# Arsenic-free water 'in the pipeline'

*A project to provide a potable water supply to two communities in an arsenic-affected area in the Department of León*

## Contact

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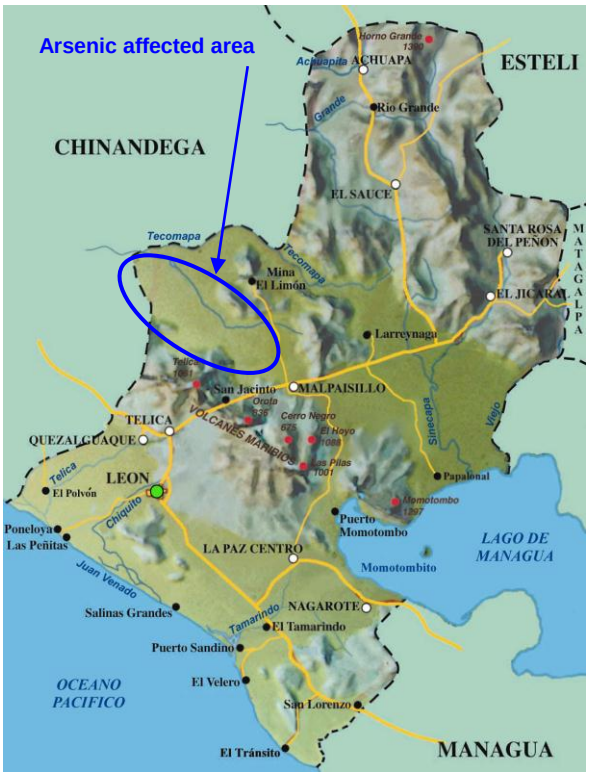


## Background

In 2007, arsenic was first identified in boreholes in the communities of Unión España and Nuevo Amanecer in the north of the Municipality of Telica, Department of León. Between March and November 2010, in looking for a site to drill a new borehole to supply these communities, arsenic was discovered in many more wells at concentrations in excess of 10 ppb, the permissible limit set by the World Health Organisation and adopted in Nicaragua under the CAPRE standards. Concentrations of up to 900 ppb have so far been proven.

## About arsenic

Arsenic is an important drinking-water contaminant. Drinking water rich in arsenic over a long period leads to arsenic poisoning, referred to as arsenicosis. This results in various health effects including skin problems (such as colour changes on the skin, and hard patches on the palms and soles of the feet), skin cancer, cancers of the bladder, kidney and lung, diseases of the blood vessels of the legs and feet, and possibly also diabetes, high blood pressure and reproductive disorders. Symptoms can start to appear over a period of 2-10 years. Arsenic is a ubiquitous element found in the atmosphere, soils, rocks, natural waters and organisms the world over. High arsenic concentration levels in water are principally restricted to groundwater, with some exceptions. It is mobilised in the environment through a combination of natural processes such as weathering reactions, biological activity and volcanic emissions as well as through anthropogenic activities.

## Project Proposal

A hydrogeological study was undertaken by Nuevas Esperanzas to find an alternative source of water for the communities of La Unión España and Nuevo Amanecer situated in a geothermally active area to the north of Volcán Telica. Official census data states the population of these two communities to be 830 although in practice the water system is likely to serve 1000 people. In order to address the need to provide an arsenic free water supply a decision to implement a multi-phase solution was taken between relevant stakeholders at a meeting in the office of the Mayor of Telica in October 2010. The phases proposed were as follows:

*Phase 1*
In the first instance, a borehole in Nuevo Amanecer is to be used to supply the communities of La Unión and Nuevo Amanecer with water suitable for washing and bathing using a gravity-fed distribution system based, as far as possible, on the existing water supply system for La Unión. It was understood that the water would not be suitable for drinking because levels of arsenic exceeded national and international standards. This phase was completed in March 2012. The water from this borehole is hot, due to the high levels of geothermal activity in the area, and contains around 40 ppb of arsenic. Whilst it not being used for drinking, this source has greatly reduced the burden of carrying water for washing and bathing for around 180 families.

*Phase 2*
In the second phase, subject to a successful trial, household filters would be introduced to remove arsenic so that the water from Nuevo Amanecer could be used for drinking. A pilot project to trial these filters is currently underway, though initial results are not encouraging with rates of arsenic removal well below that required to bring the levels within safe limits.

*Phase 3*
In the final phase, an additional source of water would be developed to supply cold, arsenic-free water from a spring in the hills nearly 4 km away, piped to public collection points to be used for drinking and cooking. This supply will ensure that the water consumed complies with national and international standards. The reason why this arsenic-free source of water cannot be developed to meet all water needs is that the flow would be insufficient to meet the demands for washing and bathing as well as drinking water of all 180 families.

With widespread implementation of filters unlikely, the final solution will be to provide two sources of water. Hot water containing moderate levels of arsenic, piped to each house with metered connections, will provide water for washing and bathing, while cold water with no arsenic, rationed by using public collection points, will ensure a safe supply of drinking water. Though not exactly conventional, this solution has certain advantages, including a backup in case one of other source fails and the rather unexpected bonus of having cold water for consumption and hot water for bathing!

In order to assess the feasibility of this option, a preliminary design was undertaken and an approximate budget calculated. This includes protection of the source and construction of a stand post for existing users in Agua Fría, a pipeline with pressure break tanks and stream crossings, a storage tank in La Unión, a distribution system and public stand posts.

