4.0 Supporting Scientific Studies

4.1 Population Viability Analysis

A focus of conservation biology research is to address the fundamental issues and causes underlying species/population declines. Species and populations can be limited by environment, anthropogenic activities, and by biological characteristics including genetics, physiology, biomechanics, and behaviour. In the case of the Blanding's turtle, populations are at risk due to their low fecundity and recruitment, delayed sexual maturity, and high adult mortality associated with poaching, habitat loss, and road mortality.

In order to model the vulnerability of a particular population to extinction or extirpation, scientists have employed Population Viability Analyses (PVA) which aims to understand population growth with respect to long-term trends (**Appendix C**). If the parameters such as survival and fecundity are predictable, then biologists and managers can understand the risks to a population and can provide mitigation or management measures to improve population longevity. A PVA analyzes the factors that are known to impact a population and uses a defined model to predict the risk of extinction of that population. Consequently, PVA is also a good tool for evaluating and identifying the most beneficial mitigation and management actions for protection of a population (Gerber and Gonzalez-Suarez, 2010).

This study employed computer modeling to mimic "real" conditions and to simulate population changes over time. By running a computer simulation thousands of times, and by randomizing unpredictable factors like weather or catastrophic events (such as introduction of an invasive species or an epidemic), computer modeling can be used to assess the risk of extinction. This approach is now common because of wide access to high-powered, desktop computers. However, as with any analysis, there are limitations and uncertainty. Some important factors, such as birth and death rates, may be poorly known. Future conditions may be difficult to predict, especially random factors like weather and diseases. Nonetheless, if these limitations are recognized and acknowledged, then a computer simulation PVA is very useful for assessing the vulnerability of a population to extinction and the comparative effectiveness of different management options.

4.1.1 Overview of Model and Analysis

A primary objective of this conservation needs assessment is to analyze the long-term viability of the South March Highland's Blanding's turtle population and to assess its ability to survive planned human activities within its habitat. A PVA was used to look at the overall resilience of the SMH Blanding's turtle population, and to compare the effects of different human activities and management options on the relative risk of extinction. Due to data limitations and uncertainties about future conditions, the analysis cannot provide reliable quantitative estimates of extinction risks.

However, it can identify the impact of each threat or management option on those risks as positive, neutral, or negative and it can assess their relative importance.

The analysis combined the Blanding's turtle population information collected between 2009 and 2012 as part of the Terry Fox Drive studies by the City of Ottawa and Dillon Consulting Limited. It used information on the current population structure, habitat quality/suitability, and movements from those studies. Because the current population study for the South March Highlands has not spanned a long enough time to accurately determine birth rates and survival rates, the PVA used demographic data collected in Michigan over a span of almost 40 years at the 525 ha University of Michigan's E.S. George Reserve (1953-1991). The reserve lies approximately 900 km to the southwest of the South March Highlands. Carrying capacity (K) was calculated based on the Michigan population (7.5 turtles per hectare). This is a conservative estimate, as a Blanding's turtle population in Nebraska has been found to have over 50 individuals per hectare (Congdon *et al.,* 2008). Another distinction of the model is that only the number of female turtles was modeled. Blanding's turtles exhibit a polygamous mating system, which means that the number of females in a population is the limiting factor in the rate of reproduction.

With respect to development pressures, the study assumed that all of the land within the study area that is currently designated for urban, residential development by Ottawa's Official Plan would eventually be lost as Blanding's turtle habitat. This area comprises all of the habitat in the areas called Zone 9A and 9B in the City of Ottawa report *SMH Blanding's Turtle Population Estimate, Distribution and Range Study, Year 2 of 4* (Dillon, 2011a) and is also referred to as KNL Phases 7 and 8.

In order to improve the realism of the computer simulations, the PVA broke the SMH population of Blanding's turtles into three sub-populations based on their distribution and movement patterns across the 690 ha study area (**Figure 6**).

- The Kizell Wetland sub-population (KW)
- The South March Highlands- Central sub-population (SMH – CEN) (includes KNL Phases 7 and 8).
- The South March Highlands- Upland sub-population (SMH – UP)

The PVA also considered differences in survival, migration potential and exposure to threats for three different life stages of Blanding's turtle: (1) eggs/hatchlings; (2) juveniles; and, (3) adults.

Typical outcomes for PVAs are: (i) the probability that the local population will become extinct; (ii) the rate of the decline; and, (iii) the length of time for the population to decrease to extinction, should it occur. However, because of the uncertainty associated with the life-cycle demographic data (i.e., vital rates, initial abundances, etc.) this analysis focused on the sensitivity of the population to different human activities and threats, and assessed different situations that in the future may impact the SMH Blanding's turtle population. The scenario outcomes presented are the relative decrease in adult female turtles when compared to existing baseline conditions in the SMH.

4.1.2 Methods

Appendix C provides a detailed description of the PVA methodology, including the demographic and statistical parameters used in the computer model. The PVA was completed using the RAMAS® Metapop software (Applied Biomathematics, Setauket, New York). The software predicts changes in populations over time, incorporating normal fluctuations in factors such as birth and death rates, and can include random factors, such as weather or catastrophic events. The model spans a 500 year period and was replicated 1000 times for each scenario.

Two catastrophes were added to the model to account for randomly occurring events that may cause negative effects on the populations. One catastrophe halved *adult abundances* in each sub-population and is analogous to a large poaching event or a fatal disease outbreak. The second catastrophe halved *reproductive ability*, and is analogous to a systemic event, such as drought, which might alter survivorship, fecundity, and development over a large area. Each catastrophe was set to occur once in one hundred years.

4.1.3 Scenarios Modeled

The Population Viability Analysis consisted of 3 models (a baseline and two alternative models) and the sensitivity of the models to several scenarios, reflecting threats and possible mitigation/compensation measures. As well, given the findings in 2012 that a nesting area is located on KNL Phase 8 lands north of the rail line, a separate scenario was created and explained below independent of the other models and scenarios.

Baseline Model

The Baseline model is a situation in which all three sub-populations are stable, but are exposed to periodic catastrophic events. However, the selection of this scenario does not presume that the current SMH population of Blanding's turtles is, in fact, stable (we have insufficient data to make that judgment). It only represents a neutral scenario against which other scenarios can be compared. The model was altered to reflect the following scenarios. Only the number of adult female turtles is modeled.

1. **Decreased survival rates**. This scenario used a slightly decreased annual survival rate for the SMH – Central sub-population and a substantially decreased annual survival rate for the

KW sub-population. The decreased survival rates reflect the greater exposure of these sub-populations to residential developments and roads, especially the KW sub-population.

2. **Low egg survival**. This scenario may result from excessive nest predation caused by a parasitic infestation of several Blanding's turtle nests or from the cumulative effects of anthropogenic disturbances of the nesting cycle by domestic animals, increased densities of urban egg predators (raccoons, skunks), traffic noise, terrain alteration and proximity to humans.

3. **No catastrophes**. This scenario models a situation in which natural catastrophic events do not occur (note: historically, not a realistic scenario).

4. **Transplantation to the Kizell Wetland**. This scenario modeled the effects of transferring two female adult turtles from the SMH-CEN sub-population to the KD sub-population every five years, which is a possible management strategy for aiding population persistence in the KD area.

5. **Increased hatching success**. This scenario modeled increased success of egg hatching to represent a nest protection program (Section 6.3.4).

6. **High hatchling survival**. This scenario modeled increased survival of new hatchlings under a "head start program" – *i.e.* a foster program for new hatchings (Section 6.3.4).

<u>Isolation Alternative Model</u>

This alternative model reflects the decreased ability of turtles to migrate between the KW sub-population and the other sub-populations following the proposed development of KNL Phases 7 & 8. Similarly to the baseline model, the model was altered to reflect the following scenarios: **No catastrophe**, **Transplantation to the Kizell Wetland**, **Increased hatching success**, and **High hatchling survival** (head start program).

<u>Urbanization Alternative Model</u>

This alternative model reflects the full development of KNL Phases 7 & 8 and the complete loss of core turtle habitats. The model combines decreased survival rates for the SMH-Central and KW sub-populations and isolation of the KW sub-population. Similarly to the baseline and isolation models, the model was altered to reflect the following scenarios: **No catastrophe**, **Transplantation to the Kizell Wetland**, **Increased hatching success**, and **High hatchling survival** (head start program).

