Homewood Board of Zoning Adjustments
Agenda
Thursday, July 9th, 2026, 6:00 P.M.
City Council Chamber
2850 19th Street South, 2nd Floor
Homewood, Alabama 35209

**NOTE: Prior to the scheduled public hearing, a brief work session will be held for Board members beginning at 5:30 p.m. in the City Council's Committee Workroom located on the 2nd floor behind the Council Chambers. Members of the public are welcome to attend and observe the work session; however, questions and/or comments from the public will only be considered during the scheduled public hearing.*

While the scheduled hearing is available for live-stream viewing here: https://www.cityofhomewood.com/live-stream, persons who wish to comment during the meeting may only do so in person. Comments in support or opposition, may be submitted via email to the Department of Engineering & Zoning by clicking the following link: *www.cityofhomewood.com/engineering-zoning* or to the Secretary to the Board of Zoning Adjustments at fred.goodwin@homewoodal.org. Comments may also be hand-delivered to the Department of Engineering & Zoning, located on the 4th floor of Homewood City Hall. Please include the address or case number and submit them no later than 24 hours prior to the meeting.

Board Members

Chair, Michael Pirkle, Ward 2 | Vice-Chair, Mario Neavez, Ward 1

John Geer, Ward 3 | William Johnson, Ward 4 | Megan Hand, At-Large

Supernumeraries

Dominic Sims Keith Young

Order of Business

I. ***Call to Order***
II. ***Roll Call***
III. ***Minutes Approval– June 6, 2026***
IV. ***Communications/Reports from Chair & Vice Chair***
V. ***Old Business***
VI. ***New Business***
   1) ***BZA-26-0034, 323 Gran Avenue, Parcel ID No. 2800074015011000, Applicant: David Lorberbaum / Property Owner: John and Laura Fiveash*** *a) A request for a variance to Article VI. District Development Criteria, Sec. D. Accessory Structures, (3) Size and Height, (a) to expand an accessory structure beyond the 25% maximum footprint.*
   2) ***BZA-26-0035 1901 Courtney Drive, Parcel ID No. 2800073032021000, Applicant: Schoel Engineering Company, Inc. / Property Owner: Chris Mobley*** *a) A request for a variance from Article IV. District Uses, Section F. R-5 Attached Dwelling Unit District, (5) Parking, Loading and Garage Regulations, (b) To allow for parking garage alley access from the side of the building.*

3) ***BZA-26-0036, 1409 Ardsley Place, Parcel ID No. 2900124017009000, Applicant: Joe Ellis / Property Owners: Abe Smith*** *a) request for a variance to Article IV. District Uses, Sec. A. Neighborhood Preservation District, (3) Development Regulations, (d) setbacks, (i) front, (ii) side, to reduce the required setback along the left property line from 34.3-feet to 28.2-feet for a total reduction of 6.1-feet, to reduce the required setback along the right property line from 5-feet to 4.3-feet for a total reduction of .7-feet in order to construct an addition.*

4) ***BZA-26-0037, 214 Peerless Avenue, Parcel ID No. 2900132018019000, Applicant: Joe Ellis / Property Owner: David Lorberbaum***

a) A request for a variance to Article IV. District Uses, Sec. A. Neighborhood Preservation District, (3) Development Regulations, (d) setbacks, (i) front, to reduce the required setback along the frontage property line from 25-feet to 6.2-feet for a total reduction of 18.8-feet in order to construct an addition.

VII. ***Communications from Staff***

VIII. ***Adjournment***

CITY OF HOMEWOOD
BOARD OF ZONING ADJUSTMENTS
Minutes of May 7, 2026 Regular Meeting

I. Call to Order

The Homewood Board of Zoning Adjustments met in regular session on Thursday, May 7, 2026, in the Homewood City Council Chambers, located at 2850 19th Street South, Homewood, Alabama 35209. In the absence of Chairman Michael Pirkle, Vice-Chairman Mario Neavez presided over the meeting, which was called to order at 6:00 p.m.

II. Roll Call

Board Members

Michael Pirkle, Chairman	Absent
Mario Neavez, Vice-Chairman	Present
William Johnson	Present
Megan Hand	Present
John Geer	Present

Supernumeraries

Keith Young	Present
Dominic Sims	Present

City Staff Present: Fred Goodwin, Emily Harris-Miller - Engineering & Zoning Department

III. Approval of Minutes

The Minutes from the Board's April 2, 2026, meeting were presented for approval. In the action which followed, Ms. Hand made a motion to approve the Minutes as submitted, subject to the correction of a minor clerical error previously noted and discussed by the Board's Secretary with members. The motion was seconded by Mr. Young and unanimously approved by a vote of all members present.

IV. Communications/Reports from the Chairman or Vice-Chairman

Next, Vice-Chairman Neavez announced that two of the cases originally scheduled for consideration (Case # BZA -26-0020 – 609 Morris Boulevard and Case # BZA- 26-0026 – 903 Westover Drive) would be carried over until the Board's June 4, 2026 meeting at the request of the respective applicants.

Prior to a discussion of the scheduled cases, Vice-Chairman Neavez proceeded to outline, for the benefit of citizens in the audience or viewing online, the statutory authority and powers of the Board, and its principal responsibility to hear petitions for variances from the strict application of the City's Zoning Ordinance. Following this, Vice-Chairman Neavez went forward to explain the organizational composition of the Board and emphasized that the approval of any variance requires the positive vote of at least four members; that a simple majority is not sufficient. Lastly, Vice-Chairman Neavez discussed the process for approving a variance and the length of time it remains in effect before expiring, as well as the process for appealing the decisions of the Board to the Jefferson County Circuit Court.

V. Old Business

There were no Old Business items to discuss.

VI. New Business

1) Case # BZA-26-0028, 2501 25th 20th Place South, Parcel ID No. 2800071005010003, Applicant: Mike Brown / Property Owner: 20th Place South, LLC—Joe Sandner III

a) A request for a variance to Article X. Signs, Table 2. General Sign Restrictions, Non-Residential Zoning Districts, to increase the maximum permitted number of wall signs per tenant from 1 to 2 and to allow signage above the ground floor.

Consideration of the case began with a presentation by the applicant, Michael Brown, an attorney with the law firm of Bradley Arant Boult Cummings, LLP (1819 Fifth Avenue North, Birmingham), representing the owner, 20th Place South, LLC (2501 20th Place South). Mr. Brown explained that Arlington Properties, a large, regional real estate firm currently located in the City of Birmingham, is seeking to relocate its corporate headquarters to the owner's building, strategically located near the intersection of Highway 280 and Red Mountain Expressway. In an effort to increase the visibility of the planned headquarters and to better identify its corporate presence to the community and to passing motorists, Mr. Brown noted that Arlington Properties and the owner of the building had discussed the need to provide additional signage to accomplish this goal. To this end, Mr. Brown explained that the owner was requesting approval for variances that would allow the installation of two wall signs at the top level (4th Floor) of the building, one

of which would face Highway 280 and the other Red Mountain Expressway. In addition, Mr. Brown also noted that requests were being made to install two signs at the ground level on the columns at the front of the building – one for Truist Bank (a major tenant) and the second for Arlington Properties. `

During his presentation, Mr. Brown emphasized that the hardship associated with both the number and location of the proposed signs was not self-created but rather was due to the unique shape and location of the property and building. In support of this position, Mr. Brown noted that the subject property is the only property in Homewood located on the east side of Red Mountain Expressway and Highway 280 and is the only property with frontage on the two main traffic corridors. Mr. Brown stressed that the need and justification for the increase in signage is due to the limited sight access to the property from these roadways and the absence of any traffic lights that would slow vehicular traffic to enable the building to be more easily seen by passing motorists. Lastly, Mr. Brown expressed his belief that a granting of the sign variances for Arlington Properties' new corporate headquarters building would enhance the neighborhood and would be consistent with other buildings fronting along the length of the two traffic corridors.

Following the completion of Mr. Brown's presentation, Jim Dixon, President of Arlington Properties addressed the Board. In general, Mr. Dixon provided a brief overview of the real estate firm and its operations, noting that the company originated in 1955 and has grown in size to over 900 employees. Mr. Dixon emphasized his excitement and positive view of his company's decision to relocate to Homewood and the many shared advantages that the move would have for both his business and the City of Homewood. Next, Jamie Justice, working with Arlington Properties, noted that the planned relocation to the subject building would have the positive benefit of helping to backfill approximately 30,000 sq. ft. of office space that was being lost due to the departure and / or downsizing of two of the building's tenants.

Upon the conclusion of the applicant's presentation, Vice-Chairman Neavez opened the public hearing on the case to questions or comments from adjacent property owners or other interested citizens. In the absence of any comments, the public hearing was closed.

In the discussion which followed among Board members, Mr. Young inquired as to how many tenants were presently located within the building and would the proposed signs be lighted. In response, Mr. Brown noted that, although there were several small businesses located within the building, the two largest tenants would be Truist Bank and Arlington Properties, and that there were no plans to have the proposed signs lighted. In response to an inquiry from Mr. Johnson regarding the possibility of other tenants coming back before the Board to request additional signs, Joe Sandner (28 Ridge Drive) representing the owner, informed the Board that signage of the size being requested was limited to only major tenants of the building like Truist and Arlington Properties, each of which would occupy approximately 30,000 sq. ft. of office space. Mr. Sandner indicated that he did not anticipate the need for any additional signage requests.

In the absence of any further questions or comments, Mr. Geer made a motion to approve Case # BZA 26-0028 as submitted. The motion was seconded by Mr. Young. Prior to the vote, Fred Goodwin, Board Secretary, informed the Board members that in the absence of Mr. Pirkle, the two supernumeraries would alternate voting on the scheduled cases with Mr. Young voting on the current case. Upon a roll call, the vote was as follows:

William Johnson	Aye
Michael Pirkle	Absent
Mario Neavez	Aye
John Geer	Aye
Megan Hand	Aye
Keith Young	Aye
Dominic Sims	Present

MOTION PASSED

2) Case # BZA-26-0030, 1403 Roseland Drive, Parcel ID No. 2900131022005000, Applicant: Robert Martin / Property Owners: Josh & Trisha Young

a) A request for a variance to Article IV. District Uses, Sec. A. Neighborhood Preservation District, (3) Development Regulations, (i) front, to reduce the required setback along the secondary frontage property line from 10-feet to 3.3-feet for a total reduction of 6.7-feet in order to construct an addition.

Discussion of the case began with a brief overview of the proposed project by the applicant, Robert Martin, a residential design consultant (1109 22nd Street South, Birmingham), representing the owner, Josh Young (1403 Roseland Drive). Mr. Martin explained that it was the desire of the owner to construct a second-floor addition to his house in order to expand his family's living space. Mr. Martin noted that the proposed addition would be constructed on top of the existing non-conforming first floor footprint, which included a small portion of the existing kitchen which encroached some 6.7 ft. into the required 10 ft. secondary front setback; thereby necessitating the need for the requested 3.3 ft. setback variance.

Upon the conclusion of the applicant's presentation, Vice-Chairman Neavez opened the public hearing on the case to questions or comments from adjacent property owners or other interested citizens. In response, Tom Walker, an adjacent property owner (1402 Roseland Drive) addressed the Board to express his support for the requested variance. Next, Courtney Ferderber, a nearby property owner (1313 Roseland Drive), also expressed his support for the proposed project. In his comments, Mr. Ferderber emphasized the irregular shape of the property as a corner lot and the physical layout of the existing older house on the lot in relation to the current required setbacks which he felt constituted a hardship that would justify the granting of the requested variance. Additionally, Mr. Ferderber noted that the proposed plans for the new second-story addition involved building on top of the house's existing footprint, thereby avoiding any further development of other portions of the existing lot which would have a positive effect in helping to lessen any potential water run-off problems that might be brought about by new construction.

There being no further comments, Vice-Chairman Neavez closed the public hearing portion of the case.

In the discussion among Board members which followed, attention was focused on the hardship factors associated with the case which would justify the requested variance. During the discussion, it was noted

that the house had been constructed in 1935 which predated the City's current setback requirements. As a point of record, Emily Harris-Miller, a member of the planning staff, noted for the Board's information, that a portion of the lot borders a flood hazard area that would limit the ability of the owner to consider any new construction toward the west of his house; thereby supporting the planned second story addition on top of the house's existing footprint.

Following a limited amount of further discussion, Ms. Hand made a motion to approve Case # BZA 26-0030 as submitted. The motion was seconded by Mr. Geer. Upon a roll call, the vote was as follows:

William Johnson	Aye
Michael Pirkle	Absent
Mario Neavez	Aye
John Geer	Aye
Dominic Sims	Aye
Megan Hand	Aye
Keith Young	Present

3) Case # BZA-26-0031, 310 Gainswood Road, Parcel ID No. 2900132003007000, Applicant: Robert Martin, Property Owners: David & Cori Johnson

a) A request for a variance to Article IV. District Uses, Sec. A. Neighborhood Preservation District, (3) Development Regulations, (iii) rear, to reduce the required setback along the rear property line from 20-feet to 8.8-feet for a total reduction of 11.2-feet in order to construct an addition.

Consideration of the case began with a joint presentation by the applicant, Robert Martin, a residential design consultant (1109 22nd Street South, Birmingham), and the owner, David Johnson (310 Gainswood Road). Mr. Martin proceeded to provide an overview of the proposed project which centered around the proposed construction of a second-floor addition to the rear of the existing house designed to provide a new bedroom suite. Mr. Martin noted that the planned addition would be built on top of the first floor and would not expand the existing footprint of the house. Mr. Martin explained to the Board members that the existing house is non-conforming, being located only 8.8 ft. from the rear property line and encroaches into the required 20 ft. rear setback, thereby necessitating the need for the requested 11.2 ft. rear setback variance. In addition to the proposed second-floor addition, it was noted that the project also included the planned construction of a new stairway that would be located on the left side of the house to provide interior access to the second-floor addition. Lastly, Mr. Johnson pointed out that his lot was approximately half the size of other residential lots, which significantly limited his ability to expand his 1945 era house in compliance with the City's existing setback requirements, and that the proposed addition would not expand the footprint of the existing house, thereby reducing potential water runoff problems.

Upon the conclusion of the joint presentation, Vice-Chairman Neavez opened the public hearing on the case to questions or comments from adjacent property owners or other interested citizens. In the absence of any comments, the public hearing was closed.

