



# STUDY ON WATER QUALITY STATUS WITH RESPECT TO FLUORIDE CONTAMINATION IN BALKH PROVINCE DRINKING WATER SOURCES

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## SCIENTIFIC INVESTIGATION REPORT

### ***Authors:***

***M. Hassan Saffi, Hydro-geologist***

***Ahmad Jawid Kohistani, Hydro-geologist***

***Edited by Leendert Vijselaar***

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Paikob-e-Naswar, Wazirabad, PO Box 208, Kabul, Afghanistan  
Phone: (+93)(020) 220 17 50 Mobile (+93)(0)70 28 82 32  
E-mail: [dacaar@dacaar.org](mailto:dacaar@dacaar.org) Website: [www.dacaar.org](http://www.dacaar.org)



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## Abstract

In Balkh province as well as in the most parts of Afghanistan, fluoride contamination along with other water quality concern parameters can be an issue for current drinking water supply systems using groundwater and potentially affect the health of inhabitants.

Therefore, the study carried out analyzing physical and chemical parameters integrating data sets from various projects collected for UNICEF (collected and tested water samples to identify fluoride and arsenic contamination in Balkh province), ECHO (collected and tested water samples to identify water point qualitative and quantitative functionality) and DACAAR GMWs network and WASH projects. The purpose of this study is to identify the water qualitative characteristics and hydro chemical process influencing the fluoride concentration of water point (WPs) sources (groundwater and surface water) of Balkh, Nahri Shahi, Dawlatabad, Chahar Bolak, Chimtal, Dehdadi, Khulm, Kaldar, Marmul, Charkint and Zari districts of Balkh province. For this purpose, 380 water samples (WSs) from different locations covering tube wells (TW), dug wells (DW), springs, stand posts (SP), streams and rivers were collected and analyzed for physical and chemical parameters according to the DACAAR water quality laboratory procedures and guideline.

The concentration of fluoride in the water samples ranged between 0.02 mg/l and 12.9 mg/l and the results revealed that 38% of tested water samples exceeded the National Drinking Water Quality Standard (DWQS) of 1.5 mg/l. Finding high concentration in the water sources in some localities such as Nahri Shahi, Dawlatabad, Chahar Bolak, Chimtal, Dehdadi, Khulm, Kaldar and Shortipa districts of Balkh province is great concern and some people did show affects from high levels of fluoride.

The result of this study also revealed other water quality concern parameters such as Electrical Conductivity/salinity (EC), Nitrate, Boron, Sodium, Chloride, Magnesium and Calcium concentrations are considerably higher than NDWQ standard which can potentially affect the health of inhabitants of Balkh province.

**Key words:** *Fluoride contamination along with other water quality concern elements, major ions chemistry, hydro-chemical process and correlations analysis*

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- Abdul Ahmad, Nasratullah and Qudratullah lab technician were analyzed bacteriological, physical and chemical of water samples.
- Assadullah, field supervisor for GMWs data collection in north, North West and north east of Afghanistan

## List of Abbreviations

DANIDA	Danish Development Aid
DACAAR	Danish Committee for Aid to Afghan Refugee
FAO	Food and Agriculture Organization
MRRD	Ministry of Rural Rehabilitation and Development
ECHO	European Commission Directorate General – Humanitarian aid and Civil Protection
RNE	Royal Norwegian Embassy
USGS	United State Geological Survey
USDA	United State Development Aid
UNICEF	United Nation Children Fund
WSP	Water and Sanitation Program
WASH	Water Sanitation and Hygiene
WHO	World Health Organization
WSG	Water Sanitation Group
MoPH	Ministry of Public Health
EHC	Environmental Health Criteria
NDWQS	National Drinking Water Quality Standard
NGVS	No Guideline Value Set
PCRWR	Pakistan Council of Research in Water Resources
RMO	Regional management Office
[13]	Reference Number
Cm	Centimeter
Ds/m	Deci-Siemens/meter
gr/L	Gram Per Liter
MCM	Million Cubic Meters
m	Meter
mm	Millimeters
m <sup>3</sup>	Cubic Meter
Mmhos/cm (mS/cm)	Millimohos/cm at 25 Degree Celsius
μS/cm	Micro – Siemence Per Centimeter
μ	Micro
μg/L	Microgram Per Liter
meq/L	Mille equivalents Per Liter
mg/L	Milligram Per Liter
SAR	Sodium Adsorption Ration
Ppm	Part Per Millions
Ppb	Part Per Billions
TDS	Total Dissolved Solid (mg/L or gr/L)
EC	Electrical Conductivity
NTU	Nephelometric Turbidity Unit
QA	Quality Assurance
QC	Quality Control
ETP	Evapo-transpiration
Vs	Versus
TW	Tube Well
DW	Dug Well
WP	Water Point
WD	Well Diameter
TD	Total Depth
WTWG	Water Technical Working Group



DWPs	Drinking Water Points
TTC	Thermo Tolerant Coli form
TCU	True Color Unit
WS	Water Sample
Al	Aluminum
As	Arsenic
Ba	Barium
BO2	Boron
Br	Bromine
Ca	Calcium
CaCO3	Alkalinity
Cl	Chloride
CO3	Carbonate
Cr	Chromium
Cu	Copper
E.Coli	Escherichia Coli
F	Fluoride
Fe	Iron
H2S	Hydrogen Sulphate
Hb	Hemoglobin
HCHO3	Bicarbonate
Hg	Mercury
I	Iodine
K	Potassium
Meth Hb	Met Hemoglobin
Mg	Magnesium
Mn	Manganese
Na	Sodium
NH4	Ammonia
Ni	Nickel
NO2	Nitrite
NO3	Nitrate
OH	Hydroxide
Pb	Lead
pH	Power of Hydrogen Ion Concentration
PO4	Phosphate
SIO	Silica
SO4	Sulphate
Zn	Zinc

## National Drinking Water Quality Standards (NDWQS)

### Physical and Chemical Parameters

Parameter	Standard Values For Afghanistan	WHO guidelines 2011	National Standard of most Asian countries
Color	15 TUC	NGVS	5 NTU
Test	Non Objectionable / Acceptable	Non Objectionable / Acceptable	Non Objectionable / Acceptable
Odor	Non Objectionable / Acceptable	Non Objectionable / Acceptable	Non Objectionable / Acceptable
Turbidity	5 NTU	NGVS	5 NTU
Total Hardness as CaCO <sub>3</sub>	500 mg/L	NGVS	500 mg/L
TDS	1000 mg/L	NGVS	1000 mg/L
pH	6.5 – 8.5	NGVS	6.5 -8.5
Aluminum	0.2	NGVS	0.2
Antimony	0.02	0.02	0.02
Barium	0.7	0.7	0.7
Boron	2.4	2.4	2.4
Cadmium	0.003	0.003	0.003
Chloride	250	NGVS	250
Chromium	0.05	0.05	0.05
Copper	2	2	2
Iron	0.3	NGVS	0.3
Sodium	200	NGVS	200
Sulphate	250	NGVS	250
Magnesium	30	NGVS	30
Calcium	75	NGVS	75
Toxic Inorganic	Mg/Liter	Mg/Liter	Mg/Liter
Cyanide	0.05	NGVS	0.05
Arsenic	0.05	0.01	0.01-0.05
Fluoride	1.5	1.5	1.5
Lead	0.01	0.01	0.01
Manganese	0.3	NGVS	0.3
Nickel	0.07	0.07	0.07
Nitrate	50	50	50
Nitrite	3	30	3
Nitrate as Nitrogen	11	11	11
Selenium	0.04	0.04	0.04
Zinc	3.0	NGVS	3.0

## 1. Introduction

In Balkh province, the surface water is scarce due to the unequal and uneven distribution of precipitation. Therefore the groundwater is the most important source of water for the inhabitants in the rural and urban areas of Balkh province as well as for the whole of Afghanistan. It is hidden resources, it is a finite and it is also extremely vulnerable and sensitive to the geological setting, over-exploitation and contamination. It is critical to investigate qualitative and quantitative status of groundwater for efficient and effective use, development and protection.

Fluorine is halogen a high electronegative and reactive element and does not occur in a free form in nature, and it is present as fluoride ions in drinking water. It occurs as fluoride ions naturally in soil and water due to chemical weathering of some fluoride containing minerals (Totsche, 2000). Fluoride in small amounts is an essential component for normal mineralization of bones and formation of dental enamel (Bel and Ludwig 1970).

The fluoride concentrations in drinking water has beneficial and can have detrimental effects on human health. Low concentrations of fluoride in drinking water are hygienically desirable, to strengthen teeth, however high concentration of fluoride in drinking water is associated with dental fluorosis (yellowish or brownish staining or mottling of the enamel), skeletal fluorosis and crippling skeletal fluorosis. The high fluoride content of water ( $> 1.5 \text{ mg/ l}$ ) is toxic for humans, animals and plants.

The WHO permissible limit of fluoride in drinking water is  $1.5 \text{ mg/l}$  (WHO 2004), the bureau of Indian standards (BIS, 1990) has suggested the permissible limit of fluoride in drinking water to be  $1 \text{ mg/l}$ , however the National DWQSI is  $1.5 \text{ mg/l}$ .

## 2. Objectives

### 2.1 Overall objective

Overall objective of this report is to provide a detailed picture of fluoride spatial distribution and concentration, along with other water quality concern parameters and their impact on human health in the rural areas of Balkh province.

### 2.2 Specific objective

The following are the specific objectives of this study:

- Evaluate tested water samples quality (physical and chemical) parameters of concern
- Map and visualize spatial distribution levels of fluoride along with other water quality parameters that interact with fluoride
- Identify the areas where the fluoride and other water quality elements are higher than national DWQS and potentially affect the health of inhabitants.
- Identify aquifers hydro-chemical processes and trends which influence fluoride concentration.

### 3. Rational of the study

Groundwater is the major source for water and especially for safe water supply in Afghanistan. It does not, however, have a large potential for development as it is a finite and hidden resource. The source should be studied to understand its qualitative and quantitative status for efficient and affective using, development and protection. The rational of this study are:

- To provide a detailed picture of drinking water points quantitative functionality and impact of fluoride concentration and interaction with other elements in drinking water supplies and the links between water use and health outcome in connection to fluoride.
- Highlights water related qualitative problems to support decision makers and policy makers for improvement of policies strategic plan and regulation regarding groundwater resources usage, development, protection and sustainability.
- Enhance technical capacity and institutional capability to implement water supply project according to the National DWQS.

### 4. General information about Fluoride.

#### 4.1. Chemical description

- Fluorine is the lightest member of the halogen group and is one of the most reactive of all chemical elements.
- Fluorine is not found as fluorine in the environment, but it is always present in combined state as fluoride.
- Fluorine is the most electronegative of all the elements and has a strong tendency to acquire a negative charge in solution from fluoride ions.
- Fluoride is present about 0.06 – 0.09 per cent of the earth's crust.
- Fluoride above an optimal level (1.5 mg/L) is becoming progressively more toxic.
- Fluoride ions have the same charge and nearly the same radius as hydroxide ions and may replace each other's in mineral structure (Hem, 1985).
- Low concentrations of fluoride in drinking water are hygienically desirable, to strengthen teeth, high concentration of fluoride in water is toxic for animals and plants.

#### 4.2 Environmental Occurrence.

- a) Granite (igneous rock) with pegmatite layer, gneiss and schist (metamorphic rocks) rocks are the major geological formation that contributes to fluoride concentration in groundwater. The minerals composition of granite is composed of quartz, feldspar and fluorite, whereas gneiss and schist are composed of quartz, k-feldspar hornblende, biotitic and fluorite. The fluoride-bearing minerals with interaction of water provide a significant fluoride level in groundwater.
- b) Granite and gneiss rocks are highly weathered which facilitate release of fluoride from minerals into groundwater.
- c) Fluoride is commonly associated with volcanic activity and fumarolic gases.
- d) Thermal waters with high pH, are also rich in fluoride (Edmunds and Smedley 1996)
- e) Granite rock polishing industries are source of fluoride concentration in groundwater
- f) Due to dust, industrial production of phosphate fertilizers, coal ash from the burning of coal and volcanic activities, fluorides are widely distributed in the atmosphere.

### 4.3. Fluoride Distribution in Water.

Fluoride is found in all natural water sources. Sea water typically contains about 1 mg/L, river and lake water have less than 0.5 mg/L, however in groundwater low or high concentration of fluoride can occur, depending on the nature of the rocks and occurrence of fluoride-bearing minerals.

The fluoride concentrations in water is limited because solubility of fluorite minerals ( $\text{CaF}_2$ ), so that in the presence of 40 mg/L calcium should be limited to 3.1 mg/L (Hen, 1989). It is the absence of calcium in solution which allow higher concentrations to be stable (Edmunds and Smedley, 1996)

High fluoride concentrations may also increase in groundwater from calcium-poor aquifer and in areas where fluoride-bearing minerals are common. Fluoride concentration may also increase in groundwater in which cat ion exchange of sodium for calcium occurs (Edmunds and Smedley)

### 4.4. Exposure

Due to dust, industrial production of phosphates fertilizers, coal ash from the burning of coal and volcanic activity, fluoride is distributed in the atmosphere. The air is responsible for only a small fraction of total fluoride exposure (USNRC, 1993).

In non-industrial areas, the fluoride concentration in air is quite low (0.05-1.9  $\mu\text{m}^3$  fluoride)(Murray. 1988). In areas where fluoride-containing coal is burned or phosphate fertilizers are produced and used, the fluoride concentration in air is elevated.

A number of products administered to, or used by children to reduce dental decay contain fluoride. This includes toothpaste (1.0-1.5 g/kg fluoride), fluoride solutions and gels for topical treatment (0.25-24 g/kg fluoride) and fluoride tablets (0.25, 0.50 or 1mg fluoride per tablet) among others. These products contribute to total fluoride exposure, albeit in different degrees.

Vegetables and fruits normally have low levels of fluoride and thus typically contribute little to exposure. However, higher levels of fluoride have been found in barley and rice (about 2 mg/kg) and taro, yams and cassava been found to contain relatively high fluoride levels.

Alkalinity, evaporation and high bicarbonate content of groundwater are the factors contributing to the dissolution of fluoride rich minerals in weathering rocks.

### 4.5. Problem due to excess fluoride

Low concentrations of fluoride in drinking water are hygienically desirable, to strengthen teeth, however, high fluoride content of water ( $> 1.5 \text{ mg/l}$ ) is toxic for human, animals and plants.

Long term use of fluoride content drinking water at concentration above 1.5 mg/l can result in dental fluorosis, value above 4 mg/l can result in skeletal fluorosis and above 10 mg/l causes crippling fluorosis [4]. The impact of using high fluoride content on human health is shown in table 1. The NDWQS for fluoride is recommended at 1.5 mg/l.

Table 1: Impact of fluoride on human health due to excess fluoride

Concentrations of fluoride in drinking water (mg/l)	Impact on human health
0 - 0.5	Dental caries, promotes dental health resulting in health teeth
0.5 - 1.5	Prevent tooth decay
1.5 - 4	Dental fluorosis
4- 10	Dental, skeletal and crippling fluorosis
> 10	Pain in back and neck bone

Fig.1, .2, 3 and 4 show the impact of fluoride on human health due to excess fluoride.

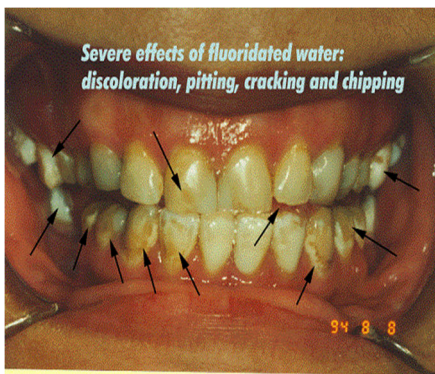


Figure 1 Fluoride effect on teeth

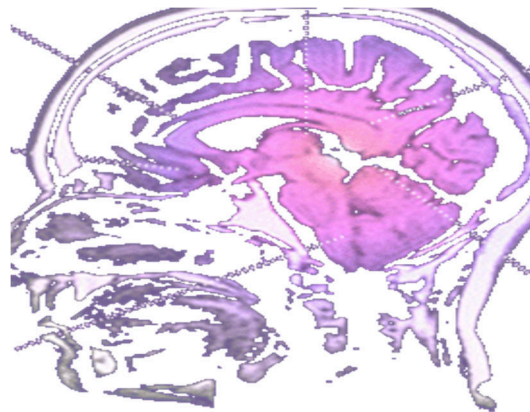


Figure 2 Fluoride effect on brain

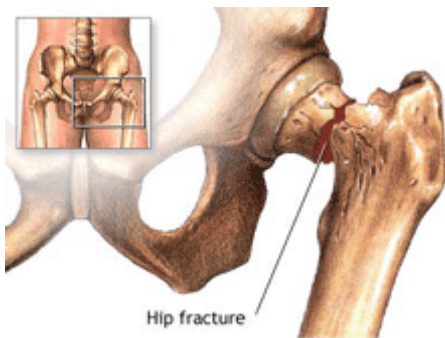


Figure 3 Bone fluorosis



Figure 4 Arthritis

## 5. Factors affecting the natural fluoride concentrations

### 5.1 Geology

During weathering and circulation of water in rocks and soils, fluoride can be leached out and dissolved in groundwater and thermal gases. The fluoride concentration of groundwater

varies greatly depending on the geological setting and type of rocks. The most common fluorine-bearing minerals are fluorite, apatite and micas. Therefore fluoride problems tend to occur in places where those minerals are abundant.

Sedimentary rocks have a fluorine concentration from 100 ppm (limestone) up to 1000 ppm (shale) (Frencken, 1992). In carbonate sedimentary rocks the fluorine is present as fluorite. Clastic sediments have higher fluorine concentration as fluorine is concentrated in mica and illites in clay. High concentrations may also be found in sedimentary phosphate beds or volcanic ash layers (Frencken, 1992).

Metamorphic rocks have a fluorine concentration from 100 ppm (regional metamorphic) up to more than 5000 ppm (contact metamorphic). In these rocks the original minerals are enriched with fluorine by metamorphic processes.

Igneous rocks have a fluorine concentration from 100 ppm (ultramafic) up to > 1000 ppm (alkaline) (Frencken, 1992). In general fluorine accumulates during magmatic crystallization and differentiation processes of magma. Consequently, the residual magma is often enriched in fluorine. Groundwater from crystalline rocks, especially (alkaline) granites (deficient in calcium) contribute to the high fluoride concentration.

## 5.2 Contact time

The ultimate concentration of fluoride in groundwater largely depends on reaction times with aquifer minerals. High fluoride concentrations can build up in groundwater which has long residence times in the aquifers. Such ground waters are usually associated with deep aquifers and a slow movement. Shallow aquifers that contain recently infiltrated rainwater usually have low fluoride concentration.

## 5.3 Climate

Arid and semi-arid region are prone to high fluoride concentration. Here, groundwater flow and the reaction times which rocks are long. The fluoride contents may increase during evaporation if solution remains in equilibrium with calcite and alkalinity is greater than hardness. Dissolution of evaporative salts deposited and arid zone may be important source of fluoride.

## 5.4 Chemical composition of groundwater

High fluoride groundwater is mainly associated with a sodium-bicarbonate water type and relatively low calcium and magnesium concentrations. Such water usually have high pH values (above 7).

## 6. Surface geology of study area

The surface geology (Figure 5) of the study area consists of the following formation:

- Recent Quaternary: Gravel, sand, clay and loess.
- Late- Recent Quaternary: Gravel, sand, clay and loess.
- Late Quaternary :Sand, clay and clay sand
- Middle Quaternary: Loam and travertine.
- Early Quaternary: Gravel, sand, siltstone, sandstone, breccia and limestone.



- Middle Miocene: Siltstone, sandstone and limestone.
- Early Miocene: Red clay siltstone and limestone.
- Eocene: Conglomerate, siltstone and sandstone.
- Paleocene: Marl, siltstone, gypsum and conglomerate.
- Late Cretaceous: Siltstone, sandstone, conglomerate and limestone.
- Early Cretaceous: Siltstone, sandstone, marl and limestone.
- Ordovician: Shale, sandstone and cherty.

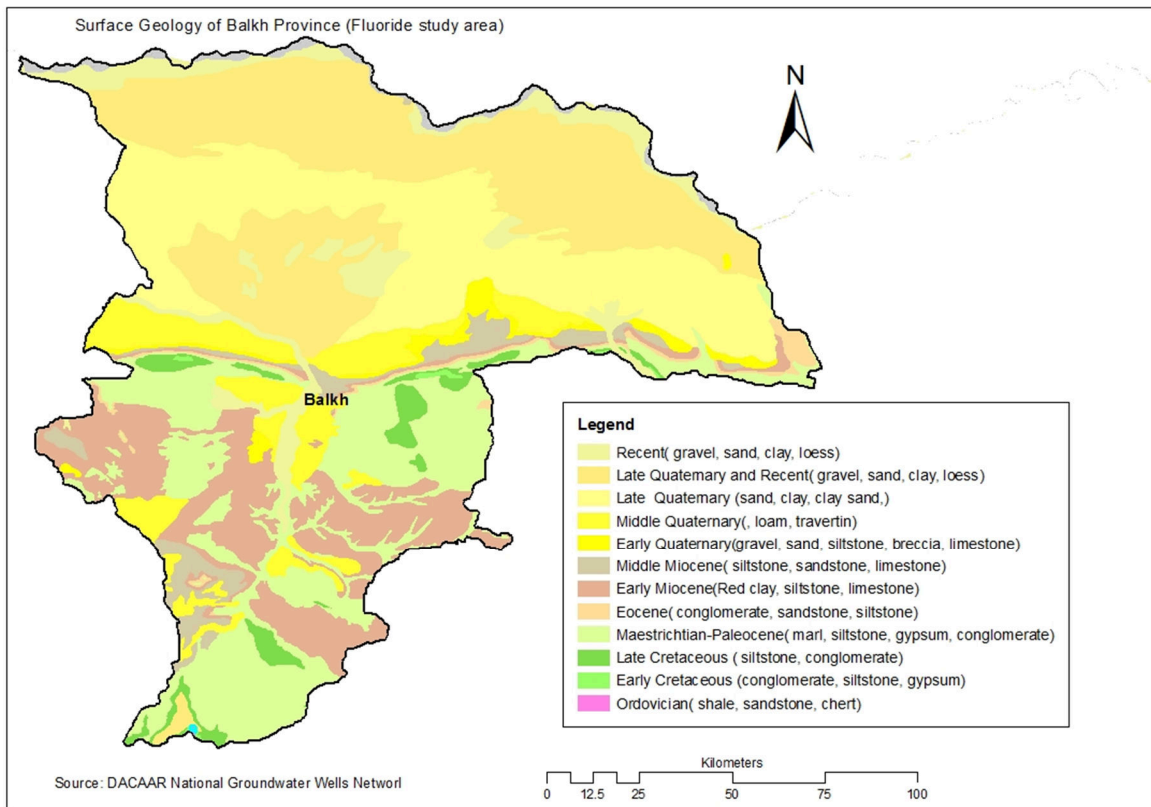


Figure 5 Surface geology of study area

## 6.1 Study Area

The study area is Balkh province which is located in the north part of Afghanistan. It is bordered with Tajikistan, Uzbekistan and Turkmenistan. It has semi- arid climate with major day-time and night-time fluctuations. The winter is characterized by low temperatures of less than -14 °C while the summer is dominated by high temperatures of more than 45 °C. The rainfall and snowfall are the main source of groundwater and surface water in the study area, and the area receives an average 150 mm rainfall. Agriculture and livestock are the main occupation of the people and are backbone of the rural community. The location of study is shown in the Figure 6.



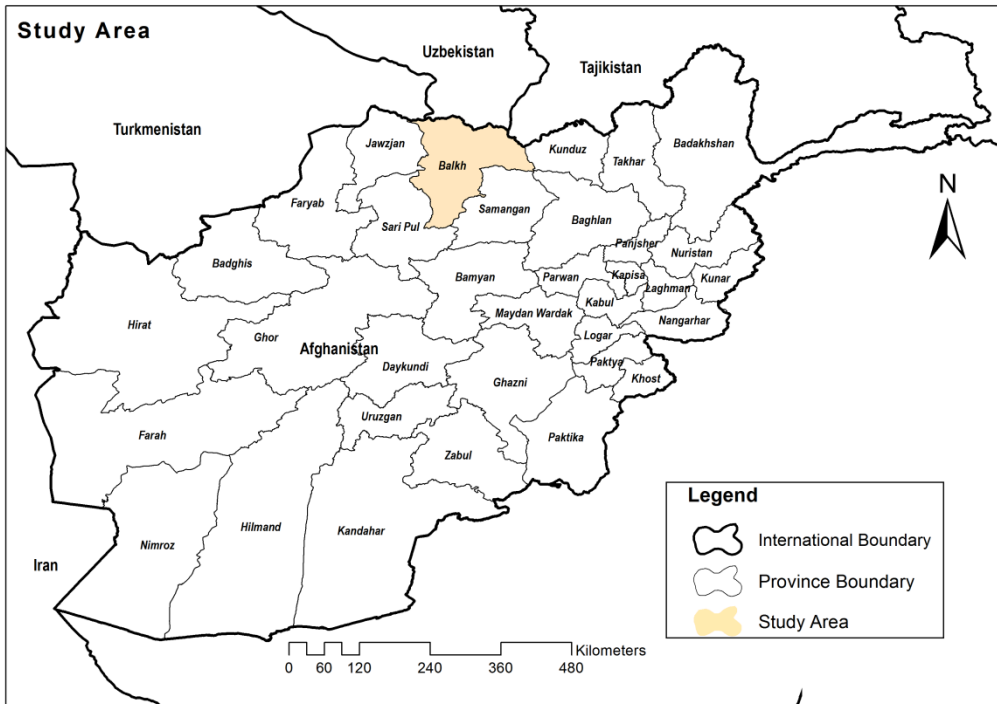


Figure 6 Location map of study area

## 6.2 Field investigation

The field investigation carried out in February-March, 2014 and the water samples were collected from water points such as tube well (TW) Dug well(DW), Spring, Stand Post (SP) and Balkhab and Khulm River. The water samples were transferred by plastic container for analysis of physical and chemical parameters using the standard procedure. The water sample locations were geo-referenced using geographical position system (GPS). The water points sampling location is mapped and presented in the Figure 7. An overview of the location and fluoride along with water quality analyzed parameters is presented in Annex 1.

