بسم الله الرحمن الرحيم

Ministry of Homeland Security, Labour and Technology
Republic of Maldives

DIGITAL MALDIVES FOR ADAPTATION, DECENTRALIZATION AND DIVERSIFICATION (D'MADD) PROJECT
P177040

TERMS OF REFERENCE

for

Consultancy Services for Data Schema Development, Data Cleaning, and Data Preparation for Climate-relevant Data for the Maldives Data Exchange Platform (National)

Reference No: MV-MoECCT-DMADD-578980-CS-QCBS

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1. INTRODUCTION

The Digital Maldives for Adaptation, Decentralization and Diversification (D'MADD) Project (P177040) aims to support the Maldives' digital transformation. The project is funded by a World Bank grant and implemented by the Ministry of Homeland Security, Labour and Technology (MoHSLT). Key stakeholders include the Maldives Digital Service (MDS), the Communications Authority of Maldives (CAM), the Department of National Registration (DNR), and the Ministry of Climate Change, Environment and Energy (MoCCEE).

The Project aims to enhance the enabling environment for the digital economy in the Maldives, improve identification for in-person and remote service delivery, and leverage data and analytics for green, resilient, and inclusive development. It is designed around three components, and the proposed activities are conceived following the country's priorities and funding needs in the medium term. The components are as follows:

Component 1: Enabling environment for improved digital connectivity and competitiveness.

1.1. Improving regulatory frameworks, oversight, and enforcement for a competitive broadband market

1.2. Empowering public institutions for digital transformation in Government

Component 2: Digital identification for improved online and in-person service delivery.

2.1. Legal and institutional enablers and safeguards for secure data and identity management

2.2. Modernizing the foundational ID system and credential

2.3. Strengthening the digital authentication ecosystem

Component 3: Digital technologies and data platform for climate resilience

3.1. Establishing a climate data platform

3.2. Leveraging digital technologies and tools for climate adaptation

2. BACKGROUND

The project aims to strengthen digital foundations and leverage digital technologies and data to improve public service delivery, economic opportunities, and climate resilience.

One of the key areas of the project is strengthening the Government's capacity to collect, manage, and securely share data across institutions. The Government is also establishing the Maldives Data Exchange (MDX) Platform to facilitate secure, standards-based, and seamless data exchange among government institutions and other authorized entities.

Climate and environmental data are particularly important for evidence-based decision-making, climate adaptation, disaster risk management, environmental monitoring, and the development of climate-resilient services. However, climate-related datasets are currently maintained by different institutions using different data structures, formats, standards, metadata practices, and quality-control procedures.

To enable effective sharing through the MDX Platform, priority climate datasets need to be assessed, standardized, cleaned, harmonized, documented, and prepared for interoperable data exchange.

The Government therefore intends to engage a qualified consulting firm to undertake the assessment and preparation of priority climate and environmental datasets included under 4.1 and develop the required data schemas, data models, metadata, data-quality processes, and data mappings necessary to make these datasets data-exchange ready.

3. OBJECTIVE OF THE ASSIGNMENT

The overall objective of this assignment is to improve the quality, consistency, standardization, interoperability, and exchange readiness of priority climate and environmental datasets listed under 4.1 and prepare them for secure sharing through the Maldives Data Exchange (MDX) Platform.

The specific objectives are to:

1. Identify and assess priority climate and environmental datasets maintained by relevant government institutions.
2. Assess the quality, completeness, consistency, structure, and interoperability of existing datasets.
3. Develop standardized data schemas and data models applicable to key climate and environmental datasets.

4. Develop appropriate data dictionaries and metadata for priority datasets.
5. Develop data transformation and validation rules and reusable data-processing scripts where appropriate.
6. Map source datasets to the schemas and technical requirements of the MDX Platform.
7. Clean, validate priority climate and environmental datasets, and standardize them into exchange-ready formats (via the MDX).
8. Support technical validation and pilot exchange of selected datasets through the MDX Platform.
9. Establish practical procedures and recommendations for maintaining data quality and keeping the datasets exchange-ready.
10. Transfer knowledge and build the capacity of relevant government technical staff.

4. SCOPE OF THE ASSIGNMENT

The consulting firm shall undertake the assignment in close coordination with the Ministry of Homeland Security, Labour and Technology (MoHSLT), D'MADD Project Management Unit, Ministry of Climate Change, Environment and Energy (MoCCEE), Maldives Digital Service (MDS), relevant climate and environmental agencies, data owners, and other relevant stakeholders.

The scope shall cover, but not necessarily be limited to, the following areas:

4.1 Identification and assessment of climate and environmental datasets

The consultant shall:

- Conduct consultations with relevant data owners and custodians.
- Develop an inventory of core climate and environmental datasets, drawing on the list of datasets and information areas identified during previous stakeholder engagement workshops (Annex 1).
- Document the source, ownership, custodian, purpose, geographic coverage, temporal coverage, update frequency, data format, storage location, and accessibility of each dataset.
- Identify existing databases, spreadsheets, files, APIs, sensors, systems, and other data sources.
- Assess existing data structures and data models.

The assessment should consider the following datasets identified via previous stakeholder engagement workshops (Annex 1):

- Reef names and identifiers
- GPS locations and reef or monitoring-site geometries
- Benthic cover and coral condition
- Coral-bleaching observations and zones
- Survey and EIA records
- Sea-surface temperature and bleaching risk
- Fish data
- Indicator-species data
- Water quality
- Bathymetry
- Ocean currents
- Jurisdiction and administrative boundaries
- Protected areas
- Coastal infrastructure and development; and
- Other priority datasets identified by the Government.

