

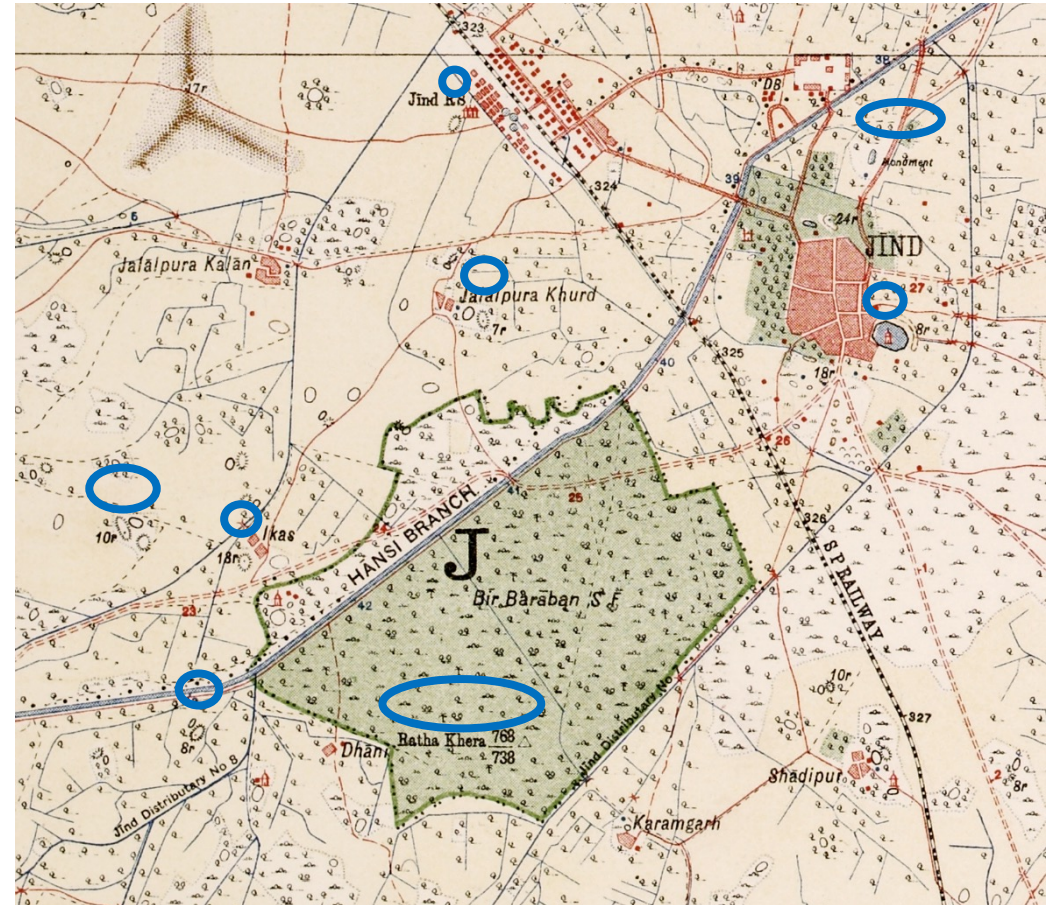


# Mapping Archaeological Heritage in South Asia: open-source technologies and sustainability

**Junaid Abdul Jabbar**

# Mapping Archaeological Heritage in South Asia (MAHSA)

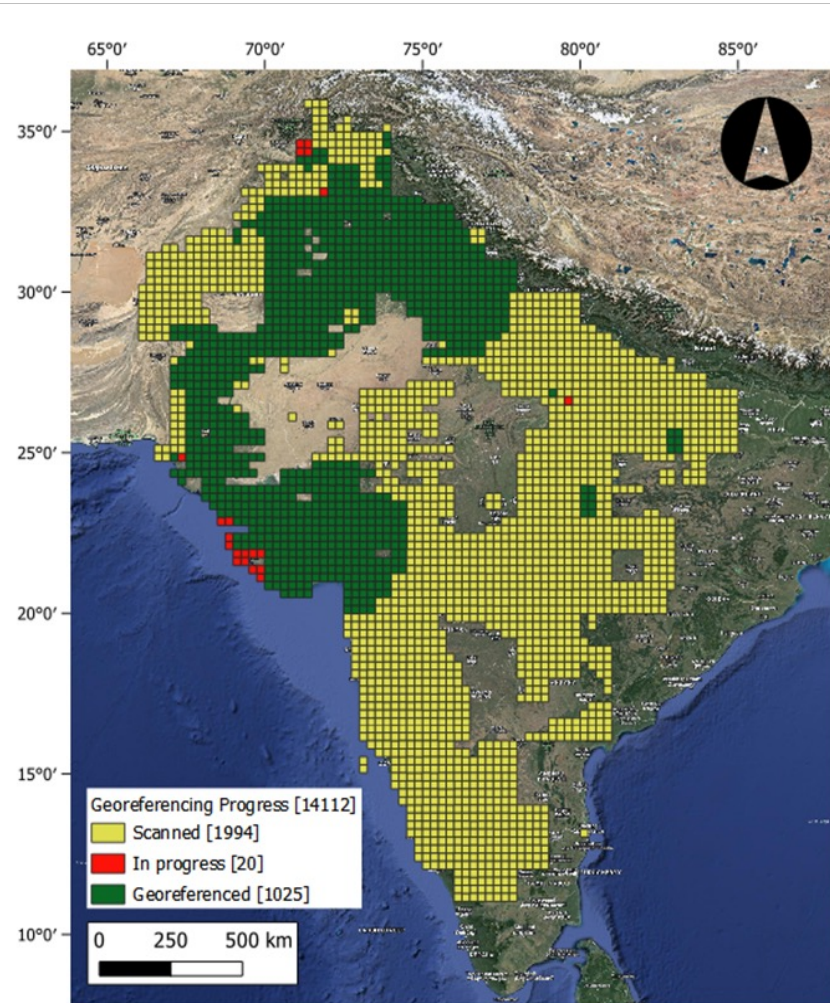
- Documentation of the endangered archaeology and cultural heritage of the Indus River Basin in an open access online database using the Arches platform
- Provide an open access mapping resource and research repository
- Collaborative research output with local heritage professionals
- Concurrent programme of collaborative development and training programmes