In the discussion which followed, it was noted by staff that the subject property was comprised of portions of four lots, as well as a portion of a vacated right-of-way and that under the City's Zoning Ordinance the property would need to be resurveyed into a single lot before a building permit could be issued. Following a limited among of discussion among Board members, Mr. Young made a motion to approve Case # BZA 26-0031 as submitted. The motion was seconded by Mr. Johnson. Upon a roll call, the vote was as follows:

William Johnson	Aye
Michael Pirkle	Absent
Mario Neavez	Aye
John Geer	Aye
Dominic Sims	Present
Megan Hand	Aye
Keith Young	Aye

VII. Communications from Staff

Staff member Emily Harris-Miller took the opportunity to announce that the next Comprehensive Plan workshop meeting would be held on May 19 and 20 at the Homewood Board of Education. Ms. Harris-Miller encouraged Board members, as well as members of the public, to attend the meetings to gain a better understanding of the planning process and to provide their input to the consultants in the preparation of the Plan.

Next, Mr. Young congratulated and extended the Board's best wishes to fellow member Megan Hand on the recent birth of her son, Wesley.

VIII. Adjournment

In the absence of any further business to come before the Board, Vice- Chairman Neavez adjourned the meeting at 6:45 p.m.

Approved:

_____

Mario Neavez - Vice Chairman
(Serving as Acting Chairman)

Attest:

Recording Secretary

City of Homewood
Department of Engineering & Zoning
2850 19th Street South, Homewood, AL 35209
cityofhomewood.com

Planning and Zoning General Application

(Page 1 of 2 – see page 2 for submittal requirements)

Property Address: 323 Gran Ave, Homewood, AL 35209

Parcel ID: _____ Current Zoning: Residential

Acreage: .22 Acres Proposed Land Use: Residential

Applicant: David Lorberbaum Property Interest of Applicant: _____

E-mail: dlorberbaum@lorberbaummcnair.com Applicant Phone #: 2058344711

Mailing Address: 2213 Morris Ave, Birmingham, AL 35203

City *State* *Zip*

Property Owner: John and Laura Fiveash

E-mail: jfiveash@gmail.com Phone #: 205-260-3819

Mailing Address: 323 Gran Ave, Homewood, AL 35209

City *State* *Zip*

Request (check all applicable items):

- ☑ Variance Request
- ☐ Other BZA Request: _____
- ☐ Rezoning
- ☐ Zoning Text Amendment
- ☐ Resurvey
- ☐ Development Plan
  - ☐ Final
  - ☐ Amended

Signatures of Property Owner and Applicant:

I, John Fiveash (Print Property Owner) am the property owner of the subject property and have read and understood all statements including the filing requirements. I hereby affirm that this application may be denied, modified, or approved with modifications and/or contingencies and that such modifications and/or contingencies must be complied with prior to issuance of building permits.

I authorize David Lorberbaum (Print Applicant) to act as representative in all matters concerning this application.

John Fiveash 5/13/26

Signature of Property Owner Date

5/13/26

Signature of Applicant Date

For office use only:

_ Completed Application form with signatures
_ Project Narrative
_ 2 Hard Copies of Site Plan, Site Photographs, Survey, Mylar, etc.
_ Digital Copies of Site Plans, Site Photographs, Survey, Mylar etc.
_ Application Fee
_ Other Required Documents: _____

Current Zoning District: _____
Proposed Zoning District: _____
Special Flood Hazard Area (Y/N): _____

Date Received in Office: _____ Time Received: _____
Received By: _____ Case Number(s): _____

City of Homewood
Department of Engineering & Zoning
2850 19th Street South, Homewood, AL 35209
cityofhomewood.com

Planning and Zoning General Application

All General Applications shall include the following at the time of submittal:

- ☐ One copy of the completed application form, with the original signature of the property owner or his/her authorized agent.
- ☐ Application fee
- ☐ Project narrative including the following as appropriate: proposed use, detailed project description, reason for request, conditions that the applicant will be willing to proffer.
- ☐ Current Property Boundary Survey
- ☐ Hard copy and pdf copy of all site plans and building elevations. *(Plans and associated documents that are too large to email can be provided on a flash drive.)*
- ☐ Restrictive Covenants *(if applicable)*
- ☐ Photographs of the site and all existing buildings and structures.
- ☐ Proof of Ownership (if property has been purchased within the last 12 months)
- ☐ Any variances previously granted by the Board of Zoning Adjustments

The following additional items will be required based on the nature of the application request and must also be submitted at the time of initial application submittal:

Variance Application Requirements

- ☐ Completed Variance Request Chart
- ☐ Hardship Statement signed by Property Owner and Applicant
- ☐ Hardship Criteria Evaluation Form (initialed and signed)

Final and Amended Development Plan Requirements

- ☐ 2 full sized copies, 2 11X17 copies, and a digital copy of the proposed development plan
- ☐ Complete legal description
- ☐ Other additional information as listed in Article VII. Required Development Plan

Resurvey Application Requirements

- ☐ 2 full sized copies of the resurvey drawing
- ☐ 1 full size mylar copy of the resurvey drawing
- ☐ Digital copy of the resurvey drawing
- ☐ Complete legal description

Rezoning Application Requirements

- ☐ Complete legal description
- ☐ Current Zoning District _____
- ☐ Proposed Zoning District _____
- ☐ Conditions that the applicant will be willing to proffer. (If applicable, please include in the detailed project narrative)

By signing below, I acknowledge that all required documents are included in the application package. Additionally, I understand that all applications must be complete by the final application deadline in order to be processed by staff and considered by the Board of Zoning Adjustments or Planning Commission.



Signature of Applicant

5/13/26

Date

City of Homewood
Department of Engineering & Zoning
2850 19th Street South, Homewood, AL 35209
cityofhomewood.com

City of Homewood Board of Zoning Adjustments Applications

General Information for Applicant

The Homewood Board of Adjustment was established pursuant to section 11-52-80, Code of Alabama 1975 and shall have all powers and duties delegated to boards of adjustment by said code, which generally are:

1) *Appeal a decision of the administrative official:* To hear and decide appeals where it is alleged there is error in any order, requirement, decision, or determination made by an administrative official in the enforcement of this ordinance.
2) *Special Exception to allow a Home Occupation or other use requiring BZA approval:* To hear and decide special exceptions to the terms of this ordinance upon which the board is required to pass under this ordinance.
3) *To authorize upon appeal in specific cases such variance from the terms of the zoning ordinance* as will not be contrary to the public interest, where, owing to special conditions, a literal enforcement of the provisions of this ordinance will result in unnecessary hardship, and so that the spirit of this ordinance shall be observed and substantial justice done.

The following pages include necessary information and requirements for applications to the Board of Zoning Adjustments. Please review closely and provide initials and/or signatures to indicate your understanding of the information.

The Purpose of a Variance

A variance is an allowance, which permits minor deviation from the zoning ordinance district requirements where individual properties are both harshly and uniquely burdened by the strict application of the law. The power to vary is restricted and the degree of variation is limited to the minimum change necessary to overcome the inequality inherent in the property. Use Variances are specifically prohibited. "Variance" means the modification of the requirements of a zoning district and does not include the substitution of uses assigned to other districts.

1) A variance recognizes that the same district requirements do not affect all properties equally; it was devised to permit minor changes to allow hardship properties to enjoy equal opportunities with properties similarly zoned. The applicant must prove that special circumstances or unusual conditions affect the subject property. These must result in uncommon hardship and unequal treatment under the strict application of the Zoning Ordinance. Where some general hardship conditions extend to other properties, a variance cannot be granted. The remedy for general hardship is a change of the map or the text of the Zoning Ordinance.
2) The applicant must prove that the combination of the Zoning Ordinance and the uncommon conditions of your property prevent them from making any reasonable use of the land as permitted by the present zoning district. Since zoning regulates land and not people, the following conditions ***cannot*** be considered pertinent to the application for a variance:
    a. Proof that a variance would increase the financial return from the land
    b. personal hardship
    c. self-imposed hardship

    In the case of a self-imposed hardship, the recognition of conditions created after the enactment of the Zoning Ordinance would encourage and condone violation of the law.
3) No variance may be granted which would adversely affect surrounding property or the general neighborhood. All variances must be in harmony with the intent and purposes of the Zoning Ordinance.

Applicant Signature **Date** 3/13/26

City of Homewood
Department of Engineering & Zoning
2850 19th Street South, Homewood, AL 35209
cityofhomewood.com

Hardship Criteria Evaluation Form

Prior to granting a variance, the Board of Zoning Adjustment must *examine* and *validate* that the following criteria apply to the request. Please examine the following criteria and initial to indicate their applicability to the variance request. *(The following criteria can be found in Article XI. Administration and Review Procedures, Section B. Variances, (3) Conditions)*

a) There are extraordinary and exceptional conditions, which are peculiar to the piece of property in question because of its size, shape or topography, that are not applicable to other lands or structures in the same district.

Applicable: _____

b) Granting the variance requested will not confer upon the applicant any special privileges that are denied to other owners of property in the district in which the property is located.

Applicable: _____

c) All literal interpretations of the provisions of this Ordinance would deprive the applicant of rights commonly enjoyed by other owners of property in the district in which the property is located.

Applicable: _____

d) The requested variance will be in harmony with the purpose and intent of this Ordinance and will not be injurious to the neighborhood or to the general welfare.

Applicable: DML

e) The special circumstances are not the intended result of the actions of the applicant (i.e., self-imposed hardship)

Applicable: DML

f) The variance requested is the minimum variance that will make possible the legal use of the land, building or structure.

Applicable: DML

g) That no non-conforming use of neighboring lands, structures, or buildings in the same district, and no permitted or non-conforming use of lands, structures, or building in other districts shall be considered grounds for the issuance of a variance.

Applicable: _____

h) That the variance will not allow the permanent establishment of a use not permissible under the terms of this Ordinance in the district involved, or any use expressly or by implication prohibited by the terms of this Ordinance in said district.

Applicable: _____

By signing below, I acknowledge that I have reviewed and evaluated the criteria, and the application and documents submitted for the requested variance will provide evidence of their applicability to the proposed request.

_____ 5/13/26

Signature of Applicant **Date**

City of Homewood
Department of Engineering & Zoning
2850 19th Street South, Homewood, AL 35209
cityofhomewood.com

Variance Request Charts

Please complete only the charts relevant to the proposed variance request project. The information in these charts should reflect the information on the proposed site plans.

PRIMARY STRUCTURE SETBACKS				
	Existing Setback Dimensions	Setback Dimensions Required by Zoning Regulations	Proposed Setback Dimensions	Total Variance Requested
Front Setback				
Secondary Front Setback				
Right Setback				
Left Setback				
Rear Setback				

ACCESSORY STRUCTURE SETBACKS

Please provide the following information regarding the proposed accessory structure:

Proposed Height: 0" **Proposed Size (in sq ft):** 225 sq.ft.

	Existing Setback Dimensions	Setback Dimensions Required by Zoning Regulations	Proposed Setback Dimensions	Total Variance Requested
Right Setback				
Left Setback				
Rear Setback				
Other: Pool Size				105 sq.ft.

FENCES AND WALLS (NOT RETAINING)

Proposed Height:	Proposed Setback:	Location of Fence:

Description of Fence (dimensions, materials, etc.): _____

_____

PARKING		STRUCTURE HEIGHT	
Required Parking Ratio		Existing Height	
Total Spaces Required		Maximum Height Permitted	
Total Spaces Provided		Proposed Height	
Total Variance Requested		Total Variance Requested	

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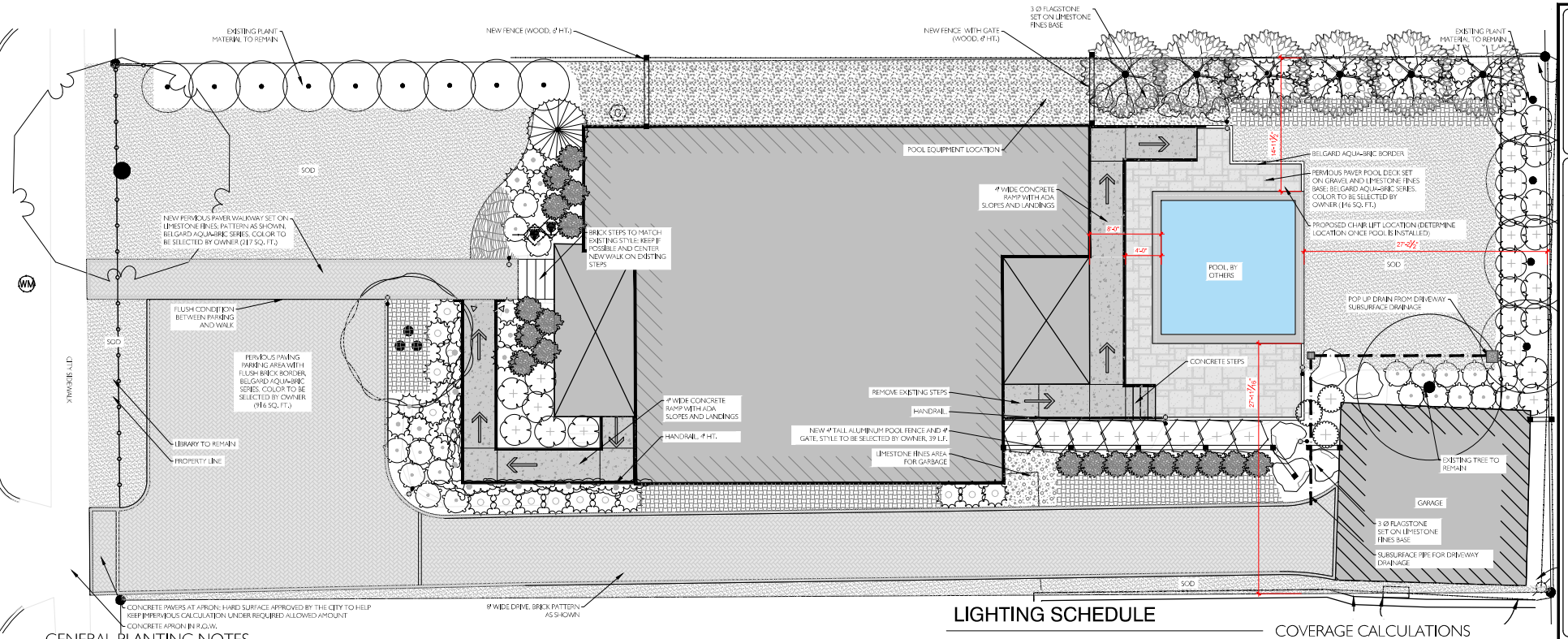
SIGNS				
Please provide the following information regarding the proposed sign(s): Sign Type: _____ Sign District: _____				
	Existing	Permitted by Zoning Regulations	Proposed	Variance Requested
Number of Signs				
Max Area				
Max Height				
Max Copy Height				
Setback				

TREE PROTECTION AND LANDSCAPING				
	Existing	Required by Zoning Regulations	Proposed	Variance Requested
Perimeter Vehicular Access Landscaping				
Width				
Number of Trees or Shrubs				
Interior Landscape Islands				
Foundation Landscaping				
Linear Feet				
Area				
Number of Shrubs				
Other				



GENERAL PLANTING NOTES

1. VERIFY ALL UTILITY LOCATIONS IN THE FIELD BEFORE BEGINNING WORK. REPAIR DAMAGED UTILITIES TO OWNER'S SATISFACTION AT NO ADDITIONAL COST.ENSURE LANDSCAPING DOES NOT CONFLICT WITH DRAINAGE,UTILITIES, OR OVERHEAD WIRES.

