MICROSCOPY
AUSTRALIA

PRINCIPLES FOR A RESEARCH DATA MANAGEMENT POLICY FRAMEWORK

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1 PURPOSE AND OBJECTIVES

This policy framework sets outs guiding principles for the facilities and linked laboratories of Microscopy Australia to enable the research data created and generated by users at the facilities and linked

laboratories to be managed in a way that is compliant with the FAIR Data Principles and the institutional, regulatory and funding requirement.

2 DEFINITIONS, TERMS AND ABBREVIATIONS

ANDS is the Australian National Data Service.

FAIR guiding principles are a set of guiding principles for scientific data management and stewardship in order to make data Findable, Accessible, Interoperable and Reusable [1].

Metadata has the meaning given in section 7 of this document.

Open science has the meaning given in section 8 of this document.

RDMP means Research Data Management Plan.

Research data has the meaning given in section 6 of this document.

Research data management has the meaning given in section 10 of this document.

Researcher is a person who conducts, or assists with the conduct of, research as defined in the Code. Note, the definition of a researcher used by institutions and funding organisations in their respective policies may vary and be more limited or broader than that used in the Code and thereby this document.

The Code refers to the *Australian Code for Responsible Conduct of Research (2018)* [2].

The Guide refers to the guide on *Management of Data and Information in Research supporting the implementation of the Code* [3].

The Roadmap refers to *the eResearch Roadmap 2019 report* of Microscopy Australia [4].

User is a researcher who creates, generates, collects, inputs, amends, appends, deletes, extracts or analyses research data at or from a facility or a linked laboratory associated with Microscopy Australia but is not a staff member of the facility or linked laboratory.

3 SCOPE

This policy framework is a recommendation to all staff (academic, professional or technical) at Microscopy Australia facilities and linked laboratories who are involved in the collection, creation, generation and/or management of research data. This is applicable to all research data, irrespective of format, size, origin and funding source, and subject to the provisions of any contracts, or funding, partnerships or collaboration agreements relevant to the institution and the facility or linked laboratory where the research project is conducted, and the facility or linked laboratory staff and user who conduct the research project.

4 STATEMENT OF INTENT

This policy framework:

(a) promotes the FAIR guiding principles and open science in the conduct of research;

(b) describes principles for good practice in the management of research data to assist in the implementation of the FAIR guiding principles at every stage of the lifecycle of research data;

(c) espouses and is complementary to the values expected from research institutions and researchers stated in the Code and supported in the Guide; specifically:

(i) principle 2: *"rigour in the development, undertaking and reporting of research"*;

(ii) principle 3: *"transparency in declaring interests and reporting research methodology, data and findings"*;

(iii) principle 7: *"accountability for the development, undertaking and reporting of research"*; and

(iv) principle 8: *"promotion of responsible research practices"*.

(d) adheres to, specifies and provides a framework for the implementation of the conclusions and the recommendations of the Roadmap; in particular:

   (i) a formal and coordinated programme management framework to impulse change in practices, procedures and policies across Microscopy Australia is critical and will contribute to its success;

   (ii) adopting a standardised approach to research data management across all facilities, including identifying and agreeing upon accountability and expectations of all stakeholders, will increase compliance and capability across Microscopy Australia and maximise impact; and

   (iii) defining and using standardised referencing tools including metadata, persistent identifiers and unique identifiers, and embedding research data management and FAIR principles across all tools and practices across Microscopy Australia, streamline and lead to capability building in research data management, informatics, training and reporting.

(e) complements, contextualises and does not replace nor supersede existing policies, procedures, provisions or guidelines pertaining to the topics of research data and management thereof and already applicable to Microscopy Australia facilities and linked laboratories through their host institutions;

(f) supports existing initiatives and facilitates planning for future initiatives to develop guidelines, provisions, procedures, policies, infrastructures, systems and services that both enable the implementation of the FAIR guiding principles and enhance good practices in the research data management at Microscopy Australia facilities and linked laboratories (or at the institutions hosting them);

(g) acknowledges the existing and evolving local operational environment with regard to research data management (policies, procedures, provisions, guidelines, infrastructures, systems, services and funding) at Microscopy Australia facilities and linked laboratories and at the institutions hosting them;

(h) acknowledges national and international initiatives to improve reuse of, sharing of and access to research data collections, including the *Policy Statement on F.A.I.R. Access to Australia's Research Outputs* [5]; and

(i) explains, makes explicit and describes terms, concepts, recommendations, expectations and responsibilities in relation to the management of research data across Microscopy Australia.

5 BACKGROUND INFORMATION

5.1 The Roadmap identified issues and challenges in how research data were managed across Microscopy Australia facilities, in particular in the areas of transfer of data, long-term storage of data and preservation of data. Given that the five-year plan of Microscopy Australia has aimed to build harmonised data processing, handling and storage capacities for all users, enabling efficient sharing of workflows and knowledge through policy development was recommended. Consequently, developing good practices and awareness and assisting in research data management, embedding those practices at every step of the data lifecycle from the stage when research data are created or generated, promoting the FAIR guiding principles and keeping abreast of technology advances—in, for example, data management, including big-data management—were identified as key areas that would deliver positive outcomes to each facility of Microscopy Australia and Microscopy Australia as a whole. The Roadmap acknowledged that despite the likely high-impact benefit of enhancing research data management overall, implementing good practices in research data management across Microscopy Australia may require significant changes in habits.

5.2 The approach to research data and research data management has been diverse nationwide across

research institutions, including universities. While, in general, research data have been increasingly considered as a strategic asset for research institutions, not all universities, in particular amongst those hosting facilities and linked laboratories of Microscopy Australia, have developed specific policies or procedures on research data management. However, all of the institutions hosting Microscopy Australia facilities and linked laboratories have put in place frameworks, platforms, guidelines and/or training resources that collate information in a single space available to researchers in order to assist them in their research data management and storage.