The final dataset list shall be agreed with the Client during the inception phase; it is expected to be limited to 10 datasets.

5. DATA QUALITY ASSESSMENT

The consultant shall undertake a structured technical quality assessment of selected datasets, applying a standardized assessment framework consistently across all datasets. The assessment shall cover:

- Completeness — proportion of missing or null values across fields
- Uniqueness — identification of duplicate records
- Consistency — internal inconsistencies within and across related datasets, including broken relationships
- Format conformity — adherence to agreed data formats, naming conventions, and coding schemes

- Validity — values falling outside documented acceptable ranges or contradicting associated metadata
- Geographic integrity — coordinates within expected geographic bounds and correctly referenced
- Metadata completeness—presence and adequacy of documentation for each dataset
- Where values appear anomalous or potentially erroneous, the consultant shall flag these for review by the relevant data owner or custodian identified under Task 4.1.

The consultant shall produce a Data Quality Assessment Report documenting findings by dataset, flagged issues, and recommended remediation measures, prioritized by severity and feasibility.

6. DATA SCHEMA AND DATA MODEL DEVELOPMENT

The consultant shall develop standardized schemas and data models for priority climate and environmental datasets.

The schemas should include, as appropriate:

- Dataset/entity definitions;
- Field names;
- Field descriptions;
- Data types;
- Field lengths;
- Mandatory/optional fields;
- Allowed values;
- Codes and classifications;
- Units of measurement;
- Date/time conventions;
- Geographic references;
- Unique identifiers;
- Primary and foreign keys;
- Relationships between datasets;

- Validation rules;
- Versioning requirements; and

The consultant shall ensure that the proposed schemas:

- Support interoperability between government datasets;
- Are sufficiently flexible to accommodate future datasets;
- Follow appropriate national and international data standards where applicable;
- Support machine-readable data exchange;
- Are suitable for implementation in the context of the MDX; and
- Align with existing national data standards.

7. DATA DICTIONARY AND METADATA

For each priority dataset, the consultant shall prepare comprehensive documentation, including:

- Dataset name;
- Dataset description;
- Data owner;
- Data custodian;
- Source system;
- Purpose;
- Geographic coverage;
- Temporal coverage;
- Update frequency;
- Data classification;
- Access restrictions;
- Data quality indicators;
- Data fields;
- Field definitions;
- Data types;

- Units;
- Code lists;
- Reference values;
- Relationships;
- Version;
- Last update;
- Responsible institution; and
- Other relevant metadata.

The consultant shall recommend a metadata structure that can be incorporated into or integrated with the MDX Platform.

8. DATA CLEANING AND HARMONIZATION

The consultant shall clean and standardize the agreed priority datasets listed under 4.1 and agreed during the inception phase.

Activities may include:

- Removal or resolution of duplicate records;
- Correction of formatting errors;
- Standardization of date and time formats;
- Standardization of geographic references;
- Standardization of units of measurement;
- Standardization of naming conventions;
- Standardization of codes and classifications;
- Identification and treatment of missing values;
- Identification and treatment of invalid records;
- Identification and documentation of anomalies;
- Data type conversion;
- Data normalization where required;
- Data aggregation or disaggregation where appropriate;
- Harmonization of datasets from different sources; and

- Other data-quality improvements identified during the assessment.

The consultant shall not alter scientifically significant climate observations merely to make datasets appear consistent. Any correction, imputation, transformation, aggregation, or removal of data shall be documented and agreed with the relevant data owner.

Both the original/source dataset and the cleaned dataset should be retained where technically and legally appropriate.

9. DATA TRANSFORMATION AND EXCHANGE PREPARATION

The consultant shall prepare the cleaned datasets for exchange through MDX.

This shall include:

- Defining source-to-target mappings;
- Mapping existing datasets to the approved climate data schemas;
- Developing transformation rules;
- Preparing machine-readable datasets;
- Developing reusable ETL/data transformation scripts where appropriate;
- Preparing API payload structures or equivalent exchange structures;
- Documenting the complete data transformation process.

The consultant shall recommend suitable exchange formats based on the characteristics of each dataset and MDX requirements, which may include structured formats such as JSON, XML, CSV, or other appropriate formats.

The consultant should take at least one use case through the complete process, from source assessment through cleaning, standardisation, and mapping, subject to availability and agreement with the Client.

10. DATA GOVERNANCE AND SUSTAINABILITY

The consultant shall recommend and agree with the Client an appropriate operating model for maintaining climate data quality and exchange readiness.

The recommendations should address:

- Data ownership;
- Data custodianship;

- Data stewardship;
- Dataset update responsibilities;
- Data-quality responsibilities;
- Data validation procedures;
- Data correction procedures;
- Change management;
- Schema version management;
- Metadata maintenance;
- Data publication procedures;
- Data-sharing arrangements;
- Access control;
- Auditability;
- Data retention;
- Backup and recovery considerations; and
- Periodic data-quality assessment.

The recommendations should be practical and appropriate for the Government's institutional and technical environment.

11. CAPACITY BUILDING AND KNOWLEDGE TRANSFER

The consultant shall conduct knowledge-transfer sessions for relevant technical and data-management personnel.

The training shall cover, as appropriate:

- Data schema and data modelling;
- Data quality management;
- Data cleaning and validation;
- Metadata management;
- Data transformation;
- Data mapping;
- Exchange-ready dataset preparation;

- Maintenance of schemas and datasets; and
- Use and maintenance of scripts/tools developed under the assignment.

The consultant shall provide training materials and practical exercises based on the actual datasets used in the assignment.

