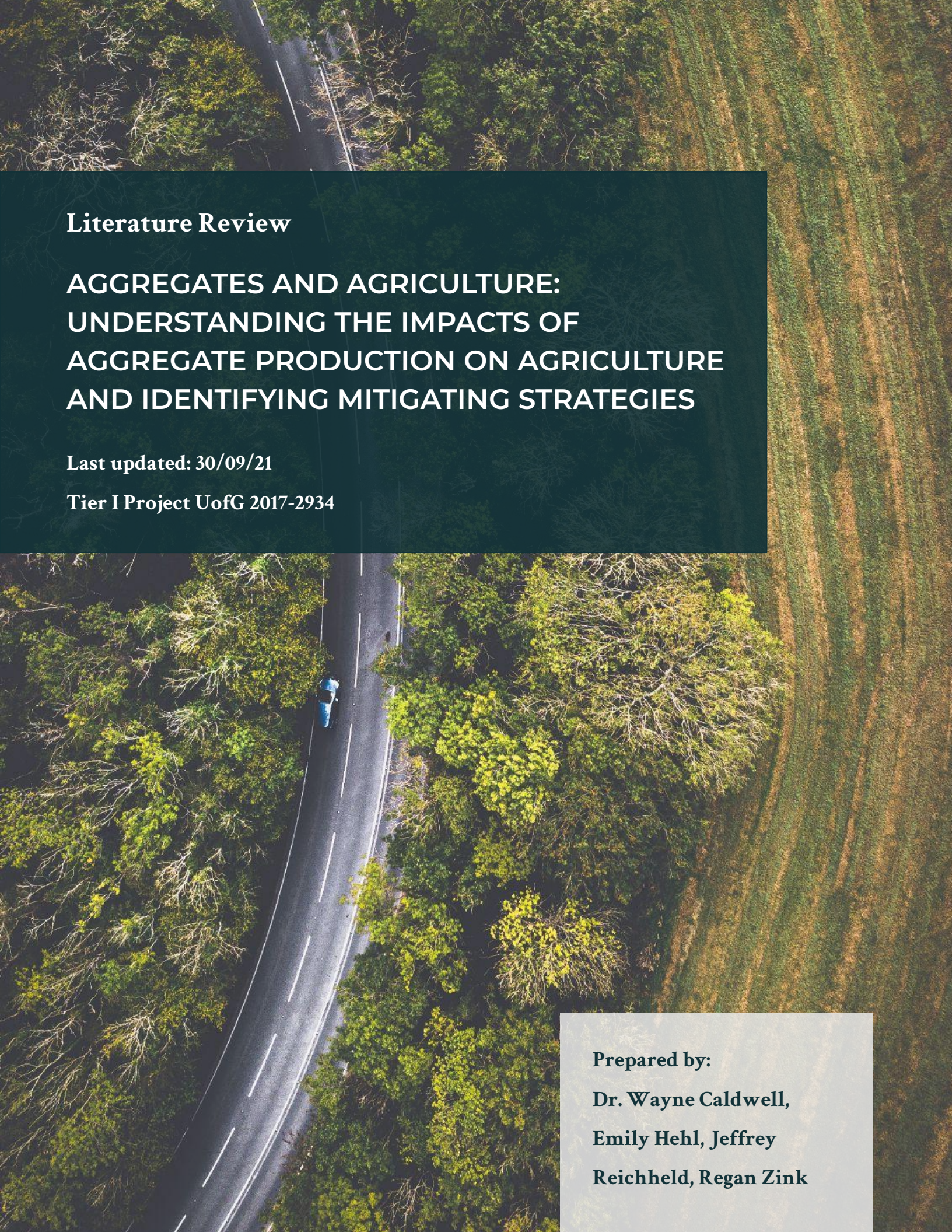

Literature Review

AGGREGATES AND AGRICULTURE: UNDERSTANDING THE IMPACTS OF AGGREGATE PRODUCTION ON AGRICULTURE AND IDENTIFYING MITIGATING STRATEGIES

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Tier I Project UofG 2017-2934

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Notes

This literature review is part of a study titled “Aggregates and Agriculture: Understanding the Impacts of Aggregate Production on Agriculture and Identifying Mitigating Strategies” being carried out by Dr. Wayne Caldwell and the School of Environmental Design and Rural Development at the University of Guelph. This project is funded by the Ontario Agri-Food Innovation Alliance, previously the OMAFRA- U of G Partnership.

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Definitions

CSPS - Comprehensive set of Policy Statements

GGH - Greater Golden Horseshoe

GTA - Greater Toronto Area

PQCA - Pits and Quarries Control Act

MARPS - Mineral Aggregate Resources Policy Statement

ARA - Aggregate Resource Act

PPS - Provincial Policy Statement

MNR - Ministry of Natural Resources

MNRF - Ministry of Mines, Natural Resources and Forestry

NDMNRF - Ministry of Northern Development, Mines, Natural Resources and Forestry

OMAFRA - Ontario Ministry of Agriculture, Food, and Rural Affairs

OSSGA - Ontario Stone, Sand, and Gravel

TOARC - The Ontario Aggregate Resource Corporation

OMB - Ontario Municipal Board

LPAT - Local Planning Appeal Tribunal

OLT - Ontario Land Tribunal

SAROS - State of Aggregate Resource in Ontario Study

1.0 Introduction

1.1 Project introduction

Aggregate extraction is a significant industry in Ontario, and contributes an estimated $1.6 billion to the Ontario economy (OSSGA, 2015). Aggregate materials are used to construct and maintain almost all of the infrastructure that many rely on day to day, including highways, bridges, and sewers (Binstock & Carter-Whitney, 2011; TOARC, 2019). As settlement areas expand to accommodate predicted population growth, so too will the aggregate industry.

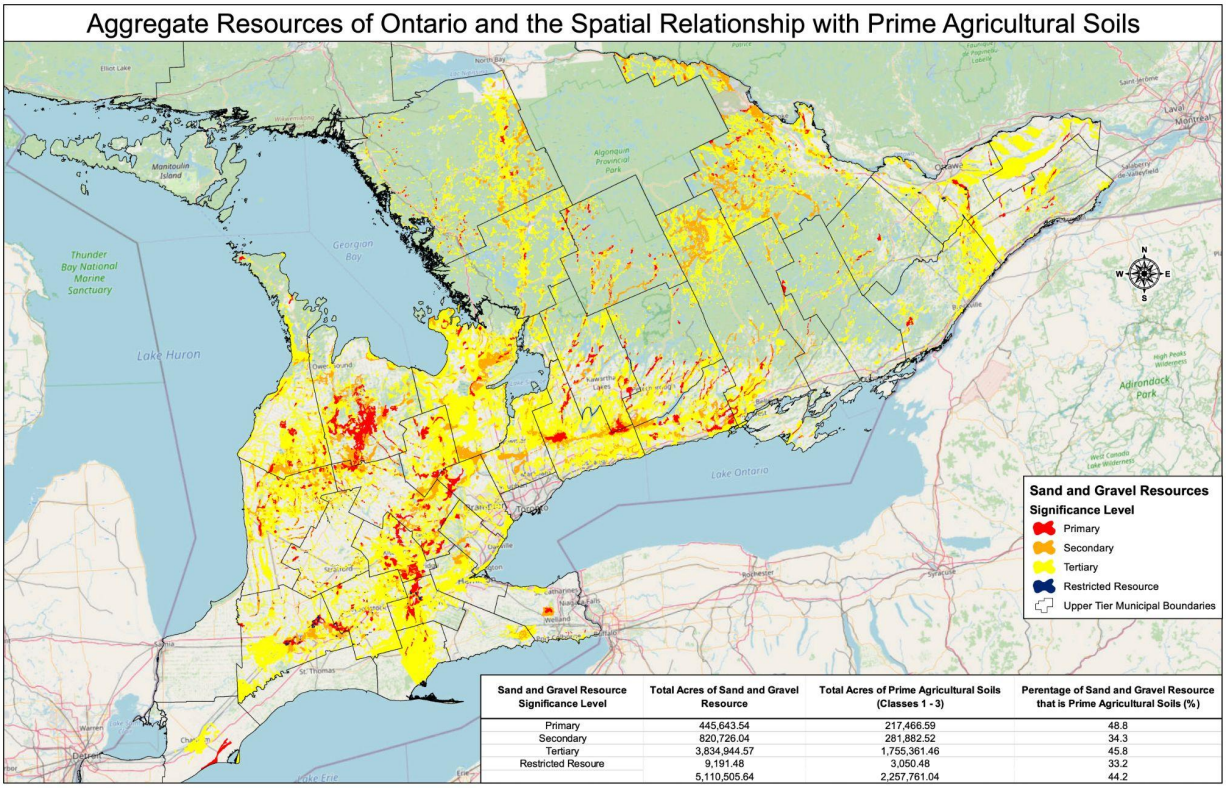
Due to economic, environmental, and social costs of transporting aggregate materials, it is prefered that aggregate extraction occurs in close proximity to development projects (Yundt, 1995, MNR, 2010). As the greatest part of population growth will occur in and around the GTA, the required aggregate will necessarily come from Southern Ontario (Chambers and Sandberg, 2007; Stewart, 1998). Southern Ontario is also home to some of the best agricultural land in Canada (Statistics Canada, 2006). This means that aggregate resources are often located on or adjacent to these agricultural lands and that the aggregate and agricultural industries are competing for the same landbase.

