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NOTHING BUT BLIND PITILESS INDIFFERENCE: BOUNDARY MONUMENTS, DEFERRAL AND THE PUBLIC INTEREST

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ABSTRACT

Boundary monuments in Canada have long been asserted to be a public good. Such goods, however, be they monuments or water and sewerage systems, are only in the public interest if they are reliable. Some 800 boundary monuments in 26 residential subdivisions in the province of Alberta were closely inspected (using metal detectors and shovels) for their reliability. Four findings resulted. First, monuments established immediately upon survey, but before servicing and construction, are reliable only 60% of the time. Second, deferring establishment for 4.5 months increases the reliability of the monuments by only 10%; they are reliable 70% of the time. Third, the practice of not deferring establishment until house construction is the reason that deferral is ineffective at significantly enhancing the reliability of monuments. Fourth, although enhanced deferral is in the public interest (if boundary monuments are a public good), land surveyors are reluctant to embrace a longer deferral period. This reluctance is partly a function of wanting to appease clients who prefer to locate house foundations from boundary monuments, and partly a function of viewing deferral as the slippery slope to the wide-spread use of coordinates in place of monuments to define boundaries. This reluctance, however, leads to a logical contradiction: If monuments are a public good, then their reliability only 60 – 70% of the time is intolerable. Conversely, if monuments are not a public good, then their current use is questionable.

KEYWORDS: Boundary monuments. Reliability. Public interest.

INTRODUCTION

Deferral in the Public Interest

There is a long tradition in Canada of the state providing public goods that the private sector is unwilling or unable to supply. These concepts of public goods are based on services that cannot easily be purchased by the individual, generally because they create external benefits for entire communities. The public interest has been defined as a balance of economic, environmental and social interests, "a broad, somewhat undefined and flexible concept, which nevertheless includes considerations beyond the interest of the parties to a dispute."[**26**]

Examples of public goods abound [**11**]. The federal government granted money and land to encourage the Canadian Pacific Railway in the 1880s, provided transcontinental broadcasting and air service in the 1930s, and continues to assist cultural activities and universities, among other things. Concurrently, provincial governments are responsible for providing elementary and secondary education, highways, and municipalities. The latter, in turn, have long provided water and electricity reticulation, and sanitary and storm water sewers. Indeed, the latter utilities are called public utilities precisely because they are public goods. A typical definition of a public utility in Canada is a system used to provide water (for example) "for public consumption, benefit, convenience or use." [**7**]

The Canadian state also regulates the creation of land parcels, in the public interest. On Canada Lands (Indian reserves, national parks, the north and the offshore) the Surveyor General's Office of the federal government ensures that parcels are defined, demarcated and delineated. The rights in many parcels, as on Indian Reserves, are then registered in a repository also maintained by the federal government. For fee simple (private) land, each of the 10 provinces regulates the creation of parcels, by

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operating systems of land titles or deeds registration and through delegating much responsibility for surveying the boundaries of the parcels to surveying associations. Parcels are thus regarded as a public good, for they enhance property rights by reducing transaction costs and by encouraging investment and improvements.

What, however, of the monuments that support the parcel fabric? It has long been asserted that the establishment and re-establishment of monuments is in the public interest, that "getting rid of the stakes would have a disastrous effect on legal surveys and coordinate systems." [**15**] However, if the parcel fabric is a public good, then it should be reliable. Conversely, if the fabric is not reliable, then it is not serving the public and is not a public good. Reliability means that the landowner – the party that has title to the parcel of land – has certainty about the location of the parcel's boundaries, as represented by monuments. The rationale underlying the use of parcel monuments is that landowner certainty is a function of reliable monuments. The rationale is not that monuments are needed to install services (such as water and sewerage) or to build houses, although temporary stakes are often needed for design and construction purposes. Rather, parcel monuments are justified as allowing landowners to know the location of parcel boundaries, and thus the spatial extent of parcels and the use to which parcels can be put.

Reliability has recently been found wanting in two other public goods – sanitary sewers and water reticulation. From August 3 to 15, 2006, 764 million litres of raw sewage was spilled, without authorization, by the City of Ottawa into the Ottawa River. The audit of the spill found that is was caused by "an almost complete lack of proper preventative maintenance and proactive management of this equipment." Once the spill occurred a culture of ignorance about the significance of sewage spills took hold. Both the lack of maintenance and the culture of ignorance represented "incompetence on the part of the managers involved." [**12**] This incompetence meant that the sewerage system was no longer working in the public interest. Indeed, over the period 1998 – 2008, there were 16 separate sewage spills. The public utility that is the Ottawa sewerage system is thus not reliable, and is now being scrutinized closely by the Environmental Commissioner for the province of Ontario.

