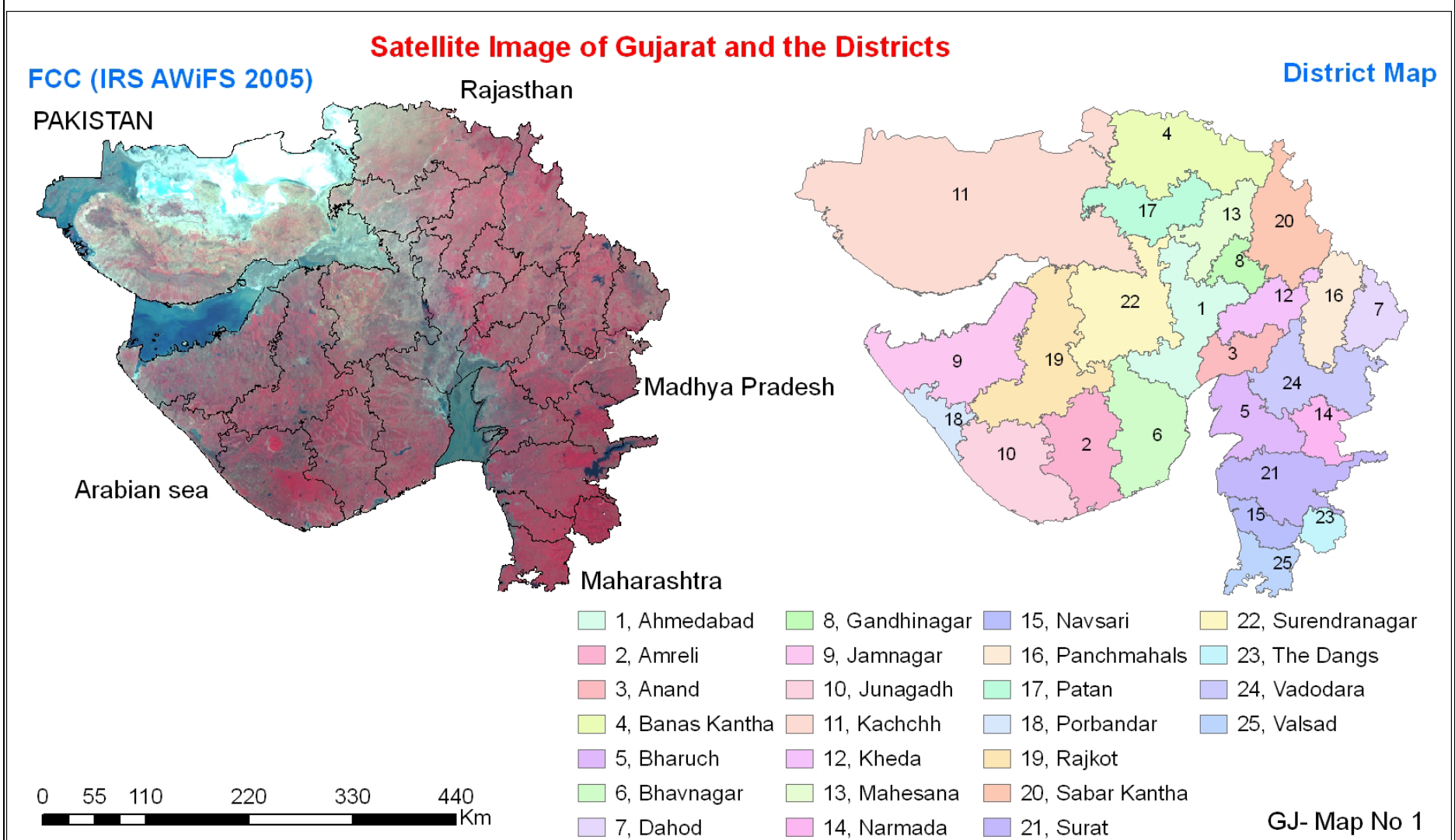
# GUJARAT

## INTRODUCTION

**Location and Administrative Setup:** Gujarat has an area of 19602.400 Th ha (196024 sq. km), which constitutes 5.96% of the geographic area of the country. It lies between latitude 20º07' and 24º43' N and longitude 68º10' and 74º29' E. The northern boundary of the state is part of the Indo-Pak international boundary. It has 1600 km long coast line forming the western and south-western boundary. The state shares its boundary by Rajasthan in the north, Madhya Pradesh in the east and Maharastra in the south and south-east. There are 25 districts (Map 1) and more than 15 towns in the state. The largest cities are Ahmedabad, Gandhinagar, Vadodara, Valsad, Surat, Rajkot, Probandar, Bhavnagar, Junagadh and Jamnagar. Ahmedabad is the state capital.