While there is some research on certain aspects of aggregate extraction, such as its environmental and economic impact, its social status, and the need and nature of rehabilitation, its impact on active farming has seen little, if any, focused study. The competition between aggregate extraction and agricultural land uses and the increasing interest around food production by a motivated and politicised population necessitates a closer examination of these potential conflicts. This report includes both academic and grey literature on the topic, and provides a review of the historic and current policy landscape, the impacts of aggregate extraction, the synergies between aggregates and agriculture, and existing research gaps.

1.2 Aggregates and agriculture in Ontario

As with all natural resources, aggregates can only be extracted where it occurs and is limited to the locations where materials are either at or near enough to the surface (e.g., Bloodworth, Scott & McEvoy, 2009; Corry, et al., 2008; Yundt, 1995). The 2010 State of the Aggregate Resource in Ontario Study (SAROS) reported that 93% of unlicensed aggregate available in Southern Ontario is located under environmental or agricultural land uses (MNR, 2010). More specifically the report concluded that there was a large overlap between prime agricultural land (Soil Class 1-3) and desirable bedrock resource areas (Ministry of Natural Resource, 2010). Figure 1, includes an analysis prepared by the Ministry of Agriculture, Food, and Rural Affairs in 2020 and confirms that 83% of Ontario's primary and secondary aggregate resources are located on prime agricultural lands (tertiary aggregate resources have limited utility and are not commonly used).

This inherently places the aggregate and agricultural sectors at odds as they are competing for the same land base. This also means that aggregate and agricultural land uses often operate adjacent to one another in the rural landscape.



Sand and Gravel Resource Significance Level	Total Acres of Sand and Gravel Resource	Total Acres of Prime Agricultural Soils (Classes 1 - 3)	Perentage of Sand and Gravel Resource that is Prime Agricultural Soils (%)
Primary	445,643.54	217,466.59	48.8
Secondary	820,726.04	281,882.52	34.3
Tertiary	3,834,944.57	1,755,361.46	45.8
Restricted Resoure	9,191.48	3,050.48	33.2
	5,110,505.64	2,257,761.04	44.2

Figure 1: Analysis looking at the spatial relationship between aggregate resources and prime agricultural soil (OMAFRA, 2020).

1.2.1 Aggregates in Southern Ontario

In 2015, it was reported that each year Ontario uses approximately 14 tonnes of aggregate per capita (MHBC Planning, 2015). This rate of consumption is higher than most developed countries (Atlus Group Economic Consulting, 2009). The GTA consumes approximately one third of all aggregate produced in Ontario annually and receives almost half of its aggregate resources from neighbouring communities (Atlus Group Economic Consulting, 2009). This puts strain on municipalities around the GTA as producers seek to locate sites close to markets.

Similarly, 75% of aggregate materials used in the Greenbelt area come from the Niagara Escarpment and Oak Ridges Moraine (MHBC Planning, 2015). These two areas, while rich in aggregates, are also home to some of the most viable agricultural land and significant environmental features in the province. Land in this area is protected from development and acts as a buffer between the highly developed GTA and the rest of

the province (Van Wagner, 2016). It can be concluded that land use conflict concerning aggregate resources is most intense in the GTA rural fringe where high volumes of accessible aggregate resources are being extracted in close proximity to some of Ontario's most sensitive environmental and agricultural features (Binstock & Carter-Whitney, 2011; Chambers & Anders Sandberg, 2007; MHBC Planning, 2015).

1.2.2 Agriculture in Southern Ontario

The agriculture and agri-food industries in Ontario contribute $47.7 billion in GDP annually, supporting over 837,000 jobs and approximately 11.6% of the Provincial labour force (OMAFRA, 2021). The Province of Ontario is home to over one quarter of Canada's farms and approximately 20% of prime agricultural land (Statistics Canada, 2017; Walton, 2003; Epp & Caldwell, 2018). Prime farmland, soil Classes 1-3, and specialty croplands, are an increasingly limited resource across Canada. Of all farmland in Canada only 5% is considered to be prime, with farmland in central and southern Ontario contributing a significant proportion to that statistic (Walton, 2003; Turvey, 2020).

An analysis prepared by OMAFRA in 2021, concluded that 27.8% of the total licenced area in Ontario is located on prime agricultural land (D. Crinklaw, personal communication, August 30, 2021). This represents approximately 44,245 hectares or 0.5% of prime agricultural land in the Province (Soil classes 1-3) (D. Crinklaw, personal communication, August 30, 2021). Beyond impacts to prime agricultural land, challenges related to fragmentation of the agricultural system pose challenges for agricultural productivity. Disrupting landscape continuity and ecosystem services, such as natural hydrology and wildlife habitats (e.g., pollintars), have negative consequences for agricultural productivity and the health of rural landscapes.

A number of provincial policies include provisions for prime agricultural lands, including: the Provincial Policy Statement, the Greenbelt Plan, Agricultural System policies, and a Place to Grow: Growth Plan for the Greater Golden Horseshoe. That being said, protection for prime agricultural lands varies across the province, with the most protected area being the Greater Golden Horseshoe (GGH).

1.3 Limitations

In preparing this literature review it became apparent that research looking at the relationship between aggregate and agricultural production is limited. A report prepared by the Canadian Institute for Environmental Law and Policy confirms the lack of research in this area and emphasizes the need to better understand the full cost of aggregate extraction, including social and environmental impacts (Binstock & Carter-Whitney, 2011). As a result some of the literature explored in this review is not directly related to agricultural production, however the topics discussed can be extrapolated and applied to assist in developing a general understanding of the relationship between aggregate extraction and agricultural production.

2.0 Aggregate & agriculture policy in Ontario

2.1 Historic policy landscape

The regulation of aggregates in Ontario has evolved from patchwork policy implementation at the municipal level to centralized Provincial regulation (Baker et al., 2001). Since the 1970's provincial policy has acknowledged the importance of both the aggregate and agricultural sectors. While the policy section of this literature review will focus primarily on the evolution aggregate policy, close attention will be paid to the intersection between aggregates and agriculture.

Aggregate policy first began to take shape in Ontario as a result of post World War II economic growth and suburban development. At this time, increased demand for aggregate products resulted in growing concerns from local governments and populations about the potential impacts of aggregate extraction (Baker et al., 2001). As more aggregate began to be exported from rural communities to adjacent urbanizing areas, it was hard to justify the negative externalities being experienced by rural communities and landscapes (Baker et al., 2001; Yundt & Messerschmidt, 1979). The Municipal Act (1948) followed by the Planning Act (1959) gave municipalities the authority to prohibit "the making or establishment of pits and quarries within the municipality".

As a result, municipalities across Ontario began to enact by-laws restricting the development and expansion of aggregate operations (Baker et al., 2001; Yundt & Messerschmidt, 1979). Beyond this, lobby groups such as the Preservation of Agricultural Land Society (PALS) and Stop the Operation of More Pits (STOMP) were formed in the 70s and 80s as a result of growing concerns related to social and environmental impacts, nuisance, and competition with other rural land uses (Baker et al., 2001; Yundt & Messerschmidt, 1979).

It wasn't long before concerns about potential aggregate shortages began to circulate (Yundt & Messerschmidt, 1979). The Department of Mines, in their Report of the Mineral Resources Committee (1969, 1970) asserted that ""There is a critical need for planned development of mineral resources close to urban areas to ensure an adequate supply of essential construction materials for the growth of the community."

2.1.1 Pits and Quarries Control Act, 1971

In 1971, the Provincial Government enacted the Pits and Quarries Control Act (PQCA) in an effort to ensure long-term availability of aggregate, enhance rehabilitation efforts, and limit environmental impact (Yundt & Messerschmidt, 1979). The PQCA gave the Province control over pits and quarries and assigned the

licensing process to the Ministry of Natural Resources (MNR) (Baker et al., 2001). The PQCA included major production areas such as southern Ontario, Sudbury, and Sault Ste. Marie (Baker et al., 2001). Although the PQCA was an initial attempt to manage the environmental impacts of the industry, inadequacies and oversights in policy became apparent after implementation. Estrin & Swaigen (1978), as cited in Baker et al. (2001), indicate that a combination of weak regulations, poorly detailed site plans, and insufficient enforcement of policy meant that the PQCA did not achieve its intended outcomes. PQCA was replaced by the Aggregate Resource Act (ARA) in 1990. For more about the ARA refer to Section 1.2.1.

