ASSESSMENT OF RESPONSIBLE SECTORS HAVING CONSIDERABLE POLLUTION LOAD IN YESILIRMAK RIVER BASIN, TURKEY

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ABSTRACT

ASSESSMENT OF RESPONSIBLE SECTORS HAVING CONSIDERABLE POLLUTION LOAD IN YESILIRMAK RIVER BASIN, TURKEY

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The Water Framework Directive(WFD) of the European Union requires achieving good quantitative and qualitative status for all water bodies within its territory. For achieving good chemical and ecological status, the Member States were expected to comply with the Environmental Quality Standards(EQSs) for 45 dangerous substances identified as "priority" and river basin "specific pollutants" requiring identification.

This study aims to identify the potential point pollution sources of the river basin specific pollutants that exist in the Yeşilırmak river; and associate these water pollution with their sources for the most effective management strategy. Towards this objective; firstly, an inventory of wastewater treatment plants(WWTPs), small industrial sites(SISs), organized industrial zones(OIZs) and individual industrial establishments in the Yeşilırmak Basin was formed and the industrial facilities inside OIZs were determined. Then, the water quality monitoring results obtained from the project entitled "Management of Point and Diffuse Pollution Sources of Yeşilırmak River Basin", of which this thesis is a part were assessed to identify the pollutants that exceed EQS, and to indicate the spatial distribution of these pollutants' sources and the major polluted areas. An ArcGIS file was used for the identification of the water pollution. A literature study on possible sources of these pollutants was conducted and then a relationship among each pollutant and its possible sources was tried to be established The results indicated that metal pollution is a major problem in the basin and the metal, machinery, plastics and food industries are the main industrial sectors having high effect on pollution..

Keywords: Priority Substances, Specific Pollutants, Source Assessment, Industrial Water Pollution, Yeşilırmak River Basin

ÖZ

YEŞİLIRMAK HAVZASI' NDA, ÖNEMLİ KİRLETİCİ YÜKÜNE SAHİP OLAN SEKTÖRLERİN DEĞERLENDİRİLMESİ

Erdem, Elif
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Avrupa Birliği Su Çerçeve Direktifi (SÇD), kendi topraklarındaki tüm su kütleleri için iyi nitel ve nicel statüyü elde etmeyi hedeflemektedir. Üye Devletlerin, iyi kimyasal ve ekolojik statü elde etmek için "öncelikli" olarak tanımlanan tehlikeli madde ve madde grupları ve ilgili nehir havzası için yüksek risk oluşturan tanımlanması gereken "belirli kirleticiler" in Çevresel Kalite Standartlarına (ÇKS) uymaları beklenmektedir.

Bir nehir havzasındaki kirliliğin uygun maliyetli yönetimi için kritik kirletici kaynakların belirlenmesi, nehir kalite yönetimi için önemli bir başlangıç adımıdır. Bu çalışma, Yeşilırmak'da bulunan nehir havzasına özgü kirletici maddelerinin ve potansiyel kirlilik kaynaklarının tespit edilmesini; ve en etkin su kirliliği yönetim stratejisini geliştirmek için kirliliğin kaynakları ile ilişkilendirilmesini amaçlamaktadır. Bu amaçla; öncelikle Yeşilırmak Havzası'nda atıksu arıtma tesisleri (AAT'ler), küçük sanayi siteleri (KSS'ler), organize sanayi bölgeleri (OSB'ler) ve bireysel sanayi kuruluşları için envanter çalışması oluşturulmuş ve OSB'lerin içindeki sanayi tesisleri belirlenmiştir. Ardından, bu tezin de bir parçasını oluşturduğu

“Yeşilırmak Havzası Noktasal ve Yayılı Kirlilik Kaynakları Yönetimi” başlıklı projeden elde edilen su kalitesi izleme sonuçları, ÇKS'yi aşan kirleticileri tespit etmek ve bu kirletici kaynakları ve başlıca kirli alanların mekansal dağılımını göstermek amacıyla değerlendirilmiştir. Su kirliliğinin belirlenmesi için ArcGIS dosyası kullanımış, bu kirleticilerin muhtemel kaynakları hakkında bir literatür çalışması yapılmış ve daha sonra her bir kirletici ile EQS aşımı bulunan izleme istasyonlarının mevcut kaynakları arasında bir ilişki kurulmaya çalışılmıştır. Çalışma sonuçları, metal kirliliğinin havzada önemli bir problem olduğunu ve metal ürünler, makine, plastik ve gıda endüstrilerinin kirliliğe yüksek etkisi olan ana sanayi sektörleri olduğunu göstermiştir.

Anahtar Kelimeler: Öncelikli Maddeler, Belirli Kirleticiler, Kaynak Değerlendirmesi, Endüstriyel Su Kirliliği, Yeşilırmak Havzası

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TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATIONS

BAT	The Best Available Techniques
BIKOP	Determination of Water Pollution Resulting from the Usage of Plant Protection Products and EQS Determination Based on Substance and Substance Groups
BREFs	The Best Available Techniques reference documents of EU
DABLAS	European Commission Black Sea and Danube River Pollution Prevention Task Force
DSI	State Hydraulic Works
EQS	Environmental Quality Standard
EU	European Union
GEF	Global Environment Facility
GIS	Geographic Information Systems
KIYITEMA	Detection of Dangerous Substance and Coastal Ecological Dynamics in the Coastal and Transitional Waters of Turkey Project
MoEU	Ministry of Environment and Urbanization
OISB	Operational Monitoring Stations of Ministry of Forestry and Water Affairs
OIZ	Organized Industrial Zone
RBMP	River Basin Management Plans
SIS	Small Industrial Sites
TMKK	The Project on Control of Dangerous Substance Pollution

TOBB	The Union of Chambers and Commodity Exchanges of Turkey
TOBB	The Union of Chambers and Commodity Exchanges of Turkey
TUBITAK	The Scientific and Technological Research Council of Turkey
TUBITAK MAM	The Scientific and Technological Research Council of Turkey Marmara Research Center
TUIK	Turkish Statistical Institute
WFD	The Water Framework Directive
WWTP	Wastewater Treatment Plant
YHYP	Management of Point and Non-Point Source Pollution in the Yeşilırmak River Basin Project

CHAPTER 1

INTRODUCTION

Rapid urbanization, industrialization and population increase put intensive pressure on water resources day by day and water resources are affected by pollution, scarcity and floods. In order to protect and improve the basic functions of water, water ecosystems should be managed appropriately, and protected against pollution. Substances used in many different household products, industry, agriculture and transportation find their way into the environment through point and diffuse pathways, and cause undesirable effects. They not only give damage the aquatic fauna and flora by changing the state of a water environment, but also are threat to public health.

Point sources are identifiable sources of pollution and usually results from a discharge from pipes and storm drains, industry or treatment plants. Urban development, industrial activities and aquaculture can be counted as the main drivers (FN & MF, 2017).

Urban wastewater mainly comprises of domestic, commercial and urban sources. Inappropriately treated or untreated urban wastewater and sewage may be one of the serious sources of point pollution. In addition, waste disposal sites are other threats for surface water since they generate leachate waters with high loads of oxygen-consuming substances, chemicals and hazardous substances due to the decomposition (FIP, 2018).

Another source of point pollution is industrial activities. Almost for all industrial activities, water is a vital raw material. During fabrication and processing, it has various uses. It can be used as a diluting and cooling agent. Moreover, it can be used for sanitation purposes or transporting a product (USGS, 2018). Thus, based on manufacturing characteristics, industrial wastewater may be of extremely diverse quantity and a diverse characteristic (EPFL ECHO). Wastewaters from heavy industries such as metal processing, plastic and chemical manufacturing and oil refining sectors usually contain vast amount of toxic and hazardous chemical compounds. In addition, industrial processes of oil and fuel sectors have a risk of accidental spills of pollutants. Moreover, abandoned ex-industrial sites together with active and inactive mining sites can be contaminated or may contain residual pollutants such as chemicals, toxins, and metals (FIP, 2018).

As a last major source of point pollution; if aquaculture wastewaters are not properly handled, fish farming activities may generate a huge amount of nutrient wastes into the surrounding water bodies (FIP, 2018).

Diffuse source water pollution; on the other hand, can result from a range of urban and rural activities which have no obvious discharge point. Agriculture is a typical source of diffuse source pollution. Forestry, atmospheric deposition, and runoff from rural and urban settlements may be other sources to consider. It is reported that diffuse water pollution together with hydromorphological pressures (as a result of interfered habitats) is the most important source of pressure affecting the rivers and streams of EU member states (EEA, 2012). Agricultural activities are stated as the top source of contamination in the freshwaters of the United States (Denchak, 2018).

Diffuse pollution sources, which are inevitable and not easy to control, is still a huge concern because of its need for cautious analysis and understanding the several natural and anthropogenic processes for determination. High level of pesticides, fertilizers used in agricultural activities, animal waste from farms and livestock facilities and eroded soils end up in fresh waters and causes pollution loads through diffusive pathways such as runoff after rain and flood (EEA, 2018).

In terms of chemical characteristics, substances polluting fresh waters can be subdivided as inorganic and organic compounds. While organic compounds comprise volatile organic chemicals, fuels, bulk wastes (such as waste from trees and plants); inorganic compounds include ammonia, industrial chemicals, personal care products and metals (Rinkesh, n.d.). Although conventional wastewater treatment plants are able to treat wastewater containing bulk solids, nutrients and pathogens, they are usually not being able to remove micropollutants coming from the industrial processes or household uses (Schwarzenbach, et al., 2006), (Luo, et al., 2014) (Musolff, Micropollutants in urban receiving waters, 2009).

According to several studies conducted in 14 different countries/regions, treatment efficiencies of micro-pollutants in several WWTPs vary between 12.5% and 100%. Advanced treatment techniques (such as advanced oxidation, activated carbon adsorption, reverse osmosis, nanofiltration and membrane bioreactors) can provide a higher percentage and more coherent removal. Nevertheless, irrespective of the treatment technology used, physicochemical properties of the micro-pollutants and treatment conditions are the main attributes for contaminants removal (Luo, et al., 2014).

Main groups of micropollutants are metals, metalloids and radioactive elements (Pb, Cd, Hg, As, Sb, Rn, U etc.); organic micro pollutants (hydrocarbons, pesticides, solvents, cosmetics and detergents); pharmaceutical products and endocrine disruptors; and natural synthetic hormones. From these micropollutants, heavy metals in fresh waters are of a global concern due to their toxic effect, high persistency and accumulation potential in aquatic organisms. Even though heavy metals naturally exist in the earth's crust, anthropogenic activities (more specifically mining, metal processing; industrial manufacturing; household, agricultural and horticultural usage of metal-containing substances) are the main reasons for most of the human exposure and the environmental pollution (Tchounwou, Yedjou, Patlolla, & Sutton, 2012).

Studies aiming to understand the annual and the spatial trends of the micro pollutants available in surface water environment have been recently increased (Carpenter & Helbling, 2018) especially in Europe after the Water Framework Directive (WFD) (Musolff, et al., 2009) (Cho, et al., 2014). The WFD (2000/60/EC) of the European Union (EU) is a regulation aiming at “good status” in all surface and ground waters. It requires the Member State to comply with the Environmental Quality Standards (EQSs) for dangerous substances that are pollutants having toxic, persistent and bio-accumulative characteristics. In the Directive, dangerous substances (industrial chemicals, metals, biocides, detergents, personal care products etc.) are sub-divided into two group; priority substances and specific pollutants. EU defines 45 priority substances and their EQSs (Directive 2000/60/EC; Directive 2013/39/EU) as the substances putting significant risks to water resources. Moreover, the Directive requires complying with the EQSs determined by the Member States themselves for the “specific pollutants” that pose a high risk in water bodies (at national or river basin scale). In this extent, from the year 2011 to 2015, the Republic of Turkey was lead and supported several scientific researches due to the ongoing harmonization with the EU legislation. As a result of the research forming a candidate list and monitoring and prioritizing the chemicals in this list, 250 specific pollutants was defined and EQSs to be met for these pollutants in surface, coastal and transitional waters of Turkey were set (Orhon, Şıltu, Güçver, & Karaaslan, 2017).

The WFD of EU requires the EU Member States to achieve good qualitative and quantitative status for all water bodies within their territory. In order to achieve good chemical status, The Member States to comply with EQSs for 45 dangerous substances and groups of dangereous substances identified as "priority". Moreover, the Directive requires the Member States to identify relevant river basin specific pollutants that pose a high risk to their water bodies and set EQSs for these pollutants, in order to reach good ecological status. Good ecological status is, in fact, not only based on specific pollutants but also on biological, general hydromorphological and physico-chemical elements of an ecosystem. As a requirement of harmonization between the WFD and the relevant national legislation, the Regulation of Surface Water Quality has been amended and 250 substances and groups of substances were identifed as the specific pollutants of Turkey.

In Turkey, in the year of 2016, Surface Water Quality Regulation[1] was amended and 250 dangerous substances and groups of dangereous substances were identified as "river basin specific pollutants" along with their EQSs values. After this amendement, 45 priority substance and 250 specific pollutants were started to be monitored in national waters of Turkey (Orhon, Şıltu, Güçver, & Karaaslan, 2017) with the purpose of achieving good status in all waters. Achievement of good status in surface water bodies can only be possible by knowing the sources of pollutants precisely and controlling them.

1.1 Management of Point and Non-Point Source Pollution in the Yeşilırmak River Basin Project

As a part of the implementation of the amended Surface Water Quality Regulation, the project entitled "Management of Point and Non-Point Source Pollution in the Yeşilırmak River Basin, No: 114Y013" has been started in 2016. This project aims to develop appropriate management strategies for controlling 45 priority pollutants discharged from point and non-point sources to receiving environment in the Yeşilırmak River Basin where industrial and agricultural activities are commonly observed andto identify basin specific pollutants . In accordance with this main purpose, the objectives of the project are as follows:

- Considering the outcomes of the projects conducted by the General Directorate of Water Management regarding Yeşilırmak River Basin, identification and prioritization of the main point and non-point pollution sources within the basin and pollutants released from these sources,

[1] Official Gazette dated 10 August 2016, numbered 29797:

- With the data obtained from water quality monitoring studies in the field, determination of specific pollutants for Yeşilırmak within the extent required by the EU-WFD,
- Determination of EQS for specific pollutant for which EQS was not set by the General Directorate of Water Management by taking background concentration into account and performing toxicity tests which are needed at this stage,
- Development of a software using total maximum daily load (TMDL) approach and determination of discharge standards for point sources by using this software to meet EQS in Yeşilırmak basin,
- Evaluation of performance and processes that are applied in existing treatment plants to reduce priority and specific pollutants released from point sources that are leading sources in terms of pollutant load and determination of required process modifications to meet discharge standards set for these pollutants,
- Studying membrane filtration and ozonation techniques as advanced treatment to remove priority and specific pollutants arising from domestic and industrial wastewaters in such a way that EQS is met and evaluation of adequacy of the removal efficiency obtained by these treatment options in meeting EQS values via TMDL software,
- Determination of the most appropriate pollution control strategy for all point and non-point sources in the Yeşilırmak River Basin in accordance with the data obtained.

1.2 Objective and Scope of the Study

The main objectives of this thesis study, which is carried out within the above mentioned project's framework, are:

- Identification of the Organized Industrial Zones (OIZs) which are potential point sources of pollution in the basin,
- Identification of main pollutants causing the deterioration of water quality in the basin,
- Associating these pollutants with the sources,
- Determination of the industrial sectors, which are responsible and need to take precautions for the control pollution in the Yeşilırmak River.

Toward the first objective, by considering the quantity and the content of their discharges, OIZs were selected as a focus in terms of pollution sources. Thus, an inventory study was conducted for OIZs in the Yeşilırmak Basin.

For the second objective, the results from the water and wastewater quality monitoring program were evaluated and the major pollutants which will be covered in the present study were determined. Through the monitoring periods, several discharge stations that samples were taken from point pollution sources (domestic and industrial wastewater treatment plant discharges), were also added to the monitored stations for accurate identificationof the responsible sectors. In order to evaluate the contribution of the pollutants to the receiving water pollution, it was calculated that the pollutant concentration was how many times of the EQS value on each riverine (receiving water) station.

In order to determinethe spatial distribution of the sources of the pollutant and the major polluted areas,an ArcGIS file including information of the potential point sources and the measurement stations was used as a map. Point sources of pollution were identified immediately before each receiving water stations. For determining the stations which exceed the EQS most, excel files including related information were created and graphics of percentage EQS vs stations were drawn for each main pollutants.

In order to explain the pollution in Yeşilırmak River Basin, a literature study on possible sources of the pollutants was conducted and tried to establish a relationship between the pollutant and the point sources at the head of the stations which exceeds the EQS most.

The OIZs and the main sectors and individual industrial facilities which have a high effect on pollution were determined to fulfill the fourth objective.

CHAPTER 2

BACKGROUND

2.1 Literature Review on The Relevant Plans and Projects in Turkey

By taking into account the Regional Development Projects and other senior policy documents of Turkey, two of the targets of the Strategic Plan of Ministry of Agriculture and Forestry (MoAF) (former Ministry of Forestry and Water affairs (2017-2021) are determining the quality classes of surface waters, and make holistic plans in accordance with EU legislation for the conservation of water in terms of both quantity and quality (Directorate of Strategy and Budget, n.d.).

In this respect, in order to identify the dangerous substances resulting from point (urban and industrial discharges) and diffuse sources, and set EQS for those substances, MoAF has carried out three researches between the years of 2011 and 2015. These are:

- The Project on Control of Dangerous Substance Pollution (TMKK),
- Detection of Dangerous Substance and Coastal Ecological Dynamics in the Coastal and Transitional Waters of Turkey Project (KIYITEMA),

- Determination of Water Pollution Resulting from the Usage of Plant Protection Products and EQS Determination Based on Substance and Substance Groups (BIKOP) (Orhon, Methodology for Improvement of Environmental Quality Standards Related to Dangerous Substances , 2015).

In the following sections, these three projects are briefly described and the main achievements are presented.

2.1.1 The Project on Control of Dangerous Substance Pollution (TMKK)

TMKK Project was carried out in the Konya Closed, Ergene and Susurluk River basins from the year of 2011 to 2013. The aim of the project was to identify and to prioritize possible pollutants that may originate from point and diffuse sources and reach inland waters (Şıltu, 2015). According to the results of the prioritization, 147 substances were evaluated as risky for the aquatic environment and they were proposed as a candidate of specific pollutants (Orhon, Dissertation on Methodology for Development of Environmental Quality Standards Related to Dangerous Substances, 2015).

2.1.2 Detection of Dangerous Substance and Coastal Ecological Dynamics in the Coastal and Transitional Waters of Turkey Project (KIYITEMA)

The KIYITEMA Project was run between the years of 2012 and 2014, in the pilot project areas of İzmir-Nemrut-Aliağa Bay, Hatay-Iskenderun Bay, İzmit Bay and Samsun Harbour. The project targeted to determine the specific pollutants from point sources in coastal and transitional waters of Turkey. For 43 pilot plants and 24 industrial sectors (including iron and steel industry, petrochemical industry, natural gas conversion and filling facilities, refineries, paper industry, port activities, ship dismantling facilities, chemical industry, fertilizer industry, pharmaceutical industry urban wastewater treatment facilities and OIZs), sectoral inventory studies were carried out (Şıltu, 2015). As a result of the 3-step elimination and prioritization on the candidate list, a total of 138 dangerous substances were identified as candidate specific pollutants (Orhon, Dissertation on Methodology for Development of Environmental Quality Standards Related to Dangerous Substances, 2015).

2.1.3 Determination of Water Pollution Resulting from Usage of Plant Protection Products and EQS Determination Based on Substance and Substance Groups (BIKOP)

The BIKOP Project was conducted between 2012-2014 in Büyük Menderes, Fırat-Dicle, Seyhan and Ceyhan Basins and provinces of Amasya, Manisa and Sakarya in order to assess the diffuse source- specific pollutants of the waters of Turkey. Water and sediment samples were collected from a total of 245 sampling points for a period of 2 months and over a 1 year period. A total of 305 plant protection products were analyzed. After compiling the pesticides which are in the list of plant protection products used in the past and being currently in use, the "Active Substance Comparison List" was established. In the end, 293 pollutants were identified as candidate- specific pollutants at the end of the prioritization study (Şıltu, 2015).

After the evaluation of the proposed pollutants within the scope of these 3 studies, 117 point-source and 133 diffuse-source specific pollutants were determined as specific pollutants of surface waters of Turkey. These projects not only have been supportive projects for determination of the specific pollutants, but also have drawn a road map with their methadologies for the later stage which is the identification of the riverbasin specific pollutants of Turkey.

2.2 Literature Review on Plans and Projects Concerning Yeşilırmak Basin

In accordance to the WFD, MoAFthe Ministry of Water Affairs and Forestry (Ministry of Agriculture and Forestry) is currently preparing river basin management plans (RBMP) for the river basins of Turkey. In this context, a RBMP for Yeşilırmak River

Basin is under preparation. There are a couple of other projects that are prepared on Yeşilırmak River Basin, and that will provide inputs to the Yesilirmak River Basin Management Plan. The present thesis is a part of one of these projects (TUBITAK Research Project 115Y013, 2014).

In the following sections, above-mentioned projects are shortly presented in order to provide background information about Yeşilırmak River Basin.

2.2.1 Anatolian Water Basin Rehabilitation Project

The project was started in 2005 and implemented for 7 years and supported by World Bank and Global Environment Facility and carried out by the former Ministry of Food, Agriculture, and Livestock. Its aim was a consistent natural resource management, improvement of the income of the people living in water basins of Anatolia and Black Sea Region, and to reduce the pollution caused by the rivers Kızılırmak and Yeşilırmak flowed into the Black Sea.

Under the scope of the Project,

- Water quality monitoring studies,
- Awareness raising activities in order to introduce the project with local people,
- Preparation of good agricultural practice guides,and
- Implementation studies related with "Regulation on the Protection of Waters against Agricultural Nitrate Pollution[2]" for harmonization with the EU

was done (Ministry of Agriculture and Forestry, n.d.).

As the World Bank reported, more than 30% of the farmers have been adopted better manure management applications such as manure holding spots that prevent dangerous nitrates from flowing directly into the soil (The World Bank, 2014).

[2] Official Gazette dated 18 February 2004, numbered 25377

2.2.2 Reduction of Agricultural Pollution in the Black Sea (GEF) Project

This project is the sub-project of Anatolian Water Basin Rehabilitation Project formulated with the assistance of the Global Environment Facility (GEF) and main objective is to prevent animal and plant-based agricultural pollution in watersheds draining into the Black Sea (Yeşilırmak and Kızılırmak Rivers) in four provinces including Amasya, Tokat, Çorum, Yozgat and Samsun (GEF, n.d.).

2.2.3 Yeşilırmak Basin Development Project

This project includes the area of provinces of Tokat, Yozgat, Çorum and Samsun covering 4.63% of Turkey's land with approximately 36,000 km^2 and 450 km long drainage area of Central Black Sea Region, which is a part of the catchment of Yeşilırmak River Basin. In terms of socio-economic development, this region lags behind the western region of Turkey. For this reason, it is aimed to ensure the planned development of the region as a whole in line with the NUTS II Regions Project that jointly prepared by Yeşilırmak Basin Development Project, State Planning Organization and EU (TUBITAK MAM, 2010).

In the scope of the project, Service Unit of Provincial Private Administrations of Yeşilırmak Basin was established. They mainly aims to prevent pollution on tributaries of Yeşilırmak River, avoid erosion in the region, organize flow regime of Yeşilırmak River, conduct all kinds of studies in order to improve the social, cultural and economic developments, plan land use, develop tourism,transportation and communication and improve agriculture and animal husbandry (TUBITAK MAM, 2010).

Under this project, two sub-projects were conducted, namely “Basis for Geographical Information System” and Yeşilırmak Master Plan. By this way, database, which includes composite satellite images; roads and settlements; administrative borders;

vegetation data; rivers and lakes; numerical height, slope, aspect enlightenment; land use; and meteorological data, has been formed and still being improved (YHKB, n.d.).

2.2.4 Report on Proposing Solution for Pollution in Yeşilırmak River and its Tributaries

This report was prepared by a commission created by the Governorship of Amasya in 2006. The reasons for the pollution in Yeşilırmak River Basin and the proposal for a solution in the short, medium and long term to prevent this pollution are stated in this report (TUBITAK MAM, 2010).

2.2.5 Pollution Prevention Project for Derinçay

Derinçay, which also takes the name of Çorum -Çat Water, consists of the merging of streams from Mount Egeri and Mount Kose. It passes by from the 3 km west of the provincial center by taking the Çomarbaşı and Frequency streams. It merges with Yılginözü and Hatap Stream in the south and takes Ahilyas' stream and after that it is named as Çorum Water. When combined with Budaközü from Alaca, it is named as Çat Water. By passing through Mecitözü District and its villages, it merges with Çekerek in Amasya province (Çorum Provincial Directorate of Culture and Tourism, n.d.).

The project was prepared in order to prevent water pollution resulting from Derinçay, one of the tributaries of Yeşilırmak River, by the Çorum Special Provincial Administration in 2006. Within the context of the project benefiting from European Union Small Scale Infrastructure Funds, natural remediation in 34 villages, septic tanks installation in 19 villages, sewage construction in 12 villages have been started (TUBITAK MAM, 2010).

2.2.6 Tersakan Basin Integrated Protection Action Plan

Tersakan, one of the subbasins of Yeşilırmak River Basin, especially crucial in terms of subjecting to continuous pollution resulting from domestic, industrial and agricultural activities in the Yeşilırmak River Basin (Directorate General for Water Management, n.d.).

The purpose of the action plan, which was under the project completed by the Amasya province Special Administrative Directorate, aims to improve and maintain the quality of surface water resources by creating an integrated management system (TUBITAK MAM, 2010).

2.2.7 Yeşilırmak River Basin Integrated Water Resources Management Project

Integrated approach to water resource management is a necessity to improve the management of limited water resources efficiently, fairly and sustainably, and to overcome the conflicting demands (UN, 2014).

In accordance with the WFD, with DABLAS (European Commission Black Sea and Danube River Pollution Prevention Task Force), Yeşilırmak Basin Integrated Water Management Plan was started for supporting the Yeşilırmak Basin Development Project Master Plan in 2008 by taking into consideration of the next 35 years (YHKB).

Project main aims and scope is listed below:

- Definition of water regime, atmospheric inputs, surface water resources, groundwater resources and total water balance in Yeşilırmak River Basin,
- Preliminary assessment of existing water resources required for the implementation of the Basin Economic Development Master Plan; and comparing current and future water needs,
- Assessment of areas where project resources are most needed for funding, focus on the needs of these sites to facilitate and then to make decisions about the management and development of water resources for achieving the sustainable economic development objectives of the Basin Area (TUBITAK MAM, 2010).

Prioritized actions proposed at the end of the project include;

- Revision of the existing Water Quality Monitoring Plan by considering the priority substances in the WFD by the coordination of Ministry of Forestry and Water Affairs, State Hydraulic Works and Development Bank of Turkey,
- Revision of Integrated Water Resources Management Plan as soon as one-year fully regulated monitoring data is available, and

- Monitoring and taking legal action against industrial discharges having high pollutant loads (especially sugar factories and animal wastes in Suluova) (YHKB, n.d.).

2.2.8 Project for the Preparation of River Basin Action Plans -Yeşilırmak River Basin

As a result of the project carried out by TUBITAK MAM; general situation, the infrastructure of the basin and the water resources were designated. With the participation of all the stakeholders, workshops and plans were made for the prevention of the pollution, and the protection and improvement of the basin quality by considering both technologically and economically viable, sustainable measures for short, medium and long terms (TUBITAK MAM, 2010). This project was not essentially comprised of the WFD applications. Instead, it focused on conventional parameters (TUBITAK Research Project 115Y013, 2016).

2.2.9 Management of Point and Diffuse Pollution Sources of Yeşilırmak River Basin (YHYP)

Upon a call of "SU0303- Basin Scale Management of Point and Diffuse Pollution Sources" from "1003 – Research and Development Project Support Program for Priority Areas", the project entitled "Management of Point and Diffuse Pollution Sources of Yeşilırmak River Basin (YHYP)" was started in March 2016.

The main objectives of the project are,

- Identification and prioritization of the dangerous substances and their main point and diffuse pollutant sources,
- The determination of specific pollutants for Yeşilırmak River Basin,
- Establishment of a pollutant inventory showing the pollution sources, discharged pollutants and spatial distribution of the pollution loads,
- Identification of the EQS(by taking into account the background concentrations) for the specific pollutants that Directorate General of Water Management have not determined, and making toxicity tests,
- Determination of the receiving environment based discharge limits for the point sources in the Tersakan Sub-basin,
- Evaluation of the processes and performances applied in existing WWTPs; and determination of the necessary process modifications,
- The assessment of the adequacy of the advanced treatment techniques and the treatment efficiencies provided by these techniques in order to provide EQSs.
- Determination of the best available pollution control strategy for all point and diffuse sources in the Tersakan Sub-basin (TUBITAK Research Project 115Y013, 2018).

With this project, for the first time, by discussing all water bodies in a basin (inland, transitional and coastal water all together), as stated by the WFD, studies on the management of dangerous substances are being carried out (TUBITAK Research Project 115Y013, 2016).With the project output, it is planned to develop a strategy for the management of point and diffuse pollution sources to provide a basis for the preparation of RBMP for Yeşilırmak River Basin (TUBITAK Research Project 115Y013, 2014).

2.3 The Study Area

Yeşilırmak River Basin (Figure 1), the third largest River Basin of Turkey, is located in the northern region of Anatolia. Yeşilırmak River, originating from the Köse and Kızıldağ mountains of Sivas province, has a length of 519 km and its water gives life to3.873.280 ha catchment area before reaching to The Black Sea from the district of Çarşamba, Samsun (YHKB, n.d.).

The flowrate of Yeşilırmak River shows an irregular pattern during the year (1-1000 m^3/s). The average flow rate is 151.4 m^3/s (Çağlar, Kılınç, Koparan, Yivli, & Topsakal, n.d.). Annual total precipitation is 646 mm/ m^2. Floods usually occur in March, April, and May. Important branches of Yeşilırmak River are namely Tersakan, Kelkit and Çekerek streams (Directorate General for Water Management, n.d.).

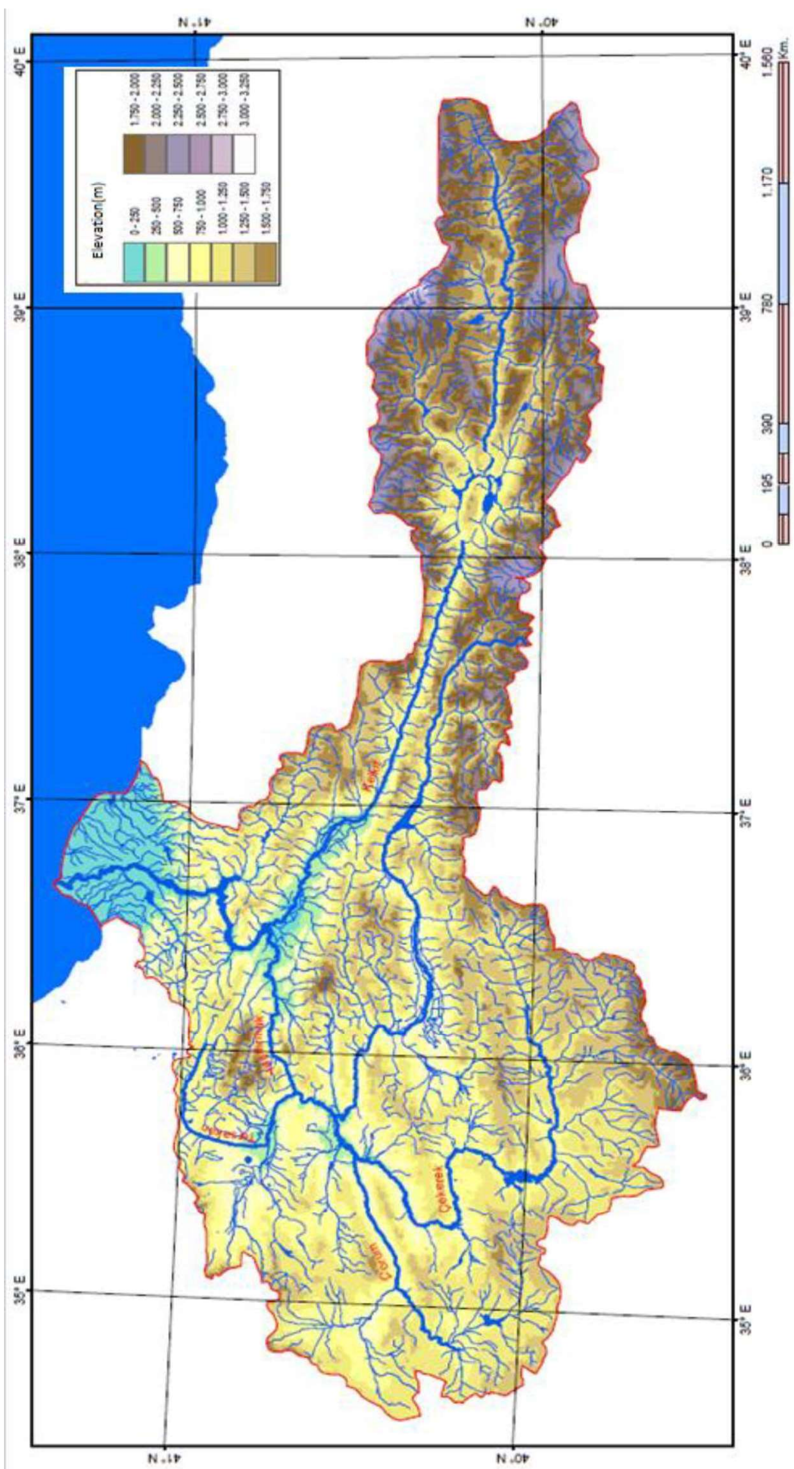

Figure 1 Map of the study area (YHKB, n.d.)

2.3.1 Tersakan Stream

Tersakan stream rises from the mountain of Akdağ. By taken the excessive water of Lake Ladik, it passes through the district of Havza and it confluences with Yeşilırmak in province of Amasya. It is 100m-long and its average flow rate is 3.96 m^3/s. Annual flow is 125x106 m^3.

Şeyhsuyu, Gümüşsuyu, Derinöz and Salhan creeks of the Tersakan Stream are important tributaries. These creeks are located on lowlands of Gümüşhacıköy, Merzifon and Suluova. In addition, on the Derinöz creek, Derinöz Dam is placed (Amasya Provincial Directorate of Culture and Tourism).

2.3.2 Kelkit Stream

It originates from mountains, having an altitude of 2600 m, at the north-west of Erzincan. In the east-west direction, by passing through the districts of Kelkit, Susehri, Koyulhisar, Reşadiye, Niksar, and Erbaa; it merges with Yeşilırmak on the border of provinces of Amasya and Tokat. Length of the stream is 400 km, and its average flow rate is 70.5 m^3/s. The total annual flow is 2526x106 m^3 (Amasya Provincial Directorate of Culture and Tourism).

2.3.3 Çekerek Stream

It rises from the Yıldız Mountains located 50 km northwest of the province of Sivas, and then merges with the Çorum Stream coming from the west and finally mixes with Yeşilırmak at the 15 km south of Amasya. The length of the Çekerek River is 200 km and the average flow rate is 20 m^3/s. The total annual flow is 842x106 m^3. The important branches are Çorum and Efennik creeks.

Süreyyabey Dam is currently being constructed on the Çekerek stream for the protection of the floods, energy production, irrigation purposes of the province of Amasya (Amasya Provincial Directorate of Culture and Tourism).

2.3.4 The Administrative structure of the Basin

Within the boundaries of Yeşilırmak Catchment, the provinces of Tokat, Amasya, Samsun, Yozgat, Çorum, Sivas, Gümüşhane, Erzincan, Giresun, and Ordu are situated(Figure 2). Provinces of Tokat, Samsun, Amasya, and Çorum covers the largest part of the basin (Table 1) and forms one of 26 NUTS 2 regions in Turkey, TR 83. Moreover, the whole basin comes under of 6 different DSI regional directorates in terms of water resources management (YHKB, n.d.).

Table 1 Provinces in Yeşilırmak River Basin and the occupied areas (TUBITAK MAM, 2010)

Province	Total Area of Province (ha)	Area in The Yeşilırmak Basin (ha)	Percentage Share of Provinces (%)	Percentage share of province placing inside the Basin (%)
TOKAT	998.200	998.200	26	100
AMASYA	570.100	488.455	12	86
SAMSUN	957.900	480.732	12	50
YOZGAT	1.412.300	423.801	11	30
ÇORUM	1.282.000	422.152	11	33
SİVAS	2.848.800	411.489	10	14
GÜMÜŞHANE	658.500	282.805	7	43
GİRESUN	693.400	267.032	7	39
ERZİNCAN	1.190.300	110.991	3	9
ORDU	600.100	61.381	1,5	10

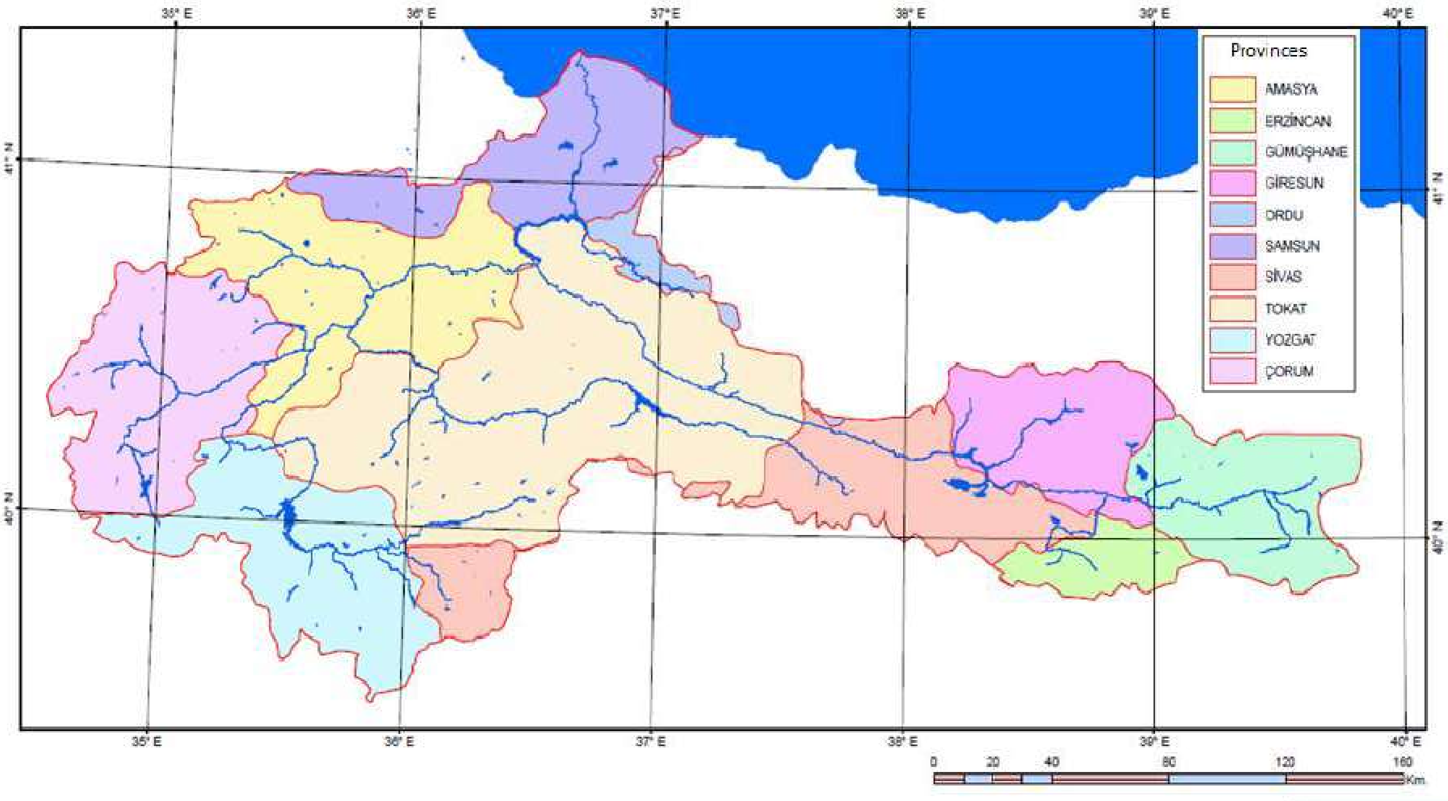

Figure 2 The Administrative Structure of the Basin (YHKB, n.d.)

Together with the four provincial centers (Tokat, Samsun, Amasya, and Çorum) and 194 municipalities/towns (with population above 2000) were located within the boundaries of Yeşilırmak River Basin (TUBITAK MAM, 2010). According to TUIK statistics, the total population of the basin is 2.661.348. According to the results of the population census, it constitutes 3.38% of the Turkey's total population. In Table 2, the percentage population distribution of the Yeşilırmak Basin is presented (TUBITAK Research Project 115Y013, 2016).

Table 2 The Percentage population distribution of the Yeşilırmak Basin (TUBITAK Research Project 115Y013, 2016)

Province	Percentage Share of Provinces (%)
TOKAT	22
AMASYA	12
SAMSUN	37
YOZGAT	7
ÇORUM	13
SİVAS	4
GÜMÜŞHANE	3
GİRESUN	1
ERZİNCAN	0
ORDU	1
Source: TUIK, 2015	

In terms of socio-economic development, while this region lags behind the western region of Turkey, it is in more advanced level when it is compared with eastern regions. Agriculture, irrigation and energy potential; accessibility in terms of all means of transportation and having the main transport axes; having natural resources and historical heritage are the main advantages of this area (DOLSAR Engineering Limited, 2006).

2.3.5 Land Use

Yesilirmak River Basin is dominated by forest and semi-natural areas with 56%. Agricultural lands are consists of 46% of the riverbasin and it followed by artificial surfaces and water surfaces, each of them are % 1. Lastly, 0.08% of the basin is covered with wetlands. More detailed land use features can be seen in Table 3 (TUBITAK MAM, 2010).

Table 3 Yeşilırmak Basin land use in CORINE Level 2 (TUBITAK MAM, 2010).

CORINE Code	Land Use	Area (ha)	Area (%)
Artificial surfaces	Urban fabric	40.507	1,02
	Industrial, commercial and transport units	5.111	0,13
	Mine, dump and construction sites	1.185	0,03
	Artificial, non-agricultural vegetated areas	573	0,01
Agricultural areas	Arable land	824.220	20,81
	Permanent crops	14.876	0,38
	Pastures	32.224	0,81
	Heterogeneous agricultural areas	785.295	19,82
Forest and semi natural areas	Forests	896.188	22,62
	Scrub and/or herbaceous vegetation associations	838.593	21,17
	Open spaces with little or no vegetation	495.210	12,5
Wetlands	Inland wetlands	662	0,02
	Maritime wetlands	2.679	0,07
Water bodies	Inland waters	22.723	0,57
	Marine waters	1.373	0,03

2.3.6 Point Pressures of Yeşilırmak River Basin

2.3.6.1. Urban Wastewater

It is reported that 93% of the basin population is having a connection to the sewer system. In the basin, most the sewer systems are combined and therefore collect rainwater runoff, domestic sewage, and industrial wastewater in the same pipe. The number and capacity of existing urban wastewater treatment plants are found to be inadequate (TUBITAK MAM, 2010).

There are 96 urban wastewater treatment plants in the basin catchment. Under the scope of YHYP project, with the help of the inventory study done, wastewater treatment plants and their current situation were identified (more detailed information in APPENDIX B).

2.3.6.2 Industrial Pressures

When it comes to examining the sectoral distribution of the industrial enterprises in Yeşilırmak River Basin, it can be seen that, in Samsun, while the food sector is in the first place with 27.7%, the second sector is the furniture with 13% and machinery and equipment products is the third place with 8.2%. Furthermore, the below sectors follows them respectively:

- 7.5% Manufacture of rubber and plastic products,
- 7.5% Manufacture of metal products,
- 4.9% Timber Wood and cork-based products,
- 4.4% Manufacture of other non-metallic mineral products,
- 3.4% Other mining and quarrying products production,
- 3.4% Manufacture of electrical equipment, and
- 3.4% Other (Yılmaz & Ümit, n.d.).

Another major province, in Amasya, dominated sectors are seen as food and beverage products production with 22% and manufacturing of furniture with 20% are in the first two places. Moreover, the below sectors follows them respectively:

- 12% Manufacture of fabricated metal products (except machinery and equipment),
- 10% Manufacture of other non-metallic mineral products,
- 8% Timber Wood and cork-based products (except furniture),

- 6% Manufacture of rubber and plastic products,
- 4% other mining and quarrying products production,
- 4% Manufacture of machinery and equipment nec,

- 3% Manufacture of electrical equipment,
- 2% Apparel Manufacturing and processing of fur coat,
- 2% Basic metal industry,
- 1% Removal of coal and lignite,
- 1% Manufacture of textile products,
- 1% Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers
- and semi-trailers and
- % 4 Other (Manufacture of leather and related products, other production; production and distribution of electric gas vapor and ventilation system; manufacture of chemicals and chemical products) (Bilgin, Biçer, & Kabacı, n.d.)

Furthermore, in the province of Çorum, enterprises mainly clustered on food sector (more specifically wheat grain and starch and starchy products; manufacture of ready-made animal feed (Middle Black Sea Development Agency, n.d.). Textile, forestry products and furniture; paper-paper products; chemical-plastic; manufacture of building materials; machinery and metal products industries are other industries succeeding each other in terms of their dominance in the area (Middle Black Sea Development Agency, 2014).

When it comes to Tokat, the agriculture-based industry is the most developed one. The food industry has the highest number of enterprises in the industry. Apart from food industry; textile, mining (marble, antimony, and hard coal), stone and earth-based industry (cement, antimony), and forestry products are other industries that exist in the region of the city (Middle Black Sea Development Agency, n.d.).

In Yozgat, the food industry constitutes the majority of industrial production. The sugar beet production, which is an industrial crop of the region, has an important place in the economy (Yozgat Provincial Directorate of Environment and Urbanisation, 2015).

Although the industry of the province of Sivas province is not sufficiently developed, there are various marble operation facilities as well as mining enterprises which extract iron ore; and zinc, copper and lead (Sivas Provincial Directorate of Environment and Urbanisation , 2015).

Gümüşhane province is rich in minerals such as gold, silver, copper, zinc, iron, lead and coal measures, and therefore mining is the major industrial activity. Limestone and marble production is also common in the province (TUIK, 2014).

In Giresun, hazelnut processing facilities have a great share in the industry. There are also facilities where tea is processed. In the districts of Şebinkarahisar, Alucra and Çamoluk, mining sector and agriculture-food sector based on grain mill products are available (Giresun Provincial Directorate of Environment and Urbanisation, 2015).

In the province of Erzincan, the activities of the agricultural and animal products, industrial products made by small retailers constitute domestic market activities (Erzincan Provincial Directorate of Environment and Urbanisation, 2015).

The private sector investments for industries are mainly focused on the production of food; forestry products and furniture industry; textile; mining and soil based industry; cement and ready-mixed concrete production sector in the province of Ordu (Ordu Provincial Directorate of Environment and Urbanisation, 2015).

2.3.6.2.1 Individual Industrial Facilities

By the YHYP project group, 255 industrial facilities were identified in the Yeşilırmak River Basin after the capacity reports prepared for the industrial establishment located in the Yeşilırmak Basin by TOBB (The Union of Chambers and Commodity

Exchanges of Turkey) were reviewed and a support from the Ministry of Environment and Urbanization was taken (listed establishments can be seen in

APPENDIX C).

2.3.6.2.2 Organized Industrial Zones

There are 14 OIZs available in the studied area. Except for Samsun Havza Tarımsal Ürün İşleme ve Tarım Makineleri İhtisas OIZ, below listed are active:

- Amasya Merkez OIZ
- Amasya Merzifon OIZ
- Amasya Suluova OIZ
- Amasya Suluova TDİ. Besi OIZ
- Çorum OIZ
- Samsun Gıda İhtisas OIZ
- Samsun Kavak OIZ
- Samsun Merkez OIZ
- Tokat Merkez OIZ
- Tokat Erbaa OIZ
- Tokat Niksar OIZ
- Tokat Turhal OIZ
- Tokat Zile OIZ

Amasya Merzifon and Samsun Merkez OIZ have their own WWTPs. Most of the others discharge into the channel of Municipality WWTPs (Further information can be seen in

4.1 Findings of the Inventory Study on Organized Industrial Zones, APPENDIX D and APPENDIX E).

2.3.6.2.3. Small Industrial Sites

By examining the Provincial Environmental Condition Reports (year of 2014 and 2015), YHYP project identified 32 Small Industrial Sites (SISs) in the basin. Majority of the SISs are located on the industrially active provinces such as Amasya, Samsun and Tokat. The identified SISs are listed in APPENDIX E.

2.3.7 Diffusive Pressures of the Yeşilırmak River Basin

Agriculture constitutes an important share of activity for the regions in the Yeşilırmak River Basin. Table 4 illustrates the agricultural areas of the provinces in the Yeşilırmak River Basin.

Table 4 Agricultural areas of the Provinces of the Yeşilırmak River Basin (TUBITAK Research Project 115Y013, 2016)

Province	Total Area (decares)	Cultivated Area (decare)	Fallow Area (decare)	Area of Vegetable Gardens (decare)	Area of Orchards (decare)
AMASYA	2.198.530	1.908.341	177.204	65.935	47.050
ÇORUM	2.879.665	2.214.747	562.374	28.731	73.813
TOKAT	3.014.697	2.440.069	281.894	151.655	141.079
SAMSUN	2.529.603	1.331.783	70.790	206.609	920.421
SİVAS	1.607.225	1.170.296	268.181	166.710	2.038
YOZGAT	2.325.573	1.523.310	774.908	1.770	25.585
GÜMÜŞHANE	540.462	355.385	176.315	2.697	6.065
GİRESUN	293.165	213.253	65.870	2.216	11.826
ERZİNCAN	329.860	227.489	100.000	491	1.880
ORDU	270.209	177.588	0	2.255	90.366

The area of Amasya, Tokat, Samsun and Çorum is very rich in terms of agricultural area and production. When the gross added value of region of TR83 was examined, it was seen that the share of the agricultural sector in the regional economy was 18,6 % in 2008. The share is more than double of Turkey's economy in this sector. The region is ranked 5th in terms of agricultural employment ratio in 2011. The vegetable production of the region was 9,69 million tons in 2011 and 6.83% of the total production of the country. The TR83 region, among the 26 regions, is in the 4th place in the production of grains and herbal products, 2nd place in vegetable production and 16th place in terms of fruit production. (Middle Black Sea Development Agency, n.d.). Yesilirmak River Basin has agricultural activities in all regions. The total amounts of pesticide used in the provinces of Yeşilırmak River Basin are listed in Table 5.

Table 5 Total pesticides used in the provinces of Yeşilırmak River Basin (TUBITAK MAM, 2010)

Provinces	Total pesticides used in provinces (ton)
TOKAT	680
SAMSUN	202
AMASYA	540
ÇORUM	213
SIVAS	190
YOZGAT	335
GÜMÜŞHANE	19
GIRESUN	131
Source: Ministry of Agriculture and Rural Affairs,2009	

The region's climate conditions and rich vegetation create great potential in terms of animal husbandry. Animal husbandry enterprises located in the region are generally small scale, and animal husbandry and vegetable production are usually done with together (Middle Black Sea Development Agency, n.d.).

Cattle, sheep and goat breeding, poultry raising, aquaculture and beekeeping are performed in the region. The region has an important potential in terms of the number of cattle. Çorum is one the leaders of Turkey in egg poultry while Samsun is the same for broiler production. Moreover, Samsun is an important province in terms of production and marketing of aquaculture (Middle Black Sea Development Agency, n.d.).

The distribution of diffuse total nitrogen loads in Yeşilırmak Basin is showed that use of agricultural fertilizer has the highest share with 44%. This is the expected result since it is the most important activity in the basin. It followed by animal husbandry and land use with the close proportions of 26% and 23%, respectively. Atmospheric transport is 5%, while septic and leachate constitute 1% each (TUBITAK MAM, 2010).

Regarding diffuse total phosphorus loads in Yeşilırmak Basin, the majority of loads are from the fertilizer use (69%), animal husbandry (25%) in order. Land use constitutes 5% and the percentage of septic and leachate is only about 1% (TUBITAK MAM, 2010).

These are expected results because the farming and animal husbandry are two of the most important activities in the basin.

CHAPTER 3

METHODOLOGY

The WFD asks for the provision of good ecological status for all river basins as well as each waterbody in a river basin. Thus, both the quality of each waterbody and the entire river basin should be taken into account when considering measures. Moreover, river basin management seeks information on the hydrologic impacts of local to regional land and water use, and installed infrastructures. For reaching the aim of the WFD in a river basin scale, there is a need for a holistic approach that considers various effects influencing the quality of water. The methodology of this study evolved from two broad category approaches, namely top-down and bottom-up approaches (Lovette, Duncan, & Band, 2016).

The top-down approach considers using readily available information and a wide range of possible effects. However, only working with this approach may result in insufficient and unreliable estimates on possible sources. On the other hand, the bottom-up approach concentrates on local scale technical specifications of measures (water divided into several masses) and monitors the receiving water bodies in detail. Nevertheless, basin-wide consequences and interactions among parameters of the monitoring may not be seen clearly (Dworak & Pielen, 2006). As a result of these concerns, both approaches have been applied in combination in this study.

