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Sustainable Management of the West Bank and Gaza Aquifers

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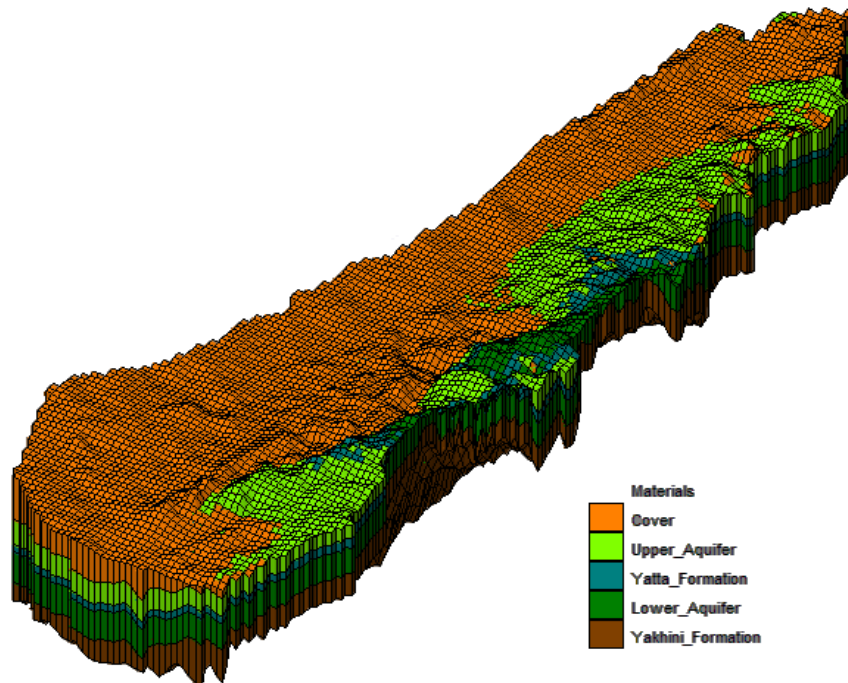
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Conceptual Flow Model of the Western Aquifer Basin



