The Legibility and Visibility of Topographical Maps

Süleyman Savaş Durduran[1], Aslı Bozdağ[2], Fatih Temiz[3], Münevver Gizem Gümüş[4]
Necmettin Erbakan Üniversitesi[1, 3], Ömer Halisdemir Üniversitesi[2, 4], Geomatics Engineering [1, 2, 3, 4]
ssdurduran@konya.edu.tr[1] , aslibozdag@ohu.edu.tr,[2] fatih.temiz@hgk.msb.gov.tr[3] , gizemkisaaga@ohu.edu.tr[4]

Abstract- Topographic Maps are the ones that can best reflect geographical objects and their relations with each other in the earth. Topographic Maps are produced by General Command of Mapping in Turkey. With the technological developments in the world, the expectations of the users from the topographic maps are changing. Topographic maps should be accurate, complete, relevant to usage, clear, understandable and legible for each user. In terms of ensuring these criteria Hierarchical Organization of Texts and Text Maps are of crucial importance. In this study, the legibility and visibility of topographic maps are examined by working on text font types, sizes and colors which are the basic materials of typography. The texts that matter more to the user have been emphasized on the map, and by removing the texts that unnecessarily take up space on the map, the visibility of topographical details have been improved.

Index Terms- Legibility, Topographical Maps, Typography.

1. INTRODUCTION

Topographic maps are the products in which natural and artificial details on the terrain are improved and contour lines drawn based on aerial photographs or satellite images and such information is presented to the end user with certain markings and legends [11].

Currently produced by the General Command of Cartography, the Topographical Maps are produced on three scales: 1:25.000, 1:50.000 and 1:100.000. Of those maps, the ones with the scales of 1:50.000 and 1:100.000 are produced based on 1:25.000 scale topographic maps using generalization method. The degree of generalization is largely determined by the scale of the map. In addition to determining the way in which the objects appear on the map, the scale also significantly determines the texts pertaining to such objects. Text optimization can be performed on a map based on the level of scaling.

In addition to the text optimization conducted on the 1:50.000 and 1:100.000 scale Standard Topographic Maps by the General Command of Cartography through the use of Computer Aided Generalization since 2005, there have been studies conducted on text fonts to further improve the legibility of such maps in line with the principles of the art of typography.

2. TYPOGRAPHY

There is a number of definitions for typography: The fact that it has multiple definitions reflects the complexity and broad impact of typography. Typography underscores the importance of new technology and the ongoing necessity of adapting the current details for the future user [1].

Generally speaking, typography is an art of design that is capable of establishing contact with people through the printed world. Typography must be clear. It should also follow a logical sequence and be used in a manner consistent with the philosophy of reading that is alphabetically linear [12].

2.1. Fonts

Each typeface has a name that informs its identity. Those names may be determined by the name of their designer, as in the cases of Baskerville and Garamond, or by the region or country in which they are created, as in the case of Americana, or based on the mentality of typeface design, as in the cases of Times Roman and Putura [7].

Typefaces, of which there are now thousands of them, are divided into four main groups. These groups include Quoted (serif/jagged) fonts, Unquoted (sans serif/non-jagged) fonts, Italics and Decorative (special) fonts [2].

2.1.1. Roman

By definition, Roman fonts consist of thin and thick font structures. The Roman font gave birth to a multitude of styles depending on geographical location, culture, politics and technology [9].

2.1.2. Italic

Today, the Italic font is primarily used for emphasizing or making a distinction within a text. Italic fonts are not usually employed in the works of art save for special purposes. They are generally used for emphasizing certain a word or words within the body of a text [4].

2.1.3. Serif (Quoted)

The use of such fonts makes reading easier in long texts such as newspapers, books and reports and creates a visual integrity thanks to the quotes. Times

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Roman is one of the most successful examples of this particular style, which is preferred by most newspapers around the from the 1900s onwards [6].

2.1.4. *Sans Serif (Non-Quoted)*

Due its simplicity and clear appearance, this font is employed when using space or thick letters. However, when formed within a text, they slow down the reading rate. The use of such mid weight recognized sans serif font types as Helvetica, Futura and Gill is less convenient in a text [5].