12. KEY DELIVERABLES

The consulting firm shall deliver, at a minimum, the following:

Deliverable 1 – Inception Report

The report shall include:

- Understanding of the assignment;
- Detailed methodology;
- Work plan;
- Stakeholder engagement plan;
- Dataset assessment methodology;
- Detailed implementation schedule.

Deliverable 2 – Climate Data Inventory and Assessment Report

The report shall include:

- Inventory of climate datasets;
- Data-owner and custodian information;
- Source systems;
- Dataset characteristics;
- Existing formats and structures;
- Data availability;
- Data quality assessment;
- Interoperability assessment;
- Data gaps;
- Recommendations.

Deliverable 3 – Data Schema, Data Model and Data Dictionary

The consultant shall provide:

- Standardized data schemas for priority climate/environmental datasets;
- Conceptual and logical data models;
- Physical data structures where applicable;
- Data dictionaries;
- Code lists;
- Validation rules;
- Data relationships; and
- Schema documentation.

Deliverable 4 – Metadata Framework and Dataset Metadata

The consultant shall provide:

- Metadata framework to be applied to climate/environmental data sets;
- Metadata templates;
- Completed metadata for priority datasets;
- Data ownership and custodianship information;
- Data quality metadata; and
- Metadata mapping to MDX requirements.

Deliverable 5 – Cleaned and Standardized Datasets

For the agreed priority datasets, the consultant shall provide:

- Original/source datasets, where permitted;
- Cleaned datasets;
- Standardized datasets;
- Data-quality reports;

- Data-cleaning logs;
- Data transformation rules;
- Data-quality validation results; and
- Documentation of all material changes.

Deliverable 6 – Data Exchange Readiness Package

The consultant shall provide:

- Source-to-target mapping;
- MDX schema mappings;
- Transformation rules;
- Validation rules;
- Exchange-ready datasets;
- API/exchange payload specifications where applicable;
- ETL/data transformation scripts;
- Technical documentation; and
- Test data.

Deliverable 7 – Final Report

The final report shall consolidate:

- Activities undertaken;
- Methodologies;
- Dataset inventory;
- Data-quality findings;
- Schemas and data models;
- Cleaned datasets;
- Metadata;
- Transformation processes;
- MDX mappings;

- Integration and testing results;
- Governance recommendations;
- Capacity-building activities;
- Lessons learned;
- Outstanding issues; and
- Recommendations for future expansion.

All technical documentation, schemas, scripts, datasets, configuration files, templates, and other relevant outputs shall be handed over to the Client in editable and machine-readable formats.

13. INDICATIVE DELIVERABLE SCHEDULE

No.	Deliverable	Indicative Timeline
1	Inception Report	Week 1
2	Climate Data Inventory & Assessment Report	Week 4
3	Data Schema, Model & Data Dictionary	Week 5
4	Metadata Framework & Metadata	Week 7
5	Cleaned & Standardized Datasets	Week 10
6	Data Exchange Readiness Package	Week 11
7	Final Report	Week 12

Indicative duration: 3 months (12 weeks).

14. FIRM QUALIFICATIONS

The assignment shall be undertaken by a qualified firm with demonstrated experience in data management, data interoperability, data engineering, or software engineering.

The firm should demonstrate:

- At least 5 years of relevant experience in data management, data engineering, interoperability, data architecture, software development or related areas
- Experience in data standardization, data modelling, data cleaning, and data quality management
- Demonstrated experience in developing data schemas and metadata
- Experience in data integration or data exchange platforms

- Experience working with government institutions or large organizations
- Experience in interoperability and data sharing initiatives

Note: The maximum number of firms to be shortlisted will be 8.

15. KEY EXPERTS

The consulting firm shall provide at least two Key Experts.

Key Expert 1 – Team Leader and Senior Data Architect / Data Interoperability Specialist

Minimum Qualifications

- Bachelor's degree in Computer Science, Information Systems, Data Science, Software Engineering, Information Technology, or a related field
- At least 10 years of professional experience in data architecture, database design, data engineering, interoperability, information systems, or related fields
- Demonstrated experience in developing data models, schemas, data dictionaries, and metadata
- Experience in interoperability standards and data governance
- Experience with data-quality frameworks and data transformation
- Experience working with government or enterprise data systems
- Knowledge of data security and privacy principles

Key Expert 2 – Data Quality Specialist

Minimum Qualifications

- Bachelor's degree in Data Science, Computer Science, Software Engineering, IT or a related field
- At least 5 years of professional experience in data management, data quality management or database development or a related field
- Experience in data quality assessment, cleaning, validation, and harmonization
- Experience developing data-quality methodologies and documentation
- Demonstrated experience working with climate or environmental datasets would be an added advantage

16. INSTITUTIONAL ARRANGEMENTS

The consulting firm will report to the D'MADD Project Management Unit (PMU).

The PMU will coordinate the assignment with relevant government stakeholders, including Ministry of Climate Change Environment and Energy and Maldives Digital Service and relevant climate/environmental data-owning institutions.

The Consultant shall:

- Participate in regular coordination meetings
- Provide progress updates
- Consult relevant stakeholders
- Present key deliverables
- Incorporate consolidated comments from the Client
- Maintain a documented issues and decisions register
- Obtain formal approval of key deliverables from the Client

The Consultant shall nominate a Team Leader who will serve as the primary point of contact with the PMU.