2. VERIFY QUANTITIES ON PLAN BEFORE PRICING WORK. NOTIFY OWNER OF DISCREPANCIES IN QUANTITIES PRIOR TO SUBMITTING PRICING.

3. ALL MATERIALS ARE SUBJECT TO APPROVAL OF THE OWNER OR OWNERS REPRESENTATIVE AT ANY TIME. INSTALL ALL PLANT MATERIALS IN ACCORDANCE WITH LOCAL CODES AND ORDINANCES.

4. ALL PLANTS SHALL BE HEALTHY, VIGOROUS MATERIALS, FREE FROM DISEASE AND PESTS, AND MEET OR EXCEED FLORIDA No. 1 GRADE AS SET FORTH IN THE FLORIDA GRADES AND STANDARDS FOR NURSERY PLANTS, LATEST EDITION. MAIN LEADERS OF ALL TREES SHALL REMAIN INTACT. NO GRAFTED MAPLES WILL BE ACCEPTED.

5. MULCH ALL PLANTING BEDS WITH MULCH SPECIFIED ON PLAN TO A MINIMUM DEPTH OF 4". PROVIDE A 4' DIA. MULCH RING, 4" DEEP, AROUND ALL TREES LOCATED IN LAWN AREAS. DO NOT PLACE MULCH IN CONTACT WITH TREE TRUNK.

6. PREPARE ALL SOIL USED IN TREE AND PLANT BEDS IN THE FOLLOWING PROPORTIONS: 4 PARTS NATIVE TOPSOIL, 2 PARTS SAND, AND 2 PARTS DECOMPOSED ORGANIC MATTER. ADD SLOW-RELEASE BALANCED FERTILIZER PER MANUFACTURER'S INSTRUCTIONS. PRE-MIX ALL SOIL BEFORE PLACING IN BED.

7. MAINTAIN PLANT MATERIAL UNTIL FINAL ACCEPTANCE UNLESS OTHERWISE SPECIFIED. MAINTENANCE INCLUDES WATERING, SPRAYING, WEEDING, MULCHING, STRAIGHTENING, PRUNING, MOWING, BLOWING, FERTILIZING, CLEAN-UP.

8. REPLACE ANY PLANT MATERIAL WHICH TURNS BROWN OR DEFOLIATES WITHIN FIVE (5) DAYS AFTER PLANTING. GUARANTEE ALL MATERIAL AND WORKMANSHIP FOR A PERIOD OF ONE YEAR FROM FINAL ACCEPTANCE BY OWNER.

9. IF AN AUTOMATIC IRRIGATION SYSTEM IS TO BE INSTALLED, CONTRACTOR SHALL PROVIDE OWNER WITH IRRIGATION PLAN AND SHOP DRAWINGS OF HEADS, VALVES, PIPE, WIRE & CLOCKS PROPOSED FOR INSTALLATION. IRRIGATION PLAN SHALL BE SUBMITTED TO OWNER FOR APPROVAL PRIOR TO INSTALLATION.

10. LANDSCAPE CONTRACTOR TO PROVIDE OWNER WITH AS-BUILT DRAWINGS FOR ALL SLEEVE LOCATIONS, IRRIGATION MAINLINE, VALVE AND CLOCK LOCATIONS; AND ALL LOW VOLTAGE LIGHTING CIRCUITS (IF PROVIDED) PRIOR TO FINAL ACCEPTANCE.

11. CERTAIN MATERIALS SPECIFIED BY LANDSCAPE ARCHITECT MAY HAVE LONG LEAD TIMES FOR ORDERING. IT IS THE CONTRACTORS RESPONSIBILITY TO ENSURE MATERIALS ARE ORDERED IN APPROPRIATE TIME FRAME. LAND. ARCH. IS NOT OBLIGATED TO SUBSTITUTE MANUFACTURER OR MATERIALS BASED UPON IN INADEQUATE LEAD TIMES.

12. ALL CANOPY TREES MUST BE LOCATED 6' MIN. CLEAR FROM ANY BUILDING OR PAVING UNLESS PLANTED IN VEHICULAR TREE ISLANDS.

PLANT SCHEDULE

SYMBOL	QTY.	COMMON / BOTANICAL NAME	SIZE	HEIGHT	SPACING
TREES					
	6	EAGLESTON HOLLY / ILEX X ATTENUATA 'EAGLESTON'	8'-10' HT.		
	1	LUSTER LEAF HOLLY / ILEX X ATTENUATA 'COOL FENCES'	20 GAL.		
	1	MULTI-TRUNK JAPANESE MAPLE / ACER PALMATUM 'GREEN LEAF'	8-10' HT.		
	1	OVERCUP OAK / QUERCUS LYRATA	2.5" CAL.	12' HT.	
SHRUBS					
	11	DWARF GARDENIA / GARDENIA AUGUSTA 'RADICANS'	3 GAL.		
	25	G.G. GERMING AZALEA AZALEA INDICA 'G.G. GERMING'	3 GAL.		
	9	LITTLE LIME HYDRANGEA / HYDRANGEA PANICULATA 'LITTLE LIME'	3 GAL.		
	35	DWARF LOW DEPOLUM / PODOPHYLLUM X 'PEDEPHYLLUM'	3 GAL.		
	8	TEA OLIVE / OSMANTHUS FRAGRANS	7 GAL.		
	3	TUSCAN BLUE ROSEMARY / ROSMARINUS OFFICINALIS 'TUSCAN BLUE'	3 GAL.		
	10	VINTAGE JADE DEPOLUM / PODOPHYLLUM X 'VINTAGE JADE'	3 GAL.		
ESPALIERS					
	6	CRAPE MYRTLE / LAGERSTROEMIA INDICA	4' POT		
SYMBOL	QTY.	COMMON / BOTANICAL NAME	SIZE		SPACING
GROUND COVERS					
	28 SF	#57 STONE / TYP. 1" TO 3" DIA. COMPACTED ON 4" #57 STONE BASE SUBMIT SAMPLE TO LAND. ARCH. FOR APPROVAL	SQ.FT.		
	54	ASPIDISTRA / TAO HILLS / SAMURAI LUCK	4" POT		18" o.c.
	216 SF	SPREADER DOWN SYSTEM BY APPLEGATE X - 20MIL PLASTIC SHEETING WITH HOLES OR WELDS. SEAMS LOCKED OUT AND LAY WITHIN 48 HOURS.	SQ. FT.		
	25	MONDO GRASS / OPHIOPOGON JAPONICUS	4" POT		12" o.c.
	128 SF	HALF STRAW / COW MATS UNDER EXISTING TREE CANOPY ISLAND COMMON AREA	SQ.FT.		

LIGHTING SCHEDULE

SYMBOL	MANUFACTURER/MODEL/DESCRIPTION	QTY	DETAIL
	FX LUMINAIRE FB FITS WELL INTO TIGHT SPACES. 7.3IN. H X 2.6IN. DIA. ORDER CODE: FB, ALUMINUM ALLOY, (BZ) BRONZE MSTALLIC, S-PRONG SPIKE LAMP: FB-ILED, 2W / 2.4VA, 2700K, BEAMSPREAD: SPOT	2	
	COPPERMOON LIGHTING CM.200 BRASS PATH LIGHT. 17IN. H X 2.25IN. W. ORDER CODE: CM.200, BRASS, ANTIQUE (A), ABS GROUND STAKE LAMP: 4W-MR16, 4W / 6VA, 2200K, BEAMSPREAD: NARROW FLOOD	7	

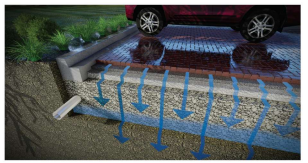
KEYNOTE LEGEND

- 4" SINGLE WALL CORRUGATED HDPE DRAIN PIPE
- 9" CATCH BASIN WITH ATRIUM GRATE IN BEDS - SEE DETAIL
- 6" CATCH BASIN WITH FLAT GRATE UNDER TURF

BELGARD COMMERCIAL

INFILTRATION RATES FOR BELGARD PERMEABLE PAVERS

Technical Note



Select Belgard Permeable Paver Infiltration Rates¹

PAVER/SIZE	MANUFACTURED JOINT WIDTH (MM)	RECOMMENDED MAXIMUM JOINT/CHAMFER LOADING	% SURFACE OPENING	SURFACE INFILTRATION RATE (GPM/SQ FT) (INCHES/HOUR)
Aqua-Bric® 6" x 9"	8	2500	9	1,000
Aqua-Bric® 6" x 9"	6	3000	7	800
Eco-Network / Aqua-Bric® 6" x 9"	8	2500	9	1,000
Eco-Basket / Grasspave2 6" x 7" / 7" x 7" / 6" x 9"	12	1,2*	9	1,000
Aqua-Bric® 7" x 7" Offset	10	2500	10	1,100
Aqua-Bric® 6.5" x 9"	10	2500	10	1,100
Aqua-Bric® 9" x 9"	12	2,5*	10	1,100

NOTE: 8" OF GRAVEL BASE MINIMUM; REFER TO WWW.BELGARD.COM FOR MORE INFORMATION

COVERAGE CALCULATIONS

Existing Site Coverage 53% Proposed Site Coverage 44,36%(Reduction by 8%)

Total site area:	9,590 SF	
Main Structure area:	2,170 SF (22,6 %)	
Garage:	419 SF	
Driveway and Parking Court: (Permeable Pavers)	799 SF	
Front Walk: (Permeable Pavers)	110 SF	
Front Ramp:	170 SF	
Pool:	225 SF	105 Sq.ft. OVER ACCESSORY STRUCTURE ALLOWANCE
Pool Deck: (Permeable Pavers)	146 SF	
Ramp and Stairs:	216 SF	
Total Coverage SF Coverage = 44,36%	4,255 SF	

MTD CALCULATIONS

Total site acreage:	0,22 acres
Trees required:	16 trees per acre
(16 x 0,22 acres = 3,52 trees)	
Total trees preserved: 4	
Total trees provided: 9	

SCALE: 3/16" = 1'-0"

NORTH

LANDSCAPE PLAN

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LORBERBAUM MCNAIR ASSOCIATES

www.lorberbaummcnair.com

A LANDSCAPE DEVELOPMENT PLAN FOR

FIVEASH RESIDENCE

323 Gran Avenue
Homewood, AL

PROJ. CODE	26-001
DRAWN BY	EB
REVIEWED BY	DML

ISSUED

DATE	DESCRIPTION

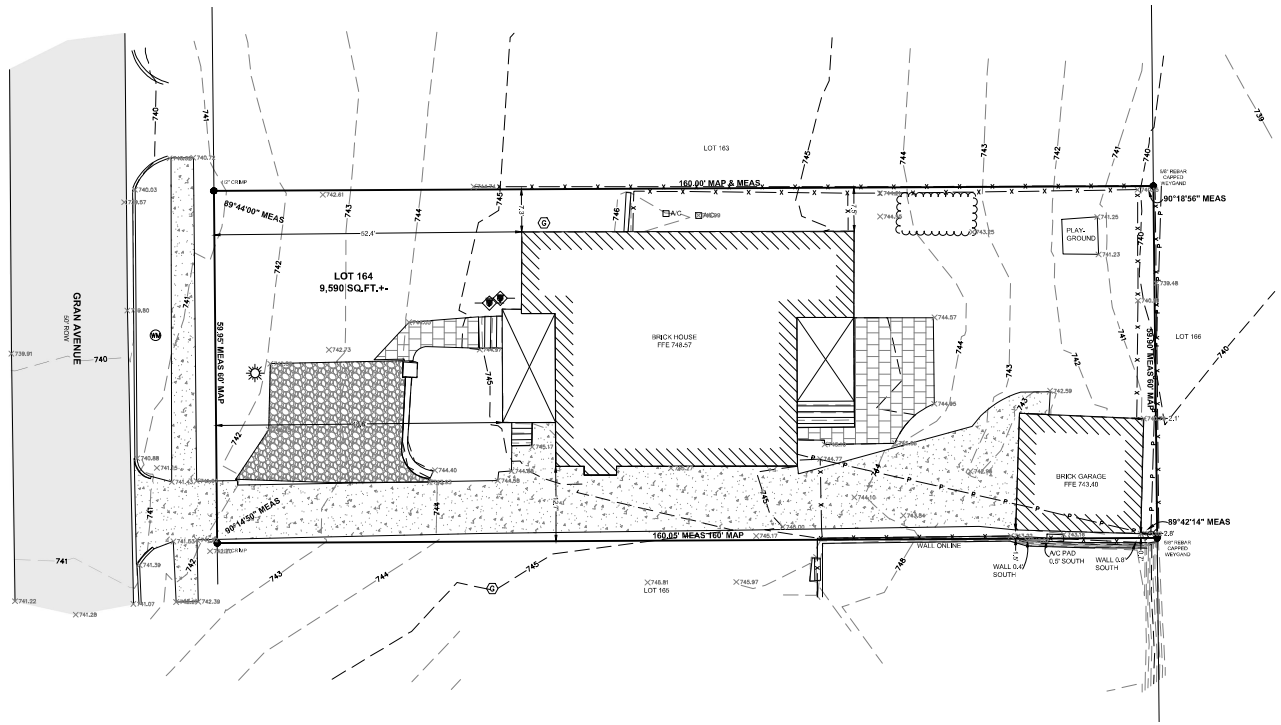
REVISIONS

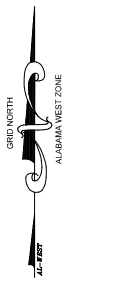
SHEET
L1.01

BOUNDARY AND TOPOGRAPHIC SURVEY FOR

DAVID LORBERBAUM

LOT 164 HOLLYWOOD MB 16 PG 94, SECTION 7,
TOWNSHIP 18 SOUTH, RANGE 2 WEST, JEFFERSON
COUNTY, ALABAMA





SCALE: 1" = 10'

0' 10' 20' 30'

DESCRIPTION

LOT 164 OF HOLLYWOOD AS RECORDED IN MAP BOOK 16 PAGE 94 IN THE OFFICE OF THE JUDGE OF PROBATE IN JEFFERSON COUNTY, ALABAMA.

