Managing Shimla's Water Challenges in an Uncertain Future

ICMA CityLinks

USAID FROM THE AMERICAN PEOPLE

2016 CityLinks™ Boulder-Shimla Climate Exchange Partnership Report

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The International City/County Management Association (ICMA) program, in partnership with the United States Agency for International Development (USAID), pairs cities from across the world in a series of exchange visits. These exchanges seek to promote shared learning that aims to help both cities better address their common challenges. The two mountain communities of Shimla, India (Shimla) and the City of Boulder, Colorado (Boulder) were paired in a CityLinks™ Climate Exchange Partnership due to similar climate challenges and topography. Through ongoing partner exchanges, the original partnership goals surrounding enhanced governance and infrastructure were refined to focus on the nexus between climate, resilience and water. This direction informed the final March 2016 CityLinks™ exchange that sent a delegation from Boulder to Shimla. The findings from that final exchange are the primary focus of this report.

Not only do Boulder and Shimla share common challenges, they also have similar aspirations around community planning and being proactive to the climate, resilience and water challenges they face. Like Boulder, numerous reports done for Shimla focus on local climate projects, impacts and concerns. However, Shimla has relatively fewer drinking water focused reports even though the community faces water stress due to low precipitation, population growth and waterborne illness. Any amount of climate change will exacerbate many of Shimla's water issues. Realizing this, the Boulder delegation sought to highlight actionable resilience planning through a climate adaptation workshop. The workshop first provided presentations on climate science and recommendations from the team's field evaluation of Shimla's drinking water system. The second part of the workshop focused on an interactive "scenario planning" exercise designed to integrate climate, resilience and water planning.

Both field and workshop findings identified several opportunities that can help reduce Shimla's water stress under a range of future conditions (or scenarios). Developing multi-pronged efforts that can be immediately implemented like community outreach around drought while also working on longer term strategies that develop new supplies (also called "schemes") will help with Shimla's overall resilience. However, a central challenge that emerges for Shimla (and the entire nation of India) is the need for a culture shift that places equal emphasis on water quantity and water quality.

While water quality issues persist for Shimla across its drinking water, wastewater treatment, and stormwater collection systems, the most immediate opportunities for improved water quality and water quantity arguably reside with the drinking water distribution system. Some of Shimla's newly planned water schemes may serve to meet both water quality and water quantity needs, but new water delivery systems will require time to develop. Conversely, water loss control, standard operating procedures and community engagement opportunities can be implemented more quickly, helping Shimla realize both short and long-term gains.

The Boulder delegation presented it's field evaluation findings at a March 3, 2016 workshop held in Shimla. Beyond the formal presentation, an interactive portion of the workshop served to demonstrate how climate change impacts might further exacerbate current and future water challenges. This exercise helped Shimla attendees develop actionable "no-low regrets" strategies that will benefit Shimla under any future scenario.

The CityLinks™ exchange helped Shimla re-prioritize it's planning efforts and the city has already acted on many of the suggested recommendations from the workshop. At the same time, Boulder also gained insights that it can apply to it's own climate, resilience and water planning efforts. Post-exchange efforts have even seen Boulder and Shimla collaborating to develop a water conservation outreach campaign that could be across other cities in India. The cumulative benefit of these efforts highlight the lasting impacts CityLinks™ program partnerships can generate.

BACKGROUND ON THE BOULDER-SHIMLA CITYLINKS™ EXCHANGE

CityLinks™ Exchange Trips

The CityLinks™ program focused on identifying high leverage assistance activities that could help Shimla address its challenges and continue on its path as a pioneering, climate-resilient city in India. Because of similar topographies and climate challenges, Boulder was paired with Shimla to provide technical assistance, governance suggestions and infrastructure solutions. The first exchange trip of the partnership occurred in May 2015 and served to familiarize the CityLinks™ team and representatives from Boulder with Shimla's governance, public services and sector-specific climate challenges.

The team received an overview of the urban development scenario in Shimla city, the current conditions of the water supply and sewerage/solid waste systems of Shimla, and participated in in-depth discussion on climate change impacts on various parts of the city. Trip activities consisted of workshops, site visits to parts of the water supply and sewage system, and planning meetings that laid the foundation for partnership activities going forward.

The second exchange trip occurred in August 2015 when a team from Shimla came to evaluate Boulder's climate preparedness in the water and energy sectors. This trip directly informed Shimla's desire to dig deeper into the connections between climate, water and resilience which became the focus for the Boulder team on it's final March 2016 exchange trip to Shimla.

The Climate-Water-Resilience Nexus

Climate change impacts have big implications for both Boulder and Shimla. Developing city and region-specific understandings of how water resources will be impacted by changes in temperature and precipitation is fundamental to a city's resilience. This is clearly demonstrated in shocks like flood and drought. However, it's also important to understand ongoing stress that both water quantity and water quality issues can have natural resources, at-risk populations, etc.

Boulder in Context

The City of Boulder is a Colorado municipality of approximately 100,000 people located on the Front Range of the Rocky Mountains. Its planning history has contributed to a culture that values public engagement and participation in governance and community decision-making. In part, this has contributed to its ability to pilot innovative initiatives—such as widespread bike infrastructure, progressive land-use policies and current efforts to consider creating an electric utility —that address the concerns of a environmentally-focused resident population.

Boulder's Resilience Challenges

Boulder's most pronounced climate change impacts included fire, drought, heat-related stresses to the ecosystem including proliferation of invasive species, and flooding. Boulder's infrastructure investments have resulted in a high level of preparedness, as demonstrated during the 2013 floods, which caused minimal long-term damage in Boulder when compared with the surrounding region. This was due in part to the existence of protective greenways and decades of progressive flood related land use planning. Similarly, the city maintains a robust drinking water supply plan and drought response plan, which performed well during the 2002 and 2012 droughts.

