Water Market Insider
WestWater Research LLC
Arizona | Q3 2014

Central Arizona's Market for Long-Term Storage Credits

The State of Arizona is well-known for its progressive groundwater management code and programs ensuring that the desert state will have adequate water supplies for the future. The ability to store surplus renewable water supplies underground for recovery at a later time is a key component of Arizona's approach to aquifer management.

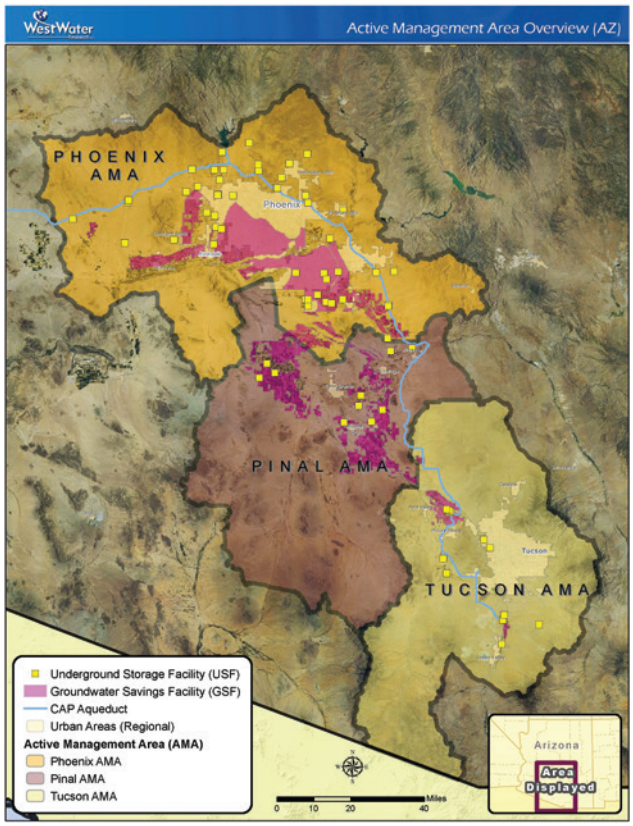
Established in 1986 and further refined in 1994, Arizona's Underground Water Storage and Recovery Program established the legal framework for storing renewable water supplies underground at permitted recharge facilities to create "long-term storage credits" that can be recovered at a later point in time. Long-term storage credits (LTSC) are created when eligible renewable water supplies are stored underground at a permitted recharge facility, and remain in storage for at least one calendar year. Each LTSC authorizes pumping of 1 acre-foot (AF) of renewable water stored underground. Recovery of a credit must occur through a permitted recovery well within the Active Management Area (AMA), irrigation non-expansion area, or basin in which the LTSC was created.

In Central Arizona, a market for LTSC has emerged in recent years as an important mechanism for satisfying municipal and industrial water demands, firming surface water entitlements, and replenishing excess groundwater pumping.[1] Purchases and sales of LTSC have occurred in the Phoenix, Pinal, and Tucson AMAs. Figure 1 shows these market regions. While the LTSC market is nascent, it has several characteristics that may eventually allow it to develop into an efficient market with active trading:

- Growing water demand in a water-short region.
- Homogenous, well-defined assets.
- A streamlined transfer process with little regulatory uncertainty.

This report provides a summary and review of LTSC trading activity and market prices in Central Arizona.

Figure 1: Phoenix, Pinal and Tucson AMA Overview



What is a Recharge Facility?

Central Arizona Project water, surface water, and reclaimed wastewater or "effluent" are eligible to be stored underground at permitted recharge facilities for later recovery and/or accumulation of LTSC. There are three types of recharge facilities where this storage can occur:

- Managed Underground Storage Facility (managed USF), where effluent storage activity is subject to at least a 50% reduction, called the "cut to the aquifer." Managed USFs are generally naturally water-transmissive areas such as ephemeral streambeds that allow percolation with minimal assistance from additional infrastructure.
- Constructed Underground Storage Facility (constructed USF), where most storage activity is subject to a 5% cut to the aquifer, with the exception of effluent for which there is no reduction. Constructed USFs generally store water through the use of injection wells or percolation basins.
- Groundwater Savings Facility (GSF), where most storage activity is subject to a 5% cut to the aquifer. At GSFs, water eligible for recharge is delivered to a groundwater user, who applies the delivered water "in-lieu" of groundwater pumping. GSFs are typically operated by irrigation districts able to receive and directly use the in-lieu renewable supplies.

