City of Manhattan Alternative Stormwater Compliance Program, Memo 2: Fee Structure and Recommendation

To: City of Manhattan, Public Works

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The purpose of this memo is to describe preliminary economic analyses of an alternative stormwater compliance program for the City of Manhattan as part of its MS4 permit.

The overarching goal of this program is to enable the City to meet its MS4 permit obligations (i.e., to reduce pollutants to the maximium extent practicable) in a more environmentally- and economically-effective manner. This is the second in a series of two memos. The first memo described the program framework, which is expected to follow a fee-in-lieu model in which developing properties within the City of Manhattan may opt in and pay fees to fund offsite BMPs in upstream agricultural areas in lieu of constructing water quality BMPs on the development site.

In this memo, the basis of the fee structure program is described, including:

(1) net present value analysis of typical urban (onsite) BMPs and agricultural (offsite) BMPs,
(2) costs of the alternative stormwater compliance program, including recommended payment rates for offsite BMPs to provide required sediment credits and technical service fees,
(3) description of a tool for determining an appropriate fee to onsite properties opting to participate in the alternative compliance program and,
(4) preliminary recommendations for the in-lieu fee structure and next steps.

These components are summarized in the following section and then presented in detail in Appendices (A.1 through A.3). A brief listing of terms used throughout this memo and definitions is first presented.

Definition of terms:

Alternative stormater compliance program: options to implement water quality BMPs at an alternative location where environmental conditions are more amenable to BMP performance and/or can achieve water quality goals in a more cost effective manner. KDHE provides an allowance for "alternative stormwater offsite pollution reduction programs" in the state's general MS4 permit.

Equivalent Commercial Acre (ECA): defined as a “typical” 1-acre commercial development with 85% impervious survace cover to serve as the base “currency” of the alternative stormwater complicance program. The base fee-in-lieu rate for the alternative compliance program is set per ECA, which can be scaled according to the actual impervious cover of developments opting to participate in the alternative compliance program.

Onsite BMP: stormwater quality control measures (BMPs) that are implemented within City boundaries to treat stormwater runoff from development or re-development sites. Typical examples of onsite BMPs constructed in the City of Manhattan include bioretention systems and hydrodynamic separaptors.

Offsite BMP: water quality practices (BMPs) implemented outside of the City boundaries, typically in agricultural settings. Here, offsite BMPs refer specifically to practices implemented within watersheds of concern to the City to provide water quality benefits in lieu of constructing onsite BMPs.

Sediment credit: refers to the quantity of sediment retained by offsite BMPs, and is the reference unit through which the required acreage of offsite agricultural BMPs needed to to offset sediment and other pollutant generation by onsite properties opting to participate in the alternative compliance program is determined.

1. Costs of the alternative compliance stormwater quality program

The primary costs to implement and maintain an alternative stormwater compliance program in which water quality BMPs are implemented in agricultural areas within watersheds of concern in lieu of implementing water quality BMPs within City of Manhattan boundaries include:

- Cost of payment to offsite agricultural landowners/managers to implement water quality practices to provide required ECA offsets and
- Cost for technical service provider who will recruit agricultural landowners/managers to the program, secure contracts, conduct field checks to ensure offsite BMPs are implemented and maintained as contracted, and provide technical assistance to landowners/managers as needed to select, implement, and maintain offsite BMPs.
- Program risks, particularly those related to the financial management of the program, regulatory changes, timing imbalances between the pace of development and implementation of practices, and the unknown mixture of offsite BMP opportunities that will be present over a long-range future.

Sources of economic data are detailed in Appendix A, along with a relative comparison between the costs of typical urban stormwater quality BMP and agricultural BMPs to demonstrate the economic feasibility of an in-lieu program.

An examination of capital and annual maintenance costs for the types of agricultural BMPs considered as part of the “portfolio” of potential water quality practices to be implemented through this program demonstrates that, while a few of these practices have high up-front capital costs, the majority have recurring annual maintenance costs that are on par with capital costs. Given the annual nature of required investments to maintain agricultural BMPs, the City could consider an annual fee approach in which revenue is gathered steadily and perpetually. In that case, setting and collecting fees on an annual basis would help maintain the cash flow needed to keep pace with the costs of payments to landowners and the technical service provided described above. On the other hand, current approaches to compliance generally involve upfront capital construction, and financing for development generally collects or requires initial costs. Annual fees would also require creation or modification of collection mechanisms currently in place. (Revision Note: The City has indicated it favors a lump sum recovery approach. Some additional context has been added to this memo for that purpose).

At this stage, the alternative compliance program is not antipated to require additional staffing or administrative time from the City of Manhattan as developments that opt to participate in the program will require less staff time to review stormwater BMP plans. Staffing and administrative requirements for the program will be examined in greater detail in the next stage of this program's development.

The following sections summarize costs for payments to agricultural managers providing offsite BMPs for sediment credits (1a.) and technical service provider (1b.). An in-lieu fee to cover both of these costs as well as consideration for management and future risk is the subject of the next section of this memo.

1a. Costs of payments for ECA offsets (sediment credits) provided by offsite BMPs. Annual costs for the set of agricultural BMPs are summarized in Table 1. For additional details regarding cost breakdowns and sources used to obtain costs, refer to Appendix A, Table A.3. Agricultural BMP costs ranged signifcantly among the practices. While some of the BMPs examined carry large upfront implementation costs (terrace rehabilitation and fencing for livestock exlusion from vegetated buffers) most have non-trivial recurring annual costs. For example, BMPs that integrate cover crops require annual planting and herbicide management costs, particularly when utilized in conjunction with no-till (which is the assumption we have made). BMPs that restrict use for agricultural production, namely permanent vegetated buffers in both cropland and grazing systems, incur annual opportunity costs such as crop revenue and foregone rental payments. For these reasons, an annual payment structure is recommended for offsite BMPs providing sediment credits to the alternative stormwater compliance program.

Annualized costs were determined by multiplying capital costs by a capital recovery factor (CRF) to put them into annual terms and then adding to annual costs. The details of the cost recovery calcuation are given in Appendix A.2.

Annualized costs determined for selected offsite agricultural BMPs are presented in Table 1. The annual cost per ton sediment retained by offsite agriculutral BMPs was then calculated by dividing the annual cost by the annual sediment retention rate presented in Memo 1. Costs are also presented per ECA offset per year. The pollutant load per ECA was determined to be 466 lb/year/ECA as described in Memo 1 (Table A.4.1). Per KDHE however, any agricultural pratices must provide for sediment offset credit that is twice (2.0) the onsite urban impact – this is a regulatory factor. So the quantity of sediment to actually retain per each ECA is 932 lb/year/ECA (0.466 tons/year/ECA)

Table 1. Equivalent annualized cost of agricultural BMPs and associated annual cost per ton sediment credit provided.

