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DEVELOPMENT OF AN ADAPTIVE GROUNDWATER MONITORING FRAMEWORK TO INFORM SALINITY MANAGEMENT ACROSS THE VICTORIAN MALLEE REGION

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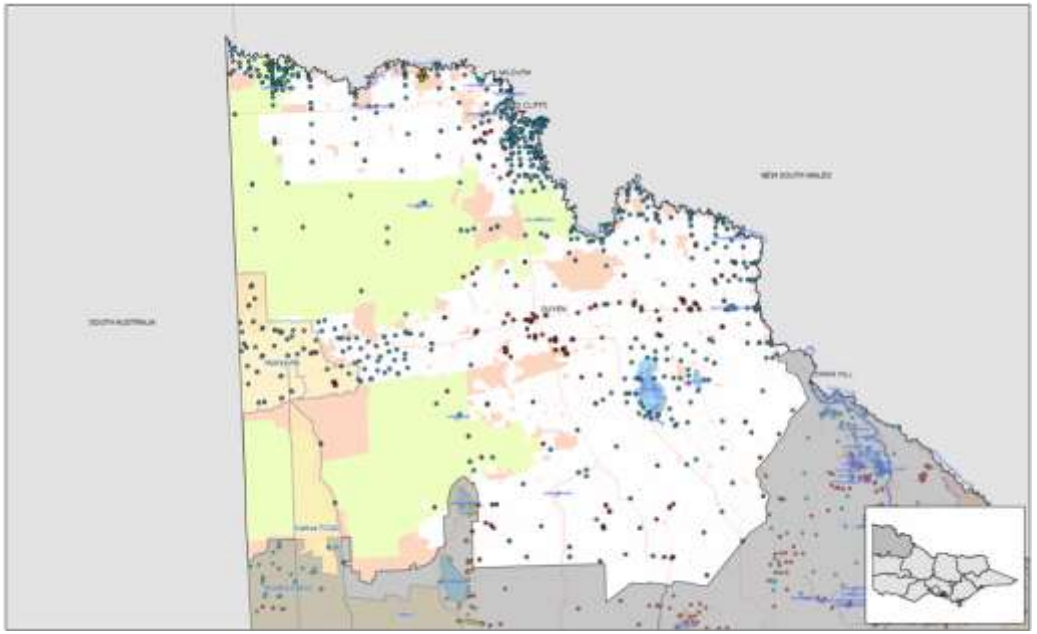
Outline

- **Background - Groundwater Monitoring and Program Development Project**
- **Groundwater Monitoring needs in the Mallee Region**
- **Regional Hydrogeology and Groundwater Monitoring**
- **Monitoring Framework Principles**
- **Application of the Framework**
- **Summary of Mallee CMA Groundwater Monitoring Network**



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Project Background

- STAGE 1 – Groundwater Monitoring and Database Development
  - Groundwater Monitoring - Once off monitoring run and bore condition assessment of the existing network and replacement bores
  - Develop a comprehensive groundwater monitoring database – bore records, water level, EC data from all networks/sources within the CMA region

- STAGE 2 - Develop a Groundwater Monitoring Framework to monitor the impacts of the Mallee CMA works and measures programs
  - for bore selection, methods for monitoring and analysis, data management requirements, reporting requirements, and a process for renewal and review