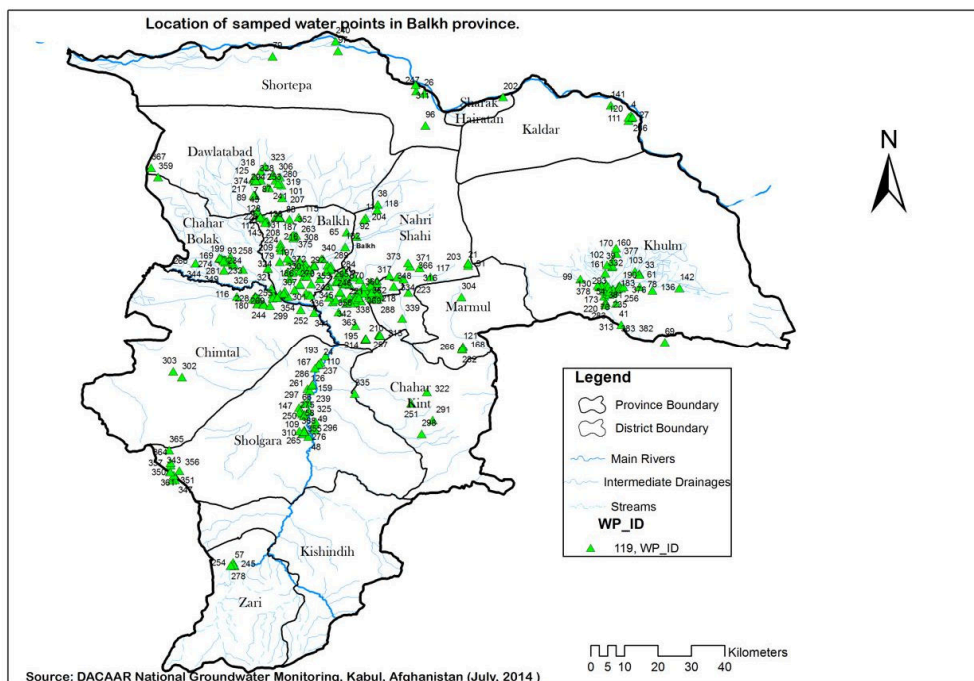


Figure 7 Location of water sample sites in Balkh Province

### **6.3 Field parameters**

The position of each water point was obtained by using GPS. Measurements of water table, pH, electrical conductivity (EC), turbidity, temperature were made on site according to the DACAAR data collection procedure by using pH/conductivity meter and water level indicator.

### **6.4 Sampling of water points**

The water samples were collected from TW, DW, SP, spring and Balkhab and Khulm Rivers. The collected water samples were transferred by plastic container to the DACAAR water quality analysis laboratory for analysis of chemical parameters. All the collected water samples were preserved at 4 °C prior to analyses.

## **7. Results and discussions**

The finding of the study focus on fluoride concentrations along with other main physical and chemical parameters that they are potentially affect the health of inhabitants in the rural areas of Balkh province. Results of physical field measurement and chemical analysis of water samples from water point in Balkh province are presented in the annex 1. The discussion of the study focus on major ions chemistry, hydro-chemical process and correlations analysis.

The spatial distribution level of fluoride concentration along with other water quality parameters mapped by using arc GIS 10.2 and the inverse distance weighted method was used to interpolate the distribution of fluoride concentration along with other water quality parameters in groundwater.

### **7.1 Fluoride contamination**

#### **7.1.1 Fluoride contamination In Afghanistan**

5,174 chemical analyzed data from UNICEF, ECHO, WASH project and National GMWs network evaluated and mapped. The results show that the fluoride concentration varied between 0.01 mg/l (Shahri Naw, Kabul city) and 15 mg/l (Wara kalli, Gurbuz district of Khost province). A fluoride spatial distribution level in the groundwater of Afghanistan is shown in annex 2.

21% of analyzed water samples from drinking water points exceeded the NDWQS of 1.5 mg/l. The percentage of fluoride distribution levels is shown in the Figure 8.

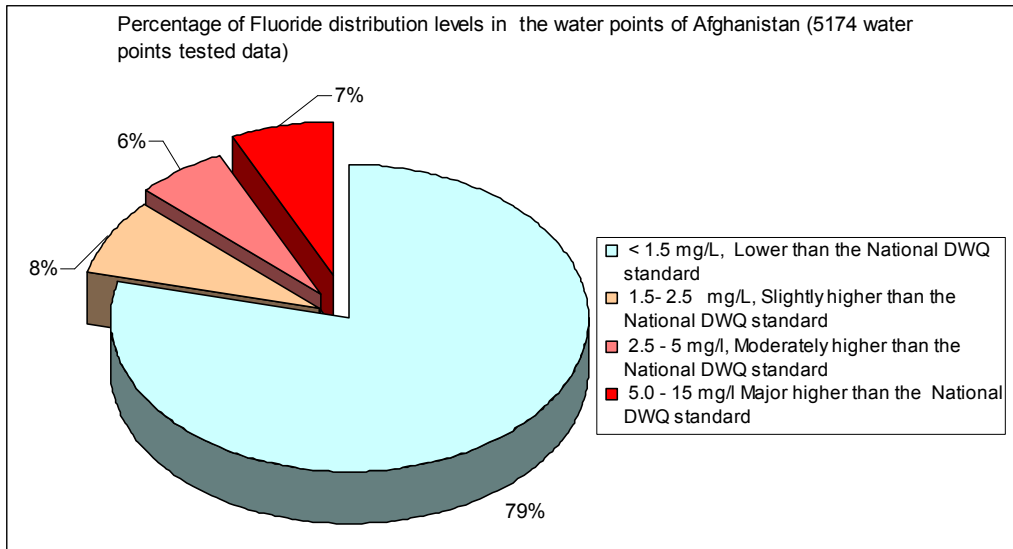


Figure 8 Percentage of fluoride distribution

### 7.1.2 Fluoride contamination in Balkh province

The fluoride value of water points in the study area varied from 0.020 mg/l (WP\_Code 337) to 12.900 mg/l (WP\_Code 235). The fluoride concentration in groundwater also varied according to the depth. In plain areas (Nahri Shahi, Dawlatabad, Chahar Bolak, Chimtal, Dehdadi, Khulm, Mazari Sharif, Kaldar, Marmul districts), the upper part of aquifer sediment (approximately to the depth of 85 m) consist of silt clay, sand clay and clay has saline and brackish water with high fluoride concentration, the lower part of aquifer sediments consist of sand and gravel has fresh water with low fluoride concentration. The fluoride concentration also varied over time (Fig 9).

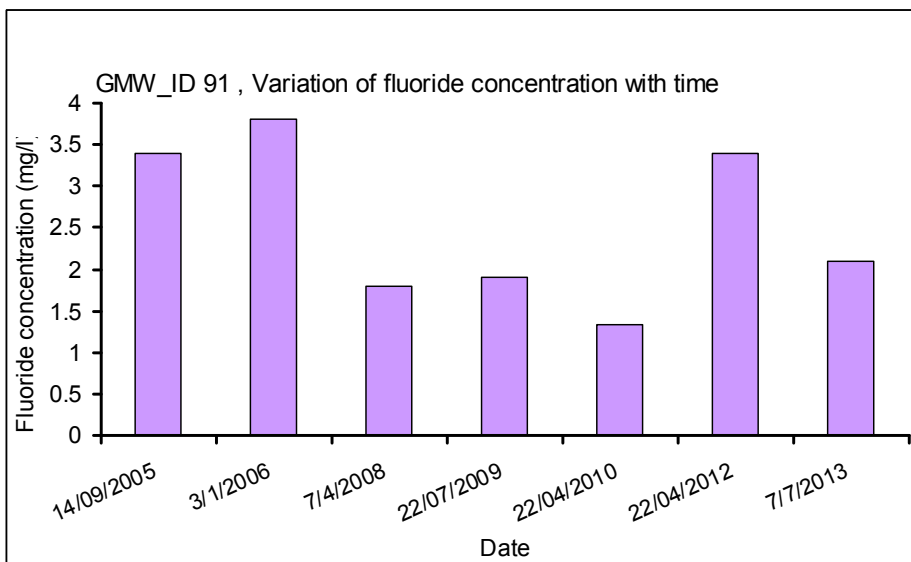


Figure 9 Variation of fluoride concentration over time

The spatial distribution level of fluoride concentration mapped and it's shown in annex 3 and the fluoride concentration interpolated contour lines mapped using arc GIS 10.2 (spatial analyst) and presented in annex 4.

38% of analyzed water samples from drinking water points exceeded the NDWQS of 1.5 mg/l. The percentage of EC distribution levels is shown in the Fig.10.

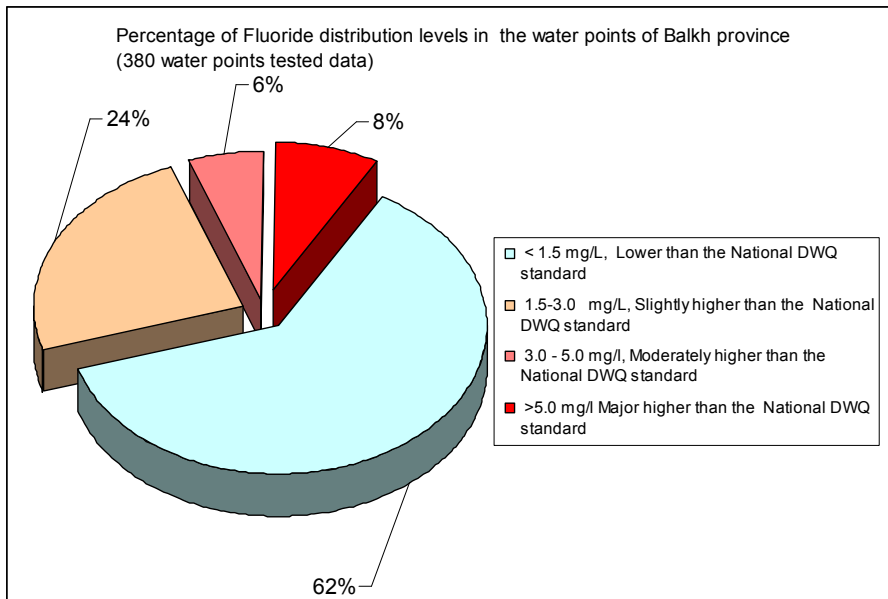


Figure 10 Percentage of fluoride levels

### 7.1.3 Health impact of high fluoride content drinking water in Balkh province

38% of analyzed water samples from drinking water points exceeded the NDWQS of 1.5 mg/l. Use of high Fluoride content drinking water (more than 1.5 mg/L) causes skeletal fluorosis and dental fluorosis.

DACAAR water expertise and training center carried out a health impact primary survey where drinking water points had high fluoride concentration. The people used high fluoride content drinking water, there were considered the dental fluorosis (Fig 11). During of consultant of the person in high level fluoride content areas there are no information about skeletal and crippling fluorosis.

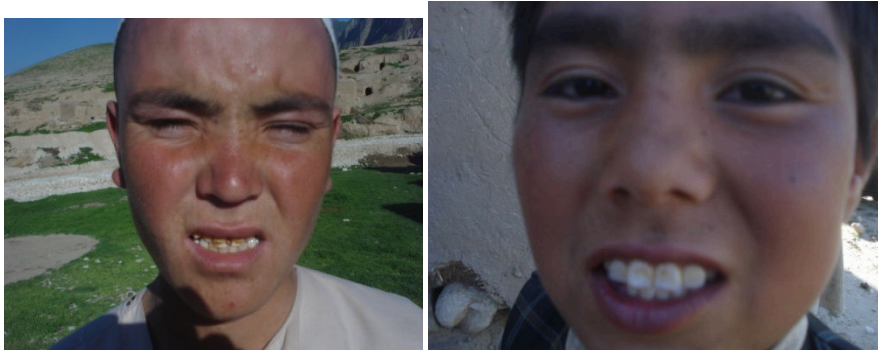




Figure 11 Dental fluorosis in Balkh Province

## 7.2 Other water quality parameters of concern

### 7.2.1 Power of hydrogen (pH)

pH is a term used to express the intensity of the acid and alkaline condition of a solution or water. The pH value of water points in the study area found values between 6.19 (WP\_Code 260) to 8.6 (WP\_Code\_ 366) and most of water samples indicated an alkaline characteristic. The pH of River water varied from 7.56 to 8.16 (Annex 1).

### 7.2.2. Electrical conductivity (EC)

EC is a measure of water capacity to convey electric current. It signified the amount of total dissolved solids. The presence of high EC values in water indicates the presence of high amount of dissolved organic constituents in ionized form .EC is an indicator of degree of mineralization of water.

The concentration of EC in water samples collected in the study area range from 320  $\mu\text{S}/\text{cm}$  (WP\_Code 320) to 25,600  $\mu\text{S}/\text{cm}$  ((WP\_Code 126) and the median value is 1,391  $\mu\text{S}/\text{cm}$ . Values are generally less than 1,000  $\mu\text{S}/\text{cm}$  along up gradient hydro geologic boundaries. Suggesting the natural processes of chemical weathering (water rock interaction) is dominant and impacts the major ion chemistry. The highest values concentrations of EC are occurred in the down gradient (lowland) and the natural chemical process such as evaporation and ions and cat ion exchange would be influential .The EC of surface water (River) varied from 479  $\mu\text{S}/\text{cm}$  (Balkhab River) to 1,887  $\mu\text{S}/\text{cm}$  (Khulm River).

In general the areas with high EC or TDS in groundwater overlap the areas with high fluoride concentration.

The spatial distribution level of EC concentration mapped is shown in annex5 and the EC values interpolated contour lines are presented in annex 6.

Our analysis result revealed that 21% of tested water samples from drinking water points exceeded the limit of 3,000  $\mu\text{S}/\text{cm}$  recommended by NDWQS, however, 44% of analyzed water samples exceeded the limit 1,500  $\mu\text{S}/\text{cm}$  recommended by WHO. Because of the acute shortage of safe drinking water in Afghanistan, the EC of drinking water up to 3,000  $\mu\text{S}/\text{cm}$  is tolerance for human consumption. The percentage of EC distribution levels is shown in the Figure 12.

Percentage of EC distribution levels in the water points of Balkh province (380 water points tested data)

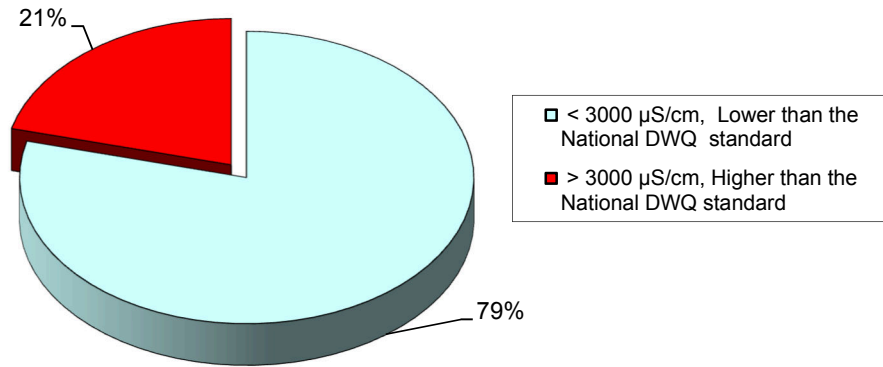


Figure 12 Percentage of EC levels

### 7.2.3 Arsenic

The WP\_Code 122 (0.001mg/l), WP\_Code 313(0.001), WP\_Code 373(0.001 mg/l), and WP\_Code 313(0.001 mg/l) (Annex 1) were observed to have an arsenic concentration but the concentration values are lower than national DWQ standard of 0.04 mg/l of As.

### 7.2.4 Sulphate

The sulphate concentration value of water points in the study area varied from 11 mg/l (WP\_Code 322) to 5200 mg/l (WP\_Code 349)(Annex 1).The sulphate spatial distribution level and its concentration interpolated contour lines are presented in annexes7 and 8.

35% of analyzed water samples from drinking water points are exceeding the NDWQS of 250 mg/l. The percentage of sulphate distribution levels is shown in Figure 13.

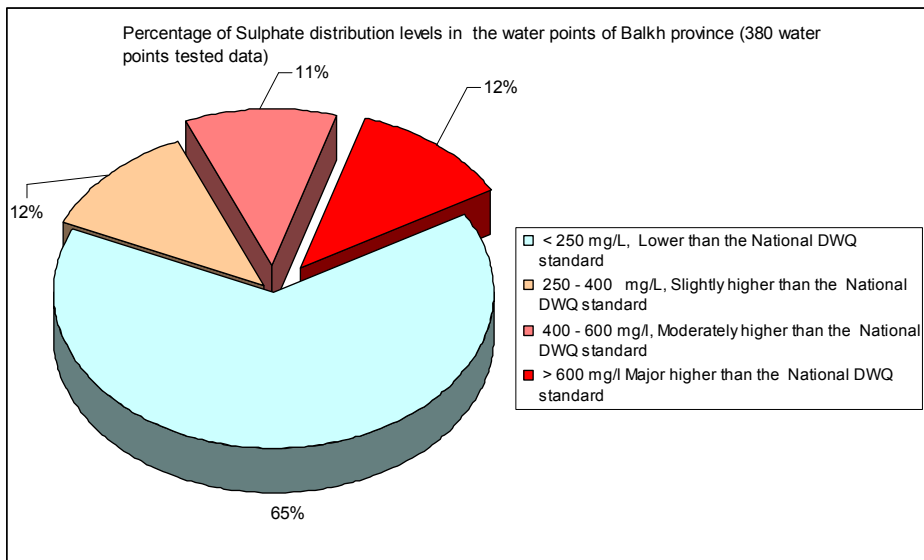


Figure 13 Percentage of sulphate levels

Using of high sulphate content drinking water (more than 400 mg/L) causes severe diarrhea and loss of body fluid of users and can be dangerous for children, however given bitter taste

to the water [6]. High concentration of sulphate in the water we drink can have a laxative effect when combined with calcium and magnesium, the two most common constituent of hardness. Bacteria, which attack and reduce sulphates, form hydrogen sulfide gas.

### 7.2.5 Nitrate

The Nitrate concentration of analyzed water samples ranged from 0.01 mg/l (WP\_Code 325) to 264 mg/l (WP\_Code 233) (Annex 1). The nitrate spatial distribution levels is presented in annex 9.

9% of analyzed water samples exceeded the NDWQS of 250 mg/l. The percentage of nitrate distribution levels is shown in the Figure 14.

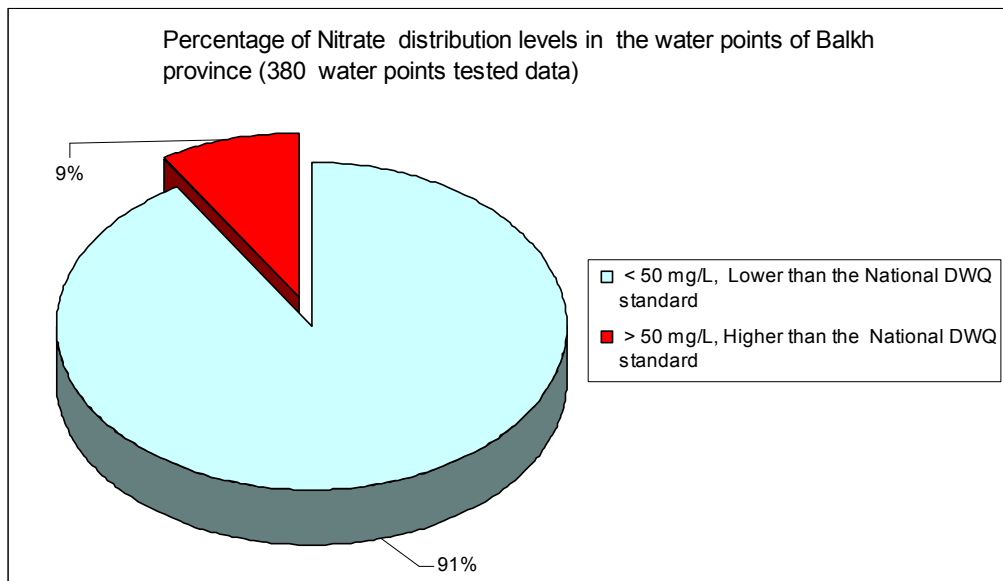


Figure 14 Percentage of Nitrate level

Nitrate can cause health problems for infants, especially those six months of age and younger. Nitrate interferes with their blood's ability to transport oxygen. This causes an oxygen deficiency, which results in a dangerous condition called *methemoglobinemia*, or "blue baby syndrome". The most common indication of nitrate toxin is bluish skin coloring, especially around the eyes and mouth. Infants six months of age and younger and pregnant and nursing women should avoid consumption of water high in nitrate. Toxic effects occur when bacteria in the infant's stomach convert nitrate to more toxic nitrate. Some scientific studies suggest a linkage between high nitrate level in drinking water with birth defects and certain types of cancer.

According to the US Environmental Protection Agency (EPA) long-term exposure to water with high nitrate levels can cause diuresis (excessive discharge of urine), increased starchy deposits, and hemorrhaging (flow of blood) of the spleen. People with heart or lung disease reduced acidity maybe more vulnerable to the toxic effects of nitrate than others.

### 7.2.6 Sodium

The Sodium concentration value of analyzed water samples ranged from 22mg/l (WP\_Code 154) to 980 mg/l (WP\_Code 349) (Annex 1). The Sodium spatial distribution levels and its concentration interpolated contour lines are shown in annex 11 and 12.



43% of analyzed water samples exceeded the National Drinking Water Quality Standard (DWQS) standard of 200 mg/l. The percentage of nitrate distribution levels is shown in Figure 16.

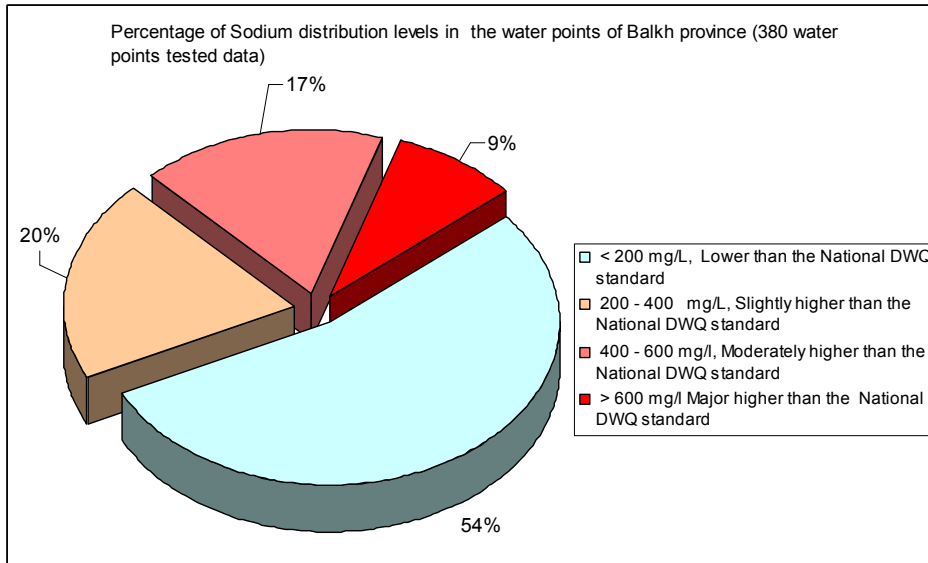


Figure 15 Percentage of Sodium levels

A high content of sodium in drinking water is injurious to health (increases blood pressure).

### 7.2.7 Chloride

The Chloride concentration value of analyzed water samples ranged from 2.1 mg/l (WP\_Code 378) to 546 mg/l (WP\_Code 235) (Annex 1). The chloride spatial distribution levels and its concentration interpolated contour lines are presented in annex 13 and 14.

31% of analyzed water samples exceeded the NDWQS of 250 mg/l. The percentage of Chloride distribution levels is shown in Figure 17.

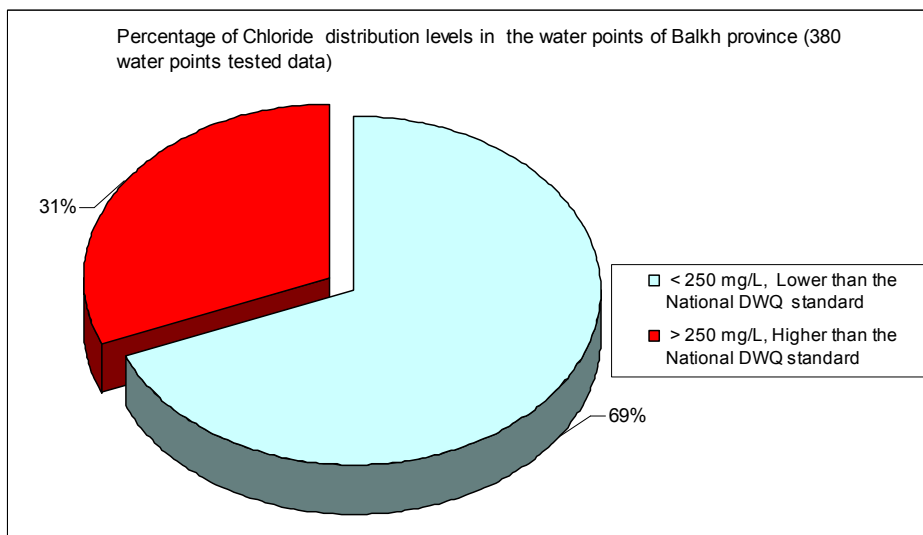


Figure 16 Percentage of Chloride level

Water with high chloride concentration gives saline taste and it can cause considerable damage to the body's fluid balance. One of the negative effects of highly saline water is also the corrosion of metal and destroys concrete elements.



### 7.2.8 Calcium

The Calcium concentration value of analyzed water samples ranged from 7.3 mg/l (WP\_Code 246) to 786 mg/l (WP\_Code 366) (Annex 1). The Calcium spatial distribution levels and its concentration interpolated contour lines are presented in annex 15 and 16.

43 of analyzed water samples exceeded the National Drinking Water Quality (DWQ) standard of 70 mg/l. The percentage of Calcium distribution levels is shown in Figure 18.

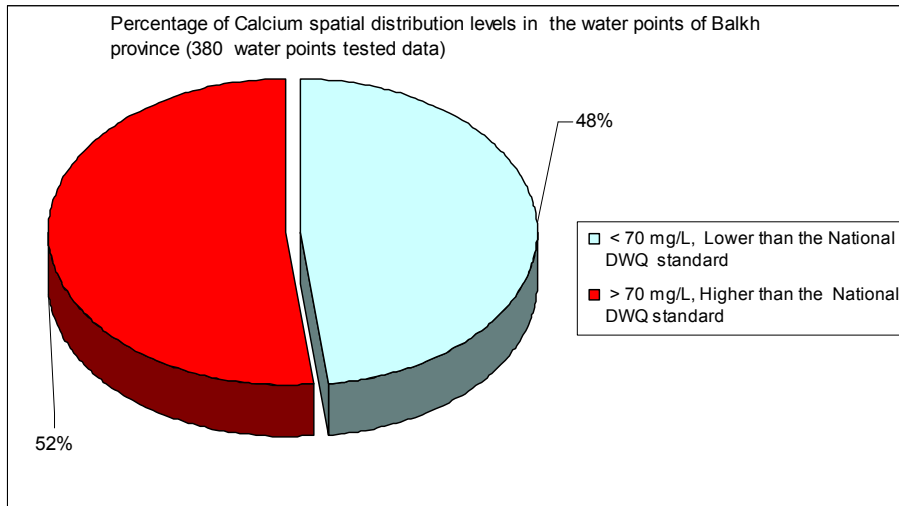


Figure 17 Percentage of Calcium level

### 7.2.9 Magnesium

The Magnesium concentration value of analyzed water samples ranged from 1.00 mg/l (WP\_Code 373) to 920 mg/l (WP\_Code 342) (Annex 1). The Magnesium spatial distribution levels and its concentration interpolated contour lines are presented in annex 17 and 18.

