

Urban Traffic Calming and Active Transportation: Effects and Implications for Practice

June 2012

This summary is the fourth in a series of five¹ short documents based on a literature review published in 2011.² In what follows, we first present the mechanisms of action underlying traffic-calming strategies,³ as these mechanisms help explain and predict the effects of such strategies on active transportation (cycling, walking, etc.). Next, we summarize the results of studies having evaluated two approaches to traffic calming⁴ (please refer to the brief descriptions of black-spots and area-wide approaches below). Lastly, we consider the implications of such results for public health.

Two approaches to traffic calming

The black-spots approach is typically aimed at improving road safety. It encompasses strategies advocating the installation of calming measures (speed humps, roundabouts, etc.) at one or more specific locations considered to be at high risk for collision.

The area-wide approach, while it also often includes road-safety objectives, aims more generally to improve the living environment. It encompasses intervention strategies whose scope of application is a network comprising more than one street.

Mechanisms of action underlying traffic-calming strategies

Four mechanisms of action help to explain and predict the effects of traffic-calming strategies on the number of trips made using active modes of transportation (walking, cycling, etc.).

Improvement of perceived safety

Perceived danger from motorized traffic has been identified as a major deterrent to cycling (Pucher, Dill, & Handy, 2010; Pucher, Garrard, & Greaves, 2011; Reynolds, Harris, Teschke, Cripton, & Winters, 2009; Jacobsen, Racioppi, & Rutter, 2009; Pucher & Buehler, 2008). Concern about danger has a greater effect on children, the elderly and women, and thus contributes to health inequalities (Pucher et al., 2011; Jacobsen, 2003; Pucher & Buehler, 2008). The same concern also discourages people from walking (Jacobsen et al., 2009) and parents from letting their children walk or cycle to school (Direction de la santé publique, 2006).

Consequently, by helping improve road safety, traffic-calming strategies should help to promote active transportation among the general population, and in particular among children, women and the elderly.

Increase in the relative speed of active transportation

Reducing the gap between the speeds of motorized and active travel can make the latter more attractive.

Traffic-calming strategies can reduce this gap in three main ways:

- by slowing down traffic (Pucher et al., 2010);
- by giving cyclists and pedestrians priority by installing facilities such as bike boxes, by synchronizing traffic lights to match cycling speeds (creating “green waves”) (Rietveld & Daniel, 2004) or by programming traffic lights to include phases reserved exclusively for pedestrian or cyclist crossing; and

¹ The four other documents focus on road safety, air quality, environmental noise and inequalities.

² To consult the comprehensive version of the literature review, please see our document entitled *Urban Traffic Calming and Health: A Literature Review* at: http://www.ncchpp.ca/175/publications.ccnpps?id_article=686.

³ Our definition of “traffic calming” is presented in the introduction to our literature review, and its historical origins are detailed in our document entitled *Traffic Calming: An Equivocal Concept*, available at: http://www.ncchpp.ca/175/publications.ccnpps?id_article=648.

⁴ For a detailed description of the two approaches and the political contexts surrounding them, please see our document entitled *Traffic Calming: Political Dimensions*, available at: http://www.ncchpp.ca/175/publications.ccnpps?id_article=670.



- by providing coordinated networks of facilities designed for active transportation that reduce active travel distances and increase those of motorized through traffic (Bassett, Pucher, Buehler, Thompson, & Crouter, 2008; Pikora, Giles-Corti, Bull, Jamrozik, & Donovan, 2003; Pucher & Dijkstra, 2003).

Reduction of perceived noise and atmospheric nuisances

Air and noise pollution caused by traffic also deter people from walking or cycling by making active travel less pleasant (Jacobsen et al., 2009).

Consequently, traffic-calming strategies that succeed in reducing these irritants could encourage active travel.⁵

Beautification of surroundings

The aesthetics of a location is one of the factors that determine the number of pedestrians and cyclists who make use of it (Pikora et al., 2003).

Traffic-calming strategies that use high-quality materials and promote the greening of spaces recovered from motorized traffic can thus help increase the number of trips made using active means of travel (Transportation Demand Management Encyclopedia, 2010).

Results of evaluative studies

Study results are categorized into the two approaches described to highlight their respective effects.

EFFECTS OF THE BLACK-SPOTS APPROACH

Increase in active travel

One article reported an increase in the number of pedestrians using a calmed street and noted that a greater number of residents reported walking or cycling more and letting their children play outside, walk, and cycle more, after the interventions (Morrison, Thomson, & Petticrew, 2004).

