DEPARTMENT OF PUBLIC WORKS

STANDARD SPECIFICATION
FOR
DOMESTIC AND FIRE WATER STORAGE AND FIRE WATER SUPPLY FOR PUBLIC BUILDINGS

MAY 2004

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NOTE:

THE FOLLOWING STANDARDS SHALL APPLY EXCEPT WHERE THE RELEVANT LOCAL AUTHORITY REQUIRES HIGHER STANDARDS IN WHICH CASE THE STANDARDS OF THE LOCAL AUTHORITY SHALL APPLY.

1. MINIMUM REQUIRED DESIGN FIRE FLOW

1.1 IN ESTABLISHED CITIES AND TOWNS WITH FIRE HYDRANTS IN STREETS AND OPERATIONAL FIRE BRIGADES WITH RELIABLE WATER SUPPLIES

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	**Public building installations**	**Minimum *available* fire water from Local Authority**	**Min *required* simultaneous fire water flow for public building(s)**	
			From fire hydrants	**From hose reels**
High risk areas	Military installations	200ℓ/s	20ℓ/s per hydrant from minimum number of hydrants required for any area of the site not exceeding 270m radius from any fire (buildings + site + nearby street hydrants)	0,5ℓ/s per hose reel from all hose reels in an individual building
	Public administration building	200ℓ/s	20ℓ/s per hydrant from minimum number of hydrants required for site (building + site + adjoining street hydrants)	0,5ℓ/s per hose reel from all hose reels in any fire division of building
Moderate risk areas	Public administration building	100ℓ/s	20ℓ/s per hydrant from minimum number of hydrants required for site (building + site + nearby street hydrants) up to a maximum of 4 hydrants	0,5ℓ/s per hose reel from all hose reels in any fire division of building
	Magistrates courts	100ℓ/s	20ℓ/s per hydrant from minimum number of hydrants required for site (building + site + nearby street hydrants) up to a maximum of 4 hydrants	0,5ℓ/s per hose reel from all hose reels in any fire division of building
	Police stations	100ℓ/s	20ℓ/s per hydrant from minimum number of hydrants required for site (building + site + nearby street hydrants) up to a maximum of 4 hydrants	0,5ℓ/s per hose reel from a maximum of 3 hose reels
Low Risk Group 1 area	**Police station**			
	a) Without prisoner cells	≥ 15ℓ/s	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel from a minimum of 2 hose reels
	b) With prisoner cells	≥ 15ℓ/s	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel from a minimum of 3 hose reels

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	Public building installations	Minimum *available* fire water from Local Authority	Min *required* simultaneous fire water flow for public building(s)	
			From fire hydrants	From hose reels
	Prison			
	a) ≤ 1000 prisoners	≥ 15ℓ/s	20ℓ/s per hydrant from minimum of 2 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	b) 1000 – 2000 prisoners	≥ 15ℓ/s	20ℓ/s per hydrant from minimum of 3 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	c) > 2000 prisoners	≥ 15ℓ/s	20ℓ/s per hydrant from minimum of 4 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
Low Risk Group 2 area	**Police station**			
	a) Without prisoner cells	≥ 8,3ℓ/s	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel for minimum of 2 hose reels
	b) With prisoner cells	≥ 8,3ℓ/s	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel for minimum of 3 hose reels
	Prison			
	a) ≤ 1000 prisoners	≥ 8,3ℓ/s	20ℓ/s per hydrant from minimum of 2 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	b) 1000 – 2000 prisoners	≥ 8,3ℓ/s	20ℓ/s per hydrant from minimum of 3 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	c) > 2000 prisoners	≥ 8,3ℓ/s	20ℓ/s per hydrant from minimum of 4 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
Low Risk Group 3 area	**Police station**			
	a) Without prisoner cells	≥ 5,8ℓ/s	20ℓ/s per hydrant from minimum of 1nearby hydrant in street or on site	0,5ℓ/s per hose reel for minimum of 2 hose reels
	b) With prisoner cells	≥ 5,8ℓ/s	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel for minimum of 3 hose reels
	Prison			
	a) ≤ 1000 prisoners	≥ 5,8ℓ/s	20ℓ/s per hydrant from minimum of 2 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	b) 1000 – 2000 prisoners	≥ 5,8ℓ/s	20ℓ/s per hydrant from minimum of 3 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	c) > 2000 prisoners	≥ 5,8ℓ/s	20ℓ/s per hydrant from minimum of 4 nearby	0,5ℓ/s per hose reel from all required hose

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	Public building installations	Minimum *available* fire water from Local Authority	Min *required* simultaneous fire water flow for public building(s)	
			From fire hydrants	From hose reels
			hydrants in street and/or on site	reels in any individual building
Low Risk Group 4 area	**Police station**			
	a) Without prisoner cells	-	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel for minimum of 2 hose reels
	b) With prisoner cells	-	20ℓ/s per hydrant from minimum of 1 nearby hydrant in street or on site	0,5ℓ/s per hose reel for minimum of 3 hose reels
	Prison			
	a) ≤ 1000 prisoners	-	20ℓ/s per hydrant from minimum of 2 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	b) 1000 – 2000 prisoners	-	20ℓ/s per hydrant from minimum of 3 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building
	c) > 2000 prisoners	-	20ℓ/s per hydrant from minimum of 4 nearby hydrants in street and/or on site	0,5ℓ/s per hose reel from all required hose reels in any individual building