- STAGE 3 – Application of the framework to revamp the monitoring network

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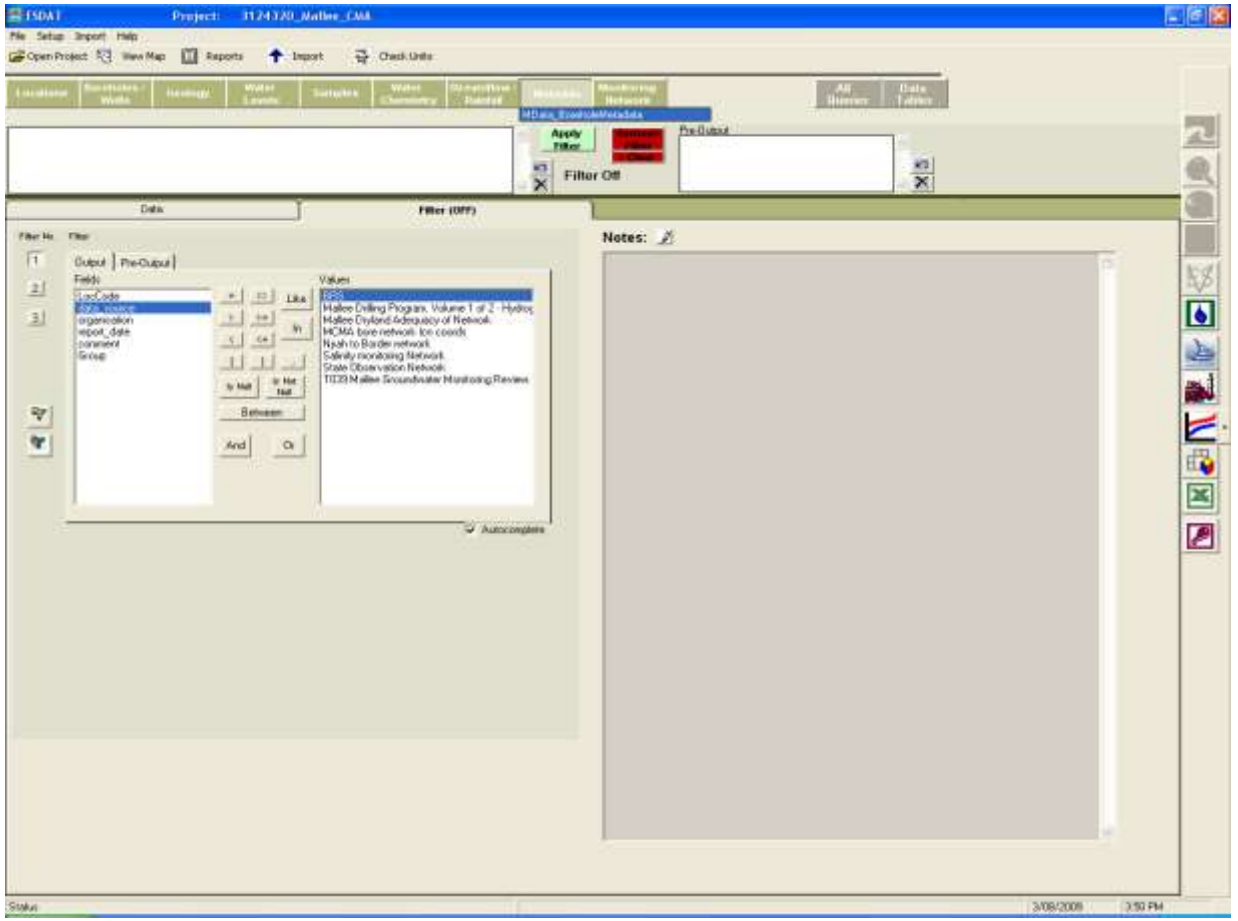
Stage 1 – ESDAT



ESDAT database, populated with following groundwater data:

- Borelog information includes – bores/location (1300) Total depth information (1125) and aquifer monitored (715)
- Groundwater level and salinity data (over 65,000)
- Surface Water Data – Murray River Lock levels / flow / EC
- Network Information – Select specific networks with new ESDAT Tab.
- Specific Bore condition table – Hyder bore network only
- Inbuilt QA system - Source of data – important for verification
- Rainfall/evaporation data from BOM sites within the Mallee Region

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Groundwater Monitoring Framework (Stage 2) and Design of the Bore Monitoring Network (Stage 3)

To provide the basis for a coordinated, comprehensive and effective groundwater monitoring, evaluation and reporting system to meet the needs of the Mallee CMA into the future.

Objectives:

- Develop a groundwater monitoring framework for the Mallee CMA
- Apply the groundwater monitoring framework to create a groundwater monitoring network based on the current needs of the Mallee CMA management programs

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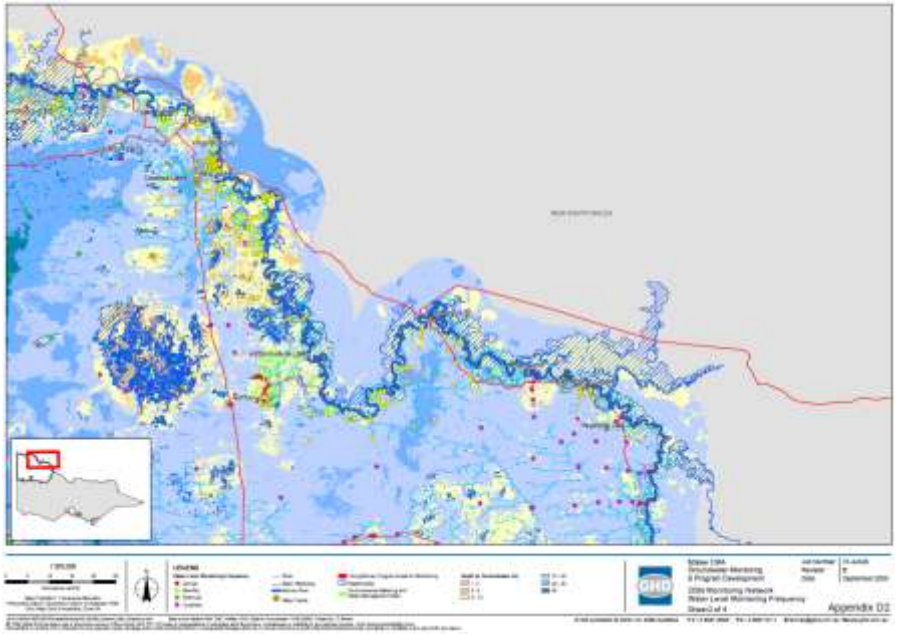
Groundwater Monitoring needs in the Mallee Region

- Mallee CMA programs
  - *Land and Biodiversity, Water Resources, River and Wetland Health*
- Federal and State Agreement obligations
  - *The Living Murray, MDBA (SDEs)*
- Victoria Groundwater Management Legislation
  - *EPA SEPP (Groundwaters of Victoria)*
- Future Funding Programs and Priorities
  - Caring for Country
  - Victorian Government Investment Funding Priorities
    - *Sustainable Irrigation Program*
    - *Sustainable Landscape Program*
    - *Natural Resources Investment Program*



