MEMBER REPORT

ESCAP/WMO Typhoon Committee
8th Integrated Workshop/2nd TRCG Forum

(Macao, China)

Macao, China
2 - 6 December 2013

CONTENTS

I. Overview of tropical cyclones which have affected/impacted Member's area in 2013

1. Meteorological Assessment (highlighting forecasting issues/impacts)

Seven tropical cyclones affected Macao in the calendar year of 2013, including Bebinca (1305), Rumbia (1306), Cimaron (1308), Jebi (1309), Utor (1311), Usagi (1319) and Krosa (1329) successively. The annual number of tropical cyclones was higher than the annual average of 6.0, while one of these tropical cyclones, Utor, necessitated the hoisting of Tropical Cyclone Signal No. 8 (gale wind signal). (Figure 1)

T.S. BEBINCA (1305)

On 21 June, a tropical depression intensified into a tropical storm over the South China Sea and was named Bebinca (1305). It moved west-northwestwards and was closest at about 320 km south-southwest of Macao at 06:00 L.T. on 22 June while crossing the Province of Hainan on the same day, then it made landfall along the northern coast of Vietnam at 23:00 L.T. on 23 June. Finally, it dissipated overland.

The highest signal being hoisted was No. 3 as fresh to strong winds were recorded over Macao with strong winds for six hours on the bridges.

Date	Time*	Signal Hoisted
21/Jun	08:00	No.1
22/Jun	04:00	No.3
22/Jun	10:30	All signals lowered

S.T.S. RUMBIA (1306)

On 28 June, a tropical depression intensified into a tropical storm to the east of the Philippines over the Pacific Ocean and was named Rumbia (1306) moving west-northwestwards. It made landfall along the eastern coast of the Philippines in the morning on 29 June.

After crossing the Philippines, Rumbia entered the 800km alert radius of Macao at 20:00 L.T. on 30 June. On 1 July, it intensified further into a severe tropical storm and turned to move northwestwards towards the western coast of Guangdong province, and it was closest at about 329km southwest of Macao at 23:00 L.T. the same day. Finally, it made landfall along the coast of Zhanjiag city in the early morning on 2 July and dissipated overland.

The highest signal being hoisted was No. 3 as strong to near gale winds were recorded over Macao for 8 hours on the bridges.

Date	Time*	Signal Hoisted
30/Jun	22:00	No.1
1/Jul	13:30	No.3
2/Jul	06:30	All signals lowered

T.S. CIMARON (1308)

On 17 July, a tropical depression intensified into a tropical storm to the east of the Philippines over the Pacific Ocean and was named Cimaron (1308) moving north-northwestwards.

After crossing the Balintang Channel on 17 July, Cimaron entered the 800km alert radius of Macao at 20:00 L.T. and turned to move northwestwards towards the eastern coast of Guangdong province. It was closest at about 432km east of Macao at 16:00 L.T. on 18 July and turned to move northwards, then it made landfall along the southeastern coast of Fujian province at the night of the same day. Finally, it dissipated overland.

Signal No. 1 had been hoisted for 17 hours and moderate to fresh winds were recorded since Cimaron was relatively far away from Macao.

Date	Time*	Signal Hoisted
18/Jul	06:30	No.1
18/Jul	23:30	All signals lowered

S.T.S. JEBI (1309)

On 31 July, a tropical depression intensified into a tropical storm to the west of the Philippines over the central part of South China Sea and was named Jebi (1309). It moved west-northwestwards and entered the 800km alert radius of Macao at 20:00 L.T. the same day.

On 2 August, Jebi intensified further into a severe tropical storm and turned to move northwestwards towards the Hainan province. It was closest at about 390km southwest of Macao at 20:00 L.T. the same day while making landfall along the coastal of Hainan province Wenchang city. After crossing the Hainan province, JEBI turned to move west-northwestwards and made landfall again along the northern coast of Vietnam at 11:00 L.T. on 3 August. Finally it dissipated overland.

The highest signal being hoisted was No. 3 as fresh to strong winds were recorded over Macao for 18 hours on the bridges.

