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Abstract
To provide useful assistance to the Colorado water community, it is necessary to know what drought mitigation projects the community has used and would prefer to use in the future, as well as the community's need for implementation support. Participants in the Drought & Water Supply Assessment identified structural and non-structural projects that may be used for mitigation of drought impacts on their individual water supplies. A list of potential structural projects for managing periods of low water availability included dam safety upgrades, reservoir dredging, storage systems (new or upgraded), delivery systems and multi-basin projects. Some of the non-structural projects examined by participants for drought mitigation included improved conservation methods, technical support for water planning, and the use of cooperative agreements. Participants were also asked to evaluate the desirability of state involvement in the planning and implementation of structural and non-structural projects.

Contents:

Introduction

Colorado water users have indicated that they have:

- Limitations to their current water supplies,
- Limitations in their ability to plan for and manage future water supplies, and
- Suffered through the recent drought with various severe impacts to their operations.

They have also indicated that although additional drought and water conservation planning may be helpful in managing future droughts, additional and more efficient water supply is needed to support currently identified water needs, especially during periods of water scarcity.

With the knowledge and understanding of their individual limitations and impacts, Colorado water users were asked to identify the structural and non-structural projects that would best mitigate the impacts of drought for their particular situations. The water users surveyed were also asked to identify whether or not the state should have a role in the planning and/or implementation of any of the mitigation projects favored.

To ascertain water user preference related to structural and non-structural projects, candidate lists of projects were identified, as presented in Tables 15-1 and 15-2 for structural and non-

Table 15-1: Structural Projects

Storage and water supply projects
▪ Structural improvements or upgrades to meet dam safety requirements
▪ Dredging existing reservoirs
▪ Install and use water meters
▪ Lining of ditches
▪ New or deepened wells
▪ New or improved aquifer storage recovery/conjunctive use programs/groundwater recharge
▪ New raw water treatment facilities
▪ New storage for groundwater
▪ New storage for surface water
Transmission, conveyance, treatment and distribution projects
▪ New or upgraded pump stations
▪ New or upgraded pipelines
▪ New or upgraded distribution systems
▪ Rehabilitation of new diversion structures
▪ Water reuse projects
▪ Implement phreatophyte control
▪ Large-scale and/or multi-basin cooperative projects
▪ Forest management

structural projects, respectively. The survey participants then ranked the relative need for each kind of project listed, plus any other project not on the list, based on a five point scale (with one indicating the lowest need and five the highest). Finally, for the structural projects, each participant was asked to spend five "water dollars" in any way they chose on those projects they considered to be most needed or desirable (i.e. one dollar on five different projects, or five dollars on one project, or anything in between). The allocation of water dollars to structural projects allowed the differentiation of true water user need from mere interest.

Structural Projects

Structural projects, as indicated in Table 15-1, can be lumped into two key groupings: storage and water supply projects; and transmission, conveyance, treatment and distribution projects. Table 15-3 lists the seven most needed structural projects as identified by Colorado water users, plus the level of support indicated overall by all of the segments and by the municipal and agricultural segments, individually, for the projects.

Table 15-3: Need for Structural Projects

Type of Project	Overall Need	Municipal Need	Agricultural Need
New storage for surface water	40%	31%	51%
Large-scale/multi-basin projects	24%	25%	27%
New aquifer storage recovery	21%	21%	22%
New storage for groundwater	19%	23%	16%
New or Upgraded Pipelines	33%	41%	26%
New or Upgraded Water Distribrution Systems	33%	34%	34%
Lining of Ditches and Canals	19%	5%	35%

(%) Need displayed represents ratings of 4 or 5 on a 5-point scale.

As this table indicates, 40% of all segments indicated a need for new storage for drought mitigation. This response had the highest overall ranking of the seven projects listed. Various infrastructure projects related to new or upgraded pipelines, and new or upgraded water distribution systems, followed closely with one out of three water users supporting them. Large-scale/multi-basin projects received the support of one out of every four water users.