2.2. *Certain basic rules of typography*

One should be familiar with the following certain rules when conducting typographical works:

- Fonts with recognized superiority should be chosen to improve legibility.
- Use of various different fonts should be avoided.
- Fonts with similar appearance should not be used together.
- Font size should be determined so as to be read comfortably from an average distance of 30 to 35 cm. This approximately starts from a font size of 8.
- Use of remarkably different font sizes should be avoided.
- There should be sufficient contrast between the text and background when working with text and color [3].

2.3. *Lists of items Visual perception and legibility*

The reaction induced by a stimulant from within our body or outside environment though our sense organs is called "sensation", whereas the interpretation of a stimulant registered in brain through one or more of sense organs is called "perception" [8].

Legibility is a term used to define the quality that is sought for in the fonts, words, pages of a book, brochures, leaflets, signboards and various other different forms. It is the relative convenience that is provided through such elements as typesetting, page design, spacing, in short every aspect of a page. When we say that something is legible, we mean that others can read it under the circumstances which we assume they will see the text based on our opinion and experiences [10].

Despite the fact that legibility is one of the fundamental principles in text, many designers compromise on legibility in favor of a neat layout design. Appealing to the eye from a pure aesthetic sense is not sufficient when choosing the font of a text, the font should be legible as well. Preference should be made in favor of the fonts that are caught by the eye immediately and facilitate reading. According to most people, a design should not included more

than three fonts. A priority based hierarchy should be created in line with the preference of the reader.

2.4. *Selection of fonts in topographical maps*

The main criterion in choosing fonts is compatibility and relationship between other details. The use of plain and straight fonts is more suitable for educational and instructional texts. The fonts are divided into two types: Serif and Sans Serif. Serif fonts include Times New Roman and Georgia, which are generally used for dominant details. However, the Sans serif fonts are less decorative as compared to the Serif fonts. These include Arial, Verdana and Helvetica style fonts. Sans serif fonts are more suitable for transparent and reflected visual materials and they improve legibility further (Table 1).

Table 1. The types of the fonts

Serif	Sans Serif
Times New Roman	Arial

The difference in font sizes should be easily perceived by the user. For instance, printing the name of a settlement - which is originally printed with the font size of 10- with the font size of 9 will be meaningless. Because the user will not be able to spot the difference between the two sizes. For an approximate font size of 10, a two figure can be distinguished. That is to say, the font sizes of 8-10-12 should be used instead of font sizes of 9-10-11.

The excess of fonts that are chosen to be used in a map presents a disadvantage for both the user and cartographer. For this reason, care should be taken in ensuring that the fonts chosen are plain. Choosing fonts out of the commonly used ones will also benefit the user in web based applications. The use of legible fonts that are easy to pick out will help terrain details to stand out especially in detail-rich topographical maps.

Quoted fonts are more decipherable than that of non-quoted ones. The fact that the quoted fonts are always easier to read and understood is still a controversial subject according to some sources. Thanks to the quotes, human eye is easily able to switch from one font to another or the difference between lines in terms of thinness or thickness renders the quoted fonts more easily understandable. On the other hand, some sources suggest that the non-quoted fonts appear far too similar to each other, and this, in turn, complicates their legibility. For instance, the upper case letter I and l (lower case L) and the number 1 (one) can be mistaken for one another in some non-quoted fonts [13].

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3. CASE STUDY

The standard 1:25.000 scale topographic maps are produced in a computer assisted manner since 1999. While the 1:50.000 and 1:100.000 scale topographic maps are produced based on automatic generalization method, as part of the Kartogen project, since 2005. The topographical maps in question have been produced using the fonts provided in the A-1 until 2010. Some of the issues identified with the fonts used are as follows:

- Since the fonts used are not the commonly employed typefaces, there have been typo related issues when numerical data was used by other users (A-1)
- The fonts are not typographically easily legible (Figure 1).
- Considering hierarchy of settlement areas, and since the font used for a village is the same size as the fonts used for neighbor or similar settlement areas within that village, the user has difficulty picking out the names. (Figure 1).
- For the user of topographic maps, the names of official buildings that are unnecessary to be shown on particularly small scale maps appear to be more dominant than other texts on the maps. (Figure 2).
- The texts pertaining to the hills, mountains, hill side and localities are not easily visible (Figure 3).
- Different fonts are used on topographic maps depending on the number of details and features, thus there is a lack of unified, standard use.

