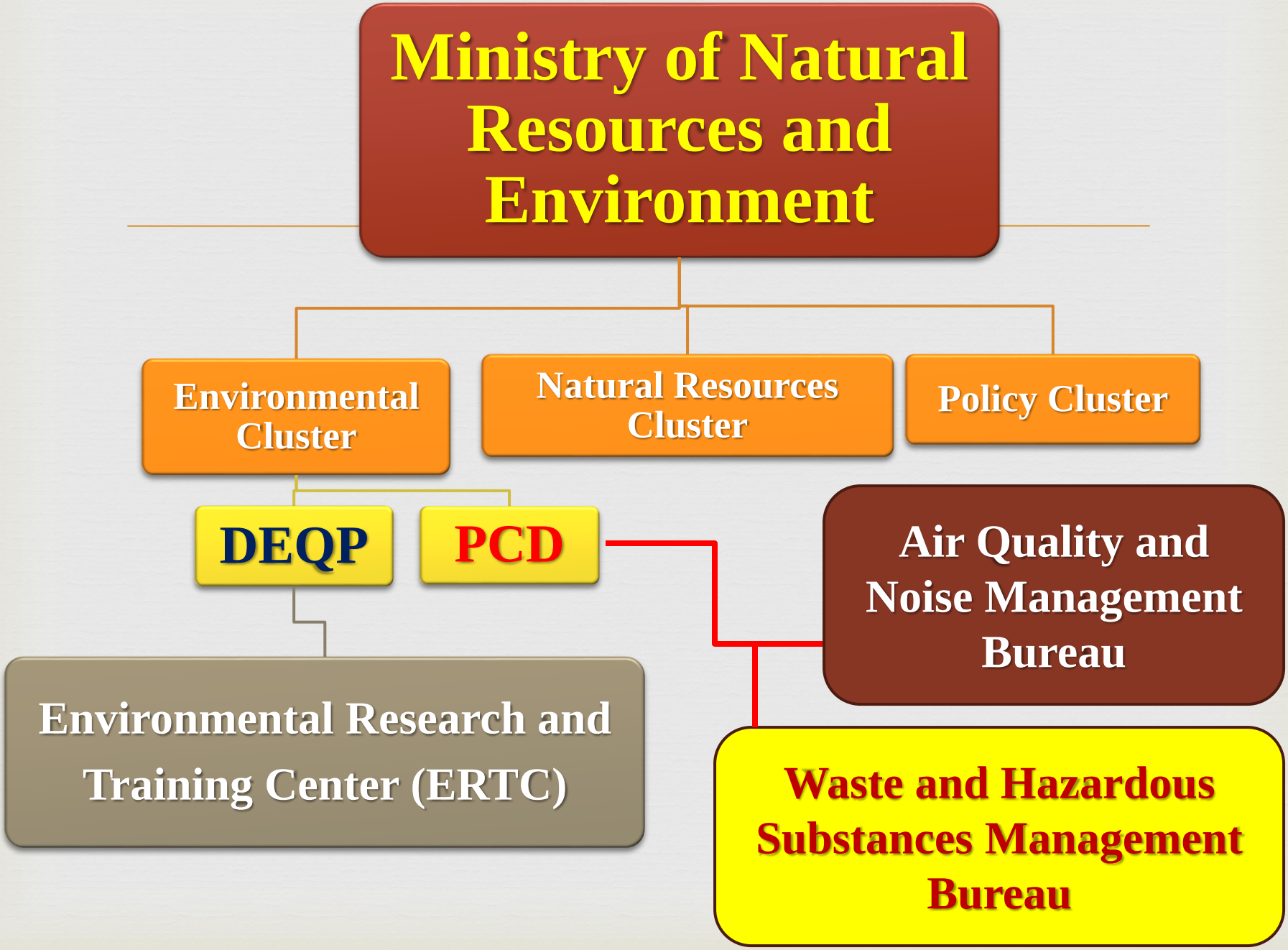
Updates on Atmospheric Mercury Research and Mercury Wet Deposition Measurement in Thailand

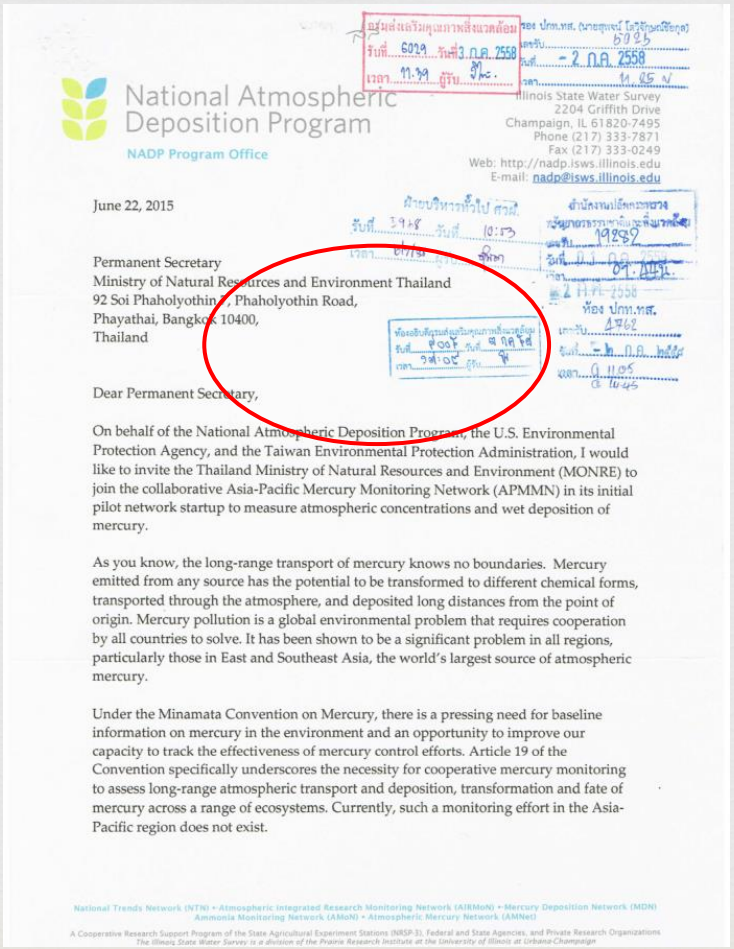
Hathairatana Garivait

Environmental Research and Training Center, Department of Environmental Quality Promotion, Ministry of Natural Resources and Environment

The 8th APMMN Partners Meeting, Jakarta, Indonesia.
15 August 2019


Ministry of Natural Resources and Environment
Environmental Cluster
Natural Resources Cluster
Policy Cluster
DEQP
PCD
Air Quality and Noise Management Bureau
Environmental Research and Training Center (ERTC)
Waste and Hazardous Substances Management Bureau

Thailand has officially collaborated with APMMN since November 2015 by Ministry of Natural Resources and Environment (MONRE)



National Atmospheric Deposition Program
NADP Program Office

Illinois State Water Survey
2204 Griffith Drive
Champaign, IL 61820-7495
Phone (217) 333-7871
Fax (217) 333-0249
Web: http://nadp.isws.illinois.edu
E-mail: nadp@isws.illinois.edu

June 22, 2015

Permanent Secretary
Ministry of Natural Resources and Environment Thailand
92 Soi Phaholyothin 7, Phaholyothin Road,
Phayathai, Bangkok 10400,
Thailand

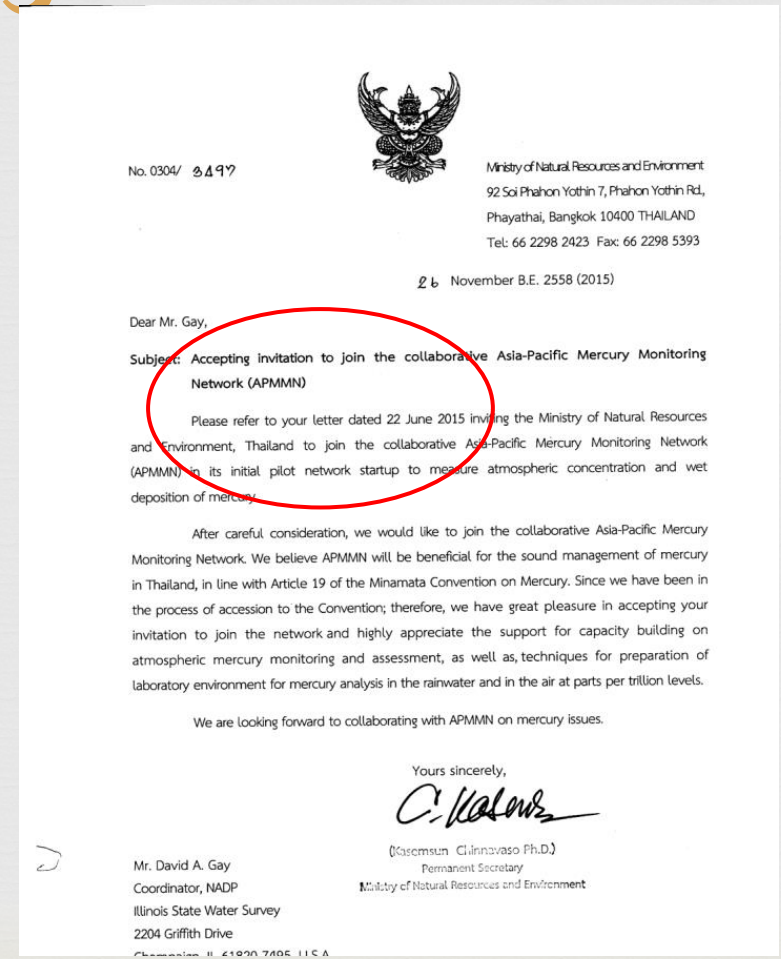
Dear Permanent Secretary,

On behalf of the National Atmospheric Deposition Program, the U.S. Environmental Protection Agency, and the Taiwan Environmental Protection Administration, I would like to invite the Thailand Ministry of Natural Resources and Environment (MONRE) to join the collaborative Asia-Pacific Mercury Monitoring Network (APMMN) in its initial pilot network startup to measure atmospheric concentrations and wet deposition of mercury.

