Sustainable Graffiti Management Solutions for Public Areas

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Abstract

Towards advancing sustainable graffiti management solutions for public areas, this article investigates the efficacy and socio-ecological effects of a range of contemporary graffiti management tactics. In addition to finding that reactive management tactics (e.g. painting over graffiti, chemical-based graffiti removal, and anti-graffiti coatings) are largely ineffective at deterring graffiti vandalism in public areas, it is shown that reactive management efforts also entail both short- and long-term environmental risks. Moreover, a comparison of reactive and proactive management tactics (e.g. landscaping techniques, green walls, community murals, legal graffiti spaces, and public art workshops) indicates that the cumulative environmental effects of reactive tactics are significantly more detrimental to human health and local ecosystems. Accordingly, it is recommended that local authorities focus on proactive graffiti management tactics for public areas. Finally, several best practice case studies of sustainable graffiti management are highlighted.

Keywords: Graffiti Management, Graffiti Countermeasures, Public Areas, Sustainable Urban Planning, Resource Efficiency

1. Introduction

As I write, graffiti are more universal and omnipresent than ever before. Observable in human settlements of all locations, shapes and sizes – along highway corridors and railways, covering trains and restrooms, within abandoned sites and war zones, deep underground and atop skyscrapers – graffiti know no borders. Yet, despite a substantial and growing prevalence, the majority of graffiti created over the past half century has been purged from the public view. Indeed, the graffiti we see today are merely "the latest layer in an ongoing urban palimpsest of spray paint and whitewash that hides away its own history." (Ferrell, 2016, p. xxxiii)

Fig.1 - Left: 'Corporate Slingshot' by Os Gemeos & 'Crown of Greed' by Blu. Lisbon, Portugal. 2014. Photo by M. Aagaard. Right: Graffiti on a tram. Lisbon, Portugal. 2015. Photo by N. Nguyen.

Graffiti management involves a wide range of public, private, and third sector actors who collectively expend significant resources towards deterring, mitigating, and removing graffiti. Many cities have introduced so-called 'zero-tolerance' policies that obligate the removal of any unauthorized graffiti in the public view, believing that "rapid removal of graffiti is the most effective method to prevent future vandalism … because it nullifies the notoriety or 'fame' sought by taggers and shows taggers that the site is being watched." (Teng et al., 2016, p. 363) For example, the official website of the City of Vancouver claims "delays in removal tend to encourage graffiti vandals to expand the graffiti to adjacent properties. In this way, graffiti can act as a magnet and attract more graffiti to the area." (City of Vancouver, 2016)

Opponents of zero-tolerance policies note, however, that such tough-on-graffiti approaches generally fail to deter or reduce graffiti over the long-term "because they fail to address, and in fact often purposefully ignore, the reasons behind graffiti." (Gomez, 1993, p. 657) Rather, zero-tolerance policies and reactive graffiti management tactics may well have helped establish today's thriving graffiti scene and anti-graffiti industry. Furthermore, several studies indicate rapid graffiti removal efforts can have unintended consequences, such as "the proliferation of tags and other forms of graffiti that people tend to dislike the most." (Shobe & Banis, 2014, p. 586)

Alas, contemporary graffiti management is not merely costly and ineffective; it is also an often-overlooked environmental threat. Indeed, some of today's most widely used and promoted reactive management tactics, such as graffiti removal using pressure washer systems equipped with chemical paint removers or the application of anti-graffiti coatings on buildings, entail both short- and long-term adverse impacts on human health and local ecosystems, including water resources and air quality.

Towards uncovering more sustainable graffiti management solutions for public areas, this article considers the efficacy and socio-ecological effects of contemporary graffiti management tactics. It reveals that many reactive management tactics are significantly worse for health and ecosystems than a variety of proactive tactics, such as preventative landscaping techniques, green walls, community murals, legal spaces for graffiti, and public art workshops. Accordingly, it is argued that local authorities should focus on proactive graffiti management tactics for public areas. Several best practice cast studies of sustainable graffiti management are considered.

Fig. 2 - Left: Chemical-based graffiti management efforts on 5 September 2016. Right: New graffiti tags appear on 17 September 2016. Hamburg, Germany. Photos by D. Huntington.

2. Reactive Graffiti Management

Effective graffiti removal poses several challenges. First, the wide range of chemical and material ingredients in aerosol paints inhibits standardization of removal methods. Moreover, the reality that graffiti differs by size, color, and location influences factors such as ease of removal and degree of damage to the substrate. While removing graffiti from plastic, ceramic, and metal surfaces may be unproblematic, effective removal from porous (e.g. concrete) surfaces is often difficult, as aerosol paints easily infiltrate any pores. Additionally, some pigments cause darker staining than others, making it more difficult to clean certain colors, such as black, red, and silver, which just so happen to be a few of the most popular colors among writers. (Sanmartín et al., 2015)

Aside from simply painting over graffiti, other common reactive management tactics include chemical paint removal products and mechanical pressure washers. Alternatively, anti-graffiti coatings, which form a protective layer on the substrate and expedite any subsequent graffiti removal efforts, are increasingly used on public and private property in urban areas prone to graffiti. Alas, chemical paint removal products may penetrate and cause irreversible damage to a substrate. Likewise, the use of pressure washers in combination with water, a chemical solution, or abrasive materials (e.g. sand, ground rubber, carbon flint) may compromise the structural integrity of some substrates, particularly in the case of historic buildings or monuments. Without proper care, even the seemingly straightforward painting over of graffiti can have precarious results. More traditional methods, such as scalpel by hand, may be appropriate for removing graffiti under highly controlled conditions or from delicate surfaces; however, this process may be very time-consuming for larger graffiti and is thus generally neither efficient or economic. Novel methods, such as dry ice blasting or laser removal have demonstrated some potential environmental benefits over traditional methods; however, these tools are still in development and not without drawbacks. Notably, they may “alter the color of the substrate (e.g. inducing yellowing), remove some grains and produce craters, and they can also transform, melt and/or fracture the minerals.” (Sanmartín et al., 2015, p. 295)

Fig.3 - Left: “Please No Tags! …Honestly!”, Dresden, Germany. 2016. Photo by D. Huntington.
Right: Hamburg, Germany. 2016. Photo by D. Huntington.

Most importantly, reactive management tactics are generally ineffective at preventing recurring acts of graffiti. Indeed, the effects of reactive management are generally temporary and may have unintended consequences, such as encouraging "quick and dirty forms of graffiti over more complex design works." (Haworth et al., 2013, p. 53)

2.1. Painting Over Graffiti

Painting over graffiti is relatively simple and inexpensive compared to most other management tactics; however, this method is generally only effective when restoring the appearance of a previously painted surface. Alternatively, painting over may be suitable for some smooth substrates, but only where color-matching is possible. Otherwise, painting over graffiti may have unintended consequences. For example, attempts to match the substrate's existing color often fall short, resulting in a telltale patchwork effect that may, in fact, attract more graffiti. Furthermore, repeated painting over can result in heavy paint buildup, which may inhibit the breathability or integrity of the substrate. (Sanmartín et al., 2014)

Notwithstanding the drawbacks of painting over graffiti, many local authorities rely on this approach regardless of the type of underlying substrate, particularly in cities with zero-tolerance policies that demand rapid removal. The ineffectiveness of this approach is perhaps best illustrated in *The Subconscious Art of Graffiti Removal*, a 2001 documentary film that satirically argues the municipal graffiti removal efforts of Portland, Oregon represent a distinctive movement in modern art rooted in the repressed artistic desires of its graffiti removal workers.

Fig. 4 - Left: An example of the 'patchwork effect'. Boston, Massachusetts. 2016. Photo by D. Huntington. Right: A new graffiti piece appears over paint over graffiti. Hamburg, Germany. 2016. Photo by D. Huntington.

Fig.5 - Left: Graffiti appears at a railway platform in February 2016. Hamburg, Germany. Photo by D. Huntington. Right: The graffiti is painted over in July 2016. Hamburg, Germany. Photo by D. Huntington.

Fig.6 - Most graffiti on public transport is removed by hand using chemical solvents. Germany. 2013. Photos by Die Welt.