<u>Removal of a Nesting Site in KNL (Kanata Lakes) Phase 8</u>

This scenario is based on the loss of an identified nesting site in SMH-CEN (Zone 9B) due to development of the KNL Phase 8 lands. It assumes that the nesting site supports 60 eggs *per* year (before egg losses due to predation and nest failure). The loss of 60 eggs per year was assumed to start in year 5 and continuing to year 35 to represent the habitual use of the site by the current generation of adult turtles. After year 35, it is assumed that no turtles will be attempting to use the site. To relate the scenario to existing conditions, it was modeled using the Baseline model; and to relate the scenario to potential conditions should development in the area occur, it was modeled using the Urbanization Alternative Model. A potential compensation measure for the destruction of this nesting site is the commitment to run a head start program to add 30 juveniles each year for 30 years to the SMH-Central population. This management action was also modeled using both the Baseline and Urbanization models.

4.1.4 Model Elasticity

An important output of the PVA (independent of the alternative models and different scenarios) is a set of numbers related to the elasticity of the model. Elasticity refers to the change in the model output caused by a change in a single variable. The variable input that had the largest impact on the model outcome was adult survivorship, followed by juvenile survivorship (**Appendix C**). These two observations are typical for Blanding's turtle populations (Congdon *et al*., 1993; Enneson and Litzgus, 2008). Because adult survival had the highest elasticity, or effect, it means that small changes in adult survival will have the greatest impact on the population size, and thus, management options should be prioritized to increase adult survivorship before considering management actions that influence other model variables.

4.1.5 Scenarios

Appendix C shows information about each of the scenarios described above in **Section 4.3.1** in comparison to the Baseline scenario. The following set of figures provides a qualitative description of the impacts of each modeled scenario on long-term population viability (in this case adult female abundance) in comparison to the Baseline scenario.

As PVAs are highly sensitive to model parameters and because the vital rate variables used in this model have been, for the most part, assumed from published datasets, we have limited our analysis and discussion of the model to its sensitivity. We have avoided, for example, stating absolute values for "time to extinction", "minimal viable population estimate", and "final number of adults". When interpreting the following figures, the percent decline in the number of adult females was used as a proxy for population decline/growth. Strong declines occurred when there was a greater than 50% reduction in the number of adult female turtles, declines occurred when there was between 5% and 50% reduction in the number of adult females. Similarly, strong growth occurred when there was greater than 50% increase in the number of adult females, and growth when there was an increase of between 5% and 50%. No change was defined as having between 5% reduction and 5% increase. Furthermore, it can be assumed, that if the model outcomes show decline, extinction will occur earlier than predicted by the Baseline model, and *vice versa*.

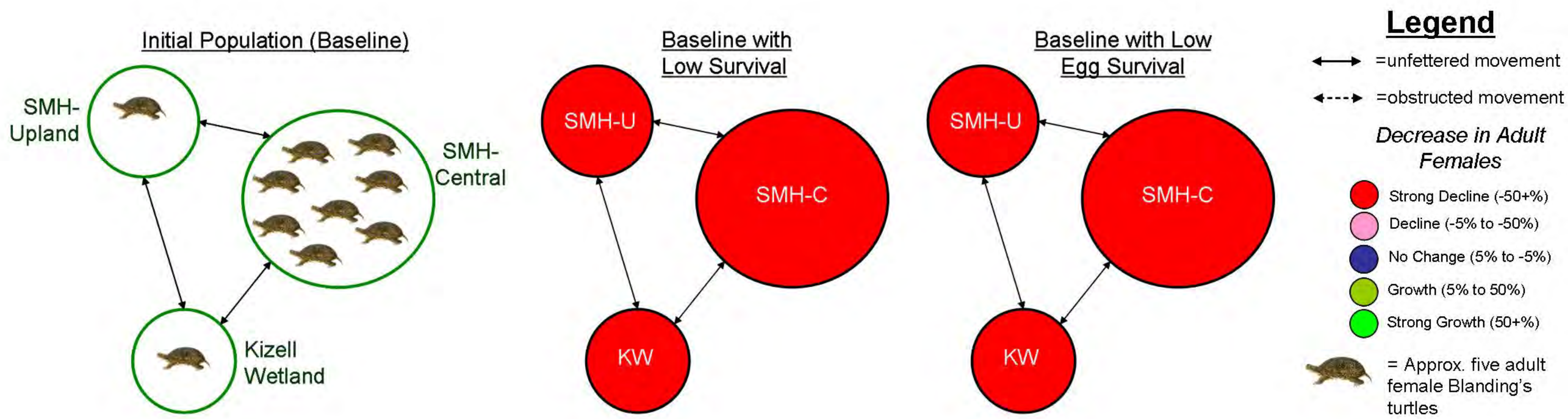


Figure 6. The initial population structure used in the PVA and the outcome of the decreased survival and decreased low egg survival scenarios.

*South March Highlands Upland (SMH-U), South March Highlands-Central (SMH-C), and Kizell Wetland (KW).

The Baseline scenario, itself, predicts eventual extinction of the SMH Blanding's turtle population due to the effects of periodic catastrophic events. Although it could be argued that the severity or the frequency of catastrophic events is too high, such a result is common for small populations of animals with low reproductive rates. The result highlights the inherent vulnerability of this population, which is clearly shown in **Figure 6** where relatively small changes in survival and egg survival result in a strong decline in adult female abundance.

To investigate the Baseline model further and to adjust the model to reflect potential management solutions, four other scenarios were run (**Figure 7**). When the Baseline model was run, omitting the potential for catastrophic events, the SMH Blanding's turtle population grows in size, which suggests that during long periods of time when no catastrophic events occur, the population is able to grow. The three remaining scenarios all relate to potential management strategies. First, if two adult female turtles every 5 years are removed from the SMH-C sub-population and transplanted in the KW sub-population, the action prevents decline in the KW sub-population, but causes the SMH-C sub-population to decline (an undesirable outcome). Second, the next management strategy modeled was to protect nests found in the area. The outcome of the nest protection scenario suggests a positive outcome, as both the SMH sub-populations grow and the KW sub-population remains unchanged, compared to the Baseline model. Third, if a head start program is implemented (eggs hatched and young reared for 2 years in captivity prior to release) both SMH sub-populations increase in size while the KW sub-population also shows positive growth.

A potential outcome of urban development in the SMH is that the KW sub-population would become isolated from the two SMH sub-populations as residential areas surround most of the wetland, with the First Line road allowance remaining forested. Should this occur, dispersion between the KW sub-population would be reduced; this model is depicted in **Figure 8**. When compared to the Baseline model, the Isolation Alternative Model shows that both the SMH-C and KW sub-populations decline, while the SMH-U grows in size. The increase in adult females in SMH-U is likely an artifact of there being few existing turtles there and the increase in turtles moving to the area because of the low dispersion rate into the KW sub-population. Again, as was seen in **Figure 7**, if no catastrophes are modeled, each sub-population grows, but this is unrealistic over the long term. The only difference in the scenario outcomes of the Isolation Alternative Model when compared to the Baseline model is for the transplantation scenario, in which case the SMH sub-populations both experience strong declines, and the KW sub-population shows less decline; meaning that transplanting turtles to the KW sub-population at the cost of turtles in the SMH-C sub-population is not a sustainable management option.

