



sustainability



Article

Collaborating for Sustainable Water and Energy Management: Assessment and Categorisation of Indigenous Involvement in Remote Australian Communities

Melissa Jackson, Rodney A. Stewart, Kelly S. Fielding, Jessie Cochrane and Cara D. Beal

Special Issue

Collaboration for Sustainability

Edited by


Prof. Dr. Edward Hackett



<https://doi.org/10.3390/su11020427>

Article

Collaborating for Sustainable Water and Energy Management: Assessment and Categorisation of Indigenous Involvement in Remote Australian Communities

Melissa Jackson ^{1,2}, Rodney A. Stewart ^{1,2,*} , Kelly S. Fielding ^{3,4}, Jessie Cochrane ⁵ and Cara D. Beal ^{2,6}

¹ School of Engineering and Built Environment, Griffith University, Gold Coast 4222, QLD, Australia; melissa.jackson@griffithuni.edu.au

² Cities Research Institute, Griffith University, Nathan 4111, QLD, Australia; c.beal@griffith.edu.au

³ School of Communication and Arts, Faculty of Humanities and Social Sciences, University of Queensland, Brisbane 4067, QLD, Australia; k.fielding@uq.edu.au

⁴ School of Psychology, Faculty of Health and Behavioural Sciences, University of Queensland, Brisbane 4067, QLD, Australia

⁵ Water Corporation, Perth 6007, WA, Australia; jessie.cochrane@watercorporation.com.au

⁶ School of Medicine, Griffith University, Nathan 4111, QLD, Australia

* Correspondence: r.stewart@griffith.edu.au; Tel.: +61-7-5552-7378

Received: 5 December 2018; Accepted: 7 January 2019; Published: 15 January 2019



Abstract: Indigenous peoples living in remote areas are often reliant on Governments for essential services and local economic development opportunities. Collaboration and partnership in resource planning and management is espoused as an approach that can provide multiple benefits for all stakeholders including more robust and long-lasting decisions, relationship-building and trust between government and community members as well as capacity building and empowerment of citizens. In Australia however, little evidence from the remote Indigenous community context is available to inform successful collaborations. This paper presents novel research using thematic analysis of practitioner interviews and document review to analyse the current situation of service-provider- remote community engagement and collaboration for sustainable water and energy management. An adapted typology of Indigenous engagement is applied as an analytical framework, categorising water and energy management initiatives according to four key types, each with varying levels of collaboration and implications for sustainable water and energy. Application of the typology shows that technocratic approaches to community engagement continue to dominate this space as collaborative processes are constrained by a range of institutional, governance, technical and cultural factors. The findings have implications for research, policy and practice, and point to a need for a systemic approach to address barriers and facilitate genuine collaboration.

Keywords: collaboration; indigenous; sustainable water; sustainable energy; community development; systemic

1. Introduction

Ensuring clean, safe, affordable, efficient and equitable supplies of water and energy are key strategies to reduce poverty by 2030 under the United Nations Sustainable Development Goals (SDGs) [1] and foundational for healthy and productive communities. Inclusive, participatory and representative decision-making (Target 16.7) [2] and partnership between institutions are also

fundamental to achieving sustainable development at all levels and a basis for empowerment of Indigenous peoples [3–5] who are some of the most marginalized in the world [6,7]. Indigenous peoples living in post-colonial settler nations such as Australia, Canada and the United States experience multiple social and economic challenges, including lower levels of health, employment, household income, literacy and life expectancy compared with Non-Indigenous counterparts [7–11]. This is particularly so in remote and regional areas including reservations and other remote settlements where significant proportions of Indigenous populations live (~20% of the Aboriginal and Torres Strait Islander population in Australia [8], 38% of the First Nations population in Canada [12] and between 22–54% of First Nations people in the US [13]). When compared with more centralised settlements, living in small and remote communities can provide increased opportunity for Indigenous residents to access traditional food sources, sharing language and customs across generations and improving sense of well-being [14]. However, access to economic development opportunities and essential services including drinking water and housing can be poor, with overcrowding in housing contributing to living conditions similar to those in developing countries and further exacerbating health and sanitation issues [7,15,16]. The need for improvements to sustainability of essential service supply and use in Indigenous communities is well acknowledged [17].

Managing remote community water and electricity services is challenging. In remote Australia, dispersed populations and harsh physical environments, unreliable and seasonal rainfall and groundwater recharge [8] and high per capita demand [15,16,18–23] constrain efficiencies. Energy is predominantly generated by off-grid diesel generation [24] which is costly and polluting. These factors lead to high rates of corrosion of equipment [14] and contribute to high costs of operation, management, and rates of repair and renewal [14,25]. Predictions of increasingly uncertain and extreme climate events are expected to further exacerbate these sustainability challenges [26]. Furthermore, the increasingly complex infrastructure being employed to provide water and electricity services in these communities requires increased technical skills and ongoing investment to operate and maintain systems, with much of this skillset, management and decision-making being sourced from outside of communities [11,27].

Management approaches also have negative consequences where key policy, program and investment decisions are driven by service providers' need to meet obligations based on regulatory guidelines that preference least capital cost and minimal risk [28,29], with little acknowledgement of the broader historical context and legacy of colonization that has significantly shaped decision-making and governance. For example, in 1994 a Federal Race Discrimination Commission investigation into water and sanitation in remote Aboriginal and Torres Strait Islander Communities [30], questioned fundamental assumptions used to inform policies and processes for service delivery to communities. The report referred to issues of water rationing, described as an "affront to basic human rights and an obvious source of health risks which would not be tolerated in non-Aboriginal communities" [30] (p2). Government investment in water and electricity infrastructure, regulation and management of remote Indigenous communities has improved access to clean water and electricity in recent decades [31], however, there remain many services in remote areas that do not meet basic regulatory or Australian Drinking Water Guidelines [32] and management practices such as water rationing still occurs in some communities.

Given that the gap between Indigenous and non-Indigenous health and wellbeing remains significant [3,9,14,33–37], addressing the limited realisation of sustainable water and energy management [4,14,18] needs to take priority in Indigenous rural and remote communities.

The complexity of factors at play in remote community water and energy management requires new ways of thinking and managing that incorporate generalist rather than specialist approaches [38]. Approaches able to recognise the interrelations between the technical, environmental, and social, including the meanings people attribute to water and energy systems [19,39–41], i.e., a systemic approach to management [38–40,42]. The rising interest in collaboration between stakeholders to address complex sustainability problems [42] is part of the "participatory turn in governance processes" [43] (p9) of the past few decades driven by the need to enable more systemic approaches as

well as increasing public and consumer expectations for involvement in decisions that affect them [44]. In Australia, participatory principles have been incorporated in legislation for local government operations [45] and natural resources management, for example in The Water Act, 2000 [46] as well as guidelines for best practice in local government (see for example Local Government Association of South Australia Community Engagement Framework [47]). Water and electricity service providers are, however, integrating participatory processes at different rates and in different ways as they navigate program delivery goals and deadlines from within a top-down hierarchical decision-making frame that is often in tension with deeper community engagement methods and timeframes [25,48].

More participatory approaches including collaboration and partnership approaches have been employed internationally in a range of contexts, including resource use and social service delivery coordination and planning [42]. However, there is little data on the extent of collaboration and power sharing arrangements being employed in relation to potable water and energy in the context of remote Aboriginal and Torres Strait Island communities [18,43] and the mechanisms for successful collaboration are not well understood [18]. The literature relating to provision of water services to indigenous populations rather focuses on the challenges and conflicts around competing water uses and water resources management [49].

This paper seeks to address this research gap, presenting novel research on potable water and electricity management initiatives in remote Australia, and assessing the extent to which collaborative and partnership processes are used by service providers to improve water and energy services and build long-term community capacity. Section 2 provides further background on collaboration in the context of participation literature and applications to the practice of remote water and electricity management. Section 3 outlines the research aims and qualitative methods including thematic analysis of practitioner interviews used to identify and analyse initiatives. Section 4 documents the findings with respect to identified initiatives, presenting key characteristics that influence community engagement and implementation of collaborative water and energy management. A categorisation of initiatives is also presented in Section 5, framed within a typology of Indigenous engagement in environmental management [50] adapted to the specific context of potable water and energy service provision in remote Indigenous Australia. A predominance of technocratic engagement approaches is identified. We discuss implications for design, planning and management and improving uptake of collaboration in practice. The paper concludes by reflecting on implications of the research and analysis for both theory and practice of sustainable community development and considerations of Indigenous wellbeing.

2. Theoretical and Practical Context for Collaborative Engagement in Indigenous Communities

Within the evolving concept of public participation, collaboration and partnership between government and citizens has featured regularly in analytic frameworks of participation (see for example [51–55]). Arnstein's (1969) Ladder of Participation is an influential and enduring framework in policy and academia [43] from which much of the theoretical literature on participation has been derived [56]. Partnership is one of the higher rungs of the ladder in which citizens control decisions with little input from external stakeholders. In this conceptualisation, the ladder metaphor is used as a 'categorical term for citizen power' [51] (p216) which is assumed to be inherently good [43,57,58]. As understanding of the complexity of the social, environmental and economic challenges becomes increasingly evident, the normative perspective of participation as a hierarchy has been critiqued for neglecting other dimensions of, and motivations for, community participation and the varied contexts within which interventions are made [43,56,59–61].

Participation as a 'mechanism' [43,62] diverges from this normative view, placing greater emphasis on questions of who participates, how they participate and the impacts of the participation process on outcomes [43,58]. This allows for understanding of the conditions under which different approaches may further objectives and aid design of specific interventions [57]. In the International Association of Public Participation (IAP2) spectrum of participation [54], a framework taken up widely in public

institutions in North America and Australia, for example, differing levels of participation are legitimate depending on the goals, time frames, resources and levels of concern in the decision to be made [44,53]. In this view, the form of participation must be carefully planned on a context-by-context basis to design and implement effective processes. Designing for collaboration is therefore considered appropriate when the objective is “To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution” [53]. There is little elaboration in participation frameworks however, as to what constitutes, or methods resulting in, successful collaboration.

Consideration of context is of critical importance when engaging Indigenous communities [7,10]. The historical context of socioeconomic disadvantage, Indigenous rights and recognition is a major factor for consideration to ensure participatory processes are of value [3,7,35,50]. Characteristics of high unemployment and low education levels, language barriers and mistrust between community and government [7] can differ significantly from the general characteristics of “public” engagement and will influence success of projects seeking to engage Indigenous people in environmental management [50].

The context of government services operating in remote Aboriginal and Torres Strait Island communities is that of a technocratic, or ‘command and control’ approach [34], where ‘technical-assistance’ [63] principles that emphasise technical and expert knowledge perpetuate top-down hierarchical decision-making processes, often made by non-Indigenous Australians, giving little regard to local views or knowledge [25,64,65]. When adopted uncritically, this can lead to rigid decision-making structures incapable of dealing with complex and rapid societal and environmental change [38,40,66]. Local geographies and cultural differences are ignored, restricting innovation from communities despite the existence of significant local skills [14]. Numerous ethical and professional concerns are also raised with this model, including the tendency to maintain power structures and undermine capacity of communities to solve their own problems, reproducing inequalities [67] and perpetuating pathways to dependency [38,42,63]. As Fred Chaney reflects (in [68], p15) “There is a system failure here; the present instruments of government are not fit for use in remote Australia”. In this context, there is a need for professionals and other stakeholders to acknowledge and better understand the impact of this model [14] and embrace alternative options [18]. Collaborative processes that move towards increased power sharing, are needed as part of efforts to enable Indigenous people to represent themselves and to avoid simply frustrating the powerless [7].

