

APPENDIX H

**Ecological Enhancement and
Mitigation Monitoring (EEMM)
Summary Reports**



**Walker Aggregates Duntroon
Quarry Expansion, Reforestation
Monitoring Program: 2023
Monitoring Report**

Final Report

October 6, 2023

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1.0 INTRODUCTION

Reforestation monitoring is a component of the Walker Aggregates Inc. Duntroon Expansion Quarry Adaptive Management Plan (AMP; Stantec and Hims Geoenvironmental 2019). The 5-year AMP review process including proposed revision to the AMP is currently under assessment by the Ministry of Natural Resources and Forestry (MNRF) which may include adjustments to Functional Indicators. The Ecological Enhancement and Mitigation Monitoring (EEMM) program was developed to oversee the ecological mitigation measures and adapt management to changing conditions and trends.

The purpose of the reforestation component of the Ecological Enhancement and Mitigation Monitoring (EEMM) program is to track the ecological development of the reforested areas and to compare the ecological characteristics to established targets for ecological form and function. If the monitored conditions differ from the target conditions, modifications to the enhancement plans are implemented. The objectives of the EEMM program are to:

- Properly implement mitigation measures (e.g., monitor the number and species of trees are planted); and
- Manage the resulting features in adaptation with changing conditions and trends (e.g., replanting for dead trees, controlling pest damage, controlling/allowing public access, etc.).

Monitoring of the EEMM programs is ongoing to provide a quantitative measure of the success of the plans over time and includes a mechanism for implementing additional efforts (i.e., adaptive management) when needed to so that the established restoration targets are achieved. The monitoring will be discontinued when the enhancement areas have met the established targets and are functioning as self-sustaining components of the local landscape. This monitoring includes the requirements of the forest monitoring and assessment required under the Agreement with the Township of Clearview dated January 25, 2010, and will form the basis for determining when extraction can commence within portions of the significant woodland (Phases 2B, 3A/3B).

1.1 OVERVIEW OF THE WOODLAND PROGRAM

The Duntroon Expansion Quarry includes removal of approximately 26.7 hectares (ha) of woodland, of which approximately 25.6 ha is part of a contiguous woodland that includes many thousands of hectares along the Niagara Escarpment and associated landforms. As mitigation for this removal, a plan (the Woodland Program) was developed for the license application (Stantec 2009) to reforest approximately 52 ha of lands owned by Walker Aggregates. Requirements for the Woodland Program, including the areas to be reforested and the methods, are included in the AMP (Stantec and Hims Geoenvironmental 2019).



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The Woodland Program will replace the forest cover removed in the extraction area through restoration of natural forest cover on lands in the adjacent landscape that were under agricultural production at the time of the quarry application. While the reforestation is guided by the general techniques and practices recommended in the Aggregate Resource Act (ARA) Site Plan notes and supporting documents, the site preparation, planting, and management may be modified through the AMP process in consultation with the MNRF so that the practices and management properly respond to future forest dynamics such as pest infestations, changing climatic conditions and state-of-the-art restoration ecology. The goal of the Woodland Program is not merely to replace the features but to achieve a net gain in the ecological functions of the forested landscape.

The Woodland Program was initiated in 2015, with tree planting and other enhancement measures undertaken over three years from 2015 to 2017. Reforestation efforts were divided between areas of active reforestation and areas of natural regeneration, which were delineated in the field based on site conditions. Active reforestation lands included sodded fields, fallow fields, and worked fields which were treated with techniques including the planting and maintenance of varying sizes and species of trees. Natural regeneration lands consisted of areas of shallow soils, primary succession woodlots and naturalizing, disturbed areas. Tree health and mortality monitoring was conducted during the warranty period for two years following each planting year. For example, for plantings completed in 2015, tree health and mortality monitoring was conducted in 2016 and 2017. Monitoring reports were prepared during the warranty period in 2018 (Stantec 2019) and 2019 (Stantec 2020) and included in the annual AMP monitoring summary reports.

