



Lake Iroquois-Patrick Brook Watershed Action Plan

Final

**Hinesburg, Richmond, St. George, & Williston, Vermont
Winooski Natural Resources Conservation District**

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SLR Project No.: 146.14439.00006

March 7, 2024

Executive Summary

SLR International Corporation (SLR, formerly Milone & MacBroom, Inc.) was retained by the Winooski Natural Resources Conservation District (WNRCD) to perform assessments within the Lake Iroquois-Patrick Brook watershed and create a lake watershed action plan (LWAP). The methodology for watershed planning combined field assessments performed by SLR engineers and scientists, analysis of existing data on the health and condition of lakes and streams within the watershed, local knowledge from project partners and watershed residents, and collaboration between project partners to identify implementable projects and strategies to improve the overall health of the Lake Iroquois-Patrick Brook watershed.

WNRCD, the Lewis Creek Association (LCA), and the Lake Iroquois Association (LIA) were important project partners and acted as community liaisons for communication with residents within the watershed throughout the project. Following a project kickoff meeting, SLR reviewed and compiled existing data into a watershed resource library summarizing all sources of data. Additionally, SLR prepared basemaps for the watershed to visually show several datasets, including land cover, municipal road assessment data, stream geomorphic assessment data, and water quality monitoring locations.

SLR and WNRCD performed field assessments to collect additional data throughout the watershed and identify potential projects to improve water quality, habitat, and flood resiliency within the watershed. Using methods outlined by the State of Vermont, WNRCD performed Storm Smart and Lake Wise assessments on properties within the watershed. SLR completed assessments of private roads and streams draining directly to Lake Iroquois and Sunset Lake (also known as Lower Pond).

A main focus of these assessments was identification of potential projects. A total of 70 projects were identified, which includes the following types of projects: rain garden, culvert replacement, stream restoration, flood resiliency, dam removal, buffer planting, lakeshore restoration, easement, road improvement, and others. Potential projects were evaluated within a prioritization matrix to identify the highest priority projects based on numerous factors including ease of implementation, water quality benefit, landowner interest, cost, and many other factors. A unified scoring matrix was prepared for stormwater infrastructure projects fitting the State of Vermont criteria. All other projects were evaluated in a non-unified matrix. Four unified and five non-unified projects were selected by project partners to move to the concept design phase.

SLR conducted additional site visits and prepared concept designs for the selected projects. WNRCD, LCA, and LIA plan to pursue funding for additional design and implementation for these projects as a next phase separate from this LWAP project. This report summarizes existing information, methods, results, and recommendations for the Lake Iroquois-Patrick Brook watershed.



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1.0 Introduction

SLR was retained by the Winooski Natural Resources Conservation District to prepare a lake watershed action plan for the Lake Iroquois-Patrick Brook watershed. The LWAP follows guidelines set forth by the State of Vermont in a document that outlines the LWAP process and outcomes. The lake watershed planning process involves identification of sources of water quality and habitat degradation and greatest threats to the health of the lake, involvement of the community members in the planning process, identification of sediment and phosphorus inputs to the lake from each of three sectors – streams, roads, and shorelands, and identification of projects that can be implemented to address lake and watershed stressors (VDEC, 2023).

This action plan summarizes existing conditions and data within the watershed and methods for the collection of new data, as well as data analysis and project identification and prioritization. The plan identifies numerous projects and strategies that aim to improve the health of the Lake Iroquois-Patrick Brook watershed. Project materials are included as appendices to this report. A project database has been prepared that aligns with the format from the State of Vermont for watershed project development.

This project was funded by the New England Interstate Water Pollution Control Commission (NEIWPC) through a grant awarded to the Winooski Natural Resources Conservation District by the Lake Champlain Basin Program (LCBP).

1.1 Watershed Description

Lake Iroquois is a 247-acre lake located in Williston, Richmond, St. George, and Hinesburg, Vermont (Figure 1). The main tributary that flows into and out of Lake Iroquois is Patrick Brook, a tributary to the LaPlatte River. Watershed action planning efforts for Lake Iroquois focus on the whole Patrick Brook watershed, including lands downstream of Lake Iroquois and Sunset Lake (Lower Pond). The Patrick Brook watershed is approximately 8 square miles in size. The subwatershed draining directly to Lake Iroquois is 3.5 square miles in size.