Principles for Collaboration

Collaborative processes provide an alternative to the traditional technocratic model and enable incorporation of situated knowledge for additional perspectives on establishing more sustainable relationships between communities and their environment [69]. This responsiveness to local issues and scales and the distribution of power amongst actors that is generated through effective collaboration has been found to improve performance of water governance, compared with centralised governance structures [70]. One study analysing Indigenous engagement in environmental management case studies in Australia, found that Indigenous-governed collaborations and Indigenous-driven co-governance types provided better prospects for integrating indigenous ecological knowledge for sustainable management of socio-ecological systems than agency-driven management [50]. Not all collaborative efforts are equal however, and ‘inauthentic collaboration’ may produce little of value and be a waste of time and money, or worse, act as ‘window dressing for decision already made’ and co-option of Indigenous views [42] (p41). Innes and Booher (2010) outline a number of conditions required for collaborations to be successful and authentic: (a) collaborations must incorporate diversity—of interests, perspectives and people; (b) actors need to be interdependent and share mutual interest in finding a solution; and (c) authentic dialogue for shared understanding of issues and to generate new knowledge and solutions needs to be facilitated. Producing agreements is seen as core to collaboration, but it is the indirect outcomes of collaborative processes, such as relationship and capacity building for

self-management, improved policy knowledge and development of locally-relevant and innovative strategies, that are often the most valuable to a community [42].

Little evidence-based research has been published on the extent of collaborative principles being employed in the context of potable water and energy management in remote Aboriginal or Torres Strait Island communities or whether efforts could be considered authentic or inauthentic, from which to inform research and practice. This paper presents research that aims to address this gap and identify the extent to which collaboration and partnership principles between service providers and Indigenous communities are being employed in water and energy management in remote Aboriginal and Torres Strait island communities. The next section documents our approach to the research.

3. Research Approach

3.1. Research Aims and Scope

This qualitative research aims to gather and analyse water and energy management initiatives in remote Aboriginal and Torres Strait Island communities to determine the extent that collaboration and partnership principles between service providers and Indigenous communities are being employed and with a view to understanding how the water and energy sectors can more effectively contribute to building sustainable Indigenous communities. The research presented here is part of a three-year collaborative research project: Remote and Isolated Communities Essential Services (RICES) project, a partnership led by Griffith University researchers in conjunction with local and state government, water and energy utility, university and an Indigenous development organisation partners, which aims to identify evidence-based, community-led strategies for sustainable water and water-related energy management in remote Indigenous Australia (see [15,18]).

The study focuses on remote Aboriginal and Torres Strait Island communities in northern and central Australia (see the Australian Bureau of Statistics [24] for an interactive map of the region). Although most Aboriginal and Torres Strait Islanders live in urban areas of Australia, over 20% live in remote and regional areas of Australia and make up over half the population of these regions [8,71]. 1187 discrete Indigenous communities are spread across remote Australia, varying in size and demography [8]. Of these remote communities, 274 have a population of 50 or more (averaging 256 people per community), while many more reside in even smaller communities (known as outstations or homelands) [31]. Within this region, our research focus is on small communities (<1000 people) who receive regulated water and energy services from dedicated providers (rather than self-managed supplies).

'Water' here encompasses potable water supply and use (including extraction, treatment, distribution and subsequent end-uses), while 'energy' includes electricity and gas for domestic and community use, but excludes transport energy.

3.2. Research Methods

The research was conducted in three main steps:

1. identification of water and electricity management initiatives that sought to engage Indigenous community members;
2. identification of key descriptive characteristics of initiatives in relation to influence on Indigenous community involvement; and
3. categorisation of the initiative according to type of community involvement.

3.2.1. Identification of Community Water and Energy Management Initiatives

We conducted a desktop review and interviewed practitioners to identify water and electricity management projects and programs (referred to herein as 'the initiatives'). Literature was sourced from published plans, reports, journal articles, utility web pages, and internal departmental reports. The data was initially selected on its relevance to water and energy infrastructure and management

in the study area and inclusion criteria were then applied to determine relevance of initiatives to the research questions (see Appendix A—Inclusion Criteria for Initiatives).

Interviews were conducted during the period June 2016–January 2018 with practitioners working in the field of remote community water or electricity management (“practitioners”). Interviews were used to supplement the limited publicly available documentation of water and energy initiatives in remote Australia and transcripts and notes provided the basis for the analysis. A combined purposive and snowball sampling technique was used to identify interviewees [72,73], initially starting with existing professional networks of the authors and project partners. Interviewees were selected based on geographic, gender and sector representation to ensure diverse perspectives were included. Interviewees (eight male and twelve females) were located across the Northern Territory (NT), Queensland (Qld) Western Australia (WA) and South Australia (SA), with three operating across jurisdictions. Eight interviewees were from service provider organisations (water or electricity utility or local government operators), with three each from State/Territory Government, Federal Government, Not-for-Profit and Research institutions.

A semi-structured, open-ended schedule of questions was used to guide interviews, allowing for investigation of key themes and reliable, comparable qualitative data, with freedom for the interviewee to provide detailed insights in their area of expertise and to express their views in their own terms [74]. We designed questions to initially focus on identification and characterisation of initiatives: What water or energy management initiatives are you aware of/have been involved in that have engaged Indigenous communities? What were the drivers for, and purpose of, the initiative/s? What methods were used to engage communities? What were the outcomes and how were these measured? All interviewees participated following a process of informed consent in accordance with the Declaration of Helsinki and as per Griffith University Human Ethics Research Guidelines (Ethics approval reference: GU/ENG/15/14/HREC).

3.2.2. Descriptive Analysis of Initiatives

We then employed thematic analysis of interviews using text-based coding in NVivo (11) to identify and consider relationships between themes in the data [75–77]. An initial coding framework based on primary themes identified from responses to the interview questions was applied [74]. Open coding [72] in this way generated a set of descriptive characteristics of the initiatives relating to how Indigenous communities are engaged: Region, timeframe, initiating or lead organisation, funding source, target area, scale, scope of change outcomes sought, type of community change outcomes sought, depth of community involvement, use of culturally appropriate methods and whether an evaluation was conducted. To enable assessment of initiatives, definitions of the characteristics were developed, where not self-evident, the authors drew further on relevant theoretical frameworks to inform definitions. For example, the characteristic ‘Scope of change outcomes sought’ encompassed the categories ‘narrow’ and ‘broad’ scope, to define these we drew from the Community Capitals Framework [78–82]. ‘Type of community outcomes sought’ drew from participation frameworks including the IAP2 Spectrum of Participation [53] and UK DFID Ladder of Participation [54] (7.5) to identify technical, information provision, education and capacity building types. Appendix B—Detailed Description of Characteristic Options provides further detail on defining characteristics. In this way both inductive and deductive approaches were used iteratively to refine the initiative characteristics and categories (following [72,80,81]). Table 1 in the results section provides the assessment of each initiative, which are de-identified and allocated a random number identifier with the prefix “I” (referring to Initiative) to protect commercial-in-confidence information.

3.2.3. Categorising Initiatives

Characteristics were grouped further in relation to influences on community involvement in water and energy management. Based on themes emerging from the interviews, we identified three groupings considered to have foundational influence on how engagement and collaboration principles were

incorporated into initiatives. The four characteristics of timeframe; region; target area; and scale; were excluded at this step as they were considered to have a less direct influence on the type of engagement and acted more as descriptive characteristics (see Appendix B). We identified similarities with the three dimensions of power sharing, process (considered as intercultural purpose) and participation analysed by [50] to develop a typology of Indigenous engagement in Australian environmental management. We drew further on this typology to inform types of water and energy management initiatives for categorisation in relation to Indigenous engagement and collaboration processes being used.

Hill et al.'s (2012) typology was considered valid at this step for a number of reasons: (1) the explicit design for consideration of Indigenous engagement context in Australia, (2) the focus on environmental management which has parallels to potable water and electricity management in the sense that it is about management of common goods, and (3) the intention to avoid further marginalisation of Indigenous interests [50] (p12) which is also central to our research purpose. We used the existing typology as a scaffolding for building on the descriptive themes and characteristics of our research on water and energy initiatives. However, the typology required adaptation to encompass the differing characteristics of water and energy service provision in remote Australia compared to environmental management. Two key differences identified are: (1) the highly regulated service provision environment for water and energy which legislates responsibility and accountability to certain entities (government utilities and government-supported service providers) varying significantly from many of the environmental management contexts which take a more proactive approach to complex management issues that could be argued to be less "essential" to community survival and wellbeing than basic water and electricity services; (2) the technical requirements of infrastructure provision and management which constrains the level of power sharing with Indigenous communities, where they are largely reliant on external expertise to operate infrastructure [14,27,83]. It is our view that the environmental management case studies analysed by Hill et al., (2012) provided greater scope for establishing truly collaborative governance arrangements than the context for this current research.

Our modifications of the types of initiatives therefore focused on reflecting the baseline of service provision which is government or government-supported infrastructure management. Categories were modified to incorporate variation in the key characteristics of water and energy initiatives identified through the thematic analysis.

The four types relevant to potable water and energy management developed are:

- **Agency-driven technical initiatives (AT):** The AT type are consistent with current standard practice or a 'Business as Usual' approach, where centralised service provision operates to achieve agency objectives with limited community involvement.
- **Agency-driven community education initiatives (ACE):** The ACE type, similarly to the AT type, are governed from the top-down but are distinguished by increased community involvement, although still to achieve agency objectives, typically through information or education targeting behaviour change which may extend to building capacity of community in relation to water or energy system understanding.
- **Externally-driven collaborations (EC):** The EC type involves an expanded focus beyond a typical agency need to incorporate broader community development goals at their core, enabled through community involvement in order to meet design parameters and pre-set objectives.
- **Community-driven collaborations (CC):** CC type initiatives are community-led with local Indigenous leadership identifying objectives and priorities in relation to broader livelihoods. Partnership with external organisations to achieve those objectives is a key feature of this type of initiative.

Appendix C provides a detailed description of each type mapped to the characteristics of initiatives.

Each initiative's key characteristics were documented, then scored according to the type description as set out in Appendix C. An initiative that was documented as having AT features for that characteristic, for example, scored 1 for that characteristic, ACE—2, EC—3, and CC—4. Half scores were also allocated

if the data indicated partial fulfilment of the category. Each type therefore had a range (based on minimum and maximum aggregate scores) with AT types falling between 7–10; ACE 11–17; EC 18–23; and CC types between 24–28. Results of the assessment are presented in Table 2 and further discussion on the assessment presented in Sections 4 and 5.

The results of the analysis are also presented visually (see Figure 1)—a subjective assessment conducted by the authors as a means to help visualize the range of water and energy initiatives, their types and the broad location with respect to collaboration and sustainability outcomes. The four types of initiatives are represented as shaded ‘fields’ and the twelve assessed energy and water initiatives as more localized dots, placed within the bounds of two axes relevant to this research: (1) the level of participation, and (2) the management lens. The former is represented along the horizontal axis by the IAP2 Spectrum of Participation categories [53]. The latter is represented on the vertical axis with technocratic at one end and systemic at the other. Technocratic management is introduced briefly in Section 2 and is consistent with the mechanistic, rational worldview which is unable to deal with complex problems [38,39,42,63]. Alternatively, to think systemically requires consideration of the interconnections and interrelationships within and among a system including the organisation, emergent properties associated with system [84] (p99). This spectrum of management lens is relevant in conceptualizing a wider perspective on water and energy management initiatives, where location towards the “technocratic” end can result in communities becoming dependent on external resources, foregoing control over their own situation and never developing the ability to solve the issues and challenges facing them [63]. While initiatives located more towards the “systemic” end are better designed to integrate the whole and respond meaningfully to the (inter)relationship of different aspects within a (community) system, recognising the cultural context and the interpretations and perceptions that people form within that cultural context [85].

3.3. Limitations

The practice of Indigenous collaboration is rapidly changing as new programs and activities that seek to improve water and energy sustainability and community involvement are being developed. The results of this research should therefore be considered a snapshot in time and will need to be reviewed in future to account for new developments and evolution of management practice.

