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| Flood Warning and management system (FWMS) Matrix |
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# Flood Sensitivity Matrix

Results from these matrixes will provide:

1. General city description
2. City characterization regarding area and population
3. Characterization of flooding
   1. Duration of flood
   2. Number of people affected
   3. Known flooded surface
4. Specify different types of flooding
   1. River flooding
   2. Sea level rise flooding
   3. Flash floods
      1. High precipitation
      2. Storm sewage capacity
5. Past flood events – records
6. Flood damage estimation – Does flood damage assessment exist?
7. Flood management planning – Does it exist and known level of defence?
8. Flood warning and management system – Does it exist and technical features?

Table 1: Flood Sensitivity Matrix

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| **A. City Description** | |
| **City name** | Bangalore |
| **1. City location** |  |
| 1. Is city in coastal area? (Y or N) | N |
| 1. Value of area slope?   [%] 0 – 5 = flat terrains  [%] 5 – 10 = low/graduate slope  [%] 10 – 20 = moderate slope  [%] 20 – 30 = steep slope  [%] above 30 = very steep slope | 0- 5 |
|  |
| 1. Is city near or on a river(s), other freshwaters? (Y or N) | N ( Arakavathi River flowing small stretch in Bangalore North Taluk, River Vrishabhavathi tribute of Arakavathi which carries bulk of the city’s sewage)  Other fresh water lakes - Bellandur, ulsoor, Hebaal, Ngavara, Hennur, Sankey and Madivala. |
| 1. Comment |  |
| **2. Hydrological Situation** |  |
| 1. Freshwaters extension | Divert water from nearby basin |
| 1. Freshwaters uses | Act as recharge zone for cities water table |
| **3. Precipitation (total amount/year)?** | 889 mm/year on average ( Jun –Sep Bangalore receives 54% of the total rainfall from south west monsoon and from North west monsoon it receives 241mm) |
| 1. Value of rain intensities for events higher then 100mm/h? | Approx. three event per year |
| **B. Size characteristics of city** | |
| 1. Area in square kilometres (km2) | 741 km2 |
| 1. City population | Approx. 5.3 million |
| **C. Characterization of flooding** | |
| 1. Duration of flood event (average) (hours, days...) | Several hours, short time more rain |
| 1. Number of people affected with flood | About 1200 households |
| 1. Known surface of city affected with flood (km2) | Approx. 20% of total area |
| * + - 1. **Different types of flooding** | |
| 1. Flooding due sea level rise (Y, N, comment) | N |
| 1. River flooding (Y, N, comment) | N |
| 1. Flash flooding |  |
| 1. Due to high precipitation (Y, N, comment) | Yes |
| 1. Due to small capacity of storm sewage system (Y, N, comment) | Yes, (design retain period is 2 and 5 years) |
| * + - 1. **Past flood events** | |
| 1. Are past events recorded in order to see spatial scale of flooding (Y, N, comment) | No, but there are some record but not systematic  (See the attached document ) |
| 1. Are past events recorded water levels of past floods (Y, N, comment) | Yes, (at some places) (see the attached documents) |
| * + - 1. **Flood damage estimation** | |
| 1. Is flood damage estimation present on city level? (Y, N, comment) | Yes, (in feasibility report but old data) |
| * + - 1. **Flood management planning** | |
| 1. Does flood management plan exist on city level? (Y, N, comment) | Y |
| 1. If yes, is it civil sector? (Y or N) | Y |
| 1. If yes is it private sector? (Y or N) | N |
| 1. Are responsibilities in flood management clearly specified? (Y, N, comment) | Yes, (by local government) |
| 1. Does it specify the level of defence? | Yes |
| 1. When FMP is established (year)? | 2010 (in master plan) |
| 1. How long is review period of FMP? | At present not yet reviewed |
| 1. What are the target areas of the plan (floodplains, city planning, etc? (specify) | City |
| 1. Is the city self-regulating regarding flood issues? (Y, N, comment) | Yes, (Bangalore Metropolitan Corporation and the Department of Drainage and Sewerage) |
| 1. Are the following sectors vulnerable to the consequences of floods   H – high level of preparedness and readiness  M – to be aware of risk and to know how to balance  L – to have no awareness of risk at all |  |
| 1. Communication system? (H, M, L) | M |
| 1. Transportation system? (H, M, L) | M |
| 1. Public transport? (H, M, L) | M |
| 1. Electricity supply systems? (H, M, L) | M |
| 1. Drinking water and supply network? (H, M, L) | M |
| 1. Energy generation and distribution system? (H, M, L) | M |
| 1. Local business, industry, and economy? (H, M, L) | M |
| 1. Health-care facilities? (H, M, L) | M |
| 1. L and use? (H, M, L) | M |
| 1. Parks and recreation areas? (H, M, L) | M |
| 1. Cultural and religious heritage? (Y or N)Tourism? (H, M, L) | M  M |
| * + - 1. **Threat of natural hazards** | |
| 1. Earthquake? (Y or N) | N |
| 2. Wind storm? (Y or N) | N |
| 3. River flood? (Y or N) | N |
| 4. Flash rainwater flood or extreme precipitation? (Y or N) | Y |
| 5. Coastal Flooding (sea level rise)? (Y or N) | N |
| 6. Tsunami? (Y or N) | N |
| 7. Drought? (Y or N) | N |
| 8. Volcano? (Y or N) | N |
| 9. Landslide? (Y or N) | N |
| 10. Storm surge? (Y or N) | Y |
| 11. Extreme temperature? (Y or N) | Y |
| 12. Latest extreme event and extension? | heavy rainfall in short duration 2010, 2009,2005 |
| * + - 1. **Disaster response system** | |
| 1. Does a disaster response system exist in the city? (Y or N) | Y |
| 1. If yes, specify to what disaster specified in h section? | Flash rainwater Flood |
| 1. If yes, specify who is managing the system? (Public or Private sector) | Public |
| 1. Is the response system comprehensive and equipped for all natural hazards specified? (Y or N) | N |
| 1. Is the disaster response system regularly practiced? (Y or N) | Not known |