NOTE:

a) Where minimum required firewater flow is *more* than that available from the Local Authority, on site firewater flow shall be augmented by storage for the shortfall in flow.

b) Minimum required hydrants are determined by the maximum distances between all hydrants and the buildings as specified in this Document.

c) The required number of hose reels in the buildings will be determined by the Architectural Division of the DPW in terms of SABS 0400.

d) Under the conditions in paragraph 1.1, the Municipal supplies are sufficient for DPW residential needs.

1.2 IN AREAS WITHOUT FIRE HYDRANTS IN STREETS, OPERATIONAL FIRE BRIDGADES AND RELIABLE WATER SUPPLIES

Provide all the necessary fire hydrants on site and in the relevant buildings. **The shortfall in firewater flow shall be taken as equal to the total minimum required firewater flow as set out in paragraph 1.1 above and on-site storage shall be provided, for this full flow.**
In addition, for residential areas of DPW works under this supply condition, provide:

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	Public residential area	Minimum *available* fire water from Local Authority	Min *required* fire water flow for residential public building(s)	
			From hydrants installed in streets	From hose reels
	Military and Prison Residential areas with individual buildings of maximum gross			

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	Public residential area	Minimum *available* fire water from Local Authority	Min *required* fire water flow for residential public building(s)	
			From hydrants installed in streets	From hose reels
	floor area:			
Low Risk Group 1 area	(i) > 200m²	-	15ℓ/s per hydrant from a minimum of 1 hydrant	0,5ℓ/s per hose reel from a maximum of 3 hose reels
Low Risk Group 2 area	(ii) 100 – 200m²	-	8,3ℓ/s per hydrant from a minimum of 1 hydrant	-
Low Risk Group 3 & 4 areas	(iii) < 100m²	-	5,8ℓ/s per hydrant from a minimum of 1 hydrant	-

2. MINIMUM DURATION OF FIRE WATER FLOW SHORTFALL (IF ANY), FOR WHICH ON SITE STORAGE SHALL BE PROVIDED

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book) and Area Fire Flow Duration	Public building installations	Minimum Fire Water Storage duration (h)	DPW storage classification for building(s)
High Risk Area (6h)	Military installations	6h	High risk
	Public administration building	4h	Moderate risk
Moderate Risk Area (4h)	Public administration building	4h	Moderate risk
	Magistrates Court	3h	Moderate to low risk group1
	Police Station	3h	Moderate to low risk group1
Low Risk Group 1 area (2h)	**Police station**		
	a) Without prisoner cells	1h	Low risk group 2
	b) With prisoner cells	2h	Low risk group 1
	Prison		
	a) ≤ 1000 prisoners	2h	Low risk group 1
	b) 1000 – 2000 prisoners	3h	Moderate to Low risk group1
	c) > 2000 prisoners	4h	Moderate risk
	Residential areas of DPW		
	a) Group cluster, town houses and schools	2h	Low risk group 1
	b) Normal housing	1h	Low risk group 2

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book) and Area Fire Flow Duration	**Public building installations**	**Minimum Fire Water Storage duration (h)**	**DPW storage classification for building(s)**
Low Risk Group 2, 3 and 4 areas	**Police station**		
	a) Without prisoner cells	1h	Low risk group 2
	b) With prisoner cells	2h	Low risk group 1
	Prison		
	a) ≤ 1000 prisoners	2h	Low risk group 2
	b) 1000 – 2000 prisoners	3h	Low to moderate risk
	c) > 2000 prisoners	4h	Moderate risk
	Residential areas of DPW		
	a) Group-, cluster-, town houses and schools	2h	Low risk group 1
	b) Normal housing	1h	Low risk group 2

3. APPLICABLE MAXIMUM ON-SITE AND SITE-TO-STREET HYDRANT SPACING

Area classification in accordance with the Guidelines for Human Settlement Planning and Design (Red Book)	**Public Building Installations**	***Maximum* Hydrant Spacing**	**Maximum Distance of any point of building from a hydrant**
High Risk Area	Military Installation	120m	60m
	Public Administration Building	120m	60m
Moderate Risk Area	Public Administration Building	180m	90m
	Magistrates Court	180m	90m
	Police Station	180m	90m
Low Risk Group 1, 2, 3 and 4	**Police Station**		
	a) Without prisoner cells	240m	120m
	b) With prisoner cells	180m	90m
	Prison		
	a) ≤ 1000 prisoners	160m	80m
	b) 1000 – 2000 prisoners	140m	70m
	c) > 2000 prisoners	120m	60m
	Residential areas of DPW		
	a) Group-, cluster-, town houses and schools	180m	90m
	b) Normal housing	240m	120m