We acknowledge that some service providers have other programs of engagement with Indigenous communities outside of the management of water and energy services, including outreach and education activities conducted as part of Corporate Social Responsibility activities. These activities, which may involve capacity building or collaboration are however excluded for the purposes of this research as they sit outside the scope of water and energy management initiatives.

The analysis is necessarily limited by available data and although we aimed for transparency and consistency in the design of the research, the analysis would have benefited from further detailed evaluations to consider specific factors that influence success or otherwise of initiatives.

4. Characteristics of Remote Water and Energy Management Initiatives Involving Communities

Twelve initiatives across NT, WA, SA and Qld were identified that involved remote Aboriginal and Torres Strait Island community members in water and/or energy management (Table 1).

Table 1. Characteristics of water and energy management initiatives involving remote Aboriginal and Torres Strait Island communities.

Initiative Identifier	1. Period of Operation	2. Region	3. Target Resource	4. Target Group	5. Scale	6. Initiating Organisation/Lead	7. Funding Source	8. Scope of Change Outcomes Sought	9. Type of Community Outcomes Sought	10. Depth of Community Involvement	11. Use of Culturally Appropriate Methods	12. Participatory Evaluation
I1	2002–2013	Multiple	Elec	Indig.	Large - 130+ RICs	INFP	FG	Broad	T, CB (varied)	Mid-Deep	Med-High (varied)	Internal Participatory
I2	2004–2006	Multiple	Water	Indig.	Med - 5 RICs	INFP	FG	Broad	CB	Mid-Deep	High	Internal Participatory
I3	2009	NT	Water	Indig.	Small - 1 RIC pilot	U, C	U	Narrow	CB	Mid	Low-Med	Project team
I4	2012–13	SA	Elec	Indig.	Med - 14 RICs	INFP	SG	Narrow	I&E, some CB	Mid	High	Project team
I5	2009–2015	QLD	Elec	All	Large - State-wide	U	SG, U, FG	Varied	T, I&E, some CB	Shallow-Mid	Medium	None
I6	2013–2016	NT	Both	Indig.	Large - 6 RICs	U, INFP	FG, U, SG	Broad	CB, T	Mid	High	Participatory
I7	2016–pres	WA	Water	Indig.	Small - 1 RIC pilot	SG, U	SG	Narrow	C, I&E	Shallow	Low-Med	n/a
I8	2012–2013	NT	Water	Indig.	Small - 1 RIC pilot	U	FG, U, LG	Narrow	I&E, T, some CB	Mid	Medium	Participatory
I9	2015–pres	NT	Elec	Indig.	Large - 30 RICs.	U	FG, SG, U	Narrow	T, C	Shallow	Low	n/a
I10	2011–12	WA	Water	Indig.	Small - 1 RIC pilot	U	U	Narrow	I&E, some CB	Shallow	Medium	Project team
I11	2006–pres	Qld	Water	All	Large - State-wide	SG, LG's	SG	Varied	I&E, some CB	Shallow-Mid	Medium	Project team
I12	2015–2016	WA	Elec	Indig.	Small - 1 RIC	I	PB	Broad	T, CB	Mid-Deep	High	Project team

Notes: FG = Federal Government; SG = State Government; LG = Local Government; U = Utility or Service Provider (may be local government); INFP = Indigenous Not-for-profit organisation; P = Private business; C = Consultant/contractor; RIC = Remote Indigenous Community; T = Technical; C = Consultation; I&E = Information and Education; CB = Capacity Building. See Appendix B for further detail.

The initiatives ranged from small-scale pilot projects in a single community through to multi-year, multi-stakeholder, multi-community collaborations (Characteristic 5, Table 1). Some initiatives operated across state/territory boundaries, with significant resources allocated for a range of community capacity building activities. Two large-scale initiatives were state-wide (I5, I11) focusing on both technology and water/energy system literacy across communities. Of three other large-scale initiatives (I6, I9, I11), two focused on renewable technology installations to replace or supplement diesel power generation. The other large-scale initiative (I6), was driven by securing significant funding for community engagement for energy demand management. The small-scale water initiatives were in the form of a pilot initiated by the utility to trial a community education approach to improving water efficiency.

The scale and duration of an initiative were viewed as both an enabler and constraint to more collaborative types of engagement by interviewees, who referred to the influence of short-term cycles of planning and policy as constraints to deeper forms of community engagement. Long-term projects were identified as preferable, because of the time needed to build trust and relationships which were considered important for the success of initiatives [11,14]. However, one project manager of a 3+ year program also indicated that even this period was insufficient for long-term change as the benefits had only just started being realised when the funding was stopped, they anticipated the good will and capacity built between the service provider and community to likely decline as 'business as usual' relationships resumed:

“Feedback from community was that it appeared to be very short-term. They felt like they finally got their confidence up and on their way when the funding ended. We knew that and tried to prepare community people for that. But they were disappointed.”

—Program Manager

There was an even split between those initiatives targeting improvements in the service of water and energy supply/consumption (Characteristic 3, Table 1). This is likely a function of jurisdictional divisions where remote water and energy governance structures vary in each State and Territory, for example a single utility in the NT, compared with small-scale systems operators for water in Qld. Only one initiative targeted both energy and water—the project manager indicated that this occurred despite Federal funding for the program targeting energy (efficiency) activities only. The service provider was able to incorporate water efficiency only because both are part of their operational remit.

The research found the majority of initiatives targeted Indigenous communities only (Characteristic 4, Table 1). Of the two initiatives that were open to all communities within the state, interviewees involved indicated that although greater resources were available due to the scope and funding available for projects at that scale, the methods of engagement leaned toward generic behaviour change methods with limited cross-cultural tools being applied. Where implemented, such as in efforts to translate to local language, culturally relevant tools were inconsistently implemented. No further data was identified that indicated strategic decision criteria being applied to determine which regions/communities were engaged while others were not, although two utility managers indicated high consumption as being a key element. However, the research also found that very little data was available to inform levels of consumption at anything more detailed than community level. Such decisions were therefore primarily based on crude estimates of household or per capita consumption based on supply data and estimated population. This method is problematic, if used as a foundation for community engagement design as it does not provide an accurate picture of the variability within households and how and why different people are using water and energy. Targeting Aboriginal or Torres Strait Island communities typically at a smaller scale allowed for tailored engagement activities, but could also constrain resources available to conduct the engagement.

4.1. Initiation/Lead of the Project or Program

At the initiative level, utilities were involved in, or led, the set-up of the majority of initiatives (seven out of twelve) (see Characteristic 6, Table 1). Interviewees provided insight into the process of

establishing initiatives: it usually involved a combination of either agency objectives as a precursor to securing funding for a specific project (such as in the small-scale trials); or funding becoming available that also aligned to agency priorities, thereby prompting a project proposal. A quarter of initiatives were led by one particular Indigenous-owned not-for-profit organization with a long history of initiating collaborative Indigenous projects.

Only one out of twelve initiatives (I12) were led by community. Literature suggests that early and collaborative involvement by communities in decisions about scope, focus, objectives of initiatives and control over design and methods contributes to longer-term and adaptive outcomes aligned with stakeholder needs [42,62]. Many interviewees recognised this but pointed to lack of early involvement primarily attributed to constraints of working within the existing Government agency structures and a culture of top-down management, as this project manager describes:

“The project wasn’t initiated by the community, it was initiated by the utilities and the government. So, best practice is in the context of imposing things from outside. “Real” best practice should be the need identified from community, and us support them to achieve their goals.”

—Utility Manager

4.2. Funding Source

Funding was also viewed by many interviewees as limited for this type of broader community activity and not core business for service providers. This theme emerged throughout conversations across different interviewee groups as the following interviewee encapsulates:

“Engaging with a number of individual customers is expensive and complex. The assets being managed are expensive and we need to streamline that. The best bang for buck is to work with key stakeholders who make decisions about the assets, this is typically not the householder. How can utilities pursue this (community-based engagement) when the funding isn’t there? Partnering with other organisations who want to achieve other benefits in communities, like adult education etc., where the activities are complementary. Building a relationship with customers is one of the benefits for us.”

—Utility Manager

4.3. Scope of Change Outcomes Sought

Following from the above point, the majority of initiatives were narrow in scope (8 initiatives, see Characteristic 8, Table 1). Constraints to broader scope of activities were acknowledged by a number of interviewees as arising from the strict regulatory regime and limitations of time, resources and capacity of service providers to go beyond compliance requirements. Although acknowledged as necessary for long-term outcomes, in practice, service providers are driven to invest in cost efficiencies rather than incorporating long-term concepts of value through community-based processes [86] as the following quote illustrates:

“Education is not part of our mandate. There is no business case [for us] to do education. Especially when you have to do so much groundwork on basic adult education—concepts of quantification, measurement, units, ... the basics. We are grant funded to deliver cost-effective services only.”

—Utility Manager

Four of the initiatives (I1, I2, I6, I12) sought to go beyond a narrow scope by facilitating community meetings and conversations, providing opportunities for leadership development and training or skills building in relation to water or energy conservation and services.

4.4. Type of Community Outcomes Sought

Four initiatives (I1, I5, I9, I12) focused on technical changes such as infrastructure improvement outcomes (Characteristic 9, Table 1). Three of those were large-scale renewable energy technology

initiatives reflecting the rapidly expanding renewables sector in Australia [87]. Interviewees indicated that infrastructure and engineering solutions are core business for service providers and therefore the system is set up to support technical, rather than human and social aspects which instead are on the fringe of business activities.

Capacity building, a core element of community-based collaborative approaches, includes skills building and investment of time and resources in the local community to facilitate communities leading from within [63]. Half of the initiatives made reference to capacity building as a desired outcome, but without providing explicit strategies to achieve it, indicating a possible lack of skills and understanding of how to design for social change. Education is often a prerequisite for capacity building in remote communities where literacy levels are lower than for many urban areas, influenced by language barriers and access to education opportunities [31]. Initiatives that incorporated capacity building often arose from clear funding specifications or organisational drivers being present. Capacity building for skills, trades and employment readiness was repeatedly observed in the literature and interviews as critical for Indigenous community development and opportunities, for example:

“Water efficiency could be a good stepping stone into further employment opportunities. The main jobs (through the CDEP) are making boxes or hammers in the community. There’s no pathway for local people.”

—Utility Project Officer

4.5. Depth of Community Involvement

Depth is indicated by a mix of the timing, duration and diversity of community engagement. Building relationships and maintaining trust with the community as the foundation of community-based management was a strong theme in interviews (see also [11,27,38,88]). Interviewees elaborated on challenges associated with investing time and resources to facilitate trusted relationships, particularly when working within strict project timelines and funding cycles. However, understanding of constraints and managing expectations of what is achievable was viewed as important also:

“You have to be prepared to stay in for the long-term and moderate that by only doing something you can sustain over time. It’s best to under commit and over deliver to communities ... there can be perverse outcomes by doing this work, you then lose trust by not being able to sustain the work when the funding is gone.”

—Utility Manager

High turn-over of staff in remote areas, which were often from outside communities, also affected relationship building and was therefore another factor inhibiting the quality of participatory processes as relationships had to be built anew each time a new staff member started.

Indigenous communities comprise “different stakeholders with diverse needs, interests and capabilities” [34,89]. Designing to engage with this diversity is important in a place-based community [34], where information may not flow from ‘representatives’ across kin/family boundaries and standard engagement techniques such as workshops and public meetings can be dominated by powerful individuals and restrict participation by others with less political clout [34]. Diversity can often be overlooked as engagement efforts are targeted to achieving agency outcomes and often will focus on input from local leadership. Only three of the twelve initiatives (I1, I2, and I6) set out details for how they designed to engage diverse groups in the community, this occurred through use of culturally sensitive and targeted engagement strategies (see next section) to maximise outreach.

