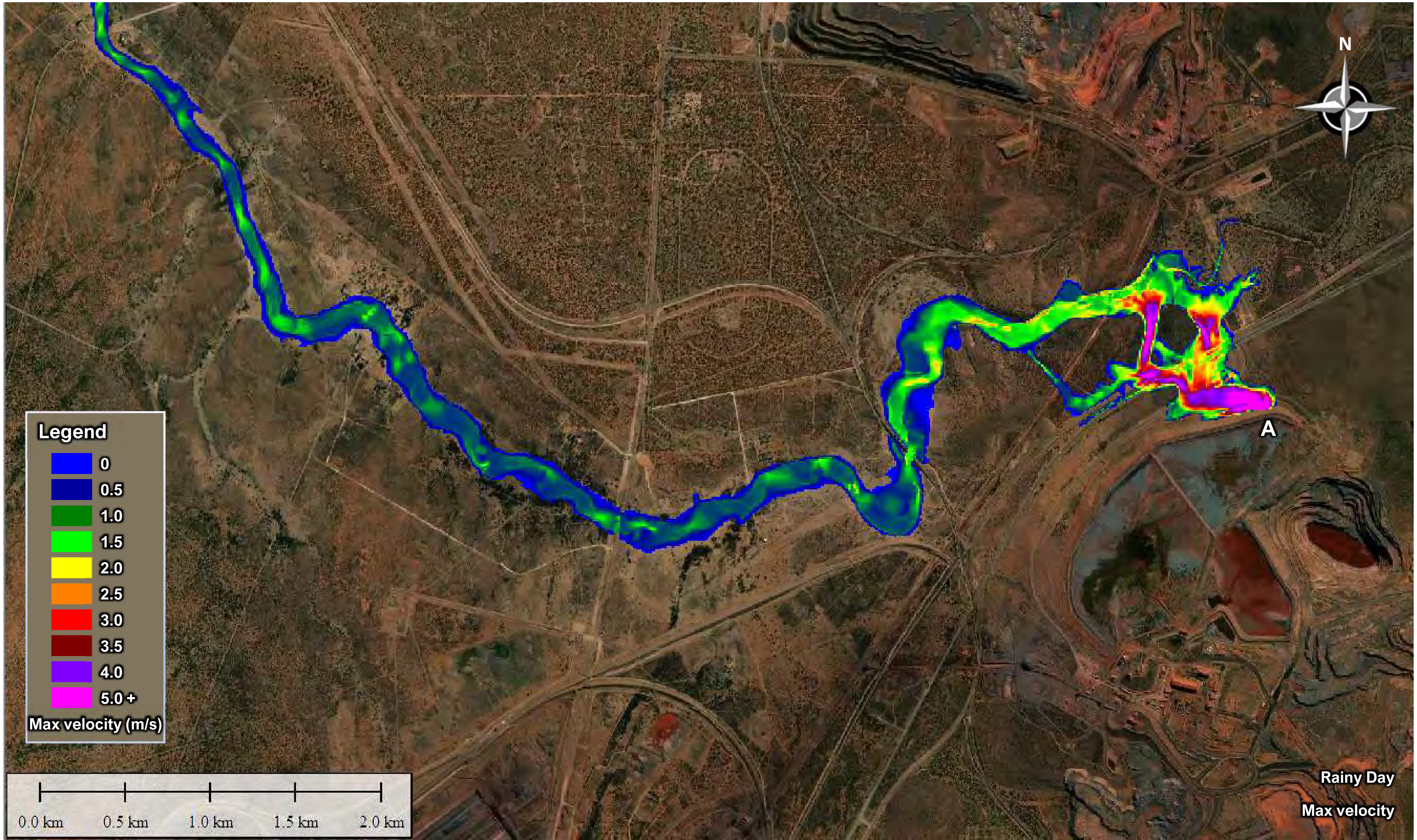

N
Legend
0
0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25 +
Max depth (m)
D
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Rainy Day
Max depth

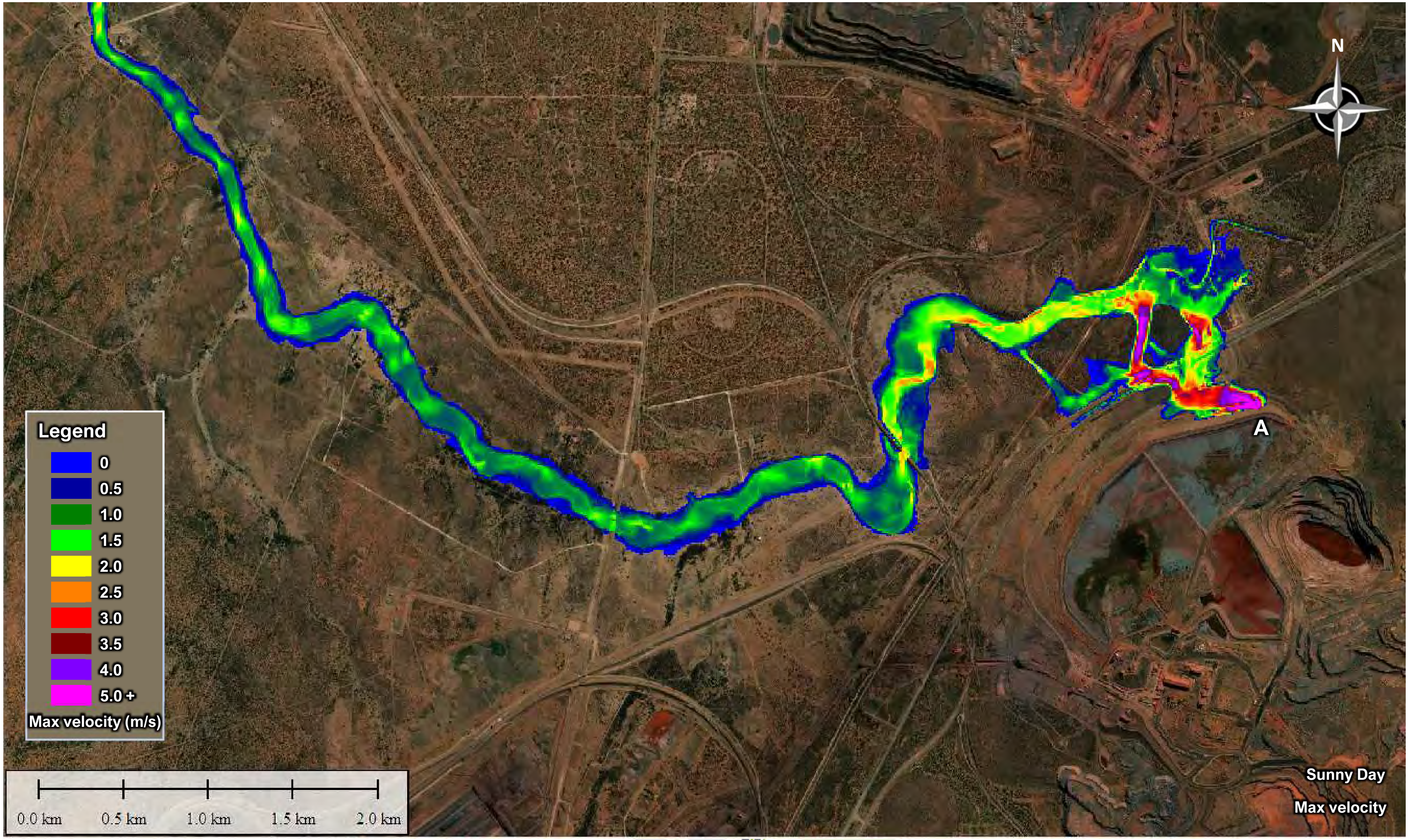

N
Legend
0
0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25 +
Max depth (m)
D
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Sunny Day
Max depth

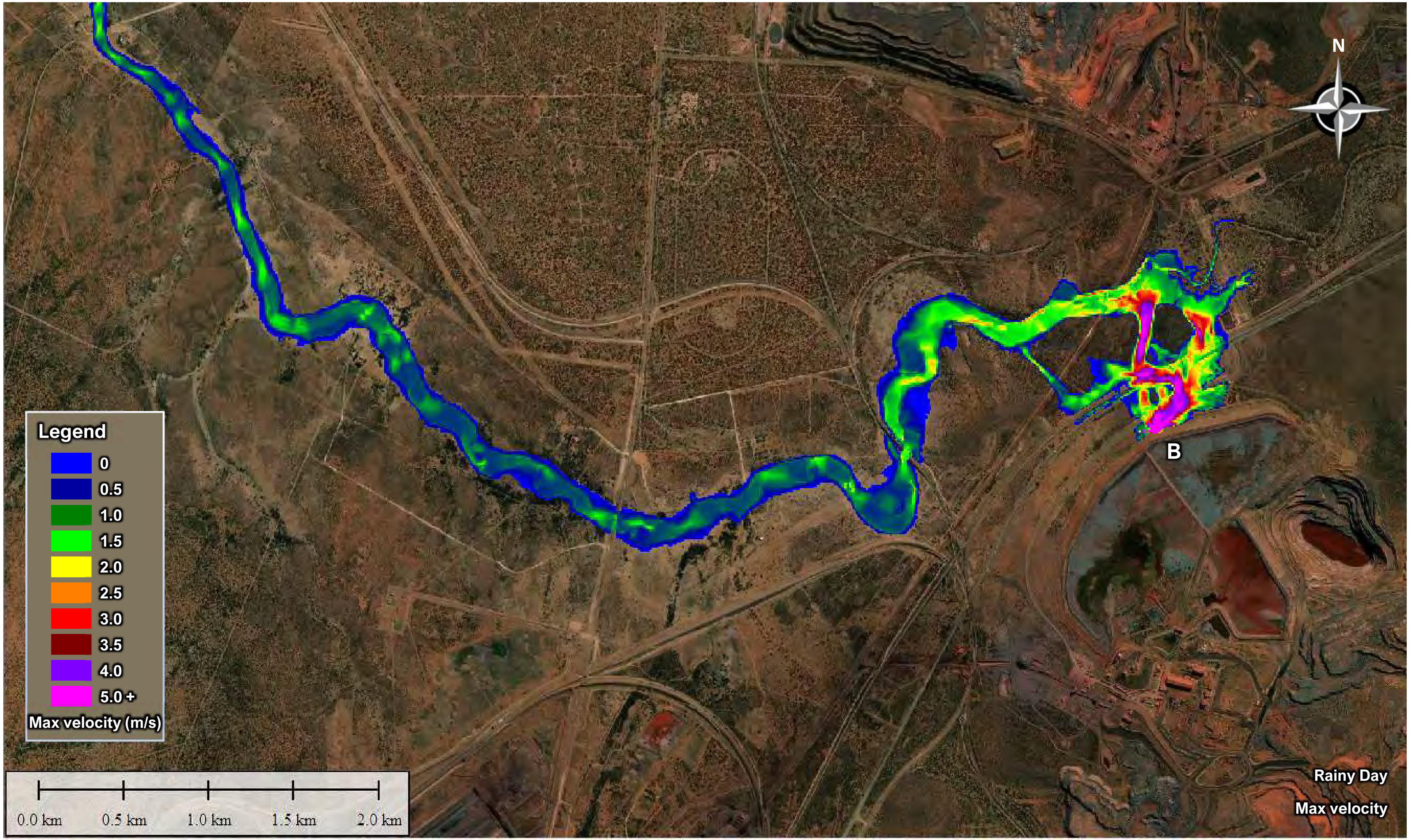

N
Legend
0
0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25 +
Max depth (m)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
E
Rainy Day
Max depth

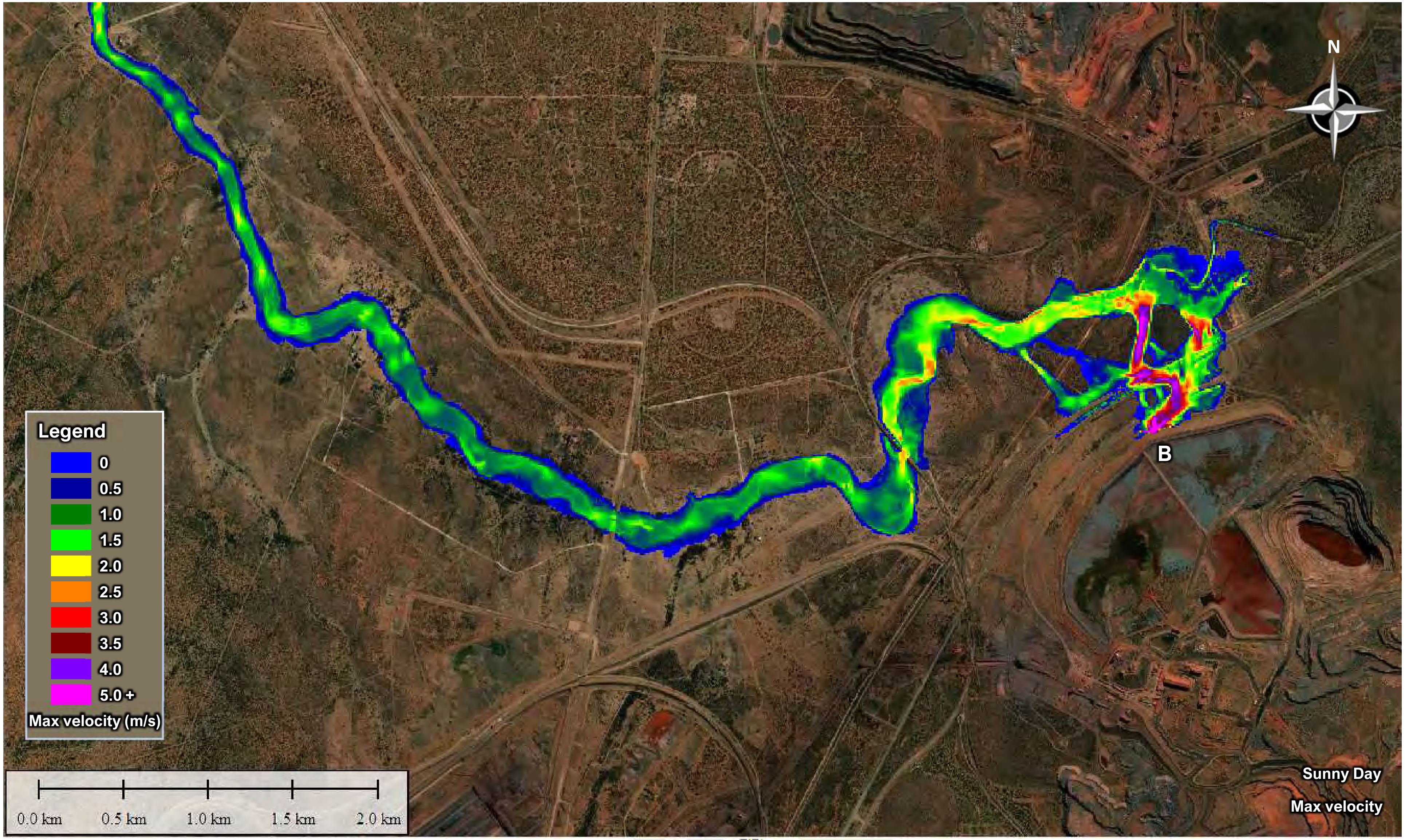

N
Legend
0
0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25 +
Max depth (m)
E
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Sunny Day
Max depth