2.1.2 Food Land Guidelines, 1978

Around this same time the Food Land Guidelines (1978) were created to assist with agricultural planning across the province. These guidelines helped to identify and protect agricultural land from urban and suburban expansion, and provided a process for re-designation of agricultural land for other uses including aggregate sites. "The general approach can be summed up as 'protect it all, but allow for an orderly retreat'" (Turvey, 2020, p. 5). It was generally believed that there was little conflict between aggregate and agricultural land uses, as rehabilitation allowed for the return to agriculture after extraction. This approach was supported by a number of studies completed in the 1980's by the MNR looking at the possible after uses of rehabilitated sites, including a study titled "Agriculture and the Aggregate Industry: Rehabilitation of Extracted Sand and Gravel Lands to an Agricultural After-Use (1982)" which emphasized that aggregates were a "temporary" or "interim" use and that extraction below the water table was sometimes justifiable for economic reasons (OSSGA, 2013, pg. 9).

The Food Land Guidelines were amended in 1983 to require agricultural rehabilitation for aggregate extraction to occur on prime agricultural land (referred to as " good general agricultural land" at the time) and specialty crop areas. A study titled Rehabilitation of Sand and Gravel Pits for Fruit Production in Ontario was completed by the MNR in 1985 in response to this and concluded that there was some risk that aggregate extraction may impact production of specialty crops (MNR, 1985).

Through numerous updates the approach outlined in the 1978 Food Land Guidelines remained generally the same until the mid 2000s when the agricultural systems approach was introduced (Turvey, 2020). Today, the provincial government requires the adoption of the agricultural system approach within the GGH and encourages municipalities outside of the GGH to do similar (Turvey, 2020).

2.1.3 Mineral Aggregate Resources Policy Statement (MARPS), 1986 and Comprehensive Set of Policy Statements (CSPS), 1995

Throughout the 1980s, policy regulating aggregate resources continued to be formalized (Baker et al., 2001; Binstock & Carter-Whitney, 2011). In 1976, Aggregate Working Party was formed by the MNR to examine the industry, address municipal concerns, and provide suggestions on how local opinions could be addressed while still meeting provincial objectives (Baker et al., 2001). Recommendations and policy guidelines prepared by the Party created the basis of the Mineral Aggregate Policy for Official Plans (1979), which was followed by the Mineral Aggregate Resource Planning Policy (1982), and was incorporated in the Planning Act in 1986 as the Mineral Aggregate Resources Policy Statement (MARPS) (Baker et al., 2001).

MARPS officially recognized aggregate resources as a provincial interest and aimed to ensure that aggregate resources remained locally available, that existing licenses were protected from incompatible land uses, and that aggregate deposits would be available for future extraction (Baker et al., 2001; Binstock & Carter-Whitney, 2011; Bull & Estrela, 2012). Additionally, MARPS asserted that aggregate extraction was "temporary" or "interim" use, emphasizing that rehabilitation could return the site to its original use. Around this time (1982) the Planning Act was amended so that municipalities no longer held the authority to prohibit "the making or establishment of pits and quarries".

MARPS was criticized for seemingly promoting the interest of the province without regard for municipal level concern (Baker et al., 2001). Less than a decade later, MARPS would be replaced by the Comprehensive Set of Policy Statements (CSPS) (1995). Relevant to agriculture, CSPS permitted aggregate extraction on prime agricultural land (requiring complete agricultural rehabilitation, same soil and same area) and introduced provisions for below water table extraction (subsequently waiving the requirement for complete agricultural rehabilitation of prime agricultural lands if a number of criteria were met). This was the first provincial policy that provided provisions for aggregate extraction below the water table.

CSPS was replaced by the Provincial Policy Statement (PPS) in 1997, less than two years after CSPS was issued. General planning principles and approaches established by MARPS and CSPS are still present in the PPS today. For more about the PPS refer to Section 1.2.2.

2.2 Current policy landscape

The Province of Ontario's interest in aggregate extraction has remained strong over the past four decades (SAROS Paper #2, 2009). However, this same time period has seen continued local concerns regarding the environmental impacts of pits and quarries and increased pressure to consider alternative sources of aggregate or locating aggregate sites further from markets (SAROS Paper #2, 2009). Today, the aggregate

industry is one of the most heavily regulated industries in the province (Ontario, 2019). The Ontario Stone Sand and Gravel Association (OSSGA) reports that the industry is regulated by more than "25 pieces of legislation and hundreds of regulations" (OSSGA, 2019a, p. 4).

The Aggregate Resource Act (ARA) in conjunction with the PPS, form the core regulatory framework for aggregate extraction in Ontario. Beyond this there are a growing number of provincial plans, policies and guidelines that are relevant to aggregate extraction, including the Planning Act, Environmental Assessment Act, On-Site and Excess Soil Management, and Endangered Species Act, among others (OSSGA, 2015).

Since 2005 there has been a renewed interest in the relationship between aggregates and agriculture. In 2010, the Province completed an intensive aggregate resource study which consisted of six industry lead research papers investigating: consumption needs and trends; availability and alternatives; economic, social, and environmental value; reuse and recycling; limestone and dolostone reserves; and rehabilitation. Many of these research papers either touch on or discuss at length the relationship between aggregate and agriculture from a high-level industry perspective. Then in 2016, OMAFRA contracted a consulting firm to prepare a Resource Guide for Aggregate Extraction on Agricultural Lands.

The following subsections provide an overview of the aggregate licensing process in Ontario, ARA and PPS, as well as a number of secondary plans, policies, guidelines that contribute to the current policy landscape. There is ongoing criticism that provincial policies prioritize access to aggregate resources over other land uses (Baker, Slam, & Summerville, 2001; Winfield & Taylor, 2005; Binstock & Carter-Whitney, 2011; ECO, 2014; Shotyk & Powell, 2021). Particular attention will be paid to the tension between aggregates and agriculture from a policy perspective.

2.2.1 Aggregate Licensing in Ontario

The aggregate licensing process in Ontario today is very different from what was required in the late 1900s. Typically there are three steps or separate applications required for the licensing of an aggregate extraction site (this applies to both pits and quarries) - an Official Plan Amendment, a Zoning By-law Amendment, and an Aggregate License Application. Local, regional, and provincial governments are involved in this process.

The Planning Act applications occur at a local or regional level while the Aggregate Licensing Process is regulated by the province (MNRF). The province will not issue an Aggregate License unless the Zoning at a municipal level is appropriate for the activity. These processes all involve various levels of public participation and consultation and are appealable to the OMB/LPAT/OLT (Government of Ontario, 2020). It should also be noted that these applications often require multiple supporting studies and that duplicates of the same study, or multiple peer reviews, may be required in some instances. Typical supplemental studies include: Hydrogeological Report(s), Environmental Impact Statement(s), Agricultural Impact Assessment(s),

Archeological Assessment(s), Noise/Vibration Studie(s), and Traffic Impact Study(s). Additionally, aggregate sites are subject to Site Plan Control and a formal site plan must be submitted with the application.

The entirety of the licensing process, from application to approval, takes several years to complete.

2.2.2 Aggregate Resource Act, 1990

In 1990, the Aggregate Resources Act (ARA) replaced the Pits and Quarries Control Act (PQCA) in an effort to gain control over extraction rates which increased from 131 to 197 million tonnes between 1987 and 1989 (Baker et al., 2001). The ARA, is issued by MNRF and regulates aggregate extraction on both private and Crown lands. The ARA does not cover the entire province, Figure 2 is a map of designated private and Crown land where the ARA applies. In areas that are not "designated", municipal by-laws and/or development agreements regulate aggregate extraction. All aggregate extraction on land within the aggregate designated area requires a license.