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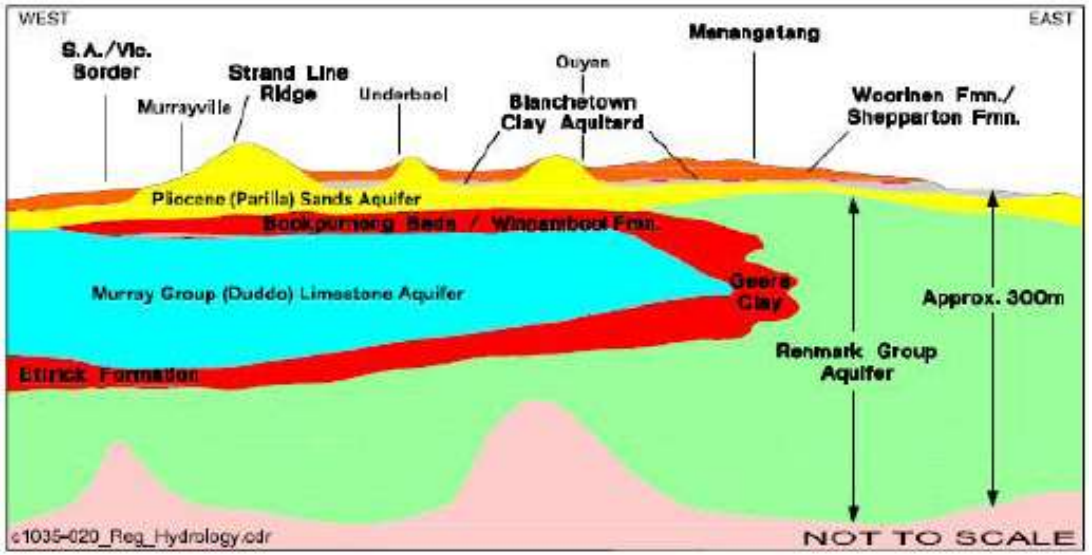
Regional Hydrogeology and Groundwater Monitoring

Hydrogeology – complex

- Numerous aquifers, groundwater flow, vertical leakage, perched aquifer systems
- Different groundwater recharge and discharge process , dryland / irrigation areas, floodplains and waterways



SKM (2004) Technical Support for the Mallee Salinity Management Plan

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Regional Hydrogeology and Groundwater Monitoring

Previous and current Groundwater Monitoring Programs

- >2000 bores
- 270 currently monitored by other organisations
  Department of Primary Industries
  Grampians Wimmera Mallee Water
  Department of Sustainability and Environment
- Mallee CMA's 2009 monitoring network

Program	No. Of bores	Years established	Monitoring Parameters	Frequency	Managed by
State Observation Bore Network (SOBN)	196	1960 onwards	GW	Quarterly to Annually	DSE
Mallee Mandatory Monitoring Program (T039)	353	1994	GW	Monthly to annually	Mallee CMA
New T039 Support Bores (shallow and deep)	49	2007	GW	Annually*	Mallee CMA
Nyah to Border Salinity management Bores	>600	1981	GW	2 – 6 monthly	Mallee CMA
Lindsay Wallpolla Floodplain Bores	109		GW, SW & WQ	2 – 6 monthly	Mallee CMA/MDBC
Murrayville Water Quality Bores	57	2003	GW, WQ	2003-2004 2006-2007	GWMWater
Murray River Floodplain Salt Storage Bores	6		GW, SW & WQ	Intermittent	MCMA
DPI Regional and "Shallow" network	300	Ongoing	Not monitored		DPI
Test wells	Unknown	Ongoing	GW	Variable	Developers
Mallee Mandatory Environmental Monitoring Program	14	1995	GW, SW, WQ & Vegetation	6 monthly	Mallee CMA
Salt Inception Scheme (SIS)	Unknown				Goulburn Murray Water

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Monitoring Framework Principles & Groundwater Monitoring Network Design

Framework Principles:

1. Groundwater Information Requirements
2. Design of a Groundwater Bore Monitoring Network
3. Monitoring Protocols for Groundwater Measurement and Sampling
4. Groundwater Data Analysis and Reporting
5. Groundwater Data Storage and Management
6. Framework Review and Renewal

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Principle 1 - Groundwater Information Requirements

The framework should reflect the relationship between the Mallee CMA Program areas and groundwater information requirements.

