

VILLAGE OF MCFARLAND **Sustainability & Natural Resources
Committee**

NOTICE OF PUBLIC MEETING

Monday, March 11, 2024

6:00 PM

McFarland Municipal Center
5915 Milwaukee St, McFarland
Community Room

AGENDA

The public may attend in-person or remotely through the Zoom webinar or telephone options listed below.

PLEASE CLICK THE LINK BELOW TO JOIN THE ZOOM WEBINAR:

<https://us02web.zoom.us/j/88668533740>

Or by Telephone: +1 (312) 626-6799

Webinar ID: 886 685 33740

Press *9 to raise/lower hand. Press *6 to mute/unmute.

1. CALL TO ORDER, ROLL CALL.

2. PUBLIC APPEARANCES.

- a. This is an opportunity for members of the public to address the Sustainability and Natural Resources Committee for items that are not on the agenda. Please remember this is a hybrid meeting conducted in person and through the Zoom online meeting platform. Meeting attendees wishing to address the Committee about items not on the agenda may do so at this time. Zoom attendees should type their name and address in the Question and Answer feature within the Zoom online meeting platform at this time. Members of the public who are present in person and wish to address the Committee should fill out a public comment form and turn into the meeting chairperson. When you are called upon to speak, state your name, address, and provide your comments to the Committee for their consideration. Please adhere to the 3-minute time limit. Additionally, you may send your public comments to sustainability@mcfarland.wi.us to be included as part of the meeting.

Members of the public may also speak during their selected agenda item as they designate on the public comment form or in the Question and Answer feature on Zoom.

3. APPROVAL OF MINUTES.

- a. Motion to approve the minutes of the January 8, 2024, Sustainability & Natural Resources Committee meeting.

4. BUSINESS.

- a. Discussion and action to make a recommendation to the Village Board regarding the final Urban Forestry Management plan.
- b. Discussion and action to submit the Village of McFarland's 2023 Green Tier Annual Report to the Wisconsin Department of Natural Resources.
- c. Discussion and action to make a recommendation to the Village Board regarding approval of bid documents for the Public Safety Center Battery and Microgrid project.
- d. Discussion and action to make a recommendation to the Village Board regarding approval of an IRS 179D Energy Tax Deduction Allocation for Services Agreement with HGA for the Public Safety Center.

5. SCHEDULE NEXT MEETING DATE.

- a. Monday, April 8, 2024 at 6:00 p.m.

6. ADJOURNMENT.

Any person who has a qualifying disability as defined by the Americans with Disabilities Act that requires the meeting or materials at the meeting to be in an accessible location or format should contact the McFarland Municipal Center at (608)838-3153, 5915 Milwaukee Street, McFarland, Wisconsin, or village.clerk@mcfarland.wi.us by 2:00 p.m. at least 5 business days prior to the meeting so that any necessary arrangements can be made to accommodate each request. If the meeting or request is less than 5 business days from the meeting, requests for accommodations may still be made and reasonable efforts will be made to accommodate each request.

Minutes
Sustainability & Natural Resources
Committee Meeting
January 8, 2024

Members Present: Mike Flaherty, Carolyn Clow, Angela Freedman, Judy Taber (6:15 p.m.)

Members Absent: Kitty Brussock, Bruce Fischer, Nina Schultz

Staff Present: Sayer Larson, Parks Superintendent; Kong Thao, associate planner; Phil McDade, utility clerk.

1. CALL TO ORDER

Flaherty called the meeting to order at 6:16 PM.

2. PUBLIC APPEARANCES.

No public appearances.

3. APPROVAL OF MINUTES.

- a. Clow motioned to approve the minutes of the November 13, 2023, Sustainability & Natural Resources Committee meeting. Seconded by Freedman. Motion carried 4-0.

4. BUSINESS.

- a. **Discussion and action to make a recommendation to the Village Board regarding design services for lake access at Lewis Park.**

Larson discussed with the committee plans to enhance access to Lower Mud Lake from Lewis Park via a boardwalk, canoe/kayak launch, and other improvements near the park shelter. Construction is anticipated to begin in the summer of 2024. Motion by Freedman, seconded by Taber, to recommend to the Village Board design services for lake access at Lewis Park. Motion carried 4-0.

- b. **Discussion of 2023 forestry operations and 2024 outlook (moved from item c).**

Larson highlighted the 2023 Department of Public Works forestry operations, including: more than 100 trees removed; more than 800 street and park trees trimmed; and 132 village park and street trees planted. Larson said recent initiatives by the Village Board to provide separate budget categories for tree planting, as well as tree removal and trimming, has helped provide certainty to the village's forestry operations and maintenance.

c. Discussion regarding 2023 sustainability and natural resources initiatives and 2024-2025 Sustainability Action Plan.

Thao reviewed progress on the village's sustainability initiatives, including: development of an eight-acre solar farm project in conjunction with the McFarland School District and Alliant Energy; the debut of a No Mow May program with signs, with 60 initial registrants; and construction of a net-zero energy usage Public Safety Center.

d. Discussion on Public Safety Center Battery Storage and Microgrid technology.

Thao discussed a proposed battery storage project with the committee, and how it can be utilized at the Public Safety Building (PSC) to both store energy and potentially distribute it. The village is working with its energy and sustainability consultants to determine the best way to hook up the battery to the PSC.

5. SCHEDULE NEXT MEETING DATE.

- a. Monday, Feb. 12, 2024 at 6:00 p.m.

6. ADJOURNMENT.

Clow motioned to adjourn; Freedman seconded. Motion carried 4-0. Meeting adjourned at 6:44 PM.

McFarland
SUMMARY SHEET

MEETING DATE: Monday, March 11, 2024

SECTION: Business

DEPARTMENT: Public Works

CONTACT: Sayer Larson, Parks Superintendent

AGENDA ITEM: Discussion and action to make a recommendation to the Village Board regarding the final Urban Forestry Management plan.

PREVIOUS ACTION:

The draft Urban Forestry Management Plan was presented to the committee on November 13, 2023.

A Public Information meeting was held on Thursday, February 1, 2024, regarding the draft plan.

ISSUE SUMMARY:

Please find enclosed the Village of McFarland Urban Forestry Management Plan. In 2023, the Village of McFarland was awarded an Urban Forestry Grant through the Wisconsin Department of Natural Resources. The grant included funding to create an Urban forestry management plan. Great Lakes Urban Forestry Management was contracted for urban forestry management planning services for the Village. The project scope included items such as:

- Conduct an analysis of the 2022 tree inventory
- Projection of long-term species composition
- Specific long-term goals for all aspects of forestry production (planting, removals, pruning, etc.)
- Long-term budget projections
- Tree risk assessment policy creation
- Review, editing recommendations, and updating of existing forestry ordinances and operating procedures
- Storm response plan (separate from urban forestry management plan)
- Creation of goals for the Villages project team for how the Urban Forest can be best managed to benefit the community
- Create a final management plan and present it to the Sustainability and Natural Resources Committee and the Village Board

Steve Lane, Principal - Director of Forestry Operations, will present a summary of the plan. The completed plan is attached for review.

In addition to overall approval of the plan, staff are seeking committee feedback regarding the following specific areas:



- Mission Statement (pg. 2)
- Change in species composition (pg. 35-37)
- Tree planting goals (pg. 53)
- Projected budget (pg. 68)

FINANCIAL/BUDGET IMPACT:

The Village contracted with Great Lakes Urban Forestry Management for the development of an urban forestry management plan. The cost of the plan is \$8,000 of which 50% was funded by the 2023 Wisconsin DNR Urban Forestry Grant.

The plan does forecast budget considerations for future capital and operations funding.

VILLAGE PLAN REFERENCE:

None.

ORDINANCE REFERENCE:

Tree related ordinances are found in [Chapter 59, Article 59-II Trees and Shrubs](#).

BOARD, COMMISSION OR COMMITTEE RECOMMENDATION:

Recommended motion:

Motion, second to recommend approval to the Village Board regarding the final draft of the Urban Forestry Management Plan as presented.

ATTACHMENTS:

1. McFarland UFMP

Village of McFarland
Urban Forestry
Management Plan



Prepared By

Stephen D. Lane: Urban Ecologist, Urban Forestry Consultant - ISA Certified Arborist #IL-4565A TRAQ

Prepared On

March 4th, 2024

This document was funded in part by and urban forestry grant from the State of Wisconsin Department of Natural Resources Forestry Program as authorized under s. 23.097, Wis. Stat.

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OVERVIEW OF MCFARLAND'S URBAN FOREST MANAGEMENT PLAN

McFarland, Wisconsin actively manages 3,452 trees throughout its Village terraces and rights of way, Village parks, on other Village-owned properties, not including conservancy trees. There are also an estimated 750 open planting spaces on McFarland terraces and ROWs which represents significant potential for growth of the Urban Forest resource. The Village's trees were inventoried by a Forestry Consultant in 2022 and that data was used to construct this Urban Forestry Management Plan which will detail how these trees will be managed for the benefit of the Village of McFarland over the next 20 years, with a focus which begins in 2024, and projects out to 2044. This plan is intended to provide guidance to forestry staff as well as the Sustainability and Natural Resources Committee. It is also designed to increase public awareness and knowledge of the Village's urban forestry activities on terraces, ROWs, and other publicly owned and managed land in the Village of McFarland.

In terms of the condition of the Urban Forest in McFarland, there are both strengths and opportunities for improvement. One strength is the fact that there are 91 species represented which is good diversity for a municipal tree population of McFarland's size. The Maple genus, however, makes up over 22% of the population which is quite high, and this statistic certainly leaves much room for improvement. The overall condition of the population as a whole can be characterized as vigorous, with 96% of the Village's 3,452 trees falling into a condition category of average or better and this presents another strength. Also, the current budget being applied towards forestry management should likely be larger. At approximately \$55,000 per year, not including salaries/in-house labor, this is enough to fulfill basic needs, even a modest increase in budget would allow McFarland to accomplish much more.

In order to enhance the Urban Forestry program so it will create long term benefits to the community while reducing costs, the following Urban Forest Management Plan will address each one of these strengths and challenges by creating goals and milestones for each. Below is a broad view of the direct goals to come in the 2024-2044 period. Further detail is given in the body of the Plan, with separate sections detailing specific Urban Forestry activities, and how we propose they are achieved, along with standards and Best Management Practices for each.

Direction for the urban forestry program has been created in this Plan which attempts to achieve the greatest benefit for the community, based on the available data we have from the inventory, as well as input from stakeholders and residents of the Village of McFarland.

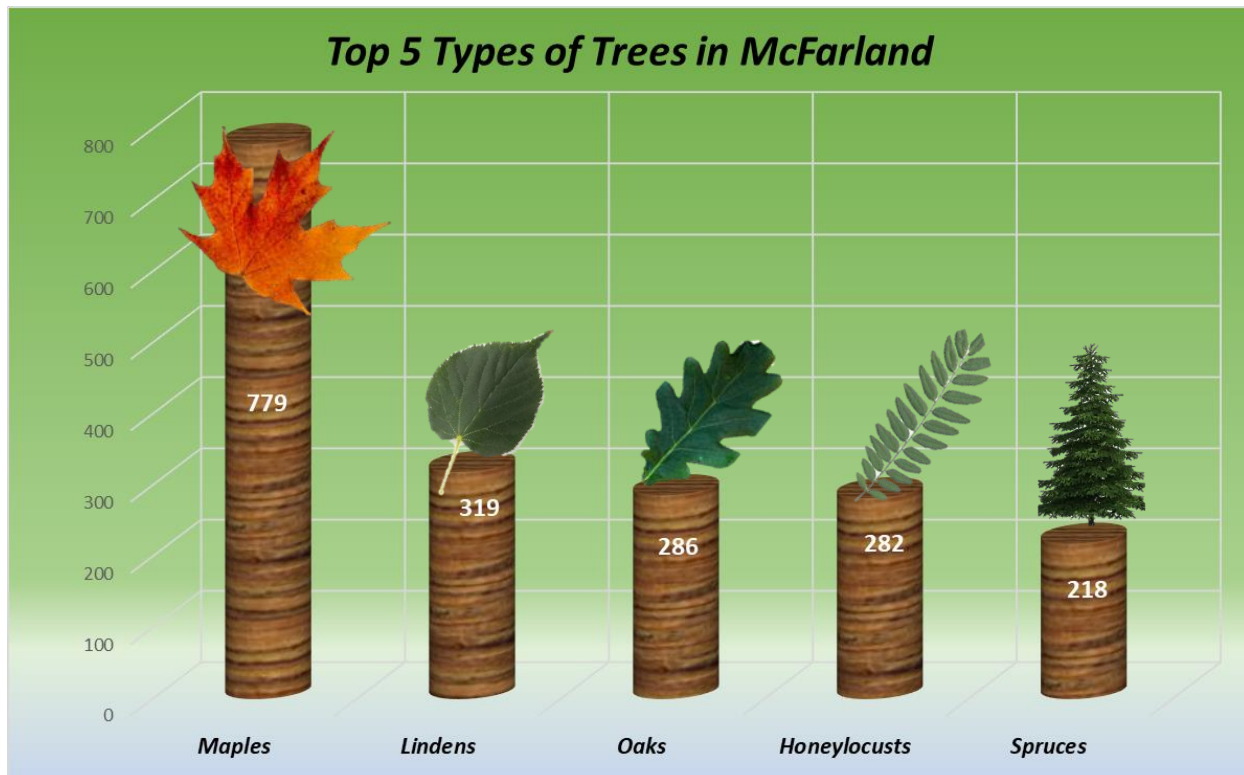
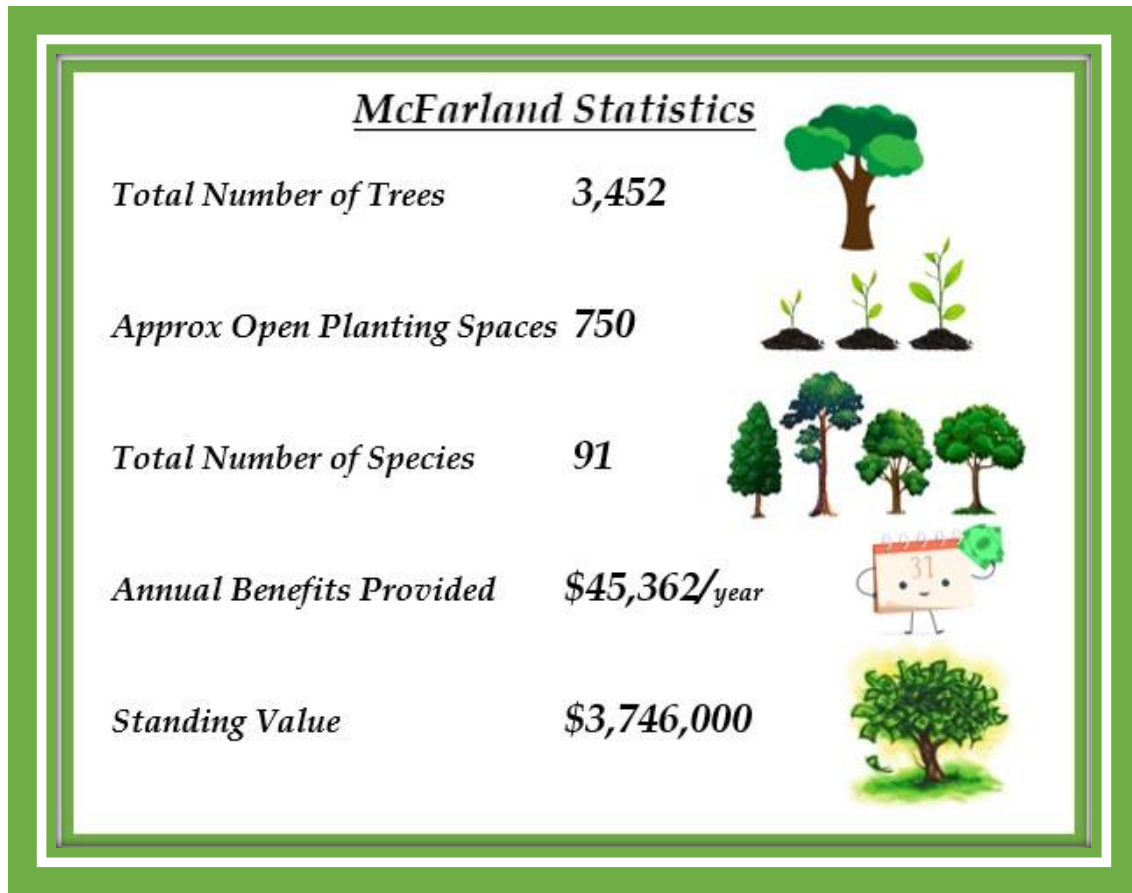
However, all plans are subject to change based on new information, budgets, or other unforeseen circumstances. For this reason, it is asked that readers consider that this plan is to be an evolving document, and goals and strategies will be updated to fit new circumstances as needed.

This Plan should be reviewed periodically, at which point Village staff, its Sustainability and Natural Resources Committee, and its residents, business owners, and other stakeholders will have an opportunity to provide input and help improve the Plan during those periodic reviews. These strategies and goals are not absolute, but rather serve as guideposts to mark the road to success.

MISSION STATEMENT

It shall be the mission of this Urban Forestry Management Plan to determine goals, forecast budgets, and utilize arboricultural best management practices for the management of the urban forest of the Village of McFarland, Wisconsin. The village seeks to sustainably grow a diverse forest canopy cover, help mitigate climate change, and continually adapt our program to manage the urban forest for the greatest public and ecological good.

MCFARLAND'S URBAN FOREST: AT A GLANCE...



DIRECT GOALS - INTRODUCTION

Listed below are the direct goals of this Urban Forest Management Plan (herein referred to as “UFMP”, or “the Plan”), as well as a brief discussion of how they shall be met. Direct goals are those which this plan addresses very explicitly in describing pruning, removal, planting, and other activities. Every attempt was made to make these goals realistic and achievable, so they do not place an undue burden on the Village of McFarland, its residents, or its resources. Instead, the direct goals of this UFMP are to save money and provide greater benefits over time through proactive, as opposed to reactive, management. The Plan is also meant to be adaptive: New concepts, the introduction of new pests or pathogens, or changing climate (both social and meteorological) may all change the way the Urban Forest is viewed.

The Plan is intended to be reviewed periodically by Village staff, the Village Board, its Sustainability and Natural Resources Committee (SNRC), and any other stakeholders. The review process should include evaluation of progress made towards these goals. Goals may be altered after the review, as conditions warrant. This UFMP is written with the understanding that organizations, stakeholders, and residents change over time, and therefore its goals require a degree of flexibility. Since trees represent a long term (50-80 year) commitment, this UFMP is intended to provide guidance and continuity through those changes, while also adapting to them as the need arises. The timelines shown below are loosely based on the following: Short-Term = Upon Plan Implementation, Mid-Term = Within 1-3 Years, Long-Term = Within 3-10 Years

<u>Organizational Goals</u>	<u>Timeline</u>	<u>Operational Goals</u>	<u>Timeline</u>
Define Trees as Infrastructure	Short Term	Increase Diversity by Planting	Long Term
Create a Needs Analysis	Short Term	Maintain Tree Inventory	Long Term
Strengths/Opportunities	Short Term	Enhance Cycle Pruning	Mid Term
Incorporate Industry BMPs	Short Term	Proper Mulching	Short Term
Establish Goals	Short Term	Manage Tree Removals	Long Term
Consider More Staff	Mid Term	Gravel Bed Program	Mid Term
		Invasive Species Management	Long Term
		Increase Stocking Density	Long Term
		Attain 20-10-5 Diversity Levels	Long Term
		Explore Staff Training Opportunities	Long Term
<u>Document/Policy Goals</u>		<u>Sustainability Goals</u>	<u>Timeline</u>
Update Village Ordinances	Mid Term	Wood Utilization Program	Long Term
Tree Risk Management Policy	Mid Term	Help Mitigate Climate Change	Long Term
Storm Response Policy	Mid Term	Increase Canopy Cover	Long Term
Tree Preservation Policy	Mid Term	Increased Forestry Awareness	Long Term
Pest Response Policy	Mid Term		
Maintain Species List	Long Term		

ORGANIZATIONAL GOALS

Define Trees as Critical Stormwater Infrastructure

Green infrastructure is rapidly becoming recognized as being just as important as grey infrastructure in many ways. Chief among these green infrastructure components are trees, and specifically the stormwater mitigation effects they provide. A mature tree can intercept or otherwise mitigate over 5,000 gallons of avoided runoff every year. On a population scale, McFarland's tree population of 3,452 trees is responsible for intercepting or avoiding over 609,7000 gallons of stormwater runoff each year. The loss of this resource due to storm damage, insect or pathogen invasion, or other such damage would have a critical impact on the local stormwater infrastructure. For this reason, a direct goal of this Management Plan will be to define trees as critical stormwater infrastructure, and that these assets should be compensated for when lost to unforeseeable events.

Create a Needs Analysis for the Current Tree Population

Every tree population today is the result of decades of past management decisions. Over time, we increase our overall level of knowledge, skill, and efficiency in managing trees. Based on that new knowledge, we sometimes discover that decisions made decades ago may appear in retrospect to have been inappropriate, even though they seemed like a good idea at the time. It is the goal of this Plan to assess the current state of the Village of McFarland's Urban Forest and examine its overall strengths and benefits, as well as look for opportunities for improvement to inform future decisions.

Each aspect of McFarland's tree data has been analyzed: How many trees, what condition they are in, how old they are, what needs do they have, and more were all examined to create goals to improve the tree population for the benefit of the organization, its residents, and other stakeholders. Specific goals in terms of planting, removals, pruning, budgets, personnel, and maintenance are all addressed by acknowledging both strengths and opportunities, and suggesting how they might be used to the Village's advantage. These strengths and opportunities will be the guiding principles for the management strategies and specific goals outlined in each section below.

To avoid repeating past mistakes, the Plan shall also attempt to leave room for adaptive management, so the plan may be changed when appropriate.



Incorporation of Best Management Practices in Tree Care Operations

"Best Management Practices" is a term which means being on the cutting edge of your industry. All Village staff and any contractors working for the Village should be compliant with the latest industry Best Management Practices, based on the appendices in this report. The ANSI and ISA Best Management Practices shall be integral parts of any Request for Proposal (RFP) or bid documents when seeking qualified contractors.

Full text of all referenced standards shall be made available to all Village employees and any contractors performing tree care operations. This UFMP will be placed in the public domain for all residents to use as a reference. A longer-term public outreach and education program will be discussed further in the Additional Goals section.

Establish Goals in Order to Enhance Strengths and Realize Opportunities

In order to accomplish anything, goals are necessary to help guide organizations through the process. Establishing or enhancing a highly functional forestry program will require a series of attainable goals to in order to be achieved. This UFMP seeks to accomplish those goals within a realistic budget and attainable timespan. As stated previously, goals are intended to change over time as the Village's capacity to manage the resource may increase or be reduced.

In each section of the Plan related to direct goals, language has been included which incorporates both a budget and a time frame in which those goals can be accomplished. The overarching goal will be to have McFarland use this UFMP to create a more sustainable and adaptable forestry program within a 5-10 year period.

This program will include tree planting, tree maintenance, and tree removal for McFarland's Urban Forest, so that the tree population will be healthy, and provide the greatest benefits and least risk to the community while maximizing benefits and minimizing risk. To learn more about the budgets, see the individual goals in each section below, or turn to the budget table on page 68.

Explore an Increase In-House Staffing

Skilled forestry and arboricultural related career positions are chronically understaffed in both the public-sector and private-sector and the Village of McFarland is no exception. At the time of this writing, the Village is expected to hire an additional FTE in April of 2024 which will help improve production in general, however the Village will continue to explore opportunities to increase in-house staffing which will help to decrease dependence on contractors which will lower forestry related costs overall.

Document and Policy Goals

Update Village Ordinances for Enforcement of Tree Policies

McFarland staff and relevant community stakeholders may explore beginning the process of editing and improving ordinances governing trees in McFarland. These ordinances are meant to reinforce proper practices while discouraging improper practices and care, and are not meant to be overly punitive, but rather to encourage the community to engage in proper tree care practices for the benefit of all parties.



These ordinances are common industry regulations, such as enforcing rules about what trees cannot be planted because they are low quality or invasive trees, or defining exactly what trees are the Village's and the homeowner's responsibility, among other things. A goal of the ordinance updates will also be to create more accountability for developers proposing construction in the Village. The goal of these ordinances is to increase canopy cover and to create a tree population which is diverse and healthy, providing the greatest benefit to the Village and its residents over the long term.

Creation, Utilization, and Maintenance of a Draft Tree Risk Assessment Policy

Trees create great benefits, but they may also pose various degrees of risk. Tree limb failure can have catastrophic effects on people or property, and trees need to be well-managed and healthy to avoid that risk. A sample risk assessment policy has been created for the Village of McFarland as part of this Plan. This policy could aid in identifying, documenting, and designating for removal or mitigation, trees which may pose a threat to public safety in a timely manner. This will reduce the overall level of risk posed by trees, as well as exposure to liability from tree-related incidents. Basic risk assessment language is included in this document, and a sample Tree Risk Assessment Policy has been created in page 66, and the ISA Basic Tree Risk Assessment Form is found in Appendix H.

Creation, Utilization, and Maintenance of a Storm Response Policy

Since storms are inevitable, they must be a consideration in any municipal management regime and a decision-making variable in managing municipal tree populations. Urban Forest Management should always include strategies for building a resilient forest and a resilient community. United States Forest Service's *Community Forest Storm Mitigation – A Guide for Communities* which was published in the latter half of 2021 can be an excellent framework for the Village to build a comprehensive storm response policy tailored to the Village's exact needs.

Tree Preservation

Sometimes trees can become damaged by construction activities, costing the Village money, and eliminating the benefit the tree had to the community. A basic tree survey and assessment should be conducted prior to the issuance of a permit for construction activities. A tree protection zone should be established and maintained during construction and the Village should monitor construction activities to ensure local ordinances are adhered to. Tree removal, for trees of a certain size on the approved species list, should require prior approval by McFarland during site planning.



Creation, Utilization, and Maintenance of a Pest & Disease Response Policy

With invasive pests such as Emerald Ash Borer, Spongy Moth, and Spotted Lanternfly and diseases such as Oak Wilt either active or looming in Wisconsin, the development and implementation of a pest and disease response policy will enable the Village to have a standard strategy for dealing with active or yet unknown infestations and infections of known pests and pathogens.



Maintain an Acceptable / Unacceptable Species List

The urban environment is a difficult place for a tree to live. Between road salts, urban pollutants, limited soil, and other challenges, not all trees will thrive in the urban environment. Trees which have very weak wood, which are known invasive species, which produce messy or foul-smelling fruits, or which create a public nuisance should also be avoided. Acceptable species are those which are adapted to our Midwest climate, are not invasive, and do not pose high risk. Included in this Plan is an “approved and unapproved” species list which will detail specific trees which may be planted on Village ROWs and other Village-owned properties, as well as in Village parks. The Village and Sustainability and Natural Resources Committee will review the list periodically to ensure that it is being maintained in accordance with the latest information on specific trees. For more information on what species can and cannot be planted in McFarland, see the Acceptable Species list in Appendix A.

Operational Goals

Increase Overall Diversity by 2044 Through Tree Planting - Attain 20-10-5 Rule

Tree species diversity is one of the most important concepts in Urban Forestry today. The reason pests and diseases like Emerald Ash Borer (EAB) and Dutch Elm Disease were so devastating is that there were too many Ash and Elm trees. When EAB arrived, many communities’ Ash population was 20% or more, resulting in mass tree loss. This can be avoided by planting a greater diversity of tree species, so that when new pests or pathogens are introduced, we only lose small amounts of specific tree species. Diversity leads to stability, and stability leads to reduced costs and increased benefits over time. The 20-10-5 rule will be further discussed on page 24.

An achievable “Diversity Vision” has been created for 2044 which will see the tree population become far more diverse than it is at present. The current population includes a respectable 91 individual species and the diversity vision included in the Plan aims to reduce the number of trees that are over-represented and/or lower quality species while also seeking to increase the number of species that are under-represented or not present in the tree population.



Not only will trees be planted which are underrepresented or not present in the current population, they will also be planted in such a manner that selects the right tree for the right site. A direct goal will be to create a tree planting program where trees are matched to existing sites for the next 10+ years. Currently, McFarland plants approximately 65 trees each year, and this plan seeks to increase that number to 100 trees per year over the course of this plan, to both be able to replace older declining trees, as well as to grow the tree population by a net of about 700 trees overall by 2044. Ideas such contract growing, creating in in house liner nursery, gravel bed, and others will be explored. To learn more about tree planting and reforestation, turn to page 53.

Maintain an Accurate Tree Inventory on an Annual Basis

Managing an urban forest requires a clear understanding of the trees, their ages, conditions, and locations, so that Village crews and contractors can perform work on these trees. A stem-by-stem tree inventory was completed in June of 2022. This inventory resulted in an unbiased assessment of all of the trees in Village parks and on public rights of way in the Village, and will serve as the data which will guide the forestry program throughout the next 20 years.



All inventories are a snapshot in time. With 3,452 trees on Village terraces and ROWs, the tree inventory should be maintained at a high level of accuracy so that it doesn't become out of date. It is also recommended that the inventory be updated periodically by a Forestry Consultant, to keep the information at its most current on a Village-wide scale. Maintaining this tree data at a high level is vital in the execution of this Management Plan. Generally, inventory data should be updated in advance of each cycle prune section, so for instance, $\frac{1}{4}$ of the town could be reinventoried each year. Inventory data should not be more than 5 years old or it will have become mostly obsolete, and 10 years entirely obsolete. The

Village also plans to explore the implementation of a more user-friendly platform from which to keep the inventory updated on a day-to-day basis.

Maintain and Enhance Cycle Pruning Program

Properly pruned trees establish faster, grow quicker, have better structure and are stronger, are more resilient, and live longer lives than trees which are not pruned, or improperly pruned. Since large trees provide the greatest benefits to the community, pruning should be a critical part of the Urban Forestry program in McFarland. Pruning will be done primarily by in-house McFarland staff, however contractors will be used for the pruning of trees that are beyond the capability of Village staff. Details will be discussed in the Tree Pruning section of this plan on page 57. After a new inventory is completed, the first goal will be to prune the trees which are in greatest need of it.

As McFarland begins to increase its budgets and capacity for tree pruning, a goal of this plan is to enhance the cyclical pruning program. Currently, the Village prunes approximately 600-700 trees each year and a goal of this plan will be to gradually increase that number until the eventual goal will be to prune an average of 800 trees per year. The cyclical pruning program in place as part of this Plan will ensure that all trees on public property are pruned at a minimum every 5 years, increasing tree health and vigor while reducing costs associated with storm damage and tree failure.

Proper Mulching of All New Plantings

As noted above, the urban environment is a difficult place for a tree to become established and to live a long, healthy life. Proper mulching can significantly increase a tree's ability to do this. Mulch helps to conserve water during the summer by preventing it from evaporating from the soil. It also helps prevent weeds from growing around the tree and competing for water and nutrients and keeps lawn equipment such as weed whips away from the trunk where they can damage the tree. All new Village plantings will be properly mulched at the time of planting by the planting contractor.

Another intended outcome of this initiative will be to educate residents about proper mulching care and notify them when poor mulching techniques are being used. Of particular concern is the practice known as "Volcano Mulching" which has the opposite effect of proper mulching and can severely damage a tree over time. For more information on proper mulching, turn to page 62.

Manage Tree Removals

To prevent the spread of tree pests and pathogens, tree removal is sometimes unavoidable. To keep the residents of McFarland safe, tree removal projections have been created in this Plan which and budgets for the removal of trees identified as requiring removal during typical staff inspections or during inventory updates, in order to maintain public safety. Cost projections for tree removals have been made based on the number, age, and condition of trees in McFarland for the next 20 years, so that long term budgeting projections can be made. Also included are ANSI and ISA safety standards, as well as suggested bid specifications to ensure the Village is hiring qualified contractors who will be held to the highest industry standards. For more information on McFarland's proposed tree removal projections, turn to page 48.

Implementation of a McFarland Gravel Bed Program

A gravel bed is an irrigated bed or pile of gravel where bare root or washed containerized stock is placed and safely held for up to 3-6 months. This system has been in use at commercial nurseries, municipalities, and universities for over 20 years. In a gravel bed, the above ground portion of the tree will not grow any faster than normal.

The purpose of the gravel bed is to increase the fibrous root system, prepare for planting at a later date and recover poor root systems. A gravel bed can provide many advantages over planting traditional bare root, balled and burlapped, and containerized stock. Such programs have been successfully instituted in other communities and represents a quality investment that results in several benefits.



Gravel beds can save the community money through the utilization of bare root stock, which is typically 1/2 the price of containerized trees and 1/4 the price of balled and burlapped trees. Gravel beds can help increase species diversity because there are typically more species available as bare root stock than as containerized or balled & burlapped stock. Greater species diversity can reduce a community's vulnerability to insects and disease. Gravel beds allow bare root stock obtained in the spring to be planted throughout the growing season and into the fall. Communities can plant less expensive trees when they have the time and resources. A goal of this Plan could be to establish and enhance a gravel bed program in McFarland to provide more potential for the growth of the Village's urban forest in the future.

Invasive Species Management

The removal of low quality or invasive species is also recommended. This not only increases the amount of usable space in a given parcel of land, but may also lead to increases in public safety. It should be noted here that McFarland maintains many acres of conservancy land. While maintaining that land to prevent the spread of invasive species is of paramount importance, the remaining trees in these areas are generally not considered in this plan. They are not accounted for in the tree count or condition data, and no projections were done for their future diversity. A direct goal of this Urban Forestry Management plan is to reduce the count of undesirable species in the Village of McFarland.

Increase Stocking Density from 78% to 95%



Currently, there are an estimated 750 open planting spaces on McFarland's streets, and the stocking density is good at approximately 78%. While 100% stocking density would be very difficult to achieve over the 20-year scope of this plan, and is not actually always desirable, we do believe that 95% stocking density is attainable and desirable. This will be done primarily by increased tree plantings in the coming years, and use of innovative strategies to fund increases in tree planting.

Sustainability Goals

Increase Urban Tree Canopy from 27.72% to 30%

Tree canopy is important to the community as a whole because more and larger trees provide greater benefits such as decreased heating and cooling costs, pollution reduction, and increased storm water uptake. Tree lined streets are more attractive to homebuyers and potential new businesses, which increases home values, home ownership, and tax revenue. All these factors benefit the community, so a direct goal will be to increase tree canopy in the Village of McFarland. Currently, McFarland contains 27.72% tree canopy coverage, compared to other land cover types. Increases in tree canopy also come with increases in total benefits provided to the community.

We believe that an increase to 30% canopy cover is a realistic goal for McFarland by 2044. This will be accomplished by increasing the number of trees on publicly owned property, as well as improving tree care allowing trees to live longer, become larger, and create more canopy cover. Please note, this 27.2% includes private property trees as well, so increasing canopy cover is different than just increasing public tree cover, but trees on private property as well, planted by residents.

As we will show in the detailed portions of this Plan, these are real benefits that will help McFarland residents save money. For more information on Urban Tree Canopy, tree benefits, and other such information, turn to page 30.

Collaborative Efforts Among Municipalities to Help Mitigate Climate Change Effects

Although McFarland is a relatively smaller Village in south-central Wisconsin, its role as part of the larger Madison region should not be understated. Collaborative efforts among municipalities in larger urban regions such as the Madison area can do a part in mitigating the effects of climate change. A proactive and effective strategy to mitigate a changing climate is to plant more trees, and in fact the United States Environmental Protection Agency lists tree planting as one of the more effective solutions to mitigate climate change through absorption of carbon dioxide (<https://www.epa.gov/heatislands/using-trees-and-vegetation-reduce-heat-islands>).

Outside of their aesthetic value, trees have a great variety of environmental benefits, specifically offsetting climate change by producing a cooling effect in urban heat islands, and flood abatement by absorbing stormwater that otherwise would run off. Trees also act as long-term sinks for carbon dioxide, where carbon from the atmosphere becomes “sequestered” in the tree’s woody parts like the trunk and limbs as a result of photosynthesis, which is how trees create energy to grow.



Increasing tree canopy, not just at a municipal level, but at a regional level, creates greater sinks for carbon dioxide, reduces localized heating from the urban heat island effect, and reduces environmental issues stemming from flooding. It also provides a great habitat for birds, pollinators, and other beneficial wildlife that can enhance the urban environment. This will all be examined at several different points throughout this UFMP, in terms of examining the hard dollar benefits trees provide, looking at where trees can be planted to maximize their effect on heat islands and flooding, and looking at what species could be planted in the future as we are subject to higher average temperatures. For more information on using trees to mitigate climate change, turn to page 41.

Increase Awareness of the Urban Forest in the Village of McFarland, and Engage Stakeholders

The reason for the establishment and enhancement of an Urban Forestry program in McFarland is to improve the lives of the residents, business owners, and other stakeholders who want to see the Village be a healthier, happier community. In order to make this happen, McFarland is looking for partners in the community to provide support for this program. McFarland staff will explore reaching out to local garden clubs, philanthropic organization, residents, and business owners to make the forestry program innovative and community based. In this manner, residents and business owners in McFarland can take ownership of this important and beneficial resource, and allow it to work for them, their families, businesses, and the good of the whole Village. For more on these innovative programs, and how you can get involved, turn to page 14.

Continue Wood Utilization Program

As necessary tree removals occur, the Village generates a considerable amount of removed tree material some of which may be suitable for use as urban timber. Urban timber is defined as saw logs generated from urban tree removal operations. Larger and longer logs are suitable for dimensional lumber production, and smaller material may be used to produce many other products. A sample Urban Timber Harvesting specification in Appendix M.

McFarland currently has an innovative program in place where saw logs generated by the Village are donated to McFarland High School where they are utilized by woodshop students to get hands on experience in using urban timber to create a variety of products, including furniture. Additionally, wood that is generated by the Village that is not suitable for saw logs is converted into firewood which is made available to McFarland residents at no cost. Any remaining wood chips are made available to residents or used in parks as mulch or path material. This program is a win-win for all involved as the high school students get experience that may inspire them to enter woodworking or carpentry fields, residents get free access to firewood and wood chips, and the Village produces virtually no waste of wood generated by tree removals. Collaborative programs similar to this could be a model for other municipalities to recycle wood.



Additional Goals

There are no strategic timelines set forth here for these programs. As the direct goals of the Urban Forestry program in McFarland are met or exceeded, these are goals to be discussed by the Village of McFarland and its Sustainability and Natural Resources Committee as time and budgets become available. We believe that many of these programs represent some of the most progressive Urban Forestry policies in the current climate, and that they should all be seriously considered for implementation.

Continuing Citizen Education (Urban Tree Alliance/Other Local Organizations)

There is an organization called the Urban Tree Alliance active in the Madison area. This organization is a non-profit which assists in educating people about trees, how to prune, plant, and manage them, and their benefits to society. There are other local organizations with which the Village could partner with as well, please see page 16 for more details. Upon acceptance of this Plan, the Village might explore reaching out to Urban Tree Alliance or a similar local organization in order to establish a relationship, and assist in the creation of an educational program in order to engage the community.

McFarland could possibly hold several annual tree education sessions, perhaps to coincide with annual Spring and Fall planting cycles. These sessions may be taught by the Village Forester, other forestry staff, or other such qualified parties, and cover tree watering, fertilization, pruning, and the basics of how to spot insects and diseases. In addition, basic tree care pamphlets might be made available at Village Hall, Public Works, and other Village staff offices in addition to website-based forestry information. The Village's Arbor Day annual celebration is an example of one such outreach events that could be enhanced to be more beneficial to the forestry department's programs and goals.

Contract Growing Program

One of the keys to a successful Reforestation Plan or Tree Planting Program is the availability of high-quality nursery stock from local sources. Incorporated with the UFMP for the Village of McFarland is a diversity vision for 2044 that includes a great variety and diversity of different trees. A new approved species list has also been developed, as well as the tree species that are prohibited on public property. Having this information is an advantage for the Village, in that the nature of the urban forest in terms of species composition is already known. It is believed that a comprehensive tree planting plan will be an important part of this process as well.

This knowledge, however, does not guarantee the availability of those specific trees when the time arrives to fill a particular site. One way to assure the availability of nursery stock the Village desires each year is to have trees contract grown by local nurseries, and reserved specifically for the Village of McFarland. This way, the Village will not have to compete with the landscape industry, other local organizations responsible for tree planting, or local retailers. Trees are ordered in annual increments. Each year, McFarland will purchase the trees previously ordered for that year, and place an order for the following year. This gives the supplying nursery time to procure, plant, and bring the agreed upon trees to the size and branching habit specified.

As numbers of trees required for planting vary from year to year based on removal rates, budgets, and other factors, tree order projections should be made conservatively to avoid the possibility of cancellation of orders. In agreement with the supplying nursery, the Village would reserve the right to increase orders when budgets allow. Supplying nurseries should be located within a specified distance from the Village of McFarland, to ensure climatic zone compatibility and reduced transportation costs and planting stock exposure to the elements. Nurseries should be of sufficient production capacity to furnish all trees ordered in advance by the Village, as well as possible increases when necessary. Nurseries should be chosen not only on their capacity to produce stock, but to meet quality, form, and health standards as specified by the Village. The nursery should allow tagging by the Village Forester or other representative as well.

A long-term tree planting contract may be developed alongside the nursery supply contract. This contract would specify all pick-up, transportation, planting, and spoil disposal procedures, as well as establish costs for planting trees. Trees should be evaluated one year after planting and assessed for health and survival. Responsibility for replacement of trees that have not survived the one-year guarantee period is divided equally between the supplier, the planter, and the Village. Trees that are dug or balled improperly will be replaced by the nursery. Trees improperly handled or planted are replaced by the planter, or if do not survive because of lack of maintenance, by the Village.

Private Property Tree Planting Incentive Programs

Tree planting on private property could also be encouraged through public-private partnerships with local organizations and businesses. Though the Village has no formal jurisdiction to plant trees on private property, the benefits of tree planting on private property are substantial in terms of energy savings, storm water benefits, and other benefits. The Village should consider incentivizing residents and business owners to plant trees on their property. Offering a slight reduction in water and sewer bills for each tree planted has been successfully utilized, or other options more suitable to McFarland might be explored. Partnering with local nurseries to create a program where residents can purchase trees from a nursery at a reduced price might encourage tree planting on private property.

Another idea which has been successfully implemented is having the Village purchase trees from a wholesale nursery at wholesale prices, and then have an annual tree sale to local residents. The Village resells the trees at a slight markup from the wholesale cost, but still less than retail, and uses the proceeds to fund its forestry initiatives. Such programs would encourage tree planting on private property by reducing tree costs to the residents.

Implementation of a Staff Training & Development Program

A longer term goal for the Village would be to develop and implement a simple ladder system for employee development, where opportunities for training, career enhancement, and continuing education could be provided to Village personnel as they reach milestones and thresholds in their employment experience. The Village will explore this opportunity and as the program evolves, the UFMP will be updated to include the developing details.

Strategic Partnerships



The purpose of these partnerships is to build capacity and advocacy in the community. Strategic partnerships are a very effective means of getting forestry projects funded when tax funding may present a shortfall, or when additional labor is needed. These typically involve either public-private partnerships or partnering with other public entities. Typically, the organizations seen participating in these programs include non-profits, local garden clubs, scout groups, rotary clubs, state departments of natural resources, and other such groups. This will be an ongoing goal, and continuing partnerships with new organizations shall always be sought.

Dane County Land & Water Resources Department/ Parks & Forestry Division

The Land & Water Resources Department strives to protect and enhance the natural, cultural, and historic resources of Dane County; provide the county's residents with a broad array of accessible, high quality resource-based recreational services and facilities; and support residents, communities, local governments and other agencies and organizations in their resource management and protection activities. One of the Department's goals is to implement stormwater management projects and as one of the primary goals of this UFMP is to define trees as critical stormwater infrastructure, Land & Water Resources Department is a logical partner. Additionally, the Parks & Forestry Division could be a partner for educational opportunities.



UW-Madison

The Department of Forest and Wildlife Ecology at the University of Wisconsin – Madison is a national leader in forest science and wildlife ecology research, teaching, and training. Their programs combine relevant course work with hands-on experience for an educational experience that not only educates students, but trains future leaders. The Department employs faculty, staff, and graduate students who maintain excellence in applied forest and wildlife ecology research. Partnering with UW-Madison could enable students to participate in educational opportunities and gain practical experience in urban forestry.



Madison Area Technical College

The Tree Care Technician program at Madison Area Technical College prepares students for exciting careers in areas related to urban forestry. By partnering with MATC, the Village could benefit from the opportunity to work with students who are interested in gaining hands-on knowledge regarding urban forestry in McFarland.



Tree Canopy Collaborative

The aim of the Tree Canopy Collaborative is to collectively maintain, protect, and expand public and private tree canopy across Dane County where ecologically appropriate. Within this aim, a particular focus is on ensuring equitable access to trees and their associated benefits for all residents.

Partnership is fundamental to achieving success. The Collaborative is working collectively in Dane County to co-develop goals with local experts in order to recognize neighborhood opportunities, needs, and constraints.



Wisconsin Arborist Association

The mission of the Wisconsin Arborist Association is to "To improve the practice of arboriculture and increase public appreciation of trees and urban forests." WAA is a professional organization made up of certified arborists from throughout the state of Wisconsin. The association strives to further the education of certified arborists and can serve as a valuable resource to reach the goals of this plan.



Urban Wood Network- Wisconsin Chapter

The Urban Wood Network was developed in 2017 to formally unite unique urban wood industry groups and efforts under the common mission of growing professional and consumer confidence in the urban wood industry through information, collaboration, and connection. Since the early 2000's, the founding groups behind the Urban Wood Network program have worked diligently to unite, promote, and demonstrate urban wood utilization. Now the ever-growing network of urban wood industry professionals and state-specific chapters are provided access to consistent messaging/marketing tools and a useful platform for collective experience, support, and connectivity to help the industry thrive.



Urban Tree Alliance

The Urban Tree Alliance is a Madison-based urban forestry not-for-profit focused on growing and diversifying the local canopy through tree planting, resource management, and research. Their mission is to preserve and grow the urban forest canopy in a sustainable and innovative manner in partnership with the public. The Urban Tree Alliance is committed to providing Madison-area residents with the knowledge, skills and resources they need to grow and maintain a healthy, resilient urban forest. They support homeowners in caring for trees on their property, and empower groups to tackle community forestry projects. The Urban Tree Alliance could be a valuable partner for McFarland.



Wisconsin Department of Natural Resources

The WDNR's mission is to protect, perpetuate, restore, conserve, and manage the forest and related resources of Wisconsin, both public and private. To that end, they have an abundance of resources, staff, and a network of partners which can help McFarland accomplish the goals laid out in this plan, including funding for such things as tree planting or local education and outreach.



Master Gardeners

Master Gardeners are trained volunteers who dedicate their time and skills to make their community a more beautiful place. They are horticultural experts who serve their communities through service projects and delivery of educational programs and could assist McFarland in coordinating educational events.



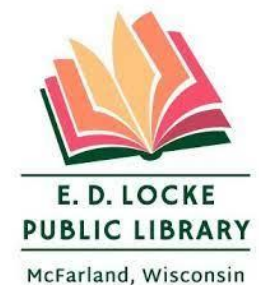
McFarland Garden Club

The McFarland Garden Club promotes an interest in gardening and the beautification of the landscape in the community. McFarland Garden Club is active in the community and in partnership with local organizations it contributes to the beauty of McFarland through donations and volunteer service. Trees are an essential part of gardening, and spreading the word about the importance of trees can be accomplished through local volunteers like those at the Garden Club and may serve as a resource for education and other environmental initiatives.



E.D. Locke Public Library

The Library is a place where people congregate and learn. As such this would be a first rate location to advertise opportunities for public outreach education about urban forestry, as well as stocking and showcasing books related to urban forestry and its related disciplines.



Local school districts

Urban Forestry is by and large an unknown profession, but there are many aspects of STEM concepts that go into it: GIS Mapping, chemistry, physics, biology, and math are all essential facets of Arboriculture. A relationship with local school districts would be a reciprocal relationship, where students could engage in study projects based around trees, and citizen science. This type of program may develop interest in or even promote careers in the green industry.



Local Boy and Girl Scout Troops

The mission of the Boy Scouts of America is to prepare young people to make ethical and moral choices over their lifetimes by instilling in them the values of the Scout Oath and Law and the mission of the Girl Scouts of the USA is to build girls of courage, confidence, and character, who make the world a better place.

Both organizations foster a dedication to education, community service, and volunteerism and a partnership with the Village could be a beneficial relationship for all entities involved.



McFarland Sparks 4-H Club

4-H is delivered by Cooperative Extension — a community of more than 100 public universities across the nation that provides experiences where young people learn by doing. For more than 100 years, 4-H has welcomed young people of all beliefs and backgrounds, giving kids a voice to express who they are and how they make their lives and communities better. 4-H would be a valuable partner, particularly for community service projects involving the Village's urban forest.



Rotary Club

Rotary is a global network of 1.2 million neighbors, friends, leaders, and problem-solvers who come together to make positive, lasting change in communities at home and abroad while developing personal relationships and having fun. The members of the Rotary Club of McFarland are an active, diverse group of individuals with a common interest in making the community and the world a better place for everyone. The Village could partner with the Rotary Club in organizing educational events.



McFarland Lions Club

The mission of Lions Club International is to empower Lions clubs, volunteers, and partners to improve health and well-being, strengthen communities, and support those in need through humanitarian services and grants that impact lives globally, and encourage peace and international understanding. The McFarland Lions Club could be an important resource for community volunteer events.



Friends of McFarland Parks

The Friends of McFarland Parks is a local non-profit organization formed in 2006 to help promote, maintain and improve the parks in McFarland, WI. The group has undertaken multiple environmental initiatives, such as removal of invasive species and restoration of prairie land. The organization is most active in overseeing the McFarland Community Garden. Friends of McFarland Parks is a logical partner to assist in the goals of this UFMP.



State of the Urban Forest

Using the tree inventory data collected for the Village of McFarland, it was determined that there are a total of 3,452 trees on Village Owned rights of way and in Village owned parks, along with an estimated 750 open planting spaces. It is important to note that the statistics that follow include all inventoried trees and both the ROW and park trees were analyzed as one population. The charts and statistics in this portion of the Management Plan illustrate that the tree population in McFarland can be characterized as being in overall above average condition and the stocking density is good, at 78%. The species diversity in McFarland is quite good as well with 91 individual species represented. Based on the following data in the Management Plan, the Village of McFarland will be equipped to use this valuable information to address short-term concerns, long term management considerations, and overall planning objectives.

Basic Statistics – Managed Trees

Number of Trees Inventoried	3,452
Total Number of Species	91
Total Diameter Inches	32,478"
Average Tree Diameter	9.41"
Average Tree Condition	2.72 (Above Average)

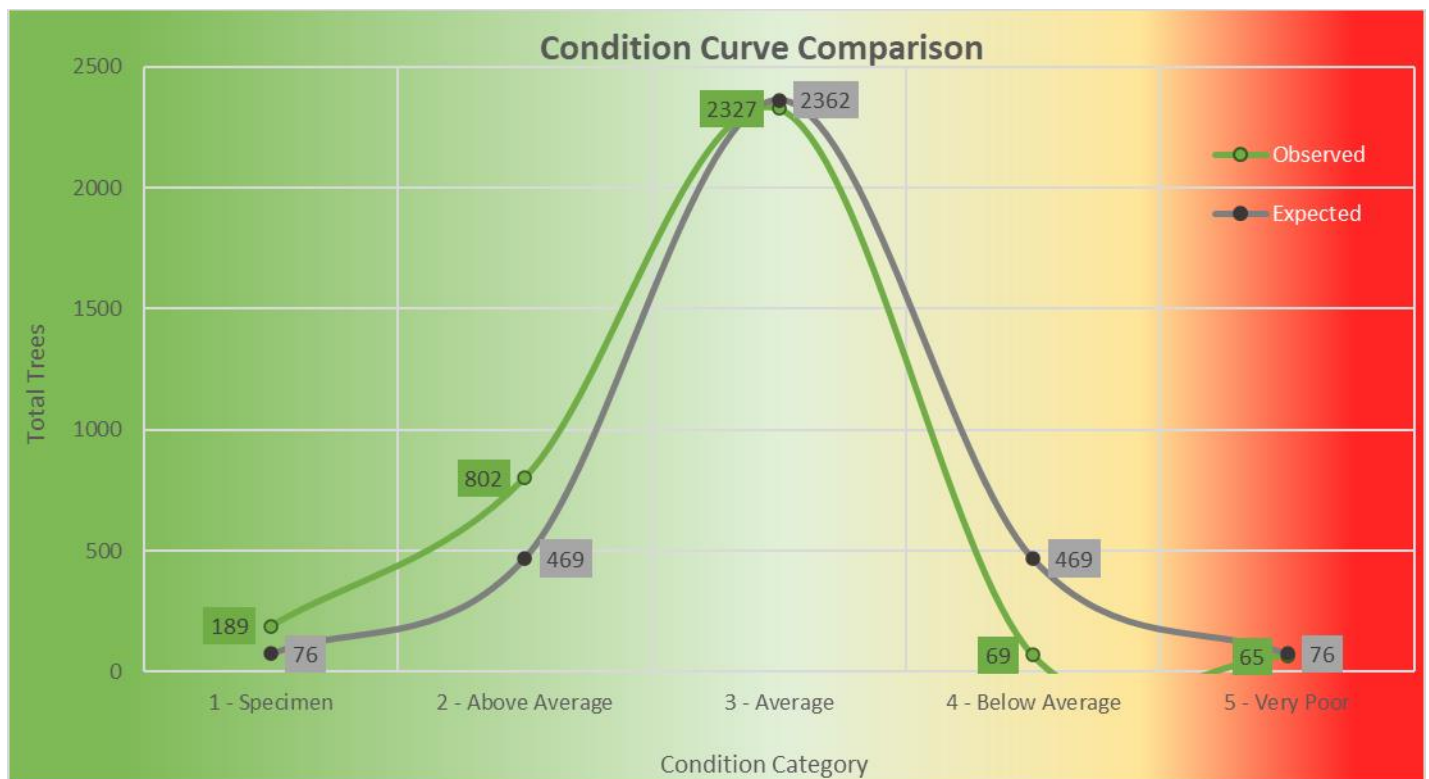
Condition Statistics

During the tree inventory, a condition rating was collected for each tree based on these parameters:

Rating category	Condition Components			Percent Rating
	Health	Structure	Form	
Excellent	High vigor and nearly perfect health with little or no twig dieback, discoloration, or defoliation.	Nearly ideal and free of defects.	Nearly ideal for the species. Generally symmetric. Consistent with the intended use.	81% to 100%
Good	Vigor is normal for the species. No significant damage due to diseases or pests. Any twig dieback, defoliation, or discoloration is minor.	Well-developed structure. Defects are minor and can be corrected.	Minor asymmetries/ deviations from species norm. Mostly consistent with the intended use. Function and aesthetics are not compromised.	61% to 80%
Fair	Reduced vigor. Damage due to insects or diseases may be significant and associated with defoliation but is not likely to be fatal. Twig dieback, defoliation, discoloration, and/or dead branches may comprise up to 50% of the crown.	A single defect of a significant nature or multiple moderate defects. Defects are not practical to correct or would require multiple treatments over several years.	Major asymmetries/deviations from species norm and/or intended use. Function and aesthetics are compromised.	41% to 60%
Poor	Unhealthy and declining in appearance. Poor vigor. Low foliage density and poor foliage color are present. Potentially fatal pest infestation. Extensive twig and/or branch dieback.	A single serious defect or multiple significant defects. Recent change in tree orientation. Observed structural problems cannot be corrected. Failure may occur at any time.	Largely asymmetrical/abnormal. Detracts from intended use and/or aesthetics to a significant degree.	21% to 40%
Very Poor	Poor vigor. Appears to be dying and in the last stages of life. Little live foliage.	Single or multiple severe defects. Failure is probable or imminent.	Visually unappealing. Provides little or no function in the landscape.	
Dead				0% to 5%

For the data analysis portion of this report, the original condition ratings were extrapolated into Great Lakes Urban Forestry Management’s data collection schema. Our rating criteria is as follows:

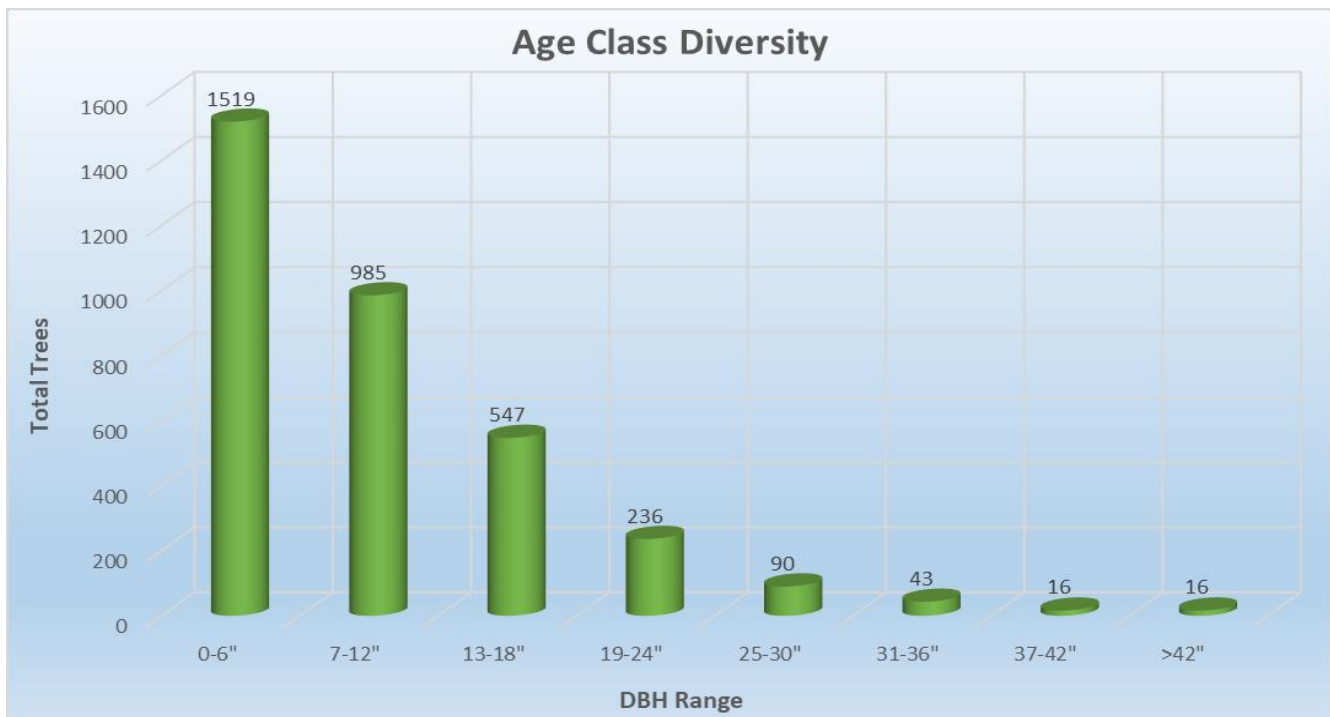
Condition 1	Specimen – Tree has no observable defects, wounds, diseases, and has perfect form for the species. Since younger trees are generally trouble free, a condition 1 tree must by the Forestry Consultant’s definition be a minimum of 16” DBH. These are legacy trees, and as such are rare.
Condition 2	Above Average – Tree may have a small amount of deadwood, or a very limited number of minor defects. The overall form of the tree must be good, and consistent for the species. These trees, by the Forestry Consultant’s definition, must be a minimum of 8” DBH.
Condition 3	Average – Tree has moderate amounts of deadwood, wounds, or other defects, but is generally healthy. A wide variety of forms is acceptable for this group, which is meant to define the middle ground around which better or worse trees can be defined.
Condition 4	Below Average – Tree has defects, deadwood, wounds, disease, etc. which are likely to cause a need for removal. Very poor form or architecture can put an otherwise healthy tree in this category as well.
Condition 5	Very Poor – Tree must be removed. Defects are too far advanced for the tree to be reasonably saved. Like condition 1 trees, these are rare, as generally trees approaching this level are removed before they deteriorate to this level.



The chart above represents the distribution of trees in each of the 5 categories. We have included the tree condition ratings observed in the field, as well as a curve representing an “average” distribution so that comparisons can be made. The green line represents what was observed in the field, and the grey line represents an average or “normal” tree population. As explained in the condition rating parameters on the previous page, please note that all trees measuring less than 8” DBH are automatically assigned a Condition 3 rating unless they happen to be in worse condition.

As is evidently illustrated on the chart above, the tree population in McFarland is currently in above average condition based on the condition ratings calculated from the Village’s inventory data.

Age Class Analysis



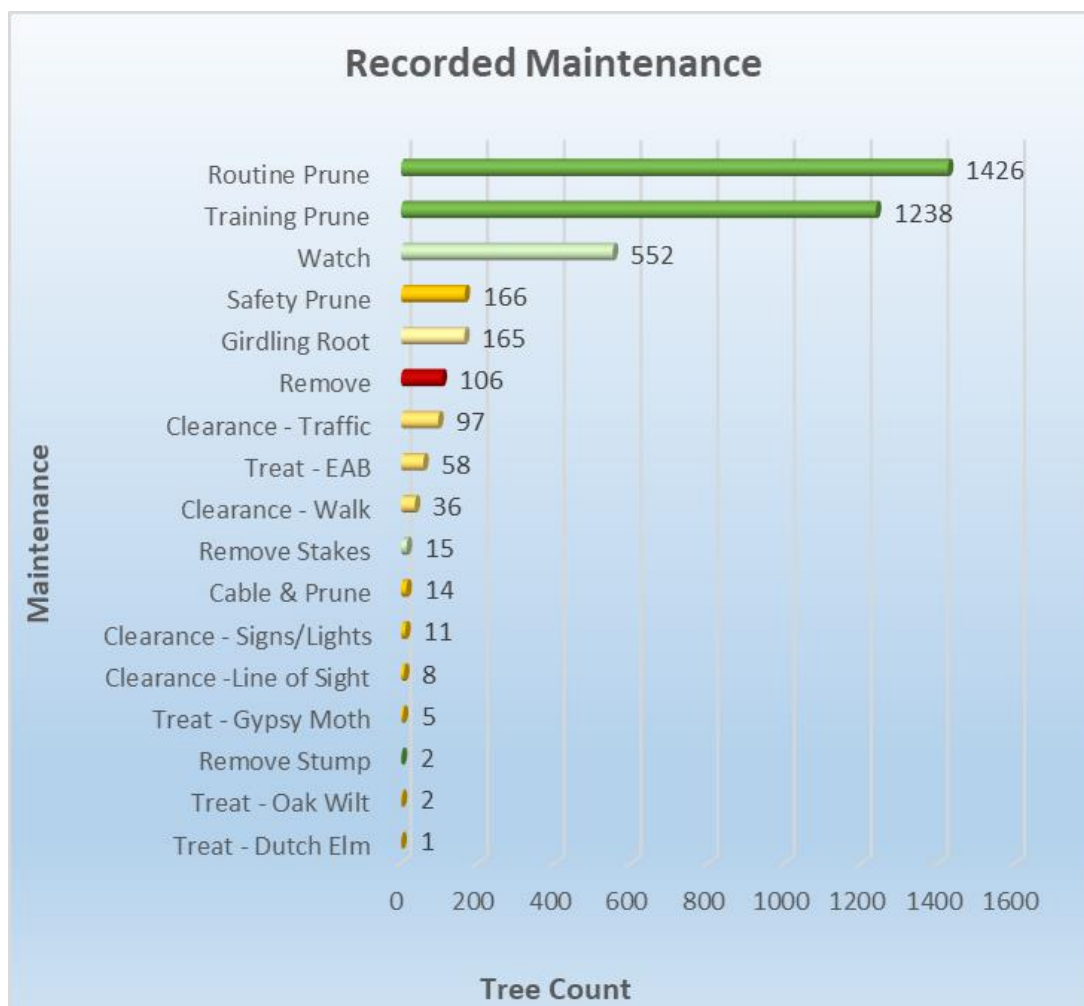
In terms of the ages of trees in McFarland, we have split the tree population into 8 “classes” of 6” diameter increments. This tells us how many trees are in each “age class”. Because trees are measured by Diameter at Breast Height (DBH) as a standard measure, this breakdown can help show where trees are in their life cycles. Some trees like Cottonwood and Silver Maple grow in diameter very quickly, up to 1” per year or possibly more. Other slower growing trees such as Oak and Hickory may only add ¼” or less every year. As a broad generalization, it can be said that most trees on average grow at around ½” per year.

This age class analysis chart illustrates a somewhat typical trend in the overall age spread of a tree population seen in a municipal setting. We often see many trees younger to middle aged and a relatively lower number of trees in the older age categories. The McFarland tree population is largely younger with 73% of the tree population measuring between 12” DBH or less. As shown above, almost 44% of the total population has a DBH of 6” or less which we generally consider to be less than about 15 years old.

Nearly 29% of McFarland's trees have a DBH of 7-12" which are generally considered to be about 15-25 years old. The 13-18" DBH category makes up 16% of the population and is considered to be approximately 25-35 years old. Moving to the 19-24" DBH category there is a steep drop in numbers and this category makes just 7% of the population. Those trees are generally mature trees over 35-45 years old.

Trees measuring over 24" DBH account for the remaining 5% of the total tree population. The 165 trees in the 25"+ DBH categories are considered to be about 45-50+ years old. A number of these may be nearing the end of their natural life. It should be mentioned that the number of trees in the 30"+ categories are often lower due to the natural senescence and ensuing decline of trees in urban settings. A fairly equal number of trees in each age classification is, within reason, desirable and indicative of a consistent focus on tree planting and tree maintenance in McFarland over the years and shows that the right trees are being planted in the correct locations. Also, the estimated 750 planting spaces gives McFarland an opportunity to focus on tree planting going forward. As the younger trees continue to grow, McFarland will have an opportunity over time to bring the age classes to a more balanced level.

Maintenance Based on Inventory Data

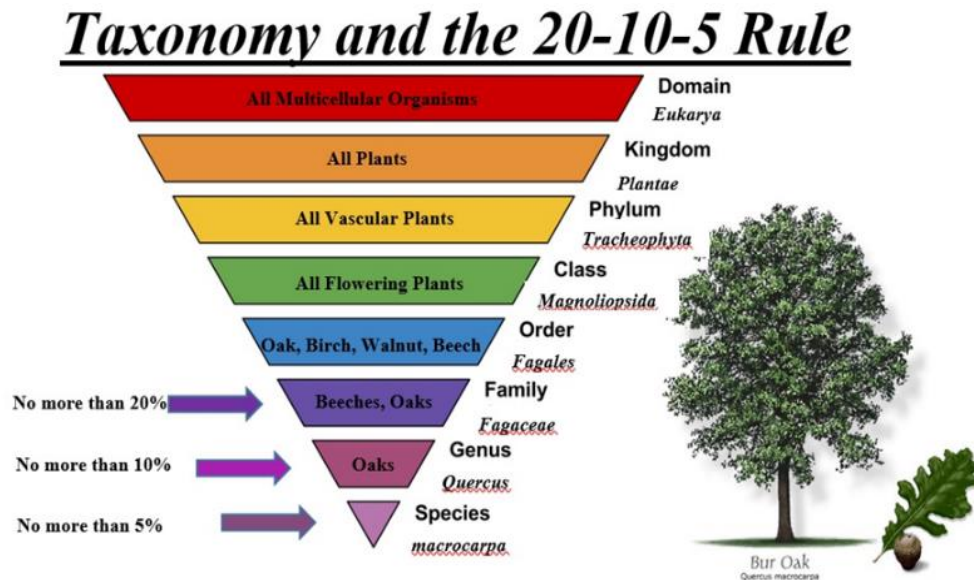


The chart above illustrates the maintenance needs recorded in the Village's inventory data. It is important to mention that this chart reflects the data originally collected during the inventory. Significant removal work of approximately 100 trees has already occurred and is not yet reflected in this data analysis.

As the data is kept updated going forward, McFarland can use the inventory to query specific issues and prioritize mitigation actions. This chart illustrates an interesting overview of the overall health, defects, and maintenance needs of McFarland's tree population.

Diversity Analysis

Taxonomy is the method by which scientists classify plants, animals, and other life forms into distinct categories. A species is unique. There is only one type in that category, such as Bur Oak (*Quercus macrocarpa*), which refers to only one specific type of tree. A genus, however, is a group that may contain multiple species. All Oak trees, for instance, are in the genus *Quercus*. The further down the taxonomic ladder you go, the more similar things become.



The more similar tree species are to each other, the higher the likelihood that an insect or pathogen can exploit every species of that genus. Emerald Ash Borer is a classic example of this, as it affected every tree species in the ash genus. The most effective prevention of tree loss we have is to limit the number of trees planted that a new pest or pathogen can affect. While diversity at the species level is important, it is also important to achieve diversity on the genus and family levels, so that a large selection of trees are planted.

The "20-10-5" rule for McFarland's future tree plantings is recommended, which states that no more than 20% of any one family, 10% of any one genus, and 5% of any one species shall be planted during any one planting cycle. It will also be a long-term direct goal of the forestry program to have the tree population in compliance with the 20-10-5 Rule, and there is a possibility that this could be attained by the 2044 date used in this document. This level of taxonomic diversity is consistent with today's arboricultural industry standards (see above graphic).

The old paradigm of urban forestry was to create tree lined streets and parks in which every tree was the same type, shape, age, and height. This was thought to produce a uniform appearance. Urban foresters have now learned that once a pest or pathogen is introduced into a monoculture planting such as this, an epicenter of infestation is created that may cause serious damage, both ecologically and financially. Diversity in the urban forest helps to prevent and reduce the impacts of pests and pathogens. There are three aspects of diversity in the urban forest. We will examine these in detail, below.

Taxonomic (Species) Diversity

Why is it important to plant a diverse set of trees at the species, Genus, and Family levels? Simply put, it is to ensure that we will not fall victim to mass tree loss from pests and pathogens in the future. The reason Emerald Ash Borer (EAB) was such a devastating expense for many organizations was because their tree populations were composed of over 20% Ash trees. When these trees died and had to be removed, those organizations lost 20% of their trees.

This comes with the obvious expenses of having to remove these trees and replace them. But it also comes with hidden expenses as well, namely the loss of the ecological services that those trees provided: Homes cost more to heat and cool, storm water infrastructure falls under heavier pressure, and increases in pollutants and greenhouse gases may be observed. For all of these reasons, a more diverse group of trees needs to be planted, such that we are never at risk of losing more than 5-10% of our trees at any given time due to a pest or pathogen.