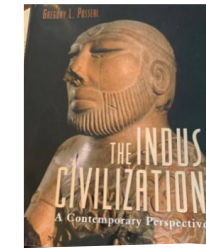
# Data Sources



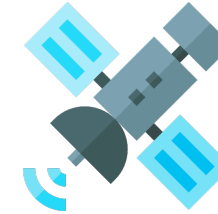
*Historical Maps*



MAHSA map sheet georeferencing: Progress to date over thousand one-inch to a mile maps



*Legacy Data*



*Remote Sensing*

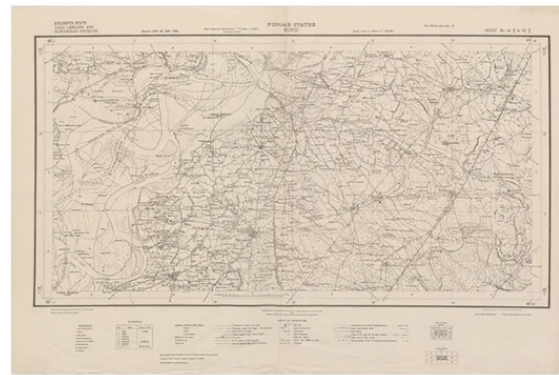


*Field Surveys*

# Data Sources



*Machine Learning*



Historical Map

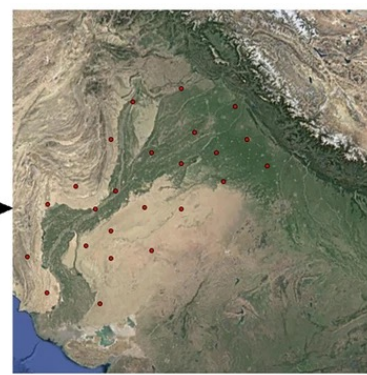
## Pre-processing

Digitalisation

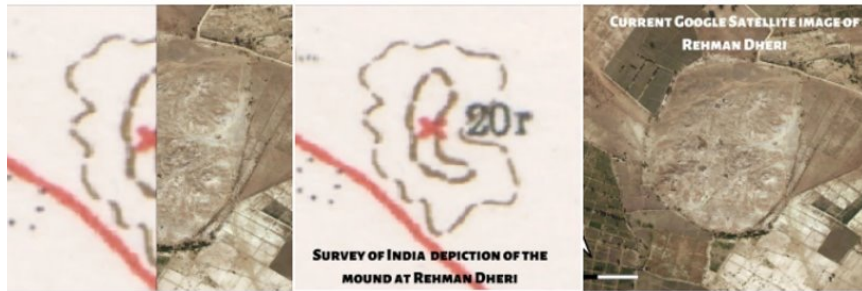
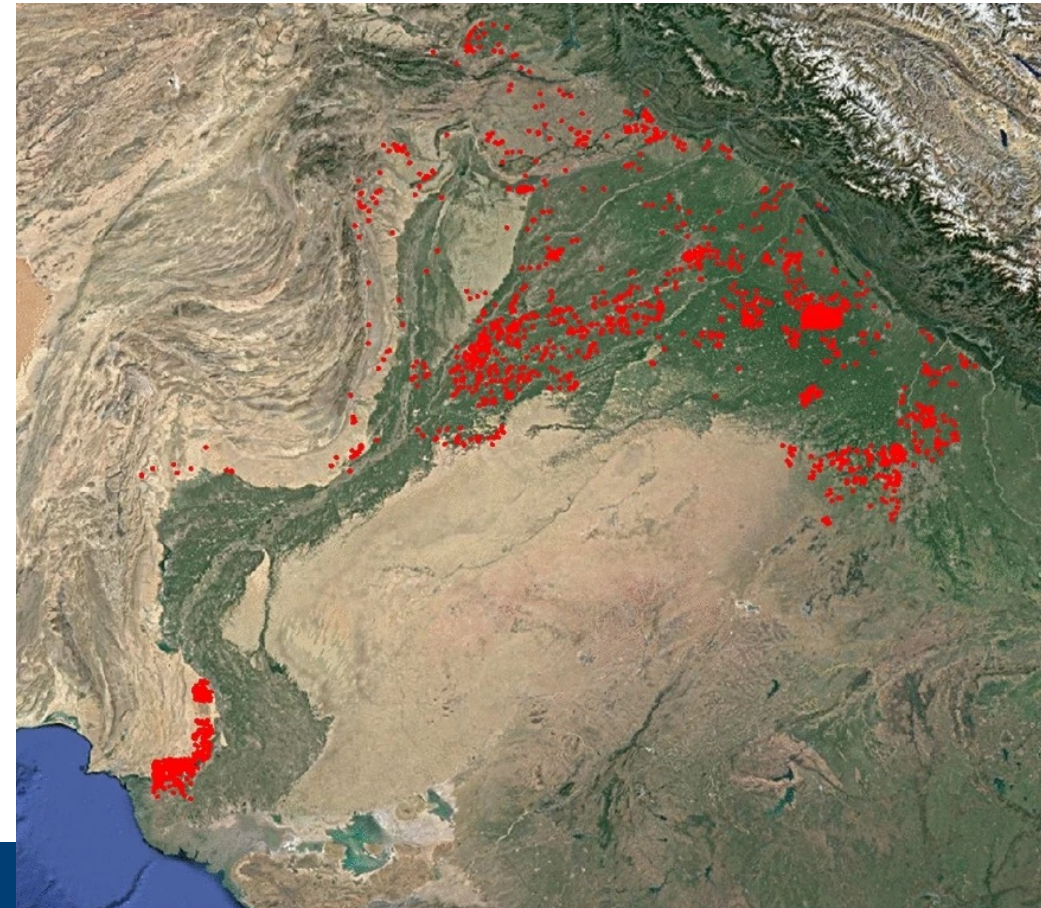
Georeferencing