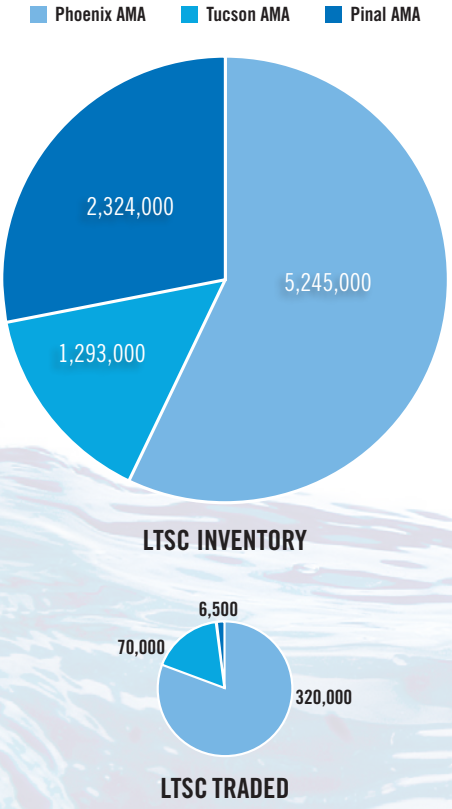
The storing entity must hold a recharge permit for the facility used to recharge eligible water supplies. All storage is subject to additional deduction for evaporation losses.

[1] Excess groundwater pumping is defined as withdrawals over and above the amounts deemed by the State to be consistent with the management goal of each Active Management Area.

LTSC Market Size and Trading Activity

Presently, the LTSC market is relatively small. Since 2008, a total of approximately 397,000 LTSC have changed hands in market transactions in the Phoenix, Pinal, and Tucson AMAs. This trading volume represents 4 percent of the total 8,862,000 LTSC that have been accumulated in those regions. Figure 2 compares the total volume traded to the total inventory of existing LTSC by AMA. A total of approximately 5,245,000 LTSC are located in the Phoenix AMA, of which 320,000 have been traded. There are 1,293,000 LTSC in the Tucson AMA, 70,000 of which have been traded. There are 2,324,000 LTSC in the Pinal AMA, 6,500 of which have been traded. Although twenty-six percent of all LTSC accumulated are stored in the Pinal AMA, the total number of credits traded in the Pinal AMA (6,500) is only 2 percent all LTSC traded.

Figure 2: Total LTSC Inventory Compared to the Number of LTSC Traded, 2008-2014

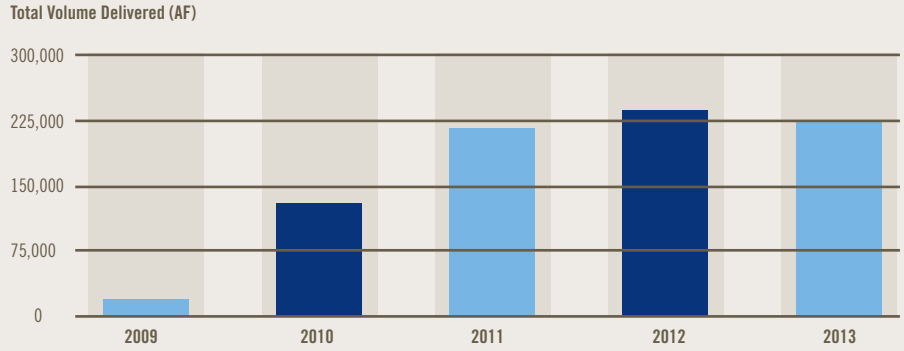


Data Source: Arizona Department of Water Resources Long-Term Storage Account Summary, 2013. Not to scale.