As will be discussed in further detail below, the tree population in McFarland is by far dominated by Maple species. In decreasing numbers, the remaining of the top 5 include Lindens, Oaks, Honeylocusts, and Spruces.

Spatial Diversity

Spatial diversity is the concept of mixing tree species over the whole geographic area. The easiest way to slow the spread of any new pest or pathogen is to increase the distance between potential host trees. Every pest or disease, such as EAB or Dutch Elm Disease (DED), has a limited area to which it can spread in a given time frame. The more difficult it is to get to the next host tree, the less of a problem the pest or pathogen becomes, and the easier quarantine becomes.

In addition to the functional benefits provided by increasing spatial diversity, organizations which have implemented diverse planting over the past several decades have demonstrated that such diversity yields an arboretum-like landscape that is both functional and aesthetically pleasing. At present, the Spatial Diversity in McFarland is moderate due to the presence of a significant percentage of Maples in the tree population. During the tree planting planning phase, extra care should be taken to ensure that new plantings are done in a manner that yields a highly spatially diverse tree population, and creation of areas of low spatial diversity (monocultures) will be avoided.

Age-Class Diversity

Age-class diversity is also an important consideration. A healthy natural forest has trees of many ages. Young, intermediate, and mature trees allow for regeneration, replacement and vigor in the overall forest community. A mixture of tree species, locations, and ages will lead to great diversity, which insulates a natural forest against pest and pathogen outbreaks. The Urban Forest is no different. The outdated urban forestry paradigm promoted even-aged tree plantings, so that all trees were approximately the same size and age. However, once these trees begin to decline, most will require removal and replanting simultaneously. This can leave an entire street segment or neighborhood without shade and aesthetics for a long time.

The current approach of the urban forestry community is to strategically plant trees on streets or in neighborhoods over a longer timeframe. With this strategy, trees will grow to maturity in different stages, and decline at different times. When declining trees are eventually removed, there will always be a variety of age classes and tree sizes on a block or in a neighborhood. This reduces the pressure to plant trees in an area immediately after tree removal, helping to manage costs. A mixed age-class planting ensures that mature trees are always present in a neighborhood. It also will allow for strategic planting of smaller or medium-sized trees.

An additional benefit of mixed-age plantings is the ability to plant shade-loving trees as well as sun-loving trees. When a street or neighborhood is newly planted with trees of the same age, all the trees are essentially in full sun. This reduces the ability to plant shade-loving trees, as they have a tendency to dry out in the summer sun. With mixed-age stands, shade-tolerant, trees may be planted underneath the canopy of larger, mature trees. This approach will be used for future tree removal and replacement and help to create an Urban Forest that has mature trees, middle aged trees, and young trees in similar quantities.

Current Tree Population

<u>SPECIES</u>	<u>COUNT</u>	<u>% OF TOTAL</u>	<u>AVG DBH</u>	<u>AVG COND</u>
AMERICAN HORNBEAM	34	0.98%	4.53	2.97
AMERICAN REDBUD	32	0.93%	2.94	2.59
ARBOR VITAE	152	4.40%	5.27	2.76
ASH-AMERICAN	18	0.52%	12.17	3.28
ASH-GREEN	58	1.68%	16.66	3.48
ASH-SPP	3	0.09%	14.33	5.00
ASH-WHITE	26	0.75%	18.12	3.31
ASPEN-SPP	1	0.03%	7.00	2.00
BIRCH-RIVER	12	0.35%	10.25	2.92
BIRCH-SPP	13	0.38%	7.08	2.69
BIRCH-WHITE	21	0.61%	11.00	2.90
BLACK LOCUST	16	0.46%	19.19	2.69
BOXELDER	19	0.55%	13.89	3.16
BUCKEYE-OHIO	29	0.84%	1.59	2.55

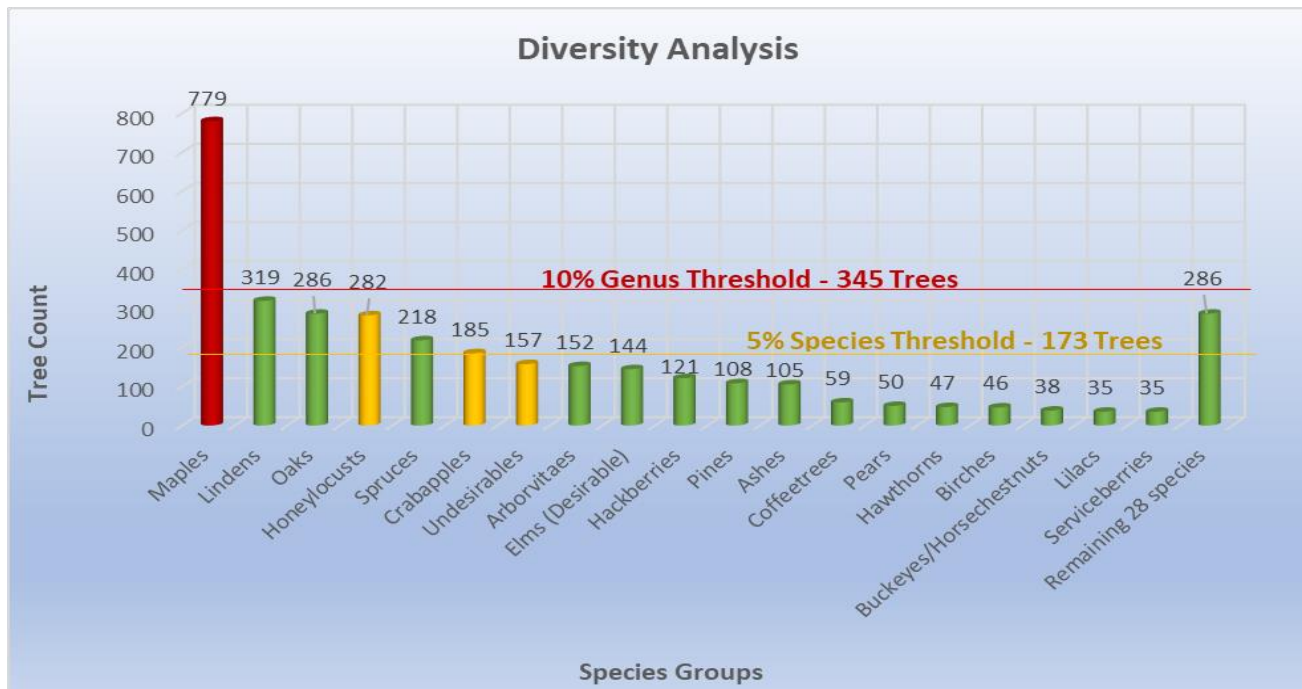
VILLAGE OF MCFARLAND URBAN FORESTRY MANAGEMENT PLAN

BUCKTHORN-ALDER	3	0.09%	4.67	3.33
CATALPA	1	0.03%	2.00	3.00
CHERRY-AMUR	9	0.26%	2.56	2.33
CHERRY-BLACK	12	0.35%	14.92	3.08
CHERRY-SPP	11	0.32%	6.36	3.00
CHESTNUT-SPP	1	0.03%	7.00	3.00
COTTONWOOD	29	0.84%	32.93	2.93
CRABAPPLE-SPP	185	5.36%	6.97	2.96
DOGWOOD-SPP	3	0.09%	3.00	3.00
DOUGLAS FIR	4	0.12%	14.00	2.75
EASTERN REDCEDAR	15	0.43%	9.07	2.67
ELM-AMERICAN	6	0.17%	20.17	3.00
ELM-HYBRID	133	3.85%	9.05	2.62
ELM-RED	5	0.14%	20.80	3.00
ELM-SIBERIAN	51	1.48%	15.92	3.04
FIR-BALSAM	4	0.12%	8.75	2.75
GINKGO	31	0.90%	2.42	2.65
HACKBERRY	121	3.51%	4.56	2.60
HAWTHORN-SPP	42	1.22%	3.45	2.88
HAWTHORN-WASHINGTON	5	0.14%	6.20	3.00
HAZELNUT-TREE	18	0.52%	2.94	2.72
HICKORY-BITTERNUT	1	0.03%	20.00	3.00
HICKORY-SHAGBARK	9	0.26%	18.11	3.00
HONEYLOCUST	282	8.17%	11.91	2.62
HORSECHESTNUT	9	0.26%	3.11	2.22
IRONWOOD	8	0.23%	4.88	2.75
JUNIPER-SPP	29	0.84%	7.76	2.55
KATSURATREE	4	0.12%	4.75	3.00
KENTUCKY COFFEETREE	59	1.71%	2.66	2.19
LARCH	1	0.03%	12.00	2.00
LILAC-JAPANESE	35	1.01%	4.69	2.54
LINDEN-AMERICAN	89	2.58%	9.55	2.52
LINDEN-LITTLELEAF	217	6.29%	10.94	2.79
LINDEN-SILVER	2	0.06%	1.50	2.00
LINDEN-SPP	11	0.32%	1.82	2.18
LONDON PLANETREE	12	0.35%	2.00	2.50
MAGNOLIA-SPP	3	0.09%	5.33	2.67
MAPLE-AMUR	33	0.96%	5.58	2.88
MAPLE-FREEMAN	254	7.36%	5.74	2.59
MAPLE-JAPANESE	1	0.03%	2.00	3.00
MAPLE-MIYABEI	9	0.26%	7.67	2.11
MAPLE-NORWAY	216	6.26%	11.20	2.81

VILLAGE OF MCFARLAND URBAN FORESTRY MANAGEMENT PLAN

MAPLE-RED	109	3.16%	5.74	2.50
MAPLE-SILVER	76	2.20%	24.47	2.96
MAPLE-SPP	14	0.41%	3.71	2.57
MAPLE-SUGAR	67	1.94%	9.97	2.90
MOUNTAIN ASH-SPP	4	0.12%	2.25	2.25
MULBERRY-SPP	13	0.38%	10.08	3.00
OAK-BURR	46	1.33%	13.39	2.48
OAK-ENGLISH	6	0.17%	3.50	3.00
OAK-HILLS	4	0.12%	6.50	2.25
OAK-PIN	5	0.14%	12.40	1.40
OAK-RED	99	2.87%	7.87	2.38
OAK-SCHUETTS	3	0.09%	2.67	3.00
OAK-SPP	12	0.35%	3.42	2.50
OAK-SWAMP WHITE	75	2.17%	6.65	2.03
OAK-WHITE	36	1.04%	24.22	2.75
PEAR-CALLERY	44	1.27%	7.82	3.05
PEAR-SPP	6	0.17%	6.17	2.83
PINE-AUSTRIAN	11	0.32%	12.64	3.09
PINE-RED	11	0.32%	15.09	3.00
PINE-SCOTCH	2	0.06%	11.50	3.00
PINE-SPP	7	0.20%	2.43	3.00
PINE-WHITE	77	2.23%	13.14	2.40
POPLAR-WHITE	3	0.09%	31.00	1.67
SERVICEBERRY-SPP	35	1.01%	2.80	2.74
SMOKETREE-AMERICAN	1	0.03%	1.00	2.00
SPRUCE-BLACK HILLS	7	0.20%	4.43	3.00
SPRUCE-BLUE	113	3.27%	11.82	2.99
SPRUCE-NORWAY	25	0.72%	10.80	2.44
SPRUCE-WHITE	73	2.11%	7.77	2.66
SWEETGUM	1	0.03%	9.00	3.00
TULIPTREE	2	0.06%	9.50	3.50
UNKNOWN	13	0.38%	1.92	2.92
WALNUT-BLACK	29	0.84%	17.03	2.90
WILLOW-SPP	11	0.32%	20.00	3.27
YEW-SPP	5	0.14%	2.40	2.60

As shown in the table above, the Village of McFarland Tree population consists of 91 distinct tree species, accounting for 3,452 total trees. The above table shows the percent of the total population each species makes up, as well as the average Trunk Diameter. This population is shown graphically below:



In general, the McFarland tree population has overall good diversity with 91 different species represented. However, one genus, which includes all Maple species, accounts for 23% of McFarland's tree population. It is quite common for Maple species to be the highest represented species in municipalities and in other urban settings because they are typically an adaptable and hardy shade tree. However, if a pest or pathogen that attacks only the Maple genus were introduced into our region, McFarland could potentially lose nearly a quarter of its tree population.

Honeylocusts alone makes up over 8% of McFarland's entire population and is followed by Freeman Maple, Littleleaf Linden, Norway Maple, and Crabapple each over the 5% species threshold and making nearly 34% of the entire population represented by 5 singular species.

Spruce trees also make up a significant portion of the population and are particularly susceptible to a number of pathogens and should be monitored for the presence or progression of these diseases. The 157 trees that were classified in the "Undesirables" tree category consist of species that are invasive and/or have fast-growing or weak-wooded characteristics that make them unwanted in the urban landscape such as Willow, Poplar, Mulberry, Siberian Elm, Black Locust, and Boxelder.

It should generally be said that reducing the number of Maples overall while increasing lesser represented species should be a strategic goal, and our Diversity Vision will help to accomplish this. With an estimated 750 available planting spaces, a long-term tree planting plan would be an valuable tool for McFarland to pursue. Such a plan would not only further improve overall diversity, but also maximize the lifespan of trees on the terraces by carefully matching tree species requirements and tolerances with each individual planting site. Trees that are well adapted to their growing conditions will establish more quickly, require less maintenance, be healthier overall, and more resistant to disease and insect problems. By matching the right trees with the right planting spaces using a tree planting plan, the Village of McFarland can help protect its investment in each new tree.

Although McFarland's diversity is good overall (with the exception of those discussed above), the Village has a number of species to choose from which are commercially available and underrepresented in their population. As mentioned above, this UFMP will lay out strategies to improve diversity even further, and we will examine the specific species recommended in the "Future of the Urban Forest" Section below.

i-Tree Report / Urban Tree Canopy Assessment

i-Tree is a state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides Urban Forestry analysis and benefits assessment tools. The i-Tree tools help communities of all sizes to strengthen their forest management and advocacy efforts by quantifying the structure of trees and forests, and the environmental services that trees provide.

The i-Tree suite calculates hard dollar values that trees provide to communities. Trees provide "ecological services" that save homeowners money, such as in heating and cooling costs, where large trees help shade houses in the summer, saving on air conditioning and electricity bills, and provide windbreaks during the winter, saving on heating and natural gas costs. They also provide CO₂ uptake, reducing the effects of climate change, as well as air quality improvements by the absorption of urban pollutants. Trees also absorb stormwater, which reduces strain on stormwater infrastructure, and saves money in replacement costs. Finally, trees contribute up to 15% of the total value of a property, so they have monetary aesthetic benefits as well.

Using the data from the tree inventory, an i-Tree report has been prepared the Village of McFarland. Below you will find reports on the Net annual benefits of the tree population, replacement values, and breakdown of benefits per species. We performed an i-Tree Eco analysis which focuses primarily on ecological benefits. The results of these analyses are below, and full tables and the i-Tree Report are available.

i-Tree Eco Analysis Results

A summary of the iTree Eco report for the McFarland tree population is provided as summary tables below:

Pollution Removal	\$4,350
Carbon Sequestration	\$5,270
Avoided Runoff	\$5,450
Building Energy Savings	\$14,500
Carbon Avoided	\$6,070
Oxygen Production	\$9,722
TOTAL ANNUAL BENEFITS	\$45,362

Carbon Storage	\$176,000
Replacement Value	\$3,570,000
TOTAL STANDING BENEFITS	\$3,746,000

The above tables are further summarized in the table below:

Annual Values	
Benefits to Residents	\$29,570/year
Benefits to Environment	\$15,792/year
SUBTOTAL (Each Year)	\$45,362/year
Standing Values	
As a Commodity	\$3,570,000
As an Ecological Resource	\$176,000
SUBTOTAL	\$3,746,000

As can be seen from the above tables, the tree population in the Village of McFarland currently provides approximately \$45,362 in benefits every year, directly related to trees and their effect on homes, businesses, and the environment. It should be noted that the annual budget for all forestry activities recommended in this plan, projected for the calendar year 2024, will total approximately \$79,045 per year, so the benefits from the tree population are worth over half of what the cost put into them will be. We will examine this further below. In addition, the total standing value as a commodity and an ecological resource of the whole tree population is \$3,746,000.

These benefits can be viewed as “income” to McFarland’s residents, and so long as the trees are well maintained, they will continue to provide these benefits, and more. As trees grow, they also increase their benefits! For example, a 3” diameter tree provides less than \$50/year in benefits, whereas a 20” tree can provide up to \$500 per year. The goal is to increase benefits even more, where the tree population pays for itself and even yields “profits”!

The replacement value of trees was also calculated. Currently, the standing value of all trees in the Village of McFarland population is \$3,570,000. This value is calculated using the industry standard reference, the *9th Edition Guide to Tree and Landscape Appraisal*, which is published by the Board of Tree and Landscape Appraisers.

The i-Tree Eco data looks at the value of the trees in the absence of the effect of homes or businesses, and looks at trees more from an ecological perspective, mostly what the tree’s value is in sequestering and storing Carbon. These numbers are based on peer reviewed science in both Arboriculture as well as Climatology and other disciplines.

The goal of this Urban Forestry Management Plan is to create a tree population which maximizes all of these ecological services to McFarland residents by increasing the number of trees in Village, and how long they live, while minimizing costs in order to create a healthy, well maintained, and vibrant tree population. Below are several examples of Ecological Services provided by trees:

Energy Savings: During the summer when temperatures are warm, trees create shade, and temperatures are cooler in the shade. Cooler temperatures cause air conditioners to have to work less, which reduces the amount of energy a household uses. During the winter when temperatures are cold, winter winds cool your home quickly. Trees act as windbreaks, causing heating systems to use less natural gas, saving energy and money.

Carbon Dioxide (CO₂): The amount of CO₂ which is put into the atmosphere each year has a direct correlation with global climate change. That change causes more severe storms, greater drought conditions, and many other costly outcomes. Reducing CO₂ from our atmosphere lessens these effects. Trees uptake CO₂ and act as a carbon sink, putting carbon into long term storage in its woody tissues, removing it from our atmosphere, creating a net benefit to society, and saving money.

Air Quality: Industrial processes and vehicle emissions put pollutants into our air. These pollutants can cause or worsen health conditions such as heart disease, asthma, and lung disease. In addition, these pollutants can mix with water in the atmosphere and create nitric and sulfuric acid, causing acid rain, which can destroy fisheries and contaminate water supplies. Trees absorb these compounds with their leaves and other tissues, and prevent them from remaining in the atmosphere. Reductions in these pollutants results in overall better health, reducing the cost of healthcare to society, and saving communities money.

Storm water: The cost of delivering fresh water to homes, as well as removing and treating wastewater and storm water is considerable. One of the greatest costs comes when these systems are overwhelmed, such as during flooding, which can cause millions of dollars of damage to homes and vehicles, or when these systems need to be replaced. Fortunately, trees take water from the soil and put it back into the atmosphere through the process of transpiration. Therefore, the more trees an organization has, the less flooding is an issue, and the less strain is put on storm water infrastructure, resulting in fewer repairs and replacements. In addition, tree canopy slows rainfall's effects on flooding by "intercepting" it with leaves and branches, delaying how quickly rainfall can become floodwater. All of this adds up to savings for an organization.

Aesthetic/Economic: Up to 15% of the value of a property can be attributed to its trees and other landscaping. Tree lined streets are much more appealing to homebuyers than streets devoid of trees, resulting in increased home sales, and therefore increased tax revenue, or increased tax revenue with which to fund initiatives relating to trees, attract new businesses, etc.

Urban Tree Canopy Assessment

Based on data available from the US Forest Service and Wisconsin Department of Natural Resources, the total Urban Tree Canopy of McFarland can be determined. This is expressed as the percent of the Village covered by tree canopy from an aerial view. This assessment included 5 total land cover types, including trees, grass and shrub, bare soil, water, buildings, roads/railroads, and other paved surfaces. The result of this tree canopy assessment was that McFarland contains 27.72% total tree canopy. The map of the canopy assessment appears on page 34.

The tree inventory itself was only conducted on publicly owned land such as terraces, boulevards, parks etc. Detailed information on each tree is not included in this assessment, only total coverage. Aerial images were used to estimate how much tree and other land cover types were in the Village using a software which is similar to Google Earth or other aerial imagery viewers.

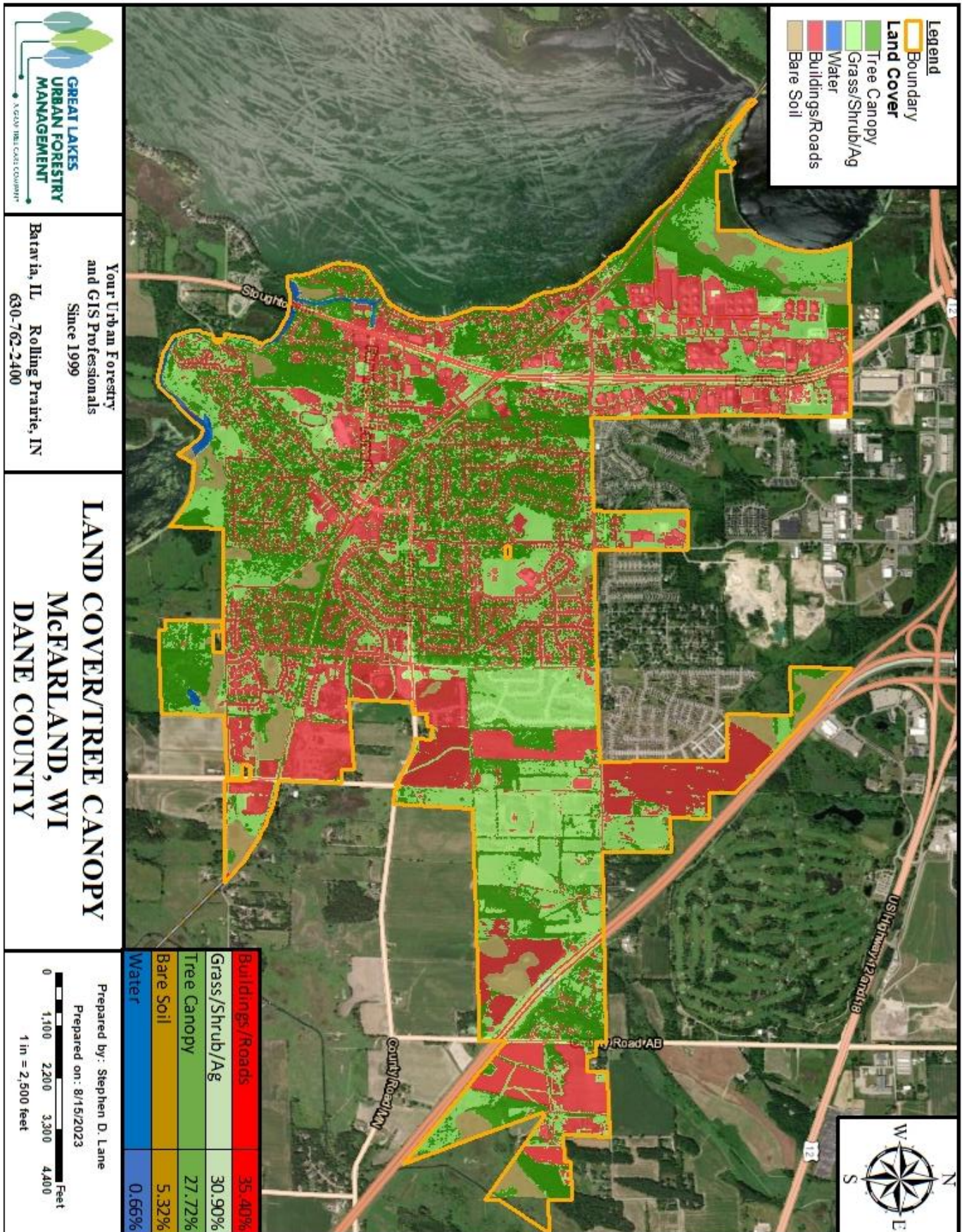
The goal is to increase the total tree canopy in McFarland to 30% by 2044. This goal has been estimated by analyzing data from many different urban tree populations in the Chicago and Northwest Indiana regions, and is based on preliminary data from the Chicago Region Trees Initiative's (CRTI) Forest Composition Workgroup.

We believe this is an attainable goal over this time period. McFarland as a whole has an overall moderate amount of tree canopy, and it is fairly average compared to other similar suburban communities of Chicagoland. The goal set is a modest, but reasonable, increase, which will still yield beneficial results.

This will be accomplished through increasing the number of trees on the Village's terraces as well as other Village-owned properties. It will also be accomplished by maintaining the existing tree population in a proactive fashion, by enhancing the Urban Forestry program in McFarland. This will ensure that existing trees will live longer as they are given appropriate care.

Tree planting and maintenance will also be encouraged on private property, by incentivizing residents and business owners to plant trees through public-private partnerships. Outreach and education will also be provided to residents through events such as Arbor Day and Earth Day celebrations. This goal will be monitored by using aerial imagery analysis like the analysis presented below. Every 10 years, the imagery will be assessed, and a new canopy cover percentage will be calculated for McFarland.

Buildings/Roads	35.40%
Grass/Shrub/Ag	30.90%
Tree Canopy	27.72%
Bare Soil	5.32%
Water	0.66%



The Future of the Urban Forest

In this section, a vision of what the tree population of McFarland could become by 2044 was created and compared with the current population. Using the existing data, and the diversity vision, we will then define exactly how McFarland can move from where it is now to where it could be.

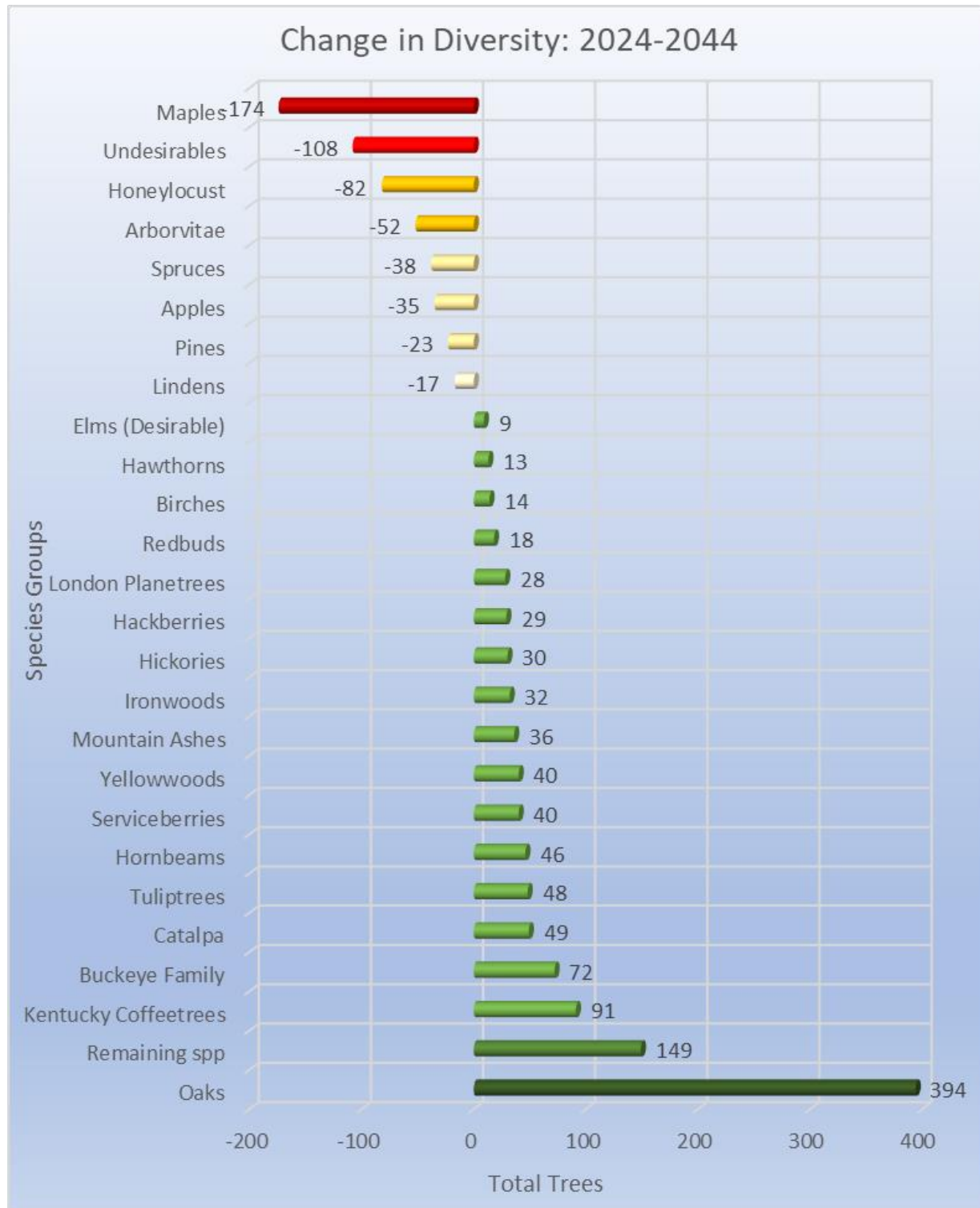
Change in Species Composition 2024 – 2044

The full calculations for this change in diversity were performed by hand, not using automated software. Local knowledge of the trees, their conditions, what is growing well and what isn't were all used and yielded this very customized forest composition change list. These goals are meant as general guideposts, and not absolutes. Be aware that this Plan, and the species composition goals, are meant to be adaptively managed over time, and as new information becomes available.

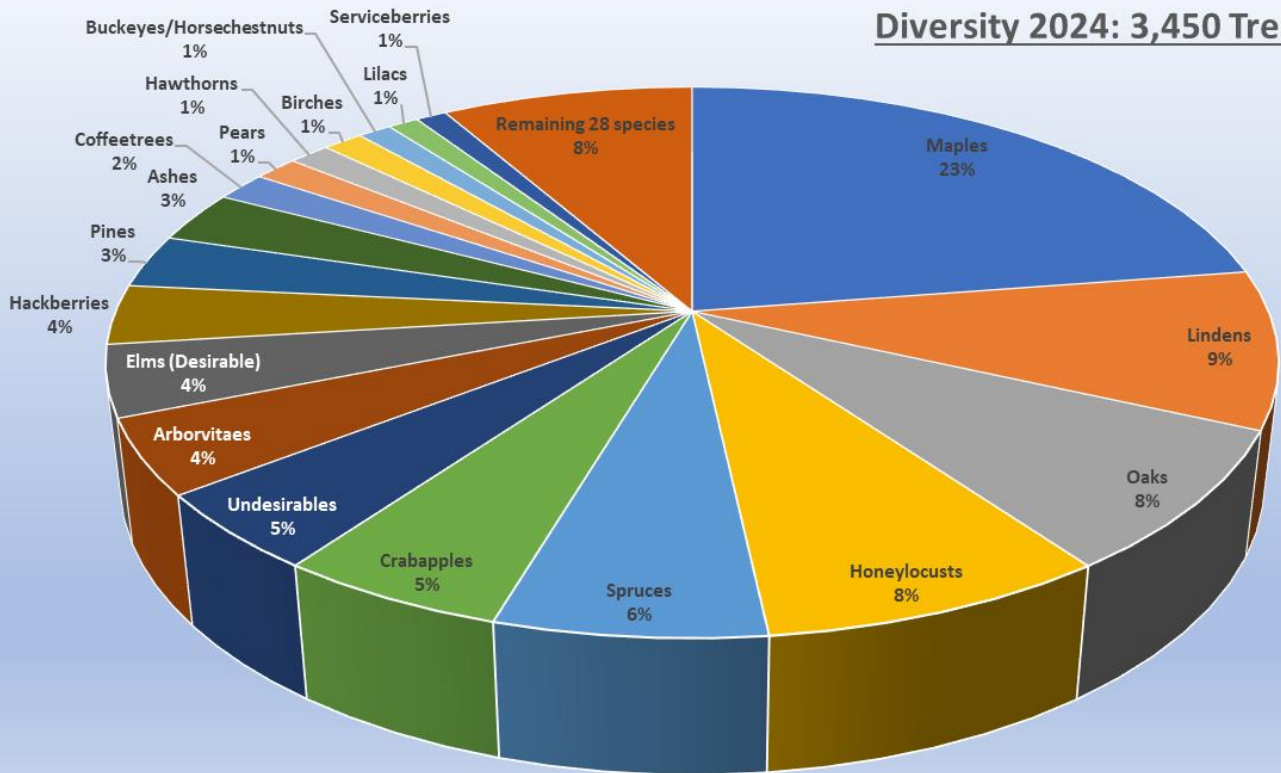
SPECIES	COUNT 2024	COUNT 2044	SPECIES	COUNT 2024	COUNT 2044	SPECIES	COUNT 2024	COUNT 2044
HONEYLOCUST	282	200	BIRCH-WHITE	21	30	MOUNTAIN ASH-AMERICAN	4	40
MAPLE-FREEMAN	254	200	BOXELDER	19	0	OAK-HILLS	4	40
LINDEN-LITTLELEAF	217	175	HAZELNUT-TREE	18	20	ASH-SPP	3	0
MAPLE-NORWAY	216	100	BLACK LOCUST	16	25	BUCKTHORN-ALDER	3	0
CRABAPPLE	185	150	EASTERN REDCEDAR	15	25	DOGWOOD-SPP	3	15
ARBOR VITAE	152	100	MAPLE-SPP	14	5	MAGNOLIA-SPP	3	3
ELM-HYBRID	133	150	BIRCH	13	15	OAK-SCHUETTS	3	30
HACKBERRY	121	150	MULBERRY-SPP	13	0	POPLAR-WHITE	3	0
SPRUCE-BLUE	113	90	UNKNOWN	13	0	LINDEN-SILVER	2	2
MAPLE-RED	109	100	BIRCH-RIVER	12	30	PINE-SCOTCH	2	10
OAK-RED	99	125	CHERRY-BLACK	12	10	TULIPTREE	2	50
LINDEN-AMERICAN	89	125	LONDON PLANETREE	12	40	ASPEN-SPP	1	1
PINE-WHITE	77	50	OAK-SPP	12	0	CATALPA	1	50
MAPLE-SILVER	76	25	CHERRY-SPP	11	0	CHESTNUT-CHINESE	1	10
OAK-SWAMP WHITE	75	125	LINDEN-SPP	11	0	HICKORY-BITTERNUT	1	10
SPRUCE-WHITE	73	50	PINE-AUSTRIAN	11	5	TAMARACK	1	20
MAPLE-SUGAR	67	100	PINE-RED	11	20	MAPLE-JAPANESE	1	0
KENTUCKY COFFEETREE	59	150	WILLOW-SPP	11	0	SMOKETREE-AMERICAN	1	30
ASH-GREEN	58	0	CHERRY-AMUR	9	10	SWEETGUM	1	30
ELM-SIBERIAN	51	10	HICKORY-SHAGBARK	9	20	ASPEN-QUAKING	0	20
OAK-BURR	46	75	HORSECHESTNUT	9	30	BEECH-AMERICAN	0	10
ASH-WHITE	44	15	MAPLE-MIYABEI	9	50	BLACKGUM	0	40
PEAR-CALLERY	44	0	IRONWOOD	8	40	BUCKEYE-YELLOW	0	20
HAWTHORN-SPP	42	0	PINE-SPP	7	0	BUCKEYE-RED	0	20
OAK-WHITE	36	75	SPRUCE-BLACK HILLS	7	20	HAWTHORN-COCKSPUR	0	20
LILAC-JAPANESE	35	35	ELM-AMERICAN	6	3	HICKORY-SHELLBARK	0	10
SERVICEBERRY	35	75	OAK-ENGLISH	6	40	MAGNOLIA-CUCUMBER	0	20
HORNBEAM-AMERICAN	34	80	PEAR-SPP	6	15	MAPLE-STRIPED	0	40
MAPLE-AMUR	33	20	ELM-RED	5	0	OAK-CHINQUAPIN	0	50
AMERICAN REDBUD	32	50	HAWTHORN-WASHINGTON	5	15	OAK-SHINGLE	0	50
GINKGO	31	30	OAK-PIN	5	40	OAK-CRIMSON SPIRE	0	30
BUCKEYE-OHIO	29	40	YEW-SPP	5	5	PERSIMMON	0	20
COTTONWOOD	29	29	DOUGLAS FIR	4	15	WITCH HAZEL-EASTERN	0	10
JUNIPER	29	30	FIR-BALSAM	4	15	WITCH HAZEL-OZARK	0	10
WALNUT-BLACK	29	10	KATSURATREE	4	5	ZELKOVA	0	30
SPRUCE-NORWAY	25	20				YELLOWWOOD	0	40

	Plant in Abundance
	Plant in Limited Quantities
	Maintain Existing Population
	Reduce Population Size

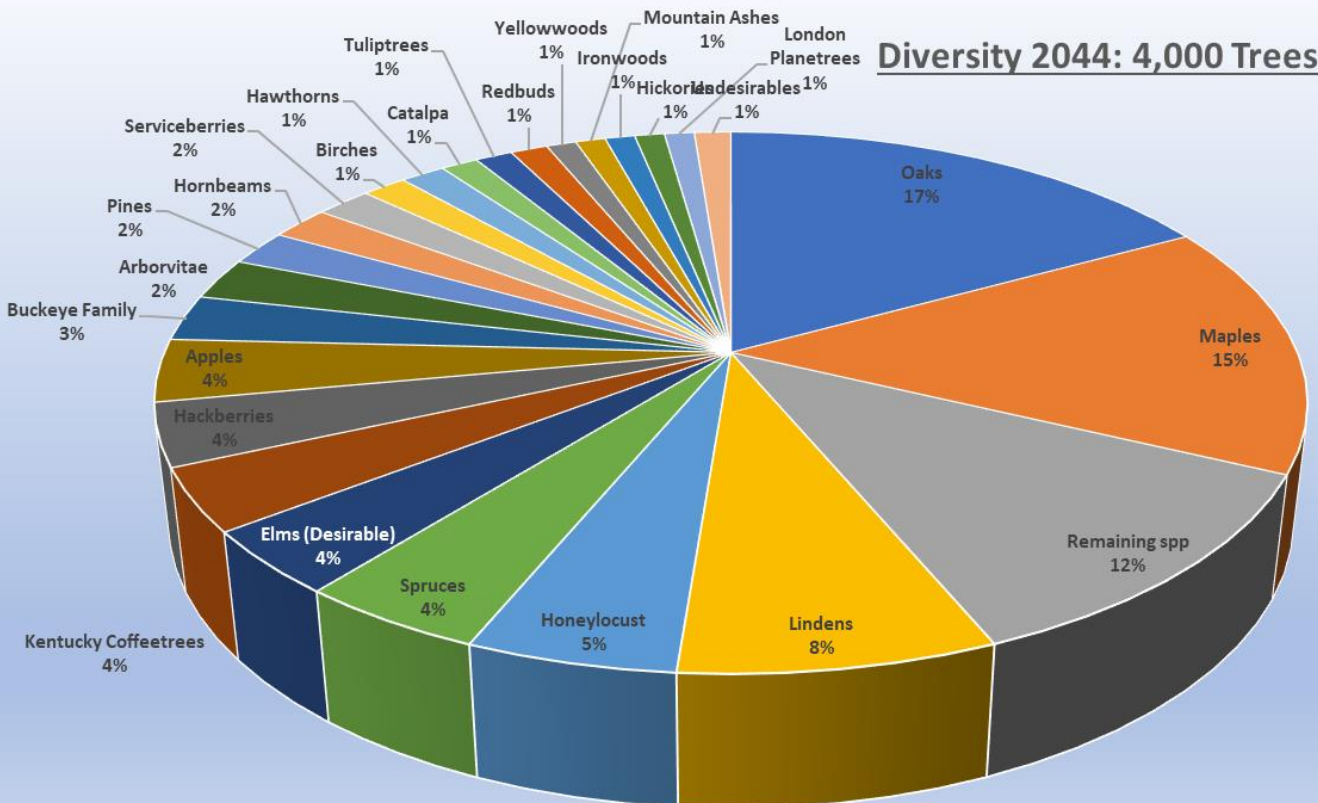
Change in Species Composition 2024 - 2044



Diversity 2024: 3,450 Trees



Diversity 2044: 4,000 Trees



As can be seen from the above several pages of charts showing the change in species composition over the next 20 years, there will broadly be a move away from the overrepresented or low quality species discussed above, and a variety of different species, those which are underrepresented or not present in the tree population, will be planted. This will lead to an overall increase from 3,452 to 4,000 trees total on the Village's ROWs, as well as a change from the current total of 91 species to a total of 95 species. This will result in an even more robust and resilient Urban Forest which is resistant to pest and pathogen outbreaks.

The Benefits of Larger, Healthier Trees

Larger trees provide greater benefits to the community: They create more shade to offset cooling costs, absorb more storm water, create greater buffers against cool winter winds for heating costs, and absorb and sequester more carbon than smaller trees do. For the 2044 vision of the tree population, a variety of methods were used to arrive at a reasonable age-class distribution. We used the current population structure, and anticipated high rates of survival based on new planting practices which would involve a "right tree/right site" approach, as well as increased survivorship of existing trees due to better management and care practices. Predicted growth, survivorship, and eventual tree losses are based on current species composition and future plantings and removals. This allowed the creation of a vision of what the tree population, including species and size, will look like 20 years from now.



It can be seen from the above chart that the existing tree population (grey bars) shows a predominantly younger tree population with gradual decreases in numbers of trees through the 13-18" category and a steep drop in numbers in the larger age class categories. The projected age class chart shows a steady increase in the larger age class category over the course of this Plan, and also projects more trees surviving into the older age classes, where they will provide the greatest benefits in terms of ecological services to the community. The table to the right shows this data in a tabular format.

	2024	2034	2044
0-6"	1519	1000	1000
7-12"	985	1300	900
13-18"	547	800	1050
19-24"	236	400	600
25-30"	90	115	250
31-36"	43	50	130
37-42"	16	25	50
>42"	16	10	20

This was based on the fact that increased levels of care for existing trees would enable them to survive longer. The graph and table show a general expectation of how the changes in tree diameters might change over the next 20 years based on the methods to be applied in this Urban Forestry Management Plan. The numbers themselves were projected by hand, based on our prior experience, and the methods detailed below. If these projections hold, McFarland could see a 20-30% increase in overall annual benefits as trees age into larger age classes.

For projections of future age classes of trees, a ½" per year growth rate was roughly estimated by assuming that it would take an average tree 10 years to go from one age class to the next (6" = appx 10 years growth). Also used were the number of trees to be planted and removed annually, as calculated below in the Tree Planting and Tree Removal sections. These numbers were arrived at based on all the above, as well as the best professional opinion of the Forestry Consultant. As time goes by, these projections will likely change. These are rough estimates for the purposes of this Plan.

The overall increase in size of the tree population and diameters of the individual trees will yield a much greater dollar figure when it comes to the ecological services provided, and provide residents with a greater sense of being in an arboretum-like setting when they are enjoying the urban forest.



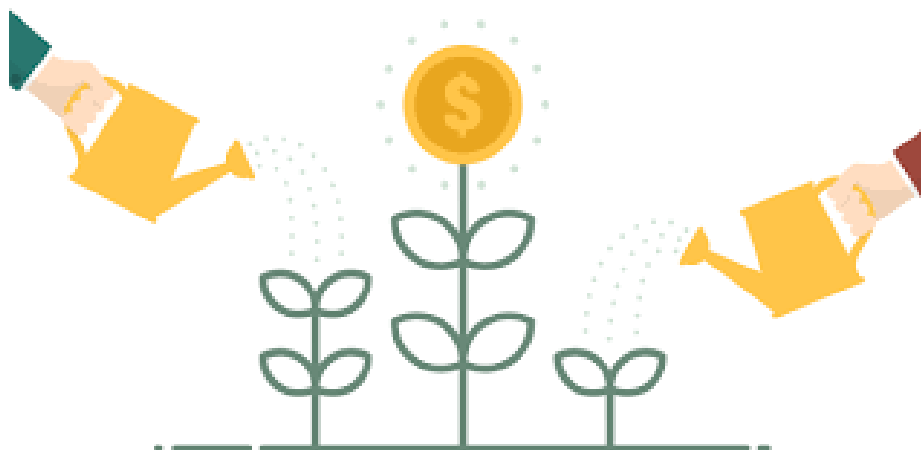
Return on Investment

Return On Investment (ROI) for an individual tree is strongly favorable over the life of a tree in terms of investment in planting, care, and removal versus the ecological benefits the tree provides. As we strive to justify the expenditures on trees and tree care, it is important that organizations and their staff are aware of this.

Below, we have provided an ROI calculation sheet. This sheet breaks the lifetime of an average tree down into three phases, based on the anticipated costs of pruning in the budgets sections below. These phases are the young (3-12" DBH), mature (13-24" DBH), and full grown (25-36") ranges shown below.

Data was taken from the i-Tree algorithm, and applied towards the average benefits provided by a typical tree at each of these life stages, and multiplies it out over the 20 year period each phase accounts for. We also looked at costs for planting, watering, routine maintenance, emergency maintenance, and eventual removal of that tree over 60 years. The sample calculations are pictured below.

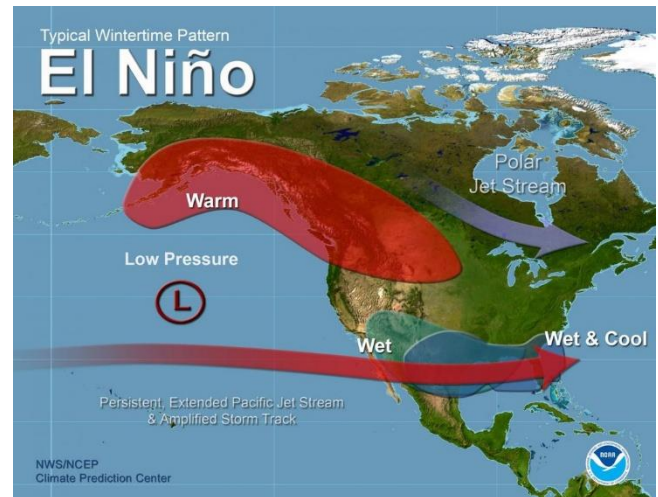
Initial Purchase and Installation	\$575	\$575
Pruning 15x Over 60 yr Lifetime	15 @ \$75/prune	\$1,125
Emergency Maintenance	1 @ \$250	\$250
Eventual Cost of Removal	\$850	\$850
SUBTOTAL		\$2,800
Annual Benefits	\$30.78/yr @ 60 years	\$1,847
Replacement Value	\$1,610	\$1,160
Carbon Storage	\$92	\$92
SUBTOTAL		\$3,099
Return on Investment		10.68%



Trees and Climate Change

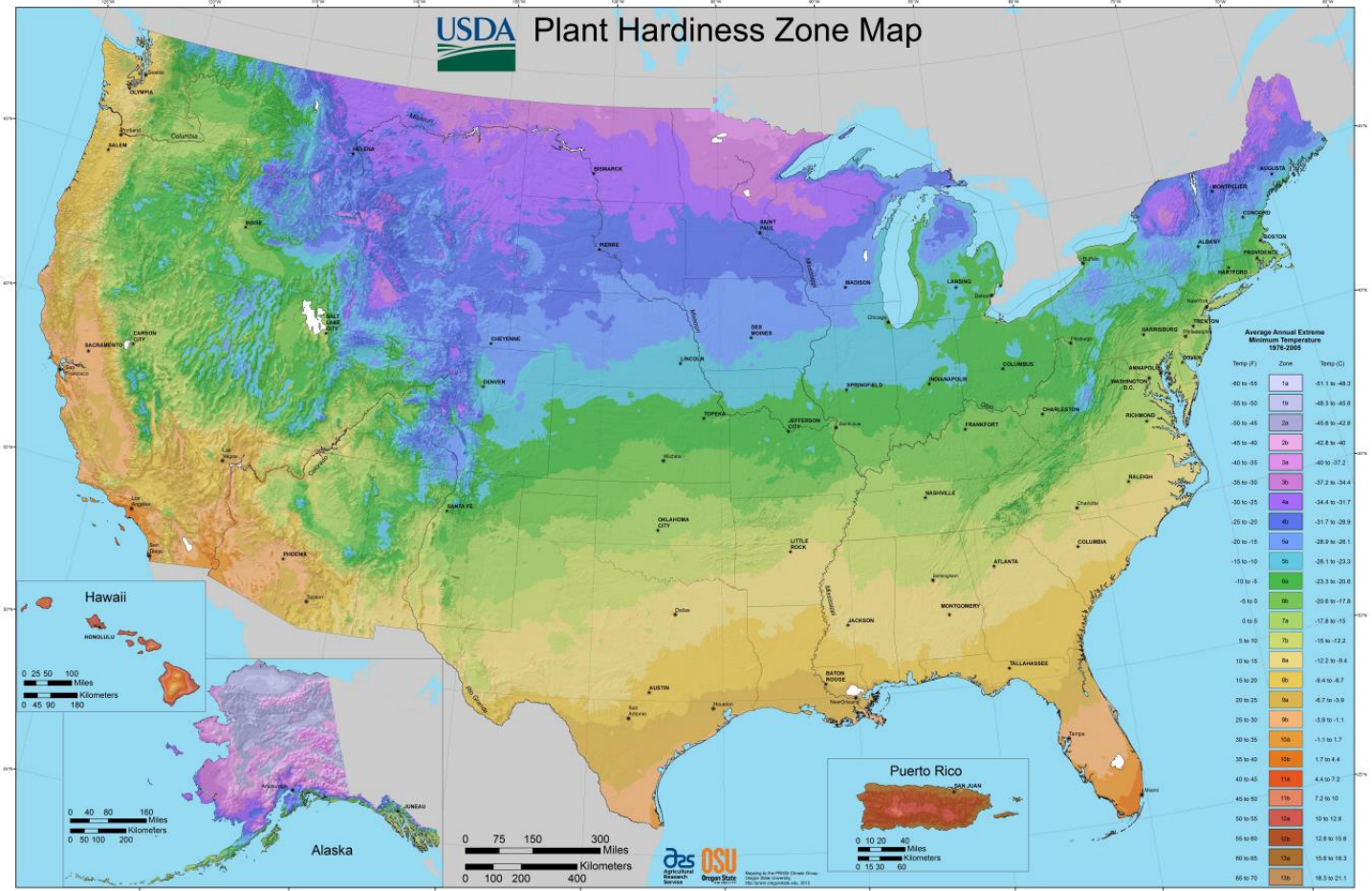
According to the United States Environmental Protection Agency, National Oceanic and Atmospheric Administration, Metropolitan Mayors Caucus, and a variety of other national and international reputable scientific and humanities-oriented sources, climate change will cause significant suffering over the coming hundreds to thousands of years. Increases in carbon dioxide, methane, and other greenhouse gasses in the atmosphere trap heat from the sun and will create a generally warming climate. Though it should be said that “climate change” means more than just warming trends.

Though the general trend will be towards a warmer climate, the transition process will be very chaotic, and will be one of more “extremes”: hotter summers, colder winters, worse storm seasons, and the like will be the trend for quite some time before the full effects of a warming trend are realized. This is due to the immense complexity of the planet’s climate, and all of the “teleconnections” which exist. Teleconnections are effects on one part of the planet from a corresponding change in another part. The most “famous” of these is the “El Nino” phenomenon, where changing ocean temperatures near the Galapagos islands strongly influences the amount of rainfall or drought in all North America. But there are literally dozens of these known teleconnections across the globe, and changing climate impacts all of them.



All of the organizations involved with changing climate and the carbon dioxide inputs that drive it have the same message: planting more trees, particularly in areas predisposed to changes in climate, will aid in pulling CO₂ from the atmosphere and reducing the impact of climate change. So the number of trees we are planting is important, both on public as well as private land. But the types of trees we are planting matters as well. The US Forest Service is already starting programs of planting climate sensitive tree species outside of their historic natural ranges in anticipation of an overall warmer climate (<https://www.fs.usda.gov/ccrc/story/helping-forests-keep-pace-climate-change>).

When it comes to tree planting in anticipation of climate change for urban environments in our area, we need to be careful, however. While the general trend is towards warming, the “extremes” side of this makes for a difficult decision. While summers may be warmer and support trees which are adapted to warmer conditions overall, our winters will still reach down into the -30° F and even colder range for extended periods. And cold weather is the limiting factor for what can be planted in an area. See the USDA Hardiness Zone map on the following page for a more detailed explanation. It shows the **coldest** temperatures which can be expected in an area, not the **warmest** ones. So before we start planting trees in south-central Wisconsin that are more native to more southern states, we must understand that we need to plan for the coldest temperature, not the warmest per se.



All of that said, we should start planting trees now at least on a somewhat experimental basis that will be more tolerant of a warmer climate. Below are some suggestions of trees which the Village could plant which are just outside of our climate region, and may be successful over the coming 30 years or so, depending how effective we are at combatting climate change using other methods:

Southern Catalpa (<i>Catalpa bignonioides</i>)	Southern Hackberry (<i>Celtis laevigata</i>)	Swamp Chestnut Oak (<i>Quercus michauxii</i>)	Cherrybark Oak (<i>Quercus pagoda</i>)
Water Hickory (<i>Carya aquatica</i>)	Pecan Hickory (<i>Carya illinoensis</i>)	Sourwood (<i>Oxydendrum arborea</i>)	Mimosa Tree (<i>Albizia julibrissin</i>)
Carolina Silverbell (<i>Halesia Carolina</i>)	Crapemyrtle spp (<i>Lagerstroemia spp</i>)	Flowering Dogwood (<i>Cornus florida</i>)	Sweetbay Magnolia (<i>Magnolia virginiana</i>)
Southern Magnolia (<i>Magnolia grandiflora</i>)	American Holly (<i>Ilex opaca</i>)	Oklahoma Redbud (<i>Cercis reniformis</i>)	Ornamental Cherries (<i>Prunus spp</i>)

All of these species grow in more southern climates and some are certainly more risky than others. Crape Myrtle for instance is barely tolerant of the climate in southern Illinois, while Southern Hackberry can already be planted in more northern climates with reliable success. But nonetheless they are good species to keep on our radar for experimental plantings.

Positive Tree Benefits for the Environment

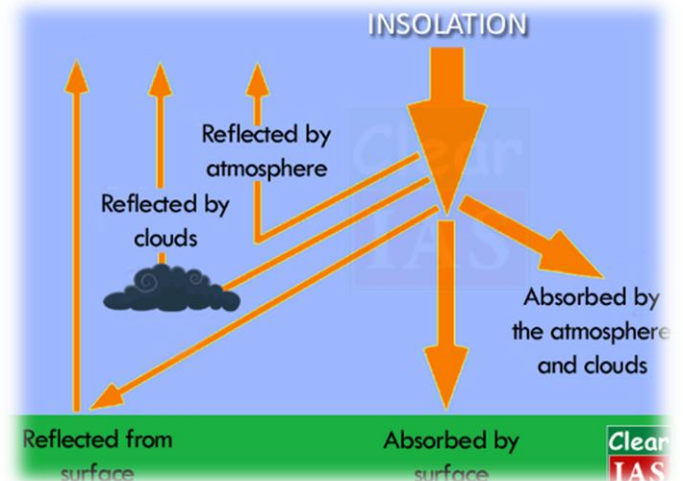
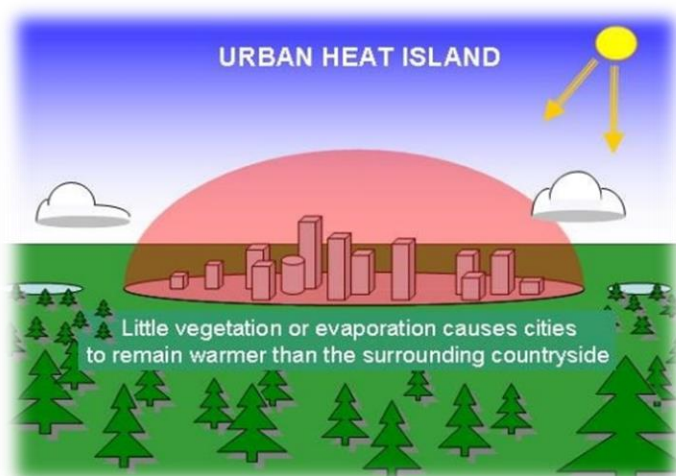
When it comes to trees and climate change, let's move on to some of the immensely positive benefits that trees provide. Here, we are focusing on 2 topics, those being the climate change and the urban heat island effect, as well as flooding prevention and stormwater benefits, since this was one of the primary focuses of this grant, and also some of the more important benefits trees provide.

Climate Change / Urban Heat Island Mitigation

First, let's define a few terms: **Climate Change** is change in the climate, both human-induced as well as naturally occurring, that disrupts what we perceive to be the normal operation of climate. It should be noted here that climate is different than weather. Weather is the day-to-day meteorology such as rain on Tuesday and sunny on Wednesday. Climate is what the long-term averages are for an area, such as average June temperatures in the mid 70's with 2-3 inches of rain. The term **Global Warming** has been misapplied many times when speaking about climate change. Yes, increases in carbon dioxide emissions lead in general to a warmer climate, which comes with very specific problems. But the climate change we are seeing currently is one of extremes: higher highs, lower lows, more severe storms, etc. The important part is that during this process of change, year to year weather becomes more unpredictable as the climate changes to generally a warmer one.

The **Urban Heat Island Effect** is a separate but related issue. Trees and other green plants contain chlorophyll, a naturally occurring compound which is custom built by nature for absorbing the sun's energy and converting it to sugars by photosynthesis. And what an energy the sun has. The amount of energy from the sun hitting the Earth at any given time is approximately 1,350 Watts per square meter, which is a LOT of energy to absorb. When an area has fewer plants, and a lot of asphalt and other dark surfaces, this produces a lot of heat.

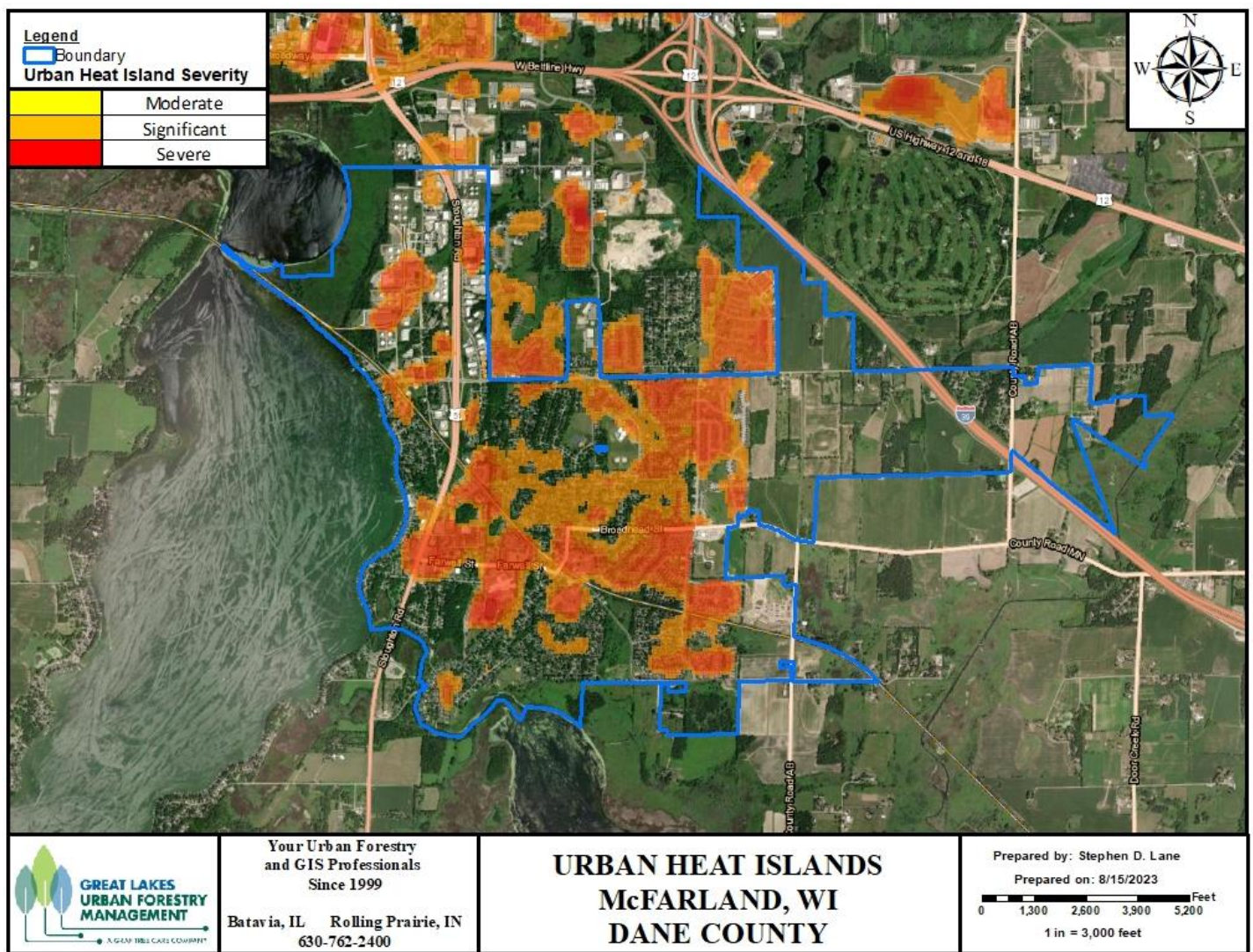
Think about it, if you wear a dark shirt when the sun is shining, you feel hotter than if you were wearing a white shirt. That is because different colors absorb things differently, and light colors reflect light while dark colors absorb it, and absorbing more light leads to more heat. So asphalt and other urban surfaces create local heating above normal atmospheric heating.



VILLAGE OF MCFARLAND URBAN FORESTRY MANAGEMENT PLAN

All of this is of course just scratching the surface of a set of very complex issues. But essentially, when we have a generally warming climate, combined with this urban heat island effect, it can dramatically raise temperatures in urban areas, leading to a variety of issues. This is where trees become a major factor in making things better. Not only do they absorb carbon dioxide from the atmosphere, which helps to reduce the effects of climate change, but especially in urban areas, if we can plant trees over areas of asphalt and dark surfaces, this will keep the sun from hitting those surfaces, and instead direct the sun's energy to photosynthesis in the tree's leaves. The combined effects of these things will lead to reductions in warming.

For the Village of McFarland, below is a map of the urban heat island areas. The darker red or orange areas represent greater heat island effects, but do not represent specific "degree based" deviations, and areas of no shading mean no deviation from long term averages:



As can be seen from this map, some of the greatest heat island effects are along the transportation corridors, as well as the industrial areas where greenspace is lower overall. These are the areas where tree planting will create the greatest cooling effects.

Planting trees not just on Village owned property, but also encouraging residents and business owners to plant trees on their own property is a long-term goal of this management plan, and one of the big reasons is to offset the effects of climate change and the urban heat island effect. It should also be remembered that the climate is global, and there are no walls that separate cities, states, countries, etc. So, when one area warms, it has effects on the whole climate system. Conversely, when an area has more trees and vegetation planted, those benefits do not just stay confined to that area but benefit the whole planet. Trees are truly an example of acting locally and impacting globally.

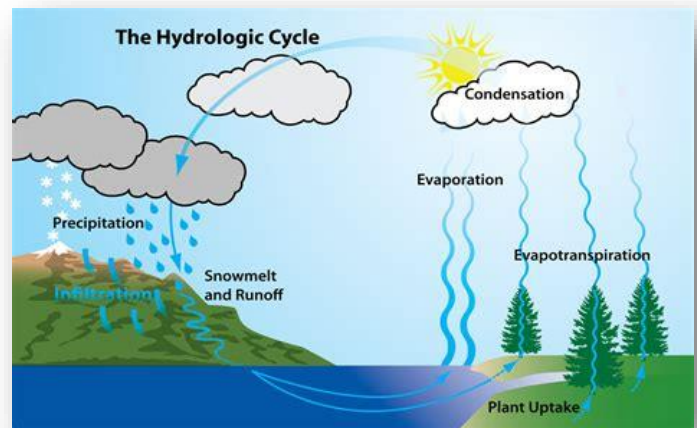
Reduction in Flooding/ Storm Effects

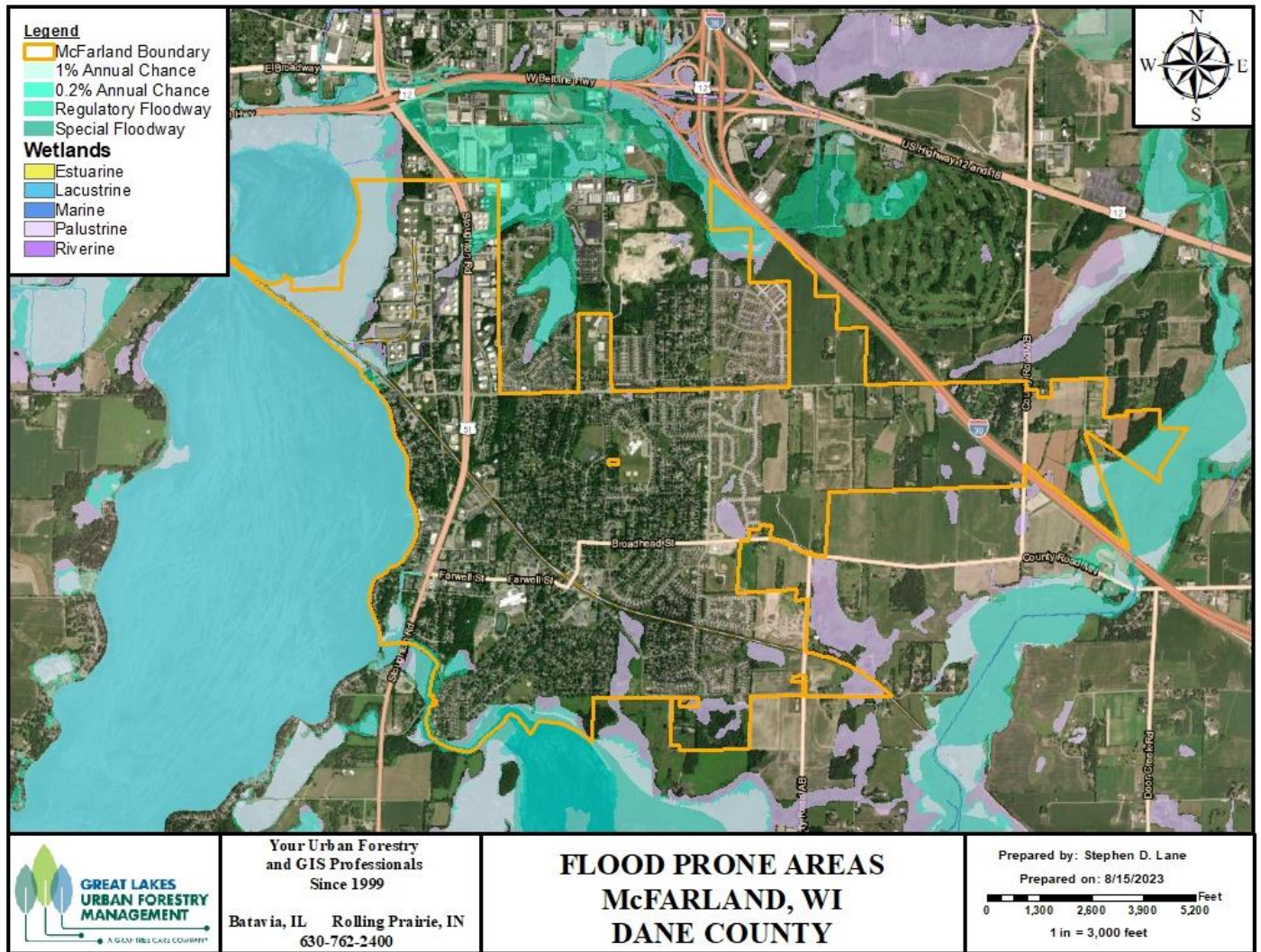
Once again, let's define a few terms here. First, the Earth has what is called a **Hydrologic Cycle**, which is pictured in a simple form to the right. All of the water that has ever existed on Earth was here when the Earth first formed around 5 billion years ago and has simply been recycled ever since then. Water stored in the oceans and lakes evaporates into the atmosphere where it forms clouds, and then rains down, either into the ocean to start again, or over land, where things get more complicated. When rain falls over land, several different things can happen to it that determine what happens next in the cycle.

If the rain falls onto the soil surface, some of that water **percolates** into the soil where it moves as groundwater (water under the soil surface). However, when there is so much rain that the soil becomes saturated like a wet sponge that cannot hold any more water, then any additional rainfall becomes **runoff**, which "runs off" over the top of the land surface. This is what we traditionally call **floodwater**.

When an area floods, the consequences can be enormous in terms of economic impact and the impact to humans and wildlife. And there is another side of this story as well. Most communities have what is called **stormwater infrastructure** to handle this water. Storm drains are things we all see regularly which are meant to handle this water. But those systems are expensive to maintain, and the more water they handle, the more often they need repair or replacing. So what can we do to reduce this floodwater? Plant more trees.

Trees do something called **transpiration**, which effectively means that their roots soak up excess water in the soil, and they release it through their leaves back to the atmosphere. So the more trees we plant, the greater the reduction in flooding, and the less our stormwater infrastructure is taxed, and the less economic and social suffering there has to be as a result of flooding. On the following page is a map showing flood prone areas in McFarland:





What is important to note from the above map is not what the exact colors mean, that these colors all show either known wetlands, water bodies, or flood prone areas near McFarland. Tree planting in proximity to any of these locations will help to transpire extra water out of the soil and prevent occasional excess stormwater runoff from occurring. In particular, there are trees which are naturally adapted to growing in wetter soils, and these trees can really move a lot of water out of the ground, especially as they age. A mature tree can move as much as 6,500 gallons of water per year out of the system. Multiply that by thousands of trees, and you can see how quickly this adds up:

(<https://www.epa.gov/sites/default/files/2015-11/documents/stormwater2streettrees.pdf>)

The important thing to note is that tree planting efforts should take the proximity to these flood prone areas into account, as well as the areas which appear to be drier and more drought prone where there is no shading on the map. And just like climate change is not confined to a single area, neither is stormwater and flooding. Whatever floodwater is not absorbed in one area moves downstream to another area. So by reducing runoff in McFarland, it will help all downstream communities, and the more communities taking take action, the more flooding will be reduced.

OPERATIONAL ACTIVITIES

The following activities are all in support of operations goals, starting with the personnel section followed by sections detailing operational goals and narrative for each activity.

Personnel

In order to streamline Urban Forestry Operations, tasks will be assigned to various staff and contractors/consultants. Below is an overview of personnel involved in forestry related tasks in the Village of McFarland.

Director of Public Works

The Village Urban Forestry Program is within the scope of the Department of Public Works. The Director of Public Works, or their designee, exercise authority related to decision-making concerning pruning, removal, and planting of Village Trees.