4. MINIMUM ELEVATED *DOMESTIC* STORAGE

PUBLIC BUILDING	MIN REQUIRED STORAGE	REFERENCE CODE
Public Administration Buildings and Magistrates Courts		
a) In cities and towns with reliable and well maintained water reticulations	24h ADWF	SABS 0252 Table 11:12h – 24h
b) In other towns and rural areas with reliable gravity supplies	24h ADWF	SABS 0252 Table 11:12h – 24h
c) In towns and rural areas with pumped or unreliable supplies	48h ADWF	"Red Book" : Chapter 9: p26 48h
Police Stations		
(a) For reliable gravity supplies and in cities and towns with reliable and well maintained water reticulations	24h ADWF	SABS 0252 Table 11:12h – 24h
(b) For pumped or unreliable supplies	48h ADWF	"Red Book" : Chapter 9: p26 48h
Prisons		
a) Prison Buildings	48h ADWF	"Red Book" : Chapter 9: p26 48h
b) Associated residential group-, cluster-, town houses and schools		
(i) For reliable gravity supplies	24h ADWF	SABS 0252 Table 11:16h – 24h
(ii) For pumped or unreliable supplies	24h – 48h ADWF	"Red Book" : Chapter 9: p26 24h-48h
c) For other associated residential areas		
(i) For reliable gravity supplies	No storage required	SABS 0252 Table 11: none required
(ii) For pumped or unreliable supplies	24h – 48h ADWF	"Red Book" Chapter 9 : p26: 24h – 48h
Military Installations		
a) Aircraft maintenance, admin & air passenger terminals		
(i) For reliable gravity supplies	24h	"Red Book": 24h – 48h
(ii) For pumped or unreliable supplies	48h	"Red Book": 48h
b) Associated residential group-, cluster-, townhouses, schools, hospitals etc		
(i) For reliable gravity supplies	12h – 24h ADWF	SABS 0252 Table 11: 16h – 24h
(ii) For pumped or unreliable supplies	24h-48h ADWF	"Red Book" : Chapter 9: p26 24h-48h
c) For other associated residential areas		
(i) For reliable gravity supplies	No storage required	SABS 0252 Table 11: none required
(ii) For pumped or unreliable supplies	24h-48h ADWF	"Red Book" : Chapter 9: p26 24h-48h

5. MINIMUM ELEVATED *FIRE* STORAGE

PUBLIC BUILDING	MIN REQUIRED STORAGE	REFERENCE CODE
For each separate public admin building, magistrates court, prison building and military building exceeding 250m² in floor area	9kℓ	SABS 0252 : Clause 7.4.2.4: 4,5kℓ – 9kℓ
For hospitals, educational institutions and where-ever a discrete fire installation is installed	9kℓ	SABS 0252 : Clause 7.4.2.4: 4,5kℓ – 9kℓ
For other residential buildings	None required	SABS 0400: Clause TT 34.1 (No hose reels required)

6. MINIMUM HEIGHT OF ELEVATED FIRE STORAGE

PUBLIC BUILDING	MIN HEIGHT	REFERENCE CODE
For all DPW buildings and two more storey on height and any single storey building with floor area exceeding 250m² excluding normal residential buildings	Floor of tank to be placed at a level to obtain a residual pressure of not less than 70kPa at the highest hose reel when a minimum of 2 hose reels are operating simultaneously	SABS 0252 : Clauses 7.2.2.1: 70kPa and TT34.1 SABS 0400: Clause WW5.4: 2 hose reels simultaneously

7. MINIMUM FIRE HOSE REEL FLOW AND PRESSURE

DPW DEVELOPMENT	MIN FIRE HOSE REEL FLOW AND PRESSURE	REFERENCE CODE
For all Public buildings of two and more storeys in height and any single storey building with floor area exceeding 250m² excluding normal residential buildings.	0,5 ℓ/s @ 300kPa with a minimum residual pressure of 70 kPa at the highest hose reel when two hose reels are in full operation	SABS 0400: Clauses WW5.1: 0,5 ℓ/s @ 300kPa and TT34.1 SABS 0252: Clause 7.2.2.1: 70kPa min at highest point with one hose reel in full operation.

8. FIRE HYDRANT BOOSTER REQUIREMENTS*

DPW DEVELOPMENT	REQUIREMENTS
For all Public buildings which do not require hydrants in the building in areas where a fully operational fire brigade is available and street hydrants are located in such a way that fire water can be boosted through the fire engine and fire fighters can reach all faces of the building with their normal equipment.	No booster connection is required

For Public building with FIRE HYDRANTS in the Building and where a fully operational fire brigade is available	Provide a booster inlet connection on the boundary connected to the building fire hydrants in accordance with the requirements of the local Fire Chief Officer
For Public buildings not served by an operational fire brigade but with a reliable water supply and pressures which do not drop below 300kPa	No fire booster connection will be required
For Public buildings not served by an operational fire brigade and with an unreliable water supply or minimum water pressures below 300kPa	Provide two booster pumps (one duty and one standby) from a ground level water storage reservoir. Connect the booster pumps to a diesel electric generating set. Each booster pump's capacity shall be sufficient to provide the calculated minimum design fire flow as set out in paragraph 1.1