## Processing

DL Algorithm  
Mask R-CNN



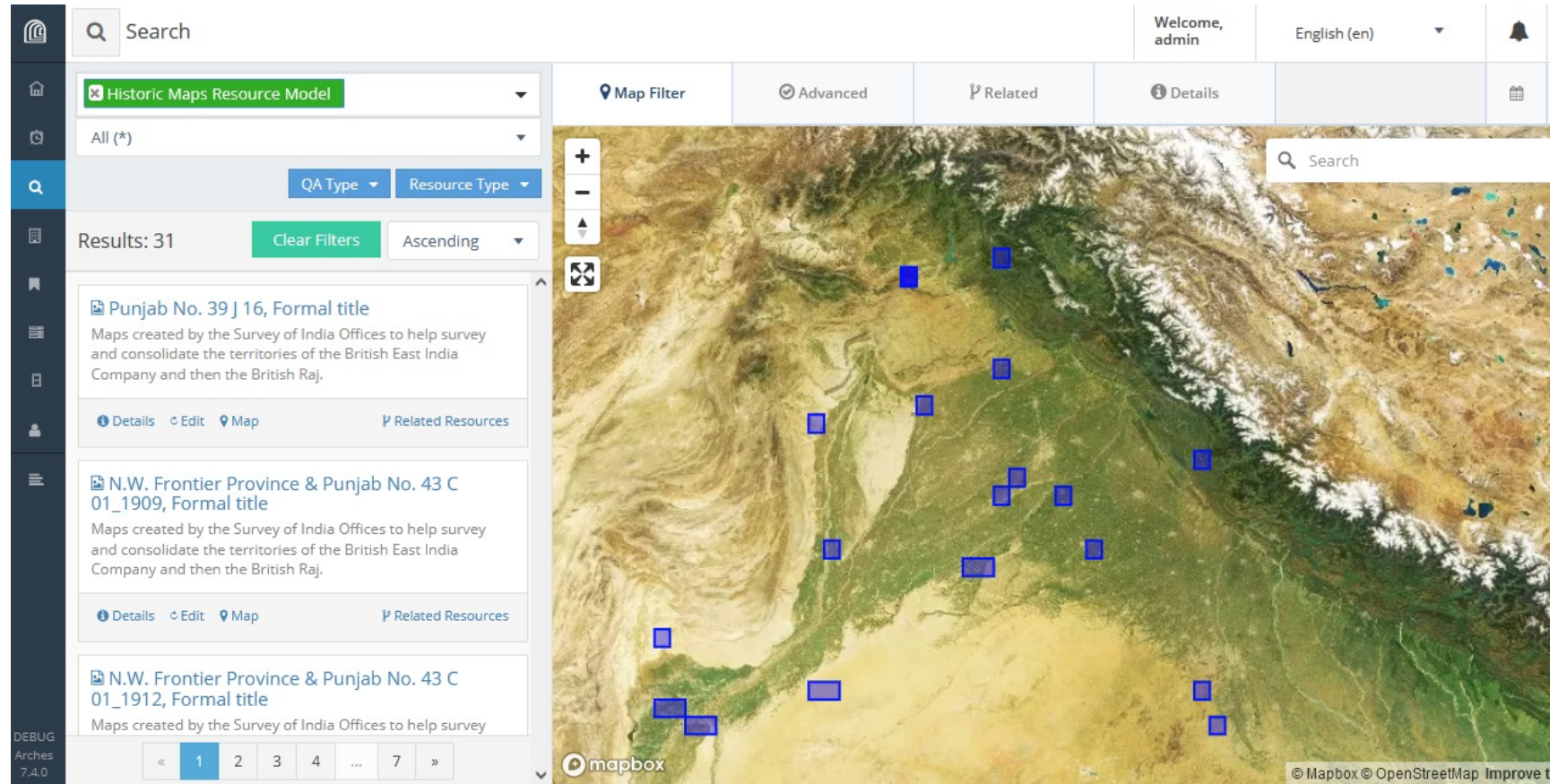
Detected distribution



# Arches



- Open-source web-based, geospatial information system for cultural heritage inventory and management.
- Developed by the Getty Conservation Institute and World Monuments Fund.



<https://www.archesproject.org/>



# Arches

- Several data types including concept i.e., controlled vocabularies (can be hierarchical as well)