Streets/Water Superintendent

This position assists with storm response management situations.

Parks Superintendent

The Parks Superintendent oversees the management of the Village's urban forest. This position is appointed as the Village Forester per the essential job functions within the position description of the Parks Superintendent.

Village Forester

The Village Forester is responsible for performing duties in accordance with Section 59-21, or as amended, within the Village Code of Ordinances including tree trimming, emerald ash borer response plan, and other duties as outlined in the code. The Village Forester will exercise authority and perform responsibilities related to forest health, storm response, and hazardous tree removal.

Parks and Public Works Crewpersons

Crewpersons perform tasks related to forest health, storm response, and hazardous tree removals, with guidance received from the Village Forester.

Tree Care Contractors

Tree Care Contractors are utilized by the Village Forester for essential tree care services that exceed the capabilities and equipment of the Village as required.

Sustainability and Natural Resources Committee

The Sustainability and Natural Resources Committee, as established by Village Ordinance, advises on maintaining a healthy and diverse urban forestry program while fulfilling the requirements as a certified Tree Village, USA. This committee is comprised of 5 citizen members and 2 Village Trustees.

Emergency Contact for Tree Related Issues

The Department of Public Works has a 24-hour on-call number 608.212.2625. This would be for non-life-threatening situations (eg: tree blocking road). 911 should be utilized for life threatening situations.

Tree Removals

The first step towards attaining McFarland's forestry goals will be to remove trees which are diseased, dying, or present a hazard. Typically, municipal inventories reveal between 3-5% of the tree population requiring some form of removal, so based on the current population of 3,452 trees and the projected 2044 population of 4,000 approximately 50 trees may require removal annually.

In order to attain the diversity goals set forth in this plan, the background rate of tree removal will be approximately 50 trees per year. From 2029 forward, reevaluation of the tree population on an annual or semiannual basis by the Village Forester or Forestry Consultant will specify which trees require removal. These numbers, detailed below, are meant to be placeholders for budget calculations and diversity standards. This does not require that 50 trees be removed each year, this is simply a projection based on the existing inventory data.

Much of McFarland's removal work is completed using in-house labor and the budget projections presented below only reflect contracted costs for trees that are either too large or too risky to remove in-house. For purposes of projection, contractor costs have been estimated using a rate of \$25/diameter inch for tree removal and stump grinding, which is a conservative estimate based on current market pricing. As is the case with all cost projections for this Plan, no cost increase is assumed for the first 5 years, and a 3% annual cost increase is assumed thereafter. This is also a conservative estimate based on the Consumer Price Index, and actual costs are likely to be lower than projected. In addition, for trees in year 6 and beyond, these are anticipated averages of tree diameters to be removed. Exact numbers of removals may be more or less.

Milestones	2024	2025	2026	2027	2028	2034-2044
Trees Removed	varying	varying	varying	varying	varying	varying
Diameter Inches	est 840"	est 880"	est 920"	est 960"	est 1,000"	est 1,040"
Notes	Removals not performed in-house	Removals not performed in-house	Removals not performed in-house	Removals not performed in-house	Removals not performed in-house	Removals not performed in-house
Removal Cost (2024)	\$21,000	\$22,000	\$23,000	\$24,000	\$25,000	\$26,000
Removal Cost (CPI)	\$21,000	\$22,000	\$23,000	\$24,000	\$25,000	\$29,900

These cost estimates were prepared for the long-term removals, based on the tree inventory data. As this is a program to be adaptively managed, these budget tables can be revisited periodically to reflect actual costs being paid.

Tree Removal Activities

Safe Removal of a Tree to an Appropriate Flush Cut

Tree removal can be dangerous, but when performed by professionals is very safe. Therefore, all tree removal activities on McFarland's public property should be done by staff and contractors knowledgeable in Arborist skills. This may be the supervision of the Village Forester, or a contractor with a Certified Arborist on staff, or other such approved personnel.

The safe removal of a tree involves the safe removal and lowering of all portions of the tree according to all relevant ANSI standards and Best Management Practices. The stump must be flush cut such that the highest portion of the cut is no greater than two inches from the highest part of the ground surface to prevent a tripping hazard on public property.

Stump Grinding

Within a reasonable amount of time following the removal, and following the Village ordinance regulating such activity, stumps and surface roots should be removed using an approved stump grinding machine, such that the stump is ground to a minimum depth of 6 inches, and no surface roots are visible. If the site is to be planted with a new tree, that depth should be increased to 12 inches below the soil surface. This will ensure that a new tree may be successfully planted, and that no re-sprouting will occur from the old stump. The depths to which the stump must be ground may be altered by the Village of McFarland depending on needs for specific circumstances or contracts. Until such time as the planting space is fully restored, the stump hole should be filled and compacted to ground level using the debris resulting from the stump removal.

Planting Site Restoration

Once the tree has been safely removed and the stump has been ground out, the open planting space must be fully restored if a tree is not scheduled to be planted in or adjacent to the old hole. Site restoration consists of removing the stump chips from the hole, filling it with a quality mineral topsoil, tamping down to match the surrounding grade, spreading grass seed over the top of the topsoil, and using straw or similar material to protect the seed. This ensures grass grows back to restore the aesthetics and function of the terrace, and prevent tripping hazards from the removal scar.

Reasons for Tree Removal

Removal of trees on public spaces is an unavoidable reality of managing large tree populations. When the trunk, branches or roots fail, a standing tree can cause personal injury or property damage, and even small dead trees can be an eyesore and reduce property values. Trees can also simply outgrow their space as well, and become just too big for the space it has to grow in. Old trees can hold great sentimental value, and many people become attached to them. However, there are times when their presence creates a public hazard or nuisance, and it is at those times that action must be taken to ensure public safety. It's also important to remember that the removal of a tree today is the promise of a new tree for tomorrow!

Removal of trees on Village of McFarland public property shall always be at the discretion of the Village Forester and/or Forestry Consultant. Trees will never be removed without a sound reason from the Village or Forestry Consultant. Residents may request a tree to be removed for reasons not covered below, and these requests will be reviewed by the Village Forester or Forestry Consultant. Removal requests may be granted and paid for under the annual forestry budget. However, trees with a greater need for removal based on public safety will always hold a higher priority. Under no circumstances will the Village of McFarland be responsible for trees which are not in the right of way.

Dead or Dying

If a tree in a public walkable space, such as a terrace, park, or village property is biologically dead or nearly dead, it will require removal. Please note, this does not apply to trees in conservancy areas, where standing dead trees are invaluable for wildlife habitat and returning nutrients back to the soil. Trees not found in conservancy areas which are standing dead, have approximately 50% dead crown or greater, or have less than approximately 40% structurally sound wood in the cross-section of the trunk shall be removed as expediently as practical. These determinations shall be at the discretion of the Village Forester or Forestry Consultant.

Diseased or Infested

Diseases are caused by viral, fungal, or bacterial pathogens. Infestations are caused by insects or other small animals. Dutch Elm Disease and Oak Wilt, for example, are fungal diseases that kill Elm and Oak trees when they are infected. Emerald Ash Borer is an insect which kills Ash trees by infesting them. The prompt removal of diseased or infested trees limits the exposure of other nearby trees. The removal of 1 tree may save dozens of others. Trees deemed to be diseased or infested by the Village Forester or Forestry Consultant shall be removed as expediently as possible in order to slow the spread of such insects and diseases.

High or Extreme Risk

“Tree Risk” is the potential of a tree or tree part to impact a nearby person or piece of property and cause property damage or personal injury. This topic is of great interest in Arboriculture today, and insurance companies are becoming increasingly involved in the process of assessing and managing the risk posed by trees. Litigation involving trees is a perennial concern for public entities. If such risk can only be safely mitigated by tree removal, as opposed to pruning or other measures, then their timely removal is critical because of potential exposure of the public or property to potential harm.

The Village Forester should assess trees that pose a potential risk and document the details of the situation prior to removal. Often, risk can be mitigated by removing a portion of the tree, or other corrective measures. If the entire tree is deemed to be at high or extreme risk of failure, however, the entire tree shall be removed as a means of reducing its residual risk to zero.

Emergency / Storm Damage Removals

A tree shall be removed if it has been severely damaged and/or compromised by lightning, wind, or other such weather event. “Storm-damaged” shall be generally defined as a tree which has lost 33% or more of its crown, has a large crack or other wound in the trunk, has a lean of greater than ten degrees from vertical, has sustained a lightning strike which damaged significant tissue, or other such issues directly related to storm events.



The Village Forester or Forestry Consultant shall determine the need for removal of a tree in these cases, although in an emergency situation such as a tree impacting a person, vehicle, home, power lines, or other such emergency, the Village may perform any actions necessary to abate public hazards so long as they are in compliance with all relevant Arboricultural standards and practices.

Damage from Construction or Vehicle Strike

The Village Forester or Forestry Consultant shall assess trees that have been impacted by a vehicle strike or piece of construction equipment. If the tree has suffered physical damage or extreme root compaction and is likely to decline and become high risk, it will be scheduled for removal in order to maintain public safety. That decision will be based on the best professional judgement of the Forestry Consultant or Village Forester.

Reasonable Resident Request

If a tree has non-terminal pest or pathogen issues, moderately poor structure or is in somewhat poor condition, a resident may request the removal of the tree. Such requests will be reviewed by the Village Forester and/or Forestry Consultant, and evaluated on a case-by-case basis. This policy does not apply to healthy, structurally sound trees that are simply unwanted. If the tree shows significant potential to decline or pose a threat in the near term, the Village may agree to the removal within the next five years. Also, note that young and/or healthy trees will generally not be considered eligible for this program. Priority will always be given to trees in danger of threatening public safety. Additionally, trees that are removed based on this policy would require a replacement tree to be planted on the ROW or terrace.

Interference with Utility or Signage

A tree shall be removed if it is interfering with the function or visibility of official traffic control devices or has impacted above or belowground utilities in a manner that cannot be mitigated by pruning or other measures. In these cases, it is likely that no new tree will be planted in these sites.

Overplanted and Underperforming

No healthy tree shall be removed for the sole reason of having been overplanted. We have established a baseline level of expected removals each year, but if those expected removals do not materialize, and this happens routinely, then we will change the goal. As a result of this UFMP, McFarland will be enhancing their use of industry best management practices for diversity in the urban forest, with the goal of building a diverse urban forest. Overplanted species listed as being in poor condition will be reviewed to assess further decline or recovery. Those trees in noticeable decline shall be removed at the discretion of the Village Forester and/or Forestry Consultant. This will be used as a preventative measure so that these trees do not continue to decline to a point where they become hazardous, and not used as a reason to remove an otherwise healthy tree.

Basic Village Tree Removal Requirements and Standards

All of the following requirements and standards shall be met during tree removal activities as matter of local policy. For a more detailed view of the specific ANSI and ISA standards, please see the Appendices.

Village of McFarland – Internal Policies

1. All personnel directly involved with process of chainsaw operation, climbing, bucket truck operation, and rigging limbs shall be provided with sufficient training and experience to perform such duties while employed by the Village of McFarland, as either Public Works and Forestry staff, or performing work as a contractor employed by the Village.
2. Only qualified utility arborists may perform tree removal operations within ten feet of an electric utility line. Village of McFarland employees or contractors may complete the process of trunk removal and stump grinding only if the remaining portion of the tree is greater than ten feet from a transmission line.
3. The Village of McFarland shall not perform or assist, programmatically or financially, with the removal of trees on private property.

Tree Planting

Whereas tree removal is necessary to promote public safety, planting of new trees must happen in order to increase our diversity and canopy cover. At present, the Village of McFarland has an estimated 750 open planting spaces on its terraces. As a means of attaining the goals of increasing canopy cover to 30% and increasing overall diversity, this plan calls for the planting of about 1,800 trees over the coming 20 years. These will be planted to both replace trees that require removal as well as in the open planting space in Village parks and on Village ROWs. This plan has a direct goal of planting trees where they have the best chances to establish and thrive based on their specific sites and species requirements.

For the projections shown below, the program began with being able to replace trees called out for removal and also to begin planting in open spaces on the Village's terraces. A goal of this plan is to set a plateau of approximately 100 new plantings per year. This plan anticipates plantings to outpace removals by approximately 2 to 1.

For the costs of planting, \$500 per tree (installed) has been used. This estimate is based on retail costs, and the Village may be able to perform planting at a more favorable rate using containerized or bare root stock.

Milestones	2024	2025	2026	2027	2028	2034-2044
Trees Planted	50	60	70	80	90	100/year avg
Planting Cost (2024)	\$25,000	\$30,000	\$35,000	\$40,000	\$45,000	\$50,000
Planting Cost (CPI)	\$25,000	\$30,000	\$35,000	\$40,000	\$45,000	\$57,500

The Importance of Planning Your Tree Planting

Right Tree in the Right Site

Urban Forestry has an unfortunate history of not planning carefully for tree planting. Whatever was readily available, inexpensive, urban tolerant, and grew fast was seen as desirable, and often planning of tree plantings was left to developers or nurseries and plantsmen. With our history of invasive insects and diseases in the Midwest region, and knowing these will only get worse in the future, it is more crucial than ever that we have a process to plan our tree plantings.

This process should involve assessing each site to be planted in much the same way we would assess a tree, except that in this case, we look for factors such as available above and below ground growing space, how much light the tree receives, amount of soil moisture present, and possibly other factors such as soil pH and texture. Once this information is collected, planting sites can be matched with trees which are well suited to those sites. Matching the right tree to the right site like this will result in trees which establish faster, grow more vigorously, live longer, and provide far greater benefits. Even a simpler version of this process is better than nothing. When you have your species list for each site assembled, it makes bidding nurseries and plantsmen much easier since you already have a plan.

Playing an active role in your tree planting planning also allows for meeting diversity standards such as the taxonomic, spatial, and age class diversity principles outlined above and attempts to get the tree population into compliance with the “20-10-5 Rule”. With approximately 750 planting sites to be assessed, tree planting planning can be phased off each year as the planting budget takes shape and diversity is evaluated. Being targeted about species selection also allows the use of species which are slightly more difficult to find appropriate sites for. These species that are considered “less urban tolerant” can still be planted when the appropriate site is found! We anticipate that over the timeline of this plan, that nearly all of these spaces will be planted.

The success of a tree depends on where and how it is planted. The Village Forester or Urban Forestry Consultant should assess planting sites before trees are purchased and installed each year, to ensure the correct tree is being planted for the correct site. Each tree planted represents a 25-75+ year commitment, and this planning helps to increase the benefits the community can reap from this commitment. A list of acceptable species to be planted for all land use types appears in Appendix A.

Nursery Stock Procurement

Nursery stock quality is yet another aspect of planning which can help a tree establish, survive, and thrive to provide great benefits to the community. The Village Forester or an Urban Forestry consultant should inspect and select every tree which is to be planted on Village property to minimize the possibility of installing lower quality nursery stock. Specifications should generally be for material no smaller than 1.5” caliper, with good form for the species, planted as either balled and burlapped or minimum 5-gallon containerized stock. Additional, bareroot stock from the Village’s gravel bed program will be utilized where appropriate.

Currently, the industry is recovering from a nursery stock shortage due to high demand to replace Ash trees lost to Emerald Ash Borer, which impacted the availability of some species. We strongly recommend to not accept substitutions in the requested species lists, as many nurseries are still attempting to substitute overplanted trees for some of the higher diversity species which may still difficult to obtain. It is recommended to have an approved substitution prepared for each requested tree species. A list of species and acceptable substitutes has been included in Appendices A, B, and C.

Tree Transport and Planting

Proper transport and planting procedures determine a tree’s success after planting. Even healthy trees from the field, if improperly transported, may dry out during transport, or have structural damage to root balls incurred. When it comes time to plant, trees planted too deeply will suffer from root compaction, trunk decay and/or girdling roots. Trees planted without properly dug holes may suffer from stunting. Trees planted without proper removal of packaging materials may develop girdling roots. It is recommended that all twine, rope, wire, and burlap be removed from the top half of the root ball prior to backfilling. Trees planted too high may have surface root desiccation. Trees improperly staked or with improper trunk protection may suffer from trunk wounds or girdling of the entire trunk. The standards and Best Management Practices for tree transport and planting are detailed later in this section, as well as the appendices.

Tree Spacing and Visibility Requirements

Minimum tree spacing between large, medium, or small sized deciduous shade trees should be appropriate for the species and conform to Village of McFarland standards. It is generally specified this be no less than 50 feet between plantings of large to medium mature height trees and 25 feet between plantings of small mature height trees. This will allow trees to grow to their full potential without heavy competition for water and nutrients with neighboring trees, and without limited space for crown growth.

In addition, no tree should be planted within 25 feet of the intersection of two streets from either corner measured on the property line and 15 feet of a driveway or alley. For known below ground utilities, trees should not be planted within 6 feet of a fire hydrant, water stop box or gas shut-off. Trees may be planted under aboveground powerlines, but must be from the “Small” selections listed in the Approved Species list in Appendix A. No evergreen species shall be considered acceptable for terrace planting as they can obscure views of the road and may lead to accidents. Evergreens are acceptable for municipal campuses, parks, and other Village-owned properties.

Watering

Watering of newly planted trees is essential to their establishment, growth, and survival, particularly during the first 2 years of their lives. Since watering is not included in our budget figures, this responsibility may have to fall on the property owners. It is highly recommended that when a tree site is selected for planting, that a basic letter be mailed to property owners describing how much water to give a tree, and when it should be given. Such simple information can make the difference between a tree dying from drought stress, a tree dying from overwatering, and a happy, healthy tree.

Challenges of Urban Plantings

Urban planting sites are a difficult environment for a tree to thrive in, and based on long term data, it is expected that 5-10% of new plantings fail each planting cycle. The Village’s contracts for tree planting should include a one to two-year replacement warranty for any new trees that fail to thrive in their new environment. Urban tree plantings can pose an uphill battle in many ways, due to limited soil volume, salt runoff, airborne pollutants, and other factors. New planting mortality is to be expected, despite best efforts to prevent such an outcome, but the planning measures outlined above will help to mitigate annual new planting mortality.



Tree Planting Requirements and Standards

Village of McFarland – Internal Policies

1. Planting sites shall be determined and monitored using the Village's tree inventory, in conjunction with staff and Forestry Consultant input.
2. New planting sites should be planted in accordance with specifications in McFarland's Municipal Ordinance Article 59-II.
3. Choice of species for planting should be done so according to the Village's taxonomic, spatial, and age-class diversity goals.
4. All planting stock shall be regionally grown in planting zones 4 or 5A.
5. Acceptable nursery stock shall conform to the following standards:
 - A. Minimum of 1.5-inch caliper, measured at six inches from the trunk flare
 - B. Root ball conforms to ANSI Z60.1 Standards for Nursery Stock
 - C. Architecture consistent for the species, cultivar, or variety in question
 - D. No included bark or other such narrow branch attachments, unless consistent with species or variety
 - E. Free of pests and pathogens
 - F. Approved species list for the Village of McFarland
6. Planting and digging of certain species shall only occur at certain times of year, in accordance with nursery industry best management practices and professional judgement. These times are subject to the professional opinions of both the Village of McFarland and its approved contractors.
7. The individual, entity, or contractor planting trees has the responsibility to locate underground utilities before digging. Diggers Hotline, or another similar utility locating service shall be contacted, and all utilities located a minimum of three days before planting is scheduled to begin.
8. A minimum of a one-year replacement guarantee shall be extended from approved nurseries and plantsmen for all new plantings rated to hardiness zone 5b or lower.

Tree Pruning

When maintaining a tree population for its greatest benefits and lowest risk, tree pruning is one of the most cost-effective maintenance activities which can be performed. Pruning provides several important services for a tree: It reduces the risk of failure, provides clearance for utilities or other structures, reduces wind resistance and wind damage, maintains overall tree health, and improves overall aesthetics.

The most critical needs of the Village of McFarland should be prioritized and the projections below are broad estimates. For the next 5 years, it is recommended that McFarland slowly increase the number of trees pruned each year as the population steadily grows. For a 5 year pruning cycle for the estimated tree population of 4,000 total trees by 2043, it is anticipated that approximately 800 trees per year will require pruning to maintain this cycle.

Currently, McFarland prunes approximately 600-700 trees per year primarily using in-house labor. The contractor budget estimates below reflect the costs paid to contractors for pruning of trees that are too large or too risky to prune in-house. Consistent with other budget tables, a 3% annual CPI increase was added for every year thereafter.

Milestones	2024	2025	2026	2027	2028	2034-2044
Trees Pruned	varying	varying	varying	varying	varying	varying
Notes	Cycle Prunes not performed in-house	Cycle Prunes not performed in-house	Cycle Prunes not performed in-house	Cycle Prunes not performed in-house	Cycle Prunes not performed in-house	Cycle Prunes not performed in-house
Cost (2024)	\$5,000	\$5,500	\$6,000	\$6,500	\$7,000	\$7,500
Cost (CPI)	\$5,000	\$5,500	\$6,000	\$6,500	\$7,000	\$8,625

Pruning Activities

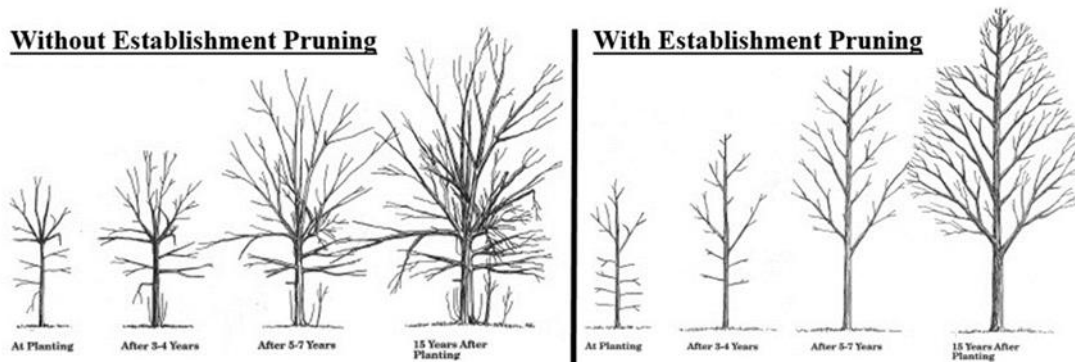
Maintenance or Enhancement of a Pruning Cycle

Initially, after inventory data is first collected or updated, the Village should prioritize the trees that may have been identified as requiring priority pruning, regardless of where they are located to prioritize public safety before routine maintenance. After these trees are pruned, McFarland should aim to enhance its 5-year pruning cycle based on the size of its tree population as it steadily grows through 2044. With approximately 4,000 Village trees total by 2044, this would mean that over a 5-year period, approximately 800 trees would require pruning each year. We believe this is a realistic goal based on communications with Village staff.

Though tree pruning may seem expensive, the cost of maintaining trees is significantly less than the costs associated with trees damaging property or injuring residents. The benefits trees provide when healthy and well maintained can be prolonged and significantly increased, as shown in the projections above. A cycle pruning program is the hallmark of an effective forestry program.

Pruning of Young Trees

For the purposes of this Plan, a young tree is considered to be under 12" DBH. Young trees are still trying to acclimate to their sites. The pruning of young trees has different goals and outcomes than the pruning of larger, mature trees. Standard nursery stock has been meticulously pruned for four to ten years to have a single trunk, and the specific branching patterns which are considered common to the various tree species. Without proper establishment pruning, these trees might have multiple trunks, poor branch structure, and overall poor form and architecture. Pruning of young trees to establish proper form is one of the most cost-effective maintenance activities which can be performed. It is an inexpensive task that does not require a great time commitment, and saves thousands of dollars in pruning and maintenance costs later in the tree's life. As mentioned above, due to not having to climb trees or use dangerous equipment, young trees may be pruned by Village staff, or even well-trained residents, with proper training from the Forestry Consultant or a similarly qualified organization, and with the approval of the Sustainability and Natural Resources Committee.



Pruning of Mature Trees

A mature tree, for the purposes of this Plan, is considered to be greater than 12" in diameter. Mature trees are established in and acclimated to their sites. The pressure these trees face from their environment generally comes from above-ground factors such as pests, pathogens, man-made structures, other trees, windstorms or lightning strikes, as well as some below ground factors like girdling roots, limited soil volume, or poor soil quality. Pruning is performed to mitigate the above-ground issues, as well as balance out any below ground issues when possible. Natural aging and limb dieback are additional reasons these trees are pruned.

Pruning of mature trees may mitigate a short-term risk, such as after a storm, or pruning may be done to maintain a tree's long-term health and structure. In the wild, trees lose limbs frequently. This is called self-pruning. Allowing trees to self-prune over time is not advisable in an urban setting. Safety factors may arise, and the process of self-pruning may bring up aesthetic issues in an urban environment. Mature public trees should only be pruned by professional Certified Arborists, Arborist trainees, or other staff with Arborist skills, and done in accordance with industry Best Management Practices and accepted ISA and ANSI standards.

Private Property Trees

The Village of McFarland shall not be responsible for the pruning of trees located on private property. The Village reserves the right to prune portions of trees overhanging public property, but is under no legal obligation to do so, and will perform such pruning at the discretion of the Village Forester and/or Forestry Consultant.

Reasons for Pruning

Establishment Pruning

Establishment pruning of newly planted trees is the single most cost-saving measure in tree care, as it establishes good form and branch structure for the life of the tree. Establishment pruning should be performed a minimum of one time prior to the tree reaching six inches in diameter. Once established, the tree will only require periodic cycle pruning to maintain an appropriate form for the urban forest and to maintain health and keep the tree free of dead limbs.

Cycle Pruning

A Best Management Practice in Urban Forestry is that trees should be pruned on a cyclical basis as preventative maintenance. No tree should go more than seven years without proper pruning. Cycle pruning ensures that dead branches, storm damaged limbs, or unsightly growth are removed before becoming hazardous or bad for the health of the tree. Cyclical pruning also ensures the proper leaf to stem ratio, which provides structural support for the tree and it ensures that clearance standards as written in ordinance are met (13.5' above streets and 10' above sidewalks). It also ensures that pruning stays relatively inexpensive, as severe issues do not have time to develop. Cycle pruning is a maintenance activity which if performed regularly, actually needs to be performed less often!



Emergency / Storm Damage Pruning

Emergency pruning is nearly always necessary to mitigate severe risk after storm events, such as limbs which have fallen and are blocking traffic, have impacted a structure, are interfering with a utility, or are hanging and in imminent danger of doing any of the above. Emergency and Storm Damage Pruning should be conducted at the discretion of the Village, with the best interests of the public in mind. This is one of the few occasions on which the recommendations of this Plan may be temporarily suspended. When life or property are in imminent danger due to conditions associated with a downed tree or tree part, the Village may take whatever remedial action is practical and reasonable to mitigate such imminent risk.

Sanitation Pruning

When a tree has been diagnosed as having been diseased or infested with a pest, sanitation pruning may be employed to maintain the tree while removing the diseased or infested portions. This technique is only effective when the host tree is infected/infested with certain pests and pathogens, and only in a localized area of the tree. With more widespread cases of disease or insect infestation, removal will be the most cost-effective and safest option to avoid endangering other nearby trees, as these pests and diseases tend to spread, particularly when there is more of the same species nearby.

Removal of High Risk Limbs

At times, a tree as a whole may not pose a high risk, but a single limb may have defects that make it hazardous. At these times, the removal of such limbs or parts may render the tree to be low risk again, without causing permanent damage to the tree.

Tree Pruning Requirements and Standards

Village of McFarland – Internal Policies

1. All activities directly related to the operation of a chainsaw, bucket truck, limb rigging, or tree climbing should be performed by a qualified employee with Arborist skills, or under the supervision of a certified arborist or arborist trainee.
2. No pruning or maintenance activity that takes place within ten feet of a power transmission line shall be accomplished by a Village of McFarland employee unless certified as a qualified Utility Arborist.
3. No cabling, bracing, or other such support systems shall be installed in Village-owned trees, either by the Village of McFarland, its residents, or any contractors. Exception may be made by obtaining prior written approval of the Village Forester.
4. No topping, pollarding or espalier pruning shall be conducted on Village-owned trees, and wound dressings shall only be used under certain circumstances such as if wilt-susceptible Oaks require pruning during the non-dormant season.
5. The need for pruning and maintenance of individual trees and terraces shall be at the discretion of the Village Forester and its designated contractors.
6. No more than 25% of a tree's crown shall be removed during pruning operations to preserve the health of the tree. Any more than 25% of the crown being removed put the tree in danger of severe dieback, and removal should be considered at that point. Deviations from this standards may be performed at the discretion of the Village Arborist.

Other General Maintenance

Retaining a Consultant

The task of enhancing a robust Urban Forestry program can be challenging. There are many tasks to carry out, challenges to overcome, contracts to renegotiate, bid documents to create, resident concerns to manage, and other responsibilities which may require the assistance of a professional.

The Forestry Consultant could be involved in sourcing and interviewing contractors and vendors for tree pruning, removal, and planting operations, assisting in maintaining the tree inventory, performing tree health and risk assessments, assisting in explaining policies to homeowners, preparing contract and bid specifications, and teaching residents how to help the Village in caring for their trees. The importance of this early relationship cannot be overstated, no matter how large or small the organization.

Chemical Applications

Trees, like people, sometimes contract pests and pathogens. Often these pests and pathogens can be controlled with a simple chemical application just as illnesses in humans can be controlled with medication. This practice is called Plant Health Care. When financially practical, chemical control for common pests or pathogens may be utilized as a preventative or curative method, and increase the aesthetics and benefits of the tree population.



At present, the Village has an Ash tree treatment program implemented where approximately 40-50 Ash trees are being treated to control Emerald Ash Borer infestation. The Village may explore performing this plant health care application in-house. Residents of McFarland may not perform chemical applications on any Village trees.

Water Management

The importance of water in the establishment, growth, and survivorship of trees is critical. Most trees adapted to our climate zone (USDA Zone 5b) are also adapted to the amount of moisture we have in an average year. However, younger trees with less expansive root systems are susceptible to prolonged drought. Young trees need supplemental watering, which is an essential maintenance activity and can prevent newly planted tree mortality. A watering program paid for by the Village, using contracted labor, is likely beyond the scope of current budgets. There is always an option to rely on well-informed residents to water trees. Upon receiving a newly planted tree on the terrace in front of their homes, residents should be supplied with an informational pamphlet which explains how often to water their new tree during the first 2-3 years. It is also suggested that the Village, perhaps acting in conjunction with the Forestry Consultant, hold basic tree maintenance classes open to all residents.

Mulch

Proper application of mulch is a necessary and cost-effective maintenance activity. Mulch has many benefits, including reducing weed growth in the root zone, protecting the tree trunk and root flare from lawn maintenance equipment, allowing water to move into the soil, reducing evaporation and drought stress, and creating a naturally fertile soil environment. Turf grass typical of terraces competes for water and nutrients, and mulch reduces this competition.



But not all mulching is beneficial. The practice known as “Volcano Mulching” is the practice of piling mulch against the trunk in excess of 3” deep. This causes moisture build up against the trunk, and can cause decay of the trunk tissue, and possibly death. Material such as crushed limestone, red volcanic rock, or rubber pellets can alter the soil chemistry in an undesirable way, and cause dieback or tree death. Fortunately, mulch is a commodity most communities can get for free so long as they are pruning and removing trees each year. As part of its successful wood utilization program, McFarland provides wood chips produced through tree maintenance and removal to Village residents at no cost. Any additional available chips are used as mulch or path material in Village parks. This arrangement works well for everyone.

All newly planted trees should have mulch applied appropriately. A future goal for McFarland should be to mulch all trees 12” DBH and smaller, but for now, mulch for all newly planted trees, and preventing volcano mulching should be a primary concern.

Cost Projections for Other Maintenance

The budget projections presented below reflect anticipated costs for contracted maintenance including inventory updates, tree risk and health assessments, plant health care treatments, GIS software, and contracted emergency storm response.

Milestones	2024	2025	2026	2027	2028	2034-2044
Notes	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software
Cost (2024)	\$12,000	\$12,500	\$13,000	\$13,500	\$14,000	\$14,500
Cost (CPI)	\$12,000	\$12,500	\$13,000	\$13,500	\$14,000	\$16,675

Tree Preservation and Management During Construction

In many municipalities, ordinances exist to protect publicly owned trees and shrubs from construction activities. The intent of these ordinances is to protect the benefits those tree and shrubs provide to the community. Trees and shrubs are community resources that provide benefits such as aesthetics, storm water benefits, energy savings, carbon sequestration and increased property values. Therefore, tree and shrub protection and preservation during construction represents an investment in the community! Ensuring the protection and preservation of these trees while minimizing burdens to businesses, developers, and residents is essential to a healthy urban forest.

Tree protection and preservation during periods of construction involves protecting publicly owned trees from damage caused by



construction activities. This damage includes physical and chemical damage to the trunk, branches, and roots. Damage may be caused by equipment such as backhoes, skid steers, or other appendage-type equipment. The effects of damage to the visible above ground portions of the tree can be obvious, as when branches are broken. But hidden effects such as root compaction or improper grading may not become evident for years until the tree begins to die back. The standards set forth below and in the appendices are industry standards with a record of success.

Tree Preservation Requirements and Standards

Village of McFarland

1. A tree survey shall be performed by a qualified individual prior to the beginning of any development activities. The survey shall detail the size, species, and condition of each publicly owned tree that is in proximity to construction zones.
2. The Tree Survey and a Tree Protection Plan shall be submitted to the Village of McFarland and all relevant architects, engineers, and workers, detailing the following:
 - A. Trees to be removed
 - B. Trees to be preserved
 - C. Location and size of the Tree Protection Zone (TPZ) for each tree generally accepted as 1 foot radius for every inch of tree diameter.
3. The Tree Protection Zones for each tree shall be visibly delineated by the site engineer, using orange snow fencing or other high visibility exclusion material. When such a delineation is not possible, all workers on site shall be made aware of the TPZ verbally.

SAMPLE Tree Risk Assessment Policy

Trees provide ecosystem and aesthetic benefits, but all trees also pose some degree of risk. Determining the acceptable level of risk, along with effectively managing that risk, is a key priority for urban forestry operations. As a tree manager, the Village of McFarland always must always assume some degree of risk. It is up to the Village to track that risk to ultimately decide how to take steps to mitigate trees which pose such risk in a manner which is responsible both economically as well as in the interest of public safety. It should be strongly noted here that while these risk assessment topics are noted in the framework of the ISA's TRAQ protocol, McFarland does not have a TRAQ Qualified Arborist on staff, and it is perfectly acceptable for staff to create their own internal protocol for Risk Assessment, which we will include in this UFMP when that policy is created. This section serves a mostly informational purpose for this first manifestation of this Plan.

Levels of Risk Assessment – An Overview

These Risk Assessment Levels are based on the International Society of Arboriculture's (ISA) Tree Risk Assessment Qualification (TRAQ) protocols, as well as the ANSI A300 Part 9 (Tree Risk Assessment) Standards. The TRAQ forms can be found in Appendix H at the end of this report. All trees in McFarland were assessed for a basic level of risk during the inventory. These assessments were rapid assessments, and do not represent any formal level of TRAQ risk assessment, and are not legally binding. They are solely intended to provide McFarland with data showing a need for a more detailed assessment of individual trees such as those listed below.

Level 1 Assessment

Also called a "limited visual assessment", whereby a tree has a basic analysis of obvious physical defects and condition. The assessor walks or drives by the tree, assesses it quickly for defects, evaluates the risk posed by the subject tree, and reports the results of the assessment to the tree owner. Often, prior to a recommendation, a more detailed (Level 2 or Level 3) assessment will be required to gather additional data.

Level 2 Assessment

A Level 2 Assessment, also called a "basic assessment", is a report detailing the information collected during a detailed visual inspection of the tree and the surrounding site. Such an inspection requires a 360 degree walk around, and may include the use of simple tools, such as binoculars, magnifying lenses, mallets, probes, and trowels or shovels. The goal is to get a more complete picture of the tree in its environment, as well as previous histories of failures, and a root to branch evaluation of not only the tree but also potential "targets" which falling tree limbs may impact. Targets are things such as structures, people, vehicles, or other things which may be damaged or injured by trees.



Level 3 Assessment

A Level 3 Assessment, also called an “advanced assessment”, provides detailed information about specific tree parts, targets, and risk associated with each potential interaction. By definition, it requires specialized equipment known as “advanced tools”, such as bucket trucks, resistance drills, sonic tomographs, and other such equipment. This is the most detailed and time-intensive type of assessment, and is typically only performed when a decision to retain or remove a tree is very difficult, as would be the case for a high quality tree near a potential target that has significant defects, the extent of which are not known, but must become known before making a decision.

Considerations in Assessing Risk

The following are meant for the reader to gain additional insight into the TRAQ process. Once again, TRAQ inspections were not performed on Village trees during the inventory data collection, and the Village may perform risk assessments according to its in house protocols. But this information will help the reader understand the terminology better, and help inform staff and residents as to how and why these inspections are performed. It should be strongly noted here that McFarland does not have a TRAQ Qualified Risk Assessor at this time, and per the above, it is permissible for their staff to perform a risk assessment on trees according to their internal protocols.

Likelihood of Tree Part Failure

Like it sounds, this is a process of determining how likely a tree part is to fail, and then how likely that failure is to impact a target. Likelihood of failure is an assessment of the tree’s defects, and the load on those defects, like weight, gravity, ice, or wind. The parts impacted are generally the roots, root plate, trunk, branches, or potentially whole tree failure at multiple points.

Likelihood of Tree Failure Impacting a Target

Determining the likelihood of impacting a target is figuring out the occupancy rate, or the amount of time that targets (particularly people or high value property) are within the fall zone. A large tree in the middle of a field could fail with little impact, but that same tree in a playground might have serious consequences. In many roadways, motor traffic is present day and night. All of the Village’s inventoried 3,452 trees are in rights-of-way adjacent to roads. where failure of a tree not only impacts motorists, but it also has a potential effect on pedestrian traffic and utilities within right-of-way also.

Consequences of a Tree Failure Impacting a Target

The potential consequences of the tree failure impacting a target are a cumulative function of both the “value” of the target and the consequences to that target if the tree fails. This step looks at the consequences of the impact, and assumes that the target is always present. To follow with the above example, it is assumed that if a terrace tree were to fail, that a car, utility line, and person are all underneath it at the time of failure, and the consequences to those targets is evaluated. Consequences are generally considered to be “minor” for targets that can be easily replaced or repaired, and step up through 4 levels with the highest level being “severe”, which would constitute severe injury to a person, or even a fatality (see the table below).

Weather

Every tree, no matter how healthy, can fail from wind, lightning strikes, ice loading or soil saturation. “Normal” weather can cause tree or tree part failures for trees which have existing defects, like deadwood, cavities, or poor architecture. Extreme weather events, by contrast, can cause the failure of perfectly healthy trees. For all Tree Risk Assessments, Risk should be assessed assuming “normal” weather conditions. Though it should be noted that “normal” weather conditions for south central Wisconsin do include gusty winds, thunderstorms, snow, and even an occasional ice storm. It is the extremes of these events that should be considered abnormal.

DRAFT Village of McFarland Tree Risk Assessment Policy

The Village of McFarland has created this SAMPLE policy to show what a TBD policy to maintain an acceptable level of risk from its tree population(s) will look like when completed. In order to maintain a high level of public safety, while mitigating undue burden, the Village shall at some point in the future adopt a policy similar to the following risk assessment protocols, all of which are DRAFT:

1. The Village of McFarland maintains a tree inventory detailing the species, size, and condition of all trees on Village Terraces, as well as a basic level of risk posed by each tree. This UFMP recommends that any trees listed as being in elevated risk categories during the initial inventory be audited on an ad hoc basis. During these audits, the Village Forester and/or Forestry Consultant should inspect these trees and identify trees potentially posing an unacceptable level of risk. Such trees identified shall either be scheduled for a more detailed risk assessment, or should be mitigated as soon as practical following the assessment.
2. During subsequent years, staff shall perform limited visual assessments on an ad hoc basis by driving by trees during the normal course of daily operations. Trees which may appear to present an elevated risk level shall be scheduled for a more detailed risk assessment, or should be mitigated as soon as practical following the assessment.
3. Upon notification from a resident of a concern about a potentially high-risk tree, the Village Forester and/or Urban Forestry Consultant perform an inspection within (14) business days of the notification by the resident. If a more detailed Risk Assessment is required based on that inspection, it shall be performed within an additional (14) business days. a decision shall be made by the Village Forester and/or Forestry Consultant as to what the appropriate mitigation measures are, if any.
4. All trees determined to be in need of mitigating actions (removal, pruning, etc.) should be documented in writing by the Village Forester and/or Urban Forestry Consultant. The documentation may include items as deemed necessary by the Controlling Authority.
5. A minimum branch diameter of three (3) inches, by ocular estimate, shall be the standard to which this risk assessment policy applies. Assessing all branches smaller than three inches represents an undue burden to the Village.

TRAQ Forms can be found in Appendix H at the end of this report.

TRAQ Tree Risk Assessment Matrices

Likelihood of Tree Failure Impacting Target

<u>Likelihood of Tree Failure</u>	<u>Likelihood of Impacting Target</u>			
	Very Low	Low	Medium	High
Imminent	Unlikely	Somewhat Likely	Likely	Very Likely
Probable	Unlikely	Unlikely	Somewhat Likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat Likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Risk Rating Matrix

<u>Likelihood of Failure and Impact</u>	<u>Consequences</u>			
	Negligible	Minor	Significant	Severe
Very Likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat Likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Projected Budget

The budget numbers below, as mentioned several times through this Urban Forestry Management Plan, are figures based on current industry rates for the services listed which are proposed for this plan. From there, generally the budget increases slightly each year, and projects through 2044, at which time, including CPI, the budget will have increased approximately 79% from the current level of approximately \$63,000 in 2024 to approximately \$112,700 by 2044. This represents a necessary budget increase for such an increase in values of the Urban Forest.

CONTRACTED REMOVALS & STUMP GRINDING	Milestones	2024	2025	2026	2027	2028	2034-2044
	Trees Removed	varying	varying	varying	varying	varying	varying
	Diameter Inches	est 840"	est 880"	est 920"	est 960"	est 1,000"	est 1,040"
	Notes	Removals not performed in-house	Removals not performed in-house	Removals not performed in-house	Removals not performed in-house	Removals not performed in-house	Removals not performed in-house
	Removal Cost (2024)	\$21,000	\$22,000	\$23,000	\$24,000	\$25,000	\$26,000
	Removal Cost (CPI)	\$21,000	\$22,000	\$23,000	\$24,000	\$25,000	\$29,900
PLANTINGS	Milestones	2024	2025	2026	2027	2028	2034-2044
	Trees Planted	50	60	70	80	90	100/year avg
	Planting Cost (2024)	\$25,000	\$30,000	\$35,000	\$40,000	\$45,000	\$50,000
	Planting Cost (CPI)	\$25,000	\$30,000	\$35,000	\$40,000	\$45,000	\$57,500
CONTRACTED PRUNING	Milestones	2024	2025	2026	2027	2028	2034-2044
	Trees Pruned	varying	varying	varying	varying	varying	varying
	Notes	Cycle Prunes not performed in-house	Cycle Prunes not performed in-house	Cycle Prunes not performed in-house	Cycle Prunes not performed in-house	Cycle Prunes not performed in-house	Cycle Prunes not performed in-house
	Cost (2024)	\$5,000	\$5,500	\$6,000	\$6,500	\$7,000	\$7,500
	Cost (CPI)	\$5,000	\$5,500	\$6,000	\$6,500	\$7,000	\$8,625
MISC CONTRACTED MAINTENANCE EXPENSES	Milestones	2024	2025	2026	2027	2028	2034-2044
	Notes	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software	Tree Assessment & Inventory Updates / Risk Management/ Treatments / Storm Response / GIS Software
	Cost (2024)	\$12,000	\$12,500	\$13,000	\$13,500	\$14,000	\$14,500
	Cost (CPI)	\$12,000	\$12,500	\$13,000	\$13,500	\$14,000	\$16,675
TOTALS	TOTALS - 2024 \$	\$63,000	\$70,000	\$77,000	\$84,000	\$91,000	\$98,000
	TOTALS - CPI 3%	\$63,000	\$70,000	\$77,000	\$84,000	\$91,000	\$112,700

Summary / Conclusion

By creating this Urban Forestry Management Plan, the Village of McFarland has taken an important step in investing in their urban forest's future by creating both shorter and longer term goals that will serve as milestones. These are all goals which, as they are undertaken, will help strengthen the urban forestry program in McFarland, maximizing the benefits that trees provide to the community and minimizing cost and risk. There are many local partners that have been suggested, as well as many yet to be discovered, who can help along the way and actually can become promoters of the urban forestry program in McFarland. The more public support and engagement this program receives, the better it will be equipped to tackle difficult situations in the future.

Certainly, none of this can be done without funding streams and innovative thinking along the way. As the basic budget and i-Tree reporting demonstrates, the return on investment for the forestry program in McFarland is considerable and the benefits from the tree population are certainly worth what the cost put into them is. As we bring information like this to light, that the forestry program yields dividends and doesn't just cost money, the more people will become interested and engaged in promoting these efforts.

Great Lakes Urban Forestry thanks the Village of McFarland, its residents, stakeholders, and the grant funding organizations which have made this endeavor possible. It has been a pleasure to work with the Village on this Urban Forestry Management Plan and we look forward to continuing to assist the Village with their Urban Forestry endeavors.



Glossary of Terms

Aerial Device: Any piece of equipment expressly intended to elevate a human worker above the level at which they typically stand with their feet on the ground surface. Can include but is not limited to bucket trucks, scissor lifts, etc

Aggressive: A floral or faunal organism which is native (endemic) to the United States or northern Indiana, but which is known to outcompete other more desirable organisms

Arborist: An individual engaged in the profession of arboriculture who is educated, trained and licensed to provide for or supervise the management of trees and other woody plants

Arborist Trainee: Any person working under the direct supervision of an Arborist or Certified Arborist

Balled and Burlapped: A tree, shrub, or other plant prepared for transplanting by allowing the roots to remain covered by a ball of soil around which canvas or burlap is tied and secured with a basket.

Bare Root: Harvested plants from which the soil or growing medium has been removed

Best Management Practices (BMP): Methods or techniques found to be the most effective and practical means in achieving an objective while making the optimum use of resources.

Caliper: Standard nurseryman's measure of tree diameter (size). Caliper measurement of the trunk shall be taken six inches above the ground up to and including four-inch caliper size. If the caliper at six inches above the ground exceeds four inches, the caliper should be measured at 12 inches above the ground.

Certified Arborist: An individual who has sufficient experience in the field of Arboriculture, and has been certified by the International Society of Arboriculture as being a Certified Arborist

Border Trees: Trees whose trunks, when measured at DBH, are situated on both Public and private property

Branch Collar: The branch collar is the point where a branch joins the trunk or another branch. This is the area the arborist chooses to make a proper cut.

Climbing Line: Any rope or other such material explicitly intended for bearing the weight of a human being

Collected Plants: Trees or shrubs which have been sourced from private property for the intent of transplanting elsewhere

Compacted Soil: A high-density soil lacking structure and porosity, characterized by restricted water infiltration and percolation (drainage), and limited root penetration

Consumer Price Index: an index of the variation in prices paid by typical consumers for retail goods and other items

Containerized: A tree, shrub, or other plant prepared for transplanting, or grown in, a solid-walled container such as a plastic pots or wooden boxes

Contracted Staff: People working for the Village as part of an independently owned and operated private company which performs work for the Village, but who are not directly employed by the Village

Controlling Authority: An agency, organization, or corporate entity with the legal authority and/or obligation to manage individual trees or tree populations

Crew Leader: Any personal who has by direction or implication been chosen to lead a team of In-House or Contracted Staff

Crown: The upper part of a tree, measured from the lowest branch, including all branches and foliage

Critical Root Zone (CRZ): The minimum volume of roots necessary for a tree to have health and stability

Cycle Pruning: The process of routine maintenance pruning of trees, not related to storm damage or other hazard or emergency related-pruning, that occurs on a set and predictable time scale set forth by the Village

Deadwood: Wood on a tree or shrub which is no longer biologically living and becomes brittle or prone to failure

Decline/Declining: Trees or shrubs which are experiencing symptoms of a general decline on health due to age, pest, or pathogen related issues

Desirable: A Tree or other plant whose characteristics are sought after due to ecology, aesthetics, or public safety

Diameter or DBH: Diameter at Breast Height. A standard forestry measure of tree diameter (size), measured at 4.5' above ground level on the uphill side of a tree using a Diameter Tape or Biltmore Stick

Diggers Hotline (811): The Wisconsin underground utility locating service

Digging Machine(s): Any piece of mechanical equipment whose express purpose is to remove soil and plants from their current locations

Diseased: The status of a tree which has been negatively impacted by a pathogen, bacterial, fungal, viral, or similar lower life forms

Drip Line: The soil surface delineated by the branch spread of a single plant or group of plants

Drought: A period of two weeks or greater, during which there is less than one inch of rainfall, when the average daytime temperature during that same period exceeds 75 degrees Fahrenheit.

Dutch Elm Disease: A fungal pathogen which causes the decline and death of specific species of Elm trees

Dying: A tree which is in the process of biological death due to senescence, disease, infestation, or other such malady from which there is very little to no hope of long-term survival

EAB: Emerald Ash Borer. An invasive beetle pest which affects all Ash trees

Establishment Pruning: The pruning of a young tree in order to establish proper form and branching habit

Established Trees: Those trees which have been permanently planted for a period of no less than 6 months, and which have permanent roots established in the soil

Failure (tree failure): Breakage of stem or branches, or loss of mechanical support in the root system

Feeder Root: Any portion of the below ground portions of the tree whose purpose is to absorb water and nutrients

Floodplain: Land which has been determined to be periodically inundated with water from a nearby moving or static water body, such as a lake or river. Determined by the Federal Emergency Management Agency

Flush Cut: Either a pruning cut or final cut to remove a stump, for which the maximum acceptable distance from the ground or the branch bark ridge shall be no greater than 2 inches

Full-Time: An employee who has regular employment through the Village and whose work hours exceed 36 hours in a week, and who is employed year-round.

Fungal: Any of a group of spore-producing organisms feeding on organic matter, including molds, yeast, mushrooms, and toadstools

Grade: The level or pitch of a certain piece of land, as defined by the trees or shrubs which inhabit it

Hardscape: The nonliving or man-made fixtures of a planned outdoor area, such as sidewalks, retaining walls, street lamps, etc

Hazard: A known and documented state of imperiling public safety

Healthy Tree: Any tree which is successfully adapting to it's environment, and shows no signs of disease, pests, pathogens, or other such maladies, as determined by the Village or Forestry Consultant(s)

Host: An organism which is susceptible to a known pest or pathogen

Infested: The status of a tree which has been negatively impacted by pests

In-House Staff: Staff directly employed by the Village of McFarland, on either a full-time or Part-Time Basis

Invasive: A floral or faunal organism which is not native (endemic) to the United States or northern Indiana

Job Site: Any geographic location where a person or persons will be performing activities related to the care and maintenance of Village of McFarland property

Liner Nursery: A privately owned plant propagation facility which specializes in the growth of small trees which are intended to be planted for growth into a full form

Managed: A tree or shrub which is in an area of the Village which is routinely mowed and managed. Not a wild forest grown tree or shrub, or area containing such trees and shrubs

Manufacturer's Recommendations: Any expressly written instruction manual for a given piece of equipment that details how said equipment is supposed to be managed or maintained

Mineral Soil: Any substrate which is composed of a variety of rocks and minerals in various states of decomposition, leading to the development of a substance on which living plants may live

Mitigation: The process of diminishing risk

Monoculture: A population of trees in close proximity to one another which is comprised of 3 species or less of trees and shrubs which is prone to pest or pathogen outbreak

Natural Resources: Flora, fauna, and other such living and non-living parts of the environment which the Village of McFarland maintains

Nursery Stock: Woody Perennials which are of a "Tree Form" growth habit and are supplied by a nursery contractor for planting. Not established trees.

Parks Department Property: Land which, by deed or title, belongs to the Village of McFarland

Parkway Tree: Any woody plant within a Publicly-Owned right-of-way, or any other property owned or managed by the Village of McFarland

Part-Time: An employee who has regular employment through the Village and whose work hours are less than 36 hours in a week, and who is employed year-round

Pathogen: A fungus, virus, or other such microscopic organism which causes decline or death of trees

Pest: An insect or other macrofaunal organism which causes decline or death of trees

Private Property: Land which, by deed or title, does not belong to the Village of McFarland

Public Safety: The welfare and protection of the general public

Reforestation: The process by which trees are planted to replace trees which have been removed

Rigging Line: Any rope or other such material explicitly intended for bearing the weight of a tree limb. Not to be used for supporting a human being

Right-of-Way (ROW): The publicly-owned land on which a road, drainage ditch, trail, or other public access is built

Risk: A situation involving potential exposure to danger or endangering public safety

Root Protection Zone (RPZ): The area on the ground surrounding a tree in which excavation, compaction, and other construction-related activities should be avoided or mitigated

Saddle: A piece of equipment expressly intended to hold a human being above ground level with the assistance of a rope or other such device

Sanitation Pruning: The removal of tree limbs that have become diseased or infested, in order to prevent the spread of disease or infestation from spreading throughout the rest of the tree e.g., Dutch Elm Disease, Black Knot Fungus, etc.

Seasonal Employees: Those employees retained by the Village for less than 6 months out of the calendar or budget year

Shrub: Any woody perennial which has a multi-stemmed growth habit not consistent with being considered a tree. Can be subject to interpretation by McFarland Staff.

Sound Wood: Structurally sound, non-decayed, non-compromised wood in the trunk or Scaffold Branches

Staff: Those employees retained by the Village on a full-time basis with benefits provided

Structural Root: Any portion of the below ground portions of the tree whose purpose is to stabilize the plant against the forces of wind and gravity

TRAQ: Tree Risk Assessment Qualification. The International Society of Arboriculture's formal status of an individual who is qualified to assess the risk that trees may bring to the general public

Tree Protection Zone (TPZ): The area surrounding a tree in which excavation and other construction-related activities should be avoided

Tree Risk: The likelihood and consequences of failure of a tree or tree parts

Tree Risk Assessment: A systematic process used to identify, analyze, and evaluate tree risk

Underperforming: Trees which have systematic health and vigor issues resulting in poor health, architecture, or other such maladies as determined by Village staff

Undesirable: A tree which is not desired in the landscape due to ecological, aesthetic, or public safety reasons, as determined by McFarland Staff

Unmanaged: A tree or shrub which is in an area of the Village of McFarland which is not routinely mowed and managed. A wild forest grown tree or shrub, or area containing such trees and shrubs

Urban Wood: Any tree or other woody perennial material which has been harvested for the sole purpose of long term storage in the form of furniture, recreational material, etc. Differentiated from “Reclaimed Wood”

Utility Arborist: A person explicitly trained in the management of trees and other plants in relation to energized power lines. Someone who is licensed to work with conflicts between trees and such energized power lines.

Appendix A: Acceptable and Unacceptable Species

Species not appearing on this list can be approved or disallowed by consensus of the Sustainability and Natural Resources Committee acting under the supervision of the Village Forester and/or Forestry Consultant.

<u>Small Ornamentals</u>	<u>Medium Trees</u>	<u>Medium Trees</u>
AMERICAN REDBUD	AMUR MAACKIA	MAGNOLIA-SPP
CHERRY-AMUR	ASPEN-QUAKING	MAGNOLIA-SAUCE
CHERRY-SPP	ASPEN-SPP	MAPLE-MIYABEI
CRABAPPLE-SPP	BIRCH-RIVER (Parks Only)	MAPLE-PAPERBARK
DOGWOOD-CORNELIAN	BIRCH-SPP (Parks Only)	MAPLE-SPP
DOGWOOD-SPP	BLACK LOCUST	MOUNTAIN ASH-SPP
HAWTHORN-COCKSPUR	BLACKGUM	OAK-CHINQUAPIN
HAWTHORN-SPP	BUCKEYE-OHIO	OAK-CRIMSON SPIRE
HAWTHORN-WASHINGTON	BUCKEYE-RED	OAK-ENGLISH
LILAC-JAPANESE	BUCKEYE-YELLOW	OAK-SHINGLE
MAPLE-JAPANESE	HAZELNUT-TREE (Parks Only)	PEAR-SPP
SERVICEBERRY-SPP	HORNBEAM-AMERICAN	PERSIMMON
SMOKETREE-AMERICAN	HORSECHESTNUT	PLUM-AMERICAN
WITCH HAZEL-EASTERN	IRONWOOD	YELLOWWOOD
WITCH HAZEL-OZARK	KATSURATREE	ZELKOVA
<u>Large Trees</u>	<u>Large Trees</u>	<u>Evergreen (Park Only)</u>
BEECH-AMERICAN	LONDON PLANETREE	ARBOR VITAE
BEECH-EUROPEAN	MAGNOLIA-CUCUMBER	DOUGLAS FIR
CATALPA	MAPLE-FREEMAN	EASTERN REDCEDAR
ELM-AMERICAN	MAPLE-RED	FIR-BALSAM
ELM-HYBRID	MAPLE-SUGAR (Parks Only)	JUNIPER-SPP
GINKGO	OAK-BURR	PINE-AUSTRIAN
HACKBERRY	OAK-HILLS	PINE-RED
HICKORY-BITTERNUT	OAK-PIN	PINE-SCOTCH
HICKORY-SHAGBARK	OAK-RED	PINE-SPP
HICKORY-SHELLBARK	OAK-SCHUETTS	PINE-WHITE
HONEYLOCUST	OAK-SPP	SPRUCE-BLACK HILLS
KENTUCKY COFFEETREE	OAK-SWAMP WHITE	SPRUCE-BLUE
LARCH	OAK-WHITE	SPRUCE-NORWAY
LINDEN-AMERICAN	SWEETGUM	SPRUCE-SERBIAN
LINDEN-LITTLELEAF	TULIPTREE	SPRUCE-WHITE
LINDEN-SILVER	WALNUT-BLACK	YEW-SPP+E14:G34

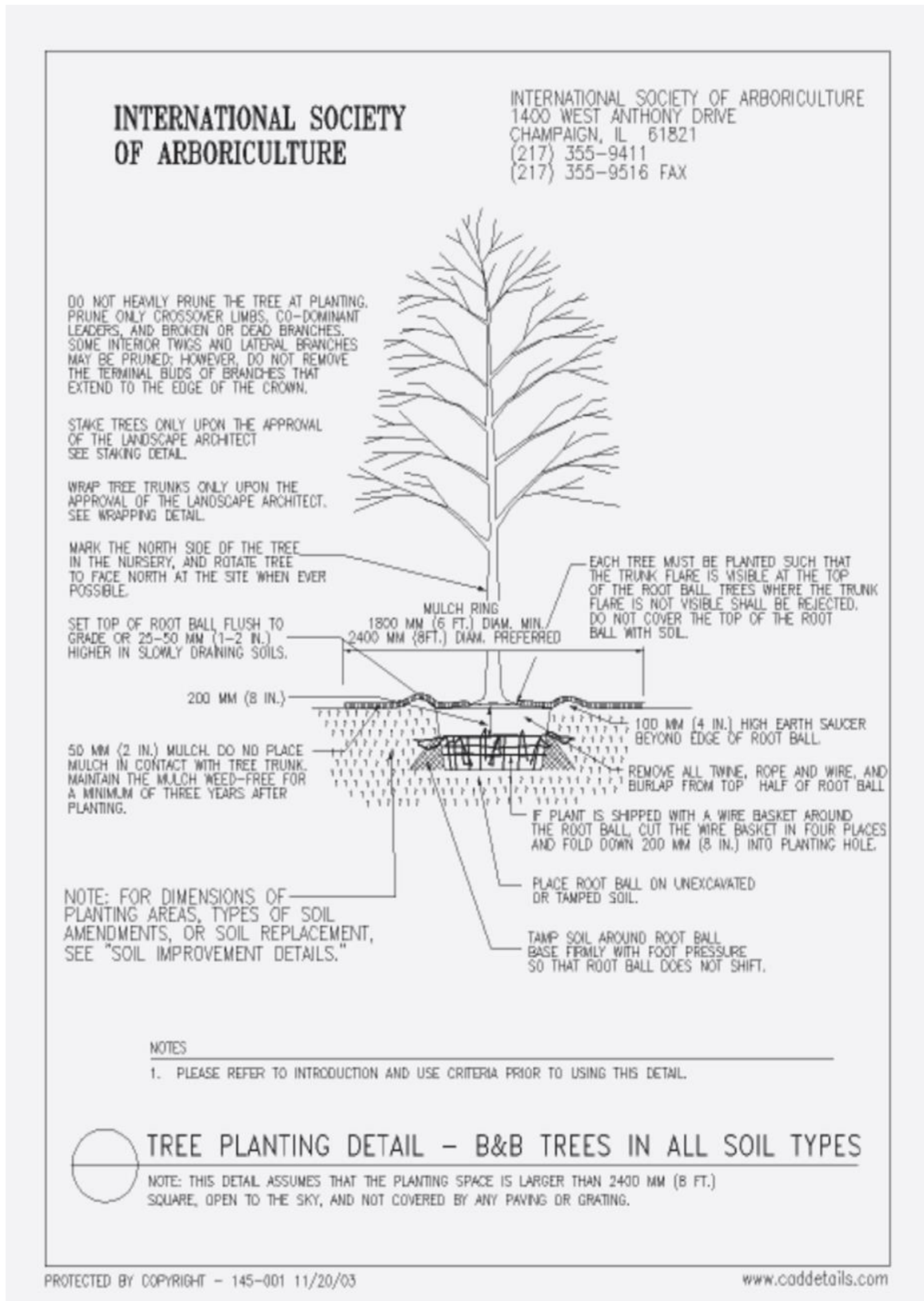
Appendix B: Additional Comments on Species

SPECIES	COMMENTS	SPECIES	COMMENTS
AILANTHUS	NOT APPROVED	LILAC-SHRUB	Parks Only
ALDER-SPP		LILAC-TREE	Improved varieties, tree form only
AMERICAN HORNBEAM		LINDEN-AMERICAN	
AMERICAN REDBUD		LINDEN-LITTLELEAF	
AMUR MAACKIA		LINDEN-SILVER	
APPLE-CRAB SPP	Apple Scab resistant varieties only	LINDEN-SPP	
APPLE-EDIBLE	Parks Only	LONDON PLANETREE	Prefer 'Exclamation!', 'Bloodgood' not allowed
APRICOT	NOT APPROVED	MAGNOLIA-CUCUMBER	
ARBOR VITAE	Parks only	MAGNOLIA-SAUCER	Scale resistant varieties only
ASH-BLUE	NOT APPROVED	MAGNOLIA-SHRUB	Star Magnolia or similar Magnolia pruned to tree form
ASH-GREEN	NOT APPROVED	MAPLE-AMUR	Parks only unless pruned to tree form
ASH-WHITE	NOT APPROVED	MAPLE-AUTUMN BLAZE	Or other similar Acer x freemannii
ASPEN	Improved varieties only	MAPLE-BLACK	
BALDCYPRESS	Prefer 'Shawnee Brave'	MAPLE-HEDGE	
BEECH-AMERICAN		MAPLE-JAPANESE	Small growing space only
BEECH-SPP	Prefer 'Tricolor' or 'Riversii'	MAPLE-MIYABEI	Prefer 'State Street'
BIRCH-RIVER	Prefer Single stem only	MAPLE-NORWAY	NOT APPROVED
BIRCH-SPP	Sweet Birch, Yellow Birch, or other newintroductions	MAPLE-PAPERBARK	
BIRCH-WHITE	Bronze Birch Borer resistant only, prefer 'Whitespire'	MAPLE-RED	Improved varieties only
BLACK LOCUST	Improved varieties only, prefer 'Purple Robe'	MAPLE-SILVER	NOT APPROVED
BLACKGUM		MAPLE-SUGAR	Prefer 'Green Mountain'
BOXELDER	NOT APPROVED	MOUNTAIN ASH	Improved varieties only
BUCKEYE-OHIO		MOUNTAIN ASH-EUROPEAN	Improved varieties only
BUCKEYE-RED	Prefer 'Ft. McNair' or Bottlebush	MULBERRY-SPP	NOT APPROVED
BUCKEYE-YELLOW		OAK-BURR	
BUCKTHORN	NOT APPROVED	OAK-CHESTNUT	
BURNING BUSH	NOT APPROVED	OAK-CHINKQUAPIN	
CAROLINA SILVERBELL	Protected sites only	OAK-ENGLISH	
CATALPA		OAK-PIN	
CHERRY-BLACK	NOT APPROVED	OAK-RED	
CHERRY-PURPLE LEAF		OAK-SWAMP WHITE	
CHERRY-SPP	Ornamental, Black Knot resistant varieties only	OAK-WHITE	
COTTONWOOD	NOT APPROVED	OTHER	Open for new introductions
DAWN REDWOOD		PAGODATREE	
DOGWOOD-SPP	Hardy varieties only	PEACH	Parks only
DOUGLAS FIR	Parks only	PEAR-CALLERY	NOT APPROVED
EASTERN REDCEDAR	Parks only	PEAR-EDIBLE	Parks Only
ELM-AMERICAN	NOT APPROVED	PERSIAN IRONWOOD	Medium growing space only
ELM-HYBRID	Hardy varieties only	PERSIMMON	American variety preferred (Diospyros virginiana)
ELM-RED	NOT APPROVED	PINE-AUSTRIAN	Parks Only
ELM-SIBERIAN	NOT APPROVED	PINE-SCOTCH	Parks only
ELM-SPP	New cultivar introductions	PINE-WHITE	Parks only
EUONYMUS	Eastern Wahoo ONLY no non-native varieties	PLUM-SPP	Parks Only
FIR-SPP	Parks only	PUSSYWILLOW	Parks only
FRINGETREE		ROSE OF SHARON	
GINKGO	Male only	SASSAFRAS	
GOLDEN RAINTREE		SERVICEBERRY-SPP	Prefer 'Autumn Brilliance'
HACKBERRY		SEVENTH SON FLOWER	
HARDY RUBBER TREE		SHRUB-SPP	Parks only, open for new introductions
HAWTHORN-SPP	Thornless varieties only	SMOKETREE	American variety preferred, small growing space only
HICKORY-BITTERNUT		SPRUCE-BLUE	Parks only
HICKORY-SHAGBARK		SPRUCE-NORWAY	Parks only
HONEYLOCUST	Prefer 'shademaster' or 'inermis'	SPRUCE-SPP	Parks only
HONEYSUCKLE	NOT APPROVED	SUMAC	Parks only
HORNBEAM-EUROPEAN		SWEETGUM	Prefer 'Happidaze'
HORSECHESTNUT		SYCAMORE	In natural areas only, London Planetree preferred
HYDRANGEA-PEEGEE		TULIPTREE	
IRONWOOD		VIBURNUM	Tree form only
JUNIPER-COMMON	Parks Only	WALNUT-BLACK	NOT APPROVED
KATSURA		WILLOW-SPP	NOT APPROVED
KENTUCKY COFFEETREE	Fruitless varieties only	YELLOWWOOD	
LARCH		YEW	Parks Only
		ZELKOVA	Prefer 'Green Vase'