Agricultural (offsite) BMPs	Annualized cost[1] ($/acre/yr)	Annual sediment retention[2] (tons/ac/yr)	Cost per ton sediment retained ($/ton)[3]	Cost per ECA offset ($/ECA/year)[4]
No-till + herbicide management	$55.80	1.44	$38.75	$18.06
Cover crops + herbicide management	$76.25	0.24[5]	$317.71	$148.06
Terrace rehab	$112.61	0.48	$234.60	$109.32
Vegetated buffer - cropland	$87.02	0.96	$90.65	$42.24
Vegetated buffer - grazing	$482.83	0.25	$1,931.34	$900.00

[1]calculated by annualizing capital costs with capital recovery factor assuming 20 year life and 3% interst rate for all practices, see Appendix A.2.
[2]sediment retention by agricultural BMPs detailed in Memo 1, Appendix A, Table A.4.4
[3]calculated by dividing Annualized cost (column 2) by Sediment retention rate (column 3)
[4]The Cost per ECA offset is based on the cost or retaining 0.466 tons of sediment from one ECA for one year, which equates to the 0.233 tons/year estimated from an ECA multiplied by 2 to reflect the KDHE regulatory requirement of a 2:1 ratio in offset pollutants (se Memo 1, Section A.4.3 and Memo 2, Section 2 for more discussion).
[5]assumes cover crops are implemented on land that is already under no-till, thus a smaller incremental increase in sediment retention is specified rather than the larger increase in sediment retention expected when cover crops are applied to fields under conventional tillage.

An example calculations follows for the cost per ton sediment retained, and cost per ECA offset for a vegetated buffer implemented as a water quality BMP in a cropland area.

Example: Annual cost per ton sediment retained by cropland vegetated buffer BMP (Column 4 in Table 1)

Cost per ton sediment retained = annualized cost / annual sediment retention sediment
Cost per ton sediment retained = ($87 per acre per year) / (0.96 tons/ac/year)
Cost per ton sediment retained = $90.65 per year
*Cost per ECA = cost per ton sediment retained * 0.466 tons sediment/year required*
*Cost per ECA = $90.65 per ton sediment * 0.466 tons sediment/year = 42.24 $/ECA/year*

As will be discussed in the next section, we recommend establishing the in-lieu fee on the basis of costs per ECA. However, payments to landowners or managers providing those sediment credits will be on a per acre BMP basis. Thus, the equivalent annualized costs per acre BMP presented in Table 1 are recommended as a minimum starting point for establishing the costs of offsite BMP payments. For comparison, payments for the same set of agriucltural BMPs offered by incentive programs at federal (USDA NRCS) and local (local watershed-based Watershed Restoration And Protection Strategy, or WRAPS) scales are presented alongside annualized BMP costs in Table 2. Incentive programs typically offer incentive payments for a set period (e.g., 3 years) over a contracted maintenance period (e.g., 10 years). In addition, some incentives, especially those associated with stream buffers or terracing, may be made on a linear basis or on an area of buffer protected instead. The details of reimbursement and sediment credit strategy would be detailed in further technical work if these practices are funded. The values given in Table 1 are for intermediate scenarios based on assumed terrace design and stream buffer area per unit cropland or grazing treatment area.

The difference between the incentive payment and the true cost is typically provided as cost-share by the land manager or land owner. These types of incentive programs are intended to incentivize a change for the public good. The aim of BMP payements through an alternative stormwater compliance program such as the City of Manhattan is considering differs; rather than incentivizing a behavior or management change, the program is paying for a service, in this case water quality benefits in the form of ECA offsets or sediment credits. Thus, we recommend framing program costs and associated payments of sediment credits in full and not incorporating cost-share on behalf of the land owner who is providing the water quality service. As will be discussed later, this does not preclude the technical service provider from managing the funds in a cost-share incentive model. However, the cost to the program should be tracked as the full cost of the sediment credits needed to offset pollutant loads from onsite developments participating in the alternative compliance program. In other words, the City of Manhattan will track and only take credit for the portion of sediment reductions that have been funded through the fee-in-lieu program, and not any portion of BMP costs provided as cost-share by the landowner or other funding sources.

Table 2. Comparison of annualized costs of candidate offsite agricultural BMPs with payments through popular environmental incentive programs in the region.

Agricultural (offsite) BMPs	Annualized cost[1] ($/acre/yr)	USDA NRCS EQIP[2, 3]	Tuttle Creek WRAPS[4]
No-till + herbicide management	$55.80 per acre of practice	$31.98/acre ($38.37/acre HU[3])	$50 per acre per year up to 3 years; 10-year minimum contract
Cover crops + herbicide management	$76.25 per acre of practice	$62.65/acre single species; $77.68/acre multi-species	$40/acre single species; $60/acre multi-species per acre per year up to 3 years; 10-year minimum contract
Terrace rehab[5]	$112.61 per acre of field protected (intermediate case)	No rehabilitation; new broadbase terrace $1.84/ft ($2.31/ft HU[3])	Terraces not incentivized through Tuttle WRAPS
Vegetated buffer - cropland[5]	$87.02 per acre of buffer	$326 per acre ($353 per acre HU[3])	$1,000 per acre per year up to 3 years ($5,000 project max)
Vegetated buffer - grazing[5]	$481.98 per acre of buffer	$2.20 per foot fence ($2.64 per foot HU[3])	$1,000 per acre per year up to 3 years ($5,000 project max) and must facilitate another BMP

[1]calculated for annualized equivlanetby method described for Table 1, where these values are taken.
[2]Enivornmental Quality Incentive Program. Kansas rates available from https://www.nrcs.usda.gov/sites/default/files/2023-12/fy24-kansas-eqip.pdf
[3]EQIP differentiates payment rates for historically underserved (HU) producers
[4]Watershed Restoration and Protection Strategy (https://kswraps.org/project-listing/tuttle-creek-lake-wraps/)
[5]Terrace and vegetated buffer calculations are based on an intermediate or average condition with assumptions regarding terrace length per acre cropland treated or buffer width and area in relation to the area of cropland or grazing land treated. Actual reimbursement strategies would likely take actual site conditions into account.

1b. Costs of offsite BMP technical assistance provider. The success of an alternative stormwater compliance program in which BMPs are implemented outside the city limits hinges on willingness of land owners or managers to implement offsite BMPs for the program and that they receive appropriate technical assistance to implement and maintain those BMPs to ensure sediment credits are provided as intended. As discussed in the first memo, an offsite BMP technical assistance provider can serve in various roles to help achieve these outcomes. From experience with the City of Wichita's alternative stormwater compliance program, it is likely that an individual outside of the City who is already working in the conservation sphere with landowners in the area is better suited for these roles than City staff. Thus, we recommend including the costs to retain the services of a technical assistance provider for the alternative compliance program.