MAHSA Geometry Qualifier

MAHSA Geometry Recording Method

Ground-truthing

Historic Map-Georeferenced

Historic Map-Paper

Legacy Data

Remote Sensing

..... Ground-truthing

..... ✖ Handheld GPS

..... ✖ Phone/Tablet Built in GPS

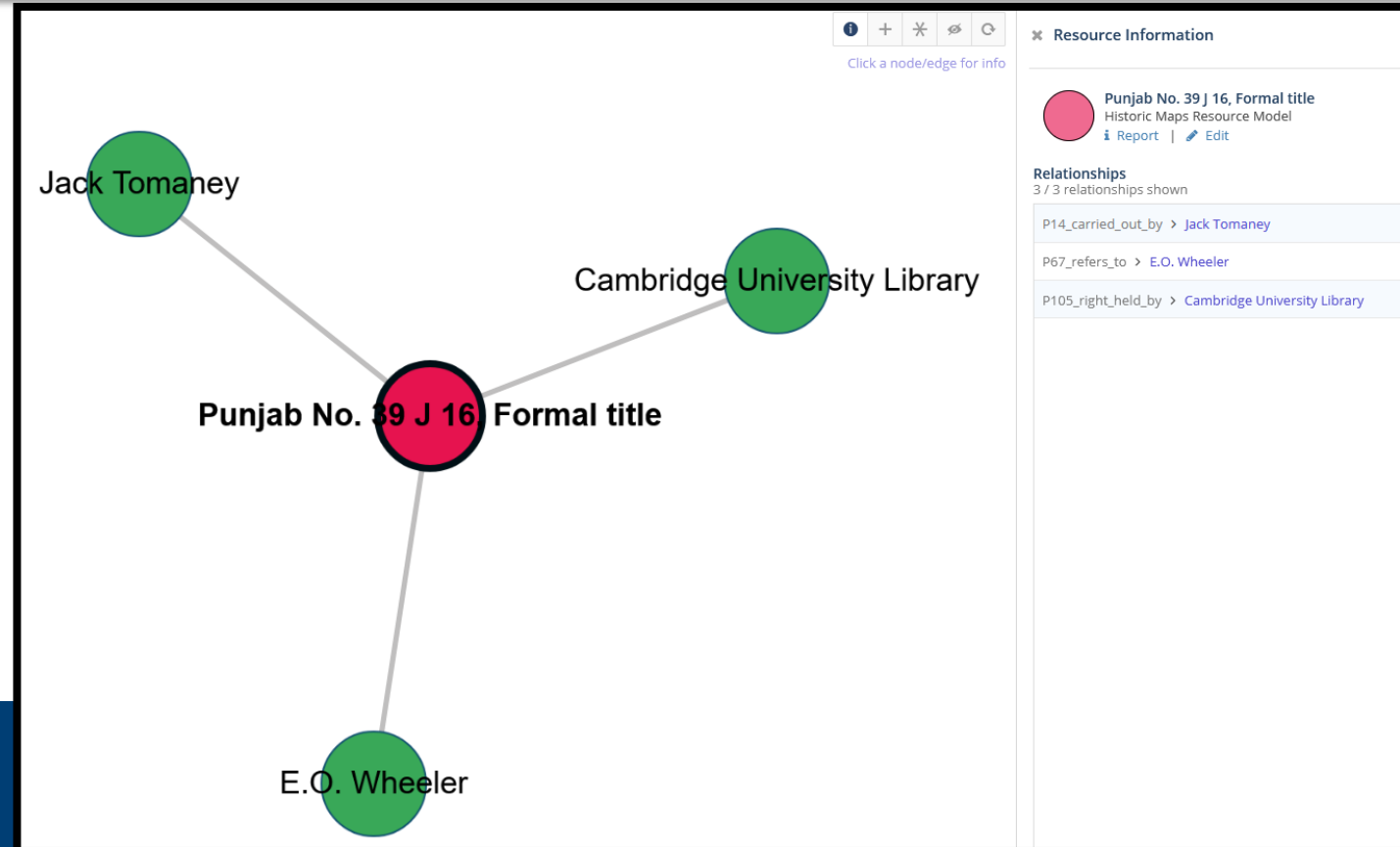
..... ✖ Total Station

Related Concepts

Values

Images

- Relate resources across database with defined relationships







# Arches - Data Template

ResourceID	attribute 1	attribute 2	attribute 3
1	attr. 1 value	attr. 2 value	attr. 3 value
2	attr. 1 value	attr. 2 value	attr. 3 value
2		attr. 2 additional value	
3	attr. 1 value	attr. 2 value	attr. 3 value

ResourceID	Name	Name Type	Classification
1	Shaheeda Abai	Primary Name	Built/Historical Heritage
2	Mohammadi Dherai	Primary Name	Archaeological Site
2	Khazana Dherai	Alternate Name	
3	Kaga Darra	Primary Name	Archaeological Feature



# Arches - Data Template

Site Name - Repeat Group	
String	Concept
Name	Name Type
	Primary Name
	Primary Name
	Alternate Name(s)
	Village Name
	Survey/Reference ID

3- Attribute Name

1- Indicates whether one site can have more than one set of the defined attribute

2- Data type

4- Dropdown for controlled vocabularies

5- Colored columns for easy identification of attribute groups

6- Unique MAHSA\_ID

ResourceID	Assessment Activity - Repeat Group	Date of Assessment	Proposed Completion Activities	Site Name - Repeat Group	Heritage Summary				
Same as MASHA_ID	Concept-list (can select multiple)	Must be in YYYY-MM-DD form	Concept-list (can select multiple)	String	Concept	Concept	Concept	String	
ResourceID	Assessment Type	Date of Assessment	Proposed Completion Activities	Name	Name Type	Heritage Location Classification	Archaeological Certainity	Overall Morphology	Previous Research Activities
HL-LD-PC0004-000001	Legacy Data Digitisation/Interpretation	2022-07-27	Condition Assessment Using Remote Sensing Methods, Location Accuracy	Anjano Dherai	Primary Name	Archaeological Site	High	Unknown	(A.R.A.S.I., F.C. 1916-17; A.P. 11:9)
HL-LD-PC0004-000001				Loya Dherai	Alternate Name(s)				
HL-LD-PC0004-000001				600	Survey/Reference ID				
HL-LD-PC0004-000002	Legacy Data Digitisation/Interpretation	2022-07-27	Condition Assessment Using Remote Sensing Methods, Location Accuracy	Takhtabad	Primary Name	Archaeological Site	High	Unknown	(S.N. Khan 1993)
HL-LD-PC0004-000002				601	Survey/Reference ID				
HL-LD-PC0004-000003	Legacy Data Digitisation/Interpretation	2022-07-27	Condition Assessment Using Remote Sensing Methods, Location Accuracy	Tajurai Dherai	Primary Name	Archaeological Site	High	Unknown	(A.R.A.S.I., F.C. 1916-17:35)
HL-LD-PC0004-000003				Shera Ghund	Alternate Name(s)				
HL-LD-PC0004-000003				602	Survey/Reference ID				



# Arches - Releases

- Several releases (minor and major updates) since October 2020
- Version 6 released with a new method to import data i.e., **SQL ETL Methods or Relational Schema**
- Version 7 released with internationalisation capability

Sr. No.	Version	Release Date
1	7.4.0	June 2023
2	7.3.0	January 2023
3	7.2.1	December 2022
4	7.2.0	November 2022
5	7.1.1	September 2022
6	7.1.0	September 2022
7	7.0	August 2022
8	6.2.3	April 2023
9	6.2.2	February 2023
10	6.2.1	October 2022
11	6.2.0	October 2022
12	6.1.2	November 2022
13	6.1	June 2022
14	6.0	October 2021
15	5.1.4	March 2021
16	5.1.3	March 2021
17	5.1.1	March 2021

# Arches - Relational Schema

← Graph Cards Permissions

Find a node, datatype, card...