⁵ For more on this subject, please refer to the second and third summaries in this series which focus, respectively, on air quality: http://www.ncchpp.ca/175/publications.ccnpps?id_article=751 and environmental noise: http://www.ncchpp.ca/175/publications.ccnpps?id_article=753.

Variable effects on perceived safety

Two studies indicate that the residents of calmed streets perceived an improvement in safety, for the various types of street users (drivers, cyclists and pedestrians), following interventions (Watkins, 2000; Morrison et al., 2004). However, one report states that cyclists feel less safe in the presence of calming measures that introduce road narrowings or horizontal deflections which force them closer to moving vehicles (Gibbard et al., 2004).

EFFECTS OF THE AREA-WIDE APPROACH

Variable effects on active travel

One article reports that the presence of calming measures close to home is associated with an increase in recreational cycling (Kamphuis et al., 2008). It also indicates that this increase tends to be greater given the presence of bike lanes or cycle tracks, which can function as calming measures when they decrease the width of lanes devoted to motorized traffic (Macbeth, 1998). Another study demonstrates that the presence of calming measures close to home is associated with an increase in distances walked to utilitarian destinations, but that it does not influence recreational walking (Forsyth, Hearst, Oakes, & Schmitz, 2008). A third article reports that the presence of calming measures in the immediate environment of children (5-6 years old) does not influence their travel behaviour (Carver, Timperio, & Crawford, 2008). It also reports that the presence of speed humps is associated with an increase in active travel among adolescent girls, but a decrease among adolescent boys; whereas the presence of lane narrowings is associated with neither an increase nor a decrease in active travel among either adolescent boys or girls. The article in question does not explain the variability of these results. Finally, one report examining an area-wide scheme recorded a slight decrease in foot travel and a slight increase in bus travel, following the scheme's implementation (Cloke et al., 1999).

Variable effects on physical activity

One article reports that the presence of calming measures in the immediate environment of children (5-6 years old) does not influence their level of physical activity (Carver et al., 2008). It also indicates that the presence of speed humps is associated with an increase in physical activity among adolescent boys after school hours, but a

decrease in physical activity among adolescent girls before school hours. Finally, it states that the presence of road narrowings is associated with a decrease in physical activity among adolescent boys on weekends, but has no observable effect on the activity of adolescent girls. The article in question does not explain the variability of these results. Another article demonstrated a positive association between the presence of calming measures near the home and distances walked for utilitarian purposes, but found no association with physical activity in general (Forsyth et al., 2008). These results could be explained by a decrease in physical activity other than utilitarian walking proportional to the increase in the latter activity, but the article in question does not draw conclusions about the matter.

Variable effects on perceived safety

Two reports state that residents of calmed areas perceive calmed streets as safer for pedestrians (Hemsing & Forbes, 2000; Cloke et al., 1999). One of these also reports that children were thought to be safer on calmed streets (Cloke et al., 1999), whereas the other report indicates that cyclists felt less safe in the presence of calming measures that deflect vehicles horizontally (Hemsing & Forbes, 2000).

Implications for practice

Traffic-calming interventions are mainly promoted as a way of reducing the number of collisions, injuries and deaths; however, they are also frequently considered for inclusion in strategies aimed at encouraging active travel. While the evaluative studies consulted demonstrate that traffic calming effectively improves road safety for the various users of public roadways, the small number of studies, their variable quality and their divergent results do not demonstrate conclusively whether or not traffic-calming strategies lead to an increase in active travel.⁶

This said, it is worth noting that the studies having evaluated the **black-spots approach** indicate that an intervention targeting a single street can be accompanied by an increase in active travel (Morrison et al., 2004) and an improvement in perceived safety among users of the public street network (pedestrians, cyclists, drivers, etc.) (Watkins, 2000; Morrison et al., 2004). However, when calming measures resulting in road narrowing (e.g., chokers, curb extensions, etc.) or horizontal deflection of vehicles (e.g., chicanes) are used, it is important to pay particular attention to the needs of cyclists who can feel less safe in the presence of such calming measures (Gibbard et al., 2004). Figure 1 illustrates one way of adapting a road narrowing to accommodate cyclists.

The installation of individual traffic-calming measures that take into account the needs of various types of street users (pedestrians, cyclists, parents, drivers, etc.) can potentially **increase their feelings of safety** (Watkins, 2000; Morrison et al., 2004).

