

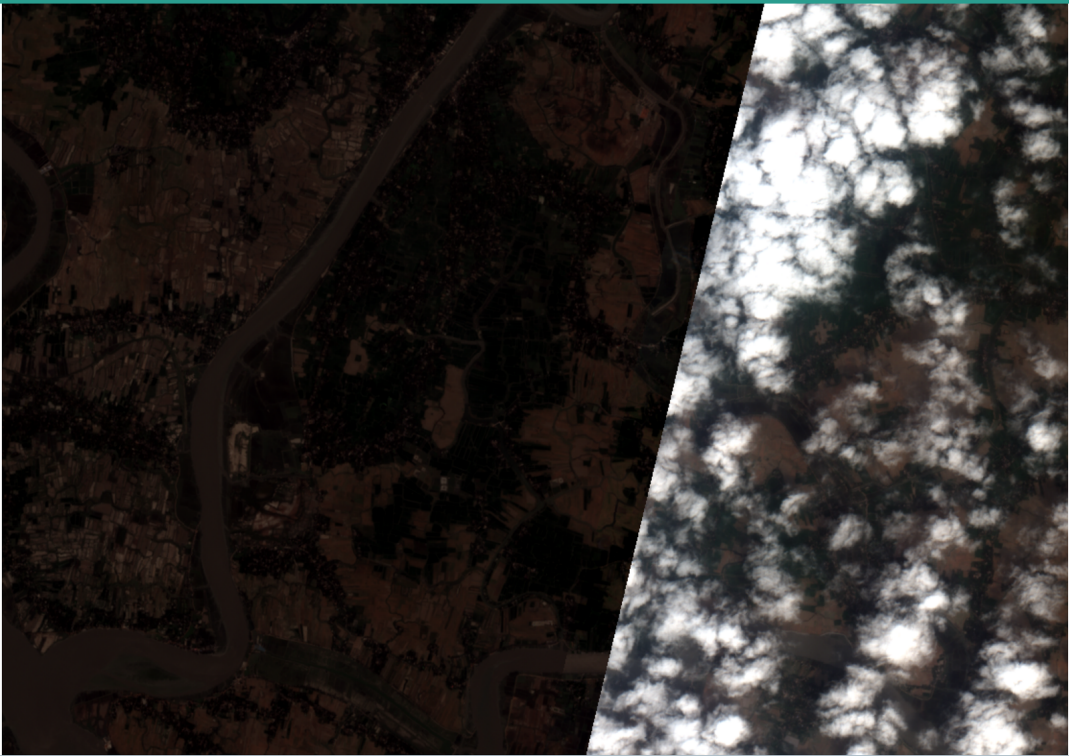
GEOSPATIAL ASSESSMENT | KHU-07 | —

Surkhali Union Coastal Cropland

BADC Surkhali Union — Coastal Cropland Baseline

Batiaghata, Khulna · Centroid 22.6765°N, 89.4645°E

Report ID	ECA-AOI007-20260801-52AAF0
Prepared by	Enhance Communication AgroVision
Acquisition	— · SENTINELHUB · cloud <5%
Generated	2026-08-01
Status	■ QA PASS Preview Tier CONFIDENTIAL



True-colour composite (Sentinel-2 L2A) — Surkhali Union Coastal Cropland, Khulna —

AOI	Cloud	Water	QA Status
KHU-07	<5%	1.9%	PASS

Scene acquired — via **SENTINELHUB**. over **Surkhali Union Coastal Cropland** (Batiaghata, Khulna). with **1.9%** permanent water observed.

1. Report Specifications

AOI / Topic	Surkhali Union Coastal Cropland	Date	—
AOI Code	KHU-07	AOI ID	AOI_007
Division	Khulna	District	Khulna
Upazila	Batiaghata	Union	Surkhali
Union PCode	BD40471283	Polder	BWDB Polder 30 (indicative)
Soil Zone	Saline Tidal Floodplain (AEZ-13)	Ecoregion	Ganges Tidal Floodplain
Area (km2)	89	EPSG	4326
Centroid	22.6765°N, 89.4645°E	AOI Bounds	—
Source File	SurkhaliU.kml	Provider	SENTINELHUB (preview)
Cloud	<5%	Resolution	10.0 m
QA Status	—	Report ID	ECA-AOI007-20260801-52AAF0

1.1 AOI Footprint Summary

Bounding Box (WGS84)	—
Centroid (lat, lon)	22.6765°N, 89.4645°E
CRS / EPSG	EPSG:4326
Source	SurkhaliU.kml

1.2 Executive Summary

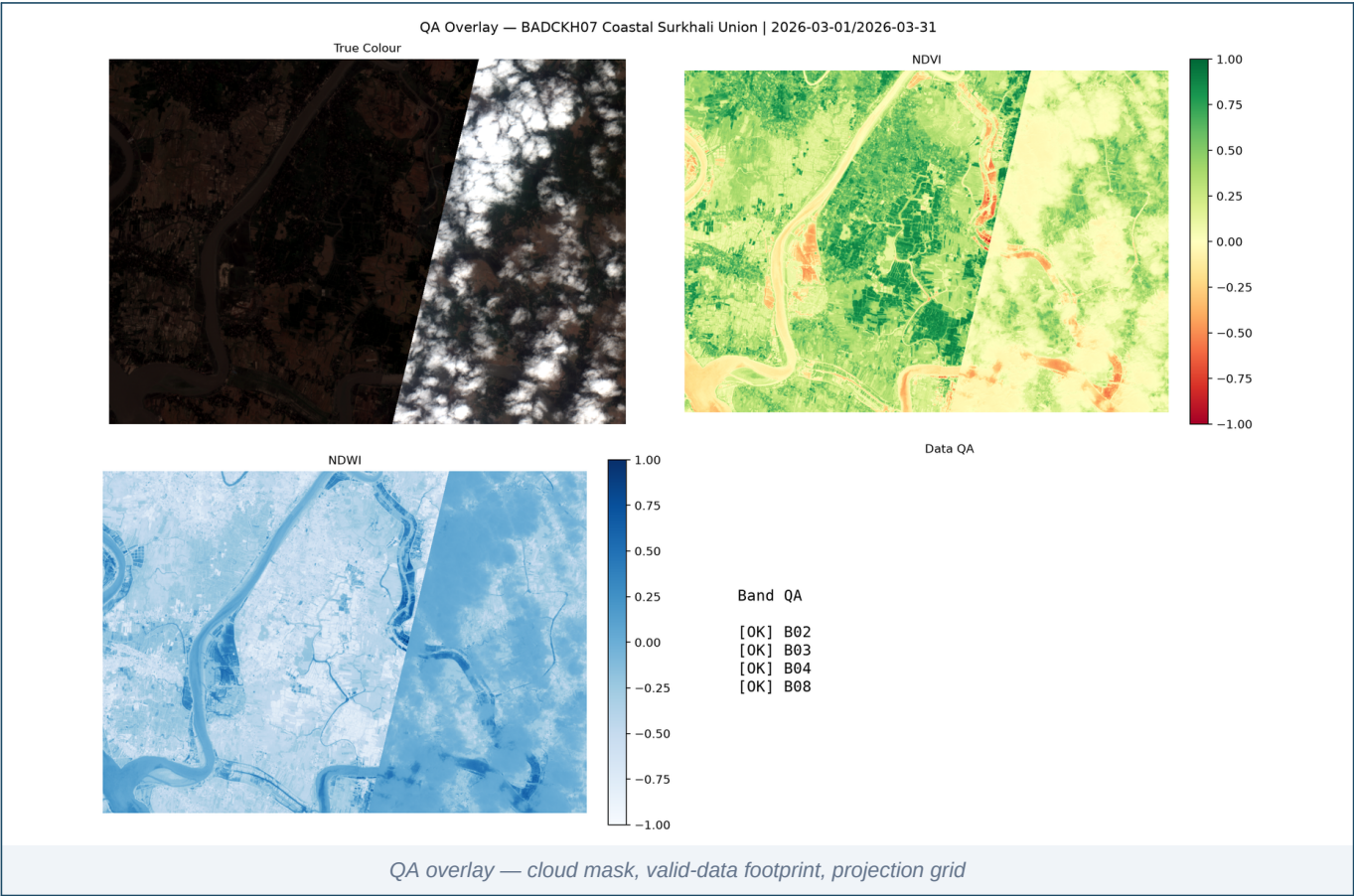
- Scene **Sentinel-2 L2A** acquired — via **SENTINELHUB**, cloud <5%, QA **PASS**.
- Waterlogging analysis: **1.9%** permanent water, **18.4%** flood-risk zone.
- Dominant land cover: **BareSoil** 37.6%, **Agriculture** 28.8%, **Fallow** 20.2%.
- Detailed analytics for water, LULC, change detection, drainage, soil carbon, and crop residue follow on subsequent pages.