Shimla in Context

Besides being the capital of the State of Himachal Pradesh, Shimla is one of the most popular and heavily visited hill stations located in the Himalayan Mountains. During recent years, Shimla experienced rapid but mostly unplanned urban growth which is increasing the susceptibility of the intensively-modified and densely-populated, steep city hillsides to mass movement and landslides.

Shimla's Resilience Challenges

Shimla is highly exposed to rainfall variability and increases in temperature which may affect ecosystem services like the availability, supply and quality of drinking water. Urban systems are vulnerable to several climate change induced risks including high intensity rainfall, flash-floods, slope failures, landslides and droughts. These events can cause devastation of life, property, urban services, infrastructure, livelihood and public health; particularly in marginalized populations and poor households. All the streams originating and flowing across the city are highly contaminated due to sewage and waste pollution.

KEY STATISTICS AND TRENDS IN SHIMLA[1]

- Temperatures ranges from- 6°C to 31°C over the year.
- Precipitation: 15 mm in November to as much as 434 mm in August.
- 40% reduction in rainfall (1987-2009).
- 0.46°C/10 years (1970 to 2000).
- Population increases (permanent and floating populations).

UNDERSTANDING SHIMLA'S WATER SYSTEM

Existing Water Scheme Challenges

Shimla has seven different drinking water sources which are locally referred to as water "schemes." The Dhalli Catchment Area scheme (about 3% of total supply) is Shimla's only gravity fed system but it's natural spring sources have diminished over time due to reduced groundwater recharge and decreases in precipitation. All of Shimla's other existing schemes require extensive pumping to supply the city. Some of these schemes like the Nauti Khad (Gumma) scheme can pump as much as 1080 feet of head over 3.5 kilometers and cost as much as $400 dollars (U.S.) a month to operate.

TABLE 1 : SHIMLA'S SOURCES AND QUANTITY OF DRINKING WATER EXPRESSED IN MILLION LITERS PER DAY (MLD)[1]

Source Name / River Name	Transmission Type	Year of Start	Installed Capacity (MLD)	Quantity of Water Produced (MLD)	Percent of Total Water Produced
Dhalli Catchment Area	Gravity	1875	4.54	1.80	3%
Cherot / agroti Nallah	Pumping	1889	4.80	3.86	7%
Chair Nallah	Pumping	1914	2.50	2.00	4%
Nauti Khad (Gumma)	Pumping	1924 & 1982	24.06	18.00	32%
Ashwani Khad (dysfunctional since December 2015)	Pumping	1992	10.80	10.80	19%
River Giri Scheme	Pumping	2008	20.00	15.00	27%
Ashwini Khad Koti Brandi	Pumping	2016	5.00	5.00	9%
	Sub Total		72.24	56.46	100%

Outside of cost, other issues presented by pumping include resilience to extended power outages and water quality concerns from distant water sources. For example, the Ashwani Khad scheme (about 17% of total supply) was off-line during the exchange trip due to contamination from a city wastewater treatment plant which is located upstream of the drinking water intake pipe. While that particular issue caused a Hepatitis and Jaundice outbreak, even in less dire circumstances, the presence of pollutants from agricultural (e.g. pesticides) and urban runoff in drinking water sources represent an ever-present challenge for water quality treatment in Shimla.

Though imperative to protecting health, investments in water quality protections have traditionally seemed to have been a lower priority (perhaps even at a national level) than investments in water supply. During times of drought, water shortages increasingly focus attention on supply and yet the quality of the water supply is no less important. In fact, water quality concerns that limit drinking water supply can exacerbate drought conditions. This was the exact case for Shimla as the temporary loss of the Ashwani Khad supply coincided with heightened city concerns of an imminent drought.

New Supply is a Long-term Resilience Strategy

Because climate change dynamics could continue to alter precipitation patterns, increase temperatures, strain power girds and lead to more frequent droughts, it make sense for Shimla to consider new, reliable water schemes. Shimla is considering two new schemes. The first requires extensive pumping from a farther river source with potential agricultural and urbanized runoff concerns. The other is a gravity-fed system from a mountain lake with minimal sources of contamination. Of these two options, the latter may best address both water quality and water quantity concerns.

A QUICK OVERVIEW OF SHIMLA'S WATER SUPPLY SYSTEM

"Water supply system of Shimla was established in 1875 to serve the population of 16,000. The water supply system was designed on pumping from nearby stream with help of engineering structures. Today, water supply is one of the major impediments in the growth and development of Shimla. It is the joint responsibility of Irrigation and Public Health Department (I&PH) and Municipal Corporation Shimla (MCS) to cater to the population drinking water needs. The I&PH department is responsible for planning and bulk water supply and distribution of water in the city, operation and maintenance of water supply infrastructure, billing, collection of user charges and penalties for domestic as well commercial connections are under the jurisdiction of MCS"

-United Nations Development Program 2015 Shimla Report [2]

Because a more pristine, gravity-fed system would not be as susceptible to interruptions in pumping, this option could also serve to enhance resilience to disruptions like power outages, disasters or terrorism. While some of these potential concerns may initially seem less likely, they are highly impactful which makes them key priorities for Shimla's resilience planning. For example, although Shimla has not been the epicenter for historic earthquakes, both Shimla and the larger Himachal Pradesh region is a highly seismic zone. Similarly, though terrorism may not be on the forefront of Shimla's concerns, riots in New Delhi in early 2016 demonstrated that protesters have broken water pumps to make a point.