While the immediate environmental impacts of painting over graffiti are relatively minor compared to most other chemical or mechanical graffiti management tactics, persistent use of paint to cover graffiti may have significant cumulative environmental effects. This reality is reflected in previous research, which estimated the use of paint to cover graffiti within the United States resulted in 1,936,839 kg of volatile organic compounds (VOCs) in 2008, a magnitude nearly four times greater than VOC emissions from chemical graffiti removal products and ten times greater than VOC emissions from anti-graffiti coatings. (Leskys, 2010)

2.2. Chemical Paint Removers

Chemical-based paint removal products are generally intended for use in conjunction with other physical or mechanical means of graffiti removal (e.g. hand scrubbing, scalpel, pressure washer). Alternatively, some manufacturers sell larger quantities of chemical paint remover formulations to be applied using physical (e.g. paint rollers) or mechanical methods (e.g. pressure sprayer systems).

The chemical substances found in most graffiti removal products belong to two groups: alkalis and solvents. Common alkalis include sodium hydroxide, better known as caustic soda, and potassium hydroxide. Solvents are generally alcohol or hydrocarbon based VOCs, such as n-methyl pyrrolidone (NMP). (Craver et al., 2011) Previously, Leskys (2010) found chemical graffiti removal products released 537,053 kg of VOCs in the United States in 2008. It has also been estimated that, within the State of California, the use of consumer graffiti removal products release 171 kg of VOCs per day, or more than 62,000 kg annually circa 2005. (Wolf, 2014)

Notable health risks associated with the use of chemical graffiti removers include:

- ethylene glycol ethers: can damage sperm, cause birth defects, and harm the blood-forming system. It is easily absorbed through the skin and may cause nose or throat irritation
- limonene: can cause eye, nose, and throat irritation. May lead to skin allergies and dermatitis.
- methyl ethyl ketone (MEK): can cause eye, nose, and throat irritation, headache, loss of balance, and other brain effects.
- methylene chloride: a known carcinogen, which may cause eye, nose, throat, and skin irritation, headache, loss of balance, and other brain effects. Exposure at higher levels may lead to liver and kidney damage or changes in the blood's ability to carry oxygen.
- n-methyl pyrrolidone (NMP): a known carcinogen, which is also suspected of causing reproductive and developmental problems. Skin contact is known to cause swelling, blistering, and burning.
- toluene: can cause eye, nose, and throat irritation, skin irritation and dermatitis, headache, loss of balance, and other brain effects.

Improper use of chemical graffiti removers may result in hazardous residual substances from either the chemical remover itself or the paint being transported into watercourses or storm water systems. Accordingly, precaution should be taken to ensure all liquids are properly contained throughout graffiti removal and disposed of safely. Protecting any storm basins, drains, or water inlets with cloth, sandbags, or tarpaulin is advised. Additionally, any wastewater generated due to cleaning of equipment or tools (e.g. brushes, rollers, respirators, tarpaulin) should be contained and disposed of safely. (Weaver, 1995)

Fig. 7 - Chemical-based graffiti removal in a public area. Hamburg, Germany. 2016. Photos by D. Huntington.

The main drawback of many chemical removal products is a high potential for ineffective results. Incorrect application or use on incompatible substrates may cause permanent discoloring or staining. At times, poor results can make any remaining graffiti more challenging, or even impossible, to completely remove. (Weaver, 1995)

2.3. Protective Anti-Graffiti Coatings

Protective anti-graffiti coating products are designed to keep graffiti from penetrating a substrate, including porous surfaces. Such coatings have become favored by governments, schools, businesses, and many other actors for their unique ability to expatiate graffiti removal on buildings, infrastructure, monuments, trains, busses, signage, and other common targets of graffiti. (Teng et al., 2012)

Broadly speaking, protective coatings may be divided into sacrificial, semi-permanent, and permanent systems. Sacrificial coatings, often made from polymers such as acrylates, biopolymers and waxes, form a clear, temporary barrier that is easily removed by chemicals or pressurized water (i.e. along with any graffiti removal efforts). The ease of removing sacrificial coatings is seen as a benefit in northern climates, where during spring and fall, “walls need to be able to breathe throughout the repeated cycle of frost and thaw.” (European Cleaning Journal, 2012) Semi-permanent coatings and permanent coatings, on the other hand, are designed to withstand repeated cleanings. Today’s most popular semi-permanent and permanent coatings are made of polysaccharides, polyurethanes, silicon resins, or fluorinated polymers.

Alas, many conservation experts do not recommend the use of semi-permanent or permanent coatings on culturally significant buildings or monuments as they may “cause chromatic variations on the treated stones, unacceptably altering the aesthetic appearance.” (Sanmartín et al., 2015, p. 306) Rather, semi- and permanent protective coatings should be reserved for substrates with low porosity, such

Fig. 8 - Regardless of the substrate, chemical-based graffiti removal often produces poor results. Hamburg, Germany. 2016. Photos by D. Huntington.

as concrete or metals. Caution has also been advised with the use of coatings to protect public murals or artwork. For example, one evaluation of the appearance (color, clarity, sheen), performance (ease of application, ease and efficiency of graffiti removal, durability), and stability (color change and ageing) of eleven different anti-graffiti coatings (including sacrificial, semi-permanent, and permanent varieties) on two public murals in Los Angeles concluded none of the coatings exhibited all of the desired characteristics or necessary requirements for mural preservation. (Macdonald-Korth et al., 2015) It also seems, while anti-graffiti coatings may be effective in the case of some frequently targeted buildings, transport, or small sized infrastructure, in most cases and especially with regard to large structures (e.g. bridges, underpasses, sound walls), coatings are generally not economical compared to alternative graffiti management methods. (Teng et al., 2016)

Anti-graffiti coatings are frequently made with nanomaterials due to their novel characteristics, such as increased strength or conductivity, compared to the same materials at a non-nano scale. (European Commission, 2016) Notwithstanding their unique ability to protect against future graffiti, however, the increasing use of permanent nanomaterial-based anti-graffiti coatings in public areas may pose latent environmental effects to ecosystems as well as chronic health risks to regularly exposed individuals. (Baalousha et al., 2016)

Nanomaterials may negatively affect the health of individuals and larger populations, and the structure and function of ecosystems. Unfortunately, there is little research into the environmental fate (uptake, localization, or toxicity) of nanomaterials in air, soils, waters, vegetation, and life forms. There is also very little understanding of the effects of nanomaterials at low doses over the long term. Moreover, the effects of any potential reactions with other materials and contaminants, such as metals and organics, are not well-known. (International Union for Conservation of Nature, 2016)

While few studies on the health effects of nanomaterials exist, there is good evidence of potential pathogenic or inflammatory effects on the lung. It has also been shown that some nanomaterials may enter the brain via the central nervous system following inhalation. (Khan, 2013)

2.4. Pressure Washer and Water-Jet Systems

A pressure (or power) washer is a mechanical tool capable of spraying liquids at low to high pressure. Pressure washers may be used to remove paint, mold, grime, dust, mud, and dirt from a variety of surfaces, such as brick, concrete, and vehicles. Alternatively, high-pressure water-jet systems have also been demonstrated to remove graffiti from marble surfaces under specific operational conditions. (Careddua & Akkoyunb, 2016)

Pressure washer and water-jet systems, which are typically classified according to the type of fuel/energy they consume (e.g. electric, diesel, and petrol gas), can be resource-intensive and generate large volumes of residual waste during graffiti removal operations. Variables that affect the resource demands and residual waste of these systems include pressure rate (usually between 500 and 3000 psi), flow rate, nozzle design, water temperature, spray angle, and distance from target. (Craver et al., 2011)

Fig.9 - The City of Chicago offers free graffiti removal on public and private property using pressure washer systems. Chicago, Illinois. 2013. Photo by A. Podgorski.

Moreover, while some high-pressure systems are capable of removing freshly made graffiti with hot water or steam alone, effective removal of most aerosol paints with a pressure washer usually requires the addition of a chemical solvent to achieve desirable results. Thus many pressure washers are equipped with a chemical injector mechanism.

