Creating a "waterways city" by addressing municipal commitment and capacity: The story of Melbourne continues

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ABSTRACT

In a recent review of integrated urban water management in the city of Melbourne, Australia, the adoption of Water Sensitive Urban Design (WSUD) by the State's regional drainage authority and the integration of best practice in new urban development has shifted the "drained city" of the 1960s toward a "waterways city" of late. However, the "waterways city" is tenuous owing to the variable commitment of local municipalities to WSUD. This paper reports on the first phase of a social research project, which aims to secure a model of the waterways city by addressing the commitment and capacity deficits of local municipalities. Municipal commitment and capacity across three geographical areas in Melbourne are measured quantitatively using an innovative, comprehensive, and replicable assessment technique. The results indicate variability in municipal capacity and commitment across the areas, with a pronounced deficit in the rural-regional area. Consequently, intergovernmental WSUD programs need to include innovative and flexible mechanisms that are responsive to the dynamics of municipal commitment and capacity. These program design principles have broader application to cities internationally where the management of urban stormwater is the shared responsibility of multiple governments.

KEYWORDS

Water Sensitive Urban Design; municipality; urban stormwater management, intergovernmental program; commitment; capacity; Melbourne, Australia

INTRODUCTION

In recent years, Integrated Urban Water Management (IUWM) has been promoted as a means to improve the management and coordination of the urban water cycle (Harremöes, 1997; Niemczynowicz, 1999; Marsalek *et al.*, 2001; Newman, 2001). An advantage of the IUWM approach is that it provides legitimacy for urban stormwater management as an equal in the urban water management regime (Lawrence *et al.*, 1999; Chocat *et al.*, 2001; Rauch *et al.*, 2005). The influence of IUWM on stormwater management practice is evidenced by a focus on more sustainable approaches, such as Water Sensitive Urban Design (WSUD) (Lloyd *et al.*, 2002; Wong, 2006a). While much of the change in urban stormwater management practice is attributed to technological improvements, there is still little understanding of the social and political realms that, so importantly, drive and sustain it (Brown, 2005; Wong, 2006b).

Brown and Clarke (2007a; 2007b), in applying the theoretical lens of socio-technical transitions to urban water management in the city of Melbourne, Australia, identified a change from a "drained city", with traditional stormwater management practices in the early 1960s, toward a "waterways city" by 2006, embracing IUWM practice in the form of WSUD (see also Brown *et al.*, submitted, for details on the transition states). The authors suggested that the latter position of the city was tenuous. The state government and local municipalities jointly manage the city's stormwater systems and, while the achievements of both tiers of government are noteworthy, commitment and implementation deficits in WSUD for a number of municipalities prevail. This situation poses a problem: how can the participation of municipalities to implement WSUD be engaged in order to achieve a sustainable waterways city?

Garnering the participation of municipalities to implement state government policy relies on two prerequisites: first, each of the local communities shall be predisposed to the relevant policy, thereby influencing the local elected officials; and second, the capacity of individual municipalities to implement the policy must be sufficient to effect commitment (May *et al.*, 1996; Burby and May, 1998; Morison and Brown, 2007). Two consequences may follow should not all organisations be committed. First, as it is accepted that water quality improvement in the receiving waters will not occur without a concerted, catchment-wide approach to urban runoff control (VSC, 1999), the evasion of stormwater management and WSUD commitment among municipalities will reduce the potential for extensive ecological improvement. Second, the ability to "free ride" (Olson, 1971) on the benefits of water quality improvement contributed to by others is available to those municipalities that currently do not commit to ameliorating urban runoff (Imperial and Hennessey, 2000), especially those downstream of the committed. Their neighbours may see this behaviour as an offence of inequity and may well follow suit. Moreover, municipalities which rely on external funding to implement WSUD may exhibit a form of "rent-seeking" behaviour (Ostrom *et al.*, 1993) that restricts the potential for municipal autonomy. Taken together, these consequences are strategic costs that may well threaten the future management of the catchments (Imperial, 2006). It is here we recognise the classic "tragedy of the commons" of "fouling our own nest" with polluted runoff, as lamented by Hardin (1968) in his seminal article.