Final Report
SUSMAQ-MOD # 06 V 0.4

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<p>Disclaimer</p> <p>This report is an output from the Modelling Study Team, part of the SUSMAQ project.</p> <p>The findings, interpretations and conclusions expressed are those of the authors (the team) and should not be attributed to other collaborators on the SUSMAQ project.</p> <p>The project does not guarantee the accuracy of the data included in this publication. Boundaries, colours, denominations and other information shown in maps, figures, tables and the text does not imply any judgment on legal status of territory or the endorsement of boundaries. The typescript of this paper has not been prepared in accordance with procedures appropriate to formal printed texts, and the partners and funding agency accept no responsibility for errors.</p>	<p>Contact Details</p> <p>Professor Enda O’Connell Project Director University of Newcastle upon Tyne Tel: 0191 222 6405 Fax: 0191 222 6669 Email: P.E.O’Connell@ncl.ac.uk</p> <p>Engineer Fadle Kawash Deputy Chairman Palestinian Water Authority Ramallah, Palestine Tel:02 295 9022 Fax 02 2981341 Email: fkawash@pwa-pna.org</p> <p>Dr. Amjad Aliewi Operations and Technical Manager Team Leader, Hydrogeology and Flow Modelling Sunrise Building Al-Irsal Road Al-Bireh/Ramallah, Palestine Tel. 02 298 89 40 Fax. 02 298 89 41 e-mail: a.s.aliawi@susmaq.org</p>
<p>The SUSMAQ Project</p> <p>The aim of the project is to increase understanding of the sustainable yield of the West Bank and Gaza aquifers under a range of future economic, demographic and land use scenarios, and evaluate alternative groundwater management options. The project is interdisciplinary, bringing together hydrogeologists and groundwater modellers with economists and policy experts. In this way, hydrogeological understanding can inform, and be informed by, insights from the social sciences. The results of the study will provide support to decision-making at all levels in relation to the sustainable yield of the West Bank and Gaza aquifers.</p> <p>The project runs from November 1999 to October 2004, and is a partnership between the Palestinian Water Authority, University of Newcastle and the British Geological Survey. The project is funded by the United Kingdom’s Department for International Development (DFID).</p>	<p>The Hydrogeology and Flow Modelling is part of the SUSMAQ project.</p> <p>The Modelling study focuses on the geology and hydrogeology of the Western Aquifer Basin (WAB), its inflows (recharge) and outflows (spring and well abstractions). The conceptual model is followed by a numerical model, using the GMS software modelling code.</p> <p>This report aims to set up a conceptual hydrogeological model of the WAB.</p>
<p>Bibliographical Reference</p> <p>Conceptual Flow Model of the Western Aquifer Basin. Report No.: SUSMAQ-MOD # 06 V 0.4, Sustainable Management for the West Bank and Gaza Aquifers, Palestinian Water Authority (Palestine) and University of Newcastle upon Tyne (UK).</p> <p>Study Team <i>Newcastle University/SUSMAQ</i>: Dr. Amjad Aliewi- Team Leader, Dr. Geoff Parkin – Modelling Advisor, Eng. Muath Abu Saada- GIS and Modeller. <i>PWA/SUSMAQ</i>: Abbas Kalbouneh, Hydrogeology Researcher; Eng. Raslan Yassin- Modelling Researcher; Hydrogeo. Clemens Messerschmid-Research and Coordination Advisor. <i>Contributors from the PWA/Water Resources and Planning Directorate</i>: Eng. Omar Awwad, Eng. Khalil Saleh, Hydrogeologist. Omar Zayed, Eng. Adel Yassin, Eng. Deeb Abdul Ghafour.</p>	<p>Feedback</p> <p>The SUSMAQ and PWA teams will appreciate any feedback on this report. Feedback should be sent to the above contacts.</p>

Table of Contents

	Page
1. Introduction	4
2. The principles of a conceptual model	7
3. Aquifer Boundaries	8
3.1 Geographical regions	8
3.2 Hydraulic boundaries	10
3.2.1 Introduction	10
3.2.2 No-Flow boundaries of WAB	10
4. Western Aquifer Basin Geometry	15
4.1 Hydrostratigraphy and aquifer units	15
4.2 Aquifer Unit Thicknesses	17
4.2.1 Approach	17
4.2.2 Determination of thicknesses of different formations	17
4.2.3 Notes on some cases of WAB geometry	29
4.3 Connection between Aquifers	40
4.3.1 Structural effect	40
4.3.2 Hydraulic connections	42
5. Hydrological stresses	47
5.1 Recharge estimation	47
5.1.1 Introduction	47
5.1.2 Recharge from rainfall	50
5.1.3 Recharge from return flows	58
5.1.4 Artificial recharge (Injection)	64
5.1.5 Seawater intrusion	65
5.1.6 Total Recharge	65
6. Well abstractions and spring discharges	67
6.1 Well abstractions	67
6.1.1 Sources of information	67
6.2 Springs discharge	70
7. The flow system of WAB	73
7.1 Water Levels	73
7.2 Groundwater flow patterns and dry zones	79
7.3 Aquifer hydraulic and physical properties	80
7.3.1 The confinement line and storage coefficients	80
7.3.2 Hydraulic conductivity and Transmissivity	80
7.3.3 Aquifer porosity	83
8. Bibliography	84
9. Appendix A: Wells used in WAB model	87