4.6. Culturally Appropriate Methods

A critical element of community engagement in cross-cultural contexts is working with differences across language, protocols, social norms and the meanings and interpretations associated with these [4,10,14]. In remote Indigenous communities where 45% of males and 35% of females

speak a language other than English as their first language [8], working with local languages is necessary for effective community engagement. The sheer diversity of languages in remote Indigenous Australia—over 120 languages are in use today [71]—however, can act as a barrier to rolling out effective strategies and engaging community members. One program manager reflected on the complexity of translating a program’s education materials into local language:

“One of the materials we’ve developed was a talking water story book and translated into local language. But . . . we got someone from [the city] to translate it. People weren’t using it, when we asked why, they told us because the person who was talking wasn’t from there, [the local trainer] felt silly playing it to people because it sounded funny.”

—Utility Program Manager

Consideration of cultural norms and taboos in practice also incorporates how different segments of the community are able or willing to relate to each other, the program manager or aspects of the engagement design:

“Younger women were very shy, especially in the presence of older women . . . They would have a conversation between themselves and then talk to the older women. The older women were bridging the conversation and saying ‘what about that thing you were saying? To encourage them to speak up.”

—Project Lead (consultant)

Similarly, relationships with technologies and practices related to material and infrastructure need to be considered beyond a Western worldview to ensure they are meaningful and support locally-relevant outcomes:

“Composting toilets were put in one community to reduce water use. They spoke to people about them then put them in, but people didn’t use them because they felt really conspicuous because they were outdoors and everyone could see when they were going to the toilet and this was culturally uncomfortable. Because it was done badly, now composting toilets have a bad name up there. You need to talk it through properly with everyone.”

—Federal Government Manager

Incorporating cultural considerations such as language, diversity and appropriate methods of community engagement were indicated in the majority of initiatives (nine out of twelve), how these were rolled out in practice however, varied considerably. Three initiatives indicated strong use of local people and languages with design tailored to the local context (I1, I2, I4, I6, I12). Train-the-trainer type activities were seen as particularly successful, while employing local people as interpreters and translating project materials from English into local languages also enabled quality involvement from locals. In three of the initiatives, there was no evidence of incorporating local language or engagement activities delivered through local people or organisations.

4.7. Conduct of Participatory Evaluation

Lack of evaluation has been identified as a gap in Government policy and programs generally in relation to Indigenous services [90]. Only two initiatives conducted structured participatory evaluations that involved the community as part of the program design.

Many interviewees commented on the lack of data in remote communities from which to base programs on, however, they were referring primarily to quantitative water and energy use data. In recent years, significant investment is occurring in metering, however this is still new and smart meters are located in only a handful of communities currently. A general lack of awareness of what constitutes robust evaluation came through in the interviews conducted with program managers and government practitioners, with many referring to project team reflections on the project when asked whether an evaluation was conducted. The findings appear to reinforce Moran’s [10] (p67)

findings that the reality of local governance was that “at the end of initiatives actors did not necessarily understand what they had done right, or vice versa, what they had done wrong” resulting in a ‘fragile basis for action’.

Interviewees considered comprehensive evaluations as those that asked for community feedback, although when we questioned further as to how these were designed, it appeared to be an opportunistic approach to asking community members as part of conducting other program activities, rather than a structured and planned component of a larger learning process. Incorporating evaluation findings into community or organisational planning was referred to only once. As one academic interviewed reflected:

“Evaluation is a problem. Research- qualitative, not just quantitative - on what worked and didn’t is an area where it’s difficult to get resources to evaluate. There may be a lessons learnt report done at the end but to actually feed-back those lessons for organisational learning can be very difficult.”

—Researcher

Lack of robust evaluation prevents social learning, because measurement and understanding of success and effectiveness factors are hindered. Given the commonality of “participation fatigue” in Indigenous communities, where community members are over-researched, often with multitudes of overlapping programs and policies in place at the same time in the same community [11], it is critical that service providers enact robust evaluations and learning cycles to address issues of trust between government and Indigenous people [7,10] and to ensure previous activities are built on and lessons learned.

5. Categorising Indigenous Involvement in Water and Energy Management Initiatives

The research identified a complex array of factors influencing how communities are involved in, and initiatives are designed for, water and energy management in remote Indigenous communities in Australia. As described in the methods section, in order to further progress our understanding and analysis of the extent of collaborative water and energy management, we categorised water and energy management initiatives according to our typology of Indigenous engagement in water and energy management (adapted from [50]). Table 2 presents the results of the categorisation process applied to the twelve water and energy initiatives across each of the key characteristics. The final type (see final column of Table 2) was determined based on the aggregate allocated for each characteristic (see Appendix C for further definition).

Table 2. Assessment and categorisation of water and energy management initiative types in remote Indigenous communities.

Initiative	Governance Arrangements		Purpose of Initiative		Community Engagement Aspects			Score (Range 7–28)	Overall Type
	Initiated by/Lead Organisation	Funding Source and Arrangement	Scope of Change Outcomes Sought	Type of Community Outcomes Sought	Depth of Community Involvement	Use of Culturally Appropriate Methods	Participatory Evaluation (if Evaluation Conducted) *		
I1	3	3	3	2.5	2.5	3	2.5	19.5	EC
I2	3	3	3	3	3	3	3	21	EC
I3	2	2	2.5	2.5	2.5	2	2.5	16	ACE
I4	2	3	2.5	2.5	2	2.5	2.5	17	ACE
I5	2	2.5	1.5	2	1.5	1.5	1	12	ACE
I6	3	3	3	3	3	3	2.5	20.5	EC
I7	2	2	2	2	2	2	2	12	ACE
I8	2.5	2	2	2.5	2.5	2.5	2	16	ACE
I9	1	1.5	1	1	1.5	2	1.3	8	AT
I10	2	2	2	2	2	2	2	14	ACE
I11	2	2	2	2	2	2	2	14	ACE
I12	4	3.5	3	3	4	4	3	25.5	CC

AT = Agency-driven technical; ACE = Agency-driven community engagement; EC = Externally-driven collaboration; CC = Community-driven collaboration. Score for individual characteristic AT = 1; ACE = 2; EC = 3; CC = 4; Aggregate Score range AT = 7–10; ACE = 11–17; EC = 18–23; CC = 24–28. * if evaluation not able to be conducted due to ongoing program, eval. score based on average value of other scores for that initiative.

5.1. Governance of the Initiatives

This process identified that the higher level governance context as well as governance of the water and energy management initiatives themselves were key to shaping design elements, having significant flow-on effects to the extent to which collaborations between Indigenous communities and service providers could be realised. The research showed that initiation, funding, and policy cycles that guided project set up and operation reflected the dominance of government-based funding and project management which was led by utilities or government agencies, with limited involvement of communities in the initial set up and establishment of projects. This approach shaped other factors such as scale, duration and the overall purpose of initiatives and the ways in which service providers engage with communities and evaluate success.

5.2. Purpose of the Initiatives

Following from the governance arrangements, the purpose of initiatives was primarily a narrow, technical focus which considered outcomes primarily in relation to water and energy infrastructure (built capital) including replacement, renewal and maintenance and optimizing cost-effectiveness. Housing infrastructure, however, which is critical in influencing how locals manage water and energy use [14,18,28], was an area of contention related to the lack of clarity between the boundaries of operation and water and energy management goals. Investment in human capital [78,81,82] in the form of community engagement to facilitate education of basic water and energy conservation principles, was driven primarily by increasing recognition by service delivery agencies of end-user influence on demand, and therefore lifetime and viability of infrastructure investments [23]. A few projects broadened their scope of water and energy management by incorporating a range of capacity building and training activities which were viewed as positive investment in a range of other community capitals including cultural, political and critically, social capital which can create new systems of positive community change and reverse the 'spiral of decline' that many communities face [81].

5.3. Community Engagement Aspects of the Initiatives

The majority of initiatives involved communities post-foundational design and objective-setting by various agencies or service providers. This "late" involvement of community members typically leads to framing of the initiatives from within the dominant Western worldview and has implications for aspects of design important to engaging locals meaningfully including preventing true collaborations when locals are excluded from key decisions early in the process. Including incorporation of cultural norms and protocols as add-ons rather than integrating cultural and social perspectives of locals throughout activities and objectives was predominant in the initiatives reviewed. The relevance of community engagement design to the local context therefore reduces as initiatives reinforce approaches that achieve agency objectives and perpetuate the cycle of project management. Efforts to overcome this deficiency by working closely with communities in collaborative ways were limited, however those considered more successful in partnering with communities applied methods to engage locals through their own languages and respected cultural norms, taboos and protocols within the initiatives.

5.4. Overall Categorisation

The results of the categorisation are also presented visually in Figure 1. The results show Agency-driven community education initiatives as the dominant approach service providers take in involving Indigenous community members in water and energy management initiatives in the remote Australian context. Seven out of the twelve initiatives were classified as such, with three externally-driven collaboration types, one community-led collaboration and a single agency-driven technical initiative.

Of the three initiatives classified as externally-driven collaboration types, promising outcomes for sustainability of water, energy and social and economic development were indicated by interviewees who were involved in those initiatives. Benefits included increased awareness of water and energy

supply systems by community members, increased community participation leading to buy-in and ongoing support for the initiative, an increase in skills and knowledge and capacity to manage water, energy and expenses (i.e., energy charges), and finally, improved education of community members and tailored employment opportunities (i.e., flexible and staged pathways to increasing skills and certification). Although longitudinal studies were not conducted to determine longevity of such benefits, even short-term attainment of these is important to contributing to community aspirations. For many Aboriginal and Torres Strait Island people aspirations include: generating local jobs and training; improving literacy and numeracy; increased health and wellbeing; incentivising young people to stay in communities; self-reliance and self-sufficiency; building life skills, economic development opportunities and connections to regional economies [4,16,27,35,91,92].

Only one Community-led collaboration was identified through this research, an energy management initiative (i.e., renewable energy installation) in which the objectives and desired outcomes were set by community leaders in partnership with an external private business and supporting not-for-profit expertise. A combination of factors relating to location, proximity to the grid, governance arrangements, strong and skilled local leadership, and restricted government support to operate the electricity generation for the community, indicates this model is unlikely to be directly transferable to many remote Indigenous communities currently. Furthermore, given a key driver for the project was cost savings (on diesel), and there is no price signal for residential water consumers in remote Indigenous communities currently, it may not be a viable model for water-related projects. An independent, participatory evaluation of the initiative to understand its contribution to the community and to understand replicable features in other contexts would be a useful contribution to this field. Particularly as the possibility of communities leading collaborations from start to finish were considered unlikely within current governance structures by a number of interviewees who indicated that the entrenched cycle of dependence on government for key resource inflows, decision-making and lack of local skills in many communities needed to be strategically addressed before ‘higher’ levels of collaboration were likely to be achieved.