According to 2001 census, total population of the state is 10596992, out of which 63444053 (59.86%) are male. Decadal growth in population is 22.48%. The state has population density of 258 persons/sq. km. The overall sex ratio is 921 i.e. 921 females per 1000 males. The state has overall literacy rate of 69.97 %.




**Climate:** The climate of Gujarat varies from arid to semi-arid to sub humid tropical monsoon type. The climate is characterized by low rainfall with erratic distribution, extremes of diurnal and annual temperatures, low humidity and high wind velocity. The coastal part has high relative humidity and wind velocity. The annual rainfall in the state varies significantly. The mean annual rainfall ranges between 300 mm to 2800 mm. Normal rainfall of the state is 720.6 mm. Marked variations in seasonal range of temperatures occur at all non-coastal areas in the state, exhibiting the most characteristic phenomenon of the warm-dry continental climate. The temperature starts rising progressively through April, May and June. The temperature rise during this period is almost uniform all over the state. The mean annual temperature ranges between 26º and 28ºC in winter and 37ºC to 42ºC in summer.

**Land use:** Land use statistics for the year 2003–'04 is given in Table 1.

**Table 1: Major Land Use (Th ha)**

| PARTICULARS | 2003-'04 |
|---|---|
| Forest | 18536.000 |
| **Not Available for Cultivation** | |
| A-Land put to Non Agriculture Uses | 11453.000 |
| B-Barren and Uncultivable Land | 26074.000 |
| **Other Uncultivable Land Excluding Fallow Land** | |
| A-Permanent Pastures & Grazing land | 8503.000 |
| B-Land under Misc. Tree Crops & Groves | 40.000 |
| C-Cultivable Wastelands | 19767.000 |
| **Fallow Land** | |
| A-Current Fallow | 5681.000 |
| B-Old Fallow | 112.000 |
| **Cropped Area** | |
| A-Net Area Sown | 98515.000 |
| B-Area Sown More Then Once | 15695.000 |
| Gross Cropped Area | 114210.000 |
| Cropping Intensity (%) | 115.93 |

**(Source: www.indiastat.com)**

**Satellite Data:** IRS P4 LISS III data of two different seasons namely, pre monsoon (April-May, 2004) and post monsoon (November-December, 2003) were used for delineation of waterlogged and salt affected areas of various commands of Gujarat.

## WATER RESOURCES AND COMMAND AREAS

**Water Resources:** Stream flow constitutes the principal source of fresh water in Gujarat. River flows are concentrated in the relatively short monsoon season. There are 17 rivers in Gujarat mainland, 71 in Saurashtra and 97 in Kutchch region. Narmada, tapi and Purna are perennial rivers. Annual replenishable ground water resources are 15.81 BCM and stage of ground water development is 76%.

**Command Areas:** There are 169 irrigation commands in Gujarat. Number of major and medium irrigation commands are 36 and 133, respectively (Map 2).

## WATER LOGGING AND SALT AFFECTED AREAS IN MAJOR AND MEDIUM IRRIGATION COMMANDS BASED ON SATELLITE REMOTE SENSING

Total waterlogged area in the state is 265.260 Th ha, out of which 49.660 Th ha is perennial and 215.600 Th ha is seasonal. Out of 169 irrigation commands, 45 commands have no area under waterlogging category. Both seasonal and perennial waterlogging is highest in SSNNL-2 command. Salt affected area covers 307.320 Th ha. Total 1320 soil samples were collected to check the salinity / alkalinity in the command. Table 2 and Map 3 show the salt affected area and waterlogged areas in major and medium irrigation commands in Gujarat state.