Pressure washer or water-jet systems may produce a contaminated effluent comprised of the chemical solvent as well as suspended paint particles. In order to prevent this effluent from harming nearby natural environments, it is important to consider a mitigation strategy prior to any pressure washing. This is particularly true of graffiti located near aquatic environments or busy public areas, which are considered the most sensitive to contamination. (Craver et al., 2011)

2.5. Blasting Systems

Graffiti may be removed using a pressure blasting system (e.g. air compressor, mechanical sprayer) combined with an abrasive blasting media, such as sand, pulverized coal, sodium bicarbonate, ground rubber, carbon flint, or corn cobs; however, these systems are usually best left for hard surfaces, as abrasive media easily causes damage to softer materials, including most types of masonry. (Sanmartín et al., 2014)

Recently, some local authorities have experimented blasting recycled crushed glass in the form of heated wet slurry to remove graffiti. According to one study, crushed glass is capable of removing many types of graffiti that cannot be removed using sodium bicarbonate. (Wolf, 2014) Alternatively, the blasting of dry ice (i.e. solid CO_2) seeks to avoid the waste-generation drawbacks of pressure washers and abrasive media blasting, as pellets of dry ice will instantly sublimate (transform directly from a solid to gas) on contact with the targeted surface. Therefore, dry ice blasting causes minimal abrasion to the substrate and creates no additional chemical residue. (Craver et al., 2011)

In a sign that some anti-graffiti stakeholders are considering the environmental impact of graffiti removal, the Omnipole *Tornado ACS*, advertised as a "revolutionary 100% environmentally friendly graffiti removal solution" (Omnipole, 2016), is a dual mobile-jet and vacuum device capable of high-pressure spraying of abrasive media (e.g. ground walnut or macadamia shells) as well as capturing and filtering any resulting waste in its closed-loop system.

Unfortunately, graffiti removal with the Tornado ACS is relatively time consuming and it may not be possible to remove graffiti from hard-to-reach places due to the device's limited suction hose (4.5 m), bulky size (126 x 69 x 63 cm), and weight (41 kg). (Omnipole, 2016)

Fig.10 - *Tornado ACS* demonstration. Hamburg, Germany. 2016. Photo by L. Hansen

Most blasting systems generate wastes that risk contaminating surrounding ecosystems. (Wolf, 2014) Furthermore, blasting systems may be inherently time-, resource-, and energy-intensive. The Tornado ACS, for example, requires 10 minutes to assemble and disassemble, as well as approximately 30 minutes to remove one square meter of graffiti. (Hansen, 2016)

Blasting systems may cause excessive noise pollution. For example, the *Tornado ACS,* rated at 75 decibels, produces noise levels equivalent to a power lawn mower or heavy urban traffic. (Omnipole, 2016) This is a cause for concern, especially when removing graffiti in public areas, given the well-documented negative effects of noise on auditory and non-auditory health (e.g. sleeping problems, hypertension and cardiovascular disease, and impaired cognitive performance). (Basner et al., 2014)

2.6. Laser Systems

Laser systems were introduced in the 1990s as an effective means of graffiti removal, especially when applied to historic buildings or porous structures. Since then, several types of lasers (e.g. CO_2, Nd:YAG, Nd:YVO_4, excimer, exciplex, and high-power diode) have been used to remove graffiti from different substrates (e.g. mortar, glass, polymers, metals, and wood) with varying results. While the use of laser systems to remove graffiti is rare compared to traditional methods, studies of laser-based techniques in the literature are abundant. Some benefits of laser removal systems include their noncontact nature, control of application, selectivity, and repeatability of treatment. (Sanmartín et al., 2014)

Laser graffiti removal is typically costly and time-consuming. Indeed, total costs may be upwards of 20 times more expensive than conventional methods and complete removal of one square meter of paint may take anywhere between ten minutes to several hours depending on the type of paint and substrate. At the extreme end, use of a Nd:YAG laser to remove black paint from the Avebury Stone Circle in Wiltshire, England required several weeks to complete. While the laser managed to remove most graffiti from the sandstone, its most porous zones responded negatively to the treatment and thus required further cleaning with methylene dichloride. Moreover, the effectiveness of most laser removal systems depends on the type and color of paint, as well as the substrate material. It has been observed that metallic paints (e.g. gold, silver, bronze) are generally more difficult to remove with laser systems than black, blue, or red paints due to differences in their chemical composition. Regarding the substrate, it has been demonstrated that CO_2 laser removal systems perform better on materials with lower thermal conductivity. Thus, removing paint from brick or concrete is easier and faster than removing paint from steel or aluminum. (Sanmartín et al., 2014)

The level of expertise required for laser removal systems is another barrier to their use. Lasers require appropriate selection of various parameters for effective graffiti removal, as imprecise settings may cause damage to the substrates, such as discoloration or melting of softer materials. Lastly, it should be noted that laser graffiti removal efforts could be resource-intensive depending on the type of equipment, as well as the location and magnitude of graffiti. Beyond energy demands, laser removal may also necessitate significant water demands, as water is often applied to the substrate in order to increase the treatment's effectiveness. (Sanmartín et al., 2014)

2.7. Bioremediation

Given the numerous drawbacks and environmental impacts of traditional physical, chemical, and mechanical approaches to graffiti removal, there is a compelling need to develop new, effective and ecologically safer methods. Using bioremediation for graffiti removal, although still in development, is one promising possibility. Bioremediation involves use of microorganisms, such as culturable bacteria and fungi, to remove graffiti without affecting the substrate. To date, several microorganisms have demonstrated good potential to degrade acrylic-based aerosol paints; however, further investigation into other microorganisms and nitrocellulose degradation is needed in order to develop more effective bioremediation techniques. (Sanmartín et al., 2015)

2.8. Criminal Law, Security and Surveillance

Generally speaking, unauthorized graffiti are illegal and punishable by fine or imprisonment in the eyes of the law just about everywhere, although varying degrees of enforcement and penalties are practiced from one region to another. For instance, in Canada, the federal criminal law considers any unauthorized graffiti as a summary or indictable offence of property damage and criminal mischief, which can result in a maximum sentence of 2 years in the case of personal property, or 10 years if the damage is deemed cultural,

religious or in relation to computer data. (Canada Criminal Code, 1985)

Common schemes to enforce laws against graffiti include police or private security patrol efforts as well as a wide range of surveillance technologies, including closed-circuit television (CCTV) surveillance, thermal or low-light cameras, sound or motion detectors, trip alarms, and automated drone cameras. (Flammini et al., 2016) Guard or attack dogs may also be relied on to catch or deter graffitists, particularly in rail yards or restricted areas. (Marr, 2015)

Many local police services maintain a graffiti database, which may include photos, measurements, and location details of reported graffiti, as well as any known information on graffitists. For example, the Halifax Regional Police service managed to assemble a database of more than 6,000 photos of graffiti, 377 tag names, and 48 graffiti crews between 2009 and 2014. According to Constable Gerry Murney, head of the anti-graffiti unit, the service also had a second list of graffiti-related charges with 206 names; however, the majority of these charges were sentenced to serve community service or participate in a restorative justice program, while only one charge resulted in a conviction. (Lawrynuik, 2014)

Although relatively expensive, surveillance cameras connected to a CCTV system that allows real-time observation are one of the most common methods of graffiti (and crime) prevention in public areas. CCTV systems may also be equipped with facial recognition software, thermal cameras, speakers, and audio or visual sensors. (Tomàs et al., 2014) Despite the popularity of CCTV systems, however, there are no reliable studies supporting their effectiveness at preventing graffiti. Moreover, several have found CCTV is not a cost-effective method of graffiti management (Carr, 2016), including one recent evaluation of surveillance cameras on the Stockholm subway that concluded the cost of preventing a single crime was approximately €1,875. (Priks, 2015) Additionally, it has been noted graffitists can effectively avoid identification by simply covering their faces, and that cameras may become the target for graffiti or further damage. (Teng et al., 2016)

In 2015, the German railway company *Deutsche Bahn* announced it would test drones equipped with high-resolution thermal imaging cameras to patrol rail yards at night. (Deutsche Welle, 2013) Germany's Federal Police have also reportedly used helicopters and thermal imaging cameras to fight graffiti. (MDR, 2016)

Fig.11 - Left: The Eurocopter 155 with four thermal imaging cameras. Right: The thermal imaging cameras can spot individuals from several kilometers away at night. Chemnitz, Germany. 2015. Photos by M. Unger.