As you know, the long-range transport of mercury knows no boundaries. Mercury emitted from any source has the potential to be transformed to different chemical forms, transported through the atmosphere, and deposited long distances from the point of origin. Mercury pollution is a global environmental problem that requires cooperation by all countries to solve. It has been shown to be a significant problem in all regions, particularly those in East and Southeast Asia, the world's largest source of atmospheric mercury.

Under the Minamata Convention on Mercury, there is a pressing need for baseline information on mercury in the environment and an opportunity to improve our capacity to track the effectiveness of mercury control efforts. Article 19 of the Convention specifically underscores the necessity for cooperative mercury monitoring to assess long-range atmospheric transport and deposition, transformation and fate of mercury across a range of ecosystems. Currently, such a monitoring effort in the Asia-Pacific region does not exist.

National Trends Network (NTN) • Atmospheric Integrated Research Monitoring Network (AIRMoN) • Mercury Deposition Network (MDN)
Ammonia Monitoring Network (AMoN) • Atmospheric Mercury Network (AMNet)
A Cooperative Research Support Program of the State Agricultural Experiment Stations (NRSP-3), Federal and State Agencies, and Private Research Organizations
The Illinois State Water Survey is a division of the Prairie Research Institute at the University of Illinois at Urbana-Champaign



No. 0304/ 8497

Ministry of Natural Resources and Environment
92 Soi Phahon Yothin 7, Phahon Yothin Rd.,
Phayathai, Bangkok 10400 THAILAND
Tel: 66 2298 2423 Fax: 66 2298 5393

26 November B.E. 2558 (2015)

Dear Mr. Gay,

Subject: Accepting invitation to join the collaborative Asia-Pacific Mercury Monitoring Network (APMMN)

Please refer to your letter dated 22 June 2015 inviting the Ministry of Natural Resources and Environment, Thailand to join the collaborative Asia-Pacific Mercury Monitoring Network (APMMN) in its initial pilot network startup to measure atmospheric concentration and wet deposition of mercury.

After careful consideration, we would like to join the collaborative Asia-Pacific Mercury Monitoring Network. We believe APMMN will be beneficial for the sound management of mercury in Thailand, in line with Article 19 of the Minamata Convention on Mercury. Since we have been in the process of accession to the Convention; therefore, we have great pleasure in accepting your invitation to join the network and highly appreciate the support for capacity building on atmospheric mercury monitoring and assessment, as well as, techniques for preparation of laboratory environment for mercury analysis in the rainwater and in the air at parts per trillion levels.

We are looking forward to collaborating with APMMN on mercury issues.

Yours sincerely,

(Kasemsun Chinnavaso Ph.D.)
Permanent Secretary
Ministry of Natural Resources and Environment

Mr. David A. Gay
Coordinator, NADP
Illinois State Water Survey
2204 Griffith Drive

Participation in the APMMN Meetings

The 5th APMMN Meeting in Bangkok 2016

The 6th APMMN Meeting in Taiwan 2017

The 7th APMMN Meeting in Manila, Philippines 2018

Minamata Convention on Mercury

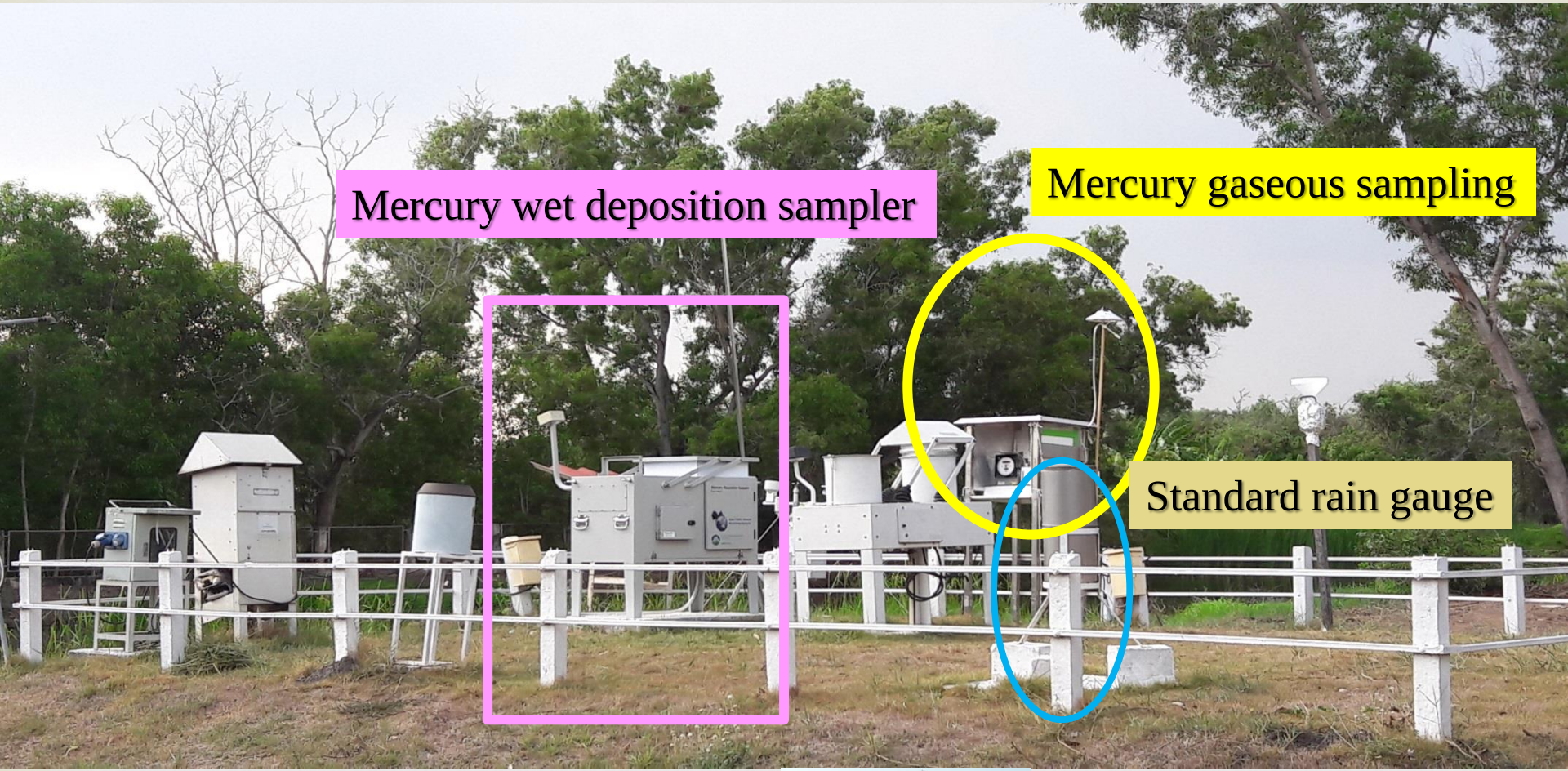
- Thailand ratified MC since 23 June 2017. We are the 66th country.

- With kind technical support of APMMN, ERTC continue building capacity on trace level mercury measurements to attain the MC on Mercury demand, especially on Article 19 (Research and Development) and Article 22 (Effectiveness Evaluation).