Note: See Schedule 1 and Schedule 2 for a list of the publicly available policies and procedures or guidelines, respectively, on research data management at the institutions hosting Microscopy Australia facilities and linked laboratories.

5.3   Increasingly, funding bodies and scholarly publishers have promoted the use of or required effective research data management plans, consistently with the responsibilities outlined in the Code; notably:

(a)   since February 2020, the Australian Research Council (ARC) has required that full, detailed data management plans be submitted prior to the commencement of ARC-funded projects in the Discovery and Linkage programs[1];

(b)   all research funded by the National Health and Medical Research Council (NHMRC) must comply with all elements of its *Open Access Policy* [6] which supports the *Policy Statement on F.A.I.R. Access to Australia's Research Outputs*. In particular, the policy *"strongly encourages researchers to take reasonable steps to share research data and associated metadata arising from NHMRC-supported research"*;

(c)   in the guidelines published for the National Collaborative Research Infrastructure Strategy (NCRIS) [7], the FAIR guiding principles are explicitly embedded in the management of research data: *"data generated, created, captured or stored by NCRIS funded projects will be made available to the wider research community based on the F.A.I.R. principles, appropriately implemented for individual research communities"*; and

(d)   all grant opportunities funded by the Medical Research Future Fund (MRFF) and administered by the NHMRC must adhere to the Guide, and MRFF grant opportunities administered by the Business Grants Hub specify requirements, where relevant, that align with NHMRC policy. Individual MRFF grant opportunities can also include additional requirements for applicants to be eligible or competitive for funding. For example, the guidelines of the Genomics Health Futures Mission – Project Grant scheme require a data management plan amongst the eligibility criteria [8]. Specifically, *"[a]t a minimum, these management plans should include the storage, security, access, sharing and re-use arrangements for the data. It is not sufficient to state that the organisation has a data management policy. [...] [Genomics Health Futures Mission] research projects proposals with plans to manage […] data in alignment with the FAIR principles […] are preferred."*

6   RESEARCH DATA

6.1   There is no authoritative definition of research data. However, in the *ANDS Guide* [9], the ANDS notes that from the point of view of an institution with a responsibility for managing research data, research data include:

(a)   all data created by researchers in the course of their work, and for which the institution has a curatorial responsibility for at least as long as the Code and relevant archives or recordkeeping acts require; and

(b)   third-party data which may have originated within the institution or come from elsewhere.

6.2   A review of data management policies, procedures, frameworks and training material available at the institutions hosting Microscopy Australia facilities and linked laboratories suggests a consensus view that research data:

(a)   are created, acquired, generated or observed by researchers in the course of research

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[1] https://www.arc.gov.au/policies-strategies/strategy/research-data-management

projects and upon which a theory, a hypothesis, an argument or another research output is based;

(b)   are diverse in nature and include data that are quantitative (numerical) and qualitative (visual or descriptive); and

(c)   are raw, cleaned, processed or annotated and encompass both born-digital and digitised data.

Note: See Schedule 3 for the definitions for research data (if any) currently used by the institutions hosting Microscopy Australia facilities and linked laboratories.

6.3   There is no unequivocal distinction between research data, research records and primary materials. In some disciplines or in some settings, research records and primary materials may be considered research data. Note, the Code makes no difference between:

(a)   research data, research records and primary materials in the responsibility of institutions for storage and management (responsibility 8); and

(b)   research data and primary materials in the responsibility of researchers for recordkeeping (responsibility 22).

6.4   Although not strictly research data, any software, algorithm, computer code and script used to acquire, create, generate, analyse or modify research data may be considered as "supporting research data" in order to enhance the reproducibility of research results and the FAIR guiding principles. Therefore, it is recommended that policies, procedures, provisions and guidelines applicable to research data also be applied to the associated supporting research data.

Note: Some institutions have included considerations for software associated with research data in their definition of research data. See Schedule 3.

7   METADATA

7.1   The ANDS defines metadata as the *"information about an object or resource that describes characteristics such as content, quality, format, location and contact information"* [10].

7.2   Metadata on research data is research data. Therefore, policies, procedures, provisions and guidelines applicable to research data also apply to the associated metadata.

7.3   Metadata can describe physical objects (*e.g.* specimen, sample, instrument, camera) or digital objects (*e.g.* document, image, dataset, software, software version).

7.4   Metadata can be free text or follow a standardised, structured, machine-readable, extensible format.

7.5   Metadata can be:

(a)   embedded within the data file;

(b)   recorded in a separate file that is linked to the data file or data files that it describes; or

(c)   contained in a catalogue record that points to the associated data.

8   OPEN SCIENCE

8.1   The OECD defines open science as *"efforts by researchers, governments, research funding agencies or the scientific community itself to make the primary outputs of publicly funded research results—publications and the research data—publicly accessible in digital format with no or minimal restriction as a means for accelerating research"* [11].

8.2   Open science enhances transparency, collaboration and interoperability and extends those concepts to the whole research cycle, fostering sharing and collaboration as early as possible in the research process[2].

8.3   Open science is multifaceted and encompasses several aspects, including open access, open

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[2] https://www.fosteropenscience.eu/node/1420

research data, open collaboration, open research notebooks, open access to research materials, open-source software and post-publication peer review.

8.4 Open science promotes the accessibility and sharing of research data and codes (for the collection, reduction, analysis and visualisation of data) that underpin publications in order to support validation, facilitate reuse and enhance the emergence of knowledge building upon previous data (subject to relevant restrictions and confidentiality agreements).

8.5 In Australia, open science, in particular open access, is promoted by funding organisations, including the Australian Research Council (ARC) [12] and the National Health and Medical Research Council (NHMRC) [6], and a range of universities, in particular through the Council of Australian University Librarians (CAUL) [13] and the Australasian Open Access Strategy Group (AOASG)[3].