Table 15-2: Non-Structural Projects

- **Improved education and awareness of the public** with respect to water, water supply and water supply planning
- **Improved or enhanced water conservation methods** and measurement techniques (municipal or agricultural)
- **Technical support in master planning** for future water supply and demand
- **Technical support in drought and conservation planning** (hydrologic studies, water rights studies)
- **Use of cooperative agreements** for each of the following: exchanges, transfers, substitute water supply plans, interruptible supply plans, dry year leases, other leases, operating agreements, water banking, water conservation easement
- **Need for financing** of large-scale or multi-basin cooperative projects, using the same 5-point scale
- **Organizational loans** for: project evaluation/feasibility studies, planning, capital projects

Notably, more than half of all agricultural respondents articultated a significant need for new surface water storage. Also noteworthy was the high support (58% rated a need of 4 or 5) by the Water Conservation District segment as well as the other[1] segment for storage; these statistics are combined with the remaining segments and included in the "Overall Need" column in Table 15-3. All water divisions, with the exception of Division 3, demonstrated high need ratings for storage when compared to other structural projects. Respondents in Division 3 rated projects involving new or upgraded pipelines, the installation of water-use meters, and new or deepened wells at approximately the same rating as storage. The project that garnered the highest need rating in Division 3 was new aquifer storage recovery – a reflection of the unique physical setting of Division 3.

Survey results also demonstrate the widespread need for infrastructure projects that address water transmission and delivery efficiency. Municipal organizations expressed strong support for new or upgraded pipelines and new or upgraded water distribution systems. Agricultural respondents indicated their preference for the lining of ditched and canals, and new or upgraded water distribution systems.

The state segment rated overall need for new or upgraded pipelines the highest of any segment with 55% rating the need as a 4 or 5. New or upgraded water distribution systems received strong support from the state segment as well, with 44% providing high ratings; however, the other segment rated this the highest of any segment or division, with almost 60% indicating extreme or urgent need. Finally, for the lining of ditches and canals, the state and other segments again had higher ratings than most other segments, closely following agriculture at 33% and 32% respectively.

As is the case in most parts of the assessment, differences between the municipal and agricultural segments are apparent when looking at the need for structural water projects. Table 15-4 illustrates both common and different priorities, in order of importance, between these two major segments.

Table 15-5 summarizes the need for structural projects as indicated by each segment other than the two key segments listed in Table 15-4.

[1] Other entities: a collection of twenty-three entities, ranging from tribes, to home owners associations (HOA's), etc., not fitting into any of the other described entities of Federal, State, Agriculture, Municipal, Power, Industry, or Water Conservation Districts.

Table 15-4: Most Needed Structural Water Projects (in rank order*) for Muncipal and Agricultural Segments

Municipal Segment	Agricultural Segment
1. New or Upgraded Pipelines (41%)	1. New Storage for Surface Water (51%)
2. New or Upgraded Water Distribution Systems (34%)	2. Lining of Ditches (35%)
3. New Storage for Surface Water (31%)	3. Rehabilitation or New Diversion Structures (34%)
4. New or Deepened Wells (27%)	4. New or Upgraded Water Distribution Systems (34%)
5. New Water Treatment Facilities (26%)	5. Large-Scale / Multi-Basin Projects (27%)
6. Install and Use Water Meters (26%)	6. Forest Management (27%)

* By percentage of respondents who rated need as a 4 or 5 on a 5-point scale

Table 15-5: Most Needed Structural Water Projects (in rank order*) for All Other Segments

Segment	Structural Project Needed
Power	New Storage for Ground Water / Aquifer Storage Recovery (40%)
Federal	New Storage for Ground Water / Aquifer Storage Recovery (64%)
State	New or Upgraded Pump Stations (55%) Large-Scale / Multi-Basin Cooperative Projects (55%)
Water Conservancy District	New Storage for Ground Water / Aquifer Storage Recovery (59%) New Water Treatment Facilities (58%)
Industrial	Install and Use Water Meters (54%)
Other Segments (largely counties, with tribes and farm bureaus)	New Storage for Surface Water (63%) Large-Scale / Multi-Basin Cooperative Projects (59%)