I hereby certify that all parts of this survey and drawing have been completed in accordance with the current requirements of the Standards of Practice for Surveying in the State of Alabama to the best of my knowledge, information, and belief.

Surveyor's Signature:
Alabama License Number 26013, Date: April 02, 2026

NOTE:

1. North arrow based on State Plane Grid Alabama West (NAD83). Elevations based on USGS datum NAVD88.
2. Date of field work (April 28, 2025 and April 01, 2026)
3. Type of survey Boundary and Topographic Survey. No title information was provided
4. Survey for David Lorberbaum
5. Address: 323 Gran Avenue Birmingham, AL 35209
6. Survey not valid without original signature.

ALABAMA
26013
ROBERT KEITH CUNNINGHAM
REGISTERED LAND SURVEYOR

LEGEND

BENCHMARK		FFE	FINISH FLOOR ELEVATION
EXISTING SPOT ELEVATION		C/L	CENTERLINE
CONTROL POINT		FL	FLOWLINE
UTILITY POLE		SW	SINGLE WING INLET
LIGHT POLE		DW	DOUBLE WING INLET
FLOOD LIGHT		RCP	REINFORCED CONCRETE PIPE
GUY WIRE		CMP	CORRUGATED METAL PIPE
ELECTRIC BOX		PLASTIC	PLASTIC PIPE
ELECTRICAL MANHOLE		P	OVERHEAD ELECTRIC
TRAFFIC LIGHT POLE		UP	UNDERGROUND ELECTRIC
TRAFFIC SIGNAL BOX		OT	OVERHEAD TELEPHONE LINE
CROSS WALK SIGNAL		FO	FIBER OPTIC LINE
FIRE HYDRANT		W	WATER LINE
WATER VALVE		G	GAS LINE
WATER METER		S	SANITARY LINE
IRRIGATION CONTROL VALVE		x	CHAIN LINK FENCE
SPRINKLER HEAD			WOOD FENCE
WATER WELL			BARB WIRE FENCE
TELEPHONE MANHOLE		UT	UNDERGROUND TELEPHONE
TELEPHONE PEDESTAL			WALL
GAS VALVE			ASPHALT
GAS REGULATOR			BRICK
GAS METER			
STORM MANHOLE			CONCRETE
GRATE INLET			GRAVEL
YARD INLET			
SANITARY MANHOLE			WOOD
CLEANOUT			STORM SEWER CULVERT
SIGN			
BOLLARD		18" RCP	STORM SEWER PIPE
PARKING METER			TREE LINE OR LANDSCAPING

DRAWN BY: RES
CHECKED BY: RKC
PROJECT No.: LORB0001
CAD FILE: LORB0001 323 GRAN AVE.dwg
SCALE: 1" = 10'

PROJECT: LOT 164 HOLLYWOOD MB 16 PG 94, SECTION 7, TOWNSHIP 18 SOUTH, RANGE 2 WEST, JEFFERSON COUNTY, ALABAMA

TITLE: BOUNDARY AND TOPOGRAPHIC SURVEY FOR DAVID LORBERBAUM

120 BISHOP CIRCLE, SUITE 300
PELHAM, AL 35124
TEL - (205) 403-9158
FAX - (205) 403-9175

EDG
ENGINEERING DESIGN GROUP, LLC
CIVIL ENGINEERING • LAND SURVEYING
205-403-9158

SHEET NO.
1 OF 1

City of Homewood Variance Request

Re: 323 Gran Ave, Homewood, AL 35209

Project Narrative

We respectfully request a variance to permit an additional 105 square feet of pool size at our residential home site. The variance request is in reference to the accessory structure ordinance (Article VI, Sec. D) and the 25% maximum footprint. The purpose of this request is to accommodate the unique therapeutic needs of Nick Fiveash, the owner's son, who has been diagnosed with severe cerebral palsy. Aquatic therapy, as prescribed by his medical and occupational therapy team, is a critical component of his care plan. It provides essential physical exercise and sensory input, helping to improve his mobility, muscle tone, and overall quality of life.

The allowed pool design, measuring 8 feet by 15 feet, is not sufficient to allow his caregiver, who has been instructed by an occupational therapist, to safely and effectively assist the child during his aquatic therapy sessions. The limited width restricts the therapist's ability to maneuver and support him while ensuring proper form and safety. By expanding the pool by an additional 105 square feet(15'x15'), we will provide the necessary space for both Nick and his therapist to perform therapeutic exercises and routines that are tailored to his needs.

This variance is not requested for recreational purposes, but rather to address a specific medical necessity. The expanded pool will directly support Nick's health and well-being, enabling him to access the full benefits of aquatic therapy under the guidance of a licensed occupational therapist.

We appreciate your consideration and understanding of the importance of this request for the Fiveash's circumstances.



City of Homewood BZA Case Map

323 Gran Avenue

BZA 26-0033

Aerial Photo Map

Subject Property
Roadway
Parcels

N

0 15 30 60
Feet

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European Journal of Medical Research

REVIEW

Open Access

Aquatic therapy for spastic cerebral palsy: a scoping review

Aomeng Xiang[1,2†], Yanxin Fu[1,2†], Chengshuo Wang[1,2], Dan Huang[1], Jingman Qi[1,2], Ruoxuan Zhao[1,2], Liang Wu[1*], Chunliang Fan[1*] and Qin Zhang[1*]

Abstract

Background Cerebral palsy (CP) is a group of dysfunction syndrome. Spastic CP is the most common form of CP. As a specific treatment, aquatic therapy (AT) can improve spasticity, increase range of motion, and increase muscle strength due to its particular properties.

Objectives This article aims to review the research status of AT in patients with spastic CP.

Methods We conducted a wide-ranging review of all existing literature on using AT to intervene with spastic CP from 10 databases from the earliest to May 2024. It follows the methodological framework for conducting a scoping review proposed by the Joanna Briggs Institute. The physical, physiological, and social–psychological functions were summarized and analyzed.

Results 18 articles were included and analyzed. The gross motor ability of patients with spastic CP improved significantly after AT, and walking efficiency was improved; muscle strength showed significant improvement, enhancing the ability to perform daily activities and quality of life. Aerobic forms of exercise are a commonly used treatment for AT, and five weekly interventions are the most effective. Notably, functional improvements were correlated with child age, CP type, and gross motor function classification system grade.

Conclusions AT can improve the gross motor function, cardiopulmonary function, daily living, and social communication ability of patients with spastic CP. This scoping review can be used as a starting point for future research on AT for children with spastic CP to design the most efficient exercise regimen.

Keywords Aquatic therapy, Hydrotherapy, Cerebral palsy, Scoping review

Introduction

Cerebral palsy (CP) is a group of non-progressive developmental-motor disorders that occur in a developing fetus or infant brain and continue throughout life [1]. The incidence is as high as 3.4% in developing countries [2]. Surveillance of Cerebral Palsy in Europe categorizes CP into spastic, ataxic, dyskinetic, and mixed CP [3]. Spastic CP can be further classified as unilateral or bilateral [4]. Children with spastic CP have neuromuscular damage during development due to brain lesions or abnormalities, including spasms, increased muscle stiffness, weakness, and muscle contracture [5–7]. 55%

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of children and adolescents with CP presented with multiple movement disorders of the same limb, the most common movement disorders being spasticity and dystonia (50%), spasticity only (36%), and dystonia only (6%) [8, 9]. Structural and functional changes occur with age, affecting movement, intelligence, and communication[10], further burdening the family and society.

The International Clinical Practice Guidelines [11] recommend that interventions begin with the child's and family's goals and be enjoyable, stimulating, and challenging activities to stimulate the child's interest. Aquatic therapy (AT) is a treatment that uses the properties of water to allow patients to perform exercise therapy in water to relieve their symptoms or improve function [12]. Currently, AT is among the most common physical activities chosen by children with neuromotor disorder and can be used in all phases of disease progression [13, 14]. The underwater environment provides buoyancy, hydrostatic pressure, and other hydrodynamic characteristics [15]. Buoyancy reduces weight, aids postural support [16], and optimizes postural control. The viscous nature of the water provides resistance equal to the degree of force exerted and facilitates muscle strengthening. Hydrostatic pressure activates sensory and motor cortex areas [17, 18], reducing muscle spasms, improving multisensory stimulants' endurance, and promoting blood circulation. The thermal effect of water can alleviate the degree of spasm and improve the range of joint activity in patients [19]. Motor learning and memory are fundamental parts of neurorehabilitation, and neuroplasticity in cortical motor areas after AT intervention enhances functional performance related to motor learning and memory [20], contributing to neurorehabilitation. Although AT benefits patients with CP [21], efficient AT protocols remain uncertain.

A scoping review aims to summarize the range of available research. Recent systematic reviews have only described specific hydrotherapy methods [22] (Halliwick) and comparisons between AT and land-based exercise [23] and have not summarized and analyzed treatment parameters and outcome indicators. To provide a scope of the existing literature, this scoping review was designed to answer the following two main questions: how is AT currently used in patients with spastic CP, and which functions does AT improve in patients with spastic CP? Therefore, the primary purpose of this study was to map the existing research interventions of AT in patients with spastic CP; more specifically, to describe the treatment parameters of AT interventions and to analyze the outcome metrics of the studies.

Materials and methods

The study followed the methodological framework for conducting a scoping review proposed by the Joanna Briggs Institute [24]. A scoping review maps the existing literature or evidence base [25], which can be used to summarize the status of research and identify research gaps [26]. The present study was based on the PRISMA–ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) checklist [27]. This article has been registered on the Open Science Framework. The registered DOI number is https://doi.org/https://doi.org/10.17605/OSF.IO/9CTSX.

Searching for the evidence

A comprehensive search was conducted in May 2024 by two independent reviewers in ten data sources: The Cochrane Library, Embase, PubMed, Web of Science, Scopus, EBSCO, China National Knowledge Infrastructure (CNKI), WanFang Knowledge Service Platform (WanFang), Chinese Biomedical Literature Service System (CBM), and Chinese Scientific Journals Database (VIP). The search period was from database creation to May 10, 2024. Three sets of keywords were used in the search. The first group used the subject terms of CP and all accessible terms from the Mesh Thesaurus, joined by the Boolean search operator "OR". The second group searched for interventions, using the Mesh subject headings Hydrotherapy and Aquatic Therapy and all related free words, concatenated with the Boolean search operator "OR". The third group retrieved the type of literature, which was limited to randomized controlled trials (RCTs). There was no time limit for the search. The specific search strategy is shown in Supplementary Table S1.

Selecting the evidence

The selection of results was carried out independently by at least two authors using Endnote 21 software. The languages familiar to both authors were Chinese and English. Inclusion criteria were developed according to the population, intervention, comparison, Outcome, and Study Design (PICOS) principles (18). Eligible studies must meet the following criteria: (1) population: children with spasmodic CP with stable vital signs, under 18 years of age, and with the consent of patients and their families; (2) intervention: any form of AT; (3) comparison: the control group received other interventions except AT; (4) outcome: physical function, physiological function (muscle strength,

muscle tension, and cardiopulmonary endurance), and social psychological function; and (5) research design: non-conference papers, dissertations, reviews, and meta-analyses. The first step in study selection consisted of analyzing titles and abstracts; this step included articles written in English and Chinese describing active AT in persons with spastic CP. The following exclusion criteria were applied: (1) repeat article; (2) animal studies; (3) articles describing treatments other than AT and/or with study groups other than persons with spastic CP; and (4) conference papers, dissertations, reviews, or meta-analysis.

The second step was to analyze the full texts of the potentially relevant papers. Exclude the following: (1) any articles without intervention; (2) articles with incomplete AT information; (3) any article with incomplete outcome data; (4) any articles that were not original, lacked full text, or were not in English or Chinese; and (5) articles not available in full text. Each paper was included based on the assessment of two independent reviewers. In the case of disagreement, consensus was reached by consulting a third reviewer.

Extracting the evidence

The following descriptive data were obtained from the included articles: first author's name, purpose of research, sample size, age of subjects and type of CP, parameters of the AT intervention treatment, measurement tools and results of outcome indicators, water temperature, and study design. Supplemental Materials Table 2 shows the quality assessment of the included studies.