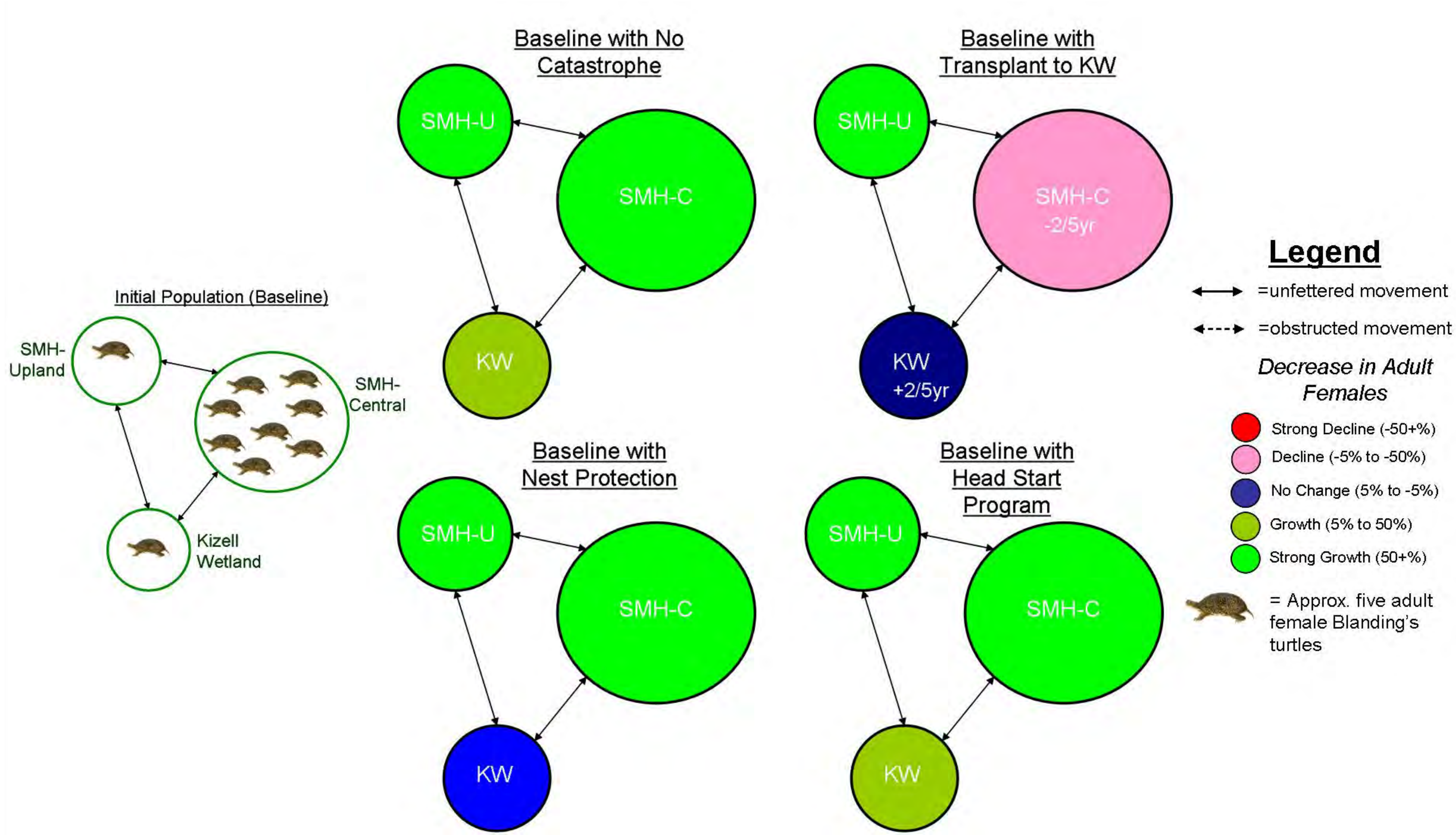


Figure 7. The Baseline model re-run with four scenarios: no catastrophe, transplanting 2 turtles from SMH-C to KW, nest protection, and head start program.

* South March Highlands Upland (SMH-U), South March Highlands-Central (SMH-C), and Kizell Wetland (KW).

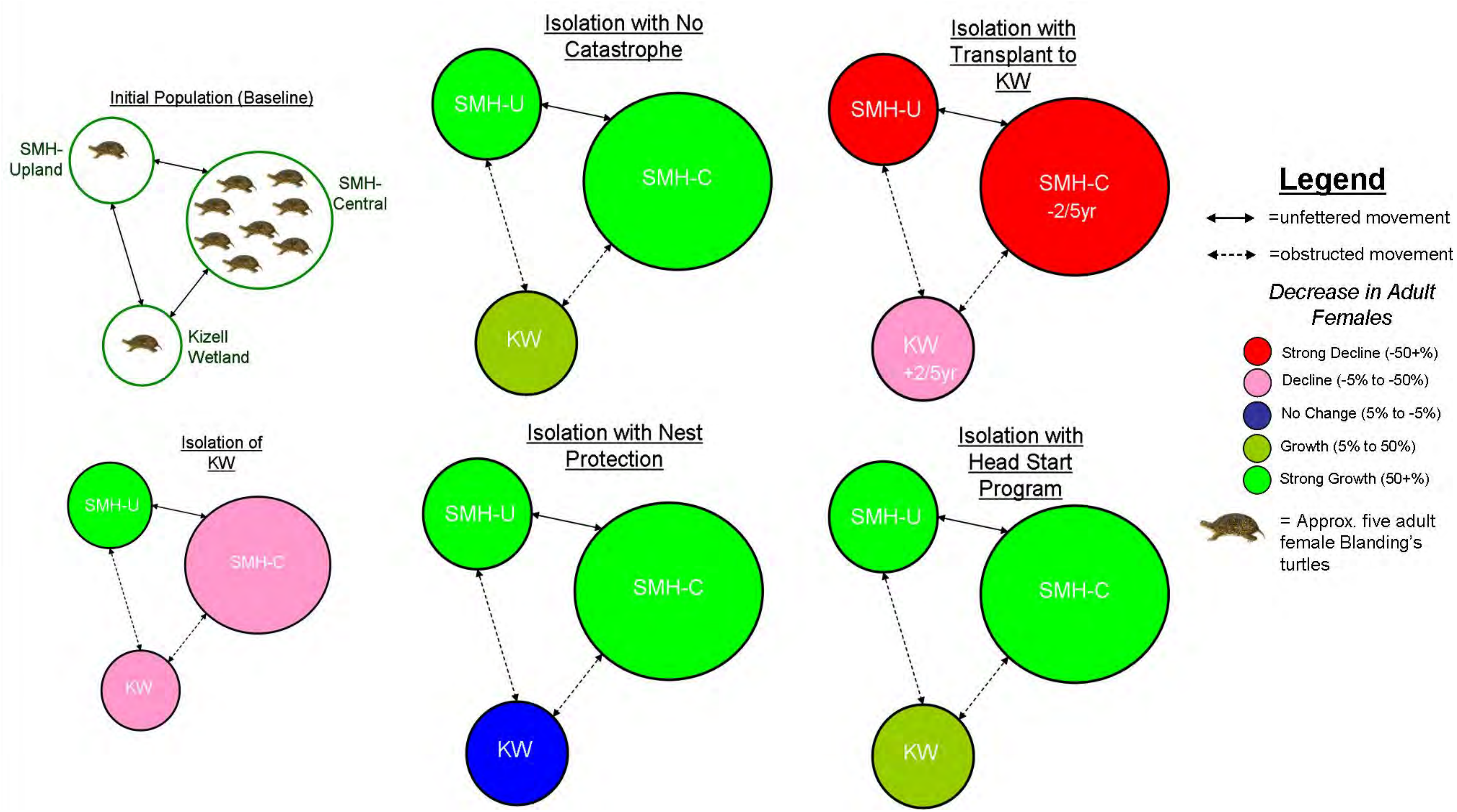


Figure 8. The Baseline model altered to reflect the isolation of KW and then re-run with four scenarios: no catastrophe, transplanting 2 turtles from SMH-C to KW, with nest protection, and head start program.

*South March Highlands Upland (SMH-U), South March Highlands-Central (SMH-C), and Kizell Wetland (KW).

Another potential outcome of development in the SMH is that the SMH-Central and KW sub-populations would have decreased survival rates (due to increased anthropomorphic disturbances or predation) and the KW sub-population would be isolated (not necessarily cut off, but reduced dispersion). This alternative model to the Baseline has been termed the "Urbanization" Alternative Model and is shown in **Figure 9**. In addition, this alternative model reflects what would be expected should KNL proceed with full development of Phases 7 and 8. Compared to the Baseline model, Urbanization would result in a strong decline of the entire SMH population. Interestingly, and somewhat of a positive outcome, if catastrophes can be avoided, the SMH sub-populations still show growth, however, the KW sub-population declines but not strongly. The potential management option of transplanting two turtles per year to the KW sub-population does not alter the outcome of the Urbanization Model, as the entire SMH population declines. Should nest protection be implemented, the two SHM sub-populations show strong growth, but the KW sub-population remains in decline (though less so than if nest protection is not implemented). The best scenario for increasing the SMH population under the Urbanization Alternative Model is to implement a head start program, as all three sub-populations show growth.