ERTC progress on ultra-trace mercury level measurement

- ERTC has established Ultra-trace Mercury Level Laboratory since 2016
- GEM measurement using Gold Amalgam Tube method analyzed by CVAFS technique
- Mercury wet deposition measurement using automatic rain sampler for mercury given by Taiwan EPA since November 2016 and US.EPA. Method 1631 revision E
- PBM measurement using thermal desorption method

ERTC, Sampling station



Ultra-trace Mercury level laboratory at ERTC

Clean room

Hood and clean benches

GEM

Hg in rain water

PBM

Atmospheric Mercury

"Study on mercury pollution from municipal wastes dumping sites"

Objective:

1. **To compare ambient Hg level between good and bad management of municipal wastes dumping sites**
2. **To study emanation and emission rates of Hg from municipal wastes**

Buriram Province

1. Mueang Buriram
2. Khu Mueang
3. Krasang
4. Nang Rong
5. Nong Ki
6. Lahan Sai
7. Prakhon Chai
8. Ban Kruat
9. Phutthaisong
10. Lam Plai Mat
11. Satuek
12. Pakham
13. Na Pho
14. Nong Hong
15. Phlapphla Chai
16. Huai Rat
17. Non Suwan
18. Chamni
19. Ban Mai Chaiyaphot
20. Non Din Daeng
21. Ban Dan
22. Khaen Dong
23. Chaloem Phra Kiat

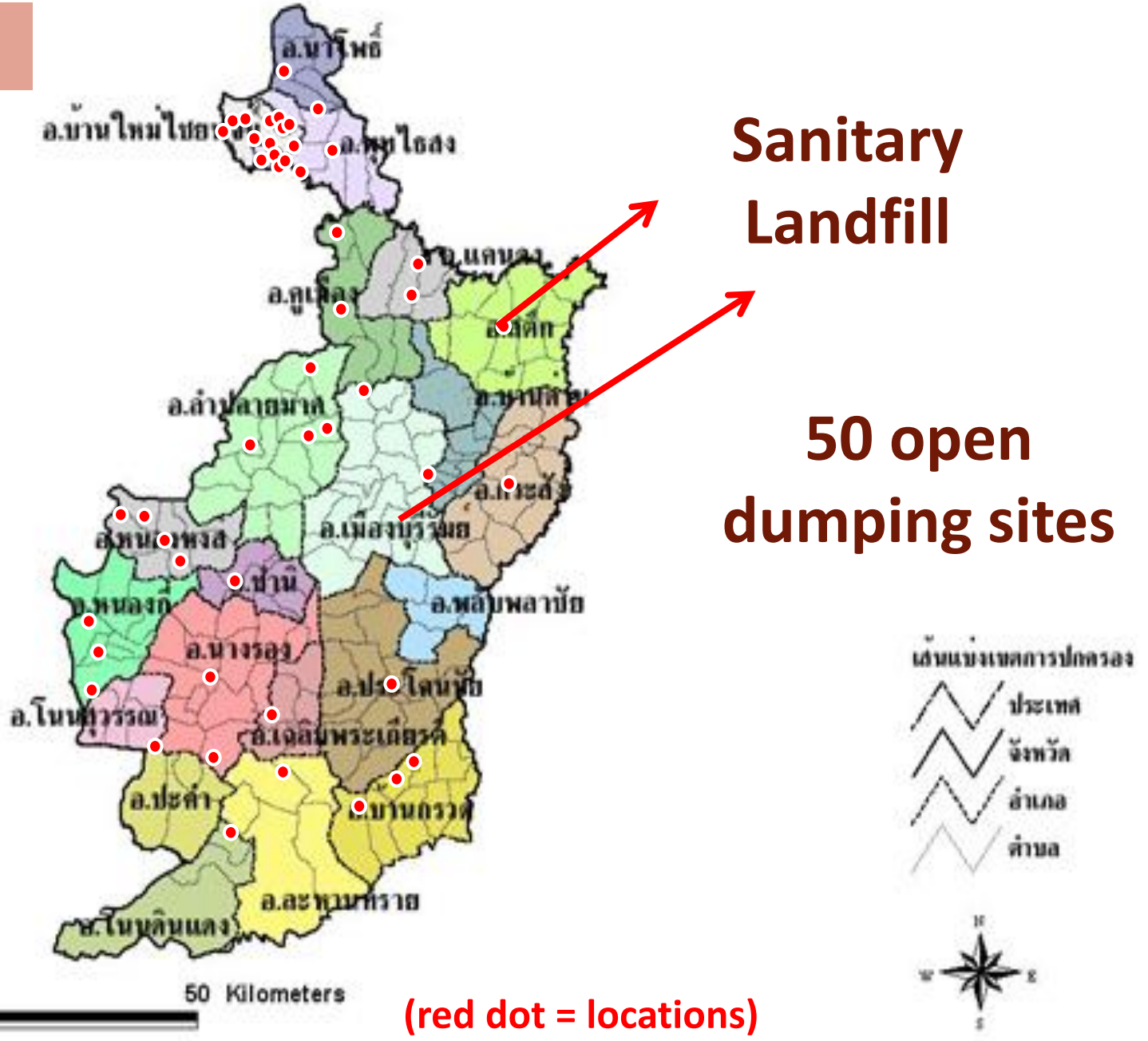
area

10,322.9 km^2

population

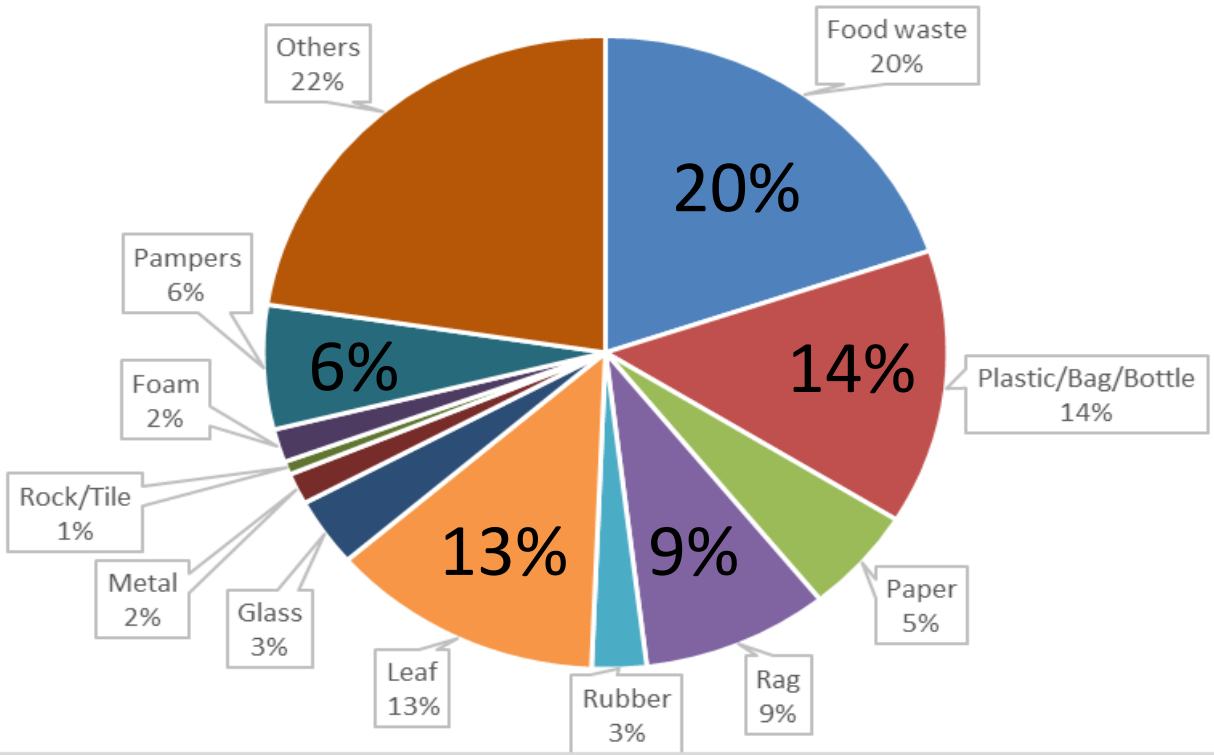
1,591,905 people

BURIRAM


Sanitary Landfill
50 open dumping sites
(red dot = locations)
0
50 Kilometers
เส้นแบ่งเขตการปกครอง
ประเทศ
จังหวัด
อำเภอ
ตำบล