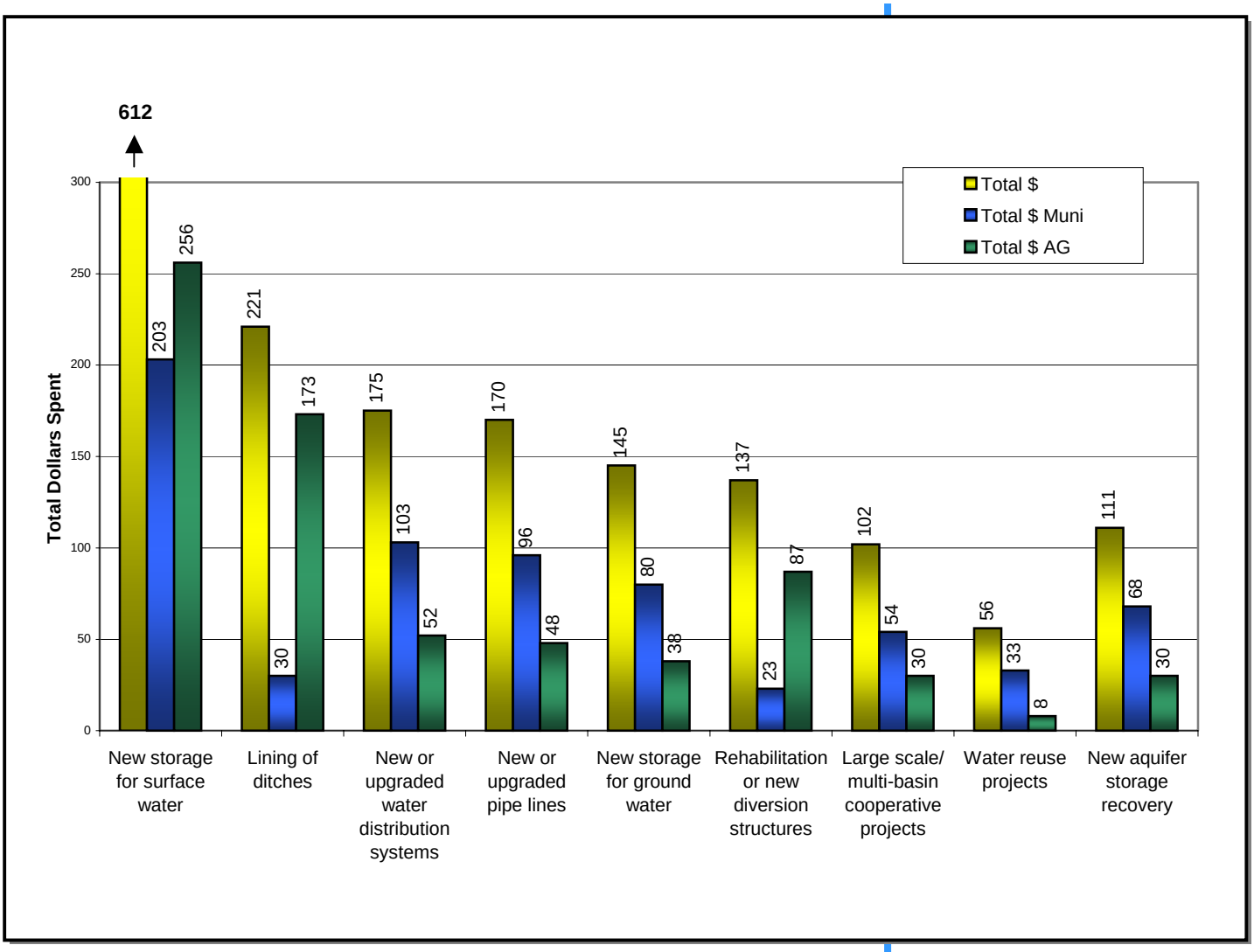
* By percentage of respondents who rated need as a 4 or 5 on a 5-point scale

Water Dollars

In the final analysis, water users surveyed identified a significant number of structural projects that receive general support without clearly identified preferred projects with the possible exception of the agricultural segment that identified the need for storage. A large set of projects was supported by 25 to 35 percent of the various water user segments.

When water users spent their "water dollars," the differences between support for different structural projects were amplified as presented in Figure 15-1. Water users overwhelmingly spent their allocation of water dollars on new surface water storage. In addition, the support for new storage was broad-based and consistent across all divisions and segments.