This paper reports on the first phase of a PhD social research project, which aims to secure a model of the waterways city by addressing the commitment and capacity deficits of local municipalities. The research establishes a new and unique assessment method that incorporates both quantitative and qualitative data for measuring the relative capacity and commitment of organisations. For intergovernmental program design, the contribution of this research is significant in providing utility for measuring the capacity and commitment of partnering organisations.

THE WATERWAYS OF MELBOURNE

The Melbourne region (Figure 1) is made up of five major catchments – Maribyrnong, Werribee, Yarra, Dandenong and Westernport – totalling approximately 12,800 square kilometres in area, and containing 1,300 kilometres of regional drains and 8,000 kilometres of rivers and creeks, which drain into Port Phillip Bay, Western Port and Bass Strait.

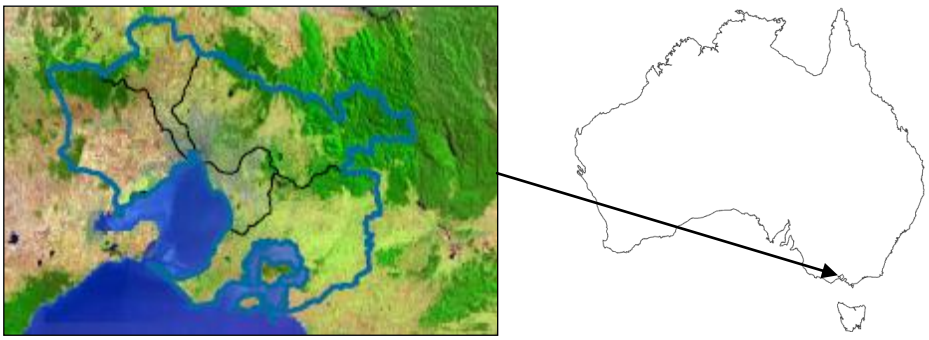

Figure 1. Study area in Melbourne, Australia (left picture defines the Port Phillip Bay and Westernport catchments)

Sources: Catchment – Melbourne Water; Outline of Australia © Commonwealth of Australia (Geoscience Australia) (2008)

Stormwater is discharged into the environment at more than 1,000 locations across Melbourne, of which nearly 400 discharge directly into Port Phillip Bay (Newton *et al.*, 2001). It is the greatest source of pollutants to the Bay (Fletcher and Deletic, 2006).

Melbourne Water, a state government corporation, is the regional drainage, waterways and floodplain manager responsible for river health, management and maintenance, and identifying and maintaining areas subject to flooding. The 38 municipalities in this region, which vary in area, population density, and land use from ultra-urban to rural contexts, have responsibility for the bulk of the Melbourne's drainage. They manage approximately 25,000 kilometres of local street and property drainage contained within small catchments (generally less than 60 hectares), which feed into the regional drains, rivers and creeks administered by Melbourne Water.

METHODS

This paper reports on the results of the survey questionnaire distributed to professional officers, as nominated by the Chief Executive Officer or delegated manager, within the 38 municipalities across Melbourne. The officers were expected to have a role in stormwater management within the municipality and represent the diversity of its business. Thus, municipal engineers, planners, scientists, managers, and other technical staff participated in the research. In this study, the great majority (92%) of officers nominated were both surveyed and interviewed to maximise the reliability of the quantitative and qualitative data. The salient questionnaire results reported here are qualified by quotations obtained from the semi-structured interviews.

Previous research (White and Boswell, 2006) has identified the influence of local context on municipal stormwater management performance. Differentiating municipalities by geographical areas provides a locus of analysis that may contrast the capacity and commitment differences influenced by context. The municipalities are grouped according to three areas – inner metropolitan, outer metropolitan, and rural-regional, which are distinguished by population density (highest in the inner metropolitan area), urban growth (most prevalent in the outer metropolitan area), and municipal area (largest in the rural-regional area) (DPCD, 2007a). The municipal services significantly vary across these groups according to community circumstances, needs, and expectations (DPCD, 2007a).

A number of variables have been developed in the survey research to describe local municipal capacity and commitment, based on previous research (May *et al.*, 1996; Brown, 2003). As

outlined in Table 1, the variables are summarised as scales for efficient analysis and explanation, and are reliable according to Cronbach's α (where relevant). Except for WSUD commitment (a choice of 1 in 7 statements), each embedded variable was constructed from a seven-point Likert scale. The stormwater management variable describes both stormwater quality and quantity management in the municipality, whereas the WSUD variable only relates to water quality and quantity management for ecological improvement. The two variables were selected to determine whether some municipalities favoured conventional stormwater management to the more recent practice of WSUD.