At the current time, staff within the Glacial Hills Resource Conservation District, and specifically the Tuttle Creek WRAPS program, have expressed interest in serving in this role for the City of Manhattan's alternative compliance stormwater program. While the roles of this position will continue to develop, initial conversations indicate that the roles outlined in Table 3 are agreeable. We would anticipate that there may be other service providers interested and that the City would undertake a designated procurement processes to select a suitable provider.

The cost for services to the alternative compliance program may include mileage (e.g., as needed for travel to recruit participants to the program and to conduct annual field checks) and time. From previous experience with the City of Wichita's alternative compliance stormwater program, time is the primary cost for the offsite BMP technical assistance provider. In the City of Wichita's program, the individual in the assistance provider role noted that for every one person he recruits to the program to implement offsite BMPs he "knocks on 10 other doors." Thus, it is appropriate to anticipate time requirements when estimating costs for this service provider. The service provider's time on the project can be expected to scale with the amount of ECA offsets and associated BMP acres needed per year.

Assuming that the fees collected through the program are representative of the effort to secure needed BMPs, a scaling factor of at least a 30% of the total BMPs costs per year is ecommended. An excel-based tool developed to assist the city with setting the base fee per ECA includes this scaling factor and will be explained further in the following section. Further discussion with City staff and the technical assistance provider are warrented to further refine the scope of the providers services and an appropriate payment rate.

Table 3. Potential roles of offsite BMP technical assistance provider. *Staff within the Tuttle Creek WRAPS program, which is administered by the Glacial Hills Resource Conservation District, have expressed interest in this role.*

Offsite BMP technical assistance provider role	**Description**
Education and dissemination	Share information about Manhatttan's program with land managers to raise awareness.
Active recruitment of offsite BMP providers	Identify land managers in the proposed offsite service area who may be willing to adopt acceptable offsite water quality BMPs and recruit them to the program
Technical BMP assistance	provide interested land managers with appropriate technical assistance to successfully implement and maintain the BMP
Coordinate contracts and BMP (sediment credit) payments	Work with land managers to ensure they understand contract terms (e.g., duration, practice maintenance requirements, payment distribution, physical location and size of the offsite BMP), maintain signed contracts, and distribute payments to offsite BMP providers
Field checks for annual maintenance	Conduct annual field checkes to ensure offsite BMPs are maintained according to contract.
Liason to City of Manhattan	Communicate with the City regarding needed sediment credits, submit invoices, and provide data needed for City's annual MS4 permit report.

2. Recommended approach for setting in-lieu fee

The following section describes a spreadsheet tool developed to assist the City in determining an appropriate in-lieu fee to be charged to developers and/or property owners who opt to particpate in the alternative compliance program. This fee should be sufficient to cover both payments to offsite land managers for implementing water quality BMPs and for the services of a technical assistance provider (see Section 1).The spreadsheet tool provides a means for establishing bounds on the annual fee to onsite properties under different sets of assumptions. Since water quality services provided by offsite BMPs (defined as ECA sediment offsets in the context of this program) are provided on an annual basis, and the costs to continue maintaining candidate offsite BMPs and retain the services of the technical assistance provider also recur annually, the City could consider assessing the fee on either an annual or lump sum cost basis. (The examples and analyses in this memo were framed primarily on an annual-cost basis first. The City subsequently determined that a lump sum approach may be preferable.)

The spreadsheet is intended to aid the City with establishing an annual fee that would be assessed to all participants in the program, though this fee could be scaled on a project-specific basis to reflect the amount of impervious cover or development type as discussed in Memo 1 and demonstrated in the example in Section 4 of this memo. Use of the tool for setting an annual in-lieu fee is outlined in Figure 1. To use the tool, the user first defines the number of onsite acres expected to particpate in the alternative compliance program each year via user inputs regarding annual development and particpation rates. The spreadsheet tool uses these inputs to automate calculations of the required ECA offsets, number of acres of offsite BMPs to provide these offsets, costs to cover annual BMP and technical service payments, and the total fees collected through the program annually.

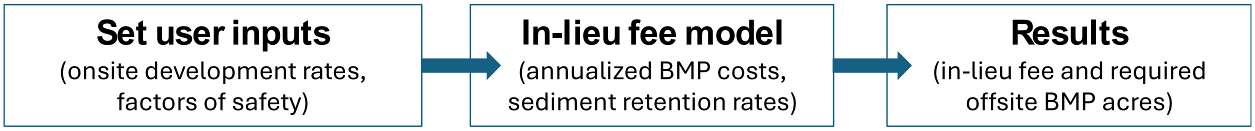

Figure 1. User inputs and results output by the in-lieu fee spreadsheet tool.

A set of factors intended to provide a factor of safety in light of uncertainty in costs and BMP performance are also included as user inputs in the tool (Figure 1). These are defined as follows:

- *Sediment credit rate*. This factor is used as a multiplier to the onsite sediment load generated per ECA. **As introduced in Memo 1, KDHE has established a *minimum* value of 2 for this factor.** In other words, for every ton of sediment generated from onsite properties participating in the program, at least 2 tons of sediment must be retained by offsite BMPs implemented through the program.
- *Program technical management factor*. This factor serves as a multiplier on offsite BMP costs to account for payments to a technical service provider responsible to recruiting, signing up, and providing assistance to offsite land managers to implement offsite BMPs as needed to provide annual ECA offsets.
- *Lumped uncertainty factor*. This factor serves as a multiplier on the total in-lieu fee to account for other uncertainties including, but not limited to BMP costs, pollutant transport and "potency," the possibility for market saturation of a particular BMP such that higher payment rates are required, and other policy and management uncertainties. These uncertainties warrant setting this factor to a value greater than 1 such that, if adverse economic and/or regulatory environments arise the City is not caught operating the program at a minimum but can demonstrate that they have built up an excess of credits against which program adjustments can be made more gradually (rather than suddenly) in response.

The spreadsheet tool also allows users to explore different "portfolios" of agricultual BMPs to be implemented through the in-lieu fee to offset the ECA sediment generation. Here, we use the term portfolio to refer to a mix of BMPs as opposed to a single BMP. As noted in Memo 1, building the program fee such that it can support a variety of BMPs likely to be implemented in the area provides more program flexibility than selecting a single agricultural BMP as the fee basis. In addition, this approach may avoid future constrains such as market saturation of the singular BMP selected as the fee basis.

