Flood Hazard Analysis of IDP Sites in Yemen

REACH & CCCM Cluster Yemen

February 2023

REACH Informing more effective humanitarian action

YEMEN
CCCM CLUSTER
دعم مجتمعات النازحين

Contents

01

Background

Photo credits: IDP camp in Aden flooded by the rain. © ACTED/2020

Background

- Next to conflict and eviction, flooding is one of the major threats to Internally Displaced Person (IDP) sites in Yemen.
- Key Informants reported flooding as a site threat for 304 (19.9%) out of 1,529 IDP sites in Yemen *(CCCM Site Report, April 2021 – October 2022)*.
- Between June 2021 and January 2023, 521 flood events were reported in 343 sites *(CCCM Flood Report)*.
- REACH has been working closely with the CCCM Cluster since 2020 to estimate flood hazard at IDP site level. To support the 2023 Flood Contingency and Response Planning of the CCCM Cluster and OCHA, REACH updated the findings of its 2022 IDP Site Flood Hazard Analysis.

02

Methodology

Scope & Data sources

Scope

This analysis aims to cover all IDP sites in Yemen. Following the analysis, an Estimated Flood Hazard Score was derived for 2,016 (88 %) out of 2,301 IDP sites. The flood hazard level for remaining IDP sites is unknown.

Data sources

In total **4 data sources** were triangulated to develop Estimated Food Hazard scores (see Table 1).

Data source	Number of IDP sites reported on
2022 National IDP Site Flood Hazard Analysis	Total scores for **2,422 IDP sites** Estimated flood hazard scores of SNCCs: **899 sites**
CCCM Site Report (April 2021-October 2022)	**1,529 sites**
REACH HEC-RAS modelling (January-September 2022)	30 M: 475 sites 12 M: 42 sites 2.5 M: 75 sites **Total: 592 sites**
CCCM Flood Report (June 2021-January 2023)	**343 sites**

Table 1. Coverage of Flood data sources 2021-2022

Acronyms

- SNCCs - Sub-National Cluster Coordinators
- HEC-RAS – Hydrologic Engineering Center's – River Analysis System

Analysis Framework

1. REACH Regional Flood Hazard Mapping (HEC-RAS analysis)

In 2021, REACH mapped a total of 17 watersheds, partially covering 8 governorates. Based on this flood hazard mapping, REACH developed flood hazard (HEC-RAS) scores for all sites that overlap with REACH's flood hazard mapping.

2. Determination of Estimated Flood Hazard Scores at Site Level

REACH triangulated all available data sources (i.e. CCCM Flood Report, CCCM Site Report, REACH HEC-RAS Flood Hazard Mapping, 2022 SNCC Flood estimates) with each other to devise a Draft Flood Score per site.