By considering the top-down approach, literature survey on possible pollution sources (from domestic and industrial wastewater discharges and non-point sources) and pollutants expected from these sources is conducted for this study. Moreover, receiving water and discharge stations measurement results of Yeşilırmak River Basin monitoring program were used under the bottom-up approach. Lastly, a correlation has been tried to set between them. Figure 3 illustrates the general framework of the methodology of the study with a timescale and a flowchart.

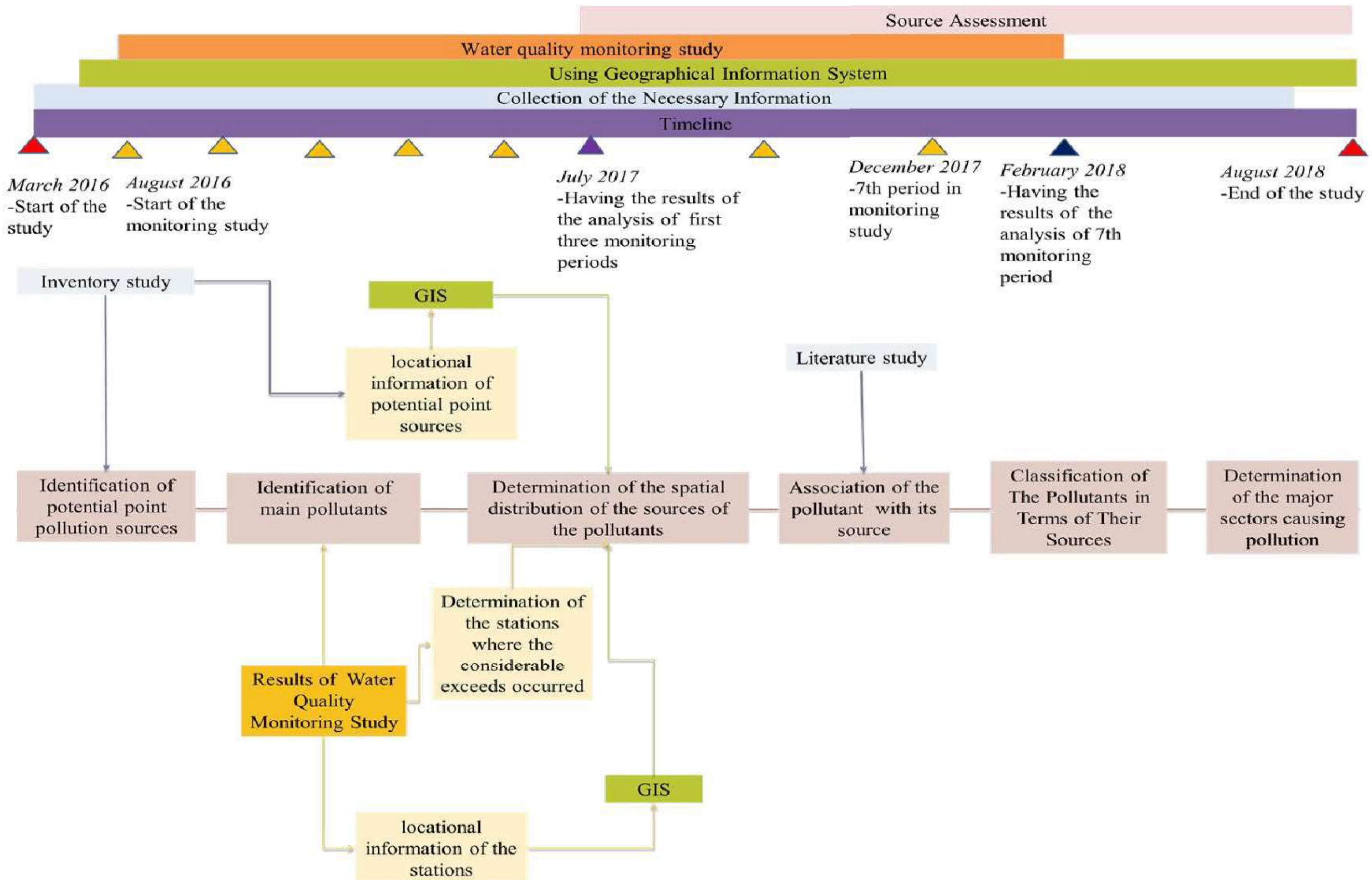

Figure 3 General framework of the methodology

3.1 Collection of Necessary Information

For successful integrated river basin management, all related institutions and stakeholders should have the reliable, adequate and updated information and they should make an effort for necessary contributions to this information growing and sharing (Alpaslan, Ataç, & Yeşil, 2007).

In order to understand and interpret the observations and findings accurately in the studied basin, it is required to extract necessary background information on current state of the basin and the industrial sources that may cause point pollution in addition to the inventory held by YHYP. Thus, it was focused on OIZs which was not studied in this context for this basin before.

3.1.1 Inventory Study

OIZs, which are started to install after 1960 in order to minimize the environmental problems caused by the industry and achieve balanced development between economically different regions of Turkey (Üstün, Solmaz, & Kestioğlu, 2004), can become a serious source of point pollution with inaccurate wastewater treatment practices.

In order to identify the OIZs and industrial establishments within the OIZs; after consulting the YHYP's stakeholder, TUBITAK MAM, by considering the similar study held by TUBITAK MAM in KIYITEMA, the provincial environmental status reports (published in 2014 and 2015) of the cities in the boundaries of the watershed and the data in the OIZ Information System of Directory of the Ministry of Science, Industry and Technology were searched for information. The official websites of the OIZ's, chambers of commerce and industry of cities and districts of the Yeşilırmak Basin were also scanned in detail. Moreover, it was got in contact with some of the authorities of the OIZs.

By taking into account all of these sources, it was mainly sought for information about:

- Current states (Active/Under construction/Under project stage),
- Locational information(address and geographical coordinates),
- Occupancy,
- Availability of WWTP (Exist / Not Exist),
- Type of WWTP,
- Discharge environment and,
- The subject of activity of the industrial establishments or NACE codes (the European statistical classification of economic activities), if the information is available.

These inputs provide better information about industrial infrastructure. It helps not only to identify the potential point pollution sources in the river basin, but also identif the cumulated sectors and industrial activities inside the special economic zones of the basin. In addition, it provides the required information for the improvement of the better representation of the basin in the GIS platform.

By this inventory study, in addition to the mentioned information, excel files including contact details of all OIZs and establishments located inside these OIZs were listed. These outputs were shared with other stakeholders such as provincial directorates seeking information and become inputs for other studies.

3.1.2 Literature Study

In the scope of YHYP, comprehensive literature search done for the subject of activities of the individual industrial sectors. After adding the information collected from the inventory study on OIZs, a further study on wastewater profiles and potentially dangerous substance resulting from these activities were studied for the assessed sectoral activity classes in the Yeşilırmak River Basin.

In addition to comprehensive literature collected for the project, a literature review has continuously being done through this thesis study in order to correctly evaluate the water quality monitoring results and the source assessment.

Information was mainly gathered from;

- Sectoral documents,
- The Best Available Techniques (BAT) reference documents (BREFs) of EU,
- Articles, and
- Online available chemical databases.

3.2 Use of Geographical Information System

While the Water Framework Directive provides a basis for a wide range of actions, it also requires working on spatial distribution data, where multiple disciplines must work together. In the case of river basin management, Geographic Information Systems (GIS) are used to collect information, analyze pressure and impacts, visualize models and scenarios and publication of the information required geographically based data results (EC, 2003). In this study, GIS is used as an effective decision support tool in the identification of the water pollution problems. Moreover, in the reporting part, it was taken help from the GIS visuals for better represention of the studied area.

For identifying the geographical locations of the pollutant sources and the major polluted areas, an ArcGIS file created for YHYP was used. Geographical locations of the monitoring stations were also layered to that file(Mapped visuals of the monitoring stations, urban WWTPs, individual industries and OIZs of Yeşilırmak River Basin can be seen in Figure 4, Figure 5,

Figure 6 and Figure 7).

Spatial information of the potential point sources were gathered with the inventory study for OIZs, Wastewater Treatment Plants (WWTPs), individual industrial establishments and SISs (they are listed in APPENDIX A, APPENDIX B,

APPENDIX C and APPENDIX E respectively.) and were helped the formation of the several layers by providing locational information to the MoAF. Latitude and longitude information was gathered from the websites of facilities, data in the OIZ Information System, the official websites of the chambers of commerce and industry of cities, and Google Earth and Google Map applications.

Together with the GIS file, by concerning monitoring results and the knowledge of inventory and literature studied for both the area and the pollutants, locations and the surroundings of establishments having highest exceedance taken place were determined. In other words, potential point pollution sources were identified immediately before each riverine station by considering the flow direction of the affluent to the closest station. In this extent, ArcGIS file was used as a map and between each riverine station, facilities situated were determined and listed. While doing the assessment, due to the pollutants characteristics, it is decided whether they are related to these facilities or not.

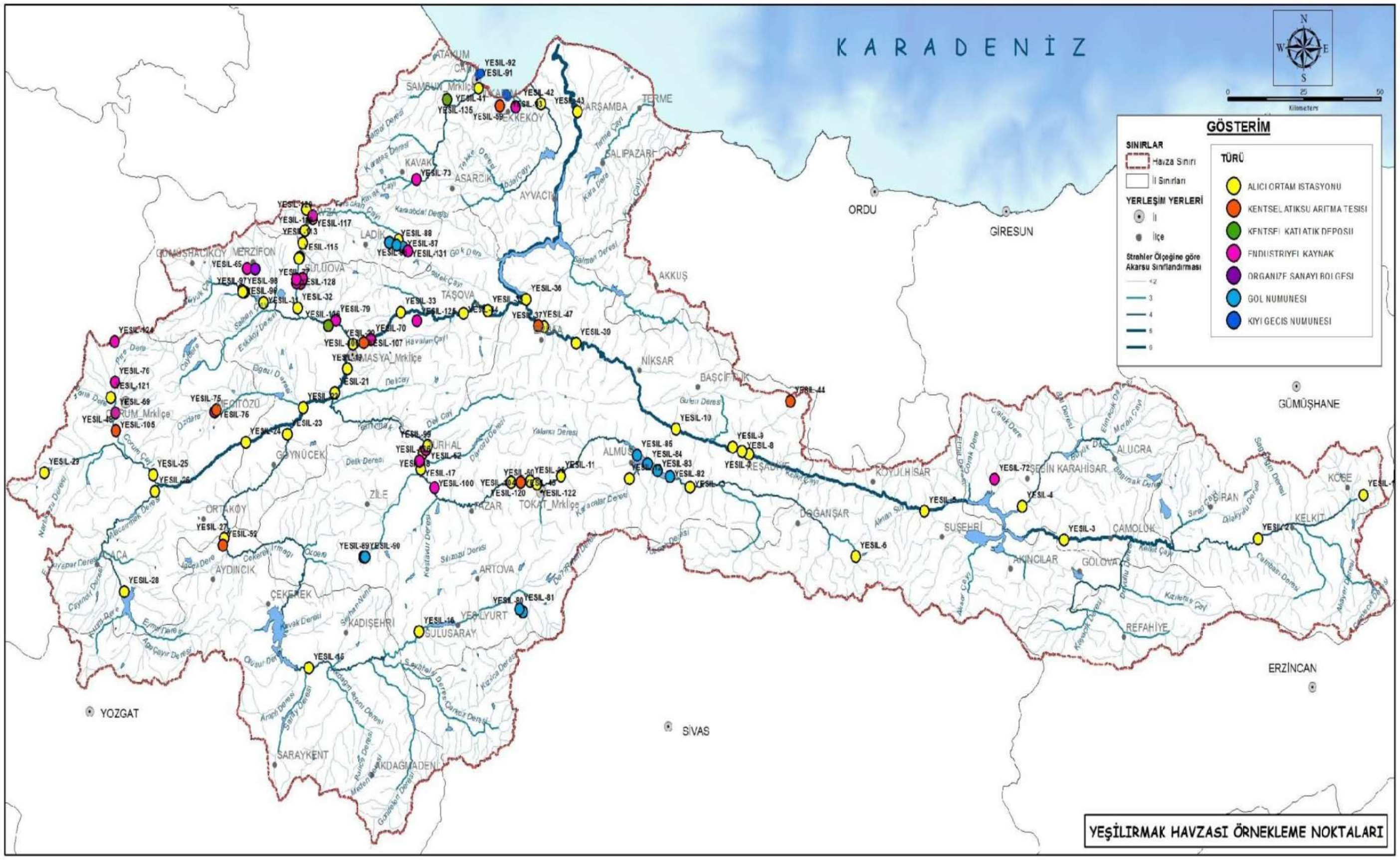

Figure 4 Map of the sampling sites (Research Project Appendix of TUBITAK Project 115Y013, 2017)

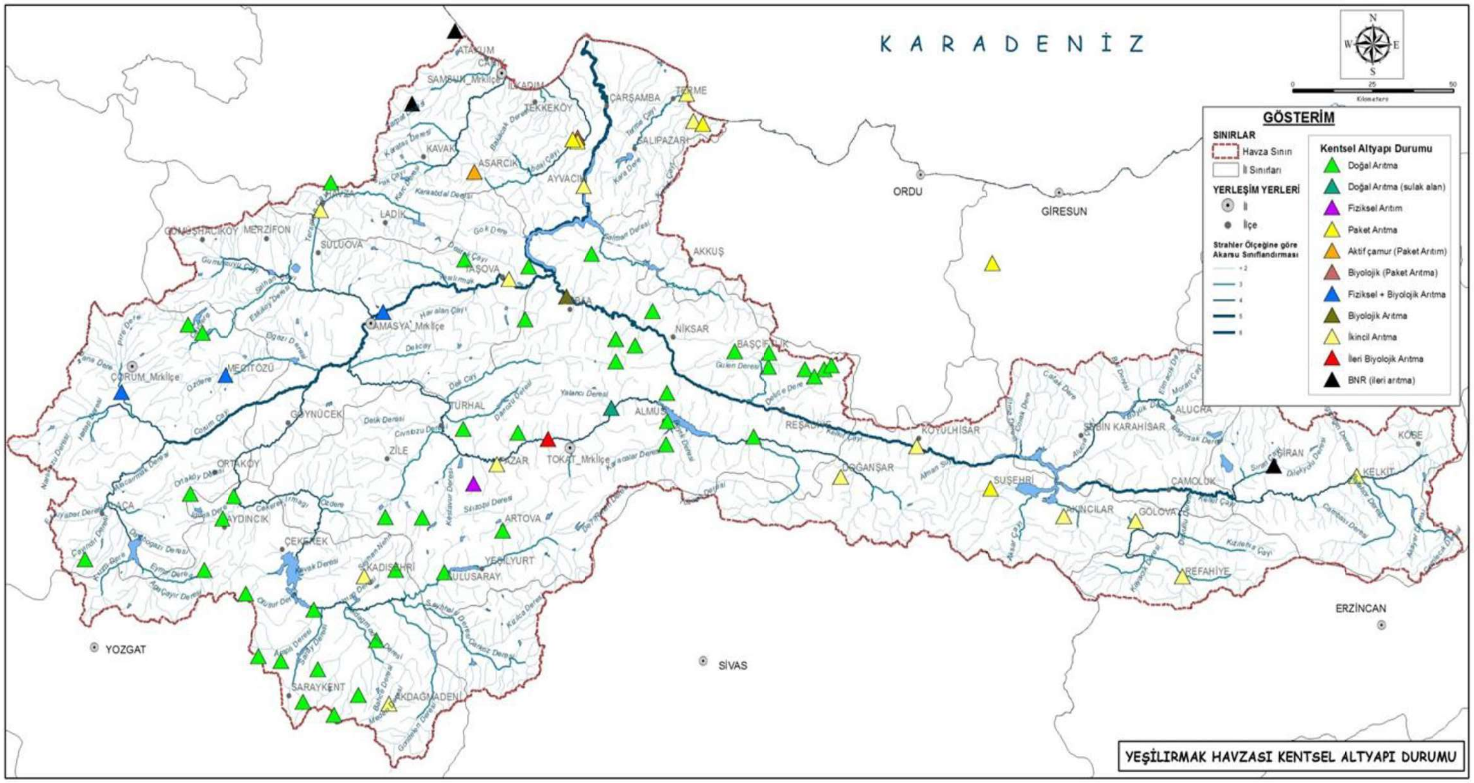

Figure 5 Urban WWTPs in Yeşilırmak Basin (Research Project Appendix of TUBITAK Project 115Y013, 2017)

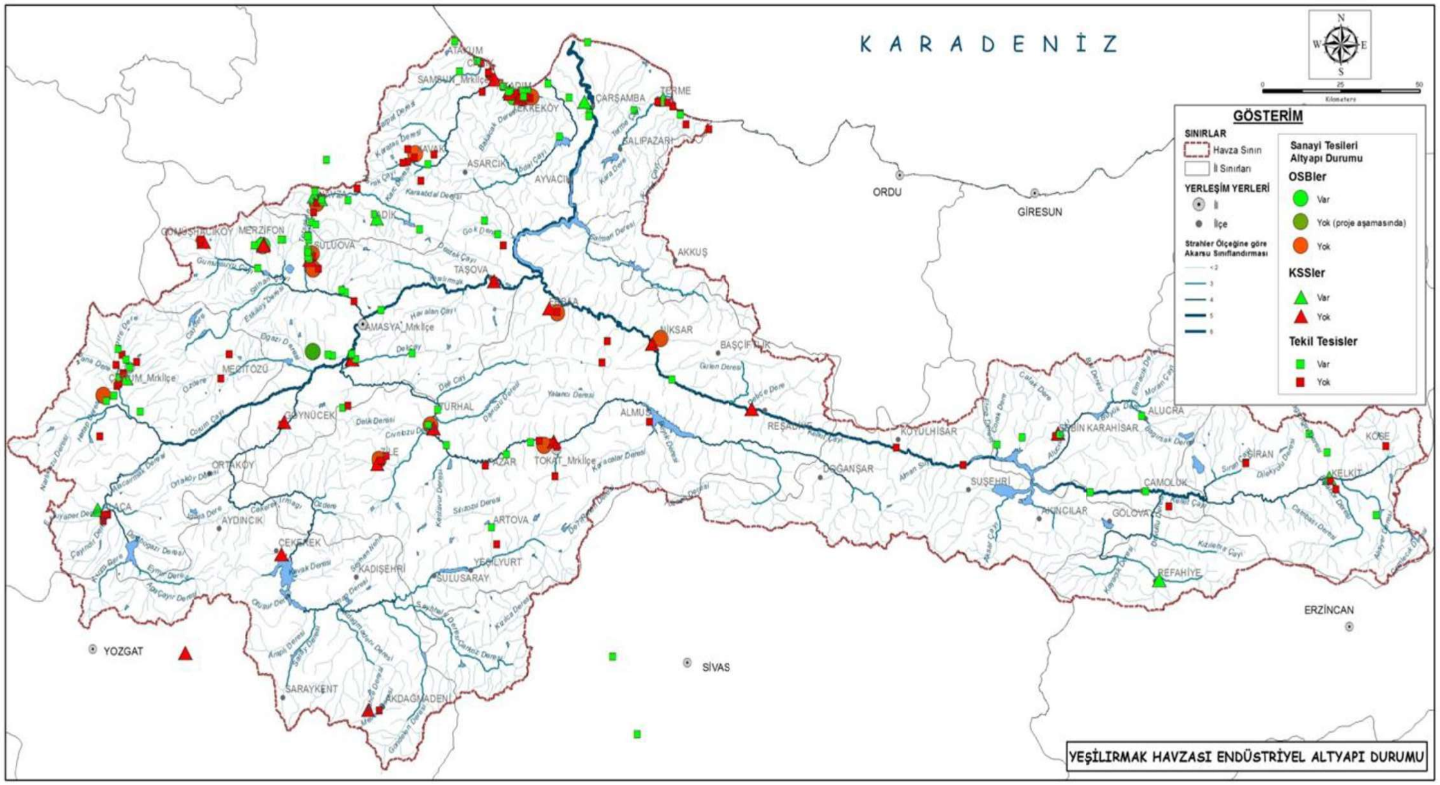

Figure 6 Industrial Infrastructure in Yeşilırmak Basin (Research Project Appendix of TUBITAK Project 115Y013, 2017)

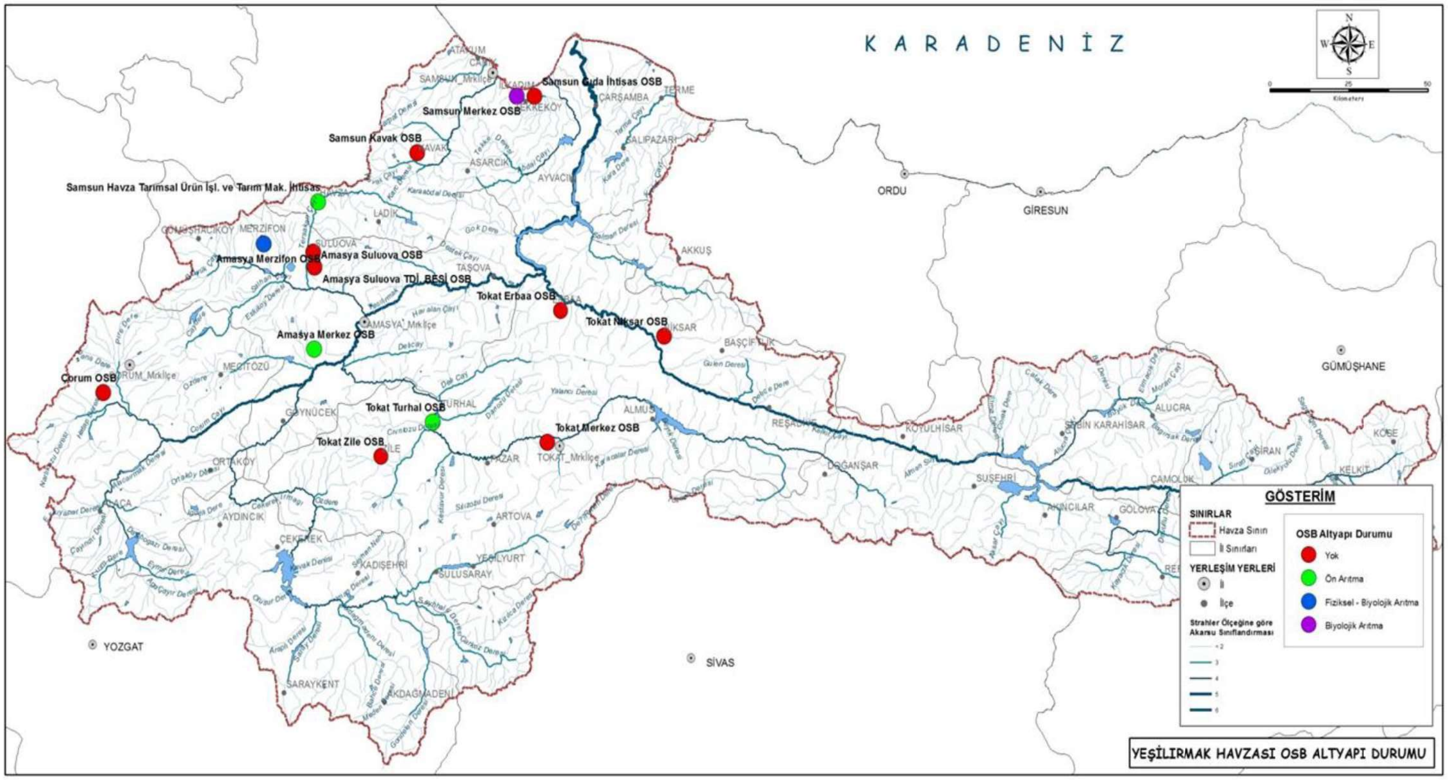

Figure 7 OIZ Infrastructure of Yeşilırmak Basin (Research Project Appendix of TUBITAK Project 115Y013, 2017)

3.3 Water Quality Monitoring

Under the YHYP extent, by using a bottom-up approach, a comprehensive water/wastewater monitoring program was implemented. These monitoring studies were conducted in every other two months. Sampling periods were in August 2016, October 2016, February 2017, April 2017, June 2017, August 2017 and December 2017, respectively. Water samples which were taken from receiving water body and point pollution sources (domestic and industrial wastewater treatment plant discharges) were analyzed.

Location of the receiving water monitoring stations was selected before and after the points considered as important pressures. Considering the accessibility of the designated stations, the current water quality monitoring stations of the State Hydraulic Works (DSİ) and the operational monitoring stations of Ministry of Forestry and Water Affairs (OİSB) were taken into consideration. As the first two monitoring studies completed, by considering the obtained information of the results, new stations were identified and some stations were canceled through the monitoring time (TUBITAK Research Project 115Y013, 2016).

In

APPENDIX I, coordinates and definitions of monitoring stations of the project can be seen. In Table I.1, receiving water stations (riverine stations) of all 7 periods are listed. As from the 3rd monitoring period to 7th period, it was added new stations to take samples from the urban wastewater treatment plants and industrial sources in the Yeşilırmak Basin. In Table I.2 provides a list of stations located at urban wastewater treatment plants while Table I.3 represents the stations situated at the industrial sources.

Started with the 6th monitoring period, the monitoring works carried out in the dams and lakes having the risk of being eutrophic (Table I.4). In order to be able to monitor agricultural irrigation-drainage systems, stations given in Table I.5 was planned to install. In addition, coastal monitoring started to take place in the coastal area of Port of Samsun and Port of Tekkeköy (Table I.6).

In 7th period, two stations which their definitions are given in Table I.7 were identified for surveillance of solid waste landfill facilities (waste leachate). (For more detailed information for which station has been monitored in which period was represented in APPENDIX F)

Since this thesis studied under this project, sample analysis results of riverine, and discharge stations of the industrial sources and urban wastewater treatment plants and are evaluated as one of the most important inputs in order to designate the existing situation in Yeşilırmak River Basin.

3.3.1 Sampling Methodology

Sampling Studies were carried out within the scope of the YHYP. Water sampling containers were prepared according to the further analysis. Sample storage conditions and sample quantities are as given in Table G. 1. The analysis and analysis methods performed on the sampling sites are listed in Table G. 2. After the samples were taken by trucks having coolers, they were delivered to TÜBİTAK MAM for analysis.

The samples were analyzed both in terms of conventional parameters as well as specific and priority pollutants in Surface Water Quality Regulation. In the scope of the YHYP, analysis methods / used devices and detection limits (LOD) for conventional parameters, priority substances and specific pollutants are respectively demonstrated in Table G. 3, Table G. 4 and Table G. 5.

3.3.2 Evaluation of the Results from Water Quality Monitoring Studies

In the present thesis, the data from water quality monitoring program is evaluated. The criteria given in Table-5 of Annex 5(titled as "Priority Substances and Environmental Quality Standards for Surface Water Sources") and in Table-4 of Annex 5 (titled as "Specific Pollutants and Environmental Quality Standards for Surface Water Sources") of the Surface Water Quality Regulation were taken as the basis for the assessments (TUBITAK Research Project 115Y013, 2018).

In order to evaluate the contribution of the pollutants to the pollution in the receiving environment, for the pollutants that exceed Environment Quality Standards (EQS), itwas calculated whatpercent of the pollutant concentration was exceeded on each station.

$$\%\mathrm{EQS} = \frac{\mathrm{C}}{\mathrm{C_{EQS}}} * 100$$

In this equation:

%EQS: Percentage value of analysis result in terms of EQS

C: Analysis result of receiving body (µg/L)

C_{EQS}: EQS of receiving body (µg/L) (yearly average-EQS)

The high percentages indicate that pollution is at more serious level. Measures above 100% represent the stations where the EQS exceedance occurs (TUBITAK Research Project 115Y013, 2018).

From the 45 priority and 250 specific pollutants, 21 pollutants exceeding the AA-EQS at more than 5 stations and/or pollutants having Average-EQS% of 7 monitoring periods higher than 100% were studied for source identification. (Results & Discussion,

Table **8** represents the pollutants studied for source assessment).

For determining and clear representation of the stations at which have the highest exceedances in terms of EQS, graphics include percentage EQS vs stations were drawn for each 21 pollutants. Top three riverine stations which were observed the highest exceedance was evaluated for each pollutant. Average and maximum concentrations were determined. Moreover, stations having highest exceedances in terms of both concentrations and the number of pollutants were determined and how many pollutants having top three greatest concentrations at that station listed(Results & Discussion,

Table **9**).

3.4 Source Assessment

After the results of water quality monitoring studies, stations with observed pollutants in high concentrations were determined. By using the GIS visuals (Figure 8), potential point pollution sources were identified immediately before each riverine station by considering the flow direction of the effluent to the closest station.

In order to reasonably assess the sources and/or the activities becoming sources of the pollutant, it was considered the gatherings of inventory study on industrial facilitiesand literature study on pollutants and further literature reviews were also done to make the assessment more clear.

By considering the economic profile of the Yeşilırmak River Basin, although possible diffuse sources are harder to differentiate with this assessment method, it was also included in the assessment when it was required. Furthermore, the places which do not have registered establishments in the GIS file or the establishments' profile not fitting to the surrounding pollution, were also considered in this study. If a possible connection was been able to set up between a diffuse source, it was also stated.

Due to the limited inventory findings on establishments (either there is no available comprehensive inventory for current establishments in the study area or they are not publicly available), lack of detailed information on SISs and WWTPs limited the level of precision of assessment. Thus, whether there is a direct relation between these sources and the studied pollutants, this relation couldn't be assessed with the methods in use except there is a discharge station at that facility. Because, during the source assessment, monitoring results of discharge stations were used as a fundamental and supportive source of information and for the reasonable claim of association of the pollutants with the subject of activity that was seen.

After the evaluation of source identification, 21 pollutants were categorized with regard to their sources such as point, diffuse and both point and diffuse source causing pollution. And since the OIZs are the main focus of the study, OIZs assessed as a main responsible mainly for the three highest exceedance of studied pollutants were determined. And the major sectors were revealed.

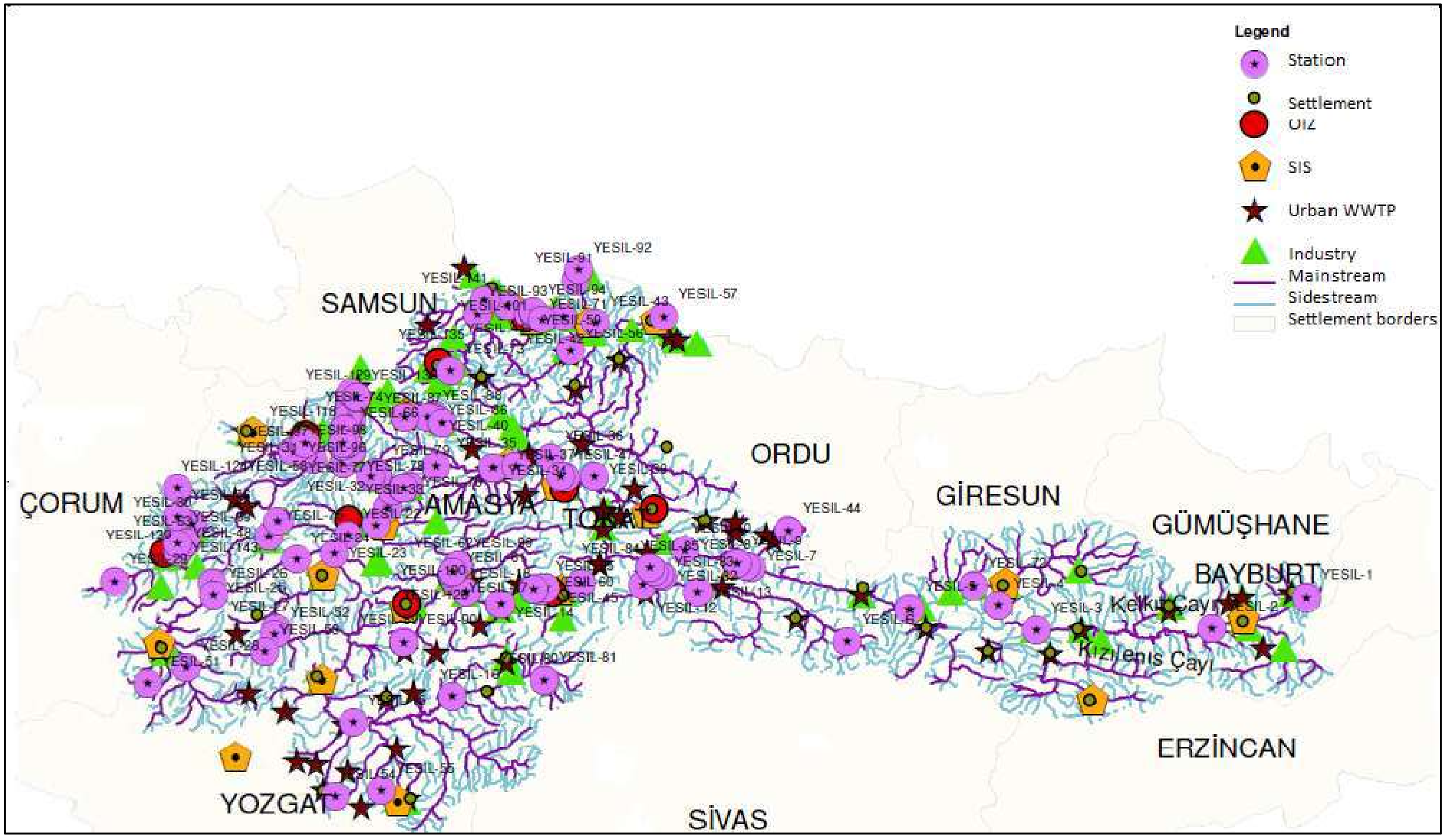

Figure 8 Monitoring Stations and Urban Infrastructure of Yeşilırmak River Basin

CHAPTER 4

RESULTS AND DISCUSSION

This chapter includes the information regarding the results of the inventory study on OIZs, the surface water quality monitoring program and the source assessment of the pollutants.

In part 4.1, the current situation of the OIZs and their main sectoral activities were described. In part 4.2, general evaluation of monitoring results and the major pollutants in Yeşilırmak River Basin were given with related pollutant tables. In part 4.3, these pollutants were evaluated in terms of their potential sources by the help of graphics and tables. Part 4.4 includes the information about their classification as a point, diffuse and both point and diffuse source causing pollutant. And in part 4.5, by also considering OIZs since it was the main focus of the inventory, the major sectors which are responsible for the pollution were determined.

4.1 Findings of the Inventory Study on Organized Industrial Zones

As a result of the inventory study, 14 OIZs were determined in the basin. The identified OIZs are listed in Table 6. Among these OIZs, except for Samsun Havza Tarımsal Ürün İşleme ve Tarım Makineleri İhtisas OIZ, others are active. Only Amasya Merzifon and Samsun Merkez OIZ have their own WWTPs, most of the others discharge into the channel of Municipality WWTPs. Further inventory information about their location and features relating their WWTPs can be seen in APPENDIX A.

Table 6 OIZs in the Yeşilırmak River Basin

OIZ	Province	District	Current State	Occupancy	Condition of WWTP	Discharge Environment
Amasya Merkez OIZ	Amasya	Merkez	Active	100%	Absent (in the project phase)	
Amasya Merzifon OIZ	Amasya	Merzifon	Active	88%	Exist	Gümüşsuyu Creek
Amasya Suluova OIZ	Amasya	Suluova	Active	26%	Absent	Tersakan creek by the municipality channel (without a treatment)*
Amasya Suluova TDİ. Besi OIZ	Amasya	Suluova	Active		Absent	
Çorum OIZ	Çorum	Merkez	Active	49%	Absent	Discharge into a channel of Çorum Municipality WWTP
Samsun Gıda İhtisas OIZ	Samsun	Tekkeköy	Active	92%	Absent	Discharge into WWTP channel of the municipality (Municipality discharges into sea)
Samsun Havza Tarımsal Ürün	Samsun	Havza	Under Construction		Absent	

OIZ	Province	District	Current State	Occupancy	Condition of WWTP	Discharge Environment
İşleme ve Tarım Makineleri İhtisas OIZ						
Samsun Kavak OIZ	Samsun	Kavak	Active	55%	Absent	Discharge into WWTP channel of the municipality
Samsun Merkez OIZ	Samsun	Tekkeköy	Active	100%	Exist	Sea discharge
Tokat Merkez OIZ	Tokat	Merkez	Active	80%	Absent	Discharge into WWTP channel of Tokat municipality
Tokat Erbaa OIZ	Tokat	Erbaa	Active	23%	Absent	Discharge into WWTP channel of Erbaa municipality
Tokat Niksar OIZ	Tokat	Niksar	Active		Absent	
Tokat Turhal OIZ	Tokat	Turhal	Active		Absent	Yeşilırmak
Tokat Zile OIZ	Tokat	Zile	Active	12%	Absent	Discharge into the channel of the municipality that does not

OIZ	Province	District	Current State	Occupancy	Condition of WWTP	Discharge Environment
						have a WWTP

*Municipality constructing a WWTP.

Manufacture of food products is the most common industrial activity among OIZs of Yeşilırmak River Basin. Grain mill, bakery products, dry fruits, dairy products are mainly processed in these establishments. Sectoral activities of manufacture of textiles, apparel products; rubber and plastics products; wood products; machinery and equipment are the other activities which are common in these OIZs.

4.1.1 Amasya Merkez OIZ

It comprises the sectors related to cutting, shaping and finishing of stone, manufacture of food products, furniture and fertilizers and nitrogen compounds, and all parcels were assigned to industrial establishments. However, seven of them are under construction and two of them are at project stage.

The OIZ's WWTP is currently under construction; Amasya Merkez OIZ discharges its wastewater after a pretreatment to Yeşilırmak River.

4.1.2 Amasya Merzifon OIZ

The main subject of activities of the OIZs are manufacture of electrical equipments; fabricated metal products; rubber and plastic products; furniture; food products; and textiles products. The Amasya Merzifon OIZ is almost full; 88% of the land parcels were assigned to industrial establishments.

The OIZ has a WWTP, having a capacity of 300 m3/day and a daily flow rate of 300 ton/day. The WWTP applies a physical-biological treatment and treated water is discharged into Gümüşsuyu Creek.

4.1.3 Amasya Suluova OIZ

Major sectors of Amasya Suluova OIZ are manufacture of food products; rubber and plastic products; furniture; textile products; and wholesale and retail sales. It does not have an WWTP. Thus, it discharges into the Tersakan stream by the municipality channel. Suluova municipality WWTP is also in construction phase.

4.1.4 Amasya Suluova TDİ Besi OIZ

The OIZ has agriculture based specialization. Its major sectors are raising of cattle and buffaloes; and processing and preserving of meat. It has also a biogas plant in it. There is no available information on whether a wastewater treatment is available in this zone.

4.1.5 Çorum OIZ

Primary sectors of Çorum OIZ are manufacture of machinery and equipment n.e.c.; basic metals and fabricated metal products; wearing apparel; other non-metallic mineral products; and rubber and plastic products. 49% of the land parcels of the OIZ were assigned to industrial establishments. It has not a WWTP; thus, its wastewater, having a flow rate of around 160tone/day is discharged into a channel connecting to Çorum Municipality WWTP.

4.1.6 Samsun Gıda İhtisas OIZ

Samsun Gıda Ihtisas OIZ is a specialized OIZ and it is food industry specialized. Industrial sectors such as dairies and cheese making; manufacture of grain mill products; and condiments and seasonings are cumulated. Wholesale of food products also a subject of activity taking places in Samsun Gıda İhtisas OIZ. 92% of the parcels are occupied. The OIZ does not have a WWTP. It discharges into WWTP channel of the municipality of Tekkeköy with an approximate flow rate of 75 tones/day.

4.1.7 Samsun Havza Tarımsal Ürün İşleme ve Tarım Makineleri İhtisas OIZ

The establishment of the Samsun Havza Tarımsal Ürün İşleme ve Tarım Makineleri

İhtisas OIZ continues and the land assignment has not started yet. It will be specialized on agricultural products processing and agricultural machinery. The OIZ applies physical pre-treatment before discharging their wastewaters.

4.1.8 Samsun Kavak OIZ

Main manufacturing sectors in the Samsun Kavak OIZ are rubber and plastics products, and other non-metallic mineral products; machinery and equipment n.e.c.;

electrical equipment; and food products. In this OIZ, 55% of the parcels is assigned. Since it does not have a WWTP, it discharges into a sewer discharging into the WWTP of the Kavak municipality.

4.1.9 Samsun Merkez OIZ

Manufacture of basic metals and fabricated metal products, except machinery and equipment; electrical equipment; machinery and equipment n.e.c.; rubber and plastics products, and other non-metallic mineral products; and food products are the major subject of activities taking place in Samsun Merkez OIZ. All land parcels have been allocated. Samsun Merkez OIZ has a biological treatment plant, having a capacity of 2000m^3/day and a flow rate of 950- 1200tone/day which discharges to the sea after the treatment.

4.1.10 Tokat Merkez OIZ

Tokat Merkez OIZ, having an occupancy rate of 82%, comprises of the sectors which are manufacture of food products, beverages and tobacco products; textiles, apparel, leather and related product; chemicals and chemical products and wholesale and retail trade. There is no WWTP inside the OIZ. Thus, it discharges its wastewater (approximately 1800 ton/day) into WWTP channel of Tokat municipality.

4.1.11 Tokat Erbaa OIZ

Major sectors of Tokat Erbaa OIZ, having an occupancy rate of 23%, are manufacture of textiles and apparel products; and food products. It has not a WWTP; thus, its wastewater, having a flow rate of around 100 ton/day is discharged into a channel connecting to Erbaa Municipality WWTP.

4.1.12 Tokat Niksar OIZ

Manufacture of textiles and apparel products; and food products are the major subject of activities taking places in Tokat Niksar OIZ. It does not have a WWTP. There is no available information on its discharge environment.

4.1.13 Tokat Turhal OIZ

Quarrying of ornamental and building stone, limestone, gypsum, chalk and slate, manufacture of food products and wearing apparel products sectors are the main sectors of the Tokat Turhal OIZ. After a pre-treatment, the OIZ discharges its wastewater into Yeşilırmak River.

4.1.14 Tokat Zile OIZ

Main manufacturing sectors in Tokat Zile OIZ, having occupancy of 12%, are forestry products and wearing apparel products. There is no WWTP inside the OIZ. Thus, it discharges its wastewater into the channel of the Zile municipality. However, the municipality does not have a WWTP.

In APPENDIX D, whole lists of the industrial establishments located in these OIZs and their subject of activities can be seen.

4.2 Results of the Seven Monitoring Period in Terms of the Exceedance of EQS

Water samples which were taken from riverine stations during 7 monitoring campaingns, were analyzed for 45 priority and 250 specific pollutants and it was determined that 43 pollutants exceeded the AA-EQS specified in the Regulation. Table 7 illustrates the pollutants having exceedance at riverine stations over 7 monitoring periods. As can be seen; while 13 of the pollutants are priority pollutants, 30 of the pollutants are specific pollutants and 10 of these 30 pollutants are pesticides.

From 43 pollutants, 21 pollutants exceeding the AA-EQS at more than 5 stations and/or pollutants having Average-EQS% of 7 monitoring periods higher than 100% were studied for source identification. Table 13 shows the minimum, average and maximum %EQS of pollutants having EQS exceedance and how many stations having EQS exceedance for each of 21 pollutants studied.

Table 7 Pollutants exceeded the EQS at riverine stations (TUBITAK Research Project 115Y013, 2018)

Priority Pollutants	Specific Pollutants	Specific pollutants (Pesticides)
DEHP	1-Chloronaphthalene	Chlorfenapyr
Hexachloro-cyclohexane	4-Chloroaniline	Chlorsulfuron
Nonylphenol	Bis(2-ethylhexyl)terephthalate	Diflubenzuron
Benzo(a)pyrene	Fenthion	Diflufenican
Aclonifen	Tridecane	Ethalfluralin
Bifenox	Al	Fenarimol
Dichlorvos	As	Fenpropathrin
Cd	B	Fenpropimorph
Ni	Co	Imidacloprid
Pb	Cr	Protiofos
Hg*	Cu	
Hexachloro-benzene*	Fe	
Benzo(k)fluoranthene *	Sb	
	V	
	Zn	
	Si	
	Ti	
	Free CN	
	Bromide	
	Total petroleum Hydrocarbons	
* MAX-EQS has been taken into consideration since there is no value of AA-EQS.		
Those with LOD greater than EQS were not included in the assessment.		

In Yeşilırmak River, it is clear that metal and heavy metal pollution is a common threat for water environment since their exceedances were observed at significant numbers

of stations. Before evaluating their potential point sources, it should be considered that heavy metal presence may be due to their natural existence. It can be stated that Al, Br- , Cu and Fe are estimated to be natural pollutants to some extent. Furthermore, under the scope of the project, their background concentrations were calculated. As a result, Al, Cu and Fe average annual and maximum EQSs were rearranged (TUBITAK Research Project 115Y013, 2018). Secondly, mentioned metals also used in pesticides and fertilizers (for further detail, in the chapter of 4.3 Source Assessment of the Main Pollutants can be seen), thus agricultural uses could be another serious reason for their existence in the water environment. Thirdly, active and inactive mines are also another consideration (SDWF, 2018).

Table 8 Minimum, Average and Maximum %EQS of pollutants having EQS exceedance (TUBITAK Research Project 115Y013, 2018)

Pollutant	AA-EQS (µg/L)	Min- %EQS	Average -%EQS	Max- %EQS	Number of stations having EQS exceedance
Pb	1.2	108.03	410.47	4134.14	54
Al*	48.1	2351.28	29001	217218	54
Cu*	13	637.38	1780.42	23844.5	54
Fe*	95.22	186.58	2652.32	17180.6	54
Zn	5.9	62.19	16810.8	852007	53
Si	1830	55.48	395.73	1167.21	53
V	1.6	81.8	332.78	1263.11	51
Total petroleum hydrocarbons	96	0	234.63	456.77	47
Co	0.3	24.06	467.79	6813.72	43
Dichlorvos	6 × 10-4	41.67	4681.15	62304.8	39
Cr	1.6	35.45	252.79	1989.36	39
Ni	4	31.93	194.5	1386.11	35

Pollutant	AA-EQS (µg/L)	Min- %EQS	Average -%EQS	Max-%EQS	Number of stations having EQS exceedance
Bromide*	31	48.39	238.8	1787.47	32
Cd	0.08	36.88	438.6	12452.1	15
Bifenox	0.012	20.83	73.87	432.88	11
Tridecane	0.05	17.72	67.11	1257.89	7
Sb	7.8	0.77	244.03	10307.6	7
Hg	0.07**	92.86	100	185.71	6
Free CN	1.2	41.67	85.46	955	6
Benzo(a)pyrene	1,7 × 10-4	29.41	524.69	24944.4	4
Fenarimol	0.07	32.74	1226.39	64335.4	1

* Al, Cu and Fe average annual and maximum EQS were rearranged due to their background concentrations (TUBITAK Research Project 115Y013, 2018).

When it comes to pesticides, such as dichlorvos, bifenox and fenarimol, they are other notable pollutants. While dichlorvos has a widespread effect on the region, fenarimol is locally observed, at only one station (

Table **8**). By considering their non-point sources like agriculture and local husbandry, it should be noted that their point sources like agriculture-based food industry can also be a serious source in Yeşilırmak Basin (Middle Black Sea Development Agency, 2018).

Table 9 represents the stations having highest exceedances in terms of both concentrations and number of pollutants. As can be seen, Station-128 A and -123 are the places which have the biggest threat in terms of the pollution. These are located at the city of Amasya, the district of Suluova. From previous studies, it was known that Tersakan Creek, also having Station-128 A and -123, suffers from the pollution of domestic, industrial, agricultural but mainly husbandry sources. Wastes, originating from different sizes of livestock barns scattered in and around Suluova, are used to be used in farming areas, and the excess was discharged to Tersakan Creek (TUBITAK MAM, 2010). Although livestock OIZ is established in Suluova (Amasya Suluova TDI Besi OIZ) and these facilities wastes tried to be controlled as a point source with an installed biogas plant. Still, the existence of local farms is common; thus, they should be considered as a result of non-point pollution (Çağlar, Kılınç, Koparan, Yivli, & Topsakal, n.d.).

For further information (such as EQSs of which pollutants were exceeded in which monitoring periods for both riverine and discharge stations); and minimum, maximum and average detectable concentrations and peaked stations can be seen in tables in APPENDIX H.

Table 9 Stations having highest exceedances in terms of both concentrations and number of pollutants

Station ID	**How many pollutants having top three greatest concentrations at that station**	**Pollutants**
Station -128 A	10	Al, Co, Cr, Cu, Fe, Ni, free CN, Si, V, Zn
Station-123	9	Al, Cd, Cr, Cu, Fe, Pb, free CN, Si, V
Station -125	6	Al, Br, Co, Fe, Si, V
Station-31	6	Br, Co, Cr, Cu, Ni, Zn
Station -25	4	Br, Cd, Pb, total petroleum hydrocarbons
Station-99	3	Ni, Pb, Sb
Station-37	2	Bifenox, tridecane
Station -15	2	Bifenox, tridecane
Station-21	2	Hg, Sb
Station-1	1	Benzo[a]pyrene
Station -12	1	Benzo[a]pyrene
Station -16	1	Benzo[a]pyrene
Station -2	1	Bifenox
Station -24	1	Cd
Station-30	1	Dichlorvos
Station -28	1	Dichlorvos
Station -19	1	Dichlorvos
Station-1	1	Fenarimol
Station -33	1	Hg
Station -34	1	Hg
Station -19	1	Sb

Station ID	How many pollutants having top three greatest concentrations at that station	Pollutants
Station -122	1	Free CN
Station -14	1	Tridecane
Station-120	1	Zn
Station-20	1	Total petroleum hydrocarbons
Station -35	1	Total petroleum hydrocarbons

4.3 Source Assessment of the Main Pollutants

4.3.1 Association of Aluminium with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, average annual EQS (AA-EQS) for aluminium was exceeded in all monitoring periods at all stations. Figure 9 illustrates the average percentage EQS values of the stations in seven monitoring periods for aluminium. The average concentrations of the stations having exceedance of EQS were around 10 times of EQS at most of the stations while they were respectively 30 and 50 times of the EQS at station-32 and -20. However, 3 of the highest exceedances are at the station-123(almost 100 times of the EQS), -128A and -125. Moreover, as the Table 10 represents, Max-concentrations of the station-123 is almost 2 times of the Avg-EQS. Meanwhile, the average and maximum concentration of the Station-128A and -125 are the same since there is only one measurement. Finally, maximum concentrations of all these three stations exceeded the MAX-EQS of Al.

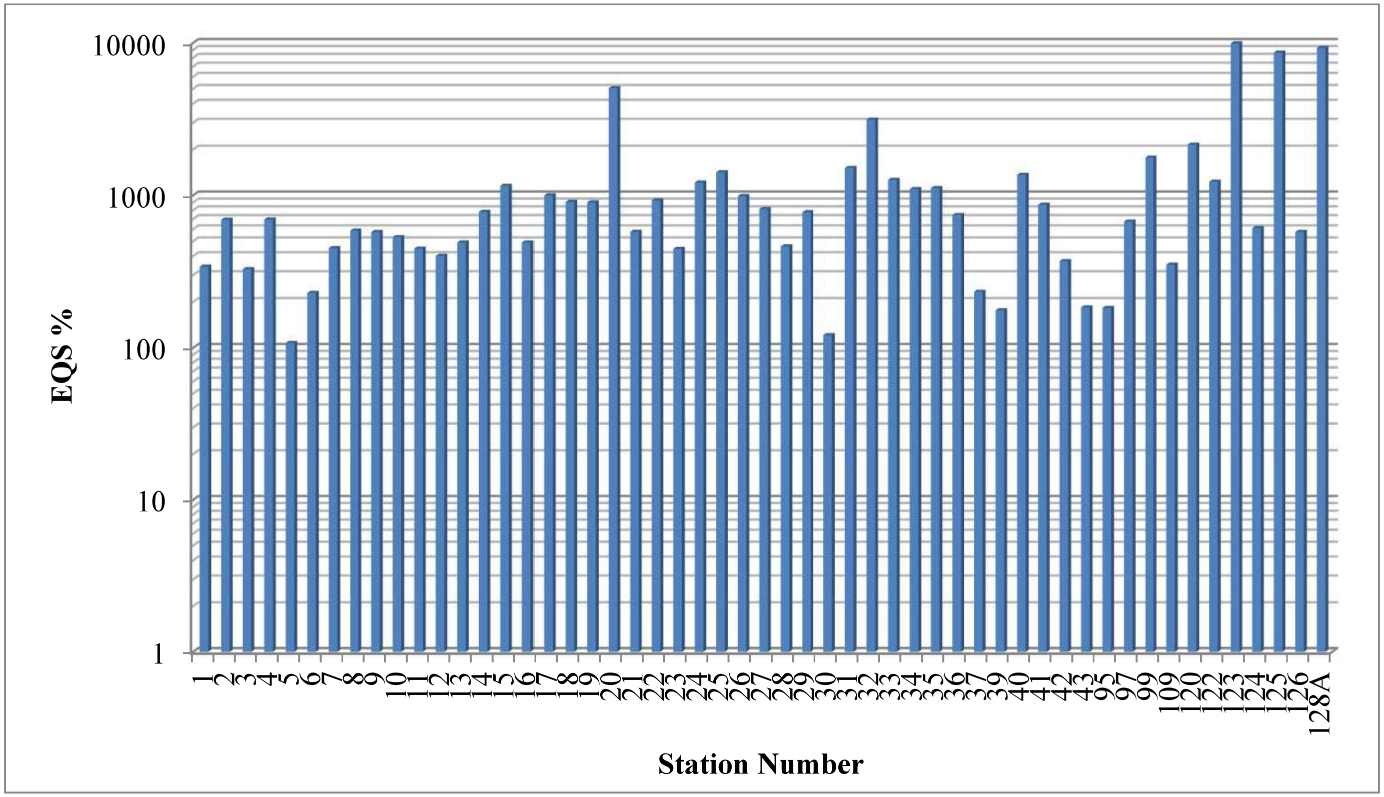

Figure 9 Average Percentage EQS values of aluminium at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurance

Table 10 Riverine Stations with the five highest Al concentrations

Station	% Avg-EQS	Avg-concentration, µg/L	Max-concentration, µg/L	Possible Point Sources
Station-123	9935.12	4778.79	8950.91	-Gülsim Flour -Amasya Sugar
Station - 128 A	9261.71	4454.88	4454.88	-Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Gurmin Energy-Mining -Eski Celtek Coal -Kozlu Food -Pan-et Slaughterhouse
Station - 125	8628.43	4150.27	4150.27	-Etaş Meat
AA-EQS of Al (µg/L): 48.1 MAX-EQS of Al (µg/L): 72.9				

As it is demonstrated in Figure 8, Station-128A and -123 located at around Suluova, Amasya. They follow each other through the direction of flow of Tersakan, the tributary of Yeşilırmak River. Before the station-128 A,

- Suluova WWTP; and
- Industrial establishments of Yenitesfikiye Feed, Hasanusta Food(grain mill products), Besgoz Arabogulları Flour, Aktan Food(grain mill products) , Gurmin Energy-Mining, Eski Celtek Coal, Kozlu Food(feed products)(Station-78), Pan-et Slaughterhouse

are located.