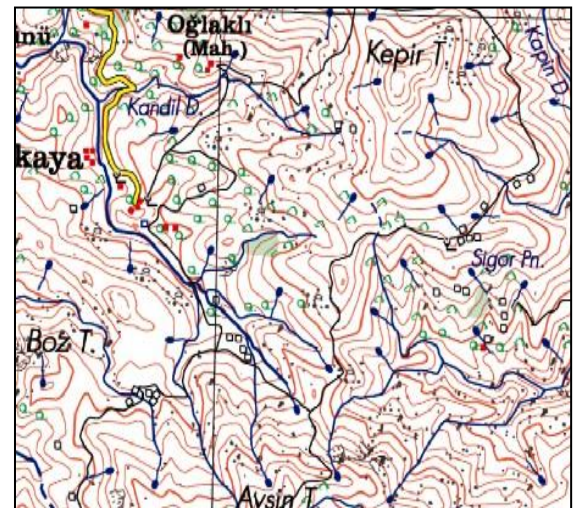Fig. 2. The text (official buildings) are more dominant than other texts

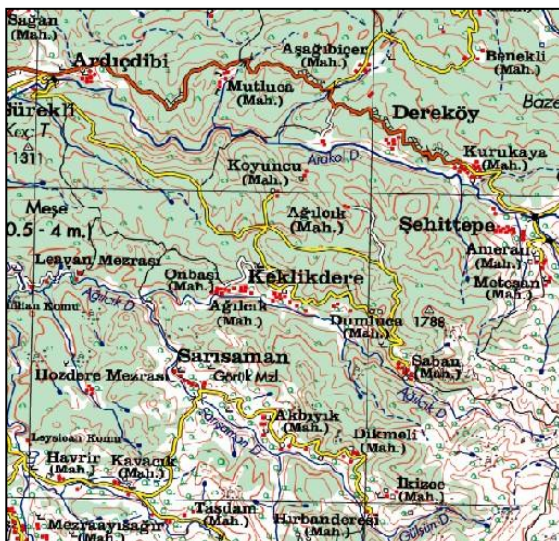Fig. 3. The texts are not easily visible (hills, mountains, hill side and localities)

Choosing the font right improves the quality of the work. The catalogue for font types, sizes, colors for 1:25.000, 1:50.000 and 1:100.000 scale topographic maps has been reorganized in A-2. Times New Roman (quoted) has been used for printing the names of provinces, counties, districts and villages on the maps. This way -since the serif/quoted font is easily traceable- the legibility of the settlement names on the maps has been improved. Arial (sans serif/non-quoted) has been used for printing the texts of neighbor, quarters, hamlets, plateaus to improve the legibility against dark backgrounds.

A hierarchy has been applied for the names of settlements in terms of font size and typeface, thus the abbreviation (Mah.) has been removed for the areas falling under the names of Neighbor (Figure 4). Since the abbreviation (Dist.) would no longer be used, the legend section of the map has been added a sample of

Fig. 1. Low legibility fonts

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each of the fonts used for village and district names to inform the reader (Figure 5).

The font type, size and color pertaining to the details of vegetation have been changed to better associate them with the details to which they belong (Figure 6).
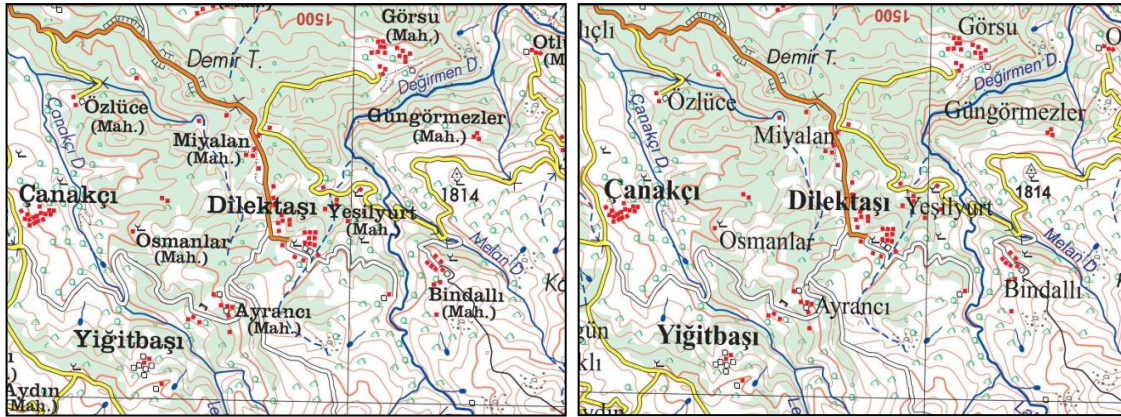

Fig. 4. This is the caption for the figure. If the caption is less than one line then it needs to be manually centered.