A fee structure incorporating a portfolio of BMPs is accomplished in the spreadsheet tool by specifying the percentage of a particular offsite BMP type that could be implemented through the program over a multi-year planning range so that the resulting in-lieu fee is sufficient to support a variety of appropriate BMPs. For example, a portfolio of offsite BMPs could be defined as 75% cover crops, 10% no-till, 15% vegetated buffers in cropland. We specifically avoided basing the in-lieu fee on the lowest cost BMP (no-till in this case; Table 1 and 2) as this would limit the pool of funds generated by the in-lieu fee to only the lowest cost BMP and may constrain the program's capacity to recruit offsite BMPs and associated sediment credits needed for ECA offsets.

Based on conversations with conservation practice providers in the area, we assume that the program will have the greatest opportunity to recruit landowners to implement cover crops (hence, we have weighted in the highest at 75%) with a mix of no-till and cropland vegetated buffers providing the remaining ECA offsets.

Once these user inputs have been provided, the tool automatically produces an estimate of the sediment credits required to offset onsite sediment production in terms of ECA offsets, the amount (acres) of the selected BMP required to provide required ECA offsets, and the magnitude of the in-lieu fee assessed to provide sufficient funding to implement offsite BMPs, compensate the technical service provider, and account for program uncertainties on a per ECA basis. Underlying assumptions in the tool include:

- An assumed rate of sediment export from onsite properties that opt into the alternative compliance program of 466 pounds/ECA/year (0.233 tons/ECA/year) as detailed in Memo 1.
- Annualized costs and rates of sediment retention by offsite agricultural BMPs presented in Section 1 (Table 1) and Appendix A.2 of this memo.

Example for setting in-lieu fee for alternative compliance stormwater program.

The following example is provided to demonstrate the use of the tool and interpretation of results to guide selection of an in-lieu fee. In this example, the following user inputs are specified:

- Annual rate of development in Manhattan: 30 acres
- Proportion of development acres that opt to participate in the alternative compliance program: 80%
- Sediment credit rate: 2.0
- Service provider cost factor: 1.3
- Lumped uncertainty factor: 1.4
- Anticipated portfolio of offsite BMPs implementated over multi-year planning range: 10% no-till; 75% cover crops on no-till; 0% terrace rehabilitation; 15% vegetated buffers on cropland; 0% vegetated buffers on grazing land

Results with this set of user inputs are presented in Table 4. Again, the purpose of the tool is to allow the City to test different sets of cost factors to establish an acceptable fee. Thus, the results presented in Table 4 are an example of the required fee under one such set of cost factors. Regardless of the final fee amount, the framework provided in the spreadsheet tool will allow the City to set a fee such that the program has flexibility in offsite BMP selection – which helps address concerns regarding market saturation of a particular type of BMP – while also creating a buffer against program uncertainties and assumed risk through the lumped uncertainty/ contingency factor.

Table 4. Equivalent annualized cost of offsite agricultural BMPs and associated annual cost per ton sedient credit provided.

Agricultural (offsite) BMPs	**Cost per ECA offset for given BMP** ($/ECA/year)[1]	**Assumed Weight in Mix of Practices**[2]	**Budgeted Value per ECA** (rounded)
No-till + herbicide management	$18.06	10%	
Cover crops + herbicide management	$148.06	75%	
Terrace rehab	$109.32	--	
Vegetated buffer – cropland	$42.24	15%	
Vegetated buffer – grazing	$900.00	--	
Combined Weighted for Direct Practices			$119
Plus Technical/Admin Est (30%)[3]			$36
Plus Future Risk Management Est (40%)[3]			$48
Grand Total, Recommended Fee			**$203**

[1]Cost per ECA taken from Table 1, which includes the regulated KDHE ratio of 2:1 for pollutant removal from offsite practices

[2]See preceding discussion in Section 2 for basis of assumed portfolio of achievable practices given costs and current anticipated market conditions

[3]See Section 2 for discussion on setting the Technical/Admin Service Fee estimate and the contingency for future uncertainty.

A comparison of these costs relative to typical cost ranges for urban onsite BMPs is presented in Appendix A.1.

In summary, the spreadsheet tool provides a means for establishing bounds on the annual basis fee to onsite properties under different sets of assumptions as exemplified in Table 4. We recommend establishing a flat fee based on development intensity that is assessed to all development sites[1] so that the costs of participating in the alternative compliance program are established up front. The challenge of setting a flat fee rate in the face of variable offsite BMP costs has been approached by basing the fee on what would be considered the “most likely” or expected portfolio of offsite BMPs to be implemented through the program based on discussions with local conservation service providers in Riley and surrounding counties.

As discussed in Memo 1, interest in cover crops is currently high among agricultural producers in the candidate watersheds surrounding the City of Manhattan where offsite BMPs could be implemented. Thus, cover crops could be selected as a “most likely” offsite BMP to be selected by offsite land owners or managers providing sediment credits to the program. In addition to being a BMP in which agricultural land managers currently have interest, there is evidence that they are unlikely to implement cover crops without access to incentive payments because, while the soil health benefits of cover crops are established (e.g., Koudahe et al., 2022), perceptions of their cost and additional labor requirements are still a barrier to long-term adoption (Dunn et al., 2016). Thus, providing payments for cover crops through an alternative compliance program can provide additionality in that the payment is likely enabling implementation of a water quality practice that wouldn’t otherwise have been implemented (Pates and Hendricks, 2020). An additional benefit of assigning a high weight to cover crops as the basis of the in-lieu fee is that

[1] This recommendation does not preclude a fee structure in which a different fee is established for different types of land use of the science on pollutant generation shows a meaningful difference. The fee should also be reviewed on a regular basis with respect to actual costs of implementing and administering the program and adjusted as appropriate.

cover crop costs represent the median BMP cost within the range presented in Table 1. Thus, while cover crops may be the most common offsite BMP implemented, the pool of BMP payment funds generated by the program could also be used to fund an appropriate balance of lower cost (no-till, cropland vegetated buffers) and higher cost (riparian buffers in grazing systems) BMPs, providing desired flexibility to the program and providing resilience against increasing costs and/or "market saturation" of a particular BMP over time.

Lump Sum Fee Considerations (per Revision Note)

To the extent that the City may wish to consider a lump sum fee approach, there would be the extra step of estimating an initial fee that would be large enough to cover annual costs into the future. The initial lump sum payments would well exceed initial costs, therefore revenue could be invested to produce additional funds for the future.

