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**CHARACTERISTICS OF POWERFREQUENCY CURRENTS
IN WATER MAINS –CANADA**

How to avoid corrosion of water mains in a rationalized,
concerted way, and reduce environmental electromagnetic field levels

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Abstract

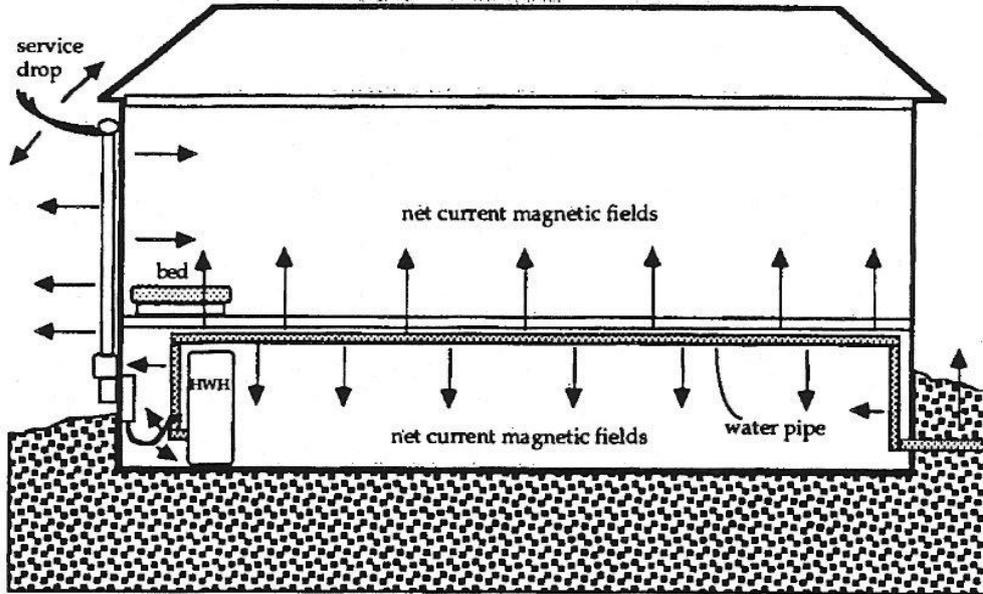
Based on a national survey of residential electromagnetic fields done for Canada Mortgage and Housing Corporation and hundreds of others, including industrial, commercial, institutional and residential some observations suggest solutions on how to avoid corrosion of water mains in a rationalized, concerted way, while reducing environmental fields.

This paper refers mostly to research based on a national survey of residential fields done for **Canada Mortgage and Housing Corporation**¹ and on hundreds of industrial, commercial, institutional and residential electromagnetic field surveys and mitigations performed across Canada and the United States of America. The observations indicate that simple solutions for avoiding corrosion in a rationalized, concerted way while reducing environmental magnetic field levels.

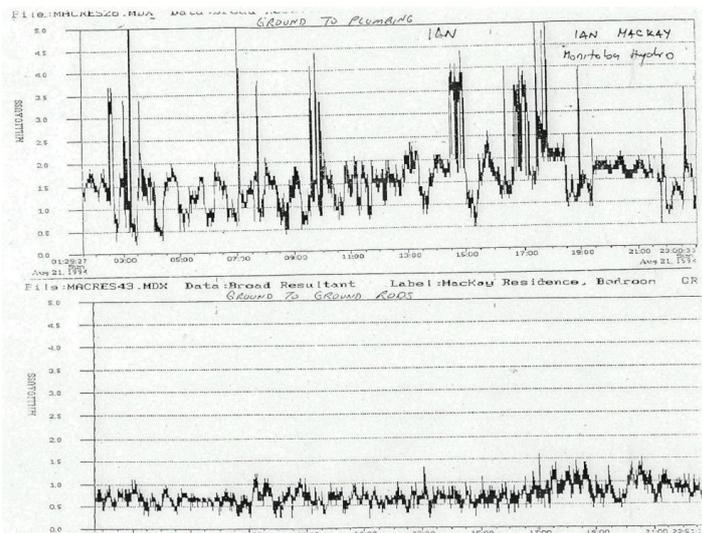
When substantial current returns to a distribution transformer *via* the ground - instead of the neutral conductor of the line, **net current** develops. It contains 60Hz and such harmonics as 90, 180, 300, 420 Hz and even variable oscillating crescendos of extremely low frequencies. The currents also can include cablevision, telephone, radiofrequency / microwave, as grounding return “noise”.