Fig. 5. The legend section of the map

Fig. 6. The details of vegetation have been changed

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In order to render details that inform significant heights on topographical maps more legible, the fonts and special signifier colors indicating the heights of antennas and chimneys have been changed (Figure 7).

- The texts of mountains, hills, hill side and localities have been made more prominent,
- The names of official buildings in a settlement area has been rendered less visible,
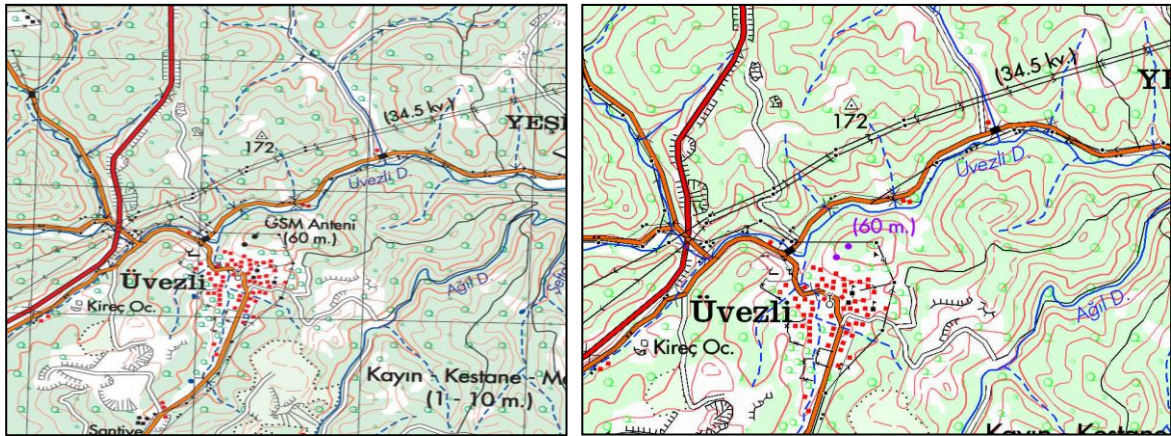

Fig. 7. The antennas and chimneys have been changed

With the aforementioned changes:
- Legibility of topographical maps have been improved,
- The area taken up by texts signifying a detail on the map have been reduced and the visibility of details increased,
- The names of settlements in a village on topographical maps have been made more prominent,
- The text catalogue (A-1) used in the production of topographical maps has been rendered more understandable,

- The variation of font size depending on the number of details and features has been eliminated,
- The more commonly used fonts have been chosen.

A comparative assessment of the current situation is presented below (Figure 8):
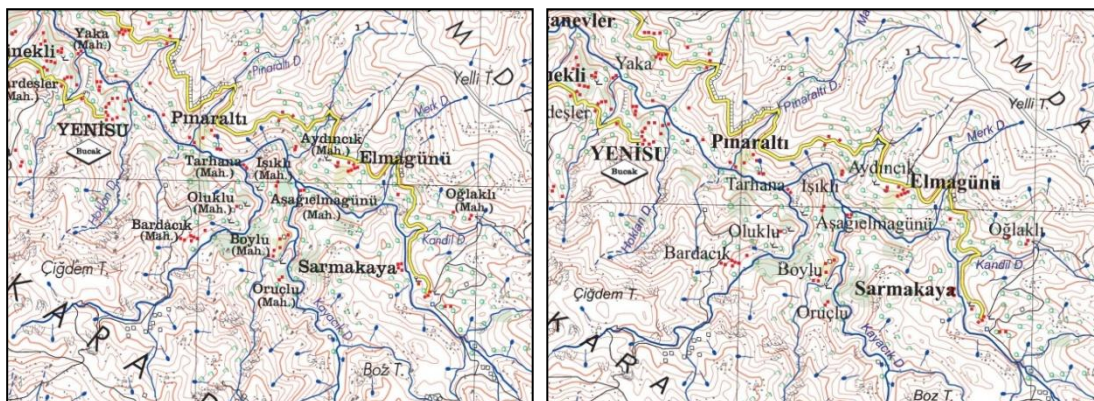