List of figures

	Page
Figure 1.1: Location map of the Western Aquifer Basin	4
Figure 1.2: Geological map of the Western Aquifer Basin (WAB)	6
Figure 3.1: The Geographical Regions of WAB SUSMAQ 2003	9
Figure 3.2: Western Basin Model Boundaries	11
Figure 4.1: Hydrogeological Map of the WAB	16
Figure 4.2: Structural Map of the Top of Mountain Aquifer (Judea Group)	18
Figure 4.3: Structural Map of the Top of Telamim Formation	19
Figure 4.4: Dalia Marl Location in WAB, SUSMAQ 2003	21
Figure 4.5: Location where Dalia marl thickness was deducted from UA	22
Figure 4.6: Location where the LA is located directly underneath Saqia Group	23
Figure 4.7: Upper Aquifer Thickness Zones-WAB	25
Figure 4.8: Yatta Formation Thickness Zones-WAB	26
Figure 4.9: Lower Aquifer Thickness Zones-WAB	27
Figure 4.10: Yakhini Formation Thickness Zones-WAB	28
Figure 4.11: Mountain Aquifer Thickness Zones-Judea Group, WAB	30
Figure 4.12: Effect of truncation on Upper Aquifer	31
Figure 4.13: Boundaries of Upper Aquifer within WAB	32
Figure 4.14: Effect of lithofacies on WAB Boundary	33
Figure 4.15a: Upper Aquifer surrounded by Yatta formation (W-E)	34
Figure 4.15b: Upper Aquifer surrounded by Yatta formation (S-N)	34
Figure 4.16: Geological Map of Upper Aquifer Isolation WAB	35
Figure 4.17a: Ain Karem Sub-basin (E-W)	36
Figure 4.17b: Ain Karem Sub-basin (S-W)	36
Figure 4.18: Geological Map of Ain Karim Sub Basin WAB	37
Figure 4.19: Aquifer connections in the Northern Negev	41
Figure 4.20: Zones of Vertical Connectivity between UA and LA	43
Figure 4.21: Conceptual Understanding of Water Levels in WAB from Field Data including Values of Target Wells	45
Figure 5.1: Schematic illustration of recharge to UA from shallow aquifer	49
Figure 5.2: Rainfall Map of the Western Basin – Done by Itlas of Israel	51
Figure 5.3: Rainfall Map for the Western Basin – Done by SUSMAQ	52
Figure 5.4: Layers Outcroppings in the Western Basin	54
Figure 5.5: Recharge Zones from Rainfall for the Western Basin	55
Figure 5.6: Yatta Formations Percentage of Aquiferous Nature	56
Figure 5.7: Recharge from Runoff for the Western Basin	61
Figure 5.8: Sewage Wadis in the Western Basin	62
Figure 5.9: Recharge zones in the Western Basin	66
Figure 6.1: Total well abstractions of WAB	68
Figure 6.2: Wells Locations and their Abstractions (1993-1998)	69
Figure 6.3: Taninim springs and aquifer connection along Benyamina fault	71
Figure 6.4: The Connection between the Taninim Spring Discharge and Groundwater Level in Cell 210	72
Figure 7.1: Steady State Water Levels Results for the UA-WAB Before Utilization	74
Figure 7.2: Steady State Water Levels Results for the LA-WAB Before Utilization	75
Figure 7.3: Steady State Water Levels Results for the UA-WAB Period (93-98)	76
Figure 7.4: Steady State Water Levels Results for the LA-WAB Period (93-98)	77
Figure 7.5: 1993 Water levels of WAB, compiled from Israeli sources	78
Figure 7.7: Hydraulic Conductivity Zones for UA	81
Figure 7.8: Hydraulic Conductivity Zones for LA	82

List of tables

Table 4.1: Chrono-litho and hydrostratigraphy of the WAB	15
Table 4.2: Approximate thickness of formation at N+ 200	38
Table 4.3: Approximate thickness of formation at N 090-200	39
Table 4.4: Approximate thickness of formation at N below 90	40
Table 4.5: Stratigraphic Column of the Mountain Aquifer (JG)	46
Table 5.1: Recharge data in Israeli Literature for transient models of the WAB	48
Table 5.2: Rainfall-recharge coefficients from different studies	50
Table 5.4: Recharge values from rainfall by aquifer formations	53
Table 5.3: Rainfall stations used to estimate the WAB aerial rainfall	57
Table 5.5: Selected values of recharge coefficients of the wadis and Water systems	58
Table 5.6: Runoff and recharge coefficients from selected studies	59
Table 5.7: Wadi runoff recharge quantities by aquiferous formations	60
Table 5.8: Estimation of recharge generated from wastewater collection Systems over the Western Aquifer Basin only	63
Table 5.9: Recharge quantities from wastewater runoff by aquifer formation	63
Table 5.10: Recharge from water supply systems by governorates and Aquifer formations in WAB	64
Table 5.12: Injection data for the transient model of WAB develop by Guttman & Zukermann, 1995	64
Table 5.13: WAB Recharge from different components according to Aquifer formations for 93-98 period	65
Table 6.1: Data of Abstraction, Injection & springs discharge	70