The immediate water resource needs constrained by the water quality problems make it clear that high quality new water schemes could be beneficial to the city. And yet, even if approval and monies were provided tomorrow, these projects would take time to develop. Thus, there is a critical need for more immediate solutions that can help reduce Shimla's water stress. This will require not only looking at source water but distribution system issues that can impact water supply and water quality.

Drought is an Increasing Community Concern

In all cases, any increases in water supply will have to be coupled with creating a greater water conservation ethic in Shimla, especially given the rapidly increasing population. Original plans to support a population of 25,000 now support a population of up to 291,871 (171,871 residents and an additional 120,000 during peak tourism). Population projections are estimated to be 440,595 by 2039 with water needs and drought concerns increasing.

At the same time, Shimla does not consistently supply water to the city 24 hours a day, 7 day a week (24/7). In an average year, Shimla's water supply is only turned on from 3-4 hours a day. In times of drought, Shimla's water supply is turned on for 45 minutes every other day. However, the 2016 drought has been so extreme that Shimla has only been able to supply water ¬every third day for 45 minutes.

In addition to home water taps, the community utilizes numerous water tanks and water delivery trucks that fill-up when the water is on. There are also, water "ATMs" where water can be purchased. While more vulnerable populations may not always have resource or access to water, the system is functional. At the same time, leaking water tanks in Shimla are not uncommon and anecdotal information suggests that the Shimla community does not fully understand the extent of its water scarcity issues.

Part of the solution to helping augment water supply could lie in community engagement through and active and participatory water conservation campaign. Shimla has recently been successful in partnering with the community to help mitigate trash disposal issues and those same avenues could likely be used to build a greater water conservation ethic in the community. Helping the community better understand the value of water and how they can help conserve is key. Mandatory rain water harvesting requirements the city has implemented can help push the message. However, there are also other opportunities the city can explore such as reducing unaccounted for water (i.e. water loss).

Water Loss Reductions Represent a "Hidden Scheme"

In evaluating Shimla's system water loss ranges from 25%-40%. To be fair, this may not be an abnormality in the country as a 2010 study from New Delhi had similar findings there.[3] However, this is in sharp contrast to studies that suggest acceptable water loss values should be no more than 15% of produced/treated water or lower.[4] Controlling water loss represents an opportunity for Shimla to conserve water and allow additional time before new supplies may be needed.

To put it in perspective, Shimla loses as much water as it gets from four of it's seven schemes. Of that water, about half is lost as treated water is carried to the city and the other half is lost in the city distribution system due to pipe leaks and other issues.

IN THE NEWS

RIOTS IN NEW DELHI

In February of 2016 riots broke out in New Delhi related to the country's Caste System. Protesters blocked, diverted and damaged New Delhi's main water canal. Police regained control but the damage was so extensive that for days the canal could only supply 240 million gallons a day (mgd) compared to the typical 820 mgd. Fare from peaceful, the altercation left almost 20 dead and impacted 10 million people in Delhi.

IN THE NEWS

OUTBREAK IN SHIMLA

In February of 2016 an outbreak of both Hepatitis E and Jaundice were linked to the Ashwani Khad scheme; one of the sources that supplies Shimla's water. The city intake pipe is downstream of a nearby wastewater treatment plant that had failed to properly treat sewage before returning it to the stream. In all, ten people died from the outbreak and 1600 were impacted. While the outbreak is among the worst since 1947, Shimla teams were responsive and mobilized to test water, identify the source of contamination, shutdown the supply and water testing and outreach efforts. Shimla even held a summit that the CityLinks™ exchange group was invited to.

Shimla's water loss ranges from 25% to 40%.

Were Shimla to realize its current goal of obtaining a continuously pressurized system without first reducing its unaccounted for water, the total volume of water lost would be far greater than it is when the leaking is contained to a few hours of pumping each day. And yet, water lost in the system is not just a water quantity problem. Water that leaks from pipes can saturate soils and further add to hillside instability and existing landslide concerns. Additionally, water leaks allow a way for bacteria from soils or wastewater piping to seep into the drinking water supply – especially when the system is shutoff and backflow conditions become possible due to loss of pressure.

New Pipe Repair Technologies May Offer Options

Shimla's clearly has aging infrastructure concerns with some distribution pipes that may date back to it's original 1875 system. However, fixing leaks and shoring up the existing system does not always require full pipe replacement. New technologies that allow for in pipe (in-situ) lining allow a cheaper and more realistic alternative to full replacement. To that end, Shimla's lack of 24/7 water supply could be advantageous towards expediting camera work that could be used to evaluate pipe conditions or lining pipes with cured-in-place piping or other in-situ options. While some main lines, laterals or joints may still need replacement, exploring options that reduce resource intensity would be advantageous given the additional challenges Shimla faces with reduced staffing. However, at present, this type of technology is not used in Shimla.

There Are Enhanced Metering Opportunities

However, not all unaccounted for water comes from leaks. Some water losses are "apparent losses" that result from discrepancies between water that is delivered and water that is billed. Billing may be done with actual meter reads in which case the accuracy of the meter must be tested. Billing can also be done through estimated use which obviously presents more of an accuracy issue. Shimla currently only fully meters it's business while it estimates a flat bill for most residential users.

Accurate metering is key to not only curbing water loss but is also important for both a revenue and water supply planning perspective. Additionally, metering and proper valuing of water helps support a greater water conservation ethic when water waste becomes financially disadvantageous for the end user.

In addition to reducing water waste, metering can also help identify smaller system leaks. As noted above, leaks can also represent potential sources of water quality contamination and/or reduced chlorine residual at any one individual users tap (faucet).

