SPATIAL DATA QUALITY: THE DUTY TO WARN USERS OF RISKS ASSOCIATED WITH USING SPATIAL DATA

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This article discusses whether and when a private provider of spatial data may be liable to pay for damages resulting from physical injury that occurs due to reliance on erroneous spatial data. The existing case law supports the view that some courts will approach harm due to errors in spatial datasets that give rise to physical harm using principles applicable to defective products, while others regard these errors as negligent misrepresentation. This article analyzes the duty to warn and spatial data in two parts. First, it provides an overview of the general problem of spatial data quality and its growing importance in light of internet dissemination to the public. Second, it sketches out the basic rules in the three main subdivisions of Canadian product liability law (manufacturing defects, design defects, and failures to warn of risks associated with products) and applies them to the context of broadly disseminated spatial data.

Cet article examine si et à quel moment un fournisseur privé de données spatiales peut être tenu responsable de payer des dommages-intérêts résultants de dommages physiques qui se sont produits en raison de la fiabilité à des données spatiales erronées. La jurisprudence va dans le sens où certains tribunaux estiment que le préjudice causé par une erreur dans le cas d'un ensemble de données spatiales causant un préjudice physique selon les principes applicables aux produits défectueux, alors que d'autres estiment que ces erreurs relèvent du ressort de la négligence. Cet article analyse l'obligation de mise en garde et les données spatiales en deux parties. Premièrement, l'article donne un aperçu du problème général de la qualité des données spatiales et de son importance grandissante, compte tenu de la dissémination d'Internet au public. Deuxièmement, il brosse les règles fondamentales des trois sous-divisions du droit de la responsabilité du fait des produits (défauts de fabrication, défauts de conception et le défaut de l'obligation de mise en garde de risques associés à un produit) et les applique au contexte de la vaste dissémination des données spatiales.

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I. INTRODUCTION

Researchers in geographic information sciences have noted a recent shift toward the "democratization" of both the production and use of geographic, or spatial, data and the use of sophisticated geographic information systems (GIS).[1] In the past, the producers and users of spatial data and GIS have tended to be experts, familiar with the strengths and weaknesses of databases of spatial information and of the associated software that together make up GIS. Notwithstanding this expertise, it is noteworthy that accidents flowing from the reliance of such experts on uncertain data have occurred.[2]

The digitization of spatial data has led to concerns that data in this form could be transferred and modified in a way that would make it difficult to trace or assess its origins, currency, and quality. These concerns have generated a lively body of research in the geographic information sciences on the problem of uncertainty in spatial data, how to measure and predict the impact of that uncertainty on subsequent decisions based on that data, and on how to reduce the risks associated with the use of uncertain data.[3] Among the attempts to address these problems has been the promulgation of national and international standards setting out the elements of spatial data quality and the manner in which it should be documented in "metadata" so that users may assess the data's fitness for their purposes.[4]

With the rise of computing power, digital storage capacity, and rapid communication via the internet, these concerns have become heightened by the increasing participation of non-expert users. While many members of the public may use spatial data for purposes that are not particularly sensitive to errors in the data, so that the consequences of such errors may be trivial, there is certainly scope for harm where users place too much reliance on data that is not fit for their purposes. The explosion of interesting, entertaining, and often useful applications available on Google Maps illustrates this point. It is unlikely, for example, that harm would result from inaccuracies (if any) in "Dig a Hole Through the Earth: Find out

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1 The term "spatial data," often used as a synonym of "geographic data," is used in this article to refer to the digital encoding of information related to space, such as maps.

2 Alex D Keuper, *The Influence of Uncertainty Metadata on Decision-Making Using Geographic Data Products* (PhD Thesis, University of California, Santa Barbara, 2004) at 1-2, online: University of California, Santa Barbara <http://www.geog.ucsb.edu/graduates/phd-dissertions/pdf/keuper_Alex_Dissertation_2004.pdf>. Keuper cites the accidental severing of an Italian gondola cable by American military pilots during a training mission in 1998. The Americans' maps did not include the cables although the maps used by the Italians did. Keuper also refers to an out-of-date map that contributed to the NATO bombing of the Chinese embassy in Belgrade in 1999.

3 The concepts of error, uncertainty, and data quality are complex in the information sciences. In this article, the term uncertainty refers to our lack of knowledge about the actual level of error in spatial data, while error refers to the discrepancy between the spatial data and the real world attribute that it describes. The actual level of error is often unknown (if it were known, then the correct data would necessarily be known), so attempts are made to measure and communicate uncertainty about a value. For example, the statement that an object is located at a particular position plus or minus ten metres is meant to indicate that there is a high chance that the actual object is located within that 20 metre range. Data quality is sometimes used as a synonym for uncertainty, although this terminology can lead to confusion between the related but different concepts of error and uncertainty. In addition, and as discussed below, data quality is not just a function of error in the data, but also is a function of its fitness for particular uses. As a result, uncertain data may thus be of adequate quality for some uses but not for others.

4 For example, the International Organization for Standardization (ISO) has released several relevant standards: ISO, *Geographic Information — Quality Principles*, ISO 19113:2002(E) (Geneva: International Organization for Standardization, 2002); ISO, *Geographic Information — Quality Evaluation Procedures*, ISO 19114:2003(E) (Geneva: International Organization for Standardization, 2003); ISO *Geographic Information — Metadata*, ISO 19115:2003(E) (Geneva: International Organization for Standardization, 2003).

where you would come out if you dug a hole straight through the center of the Earth,"[5] while harm may well result from errors in hiking maps. Indeed, a Canadian case involving inaccurate directions given to skiers in Banff culminated in a death and a lawsuit.[6]

Legal problems are most likely to arise where geographical information is used to make economically significant decisions or decisions that have a possibility of resulting in physical damage to people or property. An example of the former might be data used in deciding where to place buildings or businesses, and an example of the latter might be navigational data or data describing the locations of emergency services. A further legal difficulty, which will not be discussed further here, is the possibility that geographical data might give rise to claims in invasion of privacy.[7]

The intent of this article is to consider whether and when a private provider of spatial data may be liable to pay for damages resulting from physical injury that occurs due to reliance on erroneous spatial data. The main focus is the increasing access by the lay public to spatial datasets on the internet, and the extent of the duty to warn such users about the risks posed by uncertainty in that data. Several important limitations on the scope of the discussion are the following:

- The rules discussed are those of the common law jurisdictions of Canada, and the law in other jurisdictions may differ.[8]

- The rules applicable to compensation for pure economic loss (that is to say, financial losses that do not flow from physical injury to person or property – such as financial losses incurred when an investor relies on erroneous spatial data in choosing a property to purchase) are not addressed in this article. These rules are different from the rules applicable to compensation for physical damage.

- The discussion focuses on problems in the quality of spatial data, rather than on problems with the software in a GIS. Defective software is also a potential source of liability.

- The role of contracts or licences in limiting or controlling liability will not be covered in detail. While it is true that, in some cases, providers may attempt to limit their liability using contracts, this will not always be possible. Consumer protection

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5 This application may be found online: Google Maps <http://maps.google.com/ig/add?pid=mpl&synd=mpl&moduleurl=http://mapgadgets.googlepages.com/digahole.xml&utm_campaign=en&utm_source=en-ha-na-us-google-mp&utm_medium=ha>.

6 *Rudko v R*, [1984] 1 WWR 741 (FCTD).

7 An example of a dispute over an alleged invasion of privacy related to geographic information products is the unsuccessful claim in *Boring v Google, Inc*, 598 F Supp 2d 695 (Dist Ct 2009) that Google Streetview invaded the privacy of the plaintiffs.

8 Marc Gervais has conducted extensive analysis of the application of the principles of the Quebec civil law in this context. See Marc Gervais, *Pertinence d'un manuel d'instructions au sein d'une stratégie de gestion du risque juridique découlant de la fourniture de données géographiques numériques* (PhD Thesis, Faculté de Foresterie et de Géomatique, Université Laval, Québec et Université de Marne-La-Vallée, France, 2004), online: Théses en ligne <http://tel.archives-ouvertes.fr/tel-00008877/fr/>. Analyses from the perspective of American law can be found in Jennifer L Phillips, "Information Liability: The Possible Chilling Effect of Tort Claims Against Producers of Geographic Information Systems Data" (1999) 26:3 Fla St UL Rev 743; Jeremy Speich, "The Legal Implications of Geographical Information Systems (GIS)" (2001) 11:2 Alb LJ Sci & Tech 359.

legislation may limit the enforceability of attempts to disclaim liability.[9] Furthermore, contractual limitations of liability apply only to damages suffered by the contracting party, and not to third parties (for example, passersby or passengers) who are injured due to inadequacies in the spatial data. The law assigns duties to both producers and users of products to take reasonable steps to avoid foreseeable harm to these third parties.

- This article focuses on the potential liability of private providers rather than governmental providers of geographic information, and the reader should be aware that the legal approach may differ in the two contexts.[10]

The existing legal precedents outlining the scope of common law liability for inaccurate spatial data are sparse. In addition, they mostly predate the recent moves toward the digitization and broader dissemination of spatial data on the internet. They are accordingly a thin foundation upon which to base any conclusions about the legal obligations of providers of spatial data. Another limit on the usefulness of general conclusions is that the actual legal obligations may vary according to context (for example, type of data, identity of provider, method of dissemination, types of users, etc.). However, it is possible to offer some suggestions about how Canadian product liability law ought to apply to errors in spatial data in this new context of digitization and internet dissemination.