←*The source of the spring in Agua Fría*

## Methodology

A small spring protection box will be built over the source; a reinforced concrete chamber approximately 1.5 m x 1.5 m x 0.5 m would provide adequate protection. A pipeline will then be laid to take the water to a storage tank in La Unión. The total length of the proposed pipeline route is 3.62 km. The route will include stream crossings and pressure break tanks to ensure that excessive pressure does not build up causing leaks or burst pipes.

A 40,000 litre ferrocement header tank will be constructed alongside the existing tank in La Unión (used for the water from phase 1 of the project). The capacity of 40,000 litres is approximately equal to one full day's flow from the spring at the design flow rate of 0.48 litres/second. This would maximise the availability of water even if all users collected their water at the same time of day. The construction method for the tank would be the same as for a rainwater harvesting tank already constructed at the school in Nuevo Amanecer. Nuevas Esperanzas has constructed more than 80 such systems, mostly in the Municipality of Telica.

A distribution system to the proposed pubic stand posts will follow routes of the Phase 1 distribution systems allowing trenches to be shared. Pipes for Phase 3 were laid during Phase 1 of the project to make the most of the 7 km of trenches which had to be dug, so these are already in place. A preliminary design for the locations of public stand posts was undertaken using images from Google Earth to derive a layout which a) followed existing lines of trenches, b) ensured that a public stand post was located no more than 100 m from each house and c) ensured that no more than 20 houses would share a single stand post. The total number required to provide this level of coverage is 18.

## Objectives and expected outcomes

As funding for a large part of this project is being provided by the local Mayor's office, the availability of funding is governed by their funding cycle. For this reason, phase 3 has been divided into two sub-phases. Phase 3a will see the construction of the header tank and the 18 public stand posts and is to be completed before the end of November 2012 while Phase 3b will see the installation of the spring protection and pipeline in 2013. Part funding for Phase 3a has already been received from the local Mayor and a commitment to contribute to the project has been given by Pantaleón, a sugar company which has many employees living in the affected area. Due to time and budget constraints, it will not be possible to complete the whole project during the current funding cycle, so the spring protection and pipeline will be left until 2013. The components to be included by the end of 2012 are thus:

- Construction of a 40,000 litre ferrocement water tank which will be used to capture flow from the pipeline and ensure that the daytime demand for water can be met.
- Construction of 18 public collection points, each consisting of a concrete pillar with durable self-closing tap, concrete base and drainage to ensure good hygiene, shut-off valve and water meter to facilitate maintenance and monitoring of consumption and informative sign raising awareness of the presence of arsenic and encouraging the use of the arsenic-free water for drinking.
- Connection of the header tank and public connection points to the distribution system installed in parallel with the Phase 1 distribution system.

The components of Phase 3b to be implemented in 2013 are as follows:

- Construction of spring protection box.
- Installation of 3.62 km of pipeline, varying from 1" to 2" diameter according to the hydraulic design, using galvanised iron and concrete supporting pillars for exposed sections and PVC for buried pipes.
- Construction of up to three pressure break tanks.
- Construction of up to three cableways to support the pipeline over river bed crossings.

The implementation of Phase 3b of the project will be subject to a separate proposal and budget.

## Duration

As stated above, the deadline for completion of Phase 3a is November 2012. It is expected that the public collection points would take around 6 weeks to build with a similar time for the 40,000 litre tank.

## Budget

The total budget for the project is £12,905 of which £2,644 is requested from the 10% Fund.

| **Project budget, Phase 3a** | | *All costs are in GBP (£1 = $1.50)* |
|---|---|---|
| Materials | | |
| Header tank | | 1,067.00 |
| Public stand posts | | 2,441.00 |
| Signs | | 951.00 |
| Staff time | | |
| Director | 60 hours | 734.00 |
| Project Manager/community coordinator | 350 hours | 1,526.00 |
| Civil Engineer | 200 hours | 1,082.00 |
| Logisitician | 100 hours | 382.00 |
| Administrator | 40 hours | 175.00 |
| Building supervisors | 90 man days | 1,305.00 |
| Plumber | 5 man days | 83.00 |
| Staff expenses | | |
| Subsistence | 60 man days | 120.00 |
| Subsitence (building supervisors) | 18 weeks | 294.00 |
| Transport | | |
| Use of 4x4 vehicle | 3000 km | 1,100.00 |
| Indirect project costs | @15% | 1,645.00 |
| Total cost for Phase 3a | | **£ 12,905.00** |
| Less other funds | | |
| Pantaleón (sugar production company) - *funds allocated* | | £ 3,333.00 |
| Mayor of Telica's office - *funds received* | | £ 6,928.00 |
| Balance requested from 10% Fund | | **£ 2,644.00** |

## About Nuevas Esperanzas

Nuevas Esperanzas is a UK-registered charity (No. 1116109) and an international NGO registered with the Government of Nicaragua (No. 3537). Nuevas Esperanzas is a Christian organisation serving poor communities in Nicaragua through projects which provide practical and technical assistance in support of long-term sustainable development. Nuevas Esperanzas is based in León and has worked in many parts of Nicaragua including León, Chinandega, Estelí, Matagalpa, Granada and the North Atlantic Autonomous Region (RAAN). The organisation has had a continuous presence in the Municipality of Telica since 2004 and has developed a close working relationship with community leaders, the Mayor's office and the Ministry of the Environment and Natural Resources (MARENA). Nuevas Esperanzas has 12 permanent staff covering technical disciplines including civil engineering, agroecology and social science, and supporting functions such as logistics, administration and accounting. The organisation has a small office in León, two 4x4 vehicles and a wide range of technical equipment for surveying and the physicochemical and bacteriological analysis of water in the field.