3. Review by CCCM Cluster & Sub-National Cluster Coordinators (SNCCs)

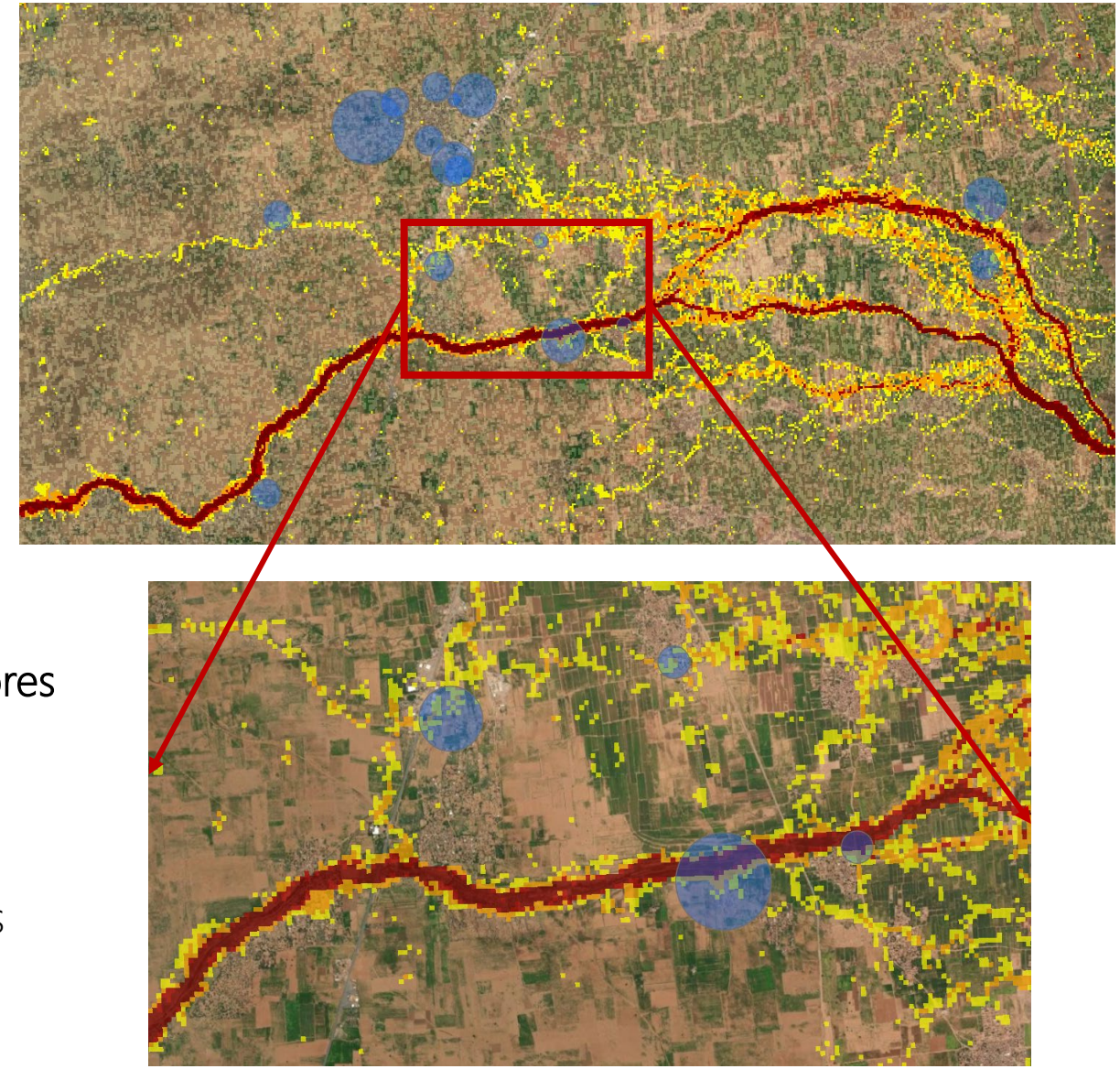
The SNCCs reviewed the Draft 2023 Flood Hazard Scores developed by REACH. Based on SNCC feedback, the CCCM Cluster then derived the final Flood Hazard Scores.

Acronyms

- HEC-RAS – Hydrologic Engineering Center's – River Analysis System

1. REACH Flood Hazard (HEC-RAS) Modelling

- Models **hydrologic flows** based on large precipitation events (*designed* storm)
- Can model **flash floods**
- Informs about flood extent, depth & velocity (hazard)



REACH determined **specific Flood Hazard (HEC-RAS) scores for 592 IDP sites** by

- Creating an estimated buffer per IDP site
- Overlaying available IDP site location with flood models
- Extracting flood hazard & depth per site
- Calculating estimated flood hazard score

2. Determination of Estimated Flood Hazard Scores at site level

01

High Hazard

- CCCM Flood Report shows at least one flooding in IDP site in 2021-2022 → most authoritative data source!
- CCCM Site Report highlights IDP site at threat of flooding
- REACH HEC-RAS Analysis identifies high hazard
- SNCC reports high hazard

02

Medium Hazard

- REACH HEC-RAS Analysis identifies medium hazard
- SNCC reports medium flood hazard

03

Low Hazard

- No flooding reported in 2021-2022 through CCCM Flood Report
- CCCM Site Report does not report IDP site at threat of flooding
- REACH HEC-RAS Analysis identifies low hazard
- SNCC reports low hazard

04

Unknown

- No information available
- Data sources at conflict

03

Findings & Limitations

Findings

Findings show that **25% of IDP hosting sites have a High Flood Hazard.**

This is an **increase of 8%** compared to the 2022 Flood Hazard Analysis (with 403 (17%) out of 2,422 IDP sites with High Flood Hazard).