+ Expand - Collapse Grid Show IDs

Heritage Location Resource Model (E18)

- MAHSA\_ID (E42)
- Assessment Activity (E7)
- Name (E41)
- Heritage Summary (E13)
- Archaeological Assessment (E12)
- Related Features Summary (E18)
- Related Feature Instances (E18)
- Related Resources (E18)
- Geographic Location (E53)
- Administrative Subdivision (E53)
- Address/Directions (E41)
- Previously Documented Locations (E53)
- Measurement Assignment (E16)
- Environmental Assessment (E13)
- Related Theme (E13)
- Description Assignment (E13)
- Past Modification (E11)

Views (44)

- address\_directions
- administrative\_subdivision
- archaeological\_assessment
- archaeological\_description
- assessment\_activity
- built\_component
- condition\_assessment
- condition\_recommendation\_description\_assignment
- cultural\_period\_assignment
- cultural\_period\_inference\_making
- description\_assignment
- disturbance\_damage\_state
- eligibility\_requirement\_type
- environmental\_assessment
- evaluation\_assignment
- evaluation\_criteria\_type
- evaluation\_time\_span
- existence\_event
- external\_xref
- finds
- finds\_assessment
- finds\_cultural\_period\_inference\_making
- finds\_image

Query Editor Query History

```
60 select __arches_create_resource_model_views(graphid)
61 from graphs
62 where isresource = true
63 and replace((name->'en')::text,' ','') != 'Arches System Settings'
64 and graphid = '51b5d8b8-e57f-11ec-8903-fa163e2afc92';
65
66
67
68
69
70
71
72
73
```

Data Output Explain Messages Notifications

__arches_create_resource_model_views	
	text
1	schema "heritage_location_resource_model_v6" created for resource model.

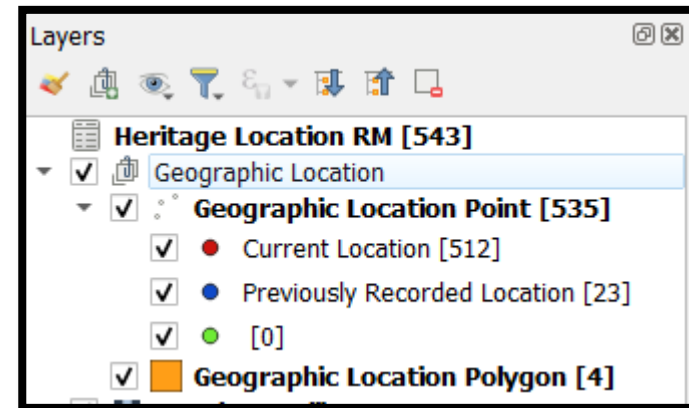
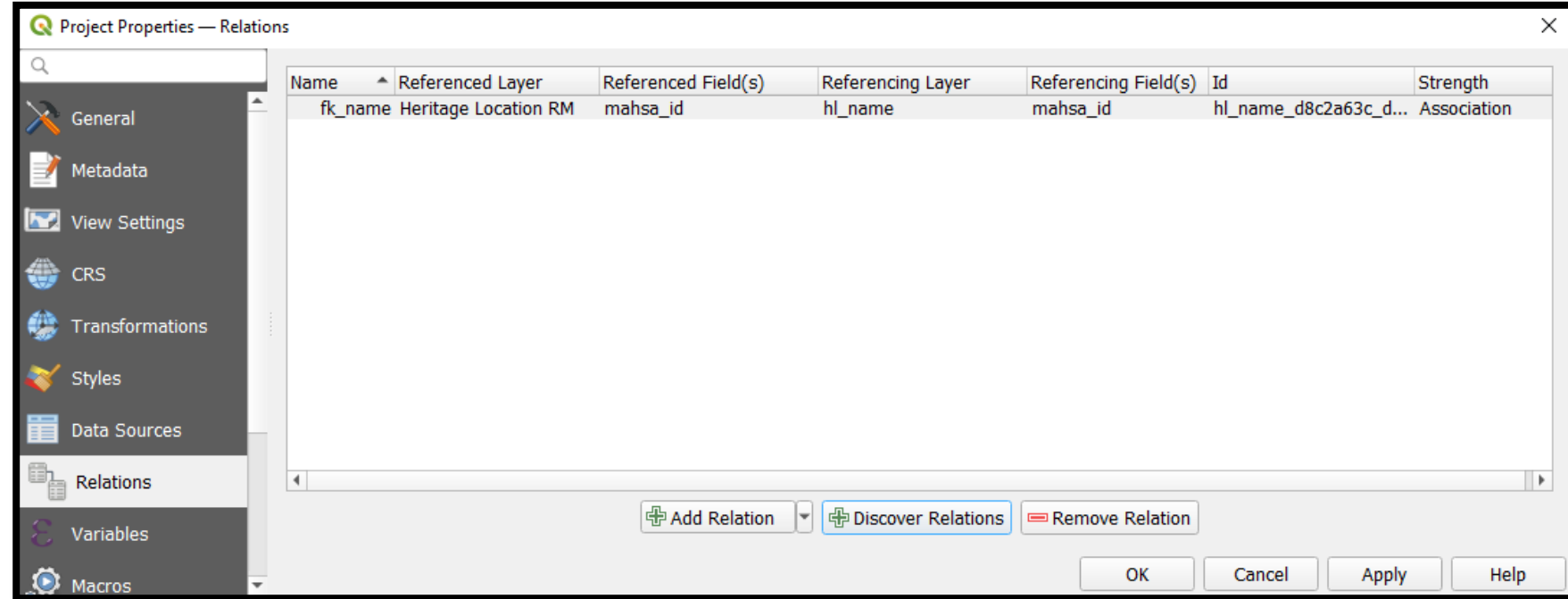
# Setting up Centralised Database