Figure 1. Lake Iroquois-Patrick Brook watershed location

Patrick Brook originates in Williston and flows southerly into Lake Iroquois. The lake, formerly known as Hinesburg Pond, was formed as a glacial kettle pond after the last ice coverage in Vermont receded about 15,000 years ago. A dam built on the lake's outlet in the mid-1800s was used to control the water supply to mills downstream in Hinesburg. Milling declined in the 20th century and in the 1960s the dam was intentionally cemented in its top position, keeping the pond at its current level throughout the year. Before the dam was built, the smaller kettle pond was located on the southern end of the current lake. The dam raised the original water level and enlarged the lake.

Below the dam, a short section of the brook is free flowing before flowing into Sunset Lake, an approximately 61-acre water body created by a second dam built in the late 1800s. Downstream, there is a series of additional small dams. Flow is split below Mechanicsville Road into a constructed canal and the natural flow channel, which has also been historically altered.

The Lake Iroquois-Patrick Brook watershed is primarily forested, with concentrated areas of agriculture and development. There are approximately 40 miles of roads within the watershed, roughly half of which are private roads (Figure 2). These private roads are concentrated around Lake Iroquois and Sunset Lake. Homes are also concentrated around the two lakes and downstream in the Village of Hinesburg.



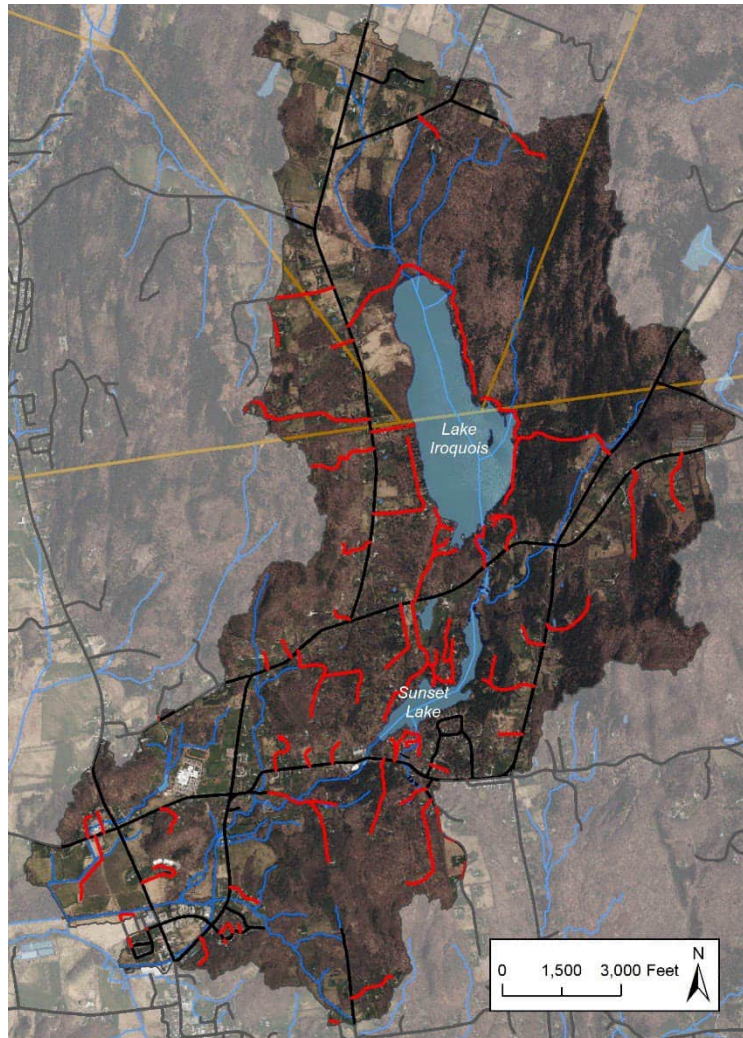


Figure 2. Private roads (red lines) within the Lake Iroquois-Patrick Brook watershed

Downstream of Sunset Lake, Patrick Brook from the dam to the confluence with the LaPlatte River is identified as a stressed waterway. The stressors identified include land development and channelization and the pollutants are sediment and physical alterations. The stressed uses are aesthetics and aquatic habitat (VDEC, 2016).