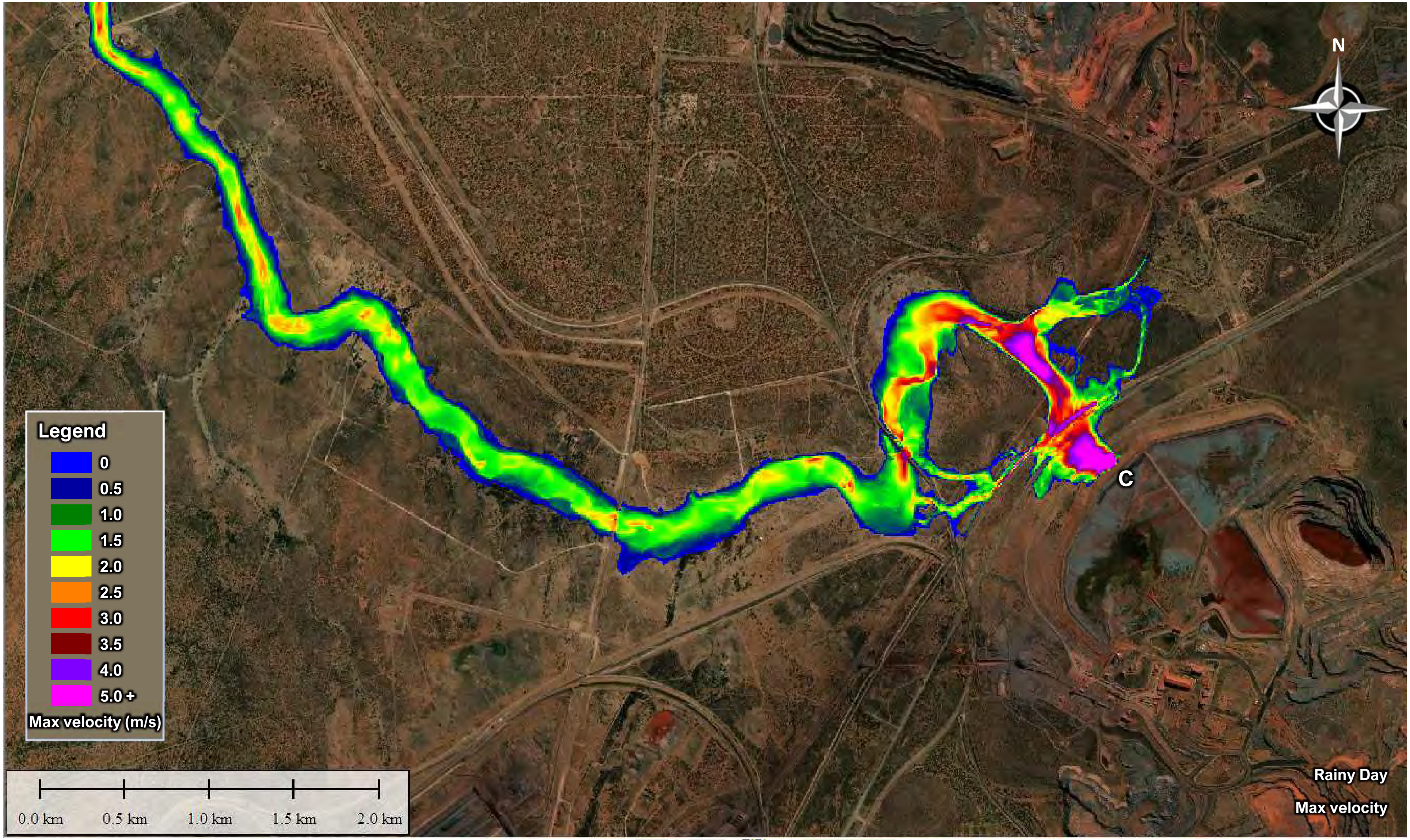
GEO TAIL

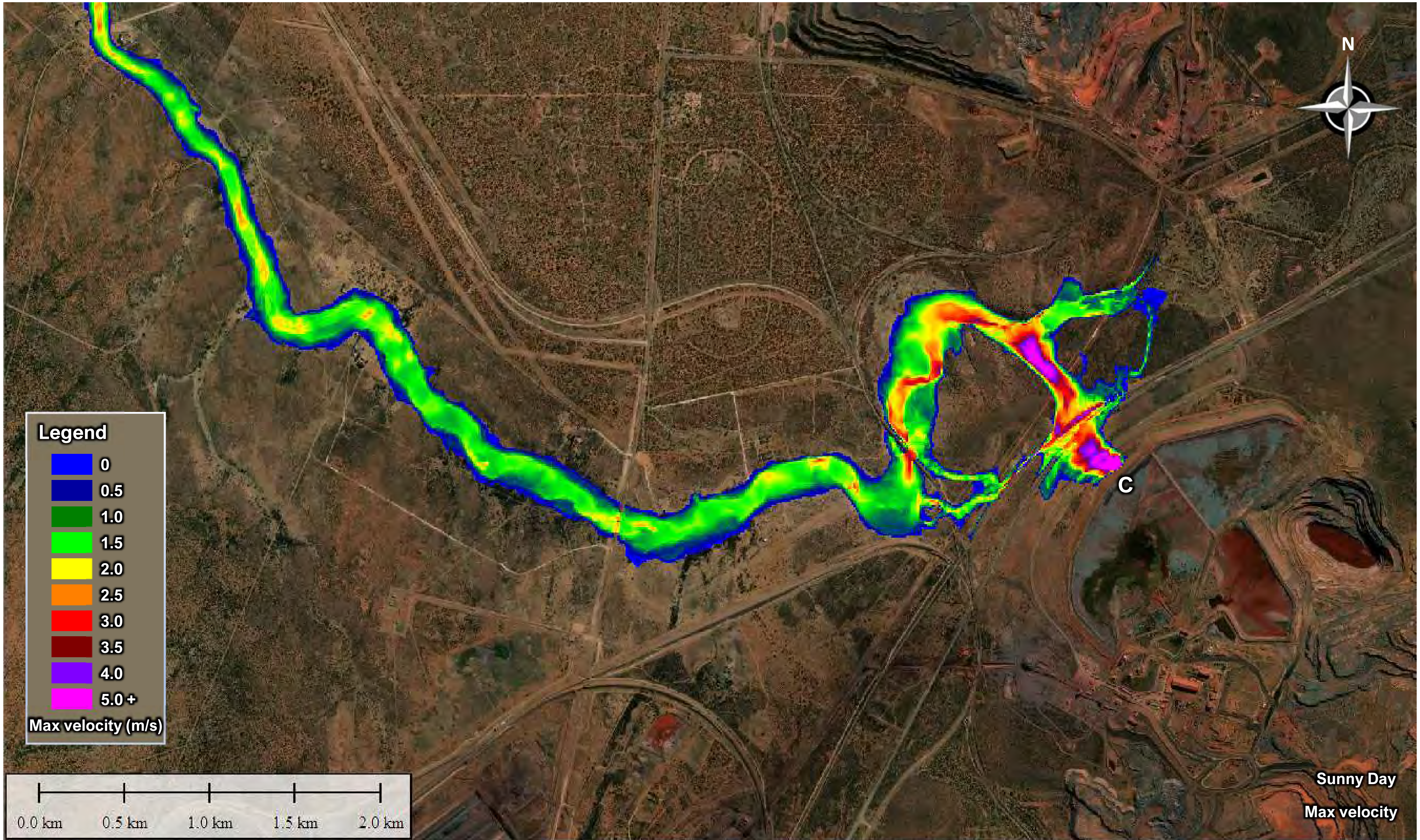

N
A
Legend
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0 +
Max velocity (m/s)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Rainy Day
Max velocity

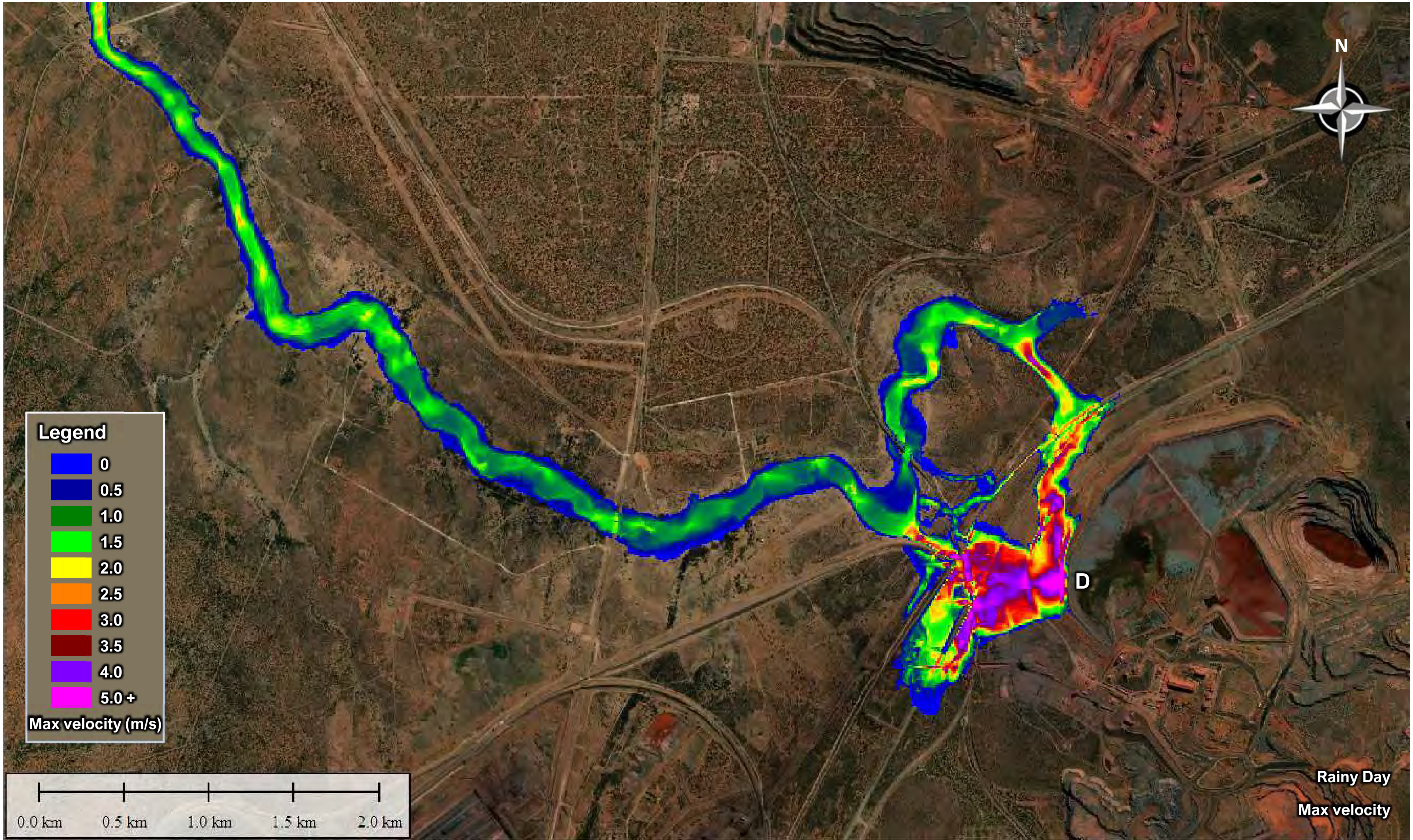

N
A
Legend
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0 +
Max velocity (m/s)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Sunny Day
Max velocity

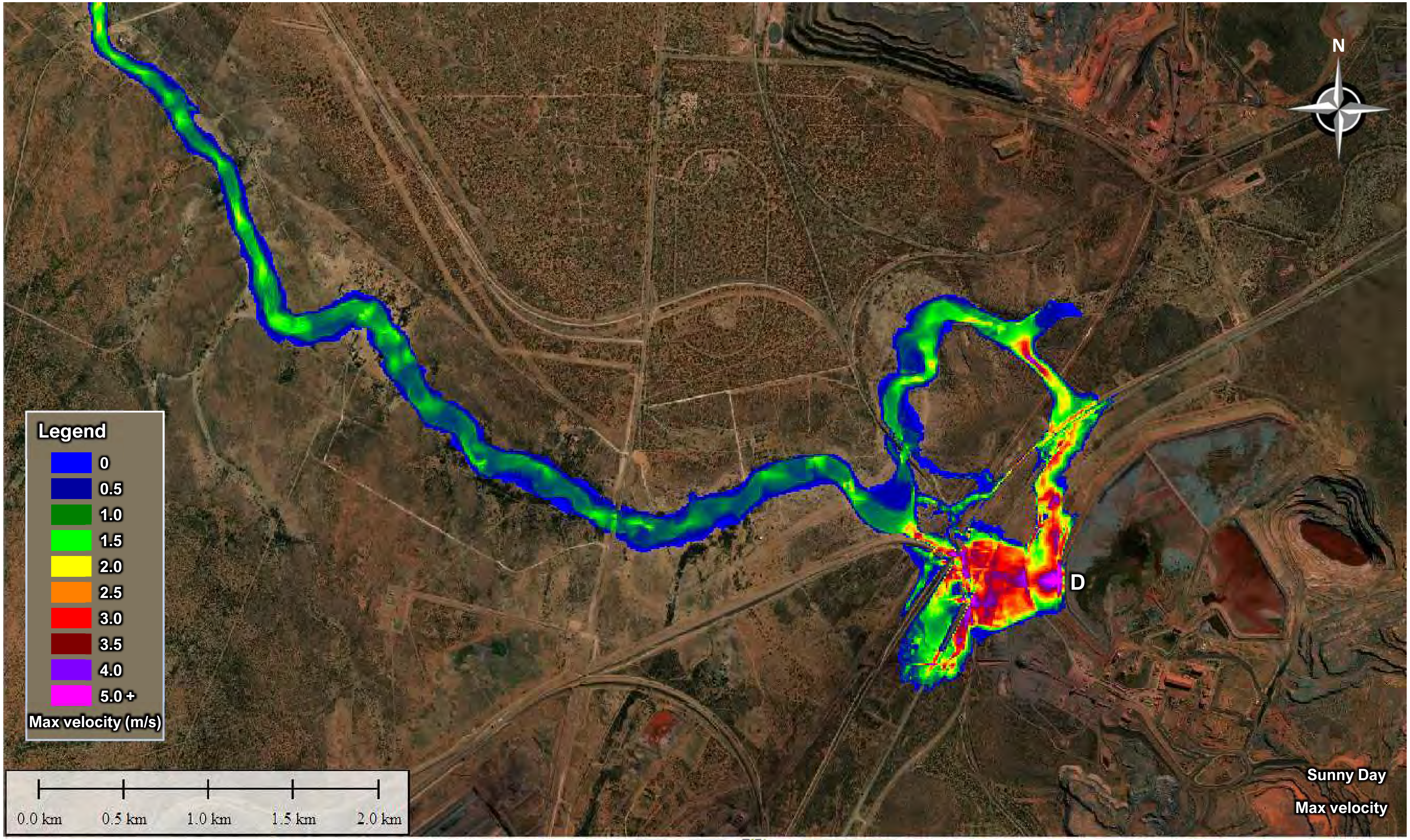

N
B
Legend
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0 +
Max velocity (m/s)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Rainy Day
Max velocity