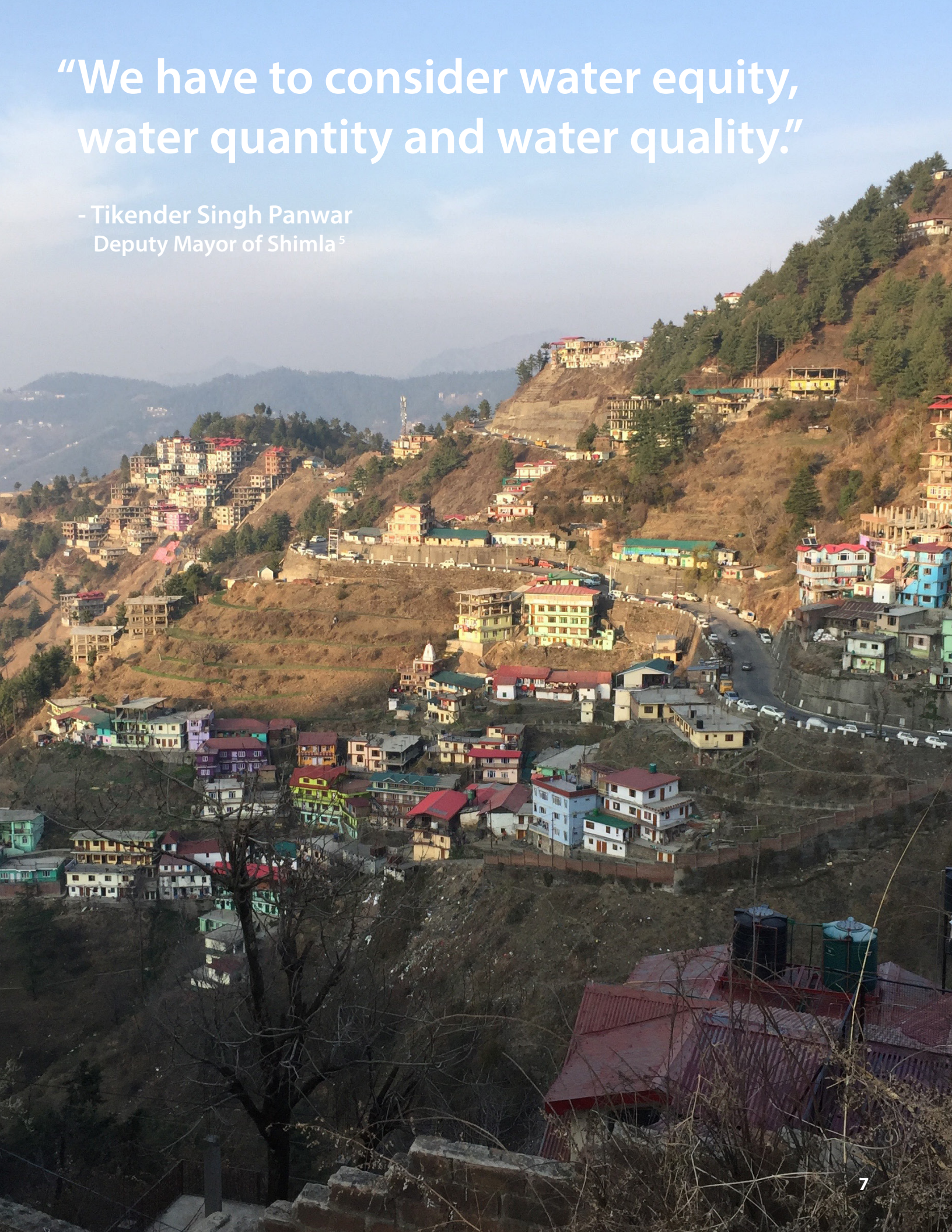
PRESERVING OPEN SPACE, NATURAL SPRINGS AND WATER SUPPLIES

Boulder and Shimla teams spent three full days in the field, visiting various city schemes, treatment plants and storage tanks. Of these site visits, the Dhalli Catchment is arguably the most unique and serves to highlight multiple environmental issues. Dhalli Catchment is the city's only gravity-fed system, is supplied by (now dwindling) natural springs and is located in the middle of the protected Shimla Water Catchment Sanctuary (shown left).

The sanctuary serves to protect more than the Dhalli Catchment scheme, as it houses 12 square kilometers of richly biodiverse Himalayan forest. Many native species can be seen in the area and some of those are endangered; one snow leopard has even been sighted in the area. However, the drying up of springs and perennial streams in the area represents a problem for Shimla's wildlife and it's water supply.

Dhalli Catchment served as the original water supply for the city when Shimla was the Summer Capital of India under British rule. Today, the catchment is the smallest contributor of Shimla's water supply needs (about 3% of total supply). This is partially due to the continued drying-up of many of the natural springs that originally supplied this scheme.

Dr. Prakesh Tiwari studies natural spring recharge and shared some disturbing findings with the Boulder exchange team. He has identified that "about 36% of springs have dried, heads of perennial streams have dried and water discharge in springs and streams has decreased substantially resulting in severe crisis of water for drinking water as well as irrigation over the last 20 years." [6] Ongoing groundwater recharge remains a high priority for the city.



"We have to consider water equity, water quantity and water quality."

- Tikender Singh Panwar
Deputy Mayor of Shimla [5]

DEVELOPING THE SHIMLA WORKSHOP: A TWO PART APPROACH

The half day workshop format allowed team members to strike a balance between presentations and breakout sessions. Workshop time was split between the following:

- WORKSHOP PART I - PRESENTATIONS ON CLIMATE, RESILIENCE AND WATER
- WORKSHOP PART II - SCENARIO PLANNING BREAKOUT SESSIONS

Details for each component are found in the following sections.