Figure 15-1: Priority of Structural Projects Based on Expended "Water Dollars"



The differences in water user segment support for various types of structural projects are illustrated by the support of the agricultural and municipal segments for projects other than new storage. Table 15-6 presents the breakdown of the support for each structural project type. The differences illustrate that although water users from all segments have needs for transmission and distribution system improvements, each water user type operates systems comprised of significantly different components.

Table 15-6: Percent of Overall Support (by Segment) for Structural Projects Based on Water Dollars Spent*

Project (total dollars spent)	Agriculture	Municipal	All Other Segments
Storage			
Surface water (612)	42	33	25
Groundwater (256)	27	58	15
New Transmission and Distribution Infrastructure			
Lining Ditches (221)	78	14	8
Distribution (175)	30	59	11
Pipelines (170)	28	56	16
Other Infrastructure			
Diversion Structures (137)	64	17	19
Large-scale Multi-basin (102)	29	53	18
Water Reuse (56)	14	59	27

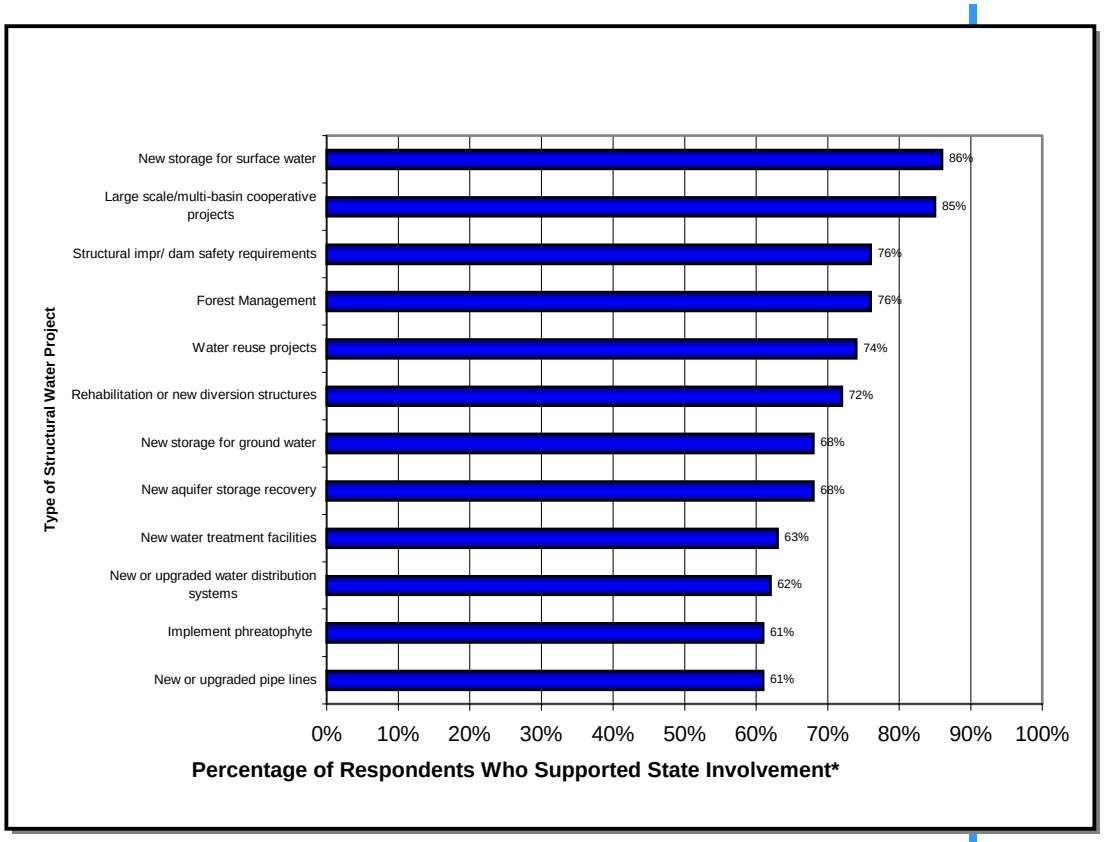
* The percentage indicates that percent of the total water dollars spent for a specific project type contributed by the identified segment (e.g., Municiapl contributed 53% of the water dollars that were contributed by all segments for large-scale multi-basin projects)