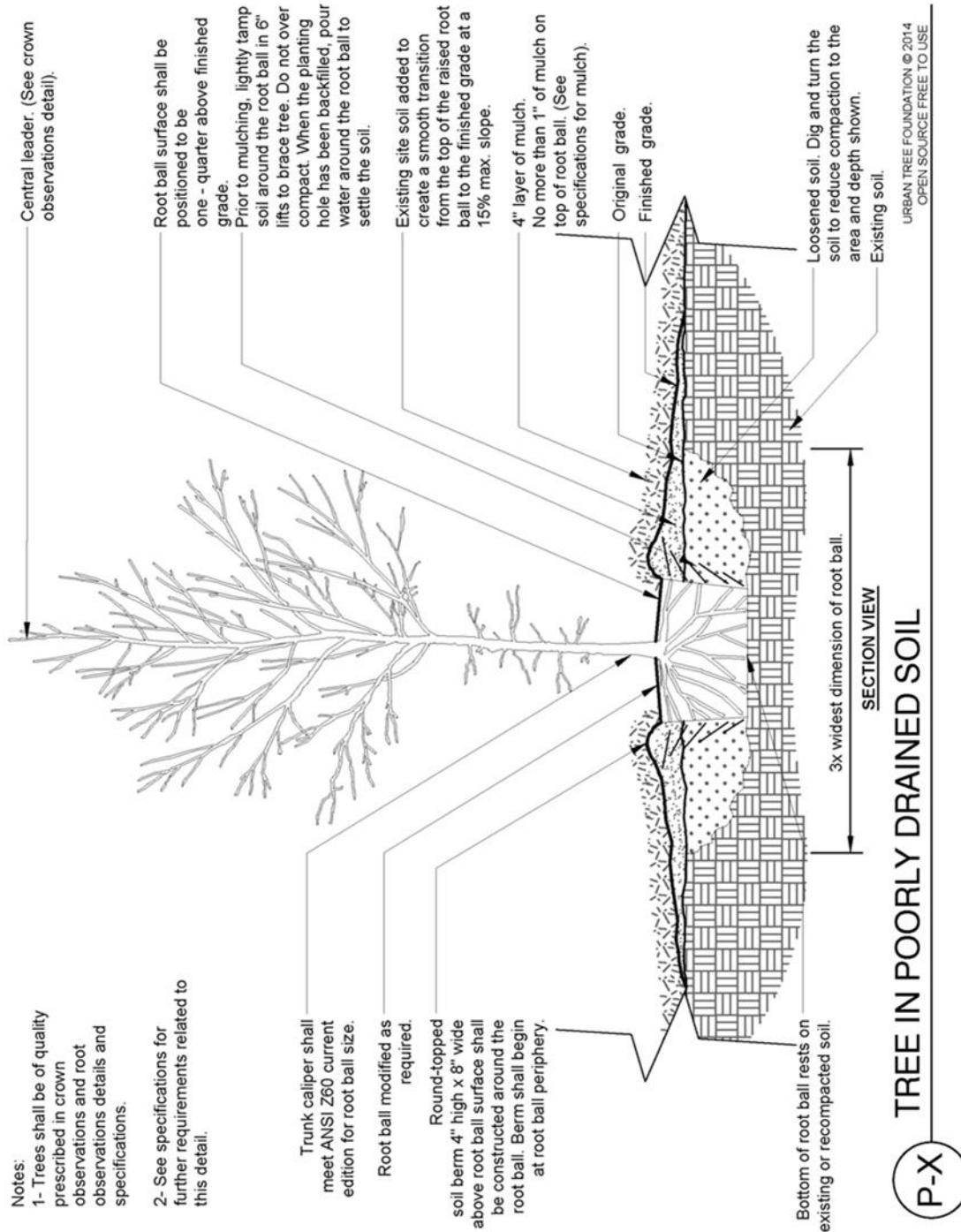
Appendix C: Species Substitutions

Species	Planting Time	Acceptable Substitutes
Alder, Black/Speckled	Spring	River Birch, Planetree
Amur Maackia	Spring	Yellowwood, Shingle Oak
Baldcypress	Spring	Larch, Dawn Redwood
Beech, European	Spring	Red Oak, Buckeye
Birch, River (Multi Stem)	Spring	Alder, Swamp White Oak
Birch, White	Spring	River Birch, Alder
Black Locust (Purple Robe)	Any	Honeylocust, Kentucky Coffeetree
Blackgum	Spring	Sweetgum, Dogwood
Buckeye, Ohio (Autumn Splendor)	Any	Horsechestnut, Catalpa
Buckeye, Red	Spring	Dogwood, Hawthorn
Buckeye, Yellow	Spring	Planetree, Sweetgum
Catalpa	Any	Kentucky Coffeetree, Tuliptree
Cherry, Sargent	Spring	Red Buckeye, Tree Lilac
Chestnut, Chinese	Spring	Turkish Hazelnut, Persimmon
Crabapple (Larger)	Any	Tree Lilac, Hawthorn
Dawn Redwood	Spring	Baldcypress, Larch
Dogwood, Cornelian	Spring	Tree Lilac, Hawthorn
Dogwood, Pagoda	Spring	Sargent Cherry, Smoketree
Douglas Fir	Spring	Concolor Fir, Spruce
Elm, Hybrid (Larger)	Any	Hackberry, Hardy Rubbertree
Fir, Concolor	Spring	Douglas Fir, Spruce
Ginkgo (Standard)	Any	Tuliptree, Catalpa
Golden Raintree	Spring	Katsura, Magnolia
Hackberry, Common	Any	Hybrid Elm, Hardy Rubbertree
Hardy Rubber Tree	Any	Tuliptree, Zelkova
Hawthorn, 'Inermis'	Any	Crab Apple, Dogwood
Hawthorn, Winterking	Any	Tree Lilac, Smoketree
Hazelnut, Turkish	Spring	Persimmon, Catalpa
Hickory, Bitternut	Spring	Oak spp, Beech spp
Hickory, Shagbark	Spring	Oak spp, Beech spp
Hornbeam, American	Spring	Ironwood, Hawthorn
Hornbeam, European (Columnar)	Spring	English Oak (columnar)
Horsechestnut (Baumani)	Any	Buckeye, Catalpa
Ironwood	Spring	American Hornbeam, Hawthorn
Katsura	Spring	Magnolia, Seventh Son Flower
Kentucky Coffeetree	Any	Honeylocust, Black Locust
Larch	Spring	Baldcypress, Dawn Redwood
Lilac, Japanese Ivory Silk	Any	Hawthorn, Sargent Cherry
Linden, Greenspire	Any	Kentucky Coffeetree, Hybrid Elm
Linden, Redmond	Any	Catalpa, Hackberry
Locust, Skyline	Any	Kentucky Coffeetree, Black locust
London Planetree	Spring	Sweetgum, Blackgum
Magnolia, Cucumber	Spring	Yellow Buckeye, Catalpa
Magnolia, Saucer	Spring	Persian Ironwood, Katsura
Magnolia, Star	Spring	Sargent Cherry, Smoketree
Maple, Autumn Blaze	Any	Black Maple, Shantung Maple
Maple, Black	Any	Shantung Maple, Autumn Blaze
Maple, Paperbark	Spring	Triflorum Maple, Tree Lilac
Maple, Shantung	Any	Sugar Maple, Miyabei Maple
Maple, Sugar	Any	Autumn Blaze, Shantung Maple
Maple, Triflorum	Spring	Paperbark Maple, Tree Lilac
Mountain Ash	Spring	Black Locust, Hawthorn
Oak, Burr	Spring	Shingle Oak, Swamp White Oak
Oak, English (Columnar)	Any	European Hornbeam
Oak, English (Standard)	Any	White Oak, Burr Oak
Oak, Red	Spring	Black Oak, Chinquapin Oak
Oak, Shingle	Spring	Chinquapin Oak, English Oak
Oak, Swamp White	Spring	London Planetree, Burr Oak
Oak, White	Spring	Burr Oak, English Oak
Oak, Chinquapin	Spring	Shingle Oak, Red Oak
Persian Ironwood	Spring	Seventh Son Flower, Katsura
Persimmon	Spring	Turkish Hazelnut, Zelkova
Pine, Limber	Spring	Spruce, Concolor Fir
Pine, Red	Spring	Douglas Fir, Eastern Redcedar
Poplar, Hybrid	Any	London Planetree, Baldcypress
Redbud	Any	Serviceberry, Hawthorn
Redcedar, Eastern	Spring	Spruce, Douglas Fir
Serviceberry	Any	Redbud, Tree Lilac
Seventh Son Flower	Spring	Persian Ironwood, Katsura
Smoketree	Spring	Magnolia, Seventh Son Flower
Sourwood	Spring	Blackgum, Sweetgum
Spruce, Black Hills	Spring	Eastern Redcedar, Concolor Fir
Spruce, Blue	Spring	Eastern Redcedar, Douglas Fir
Spruce, Norway	Spring	Eastern Redcedar, Concolor Fir
Spruce, Serbian	Spring	Eastern Redcedar, Douglas Fir
Sweetgum	Spring	Yellow Buckeye, Larch
Tuliptree	Any	Zelkova, Ginkgo
Yellowwood	Spring	Amur Maackia, Shingle Oak
Zelkova	Spring	Tuliptree, Ginkgo

Appendix D: Balled and Burlapped Planting Detail

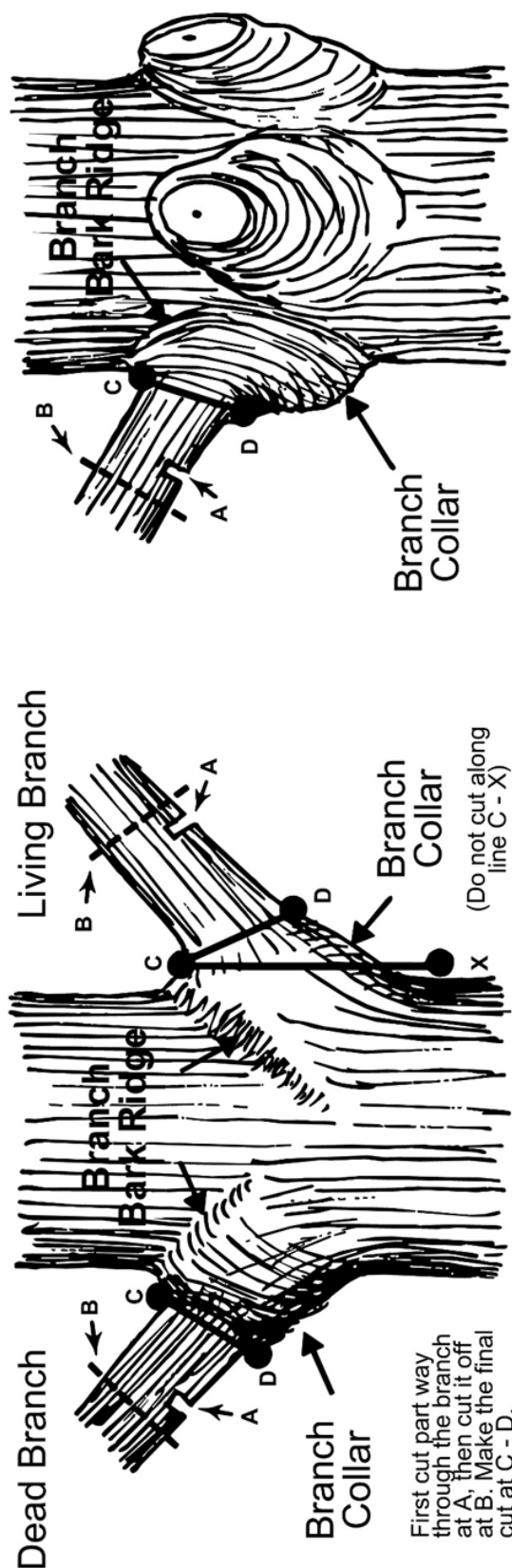


Appendix E: Containerized Planting Detail



Appendix F: Tree Pruning Detail

Proper Pruning Principles

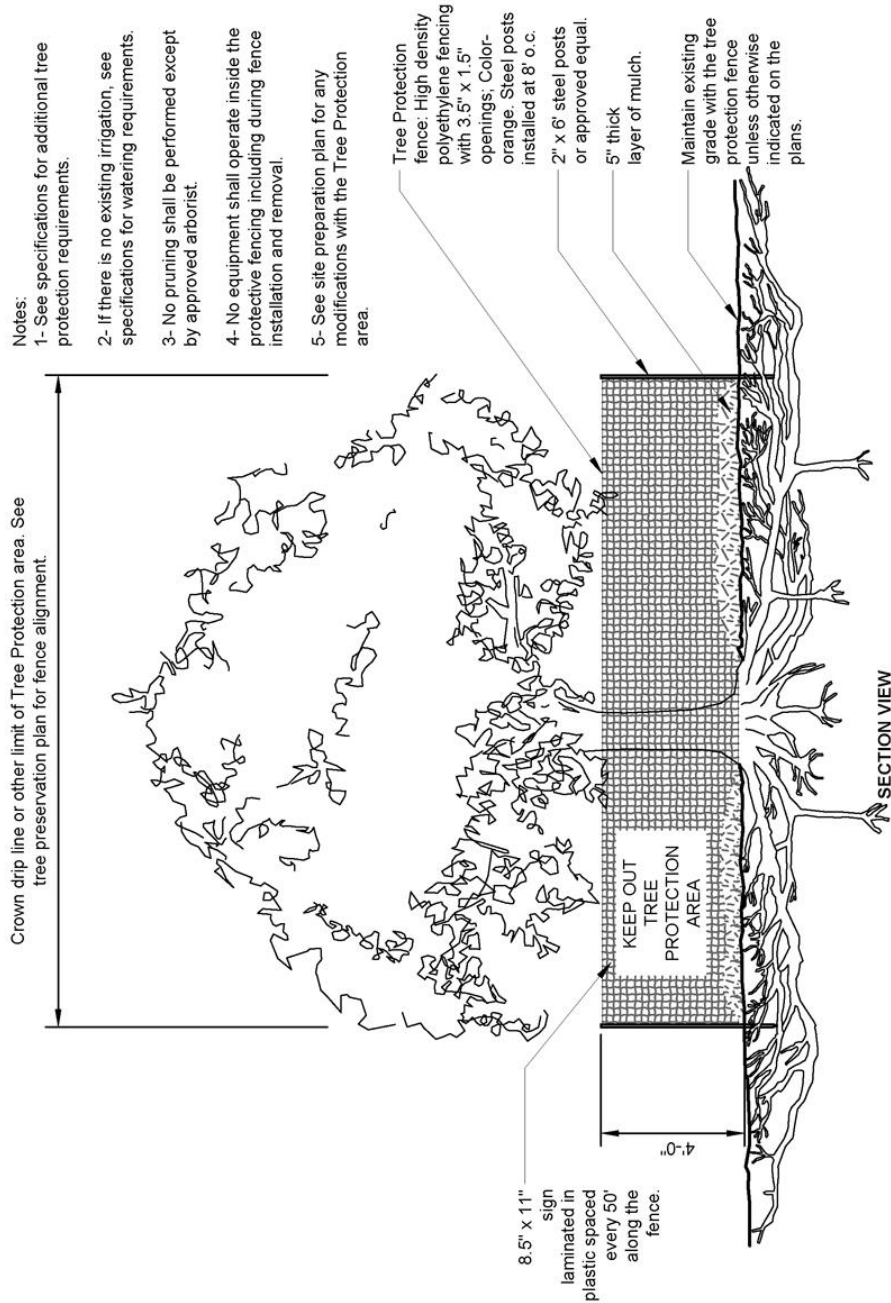


Hardwoods

Conifers



Appendix G: Tree Protection Detail



TREE PROTECTION



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Appendix H: ISA Tree Risk Assessment Form (TRAQ Level 2-Basic)

ISA Basic Tree Risk Assessment Form

Client _____ Date _____ Time _____
 Address/Tree location _____ Tree no. _____ Sheet _____ of _____
 Tree species _____ dbh _____ Height _____ Crown spread dia. _____
 Assessor(s) _____ Time frame _____ Tools used _____

Target Assessment						
Target number	Target description	Target zone			Occupancy rate 1 – rare 2 – occasional 3 – frequent 4 – constant	Practical to move target?
		Target within drip line	Target within 1 x Ht.	Target within 1.5 x Ht.		
1						
2						
3						
4						

Site Factors

History of failures _____ Topography Flat ☐ Slope ☐ _____ % Aspect _____
 Site changes None ☐ Grade change ☐ Site clearing ☐ Changed soil hydrology ☐ Root cuts ☐ Describe _____
 Soil conditions Limited volume ☐ Saturated ☐ Shallow ☐ Compacted ☐ Pavement over roots ☐ _____ % Describe _____
 Prevailing wind direction _____ Common weather Strong winds ☐ Ice ☐ Snow ☐ Heavy rain ☐ Describe _____

Tree Health and Species Profile

Vigor Low ☐ Normal ☐ High ☐ Foliage None (seasonal) ☐ None (dead) ☐ Normal _____ % Chlorotic _____ % Necrotic _____ %
 Pests _____ Abiotic _____
 Species failure profile Branches ☐ Trunk ☐ Roots ☐ Describe _____

Load Factors

Wind exposure Protected ☐ Partial ☐ Full ☐ Wind funneling ☐ _____ Relative crown size Small ☐ Medium ☐ Large ☐
 Crown density Sparse ☐ Normal ☐ Dense ☐ Interior branches Few ☐ Normal ☐ Dense ☐ Vines/Mistletoe/Moss ☐ _____
 Recent or planned change in load factors _____

Tree Defects and Conditions Affecting the Likelihood of Failure

— Crown and Branches —

Unbalanced crown ☐ LCR _____ % Cracks ☐ Lightning damage ☐
 Dead twigs/branches ☐ _____ % overall Max. dia. _____ Codominant ☐ Included bark ☐
 Broken/Hangers Number _____ Max. dia. _____ Weak attachments ☐ Cavity/Nest hole _____ % circ.
 Over-extended branches ☐ Previous branch failures ☐ Similar branches present ☐
Pruning history
 Crown cleaned ☐ Thinned ☐ Raised ☐ Dead/Missing bark ☐ Cankers/Galls/Burls ☐ Sapwood damage/decay ☐
 Reduced ☐ Topped ☐ Lion-tailed ☐ Conks ☐ Heartwood decay ☐
 Flush cuts ☐ Other _____ Response growth _____
 Main concern(s) _____
 Load on defect N/A ☐ Minor ☐ Moderate ☐ Significant ☐
 Likelihood of failure Improbable ☐ Possible ☐ Probable ☐ Imminent ☐

— Trunk —

Dead/Missing bark ☐ Abnormal bark texture/color ☐
 Codominant stems ☐ Included bark ☐ Cracks ☐
 Sapwood damage/decay ☐ Cankers/Galls/Burls ☐ Sap ooze ☐
 Lightning damage ☐ Heartwood decay ☐ Conks/Mushrooms ☐
 Cavity/Nest hole _____ % circ. Depth _____ Poor taper ☐
 Lean _____ ° Corrected? _____
 Response growth _____
 Main concern(s) _____
 Load on defect N/A ☐ Minor ☐ Moderate ☐ Significant ☐
 Likelihood of failure Improbable ☐ Possible ☐ Probable ☐ Imminent ☐

— Roots and Root Collar —

Collar buried/Not visible ☐ Depth _____ Stem girdling ☐
 Dead ☐ Decay ☐ Conks/Mushrooms ☐
 Ooze ☐ Cavity ☐ _____ % circ.
 Cracks ☐ Cut/Damaged roots ☐ Distance from trunk _____
 Root plate lifting ☐ Soil weakness ☐
 Response growth _____
 Main concern(s) _____
 Load on defect N/A ☐ Minor ☐ Moderate ☐ Significant ☐
 Likelihood of failure Improbable ☐ Possible ☐ Probable ☐ Imminent ☐

VILLAGE OF MCFARLAND URBAN FORESTRY MANAGEMENT PLAN

Risk Categorization																							
Condition number	Tree part	Conditions of concern	Part size	Fall distance	Target number	Target protection	Likelihood												Risk rating of part (from Matrix 2)				
							Failure				Impact				Failure & Impact (from Matrix 1)					Consequences			
							Improbable	Possible	Probable	Imminent	Very low	Low	Medium	High	Unlikely	Somewhat	Likely	Very likely		Negligible	Minor	Significant	Severe
1																							
2																							
3																							
4																							

Matrix 1. Likelihood matrix.

Likelihood of Failure	Likelihood of Impacting Target			
	Very low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2. Risk rating matrix.

Likelihood of Failure & Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Notes, explanations, descriptions _____

Mitigation options _____ Residual risk _____
 _____ Residual risk _____
 _____ Residual risk _____
 _____ Residual risk _____

Overall tree risk rating Low ☐ Moderate ☐ High ☐ Extreme ☐ Work priority 1 ☐ 2 ☐ 3 ☐ 4 ☐
 Overall residual risk Low ☐ Moderate ☐ High ☐ Extreme ☐ Recommended inspection interval _____
 Data ☐ Final ☐ Preliminary Advanced assessment needed ☐ No ☐ Yes-Type/Reason _____
 Inspection limitations ☐ None ☐ Visibility ☐ Access ☐ Vines ☐ Root collar buried Describe _____

This datasheet was produced by the International Society of Arboriculture (ISA) and is intended for use by Tree Risk Assessment Qualified (TRAQ) arborists – 2013

Appendix I: ANSI Z133.1 Standards – Applies to All Sections

All of the ANSI Z133.1 safety standards shall apply to all tree care operations outlined in the Urban Forestry Management Plan. Listed below is a basic overview of the standard, and it is not verbatim. A full text of this manual will be made available to all Village of McFarland employees and contractors involved with tree care operations.

1. All tools and equipment utilized during tree care operations, including those not specifically mentioned below, shall be inspected and maintained by qualified personnel in accordance with the manufacturer's care instructions.
2. All staff shall be trained in the proper use, inspection, and maintenance of said equipment.
3. Certified arborists or arborist trainees shall conduct job briefings daily prior to tree care operations of any kind and the information shall be communicated to all workers.
4. All activities performed on any job site for any activity outlined in this Urban Forestry Management Plan shall comply with all applicable OSHA guidelines and standards.
5. Traffic and pedestrian control shall be established around the job site prior to the beginning of tree care operations.
6. Emergency contact information and a safety kit conforming to the ANSI Z308.1 standards shall be made available to all workers. All employees shall have basic instruction on the use of CPR and First Aid.
7. Personal Protective Equipment (PPE) shall be required when there is a reasonable probability of injury or illness on the job site. Such a determination will be made by the Certified Arborist or Arborist Trainee prior to the beginning of tree care operations each day, and PPE shall be made available. PPE shall be well-maintained in accordance with the manufacturer's requirements.
8. Head protection shall conform to ANSI Z89.1, face and eye protection shall conform to ANSI Z87.1, respiratory protection shall comply with ANSI Z88.2, and leg protection shall always be worn when using a chainsaw.
9. Flammable liquids shall be kept a minimum of ten feet from open sources of flame or high heat and shall be stored in approved containers.
10. All Village staff and contractors working near electrical hazards shall be qualified to do so and shall be educated in the full ANSI standards for Electrical Hazards and Line Clearance.
11. Vehicles and mobile equipment shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements and shall be equipped with all standard safety devices, decals, and instructions, and shall be operated within all federal, state, and local motor vehicle codes and ordinances.

12. Aerial devices shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements, and shall be equipped with all standard safety devices, decals, and instructions.
13. Aerial devices shall be stabilized by wheel chocks, outriggers, or stabilizers as necessary for the device, and shall never be used to lift, hoist, or lower logs or equipment unless specifically designed to do so.
14. Aerial devices shall be equipped with fall protection devices and permanent load ratings, both in accordance with ANSI/SIA 92.2 or 92.5, as applicable to the specific aerial device.
15. No aerial device shall be allowed to make contact with electrical conductors, and minimum safe distances shall be maintained in accordance with the ANSI Z133.1 Standard.
16. All brush chippers shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements, and shall be equipped with all standard safety devices, decals, and instructions.
17. Sprayers and related plant health care equipment shall be inspected and maintained by qualified personnel in accordance with the manufacturer's requirements, and shall be equipped with all standard safety devices, decals, and instructions.
18. Sprayer tanks or other similar enclosed spaces shall not be entered unless performed through a confined-space entry plan in accordance with OSHA 1910.46 Requirements, including air-quality testing, training, and PPE.
19. Chain saws and other similar portable power tools shall not be operated unless the manufacturer's safety devices are in proper working order. Such safety devices shall not be removed or modified.
20. Forestry staff shall have a minimum of two points of attachment to the tree or aerial device while operating a chainsaw at all times, unless the hazard posed by the second point of attachment poses a greater hazard than utilizing one point of attachment.
21. A visual hazard assessment, including a root collar inspection, shall be performed by a certified arborist or arborist trainee prior to climbing, entering, or performing work in or on any tree, and a second crew member shall be within visual or voice communication at all times during arboricultural operations that are in excess of 12 feet from the ground surface.
22. All ropes, saddles, carabiners, and other similar climbing equipment shall be: a) approved for use in the tree care industry by the manufacturer, b) have a minimum breaking strength or load capacity of 5,000 lbs., c) be inspected before each use, d) Equipment shall be removed from service when it shows signs of excessive wear or deterioration.

23. All pruning, removal, and rigging operations shall have a designated drop zone where limbs, trunks, and tools can be dropped from aloft without impacting pedestrians or passersby. A visual or verbal communication system between the employee aloft and the employee(s) on the ground shall be established to determine when the employee aloft will safely drop tree parts or tools.
24. Any tree parts which cannot be safely dropped or controlled from aloft shall have a separate rigging line tied to them to help control their fall. The tree shall be inspected for structural stability prior to the establishment of a rigging system in the tree. When trees appear to have defects that could jeopardize the ability to safely use a rigging system to drop or control a limb, an alternate plan shall be implemented.
25. All equipment utilized in rigging shall meet the load ratings for the limb being rigged, and a qualified employee, trained in proper rigging procedure shall determine the rigging procedure and equipment to be utilized. Any equipment which has been damaged or overloaded shall be removed from service.
26. When felling (removing) a tree, a crew leader shall make the determination of what equipment is necessary, and how many crew members are to be directly involved in drop zone operations. A well-established escape route shall be planned for involved workers prior to the beginning of felling operations. Any non-involved workers shall be beyond twice the height of the trunk or tree being removed during felling operations.
27. Notches shall be used on all trees and trunks greater than five inches in diameter during felling operations, and should conform to the standards set forth in the ANSI Z133.1 Standard.
28. Loose clothing, ropes, lanyards, and saddles shall not be worn during any tree care activity where the risk of entanglement with tools or machinery is possible, particularly with brush chippers.

Appendix J: Tree Planting Standards (ANSI/ISA BMP)

ANSI Z60.1

1. All root ball and container sizes for all balled and burlapped stock shall conform to the Z60.1 standards for width and depth, such that they encompass enough of the fibrous root system as necessary for the full recovery of the plant upon installation.
2. All bare root stock shall conform to ANSI Z60.1 standards for minimum root spread.
3. All containerized stock shall conform to ANSI Z60.1 standards for plant and container size, as specified by the Village, and shall be healthy, vigorous, well-rooted and established in the container in which it is growing. The root system shall reach the sides of the container, but shall not have excessive growth encircling the inside of the container.
4. All collected plants (those grown on unmanaged land) shall be so designated, and shall be considered to be nursery-grown stock when they have been successfully reestablished in a nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons.
5. The trunk or stem of the plant shall be in the center of the ball or container, with a 10% overall variance in location.
6. The use of digging machines in both the packaging and installation of trees is considered an acceptable nursery practice.

ANSI A300 – Part 6

1. Planting sites and work sites shall be inspected for hazards by the Village prior to the beginning of work each day. If portions of the work site are outside of the original scope of work, the controlling authority shall be notified immediately.
2. Location of utilities, obstructions, and other such hazards above and below ground shall be taken into account prior to planting and transplanting operations. These include, but are not limited to, gas, electric, sewer, communication, drainage, and signage.
3. The following shall be taken into consideration prior to transport and planting: Requirements of individual trees, compass orientation of field-grown trees, site feasibility assessments, soil assessment, and drainage assessment.
4. Tools for planting and transplanting shall be properly labelled or purchased for their intended use, and be maintained in accordance with the manufacturer's recommendations
5. The system used to move and store the plant shall minimize desiccation and other damage to the crown, trunk or rootball, and the health and vigor of the plant shall be maintained during these periods.

6. The hole to be dug for all new plantings shall be a minimum of 150% larger than the rootball or container diameter, as deep as the root flare of the tree to be planted, and shall have sides from which soil has been loosened in order to aid in root penetration.
7. For balled and burlapped trees, all rootball supporting materials shall be removed from the upper third of the rootball, and removed from the planting hole prior to final backfilling.
8. Prior to planting, container root balls shall be managed by approved methods such as, shaving the root ball, slicing the root ball, and redirecting or removing encircling roots.
9. Backfill shall comprise of either the same soil created when the hole was excavated, or a similarly amended mixture to meet a specific objective, and shall be applied in a layered fashion to reduce future settling and prevent air pockets.
10. Mulch shall be applied at a depth of two to four inches, near - but not touching - the trunk of the tree, and extending to the perimeter of the planting.
11. Support systems such as guy-wires or stakes shall not be installed except where needed.

ISA BMP Manual – Tree Planting

1. Timing of planting shall be determined based on the species, and the best professional opinion of the employees of or contractors working for the Village of McFarland.
2. All employees and contractors employed by or working for the Village of McFarland shall be familiar with the following types of planting types, and when it is appropriate to use each:
 - A. **Bare-Root:** Field-grown, and dug without soil during the dormant season
 - B. **Ball and Burlap:** Field grown and packaged with a soil ball, using burlap, twine, and a retaining basket of some kind
 - C. **Tree Spade:** Transplanted using a mechanical tree spade to hold the soil ball during transport
 - D. **In-Ground Fabric Bag:** Field grown with the root mass contained in a semi-permeable fabric bag
 - E. **Container Grown:** Grown above ground in containers of various shapes, sizes, and materials
3. Trees packaged with root balls must have their first structural root within two inches of the soil surface. Trees with deeper structural roots will not perform well when transplanted, and should be avoided when selecting nursery stock.

4. Trees with root balls shall be handled by the ball, not the stem, to ensure no damage occurs to the root-soil interface or to the stem itself.
5. Trees with leaves shall be transported with a fabric tarp to minimize desiccation, and have had their root balls wetted prior to transport.
6. Sites shall be tested for drainage, nutrient levels, and pH prior to planting (or prior to species selection, if possible).
7. Container stock shall be removed from its container. For balled and burlapped trees, wrappings shall be left on until the tree is in the hole; wrapping shall then be removed from the third to fourth of the wire basket and burlap from the top of the ball. For all types, ensure any encircling (girdling) roots are removed, and root ball is shaved as necessary.
8. As soil is added, wet and tamp each layer down to ensure good moisture and reduction of air bubbles.
9. Do not prune trees at time of planting, unless to remove dead, dying, diseased, or cracked branches, as it may take away from root development to have the tree attempt to heal these above-ground wounds.
10. The use of trunk wrap may be considered in areas with harsh winters, specifically on trees with thin bark, such as London Planetree and certain Maple species.

Appendix K: Tree Pruning Standards (ANSI/ISA BMP)

ANSI A300 - Part 1

1. A designated Arborist or Arborist Trainee shall visually inspect each tree before beginning work. If any condition is observed above and beyond the original scope of work, said condition shall be reported to the controlling authority before any work begins.
2. Pruning cuts which remove a branch at its point of origin shall be made close to the trunk or parent branch without cutting into the branch-bark collar or leaving a stub.
3. Pruning cuts made to reduce the length of a limb or parent stem shall be made at a slight angle relative to the remaining stem, and not damage the remaining stem. If pruning to a lateral branch, the lateral should be large enough to assume the terminal role.
4. Final cuts shall be made such that the result is a flat surface, with the adjacent bark firmly attached.
5. Not more than 25% of the foliage shall be removed during an annual growing season, depending on the tree species, size, age, and condition. If more frequent pruning due to utilities, vistas, or health considerations is necessary, removal of the tree should be considered as an alternative to pruning.

ISA BMP Manual

1. All employees or contractors directly involved with the pruning of trees shall be familiar with the following pruning types and how they are to be used in conjunction with one another:
 1. **Pruning to Clean:** Selective removal of dead, diseased, detached, cracked, and broken branches
 2. **Pruning to Thin:** Selective removal of small live branches to reduce crown density
 3. **Pruning to Raise:** Selective removal of branches to provide vertical clearance
 4. **Pruning to Reduce:** Selective removal of branches and stems to decrease the height or spread of a tree or shrub
 5. **Structural Pruning:** Selective removal of live branches and stems to influence the orientation, spacing, growth rate, strength of attachment, and ultimate size of branches and stems
 6. **Pruning to Restore:** Selective removal of branches, sprouts, and stubs from trees and shrubs which have been topped, severely headed, vandalized, lion-tailed, storm damaged, or otherwise damaged
2. Every effort shall be made to time pruning of individual tree species to be done in accordance with best management practices for the tree species in question. All pruning work shall be done so at the discretion of the Village of McFarland and its approved contractors.

Appendix L: Tree Protection (ANSI/ISA BMP)

ANSI A300 – Part 5

1. Tree management plans and specifications for tree management shall be written and administered by a certified arborist qualified in the management of trees and shrubs during site planning, development, and construction. Such activities may include, but are not limited to: demolition, grading, building construction, walkway or roadway construction, excavation, trenching and boring, or other such activity which has the potential to negatively impact trees.
2. The management of trees and shrubs shall be incorporated into the following phases of the site development process:
 - A. Planning
 - B. Design
 - C. Pre-Construction
 - D. Construction
 - E. Landscape
 - F. Post-Construction
3. During the Planning phase, an assessment of tree and shrub resources on the site shall be performed by a certified arborist. The assessment shall identify the species, condition, and size of each tree and shall be incorporated into the site design. Trees to be retained or protected shall appear on site design maps. Trees on neighboring property which could also be impacted should also be considered.
4. During the design phase, a tree management report shall be developed for trees to be conserved on the site, and shall be included in the construction plans and specifications, which may include, but are not limited to:
 - A. Trees to be retained
 - B. Tree and Root Protection Zones
 - C. Tree Protection Zone barriers
 - D. Tree Protection plans
 - E. Soil erosion control
 - F. Soil compaction controls
 - G. Staging and storage areas
 - H. Other relevant on-site activities

5. Grading and demolition plans shall include all trees to be retained and removed, as well as the tree protection plans for working around trees to be retained. Plans shall also include equipment routes for avoiding the TPZ. Consequences for non-compliance shall be specified.
6. During the pre-construction phase, all tree protection plans shall be effectively communicated to all parties involved with the site development, and tree protection zone barriers shall be in place prior to the beginning of any construction activities.
7. The TPZ shall be delineated around all trees to be protected during construction, and shall be based on the size, species, and condition of the tree and its root system. Six to 18 times the diameter of the tree is generally considered to be acceptable. Deviations from this diameter may be made at the discretion of a certified arborist. Activities which could damage tree roots or compact soil should be avoided in the TPZ
8. Fencing or other visible barriers to the TPZ shall be installed prior to site clearing, grading, and demolition, and maintained throughout the construction and landscaping phase. When this is not feasible, alternate methods may be considered.
9. During the construction phase, compliance with tree protection plans shall be monitored by a certified arborist, and any damage to tree barriers or trees, or non-compliance shall be reported to the project manager or owner, or other controlling authority.
10. When removing vegetation or pavement during demolition, equipment used adjacent to the TPZ shall be specified to avoid damage to the tree and the surrounding soil, and soil protection measures shall be in place prior to vehicle or heavy traffic in or near the TPZ.
11. Storage or disposal of construction materials or hazardous materials shall not occur in the TPZ.
12. Fill within the TPZ shall not be permitted without mitigation to allow for proper air and water availability to existing roots. If fill cannot be avoided in the TPZ, compaction of fill shall be avoided, and consideration shall be given to a permanent well installation to protect the tree and its roots.
13. During the landscape, irrigation, and lighting phase, levels of compliance shall be documented and reported by a certified arborist. Non-compliance shall be reported to the project manager.
14. During the post-construction phase, a remedial and long-term maintenance plan shall be specified for existing and new landscaping, to ensure success of preservation efforts and newly planted landscaping.
15. Pruning shall be considered to reduce wind sail when necessary. It should not be considered to compensate for root loss.
16. Mulch shall be applied to as much of the tree protection zone as possible, in order to create a favorable soil environment for root recovery after construction activities.

ISA BMP Manual

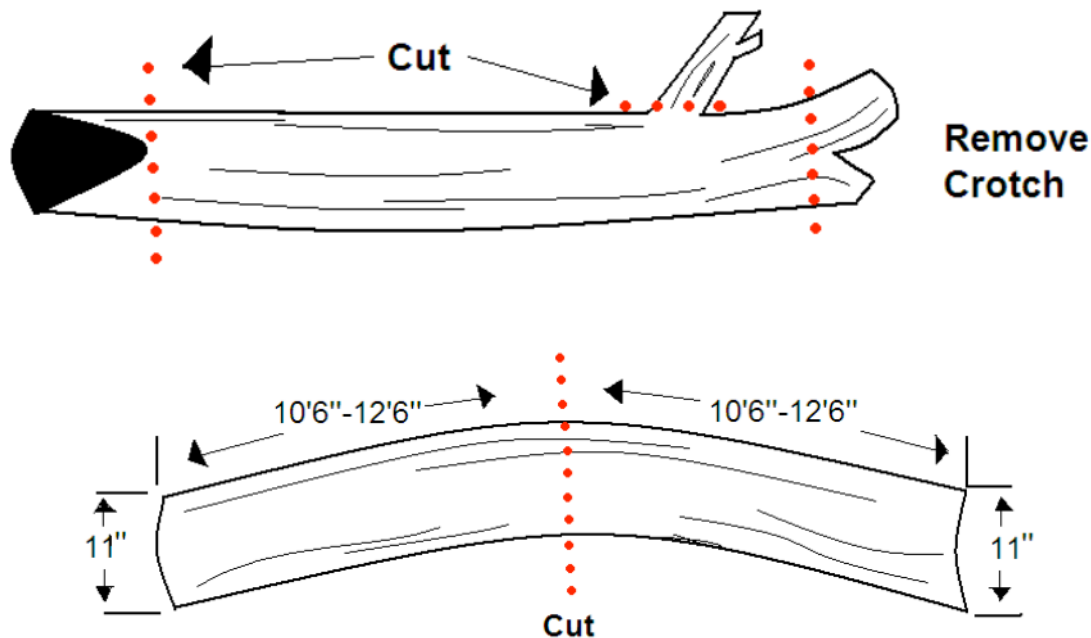
1. A cost-benefit analysis shall be conducted during the planning phase. In some cases, money may be better invested in tree planting post-construction.
2. The species and age of tree shall be evaluated by a certified arborist, so that trees in good condition with desirable characteristics are preserved, but those in poor condition or with undesirable characteristics are not.
3. A tree inventory and tree management report shall be conducted during the planning phase, and a certified arborist shall work closely with developers to ensure best management practices are being met for both parties.
4. Effort shall be made to retain groups of trees, such that there is a wind and solar buffer around the highest quality trees if possible.
5. The Critical Root Zone (CRZ) is the area around the tree trunk where roots essential for tree health and stability are located. A Tree Protection Zone (TPZ) is an arborist-defined area around the tree which should include the CRZ, as well as additional area to ensure future stability and growth. The TPZ is subject to the professional opinion of the certified arborist.
6. An attempt shall also be made to preserve native soil for landscape planting as native soil with horizons and development is preferred over fill or black dirt.
7. If a sufficient TPZ cannot be established, a 6-12" layer of hardwood mulch, 3/4-inch plywood mat over a four-inch layer of hardwood mulch, or other such measures shall be temporarily installed over the CRZ in order to prevent root and soil compaction.
8. Trunk protection shall be installed on trees very close to construction activities, and should consist of 2x4 or 2x6 planks, strapped snugly to the tree trunk with wire or other strapping, preferably with a closed-cell foam between the trunk and the planks.
9. When roots over one inch cannot be avoided, they shall be pruned, not left torn or crushed. Acceptable methods of pruning are:
 - A. Excavation using supersonic air tools, pressurized water, or hand tools, followed by selective root cutting
 - B. Cutting through the soil along a predetermined line with a tool designed to cut roots
 - C. Mechanically excavating the soil and selectively pruning remaining roots.
10. Wells, tree islands, retaining walls, and other such structures or strategies shall be considered as alternatives to any cut/fill work in the CRZ or TPZ.
11. Monitoring shall take place during construction and post-construction phases, and any non-compliance should be reported to the proper controlling authority right away, so that timely remediation or mitigation efforts may be undertaken.

Appendix M: Urban Timber Harvesting

Log Removal Specification for Urban Timber Harvesting

This tree removal standard shall not take precedence over applicable industry safe work practices and shall be implemented by a qualified arborist, urban forest manager, and /or practitioner who, through related training or on-the-job experience, or both, are familiar with the standards, practices and hazards of recovering urban forest products and the equipment used in such operations. Additionally:

- Logs shall be felled to obtain minimum 8', 10', or 12' lengths with an additional 6" of trim on each log to a minimum diameter of 11" inside the bark. Maximum log length shall be 20'6".
- If a tree must be removed in sections, every effort should be made to retain the lowest log, at the longest possible length that can be safely felled.
- Branches should be trimmed flush with the bole/trunk, root flares should be trimmed flush with the bole/trunk, and the ends of the log should be square.
- Logs shall be flush cut with no crotches or splits. All obvious defects such as decay, large holes, and rot shall be removed.
- Logs with significant sweep shall be cut in order to eliminate as much sweep as possible while yielding the longest possible straight logs to ensure logs are flush for proper milling.



McFarland
SUMMARY SHEET

MEETING DATE: Monday, March 11, 2024

SECTION: Business

DEPARTMENT: Community Development

CONTACT: Kong Thao, Associate Planner

AGENDA ITEM: Discussion and action to submit the Village of McFarland's 2023 Green Tier Annual Report to the Wisconsin Department of Natural Resources.

PREVIOUS ACTION:

ISSUE SUMMARY:

The Wisconsin Department of Natural Resources (WDNR) established the Green Tier Legacy Communities (GTLC) network to advance sustainable practices and stretch limited local government resources. GTLC offers regional collaboration opportunities and additional grant point consideration for select state grants, grant notifications and opportunities for joint grant application. As part of the program, participating communities are required to provide the WDNR with an annual report. The 2023 Green Tier Annual Report will be the Village's third annual report submitted to the Wisconsin Department of Natural Resources. All subsequent data for the reporting reflects activity achieved in 2023.

GTLC's website is up and fully functional. The packet includes a simplified copy of the Village's 2023 metrics and supporting actions spreadsheets to be imputed to the website. The data has been collected through collaborative efforts across all Village departments. Staff note that the due date for reports to be submitted is March 31st. The supporting actions are intended to be recommended activities to pursue, and not required by GTLC. Additionally, Staff is still waiting on a few data items for the report. Below are some highlights from the report comparing the past three years of data reporting.

Energy & Emissions. Renewable Energy Generated from Solar

- 35.22 MWh (2023)
- 33.03 MWh (2022)
- 24.41 MWh (2021, year of installation)

Transportation Systems. Cumulative miles of complete streets

- 57.75 miles (2023)
- 57.7 miles (2022)
- 56.06 miles (2021)



Water Quality & Conservation. Community Water Use

- 24,867.84 gal/capita (2023)
- 23,882.35 gal/capita (2022)
- 24,584.82 gal/capita (2021)

Solid Waste. Landfill waste reduction (pounds per capita)

- 440.61 (2023)
- 460.31 (2022)
- 468.81 (2021)

Health & Equity. Volunteerism in local government from events, committees, work groups, etc. Staff notes that the values provided are estimates from village-hosted events. The 2023 stat is still awaiting a few responses from other departments. Staff anticipate the respective departments will provide this estimate prior to the due date for the report.

- 13* (2023)
- 358 (2022)
- 121 (2021)

FINANCIAL/BUDGET IMPACT:

None.

VILLAGE PLAN REFERENCE:

ORDINANCE REFERENCE:

Sec. 2-398(a). - Sustainability & Natural Resources Committee

(a) Reviewing and submitting annually to the Wisconsin Department of Natural Resources the Village's Green Tier Legacy Community Annual Report and advising on the implementation of recommended Green Tier strategies.

BOARD, COMMISSION OR COMMITTEE RECOMMENDATION:

Motion, and second, to approve submittal of the Village of McFarland's 2023 Green Tier Annual Report to the Wisconsin Department of Natural Resources.

ATTACHMENTS:

1. GTLC Metrics_VOM 2023
2. GTLC Supporting Actions_VOM 2023

Green Tier Legacy Communities Report, 2023

Sustainability & Natural Resources 03.11.2024

Energy & Emissions (1)

Metric ID	Metric	Core Metric?	Data Format	Description	Annual Data	GTLC Member Notes
ER-1	Municipal Use of Renewable Electricity	Yes	%	Percentage of the local government's (GTLC member's) overall electricity consumption that comes from renewable energy sources.	2%	
ER-2A	Community Electricity Use	No	Annual kWh per capita	Electricity use in the member community	Pending	Alliant Energy reported with data for Zip Code;
ER-2B	Community Natural Gas Use	No	Annual therms per capita	Natural gas use in the member community	Pending	Alliant Energy reported with data for Zip Code;
ER-3A	Government Electricity Use	Yes	Annual kWh per capita	Gross electricity consumption (kWh) by the local unit of government (GTLC member)	162.31	Total Municipal annual electricity consumption (kWh) = 1,527,056; Renewable Energy generated from Public Works Solar = 35.22 MWh = 35,220 kWh; DOA Population Est. in 2023 = 9,625
ER-3B	Government Natural Gas Use	Yes	Annual therms per capita	Total natural gas consumption (Therms) by the local unit of government (GTLC member)	6.68	(Alliant - 63,663 Therms) + (MGE - 594 Therms); DOA Pop est. = 9,625
ER-3C	Government Fuel Oil Consumption	Yes	Gallons per capita	Total building fuel oil consumption (gallons) by the local unit of government (GTLC member)	1.88 gallons/capita	18,064.39 gallons of fuel; DOA Pop est. = 9,625
ER-3D	Government Propane Consumption	Yes	Lbs per capita	Total building propane consumption (pounds) by the local unit of government (GTLC member)	0	Total Municipal propane consumption = 0; DOA Population Est. in 2023 = 9,625
ER-4	Government building Energy Use Intensity (EUI)	Yes	kBtu/sq ft	Overall energy use intensity of all consistently occupied buildings owned by the local unit of government (GTLC member).	75.25	Total Municipal annual electricity consumption (kWh) = 1,527,056 (-27,945 kWh from US Hwy 51 Lighting, -952 kWh from Flower Corner, -23 kWh from 4905 Farwell Flasher, -40 kWh from Creamery Rd Flasher, -65 from 5204 Farwell Flasher, and -144 from Bashford Flasher); after kWh to kBtu conversion =(DIFF * 3.412); Total Municipal annual gas consumption (Therms) = 63,663+594; conversion of Therms = 64,257*100; total sf of all "enclosed"
ER-5A	Number of sustainable government buildings	Yes	Count	Number of sustainability-certified buildings owned by the local unit of government (GTLC member).	1	Net Zero Public Safety Center Completed in 2023
ER-5B	Number of sustainable buildings in the community	No	Count	Number of sustainability-certified privately owned buildings in the member community	1	Net Zero Public Safety Center
ER-6	GHG emissions intensity - government facilities	No	Metric tons per capita	Metric tons of carbon dioxide equivalents (CO2e) emitted from energy consumed by government buildings	145.86	Alliant Energy = 1,527,056 kWh & 63,663 Therms; and MGE - 21,419 kWh & 594 Therms. DOA Pop. Est. 2023 = 9,625

Energy & Emissions (2)

ER-7	Transportation fuel use	No	Gallons per capita	Gallons of gasoline and diesel transportation fuel used by vehicles owned by the local government.	3.02	18,064.39 gallons of fuel; Diesel fuel = 8,263.55 gal Voyager + 2,716.2 gal Zurbuchen; DOA Pop est. = 9,625
ER-8A	Hybrid and electric vehicles	No	Number	Number of EVs and hybrids in the local government's (GTLC member's) fleet.	1	1 EV: 45 Total vehicles
ER-8B	Hybrid and electric vehicles	No	%	Percentage of EVs and hybrids in the local government's (GTLC member's) fleet.	2%	1 EV: 45 Total vehicles
ER-9A	Alternative fuel vehicles	Yes	Number	Number of alternative fuel vehicles in the local government's (GTLC Member's).	0	
ER-9B	Alternative fuel vehicles	Yes	%	Percentage of alternative fuel vehicles in the local government's (GTLC Member's).	0	

Transportation Systems

Metric ID	Metric	Core Metric	Data Format	Description	Annual Data	GTLC Member Notes
TS-1A	Miles of bike infrastructure	Yes	miles of bikeways / centerline miles of motor vehicle roads	Miles of designated bike ways and biking infrastructure like painted bike lanes, designated bike boulevards, bike paths/shared paths, etc.	1.05	26.32 miles of bikeways / 24.99 miles of ROW (no change or additional street)
TS-1B	Miles of Pedestrian Infrastructure	Yes	Miles	Miles of designated pedestrian infrastructure like sidewalks, trails, pathways, etc.	31.85	168,183 feet of pedestrian walkways/infrastructure; (168,183 / 5280 =31.43)
TS-2	Walking infrastructure	No	Walk score average	Average Walk Score for the community	64	
TS-3	Increase in complete streets	No	Count	Cumulative miles or feet of complete streets projects constructed	57.75	138,993.27 ft or 26.32 mi of bikeways; 168,183.43 miles of pedestrian walkways/infrastructure
TS-4	Publicly accessible EV charging stations	No	Count	Number of publicly accessible EV charging stations	0	
TS-5	Traffic fatalities & serious injuries	No	Number per capita	number per capita	0.00	1 fatality, 1 suspected serious injury; DOA Pop est. = 9,625

Land Use

Metric ID	Metric	Core Metric?	Data Format	Description	Annual Data	GTLC Member Notes
LU-1	Number of known polluted sites	Yes	(% of known sites)	Percent of known brownfield sites that have been remediated in the municipality or county. If none, then state NA.	98%	159 remediated / 162 activities found
LU-2	Total green space acreage	Yes	acres	Total healthy green space acreage that is publicly accessible, including parks, natural areas, wildlife corridors, etc.	376.4 acres	No change from 2022
LU-3	Accessibility and connectivity of trails and paths	Yes	miles per capita	Miles of recreational trails or shared use pathways per capita	0.003	138,993.27 ft or 26.32 mi of bikeways; DOA Pop est. - 9,625
LU-4	Accessibility to open green space and parks	Yes	% of residential properties within .5 miles	Percent of all residential properties within .5-mile radius of dedicated open green spaces or parks.	99%	
LU-5	Tree canopy	No	% of tree canopy maintained by Muni/County	Estimate the percent of City or County managed tree canopy that received inspections or maintenance from municipal or county staff or a hired consultant in the reporting year.	15%	15% estimate from Village Forester
LU-6	Impervious area	No	% Imperviousness City Wide	Decrease or maintain amount of impervious surfaces within the municipality		
LU-7	Flood vulnerability	No	% of Total Properties	Percent of all properties within the county or municipality that are impacted by the 100-year floodplain, flood storage district, floodway, or flood fringe.		
LU-8	Land conservation practices		Acres held for conservation	Number of acres held primarily for conservation (this can include acres that are accessible for recreational purpose) in deeds or by conservationist groups, including those held by public institutions. Must be publicly accessible.	277.97	Total area of CO zoned parcels = 277.97 (2022); No change occurred in conservation lands added or lost.
LU-9	Sustainable agricultural practices		Acres dedicated for sustainable practices	Number of acres of agricultural land that has been voluntarily dedicated for sustainable conservationist agricultural practices.	NA	

Water Quality and Conservation

Metric ID	Metric	Core Metric?	Data Format	Description	Annual Data	GTLC Member Notes
WQC-1	Surface water pollutants – Phosphorus	Yes	%	Phosphorus runoff aggregated for the entire municipality	27%	Data from MS4
WQC-2	Surface water pollutants - Suspended solids	Yes	%	Suspended solids in stormwater runoff aggregated for the entire municipality	47%	Data from MS4
WQC-3	Surface water pollutants - illicit discharges	Yes	%	Percent of municipally managed stormwater outfalls inspected for illicit discharges of pollutants	100%	Data from MS4
WQC-4	Water use – Government	Yes	gallons per capita	Total volume of water used in municipal operations	133.19 gallons/capita	MC 231,000; PW 330,000; Legion 52,000; Library 67,000; Youth Center 28,000; PSC 574,000. TOTAL 1,282,000. Population DOA 9,625
WQC-5	Water use – Community	Yes	gallons per capita	Total volume of water used in the community	24,867.84 gallons/capita	239,353,000 gallons pumped in 2023. Population DOB 9625
WQC-7	Maintain clean potable water resources	No	%	Percent of the known number of existing lead water service lines replaced during reporting year, if completed, please state 100%	NA	No known lead service lines
WQC-8	Surface water pollutants – Salt	Yes	pounds per mile	Pounds of salt applied during snow and ice management per miles of streets receiving snow and ice maintenance	3888.89 lbs per mile	Salt 175 tons; Brine 2500 gallons; Lane Miles 90
WQC-9	Surface water pollutants – Sewer Inspections	No	%	Percent of sanitary sewer annually inspected by televising sewer lines or by some other method	33%	1/3 of the Village is inspected by televising per year
WQC-10	Surface water pollutants - manholes and grease traps	No	%	Percent of sanitary manholes and grease traps inspected each year.	Manholes 33%; Grease traps 50%	

Solid Waste

Metric ID	Metric	Core Metric?	Data Format	Description	Annual Data	GTLC Member Notes
SW-1	Landfill Waste	Yes	Tons/yr or cu. yds/yr, per capita	Annual tonnage of waste received at landfill locations (both municipal and residential).	0.22	62.4 tons (Municipal); 2,037.24 tons (Community); DOA Pop. Est. = 9,625
SW-2	Recycling	Yes	Tons/yr or cu. yds/yr, per capita	Annual tonnage of recyclable waste received at recycling locations (both municipal and residential).	0.09	31.2 tons (Municipal); 838.59 tons (Community); DOA Pop. Est. = 9,625
SW-3	Composting	No	Tons/yr or cu. yds/yr, per capita	Annual tonnage of compostable organic waste received at municipal composting locations or annual tonnage of waste sent to private composting locations.	0	
SW-4	Contamination rate	No	% of Total Waste Tonnage	Rate of cross-waste stream contamination	0	
SW-5	Construction and Demolition Waste	No	% of Total Waste Tonnage	Annual tonnage of Construction and Demolition (C&D) waste collected for recycling and diverted from landfills.		Unknown

Health and Equity

MUNICIPALITIES AND COUNTIES						
Metric ID	Metric	Core Metric?	Data Format	Description	Annual Data	GTLC Member Notes
HEALL-1	DEI or HIAP education	No	Count	Number of community-wide DEI events (in person or virtual) hosted.	5	5 scheduled meeting;
HEALL-2	DEI or HIAP outreach	No	Count	Annual increase in followers on a dedicated health and equity or DEI on social media account.	N/A	The Village of McFarland does not have a dedicated health and equity or DEI social media account, just general account for Village
HEALL-3	DEI or HIAP resources	No	\$	Total budget allocated to DEI initiatives in the community or county.	\$210,000	Recodification of Subdivision and Zoning Codes - \$100,000; Closed Captioning \$55,000; Community Grant Program - \$15,000; Community Outreach/Risk Reduction - \$10,000; Programming - \$30,000
HEALL-4	Civic engagement - Voter turnout for local elections by percent of voting aged population	Yes	%	Voter turnout for local elections by percent of voting aged population	February Spring Primary - 36.3%; April Spring Election - 64.6 %	No Fall elections in 2023.
HEALL-5	Volunteerism in local government (events, committees, work groups, etc.)	No	Count	Number of community volunteers	13	13 Committee Members; (pending Katie and Heidi)
HEALL-6	Housing and transportation burden	Yes	%	Percentage of income spent on housing and transportation	48%	H+T Affordability Index; Housing = 27%, Transportation = 21%

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Energy & Emissions (1)

Supporting Action ID	Supporting Action	Year Implemented (if known)	Narrative
ERSA-1	Complete a municipal GHG inventory for Scope 1 emissions (emissions from sources controlled or owned by the organization) and Scope 2 emissions (indirect emissions associated with the purchase of electricity, steam, heat, or cooling) and establish baseline emissions	2023	Completed within Municipal Comprehensive Energy Plan
ERSA-2	Complete a municipal GHG inventory for Scope 3 emissions (emissions from assets not owned or controlled by the organization but that the organization indirectly affects in its value chain) and establish baseline emissions.	2023	Completed within Municipal Comprehensive Energy Plan
ERSA-3	Complete the ICLEI US Community Protocol and establish baseline emissions		
ERSA-4	Establish municipal and community-wide emissions reduction, energy reduction, onsite renewable energy and/or energy efficiency goals in a supporting plan or resolution.	2023	Completed within Municipal Comprehensive Energy Plan 2023 and Sustainability Plan, 2021 Energy Section
ERSA-5	Use Focus on Energy, utility Commitment to Community programs, and/or other resources to conduct energy assessments on municipal facilities that are identified as high energy users	2021, 2023	Energy Data usage is included within the Municipal Comprehensive Energy Plan, 2023 and Sustainability Plan, 2021.
ERSA-6	Use ENERGY STAR Portfolio Manager, or other software tools, to track energy use in all municipal facilities		In planning; Identified as a Mid-Term Action within the Energy Actions from the Sustainability Plan (page 15)
ERSA-7	Require new municipal buildings, and significant remodels of existing buildings, to be designed to achieve a sustainable building certification, such as an ENERGY STAR score of 75, or certification through LEED, WELL, Passive House, Net Zero Energy, Green Globes, or Living Building. The local government may specify the sustainability standard(s) that it will recognize and include an Energy Use Intensity (EUI) target in the construction contract	2023	Community Center Campus Plan completed in November 2023 identifying pursuit of Net Zero building designs with rooftop solar and geothermal.
ERSA-8	Increase visibility of renewable energy in the community by installing PV systems at government facilities and enable public access to electricity production data monitoring.	2021 (initial);	Ongoing efforts to maintain data monitoring sites for tracking of energy collection systems.
ERSA-9	Offer renewable energy purchasing or participation programs or promote existing programs from outside sources to residents and businesses.	2021, 2022, 2023	Ongoing; 31 solar permits recorded in 2021, 21 solar permits recorded in 2022; 31 solar permits recorded in 2023
ERSA-10	Take steps to simplify the solar permitting process and remove other barriers to residential solar implementation.	2023	In progress; In pursuit of SolSmart Gold designation
ERSA-11	Leverage Focus on Energy and University of Wisconsin System resources to offer public educational programs, or otherwise provide resources for interested parties, on energy efficiency upgrades for homes and businesses	2023	McFarland Sustainability Planning Page includes a collection of resources from various energy savings programs

Note: All items listed are intended as recommended and not required. Items without implemented years are considered "Ongoing" or "In Planning".

Energy & Emissions (2)

ERSA-12	Implement a plan to upgrade all municipally owned or controlled streetlights and stop lights to LED lamps.		Ongoing; Replacement to LED lighting will occur at failure
ERSA-13	Incorporate energy efficiency upgrades for lighting, HVAC and building shells for all municipal buildings into the community's capital improvement plan.	2023	Comprehensive Energy Plan in 2023 includes recommendations and actions for retrofit and building improvements.
ERSA-14	Make watt meters available to the public		
ERSA-15	Adopt an energy use disclosure ordinance for residential and/or commercial buildings (Requires the seller of a property to inform prospective buyers of the building's energy use for one, or more previous years).		
ERSA-16	Pass a resolution to commit to a community renewable energy usage goal, such as 100% renewable energy by 2050.	2021	Completed; Included Energy Section of the Sustainability Plan are similar energy independent goals (pg. 14)
ERSA-17	Purchase renewable electricity for municipal buildings	2021	In Planning;
ERSA-19	Capture biogas from wastewater treatment facility, landfill, or community compost facility and use biogas to power operations.		
ERSA-21	Include energy efficiency, renewable energy, and/or sustainable building certification requirements or incentives in TIF policies and other programs assisting commercial development projects.	2023	In Planning; Expected to be included within plan updates to Redevelopment Districts 1 & 2
ERSA-22	Improve all aspects of the energy reduction program by increasing the amount of grant funding awarded to the city/county and track the amount of funding annually by making it part of staff responsibilities to do so. Please elaborate on this action in the narrative portion of the report.	2023	In Progress; OEI EIGP funding was awarded for VOM application of a Level 3, Microgrid and Battery Storage at Public Safety Center

Transportation Systems

Supporting Action ID	Supporting Action	Year Implemented (if known)	Narrative
TSSA-1	Require bike parking for all new non-residential and multifamily uses.		To be considered in 2024 Zoning Code Update
TSSA-2	Set standard for placement and number (as function of intensity of use) of bike parking spaces.		To be considered in 2024 Zoning Code Update
TSSA-3	Create a public-facing resource showing all bike routes and pedestrian paths.	2020, 2023	Ongoing updates to Village interactive Zoning Map
TSSA-4	Identify, sign, maintain, and clear bike routes in the community year-round		Ongoing updates to Village interactive Zoning Map
TSSA-5	Receive certification by the League of American Bicyclists as a Bicycle Friendly Community. Work with businesses to promote bike commuting and active transportation.		In Planning; Identified as a Long-Term Action item within the Transportation Section of the Village's Sustainability Plan adopted in 2021 (page 17).
TSSA-6	Promote bike safety and other active living education and awareness sessions, through in-school education programming, bike rodeos, and other public-facing efforts; or work with a community organization to do the same		Ongoing; Police Department holds annual bike safety educational events
TSSA-7	Implement a bike-share program for residents and visitors		Ongoing;
TSSA-8	Require large employers (50+ employees) seeking rezoning to create a transportation demand management plan		
TSSA-9	Increase safe pedestrian and bike routes to parks and public greenspace and other key destinations (grocery stores, schools, other public facilities, etc.)		Included within McFarland East Side Plan, 2023 (Ch. 2, 2. Mobility Goal and Policies - Goal 2, Blend multi-modal transportation options into neighborhood design; and Chapter 4, pg. 72-73)
TSSA-10	Eliminate or reduce parking minimums from non-residential districts when applicable		In Planning; To be considered in 2024 Zoning Code Update
TSSA-11	Charge impact fees to developers for new roads and utilities		Ongoing; Developers are required to pay for new road and utilities to serve their projects with any upsizing costs to serve future growth paid by the Village or future benefiting property owners.
TSSA-12	Create and implement a plan to incorporate EVs, hybrids, and alternative fuel vehicles to municipal fleet vehicle replacement plan.	2023	Included within McFarland Comprehensive Plan, 2023 - Fleet Vehicles and Electrification, pg 50-57
TSSA-13	Install public EV charging stations		
TSSA-14	Create a policy and train staff that prohibits idling of municipal fleet vehicles for more than 5 minutes		Identified as a Mid-Term Action item within the Transportation Section of the Village's Sustainability Plan adopted in 2021.
TSSA-15	Ban idling of unoccupied vehicles community-wide		Identified as a Mid-Term Action item within the Transportation Section of the Village's Sustainability Plan adopted in 2021.
TSSA-16	Prepare a plan that identifies disconnections in bike and pedestrian networks, prioritizing fixes and identifying potential funding sources for the most important projects. Consider solving the last mile challenge where present.	2023	Included within 2022-2023 Capital Improvement Plan F. Transportation objectives 1.
TSSA-17	Identify four-lane roadways with fewer than 20,000 vehicles per day (AADT) and evaluate them for "road diets" with bike lanes or on-street parking		
TSSA-18	Calculate Walk Scores and Bike Scores for the community on the whole and develop a plan to improve those scores		
TSSA-19	Establish an expanded public transit that serves commuters from all neighborhoods and major parks and recreation facilities and has racks on vehicles for carrying bicycles.		
TSSA-20	Adopt and implement a pedestrian and bicycle safety and improvements plan		
TSSA-21	Create a standing committee to promote pedestrian and bicycle improvements		
TSSA-22	Implement a complete streets plan		
TSSA-23	Evaluate any proposal to add lanes to a two-lane roadway for a center turn lane because it is the preferred option over an expansion to four lanes.		Future roadway expansion has been discussed in the East Side Neighborhood Plan Update. The plan update is scheduled to be completed in 2023, addressing growth east from the Village center. Any future reconstruction of Siggelkow Road to four lanes east of Catalina Parkway should include this evaluation
TSSA-24	Improve all aspects of the transportation systems program by increasing the amount of grant funding awarded to the city/county and track the amount of funding annually by making it part of staff responsibilities to do so. Please elaborate on this action in the narrative portion of the report.		The Village will be reconstructing Exchange Street in 2024, with funding assistance provided through the Madison MPO. The Village plans to continue to seek grants/cost sharing agreements for future projects where applicable.
TSSA-25	Incorporate access to bicycle and pedestrian infrastructure into decisions for siting of municipal county and school facilities, as well as into zoning decisions		Ongoing efforts by Community & Economic Development/Engineering/Public Works during review of public projects
TSSA-26	Pass ordinances that support the reduction of GHG emissions from transportation, including more funding for walking, biking, transit, reduced idling, required impact fees, transportation demand management, etc.		

Land Use

Supporting Action ID	Supporting Action	Year Implemented (if known)	Narrative
LUSA-1	Identify priority areas, like business centers or corridors, underutilized former industrial areas, or other previously developed but poor-quality areas along rivers, lakes, or streams, for infill development and then facilitate development of those areas that maintains or increases the amount of valuable green spaces (i.e. parks, recreational spaces, natural/preserved habitat, conservation lands). When possible, restore shoreline and flood prone areas to native habitat or with low impact infrastructure like pathways or boardwalks.	2023	The Village of McFarland has began updates to development district plans 1 & 2, Terminal Triangle District Plan and Downtown District Plan in September 2023.
LUSA-2	Facilitate or incentivize brownfield site redevelopment or remediation in the community or county. When possible, restore areas in flood prone locations to native habitat.		Ongoing; The Village has three existing TIF Districts that provide opportunities to incentivize brownfield site redevelopment.
LUSA-3	Implement zoning codes allowing beekeeping on single family, institutional, or agricultural properties.		This action has been identified in the Sustainability Plan, page 23, Land Use & Development Actions for Long Term Actions. To be considered in 2024 Zoning Code Update.
LUSA-4	Increase requirements for minimum tree plantings in redevelopments and new developments and require planting of diverse native tree species.		Village ordinances already require the use of native plantings. Further adjustments to landscaping requirements to be considered when the Village updates its Zoning Code in 2024
LUSA-5	Set standards for redevelopment projects to reduce overall intensity of development by requiring green infrastructure and minimum green space provisions per square foot of impervious footprint.		Village ordinances already require minimum green space provisions. Further adjustments to these requirements to be considered when the Village updates its Zoning Code in 2024
LUSA-6	Create land bank to acquire and assemble priority infill sites or to preserve land for flood mitigation, reduction of density, parks/dedicated public green space, or trails/pathways to increase accessibility.		Ongoing; The Village utilizes its TIF Districts and park impact fees to acquire and assemble priority infill sites or to increase park spaces.
LUSA-7	Revise zoning requirements for office and retail districts to permit floor-area ratio >1 on average. See the American Planning Association's Floor Area Ratio resource		In Planning; To be considered in 2024 Zoning Code Update
LUSA-8	Promote, through local policy initiatives, life cycle or adaptable housing options such as "aging in place", accessory dwelling units (ADUs), Universal or Inclusive Design, Dementia Friendly Communities, Age-Friendly Communities, workshops, presentations, etc. to minimize sprawl and improve infill development and density.		In Planning; Included in Sustainability Plan Pg 23, LU & Development Actions Mid-Term Actions; Preliminary research presented to Plan Commission October 18, 2022. To be considered in 2024 Zoning Code Update.
LUSA-9	Adopt a tree preservation ordinance.		
LUSA-10	Set a tree canopy goal, perform a tree canopy assessment, and develop a forestry management plan to achieve it.		The Parks Department has completed a tree canopy assessment in June 2022. A tree management plan for tree removal, maintenance, and planting is included.
LUSA-11	Require a planting scoresheet to regulate the number of trees, shrubs, and bushes that will be planted in redevelopments or new developments		
LUSA-12	Certification as Tree City USA	2009	Completed
LUSA-13	Certification as Bird City Wisconsin Community	2011	Completed
LUSA-14	Revise zoning codes for commercial, industrial, multifamily, or institutional properties to protect existing native habitats like sensitive areas, wildlife habitats, and wetlands, or to require installation of green infrastructure.		Village ordinances already require protection of wetlands. The Village is planning to update the Zoning Code in 2024 which will provide an opportunity to further explore this topic.
LUSA-15	Improve all aspects of the land use program by increasing the amount of grant funding awarded to the city/county and track the amount of funding annually by making it part of staff responsibilities to do so. Please elaborate on this action in the narrative portion of the report.		The Village plans to continue to seek grants/cost sharing agreements for future projects where applicable.
LUSA-16	Implement zoning code strategies to increase overall density located in areas that are highly accessible to population needs like public transit, healthy food options, daycare/childcare - schools, green space/recreational areas, and healthcare		Included as an item of consideration when the Village will be updating its Zoning Code in 2024.
LUSA-17	At the beginning of project planning, identify potential opportunities and/or funding to better connect state, regional, or local greenspaces		Most plans development by the Village include an implementation section that identifies potential sources of project funding. In 2023, the Village plans to review our Capital Improvement Plan and Strategic Plan to identify potential sources of grant funding for each project

Land Use

LUSA-18	Organize a volunteer workday on public or private lands to help promote sustainable land use (pulling invasives, planting trees, improving trails, treating plants/trees, etc.).		The Village has an annual volunteer clean-up day around the time of Earth Day. The Parks Department also hosts other smaller volunteer clean-up days.
LUSA-19	Inform residents and businesses (including properties used for agriculture) that are located along waterways or within flood zones about ways to mitigate flood damage to their properties and businesses. (FEMA funding, flood mitigation techniques, process for filing a Level of Map Revision from FEMA, etc.)		
LUSA-20	Create agricultural incentives and educational materials with a land and water conservation department and inform farmers on sustainable agricultural land use practices (cover crops, buffer crops, harvestable buffers, direct injection manure, composting, application practices, etc.)		
LUSA-21	Implement a conservation program to educate and incentivize the private ownership of deeded lands dedicated for conservationist practices, to be held on a permanent basis without the ability to develop or utilize for any economic or utilitarian purposes other than for ecological survey, hunting, fishing, or trapping. Many times these are done through conservation easements.		
LUSA-22	Promote sustainable land use practices for private and institutional properties through education and outreach.		