1.2 DEFINITION OF PLANTING TERMS

The proposed reforestation program is divided into four zones; Zone A – F (Figure 1, Appendix 1) Active Planting Units and Natural Regeneration Units are denoted by Zone location and a numeric number (e.g., F:31). Plantings were completed in a checkerboard pattern of 1 ha Active Planting Units consisting of four 0.25 ha Quadrants. Active Planting Units were interspersed with 1 ha Natural Regeneration Units where site preparation and seeding were completed but no trees were directly planted, allowing natural regeneration to occur. This will allow a diverse, spatially heterogeneous woodland with a mix of tree densities to be established. Natural Regeneration Units are included in the reforestation monitoring program to compare the effectiveness of active over passive restoration efforts on site.

Each Quadrant consists of sixteen 12.5 metre (m) x 12.5 m Planting Blocks. Each Planting Block has an average of approximately 24 plantings.

At completion of the planting there were approximately 102 Planting Units established, interspersed with approximately 163 Natural Regeneration Units where natural tree regeneration will occur supported by seed supply from the Planting Units and other natural areas. Planting units along the edges of each general planting area are irregular in shape, consequently, there can be more than four quadrants within a Planting Unit when partial quadrants are taken into account. Each Planting Unit has a unique grid number, and the location is documented in a GIS database. A total of approximately 34,800 trees were planted from 2015 to 2017.



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In this monitoring program, the definition of Woodland is according to the *Forestry Act*:

- a) 1,000 trees of any size, per hectare;
- b) 750 trees, measuring over five centimetres in diameter, per hectare;
- c) 500 trees, measuring over 12 centimetres in diameter, per hectare; or
- d) 250 trees, measuring over 20 centimetres in diameter, per hectare.

1.3 FOREST RESTORATION MONITORING

Table 1 identifies the monitoring indicators used in the Woodland Program, the method of measurement, and the targets that were established in the Agreement with the Township of Clearview. Report Cards are prepared as part of the monitoring program to summarize results of the criteria / functional indicators, and to compare the results to the targets.

Table 1: Monitoring Criteria, Methods, and Targets for Duntroon Expansion Quarry Forest Restoration Program

Criteria / Functional Indicator	Method	2020-2024 Target from Township of Clearview Agreement	2025+ Target from Township of Clearview Agreement
Active Planting Blocks			
Survival rate of trees	Numeric counts of tree survival	60%	n/a
Tree species diversity	Numeric count of tree species	Min. 12 species present	Min. 10 species present
Canopy closure (%)	Qualitative observation of % closure supplemented with aerial photo interpretation	n/a	50%
Basal area	Standard forest sampling methods (sub samples for dbh and/or prism sweeps)	n/a	15 m ² /ha
Canopy height	Stand and overall species height measurements in metres	2-3 m	4-5.5 m
Presence of tolerant hardwood understorey	Qualitative observation	n/a	Min 2 species present in 50% of sample plots
Presence of coarse woody debris	Qualitative observation	Present	Naturally increasing in 50% of sample plots
Presence of snag trees	Qualitative observation	n/a	presence
Natural Regeneration Blocks			
Number of trees	Numeric counts of tree stems	Attained 50% of stem quantity for “woodlands” definition	Attain 100% of stem quantity for “woodlands” definition



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1.4 INTERPRETATION OF RESULTS

As noted in the AMP, given the natural variability inherent in the environment, the criteria outlined in Table 1 should be interpreted with a degree of flexibility and expert judgment. The expert judgment should reflect the fact that the intent of the reforestation plan is not to create a static predetermined ecosystem stage but is to facilitate natural self-sustaining vegetation dynamics in the reforested areas. If the reforestation area is developing with a healthy mix of native plants, is not dominated by aggressive non-native species and provides a range of high-quality habitats for local wildlife, it can be considered a success and strict adherence to predetermined criteria is less important from an ecological perspective.



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2.0 METHODS

Twenty active Planting Units and five Natural Regeneration Units were randomly selected to sample the monitoring of the forest restoration Function Indicators in Table 1. Within the Active Planting Units, plots, herein referred to as Active Plots, of 12.5 m x 12.5 m were delineated and monitored. Active plots are 1/64 of a ha by area of the Planting Unit and provide a representation of the overall area. There are approximately 24 trees per Active Plot, a total of 480 trees were assessed during the 2023 sampling period (see **Figure 1, Appendix A**). The general locations of the Active Plots were marked in the field by selecting a centre point which was used to delineate a 12.5 m x 12.5 m square. Within this square all trees were assessed according to the criteria presented in Table 1.