Scrutiny has also recently been applied to the provision of drinking water in Canada, as the result of deaths at Walkerton, in rural Ontario. The importance of water reticulation is recognized by Article 54 of the 1979 Protocol of the Geneva Convention, which prohibits attacking, destroying and removing objects indispensable to the survival of the civilian population, such as "drinking water installations and supplies."[**23**] And yet, at Walkerton, manure from a farm infiltrated a well in May 2000, contaminating the water supply with e coli and campylobacter bacteria, resulting in seven deaths and 2,300 illnesses. Both the Walkerton Public Utilities Commission and the Ontario Ministry of Environment were found at fault, for operational errors and omissions and for failing to act as the overseer of communal water systems, respectively. Two of the essential elements of a water system – security of supply and quality – were not met. The water reticulation system was thus not reliable, and an essential tenet of a public good was not met. [**20**]

The moral from these two cautionary tales is that infrastructure is only a public good when it can be relied upon. It is reliable when it prevents the discharge of raw sewage, and when it provides potable water. It is in the public interest that the systems work all the time, and when they fail, are breached or cannot be relied upon, then the public interest is not being served.

BACKGROUND

The relationship between landowners, parcels, boundaries and monuments is the raison d'être behind the system of fixed boundaries that are used in Canada in general, and in Alberta in particular. The precise locations of the boundaries of parcels have been determined on the ground, and their deflection points (such as corners) demarcated. This differs from the general boundary concept that exists in some other countries, in which monuments are seldom established, and if established, are replaced by features that represent the boundary, such as hedges, walls and fences. Monuments in Alberta are three-foot long iron stakes driven into the ground at each corner of the parcel (a typical rectangular parcel will have four such monuments). These monuments are required by the standards adopted by the Alberta Land Surveyors Association (ALSA), to whom has been delegated by legislation the authority to set such standards. To be clear, iron monuments in the ground demarcate fixed boundaries in Alberta and, with some modifications as to size of monument, throughout Canada.

Deferral is a simple idea. It is the process whereby the final physical demarcation of a parcel of land is delayed until the completion of some construction and servicing. The intent of adopting a deferral process, as opposed to more conventional immediate posting (monumentation), is that boundary monument reliability would increase as a result of fewer disturbances.

In 1975, the Government of Alberta adopted deferred posting as Sec 43 of the *Surveys Act* [**25**]. Practitioners were, of course, not forced to use deferred posting and could continue using immediate posting (Sec 41) should they so choose. The inception of deferred posting in legislation, however, ignited a long ongoing debate about boundaries - the representation versus the physical location on the ground. While the parcel boundary was awaiting monumentation, what would be used as evidence of the property corner? The solution to this problem was to adopt coordinates as temporary placeholders until the actual pragmatics of physical demarcation could be realized. The notable exception in the *Surveys Act* is that the leniency in placing the monument extends to a one-year period, with an optional extension.

Given that it has been over three decades since the inception of deferred posting, one would imagine that we could give a concrete answer to the question: "Is monument deferral beneficial?" Or more specifically: "Does deferral lead to increased reliability of boundary monuments?" Much rhetoric has been bandied about, but little substance has been noted. Instead, strangely, the discourse has focused itself on the cost savings of deferral, and the expediency it would bring to survey project completion. While these are laudable goals, the proof of their causation from deferral is anecdotal at best. For instance, it was asserted while introducing the monument deferral bill (to the Alberta legislature no less) that significant cost savings to homeowners would be realized through monument deferral [**6**]. In the same vein, the Alberta Land Surveyors' Association (ALSA) noted that, among other things, the deferral process would greatly accelerate the process of registration of survey plans and issuing of mortgages [**22**]; and the City of Edmonton noted that deferral would have the effect of reducing survey tariff rates as a result of reduced field time [**17**]. All of this, of course, was mere conjecture masquerading as evidence. It reeked of a*rgumentum ad verecundiam: "*…beliefs are tentative, not dogmatic; they are based on evidence, not on authority or intuition." [**24**].