Specific monitoring needs of the Mallee CMA Programs

- Long term "Essential Baseline" monitoring
  (legislative obligations and baseline)
- Short term "Intervention" works monitoring
  (asset management effectiveness)

- Linking the Mallee CMA program needs with groundwater information requirements

Mallee CMA asset management unit	Essential monitoring requirement	Desirable monitoring requirement
Land and Biodiversity	Threat process knowledge needs (regional and sub regional), depth to water mapping to assess the risk to assets at risk from salinity. Required to: evaluate and report the effect of on ground works on the threat; evaluate and report on the impact of groundwater on regional assets; and evaluate and report on the Catchment condition (Mallee CMA, 2009).	Intervention works (including re vegetation programs for recharge control, saltbush planting for discharge control, biodiversity programs)
Water Resources	Modelling the Mallee's salt contributions to the Murray River and Salt Disposal Entitlement compliance monitoring needs as part of the State's MDBA BSMS responsibility	Intervention works (such as water use efficiency programs), Ecologically sustainable farming – Irrigation Environmental Management Action Planning (iEMAP)) Specific intervention work locations not provided, however on a sub regional scale these intervention processes occur in the irrigated areas along the Murray River.
River and Wetland Health	Living Murray Programs – Lindsay, Mulcra and Wallpolla Islands, Murray River, and Hattah Lakes	Intervention works and potential flooding sites.

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Principle 2 – Design of a Groundwater Bore Monitoring Network

In designing a groundwater monitoring program consideration should be given to the core factors associated with groundwater monitoring being: location; depth/aquifer (geology); bore separation; monitoring frequency and parameter to be measured (for example, depth and electrical conductivity).

- Consideration of core factors associated with groundwater monitoring
  - Location
  - Groundwater depth (target aquifer/s)
  - Separation distance
  - Frequency

Groundwater Depth (Target Aquifer(s)	Separation Distance	Frequency
Shallow (Murray Trench)	Small eg (< 5 km)	High (logger/daily/monthly), or Episodic
Medium (Parilla Sands)	Medium eg (5 km to 50 km)	Medium (quarterly to annually)
Deep (Renmark)	Large eg (> 50 km)	Low (bi annual/annually up to 5 - yearly)

- Mallee CMA Programs – specific monitoring network selection criteria

  Water Resources Management Unit example

Factor	Recommendation
Location	Irrigation areas and associated regional assets
Groundwater Depth /Target Aquifer(s)	Shallow to medium depth
Separation distance	Small for on-farm and asset-specific purposes; medium for regional trends
Frequency	Groundwater levels - High to medium for farm specific information; medium for regional trends Groundwater quality - Medium to low

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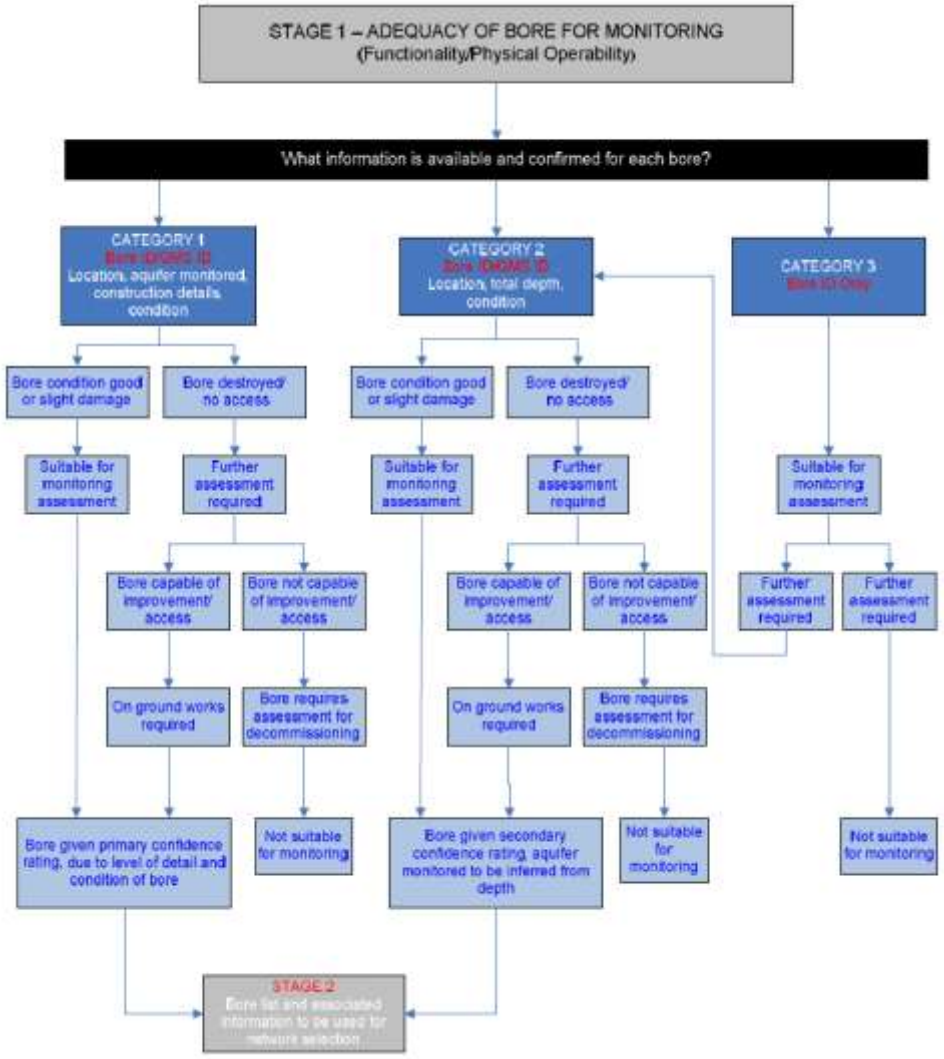
Principle 2 – Design of a Groundwater Bore Monitoring Network