2. Compliance Matrix

Verifies scene-level compliance with thresholds — resolution, cloud cover, projection, bit depth, band availability and orthorectification. **PASS** indicates all minimum requirements met.

Tier	Status	Resolution	Cloud	Bands	Projection
PREVIEW	■ PASS	10.0 m	N/A	7	EPSG:4326

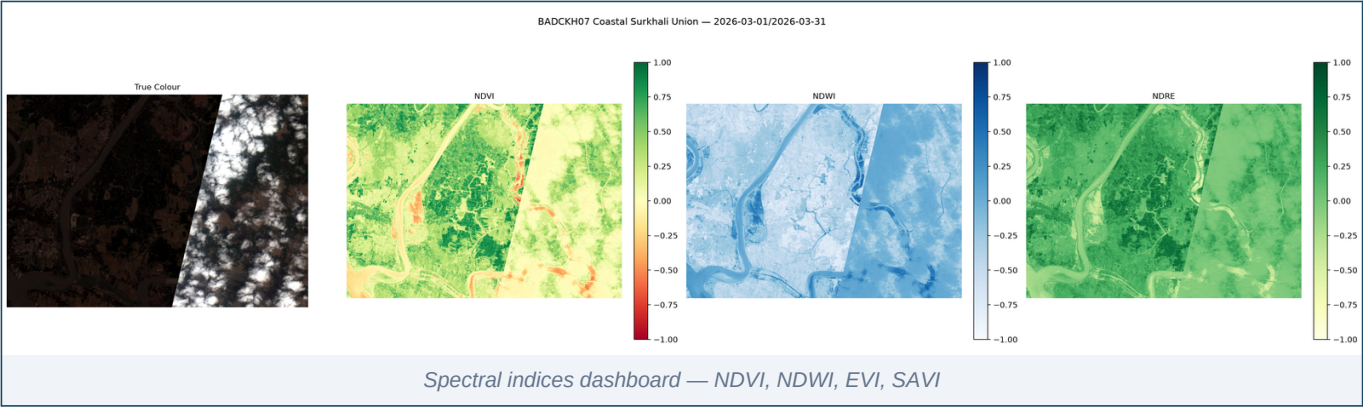
#	Check	Threshold	Actual	Status
1	Cloud Cover	≤ 5 %	<5%	PASS
2	Resolution (hard)	≤ 10 m	10.0 m	PASS
3	Resolution (preferred)	≤ 1.24 m	10.0 m	PASS
4	Bands acquired	8 required	7 acquired	PASS
5	Projection	EPSG:4326 / UTM	EPSG:4326	PASS
6	Bit Depth	16-bit	16-bit	PASS
7	Orthorectified	Required	Yes	PASS
8	QA Overall	PASS	PASS (PREVIEW)	PASS



3. Spectral Indices

Per-pixel ratios of satellite bands that highlight specific land conditions: vegetation health (NDVI / EVI / SAVI / NDRE), surface water (NDWI / MNDWI), and tillage / residue proxies. Each index is summarised over the valid (non-cloud) pixel area.

NDVI	NDWI	EVI	SAVI	NDRE
0.249	-0.243	0.188	0.146	0.141

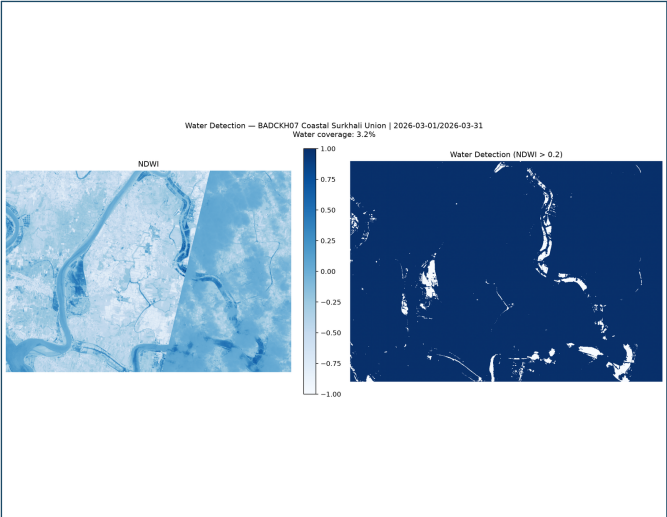


Index	Mean	Std Dev	Min	Max
NDVI	0.2490	0.2650	-0.9658	0.9654
NDWI	-0.2433	0.2544	-0.8936	0.9698
EVI	0.1881	0.2476	-1.0000	1.0000
SAVI	0.1462	0.1472	-0.2460	0.7158
NDRE	0.1406	0.2110	-0.9689	0.7864