1.2 Background Data

SLR leveraged existing data from various sources and compiled them into a watershed data library. The library includes spatial data, reports, and online databases that contain information about the watershed. Included in the library are stream geomorphic assessment data, municipal road assessment data, and water quality monitoring data. The watershed data library is included in Appendix A.

The project team reviewed existing data to identify focus areas for field assessment efforts. Local knowledge of problem areas was also an important factor. Project partners facilitated communication with residents within the watershed. The Lake Iroquois Association is a



watershed organization dedicated to the protection of Lake Iroquois and its watershed. Its members include residents of the watershed as well as both in-state and out of state lake users. LIA provided valuable information on known issues within the watershed.

2.0 Field Assessment Methodology

During 2022 and 2023, SLR and WNRCD conducted field assessments to inform the watershed planning process. SLR was responsible for assessment of roads and streams within the watershed, while WNRCD completed assessments of individual properties within the watershed following the Vermont Lake Wise and Storm Smart protocols. Additional details on assessment methodologies are provided in the subsequent sections.

2.1 Road Assessment

Assessment of all municipal (town-owned) roads within the Lake Iroquois-Patrick Brook watershed was completed previously as part of the Municipal Roads General Permit process. Road assessment efforts undertaken by SLR focused on private roads, which were not covered by the previous road assessment. SLR analyzed spatial data to characterize private roads (setting, density of development, slope, etc.) and water quality data to inform selection of roads for assessment efforts. Project partners also provided important information about known erosion and sediment issues on private roads in the watershed.

SLR scientists and engineers walked/drove nearly all private roads within the watershed over the course of three field days in April 2023. Field data were collected using a tablet and GPS antenna with submeter accuracy. Problem areas were identified on the ground and solutions identified for improvement. Mapping efforts produced a GIS database of proposed actions on private roads throughout the watershed. Action types included road grading, crowning, removal of berms, installation/improvement of swales and culverts, and installation/maintenance of turnouts and sediment traps.

2.2 Stream Assessment

A Phase 1 stream geomorphic assessment was completed for the LaPlatte River watershed in the early 2000s. A Phase 2 assessment followed for Patrick Brook/the Patrick Brook Canal in 2004. Data collected at this time included stream impacts, channel dimensions, geomorphic and habitat conditions, and potential projects to improve stream condition. Both a Phase 2 report and river corridor plan were prepared that included information about the Patrick Brook reaches.

During summer 2023, SLR engineers and scientists conducted stream assessments on numerous streams within the Lake Iroquois-Patrick Brook watershed. Streams were selected for assessment based on review of existing water quality data and local knowledge from the project team. An effort was made to assess all direct tributaries to Lake Iroquois and Sunset Lake as well as other reaches of concern elsewhere in the watershed.

Locations of various features were recorded using a submeter GPS unit, including culverts, bank erosion, lacking buffer vegetation, streambed erosion, bedrock, and beaver dams. A detailed sketch was prepared for each assessment area and annotated with observations. Channel measurements were taken periodically. Stream assessment efforts focused on identification of problem areas and potential projects to improve stream health, flood resiliency, habitat, and water quality.



2.3 Lake Wise Assessment

The WNRCD conducted outreach to lakefront landowners within the watershed and worked with interested landowners to complete several Lake Wise assessments. These assessments followed methods outlined by the State of Vermont Lakes and Ponds Program. Lake Wise is a program created by the Vermont Department of Environmental Conservation. The assessment is split into four areas – shoreland, recreation area, driveway and structure, and septic. The WNRCD evaluated properties and made recommendations for improvements to each of the four areas as needed, including specific projects and practices to implement.

2.4 Storm Smart Assessment

For properties not located directly on the lake or where stormwater is of particular concern, the WNRCD performed Storm Smart assessments. These assessments focus on individual properties and examine stormwater patterns and practices. The Storm Smart program identifies green stormwater infrastructure practices that can be implemented to keep water on properties and slow down, spread out, and sink in rainfall. Practices may include installation of rain barrels, creation of rain gardens, grading to redirect water flow, and more. Many stormwater projects identified during these assessments were included in the overall project list.

3.0 Summary of Field Assessment Results & Problem Areas

The following subsections describe the results and findings from field assessments within the Lake Iroquois-Patrick Brook watershed.