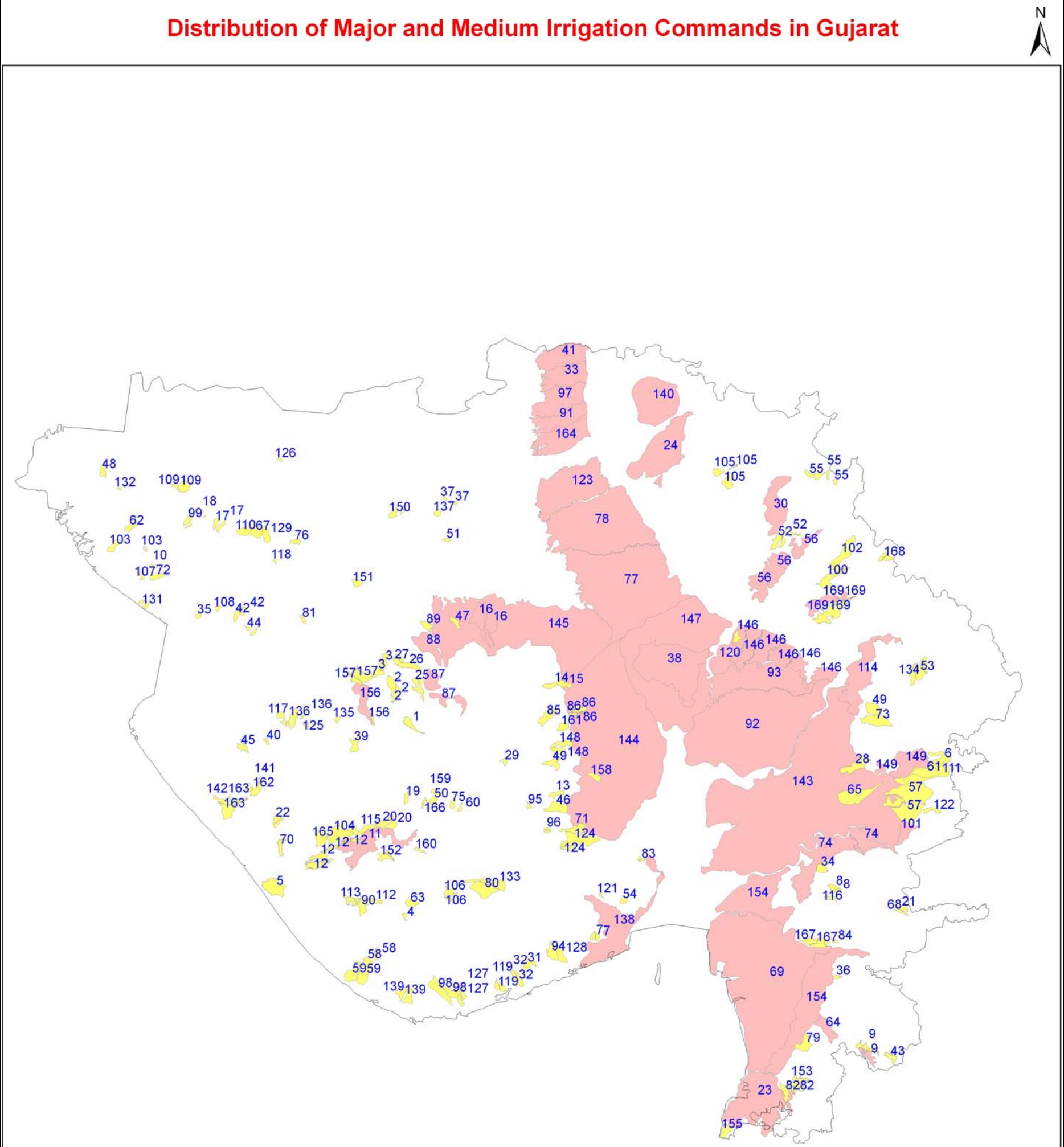
**Table 2: Waterlogged and Salt Affected areas in major and medium irrigation commands of state**

