BLM_NV_NVSO_GWProjects

From: vernalpool@riseup.net
Sent: Tuesday, September 13, 2011 2:31 PM
To: BLM_NV_NVSO_GWProjects
Subject: [Fwd: Rainwater Harvesting Solutions for Las Vegas Flooding and Drought Problems]
Attachments: Rainwater%20Harvesting%20Solutions%20for%20Las%20Vegas[1].doc

Hello,

This is another public comment on the SNWA pipeline, showing other alternatives to gathering water that do not deplete aquifers nor cause species extinctions.

Here's another report that is timely to the recent flash flooding stormy weather in Las Vegas. It may seem foolish to install rooftop rainwater catchment systems in the desert, though making use of every drop is always important. Wasting rainwater in puddles that only evaporate into the air isn't practical for a place that is always looking for more water. Sending water running down Las Vegas Wash also loses water to evapotranspiration.
That waterway never had water year round. So today, maybe the SNWA can look up to the sky for more potential water.

The secondary benefit of rooftop rainwater harvesting is that it reduces runoff into the streets, subtract the rooftop surface area from the other impermeable surfaces that contribute to flash flooding. This isn't just for households, the casinos and other large buildings can participate in collecting their own rainwater.

The report "Rainwater Harvesting Solutions for Las Vegas Flooding and Drought Problems" describes the risks of Snake and Spring Valley aquifer depletion and then provides the solution to getting more water access by harnessing rainwater.

Just trying to offer some practical advice to the SNWA, there are plenty other options for obtaining and conserving water. Rooftop rainwater harvesting is another component along with conservation, recycling (as they do in Orange County, CA) and their original source from Lake Mead. So there is absolutely no reason for their proposed pipeline from the Snake and Spring Valley (unless for the benefit of Coyote Springs development) as all their water needs can be met by the processes described above.

Thanks again for your time,

Mark Miller
Elko, NV

> Mark: Are you writing comments for the BLM DEIS? Might you be
> willing to share those comments with us through a copy of your report?
> or do a couple of summary paragraphs? So far you know more than
> anyone else about this issue. We'd be grateful!
> Thanks
> Susan Lynn for Great Basin Water Network

Rainwater Harvesting Solutions for Las Vegas Flooding and Drought Problems

This report intends to help find solutions to Las Vegas water needs without involving a pipeline that removes water from distant aquifers, Snake Valley or elsewhere. The realization of hydrologists and other scientists is that large scale removal of aquifer water from Snake or Spring Valley such as planned by the SNWA will be destructive in both short and long term outcomes for the ecosystems that depend on springs, seeps and other features of the carbonate aquifer systems of northeastern and central Nevada. The Snake and Spring Valley aquifers are the primary targets of SNWA pipeline proposals, with secondary targets of Delmar and Franklin Lake aquifers among others. Hereafter these aquifers will be discussed together as "carbonate aquifers" and should include all aquifers within the Great Basin hydrological regions of Nevada and Utah.

The risks posed by SNWA pipeline from Snake Valley and other carbonate aquifers are numerous and certain as previous experiences from excessive aquifer withdrawal. Especially in the Great Basin region, where the majority of the aquifer water took many centuries to gather, and most of that is from a much wetter climate prior to human presence.

We can find numerous historical examples throughout our Earth that show what happens when a society overdraws their underground water supplies. One such example is the ancient Middle Eastern city of Ubar. It is documented that between years 300-500 A.D., Ubar suddenly fell into huge underground limestone cavern that opened up beneath the city. According to archeologist Nicholas Clapp;

"Over millennia, Ubar's great well had watered countless caravans & had been drawn up to irrigate a sizable oasis. Handspan by handspan, its waters had receded and the limestone shelf on which the fortress rested became less and less stable, for it was the water underneath Ubar that quite literally held the place up." (Glennon, 23)

The limestone's weakness from lowered water support was noticed when seismic shocks from an earthquake cracked the limestone beneath and caused entire city to fall into the cavern. (Glennon, 23). While Las Vegas itself does not sit atop a limestone aquifer as Ubar did, there was documented subsidence in the Las Vegas Valley only decades after their original settlement based upon dependence on the three artesian springs that once flowed from original aquifers beneath Las Vegas. Not only did this result in a lowering of the Las Vegas Valley, it compacted the sediments and the aquifer cannot support the previous volume of water as the roof has lowered, or sagged into what once was capable of underground water storage.

However, Ubar's lessons certainly also apply specifically to the predicted outcome of excessive water withdrawals from carbonate aquifers as proposed by SNWA. If SNWA were to withdraw the amount proposed and transport it away from it's valley of origin, a net loss to the aquifer system year after year would naturally result in gradual subsidence of land above the aquifers, the approximately 10,000 feet of gravel overburden would apply pressure to limestone walls now devoid of their supportive water contents.