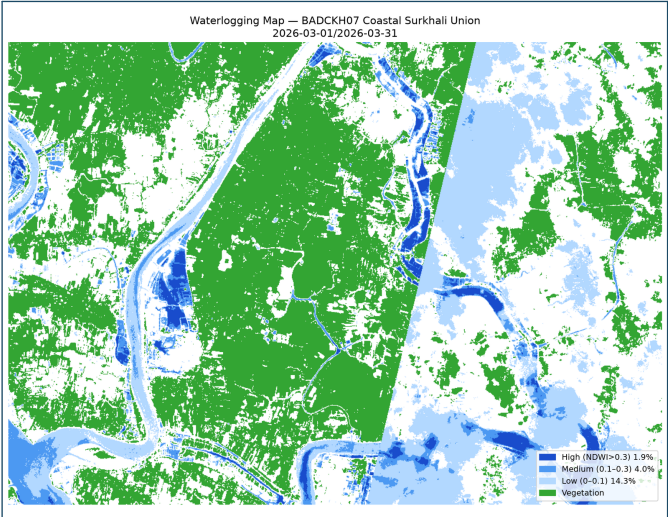
4. Water & Waterlogging Analysis

Detects open water and inundated cropland using NDWI (Green / NIR) and MNDWI (Green / SWIR) spectral indices. **Permanent Water** = pixels consistently water-covered. **Flood Risk** = low-lying areas with elevated water signatures relative to dry-season baseline.

Permanent Water	Flood Risk	Enhanced Water	MNDWI Used
1.91%	18.37%	1.91%	Yes



Water Detection Map

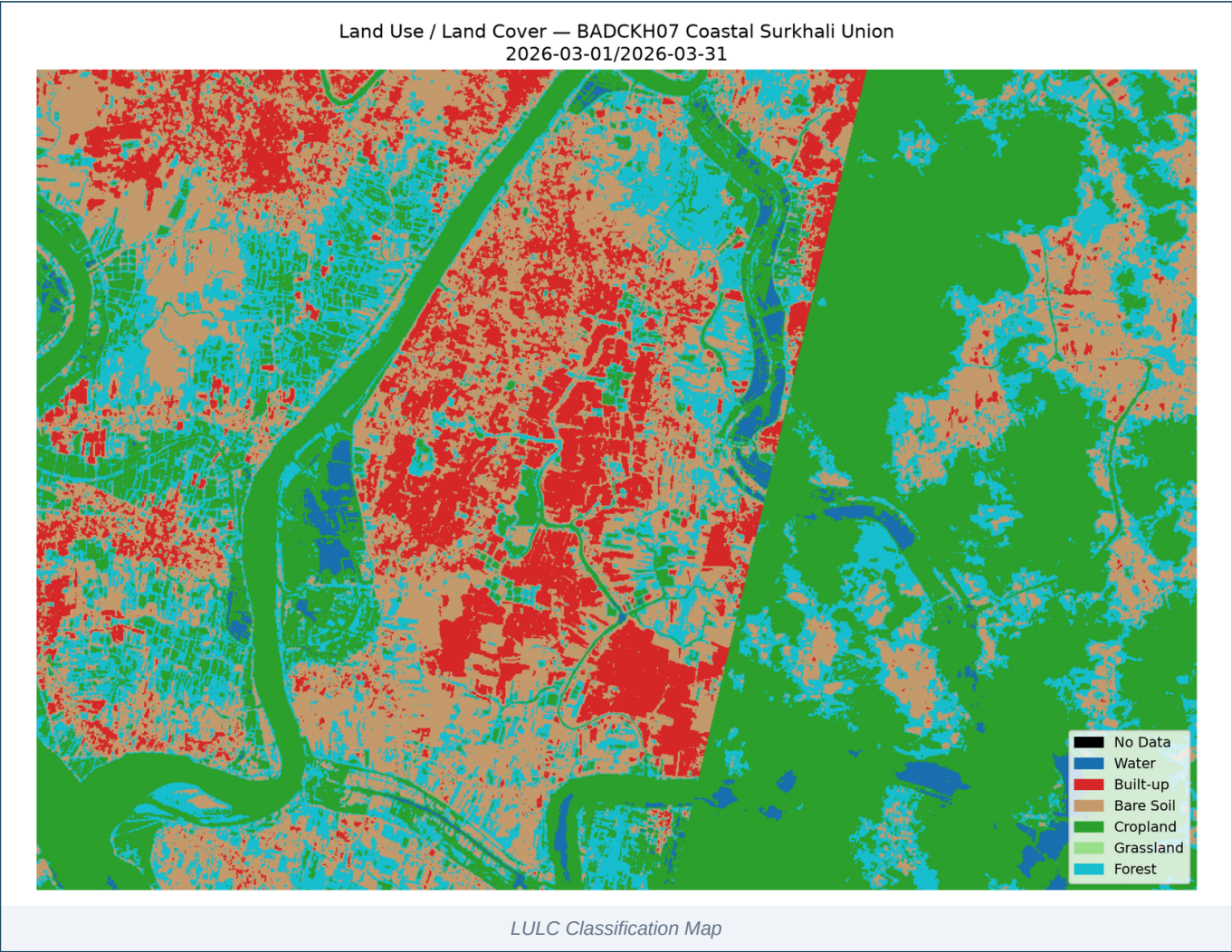


Waterlogging Risk Map

Metric	Value
Permanent Water (NDWI > 0.3)	1.91%
Flood Risk Zone	18.37%
Enhanced Water (MNDWI / fused)	1.91%
MNDWI Index Available	Yes

5. Land Use / Land Cover (LULC)

Pixel-level classification of the AOI into thematic classes (water, vegetation, agriculture, bare soil, fallow). Built from spectral signatures using the available band stack; SWIR-required Built-up class merges into Bare Soil when SWIR is unavailable.