The existing case law supports the view that some courts will approach harm due to errors in spatial datasets that give rise to physical harm using principles applicable to defective products, while others regard these errors as negligent misrepresentations. These cases tend to involve forms of spatial data products whose main purpose is quite clear, such as aeronautical charts, shipping charts, and fire hydrant maps for emergency services. Where the main purpose is clear, the harm resulting from errors is reasonably foreseeable, and the courts are able to reach some judgment about the standard of care to be expected in the production of the data. Presumably, this approach would also apply where data whose main purpose is fairly clear is made freely available via the internet. In other words, a shipping chart made available via the internet would likely be expected to meet the standard of quality applicable to shipping charts disseminated in other ways. In these cases, negligence liability for errors in the data may be found if there has been unreasonable carelessness in the production of the data, as well as in the inspection and verification of the data.

However, in other cases where providers make their spatial data widely available (including via the internet), additional issues arise. In these cases, providers have less knowledge and control of use. Further, the range of possible uses is likely to expand, some of which may be sensitive to error and some of which may not. If courts impose a standard of care appropriate for the most sensitive use that is possible, the risk of liability might chill the circulation of lower quality data that is actually quite useful for less sensitive uses. As a result, a preferable approach in these circumstances is to treat uncertainty in spatial datasets as an inherent risk associated with their use and to require that users be warned of this risk,

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9 See e.g. *Consumer Protection Act, 2002*, SO 2002, c 30, Schedule A.

10 For an overview of the general principles of government liability in tort, see Allen M Linden & Bruce Feldthusen, *Canadian Tort Law*, 8th ed (Markham: LexisNexis Canada, 2006) at 673.

pursuant to established rules of product liability. Care should be taken with this approach, however, as courts may feel that if one of the reasonably foreseeable uses is a highly sensitive one, a reasonably high standard of care in the production and verification of the data is appropriate regardless of whether a warning has been supplied.

This article concludes that, at a minimum, providers of spatial data via the internet should: (1) include quality related metadata along with their spatial datasets; and (2) clearly warn users that spatial data contains errors, that errors in the spatial data may lead to errors in any decisions they make using that spatial data, that information about the margin of error associated with the spatial data is supplied, and that they should seek expert advice before making important decisions relying on the data. More specific warnings may be required if the provider knows or ought to know of specific and serious risks. The duty to warn is a "continuing obligation," and so providers will need to communicate to users regarding serious risks that come to light after the initial release of the data. It would thus be a good idea to provide for a mechanism for the delivery of these additional warnings. Providers should also monitor research on how best to convey information about spatial data quality to users. The standard method of putting quality related metadata in a separate file from the actual spatial data it describes does not appear to be particularly effective for many users, and a variety of alternatives such as visualization methods are being developed. These improved methods may come to be accepted by courts as an appropriate means of warning users about risks while less effective standard presentations of metadata may look increasingly inadequate by comparison. It is important to note that the courts do not regard compliance with industry custom or with industrial standards as conclusive proof of reasonable care. As a result, the fact that a provider offers metadata as required by the applicable standards will not settle the question of whether that is a legally adequate attempt to warn of limitations associated with the data. In rare cases, where risks cannot be effectively mitigated by redesign or a warning, a court may conclude that data ought not to be circulated broadly to the public at all. Instead, this data could be circulated through expert intermediaries or withheld altogether.

Providers should also note that systems that permit irrational operations on the data or that invite users to ascribe a greater degree of certainty to the data than is justified might be viewed as defective in design. For example, a system that delivers responses to far more decimal places than is justified by the base data seems defectively designed as it is misleading to users. In addition, the efforts in the GIS research community to develop controls or limits on risky operations that can be incorporated directly into GIS systems seem an important aspect of careful design where it is reasonably foreseeable that users may be at risk of overreliance on the data.

This article contains two sections. The first section outlines the general problem of spatial data quality and its growing importance in light of internet dissemination to the public. The second section sketches out the basic rules in the three main subdivisions of Canadian product liability law (manufacturing defects, design defects, and failures to warn of risks associated with products), and applies them to the context of broadly disseminated spatial data. The main focus of this discussion is the duty to warn, although the other subdivisions are also relevant and so are included.

II. THE PROBLEM OF SPATIAL DATA QUALITY

A. SPATIAL DATA QUALITY AND FITNESS FOR USE

Quality is a deceptively simple word for a complex attribute. First, spatial data are representations of the world that diverge from reality in various inescapable ways. For example, they necessarily abstract from reality by simplifying, grouping, or eliminating some elements.[11] As Helen Couclelis puts it:

> [V]agueness is the inescapable punishment for cutting up a mostly continuous, heterogeneous and dynamic world into discrete, homogeneous and static categories…. [N]o amount of additional or better data can resolve the uncertainty inherent in looking for boundaries (spatial as well as conceptual) where there are none.[12]

Second, geographical models may contain various distortions necessary to force the data into a particular representation (for example, such as when the spherical earth is modeled in a two-dimensional map).

Third, a model may be inaccurate because it is incomplete, out of date, places objects in the wrong locations, or misidentifies objects (for example, indicates a river as a swamp).[13] This third class of errors could, with the investment of time and money, be reduced.

Discussions of spatial data quality usually refer to two forms of data quality: internal and external. Internal quality refers to the degree of similarity between the actual spatial dataset and the ideal dataset that would have been produced if there had been no errors made. External quality is the degree to which the actual spatial data meets the needs or expectations of the user of the data, and corresponds to the idea of "fitness for use."[14] External quality thus depends upon the suitability of the dataset in terms of its content, accuracy, and cost for the particular use contemplated by the particular user.[15]

Errors in spatial data are not necessarily harmful. Some decisions are not particularly sensitive to errors in the spatial data on which they are based. Even where a decision is sensitive to errors in the spatial data, the consequences of an incorrect decision may be relatively small, particularly compared to the expense of improving the accuracy of the spatial data. Andrew Frank questions the "commonsense belief" that better quality data will

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11 Rodolphe Devillers & Robert Jeansoulin, "Spatial Data Quality: Concepts" in Rodolphe Devillers & Robert Jeansoulin, eds, *Fundamentals of Spatial Data Quality* (London: Iste, 2006) 31 at 31.

12 Helen Couclelis, "The Certainty of Uncertainty: GIS and the Limits of Geographic Knowledge" (2003) 7:2 Transactions in GIS 165 at 169 [footnote omitted].

13 The terminology usually used to describe these types of problems are completeness, currency, positional accuracy, and attribute accuracy.

14 Devillers & Jeansoulin, *supra* note 11 at 39; R Devillers et al, "Towards Spatial Data Quality Information Analysis Tools for Experts Assessing the Fitness for Use of Spatial Data" (2007) 21:3 International Journal of Geographical Information Science 261 at 264.

15 *Ibid*. See also Devillers & Jeansoulin, *supra* note 11 at 39, where Devillers and Jeansoulin usefully illustrate the difference between the two concepts with the example of a Ford and Rolls-Royce. They suggest that the internal quality of the Rolls-Royce would likely be better, while the product with the better external quality for the vast majority of price-sensitive users would be the Ford.

necessarily produce a better decision.[16] The quality of a decision may be much more sensitive to the quality of some other informational input than the spatial data, in which case it is likely a waste of resources to try to improve the spatial data quality.[17]

In the end, the critical question is not the quality of a given spatial dataset, but whether the quality of the spatial dataset is sufficient for the intended purpose. As Frank explains, "good" data quality means quality that is "'good' enough for this decision."[18] The "fitness for use" approach recognizes that a given product may be quite appropriate for one set of users and uses, but not for others.

"Fitness for use" is unfortunately not a simple matter to determine. Whether or not data is fit for use entails an assessment of the significance of the risks associated with the proposed use.[19] This risk analysis basically consists of identifying the uncertainties in the data, tracing the effects of those uncertainties on decisions made using the data, and identifying the likelihood and seriousness of the adverse consequences that would result from errors in those decisions.[20] This type of risk analysis has the potential to be a complex and expensive process, and some sophisticated decision-makers may make a rational and educated decision not to do a full risk analysis.[21] Where data is found to be unfit for a particular use, a user may nonetheless decide to use it while taking steps that render it fit for use (for example, by changing the way that the data is used, or by taking steps to reduce vulnerability to particular harmful outcomes).[22]

A key question with respect to fitness for use is who bears the responsibility for assessing it. Producers of GIS and spatial data have tended to assume that the evaluation of fitness for use is the user's responsibility.[23] This may be a sensible assumption where it is clear that a producer is dealing with a sophisticated user who proposes to make its own assessment of fitness for use. Even in such cases, however, a producer is most likely to have superior knowledge of the characteristics of its own data and may retain some responsibilities toward sophisticated users.

Producers of geographical data should be very careful in assuming that the user has the burden of ensuring fitness for use. In some jurisdictions, consumer protection legislation imposes quality related obligations on vendors that cannot be avoided by contract. For example, Ontario's *Consumer Protection Act, 2002* states that any attempt to contract out of statutory implied conditions and warranties applicable to goods and services provided to

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16 Andrew U Frank, "Analysis of Dependence of Decision Quality on Data Quality" (2008) 10:1 Journal of Geographical Systems 71 at 72.

17 *Ibid* at 84. Frank describes the example of designing a small bridge with sufficient clearance to avoid flooding during heavy rainfall. In his hypothetical model, the precise boundaries of the watershed are less important in determining runoff volume than other factors such as the runoff coefficient (degree to which water soaks into the ground rather than flowing over the land).

18 *Ibid* at 72.

19 Aggrey Agumya & Gary J Hunter, "Responding to the Consequences of Uncertainty in Geographical Data" (2002) 16:5 International Journal of Geographical Information Science 405 at 406.

20 *Ibid*.

21 PAJ van Oort & AK Bregt, "Do Users Ignore Spatial Data Quality? A Decision-Theoretic Perspective" (2005) 25:6 Risk Analysis 1599.

22 Agumya & Hunter, *supra* note 19 at 407-11.

23 Marc Gervais, "On the Importance of External Data Quality in Civil Law" in Devillers & Jeansoulin, *supra* note 11, 283 at 285.

consumers is void.[24] As a result, producers must take reasonable steps to ensure the fitness for use of the spatial data they provide to consumers.