⁶ There are several possible explanations for the variable results tied this subject. In our literature review (Bellefleur & Gagnon, 2011, p. 71), we detail some of these reasons, having to do with threshold and synergy effects and with temporality.



Figure 1 Two road narrowings configured differently

The choker on the left forces cyclists to come closer to moving vehicles, but the one on the right does not.

Sources: On the left, www.pedbikeimages.org.

Photographer: Dan Burden. On the right, www.cyclestreets.net. Photographer: unknown.

As regards the studies having evaluated interventions based on the area-wide approach, it is worth noting that bike lanes or cycle tracks have considerable potential for encouraging cycling, in particular when they are part of an area-wide scheme (Kamphuis et al., 2008). Indeed, bike lanes or cycle tracks can be used to create or complete an interconnected cycling network, while at the same time calming traffic on streets where the installation of such facilities eliminates or narrows lanes devoted to motor vehicles (Macbeth, 1998). Moreover, because bike lanes or cycle tracks can narrow traffic lanes without forcing cyclists closer to moving vehicles, their use, combined with other calming measures adapted to active travel should help increase levels of perceived safety among the various types of street users (children, pedestrians, cyclists, etc.) on streets calmed in this way (Hemsing & Forbes, 2000; Cloke et al., 1999).

The use of **bike lanes or cycle tracks** that narrow the width of traffic lanes, within the context of area-wide calming schemes, holds promise as a way of calming traffic and promoting cycling, along with other forms of active travel (Macbeth, 1998; Kamphuis et al., 2008).

For public health actors who consider it relevant to promote traffic-calming strategies within their territory, area-wide strategies seem better adapted than targeted interventions to influencing active travel volumes, despite the variable results of evaluations.

In practice, active transportation requires coordinated and interconnected networks on which it is possible and pleasant to travel quickly and safely to multiple destinations (Pucher & Buehler, 2008; Lee & Moudon, 2008). Except in cases where a network already exists that, overall, would be suitable for active transportation and where isolated interventions could add missing connections or improve problem spots, it therefore seems unlikely, *a priori*, that isolated interventions could have as great an effect on the volume of active travel as area-wide strategies, which intervene systematically throughout a street network. Moreover, a literature review based on 14 case studies reveals that area-wide calming strategies are usually integral to the array of policies that encourage cycling which are implemented in cities that have succeeded in increasing the modal share of active and public transportation and in decreasing that of cars (Pucher et al., 2010).

Given that it leads to interventions throughout an area's street network, **the area-wide approach seems a priori better adapted than the black-spots approach** to the promotion of active travel because such travel requires coordinated and interconnected networks on which it is possible and pleasant to travel quickly and safely to multiple destinations (Pucher & Buehler, 2008; Lee & Moudon, 2008).

Because traffic calming can increase feelings of safety among public street users, it is likely that calming strategies can be used to reduce certain **health inequalities**. In fact, since women, children and the elderly are more likely than men to use motorized transportation or to limit their travel when they perceive the surroundings through which they are travelling as dangerous, traffic-calming interventions designed to meet the needs of active travellers seem to have the potential to create more incentive for these persons to walk or cycle (Pucher et al., 2011; Jacobsen, 2003; Pucher & Buehler, 2008). Moreover, it has been shown that areas occupied by persons with low socio-economic status usually have higher rates of personal injury collisions (Canadian Institute for Health Information [CIHI], 2008) and that these areas are perceived by their residents as being more polluted and noisier than more affluent areas (CIHI, 2011). Targeting these areas for the installation of area-wide calming strategies can thus, under certain conditions, help reduce inequalities and, in so doing, encourage active travel for utilitarian purposes among residents with access to a motorized alternative and active travel for recreational purposes for everyone.