WORKSHOP PART I - PRESENTATIONS ON CLIMATE, RESILIENCE AND WATER

OVERVIEW OF CLIMATE, RESILIENCE AND WATER

For the first part of the Shimla workshop the Boulder team gave short presentations. Initially time was spent on an overview of the latest in climate science and resilience planning initiatives but quickly turned to the overlaps between climate, resilience and water. From there, field findings from the Boulder team's evaluation of Shimla's water supply and delivery challenges were highlighted. Key recommendations from the field evaluation were meant to help demonstrate how Shimla might be more climate-resilient through water planning initiative and would also help inform the workshop breakout sessions that followed.

FIELD RECOMMENDATIONS FOR SHIMLA'S WATER SYSTEM

Over the course of the three day field evaluation process the Boulder team traced Shimla's water supply from source to tap, assessing near-term opportunities for enhancing system reliability and operations. The following are key areas where Shimla could advance it's water supply resilience.

1 ENGAGE THE COMMUNITY WITH A WATER CONSERVATION CAMPAIGN

Shimla officials could better communicate storage concerns in advance of a drought and work with residents to embrace ongoing water saving efforts by developing an outreach campaign.

2 REDUCE WATER LOSS

Water loss is significant (25-40%) and is costly to the city while many of the fixes (e.g. replacing valves packing glands) are low-cost and could yield big savings.

3 CONSIDER INVESTMENTS IN METERING AND OTHER TECHNOLOGIES

Shimla should investment in full water metering of the city with more automated reading capabilities. Additionally, Shimla should enhance it's real-time water quality monitoring capabilities, GIS mapping of city assets (e.g. pipes) and consider larger adoption of computer use and paperless filing systems.

4 ESTABLISH GOOD HOUSEKEEPING POLICIES

By putting best management practices in place at city facilities Shimla could reduce contamination to drinking water and the environment. Unsealed or covered pipes can lead to contamination. Poorly stored materials like chlorine can have reduced disinfection effectiveness, cause spills and degrade workplace conditions.

5 ENHANCE SAFETY & SECURITY

Protecting both employees and facilities with enhanced safety and security procedures is key. Utilizing personal protection equipment like ear plugs can prevent accidents and protect hearing. Similarly, ensuring that water treatment facilities are secured with a gate to prevent terrorist threats and that broken windows are fixed to prevent wildlife from contaminating water are important measures to take.

6 PLACE EQUAL VALUE ON WATER QUALITY

To help prevent water born diseases, Shimla should continue to embrace a cultural shift that values water quality equally with water quantity.

7 UTILIZE STANDARD OPERATING PROCEDURES (SOPs)

The use of documented SOPs to ensure that knowledge is not lost and that procedures can be correctly communicated from person to person would greatly help ensure that work is being properly conducted when new staff learn procedures, when senior staff are sick, etc.

WORKSHOP PART II - SCENARIO PLANNING BREAKOUT SESSIONS

RESILIENCE PLANNING FOR SHIMLA UNDER AN UNCERTAIN FUTURE

Breakout Session Preparation

In preparing for the Shimla workshop, the Boulder delegation considered how it's own climate and resilience planning initiatives could be applied to Shimla. As part of the Resilient Boulder effort, city staff began developing policies and programs to respond to the uncertainty associated with future climate change impacts. Those efforts are used to support a broader initiative to use stories (scenarios) of plausible disruptions spanning social, economic, and environmental conditions. The Boulder team felt this "scenario planning" process would work equally well for Shimla and could be a central point of the workshop.

Breakout Session Goals: Developing No-Low Regrets Strategies

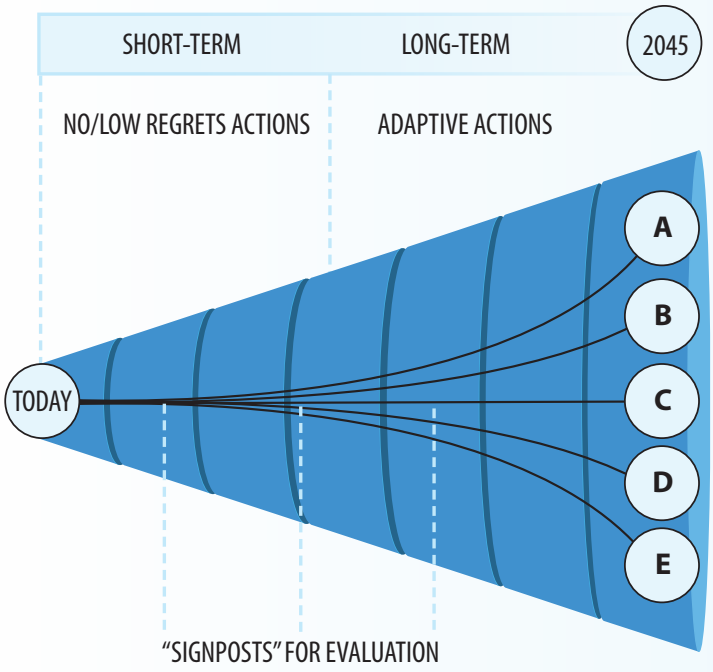
Scenario planning in the workshop would help Shimla evaluate how disruptive change can be used to test assumptions around preparedness, challenge the performance of conventional systems, and seek to surface new solutions that are integrated and inclusive. Part of the solution is to design a scenario-based process for planning that allows us to test programs, actions, and investments against different plausible potential future conditions and prioritize actions that represent "no-low regrets" strategies. These strategies are the short-term investments in adaptation that best support Shimla's long-term goals regardless of the severity of future change. The no-low regrets strategies, as well as the larger scenarios, are built on key factors (e.g. water supply), drivers (e.g. drought) and trends (e.g. increased drought) that are of concern to Shimla.