Table 1. Scaled Variables

Scale	Type (No.) Embedded Variables	α
Stormwater management capacity	Mean ratings of in-house stormwater funding, expertise; training, regulation enforcement (4)	0.755
Stormwater management commitment	Mean ratings of perceived importance given to stormwater management by: elected officials; executives (2)	0.839
WSUD capacity	Mean ratings of in-house WSUD funding, expertise, regulation enforcement (3)	0.729
WSUD commitment	Ordinal scale composed from statements of commitment	N/A

The selection of variables describing local conditions was guided by previous, relevant research into local governance (Conroy and Berke, 2004; Daley and Layton, 2004; White and Boswell, 2006; Daley, 2007). The variables were sourced from the Australian Bureau of Statistics' (ABS) community profile (2006 census) and Local Government Victoria reports for each municipality (DPCD, 2007a; b). The ABS "Index of Economic Resources" is a quantitative profile of the economic resources of families within each municipality.

Statistical analyses of the survey responses were carried out using SPSS 15.0 for Windows. With unequal group sizes for the areas, analyses of differences between groups have been performed using the nonparametric Mann-Whitney *U*-test, which is analogous to the parametric *t*-test for independent samples. Rank-order correlations (Spearman's ρ) were obtained for ordinal and non-normal scale data. For associations between normally-distributed variables, including the census demographic and economic data and the scaled variables incorporating mean responses, Pearson's *r* statistic was calculated.

RESULTS AND DISCUSSION

Of the total of 116 survey responses the majority represented the inner and outer metropolitan areas while rural-regional representation was only 18 percent (Table 2). Notwithstanding, the average number of respondents per municipality is almost equal for the three areas.

Table 2. Distribution of survey responses per area

	Frequency	Percent	Number of Municipalities	Mean Number of Respondents per Municipality
Inner Metro	49	42.2	17	2.9
Outer Metro	46	39.7	14	3.3
Rural-Regional	21	18.1	7	3.0
Total	116	100.0	38	3.1

Municipal Capacity

The differences in stormwater management capacity are significant ($p<0.01$) between the rural-regional municipalities and their inner and outer metropolitan counterparts (Mann-Whitney, z = -3.03 and -3.28, respectively). Similar results were obtained for WSUD capacity (Mann-Whitney, z = -2.03, $p<0.05$ and z = -2.61, $p<0.01$, respectively). These results indicate that the rural-regional municipalities are less able to manage urban stormwater (including flooding) generally, albeit put in place the necessary resources to manage urban runoff through WSUD. In considering this problem, an interviewee from a rural-regional municipality identified a "descending hierarchy" of priority management in these municipalities as the main reason for the capacity deficit, where the municipality "hasn't the resources to be strategic let alone fix the [stormwater] problem". Agreeing with this sentiment, another interviewee summarised their rural-regional municipality's problem in relation to WSUD capacity: "If you want to add a finger, you've got to take off a toe".

According to the results (Figure 2(b)), WSUD capacity is most developed in the outer metropolitan municipalities. This may be largely due to the spate of broad-acre urban subdivisions in the suburban reaches of Melbourne, where population growth is at its highest. It is in these subdivisions where WSUD is standard practice as a result of mandatory requirements in the planning legislation; in other developments including commercial, industrial and smaller residential, WSUD is a voluntary measure (Potter and RossRakesh, 2007). The situation is evidenced in Figure 3(a), where more than half of the respondents from the outer metropolitan area considered their respective municipality's ability to enforce the rules and regulations for WSUD as adequate. This compares to the large majority of respondents from both the inner metropolitan and rural-regional areas who considered their municipality's enforcement capacity as inadequate. A number of the interviewees from the outer metropolitan municipalities incorporating these developing areas specifically defined WSUD in terms of water quality systems for the "greenfield" subdivisions and could not see any application of WSUD to other developments under the current planning schemes.