| Code | Command name | Type | Waterlogged area (Th Ha) | Salt affected area (Th Ha) |
|---|---|---|---|---|
| 1 | Bhadar-I | Major | 0.001 | 0.000 |
| 2 | Brahmani | Major | 0.038 | 0.749 |
| 3 | Damanganga | Major | 1.082 | 0.000 |
| 4 | Dantiwada | Major | 0.008 | 0.000 |
| 5 | Dharoi | Major | 0.059 | 0.000 |
| 6 | Dhima | Major | 0.063 | 2.182 |
| 7 | Fatehwadi | Major | 9.399 | 13.896 |
| 8 | Gadsisar | Major | 0.044 | 1.299 |
| 9 | Hatmathi | Major | 0.028 | 0.000 |
| 10 | Jhuj | Major | 0.003 | 0.000 |
| 11 | Kakrapar | Major | 43.022 | 1.992 |
| 12 | Karjan | Major | 0.434 | 0.000 |
| 13 | Kbc-1 | Major | 1.664 | 70.970 |
| 14 | Kbc-2 | Major | 0.343 | 44.489 |
| 15 | Machhu-I | Major | 0.034 | 0.000 |
| 16 | Machhu-II | Major | 0.016 | 0.000 |
| 17 | Madka | Major | 0.007 | 3.346 |
| 18 | Mahi | Major | 28.375 | 7.362 |
| 19 | Mahi-meshwo | Major | 3.445 | 0.053 |
| 20 | Malsan | Major | 0.286 | 4.415 |
| 21 | Men | Major | 0.002 | 0.000 |
| 22 | Panam | Major | 0.770 | 0.000 |
| 23 | Radhanpur | Major | 0.123 | 23.497 |
| 24 | Raipur | Major | 1.674 | 0.000 |
| 25 | Shetrunji / palitana | Major | 1.980 | 1.062 |
| 26 | Sipu | Major | 0.000 | 0.000 |
| 27 | Ssnnl-1 | Major | 45.810 | 3.366 |
| 28 | Ssnnl-2 | Major | 80.023 | 71.020 |
| 29 | Ssnnl-3 | Major | 2.908 | 22.781 |
| 30 | Ssnnl-5 | Major | 1.311 | 0.000 |
| 31 | Ssnnl-6 | Major | 31.499 | 23.779 |
| 32 | Sukhi | Major | 0.014 | 0.000 |
| 33 | Ukai | Major | 5.651 | 0.201 |
| 34 | Und-I | Major | 0.012 | 0.000 |
| 35 | Vejpur | Major | 0.018 | 4.892 |
| 36 | Watrak | Major | 0.377 | 0.000 |
| 37 | Aji-II | Medium | Negligible | 0.000 |
| 38 | Aji-III | Medium | 0.000 | 0.000 |
| 39 | Aji-IV | Medium | 0.001 | 0.007 |
| 40 | Ambajal | Medium | 0.000 | 0.000 |
| 41 | Amipur | Medium | 0.174 | 0.000 |
| 42 | Ani | Medium | 0.007 | 0.000 |
| 43 | Bagad | Medium | 0.000 | 0.009 |
| 44 | Baldeva | Medium | 0.001 | 0.000 |
| 45 | Baripada | Medium | 0.026 | 0.000 |
| 46 | Berachiya | Medium | 0.000 | 0.061 |
| 47 | Bhadar-II | Medium | 0.000 | 0.000 |
| 48 | Bhimdad | Medium | 0.000 | 0.000 |
| 49 | Bhogavo-I | Medium | 0.096 | 0.301 |
| 50 | Buhkhi | Medium | 0.000 | 0.000 |
| 51 | Chari | Medium | 0.009 | 0.003 |
| 52 | Chhaparwadi-II | Medium | 0.001 | 0.000 |
| 53 | Chopodavan | Medium | 0.000 | 0.000 |
| 54 | Demi-I | Medium | 0.004 | 0.000 |
| 55 | Demi-II | Medium | 0.000 | 0.000 |
| 56 | Demi-III | Medium | 0.001 | 0.000 |
| 57 | Deo | Medium | 0.020 | 0.000 |
| 58 | Dhatarwadi-I | Medium | 0.000 | 0.000 |
| 59 | Dhatarwadi-II | Medium | 0.108 | 0.332 |
| 60 | Don | Medium | 0.001 | 0.000 |
| 61 | Doswada | Medium | Negligible | 0.000 |
| 62 | Fategadh | Medium | 0.002 | 0.020 |
| 63 | Fulzar-I | Medium | 0.000 | 0.000 |
| 64 | Gajod | Medium | 0.007 | 0.023 |
| 65 | Galkund | Medium | 0.002 | 0.000 |
| 66 | Ganda | Medium | 0.000 | 0.006 |
| 67 | Ghelo | Medium | 0.000 | 0.348 |
| 68 | Godhatad | Medium | 0.335 | 0.076 |
| 69 | Goma | Medium | 0.001 | 0.007 |
| 70 | Gondali | Medium | 0.000 | 0.000 |
| 71 | Gopal | Medium | 0.002 | 0.000 |
| 72 | Guhai | Medium | 0.009 | 0.000 |
| 73 | Hadaf | Medium | 0.048 | 0.000 |
| 74 | Hamirpura | Medium | 0.036 | 0.000 |
| 75 | Harnav | Medium | 0.002 | 0.000 |
| 76 | Heran rajwasna | Medium | 0.047 | 0.000 |
| 77 | Hiran-I | Medium | 0.000 | 0.000 |
| 78 | Hiran-II | Medium | 0.000 | 0.000 |
| 79 | Jaloda | Medium | 0.052 | 0.000 |
| 80 | Jancadia | Medium | 0.006 | 0.000 |
| 81 | Jhanjeshri | Medium | 0.000 | 0.000 |
| 82 | Jojwa-wadhwana | Medium | 0.130 | 0.000 |
| 83 | Kahari | Medium | 0.001 | 0.000 |
| 84 | Kaila | Medium | 0.000 | 0.101 |
| 85 | Kakdiamba | Medium | 0.015 | 0.000 |
| 86 | Kalindri | Medium | Negligible | 0.000 |
| 87 | Kalubhar | Medium | 0.173 | 0.597 |
| 88 | Kankawati | Medium | 0.033 | 0.000 |