Survival percentages and average heights are based on the 24-tree count for each Active Plot in consideration of the overlap. Canopy closure was estimated visually for each Active Plot. Natural regeneration and coarse woody debris were documented as present or absent with each Active Plot. Tree numbers were estimated by counting the total number of trees in a plot.

Within the Natural Regeneration Units, plots, herein referred to as Passive Plots, of 12.5 m x 12.5 m were delineated and monitored. As noted above, Natural Plots are also 1/64 of a ha by area of the Natural Regeneration Units and provide a representation of the overall area. Total tree cover in the Passive Plots was estimated by multiplying the average of the five plots by 64 to determine trees per ha.

Basal area is the sum of trees by hectare measured at 1.3 m, known as Diameter at Breast Height (DBH). The DBH of trees within an area are summed to give an overall measure of tree density for woodlots, forests, or managed habitats (Bettinger et al. 2017).

When dealing with forked trees, if the point of forking occurred below 1.3 m, the tree is categorized as having multiple stems, and the DBH of both of these stems are measured. However, if the fork occurs at or above 1.3 m the measurement is taken below the 1.3 m mark.

Total basal area for Passive Plots and Active Plots was calculated per tree using the following equation:

- Basal area in square metres = $\pi * (\text{DBH cm})^2 / 40,000$

The sum of basal area per plot was then multiplied by 64 to extrapolate basal area per ha. This was then averaged per Passive Plots and Active Plots to get an overall estimate of tree density for the entire reforestation area.

In the 2023 monitoring program, a few plot centers were not found as originally staked. However, efforts were made to relocate these centers as close as possible to their positions in the previous years. This was done to replicate the same monitoring methodology as in previous years and minimize any gaps or errors in the collected data.



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3.0 RESULTS AND DISCUSSION

Overall results have been provided in a report card format (Table 2) to demonstrate if targets for years 2020-2024 from the Township Agreement have been met. Table 3 provides a summary of field observations from each Active Plot. Results discussed below. Data are provided in **Appendix B**.

Table 2: Overall Results from 2020 and 2023 Reforestation Monitoring

Criteria / Functional Indicator	2020-2024 Target from Township of Clearview Agreement	2020 Results	2023 Results	2020-2024 Target Achieved
Active Planting Blocks				
Survival rate of trees	60%	70%	65%	Yes
Tree species diversity	Min. 12 species present	23 species present	27 species present	Yes
Canopy closure (%)	n/a	17.40%	24.5%	n/a
Basal area	n/a	1.86 m ² per hectare	2.13 m ² per hectare	n/a
Canopy height	2-3 m	3.0 m	4.4 m	Yes
Presence of tolerant hardwood understory	n/a	Present in 5 plots	Present in 24 plots	n/a
Presence of coarse woody debris	Present	Present in 6 plots	Present in 5 plots	Yes
Presence of snag trees	n/a	Present in 3 plots	Present in 2 plots	n/a
Natural Regeneration Blocks				
Number of trees	50% of "woodlands" definition	Average of 730 trees of all diameter per ha	Average of 820 trees of all diameter per ha	Criteria achieved (woodland criteria is 1000 trees/ha. Results achieve 75%)



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Table 3: Average Quantitative Results per Active Plots

Active Plots Quantitative Data and Overall Averages							
Plot #	Year Planted	Average Canopy Height		Survival rate (%) ^a		Basal Area per ha	
		2020	2023	2020	2023	2020	2023
A310	2015	4.5	6	100%	46%	3.94	6.42
B267	2015	3.5	5	53%	68%	1.23	2.00
C118	2015	3	6	67%	87%	2.16	1.97
C123	2015	3	4	67%	54%	2.61	3.26
C142	2015	3.5	4	72%	46%	2.72	1.46
C161	2015	2.5	4	89%	40%	1.61	0.98
C174	2015	2	4	61%	78%	0.86	1.33
C176	2015	2.5	5	69%	40%	1.72	1.37
C189	2016	4	4	58%	95%	1.91	2.73
C207	2016	2	2	53%	100%	1.13	0.97
C213	2016	4	4	86%	51%	1.98	2.65
C216	2016	3	6	75%	59%	4.03	5.55
C231	2016	4	4	100%	39%	2.76	1.5
C255	2016	2.5	4	64%	86%	1.19	1.75
C235	2016	2.5	5	89%	71%	2.28	2.87
F5	2017	4	7	44%	75%	1.42	2.89
F16	2017	2.5	5	66%	50%	1.03	1.10
F31	2017	2	3	50%	66%	0.66	0.64
F36	2017	2	2	61%	68%	0.99	0.53
F37	2017	2.5	3	56%	55%	0.91	0.9
Overall Average		3.0	4.4	70%	64%	1.86	2.13