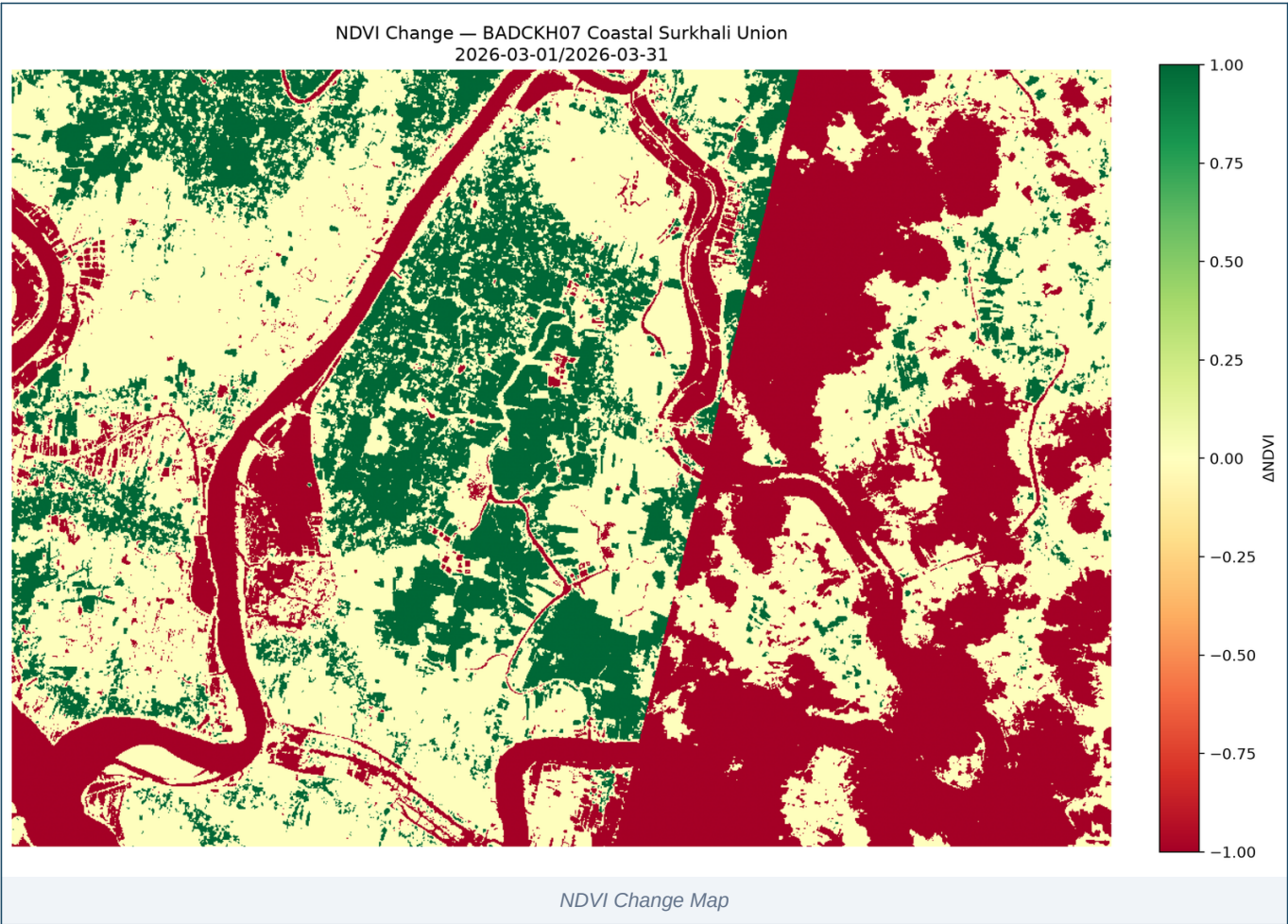


Swatch	Class	Area %	Hex
	Water	1.91%	#1F77B4
	Vegetation	11.46%	#2CA02C
	Agriculture	28.84%	#FFEB3B
	BareSoil	37.56%	#8C564B
	Fallow	20.23%	#9467BD

6. Change Detection

Compares NDVI between two acquisition dates to quantify vegetation gain, loss and stability. Synthetic-baseline mode flags single-date runs where no real prior-date scene was supplied — results in that case are indicative only.

Mode	Gain	Loss	Stable	Mean Δ
Synthetic (single date)	18.36%	32.19%	49.45%	-0.0510



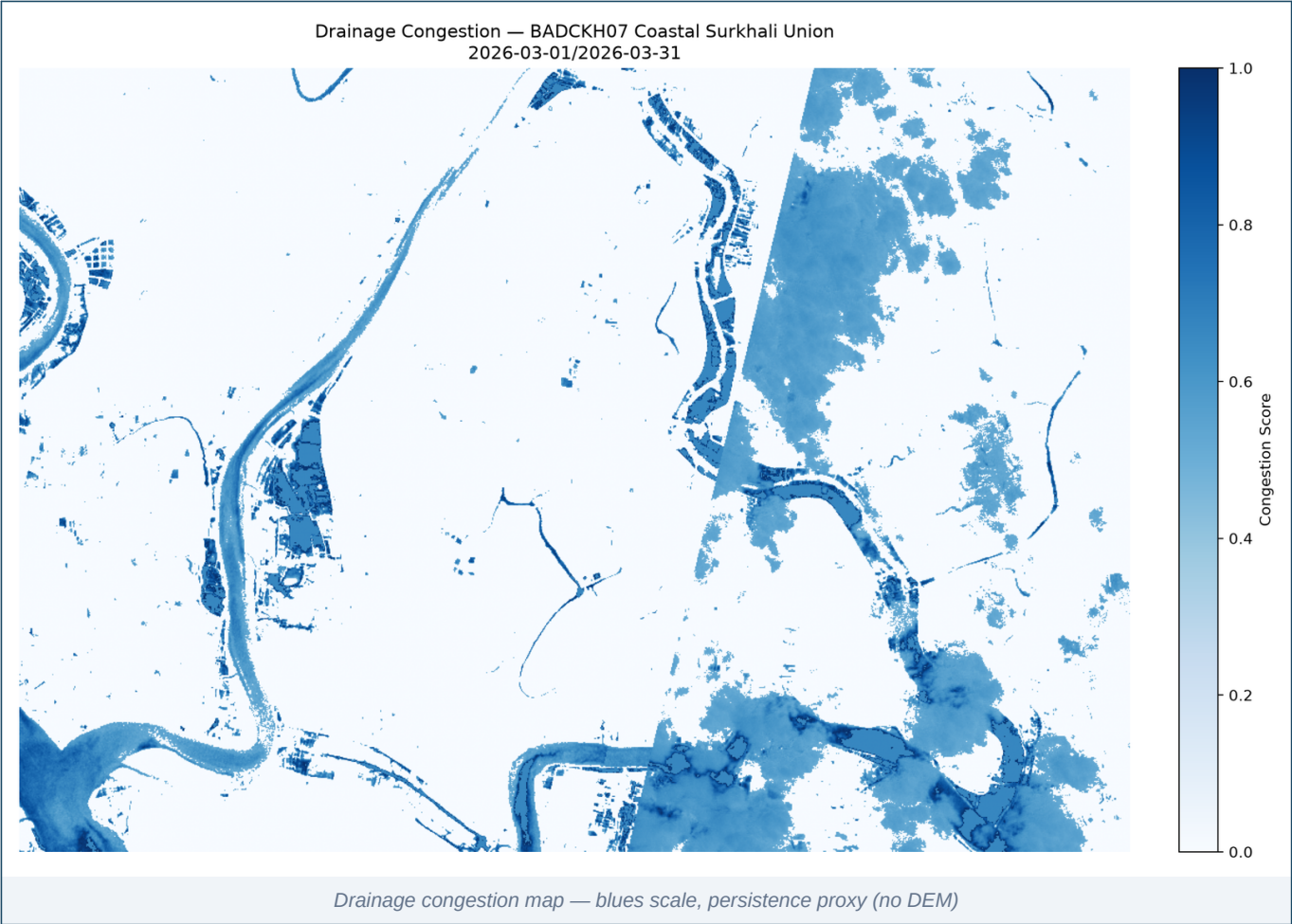
Mode	Gain %	Loss %	Stable %	Mean Δ	Gain Thresh	Loss Thresh	Synthetic Baseline
Synthetic (single date)	18.36%	32.19%	49.45%	-0.0510	0.200	0.200	0.3

■ Synthetic baseline used — no dual-date imagery provided; results are indicative only.