Fig. 8. A comparative assessment of the current situation

4. CONCLUSION

Topographical maps are of great importance in that they are used both by the Turkish Armed Forces and Official Institutions. They provide the user with highly detailed information based on their scale. Legibility and visibility of texts used on a map are significant considerations for a good and usable map.

The present study has addressed the font types, sizes and colors used on topographical maps, using the more commonly preferred and more easily legible and visible fonts. The texts that matter more to the user have been emphasized on the map, and by removing the texts that unnecessarily take up space on the map, the visibility of topographical details have been improved.

The font catalogue that was prepared for the said three scales has been applied in a standard manner. The variation of font size with respect to the number of details and features has thus been eliminated.

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Appendix
A-1
Text Catalog to 1:25 000, 1:50 000 and 1:100 000 Scored Plots

No	Areas Where Text is Used	Sample Text	Font	Punto
1	TITLE SERIES	**BOLU H28-a**	Hendrix Narrow+Bold	30
2	TITLE SERIES (Small)	**ANKARA-İ29-b1**	Hendrix Narrow + Bold	9
3	PROVINCIAL CENTERS	**KONYA**	Verdi + Bold	12
4	PROVINCIAL CENTERS	**KONYA**	Verdi + Bold	14
5	PROVINCIAL CENTERS	**KONYA**	Verdi + Bold	16
6	PROVINCIAL CENTERS	**KONYA**	Verdi + Bold	18
7	PROVINCIAL CENTERS	**KONYA**	Verdi + Bold	20
8	PROVINCIAL CENTERS	**KONYA**	Verdi + Bold	22
9	PROVINCIAL CENTERS	**KONYA**	Verdi + Bold	24
10	PROVINCIAL CENTERS	**KONYA**	Verdi + Bold	26
11	PROVINCIAL CENTERS	**KONYA**	Verdi + Bold	28
12	COUNTY CENTER and VILLAGES	KEÇİÖREN BAYAT	Verdi	10
13	SUB-DISTRICT, NEİGHBORHOOD AND SMALL PLACE NAMES	Gölbaşı Karaağaç İlker Macunköy	Verdi	9
14	NEİGHBORHOOD, HAMLET, FOLD, PLATEAU	Güzelköy Menteşe P. Kara F.	Verdi	7
15	FOLD and PLATEAU	Kuzucular Fold Davraz P.	Verdi	5
16	HILLS, HILLSIDES, MOUNTAINS	Sivri H. Uzun Hs. KARADAĞ	Beatles Light + İtalik	8
17	HILLS, HILLSIDES, MOUNTAINS	Sivri H. Uzun Hs. KARADAĞ	Beatles Light + İtalik	10
18	HILLS, HILLSIDES, MOUNTAINS	Sivri H. Uzun Hs. KARADAĞ	Beatles Light + İtalik	12
19	HILLS, HILLSIDES, MOUNTAINS	Sivri H. Uzun Hs. KARADAĞ	Beatles Light + İtalik	14
20	HILLS, HILLSIDES, MOUNTAINS	Sivri H. Uzun Hs.	Beatles Light + İtalik	16

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		KARADAĞ		
21	BIG MOUNTAINS	HASAN MOUNTAIN	Beatles Light + İtalik	10

A-2
1:25 000, 1:50 000 and 1:100 000 Scored Topographic Map
Font and Punto Catalog Used in The Texts