Considerations that would need to be taken into account include:

- The likely reliable return on investment rate that the City could earn.
- If the City wishes to target a lump sum that could fully support the program "in perpetuity" (i.e. similar to an endowment), or is there a target duration after which city-at-large would take over.
- The degree of conservative estimation the City would use to account for significant future unknowns, which include variations in terms of cost and treatment opportunity, regulatory changes and overal economics.
- The degree to which future regulatory changes may drive increased expectations for compliance, and if or how any of those changing expectations would impact properties previously enrolled in the program.
- The City should anticipate that the mix of practices necessary to achieve "net additional pollution removal" will become more expensive over time, beyond just inflation, as practices that are innovative today become baseline in the future. We have already seen this evolution in agriculture in north-central Kansas, where "no-till" type practices have become widespread and are approaching status as baseline practices for which further incentives may no longer be needed. At some point, regulators will likely expect that widely adopted approaches be considered the new baseline for measuring environmental gain. It is unknown how long the present recommended mix of practices in Table 1 will remain suitable for regulatory compliance and financial planning but there will almost certainly come a time in future program updates when it will need to be revised and more difficult and expensive practices substituted for those currently approved to obtain the target pollutant removal.

A Net Present Value Analysis is the way that recurring annual costs are translated into a current day lump sum equivalent. These analyses use a Net Present Value Factor (NPF) which relates a steady annual payment (A), and analyses period (n) and an effective interest or discount rate (i) to arrive at the Present Worth equivalent (P). This type of analyses basically answers the question "How much would I have to invest today at a guaranteed real interest rate to ensure I could make steady payments over a defined period, ending with zero balance?"

The intent of the discount rate is to incorporate all effects of the time-value of money separate from standard inflation, so that two alternatives can be compared fairly over a long period despite differing cash flows.

There are some limitations with using NPF in this case. The regulatory obligation the City would be accepting to provide these services has not defined end-date, so it is a perpetual responsibility. Over time, the average cost per ECA to obtain pollutant reductions may increase faster than the rate of inflation, given that regulatory and farming practice changes would likely lead to a transition to more expensive subsidies over time. This is a form of regulatory and market uncertainty that cannot be well-quantified. Also, municipalities typically forecast revenues based on conservative investment strategies that may not return at the same rates commonly assumed by private investors or in governmental benefit/cost analyses.

Despite these limitations, a prudent selection of cost factors would allow the City to establish a rate for initiating the program and assumptions could then be evaluated and tested over time.

For cost recovery term, it is not uncommon in engineering economic analyses to look at long-term capital costs on a 100-year time frame, and it has been found that the value over 100-years, due to the exponential factor on interest, tends to approach the theoretical "in perpetuity" value. For discount rate, a 3% value is one that is often used in standard return-on-investment scenarios and is considered relatively intermediate for risk. For reasons previously discussed, it may be prudent to use a smaller rate to account for the greater unknowns.

Upon consultation with City staff, we elected to present results for analyses period of 100-years and an effective interest rate of 1.25%, which yields an NPF of 56.9. As applied to the annual rate, this yields

NPV for 100 years = $203 acre/year per ECA * 56.9 = $11,551 per ECA.

The City will make the final decision based on financial and risk projections of the NPF to use for setting the final rates.

3. Example fee-in-lieu determination for urban developments

The following examples are provided to demonstrate how the in-lieu fee can be determined for different types of urban developments. These examples were developed on the annual-fee basis and include:

- **Example 1**: a 2-acre commercial development
- **Example 2**: a 2-acre commercial development that retains a portion of existing vegetation and soils on site
- **Example 3**: a 2-acre development with multiple single family home lots to demonstrate how the fee is assessed to individual lots

An in-lieu fee of $203/ECA/year is applied in each of these examples. This fee reflects the set of program conditions as determined for the set of program conditions detailed in the previous section (Table 4) and then rounded to the nearest dollar. The calculation for a lump sum fee using the assumptions in the previous section are also provided.

Example 1.

A 2-acre commercial development opts to participate in the alternative compliance program. The site is to be developed with 70% impervious cover with the remainder as turfgrass and other landscaped areas. The appropriate in-lieu fee for this property to participate in the offsite program is determined with the following information:

Given:

- Base in-lieu fee = $203/ECA/year
- Scaling factor = 0.9 to adjust for actual impervious surface area (70%) relative to impervious surface cover defined for ECA (85%) – see Memo 1, Table A.4.2.

Fee calculation:

$203/ECA * 2 acres * 0.9 = $365.40 per year for the 2-acre development;
or $20,792 as a lump sum per assumptions in prior section.

Example 2.

A 2-acre development opts to participate in the alternative stormwater compliance program. Rather than disturbing the entire 2-acre site, this development retains 0.3 acres of the natural vegetation and soils along drainageways on the property. The remaining acreage includes impervious surface cover (1.4 acres) and lawn/landscaped areas (0.3 acres). The appropriate in-lieu fee for this property to participate in the offsite program is determined with the following information:

Given:

- Base in-lieu fee = $203/ECA/year
- Fee assessed to developed impervious and lawn areas only (1.4 acres + 0.3 acres = 1.7 acres)
- Impervious surface cover = 82% of developed 1.7 acres (1.4 acres / 1.7 acres)
- Scaling factor = 1.0 to adjust for actual impervious surface area (82%) relative to impervious surface cover defined for ECA (85%) – see Memo 1, Table A.4.2.

Fee calculation:

$203/ECA * 1.7 acres * 1.0 = 345.10 per year for the 2-acre development;
or $19,636 as a lump sum per assumptions in prior section.

Example 3.

A 2-acre residential site is to be developed into 8, 0.25-acre single family home lots. The developer opts to praticipate in the in-lieu fee program. The average impervious surface cover of the site will be 40% with the reaminder as lawn or landscaped areas. The appropriate in-lieu fee for this property to participate in the offsite program is determined with the following information:

Given:

- Base in-lieu fee = $203/ECA/year
- Impervious surface cover = 40%
- Scaling factor = 0.5 to adjust for actual impervious surface area (40%) relative to impervious surface cover defined for ECA (85%) – see Memo 1, Table A.4.2.

Fee calculation:

$203/ECA * 2 acres * 0.5 = $203 per year for the 2-acre development or $11,551 as a lump sum per assumptions in prior section.

Since this is an annual fee, it could be passed to the owners of the 8 single family homes that are part of this 2-acre development. In that case, the fee would be divided by 8 as:

$203 per year / 8 home lots = $25.38 per year per home lot in this scenario or $1,444 as a lump sum per lot per assumptions in prior section.

4.0 Tracking sediment load reductions by offsite BMPs

In addition to serving as the basis for the in-lieu fee, the ECA is also intended as a useful tracking metric for onsite development. Recall that runoff pollutant load estimates are built into the definition of an ECA as described in Memo 1. Specifically, 1 ECA is assumed to produce 466 lb/ECA/year (0.233 tons/ECA/year) total suspended solids per year. However, KDHE requires a minimum 2:1 sediment credit ratio; thus, for each ECA enrolled in the program, 0.466 tons sediment per year (calculated as 0.233 tons/ECA/yr * 2.0) must be offset through offsite BMPs. The following example is presented to demonstrate how the ECA-equivalent for developments that opt to participate in the alternative compliance program can be used to track the quantity of sediment reductions needed to provide an appropriate ECA offset.