In addition, between Station-128A and Station-123, Gulsim Flour and Amasya Sugar (Station-127, discharge station) are situated. On the other hand, the Station-125 located before the city center of Amasya. At the upstream of Station-125,

- Konaklı SIS and Düvenci SIS; and
- industrial establishment of Etaş Meat

are placed. It is known that there are some uses of aluminum in iron and steel, textile, non-ferrous metals sectors. In addition, aluminium may be originated from the activities listed in APPENDIX J.

There were exceedances at discharge stations (Station-77, -78,-127 and -129, descriptions can be seen in Table I.3 situated at the upstream of riverine stations of Station-32 and -20(which are successive stations of station-123 and -125 respectively). Thus, it is evident that food sectors such as flour, feed, grain mill products, sugar and slaughtering in this region partially responsible for the aluminium pollution in water environment. Potential uses of aluminium compounds can range from being used as food additives (leavening, dispersing and emulsifying agent and baking powder) to being used as a fumigant ((US HHS, 2008); (Chung, 1992); (Saiyed & Yokel, 2005); (Larrañaga, Lewis, & Lewis, 2016)). Nevertheless, their contribution to the pollution is considerably low when they are compared with the results of receiving water stations, except the station-129 located at Aydınoğlu Flour Food. Secondly, WWTP discharges and wastewater of mining activities in these areas can also be seen as responsible (US HHS, 2008). Although there is not any discharge station at these establishments, exceedance was observed at stations which have similar characteristics. Lastly, since there is not any information about the industrial establishments located in SISs, it is not possible to evaluate them.

4.3.2 Association of Benzo[a]pyrene with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for benzo[a]pyrene was exceeded at only seven stations. Figure 10 illustrates the average percentage EQS values of the stations in seven monitoring periods for benzo[a]pyrene. The average concentrations of the stations having exceedance of EQS were around 2 times of EQS at Station-33 and -41 while they were respectively 15 and 20 times of the EQS at station-9 and -22. However, 3 of the highest exceedances are at the station-1 (almost 250 times of the EQS), -12(84 times of EQS) and -16(67 times of EQS). Moreover, as the Table 11 represents, Max-concentrations of the Station-1,-12 and -16 are almost 7 times of the Avg-EQS of those stations; however, only station-1 exceeded the MAX-EQS of benzo[a]pyrene.

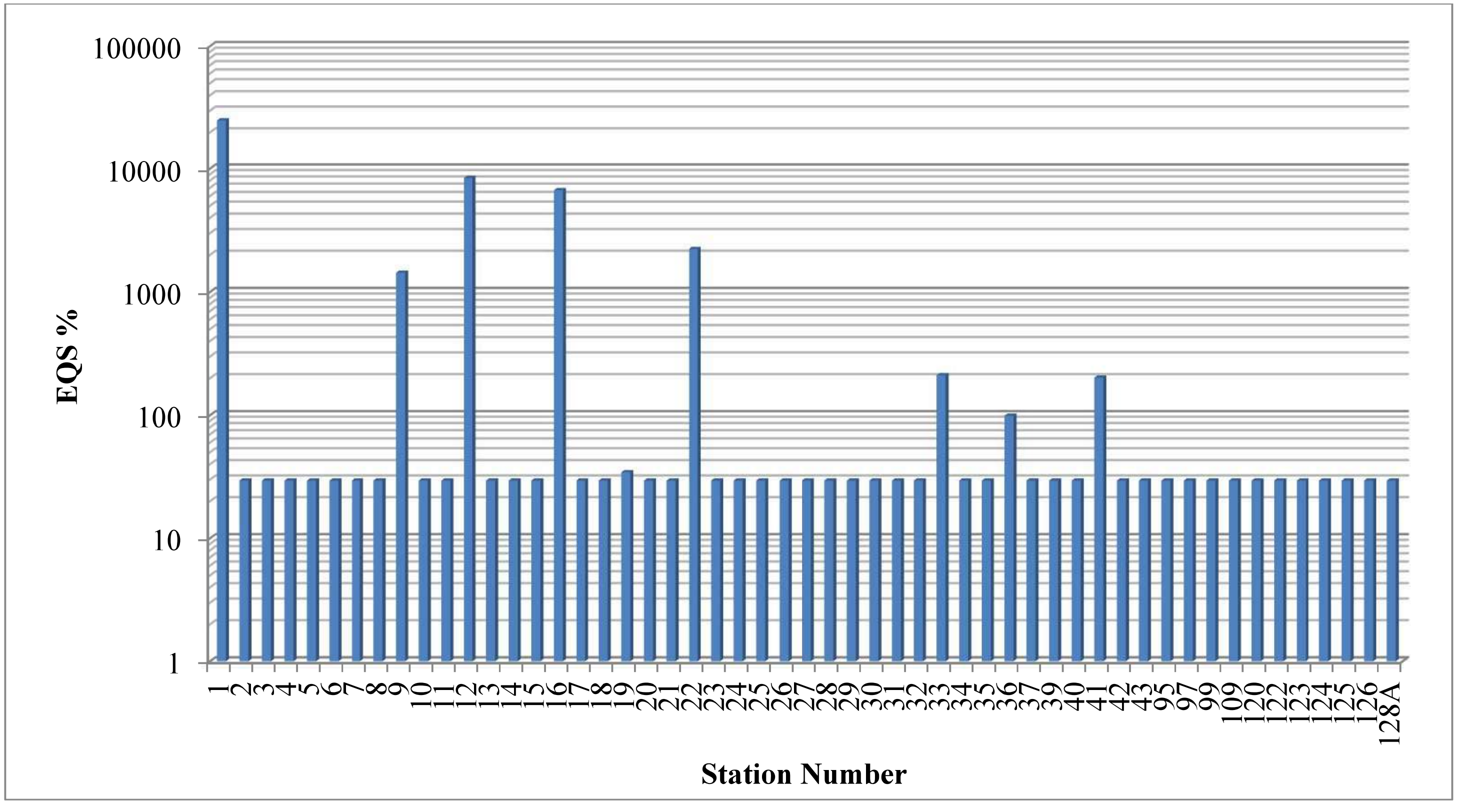

Figure 10 Average Percentage EQS values of benzo[a]pyrene at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 11 Riverine Stations with the three highest benzo[a]pyrene concentrations

Station	**% Avg-EQS**	**Average concentration, µg/L**	**Max concentration, µg/L**	**Possible Point Sources**
Station-1	24944.39	0.0424	0.2965	NA
Station -12	8384.50	0.0143	0.0995	-Kınık WWTP
Station -16	6667.73	0.0113	0.0790	-Adoçim Cement -Artova Chrome -Artova WWTP -Sulusaray WWTP
AA-EQS of benzo[a]pyrene (µg/L): 1.7×10^{-4} MAX-EQS of benzo[a]pyrene (µg/L): 0.27				

As it was demonstrated in Figure 8, there is not any establishment registered in the GIS file before the station-1.

Secondly, at the upstream of the Station-16,

- Industrial establishments of Adoçim Cement and Artova Chrome; and
- Artova WWTP and Sulusaray WWTP

are located on the affluent. Thirdly, the Station-12 is at the entrance of Almus Dam. Before the station-12, Kınık WWTP is located.

Benzo[a]pyrene can be originated from the activities listed in APPENDIX J. It was seen that exceedance was mainly seen after the municipal/urban WWTPs discharges; thus, they can be responsible for the pollution (Qi, Liu, Pernet-Coudrier, & Qu, 2013). However, since the wastewater content of the WWTPs is not known, it cannot be deduced which establishments are the sources of the pollutant. In addition, it can be expected from the cement industry situated in this region (Rengarajan, et al., 2015); (Baldantoni, Nicola, & Alfani, 2014). Lastly, PAHs may be formed during incomplete combustion of organic materials (coal and wood etc.) and are released during waste incineration, mining or oil refining. Hence, benzo[a]pyrene, used as an indicator species for PAH pollution, may be resulted from activities of chrome mining (PHE, 2008).

4.3.3 Association of Bifenox with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for bifenox was exceeded at eleven stations. Figure 11 illustrates the average percentage EQS values of the stations in seven monitoring periods for bifenox. The average concentrations of the stations having exceedance of EQS were around 1.5 to 3 times of the AA-EQS except the 3 of the highest exceedances which are at the station-37 (4.3 times of the EQS), -2(4.32 times of EQS) and -15(3.5 times of EQS). Moreover, as the Table 12 represents, Max-concentrations of the Station-37,-2 and -15 are almost 9, 5 and 7 times of the MAX-EQS of bifenox, respectively.

Table 12 Riverine Stations with the three highest bifenox concentrations

Station	**% Avg-EQS**	**Average concentration, µg/L**	**Max concentration, µg/L**	**Possible Point Sources**
Station-37	432.88	0.0519	0.3486	NA
Station -2	425.29	0.0510	0.1863	NA
Station -15	350.85	0.0421	0.2797	-Kastamonu Integrated Wood Products
AA-EQS of bifenox (µg/L): 0.012 MAX-EQS of bifenox (µg/L): 0,04				

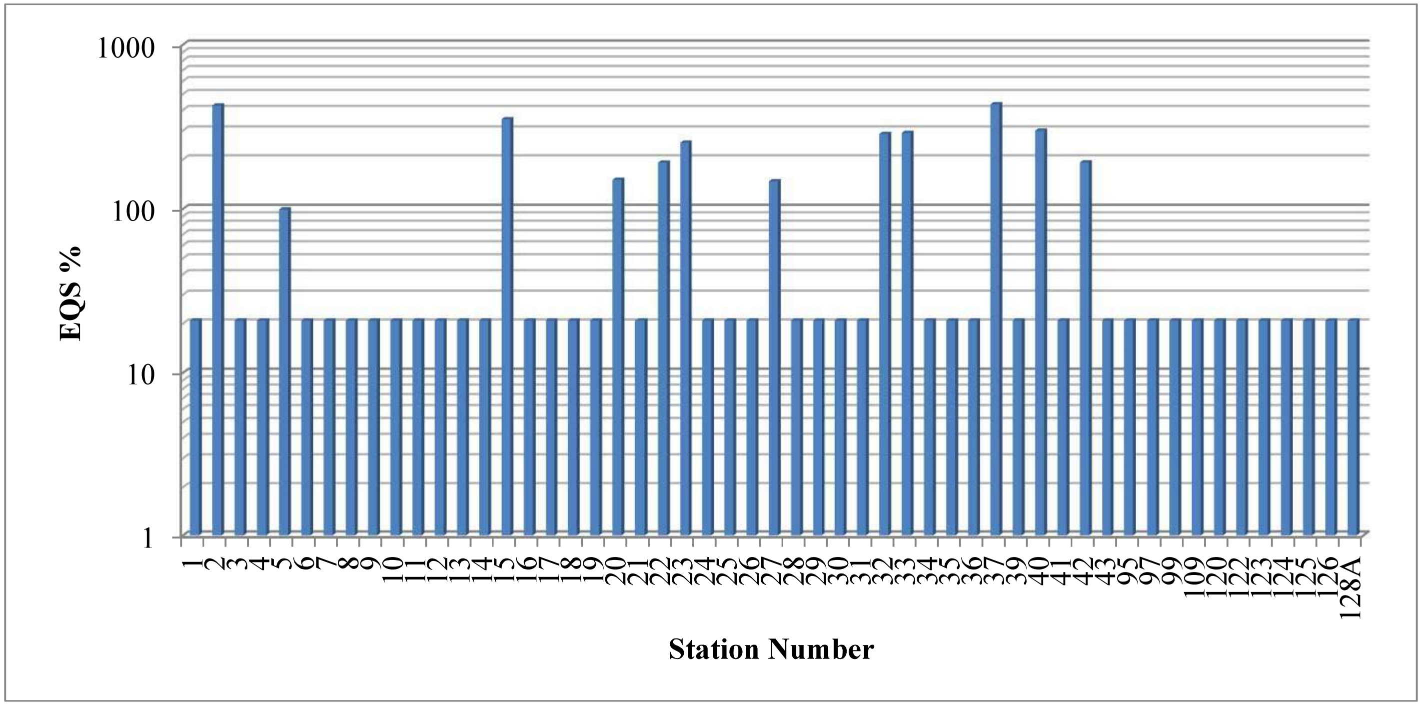

Figure 11 Average Percentage EQS values of bifenox at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.

As it was demonstrated in Figure 8, at the upstream of Station-37,

- Tokat SIS; and
- Apeas Tile-brick industry

are located.

Moreover, before the Station-2,

- Industrial establishments of Nur Coal, Ucyol Ready-mix concrete, Emmioglu Marble, YNSO Electric and Construction ;
- Erzincan Refahiye SIS; and
- Siran WWTP, Camoluk WWTP, Golova WWTP, Refahiye WWTP

are situated.

On the other hand, before the Station-15,

- Akdağmadeni SIS;
- industrial establishments of SD Sarel Plastic, Ozmersan Marble, Kastamonu Integrated Wood Products; and
- Haliköy WWTP, Kadışehri WWTP, Araplı WWTP, Akdağmadeni WWTP, Olukozu WWTP, Belekcahan WWTP, Ozan WWTP (station-54), Umutlu WWTP

are located.

Bifenox is an herbicide; it is used to control broad-leaved weeds in winter cereal crops (European Commission (DG Environment), 2011). Thus, it can be originated from diffuse sources due to an agricultural use in this area. Some of the food (agricultural products, grain mill) industries may have an effect on the pollution in the receiving water environment. Furthermore, at the mentioned stations, the Station -2 and-15, there are several urban WWTPs exist. Bifenox is not expected to be found in the sewerage system. Since Station-54, located at station-54, was not exceeded EQS, it may also support this argument. Nevertheless, if the content of their wastewater includes wastewaters of food, beverages, textiles and paper production sectors, they may be responsible for bifenox pollution in the water environment (European Commission (DG Environment), 2011). Thus, wooden products sector can be partially responsible. However, exceedance at mentioned stations cannot be concluded to the activities of the mentioned establishments such as mixed-concreate, marble, plastic, mining or construction etc. Lastly, since there is not any information about the industrial establishments located in SISs, it is not possible to evaluate them.

4.3.4 Association of Bromide with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for bromide was exceeded at several stations. Figure 12 illustrates the average percentage EQS values of the stations in seven monitoring periods for bromide. The average concentrations of the stations having exceedance of EQS were around 2.5 times of the AA-EQS. 3 of the highest exceedances are at the station-31 (18 times of the EQS), -25(11 times of EQS) and -125(8 times of EQS). Moreover, as the Table 13 represents, Max-concentrations of the Station-31,-25 and -125 are approximately 17.5, 15 and 6 times of the MAX-EQS of bromide, respectively.

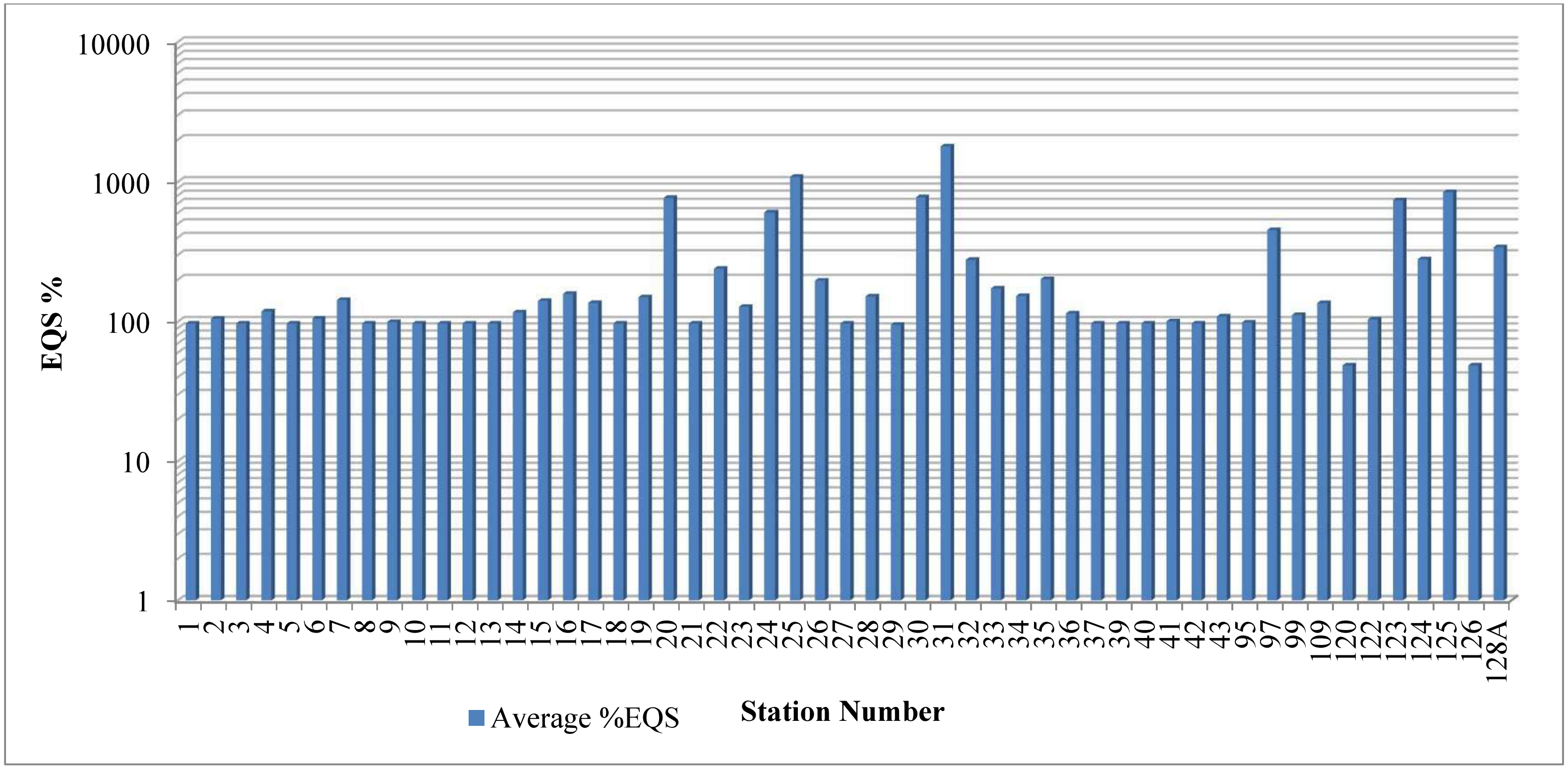

Figure 12 Average Percentage EQS values of bromide at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 13 Riverine Stations with the three highest bromide concentrations

Station	% Avg-EQS	Average concentration, µg/L	Max concentration, µg/L	Possible Point Sources
Station-31	1787.47	554.11	804.60	-Amasya Merzifon OIZ
Station -25	1083.50	335.89	706.50	-Corum WWTP -Corum OIZ -Yuva Viol Package -Yenidoğan Paper -Olmuksan Int. Paper -Hayat Paper
Station -125	841.29	260.80	260.80	-No clear connection
AA-EQS of bromide (µg/L): 31 MAX-EQS of bromide (µg/L): 46				

As it was demonstrated in Figure 8; at the upstream of the station-31,

- Amasya Merzifon OIZ(station 58, discharge station) ;
- Industrial establishments of Teksin Food(grain mill products), Nihoruz Food(oil and fat manufacturing), Omer Akay Flour; and
- Merzifon SIS and Merzifon 100. yıl SIS

are located.

Furthermore, before the station-25,

- Corum WWTP (the station-48, discharge station);
- Corum OIZ;
- Corum SIS; and

- Industrial establishments of Corum Sugar, Bim United Stores, Saray Petrol Station (grain mill products), Selhas Mining, Yuva Viol Package(Station-76, discharge station), Serra mining, Yenidoğan Paper, Cimpor Yibitas Cement, Hilal Block Brick, Mepet Metro Petrol Station (mobile food service), Gulumoglu Feed, Sedef Plastic, Olmuksan Int. Paper(Station-69, discharge station), Hayat Paper, Arsan Moulding, Mikro-win Building(pvc-door and window), Akcansa Cement Corum(ready mix concreate), Corum Hitit Flour

are situated.

Lastly, at the upstream of Station-125,

- Konaklı SIS and Düvenci SIS; and
- Industrial establishment of Etaş Meat

are placed.

Bromide compounds are used for fire safety (flame retardant chemistry), water treatment, reduction of mercury emissions, oil drilling, plant protection, energy storage and production, pharmaceutical production, plastics and rubber production, paints, drugs, pesticides, and electronic devices (TUBITAK Research Project 115Y013, 2016); (Kesner, 1999).

In terms of results of receiving environment stations, Amasya Merzifon OIZ, containing medical and industrial gas (fire extinguisher production) and plastic industries, may be partially responsible for the pollution at the station-31 in the first period. EQS exceedance at the Station-58 in the third period may also approve this argument (more detailed information about the firms inside Merzifon OIZ can be seen in Appendix D Table D. 2). Since the EQS was exceeded at the station-48, both Corum WWTP and Corum OIZ which discharges its wastewater to this WWTP can be blamed for the bromide pollution at the station-25. In this case, related individual industrial establishments inside Corum OIZ such as plastic /pvc production; pesticide and fertilizers; and electrical machinery sectors may be responsible(firms inside Corum OIZ can be seen in Appendix D Table D. 5). Additionally, since there were exceedance at the station-76 and -69, manufacture of corrugated paper and paperboard and of containers of paper and paperboard industry is partially responsible for the pollutant. Lastly, since the industrial establishments located in SISs are not known, they were not evaluated as a source.

4.3.5 Association of Cadmium and its compounds with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for Cd was exceeded at several stations.

Figure 13 illustrates the average percentage EQS values of the stations in seven monitoring periods for Cd. Average concentrations of the stations having exceedance of EQS were around 6.5 times of the AA-EQS. 3 of the highest exceedances are at the station-25 (125 times of the EQS), -24(44 times of EQS) and -123(9 times of EQS). Moreover, as the Table 14 represents, Max-concentrations of the Station-25,-24 and -123 are approximately 100,18 and 2 times of the MAX-EQS of Cd, respectively.

Table 14 Riverine Stations with the three highest cadmium concentrations

Station	**% Avg-EQS**	**Average concentration, µg/L**	**Max concentration, µg/L**	**Possible Point Sources**
Station-25	12452.14	9.9617	45.5909	-Corum WWTP -Corum OIZ -Yuva Viol Package
Station -24	4446.34	3.5571	8.0024	NA
Station -123	925.27	0.7402	0.9670	NA
AA-EQS of Cd (µg/L): 0.08 MAX-EQS of Cd (µg/L): 0.45				

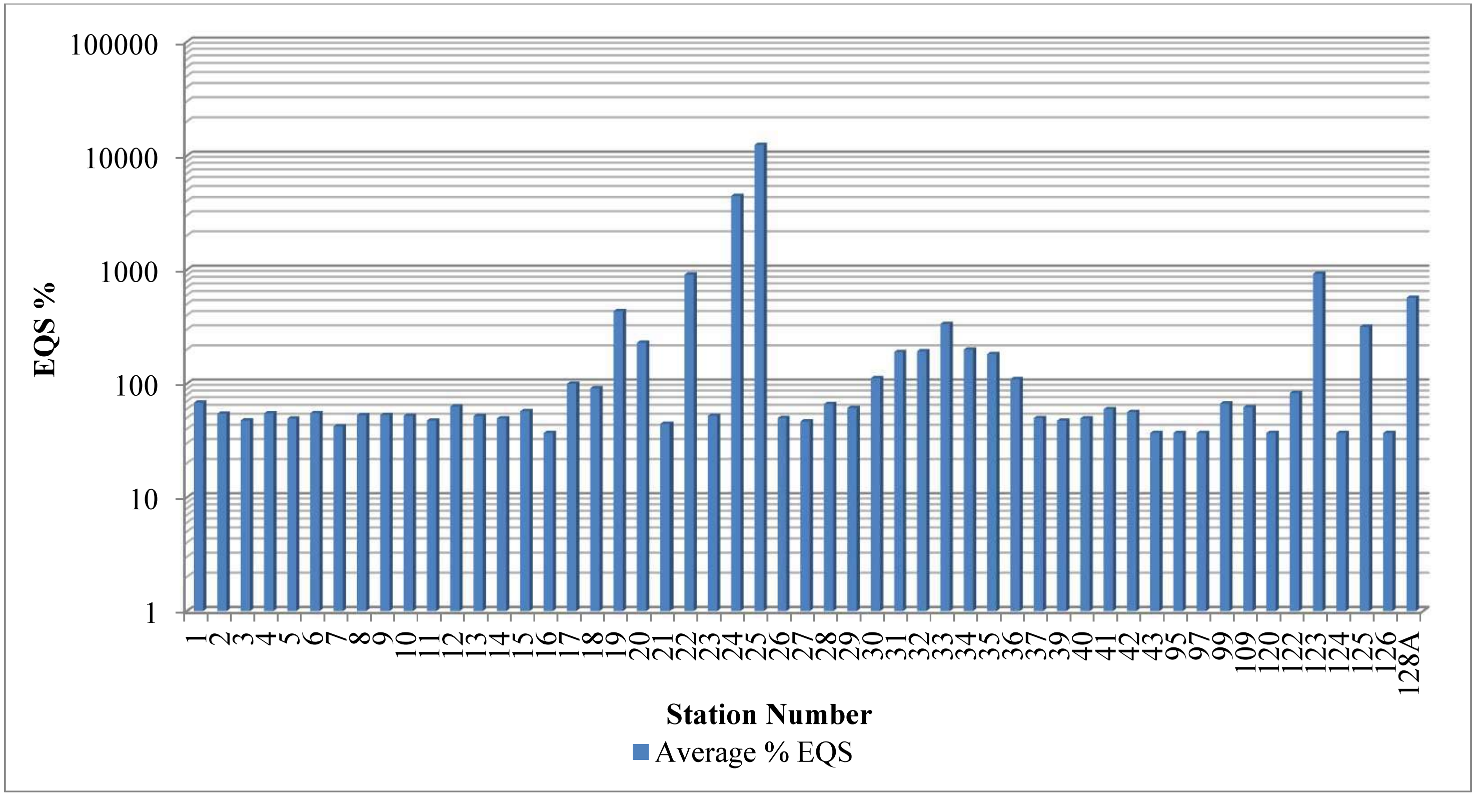

Figure 13 Average Percentage EQS values of Cd (cadmium and its compounds) at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

As it was demonstrated in Figure 8; before the station-25,

- Corum WWTP (the station-48, discharge station);
- Corum OIZ;
- Corum SIS; and
- Industrial establishments of Corum Sugar, Bim United Stores, Saray Petrol Station (grain mill products), Selhas Mining, Yuva Viol Package(Station-76, discharge station), Serra mining, Yenidoğan Paper, Cimpor Yibitas Cement, Hilal Block Brick, Mepet Metro Petrol Station (mobile food service), Gulumoglu Feed, Sedef Plastic, Olmuksan Int. Paper(Station-69, discharge station), Hayat Paper, Arsan Moulding, Mikro-win Building(PVC-door and window), Akcansa Cement Corum(ready mix concrete), Corum Hitit Flour

are located.

In addition, at the upstream of Station-123, Gulsim Flour and Amasya Sugar (Station-127, discharge station) are situated. On the other hand, there is not any establishment registered to GIS at the upstream of the Station-24.

Cadmium and its compounds are used in electrical, ceramics, paint, accumulator and battery industries (ATSDR, 2012). It may also be originated from the industrial activities listed in APPENDIX J.

In the view of this information, cadmium can be evaluated as a pollutant mostly originated from the point sources in these stations since there are several individual industrial establishments working on mining, construction, production of corrugated paper and paperboard sectors. In terms of OIZ, Station 48, located at Corum WWTP, treats wastewater of Corum OIZ. 20.15, 22.23, 23.32, 24.44, 24.52 and 27.12 coded sectors(for the NACE descriptions, APPENDIX J) inside the Corum OIZ can be the origins of the high cadmium concentration at the station-48(Related firms and their activities can be seen in Appendix D Table D. 5). In addition, since there is not any exceedance at Station-69 and -127, these establishments cannot be blamed for the Cd pollution. However, there is small exceedance at station-76 situated at Yuva Viol Package (1.1 times of EQS); thus it is partially responsible for the pollution.

4.3.6 Association of Cobalt with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for Co was exceeded at several stations.

Figure 14 illustrates the average percentage EQS values of the stations in seven monitoring periods for Co. Average concentrations of the stations having exceedance of EQS were around 4.8 times of the AA-EQS. 3 of the highest exceedances are at the station-31 (68 times of the EQS), -128 A (21 times of EQS) and -125(18 times of EQS). Moreover, as the Table 15 represents, Max-concentrations of the Station-31,-128 A and -125 are approximately 25, 2.4 and 2 times of the MAX-EQS of Co, respectively. Thus, relatively lower exceedances were seen in terms of MAX-EQS.

Table 15 Riverine Stations with the three highest cobalt concentrations

Station	% Avg-EQS	Average concentration, μg/L	Max concentration, μg/L	Possible Point Sources
Station-31	6813.72	20.44	65.50	-Merzifon OIZ -Teksin Food -Nihoruz Food -Omer Akay Flour
Station -128 A	2118.22	6.35	6.35	-Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Gurmin Energy-Mining -Eski Celtek Coal -Kozlu Food -Pan-et Slaughterhouse
Station -125	1800.23	5.40	5.40	-Etaş Meat
AA-EQS of Co (μg/L): 0.3 MAX-EQS of Co(μg/L): 2.6				

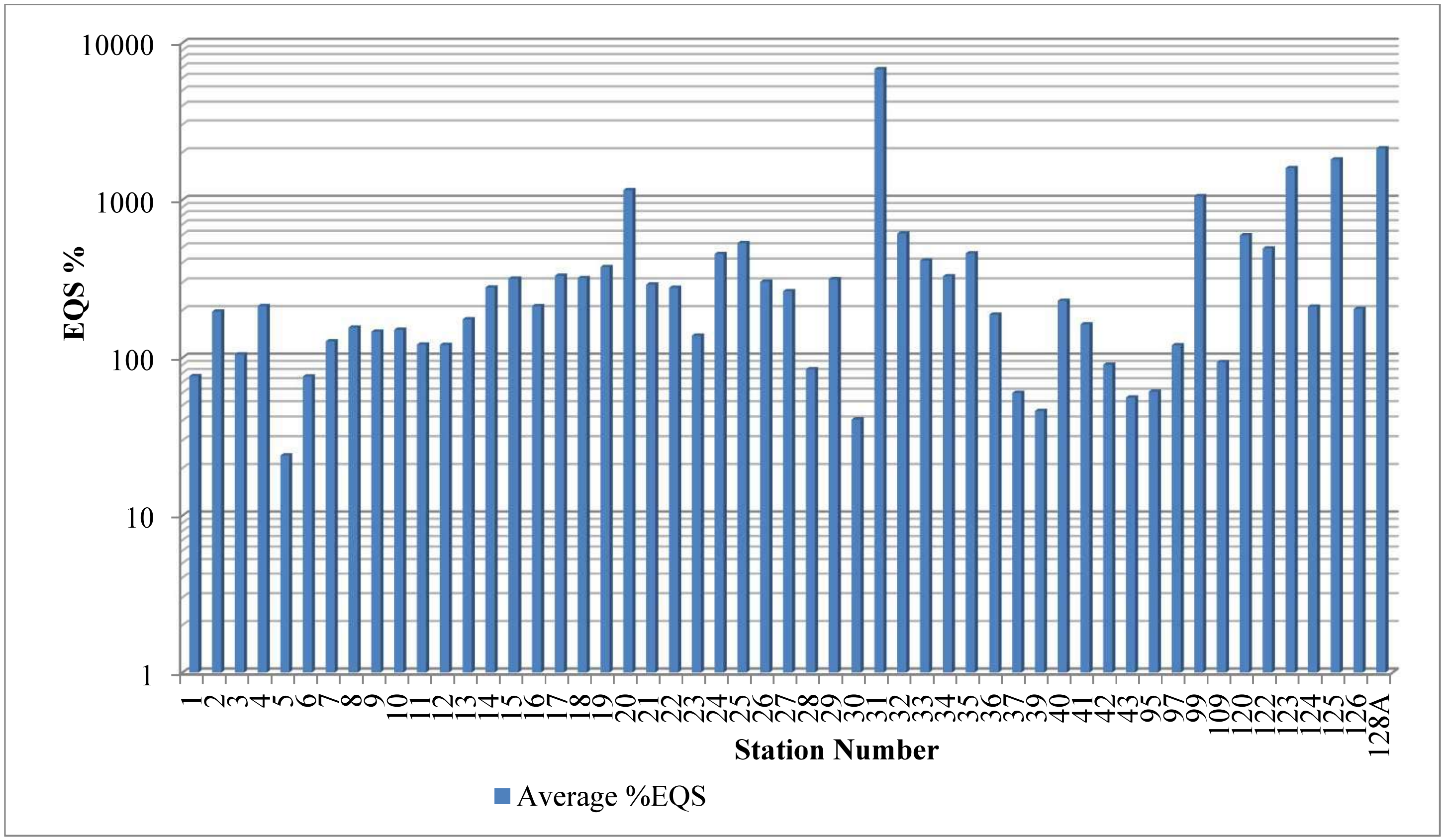

Figure 14 Average Percentage EQS values of cobalt at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

On the other hand, before the station-128 A,

- Suluova WWTP; and
- Industrial establishments of Yenitesfikiye Feed, Hasanusta Food(grain mill products), Besgoz Arabogulları Flour, Aktan Food(grain mill products) , Gurmin Energy-Mining, Eski Celtek Coal, Kozlu Food(feed products)(Station-78, discharge station), Pan-et Slaughterhouse

are situated.

Thirdly, at the upstream of Station-125,

- Konaklı SIS and Düvenci SIS; and
- Industrial establishment of Etaş Meat

are placed.

Cobalt as a pollutant, it can be discharged from porcelain and glassware industries, textile, chemical, non-ferrous metals sectors and urban WWTPs. Also, it can be originated from the activities of the industrial sectors listed APPENDIX J.

In the view of this information, cobalt can be designated as a pollutant mainly originating from relevant point sources in the basin. When the sectoral activity classes of the industrial establishments at the upstream of the Station-31 are evaluated, it can be seen that durable consumer goods and machine manufacturing and textile sectors, existing in the Merzifon OIZ, are the establishments that are partially responsible for the cobalt pollution (List of the firms which are inside the Amasya Merzifon OIZ can be seen in Appendix D Table D. 2). The exceedance observed at the station-58 (24 times of the EQS) also supports this argument. In addition, - Possible use of ^{60}Co for food irradiation (for preserving and pathogen control) in products of meat and grain mills in the region may have caused the pollutant to appear in the aquatic environment (Taner, n.d.) (Black & Libby, 1983). Moreover, exceedance at station-78(2 times of the EQS) shows that feed manufacturing also partially responsible for the pollution.

However, due to the insufficient information about the industrial establishments located in the mentioned SISs, these establishments could not be evaluated further.

4.3.7 Association of Chromium with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for Cr was exceeded at several stations. Figure 15 illustrates the average percentage EQS values of the stations in seven monitoring periods for Cr. Average concentrations of the stations having exceedance of EQS were around 2.5 times of the AA-EQS. 3 of the highest exceedances are at the station-31 (20 times of the EQS), -128 A(9 times of EQS) and -123(8 times of EQS). However, as the Table 16 represents, Max-concentrations of the Station-31,-128 A and -125 are all below the MAX-EQS of Cr.

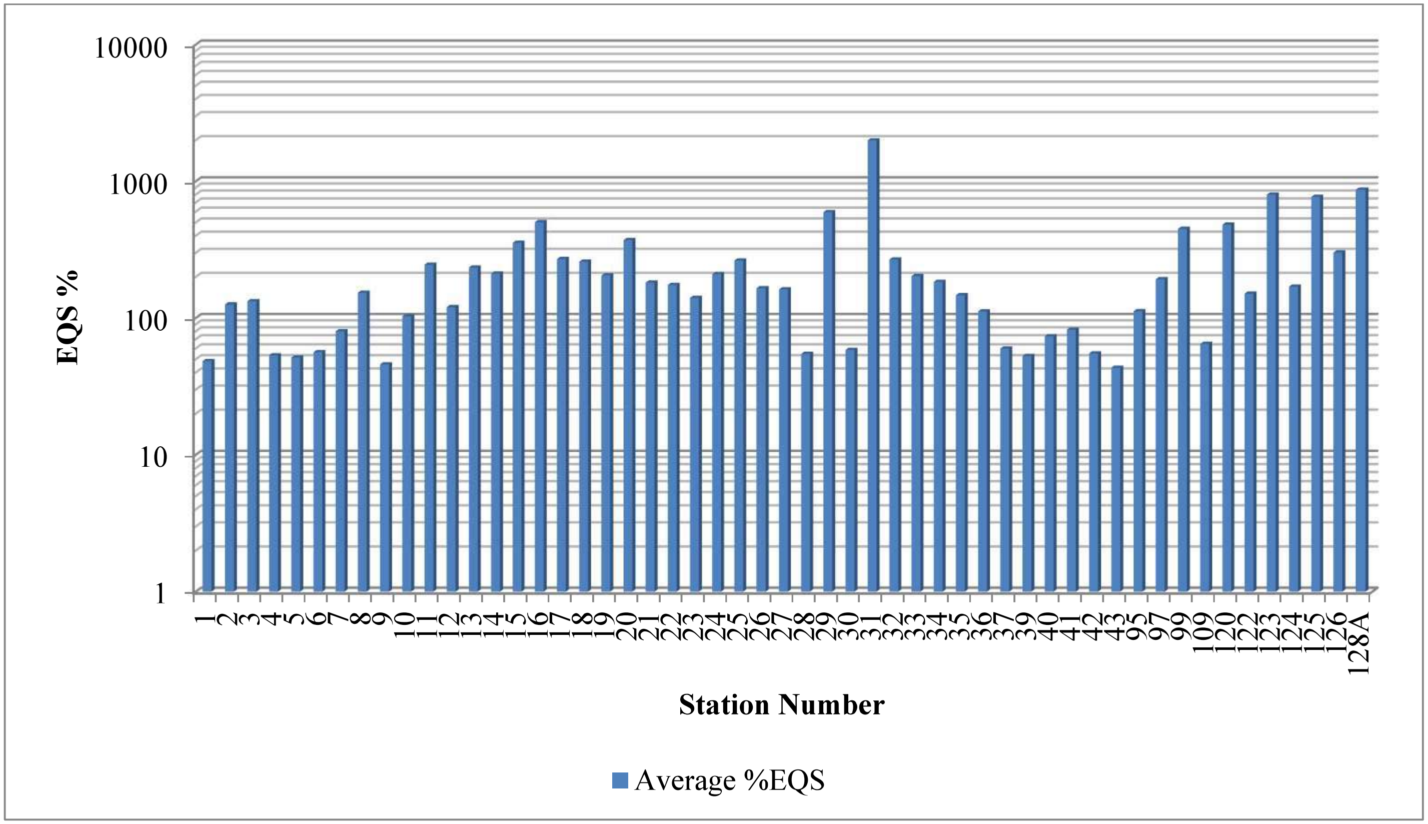

Figure 15 Average Percentage EQS values of chromium at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 16 Riverine Stations with the three highest chromium concentrations

Station	% Avg-EQS	Average concentration, µg/L	Max concentration, µg/L	Possible Point Sources
Station-31	1989.36	31.83	102.23	-Merzifon OIZ -Teksin Food -Nihoruz Food -Omer Akay Flour
Station -128A	866.93	13.87	13.87	-Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Gurmin Energy-Mining -Eski Celtek Coal -Kozlu Food
Station -123	798.01	12.77	23.13	-Gulsim Flour
AA-EQS of chromium (µg/L): 1.6 MAX-EQS of chromium (µg/L): 142				

As it was demonstrated in Figure 8; at the upstream of Station-31,

- Amasya Merzifon OIZ(station 58, discharge station) ;
- Industrial establishments of Teksin Food(grain mill products), Nihoruz Food(oil and fat manufacturing), Omer Akay Flour; and
- Merzifon SIS and Merzifon 100. yıl SIS

are located.

Secondly, Station-128A and-123 follow each other through the direction of flow of Tersakan, the tributary of Yeşilırmak River. Before the station-128 A,

- Suluova WWTP; and
- Industrial establishments of Yenitesfikiye Feed, Hasanusta Food(grain mill products), Besgoz Arabogulları Flour, Aktan Food(grain mill products) , Gurmin Energy-Mining, Eski Celtek Coal, Kozlu Food(feed products)(Station-78, discharge station), Pan-et Slaughterhouse

are situated.

Between Station-128A and Station-123, Gulsim Flour and Amasya Sugar (Station-127, discharge station) are situated.

Iron and steel, textile, chemical, paper, non-ferrous metals, industrial cooling, ship dismantling, port shipyard, paint sectors and urban WWTPs may cause chromium pollution. Also, it can be originated from the activities of the industrial sectors listed in APPENDIX J.

Chromium may also be useful as a pesticide intermediate, germicide and fumigant mainly used for wood preservation (NPIC, 2018). Thus it may be considered as a pollutant derived from both point and diffuse sources for Yeşilırmak River Basin. In addition, chromium may be expected from the cleaning waters (due to the pesticide use) of the food industries. Nevertheless, there is not any exceedance at Station-127 situated at Amasya Sugar Factory.

The reason behind the exceedance at station-31 and -58 could be the activities of the chemical and manufacture of machinery and equipment industries(metallurgical and refractory related industries)((ATSDR, 2012) inside the Amasya Merzifon OIZ (List of the firms which are inside the Amasya Merzifon OIZ can be seen in Appendix D Table D. 2). However, since there is not enough information about the industrial establishments located in SISs and the content of the WWTPs in mentioned regions, it cannot be deduced which establishments are the sources of the pollutant among them.

4.3.8 Association of Copper with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for Cu was exceeded at several stations.

Figure 16 illustrates the average percentage EQS values of the stations in seven monitoring periods for Cu. Average concentrations of the stations having exceedance of EQS were around 2.2 times of the AA-EQS. 3 of the highest exceedances are at the station-31 (29 times of the EQS), -128 A (10 times of EQS) and -123(5 times of EQS). Moreover, as the Table 17 represents, Max-concentrations of the Station-31,-128 A and -123 are approximately 40, 9 and 6 times of the MAX-EQS of Cu, respectively.

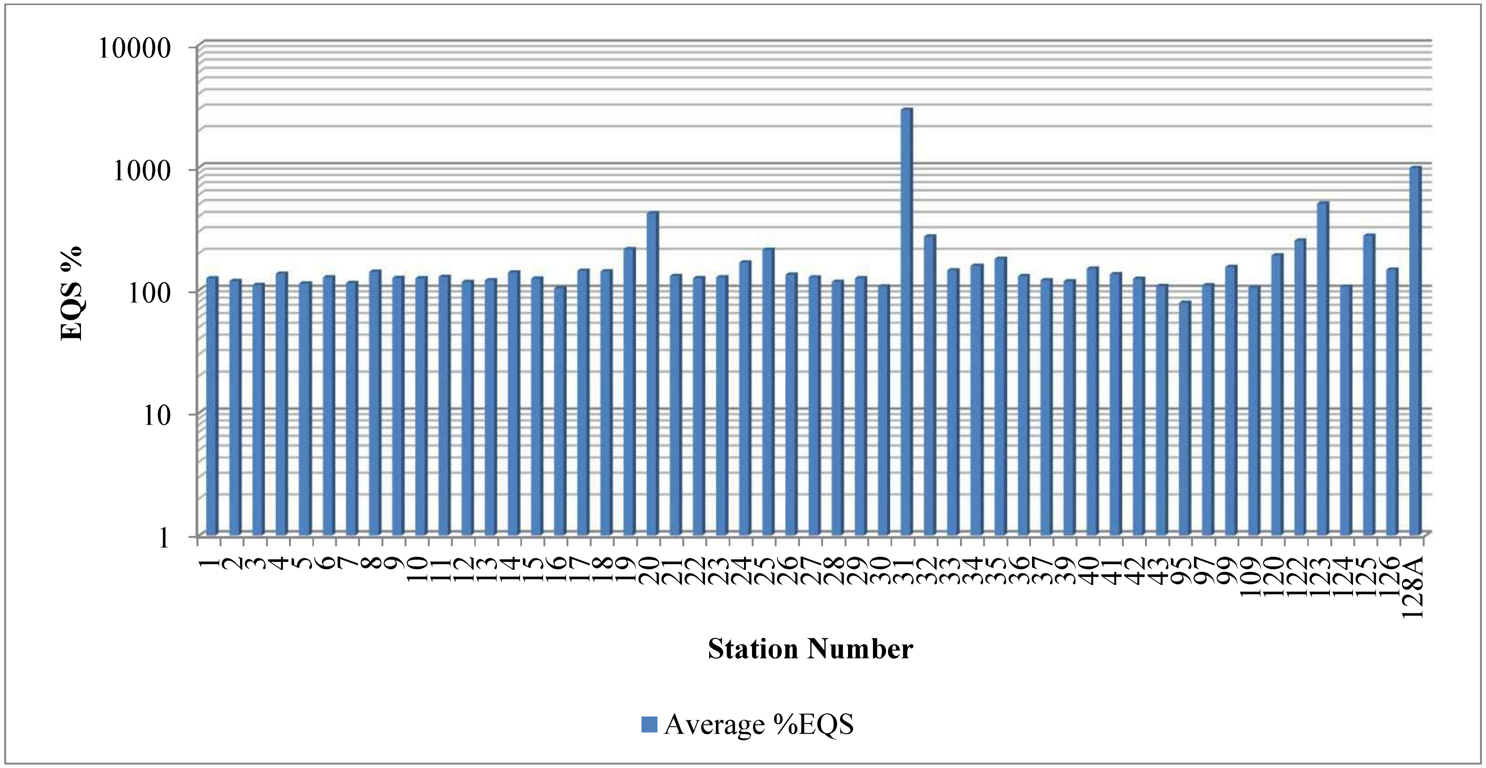

Figure 16 Average Percentage EQS values of copper at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 17 Riverine Stations with the three highest copper concentrations

Station	% Avg-EQS	Average concentration, µg/L	Max concentration, µg/L	Possible Point Sources
Station-31	2934.71	381.51	586.77	-Amasya Merzifon OIZ -Teksin Food -Nihoruz Food -Omer Akay Flour
Station -128 A	983.82	127.90	127.90	-Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Gurmin Energy-Mining -Eski Celtek Coal -Kozlu Food
Station -123	504.65	65.60	92.20	-Gulsim Flour
AA-EQS of copper (µg/L): 13 MAX-EQS of copper (µg/L): 14.5				

As it was demonstrated in Figure 8; at the upstream of Station-31,

- Amasya Merzifon OIZ(station 58, discharge station) ;
- Industrial establishments of Teksin Food(grain mill products), Nihoruz Food(oil and fat manufacturing), Omer Akay Flour; and
- Merzifon SIS and Merzifon 100. yıl SIS

are located.

In addition, Station-128A and-123 follow each other through the direction of flow of Tersakan, the tributary of Yeşilırmak River. Before the station-128 A,

- Suluova WWTP; and
- Industrial establishments of Yenitesfikiye Feed, Hasanusta Food(grain mill products), Besgoz Arabogulları Flour, Aktan Food(grain mill products) , Gurmin Energy-Mining, Eski Celtek Coal, Kozlu Food(feed products)(Station-78), Pan-et Slaughterhouse

are situated.

Finally, between Station-128A and Station-123, Gulsim Flour and Amasya Sugar (Station-127, discharge station) are placed.

Iron and steel, textile, chemical, paper, ship dismantling (harbor shipyard) and paint industries and urban WWTPs can be the source of copper pollution. In addition, it can be originated from the activities of the industrial sectors listed in APPENDIX J.

The reason behind the exceedance at station-31 and -58 could be the activities of the metal, machinery manufacturing, chemical products, electrical machinery and textile sectors inside the Amasya Merzifon OIZ (List of the firms which are inside the Amasya Merzifon OIZ can be seen in Appendix D Table D. 2). On the other hand, there is not exceedance at station-127(Amasya sugar factory). However, due to agricultural use of copper-based fungicides, grain mill and feed industries can be the source of the copper pollution (Husak, 2015). In fact, the AA- EQS was exceeded at Station-78(Kozlu feed). Mining industries yielding copper as a by-product may also effect on copper pollution (SDWF, 2018). Lastly, because of the insufficient information about the industries in SISs (namely Merzifon and Merzifon 100. Yıl,) and wastewater content of Suluova WWTP, these establishments could not be evaluated further.

4.3.9 Association of Dichlorvos with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for dichlorvos was exceeded at several stations. Figure 17 illustrates the average percentage EQS values of the stations in seven monitoring periods for dichlorvos. Average concentrations of the stations having exceedance of EQS were between 10 and 100 times of the AA-EQS. 3 of the highest exceedances are at the Station-30 (312 times of the EQS), -28 (154 times of EQS) and -19 (144 times of EQS). Moreover, as the Table 18 represents, Max-concentrations of these stations are more significant when compared to the MAX-EQS. Station-31,-128 A and -123 are approximately 534, 660 and 491 times of the MAX-EQS of dichlorvos, respectively.

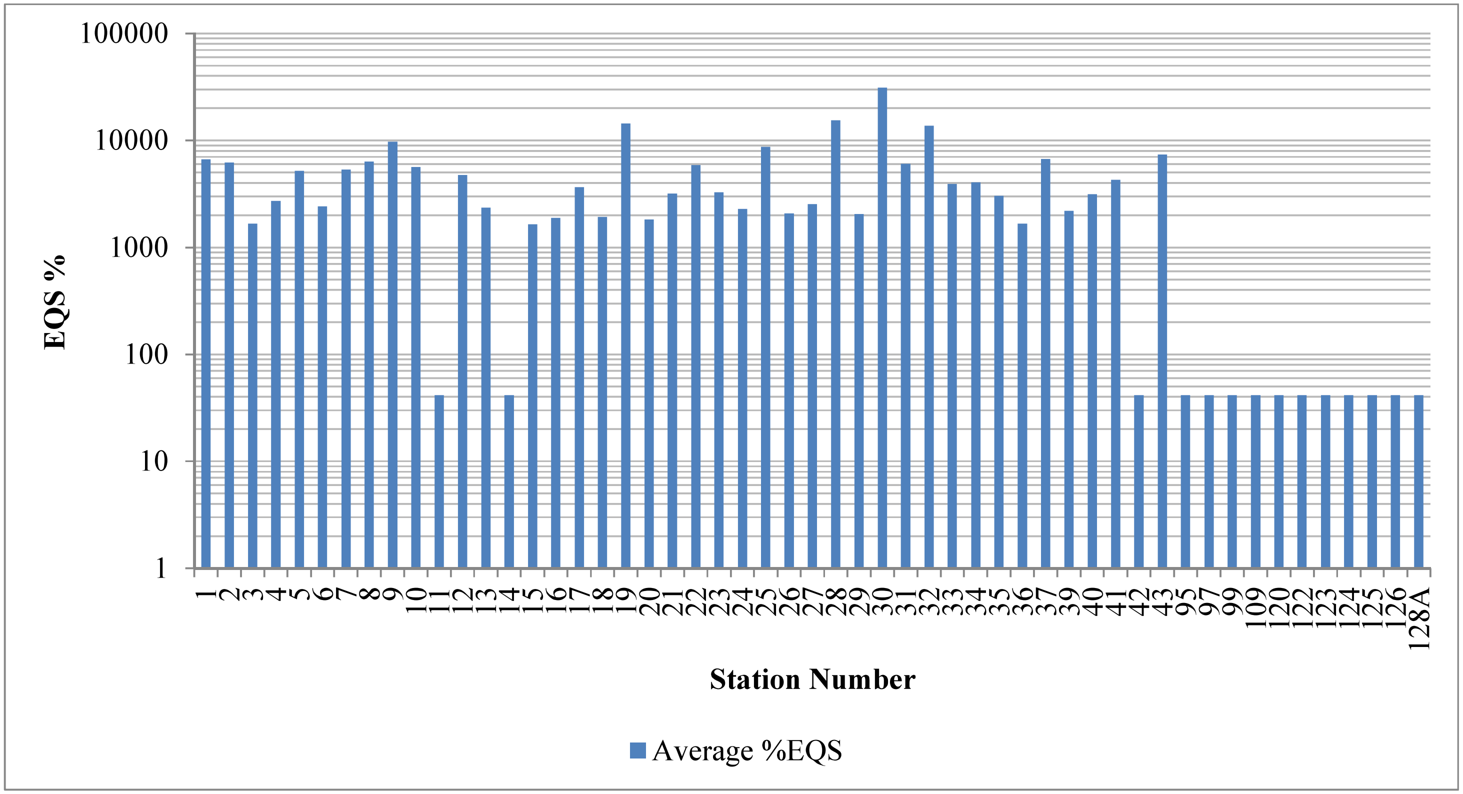

Figure 17 Average Percentage EQS values of dichlorvos at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 18 Riverine Stations with the three highest dichlorvos concentrations

Station	% Avg-EQS	Average concentration, µg/L	Max concentration, µg/L	Possible Point Sources
Station-32	31173.22	0.1870	0.3738	-Amasya Suluova TDI Besi OIZ
Station -28	15430.72	0.0926	0.4619	NA
Station -19	14372.08	0.0862	0.3434	NA
AA-EQS of dichlorvos (µg/L): 0.0006 MAX-EQS of dichlorvos (µg/L): 0.0007				

As it was demonstrated in Figure 8, Station-28 is at Alaca, Çorum. At the upper reach of the station-28, Eymir WWTP is situated.