Key Factors, Drivers and Trends that Impact Shimla

- The observed variability in rainfall pattern and increased incidences of high intensity rainfall are likely to increase the vulnerability of the densely built-up areas of the town to a variety of hydro-geological hazards, particularly flash-floods, landslides, creeping and subsidence.

- The urban sprawl of the town during last few decades has been phenomenal, but mostly unplanned and unsystematic which has emerged as one of the major reasons for slope instability in Shimla. As a result, drainage network is being encroached, obstructed and obliterated increasing the vulnerability of the slopes and large population to climate change induced risks.

- Urbanization in Shimla has largely been unplanned resulting in the lack of civic amenities in proportion to population density. Unplanned and unsystematic urban growth together with rapid urban expansion and increasing inflow of tourists have made severe environmental impacts on the urban ecosystem of the city,



WHAT IS SCENARIO PLANNING?

When referring to climate science, scenarios are often reference a specific projected trajectory (or set of trajectories) for temperature and precipitation in the future. The term "Scenario Planning" is less climate specific and more encompassing of all the various local and global trends, including climate change, that may affect the future.

The "cone of uncertainty" (shown left) is used to present the range of future scenarios. In this context, each scenario is an evidence-based story that can be used to evaluate and consider many possible futures with multiple drivers that might impact how those futures could diverge over time.

Using no-low regrets strategies allow cities to set short-term goals that are manageable and also seek to meet long-term goals without fully committing resources to one assumed trajectory. Established "signposts" are used to re-evaluate what trajectory a city is on and to set new no-low regrets strategies to be accomplished before the next signpost is reached. In this way, cities can incrementally meet long-term goals and adjust to change in spite of future uncertainty.

Breakout Session Process

The workshop was comprised of three stages: 1) Presented field evaluation findings; 2) A brief primer on scenario planning; and 3) An interactive scenario-based exercise to help Shimla evaluate it's water planning through the lens of climate and resilience. Using Shimla's known key factors, drivers and trends, staff developed mock-scenarios (see right) to help participants evaluate how they might plan differently under a given scenario.

Scenario #1-#3: Ranked Priorities

Participants were broken out into work-groups and asked to "dot vote" on the top issues they saw as helping to solve their water challenges under each scenarios. While several key topics continued to be ranked as the top four priorities (see Table 2) it was also interesting to see how priorities shifted with each scenario. However, the continued focus on these priority areas suggest these measures represent no-low regrets strategies should be pursued under any future scenario.

TABLE 2 - RANKED WATER PRIORITIES FROM THE MARCH 3, 2016 WORKSHOP

TOPIC AREA	SCENARIO #1	SCENARIO #2	SCENARIO #3
Integrated Resource Planning	1	2	1
Technological Advances	3	3	2
Reducing Water Loss	2	4	3
Rain Water Harvesting	4	2	4

Scenario #4: Unconstrained Vision Setting for Shimla

In addition to the core priorities captured in the table above, workshop teams also developed additional priority areas. This was especially true when discussing *The Ideal Shimla* scenario which challenged participants to think about a future where the outcomes were positive and barriers to implementing changes were removed. Some of these areas (captured below) offer suggestion of other areas that Shimla might consider folding into or revisiting in it's ongoing planning efforts.

- Water Quality
- Trash Disposal
- Water Treatment
- Tree Health/Planting
- Hillside Stability
- Agriculture
- Water Recharge
- Green Infrastructure
- Environmental Education

WORKSHOP SCENARIOS

#1 BUSINESS AS USUAL

- Nothing radically changes by 2046
- Assumptions are sound
- Trends play out as expected
- Few unanticipated events occur

#2 HOTTER THAN EXPECTED

- Annual average temperature is at the upper bounds
- Droughts occur 3 to 4 years out of every 10
- Snow pack diminishes beyond projections
- Other trends play out as expected

#3 HOT AND INTENSE

- Climate change is significant by 2046
- Annual average temperature is at the upper bounds
- 2-3 year droughts are common; snow pack diminishes
- Shimla experiences a large increase in population as people flee the heat of the plains for both permanent and summer residency
- Communities struggle to provide services to meet rapid business and population growth.
- Open lands are rapidly developed Extreme events are more common

#4 THE IDEAL SHIMLA

- Nothing radically changes by 2046
- Assumptions are sound
- Trends play out; Shimla adapts well
- Few unanticipated events occur
- Many other conditions improve

WORKSHOP OUTCOMES, COMMITMENTS AND SHARED GOALS

An important goal of the exchange was to move beyond recommendations to action as indicated by the following workshop outcomes, commitments and shared goals:

OUTCOMES

SHIMLA FINDS OPPORTUNITIES IN SCENARIO PLANNING

The scenario planning workshop exercise highlighted how Shimla could plan for not just one, but many possible futures. This is a tool that Shimla can continue to use as it develops no-low regrets strategies for short term gains even under an uncertain future. The Deputy Mayor, Tikender Singh Panwar, asked, the attendees "who owns this workshop" making it clear that it was up to local government to use these tools and thinking to "link climate change, social movements, social mobilization and show the way forward."

THE HIDDEN SCHEME OF WATER LOSS RESONATES WITH SHIMLA ATTENDEES

Helping Shimla realize that mitigating water loss, not just building new water supply, could help address both immediate concerns and long term climate change impacts was a concept that resonated with attendees. This was evidenced by comments made at the workshop and the fact that water loss emerged in the top four priorities during the scenario planning exercise (see page 11).