Three Stage Process for Selecting Bores for the Network

Stage 1- Determination of the adequacy of bores for monitoring *(functionality and operability)*

- Condition
- Location
- Aquifer monitored
- Construction details (to determine current suitability for monitoring)



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Principle 2 – Design of a Groundwater Bore Monitoring Network

Stage 2 – Selection of bores to meet management objectives:

Meeting the specific monitoring objectives defined for the respective Mallee CMA programs

- Step 2A - selecting bores already tagged as needed to meet specific “essential baseline” monitoring needs.
- Step 2B - selecting bores from other networks that could potential be used to fulfil “essential baseline” monitoring requirements.
- Selected based on hydrogeological criteria
  - Are within the required aquifer to be monitored
  - Perched or regional water table monitoring requirement
  - Located on the asset management area

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Principle 2 – Design of a Groundwater Bore Monitoring Network

Stage 3 – Spatial assessment of the selected bores:

Review of selected bores in Stage 1 and 2 for areal coverage adequacy

- Assess bore density and distribution
- Determine the need for bore transects and nested bores
- Gap Analysis
  - Inclusion of new bores to address gaps
  - Bore Rationalisation - reducing the number of bores
  - Bore Rationalisation - reducing the frequency of monitoring or the parameters monitored

Repeat process for “intervention” monitoring bores

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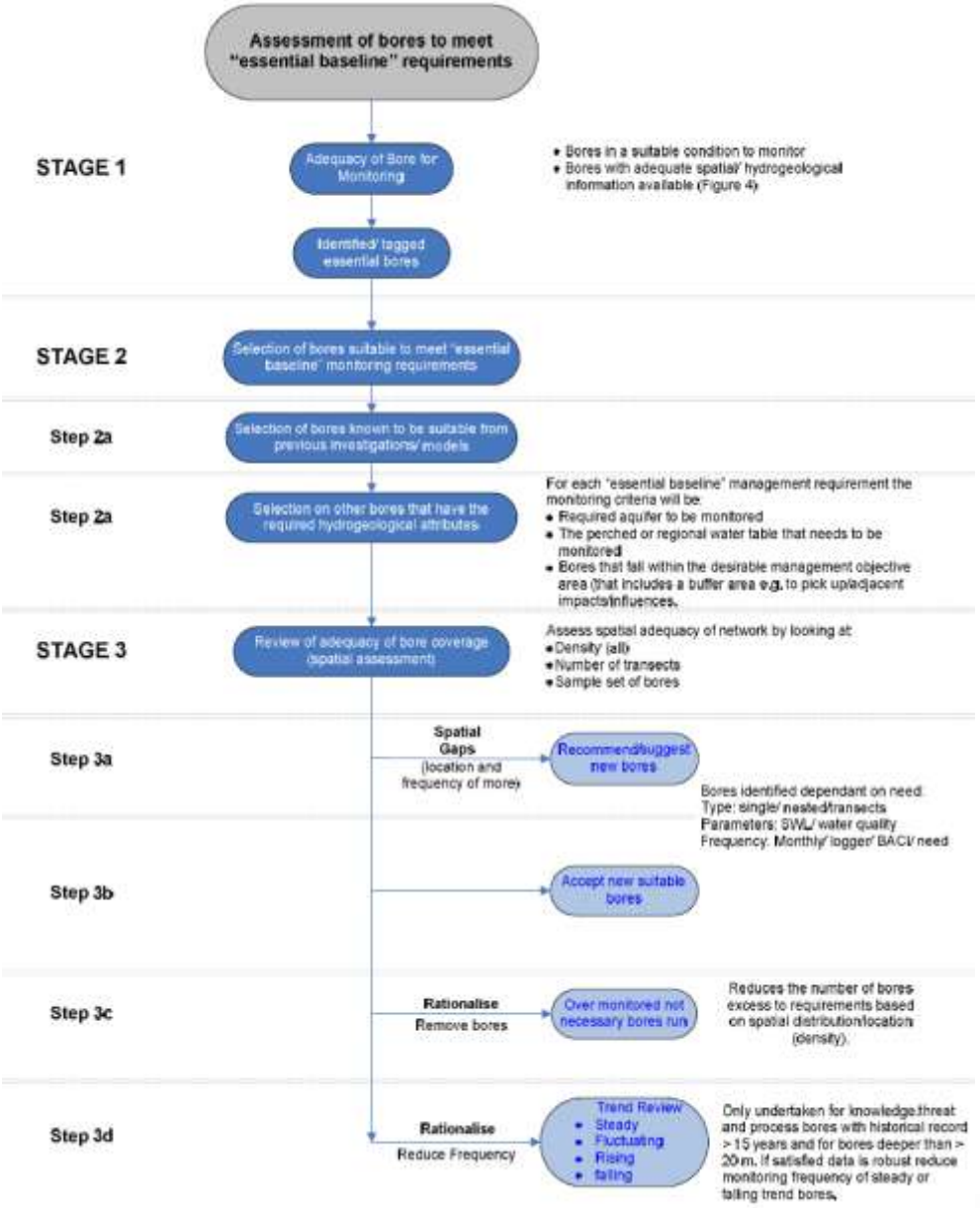
Selection process of bores to meet “essential baseline” management requirements