Date	Time*	Signal Hoisted
1/Aug	10:00	No.1
2/Aug	13:00	No.3
3/Aug	05:45	All signals lowered

Typhoon UTOR (1311)

On 10 August, a tropical depression intensified into a tropical storm to the east of the Philippines over the Pacific Ocean and was named Utor (1311). It intensified into a severe tropical storm at 11:00 L.T. and intensified further into a typhoon at 14:00 L.T. the same day moving west-northwestwards towards Luzon Island.

After crossing the Luzon Island on 12 August, Utor entered the 800km alert radius of Macao at 16:00 L.T. the same day moving west-northwestwards at around 25 km/h steadily towards the western coast of Guangdong province. On 14 August, It turned to move northwestwards and was closest at about 200km southwest of Macao at 11:00 L.T., and then it

made landfall along the coast of Yangjiang city in the afternoon. Finally, it dissipated gradually overland.

The highest signal being hoisted was No. 8 as near gale to gale winds were recorded over Macao for 9 hours on the bridges.

Date	Time*	Signal Hoisted
12/Aug	18:00	No.1
13/Aug	13:30	No.3
14/Aug	05:00	No.8NE
14/Aug	08:00	No.8SE
14/Aug	15:30	No.3
15/Aug	19:30	All signals lowered

Typhoon USAGI (1319)

On 17 September, a tropical depression intensified into a tropical storm to the east of the Philippines over the Pacific Ocean and was named Usagi (1319) moving westwards. It intensified into a severe tropical storm at 08:00 L.T. on 18 September and intensified further into a typhoon at 20:00 L.T. the same day moving westwards steadily towards Luzon Strait.

After crossing the Bashi Channel south of Taiwan in the morning on 21 September, it entered the 800km alert radius of Macao at 12:00 L.T. the same day moving west-northwestwards towards the coastal area of the Pearl River Estuary. On 22 September, Usagi made landfall over the coast of the Shanwei, Guangdong Province at about 20:00 L.T. and continued to move west-northwestwards towards inland. Typhoon USAGI was closest at about 100km away north of Macao at 04:00 L.T. on 23 September. Finally, it weakened rapidly in Guangdong Province and dissipated overland.

With the northerly air-streams constrained by the topography friction, no gale winds were recorded even it was very close to Macao. Hence, the highest signal hoisted during its passage was No. 3 only.

Date	Time*	Signal Hoisted
21/Sep	13:00	No.1
22/Sep	11:00	No.3
23/Sep	11:30	All signals lowered

Typhoon KROSA (1329)

On 30 October, a tropical depression intensified into a tropical storm to the east of the Philippines over the Pacific Ocean and was named Krosa (1329) moving westwards. It intensified into a severe tropical storm at 20:00 L.T. the same day. On 31 October, Krosa intensified further into a typhoon at 20:00 L.T. moving westwards steadily towards the northern part of Luzon island.

After crossing the Luzon Island, Krosa entered the 800km alert radius of Macao at 04:00 L.T. on 1 November moving west-northwestwards steadily towards Hainan province. On 2 November, Krosa moved to the sea area around 270km southeast of Macao and lingered over the northern part of South China Sea. It weakened into a severe tropical storm moving southwestwards at noon on 3 November and weakened continuously into a tropical storm at

22:00 L.T. due to the influence of winter monsoon, then it weakened further into a tropical depression. Finally, it dissipated into an area of low pressure on 5 November.

Signal No. 1 had been hoisted for 56 hours and moderate to fresh winds were recorded over Macao.

Date	Time*	Signal Hoisted
1/Nov	16:00	No.1
4/Nov	00:00	All signals lowered

*All time mentioned above is local time

2. Hydrological Assessment (highlighting water-related issues/impact)

Nil.

3. Socio-Economic Assessment (highlighting socio-economic and DRR issues/impacts)

Macao was hit by 6 tropical cyclones in 2013, while only Utor was strong enough to warrant the hoisting of typhoon signal no. 8. With wind gusting at over 100 kilometers per hour, Typhoon Utor brought Macao to a standstill.