17. STAKEHOLDER ENGAGEMENT

The Consultant shall work closely with relevant stakeholders, which may include:

- Ministry of Climate Change, Environment and Energy
- Environment Regulatory Authority (ERA)
- Maldives Digital Service
- Local councils and relevant government institutions
- Data owners and custodians
- Other agencies identified during implementation

The final list of stakeholders shall be agreed during the inception phase.

18. TECHNICAL APPROACH AND METHODOLOGY

The consulting firm shall propose a methodology demonstrating how it will achieve the objectives of the assignment.

The proposed methodology should generally follow the following lifecycle:

Data Discovery → Data Assessment → Data Quality Assessment → Schema/Data Model Development → Data Cleaning → Standardization → Metadata Development

The Consultant may propose an alternative methodology where it demonstrates improved efficiency or effectiveness.

19. DATA SECURITY, PRIVACY AND CONFIDENTIALITY

The Consultant shall comply with all applicable Government requirements concerning information security, confidentiality, data protection, and access control.

The Consultant shall:

- Use government data only for purposes of the assignment
- Not disclose or share government data with unauthorized parties
- Apply appropriate security controls when handling datasets
- Ensure that working copies of data are appropriately protected
- Return or securely dispose of data upon completion where required
- Immediately report any suspected data breach or unauthorized disclosure

Where datasets contain personal, confidential, sensitive, or restricted information, the Consultant shall follow the data classification and access requirements established by the relevant data owner.

20. OWNERSHIP OF DELIVERABLES AND INTELLECTUAL PROPERTY

All datasets, cleaned datasets, schemas, data models, metadata, documentation, scripts, transformation rules, mappings, tools, reports, templates, and other materials developed specifically under this assignment shall become the property of the Government, subject to the terms of the applicable contract.

The Consultant shall not publish, distribute, reuse, or disclose Government datasets or assignment outputs without prior written authorization from the Government.

Where the Consultant uses pre-existing proprietary tools, software, frameworks, or intellectual property, the Consultant shall clearly identify such components in its proposal and explain the applicable licensing arrangements.

If the Consultant has developed a tool/ application for the purpose of this assignment, it shall be handed over to the Client in working conditions to be used in the future.

21. MEETINGS AND PRESENTATIONS

The Consultant shall participate in:

- Kick-off meeting
- Stakeholder consultations
- Technical workshops
- Data-owner meetings
- Deliverable review meetings
- Schema validation workshops
- MDX integration/testing sessions
- Training sessions
- Final presentation

Key deliverables shall be presented to relevant stakeholders before finalization.

22. LOCATION AND MODE OF WORK

The assignment will be primarily undertaken in the Maldives, with a combination of on-site and remote working arrangements as agreed with the Client.

The Consultant shall be available for physical meetings and workshops in Malé when required.

Any travel to other islands required for stakeholder consultations or data assessment shall be agreed with the Client in advance.

23. PAYMENT SCHEDULE

Payments shall be linked to satisfactory completion and acceptance of deliverables.

An indicative payment schedule is:

Payment	Deliverable	Percentage
1	Approved Inception Report	10%
2	Approved Data Inventory & Assessment Report	15%
3	Approved Data Schema, Model & Data Dictionary	15%
4	Approved Metadata Framework & Metadata	15%
5	Approved Cleaned & Standardized Datasets	20%
6	Approved Data Exchange Readiness Package	10%
7	Approved Final Report	15%
Total		**100%**

The final payment schedule shall be finalized during the procurement process and reflected in the contract.

24. REQUIRED DOCUMENTS

Reference letters and certifications as proof of qualifications and experience in Section 14. The reference letters may include project experience letters and contract services successfully provided by a firm.

25. SUBMISSION

The deadline for submission of the bid proposal is before 10:00AM on 22nd November 2026. You may submit your Expression of Interest via email, postal mail, or hand delivery in sealed envelopes addressed to the project office.

Project Manager
Digital Maldives for Adaptation, Decentralization and Diversification (DMADD) Project
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ANNEX 1

Use Case Data Readiness Roadmap:

Monitoring Corals and Marine Ecosystems

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1 Introduction

The Digital Maldives for Adaptation, Decentralization and Diversification (D'MADD) Project (P177040) aims to accelerate the digital transformation of the Maldives. Funded by a World Bank grant and implemented by the Ministry of Homeland Security, Labour and Technology (MOHSLT), the project brings together key stakeholders, including the Ministry of Climate Change, Environment and Energy (MOCCEE), the Maldives Digital Service (MDS), the Communications Authority of Maldives (CAM), and the Department of National Registration (DNR). The D'MADD project lays the foundation for a modern digital economy and improved public service provision, covering digital connectivity, enhanced identification systems, and the use of digital platforms and data for climate resilience.

To achieve these goals, the project is designed around three components, with activities conceived in line with the country's priorities and funding needs in the medium term. The components are as follows:

Component 1: Enabling environment for improved digital connectivity and competitiveness.

1.1. Improving regulatory frameworks, oversight, and enforcement for a competitive broadband market

1.2. Empowering public institutions for digital transformation in Government

Component 2: Digital identification for improved online and in-person service delivery.

2.1. Legal and institutional enablers and safeguards for secure data and identity management

2.2. Modernizing the foundational ID system and credential

2.3. Strengthening the digital authentication ecosystem

Component 3: Digital technologies and data platform for climate resilience.

3.1. Establishing a climate data platform

3.2. Leveraging digital technologies and tools for climate adaptation

This engagement supports the implementation of the Climate Data Platform under Component 3.1, for which the Ministry of Homeland Security and Technology (MOHST) is procuring a robust hosting partner for the Maldives Climate Data Sharing Platform, establishing a secure, scalable, and interoperable national infrastructure that enables reliable data exchange and long-term system resilience.