State Involvement

The assessment also explored support for state involvement in structural water projects. About three out of four respondents indicated that they would like to see the state involved in structural projects at varying levels of interest. From those that indicated overall support for state involvement, opinions about state contributions to specific projects was also gathered, with strong overall support. Only two project categories - new or deepening wells and installing water use meters – received support from less than half of all respondents regarding state participation (with 4 or 5 ratings on a 5-point scale). The development of new storage for surface water emerged as the area where the most respondents, almost nine out of ten, preferred state involvement. Figure 15-2 details respondent encouragement (at 61% or higher) for State involvement in various water projects.

Support for state involvement varied according to the project priority of the segment or division responding. For example, the agricultural community expressed stronger support than any other segment for state involvement in projects that improved the lining of ditches. Municipal respondents, on the other hand, supported a strong state role in the development of new raw water treatment facilities, a project that serves the municipal segment more than any other. As might be expected, new storage for surface water led all categories and enjoyed widespread support from all divisions and segments. It is clear that Colorado water users would like the state to participate in these areas.

Figure 15-2: Support for State Involvement in Structural Projects



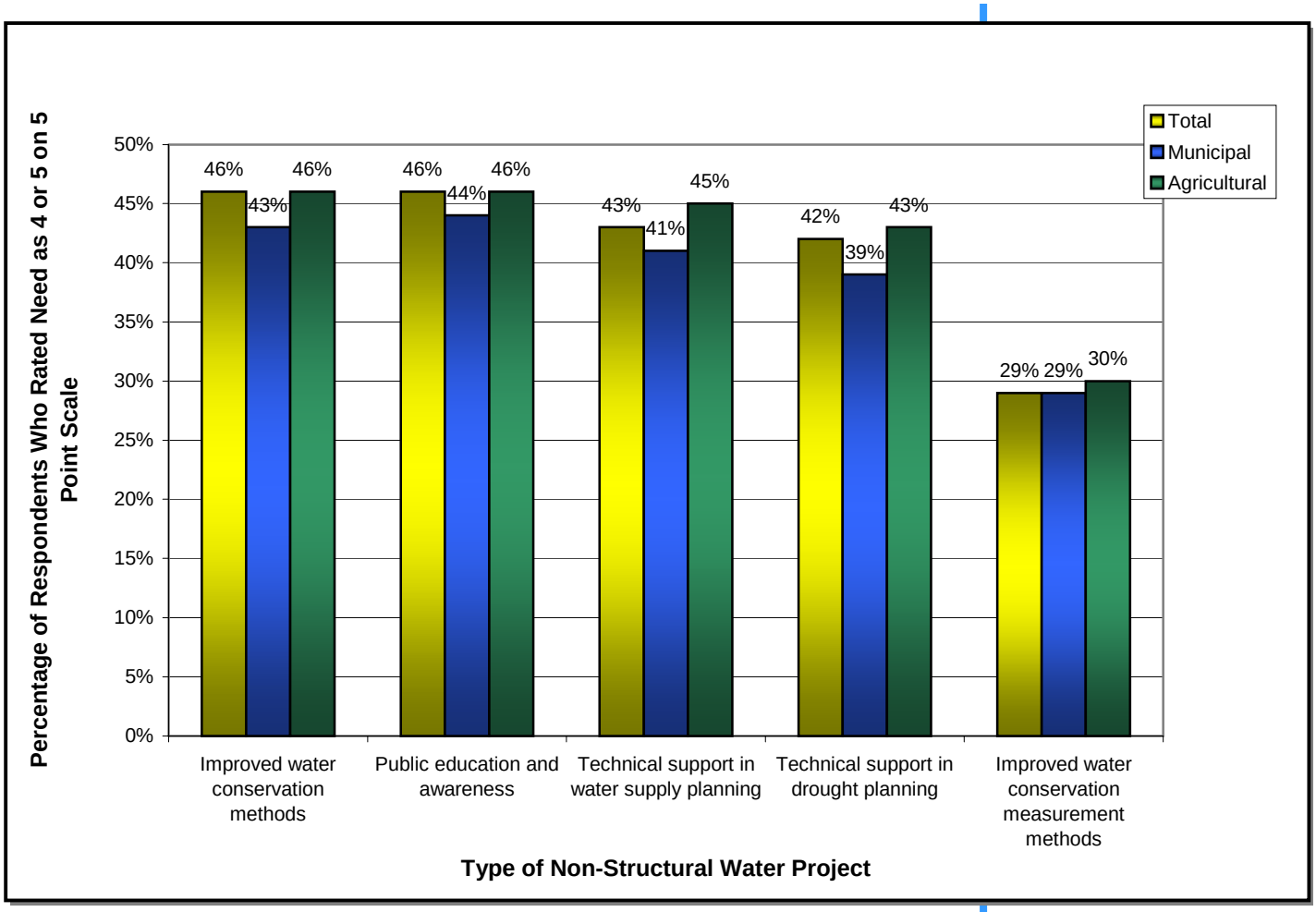
- represents percent support of those respondents that indicated interest that state should have some involvement in structural projects (about 2 of every 3 survey participants)