Another reason why producers should not assume that the risks associated with data misuse lie solely with users is that vendors who provide products that are foreseeably unfit for the purchaser's use may be liable to third parties who are thereby harmed. In *Murphy v D & B Holdings Ltd*,[25] a vendor of tires that were unsuitable for use on a truck was partly liable for the ensuing crash. Although the vendor had warned the purchaser that the tires were unsuitable, it sold them knowing the purchaser would ignore the warning. In this case, it was important to the Court that the vendor actually knew of the intended misuse of the product.[26] This case illustrates that the assumption that a user is the sole party responsible for assessing fitness for use is incorrect.

B. THE EFFECT OF THE INTERNET

Geographic information has changed in important ways in the last several decades. Digitization and mass distribution via the internet have made spatial data easier to access, manipulate, and disseminate; this has also contributed to a growing population of inexperienced users.[27] This democratization of the production and consumption of spatial data raises new risks associated with the misuse of this information.[28] One heightened risk flows from the increased difficulty in tracking the lineage of the data, as it is "collected at different periods, by different organizations, using various acquisition technologies, standards, and specifications."[29] This makes the quality of the data murky, and so it raises the risk that it will be used for purposes for which it is unfit. Nathan Engler and Brent Hall laud the "many new and exciting Web-based applications" made possible by the internet, but they also ask "whether the era of global spatial data availability and use has come with at least as many pitfalls as opportunities."[30]

Three noteworthy features of the internet-enabled world of spatial data are, first, that many spatial datasets are now easily available online, greatly expanding access to geographical data. Second, many free tools can be found to manipulate data, to create maps using existing datasets (including "mash-ups" of different datasets), and to publish maps on the internet. Third, several of these tools enable users, alone or in collaboration, to create spatial data themselves. The following examples illustrate these features.

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24 *Supra* note 9, s 9(3).

25 (1979), 31 NSR (2d) 380 (SC (AD)) [*Murphy*].

26 *Ibid* at para 9: "The finding means not that a seller is liable for damages to third parties if the buyer disregards the seller's warning, but only that he may be so liable if he knows that the buyer will disregard his warning."

27 van Oort & Bregt, *supra* note 21 at 1599.

28 See e.g. the discussion in Yvan Bédard et al, "Towards Multidimensional User Manuals for Geospatial Datasets: Legal Issues, and their Considerations into the Design of a Technological Solution" in *Proceedings of the Third International Symposium on Spatial Data Quality (ISSDQ'04), Bruck an der Leitha, Autriche, 15-17 avril*, vol 28b (Bruck an der Leitha, Austria: International Symposium on Spatial Data Quality, 2004) 183; Devillers et al, *supra* note 14.

29 Devillers et al, *ibid* at 261.

30 Nathan J Engler & G Brent Hall, "The Internet, Spatial Data Globalization, and Data Use: The Case of Tibet" (2007) 23:5 The Information Society 345 at 347.

A huge number of spatial datasets are available online. Great Britain's national mapping agency, the Ordnance Survey, makes a range of data available through OS OpenData.[31] Other governments, including Canada[32] and the United States,[33] also make large quantities of geographical data available. Various non-governmental websites offer spatial datasets or offer collections of links to spatial datasets sourced elsewhere. An example is the Haiti Earthquake Data Portal, which hosts a wide range of freely available data on a university site.[34] The GIS Data Depot is a portal that links to spatial datasets organized by country.[35]

In addition to the increased accessibility of spatial data, novices can use new web applications to produce maps using available datasets and to create new spatial data. A variety of applications are available through Google, Bing, and Yahoo!, such as Google's Mapplets and Google Maps API.[36] In essence, these Google applications allow anyone to create and publicly distribute their own enriched maps by adding objects and information to the basic Google map of the world. It is also possible to collaborate with others to produce these enriched maps.[37]

Another example of what is available to the novice user is ArcGIS Online,[38] which is a free web-based service that allows anyone to make and share their own maps. Users are invited to choose a base map (street maps, topographic maps, satellite imagery, etc.) and to add layers of information to it. These layers can be sourced from ArcGIS, the web, or various online GIS servers, and search functions enable the user to find relevant information by keyword. ArcGIS Explorer Online[39] offers users a more powerful tool in which users may create the information that is included on the map rather than merely adding layers sourced elsewhere.

A wide range of other GIS-related resources are available free to the public on the internet. For example, GIS Lounge.com offers a page entitled "free map servers" that lists free GIS

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31 See generally Ordnance Survey, *OS OpenData, Mapping Data and Geographic Information from Ordnance Survey*, online: Ordnance Survey <http://www.ordnancesurvey.co.uk/oswebsite/products/os-opendata/opendata.html>.

32 Canadian Council on Geomatics, *GeoBase*, online: GeoBase <http://www.geobase.ca>; Natural Resources Canada, *GeoConnections*, online: GeoConnections <http://www.geoconnections.org>; Natural Resources Canada, *GeoConnections — Discovery Portal*, online: GeoConnections <http://geodiscover.cgdi.ca>.

33 US Geological Survey, *Geodata.gov*, online: Geodata.gov <http://gos2.geodata.gov/wps/portal/gos>.

34 Harvard University, *Haiti Earthquake Data Portal*, online: Harvard Center for Geographic Analysis <http://cegrp.cga.harvard.edu/haiti/>.

35 MindSites Group, *GeoCommunity: GISDataDepot*, online: GeoCommunity <http://data.geocomm.com/catalog>; Robert Hijmans, *DIVA-GIS*, online: DIVA-GIS <http://www.diva-gis.org/gData>.

36 See the applications available through Google: *Google Mapplets*, online: Google <http://code.google.com/apis/maps/documentation/mapplets>; *Google Maps API Family*, online: Google <http://code.google.com/apis/maps>.

37 Google Maps, *Collaborating with others*, online: Google <http://maps.google.com/support/bin/static.py?page=guide.cs&guide=21670&topic=21676&answer=144365>.

38 Environmental Systems Research Institute Inc (ESRI), *ArcGIS Online*, online: ArcGIS Online <http://www.arcgis.com>.

39 ESRI, *ArcGIS Explorer Online*, online: ArcGIS Online <http://explorer.arcgis.com>.

software for public use.[40] Tools to convert data from one form to another are widely available as well.[41]

While many have raised concerns about the quality of the spatial data produced collaboratively by members of the public, it is not clear that such collaborative knowledge production is necessarily of lower quality than that produced by experts. Albeit in a different context, a recent comparison of entries in Wikipedia and the Encyclopedia Britannica reported that Wikipedia did quite well, although the methodology used to reach this conclusion was disputed by Encyclopedia Britannica.[42] The wiki model exists for geographic data as well. OpenStreetMap and Wikimapia are examples of the public annotation of maps to enter the location of various features, and are subject to the same types of error correction processes as Wikipedia.[43]

C. CONCLUSION

In sum, spatial data will contain certain forms of error and distortion that are a necessary part of creating an abstract representation of the world. In addition, other types of error relating to currency, completeness, and the identification and positioning of objects may exist and may result in discrepancy between the ideal representation of the world and the actual dataset. These errors could be reduced with the investment of time and money.

Whether or not these errors are a problem is a function of the use to which the data will be put. This raises the question of who is to be responsible for ensuring "fitness for use." Where access to data is carefully controlled and the assignment of responsibility for ensuring fitness for use can be negotiated between sophisticated providers and users of data, this issue may be settled by contracts within bounds set by the law of contracts and any applicable legislation (such as consumer protection legislation). Providers may not, however, be able to avoid responsibility to third parties where data is provided to a user whom the provider knows will misuse it.

With the move to the broad dissemination of spatial datasets to the public including via the internet, the problem of ensuring fitness for use is complicated in several ways. First, the group of users is more heterogeneous and is very likely to include inexperienced users. Second, it may be more difficult to know the uses to which the spatial data will be put by this broad group of users. The responsibilities of providers under these circumstances is the subject of the next section of this article.

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40 Caitlin Dempsey, "Free Map Servers' *GIS Lounge* (1 July 2010), online: GIS Lounge <http://gislounge.com/free-map-servers>.

41 Caitlin Dempsey, "Free Spreadsheet Geocoding" *GIS Lounge* (1 May 2010), online: GIS Lounge <http://gislounge.com/free-spreadsheet-geocoding>; Leszek Pawlowicz, "Downloads" *Free Geography Tools: Exploring the World of Free Tools for GIS, GPS, Google Earth, Neogeography, and More*, online: Free Geography Tools <http://freegeographytools.com/downloads>.

42 Jim Giles, "Internet Encyclopaedias Go Head To Head" (2005) 438 Nature 900; George Johnson, "The Nitpicking of the Masses vs. the Authority of the Experts," *The New York Times* (3 January 2006), online: New York Times <http://www.nytimes.com/2006/01/03/science/03comm.html>.

43 OpenStreetMap, online: OpenStreetMap <www.openstreetmap.org>; see also Michael F Goodchild, "Commentary: Whither VGI?" (2008) 72 GeoJournal 239.