^a Plot survival results of 2023 are calculated based on 24 trees per plot.

3.1 DIVERSITY AND SURVIVAL RATE OF TREES

During the 2023 reforestation monitoring, the total average survival rate of trees per Active Plot was 65% based on the reconciled tallies after the early replacements of the original plantings as report in 2020. Survival in 2019 was 70% and 65% in 2023 which remains in good standing in relation to the targeted 60% survival rate. The surveys indicated an increase in diversity which is attributed to the regenerating nature and succession of the forest communities.

There are 27 species present including: Balsam Fir (*Abies balsamea*), Red Maple, (*Acer rubrum*), Sugar Maple (*Acer saccharum*), Yellow Birch (*Betula allegheniensis*), Paper Birch (*Betula papyrifera*),



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Bitternut Hickory (*Carya cordiformis*), Common Hawthorn (*Crataegus monogyna*), Hawthorn species (*Crataegus*), American Beech (*Fagus grandifolia*), White Ash (*Fraxinus americana*), Green Ash (*Fraxinus pennsylvanica*), Black Walnut (*Juglans nigra*), Tamarack (*Larix laricina*), Apple (*Malus pumila*), White Spruce (*Picea glauca*), Red Pine (*Pinus resinosa*), White Pine (*Pinus strobus*), Trembling Aspen (*Populus tremuloides*), Large-tooth Aspen (*Populus grandidentata*), Black Cherry (*Prunus serotina*), White Oak (*Quercus alba*), Bur Oak (*Quercus macrocarpa*), Red Oak (*Quercus rubra*), Eastern White Cedar (*Thuja occidentalis*), Basswood (*Tilia americana*), Eastern Hemlock (*Tsuga canadensis*) and White Elm (*Ulmus americana*).

Survival rates observed throughout reforestation area re influenced by several factors:

- It was observed that cattle were freely roaming throughout Zone E and F. The presence of cattle may account for the low survival rate as cows often graze on young saplings, stunting their growth or killing them. It was also noted that several trees were cracked or physically damaged suggesting that the cows may have trampled or broken trees.
- It was noted throughout the survey plots several saplings still retained tie strings. The presence of tie strings may result in snapping or girdling during windstorms and ultimately damaging or killing the trees.
- Due to external factors, the stakes that designated the plot centers may have shifted or been lost due to weather, ice, and the dense understory in some of the plots. Efforts were made to relocate these centers as close as possible to their positions in the previous years, however some variation is expected to have occurred.

3.2 CANOPY HEIGHT AND CLOSURE

The canopy height across Active Plots averaged 4.4 m, meeting the 2020-2024 target height of 2-3 m. The average height among Active Plots ranged from 2-7 m. Plot F5 had the tallest average, in part to the species composition and canopy being dominated by Poplar (*Populus* sp.), which are a fast-growing pioneer species. Canopy closure averaged 24.5% across Active Plots and ranged from 10-60%. Plot C235 had the greatest overall canopy closure, which also be attributed to the rapid growth of Poplar species within the plot. Several plots (F31, F36, F37 and C161) had the lowest canopy closure which is related to low survival rates and disturbances (i.e., cows and ice), as discussed in Section 3.1. The canopy height across Passive Plots averaged 3.8 m. Height ranged from 0-12 m within the Passive Plots. Plot C137 had the tallest average height at 12 m as the area was situated within a regenerating White Ash woodland. Plot C209 did not have any trees. Which results in an open meadow community within the forest and is supported from an ecological perspective by offering interior habitat diversity now that the reforestation plan is demonstrated to be established and self propagating. This plot was located within a cultural meadow with low natural regeneration and surrounded by shrubs vegetation such as riverbank grape (*Vitis riparia*) and red raspberry (*Rubus idaeus*). Canopy closure across Passive Plots averaged 29% and ranged from 0-70%. Again, plot C209 did not have any trees to provide canopy cover. Plot E137 had the highest canopy closure at 70%, as it was located in a regenerating woodland.