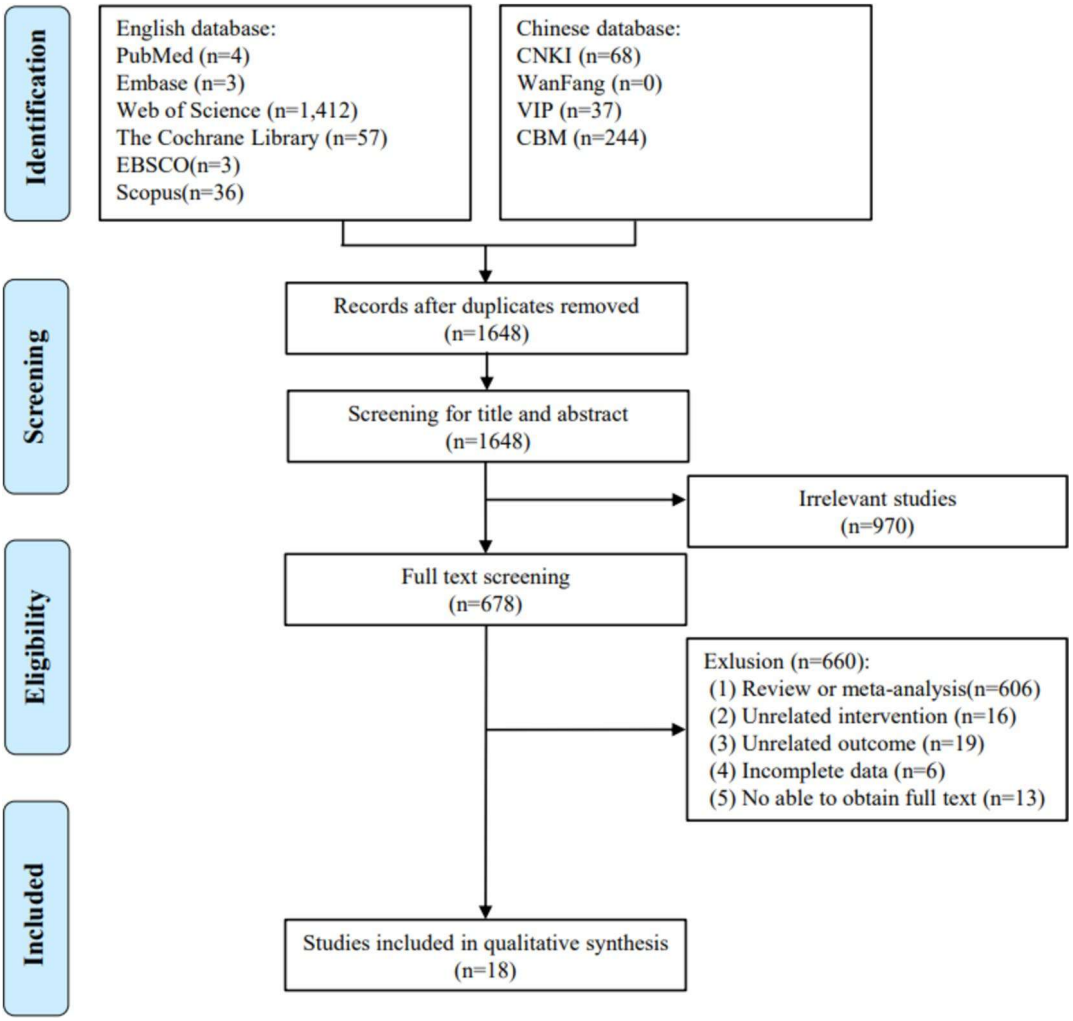

Fig. 1 Flow diagram of identified publications

Results

We rigorously searched the ten abovementioned databases according to the inclusion and exclusion criteria and initially obtained 1864 publications. The flowchart of the study screening is shown in Fig. 1. After eliminating duplicates using EndNote 21 software, 1648 articles remained. By reading the titles and abstracts of the articles, articles that did not meet the inclusion criteria were excluded, leaving 678 articles. By reading the complete text, we further excluded 660 articles, including reviews, meta-analyses ($n=606$), irrelevant interventions ($n=16$), irrelevant endpoints ($n=19$), unavailable full text ($n=13$), and incomplete data ($n=6$). 18 articles ultimately met our study requirements. Of the 18 studies, 12 (67%) were published after 2015. Details on patient attendance and adverse events for each study are shown in Supplemental Materials Table 3.

In terms of research types, 12 were clinical RCTs, 2 [28, 29] were case studies, 1 [30] was a research paper, 1 [31] was research reports, 1 [19] was a prospective study, and the other [32] was a single-masked randomized age-stratified crossover study. The results of the analyzed studies were classified into three categories (Supplementary Material Table 4): Functional performance mainly included physical mobility, balance, and walking; physiological domains mainly included cardiorespiratory capacity, body composition, and muscular strength; and psychosocial domains included quality of life, mood, and anxiety. Regarding the types of CP studied, 17 studies dealt only with spastic CP, whereas in one study [33], manual and mixed CP were also involved. Among the 18 studies, 464 children with spastic CP participated in AT, including 47% (218) males and 39% (179) females. Four studies did not report the gender of the participants. Although the inclusion criteria were spastic CP, they were explicitly divided into various studies. There were 1 case of spastic monoplegia, 80 cases of hemiplegia, 165 cases of diplegia, 1 case of triplegia, and 43 cases of quadriplegia. It can be seen that patients with spastic diplegia are more involved in AT. In addition, 5 studies did not report the classification of specific spastic CP. Seventeen studies graded patients participating in the AT site on the Gross Motor Function Classification System (GMFCS).

The average duration of AT was 12 weeks ($M=11.75$, $SD=3.09$), and two studies did not clarify the duration of AT. These interventions ranged from 6 to 20 weeks, and a single AT treatment duration ranged from 20 to 60 min. Most of the studies used aerobic exercise in the form of warm-up exercise, AT aerobic exercise, and relaxation exercise and combined with other conventional rehabilitation treatment methods. Only two studies [32, 34] have reported the implementation of specific AT methods (Halliwick, Watsu) in the intervention program for children with spastic CP, and two studies have intervention measures for AT combined with sensory integration training [33] and Bobath therapy [35]. Twelve of the 18 studies described the water temperature, ranging from 27.7 ℃ to 40 ℃. Most of the studies were higher than 30 ℃, and only one reached 40 ℃. Three studies indicated that the heart rate index was used to measure the intensity of AT. Two studies used the heart rate reserve or Karvonen formula [36] to calculate the target heart rate. Another study used the percentage of heart rate reserve, and the maximum heart rate was calculated using 220-age. In most studies ($n=11$), the frequency of AT was 2–3 times/week. In 4 studies, the frequency of AT was 5 times/week, and only 3 had a frequency of up to once a day. The results of the analysis are most common in the following three categories: functional performance, physiological field, and psychological field. The following will summarize and analyze the three types of research results. A detailed summary is shown in Table 1.

Functional performance

Evaluation metrics in the domain of functional performance have typically focused on the Gross Motor Function Measure (GMFM) scale, with studies using the GMFM-66 ($n=9$) and GMFM-88 ($n=6$). Significant differences in GMFM scores were reported in all 12 studies, which reported significant differences in GMFM scores after AT compared to before the intervention. Akinola et al. [37] reported that important differences in the dimensions of GMFM between the experimental and control groups were observed only after the tenth week of intervention. Another study found no significant difference in GMFM comparison between the two groups [38]. Further studies have found that GMFCS levels correlate highly with GMFM parts D and E [31]. For patients with GMFCS III–IV, group aquatic training significantly improved GMFM Part E scores. However, there was no change in GMFM D scores for these patients.

Other evaluation metrics focused on walking ability and walking energy efficiency. The 6-Minute Walk Test and Timed Up and GO Test are commonly used for walking function. Abdelaal et al. [39] showed that AT based on Halliwick's concept was more effective than regular exercise in improving the ability of children with spastic CP aged 3–5 years to perform multiple activities, such as sitting, standing, walking, running, and jumping. A case study [29] observed that after 12 weeks of AT, there was a significantly increased walking endurance, speed, and distance in the 6 Mins Walk Test. However, these improvements waned during the 32 week

Table 1 Study characteristics

Reference	Study aim	Sample	Intervention programme	Exercise parameters	Water-temperature	Measuring instruments and outcomes	Study design
Fragala-Pinkham et al. [28]	To assess the improvement in participants' function after the AT	*n* = 2 Case 2: CP-spastic diplegia 7 years old Case 3: CP-right hemiplegia,10 years old	Case 2: Pool sessions + land sessions Case 3: Pool sessions + land sessions	2/wk for 60 min for 6 weeks (Total of 8 pool sessions and four land sessions)	NR	Pre/post-intervention (mean score) Case2: -COPM: Performance ↑6.4, Satisfaction ↑5 -GMFM-66: ↑7.53 -OGS: ↑; –3-min fast walk: Distance (m)↑53.06 -Passive ROM: Ankle DF: L↑11° R↑5° Case3: -COPM: Performance ↑5.25, Satisfaction ↑6.75; -PEDI: ↑56 –3 min fast walk: Distance (m) ↑330 -MMT: ↑ -Passive ROM: Right ankle DF↑15°, Ankle eversion↑5°	Case study
Retarekar et al. [29]	To evaluate the effects of AT for a child with CP	CP-spastic diplegia *n* = 1 5 years old GMFCS III	Warm-Up (5 min) Aerobic Intervention (30–40 min) Cool-Down (5 min)	3/wk for 12 weeks (at least 1 day of rest between sessions)	30–32.2 ℃	Pre/post-intervention (mean score) -COPM: performance 1.8, satisfaction 2.1 -GMFM-66: ↑2.71 –6MWT: walk distance↑27.1%, walking speed(m/min) ↑9 -Modified EEI: ↓0.92	Case study

Table 1 (continued)

Reference	Study aim	Sample	Intervention programme	Exercise parameters	Water-temperature	Measuring instruments and outcomes	Study design
Ballaz et al. [30]	To evaluate the effect of a group aquatic training program on gait efficiency	spastic CP *n* = 20 14–21 years old	Warm-up (10 min) Relay race (15 min) Relaxation (5 min) Aquatic activity (15 min)	2/wk for 45 min for 10 weeks	31–32 ℃	Pre/post-intervention (mean score) -Modified EEI: ↓0.24, Walking HR: ↓13, Resting HR: ↓4 -Opposite Foot Off (%) ↑3, Foot Off (%) ↑3, Step Length (m)↑0.02, Cadence (step/min) ↓7, Walking Speed (m/s) ↓0.01, Flexion knee strength (Nm/KG) ↑0.007, Extension knee strength (Nm/KG) ↑0.007 -GMFM D↑5, GMFM E↑5	Research paper
Fragala-Pinkham et al. [31]	To evaluate the effectiveness of the aquatic exercise program	CP *n* = 8 6–15 years old GMFCS I (3) GMFCS III (5)	Warm-up (2–5 min) Aerobic exercise (40–45 min) Strength training (5–10 min) Cool down and stretch (5–10 min)	2/wk for 60 min for 14 weeks	31–34 °C	Pre/post-intervention (mean score) Primary outcome measures -GMFM D & E (% score) ↑8.8 –6 MWT (meters)↑63.7 Secondary outcome measures -SRT I and III (Levels)↑2.31	Research report
Lai et al. [19]	To investigate the effects of pediatric AT	spastic CP *n* = 24 4–12 years old PAT (*n* = 11); CG (*n* = 13)	PAT: PT + AT Warm-up (5–10 min) Pool exercises (40 min): Halliwick Cool down exercises (5–10 min) CG: PT	CG: PT + OT PAT: PT + OT + AT (2/wk for 60 min for 12 weeks)	33–36 °C	Pre/post-intervention (mean score) Primary outcome measures -MAS: Ankle: CG↓0.1 PAT no change, Knee: no change Wrist: CG↓0.4 PAT no change, Elbow: no change -GMFM-66: CG↑0.7 PAT↑5	Prospective study

Table 1 (continued)

Reference	Study aim	Sample	Intervention programme	Exercise parameters	Water-temperature	Measuring instruments and outcomes	Study design
Adar et al. [38]	To compare the effects of aquatic exercises and land-based exercises	spastic CP *n* = 32 4–17 years old Group 1 (*n* = 17); Group 2 (*n* = 15)	Group 1: warm-up (10 min) + aquatic exercise (50 min) + cool-down (5 min); Group 2: active ROM exercises and stretching exercises (10 min) + aerobic exercise (30 min) + sitting, standing, and gait training (20 min)	5/wk for 60 min for 6 weeks	33 °C	Pre/post-intervention (mean score) -MAS: G1↓ G2↓ -TUG: G1↓1.7 G2: ↓2 -GMFM: G1↑2.1 G2: ↓2 -WeeFIM: G1↑5 G2: ↑7 -Gastrocnemius thickness (mm): G1↑0.01 G2: ↑0.01 -Fascicle length (mm): G1↓1.7 G2: ↓0.8 -Pennation angle (°): G1↓0.7 G2: ↑1.4 -Compressibility ratio: G1↑0.3 G2: ↑0.1 -Child Self Report—PedsQL: G1↑61.3 G2: ↓65.2 -Parent Report—PedsQL: G1↑71.8 G2: ↑9.9	RCT

Table 1 (continued)

Reference	Study aim	Sample	Intervention programme	Exercise parameters	Water-temperature	Measuring instruments and outcomes	Study design
E. Tufekcioglu [32]	To compare and examine the effect of aquatic interventions, Watsu vs Immersion	spastic CP ($n=23$) 7.52 ± 2.78 years old WI ($n=12$); IW ($n=11$)	Period 1: WI (Watsu therapy), IW (Immersion therapy)10 weeks; Period 2: WI (Immersion therapy), IW (Watsu therapy) 10 weeks	consisted of a 6-week washout interval during which no treatment; 2/wk for 30 min for 20 weeks	34 °C	Period 1 -HRV Time: Mean R-R (ms): WI↑53.84 IW↑39, RMSSD (ms): WI↑12.17 IW↑5.09, pNN50↑8.17 IW13.64(post-intervention) -HF (nu): WI↑6.28 IW↑4.16, LF (nu): WI↑6.95 IW↑13.51 -ROM: Upper: WI↑2.81 IW↑2.02, Lowe: WI↑4.03 IW↑2.35 Period 2 -HRV Time: Mean R-R (ms): WI↑29.25 IW↑39.09, RMSSD (ms): WI↑9.25 IW↑9.91, pNN50↑5.25 IW↑9.64 -HF (nu): WI↑3.95 IW↑7.15; LF (nu): WI↑5.92 IW↑6.07 -ROM: Upper: WI↑0.41 IW↑5.1; Lowe: WI↑1.67 IW↑5.68	Single-blinded randomized and age-stratified crossover study
Abdelaal and Atia [39]	To evaluate the effectiveness of aquatic aerobic training	spastic CP AqETG ($n=13$) CG ($n=15$)	AqETG: warm-up (10 min), AqET(40 min), cool-down(10 min); CG: TPT	3/wk for 60 min for 12 weeks	27.7 ℃	Pre/post-intervention (mean scores) -FEV1(%): AqETG↑14.38 CG↑4.6 -FVC (%): AqETG↑15.23 CG↑4.13 -WMA (%): AqETG↑14.38 CG↑1.4 -WSBM: AqETG↑13.38 CG↑0.14 -WTOT: AqETG↑27.77 CG↑1.47	RCT