9 FAIR GUIDING PRINCIPLES

9.1 The FAIR guiding principles are a set of four high-level, concise principles (Findability, Accessibility, Interoperability, and Reusability) that can be used as a guideline in data management and data stewardship. The core aim is to enhance the reusability of scholarly data. Notably, the FAIR principles put specific emphasis on enhancing the ability of machines to automatically find, read and use data. The FAIR principles were initially published by a group of individuals and organisations representing academia, industry, funding agencies, and scholarly publishers [1].

9.2 The FAIR guiding principles are:

(a) technology-agnostic: there is neither assumption on nor suggestion of the methods, the techniques or the tools used; for example, for the handling and preparation of specimens and samples and for the acquisition, cleaning, processing, analysis and storage of data;

(b) standard-independent: there is neither assumption on nor suggestion of the standard, rules or convention to use for data and metadata;

(c) discipline-independent: the FAIR guiding principles can be applied to all fields of scholarly research (*e.g.* science, technology, engineering, mathematics, medicine).

9.3 The FAIR guiding principles are applicable to both research data and metadata.

10 RESEARCH DATA MANAGEMENT

10.1 Research data management is an ensemble of practices involved in the planning, collection, organisation, storage, preservation, documentation and sharing of research data during a research project in order to:

(a) maintain the quality and the integrity of research data; and

(b) ensure compliance with legal, regulatory, ethical and funding requirements.

10.2 Research data management is intrinsically linked to the research data lifecycle that describes and identifies the steps to be taken at the different stages of the research cycle from the creation of data to the preservation of data beyond publication and the end of the research project.

Note: See Appendix 1 for a schematic representation of the research data lifecycle.

10.3 Effective and successful management of research data can:

(a) enhance research impact by maximising the visibility of research data and promoting transparency in research;

(b) improve accessibility to research data by ensuring that the quality and integrity of research data are maintained during and beyond the lifetime of the research project;

(c) ensure responsible use and reuse of research data, including by attributing appropriate authorship via citations and by following confidentiality obligations, legislation, privacy or

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[3] https://aoasg.org.au/about

ethical principles or other guidelines associated with the research data; and

(d)   safeguard and future-proof research data by establishing appropriate and secure short-term and long-term storage of data; as a consequence, the risk of research data loss or corruption, or breaches in confidentiality obligations, legislation, privacy or ethical principles or other guidelines associated with the research data, is minimised.

10.4   Research data management is embedded in the principles of the Code, specifically in:

(a)   *"rigour in the development, undertaking and reporting of research"*, which requires that research be conducted with attention to detail and robust methodology and avoid or acknowledge biases (principle 2);

(b)   *"transparency in declaring interests and reporting research methodology, data and findings"*, which requires that research methodology, data and findings be shared and communicated openly, responsibly and accurately (principle 3);

(c)   *"accountability for the development, undertaking and reporting of research"*, which requires that researchers comply with relevant legislation, policies and guidelines, ensure good stewardship of public resources used to conduct research and consider the consequences and outcomes of research prior to its communication; the latter is specifically important in relation to research data being and remaining compliant with the FAIR principles beyond the publication of the research outcomes that they underpin (principle 7); and

(d)   *"promotion of responsible research practices"*, which requires that a research culture and environment that supports the responsible conduct of research be promoted and fostered; in particular in the context of research data management, in relation to supporting and enabling high-quality research, credibility, integrity and community trust in researchers and institutions engaged in research (principle 8).

11   POLICY FRAMEWORK PRINCIPLES

11.1   The five principles described hereunder for this policy framework for research data management are primarily guided by and contribute to the implementation of the FAIR principles, the Code, the Guide and the *ANDS Guide on data management plans* [14].

11.2   These five principles contribute to embedding the FAIR principles and the recommendations from the Guide in the development and the implementation of, or towards the development of, procedures, policies, good practices and guidelines for research data management across Microscopy Australia facilities and linked laboratories.

Principle 1: Research data management planning

11.3   Facilities, linked laboratories and their users are strongly encouraged to develop or take reasonable steps towards the development of a Research Data Management Plan (RDMP).

Note: See Schedule 4 for list a research data management planning tools and resources at the institutions hosting Microscopy Australia facilities and linked laboratories.

11.4   Facilities and linked laboratories are encouraged to ensure that a Research Data Management Framework is available locally or at their host institutions in order to support the development of an effective RDMP.

Note: See Schedule 1 and Schedule 2 for a list of the publicly available policies and procedures or guidelines, respectively, on research data management at the institutions hosting Microscopy Australia facilities and linked laboratories.

Principle 2: Definition of research data ownership, stewardship and custodianship

11.5   Facilities and linked laboratories are encouraged to develop or seek clear definitions from relevant stakeholders for data ownership, data stewardship and/or data custodianship that are shared and understood by all stakeholders, including facility and linked laboratory staff, users (including higher-degree-by-research students) and the host institution.

Note: There should be no confusion between the ownership of intellectual property rights that may exist in research data and the ownership of research data. Research data ownership does not override intellectual property ownership and the rights pertaining to it, unless specified in contractual provisions.

11.6 The identification and the definitions of the roles and responsibilities—if relevant—of the data owner (owners), data steward (stewards) and/or data custodian (custodians) should be described and documented.

11.7 Facilities and linked laboratories are encouraged to identify the existence, the roles and the responsibilities of third parties (*e.g.* data co-ownership) who may have a contractual interest in the user's research data (*e.g.* an industry partner co-funding the research project).

Principle 3: Identification and documentation of research data

11.8 Facilities and linked laboratories are encouraged to develop tools and procedures to identify and document research data using metadata and persistent identifiers (*e.g.* Digital Object Identifiers, handles).