Fig. 12 - Real-time display from thermal imaging cameras on the Eurocopter 155 at night. Chemnitz, Germany. 2015.

Alas, the effectiveness of the criminal law, police enforcement, and private or community security at preventing graffiti is generally poor and very few graffitists are deterred or caught this way. (Tomàs et al., 2014) Furthermore, the arrest, prosecution, or imprisonment of graffitists may have unintended consequences for cities. Consider, for instance, the ten-week jail term handed to graffitist Charlie Silver of Oxford, England in 2015, which led to a near 400 percent increase in the amount of graffiti over the next two years, and caused Oxford City Council to rethink their zero-tolerance approach and ultimately open the city's first legal graffiti walls. (BBC News, 2015; 2016)

3. Proactive Graffiti Management

Proactive graffiti management efforts have been shown to mitigate undesirable graffiti by changing the surrounding environment or engaging with graffitists and communities. Some examples of promising proactive management tactics include landscaping techniques, vegetation, green walls, public art or community murals, legal spaces for graffiti, public art programs, and urban art workshops.

3.1. Environmental Design and Landscaping

As early as 1961, Jane Jacobs pioneered the concept that environmental design influences criminal activity by identifying aspects of the physical environment that may encourage or hinder crime or vandalism. (Jacobs, 1961) In the context of graffiti, this approach suggests the arrangement or presence of certain elements of the built environment, such as street lighting, fences, walls, and vegetation, correlate to the frequency and magnitude of graffiti.

Enhancing the lighting of areas is often recommended under the assumption that graffitists prefer to work after standard business hours and especially at night. (Willcocks et al., 2014) However, it has been demonstrated that increased lighting does not necessarily help to deter all graffiti, but perhaps only certain types of graffiti. For example, one study of the spatial distribution of graffiti in Bristol (Parno, 2010) found:

> *"areas of lower access with light traffic and decreased public visibility would contain higher quantities of more detailed graffiti (e.g. pieces, stencils, and throw-ups), whereas areas of greater access with heavy traffic and increased public visibility would contain smaller quantities of detailed graffiti and greater quantities of quickly produced graffiti types (e.g. tags and stickers)."* (Crisp et al., 2014, p. 84)

Furthermore, the use of lighting in isolated or remote locations may actually attract graffiti by shedding a spotlight on it. (Weisel, 2009)

Regarding physical barriers such as fences or walls, the City of Montréal's official Tricks-and-Tips Guide to graffiti management advises residents and businesses install wire mesh fencing around the perimeter of any area affected by graffiti. Apparently, the mesh should be closely woven, and at least 1.8 to 2.4 meters high to discourage climbers. (City

of Montreal, n.d.)

Strategic landscaping of public spaces and well-thought-out positioning of plants and vegetation (e.g. vines, bushes, shrubs, and trees) can be an effective approach to graffiti management by making areas inaccessible to graffiti writers as well as improving the aesthetic appeal of public spaces, transport infrastructure, or buildings. (Kuo & Sullivan, 2001) Stamen (1993) surveyed 31 urban sites in a California neighborhood and found 90 percent of aerosol paint graffiti occurred in areas without plantings, while only 10 percent was located in landscaped areas. Similarly, Brunson et al. (2001) found both physical and social incivilities in outdoor public housing spaces with grass and trees were systematically lower than in comparable, more barren spaces.

In the Netherlands, the 'greenery against graffiti' approach has been successfully implemented in numerous public spaces, on public and private buildings, as well as along transport corridors. The most effective plants include self-clinging climbers, such as Boston ivy or Virginia creeper, which grow well in confined spaces, require little to no maintenance, and will not harm concrete or brick. Plants capable of forming a natural wall and thorny shrubs are also advised. (Mir, 2011)

Additional benefits of greening public areas include air quality improvements and helping to mitigate the urban heat island effect. (Pugh et al., 2012) Green facades and roofs may also improve the energy efficiency of buildings as well as offer an additional layer of defense against outdoor sources of noise pollution. Moreover, vegetation can help protect and extend the life of facades or other infrastructure by acting as a shield against weathering and sunlight. (Pérez et al., 2014)

One hitch with going 'green against graffiti' is that some plants or trees need years to completely cover a wall or prevent access to an area. It has also been noted that certain plants may cause damage to a substrate (e.g. if roots are capable of penetrating the material). (Mir, 2011)

Fig. 13 - Green facade. Hamburg, Germany. 2016. Photo by D. Huntington

Fig. 14 - Going ‘green against graffiti’ on retaining walls. Zwolle, Netherlands. 2016. Photo by Mobilane.

Fig. 15 - Patrick Blanc’s Vertical Garden, as seen in October 2006, March 2007, and April 2008. Madrid, Spain. Photos by P. Blanc.

3.2. Murals and Public Art

Painted murals, whether on buildings, bridges, underpasses or utility boxes, help deter graffiti due to an informal observance within the graffiti community that existing graffiti and certain types of public art should not be covered with new graffiti out of a sign of respect for the artist. (van Loon, 2014)

One of the earliest public mural and art programs to effectively deter undesirable graffiti is the City of Philadelphia's *Mural Arts Program*. Since its beginnings in 1986 as a division of the *Philadelphia Anti-Graffiti Network*, the *Mural Arts Program* has organized the creation of over 3,600 murals, "which have become a cherished part of the civic landscape and a great source of inspiration to the millions of residents and visitors who encounter them each year." (Global Philadelphia Association, 2016) In light of the program's effectiveness against graffiti, it is no surprise that it has grown to become one of the city's largest employers of artists, working with hundreds of creative types, including many prosecuted graffitists, to bring new murals to the streets of Philadelphia each year. (Mural Arts Philadelphia, 2016)

As another example, in 1993, the Chicago Transit Authority (CTA), a governmental agency that operates mass transit in Chicago, in cooperation with the city-run youth art program *Gallery 37* and the Mexican Fine Arts Center Museum, commissioned art teacher Francisco Mendoza to create a public mural at 18th Street Station in Pilsen, which was facing "a serious graffiti problem." (Wisniewski, 2016) Mendoza gathered youth from the *Gallery 37* program, along with anyone else from the neighborhood who was interested, to help paint the mural. Describing the process, Mendoza said, "it was like having a jazz session ... artists would come up and say, 'I can paint, I have an idea,' and I would give them the colors they needed." (Jyoti, 2011)

In April 2016, more than two decades after the 18th Street Station mural was first painted, CTA President Dorval Carter noted, "the [18th Street Station] art piece was so respected by the community that they didn't graffiti it, [and this] has withstood the test of time." (Wisniewski, 2016) Over time, the CTA has added more than 60 unique artworks to over 50 stations, including mosaics, sculptures, and paintings by nationally and internationally acclaimed artists. Carter, in support of this policy, feels, "If I can put a smile in a customer's face because they see an interesting and whimsical piece of art, or an interesting sculpture, in addition to getting to work or school, it's a positive for the CTA." (Wisniewski, 2016)

Fig. 16 - A bus passenger admires 'Our Lady of Grace' by A'shop. Montréal, Canada. 2011. Photo by P. McCabe.