Non-Structural Project

Among non-structural projects, survey respondents expressed even greater need, as well as almost unanimous support, for state interaction. The need for most non-structural projects was relatively consistent with slightly less than half of all respondents expressing a strong need for such projects with the exception of improved water conservation measures, which received significantly less support as indicated in Figure 15-3.

The consistency of support between the agricultural and municipal segments for non-structural projects is unique, given the normal lack of consistency between these two segments. Also worthy of note, the agricultural segment was as supportive as the municipal segment for projects such as public education and awareness. With respect to the remainder of respondents in both divisions and segments, ratings did not demonstrate significant differences with the exception of a few cases.

Figure 15-3: Need for Non-Structural Water Projects



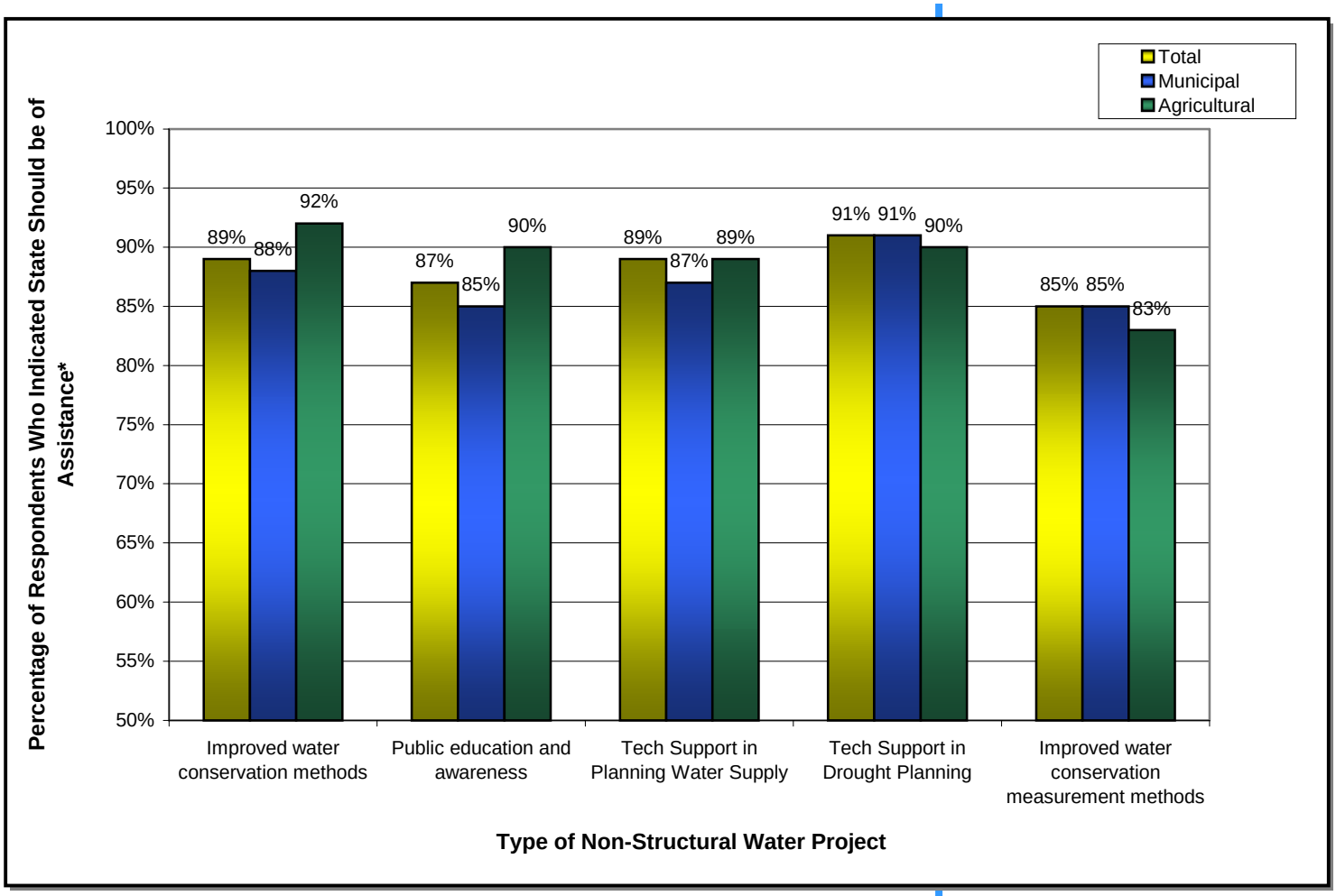
The federal segment gave the two highest percentage ratings for non-structural projects of any division or segment: improved education and awareness of the public garnered a positive rating from over 85% of respondents; improved or enhanced water conservation methods rated high with 72% of respondents. For comparison, participants overall rated the need for both of these projects at the 46% level.