88% of analyzed water samples exceeded the NDWQS of 30 mg/l. The percentage of Magnesium distribution levels is shown in Fig.19.

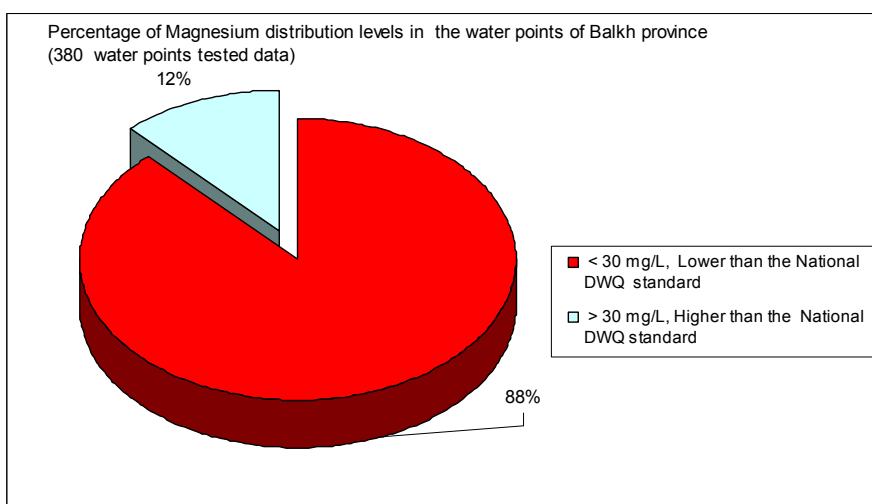


Figure 18 Percentage of Calcium level

Using of high Magnesium content drinking water (more than 150 mg/L) causes severe diarrhea among the users and gives a bitter taste to the water.

### 7.3 Major ions chemistry

Piper diagram is particularly useful comparing (chemical relationship) large number of water samples because; it enables several chemical parameters to be shown at the same time.

The Fig. 20 basically shows that the chemical composition of groundwater evolves from a slightly mineralized (natural) Ca-HCO<sub>3</sub> water type (up gradient/ up land) to a high mineralized (polluted) Mg- Na -SO<sub>4</sub>- Cl and Na - SO<sub>4</sub>- Cl water types (down gradient/plain areas). Between them (natural and polluted water types) densely clustered mixed Mg-Na-HCO<sub>3</sub>- SO<sub>4</sub>, Mg-Na-HCO<sub>3</sub>-SO<sub>4</sub>, Mg-Na-HCO<sub>3</sub>-SO<sub>4</sub>-Cl, and Mg-Ca-HCO<sub>3</sub>-SO<sub>4</sub>-Cl water types. These different chemical compositions are consistent with weathering of calcite, dolomite, silicate and other minerals.

The dominant cat-ions in the water samples is Na<sup>+</sup> > Mg<sup>+2</sup> > Ca<sup>+2</sup>. The dominant anions in the water samples is HCO<sub>3</sub><sup>-2</sup> > SO<sub>4</sub><sup>-2</sup> > Cl<sup>-</sup>. In general the Na<sup>+</sup> > Mg<sup>+2</sup> > Ca<sup>+2</sup> indicates cat-ion exchange trend. The dominance of in sodium could be due to dissolution of some miner cat-ion exchange. The high sodium concentration and alkaline environment are the factors for high fluoride concentration in the groundwater of the study area.

The dominance anion in the majority of the samples of the study area is bicarbonate (HCO<sub>3</sub><sup>-</sup>) ion with a considerably increasing of sulphate (SO<sub>4</sub><sup>-2</sup>) and chloride (Cl<sup>-</sup>) ions. The dominant source of bicarbonate ion is mainly due to the strong influence of the carbonate rocks (calcite and dolomite) aquifer that occurs in the south and south-east part of the study area.

The source of high sulphate ion most probably results from dissolution of evaporative gypsum and anhydride mineral within the carbonate rock that is considered in the Paleocene formation in the south and east parts of Balkh province.

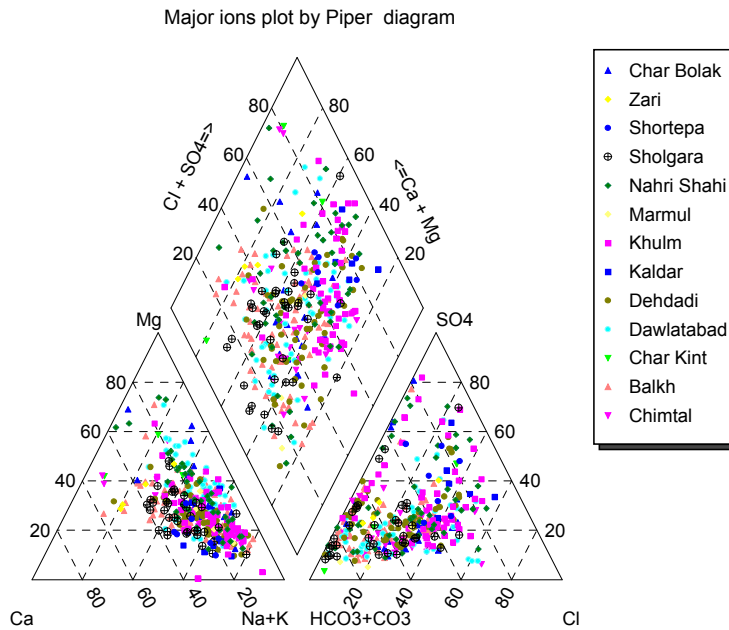


Figure 19 Piper Diagram of Groundwater

#### 7.4 Hydro-geochemical process

The physical and chemical analyzed parameters were graphically interpreted and evaluated by AquaChem (2012.1) to identify the hydro-geochemical process and mechanism in the aquifer system.

In general, it is expected that the evaporation process would cause an increase in the concentration of sodium in groundwater, however the graphic interpretation result indicates that originally the weathering of silicate and carbonate rock is one of the important processes for the concentration of fluoride and sodium ions in the groundwater of the study area which are responsible for high fluoride and sodium concentration.

If the evaporation process is dominant, assuming that no minerals precipitated, the Na/Cl ratio versus EC value would be unchanged [7]

The plot of Na/Cl versus EC (Fig. 21) gives a horizontal line, which would then be an effective indicator of concentration by evaporation, however the Na/Cl versus EC plot is not a horizontal line and the result shows that the evaporation process is not dominant.

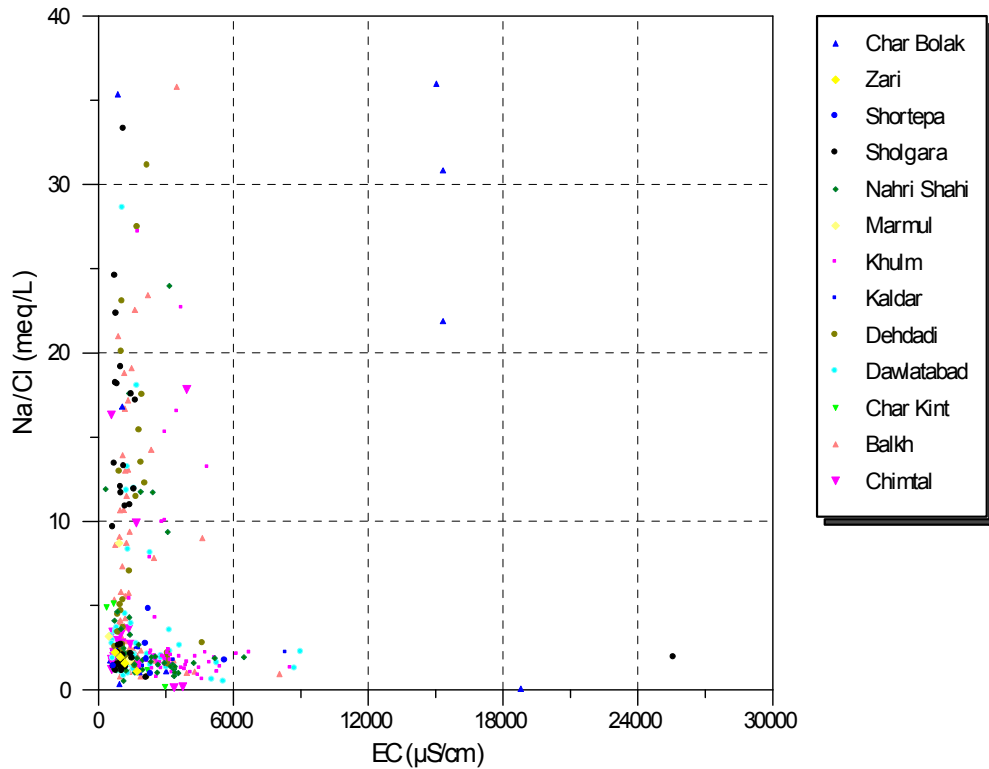


Figure 20 Plot of Na/Cl versus EC

If halite (salt) dissolution is responsible for Na ions, the Na/Cl molar ratio should be approximately equal to 1, whereas ratio greater than 1, therefore, it is interpreted that the high sodium concentration in the groundwater originally released from silicate weathering reaction [8]. The molar ratio of Na/Cl versus Cl can be used to reflect ion exchanges degree [9].

As most of water samples have the molar ratio of Na/Cl versus Cl greater than 1 (Fig.22) and Na/Cl ratio showed a decreasing trend in chloride concentration. The reason for ion exchange in high chloride groundwater was that sodium concentration increase due to evaporation and become high enough to balance the adsorbed sodium ion for ion exchanged cat-ions, also the increase in EC would be driving force for cat-ion exchange between calcium and adsorbed sodium ions. In plain areas (Nahri Shahi, Dawlatabad, Char Bolak, Chintal, Dehdadi, Khulm, Kaldar and Marmul districts), the aquifer sediment consist of medium sand and fine-mid sand, gradually finer with increase in clay mineral content and could adsorb sodium ions. Therefore, calcium and magnesium ions in the water would have exchanged with sodium ions previously absorbed in the surface of clay minerals matrix due to increase in groundwater EC. This reaction decreases of calcium and magnesium ions and increase sodium concentration in groundwater.

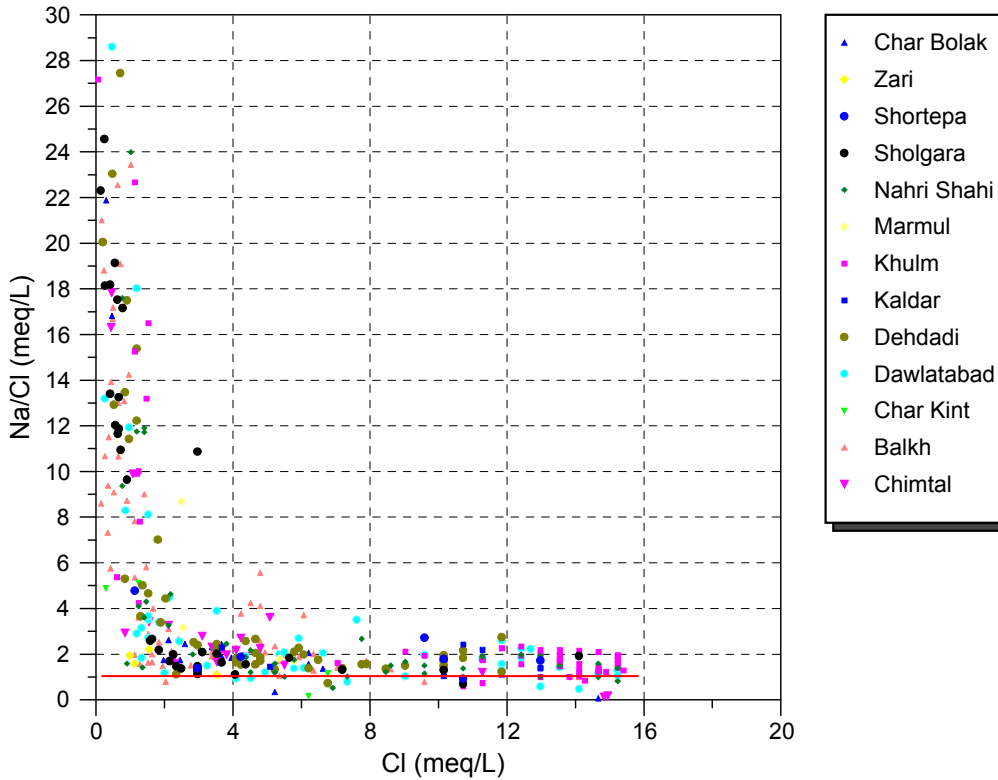


Figure 21 Plot of Na/Cl versus Cl

The sodium versus chloride (Na vs. Cl) plot (fig. 23) indicates that most of the water samples lie above the equilibrium line (1:1). The origin of excess sodium ions ( $\text{Na}^+$ ) is attributed to come from weathering of silicate rocks [10, 11].

The water samples lie below the equilibrium line, indicating that evaporation process may be cause of addition of chloride due to groundwater level rises which cause more salt dissolution from soil. Sodium concentration is also being increased by ion exchange.

The cluster of raised Na/Cl concentration related to the low land (plain area). This area has saline aquifers. The long resident time of evaporation process, clay layer and capillary rise of shallow groundwater table has caused the increase of the chloride and sodium concentration.

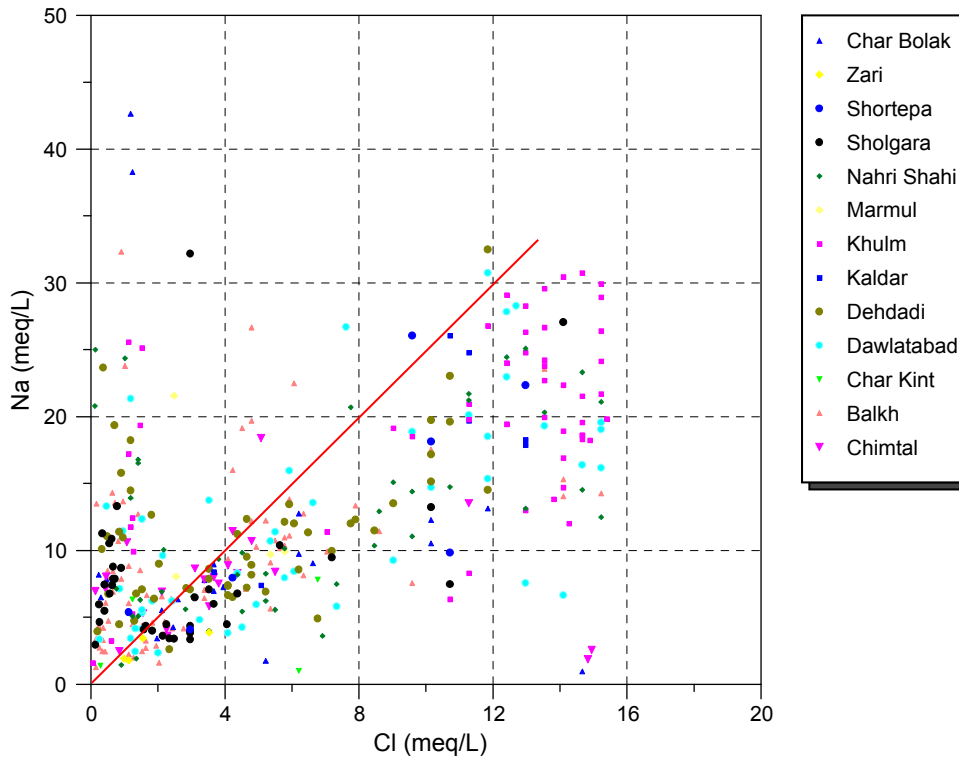


Figure 22 Plot of Na versus Cl

The study of the Ca/Mg ratio of the analyzed water samples from the study area suggest the dissolution of calcite and dolomite present (fig 24).

That is, if the ratio Ca/Mg equal 1(Ca/Mg=1), dissolution of dolomite should occur, whereas, if the Ca/Mg greater than 1(Ca/Mg>1), dissolution of calcite should occur [12].

The points clustered close or less to the line of Ca/Mg =1 indicate the dissolution of dolomite. The points clustered above to the line Ca/Mg =1 indicate the dissolution of calcite. The figure 24 shows that the dissolution of dolomite is more dominant than calcite.

Higher molar ratio of Ca/Mg>2 indicates the dissolution of silicate minerals which contribute calcium and magnesium to groundwater.

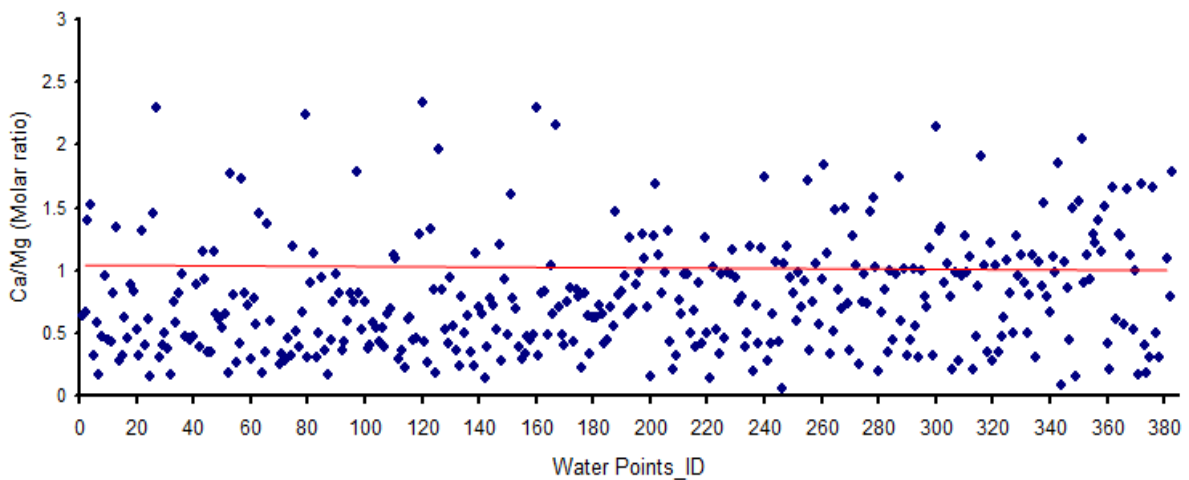


Figure 23 Ca/Mg versus water point codes

The Ca+Mg versus HCO<sub>3</sub>+SO<sub>4</sub> scatter diagram [13] shows that most of water samples are falling above the equilibrium line (1:1) indicating that the carbonate weathering is the dominant process for the supply of calcium and magnesium ions to the groundwater (fig. 25). In addition to carbonate weathering, silicate weathering process is also a contributor for calcium (Ca<sup>2+</sup>) and sodium (Na<sup>+</sup>) ions in groundwater.

Possible source of sulphate could be originated due to dissolution of gypsum (Mg SO<sub>4</sub>. 2H<sub>2</sub> O) and anhydrite(Mg SO<sub>4</sub>) minerals during their long residence time.

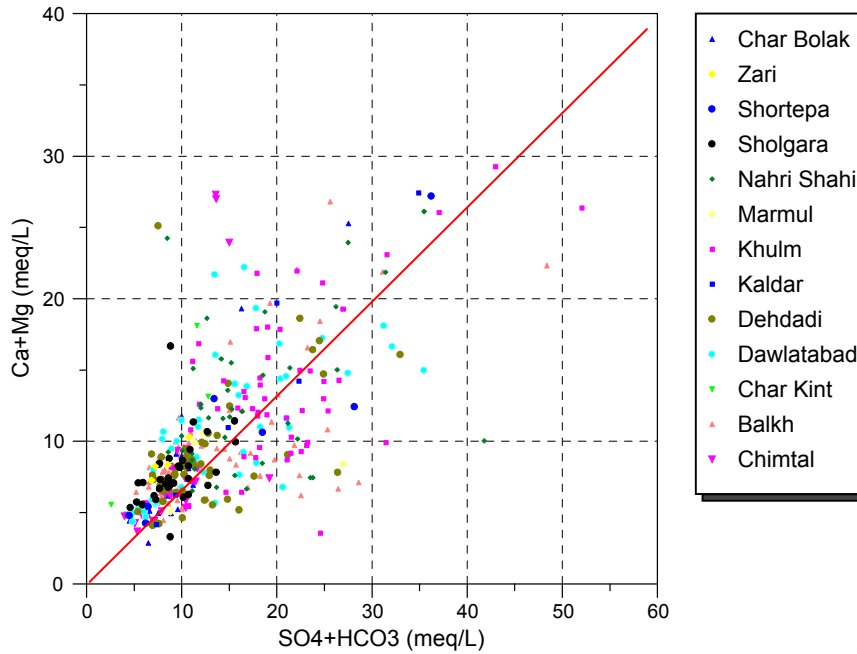


Figure 24 Ca + Mg versus HCO<sub>3</sub> + SO<sub>4</sub>

### 7.5 Correlation analysis

For understanding the correlation mechanism of fluoride concentration in the groundwater, the correlation coefficient (r) of fluoride with pH (r= 0.02), Ca(r=0.480), Mg(r=0.560), Na(r=0.510), EC(r=0.546), SO<sub>4</sub>(r=0.628), K(r=0.154), Cl (r=0.0457),HCO<sub>3</sub> (r=0.0.215),were plotted by scatter plots using Acua-Chem software.

The alkaline earth metal (Ca and Mg) show positive correlation with Fluoride (Fig.26 + 27). The positive correlation of fluoride with calcium and magnesium is expected due to high solubility of fluoride with the other ions.

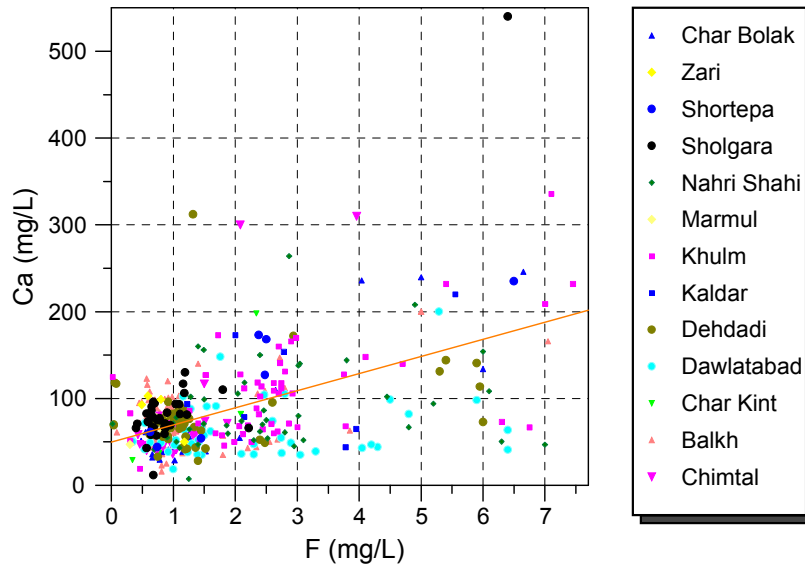


Figure 25 Correlation between calcium and fluoride

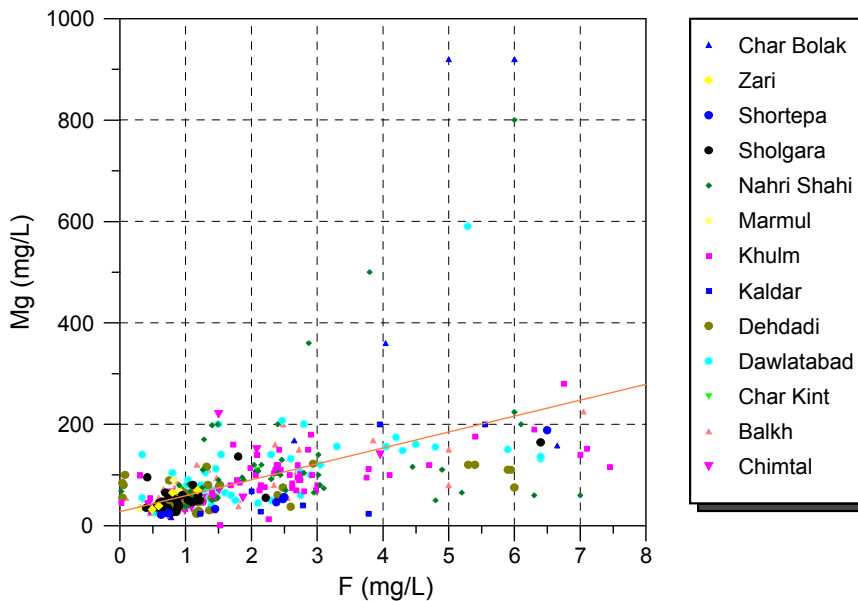


Figure 26 Correlation between magnesium and fluoride

The alkali metal  $\text{Na}^+$  show positive correlation with Fluoride (Fig.28) in groundwater, however the  $\text{K}^+$  shows very poor positive correlation with Fluoride in groundwater, The significant positive correlation between sodium and fluoride suggests that the sodium is mostly driven from rock weathering.



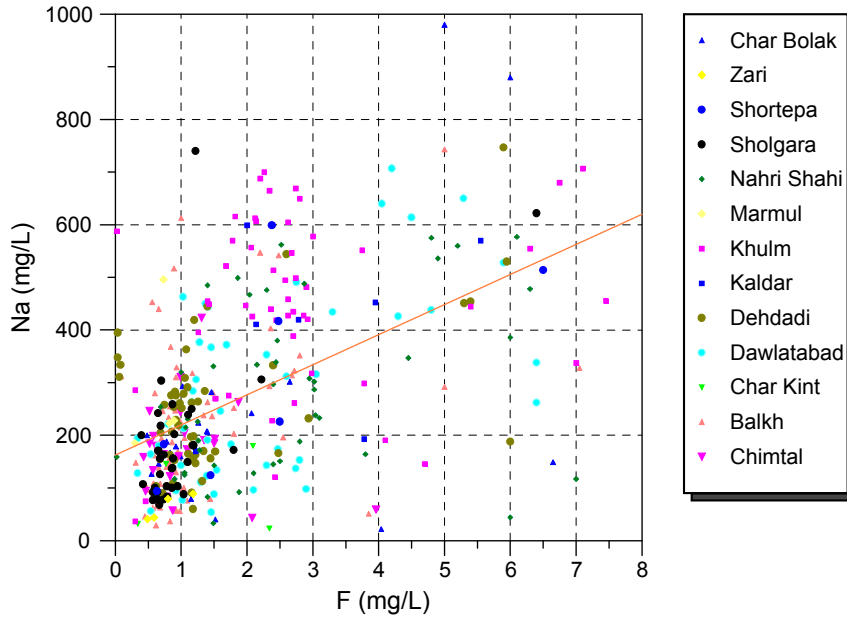


Figure 27 Correlation between sodium and fluoride

Figure 29 shows a good positive relationship between fluoride and chloride ions. This trend indicated that the evaporation process influences to the elevated fluoride concentration.

Figure 30 also shows, the concentrations of chloride concentration in the most of samples are higher than 250 mg/l which suggest evaporative influence.