| Code | Command name | Type | Waterlogged area (Th Ha) | Salt affected area (Th Ha) |
|---|---|---|---|---|
| 89 | Karad | Medium | 0.008 | 0.000 |
| 90 | Kasavali | Medium | 0.001 | 0.118 |
| 91 | Kelia | Medium | Negligible | 0.000 |
| 92 | Khodiyar | Medium | 0.000 | 0.000 |
| 93 | Kumbharia | Medium | 0.000 | 0.029 |
| 94 | Kunthali | Medium | 0.001 | 0.000 |
| 95 | Lakhanka | Medium | 0.061 | 0.000 |
| 96 | Lakhigam | Medium | 0.000 | 0.000 |
| 97 | Limbdi bhogava-I | Medium | 0.001 | 0.000 |
| 98 | Limbdi-bhogava-II | Medium | 0.405 | 0.036 |
| 99 | Machhu-III | Medium | 0.001 | 0.000 |
| 100 | Madhuvanti | Medium | 0.000 | 0.000 |
| 101 | Malan | Medium | 0.047 | 0.000 |
| 102 | Malgadh | Medium | 0.006 | 0.000 |
| 103 | Malpara | Medium | 0.000 | 0.000 |
| 104 | Manchundri | Medium | 0.004 | 0.558 |
| 105 | Mathal | Medium | 0.001 | 0.067 |
| 106 | Mazam | Medium | 0.002 | 0.000 |
| 107 | Meshwo | Medium | 0.040 | 0.000 |
| 108 | Mitti | Medium | 0.006 | 0.012 |
| 109 | Moj | Medium | 0.001 | 0.000 |
| 110 | Mukteswar | Medium | 0.108 | 0.000 |
| 111 | Munjasar | Medium | 0.001 | 0.000 |
| 112 | Naera | Medium | 0.002 | 0.019 |
| 113 | Nagavanti | Medium | 0.001 | 0.026 |
| 114 | Nara | Medium | 0.017 | 0.289 |
| 115 | Naraini | Medium | 0.023 | 0.000 |
| 116 | Orsang | Medium | 0.014 | 0.000 |
| 117 | Ozat-I | Medium | 0.000 | 0.000 |
| 118 | Ozat-II | Medium | 0.000 | 0.000 |
| 119 | Phophal | Medium | 0.011 | 0.000 |
| 120 | Pur | Medium | Negligible | 0.000 |
| 121 | Raidy | Medium | 0.017 | 0.037 |
| 122 | Rajawal | Medium | 0.029 | 0.000 |
| 123 | Ranghola | Medium | 0.398 | 1.266 |
| 124 | Ratadia | Medium | 0.001 | 0.000 |
| 125 | Raval | Medium | 0.000 | 0.006 |
| 126 | Rojki | Medium | 0.017 | 0.000 |
| 127 | Rudramata | Medium | 0.000 | 0.000 |
| 128 | Samaghogho | Medium | 0.000 | 0.000 |
| 129 | Sanandera | Medium | 0.021 | 0.000 |
| 130 | Sandhar | Medium | 0.012 | 0.087 |