If each of the developments presented in Examples 1 through 3 of Section 3 opted to participate in the alternative compliance program, the equivalent in ECAs would be determined as:

- 2-acre, 70% impervious commercial development = 2 acres * 0.9 ECAs/acre = 1.8 ECAs
- 1.7-acre, 82% impervious commercial development = 1.7 acres * 1 ECA/acre = 1.7 ECAs
- 2-acre, 40% impervious residential development = 2 acres * 0.5 ECAs/acre = 1 ECA

Thus, these three developments represent a total of 4.5 ECAs. The minimum sediment offset by offsite BMPs to mitigate for 4.5 ECAs is 2.097 tons/year (calculated as 4.5 ECAs * 0.466 tons/ECA/yr). The technical service provider would then recruit land managers to implement water quality BMPs to provide this minimum amount of sediment reduction in the watershed as ECA offsets. Based on the sediment reduction rates ascribed to various types of water quality BMPs anticipated in the program (Table 1, second column), the in-lieu fees collected from the set of example developments could provide annual payments to land managers for implementing 8.74 acres of cover crops or 2.18 acres of vegetated buffers alongside cropped areas to meet the 2.097 tons of sediment offsets needed for the 4.5 ECAs.

An additional consideration is how fees collected through the program will be dispersed to land managers recruited to implement BMPs to provide required sediment credits to the program. It is likely that funds collected through the alternative compliance program will be administered as a cost-share incentive payments similar to other conservation programs currently utilized in the area. For example, Table 2 indicates that the “true cost” to implement cover crops with herbicide management practices is just over $81 per acre per year. The Tuttle Creek WRAPS program currently offers incentive payments of $60/acre per year for up to 3 years, indicating that the remainder of the cost (about 26%) is provided through land owner cost-share. In the case that a cost-share model is used to administer the BMP payments, the City will only claim sediment credits or ECA offsets associated with the percentage of the “true cost” paid by in-lieu fees and not for the portion of the BMP cost paid through cost-share or other funding sources. For example, if cover crop acreage was contracted to provide sediment offsets for 4.5 ECAs at a 75% cost share rate, then a total of 11.65 acres of cover crops (rather than 8.74 acres) would need to be recruited to the program to provide ther required 2.097 tons sediment reductions/year. Sediment reductions for required ECA offsets attributed to the City would be:

*11.65 acres cover crop BMPs * 75% (City’s funding portion) * 0.24 tons/acre cover crop/year = 2.097 tons/year*

5. In-lieu fee recommendations and next steps

The following recommendations are provided based on the analysis of offsite BMP costs and programmatic considerations for an alternative stormwater compliance program:

- Establish a flat fee to be assessed on an annual basis[2] to match the annual time scale associated with costs to maintain offsite BMPs. The spreadsheet tool described in this memo was developed to help set this fee such that it provides adequate cash flow to the program assuming a “portfolio” of offsite BMPs will be implemented over time to offset pollutant loads generated by ECAs enrolled in the program. At this time, we assume cover crops on no-till will be the most common BMP implemented, but by incorporating

[2] A one-time fee can be established for some types of developments (e.g., public entities) whose funding sources are better matched with an upfront payment. The fee for a lump sum payment could be determined in an analogous way to the recommended annual fee using the net present value rather than annualized costs. Additional research may be required before this option can be provided.

a mix of BMP types in the fee, the program has greater flexibility and should be more robust to cost fluctuations, “market saturation” of a particular BMP type, and other changes.

- Account for program uncertainty and risk by building in an “uncertainty” factor as described in Section 2 and presented in the spreadsheet tool. Selecting higher safety factor values initially will result in a more conservative fee estimate that can later be adjusted later as more experience is gained with program costs and projections .
- In accordance with the City’s procurement process, select and contract with a service provider to finalize details of the payment for technical services to recruit and implement offsite BMPs. Once a the technical service provider is finalized, develop guidance for ensuring that offsite BMPs implemented through program fees provide the required amount of sediment reductions for ECA offsets. This could be accomplished through a separate spreadsheet tool that can be used by the technical service provide to automate tracking of sediment credits according to BMP type and cost-share. In the initial years of the program, it is likely more efficient to focus on one watershed area with a single provider for efficiency. As the program grows, additional areas may be considered to diversify.
- Establish a process for regularly reviewing the in-lieu fee (for example, annually in the first years of program implementation) and making adjustments accordingly. For example, periodic adjustment will likely be needed to account for rising BMP costs (which will likely increase on pace with inflation) and market saturation among BMP types, as well as increased effort and costs to support the technical service provider over time.

References

Center for Watershed Protection, Inc (CWP). 2012. Guidance for developing an off-site stormwater compliance program in West Virginia. Accessed at www.dep.wv.gov/WWE/Programs/stormwater/MS4/permits/Documents/WV_Mitigation-FeeInLieu-Guidance_Final_Jan-2013.pdf.

City of Manhattan Public Works. 2023. Stormwater Management Criteria. Accessed at https://cityofmhk.com/DocumentCenter/View/67431/Stormwater-Management-Criteria-MHK---Final-October-2023-PDF

Dunn, M., Ulrich-Schad, J.D., Prokopy, L.S., Myers, R.L., Watts, C.R., Scanlon, K. 2016. Perceptions and use of cover crops among early adopters: findings from a national survey. *Journal of Soil and Water Conservation* 71(1): 29-40. DOI: https://doi.org/10.2489/jswc.71.1.29

Koudahe, K., Allen, S.C., Djaman, K. 2022. Critical review of the impact of cover crops on soil properties. *International Soil and Water Conservation Research* 10(3): 343-354. https://doi.org/10.1016/j.iswcr.2022.03.003

Moore, T.L., Sheshukov, A., Graber, R. 2019. Integrating watershed management across the urban-rural interface: opportunities for extension watershed programs. *Journal of Extension* 57(1): 1IAW1

Pates, N.J., Hendricks, N.P. 2020. Additionality from payments for environmental services with technology diffusion. *American Journal of Agricultural Economics* 102(1): 281-299. https://doi.org/10.1093/ajae/aaz028

Pristel, V. 2013. An alternative compliance framework for stormwater management in the Central Coast Region. Masters Thesis, California State University, Monterey Bay. Retrieved from https://digitalcommons.csumb.edu/cgi/viewcontent.cgi?article=1034&context=sns_theses

Appendix A. Cost estimates for offsite agricultural BMPs and comparison to urban stormwater BMPs

This Appendix provides additional detail on the methods and data sources used to estimate life cycle costs (construction, operation and maintenance) to implement and maintain urban stormwater BMPs (A.1) and agricultural offsite BMPs (A.2) as summarized in Section 1of this Memo.