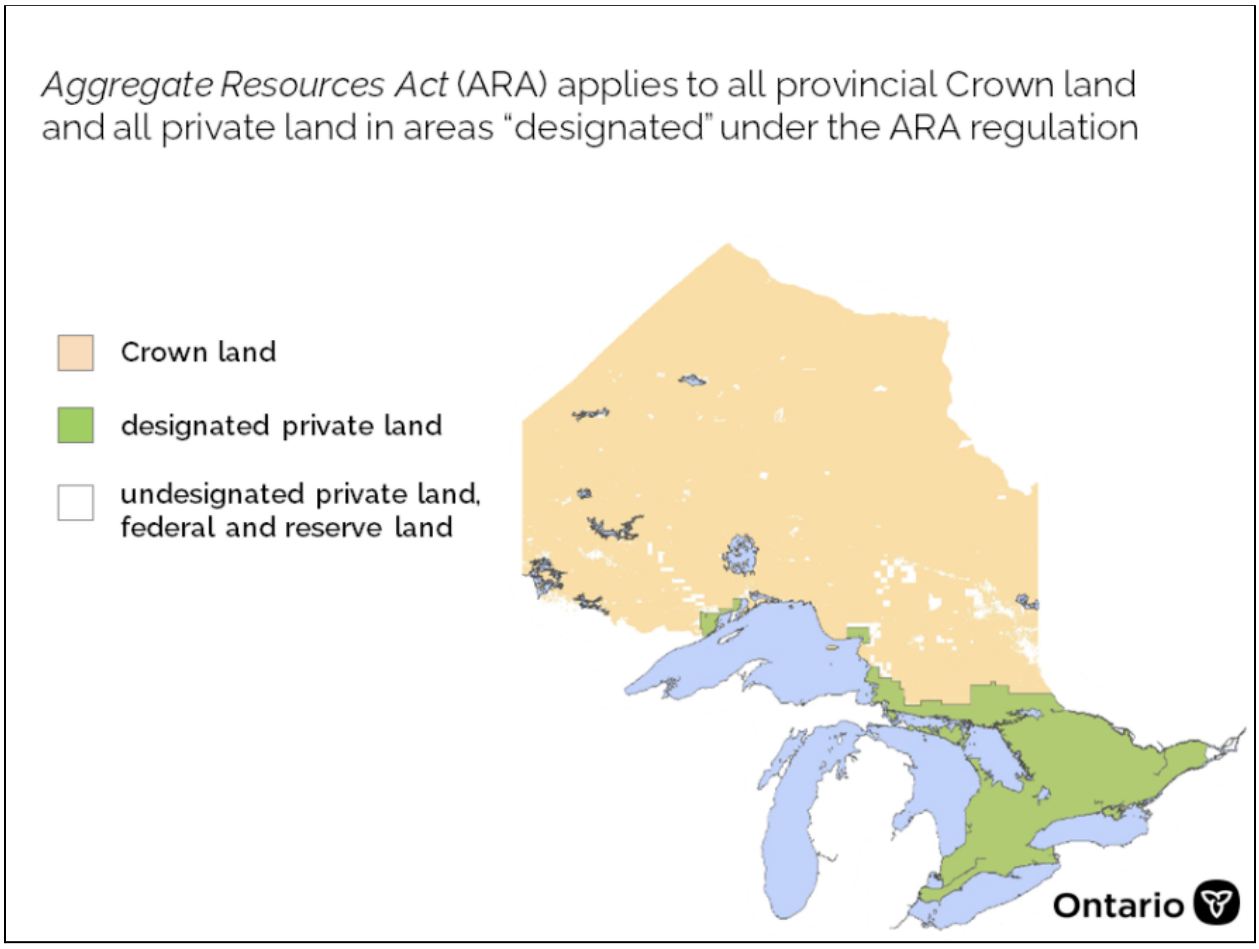


Figure 2 - Map of designated private land areas that are subject to the Aggregate Resources Act (MNRF, n.d.).

The ARA and it's amendments add more stringent and detailed requirements for the approval process and expanded the geographic coverage of PQCA (Figure 2 above) (Binstock & Carter-Whitney, 2011). Additionally, the ARA requires enhanced interaction between the aggregate industry and the public during the licensing process, reduces the role of government, and places more of the onus on aggregate operators (Baker et al., 2001). Part of this transition included the creation of the Aggregate Resource Trust (199, an industry-led organization overseen by the government, responsible for collecting annual licence fees, ensuring the proper implementation of rehabilitation plans, and rehabilitating abandoned sites (Baker et al., 2001).

A common term used by the industry is "legacy sites", the ARA refers to these sites as "abandoned pits and quarries" and specifically refers to pits and/or quarries that stopped operating before licensing and permit requirements came into force (January 1, 1990). These sites are being rehabilitated by The Ontario Aggregate Resource Corporation (TOARC) through the Management of Abandoned Aggregate Properties Program and funding from the Aggregate Resources Trust. TOARC reports 8,209 legacy pits and quarries in Ontario (n.d.). This is in addition to over 3,600 active licenses and 2,500 active permits licensed under the ARA (Ontario GeoHub, 2018).

There is only one specific mention of agriculture in the ARA. Section 12 (1) provides guidance on matters to be considered, when deciding if a licence should be issued or refused including: (f) "any possible effect of the operation of the pit or quarry on agricultural resources", along with considerations for the environment, effects on nearby communities, the suitability of rehabilitation, among others. Beyond this there is no explicit mention of agriculture or agricultural land uses.

Sections of the ARA relevant (but not explicitly linked) to agricultural land uses and agricultural rehabilitation include:

> ***2*** *The purposes of this Act are,*
>
> ***(c)*** *to require the rehabilitation of land from which aggregate has been excavated; and*
>
> ***(d)*** *to minimize adverse impact on the environment in respect of aggregate operations. R.S.O. 1990, c. A.8, s. 2.*
>
> ***48 (1)*** *Every licensee and every permittee shall perform progressive rehabilitation and final rehabilitation on the site in accordance with this Act, the regulations, the site plan and the conditions of the licence or permit to the satisfaction of the Minister. R.S.O. 1990, c. A.8, s. 48 (1).*
>
> ***Surrender of licence***

19 (1) *The Minister may accept the surrender of a licence on being satisfied that the licensee's annual licence fees and rehabilitation security payments, and special payments if applicable, have been paid and that rehabilitation has been performed in accordance with this Act, the regulations, the site plan, if any, and the conditions of the licence. 1996, c. 30, s. 16.*

Definitions of environment, rehabilitate, progressive rehabilitation, and final rehabilitation as provided by the ARA are included below:

> *"**environment**" means the air, land and water, or any combination or part thereof of the Province of Ontario.*
>
> *"**rehabilitate**" means to treat land from which aggregate has been excavated so that the use or condition of the land,*
>
> *(a) is restored to its former use or condition, or*
>
> *(b) is changed to another use or condition that is or will be compatible with the use of adjacent land.*
>
> *"**progressive rehabilitation**" means rehabilitation done sequentially, within a reasonable time, in accordance with this Act, the regulations, the site plan and the conditions of the licence or permit during the period that aggregate is being excavated.*
>
> *"**final rehabilitation**" means rehabilitation in accordance with this Act, the regulations, the site plan and the conditions of the licence or permit performed after the excavation of aggregate and the progressive rehabilitation, if any, have been completed.*

In conjunction with the ARA the Provincial Standards of Ontario provides information and study requirements for 13 categories (e.g., pit, quarry, above water, below water, crown land, etc.) of licenses. As part of the application and licensing process the Canada Land Inventory class of the site must be identified. The Provincial Standards also provide consultation requirements for applications, and require that the complete application package be circulated to OMAFRA if "only if prime agricultural land is not being restored to the same average soil quality". The applicant is the one responsible for identifying if this is the case.

Similar to the ARA Provincial Standards, the ARA provides a list of operational standards (Section 0.13 of O. Reg. 244/9) and guidelines for aggregate operators. The operational standards provide baseline rehabilitation requirements, including: reducing compaction; topsoil and overburden removal, storage, and replacement; and revegetation and drainage provisions. There is no specific mention of agricultural rehabilitation.

2.2.3 Provincial Policy Statement (PPS), 2020

The PPS is issued under Section 3 of the Planning Act, which states that all planning decisions shall be consistent with the PPS. The PPS contains key policy guidelines for the Province related to land use planning and development, including: the efficient use and management of land and infrastructure; the provision of sufficient and affordable housing; the protection of the natural environment and resources (including farmland); economic development and job creation; infrastructure needs; and manage land use conflict (Ontario, 2020). In 2020 the PPS was updated to reflect the More Homes, More Choice Act, 2019 and support the Provincial government's goals related to reducing red tape, supporting jobs, and increasing access to housing (Ontario, 2020). Limited changes were made to Section 2.5 Mineral Aggregate Resources and Section 2.3 Agriculture and so much of the discussion regarding these sections from the 2014 PPS are still relevant today.

2.2.3.1 Aggregates in the PPS, 2020

As first established by the MARPS and CCSP, aggregate extraction is recognized by the PPS (2020) as a provincial priority, an interim use, and is permitted on prime agricultural land provided that agricultural rehabilitation occurs. There are additional provisions that allow for aggregate extraction below the water table in some circumstances, waiving the requirement for complete agricultural rehabilitation.

Section 2.5 of the PPS (2020) includes policies relevant to Mineral Aggregate Resources:

> ***2.5.1*** *Mineral aggregate resources shall be protected for long-term use and, where provincial information is available, deposits of mineral aggregate resources shall be identified.*
>
> ***2.5.2.1*** *As much of the mineral aggregate resources as is realistically possible shall be made available as close to markets as possible.*
>
> *Demonstration of need for mineral aggregate resources, including any type of supply/demand analysis, shall not be required, notwithstanding the availability, designation or licensing for extraction of mineral aggregate resources locally or elsewhere.*
>
> ***2.5.2.2*** *Extraction shall be undertaken in a manner which minimizes social, economic and environmental impacts.*
>
> ***2.5.2.5*** *In known deposits of mineral aggregate resources and on adjacent lands, development and activities which would preclude or hinder the establishment of new operations or access to the resources shall only be permitted if:*
>
> *a) resource use would not be feasible; or*

b) the proposed land use or development serves a greater long-term public interest; and

c) issues of public health, public safety and environmental impact are addressed.