The intellectual dishonesty, however, was not limited to one side. Opposing advocates engaged in similar dialogues with the same (seeming) contempt for actual evidence. Among their unsubstantiated assertions were: That homeowners required

immediate monumentation to identify their property limits; that land surveyors should not be necessary to locate corners represented by coordinates only [**18**]; and that monument deferral would actually add to project costs, which, in turn, would have to be passed on to the homeowner. A survey of the profession in Alberta in 1984 reflected the division over deferred postings. Of those surveyed (n=54), half indicated that the current process was working adequately, while the other half (evidently) did not [**2**].

METHODOLOGY

In order to answer the question of monument reliability effectively, the number of monuments would have to be substantial. Additionally, the sample would have to include subdivisions in both the immediate and deferred monumentation regimes. In the City of Edmonton, 11 subdivision were selected (three - immediate, and eight – deferred), and in the City of Calgary, 15 subdivisions were chosen (seven - immediate, and eight - deferred).

The subdivisions were chosen on the basis of two criteria: 1 – the development consisted solely of ordinary residential developments (single-family homes) on single lots (as opposed to condominiums, for example); 2 – the development should be complete, or near completion, with most homes already occupied. The former ensures that the development effects on monument reliability in both deferred and immediate posting regimes can be compared adequately. The latter ensures that any major monument disruption through development has already occurred.

The search for the physical monuments was done with the aid of magnetic locator and tape measure. An obvious central starting monument (near a fence corner, for instance) was selected in each subdivision. Then using the plan dimensions and working outward, measured (theoretic) property corners were established. The magnetic locator was employed at the measured corners to inspect for a physical monument. The magnetic responses were categorized as ambiguous, unambiguous, or non-existent.

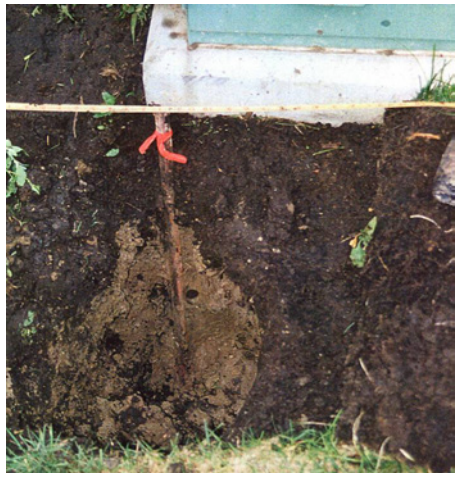

Fig. 1 – Boundary monument beneath utility box and concrete slab

Ambiguous magnetic readings were caused by many factors. In some cases it was proximity to some obstacle, such as a utility box or reinforced concrete slab (Fig. 1) which impaired magnetic locating. In other cases, the ambiguity was a magnetic

reading outside the general vicinity of the measured location. Regardless of cause, if the position was categorized as ambiguous, excavation ensued. Each monument was dug up only to the point where it could be adequately determined whether it was disturbed or in its original position.

Unambiguous magnetic readings (where the magnetic reading corresponded to the measured) were assumed to indicate intact boundary monuments in their original positions. Excavation of these monuments occurred at a rate of 1 in 5 (20%). A regular sampling pattern of excavation was employed in that, where it was possible, every fifth monument sought was excavated; thus the first, sixth, eleventh, and so on. This was done to better distribute the excavated points across the sample area.

Non-existent magnetic readings were the simplest to evaluate. Where a magnetic swathing of the general vicinity of the measured location yielded no response, the monument was assumed to have been destroyed in the development process. Excavation of a sporadic sampling of non-existent magnetic readings was performed. This was done to examine for possible evidence of the boundary monuments, even though no magnetic reading was found (Fig. 2).

Excavation was only done to such a depth as to provide a credible assessment of the monument. For instance, monuments that were plumb for the first few centimetres of exposure were assumed to be plumb in their entirety, while those that were significantly out of plumb were excavated further. The depth of excavation was also influenced by the nature of the soil. Where hard soil was reached and the monument appeared plumb, no further excavation took place on the reasoning that any disturbance would have been visible at the looser soil depth.

The monuments (magnetic signal, or excavated) were assessed, in a pass/fail environment. Monuments were classified as either acceptable evidence of a property corner, or as a disturbed monument which was no longer of any use to property definition. It should be noted that monuments flagged as acceptable not only encompassed monuments in pristine condition (Fig. 3), but any monument that could provide evidence of a credible position. This may, for instance, include a monument bent at the top but whose base is still intact (Fig. 4).