- PostgreSQL relational database with all the attribute fields from the resource models
- Simple data types as compared to 'jsonb' data type in the Arches relational views
- Configuring SSL for PostgreSQL
- Automated backup using cron job



# QGIS Project Setup

- Load all layers
- Discover relations
- Configure edit settings
- Design data entry form
- User Constraints & Validations
- Set layer visibility



# QGIS Form for Centralised Database

Heritage Location RM — Features Total: 7, Filtered: 7, Selected: 0

MAHSA Unique ID Components | Assessment Activity | Site Name | Heritage Summary | Archaeological Assessment | Cultural Period Assignment

▼ MAHSA ID

HL-LD-PO00006-000001

▼ Site Name - Repeat Group

✎ 🗑️ 📄

Expression

Alternate Name(s): Vaniwali

Primary Name: Banawali

▶ MAHSA ID Info

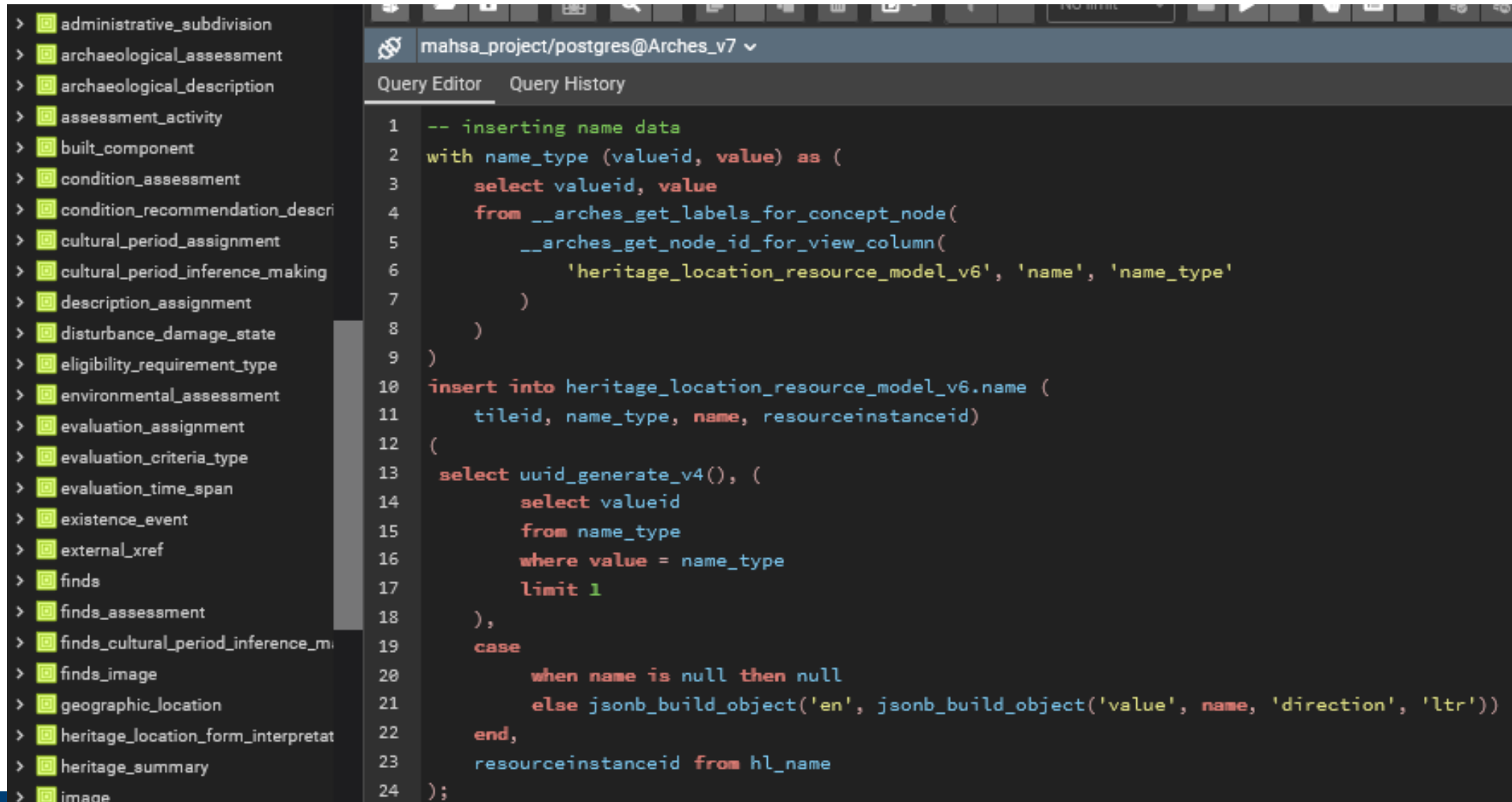
Name Vaniwali

Name Type Alternate Name(s)

1 / 2

Show All Features

# Import Data to Arches



The screenshot shows a PostgreSQL Query Editor interface. On the left, a sidebar lists various database tables with expandable icons. The main area displays a SQL query for inserting name data into the `heritage_location_resource_model_v6.name` table. The query uses a `with` clause to create a temporary table `name_type` from `__arches_get_labels_for_concept_node` and `__arches_get_node_id_for_view_column`. It then inserts data into the target table, selecting a UUID and a name value from `name_type`, with a `case` statement to handle null values and a JSONB object for the `direction` field.

```
1  -- inserting name data
2  with name_type (valueid, value) as (
3      select valueid, value
4      from __arches_get_labels_for_concept_node(
5          __arches_get_node_id_for_view_column(
6              'heritage_location_resource_model_v6', 'name', 'name_type'
7          )
8      )
9  )
10 insert into heritage_location_resource_model_v6.name (
11     tileid, name_type, name, resourceinstanceid)
12 (
13     select uuid_generate_v4(), (
14         select valueid
15         from name_type
16         where value = name_type
17         limit 1
18     ),
19     case
20         when name is null then null
21         else jsonb_build_object('en', jsonb_build_object('value', name, 'direction', 'ltr'))
22     end,
23     resourceinstanceid from hl_name
24 );
```