9. FIRE HOSE REEL BOOSTER PUMPS*

DPW DEVELOPMENT	BOOSTER PUMP REQUIREMENTS
All Public buildings served by a reliable gravity water supply under a pressure which never drops below 300kPa and in which the hose reels are under the mains pressure	None required
All Public buildings with hose reels *that are* served by a water source with minimum pressures less than 300kPa.	Provide 2 hose reel booster pumps (one duty, one standby) with a capacity sufficient to boost a flow equal to the maximum number of hose reels simultaneously in operation to a minimum pressure of 300kPa.

10. SPRINKLER SYSTEMS*

Sprinkler systems shall be provided for any Public building falling within the category of Clause TT36.1 of SABS 0400 and the water requirement for the system shall be determined by a competent specialist in sprinkler systems.

* NOTE: **All Fire Pumping Installations and Control Systems, shall comply with the "Fire Security" standards of the DPW**.

11. THE PRINCIPLES IN THESE GUIDELINES ARE ILLUSTRATED IN THE FOLLOWING EXAMPLES

11.1 Police station in a "moderate risk" area of a city with fully operational fire brigade and street fire hydrant(s) enabling the fire engine to reach all parts of the police station. The water supply is reliable and the supply rate and pressures are in excess of that required for domestic and fire demands. (See following diagram 11.1)

Design:

- Allow only for a domestic water storage tank with capacity equal to 24h ADWF for internal water disruptions.

- Firewater is always and immediately available from the municipal supply, and no firewater storage tanks are required.
- Allow on site for a fire hose reel flow from 3 hose reels directly connected to the municipal supply without a valve *on the site*.
- No fire hydrants, hydrant booster connection or hydrant booster pumps are required on site.
- No fire hose reel booster pumps are required.
- Shut off valve is provided on domestic water only for maintenance purposes.
- Domestic water tank can be situated on top of the building or on a stand higher than the building.
- Allowance is made to circulate the water through the tank by connecting three to four cisterns with the tank.
- An emergency valve (under control of the Police Station Chief) is installed on the domestic delivery line from the tank to supply water to the building during maintenance or other emergency situations.

11.2 Magistrates Court of 2 storeys in the business centre of town with fully operational fire brigade. There is however, only one street hydrant in the vicinity, which is not sufficient for use by a fire engine to extinguish a fire at any location of the building. Although the water source is sufficient and reliable, the water pressure drops at times below 300kPa. The minimum water head at the site is 24m and at least *7m* above the highest floor level. (See following diagram 11.2)

Design:

- Allow for domestic storage tank of 24h ADWF and 9kℓ of firewater storage on a stand. The bottom of the tank shall be at least 7m plus the delivery friction head loss above the highest floor level and the top water level in the tank shall not be higher than 24m above the level of the water supply main.
- No ground level fire storage reservoir is required.
- Provide fire hydrants around the building at a maximum distance of 180m apart with no part of the building further than 90m from a hydrant. Say 3 additional hydrants are required.
- Provide a fire brigade booster connection on the boundary of the site in accordance with the local municipalities requirements for boosting both the fire hydrant and hose reel supplies.
- Connect the emergency domestic storage via an emergency valve to the buildings domestic supply and to 3 to 4 cisterns for circulating purposes.
- Connect the emergency fire supply to the hose reels via a reflux valve hanging normally open and also to the fire hydrant loop.
- Provide a *reduced pressure backflow preventer (RPBP) valve* in the supply line to prevent emergency stored water draining out of the site
- Design the fire loop for a flow of 20ℓ/s from any 4 hydrants and the simultaneous flow from the hose reels in any division of the building under the maximum pressure supplied by the Local Authority's fire engines.

11.3 Police Station with prisoner cells in a rural area with no fire brigade service and street fire hydrants but with reliable and well maintained gravity water supplies with sufficient flows for domestic and fire fighting uses. The minimum water head in the mains of 25m is sufficient for domestic purposes but insufficient for fire hose reels. The police station will have an administration staff of 40 and 80 prisoners in cells. (See following diagram 11.3)

Design

- Allow for an emergency tank with 24h ADWF for domestic storage and 9kℓ min for fire hose reel storage on a tank stand. Bottom of tank shall be more than 7m plus delivery friction losses above the level of the highest hose reel on the top storey and the top water level of the tank shall be not more than 25m above the level of the main supply pipe.
- Provide a fire hydrant ring main with fire hydrants spaced at 180m maximum. The police station will require 2 hydrants of which any one can be used for fire fighting.
- Provide a booster pump installation for the hydrants (duty plus standby), connected to a diesel-electric generating set, for boosting both the fire hydrant ring and the hose reels.
- Supply water for domestic use directly from the main with an emergency supply form the tank via a manual valve under the control of the Police Station Chief. *The reduced pressure backflow* valve shall prevent emergency water escaping out of the site.
- Supply an emergency fire supply from the tank via a reflux valve (normally open) to the hose reels. The architectural division specified 4 hose reels for the police station. A maximum of three of these will be used simultaneously.
- Connect the hose reel supply also to the booster pump installation.
- The emergency tank shall be kept full under the mains pressure.
- As the water supply is reliable, no ground level fire water reservoir is required.
- The water storage and fire water requirement are calculated as follows:

Elevated domestic storage : Administration : 40 @ 70 ℓ/p/d		= 2,8kℓ
(24h)	Prisoners : 80 @ 200 ℓ/p/d	= 16,0kℓ
	Total	= 18,8kℓ
Elevated fire storage :		= 9,0kℓ
	Total elevated storage in tank on stand	= 27,8kℓ

- The water supply required by the booster pump installation, is calculated as follows:

Min Fire Design Flow as per table	= 20,0ℓ/s (one hydrant)
+ 3 hose reels max simultaneously 3 x 0,5ℓ/s = 1,5ℓ/s	= 1,5ℓ/s
Design fire flow is therefore	= 21,5ℓ/s

11.4 Prison in rural area with no fire brigade and street fire hydrants, insufficient water supplies for fire fighting and with water pressures dropping below 300kPa. Water supply and/or pressures are sufficient for the domestic requirements of the prison but are unreliable. The prison will have a prisoner population of 3000 and an average water requirement of 378 ℓ/pr/d (excluding fire). The minimum mains water pressure is 26m water head. A maximum of 8 fire hose reels have been installed in any building. (See following diagram 11.4)

Design:

- Provide a ground level fire hydrant storage reservoir connected to a booster pump set (duty and standby) and a diesel electric generating set.
- Provide a fire hydrant ring main with fire hydrants spaced at 120m centres with no hydrant further than 60m from any point of a building to be protected. Nine hydrants will be required of which no more than 4 will be operated simultaneously.
- Provide a storage tank on a stand with 48h ADWF storage for domestic purposes and 9kℓ fire hose reel storage.
- Provide *hydrant and hose reel* booster pump sets (duty and standby), *plus diesel electric generating set* automatically boosting the fire *hydrant loop and hose reels* when any hose reel in a *building* is operated.

- The necessary emergency elevated tank circulation loop and pipework shall also be provided as before.
- The elevated storage is calculated as follows:

Elevated domestic storage		
= 2 days x 3000 x 150 ℓ/d	= 900 kℓ	(average consumption reduced due to low emergency pressures and/or flow throttling)
Elevated fire storage	= 9 kℓ	
Total elevated storage	= 909 kℓ	(or 13m x 12m x 6m modular tank on stand)

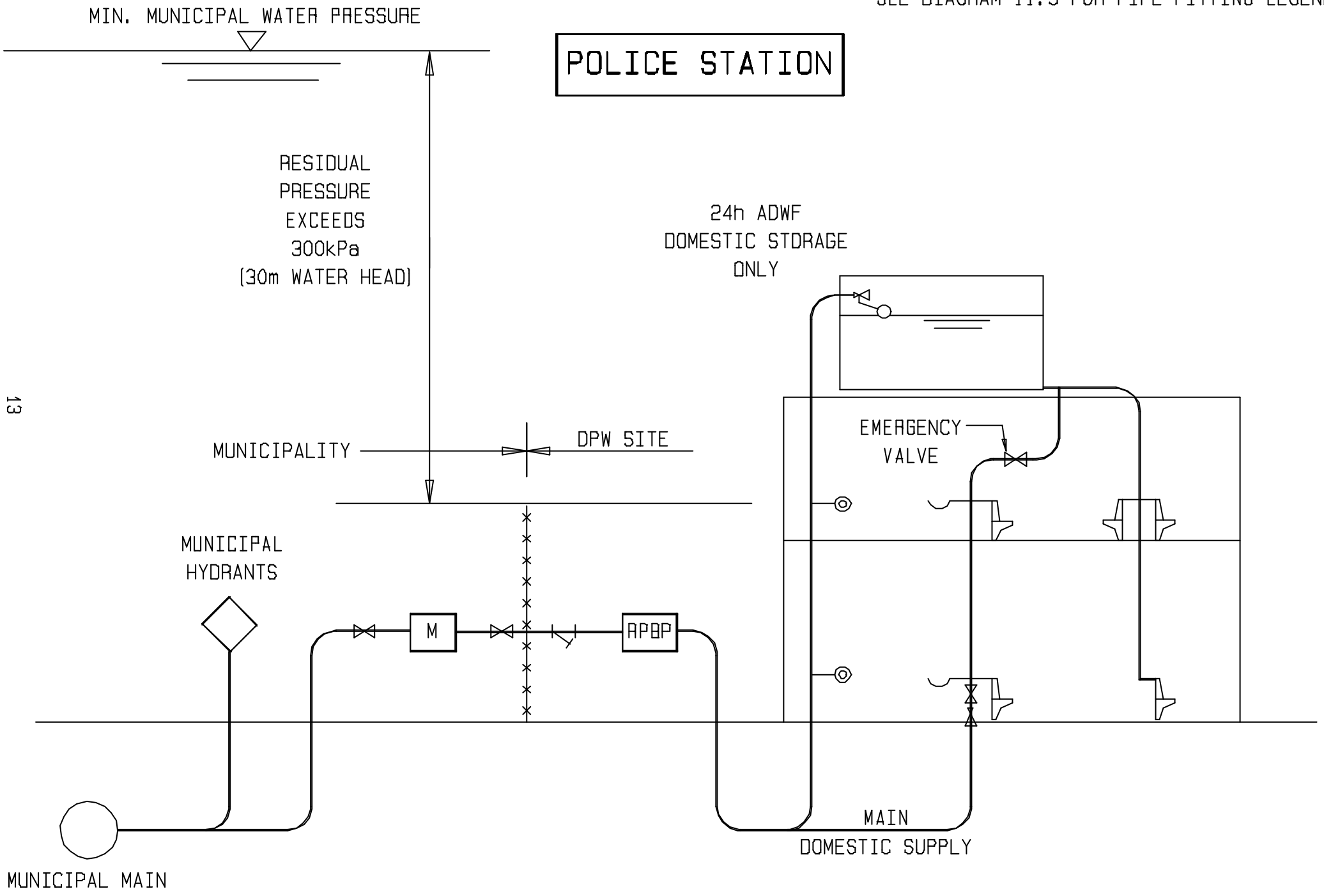
- The ground level fire water storage tank is calculated as follows:

Minimum design fire flow = 4 x 20ℓ/s	= 80 ℓ/s
For a maximum of 8 hose reels operating simultaneously, the flow required = 8 x 0,5 ℓ/s	= 4 ℓ/s
Therefore design fire flow	**= 84 ℓ/s**

Minimum ground level firewater storage required = 4h @ 84 ℓ/s = 1210 kℓ or 17m dia x 5.3m deep reservoir

(c/my doc/qs/civil.doc/fire water storage (pw 345)-04-2004)

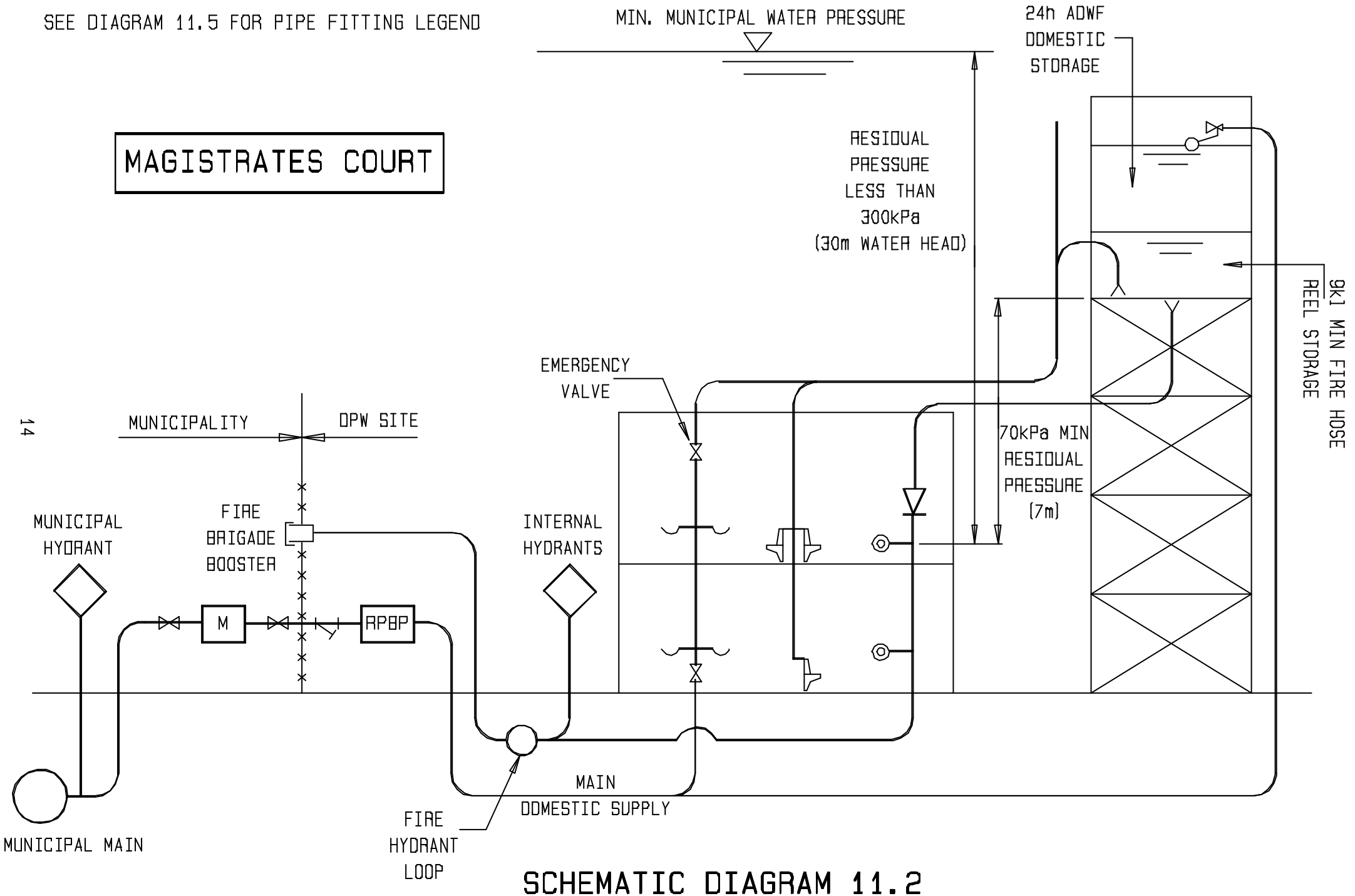
SEE DIAGRAM 11.5 FOR PIPE FITTING LEGEND