Secondly, before the station-32(Suluova, Amasya),

- Suluova SIS;
- Amasya Suluova TDI Besi OIZ;
- Industrial establishments of Et-bir Slaughterhouse(station-77, discharge station)

are located.

Thirdly, Station-19 located in central district of Amasya. Before the station-19,

- industrial establishments of Uygar Municipal Slaughterhouse, Akiktas Mining, Gür Flour, Ozen Excavation; and
- Amasya SIS (1st. Part), Amasya SIS (2nd. Part)

are placed.

Dichlorvos is an insecticide; thus, it can be originated from diffuse sources. Moreover, Amasya Suluova TDI Besi OIZ may also be an origin for the pollutant by considering the possible use of pollutant as a drug, disinfectant or insecticide etc. in livestock facilities (ATSDR, 1997) (for the firms inside OIZ, Appendix D Table D. 4 can be seen). However, dichlorvos is not expected from activities of meat processing, flour, construction or mining sectors. In addition, station-77(Et-bir Slaughterhouse) did not have exceedance of EQS. The characteristics of the wastewater of the WWTPs at the upper reach of the station-32 are not known. Thus, it was not commented on their relation with pollutant. In addition, since Lastly, there is not enough information about the industrial establishments located in SISs, which are at the upstream of station-32 and -19, could not be evaluated whether they were sources or not.

4.3.10 Association of Iron with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for Fe was exceeded at several stations. Figure 18 illustrates the average percentage EQS values of the stations in seven monitoring periods for Fe. Average concentrations of the stations having exceedance of EQS were around 10 times of the AA-EQS. 3 of the highest exceedances are at the Station-128 A (65 times of the EQS), -125 (61 times of EQS) and -123 (58 times of EQS). Moreover, as the Table 19 represents, Max-concentrations of station-123 is more significant when compared to the MAX-EQS, with 101 times of the MAX-EQS.

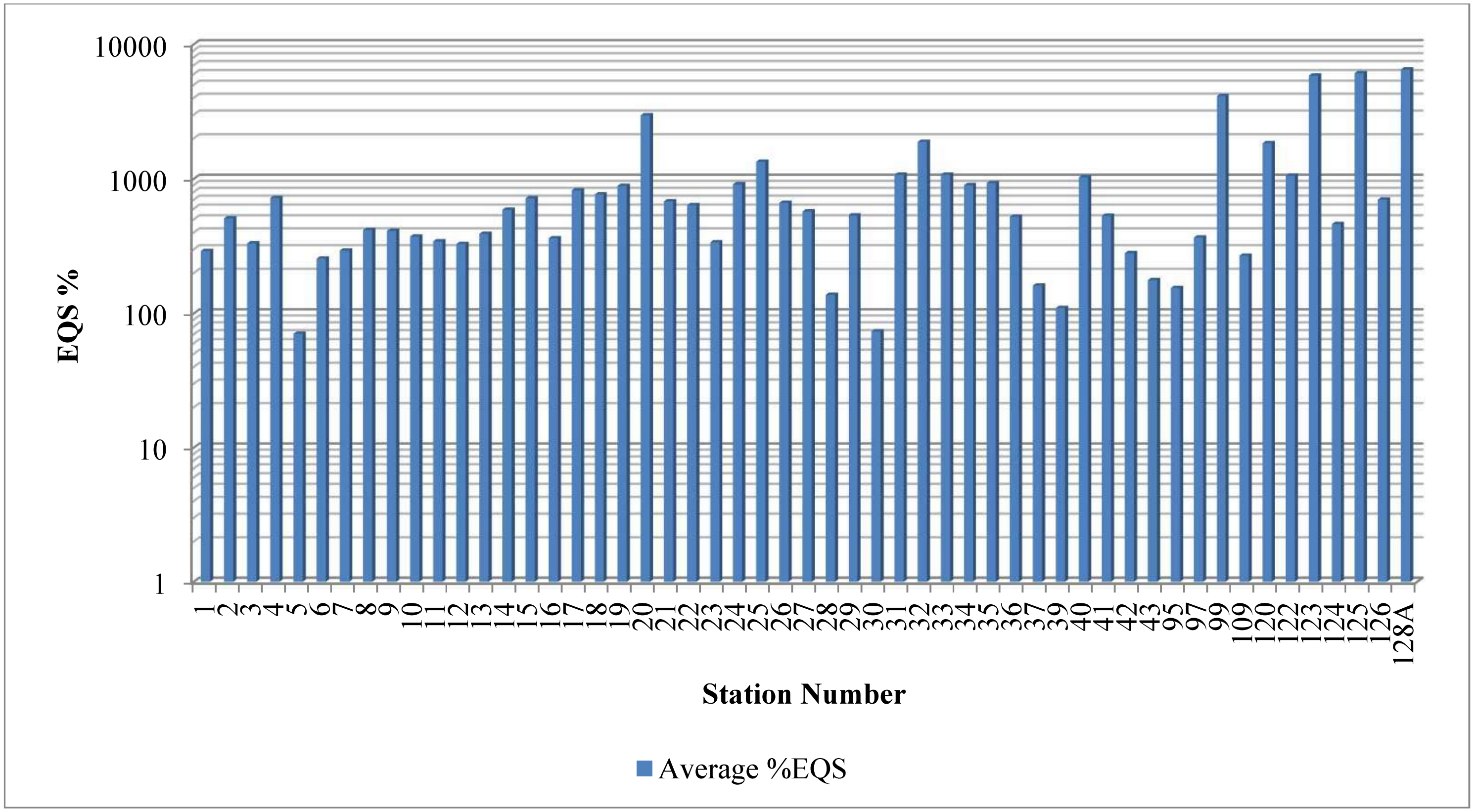

Figure 18 Average Percentage EQS values of iron at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 19 Riverine Stations with the three highest iron concentrations

Station	% Avg-EQS	Average concentration, µg/L	Max concentration, µg/L	Possible Point Sources
Station-128 A	6495.49	6185.01	6185.01	-Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Gurmin Energy-Mining -Eski Celtek Coal -Kozlu Food -Pan-et Slaughterhouse
Station -125	6095.84	5804.46	5804.46	-Etaş Meat
Station -123	5848.65	5569.08	10163.45	-Gulsim Flour -Amasya Sugar
AA-EQS of iron (µg/L): 95.22 MAX-EQS of iron (µg/L): 101				

As it is demonstrated in Figure 8; Station-128A and -123 are located at around Suluova, Amasya. They follow each other through the direction of flow of Tersakan, the tributary of Yeşilırmak River. Before the station-128 A,

- Suluova WWTP; and
- Industrial establishments of Yenitesfikiye Feed, Hasanusta Food(grain mill products), Besgoz Arabogulları Flour, Aktan Food(grain mill products) , Gurmin Energy-Mining, Eski Celtek Coal, Kozlu Food(feed products)(Station-78, discharge station), Pan-et Slaughterhouse

are located.

In addition, between Station-128A and Station-123, Gulsim Flour and Amasya Sugar (Station-127, discharge station) are situated.

Thirdly, at the upstream of Station-125,

- Konaklı SIS and Düvenci SIS; and
- industrial establishment of Etaş Meat

are placed.

It is known that iron is used in iron-steel, textile, automotive and construction sectors. Also, it can be originated from the activities of the industrial sectors listed in APPENDIX J.

Due to the iron enrichment of flour, other grain mill products during their production may result in iron pollution (Davis, 2018); (Doe1, Awua, Gyamfi, & Bentil, 2013). Exceedances at station-78 (Kozlu Food (feed products), 5.3 times of the EQS) and -127(Amasya Sugar Factory, 3 times of the EQS) shows that these establishments are some of the sources of iron pollution. In addition, the meat processing industry before the station-20 may be partially responsible (Jayathilakan, Sultana, Radhakrishna, & Bawa, 2012). Moreover, lignite and coal mines located near mentioned stations may be responsible for the iron pollution due to acid mine drainages (US EPA, n.d.). Another reason for iron pollution in water environment can be discharges of WWTPs using iron for phosphorous removal processes (IAGLR, 2006). However, due to the limited available information of the industrial establishments in SISs and the content of the WWTPs, mentioned SISs and WWTPs was not evaluated.

4.3.11 Association of Fenarimol with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for fenarimol was exceeded only at one station.

Figure 19 illustrates the average percentage EQS values of the stations in seven monitoring periods for fenarimol. Only exceedance is at the Station-1(643 times of the EQS), Moreover, as the Table 20 represents, Max-concentrations of these stations are more significant when compared to the MAX-EQS. The maximum concentration of Station-1 is 4500 times of the MAX-EQS of fenarimol, respectively.

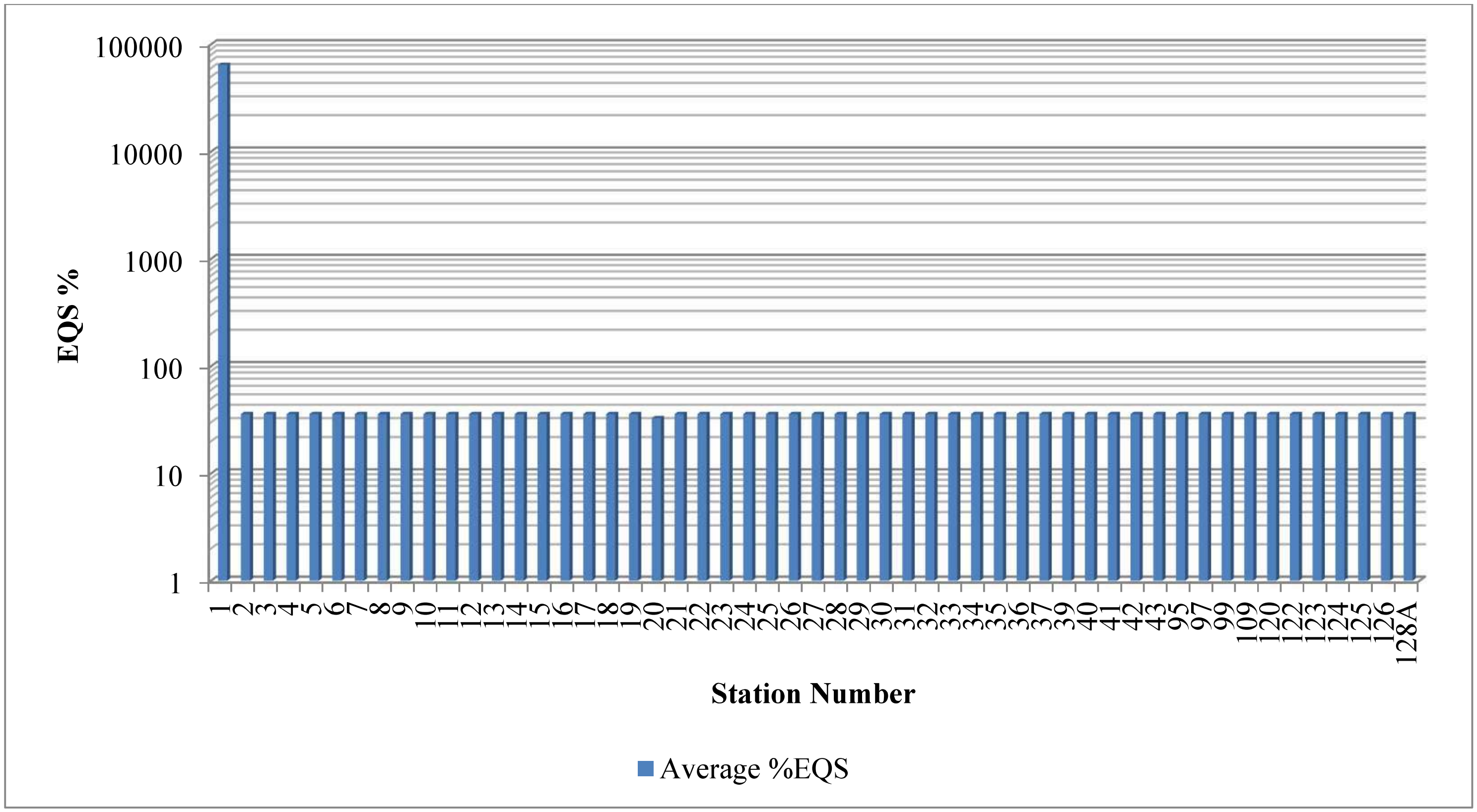

Figure 19 Average Percentage EQS values of fenarimol at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 20 Riverine Stations with the three highest fenarimol concentrations

Station	% Avg-EQS	Average concentration, µg/L	Max concentration, µg/L	Possible Point Sources
Station-1	64335,40	45,03	315,09	NA
AA-EQS of fenarimol (µg/L): 0.07 MAX-EQS of fenarimol (µg/L): 0.07				

As can be seen in Figure 8, there isn't any establishment registered to GIS before the station-1, located district of Köse, Gümüşhane. It was known that Fenarimol is fungicide (NCBI); thus, it was regarded as a diffuse pollutant in the case of Yeşilırmak River Basin.

4.3.12 Association of Mercury and its compounds with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for Hg was exceeded at six riverine stations. Figure 20 illustrates the average percentage EQS values of the stations in seven monitoring periods for Hg. Average concentrations of the stations having exceedance of EQS were just above the MAX-EQS (around 1.1 times of the EQS). 3 of the highest exceedances are at the station-21 (1.9 times of the EQS), -33(1.6 times of EQS) and -34(1.6 times of EQS). Moreover, as the Table 21 represents, Max-concentrations of these stations are more significant when compared to the MAX-EQS. Max-concentrations of the Station-21, -33 and -34 are approximately 5.6, 2.6 and 2.9 times of the MAX-EQS of Hg, respectively.

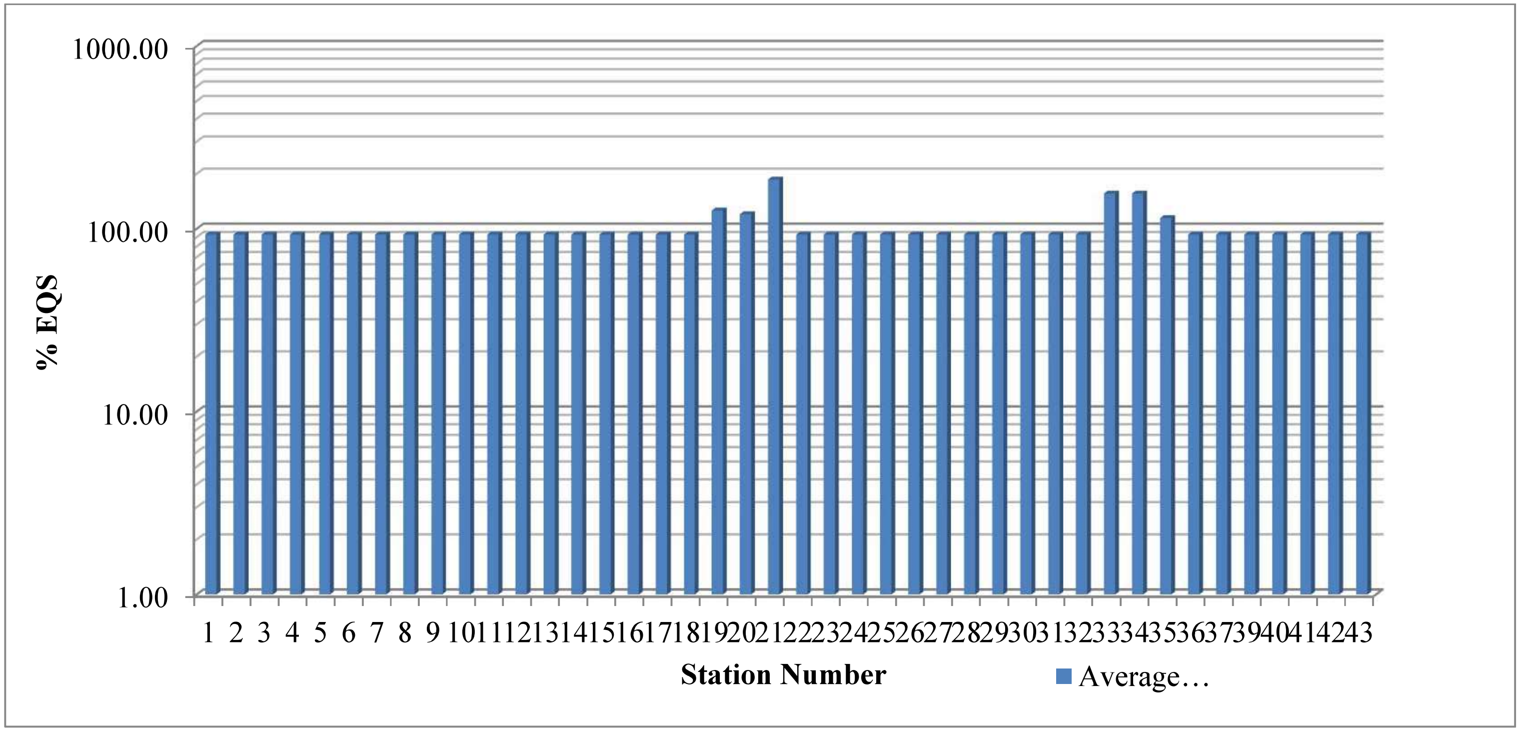

Figure 20 Average Percentage EQS values of mercury at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 21 Riverine Stations with the three highest mercury concentrations

Station	**% Avg-EQS**	**Average concentration, µg/L**	**Max concentration, µg/L**	**Possible Point Sources**
Station-21	185.71	0.1300	0.39	-Amasya Merkez OIZ
Station -33	155.71	0.1090	0.18	NA
Station -34	155.71	0.1090	0.2	NA
AA-EQS of mercury (µg/L): - MAX-EQS of mercury (µg/L): 0.07				

As it is demonstrated in Figure 8, station-21 is at the connection point of Cekerek Streamlet, Corum Streamlet and Delicay Streamlet. At the upper reach of station-21,

- Industrial establishments of Amasya Flour, Fimar Construction; and
- Amasya Merkez OIZ

  are located.

Secondly, Station-33 and -34 flows each other through the direction of flow. Before the Station-33,

- Amasya WWTP(station-107); and
- Özmaya Baker's Yeast industry(station-70)

are situated.

On the other hand; at the upstream of Station-34(near the district of Tasova, Amasya), Ballıdere WWTP is placed.

Elemental mercury is used in barometers, thermometers, and pressure sensors; lamps, accumulators, industrial processes; refining, lubricating oils; and tooth amalgam.

Moreover, Mercury chloride is used as a disinfectant and insecticide (NCBI). Mercury and its compounds can also be originated from the activities listed in APPENDIX J.

By all accounts, it can be concluded that the firms in Amasya Merkez OIZ operating in the manufacturing of furniture and organic fertilizer, hardware products and iron sectors could be responsible for mercury pollution at station-21(List of the firms which are inside Samsun Kavak OIZ can be seen Appendix D Table D. 7). Any exceedance was not observed in Station-70 (Baker's Yeast industry) and -107(Amasya WWTP). However, flour industry and construction industry cannot be seen as the source of the pollutant. Finally, since there is not enough information about the wastewater content of Ballıdere WWTP it is not possible to evaluate its effect on the river basin.

4.3.13 Association of Nickel and its compounds with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for Ni was exceeded at several riverine stations. Figure 21 illustrates the average percentage EQS values of the stations in seven monitoring periods for Ni. Average concentrations of the stations having exceedance of EQS were around 2 times of the AA-EQS. 3 of the highest exceedances are at the station-99 (almost 14 times of the EQS), -31(10 times of EQS) and -128 A(8 times of EQS). However, as the Table 22 represents, Max-concentrations of these stations are less significant when compared to the MAX-EQS. Max-concentrations of the Station-128A is not exceeded the MAX-EQS. In addition, Max-concentrations of station-99 and -31 are approximately 2.3 and 3.4 times of the MAX-EQS of Ni, respectively.

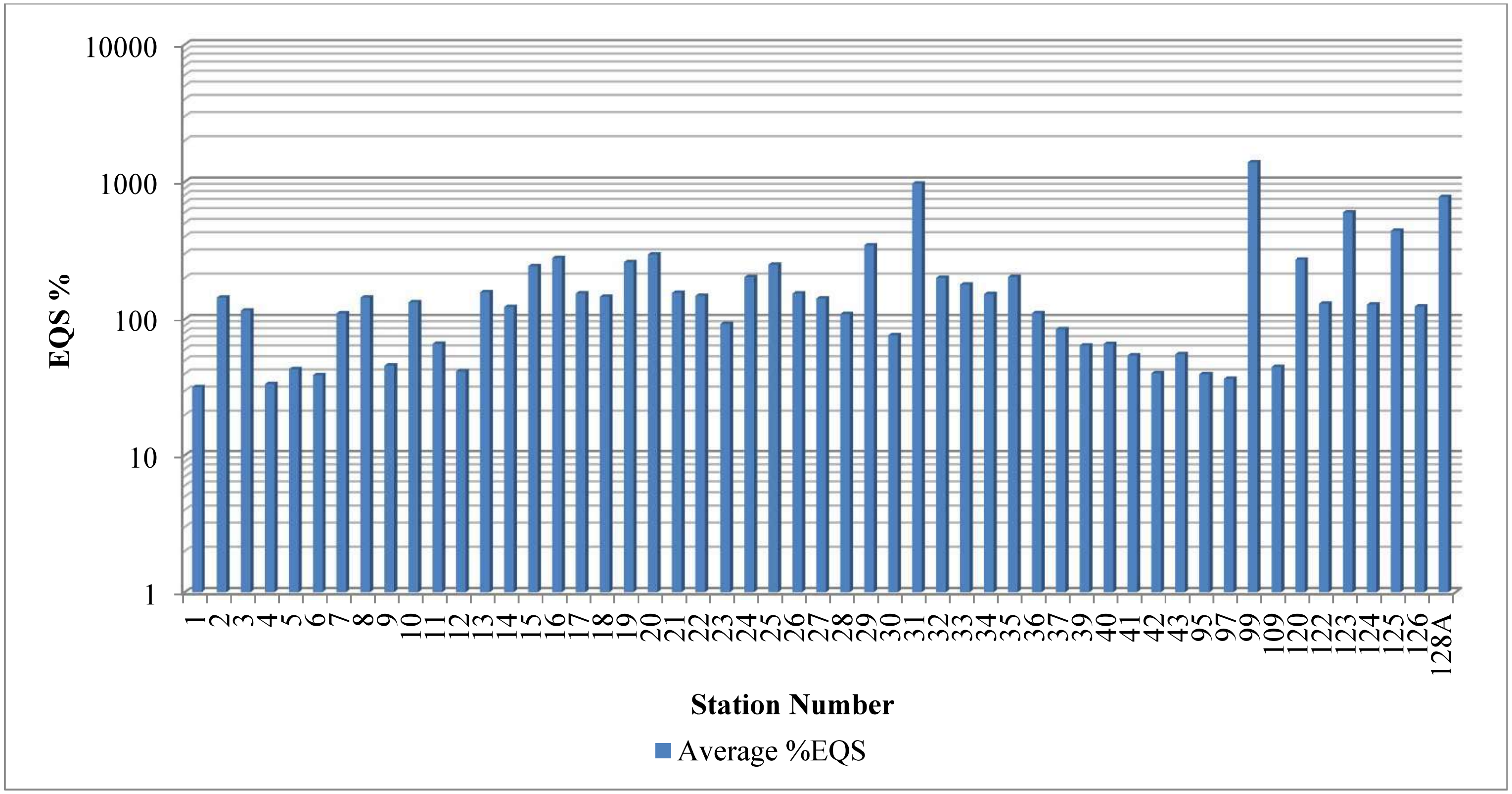

Figure 21 Average Percentage EQS values of nickel at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 22 Riverine Stations with the three highest nickel concentrations

Station	% Avg-EQS	Average concentration, µg/L	Max concentration, µg/L	Possible Point Sources
Station-99	1386.11	55.44	77.15	-Ozdemir Antimony Mining
Station -31	971.03	38.84	114.34	- Amasya Merzifon OIZ
Station -128 A	776.10	31.04	31.04	-Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food
AA-EQS of nickel(µg/L): 4.0 MAX-EQS of nickel(µg/L): 34				

As it was demonstrated in Figure 8, the station-99 is situated at the downward flow of Ozdemir Antimony Mining.

On the other hand, at the upstream of the station-31,

- Amasya Merzifon OIZ(station 58, discharge station) ;
- Industrial establishments of Teksin Food(grain mill products), Nihoruz Food(oil and fat manufacturing), Omer Akay Flour; and
- Merzifon SIS and Merzifon 100. yıl SIS

are placed.

Before the station-128 A, Suluova WWTP; and industrial establishments of Yenitesfikiye Feed, Hasanusta Food(grain mill products), Besgoz Arabogulları Flour, Aktan Food(grain mill products) , GurminEnergy-Mining, Eski Celtek Coal, Kozlu Food(feed products)(Station-78, discharge station), Pan-et Slaughterhouse are located.

Nickel is used in stainless steel production in industries and the production of other corrosion resistant alloys. Furthermore, it is also used in the production of coatings, casting and battery production and other electronic devices (US National Toxicology Program, 2011). Additionally, it can be originated from the activities listed in APPENDIX J.

After reviewing all information, it can be concluded that major source of the nickel pollution is originated from activities of Ozdemir Antimony Mining in Yeşilırmak River Basin. In terms of food sectors, grain milling can be seen as a possible source (ATSDR, 2005). However, station-78(feed production sector) did not exceed the AA-EQS of Ni.

Furthermore, manufacture of machine, electrical machinery, office furniture and metal goods sectors of Amasya Merzifon OIZ could be other sources of the pollutant (Firms inside Amasya Merzifon OIZ are listed in Appendix D Table D. 2). Finally, since there is not enough information about the wastewater content of WWTPs and the industrial establishments located in SISs, their possible effect on the river basin couldn't be evaluated.

4.3.14 Association of Lead and its compounds with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for Pb was exceeded at several riverine stations.

Figure 22 illustrates the average percentage EQS values of the stations in seven monitoring periods for Pb. Average concentrations of the stations having exceedance of EQS were around 4 times of the AA-EQS. 3 of the highest exceedances are at the station-99 (41 times of the EQS), -25(20 times of EQS) and -123(18 times of EQS) However, as the Table 23 represents, Max-concentrations of these stations are less significant when compared to the MAX-EQS. Max-concentrations of station-99, -25 and -123 are approximately 3.6, 6.8 and 2.3 times of the MAX-EQS of Pb, respectively.

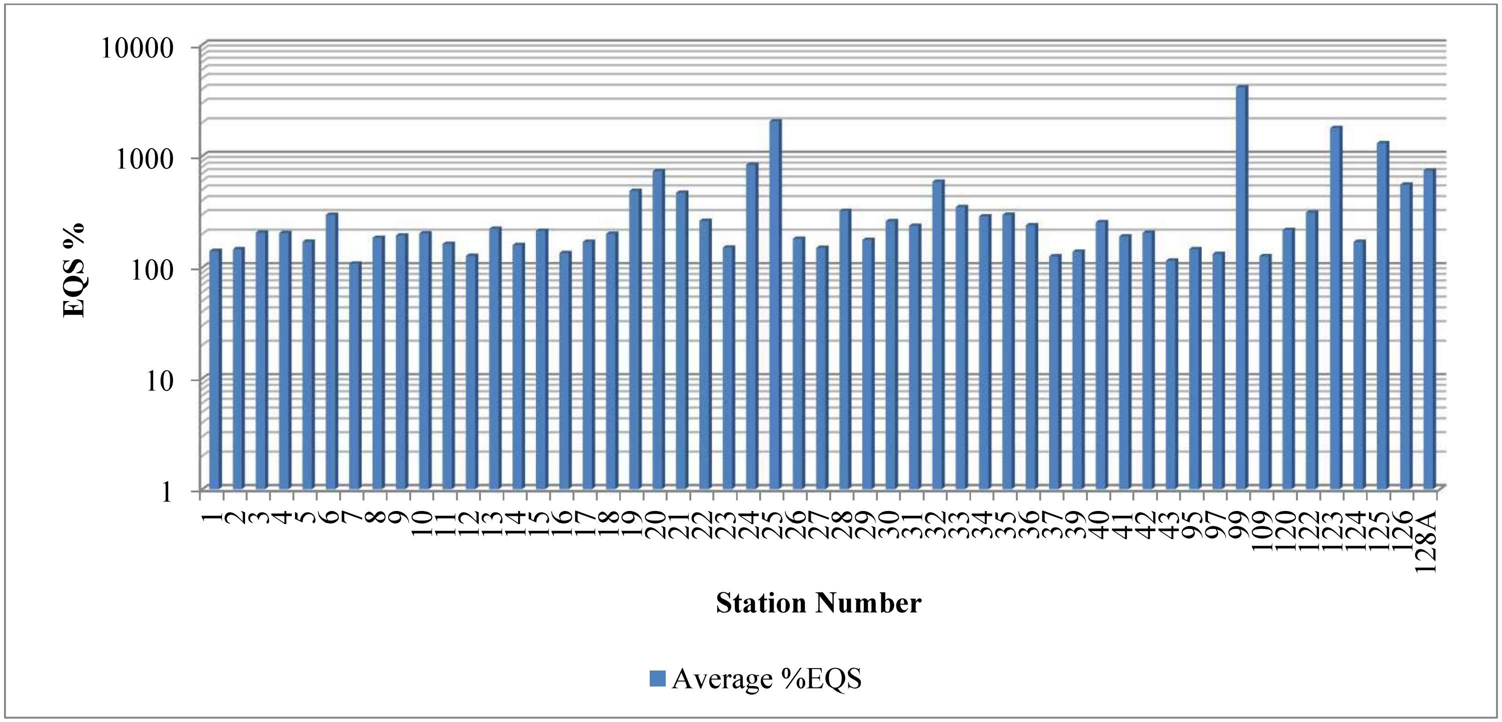

Figure 22 Average Percentage EQS values of lead at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 23 Riverine Stations with the three highest lead concentrations

Station	% Avg-EQS	Average concentration, µg/L	Max concentration, µg/L	Possible Point Sources
Station-99	4134.14	49.61	50.50	-Ozdemir Antimony Mining
Station -25	2045.09	24.54	95.63	-Yuva Viol Package -Olmuksan Int. Paper -Selhas Mining -Serra mining -Yenidoğan Paper -Cimpor Yibitas Cement -Hilal Block Brick -Sedef Plastic -Hayat Paper, -Arsan Moulding -Mikro-win Building -Akcansa Cement Corum -Corum WWTP -Corum OIZ
Station -123	1780.07	21.36	32.31	-Amasya Sugar
AA-EQS of lead(µg/L): 1.20 MAX-EQS of lead(µg/L): 14				

As it was demonstrated in Figure 8, the station-99 is situated at the downward flow of Ozdemir Antimony Mining.

Secondly; before the station-25,

- Corum WWTP (the station-48, discharge station);
- Corum OIZ;

- Corum SIS; and
- Industrial establishments of Corum Sugar, Bim United Stores, Saray Petrol Station (grain mill products), Selhas Mining, Yuva Viol Package(Station-76, discharge station), Serra mining, Yenidoğan Paper, Cimpor Yibitas Cement, Hilal Block Brick, ,Mepet Metro Petrol Station (mobile food service), Gulumoglu Feed, Sedef Plastic, Olmuksan Int. Paper(Station-69, discharge station), Hayat Paper, Arsan Moulding, Mikro-win Building(PVC-door and window), Akcansa Cement Corum(ready mix concrete), Corum Hitit Flour are located.

In addition, at the upstream of Station-123,

- Gulsim Flour and Amasya Sugar (Station-127, discharge station) are placed.

Lead is used in industries such as battery, ceramic glazes, coloring agents, ready-mix concrete, glass products, paints and coatings, paper, cardboard and coated paper, plastic or rubber products, silverware eating utensils, wire and cable insulation and assembly, recycling of mercury-containing products and wastes, and oil industries (The Massachusetts TURI, 2008). It can also be originated from the activities listed in APPENDIX J.

By all accounts, it can be concluded that it can be concluded that major source of the lead pollution is originated from activities of Ozdemir Antimony Mining (EQS exceedance at the Station-99) in Yeşilırmak River Basin. Moreover, industrial establishment working in the field of manufacture of plastic, paper (Station-69, 1.8 times of the EQS), corrugated paper and paperboard and of containers of paper and paperboard (EQS exceedance at the Station-76), construction material can be other sources of the pollutant. However, food sectors situated near the stations except for the sugar factory (Saranraj & Stella, 2014)(station-127, 3 times of the AA-EQS) cannot be the sources.

In terms of OIZs, the Station-48 is located at Çorum WWTP which treats wastewater of Çorum OIZ. Firms which have NACEs as 10.81, 17.21, 17.21, 20.15, 23.32, 24.44, 24.52, 24.52 and 25.62(for the NACE description, Appendix J) can be the origin of the high lead concentration at the station-48(Related firms and their activities can be seen in Appendix D Table D. 5).

4.3.15 Association of Antimony with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for Sb was exceeded at seven riverine stations.

Figure 23 illustrates the average percentage EQS values of the stations in seven monitoring periods for Sb. Average concentrations of the stations having exceedance of EQS were around 2.9 times of the AA-EQS. 3 of the highest exceedances are at the station-99 (103 times of the EQS), -21(6 times of EQS) and -19(3 times of EQS). However, as the Table 24 represents, Max-concentrations of these stations are less significant when compared to the MAX-EQS. Max-concentrations of Station-99, -is 13.7 times of the MAX-EQS of Sb. On the other hand, Max-concentrations of Station-21 and -19 are below the MAX-EQS of Sb.

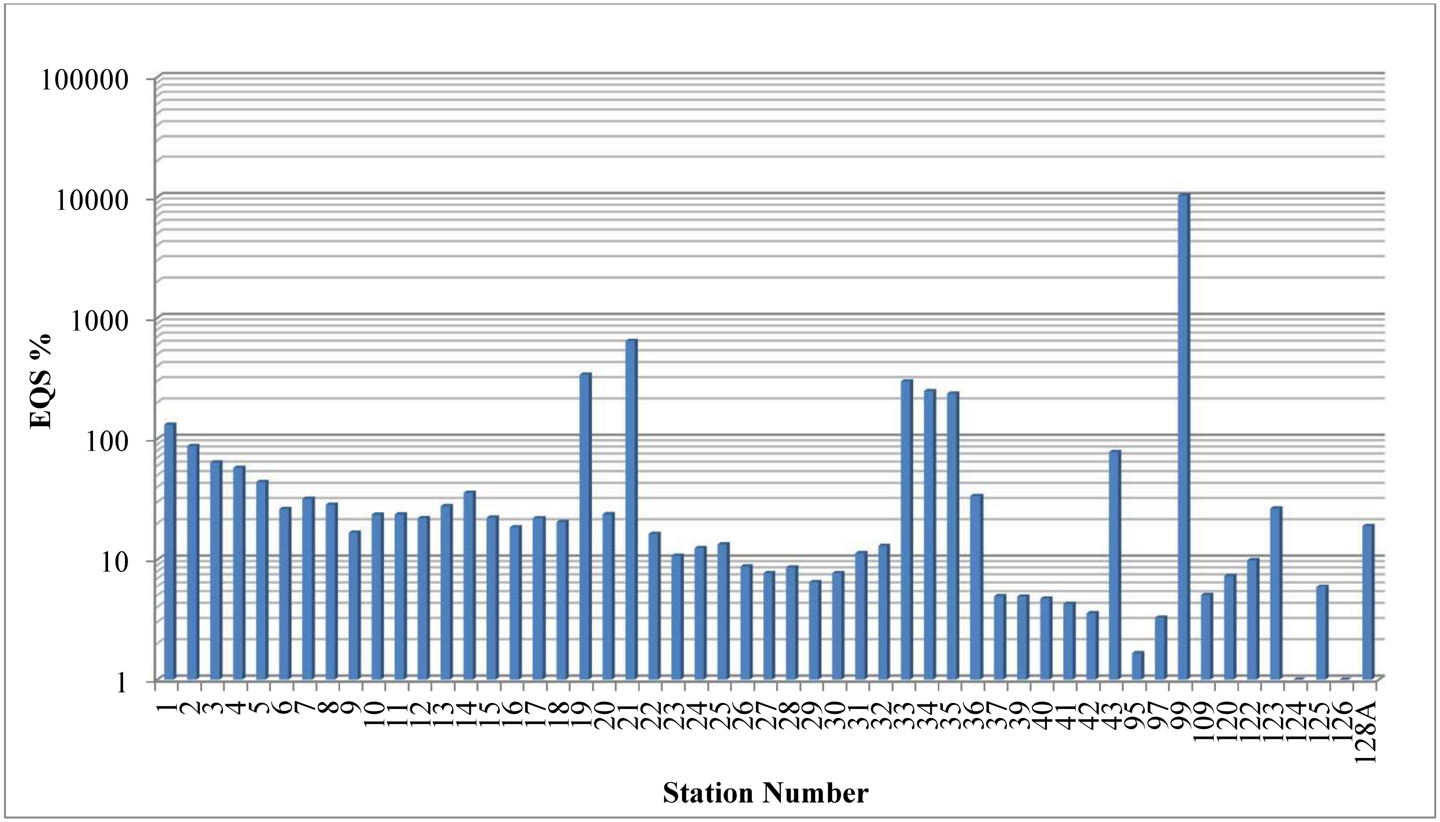

Figure 23 Average Percentage EQS values of antimony at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 24 Riverine Stations with the three highest concentrations of Sb

Station	**% Avg-EQS**	**Average concentration, µg/L**	**Max concentration, µg/L**	**Possible Point Sources**
Station-99	10307.63	803.99	1411.93	-Ozdemir Antimony Mining
Station -21	644.46	50.27	79.87	- Amasya Merkez OIZ -Fimar Construction
Station -19	339.15	26.45	40.09	-Akiktas Mining
AA-EQS of Sb (µg/L): 7.8 MAX-EQS of Sb (µg/L): 103				

As it is demonstrated in Figure 8, the station-99(receiving water station) is situated at the downward flow of Ozdemir Antimony Mining.

On the other hand; Station-21 is at the connection point of Cekerek Streamlet, Corum Streamlet and Delicay Streamlet. At the upper reach of Station-21,

- Industrial establishments of Amasya Flour, Fimar Construction; and
- Amasya Merkez OIZ

are located.

Thirdly, Station-19 is placed in the center district of Amasya. Before the Station-19,

- industrial establishments of Uygar Municipal Slaughterhouse, Akiktas Mining, Gür Flour, Ozen Excavation; and
- Amasya SIS (1st. Part), Amasya SIS (2nd. Part)

are placed.

Possibile industrial sources of the antimony found in Yeşilırmak River listed in APPENDIX J. It is clear that antimony mining activity has a major effect on the water quality at the mentioned stations. In addition to that, natural stones (mining, cutting and shaping) and manufacture of furniture and plastic packing goods sectors (ATSDR, 2017) inside the Amasya OIZ may also be associated with the pollutant (more detailed information, Appendix D Table D. 1). However, any food sector cannot be a source of the pollutant. However, due to the limited available information of the industrial establishments in SISs, mentioned SISs cannot be evaluated further.

4.3.16 Association of Free Cyanide with Potential Sources

Different from the most of the pollutants, free cyanide did not have measurements results for the first (August 2016) monitoring period. According to the evaluation of the water quality monitoring results of the six periods, AA-EQS for free CN was exceeded at six riverine stations. Figure 24 illustrates the average percentage EQS values of the stations in six monitoring periods for CN. Average concentrations of the stations having exceedance of EQS were around 1.4 times of the AA-EQS. 3 of the highest exceedances are at the station-123 (almost 10 times of the EQS), -128 A(5 times of EQS) and -122(4 times of EQS). However, as the Table 25 represents, Max-concentrations of these stations are less significant when compared to the MAX-EQS. Max-concentrations of station-123 and -122 are respectively 3.7 and 1.27 times of the MAX-EQS of free CN while Max- concentration of Station-128 A is not exceeded the MAX-EQS.

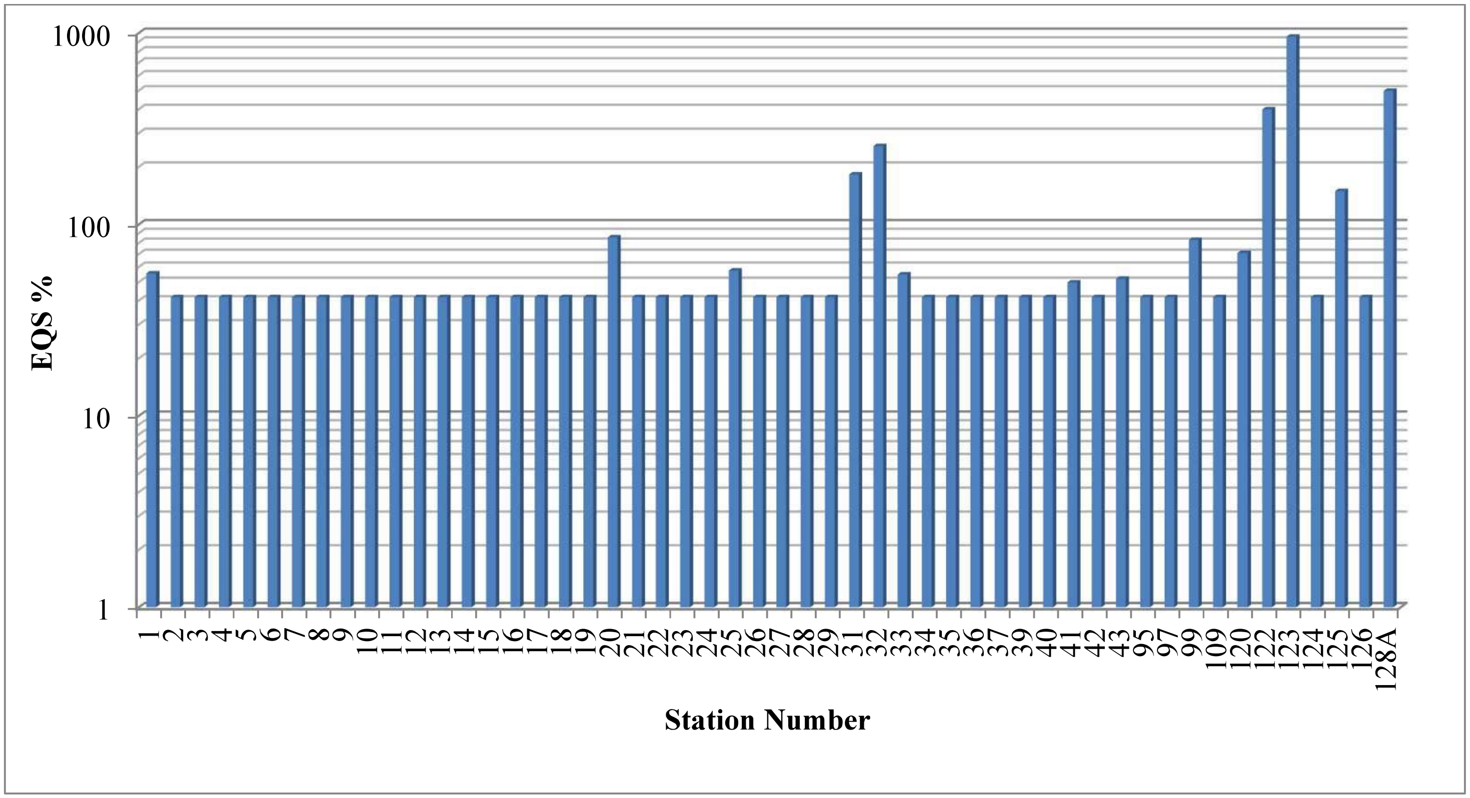

Figure 24 Average Percentage EQS values of free cyanide at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 25 Riverine Stations with the three highest free CN concentrations

Station	**% Avg-EQS**	**Average concentration, µg/L**	**Max concentration, µg/L**	**Possible Point Sources**
Station-123	955.00	11.46	22.42	-Gurmin Energy-Mining -Eski Celtek Coal
Station -128A	498.33	5.98	5.98	NA
Station -122	398.75	4.79	7.64	NA
AA-EQS of Free CN(µg/L): 1.20 MAX-EQS of Free CN (µg/L): 6				

As it is demonstrated in Figure 8; Station-128A and -123 are located at around Suluova, Amasya. They follow each other through the direction of flow of Tersakan, the tributary of Yeşilırmak River. Before the station-128 A,

- Suluova WWTP; and
- Industrial establishments of Yenitesfikiye Feed, Hasanusta Food(grain mill products), Besgoz Arabogulları Flour, Aktan Food(grain mill products) , Gurmin Energy-Mining, Eski Celtek Coal, Kozlu Food(feed products)(Station-78), Pan-et Slaughterhouse

are located.

In addition, between Station-128A and Station-123, Gulsim Flour and Amasya Sugar (Station-127, discharge station) are situated.

Thirdly, at the upstream of station-122, an industrial establishment of Mim marble is located.

Cyanide may have used in paper, textile and plastics industries. Cyanide salts are for metal cleaning, electroplating, and gold extraction from its ore (CDC, 2015). Cyanide can also be originated from the industrial activities listed in APPENDIX J.

It is evident that cyanide cannot be expected from the food sectors near the mentioned station. No exceedance at station-127 and -78 also approve this argument. Mining areas could be the reason for the cyanide pollution in the water environment (ATSDR, 2006). Lastly, there is not enough information about the wastewater content of Suluova WWTP thus, they could not be evaluated whether it is a source or not.

4.3.17 Association of Silicon with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for Si was exceeded at several riverine stations. Figure 25 illustrates the average percentage EQS values of the stations in seven monitoring periods for Si. Average concentrations of the stations having exceedance of EQS were around 3.9 times of the AA-EQS. 3 of the highest exceedances are at the station-128 A (almost 12 times of the EQS), -123(11 times of EQS) and -125(10 times of EQS). However, as the Table 26 represents, Avg-concentrations of these stations are equal to Max concentrations since they are only measured in 7th monitoring period except Station-123, its Max-concentration is 16.6 times of the MAX-EQS of Si.

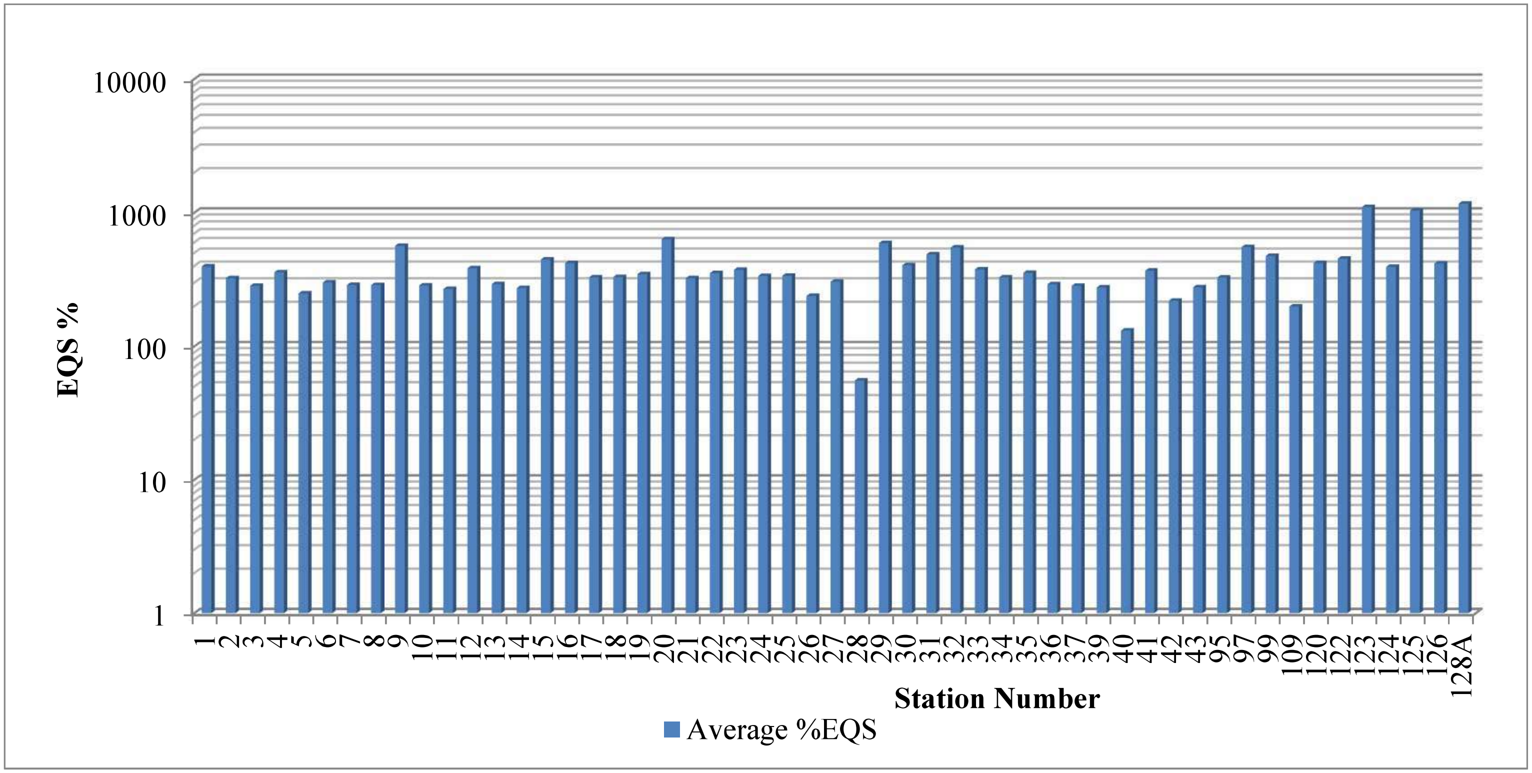

Figure 25 Average Percentage EQS values of free silicon at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 26 Riverine Stations with the three highest Si concentrations

Station	**% Avg-EQS**	**Average concentration, µg/L**	**Max concentration, µg/L**	**Possible Point Sources**
Station-128 A	1167.21	21360.00	21360.00	-Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Kozlu Food
Station - 123	1101.37	20155.00	30180.00	-Gulsim Flour -Amasya Sugar
Station - 125	1036.61	189700.0	18970.00	NA
AA-EQS of Si(µg/L): 1830 MAX-EQS of Si (µg/L): 1830				

As it is demonstrated in Figure 8; Station-128A and -123 are located at around Suluova, Amasya. They follow each other through the direction of flow of Tersakan, the tributary of Yeşilırmak River. Before the station-128 A,

- Suluova WWTP; and
- Industrial establishments of Yenitesfikiye Feed, Hasanusta Food(grain mill products), Besgoz Arabogulları Flour, Aktan Food(grain mill products) , Gurmin Energy-Mining, Eski Celtek Coal, Kozlu Food(feed products)(Station-78), Pan-et Slaughterhouse

are located.

In addition, between Station-128A and Station-123, Gulsim Flour and Amasya Sugar (Station-127, discharge station) are situated.

Thirdly, at the upstream of Station-125,

- Konaklı SIS and Düvenci SIS; and
- industrial establishment of Etaş Meat

are placed.

Silicon is used in the production of concrete, bricks, enamels, glass and ceramics tools and electronic circuits (Haynes, 2011). It can also be expected the industrial activities listed in APPENDIX J.

The use of diatomaceous earth silica(silicon dioxide) and silica gel on stored grain, food stores, feeds as insecticides (ATSDR, 2017) (Ashraf, Wakil, Hafeez, & Farooq, 2016) can be the possible reason for the exceedance at station-128A and -123. Furthermore, exceedance at the direct discharge station-78(7.6 times of the AA-EQS) located at the feed industry may approve this argument. Secondly, exceedance at station-127(2.7 times of the AA-EQS) located at Amasya Sugar Factory also clearly shows that it has one of the origins of the pollutant. It is known that silicon is available in the structures of herbs (RSC, 2018), and processes of sugar mill clearly reveal this (Lionnet & Walthew, 2004). However, in terms of the food industry, silicon is not expected from the meat processing industries. Mining regions can be considered as another source of silicon releases into water environment (Minnesota Department of Health, 2014). Lastly, since the industrial establishments located in SISs are not known and the contents of Suluova WWTP, they were not evaluated as a source in detail.

4.3.18 Association of Tridecane with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for tridecane was exceeded at seven riverine stations. Figure 26 illustrates the average percentage EQS values of the stations in seven monitoring periods for tridecane. Average concentrations of the stations having exceedance of EQS were around 3.4 times of the AA-EQS. 3 of the highest exceedances are at the station-37 (almost 13 times of the EQS), -15(4 times of EQS) and -14(3 times of EQS). However, as the Table 27 represents Max-concentrations of these stations are more significant when compared to the MAX-EQS. Max-concentrations of station-37, -15 and -14 are respectively 87, 28 and 15 times of the MAX-EQS of tridecane.