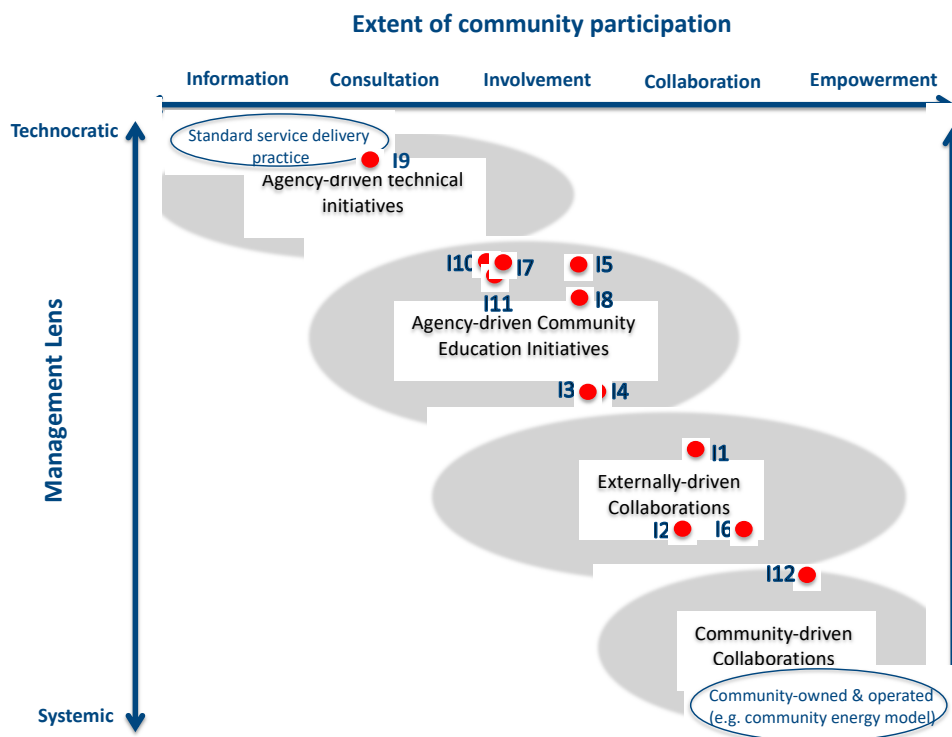


Figure 1. Visual representation of categorisation of water and energy management initiatives.

6. Discussion

In this paper we have argued that collaborative processes in the context of Indigenous community water and energy management could be contributing significantly to building community wellbeing, livelihoods and long-term sustainability outcomes for Indigenous communities which is critical to overcoming the unique context of social disadvantage faced by Indigenous peoples, particularly in post-colonial settler nations [4,7,93]. Although there are parallels to more general arguments for improved public participation, the unique historical, cultural, lingual, socio-economic and geophysical remoteness context that applies in remote Indigenous communities suggests that government/service providers collaborating meaningfully with community members is critical. Perpetuating power inequities through technocratic management has long-lasting impacts, contributing to cycles of dependency in which the community need continual inputs from the experts and government which present significant obstacles to community capacity building [42,63].

This novel research has therefore attempted to clarify the current state of practice of water and energy management in remote Indigenous communities, using the case study of Aboriginal and Torres Strait Island communities in Australia, to identify and analyse management initiatives that seek to engage Indigenous Australians. A further step of categorising the types of initiatives in relation to collaborative principles being employed by service providers was conducted based on a novel adaptation of an Indigenous engagement typology. The four types of engagement were adapted by considering categories from the broader environmental management field against key characteristics identified through analysis of practitioner interviews under the themes of governance, purpose and community engagement aspects of initiatives.

The research indicates that moving beyond technical-infrastructure focused activities for water and energy service providers is occurring, in parallel with growing recognition of the value of engaging communities in participatory processes. However, these efforts tend to be framed by the worldview or lens and associated assumptions and objectives of the managing agency. This has the result that water and energy efficiency activities are typically for the purpose of cost-management improvements rather than generating broader social benefits to communities. Despite significant investment in remote Indigenous communities of recent decades to improve the health of Indigenous people and relationships with Government [3,11,93,94], we demonstrate that a technocratic management approach continues to dominate the water and energy sectors' approach to engaging Aboriginal and Torres Strait Island communities.

Although the remote water and energy practitioners interviewed generally recognised the value of more collaborative and community-based approaches and the systemic tools and methods required to managing remote community water and energy sustainably, collaboration and partnership between service providers and remote Indigenous communities in the Australian context was limited in its application. Agency-driven community education initiatives that deliver on agency priorities continue to be the most common form of community involvement in management thereby reinforcing/creating inequitable or unsustainable pathways.

Broader adoption of truly collaborative water and energy management approaches are constrained by a range of institutional, governance, geophysical, data and cultural factors underpinned by an operational and regulatory environment driven by a Western, technocratic management model [38,42,63,86,88]. Institutional and governance constraints include a focus on least-cost planning in short-term policy and planning cycles, with leadership and organisational structures lacking coordination across agencies responsible for various aspects of communities that affect water and energy demand and supply. Based on assumptions of cost-effective infrastructure management as core business for service providers, community-based relationship building is viewed as 'risky' and the time and resources required for building relationships necessary to collaborative arrangements is beyond the (financial) business case criteria. A lack of skills and understanding of different cultural norms, practices and languages by project managers also are seen to reflect lack of scope and leadership within the regulatory and agency organisational structures. Furthermore, limited data on water or

energy use and almost no data on community needs and preferences is available to guide action. At the community side, limited drivers, including skills, knowledge, incentives and interest, are present for community members to engage in water or energy conservation or demand management.

These barriers are seen to constrain translation of interest in collaboration into practice, making efforts difficult to undertake and sustain under current governance arrangements. Challenges however, were not explored in depth in this paper and we look forward to more detailed research into the specific barriers and enablers to initiating and sustaining collaborative partnerships for potable water and energy management in this context. Such research could further inform future practice about types of engagement activities and methods that could be of value in particular geophysical, governance and cultural contexts.

Overcoming the challenges and constraints to collaboration for water and energy management will be a necessary part in the long-term trajectory of government-Indigenous engagement to build credible responses to local resource and community challenges [10,95] and to achieve both Australia's and global commitments to improving indigenous health and achieving clean, safe water and energy for all by 2030 [1]. The analytic framework developed in this research helped to consider further the dimensions of water and energy management and how different characteristics combine in practice to influence the extent and quality of engagement. We believe this to be a novel and valuable contribution in the highly variable context of remote Indigenous communities, both in Australia and elsewhere. Our intention was not to prescribe a normative approach to collaboration, rather to assess water and energy management initiatives from a basis acknowledging that highly varied and differing responses are required to adapt to different local contexts. Also, recognising the wider context for Aboriginal and Torres Strait Islanders and all Indigenous peoples, of social disadvantage that has been and continues to be perpetuated by post-colonial Government policy and programs more generally [25,96].

Based on this research, a number of pathways forward are highlighted to further progress the relationship between service providers and Indigenous communities and sustainability outcomes:

- greater recognition in service provider agency structures and processes that business-as-usual interactions will no longer suffice and the urgency of systemic change to overcome institutionalised barriers and allow genuine collaborations is recognised;
- dominant institutional and organisation structures identify and enable innovative strategies to emerge; strategies shaped by a shared understanding of the local context, and recognition of the complex interactions between communities, managers and water and energy supply and use within a broader governance environment.
- such strategies draw from Indigenous traditional knowledge, cultures, values, principles, approaches and ideas in conjunction with Western scientific knowledge and management practices [4,7,34]—a 'best-of-both-worlds' approach;
- addressing scientific knowledge and data gaps in local resource availability, community preferences and needs are identified and built into strategies;
- leadership is shared across actors with mutual commitment to the concept, establishment of curated learning environments and open dialogue facilitating long-term success.

This research provides a foundation from which to inform future practice and multidisciplinary conversations about meaningful engagement with Aboriginal and Torres Strait Island and other Indigenous communities towards new models of partnership and collaboration in water and energy management. Given the dearth of robust data available about how management is being conducted and affecting communities, this research fills a gap in knowledge, providing a novel contribution in this space. However, it is a rapidly changing environment and therefore should be considered as a snapshot in time. To build on this research and ensure continued relevance and utility over time, further assessment of water and energy management activities and the community contexts in which they are operating would be useful. Future assessment could consider the characteristics and types of management activities presented here to guide analysis and inform future practice. Testing of this assessment and typology with those who are the focus of the initiatives—the community

members—will also be necessary as part of an empowerment ethic to ensure local and cultural perspectives are considered.

By acknowledging context and core characteristics of governance arrangements, purpose and community engagement design when initiating, funding and implementing management initiatives, more awareness of the extent and success of different types of engagement activities is likely. This typology and assessment of water and energy management is therefore relevant not only for management praxis in Australia but other post-colonial settler states including New Zealand, Canada, the United States, Central and South America, and similar remote community contexts in the Pacific and Africa where issues of Indigenous sovereignty and community governance, socio-economic wellbeing, resource use and management intersect. This paper attempts to provide a further contribution to this field and reference for researchers, managers, policymakers and communities who are seeking to better comprehend the nuances of localized transitions towards sustainable water and energy use and management and ensure sustainable transformation of communities.

Author Contributions: Conceptualization, M.J.; methodology, M.J.; validation, M.J., C.D.B., and R.A.S.; formal analysis, M.J.; investigation, M.J.; writing—original draft preparation, M.J.; writing—review and editing, M.J., C.D.B., R.A.S., K.S.F., J.C.; visualization, M.J.; supervision, C.D.B., R.A.S., K.S.F.; project administration, M.J., C.D.B.; funding acquisition, C.D.B.

Funding: This doctoral research has been supported by funding from an Australian Research Council (ARC) Linkage Project Grant (Number: LP140100118) and Industry funding from Ergon Energy Corporation, NT Power and Water Corporation.

Acknowledgments: The authors would like to acknowledge the Aboriginal and Torres Strait Island peoples of Australia who never ceded sovereignty. Research partner University of Queensland is also acknowledged as are Torres Strait Island Regional Council, Water Corporation, the Centre for Appropriate Technology, Queensland Department of Natural Resources, Mines and Energy and the Torres Strait Regional Authority for their ongoing partnership and support for this research. The authors would also like to thank all the practitioners that gave their time and shared their knowledge to progress this research.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

Appendix A

Inclusion Criteria for Initiatives

The inclusion criteria applied were:

1. Initiatives (projects or programs) with a community participation element beyond standard operating procedure for service providers (e.g., technology maintenance, installation, like-for-like replacement/upgrades);
2. Initiatives where focus was potable water supply and consumption at the community level or energy supply/demand management (could extend to broader sustainability improvements as long as water or energy were a core focus);
3. Potable water initiatives which occurred in remote or regional Aboriginal or Torres Strait Island communities across Northern and Central Australia;
4. Initiatives occurring in the past fifteen years were considered to capture both recent efforts and also those that occurred further in the past but that were not too far out of recent memory or data availability to account for turnover of staff and changes to Departmental organisation; and
5. Communities between 50 and 1000 people and had designated service delivery for water and energy (i.e., excludes homelands and other satellite communities with populations less than 50 that self-manage essential services [34])

Appendix B

Table A1. Detailed description of initiative characteristics and options for categorising.

Key Characteristics of Initiative	Influence on Community Involvement	Characteristic Options
1. Period of operation	Period of operation has a more general influence on community involvement and is not directly linked, that is although opportunity for greater community involvement may be facilitated over longer time periods, it may be that a short project could demonstrate innovative methods of engagement.	Year
2. Region	Region indirectly influences community engagement through the varied jurisdictional governance arrangements (which are captured in characteristics 3 and 4.	NT, WA, Qld, SA, Multiple
3. Initiating Organisation or Lead	The initiating (or lead in the case of a collaborative initiative) organisation influences the aims, design and methods and flexibility with which an initiative can be run. In Australia, the existing regulatory and governance arrangements set out responsibility for water and energy under various agency's control, therefore initiation of remote community water or energy initiatives is unlikely to be generated internally (I) from within the community except in unusual conditions. Note: scope of this research excludes self-managed community water systems.	Options included <ul style="list-style-type: none"> • Federal Government (FG), • State Government (SG) • Local Government (LG) • Utility or Service Provider (may be local government) (U), • Indigenous Not-for-profit organisation (NFP) • Private business (P), • Consultant/contractor (C) Note: other options are feasible, but were not identified from the data set
4. Funding Source	The funding body usually controls the objectives and performance indicators of any investment, thereby setting the 'tone' of the initiative in terms of scope, objectives, timelines and so on. Given the low socio-economic status of remote Indigenous communities in Australia, and existing structures and governance firmly placing responsibility for water and energy under various agency control, funding for investments in infrastructure and any efforts to involve communities is unlikely to be generated internally (I) from within a community except in unusual circumstances.	Funding sources included: <ul style="list-style-type: none"> • Federal Government (FG)—grants, programs or direct support • State Government (SG) • Local Government (LG) • Utility or Service Provider (may be local government) (U), • Indigenous Not-for-profit organisation (INFP) • Private business (P), • Consultant/contractor (C)
5. Target Area	In the majority of jurisdictions, remote community water and energy are managed separately. A key factor that may influence the type of engagement is that residents pay for electricity use, but not directly for water, therefore this potentially influences the type of engagement, but indirectly.	Primary objective is in relation to: <ul style="list-style-type: none"> • water system, (water) • energy system (energy), • both water and energy (W/E)
6. Scale	Scale affects the design in terms of target audience, access to resources and time available to build capacity of communities. Larger scale does not necessarily correlate to more collaborative processes, however economies of scale can often be generated tools and techniques scaled up. A small initiative can also be highly effective if designed well and implemented as part of a broader plan of community development.	<ul style="list-style-type: none"> • Small (S) = pilot project in 1-2 communities <2 years, finances from operating budgets of service deliverers • Medium (M) = multiple communities, 1-3 years, financial commitment external to operational budget • Large (L) = regional scale (if not State/Territory wide), 3+ years, or smaller geographical scale with significant investment in change and learning outcomes

Table A1. Cont.