Though the Urbanization Alternative Model was developed to reflect KNL full development of Phases 7 and 8, it does not reflect the destruction of the nesting site found on the property in 2012. Given the number of adult females using the site (based on radio telemetry findings), the subset of turtles radio tagged, and the average clutch size of Blanding's turtle, it was estimated that approximately 60 eggs per year would be lost if the nesting area was removed. Furthermore, given the long generational time of turtles and the potential for habitual use of old nesting areas, it was assumed that turtles would continue to attempt to use the nesting area for another 30 years. The loss of 60 eggs per year for 30 years was run as a scenario using both the baseline and urbanization models. In both cases there is a strong decline in the entire SMH population. (**Figure 10**) Should 30 juveniles be raised in captivity and placed in the SMH to compensate for the loss of the eggs, the population declines under both baseline and urbanization models, however, the decline is less in the baseline model for SMH-C and KW (**Figure 10**). Overall, if the estimate of productivity for the nesting area is correct, and the nesting area is removed, the entire SMH population would be greatly reduced and may even result in Blanding's turtle being extirpated from the SHM. It will therefore be important to replace the value of this nesting site, either through physical replacement(s) elsewhere, nest protection strategy &/or through a headstart program.

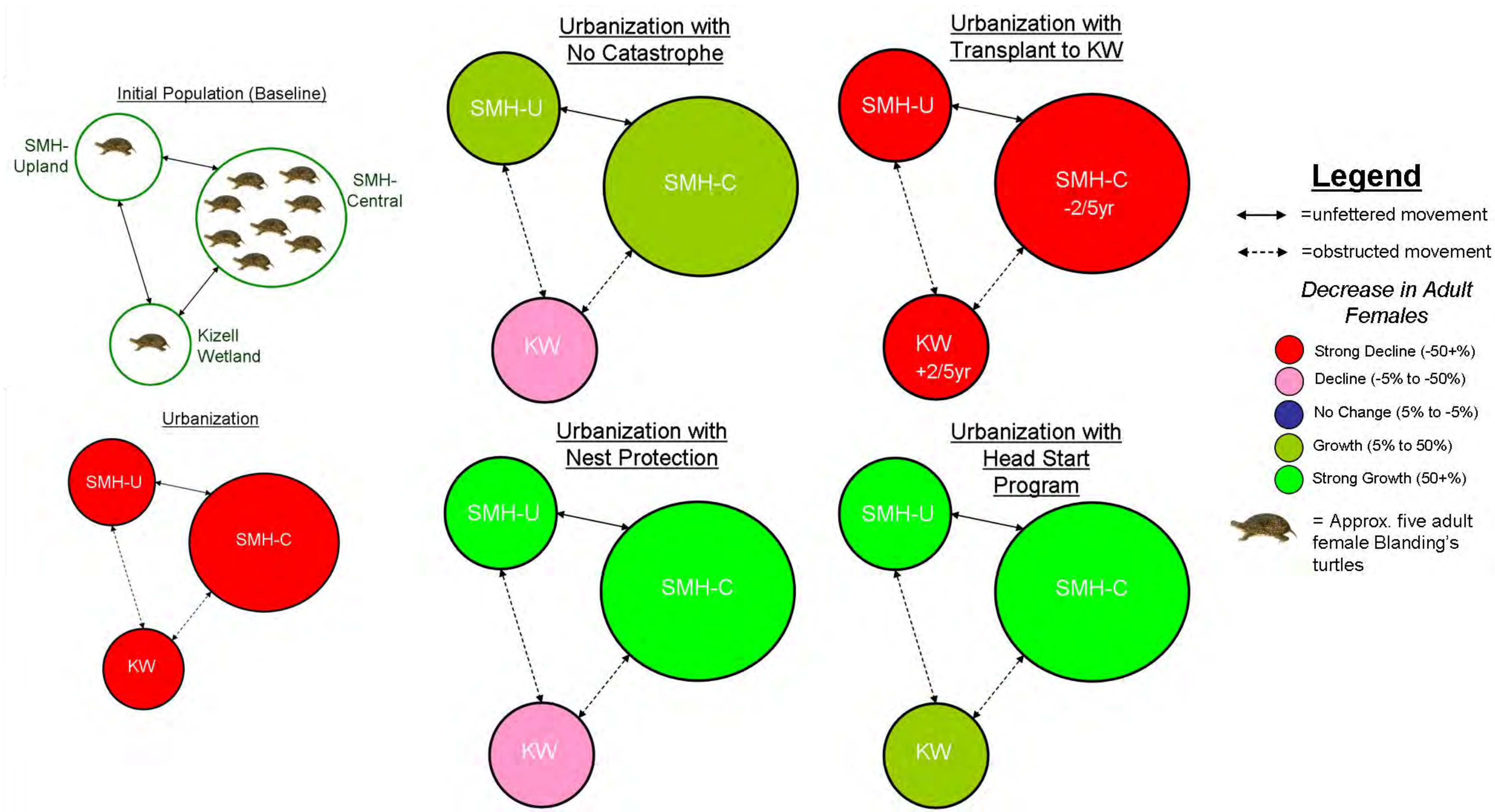


Figure 9. The Baseline model altered to reflect the Urbanization in the surrounding SMH area and then re-run with four scenarios: no catastrophe, transplanting 2 turtles from SMH-C to KW, with nest protection, and head start program.

*South March Highlands Upland (SMH-U), South March Highlands-Central (SMH-C), and Kizell Wetland (KW)

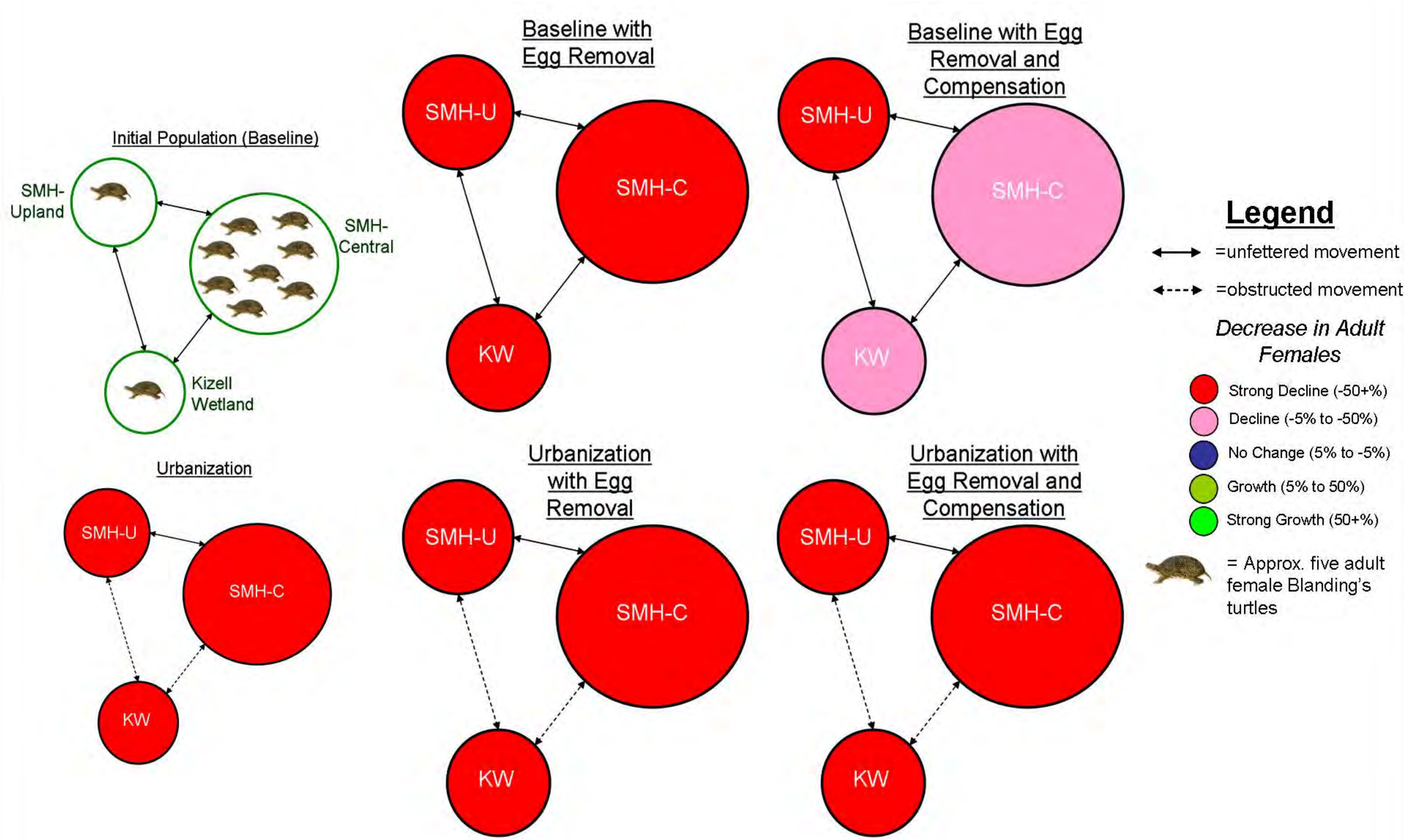


Figure 10. The Baseline model and Urbanization Alternative Model re-run twice: 1) to reflect the destruction of a nesting area in the SMH-C capable of producing 60 eggs per year for 30 years (starting year 5); and 2) to compensate for the loss of 60 eggs by introducing 60 juveniles each year for 30 years (starting year 5).