Fig.17 - A mural is painted over graffiti. Hamburg, Germany. 2016. Photos by D. Huntington

Fig. 18 - Left: Graffiti throw-ups cover a fire station. Hamburg, Germany. 2013. Photo by Google Maps. Right: A mural appears. Hamburg, Germany. 2016. Photo by D. Huntington

Notwithstanding the CTA's success using murals and public art to deter graffiti, there are some limitations of this proactive management tactic. First, murals only engage with certain types of people and they may be unlikely to earn the support of graffitists who are driven by the thrill of illegal behavior. Secondly, while murals might effectively prevent graffiti in a specific location, they do not necessary reduce the overall amount of graffiti in the surrounding area or within a city. Lastly, although completed murals are generally left untouched by other graffiti, there are numerous instances of authorized or commissioned murals being tagged. (Thompson et al., 2012)

Street-level traffic signal control or utility boxes are one of the most common locations for graffiti in public areas. In recent years, however, many local authorities and utility companies have begun to incorporate art on these easily accessible targets in an aim to prevent unauthorized graffiti. (BVE, 2015) One popular technique is to implement artworks that make these targets for graffiti blend into their surrounding environment. (Callaghan, 2004)

Typically looking to cooperate with local artists, many cities have organized competitions, request for proposals, as well as partnered with community art groups or schools. The City of Toronto, for example, as a part of its annual *Outside the Box* program, publishes the dimensions of its traffic signal cabinets online for artists to submit design proposals. (City of Toronto, 2016)

Fig. 19 - Left: A private security guard keeps watch during the painting of a public mural. Right: Within three weeks, the mural has been tagged. New York City. 2016. Photos by Elie.

Fig. 20 - Painted utility boxes in Kiel and Münster, Germany. 2015/2016. Photos by D. Huntington.

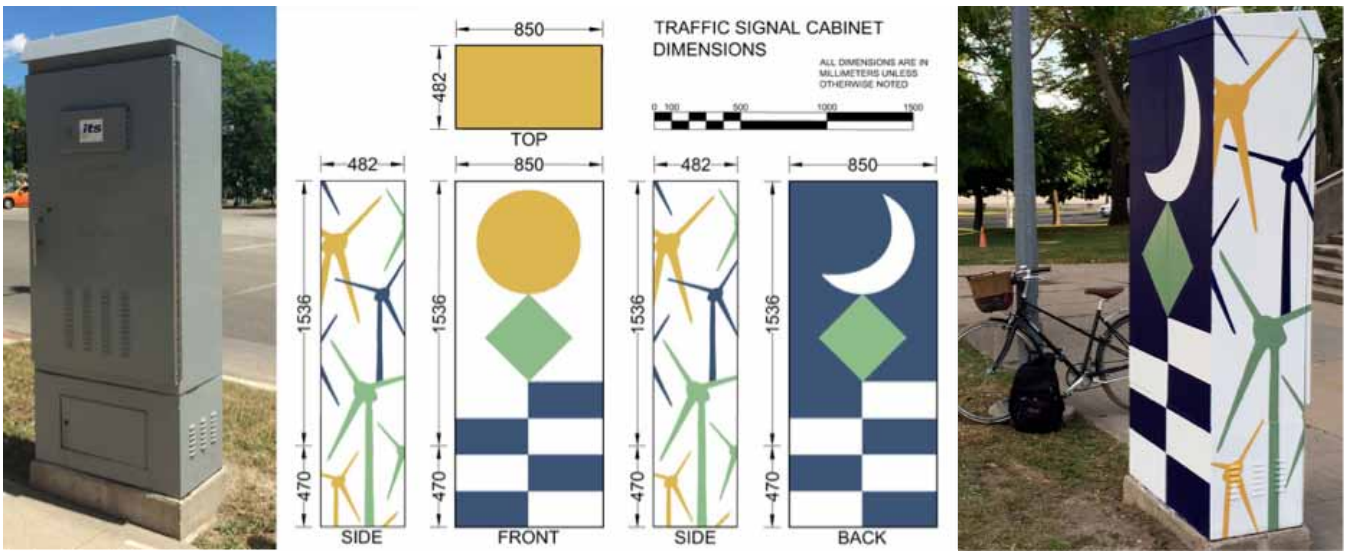

Fig. 21 - Left: Traffic signal cabinet dimensions provided by the City of Toronto feat. R. Wilmshurst's design. Right: A painted traffic signal box. Toronto, Canada. 2015. Photo by R. Wilmshurst.

Beyond graffiti murals, there are many other types of public art that might help deter graffiti from public areas. For example, between 2013 and 2014, sculptor Tobias Rehberger converted eleven utility boxes across Münster, Germany into unique works of art. Known for his colorful clashes of art and architecture, Rehberger "transformed the grey cubes into highly imaginative seating arrangements [that] invite the passerby to take a seat, rest in the middle of the city´s buzz, to wonder or simply enjoy." (Indechs, 2015) The use of public art to deter graffiti is cautioned, however, as in the case of graffitists whose primary motivation is name recognition, some works of public art might attract graffiti given their popularity with the general public and tourists.

3.3. Legal Spaces for Graffiti

Legally permitted spaces or walls for graffiti, sometimes referred to as 'free walls', are areas that explicitly permit graffiti, and which may require registration prior to use. Legal spaces for graffiti may be an effective strategy for reducing graffiti vandalism in cities, with the added benefit of enhancing public areas both aesthetically and culturally. (Fox, 2014) As Snyder notes, "legal walls have become essential to the progression of the art form [because they] allow writers to take their time, and this results in some really good art." (Snyder, 2011, p. 97)

Vienna's legal graffiti spaces are an interesting example, as it was one of the first European cities to offer legally sanctioned spaces for graffiti. Following the conviction of several young graffitists in the 1980s, a community organization known as the Graffiti Union reached an agreement with the local government to permit graffiti in certain places in the city. Subsequently, in 2004, due to growing demand for legal graffiti spaces, a task force was established to seek out appropriate locations as well as design a symbol to represent the city's legal graffiti sites, known as *WienerWand* ("ViennaWall"). The task force ultimately decided on a logo in the form of a dove to represent the *WienerWand* project and designate public areas for legal graffiti. (Tomàs et al., 2014)

Elsewhere, the ground floor facade of one building in Dresden has been transformed into a public chalkboard. The idea behind this "if you can't beat 'em, join 'em" approach is to deter graffiti by inviting passersby to create their own chalk art.

Fig. 22 - HOPE Outdoor Gallery, or Graffiti Park at Castle Hill. Austin, Texas. 2014. Photo by B. Breeze.

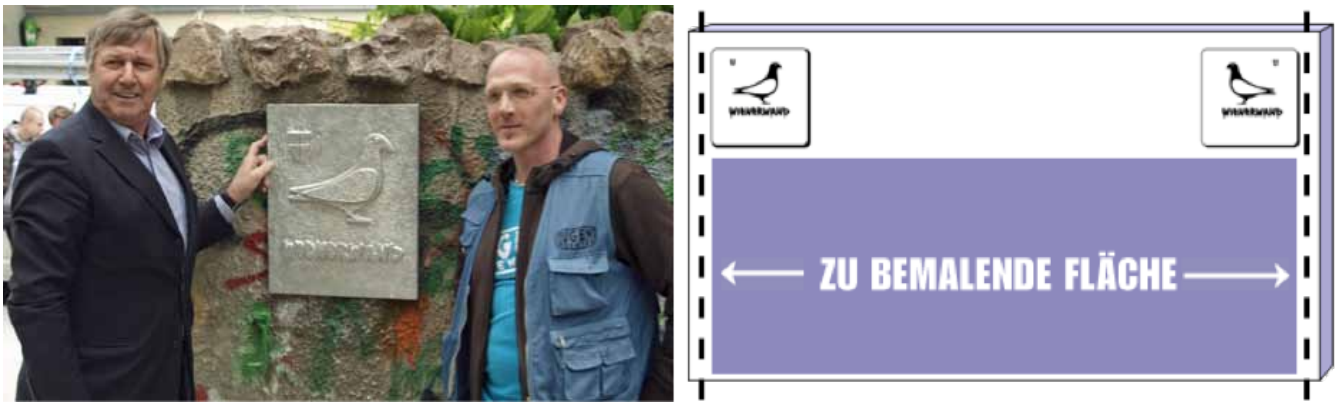

Fig. 23 - Left: Opening of a 'WienerWand' legal graffiti wall. Vienna, Austria. 2014. Photo by [Unknown]. Right: Illustration of permitted area for graffiti at WienerWand locations in Vienna, Austria. (Wiener Bildungsserver, 2016)

Fig. 24 - Graffitists paint legal walls in Berlin (left) and Hamburg (right), Germany. 2016. Photos by D. Huntington