Fig. 2 – Destroyed monument at fence corner

On average, 30 posts were sought in each subdivision in Edmonton and Calgary. It was not feasible to seek out every monument within each subdivision for several reasons. First, seeking and excavating boundary monuments is labour intensive work. Second, on a few lots, house construction had not occurred (or was incomplete) at the time of investigation; and since the construction is considered one of the largest

sources of damage to survey monuments, there was little merit in performing the search. Third, reinforced concrete driveways represent a huge obstacle in the ambiguity they introduce to magnetic detection, and it would be too time consuming to resolve them all.

Fig. 3 –Monument in excellent condition

Fourth, property owners may perceive the excavation work over elaborate landscaping as a nuisance. Fifth, monuments at the rear of fenced properties are difficult to access, and were only sought where a lane or park afforded access to them. Finally, additional monuments would not make the sample more representative.

Fig. 4 – Bent monument with base intact

As the development process on a subdivision occurs in phases (utilities, housing, sidewalks, landscaping, and so forth), three case studies were undertaken to determine which phase of development was most disruptive to boundary monuments: First, a deferred monumentation subdivision was analysed after servicing was in place (gas, water), but before housing completion was finished. Second, a deferred monumentation subdivision was analysed after both servicing was installed and housing was complete. Third, an analysis of Real Property Reports (RPR) was undertaken (n=50) for deferred monumentation lots. A land surveyor's RPR is a graphical representation of the position of immovable assets on a parcel (house, sheds, retaining walls), along with evidence of the parcel boundaries. They often accompany any transaction of the property. The purpose of the RPR analysis was to further corroborate results from the field investigation, and to provide additional insights into which phase of development is the major determinant of monument destruction.

RESULTS AND ANALYSIS

Monument Investigation

To evaluate the reliability and usability of the monuments in both the immediate and deferred paradigms, a Monument Utility Index (MUI) was developed (Eq. 1). In which, the product of the proportion of monuments found through magnetic detection (Fig. 5) and the proportion of monuments excavated (inspected) which were reliable (Fig. 6), generates a useful global gauge of monument utility. In other words, how often we should expect to find useful boundary monuments intact?

$$MUI = \left(\frac{M_F}{M_S}\right)\left(\frac{M_R}{M_I}\right) \quad (1)$$

Where:
MUI = Monument Utility Index
M_F = Monuments found through magnetic detection
M_S = Total Monuments sought
M_R = Monuments inspected which were reliable
M_I = Total Monuments inspected

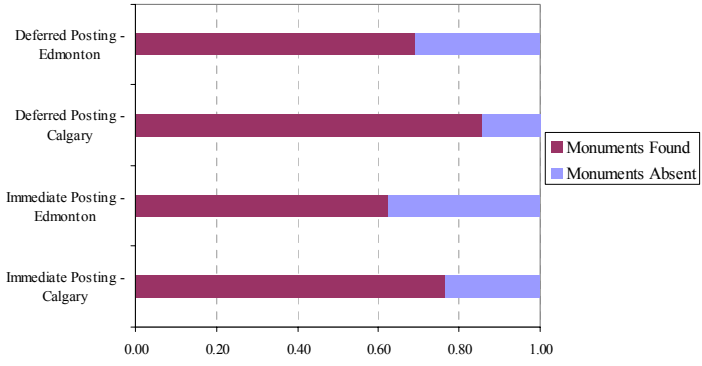

Fig. 5 – Proportion of Monuments Found/Absent Monuments

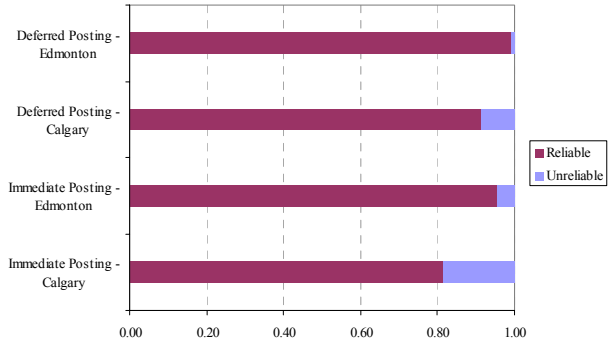

Fig. 6 – Proportion of Excavated Monuments which were reliable

Four areas were analysed in detail: immediate posting in subdivisions within the City of Calgary and the City of Edmonton (n=8 and n=3, respectively); and deferred posting in subdivisions within the same two cities (Calgary, n=7, and Edmonton, n=8). The

results of the MUI calculations are summarized in Table 1. In both cities, in total, 284 monuments were sought in immediate posted subdivisions, and 501 in deferred posted subdivisions. Of these 785 monuments sought, 213 (27%) were excavated for inspection to determine how useable the monuments were as a definition of the property boundary.