Key Characteristics of Initiative	Influence on Community Involvement	Characteristic Options
7. Target Audience	The target audience will influence methods chosen and therefore outcomes achieved. Focusing on remote Indigenous communities (I) is likely to influence culturally appropriate methods and techniques being supported as part of the design. Whereas broader programs across all communities (All) are likely to use generic methods.	Options: <ul style="list-style-type: none"> • Indigenous (I) focused • All
8. Scope of Change Outcomes Sought	<p>Focused change creation can generate change in one dimension but may not contribute to long-lasting outcomes or systemic change for the community as a whole.</p> <p>The Community Capitals Framework (CCF) [79] is an ‘assets-based framework’ (see [27,97–101]) used in this context to inform definitions of broad or narrow scope (see [27,97,102]). CCF takes a systemic approach to community development by considering seven distinct types of capitals—natural, cultural, human, social, political, financial and built capital. These capitals can be employed, invested in or leveraged to improve community wellbeing, health and sustainability [81]. The CCF has been used in rural and remote community work internationally and in Australia [103,104].</p>	<ul style="list-style-type: none"> • Narrow scope of change = 1–2 capitals, All initiatives will seek to improve at least one capital. Standard practice focus is on infrastructure management (built capital) only and as increasing recognition that community information or education (human capital) may be required to manage demand and reduce costs of service and supply, this is also becoming the norm. Where built or built and human were indicated as targeted change, this was considered a baseline and therefore a narrow approach. • Broad focus of change = 3 + capitals, requires a systemic assessment of the issues, good design and rigorous methods. This is beyond standard operating procedures to maintain water or energy infrastructure for basic service delivery.
9. Type of community outcomes sought	Many initiatives outlined their intent in terms of community engagement while others were implied through various aspects in the project design. Each category may be appropriate for different local contexts and combinations may be employed in one initiative dependent on the context.	<ul style="list-style-type: none"> • Technical (T)—seek an improvement in infrastructure through a focus on upgrades, maintenance, replacement of or installation of new, water or power equipment and technology. Only concerned with local knowledge and perspectives to the extent that infrastructure can be physically accessed, upgraded, maintained and so on. • Consultation (C)—seek support from community (focus on leadership) about the already established aims and desired outcomes of the project. That is, basic information provision with some feedback, but not widespread purposeful dialogue across the community • Information and Education (I&E)—seek a change in behaviours of community members through provision of information. May be delivered through various mechanisms, not necessarily culturally appropriate • Capacity Building (CB)—seek a change in capacity of community to act and make decisions for community wellbeing and sustainability through direct and indirect mechanisms including widespread dialogue opportunities, training, skills building, creating employment opportunities or pathways (this category necessarily incorporates C, I&E)

Table A1. Cont.

Key Characteristics of Initiative	Influence on Community Involvement	Characteristic Options
10. Depth of community involvement	<p>Depth of community engagement designed for is indicated across three related elements: timing, duration and participant diversity.</p> <p>Timing—Early involvement of Aboriginal or Torres Strait Island community members in the design phase prior to setting objectives allows for overcoming of priorities set by Government and facilitates local priorities. Co-identifying the core issues for the community and making decisions about objectives and direction of the initiative, represents a more collaborative approach. Early, during, post.</p> <p>Duration—by involving community members early, longer-term (relative to the lifespan of the initiative) opportunities for relationship building and feedback by locals into the initiative can occur. Throughout, limited.</p> <p>Diversity—Important to follow the appropriate channels for decision-making according to community-determined leadership (Hunt, 2013). It is likely that existing relationships between service providers and communities are well established (with some community members employed by service providers). However, care needs to be taken to not assume that leadership reflect or are able to effectively communicate to the whole community.</p>	<ul style="list-style-type: none"> • Deep = early (purpose and design decisions), throughout (opportunities for feedback designed in throughout and diverse participation (more than elected representatives) • Mid = variations of timing, duration and diversity between shallow and deep. • Shallow = post-design, limited opportunities for input and ‘representative’ participation only
11. Use of culturally appropriate methods	<p>Recognition and application of culturally-appropriate information and methods of communication enables deeper and more diverse participation from across segments of communities that may otherwise not have an opportunity to participate. Use of local languages and activities in locally relevant ways and by local people facilitate uptake of ideas and allow for meaningful engagement with materials. Gathering and inclusion of local anecdotes and experiences, cultural and historical knowledge, Indigenous ecological knowledge as well as technical and managerial input contribute more robust programs and community ownership of process and outcomes. This is not a linear progression, but each reflects more effort made to adopt culturally relevant information, language, tools and techniques.</p>	<ul style="list-style-type: none"> • High = a local needs assessment conducted to understand most appropriate forms of communication; local people trained, local languages used, methods of delivery in line with cultural protocols; regular communications using face-to-face methods • Medium = some use of Indigenous people and employed tailored tools/techniques to a limited extent based on existing knowledge; some face-to-face communication and information sharing throughout • Low = no local needs assessment; delivery in English language only with limited application of generic engagement techniques used such as information posters in the shop window
12. Independent, Participatory Evaluation as part of Continual Learning Cycle	<p>Evaluation of the initiative considering the aims, objectives, outcomes conducted independently and using rigorous and participatory evaluation methods provides an opportunity for feedback from the community and is necessary for continual and social learning at all levels.</p>	<ul style="list-style-type: none"> • Independent participatory evaluation (Participatory) • Internal evaluation in form of ‘lessons learned’ reflection including some community perspectives but without rigorous design (Internal) • Internal evaluation in form of ‘lessons learned’ reflection by project team only (Project Team) • No evaluation conducted at all (None) • Where initiative still in progress = not applicable (n/a)

Appendix C

Table A2. Typology of indigenous community engagement in water and energy management initiatives.

Parameter	Agency-Driven Technical (AT)	Agency-Driven Community Education (ACE)	Externally-Driven Collaborations (EC)	Community-Driven Collaborations (CC)	
Governance Arrangements	Initiating and lead organisation	External agency led (usually government or government-backed), initiated through Business As Usual agency processes to achieve operational targets	External agency-led (usually government or government-backed), operational focus, with recognition of value of end-users in demand-management for cost-effective service delivery	External agency or non-gov. org leading collaboration between partners including community	Community-led in partnership with external agencies supporting community directed initiative
	Funding source and arrangements	Funding tied to agency operational requirements driven by regulatory priorities	Funding tied to agency operational requirements driven by regulatory priorities	Grants for broader activities beyond scope of operational requirements for service delivery. Usually government, may be philanthropic or private business sourced.	Community-sourced funding, such as low-interest loans, government grants, private or social enterprise investment (for energy only as revenue stream exists to recoup investment),
Purpose of Initiative	Scope of change outcomes sought	Primarily a narrow, technical focus (built capital) incorporating improvement to infrastructure owned and operated by the service delivery agency to address cost-effective agency priorities. Also driven by need to conserve resources to ensure security of supply (natural or productive capital)	Primarily a narrow, technical focus (built capital) but recognition by service delivery agencies of end-user control over demand and therefore lifetime and viability of infrastructure investments therefore focuses on building awareness and understanding of end-users of importance of their role in conservation measures (human capital)	Incorporates multiple objectives including both service delivery and community needs, recognising role service delivery processes can contribute to community wellbeing through investing in partnerships, training, education and capacity building and identifying innovative pathways to achieve shared objectives (multiple capitals)	By default of fact that initiative is designed and chosen by the community, long-term community objectives can be met. Either narrow or broad scope may be relevant according to need, therefore fit-for-purpose to meet community priorities. Partnerships can also help to widen scope of community vision toward sustainable outcomes.
	Community engagement objective	Technical or technology and may include (but not always) consultation to confirm 'social licence to operate' in community from leaders	Information and education given to local community, messages driven by agency objectives	Capacity Building (which may incorporate changes in technology, education and skills levels)	Part of an ongoing community empowerment process (which may incorporate changes in technology, education or build capacity of community to respond across multiple areas)

Table A2. Cont.

Parameter	Agency-Driven Technical (AT)	Agency-Driven Community Education (ACE)	Externally-Driven Collaborations (EC)	Community-Driven Collaborations (CC)
Community Engagement Aspects	Depth of community Involvement	Communities may be involved as part of mechanism to support decisions already made on their behalf; consultative approach post objectives-setting and design phase.	Community members involved post objectives-setting and design phase but with more structured opportunities to participate; community representatives likely to be leaders or members of existing committees, not necessarily representative of all community member views	Community driven - participation from appropriate people at appropriate points throughout. Community seek support from partners to fill gaps in knowledge and skills and help build capacity of community in relation to ongoing change agenda (as set by community)
	Use of culturally appropriate methods	Delivery in English language dominates, some recognition of cultural difference, dependent upon skills and knowledge of project team	May incorporate some use of local languages or use of local people to distribute or disseminate information, but not necessarily designed into initiative, methods and forums for communication likely to be 'Western' style	Community determines methods, so culturally-relevant approach. Note: equitable representation by leaders or participation needs to be actively managed, i.e., any inequities in community may be reinforced without active measures to counteract
	Participatory evaluation (if evaluation conducted)	Evaluation, if conducted, focuses on meeting business case objectives (e.g., cost-benefit criteria). Unlikely to incorporate any qualitative data gathering of community perspectives on success of initiative	Community views may be reflected through project manager interpretations or notes, not directly documented or captured through formal processes	Communities given opportunities for in-depth participation in evaluation of short, medium and long-term outcomes and benefits including determining scope of activities to be evaluated. Multiple sources of data included.