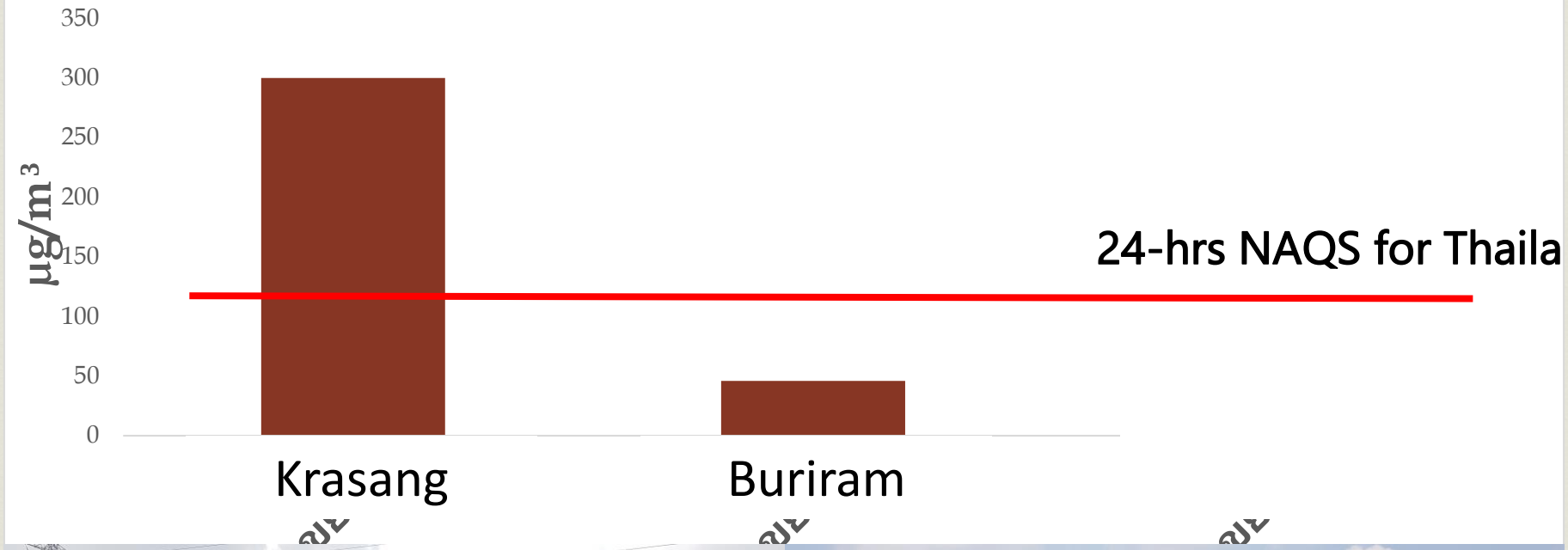

Muang Buriram
LANDFILL

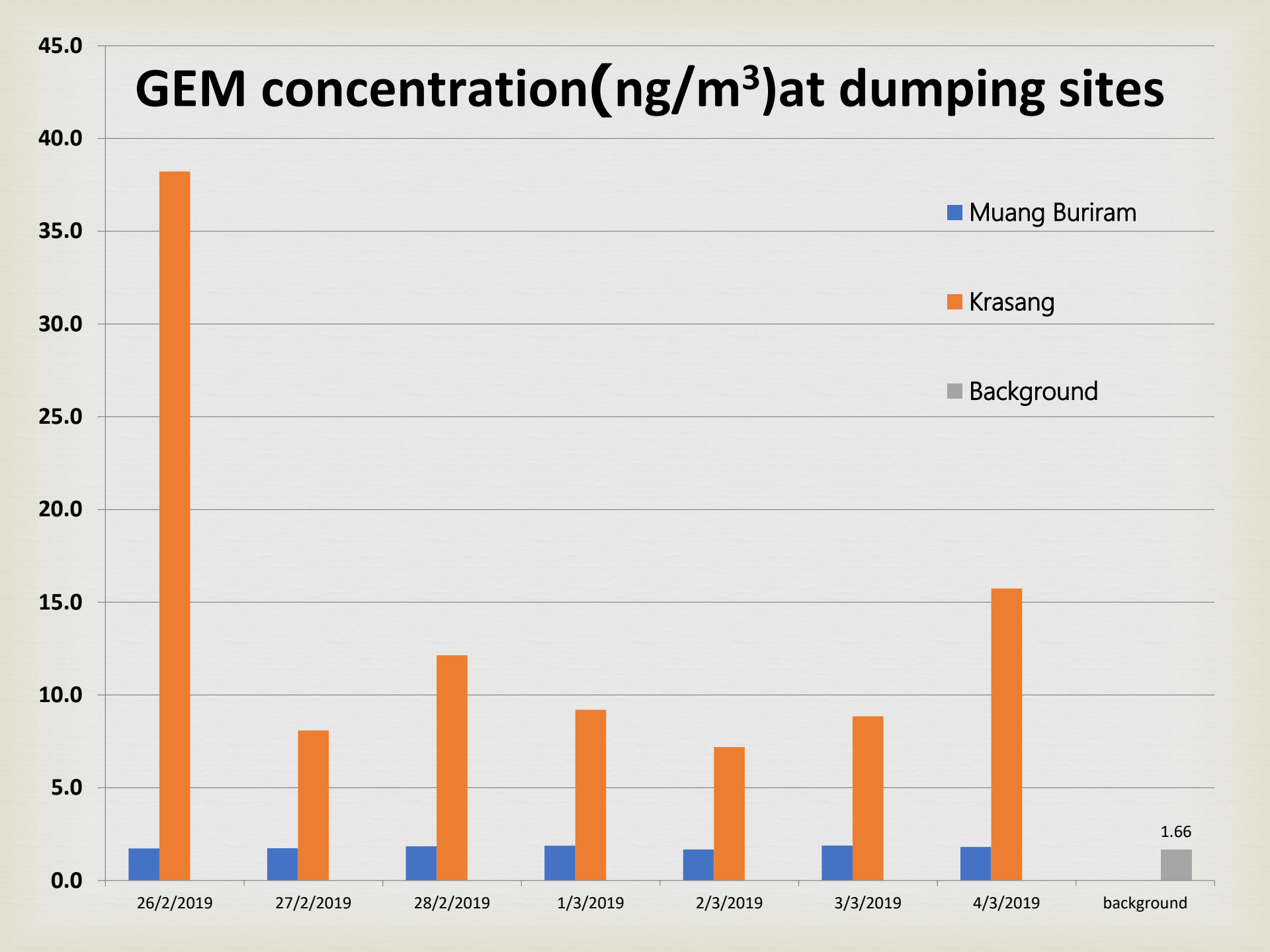

Krasang
OPEN DUMPING SITE



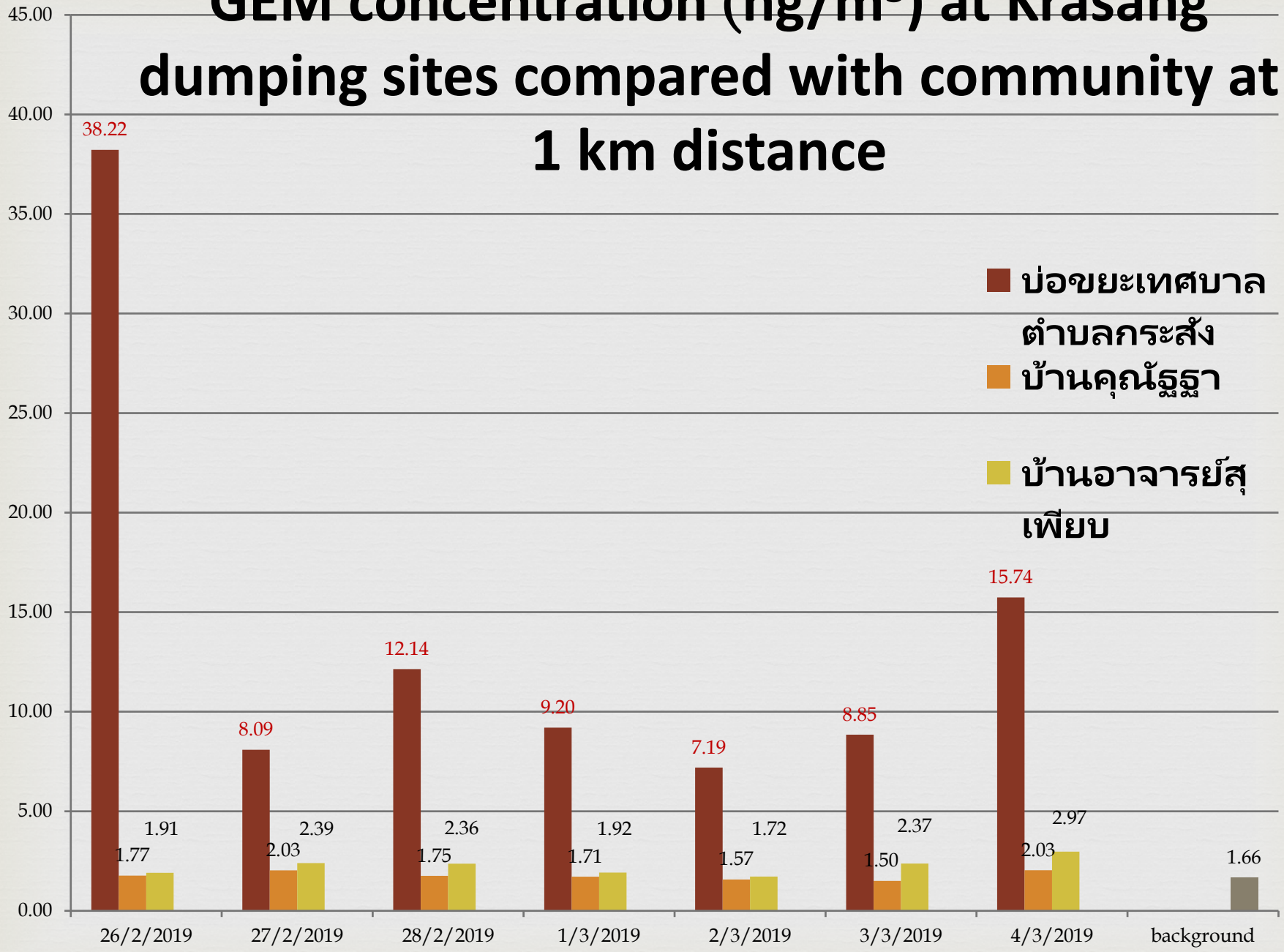
Municipal Waste COMPOSITION

Average concentration of PM2.5




GEM concentration(ng/m3)at dumping sites
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Muang Buriram
Krasang
Background
1.66
26/2/2019
27/2/2019
28/2/2019
1/3/2019
2/3/2019
3/3/2019
4/3/2019
background