4.1.6 PVA Conclusion

The PVA produced results based on SMH-specific data collected during the 2011 and 2012 mark-recapture study and using surrogate vital rate variables from a 37-year population study in Michigan. The main finding of the analyses was the elasticity of the model to adult survivorship and this indicates that adult mortality due to any cause other than old age or disease should be minimized, and be a priority of conservation management actions. Another major result of the PVA is the model outputs and different scenarios. Essentially, the SMH population, currently estimated to contain just over 100 adults, is at a state that is very sensitive to natural events, such as catastrophes, so even if no negative changes in vital rates, such as adult survivorship and fecundity occur, the SMH population may become extinct in 500 years. Should isolation of the KW sub-population and reduced adult survivorship occur because of residential and commercial development, or for any other reason, the SMH population will become extinct at a faster rate.

The modeling shows that conservation management actions requiring significant effort such as adult protection, nest protection and head start programs can potentially reduce the likelihood of extinction, may result in population growth and be quite effective in sustaining this species despite urbanization. Management actions requiring less effort, such as transplantation of adults, should generally benefit the species but may not see the same benefit of increased population growth and may even reduce it in some sub-populations. In addition, should a significant habitat like the vernal pools and nesting site on the KNL Phase 8 lands be removed without offsetting compensation or action, the entire SMH population will be greatly reduced and there is a high potential for the entire population to be extirpated from the SMH.

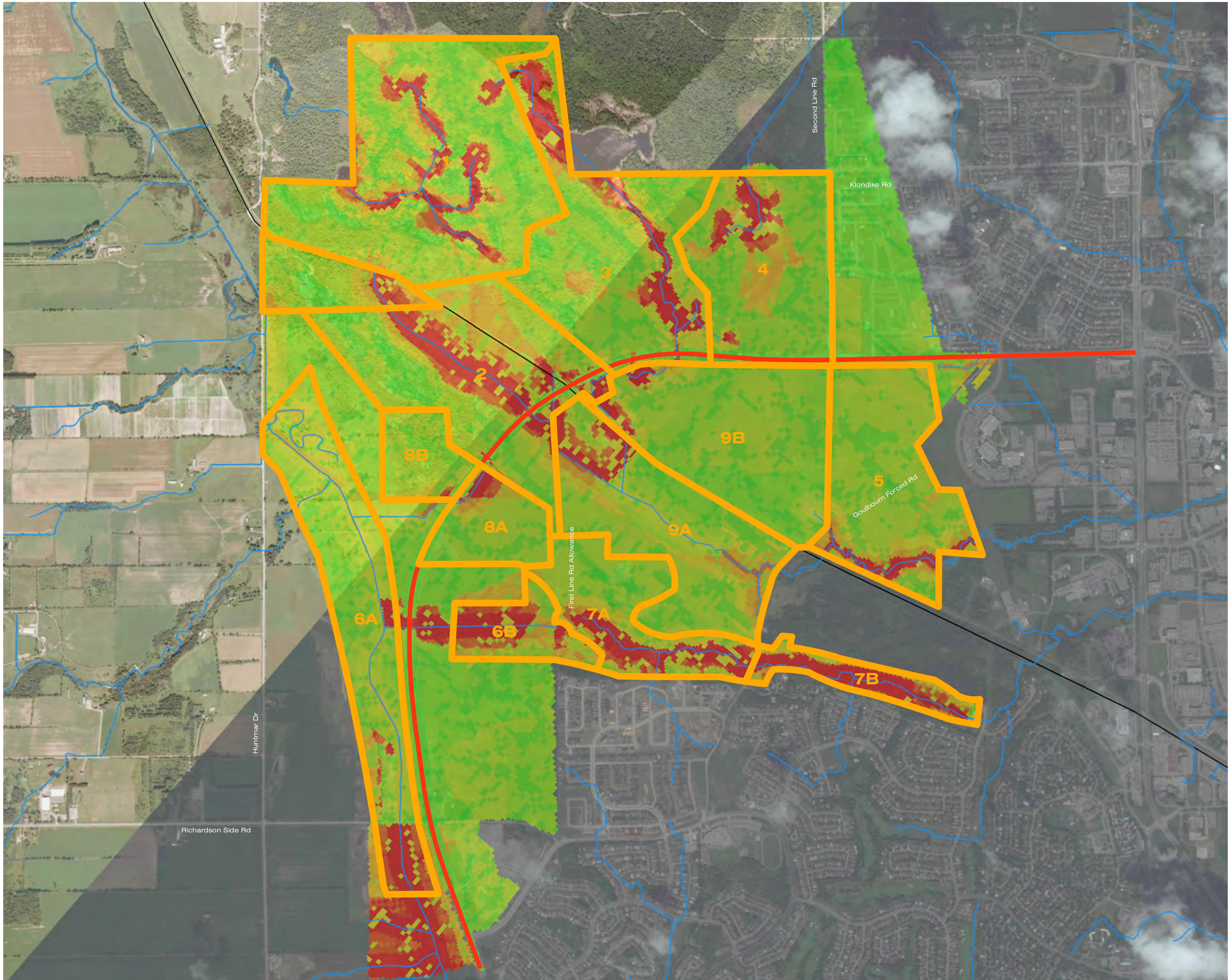
4.2 Core Habitats

4.2.1 Habitat Quality

A subjective Blanding's Turtle Habitat Quality Index (HQI_{BT}) was created to reduce biases in the one used in previous Dillon reports. The new approach uses a Geographic Information System (GIS) to model Habitat Quality based on weighted environmental variables based on researcher experiences. The updated HQI_{BT} used a vegetation classification, Topographical Wetness Index (TWI), slope, and distance to water to better classify Blanding's habitat. Refer to **Appendix E** for details on the methods used to create the new HQI_{BT}. The results for the updated 2012 HQI_{BT} are illustrated in **Figure 11A** over the Study Area. The results were generally consistent with the manually-derived results in the 2010 Blanding's Turtle Habitat Suitability Index (HSI_{BT}), but with a higher degree of precision and without the issues associated with the manual interpretation of habitat suitability. The results indicate that areas of high habitat quality are generally associated with wetlands and open water habitats as would be expected. However, the presence of smaller vernal pools was not captured within the vegetation classification or wetland mapping and was therefore not identified as quality habitat within the model. It is assumed that more refined vegetation mapping than currently exists for this area would more accurately capture these vernal pool habitats. Much of the area is identified as having low habitat quality; however, observations made during the field work for the population study suggest that vernal pools are used frequently by Blanding's turtles for movement from areas of high habitat quality to the other. Field work has also demonstrated that some vernal pools are used year-round and should be considered residential wetlands and core habitat. The modeling approach further facilitates statistical analysis and the modeling of linkages between core habitats better than the manually derived 2010 HSI_{BT} due to its increased precision, automation and transparent approach.

In addition, the HQI_{BT} model does not capture the substrate type within the wetlands and open water habitats, nor does it capture the human-induced changes to these habitats as in Zone 7B. These characteristics must be annotated to the file. Specifically, the high habitat quality values within the Beaver Pond (Zone 7B) do not accurately represent the findings from the population study, as Blanding's turtles have not been captured or observed there. The adjacent land uses have degraded substrate and water quality within this habitat, which significantly affects the habitat quality for Blanding's turtles. Substrate type and water quality were therefore not used in the model.