7. Drainage Analysis

Identifies areas of persistent surface-water accumulation that indicate poor drainage. Congestion score combines NDWI persistence with terrain proxies; full Topographic Wetness Index requires a DEM.

Congestion %	Persistence	Threshold	TWI Used
20.27%	0.126	—	No



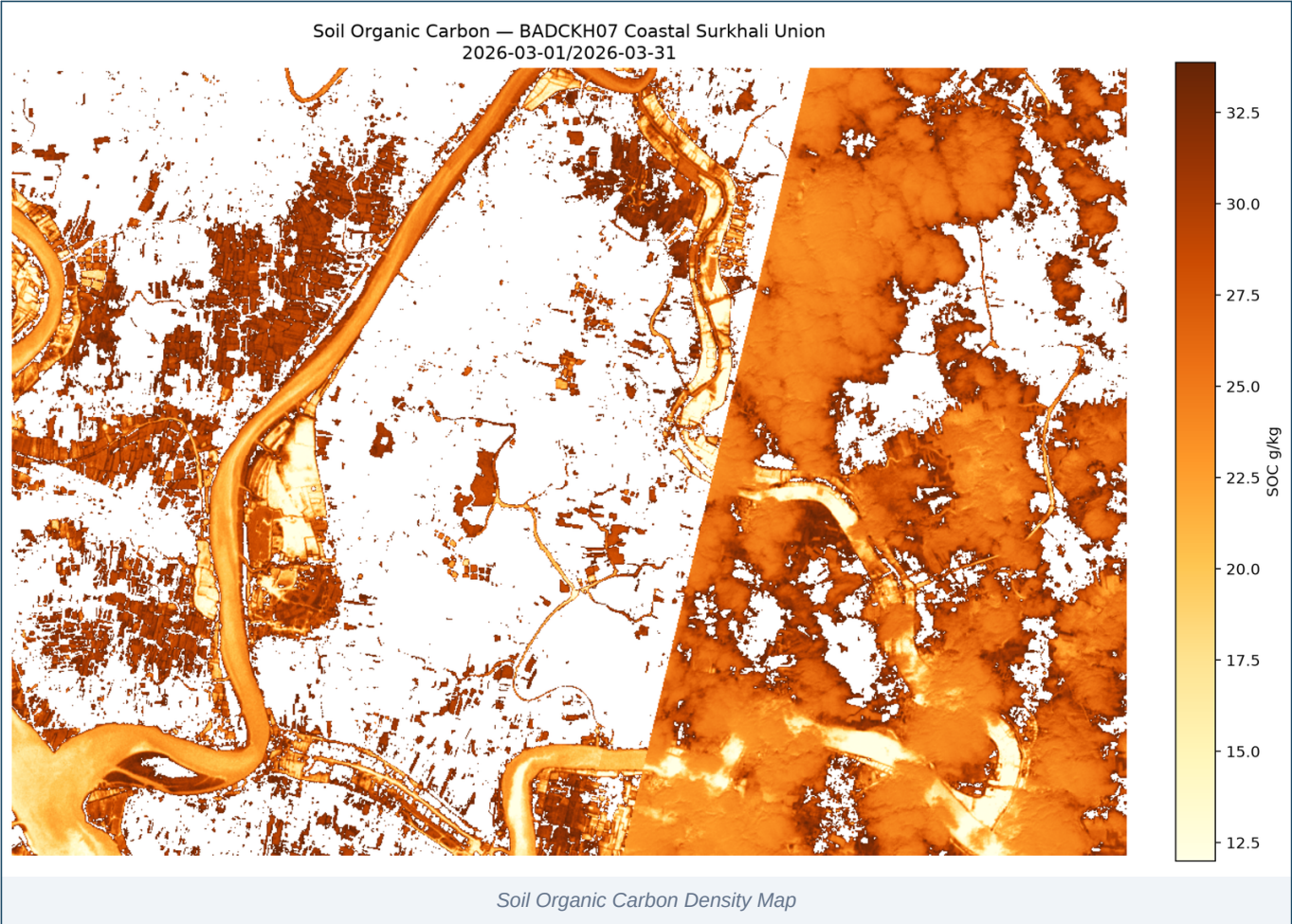
Zone	Class	Congestion %	Persistence	Pixels
LULC	Water	100.00%	0.667	16650
LULC	Vegetation	0.00%	0.000	99987
LULC	Agriculture	0.00%	0.000	251547
LULC	BareSoil	48.89%	0.302	327555
LULC	Fallow	1.00%	0.000	176396

■ No DEM supplied — TWI deferred; congestion score uses persistence-only weighting.

8. Soil Organic Carbon

Estimates Soil Organic Carbon content (g/kg) over bare-soil pixels via regional spectral calibration. Mode **regional** uses a fixed national / regional model; **field** mode would use ground-truth samples (not provided in this run).