However, it is important to be careful that traffic diversions caused by calming strategies and the configuration of certain calming measures do not, conversely, accentuate health inequalities. In fact, area-wide strategies often aim to redirect some of the traffic on local residential streets toward the arterial network, where persons of low socio-economic status tend to be overrepresented (Smargiassi, Berrada, Fortier, & Kosatsky, 2006). To avoid making active travel still more difficult and dangerous in these areas, it could be advantageous to integrate plans for streets belonging to the arterial network into area-wide calming strategies, ensuring speed limits are respected on these streets, installing attractive facilities for the various forms of active travel (e.g., cycle tracks, curb extensions, etc.) or, when possible, channelling traffic toward roads set apart from homes and away from areas where there are, or could be, a lot of pedestrians and cyclists. Two articles indicate, moreover, that it is indeed possible to calm areas without increasing, and even while decreasing, the risk of collision for the various users of adjacent streets and arteries (Elvik, 2001; Grundy, Steinbach, Edwards, Wilkinson, & Green,

2008).⁷ In addition, since some traffic-calming configurations (e.g., certain horizontal deflections, some roundabouts,⁸ etc.) can prove problematic for public street users, such as cyclists and visually-impaired pedestrians (Bahar, Smahel, & Smiley, 2009; Litman, 1999; Gibbard et al., 2004), it is important to promote configurations that are adapted to the needs of these users, when one of the aims of an intervention is to encourage active travel.

Traffic calming seems able to either reduce or accentuate certain **health inequalities** tied to the adoption of active modes of travel and to their effects. The choice of intervention sites and the planning of calming strategies, including location of calming measures, types of measures and how they are configured, should thus take into account the potential effects on health inequalities.

Although the mechanisms of action identified support the intervention logic, some interventions have produced interesting results, and traffic calming, particularly the area-wide approach, is usually integral to the policies of cities that have succeeded in increasing the modal share of public and active transportation and in decreasing that of cars (Pucher et al., 2010), it remains the case that the evaluative studies consulted fail to provide conclusive evidence of whether or not such strategies promote active travel.

In general, the decision to promote such a strategy should be based on a **global perspective** that also takes into consideration its effects on other health determinants. The literature review we carried out demonstrates that, in general, the interventions evaluated: (1) substantially reduced the number and severity of collisions; (2) increased per vehicle air pollutant emissions, although area-wide strategies that reduce traffic volume can reduce total emissions; and (3) were, in some cases, accompanied by an increase in active travel, although it was not possible to determine why this increase was not observed in other cases (Bellefleury & Gagnon, 2011). In urban environments, the mechanisms of action point toward the conclusion

⁷ In reference to this, please consult the first summary in this series, *Urban Traffic Calming and Road Safety: Effects and Implications for Practice*, at: http://www.ncchpp.ca/175/publications.ccnpps?id_article=719.

⁸ In fact, we will be devoting an entire briefing note to roundabouts.

that better results can be expected from strategies based on the area-wide approach. However, excepting the effects on air pollutant emissions, the evaluative studies are inconclusive in this regard.