11.9 Metadata and persistent identifiers can provide information about, without being limited to:

(a) the content, nature and source of the research data (*e.g.* instrument, instrument settings, measurement conditions, nature of the sample, origin of the sample);

(b) the identity of the researcher or researchers associated with the research data;

(c) the research project and the funding source or sources associated with, and the publications or publications underpinned by the research data;

(d) the date when and the location where the research data are created or generated; and

(e) the software and software version used to acquire, process and analyse the research data.

11.10 Whenever possible, the capture of metadata and persistent identifiers should be automated when research data are collected off instruments or transferred to storage services, in order to limit human intervention and enhance accuracy and reliability of metadata [15].

11.11 It is recommended to include the description of and documentation on data ownership, data stewardship and data custodianship in metadata.

Principle 4: Preservation of research data quality and integrity

11.12 Facilities and linked laboratories are encouraged to define or take reasonable steps towards the definition of basic and minimum data quality standards and ensure that all research data meet such minimum requirements. Applying standards will ensure that research data can be reused reliably and remain interoperable, and overall, will ensure that research data comply with the FAIR principles [15].

11.13 The quality and the standardisation of research data are underpinned and upheld by:

(a) using standardised, publicly documented national, international or well-established disciplinary data and metadata definition and formats;

(b) developing procedures and workflow that validate the integrity of research data and dataset (accuracy, completeness and reliability); and

(c) managing the research data lifecycle carefully in order to determine what type of and when research data can be stored, archived or deleted.

Principle 5: Ensuring research data storage, access and security

11.14 Facilities and linked laboratories are encouraged to ensure secure and safe storage of and access to research data until at least the ownership, stewardship and/or custodianship of the research data, and the responsibility for the management of the research data are transferred to the user.

11.15 Access to research data by third parties, in particular in the case of research collaboration agreements or other research-related contracts or agreements, or upon the user leaving the

institution or the research project, should be granted under the policies, procedures, provisions, guidelines, agreements and arrangements relevant to the research data (*e.g.* confidentiality agreements, industry partnerships and ethics approvals).

11.16 The security of research data should be upheld by appropriate measures and protocols that include infrastructure security measures and ensuring the adhesion to best practices regarding access to research data.

12   RESEARCH DATA MANAGEMENT PLAN

12.1   Research data have a longer lifespan than the research project. They evolve with the project and can lay the foundation for future research projects and funding. A Research Data Management Plan (RDMP) is therefore essential. A clearly defined RDMP is the cornerstone of an effective research data management strategy while both mitigating the risks associated with research data and enhancing their impact.

12.2   Most institutions hosting Microscopy Australia facilities and linked laboratories have developed or are in the process of developing research data management planning tools and online platforms which can assist in designing a RDMP, managing research data or storing research data, and have provided guidelines and training resources.

> **Note:**   See Schedule 4 for list a research data management planning tools and resources at the institutions hosting Microscopy Australia facilities and linked laboratories.

12.3   An effective RDMP is supported by a Research Data Management Framework. A Research Data Management Framework rests upon five capability-building pillars [16]:

(a)   institutional or local policy and procedures in accordance with the Code and other legal, regulatory, ethical and funding requirements;

(b)   information-technology infrastructure (hardware, software, facilities) that support research and metadata-related activities;

(c)   services that can provide advice and support (*e.g.* online toolkits and training materials);

(d)   metadata management to embed the FAIR guiding principle; and

(e)   research data management and storage in accordance with the FAIR guiding principle.

12.4   A RDMP records the formal plan for the storage, retention and disposal of and access to research data that is created or generated over the course of a research project.

(a)   A well-defined RDMP allows facilities, linked laboratories and users to have a clear and shared understanding of how research data are managed throughout the data lifecycle, in particular regarding the future of research data (retention or deletion).

(b)   The RDMP describes and documents:

(i)   the management of the research data before the project has started (including at the initial design and planning phase of the project), during the life of the research project and after the research project has finished; and

(ii)   the rules and procedures that apply to the collection, storage, use, reuse, access, retention and disposal of the research data created and generated over the course of the research project.

12.5   Microscopy Australia strongly encourages facilities, linked laboratories and users to establish and maintain RDMPs; specifically:

(a)   each facility and linked laboratory is encouraged to develop a Facility RDMP to manage the research data of their users until at least the ownership, stewardship and/or custodianship of research data and the responsibility for the management of the research data are transferred to the user; and

(b)   each user is encouraged do develop a User RDMP in collaboration and partnership with the

facility or linked laboratory.

12.6 A RDMP is a living document. It is updated whenever necessary to reflect when the research data management requirements or capacities of the research change significantly from those described in the current Facility RDMP or User RDMP.

12.7 Following the recommendations of the Guide, a RDMP can include consideration for, and is not limited to:

(a) the type and volume of research data created and generated, the instrument(s) used and the form in which the research data will be stored;

(b) the types of metadata and persistent identifiers captured, and the metadata standard(s) used to describe the research data;

(c) the value and sensitivity of the data created, in particular in relation to contractual and licensing arrangements, confidentiality agreements and ethics approvals;

(d) the institutional, local, legal, ethical and regulatory policies, procedures, provisions, guidelines, agreements and arrangements that apply to the RDMP and the research data, in particular in relation to: data ownership, stewardship and/or custodianship; the responsibility for data management for the facility or linked laboratory and the user; and upon the user leaving the institution or the research project;

(e) the physical, network and system security measures and any other technological security measures implemented for the storage of research data (including locks for physical storage, password-protected encryption and secure protocols to transfer data), in particular in cases where research data are not stored on networks and facilities approved or managed by the facility or linked laboratory or the host institution (for example when travelling or collaborating interstate or overseas);

(f) the training for the user and the user's project team, as appropriate;

(g) the purposes for which the data or information will be used, disclosed and shared (and with whom);

(h) the communication of data by publication or alternatively, the conditions under which access to or reuse of the data or information may be granted to third parties, in particular in the case of collaborative research; and

(i) what information from the RDMP, if any, needs to be communicated to potential participants or interested parties (*e.g.* patients and industry partners).