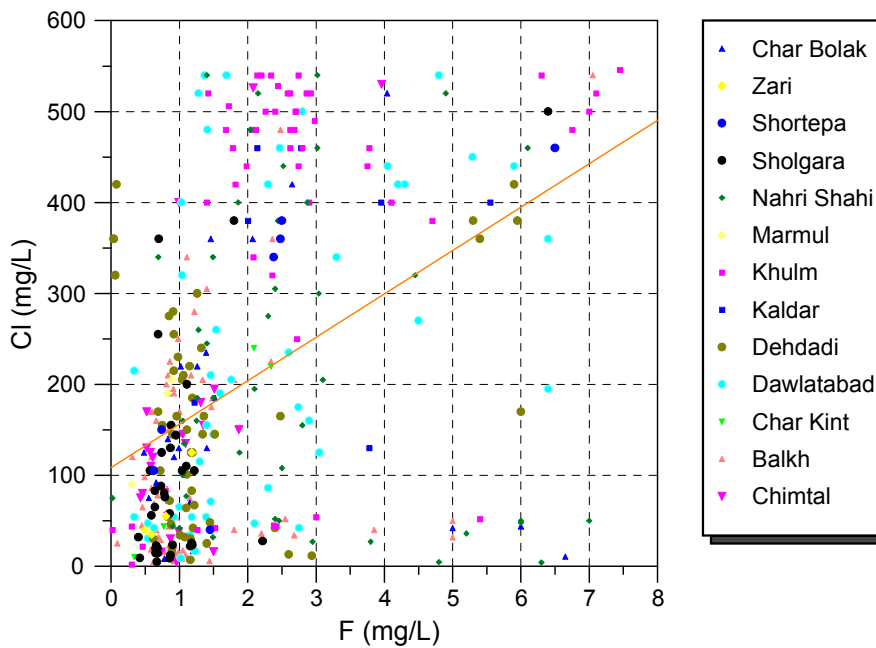


Figure 28 Correlation between chloride and fluoride

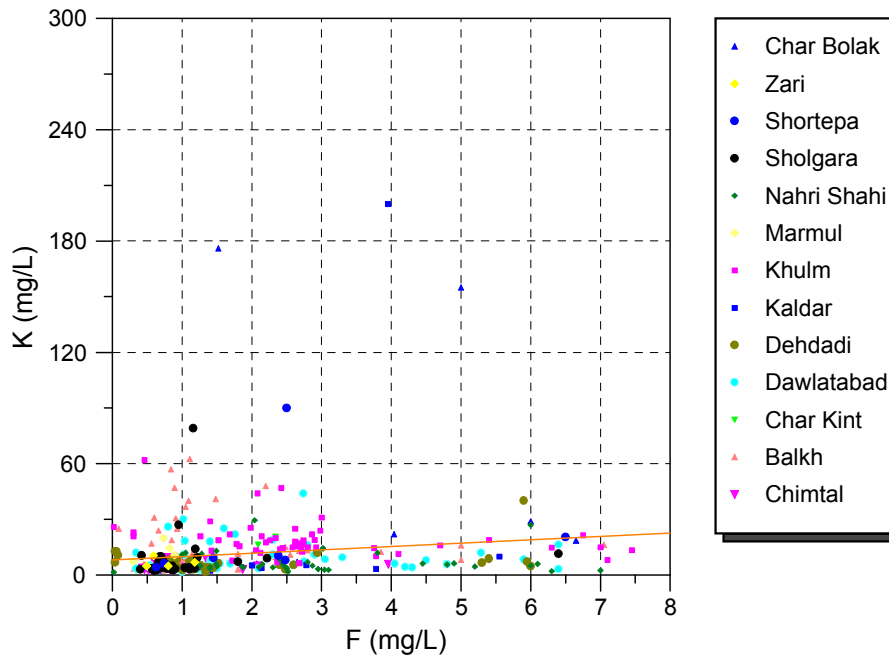


Figure 29 Correlation between potassium and fluoride

Figure 31 shows a significant positive relationship between fluoride and EC. This trend indicated where the EC value is higher, therefore observed high fluoride concentration in the groundwater.

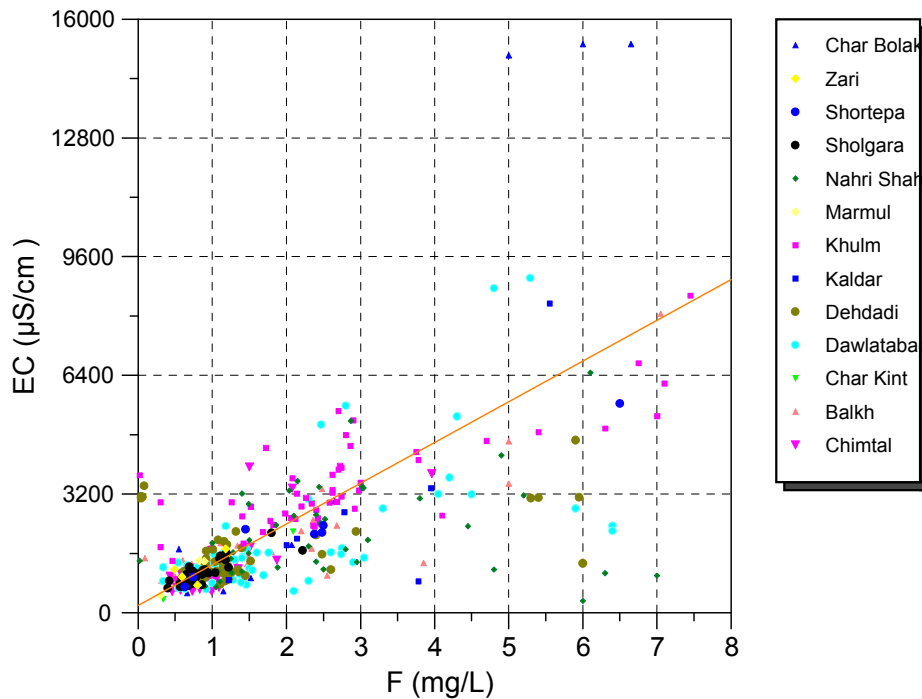


Figure 30 Correlation between potassium and EC

## 8. Conclusion

- Fluoride concentration in groundwater is mainly a natural occurrence influenced basically by the geologic setting and hydro geological conditions.

- Result from the groundwater of study area shows that the fluoride content of 38% analyzed water samples from drinking water points exceeded the National DWQS of 1.5 mg/l.
- In general the areas with high fluoride concentration in groundwater overlap the areas with high Electrical Conductivity (EC).
- Semi- arid characteristic climate with high temperature, low rainfall and alkaline nature of soil are the contributing factors to enhance the fluoride concentration in groundwater.
- The dominant hydro chemical processes are weathering and dissolution of fluoride-bearing minerals, evaporation, ion exchange and capillary rise and lowering water level.

## 9. Suggestion

- The people using drinking water with high fluoride concentration, there observed dental fluorosis, it is recommended that alternative arrangement for supply of drinking water from other safe sources to the affected villages by WASH sector may be taken as top priority.
- Encourage education and awareness' where there are the fluoride concentration is higher and potentially affects the health of people.
- Encourage research on cheap ways of fluoride removal technologies that are applicable. This could include precipitation, adsorption, ion exchange, membrane filtration processes and distillation methods.
- Encourage research for finding alternative water sources for provision of safe drinking water.
- Fluoride concentration can be diluted by induce groundwater recharge techniques construction.

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## Annexes

## Annex 1 Data from Water Samples from water points in Balkh

WP	District	Village	Sample Date	Analysis Date	Latitude	Longitude	pH	Cond (µS/cm)	Cl (mg/L)	SO4 (mg/L)	F (mg/L)	NO3 (mg/L)	B (mg/L)	Cr (mg/L)	Na (mg/L)	K (mg/L)	Mg (mg/L)	Ca (mg/L)	As (mg/L)
154	Char Bolak	Abo Shakor Balkhy	28/06/13	29/06/13	36.75317	66.67047	8.5	18790	520	185	4.04	0.184	6	0	22	22	360	236	0
329	Balkh	Mandati	03/04/10	03/04/10	36.76631	66.91201	7.3	1624	22.5	230	0.93	4.38	4	0	329	25	60	96	0
345	Balkh	Kushkak	19/10/10	19/10/10	36.68633	66.90308	7.83	1192	23	128	0.7	4.94	4	0.04	194	6.1	55	98.8	0
206	Chimtal	Nowabad bay timo	03/12/13	13/12/13	36.66291	66.76025	7.27	3750	530	390	3.96	36.5	4	0.02	59	5.8	140	310	0
363	Chimtal	Sarasyab	04/10/12	11/12/12	36.64117	66.97765	7.5	913	4.6	200	0.96	4.44	4	0	160	3.6	47	48	0
31	Dawlatabad	Elkachi Now Warid	02/01/14	08/01/14	36.88601	66.78556	7.66	3190	270	980	4.5	6.44	3.9	0.02	614	8	160	98.8	0
235	Khulm	Ali mardan bik	01/01/14	15/01/14	36.689	67.70534	6.69	8550	546	1025	7.45	35.36	3.1	0.02	456	13.4	116	232	0
307	Balkh	Samar Qandyan	28/04/10	28/04/10	36.69177	66.83037	7.17	1125	9.1	134	0.68	1.16	3	0	63	3.2	55	90	0
330	Balkh	Center	28/04/10	28/04/10	36.75699	66.89885	7.17	1390	12.5	190	1.09	6.98	3	0	76	40	55	103	0
186	Balkh	Khan agha	12/11/13	16/11/13	36.76214	66.87744	7.35	1193	54	160	0.96	33.84	3	0.02	101	9	55	65.6	0
323	Balkh	Qarshi Gak	03/05/10	03/05/10	37.03467	66.77995	7.5	2200	36	420	2.2	2.44	3	0.01	547	48	55	43	0
333	Nahri Shahi	Mula Forqany	26/10/10	26/10/10	36.71264	67.06406	8.1	1162	4.6	190	4.8	2.04	3	0.04	575	5.7	50	66.8	0
42	Dawlatabad	Kabully	02/01/14	08/01/14	36.89855	66.80918	7.67	2810	440	780	5.9	5.22	2.81	0.02	528	8.4	150	98	0
32	Dawlatabad	Kabully	02/01/14	08/01/14	36.89626	66.80869	7.66	3640	420	1140	4.2	6.82	2.71	0.03	707	4.4	174	46.8	0
136	Khulm	shahidan	01/01/14	15/01/14	36.69996	67.82077	6.69	2810	520	440	2.92	45.7	2.6	0.02	421	15	100	106	0
126	Sholgara	Bagh palwan	28/11/13	02/12/13	36.43203	66.89397	7.59	25600	500	1950	6.4	105	2.6	0.2	622	11.4	164	540	0
75	Chimtal	Nowabad bay timo	03/12/13	13/12/13	36.66337	66.75959	7.2	3360	526	380	2.08	36	2.5	0.02	43	5	150	300	0
60	Dawlatabad	Elkachi	02/01/14	08/01/14	36.898	66.76707	7.64	2340	360	380	6.4	14.4	2.5	0.02	338	16.4	132	63.6	0
293	Khulm	Guzar chattgray	09/01/14	22/01/14	36.69707	67.70599	7.36	5190	400	1240	2.9	8.68	2.5	0.02	482	19	180	166	0
376	Khulm	Smail Kaly	17/12/06	20/12/06	36.7088	67.74361	7.8	3710	40	780	0.02	0	2.5	0	588	26	45	125	0
46	Nahri Shahi	Darya-e- khan mamoor	30/11/13	05/12/13	36.67575	67.06843	7.49	3400	460	380	3.02	37.48	2.5	0.02	302	14.2	140	80	0
52	Dawlatabad	Elkachi	02/01/14	08/01/14	36.89601	66.76887	7.66	2200	195	430	6.4	23.66	2.41	0.02	262	3.2	136	40.8	0
18	Khulm	Gandah baghat	09/01/14	22/01/14	36.69349	67.71274	7.27	5300	500	700	7	16.92	2.4	0	338	15	140	209	0
2	Dawlatabad	Baido	06/01/14	17/01/14	36.95652	66.75367	7.76	758	71	70	1.46	7.98	2.3	0.01	54	4	58	65	0

214	Dehdadi	Kariz Khurd	05/01/14	20/01/14	36.56808	67.05103	7.65	3130	360	400	0.04	85.6	2.3	0.02	348	12.8	84	70	0
257	Dehdadi	Kariz Kalan	05/01/14	21/01/14	36.56881	67.05117	7.71	3090	360	380	0.04	80.2	2.3	0.02	395	6.8	55	69	0
183	Khulm	Qemahoot	09/01/14	30/01/14	36.70281	67.7154	7.52	4450	506	340	1.72	12.66	2.3	0.01	276	7.8	160	173	0
203	Nahri Shahi	shahrak fazaba camp skhi	19/11/13	25/11/13	36.77338	67.32591	7.37	4240	520	1140	4.9	43.6	2.3	0.06	536	6.3	110	208	0
218	Nahri Shahi	Baba yadgar	30/11/13	05/12/13	36.67743	67.07147	7.62	3390	380	400	2.44	4.82	2.3	0.03	339	6.4	100	70	0
194	Khulm	Sultan Dehmaridan	01/01/14	15/01/14	36.70942	67.73219	6.68	4640	380	440	4.7	47.74	2.24	0.02	146	16	120	140	0
200	Balkh	Banada	12/11/13	16/11/13	36.74921	66.884	7.32	1331	200	155	0.81	7.24	2.1	0.02	234	3.2	65	16	0
10	Balkh	Salarzy	06/01/14	16/01/14	36.82508	66.82143	7.81	8060	540	380	7.05	4.08	2.1	0.02	328	16.4	225	166	0
306	Dawlatabad	Joe arab	01/12/13	11/12/13	37.01021	66.80141	6.45	9020	450	1900	5.29	37.4	2.1	0.02	650	12	590	200	0
290	Dawlatabad	Joi Arab	03/12/13	13/12/13	37.01133	66.80136	7.37	5580	500	430	2.8	21.44	2.1	0.01	153	16	200	105	0
153	Dehdadi	Kariz Khurd	05/01/14	21/01/14	36.56737	67.05062	8.22	3420	420	400	0.08	51.2	2.1	0.02	334	10.6	100	117	0
102	Khulm	Deh Hassan	07/07/13	16/07/13	36.76805	67.6987	7.2	2320	45	285	2.38	3.16	2.1	0.01	228	9	120	82	0
195	Dehdadi	Kariz Khurd	05/01/14	21/01/14	36.56765	67.05097	7.66	3120	320	400	0.06	89.4	2.04	0.02	311	12.8	80	118	0
124	Balkh	said abad	10/12/13	25/12/13	36.7725	66.88835	6.5	1877	340	260	1.11	28.36	2.03	0.01	174	62.5	60	85	0
100	Chintal	santchall	02/01/14	07/01/14	36.68988	66.80242	7.21	1047	110	92	0.58	26.32	2.03	0.02	199	4	37	46	0
256	Khulm	sultan dah mardah	01/01/14	15/01/14	36.70598	67.73626	6.2	4120	460	380	3.78	44.8	2.01	0.03	299	10.2	112	68	0
134	Khulm	Guzar tily paen	09/01/14	30/01/14	36.70047	67.712	7.26	3860	500	410	2.7	23.4	2.01	0.02	389	17.2	120	160	0
103	Khulm	Ghazi abad Bala	22/01/14	29/01/14	36.75116	67.77394	8.5	1866	520	228	1.42	10.9	2.01	0	450	13.2	55	53	0
159	Sholgara	Sarmaug	19/11/13	25/11/13	36.42634	66.90029	7.49	2150	380	145	1.8	53	2.01	0.04	172	7.2	136	110	0
301	Balkh	Char Sang	28/04/10	28/04/10	36.69791	66.83335	7.22	873	5.8	104	1.44	1.82	2	0	79	4	30	66	0
324	Balkh	Eshanian	06/05/10	06/05/10	36.7769	66.82005	7.4	1148	8.2	140	1.04	1	2	0.01	100	8.8	60	62	0
340	Balkh	Deh Bibi	04/05/10	04/05/10	36.78511	66.93158	7.45	1472	25.2	270	0.09	2.78	2	0	312	25	55	61	0
325	Balkh	Robat	07/05/10	07/05/10	36.37219	66.89816	7.49	1255	13	230	0.95	3.26	2	0	97	4.8	50	90	0
300	Balkh	Samar Qandyan	03/05/10	03/05/10	36.68277	66.84297	7.56	748	5.2	84	0.62	1.28	2	0	29	5.1	30	108	0
336	Balkh	Auff Malik	03/04/05	03/04/05	36.69253	66.89043	7.56	1072	15.5	185	0.78	2.2	2	0	140	4.1	47	84	0
260	Char Bolak	Badaya Balkh School	07/07/13	16/07/13	36.77278	66.59397	6.19	15330	10.5	975	6.65	2.1	2	0.04	149	18.5	158	246	0
326	Char Bolak	Soliman Khil	01/05/10	01/05/10	36.75559	66.72065	7.59	1056	16.5	160	1.2	2.12	2	0.01	180	4.4	46	63	0
322	Char Kint	Baba Quwanchi	05/05/10	05/05/10	36.4234	67.21478	8.55	365	10.1	11	0.34	1.22	2	0.01	32	2.5	50	29	0

373	Nahri Shahi	Ali Abad	09/04/10	09/04/10	36.77373	67.16434	7.67	2410	50	1040	1.46	17.3	2	0.02	380	5.2	130	86.4	0.004
371	Nahri Shahi	Ali Abad	18/05/10	20/05/10	36.7644	67.17011	7.89	3080	27	1400	1.2	2.32	2	0.07	164	12	500	144	0
327	Nahri Shahi	Mula Forqany	25/10/10	25/10/10	36.71268	67.06661	8	1066	4.1	280	6.3	3.82	2	0.02	478	2.1	60	50.4	0
366	Nahri Shahi	Ali Abad	18/05/10	20/05/10	36.7644	67.17011	8.6	25800	48	2500	6	3.04	2	0.13	44	27	800	768	0
368	Sholgara	Mahajer Qeshlaq	25/03/12	27/03/12	36.31616	66.8859	7.85	660	32	66	0.4	3.6	2	0.01	200	3.1	35	66	0
294	Dawlatabad	Joi Arab	01/12/13	13/12/13	37.01332	66.8025	6.43	5070	460	410	2.47	16.64	1.82	0.02	174	8	207	104	0
9	Balkh	khwajah gholak	20/11/13	26/11/13	36.76963	66.9119	6.96	1563	195	330	0.91	21	1.8	0.02	247	30.5	75	120	0
217	Dawlatabad	Baid Watani	06/01/14	17/01/14	36.95627	66.74966	7.66	1009	540	91	1.69	31.1	1.8	0.01	372	6.2	60	91	0
71	Dawlatabad	Hayratan	05/12/13	15/12/13	37.00389	66.75045	7.48	1627	235	240	2.6	26.5	1.69	0.03	312	5.5	132	74	0
141	Kaldar	Chalcar	04/12/13	14/12/13	37.19894	67.70875	7.23	8340	400	1420	5.55	210	1.56	0.02	570	10	200	220	0
91	Nahri Shahi	shahrak faiz abad	08/01/14	28/01/14	36.77344	67.32599	7.76	3360	540	380	3.02	15.5	1.54	0.01	287	14.5	100	138	0
64	Dawlatabad	Hayratan	05/12/13	15/12/13	36.99415	66.75441	7.31	1722	210	224	1.46	6	1.53	0.04	367	8	112	35	0
130	Khulm	Masjed guzar maolla	22/01/14	24/01/14	36.70869	67.67773	8.35	3960	250	410	2.72	22.06	1.53	0.01	262	12.6	90	141	0
50	Khulm	Bandare Tangarod	01/01/14	15/01/14	36.69358	67.70153	6.68	3630	340	400	2.08	60.2	1.52	0.01	426	44	140	128	0
283	Khulm	Mullakh sultan tangi	01/01/14	15/01/14	36.66076	67.69413	6.69	2410	528	220	2.44	17.72	1.51	0.07	419	14.6	110	64.8	0
151	Dehdadi	Sharif Abad	10/11/13	10/11/13	36.66645	67.0222	7.42	2190	240	220	1.32	14.44	1.5	0	113	4	116	312	0
382	Khulm	Kulam	23/01/05	23/01/05	36.5882	67.76913	7.41	4870	52	1700	5.4	0.2	1.5	0	445	19	176	232	0
73	Khulm	Masjed Burhan (Tashqurghan)	07/07/13	16/07/13	36.69357	67.70155	7.23	2550	44	385	2.42	8.84	1.45	0.01	121	47	150	114	0
233	Char Bolak	Nawared-e-spinki	14/12/13	21/12/13	36.78035	66.67185	6.46	3010	420	440	2.65	264	1.43	0.03	302	7	168	110	0
316	Nahri Shahi	Sahrak Ali abad	04/12/13	15/12/13	36.76085	67.19551	6.49	3210	540	580	1.4	30.48	1.42	0.04	485	4.3	50	160	0
295	Balkh	zozaan	23/11/13	02/12/13	36.75051	66.94471	7.28	1510	225	260	0.86	19.94	1.41	0.03	187	4.5	60	99.6	0
117	Nahri Shahi	Lal mohammad	19/11/13	24/11/13	36.73668	67.22406	7.3	2640	305	950	2.4	27.38	1.41	0.06	297	8.3	200	150	0
3	Balkh	khwajah gholak	20/11/13	26/11/13	36.76505	66.91137	6.76	1411	170	180	0.6	22	1.4	0.01	280	31	42	98	0
317	Nahri Shahi	Yaka toot	08/12/13	16/12/13	36.72628	67.08107	6.49	3360	300	410	3.04	27.82	1.4	0.01	238	2.9	80	140	0
364	Sholgara	Cour Baqa Khana	30/01/13	01/02/13	36.23318	66.5268	7.5	1611	23.5	488	1.19	5.64	1.4	0.1	181	14	60	130	0
65	Nahri Shahi	Sharak torkamina	02/11/13	25/11/13	36.85678	66.99985	6.45	1082	185	88	1.26	4.1	1.38	0.02	190	5	110	64.4	0
129	Nahri Shahi	Yaka toot (Baba Yadgar)	07/07/13	16/07/13	36.71851	67.08112	7.46	320	50	1180	6	4.56	1.34	0.04	386	5	224	154	0



7	Dawlatabad	Hayratan	05/12/13	15/12/13	36.99914	66.74837	7.28	3200	440	825	4.05	5.06	1.33	0.03	640	6	156	43	0
374	Dawlatabad	Hayratan	15/11/13	20/11/13	36.99643	66.75626	7.34	1485	125	160	3.05	10	1.33	0.04	316	8.5	120	35	0.001
4	Kaldar	Kohna kaldar	04/12/13	15/12/13	37.17181	67.76295	6.48	1822	380	710	2	7.44	1.33	0.02	599	5.2	68	173	0
96	Shortepa	Bashirly	12/12/13	21/12/13	37.14445	67.21135	6.47	5640	460	1000	6.5	7.54	1.33	0.04	514	20.5	188	235	0
45	Dawlatabad	Khala bajgan	15/11/13	20/11/13	36.91525	66.7589	6.45	1300	320	200	1.04	5	1.31	0.04	213	18.4	90	52	0
280	Dawlatabad	Joi Arab	03/12/13	13/12/13	36.99677	66.80808	7.5	3060	420	420	2.3	15.28	1.31	0.01	353	11	140	47	0
357	Sholgara	Haji Nazar	29/01/13	01/02/13	36.22586	66.52676	7.3	1491	22	480	1.16	5.4	1.3	0	250	79	50	116.8	0
33	Khulm	Ghazi abad payan	22/01/14	29/01/14	36.74501	67.78544	8.4	3910	540	410	2.74	23.56	1.28	0.01	499	18.8	90	112	0
198	Balkh	Zazgran	12/11/13	16/11/13	36.75228	66.87456	7.38	1059	145	114	0.95	26.4	1.26	0	169	3.5	41	75.2	0
85	Khulm	koche khwaja burhan	09/01/14	22/01/14	36.70924	67.72927	7.27	3310	480	392	2.62	41.9	1.25	0.01	459	15.6	75	118	0
26	Shortepa	Kaz lai	12/12/13	21/12/13	37.23148	67.2076	6.47	2160	360	660	2.48	8.06	1.25	0.02	417	8	52	127	0
6	Balkh	Salarzy	06/01/14	16/01/14	36.8174	66.82211	7.82	3930	500	390	2.72	8.68	1.24	0.01	323	14.6	150	147	0
291	Char Kint	Shah enzir	27/11/13	01/12/13	36.3479	67.23082	7.6	2190	240	440	2.09	104.32	1.24	0	180	16.4	110	82	0
125	Dawlatabad	Hayratan	15/11/13	20/11/13	36.99911	66.7516	7.46	5290	420	380	4.3	1.54	1.24	0.02	426	4	148	44	0
226	Dawlatabad	Baido	06/01/14	16/01/14	36.88204	66.7803	7.63	1505	480	205	1.41	19.66	1.24	0.05	444	7.8	65	50	0
5	Dawlatabad	Hayratan	15/11/13	20/11/13	36.99565	66.75858	7.21	8750	540	210	4.8	13.64	1.23	0.04	438	5.8	155	82	0
89	Dawlatabad	Baid Watani	06/01/14	17/01/14	36.95611	66.75119	7.78	888	520	84	1.28	21	1.23	0.02	377	2.6	70	88	0
160	Khulm	Baba sadiq Ziarat	09/11/13	12/11/13	36.79883	67.72378	7.14	3100	500	400	2.26	28.52	1.23	0.02	700	18.8	13	50	0
282	Marmul	Lab e Hau2	13/12/13	23/11/13	36.54045	67.3093	6.54	466	90	30	0.3	54.5	1.23	0.03	185	7.3	33	47	0
53	Dawlatabad	Khala bajgan	15/11/13	20/11/13	36.91159	66.7603	6.46	1619	205	188	1.76	13	1.22	0.04	183	21.9	50	148	0
147	Sholgara	Juri saidha	28/11/13	10/12/13	36.36906	66.87354	7.38	1462	110	200	1.1	27.74	1.22	0.17	149	4	46	93.2	0
1	Chimtal	Gozar-e-Logariha	02/12/13	06/12/13	36.67655	66.74728	7.32	1769	195	210	1.51	28.44	1.2	0.01	193	4.8	70	74	0
22	Khulm	Guzar Sartrashi	09/01/14	22/01/14	36.6969	67.72009	7.82	6180	520	1940	7.1	67.5	1.2	0.02	707	8.2	152	336	0
39	Khulm	Kohna Khulum	22/01/14	29/01/14	36.76281	67.71216	8.38	2180	480	212	1.68	13.82	1.2	0.02	522	22	80	60	0
56	Nahri Shahi	Qala-e-Hajiri	04/12/13	14/12/13	36.72326	67.06454	7.35	1961	205	205	3.1	24.72	1.2	0.01	233	2.8	74	52	0
182	Dehdadi	Kariz Kalan	05/01/14	21/01/14	36.56668	67.04983	7.67	3100	360	900	5.4	79.5	1.14	0.01	454	8.8	120	144	0
170	Khulm	Now Abad Baqhat Guli	09/11/13	11/11/13	36.79883	67.72378	7.5	2560	480	292	2.06	13.92	1.13	0.02	557	13.4	100	68.4	0
74	Balkh	Wazirabad	10/12/13	24/12/13	36.84062	66.85702	6.53	1391	280	200	1.22	3.02	1.12	0.05	307	5.2	70	38	0