In addition to the study area, a gross scale analysis of Blanding's turtle habitat quality on two other properties near the SMH were investigated (**Figure 11B**). The western property lies along the Carp River and encompasses a portion of the flood plain. For the most part, only a few Blanding's turtles have been observed near the Carp River; and none this far north. However, the area does have suitable vegetation cover in the riparian zone and likely would be considered suitable Blanding's turtle habitat prior to the Carp River being channelized. This suggests that the Carp River floodplain could be a suitable target for ecological restoration, to recreate habitat suitable for Blanding's turtle.



Ottawa

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South March Highlands Blanding's Turtle Conservation Needs Assessment

Blanding's Turtle Habitat Quality

Figure 11A

- Zone Boundary
- Terry Fox Drive
- Wetlands
- Watercourse
- Railway

Habitat Suitability Index

100 – High Habitat Quality

Moderate Habitat Quality

Low Habitat Quality – 0

0 75 150 300 450 600 Meters

SCALE 1:17,000

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNR, the City of Ottawa, and Dillon Consulting Limited

MAP CREATED BY: AJZ
MAP CHECKED BY: CTH
MAP PROJECTION: NAD 1983 UTM Zone 18N

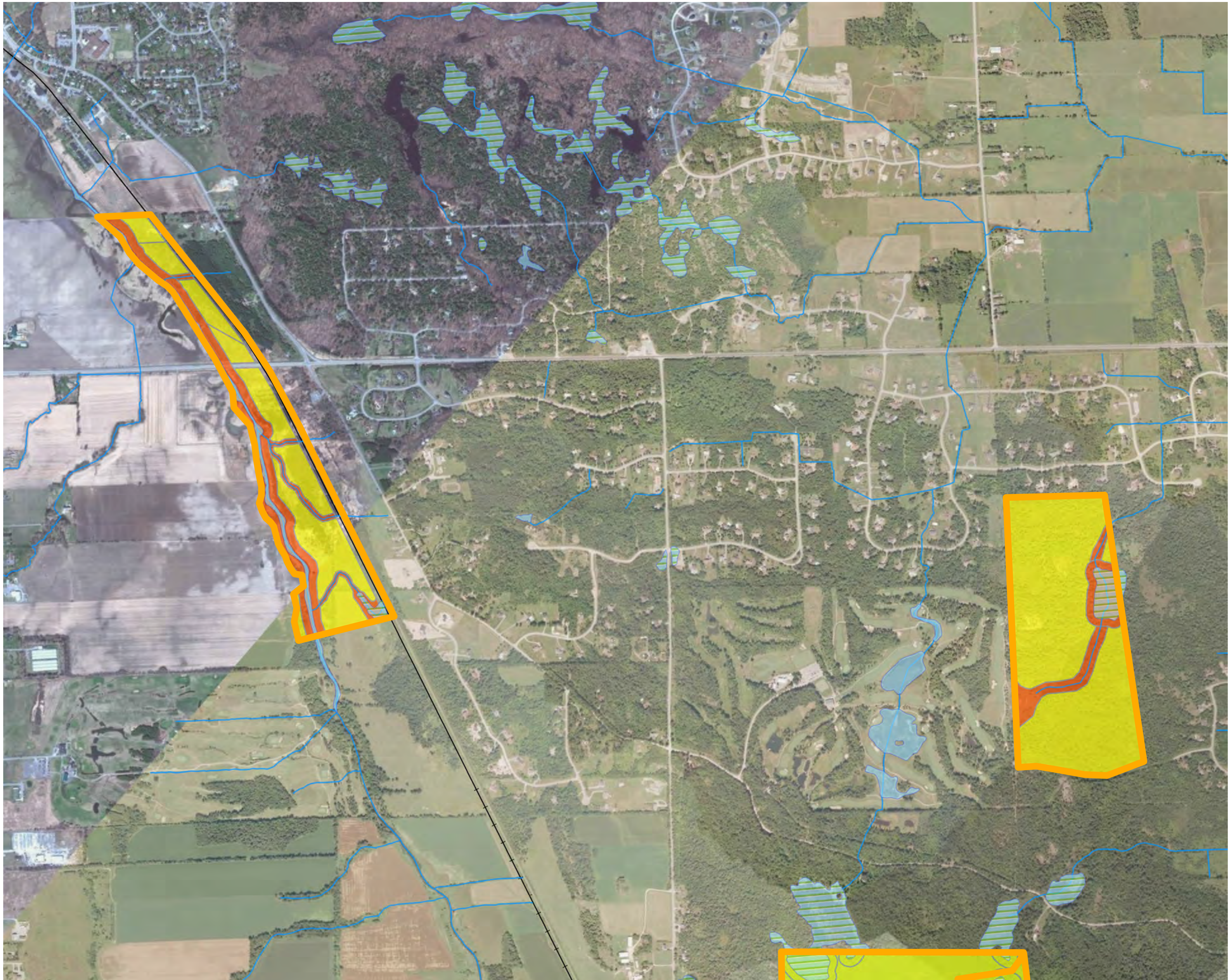
FILE LOCATION: \\DILLON.CA\DILLON_DFS\OTTAWA\OTTAWA CAD\2012\126019 34\Design_GIS\MXDs\Report Maps\6A-HabitatSuitability.MXD

DILLON CONSULTING

PROJECT: 12-6019

STATUS: FINAL

DATE: 10/16/12



Ottawa

City of Ottawa

South March Highlnads Blanding's Turtle Conservation Needs Assessment

Other Areas

Figure11B

- Study Area Boundary
- Terry Fox Drive
- Wetlands
- Watercourse
- Railway
- Upland Habitats
- Lowland habitats

0 62.5 125 250 375 500
Meters

SCALE 1:17,000

W N S E

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNR, the City of Ottawa, and Dillon Consulting Limited