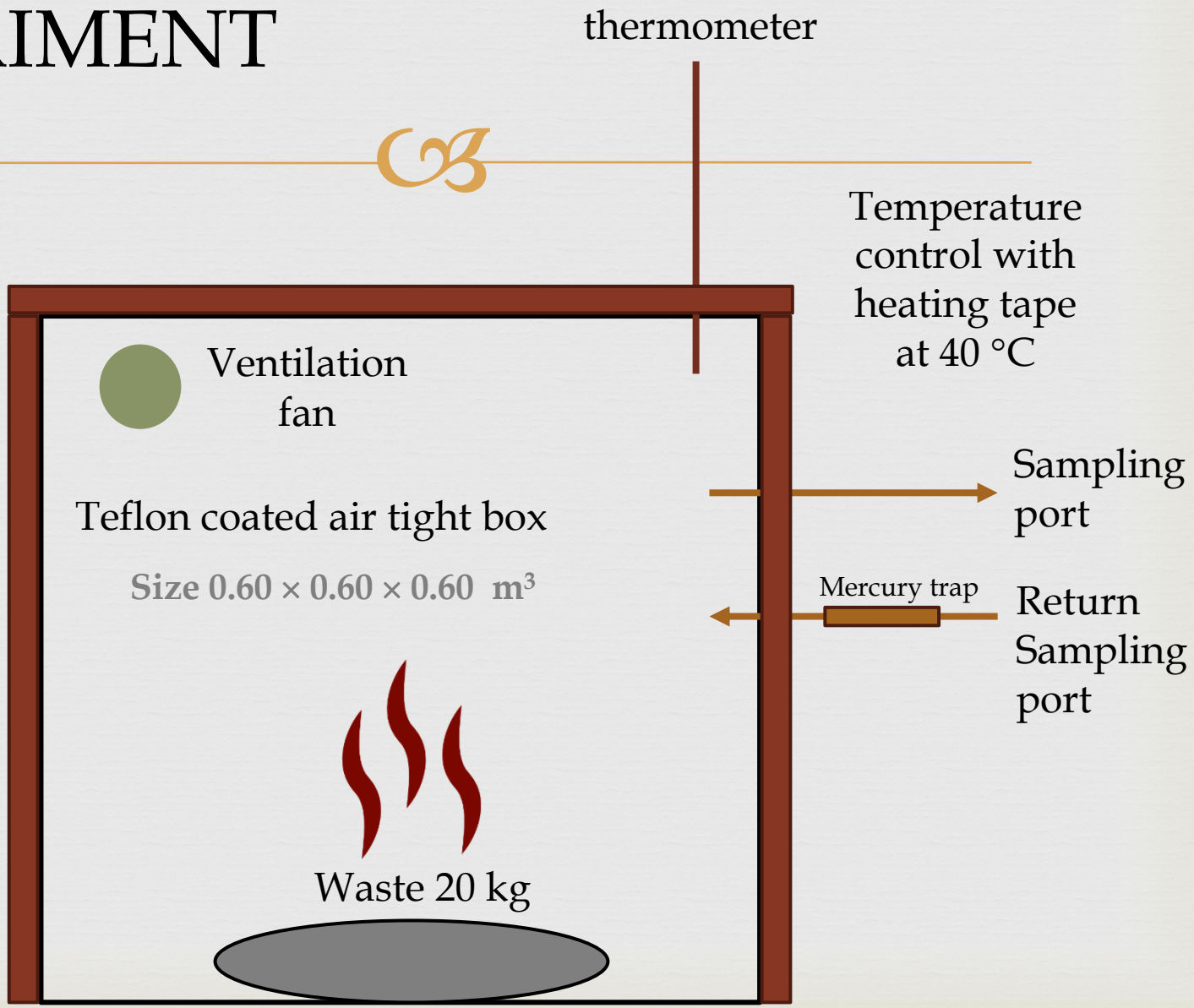
GEM concentration (ng/m^3) at Krasang dumping sites compared with community at 1 km distance