# Arches - Imported Data

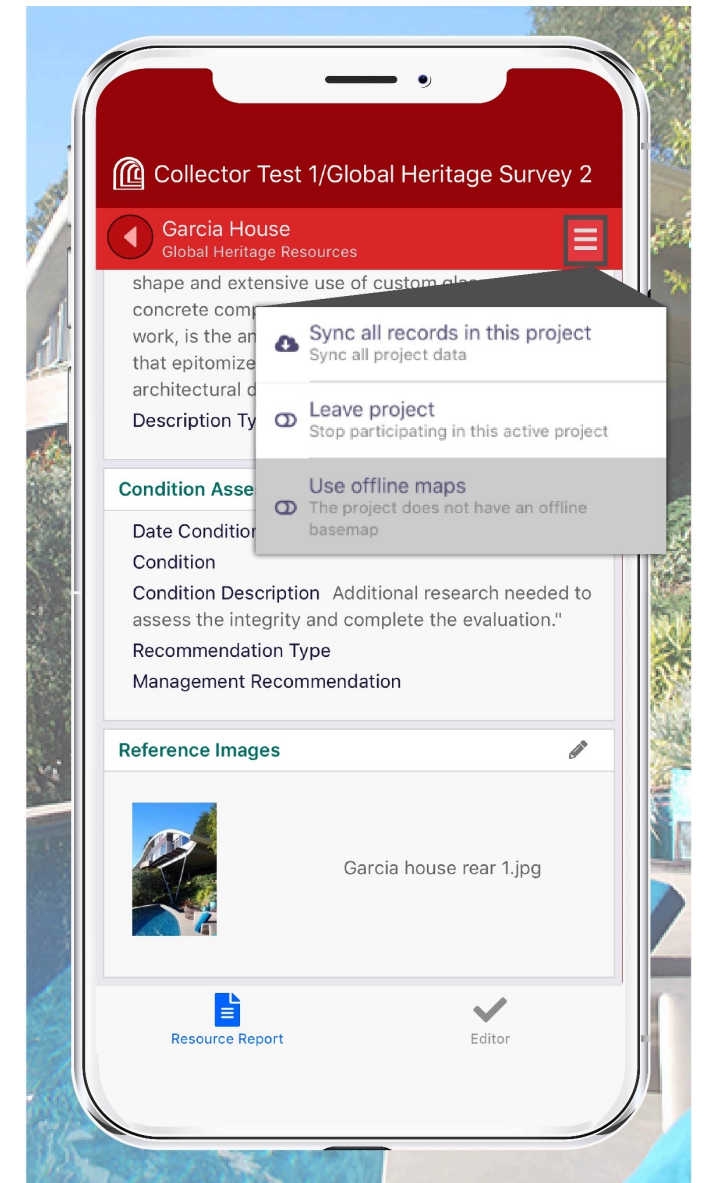
The screenshot displays the Arches interface with the following components:

- Top Bar:** Search bar, user profile (Welcome, admin), language (English (en)), and navigation icons (notifications, help, refresh).
- Left Sidebar:** Home, search, and navigation icons.
- Main Content Area:**
  - Filter Bar:** "Historic Maps Resource Model" (selected), "All (\*)", "QA Type", and "Resource Type".
  - Results:** "Results: 31", "Clear Filters", and "Ascending".
  - Resource List:**
    - Punjab No. 39 J 16, Formal title:** Maps created by the Survey of India Offices to help survey and consolidate the territories of the British East India Company and then the British Raj. (Buttons: Details, Edit, Map, Related Resources)
    - N.W. Frontier Province & Punjab No. 43 C 01\_1909, Formal title:** Maps created by the Survey of India Offices to help survey and consolidate the territories of the British East India Company and then the British Raj. (Buttons: Details, Edit, Map, Related Resources)
    - N.W. Frontier Province & Punjab No. 43 C 01\_1912, Formal title:** Maps created by the Survey of India Offices to help survey...
  - Map View:** A satellite map of a mountainous region with blue markers indicating resource locations. Includes a search bar, zoom controls, and a "Map Filter" button.
- Right Sidebar:** Filter, Basemap, Overlays, and Legend.
- Footer:** "DEBUG Arches 7.4.0" and pagination controls (1, 2, 3, 4, ..., 7).



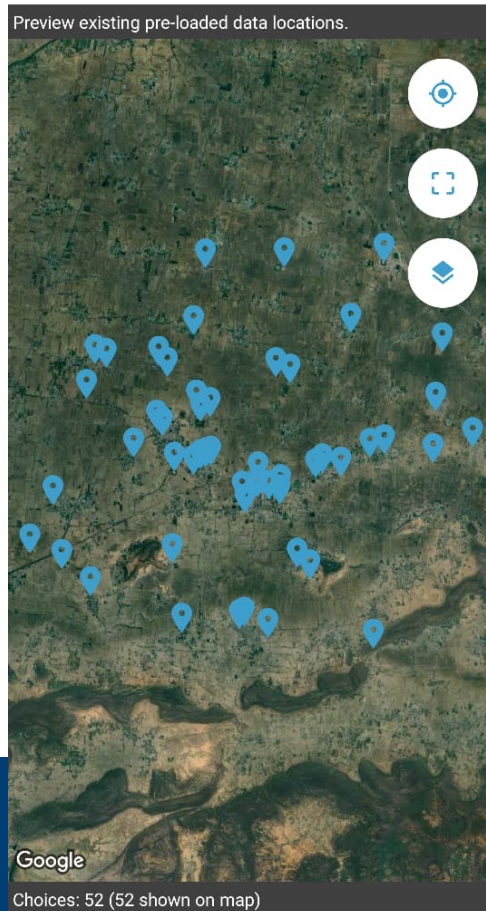
# Arches Collector

- Companion mobile data collection app for the Arches data management platform
- Variable pace of development for Arches and Arches Collector
- When updated, would provide an integrated system for data collection and validation



# Open Data Kit (ODK)

- ODK is an open-source mobile data collection platform.
- Offline Data Collection
- User scalability – stakeholder training
- Multilingual



11:27 87%

MAHSA Site Survey Fo...