Water Quality and Conservation

Supporting Action ID	Supporting Action	Year Implemented (if known)	Narrative
WQCSA-1	Reduce use of synthetic chemical pesticides, herbicides, and fertilizers in municipal, town, or county landscape management and try to promote use of more natural management processes.	2020	Chapter 3 Vegetation Management Use Policy which guides the use of pesticides and fertilizers in Village owned property
WQCSA-2	Supervise chemical applicators during pesticide or other chemical application to storm water ponds to ensure best management practices are implemented.		
WQCSA-3	Create community policy and best management practices for minimizing chemical use during vegetation management.		Village Public Works writes articles to be included in the various newsletters that may address these items
WQCSA-4	Eliminate use of groundwater for irrigation in municipal landscape management.		
WQCSA-5	Establish 75-foot natural vegetation buffer around surface water.	1982	This is required in areas subject to the Dane County Shoreland Zoning Ordinances but not in areas of the Village annexed before May 7, 1982. This areas require a 40' setback.
WQCSA-6	Apply block rates to residential and commercial water billing.		
WQCSA-7	Offer water and sewer billing credits for installation and use of stormwater management systems (ex. rain barrels, rain gardens, swales, pervious pavement).		Item to be considered in the 2024 Village Code Update.
WQCSA-8	Develop a water efficiency and conservation plan for city, town, or county buildings.		
WQCSA-9	Install faucet aerators and low-flow plumbing fixtures in all municipal facilities.		Complete as needed.
WQCSA-10	During televising inspections, clean at least 10% of the entity's sanitary sewer collection system per year.	2020	Clean 33.3% of the sanitary collection system per year
WQCSA-11	Televise or visually inspect more than 10% of the sanitary sewer collection system per year.	2020	Televise 33.3% of the sanitary collection system per year
WQCSA-12	Establish a program to inspect and control grease in the sewer system.		Village maintains an ordinance related to grease (Sec. 47-109) and annual televising is used to inspect for grease trap maintenance. Public Works may contract for additional annual inspections based on need.
WQCSA-13	Create program and train staff to identify any unapproved illicit discharges from commercial and/or industrial users.		The Village utilizes our consultant engineer for this service
WQCSA-14	Establish legal authority to inspect private residences or businesses to prohibit sump pump connections to the sanitary sewer system.		Sec. 8-311. - Conducting Tests of the Village's Municipal Code of Ordinance establishes this.
WQCSA-15	Establish a pretreatment or industrial control program that implements legal authority to administer fees/charges, to issue permit limitations for high flow and/or high strength waste discharges to the sanitary sewer system.		Madison Metropolitan Sewerage District does this for those within Village limits
WQCSA-16	Provide financial assistance to residents to replace lead sewer laterals.		
WQCSA-17	Reduce rates of inflow and infiltration in sanitary systems by at least 10%.		Ongoing
WQCSA-18	Create an inventory of wetlands in the community and ensure no net loss of preserved wetlands.		WDNR has completed a wetland inventory for the entire state. Individual development projects are required to provide certified wetland delineations
WQCSA-19	Adopt a transferable development rights program to provide an incentive for landowners to preserve sensitive natural lands and wildlife habitat on the fringe of waterways.		
WQCSA-20	Establish a dedicated source of funding for open space acquisition and management (e.g., bond proceeds, sales tax).		Completed; Park Impact Fees
WQCSA-21	Provide financial support to or collaborate with land trusts to acquire critical natural areas on or near waterways.		
WQCSA-22	Develop a water loss control plan with targets below the 15% required by the state and include a system-wide water audit implementation and a timetable.		
WQCSA-23	Replace concrete channels with re-meandered and naturalized creeks, wetlands, or swales.		
WQCSA-24	Join EPA's WaterSense Program for water utilities or the Groundwater Guardian Green Sites program and promote them to local business.		
WQCSA-25	Develop partnerships with businesses to repurpose high strength water waste.		
WQCSA-26	Develop a storm sewer catch basin cleaning program to reduce trash, debris, suspended solids, and heavily laden organic material from entering water bodies.	2021	Ongoing
WQCSA-27	Develop leaf and yard waste collection program.		Ongoing; Residents can bring yard waste material to the yard waste site, adjacent to the Public Works Building for disposal.
WQCSA-28	Develop a regular street sweeping program to reduce total suspended solids.		Ongoing; Daily records are taken as part of MS4 permit requirements
WQCSA-29	Require redevelopment of commercial and light industrial business areas to incorporate stormwater management plans that set infiltration and pollutant reduction standards.		Ongoing; Included in various Village Ordinances, in particular, Article XVIII. - Stormwater Management
WQCSA-30	Develop and implement annual construction permitting and inspection program.		Ongoing; The Village requires permits for new stormwater basins and maintenance agreements
WQCSA-31	Develop and implement asset management plans that set targets for the sustainable maintenance, operation and renewal of water and wastewater infrastructure.		Ongoing; Currently have a long term capital improvement plan that addresses water and wastewater infrastructure maintenance.
WQCSA-32	Facilitate public-private partnerships to offer rain barrels to residents annually.		Ongoing; In partnership with MAMSWAP

Water Quality and Conservation

WQCSA-33	Implement Salt Wise workshops for salt applicators and require Public Works applicators to get certified		Ongoing; Public Works staff attend Salt Wise workshops
WQCSA-34	Implement an incentive program for residents and multifamily complexes to encourage on demand water softener and low flow toilet installations.		Ongoing
WQCSA-35	Develop financial incentive program to promote and increase the number of green roofs and other types of stormwater runoff and treatment control best management practices in new developments and redevelopments.		Ongoing
WQCSA-36	Implement a drug take-back program and host a secure drop off site to mitigate the amount of drugs placed in the landfills or that get flushed to sewage treatment plants and eventually end up polluting rivers, lakes, streams, oceans		Ongoing; The Village's Police Department implements a drug drop off program in the Public Safety Center's foyer area.
WQCSA-37	Improve all aspects of the WQC program by increasing the amount of grant funding awarded to the city/county and track the amount of funding annually by making it part of staff responsibilities to do so. Please elaborate on this action in the narrative portion of the report.		Ongoing; The Village plans to continue to seek grants/cost sharing agreements for future projects where applicable.
WQCSA-38	Implement a stormwater and/or sanitary effluent testing or monitoring program to annually test at least 10% of the system.		Ongoing; Madison Metropolitan Sewerage District tests our effluent as part of their invoicing to the Village. As part of our MS4 permit, public works inspects stormwater facilities for any illicit discharges
WQCSA-39	Sponsor or hold education and outreach informational workshops, presentations, or other efforts designed to engage residents, business owners, or city/county staff on stormwater and water quality and conservation best management practices		
WQCSA-40	DNR requires the creation of a program to get private wells abandoned when served by a local water utility. Create a process and maintain it to track and get all private wells in the city abandoned.		Ongoing; Madison Metropolitan Sewerage District tests our effluent as part of their invoicing to the Village. As part of our MS4 permit, public works inspects stormwater facilities for any illicit discharges

Solid Waste

Supporting Action ID	Supporting Action	Year Implemented (if known)	Narrative
SWSA-1	Conduct a waste audit for municipal facilities (including recycling, composting as able).		Receive monthly estimated amount of waste generated. No formal waste audit has been completed
SWSA-2	Conduct a community-wide waste audit (including recycling, compost, as able), ideally breaking out data by different sectors (residential/commercial/institutional, renters/owners, etc.) to further elucidate performance and where to address future efforts.		Receive monthly estimated amount of waste generated. No formal waste audit has been completed
SWSA-3	Implement an ordinance requiring or incentivizing the recycling and reuse of construction and demolition waste (at minimum, update information on requirements for C&D waste, including required asbestos notification to DNR).		
SWSA-4	Ensure community access to a composting collection program. If access exists, engage in education and promotion to increase use of existing programs/facilities. If access is limited, implement a curbside composting service (or another locally relevant service that provides similar access) in the community.		The Village is partnering with Dane County Waste & Renewables and additional Dane County communities on a pilot composting program. Funding for this project was announced in early 2024, pending additional instructions.
SWSA-5	Ensure community access to collection programs for wood waste from construction & demolition and yard waste. If access exists, engage in education and promotion to increase use of existing programs/facilities. If access is limited, implement pickup/dropoff service or other collection program accessible to community members.		Ongoing informational notices are provided to residents where these items can be recycled
SWSA-6	Ensure community access to collection programs for electronic waste. If access exists, engage in education and promotion to increase use of existing programs/facilities. If access is limited, implement collection program accessible to community members.		
SWSA-7	Ensure community access to collection programs for hazardous waste (paints, volatile compounds, oils, batteries, pharmaceuticals, sharps, etc.). If access exists, engage in education and promotion to increase use of existing programs/facilities. If access is limited, implement a collection program accessible to community members.		Waste oil and antifreeze collection available for drop off at Public Works facility. All other items are recommended to be sent to Dane County clean sweep. Med drop off located in entry way of municipal center. Police department recently hosted a drug take back event.
SWSA-8	Host annual events to allow recycling of items that are typically difficult to recycle (E-waste, paints or volatile compounds, oils, batteries, etc.)		
SWSA-10	Implement waste-reduction practices, such as encouraging electronic document use to decrease printing, and installing water bottle filling stations to reduce plastic bottle use.		Reducing printing and paperless methods has been implemented throughout the Village's Departments. Water bottle refilling stations are added to municipal buildings where applicable.
SWSA-11	Spot-check businesses and rental properties to ensure adequate recycling facilities. Recycling facilities are required by law, but enforcement is complaint-based. Actively checking would go above and beyond existing regulations/compliance.		Businesses and rental properties are not within the village scope of recycling services. These are contracted separately of the village. (2022)
SWSA-12	Work with your Municipal Recycling Facility (MRF) to expand the list of recyclables they accept and provide clear guidance to residents on what can be recycled locally, keeping said guidance updated on a regular basis as markets and facilities change.		Ongoing; List of recycling products are available on the Village website.
SWSA-13	Implement programs to help reduce the use of single-use shopping bags and Styrofoam containers.	2022, 2023	The Lion & Lioness Club implements a plastic bag collection program since January 14, 2022 at two locations in McFarland, the Municipal Center and Pick N Save.
SWSA-14	Provide block polystyrene recycling pick-up or drop-off for residents.		
SWSA-15	Bill residents for municipal waste collection based on the amount of waste collected.		All residents are charged a base refuse collection fee annually
SWSA-16	Consider a Master Recycling program (akin to Master Gardener and Master Naturalists programs), such as the one being piloted by the City of Madison and Sustain Dane.		
SWSA-17	Implement outreach strategies that provide education to residents and businesses on recycling and composting opportunities and requirements, building on the "7 Rs of recycling," working to decrease "wish-cycling," promoting life-cycle thinking through awareness of items made from recycled materials (e.g. park benches made from recycled plastic bottles), and increasing proper recycling behavior to minimize contamination and decrease costs associated with recycling.		Ongoing; Information for this is made available through the Village website for residents. Also, additional information is sent within Outlook or The Lookout newsletters for reminders.
SWSA-18	Implement a sustainable purchasing policy encouraging municipal purchases to take into account factors such as made from recycled and recyclable/compostable materials, energy used to create the product, local sourcing, etc.		
SWSA-19	Implement outreach campaigns encouraging residents to donate unwanted items for reuse (for example, clothing and household items in good condition to thrift stores; cardboard boxes to moving companies, churches, or other organizations; building materials to companies like Habitat for Humanity).		
SWSA-20	Utilize rechargeable batteries whenever possible for municipal purposes and appropriately recycle used lithium-ion batteries		Cordless and battery operated tools are used whenever possible.
SWSA-21	Promote diversion of still-usable food from waste stream, through food banks, donation of deer meat from hunting season, partnerships between restaurants/grocers and food-donation programs, etc.		

Solid Waste

SWSA-22	Improve all aspects of the waste program by increasing the amount of grant funding awarded to the city/county and track the amount of funding annually by making it part of staff responsibilities to do so. Please elaborate on this action in the narrative portion of the report.		The Village plans to continue to seek grants/cost sharing agreements for future projects where applicable.
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Health and Equity

Supporting Action ID	Supporting Action	Year Implemented (if known)	Narrative
HESA-1	Implement zoning ordinances and programs to enable home-based or community gardens and food plots to improve accessibility to local food production and implement locations for resale of made goods and produce.		Completed; First community garden at 5710 Anthony Street.
HESA-2	Enact a Health in All Policies resolution or ordinance.		Identified as a Near-Term Action in the Village's Sustainability Plan, page 25.
HESA-3	Incorporate Health in All Policies (HIAP) and Diversity Equity Inclusion (DEI) objectives in Comprehensive Plan updates.		Village will update its Comprehensive Plan in 2026-27
HESA-4	Identify healthy food deserts in the community and use economic development tools to eliminate those deserts.		
HESA-5	Adopt an ordinance that bans use of tobacco and e-cigarettes on municipal lands and that limits exposure to secondhand smoke in apartment buildings.		Identified as a Near-Term Action in the Village's Sustainability Plan, page 25.
HESA-6	Implement a plan for crime reduction through environmental design.		
HESA-7	Establish a health impact assessment policy and procedures to assess existing and proposed programs or projects, including when an assessment is required and its scope.		
HESA-8	Create a Food Systems Plan that addresses the production, distribution, value-added, marketing, end-market, and disposal of food, and charge a new or existing governmental body to oversee the plan's implementation.		
HESA-9	Create a Food Policy Council to advise governing officials and staff on ways to provide cheap, accessible, healthy food options to the community, especially sensitive populations.		The Village does not have a Food Policy Council, but it does support the efforts of the local food pantry and its initiatives. The Food Pantry is to be included in the planned Community Center with its designated space.
HESA-10	Establish and implement harm reduction strategies for establishments such as alcohol outlets, gun stores, and sexual oriented establishments (e.g. zoning limitations and ordinances).		To be considered when the Village updates its Zoning Code in 2024
HESA-11	Implement a wellness program for employees and engage employers to establish employee wellness programs.		Wellness program offered through WI Employee Trust Funds Program (Well Wisconsin program); Active discussion continue to help determine recent changes in Employee benefits.
HESA-12	Provide a farmers' market for at least 6 months out of the year and ensure participation in the EBT/Foodshare program to enable Foodshare participants to benefit.		The existing farmer's market is located in the parking lot of the Pick 'n Save grocery store. In 2022, the program operated May 5th to October 28th, every Thursday, 2:00 PM - 6:00 PM. The indoor farmer's market is held every November 5th - December 22 every Saturday, 9:00 AM - 2:00 PM.
HESA-13	Provide, support, or encourage health and equity professional development opportunities for staff.		This supporting action varies among each department, but professional development opportunities are encouraged
HESA-14	Complete a community vulnerability assessment.	2022	The VOM was a participant in the Dane County Natural Hazard Mitigation Plan Update. The multi-jurisdictional plan was approved by FEMA Dec 20, 2022.
HESA-15	Improve all aspects of the Health In All Policies program by increasing the amount of grant funding awarded to the city/county and track the amount of funding annually by making it part of staff responsibilities to do so. Please elaborate on this action in the narrative portion of the report.		The Village plans to continue to seek grants/cost sharing agreements for future projects where applicable.
HESA-16	Create a Racial Equity Action Plan.	2022	In 2022 the Village completed a DEI Report.
HESA-17	Use a tool, such as the Transforming Organizational Culture Assessment Tool (TOCA), to help assess your local government's culture and readiness to engage in racial equity work.		
HESA-18	Conduct a survey of citizens' perception of diversity and inclusion within the municipality.	2022	In 2022 the Village completed a DEI Report.
HESA-19	Create municipal board/committee(s) specifically focused on sustainability, resource conservation, environmental and equity concerns, etc.	2020, 2022	The Sustainability & Natural Resources Committee was established in May 2022. Meetings are held every 2nd Monday of every month at 6:00 PM in the Municipal Center Community Room.
HESA-20	Host regular educational events related to equity, inclusivity, and diversity.	2022	In 2022 the Village completed a DEI Report. Projects in 2023 include land recognition and pride events
HESA-21	Create a process for community members to directly offer input in decision making (eg. participatory budgeting, deliberative engagement, etc.).		All scheduled Village-hosted meetings are open to the public to attend, during which there is a section dedicated to public appearances. Here, the floor is open to anyone wishing to speak directly to the committee/commission, either virtually or in-person, adhering to the 3-minute limit. Additionally, public comments may also be submitted to the Village Clerk to be include as part of the meeting packets.
HESA-22	Create a language access plan to ensure equal access to local government processes and information regardless of primary language.		

Health and Equity

HESA-23	Conduct an analysis of your local boards/commissions/committees to better understand power and representation.	2022	Completed
HESA-24	Create a plan or process by which you can increase diversity and representation on local boards/commissions/committees, especially active recruitment of members from underrepresented, vulnerable and impacted communities.	2022	Ongoing: In 2022 the Village completed a DEI Report. Emphasis is placed on increasing diversity and representation on local committees as vacancies arise.
HESA-25	Create a local committee, task force, or team that is interdepartmental and can coordinate complex issues of health, safety, and sustainability across departments.		
HESA-26	Demonstrate communication and/or coordination between city departments and public health (whether city or county). Examples include inviting public health to the table during a Comprehensive Planning process, or Plans related to housing, transportation, etc. Conversely, Public Health can collaborate with city departments for things like the Community Health Improvement Process and Community Health Assessment process.		
HESA-27	Improve all aspects of the DEI and HIAP programs by increasing the amount of grant funding awarded to the city/county and track the amount of funding annually by making it part of staff responsibilities to do so. Please elaborate on this action in the narrative portion of the report.		The Village plans to continue to seek grants/cost sharing agreements for future projects where applicable.

VILLAGE OF
McFarland
SUMMARY SHEET

MEETING DATE: Monday, March 11, 2024

SECTION:

DEPARTMENT: Community Development

CONTACT: Kong Thao, Associate Planner, Andrew Bremer, Comm & Eco Dev Director

AGENDA ITEM: Discussion and action to make a recommendation to the Village Board regarding approval of bid documents for the Public Safety Center Battery and Microgrid project.

PREVIOUS ACTION:

January 9, 2023 - S&NR recommended approval to the Village Board for the submittal of two OEI Energy Innovation Grant Program Applications

April 19, 2023 - Staff presented to the Committee, award of grant application by the PSC for Battery Storage and Microgrid technology at the Public Safety Center.

May 8, 2023 - S&NR recommended approval to the Village Board for HGA's proposal design, bid and construction administration services for installation of battery and microgrid at the Public Safety Center.

May 9, 2023 - Village Board approval of HGA contract.

September, 2023 - Grant contract signed with OEI.

February 22, 2024 - S&NR and Village Board project update meeting.

ISSUE SUMMARY:

Included in the packet is a Project Manual and electrical diagrams for bidding the project to install a battery and microgrid technologies at the Public Safety Center. These documents were prepared by the Village's energy design consultant HGA and are considered 95% plans. The Village Attorney is completing a review of the document as part of preparations for approval by the Village Board at their March 26th meeting. Assuming approval, the announcement of the bid would occur on March 27th with a bid closing on April 24th. The S&NR Committee would then review and recommend a preferred bidder at the May 13th meeting for Village Board approval on May 28th. Likely there will be some lead time on procuring the battery and electrical components with installation planned for Fall/Winter 2024.

FINANCIAL/BUDGET IMPACT:

The total project cost is estimated to be \$605,000. In March of 2023, the Village was awarded a \$350,000 grant from the Office of Energy Innovation for the installation of a micro grid and battery storage system at the new Public Safety Center as a Level 1 Microgrid Community Resilience Center. As the Village completes the construction of the Public Safety Center, an approximate \$250,000 of available unallocated contingency funds from the initial capital borrowing will be used to supplement this project. The costs of HGA services is \$82,000 and is included as part of the total estimated project costs of \$605,000. The project costs roughly break down as follows:



- \$82,000 HGA
- \$475,000 Equipment and Installation Labor
- \$43,000 Contingency
- \$5,000 in-kind Village labor

VILLAGE PLAN REFERENCE:

2021 Sustainability Plan. Includes near-term Energy Action to "work with energy providers to develop a community-scale solar energy installation and/or develop a program for leasing municipal rooftops for solar." The plan also includes the goal of achieving 50% of total municipal energy consumed per year generated from renewables by 2030 and 100% by 2040.

ORDINANCE REFERENCE:

BOARD, COMMISSION OR COMMITTEE RECOMMENDATION:

Motion, second, to recommend Village Board approval of bid documents for the Public Safety Center Battery and Microgrid project contingent on review by the Village Attorney.

ATTACHMENTS:

1. McFarland - Public Safety Building Microgrid_Project Manual_95% Bidding Documents
2. E24_McFarland BESS_4715-004-00 - 95% CD 030724

Village of McFarland

Public Safety Building Microgrid

McFarland, Wisconsin

Project Manual

Bidding Documents (95%)

March 7, 2024

HGA

Hammel, Green and Abrahamson, Inc
333 East Erie Street
Milwaukee, Wisconsin 53202
(414) 278-8200

Commission No. 4715-004-00

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SECTIONS

PROJECT FILES

NOT USED

COVER & TABLE OF CONTENTS

000101 - Cover Page

000110 - Table of Contents

DIVISION 00 — PROCUREMENT AND CONTRACTING REQUIREMENTS

000101 - Project Title Page

001113 - Advertisement for Bids

002113 - Instructions to Bidders

002600 - Procurement Substitution Procedures

002600a - CSI Form 1.5C

003000 - Bidder's Proof of Responsibility

003113 - Preliminary Schedules

004113 - Bid Form - Stipulated Sum (Single-Prime Contract)

004113a - V of M Affidavit of Qualifications

004313 - Bid Security Forms

004323 - Alternates Form

005200 - Agreement Forms

007201 - General Conditions of the Contract

DIVISION 01 — GENERAL REQUIREMENTS

011000 - Summary

012300 - Alternates

012500 - Substitution Procedures

012511 - Substitution Request Form

012600 - Contract Modification Procedures

012900 - Payment Procedures

013100 - Project Management and Coordination

013300 - Submittal Procedures

013310 - Submittal Transmittal Form

014000 - Quality Requirements

014200 - References

015000 - Temporary Facilities and Controls

016000 - Product Requirements

017300 - Execution

017700 - Closeout Procedures

017823 - Operation and Maintenance Data

017839 - Project Record Documents

017900 - Demonstration and Training

DIVISION 02 — EXISTING CONDITIONS

NOT USED

DIVISION 03 — CONCRETE

NOT USED

DIVISION 04 — MASONRY

NOT USED

DIVISION 05 — METALS

NOT USED

DIVISION 06 — WOOD, PLASTICS, AND COMPOSITES

NOT USED

DIVISION 07 — THERMAL AND MOISTURE PROTECTION

NOT USED

DIVISION 08 — OPENINGS

NOT USED

Village of McFarland

Public Safety Building Microgrid

4715-004-00 | Bidding Documents (95%)

March 27, 2024

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DIVISION 09 — FINISHES

NOT USED

DIVISION 10 — SPECIALTIES

NOT USED

DIVISION 11 — EQUIPMENT

NOT USED

DIVISION 12 — FURNISHINGS

NOT USED

DIVISION 13 — SPECIAL CONSTRUCTION

NOT USED

DIVISION 14 — CONVEYING EQUIPMENT

NOT USED

DIVISION 20 — MECHANICAL SUPPORT

NOT USED

DIVISION 21 — FIRE SUPPRESSION

NOT USED

DIVISION 22 — PLUMBING

NOT USED

DIVISION 23 — HEATING VENTILATING AND AIR CONDITIONING

NOT USED

DIVISION 25 — INTEGRATED AUTOMATION

NOT USED

DIVISION 26 — ELECTRICAL

260500 - Common Work Results for Electrical

260519.00 - Low-Voltage Electrical Power Conductors and Cables

260523 - Control-Voltage Electrical Power Cables

260526 - Grounding and Bonding for Electrical Systems

260529 - Hangers and Supports for Electrical Systems

260533 - Raceways and Boxes for Electrical Systems

260800 - Commissioning of Electrical

260913 - Electrical Power Monitoring and Control

262416.00 - Panelboards

263300 - Battery Performance Requirements

263700 - Microgrid Performance Requirements

DIVISION 27 — COMMUNICATIONS

270528 - Pathways for Communications Systems

DIVISION 28 — ELECTRONIC SAFETY AND SECURITY

NOT USED

DIVISION 31 — EARTHWORK

NOT USED

DIVISION 32 — EXTERIOR IMPROVEMENTS

NOT USED

DIVISION 33 — UTILITIES

NOT USED

DIVISION 34 — TRANSPORTATION

NOT USED

DIVISION 35 — WATERWAYS AND MARINE CONSTRUCTION

NOT USED

DIVISION 40 — PROCESS INTERCONNECTIONS

Village of McFarland

Public Safety Building Microgrid

4715-004-00 | Bidding Documents (95%)

March 27, 2024

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NOT USED

DIVISION 41 — MATERIAL PROCESSING AND HANDLING EQUIPMENT

NOT USED

DIVISION 42 — PROCESS HEATING, COOLING, AND DRYING EQUIPMENT

NOT USED

DIVISION 43 — PROCESS GAS AND LIQUID HANDLING, PURIFICATION AND STORAGE EQUIPMENT

NOT USED

DIVISION 44 — POLLUTION CONTROL EQUIPMENT

NOT USED

DIVISION 45 — INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT

NOT USED

DIVISION 46 — WATER AND WASTEWATER EQUIPMENT

NOT USED

DIVISION 48 — ELECTRICAL POWER GENERATION

NOT USED

DOCUMENT 000101
PROJECT TITLE PAGE

PROJECT MANUAL VOLUME 1

Public Safety Building Microgrid.

Village of McFarland.

6001 Broadhead Street, McFarland, Wisconsin 53558.

Architect/Engineer's Project No. 4715-004-00.

Hammel, Green and Abrahamson, Inc.

333 East Erie Street, Milwaukee, Wisconsin 53202

Phone: (414) 278-8200.

Website: www.HGA.com.

Issued: March 27, 2024

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END OF DOCUMENT

DOCUMENT 001113
ADVERTISEMENT FOR BIDS

1.1 PROJECT INFORMATION

- A. Notice to Bidders: Qualified bidders may submit bids for project as described in this Document. Submit bids according to the Instructions to Bidders.
- B. Project Identification: Village of McFarland - Public Safety Building Microgrid.
 - 1. Project Location: 6001 Broadhead Street, McFarland, Wisconsin 53558.
- C. Owner: Village of McFarland.
- D. Architect/Engineer: Hammel, Green and Abrahamson, Inc., 333 East Erie Street, Milwaukee, Wisconsin 53202.
- E. Project Description: Project consists of a Level 1 Microgrid Community Resilience Center at the new Net-Zero Public Safety Center providing battery storage systems and microgrid technologies.
- F. Construction Contract: Bids will be received for the following Work:
 - 1. General Contract (all trades).

1.2 BID SUBMITTAL AND OPENING

- A. Owner will receive sealed lump sum bids until the bid time and date at the location given below. Owner will consider bids prepared in compliance with the Instructions to Bidders issued by Owner, and delivered as follows:
 - 1. Bid Date: 4/24/2024.
 - 2. Bid Time: **10:00 a.m.** local time.
 - 3. Location: **<Insert bid receipt's location and room name>, <Insert street address>, <Insert city, state, and zip code>.**
- B. Bids will be thereafter publicly opened and read aloud.

1.3 BID SECURITY

- A. Bid security shall be submitted with each bid in the amount of **5 percent of the bid amount**. No bids may be withdrawn for a period of **60 days after opening of bids**. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

1.4 PREBID MEETING

- A. Prebid Meeting: A Prebid meeting for all bidders will be held at the Village of McFarland Public Safety Building on April 4th at 11:00 a.m., local time. Prospective prime bidders are required to attend.
 - 1. Bidders' Questions: Architect will provide responses at Prebid conference to bidders' questions received up to two business days prior to conference.
 - a. Direct bidder questions to: Alexander Harris; AHarris@hga.com.

1.5 DOCUMENTS

- A. Printed Procurement and Contracting Documents: Obtain after **<Insert date>**, by contacting **<preferred reprographic house address/information>**. Documents will be provided to prime bidders only; only complete sets of documents will be issued.

1. Deposit: **[\$100.00] <Insert amount>**.
- B. Online Procurement and Contracting Documents: Obtain access after **<Insert date>**, by contacting **<reprographic house address>**. Online access will be provided to prime bidders only.

1.6 TIME OF COMPLETION [AND LIQUIDATED DAMAGES]

- A. Successful bidder shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time.**[Work is subject to liquidated damages.]**

1.7 BIDDER'S QUALIFICATIONS

- A. Bidders must be properly licensed under the laws governing their respective trades and be able to obtain insurance and bonds required for the Work.**[A Performance Bond, separate Labor and Material Payment Bond, and Insurance in a form acceptable to Owner will be required of the successful Bidder.]**

1.8 NOTIFICATION

- A. This Advertisement for Bids document is issued by **<Insert name, title, and agency name>**.

END OF DOCUMENT

DOCUMENT 002113

INSTRUCTIONS TO BIDDERS

1.1 CONTENTS

- A. General Information
- B. Mandatory Pre-bid Conference
- C. Distribution to Prospective Bidders
- D. Bids
- E. Alternate Bids
- F. Acceptable Bidders/Materials
- G. Substitutions
- H. Unit Prices
- I. Bid Guarantee
- J. Contract and Contract Docs.
- K. Withdrawal of Bids
- L. Reservation
- M. Permits and Agency Notification
- N. Inadequacies and Omissions
- O. Employee and Screening Identification
- P. Power of Attorney

1.2 GENERAL INFORMATION

- A. When required by the State or municipality contractors must be licensed in the State of Wisconsin and/or if required licensed in the municipality in which the project is located.
- B. Complete sets of Contract Documents must be used in preparing bids, neither Architect nor Engineers assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents.
- C. Each Bidder shall refer to Table of Contents and read and examine all sections listed therein, all of which are part of the project manual and contain provisions applicable to successful Bidder. He shall also examine all drawings as successful Bidder will be required to do all work belonging to his contract which is either shown on drawings, mentioned in the specifications or reasonably implied as necessary to complete his contract.
- D. Each Bidder shall visit site to become acquainted with adjacent areas; means of approach to the site; conditions of actual job site; and facilities for delivering, storing, placing and handling of materials and equipment. Bidders shall compare specifications and drawings with any work in place and inform themselves of all conditions affecting execution of work, including other work, if any, being performed.
- E. Unless otherwise specifically mentioned in various sections of specifications, base bids upon assumption that work will be performed during regular working hours. Owner requests firm lump sum base bid for work contemplated and as covered by these specifications and accompanying drawings.

- F. Electronic digital data files of the Contract Drawings will be provided by Architect/Engineers for Contractor's use in preparing submittals in PDF format only. CAD files WILL NOT be provided.
- G. Building Materials Sales Tax and Use Tax. Contractors are to follow State Law regarding sales and use tax exemption for the purchase of building materials..

1.3 MANDATORY PRE-BID CONFERENCE

- A. A mandatory pre-bid conference to examine the building and site will take place per Advertisement for Bids.
- B. Notice: Bids will only be accepted from prime bidders represented on Pre-bid Meeting sign-in sheet.
- C. Failure of a Subcontractor / Bidder to attend the pre-bid meeting if such failure results in the Bidder not fully being familiar with the existing conditions and Project Requirements, shall not be considered a basis for additional compensation to the successful Bidder for the Work.
- D. Prospective contractors must complete Form 003000 "Bidder's Proof of Responsibility" in order to be considered to bid projects as indicated in these Contract Documents.

1.4 DISTRIBUTION TO PROSPECTIVE BIDDERS

- A. Instrument of Service (bidding documents) may be obtained in accordance with the Advertisement for Bids.
- B. Contract Documents can be obtained from the following printer:
<Preferred printing company>.
<Address>
<Address>
<Phone>
Email Address: <email>
<Hours>
- C. Contract Documents in Hard Copy form are available for a purchase at <Preferred printing company>.
- D. Electronic versions of the plans and specifications will be available on the <Preferred printing company> sharefile site.
- E. Contractors can email <Preferred printing company> at <email> to request an electronic file.
- F. Contractors MUST call ahead if they intend to pick up plans as this is a print to order project.
- G. Owner nor the Architect will be providing additional SETS of drawings for construction use.
- H. It is each Contractor and Sub-Contractor responsibility to review and obtain FULL SETS of construction documents and addendums for bidding and construction purposes. No additional sets of plans and specifications will be issued by the Owner nor the Architect for construction.

1.5 BIDS

- A. Lump sum base bids will be received as indicated in the Advertisement for Bids.
- B. Any amendments to Bid Form or appended thereto or any inclusion of any correspondence, written or printed matter, or details of any nature other than that specifically called for may disqualify bid. No telegraphic alterations to the bid will be accepted. No phone bids or fax (facsimile) bids will be accepted.

C. Building Materials Sales Tax and Use Tax:

Contractors are to follow State Law regarding sales and use tax exemption for the purchase of building materials.

Village of McFarland is an exempt entity for sales tax purposes pursuant to §77.54(9a)(b), Wis. Stats. and materials purchased by contractors for incorporation into any Village of McFarland facility (other than roads, highways or streets) under a contract with the Village of McFarland are similarly exempt from the imposition of sales taxes pursuant to §77.54(9m), Wis. Stats. Bids should NOT include sales tax on exempt materials or other tangible personal property which will become components of the facility. A copy of the Village of McFarland Certificate of Tax Exempt Status (CES) will be provided to the successful bidder at the time of contracting for use in documenting tax-exempt purchases. The Contractors shall include any other (non-exempted) taxes, if applicable with the bid.

D. Contracts will be awarded on the basis of base bid.

E. Completing Bid Form: Bid Form shall be filled out by typing or writing in ink and signing in ink. Erasures or other changes in bid must be explained or noted over signature of Bidder. Bid Form containing any conditions, omissions, unexplained erasures or alterations, or items not called for in proposal or irregularities of any kind may disqualify bid. Bid amount shall be entered in both written words and printed figures in space provided on Bid Form and, in case of conflict, amount given in written words will control.

F. Bidders shall not add any conditions or qualifying statements to the proposal or otherwise the proposal may be declared irregular as being not responsible to the Advertisement for Bids.

G. All Contractors bidding as Prime Contractors shall obtain bid documents and Bid Form per the Advertisement for Bids.

H. Requirements of Signing: Each bid must include full business address of Bidder. Bids by corporation should be executed in full legal name of the corporation, giving state of incorporation, and be signed by an authorized officer or officers who shall, in each case, type or print his name and corporation title beneath his signature. Corporate bids should be sealed with the corporate seal and attested by the corporate secretary. Partnership bids should state the full names of all partners, e.g., "Smith and Jones, a partnership of John S. Smith and William R. Jones". Such bids must also be signed by an authorized partner or other representative, typing or printing the name of the signer and his title beneath the signature. Individual bids shall be submitted over the usual signature of the Bidder, with his name typed or printed beneath the signature followed by the words "Sole Proprietor". When requested by Owner, satisfactory evidence of agency or authority of any person signing on behalf of another must be furnished.

I. Submission: Submit bid in sealed envelope. Contractor shall write on envelope the following information: Project name and number, indicate work covered by bid, and Bidder's name and address. Bids will be received and opened in accordance with the Advertisement for Bids.

J. The failure or omission of any Bidder to examine any form, instrument or document shall in no way relieve any bidder from any obligation in respect to his bid.

1.6 ALTERNATE BIDS

A. Each Bidder shall carefully read requests for alternate bids and thoroughly examine the plans and specifications to determine to what extent the various changes and conditions will affect his bid. Base bid may be considered informal unless the requested alternate bids are also submitted in the spaces provided in the Bid Form.

B. Bidders shall state the amount to be added to or deducted from the base bid for making the changes, including all incidentals, omissions, additions and adjustments as may be necessary or required by such changes.

1.7 ACCEPTABLE BIDDERS/MATERIALS

- A. Materials are specified in the following ways:
 - 1. Where material is listed by manufacturer and trade name, with no qualifying statement, such material shall be furnished without substitution.
 - 2. Where more than one material or manufacturer is named, Bidder has option of selecting any one of the manufacturers or materials named.
 - 3. Where material is listed by description or by ASTM or Fed. Spec. numbers, any product meeting or exceeding requirements of such specification will be acceptable.

1.8 SUBSTITUTIONS

- A. A. The materials, products and equipment described in the Bidding Documents establish a standard of function, dimension, appearance and quality to be met by any proposed substitution.
- B. B. No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten (10) days prior to the bid date. Requests shall include the name of the material and/or equipment which it is to be substituted for and a complete description of the proposed material and/or equipment including drawings, performance and test data, and other information necessary for an evaluation. Include a statement stating changes in other materials, equipment or portions of the work, including changes in the work of other contracts that incorporation of the proposed substitution would require. The burden of proof of the proposed substitution is upon the requester. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
 - 1. See Specification Section 002600 - Procurement Substitution Procedures.
 - 2. See Specification Section 002600 Attachment - Substitution Request form.
 - 3. See Specification Section 012500 - Substitution Procedures for additional information.
- C. If the Architect approves a proposed substitution prior to receipt of Bids, approval will be set forth in writing through an Addendum. Bidders shall not rely upon approvals made in any other manner.
- D. No substitutions will be considered after the Bid Date.

1.9 BID GUARANTEE

- A. A certified check, a cashier's check or a bid bond payable to the Owner in an amount not less than 5% of maximum bid shall accompany each bid as guarantee that if bid is accepted, the Bidder will file proposed contract and bond within ten days after being notified of acceptance of bid. Company executing bid bond must be licensed to do business in Wisconsin. Certified check or cashier's check shall be made payable to the Owner.
- B. If successful Bidder so files contract and bond, check will be returned to him. The successful Bidder, upon his failure or refusal to execute and deliver the contract and bonds required within ten days after he has received notice of the acceptance of his bid shall either, at Owner's option, forfeit to the Owner as liquidated damages for such failure or refusal the security deposited with his bid, it being agreed that the actual damages would be difficult to ascertain, or be liable for any loss or damage done to the Owner arising out of delay and the necessity of reletting or of reconstructing the work, including the excess of price obtained by such reletting over the Contractor's accepted bid.
- C. All check deposits, except those of the three lowest Bidders, will be returned to their makers within ten days after bid opening.
- D. Certified check deposits of three lowest Bidders will be returned immediately upon signing of contract and bond by successful Bidder.

1.10 CONTRACT AND CONTRACT DOCUMENTS

- A. The successful Bidder will be required to enter into the A.I.A. DOCUMENT A101– 2017 Standard Form of Agreement Between Owner and Contractor. Bidders are requested to familiarize themselves with conditions therein and in A.I.A. Document A201, General Conditions.
- B. See General Conditions of the Contract for Construction, **subparagraph 1.1.1**, for definition of contract documents.
- C. Contract will be awarded on basis of base bid and accepted alternate bids only.
- D. In the bidding process, the Contractor shall assume the same quality and level of detail and finish in areas of the building not specifically shown or detailed.
- E. The Contractor shall provide a complete and functional building and building system whether or not fully specified or detailed. When questions arise during construction relating to the items not detailed on the architectural or engineering drawings, the Contractor shall submit a drawing or statement illustration of what the Contractor had anticipated in their bid for this particular detail. The illustration shall be submitted to the Architect for review.
- F. Overhead and Profit Allowance: The maximum allowable markup on a Change Order proposal for overhead and profit **shall not exceed 15 percent** on the combined work of the prime and subcontractors. On that portion of the Work done under subcontract, the markup by the Prime Contractor **shall not exceed 7 percent**.

1.11 WITHDRAWAL OF BIDS

- A. Bids may be withdrawn on written request received from Bidders prior to time fixed for opening. Negligence on part of Bidder in preparing bid confers no right for withdrawal of bid after it has been opened. Withdrawn bids will be returned unopened.
- B. All bids shall be effective and open for acceptance for **period of 60 days** after date set for opening of bids.

1.12 RESERVATION

- A. The Owner reserves the right to reject any or all bids or to waive any irregularities in any bid or to accept any bid which will be to the best interests of Owner. Owner also reserves unrestricted privilege to reject any unit prices for additions to or deductions from scheduled amount of work as attached to the bid if they are considered excessive or unreasonable; or to accept, by including same in contract, any or all of such unit prices which may be considered fair and reasonable. The application of unit prices to add to or deduct from scheduled amount of work shall apply without limit.

1.13 INADEQUACIES AND OMISSIONS

- A. No oral explanation in regard to meaning of drawings and specifications will be made and no oral instructions will be given before award of contract. Bidders shall bring discrepancies, omissions, conflicts or doubt as to true meaning of any part of contract documents to attention of Architect by email only **at least seven (7) working days before due date for bids**. Prompt clarification will immediately be supplied to Bidders by addendum and receipt of each addendum shall be acknowledged on the Bid Form by each Bidder. All addenda so issued shall become part of contract documents.
- B. Neither Owner nor Architect will be responsible for oral instructions.

1.14 EMPLOYEE AND SCREENING IDENTIFICATION

- A. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

- B. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.15 POWER OF ATTORNEY

- A. There must be submitted with each bid or contract bond executed by an attorney-in-fact, a certified and effectively dated copy of his power of attorney. Where the certification is by facsimile or otherwise does not bear an original signature, the Bidder's bonding company must be qualified for recognition under facsimile execution.

END OF DOCUMENT

DOCUMENT 002600

PROCUREMENT SUBSTITUTION PROCEDURES

1.1 DEFINITIONS

- A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.
- B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 012500 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.3 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:
 - 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
 - 3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

- A. Procurement Substitution Request: Submit to Architect and Contractor. Procurement Substitution Request must be made in writing by prime contract Bidder only in compliance with the following requirements:
 - 1. Requests for substitution of materials and equipment will be considered if received **no later than 10 days** prior to date of bid opening.
 - 2. Submittal Format: Submit one copy of each written Procurement Substitution Request, using CSI Substitution Request Form 1.5C.
 - a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
 - b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:
 - 1) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
 - 2) Copies of current, independent third-party test data of salient product or system characteristics.
 - 3) Samples where applicable or when requested by Architect.

- 4) Detailed comparison of significant qualities of the proposed substitute with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - 5) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - 6) Research reports, where applicable, evidencing compliance with building code in effect for Project, from ICC-ES.
 - 7) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will become necessary to accommodate the proposed substitute.
- c. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
 - d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.
- B. Architect's Action:
1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.
- C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

END OF DOCUMENT

SUBSTITUTION REQUEST

(During the Bidding/Negotiating Phase)



PROJECT: _____ SUBSTITUTION REQUEST NUMBER: _____

FROM: _____

TO: _____ DATE: _____

A/E PROJECT NUMBER: _____

RE: _____ CONTRACT FOR: _____

SPECIFICATION TITLE: _____ DESCRIPTION: _____

SECTION: _____ PAGE: _____ ARTICLE/PARAGRAPH: _____

PROPOSED SUBSTITUTION: _____

MANUFACTURER: _____ ADDRESS: _____ PHONE: _____

TRADE NAME: _____ MODEL NO.: _____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

SUBMITTED BY: _____

SIGNED BY: _____

FIRM: _____

ADDRESS: _____

TELEPHONE: _____

A/E's REVIEW AND RECOMMENDATION:

- ☐ Approve Substitution—Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- ☐ Approve Substitution as noted—Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- ☐ Reject Substitution—Use specified materials.
- ☐ Substitution Request received too late—Use specified materials.

SIGNED BY: _____

DATE: _____

SUPPORTING DATA ATTACHED: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

BIDDER'S PROOF OF RESPONSIBILITY

-Confidential to the Extent Permitted by Laws and Regulations-

The Bidder's Proof of Responsibility must be filed with the Owner five days prior to the bid deadline. The Bidder must submit this statement, full and complete, sworn to before an officer authorized to administer oaths.

The purpose of this document is to enable the Owner to decide if the bidder has the financial ability, the equipment and the experience to perform the contract in a manner consistent with protection of the Owner's and the general welfare. It is not intended to discourage beginning contractors nor to make it difficult for qualified contractors to bid.

The Owner reserves the right to require additional information before awarding the contract in order to determine a prospective contractor's qualifications for the project. If the Owner determines that the answers to the questionnaire and the financial statement are insufficient or demonstrate that the bidder is not qualified the Owner may reject the bid.

Statement of Bidder's Qualifications

1. Name of Bidder _____
2. Bidder's address _____

3. Contact person _____
4. Telephone number _____
5. When organized _____
6. When incorporated _____
(if Sole Proprietorship or Partnership, so indicate)
7. Years in business under present name _____
8. Licenses (type and license number) _____
9. Certifications (check those that apply):
 - a. Disadvantaged Business Enterprise _____
 - b. Minority Business Enterprise _____
 - c. Woman-Owned Business Enterprise _____
 - d. Small Business Enterprise _____
10. Contracts on hand
(Attach a list of present uncompleted contracts, a schedule of their completion dates, % completed as of this date, and gross amount of each contract.)

11. General character of work typically performed by your firm _____

12. Has your firm or a firm for which a corporate officer of your firm was working ever defaulted on a contract or failed to complete any work awarded it?
Yes _____ No _____
(If yes, attach a statement setting forth when this occurred, where and why.)
13. Are there any judgments, claims, disputes or litigation pending or outstanding against your firm? Yes _____ No _____
(If yes, attach a statement setting forth when this occurred, where and why.)
14. Attach a list of major equipment now owned or leased full-time by your firm.
15. Attach a list of principal employees of your firm, including the officers, and a short resume of the background and experience of these principal employees.
16. Attach a list of credit references, showing credit available. Banks or other financial institutions are preferred references.
17. Financial statement:
Condition at the close of business on _____, 20 _____.
Assets:
a. Cash _____
b. Accounts receivable _____
c. Work in progress _____
d. Real estate equity _____
e. Materials in stock _____
f. Book value of equipment _____
g. Book value of furniture and fixtures _____
h. Other assets _____
Liabilities:
a. Accounts, notes and interest payable _____
b. Other liabilities _____

February __, 2024

Village of McFarland Public Safety Building
(PSB) Microgrid Design and Cx

Project No. ____

Net Worth:

(A standard financial statement may be submitted, if desired.)

Date at _____ this _____ day of 20 ____

Name of Organization _____

By _____

Title _____

State of _____, County of _____,

hereby certifies that the answers to all the foregoing questions and the other information provided are true and correct.

(signature)

Subscribed and sworn to before me this _____ day of _____, 20 ____

Notary Public

City/Village _____ County _____

My commission expires on _____

(Attachments consist of _____ sheets.)

DOCUMENT 003113

PRELIMINARY SCHEDULES

1.1 PROJECT SCHEDULE

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but do not affect Contract Time requirements. This Document and its attachments are not part of the Contract Documents.
- B. Available Project information includes the following:
1. Project Schedule.
- C. Project schedule including design and construction milestones are as follows:

Documents, Bidding and Contract:

Bid Documents Issued	Day, Month/Day, 2024
Bidder's Proof of Responsibility Due	Day, Month/Day, 2024
Affidavit of Qualifications Due	Day, Month/Day, 2024
Bid Opening	Day, Month/Day, 2024, 10:00AM
Village Board Approved	Day, Month/Day, 2024

Proposed Construction Milestones:

Building Permit Issuance	Day, Month/Day, 2024
Proposed Start of Construction	Day, Month/Day, 2024
Proposed Completion of Construction	Day, Month/Day, 2024

END OF DOCUMENT

DOCUMENT 004113
BID FORM - STIPULATED SUM (SINGLE-PRIME CONTRACT)

1.1 BID INFORMATION

- A. Bidder: _____.
- B. Project Name: Public Safety Building Microgrid.
- C. Project Location: 6001 Broadhead Street, McFarland, Wisconsin 53558.
- D. Owner: Village of McFarland.
- E. Owner Project Number: **<Insert Owner Project number>**.
- F. Architect/Engineer: Hammel, Green and Abrahamson, Inc., 333 East Erie Street, Milwaukee, Wisconsin 53202.
- G. Architect Project Number: 4715-004-00.

1.2 CERTIFICATIONS AND BASE BID

- A. Base Bid, Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by Hammel, Green and Abrahamson, Inc. and Architect's consultants, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:

1. _____ Dollars (\$_____).
2. The above amount may be modified by amounts indicated by the Bidder on the below "Alternate Bids" article.

All trades not included below.....Dollars (\$_____).

Electrical.....Dollars (\$_____).

1.3 ALTERNATE BIDS

- A. Refer to Section 012300 "Alternates" for full descriptions.
- B. Alternate Bid No. 1 - State the addition to/deduction from **<Alternate description from 012300>**.
ADD / DEDUCT _____ Dollars (\$_____).
- C. Alternate Bid No. 2 - State the addition to/deduction from **<Alternate description from 012300>**.
ADD / DEDUCT _____ Dollars (\$_____).

1.4 SALES AND USE TAX

- A. Contractors are to follow State Law regarding sales and use tax exemption for the purchase of building materials.

B. The Village of McFarland is an exempt entity for sales tax purposes pursuant to §77.54(9a)(b), Wis. Stats. and materials purchased by contractors for incorporation into any Village of McFarland facility (other than roads, highways or streets) under a contract with the Village of McFarland are similarly exempt from the imposition of sales taxes pursuant to §77.54(9m), Wis. Stats. Bids should not include sales tax on exempt materials or other tangible personal property which will become components of the facility. A copy of the Village of McFarland Certificate of Tax Exempt Status (CES) will be provided to the successful bidder at the time of contracting for use in documenting tax-exempt purchases.

1.5 BID GUARANTEE

A. The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within 10 days after a written Notice of Award, if offered within 60 days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached cash, cashier's check, certified check, U.S. money order, or bid bond, as liquidated damages for such failure, in the following amount constituting five percent (5%) of the Base Bid amount above:

1. _____ Dollars (\$_____).
- B. In the event Owner does not offer Notice of Award within the time limits stated above, Owner will return to the undersigned the cash, cashier's check, certified check, U.S. money order, or bid bond.

1.6 SUBCONTRACTORS AND SUPPLIERS

- A. The following companies shall execute subcontracts for the portions of the Work indicated:
- B. List the various portions of the work and the names and business addresses of the subcontractors and major material suppliers proposed to perform work, furnish materials or render service on or about the project. Subcontractors with subcontracts of \$5,000 or less need not be listed. Work for which a subcontractor is not listed will be performed by this Contractor. Submit Affidavit of Qualifications from each subcontractor. Subcontractors not meeting the qualifications established by Sec. 23-95 of the McFarland Municipal Code as evidenced by the affidavit will be rejected.

CLASS OF WORK	NAME AND ADDRESS OF SUBCONTRACTOR
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

1.7 TIME OF COMPLETION

- A. The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issued by Architect, and shall fully complete the Work within **<Insert number>** calendar days.

1.8 ACKNOWLEDGEMENT OF ADDENDA

- A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:

1. **Addendum No. 1**, dated _____.

1.9 BID SUPPLEMENTS

- A. The following supplements are a part of this Bid Form and are attached hereto.

1. Bid Form Supplement - Bid Bond Form (AIA Document A310-2010).

1.10 CONTRACTOR'S LICENSE

- A. The undersigned further states that it is a duly licensed contractor, for the type of work proposed, in the State of Wisconsin, and that all fees, permits, etc., pursuant to submitting this proposal have been paid in full.

1.11 REJECTION OF BIDS

- A. The Owner reserves the right to accept or reject any or all of the above proposals.

1.12 SUBMISSION OF BID

- A. Respectfully submitted this ____ day of _____, 2024.
- B. Submitted By: _____ (Name of bidding firm or corporation).
- C. Authorized Signature: _____ (Handwritten signature).
- D. Signed By: _____ (Type or print name).
- E. Title: _____ (Owner/Partner/President/Vice President).
- F. Witnessed By: _____ (Handwritten signature).
- G. Attest: _____ (Handwritten signature).
- H. By: _____ (Type or print name).
- I. Title: _____ (Corporate Secretary or Assistant Secretary).
- J. Street Address: _____.
- K. City, State, Zip: _____.
- L. Phone: _____.
- M. License No.: _____.
- N. Federal ID No.: _____ (Affix Corporate Seal Here).

END OF DOCUMENT

**VILLAGE OF MCFARLAND
AFFIDAVIT OF QUALIFICATIONS**

_____, (“Affiant”), a duly authorized representative of _____, a potential contractor or subcontractor (hereinafter the “Contractor”), on a project for the Village of McFarland, swears on behalf of said Contractor, under oath and penalty of perjury, as follows:

1. Contractor’s permanent place of business is located at:

2. The Contractor is authorized or registered to transact business in the state by the Department of Financial Institutions in compliance with Wis. Stat. chs. 178, 179, 180, 181, or 183.

3. Neither the Contractor, nor agent, partner or officer of the Contractor, nor any employee who will perform any work on the project, is debarred, suspended, proposed for debarment or declared ineligible from contracting with any unit of federal, state or local government.

4. The Contractor is in compliance with provisions of Section 2000e of Chapter 21, Title 42 of the United States Code and Federal Executive Order No. 11246 as amended by Executive Order No. 11375 (known as the Equal Opportunity Employer provisions).

5. The Contractor has general liability, workers’ compensation, unemployment, and automobile insurance at levels sufficient to protect the Village including those liability coverage limits specified in the contract documents.

6. The Contractor has complied with all provisions of Wisconsin prevailing wage law and federal Davis-Bacon related Acts, and all rules and regulations therein, for projects undertaken by the Contractor that are covered by these laws, for the past five (5) years.

7. The Contractor has _____ employees. The Contractor (does / does not) [STRIKE ONE] participant in an Apprenticeship program.

8. The Contractor has a written substance abuse prevention program meeting the requirements of Wis. Stat. § 103.503. As required by Wis. Stat. § 103.503, all employees are subject to drug and alcohol testing before commencing work on the public works project, except that testing of an employee before commencing work on a project is not required if the employee has been participating in a random testing program during the 90 days preceding the date on which the employee commences work on the public construction project.

9. Affiant represents and warrants that all employees who will perform work on the project are properly classified as employees or independent contractors under all applicable state and federal laws.

10. The Contractor (has / has not) [STRIKE ONE] been the subject of any investigation, order or judgment from any state or federal agency or court concerning an employment practice, including but not limited to, classification of employees, unemployment insurance, or discrimination. Copies of any investigation, order or judgment are attached. [STRIKE IF NOT APPLICABLE]

11. The Contractor's employees who will perform work on the project are:

- a. Covered under a current workers' compensation policy; and
- b. Properly classified under such policy.

12. The Contractor is in compliance with all applicable requirements of the federal Affordable Care Act.

13. The Contractor possesses all applicable professional and trade licenses required for performing the public works.

14. The Contractor has adequate financial resources to complete the public construction contract, as well as all other work the bidder is presently under contract to complete.

15. The Contractor is bondable for the terms of the proposed public construction contract.

16. The Contractor has satisfactorily completing the following five projects of similar size and complexity to the proposed public construction project within the last five years.

a. Project 1:

b. Project 2:

c. Project 3:

d. Project 4:

e. Project 5:

17. The Contractor has, and diligently maintains, a written safety program.

18. The Contractor has not been determined to have committed a Serious, Willful or Repeated violation (as defined by OSHA) of OSHA safety standards in the last 10 years.

19. The person signing below has the authority to sign on behalf of, and bind, the Contractor.

20. The Contractor understands that failing to submit the required affidavit, or providing incorrect, false, or misleading information, shall automatically disqualify the Contractor from be awarded the public construction contract and/or performing work on the project.

Project: _____

Signature: _____

Date: _____

Name: _____

Title: _____

**DOCUMENT 004313
BID SECURITY FORMS**

1.1 BID FORM SUPPLEMENT

- A. A completed bid bond form is required to be attached to the Bid Form.

1.2 BID BOND FORM

- A. AIA Document A310-2010 "Bid Bond" is the recommended form for a bid bond. A bid bond acceptable to Owner, or other bid security as described in the Instructions to Bidders, is required to be attached to the Bid Form as a supplement.
- B. Copies of AIA standard forms may be obtained from The American Institute of Architects; <https://www.aiacontracts.org/>; email: docspurchases@aia.org; (800) 942-7732.

END OF DOCUMENT

DOCUMENT 004323 - ALTERNATES FORM

1.1 BID INFORMATION

- A. Bidder: _____.
- B. Prime Contract: _____.
- C. Project Name: <Insert Project name>.
- D. Project Location: <Insert Project location>.
- E. Owner: <Insert name of Owner>.
- F. Owner Project Number: <Insert Owner Project number>.
- G. Architect: <Insert name of Architect>.
- H. Architect Project Number: <Insert Architect Project number>.
- I. Construction Manager: <Insert name of Construction Manager>.

1.2 BID FORM SUPPLEMENT

- A. This form is required to be attached to the Bid Form.

1.3 DESCRIPTION

- A. The undersigned Bidder proposes the amount below be added to or deducted from the Base Bid if particular alternates are accepted by Owner. Amounts listed for each alternate include costs of related coordination, modification, or adjustment.
 - 1. Cost-Plus-Fee Contract: Alternate price given below includes adjustment to Contractor's Fee.
- B. If the alternate does not affect the Contract Sum, the Bidder shall indicate "NO CHANGE."
- C. If the alternate does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."
- D. The Bidder shall be responsible for determining from the Contract Documents the affects of each alternate on the Contract Time and the Contract Sum.
- E. Owner reserves the right to accept or reject any alternate, in any order, and to award or amend the Contract accordingly within [60] days of the Notice of Award unless otherwise indicated in the Contract Documents.
- F. Acceptance or non-acceptance of any alternates by the Owner shall have no affect on the Contract Time unless the "Schedule of Alternates" Article below provides a formatted space for the adjustment of the Contract Time.

1.4 SCHEDULE OF ALTERNATES

- A. Alternate No. <Insert number>: <Insert title of alternate>:
 - 1. ADD ___ DEDUCT ___ NO CHANGE ___ NOT APPLICABLE ___.
 - 2. _____ Dollars (\$ _____).
 - 3. ADD ___ DEDUCT ___ calendar days to adjust the Contract Time for this alternate.

1.5 SUBMISSION OF BID SUPPLEMENT

- A. Respectfully submitted this ___ day of _____, <Insert year>.

- B. Submitted By: _____(Insert name of bidding firm or corporation).
- C. Authorized Signature: _____(Handwritten signature).
- D. Signed By: _____(Type or print name).
- E. Title: _____(Owner/Partner/President/Vice President).

END OF DOCUMENT 004323

DOCUMENT 005200 AGREEMENT FORMS

1.1 FORM OF AGREEMENT

- A. The following form of Owner/Contractor Agreement shall be used for the Project:
 - 1. AIA Document A101-2017 "Standard Form of Agreement between Owner and Contractor Where the Basis of Payment is a Stipulated Sum", as attached hereto.

END OF SECTION

DOCUMENT 007200
GENERAL CONDITIONS OF THE CONTRACT

1.1 GENERAL CONDITIONS

- A. *The following form of the General Conditions shall be used for the Project:*
1. The General Conditions for Project are AIA Document A201-2017 "General Conditions of the Contract for Construction."
 - a. The General Conditions are included in the Project Manual.
 - b. The Supplementary Conditions for Project are separately prepared and included in the Project Manual..

END OF SECTION

SECTION 011000 SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Building materials sales tax and use tax.
3. Work covered by Contract Documents.
4. Contractor's use of site and premises.
5. Work restrictions.
6. Specification and Drawing conventions.
7. Electronic Files.

1.2 PROJECT INFORMATION

A. Project Identification: Village of McFarland - Public Safety Building Microgrid .

1. Project Location: 6001 Broadhead Street, McFarland, Wisconsin 53558.

B. Owner: Village of McFarland.

C. Architect/Engineer: Hammel, Green and Abrahamson, Inc., 333 East Erie Street, Milwaukee, Wisconsin 53202.

1. The terms "Architect" and "Engineer" are synonymous within this Project Manual.

1.3 BUILDING MATERIALS SALES TAX AND USE TAX

A. Contractors are to follow State Law regarding sales and use tax exemption for the purchase of building materials.

B. The Village of McFarland is an exempt entity for sales tax purposes pursuant to §77.54(9a)(b), Wis. Stats. And materials purchased by contractors for incorporation into any Village of McFarland facility (other than roads, highways or streets) under a contract with the Village of McFarland are similarly exempt from the imposition of sales taxes pursuant to §77.54(9m), Wis. Stats. Bids should not include sales tax on exempt materials or other tangible personal property which will become components of the facility. A copy of the Village of McFarland Certificate of Tax Exempt Status (CES) will be provided to the successful bidder at the time of contracting for use in documenting tax-exempt purchases.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. The project consists of a Level 1 Microgrid Community Resilience Center at the new Net-Zero Public Safety Center providing battery storage systems and microgrid technologies and other Work indicated in the Contract Documents.

B. Type of Contract: Project will be constructed under a single prime contract.

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.6 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy Project site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.7 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between <Insert time> a.m. to <Insert time> p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 1. Weekend Hours: <Insert restrictions on times permitted for weekend work>.
 2. Early Morning Hours: As directed by Owner and complying with regulations of authorities having jurisdiction.
 3. Work in Existing Building: As directed by Owner and complying with regulations of authorities having jurisdiction.
 4. Hours for Utility Shutdowns: As directed by Owner and complying with regulations of authorities having jurisdiction.
- C. On-Site Work Day Restrictions: Do not perform work resulting in utility shutdowns or resulting in noisy activity on-site during work black-out days indicated in Document 003113 "Preliminary Schedules."
- D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
 1. Notify Architect and Owner not less than two days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- E. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Architect and Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- F. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.

- G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- H. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
 - 3. Material ID's: Materials and products are identified by reference Material ID's referencing Specification Section numbers found in this Project Manual.
- E. Days: Number of days called out in shall mean working days (i.e. not including weekends and holidays) unless noted otherwise.

1.9 ELECTRONIC FILES

- A. Upon request, one copy of electronic files in Architect's current file format, including applicable layers, for each issue (bid packages, construction packages, addenda, etc.) will be provided via e-mail, CD, or website posting at Architect's option to General Contractor at no charge for:
 - 1. Lighting plans
 - 2. Signal/System plans
 - 3. Power plans.
- B. Additional documents not listed or additional copies of electronic files are available upon request with advance payment of applicable fee(s) and subject to conditions of use. Contact Architect for schedules of fees and additional details about conditions. Subcontractors and others can obtain copies of electronic files from General Contractor.
- C. Electronic files and information therein are instruments of service and works in progress created for this Project and not to be used for other projects, additions to this project or completion of this Project by others.

- D. Signed and sealed original hard copy Drawings, Specifications and other documents as defined by General Conditions are Contract Documents. Electronic files are not Contract Documents and may be subject to manipulation beyond Architect's control. Therefore, Architect cannot verify that electronic files accurately or completely reflect Contract Documents, actual construction or field conditions. Each user of electronic files must determine accuracy, completeness and suitability for its intended use.
- E. Electronic files are subject to discrepancies as a result of numerous factors including but not limited to transmission and translation errors resulting from differences in software, hardware and other equipment related problems, disc or server malfunctions, data corruption during transmission through website or email and user error. Neither Architect nor Owner shall be responsible for such discrepancies.
- F. Architect makes no representation regarding accuracy, completeness or permanence of electronic files. Changes to Contract Documents may not be incorporated into electronic files including without limitation, Addenda information or revisions made after date indicated on electronic files.
- G. By accepting electronic files, user covenants not to sue, and agrees to indemnify and hold harmless Architect and Owner from costs (including attorneys' fees), claims or causes of action be it tort, breach of contract or otherwise that result from the use of electronic files, and waives claims for consequential and/or liquidated damages against Architect and Owner.
- H. Architect and Owner provide no warranties, express or implied with respect to electronic files, including but not limited to, Spearin type warranties, warranties of merchantability and/or fitness for a particular purpose.
- I. Use of electronic files provided by Architect does not obviate Contractor, subcontractor/installer or supplier from responsibility for proper checking and coordination of dimensions, details, member sizes, quantities and other requirements to facilitate complete and accurate fabrication, installation and completion of Work.
- J. Providing electronic files by Architect is not to be construed to be in derogation of reserved or intellectual property rights.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 012300 ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Alternates.

1.2 DEFINITIONS

- A. Alternate: Amount proposed by bidders and stated on Bid Form for certain work defined in bidding requirements that may be added to or deducted from Base Bid amount if Owner decides to accept corresponding change either in amount of construction to be completed or in products, materials, equipment, systems, or installation methods described in Contract Documents.
1. Cost or credit for each alternate is net addition to or deduction from Contract Sum to incorporate alternate into Work. No other adjustments are made to Contract Sum.

1.3 PROCEDURES

- A. Refer to Schedule of Alternates at the end of this Section.
1. Alternate descriptions are general only and are not intended to be complete tabulation of Work which may be affected by alternate.
 2. Refer to related Drawings and Specifications for detailed requirements for each alternate.
- B. Carefully examine Contract Documents and determine extent of Work of each Alternate, including:
1. Alternate-related work as indicated in Contract Documents.
 2. Coordination of work of all trades affected by Alternate.
 3. Adjustments to or revisions to other work as necessary to completely integrate work of Alternate.
 4. Miscellaneous devices, accessories and other items incidental to or required for a complete installation of alternate, whether or not indicated as part of alternate.
- C. Submit price for each Alternate listed on Bid Form.
1. State dollar amount to be added to or deducted from Base Bid, or indicate "No Change" in Base Bid sum.
 2. Alternate prices shall not increase by change in material prices, wage rates, or other escalatory factors.
 3. Alternate prices are all-inclusive, and include labor, materials, supervision, tools, equipment, taxes, overhead and profit.
- D. Owner reserves the following Rights:
1. To reject Alternates.
 2. To accept Alternates regardless of order or combination.
 3. To determine low bidder based on the sum of Base Bid and accepted Alternates.
 4. To delay decisions on Alternates and to accept or reject Alternates within 60 days after bid date, unless longer Alternate time frames are indicated.
- E. Notification: Immediately following award of Contract, notify each party involved, in writing, of status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration.
1. Include complete description of negotiated modifications to alternates, if applicable..
- F. Execution: Execute accepted alternates under the same conditions as other Work of the Contract.
1. In executing Base Bid Work, make provisions for future completion of alternates where indicated in the Contract Documents.

1.4 SCHEDULE OF ALTERNATES

Village of McFarland		Alternates
Public Safety Building Microgrid		
4715-004-00 Bidding Documents (95%)	March 27, 2024	012300 - 1

Alternate No. 1:

[TITLE]

Base Bid:

[BASE BID DESCRIPTION] [No action.]

Alternate:

[ALTERNATE DESCRIPTION]

See:

[Detail ____ / ____] [Sheet ____] [Section ____].

Alternate No. 2:

[TITLE]

Base Bid:

[BASE BID DESCRIPTION] [No action.]

Alternate:

[ALTERNATE DESCRIPTION]

See:

[Detail ____ / ____] [Sheet ____] [Section ____].

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION
Not Used

END OF SECTION

SECTION 012500 SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use Substitution Request Form attached to this Section.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 - 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
- b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
- B. Substitutions for Convenience:
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

DOCUMENT 012511
SUBSTITUTION REQUEST FORM

To: Hammel Green and Abrahamson, Inc.
Attn: Submittals Coordinator
333 East Erie Street
Milwaukee, Wisconsin 53202
submittals.glo@hga.com

Owner: Village of McFarland

Project: Public Safety Building Microgrid

HGA No.: 4715-004-00

From: _____

Address: _____

Contact: _____

Email: _____

Phone: _____

Submittal Date: _____

Previous Date: _____

PROPOSED SUBSTITUTION

Specification Section, Article, Paragraph: _____

Applicable Drawing & Details: _____

In Lieu Of: _____

Product/Model: _____

Manufacturer: _____

REASON FOR SUBSTITUTION REQUEST

☐ Substitution for Cause per Section 012500. Explain: _____

☐ Substitution for Convenience per Section 012500. Explain: _____

EFFECTS OF PROPOSED SUBSTITUTION

Does substitution affect dimensions indicated on Drawings?

☐ NO ☐ YES Explain: _____

Does substitution affect Work of other Sections?

☐ NO ☐ YES Explain: _____

Does substitution require modifications to design, changes to Drawings, or revisions to specifications to be incorporated into the Project?

☐ NO ☐ YES Explain: _____

CONTRACTOR'S / BIDDER'S REPRESENTATION

Undersigned accepts responsibility for coordination of proposed substitution and accepts all additional costs resulting from the incorporation of proposed substitution into the Project per Section 016210.

Subcontractor: _____

Signature: _____

Date: _____

Contractor: _____

Signature: _____

Date: _____

ARCHITECT/ENGINEER'S REVIEW

Review Date: _____

Reviewer Name: _____

☐ Accepted

☐ Not Accepted

☐ No Action Required

☐ Incomplete Submission

☐ Late Submiss

SECTION 012600 CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use form acceptable to Architect.

1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Contractor will issue a Change Order for signatures of Owner on AIA Document G701.

1.5 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 012900 PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than **seven** days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Arrange schedule of values consistent with format of AIA Document G703.
 - 2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports.
 - 3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 - 4. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.

3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Email a pdf of the signed and notarized copies of each Application for Payment to Architect.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. Evidence that claims have been settled.

7. Proof that taxes, fees, and similar obligations are paid.
8. Waivers and releases.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 013100 PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Web-based Project management software package.
 - 6. Project meetings.

1.2 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

1.4 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.

- b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 - 1. File Submittal Format: Submit or post coordination drawing files using PDF format.
 - 2. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 - 3. Architect will furnish Contractor digital data files for use in preparing coordination digital data files. Refer to "Electronic Files" Article in Section 011000 "Summary".

1.5 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 - 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation.
- C. RFI Forms: Software-generated form acceptable to Architect.
 - 1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 - 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.

- b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
- 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 - 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
- a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number.
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect.
 - 4. RFI number, including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
 - F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three if Contractor disagrees with response.

1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model and CAD drawings will be provided by Architect for Contractor's use during construction.
 - 1. Refer to "Electronic Files" Article in Section 011000 "Summary".
- B. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package acceptable to Architect and Owner for purposes of hosting and managing Project communication and documentation until Final Completion.
 - 1. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
 - 1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of five days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Preparation of Record Documents.
 - o. Use of the premises.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. Progress cleaning.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
- D. Progress Meetings: Conduct progress meetings at **biweekly intervals**.

1. Attendees: In addition to representatives of Owner, Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 013300 SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Preparation: Prepare and submit Submittal Schedule within 10 days after award of Contract, and prior to execution of Contract.
 - 2. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 3. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 - 1. Project name.
 - 2. Date.
 - 3. Name of Architect.
 - 4. Name of Contractor.
 - 5. Name of firm or entity that prepared submittal.
 - 6. Names of subcontractor, manufacturer, and supplier.
 - 7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 - 8. Category and type of submittal.
 - 9. Submittal purpose and description.
 - 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 - 11. Drawing number and detail references, as appropriate.
 - 12. Indication of full or partial submittal.

- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 10 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only submittals that are marked with APPROVED or CONDITIONALLY APPROVED notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 - 4. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
 - 5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

- a. Number of Samples: Submit **one** full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample set; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least two sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 DELEGATED DESIGN SERVICES

- A. Delegated Design Submittal and Shop Drawings: Where professional design services or certifications by a qualified Professional Engineer are specifically required of the Contractor by the Contract Documents, prepare and incorporate the following delegated design requirements into the shop drawings submittal package.
 1. Shop drawings shall be signed and sealed by a qualified Professional Engineer or contain an attached certificate, signed and sealed by a qualified Professional Engineer, indicating that the products and systems comply with performance and design criteria in the Contract Documents.
 2. Shop drawings or certificate shall clearly define the design criteria and applied loads for which the system components and connections have been designed. If design criteria indicated in the Contract Documents are not sufficient to perform services or certification required, submit a written request for additional information to Architect/Engineer.
 - a. Include list of design criteria, codes, standards, loads, and other factors used in performing these services.
 3. Shop drawings shall clearly indicate magnitude and location of all forces transferred to the supporting building structure by the product or system in which it is connected to. Forces shall be provided as unfactored values determined in accordance with the applicable building codes.
- B. Calculations: Upon request from the Architect/Engineer only, Contractor shall submit signed and sealed engineering calculations prepared by a qualified Professional Engineer. Submitted calculations that have not been requested by the Architect/Engineer will be returned without review.
 1. Calculations shall indicate structural integrity of members, anchors, fasteners and connections to supporting building structure, in accordance with performance and design criteria in Contract Documents. Provide load calculations, summary of loads and any applicable load diagrams.

2. Calculations will be reviewed by Architect/Engineer for stated design criteria, general compliance to specified requirements, and forces imposed on supporting structure only. The accuracy of the design calculations is the sole responsibility of the Contractor's Professional Engineer.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the systems, assemblies, or products that are similar in material, design, and extent to those indicated for this Project.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:
 - a. APPROVED: Submittal has no exceptions noted.
 - b. CONDITIONALLY APPROVED: Submittal has exceptions noted, but resubmission is not required.
 - c. NOT APPROVED: Submittal is incomplete and/or need corrections. Complete and/or correct and resubmit until final acceptance is obtained.
 - d. RECEIVED: Submittal is for information only.
 - e. NOT REVIEWED: Submittal was not required and has not been reviewed.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

DOCUMENT 013310
SUBMITTAL TRANSMITTAL FORM

To: Hammel Green and Abrahamson, Inc.
Attn: Submittals Coordinator
333 East Erie Street
Milwaukee, Wisconsin 53202
Email: submittals.glo@hga.com
RFI's: rfis.glo@hga.com

Owner: Village of McFarland
Project: Public Safety Building Microgrid
HGA No.: 4715-004-00

From: _____
Address: _____

Contact: _____
Email: _____
Phone: _____

Submittal Date: _____
Previous Date: _____

PRODUCT DATA

☐ Partial ☐ Complete ☐ Preliminary ☐ Final

Specification Section, Article, Paragraph: _____

Description: _____

Product/Model: _____

Manufacturer: _____

Supplier: _____

Subcontract: _____

SHOP DRAWINGS

☐ Partial ☐ Complete ☐ Preliminary ☐ Final

Specification Section, Article, Paragraph: _____

Description: _____

Product/Model: _____

Manufacturer: _____

Supplier: _____

Subcontract: _____

SAMPLES

☐ Partial ☐ Complete ☐ Preliminary ☐ Final

Specification Section, Article, Paragraph: _____

Description: _____

Product/Model: _____

Manufacturer: _____

Supplier: _____

Subcontract: _____

SUBMITTED BY

Name: _____ Company: _____

Signature: _____ Date: _____

SECTION 014000 QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of three previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED DESIGN SERVICES

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the systems, assemblies, or products that are similar in material, design, and extent to those indicated for this Project.
- B. Refer to Section 013300 "Submittal Procedures" for Delegated Design and Shop Drawings, Calculations submittal requirements.