The magnetic field produced by this net current is not canceled. It is usually a major source of magnetic fields nearby. **Ontario Hydro Research (D. L. Mader, et al, 1990)** noted that the main contribution to residential 60 Hz magnetic fields is from grounding or "water-pipe" currents caused by local imbalance, higher in summer, and highest daily between 6 PM and midnight.

Residential low-voltage grounding connections - neutral wire to ground contacts in houses are crucial since they protect against shock and fire from fault currents. The multi-grounding problem exists in both overhead and underground electrical distribution systems.



Net current - Splitting between service & water system grounding. Net current path as neutral return current splits at service point due to required grounding to water system at other end of house. Indoor pipe has current; service drop has same net current due to a deficit of the neutral.



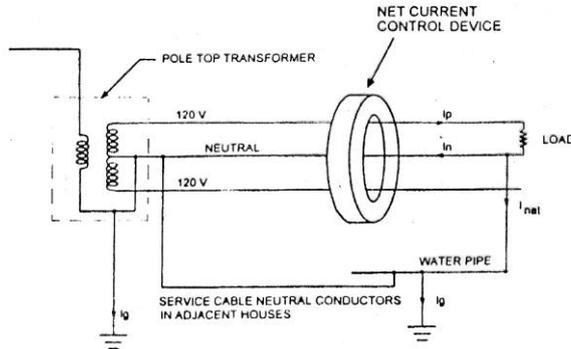
Net current - Variation over 24 hours to water mains compared to grounding rods only - residential setting. Net current varies according to use of circuits with wiring errors, start-up of appliances located throughout a neighbourhood that is inter-connected with conducting water mains and electrical supply. If grounding rods are used, only a portion of current is typically diverted from the electrical distribution system.

If the elimination of net current in water mains in a neighbourhood is not performed in one (1) public or private user by the interruption of bonding of an electrical panel to water mains with a dielectric coupler and separate grounding (as per Electrical Code) for safety reasons (at a cost ranging from \$100 to \$1000 per 5-10 building units), then

there is a recourse to a device developed by the U.S. Electric Power Research Institute (EPRI) for strategic placement in neighbourhoods on electric utility property for 10 to 100 building units at a cost of around \$1500.

EPRI Power Delivery Center • Lenox

Neutral Current Coupler-Net Current Control

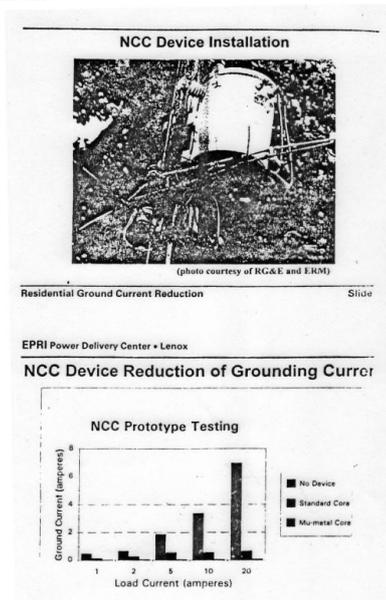


NET CURRENT CONTROL DEVICE PLACED AROUND SERVICE CABLE TO REDUCE CURRENT TO THE WATER PIPE GROUND

Residential Ground Current Reduction

Slide 13

Net current – *Neighbourhood scale net current control device developed by EPRI (Electric Power Research Institute)*. Unit provides neighbourhood-wide cancellation effect for electromagnetic fields from the multi-ground system. Such devices are installed in the electrical distribution network and have a strong effect in reducing currents on water mains.



Net current – *Neighbourhood-scale net current control device developed by EPRI (Electric Power Research Institute)*. Image of typical installation and results of reducing grounding current (up to 70-fold current reduction).

It should also be observed that radiofrequency and microwaves infiltrate water main currents through electric power transmission / distribution systems and grounding wires neutral return net currents. These include the **BPL** - Broadband over power line systems, including **Wi-Fi** (at 1.7 to 80 MHz – with 10 MHz of Bandwidth used per modem) – which bypass transformers. Computerized high-amperage facilities such as

Post Office Sorting centres, Data Centres, foundries, etc. introduce Radiofrequency / microwave emissions into powerlines and create net current conditions capable of interfacing with water mains. Furthermore, remote reading water and utility meters (SMART) apply strong pulsed RF transmissions every 14 seconds with modulated RF carrier wave using a frequency hopping technique). And, finally, the ground returns from building telephone, cablevision, security and computerized systems also affect water mains.

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1. Canada Mortgage and Housing Corporation. Survey of electromagnetic fields in Canadian Housing. Ottawa. 1996. Done with BC, Manitoba and Toronto Hydros, McGill University and US Department of Energy by the Planetary Association for Clean Energy.