Fig. 25 - Public chalkboard. Dresden, Germany. 2016. Photo by D. Huntington

Not all graffitists will be interested in legal walls, however, since the allure to create graffiti among many stems from its illegality. (Thompson et al., 2012; Ferrell, 1996) Additionally, legal spaces for graffiti may cause an increase of unauthorized graffiti in surrounding areas. (Ernstes, 2016) According to Police Constable and Graffiti Investigator Chris Fader, graffitists "might work [on] the free wall to practice or whatever. But they're still going to go out into the community and do graffiti because that's what their goal is." (Bartlett, 2015) On the flip side, increasing legalization of graffiti could, in fact, be "a form of anarchic resistance. Thus, increased tolerance of graffiti may actually demotivate some people from writing it in the first place." (Shobe & Banis, 2014, p. 586)

3.4. Virtual Graffiti

In 2016, after years of cleaning graffiti from the walls of Giotto's bell tower monument in Florence, Italy, officials decided to test a proactive graffiti management approach with the help of three tablet computers. The concept is to deter graffiti from the monument's walls by offering visitors an opportunity to create virtual graffiti that may be uploaded and shared online. With the virtual graffiti application, visitors can select from different substrates found in the monument (e.g. wood, marble, iron, plaster) and from several different marker types, ranging from aerosol paint to lip stick. (Pianigiani, 2016)

Fig. 26 - Left: The virtual graffiti tablet computer in Giotto's bell tower.
Right: Tourists leave their mark with the virtual graffiti app. Florence, Italy. 2016. Photos by A. Grassani.

3.5. Public Awareness Initiatives

Public awareness initiatives regarding the potential adverse effects of graffiti are another proactive management tactic. This approach aims to instill a sense of community pride and responsibility in citizens, with a particular focus on reducing the likelihood of youth to engage in graffiti. Public schools may, for example, lecture students on vandalism's social and economic consequences. Alas, the effectiveness of such in-school anti-graffiti programs is debatable, with some studies suggesting they may even be a source of inspiration for graffitists. (Teng et al., 2012)

Many governments have also employed anti-graffiti advertising campaigns. During the 1970s in New York City, a public-service program entitled *Make Your Mark In Society, Not On Society* featured billboards, subway ads, and television spots of professional baseball players, professional boxers, and actress and singer-songwriter Irene Cara stating that "doing graffiti was bad." (Ross, 2016, p.398) In 1997, the City of Los Angeles published a children's coloring book, titled *Kyle the Graffiti Fighting Bear*, which informed families both how to report graffiti via a newly opened graffiti reporting hotline and of potential rewards for their help towards successful prosecution of any graffitists. (Ross, 2016) Similarly, as a part of the City of Phoenix and Maricopa County's SCRUB (*Stop Crime and Reduce Urban Blight*) project, an anti-graffiti coloring book featuring *Neighborhoodasaurus* was offered to residents and schools in 1997. (Black, 1997) In keeping with the times, in 2008, the City of Tucson produced *Knock Out Graffiti in Tucson with Mr. Tuffy*, a free downloadable coloring book that aims to familiarize elementary school-age children with the crime of graffiti vandalism. (Tucson Citizen, 2008)

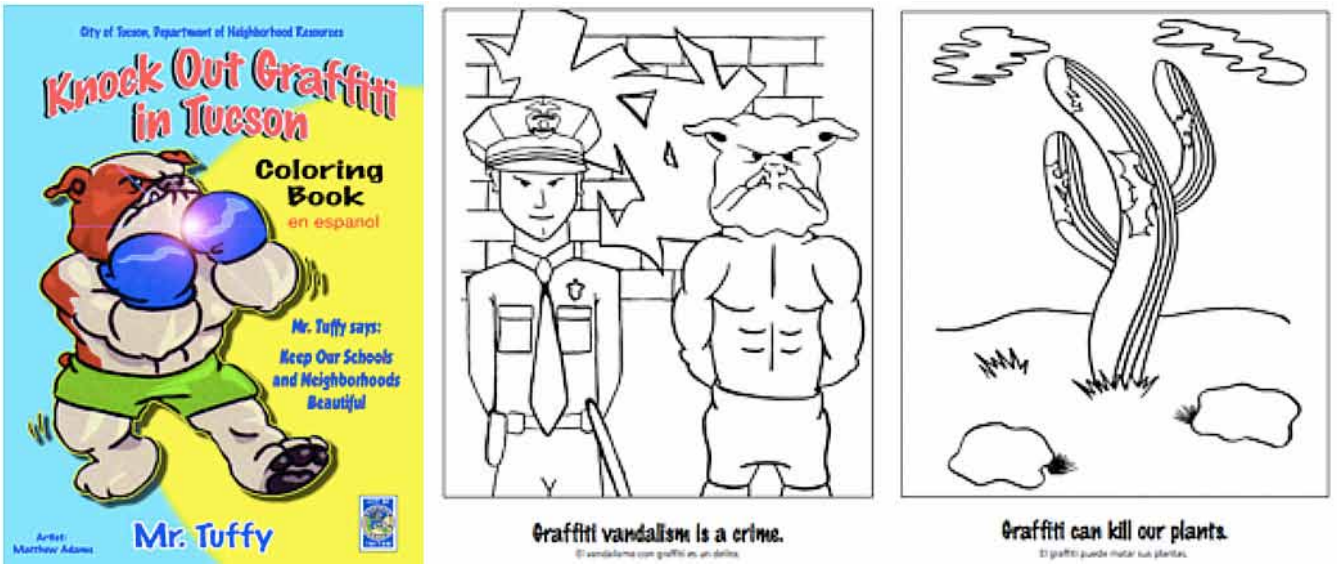

Fig. 27 - Excerpts from the City of Tucson's 'Knock Out Graffiti in Tucson with Mr. Tuffy' coloring book. (City of Tucson, 2016)

3.6. Public Art Programs

Due to the futility of anti-graffiti awareness initiatives, many cities have begun organizing public art programs for graffiti and street art. These programs or workshops are thought to help deter graffiti from public spaces by offering graffitists an alternative creative outlet. For example, a *Street Art School* In Hamburg, Germany offers youth the opportunity to make graffiti and street art with the help of experienced writers and artists. In addition to regular art classes during the summer, the *Street Art School* participates in community festivals, hosts art exhibitions, and organizes special events for refugees. (Street Art School, 2015)

4. Best Practices in Sustainable Graffiti Management

Rather than relying on a cookie-cutter solution to graffiti management, such as a zero-tolerance policy that necessitates tireless reactive graffiti management efforts to keep public areas free of graffiti, an increasing number of cities around the world are pursuing more strategic and targeted approaches to graffiti management.

Indeed, many neighborhoods and communities are decidedly tolerant of unauthorized graffiti, acknowledging that graffiti are an "unavoidable visual element of the urban landscape," (Duncan, 2016, p. 129) not unlike outdoor advertising. Elsewhere, graffiti and other forms of street or urban art are viewed in a more positive light, especially where these art forms show potential to revitalize "an otherwise drab or austere part of a city ... with a sense of cultural uniqueness." (Ross, 2016, p. 393)

Such cities tend to acknowledge the ineffectiveness of citywide reactive graffiti management efforts and rather focus on various proactive management tactics to mitigate unauthorized graffiti in public areas.