123	Balkh	Saray	10/12/13	24/12/13	36.78082	66.87258	6.53	1726	305	232	1.4	4.26	1.12	0.03	263	8.5	63	140	0
263	Balkh	Boriabar	10/12/13	25/12/13	36.8487	66.85741	6.54	1729	225	400	2.34	6.74	1.12	0.02	293	10	80	44	0
207	Dawlatabad	Mir Haidar	06/01/14	16/01/14	36.94905	66.82631	7.49	1565	400	150	1.03	11.52	1.12	0.03	463	11	65	46	0
164	Dawlatabad	Baid Watani	06/01/14	17/01/14	36.95606	66.75035	7.78	1043	540	102	1.37	22.94	1.12	0.01	450	3.6	55	45	0
210	Dehdadi	Kariz Khurd	05/01/14	20/01/14	36.56958	67.05118	7.58	4650	420	1260	5.9	229.6	1.12	0.02	747	40	110	140.8	0
63	Khulm	Guzar khwaja Burhan	09/01/14	22/01/14	36.70414	67.7277	7.27	3300	490	444	2.98	11.6	1.12	0.01	318	24	70	170	0
55	Khulm	Guzar Demahat	09/01/14	22/01/14	36.7036	67.71348	7.33	2680	440	320	1.98	25.6	1.12	0.01	447	25.5	114	50	0
61	Khulm	Ghazi abad payan	22/01/14	29/01/14	36.74261	67.78519	8.45	3720	520	330	2.62	21.52	1.12	0.01	428	18	84	109	0
221	Nahri Shahi	Babayadgar	15/11/13	25/11/13	36.68046	67.06418	7.47	1112	245	174	1.4	15.6	1.12	0.05	83	3.6	198	47	0
99	Khulm	Wajja Too	08/01/14	19/01/14	36.72982	67.62719	7.71	2990	480	460	2.68	20.2	1.11	0.03	547	6.5	70	62	0
236	Kaldar	Kohna kaldar	04/12/13	14/12/13	37.16708	67.76785	6.48	3360	400	590	3.95	153.4	1.06	0.02	453	200	200	65	0
122	Char Bolak	Qawrachi	01/01/14	12/01/14	36.78562	66.65813	7.23	1329	220	170	1.02	56.6	1.05	0.02	293	4.8	65	28.8	0.001
109	Sholgara	Sar Asiab	19/11/13	24/11/13	36.36402	66.87987	7.3	1067	144	94	0.95	10	1.04	0.02	103	27	60	69.2	0
175	Balkh	Spin Kuat	17/11/13	19/11/13	36.77076	66.87418	7.55	705	40	51	0.66	47.3	1.02	0.04	139	4.7	33	43.6	0
196	Balkh	Deh razee	05/12/13	07/12/13	36.71483	66.87457	7.92	1480	54	160	0.9	79.76	1.02	0.03	57	4	55	90	0
180	Chimtal	Yangi Qalah	02/01/14	07/01/14	36.67478	66.75564	6.82	1347	180	175	1.31	20.12	1.02	0.02	423	2	55	58	0
259	Dehdadi	Now Abad pul babo	07/11/13	09/11/13	36.66559	67.01085	7.51	1243	220	238	1.15	18.16	1.02	0.03	197	3.1	70	67	0
174	Dehdadi	Sharif Abad	06/07/13	07/07/13	36.60478	67.02297	7.61	2190	11.5	550	2.94	2.02	1.02	0.01	232	12	122	172	0
192	Dehdadi	Kariz Kalan	05/01/14	21/01/14	36.5688	67.0499	7.64	3090	380	870	5.3	39.16	1.02	0.02	451	6.6	120	131.2	0
27	Kaldar	Kohna kaldar	04/12/13	14/12/13	37.16464	67.76443	6.48	2710	460	470	2.78	58.7	1.02	0.03	420	5.4	40	154	0
173	Khulm	Guzar Aabdar	09/01/14	22/01/14	36.69795	67.69075	7.4	2970	520	390	2.58	13.56	1.02	0.01	495	15	100	71	0
286	Sholgara	Bagh palwan	30/11/13	09/12/13	36.44359	66.90755	7.16	1219	105	200	1.22	16.22	1.02	0	740	9.4	50	81.2	0
261	Sholgara	Bagh palwan	30/11/13	09/12/13	36.44046	66.90505	7.26	946	80	118	0.78	11.7	1.02	0	103	5.6	25	77.2	0
237	Sholgara	Aljar	06/07/13	16/07/13	36.48776	66.91463	7.56	1678	27.5	300	2.22	8.44	1.02	0.01	306	9	55	66	0
202	Kaldar	Hairatan	04/12/13	14/12/13	37.22145	67.41965	6.48	2000	460	370	2.14	63.3	1.01	0.03	411	3.84	28	79	0
331	Balkh	Kushkak	20/10/10	20/10/10	36.68781	66.89831	7.41	1062	5.9	138	0.92	3.24	1	0.01	310	6	43	64.4	0
309	Balkh	Nowarid-e Koshk	27/04/10	27/04/10	36.71681	66.90471	7.42	1345	15	198	0.98	4.7	1	0	56	7.5	55	88	0
315	Balkh	Pyaz Karan	29/04/10	29/04/10	36.74899	66.84044	7.58	1060	12	165	0.93	0.7	1	0	57	4.6	50	73	0

352	Balkh	Shahab-e Arabia	07/05/10	07/05/10	36.89186	66.84601	7.75	2470	40	380	1.8	0.06	1	0	203	11.4	38	57	0
244	Chimtal	Asia Shataf	02/01/14	07/01/14	36.66181	66.7766	7.16	681	135	68	1.09	13.12	0.98	0.01	173	3.2	36	64.4	0
197	Balkh	saray	10/12/13	24/12/13	36.77888	66.87326	6.53	895	120	57	0.59	4.07	0.96	0.01	162	3.8	34	73	0
181	Dehdadi	Kariz Kalan	05/01/14	21/01/14	36.56707	67.05006	7.93	3110	380	920	5.95	77	0.96	0.01	530	7.2	110	113.6	0
106	Khulm	Da Mulla Lashkari	22/01/14	23/01/14	36.71711	67.6966	8.35	2870	540	425	2.2	26.76	0.94	0.01	688	17.6	76	69.2	0
246	Nahri Shahi	Qul muh masid	21/11/13	25/11/13	36.72842	67.03441	7.26	1458	160	195	1.25	20.46	0.94	0	226	4.7	75	7.3	0
35	Dehdadi	Qul Temor	23/11/13	01/12/13	36.75073	66.99146	7.32	1663	255	205	0.92	40	0.93	0.02	229	8.2	70	96	0
8	Nahri Shahi	Gozar-e-ziannurain	05/12/13	12/12/13	36.70461	67.06919	6.44	999	50	65	7	28	0.92	0.4	117	2.5	60	46.8	0
167	Sholgara	Starkot bala	19/11/13	24/11/13	36.49768	66.92489	7.3	1030	360	175	0.7	15.2	0.92	0.03	304	10	26	94.4	0
223	Nahri Shahi	Kaj gozar	19/11/13	24/11/13	36.69397	67.16476	7.08	2330	320	740	4.45	41	0.91	0.06	347	6.2	116	102	0
48	Sholgara	Tash keldi	21/11/13	30/11/13	36.30284	66.89667	7.69	693	105	71	0.57	29.06	0.91	0.04	92	3	39	42.8	0
178	Khulm	Kuhna Bazar	09/01/14	30/01/14	36.6909	67.6998	7.47	2350	320	570	2.36	26.84	0.89	0.01	440	7.2	110	118.4	0
158	Nahri Shahi	Gozari hazrat omer faroq	04/12/13	13/12/13	36.70987	67.06405	6.43	5170	400	1950	2.87	20.8	0.88	0	488	5	360	264	0
77	Khulm	Kohna Khulum	22/01/14	23/01/14	36.76528	67.71386	8.35	2480	460	300	1.78	13.3	0.87	0.01	570	16.8	90	58	0
224	Balkh	Salarzy	06/01/14	16/01/14	36.80777	66.8244	7.67	4280	500	400	2.8	10.54	0.86	0.01	352	13.4	200	112	0
82	Dehdadi	Zerechenar	27/11/13	28/11/13	36.6646	66.99902	7.23	886	72	53	0.86	27	0.86	0.02	207	3.8	33	63	0
172	Dehdadi	Kariz Khurd	05/01/14	20/01/14	36.58052	67.08608	7.77	1102	165	138	1.36	87.1	0.86	0	284	4	30	43.2	0
29	Balkh	Kata khil	30/11/13	09/12/13	36.77858	66.84707	7.43	1052	75	72	1.15	7.44	0.85	0.03	151	12	55	36.8	0
133	Khulm	Guzar Baghdar	09/01/14	22/01/14	36.69908	67.71441	7.7	4970	540	900	6.3	33.04	0.85	0.01	555	14.8	190	73.2	0
98	Balkh	Temor saray	18/11/13	20/11/13	36.7314	66.84689	7.39	1020	69	96	0.63	16	0.84	0.02	66	3.3	50	69	0
142	Khulm	Yangara	01/01/14	14/01/14	36.70584	67.89331	6.64	6730	480	2050	6.75	88.2	0.84	0.02	680	21.5	280	66.8	0
297	Sholgara	Qara bagh khana khana	30/11/13	09/12/13	36.3922	66.88635	7.12	1029	58	118	0.86	15.68	0.84	0	100	4.9	50	59.2	0
250	Sholgara	chushma-e-baba ewaz	25/11/13	01/12/13	36.363	66.88651	7.21	1050	76	82	0.79	7.17	0.84	0.01	83	3.3	55	74.8	0
110	Sholgara	Starkot bala	25/11/13	25/11/13	36.49674	66.9233	7.32	1077	105	170	1.04	12.66	0.84	0	88	3.9	50	93.6	0
216	Balkh	Salarzy	06/01/14	16/01/14	36.81661	66.82207	7.82	2500	360	540	2.36	17.46	0.82	0.02	403	9.4	160	105.6	0
212	Chimtal	Asia Shataf	02/01/14	07/01/14	36.66207	66.77493	7.14	635	55	45	0.83	14.36	0.82	0	122	2.5	27	44	0
208	Dawlatabad	Elkachi Kandhari	06/01/14	16/01/14	36.88405	66.78308	7.48	1226	215	110	0.34	21.36	0.82	0.01	194	12	140	50	0
171	Dehdadi	Kar Malak	07/11/13	08/11/13	36.68176	67.0072	7.53	1091	230	144	0.98	16.62	0.82	0.01	261	3.6	65	82	0

242	Balkh	Khoshal abad	04/12/13	06/12/13	36.7585	66.78725	7.94	1636	205	195	1.8	6.38	0.81	0	252	3.1	50	35	0
241	Dawlatabad	Char bagh saidan	03/12/13	13/12/13	36.97702	66.78655	7.21	1427	115	190	1.3	9.56	0.81	0	111	5	105	47.6	0
156	Nahri Shahi	Khuaja persa	19/11/13	24/11/13	36.72988	67.15288	7.41	1793	275	726	2.3	15.06	0.81	0.06	476	4.2	92	52	0
249	Dehdadi	Qala Abas khan	11/11/03	14/11/13	36.6742	66.97021	7.67	1326	280	205	0.91	27.02	0.79	0	283	4	36	56.4	0
248	Chimtal	Yangi Qala	02/01/14	07/01/14	36.68124	66.75471	6.8	871	120	64	0.61	11.26	0.77	0.01	180	6.7	35	70	0
213	Dehdadi	Kariz Khurd	05/01/14	20/01/14	36.57759	67.0891	7.82	898	67	124	1.22	36.32	0.77	0.01	147	5.4	26	42	0
137	Nahri Shahi	Ansar(7)	19/11/13	24/11/13	36.73523	67.13566	7.06	1709	155	350	2.8	21	0.76	0.04	188	7	104	61	0
308	Balkh	Qarloq	10/12/13	16/12/13	36.8478	66.86345	6.53	1809	205	205	1.34	12.58	0.75	0.02	238	6.3	110	52	0
276	Sholgara	Nowabad	30/11/13	09/12/13	36.31927	66.88519	7.17	885	65	70	0.64	0.682	0.75	0.01	92	4.5	47	58	0
62	Dawlatabad	Sultan Khuaja	02/01/14	07/01/14	36.89743	66.81451	7.67	1615	190	256	1.6	12.76	0.74	0.02	246	25	65	62	0
58	Sholgara	mohammad raheem	25/11/13	03/12/13	36.33699	66.91368	7.15	1115	125	165	0.74	27	0.74	0.06	163	4	55	75	0
146	Chimtal	Yangi Qala	02/01/14	07/01/14	36.68015	66.75437	6.79	894	145	76	1.05	11.42	0.72	0.01	204	4.3	46	41	0
107	Dehdadi	shirabsyeedjan	18/11/13	23/11/13	36.69539	67.05354	7.33	1572	165	132	2.48	27.25	0.72	0.02	166	3	75	49	0
162	Dehdadi	Khanaqa Kalan	07/11/13	09/11/13	36.6665	67.00132	7.37	1116	210	144	1.06	26.38	0.72	0.01	309	4	55	75	0
279	Balkh	Deragai	28/11/13	08/12/13	36.7554	66.9558	7.2	1339	164	190	0.99	20.38	0.71	0	164	5.5	55	94	0
28	Balkh	Nowared zozaan	23/11/13	02/12/13	36.76795	66.94778	7.28	1260	190	134	0.85	152.4	0.71	0.05	209	18.8	90	45	0
83	Dawlatabad	Sultan Khuaja	02/01/14	07/01/14	36.89742	66.81718	7.67	1577	175	212	2.74	12.34	0.71	0.02	137	44	106	54.8	0
229	Nahri Shahi	Baba yadgar hotaki	05/12/13	10/12/13	36.69261	67.07884	7.19	1043	100	108	1.05	26.22	0.71	0	129	12	40	78	0
166	Nahri Shahi	Karti zarat	05/12/13	10/12/13	36.71558	67.0074	7.28	1952	185	250	1.5	20.28	0.71	0.02	143	4.7	90	99	0
44	Sholgara	Nowabad	21/11/13	30/11/13	36.31566	66.88336	7.03	1073	155	106	0.88	39.52	0.71	0.04	156	2.7	43	67	0
43	Sholgara	emam abu hanifa	21/11/13	28/11/13	36.32004	66.88636	7.22	871	83	50	0.64	23.22	0.71	0.02	79	2.6	41	79	0
199	Char Bolak	Warnagha	01/01/14	12/01/14	36.78216	66.66827	7.32	634	130	68	0.99	7.54	0.7	0.01	160	2.5	34	40	0
88	Dawlatabad	Sultan Khuaja Paien	02/01/14	08/01/14	36.89446	66.82159	7.68	1469	155	236	1.4	5.84	0.7	0.01	191	18	70	51.6	0
86	Balkh	Boriabaf	10/12/13	24/12/13	36.84456	66.85885	6.53	902	85	102	0.82	4.44	0.69	0.01	147	6.5	60	36	0
375	Balkh	Buribaf	06/07/13	08/07/13	36.84728	66.85375	7.51	2350	34	360	2.68	2.34	0.69	0	314	13	106	53	0
209	Balkh	Salarzy	06/01/14	16/01/14	36.81403	66.82249	7.82	3340	480	700	2.48	16.84	0.69	0.01	542	15.2	200	108.8	0
59	Chimtal	Asia sharaf	02/01/14	07/01/14	36.66164	66.77818	7.17	586	400	52	0.99	15.6	0.69	0.01	311	2.2	30	36	0
298	Char Kint	kabul oziamcha	27/11/13	01/12/13	36.31003	67.20088	7.44	2960	220	400	2.34	100.22	0.68	0	23	20.7	100	198	0

41	Khulm	Mollah Sultan Tangi	01/01/14	15/01/14	36.66439	67.7229	6.65	2620	400	228	4.1	46.2	0.68	0.002	191	11.5	100	148	0
112	Dawlatabad	Elkachi	02/01/14	07/01/14	36.89803	66.7683	7.64	1359	160	152	2.9	5.02	0.67	0.01	98	11	100	48.8	0
51	Khulm	Gozar -i- Chahr Su	01/01/14	15/01/14	36.69864	67.70079	6.65	2600	400	195	1.4	47.2	0.67	0.02	455	29	65	71.6	0
114	Balkh	Deb Bebe	07/07/13	16/07/13	36.78506	66.93548	7.36	1341	40	175	3.85	1.86	0.65	0.03	51	12.4	168	63	0
287	Balkh	Bangala afghania	05/12/13	07/12/13	36.69025	66.82127	7.13	1019	58	90	0.57	17.9	0.64	0.01	62	4.1	42	123	0
289	Balkh	Deragai	28/11/13	08/12/13	36.76637	66.95682	7.13	1787	250	220	0.98	28.21	0.64	0	228	5.8	60	102	0
15	Dehdadi	chel dokhtaran	27/11/13	28/11/13	36.67053	67.03879	7.12	1391	145	175	1.52	31.8	0.64	0.03	169	6.3	80	42.2	0
17	Dehdadi	Takhtapool	23/11/13	01/12/13	36.73551	67.02087	7.25	1451	215	200	0.92	29	0.64	0.02	276	9.5	70	53	0
140	Chimtal	Yangi Qala	03/01/14	10/01/14	36.68295	66.75486	6.8	606	125	65	0.57	16.3	0.63	0.03	134	2.8	34	40	0
189	Chimtal	Yangi Qala	02/01/14	07/01/14	36.6783	66.76193	6.81	870	130	76	0.52	15.06	0.63	0.02	184	4.5	34	46	0
191	Dehdadi	Kariz Khurd	05/01/14	20/01/14	36.57852	67.08704	7.98	880	125	130	1.19	53.4	0.63	0.01	198	3.6	26	41.6	0
190	Khulm	Said Noorullah	22/01/14	24/01/14	36.71276	67.73213	8.35	3210	540	410	2.14	22.68	0.63	0.01	607	21	80	112	0
49	Sholgara	qazi khawl	25/11/13	03/12/13	36.32312	66.91381	7.21	1239	255	148	0.69	27.6	0.63	0.04	218	4.4	65	66	0
93	Char Bolak	Daraghan watini	14/12/13	21/12/13	36.77674	66.68863	7.45	950	130	63	1.4	7.98	0.62	0.02	206	2.6	44	32	0
211	Dehdadi	Chal Gazai babaqashqar	12/11/13	15/11/13	36.74076	66.99885	7.33	1415	64	185	1.1	27.12	0.62	0.02	291	4.9	60	65.2	0
47	Khulm	Khwaja Borhan	01/01/14	16/01/14	36.7093	67.73063	6.69	4790	460	660	2.8	69.7	0.62	0.07	650	15	68	131.2	0
275	Sholgara	baloch	25/11/13	01/12/13	36.35892	66.88515	7.07	915	105	59	0.6	7.08	0.62	0.01	100	2.4	45	72.8	0
239	Sholgara	Abdurahim zi	30/11/13	09/12/13	36.39644	66.896	7.07	921	56	86	0.59	10.54	0.62	0	94	3.7	37	73.2	0
219	Balkh	Hasarak	05/12/13	07/12/13	36.70102	66.85986	7.44	934	78	120	0.68	13.2	0.61	0	108	3.5	35	74	0
288	Nahri Shahi	Nasaji baby badqar	08/01/14	18/01/14	36.67491	67.08198	7.6	3550	520	400	2.15	68.8	0.61	0.02	334	5.8	120	118.4	0
169	Char Bolak	Qawrachi	01/01/14	12/01/14	36.78543	66.6624	7.14	754	140	80	0.83	6.92	0.6	0.01	167	3.7	47	38.4	0
205	Dehdadi	chalgazi	12/11/13	16/11/13	36.71992	66.99886	7.36	1377	205	244	1.04	17.18	0.6	0.01	279	4	50	82.8	0
76	Khulm	Guzar Aishan Daki	09/01/14	22/01/14	36.68412	67.691	7.21	2770	500	400	2.4	18.08	0.6	0.01	514	13.8	120	102.4	0
381	Khulm	Sayyed	15/12/06	16/12/06	36.70979	67.70149	7.42	2980	40	340	1.26	0	0.6	0	396	21	47	86	0
24	Sholgara	starkot paien school	19/11/13	26/11/13	36.50324	66.92951	7.43	1529	200	200	1.11	77.3	0.6	0.03	239	3	80	82	0
79	Shortepa	Bazaro	12/12/13	21/12/13	37.33095	66.80099	6.47	2120	340	990	2.38	9.74	0.59	0.01	599	10.4	46	173	0
152	Nahri Shahi	baba Yad qar	02/12/13	23/12/13	36.68471	67.06047	6.48	1606	340	200	1.49	57.1	0.58	0.04	331	6	55	71	0
11	Nahri Shahi	Watta Qul	08/01/14	27/01/14	36.89583	67.05068	7.16	2360	400	410	1.86	9.04	0.58	0.01	499	4.5	95	69	0

36	Sholgara	Danekarni	21/11/13	26/11/13	36.31038	66.87998	7.79	784	88	61	0.73	45.9	0.58	0.02	78	7.8	35	57.2	0
230	Dehdadi	Alborz Abad	16/11/13	18/11/13	36.69308	66.98125	7.42	1128	46	185	0.88	49.4	0.57	0.01	109	4	50	78.8	0
97	Shortepa	Aragh Batoor	12/12/13	21/12/13	37.34587	66.97603	6.47	2350	380	306	2.5	8.06	0.57	0.03	226	90	56	168	0
148	Dawlatabad	Hayratan	05/12/13	15/12/13	37.00389	66.75214	7.6	1221	76	86	0.8	6	0.56	0.04	221	26	104	49	0
143	Dawlatabad	Elkachi	06/01/14	16/01/14	36.88265	66.78001	7.66	1145	260	146	1.54	16.84	0.56	0.02	134	6	140	90.8	0
13	Dehdadi	Sher Abad Ulia	07/11/13	10/11/13	36.69511	67.03325	7.15	1120	30	102	0.62	10.8	0.56	0	103	3	26	58.4	0
369	Dehdadi	Shir Abad	23/01/13	24/01/13	36.67992	67.03225	7.26	2090	42	232	2.4	8.92	0.56	0.01	333	5.4	60	52.4	0
139	Dehdadi	Kariz Khurd	05/01/14	20/01/14	36.57693	67.09024	7.96	850	125	130	1.17	41.02	0.56	0	181	3.2	23	44	0
220	Khulm	Mullakh sultan tangi	01/01/14	14/01/14	36.66647	67.69394	6.69	2530	480	350	2.12	14.08	0.56	0.01	613	12	70	59.2	0
277	Balkh	Bangala afghania	05/12/13	07/12/13	36.68979	66.82176	7.1	1002	98	96	0.49	31.64	0.54	0.02	96	4.1	39	96	0
292	Balkh	Hewad	28/11/13	08/12/13	36.75831	66.95591	7.12	1376	190	190	0.92	19.1	0.54	0.01	130	7	60	101	0
87	Dawlatabad	Baid Watani	06/01/14	16/01/14	36.95577	66.7526	7.43	1196	145	100	1.5	27.56	0.54	0.01	88	3.6	200	57.6	0
78	Khulm	Haji Ali Afghania	01/01/14	15/01/14	36.70882	67.78659	6.69	5440	500	272	2.7	18.34	0.54	0.01	435	15	95	105.6	0
113	Nahri Shahi	Takhta Pul	07/07/13	16/07/13	36.73551	67.02088	7.38	1374	52	190	2.4	2.72	0.54	0.04	145	10	104	62	0
25	Dawlatabad	Hayratan	05/12/13	15/12/13	36.99445	66.75262	7.24	2810	340	520	3.3	11	0.53	0.02	434	9.5	156	39	0
121	Marmul	Lab e Cha	13/12/13	23/11/13	36.54732	67.31203	6.52	1398	190	180	0.82	165.48	0.53	0.04	223	14.5	90	64	0
135	Balkh	Arab Godam	14/12/13	23/12/13	36.76023	66.88584	6.5	1142	150	122	0.84	26.58	0.52	0.05	368	57	70	59	0
14	Char Bolak	Sabzikar	14/12/13	21/12/13	36.77261	66.69461	6.46	929	185	126	1.52	21.88	0.52	0.02	40	176	85	39	0
116	Chimtal	Yangi Qala	03/01/14	10/01/14	36.68338	66.7045	6.79	1190	155	120	1.35	30.22	0.52	0.02	191	8.4	55	57.6	0
253	Dawlatabad	Char bagh saidan	03/12/13	13/12/13	36.97572	66.7914	7.82	660	47	78	0.54	11.08	0.52	0	56	5.2	35	41.2	0
168	Marmul	Post Qaloch	13/12/13	23/11/13	36.54448	67.31075	6.5	1387	205	200	0.89	129.4	0.52	0.03	228	10.8	70	83	0
245	Zari	Bori	28/11/13	08/12/13	35.96481	66.6946	7.61	1723	125	220	1.18	46	0.52	0	89	6.9	70	50	0
104	Balkh	Charbaghe Gulshan	07/07/13	16/07/13	36.75123	66.8564	7.86	997	52	95	2.55	1.9	0.51	0.04	196	11	55	50	0
225	Dehdadi	Shir Abad olia	11/11/13	15/11/13	36.68732	67.02798	7.25	1083	300	124	1.26	25.16	0.51	0.01	264	5.2	47	76.4	0
23	Nahri Shahi	ghazi	21/11/13	27/11/13	36.69067	67.08745	7.17	1222	125	106	1.88	47.7	0.51	0.01	92	4.3	90	59.6	0
119	Balkh	Balkh Bazar	06/07/13	07/07/13	36.75699	66.89885	7.46	1317	17.5	136	1.05	9.72	0.5	0.01	195	36.8	40	86	0
231	Dehdadi	Chal Gazai	12/11/13	17/11/13	36.71933	66.99697	7.6	1027	54	120	0.83	40.4	0.5	0.01	163	4	45	56	0
383	Khulm	Dewar Khuna	22/01/05	22/01/05	36.603	67.789	7.31	2860	42	420	1.52	0	0.5	0	270	18.8	1	127.2	0