Municipal Commitment

Notwithstanding municipal stormwater management capacity and commitment being related variables in this research (r = .38, $p<0.01$), there are differences between the areas for each variable. Comparing Figure 2 and Figure 4, the rural-regional municipalities remain the lowest ranking for organisational commitment as for capacity, but in the cases of stormwater and WSUD commitment, the outer metropolitan municipalities are generally strongest (Figure 4). Outer metropolitan municipalities were perceived to be highly committed to stormwater management (with a median of 5.0). Nonetheless, significant differences were found only between the outer metropolitan and rural-regional municipalities for stormwater commitment (Mann-Whitney z = -2.586, $p<0.05$) and WSUD commitment (Mann-Whitney z = -2.141, $p<0.05$). Although stormwater management commitment among the inner metropolitan municipalities is above par (median of 4.5), variability was marked between municipalities from perceived low to high levels of WSUD commitment in the same area.

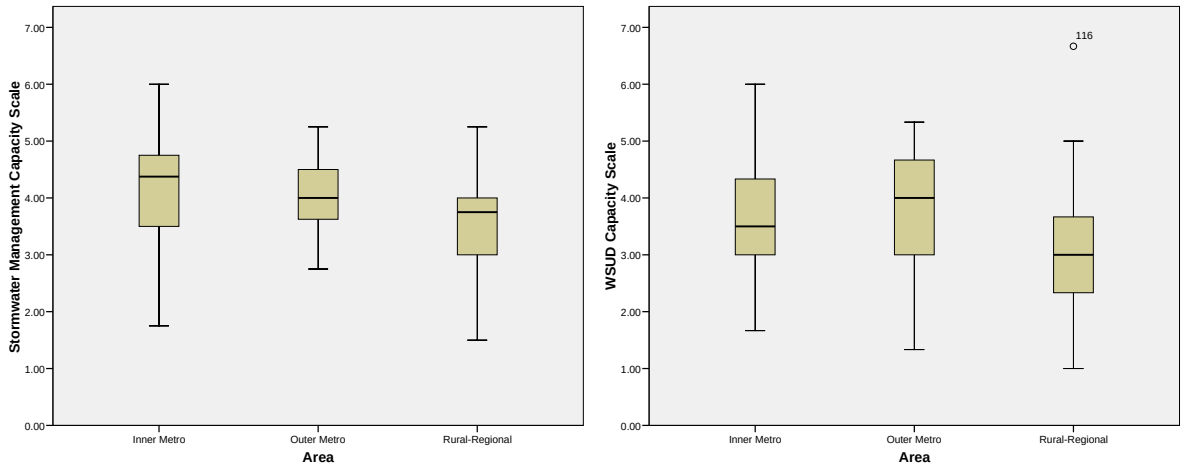

Figure 2. Areal variation in (a) Stormwater Management capacity and (b) WSUD capacity

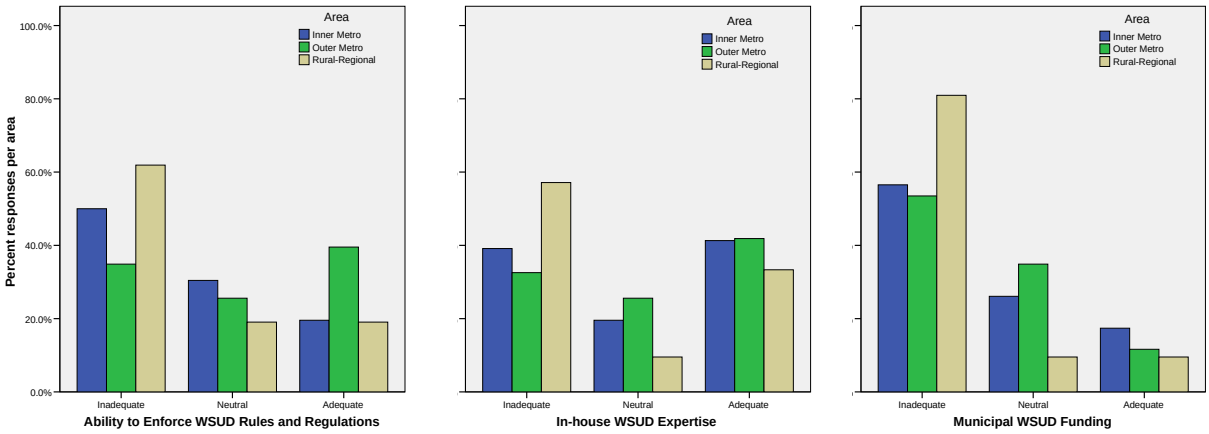

Figure 3. Differences in WSUD capacity variables between areas: (a) ability to enforce WSUD rules and regulations; (b) in-house WSUD expertise; (c) WSUD funding