Areas Where Text is Used	Sample Texts	Font	Size	Italic	Thickness
PROVINCIAL NAMES	**KASTAMONU**	Times New Roman	**12**		*
PROVINCIAL NAMES	**KASTAMONU**	Times New Roman	**14**		*
PROVINCIAL NAMES	**KASTAMONU**	Times New Roman	**16**		*
PROVINCIAL NAMES	**KASTAMONU**	Times New Roman	**18**		*
PROVINCIAL NAMES	**KASTAMONU**	Times New Roman	**20**		*
PROVINCIAL NAMES	**KASTAMONU**	Times New Roman	**22**		*
PROVINCIAL NAMES	**KASTAMONU**	Times New Roman	**24**		*
COUNTRIES NAMES	**TOSYA**	Times New Roman	**11**		*
DİSTRİCT NAMES	**YAYLA**	Times New Roman	**10**		*
VILLAGE NAMES	**Çifter**	Times New Roman	**10**		*
CENTRAL DİSTRİCT NAMES	**Hadımköy**	Times New Roman	**9**		*
NEİGHBORHOOD NAMES	Çiğiltepe	Times New Roman	**9**		
LOCALITY NAMES	**CEBECİ**	Times New Roman	**8**		*
OLD VILLAGE NAMES	Akbük	Times New Roman	**8**		
HAMLET, FOLD, PLATEAU,QUARTER AND SMALL PLACE NAMES	Çifter Y., Kayı Housetops, Ahmetin Fold, Yayla Dwelling (Çadırlı), Resort, Cooperative Housing Society, Summerhouse	Times New Roman	**7**		
OLD PLACEMENT LOCATION TEXT	(OLD PLACEMENT LOCATION)	Times New Roman	**6**		

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HILL, HILLSIDE, GATEWAY AND LOCALITY NAMES	*Kartal T., Zigana Gateway, Göynük Sr., Gazitepe, Cennet Mğ., Çatak Canyon, ÇATAK Canyon, KÜRE MOUNTAIN NATIONAL PARK , Beach*	Arial	**7**	∗
HILL, HILLSIDE, GATEWAY AND LOCALITY NAMES	*Kartal T., Zigana Gateway, Göynük Sr., Gazitepe, Cennet Mğ., Çatak Canyon, ÇATAK Canyon, KÜRE MOUNTAIN NATIONAL PARK , Beach*	Arial	**9**	∗
HILL, HILLSIDE, GATEWAY AND LOCALITY NAMES	*Kartal T., Zigana Gateway, Göynük Sr., Gazitepe, Cennet Mg., Çatak Canyon, ÇATAK Canyon, KÜRE MOUNTAIN NATIONAL PARK , Beach*	Arial	**11**	∗
HILL, HILLSIDE, GATEWAY AND LOCALITY NAMES	*Kartal T., Zigana Gateway, Göynük Sr.*	Arial	**13**	∗
LOCALITY NAMES	*(Mvk.)*	Arial	**6**	∗
MOUNTAIN NAMES	*ULUDAĞ, AĞRI MOUNTAIN, KÜRE MOUNTAINS*	Arial	**8**	∗
MOUNTAIN NAMES	*ULUDAĞ, AĞRI MOUNTAIN, KÜRE MOUNTAINS*	Arial	**10**	∗
MOUNTAIN NAMES	*ULUDAĞ, AĞRI MOUNTAIN, KÜRE MOUNTAINS*	Arial	**12**	∗
MOUNTAIN NAMES	*ULUDAĞ, AĞRI MOUNTAIN, KÜRE MOUNTAINS*	Arial	**14**	∗
MOUNTAIN NAMES	*ULUDAĞ, AĞRI MOUNTAIN, KÜRE MOUNTAINS*	Arial	**16**	∗
MOUNTAIN NAMES	*ULUDAĞ, AĞRI MOUNTAIN, KÜRE MOUNTAINS*	Arial	**18**	∗
MOUNTAIN NAMES	*ULUDAĞ, AĞRI MOUNTAIN, KÜRE MOUNTAINS*	Arial	**20**	∗
MOUNTAIN NAMES	*ULUDAĞ, AĞRI MOUNTAIN, KÜRE MOUNTAINS*	Arial	**22**	∗
VEGETATION AND METRIC	*Atabeyin Bağı,* *Pine - Poplar - Fir (1 – 5 m.)*	Arial	**6**	∗
VEGETATION AND METRIC	*Atabeyin Bağı,* *Pine - Poplar - Fir (1 – 5 m.)*	Arial	**7**	∗