III. PRODUCT LIABILITY AND SPATIAL DATA

Product liability is a sub-field of tort law dealing with harms resulting from the defective manufacture, design, marketing, and sale of products. It is important to note that when something does go wrong due to a defective product, numerous other fields of the law may also be implicated — fields which cannot be addressed here for reasons of space. As Dean Edgell writes, "[a] single claim could conceivably embrace multiple issues of negligence, contract, government regulation, damages, insurance, and even conflict of laws issues."[44]

The products at issue in product liability include just about any type of good or chattel.[45] This raises an initial question as to whether spatial data, and indeed any product essentially consisting of information, should be considered a good, a service, or something else, such as a representation of fact (such as information).[46] This may matter in determining the applicable body of legal rules. For example, the courts appear to have carved out exceptional rules for certain informational products, like books.[47] The categorization is unclear and has caused some uncertainty in the area of software, for example.[48] Relevant considerations in deciding this question for software have been whether any hardware is included, whether the software is a mass-marketed product or a custom product, whether services such as training are included, and the basis upon which payment is made (time and materials or fixed price).[49]

The categorization of spatial data products as goods, services, or information matters to the extent that the legal rules applicable to those categories differ. There are differences in the statutorily implied contractual warranties applicable to these categories,[50] but our focus here is on tort principles rather than contractual principles. Canadian tort law applies similar negligence principles to the careless provision of goods, services and information that results in physical injury.[51] There is Canadian precedent for treating errors in spatial data products as a form of defective information, addressed under the rubric of negligent misrepresentation,[52] as well as for approaching such errors using the language of product

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44 Dean F Edgell, *Product Liability Law in Canada* (Markham: Butterworths, 2000) at 3.

45 *Ibid* at 2.

46 See e.g. Lars Noah, "Authors, Publishers, and Products Liability: Remedies for Defective Information in Books" (1998) 77:4 Or L Rev 1195, noting that in the few cases available, the courts have tended not to treat books as products subject to strict product liability rules of the United States, and arguing that this is incorrect.

47 See e.g. Noah, *ibid*; Brett Lee Myers, "Read at Your Own Risk: Publisher Liability for Defective How-To Books" (1992) 45:3 Ark L Rev 699.

48 George S Takach, *Computer Law*, 2d ed (Toronto: Irwin Law, 2003) at 471-72.

49 *Ibid*.

50 See e.g. the legislation in Ontario: *Consumer Protection Act*, 2002, *supra* note 9; *Sale of Goods Act*, RSO 1990, c S.1.

51 More divergence exists in the rules that apply to the negligent supply of goods, services, or misrepresentations causing pure economic loss (i.e., financial loss that does not flow from physical damage), but here we are addressing only physical injuries.

52 *Warwick Shipping Ltd v R* (1980), [1982] 2 FC 147 [*Warwick*]. Although the Crown was ultimately not held liable for errors in spatial data, the Court approached the misleading charts and notices to mariners at issue in that case as an instance of negligent misrepresentation.

liability.[53] Several American cases have treated similar cases dealing with essentially mass-produced charts as product liability cases involving defective goods.[54]

Acknowledging the uncertainty in the proper categorization of spatial data as goods, services, or information, we will treat spatial data as goods subject to the principles of the Canadian law of product liability, although labels such as "manufacturing defect" seem to be inapposite given that the verb "to manufacture" does not seem quite right to describe the production of spatial data. Nonetheless, the underlying concerns with careless production and inspection in the context of manufacturing defects seem readily translatable to the spatial data context. When it comes to spatial data, the analogous concerns have to do with care in the gathering and processing of the data, as well as in the verification procedures.

Product liability in Canada is part of the law of negligence,[55] meaning that liability will be imposed only where a legal duty of care exists, harm is caused by a failure to adhere to the applicable standard of care (that is to say, there is a breach of the duty of care), and the harm is not a too remote consequence of the breach of that duty.[56] Product liability has commonly been divided into three subdivisions: (1) manufacturing defects; (2) design defects; and (3) the failure to warn of risks associated with non-defective products.[57] Each of the traditional categories of product liability may be relevant to harms flowing from spatial data and GIS, as will be discussed in the following sections.

A. NEGLIGENT MANUFACTURE

Liability for manufacturing defects "involves goods that cause harm when, because of some error in production, the goods fail to conform to their intended, and presumably adequate, specifications."[58] To prove negligence in a manufacturing defect case, the plaintiff must show that the defendant manufacturer's "method for producing the goods was deficient (for example, that the particular goods fell below the usual quality owing to contamination or an error in the manufacturing process) and that this deficiency caused harm to another."[59] In addition, even if a manufacturing method is considered reasonable, liability may be imposed on a manufacturer whose "defective inspection system and/or failure to inspect"[60]

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53 *Sea Farm Canada Inc v Denton* (1991), 7 CCLT (2d) 209, (BCSC) [*Sea Farm*]. The claims against the Ministry of Environment related to alleged flaws in a floodplain map and were framed in several ways including negligence in the "preparation and issuance of the floodplain map," negligent misrepresentation, and failure to warn users of the map of limitations in its use (*ibid* at para 10). The Court did not comment on the proper framing of the claim as it decided that the Ministry had not been negligent.

54 Noah, *supra* note 46 at 1207, noting that several courts have applied product liability rules to aeronautical charts: *Brocklesby v United States*, 767 F (2d) 1288 (9th Cir 1985) [*Brocklesby*]; *Saloomey v Jeppesen & Co*, 707 F (2d)671 (2d Cir 1983) [*Saloomey*]; *Aetna Casualty & Surety Co v Jeppesen & Co*, 642 F (2d) 339 (9th Cir 1981) [*Aetna Casualty*].

55 Note that this approach distinguishes Canada from the US. See Jamie Cassels & Craig Jones, *The Law of Large-Scale Claims: Product Liability, Mass Torts, and Complex Litigation in Canada* (Toronto: Irwin Law, 2005) at 25.

56 The concept of remoteness (called proximate causation in the US) captures situations in which a negligent act produces a range of harms, some of which are highly unusual. In these cases, the courts may feel it is unfair to hold a defendant responsible for the consequences judged to be unforeseeable and will label these as too remote.

57 Cassels & Jones, *supra* note 55 at 32.

58 *Ibid*.

59 *Ibid*.

60 Edgell, *supra* note 44 at 49.

allows a defective product "to leave the manufacturer's control … if injury is foreseeable as a result."[61]

In the context of spatial data, errors in datasets that result from carelessness in gathering, processing, updating, or verifying data might be viewed as analogous to "manufacturing" errors. Although the courts, in the few cases dealing with errors in spatial data products, do not tend to refer to "manufacturing" defects, they do look at problems in the production, maintenance, and inspection of spatial data. A couple of examples will illustrate this point.

In *Brocklesby v United States*,[62] the plaintiffs sued Jeppesen as provider of an aeronautical approach chart alleged to have caused a fatal crash. Jeppesen had essentially republished in graphical form a defective instrument approach procedure originally promulgated by the government. The Court found that Jeppesen was responsible for defects in its product given that it was able to research and validate the government's approach procedures and to seek corrections from the government where errors were discovered.[63] In essence, Jeppesen failed in its obligations to inspect and verify its spatial data products.

In *Saloomey v Jeppesen & Co*,[64] the Court found that a fatal crash was in part due to an error in Jeppesen's chart, which showed the relevant airport as equipped with an instrument landing system when it was not. The Court stated that there was adequate evidence upon which the jury could find the chart defective, or that Jeppesen had been negligent in the "manufacture or inspection" of the chart.[65]

In *Warwick Shipping Ltd v R*,[66] the plaintiffs' ship struck a shoal, and they sued the government alleging that its navigational chart (and subsequent "notices to mariners" updating the chart) had been inaccurate and misleading. The defendant Crown had earlier investigated the channel and discovered a shoal that crossed into the recommended shipping lane.[67] The notice to mariners that was then circulated indicated only that two shallow soundings had been found north of the shipping lane, and failed to indicate that the shoal extended into the lane.[68] The Court found that this notice was misleading in that its incompleteness invited the conclusion that the lane was safe. The Court stated that a proper notice to mariners ought to have been circulated.[69] Although the defendant Crown was not liable for reasons specific to the rules of Crown liability, the Court indicated that an ordinary defendant would have been held liable in the circumstances.[70] The Court in *Warwick* treated the misleading notice to mariners as an instance of negligent misrepresentation, rather than as a defective product.

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61 *Ibid*.
62 *Supra* note 54. Brocklesby sued both the US government as well as Jeppesen. The claim against the government was settled.
63 *Ibid* at 1296.
64 *Supra* note 54.
65 *Ibid* at 677.
66 *Supra* note 52.
67 *Ibid* at 166.
68 *Ibid*.
69 *Ibid* at 167.
70 *Ibid* at 170. The Court also found that the plaintiff failed to establish that the misrepresentation caused the shearing, since there was no evidence that the pilot had relied upon the chart (*ibid* at 176).

In *Sea Farm Canada Inc v Denton*,[71] the plaintiffs sued for damages on the basis that errors in a floodplain map had induced them to establish a salmon hatchery in flood-prone land unsuitable for that purpose. In order to comply with government regulations, the plaintiffs hired a consulting engineer who prepared a report based on floodplain charts prepared by the province. On the basis of the favourable report, the plaintiffs purchased the property but then had problems with flooding that led them to abandon the site. The defendant engineering firm compensated the plaintiffs, and then sued the province on the basis of negligent defects in the map, negligent misrepresentation, as well as "fail[ure] to warn users of the map of limitations in its use."[72] The Court eventually concluded that there had been no errors in the floodplain map, and that the problematic flood had been due to local and temporary blockages in side channels, which would not have been reflected in the map.[73] Although the Court did not comment on the proper characterization of the claim, it is noteworthy that the engineering firm sought to frame the claim as based on a product defect in addition to the other alternative bases of misrepresentation and failure to warn.

An error in a spatial dataset may be viewed as analogous to a manufacturing defect where the manufacturer has not taken reasonable care in producing and verifying the data. The standard of reasonable care in avoiding error will depend upon the reasonable foreseeability of harm, which, in turn, will depend upon the reasonably foreseeable use to be made of the data. Accordingly, an approach that considers whether specific errors are negligent product defects will be likely to apply where the use to which the data is to be put is known or ought to be known. This might include situations where the data has an intended use or common unintended uses. Where sensitive, high-stakes uses are at issue, a high standard of care in the production of accurate data is more likely to be imposed. For example, marine and aeronautical navigation charts are likely to attract a high standard of care, and one might expect charts of underground gas pipes also to attract a high standard of care given the intended or foreseeable uses of this information. An approach akin to liability for manufacturing defects, which looks at the level of care taken in the production and verification process, seems appropriate where the uses are known or ought to be known.