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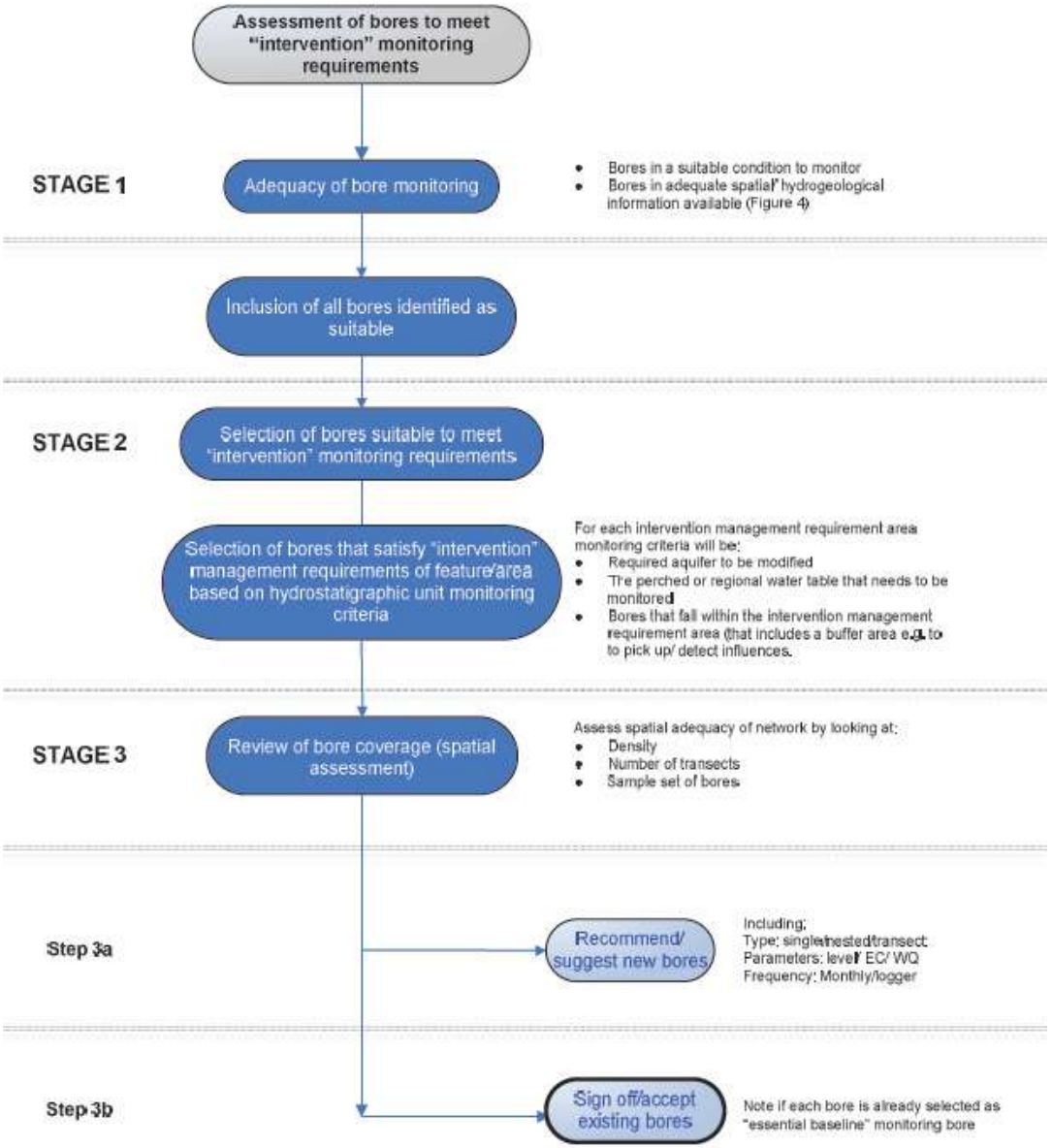
Selection process of bores to meet "intervention" management objectives



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Summary of the revamped Mallee CMA Groundwater Monitoring Network

Over 600 bores from the network, this includes:

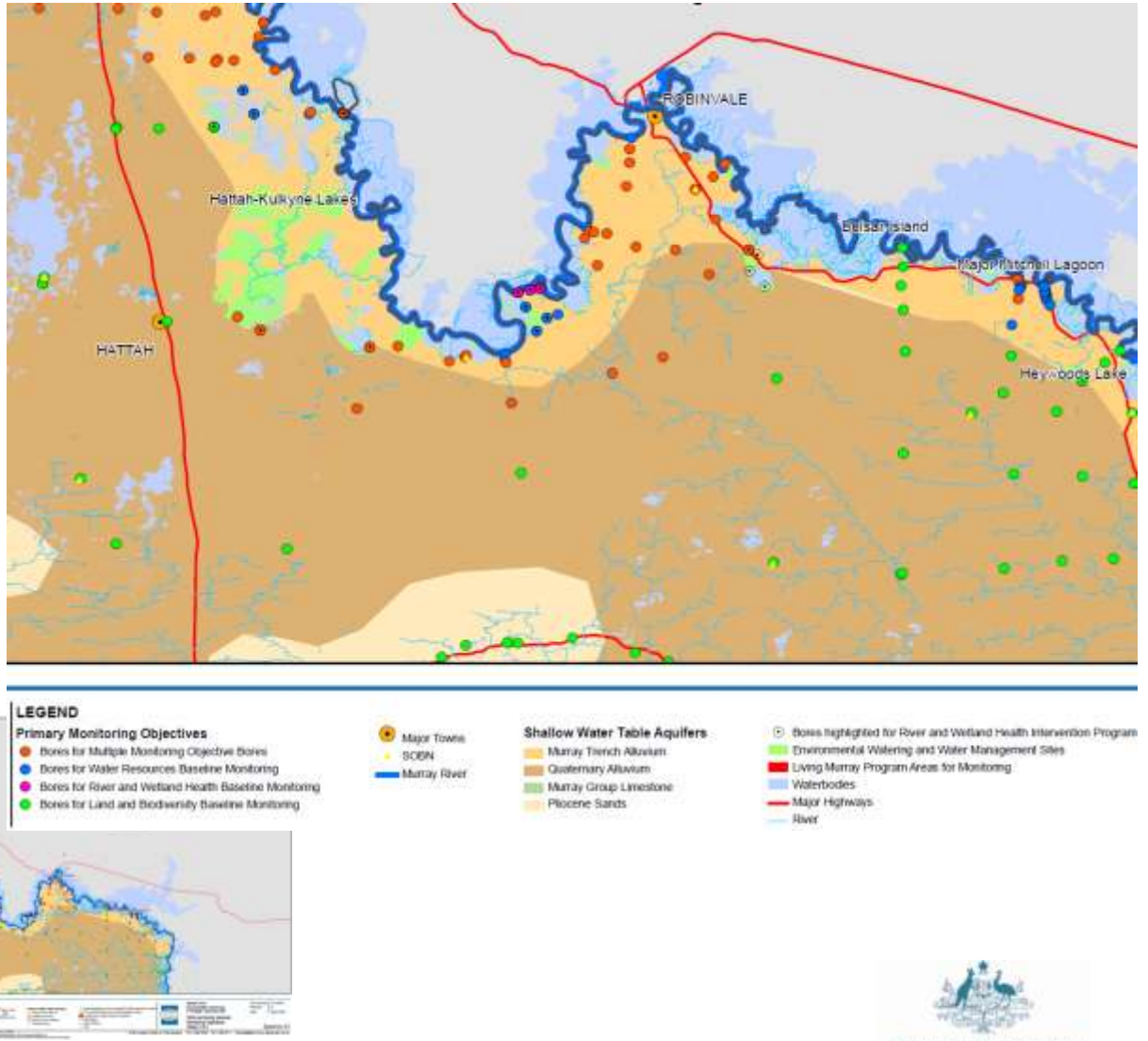
- 285 bores to inform groundwater models in the irrigated areas
- 154 Multiple – mostly between groundwater modelling and threat process
- 293 threat process monitoring
- 68 River and Wetland Health

Network is shown by each bores monitoring objective. Where more than one objective is met, this is shown as “multiple”.

Network is also shown by:

- Bore monitoring frequency
- Aquifer monitored

- Preserved in ESDAT



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Mallee CMA Groundwater Monitoring Network

- Rationalised – reduced frequency rather than number of bores

- Gaps
  - Adequate bores to meet the Water Resources objectives (although bore condition unknown for many)
  - Specific areas that are not adequately monitored (limiting Land Resources - threat process assessment and River and Wetlands Health unit) including:
  - Dryland plains area (salt bush planting in this area)
  - Ephemeral Creeks (transects missing adjacent surface water features)
  - Anabranch Island (essential site transects missing)

- Recommendations
  - Data Gap filling (total depth/aquifer monitored (down hole camera assessment and further bore log search); and
  - updated bore condition assessment of new bores
  - New bore investment strategy

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Principle 3 – Monitoring Protocols for Groundwater Measurement and Sampling

Methods for monitoring are to be based upon industry benchmark standards and practice as well as relevant guidelines. Where alternative methods are proposed for logistical reasons, the objectives of industry benchmark standards, practice and guidelines are still to be met.

- Monitoring / Sampling Protocols
  - Best practise guidelines for monitoring (EPA and MDBA) and Static Water Level and Electrical Conductivity (EC)
  - Sampling of Water Quality Parameters other than EC
  - Field Sheets
  - QA/QC – equipment calibration, data review
  - Permission to access bores (GWMW, DSE)

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Principle 4 – Groundwater Data Analysis / Reporting

The methods of analysis for groundwater data will be influenced by reporting requirements that will be determined with consideration to legislative reporting requirements, and other reporting recommendations. Emphasis is to be placed on outcomes, impacts and the processes driving the success or failure of management activities.