1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Contractor's quality-control personnel.
- B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
 - 1. Requirements for obtaining samples.
 - 2. Unique characteristics of each quality-control service.
- D. Reports: Prepare and submit certified written reports and documents as specified.
- E. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.

8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement of whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement of whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.7 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

- F. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.8 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- C. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform duties of Contractor.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

- E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- F. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspection equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 015000 TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use with metering. Provide connections and extensions of services and metering as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings. Keep office clean and orderly.

- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.
- C. Electric Power Service:
 - 1. Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- D. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- E. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Coordinate with Owner locations for temporary offices, shops and sheds where necessary.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.

- D. Parking: Coordinate locations of parking areas for construction personnel with the Owner.
- E. Project Signs: Coordinate content and location with Owner and Architect.
- F. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 - 1. Do not load elevators beyond their rated weight capacity.
 - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work, so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- G. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION

SECTION 016000 PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of This Section Includes: Administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products unless otherwise indicated.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a substitution request, if applicable.
- D. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is inconspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

- a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
3. See individual identification Sections for additional equipment identification requirements.

1.4 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections are to be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.

6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements.
4. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.

a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: Submit as Action Submittal in accordance with Section 013300 "Submittal Procedures."
- C. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 017300 EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Installation.
 - 3. Cutting and patching.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
 - 7. Correction of the Work.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.4 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.

2. Establish limits on use of Project site.
 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 4. Inform installers of lines and levels to which they must comply.
 5. Check the location, level and plumb, of every major element as the Work progresses.
 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

3.4 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb, and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.5 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
 - B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
 - C. Temporary Support: Provide temporary support of Work to be cut.
 - D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
 - E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
 - F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
 - G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
 - H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
- a. Clean piping, conduit, and similar features before applying paint or other finishing materials.

b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- D. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- E. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- F. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.7 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with commissioning requirements in individual Sections.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 017700 CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final Completion procedures.
 - 3. List of incomplete items.
 - 4. Submittal of Project warranties.
 - 5. Final cleaning.

1.2 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.

5. Submit testing, adjusting, and balancing records.
 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.8 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first, listed by room or space number.

2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
4. Submit list of incomplete items in the following format:
 - a. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 1. Submit on digital media acceptable to Architect.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program.
- C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 CORRECTION OF THE WORK

- A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION

SECTION 017823 OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
 - 2. Submit three paper copies. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a.If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b.Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a.If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b.If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.4 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.

7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1.6 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 017839 PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Product Data.
 - 3. Miscellaneous record submittals.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit Record Digital Data Files and one set(s) of plots.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit Record Digital Data Files and three set(s) of Record Digital Data File plots.
 - 2) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- C. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- D. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
 4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

1.4 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
- C. Format: Submit Record Product Data as annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Product Data.
 - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.5 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 017900 DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. **Demonstration and training video recordings.**

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.3 CLOSEOUT SUBMITTALS

- A. **Demonstration and Training Video Recordings:** Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript:
 - a. Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 - b. Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
 - 3. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Systems and equipment operation manuals.
 - b. Systems and equipment maintenance manuals.
 - c. Product maintenance manuals.
 - d. Project Record Documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.

- d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode.
 - 1. Submit video recordings on thumb drive or by uploading to web-based Project software site.
 - 2. File Hierarchy: Organize folder structure and file locations in accordance with Project Manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged in accordance with Project Manual table of contents:
 - a.Name of Contractor/Installer.
 - b.Business address.
 - c.Business phone number.
 - d.Point of contact.
 - e.Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a.Produce segments to present a single significant piece of equipment per segment.
 - b.Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c.Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.

- E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- F. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 260500 COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. This Section specifies supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.
 - 2. Electrical equipment coordination and installation.
 - 3. Common electrical installation requirements.
 - 4. Demolition.
 - 5. Cutting and patching for electrical construction.
 - 6. Touchup painting.
 - 7. Disposition of existing materials and equipment.
 - 8. Electric Service Outage and Energizations.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Comply with [Federal][State] [and /or] [City] Code requirements.
- D. All materials shall meet the standards of the following institutes where applicable:
 - 1. National Fire Protection Association (NFPA)
 - 2. American Society of Testing Materials (ASTM)
 - 3. American National Standards Institute (ANSI)
 - 4. National Electrical Manufacturer's Association (NEMA)
 - 5. Institute of Electrical and Electronic Engineers (IEEE)

1.4 REFERENCES

- A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:
 - 1. 8P8C: An 8-position 8-contact modular jack.
 - 2. A: Ampere, unit of electrical current.
 - 3. AC or ac: Alternating current.
 - 4. AFCI: Arc-fault circuit interrupter.
 - 5. AIC: Ampere interrupting capacity.
 - 6. AL, Al, or ALUM: Aluminum.
 - 7. ASD: Adjustable-speed drive; also called "variable-frequency drive" (VFD).
 - 8. ATS: Automatic transfer switch.
 - 9. AWG: American wire gauge; see ASTM B258.
 - 10. BAS: Building automation system.
 - 11. BIL: Basic impulse insulation level.
 - 12. BIM: Building information modeling.
 - 13. CAD: Computer-aided design or drafting.
 - 14. CATV: Community antenna television.
 - 15. CB: Circuit breaker.
 - 16. cd: Candela, the SI fundamental unit of luminous intensity.
 - 17. CO/ALR: Copper-aluminum, revised.

18. COPS: Critical operations power system.
19. CU or Cu: Copper.
20. CU-AL or AL-CU: Copper-aluminum.
21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
23. dB(adjusted) or dBA: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
24. dBm: Decibel absolute power with respect to 1 mW.
25. DC or dc: Direct current.
26. DCOA: Designated critical operations area.
27. DDC: Direct digital control (HVAC).
28. EGC: Equipment grounding conductor.
29. ELV: Extra-low voltage.
30. EMF: Electromotive force.
31. EMI: Electromagnetic interference.
32. EPM: Electrical preventive maintenance.
33. EPS: Emergency power supply.
34. EPSS: Emergency power supply system.
35. ESS: Energy storage system.
36. EV: Electric vehicle.
37. EVPE: Electric vehicle power export equipment.
38. EVSE: Electric vehicle supply equipment.
39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
40. FLC: Full-load current.
41. ft: Foot.
42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
43. GEC: Grounding electrode conductor.
44. GFCI: Ground-fault circuit interrupter.
45. GFPE: Ground-fault protection of equipment.
46. GND: Ground.
47. HACR: Heating, air conditioning, and refrigeration.
48. HDPE: High-density polyethylene.
49. HID: High-intensity discharge.
50. HP or hp: Horsepower.
51. HVAC: Heating, ventilating, and air conditioning.
52. Hz: Hertz.
53. IBT: Intersystem bonding termination.
54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
56. IR: Infrared.
57. IS: Intrinsically safe.
58. IT&R: Inspecting, testing, and repair.
59. ITE: Information technology equipment.
60. kAIC: Kiloampere interrupting capacity.
61. kcmil or MCM: One thousand circular mils.
62. kV: Kilovolt.
63. kVA: Kilovolt-ampere.
64. kVA_r or kVAR: Kilovolt-ampere reactive.
65. kW: Kilowatt.
66. kWh: Kilowatt-hour.
67. LAN: Local area network.
68. lb: Pound (weight).
69. lbf: Pound (force).

70. LCD: Liquid-crystal display.
71. LCDI: Leakage-current detector-interrupter.
72. LED: Light-emitting diode.
73. Li-ion: Lithium-ion.
74. lm: Lumen, the SI derived unit of luminous flux.
75. LNG: Liquefied natural gas.
76. LP-Gas: Liquefied petroleum gas.
77. LRC: Locked-rotor current.
78. LV: Low voltage.
79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
80. m: Meter.
81. MCC: Motor-control center.
82. MDC: Modular data center.
83. MG set: Motor-generator set.
84. MIDI: Musical instrument digital interface.
85. MLO: Main lugs only.
86. MV: Medium voltage.
87. MVA: Megavolt-ampere.
88. mW: Milliwatt.
89. MW: Megawatt.
90. MWh: Megawatt-hour.
91. NC: Normally closed.
92. Ni-Cd: Nickel-cadmium.
93. Ni-MH: Nickel-metal hydride.
94. NIU: Network interface unit.
95. NO: Normally open.
96. NPT: National (American) standard pipe taper.
97. OCPD: Overcurrent protective device.
98. ONT: Optical network terminal.
99. PC: Personal computer.
100. PCS: Power conversion system.
101. PCU: Power-conditioning unit.
102. PF or pf: Power factor.
103. PHEV: Plug-in hybrid electric vehicle.
104. PLC: Programmable logic controller.
105. PLFA: Power-limited fire alarm.
106. PoE: Power over Ethernet.
107. PV: Photovoltaic.
108. PVC: Polyvinyl chloride.
109. pW: Picowatt.
110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
111. RMS or rms: Root-mean-square.
112. RPM or rpm: Revolutions per minute.
113. SCADA: Supervisory control and data acquisition.
114. SCR: Silicon-controlled rectifier.
115. SPD: Surge protective device.
116. sq.: Square.
117. SWD: Switching duty.
118. TCP/IP: Transmission control protocol/Internet protocol.
119. TEFC: Totally enclosed fan-cooled.
120. TR: Tamper resistant.
121. TVSS: Transient voltage surge suppressor.
122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
123. UL CCN: UL Category Control Number.
124. UPS: Uninterruptible power supply.
125. USB: Universal serial bus.
126. UV: Ultraviolet.
127. V: Volt, unit of electromotive force.
128. V(ac): Volt, alternating current.

129. V(dc): Volt, direct current.
130. VA: Volt-ampere, unit of complex electrical power.
131. VAR: Volt-ampere reactive, unit of reactive electrical power.
132. VFC: Variable-frequency controller.
133. VOM: Volt-ohm-multimeter.
134. VPN: Virtual private network.
135. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
136. W: Watt, unit of real electrical power.
137. Wh: Watt-hour, unit of electrical energy usage.
138. WPT: Wireless power transfer.
139. WPTE: Wireless power transfer equipment.
140. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. CR: Communications raceway.
2. CR-GP: General-purpose communications raceway.
3. CR-P: Plenum communications raceway.
4. CR-R: Riser communications raceway.
5. EMT: Electrical metallic tubing.
6. EMT-A: Aluminum electrical metallic tubing.
7. EMT-S: Steel electrical metallic tubing.
8. EMT-SS: Stainless steel electrical metallic tubing.
9. ENT: Electrical nonmetallic tubing.
10. EPEC: Electrical HDPE underground conduit (thin wall).
11. EPEC-A: Type A electrical HDPE underground conduit.
12. EPEC-B: Type B electrical HDPE underground conduit.
13. ERMC: Electrical rigid metal conduit.
14. ERMC-A: Aluminum electrical rigid metal conduit.
15. ERMC-S: Steel electrical rigid metal conduit.
16. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
17. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
18. ERMC-SS: Stainless steel electrical rigid metal conduit.
19. FMC: Flexible metal conduit.
20. FMC-A: Aluminum flexible metal conduit.
21. FMC-S: Steel flexible metal conduit.
22. FMT: Steel flexible metallic tubing.
23. FNMC: Flexible nonmetallic conduit. See "LFNC."
24. HDPE: HDPE underground conduit (thick wall).
25. HDPE-40: Schedule 40 HDPE underground conduit.
26. HDPE-80: Schedule 80 HDPE underground conduit.
27. IMC: Steel electrical intermediate metal conduit.
28. LFMC: Liquidtight flexible metal conduit.
29. LFMC-A: Aluminum liquidtight flexible metal conduit.
30. LFMC-S: Steel liquidtight flexible metal conduit.
31. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
32. LFNC: Liquidtight flexible nonmetallic conduit.
33. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
34. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
35. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
36. OFR: Optical fiber raceway.
37. OFR-GP: General-purpose optical fiber raceway.
38. OFR-P: Plenum optical fiber raceway.
39. OFR-R: Riser optical fiber raceway.
40. PVC: Rigid PVC conduit.
41. PVC-40: Schedule 40 rigid PVC conduit.
42. PVC-80: Schedule 80 rigid PVC Conduit.
43. PVC-A: Type A rigid PVC concrete-encased conduit.
44. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.

45. RGS: See ERM-C-S-G.
46. RMC: See ERM-C.
47. RTRC: Reinforced thermosetting resin conduit.
48. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
49. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
50. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
51. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
52. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.

47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Abbreviations and Acronyms for Electrical Flexible Cord Types:

1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
4. SEOWO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
6. SJEOW: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
12. SJOWO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
14. SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.

16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.
18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
24. STOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

E. Definitions:

1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
 - a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.
2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
8. Direct Buried: Installed underground without encasement in concrete or other protective material.
9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
 - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - b. Concrete Box: A box intended for use in poured concrete.
 - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.

- e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
 - f. Device Box: A box with provisions for mounting a wiring device directly to the box.
 - g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
 - h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
 - i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
 - j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
 - k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 - l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
 - m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
 - n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 - o. Raised-Floor Box: A floor box intended for use in raised floors.
 - p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
 - q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
 - r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 - s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 - t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
 11. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system.
 12. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.
 - a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.
 13. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
 14. Jacket: A continuous nonmetallic outer covering for conductors or cables.

15. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
16. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
17. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
18. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
19. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
20. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
21. Sheath: A continuous metallic covering for conductors or cables.
22. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
23. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
 - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
 - c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
 - d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
 - e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
 - f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.
24. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.
25. Telecommunication (Telecom) Room: A telecommunications space that is generally considered a floor-serving space that provides a connection point between headend equipment located in the room and cabling serving devices and outlets outside of the room.

1.5 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
 1. Notify [Architect] [Construction Manager] [Owner] [Tenant] no fewer than [seven] <Insert number> days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without [Architect's] [Construction Manager's] [Owner's] [Tenant's] written permission.
 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
 - a. Exercising generators.
 - b. Emergency lighting.
 - c. Elevators.
 - d. Fire-alarm systems.
- B. Arrange to provide temporary electrical [service] [or] [power] in accordance with requirements specified in Division 01.

- C. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- D. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- E. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Section 083100 "Access Doors and Panels."
- F. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 078400 "Firestopping."
- G. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
 - 2. Core drilling through post-tensioned slab: The [existing] post-tensioned slabs contain post-tensioned tendons that must not be damaged or broken. No nailing, drilling, cutting or other disruption to the slab is allowed without prior written approval by the structural engineer. Contractor shall positively locate the [existing] tendons and submit to the structural engineer for approval a written procedure, including plans showing [existing] tendon locations and proposed disruption of the slab.
- H. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- I. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- J. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability. Document results of said testing.

1.6 DRAWINGS

- A. The drawings indicate the arrangements of electrical equipment. Review architectural drawings and details for door swings, cabinets, counters and built-in equipment; conditions indicated on architectural plans shall govern. Coordinate installation of electrical equipment with structural system and mechanical equipment and access thereto. Coordinate installation of recessed electrical equipment with concealed ductwork and piping, and wall thickness. All devices, raceway, and electrical equipment in finished and/or public spaces shall be recessed or concealed unless otherwise noted.
- B. Do not scale drawings. Obtain dimensions for layout of equipment from Architectural plans and details unless indicated on Electrical plans.
- C. Bring all discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions to the immediate attention of the Architect.
- D. Equipment layout is based on one manufacturer's product or from composite dimensions from multiple manufacturers. Where equipment selected for use on the job differs from layout, coordinate space requirements and connection arrangements.

1.7 EQUIPMENT REQUIRING ELECTRICAL SERVICE

- A. Review all specification sections and drawings for equipment requiring electrical service. Provide service to and make connections to all such equipment requiring electrical service.
- B. Drawings indicate design loads, voltages and corresponding control equipment, feeders, and overcurrent devices. If equipment actually furnished have loads other than those indicated on the drawings or specified herein, control equipment, feeders, and overcurrent devices shall be adjusted in size accordingly at no additional cost to the owner. Such adjustment shall be subject to the review of the Architect.
- C. Incidental items not indicated on Drawing or mentioned in Specifications but that can legitimately and reasonably be inferred to belong to the Work or be necessary in good practice to provide complete system, shall be furnished and installed though not itemized here in detail.

1.8 MECHANICAL SYSTEMS INTERFACE

- A. All control wiring for plumbing, heating, ventilating and air conditioning systems shall be installed under Division 23. Review Division 23 specifications and shop drawings for control systems to assure compatibility between equipment furnished under Division 23 and wiring furnished under Division 26.
- B. Motor controllers (starters) shall be furnished and installed under Division 26, unless specified to be furnished as an integral component of the equipment. Provide the number and type of auxiliary contacts necessary to interlock the equipment and provide the specified control sequence.
- C. Power wiring to all motors, motor controllers and between motors and controllers shall be provided in Division 26.
- D. All electric heating equipment shall be provided and installed under Division 23 - HEATING, VENTILATING AND AIR CONDITIONING. Power wiring to all electric heating equipment shall be provided under Division 26 of these specifications.

1.9 SITE INVESTIGATION

- A. Prior to submitting bids of the project, visit the site of the work to become aware of existing conditions which may affect the cost of the project. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems shall be restored to their original condition, with the exception of the work under this contract, before the completion of this project. Existing systems and conditions which are not detailed on the drawings must still be restored to their original condition.

1.10 PREINSTALLATION MEETINGS

- A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than [10] <Insert number> days after notice to proceed. Agenda topics include, but are not limited to, the following:
 - 1. Electrical installation schedule.
 - 2. Status of power system studies.
 - 3. Value analysis proposals and requests for substitution of electrical equipment.
 - 4. Utility work coordination and class of service requests.
 - 5. Commissioning activities.
 - 6. Sustainability activities[, including Measurement and Verification Plan].

1.11 SEQUENCING

- A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.12 SCHEDULING

- A. <Insert requirements for unusual scheduling coordination>.

1.13 EQUIVALENTS AND SUBSTITUTIONS

- A. The applicable paragraphs for General Requirements, Division 01 apply herein.
- B. Basis of Design: The manufacturer's name and product listed on the drawings, or listed first of several names in these Specifications, is used as a basis for design to establish space requirements, a standard of quality and performance.
- C. Equivalents: Products of one or more other manufacturer's names listed in these Specifications following the words "or equivalent by" may be selected, subject to paragraph below titled "Contractor's Responsibility for Equivalent and Substitutions".
- D. Other Options:
 - 1. For products specified by naming only one manufacturer, refer to paragraph below under "Substitutions".
 - 2. For products specified only by performance characteristics or reference standards, select any manufacturer meeting the requirements.
- E. Substitutions: Requests for acceptance of a product of manufacturer's name not listed in these Specifications will be considered if any one of the following conditions is met:
 - 1. The named product is not available because of strikes or discontinuance of manufacture; and the proposed product is equivalent to the named product.
 - 2. The proposed product is superior to the named product, in the opinion of the Owner's Representative.
 - 3. The proposed product is equivalent to the named product and its use will be to the advantage of the Owner, by the Owner receiving an equitable credit or cost savings. The Owner's Representative reserves the right to reject any substitution.
 - 4. Submit proposed substitutions with bid along with alternate price, complete descriptive data and a comparison of the substitute manufacturer's product with specified product. Request for acceptance of a product of manufacturer's name not listed in these Specifications, is subject to the paragraph titled "Contractor's Responsibility Equivalents and Substitutions".
- F. Contractor's Responsibility for Equivalents and Substitutions:
 - 1. Items submitted as a substitution to the Basis of Design or listed general equivalents shall be identified as such and shall include a written request for substitution indicating the following:
 - a. Contract Price adjustment.
 - b. Contract time adjustment.
 - c. Item by item breakdown of differences between Basis of Design and substituted item.
 - d. Operation, maintenance and energy cost difference.
 - 2. Products of manufacturer must match the features, construction, performance and size of those selected for design. Standard catalogued may require certain modifications to meet specified requirements.
 - 3. The responsibility for providing that specified requirements have been met remains with the manufacturer and Contractor. Should the substituted item fail to perform in accordance with the Specifications, replace same with the originally specified item without extra cost to the contract.
 - 4. When requesting review of an equivalent or substituted product, submit a comparison chart listing features, construction, performance and sizes of name product versus equivalent or substituted product.
 - 5. Submittals for review of an equivalent or substituted product will be reviewed for acceptability when all the above requirements have been met. Contractor shall be responsible for all costs incurred by the Architect and Engineer for review of equivalency beyond initial review.
 - 6. Coordinate the installation of the product with all trades.
 - 7. Contractor shall be responsible for changes in electric wiring, materials and for all other additional costs of construction by all trades involved to accommodate the product to perform the same as the product used in the "Basis of Design".
 - 8. Coordination of General Equivalents and Substitutions: Where Contract Documents permits selection from general equivalents, or where substitutions are authorized, coordinate clearance and other interface requirements with other work.
 - 9. Provide necessary additional items so that selected or substituted item operates equivalent to the Basis of Design and properly fits in the available space allocated for the Basis of Design.

10. Contractor is responsible for assuring that piping, conduit, duct, flue and other service locations for general equivalents or substitutions do not cause access, service or operational difficulties any greater than would be encountered with the Basis of Design.
11. Failure to comply with these requirements will result in immediate rejection of the request for substitution.

1.14 GENERAL SUBMITTAL REQUIREMENTS

- A. Refer to Division 01 for additional requirements.
- B. Coordination and Sequencing:
 1. Coordinate submittals 3 weeks (minimum) prior to expected order date so that work will not be delayed by submittals.
 2. Do not submit product data, or allow its use on the project until compliance with requirement of Contract Documents has been confirmed by Contractor.
 3. Submittal is for information and record, unless otherwise indicated, and is not a change order request.
 4. Submitting contractor is responsible for routing reviewed submittals to all parties affected including but not limited to electrical, building automation and temperature control, and test and balance subcontractors.
 5. Make submittals for group of similar products or materials or by area of work complete and at one time, not in piecemeal fashion.
 6. Identify submittals with Architect's project name and number, with item designation as indicated on drawings, and referenced to applicable paragraphs of the specifications. Submit in brochure form.
 7. Submittals of products needed to start of Project for its installation, or those requiring a long lead time for assembly or manufacturing, should be submitted before the others.
 8. Submittals will not be required for commodity material (Conduits, boxes, supporting devices, etc). Include this information in the Operation and Maintenance Project Manual for the Owner's records.
- C. Preparations of Submittals:
 1. Refer to Division 01 requirements.
 2. Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, Supplier, submittal name and similar information to distinguish it from other submittals.
 3. Indicate any portions of work, which deviate from the Contract Documents.
 - a. Explain the reasons for the deviations.
 - b. Show how such deviations coordinate with interfacing portions of other work.
 4. Show Contractor's executed review and approval marking.
 5. Provide space for the Owner's Representative "Action" marking.
 6. Submittals, which are received from sources other than through Contractor's office, will be returned "Without Action".
 7. Submittals shall be presented in a neat and legible fashion and shall be returned "Without Action" if presented in any other fashion.
- D. Response to Submittals: Where standard product data has been submitted, it is recognized:
 1. That the Submitter has determined that the products fulfill the specified requirements.
 2. That the submittal is for the Owner's Representative information only, but will be returned with appropriate action where observed to be not in compliance with the requirements.
- E. If more than two submittals (either for shop drawings, or test reports) are made by the Contractor due to the incompleteness, non-compliance, errors, omissions, etc., the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

1.15 ACTION SUBMITTALS

- A. **Coordination Drawings for Structural Supports: Show coordination of structural supports for equipment and devices, including restraints and [bracing for control of seismic and wind loads], with other systems, equipment, and structural supports in the vicinity.**

- B. Coordination Drawings for Ceiling Areas: Where indicated on drawings, provide reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 013100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
 2. Structural members to which equipment and suspension systems will be attached.
 3. Size and location of access panels on ceilings.
 4. Elevation, size, and route of sprinkler piping.
 5. Elevation, size, and route of plumbing piping.
 6. Elevation, size, and route of ductwork.
 7. Elevation, size, and route of cable tray.
 8. Elevation, size, and route of conduit.
 9. Elevation and size of wall-mounted and ceiling-mounted equipment.
 10. Access panels.
 11. Sprinklers.
 12. Air inlets and outlets.
 13. Control modules.
 14. Luminaires.
 15. Communications devices.
 16. Speakers.
 17. Security devices.
 18. Fire-alarm devices.
 19. Indicate clear dimensions for maintenance access in front of equipment.
 20. Indicate dimensions of fully-open access doors.
- C. Coordination Drawings for Cable Tray Routing: Reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 013100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Elevation, size, and route of cable trays.
 2. Relationships between components and adjacent structural, electrical, and mechanical elements.
 3. Vertical and horizontal offsets and transitions.
 4. Elevation and size of sleeves for wall, ceiling, and floor cable penetrations.
 5. Elevation of ceilings and size of ceiling tiles.
 6. Locations of access panels on ceilings.
 7. Locations where cable tray crosses or parallels sprinkler piping.
 8. Locations where cable tray crosses plumbing piping.
 9. Locations where cable tray crosses or parallels ductwork.
 10. Locations of access panels on ductwork.
 11. Locations where cable tray crosses conduit.
 12. Items blocking access around cable trays, including the following:
 - a. Light fixtures.
 - b. Speakers.
 - c. Fire-alarm devices.
 - d. Power outlets.
 - e. Wall-mounted equipment.
 - f. Equipment racks.
 - g. Furniture.
 - h. Door swings.
 - i. Building features.
 13. Indicate clear dimension between cable tray and walls or obstructions that are closer than 10 ft.
 14. Highlight locations where cable tray is greater than 3 ft above ceilings. Explain how personnel access will be accommodated for cable tray maintenance.
- D. Coordination Drawings for Conduit Routing: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- E. Coordination Drawings for Bus Assembly Routing: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Scaled bus-assembly layouts and relationships between components and adjacent structural, mechanical, and electrical elements.
 2. Vertical and horizontal enclosed bus-assembly runs, offsets, and transitions.
 3. Clearances for access above and to the side of enclosed bus assemblies.
 4. Vertical elevation of enclosed bus assemblies above the floor or bottom of structure.
 5. Support locations, type of support, and weight on each support.
 6. Location of adjacent construction elements including luminaires, HVAC and plumbing equipment, fire sprinklers and piping, signal and control devices, and other equipment.
- F. Coordination Drawings for Large Equipment Indoor Installations:
1. Location plan, drawn to scale, showing heavy equipment or truck access paths to loading dock or other freight access into building. Indicate available width and height of doors or openings.
 2. Floor plan for entry floor and floor where equipment is located, drawn to scale, showing heavy equipment access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Dimensioned concrete bases, outlines of equipment, conduit entries, and grounding equipment locations.
 - b. If freight elevator must be used, indicate width and height of door and depth of car. Indicate if large equipment must be tipped to use elevator.
 - c. Dimensioned working clearances and dedicated areas below and around electrical equipment where obstructions and tripping hazards are prohibited.
 3. Reflected ceiling plans for entry floor and floor where equipment is located, drawn to scale, on which the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways[, busways,] [and seismic bracing].
 - b. Location of lighting fixtures, sprinkler piping and sprinklers, ducts and diffusers, and other obstructions, indicating available overhead clearance.
 - c. Dimensioned working clearances and dedicated areas above and around electrical equipment where foreign systems and equipment are prohibited.
- G. Coordination Drawings for Large Equipment Outdoor Installations:
1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
 - b. Indicate clear dimensions for fence gates and wall openings.
 - c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
 - d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
 - e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways[, busways,] [and seismic bracing].
 - f. Dimensioned working clearances and dedicated areas around electrical equipment.
- H. Coordination Drawings for Duct Banks:
1. Show duct profiles and coordination with other utilities and underground structures.
 2. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

1.16 INFORMATIONAL SUBMITTALS

- A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:
1. Submission of power system studies.
 2. Submission of specified coordination drawings.
 3. Submission of action submittals specified in Division 26.
 4. Orders placed for major electrical equipment.
 5. Arrival of major electrical equipment on-site.
 6. Preinstallation meetings specified in Division 26.
 7. Utility service outages.
 8. Utility service inspection and activation.
 9. Mockup reviews.
 10. Closing of walls and ceilings containing electrical Work.
 11. System startup, testing, and commissioning activities for major electrical equipment.
 12. System startup, testing, and commissioning activities for emergency lighting.
 13. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
 14. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
 15. Requests for special inspections.
 16. Requests for inspections by authorities having jurisdiction.
- B. Delegated Design Drawings for Structural Masonry Wall Penetrations: Where indicated on Drawings, provide reflected ceiling plan(s), supplemented by elevations, sections, and other details, drawn to scale, signed and sealed by a qualified structural professional engineer, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Location and dimensions of structural members supporting wall.
 2. Location and dimensions of columns near penetrations.
 3. Location and dimension of headers and lintels.
 4. Doors and windows near penetrations.
 5. Location and dimensions of penetrating cuts.
 6. Sprinkler piping and sleeves.
 7. Plumbing piping and sleeves.
 8. Ductwork and sleeves.
 9. Cable tray and sleeves.
 10. Conduit and sleeves.
 11. Firestopping assemblies for rated penetrations.
 12. Structural supports for piping, ductwork, and conduit on both sides of wall.
- C. Certificates:
1. Welding certificates.
 2. Seismic-Load Performance Certificates: Provide special certification for designated seismic systems as indicated in Paragraph 13.2.2 "Special Certification Requirements for Designated Seismic Systems" of [ASCE/SEI 7-05] [ASCE/SEI 7-10] [ASCE/SEI 7-16] for all designated seismic-load systems identified on Drawings or in the Specifications.
 - a. Include the following information:
 - 1) Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2) Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4) Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

- 5) Provide equipment manufacturer's written certification for each designated active electrical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction[, or experience data as permitted by][ASCE/SEI 7-05][ASCE/SEI 7-10][ASCE/SEI 7-16].
- 6) Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in [ASCE/SEI 7-05] [ASCE/SEI 7-10] [ASCE/SEI 7-16].
- 7) Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by qualified structural professional engineer.
- b. The following systems and components are Designated Seismic Systems and require written special certification of seismic qualification by manufacturer:
 - 1) Hangers and supports specified in Section 260529 "Hangers and Supports for Electrical Systems."
 - 2) Raceways, enclosures, cabinets, boxes, and their mounting provisions specified in Section 260533 "Raceway and Boxes for Electrical Systems."
 - 3) Seismic restraints specified in [Section 260548 "Vibration and Seismic Controls for Electrical Systems."] [Section 260548.16 "Seismic Controls for Electrical Systems."]
 - 4) Cable trays, accessories, and components specified in Section 260536 "Cable Trays for Electrical Systems."
 - 5) Equipment, accessories, and components specified in Section 261116.11 "Secondary Unit Substations with Switchgear Secondary."
 - 6) Equipment, accessories, and components specified in Section 261116.12 "Secondary Unit Substations with Switchboard Secondary."
 - 7) Equipment, accessories, and components specified in Section 261116.13 "Secondary Unit Substations with Motor Control Center Secondary."
 - 8) Equipment, accessories, and components specified in Section 261213 "Liquid-Filled, Medium-Voltage Transformers."
 - 9) Equipment, accessories, and components specified in Section 261216 "Dry-Type, Medium-Voltage Transformers."
 - 10) Equipment, accessories, and components specified in Section 261219 "Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers."
 - 11) Equipment, accessories, and components specified in Section 261323 "Medium-Voltage Metal-Enclosed Switchgear."
 - 12) Equipment, accessories, and components specified in Section 261326 "Medium-Voltage Metal-Clad Switchgear."
 - 13) Equipment, accessories, and components specified in Section 261329 "Medium-Voltage Compartmentalized Switchgear."
 - 14) Equipment, accessories, and components specified in Section 262213 "Low-Voltage Distribution Transformers."
 - 15) Equipment, accessories, and components specified in Section 262216 "Low-Voltage Buck-Boost Transformers."
 - 16) Equipment, accessories, and components specified in Section 262300 "Low-Voltage Switchgear."
 - 17) Equipment, overcurrent protective devices, accessories, and components specified in Section 262313 "Paralleling Low-Voltage Switchgear."
 - 18) Equipment, accessories, and components specified in Section 262413 "Switchboards."
 - 19) Equipment, accessories, and components specified in Section 262416 "Panelboards."
 - 20) Equipment, accessories, and components specified in Section 262416.16 "Electronically Operated Circuit-Breaker Panelboards."
 - 21) Equipment, accessories, and components specified in Section 262419 "Motor-Control Centers."
 - 22) Equipment, accessories, and components specified in Section 262500 "Low-Voltage Enclosed Bus Assemblies."
 - 23) Equipment, accessories, and components specified in Section 262733 "Power Distribution Units."

- 24) Equipment, accessories, and components specified in Section 262743 "Electric-Vehicle Service Equipment - AC Level 1 and Level 2."
- 25) Equipment, accessories, and components specified in Section 262746 "Electric-Vehicle Service Equipment - DC Level 1 and Level 2."
- 26) Equipment, accessories, and components specified in Section 262816 "Enclosed Switches and Circuit Breakers."
- 27) Equipment, accessories, and components specified in Section 262913.03 "Manual and Magnetic Motor Controllers."
- 28) Equipment, accessories, and components specified in Section 262913.06 "Soft-Start Motor Controllers."
- 29) Equipment, accessories, and components specified in Section 262923 "Variable-Frequency Motor Controllers."
- 30) Equipment, accessories, and components specified in Section 262933 "Controllers for Fire Pump Drivers."
- 31) Equipment, accessories, and components specified in Section 263100 "Photovoltaic Collectors."
- 32) Equipment, accessories, and components specified in Section 263213.13 "Diesel-Engine-Driven Generator Sets."
- 33) Equipment, accessories, and components specified in Section 263213.16 "Gas-Engine-Driven Generator Sets."
- 34) Equipment, accessories, and components specified in Section 263213.19 "Bi-Fuel-Engine-Driven Generator Sets."
- 35) Equipment, accessories, and components specified in Section 263223.13 "Horizontal-Axis Wind Turbines."
- 36) Equipment, accessories, and components specified in Section 263223.16 "Vertical-Axis Wind Turbines."
- 37) Equipment, accessories, and components specified in Section 263323.11 "Central Battery Equipment for Emergency Lighting."
- 38) Equipment, accessories, and components specified in Section 263343 "Battery Chargers."
- 39) Equipment, accessories, and components specified in Section 263353 "Static Uninterruptible Power Supply."
- 40) Equipment, accessories, and components specified in Section 263533 "Power Factor Correction Equipment."
- 41) Equipment, accessories, and components specified in Section 263600 "Transfer Switches."
- 42) Luminaires, accessories, and components specified in Section 265113 "Incandescent Interior Lighting."
- 43) Luminaires, accessories, and components specified in Section 265116 "Fluorescent Interior Lighting."
- 44) Luminaires, accessories, and components specified in Section 265119 "LED Interior Lighting."
- 45) Luminaires, accessories, and components specified in Section 265123 "HID Interior Lighting."
- 46) Luminaires, accessories, and components specified in Section 265213 "Emergency and Exit Lighting."
- 47) Dimmer racks specified in Section 265561 "Theatrical Lighting."
- 48) Poles and support components specified in Section 265613 "Lighting Poles and Standards."
- 49) Luminaires, accessories, and components specified in Section 265568 "Athletic Field Lighting."
- 50) Luminaires, accessories, and components specified in Section 265617 "Fluorescent Exterior Lighting."
- 51) Luminaires, accessories, and components specified in Section 265619 "LED Exterior Lighting."
- 52) Luminaires, accessories, and components specified in Section 265621 "HID Exterior Lighting."

3. Wind-Load Performance Certificates: Provide special certification for systems and components designated on Drawings or in the Specifications to be subject to high wind exposure and impact damage.
 - a. Include the following information:
 - 1) Provide equipment manufacturer's written certification for each designated system and component, stating that it will remain in place and operable following the design wind event and comply with requirements of authorities having jurisdiction.
 - 2) Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.
 - b. The following systems and components require written special certification of resistance to effects of high wind-load and impact damage by manufacturer:
 - 1) <Insert items>.

D. Qualification Statements:

1. For qualified regional manufacturer.
2. For structural professional engineer.
3. For electrical professional engineer.
4. For lighting professional engineer.
5. For EPM specialist.
6. For welder.
7. For ERMC-S-PVC raceway Installer.
8. For medium-voltage cable Installer.
9. For medium-voltage duct Installer.
10. For medium-voltage equipment Installer.
11. For electrical power monitoring Installer.
12. For switchboard Installer.
13. For EVSE Installer.
14. For generator set Installer.
15. For lightning protection system Installer.
16. For theatrical lighting Installer.
17. For exterior athletic lighting Installer.
18. For power quality specialist.
19. For [medium-voltage and]low-voltage electrical testing agency and on-site electrical testing supervisor.
20. For power-limited electrical testing agency and on-site power-limited testing supervisor.
21. For structural testing and inspecting agency.
22. For outdoor pole testing and inspecting agency.
23. For luminaire photometric testing laboratory.
24. For lighting testing and inspecting agency.

1.17 RECORD DRAWINGS AND CLOSEOUT SUBMITTALS

- A. Record drawings shall meet all "As-built" and "Record Drawings" requirements for <insert name of client or facility>. Coordinate all requirements with <insert name of client or facility> staff prior to completion.
- B. Drawings:
 1. Record of Project Progress: Maintain drawings available at the job site for inspection. Keep an accurate, legible and continuously updated record of installed locations and all project revisions other than revised drawings issued by the Architect, including source and date of authorization. Utilize only contract drawing symbols for recording the work. Drawing notations to be sufficiently clear in the representation of the work, for utilization by a CADD operator (drafts person) who is not necessarily familiar with the installed work.
 2. Record of Installation: At the conclusion of the work, deliver one (1) set of updated drawings to the Owner's Representative for review. Following the review, Contractor shall have incorporated by a competent CADD operator all of the installed data represented on the project progress drawings.
 3. Include in Record Drawings the Following:

- a. Revisions, including sketches, bulletins, change orders, written addenda and directives, clarifications and responses generated by requests for information (RFIs), regardless of source of the revision.
- b. Location and configuration of equipment with related housekeeping pads.
- c. Physical routing of ductbank work, raceways, exposed and above ceilings with locations of fire dampers, combination fire/smoke dampers, smoke detectors, power supplies, etc., plainly marked and identified.
- d. Location of room controllers, switches, devices, and sensors.
- e. Physical routing of raceways, underground, exposed and above ceiling with locations of accessories, pull points, access points plainly marked and identified.
- f. Location of raceways below building and on exterior, accessories, manholes, appurtenances and stub outs dimensioned from buildings and permanent structures, both horizontally and vertically.
- g. Location of wall and ceiling access panels.

C. [Updated]Facility EPM Program Binders:

1. Complete Set: On [approved online or cloud solution] [and] [USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement].
2. Volumes 2 and 8: Reproducible hardcopy on archival quality, 28 lb, acid-free, bond paper.

D. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:
 - a. <Insert system, equipment, or device>.
2. Include the following information:
 - a. Manufacturer's operating specifications.
 - b. User's guides for software and hardware.
 - c. Schedule of maintenance material items recommended to be stored at Project site.
 - d. Detailed instructions covering operation under both normal and abnormal conditions.
 - e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
 - f. List of load-current and overload-relay heaters with related motor nameplate data.
 - g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
 - h. Manufacturer's instructions for setting field-adjustable components.
 - i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
 - j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.
 - k. Exterior pole inspection and repair procedures.

E. Software and Firmware Operational Documentation: Provide software and firmware operational documentation[in Facility EPM Program Binders], including the following:

1. Software operating and upgrade manuals.
2. Names, versions, and website addresses for locations of installed software.
3. Device address list.
4. Printout of software application and graphic screens.
5. Testing and adjusting of panic and emergency power features.
6. For lighting controls, include the following:
 - a. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
 - b. Operation of adjustable zone controls.

F. Software:

1. Program Software Backup: Provide [username and password for approved online or cloud solution] [and] [USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement].
2. Provide to Owner upgrades and unrestricted licenses[for Government use] for installed and backup software, including operating systems and programming tools required for operation and maintenance.

1.18 QUALIFICATIONS

- A. Qualifications: Prepare and submit qualification statements for the following entities performing Work on Project:
1. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 014000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than [eight hours] <Insert time>.
 2. Structural Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in structural engineering[including seismic- and wind-load modeling and analysis].
 3. Electrical Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.
 4. Lighting Professional Engineer: Professional engineer possessing active qualifications in accordance with Section 014000 "Quality Requirements" and the following:
 - a. Expertise in electrical engineering, lighting design, and structural requirements for exterior poles and standards.
 - b. Lighting Certified (LC) Professional by the National Council on Qualifications for the Lighting Professions (NCQLP).
 5. EPM Specialist: Recognized experts possessing the following qualifications in accordance with Section 014000 "Quality Requirements" and NFPA 70B:
 - a. Technical Competence: Person should, by education, training, and experience, be well-rounded in all aspects of electrical maintenance.
 - b. Administrative and Supervisory Skills: Person should be skilled in planning and development of long-range objectives to achieve specific results and should be able to command respect and solicit cooperation of persons involved in EPM Program development.
 6. Welder: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," with training and certification in accordance with [AWS D1.1/D1.1M] [and] [AWS D1.2/D1.2M].
 7. ERMC-S-PVC Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by ERMC-S-PVC manufacturer prior to starting installation.
 8. Medium-Voltage Cable Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with training and manufacturer certification to install, splice, and terminate medium-voltage cable[in accordance with electrical utility service provider's requirements].
 - a. Medium-voltage cable Installer must be approved by <Insert name of electrical utility service provider>.
 9. Medium-Voltage Duct Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with installation of medium-voltage duct banks[in accordance with electrical utility service provider's requirements].
 - a. Medium-voltage duct Installer must be approved by <Insert name of electrical utility service provider>.
 10. Medium-Voltage Equipment Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with hazards and safety requirements associated with installation and operation of medium-voltage equipment[in accordance with electrical utility service provider requirements].
 - a. Medium-voltage equipment Installer must be approved by <Insert name of electrical utility service provider>.
 11. Electrical Power Monitoring Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by manufacturer prior to starting installation.
 12. EVSE Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by EVSE manufacturer prior to starting installation.

13. Generator Set Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by generator set manufacturer prior to starting installation.
14. Lightning Protection System Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present [unexpired UL-Listed Installer, UL Category Control Number OWAY, credentials] [or] [unexpired LPI Master Installer credentials] prior to starting installation.
15. Theatrical Lighting Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by theatrical lighting manufacturers prior to starting installation.
16. Exterior Athletic Lighting Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by exterior athletic lighting manufacturer prior to starting installation.
17. Power Quality Specialist: Recognized experts possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction, and able to present unexpired NICET Level 4 credentials with documented experience in power quality testing for installations similar in complexity to this Project.
18. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - a. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.
19. Medium-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - a. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.
20. Power-Limited Electrical Testing Agency: Entity possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - a. On-site power-limited testing supervisor must have BICSI Registered Communications Distribution Designer certification and documented training and experience with testing power-limited equipment in accordance with NETA testing standards.
21. Structural Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing structural concrete, seismic controls, and wind-load controls.
22. Outdoor Pole Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience in accordance with ASTM C1093 for foundation testing and inspections.
23. Luminaire Photometric Testing Laboratory: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" accredited under the NVLAP for Energy Efficient Lighting Products, and complying with applicable IES testing standards.
24. Lighting Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing and inspecting lighting installations in accordance with IES LM-5.

1.19 MOCKUPS

- A. Simple Mockups for Coordinating Accessibility of Electrical Devices around Fixed Furnishings and Equipment:
 1. Build simple mockups using art supplies and other inexpensive materials for verification of general arrangement, actual dimensions, and accessibility of <Insert identification of room and fabrication> by [Architect] [Owner] [Tenant] <Insert approving stakeholders> prior to fabrication and installation of Work. Depict products from all Divisions requiring coordination including, but not limited to, fixed furnishings, casework, outlet covers and plates, HVAC controls, exposed raceway, exposed plumbing, equipment, and signage.
- B. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.20 FIELD CONDITIONS

- A. Modeling, analysis, product selection, installation, and quality control for Work specified in Division 26 must comply with requirements specified in Section 260011 "Facility Performance Requirements for Electrical."
- B. Service Conditions for Electrical Power Equipment: Besides conditions specified in Section 260011 "Facility Performance Requirements for Electrical," specified electrical power equipment must be suitable for operation under service conditions specified as usual service conditions in applicable NEMA PB series, IEEE C37 series, and IEEE C57 series standards, except for the following:
 - 1. <Insert equipment location>:
 - a. Exposure to significant solar radiation.
 - b. Exposure to fumes, vapors, or dust.
 - c. Exposure to explosive environments.
 - d. Ambient temperature not exceeding [104 deg F] [122 deg F] [140 deg F] <Insert temperature>.
 - e. Exposure to hot and humid climate or to excessive moisture, including steam, salt spray, and dripping water.
 - f. Unusual transportation or storage conditions.
 - g. Unusual grounding resistance conditions.
 - h. Unusual space limitations.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

- A. Substitution requests for electrical equipment will be entertained under the following conditions:
 - 1. Notification of Contractor's intent to request substitutions for convenience must be declared during the Electrical Preconstruction Conference so potential risks to system performance and construction schedule may be identified for Contractor's response in submission of the substitution request. Submission of requests for substitutions for convenience must meet the conditions and deadline specified in Section 012500 "Substitution Procedures" to receive approval.
 - 2. For electrical equipment and systems, substitutions for cause are considered major construction risks. If it is possible that Contractor may need to request substitutions for cause because of equipment unavailability, or inability to meet construction schedule because of lead time, Contractor must declare the possibility during the Electrical Preconstruction Conference to permit establishing a mitigation plan for minimizing risks to system performance and construction schedule.

2.2 FACILITY ELECTRICAL PREVENTIVE MAINTENANCE (EPM) PROGRAM BINDERS

- A. Description: Set of binders containing operation and maintenance data for facility's electrical equipment that was compiled during analysis of installed electrical Work for Facility EPM Program development.
- B. Applicable Standards:
 - 1. Regulatory Requirements: Comply with recommendations in NFPA 70B.
 - 2. General Characteristics:
 - a. Volume 1 - Introduction:
 - 1) Summarize how Facility EPM Program Analysis was performed, how data were collected, and how volumes are organized.
 - 2) Describe Facility EPM Program and provide recommended policies and procedures for implementing the program and keeping it current.
 - 3) Provide place for Owner to identify contact information for employees responsible for implementing and maintaining Facility EPM Program.
 - b. Volume 2 - Facility Safety, Hazards Awareness, and Emergency Procedures:
 - 1) Include training requirements for employees and contractors.
 - 2) Include list of known facility hazards impacting IT&R activities.
 - 3) Include approval and permitting procedures for IT&R activities.

- 4) Include incident emergency response procedures.
- 5) Include emergency shutdown procedures.
- 6) Include electrical disaster recovery procedures.
- c. Volume 3 - Operating Procedures for Electrical Equipment and Controls:
 - 1) <Insert requirements>.
- d. Volume 4 - Facility Diagrams and Schedules:
 - 1) Include single-line diagrams.
 - 2) Include grounding and bonding diagrams.
 - 3) Include essential wiring diagrams.
 - 4) Include system automation diagrams (SCADA, BMS, lighting, HVAC, etc.).
 - 5) Include records of switchgear, switchboard, and panelboard schedules.
 - 6) Include time-current curves for overcurrent protective devices.
 - 7) Include list of load-current and overload-relay heaters with related motor nameplate data.
- e. Volume 5 - Inventory of Facility Equipment Using Electrical Power:
 - 1) Include simplified floor plans showing equipment locations.
 - 2) Identify critical equipment (electrical or otherwise).
 - 3) Include identifying designations and nameplate data.
 - 4) Include warranty and maintenance contract information.
- f. Volume 6 - Inventory of Facility Tools, Supplies, and Personnel Protective Equipment:
 - 1) Include schedules of maintenance material items recommended to be stored at facility.
 - 2) Include list of lamp types and photoelectric relays used in facility with ANSI and manufacturers' codes.
 - 3) Include calibration and servicing data for each item.
- g. Volume 7 - Inspection, Testing, and Repair (IT&R) Plan:
 - 1) Include tables showing frequency of activities for each item.
 - 2) Include annual schedule with activities mapped to specific days of the year.
 - 3) Include exterior pole inspection and repair procedures.
- h. Volume 8 - Inspection, Testing, and Repair (IT&R) Forms:
 - 1) <Insert requirements>.
- i. Volume 9 - Inspection, Testing, and Repair (IT&R) Procedures:
 - 1) <Insert requirements>.
- j. Volume 10 - Spare Parts List:
 - 1) Include list of all parts required to perform IT&R procedures.
 - 2) Identify quantities of which parts are recommended to be stored on-site.
 - 3) Include source contact information and budget cost for each item.
- k. Volume 11 - Construction Project Closeout Record Documentation:
 - 1) Include records of power system studies and photometric studies.
 - 2) Include records of risk assessment studies.
 - 3) Include records of electrical system startup and commissioning activities.
 - 4) Include records of baseline inspections and tests.
 - 5) Include records of baseline infrared photographs with normal light photographs showing the location, direction, angle, and conditions necessary for reproducing each infrared photograph.
 - 6) Include records of baseline settings for adjustable equipment and devices.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

3.2 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Section 078400 "Firestopping."

3.3 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Reroute circuits as required to serve equipment not in the demolition area.
- C. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- D. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- E. Remove demolished material from Project site.
- F. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
- G. Remove devices on wall or ceilings being removed. Coordinate with other divisions.
- H. Assume that all existing equipment and fixtures indicated to be reused are in good working condition and can be installed without repairs. Notify the Architect of items found to be in need of repair or in unusable condition for direction or decision. Repair any damage to equipment caused in removal or handling
- I. Fixtures and other equipment removed and to be-used shall be cleaned before reinstallation. Provide new lamps for reused light fixtures.
- J. Added Circuits: All loads and circuits added to existing panelboards shall be balanced between phases. On existing panelboards where circuits are changed, replace panel directories with new typed directories.
- K. All material and equipment which is noted or required by the owner to be salvaged and which is not scheduled to be reused or relocated shall be carefully removed and shall be delivered to the owner and stored where directed on the site.
- L. Remove all abandoned low voltage wiring. All wiring disconnected on one or both ends is considered abandoned unless tagged and labeled "future" or "spare". Verify with Owner any cabling connected on both ends is still in use prior to removal.

3.4 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.5 EXAMINATION

- A. Verification of Conditions:
 - 1. <Insert Project requirements>.
- B. Preinstallation Testing:
 - 1. <Insert Project requirements>.
- C. Evaluation and Assessment:
 - 1. <Insert Project requirements>.

3.6 DEVELOPMENT OF FACILITY EPM PROGRAM

- A. Facility EPM Program must be developed by qualified EPM specialist.
- B. Conduct Facility EPM Program analysis in accordance with NFPA 70B recommendations.
 - 1. Renovation Projects:
 - a. Facility diagrams must include connected existing equipment for entire facility where known. Areas of uncertainty should be clearly indicated.
 - b. Obtain copies of existing operation and maintenance data and existing Facility EPM Program information from Owner.
 - c. Facility EPM Program analysis should identify existing equipment that does not have available operation and maintenance data, and should explain the Owner's risks because this equipment is not included in Facility EPM Program.
 - d. Data for existing equipment outside scope of Project may be inserted in Facility EPM Program Binders without analysis.
 - e. Data for existing equipment impacted by scope of Project should be analyzed and documented similar to Project's new equipment data as much as possible.
- C. Compile operation and maintenance data from Facility EPM Program analysis and submit [updated]Facility EPM Program Binders.

3.7 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.8

3.9 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Firestopping.
 - 2. Electrical demolition.
 - 3. Cutting and patching for electrical construction.
 - 4. Touchup painting.

3.10 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Section 099000 "Painting."
 - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.11 CLEANING AND PROTECTION

A. Waste Management:

1. <Insert requirements for electrical and electronics waste disposal>.
- B. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- C. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

3.12 DISPOSITION OF EXISTING BALLASTS CONTAINING PCBS

- A. Environmental Protection Agency (EPA) Regulations [and Minnesota Pollution Control Agency (MPCA) Rules] require controlled disposal of fluorescent light ballasts containing polychlorinated biphenyls (PCBs) when removed from service. The ballasts involved were generally manufactured between 1950 and 1979.
- B. Provide suitable ballast collection containers at the project site. Check the ballasts in all fluorescent fixtures removed from service under this contract. Some ballasts may be labeled to indicate whether they do or do not contain PCBs. Remove from the fixtures all ballasts known or assumed to contain PCBs and place them in the designated ballast collection container and arrange for the disposal of the ballasts off the site in manner approved by the EPA [and MPCA].
- C. Bear all cost for ballast recycling.

3.13 DISPOSITION OF EXISTING FLUORESCENT LAMPS

- A. EPA Regulations [and Minnesota Pollution Control Agency (MPCA) rules] require the controlled disposal of fluorescent lamps.
- B. Remove all existing fluorescent lamps and package to prevent breakage according to EPA Regulations. Ship the lamps to a licensed lamp recycling facility with an approved material handler.
- C. Furnish the Owner with a Certificate of Disposal for these lamps, indicating the number of lamps, time and location of disposal.
- D. Bear all cost for lamp recycling.

3.14 ELECTRIC SERVICE OUTAGE AND ENERGIZATIONS

- A. Owner Approval: Electric service outages or energizations required shall be approved by the Owner before outages or energization. Outages shall be scheduled at the convenience of the Owner.
- B. Written Request: Requests for outages and energizations shall be submitted in writing to the Owner for approval at the earliest possible date and in no case later than 14 days prior to the outage and/or energization.
- C. Cancellation: The Owner reserves the right to cancel or change the scheduling of any outage up to 24 hours before its approved starting time. There shall be no additional cost to Owner for scheduled outages, or for outages re-scheduled at the Owner's request where at least 24 hours' notice has been given by the Owner.
- D. Schedules: A minimum of two (2) weeks before the first outage, submit a schedule of proposed sequence of all the electric feeder and switchboard outages and energizations. This schedule shall show construction energizations and shall include any weekend work. The schedule shall list the work to be completed during and between each outage.
- E. Minimize all outages on the Owner's electrical system and employ sufficient workmen so that work will be carried on concurrently at more than one location, when necessary.
- F. Before submitting any energization and/or outage requests, provide the owner with evidence that the following requirements have been met:
1. All required equipment and material is on the job site. All related installations that can be worked on without an energization and/or outage are complete, tested, available for inspection, and ready for service.

2. All shop drawings, test reports, installation data, and operational data have been submitted and approved.
 3. The energizing and outage schedule has been submitted and approved.
- G. Similar outage procedures shall be followed for telecommunications and other services to the facility.

3.15 PRIMARY SERVICE PROCEDURES

- A. During the energization and/or outage follow established switching procedures. Coordinate with the Owners operating personnel.
- B. Service disconnecting means and primary switches shall be left open and tagged in the name of a person to be designated by the Owner. In no case shall these cards be removed or switches closed without that person's approval.
- C. Operation of each primary switch installed under the contract shall be under Division 26. All switching of Owner system to perform the outage shall be performed by Division 26.
- D. At the time of energizing each primary feeder and/or equipment, the Contractor will be prepared to handle any situation that may arise from a cable or equipment failure or other faults on the system. If a failure or a fault occur, check out and place the system in proper operation with the required personnel and equipment.
- E. All primary and secondary temporary connections will be performed under Division 26.

3.16 CLOSEOUT ACTIVITIES

- A. Demonstration: [With assistance from factory-authorized service representatives, demonstrate] [Demonstrate] to Owner's maintenance and clerical personnel[and building occupants] how to operate the following systems and equipment:
 1. Lighting control devices specified in Section 260923 "Lighting Control Devices."
 2. Lighting control systems specified in Section 260943.16 "Addressable Luminaire Lighting Controls."
 3. Lighting control systems specified in Section 260943.23 "Relay-Based Lighting Controls."
 4. Electronic metering and billing software specified in Section 262713 "Electricity Metering."
 5. <Insert system or equipment>.
- B. Training: [With assistance from factory-authorized service representatives, train] [Train] Owner's maintenance personnel on the following topics:
 1. How to implement [updated]Facility EPM Program.
 2. How to adjust, operate, and maintain equipment specified in Section 111136 "Vehicle Charging Equipment."
 3. How to operate normal and emergency electrical systems, including justifications for, and limitations of, protective device settings recommended in study report specified in Section 260573.16 "Coordination Studies."
 4. Electrical power safety fundamentals refresher including arc-flash hazard safety features of electrical power distribution equipment in facility, interpreting arc-flash warning labels, selecting appropriate personal protective equipment, and understanding significance of findings documented in study report specified in Section 260573.19 "Arc-Flash Hazard Analysis."
 5. How to adjust, operate, and maintain systems specified in Section 260913 "Electrical Power Monitoring."
 6. How to adjust, operate, and maintain devices specified in Section 260923 "Lighting Control Devices."
 7. How to adjust, operate, and maintain hardware and software specified in Section 260936 "Modular Dimming Controls." [Laptop computer must be used in training.]
 8. How to adjust, operate, and maintain hardware and software specified in Section 260943.16 "Addressable Luminaire Lighting Controls."
 9. How to adjust, operate, and maintain hardware and software specified in Section 260943.23 "Relay-Based Lighting Controls."
 10. How to adjust, operate, and maintain equipment specified in Section 261116.11 "Secondary Unit Substations with Switchgear Secondary."

11. How to adjust, operate, and maintain equipment specified in Section 261116.12 "Secondary Unit Substations with Switchboard Secondary."
12. How to adjust, operate, and maintain equipment specified in Section 261116.13 "Secondary Unit Substations with Motor Control Center Secondary."
13. How to adjust, operate, and maintain equipment specified in Section 261213 "Liquid-Filled, Medium-Voltage Transformers."
14. How to adjust, operate, and maintain equipment specified in Section 261216 "Dry-Type, Medium-Voltage Transformers."
15. How to adjust, operate, and maintain equipment specified in Section 261219 "Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers."
16. How to adjust, operate, and maintain equipment specified in Section 261323 "Medium-Voltage Metal-Enclosed Switchgear."
17. How to adjust, operate, and maintain equipment specified in Section 261326 "Medium-Voltage Metal-Clad Switchgear."
18. How to adjust, operate, and maintain equipment specified in Section 261329 "Medium-Voltage Compartmentalized Switchgear."
19. How to adjust, operate, and maintain equipment specified in Section 262300 "Low-Voltage Switchgear."
20. How to adjust, operate, and maintain equipment specified in Section 262313 "Paralleling Low-Voltage Switchgear."
21. How to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories[, and to use and reprogram microprocessor-based trip, monitoring, and communication units] specified in Section 262413 "Switchboards."
22. How to adjust, operate, and maintain control modules specified in Section 262416.16 "Electronically Operated Circuit-Breaker Panelboards."
23. How to adjust, operate, and maintain enclosed controllers specified in Section 262419 "Motor-Control Centers."
24. How to adjust, operate, and maintain hardware and software specified in Section 262713 "Electricity Metering."
25. How to adjust, operate, and maintain equipment specified in Section 262733 "Power Distribution Units."
26. How to adjust, operate, and maintain equipment specified in Section 262913.03 "Manual and Magnetic Motor Controllers."
27. How to adjust, operate, and maintain equipment specified in Section 262913.06 "Soft-Start Motor Controllers."
28. How to adjust, operate, and maintain equipment specified in Section 262923 "Variable-Frequency Motor Controllers."
29. How to adjust, operate, and maintain controllers[, remote alarm panels] [, low-suction-shutdown panels] [, and to use and reprogram microprocessor-based controls within this equipment] specified in Section 262933 "Controllers for Fire Pump Drivers."
30. How to adjust, operate, and maintain equipment specified in Section 263100 "Photovoltaic Collectors."
31. How to adjust, operate, and maintain equipment specified in Section 263213.13 "Diesel-Engine-Driven Generator Sets."
32. How to adjust, operate, and maintain equipment specified in Section 263213.16 "Gas-Engine-Driven Generator Sets."
33. How to adjust, operate, and maintain equipment specified in Section 263213.19 "Bi-Fuel-Engine-Driven Generator Sets."
34. How to adjust, operate, and maintain equipment specified in Section 263323.11 "Central Battery Equipment for Emergency Lighting."
35. How to adjust, operate, and maintain equipment specified in Section 263343 "Battery Chargers."
36. How to adjust, operate, and maintain equipment specified in Section 263353 "Static Uninterruptible Power Supply."
37. How to adjust, operate, and maintain equipment specified in Section 263533 "Power Factor Correction Equipment."
38. How to adjust, operate, and maintain transfer switches and related equipment, including ground-fault protection system, specified in Section 263600 "Transfer Switches."

39. How to adjust, operate, and maintain devices specified in Section 264313 "Surge Protective Devices for Low-Voltage Electrical Power Circuits."
40. How to adjust, operate, and maintain stage lighting equipment specified in Section 265561 "Theatrical Lighting."
41. How to adjust, operate, and maintain luminaires[and photoelectric controls] specified in Section 265617 "Fluorescent Exterior Lighting."
42. How to adjust, operate, and maintain luminaires[and photoelectric controls] specified in Section 265619 "LED Exterior Lighting."
43. How to adjust, operate, and maintain luminaires[and photoelectric controls] specified in Section 265621 "HID Exterior Lighting."
44. <Insert system or equipment>.

END OF SECTION

SECTION 260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Aluminum building wire rated 600 V or less.
 - 3. Metal-clad cable, Type MC, rated 600 V or less.
 - 4. Armored cable, Type AC, rated 600 V or less.
 - 5. Photovoltaic cable, Type PV, rated 2000 V or less.
 - 6. Mineral-insulated cable, Type MI, rated 600 V or less.
 - 7. Tray cable, Type TC, rated 600 V or less.
 - 8. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2 and 3 control cables.
 - 2. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 DEFINITIONS

- A. PV: Photovoltaic.
- B. RoHS: Restriction of Hazardous Substances.
- C. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [testing agency] [manufacturer's authorized service representative].
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Alanwire

- b. Alpha Wire.
- c. American Bare Conductor
- d. Belden Inc.
- e. Cerro Wire
- f. Encore Wire Corporation.
- g. General Cable Technologies Corporation.
- h. Okonite Company (The)
- i. Service Wire Co.
- j. Southwire Incorporated.
- k. United Copper Industries.

C. Standards:

- 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- 2. RoHS compliant.
- 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:

- 1. Type THHN and Type THWN-2: Comply with UL 83.
- 2. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
- 3. Type XHHW-2: Comply with UL 44.

F. Shield:

- 1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, [provide products by the following]:

- 1. AFC Cable Systems.
- 2. Allied.
- 3. Anixter
- 4. Kaf-Tech
- 5. Service Wire Co.
- 6. Southwire Incorporated.

C. Standards:

- 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- 2. Comply with UL 1569.
- 3. RoHS compliant.
- 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

- 1. Single circuit and multicircuit with color-coded conductors.

E. Conductors:

- 1. Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- 2. Aluminum, complying with ASTM B 800 and ASTM B 801.

F. Ground Conductor: Insulated.

- G. Conductor Insulation:
 - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- H. **Sheath:**Aluminum, interlocked.
- I. Jacket: PVC applied over **sheath**.

2.3 ARMORED CABLE, TYPE AC

- A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. **AFC Cable Systems.**
 - 2. **Allied.**
 - 3. **Anixter**
 - 4. **Kaf-Tech**
 - 5. **Okonite Company (The)**
 - 6. **Service Wire Co.**
 - 7. **Southwire Incorporated.**
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Comply with UL 4.
 - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
 - 1. Single circuit and multicircuit with color-coded conductors.
- E. Conductors:
 - 1. Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
 - 2. Aluminum, complying with ASTM B 800 and ASTM B 801.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation: Type THHN/THWN-2. Comply with UL 83.
- H. Armor: Aluminum, interlocked.
- I. **Sheath to have green coating to indicate separate insulated ground conductor in accordance with 250.118.**

2.4 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. **3M Electrical Products**
 - 2. **AFC Cable Systems, Inc.**
 - 3. **Gardner Bender.**
 - 4. **Hubbell Power Systems, Inc.**
 - 5. **Ideal Industries, Inc.**
 - 6. **ILSCO**
 - 7. **NSi Industries LLC.**
 - 8. **O-Z/Gedney; a brand of the EGS Electrical Group.**
 - 9. **Service Wire Co.**
 - 10. **TE Connectivity Ltd.**
 - 11. **Thomas & Betts Corporation**

- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Materials:
 - a. Copper.
 - 2. Type: Two hole with standard barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance:
 - 1. Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders:
 - 1. Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace:
 - 1. Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground:
 - 1. Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace:
 - 1. Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions:
 - 1. Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground:
 - 1. Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Cable installations shall only be allowed where identified in Part 3.2. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

- G. Group conductors with phases A, B, C, and neutral together in all conduits or raceways regardless of number of sets of conductors, conduits or raceway type.
- H. Do not install more conductors in a raceway than indicated on the drawings. A maximum of three branch circuits are to be installed in any one conduit, on 3 phase 4 wire system, unless specifically indicated otherwise on the drawings. No two branch circuits of the same phase are to be installed in the same conduit, unless specifically indicated on the drawings. Where the quantity of wires is not indicated on the drawings for branch circuits (2) #12 copper conductors shall be provided.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. After installing conductors and cables and before electrical circuitry has been energized, test conductors feeding the following critical equipment and services for compliance with requirements:
 - a. Panel SH
 - 3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.

- g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 4. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports to record the following:
- 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 260523 CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Category 5e twisted pair cable.
 - 2. Category 6 twisted pair cable.
 - 3. Twisted pair cabling hardware.
 - 4. RS-485 cabling.
 - 5. Low-voltage control cabling.
 - 6. Control-circuit conductors.
 - 7. Identification products.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- D. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262 by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: 60 inches or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.

3. Average Optical Smoke Density: 0.15 or less.
- C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.
- E. RoHS compliant.

2.2 CATEGORY 5E BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. ADC.
 2. Alpha Wire Company; a division of Belden Inc.
 3. Belden Inc.
 4. Berk-Tek
 5. CommScope, Inc.
 6. Draka Cableteq USA.
 7. General Cable.
 8. Genesis Cable Products; Honeywell International, Inc.
 9. Mohawk; a division of Belden Inc.
 10. Nexans; Berk-Tek Products.
 11. Siemon Company (The).
 12. Superior Essex Inc.
 13. SYSTIMAX Solutions; a CommScope, Inc. brand.
 14. 3M.
 15. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- C. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.
- D. Conductors: 100-ohm, 24 AWG solid copper.
- E. Shielding/Screening: Shielded twisted pairs (FTP).
- F. Cable Rating: Plenum.
- G. Jacket: Gray thermoplastic.

2.3 CATEGORY 6 BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. ADC.
 2. Alpha Wire Company; a division of Belden Inc.
 3. Belden Inc.
 4. Berk-Tek
 5. CommScope, Inc.
 6. Draka Cableteq USA.
 7. General Cable.
 8. Genesis Cable Products; Honeywell International, Inc.
 9. Mohawk; a division of Belden Inc.
 10. Nexans; Berk-Tek Products.
 11. Siemon Company (The).
 12. Superior Essex Inc.
 13. SYSTIMAX Solutions; a CommScope, Inc. brand.
 14. 3M.
 15. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

- D. Conductors: 100-ohm, 23 AWG solid copper.
- E. Shielding/Screening: Shielded twisted pairs (FTP).
- F. Cable Rating: Plenum.
- G. Jacket: Yellow thermoplastic.

2.4 BALANCED TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following :
 - 1. ADC.
 - 2. Alpha Wire Company; a division of Belden Inc.
 - 3. Belden Inc.
 - 4. Berk-Tek
 - 5. CommScope, Inc.
 - 6. Draka Cableteq USA.
 - 7. General Cable.
 - 8. Genesis Cable Products; Honeywell International, Inc.
 - 9. Mohawk; a division of Belden Inc.
 - 10. Nexans; Berk-Tek Products.
 - 11. Siemon Company (The).
 - 12. Superior Essex Inc.
 - 13. SYSTIMAX Solutions; a CommScope, Inc. brand.
 - 14. 3M.
 - 15. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- C. General Requirements for Balanced Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 6 .
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables shall be terminated with connecting hardware of same category or higher.
- D. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.
- E. Connecting Blocks: 110-style IDC for Category 5e 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25] percent spare, integral with connector bodies, including plugs and jacks where indicated.
- F. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- G. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
 - 1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 - 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
- H. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.
- I. Plugs and Plug Assemblies:
 - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.

2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
 3. Marked to indicate transmission performance.
- J. Jacks and Jack Assemblies:
1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded twisted pair cable.
 2. Designed to snap-in to a patch panel or faceplate.
 3. Standards:
 - a. Category 5e, unshielded twisted pair cable shall comply with IEC 60603-7-2.
 - b. Category 5e, shielded twisted pair cable shall comply with IEC 60603-7-3.
 - c. Category 6, unshielded twisted pair cable shall comply with IEC 60603-7-4.
 - d. Category 6, shielded twisted pair cable shall comply with IEC 60603-7.5.
 - e. Category 6a, unshielded twisted pair cable shall comply with IEC 60603-7-41.
 - f. Category 6a, shielded twisted pair cable shall comply with IEC 60603-7.51.
 4. Marked to indicate transmission performance.
- K. Faceplate:
1. Four port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
 2. Eight port, vertical double-gang faceplates designed to mount to double-gang wall boxes.
 3. Plastic Faceplate: High-impact plastic. white
 4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
- L. Legend:
1. Machine printed, in the field, using adhesive-tape label.
 2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 RS-232 CABLE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following :
1. Allied Wire & Cable Inc.
 2. Belden Inc.
 3. General Cable.
 4. Genesis Cable.
 5. Southwire Company.
 6. PVC-Jacketed, TIA 232-F:
 - a. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - b. Polypropylene insulation.
 - c. Aluminum foil-polyester tape shield with 100 percent shield coverage.
 - d. PVC jacket.
 - e. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - f. NFPA 70 Type: Type CM.
 - g. Flame Resistance: Comply with UL 1581.
 7. Plenum-Type, TIA 232-F:
 - a. Three, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - b. PE insulation.
 - c. Aluminum foil-polyester tape shield with 100 percent shield coverage.
 - d. Fluorinated ethylene propylene jacket.
 - e. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - f. Flame Resistance: Comply with NFPA 262.