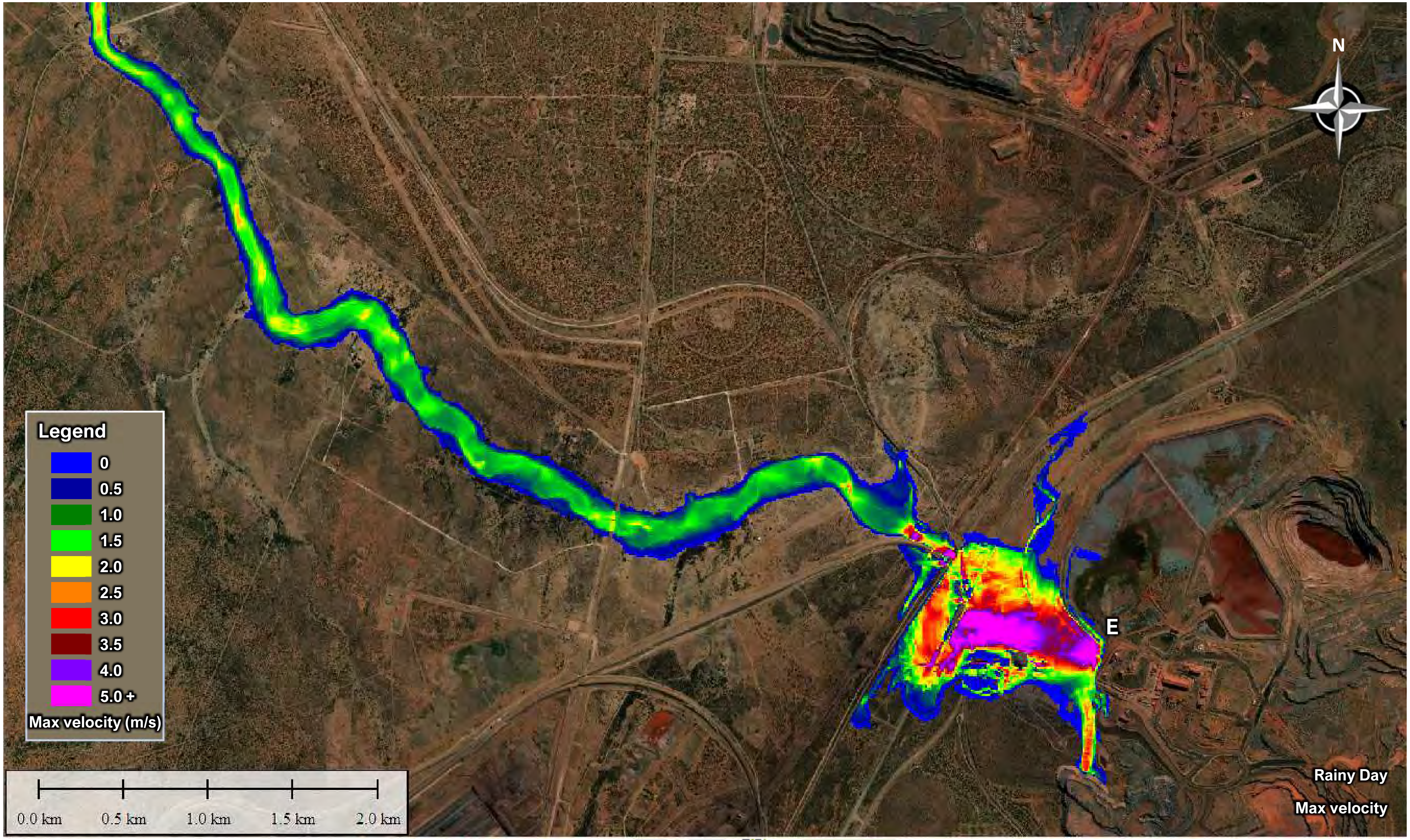

N
B
Legend
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0 +
Max velocity (m/s)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Sunny Day
Max velocity

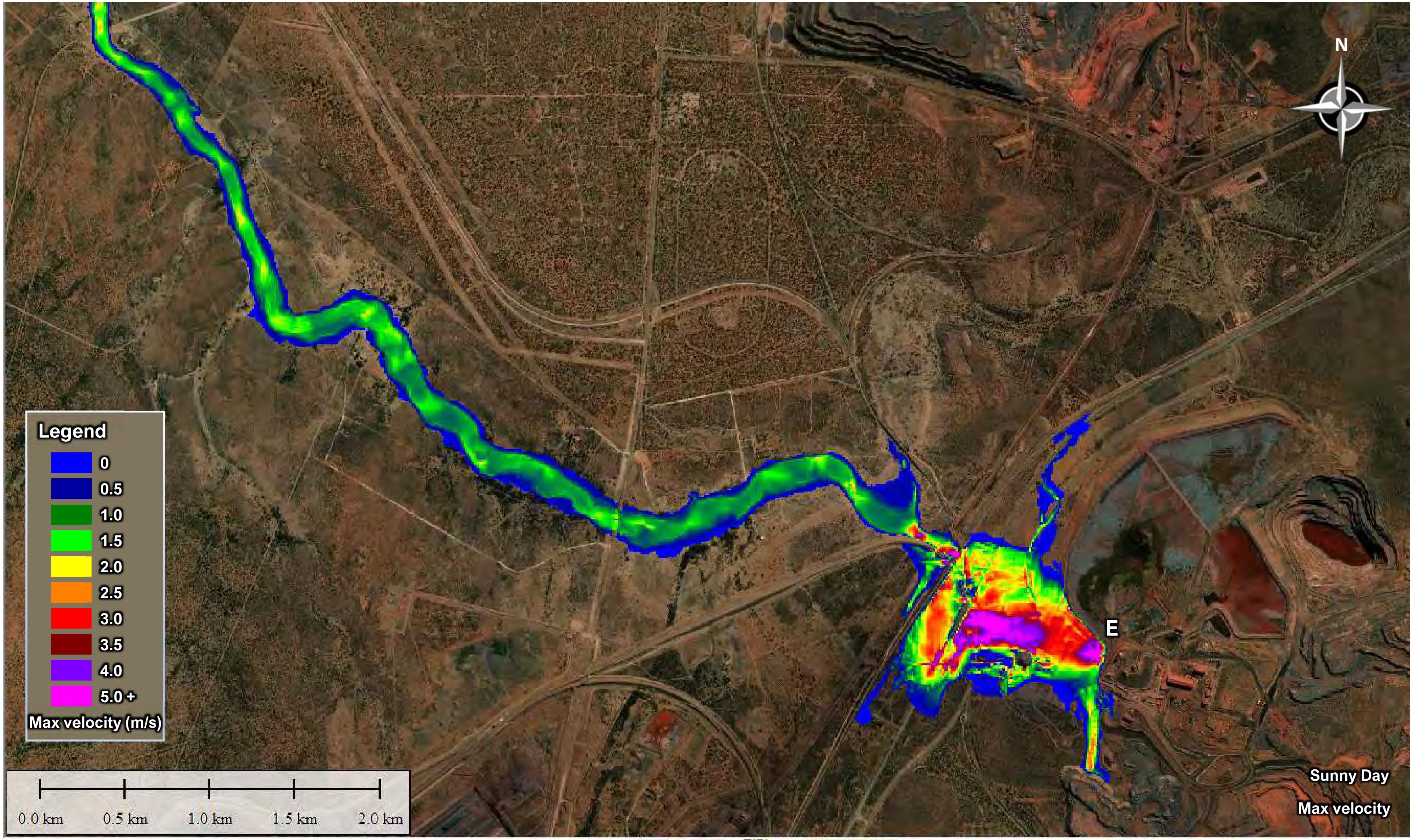

N
Legend
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0 +
Max velocity (m/s)
C
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Rainy Day
Max velocity

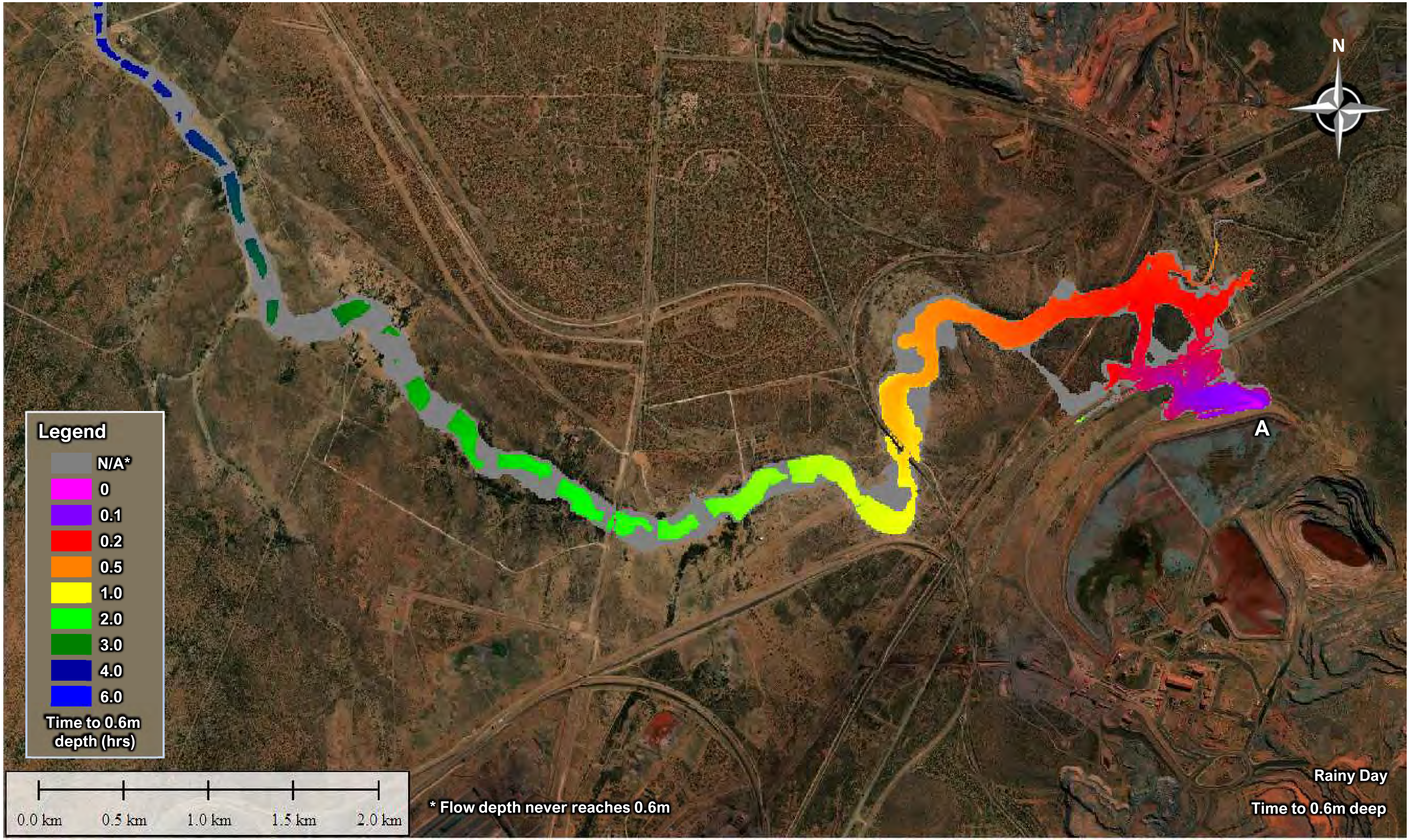

N
C
Legend
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0 +
Max velocity (m/s)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Sunny Day
Max velocity