1. Introduction

The Western Aquifer Basin covers an area of 9155 km² within Israel and Palestine and is therefore the largest of all groundwater basins in historical Palestine. A small portion extends into the northeastern Sinai. The basin extends around 235 km from Mount Carmel in the North to Northern Sinai in the South and between 70 and 30 km from the Mediterranean coast in the West to the West Bank heights in the East (Figure 1.1). Being distributed between Palestine, Israel and Egypt, this aquifer is a shared aquifer. However, this study limits the analysis to the hydrogeological boundaries within the political borders of Israel and Palestine since it is believed that there is both little recharge and discharge on the Egyptian side and the database is scarce for this area. It should be noted that the recharge and discharge potential of the Western Aquifer Basin within the political borders of Egypt is a matter for further investigation and it is beyond the scope of the Sustainable Management of the West Bank and Gaza Aquifers, SUSMAQ, Project.

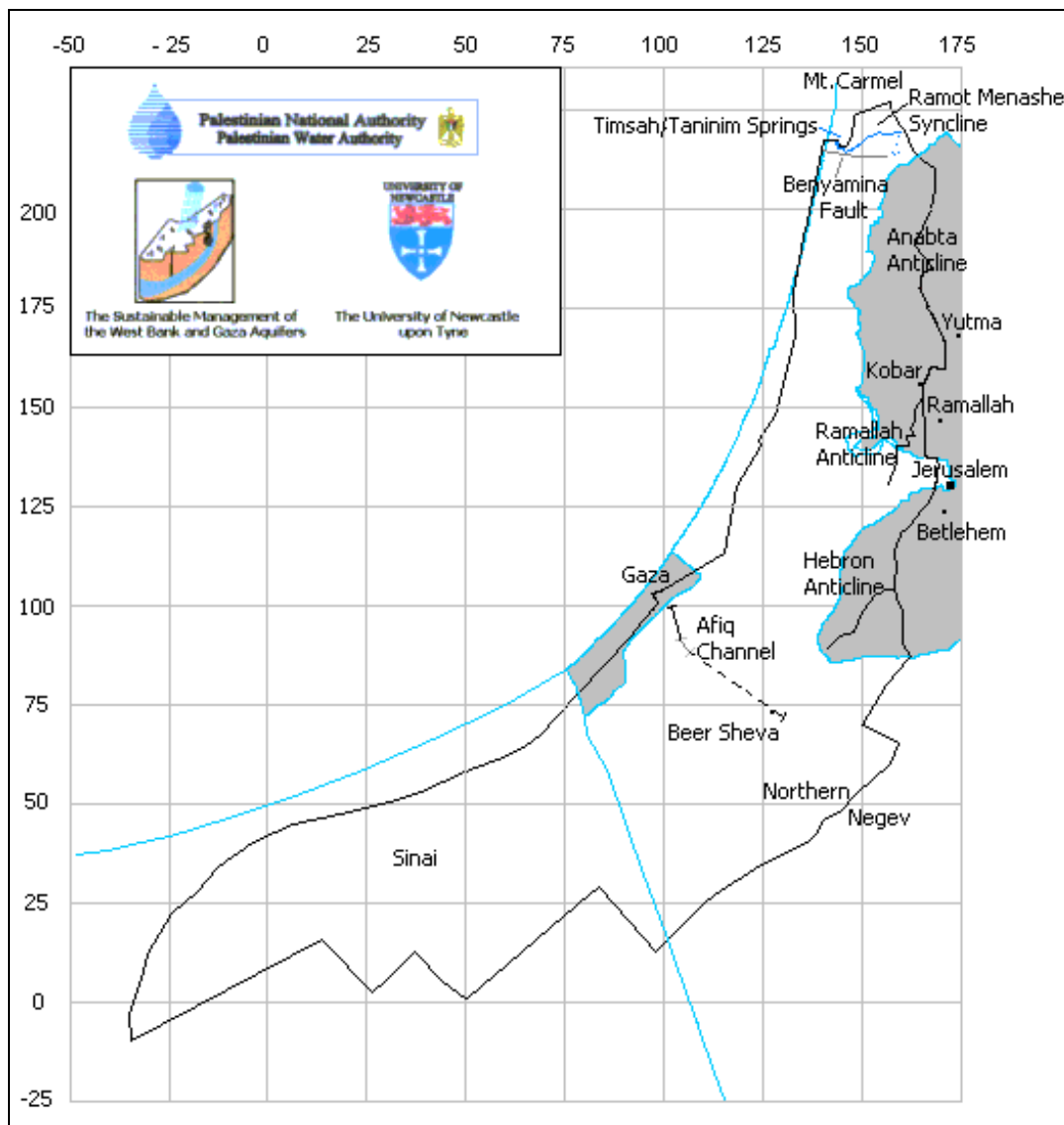


Figure 1.1: Location map of the Western Aquifer Basin

The climatic zones range from sub-humid Mediterranean climate conditions (more than 700 mm annual rainfall) to arid desert conditions in the Sinai. The ground elevation lies between sea level and 1000 m above sea level in the Hebron area. The range of age of the outcropping formations reaches from Jurassic sediments at the exposed cores of the anticlinal axes to Holocene and recent alluvial deposits, especially in the coastal plain. The water use is very heterogeneous, due to both natural and political reasons. While some areas are fully developed and even overexploited (coastal plain in central Israel), other areas rarely yield sufficient water in satisfying quality (Negev and Sinai) or are hindered by imposing unjust Israeli restrictions on developing the good potential of the aquifer basin (West Bank foothill region).