During the passage of Utor, a total of 29 incidents were reported to Civil Protection Operational Centre. Many of these incidents were related to swinging billboards, falling tree branches and windows being blown away. Due to the severe weather condition, ferry services between Macao and Hong Kong and several ports in Guangdong province were suspended, while over 70 arrival or departure flights were delayed or canceled, therefore, tourists and citizens were held up at the Outer Harbour Ferry Terminal and Macau International Airport respectively.

Date/Time		Name	The Highest Signal Hoisted	Incidents (cases)							
Start	End			Flooding	Landslide	Felled Trees	Billboards/ Awnings/ Windows/ Walls (Collapsed/ Tottering)	Scaffoldings/ Fencings/ Crane (Collapsed/ Tottering)	Power cables/ Lampposts (Collapsed/ Tottering)	Death / Injuries	Others
21-06-13 08H00	22-06-13 10H30	BEBINCA (1305)	3	0	0	0	0	0	0	0	0
30-06-13 22H00	02-07-13 06H30	RUMBIA (1306)	3	0	0	1	1	0	0	0	0
18-07-13 06H30	18-07-13 23H30	CIMARON (1308)	1	0	0	0	0	0	0	0	0
01-08-13 10H00	03-08-13 05H45	JEBI (1309)	3	0	0	0	0	0	0	0	3
12-08-13 18H00	15-08-13 19H30	UTOR (1311)	8	0	0	4	13	1	3	0	8
21-09-13 13H00	23-09-13 11H30	USAGI (1319)	3	0	0	3	10	1	1	0	4

Table 1: Damages caused by tropical cyclones in Macao during 2013

Nine rainstorm warnings were issued in 2013, and particularly on 4 September when a rainstorm warning was issued twice, with 200mm of rain and 400mm were recorded in Taipa and Coloane respectively. Referring to the following table, the heavy downpour in May and June triggered flooding and landslide in various places across Macao, and resulted in tremendous traffic disruption and temporary suspension of business in numerous shops at ground level. Some roads were temporarily closed to traffic because of rain-triggered landslide. The authority activated the flooding contingency plan to divert traffic to unaffected areas, and urged drivers to avoid going to affected areas.

Date	Duration	Incidents (cases)									
		Flooding	Felled Trees	Buildings collapsed / Concrete spalling	Billboards collapsed or tottering	Scaffoldings collapsed or tottering	Windows collapsed or tottering	Awnings collapsed or tottering	Landslide	Deaths / Injuries	Others
18-04-13	15H38-17H40	9	0	0	0	0	0	0	5	0	0
08-05-13	19H00-20H45	39	1	0	0	0	0	0	1	0	4
22-05-13	00H55-10H00	66	2	1	0	0	0	0	9	0	4
25-05-13	08H20-11H45	50	1	0	0	0	0	0	0	0	0
24-06-13	06H45-11H45	39	0	0	0	0	0	0	0	0	0
31-08-13	14H49-15H45	1	0	0	0	0	0	0	0	0	0
02-09-13	18H00-19H25	0	0	0	0	0	0	0	0	0	1
04-09-13	06H50-10H45	1	0	0	0	0	0	0	3	0	0
04-09-13	16H50-19H05	15	0	0	0	0	0	1	3	0	0

Table 2: Damages caused by rainstorms during 2013

4. Regional Cooperation Assessment (highlighting regional cooperation successes and challenges)

Nil.

II. Summary of progress in Key Result Areas

TC Members' Report
Summary of Progress in KRAs

Item 1:
Improved the ability of weather forecast and nowcasting

A new generation of dual-polarization S-band Doppler radar has been purchased and four technicians have attended the S-band Weather Radar training course at Beijing Metstar Radar Co. Ltd. in Beijing, China. The radar is still under the installation in the end of 2013, and is expected to put into operation before the rainstorm and typhoon seasons of 2014. This new Doppler weather radar will provide high quality meteorological products to improve the ability of weather nowcasting.

On the other hand, the need for meteorological data exchange has steadily increased over the years, we cooperate with a university in Hong Kong to share the GPS derived water vapour observations, and enhanced the development of numerical forecasting as well as the ability of weather nowcasting in the region.