Bibliography

- Bahar, G., Smahel, T., & Smiley, A. (2009). *Study of the environmental, economic, safety & social benefits of roundabouts for Transport Canada*. Human Factors North Inc. and Navigats Inc.
- Bassett, D. R., Pucher, J., Buehler, R., Thompson, D. L., & Crouter, S. E. (2008). Walking, Cycling, and Obesity Rates in Europe, North America, and Australia. *Journal of Physical Activity and Health*, 5(6), 795-814.
- Bellefleur, O. & Gagnon, F. (2011). *Urban Traffic Calming and Health: A Literature Review*. Montréal: National Collaborating Centre for Healthy Public Policy. Retrieved from: http://www.ncchpp.ca/175/publications.cnpps?id_article=686.
- Canadian Institute for Health Information. (2008). *Reducing Gaps in Health: A Focus on Socio-Economic Status in Urban Canada*. Ottawa: CIHI. Retrieved from: https://secure.cihi.ca/free_products/Reducing_Gaps_in_Health_Report_EN_081009.pdf.
- Canadian Institute for Health Information. (2011). *Urban Physical Environments and Health Inequalities*. Ottawa: CIHI. Retrieved from: https://secure.cihi.ca/free_products/cphi_urban_physical_environments_en.pdf.
- Carver, A., Timperio, A. F., & Crawford, D. A. (2008). Neighborhood Road Environments and Physical Activity Among Youth: The CLAN Study. *Journal of Urban Health*, 85(4), 532-544. doi: 10.1007/s11524-008-9284-9.
- Cloke, J., Webster, D., Boulter, P., Harris, G., Stait, R., Abbott, P., & Chinn, L. (1999). *Traffic Calming: Environmental assessment of the Leigh Park Area Safety Scheme in Havant* (Report No. TRL 397). Crowthorne, Berkshire: Transport Research Laboratory.
- Direction de la santé publique. (2006). *Le transport urbain, une question de santé. Rapport annuel 2006 sur la santé de la population montréalaise*. Montréal: Direction de la santé publique. Retrieved from: http://publications.santemontreal.qc.ca/uploads/tx_asssmpublications/2-89494-491-8.pdf.
- Elvik, R. (2001). Area-wide urban traffic calming schemes: a meta-analysis of safety effects. *Accident Analysis & Prevention*, 33, 327-336.
- Forsyth, A., Hearst, M., Oakes, J. M., & Schmitz, K. H. (2008). Design and Destinations: Factors Influencing Walking and Total Physical Activity. *Urban Studies*, 45, 1973-1996. doi: 10.1177/0042098008093386.
- Gibbard, A., Reid, S., Mitchell, J., Lawton, B., Brown, E., & Harper, H. (2004). *The effect of road narrowings on cyclists* (Report No. TRL 621). Crowthorne, Berkshire: Transport Research Laboratory. Retrieved from: http://www.transport-research.info/Upload/Documents/200607/20060728_163846_65628_UG171_Final_Report.pdf.
- Grundy, C., Steinbach, R., Edwards, P., Wilkinson, P., & Green, J. (2008). *The Effect of 20 mph zones on Inequalities in Road Casualties in London: A report to the London Road Safety Unit*. London: London School of Hygiene and Tropical Medicine. Retrieved from: <http://www.tfl.gov.uk/assets/downloads/the-effect-of-20-mph-zones-on-inequalities-in-road-casualties-in-london.pdf>.
- Hemsing, S. & Forbes, G. (2000). *Ottawa-Carleton Traffic Calming Evaluation Study* (Report No. 99041). Synectics.
- Jacobsen, P. L. (2003). Safety in numbers: more walkers and bicyclists, safer walking and bicycling. *Injury Prevention*, 9, 205-209. doi: 10.1136/ip.9.3.205.
- Jacobsen, P. L., Racioppi, F., & Rutter, H. (2009). Who owns the roads? How motorised traffic discourages walking and bicycling. *Injury Prevention*, 15(6), 369-373. doi: 10.1136/ip.2009.022566.

- Kamphuis, C. B. M., Giskes, K., Kavanagh, A. M., Thornton, L. E., Thomas, L. R., van Lenthe, F. J., ... Turrel, G. (2008). Area variation in recreational cycling in Melbourne: a compositional or contextual effect? *Journal of Epidemiology and Community Health*, *62*, 890-898. doi: 10.1136/jech.2007.067116.
- Lee, C. & Moudon, A. V. (2008). Neighbourhood design and physical activity. *Building Research and Information*, *36*(5), 395-411. doi: 10.1080/09613210802045547.
- Litman, T. (1999). *Traffic Calming: Benefits, Costs and Equity Impacts*. Victoria: Victoria Transport Policy Institute. Retrieved from: <http://www.vtpi.org/calming.pdf>.
- Macbeth, A. (1998). *Calming Arterials in Toronto*. Conference proceedings. "68th Annual Meeting of the Institute of Transportation Engineers". Toronto, Ontario, August 9-12, 1998. [PDF document]. Retrieved from: <http://www.ite.org/traffic/documents/AHA98C19.pdf>.
- Morrison, D. S., Thomson, H., & Petticrew, M. (2004). Evaluation of the health effects of a neighbourhood traffic calming scheme. *Journal of Epidemiology and Community Health*, *58*, 837-840. doi: 10.1136/jech.2003.017509.
- Pikora, T., Giles-Corti, B., Bull, F., Jamrozik, K., & Donovan, R. (2003). Developing a framework for assessment of the environmental determinants of walking and cycling. *Social Science & Medicine*, *56*(8), 1693-1703. doi: 10.1016/S0277-9536(02)00163-6.
- Pucher, J. & Buehler, R. (2008). Making Cycling Irresistible: Lessons from The Netherlands, Denmark and Germany. *Transport Reviews*, *28*(4), 495-528. doi: 10.1080/01441640701806612.
- Pucher, J. & Dijkstra, L. (2003). Promoting Safe Walking and Cycling to Improve Public Health: Lessons From The Netherlands and Germany. *American Journal of Public Health*, *93*(9), 1509-1516.
- Pucher, J., Dill, J., & Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: An international review. *Preventive Medicine*, *50*(Supplement 1), S106-S125. doi: 10.1016/j.ypmed.2009.07.028.
- Pucher, J., Garrard, J., & Greaves, S. (2011). Cycling Down Under: A Comparative Analysis of Bicycling Trends and Policies in Sydney and Melbourne. *Journal of Transport Geography*, *19*(2), 332-345. doi: 10.1016/j.jtrangeo.2010.02.007.
- Reynolds, C., Harris, M., Teschke, K., Crompton, P., & Winters, M. (2009). The impact of transportation infrastructure on bicycling injuries and crashes: a review of the literature. *Environmental Health*, *8*(1), 47. doi: 10.1186/1476-069X-8-47.
- Rietveld, P. & Daniel, V. (2004). Determinants of bicycle use: do municipal policies matter? *Transportation Research Part A: Policy and Practice*, *38*(7), 531-550. doi: 10.1016/j.tra.2004.05.003.
- Smargiassi, A., Berrada, K., Fortier, I., & Kosatsky, T. (2006). Traffic intensity, dwelling value, and hospital admissions for respiratory disease among the elderly in Montreal (Canada): a case-control analysis. *Journal of Epidemiology and Community Health*, *60*(6), 507-512. doi: 10.1136/jech.2005.037044.
- Transportation Demand Management Encyclopedia. (2010). *Health and Fitness: Strategies That Improve Public Health Through Physical Activity*. Victoria: Victoria Transport Policy Institute. Consulted on July 8, 2010: <http://www.vtpi.org/tm/tm102.htm>.
- Watkins, K. F. (2000). *Cambridge's Traffic Calming Program: Pedestrians are the Focus*. Conference proceedings. "ITE 2000 Annual Meeting and Exhibit" Nashville, Tennessee August 6-8, 2000. [PDF document]. Retrieved from: <http://www.ite.org/traffic/documents/AB00H3702.pdf>.