The most disparate ratings between divisions involved technical support in master planning for future water supply and demand. Responses ranged from the 25% level for Division 5 to a 62% level for Divison 3, and a 43% rating overall for all divisions combined. Also noteable were the consistently lower ratings of Division 5 for most non-structural projects.

Approximately two-thirds of respondents overall supported the state's participation in non-structural projects, as indicated in Figure 15-4. Among those two-thirds, nearly nine of ten respondents supported state involvement in the following types of projects:

- Improved water conservation methods
- Public education and awareness
- Technical support in planning water supply
- Technical support in drought planning

Figure 15-4: Support for State Involvement in Non-Structural Water Projects



Discussion

Water users across Colorado have indicated their broad-based support for structural and non-structural projects to mitigate drought impacts. More than half of agricultural water users strongly support development of new storage as do four out of ten water users. Water users also indicate support for:

- Additional groundwater storage and/or aquifer storage recovery (led by municipal interests)
- Lining of ditches and canals (led by agricultural interests)
- New or upgraded pipelines (led by municipal interests)
- New or upgraded water distribution systems (led by municipal interests)

- Rehabilitated or new diversion structures (led by agricultural interests)

One in four water users indicated strong support for large-scale / multi-basin cooperative water projects.

Four to five out of ten water users strongly support non-structural projects, including:

- Improved water conservation methods
- Public awareness and education
- Technical support in drought planning

Colorado water users also indicated their strong support of state involvement in both structural and non-structural projects. More than seven out of every ten water users that supported state involvement indicated their strong support for state involvement in:

- New storage for surface water
- Large-scale / multi-basin cooperative water projects
- Structural improvements to existing dams / dam safety requirements
- Forest management
- Water resuse projects
- Rehabilitation or new diversion structures

The desire for state support in structural projects was divided: those water user segments with entities needing or supporting the particular structural project were inclined to seek state support, while those water user segments that did not need or support specific structural projects did nor desire state support.

For non-structural projects, the desire for state support was indicated by well-over eight of every ten participants, independent of location or water user type. The non-structural projects that received the strongest call for state suppport included:

- Technical suport in drought planning
- Improved water conservation methods
- Public awareness and education
- Technical support in water supply planning