EMANATION EXPERIMENT

Additional Parameters

- Temp
- Humid



Mercury emanation sampling

MUNICIPAL WASTES

Papers

Leafs/wood

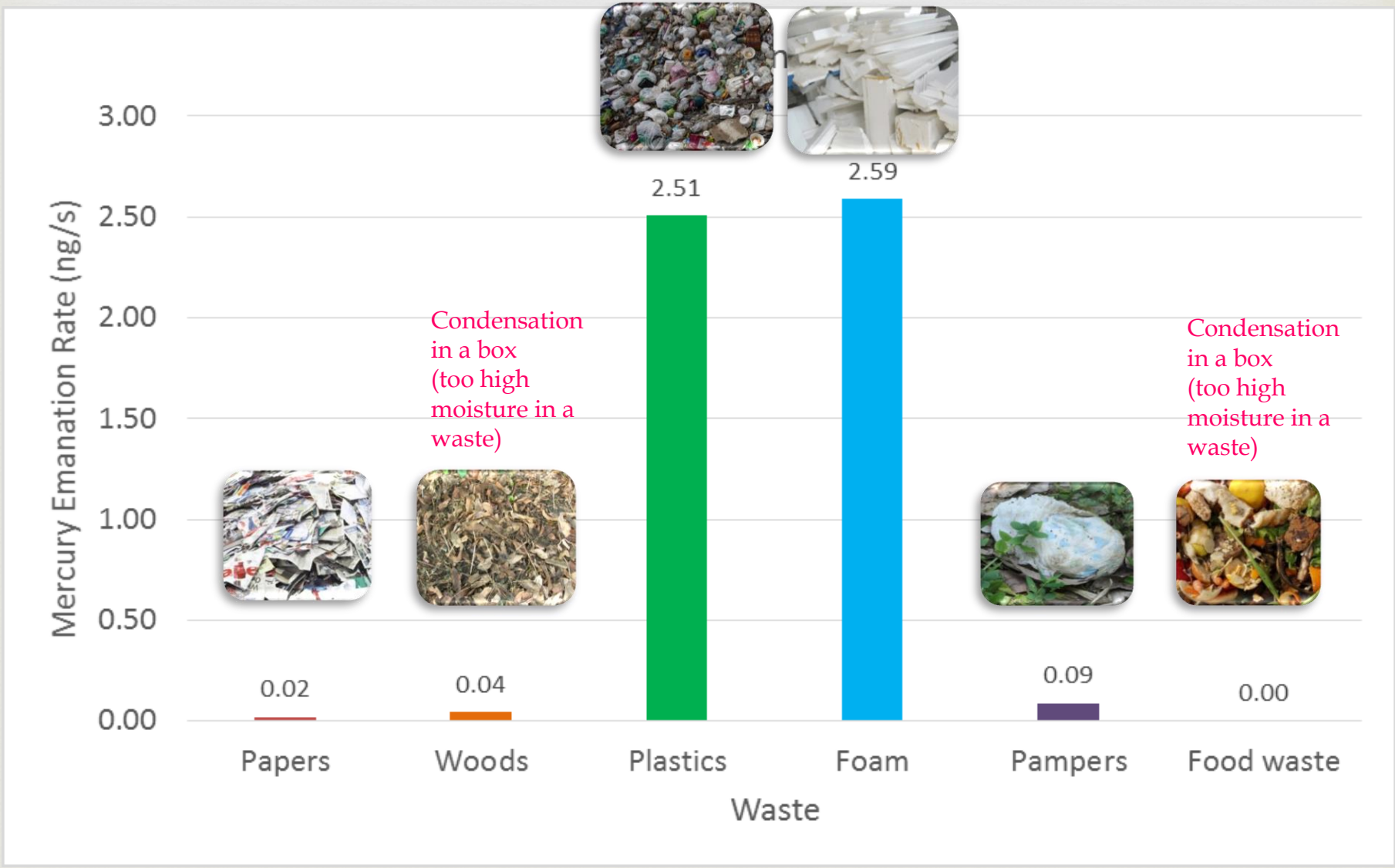
Plastics

Foam

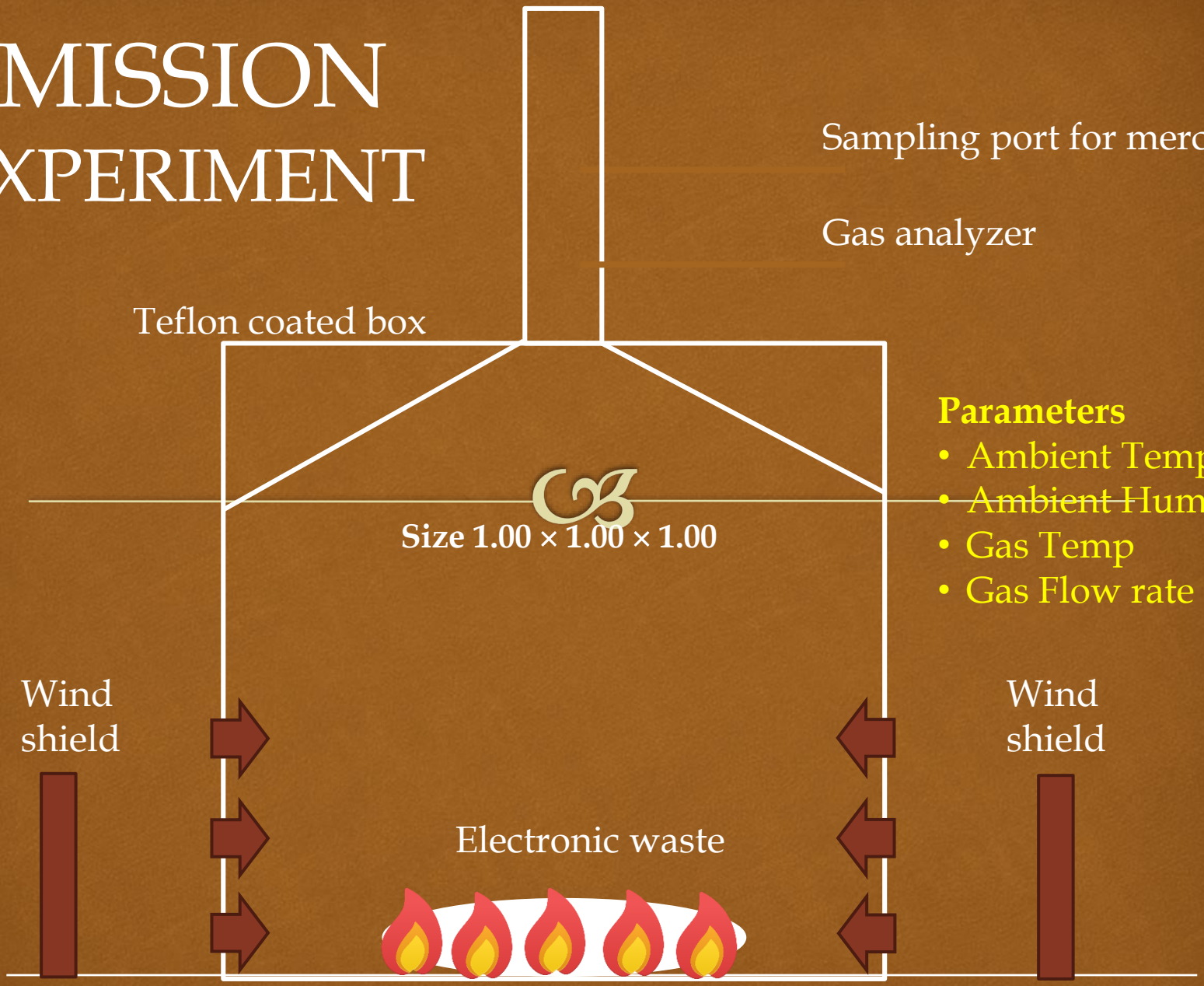
Pampers

Food Waste

$$Emanation\ Factor\ (\frac{ng}{kg \cdot h}) = \frac{Total\ Hg\ (n\,g/h)}{Weight\ of\ waste\ (kg)}$$



EMISSION EXPERIMENT



Emission sampling

Calculation of Mercury emission factors

$$Stack\ conc.\ (ng/m^3) = \frac{Total\ Hg\ (ng)}{sampling\ rate\ \left(\frac{m^3}{min}\right) \times sampling\ time\ (min)}$$

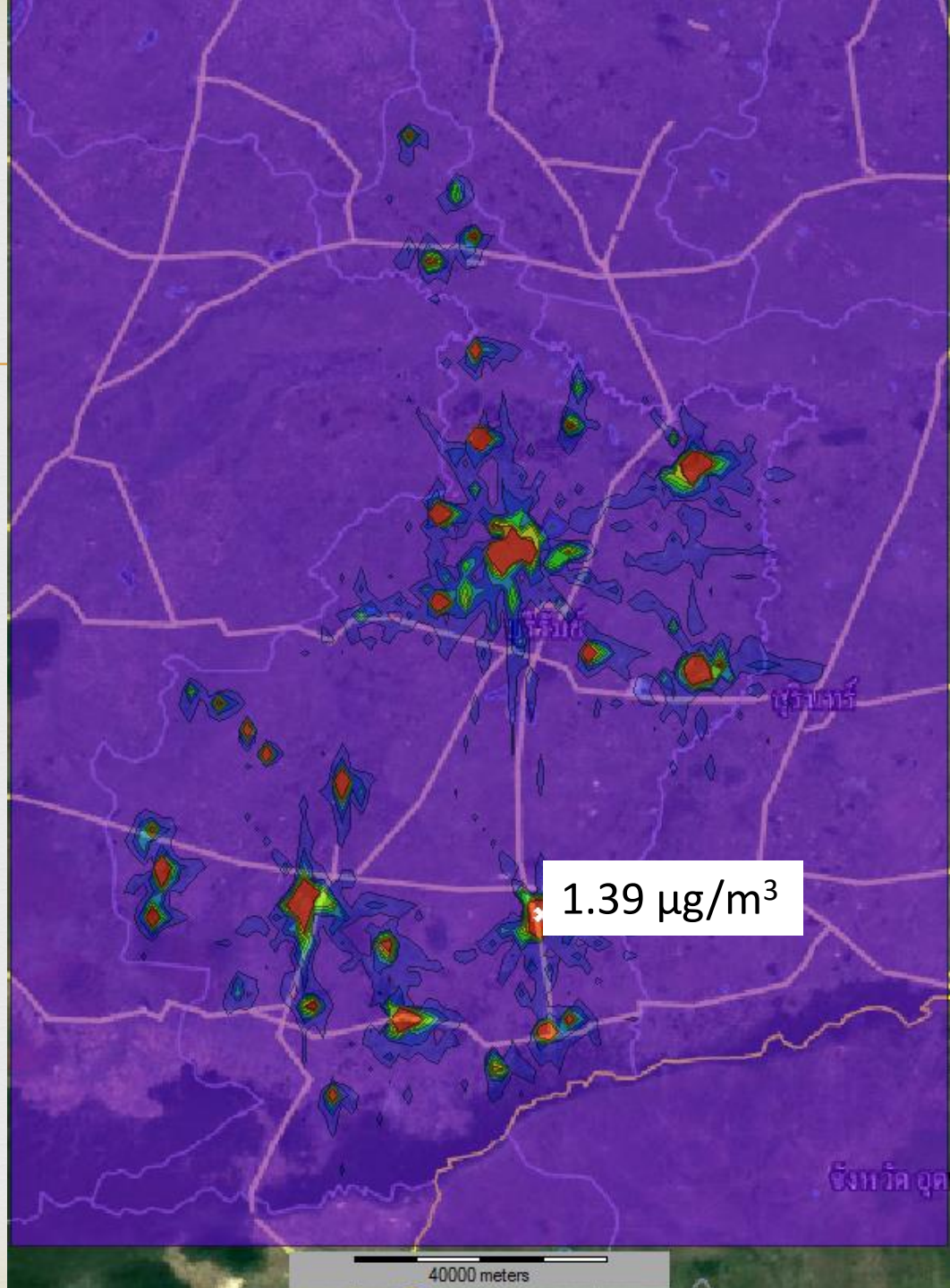
$$Emission\ Factor\ \left(\frac{ng}{kg \cdot s}\right) = \frac{Stack\ conc.\ (ng/m^3) \times flow\ rate\ (m^3/sec)}{Weight\ of\ waste\ (kg)}$$

Mercury emission factor from municipal wastes

AERMOD

mercury dispersion
from opened burning

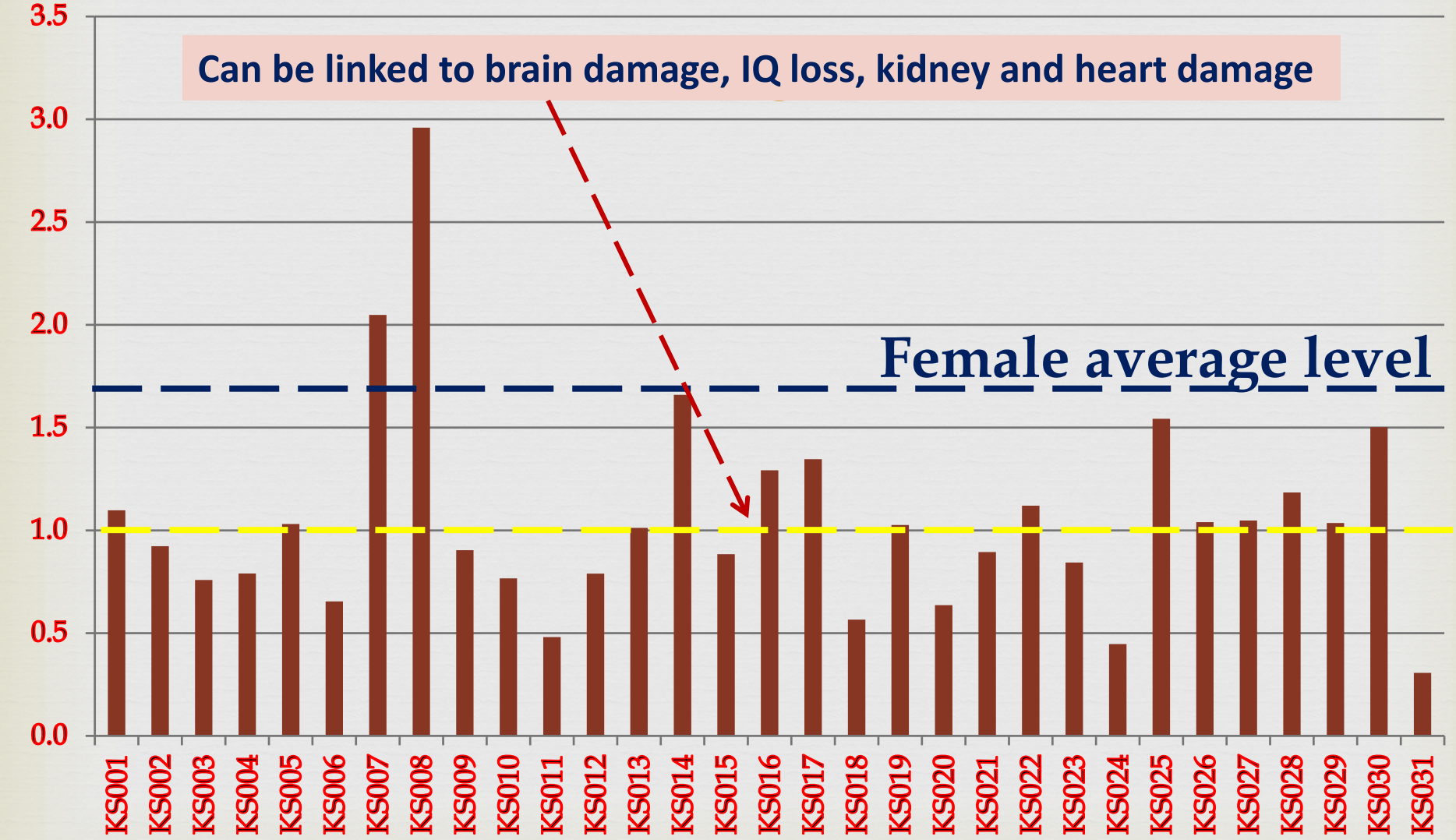
Assumption 10% of waste was openly burned Everyday at 5 p.m.