4.1. Toronto, Canada

In the wake of a citywide crackdown on graffiti led by former Mayor Rob Ford, (Flack, 2011) the City of Toronto introduced its national prize-winning *Graffiti Management Plan* in 2013, which distinguishes 'graffiti vandalism' from 'graffiti art'. (Barry, 2015) The latter are exempt from removal by either property owners or the public service; however, all graffiti art must be either commissioned and sanctioned via municipal permit or, approved by the Graffiti Panel, a group of appointed officials who determine the value of graffiti in question. (City of Toronto, 2016)

According to Elyse Parker, Director of the Public Realm, a basis of the plan was recognizing "from the outset that [the City of Toronto] would not be able to eliminate graffiti vandalism." (Archer, 2015) Therefore, Toronto

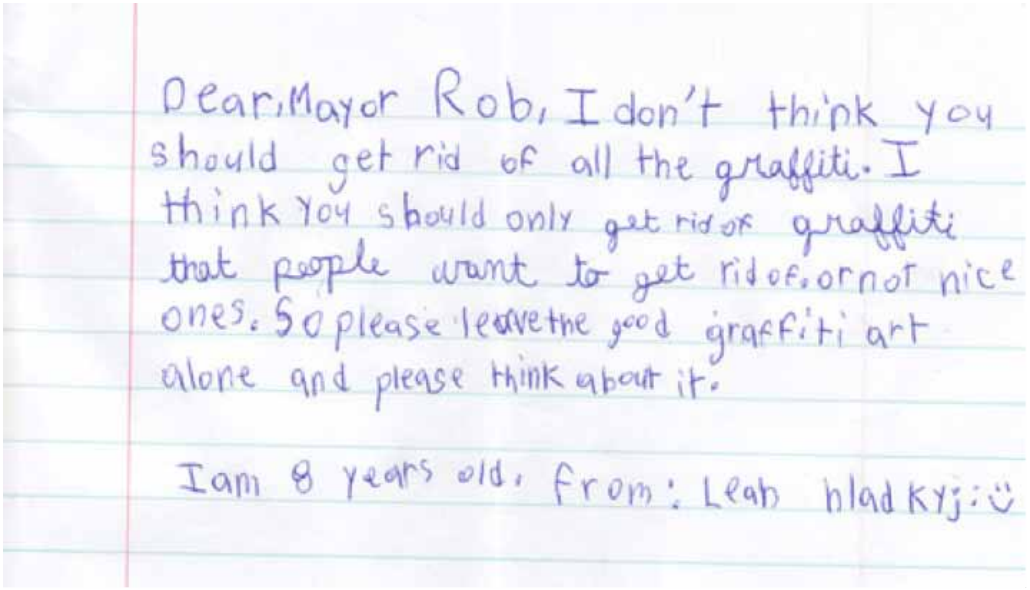

Fig. 28 - Letter to the Mayor of Toronto re: graffiti management from Leah Hladkyj, age 8. (Hogan, 2011)

seeks to proactively discourage graffiti vandalism via its *StreetARToronto* (StART), *StART Underpass Program* (StART UP), and *Outside the Box* programs.

An integral part of the *Graffiti Management Plan, StART* assists private property owners who are experiencing graffiti vandalism by purchasing the materials required to install a mural. *StART* also engages with local artists to find commissioned graffiti art and mural opportunities throughout the city. While *StART* creates artworks on both private and public property, *StART UP* is tailored to give artists an opportunity to create graffiti or street art on the city's publicly owned underpasses and tunnels. Last but not least, the *Outside the Box* program gives artists a chance to contribute "to the vitality and attractiveness of the streetscape" (City of Toronto, 2016) by creating art on the city's traffic signal boxes. Between 2013 and 2016, 120 boxes were "hand-painted by local artists and transformed into extraordinary works of art." (City of Toronto, 2016)

Fig. 29 - 'Stand Together' by SPUD, a mural funded by the City of Toronto. Toronto, Canada. 2015. Photo by M. Crandall.

Additionally, in 2015, the City of Toronto passed legislation requiring all construction sites encroaching on the public realm to incorporate public artwork on at least 50 percent of hoarding walls. Working alongside builders to make Toronto's construction sites less of an eyesore, a social enterprise known as PATCH has established an online directory of local graffitists and street artists, connects artists with new construction sites, arranges community art events, and provides custom artwork, light, or sound installations. (The PATCH Project, 2016)

Toronto also features a block-long alley where graffiti and street art are "legal and lauded." (VOGUE, 2014) According to *The New York Times,*

> "*the most concentrated display is along Rush Lane, a stretch just south of Queen Street West, between Spadina and Portland, known as Graffiti Alley. Stylistically, the works are by turns macabre (elaborate skulls), whimsical (cartoon characters) and fantastical (an undersea array that covers most of a building) - and most are stunning. You'll never look at a can of spray paint the same way again*." (Egner, 2016)

Notwithstanding these examples of proactive approaches to graffiti management, unauthorized graffiti remains illegal throughout Toronto and is actively monitored and removed, including over 18,580 square meters in 2014 alone. (Archer, 2015) Moreover, since 2005, property owners have been legally obligated to remove any unsanctioned graffiti from their property at their own expense. If reported graffiti are not removed in a timely manner, local authorities will arrange removal and charge the property owner for any incurred costs. (Beaton & Todd, 2016)

4.2. Stockholm, Sweden

In 2007, the City Council of Stockholm passed a zero-tolerance policy stating the city "shall not engage in or support activities that promote graffiti and other vandalism." (Berglund, 2014) The effects of this policy included the shutdown of several local art programs, including graffiti workshops organized by local schools and the City Museum's street art tour, as well as an outright prohibition against legal spaces for graffiti. Moreover, the policy gave police a reason to strip search young people, or place them under arrest for suspicion of having painted graffiti. (Berglund, 2014)

In the years to follow, City Council faced harsh criticism from the public for upholding a policy that censored art and was, according to the Green Party, "highly misplaced in a modern democratic society." (Berglund, 2014) Additionally, an annual conference, *Art of the Streets*, was organized by numerous graffitists from Stockholm and abroad to protest for policy change. Protests finally paid off in 2014 when, following the election of a new social democratic government, legislation was introduced that scraped the city's zero-tolerance policy and aimed to transform Stockholm into the city with the most legal spaces for graffiti in Europe. (ArtSlant, 2014)

4.3. Melbourne, Australia

During the City of Melbourne's development of an updated graffiti policy, one proposal went beyond the typical cookie-cutter approach to graffiti management by recommending the designation of three different zones in the city, including zero-tolerance zones, limited tolerance zones, and community regulated zones. (Young, 2010) This non-uniform management approach rejected "the monolithic tenets of the broken windows theory and focuses abatement in areas where there is overt community concern." (Shobe & Banis, 2014, p. 586) Moreover, it offers a possible pathway towards policies that recognize "a new ecology of urban becoming - one that makes room for graffiti as neither publicly sanctioned art nor crime." (Halsey & Pederick, 2010, p. 97)

Despite broad community support, the City of Melbourne ultimately decided (behind closed doors) to pass on the proposal, illustrating that, while nuanced approaches to graffiti management are possible, they may be politically difficult to realize. The challenge of hierarchy in public policy development is echoed by Chomsky, who argues many "people in power … firmly believe that [citizens] should not have revolutionary popular art in which people participate." (Chomsky, 2013)

4.4. Bogotá, Colombia

In 2011, the City of Bogotá decriminalized graffiti on public property following the unjust killing of 16-year-old graffitist Diego Felipe Becerra by law enforcement officers. (Brodzinsky, 2013) Indeed, although graffiti remains prohibited on culturally significant buildings, monuments, and private property without explicit permission of the owner, most of the city's publicly accessible spaces, including those along main thoroughfares, are now open canvases for graffitists and street artists. (World Cities Culture Forum, 2016)

The freedom to make graffiti in public areas, combined with the mayor's approval of graffiti "as a form of artistic and

Fig. 30 - Graffitists paint public infrastructure in the light of day. Bogotá, Colombia. 2015. Photo by Mike.

cultural expression," (Brodzinsky, 2013) has transformed Bogotá's formerly grey urban cityscape into a sea of large colorful murals. (Suarez, 2013) Moreover, with over 4,500 graffitists now living in Bogotá, graffiti has become "a legitimate professional and artistic practice for many, and the stance of the city encourages the most talented to stay and ply their trade." (World Cities Culture Forum, 2016) Bogotá's graffiti policy, drafted throughout regular discussions between local authorities and more than 50 local graffitists, has also affected perceptions towards graffiti among the general public and police. Indeed, according to one Bogota-based graffitist:

> *"Personally, I have never been fined for painting prohibited walls in Bogotá. The worst that has happened is I have been politely asked if I had permission by the police, and to move on if I did not. I have even had one of the younger officers ask me to stop but to, 'please come back after 6pm to finish the mural' because he really liked it and wanted to see it finished but would get in trouble from his senior if he let me continue."* (Crisp, 2015)

4.5. Berlin, Germany

Although graffiti are illegal and punishable by fine or imprisonment in Berlin, it has been widely reported that local authorities do not have the financial or human resources to effectively police or manage graffiti across the entire city. Consequently, graffiti proliferates in public areas due to a vibrant local scene and persistent flow of visiting graffitists.