| Code | Command name | Type | Waterlogged area (Th Ha) | Salt affected area (Th Ha) |
|---|---|---|---|---|
| 131 | Santhali | Medium | 0.000 | 0.072 |
| 132 | Santroad | Medium | 0.005 | 0.000 |
| 133 | Sasoi | Medium | 0.069 | 0.000 |
| 134 | Selari | Medium | 0.002 | 0.000 |
| 135 | Shigoda | Medium | 0.000 | 0.000 |
| 136 | Sorthi | Medium | 0.000 | 0.000 |
| 137 | Sukhbhadar | Medium | 0.312 | 0.000 |
| 138 | Suva | Medium | 0.054 | 0.010 |
| 139 | Tapar | Medium | 0.416 | 0.430 |
| 140 | Uben | Medium | Negligible | 0.000 |
| 141 | Ugta | Medium | 0.002 | 0.000 |
| 142 | Umargam | Medium | 0.639 | 0.000 |
| 143 | Und-II | Medium | 0.095 | 0.024 |
| 144 | Uthavali | Medium | 0.101 | 0.993 |
| 145 | Vadia | Medium | 0.001 | 0.000 |
| 146 | Vartu-I | Medium | 0.000 | 0.000 |
| 147 | Vartu-II | Medium | 0.004 | 0.000 |
| 148 | Venu-II | Medium | 0.000 | 0.000 |
| 149 | Ver-II | Medium | 0.013 | 0.000 |
| 150 | Bhogavo-II | Minor | 0.004 | 0.003 |
| 151 | Chhaparwadi-I | Minor | 0.000 | 0.000 |
| 152 | Dai minsar | Minor | 0.000 | 0.000 |
| 153 | Dhari | Minor | 0.000 | 0.000 |
| 154 | Dholi | Minor | 0.014 | 0.000 |
| 155 | Fulzar-II | Minor | 0.000 | 0.000 |
| 156 | Ghee | Minor | 0.000 | 0.000 |
| 157 | Ghodadhroi | Minor | 0.000 | 0.000 |
| 158 | Ishwaria | Minor | 0.000 | 0.000 |
| 159 | Karmal | Minor | 0.000 | 0.000 |
| 160 | Pigut | Minor | 0.000 | 0.000 |
| 161 | Puna | Minor | 0.262 | 0.000 |
| 162 | Rami dam | Minor | 0.006 | 0.000 |
| 163 | Rangmati | Minor | 0.002 | 0.000 |
| 164 | Sapada | Minor | 0.000 | 0.000 |
| 165 | Sonmati | Minor | 0.000 | 0.000 |
| 166 | Vachhapari | Minor | 0.000 | 0.000 |
| 167 | Vansal | Minor | 0.142 | 0.000 |
| 168 | Veri | Minor | 0.000 | 0.000 |
| 169 | Waidy | Minor | 0.000 | 0.000 |
| | **TOTAL** | | **265.260** | **307.320** |