Table 1. *Summary of MUI values*

	Calgary - Immediate	**Edmonton - Immediate**	**Calgary - Deferred**	**Edmonton - Deferred**
Monuments sought - front	183	101	154	280
Monuments sought - rear	0	0	24	43
Monuments found -front	140	63	141	183
Monuments found - rear	0	0	11	40
Monuments Inspected -front	27	22	46	73
Monuments Inspected - rear	0	0	11	34
Monuments reliable - front	22	21	42	72
Monuments reliable - rear	0	0	10	34
Monuments Sought (M_S)	**183**	**101**	**178**	**323**
Monuments Found (M_F)	**140**	**63**	**152**	**223**
Monuments Inspected (M_I)	**27**	**22**	**57**	**107**
Monuments Reliable (M_R)	**22**	**21**	**52**	**106**
MUI - Front Posts	0.62	0.60	0.84	0.64
MUI - Rear Posts	N/A	N/A	0.42	0.93
Monument Utility Index (MUI)	**0.62**	**0.60**	**0.78**	**0.68**

The results for immediate posting subdivisions paint some bleak results for monument reliability. Immediate posting subdivisions within the City of Edmonton, for instance, generated an MUI of 0.60 - meaning approximately 40% of monuments are disturbed through the development process. The City of Calgary fared little better with an MUI of 0.62 on immediately posted subdivisions; which, again, indicates a monument disturbance rate of some 40%.

Results from deferred posting subdivisions in both cities, although an improvement from the immediate postings, still reflect poor monument reliability. Within the City of Calgary, the deferred posting sample generated an MUI of 0.78, or a 22% disturbance rate. The city of Edmonton's deferred posting subdivisions were a full 10 percentage points lower with an MUI of 0.68, or a 32% disturbance rate.

The 10 point difference in MUI values between the two cities on deferred monumentation is puzzling. The average deferral period in both cities was identical, and the depth at which the monuments were found did not differ significantly. The average size of the subdivision was substantially larger in Calgary, but if anything we would expect lower MUI scores as a result of a longer development process (and hence a greater risk of destruction of monuments). The MUI values for rear monuments (back of the lot) in Calgary (0.42) and Edmonton (0.93) provide little insight. Although this is a large difference, the rear monument scores were discounted because of small sample size, and a differing relative proportion of the cities total inspected monuments (32% - Edmonton, 19% - Calgary). The only inkling of a cause can be seen in the MUI values calculated from monuments at the front of lots (on the street). In Edmonton, of a total of 280 monuments, 183 (65%) were found; while, in Calgary, 141 of 154 (92%) front monuments were found. With all other factors neutralized, the divergence in deferred monument reliability at the front of lots would appear to be function of differing practices of survey firms and developers in the two cities.

Finally, a formula for a weighted MUI was created (Eq. 2) in order to combine deferred posting results together, and likewise for immediate posting results. The weighting was placed on the number of monuments sought per area. Immediate posting generated a weighted MUI of 0.61, and deferred areas generated a value of 0.72 (Table 2). This indicates that on average, monument deferral leads to an 11% increase in monument reliability.

$$MUI(weighted) = \frac{MUI_{Edmonton}(M_{S\{Edmonton\}}) + MUI_{Calgary}(M_{S\{Calgary\}})}{M_{S\{Edmonton\}} + M_{S\{Calgary\}}} \quad (2)$$

Table 2. *MUI(weighted) values*

	Calgary - Immediate	Edmonton - Immediate	Calgary - Deferred	Edmonton - Deferred
Monuments Sought (M_S)	183	101	178	323
MUI	0.62	0.60	0.78	0.68
MUI(weighted)	**0.61**		**0.72**	

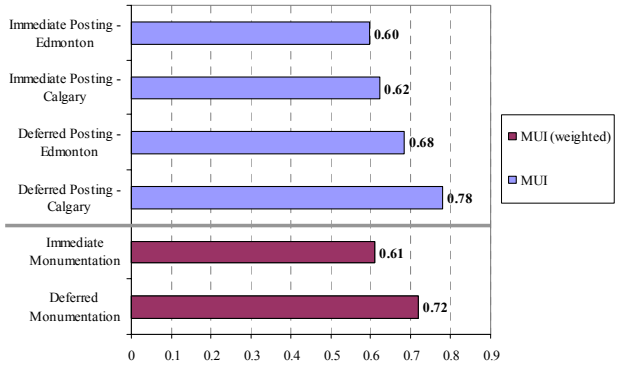

Fig. 7 – Individual and overall MUI scores.