SOC Mean	SOC Std	Uncertainty	Bare-soil	Mode
26.66 g/kg	5.12 g/kg	—	463139	regional

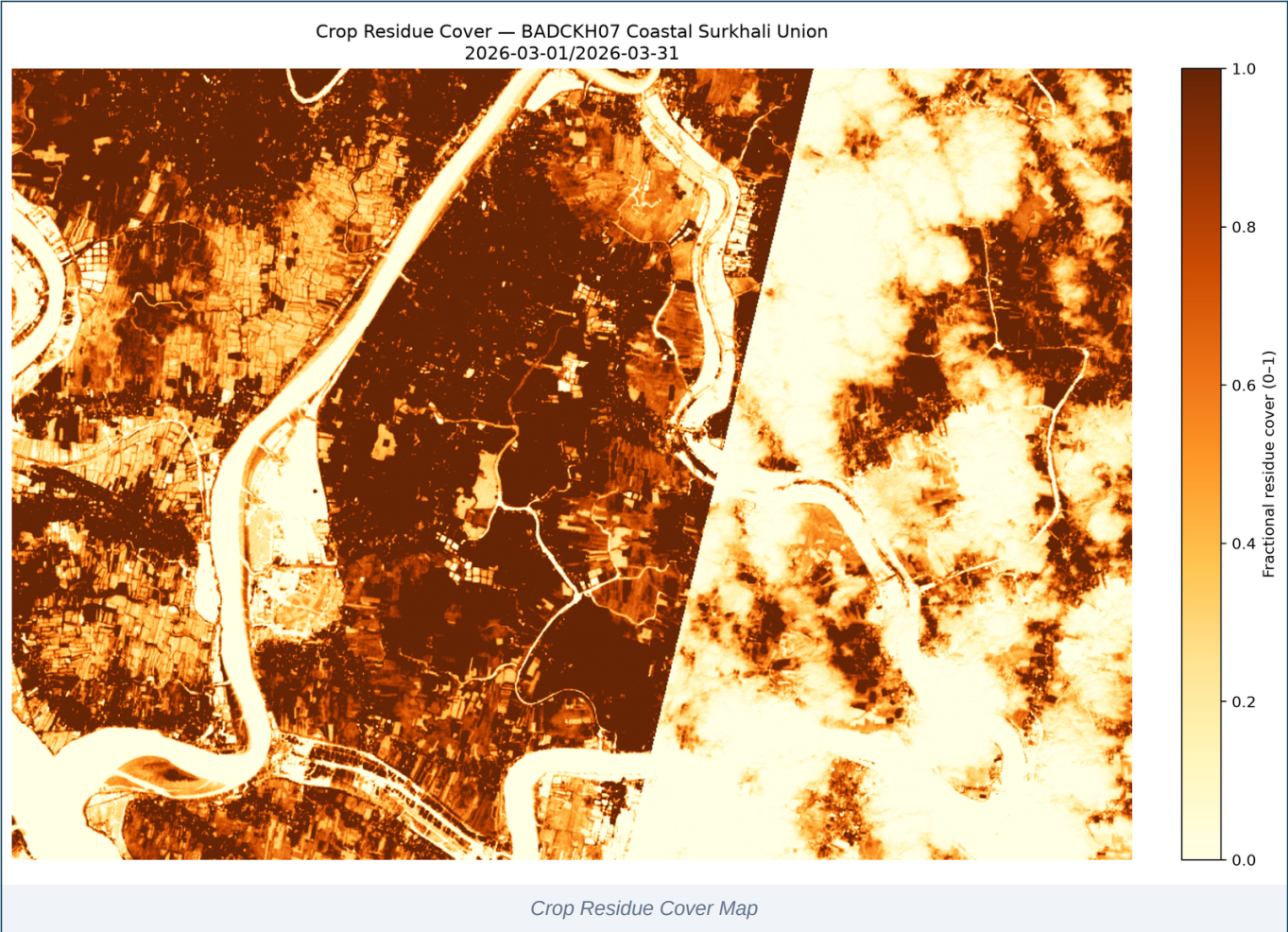


Zone	Class	SOC Mean (g/kg)	SOC Std (g/kg)	Calib Mode	R ²
ALL_BARE	bare_soil	26.660	5.123	regional	—
LULC	Water	10.926	3.641	regional	—
LULC	BareSoil	25.433	3.258	regional	—
LULC	Fallow	32.242	1.083	regional	—

9. Crop Residue

Estimates fractional residue cover over agricultural pixels. NIR/Red ratio is used as a proxy when SWIR bands are unavailable; high-accuracy NDTI / STI requires SWIR (Sentinel-2 B11 / B12 or Landsat-9).

Index Used	Mean Cover	High Cover >30%	Valid Pixels
NIR_Red_ratio	53.85%	65.07%	872,135



Zone	Class	Mean Residue Cover	High Cover %	Valid Pixels	Index Used
ALL	all_valid	0.5385	65.07%	872,135	NIR_Red_ratio
LULC	Water	0.0000	0.00%	16,650	NIR_Red_ratio
LULC	Vegetation	1.0000	100.00%	99,987	NIR_Red_ratio
LULC	Agriculture	0.9420	100.00%	251,547	NIR_Red_ratio
LULC	BareSoil	0.1044	12.07%	327,555	NIR_Red_ratio
LULC	Fallow	0.5585	100.00%	176,396	NIR_Red_ratio

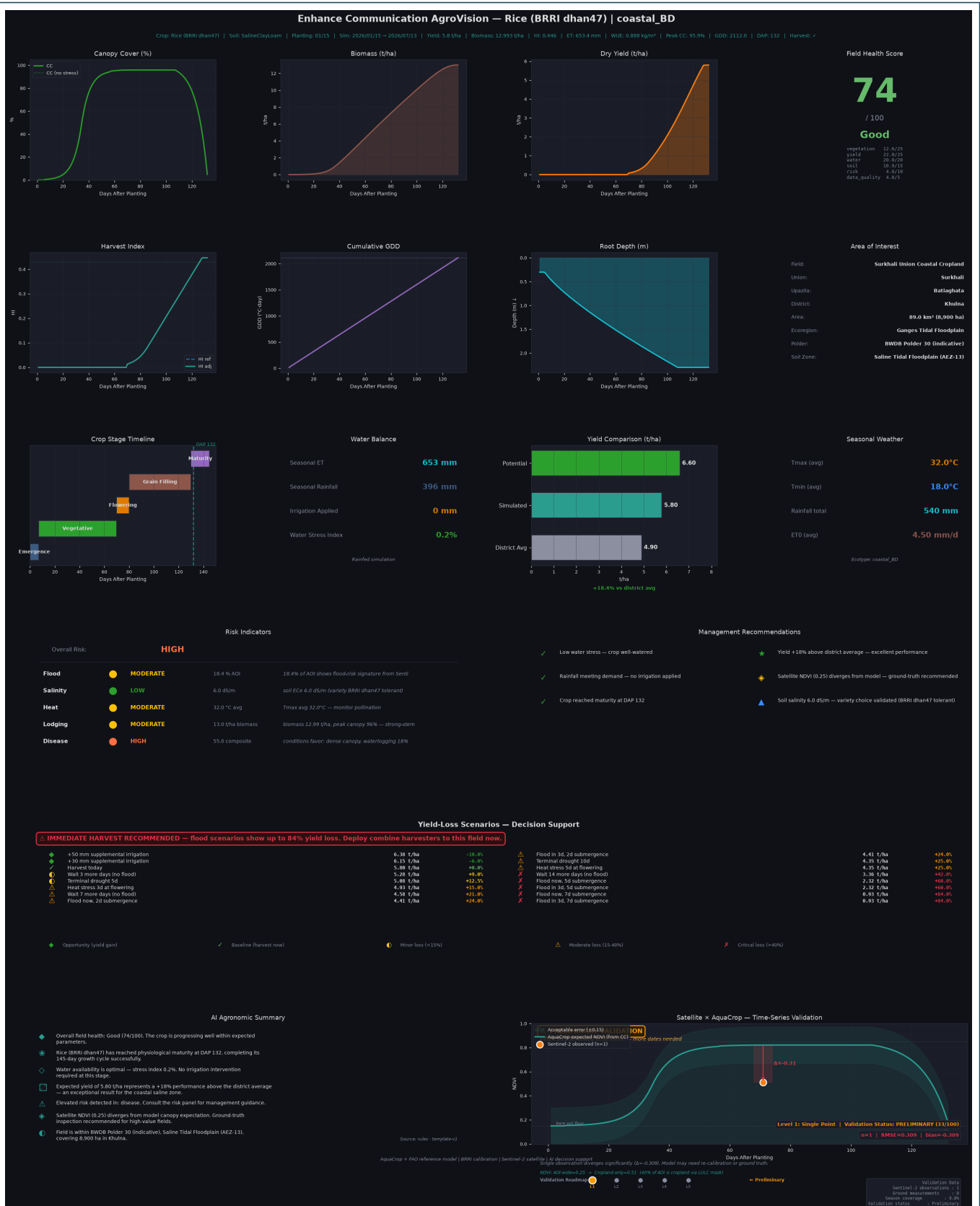
■ Residue estimated via NIR/Red ratio — SWIR bands unavailable; interpret with caution.