25%

High Flood Hazard

10%

Medium Flood Hazard

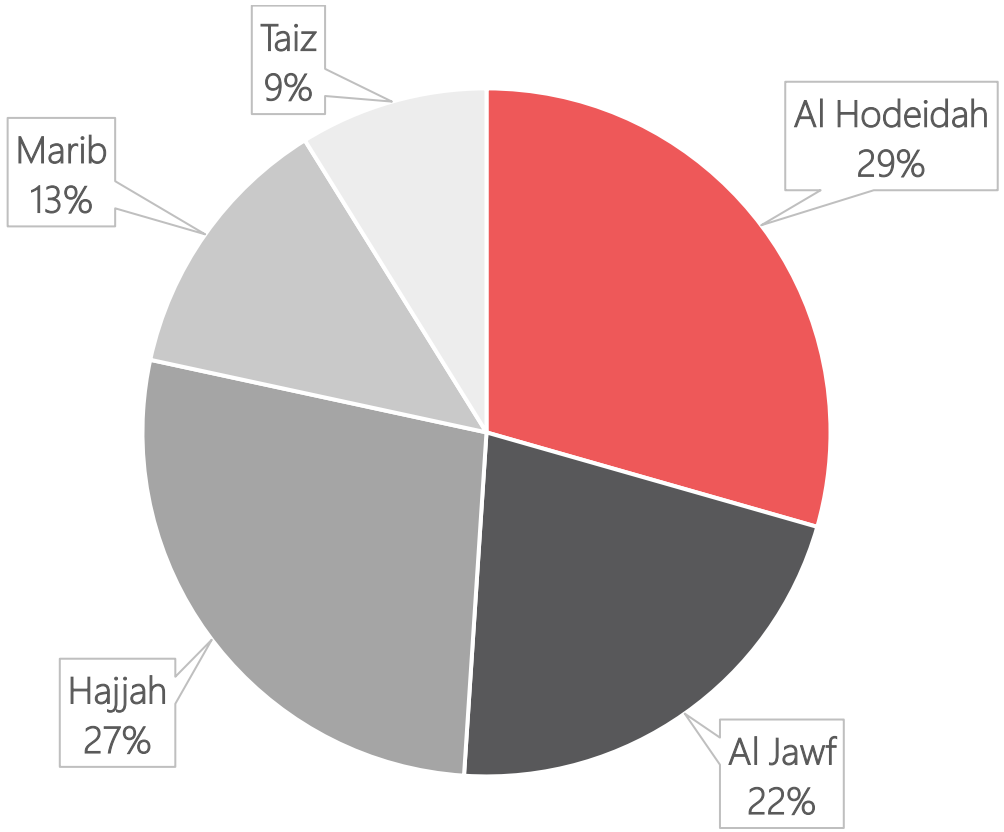
53%

Low Flood Hazard

12%

Unknown Flood Hazard

Findings

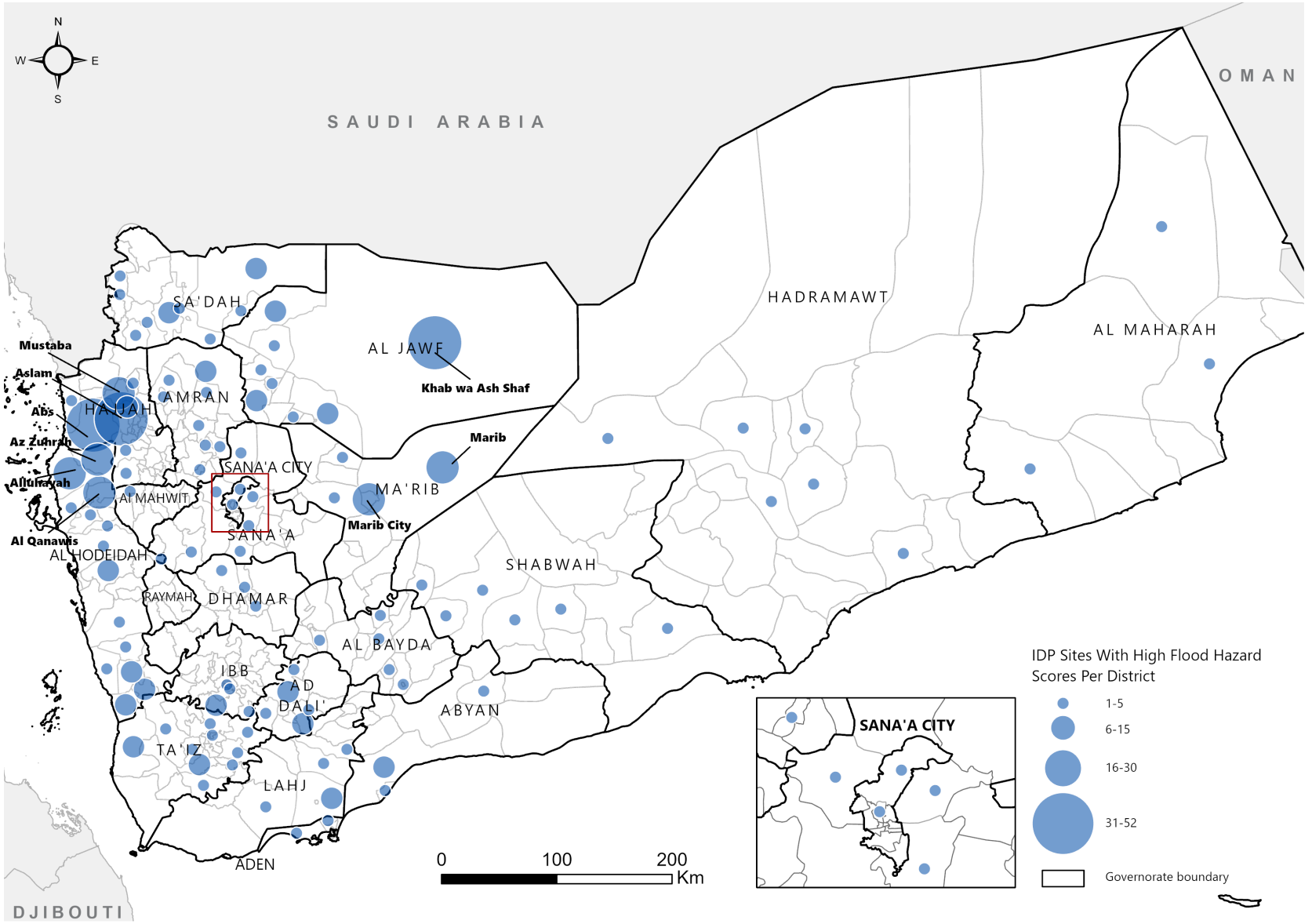


Top 5 Governorates: IDP sites with High Flood Hazard