Table 1 (continued)

Reference	Study aim	Sample	Intervention programme	Exercise parameters	Water-temperature	Measuring instruments and outcomes	Study design
Hamed et al. [34]	To compare the effectiveness of the Halliwick aquatic exercise	spastic CP (n = 34) HCG (n = 17) CEG (n = 17)	HCG: warm-up (5 min), Halliwick exercises (20 min), cool down (5 min) CEG: conventional exercises	3/wk for 45 min for 12 weeks	NR	Pre/post-intervention (mean scores) the five GMFM dimensions -Sitting: HCG↑0.28 CEG↑0.23 -Crawling and kneeling: HCG↑0.23 CEG↑0.21 -Standing: HCG↑0.26 CEG↑0.21 -Walking, jumping, and running: HCG↑0.07 CEG↑0.04 -Total GMFM: HCG↑0.1 CEG↑0.04	RCT
Akinola et al. [37]	To investigate the effect of an aquatic exercise training program	spastic CP (n = 30) 1–12 years old EG (n = 15) CG (n = 15)	EG: exercise training in water (stretching, Level 1: 2-point kneeling, Level 2: Sitting, Level 3: Standing, Level 4: Walking) CG: land-based exercise	Stretching (5 min) each level (15 min) 2/wk for 65 min for 10 weeks	28 °C and 32 °C	Pre/post-intervention (GMFM-88 mean scores) EG: -Lying and rolling↑1.03 -Sitting↑1.03 -Crawling and kneeling↑0.8 -Standing↑0.54 -Walking, running, and jumping↑0.27 -Overall gross motor function↑1.43	RCT
Yufei Ni et al. [41]	To study the effect of hydrotherapy in early rehabilitation	CP—spastic diplegia (n = 60) < 1.5 years old	EG: hydrotherapy + PT, OT, ST, ET, acupuncture, and massage CG: PT (Bobath therapy), OT, ST, ET, acupuncture, and massage	5/wk for 12 weeks	NR	Pre/post-intervention (mean scores): -BI: CG↑35.79 EG↑44.97 -FMAS: upper limb CG↑28.14 EG↑20.28, lower limbs: CG↑16.83 EG↑10.95	RCT

Table 1 (continued)

Reference	Study aim	Sample	Intervention programme	Exercise parameters	Water-temperature	Measuring instruments and outcomes	Study design
Fanxu Song et al. [42]	To observe the effect of hydrotherapy on gross motor function and lower limb muscle strength	CP—spastic diplegia ($n=60$) OG ($n=30$, 2.21 ± 1.22 years old); CG (n = 30, 2.57 ± 3.46 years old)	OG: PT, OT, ST, acupuncture, and massage + Hydrotherapy CG: PT, OT, ST, acupuncture, and massage	7/wk for 12 weeks	34–36 ℃	Pre/post-intervention (mean scores): -GMFM-88: OG↑11.54 CG↑7.09 -B ultrasonic test results: Quadriceps thickness score (mm) OG↑4.02 CG↑2.46 -MAS score of the quadriceps: OG↓1.45 CG↓0.89	RCT
Wenwen Luo. [43]	To explore the effect of functional hydrotherapy on children with spastic CP	spastic CP OG (n = 43; 22.4 ± 8.7 months); CG ($n=43$; 22.9 ± 8.5 months)	OG: Bobath exercise therapy + Functional Hydrotherapy (Adaptive training, Cardiopulmonary conditioning training, Limb motor training) CG: Bobath exercise therapy	Bobath therapy: 7/wk for 60 min for 12 weeks Functional Hydrotherapy: 5/wk for 60 min for 12 weeks	NR	Pre/post-intervention (mean scores): -Biceps surface myoelectric parameter ratio: Iemg (mV·s): OG↑8.6 CG↑4.3, MF(Hz): OG↑12.7 CG↑6.9, CR (%): OG↓6.1 CG↓3.8 -Surface myoelectricity of gastrocnemius muscle: Iemg (mV·s): OG↑11.4 CG↑4.5, MF(Hz): OG↑10.3 CG↑3.4, CR (%): OG↓17.2 CG↓10.8 -GMFM: OG↑20.9 CG↑12.6 -FMFM: OG↑17.1 CG↑13.7	RCT
Rui Zhang. [33]	To explore the effect of AT combined with sensory integration training	CP (n = 156) 3–6 years old OG ($n=78$) CG ($n=78$)	OG: Sensory integration training + Hydrotherapy CG: Sensory integration training	Once a day, 6/wk for 12 weeks	NR	Pre/post-intervention (mean scores): -MAS (adductor): OG↓1.08 CG↓0.69 -BBS: OG↑12.13 CG↑8.3 -GMFM-88: OG↑12.23 CG↑7.68 -WeeFIM: OG↑14.69 CG↑9.73 -MCAVs: OG↑12.66 CG↑7.15 -MCA Vm: OG↑10.53 CG↑6.34	RCT

Table 1 (continued)

Reference	Study aim	Sample	Intervention programme	Exercise parameters	Water-temperature	Measuring instruments and outcomes	Study design
Yonghong Zhao et al. [40]	To explore the effects of surfing hydrotherapy combined with aerobic training	CG ($n=30$, 2–6 years old) HG ($n=30$, 2–6 years old)	HG: Routine rehabilitation training + Aquatic aerobics training (5 min warm-up, 40 min aerobic training, 10 min stretch, 5 min slow stretching) CG: Routine rehabilitation training	2/wk discontinuously for 60 min for 12 weeks	30–34 °C	Pre/post-intervention (mean scores): -GMFM: CG↑7.01 HG↑16.19 –6MWT(m): CG↑60.46 HG↑92.14 –10 m return runs(times): CG↑1.9 HG↑3.07 -Brockport improves functional strength: ↑ -BBS (mean scores): CG↑13.47 HG↑13.34 -Muscular tone (°): adductor horn CG↑14.16 HG↑24.67, angle of rouge CG↑8.17 HG↑11.5, dorsiflexion angle of foot CG↓12.83 HG↓11.83	RCT
Yuting Zou et al. [35]	To investigate the effect of hydrotherapy combined with the Bobath	spastic CP ($n=80$) CG ($n=40$) EG ($n=40$)	EG: comprehensive rehabilitation training + hydrotherapy CG: comprehensive rehabilitation training (Bobath therapy, acupuncture, massage, etc.)	Comprehensive rehabilitation (40 min), Hydrotherapy (15 min); 5–6/wk for 12 weeks	37–40 ℃	Pre/post-intervention (mean scores) -MAS: CG↓0.89 EG↓1.65 -GMFM: CG↑3.83 EG↑8.63	RCT

Table 1 (continued)

Reference	Study aim	Sample	Intervention programme	Exercise parameters	Water-temperature	Measuring instruments and outcomes	Study design
Qing Zhu et al. [44]	To explore the effect of hydrotherapy intervention on lower limb motor skills	spastic CP ($n=110$) 2–8 years old CG ($n=55$) EG ($n=55$)	EG: conventional treatment + hydrotherapy CG: conventional treatment	1/d for 20 min for 90 days	NR	Pre/post-intervention (mean scores): -GMFM: (1) Gross motor score: CG↑6.46 EG↑20.12 (2) Running and jumping score: CG↑2.54 EG↑6.48 (3) Standing score: CG↑4.2 EG↑7.31 -ROM of lower extremity joints: (1) Angle of dorsal flexion: CG↑4.91 EG↑8.97 (2) Angle of popliteal fossa: CG↑3.17 EG↑6.09 (3) Angle of adductor muscle: CG↑3.8 EG↑8.46	RCT
Fen Gao. [45]	To study the effects of hydrotherapy on lower limbs	CP-spastic diplegia ($n=78$) CG ($n=39$) EG ($n=33$)	EG: rehabilitation training therapy + hydrotherapy CG: rehabilitation training	Rehabilitation training(30 min) hydrotherapy(30 min): 1/d	35 ℃	Pre/post-intervention (mean scores): -GMFM-88: CG↑5.11 EG↑11.8 -Gait parameters: Step size, Step width, Average speed, Step Frequency↑ -ROM: Knee, Ankle, Hip ROM (°): ↑ -Quadriceps femoris thickness (mm): CG↑1.75 EG↑3.6 -MAS: CG↓0.82 EG↓1 -SAS, SDS: ↓ -QOL: CG↑6.84 EG↑9	RCT

↑, increase of the parameter; ↓, decrease of the parameter

PT: physical Therapy; NR: not reported; COPM: Canadian Occupational Performance Measure; PEDI: Pediatric Evaluation of Disability Inventory; GMFM-66: Gross Motor Function Measure-66; OGS: Observational Gait Scale; EEI: Energy Expenditure Index; ROM: Range of motion; DF: dorsiflexion; 6WMT: 6-Minute Walk Test; GMFCS: Gross Motor Function Classification System; HR: heart rate; SRT: shuttle run test; CG: control group; PAT: pediatric aquatic therapy group; MAS: Modified Ashworth Scale; TUG: Timed Up and GO Test; WeeFIM: the Wee Functional Independence Measure; RCT: randomized controlled trial; PedsQL: the Pediatric Quality of Life; HRV: heart rate variability; Mean R-R: All intervals between adjacent QRS complexes also defined as interbeat intervals; RMSSD: The square root of the mean of the squares of the successive differences between adjacent R-R; Pnn50: The proportion of NN50 divided by the total number of NNs; AqETG: aquatic aerobic exercise training group; FEV1: forced expiratory volume in one second; FVC: forced vital capacity; WOTA: Water Orientation Test Alyn; WMA: WOTA mental adaptation score; WSBM: WOTA skills balance control movement score; WTOT: WOTA total score; TPT: traditional physiotherapy; HCG: the Halliwick concept group; CEG: conventional exercising group; GMFM-88: Gross Motor Function Measure-88; EG: Experimental Group; CG: Control Group; OT: Occupational Therapy; ST: Speech Therapy; ET: Electrical Therapy; BI: Barthel Index; FMAS: Fugl-Meyer assessment scale; OG: Observation group; MF: median frequency; CR: antagonistic muscle contraction rate; FMFM: Fine Motor Function Measure Scale; BBS: Berg Balance Scale; MCA: middle cerebral artery; Vs: systolic velocity; Vm: mean velocity; HG: hydrotherapy group; SAS: Self-rating anxiety scale; SDS: Self-rating depression scale; QOL: Quality of life Score

follow-up period and eventually returned to baseline levels. Another study [31] examined improved walking endurance maintained over the 1 month follow-up period. Improvement in the Timed Up and GO Test did not show a clear advantage of the AT compared to land-based exercise [38]. Retarekar et al. [29] proposed the Modified Energy Expenditure Index, which considers only two factors: waist-to-hip ratio and walking speed. It was found that the Modified Energy Expenditure Index decreased, and walking efficiency improved after AT. The secondary indicators of other studies mainly focused on the shuttle run test, the Brockport manual test, and the Fugl–Meyer assessment scale. In one study, there was no significant difference between the Brockport Manual of Lateral Steps and Curls before and after the intervention at each timepoint [40].

Physiological domain

Seven studies examined muscle tone and thickness improvements when analyzing muscle characteristics. By Modified Ashworth Scale (MAS) measurement, MAS scores of quadriceps femoris [42, 45], gastrocnemius [38], and adductor femoris [33] in children with spastic CP were improved or did not improve [19]. Three studies evaluated muscle thickness after AT and showed improvements in gastrocnemius compressibility ratio [38] and quadriceps thickness [42, 45] after AT treatment. One study concluded that muscle thickness, pinch angle, and fascicle length of the spastic gastrocnemius obtained by ultrasonographic assessment did not correlate with spastic gastrocnemius MAS scores and that the ultrasonographic compressibility ratio may be more sensitive for identifying minor improvements in spastic gastrocnemius spasticity in patients with CP compared with the classic MAS assessment of spastic gastrocnemius [38]. Therefore, muscle compressibility ratio as a new ultrasonographic parameter could be used to assess muscle elasticity in patients with CP.

Three studies [28, 44, 45] evaluated the range of motion (ROM), and the ROM of children with spastic type was improved after AT intervention. There was only one study whose primary outcome indicator was ventilatory function [39]. After the intervention, there was a significant difference in forced vital capacity and forced expiratory volume in 1 s in the experimental group. The study also found an improvement in swimming skills. The AT program can effectively enhance the activity range, circulation, and lung function of patients with CP [19].

Psychosocial domain

Outcome assessments in the psychosocial domain focused primarily on activities of daily living, quality of life (QOL), and anxiety and depression, such as the Pediatric Quality-of-Life Inventory–CP, the Wee Functional Independence Measure, the Canadian Occupational Performance Measure, and so on. Through the Pediatric Quality-of-Life Inventory–CP assessment, most of the items in the children's self-report and parent agency report were significantly improved after AT intervention [38], and the other study [19] only evaluated and compared the parent agency report part and found no significant difference. As assessed by the Wee Functional Independence Measure, a study showed that both water and land training improved activities of daily living in children with spastic CP. In another study, the independence of hydrotherapy combined with sensory integration training intervention was improved. Through the Canadian Occupational Performance Measure assessment, Retarekar et al. [29] found that parents believed that their children's ability to act in family and community environments was significantly improved, and the improvement was maintained 13 weeks after the end of the intervention.

Discussion

The purpose of this scoping review was to summarize and analyze the existing interventions and functional improvements in patients with spastic CP treated with AT. 18 papers were ultimately screened to provide a detailed summary of subject characteristics, study intervention parameters, and measures of outcome indicators. The World Health Organization considers limb motor function as the main rehabilitation goal for children with CP [46]. At present, most of the studies on AT in patients with spastic CP are RCTs (72%), but most of the studies have the problems of short intervention time and small sample size, resulting in low-quality research. Therefore, future studies should design larger-scale and appropriate trials to determine the best AT treatment regimen.

