FEDERAL UNIVERSITY OF RIO GRANDE DO SUL
INSTITUTE OF HYDRAULIC RESEARCH
UFRGS

STRATEGIES FOR DESIGNING URBAN DRAINAGE CHARGES IN PORTO ALEGRE – RS – BRAZIL

Francisco Rossarolla FORGIARINI (francisco_forgiarini@yahoo.com.br), Christopher Freire SOUZA, André Luiz Lopes da SILVEIRA, Geraldo Lopes da SILVEIRA & Carlos Eduardo Morelli TUCCI

TOWARDS URBAN DRAINAGE SUSTAINABILITY

Chaotic urbanization in Brazil

- ↓ Vegetation
- ↑ Impermeabilization
- ↑ Piping
- ↑ Riparian areas occupation

→ **FLOODS** → **INCENTIVE ECONOMIC INSTRUMENTS** → **SUSTAINABILITY**

Control of hydrological processes under natural features

OBJECTIVE

Compare strategies for designing stormwater drainage charge based on a hypothetical set of condos with different drainage systems concept: hygienist, Best Management Practices (BMP) and Low Impact Development (LID).

METHODS

Annual costs evaluation

Total cost* = US$ 835 million (Cruz, 2004)

*Cost to fund, operate and maintain the Porto Alegre drainage system through micro and macro-drainage pipes enlargement and construction of detention ponds (US$ 1.00 = R$ 1.70 – 29/02/2008).

$$\text{Total annual costs} = \frac{[\text{Total cost} \cdot i \cdot (1+i)^n]}{[(1+i)^n-1]}$$

Where: i = interest rate (9%) and n = number of years (30).

Annual unitary cost= Annual cost / Area (Porto Alegre)

Annual cost = Cost an. unit x study area

Designing strategies

I. TIA: Total Impermeable Area;

II. EIA-PoA: Effective Impermeable Area according to Porto Alegre's Municipal Decree #15.371/2006;

III. EIA-Shuster: Effective Impermeable Area, from Shuster (2005), i.e., area that drains into a permeable surface is considered permeable area;

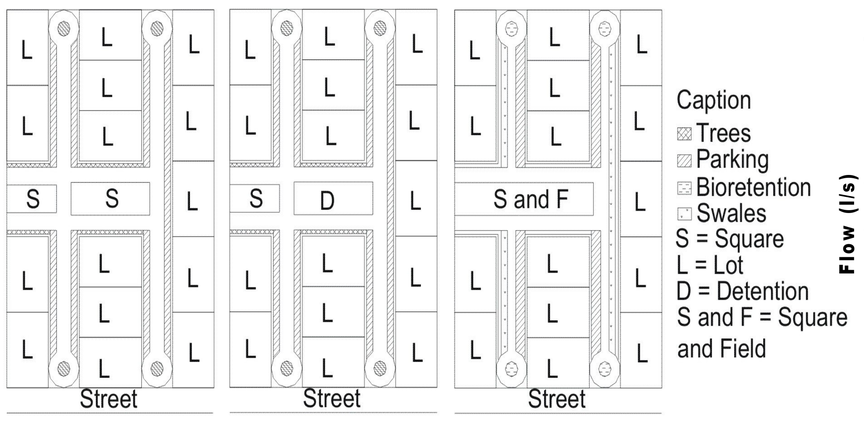
IV. Alteration in volume (ΔV): changes in volume of discharge from pristine (natural) conditions;

V. Alteration in maximum flow (ΔQ_{max}): changes in maximum flow from pristine (natural) conditions.

Case Study

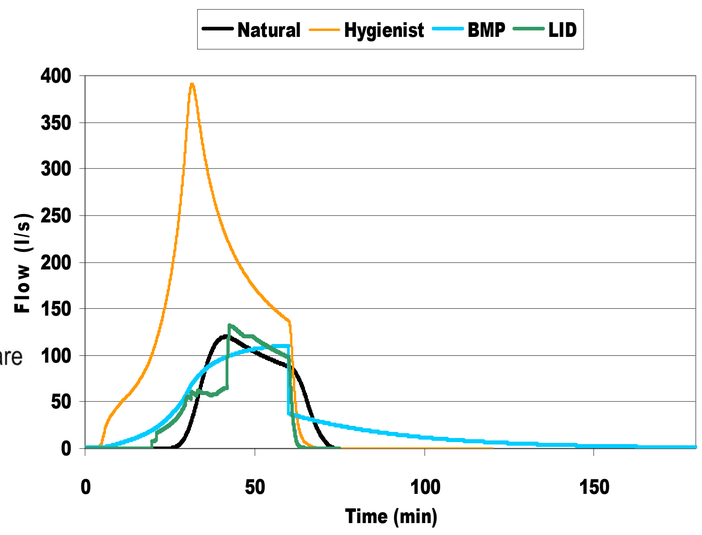
Set of 3 condos (Souza, 2005).