2.5.3 Rehabilitation

2.5.3.1 *Progressive and final rehabilitation shall be required to accommodate subsequent land uses, to promote land use compatibility, to recognize the interim nature of extraction, and to mitigate negative impacts to the extent possible. Final rehabilitation shall take surrounding land use and approved land use designations into consideration.*

2.5.4 Extraction in Prime Agricultural Land

2.5.4.1 *In prime agricultural areas, on prime agricultural land, extraction of mineral aggregate resources is permitted as an interim use provided that the site will be rehabilitated back to an agricultural condition. Complete rehabilitation to an agricultural condition is not required if:*

a) outside of a specialty crop area, there is a substantial quantity of mineral aggregate resources below the water table warranting extraction, or the depth of planned extraction in a quarry makes restoration of pre-extraction agricultural capability unfeasible;

b) in a specialty crop area, there is a substantial quantity of high quality mineral aggregate resources below the water table warranting extraction, and the depth of planned extraction makes restoration of pre-extraction agricultural capability unfeasible;

c) other alternatives have been considered by the applicant and found unsuitable. The consideration of other alternatives shall include resources in areas of Canada Land Inventory Class 4 through 7 lands, resources on lands identified as designated growth areas, and resources on prime agricultural lands where rehabilitation is feasible. Where no other alternatives are found, prime agricultural lands shall be protected in this order of priority: specialty crop areas, Canada Land Inventory Class 1, 2 and 3 lands; and

d) agricultural rehabilitation in remaining areas is maximized.

The 2020 PPS provides the following definition of agricultural condition and specialty crop area:

Agricultural condition: *means*

a) in regard to specialty crop areas, a condition in which substantially the same areas and same average soil capability for agriculture are restored, the same range and productivity of specialty crops common in the area can be achieved, and, where applicable, the microclimate on which the site and surrounding area may be dependent for specialty crop production will be maintained or restored; and

b) in regard to prime agricultural land outside of specialty crop areas, a condition in which substantially the same areas and same average soil capability for agriculture are restored.

Specialty crop area: *means areas designated using guidelines developed by the Province, as amended from time to time. In these areas, specialty crops are predominantly grown such as tender fruits (peaches, cherries, plums), grapes, other fruit crops, vegetable crops, greenhouse crops, and crops from agriculturally developed organic soil, usually resulting from:*

a) soils that have suitability to produce specialty crops, or lands that are subject to special climatic conditions, or a combination of both;

b) farmers skilled in the production of specialty crops; and

c) a long-term investment of capital in areas such as crops, drainage, infrastructure and related facilities and services to produce, store, or process specialty crops.

The 2020 PPS does not provide a definition of interim use and as a result this is left up to interpretation.

2.2.3.2 Agriculture in the PPS, 2020

The PPS also protects prime agricultural areas for long-term use (Section 2.3.1) and identifies "sustaining and enhancing the viability of the agricultural system through protecting agricultural resources, minimizing land use conflicts, providing opportunities to support local food, and maintaining and improving the agrifood network" as an important part of long-term economic prosperity (Section 1.7.1). Section 2.3 of the PPS contains policies related to agriculture:

2.3.1 *Prime agricultural areas shall be protected for long-term use for agriculture. Prime agricultural areas are areas where prime agricultural lands predominate. Specialty crop areas shall be given the highest priority for protection, followed by Canada Land Inventory Class 1, 2, and 3 lands, and any associated Class 4 through 7 lands within the prime agricultural area, in this order of priority.*

2.3.2 *Planning authorities shall designate prime agricultural areas and specialty crop areas in accordance with guidelines developed by the Province, as amended from time to time.*

Planning authorities are encouraged to use an agricultural system approach to maintain and enhance the geographic continuity of the agricultural land base and the functional and economic connections to the agri-food network.

The agricultural system approach was introduced in 2005 as part of the Greenbelt Plan and in 2017 the province committed to providing base mapping of prime agricultural areas in the GGH (Turvey, 2020). The 2020 update to the PPS encourages municipalities outside of the GGH to adopt the agricultural system

approach and undertake similar mapping exercises (Turvey, 2020). The agricultural systems approach emphasizes that agricultural land uses must be viewed as a system of component parts/actors (e.g., farmers, processors, distributors, etc.) that contribute to a healthy and thriving agri-food sector. The definition of the agricultural system from the PPS (2020) is included below.

The PPS (2020) also contains provisions regarding permitted uses in prime agricultural areas, including:

2.3.3.1 *In prime agricultural areas, permitted uses and activities are: agricultural uses, agriculture-related uses and on-farm diversified uses. Proposed agriculture-related uses and on-farm diversified uses shall be compatible with, and shall not hinder, surrounding agricultural operations. Criteria for these uses may be based on guidelines developed by the Province or municipal approaches, as set out in municipal planning documents, which achieve the same objectives.*

2.3.3.2 *In prime agricultural areas, all types, sizes and intensities of agricultural uses and normal farm practices shall be promoted and protected in accordance with provincial standards.*

2.3.3.3 *New land uses in prime agricultural areas, including the creation of lots and new or expanding livestock facilities, shall comply with the minimum distance separation formulae.*

2.3.6 Non-Agricultural Uses in Prime Agricultural Areas

2.3.6.1 *Planning authorities may only permit non-agricultural uses in prime agricultural areas for:*

a) extraction of minerals, petroleum resources and mineral aggregate resources; or

b) limited non-residential uses, provided that all of the following are demonstrated:

1. the land does not comprise a specialty crop area;
2. the proposed use complies with the minimum distance separation formulae;
3. there is an identified need within the planning horizon provided for in policy 1.1.2 for additional land to accommodate the proposed use; and
4. alternative locations have been evaluated, and
i. there are no reasonable alternative locations which avoid prime agricultural areas; and
ii. there are no reasonable alternative locations in prime agricultural areas with lower priority agricultural lands.

2.3.6.2 *Impacts from any new or expanding non-agricultural uses on surrounding agricultural operations and lands are to be mitigated to the extent feasible.*

Of note, proposed agriculture-related uses and on-farm diversified uses shall "not hinder surrounding agricultural operations", while impacts from new or expanding non-agricultural uses (aggregate extraction) are "to be mitigated to the extent feasible". The PPS (2020) provides the following definitions of prime agricultural area, prime agricultural land, and agricultural system:

> ***Prime agricultural area:*** *means areas where prime agricultural lands predominate. This includes areas of prime agricultural lands and associated Canada Land Inventory Class 4 through 7 lands, and additional areas where there is a local concentration of farms which exhibit characteristics of ongoing agriculture. Prime agricultural areas may be identified by the Ontario Ministry of Agriculture and Food using guidelines developed by the Province as amended from time to time. A prime agricultural area may also be identified through an alternative agricultural land evaluation system approved by the Province.*
>
> ***Prime agricultural land:*** *means specialty crop areas and/or Canada Land Inventory Class 1, 2, and 3 lands, as amended from time to time, in this order of priority for protection.*
>
> ***Agricultural System:*** *A system comprised of a group of inter-connected elements that collectively create a viable, thriving agricultural sector. It has two components:*
>
> *a) An agricultural land base comprised of prime agricultural areas, including specialty crop areas, and rural lands that together create a continuous productive land base for agriculture; and*
>
> *b) An agri-food network which includes infrastructure, services, and assets important to the viability of the agri-food sector.*

The PPS (2020) also provides a variety of related definitions including agricultural uses, agri-food network, agri-tourism uses, and agriculture-related uses.

2.2.3.3 Reading the PPS

Part III of the PPS provides guidance for how the PPS should be read and recommends the following:

- The PPS is to be read in its entirety;
- All relevant policies should be considered and integrated together;
- The order of the policies does not imply priority; and
- The language of each policy is key to understanding the implementation and interpretation.

Applying the PPS in its entirety and considering all relevant policies can be challenging, and resulting decisions are frequently appealed to the OMB. When using discretion, it is unclear which policies should be prioritized and in what circumstances one policy should be given priority over another. The nature of using

discretion is such that personal values are assigned some weight and as a result decisions are subjective and disputes can easily arise.

Policies regarding aggregates are much stronger and more persuasive than policies for prime agricultural lands. The PPS instructs that aggregates be sourced as close to the market as possible and waives the industry from having to demonstrate need (Section 2.5.2.1). Section 2.5.2.2 requires that extraction "be undertaken in a manner which minimizes social, economic, and environmental impacts" however the weight of that statement does little to advocate for agricultural protection in light of proximity to markets. The general directive of the PPS is heavily focused on economic growth and as a result aggregate extraction may be championed over agricultural concern. Furthermore, Section 2.5.2.5 of the PPS also introduces an interesting dynamic where agricultural uses are seen as a secondary use on prime agricultural land when aggregate materials are located beneath it.

While the PPS requires that prime agricultural land be "rehabilitated back to an agricultural condition", complete rehabilitation is not required outside of a specialty crop area if "there is a substantial quantity of mineral aggregate resources below the water table **or** the depth of planned extraction in a quarry makes restoration of pre-extraction agricultural capability unfeasible" (Section 2.5.4.1a). Even within specialty crop areas extraction without complete rehabilitation is permissible if "there is a substantial quantity of high quality mineral aggregate resources below the water table warranting extraction, **and** the depth of planned extraction makes restoration of pre-extraction agricultural capability unfeasible" (Section 2.5.4.1b). In both of these situations, there is a precondition that "alternatives have been considered by the applicant and found unsuitable" (Section 2.5.4.1). However, the wording of this policy leaves the potential for lost prime agricultural lands at the discretion of aggregate applicants. It should also be noted that the agricultural policies outlined in the PPS are not inclusive of agricultural land, and are specific to specialty crop and prime agricultural areas.