69	Khulm	Dewar Khuna	22/01/05	22/01/05	36.559	67.854	7.31	2860	42	420	1.52	5.12	0.5	0	270	18.8	1	127.2	0
264	Khulm	Guzar Eshanian	09/11/13	13/11/13	36.70972	67.70158	7.13	2940	540	448	2.34	25.7	0.49	0.02	665	20	104	88.8	0
176	Dehdadi	AlborzAbad Yakotoot	16/11/13	18/11/13	36.69416	66.98051	7.37	1086	155	200	0.75	21.18	0.48	0.01	258	3.8	89	32.8	0
66	Sholgara	mohajer qishlaq	21/11/13	26/11/13	36.38131	66.87154	7.67	797	105	49	0.57	21.18	0.48	0.02	77	3.5	36	82.4	0
278	Zari	Al temor	28/11/13	08/12/13	35.95609	66.68835	7.19	968	35	112	0.59	9.66	0.48	0	44	10.5	39	103	0
81	Dehdadi	Arab khana-e- Nigari	17/11/13	20/11/13	36.72245	66.97019	7.64	946	145	136	0.9	21.5	0.46	0.02	153	3.3	44	66	0
120	Kaldar	Joe jadeed	04/12/13	14/12/13	37.16601	67.75692	6.48	882	180	160	1.22	42	0.45	0.01	170	4.5	24	94	0
377	Khulm	Chahar Guzar	21/01/07	22/01/07	36.81353	67.72305	7.47	2980	44	680	0.3	0.37	0.45	0	286	21	99	83.2	0
19	Dehdadi	sherabad ulya	28/11/13	30/11/13	36.69099	67.02467	7.17	762	101	99	1.11	67.2	0.44	0.03	165	7.3	50	70	0
243	Dehdadi	sjrabad ulya	19/11/13	23/11/13	36.72454	66.97505	7.38	1044	83	83	1.18	46	0.44	0.03	60	8.8	65	71	0
37	Char Bolak	Sabzikar	14/12/13	21/12/13	36.76791	66.69731	6.45	703	92	67	0.66	5.58	0.43	0.01	146	4.9	41	32	0
370	Dehdadi	Shir Abad Sufia	22/01/13	24/01/13	36.70994	67.04525	7.46	1704	34	148	1.01	10.42	0.43	0.01	252	2.6	46	76.4	0
267	Khulm	Guzar Mirza Khirudeen	09/11/13	13/11/13	36.71239	67.68401	7.28	3140	440	432	2.74	22.78	0.43	0.01	669	16.4	102	118	0
266	Marmol	Dakhisay	13/12/13	23/11/13	36.53925	67.31043	6.45	919	88	102	0.73	37.94	0.43	0.04	496	20	55	78	0
268	Balkh	Samar qandian	04/12/13	07/12/13	36.68785	66.83743	7.28	920	45	104	0.45	10.02	0.42	0	46	5.9	38	95	0
285	Balkh	Khoshal abad	04/12/13	06/12/13	36.75967	66.78813	7.46	957	72	100	0.83	10.36	0.42	0	37	3.3	75	55	0
251	Char Kint	Yaltal	27/11/13	01/12/13	36.3927	67.17257	8.08	680	44	85	0.77	36.32	0.42	0	146	5.4	37	37	0
90	Chimtal	Jar Qala	03/01/14	10/01/14	36.68159	66.75612	6.79	674	170	64	0.52	8.42	0.42	0.03	246	2.5	27	44	0
252	Chimtal	Sar Asiab	04/12/13	06/12/13	36.64744	66.87607	7.82	846	30	140	0.87	12.66	0.42	0.01	57	5.2	34	56	0
227	Dehdadi	Deh Abdullah	11/11/13	14/11/13	36.67804	67.02159	7.35	1120	105	114	1.22	27.64	0.42	0.02	163	4.3	50	82.4	0
16	Nahri Shahi	Gozaree mulla faroq	05/12/13	10/12/13	36.71273	67.06654	6.44	1399	75	205	0.02	6.2	0.42	0.02	159	1.5	68	70.8	0
238	Nahri Shahi	Karti sakhi	05/12/13	12/12/13	36.7179	67.0675	7.2	2610	195	230	2.1	15.16	0.42	0	128	4.3	108	74	0
67	Nahri Shahi	Nawaridi Alme Arab	21/11/13	30/11/13	36.68464	67.08874	7.48	790	340	94	0.69	40.32	0.42	0.02	254	3.5	41	41.2	0
247	Shortepa	Tash guzar	28/11/13	08/12/13	37.23741	67.18582	8.17	960	150	185	0.74	5.76	0.42	0.01	183	6.2	25	44	0
95	Balkh	BaBa Qoo	19/12/03	23/12/13	36.74691	66.89766	6.52	1188	160	114	0.66	39.34	0.41	0.04	440	24	72	98	0
127	Balkh	Boriabaf	10/12/13	25/12/13	36.84729	66.85373	6.55	863	120	90	0.31	4.08	0.41	0.01	148	3.6	37	52	0
367	Dawlatabad	Qarshigak	27/01/13	28/01/13	37.03042	66.47477	7.2	1346	30.5	94	0.54	1.8	0.41	0	164	4	26	71.6	0
272	Dehdadi	Now Ward Baba Khana	11/11/13	15/11/13	36.67851	66.99211	7.93	980	275	180	0.85	25.88	0.41	0.02	276	8.8	39	67.6	0

111	Kaldar	khwaja louldar	04/12/13	14/12/13	37.15758	67.75692	6.48	848	130	120	3.78	67.3	0.41	0.02	193	3.4	24	44	0
38	Nahri Shahi	Sia Gird	08/01/14	27/01/14	36.93176	67.08309	7.4	2520	440	320	2.52	15.78	0.41	0.01	562	1.9	70	54	0
240	Shortepa	Joi-e-Wakil	28/11/13	08/12/13	37.3715	66.96975	7.62	694	105	97	0.63	4.6	0.41	0	94	4.2	21	61.2	0
359	Dawlatabad	Center	27/01/13	28/01/13	37.00568	66.49319	7.2	1274	23.5	116	0.66	1.16	0.4	0.01	180	2.8	27	68	0
12	Dehdadi	sherabad, qala 4 borjak	21/11/13	27/11/13	36.67991	67.03225	7.6	1096	150	89	1.11	31	0.4	0.03	150	5.4	55	75	0
105	Dawlatabad	Elkachi	02/01/14	07/01/14	36.99737	66.76978	7.46	853	86	110	2.3	9.48	0.39	0.05	143	18.8	50	35.6	0
193	Sholgara	Badam Qala	06/07/13	07/07/13	36.51996	66.94277	7.37	1424	25.5	240	1.18	4.46	0.39	0.01	181	3.5	50	106	0
271	Balkh	Wahdat Abad	12/11/13	16/11/13	36.73825	66.89265	7.35	769	58	53	0.59	7.98	0.38	0.02	75	3.3	34	72.8	0
296	Sholgara	Madtab saeed jamaluddin.36.34301	25/11/13	02/12/13	36.34301	66.91621	7.36	1038	130	110	0.87	26.58	0.38	0.04	138	3.3	50	66	0
232	Dehdadi	Baba khona	11/11/13	14/11/13	36.66826	66.96185	7.28	1102	170	128	0.69	28.62	0.37	0.02	205	5.3	44	58.2	0
177	Nahri Shahi	Baba yadgar	05/12/13	10/12/13	36.6908	67.06835	7.32	1172	108	160	2.5	35.62	0.37	0	151	3.7	55	75	0
188	Char Bolak	Khuaja Gul Border	01/01/14	15/01/14	36.78235	66.67086	7.1	1710	75	67	0.55	10.46	0.35	0.02	127	3	25	61.2	0
131	Dawlatabad	Elkachi	02/01/14	07/01/14	36.89915	66.7679	7.66	846	54	67	0.34	9.58	0.35	0.04	128	3.6	55	50.8	0
54	Khulm	Mollah Said Tangi	01/01/14	16/01/14	36.66735	67.69484	6.68	4340	440	536	3.75	15.94	0.35	0.05	552	14.6	95	128	0
70	Balkh	kokna zawat	14/12/13	23/12/13	36.76203	66.89371	6.5	1283	215	165	0.89	49.8	0.34	0.06	517	47	60	25	0
255	Balkh	Bangala afghania	05/12/13	07/12/13	36.68835	66.82211	7.32	831	65	78	0.46	17.9	0.34	0.01	106	3.7	25	72	0
258	Char Bolak	Center charbolak	14/12/13	21/12/13	36.79017	66.68771	6.45	653	125	68	0.48	10.64	0.33	0.03	200	3.5	29	51	0
155	Char Bolak	Khuaja Gul Border	01/01/14	15/01/14	36.78145	66.67071	7.1	1828	360	224	2.07	8.94	0.33	0.01	242	6.1	110	54.4	0
34	Dehdadi	dehswar school	30/11/13	04/12/13	36.74529	66.98811	7.34	1330	170	190	6	43.6	0.33	0.03	188	4.8	75	72.8	0
21	Nahri Shahi	Shahrak Sunati QaleenBafha	08/01/14	28/01/14	36.76714	67.3256	7.57	6470	460	1280	6.1	76.7	0.33	0.02	577	6	200	108.4	0
80	Balkh	Sarnar	18/11/13	21/11/13	36.76338	66.86846	7.25	1094	210	248	0.83	35	0.32	0.03	255	3.3	88	45	0
270	Balkh	Shenki	16/11/13	18/11/13	36.74707	66.85366	7.37	1307	175	155	1.47	19.58	0.32	0	236	3.5	94	57.2	0
185	Char Bolak	Khuaja Gul Border	01/01/14	15/01/14	36.77567	66.67371	7.2	1784	235	200	1.39	8.32	0.32	0.01	208	7.5	70	51.6	0
284	Dehdadi	Qul Temor	12/11/13	17/11/13	36.74164	66.97621	7.45	1166	185	200	1.19	22.94	0.32	0.02	159	3.4	46	76.8	0
20	Nahri Shahi	Park Bulakhai Hawaee	08/01/14	28/01/14	36.73926	67.11416	7.31	3290	480	380	2.04	25.26	0.32	0.02	467	29.5	120	105.6	0
262	Balkh	Samarqandian	06/07/13	08/07/13	36.69177	66.83037	7.35	1179	17	114	0.73	1.82	0.31	0	184	2.5	47	89	0
145	Balkh	Tarakhil	14/12/13	24/12/13	36.73112	66.92719	7.52	1183	170	170	1	23.74	0.31	0.07	613	31	50	60	0

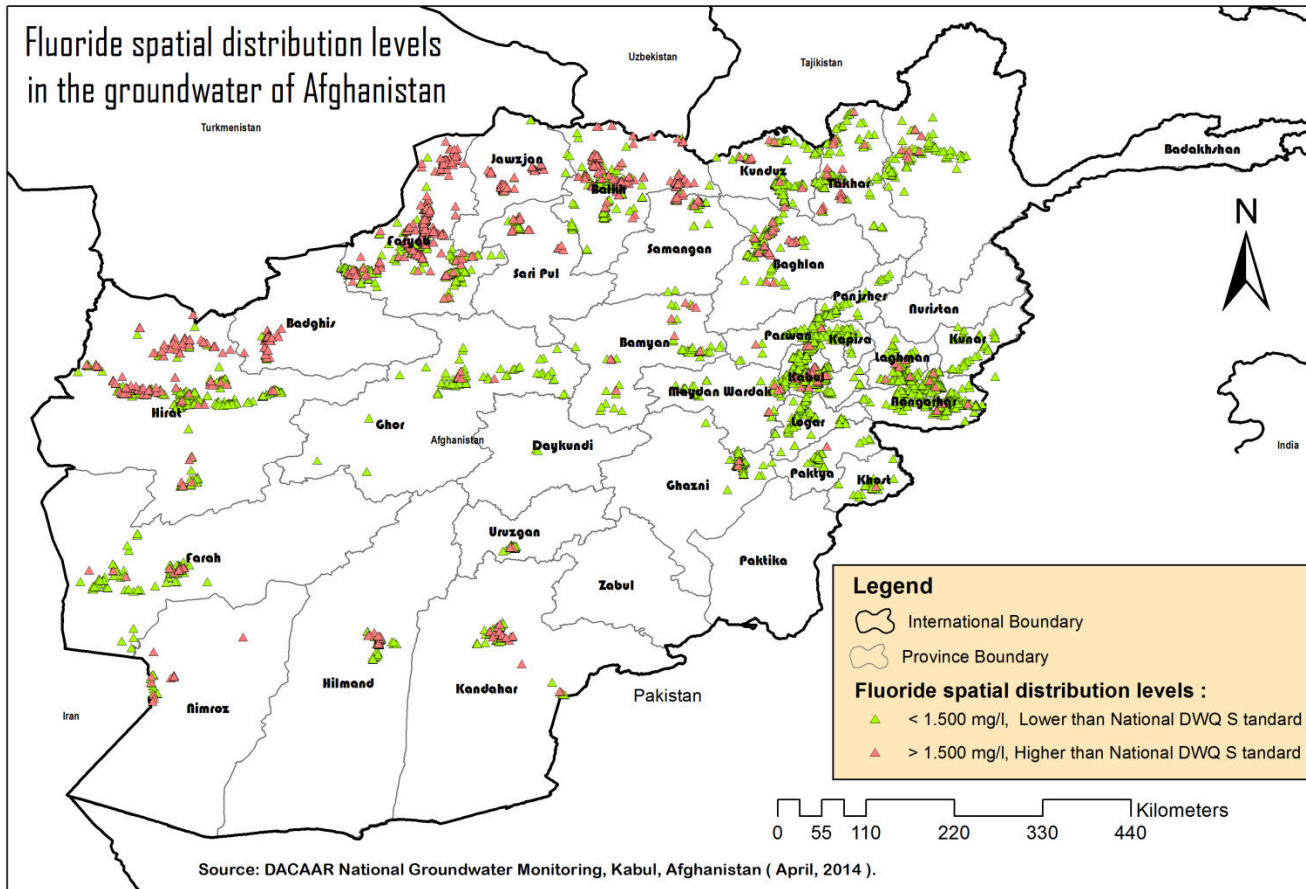


273	Balkh	Deh razee	01/12/13	06/12/13	36.71693	66.87363	7.9	916	59	108	0.81	14	0.31	0.01	153	3.1	55	23	0
144	Chimtal	Yangi Qala	02/01/14	09/01/14	36.68315	66.75288	6.79	1421	150	244	1.87	31.54	0.31	0.01	263	3	55	71.2	0
128	Dawlatabad	Makatab Elkachi	02/01/14	07/01/14	36.89262	66.77665	7.64	810	54	55	1.39	8.62	0.31	0.04	123	4.9	40	35.4	0
215	Dehdadi	Chehel Gazi	07/07/13	16/07/13	36.71695	66.99299	7.86	997	48	115	1.45	4.66	0.31	0.05	156	3.8	55	63	0
138	Dawlatabad	Elkachi	02/01/14	07/01/14	36.89717	66.76788	7.64	797	65	110	1	7.54	0.3	0.03	143	1.8	46	18.4	0
313	Khulm	Tangay	14/03/06	14/03/06	36.60716	67.73712	7.26	1402	21.5	232	0.46	0	0.3	0	75	62	55	19.2	0.001
165	Balkh	Aghabay	14/12/13	24/12/13	36.73717	66.88469	6.52	966	170	110	0.56	31.9	0.28	0.11	453	17	45	78	0
157	Char Bolak	Khuaja Gul Border	01/01/14	15/01/14	36.78143	66.67534	7.12	1800	360	240	1.46	5.68	0.28	0.01	282	9.4	75	58.8	0
269	Chimtal	Gozar-e-Logariha	02/12/13	06/12/13	36.67871	66.80061	7.19	1200	81	114	0.78	20.02	0.28	0.02	83	9.5	65	80	0
201	Dawlatabad	Sultan Khuaja Paien	02/01/14	07/01/14	36.89738	66.81966	7.69	647	42	56	0.63	6.82	0.27	0.02	79	4.1	23	49.2	0
57	Zari	Qazaq	28/11/13	08/12/13	35.9553	66.6982	7.15	1170	40	108	0.49	14.9	0.27	0.01	41	4.9	32	92.8	0
254	Zari	Qazaq	28/11/13	08/12/13	35.95718	66.69648	7.32	744	55	195	0.8	43.8	0.27	0.01	79	4.9	65	99	0
321	Char Bolak	Bazar Charbolak	04/10/10	05/10/10	36.70517	66.79745	7.74	865	8.2	170	0.78	2.98	0.265	0.04	188	4.5	17	29.6	0
163	Chimtal	Sangchil	02/01/14	09/01/14	36.68929	66.80041	6.46	986	75	104	0.43	10.36	0.25	0.02	159	3.7	42	58.4	0
378	Khulm	Mirza Khirudin	21/01/07	22/01/07	36.71312	67.67394	7.93	1774	2.1	140	0.3	0.24	0.25	0	37	23	100	51.6	0
184	Nahri Shahi	Nasaji	07/07/13	16/07/13	36.68357	67.08484	7.51	711	44	200	0.9	3.66	0.24	0.04	117	2.8	80	55	0
118	Nahri Shahi	Sia Gird	08/01/14	27/01/14	36.91683	67.0818	7.77	843	77	90	1.1	11.96	0.24	0.01	231	5	56	43.2	0
265	Sholgara	Qadim	06/07/13	11/07/13	36.31964	66.88485	7.56	756	8.6	45	0.86	2.26	0.24	0.02	137	2.6	27	67	0
115	Balkh	Qarlaq	10/12/13	24/12/13	36.89731	66.87112	6.53	994	145	120	0.99	6.38	0.23	0.04	215	3.8	39	40	0
84	Char Bolak	Afghani actifa	14/12/13	21/12/13	36.78442	66.66427	6.47	1197	220	134	1.26	10	0.23	0.05	224	2.9	65	55	0
132	Nahri Shahi	Nawabad Kampirak	02/11/13	25/11/13	36.81667	66.99582	6.45	692	160	74	1.05	11.34	0.23	0.04	125	3.4	82	50	0
92	Nahri Shahi	kampirak	02/11/13	25/11/13	36.84484	67.02653	6.45	1623	260	310	1.28	15.06	0.23	0.04	172	11.5	170	102	0
187	Dawlatabad	Sultan Khuaja Paien	02/01/14	07/01/14	36.8985	66.8191	7.68	637	54	56	0.92	7.14	0.22	0.02	95	3.4	41	38.4	0
40	Khulm	Cocha Ali Mardan Bik	01/01/14	16/01/14	36.69166	67.70317	6.64	3240	460	410	2.62	26.5	0.22	0.02	605	25	75	60	0
228	Chimtal	Jar Qala	02/01/14	09/01/14	36.67897	66.75861	6.8	572	80	58	0.46	11.96	0.21	0.02	94	2.9	29	47.2	0
150	Dawlatabad	Sultan Khuaja Paien	02/01/14	07/01/14	36.89618	66.81961	7.69	585	47	64	2.1	7.02	0.21	0.03	96	3.6	44	36	0
339	Balkh	Airport	18/10/10	23/10/10	36.62416	67.14845	7.7	3480	32	2000	5	10.7	0.2	0.05	743	8.2	150	200	0

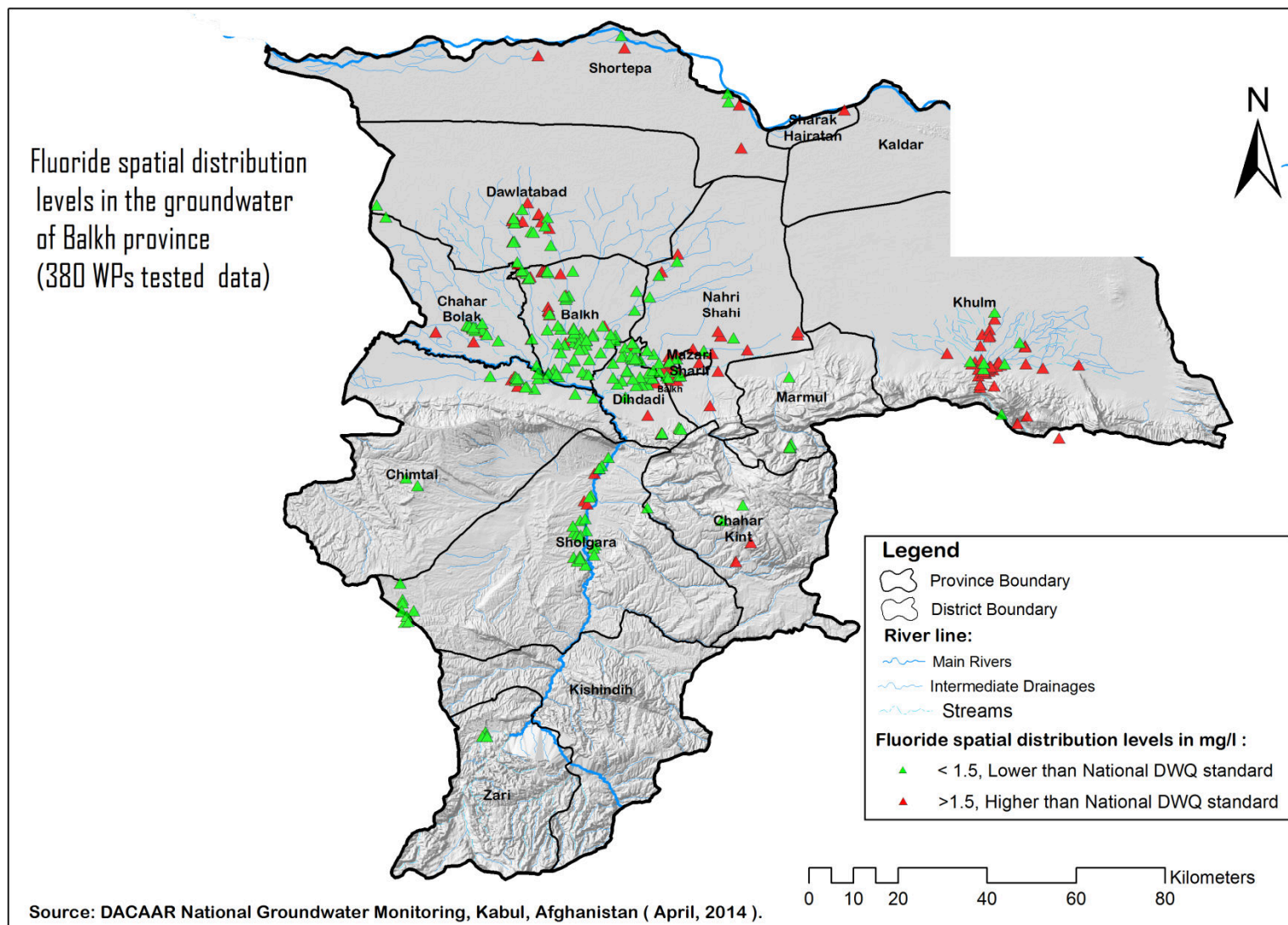
234	Char Bolak	Khuaja Gul Border	01/01/14	16/01/14	36.78712	66.65743	7.12	935	120	78	0.92	14.64	0.19	0.01	179	10.5	50	41.2	0
72	Khulm	Telly Bala	09/01/14	22/01/14	36.69916	67.70918	7.03	4500	520	380	2.86	22.16	0.18	0.01	428	22	150	71.2	0
362	Dehdadi	Shir Abad Sufia	27/01/13	27/01/13	36.69208	67.04592	7.3	1922	30	250	1.16	4.72	0.166	0.01	262	5.5	25	69.6	0
274	Char Bolak	Warnagha	01/01/14	16/01/14	36.78743	66.65843	7.01	580	70	63	1.15	7	0.15	0.01	79	6	31	38.8	0
347	Sholgara	Tashkalidy	29/01/13	30/01/13	36.18711	66.53848	7.5	862	9.1	99	0.42	2.92	0.15	0.02	107	10.5	95	70.8	0
30	Dehdadi	sheabad ulya	21/11/13	27/11/13	36.68396	67.02772	7.52	1158	145	165	1.34	29.5	0.14	0.03	170	1.8	80	67	0
94	Balkh	Masjed Tarookai Qandari	10/12/13	24/12/13	36.76828	66.88695	6.53	1564	185	252	1.48	15.6	0.13	0.02	281	41	70	70	0
108	Balkh	Spin Kwat Mmasjt	17/11/13	19/11/13	36.77212	66.87556	7.43	799	44	62	0.85	31.98	0.12	0.02	103	5.7	50	54	0
305	Balkh	Kata khil Tati	28/11/13	08/12/13	36.78619	66.8408	7.5	961	86	81	0.59	15.94	0.12	0.02	96	4.7	55	73.2	0
281	Char Bolak	Warnagha	01/01/14	16/01/14	36.77963	66.66875	7.18	530	87	59	0.66	3.73	0.12	0.01	98	2.4	32	35.8	0
204	Nahri Shahi	Watta Qul	08/01/14	27/01/14	36.8892	67.0455	7.44	1118	135	116	1.07	12.14	0.12	0.01	215	4.6	68	93.6	0
303	Balkh	Ghulam Jan	28/01/13	29/01/13	36.4785	66.53365	7.7	1319	29	176	0.72	3.44	0.1	0	246	5.1	34	51.6	0
302	Balkh	Warshow	28/01/13	29/01/13	36.46296	66.55709	7.92	1243	32	104	0.69	3.12	0.1	0	181	6.6	23	51.6	0
356	Sholgara	Mohd Karam	30/01/13	30/01/13	36.21085	66.54984	7.17	1032	22.5	142	0.66	4.66	0.1	0	170	7.4	33	67.2	0
222	Dehdadi	Chalgazi high school	12/11/13	16/11/13	36.71954	66.98959	7.85	1065	165	205	0.96	14.08	0.09	0.02	219	3.8	38	65.6	0
343	Sholgara	Sar-e Asyab	31/01/13	31/01/13	36.20952	66.52518	7.6	1022	19.5	228	0.65	4.22	0.083	0	242	4	29	90.4	0
361	Sholgara	Sar-e Asyab	31/01/12	01/02/13	36.20834	66.52582	7.9	1010	20	100	0.68	3.66	0.083	0	156	3.6	33	11.6	0
179	Balkh	Salarzy	06/01/14	16/01/14	36.80927	66.8245	7.67	1885	210	320	1.17	5.22	0.08	0.02	318	8.8	120	68	0
149	Dehdadi	Nigaazi	12/05/13	12/10/13	36.71038	66.95205	7.63	971	105	128	0.72	31.1	0.08	0.01	90	5.2	46	71	0
365	Sholgara	Bagh-e Pahlawan	29/01/13	31/01/13	36.26643	66.52254	7.21	1156	23.5	232	0.9	3.28	0.075	0.02	202	3.3	39	83.5	0
350	Sholgara	Qapchak	29/01/13	30/01/13	36.19973	66.53552	7.15	786	14.5	66	0.65	2.7	0.06	0.01	171	4.8	33	86	0
351	Sholgara	Mohajer Qeshlaq	16/11/12	25/11/12	36.18562	66.53089	7.89	731	14.5	57	0.68	3.82	0.03	0.03	126	10	28	96	0
344	Char Bolak	Baday Balkhy Schoo	05/11/10	09/11/10	36.77278	66.59397	7.49	15330	44	2700	6	3.6	0.026	0.04	880	29	920	134	0
349	Char Bolak	Abo Shokor Balkhy	05/11/10	09/11/10	36.75317	66.67047	7.55	15030	42	5200	5	4.86	0.013	0.05	980	155	920	239.6	0
335	Dehdadi	Shir Abad	26/01/13	26/01/13	36.41862	67.02156	7.39	1750	25	216	1.4	0	0.01	0.01	445	3.9	55	28	0
348	Balkh	University	31/01/10	01/02/10	36.71059	67.12623	7.99	4620	50	195	5	15.98	0	0.11	292	16	80	200	0
372	Balkh	Bazar	17/04/10	25/04/10	36.75587	66.89859	7.75	941	18.5	132	0.58	2.74	0	0.01	109	4.1	41	116	0
353	Balkh	Bazar	20/04/10	25/04/10	36.75513	66.8981	7.88	957	23	136	0.85	3.3	0	0	159	4.8	44	82.4	0