- Data Analysis:
  - Lists and describes groundwater interpretation and analysis tools (which are needed to inform on essential and desirable requirements) such as SWL, hydrographs, groundwater contour and flow maps
  - Specific data analysis requirements – from Essential baseline monitoring:
    - End of Valley Targets (DSE and MDBA needs)
    - Threat process assessment
    - The Living Murray (TLM) Program
  - Intervention Works – demonstrate effectiveness
- Reporting:
  - BSMS, TLM, BoM, Mallee CMA needs (annual and 5yr reviews)

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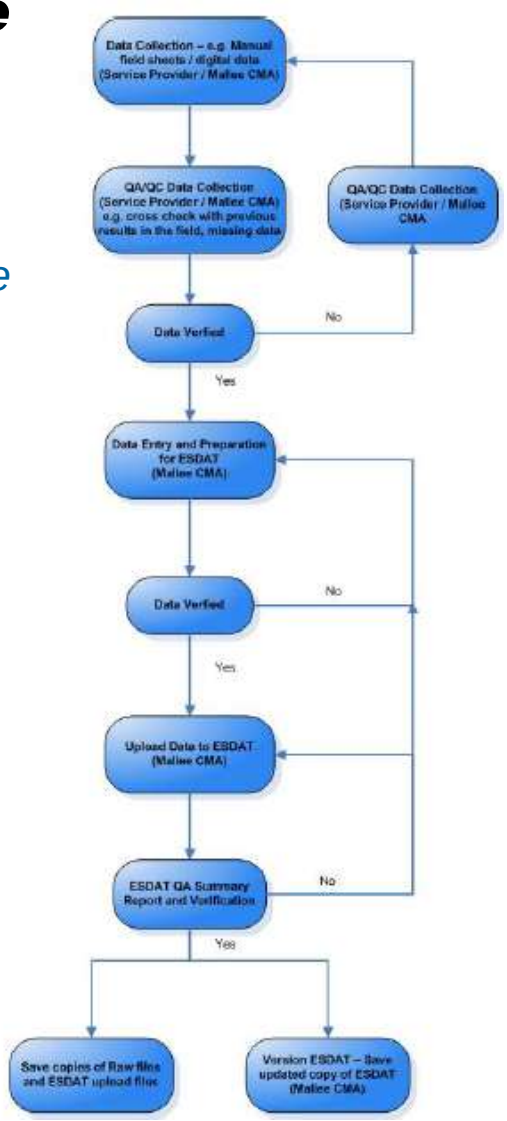
Principle 5 – Groundwater Data Storage and Management

Method for data management processes is to take into consideration specific internal and external data sharing/management strategies and allow for open and informative channels of controlled data storage and sharing.

- Major steps in storage and management:
  - Data compilation
  - Data verification
  - Data storage

- Provision of internal data management recommendations and guide for managing the ESDAT database

- ESDAT provision of data from / to external data management agencies (DSE, DPI, BoM)



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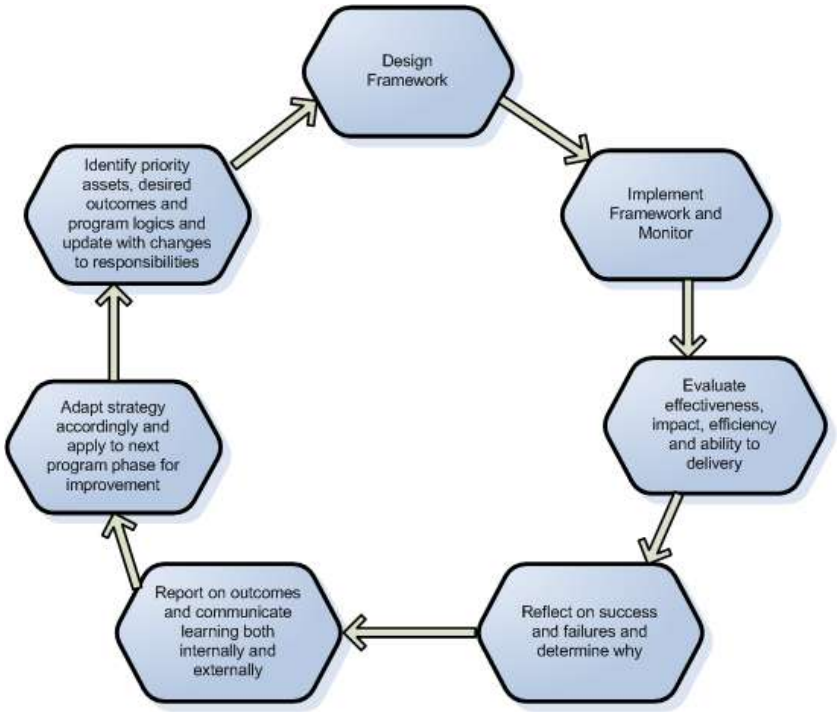
Principle 6 – Framework Review and Renewal

The Framework should be sufficiently generic such that it continues to meet the needs of the Mallee CMA following changes to program responsibilities, and that it can be assessed and amended with minimal effort.

- Why? – respond to changes in policies, strategies, funding
- Reviewed – internally (regular) and externally (every 5 yrs)
- Review needs to occur with all CMA program stakeholders



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