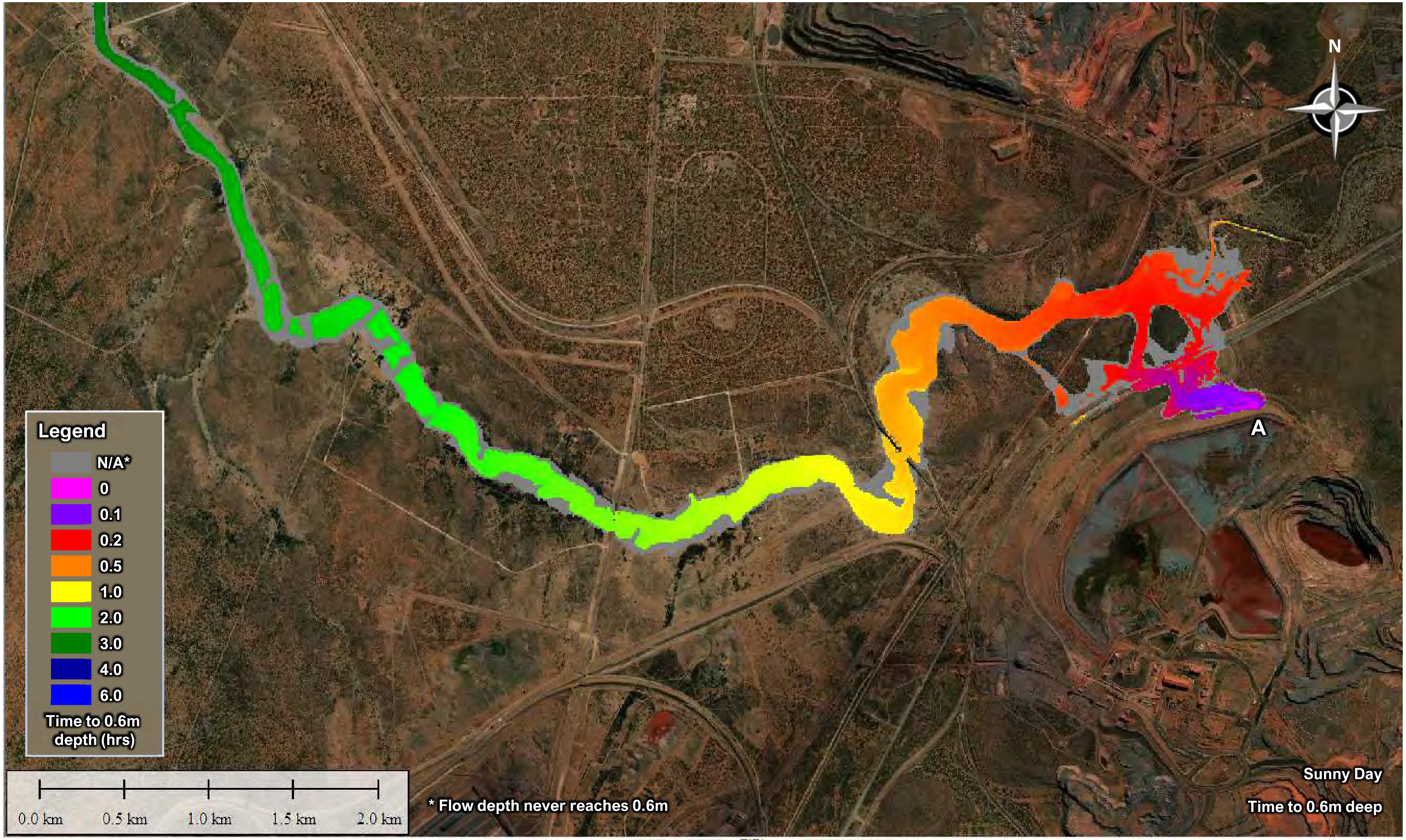

N
Legend
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0 +
Max velocity (m/s)
D
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Rainy Day
Max velocity

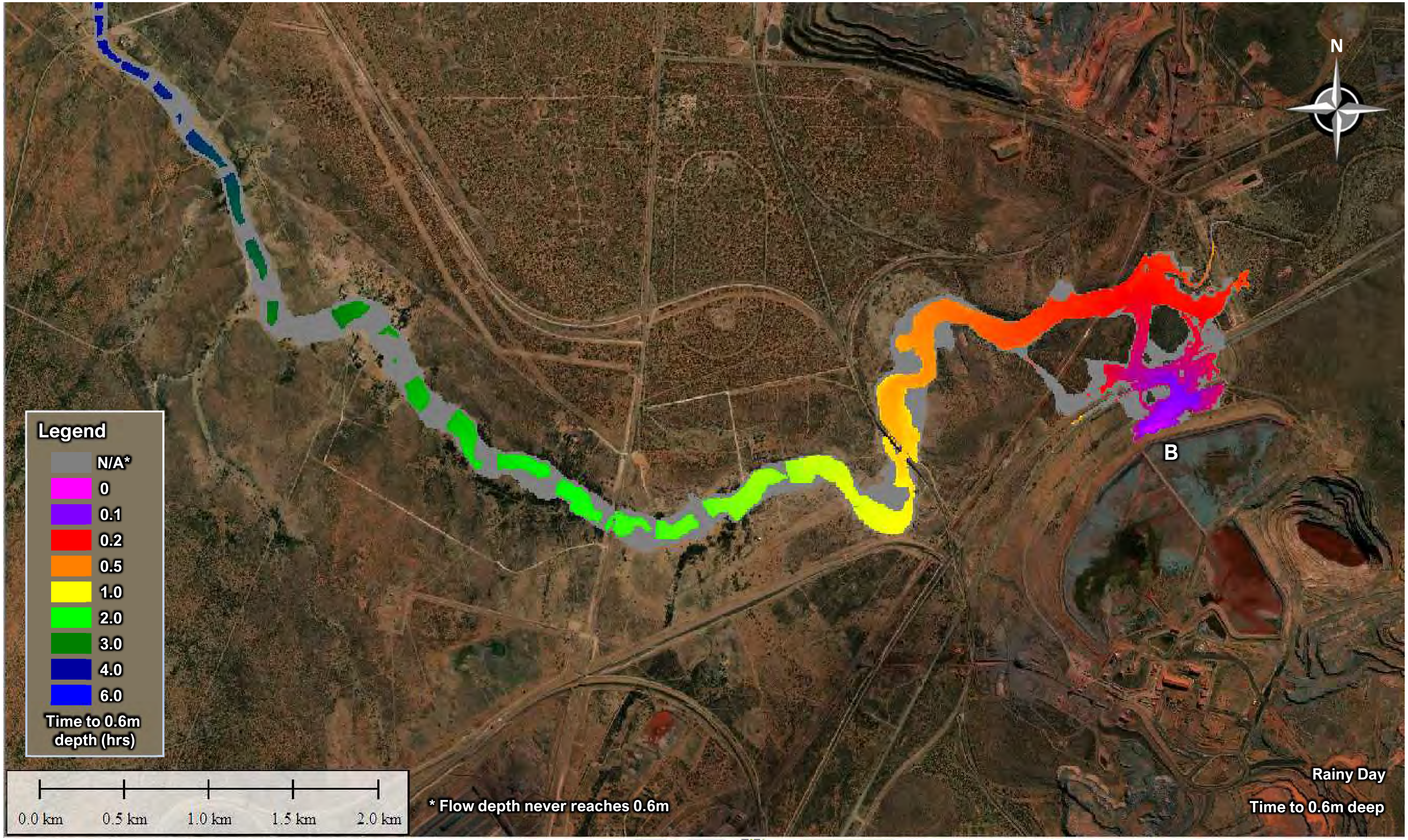

N
Legend
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0 +
Max velocity (m/s)
D
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Sunny Day
Max velocity

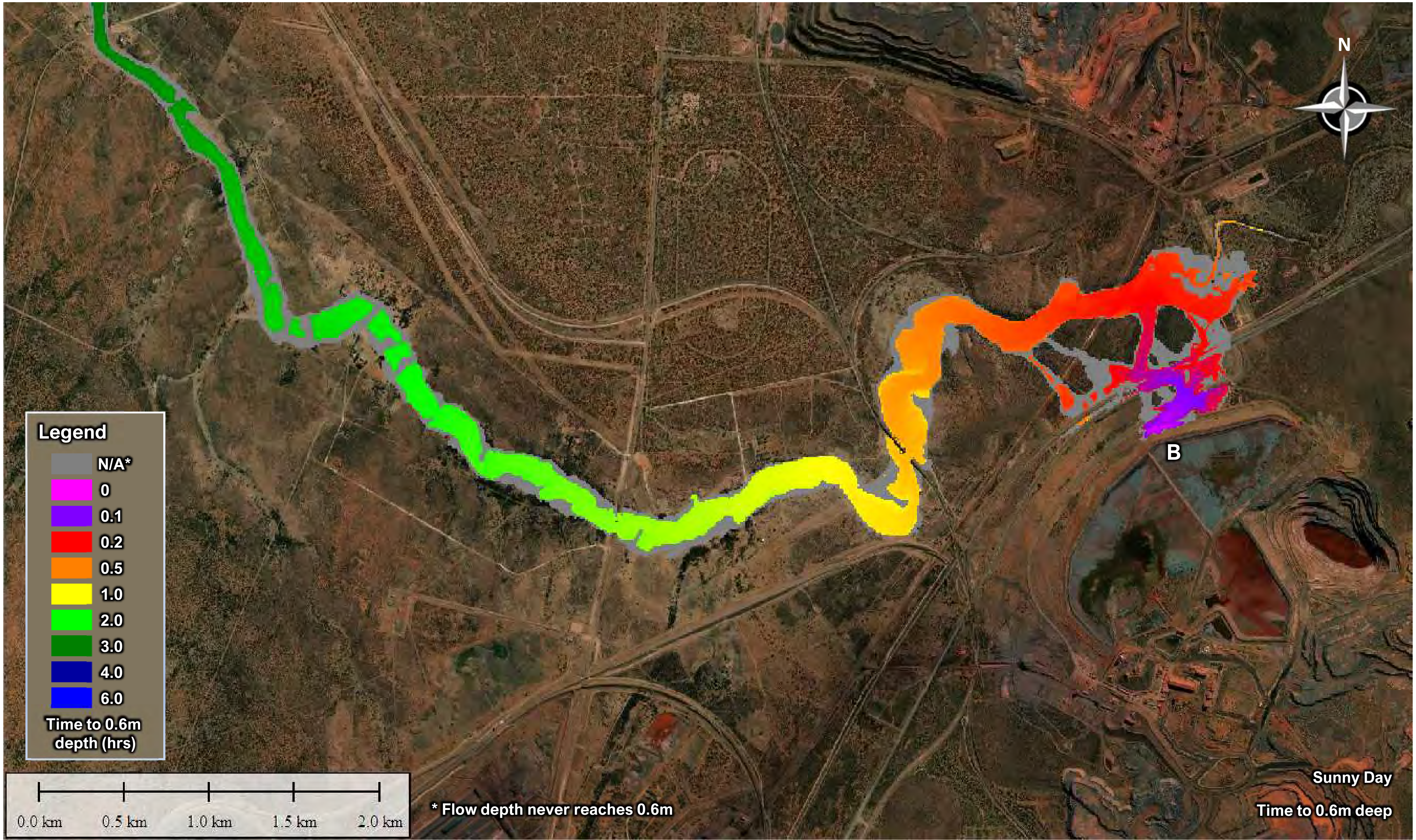

N
Legend
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0 +
Max velocity (m/s)
E
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
Rainy Day
Max velocity

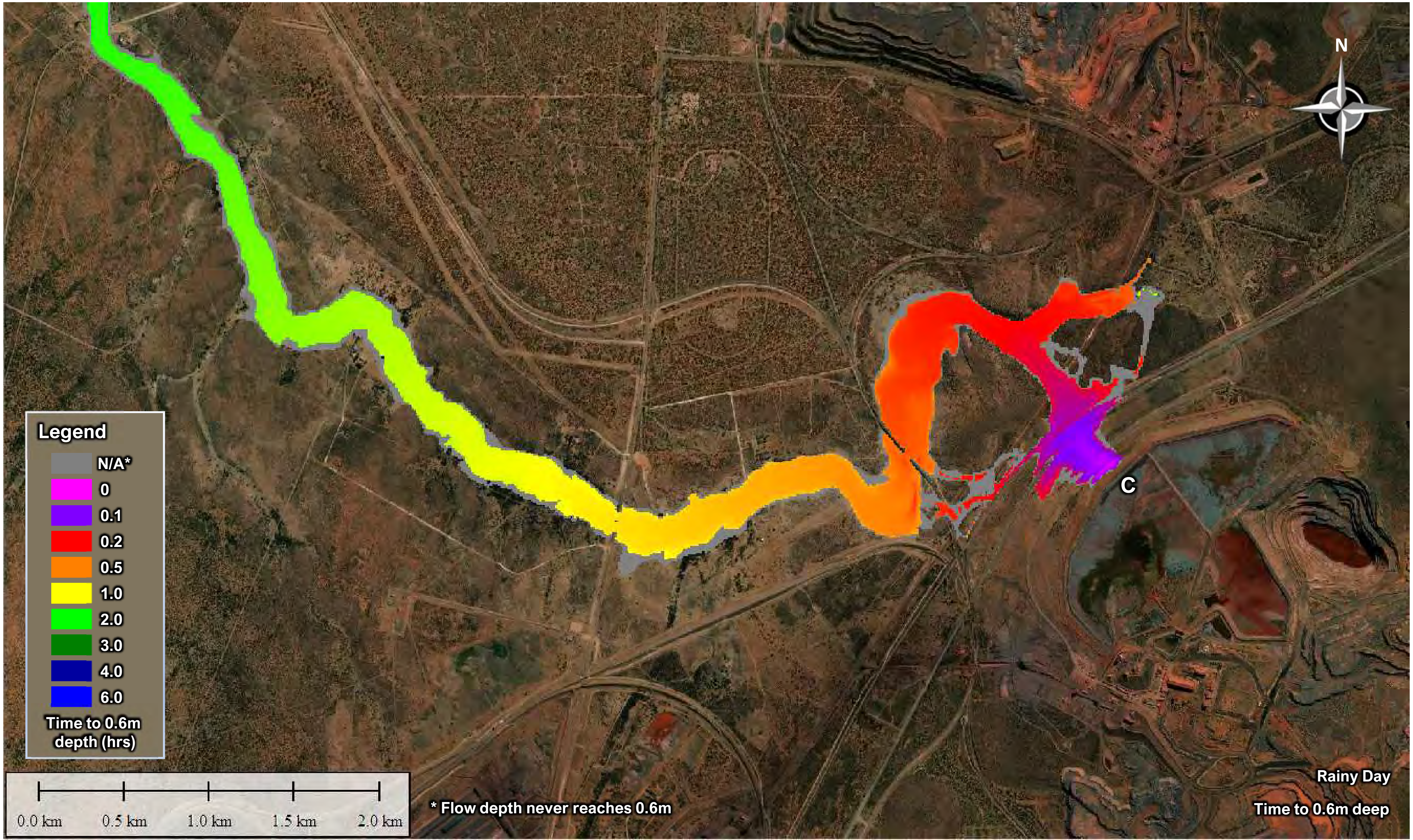

N
Legend
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
5.0 +
Max velocity (m/s)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
E
Sunny Day
Max velocity