References

1. United Nations. Transforming Our World: The 2030 Agenda for Sustainable Development. Resolution 70/1 Adopted by the United Nations General Assembly on 25 September 2015. 2015. Available online: <https://sustainabledevelopment.un.org/post2015/transformingourworld> (accessed on 17 November 2018).
2. United Nations (UN). United Nations Sustainable Development Goals. 2015. Available online: <http://www.un.org/sustainabledevelopment/sustainable-development-goals/> (accessed on 17 November 2018).
3. Dodson, M.; Smith, D.E. Governance for sustainable development: Strategic issues and principles for Indigenous Australian communities. *Cent. Aborig. Econ. Policy Res.* **2003**, *250*, 1–25.
4. Jackson, S.; Barber, M. Recognition of indigenous water values in Australia's Northern Territory: Current progress and ongoing challenges for social justice in water planning. *Plan Theory Pract.* **2013**, *14*, 435–454. [[CrossRef](#)]
5. Von der Porten, S.; de Loë, R.C. Geoforum Collaborative approaches to governance for water and Indigenous peoples: A case study from British Columbia, Canada. *Geoforum* **2013**, *50*, 149–160. [[CrossRef](#)]
6. Nance, A. Synthesis Paper for Consultation—Energy Access and Affordability Policy Research. 2017. Available online: <https://www.acoss.org.au/wp-content/uploads/2017/03/Consultation-Paper-Empowering-Vulnerable-Households-and-Decarbonisation.pdf> (accessed on 10 August 2018).
7. Kwiatkowski, R.E. Indigenous community based participatory research and health impact assessment: A Canadian example. *Environ. Impact Assess. Rev.* **2011**, *31*, 445–450. [[CrossRef](#)]
8. Australian Bureau of Statistics. Estimates of Aboriginal and Torres Strait Islander Australians June 2011. 2013. Available online: <http://www.abs.gov.au/ausstats/abs@.nsf/mf/3238.0.55.001> (accessed on 31 August 2018).
9. Hunt, J. Engagement with Indigenous Communities in Key Sectors: Resource Sheet No. 23 Produced for the Closing the Gap Clearinghouse. 2013. Available online: <https://www.aihw.gov.au/getmedia/c3d74d39-0ded-4196-b221-cc4240d8ec90/ctgc-rs23.pdf.aspx?inline=true> (accessed on 4 April 2018).
10. Moran, M. The Intercultural Practice of Local Governance in an Aboriginal Settlement in Australia. *Hum. Organ.* **2010**, *69*, 65–74. [[CrossRef](#)]
11. Moran, M. *Serious Whitefella Stuff: When Solutions Became the Problem in Indigenous Affairs*; Melbourne University Press: Melbourne, VIC, Australia, 2016; 222p.
12. Kelly-Scott, K.; Smith, K. Aboriginal Peoples: Fact Sheet for Canada. Statistic Canada, 2015. Available online: <http://www.statcan.gc.ca/pub/89-656-x/89-656-x2015001-eng.htm> (accessed on 17 November 2018).
13. Dewees, S.; Marks, B. Twice Invisible: Understanding Rural Native America. First Nations Development Institute; Research Note #2: April 2017. Available online: <https://www.usetinc.org/wp-content/uploads/bvenuti/WWS/2017/May2017/May8/TwiceInvisible-ResearchNote.pdf> (accessed on 17 November 2018).
14. Grey-Gardner, R. *Remote Community Water Management, DKCRC Research Report 27*; Desert Knowledge Cooperative Research Centre: Alice Springs, NT, Australia, 2008. Available online: <http://www.desertknowledgecrc.com.au/resource/DKCRC-Report-27-Remote-Community-Water-ManagementWEB2.pdf> (accessed on 1 August 2018).
15. Beal, C.D.; Gurung, T.R.; Stewart, R.A. Modelling the impacts of water efficient technologies on energy intensive water systems in remote and isolated communities. *Clean Technol. Environ. Policy* **2016**, *18*, 1713–1723. [[CrossRef](#)]
16. Beard, N. *Water Proofing Homelands: Integrating Approaches for Small Water Supply Reliability*; Centre for Appropriate Technology Paper: Alice Springs, NT, Australia, 2006.
17. Hoverman, S.; Ayre, M. Methods and approaches to support Indigenous water planning: An example from the Tiwi Islands, Northern Territory, Australia. *J. Hydrol.* **2012**, *474*, 47–56. [[CrossRef](#)]
18. Beal, C.D.; Jackson, M.; Stewart, R.A.; Rayment, C.; Miller, A. Identifying and understanding the drivers of high water consumption in remote Australian Aboriginal and Torres Strait Island communities. *J. Clean. Prod.* **2018**, *172*, 2425–2434. [[CrossRef](#)]
19. Beal, C.D.; Stewart, R.A.; Larsen, S. Exploring the Residential Water-Energy Nexus in Remote Regions—Results from a Far North Queensland water end-use pilot study. *Water* **2014**, *41*, 78–82.
20. Ross, K.; Delaney, C.; Mohr, S.; Mitchell, C. End of Project Evaluation; Gunbalanya water initiative, Sydney. 2014. Available online: <https://www.uts.edu.au/research-and-teaching/our-research/institute-sustainable-futures/news/evaluating-gunbalanya-water> (accessed on 1 August 2018).

21. Binks, A.N.; Kenway, S.J.; Lant, P.A.; Head, B.W. Understanding Australian household water-related energy use and identifying physical and human characteristics of major end uses. *J. Clean. Prod.* **2016**, *135*, 892–906. [[CrossRef](#)]
22. Power and Water Corporation. *2009 Sustainable Water Management Report*; Power and Water Corporation: Darwin, Australia, 2009.
23. Beard, N.; Climie, K.; Vervetjes, E.; Saunders, P.; Gerardi, W. Business Case and Implementation of Efficiency—NT Indigenous Communities. In Proceedings of the OzWater13 Conference, Perth, Australia, 7–9 May 2013.
24. Australian Bureau of Statistics. 4706.0.30.001 Maps and Census Profiles, Australian Indigenous Geographical Classification. Australian Indigenous Geographical Classification; 2008. Available online: [http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/499711EC612FF76ECA2574520010E1FE/\\$File/communitymap.pdf](http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/499711EC612FF76ECA2574520010E1FE/$File/communitymap.pdf) (accessed on 15 November 2018).
25. Queensland Productivity Commission. Service Delivery in Remote and Discrete Aboriginal and Torres Strait Islander Communities: Draft Report. 2017. Available online: <https://www.qpc.qld.gov.au/inquiries/service-delivery-in-queenslands-remote-and-discrete-indigenous-communities/> (accessed on 10 August 2018).
26. CSIRO and Bureau of Meteorology. State of the Climate: 2018. (State of the Climate Reports). Available online: <http://www.bom.gov.au/state-of-the-climate/State-of-the-Climite-2018.pdf> (accessed on 10 December 2018).
27. Moran, M.; Wright, A.; Renehan, P.; Szava, A.; Beard, N.; Rich, E. *The Transformation of Assets for Sustainable Livelihoods in a Remote Aboriginal Settlement_DKRC*; Research Report 28; Desert Knowledge CRC: Alice Springs, NT, Australia, 2007.
28. Yuen, E. *Water Consumption Patterns in Australian Aboriginal Communities*; Murdoch University: Perth, Australia, 2004. Available online: <http://researchrepository.murdoch.edu.au/id/eprint/419/1/01Front.pdf> (accessed on 10 August 2018).
29. Brown, R.R.; Farrelly, M.A. Delivering sustainable urban water management: A review of the hurdles we face. *Water Sci. Technol.* **2009**, *59*, 839–846. [[CrossRef](#)] [[PubMed](#)]
30. Commonwealth of Australia. Water: A Report on the Provision of Water and Sanitation in Remote Aboriginal and Torres Strait Islander Communities. 1994. Available online: https://www.humanrights.gov.au/sites/default/files/content/racial_discrimination/report/water_report/Report_1994.pdf (accessed on 1 November 2018).
31. Australian Bureau of Statistics. Housing and Infrastructure in Aboriginal and Torres Strait Islander Communities, 2006 (reissue) Cat.4710.0. 2006. Available online: <http://www.abs.gov.au/ausstats/abs@.nsf/mf/4710.0> (accessed on 10 August 2018).
32. AECOM; Miles, K.; Byrnes, J.; Bannon, K. *Review of Regional Water Quality & Security: Review & Reform Strategy*; Prepared for Infrastructure Australia; AECOM: Sydney, Australia, 2010; Volume 1. Available online: https://infrastructureaustralia.gov.au/policy-publications/publications/files/Review_of_RegionalWaterQuality_and_Security_Volume1_251010.pdf (accessed on 1 November 2018).
33. Hunt, J.; Smith, D.E. Further Key Insights from the Indigenous Community Governance Project. 2006. Available online: http://caep.cass.anu.edu.au/sites/default/files/docs/Key_Insights_ICGP_2006.pdf (accessed on 10 August 2018).
34. Hunt, J. Engaging with Indigenous Australia—Exploring the Conditions for Effective Relationships with Aboriginal and Torres Strait Islander Communities: Issues Paper No. 5 Produced for the Closing the Gap Clearinghouse. Closing the Gap Clearinghouse; 2013. Available online: www.aihw.gov.au/closingthegap (accessed on 10 August 2018).
35. Moran, M.; Elvin, R. Coping with Complexity: Adaptive Governance in Desert Australia. *GeoJournal* **2014**, *74*, 415–428. [[CrossRef](#)]
36. Altman, J. The Indigenous hybrid economy: A realistic sustainable option for remote communities? *Econ. Policy* **2006**, *35*, 1–6.
37. United Nations. State of the World's Indigenous Peoples. UNPFII State World's Indig Peoples. 2009. Available online: <https://www.un.org/development/desa/indigenouspeoples/publications/state-of-the-worlds-indigenous-peoples.html> (accessed on 28 August 2018).
38. Tesoriero, F. *Community Development: Community-Based Alternatives in An Age of Globalisation*; Pearson Australia: Frenchs Forest, NSW, Australia, 2010; 344p.
39. Checkland, P. *Systems Thinking, Systems Practice*; John Wiley & Sons Ltd.: Chichester, UK, 1993.
40. Checkland, P.; Scholes, J. *Soft Systems Methodology in Action*; John Wiley & Sons Ltd.: Chichester, UK, 1990.