The City of Berlin's laid-back approach to graffiti management has undoubtedly played a role in the city's status as "graffiti capital of Europe," (Tzortis, 2008) a "graffiti Mecca of the urban art world," (Trice, in Arms, 2011) and "a world leading cultural tourism destination." (Evans, 2016, p. 168) Most recently, *The New York Times*, in a special Europe issue of its travel section, recommended Berlin's graffiti and street art scene, "where elaborate murals … and images by sprayers and stencilers pop up everywhere." (Bradley, in Ferrell, 2016, p. xxxv) Even Berlin's police force has expressed tolerance for graffiti in the city, stating, "mere announcements, declarations of love, and political expressions or symbols are not considered [illegal forms of] graffiti." (Samutina & Zaporozhets, 2015)

4.6. Valparaíso, Chile

Although graffiti are illegal in most of Chile, there is no current legislation that explicitly forbids graffiti on private or public property within the coastal city of Valparaíso. (Addis, 2016) According to one report, graffiti and street art are governed by an unwritten law that gives graffitists and urban artists a de facto right to paint the streets as they wish, as well as make a legitimate living via commissioned work. In light of this laid-back approach to graffiti management, graffiti and street art flourish in Valparaíso as far as the eye can see. (Jess, 2014)

4.7. Halle (Saale), Germany

The persistent and growing legitimization of graffiti following numerous bottom-up endeavors and programs is one indication the days of zero-tolerance policies and incessant reactive graffiti management efforts may be numbered. Consider, for example, the quarter of Freiimfelde in Halle (Saale), which was completely transformed by a grassroots urban art project that would have made Hundertwasser proud. Indeed, since the launch of the *FreiRaumGalerie* ("OpenSpaceGallery") project in 2012 and its contribution of more than 20,000 square meters of urban art and ample legal graffiti wall space, a vibrant community and tourist destination has emerged from the ashes of this formerly run-down and underutilized area. (Postkult e.V., 2015) From the outset, the *FreiRaumGalerie* project sought to address two concerns. First, it was recognized that Freiimfelde was suffering from abandoned buildings and a high vacancy rate, which was reportedly greater than 60 percent in 2011. Second, due to a lively local graffiti scene, local authorities were facing an increasing number of complaints from residents regarding unauthorized graffiti within the city. In order to address both concerns at once, the *FreiRaumGalerie* project thought to transform this once "forgotten district into an urban canvas." (Postkult e.V., 2015) Towards this objective, the project team organized numerous events, such as its annual *All You Can Paint Festival*, which invited local and international artists, local residents, and especially young people, to help revitalize Freiimfelde. Thanks to the *FreiRaumGalerie* project's efforts, the quarter of Freiimfelde experienced a rapid population growth of 24 percent, or 550 residents, between 2011 and 2014, as numerous vacant buildings were filled with creative types, students, and new families. (Postkult e.V., 2015b)

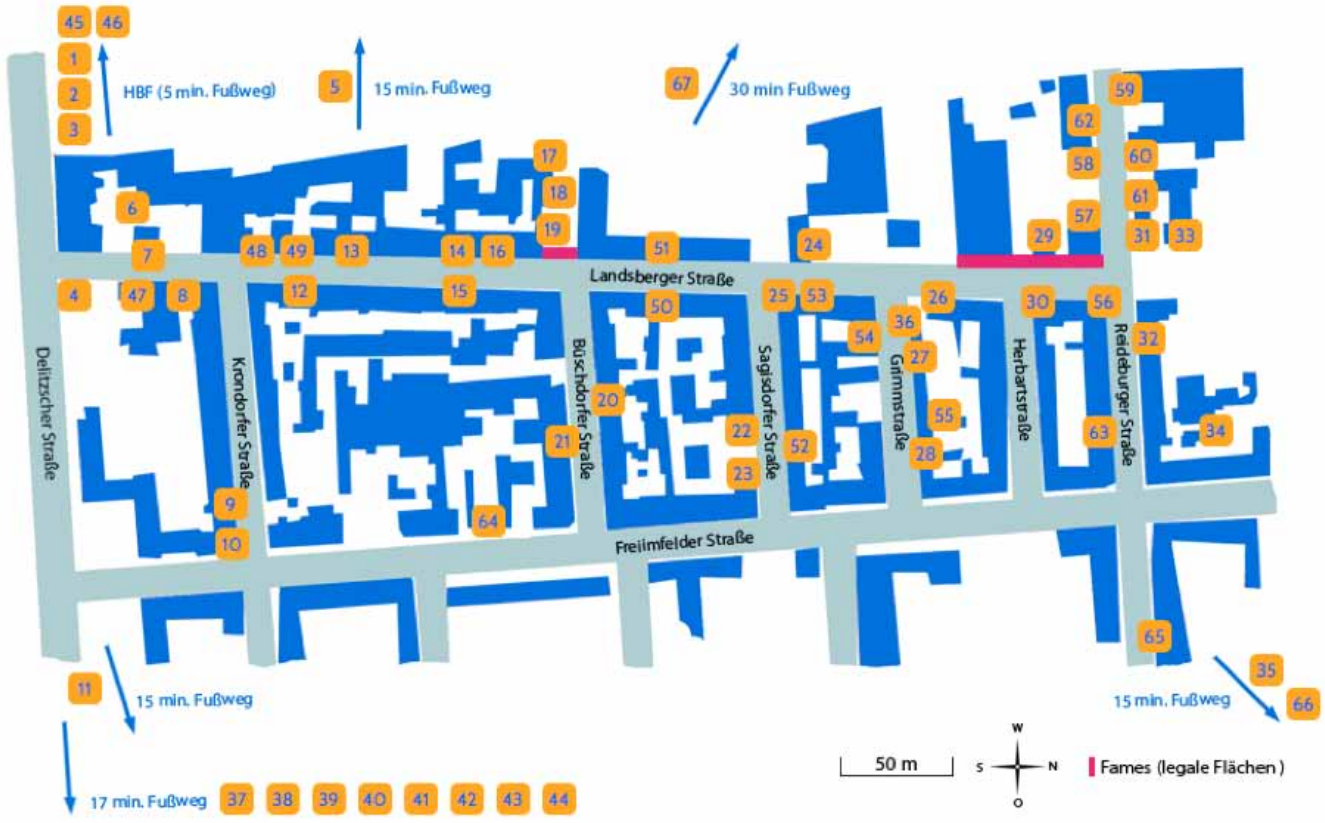

Fig. 31 - Map of FreiRaumGalerie murals and legal graffiti walls. Freiimfelde, Halle (Saale), Germany. (Postkult e.V., 2015c)

5. Conclusion

Within public areas, graffiti may be condemned and eradicated or promoted and enhanced. In either case, policy and management decisions are usually grounded in assumptions about the economic or social effects of graffiti. Often overlooked, however, are the latent environmental risks of different graffiti management tactics.

Beyond finding that zero-tolerance policies and reactive graffiti management efforts are ineffective at deterring undesirable graffiti in public areas, this article has revealed that many reactive graffiti management tactics also pose significant short- and long-term risks to human health and local ecosystems due to inefficient use of scarce resources and the release of hazardous substances into the environment.

Accordingly, in order to move towards more sustainable graffiti management solutions for public areas, local authorities must once and for all acknowledge graffiti are unlikely to be impeded by tireless reactive management tactics. Authorities should rather focus on proactive tactics, including environmental design (e.g. landscaping techniques and greenery) and public art programs (e.g. community murals, legal spaces for graffiti, art workshops) to manage graffiti in public areas, thus avoiding the need for reactive management efforts from the outset.

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NOTE: This article was financially supported by the 2018 funded topics initiative, specifically: Patron – Infraestruturas de Portugal - Responsible for the investment, management and maintenance of railway and road infrastructures in Portugal. infraestruturasdeportugal.pt

Topic - Mitigate problems of graffiti vandalism in public areas and transportation networks by focusing on technical (e.g. materials, coatings) and strategic (e.g. positive and smart prevention) solutions.