Case Studies

Three case studies were undertaken to determine the stage of development which most affects monument reliability. The results of the case studies suggest that house construction, not service installation (water and gas lines) is the larger cause of boundary monument disturbance.

The first case study was a 47 lot Edmonton subdivision monumented after service installation but before the majority of house construction was complete (there were only two anomalies – a framed house, and a newly poured foundation). Of the 17 monuments sought, all (100%) were detected as lying vertically or leaning slightly. All monuments were considered to be reliable (MUI=1.0).

A 79 lot Edmonton subdivision was chosen for the second case study. Service installation had been completed, and nearly half the lots had completed houses on them (most already appeared to be occupied). Sidewalks had yet to be installed, and no significant degree of landscaping had been undertaken. Of the 54 monuments sought, 46 (85%) were detected. Of those which were excavated, 97% were considered to be reliable property markers. The two factors taken in conjunction produce an MUI value of 0.82.

The final case study was the analysis of 50 real property reports (RPR). The RPRs were valuable in that they identify in plan form all immovable structures on the property. Of special interest were those improvements (curbs, fire hydrants, streetlights) near the monuments at the corners of the property. Of the 230 monuments identified on the RPRs, 195 (85%) were reported as being reliable definitions of the property corners. The discrepancy between survival of front monuments (on the street), and rear monuments (back of lot) was of note. Of the 121 front monuments sought, 109 (90%) were found. Of the 109 rear monuments sought, 86 (79%) were found. Overall, the assumption made was that the RPRs represent a viable determination of the found monumentation, and that all 195 posts found would be considered useable. Therefore a MUI value of 0.85 was assigned.

CANVASSING OF STAKEHOLDERS

Stakeholders in the surveying and development sectors were canvassed for their perceptions on deferral. The significant questions focused on three fronts: 1 - The experience of land surveyors in monument disturbance in the development process. 2 - The current use of deferred monumentation. 3- The scheduling of monument placement and the advantages/disadvantages of extending the deferral period beyond the current one-year period.

The geographic scope of the inquiry was province wide and included 48 land surveyors, 17 municipalities, 112 land development companies, and 5 utility companies. Although the evidence gained through this canvassing work is subjective, the corroboration among disparate sources gives an accurate reflection of actual conditions. As well, it allows a marvelous comparison of the perceived (via the questionnaire), and the actual situation (from the empirical results of the monument excavations).

Estimates by surveyors on the rate of monument destruction by development averaged 39%. This was a global figure, and did not differentiate between immediate and deferred monumentation. Some estimated the rate of destruction to be as high as two-thirds, while most were more conservative and placed the destruction rate at one-third. In a bizarre contradiction, however, they nearly unanimously suggested that every property corner must be monumented. The reasons alluded to included: increased utility to landowners in identifying the boundaries of the properties, ease of subsequent survey, and overall minimization of ambiguity in boundary disputes. It was also agreed nearly unanimously, that even if a coordinate is the governing boundary evidence (as it is during the deferral period), that some form of temporary mark should be placed at corners to guide realtors, developers, and potential purchasers of the property.

There were, however, some dissenters in the ranks. Among the opposing opinions was the notion that any competent surveyor would have little difficulty in re-establishing monuments without physical evidence, and that any monument is merely an indication of the property corner (albeit a strong one) that needs to be confirmed with the surrounding survey framework. Further along this line was the minimally held opinion that monumentation was irrelevant after development (houses, fences, curbs) are in place.

To quantify the practice of deferred monumentation, respondents were asked if they use the deferral process, and if so how often they use it. Almost three quarters of respondents (73%) indicated that they use deferral, and it was used on average half of the time in subdivision work. Among the criteria for the use of deferral were: the desired timeframe for registration, expected development, timing of the construction

stages, and the size of the subdivision. The reasoning of those who responded in the negative on the use of deferral was: the perception that the product being delivered is incomplete, and that the process of deferred monumentation is lengthier and hence more expensive than immediate monumentation. This latter point was emphasized by several respondents. The logic is that significant extra drafting work must take place in the production of point diagrams and coordinate tables which accompany deferred monumentation plan registrations.