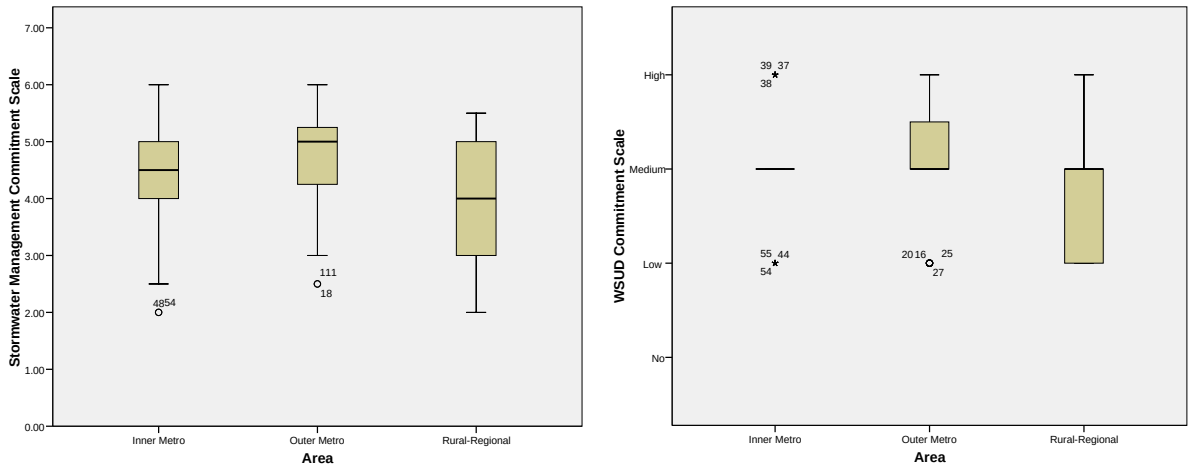

Figure 4. Areal variation in stormwater management and WSUD commitment

Looking more closely at WSUD commitment, Figure 5 presents the frequency of responses per area for each WSUD commitment statement in the survey (noting only one statement could be selected by each respondent). The rural-regional municipalities display an observable dissimilarity from the other municipalities, twenty-four percent stating that WSUD was a low priority for the municipality and a further five percent believing the risks associated

with WSUD effected implementation resistance in the municipality. A quarter of the outer metropolitan respondents felt their municipalities were committed to WSUD for the long term with a further fifty-eight percent seeing their municipality's commitment grow. As previously noted, this difference may be related to the progression of WSUD in urban subdivisions predominantly within the outer metropolitan area. If the municipalities in this area had fewer of these subdivisions, they may do little to implement WSUD. As one local officer commented, "At the moment it doesn't cost as much to do it, because we make other people do it".

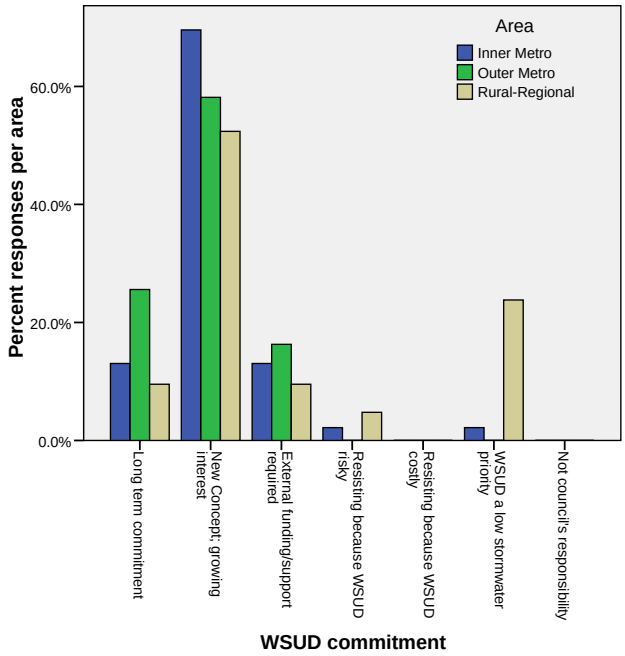

Figure 5. WSUD commitment by area

The influence of local conditions on municipal capacity and commitment

In reviewing local diffuse water pollution control under the United States' National Pollutant Discharge Elimination Scheme (NPDES) Phase II Stormwater Program, White and Boswell (2006) observed a significant positive relationship between the socioeconomic variables of median home value and percent of high school education or higher, and municipal performance.