Sellers of LTSC

Sellers of LTSC have included municipalities, private utilities, land developers, and investment firms. In addition, several Native American tribes are recharging significant volumes of Central Arizona Project (CAP) water to accrue LTSC. One tribe, the Gila River Indian Community, has started actively marketing LTSC to generate revenue. Figure 3 shows the total annual tribal deliveries of CAP water to recharge over the past 5 years. As shown, tribal deliveries of CAP water to recharge facilities has increased from 17,000 AF in 2009 to an average of 227,000 AF/year from 2011 through 2013. As of 2013, the tribes held a combined total of approximately 563,000 LTSC. Pursuant to water rights settlement agreements, tribes do not pay CAP capital charges, and in some cases the United States pays the fixed OM&R portion of the CAP delivery cost. Thus, tribes' cost of creating LTSC may be low relative to other entities.

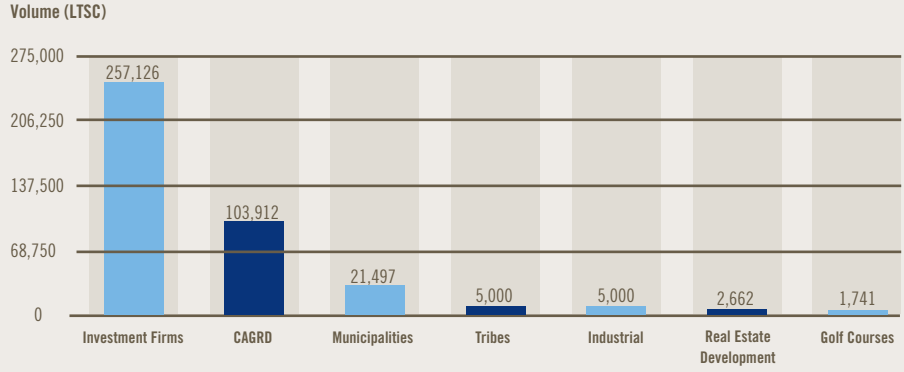
Figure 3: Total Annual Tribal Deliveries of CAP Water to Recharge, 2009 - 2013



Buyers of LTSC

Diverse buyers have been purchasing LTSC. Buyers have historically included the Central Arizona Groundwater Replenishment District (CAGRD), investment firms, municipalities, tribes, real estate developers, and golf courses. Figure 4 displays the total volume acquired by buyer type. Investment firms have purchased the largest quantity of LTSC by volume. These firms' general strategy has been to profit from LTSC price appreciation over time as demand grows, and as other unused water supplies become less available. Until 2011 investment firms were actively buying LTSC, but recently began liquidating their holdings to realize profits from price appreciation, and to reallocate capital to investments with more favorable risk-adjusted returns. CAGRD, the second largest buyer, purchases LTSC to satisfy its obligation to replenish excess groundwater pumping by its member subdivisions and municipalities.

Figure 4: Total Volume Acquired by Buyer Type, 2008 - 2014



LTSC Market Prices

As previously described, the LTSC market is just beginning to develop and thus is relatively small. Since 2008, a total of $41.4 million have changed hands in Phoenix AMA LTSC trades, equivalent to an average annual market size of $5.9 million. The average annual size of the Tucson AMA LTSC market in terms of total dollars traded is $1.3 million. For the Pinal AMA, only 2 LTSC sales have been completed to date.

Table 1 summarizes unit prices in individual sales of LTSC in the Phoenix and Tucson AMAs from 2008 through 2014. The Pinal AMA is not included in the table because only 2 sales have occurred there. As shown, prices in Phoenix AMA have ranged from $100 to $250/LTSC, and have averaged $140/LTSC. In the Tucson AMA, prices have ranged from $97 to $198/LTSC, and averaged $139/LTSC. For the 2 Pinal AMA trades, prices were $145 and $325/LTSC.

In general, sales of small quantities of LTSC are associated with higher per-unit prices. For example, the two highest-priced trades in the Phoenix AMA included a sale of 50 LTSC for $200/LTSC, and a sale of 100 LTSC for $250/LTSC. In contrast, the largest sale observed to date of 126,000 LTSC traded at a much lower price of $125/LTSC. In the Pinal AMA, a sale of 1,500 LTSC was completed at a price of $325/LTSC, while a larger sale of 5,000 LTSC traded at a price of $145/LTSC. Inverse correlations between sale size and unit price are common in water rights markets as a result of lower demand for large water volumes.