With the move toward the democratization of access to spatial data, it is becoming harder for providers of spatial data to be sure of the uses to which their datasets will be put or to control those uses. Without knowing the uses to which the data will be put, it is not possible to determine the appropriate standard of care in the production and verification of the data. Even where the uses are reasonably foreseeable, the data might be useful for a range of purposes of varying sensitivity to inaccuracy. If the law were to demand a standard of quality commensurate with the most sensitive possible use of the data, it would make it very difficult to expand public access to spatial data as the risk of liability might chill the circulation of all but the highest quality data.

A preferable approach where the purposes for which data will be used are not known or reasonably foreseeable is to treat uncertainty in spatial datasets as an inherent risk associated with their use, and to impose on providers a duty to warn of those inherent risks (the nature

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71 *Supra* note 53.
72 *Ibid* at para 10.
73 *Ibid* at paras 21-24.

of the duty to warn is discussed further in Part III.C, below). Where a range of reasonably foreseeable uses exists, it is unclear whether the courts would be satisfied with a "duty to warn" approach. If highly sensitive uses are foreseeable, a court may demand a very high standard of care in the production and verification of data, notwithstanding that other less demanding applications are also foreseeable. Outside these kinds of situations, it seems preferable to accept the "duty to warn" approach given that it facilitates public access to data.

B. NEGLIGENT DESIGN

A design defect occurs "when … goods are manufactured properly but are unduly dangerous because of the way in which they were designed in the first place."[74] A defective design is one that "poses an unreasonable risk of harm to the foreseeable user."[75] The issues that courts consider when determining whether a product poses an unreasonable risk of harm include "the extent to which the risk is latent or obvious, the probability of the injury occurring given the product's intended use and foreseeable misuse, and the likely severity of the injury."[76] In addition, courts will engage in a "risk-utility analysis," in which they balance the riskiness of the design "against the ease, cost, risks and loss of utility of a proposed safer design."[77] Some products pose unavoidable risks, and in these cases, courts will balance the risks against the "social utility" of the products in determining whether they should be manufactured at all.[78] Note, however, that even if it is determined that it is reasonable to manufacture a risky product, there may be an obligation to provide warnings to users.

The case of *Aetna Casualty & Surety Co v Jeppesen & Co*[79] offers an example of a design defect in the spatial data context. In that case, an aeronautical navigation chart presented the approach to an airport in two views ("birds-eye" and "side" view) in a way that they appeared to be at the same scale, when in fact they differed in scale by a factor of five. The parties agreed that the data was accurate, but the plaintiff alleged that the graphic presentation of the data was defective. The Court agreed that the chart-maker was liable in negligence as a result of the misleading graphic presentation of the data.

One can imagine other potential design defects in the GIS context. For example, a GIS may deliver misleadingly precise distance measurements to multiple decimal places even though the underlying data has a much lower documented accuracy.[80] In such a case, the design of the GIS is such that users may be misled as to the accuracy of the data, even if the correct metadata is provided separately.

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74 Cassels & Jones, *supra* note 55 at 32.

75 Lawrence G Theall et al, *Product Liability: Canadian Law and Practice*, looseleaf (Aurora: Canada Law Book, 2001) at L2-4.

76 *Ibid*.

77 Edgell, *supra* note 44 at 52-53. See also Theall et al, *supra* note 75 at L2-8.

78 Edgell, *ibid* at 55.

79 *Supra* note 54.

80 Rodolphe Devillers & Kate Beard, "Communication and Use of Spatial Data Quality Information in GIS" in Devillers & Jeansoulin, *supra* note 11, 237 at 238.

C. FAILURE TO WARN

The common law has developed a third category of product liability law to cover risky but nonetheless useful products. In these situations, a duty to warn is imposed "when the goods are carefully designed and manufactured but nevertheless carry an inherent danger.… In these cases a manufacturer has a duty to provide proper instructions and warnings, and a failure to do so that results in injury may also result in liability."[81]

Spatial datasets usually contain margins of error that render the data fit for some uses and unfit for others. Some of these types of errors may be reduced by, for example, using more precise measuring instruments or by conducting more comprehensive verification and correction of the datasets, which will produce a more certain but more expensive product. Given the trade-off between cost and quality, it is hard to regard a spatial dataset as defective in the legal sense solely because it contains errors. Furthermore, it is not possible to declare a single standard of reasonable quality for all spatial datasets, given that different uses will have different demands for quality. Instead, the "defectiveness" of a dataset will be a combined function of the level of uncertainty in the dataset and the use to which the dataset will be put.

As was suggested earlier in the context of manufacturing defects, where a provider knows or ought to know of the specific use to which a dataset will be put, errors in the dataset that make it unfit for that specific use may give rise to liability if the presence of those errors is unreasonably careless. For example, a failure to conduct reasonable inspection or verification of data being produced for a sensitive purpose (such as aeronautical navigation) might be negligent.

However, in situations where a provider is making a spatial dataset widely available to a broad range of users who may use the data for a variety of purposes, the analysis is more complicated. Under these circumstances, the spatial datasets are better conceived of as products that are inherently risky because they may be misused (that is to say, used for purposes that actually require higher quality data), and which may be disseminated as long as reasonable warnings and instructions accompany them.

Several questions arise in determining how the duty to warn applies. First, what dangers will give rise to a duty to warn? Second, to whom is the duty to warn owed? Third, how should that duty to warn be satisfied? And fourth, how is the user's behaviour relevant to liability for failure to warn?

1. WHAT DANGERS WILL GIVE RISE TO A DUTY TO WARN?

The law imposes a duty to warn and instruct users regarding inherently risky products. The more serious the risk, the more likely it is that a duty to warn will arise and the more extensive the warning will need to be. The Court in *Buchan* stated that "[t]he extent of the warning … should be commensurate with the potential danger — the graver the danger, the

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[81] Cassels & Jones, *supra* note 55 at 32.

higher the duty."[82] Similarly, in *Hollis v Dow Corning Corp*,[83] the Supreme Court of Canada stressed that the nature of the warning required will vary depending on the gravity of the risk associated with the use of the product. The reported legal cases typically involve failures to warn of serious rather than trivial harms for the obvious reason that it is often not worthwhile to sue for trivial harms (although the class action mechanism addresses this point to some extent), and also because it may be quite difficult to prove that a plaintiff would have behaved differently had there been a warning of a trivial harm. Courts may also be aware that a legal requirement to warn of trivial risks would likely create an information overload that would degrade the effectiveness of warnings about serious dangers.

It is usually unnecessary to provide warnings of dangers that are known to the user or those which it is reasonable to assume the user knows. As stated by the Court in *Lem v Barotto Sports Ltd*, "the dangers of use or misuse may be sufficiently apparent or well known to the ordinary prudent person that a warning in respect of them should be taken to be unnecessary in law. An example would be a sharp knife."[84] Two cautions are in order here. A high degree of user knowledge and understanding is required before the duty to warn vanishes. As the Supreme Court stated in *Bow Valley Husky (Bermuda) Ltd v Saint John Shipbuilding Ltd*, the requisite degree of knowledge must be so high as to mean that the consumer has "fully appreciated and willingly assumed the risk."[85] Another court put it in plainer language, stating that "the law is clear that manufacturers owe a duty to warn of the dangers inherent in their products except where those dangers are so clearly evident so as to make any warning silly."[86] Another caution relates to the heterogeneity of users. For example, "[a] risk that is obvious to an adult may not be obvious to a child,"[87] and this must be considered where children are among the foreseeable users of the product.[88] With the broad dissemination of spatial data to the public, the possibility of novice users increases and their minimal knowledge of the risks associated with spatial data uncertainty must be considered in assessing the duty to warn.

The provider of the product must warn not only of dangers known to the provider, but also of dangers the provider ought to know.[89] In other words, the standard is an objective one and a reasonable level of knowledge will be imputed to the provider. The constructive or deemed knowledge that is imputed to the provider gives rise to a fairly weighty obligation in relation to warnings. In *Ruegger v Shell Oil Co of Canada Ltd*,[90] a herbicide manufactured by Shell Oil Company (Shell) was sprayed on a cornfield, but drifted onto and ruined a tomato crop. Shell had warned users not to allow the "spray or spray mist to contact flowers, vegetables,

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82 *Buchan v Ortho Pharmaceutical (Canada) Ltd* (1986), 54 OR (2d) 92 (CA) at 113 [*Buchan*].

83 [1995] 4 SCR 634 at para 22 [*Hollis*].

84 (1976), 69 DLR (3d) 276 at 287 (Alta CA) [*Lem*].

85 [1997] 3 SCR 1210 at para 22 [*Bow Valley*]: "[K]nowledge that there may be a risk in some circumstances does not negate a duty to warn.… Unless the consumer's knowledge negates reasonable reliance, the manufacturer or supplier remains liable. This occurs where the consumer has so much knowledge that a reasonable person would conclude that the consumer fully appreciated and willingly assumed the risk posed by use of the product."

86 *Tabrizi v Whallon Machine Inc* (1996), 29 CCLT (2d) 176 at para 41 (BCSC) [*Tabrizi*].

87 Edgell, *supra* note 44 at 77.

88 *Ibid*.

89 *Hollis*, *supra* note 83 at para 20. In *Hollis*, the Supreme Court of Canada held that a manufacturer has a duty "to warn consumers of dangers inherent in the use of its product of which it has knowledge or ought to have knowledge."