13 RESPONSIBILITIES OF INSTITUTIONS, RESEARCHERS AND INSTITUTIONAL FACILITIES

13.1 Under the Code and the Guide, research data management is a responsibility shared by both institutions and researchers.

Responsibilities of institutions

13.2 The institutional responsibilities articulated in the Code ensure that institutions develop an organisation-wide approach to research data management so that an operational environment favourable towards a Research Data Management Framework can emerge.

13.3 Under the Code, institutions are responsible for:

(a) *"develop[ing] and maintain[ing] the currency and ready availability of a suite of policies and procedures which ensure that institutional practices are consistent with the principles and responsibilities of the Code"* (responsibility 3);

(b) *"provid[ing] ongoing training and education that promotes and supports responsible research conduct for all researchers and those in other relevant roles"* (responsibility 4);

(c) *"ensur[ing] supervisors of research trainees have the appropriate skills, qualifications and*

resources" (responsibility 5); and

(d) *"provid[ing] access to facilities for the safe and secure storage and management of research data, records and primary materials and, where possible and appropriate, allow[ing] access and reference"* (responsibility 8).

13.4 The Guide further describes aspects of research of data management for which guidance should be provided by institutional policies; specifically:

(a) ownership, stewardship and control of research data during a research project and after project closeout: the Guide recommends that institutional policies clarify the criteria used to determine whether an institution or a researcher asserts ownership or co-ownership of research data, and cases where a research project is a multi-institutional collaboration or uses data held outside Australia or from a third party;

(b) storage, retention and disposal of research data whether held in an institutional repository or externally: the Guide recommends that institutional policies:

(i) be consistent with any copyright or licensing arrangements that are in place;

(ii) be in accord with research discipline-specific practices and standards;

(iii) comply with relevant privacy, ethical and publication requirements;

(iv) comply with other relevant laws, regulations and guidelines.

(v) clarify the requirements for short and long-term storage of research data; and

(vi) include scheduled review of items in long-term storage.

(c) safety, security and confidentiality of research data: the Guide requires that institutional policies on the ownership of, and access to, databases and archives be consistent with confidentiality obligations, legislation, privacy principles and other guidelines, in particular regarding the security of computing systems and information-technology network; and

(d) access by interested parties of research data: the Guide recommends that institutional policies describe how to make research data, including the outputs of research, available to interested parties both within and outside of the institution with particular consideration to licensing, access arrangements, open access and mediated access (*i.e.* access to data or information with the assistance of a data custodian or other third party).

Responsibilities of researchers

13.5 Under the Code, researchers are responsible for:

(a) *"provid[ing] guidance and mentorship on responsible research conduct to other researchers or research trainees under their supervision and, where appropriate, monitor their conduct"* (responsibility 15); and

(b) *"retain[ing] clear, accurate, secure and complete records of all research including research data and primary materials. Where possible and appropriate, allow[ing] access and reference to these by interested parties"* (responsibility 22).

13.6 The Guide strongly recommends that researchers develop a RDMP to clarify the researchers' responsibilities from the beginning of a research project. In particular, researchers have the primary responsibility for deciding which research data should be flagged for long-term retention and wider accessibility.

13.7 In addition to the responsibilities outlined in the Code, the Guide indicates that in the absence of relevant institutional policy, researchers should fulfil a number of specific responsibilities; in particular, in the context of research data management, researchers should:

(a) respect any project-specific conditions of consent or confidentiality obligations;

(b) report any inappropriate use of, access to or loss of data, in accordance with applicable institutional policies and, where relevant, other reporting schemes;

(c)   ensure that agreements are in place to govern circumstances in which researchers leave the project or move from one institution to another during the course of the project; and

(d)   ensure that agreements are in place between institutions for managing responsibilities set out for data and information in multicentre or collaborative research projects.

13.8   The Guide recommends that in order to identify and document research data, established national and international standards (*e.g.* Digital Object Identifiers, ORCID IDs) be used and adhered to by researchers. In particular, the Guide recommends that metadata used to describe research data comply with the FAIR guiding principles, thereby requiring that researchers include metadata within the data structure or in separate records for the research data.

13.9   Researchers are strongly encouraged to store research data and associated records and documentation on systems managed by their institutions, including central data-storage services and, when possible, electronic laboratory books.

13.10   Researchers are strongly encouraged to avoid the use of portable storage devices (including USB flash drives, memory cards and external hard drives) for the short- or long-term storage of research data and the transfer of data from a geographical location to another. Instead, researchers are encouraged to use secure protocols, applications or services supported or recommended by their institutions to transfer research data.

Responsibilities of institutional facilities

13.11   Facilities and linked laboratories are strongly encouraged to identify, and if necessary, clarify, where institutional responsibilities regarding research data management are fully fulfilled centrally by the host institution (or dedicated services within the host institution) or partially devolved to them by the host institution.

13.12   Facilities and linked laboratories are strongly encouraged to identify, and if necessary, clarify, where the researchers' responsibilities regarding research data management articulated in the Code and detailed in the Guide apply to their users exclusively or are partially shared between the institutional facility and its users.

13.13   Facilities and linked laboratories are advised to retain a copy of their users' User RDMPs alongside their Facility RDMP within their research records. Users should retain a copy of their User RDMPs within their research records.

13.14   Users should develop a User RDMP for each research project that they are associated with. Facilities and linked laboratories should ensure that users develop a User RDMP for each research project that involves the facility or linked laboratory.

13.15   Through the Facility RDMP and the User RDMP, all researchers are strongly encouraged to ensure or take all reasonable steps to ensure that the FAIR guiding principles are embedded at all stages of the data lifecycle.