299	Chimtal	Palo	28/04/10	28/04/10	36.65803	66.7936	7.17	3930	16	256	1.5	3.04	0	0	185	6	220	117	0
354	Chimtal	Guzar-e Bangala	05/04/12	05/04/12	36.68013	66.81301	7.4	1684	38	134	0.99	1.7	0	0.02	244	2.3	45	70	0
341	Chimtal	Mir Qasim Jan	08/04/12	08/04/12	36.63987	66.91236	7.86	582	15.5	98	0.73	2.04	0	0.03	164	3.8	21	39	0
101	Dawlatabad	Kucha-e Bay Taka	07/07/13	16/07/13	36.98364	66.82387	7.46	1740	42	235	2.75	1.9	0	0.05	491	7.2	60	37	0
319	Dawlatabad	Masjed Rouga	18/10/10	19/10/10	36.98761	66.81525	7.49	1620	34	195	1.16	8.38	0	0.01	263	5.6	50	102.4	0
320	Dawlatabad	Tali Gak	02/05/10	02/05/10	37.02141	66.76918	7.55	1087	16.5	110	1.23	1.3	0	0.01	306	3.1	80	38	0
318	Dawlatabad	Qarshi Gak	05/05/10	05/05/10	37.02123	66.76922	7.55	1316	9	155	1.02	1.76	0	0	77	30	80	46	0
328	Dawlatabad	Kucha-e Payan	04/04/12	04/04/12	37.00543	66.81993	7.75	2330	54	200	1.18	2.56	0	0.02	284	8	30	64	0
342	Dehdadi	Naw Abad Pul-e Babo	07/04/12	07/04/12	36.66552	67.01082	7.2	1962	32	370	1.08	3.22	0	0.04	363	4.2	55	91	0
338	Dehdadi	Deh Abdullah	24/10/10	24/10/10	36.67654	67.02252	7.43	1165	13	150	2.6	6.4	0	0.02	544	5.4	37	95.5	0
337	Dehdadi	Cehl Gazy	22/10/10	22/10/10	36.72481	66.98804	7.49	1080	17	245	0.89	4.92	0	0.05	254	4.8	55	80.8	0
312	Dehdadi	Naw Warid Baba Koh	23/10/10	23/10/10	36.68061	66.95215	7.55	957	18.5	190	0.68	3.22	0	0.04	155	4.2	42	77.6	0
304	Dehdadi	Shir Abad	04/05/10	04/05/10	36.68178	67.3079	7.72	1045	7	155	1.16	3.64	0	0	91	4.6	50	88	0
358	Dehdadi	Alborz Abad Yaka Toot	07/04/12	07/04/12	36.69538	66.9814	7.9	1836	42	400	1.2	2.82	0	0	419	4.1	29	56	0
161	Khulm	Baba sadiq	09/11/13	12/11/13	36.77815	67.71346	7.14	2370	420	256	1.82	18.16	0	0.03	616	15.6	85	46	0
332	Khulm	Ruzi By	06/05/10	06/05/10	36.74556	67.69432	7.25	3510	54	630	3	1.6	0	0	578	31	80	67	0
314	Nahri Shahi	Baba Yadgar	28/04/05	28/04/10	36.71851	67.08112	7.36	2930	32	108	1.49	2.96	0	0	33	13	200	156	0
360	Nahri Shahi	Naw Abad Turkmania	03/04/12	03/04/12	36.69378	67.06661	7.22	1364	27	126	2.95	3.96	0	0.01	308	3.2	65	45	0
334	Nahri Shahi	Ansari	02/04/12	02/04/12	36.73523	67.13563	7.52	1880	42	202	1	5.66	0	0.02	320	11	38	71	0
346	Nahri Shahi	Ali Abad	26/10/10	27/10/10	36.7644	67.17011	8.1	3160	36	1180	5.2	3.64	0	0.08	560	4.6	65	94	0
310	Sholgara	Qadim	28/04/10	28/04/10	36.31964	66.88485	7.31	807	4.7	78	0.67	4.02	0	0	68	3.9	37	79	0
355	Sholgara	Qadim Clinic	13/04/12	14/04/12	36.31798	66.87237	7.9	1138	12	114	0.87	4.48	0	0	259	3.3	33	71	0
311	Shortepa	Islam Penjeh	11/07/10	13/07/10	37.25458	67.18425	8.34	2250	40	280	1.45	3.9	0	0.02	124	9.2	33	54	0

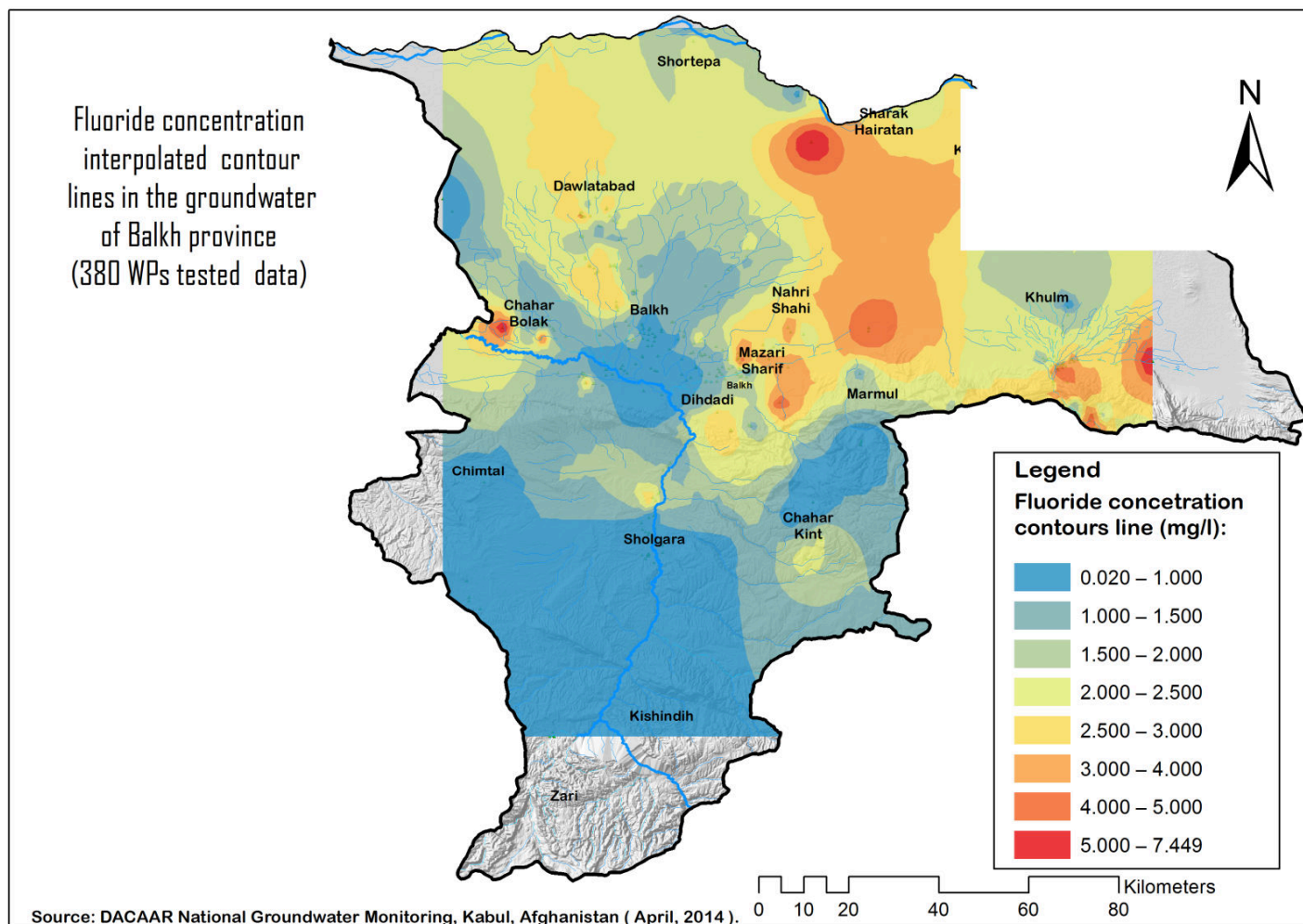
## Annex 2 Fluoride Spatial Distribution Level in Groundwater Afghanistan



### Annex 3 Fluoride Spatial Distribution Level in Groundwater in Balkh

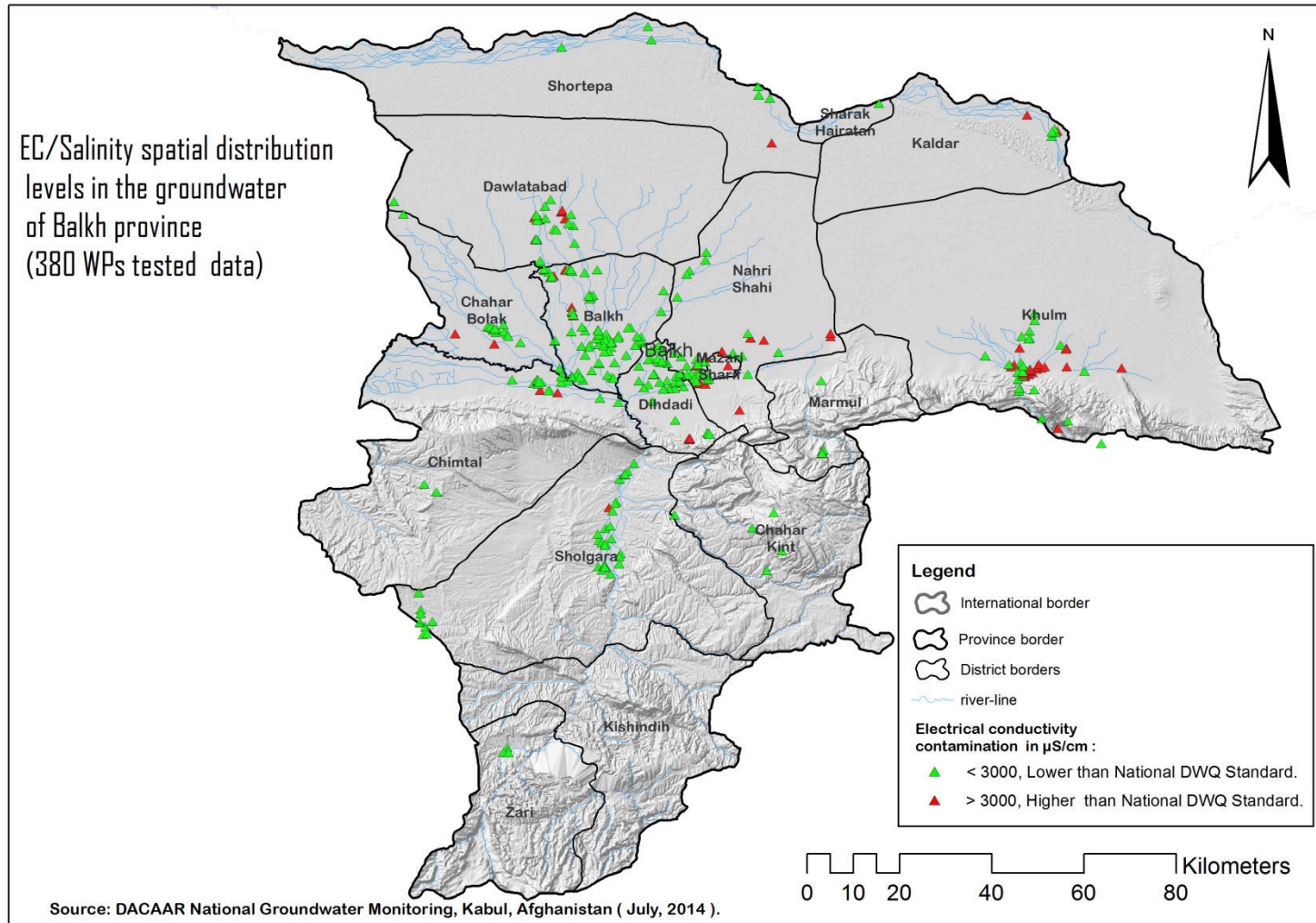


## Annex 4 Contour lines fluoride - groundwater - Balkh Province

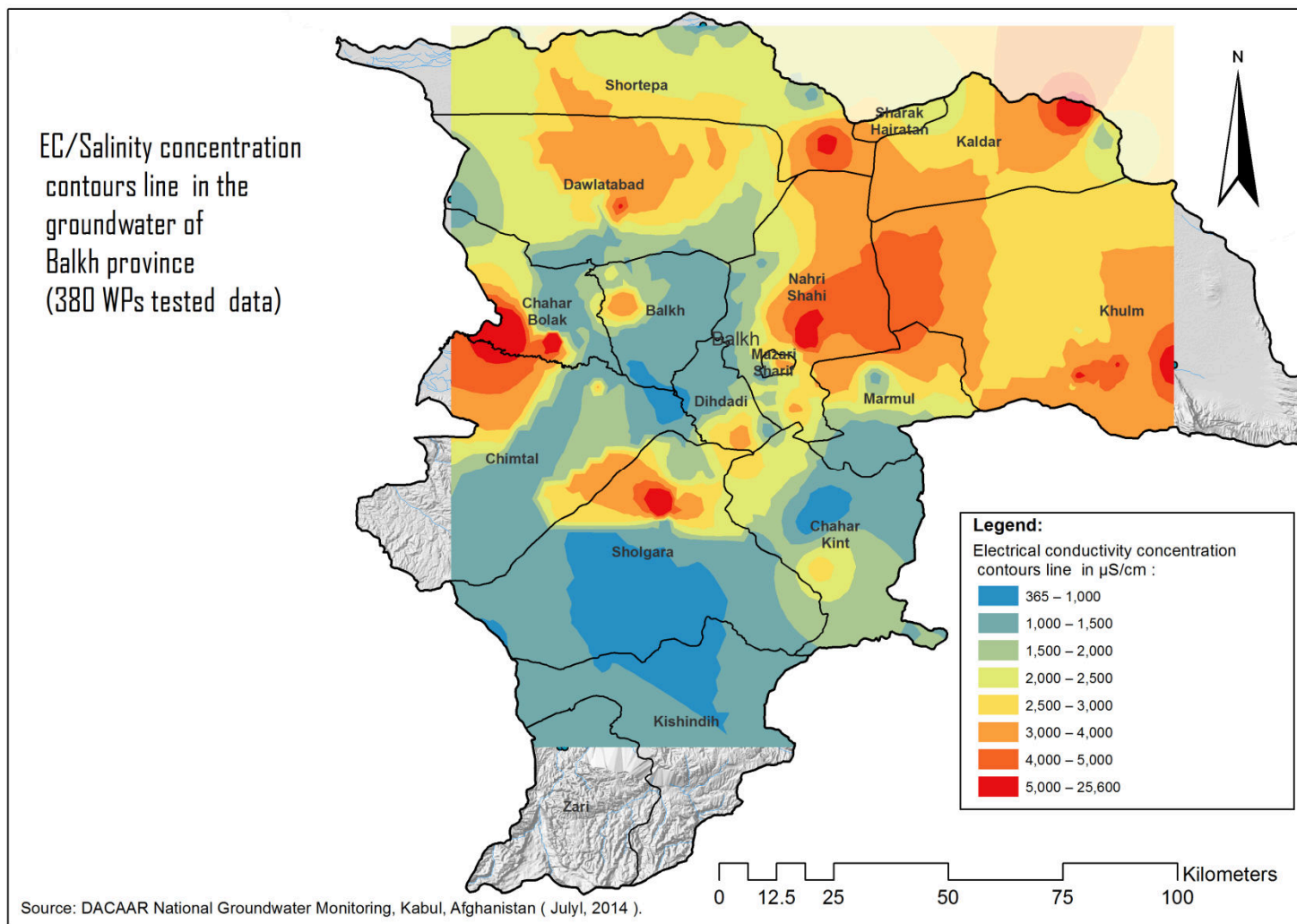




## Annex 5 EC/Salinity distribution in Balkh Province

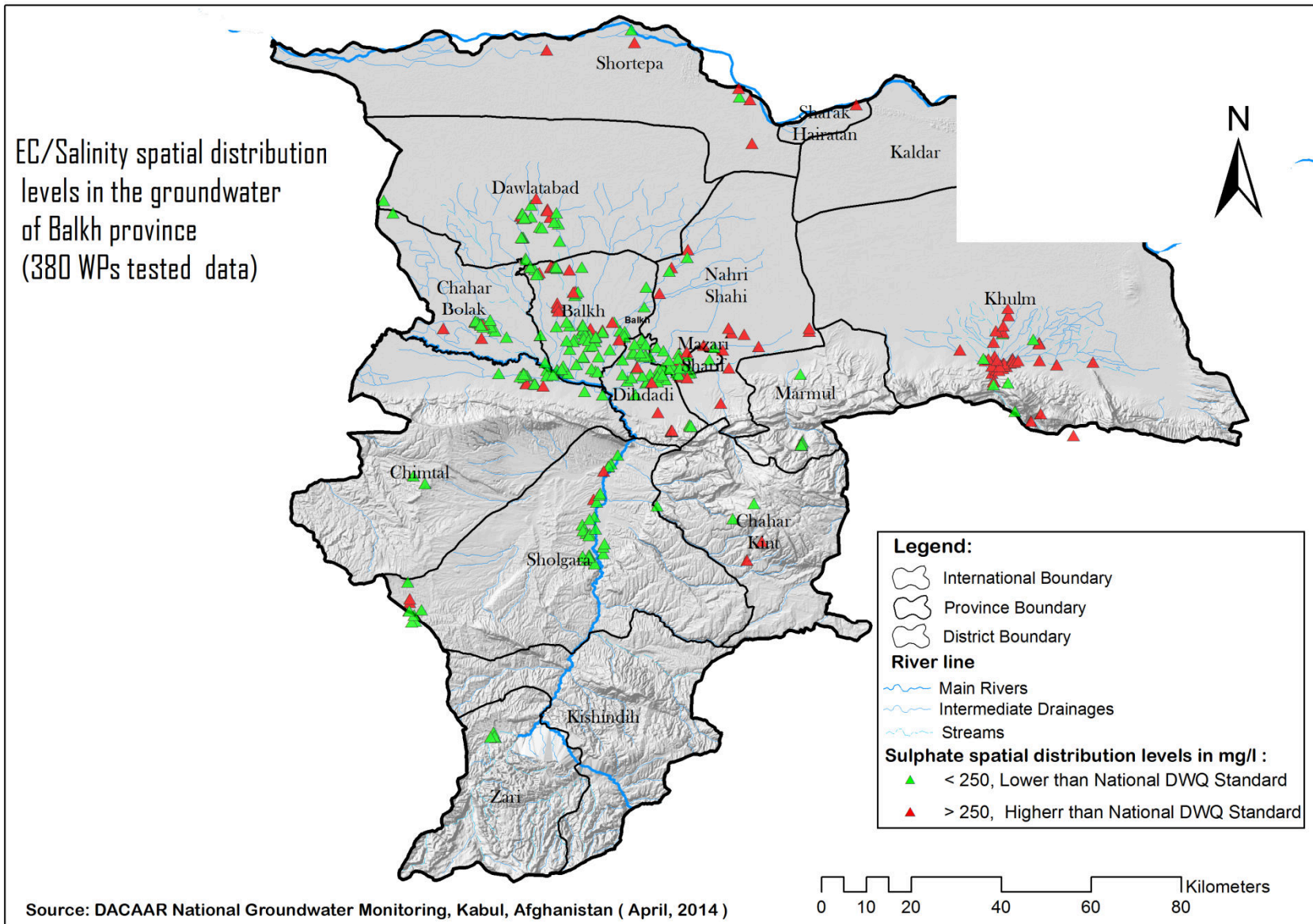


## Annex 6 EC/ Salinity interpolated contour lines Balkh Province

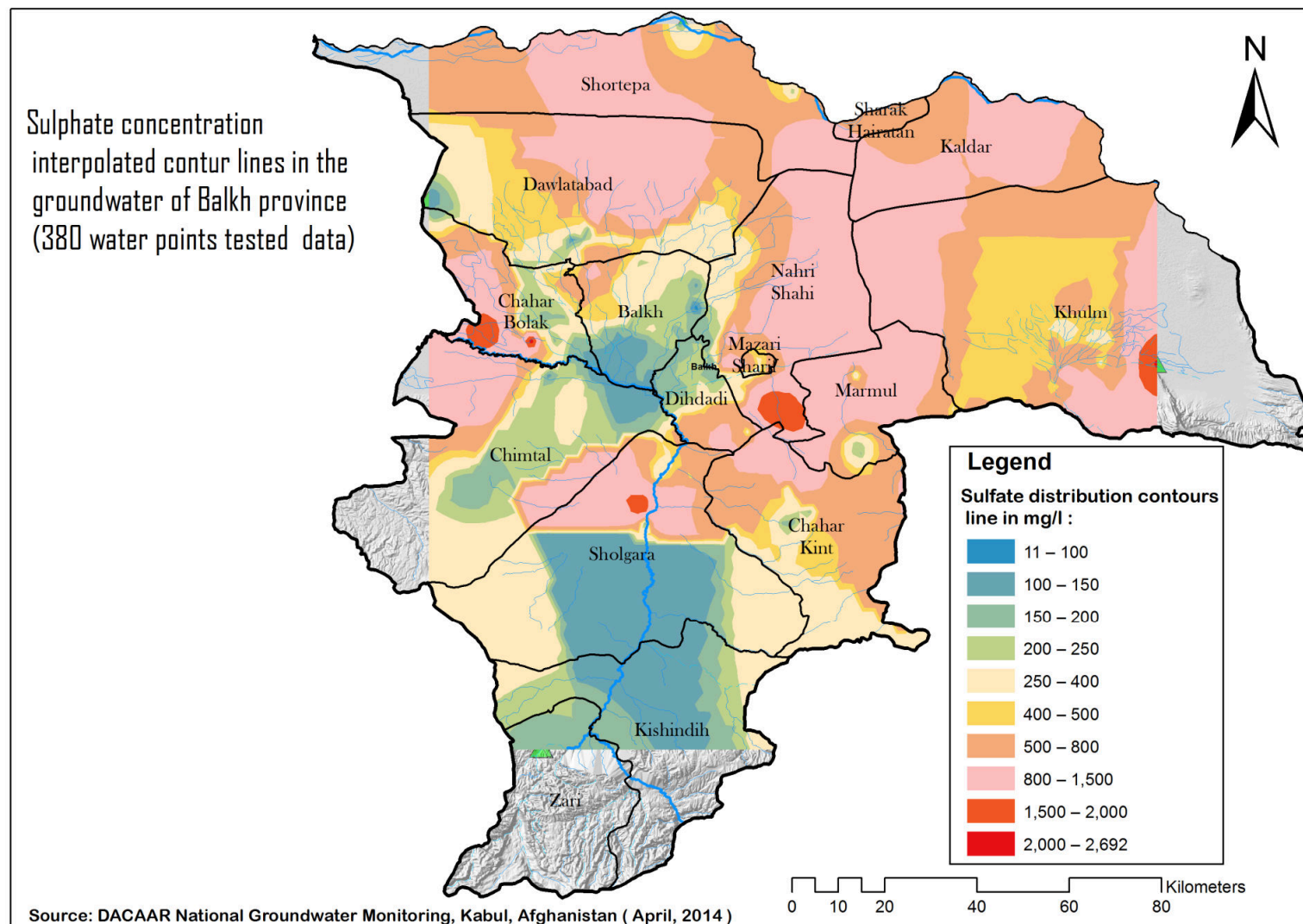




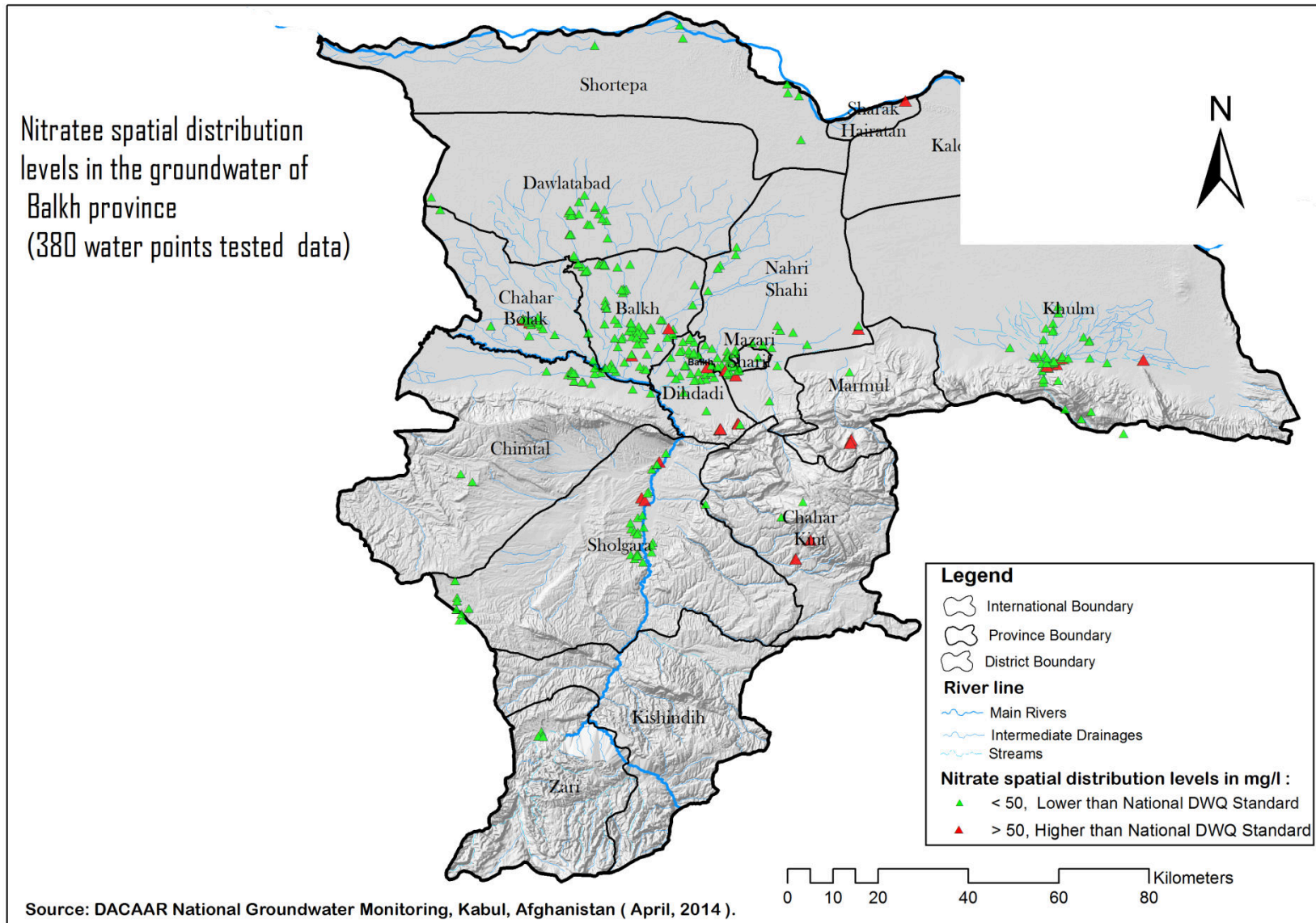
## Annex 7 Sulphate occurrence in Balkh Province groundwater