90 (1963), [1964] 1 OR 88, (H Ct J) [*Ruegger*], cited by Theall et al, *supra* note 75 at L3-5.

shrubs or other desirable plants other than those being treated."[91] The Court held that Shell's warning was inadequate, as it "was not designed to alert the ordinary man to the danger of invisible drift at any time … a danger which they must be deemed to have known or ought to have known."[92] The Court acknowledged that while Shell might not have had actual knowledge of the risk, it could not thereby avoid liability because it ought to have known of that risk:

> The Shell Oil Company cannot escape liability by pleading ignorance of the characteristics of Amine 80. I agree with the decision in *LaPlant v. DuPont* … that the manufacturer and distributor must be treated as an expert in the field and that it knew or ought to have known of the characteristic against which an adequate warning should have been given.[93]

Manufacturers must be careful not to fall behind the level of expert knowledge in their field. If others have actual knowledge of a risk this raises the chances a court will say the knowledge was reasonably discoverable and so ought to have been known by a reasonably prudent manufacturer.[94] In addition, manufacturers have a "continuing duty to warn" that extends past the moment at which the product is introduced to the market. The Supreme Court of Canada has stated that "[t]he duty to warn is a continuing duty, requiring manufacturers to warn not only of dangers known at the time of sale, but also of dangers discovered after the product has been sold and delivered."[95] Manufacturers may become aware of problems if reports of harm are sent to them. They may also be required to do more than to passively await such reports. They may need, for example, to monitor the state of scientific knowledge in the area as it develops after a product is brought to market. For example, in *Buchan*,[96] the defendant pharmaceutical company failed to warn of the risk of stroke associated with birth control pills. The Court of Appeal imposed a duty to monitor the scientific literature and to warn physicians of any additional risks that are discovered:

> A manufacturer of prescription drugs occupies the position of an expert in the field; this requires that it be under a continuing duty to *keep abreast of scientific developments pertaining to its product through research, adverse reaction reports, scientific literature and other available methods*. When additional dangerous or potentially dangerous side-effects from the drug's use are discovered, the manufacturer must make *all reasonable efforts to communicate the information* to prescribing physicians.[97]

The dangers that give rise to a duty to warn include the dangers of the ordinary or intended uses of the product and the dangers of the reasonably foreseeable misuses of the product, as well as the dangers caused by foreseeable post-market modifications of the product by users. Note that even if the intended use of a product would not pose risks to the majority of users,

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91 *Ruegger*, *ibid* at 98.
92 *Ibid* at 99.
93 *Ibid* at 100-101.
94 *Dartez v Fibreboard Corp*, 765 F (2d) 456 (5th Cir 1985) at 461, cited by Cassels & Jones, *supra* note 55 at 53. The Court in *Dartez* stated that
> [t]he actual knowledge of an individual manufacturer is not the issue. If the dangers of asbestos were known to Johns-Manville at the time of Dartez's exposure, then the same risks were scientifically discoverable by other asbestos corporations.… [*T*]*he knowledge of one manufacturer can be a proper basis for concluding that another manufacturer should have warned of a specific danger*" [emphasis added].

95 *Hollis*, *supra* note 83 at para 20.
96 *Buchan* is discussed by Cassels & Jones, *supra* note 55 at 52.
97 *Buchan*, *supra* note 82 at 112 [emphasis added].

if ordinary use by unusually vulnerable users is reasonably foreseeable, there is a duty to warn of the risks of the generally safe product to those vulnerable users.[98]

In addition to risks associated with the ordinary or intended use of the product, there may also be a duty to warn of dangers associated with reasonably foreseeable but unintended uses, as well as dangers associated with reasonably foreseeable misuses.[99] Unintended uses and misuses are mentioned separately to forestall debate over what is a "misuse." In the end, it does not matter too much as there is an obligation to warn of dangers associated with both where they are reasonably foreseeable. The characterization of the user's behavior matters more at the stage of deciding whether there has been contributory negligence by the user.

In *Lem*, the plaintiff was injured when he misused a shot-shell reloading machine by failing to follow the instructions. The Court stated that the duty to warn extends beyond the risks of the intended use of the product to dangers that could arise out of the reasonably foreseeable *misuse* of the product:

> [T]he duty of the manufacturer is to give adequate warning, that is to say explicit warning, not only as to such that would arise out of the contemplated proper use of the product, but also as to such that might arise out of reasonably foreseeable fault on the part of the purchaser in its contemplated use.[100]

The Court in *Lem* also held that as the danger arising from misuse becomes more acute, so too does the need for warnings of dangers.[101] In the end, the manufacturer in *Lem* was not liable because adequate information on misuse had been provided.[102] Subsequent courts have interpreted the reach of the statements in *Lem* to impose a duty to warn of misuse and unintended uses.[103]

In the context of the broad dissemination of spatial data, it is not possible to gauge the need for a warning without an understanding of the risk. In this context, where risk refers to the use of data that is unfit for its purpose, understanding the risk requires the data provider to have a reasonable knowledge of the quality of the data as well as a reasonable sense of the uses to which the data will be put. Providers should therefore have a reasonable level of understanding of the quality of their own data, such as by using reasonably appropriate means to verify or measure that quality as well as to respond to any reports of error. As for the usage of their data, it may be challenging to anticipate the range of possible uses that the public will make of information made freely available to the public. However, a provider of data cannot plead ignorance, as a reasonable level of knowledge of risks will be imputed to the provider. As a result, reasonable efforts should be made to anticipate the uses to which

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98 Edgell, *supra* note 44 at 69, 76.

99 *Ibid* at 76; Theall et al, *supra* note 75 at L3-7.

100 *Supra* note 84 at 287.

101 *Ibid*: "[t]he duty of care of which the duty to give warning is an aspect, grows more exacting with the degree of danger of injury or damage arising from its misuse, and accordingly the reach of foreseeability is extended further as the circumstances may reasonably require."

102 Theall et al, *supra* note 75 at L3-7.

103 See *Holowaty v Bourgault Industries Ltd*, 2007 SKQB 2, 291 Sask R 122 at para 44: "As I interpret *Lem v Barotto*, when Justice Clement refers to "misuse", he is not simply referring to using the product for something that it was not intended for, rather, he is also referring to a situation where the consumer is either employing the product improperly or in a novel fashion that may not have been intended as a usual use by the manufacturer."

the data will be put and to monitor usage even after the initial public release of the data. Where unduly sensitive uses that cannot be met with a warning are discovered, further steps may need to be taken to control use.

Manufacturers may also have to warn of dangers associated with post-manufacture modifications to their products where they have actual or constructive knowledge of those modifications.[104] In *Deshane v Deere & Co*,[105] a harvester, which was intended to be towed in a field with the use of a protective device, was modified to facilitate use of the product in a stationary manner. Although the manufacturer "was not involved in the design, installation, or approval of the stationary system or stationary installation,"[106] it was nevertheless found to have some liability for failing to warn of the dangers that could arise from such a modification to its product. The Ontario Court of Appeal found that "the dangerous use of Deere's product was not only foreseeable, but actually known to Deere."[107] The Court concluded that manufacturers "will have a duty to warn if the post-manufacture modification is actually known by it, or if it was reasonably foreseeable."[108] The case law related to post-manufacture modifications of products by third parties is also pertinent in the context of spatial data, where third parties may take, modify, and recirculate data released by the initial data provider. Given this possibility, it would be advisable to take steps where reasonably possible to warn users that additional risks may be introduced by third-party modification of the data.

2. TO WHOM IS THE DUTY TO WARN OWED?

The duty to warn is owed to a range of persons that may extend beyond the actual purchaser of the product from the manufacturer. The Supreme Court of Canada stated in *Bow Valley* that

> [m]anufacturers and suppliers are required to warn all those who may reasonably be affected by potentially dangerous products. This duty extends even to those persons who are not party to the contract of sale. The potential user must be reasonably foreseeable to the manufacturer or supplier — manufacturers and suppliers … do not have the duty to warn the entire world about every danger that can result from improper use of their product.[109]

As a result, providers of spatial data should direct their warnings to those likely to use their data, whether or not that user is a purchaser, the initial downloader of a dataset, or a subsequent user. This suggests that warnings should travel with the data, rather than being presented apart from the data files. The cases show that in some circumstances, it will be enough to warn a "learned intermediary" rather than the ultimate consumer,[110] although it

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104 Edgell, *supra* note 44 at 76.
105 (1993), [1994] 15 OR (3d) 225 (CA).
106 *Ibid* at 230.
107 *Ibid* at 236.
108 *Ibid* at 233.
109 *Bow Valley*, *supra* note 85 at para 19 [citation omitted].
110 *Hollis*, *supra* note 83 at para 28: The Supreme Court of Canada stated that the learned intermediary rule is applicable either where a product is highly technical in nature and is intended to be used only under the supervision of experts, or where the nature of the product is such that the consumer will not realistically receive a direct warning from the manufacturer before using the product. In such cases, where an intermediate inspection of the product is anticipated or where a consumer is placing primary reliance on the judgment of a 'learned intermediary' and not the manufacturer, a

seems unlikely that users will be advised by learned intermediaries in the context of free internet dissemination of spatial data.

3. HOW SHOULD THE DUTY TO WARN BE SATISFIED?

Once the court has determined that there is a duty to warn of risks associated with a product, it must then answer the question of how that duty is to be satisfied. This is the question of the applicable "standard of care," which is generally expressed as a requirement to take reasonable precautions against reasonably foreseeable harm. We have discussed above the challenge of identifying risks or foreseeing harm where spatial data is disseminated via the internet to the public given the heterogeneity of users and uses. In this context, providers should take reasonable and ongoing efforts to anticipate and respond to specific high-risk uses such as by withdrawing the data from circulation where risks are unreasonably high, by improving the quality of the data to reduce those risks, or by including controls on use where possible. When reasonable steps have been taken in this regard, the proper approach to remaining cases is likely to be to provide users with the means to judge the suitability of the data for their own purposes. The problem thus becomes one of determining how best to transmit information about the quality of the information to users so that they may determine if it is fit for their purposes.