13.16   Facilities and linked laboratories are strongly encouraged to avoid the use of portable storage devices (including USB flash drives, memory cards and external hard drives) when handing research data to users, and, instead, prefer the use of secure protocols, applications or services supported or recommended by their institutions to transfer research data.

13.17   The Guide recommends that research data be stored in facilities provided by or approved by the institution that must comply with privacy requirements and other relevant laws, regulations and guidelines, and research discipline-specific practices and standards related to safe and secure storage of data and information.

14   REFERENCES, RELATED DOCUMENTS AND FURTHER INFORMATION

REFERENCES

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RELATED DOCUMENTS

- Schedule 1: Publicly available research data management policies at the institutions hosting Microscopy Australia facilities and linked laboratories

- Schedule 2: Publicly available research data management procedures at the institutions hosting Microscopy Australia facilities and linked laboratories

- Schedule 3: Definition of research data in the context of this policy framework at the institutions hosting Microscopy Australia facilities and linked laboratories

- Schedule 4: Research data management planning tools and resources at the institutions hosting Microscopy Australia facilities and linked laboratories

FURTHER INFORMATION

- Australian National Data Service (ANDS): https://www.ands.org.au
  - ANDS Guide: https://www.ands.org.au/guides
  - ANDS resources on data management: https://www.ands.org.au/working-with-data/data-management

- Australian Research Data Commons (ARDC):
  - resources on data compliant with the FAIR principles: https://ardc.edu.au/resources/working-with-data/fair-data
  - Research data management training "All the Research Data things (23 (research data) things)": https://au-research.github.io/ARDC-23-things/researchdata/things

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15 REVISION HISTORY

Version	Section(s) Modified	Approval Authority (Authorities)	Approval Date
1.0	All (new document)	Data Management and Informatics Committee, Microscopy Australia	03.02.2021
		Operations Committee, Microscopy Australia	10.03.2021

APPENDIX 1

The research data lifecycle
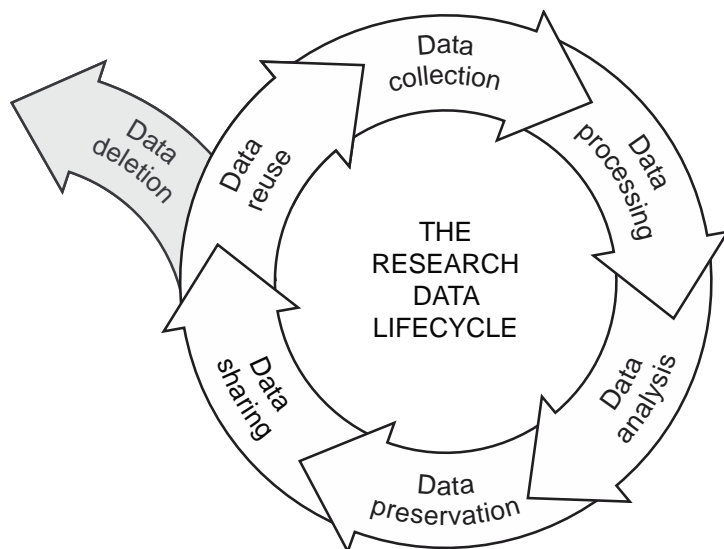
Adapted from University of Reading. *The research data lifecycle*. Retrieved December 22, 2020, from
https://www.reading.ac.uk/RES/rdm/about/res-rdm-lifecycle.aspx

SCHEDULE 1

Publicly available research data management policies at the institutions hosting Microscopy Australia facilities and linked laboratories

A   Facilities

Institution	Research data management policy[1]	Comment
Flinders University	*Management of Research Data and Primary Materials Policy*	
Monash University	*Research Data Management Policy*	
The Australian National University	n/a	No specific policy. Some aspects of (research) data management are embedded in various policies: • *Records and archives management (document No ANUP_001233)* • *Responsible Conduct of Research (document No ANUP_007402)* • *Code of research conduct (document No ANUP_007403)*.
The University of Adelaide	*Research Data and Primary Materials Policy (document No 2014/4228)*	
The University of Queensland	*Research Data Management – Policy (document No. 4.20.06a)*	Under review and could become a procedure.
The University of Sydney	*Research Data Management Policy 2014*	
The University of Western Australia	n/a	No specific policy. Research data management is embedded in the *Code of Conduct for the Responsible Practice of Research (document No. UP12/25)*.
University of South Australia	*Ownership and Retention of Data (document No. RES-17.0)*	
UNSW Sydney	*Research Data Governance & Materials Handling Policy*	

[1] The list of the publicly available policies available and the links to the documents in the policy libraries of the institutions are as at 16.09.2020 and are indicative only. For an up-to-date list of publicly available and internal policies associated with research data management, please refer to your institutional policy library.

B **Linked laboratories**

Institution	Research data management policy[1]	Comment
Australian Centre for Disease Preparedness (CSIRO)	CSIRO's Management of Research Data	Internal document, not publicly available.
Curtin University	*Research Data and Primary Materials Policy*	
Deakin University	n/a	No specific policy. Research data management is embedded in the *Research Conduct Policy* .
James Cook University	n/a	
Queensland University of Technology	*Management of research data (document No. D/2.8)*	
RMIT University	n/a	No specific policy. Research data management is embedded in the *Research Policy (POL/2016/00035[V2])*.
University of Tasmania	n/a	No specific policy. Research data management is embedded in the *Responsible Conduct of Research Policy*. The policy supports the FAIR principles explicitly.
University of Technology Sydney	n/a	No specific policy. Research data management is embedded in the *Research Management Policy (document No UR17/3686)*.
University of Wollongong	*Research Data Management Policy (document No UOW_POL_74)*	

[1] The list of the publicly available policies available and the links to the documents in the policy libraries of the institutions are as at 16.09.2020 and are indicative only. For an up-to-date list of publicly available and internal policies associated with research data management, please refer to your institutional policy library.