A.1. Urban BMP life cycle costs: hydrodynamic separators and bioretention

Costs for two urban stormwater BMPs – hydrodynamic separators and bioretention systems – were determined and compared to candidate offsite BMP cost estimates. Hydrodynamic separators and bioretention systems were selected as model urban BMPs for the following reasons:

- Previous experience with the alternative stormwater compliance program in Wichita, KS indicates that this program is most appealing to smaller developments (less than 5 acres). Larger developments are more likely to require detention systems for peak flow control, and these systems can be designed as wet detention or extended dry detention to address water quality obligations for the development. Hydrodynamic separators and bioretention systems are the most common practices implemented in Manhattan for smaller developments, and thus were selected with the expectation that costs to construct and maintain either of these systems would be weighed relative to costs to participate in the alternative compliance program.
- Hydrodynamic separators and bioretention represent contrasting approaches to stormwater management, with the former consider part of the "gray" infrastructure and bioretention as a natural-based solution; thus this comparison also captures potential differences in cost efficiencies for different types of stormwater infrastructure commonly implemented.

Estimated capital and maintenance costs for hydrodynamic separators and bioretention are presented in Table A.1. Both systems are assumed to treat a 1-acre drainage area with 70% impervious surface cover. In the case of bioretention, cost data were available on a per unit area or per unit volume treated basis. To obtain total bioretention costs from an area or volume treated basis, the volume of water treated and corresponding bioretention area were calculated using the following assumptions:

- Bioretention areas are designed to capture the water quality design storm, which is 1.10 inches or the 90th percentile storm per the City of Manhattan's Post-Construction Stormwater BMP manual.
- The water quality volume (WQv) associated with the 1.10-inch storm over a 1-acre development site was calculated using the Simple Method (Schueler, 1987) with an assumed impervious area of 70%, which is somewhat less than the intensity used to define an *Equivalent Commercial Acre (ECA)*. The resulting runoff volume was approximately 0.75 ac-inches (77 m^3).
- The ponding depth of a bioretention system (or multiple systems) designed to treat this WQv is 12 inches. Thus, a bioretention surface area of 0.06 acres (2,715 ft^2 or 252 m^2) was assumed.

- All costs were converted to 2024 dollars using historical inflation data provided by the U.S. Bureau of Labor Statistics

Table A.1. Cost estimates and references for hydrodynamic separator (HDS) and bioretention stormwater BMPs. Estimates reflect costs to treat 1-acre drainage area with 85% impervious cover following design assumptions stated in the text.

BMP	Capital costs per ECA (est)	Maintenance costs (annual) per ECA (excluding full replacement cycles)	Data sources[1]
Hydrodynamic separator	$29,580 ($15,000 - $57,175)	$1,000 ($1,000 to $1,100)	City of Charlotte, 2016; City of Wichita; USEPA, 1999
Bioretention	$32,019 ($4,480 - $77,194)	$1,921 ($270 to $2,754)	Olsson, 2007; City of Charlotte, 2016; Moore and Hutchinson, 2023; MPCA, 2022

[1]full citation given in reference list; all costs converted to $2023 dollars using inflation calculator from the U.S. Bureau of Labor Statistics (https://data.bls.gov/cgi-bin/cpicalc.pl)

Direct life cycle cost comparisons are difficult to make between urban BMPs, which are capital intensive and intended to fulfill a permanent requirement, versus agricultural BMPs which are either annual in cost or annual with a shorter-duration capital recovery period. There is also a wide variety of different practices that could be considered, which vary in part of applicability by region of country and level of intensity. There is also a relative lack of long-term O&M studies or data on the repair or reconstruction history of urban BMPs.

It can be seen from the limited data presented that urban BMPs can be very expensive on initial cost and require ongoing diligent expenses for maintenance. It can also be seen that there is an implied replacement or major rehabilitation cycle for structural measures which can easily be overlooked when doing initial project cost projections. We recommend that the City continue to gather cost data and review national studies as they become available to better assess the life cycle comparison between onsite and offsite practices.

A.2. Agricultural BMP life cycle costs: water quality and soil health practices

A summary of estimated costs and data utilized to develop these estimates is presented in Table A.3 for the set of offsite BMPs described in Memo 1. Costs include both installation and maintenance expenses as estimated from the literature. Among the cost data used was agricultural custom rate survey compiled by the Kansas Department of Agriculture and Kansas State University for 2022.

Annualized costs were determined by multiplying capital costs by a capital recovery factor (CRF) to put them into annual terms and then adding to annual costs. The details of the cost recovery calcuation are given in Appendix A.2 and represented as annualized costs in Table 1. The capital recovery factor was determined assuming an annual interest rate of 3% over a time period of 20 years as follows:

Capital recovery factor (CRF) example calculation:

$CRF = (i(1 + i)^{time} / (1 + i)^{time} - 1$ *where i is given as 3% and time as 20 years*

$CRF = (0.03*(1.03)^{20} / (1.03)^{20} - 1$

$CRF = 0.067$

Table A.3. Cost estimates and references for potential offsite BMPs. When possible, cost estimates from Riley County and Kansas were utilized.

BMP	Capital costs	Maintenance costs (annual)	Data sources[1]
No-till adoption (per acre)	N/A	Custom planting: $22.33 Custom drill: $14.67 Custom herbicide: $14.80 Herbicide BMPs: $4 **total: $55.80/acre/year** **So Annualized Cost = $55.80/acre/year based on the area of practices used.**	KDA & KSU, 2022 – mean values from NE Kansas reporting unit utilized KCARE, 2022 – mean herbicide incentive payment through City of Wichita Atrazine program
Cover crop adoption (per acre)	N/A	Seed: $40.80 (range $16-$50) Planting: $21.45 Termination: $10 (range $3-$13) Herbicide BMPs: $4 **Total: $76.25/acre/yr** **So Annualized Cost = $76.25/acre/year based on the area of practices used.**	USDA, 2015; SARE, 2020; Paukner, 2023; KDA & KSU, 2022 KCARE, 2022 – mean herbicide incentive payment through City of Wichita Atrazine program