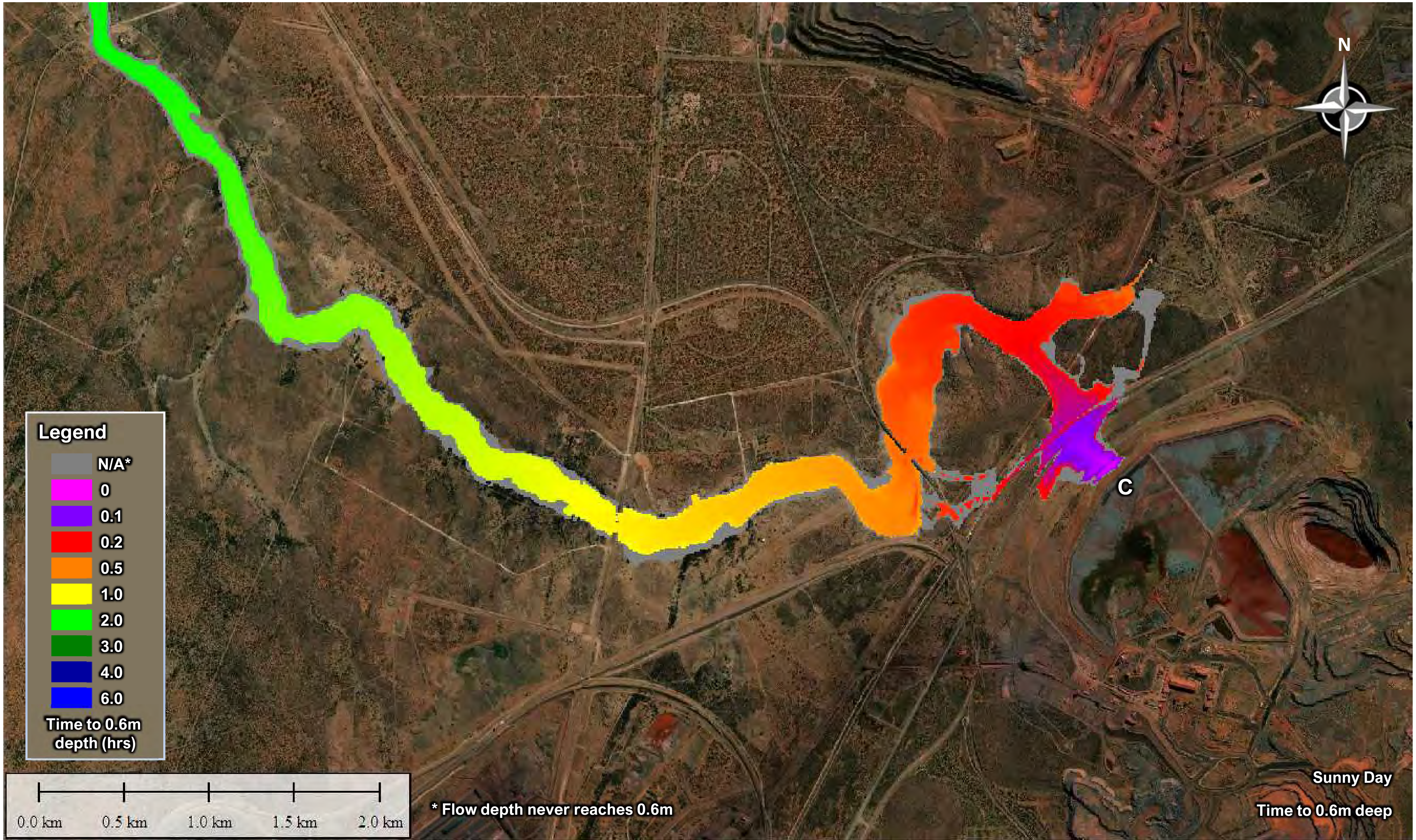

N
A
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.6m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.6m
Rainy Day
Time to 0.6m deep

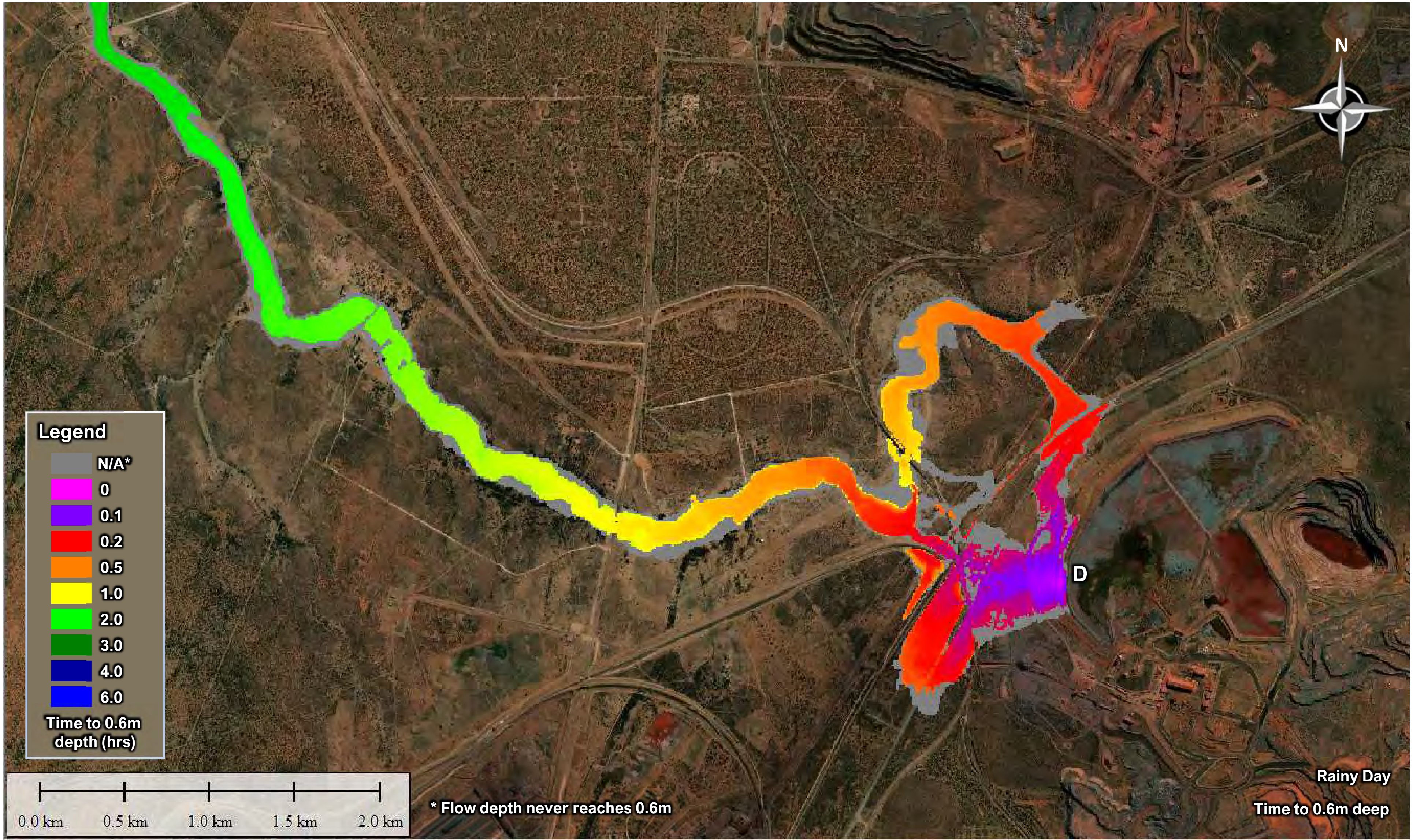

N
A
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.6m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.6m
Sunny Day
Time to 0.6m deep


N
B
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.6m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.6m
Rainy Day
Time to 0.6m deep

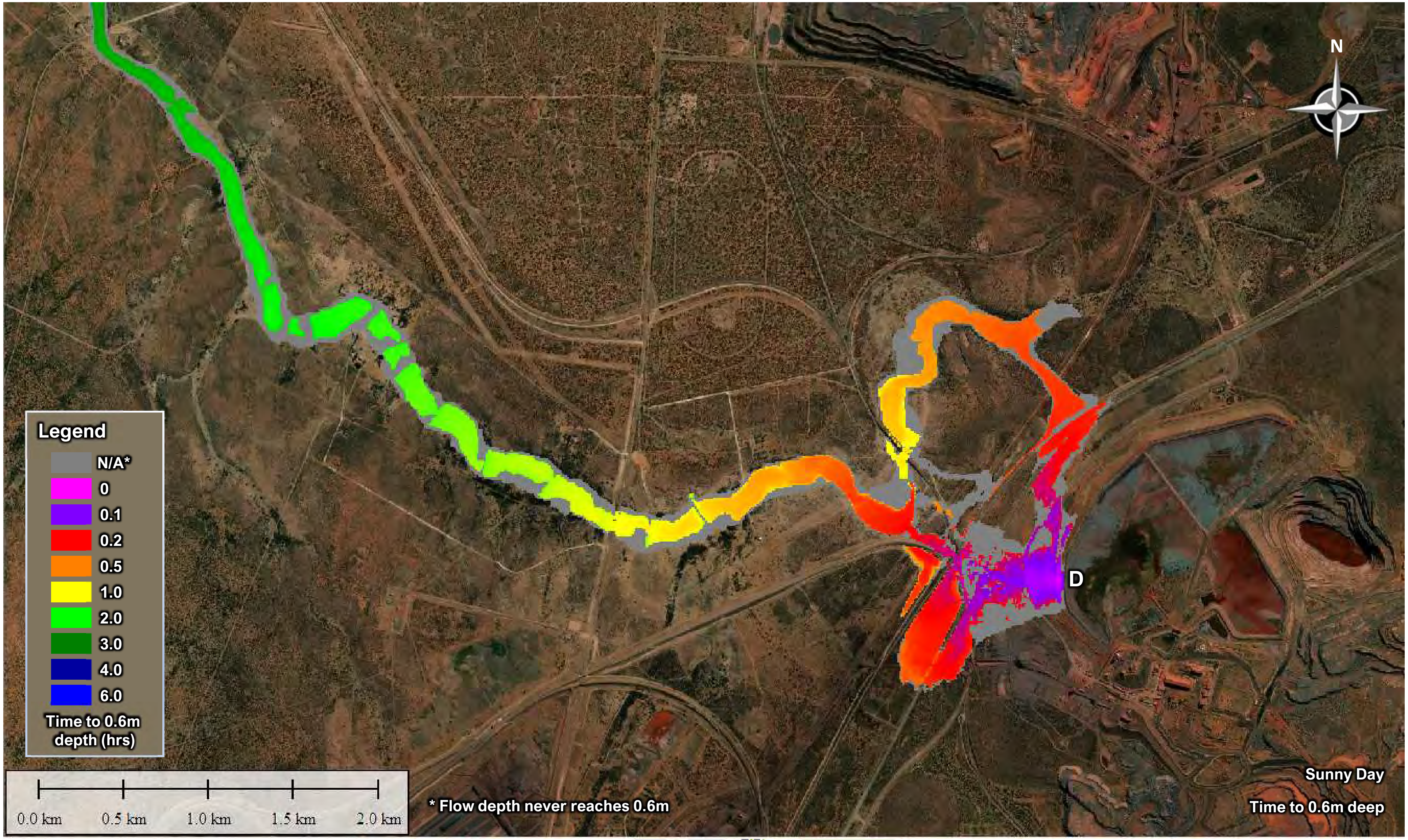

N
B
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.6m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.6m
Sunny Day
Time to 0.6m deep

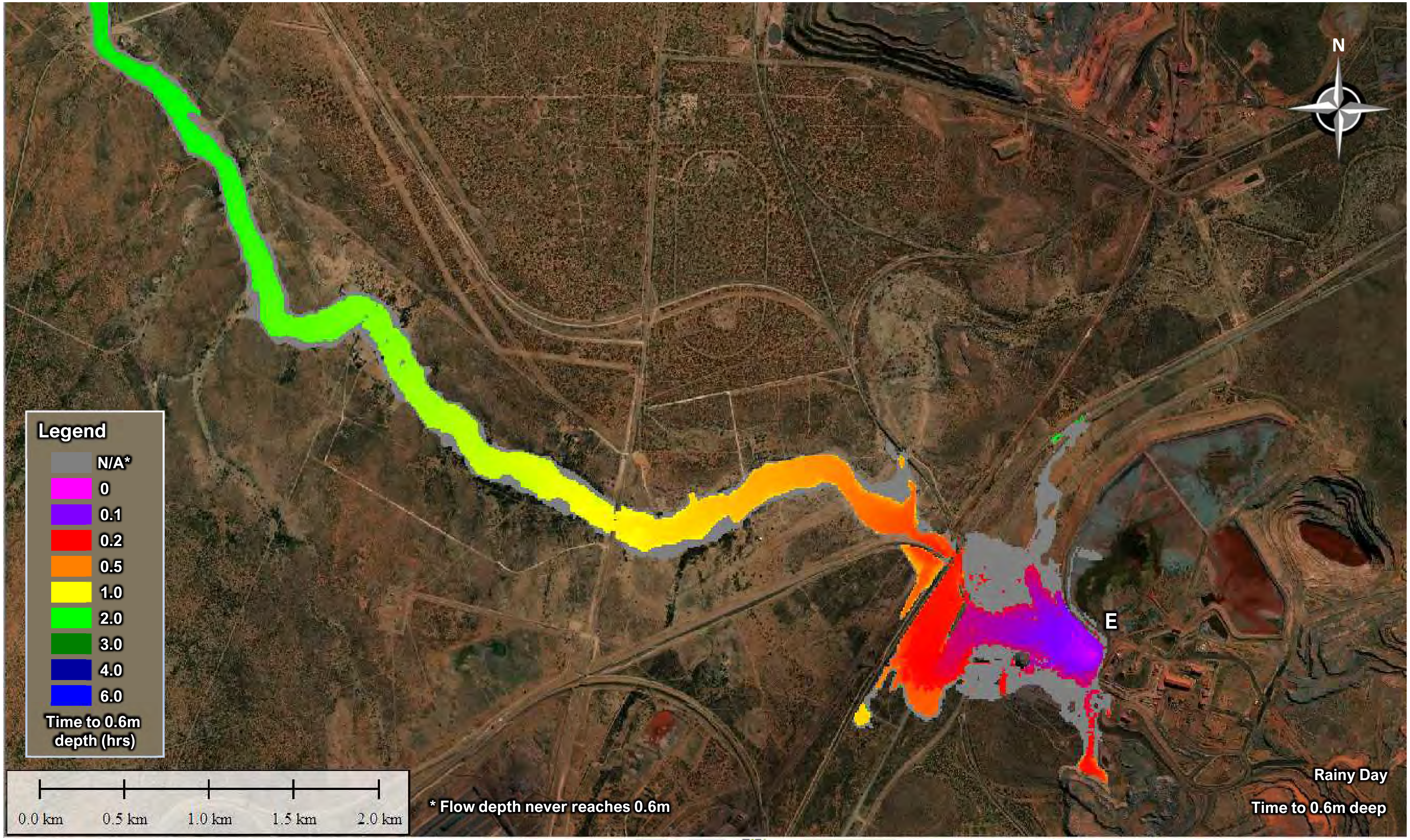

N
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.6m depth (hrs)
C
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.6m
Rainy Day
Time to 0.6m deep