3.1 Road Assessment

Thirty road improvement projects were identified from field assessments. Road improvement projects were grouped by road, with some roads having many potential improvement actions. A common issue noted on private roads within the watershed was eroding roadside swales. Swales with slopes greater than 5% should be protected with stone large enough to withstand erosion. The steeper the swale the larger the size rock required. Additionally, many roads were not well graded and without a crown, allowing water to create flow paths down the roads rather than sheet flow off into adjacent vegetated areas. The roads with the largest number of improvement actions identified included Shadow Lane, Dynamite Hill, Partridge Hill, and Mount Pritchard Lane. These roads are all very steep and have numerous homes along them. Shadow Lane runs directly into Lake Iroquois, serving as a boat launch for the residents. Dynamite Hill and Mount Pritchard Lane are farther uphill from the lake, while Partridge Hill runs along Patrick Brook lower in the watershed.

3.2 Stream Assessment

Stream assessment efforts focused on numerous tributaries to Lake Iroquois and Sunset Lake. Based on previously collected water quality monitoring data and input from project partners, the following areas were selected for assessment: Patrick Brook upstream of Lake Iroquois from its origin to South Road, an unnamed tributary to Patrick Brook northwest of Beebe Lane, an unnamed tributary to Lake Iroquois south of Shadow Lane, unnamed tributaries to Lake Iroquois between Shadow Lane and Southwest Shore Road, and Patrick Brook in the vicinity of Pond



Brook Road. Additionally, SLR assessed all tributaries to Sunset Lake that were accessible from the road network.

Many of the assessed streams were observed to be stable and without significant issues. Numerous culverts were identified as geomorphically incompatible, not fish passable, and/or in poor condition. Among those recommended for replacement are culverts under Wile Street and Jourdan Street, Richmond Road, and Old Pump Road. The streams identified as being in the poorest condition include the tributary to Lake Iroquois south of Shadow Lane and the tributary to Sunset Lake that crosses McDonald Lane, Richmond Road, Wile Street, and Jourdan Street. Both of these streams were noted as having extensive bank erosion and major channel incision.

There are numerous dams within the watershed, many of which date back to the 1800s. Some of these dams are no longer in use and may be considered for removal to improve aquatic organism passage and naturalize hydrology. Further study of the network of dams within the system is recommended to determine whether dam removal would be beneficial and feasible for dams that are no longer serving a purpose. Eighteen stream-related projects were identified within the Lake Iroquois-Patrick Brook watershed.

3.3 Property Assessments

The WNRCD completed assessments of twelve properties for the Storm Smart program and three for the Lake Wise program. Nine potential rain garden locations were identified as part of these assessments. The assessments also identified driveway improvement opportunities, potential filter berm locations, and potential lakeshore restoration areas. Property assessment reports were completed by WNRCD that detail site conditions and opportunities and are included in Appendix B.

3.4 Project Prioritization

Projects identified during field assessments were compiled into two matrices for evaluation – unified and nonunified. The Vermont DEC has developed guidelines for stormwater master planning along with a Unified Scoring Prioritization for Stormwater Master Plans table to provide standardized scoring for projects. Green stormwater infrastructure projects were evaluated using the unified scoring table. For projects that did not fit within the structure of the unified scoring matrix, a non-unified scoring method was used. The project prioritization process is further detailed in a November 13, 2023 memo authored by SLR, which is included in Appendix C.

4.0 Concept Designs

Of the 70 projects identified during the field assessment phase, four conceptual designs were prepared for rain garden projects (10% design) and five conceptual designs were prepared for stream and road projects (30% design), as detailed below in Table 1. Selection of projects for which to prepare concept designs considered project score and ranking, as well as level of design that would need to be completed prior to implementation. Generally, projects with higher scores and that would need additional engineering design were prioritized for concept designs. There are many projects (e.g. buffer plantings and land conservation) that would not need further engineering design and could be implemented directly by the WNRCD or LCA. SLR prepared cost estimates for each concept design to aid in the process of implementing selected projects. Cost estimates include both cost of future design work and implementation (construction) cost.



Table 1. Projects for which concept designs were prepared.