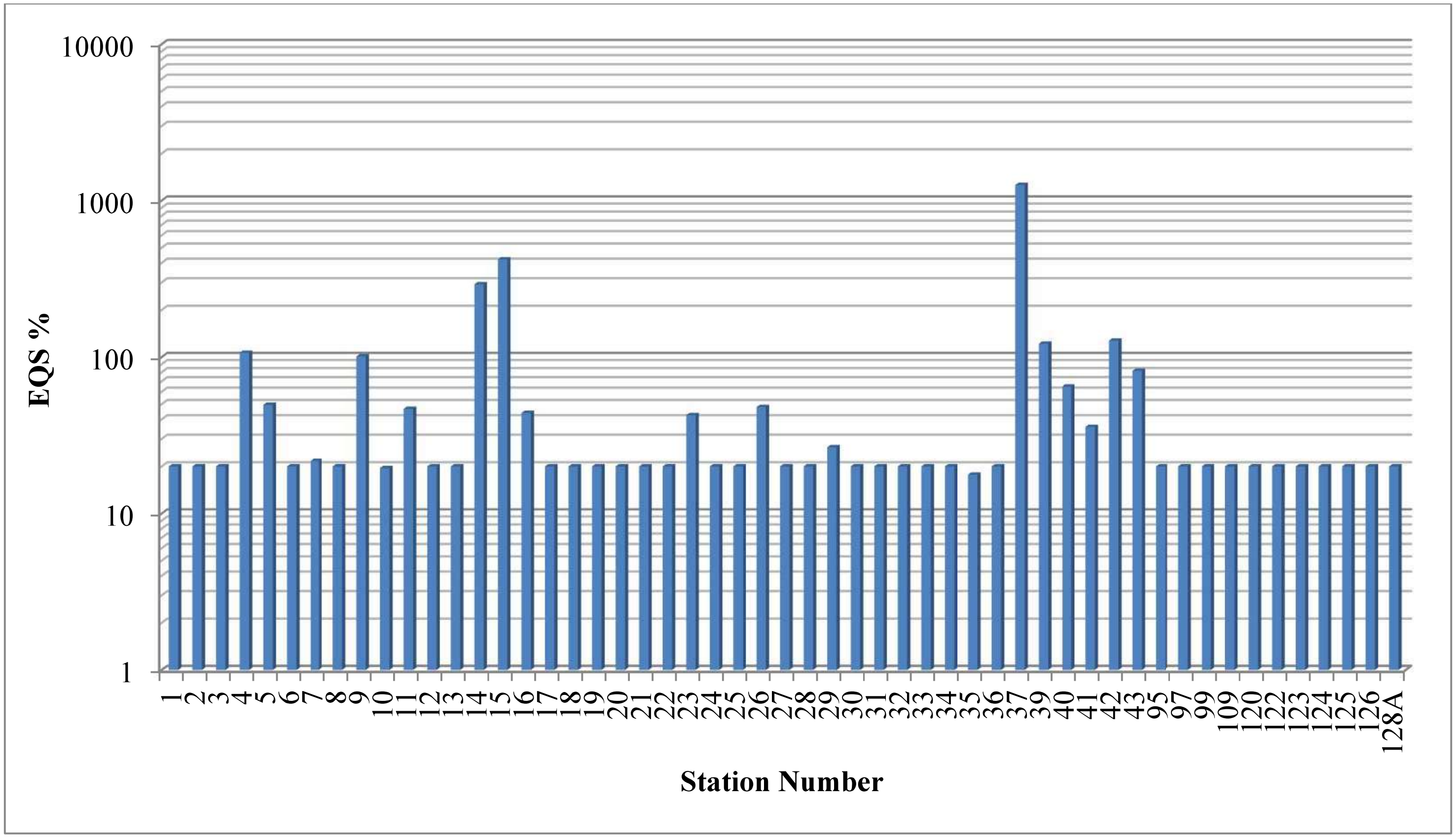

Figure 26 Average Percentage EQS values of tridecane at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 27 Riverine Stations with the three highest tridecane concentrations

Station	**% Avg-EQS**	**Average concentration, µg/L**	**Max concentration, µg/L**	**Possible Point Sources**
Station-37	1257.89	0.63	4.34	NA
Station -15	420.32	0.21	1.41	-Sarel Plastic -Ozmersan Marble -Kastamonu Integrated Wood Products
Station -14	291.72	0.15	0.69	-Tokat Airport
AA-EQS of tridecane (µg/L): 0.05 MAX-EQS of tridecane (µg/L): 0.05				

As it was demonstrated in Figure 8; at the upstream of Station-37,

- Tokat SIS; and
- Apeas Tile-brick industry

are located.

Moreover, before the Station-15,

- Akdağmadeni SIS;
- industrial establishments of SD Sarel Plastic, Ozmersan Marble, Kastamonu Integrated Wood Products; and
- Haliköy WWTP, Kadışehri WWTP, Araplı WWTP, Akdağmadeni WWTP, Olukozu WWTP, Belekcahan WWTP, Ozan WWTP(station-54), Umutlu WWTP

are placed.

On the other hand; before the station-14,

- Tokat Airport, and
- Güryıldız WWTP

are situated.

Tridecane is a solvent and distillation chaser and used in the production of rubber and processing of paper (HMDB, 2017);jet-fuel research (HSDB, 2017); perfumes, fragrances and personal care products; household goods such as cooling liquids in refrigerators and oil-based electric heaters (ECHA, 2018).

By considering this information, it can be concluded that plastic, wood products industries could be the potential sources of the pollutant. Secondly, tridecane(mainly air pollutant) (US DOF FAA , 2001) and other n-alkanes(such as tetradecane) (Sulej, Polkowska, & Namieśnik, 2011) can be expected from the runoffs of the airport.

Finally, due to the insufficient information about the industrial establishments located in the mentioned SISs and the wastewater content of the WWTPs in this region, these establishments could not be evaluated further. However, at station-54(Ozan WWTP), there is no exceedance of tridecane.

4.3.19 Association of Vanadium with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for V was exceeded at almost all riverine stations. Figure 27 illustrates the average percentage EQS values of the stations in seven monitoring periods for V. Average concentrations of the stations having exceedance of EQS were around 3.5 times of the AA-EQS. 3 of the highest exceedances are at the station-125 (almost 13 times of the EQS), -123(11 times of EQS) and -128 A (10 times of EQS). However, as the Table 28 represents Max-concentrations of these stations are more significant when compared to the MAX-EQS. Max-concentrations of station-125, -128A and -123 are respectively times of the MAX-EQS of V.

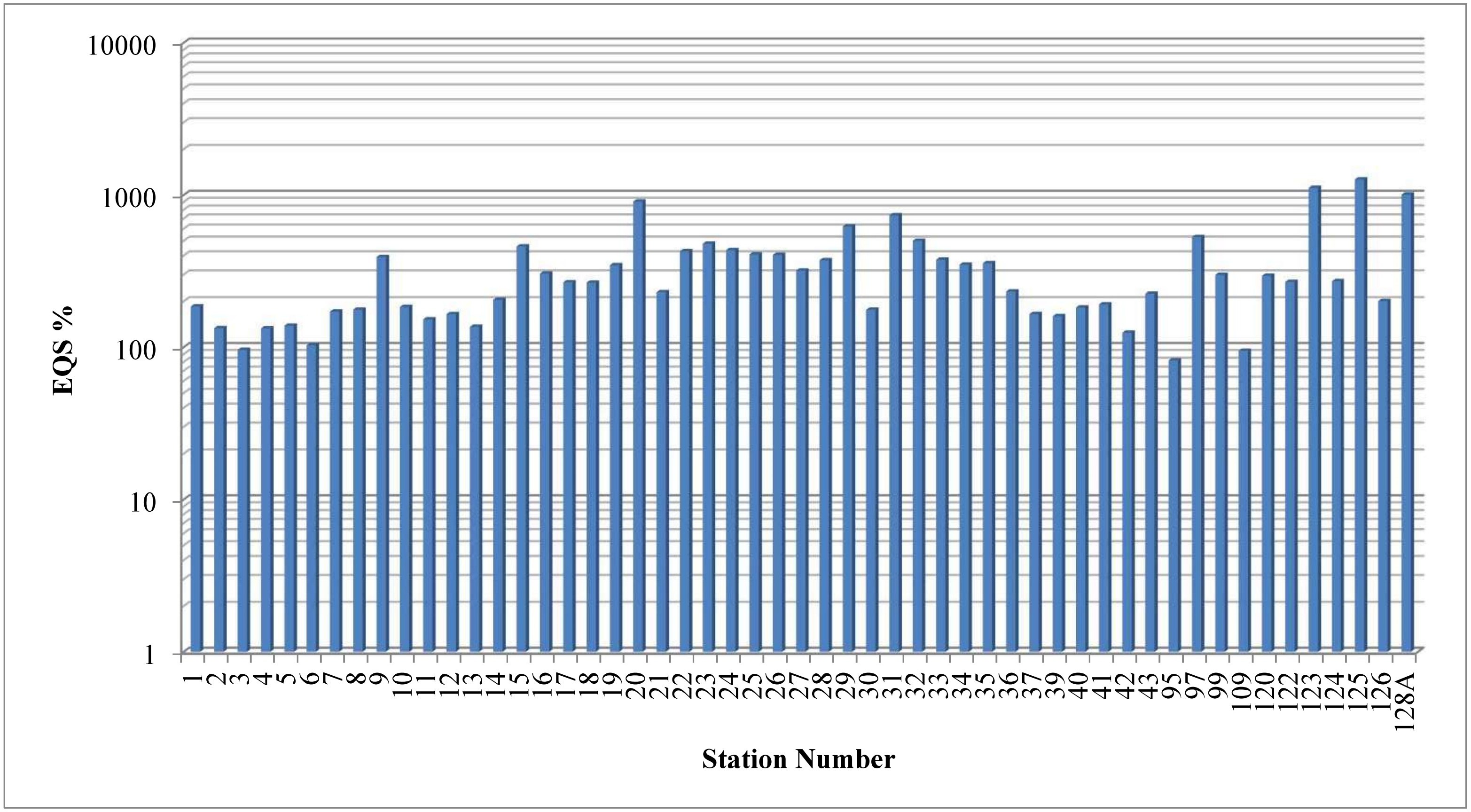

Figure 27 Average Percentage EQS values of vanadium at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 28 Riverine Stations with the three highest V concentrations

Station	% Avg-EQS	Average concentration, µg/L	Max concentration, µg/L	Possible Point Sources
Station-125	1263.11	20.21	20.21	-Etaş Meat
Station -123	1112.92	17.81	30.12	-Gulsim Flour
Station -128A	1004.73	16.08	16.08	-Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Kozlu Food
AA-EQS of V(µg/L): 1.6 MAX-EQS of V(µg/L): 97				

As it is demonstrated in Figure 8; Station-128A, -123 are located at around Suluova, Amasya. They follow each other through the direction of flow of Tersakan, the tributary of Yeşilırmak River. Before the station-128 A,

- Suluova WWTP; and
- Industrial establishments of Yenitesfikiye Feed, Hasanusta Food(grain mill products), Besgoz Arabogulları Flour, Aktan Food(grain mill products) , Gurmin Energy-Mining, Eski Celtek Coal, Kozlu Food(feed products)(Station-78), Pan-et Slaughterhouse

are placed. In addition, between Station-128A and Station-123, Gulsim Flour and Amasya Sugar (Station-127, discharge station) are situated. On the other hand, at the upstream of Station-125,

- Konaklı SIS and Düvenci SIS; and
- industrial establishment of Etaş Meat

are placed.

Produced vanadium is mostly used as a steel additive and these alloys are used for armor plates, tools, axles, crankshaft and piston rods. In addition, Vanadium (V) oxide can be used as a catalyst for glass and ceramics (ROC). It can also be expected from the sectoral activities listed in APPENDIX J.

Leachates from mining tailings can be one source of vanadium pollution (ATSDR, 2012). Since there are some exceedances observed in discharged stations located in food processing industries such as flour, feed and meat processing sectors in Yeşilırmak River Basin and there is known uses of vanadium as nutritional supplements (EFSA, 2008); (Institute of Medicine (US) Panel on Micronutrients., 2001) , mentioned establishments working in these sectors can also be responsible for vanadium in water environment. In addition, EQS exceedance at the station-78(12.8 times of the AA-EQS) also approves its effect. However, since there is not exceedance at Station-127, sugar factory cannot be seen as source. Since the characteristics of the wastewater of the WWTPs were not known, it was not commented on their relation with pollutant. However, municipal sewage sludge can be seen as another anthropogenic source (ATSDR, 2012). Lastly, there is not enough information about the industrial establishments located in SISs; thus, they could not be evaluated whether they are sources or not.

4.3.20 Association of Zinc with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for Zn was exceeded at almost all riverine stations. Figure 28 illustrates the average percentage EQS values of the stations in seven monitoring periods for Zn. Average concentrations of the stations having exceedance of EQS were around 10-100 times of the AA-EQS. 3 of the highest exceedances are at the station-120 (8520 times of the EQS), -128A (82 times of EQS) and -31 (59 times of EQS). However, as the Table 29 represents Max-concentrations of these stations are less significant when compared to the MAX-EQS. Max-concentrations of station-120 and -31 are respectively 435 and 3.2 times of the MAX-EQS of Zn. In addition, Avg-concentration of station-128 A is equal to Max-concentration since it was only measured in the 7th monitoring period.

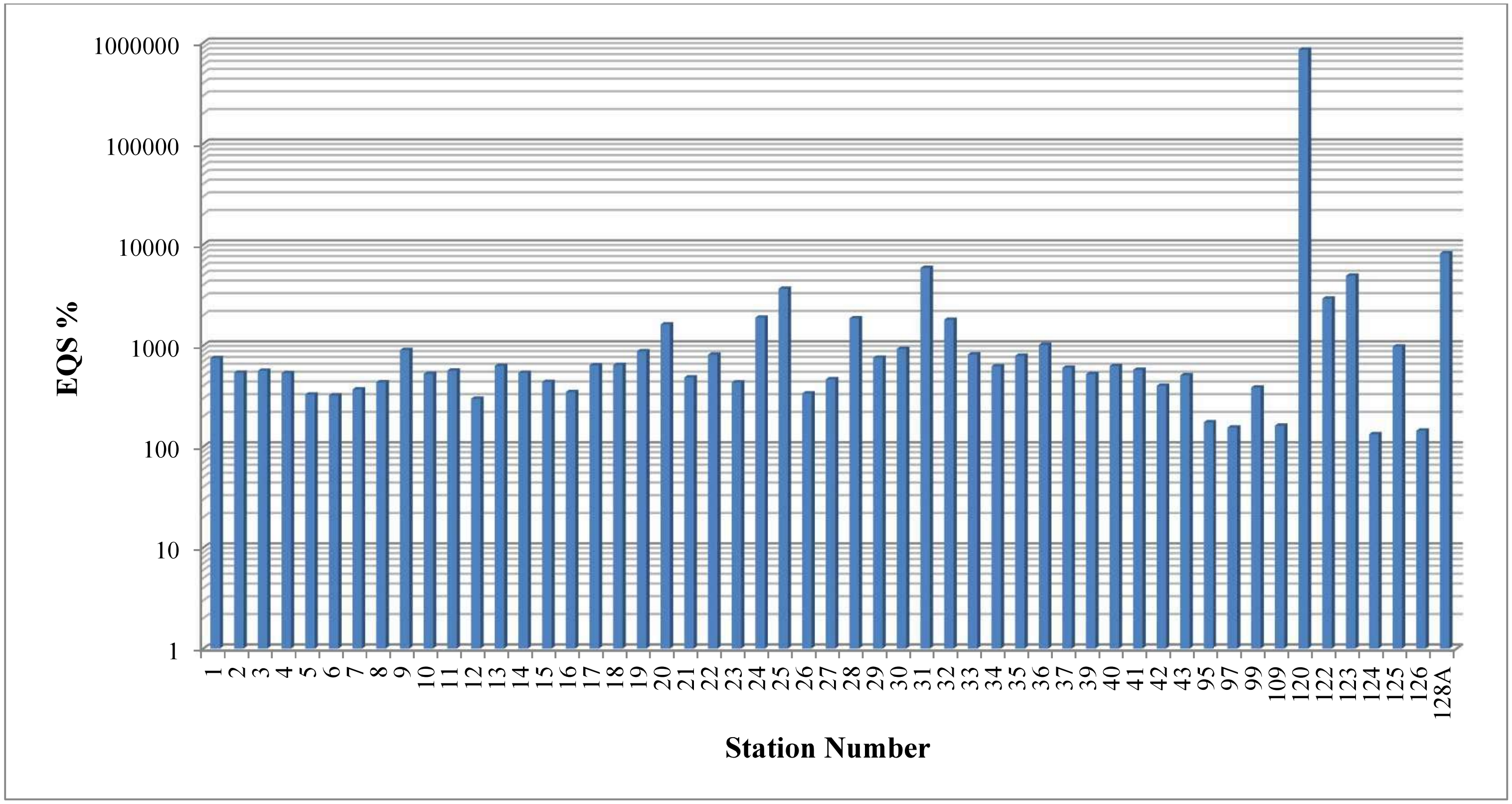

Figure 28 Average Percentage EQS values of zinc at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 29 Riverine Stations with the three highest Zn concentrations

Station	% Avg-EQS	Average concentration, µg/L	Max concentration, µg/L	Possible Point Sources
Station-120	852007.11	50268.42	100519.19	-DIMES Food Industry and Trade Inc.
Station -128A	8187.37	483.06	483.06	-Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Kozlu Food -Suluova WWTP
Station -31	5865.64	346.07	737.14	-Amasya Merzifon OIZ
AA-EQS of Zn(µg/L): 5.90 MAX-EQS of Zn (µg/L): 231				

As it was demonstrated in Figure 8; before the station-120(receiving water station), only known industry is DIMES Food Industry and Trade Inc.(Dairy and fruit juice industry) (station 60, discharge station).

Secondly, before the station-128 A,

- Suluova WWTP; and
- Industrial establishments of Yenitesfikiye Feed, Hasanusta Food(grain mill products), Besgoz Arabogulları Flour, Aktan Food(grain mill products) , Gurmin Energy-Mining, Eski Celtek Coal, Kozlu Food(feed products)(Station-78), Pan-et Slaughterhouse are located. On the other hand, at the upstream of the station-31,
- Amasya Merzifon OIZ(station 58, discharge station) ;

- Industrial establishments of Teksin Food(grain mill products), Nihoruz Food(oil and fat manufacturing), Omer Akay Flour; and
- Merzifon SIS and Merzifon 100. yıl SIS

are located.

Iron and steel, textile, chemical, paper, non-ferrous metals, industrial cooling, ship dismantling, paint, rubber industries and urban WWTP can be responsible for zinc pollution. It can also be expected from the sectorial activities listed in APPENDIX J.

Both active and inactive mining sites may have an effect on zinc pollution in Yeşilırmak River Basin (ATSDR, 2005). On the other hand, Amasya Merzifon OIZ, containing several industries like iron and steel, electrical machinery, non-ferrous metal and plastic, may be widely responsible for the pollution at station-31. EQS exceedance at the station-58(347 times of the AA-EQS) may also approve this argument (more detailed information about the firms inside Amasya Merzifon OIZ can be seen in Table D. 2). WWTPs at the upper reach of station-128 A can be another source of the pollutant (ATSDR, 2005). Since it is known that zinc alloys can be used in fertilizers, animal feeds and agriculture (as pesticide or insecticide) (Goodwin, 2006), flour, feed sectors can be responsible for the zinc pollution in the water environment. In addition, exceedance at station-78 (45 times of the AA-EQS) shows that the feed industry has some effect on zinc concentration. Lastly, since the industrial establishments located in SISs were not known, they were not evaluated in detail.

4.3.21 Association of Total Petroleum Hydrocarbons with Potential Sources

According to the evaluation of the water quality monitoring results of the seven periods, AA-EQS for total petroleum hydrocarbons was exceeded at several riverine stations. Figure 29 illustrates the average percentage EQS values of the stations in seven monitoring periods for total petroleum hydrocarbons. Stations having exceedance of EQS were around 2.6 times of the AA-EQS. 3 of the highest exceedances are at the station-20 (almost 5 times of the EQS), -35(4 times of EQS) and -25 (nearly 4 times of EQS). However, as the Table 30 represents Max-concentrations of these stations are more significant when compared to the MAX-

EQS. Max-concentrations of station-20, -35 and -25 are respectively 10, 6 and 4.8 times of the MAX-EQS.

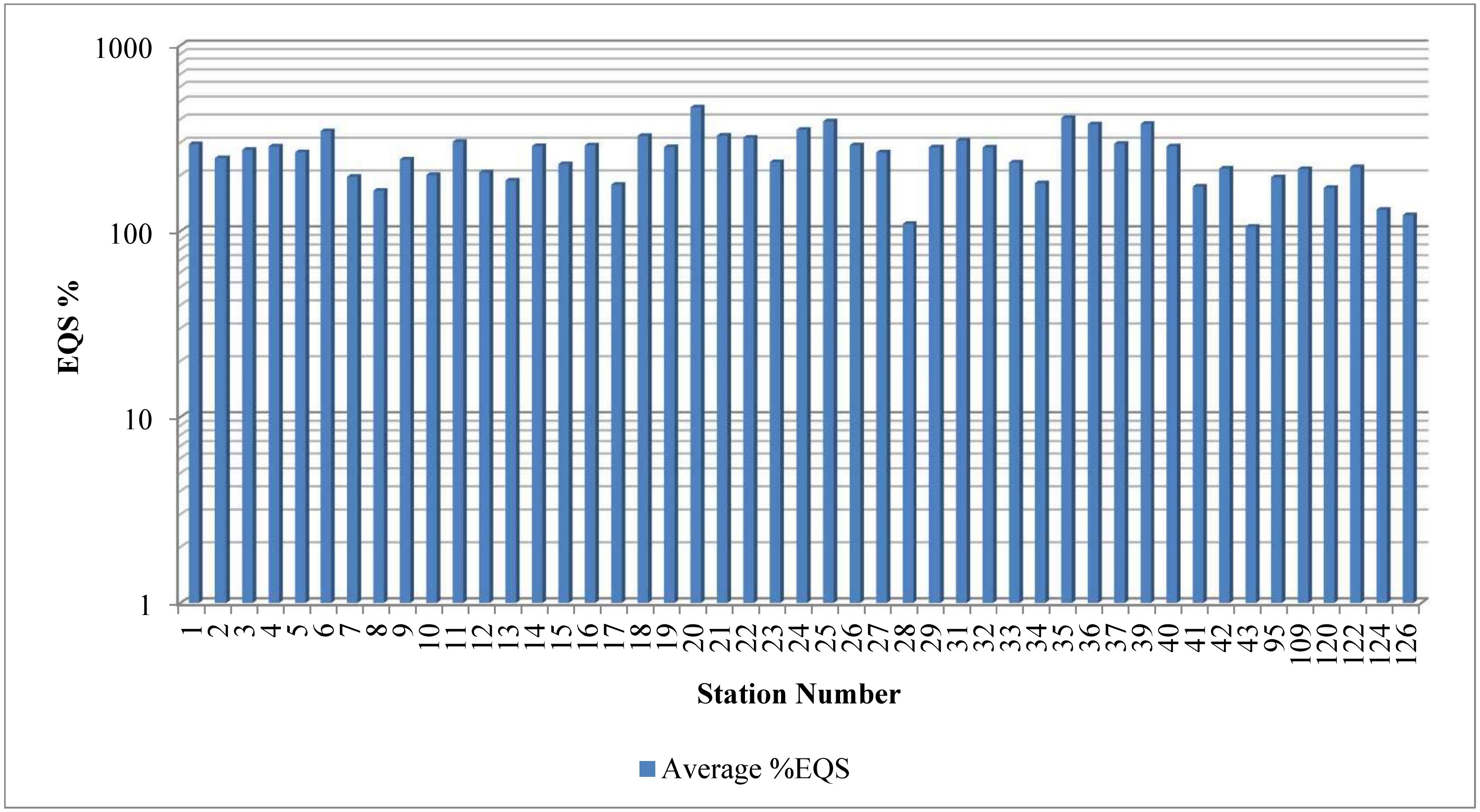

Figure 29 Average Percentage EQS values of total petroleum hydrocarbons at riverine stations (Measures above 100% represent the stations where the EQS exceedance occurs.)

Table 30 Riverine Stations with the three highest total petroleum hydrocarbons concentrations

Station	**% Avg-EQS**	**Average concentration, µg/L**	**Max concentration, µg/L**	**Possible Point Sources**
Station-20	463.28	444.75	997	NA
Station -35	406.25	390	624	NA
Station -25	389.58	374	483	-Yuva Viol Package -Yenidoğan Paper -Olmuksan Int. Paper -Hayat Paper -Sedef Plastic -Saray Petrol Station -Corum WWTP -Corum OIZ
AA-EQS of total petroleum hydrocarbons (µg/L): 96 MAX-EQS of total petroleum hydrocarbons (µg/L): 100				

As it is demonstrated in Figure 8; On the other hand, at the upper reach of the station-20(receiving water station), Konaklı SIS and Düvenci SIS; and Industrial establishments of Bakraç Dairy (station 79, discharge station), Etaş Meat, Beşgöz Cold Storage (fruit and vegetables) are situated.

On the other hand, at the upstream of Station-35,

- Tasova SIS;
- Taşova WWTP; and
- Erbaa Ready-mixed concrete industry

are located. Furthermore, before the station-25,

- Corum WWTP (the station-48, discharge station);

- Corum OIZ;
- Corum SIS; and
- Industrial establishments of Corum Sugar, Bim United Stores, Saray Petrol Station (grain mill products), Selhas Mining, Yuva Viol Package(Station-76, discharge station), Serra mining, Yenidoğan Paper, Cimpor Yibitas Cement, Hilal Block Brick, Mepet Metro Petrol Station (mobile food service), Gulumoglu Feed, Sedef Plastic, Olmuksan Int. Paper(Station-69, discharge station), Hayat Paper, Arsan Moulding, Mikro-win Building(PVC-door and window), Akcansa Cement Corum(ready mix concrete), Corum Hitit Flour are located.

Petrochemicals industry enables the production of thousands of materials such as health and hygiene materials, medical equipment, home appliances, sports equipment and textile industry. Petrochemicals are also raw materials of computers, CDs, or packaging materials (Beşergil, 2007). In addition, it can be originated from the activities of the industrial sectors listed in Appendix J.

Since there are two petrol stations in the mentioned stations, possible leakage can be a reason for the existence of pollutant in water environment. On the other hand, petroleum used in plastic related industries; viol, plastic and paper industries (Beşergil, 2007) can be sources of the pollutant. Also, Station-76(viol package, 2.4 times of the EQS) and -69(paper, 2.9 times of the EQS) are exceeded AA-EQS. Moreover, Station-48, located at Corum WWTP, treats wastewater of Corum OIZ. 20.15 and 29.32 coded and sectors inside the Corum OIZ can be the origins of the high total petroleum hydrocarbons concentration at the station-48(Related firms and their activities can be seen in Appendix D Table D. 5). There is no exceedance at the station-79(dairy industry). In addition, total petroleum hydrocarbons are not expected from any other food industries. Moreover, since there is not enough information about the industrial establishments located in SISs and the wastewater content of Taşova WWTP, it could not be possible to evaluate their possible responsibility for the pollution.

4.4 Classification of the Pollutants in Terms of Their Sources

In the previous sections, the pollutants observed in Yeşilırmak River and their possible sources were assessed and possible sources were identified. In the present section, a summary of all those evaluations is given and 21 pollutants are categorized with regard to their sources.

Table 31 Pollutants classified in terms of their sources

	Possible Type of Sources		**Sources**
	Point Sources	**Diffuse Sources**	
Aluminium	x	x	-Gülsim Flour -Amasya Sugar -Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Gurmin Energy-Mining -Eski Celtek Coal -Kozlu Food -Pan-et Slaughterhouse -Etaş Meat
Benzo[a]pyrene	x		-Kınık WWTP -Adoçim Cement -Artova Chrome -Artova WWTP -Sulusaray WWTP
Bifenox	x	x	-Kastamonu Integrated Wood Products
Br-	x	x	-Amasya Merzifon OIZ -Corum WWTP -Corum OIZ -Yuva Viol Package -Yenidoğan Paper -Olmuksan Int. Paper -Hayat Paper

Cd	x	x	-Corum WWTP -Corum OIZ -Yuva Viol Package
Co	x	x	-Merzifon OIZ -Teksin Food -Nihoruz Food -Omer Akay Flour -Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Gurmin Energy-Mining -Eski Celtek Coal -Kozlu Food -Pan-et Slaughterhouse -Etaş Meat
Cr	x	x	-Merzifon OIZ -Teksin Food -Nihoruz Food -Omer Akay Flour -Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Gurmin Energy-Mining -Eski Celtek Coal -Kozlu Food -Gulsim Flour
Cu	x	x	-Amasya Merzifon OIZ -Teksin Food -Nihoruz Food -Omer Akay Flour -Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Gurmin Energy-Mining -Eski Celtek Coal -Kozlu Food -Gulsim Flour
Dichlorvos	x	x	-Amasya Suluova TDI Besi OIZ
Fe	x	x	-Yenitesfikiye Feed -Hasanusta Food

			-Besgoz Arabogulları Flour -Aktan Food -Gurmin Energy-Mining -Eski Celtek Coal -Kozlu Food -Pan-et Slaughterhouse -Etaş Meat -Gulsim Flour -Amasya Sugar
Fenarimol		x	
Hg	x		-Diffuse sources -Amasya Merkez OIZ
Ni	x	x	-Ozdemir Antimony Mining - Amasya Merzifon OIZ -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food
Pb	x	x	-Ozdemir Antimony Mining -Yuva Viol Package -Olmuksan Int. Paper -Selhas Mining -Serra mining -Yenidoğan Paper -Cimpor Yibitas Cement -Hilal Block Brick -Sedef Plastic -Hayat Paper, -Arsan Moulding -Mikro-win Building -Akcansa Cement Corum -Corum WWTP -Corum OIZ -Amasya Sugar
Sb	x		-Ozdemir Antimony Mining - Amasya Merkez OIZ -Fimar Construction -Akiktas Mining
CN	x		-Gurmin Energy-Mining -Eski Celtek Coal
Si	x	x	-Yenitesfikiye Feed -Hasanusta Food

			-Besgoz Arabogulları Flour -Aktan Food -Kozlu Food -Gulsim Flour -Amasya Sugar
Tridecane	x		-Sarel Plastic -Ozmersan Marble -Kastamonu Integrated Wood Products -Tokat Airport
Vn	x	x	-Etaş Meat -Gulsim Flour -Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Kozlu Food
Zn	x	x	-DIMES Food Industry and Trade Inc. -Yenitesfikiye Feed -Hasanusta Food -Besgoz Arabogulları Flour -Aktan Food -Kozlu Food -Suluova WWTP -Amasya Merzifon OIZ
Total petroleum hydrocarbons	x	x	-Yuva Viol Package -Yenidoğan Paper -Olmuksan Int. Paper -Hayat Paper -Sedef Plastic -Saray Petrol Station -Corum WWTP -Corum OIZ

As it is demonstrated in Table 31, benzo[a]pyrene, free CN, Hg, Sb and tridecane were considered as point pollutants. Although one of the major sources of Sb and free CN were the mining activity, it was evaluated as the point pollutant because of direct correspondence with mining activity.

On the other hand, fenarimol, having exceedance at only one station and having no point-source detected before, is classified as the diffuse pollutant.

By considering their exceedance of EQS at the wide number of stations, possibility of being indegrients of pesticides and fertilizers used in the area and natural existence, some metals were evaluated as both point and diffuse pollutants. Furthermore, pesticide dichlorvos was defined as both point and diffuse source due to its both industrial and agricultural use.

Due to wide number of stations having exceedances, although the industrial activities are mainly responsible for the total petroleum hydrocarbons, they were evaluated as both point and diffuse pollutant.

4.5 OIZs and Main Sectors Having Considerable Pollution Load

As it is illustrated in Table 32, Amasya Merzifon OIZ is one of the main responsible of 7 of the studied pollutants. Major sectors of Merzifon OIZ are electrical machine, plastic, furniture, metal and food industry. On the other hand in Çorum OIZ (the main responsible of 4 of the studied pollutants), major sectors are machine-metal, textile, stone-based, and chemistry-plastic industries. It can be said that there is interclusion between the main sectors and main pollutants inside these OIZs.

Moreover, production of hardware products, food, glass and iron Industry are the major sectors of the Samsun Kavak OIZ. And together with pesticide and fertilizer production sector, hardware products and iron industry, they are the sources of the Hg. Moreover, natural stone and food industry are primary sectors inside Amasya OIZ. It's evident that the food sector is not the source of the Sb. Different than other OIZs profile, the major sector of Amasya Suluova Besi OIZ is food and husbandry, but it coincides the pollutant characteristics and the activities resulted in livestock facilities.

Table 32 OIZs Having Considerable Pollution Load

Name of the OIZ	**Pollutants associated with OIZ as main sources**
Amasya Merzifon OIZ	Br-, Co, Cr, Cu, Ni, Pb, Zn
Çorum OIZ	Br-, Cd, Pb, Total petroleum Hydrocarbons
Amasya Suluova TDI Besi OIZ	Dichlorvos
Samsun Kavak OIZ	Hg
Amasya Merkez OIZ	Sb

It should be pointed out that although the province of Samsun is a major industrial city in the Yeşilırmak Basin, through the assessment of the source of the pollutant, there is less relation with the Samsun. The reson behind is that city is located at the mouth of the tributaries of Yeşilırmak River and most of the establishments and WWTPs discharges are into the Black Sea.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

This study was performed in order to identify the potential point pollution sources and the main pollutants in Yeşilırmak River Basin; and associate the water pollution with their sources under the scope of Surface Water Quality Regulation.

Toward this objective, in addition to the inventory study of the YHYP including information on WWTPs; SISs, and individual industrial establishments in Yeşilırmak Basin, an inventory was formed for OIZs and the sectors inside of these OIZs were determined. In the first place, inventory study revealed that some of the industrial facilities and municipalities do not have a WWTP or they are in the construction phase.

Due to the results of the seven monitoring periods of the river basin water quality monitoring program, the pollutants that exceeded EQS at riverine stations were determined. Over the 250 specific pollutants and 45 priority substances, 21 of the pollutants (namely Pb, Al, Cu, Fe, Zn, Si, V, TPH, Co, Dichlorvos, Cr, Ni, Br-, Cd, Bifenox, Tridecane, Sb, Hg, CN, Benzo(a)pyrene, Fenarimol) having exceedance of AA-EQS at more than 5 receiving water stations and/or having Average-EQS% higher than 100% were linked to the activities occurring the region located at the upstream of the sampling stations.

By doing this, top three riverine stations which were observed the highest exceedance were evaluated. The station-128 A and -123 and -125, located on Tersakan Creek following through Suluova and the mainstream at the center of Amasya, were the most polluted stations with regard to both concentrations and the number of pollutants. This brought out that necessary action has been required for the appropriate water management for Tersakan Sub-Basin and the city of Amasya.

For associating the pollutants with their sources, a literature study on possible sources of pollutants was conducted before and during the source assessment process and tried to establish a relationship among pollutant and the sources head of the stations which exceed the EQS most. The main industrial sectors which have high effects on pollution were determined. By considering the economic profile of the Yeşilırmak River Basin, although possible diffuse sources are harder to differentiate with this assessment method, it was also included in the assessment when it was required.

Mainly OIZs, WWTPs and individual industries of metal goods, machinery, plastic and food (mainly flour, feed, livestock, meat processing industries) were listed as point sources that have a high effect on the water quality in the Yeşilırmak River Basin. In terms of OIZs,

- Amasya Merzifon having the industries of electrical machine, plastic, furniture, metal and food,
- Corum having the industries of machine-metal, textile, stone-based, chemistry-plastic,
- Amasya Suluova TDI Besi having the industries of food and husbandry(livestock facilities),
- Samsun Kavak having the industries of pesticide and fertilizer production, hardware products and iron
- Amasya Merkez OIZ having the industry of natural stone

are regarded as they have a considerable pollution load on the Yeşilırmak River Basin.

After the source assessment, pollutants were classified in terms of their sources. Benzo[a]pyrene, Sb, Cn, Hg and tridecane were listed as point pollutants. On the other hand, fenarimol was defined as diffuse pollutant since it has only one exceedance which have no point source detected. Finally, Al, bifenox, Br-, Cd, Co, Cu, dichlorvos, Fe, Cr, Ni, Pb, Si, Vn, Zn, TPH were classified as they have resulted from both point and diffuse sources. Pollutants profile clearly shows that metal pollution is a common problem as a result of both point and non-point sources and requires a large-scale integrated solution.

This study reveals that a water management strategy is required for the specified water pollution in the Yeşilırmak River Basin. Some recommendations were developed for further actions and measures to be taken. These are listed below:

1. WWTP Projects for facilities and municipalities not having WWTPs should be initiated and those are under construction should be accelerated.
2. It should be evaluated the currently projected WWTPs whether they have processes suitable for treating the pollutants having EQS exceedance in the Yeşilırmak River Basin.
3. Modification and improvement on processes should be done in WWTPs which have been determined to have a negative effect on the water quality.
4. For the pollution responsible sectors and facilities, prior to the treatment of any pollutants, the industrial manufacturing processes should be improved. The efficiency of raw materials used should be increased and the pollution reduction should be targeted and the clean production should be supported.
5. In the process of permitting new facilities in the Yeşilırmak River Basin, it is necessary to take into account the pollutants in which the basin is sensitive. Facilities should be guided for the chemicals that they use and produce in their processes and restrictions should be imposed.
6. By developing more projects (such as Reduction of Agricultural Pollution in the Black Sea (GEF) Project) supporting good agricultural practices, it should be aimed to reduce the use of fertilizers and pesticides in agriculture and animal husbandry to minimize diffuse sources of pollution.
7. As they are both point and diffuse source of pollution of some metals, to minimize the negative impact of the active mines on the surrounding land, mine operators should be held responsible for the recovery and the process of

improvement of the environment damaged by the help of powerful regulations and consistent implementations(such as frequent site inspections).

8. Efforts should be made to restore the old mine areas and the surrounding land (soil replenishment, waste removal, etc.) and to improve the water quality in the affected area by governmental initiatives.
9. For organizations that are responsible for pollution but not willing to do any improvement on their WWTPs or manufacturing processes, sanctions must be imposed in a range from financial enforcements to closure.
10. In the city of Amasya, an environmental initiative committee should be set up to develop a more comprehensive strategy for water pollution control (especially for the highly affected Tersakan Sub-basin) to strengthen public participation and to monitor and coordinate the responsibilities of the different stakeholders.

During the whole study, the main limitations were that either there is no available comprehensive inventory for industrial establishments or they are not publicly available. In addition, capacity reports obtained through project connections in order to gather information for industrial enterprises was dated as the year of 2014. Thus, there is a possibility that more industrial establishments exist in the studied regions or some of the enterprises are not active anymore. Moreover, lack of detailed information on SISs and WWTPs limit the level of precision of assessment. Moreover, since there is inadequate information on pollution load on point sources, the precisions were lack to understand which potential source had the largest share at the stations having multiple sources of pollution. In future studies, it would be fundamental to work for an improvement of such inventories or if such inventories already exist, it should be encouraged to be open to public access with the computer-based information systems.

Moreover, for diffuse sources, detailed field and product based inventorial records and which pesticides and fertilizers are used for agricultural areas should also be studied for better predictions of the diffuse sources. Moreover, since the seasonal variability of the use of these chemicals has an effect on the pollution load, studies focusing more on seasonal variations would increase the reliability of the study.

In future studies, in order to represent more certain source assessment of the pollutants, smaller water masses such as subbasin or a tributary of a river would be studied in more detailed. In Yeşilırmak case, this should be Tersakan Subbasin. In addition, the estuary of Yeşilırmak would also be evaluated. For better representing the sectors intrusion to the receiving water environment, different sampling locations would be included in future researches.

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APPENDICES

APPENDIX A. Inventory Information of Organized ındustrial Zones in Yeşilırmak Basin

Table A. 1 Locational Information of Organized Industrial Zones in Yeşilırmak Basin

GIS ID	**Name of the Plant**	**Province**	**District**	**Latitude**	**Longitude**
OSB-1	Amasya Merkez OIZ	Amasya	Merkez	40,58256	35,64475
YESIL_58	Amasya Merzifon OIZ	Amasya	Merzifon	40,85873	35,46324
OSB-2	Amasya Suluova OIZ	Amasya	Suluova	40,83529	35,64679
OSB-3	Amasya Suluova TDİ. Besi OIZ	Amasya	Suluova	40,79658	35,65159
OSB-4	Çorum OIZ	Çorum	Merkez	40,47839	34,8563
OSB-5	Samsun Gıda İhtisas OIZ	Samsun	Tekkeköy	41,22534	36,49242
OSB-6	Samsun Havza Tarımsal Ürün İşleme ve Tarım Makineleri İhtisas OIZ	Samsun	Havza	40,96581	35,66915
OSB-7	Samsun Kavak OIZ	Samsun	Kavak	41,08797	36,04723
YESIL_59	Samsun Merkez OIZ	Samsun	Tekkeköy	41,22729	36,42553
OSB-8	Tokat Merkez OIZ	Tokat	Merkez	40,32432	36,50543
OSB-9	Tokat Erbaa OIZ	Tokat	Erbaa	40,66664	36,56955
OSB-10	Tokat Niksar OIZ	Tokat	Niksar	40,5897	36,95443
OSB-11	Tokat Turhal OIZ	Tokat	Turhal	40,38628	36,0833
OSB-12	Tokat Zile OIZ	Tokat	Zile	40,30035	35,88698

Table A. 2 Information on Wastewater Treatment of Organized Industrial Zones in Yeşilırmak Basin

GIS ID	Name of the Plant	Availability of WWTP (Exist / Not Exist)	Capacity (m3/day)	Flow rate (tone/day)		Type of WWTP	Discharge Environment
				Feb	Apr		
OSB-1	Amasya Merkez OIZ	Not exist (in the project phase)	-	-		Preliminary treatment	-
YESIL_58	Amasya Merzifon OIZ	Exist	300	300	300	Physical-biological treatment	Gümüşsuyu Creek
OSB-2	Amasya Suluova OIZ	Not exist	-	-		-	Tersakan creek by the municipality channel (without a treatment)*
OSB-3	Amasya Suluova TDİ. Besi OIZ	Not exist	-	-		-	-
OSB-4	Çorum OIZ	Not exist	-	164		-	Discharge into channel of Çorum Municipality WWTP
OSB-5	Samsun Gıda İhtisas OIZ	Not exist	-	75,54		-	Discharge into WWTP channel of municipality (Municipality discharges into sea)
OSB-6	Samsun Havza Tarımsal Ürün İşleme ve Tarım Makineleri İhtisas OIZ	Not exist	-	-		Preliminary treatment	-
OSB-7	Samsun Kavak OIZ	Not exist	-	-		-	Discharge into WWTP channel of municipality
YESIL_59	Samsun Merkez OIZ	Exist	2.000	1.140	960	Biological Treatment	Sea discharge
OSB-8	Tokat Merkez OIZ	Not exist	-	1.185		-	Discharge into WWTP channel of Tokat municipality
OSB-9	Tokat Erbaa OIZ	Not exist	-	1.000		-	Discharge into WWTP channel of Erbaa municipality
OSB-10	Tokat Niksar OIZ	Not exist	-	-		-	-
OSB-11	Tokat Turhal OIZ	Not exist	-	-		Preliminary treatment	Yeşilırmak
OSB-12	Tokat Zile OIZ	Not exist	-	-		-	Discharge into channel of municipality that does not have a WWTP

APPENDIX B - Inventory Information of Wastewater Treatment Plants in Yeşilırmak Basin

Table B. 1 Inventory Information of Wastewater Treatment Plants in Yeşilırmak Basin

GIS ID	**Name of the plant**	**Province**	**District**	**Lat**	**Long**
YESIL_56	Ağacagüney	Samsun	Çarşamba	41,1175	36,61278
KAAT-1	Ahmetfakılı	Yozgat	Sorgun	39,795199	35,40398
KAAT-2	Akdağmadeni	Yozgat	Akdağmadenli	39,665609	35,87197
KAAT-3	Akıncılar	Sivas	Akıncılar	40,082648	38,34588
KAAT-4	Alaca	Çorum	Alaca	40,165252	34,83015
KAAT-5	Almus	Tokat	Almus	40,374801	36,91351
KAAT-6	Amasya	Amasya	Merkez	40,679901	35,87943
KAAT-7	Araplı	Yozgat	Sorgun	39,830251	35,83025
KAAT-8	Artova	Tokat	Artova	40,105996	36,29882
KAAT-9	Asarcık	Samsun	Merkez	41,036988	36,22869
KAAT-10	Ataköy	Tokat	Almus	40,448295	36,91514
KAAT-11	Avlunlar	Tokat	Merkez	40,534601	36,73183
YESIL_53	Aydıncık	Yozgat	Aydıncık	40,152778	35,27889
KAAT-12	Ayvacık	Samsun	Ayvacık	40,990895	36,63126
KAAT-13	Ballıdere	Amasya	Taşova	40,734959	36,25078
KAAT-14	Başçiftlik	Tokat	Başçiftlik	40,549018	37,16788
KAAT-15	Batı İleri Biyolojik	Samsun	Atakum	41,402881	36,16858
KAAT-16	Baydarlı	Tokat	Reşadiye	40,49318	37,49429
KAAT-17	Baydiğin	Yozgat	Aydıncık	40,218663	35,16171
KAAT-18	Belekçahan	Yozgat	Akdağmadenli	39,639977	35,67282
KAAT-19	Bereketli	Tokat	Reşadiye	40,505125	37,29144
KAAT-20	Beyyurdu	Yozgat	Çekerek	39,957806	35,36143
KAAT-21	Boraboy	Amasya	Taşova	40,809773	36,18329
KAAT-22	Bozçalı	Tokat	Reşadiye	40,541962	37,29539
YESIL_51	Büyükhırka	Çorum	Alaca	40,0525	34,77722
KAAT-23	Cimitekke	Tokat	Reşadiye	40,495093	37,42474
KAAT-24	Çat	Tokat	Merkez	40,325791	37,22613
YESIL_46	Çaylı	Tokat	Turhal	40,372047	36,16378
KAAT-25	Çakmak Barajı	Samsun	Çarşamba	41,106999	36,61192
KAAT-26	Çamoluk	Giresun	Çamoluk	40,133587	38,7469
KAAT-27	Çarşamba	Samsun	Çarşamba	41,202193	36,72444
KAAT-28	Çekerek	Yozgat	Çekerek	40,058437	35,51136
KAAT-29	Çiçekli	Yozgat	Saraykent	39,91344	35,60716
YESIL_48	Çorum	Çorum	Merkez	40,485	34,91556
YESIL_44	Demircili	Tokat	Reşadiye	40,502222	37,52083

GIS ID	Name of the plant	Province	District	Lat	Long
KAAT-30	Deredolu	Gümüşhane	Kelkit	40,038112	39,5126
KAAT-31	Doğanşar	Sivas	Doğanşar	40,212896	37,53976
KAAT-32	Doğu İleri Biyolojik	Samsun	Tekkeköy	41,217055	36,00373
KAAT-33	Düvenci	Çorum	Merkez	40,656649	35,16114
YESIL_47	Erbaa	Tokat	Erbaa	40,706667	36,555
KAAT-34	Esençay	Samsun	Çarşamba	41,112375	36,59462
KAAT-35	Evci	Samsun	Terme	41,149686	37,04408
YESIL_50	Evrenköy	Tokat	Zile	40,148644	35,87286
KAAT-36	Eymir	Yozgat	Sorgun	40,021225	35,20881
KAAT-37	Gökal	Tokat	Erbaa	40,81527	36,65375
KAAT-38	Gökçeli 1	Tokat	Niksar	40,592459	36,73435
KAAT-39	Gökçeli 2	Tokat	Niksar	40,59246	36,73435
KAAT-40	Gökçeli 3	Tokat	Niksar	40,592461	36,73435
KAAT-41	Gölova	Samsun	Terme	40,058787	38,60755
KAAT-42	Göynücek	Amasya	Göynücek	40,389601	35,52033
KAAT-43	Gülşehri	Yozgat	Sorgun	39,78208	35,48462
KAAT-44	Gümüşgöze	Gümüşhane	Kelkit	40,190332	39,37711
KAAT-45	Gümüşhacıköy	Amasya	Gümüşhacıköy	40,873622	35,21594
KAAT-46	Gürçeşme	Tokat	Niksar	40,574286	36,80405
KAAT-47	Güryıldız	Tokat	Merkez	40,358177	36,36462
YESIL_49	Güzelbeyli	Tokat	Zile	40,145169	36,00819
KAAT-48	Halıköy	Yozgat	Kadışehri	40,011697	35,90613
KAAT-49	Hasanşeyh	Tokat	Reşadiye	40,475249	37,45704
KAAT-50	Havza	Samsun	Havza	40,946983	35,65621
KAAT-51	Kadışehri	Yozgat	Kadışehri	39,996256	35,79125
KAAT-52	Karakaya 1	Tokat	Merkez	40,413796	36,70923
KAAT-53	Karakaya 2	Tokat	Merkez	40,413796	36,70923
KAAT-54	Kavak	Samsun	Kavak	41,076002	36,04007
YESIL_52	Kazankaya	Yozgat	Kazankaya/Aydıncık	40,210278	35,3225
KAAT-55	Kelkit	Gümüşhane	Kelkit	40,13905	39,42203
KAAT-56	Kınık	Tokat	Almus	40,315399	36,90611
KAAT-57	Konaklı	Çorum	Merkez	40,634965	35,21381
KAAT-58	Kovanlık	Giresun	Bulancak	40,746711	38,12813
KAAT-59	Koyulhisar	Sivas	Koyulhisar	40,282659	37,82084
KAAT-60	Köse	Gümüşhane	Köse	40,209436	39,6487
KAAT-61	Ladik	Samsun	Ladik	40,913635	35,89624
YESIL_75	Macitözü	Çorum	Macitözü	40,524933	35,29709
KAAT-62	Merzifon	Amasya	Merzifon	40,865304	35,43289
KAAT-63	Niksar	Tokat	Niksar	40,579944	36,92369

GIS ID	Name of the plant	Province	District	Lat	Long
YESIL_55	Oluközü	Yozgat	Akdağmadeni	39,689444	35,76139
YESIL_54	Ozan	Yozgat	Saraykent	39,674722	35,56222
KAAT-64	Özükavak	Yozgat	Çekerek	41,018442	35,69615
KAAT-65	Pazar	Tokat	Pazar	40,277379	36,28471
KAAT-66	Refahiye	Erzincan	Refahiye	39,908851	38,76703
KAAT-67	Sakarlı	Samsun	Terme	41,140213	37,07934
KAAT-68	Salıpazarı	Samsun	Salıpazarı	41,08229	36,82526
KAAT-69	Saraykent	Yozgat	Saraykent	39,699275	35,51234
KAAT-70	Serenli	Tokat	Niksar	40,661696	36,87116
KAAT-71	Suluova	Amasya	Suluova	40,849869	35,6268
KAAT-72	Sulusaray	Tokat	Sulusaray	40,00124	36,08413
KAAT-73	Suşehri	Sivas	Suşehri	40,164228	38,08428
KAAT-74	Şiran	Gümüşhane	Şiran	40,179711	39,1202
KAAT-75	Tanoba	Tokat	Erbaa	40,651472	36,40115
KAAT-76	Taşova	Amasya	Taşova	40,756345	36,3458
YESIL_57	Terme	Samsun	Terme	41,22	37,02333
YESIL_45	Tokat	Tokat	Merkez	40,339722	36,47389
KAAT-77	Uluköy	Amasya	Taşova	40,786947	36,41915
KAAT-78	Umutlu	Yozgat	Akdağmadeni	39,75812	35,61796
KAAT-79	Ünlüpınar	Gümüşhane	Kelkit	40,207588	39,43561
KAAT-80	Üzümören	Tokat	Pazar	40,229199	36,19715
KAAT-81	Zile	Tokat	Zile	40,296949	35,87703

Table B. 2 Inventory Information of Wastewater Treatment Plants in Yeşilırmak Basin

GIS ID	Name of the plant	Treatment Type	Capacity (m3/day)	Flow rate (m3/day)		Discharge environment	Plant Condition
				Feb	Apr		
YESIL_56	Ağacagüney	Biologic(package)	110	Flow rate couldn't be measured		Direct discharge to Cakmak Dam	
KAAT-1	Ahmetfakılı	Natural Treatment	-	-		Çağsak Stream	Under Construction
KAAT-2	Akdağmadeni	Secondary Treatment	-	-		Madenönü Stream	Under Project Stage
KAAT-3	Akıncılar	Secondary Treatment	625	-		Akıncılar Stream	Under Construction
KAAT-4	Alaca	-	-	-		Eskiyapar Stream	Under Project Stage
KAAT-5	Almus	Natural Treatment	-	-			Plant cannot be operated.
KAAT-6	Amasya	Physical-Biological Tretment	25.400	12.000		Yeşilırmak	
KAAT-7	Araplı	Natural Treatment	-	-		Büyükdere	Under Construction
KAAT-8	Artova	Natural Treatment	-	-		Lake of Kuzu Stream	Under Construction
KAAT-9	Asarcık	Active Sludge(package)	200	-			
KAAT-10	Ataköy	Natural Treatment	-	-			Plant cannot be operated.
KAAT-11	Avlunlar	Natural Treatment	-	-		stream bed	
YESIL_53	Aydıncık	Natural Treatment	450	Flow rate couldn't be measured			It Uses as irrigation water, water level is too low.
KAAT-12	Ayvacık	Secondary Treatment	500	-		Hıdışali Stream	
KAAT-13	Ballıdere	-	-	-		Yeşilırmak	Under bidding phase -