N
C
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.6m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.6m
Sunny Day
Time to 0.6m deep

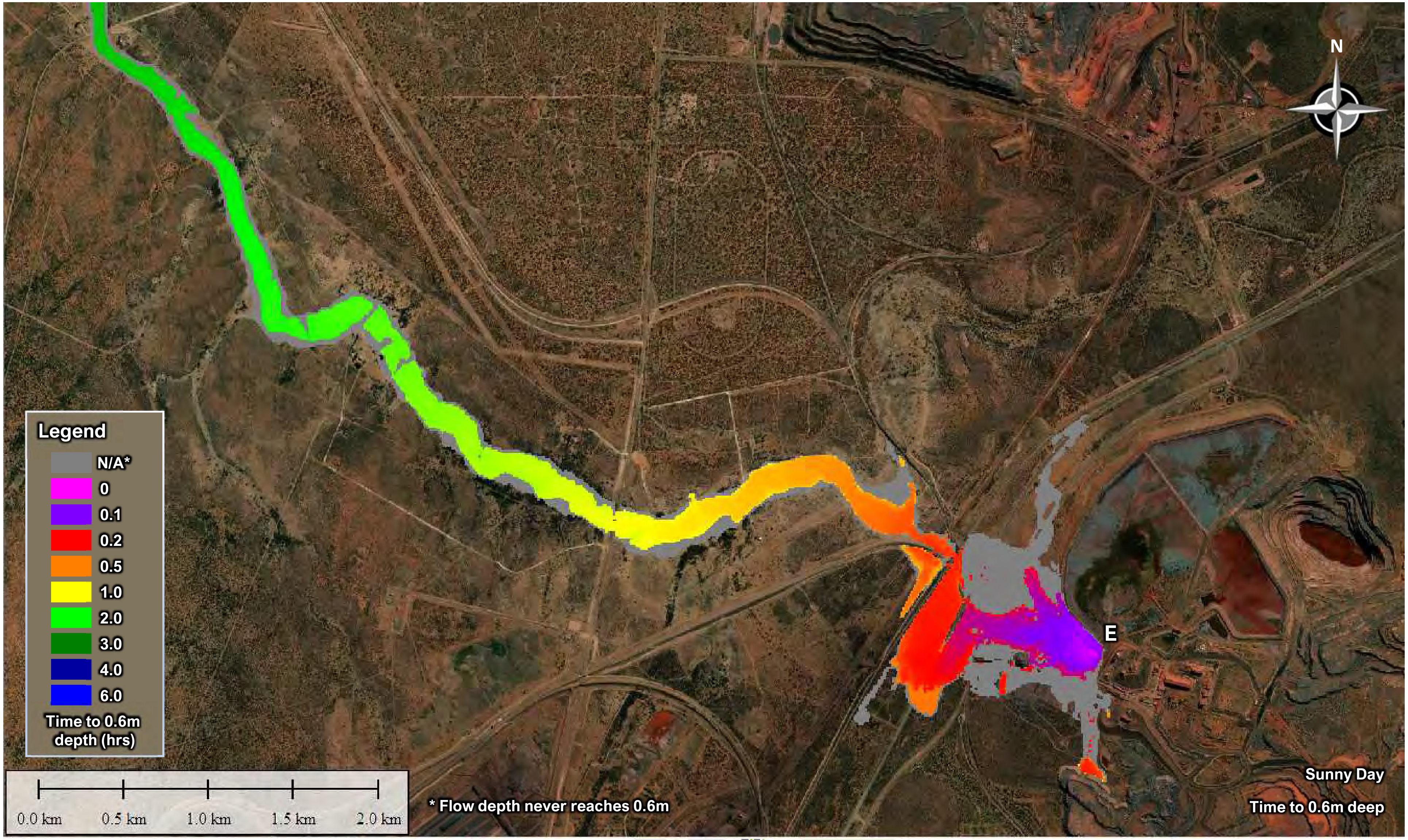

N
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.6m depth (hrs)
D
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.6m
Rainy Day
Time to 0.6m deep

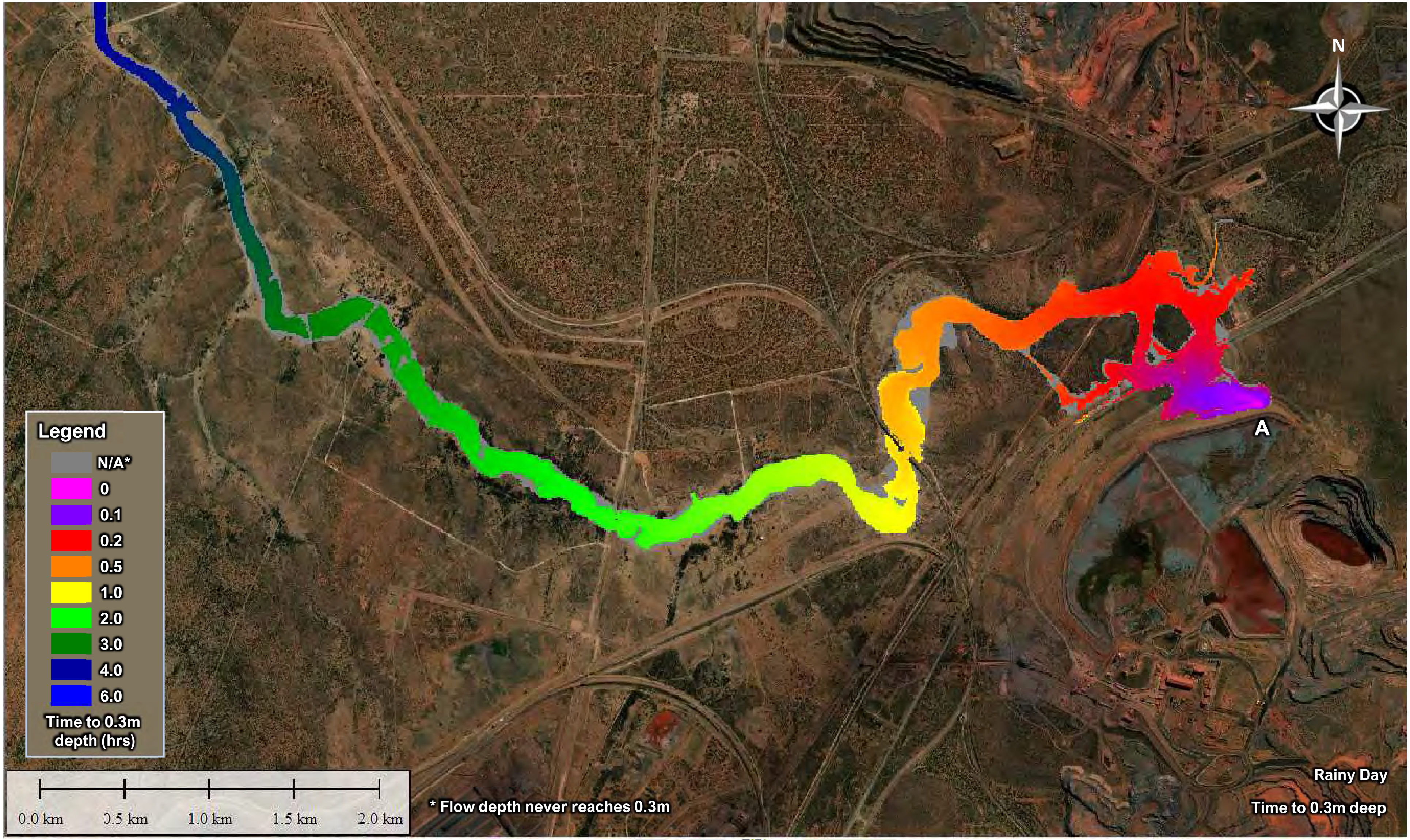
GEO TAIL

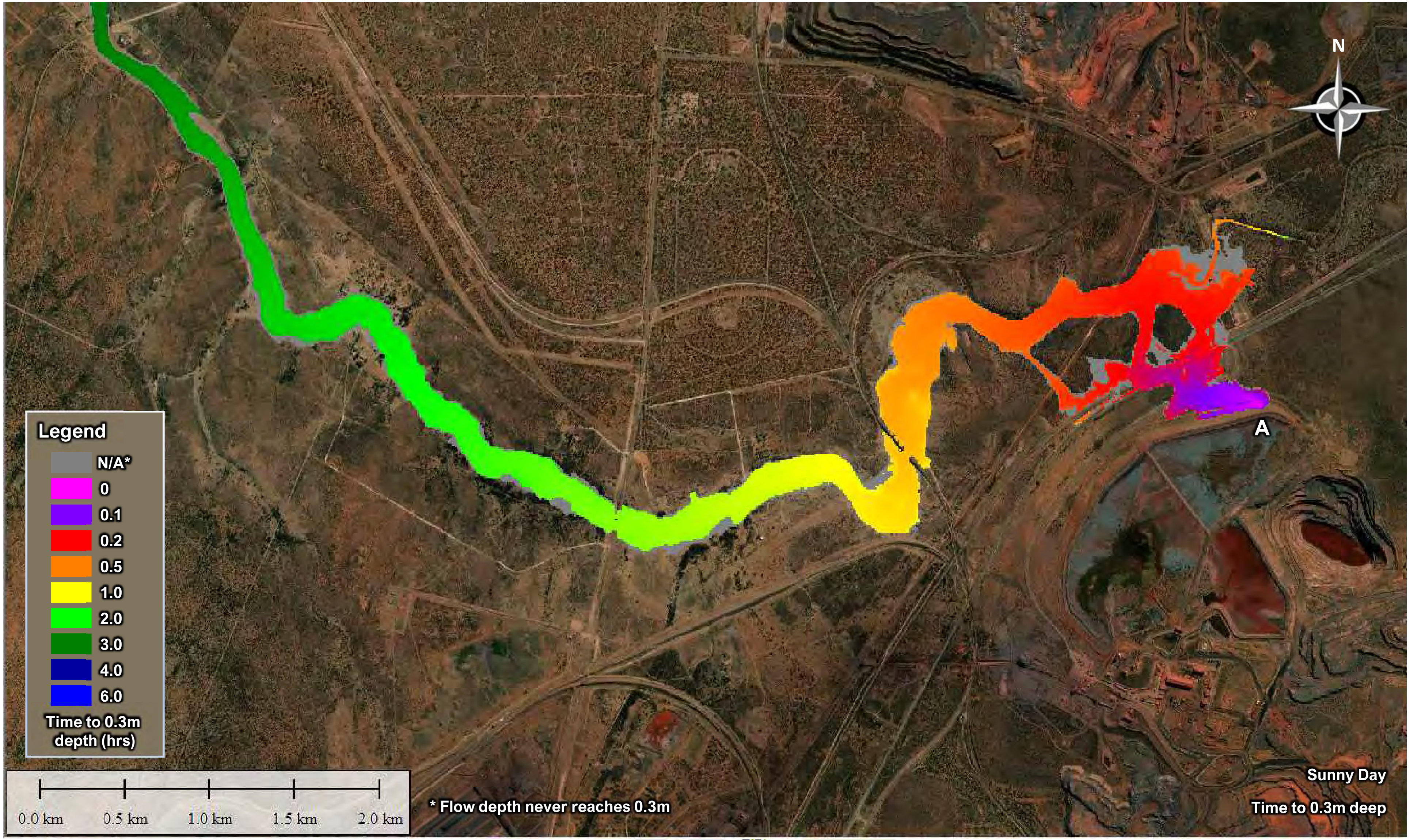

N
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.6m depth (hrs)
D
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.6m
Sunny Day
Time to 0.6m deep