10. AquaCrop Digital Twin — Yield Simulation & Decision Support

AquaCrop process-based simulation for **Rice** (variety **BRRI dhan47**) on **SalineClayLoam**, ecotype **coastal_BD**. Calibration: **equivalence**. Results below combine model output with multi-source confidence, field-health scoring and a yield-loss scenario matrix.

Metric	Value
Season ET	653 mm
Water Use Efficiency	0.888 kg/m³
Harvest Reached	Yes
— PERFORMANCE —	
District Average	4.90 t/ha
Simulated Yield	5.80 t/ha
Performance	+18.4% vs district
Potential Yield	6.60 t/ha
— FIELD HEALTH —	
Health Score	74/100
Profile	government
Model Confidence	95/100 (A+)
Validation Status	—
— DECISION SUPPORT —	
Scenarios Computed	—
Priority	—
Best Case	{'name': '+50 mm supplemental irrigation', 'yield_t_ha': 6.38, 'loss_pct': -10.0, 'priority': 'opportunity', 'note': '7d submergence'}
Worst Case	{'name': 'Flood now, 7d submergence', 'yield_t_ha': 0.928, 'loss_pct': 84.0, 'priority': 'critical', 'note': '7d submergence'}
Recommendation	■ IMMEDIATE HARVEST RECOMMENDED — flood scenarios show up to 84% yield loss. Deploy cover crops for soil health.

AquaCrop Digital Twin Dashboard



16-panel AquaCrop simulation dashboard — crop growth, water balance, yield trajectory, health composite and scenario matrix.

11. Key Findings

Auto-generated narrative summarising the most significant metrics, exceedances and data caveats from the preceding analytics. The full machine-readable trace is preserved in `geodata_run_result.json`.

GeoData Findings — BADCKH07 Coastal Surkhali Union

Generated by Unit-GeoData

1. Acquisition Summary

- **Status:** success ■
- **Provider:** sentinelhub
- **Satellite:** —
- **Scene ID:** —
- **Acquisition window:** —
- **Cloud cover:** —
- **Resolution:** 10.0 m
- **Bit depth (delivered):** —bit
- **Projection:** — / —
- **Bands acquired:** 7/7 ['B01', 'B02', 'B03', 'B04', 'B05', 'B08', 'B8A']

2. Quality Assurance

Check	Result
bands_ok	■
bit_depth_ok	■
cloud_ok	■
files_ok	■
ortho_ok	■
projection_ok	■
resolution_ok	■
resolution_preferred_ok	■
PASS	■

Violations (2):

- ■ X resolution 10.0 m > hard limit 1.24 m (§4.1)
- ■ X missing bands: ['Coastal', 'Blue', 'Green', 'Yellow', 'Red', 'RedEdge', 'NIR1', 'NIR2']

Warnings (1):

- ■■ cloud_cover_pct not reported by provider

4. Spectral Indices (Stage 3)

- **Status:** success ■
- **Provider:** sentinelhub
- **Computed:** 5 indices
- **Skipped:** 4 (provider missing required bands)

4a. Generic Indices

Index	Min	Max	Mean	Range	Note
NDVI	-0.966	0.965	0.249	■	Vegetation health
NDWI	-0.894	0.970	-0.243	■	Surface water / vegetation moisture
EVI	-1.000	1.000	0.188	■	Enhanced vegetation index (atmosphere-corrected)
SAVI	-0.246	0.716	0.146	■	Soil-adjusted vegetation (sparse cover)

4b. WV-3-specific Indices (Yellow / RedEdge / NIR2)

Index	Min	Max	Mean	Range	Tender	Note
NDRE	-0.969	0.786	0.141	■	—	Red Edge — chlorophyll stress (WV-3) §5.1

5. Compliance Matrix

Requirement	Spec	Actual	Status	Ref
Resolution	≤ 0.5 m	10.0 m	■	§4.1

Requirement	Spec	Actual	Status	Ref
Cloud cover	≤ 5.0%	—	■ ■	§4.2
Projection	UTM / WGS84	—	■	§4.3
Bit depth (final)	16-bit	None-bit	■	§4.4
Bands present	0 ()	7	■	§4.5
Orthorectified	required	yes	■	§4.3
Overall	passed_qa	FAIL	■	—

6. §5 Deliverables — Gap Analysis

Section	Deliverable	Tool	Status	Tender Ref	Next Steps
§5.1	Soil Organic Carbon	soil_carbon	■ disabled in profile	§5.1	Enable in geod ata_tools to surface gap
§5.1	Crop Residue Cover	crop_residue	■ disabled in profile	§5.1	Enable in geod ata_tools to surface gap
§5.2	Drainage Congestion	drainage	■ disabled in profile	§5.2	Enable in geod ata_tools to surface gap

7. Generated Visualizations

PNG outputs (22):

- png/.pdf_change_map.png
- png/.pdf_dashboard.png
- png/.pdf_drainage_map.png
- png/.pdf_false_color.png
- png/.pdf_lulc_map.png
- png/.pdf_qa_overlay.png
- png/.pdf_residue_map.png
- png/.pdf_soc_map.png
- png/.pdf_true_color.png
- png/.pdf_water_detection.png
- png/.pdf_waterlogging_map.png
- png/change_map.png
- png/dashboard.png

- png/drainage_map.png
 - png/false_color.png
 - png/lulc_map.png
 - png/qa_overlay.png
 - png/residue_map.png
 - png/soc_map.png
 - png/true_color.png
 - png/water_detection.png
 - png/water_logging_map.png
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Report generated by CF2 Unit-GeoData · 2026-08-01T03:48:33 Full machine-readable trace:
geodata_run_result.json (49,630 bytes)

12. Glossary of Terms

Reference definitions for every acronym and technical term used across this report. Terms appear in the order they are first encountered above; entries are alphabetical within this glossary.