Transect.

**\* Transect Questions**

What type of transect or assessment are you conducting?

Cross Transect

Parallel Transect

Parallel Transect

< BACK NEXT >

11:10 91%

MAHSA Site Survey Fo...

Site Condition Information.

Assess the overall condition and current state of the site.

Excellent/Undisturbed

Good

Partially Damaged/Poor

Heavily Damaged

No Feature/Mound Visible

Unknown/Not Clear

Record any past or current disturbances to the site.

Select Answer ▼

What percentage of the site is affected by damage?

1-10%

11-30%

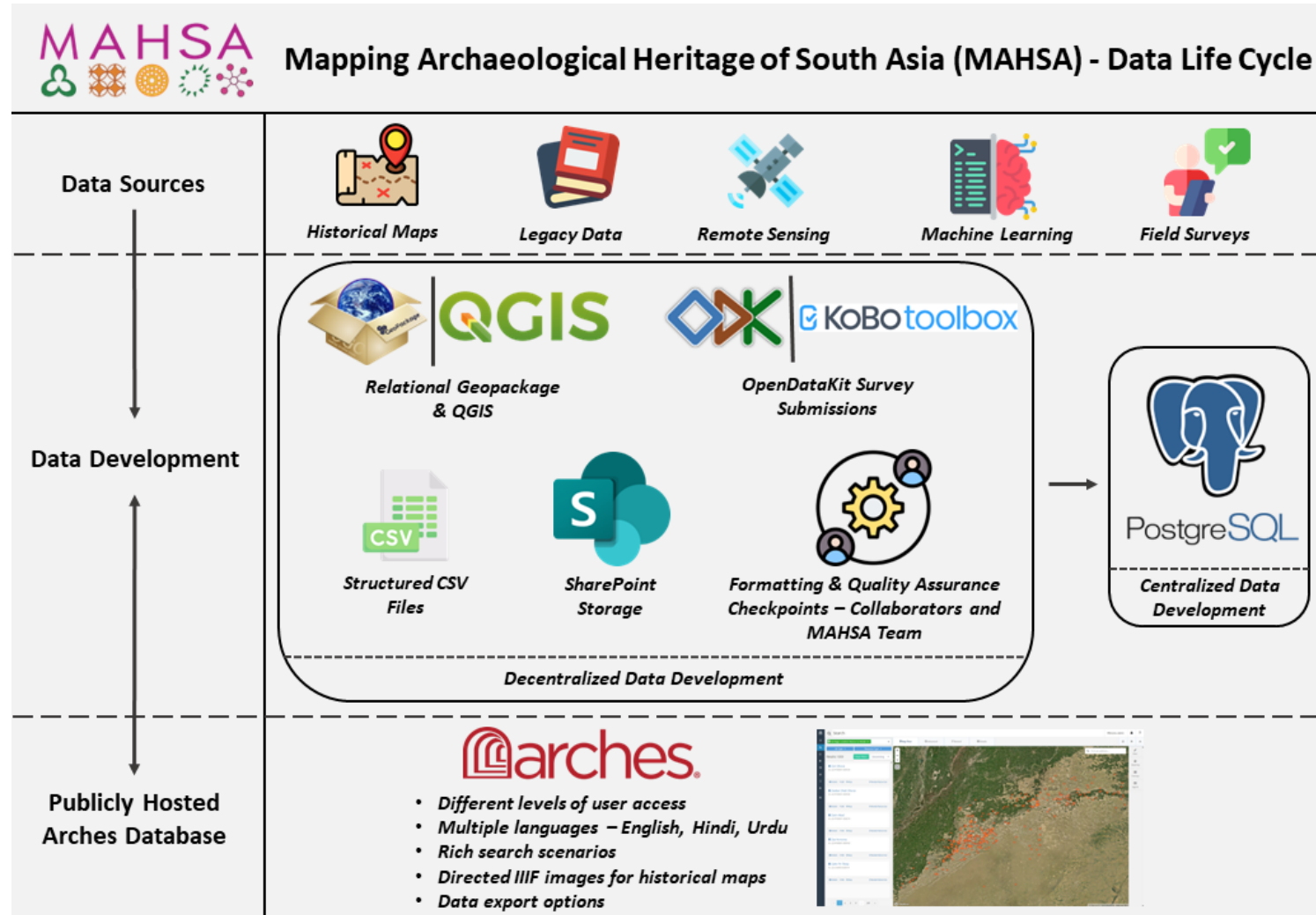
< BACK NEXT >

ODK



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# MAHSA Data Life Cycle



# Further Steps

- A new sustainability group
- Collaborative sustainability group meetings for multiple Arcadia funded projects
- Sustainability consultant for Arches
- Active community engagement



[archesproject.org](#) [about](#) [documentation](#) [code of conduct](#)



Welcome to the Arches Project Community Forum!

Expand Close

Do you want live notifications when people reply to your posts? [Enable Notifications](#)

all categories ▾

all tags ▾

Categories

Latest

New (3)

Unread (54)

Top

+ Open Draft

Category

Topics

Latest

News & Announcements

1 / month



Welcome to the Arches Project

0



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# Acknowledgements

- Arcadia Fund for generously supporting the MAHSA project
- Staff at the British Library and Cambridge University Library for their guidance and advice
- IIF Maps community for developing the standards, use cases and demos
- Teams at our sister Arcadia projects MAEASaM, CAAL, EAMENA, MarEA for their openness and support
- Teams from the *Land, Water & Settlement* and *TwoRains* projects for making a fundamental contribution to the development of many of the underlying methods being used by the MAHSA project



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# Thank you!

[www.mahsa.arch.cam.ac.uk](http://www.mahsa.arch.cam.ac.uk)