2 Background

The Republic of Maldives faces a range of development, governance, and service delivery challenges that require timely, reliable, and well-coordinated data across government. Effective policy-making, planning, and service delivery depend on access to accurate, up-to-date, and interoperable data spanning sectors such as climate and environment, health, infrastructure, tourism, and the economy. However, as in many small island states, data in the Maldives is often fragmented across multiple agencies, constrained by inconsistent standards, and not readily accessible for integrated analysis or decision-making.

In recognition of these challenges, the Government of Maldives has prioritized the establishment of a National Data Exchange to enable secure, efficient, and governed data exchange across sectors. This work builds on initial diagnostic efforts that identified critical gaps and requirements in data management, interoperability, and institutional coordination, directly informing the development and adoption of a roadmap to implement the data-sharing platform over a two-year period.

The overarching goal in implementing the data sharing platform is to unlock the full value of national data assets by:

- Improving data collection, integration, and standardization across government agencies and sectors;
- Enhancing access to and secure sharing of data to support evidence-based policy-making, planning, service delivery, and emergency response;
- Ensuring alignment with global best practices and standards (such as the FAIR Data Principles) to promote interoperability, data quality, and long-term sustainability;
- Strengthening institutional capacity for effective data management, stewardship, governance, and cross-agency coordination; and
- Building core digital infrastructure to enable advanced analytics, integrated decision-making, scenario planning, and forward-looking risk and opportunity assessment.

3 Context

The Use Case Data Readiness Design Lab for Monitoring Corals and Marine Ecosystems was held as part of the National Data Sharing Programme's three-day Design Labs from 14–16 July 2026. The labs were structured as practical, cross-agency working sessions to help participating institutions clarify what would be required to move each priority use

case towards implementation through the National Data Sharing Programme and the future National Data Platform. For the coral and marine ecosystem use case, the Design Lab had four primary objectives:

- **Develop a shared and practical definition of the use case.** Establish a common understanding of the environmental monitoring need, the principal questions the use case should support, and the intended flow from source observations to a usable shared view.

- **Identify the required datasets and determine where readiness work should begin.** Within the context of the aligned upon use case definition, map the wider landscape of coral, marine, environmental, geospatial, regulatory, and contextual datasets raised by stakeholders; identify the agencies or sources associated with them; and distinguish the small set of essential datasets that should receive detailed readiness work first, given limited institutional capacity.

- **Clarify agency and data-governance responsibilities.** Surface existing and proposed roles in relation to the use case and its datasets, including the prospective lead-agency arrangement, dataset ownership, custodianship or stewardship, data production and contribution, and the designation of authoritative sources.

- **Agree the immediate actions needed to move the use case forward.** Define the practical work required to make the priority datasets ready, including confirming roles, coverage, quality, standards, metadata, identifiers, provenance, access conditions, and update arrangements. The Lab also aimed to identify the decisions and unresolved issues that should feed into the MDS data-ownership and source-of-truth exercise and, where national oversight or enablement is required, be taken forward with NDSSC.

- The resulting roadmap consolidates these discussions into a focused use-case definition, an overall dataset and agency landscape, a recommended first set of datasets for full readiness work, a proposed lead and support model, and practical next steps for preparing the use case for later platform configuration.

4 Use Case Definition

Stakeholders began by discussing the practical problem the use case needs to address. Coral and marine monitoring evidence is produced through different programmes, surveys, EIAs, agency activities, and external products, but the records are held across multiple organisations and use different reef or site references, methods, and levels of supporting information. Participants noted that this makes it difficult to form a consistent picture of coral condition and bleaching across locations and over time, compare observations with confidence, or see where the evidence is incomplete.

The dialogue considered a range of possible ambitions for the use case, including wider ecosystem assessment and links to sector or economic impacts. Stakeholders nevertheless aligned that the first iteration should remain practical and be cognizant of political realities. It should establish the common environmental evidence needed to understand coral condition and bleaching before more complex analytical extensions are attempted.

Based on that discussion, stakeholders aligned the following definition: **The use case is to monitor coral health, with an initial focus on benthic coral conditions and coral bleaching.**

5 Key Themes Surfaced Through the Design Labs Dialogue

Keep the first use case focused and pragmatic

Participants discussed the potential value of connecting coral-health information to economic activity and impacts. The group nevertheless considered this too complex for the initial use case. Meaningful economic analysis would require a much wider range of sector and activity data, consistent spatial and time references, agreed methods for relating environmental change to economic outcomes, and coordination across a substantially broader set of institutions.

Stakeholders also recognised that making environmental and economic relationships readily analysable could introduce policy and political sensitivity. If the evidence base is incomplete or the analytical method is not agreed, results could be interpreted as attributing impact, responsibility, or economic loss more conclusively than the data supports. This would risk distracting from the immediate objective of building a credible coral-monitoring capability.

The dialogue therefore supported a sequenced approach: first establish a trusted view of coral condition and bleaching; then consider economic or sector-impact analysis

through a separately governed extension with clear methods, interpretation safeguards, and access arrangements. This does not diminish the value of economic analysis - it places it at a stage when it can be undertaken more credibly.

The monitoring picture is spread across several systems and processes

Stakeholders described coral-monitoring evidence as distributed across MMRI monitoring, agency and independent surveys, EIA studies, reef and location references, environmental datasets, and national or external bleaching-risk products. Fish, indicator-species, water-quality, and pressure data were also discussed as potentially important for interpreting what is happening at particular reefs.