Table 1: Summary of LTSC Unit Prices in the Phoenix and Tucson AMAs, 2008-2014

	Phoenix AMA	Tucson AMA
	Price ($/LTSC)	Price ($LTSC)
Average	$140	$139
Median	$134	$135
Min	$100	$97
Max	$250	$198
StDev	$26	$23
Count	41	21

LTSC Prices Correlated with CAP Costs

Historically, LTSC prices have tracked closely with CAP water delivery rates and the cost of generating LTSC by storing CAP water at a constructed USF. Figure 5 displays the strong correlation between the cost of generating LTSC, and LTSC market prices. As shown, prices have generally fallen between the cost of accruing LTSC at constructed USFs and GSFs. Along with rising CAP rates, LTSC market prices have appreciated over time. In both the Tucson and Phoenix AMAs, average annual LTSC prices have increased by approximately 4% yearly (see Figures 6 and 7). Table 2 shows the itemized costs associated with accruing LTSC by delivering and storing CAP water.

Figure 5: Correlation between LTSC Market Prices, CAP Rates, and the Cost of Accruing LTSC, 2008-2014

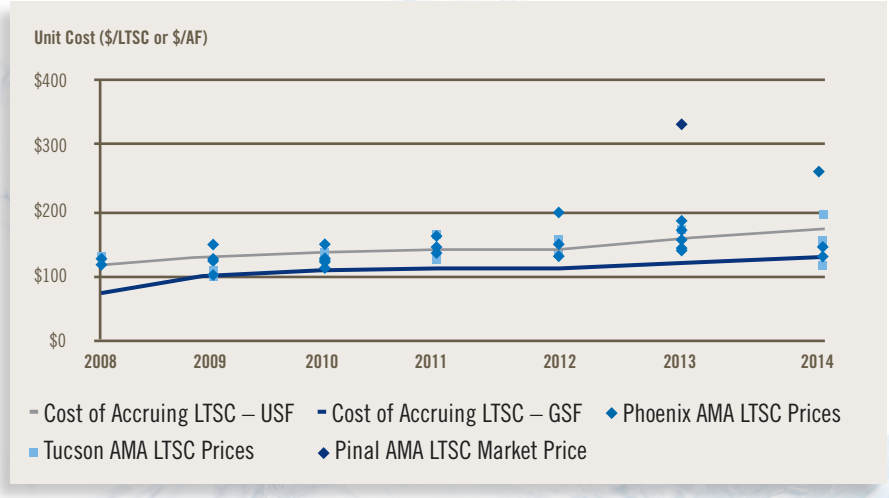


Table 2: Itemized Costs Associated with Accruing LTSC by Delivering and Storing CAP Water, 2014

Component	Constructed USF ($/AF)	GSF ($/AF)
Water Delivery Rate	$146	$146
CAP Underground Storage O&M	$15	-
GSF Cost Share	-	($15)
Cut to Aquifer (5%)	$8	$7
Evaporation (1%)	$2	-
LTSC Unit Cost	**$171**	**$138**

Figure 6: Trends in Phoenix AMA LTSC Market Prices and Total LTSC Volume Traded, 2008-2014