The legal precedents dealing with the content and form of warnings make it clear that warnings should be reasonably efficacious.[111] This will include a requirement to ensure that a warning is reasonably clear, understandable, and specific, and also that the method of dissemination is one that is likely to reach the relevant parties.[112] Several cases will illustrate these points.

The case *Lambert v Lastoplex Chemicals Co Ltd*[113] illustrates the point that warnings must specifically identify dangers. In *Lambert*, the plaintiff was injured when he used the defendant manufacturer's lacquer sealant in the basement of his home near a pilot light, resulting in an explosion. The product contained a general warning that the product was inflammable, that users should keep it away from fire, heat, and open-flame lights, and that they should ventilate the room while using it.[114] The plaintiff had duly opened windows and turned the furnace thermostat down to prevent the furnace from starting, but had not extinguished the pilot light. The Court concluded that the warning that the product was inflammable was too general, particularly given the surroundings in which the product could be expected to be used.[115] The fact that manufacturers of similar products included a specific warning against sparks and pilot lights helped to convince the Court that the defendant had not fulfilled its duty to warn the plaintiff by being explicit enough about the precise dangers

warning to the ultimate consumer may not be necessary and the manufacturer may satisfy its duty to warn the ultimate consumer by warning the learned intermediary of the risks inherent in the use of the product.

111 Edgell, *supra* note 44 at 71.

112 *Ibid*.

113 (1971), [1972] SCR 569 [*Lambert*]. See discussion in Theall et al, *supra* note 75 at L3-16.

114 *Ibid* at 573.

115 *Ibid* at 575.

in the use of the product.[116] The Supreme Court of Canada in *Hollis* also stated that warnings must identify dangers precisely:

> Where significant dangers are entailed by the ordinary use of the product, it will rarely be sufficient for manufacturers to give general warnings concerning those dangers; the warnings must be sufficiently detailed to give the consumer a full indication of each of the specific dangers arising from the use of the product.[117]

Warnings must also be comprehensible and unambiguous. In *Buchan*,the Ontario Court of Appeal emphasized that warnings should be understandable, so as to ensure the consumer is informed of the risks involved in the product's use:

> Once a duty to warn is recognized, it is manifest that the warning must be adequate. It should be communicated clearly and *understandably* in a *manner calculated to inform the user of the nature of the risk and the extent of the danger*; it should be in terms commensurate with the gravity of the potential hazard, and it should not be neutralized or negated by collateral efforts on the part of the manufacturer.[118]

Warnings must also be noticeable, as was made clear in *LeBlanc v Marson Canada Inc*,[119] where an injury resulted when the plastic tube of liquid hardener in a fiberglass repair kit ruptured. Although the Court in the end decided this case on the basis of a manufacturing defect, the Court also found that the warnings that came with the repair kit were insufficient, as they were not noticeable enough, and did not include instructions to wear goggles:

> The warning certainly cannot be described as "arresting" or "imposing." It is in very small print and commences with minor dangers regarding flammability and the manner of storage, the least of its dangers to the ultimate consumer.… [T]his warning is not commensurate with the danger and hazard involved.… [G]loves and eye goggles would offer sufficient protection to the consumer. This caution or precaution has not been recommended to the ultimate consumer when it was reasonably foreseeable … that the absence of such precaution could result in serious injury.[120]

The method chosen to disseminate the warning must be reasonably effective. A warning supplied with the product might address the risks known at the time of sale, but other methods may be required to reach users where a new risk is discovered after the product has been introduced to the market. Lawrence Theall et al observe that the Court in *Nicholson v John Deere Ltd*[121] "set a very high standard for manufacturers to meet when devising programs to alert owners about product defects,"[122] including those learned of post-sale. In *Nicholson*, the manufacturer became aware of a hazard associated with some models of its lawn and garden tractors and took steps to address the hazard. The Court determined that the methods chosen to alert users, including the distribution of safety kits, notices in newspapers, and sending letters to known users, was far from adequate:

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116 *Ibid* at 573-74.
117 *Hollis*, *supra* note 83 at para 22.
118 *Buchan*, *supra* note 82 at 101 [emphasis added].
119 (1995), 139 NSR (2d) 309 (SC) [*LeBlanc*]. See discussion in Theall et al, *supra* note 75 at L3-17.
120 *LeBlanc*, *ibid* at para 24.
121 (1987), 58 OR (2d) 53 (H Ct J) [*Nicholson*].
122 Theall et al, *supra* note 75 at L3-23.

> [T]he manufacturer in this case, assuming that full knowledge, actual or imputed, of the serious potential risk of harm reached him only some years after his product was marketed, had a duty to devise a programme that *left nothing to chance*…. [T]he efforts to warn were *deficient* in that *the means chosen were doomed to failure with respect to the vast majority of users*.[123]

Another problem that is related to the dissemination of warnings is to ensure that the method chosen will reach not just initial users, but subsequent users in the second-hand market. A method that is likely to reach the first purchaser but not subsequent users may well be inadequate.[124]

How then should providers of spatial data ensure that users are provided with clear, specific, and noticeable information and instructions that enable them to judge the fitness of the data for their use, and how can the provider ensure that this quality-related information reaches the ultimate user given that third parties may modify and recirculate spatial data sets? The following section discusses the state of GIS research having to do with the communication of spatial data quality information to users, which sheds light on the forms of warning that courts may find reasonable from the legal perspective.

4. COMMUNICATION OF SPATIAL DATA QUALITY INFORMATION

The shift toward the digitization of spatial data, with its greater mobility and susceptibility to modification than analog forms of data, raised concerns about how to ensure knowledge about the limitations of datasets was not lost along the way. Researchers have, for several decades now, worked on ways to address this problem. The initial response was to ensure that metadata (for example, data about the source, currency, and estimated accuracy of the spatial data) was included with spatial data, so that anyone interested in the quality of that data could consult the metadata file. National and international standards reflect consensus understandings on what this metadata should include and how it should be organized.[125]

Text files of metadata remain the most common method for communicating spatial data quality to users.[126] There are unfortunately numerous difficulties with this form of communication. Metadata tends to be difficult to understand, and nearly unintelligible for novice users.[127] As Rodolphe Devillers et al explain, metadata "are typically expressed in a cryptic language."[128] Another repeated criticism of most presentations of metadata is that they are awkwardly located in a file separate from the spatial data they describe, making the metadata difficult and inconvenient to use.[129] An additional problem with the information conveyed in typical metadata is that it is rather general. Where quality varies within a dataset, data quality may need to be communicated at a more fine-grained or granular level, although this increases the expense and volume of metadata.[130] Jibo Qiu and Gary Hunter also suggest

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123 *Nicholson*, *supra* note 121 at 60-61 [emphasis added].
124 *Nicholson*, *ibid* cited in Edgell, *supra* note 44 at 71.
125 See e.g. the ISO standards listed *supra* note 4; Devillers et al, *supra* note 14 at 262.
126 Devillers & Beard, *supra* note 80 at 240.
127 S Hope & GJ Hunter, "Testing the Effects of Positional Uncertainty on Spatial Decision-Making" (2007) 21:6 International Journal of Geographical Information Science 645 at 646.
128 Devillers et al, *supra* note 14 at 262.
129 *Ibid* at 264-65.
130 Devillers & Beard, *supra* note 80 at 239.

that the utility of the metadata is undermined by the paucity of useful tools to "manage (that is, to store, manipulate, query, update and display) any embedded data quality information."[131]

In addition to these criticisms of the form in which uncertainty information is presented, a recent graduate thesis explored the question of whether and how experimental subjects actually use information about uncertainty. Alex Keuper found that when uncertainty information or prompting about uncertainty is absent, experimental subjects tended to take geographical data as given, without considering questions of quality (including currency and positional accuracy).[132] Novices and most experts had to be prompted "to begin to think about uncertainty in the geographic data product,"[133] and novices, unlike experts, had difficulty in determining whether uncertainty was a problem or could be ignored for a particular geographical decision.[134]

Given these reasons to question the utility and efficacy of traditional presentations of spatial data quality information, it seems likely that they would not meet the legal requirements of the duty to warn, particularly in the case of inexperienced users.

Researchers have noted the limitations of textual metadata, and have explored a range of other means of communicating spatial data quality. Among these techniques are methods to enable direct visualization of quality information, and pop-up warnings presented to users when they perform a risky operation on the data.

Visualization techniques are promising because of the improved efficiency of information transmission they enable, as well as because of the greater degree of comprehension that can be achieved in this way.[135] Numerous approaches exist. Levels of uncertainty may be indicated using static variables such as colour saturation, hue, orientation, pattern or texture, and focus.[136] For example, graduated shading may be used to indicate the increasing or decreasing probability that an object is in the marked location.[137] In addition, animations such as blinking, flickering, or sound might be used.[138] Another approach is to facilitate simultaneous consultation of data and quality information by allowing users to toggle between data and uncertainty metadata or to view both in side-by-side windows.[139]

Another approach which goes beyond simply improving access to and understanding of spatial data quality information is to provide warnings to users when they attempt to perform

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131 Jibo Qiu & Gary J Hunter, "A GIS with the Capacity for Managing Data Quality Information" in Wenzhong Shi, Peter F Fisher & Michael F Goodchild, eds, *Spatial Data Quality* (New York: Taylor & Francis, 2002) 230 at 230.

132 Keuper, *supra* note 2 at 173.

133 *Ibid* at 175.

134 *Ibid* at 179.