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BUILDING AND FACILITIES TEXTS	Cottage Hospital, INDUSTRY AREA , Bent, (34.5 kv.), TCK, Colliery,İpsala Berm, Mahmuz (No:665), Fish Farming, Holiday Village, Education and Recreation Facilities, Hotel, Camping Site, Holiday Village, Beach (if the official building exists)	Arial	6		
BUILDING AND FACILITIES TEXTS	INDUSTRY AREA , Bent, TCK,	Arial	8		
BUILDING AND FACILITIES TEXTS	INDUSTRY AREA , Bent, TCK	Arial	10		
BUILDING AND FACILITIES TEXTS	INDUSTRY AREA , Bent, TCK	Arial	12		
ANTENNA-FLUE TEXTS AND HEIGHT	(40 m.), GSM , TV Transmitter, GSM, TV Transmitter (35 m.) (25 m.)	Arial	6		
HEIGHT TEXTS	1299, 1453, 1923	Arial	6		
STREAM NAMES	*Ulu S., Şehit St., Irrigation Channel (8 m.), (549 m.) SANLIURFA IRRIGATION TUNNEL (25 m.), Fish Production Pool*	Arial	6	∗	
IMPORTANT STREAM, BROOK, FLOOD AND RIVER NAMES	*Ulu S., Devrez Br., Sakarya Fl., FIRAT R., Kızılırmak*	Arial	8	∗	
IMPORTANT STREAM, BROOK, FLOOD AND RIVER NAMES	*Sakarya Fl., FIRAT R., KIZILIRMAK*	Arial	10	∗	
IMPORTANT STREAM, BROOK, FLOOD AND RIVER NAMES	*Sakarya Fl., FIRAT R., KIZILIRMAK*	Arial	12	∗	
IMPORTANT STREAM, BROOK, FLOOD AND RIVER NAMES	*Sakarya Fl., FIRAT R., KIZILIRMAK*	Arial	14	∗	
IMPORTANT STREAM, BROOK, FLOOD AND RIVER NAMES	*Sakarya Fl., FIRAT R., KIZILIRMAK*	Arial	16	∗	
LAKE, POND, DAM AND MARINE NAMES	*Dipsizgöl, Nazik L., Özlüce Dam , Akdoğan Pond*	Arial	6	∗	
LAKE, POND, DAM AND MARINE NAMES	*Dipsizgöl, Nazik L., Özlüce Dam , Akdoğan Pond*	Arial	8	∗	
LAKE, POND, DAM AND MARINE NAMES	*ATATÜRK DAM LAKE, Van L., TUZ LAKE*	Arial	10	∗	
LAKE, POND, DAM AND MARINE NAMES	*ATATÜRK DAM LAKE, Van L. TUZ LAKE*	Arial	12	∗	
LAKE, POND, DAM AND MARINE NAMES	*MEDITERRANEAN, BLACK SEA*	Arial	14	∗	
LAKE, POND, DAM AND MARINE NAMES	*MEDITERRANEAN, BLACK SEA*	Arial	16	∗	
LAKE, POND, DAM AND MARINE NAMES	*MEDITERRANEAN, BLACK SEA*	Arial	18	∗	

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LAKE, POND, DAM AND MARINE NAMES	*MEDITERRANEAN, BLACK SEA*	Arial	**20**	∗	
LAKE, POND, DAM AND MARINE NAMES	*MEDITERRANEAN, BLACK SEA*	Arial	**22**	∗	
LAKE, POND, DAM AND MARINE NAMES	*MEDITERRANEAN, BLACK SEA*	Arial	**24**	∗	
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**6**		∗
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**8**		∗
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**10**		∗
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**12**		∗
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**14**		∗
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**16**		∗
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**18**		∗
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**20**		∗
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**22**		∗
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**24**		∗
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**26**		∗
COUNTRY NAMES	**TURKEY, SYRIA**	Arial Narrow	**28**		∗
OFFICIAL BUILDING NUMBER	1, 2, 3, 4, 5	Arial	**6**		
NEIGHBORHOOD NUMBER	**1, 2, 3, 4, 5**	Times New Roman	**8**		∗
CONTOUR HEIGHT WRITING	**1300, 1500, 4100**	Arial	**6**		∗
CONTOUR HEIGHT WRITING	**1300, 5100, 4100**	Arial	**6**		∗

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MULTIPLE HEIGHT WRITING	**1300, 5100, 4100**	Arial	**6**		**∗**
ROAD NUMBER	D 250	Arial	**6**		