2.2.4 Other relevant legislation

As mentioned previously, there are more than 25 pieces of legislation and hundreds of regulations that regulate the aggregate industry (OSSGA, 2019a, p. 4). The Ontario Environmental Protection Act (1990) provides a definition of contaminant that includes " sound, vibration" that result either "directly or indirectly from human activities that causes or may cause an adverse effect". Further to this the Ministry of Environment and Climate Change Environmental Noise Guideline - Stationary and Transportation Sources provides guidelines to land use professionals about the potential conflict between noise emitting and noise sensitive land uses.

Sensitive land uses include:

- "a property of a person that accommodates a dwelling and includes a legal nonconforming residential use; or
- a property of a person that accommodates a building used for a noise sensitive commercial purpose; or
- a property of a person that accommodates a building used for a noise sensitive institutional purpose" (MOECC, 2013).

It's important to note that agricultural uses, including livestock operations, are not considered a sensitive land use.

2.3 Policy imbalance

Both aggregates and agriculture are natural resource industries. While both sectors provide essential resources, rely heavily on the natural environment, and are protected by the Province for long-term use, there are some distinct differences. Agriculture, much like forestry, benefits from stewardship and sustainable management of the environment for the industries long term benefit. Aggregate extraction on the other hand, relies on the extraction of a finite resource (much like mining) and does not benefit in the same way from long-term planning and environmental stewardship.

As discussed previously, the development of aggregate policy and regulation in Ontario appears to be accelerated by criticism and rising conflict between competing land uses. Although there were notable attempts to rectify these issues (the Pits and Quarries Control Act, MARPS, ARA, etc.), regulation is criticized for a lack of meaningful change between political regimes (Baker et al., 2001; Binstock & Carter-Whitney, 2011; Yundt & Messerschmidt, 1979). Particularly, weak regulations, insufficient licensing requirements, and minimal enforcement are the key issues highlighted by Estrin & Swaigen (1978), and echoed by Baker et al. (2001). Provincial policy has established and maintained aggregate resources as a provincial interest since 1983 (Baker et al., 2001; Binstock & Carter-Whitney, 2011; Bull & Estrela, 2012; Government of Ontario, 2021).

M. S. Winfield & Taylor in 2005, argued that Ontario's policy framework for regulating aggregate resources was not sustainable for the long-term as policy continues to prioritize aggregate extraction over other important land uses that may better support public interest (such as environmentally sensitive landscapes and prime agricultural lands). This was predicted to cause increasingly tense social conflicts across southern Ontario where the competition between aggregate extraction and environmental protection and social wellbeing is most acute (M. S. Winfield & Taylor, 2005).

Although developed seemingly through trial and error, the ARA implemented in 1990 added more stringent and detailed requirements for licensing. Additionally, the ARA works to expand the reach of aggregate

regulation through increased geographic coverage (Binstock & Carter-Whitney, 2011). Most recent amendments establish stricter industry operating standards that place more accountability on operators, reducing the role of government. The current hierarchy of Ontario's Planning documents involved in the regulation of aggregate extraction is pictured below (Figure 3, prepared by Emily Hehl).

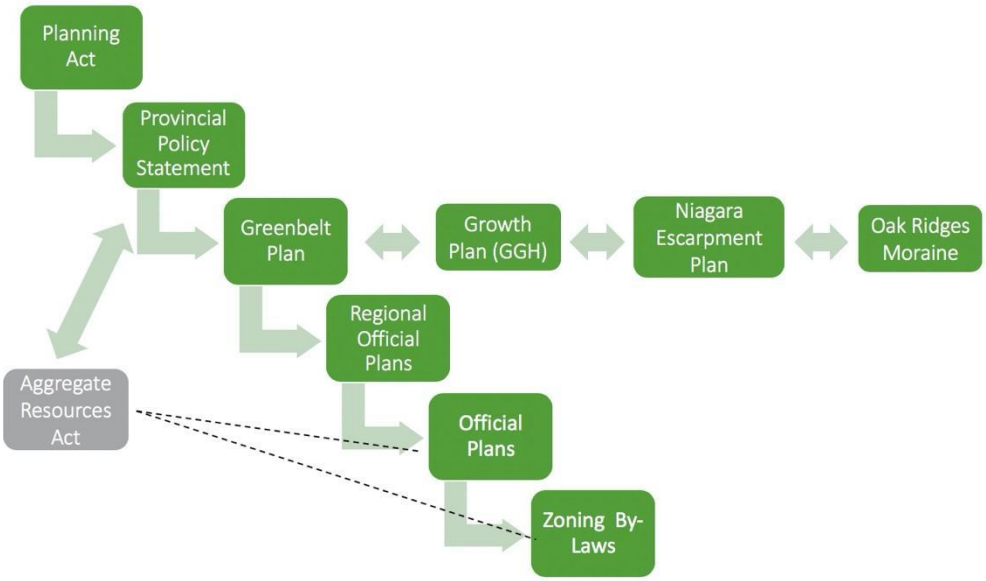


Figure 3 - Hierarchy of Ontario Planning Documents (prepared by Emily Hehl)

3.0 Impacts of aggregate extraction

Aggregate extraction operations are limited by geology to the places where aggregate naturally occurs. In Southern Ontario, this means that over 83% of possible aggregate sites (primary and secondary aggregate resources) overlap with prime agricultural lands (MNR, 2010; OMAFRA, 2020) and that 27.8% of the total licenced area in Ontario is located on prime agricultural land (D. Crinklaw, personal communication, August 30, 2021). This is not particularly surprising as aggregate extraction is largely seen as a rural land use.

The State of Aggregate Resource in Ontario Study completed in 2010 found that the top three public concerns from property owners living in close proximity to aggregate sites were truck traffic, noise, and air pollution/dust (MNR, 2010). These are the same three concerns raised by Baker et al. (2001) who mentions "the noise, dust, and truck traffic that accompany aggregate extraction is often disruptive to rural and urban settings" (p. 2). Research conducted by Grant (2017) in Wellington County found that other common concerns included water quantity and quality, bi-products of aggregate processing, impacts of physical infrastructure and operations on the landscape, soil health, vibrations, species at risk, archeology, and agriculture. This literature review addresses a range of impacts of aggregate extraction, some specific to agricultural land uses, others relevant to rural communities at large.

While it is not uncommon for aggregate impact analyses to address the potential relationships between the aggregate operation and local residents, the potential impact on farms and agricultural practice is minimised (see Hardy, Stevenson and Associates, 2013 and MHBC, 2009). For example, the "Dufferin Aggregates Acton Quarry extension Agricultural Impact Analysis," justifies the extension of the Acton Quarry pit, in part, because "Mineral aggregate operations are typically found located adjacent to or in close proximity to agricultural operations. These land uses are both legitimate rural land uses and have historically co-existed in proximity to the Acton Quarry for over 50 years" (MHBC, 2009, p. 18). This tendency to brush over the relationship between aggregates and agriculture has left us with a rather limited understanding of how these two industries impact one another and how policy could better support their coexistence in the rural landscape.

3.1 Loss of agricultural land

In practice aggregate extraction is often prioritised over agriculture. This is because the economic value of aggregate resource is considered to be greater than the agricultural production value of the land - it is also generally believed that rehabilitation can restore the land to its prior productivity (Yundt, 1995; MNR, 2010; Corry, Lafortezza & Brown, 2010; OSSGA, 2017; TOARC, 2016).

In a recent letter to municipal councils across Ontario, OSSGA (2021a) comments on the loss of agricultural land as a result of aggregate operations:

> The reality is that loss of agriculture because of aggregate is not accurate. Of the 4.9 million ha of prime agricultural land in southern Ontario, only 0.7% contains a licensed aggregate operation. And much of that land is returned to an agricultural use after extraction. In addition, aggregate is an essential part of the agri-food system – necessary for farm structures, farming road construction, soil amendments, bedding, drainage, etc.

These numbers are similar to the numbers produced by OMAFRA in 2021 indicating that approximately 44,245 hectares or 0.5% of prime agricultural land in the Province contains an active aggregate licence (D. Crinklaw, personal communication, August 30, 2021). When reading these numbers it should be remembered that this does not include inactive or surrendered licenses or future aggregate sites. It should also be noted that there is little publicly available data on rehabilitation and that not all aggregate sites can be rehabilitated to an agricultural use. Steep slopes and low-lying topography are two challenges that prevent agricultural rehabilitation. Additionally, some rehabilitation plans require long-term, permanent engineered hydrological solutions (e.g., dewatering systems). This type of technical fix requires ongoing maintenance.

Rehabilitation requirements were first introduced in Ontario legislation in 1972 (Port, 2013; Skelton Brumwell & Associates Inc. & Savanta Inc., 2010). Historically, aggregate operators would sell topsoil as an additional revenue source (OSSGA, 2016). For legacy sites new soils must be brought in for rehabilitation. An article published by OSSGA in 2016 talks about the challenges of rehabilitating legacy sites, stating that "building up a level of soil nutrition adequate for profitable agricultural use is a much longer-term proposition [than rehabilitating a site for wildlife habitat]" (Hood, 2016, pp. 9). This is echoed in the 2013 report by TOARC looking at agricultural rehabilitation of legacy sites, which also emphasises that ", the quality of the rehabilitation (as measured by farmers ratings) is varied, and that there is room for improvement in rehabilitation techniques".