Identified opportunities/challenges, if any, for further development or collaboration:
Nil.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

KRA =	1	2	3	4	5	6	7
Meteorology	✔	✔					
Hydrology							
DRR							
Training and research	✔						
Resource mobilization or regional collaboration	✔						

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Item 2:
Enhanced public weather service and public education

Due to the improvement of tropical cyclone forecast technology and experience accumulation, the track forecast of tropical cyclone becomes more accurate. Therefore, detailed warning information for typhoon becomes possible. The information will help the public to arrange in advance their planning and minimize the Typhoon-related Social and Economic Impacts.

In order to enhance our public weather service, we have successfully launched the SMG official mobile app in both iOS and Android versions which are two widely used smartphone platforms in Macau.

To enhance the communication with other government departments during severe weather, especially tropical cyclones and rainstorm to promote better awareness and preparedness.

In order to let citizens have a better understanding our operations as well as the meaning of different warnings, around 560 students and citizens were recorded visiting the SMG headquarters in the year 2013.

Besides, for the World Meteorological Day 2013, the Macao Meteorological and Geophysical Bureau held a fun fair in the residential district aiming to promote general meteorology knowledge to the public. The event was composed of a series of activities which included a drama about our Bureau's weather service, a student quiz on meteorology knowledge, game booths and exhibitions which help to enhance the public's knowledge on meteorology, tropical cyclone and the effects induced by typhoon-related disasters, plus to promote public's awareness on climate change. In addition to the one-day fun fair, SMG conducted roving educational workshops during April to July in 2013. This workshop is a practical workshop with topics covering meteorological knowledge and fundamental teaching on meteorology monitoring and tropical cyclone. Over 1100 students from about 20 schools participated in this workshop.

Identified opportunities/challenges, if any, for further development or collaboration:
Nil.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

KRA =	1	2	3	4	5	6	7
Meteorology	✔	✔		✔			
Hydrology							
DRR							
Training and research							
Resource mobilization or regional collaboration							

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Item 3:
Reinforce urban flooding monitoring

In order to reinforce the capability of urban flooding monitoring in Macao, Meteorological and Geophysical Bureau is cooperating with Land, Public Works and Transport Bureau and Civic and Municipal Affairs Bureau to construct 8 brand new water level monitoring stations(WLMS) which are distributed in Macao peninsula, Taipa and Coloane, respectively. Differ from the existing 9 WLMS, except the function of real-time water level monitoring, the new stations also include the module of automatic weather station and webcam. Citizens in Macao may not only get the water level information from the WLMS, but also know the meteorological elements (ex. Precipitation and wind speed, etc) and the real-time image of the road simultaneously when there is a rainstorm. The new WLMS will come into operation in the beginning of 2014.

Identified opportunities/challenges, if any, for further development or collaboration:
Nil.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology	✔	✔					
DRR							
Training and research							
Resource mobilization or regional collaboration							

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Item 4:
Disaster Risk Reduction

Slope safety has been one of the great concerns for Macao SAR Government. Regular inspection on slopes is conducted by Land, Public Works and Transport Bureau (DSSOPT) ahead of rainy season. In 2013, the number of high risk slopes is reduced from 9 to 5, while reinforcement and related works on 28 slopes has already been completed since 2004. (Figure 2)

Moreover, the Bureau has also established "Slope Safety Information Network" website (Figure 3) in order to provide free and convenient public access to slope information from homes and offices, as well as to arouse the awareness of private slope owners hoping they will take the initiative to check and repair the slopes.

In addition, Macao SAR Government is planning to install an automatic slope

monitoring system, aiming to collect hydrological and geological information to locate potentially dangerous slopes and carry out renovation works accordingly.

	High Risk	Medium Risk	Low Risk	Total
Macao Peninsula	2	25	52	79
Taipa	0	19	34	53
Coloane	3	23	35	61
Total	5	67	121	193

Table 3: Distribution of slopes in Macao according to the landslide risk level

In order to avoid various incidents of falling trees, Civic and Municipal Affairs Bureau (IACM) employs radar tree-testing devices (Figure 4) to detect non-visible diseases affecting the trees, and trimming or removing those trees that are deemed dangerous (Figure 5).