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Both canopy closure and canopy height have increased compared to the 2020 reforestation monitoring results. This is expected as a greater canopy closure and tree height is achieved with growth.

3.3 BASAL AREA

Basal area (in m²) was calculated per Active Plots and Passive Plots and averaged as basal area per hectare. The overall basal area across Active Plots averaged 2.13m²/ha. The average basal area amongst Active Plots ranged from 0.53-6.42 m²/ha. Plot A310 had the greatest basal area, again attributable to the Poplar species within the plot. Plot F36 had the lowest average basal area which can be related to disturbances and external factors explained in Section 3.1.

The overall basal area across Passive Plots averaged 2.62 m²/ha and ranged from 0-10.25 m²/ha. Plot B279 had the greatest basal area, due to the presence of well-established ash trees. Plot C209 had a basal area of zero, as it did not contain any trees.

Compared to the 2020 reforestation monitoring results, basal area for the Active Plots has increased from 1.86 m²/ha in 2020 to 2.14 m²/ha in 2023 (see **Table 2**). This increase is expected as a greater basal area or stand density is achieved through growth.

3.4 PRESENCE OF TOLERANT HARDWOOD UNDERSTOREY

Presence of tolerant hardwood understorey plants was documented in all but one (C231) of the twenty Active Plots. Similarly, presence of tolerant understorey plants was documented in all the Passive Plots. Understorey species observed include sugar maple (*Acer saccharum*), paper birch (*Betula papyrifera*), Shagbark hickory (*Carya ovata*), roundleaf dogwood (*Cornus rugosa*), red-osier dogwood (*Cornus sericea*), Hawthorn (*Crataegus* sp), white ash (*Fraxinus americana*), green ash (*Fraxinus pennsylvanica*), White spruce (*Picea glauca*), Eastern Cottonwood (*Populus deltoides*), trembling aspen (*Populus tremuloides*), black cherry (*Prunus serotina*), apple (*Malus pumila*), bur oak (*Quercus macrocarpa*), American buckthorn (*Rhamnus cathartica*), Staghorn sumac (*Rhus typhina*), blackberry (*Rubus allegheniensis*), red raspberry (*Rubus idaeus*), black raspberry (*Rubus occidentalis*), meadowsweet (*Spiraea alba*), American basswood (*Tilia americana*), and riverbank grape (*Vitis riparia*).

The presence of tolerant hardwood understorey has significantly increased since the 2020 monitoring program, where the presence of tolerant hardwood understorey was only documented in 10 of the twenty-five plots. This is an indication that the forest is attaining natural growth and succession with presence of understorey growth and tree regeneration.

3.5 PRESENCE OF COARSE WOODY DEBRIS

The presence of coarse woody debris was documented in three of the twenty Active Planting Plots and in two Natural Regeneration (passive) plots: C-137, C-161, C-174, E-57, and F5. The majority of coarse woody debris within the plots originated from stumps placed during restoration or deceased saplings from woodland plantings.



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It is expected that the presence of coarse woody debris should increase with time once trees mature and limbs and trunks fall from natural succession. However, the results from the 2020 reforestation monitoring program indicate that six reforestation plots had coarse woody debris, which is one more plot than 2023. The early wood debris may not be as evident given that it was small and size and may have deteriorate into the organic matter, this is a positive scenario. As this forest matures and trees reach the end of there life cycle more debris will be evident, at this point the forest is showing natural signs of successional progress with respect to woody debris as suspected.

3.6 PRESENCE OF SNAG TREES

Presence of snag trees were documented in one of the twenty Active Planting Plots and one in a passive plot: C-123, and C-137. Snag trees that were observed were typically woodland plantings that had died. These trees provide open perches, which may be utilized by predatory birds to catch prey and will support an insect community as the wood decays. Similar to woody debris as the age class of the forest increases, the older mature trees will display more snag habitat, at this time the forest is successionaly progressing as expected.