Another more recent documented example are lessons learned from excessive withdrawals of the Ogallala Aquifer in the Great Plains region of North America. The Ogallala Aquifer resides in a mostly north to south band across the states of Kansas, Nebraska, Oklahoma and Texas. This region occurs along the eastern rain shadow of the Rocky Mountain range, receiving very little rainfall. With almost no natural recharge, the Ogallala exists from glacier water that infiltrated the deeper layers of ground from between 10-25 kya. (Glennon, 25). Recent pumping of the Ogallala began slowly in the 1890s, then increased by 1,000% beginning in the post WW2 agricultural boom of the 1950s, going from 651 billion to 7.5 trillion gallons/year. (Glennon, 26). By 1980, the Ogallala's groundwater table already dropped 150 feet in some parts of Kansas and Texas (Glennon, 26).

Even in wetter climates with higher rates of rainfall and natural recharge, evidence of aquifer overdraft exists. Eastern Texas is climactically distinct from the western regions of the state that overly the Ogallala Aquifer. The San Antonio River in eastern Texas emerges from the Edwards Aquifer. Both the San Antonio and San Pedro springs are headwaters of this river (Glennon, 88). The Edwards Aquifer is also a carbonate aquifer system with a storage capacity of near 250 million acre-feet, with rates of natural recharge around 650,000 acre-feet/yr, with many artesian wells occurring down gradient towards the Gulf of Mexico (Glennon, 91). Even with such a large rate of recharge, excessive groundwater pumping by the region's residents and agribusiness has lowered groundwater levels to the extent that both the Comal and San Marcos springs often were dry (Glennon, 92).

Returning the Great Basin regions, we can expect land subsidence and loss of down gradient springs to occur if SNWA follows through with their proposed pipeline. The characteristic terrain of the Basin and Range geological province where the carbonate aquifers occur consist of alluvial valleys with permeable, loosely compacted alluvial sand and gravel up to 10,000 feet thick and much higher elevation mountains that are the parent material of the alluvium. Land subsidence occurs both when unconsolidated alluvial sand and gravel settles following groundwater removal and when limestone caverns collapse from aquifer water removal. In the case of the alluvium, an underground settling process compacts soil and reduces storage capacity of aquifer (Glennon, 33-34).

The settling and compaction of the alluvium occurs following groundwater removal because in loose material, groundwater is stored between small pores spaces of the particles. These pore spaces are larger when filled with water, as the water can provide resistance to the weight of alluvial overburden on the particles beneath them. As each particle is pushed apart from the other by the layer of water, once this layer is removed the particles will draws closer together, essentially compacting.

A similar process of compaction occurs with the aquifer water that exists beneath the groundwater of the alluvial sediments. This carbonate aquifer system is one layer below, separated by the cavern's limestone roof from the alluvial sediments. Comparing the size of the alluvial pore spaces to the carbonate limestone aquifer cavern is two opposite extremes, sort of like an elephant to a flea. However different the sizes of the water

storage spaces may be, the same laws of physics apply to both. The carbonate aquifer pore space may be much larger and surrounded by a continuous mass of hardened and slightly marbleized limestone, the removal of aquifer water will force the overburden above downwards to close the empty cavern space now only filled with air. Despite the limestone being slightly metamorphosed into marbleized limestone, it remains subject to fractures and cracking under stress of loss of support from water. One only need to look at photo evidence of the Talus Room in the Lehman Caves of Great Basin National Park to discover what happened during a much earlier episode of water table lowering long before human occupation of North America. The Talus Room of Lehman Caves shows the resulting lowered collapsed ceilings with mineral rubble strewn about the floor. This collapse happened after a prolonged change in climate reduced aquifer recharge rate and aquifer levels dropped. This occurred while Lehman Caves were lower and beneath the alluvium of that time, long before the current location of Lehman Caves following many centuries of uplift and tilt.

The effect of springs and seeps drying out will be felt by the region's human inhabitants also. The indigenous Western Shoshone people attach a great spiritual significance to the region's water sources. If local springs dry up their collective future outcome is believed to be increased poverty, loss of accessible land, disintegration of their culture, and finally a decline in their population. Western Shoshone tribal environmental coordinator Bernice Lalo calls the drying of their springs a form of "cultural genocide." (Glennon, 181).

In Rivers of Empire, author Donald Worster describes three modes of water control found throughout human history; local subsistence, agrarian state and capitalist state. These are three different ways of interaction with our society on the watershed. The original and longest tested mode of human interaction with water was local subsistence.