AT has a positive impact on the functional performance, physiological domain, and psychological domain of children with spastic CP. There are differences in the timepoint of improvement in GMFM scores or no improvement, which might be associated with the duration of intervention. AT plays an active role in enhancing the gross motor function of children with CP. The research discovers that especially for children with GMFCS level II and spastic diplegia, this could be because patients with mild functional impairments have more chances to engage in aquatic sports, thereby achieving better improvement in motor function [19]. The overall responsiveness of the GMFM-66 was better than that of the GMFM-88 in terms of correlation with therapist judgment, with scores > 1.6 indicating clinically meaningful improvement [47]. Ballington

et al. [16] discovered that the Halliwick therapy resulted in a clinically meaningful improvement of 4.25 points in mean GMFM-66 scores for gross motor function in children with CP, consistent with the conclusions reached in this scoping review. One aspect of the functional improvement may be due to the Halliwick therapy's focus on trunk rotation and core stability [48], which is more conducive to improvements in gross motor function. On the other hand, it may be due to the thermal effect of water, hydrostatic pressure, and viscosity. Warm water raises the body's core temperature, which relaxes muscles and relieves spasms. Hydrostatic pressure redistributes body fluids, increasing central blood volume, which reduces peripheral vascular resistance and promotes systemic circulation. Viscosity leads to resistance, providing resistance equal to the child's strength, facilitating improved muscle strength, and balancing body posture.

The improvement of walking ability is manifested in endurance, speed, distance, and efficiency. Thabet et al. [49] found that children with spastic hemiplegia showed improvements in gait parameters such as average walking speed, stride length (on the healthy and the affected side), and stride duration after both water exercise and treadmill training. Another study also proved improvements in walking speed and metabolic cost in children with CP after AT [50]. Children with spastic CP showed a significant reduction in walking speed, gait cycle time, and percentage of standing phase while walking in water but no change in gait rhythm [51]. This may explain the improvement in walking ability after AT. Buoyancy provides weight support, increases dynamic balance, and permits longer single-leg support. The increased ability to single-support the phase increases stride duration and enhances stability in children with CP. Improvements in walking efficiency are due to enhanced cardiorespiratory fitness after AT. Study has shown that water immersion also induces physiological responses in the heart and respiratory system, including increased cardiac output and improved cardiorespiratory function [15]. Possible benefits of adaptive AT include improved cardiorespiratory endurance, strength, coordination, and swimming skills [52]. This scoping review observed that AT intervention significantly improved cardiopulmonary ventilation in patients with spastic CP. Improvements in lung function were due to improved respiratory muscle strength and increased thoracic ROM after AT [53]. It is worth noting that improvements in ROM have been found in studies combining land-based and aquatic exercise. Therefore, follow-up studies are necessary to compare the effects of land-based and aquatic exercises further and determine which method is responsible for the improvements in ROM.

This study found improvements in activities of daily living and QOL in children with spasmodic CP during both water and land exercise. GMFCS grade was negatively correlated with total QOL [54]. Social participation level, physical activity performance, and walking ability were positively associated with QOL [55]. It was found that intervening in childhood with CP to reduce psychological difficulties and stress, especially pain, may then have long-term effects on QOL [56]. This study found that AT can benefit motor performance, walking ability, and cardiorespiratory endurance, which carried over to other aspects of the child's life, such as quality of survival. One possible reason for the improvement in activities of daily living and QOL is the ideal water environment. The water provides support, reduces joint load, and improves limb control. Water exercise is more fun for children, increases confidence, reduces resistance to complex tasks [28], and increases training motivation [29].

Limitations

To include as wide a range of literature as possible, two authors have minimized selection bias using detailed search terms and search formulas and independent screening.

Conclusion

The AT can improve physical function, physiological function, and psychosocial aspects of patients with spastic CP. In particular, lower limb muscle strength, lower limb joint mobility, and lower limb muscle tone were improved to varying degrees, and enhanced lower limb function led to improved walking ability, further improving activities of daily living and independence. Although the included studies analyzed many aspects of improvement, little consideration was given to aspects of fine motor ability and cardiorespiratory endurance. This scoping review's summary of the existing literature can be used as a starting point for future research on AT interventions for patients with spastic CP and to standardize the parameters to design the most efficient exercise regimen.

Supplementary Information

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Additional file 1.
Additional file 2.
Additional file 3.
Additional file4

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Author contributions
AMX: conceptualization, methodology, investigation, formal analysis, writing—original draft, writing—review & editing; YXF: investigation, data curation, methodology, writing—original draft; CSW: formal analysis, methodology, writing-review & editing; DH: resources, supervision; writing—review & editing JMQ: investigation, validation; writing—original draft; RXZ: investigation, validation; writing—original draft; LW: funding acquisition, supervision, writing—review & editing; CLF: conceptualization, funding acquisition, resources, writing—review & editing; QZ: funding acquisition, supervision, investigation, writing—review & editing. All authors have read and agreed to the published version of the manuscript.

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Availability of data and materials
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Declarations

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COMPLETE AND SUBMIT
PRIOR TO THE DEADLINE DATE

City of Homewood
Board of Zoning Adjustments
Request for Variance

☑ **VARIANCE** ☐ **APPEAL**

ADDRESS OF PROPERTY: 1901 Courtney Drive

BZA CASE # (assigned by city staff): _____

APPLICANT INFORMATION

Name of Applicant (s): Schoel Engineering Company, Inc

Address of Applicant(s): 1001 22nd St S

Birmingham	AL	35205
City	State	Zip

Telephone Number(s) of Applicant(s): 205.323.6166

Email: tschoel@schoel.com

Property Interest of Applicant(s): civil engineer
(i.e., owner, contract purchaser, agent, architect, contractor, developer, etc)

OWNER INFORMATION – *If different from Applicant*

Name of Owner(s): Chris Mobley

Address of Owner(s) (**ONLY** if address is different from property address) otherwise put same:

Birmingham	AL	35233
City	State	Zip

Email: chris@mobleydevelopment.com

Telephone Number(s) of Owner(s): 205.327.5700

DESCRIPTION, USE AND ZONING OF PROPERTY (Parcel ID & present zoning can be filled out at time of application submittal)

PARCEL IDENTIFICATION NUMBER: 021000

PRESENT USE: _____ vacant x residence

_____ commercial (describe): _____

_____ other (describe): _____

PRESENT ZONING (City Zoning Map): R-5

COMPLETE AND SUBMIT
PRIOR TO THE DEADLINE DATE

City of Homewood
Board of Zoning Adjustments
Request for Variance

INDICATE THE FOLLOWING

The following information can be completed when applying but applicant must provide a survey to verify:

	*Required by Zoning Regulations	Setback dimensions as they **NOW** exist	Setback dimensions **AFTER** construction	FINAL Setback Variance Requested
Front Bldg. Setback:	35 ft			
Front Bldg. Setback: (secondary - corner lot)				
Right Bldg. Setback	15 ft			
Left Bldg. Setback	15 ft			
Rear Bldg. Setback	35 ft			
Accessory Structure Height / Setbacks	/	/	/	/
	As Required	Existing NOW	Proposed	Variance Required
Parking	32.5		36	
Height of Structure	35 ft			

*Required setback information is available in the Zoning Ordinance which is available on the City of Homewood website. If you need to find out how your property is zoned, please contact the zoning department by calling 332-6828 or 332-6854 or by clicking on the following link to email: Zoning Information.

INDICATE THE FOLLOWING

The following information can be completed when applying but applicant must provide a survey to verify:

Proposed Location of Fence *(check all that apply):*

☐ Front Yard ☐ Side Yard (left) ☐ Side Yard (right) ☐ Rear Yard

Description of Proposed Fence *(please include dimensions, materials, etc. of the proposed fence):*

No fence proposed.

COMPLETE AND SUBMIT
PRIOR TO THE DEADLINE DATE

City of Homewood
Board of Zoning Adjustments
Request for Variance

PURPOSE OF VARIANCE

A variance is requested on the property described below in conformity with the powers vested in the Board to permit:

___ the construction of an addition to a residence,
_x_ the construction of residence,
___ the construction of an addition to a commercial structure,
___ the construction of a commercial structure,
___ the construction of a fence
___ other (describe):

The applicant requests a variance to permit access to the proposed parking garage from Courtney Drive in lieu of the alley south of the property.

This request is a variance from Section F: R-5 Attached Dwelling Unit District No. 5:

"Parking, Loading, and Garage Regulations," item (b), which requires that all required parking be accessed from the rear of the units

by an alley or common drive.

PLEASE STATE HARDSHIP – for guidance, see "*What is a Variance*" on page 1 of instructions page:

See the attached letter stating the full explanation of hardship.

The undersigned hereby grants permission for a sign, advertising the BZA hearing date, time and place to be posted on my property. I (we) attach $100.00 application fee and promise to pay any additional costs billed separately for extra items related to this variance request.

I (we) certify that all of the above statements and the statements contained in any paper of plans submitted herewith are true to the best of my (our) knowledge and belief.

Taylor Schoel — Signature of Applicant — 6/9/26 — Date

Chris Mobley — Signature of Owner — 6/9/26 — Date

Robin R Mobley — Signature of Owner — 6/9/26 — Date

SCHOEL

June 9, 2026

City of Homewood Zoning Board
2850 19th Street South
Homewood, AL 35209

Re: 1901 Courtney Drive Access Variance Request - Hardship

In addition to the information on the attached application, please see the details of the hardship that will be created if entry to the parking garage must be accessed via the alley at the back of the property.

The requested variance is justified by existing site constraints. Allowing access from Courtney Drive would provide a more direct and logical means of access while avoiding the operational issues associated with the alley.

1. The alley intersects Courtney Drive at an angle of approximately 65 degrees, near the intersection of Courtney Drive & Huntington Rd. This geometry limits the southbound sight distance. (Reference Exhibit 4)

2. Alley access further restricts maneuvering space and creates a constrained access condition for garage users. (Reference Exhibit 4)

3. The alley also lacks clear wayfinding and directional control, and its narrow width and alignment create a confusing circulation pattern for residents. (Reference Exhibit 4)

4. The site's topography slopes north to south. The high point of Courtney Drive north of the site is at elevation 744+/-. The alley slopes east to west but the average grade is generally 731+/-. Based on design performed to date, the proposed finished floor elevations for the building will be 744.5+/- with a garage elevation of 733.5+/-. It is desired for the southerly facing units to have porches. This means that the access from the alley will need to wrap around the southwestern corner of the building and be cut into the existing grade that slopes up from the alley to the north. This results in additional earthwork, additional impervious surface and an unnecessary site retaining wall. (Reference Exhibit 5)

5. For a building that is properly sited on the site given setbacks and topography, and that is designed appropriately to maximize the experience for the future residents; an access

access from the alley to the garage will conflict with buildable area and negatively impact the form and function of the building. (Reference Exhibit 4)

Sincerely,

Taylor Schoel
President
Schoel Engineering

Exhibits:

1. Topographic Survey
2. Proposed Site Plan
3. Proposed Grading Plan
4. Alley Access Site Plan
5. Alley Access Grading Plan

Additional Signatures:

Chris Mahler 6/9/26

Owner Date

Robin P Mahler 6/9/26

Owner Date

To ensure your application packet is complete, and to indicate that the necessary documents have been included, please initial the line below each document type.

A. *Required Documents*

1. **Application:** The application must be completed and signed by the applicant and property owner and submitted by noon of the Final Application Deadline. The application must include a written description of the changes proposed and the specific hardship suffered, for which a variance is being requested. ***Incomplete applications will not be included on an agenda.***

Included: TS

2. **Filing fee of $100.00:** Check should be made payable to City of Homewood. BEZ Staff will notify adjacent property owners, in writing, of the variance request. Letters will be sent by U. S. Mail and addressed per Jefferson County Tax Assessor's record. Any costs associated with mailing public notice letters will be billed separately and must be paid prior to the scheduled meeting.

Included: TS

3. **Survey:** A copy of a scaled Survey, prepared within 24-months of the date of application submittal, or one that represents the property exactly as it exists at the time of application. The survey shall be scaled and include the locations, setbacks and dimensions of all buildings, locations and dimensions of all easements and rights-of-way, locations, materials and dimensions of all sidewalks, driveways, swimming pool, decks, etc. The survey shall be prepared by a licensed Alabama registered surveyor.

Included: TS

4. **Survey/Plot Plan:** A copy of the survey/plot plan that represents the existing conditions prescribed in #3 as well as the locations, dimensions and setbacks of all proposed changes to the site and buildings.

Included: TS

5. **Previous Variance**: Provide date and nature of previous variance request(s) and state the outcome of the variance request.

Included: N/A

6. **Site Photographs:** Photographs of the site, from the front, sides and rear, shall be included with the application. Photographs of the front of the property should be taken from a vantage point to include the fronts of the buildings/houses on adjacent properties. Photos may be emailed to BEZ staff.

Included: TS

7. **Building Elevations:** An illustration, with accurate measurements and height, of exterior elevations for all proposed new construction or additions to existing structures, shall be made a part of the application, to accurately depict the relationship of any proposed new construction or additions to existing structures.

Included: TS

8. **Restrictive Covenants:** Provide a copy of the recorded restrictive covenants for the subdivision, when applicable.

Included: N/A

9. **Proof of Ownership:** Proof of ownership if property has been purchased within the last 12 months.