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| UBIFLOOD project |
| Flood Warning and management system (FWMS) Matrix |
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Table 2: Flood warning and management system (FWMS) matrix

Flood Diagnostic and Management System (FDMS)

Network Communication System

Devices to collect data from persons

Devices to collect data on the ground

Personal devices to inform the population

Public devices to inform the population

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| --- | --- |
| **A. Flood Diagnostic and Management System** | |
| 1. Is there any FDMS ? (Y/N) | N |
| 1. Is there any standard associated to the interfaces of the FDMS ? (Y/N, comments) | N |
| 1. type of network connection (comments) | Mobile and land line telephones |
| 1. Is it an open software system ? (Y/N, comments) | N |
| 1. Is it a distributed or centralized system ? (comments) | N |
| 1. what is the architecture of the FDMS ? (comments) | Not known |
|  |  |
| 1. other comments |  |
| 1. other features |  |
| **B. Network Communication System** | |
| Is there a global network system for the FWMS ? (Y/N, comments) | N |
| Is there only one homogeneous network or many heterogeneous networks ? (Y/N) interconnected or not ? (comments) | N |
| For each network : |  |
|  |  |
| Technology (name) |  |
| IP based ? (Y/N) others ? (comments) |  |
| Type of reliability (QoS, without packet loss...) (comments) |  |
| What kind of communications ? data ? text ? voice ? (comments) |  |
| Maximum Volume of data (in both ways) (comments) |  |
| Maximum Bandwith of the communications (comments) |  |
| Type of security supported by the network (comments) |  |
| other features |  |
|  |  |
| Technology (name) |  |
| IP based ? (Y/N) others ? (comments) |  |
| Type of reliability (QoS, without packet loss...) (comments) |  |
| What kind of communications ? data ? text ? voice ? (comments) |  |
| Maximum Volume of data (in both ways) (comments) |  |
| Maximum Bandwith of the communications (comments) |  |
| Type of security supported by the network (comments) |  |
| other features |  |
|  |  |
| Technology (name) |  |
| IP based ? (Y/N) others ? (comments) |  |
| Type of reliability (QoS, without packet loss...) (comments) |  |
| What kind of communications ? data ? text ? voice ? (comments) |  |
| Maximum Volume of data (in both ways) (comments) |  |
| Maximum Bandwith of the communications (comments) |  |
| Type of security supported by the network (comments) |  |
| other features |  |
|  |  |
| other comments | Still most of the work is done manually |
| **C. Devices to collect data on the ground** | |
| For each device : | Not Known |
|  |  |
| Type of the device (comments) |  |
| Type of supported sensors (comments) |  |
| Type of the collected data (comments) |  |
| Data sampling frequency (comments) |  |
| Type of network connection (comments) |  |
| Powered using batteries or AC (comments) |  |
| Local data processing ? (Y/N) |  |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) |  |
| Fixed or mobile device ? (Y/N) |  |
| Remote monitoring system of the device ? (Y/N) |  |
| Other features |  |
|  |  |
| Type of the device (comments) |  |
| Type of supported sensors (comments) |  |
| Type of the collected data (comments) |  |
| Data sampling frequency (comments) |  |
| Type of network connection (comments) |  |
| Powered using batteries or AC (comments) |  |
| Local data processing ? (Y/N) | No |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) | N |
| Fixed or mobile device ? (Y/N) | N |
| Remote monitoring system of the device ? (Y/N) | N |
| Other features |  |
|  |  |
| Type of the device (comments) | Not known |
| Type of supported sensors (comments) | Not known |
| Type of the collected data (comments) | Not known |
| Data sampling frequency (comments) | Not known |
| Type of network connection (comments) | Not known |
| Powered using batteries or AC (comments) | Not known |
| Local data processing ? (Y/N) | Not known |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) | Not known |
| Fixed or mobile device ? (Y/N) | Not known |
| Remote monitoring system of the device ? (Y/N) | Not known |
| Other features | Not known |