# Distribution of Major and Medium Irrigation Commands in Gujarat



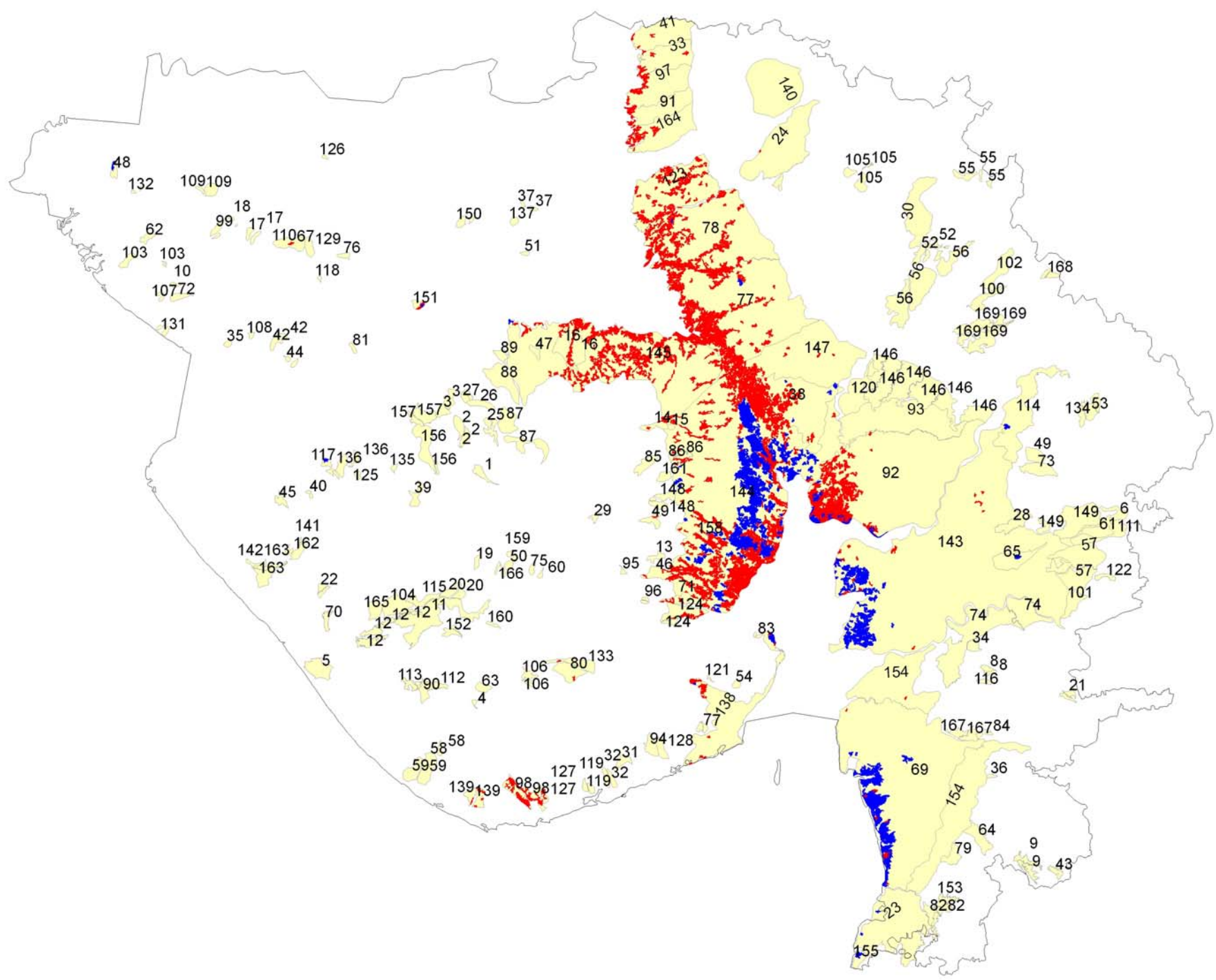

1 Major comamnd areas with code

37 Medium comamnd areas with code

GJ - Map No 2

Source: Irrigation Department, Gujarat

# Waterlogged and Salt Affected Areas in the Commands of All Major and Medium Irrigation Projects of Gujarat Using Satellite Remote Sensing