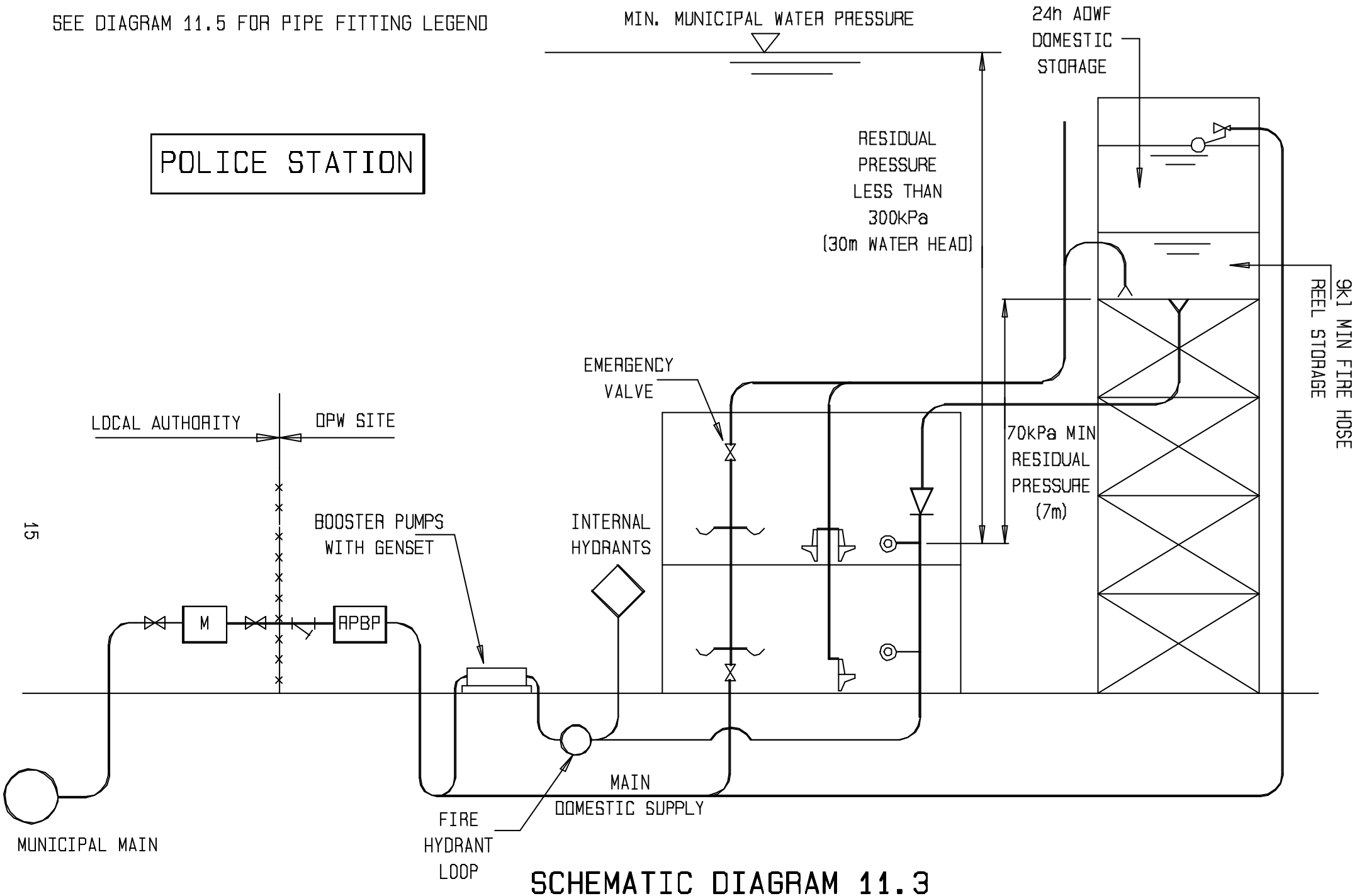
SCHEMATIC DIAGRAM 11.1

SEE DIAGRAM 11.5 FOR PIPE FITTING LEGEND

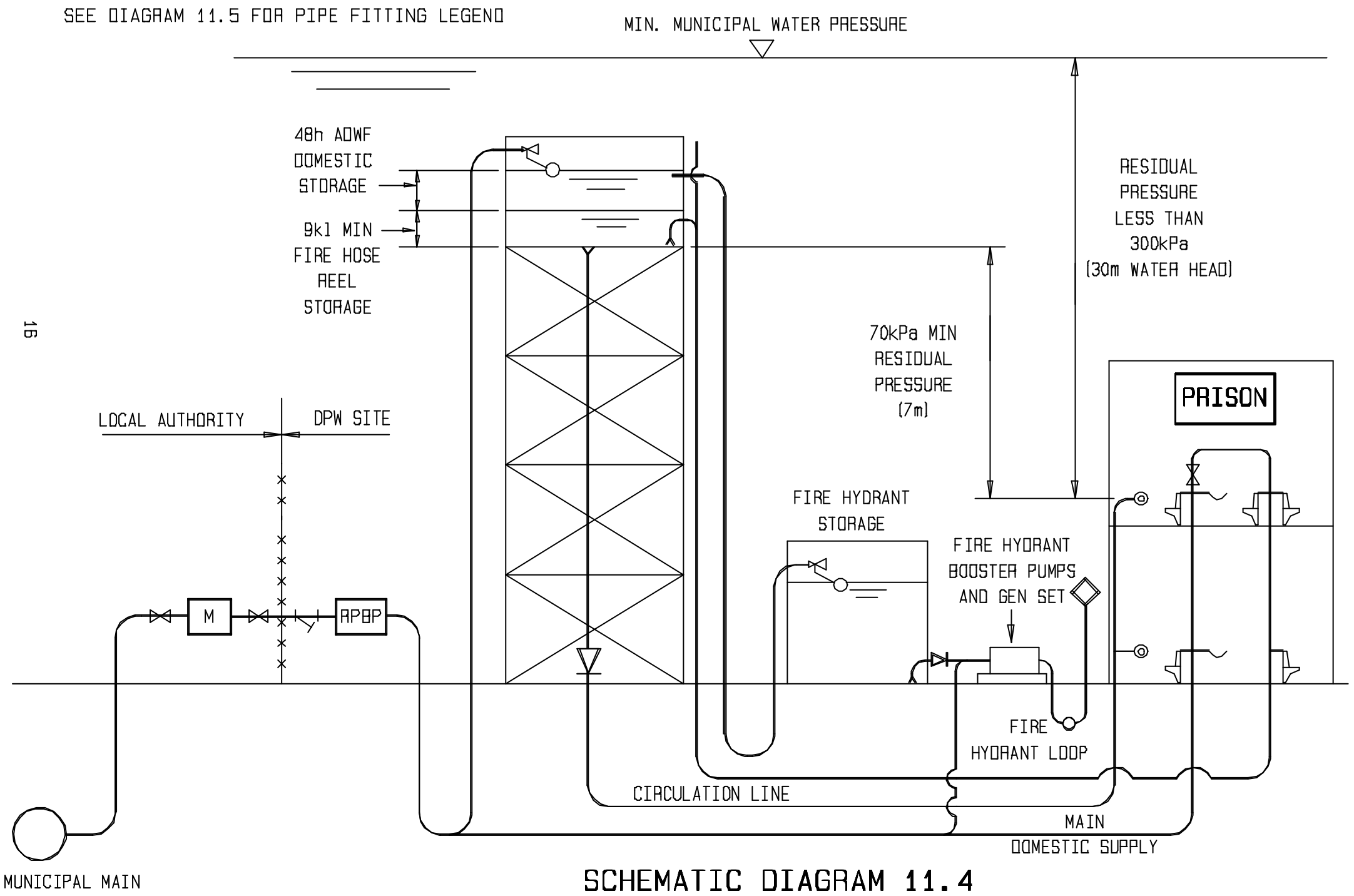
MAGISTRATES COURT



SCHEMATIC DIAGRAM 11.2



SCHEMATIC DIAGRAM 11.3

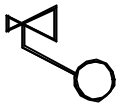


SCHEMATIC DIAGRAM 11.4

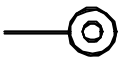
TOILET (CISTERN)

WASH HAND BASIN

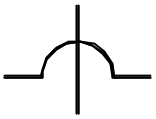
WATER METER



FLOAT VALVE



FIRE HOSE REEL



PIPE CROSSING

REDUCED PRESSURE BACKFLOW PREVENTER

STRAINER

PRESSURE REDUCING VALVE

MAINTENANCE, ISOLATION OR EMERGENCY VALVE

FIRE HYDRANT

PIPE FITTING LEGEND

SCHEMATIC DIAGRAM 11.5