GIS ID	Name of the plant	Treatment Type	Capacity (m3/day)	Flow rate (m3/day)		Discharge environment	Plant Condition
				Feb	Apr		
							Mutual WWTP
KAAT-14	Başçiftlik	Natural Treatment	-	100			
KAAT-15	Batı İleri Biyolojik	BNR (advanced treatment)		-		Blacksea	Under bidding phase
KAAT-16	Baydarlı	Natural Treatment	-	50			Plant cannot be operated.
KAAT-17	Baydiğin	Natural Treatment	430	100		Lake of Sağlan Stream	
KAAT-18	Belekçahan	Natural Treatment	400	50			
KAAT-19	Bereketli	Natural Treatment	-	-			Plant cannot be operated.
KAAT-20	Beyyurdu	Natural Treatment	-	50			
KAAT-21	Boraboy	Natural Treatment	-	50			Under Construction
KAAT-22	Bozçalı	Natural Treatment	-	-			Plant cannot be operated.
YESIL_51	Büyükhırka	Natural Treatment	-	12.727	17.842	Çökecik Stream	
KAAT-23	Cimitekke	Natural Treatment	-	-			Plant cannot be operated.
KAAT-24	Çat	Natural Treatment	-	-			Plant cannot be operated.
YESIL_46	Çaylı	Natural Treatment	-	Flow rate couldn't be measured		Stream bed	Under Construction
KAAT-25	Çakmak Barajı	Package Treatment	35	35		Abdal stream	
KAAT-26	Çamoluk	-	-	-		Cesspool	Under Construction
KAAT-27	Çarşamba	-	-	-		Yeşilırmak	Under Project Stage
KAAT-28	Çekerek						Under Project Stage

GIS ID	Name of the plant	Treatment Type	Capacity (m3/day)	Flow rate (m3/day)		Discharge environment	Plant Condition
				Feb	Apr		
KAAT-29	Çiçekli	Natural Treatment					
YESIL_48	Çorum	Physical-Biological Tretment	80.500	56.400	62.880	Derinçay	
YESIL_44	Demircili	Natural Treatment	-	Flow rate couldn't be measured		Into stream bed	There is no wastewater discharge into the plant.
KAAT-30	Deredolu	-	-	-			Under Project Stage
KAAT-31	Doğanşar	Secondary Treatment	-	-			Under Project Stage
KAAT-32	Doğu İleri Biyolojik	BNR (advance treatment)	105.000	-		Blacksea	
KAAT-33	Düvenci	Natural Treatment	400	-			
YESIL_47	Erbaa	Biological Treatment	15.600	9.480	10.512	Kelkit Creek	
KAAT-34	Esençay	Package Treatment	-	110		Abdal Stream	
KAAT-35	Evci	Secondary Treatment	2.100	1.000		Arım Stream	
YESIL_50	Evrenköy	Natural Treatment	-	Flow rate couldn't be measured		Irrigation bed	Under Construction
KAAT-36	Eymir	Natural Treatment	-	-			
KAAT-37	Gökal	Natural Treatment	-	-			Plant cannot be operated.
KAAT-38	Gökçeli 1	Natural Treatment	-	25			
KAAT-39	Gökçeli 2	Natural Treatment	-	25			
KAAT-40	Gökçeli 3	Natural Treatment	-	-			Plant cannot be operated.
KAAT-41	Gölova	Secondary Treatment	313	-			Under Construction
KAAT-42	Göynücek	-	-	-			Under Project Stage

GIS ID	Name of the plant	Treatment Type	Capacity (m3/day)	Flow rate (m3/day)		Discharge environment	Plant Condition
				Feb	Apr		
KAAT-43	Gülşehri	Natural Treatment	-	-			Under Construction
KAAT-44	Gümüşgöze	-	-	-			Under Project Stage
KAAT-45	Gümüşhacıköy	-	-	-			Under Project Stage
KAAT-46	Gürçeşme	Natural Treatment	-	100			
KAAT-47	Güryıldız	Natural Treatment	-				
YESIL_49	Güzelbeyli	Natural Treatment	-	Flow rate couldn't be measured		Used for irrigation purposes	Under Construction
KAAT-48	Halıköy	Natural Treatment	-	-	-	Halıdere	Plant cannot be operated.
KAAT-49	Hasanşeyh	Natural Treatment	-	100			
KAAT-50	Havza	Secondary Treatment	7.636	3.555		Tersakan	
KAAT-51	Kadışehri	Secondary Treatment	600	-			Under Construction
KAAT-52	Karakaya 1	Natural Treatment(wetland)	450	100			Because of dried vegetation, Plant cannot be operated.
KAAT-53	Karakaya 2	Natural Treatment(wetland)	-	-			Under Construction
KAAT-54	Kavak	-	-	-		Cevizlik Stream	Under Project Stage
YESIL_52	Kazankaya	Natural Treatment	-	Flow rate couldn't be measured		Direct discharge to river	WWTP is not exist
KAAT-55	Kelkit	Secondary Treatment	5.600	2.700		Balahor Creek	
KAAT-56	Kınık	Natural Treatment	-	-			Under Construction

GIS ID	Name of the plant	Treatment Type	Capacity (m3/day)	Flow rate (m3/day)		Discharge environment	Plant Condition
				Feb	Apr		
KAAT-57	Konaklı	Natural Treatment	-	-			
KAAT-58	Kovanlık	Package Treatment	200	-			
KAAT-59	Koyulhisar	Secondary Treatment	625	-		Kelkit Creek	Under Construction
KAAT-60	Köse	-	-	-		Köse Stream	Under Project Stage
KAAT-61	Ladik	-	-	-			Under Project Stage
YESIL_75	Macitözü	Physical - Biological Treatment	1.050	-	-		
KAAT-62	Merzifon	-	-	-		Paşa Stream	
KAAT-63	Niksar	-	-	-		Kelkit Creek	Under bidding phase
YESIL_55	Oluközü	Natural Treatment	-	Flow rate couldn't be measured		Direk discharge into casspool	
YESIL_54	Ozan	Natural Treatment	-	Flow rate couldn't be measured		Usually discharged into casspool.	
KAAT-64	Özükavak	Natural Treatment	-	100			
KAAT-65	Pazar	Secondary Treatment	-	-			Under Construction
KAAT-66	Refahiye	Secondary Treatment	1.000	-		Köroğlu Stream	
KAAT-67	Sakarlı	Package Treatment	200	-			Under Construction
KAAT-68	Salıpazarı	-	-	-			Under Project Stage
KAAT-69	Saraykent	-	-	-		Kaynayan Stream	
KAAT-70	Serenli	Natural Treatment	-	-			Under Construction

GIS ID	Name of the plant	Treatment Type	Capacity (m3/day)	Flow rate (m3/day)		Discharge environment	Plant Condition
				Feb	Apr		
KAAT-71	Suluova	-	-	-		Tersakan	Under Project Stage
KAAT-72	Sulusaray	Natural Treatment	-	-		Çekerek Stream	Plant cannot be operated.
KAAT-73	Suşehri	Package Treatment	1.250	-		Kuru Dere	
KAAT-74	Şiran	BNR (advance treatment)	3.096	1.496			
KAAT-75	Tanoba	Natural Treatment	-	100			
KAAT-76	Taşova	Secondary Treatment	-	-		Yeşilırmak	Not in operation yet
YESIL_57	Terme	Secondary Treatment	-	8.880	-	Blacksea	
YESIL_45	Tokat	Advance Biological Treatment	64.500	2.957	2.957	Yeşilırmak	
KAAT-77	Uluköy	Natural Treatment	-	-		Köy Stream	Under Construction
KAAT-78	Umutlu	Natural Treatment	-	100			
KAAT-79	Ünlüpınar	-	-	-			Under Project Stage
KAAT-80	Üzümören	Physical Treatment	-	-			Under Construction
KAAT-81	Zile	-	-	-		Hoton Stream	Under Project Stage

APPENDIX C - Inventory Information of Individual Industrial Facilities in Yeşilırmak Basin

Table C. 1 Inventory Information of Individual Industrial Facilities in Yeşilırmak Basin

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WWTP (Exist / Not Exist)
END-1	Adoçim Çimento Beton	Tokat	Merkez	40,3381	36,48899	Manufacture of ready-mixed concrete	23-63	Not Exist
END-2	Adoçim Çimento Beton	Tokat	Artova	40,11811	36,30101	Manufacture of other articles of concrete, plaster and cement	23-69	Exist
END-3	Ahşa Makina, Kent Mobilyaları	Samsun	Tekkeköy	41,23188	36,43966	Manufacture of pesticides and other agrochemical products	20-20	Not Exist
END-4	Akar Un İnşaat Nakliye Tarım Petrol Ürünleri Imalat ve Pazarlama	Tokat	Pazar	40,27726	36,28488	Manufacture of grain mill products	10-61	Not Exist
END-5	Ak-Can Yem	Gümüşhane	Köse	40,20839	39,65435	Manufacture of prepared feeds for farm animals	10-91-01	Not Exist
END-6	Akçansa Çimento i	Çorum	Merkez	40,50886	34,91377	Manufacture of ready-mixed concrete	23-63	Not Exist
END-7	Akçansa Çimento	Samsun	Ladik	40,93478	35,88578	Manufacture of cement	23-51	Exist
END-8	Akçansa Çimento	Tokat	Merkez	40,24453	36,54581	Manufacture of ready-mixed concrete	23-63	Not Exist
END-9	Akın Pompa Makine	Samsun	Tekkeköy	41,21326	36,46312	Casting of steel	24-52	

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WWTP (Exist / Not Exist)
END-10	Akiktaş Madncilik İnşaat Taahüt Turizm Tekstil Nakliye ve Otomotiv	Amasya	Merkez	40,56153	35,8046	Cutting, shaping and finishing of stone(23-70)	23-75	Exist
END-11	Akkisan Kireç	Samsun	Kavak	41,10076	36,01859	Manufacture of lime and plaster	23-52	Not Exist
END-12	Akpen Kapı ve Pencere Sistemleri İnşaat Doğrama	Samsun	Tekkeköy	41,23327	36,42777	Manufacture of builders' ware of plastic	22-23-01	
END-13	Aksa Enerji Üretim	Samsun	Tekkeköy	41,24338	36,47756			Exist
END-14	Aktan Gıda	Amasya	Suluova	40,88428	35,63531	Manufacture of grain mill products	10-61	Exist
END-15	Ali Bay Salihoğlu Kum-Çakıl Ocağı	Giresun	Şebinkarahisar	40,27561	38,20211	Manufacture of ready-mixed concrete	23-63	Exist
END-16	Ali Durmuş Madencilik	Gümüşhane	Kelkit	41,25424	39,3714	Mining of hard coal	05-10-01	Exist
END-17	Altınbaş Petrol	Samsun		41,25424	36,38787	Wholesale of solid, liquid and gaseous fuels and related products	46-71	Exist
END-18	Altınbaşak Un İrmik ve Yem	Samsun		41,07842	35,70827	Manufacture of grain mill products	10-61	Exist
END-19	Alsan Aliminyum, Plastik, Mermer, Doğrama, Gıda ve Hayvancılık	Samsun	Kavak	41,17653	36,1133	Manufacture of builders' ware of plastic	22-23-01	
END-20	Amasya Şeker Fabrikası	Amasya	Suluova	40,83248	35,64453	Manufacture of sugar	10-81	Exist
END-21	Amasya Un Gıda	Amasya	Merkez	40,57131	35,71788	Manufacture of grain mill products	10-61	Exist
END-22	Apeas Toprak	Tokat	Erbaa	40,66844	36,57032	Manufacture of bricks,	23-32	Not Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WW TP (Exist / Not Exist)
						tiles and construction products, in baked clay		
END-23	Arılar Toprak	Samsun	Kavak	41,06821	36,01832	Manufacture of bricks, tiles and construction products, in baked clay	23-32	Not Exist
END-24	Arsan Döküm	Çorum	Merkez	40,51194	34,91251	Casting of iron	24-51	Not Exist
END-25	Artova Krom Metal Madencilik İnşaat	Tokat	Artova	40,07369	36,32005	Mining of other non-ferrous metal ores	07-29	Not Exist
END-26	Astek Tekel Ürünleri ve Gıda Pazarlama	Tokat	Niksar	40,58833	36,75434	Manufacture of soft drinks;production of mineral waters and other bottled waters	11-07	Not Exist
END-27	Aybet Beton Prefabrik Yapı Elemanları	Samsun	Ilkadım	41,29836	36,22204	Manufacture of concrete products for construction purposes	23-61	Exist
END-28	Aydınoğlu Un Gıda	Samsun	Havza	40,98055	35,68856	Manufacture of grain mill products	10-61	Not Exist
END-29	Aygaz. Dolum Tesisi	Samsun	Tekkeköy	41,24487	36,41411	Wholesale of solid, liquid and gaseous fuels and related products	46-71	Exist
END-30	Baki Otomotiv.	Samsun	Ilkadım	41,29392	36,29156	Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres	22-11-04	
YESIL _79	Bakraç Süt Ürünleri	Amasya	Merkez	40,73404	35,77057			Exist
END-31	Berk Beton Elemanlari	Samsun	Terme	41,14035	37,07579	Cutting, shaping and	23-70	Not Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WW TP (Exist / Not Exist)
	Turizm İnşaat					finishing of stone		
END-32	Beşgöz Araboğulları Unculuk.	Samsun	Havza	40,91772	35,64813	Manufacture of grain mill products	10-61	Exist
END-33	Beşgöz Soğuk Hava, Tarım,	Amasya	Merkez	40,71156	35,80276	Other processing and preserving of fruit and vegetables	10-39	Not Exist
END-34	Betontaş Yapı Elemanları İnşaat	Samsun	Kavak	41,08165	36,07347	Manufacture of ready-mixed concrete	23-63	
END-35	BİM Birleşik Mağazalar Depo	Çorum	Merkez	40,46502	34,86652	Other transportation support activities	52-29	Exist
END-36	Birsan Birlik Gıda	Tokat	Zile	40,29591	35,89653	Manufacture of grain mill products	10-61	Not Exist
END-37	Botaş	Samsun	Çarşamba	41,36228	36,71228	Distribution of gaseous fuels through mains	35-22	Exist
END-38	Bozdemir Un Yem Nakliye İnşaat Temizlik Güvenlik Petrol Ticaret	Yozgat	Çekerek	40,06057	35,51057	Manufacture of grain mill products	10-61-01	
END-39	Çağlayan Ticaret	Tokat	Zile	40,29811	35,89243	Cutting, shaping and finishing of stone	23-70	Not Exist
END-40	Çak-Sa Hazır Beton Kum Çakıl ve İnşaat	Samsun	Terme	41,19967	37,00929	Manufacture of ready-mixed concrete	23-63	Not Exist
END-41	Camadanlar Un. Gıda Ve Nakliyat	Samsun	Ilkadım	41,31805	36,30677	Manufacture of grain mill products	10-61	Not Exist
YESIL_67	Çarşamba Şeker Fabrikası	Samsun	Çarşamba	41,17875	36,7114			Exist
END-42	Celepciler Örnek Beton	Samsun	Terme	41,18825	37,02761	Manufacture of ready-	23-63	Not Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WW TP (Exist / Not Exist)
	ve Taş Parke Sanayi					mixed concrete		
END-43	Cengiz Enerji	Samsun		41,24152	36,47733			Exist
END-44	Çevikler Enerji Madencilik Mermer Turizm	Sivas	Zara			Cutting, shaping and finishing of stone	23-70-01	Not Exist
END-45	Cimpor Yibitaş Çimento (Votorantim Çimento)	Çorum	Merkez	40,56488	34,98245	Manufacture of lime and plaster	23-52	Not Exist
END-46	Cimpor Yibitaş Çİmento	Samsun	Ilkadım	41,32341	36,28974	Manufacture of ready-mixed concrete	23-63	Exist
END-47	Çopuroğlu Un Tarım Ürünleri Nakliyat	Çorum	Alaca	40,17158	34,86871	Manufacture of grain mill products	10-61	Not Exist
END-48	Çorum Hitit Un Gıda	Çorum	Merkez	40,50374	34,90736	Manufacture of grain mill products	10-61	Not Exist
END-49	Çorum Şeker Fabrikası	Çorum	Merkez	40,47833	34,89472	Manufacture of sugar	10-81	Exist
END-50	Deko Plastik Ambalaj	Amasya	Gümüşhacıköy	40,87033	35,22737	Manufacture of other plastic products	22-29	Not Exist
END-51	Dem-Ak Madencilik Petrol Nakliye Taahhüt	Çorum	Mecitözü	40,58139	35,33109	Mining of lignite	05-20	Not Exist
END-52	Demirgil Un Gıda Hayvancılık Tarım Madencilik Nakliyat İnşaat	Çorum	Mecitözü	40,51849	35,29946	Manufacture of grain mill products	10-61	Not Exist
END-53	Dila Tekstil	Amasya	Suluova	40,82872	35,65034	Finishing of textiles	13-30	Not Exist
YESIL_60	Dimes Gıda	Tokat	Merkez	40,33343	36,53552	Manufacture of fruit and vegetable juice	10-32	Exist
END-54	DK Doruk Hazır Beton	Giresun	Alucra	40,32818	38,74884	Manufacture of ready-	23-63	Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WW TP (Exist / Not Exist)
						mixed concrete		
END-55	Doğa Su Gıda Maddeleri	Samsun		40,89308	36,0576	Manufacture of soft drinks;production of mineral waters and other bottled waters	11-07	Exist
END-56	Dörtler Kireç ve Toprak Sanayi	Samsun	Kavak	41,06637	36,00078	Manufacture of lime and plaster	23-52	Not Exist
END-57	Elvan Baharat Gıda	Samsun	Tekkeköy	41,22335	36,48704	Manufacture of condiments and seasonings	10-84	Not Exist
END-58	Emmioğlu Mermer Madencilik İnşaat Taahhüt İnşaat Malzemeleri Mühendislik Akaryakıt Petrol Ürünleri Turizm	Amasya	Eliktekke Köyü	40,43699	35,75167	Cutting, shaping and finishing of stone	23-70	Exist
END-59	Emmioğlu Mermer Madencilik İnşaat Taahhüt İnşaat Malzemeleri Mühendislik Akaryakıt Petrol Ürünleri Turizm	Giresun	Çamoluk	40,09036	38,83327	Cutting, shaping and finishing of stone	23-70	Not Exist
END-60	Eralp Madencilik	Amasya	Taşova	40,84537	36,3712	Mining of lignite	05-20	Not Exist
END-61	Erbaa Hazır Beton İnşaat	Amasya	Taşova	40,75403	36,33324	Manufacture of ready-mixed concrete	23-63	Not Exist
END-62	ERCO Konfeksiyon İnşaat	Giresun	Şebinkarahisar	40,28972	38,42202	Manufacture of ready-	23-63	Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WW TP (Exist / Not Exist)
						mixed concrete		
END-63	Es-Kav Değirmen ve Yem	Samsun	Kavak	41,07839	36,04302	Manufacture of grain mill products	10-61	Not Exist
YESIL_66	Eski Çeltek Kömür İşletmesi	Amasya	Suluova	40,8714	35,63677	Manufacture of coal		Exist
END-64	Estaş Kireç	Samsun	Kavak	41,10076	36,01858	Manufacture of lime and plaster	23-52	Not Exist
END-65	Etaş Et Ürünleri	Amasya		40,74126	35,75776			Exist
YESIL_77	Et-Bir Kesimhanesi	Amasya	Suluova	40,82305	35,63658			Exist
YESIL_71	Eti Bakır.	Samsun	Tekkeköy	41,24278	36,46028	Copper production	24-44	Exist
END-66	Fen Yem ve Gıda	Çorum	Alaca	40,15426	34,85164	Manufacture of prepared feeds for farm animals	10-91	Not Exist
END-67	Fırat Un ve Un Mamülleri	Sivas	Koyulhisar	40,28172	37,82295	Manufacture of grain mill products	10-61-01	Not Exist
END-68	Fimar İnşaat Taahüt Nakliye Mermer Madencilik Petrol Akaryakıt Ürünleri	Amasya	Merkez	40,57453	35,70178	Support activities for other mining and quarrying	09-90	Exist
END-69	Florya Entegre Et Gıda	Samsun		41,37597	36,2066	Production of meat and poultry meat products	10-13	Exist
END-70	Gülbahar Un Tarım Ürünleri	Amasya	Merzifon	40,87442	35,53969	Manufacture of grain mill products	10-61	Exist
END-71	Gülümoğlu Yem	Çorum	Merkez	40,53606	34,92984	Manufacture of prepared feeds for farm animals	10-91	Not Exist
END-72	Gülşim Un ve İrmik	Amasya	Suluova	40,82835	35,63295	Manufacture of other food products n.e.c.	10-89	Exist
END-73	Güner Kardeşler Gıda.	Samsun		41,18207	36,88236	Operation of dairies and cheese making	10-51	Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WWTP (Exist / Not Exist)
END-74	Günsan Akaryakıt Otomotiv Nak. Gıda	Samsun		41,22074	36,63677			Exist
END-75	Gürmin Enerji Madencilik	Amasya	Merzifon	40,88177	35,63246	Mining of lignite	05-20	Exist
END-76	Gür Un	Amasya	Merkez	40,57282	35,78851	Manufacture of grain mill products	10-61	Exist
END-77	Has Beton İnşaat	Sivas	Suşehri	40,22862	38,07293	Manufacture of ready-mixed concrete	23-63-00	Not Exist
END-78	Has Hisar Yem ve Gıda	Giresun	Ş.Karahisar	40,28826	38,42015	Manufacture of prepared feeds for farm animals	10-91	Not Exist
YESIL_74	Hasanusta Gıda	Samsun	Havza	40,91148	35,6648	Manufacture of grain mill products, starches and starch products(10-60)	10-63	Exist
END-79	Hasaş İnşaat (Has Un)	Çorum	Alaca	40,1696	34,85337	Manufacture of grain mill products	10-61	Not Exist
YESIL_63	Hayat Kağıt	Çorum	Merkez	40,51351	34,91391	Manufacture of paper and paperboard	17-12	Exist
END-80	Hilal Blok Tuğla Fabrikasi	Çorum	Merkez	40,55766	34,90498	Manufacture of bricks, tiles and construction products, in baked clay	23-32	Not Exist
END-81	Kalenderoğlu (Almus Un Fabrikası)	Tokat	Almus	40,37605	36,90363	Manufacture of grain mill products	10-61	Not Exist
END-82	Kanoğlu Un Gıda Tarım	Samsun	Havza	41,00221	35,82266	Manufacture of grain mill products	10-61-01	Not Exist
END-83	Karademir Dondurma	Samsun	Terme	41,20116	36,97172	Manufacture of ice cream	10-52	Not Exist
END-84	Karatay Madencilik İnşaat	Gümüşhane	Kelkit	40,20305	39,43411	Manufacture of ready-mixed concrete	23-63-00	Exist
END-85	Kardez Su Ürünleri	Samsun	Çarşamba	41,17122	36,70995	Processing and	10-20	Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WW TP (Exist / Not Exist)
						preserving of fish, crustaceans and molluscs		
END-86	Karsan Kireç Sanayi	Samsun	Kavak	41,08459	36,11912	Manufacture of lime and plaster	23-52	Not Exist
END-87	Kastamonu Entegre Ağaç	Samsun		39,57125	36,82321		10-21	Exist
END-88	Kaygılar Çakıl Kum Kırma Eleme Tesisi	Samsun	Terme	41,12629	37,16108	Manufacture of ready-mixed concrete	23-63	Not Exist
END-89	Kayseri Stropor Ambalaj	Samsun	Tekkeköy	41,2125	36,45695	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	17-21	Not Exist
END-90	Kazova Vasfi Diren Tarım	Tokat	Turhal	40,33343	36,14094	Wheat, sunflower, sugar beet and forage plants, fruit growing and dairy cattle farming		Exist
END-91	Kılıç Aliminyum Levha İmalathanesi	Samsun	Tekkeköy	41,23362	36,43799	Aluminium production	24-42	
END-92	Kılınç Kardeşler Gıda	Tokat	Merkez	40,53411	36,73258	Manufacture of grain mill products	10-61	Not Exist
YESIL_78	Kozlu Gıda	Amasya	Suluova	40,84872	35,63049	Manufacture of prepared feeds for farm animals	10-91	Exist
END-93	Kurtoğlu Un Yem Gıda	Samsun	Atakum	41,27371	36,32198	Manufacture of grain mill products	10-61-01	
END-94	Ladik Akdağ Yatırım Turizim	Samsun	Ladik	40,9721	35,78649	Hotels and similar accommodation	55-10	Exist
END-95	Makro-Win Yapı Malzemeleri	Çorum	Merkez	40,51178	34,91445	Manufacture of builders’	22-23	Not Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WW TP (Exist / Not Exist)
						ware of plastic		
END-96	Mepet Metro Petrol ve Tesisleri	Çorum	Osmancık	40,5506	34,9556	Restaurants and mobile food service activities /Retail sale of automotive fuel in specialised stores	56-1 and 47-3	Exist
YESIL_65	Meray Yağ	Amasya	Merzifon	40,86028	35,43173	Manufacture of oils and fats	10-41	Exist
END-97	Mim Mermer Madencilik	Amasya	Suluova	40,79678	35,67037	Cutting, shaping and finishing of stone	23-70	Not Exist
END-98	Mizan İnş.	Giresun	Alucra			Manufacture of ready-mixed concrete	23-63	Exist
END-99	Murathanoğulları Hazır Beton	Gümüşhane	Kelkit	40,12861	39,43833	Manufacture of ready-mixed concrete	23-63-00	Not Exist
YESIL_72	Nesko Maden	Giresun	Şebinkarahisar	40,29095	38,29693	Zinc Lead Flotation Plant		Exist
END-100	Nihoruz Gıda	Amasya	Merzifon	40,80149	35,44343	Manufacture of oils and fats	10-61	Exist
END-101	Nimsan	Samsun	Ilkadım			Manufacture of ready-mixed concrete	23-63	Exist
END-102	Nimsan	Samsun	Kavak	41,01824	36,06639	Manufacture of ready-mixed concrete	23-63	Not Exist
END-103	NTF İnşaat	Gümüşhane	Kelkit	40,03275	39,6034	Manufacture of ready-mixed concrete	23-63-01	Exist
END-104	Nur Kömür Demir	Gümüşhane	Şiran	40,19069	39,12749	Mining of hard coal	05-10-01	Not Exist
END-105	Nur Un	Samsun	Havza	40,96838	35,66923	Manufacture of grain mill products	10-61	Not Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WW TP (Exist / Not Exist)
END-106	Nuryak Yakıt İnşaat Hazır Beton	Samsun	Terme	41,16988	37,05552	Manufacture of ready-mixed concrete	23-63	Not Exist
END-107	Oğuzlar Gıda	Samsun	Tekkeköy	41,12206	36,59713	Operation of dairies and cheese making	10-51	Exist
YESIL_69	Olmuksan International Paper Sabancı Ambalaj	Çorum	Merkez	40,52558	34,91417	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	17-21	Exist
END-108	Ömer Akay Un ve Gıda	Amasya	Gümüşhacıköy	40,87831	35,2285	Manufacture of grain mill products	10-61	Not Exist
END-109	OMV Petrol Ofisi	Samsun	Tekkeköy	41,25495	36,38783	Retail trade in specialized stores for food, beverages and tobacco	52-20	Exist
END-110	Onur Beton Sanayi	Tokat	Niksar	40,57586	36,92268	Manufacture of ready-mixed concrete	23-63	Not Exist
END-111	Ösak İnşaat	Tokat		40,48328	36,99215	Construction		Exist
END-112	Otat Gıda	Samsun	Havza	40,97504	35,68716	Manufacture of dairy products	10-05	Exist
END-113	Oyak Beton	Samsun	Merkez	40,92765	39,72761	Manufacture of ready-mixed concrete	23-63	Exist
YESIL_62	Özdemir Antimuan Madenleri	Tokat	Turhal	40,42543	36,11014	Mining of other non-ferrous metal ores	07-29	Exist
END-114	Özen Hafriyat Kum Nakliye İnşaat Mermer	Amasya	Suluova	40,5751	35,79008	Manufacture of ready-mixed concrete	23-63	Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WWTP (Exist / Not Exist)
END-115	Özgür Gıda	Çorum	Alaca	40,17042	34,86712	Manufacture of grain mill products	10-61	Not Exist
END-116	Özkuş Hayvancılık Gıda	Tokat	Merkez	40,33322	36,53838	Manufacture of condiments and seasonings	10-84	Not Exist
YESIL_70	Özmaya	Amasya	Merkez	40,68694	35,90663	Manufacture of other food products n.e.c.	10-89	Exist
END-117	Özmersan Mermer	Sivas	Yıldızeli	39,77336	36,74036	Cutting, shaping and finishing of stone	23-70-01	Exist
YESIL_64	PAN-ET Hayvan Kesim ve Et Ürünleri	Amasya	Suluova	40,84074	35,63257	Production of meat and poultry meat products	10-13	Exist
END-118	Parlar PlastiK PVC İnşaat	Samsun	Ilkadım	41,2817	36,33828	Manufacture of builders' ware of plastic	22-23	Not Exist
END-119	Regal Mermer Madencilik Nakliye İnşaat	Amasya	Merkez	40,44195	35,77147	Cutting, shaping and finishing of stone	23-70	Not Exist
END-120	Sadık Kaplan Un ve Kepek İmalatı	Amasya	Göynücek	40,39648	35,52416	Manufacture of grain mill products	10-61	Not Exist
END-121	Şakir Genç Muhtelif Plastik Ev Eşyası İmalatı	Samsun	Tekkeköy	41,21337	36,45687	Manufacture of plastic packinggoods	22-22	Not Exist
END-122	Sam Çelik Döküm İşleme	Samsun	Tekkeköy	41,2352	36,43576	Casting of steel	24-52	Not Exist
END-123	Samsun-Çarşamba Havaalanı Müdürlüğü	Samsun	Çarşamba	41,25881	36,55628	Service activities incidental to air transportation	52-23	Exist
YESIL_68	Sames Samsun Mezbahane	Samsun				Slaughterhouse and meat packing		Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WWTP (Exist / Not Exist)
	ve Et Entegre							
END-124	Samsun Sagimad Toptancılar Sitesi	Samsun	Tekkeköy	41,29215	36,33187	Other personal service activities n.e.c.	96-09	Exist
END-125	Samsun Soğuk Kaplama Kauçuk	Samsun	Ilkadım	41,29215	36,33187	Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres	22-11	Not Exist
END-126	Saray Petrol Turizm Gıda	Çorum	Merkez	40,43611	34,99389	Manufacture of grain mill products	10-61	Exist
END-127	SD Sarel Plastik ve Ambalaj	Yozgat	Akdağmadeni	39,65238	35,86885	Manufacture of plastic packinggoods	22-22	Not Exist
END-128	Sedef Plastik Sanayi	Çorum	Merkez	40,53288	34,92977	Manufacture of plastic packinggoods	22-22	Not Exist
END-129	Sel-Beton, Yapı Elemanları İnşaat	Samsun	Tekkeköy	41,22781	36,47356	Manufacture of ready-mixed concrete	23-63	Not Exist
END-130	Sel-Beton Yapi Elemanları İnşaat	Samsun	Kavak			Manufacture of ready-mixed concrete	23-63	Not Exist
END-131	Selhas Maden Kimya	Çorum	Merkez	40,37382	34,84112	Mining of other non-ferrous metal ores	07-29	Not Exist
END-132	Serra Madencilik İnşaat Beton Santrali Gıda Nakliyat Tarım Ürünleri ve Hayvancılık	Çorum	Merkez	40,58363	34,92766	Manufacture of ready-mixed concrete	23-63	Not Exist
END-133	Sevil Dekorasyon Mutfak İnşaat ve Malzemeleri	Samsun	Tekkeköy	41,23782	36,41922	Manufacture of plastic plates, sheets, tubes and profiles	22-21-01	

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WW TP (Exist / Not Exist)
END-134	Sipahiler Kolonyaları	Samsun	Ilkadım	41,29374	36,33061	Manufacture of perfumes and toilet preparations	20-42-01	
END-135	Standart Beton Sanayi Nakliye İnşaat	Samsun	Canik	41,24362	36,30686	Manufacture of ready-mixed concrete	23-63	Not Exist
END-136	Taşmak Madencilik İnşaat	Samsun	Tekkeköy	41,22483	36,45251	Manufacture of ready-mixed concrete	23-63	Exist
END-137	Tat-Alsam Unlu Gıda Mamulleri	Samsun	Ilkadım	41,29283	36,3318	Manufacture of bread; manufacture of fresh pastrygoods and cakes	10-71	Not Exist
END-138	Tataroğlu Un Yem ve Gıda	Gümüşhane	Kelkit	40,10572	39,45765	Manufacture of grain mill products	10-61-01	Not Exist
END-139	Tek Yapı PVC ve İnşaat Dekorasyon	Samsun	Tekkeköy	41,22428	36,44976	Manufacture of builders' ware of plastic	22-23	Not Exist
END-140	Teksin Gıda	Amasya	Merzifon	40,86739	35,47376	Manufacture of grain mill products	10-61	
END-141	Temiz Et Ürünleri	Samsun	Havza	40,99711	35,66284	Processing and preserving of meat	10-11	Exist
END-142	Terme Metal	Samsun	Terme	41,16604	37,05477	Treatment and coating of metals	25-61	Exist
END-143	Tokat Havaalanı Müdürlüğü	Tokat	Pazar	40,30459	36,36398	Service activities incidental to air transportation	52-23	Exist
END-144	Toros Tarım	Samsun	Tekkeköy	41,22721	36,46229	Manufacture of fertilisers and nitrogen compounds	20-15-01	Exist
YESIL_61	Türkiye Şeker Fabrikaları A.Ş. Muammer Tuksavul	Tokat	Turhal	40,38569	36,07497	Manufacture of sugar	10-81	Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WWTP (Exist / Not Exist)
	Turhal Şeker Fabrikası							
END-145	Üçler Kireç	Samsun	Kavak	41,03243	36,04972	Manufacture of lime and plaster	23-52-01	
END-146	Üçyol Gıda Temizlik Katı Yakıt Hazır Beton Kum Çakıl Akaryakıt Hafriyat Nakliyat İnşaat Proje	Gümüşhane	Şiran	40,18936	39,12781	Manufacture of ready-mixed concrete	23-63-00	Not Exist
END-147	Ulupınar Maden Mermer	Giresun	Çamoluk	40,14005	38,54335	Cutting, shaping and finishing of stone	23-70	Exist
END-148	Unay Gıda	Çorum	Alaca	40,16976	34,85617	Manufacture of grain mill products	10-61	Not Exist
END-149	Üncü Baharat	Tokat	Merkez	40,32127	36,5543	Manufacture of condiments and seasonings	10-84	Not Exist
END-150	Unsan-Un	Samsun	Tekkeköy	41,24084	36,40594	Manufacture of grain mill products	10-61	Exist
END-151	Usta Un Gıda.	Amasya	Merzifon	40,87433	35,53219	Manufacture of grain mill products	10-61	Exist
END-152	Uygar Belediye Başkanlığı Mezbahanesi	Amasya		40,57292	36,02016	Processing and preserving of meat	10-11	Exist
END-153	Yaprak 1 Barajı ve HES	Amasya	Taşova	40,91084	36,30354	Construction of water projects	42-91	Exist
END-154	Yaprak 2 HES	Amasya	Taşova	40,87493	36,35238	Construction of water projects	42-91	Exist
YESIL_73	Yemsel Tavukçuluk Hayvancılık Yem.	Samsun	Tekkeköy	41,06015	36,0946	Processing and preserving of poultry meat	10-12	Exist
END-155	Yeni Doğan Kağıt Sanayi	Çorum	Merkez	40,57109	34,94243	Manufacture of paper and paperboard	17-12	Exist

GIS ID	Name of the plant	Province	District	Lat	Long	Subject of Activity	Code of NACE	WWTP (Exist / Not Exist)
END-156	Yeni Teşvikiye Yem	Samsun	Havza	40,94311	35,65622	Manufacture of prepared feeds for farm animals	10-91	Not Exist
END-157	YNSO Hazır Beton	Giresun	Çamoluk	40,13298	38,74931	Manufacture of ready-mixed concrete	23-63	Exist
END-158	Yılancıoğlu Hazır Beton Üretim Tesisi	Giresun	Ş.Karahisar	40,29315	38,43775	Manufacture of ready-mixed concrete	23-63	Exist
YESIL_76	Yuva Viyol ve Ambalaj	Çorum	Merkez	40,59874	34,91236	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	17-21	Exist
END-159	Zile Taşel İnşaat	Tokat	Zile	40,30961	35,91392	Manufacture of ready-mixed concrete	23-63	Not Exist

APPENDIX D - Organized Industrial Zones and Facilities That Are Inside of These OIZs

Table D. 1 List of the firms which are inside Amasya Merkez OIZ

Name of the Firm	Current State	Subject of Activity
Pak-İş Doğaltaş Orman ve Petrol Ürünleri LPG Maden	Active	Marble
Fimar Mermer	Active	Marble
Alkataş Mermer	Active	Marble
Gökmer Mermer	Active	Marble
Doğansoy Mermer	Active	Marble
Alternatif Mermer	Active	Marble
Albamar Mermer	Active	Marble
Pileki Mermer	Active	Marble
Sezenoğlu Mermer Madencilik (Özbakır Kiracısı)	Active	Marble
4 Line Mobili Park İmalat	Active	Furniture
Nesil Gıda Tekstil	Active	Plastic Bag
Yılsar Gıda Yağ	Active	Herbal oil
Koçak Kuruyemiş	Active	Dried Fruits
Cold Karb.Oks.Likid Dolum Gaz	Active	Ammonia Filling
A.Z.İ Tarım	Active	Organic Fertilizer
Keleş Mermer	Under Construction	Marble
Ekinciler Mermer	Close	Marble
Kapadokya İthalat İhracaat	Under Construction	Marble
Atlaskent PVC	Under Construction	Pvc Window
Benal Danışmanlık	Under Project Stage	LPG and Electric
Amasya OSB Müt.Hy. Bşk (Prestij A.Ş.)	Cancelled Allotment	
Feritoğulları Mermer	Under Construction	Marble
Asil İzolasyon ve Yalıtım Malzemeleri	Active	Exterior coating
Sarem Mermer	Under Construction	Marble
Verde Mod. Mobilya	Under Construction	Furniture
Türkmenoğlu Karo Mermer	Under Project Stage	Marble

Table D. 2 List of the firms which are inside Amasya Merzifon OIZ

Name of the Firm	Subject of Activity
ADF Ankastre Ürünler	Electrical Machines Industry / Built-in kitchen products, hood fume and aspirator
Apaydın Metal Ürünler	Metal Industry / galvanized, pvc coated, hexagonal knitted, spiral knitted, barbed wire and panel fence and steam-cured concrete pole
APS Giyim	Textile Industry / Outwear for Ladies
Asya Isı Sistemleri	Metal Industry / All kinds of connection clamps
Atmaca	Furniture / Office Furniture
İdeal Ambalaj	N/K
Bilgeler Plastik	Plastic Industry / PVC hose, polyethylene pipe and sprinkler pipe
Bilgin Orman Ürünleri-İbrahim Bilgin	Wood Industry /Production of structural plank, timber and pallet production
Coşkun Tekstil-Kazım Coşkun	Confection /Underwear
Çelikörs	Machinery Industry / Agricultural Instruments and other
Dovi Mobilya	Furniture / Office Furniture
Elsa	Food industry/ Manifacture of flour
Esme Dayanıklı Tüketim	Sales of durable goods
Gencoğlu Tekstil	Chemical products / styrofoam, packing
Gümüşmak Endüstri	Machine manufacturing / Mold making
Gür Kalıp	Machine manufacturing / Mold making, plastic injection products
Kervan Makine	Machinery Manufacturing-Agricultural Machines
Gür Kalıp	Plastic Industry
Meksan	Food Industry / bakery products
Mer-Bak Gıda	Food Industry / Dry Food and Pulses
Merpor	Strafor Production / Strafor, asmolen, papier-mache and jamb
Merzifon Elektro Motor	Electric Electronic / Induction motors
Plasform Plastik	Plastic, Metal Products / Aspirators, filters, plastic products
Platform Mobilya	Furniture, decoration and wooden building elements
Sente Makine	Metal goods / Kitchen extractor, hood, air curtain
Silverline Endüstri	Metal Goods / Built-in kitchen products
Silver	Electric Machineries / Built-in kitchen products
Solaren Isıtma Sistemleri	Electric Machines / Solar energy systems, collector and boiler

Name of the Firm	Subject of Activity
Tez Oksijen	Medical and industrial gases / Fire extinguisher
TimayTempo	Metal Goods / Button, gripper, hooks etc.
Ünsal Yemek	Food Industry / Manufacture of convenience food and catering
Yurtseven Giyim Sanayi-Sami Yurtseven	Confection /Outerwear

Table D. 3 List of the firms which are inside Amasya Suluova OIZ

Name of the Firm	Current State	Code of NACE	Subject of Activity
Gülen Yem	N/K	47.29.06	Other retail sale of food in specialised stores
Gülen Yem	Project Stage	47.29.06	Other retail sale of food in specialised stores
Melek Market(Melek yemek fabrikası)	N/K	56.10.08	Restaurants and mobile food service activities
Sigma Müh.	Active	46.90.04	Non-specialised wholesale trade
And Makina	Under Construction		
Sert Kardeşler Gıda	Active	47.22.01	Retail sale of meat and meat products in specialised stores
Yedikır Kuruyemiş Gıda	Active	10.39.06	Other processing and preserving of fruit and vegetables
Ulu Mobilya	Active	47.59.03	Retail sale of furniture, lighting equipment and other household articles in specialised stores
Abalıpğlu Lezita Piliç	Active	10.12.01	Processing and preserving of poultry meat
Sultaş İnşaat	N/K	41-20-02	Construction of residential and non-residential buildings
Sörka Asansör İmalatı	Under Construction		
Agrolino Tarım Gıda	Active	46.31.08	Wholesale of fruit and vegetables
Üner İskele	Under Construction		
Es Çelik Eşya	Under Construction		
Egemen Ayakkabı	Active	15.20	Manufacture of footwear
Ustalar Parke ve Kapı	Under Construction		

Name of the Firm	**Current State**	**Code of NACE**	**Subject of Activity**
Kalkavanlar (Kalkavan Gıda Ürünleri)	Active	10.13.01	Production of meat and poultry meat products
Seferağa Süt	Active	10.51.03	Operation of dairies and cheese making
Pi-Pa Piliç Gıda	Active	46.32.01	Wholesale of meat and meat products
Mirza Giyim	Under Construction	14.13.04	Manufacture of other outerwear
Yüce Makina İmalat	Under Construction		
Mutaflar Makina	N/K	25.12.06	Manufacture of doors and windows of metal
Siğma	N/K		Meat packing
Endotar Tarım	N/K		Seed production and marketing; contracted supply productions for companies

Table D. 4 List of the firms which are inside Amasya Suluova Tdi Besi OIZ

Name of the Firm	**Current State**	**Code of NACE**	**Subject of Activity**
Ekur Et Entegre	Active	10-11-01	Processing and preserving of meat
7450 Baş hayvan kapasiteli besi tesisleri	Active	01.42.09	Raising of other cattle and buffaloes
Ahi Slv.Biyogaz Enerji Üretim	Project Stage		
Sigma Enerji A.Ş. (Sigma Suluova Biyogaz Tesisi)	Active	35-11-19	Production of electricity

Table D. 5 List of the firms which are inside Corum OIZ

Name of the Firm	**Current State**	**Code of NACE**	**Subject of Activity**
İki-El Makine	Active	28.93.06	Manufacture of machinery for food, beverages and tobacco processing
Aksu Makine	Active	28.93.06	Manufacture of machinery for food, beverages and tobacco processing
Akça Palet Orman Ürünleri	Active	16.24.02	Manufacture of wooden containers
Alapala Makine	Active	28.93.06	Manufacture of machinery for food, beverages and tobacco processing
Altan Makine İmalat	Active	28.99.04	Manufacture of other special-purpose machinery n.e.c.
Bilsar Tekstil	Active	14.14.01	Manufacture of underwear
Beğenal Tarım Aletleri	Active	46.61.02	Wholesale of agricultural machinery, equipment and supplies
Cazgır İnşaat Isı Sistemleri	Active	25.29.02	Manufacture of other tanks, reservoirs and containers of metal
Duduoğlu Çelik Döküm	Active	28.41.03	Manufacture of metal forming machinery
Ekmekçioğulları Metal ve Kimya	N/K	20.15.01	Manufacture of fertilisers and nitrogen compounds
Eltes Elektrik Tesisleri	N/K	N/K	Electric and Electronic
Emin Mak. Döküm	N/K	24.51.13	Casting of iron
Erdemli Mak.	N/K	29.10.07	Manufacture of motor vehicles
Göral Tarım Aletleri Makina	Active	28.30.08	Manufacture of agricultural and forestry machinery

Name of the Firm	Current State	Code of NACE	Subject of Activity
Halit Deniz	Active	28.93.06	Manufacture of machinery for food, beverages and tobacco processing
Kristal Şeker	Active	10.81.01	Manufacture of sugar
Sidre Tekstil	N/K	N/K	Textile and leather
Medripo Medikal Ürünleri	N/K	32.50.07	Manufacture of medical and dental instruments and supplies
Orkisan Mermer	N/K	46.73.08	Wholesale of wood, construction materials and sanitaryequipment
Teknik Ateş Ateşe Mukavim Malzemeler	Active	23.32.01	Manufacture of bricks, tiles and construction products, in baked clay
Tez Oksijen	Active	20.11.01	Manufacture of industrial gases
TSE Bölge Müdürlüğü	N/K	N/K	Services
Yağmaksan YAağlılae Makina	Active	25.62.02	Machining
Yılpen Plastik	N/K	N/K	Technical Material-Bench Equipment
Ece Banyo Gereçleri.	Active	23.42.01	Manufacture of ceramic sanitary fixtures
Çorum Palet Orman Ürünleri	N/K	16.23.01	Manufacture of other builders' carpentry and joinery
Çorum Tekstil Ürünleri	Active	23.10.12	Preparation and spinning of textile fibres
Arsan Makina İmalat	Active	24.51.13	Casting of iron
Taç Mak.-Oğuz Taç	Active	28.41.03	Manufacture of metal forming machinery
Selhas Maden Kimya	Active	46.75.01	Wholesale of chemical products
Arzu Özkahriman-Seda Giyim	N/K	N/K	Textile and Leather
Hitit Yalıtım ve Yapı Malzemeleri	Active	22.23.90	Manufacture of builders' ware of plastic
Esse Mak.ve Kalıp	Active	25.62.02	Machining
Gurur Tekstil	Active	14.13.04	Manufacture of other outerwear
Ecm Banyo Gereçleri	N/K	N/K	Bathroom utensils
Mone Medikal	Active	32.50.04	Manufacture of medical and dental instruments and supplies
Çorum Teknik Çelik Döküm Makina	Active	24.52.20	Casting of steel
Mutlu Gömlek Tekstil	Active	14.14.01	Manufacture of underwear
Deniz Yalıtım Kon. Sistemleri	Active	23.64.01	Manufacture of mortars
A.Aksular Gıda	Active	10.72.02	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes
Karadayı Makina.	Active	28.99.04	Manufacture of other special-purpose machinery n.e.c
Yetsan Oto Radyatör Kalorifer	Active	29.32.20	Manufacture of other parts and accessor ies for motor vehicles

Name of the Firm	Current State	Code of NACE	Subject of Activity
Pakpiyer Makina	Active	43.29.03	Other construction installation
Sedat Yılmazer-Akyılmaz Kağıt Ambalaj	Active	17.21.12	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard
Kat-San Oto Rad.	N/K	29.32.20	Manufacture of other parts and accessor ies for motor vehicles
Armor Isı Transfer.	Active	29.32.20	Manufacture of other parts and accessor ies for motor vehicles
Anadolu Grup Enerji Üretim	N/K	N/K	Electric &Electronic
Boyraz Yem Gıda.	Active	10.91.01	Manufacture of prepared feeds for farm animals
Eren Gıda	Active	10.51.03	Operation of dairies and cheese making
Kemal Öz Gıda	Active	10.72.03	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes
Tektaş Prefabrik Beton	Active	23.61.02	Manufacture of concrete products for construction purposes
Tekin Karo	Active	23.61.02	Manufacture of concrete products for construction purposes
Medine Açıkgöz- ADS Döküm Sanayi	N/K		Metal and metal processing
Abdullah Eker - Eker Makina	Active	25.12.06	Manufacture of doors and windows of metal
Çakır Tarım Aletleri Zirai Makina	Active	28.30.14	Manufacture of agricultural and forestry machinery
Erdem Eral	Active	43.99.01	Other specialised construction activities n.e.c.
Başaran Ahşap	Active	16.10.01	Sawmilling and planing of wood
Hitit Makina	Active	28.93.06	Manufacture of machinery for food, beverages and tobacco processing
Poleks Ayakkabı Deri Spor Giyim	Active	N/K	Textile and leather
Orta Anadolu Tarım Gıda	Active	46.21.02	Wholesale of grain, unmanufactured tobacco, seeds and animal feeds
Yıltex Teknik Tekstil Konfeksiyon	Active	14.13.04	Manufacture of other outerwear
Necati Sadıklı-Sadıklı Metal ve Hurdacılık	Active	46.77.01	Wholesale of waste and scrap
Öz-ak Gıda	N/K	N/K	Food
FKK Kimyasal Yapı Elmanları Ambalaj	Active	29.32.20	Packaging-Paper-Stationery /Manufacture of other parts and accessor ies for motor vehicles
Hançerliler Bakır Aliminyum	Active	24.44.04	Copper production

Name of the Firm	Current State	Code of NACE	Subject of Activity
Bilkon Elektronik Otom. Yaz. ve Mün.	Active	27.12.01	Manufacture of electricity distribution and control apparatus
Arar Makina	Active	28.93.06	Manufacture of machinery for food, beverage and tobacco processing
Mutlukal Gıda.	Active	10.72.02	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes
Gentürk Elektromekanik Sis.	Active	27.11.01	Manufacture of electric motors, generators and transformers
Dura Makina	Active	28.93.06	Manufacture of machinery for food, beverages and tobacco processing
Şahin Ticaret-Nizam Şahin	N/K	N/K	Other
Makina ve Enerji Endüstriyel Çözümler Gıda Turizm	Active	28.93.06	Manufacture of machinery for food, beverage and tobacco processing
Anadolu Hitit Gıda	Active	10.73.03	Manufacture of macaroni, noodles, couscous and similar farinaceous products
Yörem Süt Ürn. Gıda	Active	10.51.05	Operation of dairies and cheese making
ISD Proje Danışmanlık Müh. İnş. Turz.	N/K	46.35.01	Others/Wholesale of tobacco products
Altunok Tekstil	Active	14.14.01	Manufacture of underwear
Gazel Değirmencilik	Active	28.93.06	Manufacture of machinery for food, beverages and tobacco processing
Albamar Mermer ve Madencilik	N/K	N/K	Marble and mining
Real 19 Tekstil ve Konfeksiyon	Active	14.14.01	Manufacture of underwear
Ünal Yem	Active	10.91.01	Manufacture of prepared feeds for farm animals
Pir Müh. Makina ve İnşaat	Active	25.62.02	Machining
River İnş. Mak. Gıda Tarm.	Active	52.10.02	Warehousing and storage
Uğur Makina	N/K	N/K	Machinery equipment
Hititler Metal Makina	N/K	25.62.02	Machining
Genesis Teknolojik Ürünler	Active	28.92.03	Manufacture of machineryfor mining, quarrying and construction
Oto Yapı Mak.	N/K	N/K	Other
Doğuş Tekstil Konfeksiyon-Nejdet Dinçay	Active	14.13.04	Manufacture of other outerwear
19 Mobilya Dekorasyon	Active	31.01.03	Manufacture of office and shop furniture
Ahlatçı Metal Rafineri Kuyumculuk	N/K	N/K	Other
Ganik Şekerleme Gıda	N/K	46.36.01	Wholesale of sugar and chocolate and sugar confectionery

Name of the Firm	Current State	Code of NACE	Subject of Activity
Halil Demir-Azık Süt Ürünleri	Active	10.51.05	Operation of dairies and cheese making
Akyollar Deri ve Teks. Mam.	Active	14.19.04	Manufacture of other wearing apparel and accessories
Kuzgun Makina İml. Müh.	Active	28.92.03	Manufacture of machineryfor mining, quarrying and construction
Ömer Faruk Karakuş- Karakuş Kuruyemiş	Active	47.21.05	Retail sale of fruit and vegetables in specialised stores
Orhan Tiraki- Değişim Yapı Market	N/K	25.11.06	Manufacture of metal structures and parts of structures
Osman İzgi	N/K	N/K	Food
Karabacaklar Oluklu Mukavva Kutu	Active	17.21.12	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard
Tuğra Un İrmik Yem	Active	28.93.06	Manufacture of machinery for food, beverages and tobacco processing
Adnan Tevfik Kaşıkçı-Adnan Kaşıkçı Makina İmalatı	Active	28.93.06	Manufacture of machinery for food, beverages and tobacco processing
Özürgen Makina Rulman	Active	28.41.03	Manufacture of metal forming machinery
Başaran Kardeşler Orman Ürn.İnş.	Active	16.23.01	Manufacture of other builders' carpentry and joinery
Ar Eelektrik Elektronik Enerji Akaryakıt Gaz	Active	41.20.02	Construction of residential and non-residential buildings
Baytom Makina	Active	28.99.90	Manufacture of other special-purpose machinery n.e.c.
Başer Lazer Metal	Active	25.62.01	Machining
Ser Döküm Mak.	Active	24.52.20	Casting of steel
MS Makina Gıda	N/K	N/K	Machinery Equipment
FWG Tarım	Active	46.21.02	Wholesale of grain, unmanufactured tobacco, seeds and animal feeds /Machinery Equipment
Erdal Özkan Makina	Active	25.62.02	Machining
Arsan Döküm	Active	24.51.13	Casting of iron
Era Özel Civata ve Mak.	Active	25.94.02	Manufacture of fasteners and screw machine products
3F Hazır Giyim Tekstil	Active	14.13.04	Manufacture of other outerwear
Başaranlar Makina	Active	28.41.03	Manufacture of metal forming machinery
Özçelik Yakupoğulları	Active	46.73.06	Wholesale of wood, construction materials and sanitaryequipment
İbrahim Balaban-Balaban Makina	Active	41.20.01	Construction of residential and non-residential buildings