2.6 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.

1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1685.
- B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with NFPA 262.

2.7 CONTROL-CIRCUIT CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following :
1. Encore Wire Corporation.
 2. General Cable Technologies Corporation.
 3. Southwire Company.
- B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
1. Outlet boxes for cables shall be no smaller than 4 inches square by 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
 2. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard if entering the room from overhead.
 4. Extend conduits [3 inches] <Insert dimension> above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1 and NFPA 70.
- B. General Requirements for Cabling:
1. Comply with TIA-568-C Series of standards.
 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
 5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
 6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
 11. Support: Do not allow cables to lay on removable ceiling tiles.
 12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
 13. Provide strain relief.
 14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
 15. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
- C. Balanced Twisted Pair Cable Installation:
1. Comply with TIA-568-C.2.
 2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
 3. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.
- D. Installation of Control-Circuit Conductors:
1. Install wiring in raceways.
 2. Use insulated spade lugs for wire and cable connection to screw terminals.
 3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of 72 inches of cable in a coil not less than 12 inches in diameter.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified for future use with a tag.

3.5 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No. 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No. 12 AWG.

3.6 FIRESTOPPING

- A. Comply with requirements for "Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

- A. For data communication wiring, comply with ANSI-J-STD-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

- A. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.
- B. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform the following tests and inspections:
- E. Tests and Inspections:
 - 1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- F. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- G. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.
- D. .

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in "Closeout Submittals," include the following:
 - a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1) Ground rods.
 - 2) Grounding arrangements and connections for separately derived systems.
 - b. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following :
 - 1. 3M
 - 2. Alanwire
 - 3. Burndy
 - 4. Cerrowire
 - 5. Erico
 - 6. Galvan Electrical
 - 7. General Cable Technologies Corporation.
 - 8. Harger
 - 9. Hilti
 - 10. Hubbell
 - 11. IlSCO
 - 12. Lyncole
 - 13. Panduit
 - 14. Southwire Incorporated.
 - 15. Thomas & Betts
 - 16. United Copper Industries.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2.
- D. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- E. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- E. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- F. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- G. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- H. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- I. Conduit Hubs: Mechanical type, terminal with threaded hub.
- J. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- K. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- L. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- M. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- N. Straps: Solid copper, copper lugs. Rated for 600 A.
- O. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.
- P. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- Q. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Tin-plated aluminum.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector.
- R. Compression Connectors: Irreversible type, copper or copper alloy connectors, meet or exceed IEEE837, UL467, and CSA22.2, factory filled with oxide inhibitor compound, and marked and approved for Direct Burial. Connectors must be fully crimped, allowing visible inspection of the embossed index number on the crimped connector, which should match the same index number on the die. May be used above and below grade, on electrodes, and in concrete encased applications.
 - 1. Thomas & Betts Easy Ground Figure 6 Connector, Easy Ground Figure 8 Connector, Easy Ground C-Taps, Easy Ground C-Crimps.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad; 3/4 inch by 10 feet.
 - 1. Ground rods to have knurled pattern at clamp or compression connection.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.
- C. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare [tinned-]copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 30 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- D. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- F. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Irreversible compression or welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- G. Panelboard Bonding:
 - 1. Bond normal and critical circuit panelboards commonly serving patient care areas together, per NFPA 70 517.14.
 - a. The equipment grounding terminal busses of the normal and essential branch circuit panelboards serving the same individual patient vicinity, shall be bonded together with an insulated continuous copper conductor not smaller than #10 AWG.
- H. Equipotential Bonding:
 - 1. Provide bonding between all metal parts in Operating and Procedure Rooms including booms, door frames, medical gas outlets, and any other metal surfaces below 7'0".

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.

3. Rod to have knurled area for clamp or compression connection. Knurl may be field installed with tool made for purpose.
 4. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use irreversible compression or exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 13 ohm(s).
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems.
 - 2. Aluminum slotted support systems.
 - 3. Nonmetallic slotted support systems.
 - 4. Conduit and cable support devices.
 - 5. Support for conductors in vertical conduit.
 - 6. Structural steel for fabricated supports and restraints.
 - 7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 8. Fabricated metal equipment support assemblies.
 - 9. Construction requirements for concrete bases.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Ductwork, piping, fittings, and supports.
 - 3. Structural members to which hangers and supports will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Projectors.
 - g. <Insert item>.
- B. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.2/D1.2M.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014500 "Quality Control," to design hanger and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Power-Strut
 - f. Thomas & Betts Corporation.
 - g. Unistrut; Tyco International, Ltd.
 - h. Wesanco, Inc.
 - 2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 4. Channel Width: Selected for applicable load criteria.
 - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper Industries.
 - b. Flex-Strut, Inc.
 - c. Haydon Corporation
 - d. MKT Metal Manufacturing
 - e. Power-Strut
 - f. Thomas & Betts Corporation.
 - g. Unistrut; Tyco International, Ltd.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Channel Material: 6063-T5 aluminum alloy.
 - 4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 - 5. Channel Width: Selected for applicable load criteria.
 - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c., in at least one surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. B-Line, Inc.
 - c. Fabco Plastics
 - d. G-Strut
 - e. Haydon Corporation
 - f. **Power-Strut**
 - g. Seasafe, Inc
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Channel Width: Selected for applicable load criteria.
 4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
 5. Fitting and Accessory Materials: Same as those for channels and angles.
 6. Rated Strength: Selected to suit applicable load criteria.
 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101

Retain first subparagraph below for installation and support of aluminum conduit.

- 3. NECA 102.

Retain first subparagraph below for installation and support of metal cable tray systems.

Retain subparagraph below for installation and support of nonmetallic cable tray systems.

- 4. .
- B. Comply with requirements for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted [or other]support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Concrete bases shall be 4 inches high for power systems where identified required by drawings or for ground or floor mounted equipment.
- C. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements as specified.
- D. Anchor equipment to concrete base.
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 260533 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Nonmetal wireways and auxiliary gutters.
 - 5. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
- B. Manufacturers: Subject to compliance with requirements, provide products by the following :
 - a. AFC Cable Systems, Inc.
 - b. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - c. Anamet Electrical, Inc.
 - d. Calconduit
 - e. Electri-Flex Company.
 - f. FSR Inc.
 - g. Gibson Stainless
 - h. Korkap
 - i. Opti-Com Manufacturing Network, Inc.
 - j. O-Z/Gedney; a brand of EGS Electrical Group.
 - k. Perma-Cote

- l. Picoma Industries, Inc.
- m. Plasti-Bond
- n. Republic Conduit.
- o. Robroy Industries.**
- p. Southwire Company.
- q. Thomas & Betts Corporation. (ABB Installation Products)
- r. Western Tube and Conduit Corporation.
- s. Wheatland Tube Company; a division of John Maneely Company.
- 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 3. GRC: Comply with ANSI C80.1 and UL 6.
- 4. ARC: Comply with ANSI C80.5 and UL 6A.
- 5. IMC: Comply with ANSI C80.6 and UL 1242.
- 6. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch, minimum.
- 7. EMT: Comply with ANSI C80.3 and UL 797.
- 8. FMC: Comply with UL 1; zinc-coated steel.
- 9. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- C. Metal Fittings:
- D. Manufacturers: Subject to compliance with requirements, provide products by the following :
 - a. AFC Cable Systems, Inc.
 - b. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - c. Anamet Electrical, Inc.
 - d. Bridgeport Fittings, Inc.**
 - e. Calconduit
 - f. Electri-Flex Company.
 - g. FSR Inc.
 - h. Gibson Stainless**
 - i. Konkore**
 - j. Opti-Com Manufacturing Network, Inc.
 - k. O-Z/Gedney; a brand of EGS Electrical Group.
 - l. Perma-Cote
 - m. Picoma Industries, Inc.
 - n. Plasti-Bond
 - o. Republic Conduit.
 - p. Robroy Industries.**
 - q. Southwire Company.
 - r. Thomas & Betts Corporation.
 - s. Topaz Electric; a division of Topaz Lighting Corp.
 - t. Western Tube and Conduit Corporation.
 - u. Wheatland Tube Company; a division of John Maneely Company.
- 2. Comply with NEMA FB 1 and UL 514B.
- 3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 4. Fittings, General: Listed and labeled for type of conduit, location, and use.
- 5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
- 6. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.
- 7. **EMT Fittings Materials:**
 - a. All Zinc materials shall be ASTM B86 certified**
 - b. All Zinc Product shall be ZAMAK #3 and/or #7 formula.
 - c. All Steel shall be SAE 1050.
- 8. **EMT Fittings Design:**
 - a. Zinc die cast components shall be ball burnished.**
 - b. Steel parts shall be zinc plated for corrosion protection.

- c. All Locknuts shall have a dual, precision machined-cut thread, reversible and possess a serrated face on each side.
- d. All set screw products shall be manufactured with a tri-drive head and staked or modified to prevent disassembly.
- e. All fitting throat diameters shall be smooth with no sharp edges or slag.
- f. Rain tight products shall have internal sealing rings to create and maintain a rain tight seal.
- g. All fittings shall be tested per UL 514B and be listed by Underwriters Laboratories.
- 9. **Transition Fittings:**
 - a. **All transitions fittings (go-to or from-to fittings) or fittings used to transition from one raceway type to another must be UL listed for that application.**
- 10. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- 11. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- E. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following :
 - 1. B-Line, an Eaton business
 - 2. Hoffman; a Pentair company.
 - 3. **Milbank**
 - 4. Mono-Systems, Inc.
 - 5. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.3 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. [Manufacturer's standard enamel finish in color.
- A. Manufacturers: Subject to compliance with requirements, provide products by the following :
 - a. Hubbell Incorporated; Wiring Device-Kellems
 - b. Mono-Systems, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.
- B. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- A. Manufacturers: Subject to compliance with requirements, provide products by the following :
 - a. Hubbell Incorporated; Wiring Device-Kellems
 - b. Mono-Systems, Inc.
 - c. Panduit Corp.

- d. Wiremold / Legrand.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following :
 - 1. Adalet.
 - 2. Crouse-Hinds, an Eaton business
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. FSR Inc.
 - 6. Hoffman; a Pentair company.
 - 7. Hubbell Incorporated; Killark Division.
 - 8. Kraloy.
 - 9. Milbank Manufacturing Co.
 - 10. Mono-Systems, Inc.
 - 11. O-Z/Gedney; a brand of EGS Electrical Group.
 - 12. Plasti-Bond
 - 13. RACO; a Hubbell Company.
 - 14. Spring City Electrical Manufacturing Company.
 - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
 - 16. Thomas & Betts Corporation.
 - 17. Topaz Electric; a division of Topaz Lighting
 - 18. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- G. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- H. Gangable boxes are prohibited.
- I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- J. Cabinets:
 - 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.

2. Concealed Conduit, Aboveground: GRC.
 3. Underground Conduit: RNC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 - e. <Insert designations of applicable spaces or locations>.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use setscrew fittings. Comply with NEMA FB 2.10 and UL514B.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Do not install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed.
- I. Support within 12 inches of changes in direction.
- J. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- K. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- L. Support conduit within 12 inches of enclosures to which attached.
- M. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.
 - 4. Conduit extending into pressurized duct and equipment.

5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 6. Where otherwise required by NFPA 70.
- Y. **EMT, RSC/IMC Expansion Joint Fittings:**
1. **Install in each run of metallic conduit, indoors or outdoors, that is over 100' long in a straight run, or crosses a building (or structure) expansion joint.**
 2. Weatherproof and approved for use without external bonding jumper.
 3. Sizes ½" through 4" EMTconduit, 1/2" to 6" RSC/IMC.
 4. 4" maximum movement.
 5. Electrogalvanized steel body.
- Z. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- AA. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
- BB. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- CC. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. **Do not install boxes back-to-back.**
- DD. Locate boxes so that cover or plate will not span different building finishes.
- EE. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- GG. Set metal floor boxes level and flush with finished floor surface.
- HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- II. **Install hinged-cover enclosures and cabinets plumb. Support at each corner.**
- JJ. **Boxes installed in metal stud and sheetrock walls shall have far-side box support.**
- KK. **Boxes shall be secured to metal studs with spring steel clamp which wraps around the entire face of the stud and digs into both sides of the stud. Clamp shall be screwed into the stud.**
- LL. **Set outlet boxes for flush mounted devices to within 1/8" of finished wall.**
- MM. **Minimum box size to be two gang. For installation of single gang device use properly sized mud ring with thickness to install device within 1/8" of finished wall.**
- NN. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified for pipe less than 6 inches in nominal diameter.
 2. Install backfill as specified.

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements.

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 260800 COMMISSIONING OF ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification Sections, apply to this Section.
- B. BoD-Electrical Systems Narrative documentation prepared by Owner and consultants contains requirements that apply to this Section and specified systems.
- C. This project will have selected building systems commissioned. Selected electrical systems are identified herein.
- D. A Commissioning Authority (CxA) shall be appointed by the Owner and will direct the commissioning process.

1.2 SUMMARY

- A. This Section includes requirements for commissioning the electrical systems, subsystems and equipment.

1.3 DEFINITIONS

- A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor.
- B. Design Team: Includes the architect plus consultant/design professionals responsible for design of fire suppression, plumbing, HVAC, controls for HVAC systems, electrical, communications, electronic safety and security, as well as other related systems.
- C. BoD: Basis of Design.
- D. BoD-Electrical: Electrical systems basis of design.
- E. CxA: Commissioning Authority.
- F. OPR: Owner's Project Requirements.
- G. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the CxA. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
- B. List of electrical systems to be commissioned:

Power Electrical Distribution Equipment
Power Generation Equipment
Electrical Power Management systems

1.5 SUBMITTALS

- A. Submittals shall be reviewed concurrently to the owner and delegated parties responsible for review for the purposes of verifying necessary components are in place to support the commissioning process and understanding of components for functional test procedure(s) for verification of system operation.
- B. Updated Submittals: Keep the Commissioning Authority informed of all changes: revise and resubmit when substantial changes are made.
- C. Startup Reports: Submit for acceptance of Commissioning Authority.
- D. Operation and maintenance manual shall be submitted in compliance with close out documents and in support of training required by the contract documents. Manual shall include the following as a minimum.
 - 1. Product Data: Include manufacturer's technical literature for each control device indicated, labeled with setting or adjustable range of control. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials and installation and startup instructions for each type of product indicated. Product data shall be updated to identify any changes which occurred during construction to reflect installed systems and components.
 - 2. Maintenance instructions and lists and spare parts for components, equipment, and systems installed.
 - a. Maintenance schedule for systems, equipment, and components are to be identified for installed systems compliant with manufacturer's requirements.
 - b. Cleaning methods and materials shall be identified.
 - 3. Calibration records, startup and system test reports, and list of setpoints and schedules applicable to the systems installed.
 - 4. As-built drawings identifying installation which deviates from the contract documents shall be provided.
 - 5. Manufacturer warranties executed and registered to the Owner.

PART 2 - PRODUCTS

- 1. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing: unless otherwise noted such testing equipment will NOT become the property of Owner.
- 2. Equipment-Specific Tools: Where special testing equipment, tools, and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 - EXECUTION

3.1 COMMISSIONING PLAN

- A. The CxA shall prepare and implement a commissioning plan identifying the commissioning and testing standards and outline the overall commissioning process, the commissioning schedule, the commissioning team members and responsibilities, lines of communication, and documentation requirements.
 - 1. All parties shall be responsible for complying with the requirements identified within the commissioning plan.
 - 2. Furnish additional information as requested by the CxA.

3.2 FUNCTIONAL PERFORMANCE TESTING

- A. Functional performance testing shall take place after manufacturer startup and testing is complete with report provided to the CxA.
- B. System functional performance testing is part of the Commissioning Process. Functional performance testing shall be performed by the contractor under the direction of the CxA. The CxA will witness and document the functional performance testing.
 - 1. Retesting shall be an additional cost to the owner with party responsible for contributing deficiencies reimbursing the owner for all related costs.
 - 2. The inability for a contractor to provide the personnel, tools, or schedule, to complete the intended testing in the duration previously coordinated shall result in a test identified as failed and will require retesting.
 - 3. Deficiencies shall be corrected, re-inspected, and/or retested, as applicable, at no additional cost of the owner.

3.3 OPERATIONS AND MAINTENANCE MANUALS

- A. General: Comply with the requirements for closeout documents and procedures.
- B. CxA Review and Approval: Prior to substantial completion, the CxA shall review the O&M manual data, documentation and redlined as-builds for equipment and systems that were commissioned to verify compliance with the O&M documentation requirements of the specifications. The CxA shall communicate deficiencies in the manuals to the Owner. Upon a successful review of the corrections, the CxA shall recommend approval and acceptance of these sections of the O&M manuals to the Owner. The CxA shall also review each equipment warranty and verify that all requirements to keep the warranty valid are clearly stated. This work does not supersede the normal review requirement of the O&M manual data as indicated elsewhere in the specifications.

3.4 TRAINING OF OWNERS PERSONNEL

- A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans.
- B. Provide training agenda and attendance logs to the owner and CxA after completion of training, prior to completion the commissioning process.

3.5 COMMISSIONING REPORT

- A. The CxA shall provide a commissioning report which summarizes the commissioning process implemented, systems commissioned, deficiencies and corrective measures, and a record of completed functional performance test procedure(s) with a recommendation for owner acceptance at the discretion of the CxA.

END OF SECTION

SECTION 260913 ELECTRICAL POWER MONITORING AND CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Distributed Energy Resources Control System (DCS)
 - 2. Power Quality meters.
 - 3. Distributed Energy Resources Management System (DMS)
 - 4. Raceways and boxes.
 - 5. Wires and cables.

1.3 REFERENCES

- A. General, Publications: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
 - 1. Institute of Electrical and Electronics Engineers (IEEE):
 - a. IEEE 1547, "IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces"
 - b. IEEE 2030.7, "Standard for the Specification of Microgrid Controllers"
 - c. IEEE 2030.8, "Standard for the Testing of Microgrid Controllers"
 - 2. American National Standards Institute (ANSI)
 - a. ANSI C12.20, "Electricity Meters - 0.2 and 0.5 Accuracy Classes."
 - b. ANSI C12.18, "Protocol Specification for ANSI Type 2 Optical Port."

1.4 DEFINITIONS

- A. Active Power: The average power consumed by a unit. Also known as "real power."
- B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.
- C. Apparent (Phasor) Power: " $S = VI$ " where "S" is the apparent power, "V" is the rms value of the voltage, and "I" is the rms value of the current.
- D. BESS: Battery Energy Storage System
- E. DER: Distributed Energy Resource (e.g. generators, PV arrays, BESS, etc.)
- F. DCS: Distributed Energy Resources Control System
- G. DMS: Distributed Energy Resource Management System
- H. ECC: Energy Control Center
- I. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.
- J. HMI: Human Machine Interface
- K. KY Pulse: A method of measuring consumption of electricity that is based on a relay operating like a SPST switch.
- L. KYZ Pulse: A method of measuring consumption of electricity based on a relay operating like a SPDT switch.

- M. LAN: Local area network.
- N. L-G: Line to ground.
- O. L-L: Line to line.
- P. L-N: Line to neutral.
- Q. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.
- R. Modbus TCP/IP: An open protocol for exchange of process data.
- S. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- T. N-G: Neutral to ground.
- U. Power Factor: The ratio of active power to apparent power, sometimes expressed in percentage.
- V. PV: Photovoltaic (e.g. solar electric)
- W. rms: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.
- X. TCP/IP: Transport control protocol/Internet.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Provide coversheet indicating project title, project location, and vendor contact information.
 2. Organize submittal into logical sections and provide table of contents.
 3. Provide itemized bill of materials indicating model number and quantity for each product.
 4. On datasheets with multiple products, indicate which product is provided under this project.
 5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
 6. Manufacturers' catalog sheets with complete technical data for each item being furnished.
 7. Attach copies of approved Product Data submittals for products (such as switchboards and switchgear) that describe power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.
 8. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for power monitoring and control.
 9. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For power monitoring and control equipment.
 1. Include plans, elevations, sections, and attachment details.
 2. Include details of equipment assemblies. Indicate dimensions, method of field assembly, components, and location and size of each field connection.
 - a. Attach copies of approved Product Data submittals for products (such as switchboards, switchgear, and motor-control centers) that describe the following:
 - 1) Location of the meters and gateways, and routing of the connecting wiring.
 - 2) Details of power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.
 3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
 4. Network naming and numbering scheme.
 5. Include diagrams for power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
 6. Specifications for workstations.

7. Surge Suppressors: Data for each device used and where applied.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Design Data:
 1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.
 - a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format on compact disk or portable storage device with a USB interface.
 - b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
 - c. As-built versions of submittal Product Data.
 - d. Names, addresses, e-mail addresses, and 24-hour telephone numbers of Installer and service representatives for the system and products.
 - e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.
 - f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - g. Engineering, installation, and maintenance manuals that explain how to do the following:
 - 1) Design and install new points, panels, and other hardware.
 - 2) Perform preventive maintenance and calibration.
 - 3) Debug hardware problems.
 - 4) Repair or replace hardware.
 - h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
 - i. Backup copy of graphic files, programs, and database on compact disk or portable storage device with a USB interface.
 - j. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - k. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software on compact disk or portable storage device with a USB interface.
 - l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
 - m. Owner training materials.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power monitoring and control units to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
 1. Software operating and upgrade manuals.
 2. Software licenses.
 3. Software service agreement.
 4. Program Software Backup: On compact disk or portable storage device with a USB interface, complete with data files.
 5. Device address list.
 6. Printout of software application and graphic screens.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 COORDINATION

- A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.
 - 1. Match components and interconnections for optimum performance of specified functions.
- B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.
- B. Backup Power Source:
 - 1. Electrical power distribution equipment served by a backup power source for controls shall have associated distributed energy system products that monitor and control such systems and equipment also served from a backup power source.

2.2 DISTRIBUTED ENERGY RESOURCES CONTROL SYSTEM (DCS)

- A. Acceptable Products / Manufacturers: Subject to compliance with requirements, specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance. Products shall be modified as necessary by the manufacturer for compliance with requirements. Provide one of the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date:
 - 1. EcoStruxure Microgrid Operation by Schneider Electric.
 - 2. EnergyX by AZZO.
 - 3. PowerMax by Schweitzer Engineering Laboratories.
- B. Communications: The DCS shall provide an Ethernet, Modbus TCP, and IEC 61850 interface for communications to DERs, circuit breakers, meters, etc. as needed for monitoring and control. The Ethernet network shall be a secure private network or VPN dedicated to the DCS and the Electrical Power Management System. The Ethernet network shall support connectivity provided by cellular communications. DCS Ethernet network should be separate and isolated from all other facility IT / OT computer networks. DCS shall support communications with the PV inverter system(s) via REST API. PV inverter(s) need to be connected to the internet.
- C. The DCS shall include a web client HMI display accessible from common internet browsers. These interfaces shall provide the following:
 - 1. Status indicator light: ON = ready and ok, BLINKING = not ready action required
 - 2. One-line diagram showing circuit breaker arrangement, service and status
 - 3. Power, reactive power, voltage, frequency, and current measured by each breaker or meter
 - 4. The relative priority of each load breaker
 - 5. Key information available from DERs, such as power output and status
 - 6. Pertinent alarms, such as breakers tripped for overcurrent
 - 7. Pertinent events, such as breakers opened or closed by commands from the touchscreen
 - 8. Trends of key measurements, such as power measured by a breaker vs time
- D. The DCS shall be able to comply with a utility requirement for minimum import power or zero export power. To achieve this compliance, the system shall send commands to decrease the power output from DERs, including curtailing output of PV inverters, and/or send commands to increase the power flowing into energy storage devices.
- E. DCS hardware shall be configured to order pre-engineered components.
 - 1. NEMA 1 enclosure minimum
 - 2. Control enclosure to contain the following components at a minimum:
 - a. Power supplies

- b. UPS
- c. Controller
- d. Cellular gateway
 - 1) Must support over the air system updating
 - 2) Managed as part of a unified fleet management system
- e. Meter(s)
- f. I/O
- g. Ethernet switch(es)
- h. Exterior enclosure mounted cellular antennae
- 3. Provide separate enclosures for accessory equipment as indicated on the drawings for:
 - a. Metering
 - 1) Metering per section 262713.16
 - 2) Provide 0-5a CTs rated for specified current with shorting blocks or:
 - 3) Low voltage Rogowski coils type CTs
 - (a) Coil and transducers
 - (b) Power supply
 - 4) Disconnect and fusing
 - b. I/O
 - c. Networking equipment
- F. Control power within the DCS shall be uninterruptible with a minimum runtime of 5 minutes.
 - 1. When a battery within the control power subsystem needs to be replaced (e.g. due to end of life), the HMI shall display an alarm.
 - 2. In the event of a power outage, the system shall automatically switch the source of control power from the utility to the anchor resource once it is available. When utility power is restored, the System shall automatically switch the source of control power back to the utility.
 - 3. The system shall provide electrical isolation between the source (e.g. utility) and the control power subsystem.
- G. DCS control functionality shall be located at the edge, on site. Control functions shall not depend on cloud services. Default operation shall always be located on site.
- H. Economic Optimization: The DCS shall include a subscription cloud-based service integrated for dispatch of DERs for economic optimization (e.g. to maximize Return on Investment).. The System shall be capable of running multiple use cases simultaneously. The following services shall include:
 - 1. Self-Consumption: control energy storage to maximize energy consumed and charged directly from solar sources.
- I. Alarms: The MEMS shall offer at least one of the following options for remote notification of alarms (e.g. breaker tripped due to overcurrent):
 - 1. Email: The DCS shall send an email to designated recipients in the event of an alarm.
 - 2. SMS: The DCS shall send an SMS to designated recipients in the event of an alarm.

2.3 POWER QUALITY METERS

- A. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date: PowerLogic PM8000 by Schneider Electric
- B. Description: The metering device used to monitor the low voltage feeders for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall have at minimum the following features:
 - 1. High-visibility color graphical display.
 - 2. Direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; Four metered 5 A nominal current inputs for 3 phase measurement plus neutral.
 - 3. Supported monitoring parameters—full range of 3-phase voltage, current, power, and energy measurements, total harmonic distortion (THD), individual current and voltage harmonics readings, waveform capture, voltage and current disturbances (dip/swell) detection, ability to determine the location of a disturbance (upstream or downstream).

4. COMTRADE—up to 255 COMTRADE disturbance capture files available directly from meter via FTP and providing client notification of new captures through IEC 61850 (RDRE logical node).
 5. Power Quality compliance—without using separate software, determine statistical indicators of power quality that include but are not limited to voltage dips and swells, harmonics, and frequency in accordance with EN 50160 power quality standard and provide an indication of pass/fail in a web interface; Third party laboratory tested to the power quality standard IEC 61000-4-30 Class 'S'.
 6. User customization—capable of deriving values for any combination of measured or calculated parameters using arithmetic, trigonometric, and logic functions through graphical, flexible object oriented, programmable modules. Modules can be linked together in an arbitrary manner to create functionality such as totalization, efficiency measurements, control functions, load shedding, demand response, power factor correction, and compliance monitoring.
 7. Communications capability—multi-port Ethernet and serial communications with at least two Ethernet ports and one RS485 serial port. Functionality through Ethernet connectivity includes e-mail on alarm, e-mail interval energy data, on-board web server, SNMP network management, NTP time synchronization, Ethernet-to-serial RS-485 gateway, Modbus, DNP3, and IEC 61850.
 8. On-board logging: non-volatile time stamped on-board logging of input/output (I/O) conditions, minimum and maximum values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand; custom alarming with time stamping in which the meter has the capability of learning set-point limits based on the system behavior; trigger alarms on at least 50 definable power or I/O conditions; use of Boolean logic to combine alarms.
 9. Input/outputs—provide at least three 3 digital inputs and 1 digital output for equipment status/position monitoring and equipment control or interfacing with millisecond timestamp. The meter shall accept up to four field installable I/O modules. Provide additional modules as required for application. Each digital I/O module shall provide 6 digital status/counter inputs and 2 Form C relay outputs rated at 250 V, 8 A. Each analog I/O module shall provide 4 inputs configurable to 4-20 mA or 0-30V ranges and 2 outputs configurable to 4-20 mA or 0-10V ranges..
 10. Disturbance direction – provide an indication of the location of each power system event as “up stream” or “down Stream” along with the level of confidence of the location.
- C. The equipment specified herein shall provide the necessary communications connectivity and functionality required to support the functionality of an Distributed Energy Resources Management System (DERMS). This shall include, but not be limited, to the following:
1. Communications connectivity using the specified Ethernet network and protocols of the DERMS and related DERMS connected equipment necessary to provide functionality. Equipment may be connected through a communications gateway as shown or specified; otherwise Ethernet and protocol connectivity shall be provided within the equipment.
 2. Compliance with Cyber security requirements.
 3. Remote EPMS application functionality for equipment configuration and operational control; electrical power monitoring; power quality monitoring, compliance and correction; and alarm monitoring with event log.
 4. Refer to the Electrical Power Management System specification section for additional requirements.
- D. Native EPMS software compatibility shall be fully factory-tested, and shall include the following characteristics.
1. Capability for pre-engineered, interactive graphical display screens to view and analyze real-time device data.
 2. Pre-mapping of registers to standard measurement names without the need for additional configuration or internal device registers.
 3. Automatic collection and logging of device data by EPMS software without additional configuration.

4. Refer to the individual power and energy meter device requirements for EPMS monitoring of measured and calculated values, alarms, events, parameters and additional data as available from the device, as specified herein and within the Electrical Power Management System specification.

2.4 DISTRIBUTED ENERGY RESOURCES MANAGEMENT SYSTEM (DMS)

- A. Manufacturers: Subject to compliance with requirements, provide products from the same manufacturer that is supplying the Distributed Energy Resources Control System.
- B. Description: The equipment specified herein shall provide the necessary communications connectivity and functionality of a Distributed Energy Resource Management System (DMS). DMS system functionality shall be integral to the operation of the DCS system. This shall include, but not be limited, to the following:
 1. Communications connectivity using the specified Ethernet network and protocols of the DMS and related DMS connected devices and equipment necessary to provide functionality. Devices may be connected through a communications gateway as shown or specified; otherwise, Ethernet and protocol connectivity shall be provided within the equipment. Equipment sections with multiple connected devices and assemblies of bolted adjacent bays shall include an internal inter-wired communications network for a single connection to the DCS network for power monitoring, equipment status and alarms.
 2. Compliance with Cyber security requirements.
 3. DMS platform shall be cloud hosted within a secure Microsoft Azure environment
 4. Remote DMS application functionality for equipment configuration, electrical power monitoring; power quality monitoring, compliance, and correction; and alarm monitoring with event log.
- C. Software – General: Furnish a dedicated, edge control, software platform (The Software Platform) that is purpose-built to be the operational interface for a Distributed Energy Resources Management System (DMS) whose primary purpose is to support the provision and management of safe, reliable and efficient power within buildings and facilities.
 1. The Software Platform shall have specialized data acquisition, visualization, analysis and reporting tools specifically designed for Power Management applications such as:
 - a. Electrical Distribution System Monitoring and Alarming.
 - b. Distributed Energy Resources monitoring and alarming
 - c. Power Purchase Agreement (PPA) billing
 - d. Virtual Power Plant (VPP) Agreement billing
 - e. Distributed Energy Resource Management Systems (DERMS) integration
 - f. Power Quality Monitoring and Compliance.
 - g. Multi Source Management.
 - h. Power Events Analysis.
 - i. Energy Usage Analysis and Energy Benchmarking.
 - j. Energy Performance Analysis and Verification.
 2. The Software Platform shall natively support (no additional installation or configuration of the software required) at least 112 devices specifically designed for power distribution and power quality monitoring including: programmable power analyzers, power meters, branch and multi-circuit meters, smart panels with communicating circuit breakers, protection relays, uninterruptable power supplies, active harmonic filters, capacitor bank controllers, electrical distribution thermal sensors.
 - a. All registers shall be pre-mapped to standard measurement names – no additional register mapping required.
 - b. All native device types will come with a comprehensive set of a factory device graphical screens – no additional graphics creation or installation required.
 - c. All native device types have been factory-tested and proven to perform.
 3. The Software Platform's web applications shall be simultaneously accessible from their unique web addresses so that they may be embedded in other web-based software environments.
 4. The functionality of the Software Platform shall be extensible whereby additional capabilities may be added via software license activation codes without the need to install additional software modules or add-ons.
 5. The Software Platform shall be certified as part of an Energy Data Management System according to the sections of the following ISO standards:

- a. ISO 50001
 - 1) Energy review
 - 2) Energy baseline
 - 3) Energy performance indicators
 - 4) Monitoring, measurement, and analysis
 - 5) Input to management review
 - b. ISO 50002
 - 1) Data collection
 - 2) Measurement plan
 - 3) Analysis
 - 4) Energy audit reporting
 - c. ISO 50006
 - 1) Obtain relevant energy performance information from the energy review
 - 2) Identify energy performance indicators
 6. The Software Platform shall be certified to comply with cybersecurity standard IEC62443 at the component level: IEC62443-4-1 and IEC62443-4-2 (SL1).
 7. The Software Platform shall be designed to streamline the process of checking and maintaining EN50160 and IEEE 519 Power Quality compliance.
 8. The Software Platform shall natively support the vendor's continuous electrical thermal monitoring system with the ability to detect abnormal bus bar or cable temperatures due to loose or faulty connections and to prevent equipment damage and fire.
 9. The Software Platform shall be designed to integrate and embed within the vendor's Building Management System (BMS) software platform to provide Distributed Energy Resources Management System applications within the context of the BMS environment.
 10. The Software Platform shall natively support the vendor's active arc flash protection system with the ability to detect and then distinctively indicate, classify and display alarm information as an arc flash alarm.
- D. Software – Real Time Monitoring:
1. The Software Platform shall support Auto Network Diagram Creation whereby a comprehensive set of linked hierarchical graphical diagrams is automatically created for all directly connected devices in the power monitoring network.
 2. The Software Platform shall support advanced power quality meters with onboard High Speed Power Analysis with Disturbance Direction Detection (DDD) capabilities and come equipped with a built-in set of real-time graphical indicators for use in electrical one-line diagrams that indicate:
 - a. The type of Power Quality Disturbance (sag, swell, transient).
 - b. The direction of Power Quality Disturbance relative to the compliant DDD device (upstream, downstream).
 3. The Software Platform shall provide real-time indication of the aggregated demand being measured by one or more devices in a predefined zone. The application shall allow:
 - a. The demand for the zone to be expressed using either Kilowatts or normalized Kilowatts/Area.
 - b. Visual indication of how the present demand for a zone compares with four (4) configurable limits / targets using a color scale.
 - c. Configurable limits shall be further configurable to allow for the use of different values during an On-Peak period compared to an Off-Peak period.
 4. The Software Platform shall allow web client users to quickly and easily create interactive dashboard visualization of any real-time measurements that:
 - a. Display tabular and trend line views to compare device readings from multiple devices in the power monitoring network including power meters, circuit breakers, protection relays, uninterruptable power supplies, automatic transfer switches and generators.
 - b. Permit users to create, modify, view and share views directly from the web client browser without the need for a separate software application.
 - c. Support both physical and virtual devices defined in the system.
 - d. Support exporting real time data into Excel formats directly from the web client browser environment.

5. The Software Platform shall support arc flash protection devices with a built-in set of real-time graphical indicators for use in electrical one-line diagrams that indicate occurrence of arc flash incidents.
 6. The Software Platform shall continuously monitor the health status of the arc flash sensors and the sensor's interconnection between different devices. In case of bad health state, the operator shall receive an alarm in the Software Platform.
- E. Software – Alarm and Event Analysis and Notification:
1. The Software Platform shall be able to acquire specialized, high speed power disturbance data directly from onboard advanced power quality meters for the purpose of Power Events Analysis, including:
 - a. Timestamped Power Events with Disturbance Direction Detection (DDD).
 - b. Timestamped high speed (1/2 cycle sample rate) pre/post event RMS data.
 - c. Pre/post event waveform captures (Voltage and Current all phases).
 2. The Software Platform shall provide a web based power events analysis application that includes but is not limited to the following features:
 - a. Automatic, intelligent clustering of events into alarms and multiple alarms from multiple devices into “incidents” to simplify the analysis of multiple cascading events.
 - b. Automatic categorization of alarms and incidents into predefined categories such as Power Quality, Energy Management, Arc Flash, Arc Fault, Load Loss, Diagnostics, and Other.
 - c. Predefined views for events, alarms and incidents with intuitive navigation and easy to use, configurable filters based on priority, status, source and categories.
 - d. Ability to create private or shared event, alarm and incident views with custom filters.
 - e. Popup window with detailed information about where, what and when an alarm or incident happened, plus other relevant information including Power Quality details and a thumbnail summary view of all waveforms associated with the alarm or incident.
 - f. For Power Quality alarms or incidents captured by Disturbance Direction Detection (DDD) compliant devices there shall be clear graphical indication of the direction of the disturbance (upstream or downstream relative to the DDD compliant device).
 - g. For Power Quality alarms or incidents captured by advanced power quality meters, there shall be indication of the changes in steady state electrical loads as a result of a voltage disturbance.
 3. The Software Platform shall provide a graphical timeline view of alarms and events that constitute an “incident” in the electrical distribution network. The timeline view shall:
 - a. Display alarms/events stacked by order of time for sequence of events analysis.
 - b. Display the start and end of alarms/events with color-coded dots.
 - c. Indicate the direction of a Power Disturbance and if there are captured waveforms associated with the incident.
 - d. Have a configurable analysis window with a color-coded time slider that uses color to indicate areas in the timeline where there are greater numbers of alarms.
 - e. Be able to display pre- and post-event high speed RMS data coming from supported power quality meters.
 4. The Software Platform shall include a web-based Smart Waveform Analyzer interface with the following capabilities:
 - a. Toggle on/off Voltage/Current channels.
 - b. RMS calculation, zoom, pan, export to CSV.
 - c. Interactive phasor and harmonic (voltage and current) diagrams.
 - d. Allow multiple waveforms to be compared to each other.
 - e. Select two reference points on a waveform and compare their values.
 5. The Software Platform shall include an alarm annunciator to display the total number of unacknowledged alarms with a breakdown of how many are high, medium and low priority and shall allow easy navigation to the alarm viewer with a single click.
 6. The Software Platform shall provide the ability to send email notifications based on recent changes to the system which will be used to formulate notification types including:
 - a. Communication Loss Notification – sent when the Software Platform loses communication with selected devices.
 - b. Alarm Summary Notification – sent regularly to indicate changes in the average amount of high, medium, and low priority alarms.

- c. Power Quality Event Notification – sent regularly to indicate changes in the average amount, duration, and magnitude of Sag, Swell and Transient power disturbances.
 - d. Data Log Status Notification – sent when PC logging of device data is stopped or interrupted.
- 7. The Software Platform shall have a web-based Alarm Configuration interface to allow end users to create smart alarms with the following capabilities:
 - a. Realtime Analog and Digital Setpoints with options for time delays and custom alarm labels.
 - b. Smart Over/Under Setpoints designed specifically for energy (WAGES) and power alarms based on historical average, standard deviation or maximum with options for time ranges, aggregation periods, multipliers and ability to compare specific time periods (Same Hour of Day and/or Same Day of Week).
 - c. Communication Loss alarms with options for sensitivity and custom alarm labels.
 - d. Data Log Status alarms with options for sensitivity and custom alarm labels.
 - e. Schedules interface for end users to configure when smart software alarms are active or not.
- F. Software – Data Analytics and Visualization:
 - 1. The Software Platform shall include an interactive, web-based Dashboard application that provides auto-updating dashboard views that may contain not only energy and power data but water, air, gas, electric, and steam (WAGES), historical data trends, power quality performance data, images, and content from any accessible URL address.
 - 2. Users shall be able to create, modify, view, and share their dashboards (including graphics, labels, scaling, measurements, date ranges, etc.) using only a browser and without the need for a separate software application to design, create, modify or publish dashboards.
 - 3. The Software Platform shall support kiosk slideshow displays by assigning individual dashboards to slideshows to run in unattended mode, scrolling through designated dashboards at a configurable time interval.
 - a. Any number of kiosk slideshow displays may be created and configured to run independently on any computer using a browser.
 - 4. The Dashboard application shall provide a library of standard graphical objects (gadgets) including Bar, Pie, Trend, Real Time and Web Portal.
 - 5. The Dashboard application shall provide a library of specialized energy usage graphical objects (gadgets) including Period Over Period Comparison, Pareto Charts, Heat Map / Carpet Plot and Sankey Diagrams, which are required for ISO50001 compliant reporting
 - 6. The Dashboard application shall provide a library of specialized Power Quality graphical objects (gadgets) including PQ Downtime Impact, PQ Rating, PQ Incident Breakdown and Location.
 - 7. The Software Platform shall provide an interactive, web-enabled Reports application that allows users to generate, modify, save and manage reports based on pre-formatted report templates (up to 64 templates) that are designed to support the following:
 - a. Energy Cost Allocation and Bill Verification.
 - b. Energy Usage, Modeling and Performance Verification.
 - c. Power Quality Performance and Compliance (EN50160 and IEEE 519).
 - d. System Average RMS Variation Frequency Index (SARFI)
 - e. Electrical Equipment Operation and Performance (Breakers, UPSs, Generators).
 - 8. The reporting tool shall support automatic distribution (via email or shared folder) on a schedule basis or based on event or manual export using the following output formats: .csv, .xlsx, .pdf, .tiff, .html, .xml.
- G. Software – Technical Infrastructure:
 - 1. The Software Platform shall be able to be hosted within a Microsoft Azure environment and shall support a variety of Windows operating systems including Server and non-Server class Windows operating systems.
 - 2. The Software Platform shall support a variety of SQL Server Editions including Enterprise, Standard and Express Editions.
 - 3. The Software Platform shall only require SQL Server Database Engine Services and Basic Management Tools and not require the installation of any other additional SQL components such as Analysis Services or Reporting Services.
 - 4. The Software Platform shall support the following cybersecurity features:
 - a. Encrypt the transmission of data between the Software Platform Server and its Web Clients using Transport Layer Security (TLS) version 1.2.

- b. Establish secure authentication between the Software Platform Server and its Web Clients using Certification Authority (CA) certificates.
 - c. Encryption and hashing of system credentials using AES256 and SHA-512 respectively.
 - d. Capable of installing into a Federal Information Processing Standard (FIPS) compliant environment.
 - e. Application Whitelisting.
- 5. The Software platform shall support the integration of Windows Active Directory for users and groups from across multiple domains to facilitate the following:
 - a. Login to the Software Platform using Windows credentials.
 - b. Enforce password policies via Windows (complexity and expiration).
 - c. Role-Based Access Control (RBAC).
- 6. The Software Platform shall intelligently and automatically acquire data from devices, including onboard events, trends and waveforms from natively supported device types:
 - a. Without any need for software configuration or data upload scheduling.
 - b. Onboard, high-resolution timestamps (1ms) shall be retrieved without degradation or modification even for devices that support clock synchronization via GPS, IRIG-B, NTP or PTP (Precision Time Protocol).
- 7. The Software Platform shall support Multi-Factor Authentication
- 8. The Software Platform shall allow end users to configure access to commonly needed documents such as user manuals, Standard Operating Procedures, Submittal Drawings, equipment specifications and contact lists
- 9. The Software Platform shall have a component which enables integration and interoperability with other systems such as Building Management Systems, Industrial Control Systems and Data Center Information Management Systems
- 10. The Software Platform shall enable enrollment into a Fleet Management platform so that multiple instances of the Software can be centrally monitored and maintained
- 11. The Software platform database must support aggregation/rollup of data into single hourly, daily, weekly and/or monthly values
- 12. The Software Platform shall support logical device definitions based on inputs/outputs or channels on devices that represent a downstream device with the following features:
 - a. Software user interface for device and measurement mapping.
 - b. Bulk-import capability to create large numbers of logical devices without manual single-device configuration.
- 13. The Software Platform shall support real-time and historical data aggregation within defined hierarchy views (e.g. Tenants/Racks/Circuits, PDUs/RPPs/Panels, Buildings/Floors/Rooms, or any user defined view) with the following capabilities:
 - a. Web-based, end user interface.
 - b. Automatic and intelligent data aggregation across all nodes in the hierarchy for data visualization in Dashboards, Trends and Reports.
 - c. Creation of virtual devices to enable applications such as net metering, common area allocation and apportionment.
 - d. Update node names and associated time ranges in the hierarchy to properly reflect and accurately report on facility changes (e.g. tenant move in – move out).
 - e. Bulk-import capability to create and edit large hierarchies without manual per-device setup.
- 14. The Software Platform shall support OPC DA Server 2.01 with the following capabilities:
 - a. Provide default OPC Server tag mappings for all natively supported device types without the need to select, configure, or program the mapping of device registers to OPC tags.
 - b. Provide a flexible means to add or change OPC mappings and shall support the ability to add custom measurements.
- 15. The Software Platform shall support OPC DA Client 2.01 and come with a built in OPC Test Client.
- 16. The Software Platform shall support device-level Modbus integration with the following capabilities:
 - a. Modbus master to read/write registers in Modbus devices for monitoring and control applications.

- b. Support for at least 70 Modbus data formats including 16bit Signed/Unsigned Integers (S16-21, S16-12, U16-21, U16-12, S16-1-15), 16bit Signed/Unsigned Array (U16-21-ARRAY U16-12-ARRAY), 32bit Signed/Unsigned Integers Big-Endian and Little-Endian (S32-4321, S32-1234, U32-4321, U32-1234), 64bit Signed/Unsigned Integers (S64-21-87, U64-21-87, S64-87-21, U64-87-21), Signed/Unsigned Modulo10000 (S32-M10k-4321, S32-M10k-1234, U32-M10k-4321, U32-M10k-1234, S64-M10k-21-87, U64-M10k-21-87, S48-M10k-21-65, U48-M10k-21-65, S48-M10k-65-21, U48-M10k-65-21), Signed/Unsigned Modulo1000 (S64-M1K-87-21 U64-M1K-87-21), IEEE Float/Swapped Float (F32-4321, F32-1234, F64-87-21, F64-12-78), ASCII/ASCII Reverse, Packed Boolean/ Masked Boolean, Inverted Masked Boolean, Binary Coded Decimal (BCD, Packed BCD), Formats for Power Factor (PF Nexus, PF32, PF_ALT), Formats for Date-Time (DateTime4_UTC, DateTime4_LOCAL, DateTime4, DateTime3_UTC, DateTime3_LOCAL, DateTime3, DateTime_YMDhms_UTC, DateTime_YMDhms_LOCAL, DateTime_YMDhms, DateTime_IEC870_UTC, DateTime_IEC870_LOCAL, DateTime_IEC870, DateTime3_IEC870_UTC, DateTime3_IEC870_LOCAL, DateTime3_IEC870, DateTime3_MDYhms_UTC, DateTime3_MDYhms_LOCAL, DateTime3_MDYhms, DateTime4_MDYhms_UTC, DateTime4_MDYhms_LOCAL, DateTime4_MDYhms, DateTime2_s2000, DateTime3_s2000, DateTime4_shmMDY, DateTime6_smhDMY, DateTime7_YMDhms, DateTime8_MDYdowhmsc, DateTime6_MDYhms, DateTime_NSX2_UTC, DateTime_NSX2_LOCAL, DateTime_NSX3_UTC, DateTime_NSX3_LOCAL).
17. The Software Platform shall have a single, end user software application specifically designed for integrating Modbus and OPC device types and shall have the following capabilities:
 - a. Simple creation and management of Modbus and OPC device definitions (device drivers) and association of device graphic template screens.
 - b. Pre-defined, default measurement system (Common Data Model) for consistent mapping of Modbus registers and OPC tags to standard measurements.
18. The Software Platform shall support Web Services interoperability with the following capabilities:
 - a. Web Services Server for sharing real-time, historical (i.e. timestamped trend data), and alarm data (i.e. timestamped event strings) from the Software Platform to other Web Services Client applications.
 - b. User interface for Web Services configuration and mapping.
 - c. Provide the ability to acknowledge alarms by authenticated and authorized clients.
19. The Software Platform shall have an Extract, Transform, and Load (ETL) engine for exchanging data between files, databases and systems with the following capabilities:
 - a. User Interface for specifying connection information, data formats, measurement mappings and schedules.
 - b. Support for importing data from .csv and .xml data files, Wonderware Historian databases and other 3rd party databases via OleDb connections.
20. The Software Platform shall support system-wide programs using a graphical, object-oriented application engine capable of logic and arithmetic functions, database queries, XML data import, complex logic-based alarming and data logging, email and text notifications.
21. Software will support multiple users and sites including adjusting for different time zones.
22. The Software Platform shall remain online (including communications, logging, and alarming) and not require an operator to take the system offline during all system administration functions such as adding, modifying, or removing devices in the system; creating, modifying, or removing graphical diagrams, dashboards, tables, and reports; creating, modifying, or removing application logic programs in the application logic engine.
23. The Software Platform shall support offline software configuration management for efficient system deployments and upgrades with a dedicated user interface for creating, copying and deploying software configuration projects.
24. The Software Platform shall support internationalization and regional settings.
25. The Software Platform shall provide factory support for the following languages: Chinese (Simplified), Chinese (Traditional), English, French, German, Italian, Russian, Spanish, Polish, Czech, Portuguese, Swedish, Norwegian (Bokmål) and Turkish.
26. The Software Platform shall support the ability to change its default language at any time directly from the web client without the need for any additional installation or advanced software configuration.

- H. Native software compatibility shall be fully factory-tested and shall include the following characteristics.
1. Pre-mapping of Capability for pre-engineered, interactive graphical display screens to view and analyze real-time device data. Data displayed shall include the following:
 - a. Heat mapping of production of PV systems
 - b. Performance monitoring of the PV system production based on PVsys design, actual production, forecast production based solar irradiance
 - c. BESS state of charge
 - d. Total facility energy consumption
 - e. PV production
 - f. Weather
 - g. Current PV Power
 - h. Cost offset in \$ USD from PV production
 - i. PV energy
 - j. Emissions avoided via industry standard conversion for gas vehicle consumption and/ or coal power production
 - k. Power Quality Data
 2. DMS system shall have the capability to provide public accessible kiosk display slideshows
 3. Registers to standard measurement names without the need for additional configuration or internal device registers.
 4. Automatic collection and logging of device data by DMS software without additional configuration. Historical data logged shall include the following.
 - a. All data indicated in section 2.10.B.1
 - b. Facility total energy consumption
 - 1) KW
 - 2) KWh
 - 3) PF
 - 4) Demand
 - 5) THDv
 - 6) THDi
 5. DMS platform shall have native REST API connectivity to the following:
 - a. Inverter Manufacturers:
 - 1) Fronius
 - 2) SolarEdge
 - 3) SMA
 - 4) SunGrow
 - b. Weather service
 - c. Irradiance data service
 - d. Microsoft Azure
 6. DMS platform shall provide common data model across various DER vendors
 7. DMS platform shall be provided as a subscription-based Software-as-a-Service (SaaS) that will have ongoing subscription fees that will be the responsibility of the customer.
 8. System integrator to provide basic level of technical support service plan to support the system while it is in operation as part of the SaaS.
 - a. Email help desk access
 - b. Support phone number access
 - c. 24-hour response to service ticket requests

2.5 RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power wiring and NFPA 70 Class 1 remote-control and signaling circuits.
- B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for control wiring, RS-232 cable, and NFPA 70 Class 2 remote-control and signaling circuits.

2.6 WIRES AND CABLES

- A. Electrical Power Wiring: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

1. Copper conductors are Type THHN/THWN-2.
- B. Control Wiring: Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
 1. Optical-Fiber Cable: Multimode, 50/125-micrometer OM3, six-fiber, nonconductive, tight-buffer, optical-fiber cable, with aqua jacket.
 2. UTP Cable: 100-ohm, four-pair UTP, Category 6.
 3. RS-485 Cable: Paired, one pair, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 4. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.
 - a. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
 - b. Ordinary Switching Circuits: Three conductors unless otherwise indicated.
 - c. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.
- C. RS-232 Cable:
 1. PVC-Jacketed, RS-232 Cable: Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - a. Type CM.
 - b. Flame Resistance: UL 1581, vertical tray.
 2. Plenum-Type, RS-232 Cable: Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - a. Type CMP.
 - b. Flame Resistance: NFPA 262, flame test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF POWER MONITORING AND CONTROL SYSTEMS

- A. Comply with NECA 1.
- B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- D. Wiring and Cabling Installation:
 1. Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.
 2. Comply with Section 260523 "Control-Voltage Electrical Power Cables" for control wiring.
- E. Raceways Installation:
 1. Comply with Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power wiring and NFPA 70 Class 1 remote-control and signaling circuits.
 2. Comply with Section 270528 "Pathways for Communications Systems" for control wiring, RS-232 cable, and NFPA 70 Class 2 remote-control and signaling circuits.
- F. Identification Installation:

1. Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.
2. Comply with Section 271513 "Communications Copper Horizontal Cabling" for identification products and cable management system requirements for UTP, optical-fiber cable, RS-485 cable, low-voltage control cable, and RS-232 cable.

3.3 GROUNDING

- A. For data communication wiring, comply with NECA/BICSI 568.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 2. Visually inspect UTP and optical-fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 4. Test balanced twisted pair cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
 5. Optical-Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.0. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to IEC 61280-4-1.
 - 2) Attenuation test results for links shall be less than 2.0 dB.
 - c. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
 6. Distributed Energy System Tests.
 - a. Test Analog Signals:
 - 1) Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
 - 2) Check analog current signals using a precision current meter at zero, 50, and 100 percent.
 - 3) Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.
 - b. Test Digital Signals:
 - 1) Check digital signals using a jumper wire.
 - 2) Check digital signals using an ohmmeter to test for contact making or breaking.

- c. I/O Control Loop Tests:
 - 1) Test every I/O point to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
 - 2) Test every I/O point throughout its full operating range.
 - 3) Test every control loop to verify that operation is stable and accurate.
 - 4) Adjust control loop proportional, integral, and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
 - 5) Test and adjust every control loop for proper operation according to sequence of operation.
 - 6) Test software and hardware interlocks for proper operation.
 - 7) Operate each analog point at the following:
 - (a) Upper quarter of range.
 - (b) Lower quarter of range.
 - (c) At midpoint of range.
 - 8) Exercise each binary point.
 - 9) For every I/O point in the system, read and record each value at operator workstation, at controller, and at field instrument simultaneously. Value displayed at operator workstation and at field instrument shall match.
 - 10) Prepare and submit a report documenting results for each I/O point in the system, and include in each I/O point a description of corrective measures and adjustments made to achieve desired results.
- D. Wiring and cabling will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 FINAL REVIEW

- A. Submit written request to Architect when the distributed energy system is ready for final review. Written request shall state the following:
 - 1. The system has been thoroughly inspected for compliance with Contract Documents and found to be in full compliance.
 - 2. The system has been calibrated, adjusted, and tested and found to comply with requirements of operational stability, accuracy, speed, and other performance requirements indicated.
 - 3. The system monitoring and control of electrical distribution systems results in operation according to sequences of operation indicated.
 - 4. The system is complete and ready for final review.
- B. Review by Architect will be made after receipt of written request. A field report shall be issued to document observations and deficiencies.
- C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.
- D. Final review shall include a demonstration to parties participating in final review.

3.6 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.7 CYBERSECURITY RISK MITIGATION

- A. Refer to the manufacturer hardening guides and apply the most stringent manufacturer recommendations.

- B. Coordinate with Owner's IT Department to restrict external network access to Internet connected system through virtual private network (VPN) connections only.
- C. Disable any protocols for remote connectivity, unless constantly required for day-to-day operations. Secure VPN connections shall be the only acceptable form of remote connectivity unless otherwise approved by the Owner and Engineer.
- D. Protect data in transit and at rest. All external transport data shall be routed through encrypted channels using Transport Layer Security (TLS 1.2).
- E. Coordinate with Owner's IT Department to implement a Web server-based human machine interface (HMI) that relies on IT technologies to secure access and restrict ports that can be opened on the firewall. Coordinate with Owner's IT Department to restrict access to known IP addresses only.
- F. Where building system networks are not physically separate from IT business networks, coordinate with Owner's IT Department to segregate networked and Internet connected systems from the IT business network using virtual local area network (VLAN) IT technologies to restrict internal attacks/breakdowns.
- G. Set unique, strong passwords for administrator and user accounts. Default passwords must be changed before systems and devices are connected to the Owner's network.
- H. Collect only the data that is necessary for analytics, optimization, and trending.
- I. Adhere to the following compliance requirements:
 - 1. ISO/IEC 27001
 - 2. IEC 62443: Industrial Network and System Security
 - 3. SOC-2 (for hosted services)
- J. Abide by best practices outlined in the following references:
 - 1. NIST Special Publication 800-14 – Generally Accepted Principles and Practices for Securing Information Technology Systems.
 - 2. NIST Special Publication 800-54 Revisions 4 – Security and Privacy Controls for Federal Information Systems and Organizations.
 - 3. Defense Security Service Office of the Designated Approving Authority – Master System Security Plan (MSSP) Template for Peer-to-Peer Networks (June 2011, Version 3.0).

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain the distributed energy system.
- B. Extent of Training:
 - 1. Base extent of training on scope and complexity of the distributed energy system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
 - 2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
 - 3. Minimum Training Requirements:
 - a. Provide no fewer than one day of training total.
 - b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
 - c. Total days of training shall be broken into not more than two separate training classes.
- C. Attendee Training Manuals:
 - 1. Provide each attendee with a color hard copy of all training materials and visual presentations.
 - 2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
 - 3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.
- D. Instructor Requirements:
 - 1. One or multiple qualified instructors, as required, to provide training.

2. Instructors shall have no fewer than five years of providing instructional training on no fewer than five past projects with similar electrical monitoring and control system scope and complexity.
- E. Training Outline: Submit training outline for Owner review at least 10 business days before scheduling training. Outline shall include a detailed agenda for each training day that is broken down into each training session that day, training objectives for each training session, and synopses for each lesson planned.
- F. On-Site Training:
1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power, and data connectivity for instructor and each attendee.
 2. Instructor shall provide training materials, projector, and other audiovisual equipment used in training.
 3. Provide as much of training located on-site as deemed feasible and practical by Owner.
 4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration, and service requirements.
 5. The operator workstation provided with the system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.
- G. Off-Site Training:
1. Provide conditioned training rooms and workspace with ample tables, chairs, power, and data connectivity for each attendee.
 2. Provide capability to remotely access to Project monitoring and control system for use in training.
 3. Provide a workstation for use by each attendee.

3.9 AT COMPLETION OF TRAINING

- A. Staff familiar with the system installed can demonstrate operation of the system during final review.
- B. Demonstration shall include, but not be limited to, the following:
1. Accuracy and calibration of 4 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
 2. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
 3. Trends, summaries, logs, and reports set-up for Project.
 4. Software's ability to communicate with controllers, operator workstations, and uploading and downloading of control programs.
 5. Software's ability to edit control programs off-line.
 6. Data entry to show Project-specific customizing capability including parameter changes.
 7. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
 8. Execution of digital and analog commands in graphic mode.
 9. Spreadsheet and curve plot software and its integration with database.
 10. Online user guide and help functions.
 11. For Each Meter:
 - a. Memory: Programmed data, parameters, trend, and alarm history collected during normal operation is not lost during power failure.
 - b. Operator Interface: Ability to connect directly to each meter with a portable operator workstation.
 - c. Wiring Labels: Match control drawings.
 - d. Network Communication: Ability to locate a meter on the network. Communication architecture matches Shop Drawings.
 - e. Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators, and devices.
 12. For Each Operator Workstation:
 - a. I/O point lists agree with naming conventions.

- b. Graphics are complete.
- c. UPS unit, if applicable, operates.

END OF SECTION

SECTION 262416 PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Electronic-grade panelboards.

1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Provide coversheet indicating project title, project location, and vendor contact information.
 - 2. Organize submittal into logical sections and provide table of contents.
 - 3. Provide itemized bill of materials indicating model number and quantity for each product.
 - 4. On datasheets with multiple products, indicate which product is provided under this project.
 - 5. Combine electronic submittals into one unified PDF document that is organized per the table of contents. The submittal shall be free of copyrighted files and proprietary file formats. Electronic links may be submitted to supplement product datasheets, but may not be used as a substitute for product datasheets that are required to be included in the unified PDF submittal.
 - 6. Manufacturers' catalog sheets with complete technical data for each item being furnished.
 - 7. Include dimensioned plans, elevations, sections, and details.
 - 8. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
 - 9. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 10. Detail bus configuration, current, and voltage ratings.
 - 11. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 12. Include evidence of NRTL listing for series rating of installed devices.
 - 13. Include evidence of NRTL listing for SPD as installed in panelboard.

14. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
15. Include wiring diagrams for power, signal, and control wiring.
16. Key interlock scheme drawing and sequence of operations.
17. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.
18. Include report of emergency system(s) overcurrent devices selective coordination with all supply side overcurrent protective devices.
19. Refer to Section 018113 "Sustainable Design Requirements" for requirements of sealants, primers, paints, adhesives, caulk, aerosols, and coatings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical Systems." Include the following:
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Panelboard Schedules: For installation in panelboards.[Submit final versions after load balancing.]

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017800 "Closeout Submittals," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: [Two] <Insert number> spares for each type of panelboard cabinet lock.
 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: [Two] <Insert number> spares for each panelboard.
 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 5. <Insert extra materials>.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

- B. IBC 1708.5 Electrical equipment. Each manufacturer of designated seismic system components shall test or analyze the component and its mounting system or anchorage and submit a certificate of compliance for review and acceptance by the registered design professional in responsible charge of the design of the designated seismic system and for approval by the building official. The evidence of compliance shall be by actual test on a shake table, by three-dimensional shock tests, by an analytical method using dynamic characteristics and forces, by the use of experience data (i.e., historical data demonstrating acceptable seismic performance) or by more rigorous analysis providing for equivalent safety. The special inspector shall examine the designated seismic system and determine whether the anchorages and label conform with the evidence of compliance.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

1.10 FIELD CONDITIONS

- A. Environmental Limitations:
1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding [minus 22 deg F] [23 deg F] to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify [Architect] [Construction Manager] [Owner] no fewer than [ten] <Insert number> days in advance of proposed interruption of electric service.
 2. Do not proceed with interruption of electric service without [Architect's] [Construction Manager's] [Owner's] written permission.
 3. Comply with NFPA 70E.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
1. Panelboard Warranty Period: [18] <Insert number> months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fail in materials or workmanship within specified warranty period.
1. SPD Warranty Period: [Five] <Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS [AND LOAD CENTERS]COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical Systems."

- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: [Flush] [and] [Surface]-mounted, dead front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, [Type 1] <Insert type>.
 - b. Outdoor Locations: NEMA 250, [Type 3R] <Insert type>.
 - c. [Kitchen] [Wash-Down] Areas: NEMA 250, [Type 4X] <Insert type>, [stainless steel] <Insert material>.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, [Type 4] <Insert type>.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, [Type 5] [Type 12].
 - 2. Height: 84 inches maximum.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
 - 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 7. Finishes:
 - a. Panels and Trim: [Steel] [and] [galvanized steel], factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: [Galvanized steel] [Same finish as panels and trim].
 - c. For panels in Operating Rooms and adjacent spaces, provide trim of 304 stainless steel, with a #4 brushed finish.
 - d. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
 - 8. <Insert optional features>.
- G. Incoming Mains:
 - 1. Location: [Top] [Bottom] [Convertible between top and bottom].
 - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- H. Phase, Neutral, and Ground Buses:
 - 1. Material: [Tin-plated aluminum] [Hard-drawn copper, 98 percent conductivity].
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 4. Isolated Ground Bus (where noted on drawings): Adequate for branch-circuit isolated ground conductors; insulated from box.
 - 5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
 - 6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads. Rated 200 percent of full load current for K-factor rated transformers, and any transformer shown on the riser diagrams or one-line diagrams with 200% rated feeders.

7. Split Bus: Vertical buses divided into individual vertical sections.
 8. <Insert optional features>.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: [Tin-plated aluminum] [Hard-drawn copper, 98 percent conductivity].
 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 4. Main and Neutral Lugs: [Compression] [Mechanical] type, with a lug on the neutral bar for each pole in the panelboard.
 5. Ground Lugs and Bus-Configured Terminators: [Compression] [Mechanical] type, with a lug on the bar for each pole in the panelboard.
 6. Feed-Through Lugs: [Compression] [Mechanical] type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 7. Subfeed (Double) Lugs: [Compression] [Mechanical] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 8. Gutter-Tap Lugs: [Compression] [Mechanical] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
 10. <Insert optional features>.
 - J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
 - K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 1. Percentage of Future Space Capacity: [5] [10] [20] <Insert number> percent.
 - L. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
 1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
 - M. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD [Type 1] [Type 2].

2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
1. ABB
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
1. ABB
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- C. Panelboards: NEMA PB 1, distribution type.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than [36 inches] <Insert dimension> high, provide two latches, keyed alike.
- E. Mains: As indicated on drawings and schedules.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: [Plug-in circuit breakers] [Bolt-on circuit breakers] [Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal].
- G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: [Bolt-on circuit breakers] [Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal].
- H. Branch Overcurrent Protective Devices: Fused switches.
- I. Arc Energy Reduction
1. Provide for circuit breakers 1200A and larger with [one of the following]:
 - a. [An energy reducing maintenance bypass switch with visual status indicator. Switch, indicator, and associated circuitry and connections shall meet the requirements of NEC article 240.87.]
 - b. [Short-Time and Ground Fault Zone Selective Interlocking to meet the requirements of NEC article 240.87 and 0.1 second coordination requirements.]
 - c. [Instantaneous, Short Time, and Ground Fault Zone Selective Interlocking to meet the requirements of NEC article 240.87 and 0.01 second coordination requirements.]
- J. Contactors in Main Bus: NEMA ICS 2, Class A, [electrically] [mechanically] held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 2. External Control-Power Source: [120-V branch circuit] [24-V control circuit] <Insert requirement>.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
1. ABB
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.

- B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 - 1. ABB
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- D. Mains: **As indicated on drawings and schedules.**
- E. Branch Overcurrent Protective Devices: [Plug-in] [Bolt-on] circuit breakers, replaceable without disturbing adjacent units.
- F. Contactors in Main Bus: NEMA ICS 2, Class A, [electrically] [mechanically] held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: [120-V branch circuit] [24-V control circuit] <Insert requirement>.
- G. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- H. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.
- I. Column-Type Panelboards: Single row of overcurrent devices [with narrow gutter extension] [and] [overhead junction box equipped with ground and neutral terminal buses].
 - 1. Doors: Concealed hinges secured with multipoint latch with tumbler lock; keyed alike.

2.5 LOAD CENTERS

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - 1. **ABB**
 - 2. **Eaton Electrical Inc.; Cutler-Hammer Business Unit.**
 - 3. **Siemens Energy & Automation, Inc.**
 - 4. **Square D; a brand of Schneider Electric.**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 - 1. ABB
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Load Centers: Comply with UL 67.
- D. Mains: **As indicated on drawings and schedules.**
- E. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- F. Doors: Concealed hinges secured with flush latch with tumbler lock; keyed alike.
- G. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.6 ELECTRONIC-GRADE PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
1. ABB
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
1. ABB
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- C. Panelboards: NEMA PB 1; with factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 and UL 1449 after installing SPD.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- E. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- F. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- G. SPD.
1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than [100 kA] <Insert value>. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
 2. Protection modes and UL 1449 VPR for grounded wye circuits with [480Y/277 V] [208Y/120 V], three-phase, four-wire circuits shall not exceed the following:
 - a. Line to Neutral: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
 - b. Line to Ground: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
 - c. Neutral to Ground: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
 - d. Line to Line: [2000 V for 480Y/277 V] [1200 V for 208Y/120 V].
 3. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
 - a. Line to Neutral: 700 V.
 - b. Line to Ground: 700 V.
 - c. Neutral to Ground: 700 V.
 - d. Line to Line: 1200 V.
 4. SCCR: Equal to [the SCCR of the panelboard in which installed] [or exceed 100 kA] [or exceed 200 kA] [or exceed <Insert value>].
 5. Inominal Rating: [20 kA] [10 kA].
- H. Buses:
1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
 2. Copper equipment and isolated ground buses.

2.7 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
1. ABB
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.

- B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
1. ABB
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- C. In the emergency distribution system(s), provide devices to selectively coordinate with all supply side overcurrent protective devices.
- D. MCCB: Comply with UL 489, with [series-connected rating] [interrupting capacity] to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 8. Subfeed Circuit Breakers: Vertically mounted.
 9. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: [Compression] [Mechanical] style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - f. Ground-Fault Protection: [Integrally mounted] [Remote-mounted] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Communication Capability: [Circuit-breaker-mounted] [Universal-mounted] [Integral] [Din-rail-mounted] communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
 - h. Shunt Trip: [120] [24] <Insert voltage>-V trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage.
 - i. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage [without intentional] [with field-adjustable 0.1- to 0.6-second] time delay.

- j. Rating Plugs: Three-pole breakers with ampere ratings greater than [150] <Insert value> amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - k. Auxiliary Contacts: [One SPDT switch] [Two SPDT switches] with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - l. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - m. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - n. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - o. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
 - p. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in [on] [off] [on or off] position.
 - q. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- E. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- 1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
 - 2. Fused Switch Features and Accessories:
 - a. Standard ampere ratings and number of poles.
 - b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
 - c. Auxiliary Contacts: [One] [Two] normally open and normally closed contact(s) that operate with switch handle operation.

2.8 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in [transparent card holder] [metal frame with transparent protective cover].
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.9 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.
- C. **Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.**
- D. Handle Padlock Attachment: Handle attachment for 1, 2, or 3 pole breakers to lock breaker in ON or OFF position.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INTEGRATED POWER AND CONTROL SOLUTIONS EQUIPMENT

- A. As a voluntary alternate provide the panelboards, lighting controls, dry-type transformers, and other electrical room components, as a factory assembled UL Listed unit. It is the contractor's responsibility to provide coordination drawings indicating code required working clearances are able to be maintained as well as door swings and locations. This must be approved by the Owner and Architect.