## Annex 8 Sulphate interpolated contour lines in groundwater Balkh Province

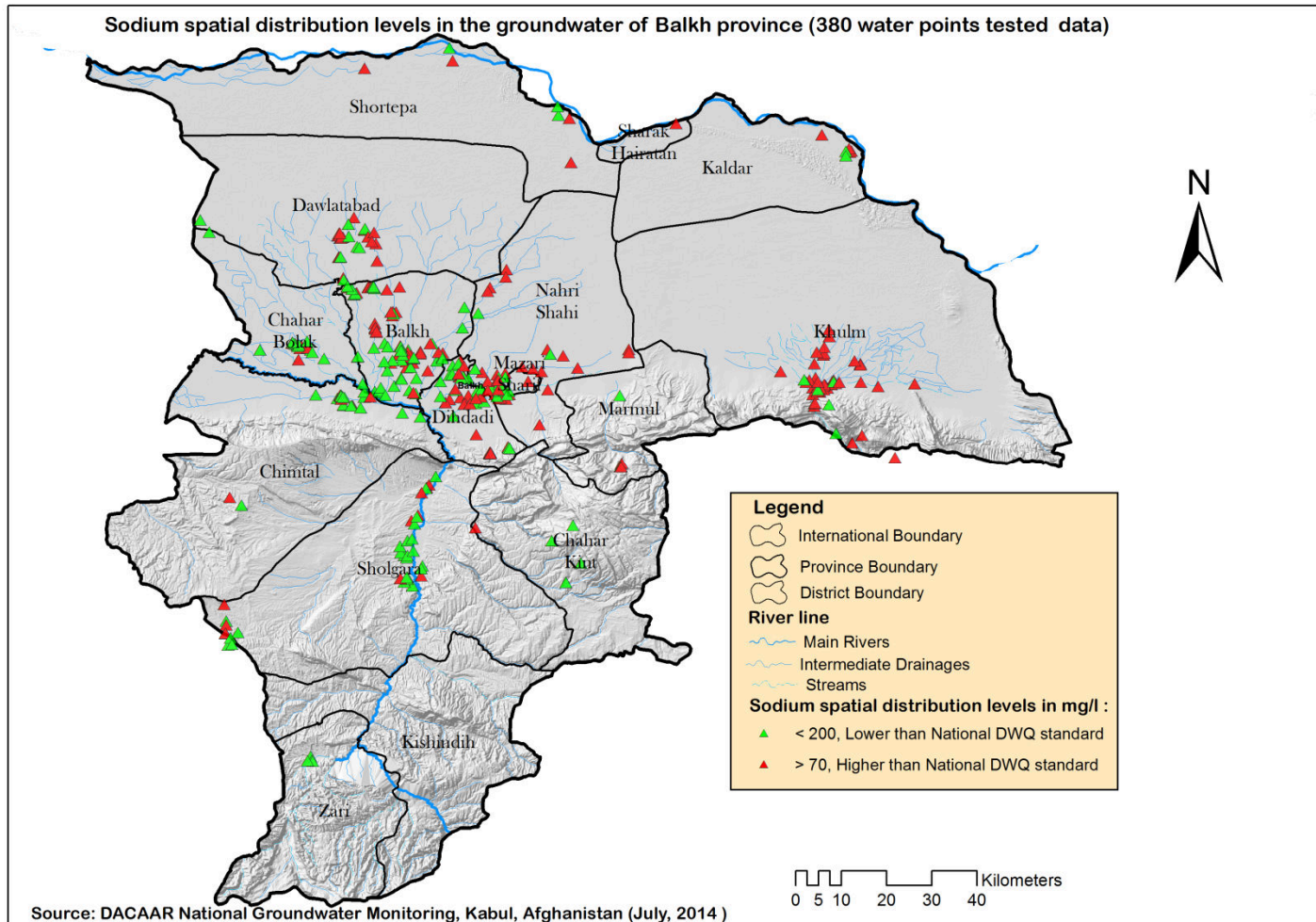


## Annex 9 Nitrate levels in groundwater in Balkh Province

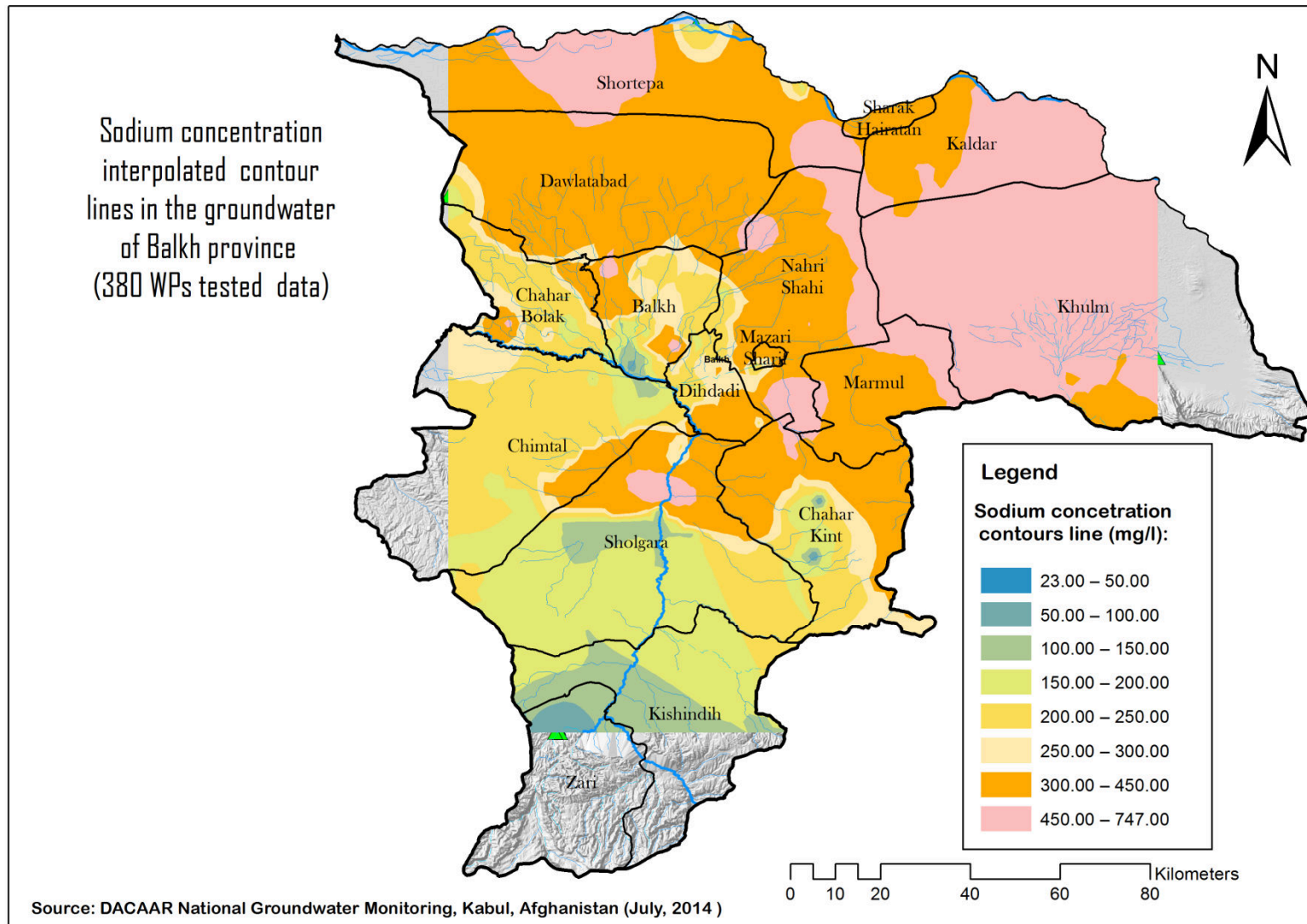




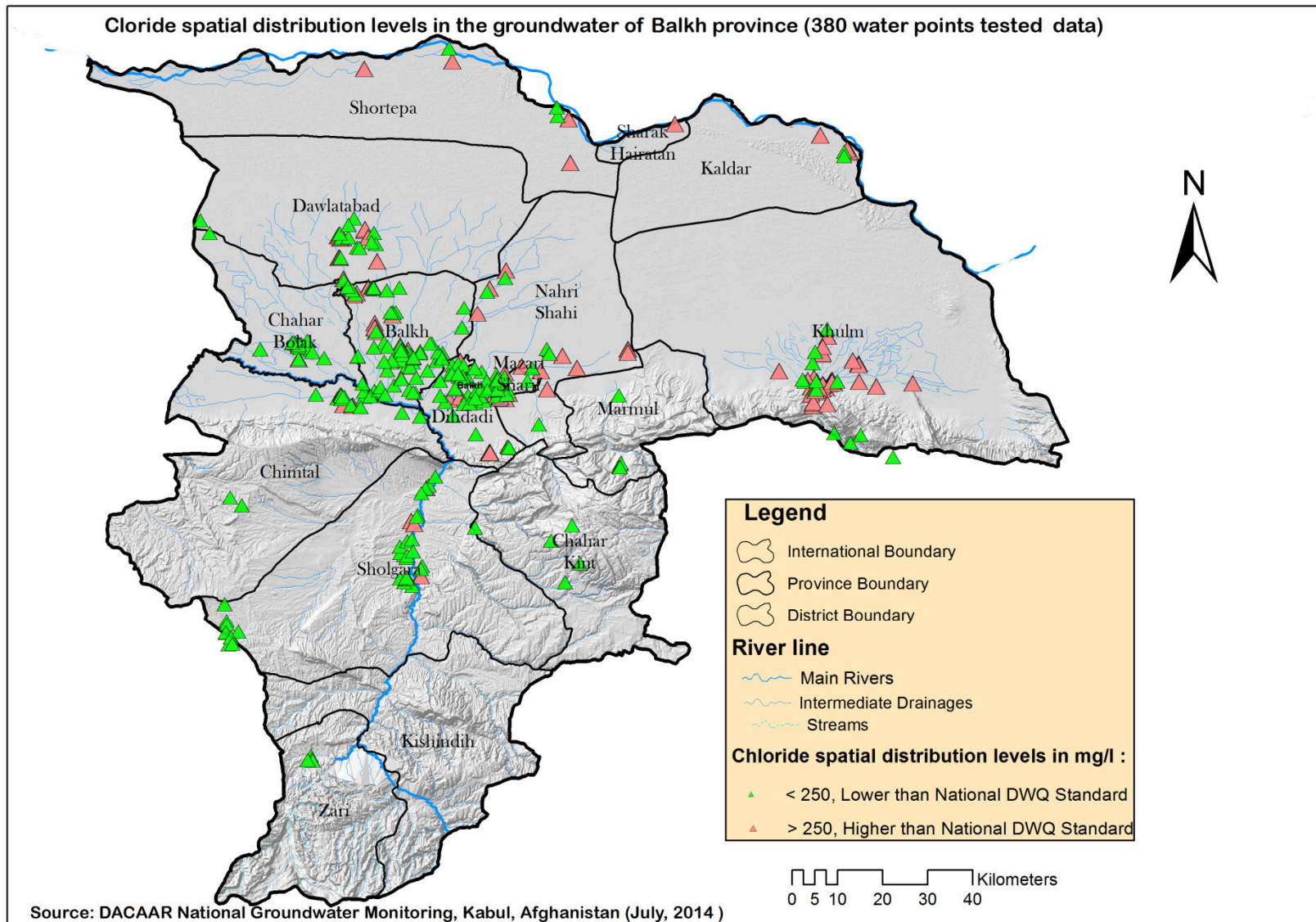
## Annex 10 Sodium level in groundwater in Balkh Province



## Annex 11 Sodium interpolated contour lines groundwater in Balkh Province

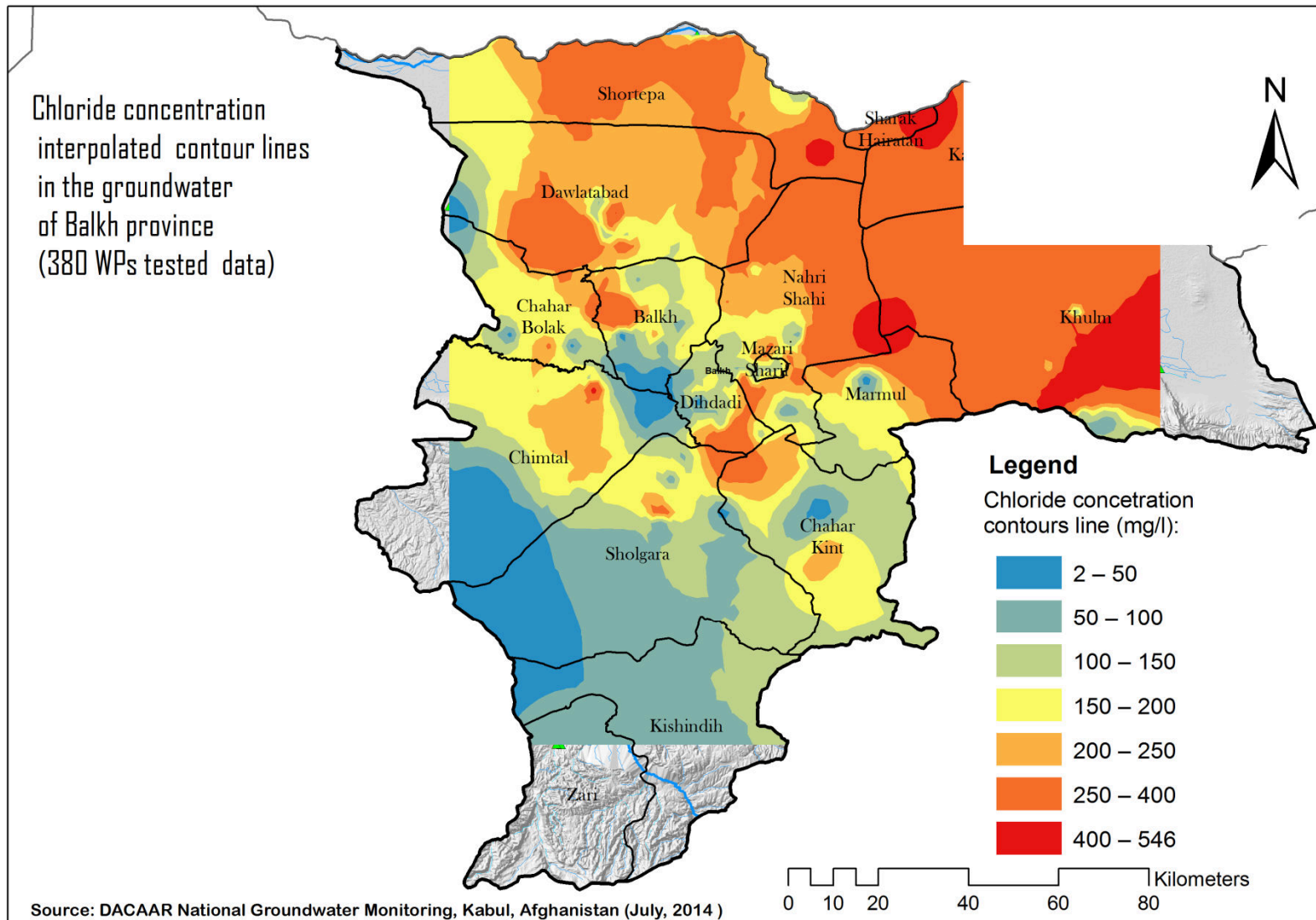


## Annex 12 Chloride levels in groundwater in Balkh Province

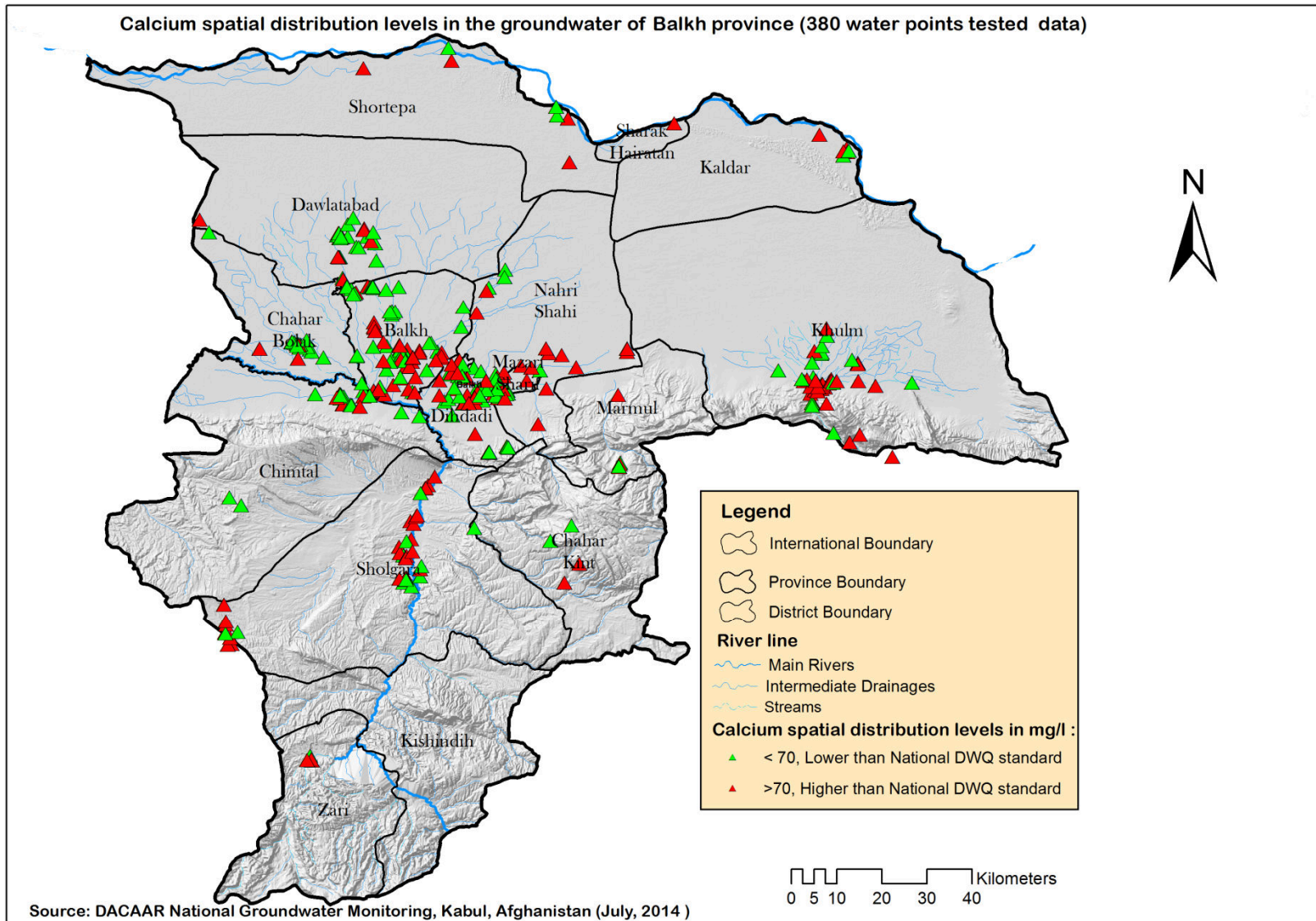




## Annex 13 Chloride interpolated contour lines in groundwater Balkh Province

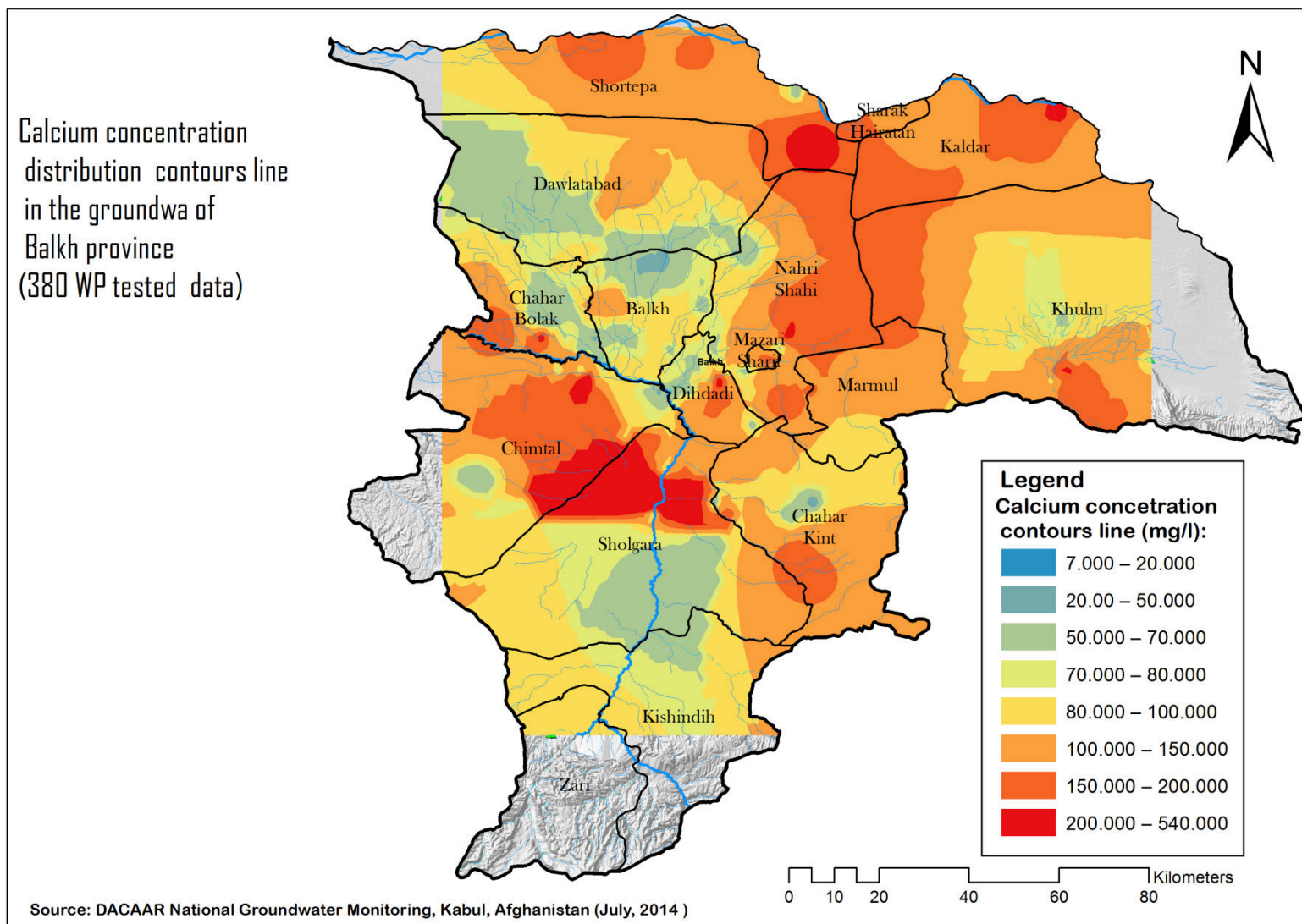


## Annex14 Calcium levels in groundwater Balkh Province

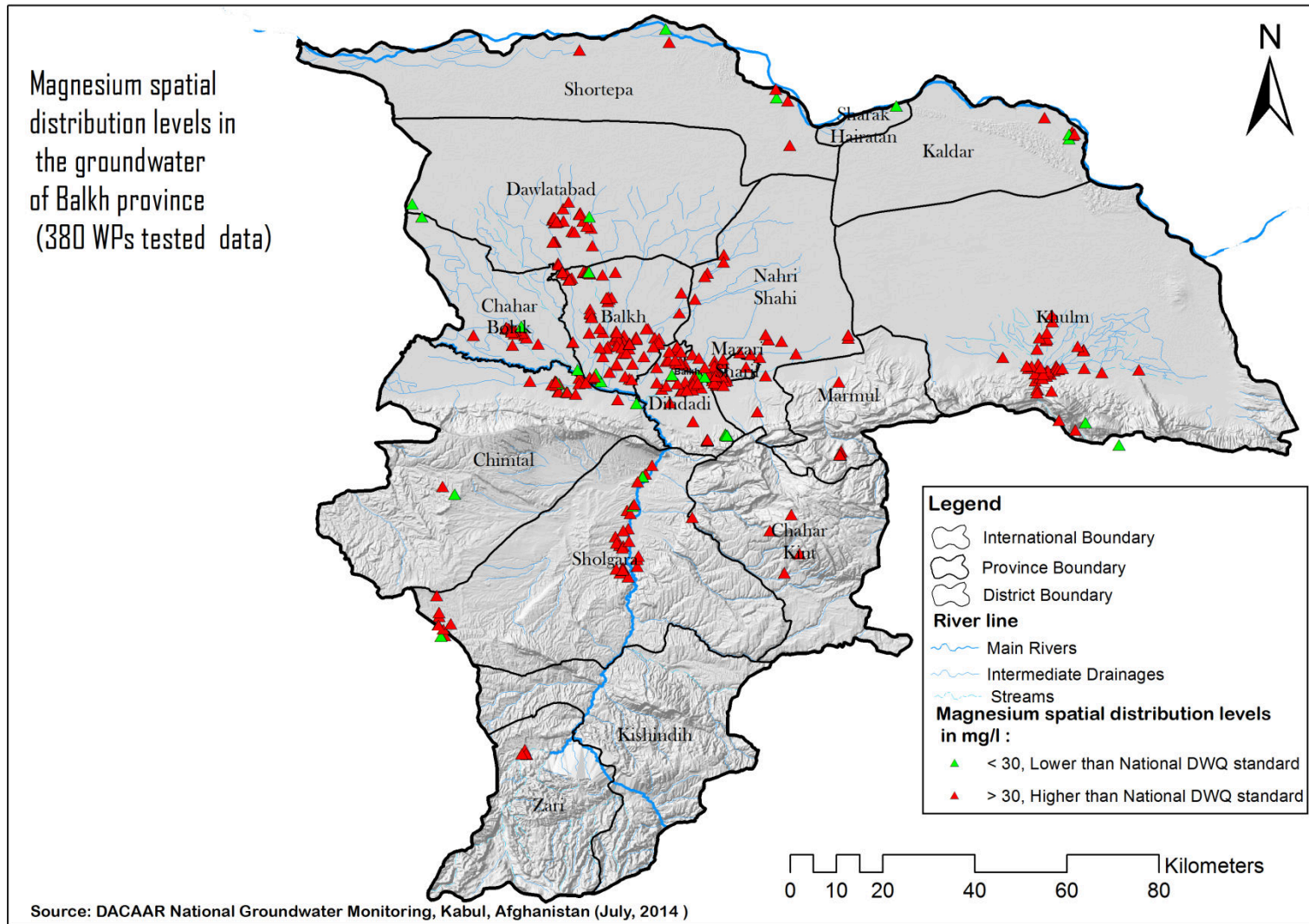




## Annex 15 Calcium interpolated contour lines in Balkh Province



## Annex 16 Magnesium levels in groundwater in Balkh Province



## Annex 17 Magnesium interpolated contour lines in groundwater Balkh Province