Included: N/A

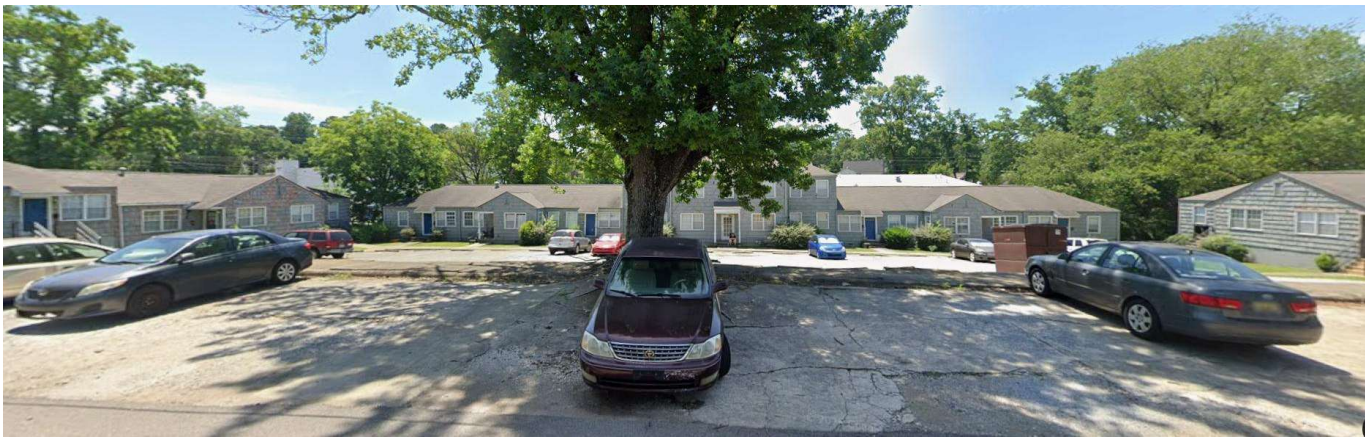
Taylor School
Applicant

6/5/2026
Date

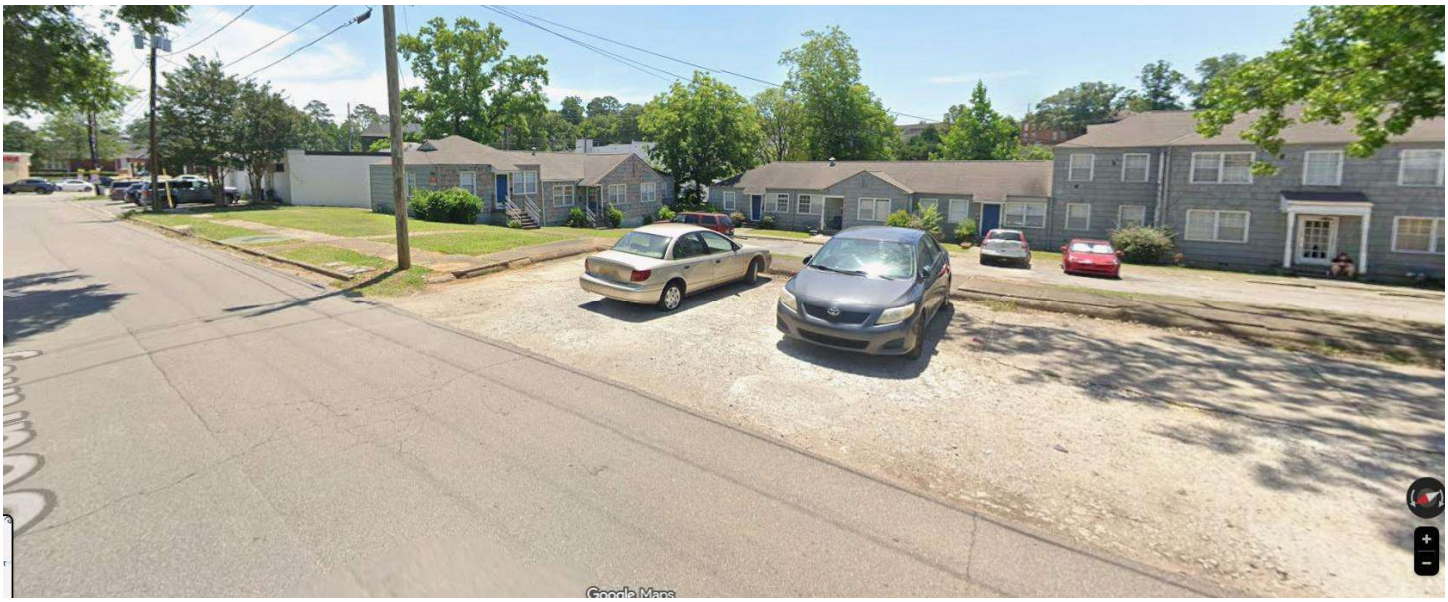
AERIAL



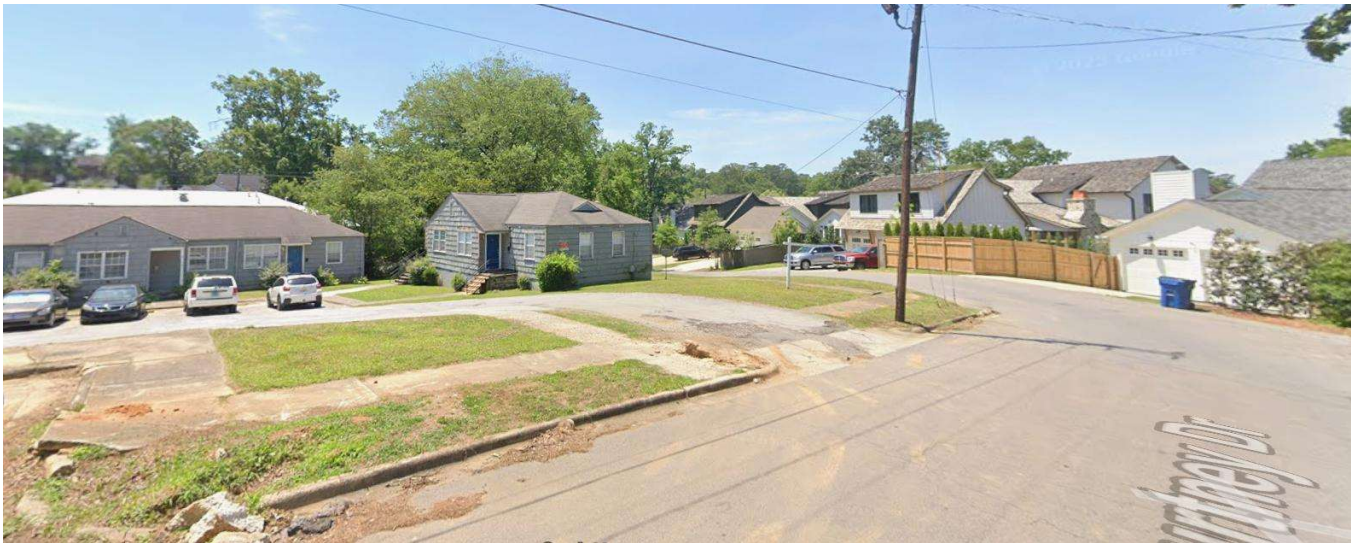
FRONT MIDDLE



FRONT LEFT



FRONT RIGHT

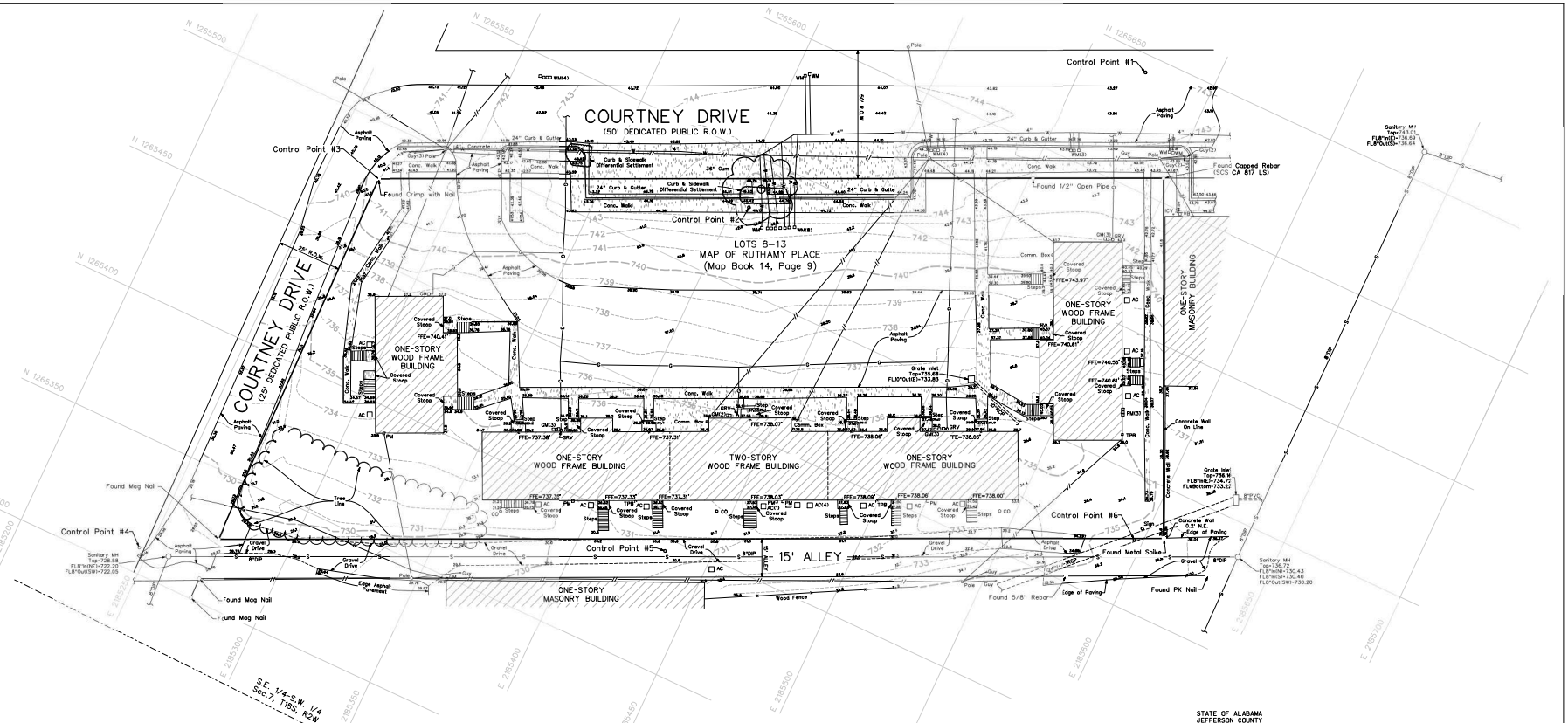


RIGHT SIDE



LEFT SIDE





LEGEND

W	UNDERGROUND WATER LINE
G	UNDERGROUND GAS LINE
S	SANITARY SEWER
	STORM SEWER
//	OVERHEAD UTILITIES
x x x	FENCE
WM	WATER METER
ICV	IRRIGATION CONTROL VALVE
GRV	GAS REGULATOR VALVE
GM	GAS METER
CO	CLEANOUT
PM	POWER METER
MH	MANHOLE
TPB	TELEPHONE PULL BOX
AC	AIR CONDITIONING UNIT
	CONCRETE
620	CONTOUR
16.39	SPOT ELEVATION
16.2378	TOP OF WALL ELEVATION

Scale: 1" = 20'
Graphic Scale
0 20 40 50 75 100

LEGAL DESCRIPTION

Lots 8-13, Block 1, according to the Map Of Ruthamy Place, as recorded in Map Book 14, Page 9, in the Office of the Judge of Probate of Jefferson county, Alabama.

SITE CONTROL:

Control Point #1: N 1265643.30, E 2185523.52, Elev. 743.31, Schoel Control Cap
Control Point #2: N 1265530.29, E 2185405.67, Elev. 745.17, Cross Cut
Control Point #3: N 1265479.34, E 2185270.15, Elev. 740.93, Crimp Iron with Nail
Control Point #4: N 1265309.45, E 2185246.31, Elev. 728.57, Crows Foot
Control Point #5: N 1265395.06, E 2185432.69, Elev. 730.94, Nail
Control Point #6: N 1265476.48, E 2185596.63, Elev. 735.64, Nail

STATE OF ALABAMA
JEFFERSON COUNTY

I, Christopher W. Ward, a Registered Professional Land Surveyor in the State of Alabama, hereby certify that this survey and drawing of the parcel described hereon, were made by individuals under my supervision (Field Work completed on May 22, 2026), and all parts of this survey and drawing have been completed in accordance with the current requirements of the Standards of Practice for Surveying in the State of Alabama to the best of my knowledge, information, and belief.

SCHOEL ENGINEERING COMPANY, INC.

Christopher W. Ward, Alabama License No. 37175
Issue Date: May 29, 2026

NOTES:

1. Site control was established by GNSS observations. Horizontal datum is NAD83, Alabama State Plane Coordinate System, West Zone. Vertical datum is NAVD 88, Geoid 12b.

2. This property is not located within the 100 year flood area and is in Unshaded Zone "X" (areas determined to be out of 0.2% annual chance floodplain) as shown on the National Flood Insurance Programs "FIRM" Flood Insurance Rate Map of Jefferson County, Alabama, according to Panel 556 of 755, Map Number 01073C0556J dated September 24, 2021, as published by the Federal Emergency Management Agency.

3. The underground utilities shown are shown from field survey locations of private utility markings as coordinated by the surveyor, existing drawings obtained from cooperating utility companies, and marking by utility companies and other appropriate sources. The surveyor makes no guarantee that the underground utilities shown comprise all such utilities in the area, either in service or abandoned.

4. No investigation or research has been performed for the purpose of determining the location of subsurface features, such as footings, foundations or structural supports of the buildings shown hereon.

5. No title commitment information was provided for the purpose of this survey. Therefore, there may be easements and other matters of record of which the surveyor has no knowledge that are not shown on the survey.

6. This topographic survey is not a boundary survey. The property lines shown hereon are for reference purposes only.

7. This survey is not valid without the original signature and seal of the Professional Land Surveyor.

8. Christopher W. Ward can be contacted by telephone at (205) 313-1146 or by email at wward@schoel.com.

SCHOEL
BIRMINGHAM
HUNTSVILLE
TUSCALOOSA
SCHOEL.COM

ALABAMA LICENSED No. 37175 PROFESSIONAL LAND SURVEYOR CHRISTOPHER W. WARD

HYDINGER HOMEWOOD RESIDENTIAL DEVELOPMENT

SITUATED IN THE S.E. 1/4 OF THE S.W. 1/4 OF SECTION 7, TOWNSHIP 18 SOUTH, RANGE 2 WEST
JEFFERSON COUNTY, ALABAMA

REVISIONS:

TOPOGRAPHIC SURVEY

DATE: MAY 2026
DRAWN BY: MTK
CHECKED BY: CWW
FIELD BOOK: #3429, #3439
FIELD CREW: AWE, AKG
FILE NAME: 26128_TOPO.DWG

TP1

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G:\26\128 - Hydinger Homewood Residential Dev\Survey\Topo

REAR





MAIN ELEVATION

SCALE: 1" = 20'-0"

COURTNEY DRIVE CONDOS

MAIN ELEVATION
06/09/2026