Term	Definition
AAFC	Agriculture and Agri-Food Canada. Federal department funding agricultural innovation, research, and climate-adaptation programs.
Black Chernozem	Prairie soil class with deep, dark, humus-rich topsoil. High native fertility. Typical SOC range 28-40 g/kg. Dominant in the Aspen Parkland ecoregion (SK, AB, MB).
BMP	Beneficial Management Practice. AAFC term for evidence-based on-farm practices reducing GHG emissions or improving soil health.
Brown Chernozem	Semi-arid prairie soil class with thinner organic layer than Black Chernozem. Typical SOC 15-25 g/kg. Dominant in the Palliser Triangle (drought-prone southern SK and AB).
OFCAF	On-Farm Climate Action Fund. AAFC program (CAD \$704M, 2021-2028) supporting cover crops, nutrient management, and rotational grazing.
Palliser Triangle	Semi-arid Prairie region of southern AB/SK (250-400mm precip). Historically drought-prone; priority area for AgriRecovery.
Prairie Pothole	Glacially-formed wetland depressions in the Canadian Prairies. Critical waterfowl habitat. Mapped under ECCC Nature Smart Climate Solutions Fund.
SCAP	Sustainable Canadian Agricultural Partnership. CAD \$3.5B federal-provincial framework (2023-2028) funding agricultural innovation and climate resilience.
Summer Fallow	Traditional Prairie dryland practice — leaving cropland unplanted for one season to conserve soil moisture. Detected in remote sensing as bare-soil signal. Common in Brown Chernozem zone.
4 per 1000	International soil carbon initiative aiming to increase global soil carbon stocks by 0.4% annually as a climate-mitigation lever. Endorsed by AAFC and integrated into SCAP.
AOI	Area of Interest. The geographic region delimited by the bounding box for which all analytics in this report are computed.
Bit depth	Number of bits per pixel per band in the source imagery. Higher bit depth (e.g. 16-bit) preserves finer reflectance gradations.
Cloud cover %	Estimated fraction of the AOI obscured by cloud at acquisition time, as reported by the provider or computed from the scene quality mask.
Congestion score	Drainage-section metric combining NDWI persistence with terrain proxies. Higher values indicate areas prone to standing water.
EPSG	EPSG Geodetic Parameter Dataset code identifying the coordinate reference system. EPSG:4326 = WGS-84 geographic (lat / lon).
EVI	Enhanced Vegetation Index. Atmosphere-corrected variant of NDVI; less prone to saturation in dense canopy. Range -1 to +1.
Flood Risk	Pixels with elevated water signatures relative to dry-baseline; indicates seasonal inundation or low-lying areas vulnerable to flooding.

Term	Definition
L2A	Sentinel-2 Level-2A product — bottom-of-atmosphere surface reflectance, atmospherically and topographically corrected.
LULC	Land Use / Land Cover. Pixel-level classification into thematic classes (water, vegetation, agriculture, bare soil, fallow, etc.).
MNDWI	Modified NDWI. Uses SWIR instead of NIR; better separation of water from built-up surfaces. Requires SWIR band (B11 / B12).
NDRE	Normalized Difference Red-Edge. Uses the Red-Edge band (B05); sensitive to canopy chlorophyll content — useful for crop-stress detection.
NDTI	Normalized Difference Tillage Index. Detects crop residue using SWIR1 / SWIR2 bands. High accuracy; SWIR-required.
NDVI	Normalized Difference Vegetation Index. Ratio of NIR and Red bands; sensitive to live green vegetation. Range -1 to +1.
NDWI	Normalized Difference Water Index. Detects open water using Green and NIR bands. Range -1 to +1 (positive = water).
NIR / Red ratio	Near-Infrared / Red reflectance ratio. Fallback proxy for crop residue when SWIR bands are unavailable. Indicative accuracy only.
Permanent Water	Pixels consistently water-covered across the analysis window — distinct from seasonal flood-risk zones.
Preview Tier	Lower-resolution / lower-cost imagery tier used for preliminary scoping. Field-level decisions typically require Tasked tier.
QA	Quality Assurance. Per-scene compliance checks (cloud cover, bit depth, band availability, projection, orthorectification).
Resolution	Ground sample distance (pixel size) of the source imagery. Sentinel-2 native: 10 m (visible/NIR), 20 m (SWIR/RE), 60 m (atmospheric).
SAVI	Soil-Adjusted Vegetation Index. NDVI variant correcting for soil-brightness; useful when vegetation cover is sparse (<40%).
Sentinel-2	ESA optical Earth-observation mission providing 13-band multispectral imagery at 10-60 m resolution with 5-day global revisit.
SOC	Soil Organic Carbon (g/kg). Carbon stored in soil organic matter; indicator of soil health, fertility and water-retention capacity.
STI	Soil Tillage Index. SWIR-based residue cover proxy; complements NDTI for tillage / residue mapping.
Synthetic baseline	Change-detection mode used when only a single date of imagery is available — a baseline is statistically synthesised. Indicative only.
TWI	Topographic Wetness Index. DEM-derived index identifying low-lying areas with high water-accumulation potential. Required for high-accuracy drainage congestion mapping.

13. Recommendations & Next Steps

Auto-derived action items addressing each gap or exceedance found in earlier sections: procurement upgrades, supplementary data acquisition (DEM / SWIR), and follow-up analytical work.

1. **Procurement:** Activate Maxar/WorldView tasking to meet 1.24 m spec. Sentinel-2 fallback is QA-compliant but limits field-level mapping.
 2. **Flood Risk:** 18.4% AOI flood-prone. Coordinate with BWDB for khal clearance before monsoon onset.
 3. **Drainage:** 20.3% drainage congestion detected. Acquire DEM/LiDAR to enable Topographic Wetness Index (TWI) and refine outlet design.
 4. **Baseline:** Synthetic baseline used — schedule a dual-date acquisition (e.g. pre/post-monsoon) for verifiable change-detection metrics.
 5. **QA Metadata:** Provider did not report cloud_cover_pct. Switch to a provider that exposes per-scene cloud statistics for full QA traceability.
-