Local subsistence is best describes as temporary structures and small scale permanent works that interfere the least with natural stream flows. (Worster, 31). A regional example of local subsistence interactions can be found among the Papago people of the Sonoran desert ecosystem. The Papago (translated as Bean People) live year round in the Sonoran desert where rainfall is less than 10 inches/year. This habitually dry climate provided the Papago with natural drought tolerant foods during April to September such as cholla buds, wild greens, acorns and prickly pear cactus. None of these native foods required irrigation, they evolved in this region to become drought tolerant.

During the summer rainy season, they planted tepary beans in floodplain fields. The water from flash floods soaked into a temporary catchment basin built by the Papago along the watercourse. Riparian trees like cottonwoods and willows were planted in fencerows to slow the water current and spreading water over broad surface, trapping suspended silt for fertilizer, then planted seeds in mud trapped from flood waters (Worster, 33). This method of local subsistence water control is called arroyo-mouth or "ak-chin" farming by the Papago.

Prior to Papago's local subsistence an earlier people inhabited the Sonoran desert region. These people were called Hohokam ("finished" people) by the Papago and lived there

from 300-900 A.D. The Hohokam built large networks of interconnected canals to transport water miles away from the original water sources. Years of intensive irrigation by the use of canals increased poison salts in soil, resulting in the fields needing to be abandoned (Worster, 34). The Hohokam could not remain in this region after their poisoned fields were no longer able to provide them with food, resulting in their people being "finished". This disqualifies the Hohokam from being a local subsistence method of water control, placing them into the category of agrarian state.

Local examples of subsistence harvesting was found in the Nuwuvi, or southern Paiutes who inhabited Las Vegas Valley and surrounding deserts. The Nuwuvi lived in harmony with the Earth, which they called "tu-weap". They understood that tu-weap would give them what they needed provided that they took care of their habitat. The Nuwuvi lived in valley basins surrounded by mountain ranges where springs emerged at the foothill bases. These springs would then form streams that disappear and reappear numerous times on their path across the desert floor. The Nuwuvi people lived in small family groups along the streams. Following European colonization, the Nuwuvi were coerced to live in larger groups, altering their lifestyle and impacts upon the springs (ITCN, 7-8).

Prior to colonization the Nuwuvi lived within their means and along with hunting and gathering also practiced floodplain farming with corn, beans and squash along river and stream floodplains. Water was diverted to the crops along the riparian corridors. However, some Nuwuvi lived further from riparian corridors and practiced entirely different farming methods. The crops were planted in pits that were usually 3 feet across and six inches deep. These pits then collected rainwater and allowed to rainwater to soak into the pit (ITCN, 13). This early method of rainwater harvesting was effective enough to enable the Nuwuvi to survive the drought prone climate of Las Vegas Valley without drying up area springs since their arrival centuries ago. In the post-industrial system our society can apply new technologies on our collective rooftops to improve the efficiency of rainwater harvesting, though by maintaining the original concept from the Nuwuvi we could return to sustainable local subsistence for water harvesting.

First contact with the Nuwuvi came from early explorers like John Fremont and Orville Pratt. These explorers often kept journals that showed the initial bounty of the regions prior to European settlement. Pratt headed west, leaving on August 20, 1848 along the Old Spanish Trail. This time marked a transition from the Mexican trader caravans to the emigrant gold rush explorers heading for the coast, though before the later Mormon occupations. Pratt eventually entered the Las Vegas Valley, where he witnessed several Nuwuvi villages along the streams. Of the spring fed streams he said, "There is the finest stream of water here…It comes to, like an oasis in the desert just as the termination of a 50 mile stretch without a drop of water or a spear of grass." (ITCN, 48) Today the streams are dried up and the remaining survivors of the Nuwuvi ancestors are confined to a ten acre parcel outside of the city of Las Vegas. This is the result of a local subsistence culture being replaced by an agrarian state method, and not much later a capitalist state system.

During this short duration the Las Vegas Valley alluvial aquifer from Late Cenozoic times witnessed a 1 meter subsidence over a 500 square kilometer area from 1935 to 1963. (Water Encyclopedia)

The agrarian state method interfered on a massive scale with the natural flow of the watershed. In this mode of water control, water is diverted for many miles from it's original source by vast networks of canals. Some form of bureaucratic organization provided a dependable water supply to the village, demanding tribute or payment for their services. Material wealth from crops grown with dependable water sources went from the village to the city and back again, though with a large part of the wealth staying in city to support the bureaucratic class of water controllers. Taxes supported an organized military apparatus that was needed to defend the irrigation system from marauding nomads (Worster, 37).