Terrace-waterway system rehabilitation	Terrace rebuilding: $1.61-$3.30 per foot ($842-$1,740 per acre)[2] ; **mean $1,291 per acre (intermediate case assumed)**	O&M: $26 **Total: $26/year** **So Annualized Cost = $112.61/acre/year based on area of field protected (assumed intermediate case)**	USDA NRCS KS, 2023; KDA & KSU, 2022 O&M USDA-NRCS, 2002
Vegetated buffer establishment in cropland	Seed and herbicide: $60.40/acre Planting: $21.70/acre **Total: $82.10/acre. Assumes practice is assists in the protection of water from runoff from adjacent range land, based on location.**	Foregone rent: $81.50/acre/year **Total: $81.50/year** **Annualized Cost = $87.02/acre/year per area of buffer zone only.**	KDA & KSU, 2022; USDA NRCS KS, 2023 Foregone rent based on cropland rental rate for Riley Co. KS from USDA NASS, 2022
Riparian buffer with livestock exclusion[3]	Fencing: $2.83/ft (range $2 to $2.90); $3,818/acre[3]; Planting: $21.70/acre **Total: $3,940/acre. Assumes practice assists in the protection of water from activity on adjacent range land, based on location.**	Foregone rent: $22/acre/year O&M: $196/year **Total: $218/year** **Annualized Cost = $481.98/acre/year per area of buffer zone only**	Fence cost average of: KDA & KSU, 2022; ISU, 2012; Line and Osmond, 2023; and USDA NRCS KS 2023. O&M from USDA NRCS KS, 2023. Foregone rent from rangeland rental rate for Riley County, KS, USDA NASS, 2022

[1]inflation factors applied to historic data to present in terms of 2022 dollars.
[2] assumes 3% field slope such that 85-ft spacing along the slope recommended
[3]assumes buffer is 70 feet total width (35 ft on either side of the channel) such that total length of fence to enclose 1 acre may be approximated as 70*2+726*2 = 1,385 ft per acre.

A set of example calculations follows to demonstrate determination of annualized cost calculations given above.

Example: Calculation of annualized costs

*Cropland vegetated buffer capital costs * CRF + annual costs*

Costs given: Capital $82.10 per acre; Annual $81.50 per acre per year

*Cropland vegetated buffer annualized cost = $82.10 * 0.067 + $81.50/year*

Cropland vegetated buffer annualized cost = $87.02 per acre per year

For additional context, estimated implementation costs and associated annualized costs were compared with rates currently available to farmers and ranchers in the Riley County area through various agricultural environmental quality incentive programs, including the USDA Environmental Quality Incentive Program (EQIP) and the Tuttle Creek WRAPS program. These comparisons were provided in Table 2 of the main body of this memo..

Comparison of the life cycle costs of urban versus agricultural BMPs provides strong support that agricultural BMPs present substantial cost savings. This suggests that a fee established in lieu of implementing onsite BMPs can compare favorably to costs for onsite BMP implementation from the perspective of developers and future property owners who may consider the fee-in-lieu program to meet their water quality obligations within the City of Manhattan.

As noted previously, annualized costs are recommended as the basis for the in-lieu fee to be established for the alternative compliance program. This recommendation helps with planning related to cash flows, and also aligns with the economic nature of many agricultural BMPs. While some agricultural BMPs include structrual practices with high capital costs relative to annual maintenance costs (e.g., terrace rehabilitation or livestock exclusion fencing) like the urban BMPs presented in Table 1, the majority have recurring annual costs that are of a similar magnitude to implementation costs.

A.3 References Cited, Appendix A

Bell, C.D., Wolfand, J.M., Hogue, T.S. 2020. Regionalization of default parameters for urban stormwater quality models. *Journal of the American Water Resources Association* 56(5): 995-1009.

Iowa State University Extension and Outreach. 2012. Estimated costs for livestock fencing. File B1-75. Accessed from https://www.extension.iastate.edu/agdm/livestock/pdf/b1-75.pdf

Kansas Center for Agricultural Resources and the Environment. 2022. Atrazine management in the Little Ark Watershed. Accessed from https://www.kcare.k-state.edu/documents/Atrazine_update_03142022.pdf

Kansas Department of Agriculture, Kansas State University Land Use Survey Office. 2022. 2022 rates paid by Kansas farmers for custom work. Report accessed from https://www.agmanager.info/sites/default/files/pdf/2022_CustomRates_05-19-22.pdf

Line, D., Osmond, D. 2023. Livestock Exclusion Fencing: Lessons Learned. N.C. Cooperative Extension Publication AG-948. Accessed from https://content.ces.ncsu.edu/livestock-exclusion-fencing-lessons-learned

Milone & MacBroom. 2016. Ballpark opinion of probable construction cost, Charlotte Senior Center. Charlotte, Vermont. Accessed at https://www.charlottevt.org/vertical/sites/%7B5618C1B5-BAB5-4588-B4CF-330F32AA3E59%7D/uploads/SeniorCenter-costestimate_v2.pdf

Moore, T., Hutchinson, S. 2023. Ecosystem service assessment of the riparian corridor in the Blue River Headwaters watershed. Report to The Nature Conservancy in Kansas.

Paukner, M. 2023. Cover crop costs, popularity of planting green remains steady. Cover Crop Strategies. Article accessed from https://www.covercropstrategies.com/articles/2775

University of Florida. 2019. Municipal Separate Storm Sewer System (MS4) Practices Assessment Phase III – Reclaimed Water Areas. Final report submitted to the Florida Department of Environmental Protection. Report accessed at https://www.florida-stormwater.org/assets/FSAEF/Research/MS4/UF%20FDEP%20MS4%20Maintenance%20Final%20Report_edited.pdf

US EPA. 1999. Stormwater technology fact sheet: hydrodynamic separators. EPA 832-F-99-017. Accessed at https://files.knowyourh2o.com/Waterlibrary/Stormwater/hydrodynamic.pdf

USDA National Agricultural Statistics Service. 2022. 2022 Non-irrigated cropland cash rent paid per acre – Kansas and 2022 Pasture cash rent paid per acre – Kansas. Accessed from https://www.nass.usda.gov/Statistics_by_State/Kansas/Publications/County_Estimates/22KScashrents.pdf

USDA-NRCS. 2023. Kansas practice scenarios – fiscal year 2024: Practice 600 – Terrace, Scenario #9 – Narrow base, rebuild. Accessed from https://www.nrcs.usda.gov/sites/default/files/2023-12/fy24-kansas-scenarios.pdf

USDA-NRCS. 2002. Conservation practice life span list and operation and maintenance cost reference. Section 1 – General resource reference, Kansas Field Office Technical Guide. Guide access from https://efotg.sc.egov.usda.gov/references/Agency/KS/Archived_lifespano&m_070628.pdf

Weiss, P.T., Gulliver, J.S., Erickson, A.J. 2007. Cost and pollutant removal of stormwater treatment practices. *Journal of Water Resources Planning and Management* 133(3): 218-2