Name of the Firm	**Current State**	**Code of NACE**	**Subject of Activity**
Ak Basım ve Ofset	Active	17.23.04	Manufacture of paper stationery
LSY Ayakkabı	Active	15.20.17	Manufacture of footwear
SEM Tekstil-Erdal Güvenli	Active	14.13.04	Manufacture of other outerwear/ Food
Ertuğrul Özel Elit Makina			Machinery Equipment
Saray İnşaat Makina Malz.	Active	52.10.02	Warehousing and storage
Oba Paslanmaz Met.ve Malz.	N/K	N/K	Other
Çorum Teknik Çelik Döküm Makina	Active	24.52.20	Casting of steel
Ünal Yem	Active	10.91.01	Manufacture of prepared feeds for farm animals
Çorum Teknik Çelik Döküm Makina İnşaat	Active	24.52.20	Casting of steel
Selhas Maden Kimya	Active	46.75.01	Wholesale of chemical products
Bilsar Tekstil	Active	14.14.01	Manufacture of underwear
Yetsan Oto Radyatör Kalorifer	Active	29.32.20	Manufacture of other parts and accessor ies for motor vehicles
Mone Medikal	Active	32.50.04	Manufacture of medical and dental instruments and supplies
Hayat Tıbbi Aletler ve Oluklu Mukavva	N/K	N/K	Packaging-Paper-Stationery
Aalapala Mak.ve Gıda	Active	28.93.06	Manufacture of machinery for food, beverages and tobacco processing
Arslan Alkr-Özkur Makina	Active	28.22.13	Manufacture of lifting and handling equipment
Naturoil Gıda ve Kimya	N/K	N/K	Other/Vegetable Oil Production and Sales
Hitit Terra Toprak	Active	23.41.04	Manufacture of ceramic household and ornamental articles
Nasip Unlu Mamüller Gıda	Active	10.71.02	Manufacture of bread; manufacture of fresh pastrygoods and cakes

Table D. 6 List of the firms which are inside Samsun Gıda İhtisas OIZ-Tekkeköy

Name of the Firm	**Code of NACE**	**Subject of Activity**
Takış Gıda	10.51.05	Operation of dairies and cheese making
Filiz Şekerleme Gıda.	10.39.07	Other processing and preserving of fruit and vegetables
Mutena Gıda Tar Hayvancılık	56.10.08	Restaurants and mobile food service activities
Adeka İlaç	21.20.01	Manufacture of pharmaceutical preparations
Samsun Yem	10.91.01	Manufacture of prepared feeds for farm animals
Ulusoy Un	10.61.02	Manufacture of grain mill products
Adeka İlaç	21.20.01	Manufacture of pharmaceutical preparations
Matlı Yem	N/K	
Unsan Un	10.61.02	Manufacture of grain mill products
Zaimoğlu Gıda	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Temel Çamlıdağ Gıda	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Bora Soğ. Hav. Dep. Gıda	10.20.03	Processing and preserving of fish, crustaceans and molluscs
Akkurt Gıda Tarım	46.31.04	Wholesale of fruit and vegetables
Samsun Gıda	52.29.06	Other transportation support activities
Seyhanlar Gıda.	10.82.04	Manufacture of cocoa, chocolate and sugar confectionery
Gifo Gıda Paz.	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Botafarma Sağlık Ürünleri	21.20.01	Manufacture of pharmaceutical preparations
Erim İlaç Koz. Ve Gıda Ürünleri	10.83.03	Processing of tea and coffee
Anasüt Süt ve Süt Ürnleri	10.51.03	Operation of dairies and cheese making
Zaimoğlu Gıda	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Elvan Baharat Gıda	10.84.01	Manufacture of condiments and seasonings
Karadeniz Süt ve Süt Ürünleri	10.51.05	Operation of dairies and cheese making

Table D. 7 List of the firms which are inside Samsun Kavak OIZ

Name of the firms	**Code of NACE**	**Subject of Activity**
Güven Isı	N/K	Manifacture of solar energy systems
Meşale Çay Kazan	31.01.03	Manufacture of office and shop furniture
Sam Kek Gıda	N/K	Food
Ekin Pen PVC	N/K	Door, window and modular furniture production and steel door manufacturing
Keprosan	22.23.08	Manufacture of builders' ware of plastic
Usta Makine	N/K	Manufacture of combine harvester
Alemdar Soğutma	28.25.01	Manufacture of non-domestic cooling and ventilation equipment
Çetaş Cam	23.11. 01	Manufacture of flat glass
Okan Cam	N/K	Glass cutting and processing
Atölye Yapı Elemanları	41.20.02	Construction of residential and non-residential buildings
Kuzey Kardelen Isı	N/K	Manufacture of Heater, stove
Çetinkaya İnşaat	N/K	
Şelale Endüstriyel	27.51.04	Manufacture of electric domestic appliances
Afacan Plastik	22.29.90	Manufacture of other plastic products
Akkaya Makina	28.99.90	Manufacture of other special-purpose machinery n.e.c.
Kurıştaş	N/K	Concrete parquet modular locked stone production
Tekno End.	23.63.01	Manufacture of ready-mixed concrete
Agan Yapı	43.33.01	Floor and wall covering
Goksaran İnşaat Malzemeleri	N/K	Production of internal and exterior Wall coating materials
Keprosan Profil	22.23.08	Manufacture of builders' ware of plastic
Atolye Yapı Elemanları	41.20.02	Construction of residential and non-residential buildings
Ekoterm Strafor	23-99	Manufacture of other non-metallic mineral products n.e.c.
Turuncu Gıda	46.17.02	Agents involved in the sale of food, beverages and tobacco
Okyanus Grup		Dried fruits and vagetables
Murzı Oğlu Mimarlık	24.44.03	Copper production
Yalım Yapı	N/K	Production of prefabricated building elements
Muteks-Mustafa Mutlu Tekstil	N/K	Knitwear and textile
Weber Yapı Kimyasalları	N/K	Construction chemicals
Lufer Metal Sanayi	27.51.08	Manufacture of electric domestic appliances
Beşer Koll.	N/K	Production of polypropylene plastic holdall

Table D. 8 List of the firms which are inside Samsun Merkez OIZ

Name of the Firm	**Current State**	**Code of NACE**	**Subject of Activity**
Özfen Makine	Active	28.92.01	Manufacture of machinery for mining, quarrying and construction
Samasa Samsun Ağaç Sanayi	Active	16.10.01	Sawmilling and planing of wood
Ahenk Çikolata Helva Şekerleme Gıda	Active	10.82.04	Manufacture of cocoa, chocolate and sugar confectionery
Ahmet-Fahri Apaydın	Active	N/K	Metalware industry
Ak Metal	Active	24.42.18	Aluminium production
Anadolu Isı İnşaat	Active	28.21.10	Manufacture of ovens, furnaces and furnace burners
Ar-çelik Raf	Active	25.12.06	Manufacture of doors and windows of metal
Arısan Samsun Akın Rejenere Kauçuk ve Lastik Ayakkabı	Active	N/K	Regenerated Rubber, Rubber-Plastic Shoes
As Çelik Döküm İşleme	Active	24.52.20	Casting of steel
Aygun Cerrahi Aletler	Active	32.50.10	Manufacture of medical and dental instruments and supplies
Aysam Ortopedi ve Tıbbi Aletler	Active	46.46.01	Wholesale of pharmaceutical goods
Bahadır Tbbi Alet Cihaz	Active	32.50.02	Manufacture of medical and dental instruments and supplies
Borsan Kablo Elektrik Aydınlatma	Active	27.32.03	Manufacture of other electronic and electric wires and cables
Bülbüloğlu Oksijen Asetilen Tıbbi Gazlar	Active	20.11.01	Manufacture of industrial gases
Çakıroğlu Gıda-Tarım Ürinleri, Yem	Active	46.21.02	Wholesale of grain, unmanufactured tobacco, seeds and animal feeds
Campor Yapı Malzemeleri	Active	22.23.03	Manufacture of builders' ware of plastic
Camvit Seramik	Active	23.42.01	Manufacture of ceramic sanitary fixtures
Ceykan Endüstriyel Mutfak Eşyaları Ambalaj Malzemeleri	Active	17.21.12	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard
Doğuş Okul Yayınları	Active	31.01.01	Manufacture of office and shop furniture
Domak Pompa ve Makina	Active	28.13.02	Manufacture of other pumps and compressors
Dundar Elektromekanik	Active	N/K	Electrical machinery industry

Name of the Firm	Current State	Code of NACE	Subject of Activity
Durapay Mobilya Tekstil	Active	N/K	Furniture, bed
Elektrosan Elektrobakır	Active	24.44.03	Copper production
Emek lastik ve Plastik Ayakkabı	Active	22.19.05	Manufacture of other rubber products
Enkay Aluminyum Levha-Mutfak Eşyaları	Active	25.99.01	Manufacture of other fabricated metal products n.e.c.
Erser Makina	Active	25.62.02	Machining
Fethi Yılmaz Kereste	Active	N/K	Board(timber)
Filiz Şekerleme	Active	N/K	Halva, jam(food industry)
Goze Hurdacılık Atık Toplama ve Geri Dönüşüm	Active	38.32.02	Recoveryof sorted materials
Gübre Fabrikaları	Active	20.15.01	Manufacture of fertilisers and nitrogen compounds
Güneyoğlu Elektrik	Active	27.12.01	Manufacture of electricity distribution and control apparatus
Güngörsün Gıda	Active	N/K	Dried nuts and fruits
Hadde Metal	Active	24-44	Copper production
Halısa Halı	Active	31.03.01	Manufacture of mattresses
Haluk Hüseyin Darı (Gelişim Tekstil Mobilya)	Active	46.16.04	Agents involved in the sale of textiles, clothing, fur, footwear and leather goods
Hamdi Topal-Samsun Kazan Sanayi	Active	25.21.11	Manufacture of central heating radiators and boilers
Has Tel	Active	25.93.03	Manufacture of wire products, chain and springs
Kar-Ker Kereste	Active	46.73.01	Wholesale of wood, construction materials and sanitaryequipment
KAR-DAĞ Karedeniz Gıda	Active	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Kefeli Ofset Matbaacılık Oluklu Mukavva	Active	17.21.12	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard
Kestek Isı Cihazları Emaye	Active	27.52.02	Manufacture of non-electric domestic appliances
Kromteks Endüstriyel Makina ve Tekstil	Active	28.92.03	Manufacture of machineryfor mining, quarrying and construction
Kurplas PVC Pencere Kapı Sistemleri	Active	22.23.08	Manufacture of builders' ware of plastic

Name of the Firm	Current State	Code of NACE	Subject of Activity
Kutlu Kereste	Active	47.52.10	Retail sale of hardware, paints and glass in specialised stores
MSY Su Filtreleri	Active	28.29.04	Manufacture of other general-purpose machinery n.e.c.
Özdemir Kardeşler Dingil Danper Imalatı	Active	23.19.01	Manufacture and processing of other glass, including technical glassware
Öziçler Plastik Ürünleri	Active	N/K	Plastic bag, rubbish bag
Pınar-Al Kimya Otomotiv	Active	19.20.16	Manufacture of refined petroleum products
Poelsan Plastik	Active	22.21.03	Manufacture of plastic plates, sheets, tubes and profiles
Profal Aluminyum Metal	Active	24.42.21	Aluminium production
Resman Cam PVC Aluminyum	Active	23.12.03	Shaping and processing of flat glass
Sampa Otomativ	Active	29.32.20	Manufacture of other parts and accessor ies for motor vehicles
Samsun Makina	Active	24.51.13	Casting of iron
Samsun Mutfak, Soğutma, Isıtma, Havalandırma	Active	28.25.01	Manufacture of non-domestic cooling and ventilation equipment
Samsun Segman ve Gömlek	Active	28.11.10	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
Samsun Yem	Active	10.91.01	Manufacture of prepared feeds for farm animals
Samsun Yurt Savunma	Active	25.40.01	Manufacture of weapons and ammunition
Saraçoğlu Kuruyemişleri ve Gıda	Active	10.39.02	Other processing and preserving of fruit and vegetables
Semolina Mısır İrmiği Gıda	Active	10-61-06	Manufacture of grain mill products
Semsan Pompa Makine	Active	28.29.10	Manufacture of other general-purpose machinery n.e.c.
Seral Pamuk Elyaf	Active	46.21.06	Cotton, fiber/Wholesale of grain, unmanufactured tobacco, seeds and animal feeds
SNS Isı Sistemleri	Active	28.21.10	Manufacture of ovens, furnaces and furnace burners
Star Cam Mozaikleri	Active	23.31.01	Manufacture of ceramic tiles and flags
Sultans International Gıda	Active	N/K	Delight, confectionery(food industry)

Name of the Firm	Current State	Code of NACE	Subject of Activity
Uslu Demir Çelik	Active	24.10.02	Manufacture of basic iron and steel and of ferro-alloys
Yeşilyurt Demir Çelik	Active	24.10.03	Manufacture of basic iron and steel and of ferro-alloys
Yıldız Entegre Ağaç	Active	20.52.05	Manufacture of glues
Yıldızlar Otomotiv	Active	22.21.03	Manufacture of plastic plates, sheets, tubes and profiles
Ali Kutlu	Under Construction	N/K	
Cam-Por Yapı	Under Construction	22.23.03	Manufacture of builders' ware of plastic
Enver Kahvecioğlu	Under Construction	N/K	
İzcan Gıda	Under Construction	N/K	Icecream
Kar-Ker	Under Construction	46.73.01	Wholesale of wood, construction materials and sanitaryequipment
Recepoğlu Gıda	Under Construction	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Sampa Otomativ	Under Construction	29.32.20	Manufacture of other parts and accessor ies for motor vehicles
Samsun Bakır Boru	Under Construction	24.44.01	Copper production
Yeşilyurt Elektrik Enerji	Under Construction	35.11.19	Production of electricity

Table D. 9 List of the firms which are inside Tokat Merkez OIZ

Name of the Firm	Current State	Code of NACE	Subject of Activity
GIDA Çopuroğlu Gıda	Active	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Espa Gıda	Active	46.36.03	Wholesale of sugar and chocolate and sugar confectionery
Tokat Erenler Gıda	Active	47.11.01	Retail sale in non-specialised stores with food, beverages or tobacco predominating
Mert ve Merve Gıda	Active	46.17.01	Agents involved in the sale of food, beverages and tobacco
Tokat Mepesan A.	Active	N/K	Food
Tokat Yeşilırmak Ata Ekmek	Active	N/K	Food
Aziz– Ayhan – Mustafa Karataş	Active	N/K	Food
Kışla Unlu Mamülleri	Active	56.10.09	Restaurants and mobile food service activities
Bera Gıda	Active	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Fatih Ekmek	Active	N/K	Food
Mehmet Şanlı – Akın Ekmek Fabrikası	Active	47.24.01	Retail sale of bread, cakes, flour confectionery and sugar confectionery in specialised stores
Aher Gıda	Active	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Baki Nadir	Active	N/K	Food
Tokat Çiğdem Ekm	Active	N/K	Food
Alpay Unlu Mamülleri	Active	47.24.01	Retail sale of bread, cakes, flour confectionery and sugar confectionery in specialised stores
Galip ARAZ Yemek Gıda	Active	10.85.01	Manufacture of prepared meals and dishes
Pipa Piliç	Active	N/K	Food
Tokat Madenoğlu	Active	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Tokat Edeler Gıda	Active	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Meka Gıda	Active	47.11.01	Retail sale in non-specialised stores with food, beverages or tobacco predominating

Name of the Firm	Current State	Code of NACE	Subject of Activity
Tokat Topçam Gıda	Active	10.81.01	Manufacture of sugar
Oktay Kızılkaya	Active	46.17.01	Agents involved in the sale of food, beverages and tobacco
Tavpa Tavukçuluk	Active	N/K	Food
Koplu Baharat	Active	N/K	Food
Özseven Gıda	Active	46.39.02	Non-specialised wholesale of food, beverages and tobacco
Toksütsan Gıda	Active	10.51.05	Operation of dairies and cheese making
Nihat Değirmenci	Active	N/K	Food
Özgenç Komisyon	Active	N/K	Food
Aşıkbaba Et ve Et ürünleri	Active	10.13.02	Production of meat and poultry meat products
SNS Gıda Kozmetik	Active	10.83.03	Processing of tea and coffee
Gökçe İnşaat Tarım Gıda	Active	46.31.09	Wholesale of fruit and vegetables
Hasözgen Tekstil	Active	14.19.02	Manufacture of other wearing apparel and accessories
Gür Aksesuar	Active	13.96.03	Manufacture of other technical and industrial textiles
Yüce Tekstil	Active	14.14.01	Manufacture of underwear
Dimteks Tekstil	Active	14.13.04	Manufacture of other outerwear
CRS Denim	Active	14.13.04	Manufacture of other outerwear
Sabri Gündüzlü	Active	13.99.06	Manufacture of other textiles n.e.c.
Kardelen Ayakkabı Tekstil	Active	14.12.07	Manufacture of workwear
Eroğlu Ambalaj	Active	46.73.01	Wholesale of wood, construction materials and sanitaryequipment
Tokat Şahinler	Active	46.73.01	Wholesale of wood, construction materials and sanitaryequipment
Turanlar Kereste	Active	46.73.01	Wholesale of wood, construction materials and sanitaryequipment
Nur Akü	Active	N/K	Chemical
Selahattin Ulusu	Active	N/K	Chemical
Alke Sağlık Ürünleri	Active	21.20.01	Manufacture of pharmaceutical preparations
SNS Gıda Kozmetik	Active	N/K	pharmaceutics
Gummisan Lastik	Active	N/K	Rubber and plastic
Güvenal Metal	Active	25.11.06	Manufacture of metal structures and parts of structures
Al-Sa Profil	Active	22.23.08	Manufacture of builders’ ware of plastic
Tokat Cemka İnşaat	Active	41.20.02	Construction of residential and non-residential buildings

Name of the Firm	Current State	Code of NACE	Subject of Activity
Ady Tarım Turan Adıyaman	Active	N/K	Base metal industry
Hasan – Hüseyin Yılmaz	Active	N/K	Base metal industry
Şener Elektrik	Active	27.12.01	Manufacture of electricity distribution and control apparatus
A.Turan Ayyıldız	Active	N/K	Agricultural instruments
Keskin Tarım	Active	28.30.14	Manufacture of agricultural and forestry machinery
Şahin Tarım	Active	N/K	Agricultural instruments
Tokat Nova İnşaat	Active	31.09.04	Manufacture of other furniture
Avrupa Mobilya	Active	16.23.01	Manufacture of other builders' carpentry and joinery
Turan Güneş	Active	31.01.01	Manufacture of office and shop furniture
Diva Ahşap	Active	16.23.01	Manufacture of other builders' carpentry and joinery
Fuat İbiş	Active	47.19.01	Other retail sale in non-specialised stores
Bektaşlar Mobilya	Active	16.23.90	Manufacture of other builders' carpentry and joinery
Safir Mobilya	Active	31.09.04	Manufacture of other furniture
Seçilmiş Mobilya	Active	31.02.01	Manufacture of kitchen furniture
Ahmet Öztürk	Active	31.02.01	Manufacture of kitchen furniture
As Yıldız Gıda hayv.	Active	22.23.08	Manufacture of builders' ware of plastic
Altunek PVC Cam Sistemleri	Active	22.23.06	Manufacture of builders' ware of plastic
Pencrm PVC Cam	Active	22.23.08	Manufacture of builders' ware of plastic
Şanlı Alüminyum	Active	N/K	Plastic/PVC
Tokat Isıcam	Active	23-11	Manufacture of flat glass
Cevat Atılgan	Active	N/K	Marble
Ali Balcı	Active	N/K	Marble
Vural Elektrik Sanayi	Active	N/K	Agricultural instruments and machinery
Yetersa Makina, Plastik	Active	22.22.43	Manufacture of plastic packinggoods
Atılgan Plastik ambalaj	Active	N/K	Plastic/PVC
Er-pa Tarım	Active	10-91/45.20.02	Manufacture of prepared feeds for farm animals/ Maintenance and repair of motor vehicles
Aytem İnşaat	Active	23.61.02 /41.20.02	Manufacture of concrete products for construction purposes/Construction of residential and non-residential buildings
Özgel Ticaret	Active	22.29.90	Manufacture of other plastic products

Name of the Firm	Current State	Code of NACE	Subject of Activity
Tokat Altuntaş Ayakkabı	Active	N/K	Shoes
M.Ali Akman	Active	N/K	Advertising board
Kuzey Fittings	Active	28.14.01	Manufacture of other taps and valves
Yalçın Isı Sistemleri	Active	28.21.10	Manufacture of ovens, furnaces and furnace burners
Mustafa Balcı	Active	N/K	Glass
Damızlık Sığır Yetiştiriciler Birliği / Maksutuoğlu Tekstil	Active /as a tenant	N/K	Food
Algida Gıda / Mustafa Polat	Active /as a tenant	N/K	Food
Enes Gıda / Ahmet Akar	Active /as a tenant	N/K	Food
Kılıçarslan Gıda / Necmi Ayhan	Active /as a tenant	N/K	Food
A-101 / Galip Akgün Akgün İnşaat Müh.	Active /as a tenant	N/K	Food
Mufi Gıda	Active /as a tenant	10-39	Other processing and preserving of fruit and vegetables
Ferhat Çeyiz / Gür Aksesuar	Active /as a tenant	13.96.03	Manufacture of other technical and industrial textiles
ARJ Konfeksiyon / Göltaş Konfeksiyon	Active /as a tenant	14.13.04	Manufacture of other outerwear
Umut Tekstil / Hasözgen Tekstil	Active /as a tenant	14.19.02	Manufacture of other wearing apparel and accessories
Relaks Tekstil / Tokat Akın Mobilya	Active /as a tenant	N/K	Wearing apparel
Yıldız Tekstil / Salih Kesici Tekstil	Active /as a tenant	46.41.01	Wholesale of textiles
PGS Tekstil / Romaş Mobilya	Active /as a tenant	N/K	Wearing apparel
Ülkü Tekstil / Yüce Tekstil	Active /as a tenant	14.14.01	Manufacture of underwear
Cemre Tekstil / Tokkal Petrokimya Gıda	Active /as a tenant	N/K	Wearing apparel
Trelleborg / Se-Na Tekstil	Active /as a tenant	28.29.10	Manufacture of other general-purpose machinery n.e.c.
ESS Çelik / Deniz Tarım	Active /as a tenant	25.11.06	Manufacture of metal structures and parts of structures
Anadolu Sadem / Betül ALKUMRU Öztuğ İnşaat	Active /as a tenant	N/K	Base metal
Asya Gıda / Cansu Plastik San.	Active /as a tenant	N/K	Advertisement products

Name of the Firm	Current State	Code of NACE	Subject of Activity
Hasan Özcan / Üncü Baharat	Active /as a tenant	N/K	Isolation
Yancı Geri Dönüşüm / Sentafe Tekstil	Active /as a tenant	14.13.04	Manufacture of other outerwear
Ece Dekor / Ahmet Arısoy Kral mobilya	Active /as a tenant	N/K	Glass industry
Oskar Mimarlık / Sabri Gündüzlü	Active /as a tenant	13.99.06	Manufacture of other textiles n.e.c.
Türk Telekom	Active/Official Body	N/K	Telecominication
İŞGEM	Active/Official Body	N/K	Other
Tuvtürk	Active/Official Body	N/K	Vehicle inspection
Durmaz Teknoloji	Active/education institution	85.31.14	General secondary education
Gümüşay	Active/education institution	85.31.14	General secondary education
Umut Gıda	Under Construction	N/K	Food
Merve Gıda Paz. H. Ahmet ÖZEN	Under Construction	N/K	Food
Emin GENÇ	Under Construction	N/K	Base metal industry
İbrahim AYBASTI	Under Construction	25.62.02	Machining
Hasan ÖZCAN	Under Construction	22.21.03	Manufacture of plastic plates, sheets, tubes and profiles
Türkeller Metal	Under Construction	33.11.90	Repair of fabricated metal products
Sarıbaşlar PVC	Under Construction	N/K	Plastic/PVC
Alparslan Yancı	Under Construction	N/K	Recycling

Table D. 10 List of the firms which are inside Tokat Erbaa OIZ

Name of the Firm	**Current State**	**Subject of Activity**
Dumanlar Konfeksiyon	Active	Textile
Erbaa Şentürk Tekstil	Active	Textile
Erbaa Birlik Ekmek, Gıda, Turizm, Tekstil, Kereste	Active	Food-bread production
Sefa Tekstil	Active	Textile
Tiryakioğulları Tekstil	Active	Textile
Libra Tekstil	Active	Textile
Anayurt Ambalaj	Active	N/K
Dev Yapı Ürünleri	Under Construction	
Erbaa Eryapı – Ramazan ER	Under Construction	
Helka İnş.Enr.Ma.Mi.Mü.Müt.Müş.Tar.ve Hay.Tur	Under Construction	
Köklü Plastik, İnşaat, Tekstil, Gıda Maddeleri	Active	N/K
Zöhra YILMAZ Tekstil - Zöhra YILMAZ	Active	Textile
Aster Tekstil	Active	Textile-outfit
Aksel Rene Möller	Active	N/K
Kaizen Tekstil	Active	Textile
Mistat Gıda	Active	N/K
Akarteks Tekstil	Active	Textile
Erdonat Tekstil ve Giyim.	Under Construction	Textile
Kardem Tekstil	Under Construction	Textile

Table D. 11 List of the firms which are inside Tokat Niksar OIZ

Name of the Firm	**Current State**	**Code of NACE**	**Subject of Activity**
Özumut Tekstil	Under Construction	N/K	Textile
CBF Tekstil	Under Construction	14.13.04	Manufacture of other outerwear
KV Gıda	Active	N/K	Food
Niksar Öz-Bağ Tarım Ürünleri Gıda	Active	10.39.03	Other processing and preserving of fruit and vegetables

Table D. 12 List of the firms which are inside Tokat Turhal OIZ

Name of the Firm	Current State	Code of NACE	Subject of Activity
Mensace Mermer Madencilik	Active	08.11.01	Quarrying of ornamental and building stone, limestone, gypsum, chalk and slate
Dörtler Kablo	Active	27.32.03	Manufacture of other electronic and electric wires and cables
Öz Apsa Madencilik	N/K	46.72.02	Wholesale of metals and metal ores
Akar Un	N/K	10.41.01	Manufacture of oils and fats
Yalçın Karabina Xanadu Travertine	N/K	23.70.01	Cutting, shaping and finishing of stone
Turhal Eky Tekstil	N/K	14.19.08	Manufacture of other wearing apparel and accessories
TET Giyim	N/K	14.13.04	Manufacture of other outerwear
Mensace Mermer Madencilik	N/K	08.11.01	Quarrying of ornamental and building stone, limestone, gypsum, chalk and slate
Kazova Gıda Tarım, Turizm ve İnşaat	Under Construction	10.89.06	Manufacture of other food products n.e.c.

Table D. 13 List of the firms which are inside Tokat Zile OIZ

Name of the Firm	**Current State**	**Subject of Activity**
Zela Tekstil	Active	Ready made-cloating-Outfit
Kral Orman Ürünleri ve İnşaat Malzemeleri	N/K	Forestry Products
Aktaşlar Kereste Nakliye	N/K	Forestry Products
Kutsan Orman Ürünleri	N/K	Forestry Products

APPENDIX E - Inventory Information of Small Industrial Sites in Yeşilırmak Basin

Table E. 1 Inventory Information of Small Industrial Sites in Yeşilırmak Basin

GIS ID	**Name of the SIS**	**Province**	**District**	**Lat.**	**Long.**
KSS-1	Amasya SIS (1st Part)	Amasya	Merkez	40,56379	35,78992
KSS-2	Amasya SIS (2nd Part)	Amasya	Merkez	40,5623	35,79184
KSS-3	Goynucek SIS	Amasya	Goynucek	40,40318	35,53349
KSS-4	Gumushacikoy SIS	Amasya	Gumushacikoy	40,8738	35,24053
KSS-5	Merzifon SIS	Amasya	Merzifon	40,86441	35,46693
KSS-6	Merzifon 100. Yil SIS	Amasya	Merzifon	40,86006	35,46441
KSS-7	Suluova SIS	Amasya	Suluova	40,82103	35,63832
KSS-8	Tasova SIS	Amasya	Tasova	40,75426	36,33367
KSS-9	Corum SIS	Corum	Merkez	40,52349	34,94164
KSS-10	Corum SIS	Corum	Alaca	40,18569	34,8305
KSS-11	Erzincan Refahiye SIS	Erzincan	Refahiye	39,9039	38,78315
KSS-12	Kelkit SIS	Gumushane	Kelkit	40,13786	39,43672
KSS-13	S.Karahisar SIS	Giresun	Sebinkarahisar	40,29764	38,43173
KSS-14	Gulsan Industrial Site	Samsun	Canik	41,27445	36,3543
KSS-15	Samsun I. SIS	Samsun	Canik	41,27527	36,35446
KSS-16	Carsamba Industrial Site	Samsun	Carsamba	41,20999	36,6949
KSS-17	Havza Industrial Site	Samsun	Havza	40,97827	35,68492
KSS-18	Yirmibes Mayis SIS	Samsun	Havza	40,98521	35,65921
KSS-19	Ladik Industrial Site	Samsun	Ladik	40,92396	35,89699
KSS-20	Ondokuz Mayis SIS	Samsun	Tekkekoy	41,2247	36,44947
KSS-21	Ornek Industrial Site	Samsun	Tekkekoy	41,2436	36,4098
KSS-22	Ilkadim Industrial Site	Samsun	Tekkekoy	41,2374	36,41222
KSS-23	Terme Industrial Site	Samsun	Terme	41,20849	36,99175
KSS-24	Tokat SIS	Tokat	Merkez	40,33469	36,54376
KSS-26	Akdagmadeni SIS	Yozgat	Akdagmadeni	39,6558	35,82726
KSS-27	Cekerek SIS	Yozgat	Cekerek	40,06226	35,51443
KSS-28	Tokat SIS	Tokat	Erbaa	40,67971	36,54002
KSS-29	Tokat SIS	Tokat	Niksar	40,5787	36,9229
KSS-30	Tokat SIS	Tokat	Resadiye	40,39925	37,28996
KSS-31	Sorgun Yesilova SIS	Yozgat	Sorgun	39,812	35,15193
KSS-32	Tokat SIS	Tokat	Turhal	40,37863	36,09421
KSS-33	Tokat SIS	Tokat	Zile	40,29089	35,87925

APPENDIX F - Stations of Seven Monitoring Periods, Indication of Whether They Are Active

Table F. 1 Stations of Seven Monitoring Periods, Indication of Whether They Are Active

Station ID	1st period	2nd period	3rd period	4th period	5th period	6th period	7th period
Station-1							
Station -2							
Station -3							
Station -4							
Station -5							
Station -6							
Station -7							
Station -8							
Station -9							
Station -10							
Station -11							
Station -12							
Station -13							
Station -14							
Station -15							
Station -16							
Station -17							
Station -18							
Station -19							
Station -20							
Station -21							
Station -22							
Station -23							
Station -24							

Station -25							
Station -26							
Station -27							
Station -28							
Station -29							
Station -30							
Station -31							
Station -32							
Station -33							
Station -34							
Station -35							
Station -36							
Station -37							
Station -38							
Station -39							
Station -40							
Station -41							
Station -42							
Station -43							
Station-44*							
Station-45							
Station-46*							
Station-47							
Station-48							
Station-49*							
Station-50*							
Station-51*							
Station-52*							
Station-53*							
Station-54*							
Station-55*							

Station-56*							
Station-57*							
Station-58							
Station-59							
Station-60							
Station-61							
Station-62							
Station-63*							
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Station-68*							
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Station-77							
Station-78							
Station-79							
Station-80							
Station-81							
Station-82							
Station-83							
Station-84							
Station-85							
Station-86							

213

Station-87							
Station-88							
Station-89							
Station-90							
Station-91							
Station-92							
Station-93							
Station-94							
Station-95							
Station-96*							
Station-97							
Station-98*							
Station-99							
Station-100							
Station-101*							
Station-102							
Station-103							
Station-104							
Station-105							
Station-106							
Station-107							
Station-108							
Station-109							
Station-110*							
Station-111*							
Station-112*							
Station-113*							
Station-114							
Station-115*							
Station-116							
Station-117*							

Station-118							
Station-119*							
Station-120							
Station-121*							
Station-122							
Station-123							
Station-124							
Station-125							
Station-126							
Station-127							
Station-128 A							
Station-128 B							
Station-129							
Station-130*							
Station-131							
Station-132*							
Station-133							
Station-134*							
Station-135							
Station-136							

Explanation	
	: No measurement result
	: Measurement exist
*	: Cancelled station

APPENDIX G -Sampling Methodology

Table G. 1Storage conditions and quantities of Sampling (TUBITAK Research Project 115Y013, 2018)

Type of Sampling Bottle	**Bottle Volume**	**Bottle Number**	**Protection Measures**	**Monitored Parameter/s**	**Delivery Period**	**Exlusive Notes**
Dark glass	2 L	1	For 1000 mL, 0.1 g of sodium thiosulfate should be added and stored at 4 ° C.	PAH, Pesticide, phthalate	7 days	Teflon lid should be used. The container should not agitate with the sample. Bottle mouth must be tightly closed, and fully loaded.
Dark glass	2 L	1	For 1000 mL, 0.1 g of sodium thiosulfate should be added and stored at 4 ° C, pH should between 5-7.5.	PCB, dioxin/furan, PBDE analysis	7 days	Teflon lid should be used. The container should not agitated with the sample. Bottle mouth must be tightly closed, and not fully loaded.
Dark glass	1 L	1	For 1000 mL, 0.1 g of sodium thiosulfate should be added, stored at 4 ° C, acidified with H2SO4 to pH <4.	Phenole analysis	7 days	Teflon lid should be used. The container should not agitated with the sample. Bottle mouth must be tightly closed, and not fully loaded.
Dark glass	250 mL	1	For 1000 mL, 0.1 g of sodium thiosulfate should be added, acidified with H2SO4 to having pH <2.	VOC analysis	7 days	Teflon lid should be used. It should be sampled is the way that there is no space left for air.
Dark glass	1 L	1	Acidified with H2SO4 and HCl to having pH <2.	Total Petroleum Hydrocarbons	-	-

Type of Sampling Bottle	Bottle Volume	Bottle Number	Protection Measures	Monitored Parameter/s	Delivery Period	Exlusive Notes
Plastic bottle	100 mL	1	NaOH should be added in order to be pH = 12.	Free cyanide	-	-
Containers and shields required for conventional parameters						
Plastic bottle	250 mL	1	Acidified with Nitric Acid to having pH <2	Metals	-	-
Plastic bottle	250 mL	1	Freezed	Spare sample	-	-
Plastic bottle	500 mL	2	Freezed	SS, nutrient, TOC	-	-

Table G. 2 The analyzes and analysis methods performed on the sampling sites (TUBITAK Research Project 115Y013, 2018)

Parameter	Type of Sample	Analysis Method
Flow rate	Instant	Measurement of the multilinear speed
Temperature	Instant	pH meter
pH	Instant	pH meter
Dissolved Oxygen	Instant	Dissolved Oxygen meter
Conductivity	Instant	Conductometer
TDS	Instant	Conductometer

Table G. 3 Analysis methods, used devices and detection limits (LOD) for conventional parameters

Name of the parameter	Analysis method	Device	LOD (mg/L)
COD	SM 5220 B open reflux	COD Heater Set, Automatic Titration Device	3
NH4-N	S.M. 4500-NH3 H:2012	Autoanalyzer device	0,003
Nitrate / Nitrite Nitrogen	SM 4500-NO3- I	Autoanalyzer device	0,003
Nitrate Nitrogen	SM 4500-NO3- I	Autoanalyzer device	0,003
Nitrite Nitrogen	SM 4500-NO3- I	Autoanalyzer device	0,003
Kjeldahl Nitrogen	SM-4500 N org.	Gerhardt- Vapodest	0,15
Total Phosphorous	S.M. 4500 P J	Autoanalyzer device	0,008

Table G. 4 Analysis methods, used devices and detection limits (LOD) for priority substances

Order	**Parameter**	**Analysis method**	**Device**	**LOD (mg/L)**
1	Alachlor	Direct injection	LC-MSMS	0,1
2	Anthracene	EPA 8270D	GC-MSMS	0,001
3	Atrazine	Direct injection	LC-MSMS	0,05
4	Benzene	ISO 15680	P&T GC-MS	0,1
5	Brominated diphenyl ether	Liquid / Liquid Extraction /Silica column cleanup	GC-MSMS	0,004
	PBDE 28	Liquid / Liquid Extraction /Silica column cleanup	GC-MSMS	0,004
	PBDE 47	Liquid / Liquid Extraction /Silica column cleanup	GC-MSMS	0,004
	PBDE 99	Liquid / Liquid Extraction /Silica column cleanup	GC-MSMS	0,004
	PBDE 100	Liquid / Liquid Extraction /Silica column cleanup	GC-MSMS	0,004

Order	Parameter	Analysis method	Device	LOD (mg/L)
	PBDE 153	Liquid / Liquid Extraction /Silica column cleanup	GC-MSMS	0,004
	PBDE 154	Liquid / Liquid Extraction /Silica column cleanup	GC-MSMS	0,004
6	C10-13-chloroalkanes those	Stir Bar Sorptive Extraction (SBSE)	Twister GC-MSMS	0,05
7	Klorfenvinphos	Direct injection	LC-MSMS	0,005
8	Chlorpyrifos (chlorpyrifos-ethyl)	EPA 8270D	GC-MSMS	0,01
9	1,2-dichloroethane	ISO 15680	P&T GC-MS	0,1
10	Dichloromethane	ISO 15680	P&T GC-MS	2
11	Di (2-ethylhexyl) phthalate (DEHP)	EPA 8270D	GC-MSMS	0,001
12	Diuron	Direct injection	LC-MSMS	0,01
13	Endosulfan	EPA 8270D	GC-MSMS	0,005

Order	Parameter	Analysis method	Device	LOD (mg/L)
14	Flouranthene	EPA 8270D	GC-MSMS	0,001
15	Hexachloro-benzene	EPA 8270D	GC-MSMS	0,001
16	Hexachloro-butadiene	ISO 15680	P&T GC-MS	0,1
17	Hexachloro-cyclohexane	EPA 8270D	GC-MSMS	0,005
18	Isoproturon	Direct injection	LC-MSMS	0,05
19	Naphthalene	ISO 15680	P&T GC-MS	0,1
20	Nonylphenol (4-Nonylphenol)	SBSE	Twister GC-MSMS	0,001
21	Octylphenol ((4- (1,1 ', 3,3'-tetramethylbutyl) -phenol)	SBSE	Twister GC-MSMS	0,005
22	Pentachloro-benzene	SBSE	Twister GC-MSMS	0,005
23	Pentachloro-phenol	Direct injection	LC-MSMS	0,1

Order	Parameter	Analysis method	Device	LOD (mg/L)
24	Polyaromatic hydrocarbons (PAH)	SBSE	Twister GC-MSMS	
	Benzo (a) pyrene	SBSE	Twister GC-MSMS	0,0001
	Benzo (b) fluoranthene	SBSE	Twister GC-MSMS	0,001
	Benzo (k) fluoranthene	SBSE	Twister GC-MSMS	0,001
	Benzo (g, h, i) perylene	SBSE	Twister GC-MSMS	0,001
	Indeno (1,2,3) pyrene	SBSE	Twister GC-MSMS	0,001
25	Simazine	Direct injection	LC-MSMS	0,05
26	Tributyltin compounds (Tributyltin-cation)	SBSE	Twister GC-MSMS	0,0005
27	Trichloro-benzenes	ISO 15680	P&T GC-MS	0,1
	1,2,3-Trichloro-benzenes	ISO 15680	P&T GC-MS	0,1

Order	Parameter	Analysis method	Device	LOD (mg/L)
	1,2,4-Trichloro-benzenes	ISO 15680	P&T GC-MS	0,1
	1,3,5-Trichloro-benzenes	ISO 15680	P&T GC-MS	0,1
28	Trichloro-methane	ISO 15680	P&T GC-MS	0,1
29	Trifluralin	EPA 8270D	GC-MSMS	0,01
30	Dicofol	EPA 8270D	GC-MSMS	0,001
31	Perfluorooctane sulfonic acid and its derivatives (PFOS)	Direct injection	LC-MSMS	0,05
32	Quinoxyfen	Direct injection	LC-MSMS	0,1
33	Dioxin	Liquid / Liquid Extraction /Silica column cleanup	HRGC-HRMS	0,000005
	Dioxin-like compounds	Liquid / Liquid Extraction /Silica column cleanup	HRGC-HRMS	0,00001
34	Aclonifen	SBSE	Twister GC-MSMS	0,005

Order	Parameter	Analysis method	Device	LOD (mg/L)
35	Bifenox	SBSE	Twister GC-MSMS	0,005
36	Cybutryne	SBSE	Twister GC-MSMS	0,001
37	Cypermethrin	EPA 8270D	GC-MSMS	0,005
	Alpha-Cypermethrin	EPA 8270D	GC-MSMS	0,005
	Beta-Cypermethrin	EPA 8270D	GC-MSMS	0,005
	Teta-Cypermethrin	EPA 8270D	GC-MSMS	0,005
	Zeta-Cypermethrin	EPA 8270D	GC-MSMS	0,005
38	Dichlorvos	EPA 8270D	GC-MSMS	0,0005
39	Hexabromo-cyclododecane (HBCDD)	Direct injection	LC-MSMS	0,05
	1,3,5,7,9,11-Hexabromo-cyclododeca	Direct injection	LC-MSMS	0,05

Order	Parameter	Analysis method	Device	LOD (mg/L)
	(CAS 25637-99-4)			
	1,2,5,6,9,10-Hexabromo-cyclododeca	Direct injection	LC-MSMS	0,05
	α-hexabromocyclododecane-cyclododeca	Direct injection	LC-MSMS	0,05
	β-hexabromocyclododecane-cyclododeca	Direct injection	LC-MSMS	0,05
	γ-Hexabromo-cyclododeca	Direct injection	LC-MSMS	0,05
40	Heptachlor and heptachlor epoxide	EPA 8270D	GC-MSMS	0,001
41	Terbutryn	Direct injection	LC-MSMS	0,001
42	Mercury	TS 2537 EN 1483:1999-4	AAS Cold Steam	0,04

Order	Parameter	Analysis method	Device	LOD (mg/L)
43	Lead	EPA 6020 A ICP-MS	ICP-MS	0,063
44	Nickel	EPA 6020 A ICP-MS	ICP-MS	0,076
45	Cadmium	EPA 6020 A ICP-MS	ICP-MS	0,013

Table G. 5 Analysis methods, used devices and detection limits (LOD) for specific pollutants

Order	Parameter	Analysis method	Device	LOD (mg/L)
1	1,1-Dichloroethane	ISO 15680	P&T GC-MS	0,1
2	1,2,4,5-tetraklorobenz	EPA 8270D	GC-MSMS	0,005
3	1,2,4-trimethylbenzene	ISO 15680	P&T GC-MS	0,1
4	1,3,5-trimethylbenzene; mesitylene	ISO 15680	P&T GC-MS	0,1
5	1,3-dichlorobenzene	ISO 15680	P&T GC-MS	0,1

Order	Parameter	Analysis method	Device	LOD (mg/L)
6	1,4-dichlorobenzene	ISO 15680	P&T GC-MS	0,1
7	17alpha-ethinylestradiol	Direct injection	LC-MSMS	0,1
8	17-beta-estradiol	Direct injection	LC-MSMS	0,025
9	1-chloro-2,4-dinitrobenzene	SBSE	Twister GC-MSMS	0,01
10	1-chloronaphthalene	EPA 8270D	GC-MSMS	0,005
11	1-methylnaphthalene	EPA 8270D	GC-MSMS	0,005
12	2,3,4,5,6-Pentachlorotoluene, Pentachlorotoluene	EPA 8270D	GC-MSMS	0,1
13	2,4,6-tri-tert-butylphenol	EPA 8270D	GC-MSMS	0,001
14	2,6-di-tert-butylphenol, 2,6-di-tert-butylphenol	EPA 8270D	GC-MSMS	0,001
15	2,6-xylenol	SBSE	Twister GC-MSMS	0,001

Order	Parameter	Analysis method	Device	LOD (mg/L)
16	2-amino-4-chlorophenol	Direct injection	LC-MSMS	0,1
17	2-chloronaphthalene	SBSE	Twister GC-MSMS	0,005
18	The 3,6-dimetilfenantr	SBSE	Twister GC-MSMS	0,005
19	4,4'-DDD	SBSE	Twister GC-MSMS	0,001
20	4,4'-Dibromodiphenyl ether	EPA 8270D	GC-MSMS	0,004
21	4,5-dichloro-2-octyl-2H-isothiazol-3-one	Direct injection	LC-MSMS	0,05
22	The 4-Aminoazobenz	SBSE	Twister GC-MSMS	0,1
23	4-Chloro-3-methylphenol; Paraklorometakresol	EPA 8270D	GC-MSMS	0,005
24	4-chloroaniline	EPA 8270D	GC-MSMS	0,005

Order	**Parameter**	**Analysis method**	**Device**	**LOD (mg/L)**
25	Aldrin	SBSE	Twister GC-MSMS	0,005
26	Acenaphthene	SBSE	Twister GC-MSMS	0,005
27	Asetakl the 2-chloro-N-(ethoxymethyl) -N- (2-ethyl-6-methylphenyl) acetamide	Direct injection	LC-MSMS	0,1
28	Azinphos-methyl	Direct injection	LC-MSMS	0,05
29	Benzyl benzoate	SBSE	Twister GC-MSMS	0,001
30	Benzylbutylphthalate (BBP)	EPA 8270D	GC-MSMS	0,005
31	Benzo (a) fluoren	SBSE	Twister GC-MSMS	0,001
32	Benzo (e) pyrene	SBSE	Twister GC-MSMS	0,001

Order	Parameter	Analysis method	Device	LOD (mg/L)
33	Biphenyl	SBSE	Twister GC-MSMS	0,005
34	Bis (2-ethylhexyl) terephthalate	EPA 8270D	GC-MSMS	0,001
35	Bisphenol-A	SBSE	Twister GC-MSMS	0,001
36	DDT total	SBSE	Twister GC-MSMS	0,005
	p, p'-DDT	SBSE	Twister GC-MSMS	0,001
	p, p'-DDE	SBSE	Twister GC-MSMS	0,001
	o, p-DDT	SBSE	Twister GC-MSMS	0,005
	p, p'-DDD	SBSE	Twister GC-MSMS	0,005

Order	Parameter	Analysis method	Device	LOD (mg/L)
37	Decamethylcyclopentasiloxane; Siloxane-D5	SBSE	Twister GC-MSMS	0,001
38	Demeton	SBSE	Twister GC-MSMS	0,01
39	Diazinon	Direct injection	LC-MSMS	0,002
40	Dibutylphthalate (DBP)	EPA 8270D	GC-MSMS	0,01
41	Dibutyltin oxide	Türevlendirme / SBSE	Twister GC-MSMS	0,01
42	Dieldrin	SBSE	Twister GC-MSMS	0,005
43	Diethyl Phthalate	SBSE	Twister GC-MSMS	0,001
44	Diphenyl ether; diphenyl oxide	SBSE	Twister GC-MSMS	0,001
45	Diphenylamine	EPA 8270D	GC-MSMS	0,002

Order	Parameter	Analysis method	Device	LOD (mg/L)
46	Diisobutyl adipate	EPA 8270D	GC-MSMS	0,01
47	Diclofenac	Direct injection	LC-MSMS	0,1
48	Dioctyl phthalate (DnOP)	EPA 8270D	GC-MSMS	0,01
49	EDTA	Analiz yapılmadı		
50	Endrin	SBSE	Twister GC-MSMS	0,005
51	Ethylenithiole (ETU); Imidazolidin-2-thione; Ethylenithiole (ETU)	Direct injection	LC-MSMS	0,2
52	Phenanthrene	SBSE	Twister GC-MSMS	0,001
53	Phenitrothion (ISO); O, O-dimethyl O-4-nitro-m-tolyl phosphorothioate	EPA 8270D	GC-MSMS	0,5
54	Fenthion	Direct injection	LC-MSMS	0,05

Order	Parameter	Analysis method	Device	LOD (mg/L)
55	Floren	EPA 8270D	GC-MSMS	0,001
56	Isopropylbenzene-	ISO 15680	P&T GC-MS	0,1
57	Isopropoxybenzene	SBSE	Twister GC-MSMS	0,001
58	Carbon tetrachloride	ISO 15680	P&T GC-MS	0,1
59	Clofibric acid	Direct injection	LC-MSMS	1,5
60	Chloroacetic acid	Analizi yapılamıyor		
61	Chlorothalonil	EPA 8270D	GC-MSMS	0,01
62	Krisen	SBSE	Twister GC-MSMS	0,001
63	Xylene (m)	ISO 15680	P&T GC-MS	0,1
64	Xylene (o)	ISO 15680	P&T GC-MS	0,1

Order	Parameter	Analysis method	Device	LOD (mg/L)
65	Xylene musk	ISO 15680	P&T GC-MS	0,1
66	Linuron	Direct injection	LC-MSMS	0,02
67	Mercaptobenzothiazole (MBT); Benzothiazole-2-thiol; 2-Mercaptobenzothiazole (MBT)	SBSE	Twister GC-MSMS	0,001
68	N, N, N ', N'-tetramethyl-4,4'-methylenedianiline (Michler's base)	Direct injection	LC-MSMS	0,005
69	n-butyltin trichloride	Türevlendirme / SBSE	Twister GC-MSMS	0,003
70	nitrobenzene	SBSE	Twister GC-MSMS	0,2
71	p- (1,1-dimethylpropyl) phenol	EPA 8270D	GC-MSMS	0,01
72	Polychlorlubiphenyls (PCBs)	SBSE	Twister GC-MSMS	0,005

Order	Parameter	Analysis method	Device	LOD (mg/L)
73	PCB 101	SBSE	Twister GC-MSMS	0,005
74	PCB 138	SBSE	Twister GC-MSMS	0,001
75	PCB 153	SBSE	Twister GC-MSMS	0,001
76	PCB 180	SBSE	Twister GC-MSMS	0,001
77	PCB 28	SBSE	Twister GC-MSMS	0,001
78	PCB 31	SBSE	Twister GC-MSMS	0,001
79	PCB 52	SBSE	Twister GC-MSMS	0,001
80	Perylene	SBSE	Twister GC-MSMS	0,01

Order	Parameter	Analysis method	Device	LOD (mg/L)
81	Permethrin	SBSE	Twister GC-MSMS	0,01
82	Pyrene	SBSE	Twister GC-MSMS	0,005
83	Pyriproxyfene	Direct injection	LC-MSMS	0,02
84	Prochloraz; N-propyl-N- [2-(2,4,6-trichlorophenoxy) ethyl] -1H-imidazole-1-carboxamide	Direct injection	LC-MSMS	0,05
85	Propetamphos	Direct injection	LC-MSMS	0,05
86	Propylbenzene	ISO 15680	P&T GC-MS	0,1
87	Styrene; vinylbenzene	ISO 15680	P&T GC-MS	0,1
88	Sulphamethoxazole	Direct injection	LC-MSMS	0,1
89	Tert-butyl-4-methoxyphenol	Analizi yapılamıyor		

Order	Parameter	Analysis method	Device	LOD (mg/L)
90	Tetrabromobisphenol A (TBBP-A)	Direct injection	LC-MSMS	0,1
91	Triedimenol; α-tert-butyl-β-(4-chlorophenoxy) -1H-1,2,4-triazole-1-ethanol	Direct injection	LC-MSMS	0,1
92	Tribromodiphenyl ether	EPA 8270D	GC-MSMS	0,004
93	Tributyl phosphate	Direct injection	LC-MSMS	0,001
94	Tridecane	EPA 8270D	GC-MSMS	0,02
95	Triphenyltin; fentin	Derivatization / SBSE	Twister GC-MSMS	0,0005
96	Trichloroethylene (TRI)	ISO 15680	P&T GC-MS	0,1
97	Triclosan	Direct injection	LC-MSMS	0,1
98	Tris (nonylphenyl) phosphite	Direct injection	LC-MSMS	1,5
99	Aluminum	EPA 6020 A ICP-MS	ICP-MS	2,16

Order	Parameter	Analysis method	Device	LOD (mg/L)
100	Antimony	EPA 6020 A ICP-MS	ICP-MS	0,042
101	Arsenic	EPA 6020 A ICP-MS	ICP-MS	0,158
102	Copper	EPA 6020 A ICP-MS	ICP-MS	0,03
103	Barium	EPA 6020 A ICP-MS	ICP-MS	0,39
104	Beryllium	EPA 6020 A ICP-MS	ICP-MS	0,005
105	Boron	ISO 11885 ICP-OES	ICP-OES	5,17
106	bromide	SM-4110 B İyon krom.	DIONEX ICS-1000	31
107	Zinc	EPA 6020 A ICP-MS	ICP-MS	0,687