When typhoon signal is hoisted, DSSOPT will send SMS message to construction industry warning them to adopt precautionary measures such as securing and fastening the works, scaffoldings, and working platforms in order to prevent the occurrence of accidents. In addition, Marine and Water Bureau (DSAMA) will delegate staff to inspect ports to ensure that the port facilities are properly fastened, and urge the marine industry to lead all the ships and other sailing crafts into typhoon shelters (Figure 6); as well as to check the steadiness of their anchor chains.

In view of the intense flooding caused by torrential downpours this year, several solutions to reduce the danger of flooding and landslides were proposed. These include reviewing the current contingency plans against flooding to better protect the safety of the citizens; improvement of the capacity of the underground drainage system particularly in Taipa in order to cope with the larger population (Figure 7); installing a new rainwater catchment and drainage system to divert water from Taipa Grande Hill to the Pac On area which would help solve flooding issues in old Taipa Village; as well as constructing an embankment in the Inner Harbour, where is one of the flooding blackspots in Macao.

Identified opportunities/challenges, if any, for further development or collaboration:
Nil.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR	✔	✔					
Training and research							
Resource mobilization or regional collaboration							

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Item 5:
Training on Severe Weather Forecasting and Effective Warning System

Two forecasters participated in Severe Weather Forecasting and Warning Services Workshop in Macao during 8th to 19th April 2013, focusing on topics of weather forecasting, especially the dramatic development in numerical weather prediction (NWP) systems, including ensemble prediction systems (EPS) which give guidance in advance of potential hazardous weather conditions, the development of an efficient warning system, and how to strengthen interaction with disaster management and civil protection agencies, local communities and media.

Two forecasters participated in the training course on the SWIRLS (Short-range Warning of Intense Rainstorms in Localized Systems) nowcasting system held at Hong Kong Observatory during 21st October to 1st November 2013. One of the major components of the system is to make use of both radar and raingauge data to monitor and predict local rainfall distribution trends within the next couple of hours, which can improve the short-range forecasting ability, including quantitative precipitation forecast.

SMG participated in the APEC Typhoon Symposium (APTS) held in Taipei during 21st to 23rd October 2013. The symposium encompasses five topics: Typhoon behavior in a warming globe, Flood Resilience and Mitigation, Mainstream Adaptation Policy, Hydrologic/Hydraulic Modeling and Climate Change, and Member Economy Experience Sharing. The symposium offers a platform for dialogue and exchange of information among Meteorological and Hydrologic experts from various countries, which helped the participants to widen their knowledge in facing typhoons behavior in a warming globe, as well as other destructive impacts.

In 2013, Macao Security Forces Coordination Office continued to participate actively in the meetings organised by Typhoon Committee (TC) as well as the TC Working Groups. These include:
29 January to 1 February 2013, 45th Session of Typhoon Committee
29 to 30 May 2013, 8th Meeting of WGDRR
2 to 6 December 2013, 8th Integrated Workshop / 2nd TRCG Forum

Identified opportunities/challenges, if any, for further development or collaboration:
Nil.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

KRA =	1	2	3	4	5	6	7
Meteorology				✔			
Hydrology				✔			
DRR							✔
Training and research	✔	✔					
Resource mobilization or regional collaboration							

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Item 6:
Drill and Emergency Plan with Government Departments and Organizations in Preparation for Severe Weather

The SMG Emergency Plan was revised and rehearsed in 2013 to ensure the provision of meteorological services, including tropical cyclone forecasts and warnings, in all-weather.

A typhoon drill was staged by Macao Security Forces Coordination Office at the Civil Protection Operational Centre in April. The drill lasted almost 4 hours and involved over 1,200 participants from 27 public and private entities. The simulation exercise has been annually organized to test the efficiency of the General Plan of Civil Protection, as well as the coordination and communication among members of Civil Protection System when handling typhoon-related incidents. (Figure 8)

Since a robustic IT infrastructure is a very crucial factor for an 24-hour service department, a certain number of network appliances that were announced as End of Life (EOL) have been upgraded and substituted.