BOULDER SUPPORTS SHIMLA'S WATER CONSERVATION EFFORTS

Beyond bring up the concept of coordinating a water conservation campaign, Boulder staff worked to help the Shimla team develop and design a water conservation campaign logo and action plan to help with Shimla's drought planning (see page 13).

COMMITMENTS

ADOPTING BEST MANAGEMENT PRACTICES

Shimla engineering staff have begun to pilot the use of Standard Operating Procedures and Shimla staff like Dharmendra Gill vowed to use Best Management Practices that could help keep new pipe clean before it's installed.

SHIMLA MUNICIPAL CORPORATION AND IRRIGATION DEPARTMENT MERGE

To help improve collaboration and remove barriers to water protection, the Municipal Corporation of Shimla and the Irrigation Company of Shimla have merged. Now those responsible for source water pumping to the city and water quality in the city have more shared responsibility.

DEVELOP ENHANCED WATER CONSERVATION INITIATIVES

Water Conservation planning can't just be reactive to drought, it has to be embedded in long-term planning. Beyond the initial launch of Shimla's Water Conservation campaign, Shimla and Boulder continue to work together on ongoing campaign strategies, program evaluation and project support. Project implementation successes were also shared at an international ICMA CityLinks™ workshop in Bangkok, Thailand in May 2016.

SHARED GOALS

USE SCENARIO PLANNING TO ENHANCE CLIMATE RESILIENCE

Scenario planning is a cutting edge planning tool that may help both Shimla and Boulder evaluate future conditions and identify climate (and related) adaptation strategies. In fact, the Shimla workshop helped highlight strategies for educating City of Boulder staff about it's own climate adaptation planning. A key goal for both communities will be to identify routine check-in intervals in future years to evaluate progress, trends and new adaptation needs for future planning.

START A PUBLIC DIALOGUE ABOUT THE IMPORTANCE OF WATER QUALITY

The field analysis provided at the Shimla workshop helped reinforce the importance of water quality not just water quantity. Shimla and Boulder both share goals of continuing to enhance the dialogue around the importance of water quality, water infrastructure needs and water quantity as they are all contribute to overall city sustainability goals.

CONTINUE CONNECT CLIMATE CHANGE WITH CHANGES IN WATER

As was noted recently in the Washington Post article, "Climate Change is Water Change."[7] The Boulder-Shimla CityLinks™ exchange embodies this concept and will continue to build water planning into larger climate adaptation planning efforts.

◆ **HIGHLIGHT:** BOULDER SUPPORTS SHIMLA'S WATER CONSERVATION EFFORTS

To help Shimla better prepare for its (then) upcoming 2016 drought, Boulder worked with Shimla to create a water conservation campaign logo, message and marketing strategy. The goal was to develop a campaign to not only increase awareness but also to change behaviors that could help reduce city water use.

The campaign launched to coincide with India Water Week (April 4-8, 2016). The tie in to the national event worked well as the Shimla logo was designed to be shared. In an effort to give the campaign instant recognition, the "water is our guest" borrows from a Hindu saying that a "guest is like a god" which should be cherished.

Shimla Municipal Corporation members at the launch of the "Water is Our Guest. Use It Wisely" campaign (shown right).

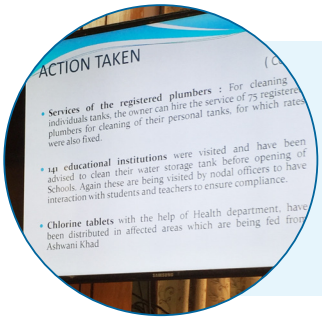
◆ **HIGHLIGHT:** ADOPTING BEST MANAGEMENT PRACTICES

Across all the exchange trips the Boulder delegation gained valuable insights from Shimla. A great example of a key takeaway from the final exchange trip was Shimla's tank cleaning and marking system (shown right). City of Boulder Public Works/Utilities staff often get asked when tanks were last cleaned and utilizing Shimla's approach could help save staff time spent answering these questions.