Order	Parameter	Analysis method	Device	LOD (mg/L)
108	Iron	EPA 6020 A ICP-MS	ICP-MS	32,2
109	Silver	EPA 6020 A ICP-MS	ICP-MS	1,5
110	Tin	EPA 6020 A ICP-MS	ICP-MS	3
111	Cobalt	EPA 6020 A ICP-MS	ICP-MS	0,009
112	Chromium	EPA 6020 A ICP-MS	ICP-MS	0,145
113	Free CN	ISO14403:2002 (E)	Autoanalyzer	0,3
114	Silicon	ISO 11885	ICP-OES	1,57
115	Titanium	ISO 11885	ICP-OES	2,3

Order	Parameter	Analysis method	Device	LOD (mg/L)
116	Vanadium	EPA 6020 A ICP-MS	ICP-MS	0,07
117	Total petroleum hydrocarbons	ISO 9377 part4	GC FID	20
118	2,4,5-trichlorophenoxyacetic acid (2,4,5-t)	Direct injection	LC-MSMS	0,5
119	2,4-d isooctyl ester	Analiz yapılmadı		
120	2,4-D; (2,4-dichlorophenoxy) acetic acid	Direct injection	LC-MSMS	0,025
121	2-methyl-4,6-dinitro-phenol DNOK	Direct injection	LC-MSMS	0,05
122	aAcetamiprid	Direct injection	LC-MSMS	0,05
123	Atrazine-desethyl	Direct injection	LC-MSMS	0,3
124	Azoxystrobin	Direct injection	LC-MSMS	0,05
125	Bentazone	Direct injection	LC-MSMS	0,05

Order	Parameter	Analysis method	Device	LOD (mg/L)
126	Lindan (γ-bhc, 1α, 2α, 3β, 4α, 5α, 6β-hexachlorocyclohexane)	SBSE	Twister GC-MSMS	0,001
127	Boscalid	Direct injection	LC-MSMS	0,04
128	Bromophos-ethyl	SBSE	Twister GC-MSMS	0,001
129	Bromophos-methyl	SBSE	Twister GC-MSMS	0,001
130	Bromopropylate	EPA 8270D	GC-MSMS	0,01
131	Bromoxynil	Direct injection	LC-MSMS	0,05
132	Buprofezin	Direct injection	LC-MSMS	0,01
133	Butralin	Direct injection	LC-MSMS	0,05
134	Cadusafos	Direct injection	LC-MSMS	0,01
135	Captain	EPA 8270D	GC-MSMS	0,002

Order	Parameter	Analysis method	Device	LOD (mg/L)
136	Carbaryl	Direct injection	LC-MSMS	0,01
137	Carbendazim	Direct injection	LC-MSMS	0,002
138	Carbofuran	Direct injection	LC-MSMS	0,1
139	Carboxin; vitavax	Direct injection	LC-MSMS	0,05
140	Chloranthraniliprole	Direct injection	LC-MSMS	0,05
141	Chlorobenzilate	Direct injection	LC-MSMS	0,5
142	Chlordane	EPA 8270D	GC-MSMS	0,005
143	Chlorfenapyr	EPA 8270D	GC-MSMS	0,005
144	Chloridazon; pyrazole	Direct injection	LC-MSMS	0,05
145	chlorsulfuron	Direct injection	LC-MSMS	0,02
146	Clofentezine	Direct injection	LC-MSMS	0,01

Order	Parameter	Analysis method	Device	LOD (mg/L)
147	Clopyralid	Direct injection	LC-MSMS	0,002
148	Clothianidin	Direct injection	LC-MSMS	0,05
149	Cyclanilide	Direct injection	LC-MSMS	0,5
150	Cyfluthrin; beta sibutyrin	EPA 8270D	GC-MSMS	0,01
151	Cyprodinil	Direct injection	LC-MSMS	0,01
152	Cyromazine	Direct injection	LC-MSMS	0,05
153	4,4-d; 1,1-dichloro-2,2-bis (4-chlorophenyl) ethyne	SBSE	Twister GC-MSMS	0,001
154	Dichlobenil	EPA 8270D	GC-MSMS	0,005
155	Diethofencarb	Direct injection	LC-MSMS	0,05
156	Difenoconazole	Direct injection	LC-MSMS	0,05
157	Diflubenzuron	Direct injection	LC-MSMS	0,05

Order	Parameter	Analysis method	Device	LOD (mg/L)
158	Diflufenican	EPA 8270D	GC-MSMS	0,01
159	Dimetheneamid	EPA 8270D	GC-MSMS	0,01
160	Dimethoate	Direct injection	LC-MSMS	0,002
161	Dimethomorph	Direct injection	LC-MSMS	0,01
162	Dimetilaminosulfanilid	Direct injection	LC-MSMS	0,04
163	Dinobuton	EPA 8270D	GC-MSMS	0,01
164	Epoxiconazole	Direct injection	LC-MSMS	0,005
165	Ethalfluralin	EPA 8270D	GC-MSMS	0,005
166	Ethofumesate	Direct injection	LC-MSMS	0,05
167	Ethoprophos	Direct injection	LC-MSMS	0,05
168	Phenamiphos	Direct injection	LC-MSMS	0,01

Order	Parameter	Analysis method	Device	LOD (mg/L)
169	Fenarimol	Direct injection	LC-MSMS	0,05
170	Fenbutatinite	Direct injection	LC-MSMS	0,1
171	Feneksamid	Direct injection	LC-MSMS	0,04
172	Fenpropathrin	Direct injection	LC-MSMS	0,01
173	fenpropimorph	Direct injection	LC-MSMS	0,1
174	Fluazifop-p-butyl	Direct injection	LC-MSMS	0,05
175	Fludioxonil	Direct injection	LC-MSMS	0,05
176	Fluopyram	Direct injection	LC-MSMS	0,01
177	Fluquinconazole	Direct injection	LC-MSMS	0,025
178	Fluroxypyr	Direct injection	LC-MSMS	0,05
179	Flutolanil	Direct injection	LC-MSMS	0,05

Order	Parameter	Analysis method	Device	LOD (mg/L)
180	Flutriafol	Direct injection	LC-MSMS	0,05
181	Fosetyl Al	Direct injection	LC-MSMS	2,5
182	Fosthiazate	Direct injection	LC-MSMS	0,005
183	Hexaconazole	Direct injection	LC-MSMS	0,04
184	Hexythiazox	Direct injection	LC-MSMS	0,05
185	Imazamil	Direct injection	LC-MSMS	0,02
186	Imazapyr	Direct injection	LC-MSMS	0,04
187	Imidacloprid	Direct injection	LC-MSMS	0,02
188	Lenacil	Direct injection	LC-MSMS	0,02
189	Malathion	Direct injection	LC-MSMS	0,1
190	Mandipropamid	Direct injection	LC-MSMS	0,05

Order	Parameter	Analysis method	Device	LOD (mg/L)
191	Mepiquat chloride	Direct injection	LC-MSMS	0,05
192	Mesotrione	Direct injection	LC-MSMS	0,05
193	Metalaxyl	Direct injection	LC-MSMS	0,005
194	Metam potassium	Direct injection	LC-MSMS	0,1
195	Metamitron	Direct injection	LC-MSMS	0,05
196	Metazachlor	Direct injection	LC-MSMS	0,05
197	Methamidophos	Direct injection	LC-MSMS	0,01
198	Methidathion	Direct injection	LC-MSMS	0,05
199	Methomyl	Direct injection	LC-MSMS	0,05
200	Methoxyfenozide	Direct injection	LC-MSMS	0,1
201	Metolachlor	Direct injection	LC-MSMS	0,05

Order	Parameter	Analysis method	Device	LOD (mg/L)
202	Metrafenone	EPA 8270D	GC-MSMS	0,01
203	Molinatone	Direct injection	LC-MSMS	0,05
204	Monocrotophos	Direct injection	LC-MSMS	0,05
205	Myclobutanil	Direct injection	LC-MSMS	0,04
206	Nicosulfuron	Direct injection	LC-MSMS	0,02
207	Nitrofen	EPA 8270D	GC-MSMS	0,01
208	Omethoate	Direct injection	LC-MSMS	0,02
209	Oxadiazol	Direct injection	LC-MSMS	0,05
210	oxadixyi	Direct injection	LC-MSMS	0,05
211	Parathion-methyl	SBSE	Twister GC-MSMS	0,01
212	Penconazole	Direct injection	LC-MSMS	0,02

Order	Parameter	Analysis method	Device	LOD (mg/L)
213	Pendimethalin	Direct injection	LC-MSMS	0,05
214	Fenthoate	Direct injection	LC-MSMS	0,05
215	Picloram	Direct injection	LC-MSMS	0,05
216	Piperonyl butoxide	EPA 8270D	GC-MSMS	0,01
217	Pyrimicarb	Direct injection	LC-MSMS	0,05
218	Procymidone	EPA 8270D	GC-MSMS	0,01
219	Prometryn	Direct injection	LC-MSMS	0,05
220	Propamocarb HCL	Direct injection	LC-MSMS	0,005
221	Propazine	Direct injection	LC-MSMS	0,01
222	Propham	Direct injection	LC-MSMS	0,05
223	Propiconazole	Direct injection	LC-MSMS	0,04

Order	Parameter	Analysis method	Device	LOD (mg/L)
224	Propyzamide	Direct injection	LC-MSMS	0,05
225	Prothiofos	Direct injection	LC-MSMS	0,05
226	Pyraclostrobin	Direct injection	LC-MSMS	0,05
227	Pyridaben	Direct injection	LC-MSMS	0,05
228	Pyrimethanil	Direct injection	LC-MSMS	0,02
229	Quinalphos	Direct injection	LC-MSMS	0,05
230	Quizalofop-p-ethyl	Direct injection	LC-MSMS	0,05
231	Spiroxamine	Direct injection	LC-MSMS	0,05
232	Tebuconazole	Direct injection	LC-MSMS	0,02
233	Tebuthiuron	Direct injection	LC-MSMS	0,05
234	Tecnazene	EPA 8270D	GC-MSMS	0,01

Order	Parameter	Analysis method	Device	LOD (mg/L)
235	Tefluthrin	EPA 8270D	GC-MSMS	0,01
236	Terbuthylazine	Direct injection	LC-MSMS	0,05
237	Thiabendazole	Direct injection	LC-MSMS	0,01
238	Thiacloprid	Direct injection	LC-MSMS	0,05
239	Thiamethoxam	Direct injection	LC-MSMS	0,002
240	Thidiazuron	Direct injection	LC-MSMS	0,1
241	Thiometon	EPA 8270D	GC-MSMS	0,01
242	Thiophanate-methyl	Direct injection	LC-MSMS	0,01
243	Tolclofos-methyl	Direct injection	LC-MSMS	0,5
244	Tolfenpyrad	Direct injection	LC-MSMS	0,05
245	Triasulfuron	Direct injection	LC-MSMS	0,01

Order	**Parameter**	**Analysis method**	**Device**	**LOD (mg/L)**
246	Tribenuron-methyl,	Direct injection	LC-MSMS	0,04
247	Trifloxystrobin	Direct injection	LC-MSMS	0,05
248	Triflumuron	Direct injection	LC-MSMS	0,05
249	Trinekzapak-ethyl	EPA 8270D	GC-MSMS	0,01
250	Vinclozolin	EPA 8270D	GC-MSMS	0,01

APPENDIX H - Assessment of the Seven Monitoring Period Results in Terms of EQS

Table H. 1Monitoring periods that exceeded EQS (includes all stations)

Pollutants	Monitoring periods that exceeded EQS(How many stations that exceeded EQS)						
	1st Period (42)*	**2nd period (40)***	**3rd period (52)***	**4th period (52)***	**5th period (58)***	**6th period (84)***	**7th period (94)***
Aluminum	✓(41)	✓(34)	✓(46)	✓(51)	✓(58)	✓(72)	✓(87)
Benzo[a]pyrene		✓(1)		✓(8)			✓(4)
Bifenox				✓(1)	✓(2)	✓(12)	
Bromide	✓(5)	✓(6)	✓(9)	✓(20)	✓(23)	✓(49)	✓(42)
Cadmium and its compounds	✓(11)	✓(5)	✓(14)	✓(12)	✓(42)	✓(27)	✓(23)
Cobalt	✓(28)	✓(22)	✓(29)	✓(42)	✓(43)	✓(57)	✓(64)
Chromium	✓(26)	✓(18)	✓(25)	✓(33)	✓(40)	✓(42)	✓(59)
Copper	✓(32)	✓(36)	✓(45)	✓(50)	✓(58)	✓(67)	✓(83)
Dichlorvos	✓(34)	✓(16)	✓(6)				
Iron	✓(40)	✓(31)	✓(40)	✓(48)	✓(58)	✓(65)	✓(86)
Fenarimol			✓(1)				
Mercury and its compounds		✓(5)	✓(4)				
Nickel and its compounds	✓(23)	✓(12)	✓(21)	✓(32)	✓(38)	✓(35)	✓(52)
Lead and its compounds	✓(34)	✓(19)	✓(24)	✓(40)	✓(58)	✓(65)	✓(82)
Antimony	✓(5)	✓(5)	✓(12)	✓(13)	✓(5)	✓(10)	✓(10)

Free Cyanide			✓(1)	✓(1)	✓(1)	✓(17)	✓(29)
Silicon	✓(42)		✓(52)	✓(49)	✓(57)	✓(64)	✓(84)
Tridecane			✓(1)	✓(25)			
Vanadium	✓(40)	✓(36)	✓(43)	✓(46)	✓(51)	✓(73)	✓(76)
Zinc	✓(35)	✓(30)	✓(43)	✓(51)	✓(58)	✓(82)	✓(61)
Total petroleum hydrocarbons		✓(30)	✓(48)	✓(52)			✓(44)
* number of the stations that measurements had been done.							

Table H. 2 AVG %EQS calculated for the stations that have detectable measurements (µg/L)(includes all stations)

Pollutants	AA-EQS (µg/L)	AVG %EQS calculated for the stations that have detectable measurements(µg/L)(How many stations that had detectable concentration)						
		1st monitoring Period (42)*	2nd monitoring period (40)*	3rd monitoring period (52)*	4th monitoring period (52)*	5th monitoring period (57)*	6th monitoring period (84)*	7th monitoring period (94)*
Aluminum	48.1	1025,61 (42)	411,46 (40)	556,23 (52)	1044,81 (52)	1149,54 (58)	491,27 (84)	60300,75 (92)
Benzo[a]pyrene	1,7 × 10-4		515,85 (1)		2998,63 (9)			55670,75 (4)
Bifenox	0,012				568,19 (1)	1267,96 (2)	1918,88 (12)	
Bromide	31	793,55 (5)	983,87 (6)	1317,20 (9)	650,13 (20)	589,57 (23)	14981,61 (52)	2889,35 (43)
Cadmium and its compounds	0,08	208,10 (15)	1284,39 (6)	4528,99 (17)	2222,82 (15)	384,10 (50)	1001,26 (36)	694,89 (30)
Cobalt	0,3	277,43 (42)	232,65 (40)	1090,64 (52)	627,92 (52)	2607,50 (58)	1324,01 (84)	12616,08 (92)
Chromium	1,6	206,29 (42)	138,45 (40)	407,29 (52)	351,93 (52)	669,36 (58)	526,00 (83)	5886,35 (92)
Copper	13	174,03 (42)	234,23 (40)	233,37 (52)	199,29 (52)	251,56 (58)	162,82 (84)	665,86 (92)
Dichlorvos	6 × 10-4	22018,50 (34)	33069,87(16)	8287,02 (6)				
Iron	95,22	735,11 (42)	317,49 (40)	431,12 (52)	826,06 (52)	810,43 (58)	554,27 (84)	66278,60 (94)
Fenarimol	0,07			450133,52 (1)				
Mercury and its compounds	0,07**		308,57 (5)	246,43 (4)				
Nickel and its compounds	4	142,47 (42)	99,16 (40)	263,06 (52)	401,88 (52)	454,63 (58)	293,65 (84)	4110,76 (92)
Lead and its compounds	1,2	252,56 (42)	172,00 (39)	197,26 (52)	280,38 (52)	462,47 (58)	405,91 (84)	24986,96 (92)
Antimony	7,8	49,37 (39)	50,03 (40)	502,20 (52)	625,57 (42)	454,24 (58)	669,76 (81)	88617,27 (87)

Free Cyanide	1,2			885,83 (1)	150 (1)	188,33 (1)	143,75 (20)	7811,21 (31)
Silicon	1830	363,01 (42)		339,19 (52)	335,42 (52)	372,55 (58)	333,09 (74)	534,82 (94)
Tridecane	0,05			624,95 (1)	2919,84 (29)			
Vanadium	1,6	310,42 (42)	262,50 (40)	224,54 (52)	272,37 (52)	341,20 (58)	262,85 (84)	4640,07 (92)
Zinc	5,9	551,66 (42)	436,80 (40)	1342,03 (52)	1213,58 (52)	6702,31 (58)	24031,93 (84)	4759,89 (92)
Total petroleum hydrocarbons	96		212,09 (38)	327,78 (51)	413,84 (52)			254,32 (70)

* number of the stations that measurements had been done.

**(MAX-EQS)

Table H. 3 MAX EQS% (at which station) (includes all stations)

Pollutant	AA-EQS (µg/L)	MAX EQS% (at which station)						
		1st monitoring Period	**2nd monitoring period**	**3rd monitoring period**	**4th monitoring period**	**5th monitoring period**	**6th monitoring period**	**7th monitoring period**
Aluminum	48.1	6376,29 (station 20)	2418,95 (station 32)	2007,65 (station 17)	4813,98 (station 25)	10145,84 (station 20)	4391,76 (station 58)	5395069,39 (Station 62)
Benzo[a]pyrene	1,7 × 10-4		515,85 (Station 36)		8439,12 (Station 9)			174434,28 (Station 1)
Bifenox	0,012				568,19 (Station 5)	1320,44 (Station 2)	3529,40 (Station 103)	
Bromide	31	1548,39 (Station 31)	1903,23 (Station 25)	3851,29 (Station 59)	3212,90 (station 59)	3647,74 (Station 59)	520741,94 (station 77)	85361,29 (station 102)
Cadmium and its compounds	0,08	788,20 (Station 25)	6426,50 (Station 25)	56988,62 (Station 25)	16515,90 (Station 25)	6105,29 (station 24)	27504,70 (station 93)	7934,66 (Station 62)
Cobalt	0,3	2582,02 (Station 31)	3461,97 (Station 31)	42678,79 (Station 59)	12303,56 (Station 59)	162174,82 (station 59)	81855,74 (station 59)	1061441,04 (station 62)
Chromium	1,6	1490,87 (Station 31)	765,49 (Station 31)	11853,82 (Station 59)	5626,21 (station 59)	19388,02 (station 59)	30771,03 (station 59)	465274,76 (station 62)
Copper	13	2355,30 (station 31)	4402,10 (station 31)	4513,61 (station 31)	2448,77 (station 31)	1511,38 (station 31)	1781,16 (station 31)	38789,23 (station 62)

Pollutant	AA-EQS (µg/L)	MAX EQS% (at which station)						
		1st monitoring Period	**2nd monitoring period**	**3rd monitoring period**	**4th monitoring period**	**5th monitoring period**	**6th monitoring period**	**7th monitoring period**
Dichlorvos	6 × 10-4	76986,93 (Station 28)	71177,61 (Station 32)	18850,36(Station 4)				
Iron	95,22	4153,39 (Station 20)	1666,58(station 20)	1517,59(station 17)	3386,72(Station 25)	4639,70(station 20)	8915,90(Station 59)	6058241,93(Station 62)
Fenarimol	0,07			450133,52 (Station 1)				
Mercury and its compounds	0,07*		557,14 (Station 21)	285,71 (Station 34)				
Nickel and its compounds	4	398,31 (Station 16)	418,70 (Station 31)	6188,22 (Station 59)	6677,82 (station 59)	8732,12 (station 59)	10116,30 (station 59)	329409,88 (station 62)
Lead and its compounds	1,2	603,78 (Station 31)	1714,81 (Station 25)	1995,01 (Station 62)	3279,39 (station 62)	3951,70 (station 62)	9617,73 (Station 93)	2245196,20 (station 62)
Sb(Antimony)	7,8	486,36 (Station 21)	608,27 (Station 21)	21720,13 (Station 62)	22228,73 (station 62)	24519,10 (station 62)	31757,45 (station 62)	7702852,48 (station 62)
Free Cyanide	1,2			885,83 (Station 31)	150 (Station 70)	188,33 (station 69)	383,33 (station 77)	144916,67 (station 135)
Silicon	1830	679,23 (Station 31)		720,77 (Station 65)	539,78 (station 47)	844,26 (station 20)	819,67 (station 58)	9415,30 (station 62)
Tridecane	0,05			624,95 (Station 4)	33567,76 (station 70)			

Pollutant	AA-EQS (μg/L)	MAX EQS% (at which station)						
		1st monitoring Period	**2nd monitoring period**	**3rd monitoring period**	**4th monitoring period**	**5th monitoring period**	**6th monitoring period**	**7th monitoring period**
Vanadium	1,6	1467,38 (Station 31)	666,22 (Station 32)	1145,83 (Station 65)	811,41 (station 25)	1970,26 (station 20)	913,67 (station 31)	369453,14 (station 62)
Zinc	5,9	3706,55 (Station 31)	6395,93 (Station 31)	20217,12 (Station 58)	21304,91 (station 58)	156931,15 (station 59)	1703715,03 (station 120)	214103,77 (station 103)
Total petroleum hydrocarbons	96		619,79 (Station 37)	1038,54 (Station 20)	613,54 (station 47)			6878,13 (station 102)

*(MAX-EQS)

Table H. 4 MIN EQS% (at which station) (includes all stations)

Pollutants	**AA-EQS (µg/L)**	**MIN EQS% (at which station)**						
		1st monitoring Period	**2nd monitoring period**	**3rd monitoring period**	**4th monitoring period**	**5th monitoring period**	**6th monitoring period**	**7th monitoring period**
Aluminum	48.1	94,31 (station 5)	52,58 (station 16)	74,1 (station 13)	68,03 (station 60)	135,26 (station 73)	43,84 (station 78)	55,55 (station 77)
Benzo[a]pyrene	1,7 × 10-4		515,85 (Station 36)		63,82 (station 19)			9677,89 (station 76)
Bifenox	0,012				568,19 (Station 5)	1215,48 (Station 42)	903,74 (station 27)	
Bromide	31	354,84 (Station 24)	322,58 (Station 22)	415,48 (Station 32)	109,35 (station 45)	114,19 (station 45)	33,87 (Station 29)	97,10 (Station 107)
Cadmium and its compounds	0,08	74,73 (Station 35)	86,16 (Station 26)	80,57 (Station 10)	74,38 (Station 31)	73,57 (station 13)	38,40 (Station 91)	84,06 (station 128-B)
Cobalt	0,3	16,80 (Station 5)	15,37 (Station 5)	25,12 (Station 13)	32,27 (Station 4)	34,24 (Station 5)	17,73 (Station 5)	12,67 (station 77)
Chromium	1,6	32,13 (Station 9)	20,70 (Station 6)	18,30 (Station 54)	20,21 (Station 4)	41,09 (station 73)	23,54 (Station 9)	16,17 (Station 77)
Copper	13	63,10 (station 3)	4,43 (station 16)	87,19 (station 62)	97,07 (Station 53)	104,61 (station 43)	30,92 (station 109)	85,37 (Station 28)
Dichlorvos	6 × 10-4	8741,86 (Station 5)	17521,45 (Station 27)	4705,26 (Station 56)				
Iron	95,22	55,55 (station 5)	38,14 (station 16)	48,99 (station 1)	77,28 (station 60)	104,23 (station 73)	49,36 (station 83)	4,32 (station 136)
Fenarimol	0,07			450133,52 (Station 1)				

Pollutants	AA-EQS (µg/L)	MIN EQS% (at which station)						
		1st monitoring Period	**2nd monitoring period**	**3rd monitoring period**	**4th monitoring period**	**5th monitoring period**	**6th monitoring period**	**7th monitoring period**
Mercury and its compounds	0,07*		200,00 (Station 35)	214,29 (Station 34)				
Nickel and its compounds	4	26,82 (Station 1)	20,17 (Station 6)	8,48 (Station 1)	23,81 (station 4)	32,36 (station 6)	4,38 (station 12)	17,58 (Station 42)
Lead and its compounds	1,2	63,39 (Station 3)	12,85 (Station 22)	15,02 (Station 29)	66,02 (station 39)	131,14 (Station 6)	19,47 (Station 109)	72,88 (station 28)
Sb(Antimony)	7,8	1,59 (Station 6)	1,82 (Station 42)	2,42 (Station 53)	1,44 (Station 37)	1,79 (Station 51)	2,44 (Station 44)	2,07 (station 128-B)
Free Cyanide	1,2			885,83 (Station 31)	150 (Station 70)	188,33 (station 69)	88,33 (Station 62)	99,17 (Station 78)
Silicon	1830	108,47 (Station 24)		135,68 (Station 26)	56,56 (Station 25)	26,28 (station 28)	6,61 (Station 94)	30,55 (Station 55)
Tridecane	0,05			624,95 (Station 4)	4,02 (station 35)			
Vanadium	1,6	90,95 (Station 6)	69,91 (Station 3)	24,02 (Station 62)	32,32 (station 53)	45,40 (Station 73)	22,49 (station 62)	17,76 (Station 73)
Zinc	5,9	67,42 (Station 5)	11,39 (Station 16)	75,41 (Station 39)	74,80 (station 4)	546,44 (station 6)	25,20 (Station 25)	27,44 (Station 43)
Total petroleum hydrocarbons	96		65,63 (Station 18)	69,79 (Station 34)	109,38 (Station 70)			54,17 (station 39)

*(MAX-EQS)

APPENDIX I - Monitoring Stations

Table I. 1 Riverine sampling stations of Yeşilırmak Basin, their definitions and coordinates (TUBITAK Research Project 115Y013, 2018)

Station ID	GIS ID	Definition	North (N)	East (E)	The period that was added
Station-1	YESIL-1	DSİ Current Monitoring Station	40,19083	39,71139	1
Station -2	YESIL-2	DSİ Current Monitoring Station	40,10806	39,29917	1
Station -3	YESIL-3	OSİB Operational Station	40,1375	38,55472	1
Station -4	YESIL-4	Dam of Şebinkarahisar-Kılıçkaya	40,22278	38,39861	1
Station -5	YESIL-5	DSİ Water Quality Station	40,22667	38,02333	1
Station -6	YESIL-6	DSİ Water Quality Station	40,12889	37,75333	1
Station -7	YESIL-7	Life line of Reşadiye-3 Dam	40,38222	37,35639	1
Station -8	YESIL-8	Reşadiye, after the pressure	40,39472	37,32333	1
Station -9	YESIL-9	Delice, Stream out	40,40139	37,29333	1
Station -10	YESIL-10	OSİB Operational Station	40,475	37,00861	1
Station -11	YESIL-11	OSİB Operational Station	40,35028	36,62833	1
Station -12	YESIL-12	Entrance of Almus Dam	40,33806	36,89167	1
Station -13	YESIL-13	DSİ Current Monitoring Station	40,31167	37,12611	1
Station -14	YESIL-14	OSİB Operational Station	40,2925	36,2825	1
Station -15	YESIL-15	Entrance of Süreyyabey Dam	39,91694	35,64667	1
Station -16	YESIL-16	DSİ Water Quality Station	39,99583	36,07083	1
Station -17	YESIL-17	Before the district of Turhal (Tokat)	40,37917	36,08889	1
Station -18	YESIL-18	DSİ Water Quality Station	40,42194	36,11278	1
Station -19	YESIL-19	DSİ Current Monitoring Station	40,61944	35,81056	1
Station -20	YESIL-20	OSİB Operational Station	40,67583	35,83417	1
Station -21	YESIL-21	Connection point of Çekerek Streamlet-Çorum Streamlet-Deliçay	40,56333	35,76167	1
Station -22	YESIL-22	DSİ Current Monitoring Station	40,53028	35,63889	1
Station -23	YESIL-23	Connection point of Çekerek Streamlet -Çorum Streamlet	40,46806	35,57778	1
Station -24	YESIL-24	DSİ Water Quality Station	40,45028	35,41692	1
Station -25	YESIL-25	OSİB Operational Station	40,37889	35,0575	1

Station -26	YESIL-26	DSİ Water Quality Station	40,33972	35,06389	1
Station -27	YESIL-27	DSİ Current Monitoring Station	40,22667	35,32694	1
Station -28	YESIL-28	DSİ Current Monitoring Station	40,10528	34,94194	1
Station -29	YESIL-29	DSİ Water Quality Station	40,38667	34,63917	1
Station -30	YESIL-30	OSİB Operational Station	40,57361	34,97472	1
Station -31	YESIL-31	Before district of Merzifon	40,78	35,4925	1
Station -32	YESIL-32	OSİB Operational Station	40,76528	35,62389	1
Station -33	YESIL-33	DSİ Water Quality Station	40,74833	36,02417	1
Station -34	YESIL-34	Before District of Taşova	40,74139	36,26639	1
Station -35	YESIL-35	OSİB Operational Station	40,74583	36,36222	1
Station -36	YESIL-36	Entrance of Hasan Uğurlu Dam	40,77389	36,50917	1
Station -37	YESIL-37	OSİB Operational Station	40,70306	36,57528	1
Station -38	YESIL-38	OSİB Operational Station	40,73694	36,71786	1
Station -39	YESIL-39	DSİ Water Quality Station	40,66639	36,69694	1
Station -40	YESIL-40	Stream out of Lake Ladik	40,92504	36,02111	1
Station -41	YESIL-41	OSİB Operational Station	41,27083	36,34528	1
Station -42	YESIL-42	OSİB Operational Station	41,22861	36,58639	1
Station -43	YESIL-43	OSİB Operational Station	41,20361	36,72722	1
Station -95	YESIL-95	Between Tokat WWTP and DIMES Food	40,341000	36,509389	6
Station -96*	YESIL-96	Upper reach of Meray Herbal Oil	40,809875	35,410306	6
Station -97	YESIL -97	Upper reach of Merzifon OIZ and downward flow of Meray Herbal oil	40,805844	35,420706	6
Station -98	YESIL -98	Meray Herbal oil(side stream)	40,805462	35,412894	6
Station -99	YESIL -99	Downward flow of Özdemir Antimony Mining	40,432571	36,116737	6
Station -109	YESIL -109	the upstream of discharge point of Havza WWTP (from river)	40,946983	35,656210	6
Station -111*	YESIL -111	the upstream of discharge point of Aktan Food (from river)	40,884275	35,635308	6
Station -113*	YESIL -113	the upstream of discharge point of Beşgöz Araboğulları Unculuk Sanayi Cold storage (from river)	40,917721	35,648131	6
Station -115*	YESIL -115	the upstream of the discharge point of Gürmin Energy-Mining (from river)	40,881773	35,632456	6
Station -117*	YESIL -117	the upstream of discharge point of Otat Fed(from river)	40,975040	35,687155	6
Station -119*	YESIL -119	the upstream of discharge poit of Temiz Meat products(from river)	40,997111	35,662839	6
Station -120	YESIL -120	Downstream of city of Tokat	40,338333	36,424444	6
Station -121*	YESIL -121	the upstream of city of Çorum	40,573611	34,974722	6

Station-122	YESIL -122	the upstream of discharge point of Kozlu Food (from river)	40,804444	35,662222	6
Station-123	YESIL -123	the upstream of discharge point of Et-Bir (from river)	40,825556	35,620556	6
Station-124	YESIL -124	the upstream of discharge point of Olmuksa (from river)	40,694167	34,913611	7
Station-125	YESIL -125	the upstream of discharge point of Bakraç Dairy (from river)	40,727778	35,770833	7
Station-126	YESIL -126	the upstream of discharge point of Turhal Sugar (from river)	40,397778	36,085556	7
Station-128A	YESIL -128 A	the upstream of discharge point of Amasya Sugar (from river)	40,833333	35,621111	7
Station-130*	YESIL -130	the upstream of discharge point of Aydınoğlu Flour Food (from river)	40,981192	35,688048	7
Station-132*	YESIL -132	upstream of discharge point of Doğa Water and Food(from river)	40,893333	36,053333	7
Station-134*	YESIL -134	upstream of discharge point of Akçansa Cement (from river)	40,912781	35,894430	7
Station-138*	YESIL -138	At the upstream of discharge point of Dem-Ak Mining (from river)	40,579694	35,342321	7
Station-140*	YESIL -140	the upstream of discharge point of Makro-Win Building Materials (from river)	40,514420	34,948494	7
Station-142*	YESIL -142	the upstream of discharge point of Özpar Plastic (from river)	41,292737	36,252044	7
Station-144*	YESIL -144	At the upstream of discharge point of Ekmekçioğulları (from river)	40,510479	34,910806	7

*cancelled stations

Table I. 2 Sampling stations of urban wastewater treatment plant stations of Yeşilırmak River Basin, their definitions and coordinates (TUBITAK Research Project 115Y013, 2018)

Station ID	**GIS ID**	**Definition**	**North (N)**	**East (E)**	**The period that it was added**
Station-44*	YESIL -44	Exit of Demircili WWTP	40,502222	37,520833	3
Station-45	YESIL -45	Exit of Tokat WWTP	40,33972	36,47389	3
Station-46*	YESIL -46	Exit of Çaylı WWTP	40,372047	36,163779	3
Station-47	YESIL -47	Exit of Erbaa WWTP	40,70667	36,555	3
Station-48	YESIL -48	Exit of Çorum WWTP	40,485	34,91556	3
Station-49*	YESIL -49	Exit of Güzelbeyli WWTP	40,145169	36,008185	3
Station-50*	YESIL -50	Exit of Evrenköy WWTP	40,148644	35,872856	3
Station-51*	YESIL -51	Exit of Büyükhırka WWTP	39,99626	35,79125	3
Station-52*	YESIL -52	Exit of Kazankaya WWTP	40,210278	35,322500	3
Station-53*	YESIL -53	Exit of Aydıncık WWTP	40,15278	35,27889	3
Station-54*	YESIL -54	Exit of Ozan WWTP	39,67472	35,56222	3
Station-55*	YESIL -55	Exit of Oluközü WWTP	39,68944	35,76139	3
Station-56*	YESIL -56	Exit of Ağcagüney WWTP	41,1175	36,61278	3
Station-57*	YESIL -57	Exit of Terme WWTP	41,22	37,02333	3
Station-75	YESIL -75	Exit of WWTP of Macitözü Municipality	40,524933	35,297087	5
Station-104	YESIL -104	Entrance of Tokat WWTP	40,339722	36,473889	6
Station-105	YESIL -105	Entrance of Çorum WWTP	40,485000	34,915556	6
Station-106	YESIL -106	Entrance of Amasya WWTP	40,679901	35,879433	6
Station-107	YESIL -107	Exit of Amasya WWTP	40,679901	35,879433	6
Station-108	YESIL -108	Exit of Havza WWTP	40,946983	35,656210	6

*cancelled stations

Table I. 3 Sampling stations of industrial sources of Yeşilırmak River Basin, their definitions and coordinates (TUBITAK Research Project 115Y013, 2018)

Station ID	**GIS ID**	**Definition**	**North (N)**	**East (E)**	**The period that it was added**
Station-58	YESIL-58	Merzifon OIZ	40,85873	35,46324	3
Station-59	YESIL-59	Samsun Merkez OIZ	41,22729	36,42553	3
Station-60	YESIL-60	DIMES Food Industry and Trade Inc. (Dairy and fruit juice industry)	40,33341	36,53554	3
Station-61	YEŞİL-61	Turhal Sugar Factory	40,394439	36,080337	3
Station-62	YESIL-62	Ozdemir Antimony Maining Inc.	40,42344	36,11084	3
Station-63*	YEŞİL-63	Hayat Paper and Energy Industry and Trade Inc.	40,512688	34,914473	3
Station-64*	YEŞİL-64	Pan-Et Hayvan Kesim ve Et Ürünleri	40,838309	35,633073	3
Station-65	YEŞİL-65	Meray Herbal Oil Industry and Trade Inc.	40,860281	35,431734	3
Station-66*	YEŞİL-66	Eski Çeltek Coal Mining Establishment (coal mining industry)	40,868421	35,639073	3
Station-67*	YEŞİL-67	Çarşamba Sugar Factory Process Water	41,170326	36,706233	3
Station-68*	YEŞİL-68	Sames (Samsun Slaughter House and Meat Packing Industry Inc.)	41,258967	36,345313	3
Station-69	YEŞİL-69	Olmuksa International Paper Sabancı Ambalaj	40,525577	34,914168	4
Station-70	YEŞİL-70	Özmaya (Baker's-yeast)	40,686941	35,906630	4
Station-71*	YEŞİL-71	Eti-Copper Corporation	41,242688	36,461870	4

Station-72*	YEŞİL-72	Nesko Mining	40,290952	38,296925	4
Station-73	YEŞİL-73	Yemsel Poultry Husbandry	41,060149	36,094598	4
Station-74	YEŞİL-74	Hasanusta Food(grain mill products)	40,911482	35,664800	4
Station-76	YEŞİL-76	Yuva Viol Package	40,598739	34,912361	5
Station-77	YEŞİL-77	Et-Bir Suluova Slaughterhouse	40,823054	35,636581	5
Station-78	YEŞİL-78	Kozlu Food(feed products)	40,654978	35,840261	5
Station-79	YEŞİL-79	Bakraç Dairy	40,734038	35,770572	5
Station-102	YEŞİL-102	Entrance of Meray Herbaloil WWTP	40,860281	35,431734	6
Station-103	YEŞİL-103	Entrance of Merzifon OIZ WWTP	40,858726	35,463237	6
Station-110*	YEŞİL-110	Aktan Food Industry	40,884275	35,635308	6
Station-112*	YEŞİL-112	Beşgöz Araboğulları Unculuk Sanayi Cold Storage(fruit and vagetables)	40,917721	35,648131	6
Station-114*	YEŞİL-114	Gürmin Energy-Mining	40,881773	35,632456	6
Station-116	YEŞİL-116	Otat Fed(dairy products) Industry	40,975040	35,687155	6
Station-118*	YEŞİL-118	Temiz Meat Products	40,997111	35,662839	6
Station-127	YEŞİL-127	Amasya Sugar Factory	40,833889	35,640556	7
Station-129	YEŞİL-129	Aydınoğlu Flour Food	40,981389	35,688889	7
Station-131	YEŞİL-131	Doğa Water and Food(soft drink)	40,900000	36,053333	7
Station-133*	YEŞİL-133	Akçansa Cement Industry Samsun Ladik	40,935556	35,886389	7
Station-137*	YEŞİL-137	Dem-Ak Mining	40,579694	35,342321	7
Station-139*	YEŞİL-139	Makro-Win Building Materials	40,514420	34,948494	7

Station-141*	YEŞİL-141	Özpar (Parlar) Plastic	41,292737	36,252044	7
Station-143*	YEŞİL-143	Ekmekçioğulları Zinc Copper Lead Industry	40,510479	34,910806	7
Station-145*	YEŞİL-145	Gülşim Un ve İrmik	40,804801	35,659994	7
Station-146*	YEŞİL-146	Kanoğlu Flour Food Agriculture	41,002214	35,822515	7
Station-147*	YEŞİL-147	Nur Flour Industry and Trade (feed)	-	-	7
Station-148*	YEŞİL-148	Yeni Teşvikiye Feed Industry	40,943291	35,656811	7

* Cancelled stations

Table I. 4 Sampling stations of the dams and lakes in Yeşilırmak River Basin, their definitions and coordinates (TUBITAK Research Project 115Y013, 2018)

Station ID	**Code**	**Defination**	**North (N)**	**East (E)**	**The period that station was added**
Station-80	YEŞİL-80	Bedirkale Dam-1	40,033607	36,470787	6
Station-81	YEŞİL-81	Bedirkale Dam-2	40,041115	36,457206	6
Station-82	YEŞİL-82	Almus Dam -1	40,338308	37,048128	6
Station-83	YEŞİL-83	Almus Dam -2	40,354267	37,000388	6
Station-84	YEŞİL-84	Almus Dam 3	40,371216	36,964076	6
Station-85	YEŞİL-85	Almus Dam -4	40,392135	36,924821	6
Station-86	YEŞİL-86	Lake Ladik -1	40,914672	35,983784	6
Station-87	YEŞİL-87	Lake Ladik -2	40,901287	36,037295	6
Station-88	YEŞİL-88	Lake Ladik -3	40,907864	36,012335	6
Station-89	YEŞİL-89	Boztepe Dam -1	40,174900	35,864373	6
Station-90	YEŞİL-90	Boztepe Dam -2	40,174918	35,869398	6

Table I. 5 Sampling stations of agricultural irrigation-drainage systems in Yeşilırmak River Basin, their definitions and coordinates (TUBITAK Research Project 115Y013, 2018)

Station-ID	**GIS ID**	**Definition**	**North (N)**	**East (E)**	**The period that station was added**
Station-100	YEŞİL-100	Kazova Vasfi Diren (Agricultural Enterprise)	40,333426	36,140940	6
Station-101*	YEŞİL-101*	Samsun Wholesalers' Sites (SAGİMAD)	41,223350	36,487039	6

*cancelled station

Table I. 6 Sampling stations of solid waste landfill facilities in Yeşilırmak River Basin, their definitions and coordinates (TUBITAK Research Project 115Y013, 2018)

Station-ID	**Code**	**Definition**	**North (N)**	**East (E)**	**The period that station was added**
Station-135	YEŞİL-135	Samsun Solid Waste Landfill Facility	41,246382	36,220269	7
Station-136	YEŞİL-136	Amasya Solid Waste Landfill Facility	40,722075	35,742571	7

Table I. 7 Coastal Monitoring Stations, their definitions and coordinates (TUBITAK Research Project 115Y013, 2018)

Station-ID	**Code**	**Definition**	**North (N)**	**East (E)**	**The period that station was added**
Station-91	YESİL-91	Samsun -inside of the harbor	41,303278	36,346861	6
Station-92	YESİL-92	Samsun -outside of the harbor	41,305111	36,355944	6
Station-93	YESİL-93	Shore of Toros Agriculture and Eti Copper	41,248444	36,459139	6
Station-94	YESİL-94	Offshore of Toros Agriculture and Eti Copper	41,254361	36,452806	6

APPENDIX J -Possibile Industrial Sources of the Pollutants Found in Yeşilırmak River (TUBITAK Research Project 115Y013, 2016).

Table J. 1 Possible Industrial Sources of the Pollutants Found in Yeşilırmak River Basin(TUBITAK Research Project 115Y013, 2016)

Pollutant	**NACE**
Aluminium	05-10:Mining of hard coal 05-20: Mining of lignite 07-29: Mining of other non-ferrous metal ores 11-07: Manufacture of soft drinks; production of mineral waters and other bottled waters 17-12: Manufacture of paper and paperboard 17-21: Manufacture of corrugated paper and paperboard and of containers of paper and paperboard 20-15: Manufacture of fertilizers and nitrogen compounds 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 20-42: Manufacture of perfumes and toilet preparations 22-11: Manufacture of rubber tires and tubes; retreading and rebuilding of rubber tires 22-21: Manufacture of plastic plates, sheets, tubes and profiles 22-22: Manufacture of plastic packing goods 22-29: Manufacture of other plastic products 23-11: Manufacture of flat glass 23-12: Shaping and processing of flat glass 24-10: Manufacture of basic iron and steel and of ferro-alloys 25-62: Machining
Benzo[a]pyrene	20-15: Manufacture of fertilizers and nitrogen compounds 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 22-21: Manufacture of plastic plates, sheets, tubes and profiles 22-22: Manufacture of plastic packing goods 22-23: Manufacture of builders' ware of plastic 22-29:Manufacture of other plastic products 24-10: Manufacture of basic iron and steel and of ferro-alloys 25-62: Machining

Cadmium and its compounds	05-10: Mining of hard coal 05-20: Mining of lignite 07-29 : Mining of other non-ferrous metal ores 10-12: Processing and preserving of poultry meat 10-13 : Production of meat and poultry meat products 11-07 : Manufacture of soft drinks; production of mineral waters and other bottled waters 17-12 : Manufacture of paper and paperboard 20-15: Manufacture of fertilizers and nitrogen compounds 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 20-42: Manufacture of perfumes and toilet preparations 22-21: Manufacture of plastic plates, sheets, tubes and profiles 22-22 : Manufacture of plastic packing goods 22-23: Manufacture of builders' ware of plastic 22-29: Manufacture of other plastic products 23-12: Shaping and processing of flat glass 23-32: Manufacture of bricks, tiles and construction products, in baked clay 24-10: Manufacture of basic iron and steel and of ferro-alloys 24-44: Copper production 24-52: Casting of steel 24-54: Casting of other non-ferrous metals 25-62: Machining 27-12: Manufacture of electricity distribution and control apparatus, and 31-09: Manufacture of other furniture
Cobalt	05-10: Mining of hard coal 05-20: Mining of lignite 07-29: Mining of other non-ferrous metal ores 10-12: Processing and preserving of poultry meat 10-13: Production of meat and poultry meat products 11-07: Manufacture of soft drinks; production of mineral waters and other bottled waters 20-15: Manufacture of fertilizers and nitrogen compounds 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 22-11: Manufacture of rubber tires and tubes; retreading and rebuilding of rubber tires 22-21: Manufacture of plastic plates, sheets, tubes and profiles 22-29: Manufacture of other plastic products 23-11: Manufacture of flat glass 23-12: Shaping and processing of flat glass 24-10: Manufacture of basic iron and steel and of ferro-alloys 24-44: Copper production 24-54: Casting of other non-ferrous metals 31-09: Manufacture of other furniture

Chromium	05-10: Mining of hard coal 05-20: Mining of lignite 07-29: Mining of other non-ferrous metal ores 10-12: Processing and preserving of poultry meat 10-13: Production of meat and poultry meat products 11-07: Manufacture of soft drinks; production of mineral waters and other bottled waters 17-12: Manufacture of paper and paperboard 20-15: Manufacture of fertilizers and nitrogen compounds 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 20-42: Manufacture of perfumes and toilet preparations 22-11: Manufacture of rubber tires and tubes; retreading and rebuilding of rubber tires 22-21: Manufacture of plastic plates, sheets, tubes and profiles 22-29: Manufacture of other plastic products 23-11: Manufacture of flat glass 23-12: Shaping and processing of flat glass 24-10: Manufacture of basic iron and steel and of ferro-alloys 24-44: Copper production 24-54: Casting of other non-ferrous metals 25-62: Machining 31-09: Manufacture of other furniture

Copper	05-10: Mining of hard coal 05-20: Mining of lignite 07-29: Mining of other non-ferrous metal ore 10-11: Processing and preserving of meat 10-12: Processing and preserving of poultry meat 10-13: Production of meat and poultry meat products 10-81: Manufacture of sugar 10-89: Manufacture of other food products n.e.c. 11-07: Manufacture of soft drinks; production of mineral waters and other bottled waters 17-12: Manufacture of paper and paperboard 20-15: Manufacture of fertilizers and nitrogen compounds 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 20-42: Manufacture of perfumes and toilet preparations 22-21: Manufacture of plastic plates, sheets, tubes and profiles 22-29: Manufacture of other plastic products 23-11: Manufacture of flat glass 23-12: Shaping and processing of flat glass 23-52: Manufacture of lime and plaster 24-10: Manufacture of basic iron and steel and of ferro-alloys 24-44: Copper production 24-52: Casting of steel 24-54: Casting of other non-ferrous metals 25-62: Machining 27-12: Manufacture of electricity distribution and control apparatus 31-09: Manufacture of other furniture 81-29: Other cleaning activities

Iron	05-20: Mining of lignite 07-29: Mining of other non-ferrous metal ores 10-12: Processing and preserving of poultry meat 10-13: Production of meat and poultry meat products 10-81: Manufacture of sugar 10-89: Manufacture of other food products n.e.c. 11-07: Manufacture of soft drinks; production of mineral waters and other bottled waters 17-12: Manufacture of paper and paperboard 17-21: Manufacture of corrugated paper and paperboard and of containers of paper and paperboard 20-15: Manufacture of fertilizers and nitrogen compounds 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 20-42: Manufacture of perfumes and toilet preparations 22-11: Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres 22-21: Manufacture of plastic plates, sheets, tubes and profiles 22-29: Manufacture of other plastic products 23-12: Shaping and processing of flat glass 23-51: Manufacture of cement 23-52: Manufacture of lime and plaster 24-10: Manufacture of basic iron and steel and of ferro-alloys 24-52: Casting of steel 24-54: Casting of other non-ferrous metals 25-62: Machining
Mercury	05-20: Mining of lignite 07-29: Mining of other non-ferrous metal ores 17-12: Manufacture of paper and paperboard 20-15: Manufacture of fertilizers and nitrogen compounds 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 22-11: Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres 23-52: Manufacture of lime and plaster 24-10: Manufacture of basic iron and steel and of ferro-alloys 24-44: Copper production 24-54: Casting of other non-ferrous metals 25-62: Machining 27-12: Manufacture of electricity distribution and control apparatus 31-09: Manufacture of other furniture

Nickel and its compounds	05-10: Mining of hard coal 05-20: Mining of lignite 07-29: Mining of other non-ferrous metal ores 10-12: Processing and preserving of poultry meat 10-13: Production of meat and poultry meat products 17-12: Manufacture of paper and paperboard 17-21: Manufacture of corrugated paper and paperboard and of containers of paper and paperboard 20-15: Manufacture of fertilisers and nitrogen compounds 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 20-42: Manufacture of perfumes and toilet preparations 22-29: Manufacture of other plastic products 23-11: Manufacture of flat glass 23-12: Shaping and processing of flat glass 23-52: Manufacture of lime and plaster 24-10: Manufacture of basic iron and steel and of ferro-alloys 24-44: Copper production 24-52: Casting of steel 24-54: Casting of other non-ferrous metals 29-32: Manufacture of other parts and accessories for motor vehicles
Lead and its compounds	05-10: Mining of hard coal 05-20: Mining of lignite 07-29: Mining of other non-ferrous metal ores 10-12: Processing and preserving of poultry meat 10-13: Production of meat and poultry meat products 10-81: Manufacture of sugar 11-07: Manufacture of soft drinks; production of mineral waters and other bottled waters 17-12: Manufacture of paper and paperboard 17-21: Manufacture of corrugated paper and paperboard and of containers of paper and paperboard 20-15: Manufacture of fertilisers and nitrogen compounds 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 20-42: Manufacture of perfumes and toilet preparations 22-21: Manufacture of plastic plates, sheets, tubes and profiles 23-11: Manufacture of flat glass 23-12: Shaping and processing of flat glass 23-32: Manufacture of bricks, tiles and construction products, in baked clay 24-10: Manufacture of basic iron and steel and of ferro-alloys 24-44: Copper production 24-52: Casting of steel 24-54: Casting of other non-ferrous metals 25-62: Machining

Antimony	05-20: Mining of lignite 07-29: Mining of other non-ferrous metal ores 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 22-21: Manufacture of plastic plates, sheets, tubes and profiles, 22-22: Manufacture of plastic packing goods, 22-23: Manufacture of builders' ware of plastic, 22-29: Manufacture of other plastic products 23-11: Manufacture of flat glass 23-12: Shaping and processing of flat glass 23-52: Manufacture of lime and plaster 24-42: Aluminium production 24-44: Copper production 24-54: Casting of other non-ferrous metals
Free cyanide	07-29: Mining of other non-ferrous metal ores 24-10: Manufacture of basic iron and steel and of ferro-alloys 24-42: Aluminium production 24-44: Copper production 24-54: Casting of other non-ferrous metals 25-62: Machining
Silicon	11-07: Manufacture of soft drinks; production of mineral waters and other bottled waters (at bottle production stage) 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 24-10: Manufacture of basic iron and steel and of ferro-alloys
Vanadium	05-10: Mining of hard coal 05-20: Mining of lignite 07-29: Mining of other non-ferrous metal ores 10-12: Processing and preserving of poultry meat 10-13: Production of meat and poultry meat products 20-15: Manufacture of fertilizers and nitrogen compounds 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 24-10: Manufacture of basic iron and steel and of ferro-alloys 24-54: Casting of other non-ferrous metals

Zinc	05-10: Mining of hard coal 05-20: Mining of lignite 07-29: Mining of other non-ferrous metal ores 10-11: Processing and preserving of meat 10-12: Processing and preserving of poultry meat 10-13: Production of meat and poultry meat products 10-81: Manufacture of sugar 10-89: Manufacture of other food products n.e.c. 11-07: Manufacture of soft drinks; production of mineral waters and other bottled waters 17-12: Manufacture of paper and paperboard 17-21: Manufacture of corrugated paper and paperboard and of containers of paper and paperboard 20-30: Manufacture of paints, varnishes and similar coatings, printing ink and mastics 20-42: Manufacture of perfumes and toilet preparations 22-21: Manufacture of plastic plates, sheets, tubes and profiles, 22-29: Manufacture of other plastic products 23-11: Manufacture of flat glass 23-12: Shaping and processing of flat glass 23-32: Manufacture of bricks, tiles and construction products, in baked clay 24-10: Manufacture of basic iron and steel and of ferro-alloys 24-44: Copper production, 24-52:Casting of steel, 24-54:Casting of other non-ferrous metals, 25-62: Machining, 27-12: Manufacture of electricity distribution and control apparatus 29-32: Manufacture of other parts and accessories for motor vehicles 31-09: Manufacture of other furniture 81-29: Other cleaning activities