Mercury in Hair at Krasang municipality

Hg in human hair analyzed by thermal desorption method

Hg Concentration in hair (ppm), n=31



Mercury wet deposition monitoring (ERTC)

Hg wet deposition sampling with automatic rain sampler donated by Taiwan EPA has started since 27 September 2016

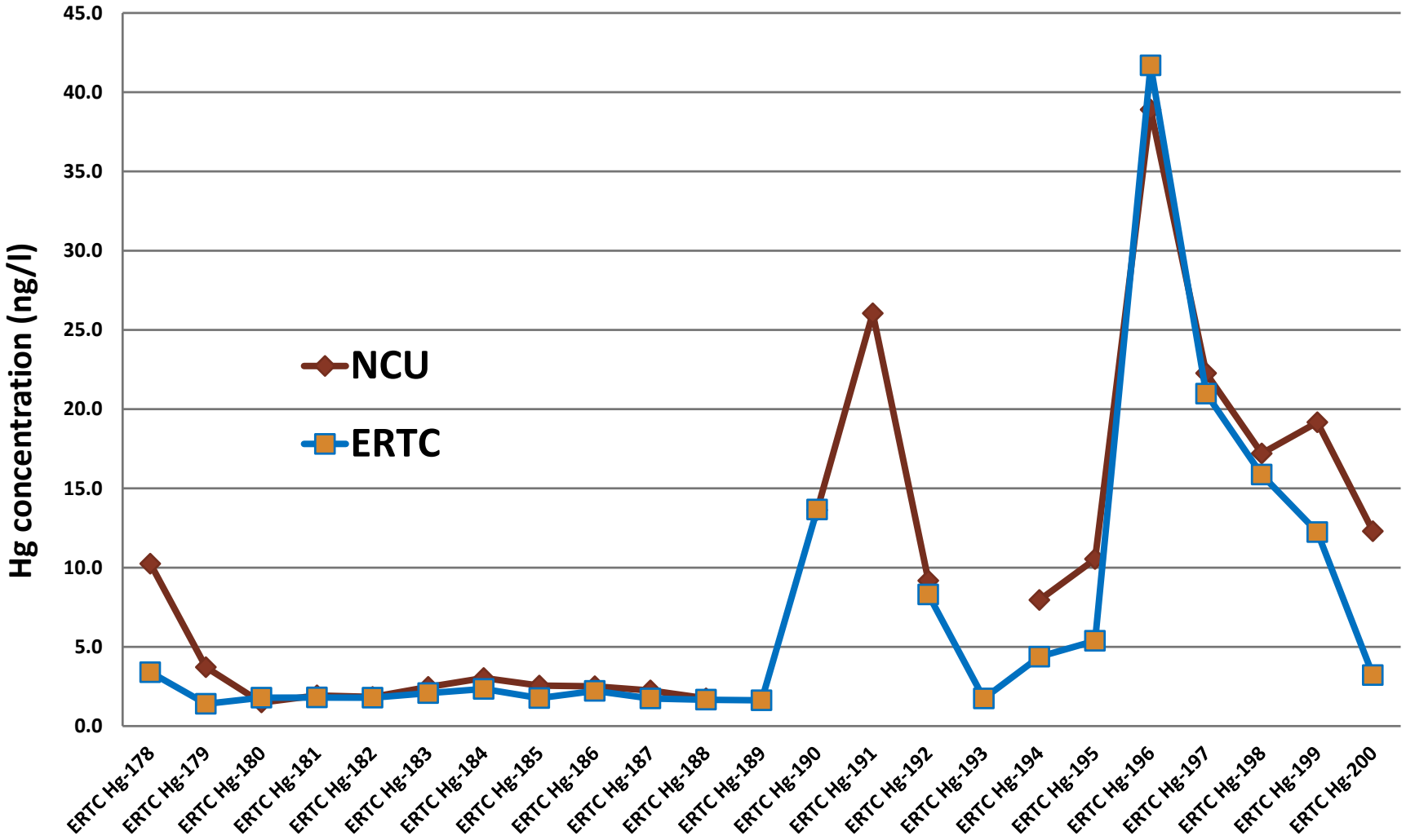
Guidelines for sampling and measurement

- APMMN Field Sample SOP
- EPA method: Method 1631 revision E

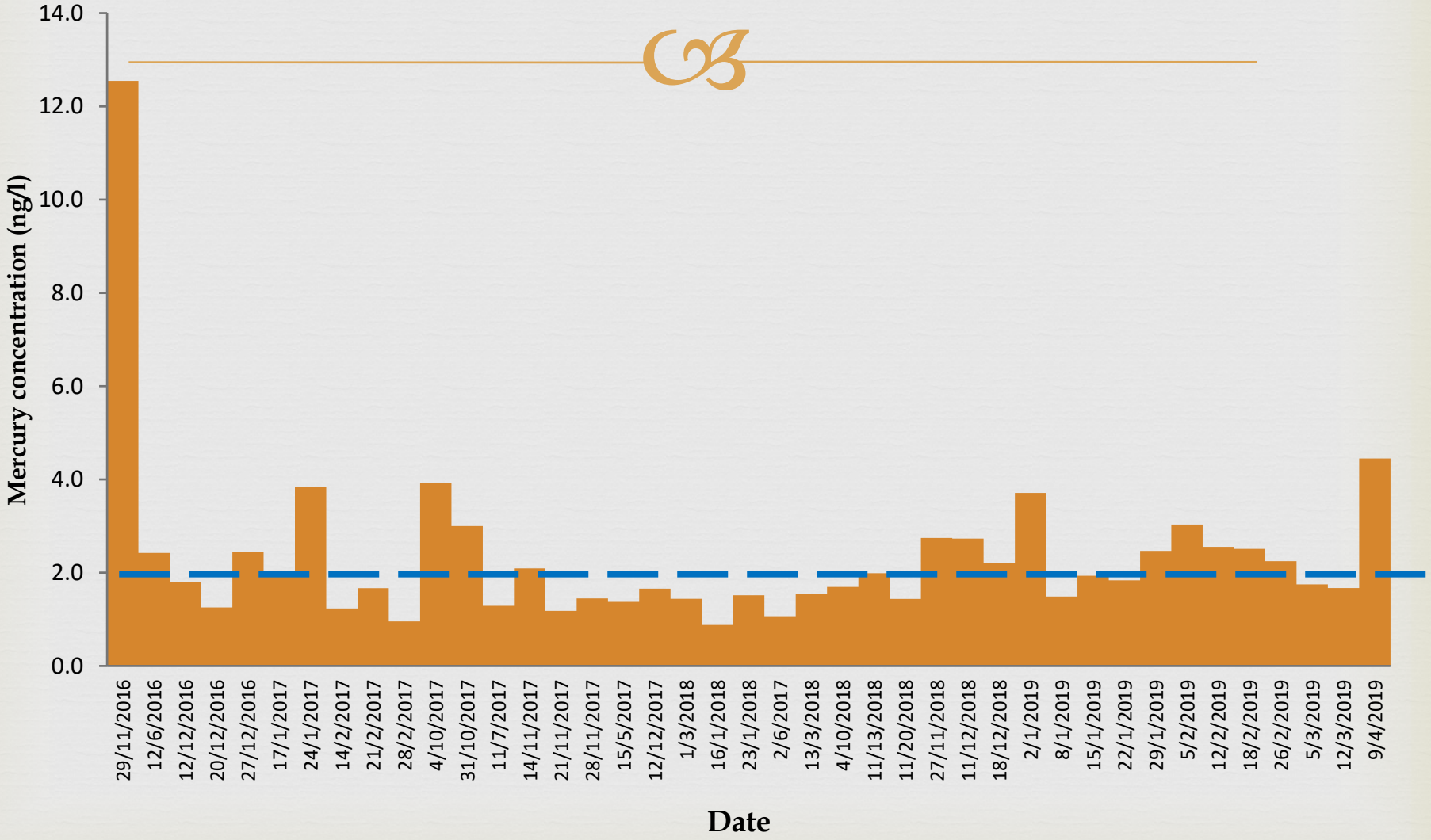
Acknowledgement

ERTC would like to acknowledge the National Central University, Taiwan, especially Prof. Sheu and Mr. Da-Wei, for their never ending supports to analyze mercury wet deposition samples from Thailand.