SCHEDULE 2

Publicly available research data management procedures at the institutions hosting Microscopy Australia facilities and linked laboratories

A   Facilities

Institution	Research data management procedure (or procedures) or guidelines[1]	Comment
Flinders University	*Research data management guidelines*	In the process of redesigning the policy and procedure library.
Monash University	• *Research Data Management: HDR Candidates Procedures* • *Research Data Management: Staff, Adjuncts and Visitors Procedures*	
The Australian National University	*Records Management (document No ANUP_000513)*	No specific procedure on (research) data management.
The University of Adelaide	*Research Data and Primary Materials Policy (document No 2014/4228)*	
The University of Queensland	The Research Data Manager (RDM) system provides guidelines and training resources.	No specific procedure on research data management. The *Information Management Policy (document No 6.40.01a)* and all the procedures attached to it apply to research data management.
The University of Sydney	*Research Data Management Procedure 2015*	
The University of Western Australia	Guidelines and best practices are provided in the Research Data Management Toolkit platform	No specific procedure on research data management.
University of South Australia	*Ownership and Retention of Data (document No. RES-17.0)*	
UNSW Sydney	The RDM@UNSW platform provides tools, resources and guidelines.	No specific procedure on research data management. Guidelines developed elsewhere (*e.g.* the *UNSW Data Classification Standard*).

[1] The list of the publicly available procedures and guidelines available and the links to the documents in the procedure or guideline libraries of the institutions are as at 16.09.2020 and are indicative only. For an up-to-date list of publicly available and internal procedures or guidelines associated with research data management, please refer to your institutional library.

B   Linked laboratories

Institution	Research data management procedure (or procedures) or guidelines[1]	Comment
Australian Centre for Disease Preparedness (CSIRO)		Internal document, not publicly available. An internal tool (Research Data Planner) is available.
Curtin University	n/a	
Deakin University	_Research Data and Primary Materials Management Procedure_	
James Cook University	Best practices and training resources are provided in the Research Data Management Toolkit platform.	No specific procedure on research data management.
Queensland University of Technology	_Guidelines for the Management of Research Data at QUT_	
RMIT University	_Research Data Management Policy Process (document No. POL/2018/00024[V2])_	
University of Tasmania	_Management of Research Data Procedure_	
University of Technology Sydney	n/a	No specific procedure on research data management. Guidelines available on the intranet.
University of Wollongong	_Research Data Management Guidelines (document No UOW_GUI_424)_	

[1] The list of the publicly available procedures and guidelines available and the links to the documents in the procedure or guideline libraries of the institutions are as at 16.09.2020 and are indicative only. For an up-to-date list of publicly available and internal procedures or guidelines associated with research data management, please refer to your institutional library.

SCHEDULE 3

Definition of research data in the context of this policy framework at the institutions hosting Microscopy Australia facilities and linked laboratories

A   Facilities

Institution	Definition of research data[1]	Comment
Flinders University	*"Research Data means the primary and secondary data, records, files or other elements that form the basis of the main inferences, observations, findings, conclusions, outcomes or elements of a research project or publication, irrespective of the form in which it exists, e.g., in print, electronic, physical, multi-media or other forms."* (<ins>*Management of Research Data and Primary Materials Policy*</ins>)	
Monash University	*"[The] data, records, files or other evidence, irrespective of their content or form (e.g. in print, digital, physical or other forms), that comprise a research project's observations, findings or outcomes, including primary materials and analysed data."* (<ins>*Research Data Management: HDR Candidates Procedures*</ins> and <ins>*Research Data Management: Staff, Adjuncts and Visitors Procedures*</ins>)	
The Australian National University	*"Digital research data is any data that is created during research that can be stored on a computer. Data also includes field notes, analog recordings, and non-digital images as they can be converted to digital images. […] Although not strictly data, you may also wish to consider the storage of any software developed to analyze the data, as an aid to being able to reproduce the results of your research."* (<ins>*ANU Research Data Management Manual*</ins>)	• The definition of research data also considers the software associated with research data. • Research data is not defined in a policy or a procedure. The policy <ins>*Records and archives management (document No ANUP_001233)*</ins> provides a definition for record (AS ISO 15489) that includes data: *"recorded information, in any form, including data in computer systems, created or received and maintained by an organisation or person in the transaction of business or the*

		conduct of affairs and kept as evidence of such activity".
The University of Adelaide	• *"Research Data are facts, observations or experiences on which an argument, theory or test is based. […] Data may be raw or analysed, experimental or observational. […] The software code used to generate, annotate or analyse the data may also be included."* • *"Digital research data [are] data and records created and/or maintained by means of electronic equipment and which may also be communicated through electronic means."* (*Research Data and Primary Materials Policy (document No 2014/4228)*)	The definition of research data also considers the software associated with research data.
The University of Queensland	*"Research Data includes all data created and/or generated by Researchers in the course of their research work, on which an argument, theory, test or hypothesis, or another research output is based, for which the University has a custodial responsibility under relevant agreements and the relevant archives/record keeping acts."* (*Research Data Management (document No. 4.20.06a)*)	
The University of Sydney	*"[…] Research data may be numerical, textual, audio-visual, digital or physical, depending on the discipline and the nature of the research. […] Research data may include: laboratory and field notebooks; primary research data (including machine data in hardcopy or computer readable form); databases […]"* (*Research Data Management Policy 2014*)	See clause 7 of the *Research Data Management Policy 2014* for a full definition.
The University of Western Australia	*"Research Data means facts, observations or experiences on which an argument, theory or test is based and could be retested. […] Data may be raw or analysed, experimental or observational. […] Provenance information about the data might also be included: the how, when, where it was collected*	The definition of research data is broad and considers information on the origin and software associated with research data.