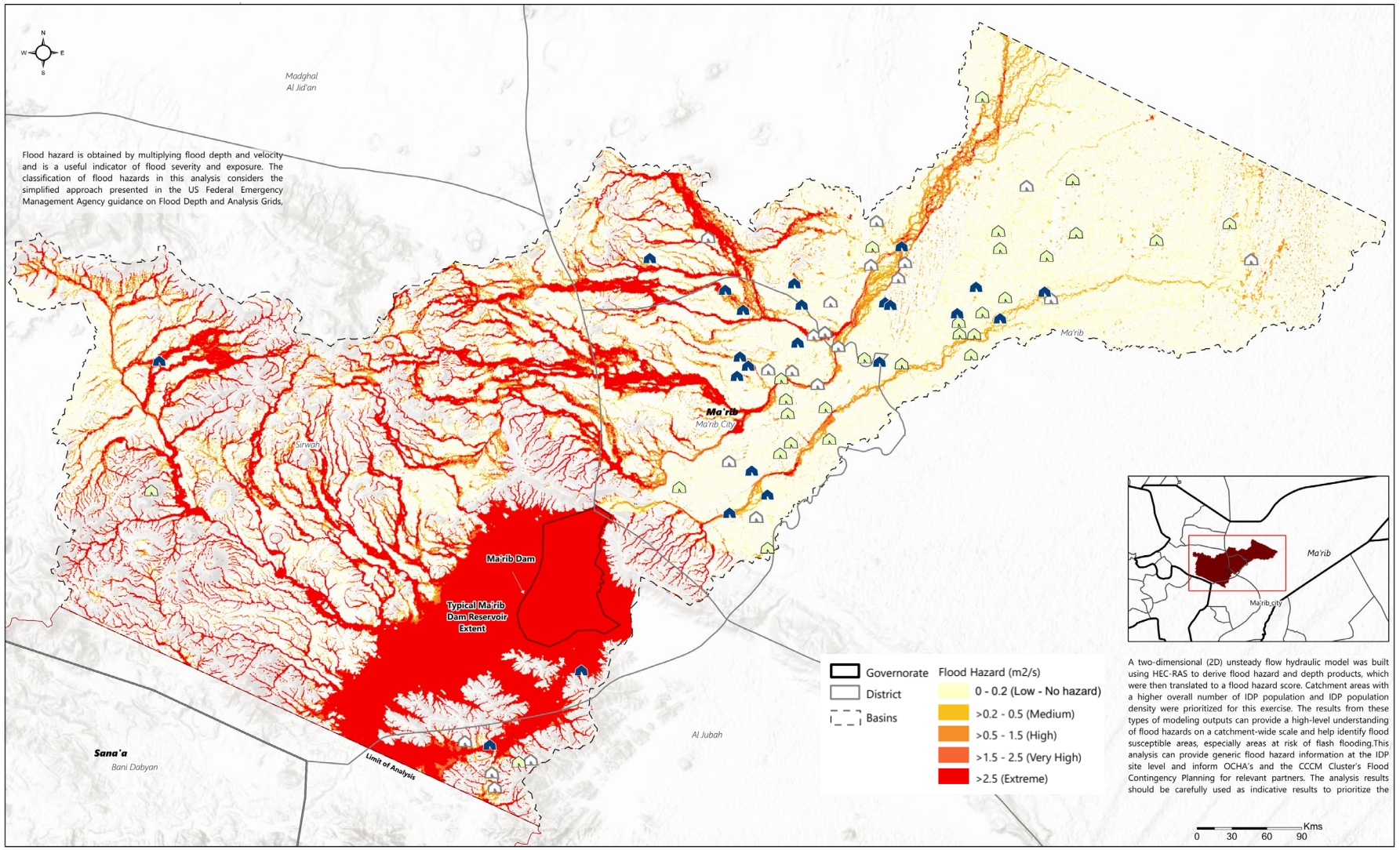
IDP sites with High Flood Hazard

- **571 IDP sites** have a High Flood Hazard covering a **total of 603,227 site residents** *(status: CCCM IDP Hosting Site Master List, December 2022).*
- **67% of IDP sites** with High Flood Hazard are **managed** by CCCM partners *(status: CCCM IDP Hosting Site Master List, December 2022).*
- **Top 5 governorates** with IDP sites having High Flood Hazard include Al Hodeidah, Al Jawf, Hajjah, Marib and Taiz.