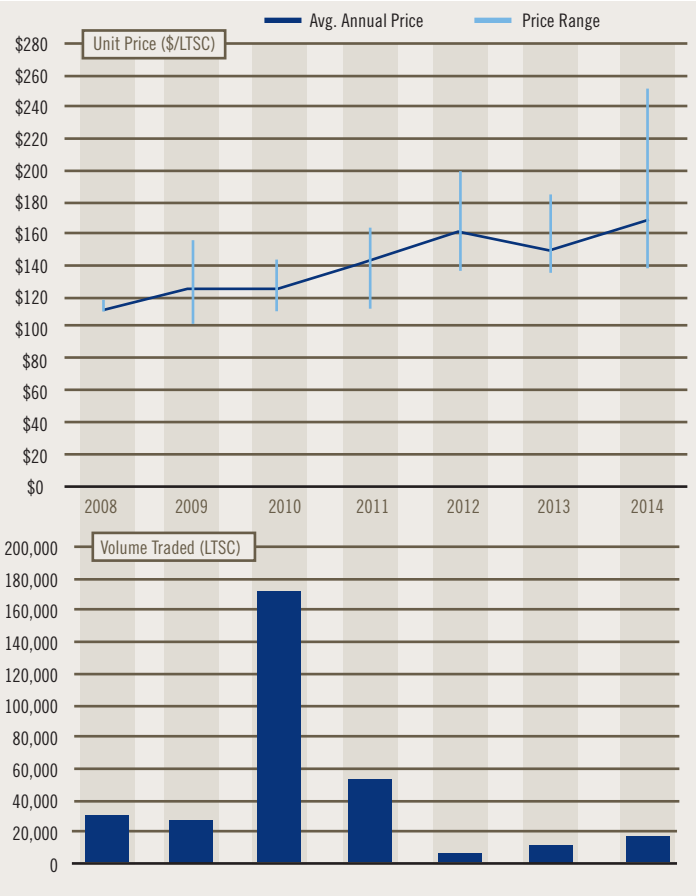
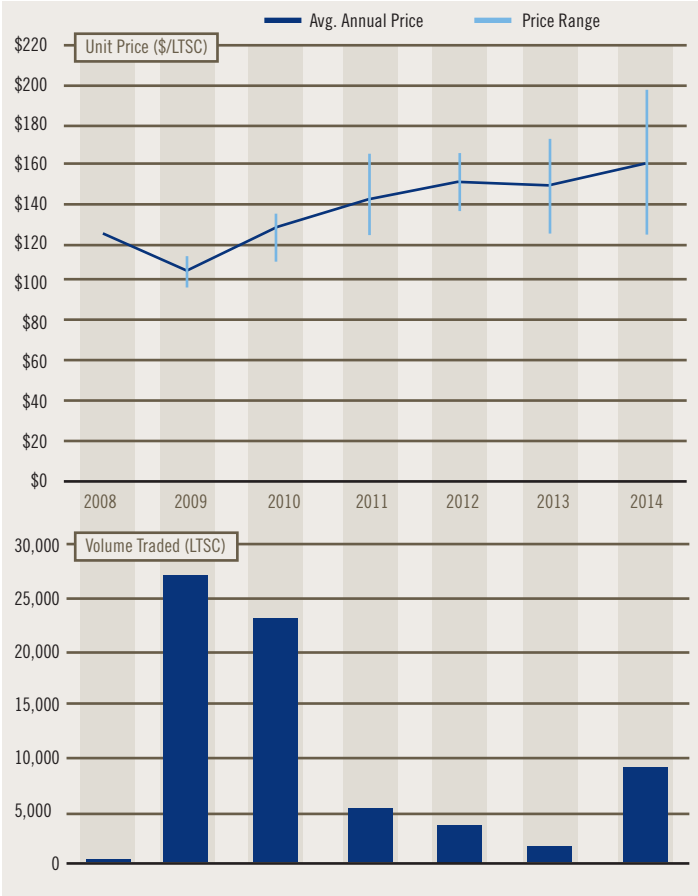


Figure 7: Trends in Tucson AMA LTSC Market Prices and Total LTSC Volume Traded, 2008-2014



Market Outlook

Trading activity of LTSC has been increasing and the market will continue to develop as water demands in Central Arizona grow, otherwise unused water supplies decrease, and new buyers enter the market. Anticipated Colorado River shortages may catalyze the LTSC market as water users pursue acquisitions of LTSC for firming of Colorado River entitlements. Most recently in 2013, the Arizona Water Banking Authority (AWBA) proposed amendments to state law to expand the AWBA's ability to purchase LTSC in response to reductions in excess CAP water supplies.

Market prices for LTSC are anticipated to continue increasing in correlation with CAP delivery charges and the cost of creating LTSC. Based on CAP's firm water delivery and recharge rates, the average LTSC price in 2015 is projected to be between $157 and $183/LTSC with prices continuing to trend upward to $195 to $225/LTSC by 2020 based on published CAP advisory rates.