41. Howarth, C.; Monasterolo, I. Opportunities for knowledge co-production across the energy-food-water nexus: Making interdisciplinary approaches work for better climate decision making. *Environ. Sci. Policy* **2017**, *75*, 103–110. [CrossRef]
42. Innes, J.E.; Booher, D.E. *Planning with Complexity: An Introduction to Collaborative Rationality for Public Policy*; Routledge: Abingdon, UK, 2010; pp. 1–237.
43. Tawfik, S. Pursuing Sustainable Urban Water Management through Co-Governance: A Case Study of Marrickville Council. 2016. Available online: https://watersensitivocities.org.au/wp-content/uploads/2016/09/PC762-Cogovernance-in-MC_SP_ST_9_8_WEB.pdf (accessed on 1 June 2018).
44. Reed, M. Stakeholder participation for environmental management: A literature review. *Biol. Conserv.* **2008**, *141*, 2417–2431. [CrossRef]
45. Herriman, J. Local Government and Community Engagement in Australia. Working Paper No 5. for the Australian Centre of Excellence for Local Government (ACELG). 2011. Available online: http://www.ancelg.org.au/upload/program1/1320191471_Community_Engagement_web.pdf (accessed on 10 August 2018).
46. Queensland Government. Water Act 2000. Available online: <https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-2000-034> (accessed on 1 November 2018).
47. Local Government Association of South Australia. *Community Engagement Framework: A Model Framework for Leading Practice in Local Government in South Australia*; Revised; Local Government Association of South Australia: Adelaide, South Australia, 2016. Available online: https://www.lga.sa.gov.au/webdata/resources/project/2016_LGA%20Community%20Engagement%20Handbook%20Revised%204th%20Edition%20June%202016_Final.pdf (accessed on 28 August 2018).
48. Commonwealth of Australia. *National Partnership Agreement on Remote Service Delivery Evaluation 2013*; Commonwealth Government: Canberra, Australia, 2014.
49. Jiménez, A.; Cortobius, M.; Kjellén, M. Water, sanitation and hygiene and indigenous peoples: A review of the literature. *Water Int.* **2014**, *39*, 277–293. [CrossRef]
50. Hill, R.; Grant, C.; George, M.; Robinson, C.J.; Jackson, S.; Abel, N. A Typology of Indigenous Engagement in Australian Environmental Management: Implications for Knowledge Integration and Social-ecological System Sustainability. *Ecol. Soc.* **2012**, *17*. [CrossRef]
51. Arnstein, S.R. A ladder of citizen participation. *J. Am. Inst. Plann.* **1969**, *35*, 216–224. [CrossRef]
52. Hurlbert, M.; Gupta, J. The split ladder of participation: A diagnostic, strategic, and evaluation tool to assess when participation is necessary. *Environ. Sci. Policy* **2015**, *50*, 100–113. [CrossRef]
53. IAP2 Australasia. Quality Assurance Standard for Community and Stakeholder Engagement. 2015. Available online: https://www.iap2.org.au/Tenant/C0000004/00000001/files/IAP2_Quality_Assurance_Standard_2015.pdf (accessed on 1 June 2018).
54. Department for International Development. *Tools for Development*; Department for International Development: London, UK, 2003; Volume 15, Available online: <https://webarchive.nationalarchives.gov.uk/+http://www.dfid.gov.uk/Documents/publications/toolsfordevelopment.pdf>; (accessed on 1 June 2018).
55. Gaventa, J. Finding spaces for change. *Inst. Dev. Stud. Bull.* **2006**, *37*, 23–33. [CrossRef]
56. Norad, A. *Framework for Analysing Participation in Development*; Oxford Policy Management: Oslo, Norway, 2013.
57. Hall, N.; Barbosa, M.C.; Currie, D.; Dean, A.J.; Head, B.; Hill, P.S.; Naylor, S.; Reid, S.; Selvey, L.; Willis, J. Water, sanitation and hygiene in remote Indigenous Australia: A scan of priorities. Global Change Institute Discussion Paper: Water for Equity and Wellbeing Series. 2017. Available online: <https://gci.uq.edu.au/un-sustainable-development-goals-water-sanitation-and-hygiene> (accessed on 1 November 2018).
58. Fung, A. Varieties of Participation in Complex Governance. *Am. Soc. Public Adm.* **2006**, *66*, 66–75. [CrossRef]
59. Collins, K.; Ison, R. Jumping off Arnsteins' ladder: Social learning as a new policy paradigm for climate change adaptation. *Environ. Policy Gov.* **2009**, *19*, 358–373.
60. Day, D. Citizen participation in the planning process: An essentially contested concept? *J. Plan. Lit.* **1997**, *11*, 421–434.
61. Bishop, P.; Davis, G. Mapping public participation in policy choices. *Aust. J. Public Adm.* **2002**, *61*, 14–29.
62. Innes, J.E.; Booher, D.E. Reframing public participation: Strategies for the 21st century. *Plan Theory Pract.* **2004**, *5*, 419–436.
63. Robinson, J.W.; Green, G.P. *Introduction to Community Development: Theory, Practice and Service-Learning*; Robinson, J.W., Green, G.P., Eds.; SAGE Publications, Inc.: Thousand Oaks, CA, USA, 2011; pp. 1–9.

64. Escott, H.; Beavis, S.; Reeves, A. Incentives and constraints to Indigenous engagement in water management. *Land Use Policy* **2015**, *49*, 382–393. [CrossRef]
65. Jackson, S.; Tan, P.L.; Mooney, C.; Hoverman, S.; White, I. Principles and guidelines for good practice in Indigenous engagement in water planning. *J. Hydrol.* **2012**, *474*, 57–65. [CrossRef]
66. Innes, J.E.; Booher, D.E. Collaborative rationality as a strategy for working with wicked problems. *Landsc. Urban Plan.* **2016**, *154*, 8–10. [CrossRef]
67. Zeitoun, M.; Lankford, B.; Krueger, T.; Forsyth, T.; Carter, R.; Hoekstra, A.Y.; Taylor, R.; Varis, O.; Cleaver, F.; Boelens, R.; et al. Reductionist and integrative research approaches to complex water security policy challenges. *Glob. Environ. Chang.* **2016**, *39*, 143–154. [CrossRef]
68. Walker, B.; Porter, D.; Marsh, I. *Fixing the hole in Australia's Heartland: How Government needs to work in remote Australia*; Desert Knowledge Australia: Alice Springs, Australia, 2012.
69. Diver, S. Negotiating Indigenous knowledge at the science policy-interface: Insights from the Xáxli'p Community Forest. *Environ. Sci. Policy* **2017**, *73*, 1–11. [CrossRef]
70. Pahl-Wostl, C.; Lebel, L.; Knieper, C.; Nikitina, E. From applying panaceas to mastering complexity: Toward adaptive water governance in river basins. *Environ. Sci. Policy* **2012**, *23*, 24–34. [CrossRef]
71. Australian Bureau of Statistics. *Cat. 3228.0 Estimates and Projections, Aboriginal and Torres Strait Islander Australians, 2001 to 2026*; Australian Bureau of Statistics: Canberra, Australia, 2014.
72. Neuman, W.L. *Social Research Methods: Qualitative and Quantitative Approaches*, 7th ed.; Allyn & Bacon: Boston, MA, USA, 2011.
73. Lindlof, T.R. *Qualitative Communication Research Methods*; Sage Publications: Thousand Oaks, CA, USA, 1995.
74. Denzin, N.K.; Lincoln, Y.S. *Strategies of Qualitative Inquiry*; Sage Publications Inc.: Thousand Oaks, CA, USA, 2008.
75. Charmaz, K. *Constructing Grounded Theory*, 2nd ed.; SAGE Publications: London, UK, 2014.
76. Beekhuyzen, J.; Nielsen, S.L.; von Hellens, L.A. The NVivo Looking Glass: Seeing the Data through the Analysis. In Proceedings of the 5th Conference on Qualitative Research in IT, Brisbane, Australia, 29–30 November 2010.
77. Attride-Stirling, J. Thematic networks: An analytic tool for qualitative research. *Qual. Res.* **2001**, *1*, 385–405. [CrossRef]
78. Flora, C.B.; Flora, J.L.; Fey, S. *Rural Communities: Legacy and Change*, 2nd ed.; Westview Press: Boulder, CO, USA, 2004.
79. Butler Flora, C.; Emery, M.; Fey, S.; Bregendahl, C. Community Capitals: A Tool for Evaluating Strategic Interventions and Projects. 2004. Available online: <https://naaee.org/sites/default/files/204.2-handout-community-capitals.pdf> (accessed on 28 August 2018).
80. Fey, S.; Bregendahl, C.; Flora, C. The Measurement of Community Capitals through Research. *Online J. Rural Res. Policy* **2006**, *1*, 1–28. [CrossRef]
81. Emery, M.E.; Flora, C. Spiraling-Up: Mapping Community Transformation with Community Capitals Framework. *Community Dev.* **2006**, *37*, 19–35. [CrossRef]
82. Butler Flora, C. Community Dynamics and Social Capital. *Agroecosyst. Anal.* **2004**, 1–29.
83. Centre for Appropriate Technology. Safe and Smart Power Program: Demand Management Community Education Program Final Community Report July 2013. 2013. Available online: <https://cfat.org.au/safe-and-smart-power-program> (accessed on 1 June 2017).
84. Bawden, R.; Reichenbach, M. Learning by Experiencing: Systemics, Futures Thinking, and Scenarios. In *Sustainable Development: Principles, Frameworks, and Case Studies*; CRC Press: Boca Raton, FL, USA, 2010.
85. Flood, R.L. *The Relationship of "Systems Thinking" to Action Research*; Reason, P., Bradbury, H., Eds.; Handbook of Action Research; SAGE Publications Ltd.: London, UK, 2006.
86. Green, D.; Minchin, L. Living on climate-changed country: Indigenous health, well-being and climate change in remote Australian communities. *Ecohealth* **2014**, *11*, 263–272. [CrossRef] [PubMed]
87. Dunstan, C.; Ross, K.; Ghiotto, N. *Barriers to Demand Management: A Survey of Stakeholder Perceptions*; Institute for Sustainable Futures: Sydney, Australia, 2011.
88. Westoby, P.; Dowling, G. *Dialogical Community Development: With Depth, Solidarity and Hospitality*; Tafina Press: West End, QLD, Australia, 2009; 227p.

89. Hall, N.; Acosta Jaramillo, C.M.; Jagals, P.; Currie, D.; Ossa-Moreno, J.; Dean, A.; Ross, H.; Bowling, T.; Hill, P.; Head, B.; et al. Strengthening Community Participation in Meeting UN Sustainable Development Goal 6 for Water, Sanitation and Hygiene: Discussion Paper November 2016. Brisbane, Australia, 2016. Available online: <http://gci.uq.edu.au/un-sustainable-development-goals-water-sanitation-and-hygiene> (accessed on 1 November 2018).
90. Australian Government Productivity Commission. Better Indigenous Policies: The Role of Evaluation Roundtable Proceedings. In *Productivity Commission Policy Roundtable*; Australian Government Productivity Commission: Canberra, Australia, 2013.
91. Abrahams, J.; Henderson, R. *Pilot Project for Community Engagement in Water Conservation at Ali Curung Final Report: Key Findings, Recommendations and Options, Power and Water Corporation*; Alice Springs: Northern Territory, Australia, 2010.
92. Jackson, S. Compartmentalising Culture: The articulation and consideration of Indigenous values in water resource management. *Aust Geogr.* **2006**, *37*, 19–31. [[CrossRef](#)]
93. Tuhiwai-Smith, L. *Decolonising Methodologies: Research and Indigenous Peoples*; Zed Books Ltd and University of Otago Press: Dunedin, New Zealand, 2003.
94. Moran, M.; Porter, D.; Bank, W. Reinventing the Governance of Public Finances in Remote Indigenous Australia. *Aust. J. Public Adm.* **2014**, *73*, 115–127. [[CrossRef](#)]
95. Zurba, M.; Ross, H.; Izurieta, A.; Rist, P.; Bock, E.; Berkes, F. Building co-management as a process: Problem solving through partnerships in Aboriginal Country, Australia. *Environ. Manag.* **2012**, *49*, 1130–1142. [[CrossRef](#)] [[PubMed](#)]
96. Howitt, R. Sustainable indigenous futures in remote Indigenous areas: Relationships, processes and failed state approaches. *GeoJournal* **2012**, *77*, 817–828. [[CrossRef](#)]
97. Stayner, R. Chapter 4 Guyra. New South Wales. In *Community Sustainability in Rural Australia: A Question of Capital?* Cocklin, C., Alston, M., Eds.; Centre for Rural Social Research, Charles Sturt University: Wagga Wagga, NSW, Australia, 2003; pp. 38–64.
98. Haidar, M. Sustainable Livelihood Approaches: The Framework, Lessons Learnt from Practice and Policy Recommendations. 2009. Available online: <https://digitallibrary.un.org/record/679330> (accessed on 1 June 2018).
99. Scoones, I. Sustainable Rural Livelihoods: A Framework for Analysis—IDS Working Paper 72. 1998. Available online: <https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/3390/Wp72.pdf?sequence=1> (accessed on 1 June 2018).
100. Sseguya, H.; Mazur, R.E.; Masinde, D. Harnessing Community Capitals for Livelihood Enhancement: Experiences From a Livelihood Program in Rural Uganda. *Community Dev.* **2009**, *40*, 123–138. [[CrossRef](#)]
101. Nikolakis, W.; Grafton, R.Q. Putting Indigenous water rights to work: The Sustainable Livelihoods Framework as a lens for remote development. *Community Dev.* **2015**, 5330. [[CrossRef](#)]
102. Cocklin, C.; Alston, M. *Community Sustainability in Rural Australia: A Question of Capital?* Centre for Rural Social Research; Charles Sturt University: Sydney, Australia, 2003; pp. 1–207.
103. Academy of the Social Sciences in Australia. *Community Sustainability in Rural Australia: A Question of Capital?* Cocklin, C., Alston, M., Eds.; Wagga Wagga National Library of Australia: Canberra, Australia, 2003.
104. Pierce, J.; Mckay, J. On community capitals as we see them through photovoice: Cowell oyster industry in South Australia. *Australas. J. Environ. Manag.* **2008**, *15*, 159–168. [[CrossRef](#)]