The dialogue made clear that there is no single, ready-made "coral-health dataset." A usable national view will need to connect several records while retaining the source, method, date, location, and validation status of each observation.

Parallel and overlapping mandates are creating uncertainty over data roles

The discussion repeatedly associated more than one agency with the same data area. Benthic and coral-condition information was linked to MMRI, ERA/EIA holdings, and the Ministry of Environment. Reef names and site locations were associated with Geomatics and several agencies that collect or use reef-level data. Water-quality information was linked to ERA, HPA, and URA, while fish data was described as distributed across several institutions.

These overlaps may reflect legitimate but different scientific, regulatory, policy, collection, or operational mandates. However, where those roles are not clearly distinguished, it becomes difficult to determine who is accountable for a dataset, who maintains it, who contributes records, and which source should be treated as authoritative for a particular data element or purpose. An agency identified as a data holder may not be the producer, scientific validator, or accountable authority.

The upcoming MDS exercise to identify data owners, custodians, and sources of truth should use these concrete overlaps as cases for validation. The aim should not be to force every data area under one institution, but to make the respective mandates and data roles explicit and to document where authority is shared or purpose specific.

6 Dataset and Agency Landscape

Dataset or information area	Why it matters to the use case	Agencies or sources identified in the dialogue
Reef names and identifiers	Provides the common reference needed to connect records about the same reef	Geomatics; Ministry of Finance and Public Enterprises,MMRI and ERA references
GPS locations and reef or monitoring-site geometries	Locates observations and allows records from different sources to be joined spatially	Geomatics; Ministry of Finance and Public Enterprises,, MMRI; ERA; Ministry of Climate Change, Environment and Energy; construction/infrastructure function
Benthic cover and coral condition	Provides the principal direct evidence of coral condition and change over time	MMRI; ERA/EIA holdings; Ministry of Climate Change, Environment and Energy
Coral-bleaching observations and zones	Records observed bleaching events, their location, and potential extent	MMRI; ERA; Ministry of Climate Change, Environment and Energy; national and independent surveys; validated citizen-science inputs where appropriate
Survey and EIA records	May contain site-level coral, benthic, fish, water-quality, and development-related evidence	ERA/EIA repository; MMRI; Ministry of Climate Change, Environment and Energy; Private and Individual environmental consultants

Dataset or information area	Why it matters to the use case	Agencies or sources identified in the dialogue
Sea-surface temperature and bleaching risk	Provides heat-stress and early-warning context for observed or likely bleaching	NOAA Coral Reef Watch; national climate or meteorological sources; CBAS
Fish data	Provides broader ecological context for interpreting coral and benthic condition	MMRI; ERA; Ministry of Fisheries, Agriculture and Marine Resources, additional agencies referenced but not fully identified
Indicator-species data	Supports interpretation of ecosystem condition beyond coral cover alone	MMRI; ERA; linked fish and benthic transects
Water quality	May help explain local environmental stress and changes in reef condition	ERA; HPA; URA
Bathymetry	Supports spatial interpretation of reef observations and future modelling	MMRI; ERA
Ocean currents	May support interpretation of environmental conditions and future modelling	Local source not clearly identified; ERA may hold or use relevant information
Resource use	Provides information on human use and potential pressure around reefs	Ministry of Fisheries, Agriculture and Marine Resources ; MMRI; Tourism; Waitt Institute; other sources TBC

Dataset or information area	Why it matters to the use case	Agencies or sources identified in the dialogue
Jurisdiction and administrative boundaries	Supports reporting, management responsibility, and presentation by administrative area	Geomatics; Ministry of Finance and public enterprises
Protected areas	Provides conservation and management context	Ministry of Climate Change, Environment and Energy
Coastal infrastructure and development	Provides development and pressure context around reef locations	ERA; Tourism; Ministry of construction/infrastructure

6.1 Indicative Data Producers, Consumers, and Data Flows

The Design Lab identified the agencies and sources associated with each health dataset, but did not formally assign producer, consumer, custodian, or source-of-truth roles. The table below therefore provides an indicative best-judgement mapping for discussion.
For each dataset, the Producer, Consumer, and Both columns are mutually exclusive: an agency is listed in only one of these three columns for that dataset. Producer means the agency, facility, system, or source is treated as contributing or holding the record but not as a primary user of the shared health-trend view for that dataset. Consumer means it is treated as a user of the record or shared view but not as a producer for this dataset. Both means it is treated as both a contributor/holder and a likely user of the record or shared view. These are working designations, not final institutional assignments; MDS and the relevant agencies should validate them through the data-owner, custodian, and source-of-truth exercise.

Dataset or information area	Producer	Consumer	Both	High-level data-flow direction
Reef names and identifiers	Geomatics; Ministry of Finance and Public Enterprises; construction/infrastructure function	Ministry of Climate Change, Environment and Energy	MMRI; ERA	Primarily unidirectional: reference holders provide reef names and identifiers for the monitoring view.