3.7 NUMBER OF TREES

Tree cover was estimated by counting the total number of trees in a Passive Plot as per the *Forestry Act*. Tree tally results are presented for each of the 5 Passive Plots.



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Table 4: Woodland Threshold for Passive Plots

Tree Tally (number of stems per 156m ²)					
Passive	Diameter in cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
B279 raw	5	2	1	0	8
B279 estimated total / ha	320	128	64	0	512
C137 raw	17	9	2	1	29
C137 estimated total / ha	1088	576	128	64	1856
C209 raw	0	0	0	0	0
C209 estimated total / ha	0	0	0	0	0
E57 raw	24	0	0	0	24
E57 estimated total / ha	1536	0	0	0	1536
F7 raw	2	0	1	0	3
F7 estimated total / ha	128	0	0	0	192
Threshold trees / ha		750	500	250	1000

The average number of trees for all diameter classes from the five Passive Plots is 820 trees per hectare which is greater than the targeted '50% of woodlands definition' from the Township Agreement, regardless of the absence of trees in one plot.

The average number of trees presence for all diameters has increased from 2020 to 2023; 750 trees to 820 trees respectively. The most significant difference was observed in Plot C57 where the number of trees for all diameters increased from 6 trees to 24 trees. These results indicate that desirable tree species are naturally regenerating, and the Natural Regeneration Units are on a trajectory to becoming self-sustaining woodland communities.



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4.0 RECOMMENDATIONS AND CONCLUSION

Based on the results of the 2023 monitoring program, the Active Planting Plots and Passive Regeneration Plots have met the 2020-2024 targets established in Township Agreement, as shown in the report card in Table 2. The degree to which the Active Planting Plots meet the reforestation targets is a reasonable indication of woodland succession within the reforested areas. The current results show improvement in key metrics from 2020, including canopy height and closure, basal area, and native tree species diversity including shade tolerant hardwood species. These results indicate a clear trend toward diverse, self-sustaining forest communities that are adapted to the microenvironments and climates found on this landscape.

Based on the 2023 reforestation surveys the following observation and recommendations are provided:

- All plots in Zone E and F experience active cattle grazing which negatively affects tree survival rate. Measures should be implemented to eliminate the cattle from the area (such as electrical fences) to protect the remained saplings and reduce the soil compaction to encourage a natural succession of the existing communities.
- Some plots show lower survival rate (B-267, C-123, C-142, C-174, C-231, C-213, C-216, C-161, C 176, F-36, F5, F16, F-31, F-37); however, natural regeneration is evident. Natural regeneration is adapted to the existing microclimate conditions and should be allowed to continue. Should concerns be observed in future monitoring, enhancement planting may be considered.
- Removing all ties from the sapling stems is required to prevent girdling, which can result in the death of the area above the gridle overtime.
- It is recommended that the centre plot stakes, and plot corners be documented using sub metre GPS units to maintain plot location and consistent data comparisons.



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5.0 REFERENCES

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**APPENDIX A: FIGURE 1:
REFORESTATION PLOTS
- 2023 MONITORING**



Legend

- Proposed Duntroon Quarry Expansion License Area
- Limit of Extraction - Walker
- Phase Boundary
- Phase 4 - Lower Bench
- Walker Owned Lands
- Randomly Selected Reforestation Plots**
- Active
- Natural
- Reforestation Plots**
- Active
- Natural



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 17N
 2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.
 3. Orthimagery © First Base Solutions, 2018. Imagery Date, 2016, 2010.

Project Location: Grey County
 Prepared by DH on 2023-09-25
 Technical Review by ABC on yyyy-mm-dd
 Independent Review by ABC on yyyy-mm-dd

Client/Project: WALKER AGGREGATES INC.
 DUNTROON QUARRY EXPANSION
 ADAPTIVE MANAGEMENT PLAN

Figure No. **1**
 Title: **Reforestation Plots- 2023 Monitoring**

\\CA\004\4\PPSS04\workgroup\01669\active\62602732\drawing\GIS\W\2023_Reforestation\Monitoring\62602732_VegPlot_Monitoring_RandomlySelected.mxd
 Revised: 2023-09-25 By: abchevy
 4914500
 4915000
 4915500
 4916000