135 Devillers & Beard, *supra* note 80 at 241.

136 These techniques are discussed in various places. See e.g. Karin Reinke & Gary J Hunter, "A Theory for Communicating Uncertainty in Spatial Databases" in Shi, Fisher & Goodchild, *supra* note 131, 76 at 86; Devillers & Beard, *supra* note 80 at 242; Hope & Hunter, *supra* note 127 at 647; Alan M MacEachren et al, "Visualizing Geospatial Information Uncertainty: What We Know and What We Need to Know" (2005) 32:3 Cartography and Geographic Information Science 139.

137 Hope & Hunter, *ibid* at 646.

138 See e.g. MacEachren et al, *supra* note 136; Reinke & Hunter, *supra* note 136 at 86; Hope & Hunter, *ibid* at 647.

139 Reinke & Hunter, *ibid* at 97.

risky actions with the data. Warnings may range from the non-disruptive, which a user may choose to ignore, to warnings that require a user response.[140] For example, a warning system might send a message to users when they attempt to perform operations that violate pre-defined rules.[141] A range of methods exist for communicating warnings, including visual (such as blinking or flashing icons, or pop-up windows) or auditory methods of attracting user attention. [142]

The foregoing are essentially methods of communicating quality-related information. Other approaches attempt to control use. One difficulty of the approaches that control use is that they limit the flexibility of the dataset in ways that may protect novice users, but overly restrict more experienced users. Some of the "control" approaches attempt to take this into consideration. For example, a "quality slider" is a form of data filter that enables a user to set a quality threshold so that only data above a certain level of quality will be displayed.[143] A more heavy-handed approach would be to build limits into the system to ensure that erroneous operations cannot be performed, and functions of this type are to some extent present in commercial GIS.[144]

Although the foregoing approaches may be helpful, there may be situations in which users are unable to handle spatial data quality information appropriately. This may arise where users are insufficiently sophisticated and the costs of decision-making errors are too high. In these cases, some researchers suggest that an expert human intermediary should be required. For example, Devillers et al make such a recommendation and suggest that researchers should pay attention to developing tools to assist these experts in making fitness for use assessments on behalf of end-users.[145]

We draw several conclusions relating to the duty to warn from the foregoing discussion of efforts to communicate data quality information to users.

First, it seems fairly clear that the failure to include data quality information is a breach of the duty to warn if it is reasonably foreseeable that defects in the data might cause harm. The existence of industry standards specifying that spatial data quality should be documented in metadata tends to support this idea, given the consensus that this is an appropriate practice.[146] From the policy perspective as well, it is clearly desirable that spatial data quality information be available along with the spatial data because of the ease with which spatial data can be moved, modified, and combined with other data. Under these circumstances, it is hard to keep track of the quality of the data, which makes it less useful later on for those trying to use it to create spatial information products of known quality and also raises the risk of its downstream misuse by those unaware of the risks of using the data.

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140 *Ibid* at 91.
141 Devillers & Beard, *supra* note 80 at 245.
142 Reinke & Hunter, *supra* note 136 at 86-87.
143 Igor Drecki, "Visualisation of Uncertainty in Geographical Data" in Shi, Fisher & Goodchild, *supra* note 131, 140 at 144.
144 Devillers & Beard, *supra* note 80 at 246.
145 Devillers et al, *supra* note 14 at 263.
146 Compliance with standards may not be sufficient from the legal point of view, however, as was made clear by the Supreme Court of Canada in *Waldick v Malcolm*, [1991] 2 SCR 456 [*Waldick*]. See also *Tabrizi*, supra note 86 at para 37: "[E]ven widespread industry customs can be found negligent."

Second, where there is a duty to warn of risks associated with spatial datasets because there is foreseeable risk of harm from misuse, it seems likely that the simple inclusion of metadata in a separate text file is insufficient, particularly where data may fall into the hands of inexperienced users. Although the empirical data is thin, it appears that few novice users are aware of the problem of uncertainty and error in spatial data and that they tend to take data (particularly that which appears highly scientific or technical) as completely accurate. Even if novice users do consult metadata, they are generally unable to comprehend the standard presentation of metadata. Under such conditions, the appropriate warning would, at a minimum, clearly notify and educate users that spatial data contains errors, that errors in the spatial data may lead to errors in any decisions they make using that spatial data, that information about the margin of error associated with the spatial data is supplied, and that they should seek expert advice before making important decisions relying on the data. This information should be conveyed in language that is comprehensible to the likely users of the spatial data, and should be associated with the dataset in a way that it is likely to come to the attention of users.

If there are any specific and serious risks known (or which ought to be known) to the provider regarding the use or misuse of the data, then they must be specifically mentioned. As noted in *Lambert*[147] a general warning is not enough where specific significant risks exist. As a result, the general information and statements outlined in the preceding paragraph ought to be supplemented with specific warnings where necessary.

Given that the duty to warn is a "continuing obligation," meaning that serious risks that come to light after release of a product must be communicated to users, it would be a good idea to provide for a mechanism for the delivery of these additional warnings. The kinds of errors that might trigger this continuing duty would be errors that fall outside the margins of error already specified in earlier warnings for the data. The possibility that further warnings or corrections might be forthcoming ought to be mentioned in the basic information presented to users about the spatial data.

Third, information about spatial data quality should accompany spatial datasets although the manner in which this information should be conveyed is not established, as the industry and researchers continue to work on finding ways to make the information as useful as possible. The standard presentation of metadata in separate text files is likely inadequate, particularly given the consensus that inexperienced users do not understand it. Instead, efficient and effective methods to communicate and use spatial data quality information, perhaps including the visualization methods, warnings, and such, as discussed above, ought to be taken up where the level of risk warrants it. It is essential to note that the courts do not regard compliance with industry custom or with industrial standards as conclusive proof of reasonable care.[148] As a result, the fact that a provider offers metadata as required by the applicable standards will not settle the question of whether that is a legally adequate attempt to warn of limitations associated with the data. Providers should inform themselves of the state of research in the area and take up improved methods of conveying quality information where it is reasonable to do so.

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147 Lambert, *supra* note 113.
148 *Waldick*, *supra* note 146; *Tabrizi*, *supra* note 86.

Finally, it is possible that some data ought not to be circulated broadly to the public where a warning cannot effectively mitigate the risks of misuse. Instead this data could be circulated through expert intermediaries, or withheld altogether. The courts engage in a kind of risk/utility trade-off in relation to inherently risky products. Where the risks cannot be reduced by redesign or by warning, they should not be circulated unless their social utility outweighs those risks. It is likely to be only rare cases, involving serious risk of harm, which would justify this type of restriction on the circulation of spatial data.

4. THE BEHAVIOUR OF THE USER

The behaviour of the user is relevant at several stages of the analysis and may lead to a finding that the provider of a product is not liable, or it may lead to the apportionment of liability between provider and user of the data. A user may behave unreasonably by disregarding obvious dangers or by ignoring warnings. As noted earlier, it is usually the case that there is no need to warn of obvious dangers, although some caution must be taken because courts tend to be protective of users in determining what is obvious. Furthermore, "[i]n some cases, the court will find that a warning has been warranted, and also find the plaintiff contributorily negligent for having acted as he or she has done in the face of the 'obvious' danger leading to an apportionment of liability."[149]

A user may also disregard warnings, which, it would seem, would also absolve the provider of liability. Again, care must be taken here because liability might still arise if it is reasonably foreseeable that instructions (including warnings with respect to reasonably foreseeable misuse) will be ignored by users.[150]

A manufacturer may still be liable even where it provides a proper warning to a user, if it supplies a product to a user who it knows will misuse it.[151] While the manufacturer may be less likely to be liable to the user, it may still be liable to any third parties who are injured as a result.[152] Therefore, a manufacturer's potential responsibilities do not necessarily end with the knowing assumption of risk by the user.

IV. CONCLUSION

The democratization of both the use and production of spatial data is a welcome development in the realm of geographical data. Nonetheless, increasing public participation exacerbates the risk that data will be used for purposes for which it is not fit. The issue of potential legal liability for harm flowing from the misuse of unfit data for various decisions thus comes to the fore. This article has focused on one form of legal liability under the rules of the Canadian common law of negligence — namely, liability for physical harm to persons or property caused in part by uncertainty in spatial data.

Providers of spatial data tend erroneously to presume that users bear the responsibility for ensuring fitness for use. Where it is reasonably foreseeable that spatial data will be used for

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149 Edgell, *supra* note 44 at 77.
150 Theall et al, *supra* note 75 at L2-5 - L2-6.
151 *Murphy*, *supra* note 25 at para 26.
152 *Ibid* at para 19.

particular sensitive applications, the courts tend to apply negligence principles to assess whether errors in the data are the result of a lack of reasonable care in the production or verification of the spatial data.

As we move forward with the broad internet dissemination of spatial datasets, a provider's knowledge and control of the uses to which the data will be put and the type of user who will use it may be lessened. Indeed, it is likely that a broad range of types of users and of uses will be reasonably foreseeable. The difficulty in this case is that if courts were to demand a very high standard of quality in the data appropriate for the most sensitive potential use, it may chill the circulation of datasets that are perfectly satisfactory for less sensitive uses. This article has suggested that the better way to approach this scenario is to regard uncertainty and error in spatial data as a form of inherent risk in its use rather than as a defect, per se. As a result, the legal requirement of providers is to issue a reasonably effective warning to users regarding this inherent risk. This approach may not be sufficient where one of the reasonably foreseeable uses is a highly sensitive use, but it seems appropriate where a range of less sensitive uses is foreseeable.

Given that spatial datasets disseminated online are accessible to novice users, the duty to warn will include an educational function. Novice users seem to assume spatial data is accurate, and must be notified about the existence and significance of uncertainty and error, as well as what they should do about it. Beyond this, information about spatial data quality must also be made available in an effective manner. The progress made in the research community on methods to do so will be important in determining how this should be done. Simple compliance with extant standards describing metadata is unlikely to be enough to meet the legal duty to warn where a duty to warn exists because of the foreseeable risk of misuse of the data.