National Map: IDP Sites with High Flood Hazard Score per district



Marib Snapshot: Flood Hazard Model Map



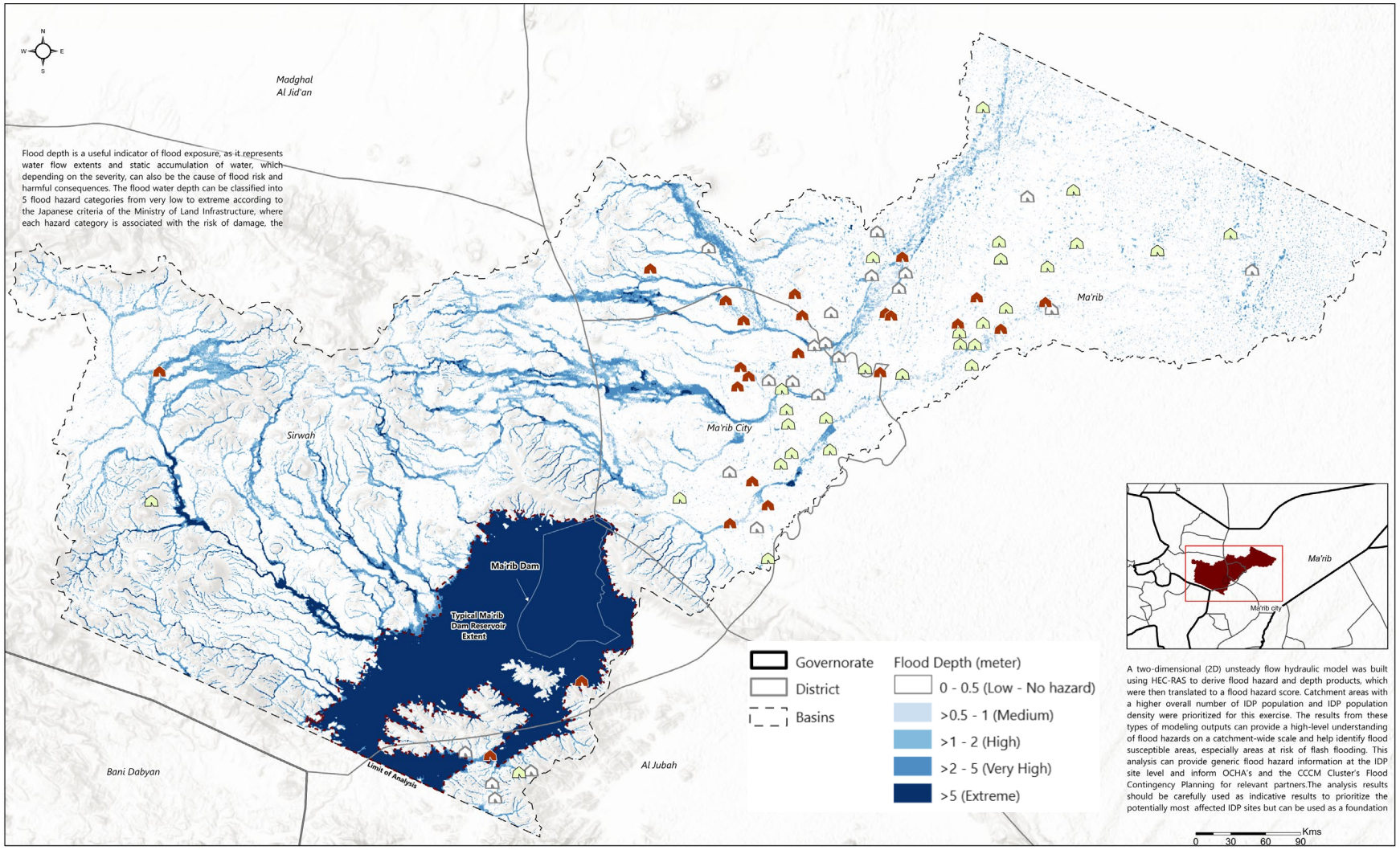
Marib is one of the Top 5 governorates with the highest number of IDP sites with high flood hazard (49 sites, 13%). This map provides an example of a HEC-RAS analysis that shows the area's **Flood hazard** and severity of flood hazard per IDP site. See Table 1 for detailed results.

Table 1. Overview of IDP site flood hazard scores, Marib governorate

Flood Score	# IDP sites	# Managed IDP sites
High	49	43
Medium	1	1
No/Low	131	67
Unknown	43	9

NOTE: Exact IDP site locations are not available for all site and are not verified by REACH.

Marib Snapshot: Flood Depth Model Map



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Interpretation of Estimated Flood Hazard Scores

- **Flood Hazard Scores** per IDP site mostly refer to the **likelihood** of flooding in a site based on at least one reported historical flood event or perception of Key Informants. This does not include a specific analysis of value of assets or vulnerability criteria of IDP site residents.
- However, REACH's HEC-RAS Flood Hazard derived scores also refer to the **potential extent** of a flood event.
- **SNCC derived Estimated Flood Hazard Scores** might also refer to the number of people/assets affected, number of flood events happening or whether any flood prevention activities have been implemented in the site.
- Estimated Flood Hazard Scores may be used to **support prioritization of flood prevention activities for specific IDP sites at national level**.
- **Further detailed site flood hazard assessments** are necessary to understand the exact potential extent & impact of a flooding event and appropriate flood response plans.

Limitations

01

General Analytical Limitations

- Information gaps: All data sources have diverging data gaps. Estimated Flood Hazard Scores could be derived for 88% of IDP sites in Yemen.
- Contradictory information: Data sources had contradictory information over time and between each other.
- Different methodologies of data sources: Data sources have diverging methodologies and results in terms of deriving the estimated flood hazard per site, with each their unique limitations. Thus, overall triangulating the results was challenging.
- Interpretation of results: Flood Hazard scores should be considered indicative estimates.