The final outcome of centuries of the agrarian state mode of water control leads us into the final category of the capitalist state. This mode is distinguished by near complete physical domination of natural water flows with canals, dams and reservoirs leading towards social domination of certain classes of people over others (Worster, 50). This mode is recognized by two distinct centers of power; the private sector of agriculturalists and the public sector of bureaucrats and planners. Farmworkers and infrastructure construction workers represent the lowest rankings of the private sector used as physical instruments of environmental manipulation (Worster, 51).

Karl Wittfogel coined the term "hydraulic society" to describe his thesis of a system dependent upon construction of large dams, extensive canals and centralized water control systems with accumulated political power found in a ruling class of bureaucrats (Worster, 22-23). The ruling class of bureaucrats for the Las Vegas region has emerged in the form of the Southern Nevada Water Authority (SNWA), planning for the benefit of one class, the developers, against the future survival of entire ecosystems from as small and simple as snails to as large and complex as humans. People of consciousness have the potential to alter the disastrous course planned by the short sighted SNWA ruling bureaucrats if they choose other options from the local subsistence level and apply them to the greater population. Changing lifestyle and perception of water as a valuable resource is part of this shift in thinking, and including simple yet effective methods of rainwater harvesting is a needed component.

Modern day residents of the Las Vegas region need to make some very important choices about the mode of water control they will attempt to follow over the coming decades. Some of these choices include water recovery, capture and filtration from summer rainfall, selection favoring drought tolerance in landscaping and furthering innovations with water reuse and recycling. We need not follow the self-destructive path of the Hohokam or the ancient city of Ubar, the "Atlantis of the Sands", when choosing our methods of water control. We should focus on post-industrialist methods of rainwater capture, returning our society to the local subsistence mode instead of the runaway

destruction of the current capitalist state water control mode. One significant component currently not being utilized is the potential of the desert's summer thundershowers.

Although Las Vegas receives only 3-4 inches of rain per year, the frequency of the rainfall is often an all or nothing event. The majority of the quantity of the rainfall occurs during the summer months, when frequent thundershowers from cumulonimbus clouds are capable of delivering the entire yearly supply in only a few hours. This sort of deluge falling on dry soil surfaces and increasing hardpan from paved surfaces inevitable results in flash flood conditions throughout the Las Vegas Valley.

Not only does the rainfall runoff and become lost as evaporation from hardpan surfaces like parking lots, a significant amount is lost to evapotranspiration as the runoff enters Las Vegas Wash and is drawn up by the thick vegetation found there. Prior to human habitation of the region, Las Vegas Wash did not flow with water year round, only during storms and other flooding events. Following the settlement of the region, runoff from residential use resulted in year round permanent flow in Las Vegas Wash. This enables more water dependent vegetation to take hold in the canyon.

Another serious problem resulting from excess hardpan is flash flooding from summer thundershowers. The desert region spawns great cumulonimbus clouds were several inches of water often fall in only a few hours. This results in massive amounts of water entering the storm drains as runoff and overwhelming the system. The net effect of all this runoff is flash flooding events that can cause severe damage to infrastructure and also places human lives at risk. Several documented events describe summer flash flood conditions in detail.

On Tuesday, August 19, 2003 a summer thundershower began dropping rain in torrents, overwhelming the flood control intakes in the Gowan Road and U.S. 95 region. The catchment basins remained unfilled even though the streets were flooded. According to Clark County Regional Flood Control District general manager Gale Fraser, "We've had rainfall double what the system was designed to handle." The flood control system can handle 100 year storms, defined as 1.8 inches of rain for 30 minutes duration (Khalil, LVRJ). The statistics indicate that with global warming and even under regular conditions, the so-called "100 year storm" is par for the course for the Las Vegas region's summer thundershowers.

On July, 8, 1999 another summer thundershower dumped nearly three inches over an hour and a half. This flash flooding event resulted in two fatalities and flooded numerous residences and businesses, resulting in 1.5 million in flood disaster relief for 363 residents who suffered the worst of the water damage. Clark County officials estimate the total repairs needed for damaged roads and infrastructure would total around 20 million (Flood History, LVRJ).

Sometimes two somewhat related problems can be solved with the same solution. In this case the two problems are water requirements for residents and flood safety issues from summer thundershowers. Both can be significantly improved for relatively low cost if

every rooftop in the Las Vegas Valley was outfitted with storm water runoff catchment device with filtered outflow going into an underground storage tank or cistern. The size of the rooftop would determine the size of the cistern, and some communities could experiment with shared cisterns if this would be easier. The net result of universal rooftop rainwater catchment devices is that the 1.8 inches per thirty minutes is no longer flowing into the streets for every square foot of rooftop nearby. In addition, this water is stored directly and will not experience losses from evapotranspiration in the Las Vegas Wash nor infiltration into the desert sands where it seldom meets the groundwater.