3.3 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- D. Equipment Mounting:
 - 1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 - 3. Comply with requirements for seismic control devices specified in Section 260548 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Comply with mounting and anchoring requirements specified in Section 260548 "Seismic Controls for Electrical Systems."
- G. Mount top of trim [90 inches] <Insert height> above finished floor unless otherwise indicated. Operating handle of top-most circuit breaker, in on position, shall not be higher than 79 inches (2000 mm) above finished floor or grade.
- H. Mount panelboard cabinet plumb and rigid without distortion of box.
- I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- J. Mount surface-mounted panelboards to steel slotted supports [5/8 inch] [1 1/4 inch] in depth. Orient steel slotted supports vertically.
- K. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

- L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- M. Install filler plates in unused spaces.
- N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- O. Arrange conductors in gutters into groups and bundle and wrap with wire ties[after completing load balancing].
- P. Mount spare fuse cabinet in accessible location.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads[after balancing panelboard loads]; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.
- F. Label panelboards "LIFE SAFETY", CRITICAL", OR "EQUIPMENT", PER NEC 517 AND 700 as applicable to the branch they serve.
- G. Panelboards using series ratings must meet field labeling requirements per NEC Sections 110.22 and 240.86(B). The equipment marking shall be readily visible and state the following: CAUTION-SERIES COMBINATION SYSTEM RATED _____AMPERES. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:

1. An arc-energy reduction protection performance test must be completed after the equipment is first installed on-site and energized, and the test must be performed according to the manufacturer's instructions. Provide separate documentation of this testing, certifying that the primary current injection test, or another approved testing method, was conducted by a qualified person(s) in accordance with the equipment instructions. Provide copies of this certification to the engineer, owner, and the AHJ.
2. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. [Do not perform] [Perform] optional tests. Certify compliance with test parameters.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- G. Submit report to show emergency system(s) overcurrent devices selective coordination with all supply side overcurrent protective devices.

3.6 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Coordination Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 1. Measure loads during period of normal facility loading.
 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.7 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.8 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

**SECTION 263300
BATTERY PERFORMANCE REQUIREMENTS**

PART 1 GENERAL

1.1 DESCRIPTION

- A. This specification contains general performance requirements for the installation of an electric battery energy storage system (BESS) at the Village of McFarland Public Safety Building. The design-build contractor shall complete the design, procurement and installation of the battery system as detailed in this performance specification. The bid has two options:
1. **Base Bid- Microgrid.** Full building microgrid capability connecting existing natural gas generator, existing solar PV and new BESS into a distributed energy resources (DER) panel for grid connected and islanding mode operation. See drawings E030 and E050 for locations, electrical plan, one-line diagram, and details. Basis of design BESS is a 250 kW-hr (125kW) battery and bi-directional inverter nominal size.
 2. **Alternate 1- Grid Connected BESS.** Grid connected battery energy storage system (BESS) that works with existing solar PV system for utility savings. See drawings E030 and E050 for locations, electrical plan, one-line diagram, and details. Basis of design BESS is a 250 kW-hr (125kW) battery and bi-directional inverter nominal size.
- B. The bid shall clearly itemize manufacturers, model numbers, capacities, locations, and quantities of products that are proposed.
1. Inverter, batteries and system controller shall be packaged and integrated by one common manufacturer. Basis of design is Current Energy Storage C-BESS MG 125 kW ELM FieldSight Controller with grid forming capabilities.
 2. Where system utilizes Software as a Service (SaaS) to provide supervisory control of battery energy storage system, provide annual subscription costs over life of battery as itemized line item.
 3. Provide annual maintenance cost over life of battery as itemized line item.
- C. Bidders may be required to provide 2 hour demonstration and question/answer of existing contractor installed ESS as part of the selection process.
- D. Provide reference information for 3 previous ESS projects including the following information:
1. System size, location, client name, phone, email, title
 2. Performance and economic validation (if available)
- E. The battery system will be capable of responding to an external dispatch signal from the microgrid controller in all use cases, and switch between each service using a microgrid controller to maximize the cost effectiveness of the renewable energy systems (existing 470 kW DC solar system) and BESS, while maintaining all battery parameters within manufacturer required limits.
- F. The Contractor may propose other configurations to achieve the minimum storage requirements, provided they are within the physical limitations of the system locations as indicated on the drawings and meet all other criteria in the Contract Documents. If alternate products are proposed, the bid is to document the proposed solution's impacts to system energy yield, efficiency, longevity, and overall cost effectiveness (on a life-cycle cost basis) to the Owner.
- G. All work in this specification section is subject to the provisions of Division 01 of the Project Manual and all other applicable parts of the Contract Documents related to this work.

- H. All electrical design work shall be performed and sealed by a Professional Engineer employed or retained by the Contractor. All design work shall conform to the relevant building codes for the jurisdiction.
- I. Incentives/Grant Coordination:
 - 1. The project shall meet all criteria required by IRA language to qualify for the base and bonus tax incentives.
 - a. Domestic Content Bonus
 - 2. OEI PSC Grant requirements for the Microgrid and BESS System
 - a. Buy American Provisions
 - b. Davis Bacon Wages Rate Requirements
- J. The system will be verified by a third party Commissioning Provider under direct contract with the Owner. The Commissioning Provider is responsible for reviewing the construction and verifying system performance. The Contractor shall provide support to the commissioning provider by supplying the approved submittals, test reports, and O&M manuals and by demonstrating system performance in the Commissioning Provider's presence. See 3.4 for additional information.

1.2 DEFINITIONS

- A. General Definitions
 - 1. Designer of Record: A Professional Engineer or Designer of Engineering Systems licensed in the State of Wisconsin who is responsible for the design of all or a portion of the project, including structural and architectural design and/or electrical design.
- B. Electrical Definitions
 - 1. Inverter Output Circuits: The AC conductors from each inverter to the point-of-connection with the building distribution.
- C. Electrical Abbreviations
 - 1. AC: Alternating Current
 - 2. DC: Direct Current
 - 3. ESS: Energy Storage System
 - 4. Isc: Short Circuit Current.
 - 5. NABCEP: North American Board of Certified Energy Practitioners

1.3 PRE-CONSTRUCTION SUBMITTALS

- A. Submit all documentation in accordance with the General Conditions outlined by the Project Manual.
- B. It is the Contractor's responsibility to highlight differences/exceptions, if any, between the submitted products and the requirements in the Contract Documents.
- C. Contractor shall review electrical panelboards submittal and solar PV inverter selection, and coordinate connection with respective contractors.
- D. The Contractor shall not fabricate materials or order equipment until corresponding submittals have been reviewed and approved.
- E. Qualification Data:
 - 1. The Contractor shall provide the names, addresses, and descriptions of 3 similar projects that the Contractor has completed within the last 5 years.
 - 2. Submit a copy of the resume for each of the Contractor's Designers of Record.

- F. Product Data: For each type of component indicated below include rated capacities, operating characteristics, and furnished specialties and accessories. Submittals which include more than one model number shall be marked with highlighting and/or crossing out to clearly indicate which model is being submitted. All product data submittals shall be submitted for review by Engineer prior to purchasing any materials or equipment.
1. Battery banks
 2. Battery inverter
 3. Energy monitoring devices including points list that can be communicated over BAS communication connection
 4. Disconnects
 5. Fuses
 6. Manufacturer's installation instructions
- G. Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. All drawings shall be submitted for review by the Owner prior to purchasing any materials or equipment. Provide CAD drawings (in .dwg format):
- H. Electrical Design
1. Submitted for review prior to material procurement and fabrication. Submit electronically. Include the following items
 - a. BESS Electrical 1-line for battery system
 - b. BESS controls sequences
 - c. System wiring diagram
 2. Letter of Certification from Designer of Record: Sealed and signed. Certify that the electrical system and all its components have been reviewed, coordinated, and designed in accordance with NFPA 70.
- I. Coordination Meeting
1. Contractor shall attend and participate in coordination meeting with general contractor, electrical contractor, electrical supplier, controls contractor, electrical designer and commissioning provider within 4 weeks of bid award to coordinate connection of battery system to components provided by others including transfer switch, solar inverters and panelboards.
- J. Permitting and Agreements
1. The following permits and agreements shall be procured by the Contractor on behalf of the Owner. The Contractor shall cover the costs for all applicable permits necessary for the construction of the project. All approved permits and agreements shall be submitted for review by Owner prior to purchasing any materials or equipment.
 - a. Building permit
 - b. Electrical permit

1.4 CLOSEOUT SUBMITTALS

- A. As-built drawings
1. Dimensioned AutoCAD plan drawings of equipment including batteries and inverters, disconnects, metering, and electrical routing.
- B. Field quality-control test reports

1. Testing report by factory authorized start-up technician.
- C. Operation and Maintenance Data: Include the following for batteries, inverter, electrical distribution, metering, and monitoring.
 1. Instructions for operating and maintaining equipment, including system startup and shutdown procedures, troubleshooting, and a routine maintenance schedule.
 2. Identification of operating limits which may result in hazardous or unsafe conditions.
 3. Document ratings of equipment and each major component.
 4. Technical Data Sheets.
 5. Wiring Diagrams.
 6. Parts list.
- D. Warranty: Copies of all manufacturer's and installer's warranties.

1.5 **WARRANTY**

- A. Contractor's Workmanship Warranty:
 1. The Contractor must provide a two-year installation warranty covering any defects of the installation.
 2. The Contractor's workmanship warranty period shall begin from date of Substantial Completion.
- B. Manufacturer Warranties:
 1. The ESS manufacturer shall agree to replace components that fail within the specified warranty period, beginning from date of Substantial Completion.
 - a. 10-year product warranty.

1.6 **QUALITY ASSURANCE**

- A. Contractor Qualifications:
 1. Proximity: Not more than four hours' normal travel time from the Contractor's place of business or from the Contractor's local representative to the project site.
 2. The Contractor is required to have experience with minimum of (3) similar completed projects.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with Madison Gas and Electric interconnection requirements.

1.7 **UTILITY COORDINATION**

A. Coordinate metering and interconnection agreement with electric utility. Contractor shall pay all interconnection fees including the application review fee, engineering review fee, and distribution system study fee. Contractor shall submit all required forms to utility.

PART 2 PRODUCTS

2.1 **BATTERY**

- A. Manufacturer: Basis of design is Current Energy Storage.
- B. Equivalent system may be accepted and are subject to compliance with project requirements and review.
- C. BESS shall include integral temperature control and fire suppression.

2.2 ESS INVERTER

- A. Manufacturer: Basis of design is Current Energy Storage.
- B. Equivalent system may be accepted and are subject to compliance with project requirements and review.
- C. Features
 - 1. BACnet or Modbus communication
 - 2. Integral AC & DC disconnects.
 - 3. DC side ground fault protection.
 - 4. Inverter must limit power output to nameplate value.
 - 5. User navigable LCD display.
 - 6. LED status lights on enclosure.
 - 7. Communication port for diagnostics and communication port for communication with multiple inverters and internet interface device.
 - 8. NEMA 3R enclosure
 - 9. User adjustable reserve power requirement for backup power upon loss of grid
 - 10. System controller shall utilize control logic that maximizes economic savings of battery utilizing the following minimum inputs:
 - a. Historic building energy consumption with at least 15 minute interval data
 - b. Current building load
 - c. Max building load targets
 - d. Current and day ahead weather
 - e. MGE electric rates for actual building including energy charges and peak charges
 - f. Current and predicted solar production
 - g. Battery performance criteria and operating limits

2.3 ESS CONTROLLER

- A. Battery ESS will be monitored by a web-based energy monitoring system that can share data with the HVAC building automation system and 3rd party energy benchmarking and verification software through BACnet or ModBus communication protocol.
- B. Battery controller manufacturer to remotely monitor and adjust system control algorithms to optimize system performance and economics for 1 year after substantial completion.

2.4 BATTERY WIRING

- A. Input Wiring
 - 1. For use from the battery module to the inverter inputs.
 - 2. Conductors: Stranded, uncoated copper
 - 3. Insulation: Cross-linked polyethylene (XLPE)
 - 4. Temperature Rating: -40°C to 90°C (wet or dry)
 - 5. Moisture resistant and suitable for conduit and raceways.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Do not begin installation until mounting surfaces have been properly prepared.
- C. Examine all equipment and materials before installation. Reject any equipment and materials that are physically damaged in any way, including scratched, dented, bent, wet, moisture damaged, or mold damaged.
- D. Examine supports and supporting structures for suitable conditions where battery system will be installed.
- E. Examine roughing-in of electrical connections. Verify actual locations of connections before panel installation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ELECTRICAL INSTALLATION

- A. Install BESS per manufacturer's instructions.
- B. Contractor to provide all auxiliary wiring and communication devices integrated from BESS to solar inverters, islanding transfer switch and other components as required to meet the performance specification. Items not shown on E030 and E050 necessary for BESS functionality to be provided by battery contractor as part of this scope of work.

3.3 IDENTIFICATION

- A. Identify and label system components according to Division 26.
 - 1. Provide a unique label for each inverter, battery bank and disconnects. Labeling shall match labeling shown on as-built diagram and plan provided by contractor.
- B. Provide all labeling required by NEC article 690, including, but not limited to:
 - 1. Label disconnects capable of being energized from both directions as such.

3.4 FIELD QUALITY CONTROL / DEMONSTRATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Notify commissioning provider, utility and owner 1 week before test date.
- C. Final testing of BESS will include:
 - 1. Grid connected functions (load shedding, energy storage, ect.)
- D. Final BESS testing and demonstration shall be witnessed by the owner and commissioning teams.
- E. Perform tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Visually inspect all connections.
 - 2. Verify correct operation of inverter in all modes of operation including grid connected, islanded and off.
 - 3. Verify correct operation of complete system.
 - 4. Replace any defective products at contractor's expense.
- F. Correct any deficiencies.

G. Prepare test and inspection reports.

3.5 TRAINING

- A. Simulate power outage by interrupting normal source and demonstrate that system disconnects from utility and operates in island mode.
- B. Provide owner's maintenance personnel with minimum two hour training session and in compliance with Div 01 Training Requirements.
 - 1. Provide training on function and operation of each piece of equipment.
 - 2. Provide training on maintaining the system.
 - 3. Explain means of disconnecting and re-energizing the system.
 - 4. Explain principles of operation, troubleshooting, and safety.

END OF SECTION

**SECTION 263700
MICROGRID PERFORMANCE REQUIREMENTS**

PART 1 GENERAL

1.1 DESCRIPTION

- A. This specification contains general performance requirements for the installation of an microgrid control system at the Village of McFarland Public Safety Building. The design-build contractor shall complete the design, procurement and installation of the microgrid system as detailed in this performance specification. The bid has two options:
1. **Base Bid- Microgrid.** Full building microgrid capability connecting existing natural gas generator, existing solar PV and new BESS into a distributed energy resources (DER) panel for grid connected and islanding mode operation. See drawings E030 and E050 for locations, electrical plan, one-line diagram, and details.
 2. **Alternate 1- Grid Connected BESS.** None.
- B. The bid shall clearly itemize manufacturers, model numbers, capacities, locations, and quantities of products that are proposed.
1. Where system utilizes Software as a Service (SaaS) to provide supervisory control of battery energy storage system, provide annual subscription costs over life of battery as itemized line item.
- C. Bidders may be required to provide 2 hour demonstration and question/answer of existing contractor installed ESS as part of the selection process.
- D. Provide reference information for 3 previous microgrid projects including the following information:
1. System size, location, client name, phone, email, title
 2. Performance and economic validation (if available)
- E. The microgrid system and connected distributed energy resources (DERs) is intended to meet the following use cases (in order of priority):
1. Shaving utility peak charges
 2. Storing solar PV energy overproduction for use in high energy consumption times
 3. Providing automated back-up power for building electrical loads in combination with the fossil fuel generator(s) and solar PV system.
 4. Manual microgrid mode- operator control of islanding and microgrid modes.
 5. Capabilities to provide ancillary grid services such as frequency regulation or voltage support as the market becomes available through MISO.
- F. The battery system will be capable of utilizing all use cases listed above, and switch between each service using a microgrid controller to maximize the cost effectiveness of the renewable energy systems (existing 470 kW DC solar system) and BESS.
- G. The Contractor may propose other configurations to achieve the microgrid control requirements, provided they are within the physical limitations of the system locations as indicated on the drawings and meet all other criteria in the Contract Documents. If alternate products are proposed, the bid is to document the proposed solution's impacts to system energy yield, efficiency, longevity, and overall cost effectiveness (on a life-cycle cost basis) to the Owner.
- H. All work in this specification section is subject to the provisions of Division 01 of the Project Manual and all other applicable parts of the Contract Documents related to this work.
- I. All electrical design work shall be performed and sealed by a Professional Engineer employed or retained by the Contractor. All design work shall conform to the relevant building codes for the jurisdiction.
- J. Incentives/Grant Coordination:
1. The project shall meet all criteria required by IRA language to qualify for the base and bonus tax incentives.

- a. Domestic Content Bonus
- 2. OEI PSC Grant requirements for the Microgrid and BESS System
 - a. Buy American Provisions
 - b. Davis Bacon Wages Rate Requirements
- K. The system will be verified by a third party Commissioning Provider under direct contract with the Owner. The Commissioning Provider is responsible for reviewing the construction and verifying system performance. The Contractor shall provide support to the commissioning provider by supplying the approved submittals, test reports, and O&M manuals and by demonstrating system performance in the Commissioning Provider's presence. See 3.4 for additional information.
- L. Hourly or sub hourly simulated building loads and solar production data is available upon request in excel format.

1.2 DEFINITIONS

- A. General Definitions
 - 1. Designer of Record: A Professional Engineer or Designer of Engineering Systems licensed in the State of Wisconsin who is responsible for the design of all or a portion of the project, including structural and architectural design and/or electrical design.
- B. Electrical Definitions
 - 1. Inverter Output Circuits: The AC conductors from each inverter to the point-of-connection with the building distribution.
- C. Electrical Abbreviations
 - 1. AC: Alternating Current
 - 2. DC: Direct Current
 - 3. ESS: Energy Storage System
 - 4. Isc: Short Circuit Current.
 - 5. NABCEP: North American Board of Certified Energy Practitioners

1.3 PRE-CONSTRUCTION SUBMITTALS

- A. Submit all documentation in accordance with the General Conditions outlined by the Project Manual.
- B. It is the Contractor's responsibility to highlight differences/exceptions, if any, between the submitted products and the requirements in the Contract Documents.
- C. Contractor shall review electrical panelboards submittal and solar PV inverter selection, and coordinate connection with respective contractors.
- D. The Contractor shall not fabricate materials or order equipment until corresponding submittals have been reviewed and approved.
- E. Qualification Data:
 - 1. The Contractor shall provide the names, addresses, and descriptions of 3 similar projects that the Contractor has completed within the last 5 years.
 - 2. Submit a copy of the resume for each of the Contractor's Designers of Record.
- F. Product Data: For each type of component indicated below include rated capacities, operating characteristics, and furnished specialties and accessories. Submittals which include more than one model number shall be marked with highlighting and/or crossing out to clearly indicate which model is being submitted. All product data submittals shall be submitted for review by Engineer prior to purchasing any materials or equipment.
 - 1. Microgrid switchgear
 - 2. Microgrid controller
 - 3. Energy monitoring devices including points list
 - 4. Automated breakers
 - 5. Disconnects
 - 6. Fuses
 - 7. Manufacturer's installation instructions

- G. Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. All drawings shall be submitted for review by the Owner prior to purchasing any materials or equipment. Provide CAD drawings (in .dwg format):
- H. Electrical Design
1. Submitted for review prior to material procurement and fabrication. Submit electronically. Include the following items
 - a. Electrical 1-line for battery system
 - b. Microgrid and BESS controls sequences and associated control wiring and associated communication to solar inverters
 - c. System wiring diagram
 2. Letter of Certification from Designer of Record: Sealed and signed. Certify that the electrical system and all its components have been reviewed, coordinated, and designed in accordance with NFPA 70.
- I. Coordination Meeting
1. Contractor shall attend and participate in coordination meeting with general contractor, electrical contractor, electrical supplier, solar PV contractor, controls contractor, electrical designer and commissioning provider within 4 weeks of bid award to coordinate connection of microgrid system to components provided by others including transfer switch, solar inverters and panelboards.
- J. Permitting and Agreements
1. The following permits and agreements shall be procured by the Contractor on behalf of the Owner. The Contractor shall cover the costs for all applicable permits necessary for the construction of the project. All approved permits and agreements shall be submitted for review by Owner prior to purchasing any materials or equipment.
 - a. Utility interconnection application and agreement
 - b. Building permit
 - c. Electrical permit

1.4 CLOSEOUT SUBMITTALS

- A. As-built drawings
1. Dimensioned AutoCAD plan drawings of equipment including batteries and inverters, disconnects, metering, and electrical routing.
- B. Field quality-control test reports
1. Testing report by factory authorized start-up technician.
- C. Operation and Maintenance Data: Include the following for batteries, inverter, electrical distribution, metering, and monitoring.
1. Instructions for operating and maintaining equipment, including system startup and shut down procedures, troubleshooting, and a routine maintenance schedule.
 2. Identification of operating limits which may result in hazardous or unsafe conditions.
 3. Document ratings of equipment and each major component.
 4. Technical Data Sheets.
 5. Wiring Diagrams.
 6. Parts list.
- D. Warranty: Copies of all manufacturer's and installer's warranties.

1.5 WARRANTY

- A. Contractor's Workmanship Warranty:
1. The Contractor must provide a two-year installation warranty covering any defects of the installation.
 2. The Contractor's workmanship warranty period shall begin from date of Substantial Completion.

B. Manufacturer Warranties:

1. The microgrid control manufacturer shall agree to replace components that fail within the specified warranty period, beginning from date of Substantial Completion.
 - a. 10-year product warranty.

1.6 **QUALITY ASSURANCE**

A. Contractor Qualifications:

1. Proximity: Not more than four hours' normal travel time from the Contractor's place of business or from the Contractor's local representative to the project site.
2. The Contractor is required to have experience with minimum of (3) similar completed projects.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with Madison Gas and Electric interconnection requirements.

1.7 **UTILITY COORDINATION**

A. Coordinate metering and interconnection agreement with electric utility. Contractor shall pay all interconnection fees including the application review fee, engineering review fee, and distribution system study fee. Contractor shall submit all required forms to utility.

PART 2 PRODUCTS

2.1 **MICROGRID SWITCHGEAR**

- A. Microgrid switchboard required for microgrid functionality shall comply with all switchboard specifications in section 26 24 13 along with the performance requirements in this section.
- B. The basis of design is Manufacturer: Schneider Electric, Square D Energy Control Center (ECC).
- C. Equivalent system may be accepted and are subject to compliance with project requirements and review.
- D. The microgrid switchboard shall act as the microgrid control center and perform the following functions:
 1. Distributed energy resource (DER) automated dispatch based on grid connected and microgrid sequences (see microgrid controller).
 2. Manual microgrid islanding mode functions (see microgrid controller).
- E. Where indicated on drawings or required for microgrid control provide electrically operated circuit breakers for control by the microgrid controller, capable of being opened and closed by commands over the microgrid controller's communication protocol.
- F. Where indicated on drawings or required for microgrid control specified functionality, provide circuit breakers with electronic trip units capable of reporting real power, reactive power, voltage, frequency, and current over the microgrid controller's communication protocol.
- G. Markings and Labeling:
 1. Provide identification and warning labels/nameplates exterior to equipment resistant to weather, UV, and intended installation environment.
 2. Provide engraved nameplate identifying project-specific equipment tag and service description.

3. Provide warning labels/nameplates complying with ANSI Z535.4 at access locations to advise personnel of possible hazards in accordance with listing, NFPA 70, NFPA 70E, and other applicable standards.

2.2 MICROGRID CONTROLLER

- A. Provide low-voltage microgrid controller consisting of one or more power distribution equipment items (e.g., power panels or switchboards) with required components, including but not limited to, microgrid operator interface(s), microgrid controller(s), communications interfaces, and electrically operated circuit breakers to control operation of DERs per sequence of operations.
- B. Control sequence of operation on sheet E060.
- C. Provide operator interface with display and controls with the following functionality:
 1. Status indicator light(s).
 2. Provide one-line diagram including circuit breaker arrangement, service, and status.
 3. Indicate power, reactive power, voltage, frequency, and current measured by each breaker or meter as required.
 4. Indicate relative priority of each load breaker.
 5. Indicate key information available from DERs (e.g., power output and status).
 6. Indicate pertinent alarms (e.g., breakers tripped for overcurrent).
 7. Indicate pertinent events (e.g., breakers opened or closed by commands from touchscreen).
 8. Indicate trends of key measurements (e.g., power measured by breaker versus time).
 9. Manual microgrid and islanding functions and commands.
- D. Microgrid controller will be monitored by a web-based energy monitoring system that can share data with the HVAC building automation system or 3rd party energy benchmarking and verification software (eGauge) through BACnet or ModBus communication protocol.
- E. Remote Notification of Alarms
 1. Existing generator system is monitored remotely via a SCADA system operated by the owner.
 2. Critical back-up power, microgrid and DER alarms shall be communicated over the existing SCADA system.
 3. Coordinate remotely monitored microgrid points via the SCADA system interface with the owner.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Do not begin installation until mounting surfaces have been properly prepared.
- C. Examine all equipment and materials before installation. Reject any equipment and materials that are physically damaged in any way, including scratched, dented, bent, wet, moisture damaged, or mold damaged.
- D. Examine supports and supporting structures for suitable conditions where battery system will be installed.

- E. Examine roughing-in of electrical connections. Verify actual locations of connections before panel installation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

1.1 ELECTRICAL INSTALLATION

- A. Install microgrid controller per manufacturer's instructions.
- B. Contractor to provide all auxiliary wiring and communication devices integrated from microgrid controller to BESS, solar inverters, islanding transfer switch and other components as required to meet the performance specification. Items not shown on E030 and E050 necessary for microgrid functionality to be provided by microgrid contractor as part of this scope of work.
- C. Electrical installation timing to be coordinated with owner. This will include electrical work during times that are operationally acceptable for the Fire Station and Police Station operations to continue functioning during microgrid installation.
- D. Planned electrical utility outages are expected to be required for installation of microgrid electrical equipment. Minimum 2 week notice must be coordinated with owner for any

3.2 IDENTIFICATION

- A. Identify and label system components according to Division 26.
 - 1. Provide a unique label for each panel, controller and disconnects. Labeling shall match labeling shown on as-built diagram and plan provided by contractor.
- B. Provide all labeling required by NEC article 690, including, but not limited to:
 - 1. Label disconnects capable of being energized from both directions as such.

3.3 FIELD QUALITY CONTROL / DEMONSTRATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Notify commissioning provider, utility and owner 1 week before test date.
- C. Final testing of microgrid system will include:
 - 1. Test script coordinated with commissioning team based on final microgrid system sequence of operation
 - 2. Automatic and manual microgrid islanding functions- demonstrate functionality as described in the performance specification sequence of operation
 - 3. Grid connected functions (load shedding, energy storage, ect.)
- D. Final microgrid testing and demonstration shall be witnessed by the owner and commissioning teams.
- E. Perform tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Visually inspect all connections.
 - 2. Verify correct operation of inverter in all modes of operation including grid connected, islanded and off.
 - 3. Verify correct operation of complete system.
 - 4. Replace any defective products at contractor's expense.
- F. Correct any deficiencies.
- G. Prepare test and inspection reports.

3.4 TRAINING

- A. Simulate power outage (using operator workstation) by interrupting normal source and demonstrate that system disconnects from utility and operates in island mode.
- B. Provide owner's maintenance personnel with minimum two hour training session and in compliance with Div 01 Training Requirements.
 - 1. Provide training on function and operation of each piece of equipment.

2. Provide training on maintaining the system.
3. Explain means of disconnecting and re-energizing the system.
4. Explain principles of operation, troubleshooting, and safety.

END OF SECTION

SECTION 270528 PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Metal wireways and auxiliary gutters.
 - 5. Nonmetallic wireways and auxiliary gutters.
 - 6. Metallic surface pathways.
 - 7. Nonmetallic surface pathways.
 - 8. Hooks.
 - 9. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.
- D. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

- A. Product data for the following:
 - 1. Surface pathways
 - 2. Wireways and fittings.
 - 3. Boxes, enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
 - 3. Underground ducts, piping, and structures in location of underground enclosures and handholes.
- B. Qualification Data: For professional engineer.
- C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit.
 3. Anamet Electrical, Inc.
 4. Bridgeport Fittings, Inc.
 5. Electri-Flex Company.
 6. O-Z/Gedney.
 7. Picoma Industries.
 8. Republic Conduit.
 9. Robroy Industries.
 10. Southwire Company.
 11. Thomas & Betts Corporation.
 12. Western Tube and Conduit Corporation.
 13. Wheatland Tube Company.
- C. General Requirements for Metal Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-E.
- D. GRC: Comply with ANSI C80.1 and UL 6.
- E. ARC: Comply with ANSI C80.5 and UL 6A.
- F. IMC: Comply with ANSI C80.6 and UL 1242.
- G. PVC-Coated Steel Conduit: PVC-coated GRC.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- H. EMT: Comply with ANSI C80.3 and UL 797.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.
 3. EMT Fittings Materials:
 - a. All Zinc materials shall be ASTM B86 certified
 - b. All Zinc Product shall be ZAMAK #3 and/or #7 formula.
 - c. All Steel shall be SAE 1050.
 4. EMT Fittings Design:
 - a. Zinc die cast components shall be ball burnished.
 - b. Steel parts shall be zinc plated for corrosion protection.
 - c. All Locknuts shall have a dual, precision machined-cut thread, reversible and possess a serrated face on each side.
 - d. All set screw products shall be manufactured with a tri-drive head and staked or modified to prevent disassembly.
 - e. All fitting throat diameters shall be smooth with no sharp edges or slag.
 - f. Rain tight products shall have internal sealing rings to create and maintain a rain tight seal.
 - g. All fittings shall be tested per UL 514B and be listed by Underwriters Laboratories.
 5. Transition Fittings:
 - a. All transitions fittings (go-to or from-to fittings) or fittings used to transition from one raceway type to another must be UL listed for that application.
 6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for plenum installation unless otherwise indicated.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Alpha Wire Company.
 - 2. Arnco Corporation.
 - 3. Endot Industries Inc.
 - 4. IPEX.
 - 5. Lamson & Sessions; Carlon Electrical Products.
- C. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with TIA-569-E.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Mono-Systems, Inc.
 - 4. Square D.
- C. General Requirements for Metal Wireways and Auxiliary Gutters:
 - 1. Comply with UL 870 and NEMA 250, Type 1 unless otherwise indicated or required for intended installation location, and sized according to NFPA 70.
 - 2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
 - 3. Comply with TIA-569-E.
- D. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: Screw-cover type unless otherwise indicated.
- F. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE METAL PATHWAYS

- A. Description: Galvanized steel with snap-on covers, complying with UL 5.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Mono-Systems, Inc.
 - 2. Niedax-Kleinhuis USA, Inc.
 - 3. Panduit Corp.
 - 4. Wiremold / Legrand.
- C. Finish: Manufacturer's standard enamel finish in color selected by owner.
- D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- E. Comply with TIA-569-E.

2.5 HOOKS

- A. Description: Prefabricated sheet metal cable supports for telecommunications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. B-Line

2. Mono Systems, Inc
 3. Panduit Corp.
 4. Pentair
 5. Wiremold/Legrand
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-E.
- E. Galvanized steel.
- F. J shape.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Adalet.
 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 3. EGS/Appleton Electric.
 4. Erickson Electrical Equipment Company.
 5. Hoffman.
 6. Lamson & Sessions; Carlon Electrical Products.
 7. Milbank Manufacturing Co.
 8. Molex; Woodhead Brand.
 9. Mono-Systems, Inc.
 10. O-Z/Gedney.
 11. Quazite:Hubbell Power Systems, Inc.
 12. RACO; Hubbell.
 13. Robroy Industries.
 14. Spring City Electrical Manufacturing Company.
 15. Stahlin Non-Metallic Enclosures.
 16. Thomas & Betts Corporation.
 17. Wiremold / Legrand.
- C. General Requirements for Boxes, Enclosures, and Cabinets:
1. Comply with TIA-569-E.
 2. Boxes, enclosures and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
 5. Gangable boxes are prohibited.
- D. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- I. Cabinets:
1. NEMA 250, Type 1 minimum or as otherwise required for installation location, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Damp or Wet Locations: GRC.
 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
 7. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.
 8. Boxes and Enclosures: NEMA 250 Type 1.
- C. Minimum Pathway Size: 3/4-inch trade size. Minimum size for optical-fiber cables is 1 inch.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10 and UL514B.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F].

3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
 1. NECA 1.
 2. NECA/BICSI 568.
 3. TIA-569-E.
 4. NECA 101
 5. NECA 102.
 6. NECA 105.
 7. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

- C. Comply with requirements for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.
- E. Comply with requirements for sleeves and sleeve seals for communications.
- F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- G. Complete pathway installation before starting conductor installation.
- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- I. Install no more than the equivalent of two 90-degree bends and no more than 100 feet (30 meters) of length in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- J. Conceal rigid conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- P. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- R. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- S. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- T. Surface Pathways:
 - 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 - 2. Install surface pathway with a minimum 2-inch radius control at bend points.
 - 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- U. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.

3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- V. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- W. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service pathway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- Y. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Z. Hooks:
1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
 2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
 3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
 4. Space hooks no more than 5 feet o.c.
 5. Provide a hook at each change in direction.
- AA. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
- BB. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- CC. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Do not install boxes back-to-back.

- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- GG. Boxes installed in metal stud and sheetrock walls shall have far-side box support.
- HH. Boxes shall be secured to metal studs with spring steel clamp which wraps around the entire face of the stud and digs into both sides of the stud. Clamp shall be screwed into the stud.
- II. Set outlet boxes for flush mounted devices to within 1/8" of finished wall.
- JJ. Minimum box size to be two gang. For installation of single gang device use properly sized mud ring with thickness to install device within 1/8" of finished wall.
- KK. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

CIRCUIT BREAKER TYPE

- MC - MOLDED CASE CIRCUIT BREAKER
- IC - INSULATED CASE CIRCUIT BREAKER
- PC - LOW VOLTAGE POWER CIRCUIT BREAKER
- SS - SOLID STATE MOLDED CASE CIRCUIT BREAKER

CIRCUIT BREAKER OPTIONS

- AR - ARC FLASH REDUCTION
- CL - CURRENT LIMITING
- FR - FULLY RATED (100%)
- GE - GROUND FAULT PROTECTION - EQUIPMENT
- GP - GROUND FAULT PROTECTION - PERSONNEL
- GS - GROUND FAULT SENSING / ALARM
- HC - HEATING, COOLING, AIR CONDITIONING, REFRIGERATION- HCAR
- HM - HIGH MAGNETIC - HID MOTORS
- MS - MOLDED CASE SWITCH
- MP - MOTOR CIRCUIT PROTECTOR
- LI - LONG TIME / INSTANTANEOUS
- LSI - LONG TIME / SHORT TIME / INSTANTANEOUS
- LSIG - LONG TIME / SHORT TIME / INSTANTANEOUS / GROUND FAULT TRIP
- LSIGS - LONG TIME / SHORT TIME / INSTANTANEOUS / GROUND FAULT SENSING
- SC - SYSTEM COMMUNICATION
- SD - SYSTEM DIAGNOSTICS
- SM - SYSTEM MONITORING
- ZS - ZONE SELECTIVE INTERLOCKING

CIRCUIT BREAKER ACCESSORIES

- ALS - ALARM SWITCH
- AXS - AUXILIARY SWITCH
- EOP - ELECTRIC OPERATOR
- ST - SHUNT TRIP
- UVT - UNDER VOLTAGE TRIP

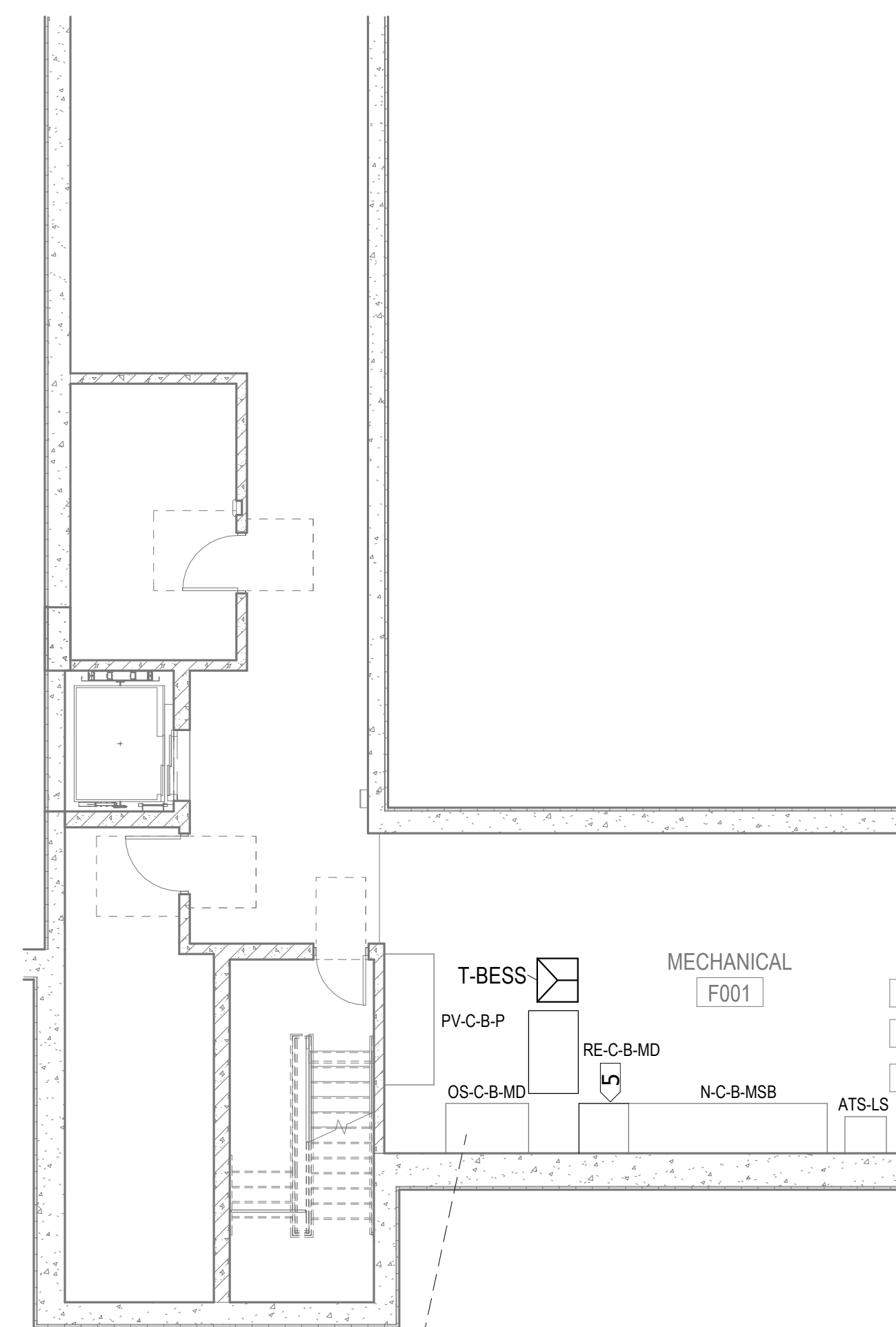
A	EO	ELECTRICALLY OPERATED	DC	DIRECT CURRENT	H		M		P		TGB	TELECOMMUNICATIONS GROUNDING BUSBAR
	A	AEROSOL	DC	DRY CHEMICAL	HH	HANDHOLE	MCA	MINIMUM CIRCUIT AMPACITY	P	POLE	TIA	TELECOMMUNICATIONS INDUSTRIES ASSOCIATION
			DED	DEDICATED CIRCUIT	HL	HALON	MCB	MAIN CIRCUIT BREAKER	PB	PULL BOX		
			DIA	DIAMETER	HMT	HARMONIC MITIGATING TRANSFORMER	MH	MANHOLE	PF	POWER FACTOR	TYP	TYPICAL
A or AMP	AMPERE	DL	DELUGE FIRE SPRINKLER	HP	HORSE POWER	MLO	MAIN LUG ONLY	PH or Ø	PHASE	U	UL	UNDERWRITERS LABORATORIES
AV or AV	AUDIO/VISUAL	DSP	DIGITAL SIGNAL PROCESSOR	HR	HORIZONTAL	MM	MULTI-MODE	PNL	PANEL			
AC	ALTERNATING CURRENT	DW	DISH WASHER	Hz	HERTZ	MMCS	MANUAL MOTOR CONTROL SWITCH	POS	POINT OF SALE			
ACS	AUTOMATIC CONTROL SYSTEM	E		I		MOC	MAXIMUM OVERCURRENT PROTECTION	PR	PAIR		UNO	UNLESS OTHERWISE NOTED/UNLESS NOTED OTHERWISE
AFF	ABOVE FINISHED FLOOR	ELEC	ELECTRICAL	IO	IN-BOARD/OUT-BOARD	MSS	MOTOR STARTER SWITCH	PRI	PRIMARY			
AL	AMPERE INTERRUPTING RATING	EMI	ELECTROMAGNETIC INTERFERENCE	I/O	ISOLATED GROUND	MTD	MOUNTED	PTR	PRINTER		UPS	UNINTERRUPTABLE POWER SUPPLY
AIC	ALUMINUM	EMT	ELECTRICAL METALLIC TUBING	IP	INTERNET PROTOCOL	MV	MEDIUM VOLTAGE	PTZ	PAN TILT ZOOM		UTP	UNSHIELDED TWISTED PAIR
ATS	AUTOMATIC TRANSFER SWITCH	EW	ELECTRIC WATER COOLER	IPC	INTERGRATED POWER CENTER	MW	MICROWAVE	PVC	POLYVINYL CHLORIDE		V	V
AUX	AUXILIARY	EXST	EXISTING	IR	INFRARED							
AWG	AMERICAN WIRE GAUGE	F		K		N		R				
B	BAS	BUILDING AUTOMATION SYSTEM	FA	FIRE ALARM	kHz	KILOHERTZ	N	REF	RECEPTACLE		V	VOLT
	BIO	BIOMETRIC	FAAP	FIRE ALARM ANNUNCIATOR PANEL	KK	KIRK KEY	N	RF	REFRIGERATOR		VA	VOLT-AMPERE
	BMS	BUILDING MANAGEMENT SYSTEM	FACU	FIRE ALARM CONTROL UNIT	KV	KILOVOLT	NAC	RX	RADIO FREQUENCY RECEIVE/RECEIVER		VEND	VENDING
			FLA	FULL-LOAD AMPERE	KVA	KILOVOLT-AMPERE	NEC				VGA	VIDEO GRAPHICS ARRAY
C	FO	FOAM	FO	FOAM	KW	KILOWATT	NEMA	SEC	SHORT CIRCUIT CURRENT RATING	S	VSD/VFD/ VFC	VARIABLE SPEED DRIVE/ FREQUENCY DRIVE / FREQUENCY CONTROLLER
	CA	CLEAN AGENT	FP	FURNITURE POWER	L		NFPA	SM	SINGLEMODE		W	
	CATV	CABLE TELEVISION	FSS	FUSED SAFETY SWITCH	LAN	LOCAL AREA NETWORK	NFSS	SPD	SPRUE PROTECTION DEVICE		W	WATT
	CLG	CEILING	G		LCP	LIGHTING CONTROL PANEL	NTS	ST	SHUNT TRIP		WAP	WIRELESS ACCESS POINT
D	CO2	CARBON DIOXIDE	GAP	GENERATOR ANNUNCIATOR PANEL	LED	LIGHT EMITTING DIODE	OC	STP	SHIELDED TWISTED PAIR	T	WG	WET CHEMICAL
	COFF	COFFEE MAKER	GD	GARBAGE DISPOSAL	LSI	LONG TIME SHORT TIME INSTANTANEOUS	O				WC	WIRE GUARD
	CU	COPPER	GFCI	GROUND FAULT CIRCUIT INTERRUPTER	LV	LOW-VOLTAGE	OC	ON CENTER	TBB	TELECOMMUNICATIONS BONDING BACKBONE	WM	WATER MIST
			GND	GROUND			OC	OVER CURRENT PROTECTIVE DEVICE	TELECOM	TELECOMMUNICATIONS	WP	WEATHER-PROOF
dB	DECIBEL									X	XFMR	TRANSFORMER

A. ELECTRICAL ORDINANCES: ALL ELECTRICAL WORK SHALL BE INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE AND FEDERAL LAWS OR ORDINANCES GOVERNING THE PROJECT. IF, IN ANY INSTANCE, THE PLANS AND SPECIFICATIONS ARE IN DIRECT CONFLICT WITH SUCH CODES, LAWS OR ORDINANCES, THE CODE, LAWS AND ORDINANCES SHALL HAVE JURISDICTION AND THE WORK IN QUESTION SHALL BE INSTALLED ACCORDING TO THE CODES, LAWS AND ORDINANCES. ALL WORK SHALL BE INSTALLED UNDER THE SUPERVISION OF A LICENSED MASTER ELECTRICIAN. B. BRING DISCREPANCIES SHOWN ON DIFFERENT DRAWINGS AND BETWEEN DRAWINGS AND SPECIFICATIONS OR BETWEEN DOCUMENTS AND FIELD CONDITIONS TO THE IMMEDIATE ATTENTION OF THE OWNER AND ENGINEER. C. COORDINATE ELECTRICAL INSTALLATION WITH ALL OTHER CONTRACTORS AND OWNER FOR THE LOCATION AND SIZES OF ALL EQUIPMENT PRIOR TO ROUGH-IN. SHOULD ELECTRICAL WORK BE INSTALLED WHICH INTERFERES WITH THE WORK OF OTHER CONTRACTORS OR OWNER, SUCH WORK SHALL BE CHANGED WITH NO ADDITIONAL COST TO OWNER. D. CONDUCTORS SHALL BE COPPER, UNLESS SPECIFIED OTHERWISE. BUILDING WIRING SHALL HAVE THIRTYTHIN INSULATION. CONDUCTOR AMPACITY SHALL BE BASED ON TABLE 310-16 OF THE NEC. USE 60-DEGREE C RATING FOR CIRCUITS TERMINATING ON DEVICES RATED BELOW 100A. USE 75-DEGREE RATING FOR CIRCUITS TERMINATING ON DEVICES AND IN ENCLOSURES RATED 100A AND OVER. E. INSTALL INSULATED GREEN EQUIPMENT GROUNDING CONDUCTOR WITH ALL BRANCH CIRCUIT AND FEEDER CONDUCTORS, SIZED IN ACCORDANCE WITH NEC ARTICLE 250. F. DRAWINGS INDICATE DESIGN LOADS, VOLTAGES, CORRESPONDING CONTROL EQUIPMENT, FEEDERS AND OVER CURRENT DEVICES. IF EQUIPMENT ACTUALLY FURNISHED HAVE LOADS OTHER THAN THOSE INDICATED ON THE DRAWINGS OR SPECIFIED HEREIN, CONTROL EQUIPMENT, FEEDERS AND OVER CURRENT DEVICES SHALL BE ADJUSTED IN SIZE ACCORDINGLY AT NO ADDITIONAL COST TO THE OWNER. SUCH ADJUSTMENT SHALL BE SUBJECT TO THE REVIEW OF THE ARCHITECT PRIOR TO ACCEPTANCE OR PURCHASE.	I. IN GENERAL, BRANCH CIRCUIT CONDUIT AND WIRE IS NOT SHOWN. PROVIDE CONDUIT AND WIRE TO CONNECT DEVICES TO CIRCUITS SHOWN. WIRE FILL AND CONDUCTOR SIZE SHALL BE AS SPECIFIED. PROVIDE A MAXIMUM OF THREE PHASE CONDUCTORS IN A SINGLE HOME RUN. PROVIDE A DEDICATED NEUTRAL FOR EACH PHASE CONDUCTOR UNLESS OTHERWISE NOTED. INSTALL PULL BOXES AND JUNCTION BOXES AS REQUIRED TO AID IN THE INSTALLATION OF CABLES AND CONDUCTORS. LABEL LOCATION OF POWER CIRCUITS ON COVER OF ALL RECEPTACLES AND ON COVER OF JUNCTION BOXES AND BOXES ASSOCIATED WITH EQUIPMENT. INCLUDE PANEL AND CIRCUIT IDENTIFICATION. LABEL LOCATION OF POWER CIRCUITS ON COVER OF ALL LIGHT SWITCHES. INCLUDE PANEL AND CIRCUIT IDENTIFICATION. J. INSTALL ALL ITEMS NECESSARY TO COMPLETE THE INSTALLATION. TOUCH-UP OR REFINISH THE FACTORY FINISH OF EQUIPMENT MARRED DURING SHIPMENT, DEMOLITION OR INSTALLATION. K. SUBMIT SHOP DRAWINGS OF ALL NEW EQUIPMENT, DEVICES, FIXTURES AND CABLES/CONDUCTORS TO BE INSTALLED IN SYSTEM FOR WRITTEN APPROVAL FROM ENGINEER PRIOR TO INSTALLATION. REFER TO SPECIFICATIONS FOR ADDITIONAL SUBMITTAL REQUIREMENTS. L. ALL WORK SHALL BE GUARANTEED FREE FROM DEFECTS FOR A PERIOD OF ONE YEAR FROM DATE OF FINAL ACCEPTANCE. M. ELECTRICAL DEVICES AND EQUIPMENT SHOWN AS DASHED ARE TO BE DEMOLISHED. ELECTRICAL DEVICES/EQUIPMENT SHOWN WITH LIGHT SOLID LINE TYPE ARE EXISTING TO REMAIN. ANY ITEMS TO BE TURNED OVER TO FACILITIES MANAGEMENT WILL BE NOTED. N. MAINTAIN FIRE RATING WHERE RACEWAYS, CABLING, DEVICES, ETC. PENETRATE A FIRE RATED STRUCTURE. FIRE PROOF ALL PENETRATIONS AS REQUIRED. O. SEAL INTERIOR OF ALL CONDUITS WHERE THEY PENETRATE WALLS, FLOORS, OR CEILINGS ENTERING OR EXITING STAIRWELLS. P. EXISTING EQUIPMENT, DEVICES INDICATED ON PLAN WERE TAKEN FROM EXISTING PLANS AND SHALL NOT BE CONSIDERED 100% ACCURATE. THE ELECTRICAL CONTRACTOR IS RESPONSIBLE TO FIELD VERIFYING LOCATIONS OF EXISTING SYSTEMS PRIOR TO CONSTRUCTION AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES WHICH MAY AFFECT ANY WORK UNDER THIS CONTRACT.
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[illegible]

DRAWING INDEX -...	
MEP DRAWING INDEX	
NUMBER	SHEET NAME
!!!	NOTE TO DETAILER SCHEDULE
E000	ELECTRICAL GENERAL NOTES AND SYMBOLS
E030	ELECTRICAL SITE PLAN
E050	ELECTRICAL RISER/ONE-LINE DIAGRAM - FULL MICROGRID
E060	MICROGRID CONTROLS
ZE005	Unnamed

HGA 333 East Erie Street Milwaukee, Wisconsin 53202 Telephone 414.278.8200		
VILLAGE OF MCFARLAND MCFARLAND, WI 53558		
PUBLIC SAFETY BUILDING- MICROGRID		
		
NOT FOR CONSTRUCTION		
△ NO	DESCRIPTION	DATE
ISSUANCE HISTORY - THIS SHEET		
HGA NO:	4715-004-00	
ELECTRICAL GENERAL NOTES AND SYMBOLS		
DATE:	MARCH 27, 2024	
CONSTRUCTION DOCUMENTS		
E000		



2 POWER PLAN - LOWER LEVEL
1/8" = 1'-0"



1. EXISTING ATS-OS SHALL BE DEMOLISHED, EXISTING CONDUIT TO REMAIN AND BE REUSED TO SERVE NEW DISTRIBUTION PANEL. REFER TO SHEET E050 FOR MORE INFORMATION.

1. BATTERY ENERGY STORAGE ENCLOSURES, ADDITIONAL ENCLOSURES PER ALTERNATES. REFER TO SPECIFICATION XXX FOR ADDITIONAL INFORMATION.
2. EXTEND EXISTING UNDERGROUND 4" CONDUIT TO NEW BESS. PROVIDE ADEQUATE WEATHERPROOFING AS NEEDED.
3. PROVIDE AND INSTALL PROTECTIVE BOLLARDS AS NECESSARY SURROUNDING ELECTRICAL EQUIPMENT.
4. PROVIDE AND INSTALL CONCRETE SLAB WITHIN THE ENTIRE AREA BETWEEN THE CURB AND ENCLOSURE FENCE.
5. NEW SWITCHBOARD SECTION, REFER TO SHEET E050 FOR MORE INFORMATION.

E030



GENERAL NOTES

A. REFER TO FEEDER SCHEDULE FOR WIRE AND CONDUIT SIZES AS WELL AS FEEDER REQUIREMENTS.

B. ELECTRICAL FEEDERS AND EQUIPMENT SHOWN WITH HALFTONE/LIGHT LINES ARE EXISTING TO REMAIN. ALL ELECTRICAL EQUIPMENT SHOWN WITH BOLD/DARK LINES ARE NEW.

C. CONTRACTOR SHALL PROVIDE FINAL DESIGN OF MICROGRID SYSTEM BASED ON ACCEPTED ELECTRICITY SELECTIONS. SEE PERFORMANCE SPECIFICATION SECTIONS 26.33.00 AND 26.37.00 FOR MICROGRID PERFORMANCE, BASIS OF DESIGN AND OTHER REQUIREMENTS.

1. BATTERY ENERGY STORAGE DEVICE, REFER TO SPECIFICATION XXX FOR ADDITIONAL INFORMATION AND ALTERNATES.
2. FURNISH AND INSTALL NEW POWER PACT MOLDED CASE CIRCUIT BREAKER AND SEL 751 RELAY CONNECTED TO THE TRIP FUNCTION OF THE CIRCUIT BREAKER. MATCHING EXISTING SWITCHBOARD AIC RATING.
3. 150KVA ISOLATION TRANSFORMER.

ISSUANCE HISTORY - THIS SHEET

**ELECTRICAL
RISER/ONE-LINE
DIAGRAM -
ALTERNATE 1 - GRID
CONNECTED BESS**

CONSTRUCTION DOCUMENTS

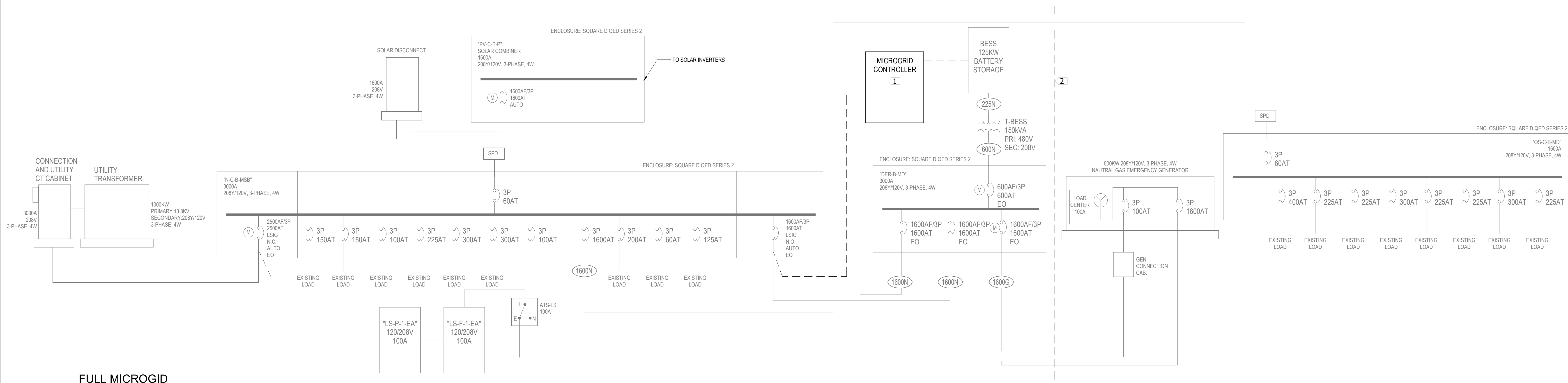
E051

1. REFER TO PERFORMANCE SPECIFICATION 26 37 00 FOR MORE INFORMATION, MICROGRID CONTROLLER SEQUENCE OF OPERATIONS:

1. REMOTE MONITORING, FORECASTING, AND DATA STORAGE: SUPPORT MONITORING OF POWER, ENERGY, AND PRODUCTION INFORMATION FOR EACH DER USING WEB-BASED INTERFACE
2. TARIFF MANAGEMENT: CONTROL DERS (CONSUME/PRODUCE/STORE ENERGY) ACCORDING TO VARIABLE ELECTRICITY TARIFF RATE (E.G., TIME-OF-USE RATES).
3. DEMAND CHARGE REDUCTION (PEAK SHAVING): CONTROL DERS (CONSUME/PRODUCE/STORE ENERGY) TO REDUCE PEAK CONSUMPTION AND RESULTING CHARGES FROM UTILITY.
4. SELF-STORAGE: CONTROL ENERGY STORAGE TO MAXIMIZE ENERGY CONSUMED AND CHARGED DIRECTLY FROM SOLAR SOURCES.
5. DEMAND RESPONSE: CONTROL DERS TO PARTICIPATE IN UTILITY OR ISO PROGRAMS.
6. OFF GRID PREPARATION (STORM HARDENING): CONTROL DERS TO PREPARE FOR POWER OUTAGE EVENTS (E.G., DUE TO STORMS).
7. MICROGRID CONTROLLER PROVIDER TO REMOTELY MONITOR AND ADJUST SYSTEM CONTROL ALGORITHMS TO OPTIMIZE SYSTEM PERFORMANCE AND ECONOMICS FOR 1 YEAR AFTER SUBSTANTIAL COMPLETION.

1. SERVICE SIDE ISLANDING SWITCH WILL BE SELF-CONTROLLED. WHEN GRID POWER IS LOST, ISLANDING SWITCH WILL AUTOMATICALLY OPEN. WHEN GRID POWER IS AVAILABLE IT WILL AUTOMATICALLY CLOSE.
2. INVERTER TO MONITOR THE SERVICE SIDE ISLANDING TRANSFER SWITCH SO THAT INVERTER WILL OPERATE IN THE CORRECT MODE BASED ON SWITCH POSITION.
3. ISLANDING MODE SHALL ALSO BE ABLE TO INITIATE BY OPERATOR COMMAND (MANUAL MICROGRID) FOR TESTING AND CONTROLS LOSS OF COMMUNICATION CASES.
4. INVERTER TO COMMUNICATE TO BAS IF SYSTEM IS GRID CONNECTED OR ISLANDED
5. DURING GRID OUTAGE, INVERTER SHALL DETECT LOSS OF GRID POWER AND OPENING OF TRANSFER SWITCH, AND OPERATE IN ISLAND MODE.
6. MICROGRID CONTROLLER SHALL MANAGE CONNECTED DERS TO AVOID UNACCEPTABLE OPERATING CONDITIONS, INCLUDING BACK-FEEDING GENERATOR OR ATTEMPTING TO CHARGE FULLY CHARGED BESS; SEND COMMANDS TO DECREASE POWER OUTPUT FROM DERS (E.G., CURTAILING OUTPUT OF PV INVERTERS) AND/OR SEND COMMANDS TO INCREASE POWER FLOWING INTO ENERGY STORAGE DEVICES AS REQUIRED.
7. MICROGRID CONTROLLER SHALL AUTOMATICALLY SHUT DOWN WHEN POWER LEVEL IS NOT ADEQUATE TO MEET ISLANDED BUILDING DEMAND.
8. UPON RETURN OF GRID POWER, MICROGRID CONTROLLER TO MONITOR ISLANDING TRANSFER SWITCH AND AUTOMATICALLY RETURN TO GRID CONNECTED MODE THROUGH A CLOSED TRANSITION.

2. LOW VOLTAGE COMMUNICATIONS AND CONTROL CABLE.



VILLAGE OF
MCFARLAND
MCFARLAND, WI 53558

PUBLIC SAFETY
BUILDING
MICROGRID



NOT FOR CONSTRUCTION

[illegible]

ISSUANCE HISTORY - THIS SHEET

HGA NO: 4715-004-00

MICROGRID CONTROLS

DATE: MARCH 27, 2024

CONSTRUCTION DOCUMENTS

E060

McFarland
SUMMARY SHEET

MEETING DATE: Monday, March 11, 2024

SECTION: Business

DEPARTMENT: Community Development

CONTACT: Andrew Bremer, Comm & Eco Dev Director

AGENDA ITEM: Discussion and action to make a recommendation to the Village Board regarding approval of an IRS 179D Energy Tax Deduction Allocation for Services Agreement with HGA for the Public Safety Center.

PREVIOUS ACTION:

ISSUE SUMMARY:

Included in the Energy Policy Act of 2005, Congress enacted Internal Revenue Code Section 179D (§179D) to encourage the design, construction and renovation of energy efficient buildings. Included is a provision allowing governmental building owners to allocate the tax deduction for eligible projects to eligible taxpayers, including architects, engineers, contractors, environmental consultants, and energy service providers. Governmental entities are not responsible for the verification of the energy efficiencies. Instead, the taxpayer (consultant) receiving the allocation is solely responsible for obtaining required energy modeling and onsite verification and certification, as well as ensuring their accuracy. Upon certification of the energy efficiencies by a Qualified Individual licensed in the jurisdiction of the building, the governmental entity will be provided with an analysis outlining estimated energy savings based on the ASHRAE 90.1 standard, as calculated by Department of Energy approved software.

HGA served as the Energy Consulting Engineer and created the technical specifications for the newly constructed McFarland Public Safety Center, thus they are eligible to receive the 179D tax deduction. HGA has worked with Eide Bailly, a CPA and business advisory firm, to confirm that the Public Safety Center meets the criteria set forth under 179D. The maximum potential deduction under 179D is \$5.00 per square foot. Tax exempt organizations, such as the Village, are permitted under 179D to assign the tax deduction to the design professionals involved with the applicable project. Within the packet is a Section 179D Deduction Allocation Letter which would assign the 179D PSC tax deductions to HGA. In return for the value of this tax deduction, the Village will receive approximately \$28,000 in future energy planning and design services. Potential services include designing future solar PV installations, energy modeling, commissioning and retrocommissioning at existing buildings, updates to the Village's Comprehensive Energy Plan, pre-design energy modeling, and EV charging station planning and design. These services would be provided on a time and materials basis upon authorization of the Village through March 1, 2027. The following table is a break-down of the estimated tax deduction.

\$280,000	Total assumed tax deduction (\$5.00 x 56,000 SF)
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20%	HGA corporate tax rate
\$56,000	Total tax deduction value to HGA
\$13,750	Paid for 3rd Party Certification to claim tax deduction (~1/4)
\$14,250	HGA portion for risk and project management (~1/4)
\$28,000	Village of McFarland services credit (10% of total tax deduction)

FINANCIAL/BUDGET IMPACT:

Under the services agreement, HGA will provide the Village with a credit of \$28,000 to use for future energy design services.

VILLAGE PLAN REFERENCE:

ORDINANCE REFERENCE:

BOARD, COMMISSION OR COMMITTEE RECOMMENDATION:

Motion, second, to recommend the Village Board approve an IRS 179D Energy Tax Deduction Allocation for Services Agreement with HGA for the Public Safety Center.

ATTACHMENTS:

1. Village of McFarland 179D Allocation for Services-030724

Date 3/6/2024

WRITER'S DIRECT DIAL 608-554-5342

Matt Schuenke
Village Administrator
Village of McFarland
5915 Milwaukee Street
P.O. Box 110
McFarland, WI 53558
matt.schuenke@mcfarland.wi.us

Re: McFarland Public Safety Center / 6001 Broadhead Street, McFarland, WI 53558
IRC § 179D
HGA Commission Number 4715-004-00

Dear Mr. Schuenke:

Hammel, Green and Abrahamson, Inc. ("HGA") is pleased to submit to the Village of McFarland ("Client") this Letter Agreement ("Agreement") to memorialize the terms of the Agreement between HGA and Client regarding the apportionment and assignment of Client's Internal Revenue Code § 179D Energy Tax Deduction for the McFarland Public Safety Center project located at 6001 Broadhead Street, McFarland, WI 53558 (the "Project"). We are providing you this Agreement to assure a clear understanding of our mutual Agreement.

Client retained HGA on or around March 23, 2021, to provide a complete geothermal and solar energy system design, bidding, construction administration services, and commissioning services for the Project. As you know, HGA worked with Eide Bailly, a CPA and business advisory firm, to identify and document whether the Project meet the criteria set forth in the Energy Efficient Commercial Property under § 179D of the Internal Revenue Code (IRC) for federal income tax purposes. The maximum potential deduction under the § 179D is \$5.00 per square foot. Tax exempt organizations, such as Client, are permitted under the IRC to assign the tax deduction to the design professional(s), such as HGA, involved with design of the applicable project.

This Agreement sets forth the terms and conditions under which Client shall assign such § 179D tax deductions to HGA pursuant to an allocation letter ("Allocation Letter") and the subsequent trade services HGA shall provide to Client in consideration for said assignment and allocation.

HGA and Client agree as follows:

- Client shall execute the Allocation Letter prepared by Eide Bailly within thirty (30) days of executing this Agreement;
- Client agrees to allocate to HGA 100% of the allowable tax deduction as a result of the Project, as set forth in the Allocation Letter;
- For good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, HGA and Client agree that in exchange for the assignment and allocation of the §179D tax deduction in the Allocation Letter by Client to HGA, HGA shall provide Client with various trade services, including but not limited to (the Services);

- HGA will assist the Village of McFarland and its tax advisor in gathering and breaking out the cost associated with the investments associated with the installed geothermal system and photovoltaic system that qualify for the Investment Tax credit (in progress).
- HGA will also continue to consult with the Village to resolve any performance issues that significantly increase the energy consumption of the PSB building or otherwise reduce the performance of the building (in progress).
- HGA can assist with solar PV opportunities that further the Village's renewable energy plan. These opportunities can support services such as design services associated with the 'Lift Station 2 Solar PV' project or similar.
- HGA can assist with continuous commissioning and retrocommissioning opportunities at the Village's existing buildings.
- HGA can assist with energy and renewable strategy with the Village, consulting on utility cost reduction and long term renewable energy procurement and implementation of the comprehensive energy plan.
- HGA can assist with pre-design updates and new opportunities with Village's building projects.
- HGA can assist with electric vehicle charging station planning and infrastructure analysis.
- The Services shall be performed between March 1, 2024 and March 1, 2027;
- Any unused Services by Client at the end of March 1, 2027 shall be forfeited and shall have no numerical or refundable credit value;
- HGA will send the client quarterly updates on tasks/hours performed during the quarter that were part of this agreement and an update on remaining value of services;
- The value of the Services shall be computed as follows:
 - First: Services shall be computed at a rate of 10% of the value of the 179D tax deduction which is assumed to be \$5 per sf times 56,000 sqft equal to \$280,000 tax deduction, resulting in a total value of the services to be \$28,000 , which shall be tracked as follows:
 - On an Hourly Rate basis at a multiple of 2.55 times Direct Personnel Expense (DPE)
 - Second: Services shall then be prorated based upon the amount of the tax deduction taken by HGA on its taxes. Assuming 100% of the assigned/allocated § 179D tax deduction from Client is taken on HGA's taxes, no proration will occur, and Client shall receive the full value set forth in the First set above.

Matt Schuenke
Village of McFarland
Date 3/6/2024
Page 3

This Agreement has been signed by me on behalf of HGA. If this Agreement is satisfactory, please sign and date as indicated below.

Sincerely,

HAMMEL, GREEN AND ABRAHAMSON, INC.

Svein Morner, Vice President

ACCEPTED FOR VILLAGE OF MCFARLAND

By _____	By _____
Name <u>Carolyn Clow</u>	Name <u>Cassandra Suettinger</u>
Title <u>Village President</u>	Title <u>Deputy Administrator/Clerk</u>
Date _____	Date _____

cc: _____, HGA

HAMMEL GREEN AND ABRAHAMSON, INC
7475 HUBBARD AVE, STE 201
MIDDLETON, WI 53562
608.554-5342
www.hga.com

SERVICES PROVIDED: COMMISSIONING, RETROCOMMISSIONING, ENERGY EFFICIENCY,
SUSTAINABLE DESIGN, RESEARCH

Hourly Rate Structure as of January 2024:

Adam Jablonski	\$162 /hr
Alayna Lotto	\$109 /hr
Alexander Harris	\$194 /hr
Amanda Wendling	\$138 /hr
Andy DeRocher	\$217 /hr
Ariane Laxo	\$253 /hr
Brendan Huss	\$187 /hr
Brian Kuhn	\$206 /hr
Bryanna Krekeler	\$143 /hr
Chris Garcia	\$150 /hr
Chris Iacono	\$203 /hr
Drew Dillmann	\$142 /hr
Elizabeth LeRiche	\$143 /hr
Garrett Corbett	\$270 /hr
Intern	\$55 /hr
Kevin Standlee	\$222 /hr
Leah Wirgau	\$165 /hr
Maggie Pipek	\$234 /hr
Michael Barnett	\$208 /hr
Mickey Thiry	\$135 /hr
Molly Dunlap	\$196 /hr
Raisa Saif	\$201 /hr
Russell Knudson	\$218 /hr
Svein Morner	\$326 /hr

Section 179D Deduction Allocation Letter

Included in the Energy Policy Act of 2005, Congress enacted Internal Revenue Code Section 179D (§179D) to encourage the design, construction and renovation of energy efficient buildings. Included is a provision allowing governmental building owners to allocate the deduction to eligible taxpayers, including architects, engineers, contractors, environmental consultants, and energy services providers.

Governmental entities are not responsible for the verification of the energy efficiencies. Instead, the taxpayer receiving the allocation is solely responsible for obtaining required energy modeling and onsite verification and certification, as well as ensuring their accuracy.

Upon certification of the energy efficiencies by a Qualified Individual licensed in the jurisdiction of the building, the governmental entity will be provided with an analysis outlining estimated energy savings based on the ASHRAE 90.1 standard, as calculated by Department of Energy approved software.

Hammel, Green and Abrahamson, Inc. & Subs served as the Energy Consulting Engineer and created the technical specifications for the newly constructed McFarland Public Safety Center.

Village of McFarland hereby allocates Hammel, Green and Abrahamson, Inc. & Subs the §179D deduction for the property listed below:

Government-Owned Building Information				
Property Name	Property Address	Placed in Service	Cost of Property	Amount Allocated
McFarland Public Safety Center	6001 Broadhead St McFarland, WI 53558	August 2023	\$18,782,943	100%

Governmental Building Owner Authorized Representative Information	
Agency:	Village of McFarland
Representative Name:	
Mailing Address:	
City, State Zip:	
Telephone:	

Hammel, Green and Abrahamson, Inc. & Subs Representative Information	
Company:	Hammel, Green and Abrahamson, Inc. & Subs
Representative Name:	
Mailing Address:	420 5 th St N Ste 100
City, State Zip:	Minneapolis, MN 55401
Telephone:	612-758-4557

Under penalties of perjury, I declare that I have examined this allocation, including accompanying documents, and to the best of my knowledge and belief, the facts presented in support of this allocation are true, correct, and complete.

Agreed to and Accepted:

Governmental Representative

Date

Hammel, Green and Abrahamson, Inc. & Subs Representative

Date

--End of Document--