The geology of the Western Aquifer Basin (WAB) consists mainly of a group of karstified limestone and dolomite of Late Albian to Turonian, shown in a geological map (see Figure 1.2). The WAB boundaries extend between the anticlines of the mountainous ridges of the West Bank in the east to the Mediterranean Sea in the west. In the north, the basin is bounded by the edge of the foothills of the Carmel Mountain and the Taninim Stream. In the south it is bounded by a rift located southwards of Beer Al Sabi'.

The WAB is recharged mainly from precipitation falling on the mountains of West Bank while the historical outlets of the basin were through Ras Al Ain (Yarkon) and Al Timsah (Taninim) springs and hence the Israeli named the basin Yarkon - Taninim Basin.

There are a number of modelling studies about the Western Aquifer Basin carried out by the Israelis (Bachmat, 1995; Guttman and Zukerman, 1995; Zukerman, 1999), but no comprehensive model has been undertaken on the Palestinian side as yet. However, the Israeli studies lack the following:

- Some of them are based on a coarse grid of 25 km² cell size and therefore do not reflect realistic averages of the aquifer hydraulic and physical properties.
- Recharge estimates were made on generic relationship between rainfall and runoff.
- There is a great distrust in the geometry and hydraulic connection between aquifers developed in most of these studies.
- The assumption of considering the WAB to have only one aquifer unit is not very convincing
- Even with the above inaccuracies about most of the Israeli studies, the SUSMAQ team was not able to have free access to all the details of the Israeli studies on the WAB.

The aim of this study is to develop a conceptual model for the Western Aquifer Basin with emphasis on the boundary conditions, geometry, recharge, and other important conceptual details about WAB.