Similar findings to those of White and Boswell (2006) emerge in this study (Table 3). Here the variables of education and wealth may influence the capacity of municipalities to manage urban stormwater and implement WSUD. A municipality's ability to allocate sufficient resources for addressing urban runoff appears contingent upon the local community's economic status. Furthermore, the more educated communities are associated with the better-resourced local municipalities managing urban stormwater.

However, it is evident in Table 3 that local socioeconomic conditions play only a minor role in materialising municipal commitment to urban stormwater management. There is a correlation between education and commitment but the other socioeconomic variables are not related. The relationships between municipal population, municipal area, and income and the variables of commitment and capacity are also identified in Table 3. The lower capacity and commitment specifically in the rural-regional group of municipalities, their reduced

community populations, recurrent income, and increased areas of administration may account for these relationships.

Table 3. Pearson's correlations between local conditions and commitment and capacity

Local conditions	Stormwater Management Capacity	WSUD Capacity	Stormwater Management Commitment
Total Population (2006)	.25**	.16	.23*
Municipal Area (km^2)	-.32**	-.28**	-.24**
Municipal Recurrent Income 2005-06 ($million)	.35**	.19*	.22*
Median Household Income ($/weekly)	.32**	.24*	.08
Median Individual Income ($/weekly)	.30**	.26**	-.04
Persons Completed Year 12	.33**	.16	.21*
% Total Population Completed Year 12	.31**	.15	.10
Index of Economic Resources (2001)	.37**	.27**	.08

* significant at the 0.05 level, ** significant at the 0.01 level

The tyranny of distance associated with municipal capacity

The capacity and commitment decline with distance from the centre paints a complex picture for improving the water quality conditions of the catchments throughout Melbourne. Historian Geoffrey Blainey used the phrase "The tyranny of distance" in the title of his book (1968) to explain the constraint of Australia's geography. The rural-regional municipalities of Melbourne suffer the tyranny of distance from the centre, struggling to manage urban stormwater and instigate WSUD. Particularly in the rural sector (Dollery and Crase, 2004), municipalities are grappling with ongoing asset replacement and maintenance (SCEFPA, 2003), and combined with the increasingly-devolved responsibilities from the state (Dollery *et al.*, 2003), little or no scope is available in this area to pursue non-core activities such as water quality improvement.

Revisiting program design

The results demonstrate that the current approach and best practice in intergovernmental program design is likely to be highly ineffective. Intergovernmental programs need to include innovative and flexible mechanisms that are responsive to the dynamics of individual organisational commitment and capacity. For Melbourne, both the state and municipalities need to critically address these localised attributes to maintain the city's current position as a "waterways city" that pursues water quality improvement through WSUD. Therefore, it is recommended that program architects utilise the methods presented and tested in this research to undertake a comprehensive assessment of the partner organisations prior to program formulation and revision. From the assessment, a suite of specific policy instruments and capacity-building approaches that are tailored to the type of organisations involved can be included in the program design.

CONCLUSIONS

Achieving ecological improvement of the waterways relies on partnerships between all catchment stakeholders. When these partnerships are primarily intergovernmental, the leading organisations must consider the following principles in order to bring about long-term ecological improvements:

- Organisational commitment and capacity vary according to local conditions and governance styles;
- Program design must incorporate and respond to an assessment of local conditions, organisational capacity, and organisational commitment prior to, and at critical points during, implementation.

These principles not only apply to the city of Melbourne, but will have broader application to cities internationally where the management of urban stormwater is the shared responsibility of multiple governments. The organisational capacity and commitment assessment method outlined in this paper provides an opportune instrument for measuring these variables.

Returning to Brown and Clarke's assessment, is Melbourne a "Waterways City"? The variability of commitment and capacity of the city's municipalities suggests the answer is "not yet". With the recent institution of a collaborative intergovernmental WSUD program, time will tell.

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