The 2009 SAROS indicated that it is difficult to quantify the total amount of rehabilitation within the province as the information is not readily available (Skelton Brumwell & Associates Inc. & Savanta Inc., 2010). However, of the information that is available it is estimated that there is a 1.7% annual net growth of disturbed land (Port, 2013). Even in situations where rehabilitation is attempted, it is very challenging for producers to restore the land to the quality that existed before disturbance (Skelton Brumwell & Associates Inc. & Savanta Inc., 2010). Additional concerns arise from the fact that although rehabilitation plans are required to be submitted upon application, they are not obligated to be updated throughout the lifespan of the operations. This is a cause for concern as some operations may be active for greater than 20 years, and

the Site Plan submitted with the application may not be relevant when the time for closure approaches (Port, 2013).

A review conducted by Peel Region in 2009 concluded that, within that jurisdiction alone, 700 ha of land had been disturbed by extraction with only 300 ha of rehabilitated land on record (Binstock & Carter-Whitney, 2011). Binstock and Carter-Whitney (2011) also asserted that there was no evidence that rehabilitation could restore land to Class 1 soil. This is echoed in a call for research "to assess the quality of land rehabilitated for agricultural practices" from OSSGA in 2013. This same study reported that of 568 rehabilitated sites, 18% were rehabilitated for agricultural use (including: vineyard, livestock, orchard, pasture, fieldcrop, or other agricultural use) (OSSGA, 2013).

Although aggregate extraction is considered to be a temporary or interim use, it is often the case that a permanent loss of farmland results, having a long-term negative impact on agricultural production. It is indicated that farmland loss is one of the only quantifiable negative impacts associated with aggregate extraction (Port, 2013).

Further to this discussion, a survey of 437 academics, aggregate producers, consultants, farmers, municipal and provincial government officials, stakeholder associations, landowners and citizens, commissioned by OMAFRA in 2015/2016, found that:

- Respondents indicated that current statutory and policy requirements were not properly assessing the impacts of aggregate extraction on prime agricultural land, soil and natural hydrological systems; and
- Respondents also underscored the importance of AIA in the extraction and rehabilitation process, requesting that it be added as a requirement for license approval, and in some cases recommending that an independent third party review of the AIA be completed.

These sentiments are echoed in OSSGA's letter to OMAFRA in 2018 regarding the Agricultural Impact Assessment Guidance Document.

3.2 Water quantity and quality

The impacts of aggregate operations on water quantity and quality is a common concern for neighbouring residents. It cannot be denied that aggregate industries use water. Natural aggregate deposits perform important hydrological services (including water storage and filtration) that are disrupted by their removal (Binstock & Carter-Whitney, 2011). Below water table extraction has the most significant impacts on water quantity and quality. However, the initial removal of vegetation at the start of extraction activity also results in changes to natural water flow patterns (Binstock & Carter-Whitney, 2011). While hydrological modelling

has become more advanced, there is always risk when relying on engineering solutions or hard technical fixes in minimizing disruption to natural hydrologic and the ecosystems they support.

During their analysis of multiple quarry sites in the United States, West & Cho (2006) determined that aggregate extraction, in some instances, resulted in a lowering of the water table and a 'drawdown' effect on groundwater. West & Cho (2006) also identified several cases wherein aggregate extraction was determined to be the cause of abnormal contaminants entering aquifer systems. Through their research West & Cho (2006) argue that aggregate extraction can significantly impact neighbouring communities and ongoing activities.

Onsen et al., (1999) indicate similar experiences materializing in Wisconsin, United States, with almost 100 wells near active extraction sites being affected as the result of an uncommon accident occurring on-site. The researchers further explain that although the incident ultimately led to updated practices and improved communications between the aggregate operators and the local community, it was still a cause for concern (Onsen et al., 1999). In the Ontario conext, MNRF research from 2006 indicated very few quantifiable impacts to Ontario's water supply and quality linked to aggregate extraction. More research in this area is needed (Binstock & Carter-Whitney, 2011).

In Ontario, before beginning operations, aggregate operators are required to obtain a MOECC Permit to Take Water (as regulated by the Ontario Water Resources Act, Section 34). For quarries operating below the groundwater table an additional approval must be obtained to discharge water being pumped out of the quarry to maintain safe and dry working conditions (Ontario Water Resources Act, Section 53). Additionally, the MNRF, conservation authorities, Fisheries and Oceans Canada, and the local municipalities (both upper- and lower-tier) can place additional requirements on aggregate operators regarding the handling and discharging of water.

Washing aggregate, dust suppression, and dewatering (most often associated with quarry operations) are the three most common uses of water in aggregate extraction. Typically aggregate operations do not affect the water table, however fractures in the bedrock of a quarry operation does affect groundwater flow patterns (OSSGA, 2016b). The area affected by the quarry is called the drawdown cone or cone of depression (OSSGA, 2016b). Prior to commencing extraction, studies must be completed to determine if there is a chance neighbouring wells, wetlands, streams or other environmental features will be impacted. If there is a chance neighbouring wells may be impacted a water mitigation plan must be implemented (OSSGA, 2016b). Once operation begins, operators are required to follow a comprehensive water monitoring plan (OSSGA, 2016b). While the need to restore water supplies as a result of aggregate activities is rare, it does happen in Ontario (OSSGA, 2016b).

Another concern the impact of aggregate operations on water quantity and quality is the cumulative impacts of multiple aggregate operations in close proximity to one another. The Ontario Water Resources Act addresses this by undertaking cumulative impact assessments (OSSGA, 2016b). One of the largest cumulative impact assessments related to aggregate operations in Ontario involved twelve quarries on the Carden Plain (OSSGA, 2016b; Golder, 2012). The aggregate industry argues that rehabilitation provides the opportunity to enhance water management through water stores and diverse wetland habitats (OSSGA, 2016b).

3.3 Noise and vibration

The first step in removing bedrock from Ontario quarries is blasting. Blasting involves drilling strategic holes into the rock and using explosive charges to break and move rock. The Ontario Stone, Sand and Gravel Association (2017b) recognizes that there are a variety of factors that affect the sound and vibration associated with blasting, including technical factors (e.g., size and depth of drill holes), atmospheric conditions (e.g., humidity, wind direction, cloud cover), and geologic characteris (e.g., soil type, water table level). Noise pollution is one of the main concerns expressed by the public regarding the siting of aggregate operations (Winfield & Taylor, 2005; Campbell, 2014). In addition to social nuisances associated with increased noise volumes during active production and working hours, there is the potential for considerable environmental impacts to result.

The most relevant pieces of legislation in Ontario related to blasting are the Environmental Protection Act and Noise Guidelines (e.g., NPC-300, NPC-119) created by the Ministry of Environment and Climate Change, the Occupational Health and Safety Act administered by the Ministry of Labour, and the Aggregate Resource Act administered by the MNRF. Combined this legislation aims to minimize adverse impacts on human health, neighourhouring property uses, and the natural environment. This same legislation also addresses the combined effects of noisy equipment on site (crushers, rock drilling, diesel generators, on-site haul trucks, screening plants, etc.) and vibrations from on-site activity. Aggregate operators are required to minimize sound and impacts on neighbouring properties through site design (berms) and carefully calculated and monitored blasts (Coulson & Haniff, 2016). That being said, Coulson & Haniff (2016) point out that while initial applications and permits look at worst case scenarios, they often fail to address the dynamic and changing nature of aggregate operations.

Noise studies are required to be submitted with a completed aggregate licensing operation (Ministry of Natural Resources, 2006; OMAFRA 2018). OMAFRA (2018) indicates that particular attention should be given to the potential impacts on livestock or nearby agri-tourism businesses. These are particularly sensitive farm operations in regard to noise level impacts (OMAFRA 2018). For example, a study conducted by Christensen et al. (2005), indicates that when introduced to auditory stimuli, horses experience an

increased heart rate as the animal prepares to initiate a flight response. This can have dangerous consequences for both human/ rider and equine safety (Christensen et al., 2005). Similar results have been found for cattle in respect to sudden and unexpected noise (Broucek, 2014). Flight responses evoked during milking or handling could result in adverse behaviours such as kicking, stomping, and retreat- potentially posing a danger to individuals in close proximity during these activities (Broucek, 2014). OMAFRA (2018) stresses the importance of keeping a regular blasting schedule or modifying hours to accommodate nearby agricultural activities. Further, risk can also be reduced by notifying nearby farms if blasting must occur during an irregular time (OMAFRA 2018).

3.4 Dust

Dust is another significant impact of aggregate extraction and processing. Activities that create dust include: blasting, extraction, and crushing. Concern regarding the potential impacts of dust is frequently discussed and identified in various types of literature and in the media (Binstock & Carter-Whitney, 2011; Campbell, 2014; Gravel Watch Ontario, n.d.). Dust generated on site from quarry and pit activities that blows or travels off site is often referred to as nuisance/fugitive dust (Gravel Watch Ontario, n.d.). This not only imposes potential health risks to nearby residents, but there is growing concern for the impacts to agricultural productivity and the environment.