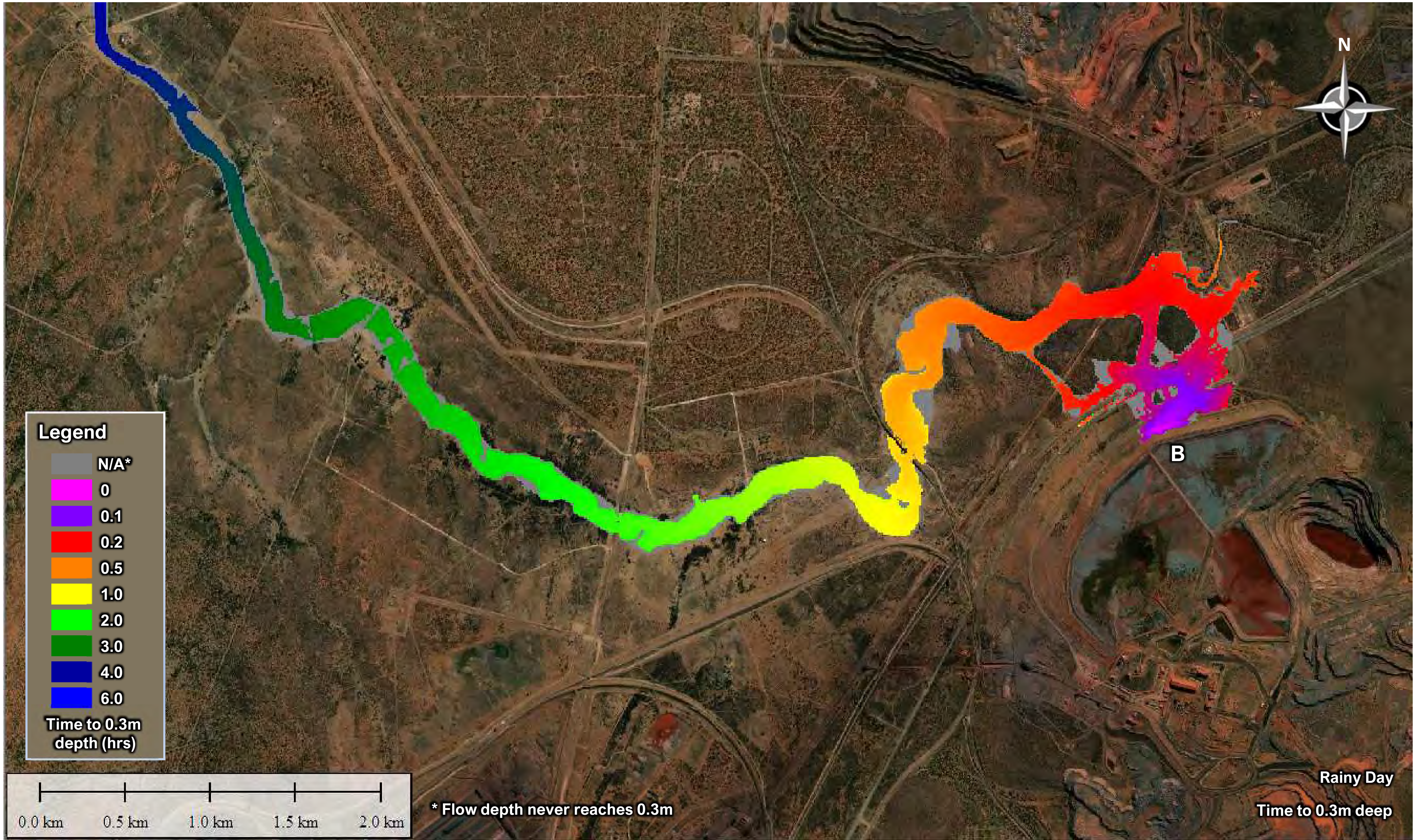


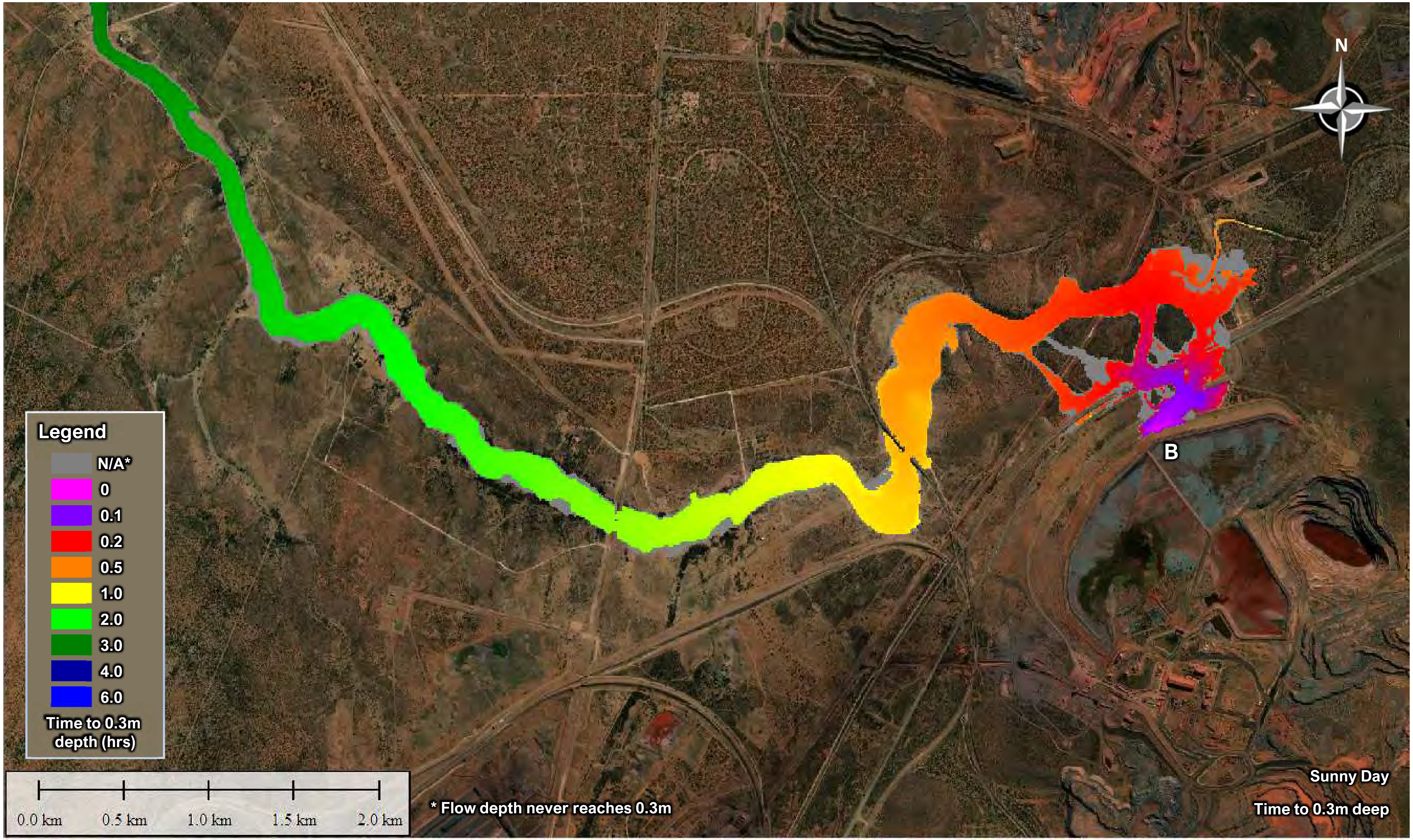
N
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.6m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.6m
E
Rainy Day
Time to 0.6m deep

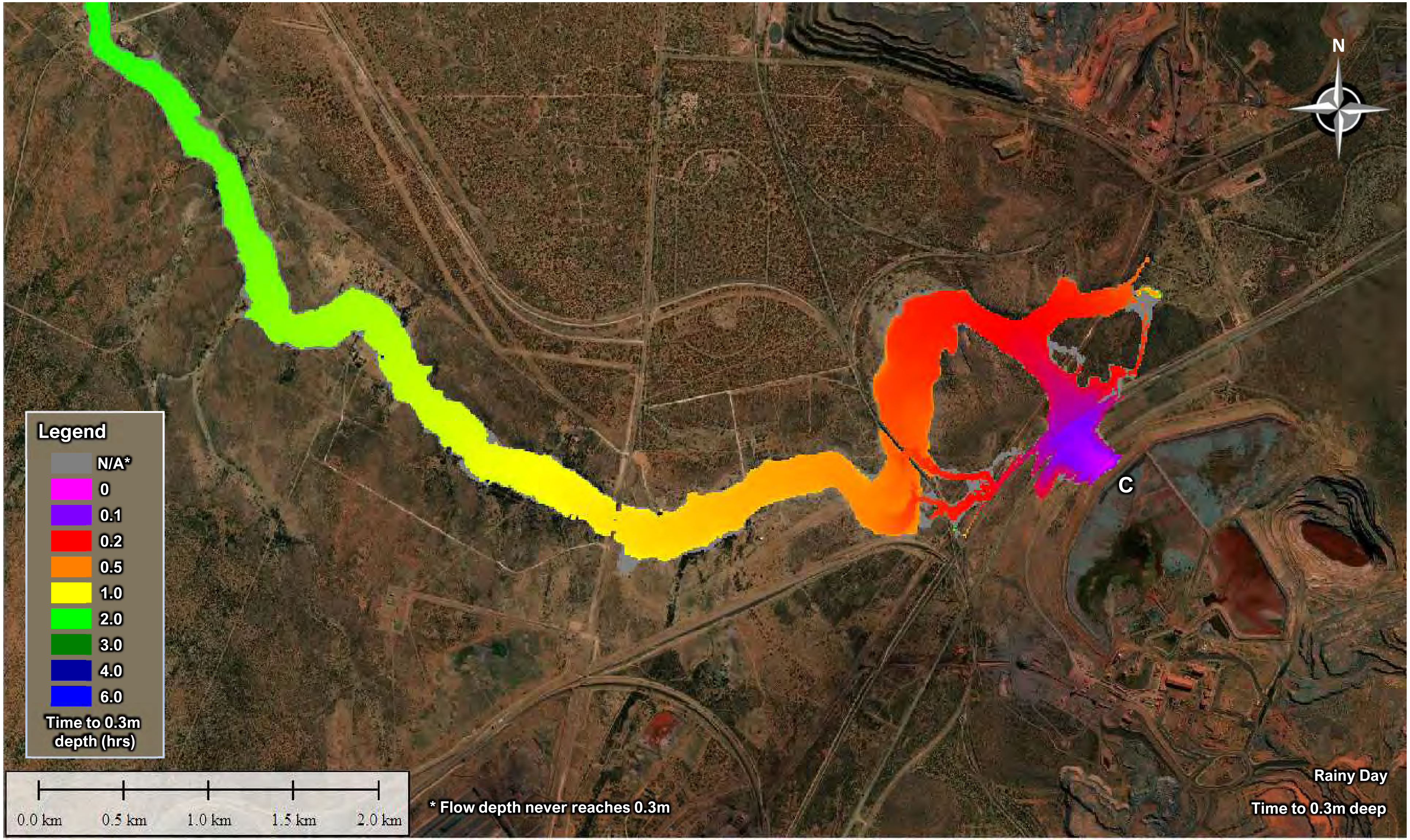

N
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.6m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.6m
E
Sunny Day
Time to 0.6m deep

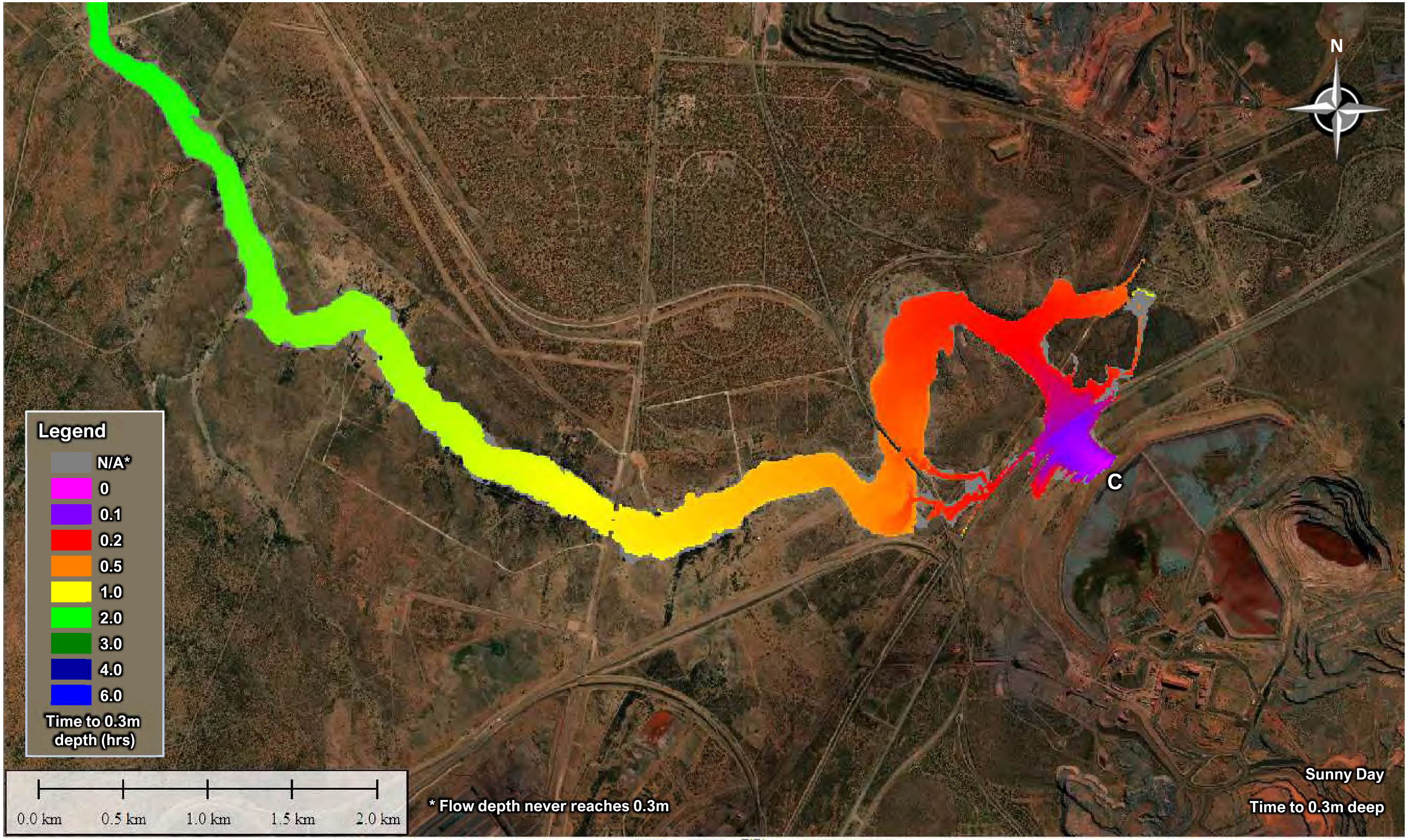

N
A
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.3m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.3m
Rainy Day
Time to 0.3m deep