02

REACH Flood Hazard Mapping (HEC-RAS) limitations

- Site boundaries: The exact site boundaries of IDP sites are not available. REACH had to develop estimated buffer radiuses based on population size, which may not be accurate.
- Site location: Exact site locations are not available for all IDP sites and have not been verified by REACH. Thus, available site locations might contain errors.
- Interpretation of HEC-RAS score: HEC-RAS Flood Hazard modelling might slightly overestimate or underestimate flood hazard. REACH's developed scoring system is not an officially hydrologically tested system.

04

Next steps

Prioritization of IDP sites

Prioritization of IDP sites with High Flood Hazard for flood prevention activities

From the 571 IDP sites with High Flood Hazard priority locations need to be selected for flood prevention and anticipatory action activities. The CCCM Cluster is currently developing potential criteria for such a prioritization activity, which may include:

- Access to sites
- Site management
- Population size

Thank you for your attention!

REACH: Christine Pfeffer, CCCM & Intersectoral Team Lead, christine.pfeffer@reach-initiative.org

CCCM Cluster: Gabriel Mathieu, CCCM Cluster Coordinator, mathieu@unhcr.org

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Annex I: Data Sources & Outputs

Below you can find links to references and outputs relating to REACH-CCCM 2023 IDP Hosting Site Flood Hazard Analysis.

Data sources

- CCCM Flood Report
- CCCM Site Report
- REACH Flood Hazard (HEC-RAS) Mapping
- 2022 REACH-CCCM IDP Site Flood Hazard Analysis (Methodology + Dataset)

Methodology Note

2023 REACH-CCCM IDP Site Flood Hazard Analysis – Methodology Note

Dataset

2023 REACH-CCCM IDP Site Flood Hazard Analysis – Dataset

Maps

- Nationwide Flood Hazard Scores
- Historical Flood Events
- Ma'rib Governorate - Flood Depth Model
- Ma'rib Governorate - Flood Hazard Model
- Hajjah governorate - Flood Depth Model
- Hajjah governorate - Flood Hazard Model
- Al Hodeidah governorate - Flood Depth Model
- Al Hodeidah governorate - Flood Hazard Model
- Ta'iz governorate - Flood Depth Model
- Ta'iz governorate - Flood Hazard Model

Annex II: Overview of methods and limitations of data sources

Below Table provides an overview of the methods and limitations of the data sources used for the 2023 National IDP Site Flood Hazard Analysis. It aims to facilitate understanding of how to interpret the Estimated Flood Hazard Scores.

Data source	Method	Limitations
CCCM Site Report (April 2021-October 2022)	**CCCM Site Report** reports whether a site is at hazard of flooding, based on Key Informants perception.	Only provides subjective reports from Key Informants on whether flooding may be a threat to the site based on their perception. No official flood hazard assessment.
CCCM Flood Report (June 2021-January 2023)	**CCCM Flood Report** highlights sites where flooding occurred in 2021/2022. **Overall, the CCCM Flood Report is considered the most authoritative dataset in this analysis, since it reports actual events.** The CCCM Flood Report also allows REACH to validate its HEC-RAS model findings over time.	Only reports sites where flooding has happened in 2021-2022. Flood events might not have been accurately reported, so total number of flooding might be higher.
REACH HEC-RAS modelling (January-September 2022)	**HEC-RAS model** develops flood hazard and flood depth products based on a *designed* storm. These products are overlaid with IDP site location and an estimated buffer / boundary to derive estimated flood hazard scores.	Based on modelling and not an actual flooding event. In addition, exact IDP site extents/boundaries are not available, and coordinates might be inaccurate. Thus, the model may overestimate or underestimate Flood Hazard.
SNCC Flood Estimates (March 2022)	In 2022, SNCCs provided feedback on the Draft Flood Hazard scores of the analysis. Their feedback was based on their and partner's field knowledge, including historical flooding events. **SNCC feedback can provide a new Flood Hazard score, if a clear justification is given.**	SNCC feedback is not available for all sites and subjective interpretation of flood hazard. No official flood hazard assessment.