The majority of respondents indicated that they place monuments at property corners in deferred subdivisions after municipal services are constructed (and in some cases, sidewalks, curbs, and gutters), but before foundations are in place. It was recognized by most that the current one year deferral maximum (with a possible extension) was sufficient. Of those in the minority who preferred a longer deferral period, the average time allowed to elapse for monument placement was 2.8 years, with a maximum of five years cited. The perception is that this longer monument deferral allows greater flexibility and greater chance of monument survival. The caveat is that the longer deferral may adversely affect homeowners who do not have the wherewithal to locate their boundaries through coordinate methods.

In general, the responses from the development sector (development firms, utility companies) on the value of monuments can be summarized as apathetic. While it was acknowledged that monuments had value in assisting with house construction, the perceived significance of further monument reliability was not recognized. Furthermore, temporary staking was regarded as more than sufficient for most development practices.

Overall, the general apathy shown to monument reliability is reflected in the comments of the stakeholders. The title of this paper, drawn from a popular evolutionary biology book [**13**], is particularly apt in summation. Most parties involved display a general disregard to the survival of the boundary monuments akin to the natural world's pitiless indifference to the survival of its various species.

DISCUSSION

The debate surrounding deferral is, most likely, a function of deferral being a microcosm of a larger debate in the surveying community. That debate is about using coordinates exclusively to define and represent parcel boundaries. Deferral is viewed as the slippery slope towards a coordinate-based cadastre – the thin end of a wedge. Indeed, the coordinates debate in the survey profession can be traced back to at least 1966 when Hadfield noted glibly that a surveyor might think it "a dandy idea to get rid of stakes" [**15**]. Historically, surveyors have adhered staunchly to the concept of monuments-good, coordinates-bad [**10**],[**16**].

As couched in this dichotomy, however, the coordinate debate misses the point. The use of coordinates, albeit using bearings (or azimuths) and distances as opposed to Northings and Eastings, has been a common practice across Canada for some time. In the single front and double-front township systems in Ontario, rear corners of parcels were not originally monumented [**14**]. Their location was a function of direction and distance from front corner monuments. Through Western Canada, the Dominion Land Survey System's grid required that a typical section (divided into four quarter-sections) have only three corners monumented out of a possible nine [**19**]. Again, the other six parcel corners were a function of direction and distance from the three monuments, sometimes across a road allowance. In Alberta from 1912-1988 there was no requirement to monument individual parcel corners – only block corners were mandatory in legislation [**24**]. In the City of Calgary alone, over 109 000 parcels were created, built upon, and lived on, all in the absence of monuments [**8**].

Implicitly, all parties have agreed that mathematical interpretation of property limits (coordinates) is tolerable in some circumstances. However, in a questionnaire in 1984 about the rewriting of the S*urveys Act*, Alberta Land Surveyors (ALS) responded overwhelmingly (88%) that all lot corners should be monumented [**3**]. Likewise, the Alberta Bureau of Surveying and Mapping (ABSM) supported full monumentation with the justification that it provided "additional security of land tenure and may reduce costs of future relocation of property boundaries" [**1**].

All of this suggests that the current debate over monument deferral is rather disingenuous. If boundary monuments are in the public interest, we should not cloud the discourse with unhelpful coordinate paranoia. Instead, we should turn our attention to the reliability of the monuments themselves.

The results from the monument investigation indicate relatively poor monument reliability in both immediate and deferred monumentation regimes (MUI = 0.61, and 0.71 respectively). This corroborates the perception of the majority of stakeholders that monuments are destroyed roughly one-third of the time. Yet, strangely, nearly all canvassed indicated the value of boundary monuments to all parties, and that they should in all circumstance be placed at every property corner. The implication is that surveyors hold monuments to be in the public interest.

This, clearly, is a contradiction of striking proportions. If monuments are of such a value, how is a destruction rate of 30-40% tolerable? Moreover, if it is considered tolerable, then how can the ideology of the benefit of monuments at every corner be tenable? Either boundary monuments are a public good, and therefore reliability is a critical concern; or they are not, and placing monuments altogether becomes questionable.

If monuments are in the public interest, then every reasonable effort should be made to ensure their survival. For instance, judging by the eleven point increase in MUI values on deferred subdivisions, it would seem that deferral helps in some ways to increase monument reliability. Of the subdivisions analysed, 4.5 months was the average deferral period. Stakeholders canvassed indicated that monuments are generally placed in deferred subdivisions after service installation (water, gas) but before foundation staking.