MAP CREATED BY: AJZ
MAP CHECKED BY: CTH
MAP PROJECTION: NAD 1983 UTM Zone 18N

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DILLON CONSULTING

PROJECT: 12-6019

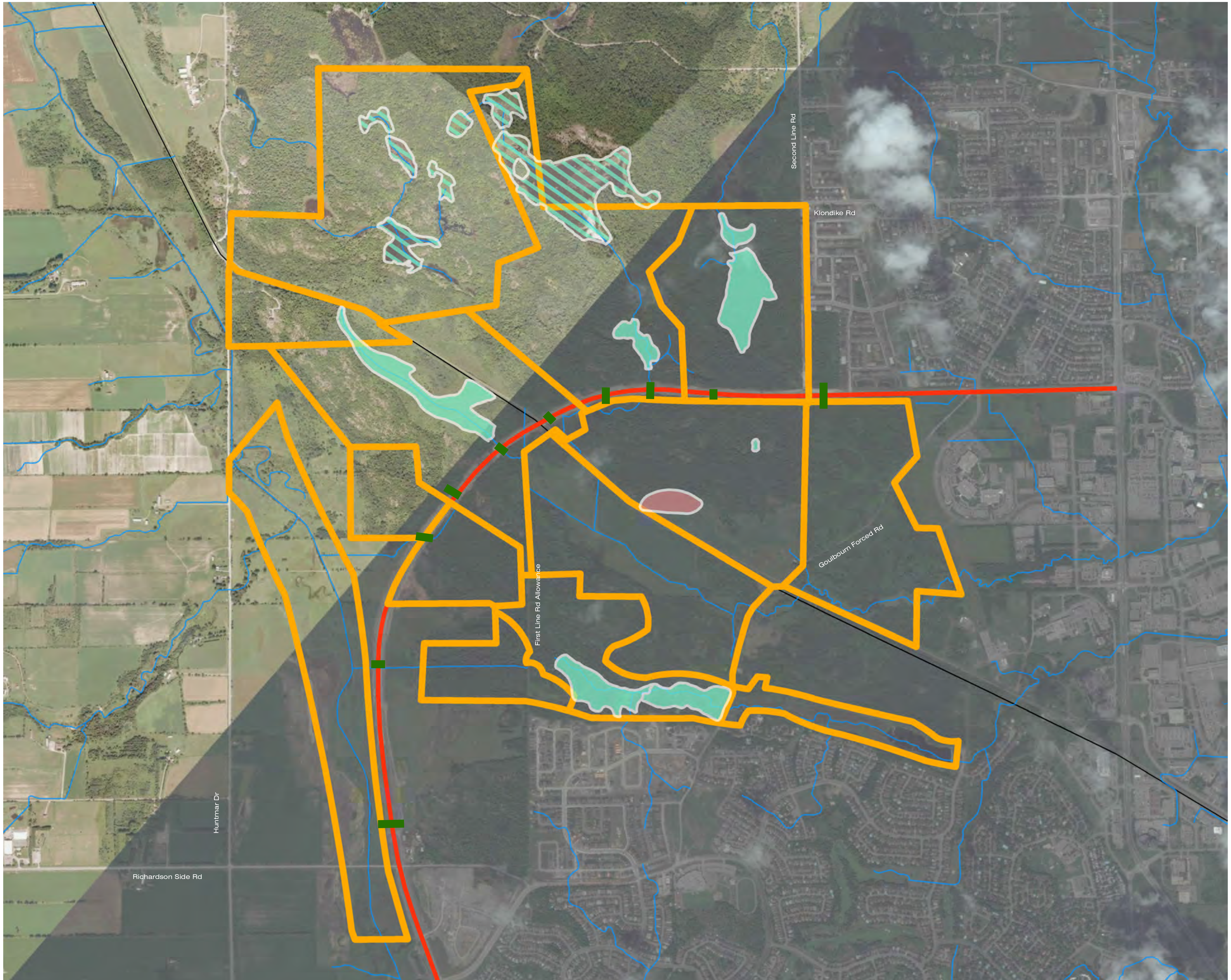
STATUS: FINAL

DATE: 10/16/12

4.2.2 Defining Core Habitats for the SMH Blanding's Turtle Population

Blanding's turtles are threatened provincially (*Endangered Species Act, 2007*) and nationally (Species at Risk Act, 1993), and require protection by both *Acts*. In Ontario, general habitat protection for Blanding's turtle will become regulated on June 30, 2013. Once a species is listed nationally, a recovery strategy is prepared by a team of experts to facilitate conservation and protection. To date, only a national recovery plan has been developed for the Nova Scotia Blanding's turtle population and it does not identify critical habitat because of data deficiencies and ongoing research (The Blanding's Turtle Recovery Team, 2002). It is neither the intent of the Conservation Needs Assessment, nor is it in the City of Ottawa's jurisdiction to identify critical habitat. That task will be guided by the Ministry of Natural Resource and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Data collected from the ongoing radio-telemetry and mark recapture population study has provided information pertaining to habitat use, and as such, we know of important core habitat areas (i.e., overwintering and nesting sites) that need to be identified as part of the conservation needs assesment for Blanding's turtle. A broad map of the core habitats in the SMH has been included with this report (**Figure 12**). In general, most of the SMH areas forested areas, stream corridors or wetlands are is core habitats or connects core habitats one to another. Existing connections between the core areas are along the First Line road allowance, the western extension of Kizell Drain wetland west of First Line and West Shirley's Brook. Both tributaries of Shirley's Brook have been modified in the past, with a significant rechannelization and entrenching of the West Branch that occurred over 40 years ago to improve agricultural drainage. There have been several observations of Blanding's turtle utilizing these corridors during the range study field work, most often along the altered watercourse in Zone 9A (Dillon 2011 b, 2012b In Print).



City of Ottawa

South March Highlands Blanding's Turtle Conservation Needs Assessment

Overwintering Areas & Nesting Sites

Figure 12

- Zone Boundary
- Terry Fox Drive
- Wetlands
- Watercourse
- Railway
- Wildlife Culvert Crossings
- Potential Blanding's Turtle Nesting Site
- Potential Overwintering Area
- Confirmed Overwintering Area

0 75 150 300 450 600
Meters

SCALE 1:17,000

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNR, the City of Ottawa, and Dillon Consulting Limited

MAP CREATED BY: AJZ
MAP CHECKED BY: CTH
MAP PROJECTION: NAD 1983 UTM Zone 18N

FILE LOCATION: \\DILLON.CA\DILLON_DFS\OTTAWA\OTTAWA CAD\2012\126019 34\Design_GIS\MXDs\Report Maps\12-Overwintering-Nesting.MXD

PROJECT: 12-6019

STATUS: FINAL

DATE: 10/16/12

4.2.3 Potential Corridors for Blanding's Turtle Movements

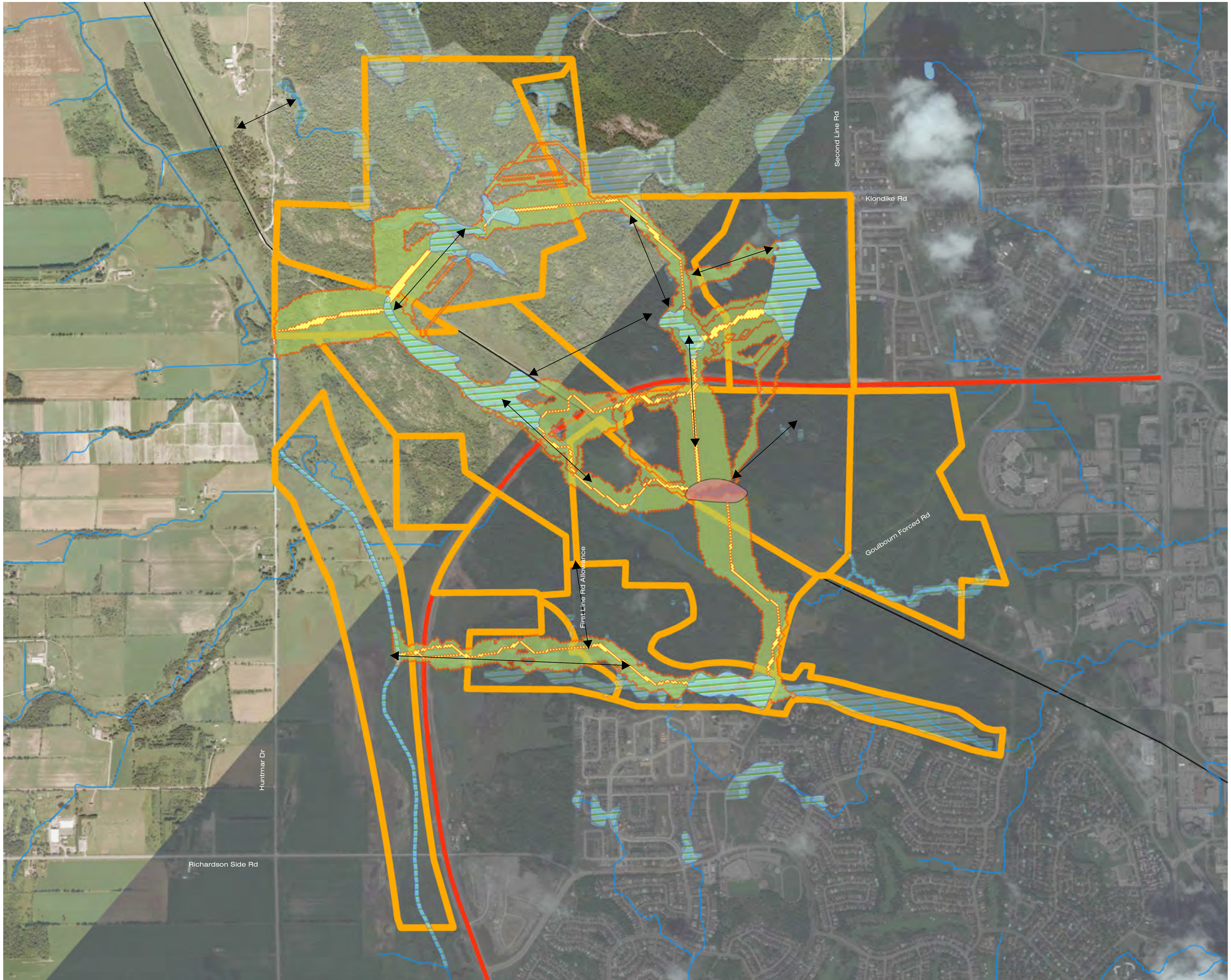
A number of core habitat functions have been identified within the study area during the population study (**Figures 5** and **12**). These include providing spaces for nesting, feeding, mate-searching, overwintering, year-round residence and activity centers. Functionally, many of these habitats are independent from one another generally requiring the females to travel outside of the core habitats to complete some of their life processes. The range study findings (Dillon 2011b) confirm the presence of turtles in habitats of lower quality/suitability, suggesting the turtles are moving between the core areas.