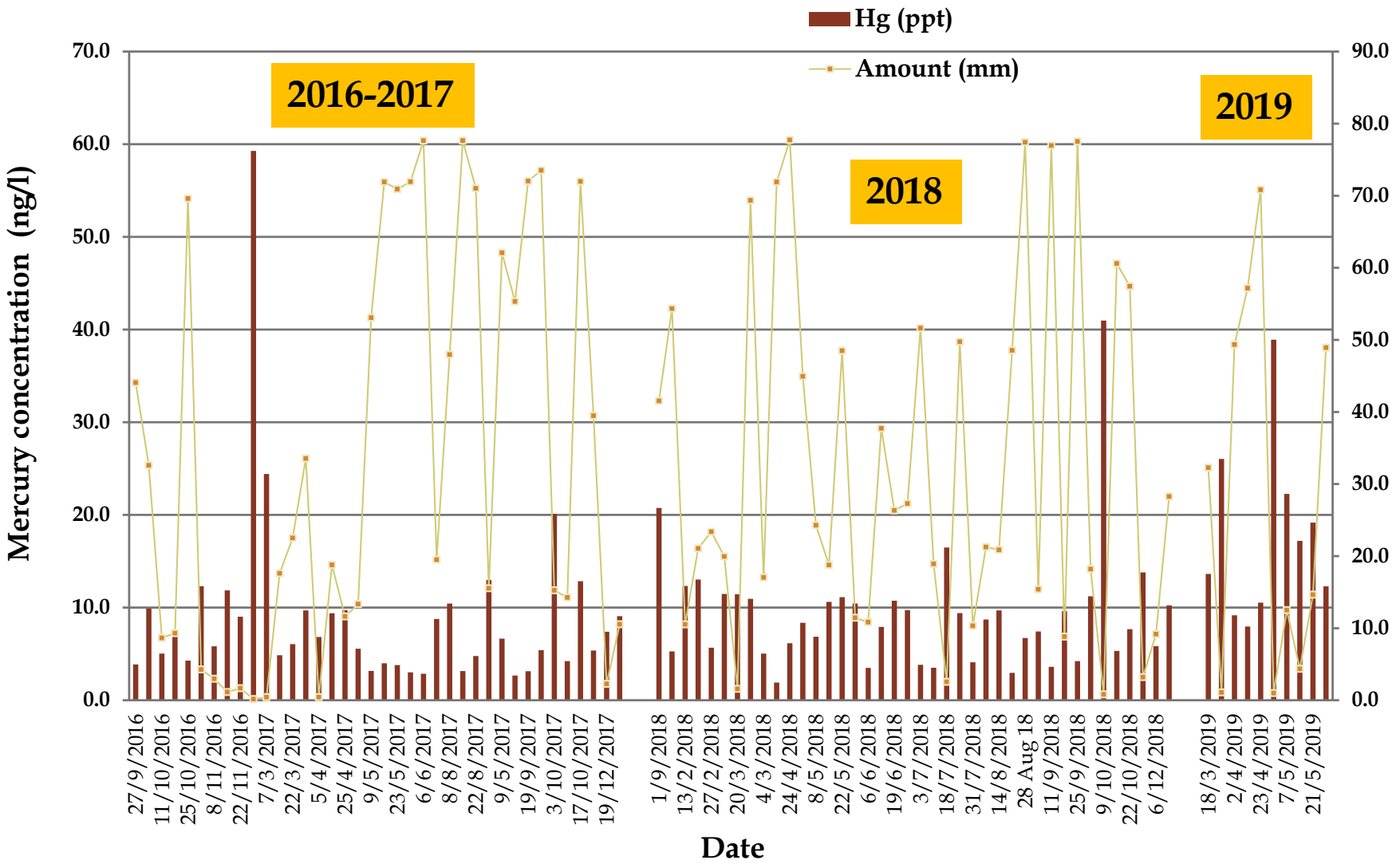
Hg concentration in rain water (ng/l): Comparison



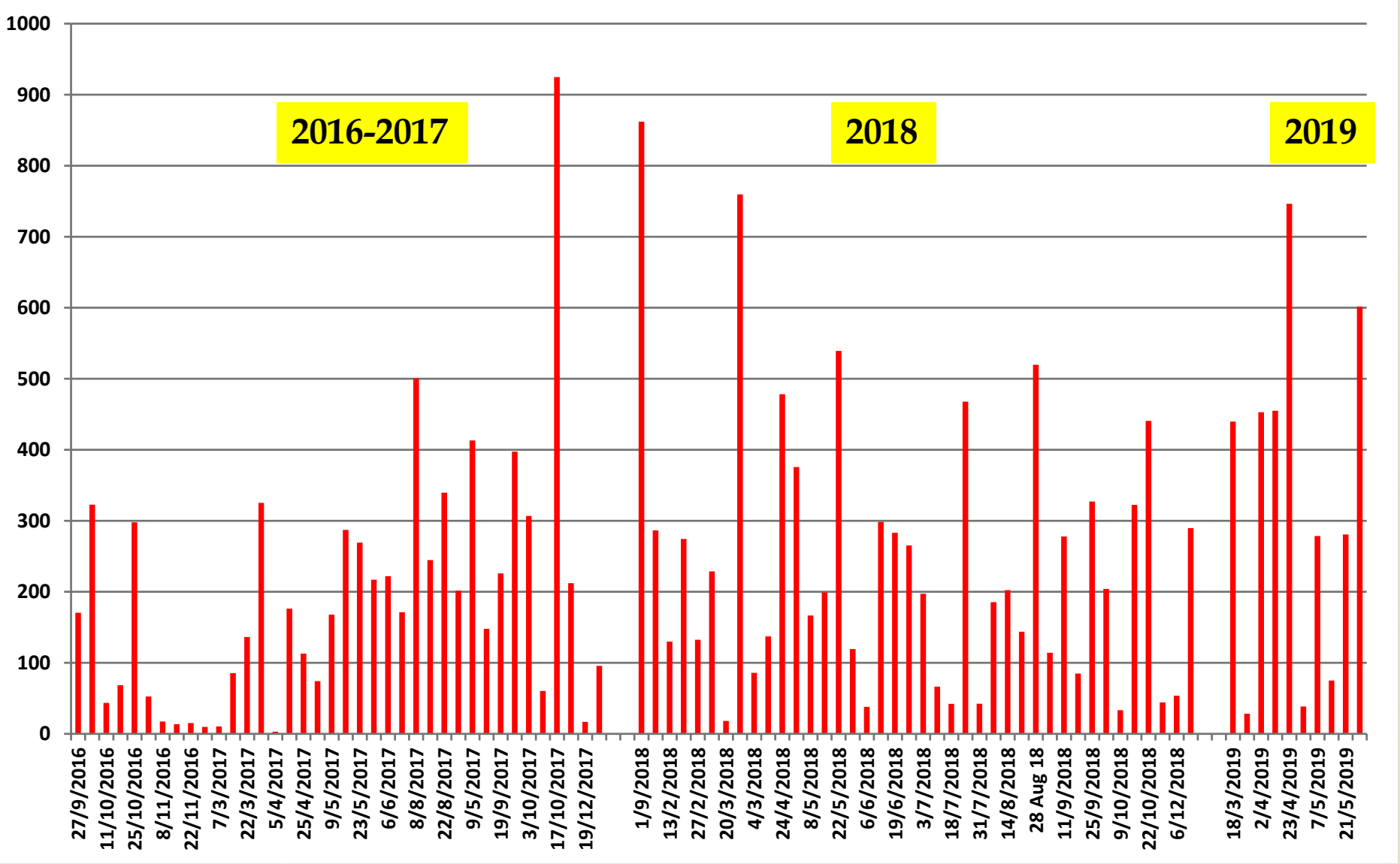
Field blank: rinse the funnel with 100 ml DI water



Mercury concentration in rain water at ERTC



Mercury wet deposition (ng/m^2)



Volume weighted average concentration

Year	Total Hg dep.(ng/m^2)	Total PPT (mm)	VWA (ng/L)	Number of samples
2016-2017	7356.5	1286.6	5.72	38
2018	9736.9	1316.1	7.40	40
2019*	3396.4	292.1	11.6	10

Thank you for your kind attention