In the two field case studies, monuments inspected after service installation were still reliable (MUI = 1.0); whereas monuments inspected after partial house construction showed a sharp decline (MUI =0.82). This suggests that house construction (primarily constructing foundations) is a far bigger determinant of monument reliability than service installation. Monument survival rates would therefore increase if the placement was deferred until after house construction. This intuitively rings true. However, surveyors' anxiety to appease developer clients outweighs their concern about the reliability of the monuments, and developers enjoy ease of staking foundations from parcel corner monuments.

If monuments are not established so as to give long-term certainty to landowners, then the dogma of placing monuments at all corners (and perhaps even placing monuments at all) is weakened by virtue of: 1- the significant time and expense of placing a boundary monument, and 2- a three foot iron post at all four corners of a typical parcel (as is now the norm in Alberta) is overkill for a primary function of house foundation staking.

CONCLUSION

The purpose of this article was to ascertain three things:
1- the reliability of boundary monuments in Alberta, 2- the major determinants of this reliability, and 3- what can be done to improve reliability. The intent of the criticism

is merely to reflect the logical contradictions in the stance of the profession in Alberta on monument reliability.

Prior to this study, it was intuitively and anecdotally known that monuments are destroyed as part of the development process. In some ways, the indifference shown to monument survival was explicable up to this point on the lack of concrete evidence to guide the decision-making process. Maintaining this indifference in the face of the empirical data presented here, however, is far more perplexing. It is hypothesized that for some the use of deferral has become so intertwined with the coordinate debate, that the knee-jerk reaction to the former is a function of the latter.

As an example, it was recommended to ALSA (bolstered by the research) to begin monitoring four new subdivisions, with coordinates as the boundary markers, over a five year period. The committee rejected the recommendation on the basis of primarily technical requirements. In particular, the lack of a suitable control infrastructure, and increased technical requirements (training, equipment) of working in a coordinate environment were mentioned as impediments [**4**]. Additionally, it was noted that landowners would be negatively impacted by the increased difficulty of locating the spatial extent of their parcels in the absence of monuments (in a coordinate based system) [**5**].

These technical concerns are quashed today by two separate realities:
1- the use of GPS is pervasive and 2 – techniques like Precise Point Positioning (PPP) [**21**] make integration with rigorous control networks facile. The appeal to landowner necessities, however, is as ill-conceived now as it was six years ago when the recommendation was made, for at least four reasons. First, there is no evidence to suggest that land owners would suffer difficulties in a coordinate-based subdivision. Indeed, as was outlined in the discussion, coordinate use is omnipresent across Canada, with seemingly few ill-effects. Second, it is hypocritical to rely on the so-called need that landowners have for monuments if a destruction rate of 30-40% persists. Third, the house and foundation is a good witness monument to the boundary. The ability to measure off perpendicular from a foundation (for fence construction, for instance) is a simple mechanical task, and one that is easily accessible to the landowner. Fourth, and most significantly, the objection prejudged the five-year research that was suggested, and paints the study as a Trojan horse to introduce coordinates into Alberta.

The debate on deferral, however, is still alive and well in Canada. In September 2008, the Surveyor General's Branch of the federal government was confronted with the realities of surveying a residential subdivision in Arviat, Nunavut, a small, remote hamlet. The surveyor was reluctant to impose immediate monumentation because the subdivision was to be back-filled within a fortnight to a depth of 1.5 m. Such backfilling would have the effect of rendering the monuments useless for most applications, either because they would be inaccessible or destroyed. The merits of deferring the monumentation until after the backfilling had finished were debated. However, it was decided to monument the exterior boundaries of the subdivision immediately, and to subdivide the internal parcels at some later point, as required. Deferred monumentation was not chosen in this instance, mainly due to the logistical difficulty of returning to Arviat to monument post-winter, some nine months hence.

Similarly, the use of coordinates is being debated in Manitoba. Manitoba Hydro is questioning the need to monument boundaries along thousands of kilometres of transmission line corridors. The superfluous role of monuments for such an application, the scale and location of the work, and the declining number of land surveyors are the driving factors behind the inquiry [**9**]. Although this is not explicitly deferral, the simple act of questioning monument use has obvious parallels.

Indeed, the Arviat and Manitoba Hydro cases serve as encouraging signs that the indifference towards deferral is not universal in Canada. It would seem that deferral, when used optimally, has a role in increasing monument reliability; while coordinates may fit the circumstances where placing a monument is impractical or excessive. The debate must hinge on these requirements. Clouding the discourse any other way is dishonest and misleading.

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