❑ Condos layout:



Hygienist – piping | BMP (detention pond) | LID (with no planning)

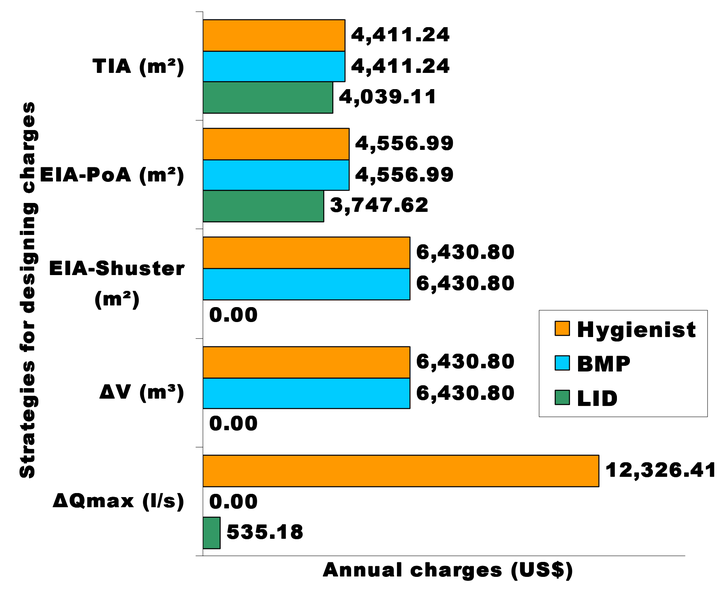
❑ Hydrographs from a 10-year and 1 hour (duration) rainfall event



❑Condos features for each designing strategy - (US$ 1.00 = R$ 1.70 – 29/02/2008)

Condos	TIA (m²)	EIA-PoA (m²)	EIA-Shuster (m²)	ΔV (m³)	ΔQmax (l/s)
Natural	0.00	0.00	0.00	204.30	119.85
Hygienist	13,869.00	12,139.00	8,320.50	589.48	391.01
BMP	13,869.00	12,139.00	8,320.50	589.48	110.78
LID	12,699.00	9,983.00	0.00	189.65	131.62
Drainage charge	**US$ 0.32/m²**	**US$ 0.38/m²**	**US$ 0.77/m²**	**US$ 16.69/m³**	**US$ 45.46/l/s**

RESULTS AND DISCUSSION



❑ TIA doesn't encourage adopting flow reducing techniques;

❑ EIA-PoA isn't sensitive to drainage system concept, since the flow reduction by bioretentions (LID) isn't considered in the municipal decree;

❑EIA-Shuster only encourages the adoption of LID, which induces downspout disconnection;

❑ Volume alteration strategy isn't sensitive to flow control by detention ponds. Solely LID condos are encouraged;

❑ Peak flow alteration strategy encourages both BMP and LID systems. Peak flow reduction lowers costs once there is no need for enlarging pipes.

CONCLUSION

Encouraging sustainable techniques (LID) is only possible through hydrograph change (volume and/or peak) strategy, or partially (EIA), which deserves further investigations.

REFERENCES

CRUZ, M. A. S. (2004). Otimização do Controle da Drenagem em Macro-bacias Urbanas. Tese de Doutorado. Universidade Federal do Rio Grande do Sul. Instituto de Pesquisas Hidráulicas. Programa de Pós-Graduação em Recursos Hídricos e Saneamento Ambiental. Porto Alegre. BR-RS, 217 p.

PORTO ALEGRE. (2006). Decreto nº 15371 de 17 de novembro de 2006: Regulamenta o controle da drenagem urbana de que dispõe os art. 97 e art. 135, § 6º, da Lei Complementar n° 434/99.

SHUSTER, W. D., BONTA, J., THURSTON, H., WARNEMUENDE, E., SMITH, D. R. (2005). Impacts of impervious surface on watershed hydrology: a review. Urban Water Journal, vol. 2, n° 4, 263-275.

SOUZA, C. F. (2005). Mecanismos técnico-institucionais para a sustentabilidade da Drenagem Urbana. Dissertação de Mestrado. Universidade Federal do Rio Grande do Sul. Instituto de Pesquisas Hidráulicas. Programa de Pós-Graduação em Recursos Hídricos e Saneamento Ambiental. Porto Alegre. BR-RS, 193 p.

ACKNOWLEGEMENT

CNPq
Conselho Nacional de Desenvolvimento Científico e Tecnológico

EVENT

13th IWRA World Water Congress
Global Changes and Water Resources
1-4 September, Montpellier, France

Avenue Bento Gonçalves, 9500 – PO Box 15029
Zip Code 91501-970 – Porto Alegre – RS – Brazil
Phone: (+55) (051) 33086670; Fax: (+55) (051) 33087509.
www.iph.ufrgs.br