This conceptual model will then be used to develop the numerical model for the WAB.

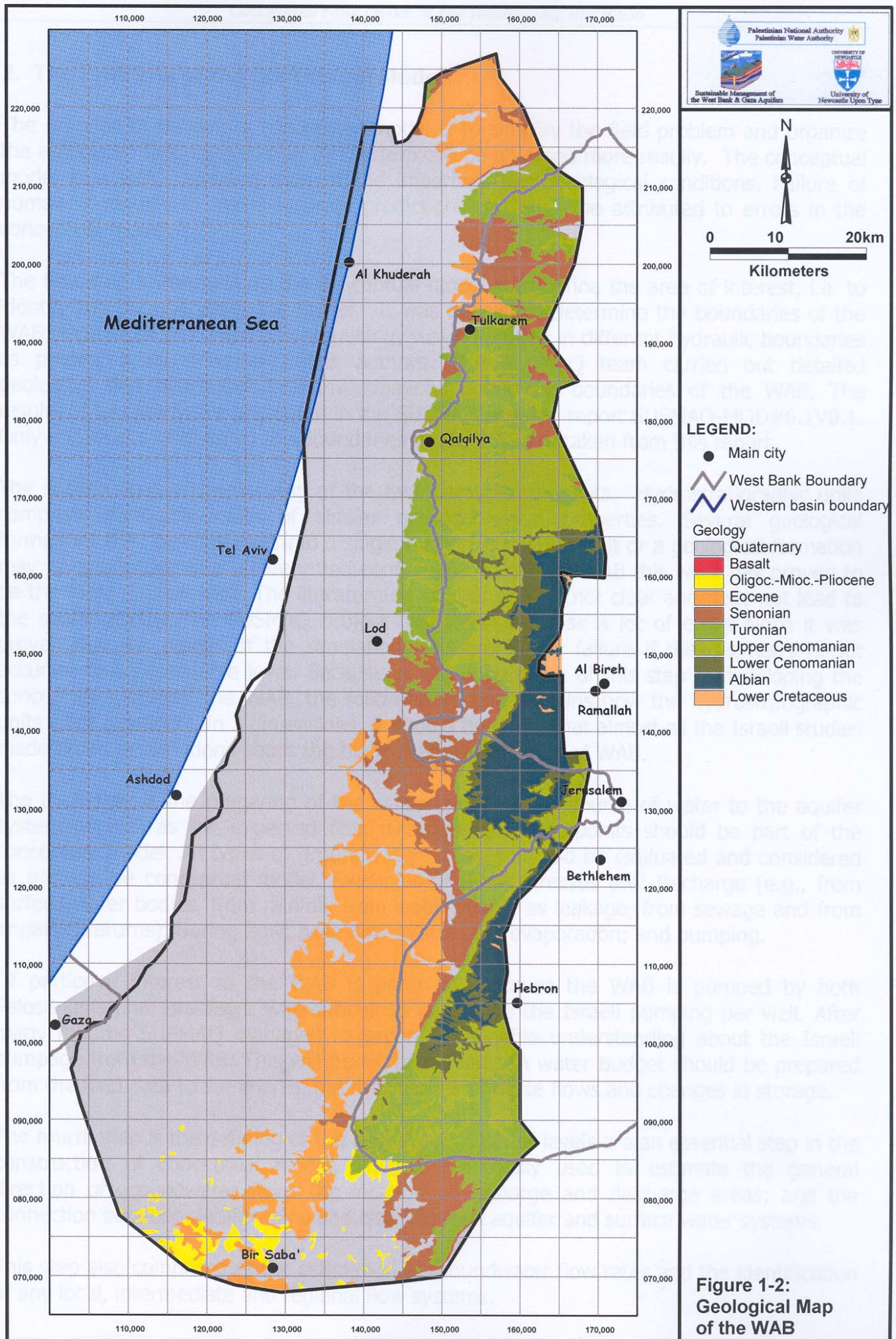


Figure 1-2:
Geological Map
of the WAB



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