WALKER AGGREGATES DUNTROON QUARRY EXPANSION, REFORESTATION MONITORING PROGRAM: 2023 MONITORING REPORT

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APPENDIX B: DATA ANALYSIS

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
A310	12	4	3	0	19
Total / ha	768	256	192	0	1216
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C189	12	8			20
Total / ha	768	512	0	0	1280
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
B267	8	5			13
Total / ha	512	320	0	0	832
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C118	16	5			21
Total / ha	1024	320	0	0	1344
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C123	3	10			13
Total / ha	192	640	0	0	832
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C142	6	6			12
Total / ha	384	384	0	0	768
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C161	12	2			14
Total / ha	768	128	0	0	896
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C174	13	5			18
Total / ha	832	320	0	0	1152
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C176	3	7			10
Total / ha	192	448	0	0	640
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C207	17	3			20
Total / ha	1088	192	0	0	1280

Threshold trees/ha		750	500	250	1000
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Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C213	8	8			16
Total / ha	512	512	0	0	1024
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C216	4	12			16
Total / ha	256	768	0	0	1024
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C231	8	7			15
Total / ha	512	448	0	0	960
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C255	13	7			20
Total / ha	832	448	0	0	1280
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.

C235	16	7			23
Total / ha	1024	448	0	0	1472
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
F5	8	4			12
Total / ha	512	256	0	0	768
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
F16	9	3			12
Total / ha	576	192	0	0	768
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
F31	10	2			12
Total / ha	640	128	0	0	768
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Active	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
F36	15				15
Total / ha	960	0	0	0	960
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
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Active	Diametre cm (dbh)				All Diam.	
	Plot #	≤5	>5 ≤12	>12 ≤20		>20
F37		10	1		11	
Total / ha		640	64	0	0	704
Threshold trees/ha			750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Passive	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
B279	5	2	1		8
Total / ha	320	128	64	0	512
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Passive	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C137	18	8	3		29
Total / ha	1152	512	192	0	1856
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Passive	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
C209	0				0
Total / ha	0	0	0	0	0
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Passive	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
E57	24				24
Total / ha	1536	0	0	0	1536
Threshold trees/ha		750	500	250	1000

Tree Tally (number of stems per 156m ²)					
Passive	Diametre cm (dbh)				
Plot #	≤5	>5 ≤12	>12 ≤20	>20	All Diam.
F7	2		1		3
Total / ha	128	0	64	0	192
Threshold trees/ha		750	500	250	1000

Active Plots Quantitative Data and Overall Averages					
Plot #	Year Planted	Average Canopy Height	Survival rate (%)	Basal Area per ha	
A310	2015	6	79.17	6.42	
B267	2015	5	54.17	2.00	
C118	2015	6	87.50	1.97	
C123	2015	4	54.17	3.26	
C142	2015	4	50.00	1.46	
C161	2015	4	58.33	0.98	
C174	2015	4	75.00	1.33	
C176	2015	5	41.67	1.37	
C189	2016	4	83.33	2.73	
C207	2016	2	83.33	0.98	
C213	2016	4	66.67	2.27	
C216	2016	6	67	5.55	
C231	2016	4	62.50	1.50	
C255	2016	4	83.33	1.75	
C235	2016	5	95.83	2.87	
F5	2017	7	50.00	2.89	
F16	2017	5	50.00	1.10	
F31	2017	3	50	0.65	
F36	2017	2	62.50	0.53	
F37	2017	3	45.83	0.90	
Overall Average		4.35	65	2.13	

Active Plots Quantitative Data Averages Per Zone					
Zone	Year Planted	Average Canopy Height	Survival rate (%)	Basal Area per ha	
A	2015	6	79.17	6.42	
B	2015	5	54.17	2.00	
C	2015/2016	4.31	69.87	2.16	
F	2017	4	51.67	1.22	
Overall Average		4.8275	64	2.95	

Passive Plots Quantitative Data and Overall Averages		
Plot #	Average Canopy Height	Basal Area per ha
B279	4	1.572
C137	12	10.249
C209	0	0
E57	1	0.121
F7	2	1.172
Overall Average	3.8	2.623