Institution	Definition of research data[1]	Comment
	and with what (for example, instrument). The software code used to generate, annotate or analyse the data may also be included." (*Code of Conduct for the Responsible Practice of Research (document No. UP12/25)*)	
University of South Australia	n/a	The policy and procedure *Ownership and Retention of Data (document No. RES-17.0)* lists examples of research data without providing a definition for it.
UNSW Sydney	*"Research data and materials are the original sources or material that have been created, generated or collated in the conduct of research. They can be digital or non-digital. The response to a particular research question is based on the analysis of the research data and material."* (*Research Data Governance & Materials Handling Policy*)	

[1] The publicly available named policies and procedures and the links to the documents in the policy and procedure libraries of the institutions are as at 16.09.2020 and are indicative only. For an up-to-date definition of research data and the publicly available and internal policies and procedures pertaining to it, please refer to your institutional policy and procedure library.

B   Linked laboratories

Institution	Definition of research data[1]	Comment
Australian Centre for Disease Preparedness (CSIRO)		Internal document, not publicly available.
Curtin University	*"Research data are facts, observations or experiences on which an argument, theory or test is based. Research data may be numerical, descriptive or visual. Research data may be durable records derived from primary materials such as assays, test results, transcripts, and laboratory and field notes. Research data may be raw or analysed, experimental or observational."* (*Research Data and Primary Materials Policy*)	
Deakin University	*"Research data are broadly defined as all data created by researchers in the course of their work, including data that are collected, observed, or created,*	

	for purposes of analysis to produce original research results. This will vary depending on the research discipline. Research data may include primary data or secondary data, and materials." (*Research Data and Primary Materials Management Procedure*)	
James Cook University	n/a	The definition used in the Research Data Management Toolkit platform is that of the University of Melbourne cited in the *ANDS Guide* [9].
Queensland University of Technology	*"Research data means data in the form of facts, observations, images, computer program results, recordings, measurements or experiences on which an argument, theory, test or hypothesis, or other research output is based. It relates to data generated, collected, or used, during research projects, and in some cases may include the research output itself. Data may be numerical, descriptive, visual or tactile. It may be raw, cleaned or processed, and may be held in any format or media. Research data, in many disciplines, may by necessity include the software, algorithm, model and/or parameters, used to arrive at the research outcome, in addition to the raw data that the software, algorithm or model is applied to."* (*Management of research data (document No. D/2.8)*)	The definition of research data is broad and includes algorithms, software and calculation or experiment settings associated with research data.
RMIT University	*"The material, data, records, files, and other evidence upon which a research project's observations, findings, or outcomes are based. This includes […] both primary material and analysed data. Examples of research data are […] computer code and any other records needed to reconstruct or evaluate reported results of research, and the events and methods leading to those results."* (*Research Data Management Policy Process (document No. POL/2018/00024[V2])*)	

University of Tasmania	*"Facts, observations, measurements or experiences on which an argument, theory or test is based. […] Research Data may be raw or analysed, experimental or observational. Includes laboratory notebooks, field notebooks, primary Research Data, questionnaires, audiotapes, videotapes, models, photographs, films, test responses, and any other records that are necessary for the reconstruction and evaluation of the reported results of research."* (<u>Responsible Conduct of Research Policy</u>)	
University of Technology Sydney	*"Research data means data collected or created during research, used to validate research findings and/or used to enable reproduction of the research."* (<u>Research Management Policy (document No UR17/3686)</u>)	
University of Wollongong	*"The data, records, files or other evidence, irrespective of their content or form […], that comprise research observations, findings or outcomes, including primary materials and analysed data. Research data referred to in this policy relates to data generated in research projects […]."* (<u>Research Data Management Policy (document No UOW_POL_74)</u>)	

[1] The publicly available named policies and procedures and the links to the documents in the policy and procedure libraries of the institutions are as at 16.09.2020 and are indicative only. For an up-to-date definition of research data and the publicly available and internal policies and procedures pertaining to it, please refer to your institutional policy and procedure library.

SCHEDULE 4

Research data management planning tools and resources at the institutions hosting Microscopy Australia facilities and linked laboratories

A   Facilities

Institution	Research data management planning tool or resource[1]	Comment
Flinders University	Research Data Management as a Service	Under development
Monash University	Research data management platform that provides resources and guidelines	
The Australian National University	DMPTool	An online platform with training resources and general guidelines is available.
The University of Adelaide	Research Data Planner	
The University of Queensland	The Research Data Manager (RDM) system provides a simple template for a data management plan.	The RDM complies with the FAIR principles.
The University of Sydney	Researcher Dashboard (DashR)	Provides a planning tool and resources to request data storage.
The University of Western Australia	Research Data Management Toolkit	
University of South Australia	MyDMP	
UNSW Sydney	RDM@UNSW	Provides a planning tool, training resources and guidelines.

[1] The publicly available tools and resources and the links to the documents and/or webpages are as at 16.09.2020 and are indicative only. For an up-to-date list of tools and resources on research data management planning and the documents and/or webpages pertaining to them, please refer to your dedicated institutional online service.

B   Linked laboratories

Institution	Research data management planning tool or resource[1]	Comment
Australian Centre for Disease Preparedness (CSIRO)	Research Data Planner	Not publicly available.
Curtin University	Research Data Management Planning Tool (RDMPT)	
Deakin University	Research Data Footprints	
James Cook University	Research Data Management Toolkit	Provided guidelines, best practices and training resources.

Queensland University of Technology	QUT Data Management Planning Tool	
RMIT University	Research data management platform that provides resources and guidelines	
University of Tasmania	Data Management Plan template	
University of Technology Sydney	Research data management plan resource	Details available on the intranet.
University of Wollongong	RDMP template	

[1] The publicly available tools and resources and the links to the documents and/or webpages are as at 16.09.2020 and are indicative only. For an up-to-date list of tools and resources on research data management planning and the documents and/or webpages pertaining to them, please refer to your dedicated institutional online service.