Project Number	Town	Name	Project Type	Total Score	Design Level
15	Hinesburg	Stabilize gully in lower Shadow Lane Tributary	Stream Restoration	21	30%
16	Hinesburg	Riparian buffer planting along Shadow Lane Tributary	Buffer Planting	25	30% - included with Project #15
24	Hinesburg	Shadow Lane Improvements	Road Improvement	23	30%
34	Williston	Lake Iroquois Boat Launch Rain Garden	Rain Garden	16	10%
43	Hinesburg	Red Pine Road Improvements	Road Improvement	15	30% - included with Project #44
44	Hinesburg	Partridge Hill Improvements	Road Improvement	23	30%
50	Hinesburg	Pine Shore Drive Rain Gardens	Rain Garden	27	10%
53	St. George	Oak Hill Road Rain Garden	Rain Garden	27	10%
62	Hinesburg	Shadow Lane Rain Garden	Rain Garden	17	10%
67	Hinesburg	Arrest incision and create settling area in upper Shadow Lane Tributary	Stream Restoration	18	30%
68	Hinesburg	Enos Road Improvements	Road Improvement	11	30%

4.1 Rain Garden Projects

All four proposed rain gardens selected for concept designs are located within 1,000 feet of the shore of Lake Iroquois. These proposed rain gardens, three on private property and one on public property, would capture currently untreated stormwater runoff and prevent it from flowing into the lake. The proposed rain garden on public land, located at the Fish and Wildlife Lake Iroquois boat launch provides an opportunity for visibility and education surrounding green stormwater infrastructure. Proposed rain gardens have individual phosphorus reduction potential of 0.04 to 0.95 kg per year.

4.2 Road and Stream Projects

Of the five concept designs prepared, two are stream projects and three are road projects. Both stream projects are on the tributary to Lake Iroquois south of Shadow Lane. The tributary has formed a deeply eroded gully that is actively incising (Figure 3). The proposed project on the



lower portion of the stream aims to stabilize the gully and reconnect the stream to its floodplain via addition of rock and large wood to the channel. An area in the riparian zone that is lacking woody vegetation has also been called out for the planting of native trees and shrubs. The upper portion of tributary is also eroding and actively incising. The tributary receives flow from a portion of the Dynamite Hill Road neighborhood, as well as wooded lands. The upper project on the tributary aims to arrest active incision via rock addition to the channel and capture water and sediment in a proposed settling basin just upstream of Pond Road.



Figure 3. Deeply eroded Shadow Lane tributary

Concept designs for road improvements were prepared for Shadow Lane, Partridge Hill, and Enos Road in Hinesburg. Shadow Lane is a very steep road that runs east-west between Pond Road and Lake Iroquois. There is dense single family development along the road. House lots are small and there is little open space between houses and their associated septic mounds. Currently, stormwater flows down the road and eroding roadside swales and directly into the lake (Figure 4). The concept design calls out numerous proposed actions, including reshaping and stone lining swales, installing new swales to direct water away from the road into naturally vegetated areas to the north and south of the road, and installing sediment traps in several locations. The design also identifies two potential locations for larger stormwater treatment areas, likely gravel wetlands, in open space along the road.





Figure 4. Stormwater from Shadow Lane flows into Lake Iroquois

Partridge Hill and adjacent Red Pine Road are additional roads with very steep sections and stormwater management challenges. Partridge Hill is in the lower portion of the watershed and runs along Patrick Brook. Recommended actions include reshaping and stone lining swales and adding check dams, installing sediment traps, and adding cross culverts to divert stormwater to naturally vegetated areas. Recommendations for nearby Enos Road just east of Partridge Hill include stone lining a steep swale and adding cross culverts to divert stormwater. A portion of stormwater from Enos Road flows downhill to Partridge Road. Improved stormwater management along Enos Road would also benefit those on Partridge Hill.

5.0 Next Steps

Partners can work with landowners and help pursue grant funding to move the concept designs forward. Some of the projects identified would not need further design work, such as the buffer planting projects, and could be implemented directly by the WNRCD or other project partners. Other projects identified would require additional landowner outreach and engineering design.