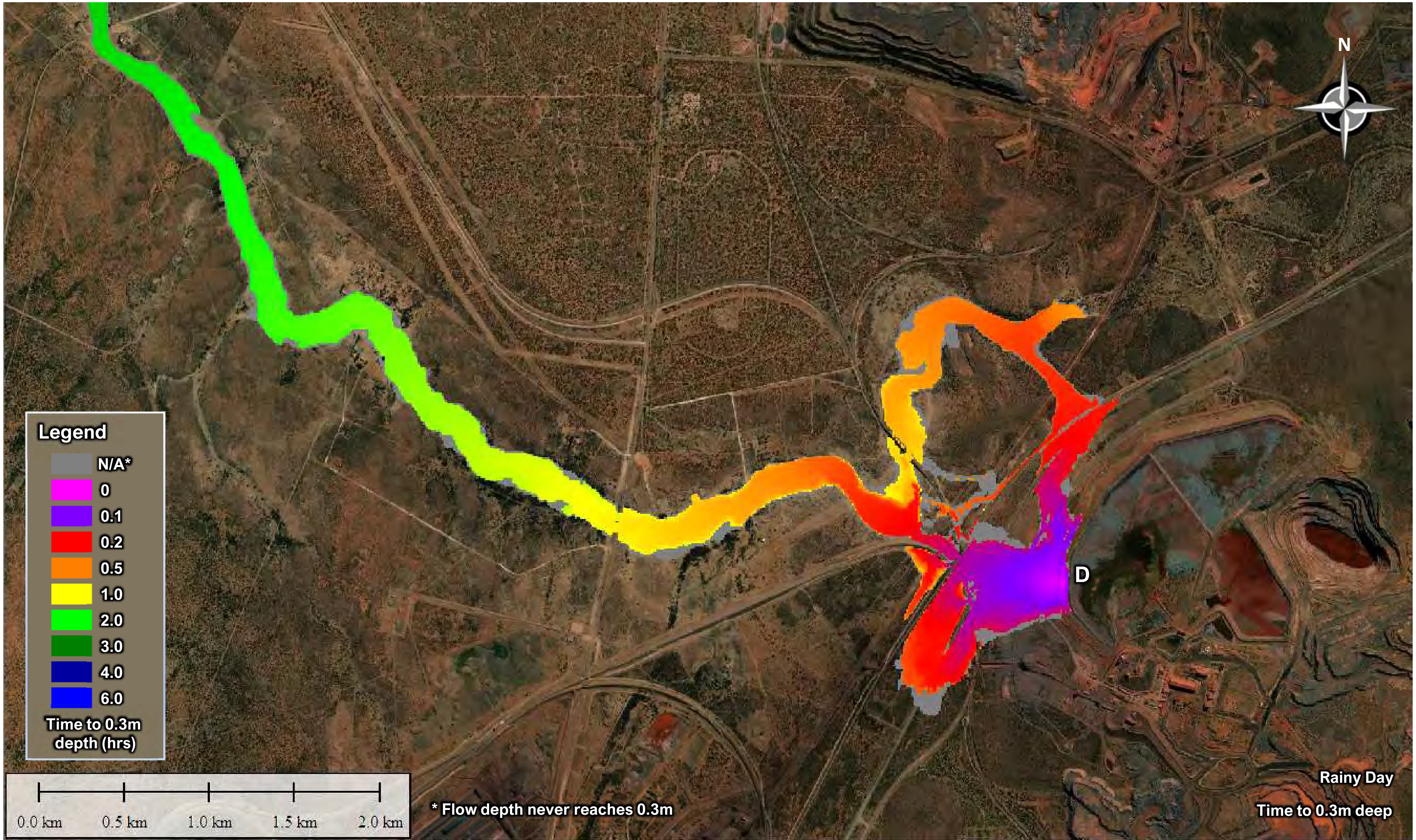

N
A
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.3m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.3m
Sunny Day
Time to 0.3m deep

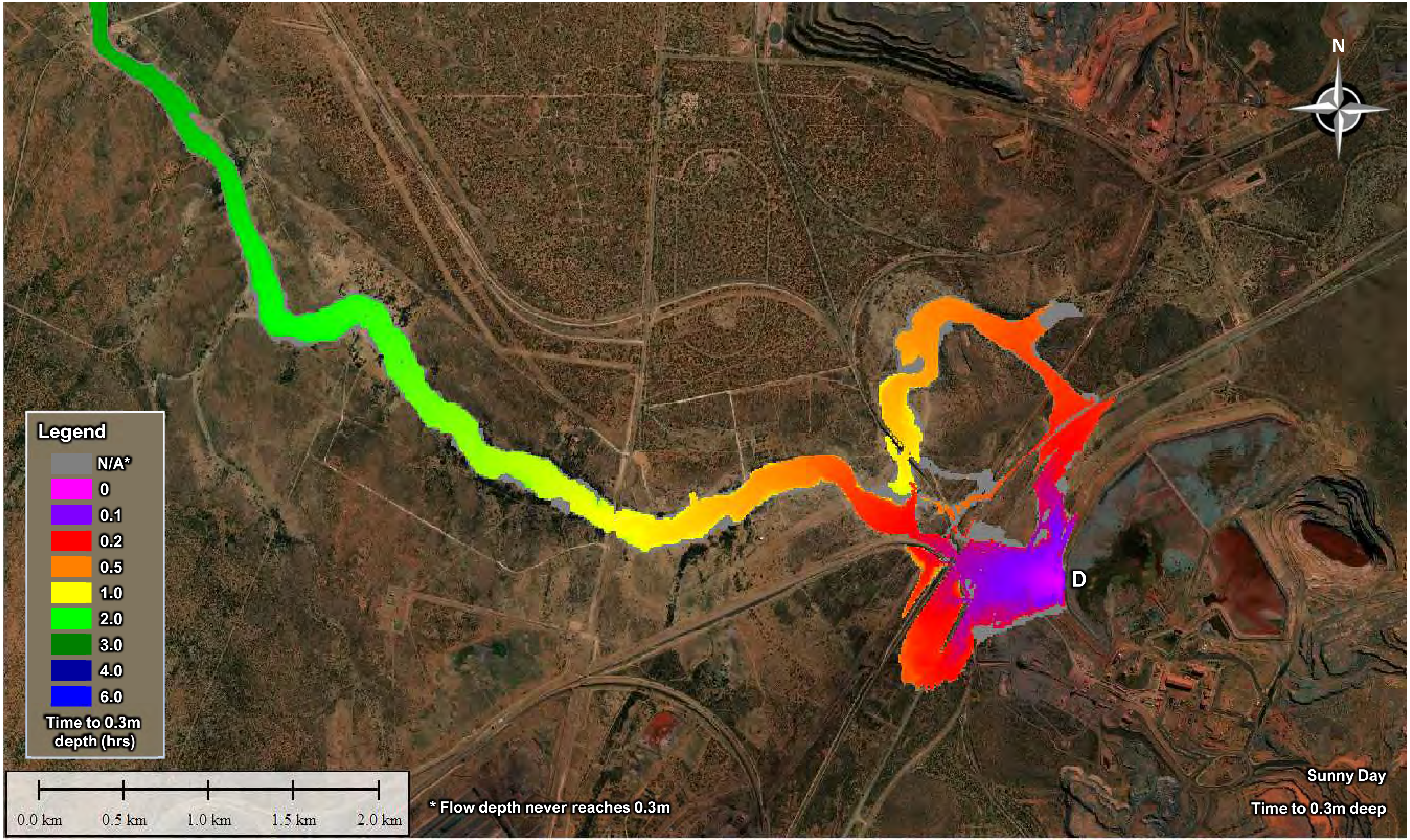

N
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.3m depth (hrs)
B
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.3m
Rainy Day
Time to 0.3m deep

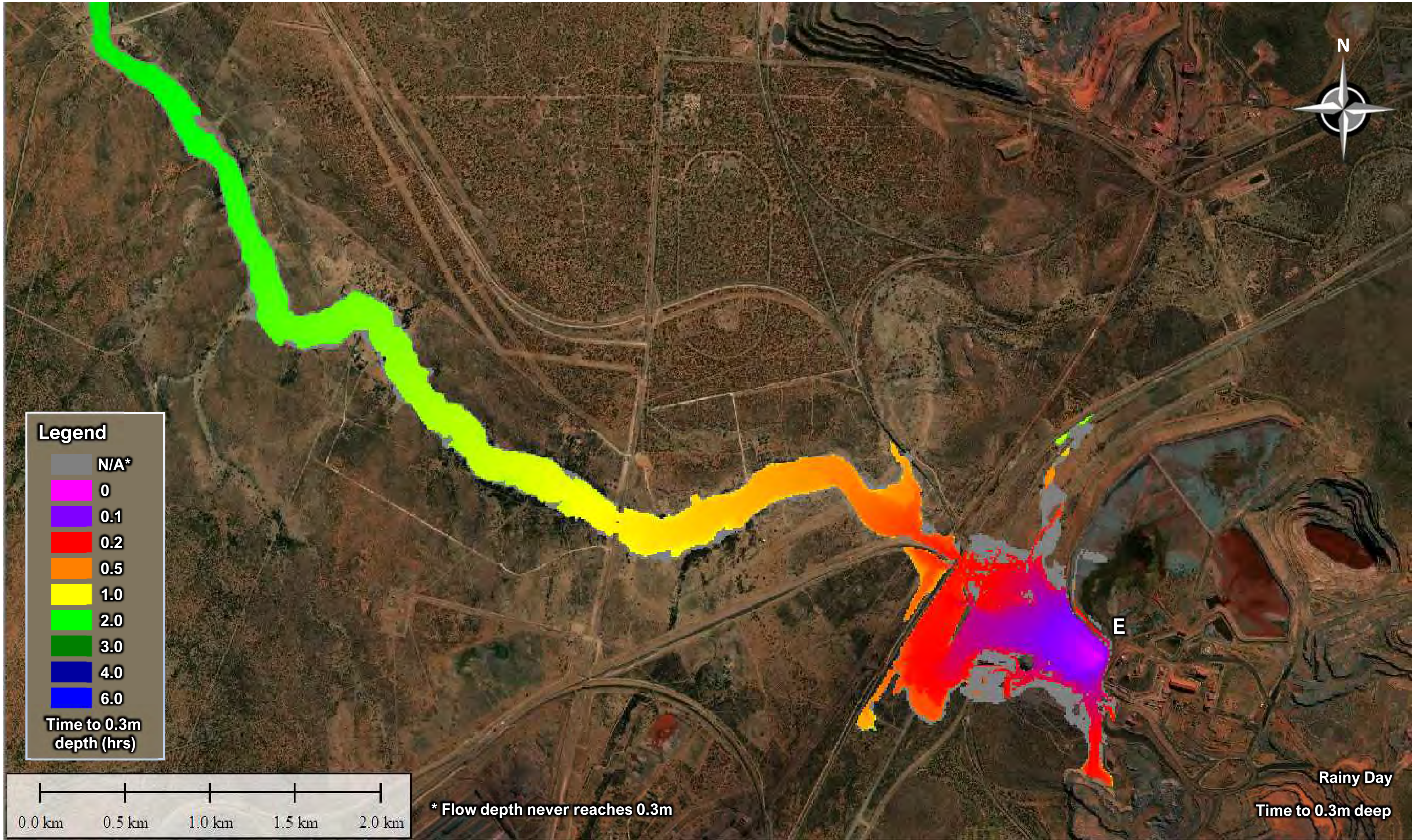

N
B
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.3m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.3m
Sunny Day
Time to 0.3m deep

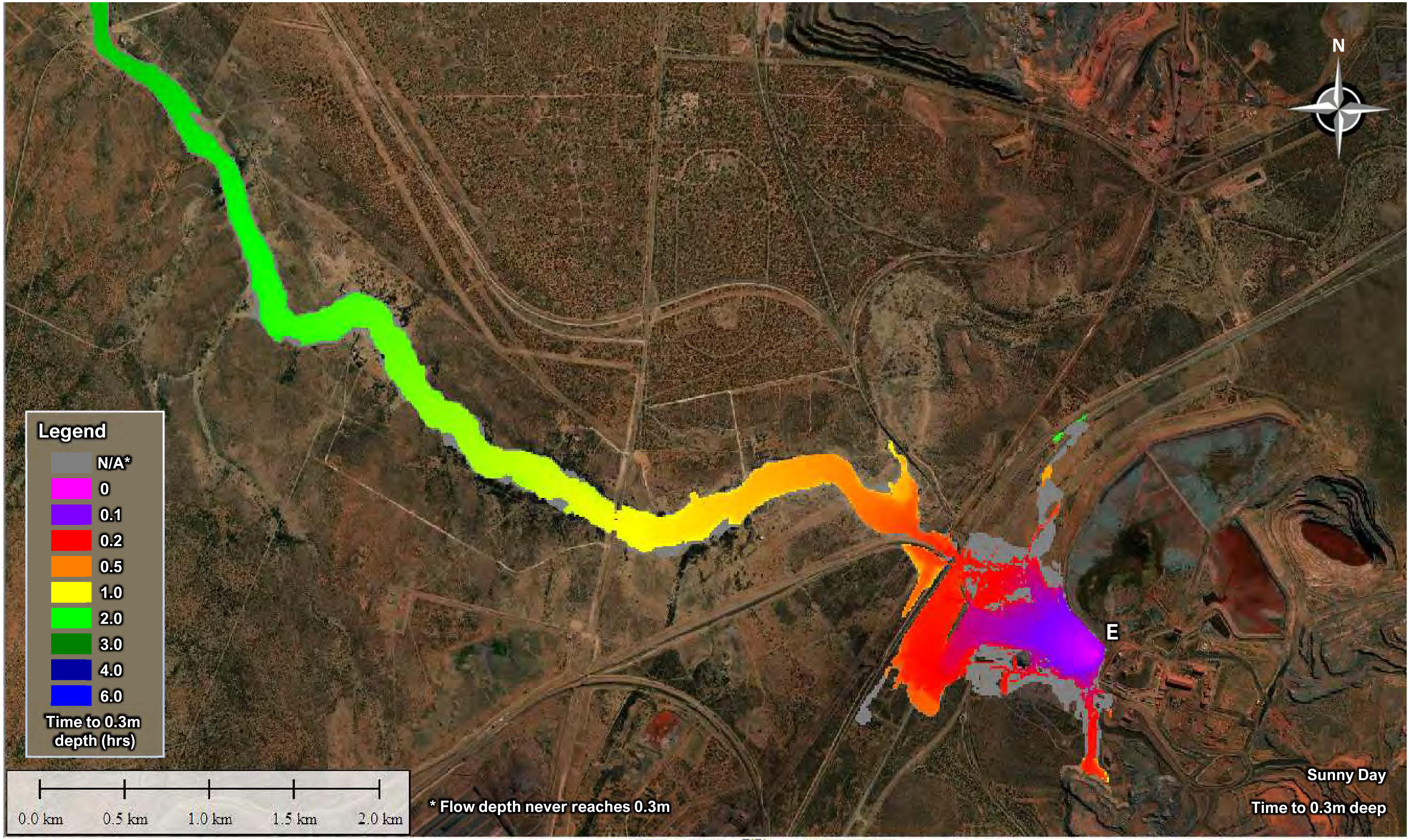

N
C
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.3m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.3m
Rainy Day
Time to 0.3m deep


N
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.3m depth (hrs)
C
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.3m
Sunny Day
Time to 0.3m deep


N
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.3m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
D
* Flow depth never reaches 0.3m
Rainy Day
Time to 0.3m deep


N
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.3m depth (hrs)
D
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.3m
Sunny Day
Time to 0.3m deep


N
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.3m depth (hrs)
E
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.3m
Rainy Day
Time to 0.3m deep


N
E
Legend
N/A*
0
0.1
0.2
0.5
1.0
2.0
3.0
4.0
6.0
Time to 0.3m depth (hrs)
0.0 km
0.5 km
1.0 km
1.5 km
2.0 km
* Flow depth never reaches 0.3m
Sunny Day
Time to 0.3m deep