Given the development pressures on the SMH Blanding's turtle population, the identification of the potential corridors that link core habitats would provide a valuable management tool to maintain a viable population within the area. To identify these potential movement corridors a GIS model was created to link the core habitats together using the 2012 HSI_{BT} mapping, described above, to calculate the 'least cost' method of linking two or more core habitats. The basic premise to this GIS model assumes the turtles will follow the most direct route that expends the least amount of energy, while moving between suitable habitats, as they move from core area to core area. The corridor model does not identify all the possible corridors that may exist on the landscape, but rather identifies the pathway of a conceptual corridor, as identified in the model design. As an output, the corridor model also illustrates the functionality of the wildlife culverts installed during construction of the Terry Fox Drive extension as a 'gateway' within each corridor. The GIS model was run twice: once assuming movement through KNL Phase 7 and 8 lands as existing (**Figure 13A**), and again assuming no movement through the lands under a post-development scenario (**Figure 13B**).

The results of both corridor analyses identify potential ecological corridors linking core habitats (**Figure 13A** and **13B**). The results outline the best modeled corridor solution and a more general corridor solution. The best modeled corridor solution is based on the best 0.1% solution linking core features while the general corridor represents the best 2% solution. These modeled movement corridors generally link the core habitats through the most efficient route of suitable habitats, generally using highly suitable areas where possible.

The model output mapping differs because of the assumption of obstructed movement through KNL Phases 7 and 8. Particularly, the existing model where movement is allowed to occur over the KNL lands clearly shows the influence of the nesting site (**Figure 12**) identified during the distribution and range portions of the field studies (Dillon 2012a). Under existing (pre-development) conditions (**Figure 13A**), there are five potential corridors that connect the nesting area to the rest of the core habitats in the SMH and Kizell Wetland. Under the scenario that the KNL lands will be inaccessible to turtles (**Figure 13B**), the aforementioned corridors are no longer predicted and the Kizell Wetland becomes isolated from the rest of the SMH turtle population. The model predicts no pathway connecting it to the rest of the SMH, other than west to the Carp River system which is weakly connected to the SMH - Central population due to a major ridge lying between the Carp River and the West Shirley's Brook wetlands of Zone 2. Both in 2011 (Dillon 2011b) and 2012 (Dillon 2012b) there was only one movement each year of the same old-age, non-gravid female (Female #1-11) along the First Line road allowance, so we conclude that this potential linkage is not currently an important link between the Kizell Drain and Shirley's Brook basins for Blanding's turtle.

If the Kizell Drain wetland sub-population of Blanding's turtle are to be sustained, it is therefore imperative that the conservation management strategies include provision for enhancing the habitat availability, nesting sites and corridor linkages along the Carp River system, and as a second priority to maintain and utilize the retained forest lands along the First Line road allowance as a connection to the Shirley's Brook wetlands. It is also important to note that "under utilized corridors may still be important in maintaining long-term population connectivity" (Pers Comm, Dr. Gabriel Blouin-Demers).



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South March Highlands Blanding's Turtle Conservation Needs Assessment

Blanding's Turtle Corridor Analysis

Figure 13A

- Zone Boundary
- Terry Fox Drive
- Wetlands
- Watercourse
- Railway
- Potential Blanding's Turtle Nesting Site
- Best Modeled Corridor Solution
- General Modeled Corridor Solution
- Radio Telemetry Determined Movement Corridors

0 75 150 300 450 600
Meters

SCALE 1:17,500

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNR, the City of Ottawa, and Dillon Consulting Limited

MAP CREATED BY: AJZ
MAP CHECKED BY: CTH
MAP PROJECTION: NAD 1983 UTM Zone 18N

FILE LOCATION: \\DILLON.CA\DILLON_DFS\OTTAWA\OTTAWA CAD\2012\126019 34\Design_GIS\MXDs\Report Maps\13A-CoridorModel.MXD

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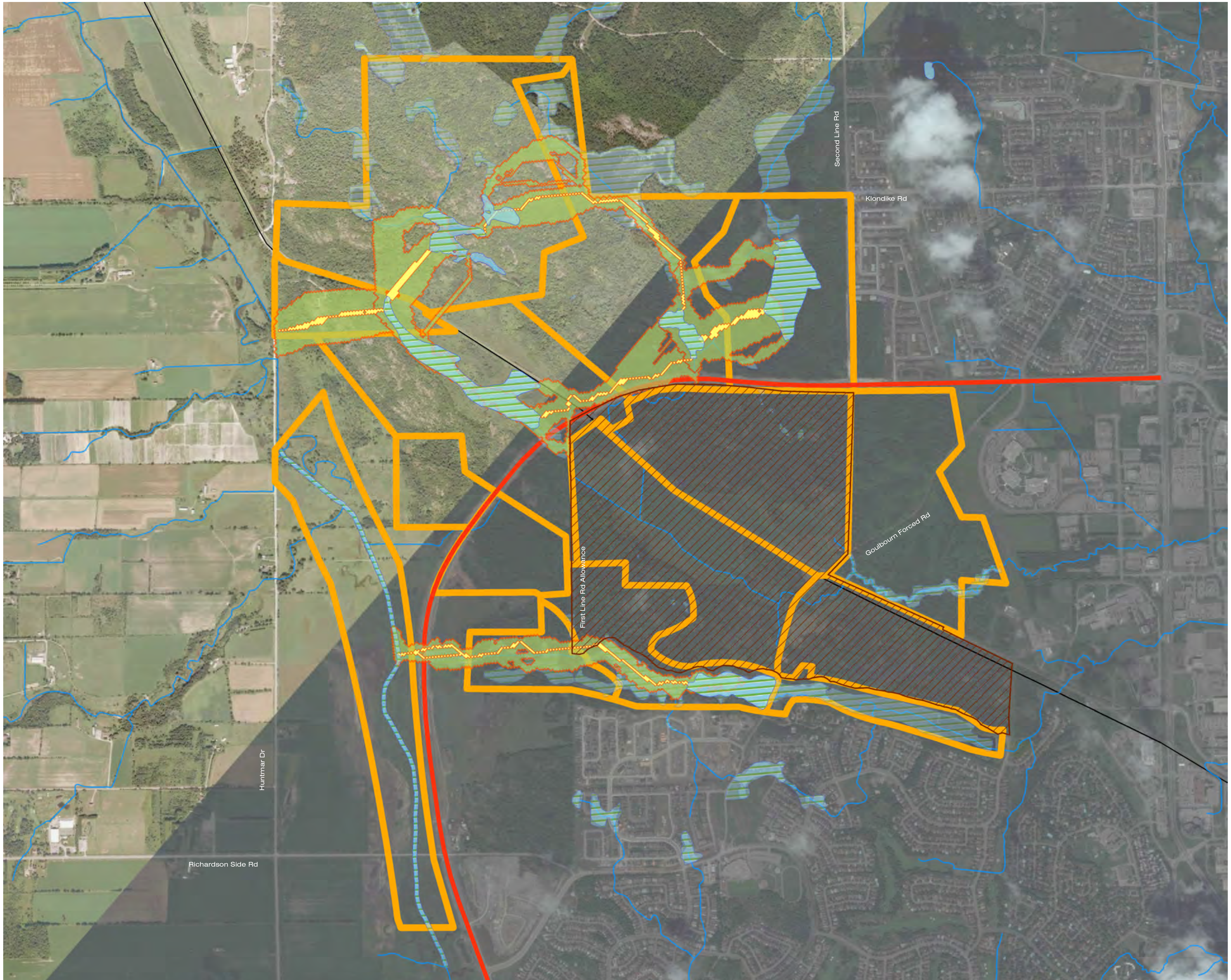
DATE: 12/4/12



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South March Highlands Blanding's Turtle Conservation Needs Assessment

Blanding's Turtle Corridor Analysis with Proposed Development

Figure 13B

- Zone Boundary
- Terry Fox Drive
- Wetlands
- Watercourse
- Railway
- Potential Blanding's Turtle Nesting Site
- Best Modeled Corridor Solution
- General Modeled Corridor Solution
- Proposed Development Area

0 75 150 300 450 600
Meters

SCALE 1:17,500

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNR, the City of Ottawa, and Dillon Consulting Limited

MAP CREATED BY: AJZ
MAP CHECKED BY: CTH
MAP PROJECTION: NAD 1983 UTM Zone 18N

FILE LOCATION: \\DILLON.CA\DILLON_DFS\OTTAWA\OTTAWA CAD\2012\126019 34\Design_GIS\MXDs\Report Maps\13B-CoridorModel.MXD

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