6.0 References

Vermont Department of Environmental Conservation, 2016. State of Vermont 2016 Stressed Waters List. Available at: https://dec.vermont.gov/sites/dec/files/wsm/public-notices/mapp/Stressed_2016_draft_complete.pdf

Vermont Department of Environmental Conservation (VDEC), 2023. Vermont Lake Watershed Action Plans: Technical Guidelines for Conducting a LWAP. Available at: <https://dec.vermont.gov/sites/dec/files/wsm/lakes/Lakewise/docs/LWAP%20Technical%20Guidance%20Doc%202023%20Version%205.pdf>





Appendix A Watershed Data Library

Lake Iroquois-Patrick Brook Watershed Action Plan

Winooski Natural Resources Conservation District

SLR Project No.: 146.14439.00006

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Appendix B WNRCD Property Assessment Reports

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Appendix C Project Prioritization Memo

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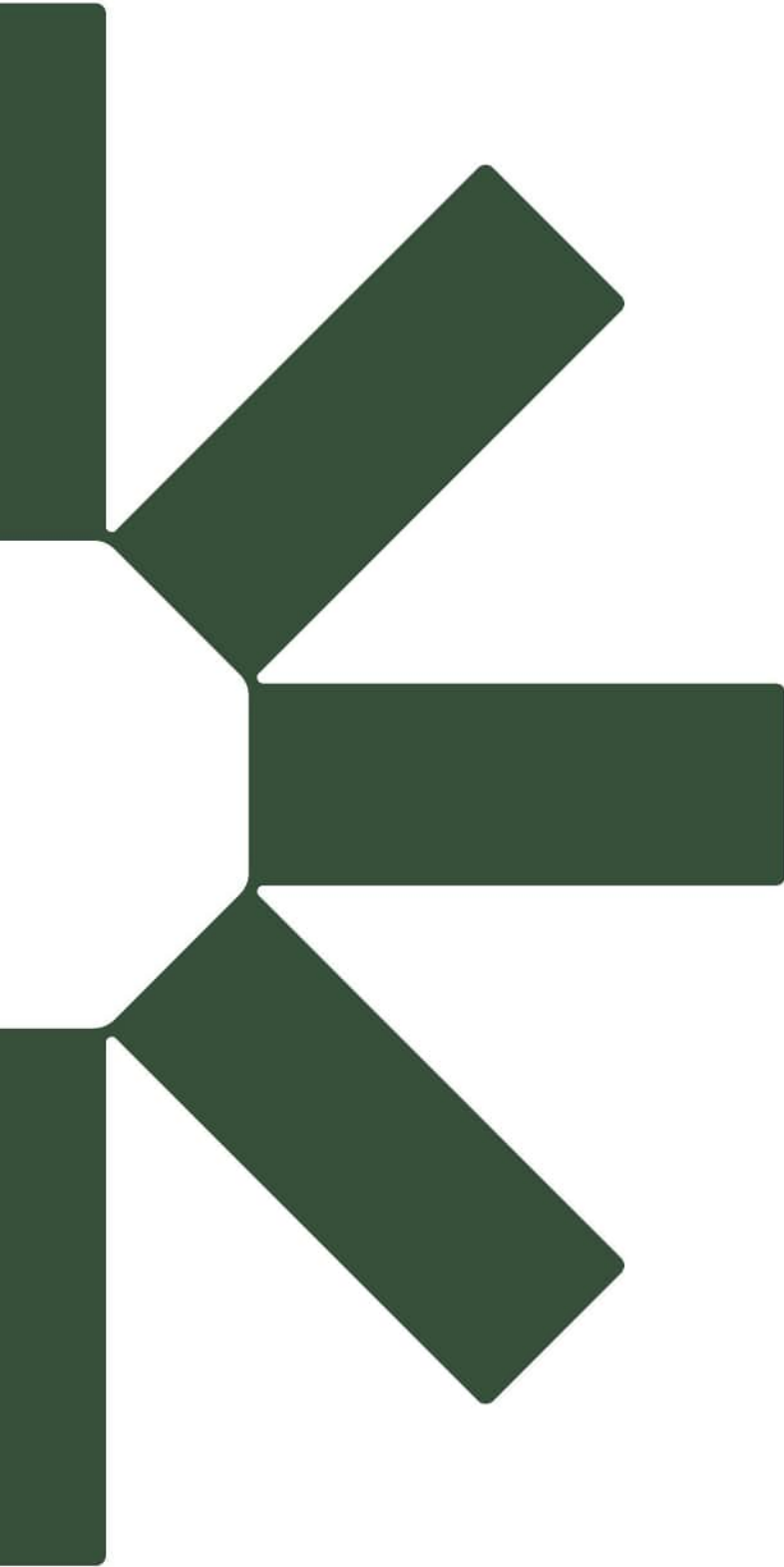
Appendix D Concept Designs

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