Identified opportunities/challenges, if any, for further development or collaboration:
Nil.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

KRA =	1	2	3	4	5	6	7
Meteorology				✔			
Hydrology							
DRR				✔			
Training and research							
Resource mobilization or regional collaboration							

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Item 7:
Strengthened Resilience of Communities to Typhoon-related Disasters

In response to the severe flooding this year, Chief Executive of Macao SAR, Chui Sai On visited drainage facilities in Taipa and Coloane islands to learn more about plans to solve flooding caused by heavy rains. (Figure 9) Moreover, he also visited a pumping station in Taipa (Figure 10) where he instructed officials from several government bureaus to improve the island's drainage system to minimise the impact that torrential downpours have on residents.

In addition, Macao Security Forces Coordination Office was invited to delegate representative to attend the regular meeting (Figure 11) between IACM and community groups in July to explain Macao's Civil Protection Structure as well as to discuss options and exchange opinions on how to improve Macao's Civil Protection.

Identified opportunities/challenges, if any, for further development or collaboration:
Nil.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR					✔		
Training and research							
Resource mobilization or regional collaboration							

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Item 8:
Released the new series of disaster prevention brochures and video clips

In 2013, Macao Security Forces Coordination Office released the new series of disaster prevention brochures as well as video clips in order to promote public awareness on disaster prevention for the purpose of saving lives and reducing its impacts. (Figure 12)

Identified opportunities/challenges, if any, for further development or collaboration:
Nil.

Summary Table of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR						✔	
Training and research							
Resource mobilization or regional collaboration							

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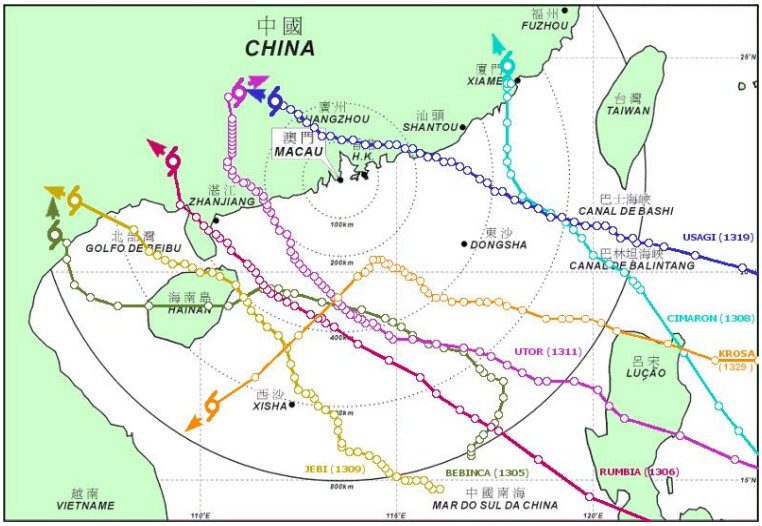

Figure 1 Tropical cyclone tracks in 2013

Figure 2 DSSOPT has already completed reinforcement and related works on 28 slopes since 2004

Figure 3 “Slope Safety Information Network” website has been established by DSSOPT to provide free access of slope information for the public

Figure 4 Regular tree inspection is conducted by IACM

Figure 5 After tree inspection, IACM staff will trim or remove those trees which are deemed dangerous

Figure 6 When typhoon signal is hoisted, DSAMA will urge the marine industry to lead all the ships and other sailing crafts into typhoon shelters

Figure 7 Underground drainage system will be improved including the increase of the number of drainage pipes as well as the length of the pipes

Figure 8 An annual typhoon drill was staged in April in order to test the capacity of the members of Civil Protection System

Figure 9 Chui Sai On visited drainage facilities in Taipa and Coloane islands to learn more about plans to solve flooding caused by heavy rains

Figure 10 Chui Sai On visited a pumping station in Taipa

Figure 11 Representative of Macao Security Forces Coordination Office was invited to attend the regular meeting between IACM and community groups to explain Macao's Civil Protection Structure

Figure 12 The new series of disaster prevention brochures and video clips were released by Macao Security Forces Coordination Office in 2013