Salt Affected Area
Waterlogged Area
Command Area

0 25 50 100 150 200 Kms

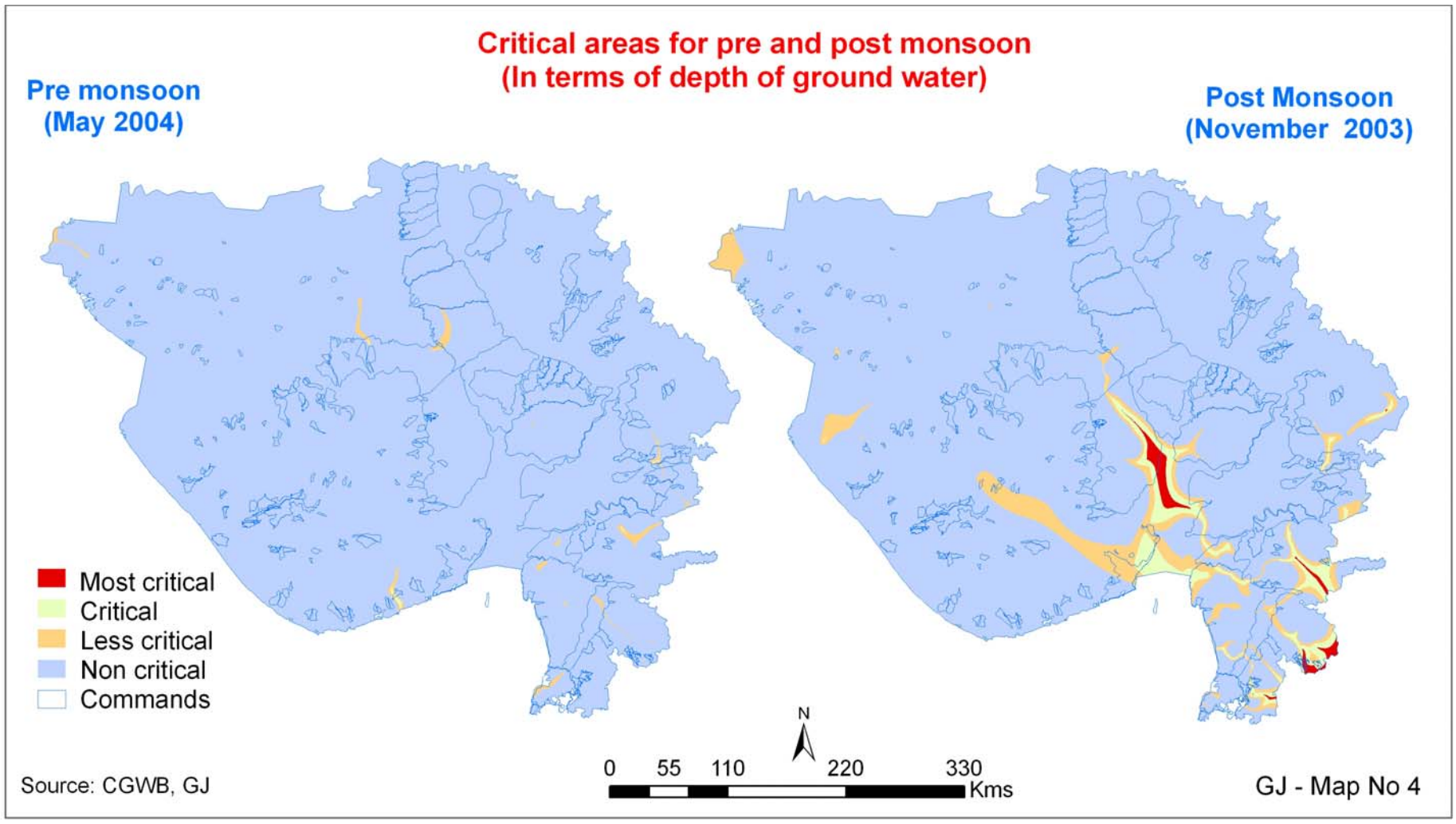
GJ - Map No 3

Source: RRSSC/ISRO Jodhpur

For demarcation of critical waterlogged areas due to rise in water table depth, ground water table data of monitoring stations of CGWB were used. Table 3 and Map 4 show the critical area of depth of ground water for pre (May, 2004) and post (November, 2003) monsoon.

**Table 3: Critical Area of Depth of Ground Water for Pre (May, 2004) and Post (November, 2003) Monsoon**

| | Most critical (< 1m) | | Critical (1 – 2 m) | | Less critical (2 – 3 m) | | Non-critical (> 3 m) | |
|---|---|---|---|---|---|---|---|---|
| | (Th ha) | (%) | (Th ha) | (%) | (Th ha) | (%) | (Th ha) | (%) |
| Pre Monsoon (May, 2004) | 1.460 | 0.03 | 520.700 | 9.76 | 2080.010 | 38.99 | 2732.002 | 51.22 |
| Post Monsoon (November, 2003) | 154.790 | 2.90 | 845.680 | 15.85 | 1702.300 | 31.91 | 2631.400 | 49.34 |



## Project Team

Dr. D. Dutta (PI), RRSSC, Jodhpur
Smt. Rajashree V. Bothale, RRSSC, Jodhpur
Shri S.K. Singh, CWC, New Delhi
Shri Jamalaiah, CWC, New Delhi

**Soil Sample Collection and Analysis support by IEMSD, Jodhpur**

## Acknowledgements

Shri D.H. Patel, Shri V.M. Parmar, Shri P.D. Bhatta, Shri B.K. Bhinde
Shri K.A. Patel, Shri S.R. Kamde, Shri N.P. Sutaria, Shri B.N. Rathod
Shri R.K. Jha, Shri J.J. Pandya, Shri O.T. Gulati, Shri J.C. Choudhary
Shri U.S. Chandorikar, Shri A.D. Kanani, Dr. R.C. Tank, Shri S.J. Patel
Shri H.P. Pandya, Shri D.R. Chavda, SE, Surat Irrigation Circle
Shri Anoop Nagar, CGWB, Shri Parekh, Rajkot, Shri Kalaria, Rajkot
Shri Rajparia, Rajkot, Shri V.M. Gajera, Junagarh, Shri M.R. Hardial, Jamnagar
Shri G.J. Shyara, Veraval, Shri Kamalesh Davda, Rajkot, Shri Pradeep Pagaria
Shri Chandrakant, Shri Mukesh, Shri Narender Singh