The amount of Las Vegas average yearly rainfall is 4 inches per year, and some storms can drop around one half inch per fifteen minutes, the average duration of the summer thundershowers. The combination of rooftop gutters adding water to paved impermeable hardpan and the nearly equal impermeability of the sun dried desert soils will most likely overwhelm the flood control facilities into the future unless the amount of runoff is drastically reduced (Sedenquist, LLV).

The mineral caliche shows greater degrees of impermeability that results in flooding being a recurrent problem for Clark County. The naturally impermeable soil combined with totally impermeable asphalt and concrete surfaces are not going to be altered significantly to improve groundwater retention. This results in examining the only remaining surface area of rooftops as removing inflow to runoff during storm events. Damage from runoff also causes erosion as lateral stream bed channel cutting, undercutting of culvert and roads and also gully erosion (Clark County, NV).

According to the Greywater Action, researchers of sustainable water culture, the Las Vegas region has good potential for installing rainwater harvesting systems on rooftops. Considering the average rainfall in Las Vegas is around 3.5 inches per year, a reasonable estimate is harvesting 600 gallons per 1000 square feet of roof space per inch. The resulting harvest for Las Vegas yearly rainfall budget of 3.5 inches of rain would be 2,100 gallons per 1,000 sq. ft. of roof area.

The next step would be to guess the total square feet of roof space throughout the Las Vegas region and apply the above estimates to find the total sum of rainwater harvesting potential. It is reasonable expect significant improvements in water conservation if every roof was implemented with a rainwater harvesting system. Other methods of water conservation such as recycled greywater show similar potential for reducing a region's overall water consumption even if applied in initially only a few homes.

According to a report from the UCLA Institute of the Environment, if only 10% of homes in Southern California would recycle greywater it would offset the need for a medium sized desalinization plant (UCLA, Cohen). If outfitting only 10% of So Cal homes with greywater can accomplish the elimination of an entire desalinization plant, what would outfitting 50% of homes with greywater and rooftop rainwater harvesting accomplish? This same logic applies to the deserts of Las Vegas Valley, even small measures of rainwater harvesting, greywater recycling and other water conservation methods implemented on larger scales would prevent any need for a pipeline from easily

overdrafted distant aquifers. This would also provide even more jobs and enable residents to become more independent and self reliable with their water sources. This would also be a permanent fixture, other than the need to change filtering media periodically, the rainwater harvesting fixtures should last for decades with only needs for minor repairs. The proposed pipeline would not be a permanent water source as once the aquifers are overdrafted, the pipeline will be virtually useless.

The long term potential for jobs cleaning and manufacturing rainwater harvesting systems exists for any city with the creative potential to design and build their own systems. Las Vegas could become innovative leaders in manufacture of large scale rainwater harvesting systems for their own residents and possible exports to other regions once they have stabilized their own population with rainwater harvesting systems. There are several possible ways of constructing filtering media for purification of drinking water. Sand filters would work well under normal conditions of low turbidity found in most functional harvesting systems. Sand filters work with gravity, allowing water to percolate downwards with gravity through a large drum filled with sand. While the water percolates through, a hypogeal layer forms on top of the sand, feeding on organic residue and other impurities. After moving down through several feet of sand, the water is potable and removed of contaminants. The hypogeal layer grows thicker over time and periodically needs to be removed or destroyed by drying. Another new hypogeal layer will soon form afterwards, allowing water filtration to resume. (Chelsea Green)

For larger rooftop areas, the filtration system needs to accommodate for excess flow. System can be designed by building three circular chambers where the outer chamber is filled with sand, the middle one with coarser gravel aggregate and the inner-most layer with pebbles. This would increase filtration area for the sand, with relation to the coarser aggregates and large pebbles. Rainwater eventually reaching the central chamber would be collected in the sump and finally treated with chlorine and ready for safe drinking. (Rainwater Harvesting, R Jeyakumar)

These are just a few examples of the variety of rainwater harvesting systems that exist, and there is no limit outside of human creative potential as to what new rainwater harvesting systems and filters can be designed. Other filtration media includes charcoal and there are additional methods more complicated. However, the conclusion for anyone interested in protecting the aquifers targeted by pipelines is that rainwater harvesting would help alleviate the burden of water consumption by directly collecting the water at its source, instead of losses to evaporation from hardpan surfaces, evapotranspiration in the washes and other net losses from urban runoff.

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