Dataset or information area	Producer	Consumer	Both	High-level data-flow direction
				Limited return flow: MMRI and ERA can identify needed corrections or reference updates.
GPS locations and reef or monitoring-site geometries	Geomatics; construction/infrastructure function	Ministry of Climate Change, Environment and Energy	MMRI; ERA	Primarily unidirectional: spatial-reference contributors provide locations and geometries for linking observations. Limited return flow: users identify alignment or correction needs.
Benthic cover and coral condition	—	—	MMRI; ERA/EIA holdings; Ministry of Climate Change, Environment and Energy	Bidirectional: the agencies contribute or hold condition observations and use the combined view to interpret coral condition and change. Validation, quality, and correction feedback returns to the relevant holder.
Coral-bleaching observations and zones	National and independent surveys; validated citizen-science inputs where appropriate	—	MMRI; ERA; Ministry of Climate Change, Environment and Energy	Bidirectional: observations from agencies and other contributors are brought together for monitoring; interpretation or validation can generate feedback on records,

Dataset or information area	Producer	Consumer	Both	High-level data-flow direction
				methods, or metadata.
Survey and EIA records	Private and individual environmental consultants	—	ERA/EIA repository; MMRI; Ministry of Climate Change, Environment and Energy	Bidirectional: survey and EIA records flow into the evidence base; the agencies that hold or use them can identify quality, coverage, method, or access issues for resolution.
Sea-surface temperature and bleaching risk	NOAA Coral Reef Watch; national climate or meteorological sources; one additional source TBC	MMRI; ERA; Ministry of Climate Change, Environment and Energy	—	Unidirectional: external and national temperature/risk sources provide heat-stress and early-warning context for interpretation of local observations.
Fish data	Additional agencies referenced but not fully identified	Ministry of Climate Change, Environment and Energy	MMRI; ERA; Ministry of Fisheries, Agriculture and Marine Resources	Bidirectional: fish-data holders contribute contextual records and use the combined evidence to interpret coral and benthic condition; any needed clarification returns to the relevant holder.
Indicator-species data	—	Ministry of Climate Change, Environment and Energy	MMRI; ERA	Bidirectional: MMRI and ERA contribute or hold linked indicator-species records and use them to

Dataset or information area	Producer	Consumer	Both	High-level data-flow direction
				interpret ecosystem condition; validation and update feedback returns to the relevant holder.
Water quality	—	Ministry of Climate Change, Environment and Energy	ERA; HPA; URA	Bidirectional: the agencies associated with water-quality records contribute or hold relevant information and may use the combined view to interpret environmental stress; quality and access issues return to the relevant holder.
Bathymetry	—	Ministry of Climate Change, Environment and Energy	MMRI; ERA	Bidirectional: MMRI and ERA contribute or hold bathymetry information and use it for spatial interpretation and future modelling; corrections or updates return to the holder.
Ocean currents	Local source TBC	MMRI; Ministry of Climate Change, Environment and Energy	ERA, where it holds or uses relevant information	Primarily unidirectional: the identified or future local source provides current information for environmental interpretation and future modelling. Limited return flow: users may

Dataset or information area	Producer	Consumer	Both	High-level data-flow direction
				identify coverage, method, or update requirements.
Resource use	Fisheries or ocean-resources agencies; Waitt Institute; other sources TBC	Ministry of Climate Change, Environment and Energy	MMRI; Ministry of Fisheries, Agriculture and Marine Resources; Tourism	Bidirectional: contributing agencies and sources provide information on human use and pressures around reefs and may use the combined evidence for interpretation; scope and quality feedback returns to contributors.
Jurisdiction and administrative boundaries	Geomatics; Ministry of Finance and Public Enterprises	MMRI; ERA; Ministry of Climate Change, Environment and Energy	—	Primarily unidirectional: boundary reference holders provide administrative context for reporting and management presentation. Limited return flow: users identify needed boundary or reference updates.
Protected areas	Responsible custodian TBC	MMRI; ERA; Ministry of Climate Change, Environment and Energy	—	Primarily unidirectional: the responsible custodian, once confirmed, provides protected-area context for monitoring and management interpretation.

Dataset or information area	Producer	Consumer	Both	High-level data-flow direction
Coastal infrastructure and development	Tourism; construction/infrastructure function	MMRI; Ministry of Climate Change, Environment and Energy	ERA	Bidirectional: contributing sources provide development and pressure-context information; ERA contributes or uses relevant records and can identify any required clarification, quality, or update action.

7 Priority Datasets

Recognizing that the technical capacity to conduct robust data readiness and management is limited, it is understood that it will not be feasible to ensure the readiness of the entire dataset inventory at the same time. Full readiness work should therefore begin with the smallest "priority" dataset that is essential to the defined coral-monitoring use case, provides the foundation for organising other records, is sufficiently available to work on now, and contains governance questions that need to be resolved early.

The following criteria can provide a transparent and reusable basis for selecting that first set. D'MADD and the agencies can apply them again if capacity, availability, or the scope of the use case changes.

Criteria for selecting the first datasets

Criterion	Practical test
Essential to the defined use case	Without the dataset, agencies cannot answer a core question about reef identity, observed coral condition, bleaching, or bleaching risk
Foundational for other data	It provides identifiers, locations, provenance, or another reference needed to organise and compare other records

Criterion	Practical test
Available enough to work on now	A recognised source or substantial existing holding is already known, so readiness work can begin without first creating the dataset from scratch
Important governance issue to resolve early	Unclear ownership, fragmented holdings, or overlapping mandates would otherwise block the use case or carry the same ambiguity into the future platform

Priority datasets

Priority dataset	Why it should be addressed first
Authoritative reef and monitoring-site reference - reef names, IDs, coordinates, and site geometries	It provides the common reference needed to organise observations and determine whether records from different agencies concern the same reef or site
Benthic and coral-condition observations	It provides the principal evidence for assessing coral health and change over time;
Coral-bleaching observations and event records	It provides the local evidence of where and when bleaching has occurred and allows risk information to be assessed against actual observations
Sea-surface-temperature and bleaching-risk information	It provides the heat-stress and early-warning context needed to interpret observed or likely bleaching

Together, these datasets provide the minimum evidence needed to identify a reef or site, describe observed coral conditions and bleaching, and interpret the observations against current bleaching-risk conditions. The management and readiness of secondary datasets can follow subsequently.