June 2012

Author: Olivier Bellefleur, National Collaborating Centre for Healthy Public Policy

The National Collaborating Centre for Healthy Public Policy (NCCHPP) seeks to increase the expertise of public health actors across Canada in healthy public policy through the development, sharing and use of knowledge. The NCCHPP is one of six centres financed by the Public Health Agency of Canada. The six centres form a network across Canada, each hosted by a different institution and each focusing on a specific topic linked to public health. In addition to the Centres' individual contributions, the network of Collaborating Centres provides focal points for the exchange and common production of knowledge relating to these topics. The National Collaborating Centre for Healthy Public Policy is hosted by the Institut national de santé publique du Québec (INSPQ), a leading centre in public health in Canada.

Production of this document has been made possible through a financial contribution from the Public Health Agency of Canada through funding for the National Collaborating Centre for Healthy Public Policy (NCCHPP). The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada.

All Images in this document have been reproduced with permission or in accordance with licences authorizing their reproduction. Should you discover any errors or omissions, please advise us at ncchpp@inspq.qc.ca.

Publication N°: 1498

This document is available in its entirety in electronic format (PDF) on the Institut national de santé publique du Québec website at: www.inspq.qc.ca/english and on the National Collaborating Centre for Healthy Public Policy website at: www.ncchpp.ca.

La version française est disponible sur les sites Web du Centre de collaboration nationale sur les politiques publiques et la santé (CCNPPS) au www.ccnpps.ca et de l'Institut national de santé publique du Québec au www.inspq.qc.ca.

Reproductions for private study or research purposes are authorized by virtue of Article 29 of the Copyright Act. Any other use must be authorized by the Government of Québec, which holds the exclusive intellectual property rights for this document. Authorization may be obtained by submitting a request to the central clearing house of the Service de la gestion des droits d'auteur of Les Publications du Québec, using the online form at <http://www.droitauteur.gouv.qc.ca/en/autorisation.php> or by sending an e-mail to droit.auteur@cspq.gouv.qc.ca.

Information contained in the document may be cited provided that the source is mentioned.

LEGAL DEPOSIT – 3rd QUARTER 2012
BIBLIOTHÈQUE ET ARCHIVES NATIONALES DU QUÉBEC
LIBRARY AND ARCHIVES CANADA
ISBN: 978-2-550-65441-4 (FRENCH PRINTED VERSION)
ISBN: 978-2-550-65442-1 (FRENCH PDF)
ISBN: 978-2-550-65443-8 (PRINTED VERSION)
ISBN: 978-2-550-65444-5 (PDF)

© Gouvernement du Québec (2012)