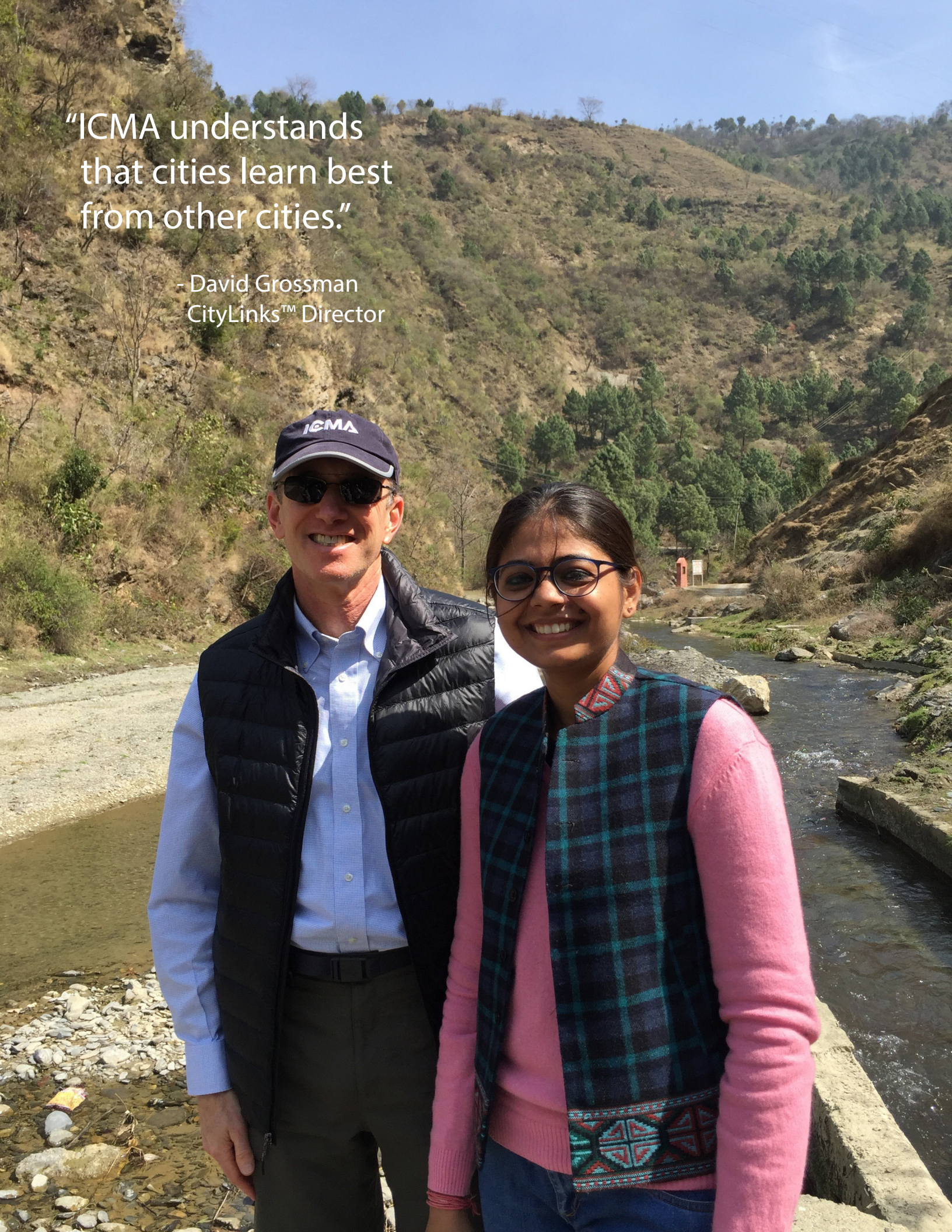
Shimla's Best Management Practice to sign and date the time of the last water tank (tank) cleaning and the next cleaning takes a proactive approach to customer service (sign shown right).

◆ **HIGHLIGHT:** VALUING WATER QUALITY AND WATER QUANTITY

On March 4, 2016, directly after the CityLinks™ exchange workshop, the Municipal Corporation of Shimla held a workshop to address the recent water quality issues associated with the Aswanhi Khad scheme and related cases of Jaundice and Hepatitis. The workshop helped to highlight the actions that were taken to prevent illness but also served to spur the emerging national dialogue about the importance of, not just water supply but, water quality.



Shimla invited the Boulder exchange team to participate in a workshop to address water quality concerns and water quality protection measures in order to help elevate the importance of water quality (workshop picture shown right).


"ICMA understands
that cities learn best
from other cities."
- David Grossman
CityLinks™ Director
ICMA

ACKNOWLEDGMENTS

The City of Boulder would like to thank the Shimla team for making this exchange meaningful for both exchange cities. Special thanks to Mayor Sanjay Chauhan, Deputy Mayor Tikender Singh Panwar and multiple Shimla staff who advanced exchange efforts. This includes the tireless efforts of Komal Kantariya without whom, this exchange would not have happened. The City of Boulder would also like to thank the ICMA CityLinks™ team including Jessica Johnston and David Grossman in addition to USAID for their support of this initiative.

CityLinks™ Shimla Support Team

Pankaj Rai, Prashant Sirkek, Vijay Gupta, Adarsh Bhotta, Sudhir Sharma, Sonam Negi, Dharmendra Gill, Komal Kantariya, Sanjay Chauhan, Sushil Justa.

CityLinks™ Boulder Support Team

Jane Brautigam, Russ Sands, Greg Guibert, Bryan Ortiz, Jeff Arthur, Brett KenCairn, Jonathan Koehn, Casey Earp, Sherry Peng, Carl Castillo.

REFERENCES:

1 Shimla Municipal Corporation "Presentation on Challenges of Shimla: Water Supply and Sewerage System."

2 United Nations Development Program 2015 Shimla Report on Multi-Hazard Mapping and Analysis, Development of Exposure and Vulnerability Assessment (Physical, Economic, Social and Environment) and Risk Assessment; Capacity Assessment

3 The Hindu, January 2010 news article "40 per cent of water supply gets wasted: Study"

4 Shimla Deputy Mayor quote taken from speech at the March 3, 2016 CityLinks™ exchange Climate Workshop in Shimla.

5 Control and Mitigation of Drinking Water Losses in Distribution Systems, United States Environmental Protection Agency, Nov 2010

6 Springer Science and Business Media, Environmental Changes and Sustainable Development of Water Resources in the Himalayan Headwaters of India; Tiwari and Joshi, 2011

7 The Washington Post, 'Climate change is water change' - why the Colorado River system is Headed for Major Trouble by Chelsea Harvey, August 19, 2016.

8 Prime Minister of India quote taken from April 2016 radio address to the country.

IN THE NEWS

SAVE WATER MOVEMENT

During an April 2016 radio address in India, Prime Minister Nerendra Modi discussed drought concerns, low reservoir levels and the publics' role in helping to conserve water. He said "To fight the drought and water scarcity, the governments will do their work. But I have seen people also make their own efforts. In several villages, an awareness has been seen with regard to the value of water and in such places, there is sensitivity and a will to do something to conserve."

Let us pledge to conserve every drop of water.

-Nerendra Modi
Prime Minister of India[8]

International City/County Management Association CityLinks™