What must be established for each priority dataset

The same readiness framework should be applied consistently to every priority dataset through agency validation and the MDS exercise.

Readiness area	**What needs to be established**
Roles and accountability	The accountable owner, the custodian or steward, and the agencies, programmes, consultants, or observers that produce or contribute records
Source of truth	The recognised system, repository, register, or external product for the relevant data element and official purpose
Coverage and quality	Geographic and time coverage, completeness, known gaps, validation status, quality controls, and whether different methods or records are comparable
Common identifiers and linkage	The reef IDs, site IDs, coordinates, and other fields needed to relate records from different sources to the same reef, site, or observation
Standards and metadata	Agreed definitions, formats, methods, required metadata fields, and documentation needed for consistent interpretation and reuse
Provenance	Where the record originated, who produced and validated it, the original source, and any relevant version or processing history
Access and sharing	Who may access and use the data, under what conditions, and whether legal, commercial, confidentiality, or attribution restrictions apply

Readiness area	What needs to be established
Updates and corrections	Who updates the dataset, how often, how corrections or revised records are managed, and how users are informed of changes

How to treat the remaining datasets

All remaining datasets should receive baseline registration now: a clear name and description, the agencies or sources identified in the dialogue, their relevance to the use case, and their current ownership or source-of-truth status where known. This preserves the wider landscape without requiring agencies to complete detailed readiness work on every dataset immediately.

As capacity becomes available, the next secondary and tertiary datasets should be selected for full readiness work according to the decisions the use case needs to support.

8 Lead Agency and Supporting Roles

The lead agency for the coral-monitoring use case remains to be confirmed between MMRI and the Ministry of Environment. During the workshop, both entities suggested the need to reflect on their internal capacity and mandates to better determine their appetite to be the lead agency to facilitate the progression of this use case.

It was well understood that the lead is not expected to own every contributing dataset. Its role is to hold the use case together. It should maintain the agreed scope and priority questions; convene the owners, custodians, producers, and users of the priority datasets; validate the priority set and the readiness decisions applied to it; track unresolved ownership, source-of-truth, access, quality, and standards issues; and maintain a clear decision log and readiness record for the use case. It should represent the use case in discussions on the National Data Platform and validate that any eventual platform configuration meets the agreed coral-monitoring need.

The other agencies identified in the dataset landscape remain responsible for decisions and actions relating to the data they own, maintain, produce, validate, or regulate. The use-case lead coordinates these inputs; it does not replace those institutional responsibilities or unilaterally assign ownership.

D’MADD PMU team should continue to support internal coordination, documentation, and follow-up during the readiness phase, while helping the designated lead transition into the ongoing convening role.

The National Data Sharing Steering Committee (NDSSC) should support the use case through its national oversight and enablement role. Maldives Digital Service (MDS), as the designated chair of NDSSC, carries operational implementation responsibilities for the national programme including setting cross-government data-sharing policy, establish national standards on its own, resolve matters that require national-level authority.

9 Practical Next Steps

1. First, confirm the lead arrangement and the use-case decision rights. MMRI and the Ministry of Environment should agree which agency will act as the accountable lead, which will serve as the core partner, and who the named focal points will be. The agreement should define who maintains the use-case scope, convenes the sector agencies, validates scientific requirements, and escalates unresolved issues.

2. Second, convene the priority-dataset agencies and confirm the starting scope. The use-case lead should bring MDS together with the agencies associated with the proposed priority datasets. The group should validate the priority set against the criteria in Section 4, identify a responsible agency and focal point for each dataset.

3. Third, MDS should launch the structured data-readiness exercise. MDS should provide the common process, templates, guidance, and timetable and work directly with each contributing agency to apply the readiness framework in Section 7. This work should be informed by the Data Management Framework and integrated with MDS’s wider exercise on data owners, custodians, and sources of truth rather than creating a parallel process for the coral use case.

4. Fourth, each agency should assess and improve the datasets for which it is responsible. With support from MDS, agencies should confirm their data roles and authoritative sources; document coverage, quality, identifiers, standards, metadata, provenance, access conditions, and update arrangements; and identify gaps or restrictions. Each material remedial action should have a responsible agency, an agreed route to resolution, and an indication of whether it must be completed before platform onboarding or can be managed as a known limitation. MDS should consolidate the findings

5. Fifth, resolve issues at the appropriate institutional level. Questions about coral-monitoring scope, scientific validity, or sector priorities should return to the use-

case lead and core partner. MDS should facilitate issues that cut across contributing agencies. Conflicts over mandates, national policy, common standards, or other matters requiring cross-government authority should be referred by MDS to NDSSC for oversight or decision.

6. Sixth, confirm the minimum data package and its fitness for the use case. MDS should consolidate the proposed common fields, identifiers, metadata, access conditions, update arrangements, and representative records for the priority set. The use-case lead and core partner should review this package only to confirm that it can support the agreed coral-health use case and preserves the required scientific meaning; they are not expected to perform the agencies' readiness work themselves.

7. Finally, MDS should maintain the use-case readiness package for later platform onboarding. The package should bring together the agreed scope, priority datasets, confirmed and unresolved data roles, sources of truth, common requirements, quality and access issues, remedial actions, representative records where appropriate, and the decisions the future platform must support. MDS should keep it aligned with agency updates and its wider data-management work (in alignment with the data management framework), while the use-case lead reconvenes the sector group when the use-case scope, priorities, or scientific requirements change. NDSSC should retain visibility of unresolved national governance or enablement issues.