|  |  |
| other comments |  |
| **D.** **Devices to collect data from persons** | |
| For each device : |  |
|  |  |
| Type of the device (comments) |  |
| Type of supported sensors (comments) |  |
| Type of the collected data (comments) |  |
| Data sampling frequency (comments) |  |
| Type of network connection (comments) |  |
| Powered using batteries or AC (comments) |  |
| Local data processing ? (Y/N) |  |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) |  |
| Fixed or mobile device ? (Y/N) |  |
| Remote monitoring system of the device ? (Y/N) |  |
| Other features |  |
|  |  |
| Type of the device (comments) |  |
| Type of supported sensors (comments) |  |
| Type of the collected data (comments) |  |
| Data sampling frequency (comments) |  |
| Type of network connection (comments) |  |
| Powered using batteries or AC (comments) |  |
| Local data processing ? (Y/N) |  |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) |  |
| Fixed or mobile device ? (Y/N) |  |
| Remote monitoring system of the device ? (Y/N) |  |
| Other features | Field officer in mobile unit will report flood condition to the flood control centre using radio. |
|  |  |
| Type of the device (comments) |  |
| Type of supported sensors (comments) |  |
| Type of the collected data (comments) |  |
| Data sampling frequency (comments) |  |
| Type of network connection (comments) |  |
| Powered using batteries or AC (comments) |  |
| Local data processing ? (Y/N) |  |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) |  |
| Fixed or mobile device ? (Y/N) |  |
| Remote monitoring system of the device ? (Y/N) |  |
| Other features |  |
|  |  |
| other comments |  |
| **E. Public Devices to inform the population** | |
| For each device : |  |
|  |  |
| Type of device (public display, public audio alert system, public broadcasting system...) (comments) | Public display using sign boards at streets junctions |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) | Not known |
| Fixed or mobile device ? (Y/N) | Fixed |
| Type of network connection (comments) |  |
| Dedicated to the alert system or shared with other services ? (comments) which one ? (comments) |  |
| Remote monitoring system of the device ? (Y/N, comments) |  |
| Other features |  |
|  |  |
| Type of device (public display, public audio alert system, public broadcasting system...) (comments) | Sign boards, help number |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) | - |
| Fixed or mobile device ? (Y/N) | - |
| Type of network connection (comments) |  |
| Dedicated to the alert system or shared with other services ? (comments) which one ? (comments) |  |
| Remote monitoring system of the device ? (Y/N, comments) |  |
| Other features |  |
|  |  |
| Type of device (public display, public audio alert system, public broadcasting system...) (comments) |  |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) | - |
| Fixed or mobile device ? (Y/N) | - |
| Type of network connection (comments) |  |
| Dedicated to the alert system or shared with other services ? (comments) which one ? (comments) |  |
| Remote monitoring system of the device ? (Y/N, comments) |  |
| Other features |  |
|  |  |
| other comments |  |
| **F. Personal Devices to inform the population** | |
|  |  |
| For each device : | No |
|  |  |
| Type of device (pda, mobile phone...) (comments) |  |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) |  |
| Fixed or mobile device ? (Y/N) |  |
| Type of network connection (comments) |  |
| Remote monitoring system of the device ? (Y/N, comments) |  |
| other features |  |
|  |  |
| Type of device (pda, mobile phone...) (comments) |  |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) |  |
| Fixed or mobile device ? (Y/N) |  |
| Type of network connection (comments) |  |
| Remote monitoring system of the device ? (Y/N, comments) |  |
| other features |  |
|  |  |
| Type of device (pda, mobile phone...) (comments) |  |
| Location on these devices ? (Using GPS, Cellular positioning, other, ...) (Y/N, comments) |  |
| Fixed or mobile device ? (Y/N) |  |
| Type of network connection (comments) |  |
| Remote monitoring system of the device ? (Y/N, comments) |  |
| other features |  |
|  |  |
| other comments |  |