While, MOECC and MNRF requires certain measures to be taken to minimize the impacts of dust (including the use of water or approved dust suppressant, ground cover and vegetation, berms and tree screens, and dust enclosures) there is evidence that dust is still an issue for neighbouring properties.

A study conducted by Bluvshtein et al. in Israel 2011 found that the total suspended particulates one kilometer downwind from a quarry could be as high as 400 percent more than sites located one kilometer upwind. Similarly, Sett (2017) indicates that quarry operations significantly increased the amount of dust particles in the air. Research conducted by Aleadelat & Ksaibati (2017) looking at the damage of dust from unpaved roads, concluded that the most significant costs resulting from road dust were associated with reduced crop yields. While this research is not specific to the aggregate industry, dust, whether from unpaved roads or aggregate operations, will have an impact on crop yields.

Dust particles have been found to adhere to plant and crop leaves thus reducing a plant's ability to photosynthesize (Sett, 2017). Reduced photosynthesis can cause plants to become more susceptible to pests and diseases and other secondary stressors, thus resulting in smaller crop yields. Particles can also hinder effective pollination of small seeded fruits by insects (Sett, 2017). Dust contamination also is shown to reduce the overall attractiveness of a product, potentially reducing sales and the aesthetic value of the crop (McCrea, 1984).

McCrea (1984) further explains that dust particles can cause health related issues to animals, such as pneumonia and pink eye. Dust build-up in the eyes prevents animals from effectively removing harmful bacteria, which leads to greater instances of pink eye (McCrea, 1984). However, it is important to note that in practice, many of these impacts are difficult to distinguish causation from correlation. McCrea (1984) notes that dust from nearby roads or other farming activities can also contribute to an increased instance of dust on crop fields. There is an additional element of cumulative impact identified in Binstock & Carter-Whitney's (2011) research paper.

Aggregate activity in southern Ontario often appears to occur in a clustering effect due to the nature of urban development and the availability of resources. Therefore, it is important to recognize that the impacts of dust in areas where there are high volumes of extraction may be greater than in other areas of the province (Binstock & Carter-Whitney, 2011).

3.5 Economic impact

The majority of research in this area defines impact in terms of its economic effect, quantified in terms of hedonic values, or in terms of real estate values at resale (Grant, 2017; Garrod & Willis, 2000; Altus Group, 2015; Secchi, 2007). The perception that industries like aggregate extraction and landfill (often related sequentially) affect one's ability to enjoy property often forms public opinion surrounding the development of new and expanded sites (Grant, 2017; Garrod & Willis, 2000). Arguments take the shape of perceived economic effects and changes to the use-value of properties affected and often positions the production companies against the local residents (e.g., Garrod & Willis, 2000; Chambers & Sandberg, 2007; Patano & Sandberg, 2005; Lu, 2011; Rayner, 2009).

For example, Lansink Appraisals and Consulting (2014) prepared an industry led market price study analyses on the effect of aggregate operations (pit or quarry or a haul route) on 19 properties in Ontario. This study found that aggregate operations' impact on neighbouring property values varies, ranging from -8.57 to -39.36 percent of property value loss (Lansink, 2014). However, Grant (2017) provides some criticism of this study that the sites were hand selected, does not control for other variables (e.g., proximity to urban areas) and as a result may be biased.

Grant (2017), as part of a thesis research project, looked at the impacts of aggregate sites on neighbouring residents in Wellington County and used a hedonic model to estimate the impact of aggregate operations on neighboring property values. Findings of this research do not support the claim that aggregate sites negatively impact neighbouring property values in Wellington County (Grant, 2017). That being said, Grant also reports that the Municipal Property Assessment Corporation (MPAC) reduces assessed values of properties adjacent to aggregate sites in some counties based on market evidence that property value

changes due to aggregate site activities (Grant, 2017). MPAC categorizes both pits and quarries as industrial land uses as adjusts neighbouring property values on that basis (Grant, 2017). This benefits property owners as the reduced assessed value is used to calculate property taxes (Grant, 2017). However, beyond anecdotal evidence and appraisals, there is limited academic research to substantiate these concerns, particularly in Canada (Grant, 2017).

In the USA studies looking at specific communities in Ohio (Hite, 2006; Zhang and Hite, 2016) and Michigan (Erickcek, 2006) confirms that aggregate sites diminish surrounding property values to some extent, although the specifics of the impact vary spatially and temporally (Grant, 2017; Hite, 2006; Erickcek, 2006; Zhang and Hite, 2016).

3.6 Nuisance and other social impacts (social perceptions are a grey area)

The 'Not in My Backyard' (NIMBY) effect is commonly utilized to describe public opposition to the siting and development of locally unwanted land uses (Pelekasi et al., 2012). The NIMBY effect can often be identified in situations wherein certain land uses are perceived to be associated with harmful effects to the environment, public health, quality of life, or other impacts that create a 'stigma' in the subject community. It can be argued that NIMBY conflicts often arise as a result of the external costs experienced in the community adjacent to the opposed land use, while the benefits are distributed elsewhere (Pelekasi et al., 2012). This phenomenon described by Pelekasi et al. (2012) appears to be prevalent in Ontario aggregate land use planning processes (Port, 2013; Van Wagner, 2016). Aggregate extraction is one of the most controversial land uses in Ontario (Binstock & Carter-Whitney, 2011).

In general, aggregate extraction in Ontario is not overtly accepted by members of the public and residents in accommodating communities (Port, 2013). Public opposition or 'coalition' groups commonly form throughout the province in attempts to prevent the siting of aggregate extraction operations in rural communities (Patano & Sandberg, 2005b). This poses a challenge for local municipal governments who often face the brunt of this outcry. Municipal Planners are often left with very limited tools and defence, in a system that promotes a rural consumptionist landscape (Baker et al., 2001; Patano & Sandberg, 2005b). Armed with the understanding that proponents are able to appeal decisions to the OMB/LPAT/OLT, it is not uncommon for municipal Councils to deny approvals in attempts to appease angry residents (EcoVue Consulting, 2013).

The above discussion is not intended to discount the transition of rural Ontario from a productive landscape to one that is largely utilized as a 'resource sink' for larger urban communities (Patano & Sandberg, 2005b; Van Wagner, 2016). However, the overall negative opinion of the extractive industry has created a sensitive issue in which the differences between perception and reality are blurred (EcoVue Consulting, 2013). It

appears that the combination of legacy or historic issues, visual impact, and inconvenience factors can often contribute to a distorted interpretation of the industry in present day (Binstock & Carter-Whitney, 2011; Pelekasi et al., 2012; Port, 2013).

4.0 Gaps in the literature

Across Ontario, aggregate extraction provides economic stimulus for many rural communities. Such operations often occur on agricultural land or within close proximity to productive farmland. Aggregate operations significantly alter the landscape and are often considered a nuisance to adjacent land owners. While research regarding the social impacts of aggregate extraction on rural residents has been conducted, little is known regarding the social, economic, environmental and land use impacts on farms in close proximity.

While the effects on agriculture have not been wholly ignored in the literature, research has focused primarily on issues such as land take (Geneletti, Biasiolli, & Morrison-Saunders, 2017; Bloodworth, Scott & McAvoy, 2009), the removal of land from active agricultural production to be used for extraction. This is, however, often justified by the caveat that these sites can be returned to active use through the rehabilitation methods mentioned above, and the fact that the take is only a miniscule percentage of prime agricultural land (MHBC, 2009). However, this leaves significant issues surrounding extraction activity unaddressed:

- effects on livestock and crop production (blasting, other noise, dust, water availability, etc.)
- effects on cost of production of livestock and/or crops (increased transportation costs, buffering, etc.)
- effects on water availability (changes to water table level, containment, runoff, volume).
- effects on local infrastructure (increased traffic, changes to roadways, etc.)
- effects on quality of soil/water.
- effects on perceived quality of life (enjoyment of property, economic effects).

There is currently a significant gap in the literature that needs to be addressed, as the effects of aggregate extraction on local agricultural production are largely unknown. As of 2008, there were 5,300 active extraction sites in Ontario, with a working area of approximately 70 square kilometers (Corry, et al., 2008, p. 120) located primarily on or beside active agricultural land, with the potential for significant interaction between agriculture and extraction activities. To achieve compatibility between the two land uses, economic, environmental, and social dimensions that can influence the relationship and potentially impact on farm viability must be analyzed.

Understanding the nature of these interactions will help to develop evidence based best practices for the mitigation of these effects, leading to improved relationships between agriculture and aggregate extraction and the potential of enhanced outcomes for the farms surrounding aggregate extraction operations. Findings of this research will be relevant to rural communities, policy makers, and other stakeholders who currently lack the necessary information for making informed decisions regarding the management of this relationship and the siting of new aggregate operations. Achieving compatibility of land uses is a key aspect of ensuring that both the aggregate and agricultural industries can continue to thrive in southern Ontario.

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